CONGRÈS DES DOCTORANTS 2012

Ecole et Observatoire des Sciences de la Terre

UNIVERSITÉ DE STRASBOURG

ECOLE DOCTORALE SCIENCES DE LA TERRE DE L'UNIVERS ET DE L'ENVIRONNEMENT

Laboratoire d'Hydrologie et de Géochimie de Strasbourg

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Image Ville Environnement

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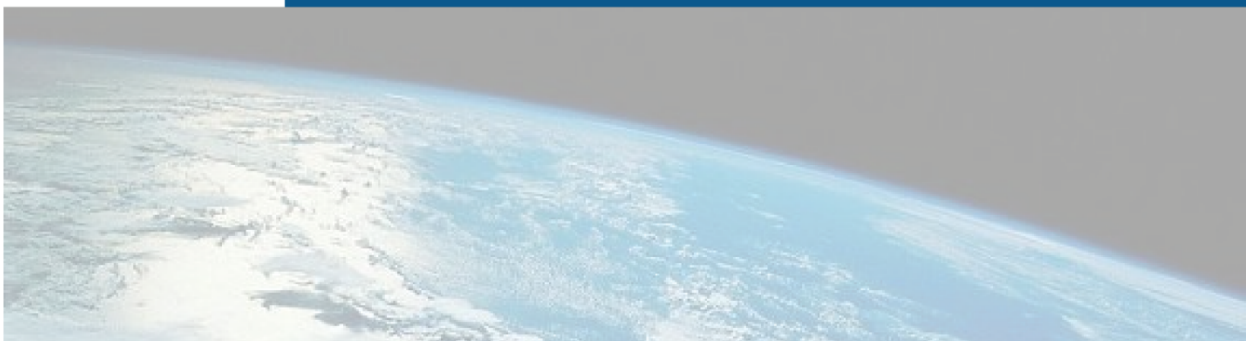
COLLÈGE DOCTORALE EUROPÉEN
LUNDI 10 DECEMBRE



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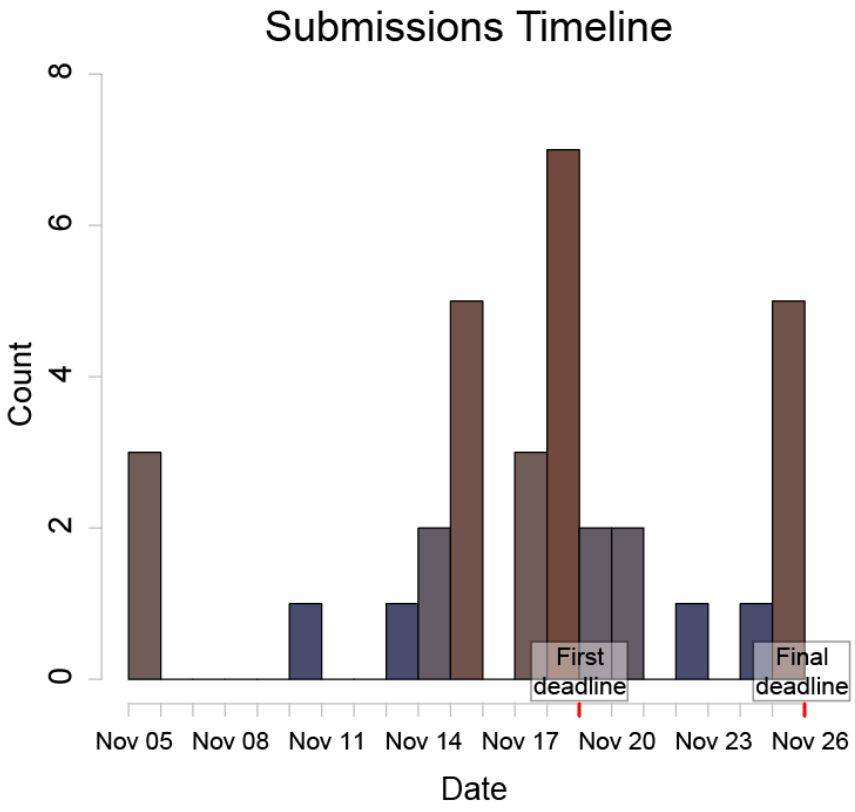
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First deadline
Final deadline
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Nov 14
Nov 17
Nov 20
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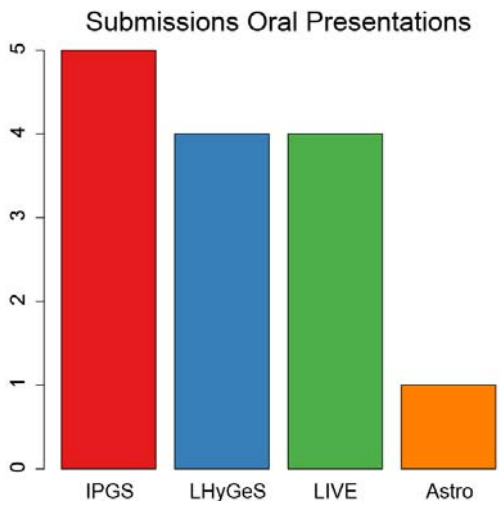
Date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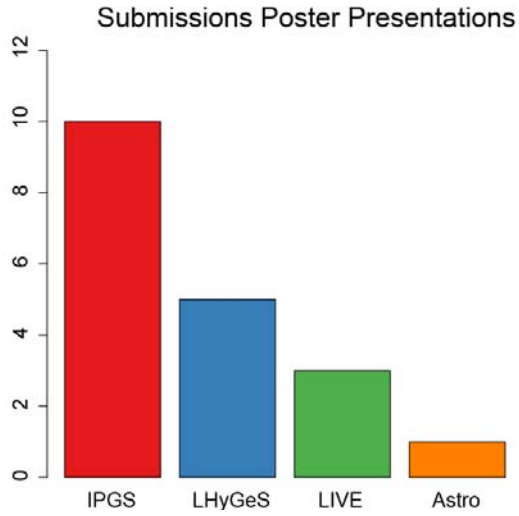
IPGS
LHyGeS
LIVE
Astro


Submissions Poster Presentations
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12
IPGS
LHyGeS
LIVE
Astro

Program Morning

9:00 – 9:10	*Welcome speech by **Prof. Francois Chabaux***
9:20 – 9:40	**Romy Schlögel** (IPGS) Landslide Hazard Assessment: Integration of multi-source remote-sensing data and development of probabilistic models at regional and local scales
9:40 – 10:00	**Ashour Abouessa** (IPGS) Sedimentary structures and their significance in recognizing ancient depositional environment, case study from Dur At Talah sequence, Upper Eocene, Sirt Basin, Libya
10:00 –10:20	**JulieTugend** (IPGS) The Architecture of Hyper-Extended Domains at Rifted Continental Margins and Its Role during Orogene Formation: The Bay of Biscay-Western Pyrenees Example
10:20 –10:40	**Alexis Nutz** (IPGS) Late and Post-glacial sedimentary evolution of the Saint-Jean depocentre (Québec, Canada): emplacement and evolution of a Wind driven Water Body
10:40 – 11:20	*Coffee Break and Poster session I*
11:20 –11:40	**Nodot Emilie** (IPGS) Detection and characterization of anthropogenic objects by geophysical methods
11:40 – 12:00	**Noura Fajraoui** (LHyGeS) On the identification of soil hydraulic parameters
12:00 – 12:20	**Morgane Mey** (LHyGeS) The Life Cycle Assessment of the anthropic activities within the Milazzo Peninsula (north-eastern Sicily, Italy): Environmental Impact Assessment of waters and soils
12:20 – 12:40	**Frederic Marin** (Astro) Investigating the complex morphology of thermal Active Galactic Nucleus: multi-wavelength radiative transfer and scattering-induced polarization signatures
12:40 – 13:40	*Lunch Break and poster session II*
13:40 – 14:00	*Farewell for **Anette Winter***

Program Afternoon

14:00 – 14:20 **Dasaraden Mauree** (LIVE)
Development of a 1D canopy module to couple mesoscale meteorogical model with microscale models

14:20 – 14:40 **André Stumpf** (LIVE)
Machine learning techniques for the interactive classification of very-high resolution (VHR) satellite images

14:40 – 15:00 **T. Yan W. M. Iskandarsyah** (LIVE)
Ujung Kulon Peninsula at the west end of Java Island, Indonesia, and the depositional signatures of tsunami generated by the past eruption of Krakatau

15:00 – 15:20 ***Coffee Break and poster session III***

15:20 – 15:40 **Barbora Vysloužilovà** (LIVE)
Pedogenesis of chernozems and luvisols in Central Europe

15:40 – 16:00 **Adrien Gontier** (LHyGeS)
Impact of vegetation change on the mobility of uranium- and thorium-series nuclides

16:20 – 16:40 **Elodie Maillard** (LHyGeS)
Transport and biodegradation of chloroacetanilide herbicides in lab-scale wetlands

16:40 – 16:50 *Closing speech by **Prof. Francois Chabaux***

18:45 *Social dinner at L'Alsace à Table*

Abstracts Oral Presentations

Landslide Hazard Assessment: Integration of multi-source remote-sensing data and development of probabilistic models at regional and local scales

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The objective of this PhD is to propose a methodology for the quantitative assessment of landslide hazard (spatial and temporal probabilities of occurrence, magnitude estimation) making extensive use of Earth Observation (EO) products, remote-sensing techniques and modelling. The research is covering the Barcelonnette area (France) as the main study area and the Buzau County (Romania) as a back-up. The methodology can be sub-divided in three main parts: (1) to update catalogues and inventories of landslides using a variety of geomorphological and geodetical techniques, (2) to characterize the spatial and temporal occurrences and the intensity of events by analyzing the dynamics (deformation and displacement patterns, contour changes) of active landslides, and (3) to identify relations among predisposing factors and triggering factors using multivariate models and propose quantitative hazards assessments at the local scale through the use of process-based models of slope hydrology, slope stability and slope kinematics. The final aim should be to embed the results in a probabilistic framework for the creation of robust hazard maps. The methodology and techniques will be developed and tested at both regional (1:25.000-1:10.000) and local scales (1:5000 – 1:2000).

In order to update the landslide inventories, different source of information (existing reports such as local stakeholder catalogues, series of aerial photographs and SAR images) were used to cover different time intervals (1956, 1972, 1984, 1995, 2000, 2004, 2008 and 2010). The multi-parameter landslide inventory associates several parameters (e.g. type, subtype, age, activity, area affected, estimation of volume…).

Several images processing techniques are used to infer information from complex mountain environments. ALOS PALSAR images (radar in L-band) were analyzed for the period early 2007 to mid 2010 and the construction of several interferograms (15 m resolution) from a serie of 15 images (fine beam single and double polarizations). Such images have the potential to detect small-sized landslides and are appropriate to map landslides with large deformation gradients. The conversion of the LOS displacements to topographical displacements is currently in progress. Statistics were constructed using the different inventories created. The analysis indicates that the number of landslide is increasing from 1850 till today with a peak in the 1990's.

The Architecture of Hyper-Extended Domains at Rifted Continental Margins and Its Role during Orogene Formation: The Bay of Biscay-Western Pyrenees Example

Tugend, J. (IPGS); Manatschal, G.; Kusznir, N. J.; Masini, E.; Mohn, G.; Thinon, I.

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The Bay of Biscay-Western Pyrenees represents a natural laboratory to study the processes related to passive continental margin formation and reactivation. This domain corresponds to a Lower Cretaceous rifting leading to the development of hyper-extended domains and ultimately embryonic oceanic crust in the Bay of Biscay. During late Cretaceous time, these domains were inverted and, in the eastern part, integrated into the Pyrenean orogene. The increasing of inversion eastwards gives the spatial access to a progressive reactivation of the hyper-extended rifted margin. We combine offshore studies, based on seismic reflection data and geophysical methods, with onshore field observations to investigate the Bay of Biscay-Western Pyrenees rift system. This multidisciplinary approach enables us to characterize the sedimentary and crustal architecture across the hyper-extended domains and to understand the role of rift inheritance during compressional deformation. First results on the study of the Bay of Biscay-Western Pyrenees rift system suggests that (1) the architecture of hyper-extended domains is mainly controlled by detachment faults and (2) the rift system is strongly segmented at different scales: from small scale lateral ramps observed within the Mauléon basin, to major transfer faults and shear zones bounding different rift basins (e.g. the Pamplona fault, onshore) or delimiting major changes of architecture (e.g. the South Armorican Shear Zone, offshore). Furthermore, the investigation of the role of rift related architecture during compression shows that inversion is initiated in the hyper-extended domain with the reactivation of detachment faults and with increasing reactivation the former necking zone progressively acts as a buttress. Through this contribution, we aim to illustrate and investigate the processes related to the formation and reactivation of the Bay of Biscay-Western Pyrenees rift system. Moreover, these results may also be important to better understand other hyper-extended rifts and the role of rift inherited structures for orogen formation.

Sedimentary structures and their significance in recognizing ancient depositional environment, case study from Dur At Talah sequence, Upper Eocene, Sirt Basin, Libya

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Sedimentary structures and their significance in recognizing ancient depositional environment, case study from Dur At Talah sequence, Upper Eocene, Sirt Basin, Libya Ashour Abouessa Abstract The Dur At Talah Escarpment is composed of 150 m thick siliciclastic rock of Upper Eocene age. It is located in the southern fringes of the large hydrocarbon bearing Sirt basin of Libya. Studying this sequence is important for both the hydrocarbon exploration and the sedimentological researches. Based on the differences in sedimentological characteristics, the entire sequence has been subdivided into two main rock units. The lower unit is called New Idam Unit (80-100) m, composed of alternating strata of very fine grained sandstone to claystones and their transitions. The succession of this unit is horizontally to subhorizantal stratified and characteristically dominated by 1) variable biogenic activities traces including levels with fossil roots; 2) Vertebrates and invertebrate body fossils of different occurrences; 3) Vertically organized strata of distinctive reoccurring manner Unlike the New Idam Unit, the overlying Sarir Unit (50-70 m) is made up of medium to coarse cross-bedded sandstone. Except the occurrence of local accumulation of petrified wood trunks, this unit constitutes very scars biogenic traces. In the other hand it exhibit distinctive physical sedimentary structures of different scale. The differences in the sedimentary and the biogenic structures between the two units provide significant criteria that made the recognition of their depositional environments possible, which was the prime objective of this project. Utilizing those criteria would be useful as indicators to recognizing similar depositional environments in the sedimentary record. Greater focus is given to distinguish ancient sandy megaripples of tidal origin, from counterparts created by fluvial processes. Field work in the area of Dur At Talah was the essential data source for this study, supported by site visits to the modern sedimentary analogues in Mont Saint Michel Macrotidal Bay of France.

Late and Post-glacial sedimentary evolution of the Saint-Jean depocentre (Québec, Canada): emplacement and evolution of a Wind driven Water Body

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Wind driven Water Body (WdWB) refers to as water bodies which are characterized by common physiographic pattern, (1) their depth is small with respect to their size (i.e., low depth/length ratio) and (2) they display limited to null connection to the open sea (i.e., no tide, no swell influences), most of them being closed water bodies. As a consequence, they show typical hydrodynamics and sediment transport driven by wind waves and develop along their shorelines as well as on their bottom, significant sedimentary features. WdWB mostly groups lacustrine systems (e.g., lake Erie; lake Turkana and lake Khyargas), but other types of water bodies can also be included in the WdWB designation such as marginal seas (e.g., Azov sea) or coastal lagoon (e.g., Patos lagoon; Alaskan lagoon; Nantucket lagoon). Although WdWB represent large surface in the present-day continental domain, they are rarely considered in the geological record. Thus, to conceptualize this type of depositional system is of first importance in order to prevent misinterpretations of continental successions and to reappraise some marine successions. In addition, lacustrine source rocks produce 20% of the oil worldwide and to apprehend WdWB evolution could be a major issue for reservoir quality prediction. The Saint-Jean depocentre (Québec, Canada) represents a sediment sink active since the retreat of the Laurentide ice sheet (i.e. about 15 Cal. ka BP), evolved in WdWB since about 9 Cal. ka BP. Onshore data (i.e. field geology) combined to offshore data (i.e. geophysical imagery) provide a complete view of the system, registering the onset and the evolution of this WdWB. This system registered contrasted sedimentary evolutions ascribed to the two major successive modifications in the depocentre which are (1) the transition from glacial influenced to non-glacial influenced periods and (2) the transition from marine to lacustrine (WdWB) environment resulting from glacio-isostatic forced regression. All along its evolution, the Saint-Jean depocentre is characterized by the evolution of high energy coastal dynamic, highlighted by raised and active beach ridges, shoreface sediments as well as by the identification of a still active infralittoral prograding wedge. In opposition, during the marine and then lacustrine (WdWB) periods, the offshore domain display contrasted evolutions. The marine period was characterized by low energetic depositional processes (i.e. hemipelagic mud settling) typical of glacimarine and prodeltaïc sedimentation, while the lacustrine period is characterized by the appearance of more energetic sedimentary processes mainly related to hyperpycnal flows and bottom currents. Erosive channel, deep erosional surfaces, contourites, confined lobes and deep prograding shelf correspond to the major sedimentary features on the lake bottom. This sedimentary evolution is forced both by fluvial influence and by internal hydrodynamic related to wind action (i.e., fetch) which are the main forcings expected in this type of basin (Nutz et al., in prep). Finally, this study breaks the belief that continental water bodies create simple sedimentary architectures easily identifiable from open marine systems. It brings new sedimentary characteristics concerning WdWB evolution and identification in the geological record.

Detection and characterisation of anthropogenic objects by geophysical methods

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Human activities have let many anthropogenic objects buried under our feet. Some of these like explosive devices left after the World Wars turn out to be a threat to safety or environment. Others must be perfectly localized in case of construction work, for example gas pipe. Geophysics and more specifically magnetic cartography (many of these items are magnetic) can obviously help to locate them. We already use this method on daily basis to detect UXO (unexploded ordnance) but less than 10% of the unearthed objects are actually bombs or shells. Detection and mostly characterization methods must be improved in order to reduce this proportion. On the field there are a few things we can do to increase data qualities. In the case of measurements in an urban environment for example, data are distorted. The traffic (train, tramway, cars…) produces temporal variations of the magnetic field. This effect can be lessened, sometimes even removed by the use of a fixed scalar magnetic sensor. Data treatment is one of the keys as regards the characterization. Tools such as analytic signal or derivative are frequently used at the first degree. We will see that in a synthetic case the second and third degree bring even more information. A new issue appeared recently about pipes. Can we localize very precisely (less than 10 cm uncertainty) a gas pipe? Horizontally we can but due to our inversion method we still have trouble with the depth accuracy. Our final concern is about the amplitude of some anomalies. Potential methods equations are based on the fact that the anomaly norm must be minor to magnetic field norm. Sometimes this is not the case but we have some lead to solve this problem.

On the identification of soil hydraulic parameters

Fajraoui, N. (LHyGeS); Younes, A.; Mara, T.; Lehmann, F.

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Drainage experiments are commonly conducted to determine soil hydraulic parameters. Experiments generally measure the temporal evolution of the cumulative outflow as well as pressure heads and water contents at several levels in the column. Then, the analysts try to calibrate the model by fitting the model response to the data series. The aim of the present work is to investigate the quality of the inverting Richars-Van Genuchten Mualem equations prior to experiment. For this purpose, we invert R-VGM in a Bayesian framework from artificial data series. Prior to the inverse modelling, global sensitivity analyses are performed with polynomial chaos expansions. Then, we use the Monte Carlo Markov Chain to estimate the posterior distributions of the parameters. Such an approach allows addressing the following issues: Is the model over-parameterized? What are the parameters that can be reasonably estimated? And from which measurements?

The Life Cycle Assessment of the anthropic activities within the Milazzo Peninsula (north-eastern Sicily, Italy): Environmental Impact Assessment of waters and soils

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The Milazzo Peninsula, located in the North-East of Sicily (Italy) is a highly polluted zone. Since the last decades, many studies show an increase of the number of cancers and lung infections in this area. The coastal environment is also stressed and an important line of coast is forbidden to swimming due to pollution. Four main anthropogenic activities seem to contribute to the environmental damages: the illegal combustion of domestic waste, the road traffic, a thermo-electric plant and a refinery. In order to assess the impacts caused by these anthropic activities, I used the Life Cycle Impact Assessment methodology. I applied it a two different scales: global-scale and local-scale. The results are compared together. They show which chemicals cause the most impacts to my site of study, what kind of damages they make, and the importance of using site-specific scale for peculiar systems.

Investigating the complex morphology of thermal Active Galactic Nucleus: multi-wavelength radiative transfer and scattering-induced polarization signatures

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Since the discovery of active galactic nuclei (AGN), the physics occurring in the inner regions of AGN has been intensively studied at all possible wavelengths using ground-based and space telescopes. The unified model of AGN postulates that the optical emission of the continuum source and of the broad line region (BLR) is highly anisotropic because it is confined by the funnel of an obscuring, dusty torus. A type-1 AGN has a visible BLR and is seen at a line of sight towards the central source that passes through the torus funnel. For a type-2 AGN, the view of the BLR is blocked by circumnuclear dust. The radiation from the center of the AGN escapes only along the polar regions of the funnel where it photo-ionizes conically shaped outflows driven along the small scale radio-structure that is present in both radio-loud and radio-quiet AGN. Beyond the sublimation radius of the wind, dust grains can form and coexist with the outflows forming the so-called narrow line region (NLR). This anisotropic distribution and irradiation of absorbing and scattering media in AGN must induce a net polarization that we can exploit in order to investigate the complex radiative coupling between the innermost components of AGN. However, the core of an AGN cannot be resolved by current optical instruments and our understanding is mostly based on timing and spectroscopic studies. Spectropolarimetry can be an independent tool to probe the unresolvable parts of AGN thanks to the two more observables it adds: the percentage and the position angle of polarization. So far, spectropolarimetry observations and polarization mapping could be performed from the radio to the optical/UV bands, while the community is still waiting for a forthcoming X-ray satellite equipped with an X-ray polarimeter. To interpret the multi-wavelength data, polarization modeling of the radiative interplay between different AGN components is necessary. During this presentation, I will focus on the polarization signature emerging from complex radiative coupling that occurs in radio-quiet, thermal AGN. From the optical to the X-ray domains, I will then present an overview of the new morphological and composition constraints I have obtained over my first two PhD years.

Development of a 1D canopy module to couple mesoscale meteorogical model with microscale models

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The actual global warming, highlighted by the scientific community, is due to the greenhouse gases emissions resulting from our energy consumption. This energy is mainly produced in cities (about 70% of the total energy use for the world as well as in France). Around 36% (40% in France) of this energy are used in buildings (residential/tertiary) and this accounts for about 23% (France) of the greenhouse gases emissions. Moreover, the world population is more and more concentrated in urban areas, 50% of the actual world population already lives in cities and this ratio is expected to reach 70% by 2050. With the obviously increasing responsibility of cities in climate change in the future, it is of great importance to go toward more sustainable cities that would reduce the energy consumption in urban areas.

The energy use inside buildings is driven by the desired level of comfort of inhabitant as well as by urban climate. On the other hand, the urban climate is influenced by the presence of buildings. Indeed, artificial surfaces of urban areas modify the energy budget of the Earth's surface and furthermore heat is released into the atmosphere due to the energy use by buildings. Modifications at the scale of the buildings (micro-scale) can thus have an influence on the climate of the urban areas (meso-scale) and vice and versa.

During the last decades, meso-scale models have been developed to simulate the atmospheric conditions at the city scale. Due to their low resolution, the effects of small obstacles (such as buildings, trees, ...) near the ground are not reproduced properly and parameterizations have been developed to represent such effects in mesoscale models. On the other side, microscale models have a higher resolution and consequently can better simulate the impact of obstacles on the atmospheric heat flux exchanges with the earth surface. However due to their finer resolutions, only a smaller domain can be simulated within the same computational time.

To simulate the processes at the building scale as well as at the city scale, it is necessary to connect these two types of models. It is proposed here to develop a canopy module able to act as an interface between these two scales. The meso-scale model provides the meteorological variables to the micro-scale model via the canopy module. The micro-scale model then calculates the influence of the different type of surfaces on the variables and gives its back through the module to the meso-scale model. These improvements will enhance the calculation of the interactions between the atmosphere and the surface, as the energy exchanges between the layers of the urban canopy will be better simulated. Future development includes coupling the model to an urban dynamics model that can optimize urban forms so as to reduce building energy consumption. They can hence be used to optimize urban planning in order to improve the sustainability of cities.

Machine learning techniques for the interactive classification of very-high resolution (VHR) satellite images

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Supervised image classification has been demonstrated to be an efficient tool for the analysis remote sensing images with multiple applications such as land cover mapping, the retrieval of biophysical parameters, change- and anomaly detection, and geomorphological mapping. However, a bottleneck for the efficiency of such approaches often still remains the amount of required training data and associated costs for field surveys, sample analyses and image interpretation.

Active learning (AL), a branch of machine learning research, has evolved as key concept to reduce the costs of sampling. AL generally refers to systems where the learning algorithm receives some control over the selection of additional training data during several iterations. The underlying idea is to initialize a machine learning model with a small training set, and to subsequently exploit the model state and/or the data structure to iteratively select the most valuable samples that should be labelled by the user and added in the training set. The presented work targeted the development and application of a machine learning algorithm for the classification of VHR remote sensing images. Unlike most proposed techniques our approach explicitly considers the spatial distributions of the queried samples and guides the sampling efforts towards compact spatial regions with the most valuable samples for the model update. Experimental results of the approach are presented for landslide mapping with multi-temporal VHR satellite images.

Ujung Kulon Peninsula at the west end of Java Island, Indonesia, and the depositional signatures of tsunami generated by the past eruption of Krakatau

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In August 1883 Mount Krakatau erupted and generated a mega-tsunami, which had destroyed the neighbouring coastal areas and reached Ujung Kulon, a peninsula at the west end of Java Island, up to the coastal of Indian Ocean. Regionally, Ujung Kulon has an interesting coastal geomorphologic system. Its coastline, that formed by a V-shape and associated with the isthmus, could be an ideal wave trap of tsunami. This peninsula isthmus is produced by the combination of tectonic setting between an oblique subduction zone which parallel extends with the west-coastline of Sumatera and frontal subduction zone in the southern part of Java. In general, its geomorphologic system keeps a good condition for the depositional signatures of tsunami. The tsunami deposits had been observed at the several sites of Ujung Kulon through the drilling and trenching methods. Afterwards, the samples collected were assessed using textural and compositional analysis to identify the layers formed by tsunami. An important diagnostic criterion is the presence of pyroclastic materials in a sequence of tsunami deposits consisting of a sandy layer with abundant reworked shell, foraminifera, and other carbonate fragments (corals) which was overlaid by volcanic ash and pumice. In the western part of Ujung Kulon Peninsula, the tsunami deposits could be thicker than 1 meter, whereas in the eastern part (Gunung Honje) the tsunami deposits are less than 15 cm in average. Furthermore, some coral boulders were found in the middle part of paddy field, 1 km from the coastline, also present as boulder floaters in sand and dump deposits or on the parabolic dune. All of the tsunami signatures are well preserved in Ujung Kulon and provide the best information for reconstructing past eruption and mega-tsunami from the Krakatau.

Pedogenesis of chernozems and luvisols in Central Europe

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Chernozems and luvisols are the soil types developed on loess which are widely represented in Central Europe. Traditionally it is considered that the evolution of chernozems is connected to the open landscape with grassy vegetation, by contrast luvisols are supposed to be developed under forests. However, Holocene chernozems have developed in the areas where the climate is favourable to the existence of forests. This fact is to be studied in order to understand the pedogenesis of these soil types. As the chernozem is the soil with an important agronomical potential, it was exploited by the first European farmers – the Linear Band Culture civilization. At the same time the aim is to understand the variations of the ecology of pedogenesis in relation to the Neolithic population.

Impact of vegetation change on the mobility of uranium- and thorium-series nuclides

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The use of U and Th series radioactive disequilibria are well established as tools and chronometers. Indeed, the matching of these nuclides half-live to the pedogenic processes rates make these nuclides especially suitable to investigate either time or mechanism of transfers within a soil-water-plant system. This study was carried out from the experimental Breuil-Chenue site (Morvan mountains, France). The native forest (150 year-old) was partially clear-felled and replaced in 1976 by mono-specific plantations distributed in different stands. Following this cover-change, some mineralogical changes in the acid brown soil were recognized. Four soil sections were sampled: two under the native forest and the replanted oak and Douglas spruce stands respectively. The (238U), (234U), (230Th), (226Ra), (232Th) and (228Ra) activities were analysed by thermal ionization mass spectrometry (TIMS), inductively coupled plasma mass spectrometry (MC-ICPMS) and gamma spectrometry. Significant differences in U, Th, and Ra activities were observed between the soils located under the native forest or the replanted-trees stands, mostly dominated by a large uranium mobilization from the replanted soils. Moreover, all the investigated U and Th-series activity ratios show a different trend between the shallowest horizons (0-40cm) and the deepest one (below 40cm), demonstrating the chemical effect of the vegetation change on the shallow soil layers.

Transport and biodegradation of chloroacetanilide herbicides in lab-scale wetlands

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Chloroacetanilide herbicides are extensively used in the U.S. and in Europe in a variety of crops, including maize, sugar beet or sunflower. Biodegradation is a major attenuation process of chloroacetamides in water and soil ecosystems which can be enantioselective, and thus change the enantiomeric signatures of chiral chloroacetanilides. However, knowledge on the transport and biodegradation of chloroacetanilides in wetlands in relation with biogeochemical conditions and changes in the enantiomeric signatures is scarce. Here, we examine the transport and in situ biodegradation of metolachlor, alachlor and acetochlor in lab-scale wetlands by combining hydrochemical and biomolecular approaches with enantiomeric and compound-specific isotope analysis (CSIA). Changes in hydrochemical conditions are evaluated using redox-sensitive species. Oxygen concentrations ranged from 6.8 ± 0.8 mg L-1 to 0.7 ± 1.3 mg L-1, respectively, at the inlet and outlet of the wetlands. Changes in the herbicides, their enantiomeric signatures and their degradation products are quantified over the flow path and over time. CSIA methods are developed for assessing the in situ biodegradation with respect to the biogeochemical changes in the wetlands. In parallel, the structures of microbial communities in wetland pore water samples are characterized based on T-RFLP analyses of 16S rRNA genes. Based on a multiple-method approach, the results underscore the linkage between the microbial communities, changes of hydrochemical conditions and degradation of chloroacetanilide herbicides in wetlands.

Poster Program

Unraveling the breakup processes along the Australo-Antarctic rift-system

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The study of Atlantic type rifted margins shows that margin architecture and evolution is complex and that location, timing and processes related to continental breakup and onset of seafloor spreading are yet little understood. Although some new ideas have been recently developed, in particular in the North Atlantic and the Gulf of Aden, it is yet unclear how these models can be applied to other rifted margins. In particular the question of how rifting evolves and continents break up under the presence of variable amounts of syn-rift magmatism is yet unclear and needs to be investigated. The Australo-Antarctic conjugate rifted margins show variable styles and width of the ocean-continent transitions (OCT) with yet poorly defined limits to the adjacent less extended continental and oceanic domains. At present, age and location of break-up are poorly defined. The goal of this PhD project is to map and characterize earlier episodes of hyper-extension and magma-emplacement, define the structure of the OCT and in particular to better understand how, where and when rupture of the lithosphere occurred along the Australo-Antarctic conjugate rifted margins.

The tectono-stratigraphic evolution of basement highs in hyper-extended deep-water rifted margins: the example of the Briançonnais Domain in the Alps and comparisons with modern analogues

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The discovery of hydrocarbon systems in hyper-extended deep-water rifted margins in conjunction with technical developments expanded the domain of hydrocarbon exploration into domains that are yet little investigated. The increasing number of high-quality reflection and refraction seismic surveys and drill hole data show that deep-water rifted margins are very different from proximal margins. The new data show evidence for a polyphase rift evolution resulting in complex rift architectures with variable amounts of magmatic activity and local mantle exhumation that cannot be predicted by classical rift models. Thus, understanding the thermal structure, subsidence history, depositional environment and sedimentary architecture is a prerequisite to apply the "play elements" in these yet little investigated domains, which is essential to evaluate the survivability of syn- to post-rift petroleum systems. Although a big progress was made in the understanding of deep water rifted margins in the last 5 years, there are still many fundamental questions that remain open and ask for further research on this topic. One open scientific question, also relevant for hydrocarbon exploration, is related to the tectono-sedimentary evolution and subsidence history of basement highs in deep water rifted margins. Péron-Pinvidic and Manatschal (2010) showed that different types of basement highs can be distinguished in rifted margins. These highs include micro-continents, continental ribbons, Hblocks and extensional allochthons. Mapping these highs and properly define their stratigraphic and tectonic evolution provide important insights into the tectonic evolution of rifted margins and ultimately enable to propose predictive and quantifiable rift models that are required for the hydrocarbon exploration. To achieve our goal we propose to: - Review the existing structural, stratigraphic and age data from the whole Briançonnais domain ranging from Liguria/Italy, across the French Alps to Grisons in Switzerland - Construct key tectonic sections across the Briançonnais domain that enable to constrain its tectono-stratigraphic evolution (Liguria/S-Alps, Briançonnais/France; Préalpes/Switzerland) - Constrain the first order stratigraphic relationships, compare the nature of the internal and external domains and the lateral variations along strike of the Briançonnais domain - Constrain the temporal and spatial evolution of the subsidence of the Briançonnais domain (review of existing studies (e.g. Borel 1995) and new studies) - Compare the results obtained from the Briançonnais domain with that of seismically imaged basement highs in deep-water rifted margins (e.g. outer high in Campos or Santos).

Fluid history in hyper-extended rifted margins: Examples from the fossil Alpine and western Pyrenean rift systems and the present-day Iberia rifted continental margin.

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The evolution of deep-water rifted margins is intimately linked with complex and poly-phase fault structures. These structures known as detachment faults are responsible for extreme crustal thinning and mantle exhumation. During the evolution of detachment faults fluid-rock interaction play an important role, changing the chemical and physical properties of rocks with major implications for the strain localization and structural evolution of the margin. The change in rock chemistry and rheology is best indicated by the breakdown of feldspars and olivine into clays and serpentine minerals, and the pervasive cementation and precipitation of quartz within the fault rocks and veins along detachment faults. Although the chemical and mineral reactions are well known it is still unclear to what extent these reactions can lead to changes in the rheology of the lithosphere and how they can affect the thermal evolution of deep water, hyper-extended rifted margins. Another important question arise about the origin, timing, pathways and composition of these fluids. Are they mantle-derived fluids and/or of marine origin? Can we determine the range of temperature and consequently at what depth these fluids are formed? And can we constrain the age of their migration? The aim of this project is to understand how and where fluids form and how they migrate during the evolution of passive margins. In doing so we need to know their chemical composition that is given by major and trace elements and isotopic ratios (Sr and B) and then link the chemical trends to the evolution of major structures. Those structures (detachment faults) are well known in the eastern Alps in Switzerland that is our main field area to understand the coupling between fluids and detachment faults. The second field area is the Mauléon basin in the Western French Pyrenees, where extensional architecture characteristic from rifted-margins has been recognized. As these field areas have been reactivated during convergence, we will compare the results with those from the present-day Iberia Passive Margin. In this margin we take the advantage of seismic and well core data to have an example of a margin not affected by compressional tectonics. The first results show that in all three geological setting fluid percolation can be recognized in fault rocks linked to deep detachment systems. Evidence for the presence of fluids come form the analyses of hydration reactions in fault zones. In the Alps the major and trace elements show a gain in elements typical from mantle rocks (Ni, Cu, Co, V) associated with marine derived fluids as shown by gains of Sr, Na and Ca. This suggests that marine and mantle-derived fluids are important. In the Pyrenees, microtectonic studies show evidences for different depth formation of the detachment faults given an idea about the depth that fluids can migrate. A next step will include a more detailed analysis of the fault rocks from all 3 sites including isotopic studies.

The granulites of the Campo Unit (Central Alps): witnesses of Permian orogenic collapse and Jurassic hyper-extension

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The final stages of Variscan orogeny within the Alpine realm are classically characterized by the emplacement of large felsic and mafic complexes at all crustal levels during lithospheric extension in the Permian. At deeper levels, the building of the new continental crust is associated with a high temperature metamorphic event in the granulite facies. Nevertheless, the link between this regional metamorphic event and the mostly mafic intrusions is not straightforward. This as yet little understood tectonic, magmatic and metamorphic event modified the compositional and thermal structure of the Variscan lithosphere and may have controlled the strain and magmatic evolution during the Jurassic opening of the Alpine Tethys. To better understand these processes, we initiated a multidisciplinary research project coupling structural geology, igneous and metamorphic petrology and geochronology in the former hyper-extended Adriatic rifted margin outcropping in the Austroalpine Campo Unit (SE-Switzerland and N-Italy). The Campo Unit is composed of metamorphic rocks (kyanite-garnet-staurolite bearing micaschists and amphibolites) of unknown (probably Variscan) age that record amphibolite-facies conditions. A gabbroic plutonic complex (the Sondalo gabbro) was emplaced during late-Carboniferous and early-Permian times between ca. 300 and 270 Ma. This intrusion produced a metamorphic contact aureole leading to partial melting of the surrounding rocks as proved by the presence of migmatites. Thin-section observations show destabilization of muscovite, appearance of sillimanite, spinel, cordierite, crystallization of a large amount of garnet and finally to the disappearance of biotite and potassic feldspar. As a consequence, granulitic rocks composed of garnet, sillimanite, cordierite, spinel and ilmenite are formed in an intra-plutonic position. The late evolution of the area is marked by static crystallization of andalusite. Preliminary qualitative P-T estimates indicate a barrovian prograde path, perturbed during the retrogression by the intrusion of the mafic body at around 5-6 kbar, causing transient heating of the surrounding metasediments to ≈ 900°C. The lack of orthopyroxene, characteristic for low-pressure granulite is interpreted as proving the low exhumation rate of the area during the Permian temperature peak. These lithologies are cross-cut by several rift related Jurassic shear zones localized at the top of the Campo unit. These structures were interpreted as accommodating the positioning of the Campo unit in shallow crustal levels (<10km) during the Jurassic hyper-extension. This interpretation is supported by 40Ar/39Ar cooling ages on muscovite and biotite ranging between 180 and 200 Ma. Studying the Permian intrusions, their relations to the host rocks and their exhumation processes enables to establish (1) a snapshot of the crustal architecture in Permian time and (2) characterize the tectonic, thermal and magmatic evolution from the Permian orogenic collapse to subsequent Jurassic rifting. In order to get better constrains on the P-T-t conditions from the formation to the exhumation of the granulites, we will use thermodynamic modeling and 40Ar/39Ar dating.

Seismic moment magnitude and crustal wave coda

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A stable and unbiased magnitude estimation is very important to establish accurate seismicity catalogs in order to assess seismic hazard. Since 40 years, many studies have showed that coda waves are an effective way to estimate source and propagation medium parameters (Aki et Chouet, 1975 ; Mayeda et al., 2003). Unlike the direct phases, the crustal waves are not affected by a particular travel path and are not sensitive to directional source radiation effects. The properties of coda waves permit an alternative approach in magnitude estimation. The PhD aim is to study the regional properties of crustal wave codas in France. This will allows us to analyse old analogue seismograms and to develop a coda method for determining moment magnitude Mw of earthquakes recorded by French networks. The poster explains the interest of using coda waves for magnitude estimation and more generally the coda methodology used to determine frequency dependent source parameters. After showing the difficulties in estimating the coda parameters, we focus on the development of a coda magnitude method applicable to analogue records: the fixed time tc method.

Active tectonics of the region of Ulaanbaatar, Mongolia

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The estimation of the seismic potential of active faults is one of the most important input data to constrain the seismic hazard assessment. To characterize active faults, in addition to instrumental seismic data, we need to identify and date previous co-seismic dislocation. We use for that several techniques such as geomorphologic mapping, sub-surface geophysical survey and paleoseismological investigations. Excavation of trenches in deformation zones, and particularly through surface ruptures of past earthquakes, has become a major element of paleoseismic studies. The aim is to identify and date previous large events (magnitude >6) by dating seismic dislocations, and associated to geomorphologic measurements along the active faults, estimate paleo-earthquake magnitude. In favourable case, we can identify recurrence time of large events. Mongolia is located in the centre of Asia, between India-Eurasia collision and the zone in extension of Baykal. It was the site of four M>8 events during the last 110 years. The region of Ulaanbaatar (capital of Mongolia with about 1.2 million inhabitants), considered less active, is nevertheless associated with a dense seismic activity of low magnitude (up to 5,8 ML) and an increasing seismicity since 2005 along a new discovered fault at less than 20 km. The main active faults near Ulaanbaatar could produce earthquakes with magnitudes up to 7.5. The aim of this thesis, which started in 2012 March, is to study the seismic potential of active faults near the capital of Mongolia, Ulaanbaatar, result that will be used for seismic hazard assessment. I will use for that. - Mapping of major active faults in the region using satellite images and field investigations. - Characterization of active faults (type of movement, surface deformation) - Identification and dating of paleoseismic events, - Study of the interaction between the active faults in the region, During 2012 August, I participated in a fieldwork of three weeks near Ulaanbaatar and along surface ruptures of Mogod earthquake (Mw=7,2, 1967). My work was mainly dedicated to: - Morphological observation associated to active faults (Avdar, Sharai and Mogod fault) - Paleoseismological investigations (2 trenches) through the Avdar fault (NE-SW, 30km south of Ulaanbaatar) - Sampling of deposits for OSL and C14 dating. The team who participated in this fieldwork (EOST, ISTEM, RCAG) collected also shallow geophysical data (GPR, high resolution magnetic mapping) and morphological data (differential GPS). I participated partially in this geophysical survey. We collected important data on the field which will contribute to my study. The next step of my study is to analyse and interpret acquired data, as geomorphologic observations (using field and satellite data), trench logging (using 2012 field observations), dating of samples (collected in the 2012 trenches) and to participate in the processing of geophysical data. This study is in the framework of collaboration between RCAG (Research Centre of Astronomy and Geophyiscs, Academy of Sciences of Mongolia) and EOST. The results of this study will be included in the seismic hazard assessment for the capital of Mongolia, Ulaanbaatar.

Magnetic mapping and interpretation of an archaeological site in Syria

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Among the subsurface methods of exploration that have been developed to meet the new requirements of archaeological research, geophysical methods offer a very wide range of applications in the study of buried deposits. In their latest developments, the prospecting method based on the measurement of the magnetic field is particularly effective at very different types of sites, ranging from prehistoric times to the most recent. The measured magnetic field observed at a place and at a time, results from the vector sum of the main regional field, the effect of subsurface structures, local disturbances such as power lines, buildings, fences, and the diurnal variation (solar influence). The principle of the magnetic method is, from magnetic measurements on a flat plane above the prospected surface, to study the three-dimensional variations of magnetization producing the magnetic anomalies. The main purpose of the thesis is to acquire new magnetic data on the field and to propose quantitative interpretations of magnetic maps obtained on three archaeological sites of Bronze Age in Syria (Badiyah ANR program) and on two sites in Saudia Arabia (Yamama ANR program). More precisely, I present in this poster some results obtained on one of the five sites, the Rawda-site which corresponds to a circular city of Bronze Age with a radius of about 200 m. Several profiles are used to characterize the magnetization. A simple magnetic model corresponding to rectangular structures uniformly magnetized associated to walls cannot explain the magnetic anomalies. On contrary, the shape of the magnetic anomalies implies to propose magnetized or non-magnetized structure with a width of several meters. To fit completely the shape of the magnetic anomaly, an iterative algorithm is used consisting of modifying the shape of the top of the magnetized layer.

Seismic and aseismic deformation along the East African Rift System from a reanalysis of the GPS velocity field of Africa

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The geodetic coverage of Africa has been improved in the last few years, so the GPS station network is denser and the GPS position time series are longer in the present work than in the prior geodetic studies. We propose here a model, which confirms in a large part the precedent studies and in particular it is consistent with the existence of two additional plates (Victoria and Rovuma), which allow model to fit with the observations. Based on this geodetic model, we compute velocities along plate boundaries and thanks to a scalar form of the Kostrov relation; a geodetic moment rate is estimated. In terms of seismology, we evaluate a cumulative moment rate based on earthquakes catalogues. The comparison between energy release estimates by geodesy and by seismology allows us to clearly observe the differences of behaviour along the EARS. The pattern depicts along the rift by percentage of geodetic moment seismically accommodate, bring out a significant control of the thermal structure associated with different states of rifting evolution.

Automated detection and location of seismic events on Piton de la Fournaise volcano by waveform migration

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Owing to their increasing number, the automation of the analysis of seismological data has become a crucial issue. WaveLoc is an algorithm for event detection and location by migration of continuous waveforms. Its principle relies on 3 main steps: 1. data filtering and kurtosis computation in order to highlight the signal transients; 2. migration of the positive first derivatives of the kurtosis; 3. detection and location of seismic events. WaveLoc has been applied to a dataset from Piton de la Fournaise volcano, La Reunion Island (France). We have focused more particularly on the 14th October 2010 crisis for which manual locations were also available. The comparison between manual and automatic locations allowed assessing the reliability and efficiency of WaveLoc. Still, in order to improve the precision and accuracy of WaveLoc locations, we have cross-correlated the waveforms to form clusters of similar events. The latter have been relocated by using a double-difference algorithm.

Imaging of a geothermal reservoir using ambient noise cross correlation

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The ambient noise cross correlation technique is a method which was initiated about 20 years ago in helioseismology. It was demonstrated that cross-correlating Sun's surface motion recorded at two distinct points could lead to an estimation of the medium properties in-between the recording points. Nowadays this method is widely used in seismology and many applications can be found in the literature. This method allows determining the Green's function between a pair of receivers only by correlating sufficiently long noise records. Thanks to this, it is now possible to perform tomographic studies without any deterministic sources. Nowadays, this method is widely applied at regional and continental scales using coherent seismic noise at periods larger than ~5s. In contrary, few applications of this method have been performed at a more local scale and at periods lower than 5s, where the seismic noise is mostly dominated by anthropogenic sources. This represents the context of our study in the area of Rittershoffen (North-East of France) where a geothermal plant is about to be installed (ECOGI project). The aim of this study is to build an image of the geothermal reservoir using ambient noise cross-correlation in a high frequency range (0.2 to 5 Hz) and to develop tools in order to follow the evolution of the reservoir during the production period. We applied the ambient noise cross correlation technique using about 3 years of continuous data recorded by short-period permanent stations in this region. Various classical processing schemes have been tested but the estimation of the dispersion curves remains poorly constrain at periods lower than 0.5s. Based on synthetics tests and a statistical analysis of the seismic noise we expect that a smarter data processing associated with careful noise selection will significantly improve the quality of the correlations and the estimation of their temporal variations.

Stars and Galaxies with ESO / VLT / XShooter : joint optical and near - infrared spectroscopic studies of stars and stellar populations

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Our star, the Sun, as more than two hundred billion stars, belongs to what we call the Milky Way. A galaxy is a massive system consisting of stars, stellar remnants, an interstellar medium of gas and dust, and dark matter. One way to improve the models of formation and evolution of galaxies could be to focus on the stars within those galaxies.

The transformation from the observed light of a spectrum to meaningful physical parameters requires the comparison with predictions of stellar population synthesis models, which are fed by stellar spectral libraries.

Unfortunately, the current stellar spectral libraries are usually bounded to a range of wavelength. And the joint studies of different ranges (for example, the optical and the near-infrared parts) do not agree. Thus, it will be extremely useful to create an extended library from the ultraviolet arm to the near-infrared one.

This could be achieved thanks to XShooter, a new multi-wavelength spectrograph installed at the Very Large Telescope (VLT/ESO, Chili), which simultaneously acquires spectra covering the ultraviolet up to the near-infrared.

The XShooter Spectral Library (XSL) is the result of the collaboration between various institutes, among them Strasbourg and Groningen (NL). Over the last two years, 236 spectra have been obtained, and this collection will be extent to 600, thanks to a Large Program.

My contribution to this project implies to focus on the 130 cool stars present in the current library, by assessing the data in order to compute the first generation of population synthesis models based on XSL. Once this will be done, we will be able to tackle one of many current questions about stellar populations.

Non-axisymmetric signatures in the Milky Way

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To a 1st order approximation, the Milky Way can be described as a superposition of axisymmetric components. However, recent results from spectroscopic surveys that give access to the full phase space information (position and velocities) showed that the effect of non-axisymmetric perturbations can not be neglected. As an example, using the RAVE survey, a gradient in the mean radial motion of stars in the disc is observed that cannot exist in a pure axisymmetric Galaxy. Thus, to gain a deeper knowledge of the present state of our host, we need to consider the influence of the non-axisymmetric components such as the spiral arms and the central bar.

As a first step, a two-dimensional density wave approach (Lin & Shu 1964) gave us new constraints on the physical quantities describing the spiral perturbation in the plane of the Galaxy such as the number of arms (a best fit for 2 arms), its pattern speed, amplitude and pitch angle (Siebert et al 2012).

However this study has limitations and for example we know that the strength of the pertubation should depend on the age of the stellar populations we study (e.g. the height above/below the plane). This is not taken into account in the previous study. Hence, it needs to be extended to a three-dimensional case taking into account the vertical variation of the spiral potential. This extension in the third spatial dimension is done using a particle-test scheme where we start from an axisymmetric disc and we perturb the orbit of each star using a pre-defined growing perturbation. This technique allows us not only to recover details of the mean velocity fields at various locations in the Galaxy but also it allows us to resolve the effect of resonances which are not modelled in the analytic formulation of Lin & Shu.

Sustainable Urban Form; Multifunctionality and Adaptation; Redefining urban spaces as multifunctional shared areas by using SOLAP as a decision-making tool

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More than half of the world's population lives in the cities and this ratio is increasing steadily (Population Reference Bureau). Consequently, landscapes and forms of the cities are constantly changing, developing and expanding horizontally and vertically. The concept of "Sustainable City" - that involves objectives such as democracy, social welfare, preserving natural resources and environment, economic viability and transportation- requires a framework that can encompass all these aspects. A sustainable city, as the context of the citizenry's social life, has these characteristics: - Polycentric structure - Varied densities (in city centre, intermediate area and suburb) - A mixture of generations and generational adaptation - Mixture of uses (mixed-use and multifunctional spaces) - Transport choices - Urban form facilitating active mobility (walking, cycling, skating, etc.) - A building design adapted to climate change (materials, compact form, ventilation corridors, etc.) - Integrated form with natural environment In order to make our existent cities more sustainable, besides generating new facilities and making changes, the use of current facilities should be more efficient as well. An urban space, in different scales - from a residential complex or a city block to a neighbourhood or the whole city - has a defined function which is limited to specified hours of the day, days of the month or months of the year. For instance, the parking spots of a residential complex has many free spaces during working hours; while the parking area of an office has free areas outside business hours and during public holidays. These spaces can be rekindled with other functions during their idle hours. On the other hand, spaces with private or semi-private uses might also be allocated to a public performance. For example, the school yards can be opened to the public during school holidays and temporarily used as a shared communal space. The aim of this thesis is studying the possibilities of reviving public, semi-public and private spaces for functions other than their main and during their idle hours to make multi-functional shared urban spaces. To this aim, understanding these spaces, their functions, and possible uses for them is of paramount importance. For this goal, it is imperative to determine the possibilities but also the limitations of these spaces considering legal and cultural restrictions, as well as the needs of the possible users. In this research SOLAP (Spatial On-Line Analytical Processing) software will be used for data analysing. SOLAP is a tool for analysing localized data (Spatial OLAP) which can organize data in three faces as a data cube: theme, time and location. This software has higher speed and more capabilities than other GIS software in terms of summarizing data and generating result. This software has been used in forestry, health care and traffic studies and it is hoped to have a great value in this research as a decision-making tool.

Assessing ecosystem services provided by urban green spaces

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In a general context, of the environmental crisis, the erosion of biodiversity and the decline of human welfare, caused by the overexploitation of natural resources, new sustainable policies have emerged aiming at the integration of environmental concerns into the decision making (Bruntland report, 1987). New disciplines and approaches have thus developed to rapidly find solutions to these problems. The concept of Ecosystem Services (ES), for example, is one of the "important areas of investigation" since the 1990's (Fisher et al, 2009). The community of researchers believes that this concept provides a functional link between man and nature. Furthermore, it can implement new strategies for the conservation of natural capital and the improvement of the quality of life (McDonald, 2009; Haines-Young, 2010; De Groot et al, 2010). The assessment of ecosystem services has been the subject of numerous studies made on global natural ecosystems without particular interest in "urban natural ecosystems". In Polund and Hunhammar (1999) proposed that urban green spaces can also generate, locally, ecosystem services which have a significant impact on human life. From this originates the interest of studying this concept in urban area. It highlights interaction between nature and society.

Trajectories and positions of the daily mobility: spatial, social and cognitive dimension

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In the first place this thesis raises a general question about spatial, social and societal problems: Does the intra-urban daily mobility play a role in the urban socio-spatial segregation, and, if so how and to what extent? A detailed literature review (Jodelet, 1982; Clément, 2000; etc.) allows us to hypothesize that the cognitive patterns involved in the representation of the city (cognitive position) contribute to the spatial structure of urban practices (location) and will vary among individuals belonging to different social groups (social position). In other words it is not only a set of urban elements that differs from one cognitive representation to another, but mainly the socio-spatial categorization that is structured differently. Indeed, the accessibility of a place does not depend solely on the physical properties of space but we must also consider the relationship between the socio-spatial representation internalized by the individual and projected in geographic space (Ramadier, 1998). In response to this questioning, it is important to understand the spatial trajectories of the individual. Here it is not the description and the understanding of the routes that is covered but the recurrences (routines, morphology identical socio-spatial locations) as the variety (the configuration in different places) of the activity places. The social trajectory is equally important. It will be addressed with traditional indicators of sociology. Similarly we must integrate, and this is the challenge of this thesis, the analysis of socio-cognitive processes (such as social representations of places) in the study of the relationship between the individual and its environment to describe, understand and better explain observed spatial practices. This doctoral research will finally consists in the analysis of the townsmen's relation to space, which lies between research on urban lifestyles and the one on the socio-spatial practices of daily trips. Its uniqueness rests on understanding the three dimensional position of an individual from their respective trajectories, and partly on an approach of the socio-spatial trajectory that is both objective and subjective. Our preliminary results indicate and confirm the role played by social trajectories in the structure of representations and socio-spatial practices. Indeed, we note in our population-test that its difference of representations and practices is depending of the context to acquire social position and not of the position herself. We can think that representation and practice of geographic space is a means for to be socially distinguishing (Bourdieu, 1979) in relation to each other. In other words, representations and spatial practices, participate in the construction of social differentiation.

Design Tool for Mechanical Reliability and Energy Conversion Efficiency in Solid Oxide Fuel Cells

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The demand for energy generation has increased dramatically over the last few years, as well as the need to reduce its impact on the environment. Fuel cell systems are one of the most promising technologies that can help achieve these objectives. The main characteristics of fuel cells are their lower noise, pollution emission and their higher energy conversion efficiency (40% and higher) compared to most conventional thermo mechanical-based power generation processes (only 25% to 30% at best). However, major developments are still required to reach the performance where fuel cells can be widely commercialized. Among the existing fuel cell systems, planar Solid Oxide Fuel Cell (SOFC) is a promising technology that offers a clean alternative to fossil fuels due to its high kinetic activity, its fuel flexibility and its fuel reforming within the cell unit. The major drawback of this technology is the high operating temperature that can lead to complex materials problems, including residual mechanical stresses due to the different thermal expansion coefficients of the cell components. To overcome these limitations, we propose in this PhD research project to optimize SOFC components to both improve their mechanical reliability and energy conversion performance. The optimized porous SOFC components present sufficient porosity, high connectivity between pores, optimized mechanical and transport properties to improve its mechanical reliability and energy conversion efficiency. To this aim a robust numerical tool is being developed to link the flow of gazes (Fuel and oxygen) and heat in the porous component of the SOFC to their mechanical response. To predict any possible crack nucleation and propagation within the SOFC components, the eXtended Finite Element Method (XFEM) is being used to solve for the mechanical response and the heat transfer. Darcy's law is being applied to describe the fluid flow using Nonconforming Finite Element Method. While the heat transport related to the fluid flow and dispersion is being solved with a combination of Discontinuous Galerkin (DG) and Multi-Point Flux Approximation (MPFA) methods.

Numerical modeling of three-phase compressible flow in porous media using the global pressure formulation

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Hydrosystem subsurface and reservoir modelling plays a crucial part in the management of subsurface water resources as well as in the monitoring of polluted sites. It is particularly helpful for the planning of depollution processes. The aim of this thesis in Hydrology and Applied Mathematics is to estimate the effect of a hydrophobic contaminant infiltration (DNAPL) by developing a 3D-code to simulate three-phase (DNAPL, water, and gas), compressible flow in porous media. Our research at the Laboratoire de Hydrologie et de Géochimie de Strasbourg will be pursued in collaboration with the Institut de Mécanique des Fluides de Toulouse and the engineering society BURGEAP, for the CubicM project. The mathematical model for multiphase flow in porous media is generally composed of a system of one Pressure and two Saturation equations. The choice of the primary variable is crucial for the efficiency of the numerical method. Our approach is based on the Global Pressure Model (Chavent and Jaffre, 1986): it leads to a partial decoupling of the Pressure and the Saturation equation and should be more efficient from the computational point of view. The new model is discretized by a Mixed Finite Elements and Discontinuous Finite Elements resolution method. These researches consist in integrating the gravity effects and quantifying the initial three-phase parameters for the actual three-phase incompressible and compressible flow model for porous media. The implementation of the gravity for two-phase oil/water incompressible flow, in the Saturation equation, through a Finite Elements Method has been realized. Comparison with the 1D Buckley-Leverett analytical solution, as well as 2D-comparison with water/air incompressible (or compressible) experience SCERES (ANR Fluxobat project) is in progress. Then, the SCERES imbibition-drainage experiment will also enable a comparison of the gas relative permeability values in the three-phase case with our data. In the second step of the project, the model shall be extended to a three-phase incompressible and compressible flow. Moreover, the code will be optimized. One of the final objectives is to compare this code with classical reservoir simulation model.

Bleaching of effluent colors with natural clay

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Industrial effluents from textile production often have a significant pollutant load of dye, difficult to biodegrade. Decontamination by conventional techniques such as adsorption (multiple adsorption) on activated carbon (Ekpete et al. 1997) is expensive. Thus, clays could be an interesting alternative products because they are inexpensive, available and have a high potential for adsorption of organic molecules and trace elements. Previous works (Errais et al. 2010; Errais 2011) have shown the high depollution potential of dye-loaded effluents by non-treated natural clays. In this work we focus on the adsorption by clays of mixtures of anionic and cationic dyes and additives used in industry dyer (enzymes, bleaches, detergent, organic acids, salts, etc.). It is proposed here to better understand the conditions and mechanisms involved in this bleaching by clays. For this, adsorption experiments are carried out by adding natural clay composed of various types of clay (kaolinite, illite and smectite) to a colorants and additives solution. The results show that some additives, including enzymes, promote discoloration when the dye is anionic. Other additives (detergent) seem to induce desorption with color change when the dye is cationic. In all cases the addition of slat furthers the discoloration.

Copper isotope analysis to study copper transport processes in wetland systems

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Copper is an essential micronutrient for many organisms but may also be a contaminant in terrestrial and aquatic ecosystems. Wetlands engineered worldwide to temporarily retain urban and agricultural runoff are characterized by high spatial and temporal heterogeneity in a geochemical point of view. Therefore, the understanding of processes that control during rainfall-runoff events the mobilization and the transfer of copper in wetlands require novel approaches. Copper transport is associated with the fractionation of copper stable isotopes as shown in previous studies in hydromorphic soils, rivers and lake sediments. The integrative signal of δ65Cu can serve as a proxy to investigate copper transport processes in dynamic wetlands, where copper transport is controlled by the interplay of simultaneously occurring biogeochemical and physical processes. Here we evaluated, using copper isotopes, copper fate and transport in a stormwater wetland that regularly received contaminated runoff from a 42 ha vineyard catchment (Rouffach, Alsace, France), where copper was used as a main fungicide. Runoff water, suspended solid, sediment and plant samples were regularly collected through the period of copper-based fungicides application on vineyards (May to July 2011) for copper quantification and isotopic analysis using MC-ICP-MS. The results show that the wetland retained 80 % of the aqueous copper mass entering. Aqueous copper transport from the inlet to the outlet of the wetland yielded an isotopic shift (δ65Cuinlet-δ65Cuoutlet) that ranged from 0.16 to 0.76 ± 0.08 ‰. Runoff-associated copper became depleted in 65Cu when passing through the wetland, suggesting that sorption to Al and Fe oxy(hydr)oxides as well as complexation with insoluble organic matter are major processes controlling aqueous copper transport in the wetland. Copper isotope signature in the wetland sediment was 0.02 ± 0.02 ‰ over the investigation period, indicating that solid phase copper was enriched in 63Cu compared to aqueous copper. Copper was mobilised from the sediment during major hydrological events (inlet runoff > 180 m3), which resulted in lower copper retention rate and concomitant lowered isotope signature of aqueous copper at the outlet. The observed isotopic shift during high-flow conditions likely reflected the contribution of sediment-bound copper to the isotope signature of aqueous copper. Overall, our results underscore that 60 – 93% of entering copper mass was associated with suspended solids, thereby determining the copper isotope composition of wetland sediments. We anticipate our results to be a starting point for using copper isotopes to highlight processes driving copper transport in hydro-biogeochemically dynamic systems, such as wetlands or hyporheic zones. At last, copper isotope geochemistry could be integrated in modelling copper reactive transport in dynamic environmental systems to better evaluate the impact of copper contamination. Further studies will focus on copper cycle along biogeochemical gradients in wetland sediments by coupling sequential extractions with copper isotope analysis.

Hazards of caused by textile industry effluents and curative actions

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Tunisia, country located in an arid bioclimatic stage, has limited hydrous potentialities. The recourse to the use of not-conventional water (particularly the re-use of treated waste water) becomes a necessity to satisfy the requirements of water. Among industries consuming water in great quantity, the textile industry generates important waste water pollution.

The waste water of the textile industry usually presents color problems, relatively high temperature and high concentrations of BOD5, COD, solids in suspension and as well as high toxicity of conductivity. Their characteristics can be extremely variable because of the broad spectrum of dyes, pigments, auxiliary products and processes used.

Effects on the environment

Under the action of the micro-organisms, the dyes release nitrates and phosphates in the natural environment. These mineral ions introduced in too large quantity can become toxic for the animal life and vegetable and accelerates the phenomenon of eutrophication. When important organic matter loads are brought to the medium via specific rejections, the natural processes of regulation cannot compensate the bacterial oxygen consumption any more. The accumulation of the organic matters in the rivers induces the appearance of bad tastes, bacterial proliferation, stenches and abnormal colorings.

The synthetic organic dyes are compounds impossible to purify by natural biological degradations [1] and they are bio-accumulated and disturbs the trophic chain. Their mutagen, teratogenic or carcinogenic effects appear after degradation of the initial molecule in by-products of oxidation [2]

Curative actions: Treatments of the dyes

These organic rejections are toxic and require an adapted technique of depollution.

The treatment of the textile rejections, taking into account their heterogeneity of composition, will always lead to the design of a data processing, sequence ensuring the elimination of the various pollutants by successive stages. The first stage consists in eliminating of insoluble pollution via pretreatments (cleaning, desanding, de-oiling.) and/or of physical or physicochemical treatments ensuring a separation solid/liquid. The depollution techniques, which occur most usually during the second phase in textile industries according to Barclay and Buckley [3] and kurbus and Al [4], are divided into three types: biological, physical and chemical treatment