INSTITUTO DOM LUIZ SCIENCE REPORT 2010

Contents

1. UNIT DESCRIPTION

IDL is a research institute established in 1853 that studies, in quantitative fashion, most of the important components of the Earth System. It combines analytical studies, data analysis, observational activities and modeling. The targets correspond to a wide range of processes going from the structure of the deep Earth, surface processes, atmospheric processes and natural hazards at or near the Earth surface. IDL aims to be a national nucleus of scientific activities and an educational platform of high-level research and teaching, thereby attracting the brightest students in the field, and providing a stable base for European partnership in major research initiatives in these areas.

IDL organization relies on a Scientific Council, grouping all researchers, which are organized into 10 research groups, each one led by a senior researcher. Research Group leaders form a Coordination Board that meets on a regularly basis, headed by the Director, directly elected by the Scientific Council. Administration and Management is done by IDL Direction Board, also elected by the Scientific Council. Research Lines and Research Group leaders are chosen by the Director. A part of the geophysical monitoring operation is conducted within the Geophysical Institute of the University of Lisbon. The director of both ID and IGIDL is presently J M Miranda.

2. GENERAL OBJECTIVES

The ultimate goal of IDL is to develop physics based tools to study Earth processes. These tools combine theoretical approaches, numerical and physical modeling, and a range of applications that go from the global scale earth processes to local scale environmental problems. IDL focuses on Solid Earth Sciences and Atmosphere and Climate Physics. IDL is committed to Earth's monitoring, playing a role in some of the global geophysical and geodetic networks.

Within IDL research is combined with an active commitment to conduct post-graduate and graduate teaching. We promote the interaction between students and research. IDL maintains a number of laboratory facilities at Lisbon and Beira Interior Universities, here including a cluster for numerical modeling, an experimental tectonics lab, a rock magnetic lab, mobile arrays of seismic sensors (for deep sea surveys and land operations), a GNSS processing system, and a series of high quality instruments (e.g. gravity meter, magnetometers, resistivity sounds, meteorological stations, GPS). We commit ourselves to maintain the needed skills to develop geophysical instrumentation as a key factor of our research strategy.

3. MAIN ACHIEVEMENTS DURING THE YEAR OF 2010

COOPERATIVE RESEARCH: The majority of research results was published in high rank journals. The Institute published a total of +110 articles, in all areas of the activity. Funding was kept at a very good level, reaching 1.9M€ for research salaries, base and competitive funding. Resources from the EU represent 15% of the total, and new internationally funded initiatives started during 2010. The University of Lisbon, which hosts IDL, is the only Portuguese Institution ranked by ISI in Geosciences.

EC-EARTH DEVELOPMENT. In 2010, the contributions of IDL to EC-Earth model have come to print. The new snow model included in ECMWF's IFS and in the operational EC-EARTH model was published. A new component of the model, namely the lake model FLAKE was integrated

also into HTESSEL, and was subject to substantial and successful testing. Further developments, including a multi-layer snow model developed by Dutra and co-authors, are under way.

CLIMATE PROCESSES. Output from IDL in relation with global and regional climate dynamics has progressed significantly. A number of important results address the dynamics of blocking events, its impact on inter-annual variability and its links with external forcing, namely solar variability. Another important set of results concerns the regional and continental flows of atmospheric water, and its control of in-land precipitation. Some of this work had significant international impact with successive references to Barriopedro and co-authors in the New Scientist.

COASTAL HAZARDS AND TSUNAMI WARNING: The installation of the new video observation systems for coastal monitoring, the development of software for tide prediction and the design of the Tsunami Warning System in cooperation with JRC and IM, gained the interest of media and local actors for the role of new scientific approaches to sea-related hazards. The design of the Tsunami Warning System was completed under the coordination of Matias. Baptista was awarded a prize by the International Tsunami Society. The new Geophysical Fluid Laboratory set up during 2010 will enlarge the scientific cooperation between research groups.

ACTIVE EARTHQUAKE SOURCES IN THE GULF OF CADIZ. New results were presented based on the 1-year OBS deployment. The analysis of the seismic sources and focal mechanisms, pointed to the existence of important sub-crustal seismic deformation. Numerical and physical modeling of these processes progressed, in cooperation with TOPO-IBERIA. Paleosesimic research increased significantly and a large effort is being made in cooperation with SHARE for a common view concerning active seismic sources.

GEOPHYSICAL SOFTWARE: A new application for electromagnetic prospection was developed by Santos in collaboration with UK partners. A large research project funded by Petrobrás was conducted by Moulin and collaborators, in close cooperation with IFREMER.

CONFERENCES: IDL has been very active in the organization of international conferences during 2010.We emphasize the conference entitled "The Medieval Warm Period Redux. Where and when was it warm?" organized by Trigo and Barriopedro in cooperation with Diaz from NOAA, GEOMOD 2010 organized by Marques and DAMES organized by Barbosa, all held in Lisbon, in September 2010.

4. INTEGRATIVE/MULTIDISCIPLINARY ACTIVITIES DURING THE YEAR OF 2010

GLOBAL CHANGE AND SOCIETAL RISKS: The cooperation with the Portuguese Civil Protection and the Lisbon Municipality concerning seismic and tsunami risk gathered the cooperation of GR3 (Coastal Hazards and Warning Systems), GR4 (Seismology), GR8 (Seismic Risk) and GR7 (Earth Observation). IDL also promoted the development of the NEAMTWS UNESCO initiative cooperating with the Portuguese Meteorological Institute for the implementation of the tsunami warning system.

GEOPHYSICS AND TECTONOPHYSICS: The combination of physical and numerical modeling progressed on a series of research targets (SW Iberian Margin, Azores, Cape Verde and

Variscan tectonics) and on a series of basic research topics (folding/unfolding, subduction initiation). Cooperation is high between basin studies (GR9), Earth Processes (GR5) and Physical Volcanology (GR8). On-going research on the physical basis of AMS methods is also progressing, with large potential impact on tectonic studies.

EARTH OBSERVATION AND GEODYNAMICS: Most research and observational initiatives of IDL is focused on the different boundaries of the Nubian plate: Azores Triple Junction; Iberian Margin; East African Rift. New permanent GNSS stations were installed and an integrated real time processing system was installed in the University of Beira Interior. Results on permanent scatters radar interferometry (GR7), are creating new challenges for research related with natural hazards (GR1, GR3, and GR8). Cooperation between GR7 and GR3 is also progressing fast in what concerns GPS meteorology.

METEOROLOGY AND CLIMATE RESEARCH: In 2010, the contributions of IDL to the EC-Earth model have come to print. The new snow model included in ECMWF's IFS and in the operational EC-EARTH model was published. A new component of the model, namely the lake model FLAKE was integrated also into HTESSEL, and was subject to substantial and successful testing. Further developments, including a multi-layer snow model are under way.

5. OUTREACH ACTIVITIES DURING THE YEAR OF 2010

The presence of IDL and IDL's researchers on the Portuguese media was constant during the year of 2010. This took the form of interviews or scientific statements and addressed mainly climate change, geo and coastal hazards and earth observation themes. The topics mostly discussed concerned the impact of the eruption of Eyjafjallajökull, the heavy rains on Madeira Island, the Chile earthquake and tsunami. The newspapers where the presence of IDL was most relevant are Público, Expresso, Diário de Noticias and Visão, the media with the largest impact in Portugal. Numerous TV participations must also be emphasized at RTP, TVI and SIC. IDL webpage was upgraded and updated including topics of public interest, and complementary web materials were prepared by V Mendes and C Antunes on GPS seismology and tide prediction, respectively.

INVITED TALS AT HIGH SCHOOLS: Escola Secundária Emídio Navarro (11º ano de Ciências e Tecnologias), 26-10-10 (Virgílio Mendes); Pavilhão do Conhecimento, 6-3-10 “Desertos e Clima” (Pedro Miranda). Similar talks were made at the Lisbon Engineering School and the Université Paris-Sud (Susana Barbosa), Minho University (Maria Ana Baptista) and Universidade Estadual de S Paulo (Rui Fernandes).

INVITED TALKS TO THE OIL INDUSTRY: talks were held by Moulin, in cooperation with D Aslanian, for GDF-Suez in Paris, (10-2-10) and Petrobras in S Salvador da Baía (20-23 January 2010).

WEATHER FORECAST ON THE WEB: IDL maintains several numerical models used for weateher forecast (http://www.weather.ul.pt/) including high resolution grids for Madeira and Azores. These models, mainly developed for research and post-graduate training, have increased their public impact.

SUMMER COURSE ON TSUNAMIS: M A Baptista and R Omira, collaborated in a summer course held in Tetouan (5-10 July 2010), organized by the Universidad Internacional de Andalucia.

CLIMATE AND SEISMIC DATA ON THE WEB: IGIDL webpage freely disseminates climate and seismological data obtained by IDL networks. After 2008 the Annals of the Institute that compile geophysical information since 1853 are also openly available through internet.

ACADEMY OF SCIENCES INITIATIVES: M A Baptista and J M Miranda made invited talks on Natural Hazards in the framework of an initiative promoted by the Lisbon Academy of Sciences.

WORLD ENVIRONMENT DAY: P M Miranda and J Cabral made invited talks associated with the WED in Portugal, on climate change and seismic risk.

6. RESEARCH GROUPS

6.1 Climatology and Climate Change

6.1.1. Funding

Project FUME – (FP7), €181k, 2010-2014; Project CIRCE - (FP6), (€110k). 2007-2011; Project MedCLIVAR. ESF (about €30k). 2006-2010; Project COST733. EU (about €10k.). 2008-2010; Project COST604. EU (about €10k.). 2009-2011; Project ENAC. FCT (€135k). 2010-2012; Project FLAIR FCT (€106k). 2010-2012; Project MEDIATIC. FCT (€35k). 2010-2012.; Project DISASTER. FCT (€20k). 2010-2012; Project PTDC/AGR-AAM/71649/2006 – Droughts Risk Management: Identification, Monitoring, Characterization, Prediction and Mitigation. Funding: FCT (€166k). 2007-2010: Project TRODIM. Min. Esp. Ciencia, (€20k). 2007- 2010; Portuguese-Spanish integrated action on "Diagnosis of the Northern Hemisphere jet stream: a new perspective from tropopause maps". Funding: CRUP (€4k). 2009-2010; Portuguese-Spanish integrated action on "Transport mechanisms Stratosphere-Troposphere over the Iberian Penisula". Funding: CRUP (€4k). 2010-2011.

6.1.2 Objectives

- The study of significant changes in relevant surface climatic variables (e.g. maximum and minimum temperatures, precipitation monthly averages and daily extremes);
- Assessment of major teleconnections (e.g. the North Atlantic Oscillation, the Scandinavian pattern or the Eastern Atlantic pattern) to characterize changes in the European climate.
- Development of tools to diagnostic the atmospheric circulation: circulation weather types (daily), cut-off low systems (COLs) and storm-tracking (several days), blocking events (up to 3 weeks).
- Development of statistical models and predictability studies at the monthly-seasonal range in the Atlantic-European region.
- Recovery of historical meteorological data from worldwide ancient archives and contribution to several international projects of historical reanalyses.
- Evaluation of different types of weather driven natural hazards: floods, droughts, landslides and heat waves. This objective and the corresponding achievements and output will be included in the Global Change and Societal Risks Research Line.
- Assessment of the impact of volcanoes, solar storms and variability on the Earth's magnetic field and climate. This objective and the corresponding achievements and output will be included in the Global Change and Societal Risks Research Line.

Within the framework of future warming scenarios projecting increases in the risk of more frequent heat waves and severity of rainfall extremes in regions of mid-high latitudes, it is of major importance to investigate the link of extreme events to atmospheric weather conditions. The research group has acquired a large experience in this topic, due to the enormous effort made in developing objective automatic methods to diagnose specific weather systems, such as weather types, extra-tropical cyclones and storm-tracks, blocking

anticyclones, cut-off lows. The research group of Climatology and Climate Change is integrated in the Global Change and Societal Risks research line of the CGUL-IDL.

Recent new topics of research

The team will continue broadening its multi-disciplinary character, which ranges from proxy-based climate reconstructions to modern assimilated remote sensing output, but always with a main endeavor related to weather driven natural hazards and mid-latitude climate variability.

Furthermore, the expertise of the group in exploring historical datasets, together with the recent approval of different funded projects, which embrace topics such as the exploration of natural proxies (e.g., MEDIATIC) and the analysis of General Circulation Models (GCMs) simulations for the last centuries/millennium (e.g., ENAC) and future climate scenarios (e.g., AMIC) provides a unique opportunity of merging observational and modeling studies. In this sense, the research group is making a large effort to self-adapt and invest in order to increase data storage and share facilities.

- Satellite derived analysis: The Climatology group is growing its activity in areas that require a strong component of remote sensing. In particular we are interested in the development of satellite-based tools to monitor long-lasting drought events (Iberia, Iraq, China, Australia), but equally to evaluate burned areas (Iberia and Mediterranean).
- 20th Century Reanalysis: As the team has been involved in the development of the recently Published re-analyses for the 20th century through a digitization project funded by FCT, the applicability of automatic algorithms to diagnose weather systems (which require daily gridded data sets of enough spatial resolution) is now possible and arises as one of the principal objectives within the near future. This effort will be further supported within the framework of the new FP7 project ERA-CLIM dealing with recovering worldwide meteorological data from old publications.
- Long-term modelling studies: GCMs and paleoclimate proxy-based reconstructions provide a powerful tool to place the observed recent trends into a broader temporal context and to investigate the responses to external forcing factors.
- Statistical Forecasting Models: The group is developing statistical forecasting model capacities namely to predict river flow and periods and intensity of droughts as an attempt to cope partially with the relative low number of studies within IDL regarding surface hydrology and river system. Development of methods of non-gaussian statistical modeling for climatic diagnostics and inverse problems in climate-related problems are also assessed.

6.1.3 Main Achievements

COOPERATIVE RESEARCH: We have been publishing the majority of attained results in specialized literature (SCI journals) related to natural hazards, meteorology, climatology, hydrology and solar variability. The year 2010 can be considered as a good year, with the group members publishing 20 papers in SCI literature (with an additional 8 already published or in press in 2011). Most of the research results were obtained within the framework of national projects (funded by FCT, Gulbenkian, CRUP, etc), but equally European projects (e.g. CIRCE, FUME, MedCLIVAR, LANDSAF, etc). Furthermore, a significant amount of this research

corresponds to active collaborations with researchers from other groups within the CGUL-IDL and also with other national and international centers and institutions.

NEW PROJECTS: The group has secured the participation in a new large European FP7 project ERA-CLIM dealing with recovering worldwide meteorological data from old publications. The group has become also involved in the large international IMILAST project, aiming to provide a more comprehensive assessment of uncertainties inherent in the mid-latitudinal storm tracking by comparing different methodologies with respect to data of different resolution (time and space) and limited areas, for both cyclone identification and cyclone tracking respectively.

TECHNICIAN Using funding from different projects we have hired a part-time system administrator to help with the hardware and software used in the group. This IT technician is shared with the Land-Climate interaction Group (RG 10).

CONFERENCES: The group was involved in the organization of several important conferences during 2010, namely:

- International Precipitation Conference 2010 that took place in Coimbra, Portugal, 23-25 June 2010;
- The ESF-MedCLIVAR workshop “Hydrological, Socio-economic and Ecological impacts of the North Atlantic Oscillation in the Mediterranean”, Zaragoza, Spain, 24 - 27 May 2010;
- The workshop "The medieval Warm Period Redux. Where and When was it warm?” that took place in FLAD (Fundação Luso-Americana), Lisbon, Portugal, 22 - 24 September, 2010.

INVITATION: Ricardo Trigo was invited in 2010 to be a member of the Drought Interest Group (DIG) run jointly by the Climate Variability and Predictability (CLIVAR) and and Global Energy and Water Cycle Experiment (GEWEX) (http://www.clivar.org/organization/extremes/dig.php)

6.1.4 Group Productivity

Publications in peer review Journals

1) Barriopedro D., García-Herrera R., Trigo R.M. (2010) “Application of blocking diagnosis methods to General Circulation Models. Part I: a novel detection scheme”. Climate Dynamics, 35, 1373-1391, DOI 10.1007/s00382-010-0767-5

2) Barriopedro D., García-Herrera R., González-Rouco J.F., Trigo R.M. (2010) “Application of blocking diagnosis methods to General Circulation Models. Part II: model simulations”. Climate Dynamics, 35, 1393-1409, DOI 10.1007/s00382-010-0766-6

3) Barriopedro D., Antón M., García J.A. (2010): Atmospheric blocking signatures in total ozone and ozone mini-holes. Journal of Climate, 23, 3967-3983, doi: 10.1175/2010JCLI3508.1

4) Barriopedro D., García-Herrera R., Lionello P., Pino C. (2010): A discussion of the links between solar variability and high-storm-surge events in Venice. J. Geo phys. Res., 115, D13101, doi:10.1029/2009JD013114

5) Bocquet, M., Pires C., Wu, L., 2010 Beyond Gaussian stattistical modeling in geophysical data assimilation. Monthly Weather Review, 138, 2997-3023.

6) Castanheira JM, Anel JA, Marques CAF, Antuna JC. Liberato MLR, de la Torre L, Gimeno L (2010) Increase of upper troposphere/lower stratosphere wave baroclinicity during the second half of the 20th century. Atmospheric Chemistry and Physics, 10, 18, 9057-9058.

7) Castanheira J.M., Barriopedro D. (2010): Dynamical connection between tropospheric blockings and stratospheric polar vortex. Geophysical Research Letters, 115, D13101, doi:10.1029/2009JD013114.

8) Drumond A., Nieto R., Trigo R.M., Ambrizzi T., Sousa E. Gimeno L. (2010) "A Lagrangian identification of moisture sources affecting Northeastern Brazil during its pre-rainy and rainy seasons". PLoS ONE, 5 (6), e11205. doi:10:1371/journal.pone.0011205

9) Fragoso M., Trigo R.M., Zêzere L., Valente M.A. (2010) "The exceptional rainfall episode registered in Lisbon in 18 February 2008", Weather, 65, 31-35

10) Gámis-Fortis S., Esteban-Parra MJ., Trigo R.M., Castro-Diez Y. (2010) "Potential predictability of an Iberian river flow based on its relationship with previous winter global SST". Journal of Hydrology, doi:10.1016/j.jhydrol.2010.02.010, 385, 343-349

11) García-Herrera R., Díaz J., Trigo R.M., Luterbacher J., Ficher E. (2010) "A review of the European summer heat wave of 2003". Critical Reviews in Environmental Science and Technology, 40, 267 - 306

12) Gimeno L. Drumond A., Nieto R., Trigo R.M., Sthol A., (2010) "On the origin of continental precipitation". Geophysical Research Letters, 37, L13804, doi:10.1029/2010GL043712

13) Gimeno L., Nieto R., Trigo R.M. , Vicente-Serrano S.M, Lopes-Moreno J.I., (2010) "Where does the Iberian Peninsula moisture come from? An answer based on a Lagrangian approach". Journal of Hydrometeorology, DOI: 10.1175/2009JHM1182.1, 11, 421-436

14) Gouveia C., DaCamara C.C, Trigo R.M., (2010) " Post fire vegetation recovery in Portugal based on SPOT-VEGETATION data ", Natural Hazards and Earth System Sciences, 10, 673-684.

15) Pires, C., O. Talagrand, M. Bocquet, 2010 Diagnosis and Impacts of non-Gaussianity of Innovations in Data Assimilation. Physica D, 239, 1701-1717.

16) Trigo, R.M., Barriopedro D., Gouveia C, Obregón A., Bissolli P., Kennedy J.J., Parker D.E. (2010) "Iberia", in State of the Climate in 2009. Peterson T.C. and Baringer M.O., Eds., Bulletin of the American Meteorological Society, 91, s165-s167

17) Trigo R.M., Gouveia C., Barriopedro D., (2010) " The intense 2007-2009 drought in the Fertile Crescent: Impacts and associated atmospheric circulation", Agricultural and Forest Meteorology, 150, 1245-1257

18) Trigo R.M., Vaquero J.M., R. B. Stothers (2010) "Witnessing the impact of 1783-1784 Laki eruption in the Southern Hemisphere", Climatic Change, 99, 535-546, DOI 10.1007/s10584-009-9676-1

19) Vaquero J.M., Trigo R.M. (2010), Vazquez M., Gallego M.C. "155-day Periodicity in solar cycles 3 and 4", New Astronomy, 15, 385–391

20) M. Vázquez and J. M. Vaquero (2010) “Aurorae observed at the Canary Islands” Solar Physics 267, 431-444.

Other international publications

Books

L. S. Pereira, J. T. Mexia, C. A. Pires (eds.), 2010. Gestão do Risco em Secas, Métodos, Tecnologias e Desafios. Edições Colibri, CEER, 344 p.

Book chapters

Pires, C. A., Sousa J.M.B., 2010. Previsão de Classes de seca por cadeias de Markov condicionadas por regimes da Oscilação do Atlântico Norte e Oscilação Ártica. In: L. S. Pereira, J. T. Mexia, C. A. Pires (eds.), 2010. Gestão do Risco em Secas, Métodos, Tecnologias e Desafios. Edições Colibri, CEER, pp. 209-224.

Other national publications

Liberato, M. L. R., Gouveia C., Lopes D., 2010: Avaliação das Potencialidades da Utilização de Dendrocronologia no Estudo dos Impactos Climáticos sobre a Fixação de Carbono no Estrato Arbóreo de Ecossistemas de Pinheiro-bravo no Nordeste de Portugal, Silva Lusitana, Nº Especial: 51 – 63

Ph.D Thesis

Perdigão R. P., 2010. "Nonlinear Statistics and Dynamics of Atmospheric Predictability and Downscaling". Tese de doutoramento (PhD) em Física, Universidade de Lisboa. 198 p. Orientador: Carlos Pires.

Msc thesis

Correia J. M. 2010. O limite Cretácico-Paleogénico: Alterações Climáticas e Crises Biológicas. Tese de Mestrado (Msc) em Ciências Geofísicas (especialização Meteorologia), Universidade de Lisboa, 54 p. Orientador: Carlos Pires.

Fernández M.I.F, 2010. "Un estudio de la variabilidad de series de ozono troposférico". Mestrado em contaminação Ambiental, Facultad de Ciencias, Universidad de Extremadura. Orientadores: María de la Cruz Gallego Herrezuelo y José M. Vaquero.

Farrona A.M.M., 2010. "The meteorological observations of Bento Sanches Dorta, Brazil: 1781-1788" 30 de Máster Universitario en Investigación en Ciencias, especialidad Física. Facultad de Ciencias, Universidad de Extremadura. Orientadores: José Manuel Vaquero y María de la Cruz Gallego Herrezuelo.

Organization of conferences

- Ricardo Trigo served in the scientific committee of the International Precipitation Conference 2010 that took place in Coimbra, Portugal, 23-25 June 2010. (http://www.ci.uc.pt/imar/ipc10/).
- Ricardo Trigo co-organized the ESF-MedCLIVAR workshop entitled “Hydrological, Sócio-economic and Ecological impacts of the North Atlantic Oscillation in the Mediterranean” that took place in Zaragoza, Spain, 24 - 27 May 2010. (http://www.ipe.csic.es/medclivar/home. htm).

- Ricardo Trigo and David Barriopedro organized the workshop "The medieval Warm Period Redux. Where and When was it warm?" that took place in FLAD (Fundação Luso-Americana), Lisbon, Portugal, 22 - 24 September, 2010. (http://mwplisbon2010.fc.ul.pt/).
- Carlos Pires co-organized the Workshop "Gestão do Risco em Secas, Métodos, Tecnologias e Desafios" that took place in in the Instituto Superior de Agronomia, Lisbon, Portugal, 11 November 2010.
- Margarida Liberato co-organized the IUFRO International Conference on "Mixed and Pure Forests in a Changing World", Vila Real, Portugal, 6 - 8 October, 2010.

Internationalization

The group is involved in several national and European projects that will endure for several years. In particular we are involved in three major European projects dealing with climate variability and climate change for the Mediterranean. In 2011 the group is starting its participation in another major European project:

- MedCLIVAR (Funded by European Science Foundation until 2011) and endorsed by WMO. Ricardo Trigo seats at the Steering Committee of MedCLIVAR. This group has published a Book in 2006 (ELSEVIER) and his planning a second version to be published in 2011 (Imperial College Press).
- CIRCE (Funded by FP7 until 2011). CIRCE aims at developing for the first time an assessment of the climate change impacts in the Mediterranean area. A monographic issue dealing with changes of climatic extremes in the Mediterranean is currently being produced, with manuscripts submitted during January-February 2010.
- FUME (Funded by FP7 until 2013) FUME deals with extreme forest fires under climate, social and economic changes in Europe, the Mediterranean and other fire-affected areas of the world (started in January 2010)
- ERA-CLIM – (Funded by FP7, 2011-2013) ERA-CLIM aims to develop observational datasets suitable for global climate studies, with a focus on the past 100 years. A specific goal is to improve the quality and consistency of climate observations through new pilot and already existing reanalyses, and to make the observational datasets and reanalyses available to world-wide users.
- IMILAST- The group has become also involved in the large international IMILAST project, aiming to provide a more comprehensive assessment of uncertainties inherent in the mid-latitudinal storm tracking by comparing different methodologies with respect to data of different resolution (time and space) and limited areas, for both cyclone identification and cyclone tracking respectively.

Participation in Graduate training

Ricardo Trigo and David Barriopedro have participated in the Climate change Master course at the University of Vigo (Campus Ourense).

6.2 Applied and Environmental Geophysics

6.2.1 Funding

FCT: PERMANTAR, Permafrost e Alterações climáticas na Antárctida Maritima (PTDC/CLI/70020/2006), Funded by FCT- 39 k€; PERMANTAR 2 - Permafrost e Alterações climáticas na Antárctida Maritima (PTDC/AAC-CLI/098885/2008), Funded by FCT- 25 k€; CHAVESMT- Estudo do potencial geotérmico para a região de Chaves usando MT, PTDC/CTE-GIX/098538/2008, 180 k€ ; FREEROCK - Fracture evolution and solid-fluid interaction in igneous rocks at Atlantic Volcanic Edifices, PTDC/CTE-GIX/100687/2008, Funded by FCT: 175 k€.

BI-LATERAL COOPERATION: PESSOA (2009-2012): Calibração da Curva de Derive Polar Aparente e determinação dos Polos Eulerianos da Ibéria ao Jurássico-Cretácico. Colaboraçao bilateral entre LMTG-CNRS (França) e IDL (Portugal). (FCT; financiamento para 2010=3,200.00 euros).

INDUSTRY: MT studies in Cabo Verde for geothermal evaluation-Private funding by Martifer; 100 k€; MT studies in the Panasqueira mine-Private funding by Beralt; 15 k€;

6.2.2 Objectives

Applied Geophysics is an important topic of research in IDL, mainly due to the impact of groundwater and environmental issues in human activities. The activity of the group is divided mainly in three areas: (1) field work and data interpretation, (2) software development and (3) design and construction of instrumentation.

The main objectives of the group are:

- To develop geophysical methods for environmental, hydrogeological and structural (geological) studies;
- To develop electromagnetic methods for aquifer characterization and groundwater monitoring;
- To develop specific software for interpretation of electromagnetic data acquired in isotropic and anisotropic media;
- To develop algorithms for joint interpretation of different type of geophysical data (DC/TEM; gravity/AMT, DC/MT, seismic/DC);
- To design and construct geophysical instrumentation for marine magneto-tellurics;
- To apply magnetic rock properties to environmental and more regional and global geological studies.
- To establish cooperation with industry;
- To maintain the already large international collaboration.

6.2.3 Main Achievements

ANTARTICA PROGRAM: The group has been supporting the Portuguese participation on Antarctica program (project PERMANTAR). A member of the group (Ivo Bernardo) has participated in the 2010/2011 expedition to the Deception Island. An annual record (December 2009 to December 2010) of the variations of the electrical resistivity of the uppermost part of the soil (each 6h) was made and is now under interpretation.

GROUNDWATER RESEARCH: During the last year the group worked in projects related to the use of geophysical methods in hydrogeology and environment. The group is supporting a PhD work in the application of geophysical data to understand the dynamic of the water infiltration process.

GEOPHYSICAL INVERSE PROBLEMS: Two computer programs (EM34-2D and Inv2DVLF) for inversion of geophysical data developed in the last years were spread all over the world. There are more than thirty researchers of international institutions (mainly universities) using such programs. A new program, allowing the joint inversion of several EM data was developed in collaboration with Dr. John Triantafilis (The University of New South Wales, Sydney, Australia). Several new developments have been achieved in what concern 1-D and 2-D modeling (and inversion) of MT data assuming anisotropic media. This work was developed in collaboration with Josef Pek (from Czech Republic). The group starts spreading the code developed for joint inversion of resistivity and gravity data collected in basins. A program for joint inversion of DC and TDEM data assuming Quasi-2D and 3D models and using smooth constraints were developed in collaboration with Dr. Hesham (now at LAncastre University, U.K.).

ROCK MAGNETISM: Review about the deposition time of the Marinoan cap carbonates (Font et al., 2010a) showing that the deglaciation period after a snowball Earth event is much shorter than estimated by the model of Paul Hoffman. For the first time, rock magnetic properties study was applied to tsunami-induced deposit showing that it represent a powerful tool to locate this kind of deposits in the geological record (Font et al., 2010b).

MULTIDISCIPLINARY (ROCK MAGNETISM, GEOCHEMISTRY, PETROGRAPHY) STUDY of the KTB (Cretaceous-Tertiary Boundary) in three sections from the Basque-Cantabric Basin (France and Spain) showed the presence of a anomalous level just below the boundary that we interpreted to represent the sedimentary record of the Deccan Traps (Font et al., in elaboration). These results will certainly provide better clues to elucidate the origin of the mass extinction of the KTB.

PALEOMAGNETISM AND ROCK MAGNETISM OF THE BASALTS from the Central Atlantic Magmatic Province (CAMP) in Morocco show that geomagnetic reversals identified by previous studies (Marzoli et al., 2004; Knight et al., 2004) are in fact a product of remagnetization. Consequently, it shows that we cannot affirm that the CAMP in Morocco precede the one in US and thus its synchronism with the Triassic-Jurassic boundary need still to be demonstrated. A new good quality paleomagnetic pole that is now in better agreement with the US counterpart will be also published (Font et al., in submission).

COOPERATION WITH THE PRIVATE SECTOR: During 2010 the group had colaboration with the EDP-LABELEC Company; Martifer Company and Beralt Company.

6.2.4 Group Productivity

Publications in peer review Journals

1) Font E., Nascimento, C., Omira, R., Baptista, M.A. and P.M.F Silva (2010). Identification of tsunami-induced deposits using rock magnetism techniques and numerical modeling: a study case of the 1755 Lisbon Tsunami in Algarve, Portugal. Physics of the Earth and Planetary Interiors, 182, 187-198. doi:10.1016/j.pepi.2010.08.007 IF: 1.993

2) Font E., Nédélec, A., R.I.F., Trindade, and C. Moreau (2010). Slow or fast ice melting at the snowball Earth Aftermath? the cap dolostone record. Palaeogeography, Palaeoclimatology, Palaeoecology, 195, issue 1-2, 215-225, doi:10.1016/j.palaeo.2010.05.039. IF:2.646

3) Mota, R. and Monteiro Santos, FA, 2010. 2D sections of porosity and water saturation from integrated resistivity and seismic surveys. Near Surface Geophysics, 8, 575-584. doi: 10.3997/1873-0604.2010042, IF: 0.838

4) Carreira, P.M., Marques, J.M., Pina, A., Gomes, A.M., Fernandes, P.A,G., Monteiro Santos, FA, 2010. Groundwater assessment at Santiago Island (Cabo Verde): a multidisciplinary approach to a recurring source of water supply. Water Resour Manage, 24, 1139-1159. doi: 10.1007/s11269-009-9489-z; IF:2.013

5) Carreira, P.M., Marques, J.M., Marques, J.E., Chaminé, H.I., Fonseca, P.E., Monteiro Santos, FA, Moura, R.M. and Carvalho, J.M., 2010. Defining the dynamics of groundwater in Serra da Estrela Mountain area, central Portugal: an isotopic and hydrogeochemical approach. Hydrogeology Journal. DOI 10.1007/s10040-010-0675-0; IF: 1.417

6) Triantafilis, J., and Monteiro Santos, FA, 2010. Resolving the spatial distribution of the true electrical conductivity with depth using EM38 and EM31 signal data and a laterally constrained inversion model. Australian Journal of Soil Research, 48, 434-446; IF: 1.007

7) Monteiro Santos, FA, Triantafilis, J., Taylor, R., Holladay, S. and Bruzgulis, K., 2010. Inversion of conductivity profiles using full solution and a 1-D laterally constrained algorithm. Journal of Environmental and Engineering Geophysics, 15, 3, 163-174.IF: 0.698

8) Ruiz-Constán, A., Galindo-Zaldivar, J., Pedrera, A., Arzate, J.A., Pous, J., Anahnah, F., Heise, W., Monteiro Santos, FA, and Marín-Lechado, C., 2010. Deep deformation pattern from electrical anisotropy in an arched orogen (Betic Cordillera, western Mediterranean). Geology, 38, 8,731-734. doi: 10.1130/G31144.1, IF: 4.368

9) Khalil, M.A., Hafez, M.A., Monteiro Santos, FA, Ramalho, ElC., Mesbah, H.S.A. and El-Qady, G., 2010. An approach to estimate porosity and groundwater salinity by combined application of GPR and VES: a case study in the Nubian sandstone aquifer. Near Surface Geophysics, 8, 223233. doi:10.3997/1873-0604.2010007 ; IF: 0.838

10) Khalil, MA, Abbas, A.M., Monteiro Santos, FA, Mesbah, H.S.A. and Massoud, U., 2010. VLF-EM study for archaeological investigation of the labyrinth mortuary temple complex at Hawara area, Egypt. Near Surface Geophysics, 8, 203-212. doi: 10.3997/1873-0604.2010004; IF:0.838

11) Sultan, A.S., Monteiro Santos, FA, Abbas, AM., 2010. Joint inversion interpretation for gravity and resistivity data: a case study at New Heliopolis City, Cairo, Egypt. Near Surface Geophysics, 8, 43-53. doi: 10.3997/1873-0604.2009050; IF: 0.838

12) Monteiro Santos, FA, Triantafilis, J., Bruzgulis, K. and Roe, J.A.E., 2010. Inversion of multiconfiguration electromagnetic (DUALEM-421) profiling data using a one-dimensional laterally constrained algorithm. Vadose-Zone Journal, 9, 1117-125. doi: 10.2136/vzj2009.0088; IF: 1.991

13) Chaminé, HI, Afonso, MJ, Robalo, PM, Rodrigues, P., Cortez, C., Monteiro Santos, FA, Plancha, JP, Fonseca, PE, Gomes, A., Devy-Vareta, NF, Marques, JM, Lopes, ME, Fontes, G., Pires, A. and Rocha, F., 2010. Urban speleoplogy applied to groundwater and geo-engineering studies: underground topographic surveying of the ancient Arca D'Água galleries catcheorks (Porto, NW Portugal). International Journal of Speleogy, 39, 1-14. IF:0.9

14) Monteiro Santos, FA, and El-Kaliouby, H., 2010. Comparative study of local versus global methods for 1D joint inversion of direct current resistivity and time-domain electromagnetic data. Near Surface Geophysics, 8, 135-143. doi: 10.3997/1873-0604.2009056; IF: 0.838

15) Sultan, Monteiro Santos, FA, Abd Alla, MA, Mekhemer, H.M. 2010. Application of the resistivity/gravity joint inversion technique for NUbian sandstone aquifer assessment on the area located at the central part of Sinai, Egypt. J. Geophy. Eng., 7, 1-15. Doi:10.1088/1742-2132/7/1/001; IF:0.787

16) Santos FAM (2010) Inversion of self-potential of idealized bodies' anomalies using particle swarm optimization COMPUTERS & GEOSCIENCES Volume: 36 Issue: 9 Pages: 1185-1190 Published: SEP 2010 IF: 1.142

17) Usama Massoud, Fernando Santos, Mohamed A. Khalil, Ayman Taha, Abbas M. Abbas: Estimation of aquifer hydraulic parameters from surface geophysical measurements: a case study of the Upper Cretaceous aquifer, Central Sinai, Egypt. Hydrogeology Journal, 2010, 18:699-710, DOI 10.1007/s10040-009-0551-y.(IF: 1.417)

Other international publications

1. Mohamed A. Khalil: Real surface conductivity component as indicator of hydraulic conductivity, Arabian J. of Geosciences, 2010, DOI 10.1007/s12517-010-0143-0.

2. Mohamed A. Khalil and Fernando M. Santos: Comparative study between filtering and inversion of VLF-EM profile data, Arabian J. of Geosciences, 2010, DOI 10.1007/s12517-010-0168-4

Abstract in international congress

1. Font E., Nascimento, C., Omira, R., Baptista, M.A. and P.M.F Silva (2010). Magnetic evidences of Lisbon 1755 tsunami in re-worked litoral sediments. AGU Meeting Iguaçu, invited oral session.

2. Font E.. Ernesto, M., Ponte de Neto, C.F., 2010. Paleomagnetism and Rock Magnetism of the Itajaí Basin, Santa Catarina (Brazil), and the large-scale remagnetization of the Rio de la Plata craton. AGU Meeting Iguaçu 2010, poster.
3. Font E., Nascimento, C., Omira, R., Baptista, M.A. and P.M.F Silva (2010). Identification of tsunami-induced deposits using numerical modelling and rock magnetism. AGU Meeting Sao Francisco, poster session.
4. Font, E., Nédélec, A., Correia, J., Silva, P.M.F., 2010. Revisiting the KTB transition in Basque Country using detailed rock magnetism and chemostratigraphy: multiple impacts for mass extinction? Castle Meeting 2010, oral session.
5. Neres, M., Font, E., Terrinha, P., 2010. Paleomagnetism, Rock Magnetism and AMS study of the Paço d'Ilhas sill, western Portugal: implications for the APWP of Iberia at the Cretaceous. Castle meeting 2010, poster session.
6. Mário Moreira, José Madeira, João Mata, Patrícia Represas; Age dependent variation of magnetic fabric on dike swarms from Maio Island (Cape Verde). Geophysical Research Abstracts, Vol. 12, EGU2010-9878-2, EGU General Assembly 2010.
7. Khalil M.A. and Fernando M. Santos: Using a real surface conductivity component to estimate hydraulic conductivity. Society of Exploration Geophysics (SEG 2010, Denver, USA), 17-22 Oct.2010.
8. Mehrez Elwaseif and Khalil M.A.: Stratigraphic Interpretation of GPR Data Using 2D S-Transform., Society of Exploration Geophysics (SEG 2010, Denver, USA), 17-22 Oct.2010.
9. Khalil M.A., Ramalho, E. C.and Fernando A. Monteiro Santos: Using resistivity logs to estimate hydraulic conductivity: a case study in the Nubian sandstone aquifer, southern Egypt, IAGA WG 1.2 on Electromagnetic Induction in the Earth, 20th Workshop, Giza, Egypt, September 18-24, 2010

Ph.D. thesis completed

Eugénio Pina Almeida- Caracterização electromagnética da Zona Ossa Morena (supervisors: Prof. Dr. Mendes Victor and Fernando Santos)

Industry contract research

Our expertise in applied geophysics, mainly in electromagnetic methods, allowed us to celebrate contracts with industry and public services, mainly related with groundwater detection and geoelectrical terrain characterization. In 2009 the group celebrated contracts with:

- LABELEC/EDP for geoelectrical site characterization;
- MARTINFER for geothermal evaluation in Cape Verde;
- BERALT for mining research.

Internationalization

The group has working with researchers in different international institutes:

- the group has carried out several MT studies in SW Iberia with the University of Barcelona and Granada;
- the group has collaborated with the Geophysical Institute of the Sciences Academy of Czech Republic in the study of new methods for inversion of MT data collected in anisotropic media;
- the group has collaborated with scientists of the National Institute of Astronomy and Geophysics in Cairo in hydrogeophysics domain;
- the group has collaboration with others groups in France, Brazil, Morocco, Tunisia, Australia and Argentina;
- In the scope of the different collaborations the group was visited by researches from Czech Republic (Josef Pek), Egypt (Dr Mahfooz Hafez). Members of the group visited Egypt (F.Santos), France (E. Font).
- H. Matias has a participation in the PROJECT ATLANTIS (FCUL/PETROBRAS) as a Consultant and training for Seismic Interpretation and basin modeling.

6.3 Seismology and Earth Tomography

6.3.1 Funding

114k€, Project WILAS PTDC/CTE-GIX/097946/2008, FCT, 2010-2012

150k€, Project CV-PLUME PTDC/CTE-GIN/64330/2006, FCT, 2007-2011

5k€, Cooperation FCT/DAAD, 2010-2011

10k€, Project ESONET-NOE, EC, 2007-2010

45.72k€, Project TopoMed,Topo-Europe EUROCORES Programme (ESF/FCT), 2008-2010

6.3.2 Objectives

Seismological and in particular seismic tomographies are key approaches in solid earth sciences as they allow indirect probing of deep earth processes. IDL manages fixed and mobile observational means and cooperates in with national and international institutions to design, operate, process and analyze passive and active seismic operations. The main objectives of the group are:

- Seismicity analysis, earthquake sources and related seismogenic processes. Evaluation of lithospheric stress and seismic strain. Comparison with lithospheric thin-sheet modelling. Contribution to the integrated strain mapping of the Nubia-Eurasia plate boundary.
- Cartography of the main inner earth discontinuities using joint inversion of PS and SP receiver functions.
- 3a. Development of different scales 3D tomographic models for the crust and lithosphere, using body and surface waves.
- 3b. - Construction of high resolution maps of lithospheric shallower structures using seismic ambient noise, especially at periods shorter than 20 sec, which are hard to obtain from earthquake surface waves.
- Evaluation of seismic anisotropy at crustal and lithospheric scales, through shear-wave splitting measurement, their connection with the tomographic models and its correlation with crustal stress and mantle plastic deformation.
- Correlation between multi-scale results and integration in anisotropic 3D models and relationship with the geodynamic environment, either at local, regional or global scales.
- To maintain and develop Ocean Bottom Seismometers for long-term recording, both short- and long-period.

6.3.3 Main Achievements

DEEP STRUCTURE OF THE GULF OF CADIZ: First results on the analysis of the dataset obtained by the array of OBS deployed during 2008-2009 in the Gulf of Cadiz were presented by Monna et al., 2010 and Zitellini et al., 2010. The paper by Geissler et al., 2010 focused on the analysis of the most significant sub-crustal seismic activity.

ACTIVE SOURCES THAT CAN GENERATE GREAT EARTHQUAKES AND TSUNAMIS: Work continued along complementary directions: i) investigation of geological and geophysical data; ii) numerical modelling. The paper of Duarte et al. (2010) focused on the analysis of the most prominent of morphological structures. The design of the TWS was developed (Matias et al., 2010) in cooperation with RG3. The other activities are coordinated with RG3 and RG9.

INVESTIGATION OF OCEAN ISLAND STRUCTURE IN THE ATLANTIC AZORES:

- The results from the investigation of the Azores deep seismic structure using P and S receiver functions joint analysis were published in EPSL by Silveira et al (2010).
- The IDL/IGIDL short-period OBS were deployed in the Lucky Strike area in October 2010 to be recovered in June/July 2012.

INVESTIGATION OF OCEAN ISLAND STRUCTURE IN THE ATLANTIC CAPE VERDE:

- Preliminary results on Rayleigh wave group and phase velocity obtained from Noise Correlation Functions were presented at the AGU fall meeting in San Francisco (14-18 December 2010).
- An analysis was performed using the data recorded in the period Nov.2007 – Sep. 2008 by the CV-Plume temporary network, in order to assess the local/regional seismicity rates and its correlation with volcanic processes known to be active. Two clusters of events, appearing to have a NE-SW trend, stand out from the background dispersed seismicity: one occurring near Brava-Fogo islands (last eruption in April 1995), and the other near Santo Antão and São Vicente Islands, near the SW and NW limits of the Cape Verde archipelago. The cluster found in the vicinity of Santo Antão was somewhat unexpected and not previously reported. The correlation with a volcanic origin suggests an on-going growth of the archipelago in the SW direction, associated with volcanic seamounts that are currently being built.
- The crust, the upper mantle and the mantle transition zone (TZ) under the Cape Verde archipelago is being investigated with P and S receiver functions from a few tens of seismograph stations. The results obtained show that the crust is similar to that previously found with the same techniques under the Azores. The upper mantle differs from that under the Azores by a relatively shallow Gutenberg discontinuity, lower S velocity in the mantle lid and a relatively high Vp/Vs velocity ratio.

DEEP STRUCTURE IN SW IBERIA:

- The ongoing work on the investigation of the isotropic structure beneath Iberia by joint inversion of S and P receiver functions was presented at the AGU fall meeting in San Francisco (14-18 December 2010).
- The preliminary tomographic images derived from cross-correlation of about 24 months of ambient seismic noise reveal a good correlation between the main velocity anomalies and the principal geological units on the western Iberian Peninsula. Those results have been presented at the TopoEurope meeting in Oslo (4-7 November 2010).
- The knowledge of the Crust, Lithosphere and Astenosphere seismic structure beneath W Iberia must be dealt at different scales, each involving different but complementary methods. To achieve that purpose access to high quality seismic data is decisive. Within

FCT project "WILAS – West Iberia Lithosphere and Astenosphere Structure", in 2010 a temporary network of nearly 30 VBB/BB stations was deployed, in order to complete the existing coverage provided by the permanent network. This deployment was synchronized with the IBERArray/TOPO-IBERIA project, to achieve a full coverage of the Iberian Peninsula with a roughly 60x60 km BB seismic network.

- In cooperation with GR9 a geophysical modeling of the southern edge of Galicia Bank was made.
- IDL participated in the land acquisition of seismic data in the Brasil Santos basin (SANBA project), in coordination with GR9 (an analogue of Iberian Margin deep structure).

6.3.4 Group Productivity

Publications in peer review Journals

1. Cabral, J. M., Marques, F., Figueiredo, P. and Matias, L., 2010. Active surface faulting or landsliding in the Lower Tagus Valley (Portugal)? A solved controversy concerning the Vila Chã de Ourique site, J. Seismology, DOI 10.1007/s10950-010-9221-8.
2. Duarte JC, Terrinha P, Rosas FM, Valadares V, Pinheiro LM, Matias L, Magalhaes V, Roque C (2010). Crescent-shaped morphotectonic features in the Gulf of Cadiz (offshore SW Iberia). MARINE GEOLOGY, 271, 3-4, 236-249.
3. Geissler WH, Matias L, Stich D, et al. (2010) Focal mechanisms for sub-crustal earthquakes in the Gulf of Cadiz from a dense OBS deployment. GEOPHYSICAL RESEARCH LETTERS, 37, L18309.
4. Silveira G, Vinnik L, Stutzmann E, et al. (2010). Stratification of the Earth beneath the Azores from P and S receiver functions. EARTH AND PLANETARY SCIENCE LETTERS, 299, 1-2, 91-103.

Other international publications

1. Afilhado, A., Lourenço, N., Matias, L., Moulin, M., Corela, C., Pinto de Abreu, M., Cunha, T., Neves, M.C., Pinheiro, L., Terrinha, P. & Rosas, F. Constraint on the lithosphere structure of the southern edge of the Galicia Bank: comparison with adjacent margin segments. Central and North Atlantic II Conjugate Margins Conference, Lisboa, 29 Sept – 1 Oct. 2010.
2. Aslanian, D., Moulin, M., Klingelhoefer, F., Rabineau, M., Bache, F., Matias, L., Gailler, A., Afilhado, A., Gorini, C., Schnürle, P., Patriat, M., Beslier, M.-O., Labails, C., Olivet, J.-L. & Leroux, E., Towards general rules for the continental thinning process through studies in South Atlantic, Central Atlantic and West Mediterranean sea? AAPG, New Orleans, 11 – 14 April 2010.
3. Baptista M A, Matias L., Carrilho F., Annunziato A., J.M.Miranda, Omira, R. Monitoring, Detecting and Warning of Tsunamis in North East Atlantic area. 4th Symposium of the Tsunami Society International, Toronto-Canada, July 2010.
4. Cabral, J., Perea, H., Figueiredo, P.M., Besana-Ostman, G., Brum da Silveira, A., et al (2010) Preliminary results of a paleoseismological study of the Vilariça fault (NE Portugal). In: Contribución de la Geología al Análisis de la Peligrosidad Sísmica, J. M. Insua e F. Martín

González (eds), Abstracts Book, IBERFAULT 2010, Sigüenza, Spain, 27-29 October 2010, 41-44.

5. Dias, N.A., C. Corela, P. Alves, H. Ferreira, F. Carrilho, C. Haberland, S. Custódio, J. Fonseca, B. Caldeira, A. Villaseñor and the WILAS team, 2010. Project WILAS – West Iberia Lithosphere and Astenosphere Structure: closing the coverage on Western Iberia, ESC General Assembly, abstract SD9/P2/ID128.
6. Duarte, J.C., Rosas, F., Terrinha, P., Gutscher, M.A., Malavieille, J., Silva, S. & Matias, L., Thrust - wrench interference tectonics in the Gulf of Cadiz (Africa - Iberia plate boundary): insights from (sand-box) analogue modeling experiments. Geomod2010, Lisbon, 27-29 sept. 2010.
7. Fernandes, R M, Miranda, J M, Matias, L M, Soto, J I, Bos, M S, Almeida, P G, 2010. Nubia-Eurasia Plate Boundary in Iberia From GPS Data, Abstract G43A-0843 presented at 2010 Fall Meeting, AGU, San Francisco, Calif., 13-17 Dec.
8. Matias, H., Kress, P., Terrinha, P., Mohriak, W., Tarso Menezes, P., Matias, L., Santos, F., & Sandnes, F., Salt Tectonics in the Western Gulf of Cadiz (SW Iberia), IIe Central and North Atlantic Conjugate Margins Conference, p. 176-180, Lisboa, 29 Sept – 1 oct. 2010.
9. Matias, L., Annunziato, A., Baptista, M.A. Testing Software Tools of the Portuguese Tsunami Warning System. General Assembly of the European Sesimological Commission. Montpelier, France, September 2010.
10. Matias, L., N. Dias, J. Nunes, D. Vales, I. Rio, J. Madeira, G. Silveira, C. Haberland, 2010. Intraplate Seismicity across the Cape Verde Swell: insights on volcanic build-up, ESC General Assembly, abstract SD14/P7/ID235.
11. Matias, L., S. Silva, M. Romsdorf, W. Geissler, F. Carrilho, W. NEAREST-Working-Group, 2009. The seismicity in the Gulf of Cadiz: a comparison between the locations provided by the land network and the NEAREST OBS passive seismic experiment, ESC General Assembly, abstract D9/Tu/O3.
12. Monna S, Giovanni B. Cimini, Caterina Montuori, Paolo Favali, Wolfram H. Geissler, Luis M. Matias, Aomar Iben Brahim, and Nevio Zitellini. Teleseismic tomography beneath Gulf of Cadiz based on seafloor and land recordings: preliminary results. EGU2010-8461.
13. Morais I, Vinnik, L., Matias, L. and Kiselev, S., 2010. DEEP STRUCTURE OF THE EARTH BENEATH IBERIA FROM P AND S RECEIVER FUNCTIONS AND SKS WAVEFORMS, 6th TOPO-EUROPE Workshop, 4-7 November 2010, Hotel Klækken, Hønefoss, Norway.
14. Morais, I.; Vinnik, L. P.; Silveira, M. M.; Kiselev, S.; Matias, L. M., 2010. Deep structure of crust and mantle beneath Iberian Peninsula and surrounding regions from P and S receiver functions, American Geophysical Union, Fall Meeting 2010, abstract #T23C-2288.
15. Rocha J, Mourad Bezzeghoud, Bento Caldeira, Nuno Dias, José Borges, Luís Matias, Catherine Dorbath, and Fernando Carrilho. Imaging 3D seismic velocity along the seismogenic zone of Algarve region (southern Portugal). EGU2010-13298.

16. Silva S., M. Romsdorf, L. Matias, W.H. Geissler, P. Terrinha, F. Carrilho, and NEAREST Working-Group. Characterization of the seismicity in the Gulf of Cadiz based on eleven month monitoring by the NEAREST OBS network. EGU2010-11554.

17. Silveira, G., Dias, A., Villaseñor, A., "Seismic imaging of the western Iberian crust using ambient noise: boundaries and internal structure of the Iberian Massif", 6th TOPO-EUROPE Workshop, 4-7 November 2010, Hotel Klækken, Hønefoss, Norway

18. Silveira, Graça M, Luis Manuel Matias, Joana, Nunes, Paula Teves-Costa, 2010. Short-Period Rayleigh Wave Dispersion Measurements across the Cape Verde Archipelago using Ambient Noise, American Geophysical Union, Fall Meeting 2010, abstract #S33A-2063.

19. Vales D, Luís Matias, Christian Haberland, Graça Silveira, Michael Weber, Fernando Carrilho, Nuno Dias and the CV-PLUME Team. Intraplate seismicity across the Cape Verde swell. EGU2010-10582.

20. Vinnik, L.; Stutzmann, E.; Silveira, M. M.; Kiselev, S.; Farra, V.; Morais, I., "Azores Deep Structure as Revealed by P and S Receiver Functions", American Geophysical Union, Fall Meeting 2010, abstract #DI51C-1885.

21. Zitellini N, Maria Ana Baptista, Juanjo Dañobeitia, Wilfried Jokat, Marc-Andre Gutscher, Paolo Favali, Hans W. Gerber, Jose Morales, Fernando Carrilho, and Azelarab El Mouraquah. Integrated observations from Near Shore Sources of Tsunamis in the Gulf of Cadiz. EGU2010-11347.

Other national publications

1. Matos, L.J., L. Matias & P. Teves-Costa (2010). Perigosidade sísmica em Ponta Delgada. Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital, Paper 75, 10p.

2. Nemser, E.S., J. Cabral, P. Terrinha, S. Vilanova, G.M., Besana-Ostman , M. Bezzeghoud, J.F. Borges, A. Brum da Silveira, J. Carvalho, R.P. Dias, P.M. Figueiredo, J.F.B.D. Fonseca , F.C. Lopes, J. Madeira, L. Matias, H. Perea, S. Silva, I.G. Wong, 2010. Compilation of Active Fault Data in Portugal for Use in Seismic Hazard Analysis, Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital.

3. Silva, S., P. Terrinha, L. Matias, F. Carrilho, W. Geissler, D. Stich, A. Ibenbrahim, S. Monna, 2010. Sismicidade de Profundidade Intermédia no Golfo de Cádis - Resultados da Campanha de OBS's do Projecto NEAREST, Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital.

4. Vales, D.; Matias, L.; Nunes, J; Rio, I.; Silveira, G.; Dias, N.; Carrilho, F.; Haberland, C.; Weber, M. and the CV-PLUMME Team (2010). "Actividade Sísmica na região de Cabo Verde", Sísmica 2010, 8º Congresso Nacional de Sismologia e Engenharia Sísmica, 148 (CD-ROM).

6.4 Coastal Hazards and Warning Systems

6.4.1 Funding

- MAREMOTI MAREgraphy, tsunaMi observations, mOdeling and vulnerabiliTy studies -2009-2012
- NEAREST –Integrated observations from NEAR shore sourcES of Tsunamis: towards an early warning system FP6
- 2006-2010
- FCT - MorFeed - Morphodynamic feedback of estuarine margins to climate change, 2010-2013
- FCT - 3D MOrphodynamic modelling of WAve Dominated Inlets, 2010-2012
- FCT - *Sand beach textural and compositional variability as indicator of sedimentary dynamics*, 2009-2012
- FCT - *Multidisciplinary integrated analysis of the sediment dynamics and fecal contamination in intermittent coastal systems* – 2008-2011
- FCT - BAYBEACH - *Evolution and Management of Embayed Beaches in Contrasting Environments* 2007-2011
- EU - MICORE - *Morphological Impacts and COastal Risks induced by Extreme storm events*. ENV.2007.1.3.1.1 European Union. Coord Univ. Ferrara - 2008-2011 Protocol CMC/FCUL - *Impact of climate changes in the Cascais administrative region*, 2010
- Protocol ARH-Tejo/FCUL – *Development of a coastal monitoring system*, 2010-2012
- Protocol IH/FCUL - *Simple Underwater Renewable generation of Electricity* - 2010-2012

6.4.2 Objectives

The main objectives of the group are:

- To develop and demonstrate on-line tools for reliable predictions of the morphological impact of marine storm events in support of civil protection mitigation strategies
- To study the coastal response to projected climate change scenarios, including sea level change and wave climate changes, specially the shifts in the direction of predominant winds;
- To develop innovative observational methods to quantify beach changes at different spatial and temporal scales;

6.4.3 Main Achievements

Development of an operational video monitoring system to evaluate morphological impacts and coastal risk induced by extreme storms;

Understanding long-term evolution and variability of major drivers of coastal change: relative and absolute sea level and wave climate.

Improve the understanding of coastal response to climate variability and projected climate change scenarios at a regional level.

6.4.4 Group Productivity

1) Dodet G, Bertirn, X, Taborda (2010) - Wave climate variability in the North-East Atlantic Ocean over the last six decades. Ocean Modelling, Volume 31, Issue 3-4, January 2010, Pages 120-131.

2) Font, E., Nascimento, C., Omira, R., Baptista, M.A., Silva, P.F. 2010. Identification of tsunami-induced deposits using numerical modelling and rock magnetism techniques: A study case of the 1755 Lisbon tsunami in Algarve, Portugal. Physics of the Earth Planet Interior

3) Lima, V.C., J.M.Miranda, M.A.Baptista, J. Catalão, M. Gonzalez, L. Otero, M. Olabarrieta, J. A. Alvarez-Gomez, E. Carreño, 2010. Impact of a 1755-like tsunami in Huelva, Spain. Nat. Haz. And Earth Systs. Sci., 10,1-10. www.nat-hazards-earth-syst-sci.net/10/1/2010/

4) Mário Cachão, Paula Redweik, Edgar Barreira, Joel Dinis, Cristina Catita, Carlos M. Silva, Ana Santos, Eduardo Mayoral (2010). Photogrammetric and spatial analysis of a bioeroded Early Miocene rocky shore, western Portugal. FACIES, Springer-Verlag.

5) Nico, G., J. Catalão, R. Hanssen, C. Catita (2010). Merging GPS and atmospherically corrected InSAR data to map 3D terrain deformation velocity. Accepted for publication in IEEE Transactions on Geoscience and Remote Sensing. On line: http://earth.eo.esa.int/workshops/fringe09/proceedings/papers/p2_27cata.pdf.

6) Omira, R., M.A. Baptista, J. M. Miranda, 2010. Evaluating Tsunami Impact on the Gulf of Cadiz Coast (Northeast Atlantic). Pure Appl. Geophys. _ 2010 Springer Basel AG DOI 10.1007/s00024-010-0217-7

7) Roger, J., M.A. Baptista, M.A., A. Sahal, F. Accary, S. Allgeyer, H. Hebert, 2010. The Transoceanic 1755 Lisbon Tsunami in Martinique, Pure Appl. Geophys.2010 Springer Basel AG, DOI DOI 10.1007/s00024-010-0216-8

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Other Publications

Baptista, M.A., J.M.Miranda, R. Omira, J. Catalão. Prediction of Tsunami Inundation in the City of Lisbon. session NH21A. Natural Hazards General Contributions

Font, E.,.Nascimento, C., Omira, R., Baptista, M.A. and P.M.F Silva. Identification of tsunami-induced deposits using numerical modeling and rock magnetism techniques: A study case of the 1755 Lisbon tsunami in Algarve, Portugal. Session OS31D

Roger, J., M.A. Baptista, D. Mosher, H. Hébert, , A. Sahal. Tsunami Impact on Newfoundland, Canada, due to far-field generated tsunamis. Implications on hazard assessment. 4th Symposium of the Tsunami Society International, Toronto-Canada, July 2010

Baptista M A, Matias L., Carrilho F., Annunziato A., J.M.Miranda, Omira, R. Monitoring, Detecting and Warning of Tsunamis in North East Atlantic area. 4th Symposium of the Tsunami Society International, Toronto-Canada, July 2010

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Almeida, L.P., Vousdoukas, M.V., Ferreira, P.M., Ruano, A.E., Dodet, G., Loureiro, C., Ferreira, Ó., Taborda, R., 2010. Correlating Wave Hindcast and Buoy data with Artificial Neural Networks. 1as Jornadas de Engenharia Hidrográfica, Instituto Hidrográfico, Lisboa, 21-22 de Junho de 2010.

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Redweik, P., J. Dinis, E. Barreira, M. Cachão, C. Catita, A. Santos, E. Mayorale, C. M. Silva and W. Linderf. Spatial analysis of trace fossils for paleogeographic studies. The 13th AGILE International Conference on Geographic Information. G Science, Guimarães, Portugal, May 2010.

Catalão, J., G. Nico, C. Catita (2010). Present day vertical deformation of Pico and Faial islands revealed by merged INSAR and GPS data. European Geosciences Union General Assembly 201, Vienna, Austria, 02 – 07 May 2010.

Catita, C. (2010). “Spatial data analysis” - 2nd International Conference on Data Analysis and Modelling in Earth Sciences (DAMES) - 22 - 24 September 2010, University of Lisbon, IDL.

INVITED TALKS

Baptista, M. A., 2011. Tsunamis do fundo do oceano à costa. Centro de Física da Universidade do Minho. 26.01.2011

Baptista, M.A. ,2010. Riscos Naturais – Tsunamis. Academia das Ciências de Lisboa, 10 de Novembro 2010.

Baptista, M.A., 2010. Tsunamis Historicos. Cursos: Tormentas y Tsunamis en las costas Ibéricas y Marroquinas el el pasado. Prediccion de daños futuros” , Curso de Verano – Universidad Internacional de Andalucia. Tetouan 5-9 de Julho 2010.

Baptista, M.A. ,2010. Sistemas de Alerta en la costa Atlantica nordeste. Cursos: Tormentas y Tsunamis en las costas Ibéricas y Marroquinas el el pasado. Prediccion de daños futuros” , Curso de Verano – Universidad Internacional de Andalucia. Tetouan 5-9 de Julho 2010.

University Ibn Tofail Morocco

Master and Ph.D. thesis completed

PhD Thesis Kaabouben, F. (2010). Evaluation Preliminaire de L’alea des tsunamis au Maroc. University Ibn Tofail Morocco

PhD Thesis Omira R. (2010). Modelling Tsunamis Impact in NWMorocco and SW Iberia. University Ibn Tofail Morocco

Internationalization

Baptista, M.A. Tsunami Society Award 2010 – International Tsunami Society

Baptista M.A. Jury member of EUCYS – European Union Contest of Young Scientists 2010

Baptista, M.A. Vice Chair person of the Intergovernmental Coordination Group for the implementation of the NEAMTWS (North East Atlantic& Mediterranean Tsunami Warning System.

Taborda R., Participation in the "Red Iberoamericana en Teledetección Aplicada a la Prevención de Riesgos Geológicos Litorales".

Taborda R., Cooperation with leading European research teams on coastal hazards within MICORE -EU project - Morphological Impacts and COastal Risks induced by Extreme storm events. ENV.2007.1.3.1.1 European Union.

Taborda R. ,Consultant of the project "Determination of morphodynamics and sediment transference mechanisms in beach-dune systems, as well as their variation in the face of different climatic scenarios. Application to the Ebro River deltaic system." funded by the Spanish "Ministerio de Ciencia e Innovación"

6.5 Earth Dynamics

6.5.1 Funding

MEGAHazards, PTDC/CTE-GIX/108149/2008

AMSprogress, PTDC/CTE-GIX/098696/2008

MAREKH, FCT (finish December 2012)

KINEMA, FCT (finish July 2011)

ESONET, NoE, EU (finish March 2011)

EMSO, EU (finish March 2012)

6.5.2 Objectives

The group objectives for 2010 were:

- Completion of the TEAMINT project – this includes all isotopic dating of sampled granites, all AMS of sampled granites and the Foum Zguid dyke, and palaeomagnetism of S. Jorge, Faial and Terceira Islands (Azores).
- Data compilation and analysis, and manuscript writing related to the experimental work carried out in the ETH-Zurich during 2007/2008 by FO Marques.
- Analogue and numerical modeling of large scale tectonics: (i) folding/unfolding of thin elastic cores in a viscous medium; (ii) fold first or fault first in the compressional deformation of the lithosphere (long-term project); (iii) Subduction initiation at passive margins in 2D and 3D (long-term project); (iv) Transform faulting orthogonal to the rift in 3D (long-term project).
- Tectonics, geochemistry, geochronology and characterization of the transcurrent Variscan tectonics in the Iberian Massif.
- Granites dating – we could not finish isotopic dating of granites in 2009 because the lab carrying out dating (Université Paris-Sud) was not allowed to date rock samples by 40Ar/39Ar due to lack of governmental authorization to use radioactive products. This problem should be solved hopefully in 2010.
- Rock rheology – the long-term illness and death of Luigi Burlini in December 2009 greatly delayed publication of the results. Moreover, EBSD to be realized in ETH-Zürich did not work because samples could not be polished properly (technical problems), and part of the EBSD is now being carried out in Prague because the University of Lisbon does not have a Universal stage. This will be addressed during 2010.
- Study of the structure and tectonic mechanisms related with the Azores Triple Junction. With the availability of new information and the integration in the group of Joaquim Luis and Nuno Lourenço, a new effort will be done to address the tectonic modeling of the triple junction.
- Collation of Magnetic data for the Atlantic and derivation of kinematic plate models for the African Plate (up to anomaly 6, related with MAREKH project) and to the Iberian Margin

(related with TECTAP project).

- Detailed microstructural study of magnetic fabric development with progressive strain: experimental deformation of calcite in frame of FCT project (Long-term project:).

6.5.3 Main Achievements

With regards to the 2010 objectives, the following achievements were reached

- For the TEAMINT project, granites are still to be dated Ar/Ar; AMS and paleomagnetism are being written.
- Completion of this work is in progress but we are not anticipated that it will be finished in 2011.
- Analogue and numerical modeling of large scale tectonics: (a) Analogue experiments of folding/unfolding are finished and the numerical modeling is planned. (b) Numerical modelling of the compressional deformation of the lithosphere is being done by a MSc student with Boris Kaus (ETH) (c) The subduction initiation at the Brazil margin is to be submitted soon, and 3D modelling of such process is being carried out. (d) A paper on analogue modelling of transform faulting orthogonal to the rift has been submitted.
- On the transcurrent Variscan tectonics in the Iberian Massif: (a) New data from stratigraphic correlation between Cambrian sedimentary and volcanic sequences of the OMZ (northern Gondwana margin) in Portugal and Spain were complemented showing that the Cambrian is represented by a stratigraphic sequence typical of a passive continental margin with important bimodal volcanism. (b) The Variscan deformation has been dated with U-Pb zircon ages (SHRIMP and LA-ICP-MS) obtained from gneisses and granites of the Coimbra-Cordoba shear zone (Portugal). The ages are early Carboniferous and reveal the timing of the ductile deformation in such shear zone that is older than the late Carboniferous Porto-Tomar fault zone. (c) First SHRIMP U-Pb zircon datings in high-pressure gneisses and migmatites of the Coimbra-Cordoba shear zone (Portugal) indicate Early Carboniferous ages.
- Granites dating – Unfortunately the issue encountered in 2010 has only being solved. Now the dating should be completed in 2011.
- Rock rheology – EBSD took much longer than expected, but should be completed in 2011.
- Two new sets of finite rotation models for EU-NA and AF-NA plate pairs were computed for anomalies 2 to 6c. Participation at MomarD (ESONET Demo Mission), with the deployment of a set of Ocean Bottom Seismometers, which will record fracturation in the Mid-Atlantic Ridge associated with hydrothermal activity and inter-segment tectonics.
- Compilation of North Atlantic magnetic data was completed and presented at the AGU Fall Meeting. Iberian magnetic data were completed with the aeromagnetic surveys of Biscay Gulf, made available by A. Galdeano, and a number of marine surveys conducted by Collette, made available by IFREMER.
- The detailed microstructural study of magnetic fabric development with progressive strain is ongoing. Rock magnetic fabrics studies reveal that AMS cannot always be used to infer

magma flow. Host-rock deformation shows how room is made to emplace a thick dyke at depth.

Outside, the objectives that were set for 2010, the following outcomes were generated:

- Torsion deformation of polyphase synthetic aggregates shows the effects of rigid inclusions on rock strength and microstructural evolution. Torsion experiments showed the importance of using polymer jackets when testing soft rocks.
- A 3D numerical study on the stability of mantle plumes has been completed. A paper was published in 2011.
- A laboratory designed for the study of high-Reynolds-number particulate gravity currents has been set up.
- Field work in calcite shear zone (Estremoz) and salt structures (Loule); treatment of the samples (microscopy, AMS, magnetic mineralogy); preparation + analysis of the experimental materials; analysis of the porphyric calcite (AMS, EBSD, universal stage).
- Study of significance of magnetic fabric in igneous complexes in Neoproterozoic orogen, Namibia including AMS and magnetic mineralogy and microstructures
- Study of tsunami sources in SW Iberia: As partner of TRANSFER European project, final results considering tsunami inundation modeling in the city of Huelva were published, as well as a revision of tsunami sources if SW Iberia (contribution to EMSO-ESONET projects).
- A new course called Tectonophysics was initiated in the Geophysics MSc. Course (DEGGE, FCUL). The course includes numerical and analytical modelling of geological processes. J.M. Miranda, C. Mériaux and F.O. Marques were in charge of the lectures and practical classes (October-December 2010).

6.5.4 Group Productivity

1) Colaço, A., Blandin, J., Cannat, M., Carval, T., Chavagnac, V., Connelly, D., Fabian, M., Ghiron, S., Goslin, J., Miranda, J. M., Reverdin, G., Sarrazin, J., Waldmann, C., and Sarradin, M. MoMAR-D: a technological challenge to monitor the dynamics of the Lucky Strike vent ecosystem (2010). ICES Journal of Marine Science, doi:10.1093/icesjms/fsq075

2) Font, E; Nascimento, C; Omira, R; Baptista, M.A.; Silva, P.F.. Identification of tsunami-induced deposits using numerical modeling and rock magnetism techniques: A study case of the 1755 Lisbon tsunami in Algarve, Portugal. Physics of the Earth and Planetary Interiors Volume: 182 Issue: 3-4 Pages: 187-198, 2010

3) Kratinová, Z., J. Ježek, K. Schulmann, F. Hrouda, R. K. Shail, and O. Lexa (2010), Noncoaxial K-feldspar and AMS subfabrics in the Land's End granite, Cornwall: Evidence of magmatic fabric decoupling during late deformation and matrix crystallization, J. Geophys. Res., 115, B09104, doi:10.1029/2009JB006714.

4) Kratinová, Z., Machek, M., Kusbach, V., 2010. AMS record of internal fabric evolution in growing vertical viscous structures. J. Geol Soc India 75, 267-277.

5) Lechmann, S.M., Schmalholz, S.M., Burg, J.-P., Marques, F.O., 2010. Dynamic unfolding of multilayers: 2D numerical approach and application to turbidites in SW Portugal. Tectonophysics 494, 64-74.

6) Lemiale, V., H.B. Mühlhaus, C. Mériaux, L. Moresi and L. Hudkinson, 2010, Rate Effects in dense granular materials: linear stability analysis and the fall of granular columns, Int. J. Num. Anal. Meth. Geomech., doi:10.1002/nag.895.

7) Lima VV, Miranda JM, Baptista MA, Catalão J, Gonzalez M, Olabarrieta M, Alvarez-Gomez A, Carreno E. (2010) Impact of a 1755-like Tsunami in Huelva, Spain, Nat. Hazards Earth Syst. Sci., 10, 139-148.

8) Marques, F.O., Burg, J.-P., Lechmann, S. M., Schmalholz, S. M., 2010. Fluid-assisted particulate flow of turbidites at very low temperature: A key to tight folding in a submarine Variscan foreland basin of SW Europe. Tectonics 29, TC2005, doi:10.1029/2008TC002439.

9) Marques, F.O., Burlini, L., Armann, M., 2010.Technical note on the strength of copper versus polymer jackets in torsion tests on halite up to 300 ºC. Tectonophysics 490, 55-59.

10) Marques, FO, 2010. Comment on "Deep structure, recent deformation and analog modeling of the Gulf of Cadiz accretionary wedge: Implications for the 1755 Lisbon earthquake", by Gutscher et al. 2009. Tectonophysics, 485, 327-329.

11) Marques, FO, Burlini, L, Burg, J.-P., 2010. Rheology and microstructure of synthetic halite/calcite porphyritic aggregates in torsion. Journal of Structural Geology 32, 342-349.

12) Nikolaeva, K., Gerya, T., Marques, F.O., 2010. Subduction initiation at passive margins: numerical modelling. Journal of Geophysical Research, 115, B03406, doi:10.1029/2009JB006549.

13) Omira, R; Baptista, MA; Miranda, JM; Toto, E; Catita, C; Catalao, J. (2010) Tsunami vulnerability assessment of Casablanca-Morocco using numerical modelling and GIS tools. Natural Hazards, 54, 1, 75-95.

14) Pereira, M.F., Apraiz, A., Chichorro, M., Silva, J.B., Armstrong, R.A., 2010b. Exhumation of high pressure rocks in northern Gondwana during the Early Carboniferours (Coimbra-Cordoba shear zone, SW Iberian Massif): tectonothermal analysis and U-Th-Pb SHRIMP in-situ zircon geochronology. Gondwana Research, v. 17, 2-4.

15) Pereira, M.F., Silva, J.B., Drost, K., Chichorro, M., Apraiz, A., 2010a. Relative timing of transcurrent displacements in northern Gondwana: New U-Pb laser ablation MS-ICP-MS zircon and monazite geochronology of gneisses and sheared granites from the Western Iberian Massif (Portugal). Gondwana Research, v. 17, 2-4.

16) Rabeh T, Miranda M and Hvozdara M (2010). Strong earthquakes associated with high amplitude daily geomagnetic variations. Natural Hazards. Volume 53, Issue 3 (2010), Page 561. DOI: 10.1007/s11069-009-9449-1

17) Rayan A, Fernandes RMS, Khalil HA, Mahmoud S, Miranda JM, Tealab, A. (2010) Evaluation of the crustal deformations in Lake Nasser (Egypt) region derived from 8 years of GPS campaign observations Journal of Geodynamics. Volume: 49 Issue: 3-4 Special Issue: Sp. Iss. SI Pages: 210-215.

18) Sánchez-Garcia, T., Bellido, F., Pereira, M.F., Chichorro, M., Quesada, C., Pin, C., Silva, J.B., 2010. Rift related volcanism predating the birth of the Rheic Ocean (Ossa-Morena Zone, SW Iberia), Gondwana Research, v. 17, 2-4.

19) Silva, P.F., Marques, F.O., Henry, B., Madureira, P., Hirt, A.M., Font, E., Lourenço, N., 2010. Thick dyke emplacement and internal flow: A structural and magnetic fabric study of the deep-seated dolerite dyke of Foum Zguid (Southern Morocco). Journal of Geophysical Research 115, B12108, doi:10.1029/2010JB007638.

20) Žák, J., Kratinová, Z., Trubač, J., Janoušek, V., Sláma, J., Mrlina, J., 2010. Structure, emplacement, and tectonic setting of the Late Devonian granitoid plutons in the Teplá–Barrandian unit, Bohemian Massif. Int J Earth Sci (Geol Rundsch), doi:10.1007/s00531-010-0565-7.

Organization of conferences

The International Conference GeoMod2010 (Modelling in Geosciences) in the Faculty of Sciences, University of Lisbon, was held in September 2010.

Internationalization

- ETH-Zurich (Switzerland), PGP-Oslo (Norway), IPGP-Paris (France), NRIAG-Cairo (Egypt), UFRN-Natal (Brazil).
- Active collaboration with GPI (Prague) and Agico (Brno) in terms of environmental tasks and fundamental fabric analysis. Collaboration with ETH in terms of deformational experiments (sample preparation etc). A new collaboration with the GFZ institute in Potsdam in terms of deformation experiments.

6.6 Atmospheric and Climate Modeling

6.6.1 Funding

In 2010, the following contracts were active:

Led by IDL:

FCT project AMIC (2010-2012), 170k€, a collaboration with RG10 and the University of Porto, University of Azores and the Institute of Meteorology, on climate change in Iberia and the Azores Islands, including its impacts on the Energy sector.

FCT Project Re-WRITE (2009-2011), 118k, a collaboration with the Univ Evora and the Institute of Meteorology on regional climate.

FCT Project AWARE (2008-2010), 60k€, a colloboration with the Univ Algarve, on orographic meteorology.

Contract with the Institute of Meteorology, funded by CECAC (The Portuguese governmement Climate Change Commission) to support Climate Change studies with the EC-Earth Model, about 100k€/year (2010-2013), IDL receives 40%. Some of the funds are used to contribute to EC-Earth support in Reading.

Participations in projects led by other Institutions:

FCT Project Pinus (2010-12), a collaboration with the Institute of Agronomy on climate change impacts on Pinus trees, about 20k€ for IDL

FCT Project FutureOliv (2010-12), a collaboration with the Institute of Agronomy on climate change impacts on Olive trees, about 15k€ for IDL.

6.6.2 Objectives

The Atmospheric and Climate Modelling (ACM) Group was established as a process study group, addressing problems in dynamical meteorology, such as gravity wave drag and turbulence. In recent years, ACM has evolved also towards more applied research based on numerical models, namely in applications related with climate change. The ACM group has a well-established collaboration with the Land-Climate group on surface processes, and with the Climatology group. A new collaboration with the group on Earth Observation is being built, concerning the use of atmospheric data for image processing and also GPS data for meteorology. Output from such collaborations is expected in the following years.

The main current objectives of the group are the following:

- Contribute to the development of the EC-Earth Earth system model, both in terms of basic code development and by the preparation of simulations for the EC-Earth ensemble to be submitted to IPCC-AR5;
- Establish a capability for Regional Climate Modeling of the Portuguese region, including the Portuguese Islands of Azores and Madeira, based on experience gathered by the Group in day-to-day numerical weather prediction (www.weather.ul.pt); the possibility of extending that capability to Portuguese-speaking African countries will be envisaged;

- Develop know-how in atmosphere-ocean modelling, namely in relation with regional climate issues;
- Maintain some capabilities in more focused, process-based, studies, namely in atmospheric boundary layer, turbulence and orographic processes.

6.6.3 Main Achievements

EC-EARTH MODEL DEVELOPMENT. The EC-Earth model went into "production" phase. Early results (Hazeleger et al 2010) indicated promising performance in key areas. One important IDL development, the new ECMWF H-TESSEL snow scheme (Dutra et al 2010a), was included in EC-Earth. Another development, the inclusion of a lake model done also in collaboration with ECMWF and with D Mironov from DWD and V Stepanenko from Univ Moscow (Dutra et al 2010b, Balsamo et al 2010) was also published, and may be considered for a future EC-Earth release. Further developments of the snow model, namely a multi-layer version, and sensitivity tests, have also been performed and will lead to publications in 2011.

REGIONAL CLIMATE MODELLING. After 3 years of tests as a NWP displayed in the IDL web site (weather.ul.pt) , WRF was setup as a regional climate model and the first 20 year run at high climate resolution (9km for an extended Iberian area) was performed successfully, occupying the cluster for more than 6 months. Results look very promising and are currently being analyzed.

BOUNDARY LAYER STUDIES. The collaboration with J Teixeira at NASA/JPL, was actively pursued, leading to a first joint publication on the performance of the new remote sensing platforms in the retrieving of boundary layer profiles during the RICO experiment (Martins et al 2010). In another collaboration with researchers from Brazil, P Soares used the DALES LES mode to characterize boundary layer structures relevant for dispersion (Moreira et al 2010).

ATMOSPHERE OCEAN MODELLING. New results on basic ocean dynamics, concerning Langmuir circulations were published (Teixeira and Belcher 2010), continuing earlier research by M Teixeira. First results from the LASIE experiment, concerning atmosphere-ocean interaction in the Mediterranean were published (Sempreviva et al 2010). Work by J Alves, a PhD student from the group, was included in a paper on regional oceanography offshore the Portuguese Coast (Carton et al 2010).

OTHER RESULTS. J Martins co-authored a paper with colleagues from Physics on a curious topic: Rossby waves in a Bose Einstein condensate (Terças et al 2010). G King co-authored a paper on analogue flow modelling (Keane et al 2010). M Brito co-authored two papers on applications of solar energy.

6.6.4 Group Productivity

Publications in peer review Journals

1. Balsamo G, Dutra E, Stepanenko VM, Viterbo P, Miranda PM, Mironov D, 2010, Deriving an effective lake depth from satellite lake surface temperature data: a feasibility study with MODIS data, Boreal Environment Research , 15,178-190.
2. Carton X., Daniault N., Alves J., Cherubin L., Ambar I. (2010) Meddy dynamics and interaction with neighboring eddies southwest of Portugal : observations and modeling

Journal of Geophysical Research, Volume 115, Issue C6, CiteID C06017 DOI: 10.1029/2009JC005646

3. Dutra E, Balsamo G, Viterbo P, Miranda PMA., Beljaars A, Schär C, Elder K, 2010: An improved snow scheme for the ECMWF land surface model: description and offline validation. J. Hydrometeorology, 11, 899–916. doi: 10.1175/2010JHM1249.1.
4. Dutra EN, Stepanenko VM, Balsamo G, Viterbo P, Miranda PMA, Mironov D, Schaer C. 2010. Impact of lakes on the performance of global simulations with the ECMWF surface scheme, Boreal Environment Research 15,100-112.
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9. Peled, E., Dutra, E., Viterbo, P., and Angert, A., 2010: Technical Note: Comparing and ranking soil drought indices performance over Europe, through remote-sensing of vegetation. Hydrol. Earth Syst. Sci., 14, doi:10.5194/hess-14-271-2010.
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Other international publications

Book chapter:

Soares, P.M.M., J. Teixeira and P.M.A. Miranda,2010,: "Parameterization of Convective Boundary Layer Turbulence and Clouds in Atmospheric Models". In Air Pollution Turbulence, Modeling and Applications, Ed. Moreira and Vilhena, CRC Press, Taylor & Francis group, 324 pp.

Conferences:

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5. Dutra E, Balsamo G, Viterbo P, Miranda PMA,2010, Snow complexity representation and GCM climate, EGU2010.
6. Dutra E, Balsamo G, Viterbo P, Miranda PMA, Beljaars A, Schär C, Elder K,2010, An improved snow scheme for the ECMWF land surface model: description and offline validation, EGU2010.
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8. Dutra E., G. Balsamo, P. Viterbo, P.M.A. Miranda, A. Beljaars, C. Schär, K. Elder,2010,: Revised Snow Scheme in the ECMWF Land Surface Model: Offline Validation and Impacts on EC-EARTH. Work. Cold Regions Hydrology. Innsbruck.
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11. King GP and Dias J (2010) A methodology for constructing a weekly upwelling index at high spatial resolution from satellite sea surface temperature maps with application to West Iberia., AGU Fall Meeting.
12. Gomes SC, Dutra E, Viterbo P, Miranda PMA,2010, Assessment of hydrological characteristics of ERA-40 and ERA-Interim reanalysis, EGU2010.

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15. Martins JPA, Teixeira J, Soares PMM, Miranda PMA, Dang V, Fetzer EJ, Fishbein E, Irion FW,2010,: Infra-red sounding of the Trade-wind boundary layer: AIRS and the RICO Experiment. Symposium on Boundary Layers and Turbulence of the American Meteorological Society (Keystone, CO, USA)

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28. Teixeira J, Matheau G, Chung D, Miranda P, Martins J, Soares P,2010, Climate prediction as a multidisciplinary computational fluid dynamics problem: Turbulence, clouds and LES models. European Conf. Computat. Fluid Dynamics, Lisboa.

29. Tomé R, Semedo A, Pensieri S, Sempreviva AM, Miranda P, Teixeira J, Schiano M,2010, Atmospheric Boundary Layer Height Estimations during the LASIE Experiment, EGU2010.

30. Tomé R, Semedo A, Teixeira J, Sempreviva AM, Schiano M, Miranda P,2010, Evaluation and Intercomparison of MM5 and WRF Predictions during the LASIE Experiment, EGU2010.

31. Tomé R, Semedo A, Ranjha R, Tjernstrom M, Svensson G,2010, Case Study of the California Low Level Coastal Jet Comparisons Between Observed and Model-Estimated Winds and Temperatures using WRF and COAMPS, EGU2010.

32. Tomé R, Semedo A, Sempreviva AM, Schiano E, Pensieri S, Miranda P, Teixeira J,2010, Marine Atmospheric Boundary Layer Height Estimations during the LASIE Experiment, AMS Conference on Air-Sea Interaction, Annapolis, USA.

Industry contract research

A contract with the wind energy sector was concluded in 2010 and led to a small spin-off company, integrating the University of Lisbon (through ICAT) and the University of Porto (through INEGI and INESC-Porto).

Internationalization

IDL has kept a very active role in the EC-Earth climate modelling consortium. A collaborative paper by EC-Earth (Hazeleger et al 2010) was published in the Bulletim of the American Meteorological Society.

The following ACM PhD students were involved in relevant international collaborations:

- Emanuel Dutra spent 6 months at ETH-Zurich, with Christoph Schaer, working on surface processes.
- Miguel Nogueira spent 9 month at Duke University, USA, with Ana Barros, working orographic precipitation.
- João Martins spent 4 months at NASA/JPL (Caltech), with João Teixeira, working on boundary layer clouds.
- José Alves spent 2 months at USGS, with John Warner, working on coupled atmosphere ocean modelling (WRF+ROMS).

Government/Organization contract research

A contract between IDL and the Institute of Meteorology, funded by the Portuguese government through CECAC (Climate Change Commission), aims to support the climate change impact community by the release of regional scenarios. This contract is supporting the Portuguese participation in EC-Earth, and will lead to the release of output from EC-Earth and from the Regional Model, obtained mainly within Project AMIC. The first annual report was issued in 2010, and others will be prepared every year until 2012.

6.7Earth Observation and Space Geodesy

6.7.1 Funding

"COASTALT" - Development of Radar Altimetry Data Processing in the Coastal Zone. ESA (European Space Agency), 9.1k €, 2010-2011.

“SHA-AZORES” - Seismic Hazard Assessment in the AZORES through neotectonics and paleoseismology studies. Fundação para a Ciência e a Tecnologia (PTDC/CTE-GIX/108637/2008), 90k €, 2010-2012

"CV-PLUME" - An investigation on the geometry and deep signature of the Cape Verde mantle plume. Fundação para a Ciência e a Tecnologia (PTDC/CTE-GIN/64330/2006), 200k €

“MICORE" - Morphological Impacts and COastal Risks induced by Extreme storm events. Grant agreement no.: 202798, Seventh Framework programme THEME ENVIRONMENT Version: 7 March 2008 Grant agreement for: CollaborativeProject (small or medium scale focused research project), 3.4M €, 2008-2011

“MAPRISK" - Metodologias de Avaliação da Perigosidade e Risco de movimentos de vertente no âmbito dos planos municipais de ordenamento do território. Fundação para a Ciência e a Tecnologia (PTDC/GEO/68227/2006), 200k €

6.7.2 Objectives

Earth observation and particularly space geodesy give direct assess to morphological changes at earth’s surface, which can be described as a function of time. The group combines the expertise of a number of survey engineers in both conventional and modern techniques, and aims to integrate land and space-based approaches in earth science studies.

6.7.3 Main Achievements

EXTREME SEA-LEVELS: development of a new methodology for the analysis of extreme sea-levels from tide gauge records based on the joint application of extreme value theory and time series clustering (Scotto et al., 2010).

ENVISAT ALTIMETRY PRODUCTS: preliminary testing in the west Iberia margin of the new ESA experimental 18 Hz coastal altimetry product COASTALT

GPS DATA PROCESSING: Full reprocessing of GPS data (global and regional sites from Portuguese SERVIR and REPRAA networks) using a consistent set of models, orbits and coordinates for the period 1998-2010.

GPS METEOROLOGY: A methodology was developed to study the statistical properties of spatial and temporal distribution of tropospheric Precipitable Water (PW) density. The methodology relies on the merging of GPS and InSAR measurements and on forecasts of a Numerical Weather Model (WRF). This methodology could be used to mitigate atmospheric artifacts in geodesic applications of SAR interferometry (Fernandes et al., 2010).

IMPLEMENTATION OF AFREF: We conducted a series of preliminary regional studies (Nigeria, Arabia, (Jatau et al., 2010; Al-Sahhaf et al., 2010). In cooperation with DLR we conducted a series of long GPS profiles across Africa and Arabia to support the calibration of TanDEM-X.

PS-InSAR TECHNIQUES FOR GEO-HAZARDS ASSESSMENT. Two targets were defined to develop the use of PS-InSAR techniques with very positive results: the Azores volcanic islands, where there is geological evidence of significant mass waste (Catalão et al., 2010); and the area north of Lisbon, where large landslides do occur (Nico et al., 2010).

DETAILED TOPO-BATHYMETRY STUDIES FOR TSUNAMI MODELLING: In cooperation with GR3, a series of regional studies were made to compute homogeneous topo-bathymetric descriptions needed to develop tsunami modeling studies (Lima et al., 2010; Omira et al. 2010).
COAST-LINE STUDIES: Preliminary studies were conducted on the combination of SAR imagery for coastline detection, an important target in forthcoming years.

6.7.4 Group Productivity

Publications in peer review Journals

1. Bastos, L., M.S. Bos, R.M.S. Fernandes, “Deformation and Tectonics: Contribution of GPS Measurements to Plate Tectonics – Overview and Recent Developments”, Sciences of Geodesy – I, Advances and Future Directions, Xu, G. (Ed), Springer Heidelberg, 2010 (pp 155-184).
2. Fernandes MJ, Lazaro C, Nunes AL, Pires N, Bastos L, Mendes VB (2010). GNSS-Derived Path Delay: An Approach to Compute the Wet Tropospheric Correction for Coastal Altimetry. IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, 7, 3, 596-600.
3. Barbosa, SM, Zafrir, H, Malik, U, Piatibratova, O, 2010. Multi-year to daily Radon variability from continuous monitoring at the Amram tunnel, southern Israel Geophysical Journal International, 182, 829-842
4. Barbosa, SM, Madsen, KS, 2010. Quantile analysis of relative sea-level at the Hornbæk and Gedser tide gauges. International Association of Geodesy Symposia (in press)
5. Scotto, MG, Alonso, AM, Barbosa, SM, 2010. Clustering time series of sea levels: an extreme value approach. Journal of Waterway, Port, Coastal, and Ocean Engineering 136, 215-225
6. Lima V. V., J. M. Miranda, M. A. Baptista, J. Catalao, M. Gonzalez, L. Otero, M. Olabarrieta,J. A. Alvarez-Gomez, and E. Carreno, 2010. Impact of a 1755-like tsunami in Huelva, Spain. NATURAL HAZARDS AND EARTH SYSTEM SCIENCES Volume: 10 Issue: 1 Pages: 139-148.
7. Omira, R., Baptista, M. A., Miranda, J. M., Toto, E., Catita, C., Catalão, J., 2010. Tsunami vulnerability assessment of Casablanca-Morocco using numerical modelling and GIS tools. NATURAL HAZARDS Volume: 54 Issue: 1 Pages: 75-95. DOI:10.1007/s11069-009-9454-4.

Other international publications

1. Al-Sahhaf, N., R.M.S. Fernandes, and S. Alhamidi, The ArabRef Project – A New Geodetic Network for Arabia, FS 4C - Adjustment Techniques and Reference Frames, FIG Congress 2010, Facing the Challenges – Building the Capacity, Sydney, Australia, April 2010.

2. Barbosa, SM, Fernandes, MJ, Lazaro, C, Nunes, A, Pires, N, Cipollini, P, 2010. Validation of coastal altimetry data along the west Iberian coast. Proceedings of ESA Living Planet symposium, Bergen, July 2010

3. Barbosa, SM, Lazaro, C, Fernandes, MJ, Ferreira, A, 2010. Changing Seasonality of AVHRR Sea Surface Temperature along the west Iberian Coast. Proceedings of ESA Living Planet symposium, Bergen, July 2010

4. Barbosa, SM, Matos, JAO, 2010. Global sea-level rise from satellite altimetry: the tale of the mean. Proceedings of ESA Living Planet symposium, Bergen, July 2010

5. Catalão J, G. Nico, Ramon Hanssen, Cristina Catita (2010).Measuring the vertical deformation in Azores Islands: enhanced PS-InSAR processing by tropospheric phase delay correction. . ESA Living Planet 2010. ESA as Special Publication SP-686.

6. Catalão, J. and Sevilla M., 2010. Towards a unified vertical datum on Iberia and Macaronesian Islands. In: The Apple of Knowledge, Ed: M.E.Contadakis et al., AUTH – Faculty of Rural and Surveying Engineering, ISBN 978-960-243-674-5, pp. 31-42.

7. Dinis, J., Navarro, A., Soares, F., Santos, T., Freire, S., Fonseca, A., Afonso, N. and Tenedório, J., 2010. Hierarchical object based classification of dense urban áreas by integrating high spatial resolution satellite images and LIDAR elevation data. Proceedings of GEOBIA2010-Geographic Object-Based Image Analysis. 29-June to 2-July, Ghent, Belgium. Link: http://geobia.ugent.be/proceedings/html/papers.html

8. Fernandes R.M.S., H. Farah, L. Combrinck, H. Khalil, and S. Leinen, Towards the implementation of AFREF: results of case-studies for the computation of the reference solution, Geophysical Research Abstracts, Vol. 11, EGU2009-11242, 2009.

9. Fernandes, R.M.S., D.K. Adams, J. Maia, Sensitivity of Precipitable Water Vapour Estimations using GNSS Observations, Proceedings of the 9th International Conference on Hydroinformatics, Tianjin, China, September, 2010, Chemical Industry Press, Vol 2, pp 1631-1636.

10. Fernandes, R.M.S., J.M.F. Santos, D. Kosmann, Merging GNSS kinematic tracks – using the TanDEM-X mission in Africa, TS 8C – Instruments and Calibration, FIG Congress 2010, Facing the Challenges – Building the Capacity, Sydney, Australia, April 2010.

11. Freire, S., Santos, T., Navarro, A., Soares, F., Dinis, J., Afonso, N., Fonseca, A. and Tenedório, J., 2010. Extraction of buildings from QuickBird imagery for municipal planning purposes: quality assessment considering existing mapping standards. Proceedings of GEOBIA2010-Geographic Object-Based Image Analysis. 29-June to 2-July, Ghent, Belgium. Link: http://geobia.ugent.be/proceedings/html/papers.html

12. Jatau B., R.M.S. Fernandes, A. Adebomehin, and N. Gonçalves, NIGNET – The New Permanent GNSS Network of Nigeria, FS 2H - GNSS CORS Networks, FIG Congress 2010, Facing the Challenges – Building the Capacity, Sydney, Australia, April 2010.

13. Jorge, Marco; Vieira, Gonçalo; Catalão, João; Ramos, Miguel. Rock glacier activity in the South Shetland Islands: DINSAR, ground-truth and GIS analysis. Methodology and first results. ESA Living Planet 2010. ESA as Special Publication SP-686.

14. Mateus P, G. Nico, R. Tomé, J. Catalão and P. Miranda, "Comparison of precipitable water vapor (PWV) maps derived by GPS, SAR interferometry, and numerical forecasting models", Proc. SPIE 7827, 782714 (2010); doi:10.1117/12.864733

15. Mateus P, Giovanni Nico and João Catalão, "Mapping temporal evolution of water vapor in troposphere by interferometric SAR data", Proc. SPIE 7827, 782712 (2010); doi:10.1117/12.864727

16. Mateus P., G. Nico and J. Catalão, "Interpolating MERIS and GPS measurements of precipitable water vapour (PWV) to estimate atmospheric phase delay maps", Proc. SPIE 7827, 782713 (2010); doi:10.1117/12.864731

17. Mateus, Pedro; Nico, Giovanni; Tome, Ricardo; Catalao, Joao; Miranda, Pedro On the Tropospheric Water Vapour Mapping: GPS, SAR Interferometry and Numerical Forecasting Models. . ESA Living Planet 2010, ESA as Special Publication SP-686.

18. Nico G, S.C. Oliveira, J. Catalão, J.L. Zêzere, R.A.C. Garcia. Landslide susceptibility mapping based on Persistent Scatterers inventories. ESA Living Planet 2010. ESA as Special Publication SP-686.

19. Santos, T., Freire, S., Navarro, A., Soares, F., Dinis, J., Afonso, N., Fonseca, A. and Tenedório, J., 2010. Extracting buildings in the city of Lisbon using QuickBird images and LIDAR data. Proceedings of GEOBIA2010-Geographic Object-Based Image Analysis, 29-June to 2-July, Ghent, Belgium. Link: http://geobia.ugent.be/proceedings/html/papers.html

20. Soares, F. and Nico, G., 2010. A waterfall segmentation algorithm for coastline detection in SAR images. Proceedings of SPIE2010-Image and Signal Processing for Remote Sensing XVI, 20-23 September, Toulouse, France. DOI Link: http://dx.doi.org/10.1117/12.864700

21. Soares, F. and Nico, G., 2010. Fringe detection in SAR interferograms. Proceedings of SPIE2010-Image and Signal Processing for Remote Sensing XVI, 20-23 September, Toulouse, France. DOI Link: http://dx.doi.org/10.1117/12.864581

22. Soares, F. and Nico, G., 2010. Waterline extraction in optical images and InSAR coherence maps based on the geodesic time concept. Proceedings of SPIE2010-Image and Signal Processing for Remote Sensing XVI, 20-23 September, Toulouse, France. DOI Link: http://dx.doi.org/10.1117/12.864687

23. Soares, F., Navarro, A., Santos, T., Freire, S., Fonseca, A., Afonso, N. and Tenedório, J., 2010. Cartographic data extraction from airborne imagery by hierarchical-based morphologic image processing. Proceedings of GEOBIA2010-Geographic Object-Based Image Analysis, 29-June to 2-July, Ghent, Belgium. Link: http://geobia.ugent.be/proceedings/html/papers.html

24. Zafrir, Malik, U, Barbosa, SM, 2010. Differentiation between the effects of temperature and pressure on radon migration in subsurface media - by simultaneous monitoring with new narrow gamma and alpha radon sensors, TR-GSI/06/2010, Jerusalem, November 2010

Other national publications

Trota, A., V. B. Mendes, P. Amaral (2010). “Subsidência generalizada nas ilhas de S. Miguel e Terceira (Açores) detectada por GPS.” Cartografia e Geodesia 2009, Actas da VI Conferência

Nacional de Geodesia e Cartografia, 7-8 de Maio de 2009, Caldas da Rainha, Lidel-Edições técnicas, pp. 330-335.

Organization of conferences

- Data Analysis and Modeling in Earth Sciences DAMES'2010, 22 - 24 September 2010, University of Lisbon, IDL
- EGU 2010: NP4.1 Open Session on Geoscientific Time Series Analysis (co-convener)
- Participação na Comissão Científica da Session "Global Navigation Satellite System Techniques for Meteorological/Climate Studies ", AGU Meeting of Americas, Foz do Iguassu, Brazil, Agosto 2010.
- Participação na Comissão Científica da Session "Plate Motion and Continental Deformation I", AGU Fall Meeting, San Francisco, Dezembro 2010.

Internationalization

Short-term visiting scientists:

- Dr Mikhail Karpytchev, Université La Rochelle, France, visited IDL for scientific cooperation in June 2010 and November 2010
- Prof Didier Dacunha Castelle, Université Paris-Sud, France, visited IDL for scientific cooperation in May 2010

Invited seminar on “Seasonality in a global warming context” Journées thématiques : Statistiques et changement climatique, Université Paris-Sud, January2010

Post-graduate short-course on “Seasonality and trend detection conundrums for environmental variables”, Instituto Hidrografico Cantabria, Spain, 14-18 June 2010

Post-graduate short course in Data Analysis in Earth Sciences, 20 - 21 September 2010, University of Lisbon, IDL

NIGNET, Nigerian GNSS Network, to implement the new reference network for Nigeria in collaboration with OSGoF (Office of Survey General of Federation of Nigeria) by establishing a network of 9 GNSS CORS systems and the Centre of Control and Analysis.

REPANGOL, Rede Permanente de Angola, to implement the new reference network for Angola in collaboration with IGCA (Instituto Geográfico e Cadastral de Angola) by establishing a network of 18 GNSS CORS systems and the Centre of Control and Analysis.

Project TandemX-Arabia, an international cooperation with DLR (Deutschen Zentrums für Luft- und Raumfahrt), the German Space Agency, to measure one GNSS kinematic track in Arabia (Bahrein - Jeddah).

Institute for Space Sciences, ICE/CSIC, Barcelona, Spain, The Canary GNSS Centre, Canarias

6.8 Seismic and Volcanic Hazards

6.8.1 Funding

Portugal-Spain Bilateral coop. E-22/09, 2009-2010. CRUP, MEC Spain, 2 k€

Res. Prog. IEC, Spain. PT2008-S0201-BARTOMEU01. 2008-2010. 5 k€

DGI/MCI, Spain. CGL2008-01830. 2008-2010 25 k€

EVENT, Project CGL2006-12861-C02-02, MEC Spain, 2006-2010.

Scientific and Technological Cooperation FCT/CSIC, Proc 441.00 CSIC. 2010/2011, 3 k€

Contribution to NERIES Archive of Historical Earthquake Data. Agreement INGV-MI / UL, IDL. 2010, 10 k€

Project CGL2008-03463. MCI, Spain. 2009-2011. 10 k€

NERIES JRA4 Geothecnical Site characterization (RII3-CT-2006-026130), EU, ORFEUS. 30 k€

PALEOSISPOR, project PTDC/CTE-GIN/66283/2006. FCT. 2009-2011. 20 k€

SHA-AZORES, project PTDC/CTE-GIX/108637/2008, 2010-2012. 30 k€

PLUME, project PTDC/CTE-GIN/64330/2006. 2007-2011, 20 k€

FREEROCK, project PTDC/CTE-GIX/100687/2008, 2009-2012. 20 k€

GeoSIS-Lx, project PTDC/ECM/64167/2006. FCT. 2007-2011. 43 k€

Project LISBOA-02-3207-FEDER-000044, CCDR LVT, Programa QREN-PORL, 2010-2011. 107 k€

NEFITAG, project PTDC/CTE-GIX/102245/2008. FCT. 2010-2013. 20k€.

6.8.2 Objectives

The Research Group addresses the characterization of seismotectonics, volcanic and related hazards in areas with distinct geodynamic settings, with emphasis on the Portuguese mainland territory (W Iberia margin) and the Ibero-Maghrebian diffuse transpressive plate boundary between Nubia and Iberia, the Azores archipelago, on a triple junction setting, and other Macaronesian volcanic archipelagos (Madeira, Cape Verde, Canary islands) located in oceanic intraplate domain. Other active tectonic study areas are envisaged, as the Alboran and other Mediterranean domains, and Central America.

The main objectives of the group are:

- to constrain the seismogenic potential of active faults in the study regions and characterize their seismic cycle using modern techniques in Active Tectonics and Paleoseismology, for providing a complementary earthquake data set to complete the historical and instrumental earthquake catalogues using the geological information;
- to predict ground motions due to strong earthquakes and the potential damage on built structures, based on the seismic attenuation laws, physical characterization of the shallower geological formations, identification of potential site effects, and buildings response, in order to develop seismic scenarios for urban areas;

- to characterize vertical motions of the crust in the Plio-Quaternary, based upon geological and geomorphologic references as proxys of land uplift, for building a comprehensive regional neotectonic evolution, particularly in the West-Iberia Atlantic margin and the Atlantic islands;
- to characterize volcanotectonics, volcanostratigraphy and volcanic related hazards of the Macaronesia (Azores, Madeira, Canary and Cape Verde archipelagos) in the regional geodynamic framework;
- to search for evidences of past and of potential or nucleating collapses of volcanic edifices, as potential sources for major tsunamis, and search for evidences of correlative tsunamites and their characterization;
- to continue developing a complete seismotectonic and volcanotectonic database for the National and European scientific community, local authorities, land-use planners, and Civil Protection agents, to assure reliable assessment of regional seismic and volcanic hazards.

6.8.3 Main Achievements

ACTIVE TECTONICS AND PALEOSEISMOLOGY STUDIES in S Portugal; one more trench was opened on the S. Marcos-Quarteira fault system; geoelectrical tomography and GPR exploration were performed for selection of other trenching sites; further fault reconnaissance and characterization of raised marine terraces were performed. Studies were also focused on other structures: the Vilariça fault, where two trenches were opened, and the Segura, Messejana and Vidigueira-Moura (Central and SE Portugal) faults; characterization and sampling for OSL dating of the Guadiana River terraces near the Vidigueira-Moura fault were performed. Morphotectonic study of the western mountain front of Sierra Nevada de Santa Marta in NE Colombia was started, in cooperation with researchers from INVEMAR (Colombia), to determine Quaternary activity and select paleoseismological study sites. One team member participated in EVENT-DEEP oceanographic campaign in the Alboran Sea, with acquisition of seismic reflection data, and interpretation of seismic reflection profiles in the “Bajo Segura” fault zone (NE East Betic Shear Zone, Spain) continued, for searching offshore Iberia active structures;

Cooperation with FP7 SHARE European project continued, with insertion of data from the GIS PORTUGUESE SEISMOTECTONICS DATABASE, developed by IDL, into the SHARE database. Insertion of the IDL database into the Quaternary Active Faults Database of Iberia (coordinated by IGME, Spain) was started.

NEOTECTONIC STUDIES OF THE AZORES continued in S. Miguel and in Santa Maria (raised marine terraces) islands; paleoseismological trenching was performed in S. Jorge island, and a GPS monitoring campaign was accomplished. Concerning CHARACTERIZATION OF VOLCANOTECTONICS, VOLCANOSTRATIGRAPHY AND VOLCANIC HAZARD OF THE MACARONESIAN ARCHIPELAGOS, team members participated in field campaigns in the Grã Canaria, Tenerife, and Maio (Cape Verde) islands for studying probable tsunamites sediments.

Fieldwork and definition of geological frameworks continued for identification and characterization of the most representative Madeira Island and Mainland Portugal geosites, for the REGIONAL AND THE NATIONAL GEOLOGIC HERITAGE INVENTORY;

Office design and edition of the GEOLOGIC MAP OF MADEIRA ISLAND (2 sheets, 1:50.000 scale) for Secretaria Regional do Ambiente e Recursos Naturais (Madeira) was concluded; Art Work was made in the IGeoE and the map is presently in print. Digitalization of the GEOLOGICAL MAP OF FOGO ISLAND (Cape Verde), 1:50,000 scale, was performed.

Concerning SEISMIC HAZARD STUDIES, damage scenarios for Lisbon were performed considering a simple level 1 approach. Infill deposits of downtown Lisbon were characterized for microzonation purposes. Compilation of all results on site characterization obtained during NERIES project (JRA4 activity) were presented at a national meeting (Sísmica2010). A first estimation of Vs30 values at national level (Portugal mainland) was performed based on surface geology information, and results were used on shakemaps generation produced by Institute of Meteorology. VS30 values were estimated for the Lower Tagus Valley region in more detail. Obtained shakemaps were compared with the macroseismic field of the 1909 Benavente earthquake. Estimation of Vs30 values at a town level was also performed, selecting downtown Lisbon as pilot zone, and the results were presented in two international meetings (ESC, Monpellier, and AGU, San Francisco). Less detailed studies were performed for the Algarve region and Ponta Delgada (Azores, São Miguel Island).

REVISION OF HISTORICAL AND INSTRUMENTAL SEISMICITY continued for assessing seismic hazard in Lisbon. There was cooperation with FP7 SHARE European project on the subject of the Iberian historical seismicity; location of several Portuguese earthquakes was revised. Records of the Alicante and Murcia earthquakes of September 1919 were digitalized and a preliminary study was performed. Data concerning the 19 November 1923 earthquake in the Aran Valley (central Pyrenees) is being compiled to study this event.

COOPERATION WITH OTHER RG: Work was accomplished in cooperation with Research Groups RG-LVT-50019-3386 (geophysical prospecting of active faults), RG-LVT-50019-3388 (active faults and the seismicity database for the Portuguese territory; GIS Seismotectonics Database), RG-LVT-50019-3389 (analogue modeling of active faulting), and RG-LVT-50019-3429 (active tectonics characterization through the use of space-geodetic techniques for geodynamics studies).

6.8.4 Group Productivity

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3. Cabral, J., Perea, H., Figueiredo, P.M., Besana-Ostman, G., Brum da Silveira, A., et al (2010) Preliminary results of a paleoseismological study of the Vilariça fault (NE Portugal). In: Contribución de la Geología al Análisis de la Peligrosidad Sísmica, J. M. Insua e F. Martín González (eds), Abstracts Book, IBERFAULT 2010, Sigüenza, Spain, 27-29 October 2010, 41-44.

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9. Gràcia, E., Bartolomé, R., Lo Iacono, C., Moreno, X., Martínez-Loriente, S., Perea, H., et al (2010) Characterizing active faults and associated mass transport deposits in the south Iberian margin (Alboran sea and Gulf of Cadiz): On-fault and off-fault paleoseismic evidence. In: Contribución de la Geología al Análisis de la Peligrosidad Sísmica, J. M. Insua e F. Martín González (eds), Abstracts Book, IBERFAULT 2010, Sigüenza, Spain, 27-29 October 2010, 163-166.

10. Masana, E., Gràcia, E., Martínez-Díaz, J.J., Moreno, X., Ortuño, M., Perea, H. et al (2010) Characterizing the seismic potential of the Eastern Betic Shear Zone (EBSZ), a major source of earthquakes in southeastern Iberia. In: Contribución de la Geología al Análisis de la Peligrosidad Sísmica, J. M. Insua e F. Martín González (eds), Abstracts Book, IBERFAULT 2010, Sigüenza, Spain, 27-29 October 2010, 101-104.

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2. Barreira, E., Teves Costa, P., Omira, R., (2010) Vulnerabilidade Sísmica do Parque Habitacional da Cidade de Lisboa, 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, Portugal, 20-23 Outubro, 11p.

3. Batlló, J. (2010). Historical Seismograms and Seismographs: Much more than collection pieces, in Brandao, J. M., Callapez, P. M.; Mateus, O. and Castro, P. (eds.): Colecções e museus de Geologia: missão e gestão, MMGUC & CEHFCi, Coimbra, Portugal, ISBN: 978-989-96564-0-6, pp. 261-266.

4. Batlló, J.; Teves-Costa, P.; Stich, D.; Macià, R.; Morales, J. (2010) Uso de sismogramas antiguos para el estudio de parámetros focales de terremotos Ibéricos. 6º Simpósio de Meteorologia e Geofísica da APMG, 65-69. ISBN 978-989-95660-0-2

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15. Ressurreição, R., Cabral, J., Dias, R., Carvalho, J., Pinto, C.C. (2010): Neotectonic studies on the Carcavai fault – Eastern Algarve. Actas do VIII Congresso Nacional de Geologia, e –Terra, Geosciences On-line Journal, http://e-terra.geopor.pt, ISSN 1645-0388, Vol. 11 – nº 7, 2010, 4 pp.

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17. Teves-Costa, P., Almeida, I.M., Rodrigues I., Pinto, C. (2010) Determinação de Funções de Transferência - aplicação à Baixa de Lisboa. SISMICA2010, 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, Portugal, 20-23 Outubro, 12p.
18. Teves-Costa, P., Veludo I., Almeida, J., Rodrigues I. (2010) Caracterização de Sítio através de Medidas de Vibrações Ambientais em 'Array'. SISMICA2010, 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, Portugal, 20-23 Outubro, 12p.
19. Vilanova, S.P.; Oliveira, C.S.; Brum da Silveira, A.; Madeira, J.; Nemser, E.S.; Fonseca, J.F.B.D.; Arvidsson, R.; Besana-Ostman, G.M.; Bezzeghoud, M.; Borges, J.F.; Cabral, J.; Carvalho, J.; Cunha, P.P.; Dias, R.P.; Lopes, F.C.; Perea, H., I.G. Wong (2010) New seismic source zone model for Portugal and Azores. SÍSMICA 2010 – 8º Congresso de Sismologia e Engenharia Sísmica, 20-23 Outubro 2010, Univ. Aveiro, Aveiro, Portugal.

Organization of conferences

1. Batlló, J., Member of the Scientific Committee of Applied History: Climas e Sismos, Universidade de Évora, Évora, Portugal, 2010-06-08.
2. Ferrari, G. and Batlló, J., Co-conveners of session ES4 “Methods and data for the study of events recorded on pre-WWSSN historical seismograms”, XXXII General Assembly of the European Seismological Commission, Montpellier (France), 6-10 September 2010.
3. Albini, P.; Scotti, O.; Rovida, A. and Batlló, J., Co-conveners of session SD4 “Compiling the earthquake history of the European Mediterranean area”, XXXII General Assembly of the European Seismological Commission, Montpellier (France), 6-10 September 2010.
4. Vaquero, J.M. and Batlló, J., Co-conveners of session S31 “Historical Geophysical and Astronomical Data (H-GAD)”, 4th International Conference of the European Society for the History of Science, Barcelona, Spain, 18-20 November 2010.
5. Batlló, J., Member of the Organizing Committee of XVI Jornades de Meteorología Eduard Fontserè. Barcelona, Spain, 27 November 2010.
6. Cabral, J. and Perea, H., Members of the Organizing Committee and the Scientific Committee of “First Iberian Meeting on Active Faults and Paleoseimology”, Spain, 27-29 October 2010.
7. Cabral, J., Dias, R.P. and Ressurreição, R., Leaders of Post-Meeting Field Trip, 1st SHARE IBERIA Workshop on Seismogenic Sources, Olhão, Portugal, January 14-16, 2010, FP7 Project SHARE

Internationalization

The Research Group maintains a high level of international cooperation in the fields of seismic risk, active tectonics, paleoseismology and volcanology. It is an active partner of NERIES European initiative (P Costa, J. Batlló). The Group maintains close links with the Moroccan scientific community (Marrakech University) (J. Madeira) and the S. Diego State University (California, USA) (J. Cabral), mainly through co-supervision of post-graduate students, and with

Spanish researchers (from Madrid Complutense University, Barcelona University, IGME, and CSIC) (J. Cabral, H. Perea, A. Brum da Silveira and J. Batlló) and Colombian researchers (from INVEMAR) (H. Perea), trough co-participation in research projects. Cooperation with FP7 SHARE – Seismic Hazard Harmonization in Europe, continued, aiming at providing a seismic hazard model for the Euro-Mediterranean region and establish new standards in Probabilistic Seismic Hazard Assessment practice. Collaboration in the construction of the Quaternary Active Faults Database of Iberia (coordinated by IGME, Spain) was started.

6.9 Sedimentary Basins

6.9.1 Funding

Participation in EC research projects

NEAREST - Budget, 87K€ - Funded by the European Comission-01-10-06.

ESF-EUROMARGINS MVSEIS - Funded by the European Science Foundation.

ESF-EUROMARGIN TOPOMED - 63K€ - 15-09-2008 - Funded by the European Science Foundation

SANBA Project – Petrobras – Ifremer – IDL – IUEM – 16-12-2009 – 360 k€

Participation in National research projects

ALMOND - (PTDC/CTE-GIN/71862/2006 - 50K€ - 01-01-2008

HOLOCLIMA - PTDC/CTE-GEX/71298/2006. 120K€ - 2006

SWIMGLO – PTDC/CTE-GIX/102700/2008 – 194,5k€ - 2009

TECTAP – PTDC/CTE-GIN/68462/2006 - 120K€ - 2006

6.9.2 Objectives

Sedimentary Basins are key areas to investigate the complex interplay of the processes that govern the evolution of the Earth. Besides the surface geological manifestations of the shallow Earth dynamics (e.g. subsidence and sediment loading, faulting of the rigid upper crust and syn-sedimentary tectonics, sedimentary deposition, erosion, eustasy), the processes controlling the formation and evolution of sedimentary basins are also critically linked to the internal dynamics of our planet. Although much progress has been achieved over the last three decades in understanding the deformation, and in particular the kinematics of continental lithosphere, it is generally acknowledged by the Earth Science community that state of the art knowledge on the physics of continental lithosphere deformation is still far from comprehensive, namely with respect to processes occurring at the middle/lower crust and within the underlying asthenospheric mantle.

Although most of our studies can be considered as fundamental research, focusing up to date topics, which are of general interest to the scientific community, the research on Sedimentary Basins, and Passive Continental Margins in particular, is of enormous interest to the society in general. First, because a large proportion of the Earth's recoverable natural resources are concentrated in basins and continental margins (e.g. oil exploration/exploitation, fish resources, ores exploration/exploitation, methane fluxes…). And secondly, because margins are highly populated areas, which are particularly exposed to a number geological and associated environmental hazards, such as large mass wasting events, earthquakes and tsunami, and pollution related to hydrocarbon exploration and transport.

The research in the group has covered several inter-related topics, including: (i) source to sink sedimentary processes; (ii) rifting dynamics, from the convecting mantle to Earth surface; (iii) structural and stratigraphic analysis at different scales, (iv) lithospheric plate kinematics; and

(v) rock kinematics using magnetic fabrics. Importantly, the group expertises, which combine analogue and numerical modelling techniques, field geology and offshore geophysics, which allows for an interdisciplinary approach for the studied issues.

One of the strengths of the group is the interdisciplinary approach, benefiting from the combined methodologies and existent expertises, to address the complexity of scientific problems concerning the formation and evolution of sedimentary basins and the mechanisms of rifting in general (e.g. wide-angle and multi-channel seismic processing and interpretation, sequence stratigraphy, large-scale kinematic reconstructions, analogue and numerical modeling, potential field analysis and modelling, geomorphology and structural geology). We added in 2011, a new exciting branch on organic matter diagenesis (i.e., hydrocarbon formation and degradation) with the integration of M. Nuzzo.

6.9.3 Main Achievements

WEST IBERIAN MARGIN: POGM have been applied along the conjugate margins of West Iberia and Newfoundland, to recover the geometry of the rift margin and put constraints on the long-term mechanical structure and thermal evolution of the lithopshere. In parallel, a new numerical modelling approach was used to investigate the mechanisms that control conjugate margins asymmetries and explain the overall geometry, subsidence history and thermal evolution. We used analogue modeling to study the passive behaviour of faults (and other tabular anisotropies) lying in the hanging wall of reverse-reactivated normal faults of variable geometry (in collab. with RG8) and propagation of extension along a rifted margin, as a function of a varying crustal rheological stratigraphy. One paper is in preparation. A detailed shallow velocity model for IAM6 profile was obtained from first arrival tomography applied to shot gather records. Several tests on merging the shallow tomographic and deep wide-angle models were performed to further obtain a pre-stack depth migrated section. The re-evaluation of wide-angle velocity models and MCS interpretation is on-going. Four papers were published.

MEDITERRANEAN MARGINS: in order to study the structure of the two young pair of margins: the Gulf of Lion and Sardinian margins, we characterized the nature of the crust, using wide-angle modelling, in continent–ocean transition zone. Two papers are in preparation.

BRAZILIAN MARGIN: we modelled the initial evolution of the entire South Atlantic Ocean using kinematic plate modelling. We detailed also the evolution of the Santos basin using kinematic plate modelling and the SanBa seismic experiment, which started the 14th Dec. 2010 will allow us to confirm these hypothesis by determining the nature of the crust, using wide-angle modelling. Using a dataset provided by GALP we implemented a methodology to generate 3D-DFN models of fractured oil fields. Our contribution was to simulate the density and orientation of small scale faults that remain undetected in seismic surveys. The numerical models provide a spatial distribution of predicted sub-seismic fault density and orientation.

GULF OF CADIZ (GC) (1 paper): New results on the seismicity of the GC are presented based on the passive seismic data acquired, during 1 year, by 24 OBS and a seafloor multi-parametric station GEOSTAR (Nearest Project). These new knowledge will improve the understanding of the relationship between the morphology in this area and the rheological behavior of the crust and the mantle, to realize a detailed classification of seismogenic structures. We worked on

the development of fully 3D numerical models of the stress field in the GC, that allow us to explore the local effects of topographic and bending stresses and to quantify its impact on the overall stress pattern dominated by the Eurasia-Africa convergence. The models are used to discriminate the variation of stress with depth and to evaluate the relative contribution of regional plate tectonic and local processes. Two papers were submitted regarding previously analogue modelling in the GC, focusing on the tectonic interference between major (SWIM) strike-slip faults and; a) the Horseshoe Thrust Fault; b) The GC Accretionary Wedge.

CONSTRAINS ON THE RECURRENCE PERIODS OF LARGE EARTHQUAKES: We used a thin-shell numerical approximation to model the neotectonics of the GC and SW Iberia Margin and to put constraints on the recurrence periods of large earthquakes and tsunamis. Different plate boundary conditions and fault networks have been tested and the results compared with the seismic strain, GPS observations and stress data. Our preferred tectonic model corresponds to minimum return periods of ~1000 yr, 3500 yr and 10000 yr for an earthquake of Mw 7, 8 and 8.7, respectively. 1 paper was submitted.

MORPHOSTRUCTURAL STUDIES: Multibeam swath bathymetry data from the NW part of the GC revealed the existence of several intriguing kilometric crescentic depressions, never before reported to occur at such great depths. The coupled analysis of the bathymetry and seismic reflection profiles showed that these features were formed due to the interaction of active tectonic thrusting and turbidity currents.

6.9.4 Group Productivity

Publications in peer review Journals

1. Aslanian, D. & Moulin, M., Comment on ‘A new scheme for the opening of the South Atlantic Ocean and the dissection of an Aptian salt basin’ by Torsvik, Rousse, Labails & Smethurst, accepted to Geophysical Journal International, le 5 Fev. 2010.
2. Cunha, T., Watt, A.B, Pinheiro, L.M., & R. Myklebust, (2010). Seismic and gravity anomaly evidence of large-scale compressional deformation off SW Portugal. Earth Planet. Sci. Lett. (2010), doi:10.1016/j.epsl.2010.01.047
3. Duarte, J.C., Terrinha, P., Rosas, F.M., Valadares, V., Pinheiro, L.M., Matias, L., Magalhães, V. and C. Roque, (2010). Crescent-shaped morphotectonic features in the Gulf of Cadiz (offshore SW Iberia), Marine Geology, 271: 236-249, doi:10.1016/j.margeo.2010.02.017.
4. Moulin, M., Aslanian, D. and Unternehr, P., (2010). A new starting point for the history of the Equatorial and South Atlantic, Earth Science Reviews, 98: 1-37, doi:10.1016/j.earscirev.2009.08.001.
5. Moulin, M. & Aslanian, D., (2010). Corrigendum to: A new starting point for the South and Equatorial Atlantic Ocean (Earth Science Reviews 98 (2010), 1-37), Earth Science Reviews, 103 : 197-198, doi:10.1016/j.earscirev.2010.10.001.

Other international publications

1. Alves, T.M., Moita, C., Cunha, T., Ullnaess, M., Myklebust, R., Monteiro, J.H. & Manuppela, G., Structural Evolution and Timing of Continental Rifting in the Northeast Atlantic (West

Iberian Margin), IIe Central and North Atlantic Conjugate Margins Conference, Lisboa, 29 Sept – 1 oct. 2010.

2. Aslanian D. & M. Moulin, 2010, Passive Margin and Continental Basin: the necessity of the Holistic approach, IIe Central and North Atlantic Conjugate Margins Conference, Lisboa, 29 Sept – 1 oct. 2010.
3. Cunha, D., Roque, C., Silva, F., Silva, E. A., Lourenço, N., Pinto de Abreu, M., Morphostructure of the S. Vicente Canyon, Marquês de Pombal Fault and Pereira de Sousa Fault (SW Iberia margin), IIe Central and North Atlantic Conjugate Margins Conference, p. 65 - 69, Lisboa, 29 Sept – 1 oct. 2010.
4. Cunha, T.A., Petersen, K.D., Nielsen, S.B. & Terrinha, P., Mechanisms for Asymmetric Lithospheric Extension and Implications for the West Iberia-Newfoundland Conjugate Margins: A New Perspective from a Self-Consistent Asthenosphere-Lithosphere Numerical Model, IIe Central and North Atlantic Conjugate Margins Conference, p. 70-75, Lisboa, 29 Sept – 1 oct. 2010.
5. Cunha, T.A., Petersen, K.D., Nielsen, S.B., Some Remarks on Lithospheric Extension: Insights from a Self-Consistent Asthenosphere-Lithosphere Numerical Model, Geomod2010, Lisbon, 27-29 sept. 2010.
6. D'Almeida, L., Rosas, F., Perea, H. & Moulin, M., Hanging wall strain accommodation during thrust reactivation of basement normal faults: comparative analogue modeling of smooth (convex-concave) and flat-ramp (stair-stepping) fault geometries. Geomod2010, Lisbon, 27-29 sept. 2010.
7. Duarte, J.C., Rosas, F., Terrinha, P., Gutscher, M.A., Malavieille, J., Silva, S. & Matias, L., Thrust - wrench interference tectonics in the Gulf of Cadiz (Africa - Iberia plate boundary): insights from (sand-box) analogue modeling experiments. Geomod2010, Lisbon, 27-29 sept. 2010.
8. Gutscher, M-A, Gallais, F., Dominguez, S., Malavieille, J., Rosas, F., Duarte, J. C., Chamot-Rooke, N. & Polonia, A., Interference patterns of two orthogonally converging accretionary wedges: analog modeling applied to the Calabrian prism and Western Mediterranean Ridge collision zone (Ionian Sea). Geomod2010, Lisbon, 27-29 sept. 2010.
9. Keppler, R., Rosas, F., Nagel, T. & Blanco, A., Influence of viscous channel thickness on the development of overlying brittle deformation patterns under extension: news insights from analogue modeling, Geomod2010, Lisbon, 27-29 sept. 2010.
10. Lopes, S., Neves, M.C. & Afilhado, A., Small-scle fracture characterization in the Gulf of Cadix, Geomod2010, Lisbon, 27-29 sept. 2010.
11. Moulin, M., D. Aslanian, Patriat, M., Rabineau, M., Matias, L., 2010, Geodynamic Keys of the Santos Basin, IIe Central and North Atlantic Conjugate Margins Conference, Lisboa, 29 Sept – 1 oct. 2010.
12. Martins, L., Miranda, R., Alves, C., Mata, J., Madeira, J., Munhá, J., Terrinha, P., Youbi, N., Bensalah, K., Mesozoic magmatism at the West Iberian Margins: timing and geochemistry, IIe Central and North Atlantic Conjugate Margins Conference, p. 172-175, Lisboa, 29 Sept – 1 oct. 2010.

13. Matias, H., Kress, P., Terrinha, P., Mohriak, W., Tarso Menezes, P., Matias, L., Santos, F., & Sandnes, F., Salt Tectonics in the Western Gulf of Cadiz (SW Iberia), IIe Central and North Atlantic Conjugate Margins Conference, p. 176-180, Lisboa, 29 Sept – 1 oct. 2010.
14. Neves, M. C., Relating Stress and Earthquakes in the Gulf of Cadix: 3D Finite element models combining local and regional loading, Geomod2010, Lisbon, 27-29 sept. 2010.
15. Nielsen, S.B., Petersen, K.D., Stephenson, R., Cunha, T., Pedersen, V.K., Goledowski, B., Egholm, D.L., McGregor, E., Clausen, O.R., Medhus, A.B., Jacobsen, B.H., Balling, N. & Gallagher, K., Long-term post-orogenic evolution of N Atlantic conjugate margins constrained by on- and offshore data, IIe Central and North Atlantic Conjugate Margins Conference, p211-215, Lisboa, 29 Sept – 1 oct. 2010.
16. Nogueira, C.R., Basin inversion by orthogonal compression: analogue experiments with weak faults, Geomod2010, Lisbon, 27-29 sept. 2010

Abstracts

1. Afilhado, A., Lourenço, N., Matias, L., Moulin, M., Corela, C., Pinto de Abreu, M., Cunha, T., Neves, M.C., Pinheiro, L., Terrinha, P. & Rosas, F. Constraint on the lithosphere structure of the southern edge of the Galicia Bank: comparison with adjacent margin segments. Central and North Atlantic II Conjugate Margins Conference, Lisboa, 29 Sept – 1 oct. 2010.
2. Aslanian, D., Moulin, M., Klingelhoefer, F., Rabineau, M., Bache, F., Matias, L., Gailler, A., Afilhado, A., Gorini, C., Schnürle, P., Patriat, M., Beslier, M.-O., Labails, C., Olivet, J.-L. & Leroux, E., Towards general rules for the continental thinning process through studies in South Atlantic, Central Atlantic and West Mediterranean sea? AAPG, New Orleans, 11 – 14 april 2010.
3. Aslanian. D. & Moulin, M., 2010. A holistic approach of the sedimentary basin genesis. AAPG, New Orleans, 11 – 14 april 2010.
4. Aslanian. D. & Moulin, M., 2010. A holistic approach of the sedimentary basin genesis. Sample Colloquim, Kiel, 13 – 17 June 2010.
5. Moulin, M., Aslanian, D., Rabineau, M., Matias, L., Patriat, M. New plate kinematic evolution on the South and Equatorial Atlantic Oceans: Geodynamic implications and passive margins genesis. AAPG, New Orleans, 11 – 14 April 2010.
6. Terrinha P, Duarte,J., Valadares, V., Batista, L., Zitellini, N., Gràcia, E., Lourenço, N., Rosas, F., and C. Roque. Seafloor morphology of the Eurasia-Nubia (Africa) plate boundary between the Tore-Madeira Rise and the Straits of Gibraltar: a case of coexistent Mesozoic through Present day features of tectonic, oceanographic and sedimentary origin. EGU2010-12658

Other national publications

1) Afilhado, A., Moulin, M., Cunha, T., Lourenço, N., Neves, M., Matias, L., Terrinha, P., Rosas, F., Pinheiro, L. & Pinto de Abreu, M., Margem Oeste Portuguesa, chapitre d'un livre Geologia de Portugal no contexto da Ibéria (R. Dias, A. Araújo, P. Terrinha & J. C. Kullberg, Eds.). Univ. Évora, pp. 247-316, submitted in jun. 2010, accepted in January 2011.

1. Extended Abstracts

1) Batista, L., Terrinha, P., Lourenço, N., Roque, C., Matias, L. & Carrara, G., A tectónica na fronteira de placas Núbia-Eurasia na região dos Montes Submarinos Hirondelle e Josephine; ligação da falha da Glória com as falhas SWIM, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 11, n°5, 316-1655-1-PB.pdf, Braga, 9-16 Jul. 2010.

2) Carrara, G., Geo-Seas: a Pan-European infrastructure for retrieving marine geological and geophysical data, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 15, n°11, 155-1725-1-PB.pdf, Braga, 9-16 Jul. 2010.

3) Carvalho, J., Pinto, C.C., Costa, M., Rabeh, T., Terrinha, P., Duarte, H. & Borges, J., Caracterização de falhas com potencial sismogénico no Vale Inferior do Tejo utilizando dados geofísicos, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 10, n°5, 183-1736-1-PB.pdf, Braga, 9-16 Jul. 2010.

4) Costa, A., Duarte, J.C., Rosas, F. & Terrinha, P., Influência do atrito basal na formação de lineamentos na superfície de um prisma acrecionário, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 11, n°2, 165-1651-1-PB.pdf, Braga, 9-16 Jul. 2010.

5) Cunha, T.A., Matias, L., Terrinha, P., Negredo, A., Rosas, F., Fernandes, R. & Pinheiro, L.M., Neotectónica e períodos de recorrência de grandes sismos e tsunamis na margem SW Ibérica e Golfo de Cádis, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 11, n°4, 278-1654-1-PB.pdf, Braga, 9-16 Jul. 2010.

6) Duarte, J.C., Terrinha, P., Rosas, F., Valadares, V., Pinheiro, L.M., Matias, L., Magalhães, V. & Roque, C., Estruturas morfotectónicas em forma de crescente nas águas profundas do Golfo de Cádis, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 12, n°16, 199-1696-1-PB.pdf, Braga, 9-16 Jul. 2010.

7) Fernandes, A.B., Roque, C., Carrara, G., Duarte, H., Lourenço, N., Pinto de Abreu, M. & Terrinha, P., Deformação sin- e pós-rifting oceânico nos sedimentos Cretácico-Plistocénicos da Planície Abissal da Madeira, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 11, n°12, 284-1663-1-PB.pdf, Braga, 9-16 Jul. 2010.

8) Noiva, J., Terrinha, P. & Duarte, H., Alterações morfológicas do Holocénico e tectónica recente ao largo de Quarteira, Algarve, sul de Portugal, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Jounal, vol. 12, n°7, 259-1686-1-PB.pdf, Braga, 9-16 Jul. 2010.

9) Roque, C., Duarte, J., Valadares, V. & Terrinha, P., Sismostratigrafia e estrutura dos corpos caóticos do Golfo de Cádiz e Planície Abissal da Ferradura: implicações genéticas, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 12, n°15, 315-1695-1-PB.pdf, Braga, 9-16 Jul. 2010.

10) Silva, S.M., Matias, L., Romsdorf, M., Geissler, W., Terrinha, P. & Zitellini, N., Sismicidade instrumental no Golfo de Cádis: Resultados da campanha de aquisição do Projecto

NEAREST, VII Congresso Nacional de Geologia, Revista Electronica de Ciências da Terra, Geosciences On-line Journal, vol. 10, n°6, 314-1643-1-PB.pdf, Braga, 9-16 Jul. 2010.

Ph.D. thesis completed

Rui Miranda, Petrogenesis and Geochronology of the Late Cretaceous alkaline magmatism in the West Iberian Margin, 3 dec. 2009. (Directors: J. Mata & P. Terrinha)

Industry contract research

A/ Contract between Petrobras (Brasil) – Ifremer - IUEM (France) - IDL and Univ. of Brasilia (360 k€)

1) The SanBa Experiment to study of the deep structures of the Santos Basin started the 10 Dec. 2010 until 30th Jan. 2011.

2) In the scope of the presence of Petrobras at the international conference (IIe Central and North Atlantic Conjugate Margins Conference), Petrobras wanted to meet IDL researchers. We organised a meeting, with A. Viana (Responsible of PROFEX program (Technological Program for Exploration Frontiers) at Petrobras) and M. Miranda, P. Terrinha, F. Santos, E. Font, P. Silva, C. Meriaux, F. Ornelas and F. Rosas.

Invited keynote – PETROBRAS - Salvadore de Bahia, Brazil, janv. 2010 - Aslanian, D., Moulin, M., and the Geodynamic Group, Hot Spot, Segmentation, Kinematic And Passives Margins (Part I), IIIeme Workshop de Riftes Continentaises de Margens Passivas, PROFEX (Technologia em fronteiras exploratorias), 20-23 january 2010.

Invited keynote – PETROBRAS - Salvadore de Bahia, Brazil, janv. 2010 - Moulin, M., Aslanian, D., and the Geodynamic Group, Hot Spot, Segmentation, Kinematic And Passives Margins (Part II), IIIeme Workshop de Riftes Continentaises de Margens Passivas, PROFEX (Technologia em fronteiras exploratorias), 20-23 january 2010.

B/ Contract with GALP (Portugal)

1) The Subsalt project (PI: J.Carvalho - LNEG) was signed in 19/07/2010.

This proposal includes a strong knowledge transfer on seismic interferometry, including the promotion of a short course on this topic to be held in Lisbon (Feb. 2011). The project foresee a close collaboration with Deyan Draganov - Univ of Delft

2) The Modelling and characterization of fractures reservoirs project (PI: José António Almeida - CICEGe/FCT-UNL) was signed .

C/ Contact with GDF-Suez (France), for a proposal of seismic experiment on the Equatorial margins, in collaboration with Petrobras, Ifremer, Geosciences Rennes, IUEM, NGU and IDL.

Invited keynote – GDF-Suez – Paris – 10 fev. 2010 – Aslanian, D., Moulin, M. and the Geodynamic Group, Segmentation et formation des marges continentales passives.

Internationalization

Cooperation with other researchers from

France (Géosciences Rennes: TOPOAFRICA project, IUEM : SanBa project & ALMOND project, Montpellier: ALMOND project),

Italy (SMAR-CNR : TOPOMED, NEAREST projects)

Germany (AWI - BGR: MoBaMaSis project, Geomar: TECTAP project),

Holland (Univ of Delft: GALP Subsalt Proposal),

Denmark (Univ. Aarhus),

Spain (Univ. Barcelona: TOPOMED, NEAREST projects)

and Brazil (UERJ: Monica Heilbron, Univ. de Brasilia : José Soares: SANBA project), …

Government/Organization contract research

Cooperation protocol between Instituto Dom Luiz (IDL) and the Estrutura de Missão para a Extensão da Plataforma Continental (EMEPC)

EMEPC is partner on the FCT project SWIMGLO (PI: P. Terrinha).

6.10 Land Climate Interaction

6.10.1 Funding

The following contracts were valid during the year 2010:

1. Land SAF CDOP - Land Surface Analysis Satellite Applications Facility, funded by EUMETSAT, 2007-2012, €2500k

2. AMIC, 2010-2012, PTDC/AAC-CLI/109030/2008, funded by FCT, €170k

3. REWRITE, 2009-2011, PTDC/CLI/73814/2006, funded by FCT, €120k

4. FLAIR, FCT, PTDC/AAC-AMB/104702/2008, 2010-2012, funded by FCT, €106k

5. Determinação do forçamento radiativo devido à absorção da luz por aerossóis atmosféricos, E-99/09, 2009-2010, funded by Acções Integradas Luso-Espanholas - 2009, €7k

6. Geoland-2 , funded by EU FP7, 2008-2012, €930k

7. WATCH, funded by EU FP6, 2007-2011, €160k

8. FUME, funded by EU FP7, 2010-2014, €181k

9. PINUS RAIN Phenotypic plasticity of maritime pine to climate change, PTDC/AGR-CFL/099614/2008, FCT, 2010-2012, led by Institute of Agronomy, €20k

10. Redes de medida a largo plazo de aerosoles, ozono y radiacion solar y UV. Enfasis en las metodologías de calibración y validación (Red-CAL),

11. Organizacion de congreso cientifico: 37 AMASOM, 2010-2011, CGL2010-09016-E, €8k

6.10.2 Objectives

This group aims to advance the understanding of the co-variability of land surface and climate, in regional, continental and global scales. A variety of approaches is used, ranging from numerical modelling to remote sensing observations. The group contributes to the study of physical processes at the interface surface-vegetation-atmosphere, the development of numerical modelling, data assimilation methods, and remote sensing estimates of surface related parameters and links to climate and climate variability. This work, performed in close cooperation with the Atmospheric and Climate Modelling Group, is based on close collaboration with ECMWF and an active participation in the EC-EARTH consortium for climate modelling. Land surface models need global data for forcing and validation, provided by a combination of bias-corrected reanalysis data and remote sensing estimates of key aspects of the surface energy, water and carbon budget. Remote sensing activities are mostly shaped by the leadership of the Land Surface Analysis (LSA) SAF consortium, based on collaboration with EUMETSAT and EC-funded GMES land research, and in collaboration with the Climatology and Climate Change Group.

The main objectives of the group are:

- To study hydrological as well as related atmospheric problems on time scales ranging from the diurnal cycle to seasonal, interannual, decadal fluctuations and climate. Developed

models and analysis addresses a range of spatial scales, from the mesoscale to regional, synoptic and continental scales.

- To study cold processes hydrology (seasonal snow) and lakes for process modelling, design and test of land surface parameterization schemes. This is done in close collaboration with RG6 on Atmospheric and Climate modelling.
- Development of global forcing data for the XX and XXI century, based on a merge of reanalysis data, bias corrected by observations, and remote sensing data. Such data is used to force land surface models in order to characterize large-scale hydrology of the XX and XXI century.
- Exploit remote sensing data to derive land surface variables relevant to surface and atmospheric models. To develop and validate algorithms that can be used to provide a reliable service of near real time and climate products covering the surface radiative balance, evaporation, vegetation properties, carbon emission by forest fires, and fire disturbances. Geographical area of interest ranges from the MSG disk to the globe. To strengthen the link with RG1 Climate and Climate Change Group on the interplay between land surface disturbances (e.g., drought, fire disturbances) and climate variability, in particular the large scale circulation regimes.
- To understand and quantify the physiologic and phenotypic plasticity of Mediterranean vegetation to climate change from the leaf to the ecosystem scale to provide validation databases for plant-soil-atmosphere modelling (HTESSEL, CTESSEL).
- To develop instrumentation to measure, in situ, the optical properties of atmospheric aerosols and estimate the contribution of aerosols to the radiative forcing.

6.10.3 Main Achievements

REPRESENTATION OF SURFACE PROCESSES IN CLIMATE/EARTH-SYSTEM MODELS: A comprehensive effort to produce a new snow parameterization scheme for the EC-EARTH model, STESSEL, including its validation was done as part of the PhD Project of E. Dutra (2008-2011), and in collaboration with G. Balsamo /ECMWF) and C. Schaer (ETH, Zurich). One paper was published and 3 other papers are ready to be submitted. Work done in collaboration with the Atmospheric and Climate Modelling Group.

PRODUCTION OF SCENARIOS FOR EC-EARTH: EC-EARTH model integrations for current and future climate started, following the CMIP5 protocol and due to be included in the next IPCC AR5 review. 2 realizations of the model (starting with different pre-industrial initial conditions will be produced by the group. A paper describing the EC-EARTH model was published. The very large volume computer integrations programme will continue into 2011. Work done in collaboration with the Atmospheric and Climate Modelling Group.

DEVELOPMENT OF FORCING DATA FOR HYDROLOGICAL MODELLING FOR THE XX AND XXI CENTURY: Results presented here are part of the PhD Project of S. Gomes (2008-2012), developed in the context of the EU Project WATCH. Methods for time stochastic and deterministic disaggregation of forcing from daily to hourly have been validated, using a large ensemble of 20-year model integrations, with alternative forcing data. The integrations

covering the XX and XXI century were performed and are currently under scrutiny. One paper published and 2 papers accepted for publication.

FIRE DETECTION AND MONITORING AND BURNT AREA: Algorithms for fire detection and burnt area were developed and validated as part of the PhD work of Renata Libonati (FCT Grant No. SFRH/BD/21650/2005) and Malik Amraoui (FCT Grant No. SFRH/BD/36964/2007). The fire detection and monitoring is currently used in the LSA SAF production chain.

PREPARATION OF THE NEXT 5 YEAR PHASE OF THE LSA SAF, 2012-2017: New partners, new and broader services, and a special focus on the next generation geostationary EUMETSAT satellite series, MTG, with richer spectral, spatial and temporal information. Use of additional sensors, e.g. on SENTINEL-3 platform, is foreseen.

PREPARATION OF THE FUTURE GMES LAND GLOBAL SERVICE: This is part of the collaborative work with IM, as a future spin-off from activities in LSA SAF and geoland-2 consortia. IM managed to produce global data (60 N-60 S) for downward SW and LW radiation fluxes and Land Surface Temperature .Further work was done with the EC and EUMETSAT to define the contents of the future GMES Land global service.

CONTRIBUTION TO THE QUANTIFICATION OF THE IMPACT OF PRECIPITATION CHANGES ON WATER AND CARBON FLUXES AND BALANCES OF MEDITERRANEAN FORESTS, relying on field observations of Cork oak (EU project MIND, EVK2-CT-2002-00158, national POCI/AGR/59152), Eucalyptus (POCI/CLI/60006/2004) and Maritime pine (PTDC/AGR-CFL/099614/2008) species, with the collaboration of J.S Pereira (ISA), T.S. David (INRB) and J. Tenhunen (Bayreuth University).

DEVELOPMENT OF AN INTEGRATING SPHERE SPECTRAL SYSTEM TO MEASURE CONTINUOUS SPECTRA OF AEROSOL ABSORPTION COEFFICIENTS: The improvement and calibration of this instrument was part of the PhD Project of E. Montilla (2007-2010), developed in the context of the Atmospheric Optics Group (GOA) of the Valladolid University (UVa). One paper is accepted for publication.

6.10.4 Group Productivity

Publications in peer review Journals

1. Amraoui, M, C.C. DaCamara, J.M.C. Pereira, 2010: Detection and monitoring of African vegetation fires using MSG-SEVIRI imagery. Remote Sensing of Environment, 114, 1038-1052.

2. Balsamo, G., E. Dutra, V.M. Stepanenko, P. Viterbo, P.M.A. Miranda, and D. Mironov, 2010: Deriving an effective lake depth from satellite lake surface temperature data: A feasibility study with MODIS data. Bor. Env. Res., 15, 178-190.

3. de Bruin, H.A.R, I. F. Trigo, M. A. Jitan, N. T. Enku, C. van der Tol, and A. S. M. Gieske, 2010: Reference crop evapotranspiration derived from geo-stationary satellite imagery: a case study for the Fogera flood plain, NW-Ethiopia and the Jordan Valley, Jordan. Hydrol. Earth Syst. Sci., 14, 2219-2228. www.hydrol-earth-syst-sci.net/14/2219/2010/, doi:10.5194/hess-14-2219-2010.

4. Dutra, E., G. Balsamo, P. Viterbo, P.M.A. Miranda, A.C.M. Beljaars, C. Schär, and K. Elder, 2010: An improved snow scheme for the ECMWF land surface model: descrition and offline validation. J. Hydrometeor., 11, 899-916, doi: 10.1175/2010JHM1249.1.

5. Dutra, E., V.M. Stepanenko, G. Balsamo, P. Viterbo, P.M.A. Miranda, D. Mironov, and C. Schaer, 2010: Impact of lakes on the performance of global simulations with the ECMWF surface scheme. Bor. Env. Res., 15, 100-112.

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Other international publications

1. Balsamo, G., P. Bechtold, A. Beljaars, S. Boussetta, P. de Rosnay, E. Dutra, J.-J. Morcrette, J. Muñoz-Sabater, F. Pappenberger, B. van den Hurk, and P. Viterbo, 2010: Modelling and data assimilation at ECMWF in support to land surface international projects: Lesson learnt from GSWP2+ERA40 and perspectives offered by new reanalyses. S7.1, HESSS 2 International Conference, 22-25 June 2010, Institute of Industrial Science, The University of Tokyo, Japan.

2. Barja, B., S. Mogo, E. Montilla, J. Antuña, R. Estevan, and V. E. Cachorro, 2010: Optical absorbing characteristics of the atmospheric aerosols at Camagüey, Cuba. 37th Annual European Meeting on Atmospheric Studies by Optical Methods, Valladolid, Spain, 23-27 August, 2010.

3. Belo-Pereira, M., E. Dutra, P. Viterbo, and S. Gomes, 2010, Evaluation of precipitation from ECMWF re-analyses over Iberian Península, EMS2010-639, EMS, Zurich.

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6. Calheiros, T., M.G. Pereira, and C.C. DaCamara, 2010: Assessment of the potential effects of regional climate change on wildfires, Geophysical Research Abstracts, EGU2010-14076, 2010.

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8. DaCamara, C.C., 2010: Inter-relações fogo – vegetação – atmosfera: entender os processos para prever os regimes de fogos rurais em Portugal, 2ª Conferência Internacional dos Países de Língua Portuguesa: Mudanças Globais e Desastres Naturais, 21-23 June 2010, Rio de Janeiro, Brazil.

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21. Montilla-Rosero, E., S. Mogo, V. E. Cachorro, J. F López, and A. de Frutos, 2010: Comparative analysis of aerosol absorption coefficients at European subarctic area measured by two different instruments. IV Reunión Española de Ciencia y Tecnología de Aerosoles, 28-30 de junio, 2010.

22. Mora, C., M.J. Rocha, E. Dutra, I. Trigo, G. Vieira, M. Fragoso, and M. Ramos, 2010: Weather types in the South Shetlands (Antarctica) using a circulation type approach. Geophys. Res. Abstracts, 12, EGU2010-8829-1, EGU General Assembly 2010.

23. Pereira, M.G., T. Calado, C.C. DaCamara, and R.M. Trigo, RM, 2010: Analysis of fire size distribution in Portugal, Geophysical Research Abstracts, EGU2010-12525, 2010.

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25. Viterbo, P., 2010. Assimilation of remote sensing data and operational constraints. 1st TERRABITES Symposium, Hamburg, Germany, 9-11 February 2010, TERRABITES-93.

26. Viterbo, P., 2010: Activities of the Land Surface Analysis SAF for Africa. 9th EUMETSAT User Forum in Africa, Ouagadougou, Burkina Faso – 27 Sep-1 Oct 2010.

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Other national publications

1. DaCamara, C.C., 2010: Paying tribute to the forgotten channel - Applications of 3.9 micrometer to vegetation studies (keynote talking), Mixed and Pure Forests in a Changing World, 6-8 October 2010, Vila Real, Portugal.

2. Dutra, E., P. Viterbo, and P.M.A Miranda, 2010: Impacto climático global da neve sazonal nas latitudes elevadas. 2ª Reunião Portuguesa de Ciências Polares: O estado da ciência polar portuguesa no final do IV Ano Polar Internacional. Sociedade Portuguesa de Geografia, Lisboa, 26 de Abril de 2010.

3. Mora, C., M.J. Rocha, M. Fragoso, I. Trigo, E. Dutra, G. Vieira, and M. Ramos, 2010: Tipos de tempo nas ilhas Shetland do Sul (Península Antárctica). Classificação e frequência de ocorrência. 2ª Reunião Portuguesa de Ciências Polares: O estado da ciência polar portuguesa no final do IV Ano Polar Internacional. Sociedade Portuguesa de Geografia, Lisboa, 26 de Abril de 2010.

4. Vieira, G., P. Amaral, V. Batista, J.J. Blanco, A. Caselli, A. Correia, E. Dutra, M. A. Ferreira, Fragoso, D. Gilichinski, M.A. Hidalgo, M. Jorge, R. Kenderova, R. Melo, L. Mendes-Victor, P. Miranda, C. Mora, M. Neves, C. Pimpirev, A. Trindade, M. Ramos, M.J. Rocha, F. Santos, I. Trigo, and P. Viterbo, 2010: Projecto PERMANTAR - Monitorização e modelação da distribuição espacial e do estado térmico do permafrost na região da Península Antárctica. 2ª Reunião Portuguesa de Ciências Polares: O estado da ciência polar portuguesa no final do IV Ano Polar Internacional. Sociedade Portuguesa de Geografia, Lisboa, 26 de Abril de 2010.

5. Vieira, G., J. Xavier, A. Canário, L.A. Mendes-Victor, P. Miranda, V.A. Fernandes, A.M. Silva, and P. Viterbo, 2010: O Programa Polar Português e o Ano Polar Internacional. 2ª Reunião Portuguesa de Ciências Polares: O estado da ciência polar portuguesa no final do IV Ano Polar Internacional. Sociedade Portuguesa de Geografia, Lisboa, 26 de Abril de 2010.

6. Viterbo, P., 2010: Impacto da mudança climática na frequência e intensidade de eventos extremos. Sessão Clima e Alterações climáticas, CIENCIA 2010, 4-7 Julho, Lisboa, Portugal.

7. Viterbo, P., 2010: Riscos em meteorologia e clima. Dia Internacional para a redução das catástrofes naturais. Sociedade Portuguesa de Geografia, Lisboa, 11 de Outubro de 2010.

Ph.D. thesis completed

1. Amorim, E.V.F. (2010). Processos de Superfície em Portugal Continental – Um estudo climatológico baseado em dados de satélite. Dissertação. Dissertação elaborada sob orientação do Professor Doutor Carlos do Carmo de Portugal e Castro da Camara, apresentada na Universidade de Trás-os-Montes e Alto Douro, no cumprimento dos requisitos para obtenção do grau de Doutor.
2. Le Page, Y:L:B. (2010). Anthropogenic and climatic control upon vegetation fires: new insights from satellite observations to assess current and future impacts. Dissetação elaborada sob orientação dos Professores Doutores José Miguel Oliveira Cardoso Pereira e Carlos do Carmo de Portugal e Castro da Camara, apresentada na Universidade Técnica de Lisboa, no cumprimento dos requisitos para obtenção do grau de Doutor.
3. E. Montilla (GOA/UVa) presented her PhD thesis on February 2010, co-supervised by Sandra Mogo (IDL/UL/UBI).

Organization of conferences

Isabel Trigo co-organized the 4th LSA SAF user Workshop, held in Toulouse, 15-17 November

7. RESEARCH LINES

7.1 GLOBAL CHANGE AND SOCIETAL RISKS

7.1.1 General Objectives

The general objective of GLOBAL CHANGE AND SOCIETAL RISKS research line is to provide to the society all the needed information (and associated uncertainties) that must be the base for territorial management. Between all natural hazards, two are particularly important within the Portuguese setting, namely: weather driven hazards (within the global climatic change context) and earthquake hazard (including tsunami).

With “faster than usual” anthropogenic climate change, as it is currently expected, climate will be one of the main constraints in decision making both at the national and world level. Main Thematic Areas: (1) Evaluation of weather driven natural hazards; floods, droughts, landslides, wildfires and heatwaves; (2) Earthquake Hazard and Seismic Site Effects; (3) Volcanic Hazard; (4) Neotectonic Mapping; (5) Coastal Related Hazard; (6) Seafloor Monitoring at Coastal Areas: (7) Solar variability and solar storms impacts.

7.1.2 Main Achievements

NEW PROJECTS: The Climatology branch of this research line has secured several new projects namely an important participation in the large European project FUME dealing with wildfires and 5 new projects funded by FCT.

OUTREACH: several researcher from IDL participate in a workshop organized by a firemen association (“Associação Hum. de Bomb. Volunt. de Carcavelos e São Dom. de Rana”) in Estoril 29-30 October, on the subject “Seismic catastrophe – Are we prepared ?” IDL researchers present communications on historical seismicity, seismic sources, seismic hazard and tsunami warning systems.

FAR-FIELD IMPACT OF TSUNAMIS GENERATED IN THE GULF OF CADIZ: In the framework of project MAREMOTI the impact of a 1755 tsunami like event in the french Islands of the Caribbean region was investigated (Roger et al., 2010a, 2010b).

NEAR FIELD IMAPCT OF TSUNAMIS GENERATED IN THE GULF OF CADIZ: In the framework of the EU projects NEAREST and TRANSFER the impact ofa 1755 tsunami like event was investigated. Inundation maps for Casablanca (Morocco), Huelva (Spain) and Algarve south Portuguese coast were completed (Omira et al., 2010; Lima et al., 2010),

OPERATIONAL MAREVB. This software application, named MareVB (in development since 2008) is now fully operational: it gets a 3 minute stream input of sea level height and a 10 minute stream input of air-pressure. Based on a predicted tide model, the sea level height is compared and analyzed, and storm-surge amplitude is determined, as well as the high frequency oscillation (seichas) due to the storm and tsunami waves.

COSMOS - BEACH MONITORING SYSTEM: the new video monitoring system (COSMOS - cosmos.fc.ul.pt) targets several key characteristics including portability, low-cost, robustness and easy installation.

SEISMIC HAZARD STUDIES: Vs30 values were estimate for Portugal mainland using the surface geology. Besides the site characterization and the identification of potential site effects, Vs30 values were used on shaking maps estimation in collaboration with the Institute of Meteorology (IM). A preliminary assessment of the seismic hazard for the town of Ponta Delgada (Azores) was performed. Vulnerability studies of the Lisbon building stock were conducted in order to be applied on damage scenarios estimation.

7.1.3 Research Line Output

Collaborative Publications in peer review Journals

- Barriopedro D., Fisher E., Luterbacher J., Trigo R.M., García-Herrera R., (2011) “The hot summer of 2010: redrawing the temperature record map of Europe”. Science. doi: 10.1126/science.1201224
- Font, E., Nascimento, C., Omira, R., Baptista, M.A., Silva, P.F. 2010. Identification of tsunami-induced deposits using numerical modelling and rock magnetism techniques: A study case of the 1755 Lisbon tsunami in Algarve, Portugal. Physics of the Earth Planet Interior
- Fragoso M., Trigo R.M., Zêzere L., Valente M.A. (2010) “The exceptional rainfall episode registered in Lisbon in 18 February 2008”, Weather, 65, 31-35
- García-Herrera R., Díaz J., Trigo R.M., Luterbacher J., Ficher E. (2010) “A review of the European summer heat wave of 2003”. Critical Reviews in Environmental Science and Technology, 40, 267 - 306
- Gouveia C., DaCamara C.C, Trigo R.M., (2010) " Post fire vegetation recovery in Portugal based on SPOT-VEGETATION data ", Natural Hazards and Earth System Sciences, 10, 673-684.
- Lima, V.C., J.M.Miranda, M.A.Baptista, J. Catalão, M. Gonzalez, L. Otero, M. Olabarrieta, J. A. Alvarez-Gomez, E. Carreño, 2010. Impact of a 1755-like tsunami in Huelva, Spain. Nat. Haz. And Earth Systs. Sci., 10,1-10. www.nat-hazards-earth-syst-sci.net/10/1/2010/
- Liberato M.L.R., Pinto J.G., Trigo I.F., Trigo R.M. (2011) " Klaus - an exceptional winter storm over Northern Iberia and Southern France", Weather (in press)
- Trigo, R.M., Ramos A., Nogueira P., Santos F.D., Garcia-Herrera R., Gouveia C. and Santo F.E. (2010) "The impact of the 2003 heatwave in Portugal: diagnostics and modelling of excessive mortality", Environmental Science & Policy, 12. 844-854.
- Trigo R.M., Gouveia C., Barriopedro D., (2010) " The intense 2007-2009 drought in the Fertile Crescent: Impacts and associated atmospheric circulation", Agricultural and Forest Meteorology, 150, 1245-1257
- Trigo R.M., Vaquero J.M., R. B. Stothers (2010) "Witnessing the impact of 1783-1784 Laki eruption in the Southern Hemisphere", Climatic Change, 99, 535-546, DOI 10.1007/s10584-009-9676-1

Collaborative Other Publications

- Bard P.-Y., H. Cadet, B. Endrun, M. Hobiger, F. Renalier, N. Theodulidis, M. Ohrnberger, D. Fäh, F. Sabetta, P. Teves-Costa, A.-M. Duval, C. Cornou, B. Guillier, M. Wathelet, A Savvaidis, A Köller, J. Burjanek, V. Poggi, G. Gassner-Stamm, H.B. Havenith, S. Hailemikael, J. Almeida, I. Rodrigues, I. Veludo, C. Lacave, S. Thomassin and M. Kristekova (2010). From Non-invasive Site Characterization to Site Amplification: Recent Advances in the Use of Ambient Vibration Measurements. In: Mihail Garevski and Atilla Ansal (Ed.).Earthquake Engineering in Europe. Geotechnical, Geological, and Earthquake Engineering, Volume 17, Part 2, 105-123, DOI: 10.1007/978-90-481-9544-2_5, ISBN: 978-90-481-9543-5.
- Barreira, E., P. Teves-Costa & R, Omira (2010). Vulnerabilidade sísmica do parque habitacional da cidade de Lisboa. Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital, Paper 92, 11p.
- Pires, C. A., Sousa J.M.B., 2010. Previsão de Classes de seca por cadeias de Markov condicionadas por regimes da Oscilação do Atlântico Norte e Oscilação Ártica. In: L. S. Pereira, J. T. Mexia, C. A. Pires (eds.), 2010. Gestão do Risco em Secas, Métodos, Tecnologias e Desafios. Edições Colibri, CEER, pp. 209-224.
- Rodrigues, I., M.L. Sousa & P. Teves-Costa (2010). Cenários de perigosidade sísmica para o Algarve. Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital, Paper 109, 10p.
- Matos, L.J., L. Matias & P. Teves-Costa (2010). Perigosidade sísmica em Ponta Delgada. Sísmica2010 – 8º Congresso de Sismologia e Engenharia Sísmica, Universidade de Aveiro, 20-23 Outubro, Proc. publicados em suporte digital, Paper 75, 10p.

PhD thesis completed

Joana Rosa Nunes. Estudo do Ruído Sísmico no Arquipélago de Cabo Verde. MSc in Geophysical Sciences, specialization on Solid Earth Geophysics, DEGGE-FCUL, 2010 (Supervisors: Graça Silveira & Paula Teves Costa).

7.2 GEOPHYSICS AND TECTONOPHYSICS

7.2.1 General Objectives

The general objective is the development of integrated geophysics/tectonophysics studies, combining regional scale geophysical probing, geologic-structural field surveying and rock physics from the meso to the micro-scale.

Target studies include ridge processes, basin studies, Paleozoic geology and tectonic inversion, in a variety of geological settings, from active extensional tectonics to compressive and transpressive regimes. This approach, of Integrated Solid Earth Sciences, combines high-level geophysical techniques with geologic-structural field methods, and includes an effort to model the past up to the present tectonic processes that shape the Earth. This is done, in particular, through analogue modeling and numerical modeling.

Main topics include: (1) Earth Tomography; (2) Marine Geology and Geophysics; (3) Experimental Tectonics; (4) Paleozoic Tectonics in Portugal; (5) Alpine Tectonics in Portugal; (6)

Portuguese Margin Geological and Geophysical Studies; (7) Volcanostratigraphy and Volcanotectonics of Macaronesian Archipelagos; (8) Paleomagnetism and Rock Magnetism.

7.2.2 Main Achievements

SW IBERIAN MARGIN DEEP STRUCTURE: Research continued based on a combination of analogue modeling, passive seismological probing and numerical modeling. Synergies between three research groups of IDL (RG4, RG8 and RG9) have been fundamental for the progress made, tackling the deep structure of the lithosphere, basin development and neotectonics, respectively.

VOLCANOTECTONICS OF MACARONESIAN ISLANDS: Geological mapping and rock sampling in Madeira and Cape Verde was mostly concluded and used as a starting point for further research concerning landscape changes. Cooperation between RG4 and RG8 is building the bridge between geological observation and deep processes, particularly in Cape Verde.

PALEOMAGNETISM AND ROCK MAGNETISM: We reviewed the deposition process associated with the Marinoan cap carbonates using rock magnetic methods, improved the analysis of KTB in three sections of the Basque-Cantabric Basin, and showed that geomagnetic reversals previously identified in the CAMP-Morocco, were in fact remagnetizations. Detailed microstructural studies of magnetic fabrics proceeded, to assess the validity of AMS as a marker of magma flow in dykes.

7.2.3 Research Line Output

Collaborative Publications in peer review Journals

- Cabral, J. M., Marques, F., Figueiredo, P. and Matias, L., 2010. Active surface faulting or landsliding in the Lower Tagus Valley (Portugal)? A solved controversy concerning the Vila Chã de Ourique site, J. Seismology, DOI 10.1007/s10950-010-9221-8.
- Duarte JC, Terrinha P, Rosas FM, Valadares V, Pinheiro LM, Matias L, Magalhaes V, Roque C (2010). Crescent-shaped morphotectonic features in the Gulf of Cadiz (offshore SW Iberia). MARINE GEOLOGY, 271, 3-4, 236-249.
- Font E, Nascimento C, Omira R, Baptista MA, Silva PF (2010). Identification of tsunami-induced deposits using numerical modeling and rock magnetism techniques: A study case of the 1755 Lisbon tsunami in Algarve, Portugal. PHYSICS OF THE EARTH AND PLANETARY INTERIORS, 182, 3-4, 187-198.
- Lima VV, Miranda, JM, Baptista MA, Catalão J, Gonzalez M, Olabarrieta M, Alvarez-Gomez A, Carreno E. (2010) Impact of a 1755-like Tsunami in Huelva, Spain, Nat. Hazards Earth Syst. Sci., 10, 139-148..
- Omira, R; Baptista, MA; Miranda, J. M.; Toto, E; Catita, C; Catalao, J. (2010) Tsunami vulnerability assessment of Casablanca-Morocco using numerical modelling and GIS tools. Natural Hazards, 54, 1, 75-95.

Collaborative Other Publications

- Afilhado, A., Lourenço, N., Matias, L., Moulin, M., Corela, C., Pinto de Abreu, M., Cunha, T., Neves, M.C., Pinheiro, L., Terrinha, P. & Rosas, F. Constraint on the lithosphere structure of

the southern edge of the Galicia Bank: comparison with adjacent margin segments. Central and North Atlantic II Conjugate Margins Conference, Lisboa, 29 Sept – 1 Oct. 2010.

- Aslanian, D., Moulin, M., Klingelhoefer, F., Rabineau, M., Bache, F., Matias, L., Gailler, A., Afilhado, A., Gorini, C., Schnürle, P., Patriat, M., Beslier, M.-O., Labails, C., Olivet, J.-L. & Leroux, E., Towards general rules for the continental thinning process through studies in South Atlantic, Central Atlantic and West Mediterranean sea? AAPG, New Orleans, 11 – 14 April 2010.
- Moreira Mário, José Madeira, João Mata, Patrícia Represas; Age dependent variation of magnetic fabric on dike swarms from Maio Island (Cape Verde). Geophysical Research Abstracts, Vol. 12, EGU2010-9878-2, EGU General Assembly 2010.
- Moulin, M., Aslanian, D., Rabineau, M., Matias, L., Patriat, M. New plate kinematic evolution on the South and Equatorial Atlantic Oceans: Geodynamic implications and passive margins genesis. AAPG, New Orleans, 11 – 14 april 2010.

7.3 EARTH OBSERVATION AND GEODYNAMICS

7.3.1 General Objectives

The General Objective of EARTH OBSERVATION AND GEODYNAMICS is to measure and model the present day crustal motion in relation with the corresponding tectonic and volcanic processes. Geodetic techniques are complemented by Seismology and Active Tectonics research. Recent advances on real time geodetic measurements which allow to directly measure ground deformation with great accuracy, and the use of numerical and analog modeling are the basic tools to address geological processes. Base studies concerning the Earth's gravity field in particular in what concerns the use of the new satellite platforms are also important topics of research.

Research topics include: Co-seismic and Interseismic deformation; Littoral changes; Ground Deformation Monitoring using Radar Interferommetry; Geological Mapping using RS; Seafloor Morphology; Instrumentation For Planetary Observation And Monitoring.

7.3.2 Main Achievements

LITTORAL CHANGES: Development of numerical and observational tools for the understanding of coastal sediment dynamics, combining video and numerical modeling, and made available through internet.

GROUND DEFORMATION MONITORING USING RADAR INTERFEROMETRY: Studies conducted in the Azores and Lisbon area showed very positive results, in areas where other approaches (GPS, DInSAR) were impossible. These observations conducted by RG7 were integrated into geo-hazard studies conducted by RG8 and RG5.

GEOLOGICAL MAPPING BASED ON RS TECHNIQUES: Revision, updating and detailing of the Portuguese mainland and the Azores islands database of active faults and of their seismogenic potential as earthquake sources, based upon imagery and cartographic analysis; Geological databases developed by IDL was provided to SHARE project for integration in the larger scale

European database. The Geologic Map of Madeira Island was integrated in a GIS, in cooperation with local authorities was concluded.

CONTINUOUS GPS OBSERVATION: Enlargement of a network of permanent GNSS stations in Europe and Africa, devoted to the study of a set of Nubia Plate Boundary segments (Azores, SW Iberia, East African Rift); New stations have been installed. New GNSS methodology to study the statistical properties of spatial and temporal distribution of tropospheric Precipitable Water.

GPS METEOROLOGY: Cooperation between RG7 and RG6 developed further, with a series of initiatives concerning the use of GPS observations to study the atmosphere and the use of spin-offs from the meteorological modelling to increase the accuracy of geodetic measurements.

7.3.3 Research Line Output

Collaborative Publications in peer review Journals

- Fernandes MJ, Lazaro C, Nunes AL, Pires N, Bastos L, Mendes VB (2010). GNSS-Derived Path Delay: An Approach to Compute the Wet Tropospheric Correction for Coastal Altimetry. IEEE GEOSCIENCE AND REMOTE SENSING LETTERS, 7, 3, 596-600.
- Rayan A, Fernandes RMS, Khalil HA, Mahmoud S, Miranda, JM, Tealab, A.(2010) Evaluation of the crustal deformations in Lake Nasser (Egypt) region derived from 8 years of GPS campaign observations Journal of Geodynamics. Volume: 49 Issue: 3-4 Special Issue: Sp. Iss. SI Pages: 210-215.

Collaborative Other Publications

- Mateus P., G. Nico, R. Tomé, J. Catalão and P. Miranda, "Comparison of precipitable water vapor (PWV) maps derived by GPS, SAR interferometry, and numerical forecasting models", Proc. SPIE 7827, 782714 (2010); doi:10.1117/12.864733
- Mateus, Pedro; Nico, Giovanni; Tome, Ricardo; Catalao, Joao; Miranda, Pedro On the Tropospheric Water Vapour Mapping: GPS, SAR Interferometry and Numerical Forecasting Models. ESA Living Planet 2010, ESA as Special Publication SP-686.

7.4 METEOROLOGY AND CLIMATE RESEARCH

7.4.1 General Objectives

Three groups of IDL focus their activity in Atmospheric Science problems, in relation with climate change, climate variability, process studies and remote sensing techniques. The Climatology Group (RG1) has been increasingly interested in synoptic climatology studies, both at regional and global scales, with emphasis on low-frequency variability statistics, such as blocking and NAO dynamics. The Atmospheric Modeling Group (RG6), historically interested in dynamical meteorology processes as waves and turbulence, is increasingly involved in regional and global climate modeling. The Land-Climate Group (RG10) focus its work on applications of remote sensing.

IDL work on Meteorology and Climate is largely influenced by its participation in two European Consortia: the EC-Earth climate modelling consortium, built to use the ECMWF model, coupled with the NEMO ocean model, as a basis for a new state-of-the-art Earth System model; the LandSAF/Geoland consortium, working on the development of land surface satellite imagery for the improvement of Numerical Weather forecast models.

7.4.2 Main Achievements

EC-EARTH DEVELOPMENT. In 2010, the contributions of IDL to the EC-Earth model have come to print. The new snow model included in ECMWF's IFS and in the operational EC-EARTH model was published. A new component of the model, namely the lake model FLAKE was integrated also into HTESSEL, and was subject to substantial and sucessful testing. Further developments, including a multi-layer snow model are under way, with the correponding papers being submitted.

CLIMATE PROCESSES. Output from IDL in relation with global a regional climate dynamics has progressed significantly. A number of important results address the dynamics of blocking events, its impact on interannual variability and its links with external forcing, namely solar variability. Another set of important set of results concerns the regional and continental flows of atmospheric water, and its control of in-land precipitation.

REMOTE SENSING. The IDL research in remote sensing products has also progressed substantially in 2010, with a set of relevant results concerning, in particular, the use of satellite imagery for the characterization of fire in tropical regions and also in Portugal, the use of remote sensing data (both satellite imagery and thermal images) for the characterization of vegetation, and the potential use of advanced multisensor imagery for boundary layer studies.

A small number of relevant IDL publications focused on theoretical issues in atmospheric and oceanic sciences, including the role of non-Gaussian statistics, and the role of Langmuir circulations in the ocean boundary layer.

Although we have not yet attained the publication stage, it is important to report that, besides the natural collaboration between the Climatology, Atmospheric and Climate Modelling and Land-Climate groups, there is a growing collaboration also with the Earth Observation Group in the use of meteorology data for image correction and also in the use of GPS data for meteorological analysis. Such collaboration is likely to translate in new research opportunities.

7.4.3 Research Line Output

Collaborative Publications in peer review Journals

- Balsamo G, Dutra E, Stepanenko VM, Viterbo P, Miranda PM, Mironov D, 2010, Deriving an effective lake depth from satellite lake surface temperature data: a feasibility study with MODIS data, Boreal Environment Research, 15,178-190.
- Dutra E, Balsamo G, Viterbo P, Miranda PMA., Beljaars A, Schär C, Elder K, 2010: An improved snow scheme for the ECMWF land surface model: description and offline validation. J. Hydrometeorology, 11, 899–916. doi: 10.1175/2010JHM1249.1.

- Dutra EN, Stepanenko VM, Balsamo G, Viterbo P, Miranda PMA, Mironov D, Schaer C. 2010. Impact of lakes on the performance of global simulations with the ECMWF surface scheme, Boreal Environment Research 15,100-112.
- Gouveia C., DaCamara C.C, Trigo R.M., (2010) " Post fire vegetation recovery in Portugal based on SPOT-VEGETATION data ", Natural Hazards and Earth System Sciences, 10, 673-684.
- Hazeleger, W., C. Severijns, T. Semmler, S. Stefanescu, S. Yang, X. Wang, K. Wyser, E. Dutra, J. Baldasano, R. Bintanja, P. Bougeault, R. Caballero, A. M. L. Ekman, J. H. Christensen, B. van den Hurk, P. Jimenez, C. Jones, P. Kallberg, T. Koenigk, R. McGrath, P. Miranda, T. Noije, T. Palmer, J. Parodi, T. Schmith, F. Selten, T. Storelvmo, A. Sterl, H. Tapamo, M. Vancoppenolle, P. Viterbo, U. Willén, 2010 : EC-Earth: A Seamless Earth System Prediction Approach in Action. Bulletin of the American Meteorological Society, 91, 1357-1363 . doi: 10.1175/2010BAMS2877.1

8. OTHER ACTIVITIES

8.1 Internal Services and Resources

METEO-CLUSTER: IDL owns 2 clusters: a Dell 198 core Xeon CPUs at 2.7GHz and about 30Tb of disk space, and a new 160-core Xeon 5600 system with a 72Tb storage. The new cluster, representing an investment of about 100k€ in 2010, from different sources, has tripled our capabilities, allowing the operation of the EC-Earth global model and also of the WRF regional climate model. The system is still underspecified for our needs. In 2011, we will try to mobilize some extra resources to add extra cores and storage, using in particular the CECAC contract.

ROCK MAGNETICS LABORATORY: The Rock Magnetics Laboratory comprehends a set of instruments: Magnetometer JR6, Alternating Magnetic Field Demagnetizer, Anhysteretic Magnetizer, Magnetic Susceptibility Meter, Furnace Apparatus CS23, Minispin, Portable Rock Magnetometer Magnetometer, Molspin Inc Flux magnetometer, MAG-01H from Bartington and a Thermal Demagnetizer home built.

APPLIED GEOPHYSICS LAB: The Lab comprehends a set of field instruments: two magnetotelluric stations in the frequency range 8000Hz to 4000s. Two magnetometer (3-components fluxgate). Resistivity meter and IP system. Lacoste-Romberg gravity meter. Scalar Magnetometer (GSM). A HP unit for resistivity and capacity measurements on samples. Several data loggers used in EM monitoring. Most of the present effort is directed.

PORTABLE SEISMIC STATIONS: IDL operates and maintains a mobile short period network of HATHOR 3 (LEAS) seismic stations that can record different sensors, 1 Hz Lenhartz LE-3D, 2 Hz CTS, 4.5 Hz 3C geophones. Acquisition is based upon a 24 bits converter and, at 100 Hz, the dynamic range equals 18 bits. These stations have been used in several seismic experiments. This array was upgraded within the SANBA initiative leaded by IFREMER/IDL under contract of PETROBRAS.

EXPERIMENTAL TECTONICS LAB: IDL operates a facility for physical modeling. The lab is presently equipped with simple shear rigs, an automated pure shear rig, analogue and

computer controlled stepping motors for a wide range of strain rates, and a variety of image acquisition equipment.

OBS ARRAY: We developed internally an array of SP OBS instruments that have been used in a number of international operations. Most of these instruments were built within a Contract with EMEPC and used for both active and passive operations. Currently there are 12 instruments ready and a new set of 4 OBB funded by FCT-Infrastructure Program).

GEOPHYSICAL FLUIDS LABORATORY: A new facility was set up by C Mériaux.

8.2 External Services and Resources

LISBON CLIMATE STATION: The climate and meteorological stations installed at the Botanic Garden in Lisbon is the oldest station continuously operating in Portugal and Western Europe. It is observed 7*24 since 1853 and its data are openly available. It is the reference station for most long term climatic studies, and an ex-libris of IDL.

SEISMIC NETWORK: The ULISSEIS (University of Lisbon Seismic Network) is one of the Portuguese components of the networks of seismic monitoring known as "very broad band". ULISSEIS was launched in 2001. Its main target is to serve the seismological community with high quality broad band seismic data for all kinds of scientific tasks. Another important goal is to contribute to fill, at least, some of the VBB network gaps in Western Europe, in cooperation with other FDSN members. The network in now accessible in real time through IRIS, and integrated into the national seismological network.

GNSS NETWORK: IDL is responsible for the installation and data management (acquisition, storage and processing) of the network of Continuous Operating Reference Stations installed around the world. Most of the stations were installed in the framework of the FCT or international projects (e.g. IOC-UNESCO) and in cooperation with the major partners. IDL integrates AFREF. Most of the effort is concentrated on the different segments of Nubia plate boundary (Azores, Iberia, Eastern Africa, South Africa, and Morocco).

LIBRARY AND HISTORICAL ARCHIVE: IDL owns an important archive of data and observations made in Portugal and overseas since 1853. These data are progressively being digitized and made available through the internet but are an important resource for science history groups. During 2008 the major effort of data digitization was finished under SIGN project and now the institute annals are available through internet.

8.3 Networking Actions

IRIS, ORFEUS and EMSC: IDL integrates the three networks, sharing the monitoring resources and data. They correspond to the most important US and/or European initiatives on seismic data archiving and dissemination. IDL contributes to the operational EMSC service on earthquake location and warning. IDL participated in the most important European initiative on operational seismology (NERIES) and also joined the proposal EPOS to continue the effort on seismic monitoring in Europe. IDL is leading the Portuguese participation on NERA.

IDL actively participates in the ESONET Network of Excellence, and took the responsibility to led in Portugal the EMSO infrastructure proposal. We also support the UNESCO/NEAMTWS initiative on tsunami warning in the north Atlantic.

IDL develops intense international cooperation with a number of entities also devoted to Earth Sciences: IFREMER (marine geophysics); IPGP (marine geophysics and global seismology); University of Barcelona (MT and Applied Geophysics); University Complutense (exchange of students and researchers on Climatology); University of Granada (Active Tectonics); Institut Jaume Almera (TOPOEUROPA); Univ de Grenoble (Seismic Site effects); CNRST, University of Kenitra and Institute Agronomique Hassan V in Rabat (Tsunamis and Applied Geophysics); NRIAG in Cairo (cooperation in all areas of Geophysics and Geodesy); Czech (Applied Geophysics); DAAD (Very Broad Band monitoring); Hartebeesthoek Radio Astronomy Observatory (GNSS); Direcção Nacional de Geologia, Instituto Nacional de Hidrografia e Navegação, and Centro Nacional de Cartografia e Detecção Remota in Mozambique (GNSS); Building and Roads Research Institute in Ghana (GNSS); Meteorological Service in Mauritius Islands (GNSS); University of Sana'a in Yemen (GNSS); Regional Centre for Mapping of Resources for Development) in Kenia (GNSS).

IDL cooperates intensively with the Meteorological Institute and the Geological Survey now at LNEG, where groups of IDL researchers have leading roles in Meteorology and Basin Geology, respectively.

8.4 Training Activities

IDL researchers teach at the BSc, MSc and PhD programs under the responsibility of the University of Lisbon on Geophysical Sciences, Survey Engineering, Geology and Energy Engineering.

BSc and MSc in Meteorology, Oceanography and Geophysics: Enrolls each year ca. 20 students and ensures a comprehensive study of Earth Physics. IDL researchers cover all disciplines of Meteorology and Geophysics.

BSc and MSc in Geology: Enrolls each year ca. 100 students and ensures a general training of professional geologists. IDL researchers mainly cover disciplines of Structural Geology.

BSc and MSc in Survey Engineering. Enrolls each year ca. 30 students and corresponds to the reference MSc existing in Portugal in this area of knowledge.

MSc in Bioenergy Resources. Common degree with the Lisbon Technical University (Faculty of Agronomy).

PhD program in Geophysical and Geoinformation Sciences. Common post-graduate program with presently 30 students from Portugal and abroad.

PhD program in Geology. Post graduate program from the Department of Geology, where IDL researchers are mainly concerned with structural geology topics.

BasinMaster: After 2009 IDL joined as associated member the BasinMaster consortium, which joins some of the most relevant earth science schools in Europe.

8.5 Outreach/Science and Society

- Aslanian, D., Moulin, M. and the Geodynamic Group, Segmentation et formation des marges continentales passives. Invited keynote – GDF-Suez – Paris – 10 fev. 2010 –

- Aslanian, D., Moulin, M., and the Geodynamic Group, Hot Spot, Segmentation, Kinematic And Passives Margins (Part I), PROFEX (Technologia em fronteiras exploratorias), 20-23 january 2010. Invited keynote – PETROBRAS - Salvadore de Bahia, Brazil, janv. 2010 -
- Baptista, M. A., 2011. Tsunamis do fundo do oceano à costa. Universidade do Minho. 26.01.2011.
- Baptista, M.A., 2010. Riscos Naturais, Tsunamis. Academia das Ciências de Lisboa, 10 de Novembro 2010.
- Baptista, M.A., 2010. Sistemas de Alerta en la costa Atlantica nordeste. Cursos: Tormentas y Tsunamis en las costas Ibéricas y Marroquinas el el pasado. Prediccion de daños futuros" , Curso de Verano – Universidad Internacional de Andalucia. Tetouan 5-9 de Julho 2010.
- Cabral, J., 2010. Neotectonics in Mainland Portugal. "Evolución histórica de la neotectónica y el estudio de las fallas activas en la Península Ibérica", 1ª Reunião Ibérica sobre Falhas Activas e Paleossismologia, Sigüenza (Guadalajara, Espanha) 27 a 29 de Outubro de 2010.
- Cabral, J., 2010. Sismos em Portugal Continental. "Forum Prevenção Sísmica em Caldas da Rainha", Associação Nostrum, Câmara Municipal de Caldas da Rainha, Auditório Expoeste, Caldas da Rainha, 5 de Junho de 2010.
- Cabral, J., 2010. Sismotectónica em Portugal Continental. "Afinal os sismos podem ou não prever-se?", Museu Nacional de História Natural, Lisboa, 17 de Março de 2010.
- Fernandes, R.M.S., Optimizing the use of GNSS stations: Applications on Tectonics and Meteorology, East, Central and Southern Africa GNSS and Space Weather Workshop, Nairobi, Quénia, 20 Julho 2010.
- Fernandes, R.M.S., Utilização de GPS na estimação de sinais geofísicos: do século ao segundo, Universidade Estadual de São Paulo, Presidente Prudente, Brasil, 13 Agosto 2010.
- Madeira, J. (11 November 2010) "Evolution et stucture d'une île oceanique: le cas de l'île Brava au Cap Vert", Faculdade de Ciências Semlalia, Universidade Cadi Ayyad de Marraquexe.
- Madeira, J. (16 April 2010) RTP, noticiário "Bom Dia Portugal" (08:00 e 09:00), comments on Eyjafjallajökull, Iceland. Another comment on RTP-N, "À noite, as Notícias" (21:00).
- Madeira, J. (21 April 2010) "Vulcões e Terramotos no meio do mar: o Arquipélago dos Açores", Palestra na Escola Secundária de António Sérgio, Cacém.
- Madeira, J. (24 de Abril de 2010) RDP Antena1, comments on Eyjafjallajökull, Iceland.
- Madeira, J. (25 de Janeiro de 2010) field trip Cascais-Sintra for geology teachers "Sciences de la Terre et de la Vie", Liceu Francês Charles Lepierre.
- Madeira, J. (26 de Maio de 2010) "Porque treme o país? Sismicidade em Portugal continental e Açores", Escola Secundária de Fernão Mendes Pinto, Almada.
- Madeira, J. (29 de Outubro de 2010) "Fontes Sísmicas: onde se formam os sismos?", Conferência Prevenção e Segurança 2010. Bombeiros Voluntários de Carcavelos e São Domingos de Rana.

- Madeira, J. (3 de Maio de 2010) TVI 24, “Jornal – 2ª edição” (14:00), comments on Eyjafjallajökull, Iceland.
- Marques, F.O., 2010. A Placa Sul Americana: passado, presente e futuro. Universidade Federal do Rio Grande do Norte, Natal, Brazil.
- Matias Luís. Sismologia - Geração de sismos - Tectónica de Placas. Colóquio. Afinal os sismos podem ou não prever-se? Museu Nacional de História Natural. March 2010.
- Mendes Victor Luís: Da previsão à prevenção. Colóquio. Afinal os sismos podem ou não prever-se? Museu Nacional de História Natural. March 2010.
- Mendes, V.B., 2010. Astronovas, 15 April 2010, Chile earthquake: changes on the length of the day, http://www.oal.ul.pt/astronovas/index.html
- Mendes, V.B.,2010. Funcionalidades e aplicações do GPS. Escola Secundária Emídio Navarro (11º ano de Ciências e Tecnologias), Almada, 26 de Outubro de 2010.
- Pereira, M.F., 2010. A aplicação da geocronologia U-Th-Pb de zircão com Laser Ablation-ICP-MS a estudos de proveniência sedimentar e paleogeografia.. Núcleo de Geologia da AE-FCT-Universidade Nova de Lisboa, Abril 2010.
- Terrinha, Pedro: Sismotectónia de Portugal Continental – area imersa. Colóquio. Afinal os sismos podem ou não prever-se? Museu Nacional de História Natural. Dia 17 de Março, 2010.
- Trigo R, interview for the newspaper PUBLICO on the heavy rains on the island of Madeira in the past 24 hours. 21 February 2010.
- Trigo R, interview for the newspaper PUBLICO, on the main implications and conclusions attained at the Medieval Warm Period Workshop that occurred in the Luso-American FLAD on days 22-24 September.
- Trigo R, interview on the TV channel SIC, on the impacts of eruptions on the climate of Europe (in the wake of the volcano in Iceland). 17 April 2010.
- Trigo R. Seminar on "Factors that control the atmospheric circulation of the great droughts of the Iberian Peninsula" at the Portuguese Academy of Sciences, November 15, 2010.

8.6 Organization of International Events

The medieval Warm Period Redux. Where and When was it warm?, International Workshop in FLAD, Lisbon, Portugal, 22 - 24 September, 2010. R Trigo and D Barriopedro organized the workshop.

4th International Conference of the European Society for the History of Science, Barcelona, Spain, 18-20 November 2010. (Vaquero, J.M. and Batlló, J., Co-conveners of session S31 “Historical Geophysical and Astronomical Data H-GAD”).

AGU Meeting of Americas, Foz do Iguaçu, Brazil, Agosto 2010. (R Fernandes, member of the Sc Comm of the Session "Global Navigation Satellite System Techniques for Meteorological / Climate Studies ".

AGU Fall Meeting, S Francisco, 2010. Session "Plate Motion and Continental Deformation I", AGU Fall Meeting, San Francisco, Dezembro 2010 (R Fernandes).

Data Analysis and Modeling in Earth Sciences DAMES'2010, 22 - 24 September 2010, University of Lisbon, IDL (S Barbosa, organizer).

EGU 2010: S Barbosa co-convener of NP4.1 Open Session on Geoscientific Time Series Analysis.

ESF-MedCLIVAR workshop entitled “Hydrological, Sócio-economic and Ecological impacts of the North Atlantic Oscillation in the Mediterranean” Zaragoza, Spain, 24 - 27 May 2010. Co-organized by R Trigo.

First Iberian Meeting on Active Faults and Paleoseimology (Cabral, J. and Perea, H., Members of the Organizing Committee and the Scientific Committee). Spain, 27-29 October 2010.

International Precipitation Conference 2010, Coimbra, Portugal, 23-25 June 2010. Ricardo Trigo served in the Sc Committee.

IUFRO International Conference on “Mixed and Pure Forests in a Changing World”, Vila Real, Portugal, 6 - 8 October, 2010 (co-organizer M Liberato).

Post-Meeting Field Trip, 1st SHARE IBERIA Workshop on Seismogenic Sources (Cabral, J., Dias, R.P. and Ressurreição, R.). Portugal, January 14-16, 2010, FP7 Project SHARE

The International Conference GeoMod2010 (Modelling in Geosciences) in the Faculty of Sciences, University of Lisbon. September 2010 (F O Marques, organizer).

XXXII General Assembly of the European Seismological Commission, Montpellier (France), 6-10 September 2010. (Batlló, J., Co-convener of session ES4 “Methods and data for the study of events recorded on pre-WWSSN historical seismograms”; Batlló, J., Co-convener of session SD4 “Compiling the earthquake history of the European Mediterranean area”)

9. INTERNAL EVALUATIONS

9.1 Summary of internal evaluations during 2010

Internal evaluation took place in 2010 in the period 12-13 July, with the presence of Sierd Cloething and Michael Bevis.

Day 1 Cloetingh and Bevis attended presentations by the Director of IDL, and each of the ten research groups, and individual presentations by seven of the new researchers. These formal presentations were followed by an open discussion and a poster session by Ph.D. students presenting their recent research. In the afternoon the committee met with eight of the ten research groups one at a time for an in-depth discussion of past and present performance, group strategy and scientific planning. During this the committee explicitly addressed issues related to the synergies between research groups, opportunities for the generation of added value, the optimal use of existing resources, and the need for new initiatives to attract funding.

Day 2. The committee interviewed the two remaining research groups, and then attended 12 short presentations by Ph.D. students on their ongoing research within IDL. These presentations were enthusiastic and quite impressive. At the end of this session the committee and the graduate students discussed the formation of an IDL association of graduate student

researchers, to provide IDL leadership with a different perspective and the students with a mechanism to voice their concerns about issues that cut across the needs of individual research groups and affect many students.

The committee prepared a detailed report which was made available to FCT, and discussed by all researchers of the Institute. The recommendations described in the report were took into consideration by research group leaders in the preparation of this report.

9.2 Future internal Evaluations plan for 2011

Internal Evalutaion is scheduled for the period 18-19 July 2011 with the presence of Sierd Cloething, Michael Bevis and Phillipe Bougeault.