



SECTOR : Higher Education Institution

LOCATION: France, Grenoble

RESEARCH FIELD: Spatial and Temporal Semantic Web

RESEARCHER PROFILE:

- *First stage researcher,*

**INSTITUTION:** Univ. Grenoble Alpes, University of Innovation

One of the major research-intensive French universities, Univ. Grenoble Alpes\*\*1 enjoys an international reputation in many scientific fields, as confirmed by international rankings. It benefits from the implementation of major European instruments (ESRF, ILL, EMBL, IRAM, EMFL\*2). The vibrant ecosystem, grounded on a close interaction between research, education and companies, has earned Grenoble to be ranked as the 5th most innovative city in the world. Surrounded by mountains, the campus benefits from a natural environment and a high quality of life and work environment. With 7000 foreign students and the annual visit of more than 8000 researchers from all over the world, Univ. Grenoble Alps is an internationally engaged university.

A personalized Welcome Center for international students, PhDs and researchers facilitates your arrival and installation.

In 2016, Univ. Grenoble Alpes was labeled «Initiative of Excellence ». This label aims at the emergence of around ten French world class research universities. By joining Univ. Grenoble Alpes, you have the opportunity to conduct world-class research, and to contribute to the social and economic challenges of the 21st century ("sustainable planet and society", "health, well-being and technology", "understanding and supporting innovation: culture, technology, organizations" "Digital technology").

\* ESRF (European Synchrotron Radiation Facility), ILL (Institut Laue-Langevin), IRAM (International Institute for Radio Astronomy), EMBL (European Molecular Biology Laboratory), EMFL (European Magnetic Field Laboratory)

#### **Key figures:**

- + 50,000 students including 7,000 international students
- 3,700 PhD students, 45% international
- 5,500 faculty members
- 180 different nationalities
- 1st city in France where it feels good to study and 5th city where it feels good to work
- ISSO: International Students & Scholars Office affiliated to EURAXESS

#### **MANDATORY REFERENCES:**

**CDP TITLE:** Trajectories

**SUBJECT TITLE:** A multidimensional spatio-temporal model for the analysis of environmental and territorial observations

**Scientific department** (laboratory's name): LIG & IGE

**Doctoral School's:** Mathématiques, Sciences et technologies de l'information, Informatique (MSTII)

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<sup>1</sup> Univ. Grenoble Alpes

**Supporter's names:** D. Ziebelin (LIG), S. Anquetin (IGE)

## **SUBJECT DESCRIPTION:**

Making interoperable heterogeneous data sources and linking data sets obtained on a common territory by different experts (biologists, ecologists, geographers, hydrologists etc ) is still an issue for current information systems and modeling methods. Existing observation systems are complex and record either long-term observations or short-term validity data at, for example, molecular or cellular level. The objective of the PhD is to develop an infrastructure allowing the different available observation data sets to be brought into a coordinated platform able to address questions relating to different correlated impacts from natural environment, land use or climate evolution.

The challenge of this PhD concerns multidisciplinary interoperability and modeling interdependent observation systems, across different space scales and time granularity. Our approach requires developing a multidimensional spatio-temporal model (4D + spatial scale + time granularity) based on semantic linked data architecture.

The multidimensional model will offer:

- A representation of observations and related operators. The approach will focus on ecological observations, biophysical, geological, and hydrological with socio-economic or political factors. The knowledge will be formalized through a multi-domain ontology;
- A spatio-temporal representation, which will propose a geographical dimension (geometry, topography) and a temporal dimension (observation time-slice with its location, observation time validity, etc ) ;
- A temporal granularity and spatial scale related to an observation or a set of observations (they have to be explicit during the collect of the observation sets, or event sets);
- A model of time evolution of the observations (dynamic).

## **Deliverables**

**Step 1 using existing technologies:** i) To link existing observation data sets from different sites (Orchamp, GLACIOCLIM, Arve valley) by using linked open data technologies – a technical case study; ii) To represent the existing models from existing observations data sets by using a common formal representation based on spatio-temporal ontologies (GeoSPARQL, OWLTime or any adequate existing spatio-temporal ontology); iii) To identify a set of concepts and provide semantic and syntactic standardization to linked observation data sets. These concepts are classified in a multidomain ontology by studying links between life science ontologies (OBOE, EnvO, GeneOntology, etc), environmental ontologies (Cuahsi, SWEET, EIONET, GEOSS, etc) and socio-economic environment (AGROVOC, FAO Geopolitical Ontology etc).

**Step2 providing new models and tools:** ii) This multi-domain ontology will be built and used to index the observation data sets in different sites (as linked data architecture); Realize 6D model: 3Dspace + time + time-granularity + scale. Time dimension is separately handled by adding attributes to 3D object. Time granularity specifies which dimension is used for which data structure. Multi-scale model integrates different scales as hierarchical structure and scales transition to navigate in the scale hierarchy; iii) Expand the previous transition model to identify relevant properties which characterize the changes and the evolution. These properties form the model of evolution via patterns.

**Step 3** implementing of the 6D model in the integrated observation platform.

## **5 references to support the work**

- Anquetin, S., Beaufig X., Chaffard Juen P “*OLES: Online Laboratory for Environmental Sciences, International Environmental Modelling and Software Society (iEMSs), Env. Modelling and Software*”, 2014, San Diego, CA, USA, Vol 1, 630 -638
- Jenny J.-P., Wilhelm B., Arnaud F. , Sabatier P., Giguet-Covex C. , Mélo A. , Fanget B., Malet E., Ployon E., Perga M.E. (sous presse) “A 4D sedimentological approach to reconstructing the flood frequency and intensity of the Rhône River (Lake Bourget, NW European Alps)”. *Journal of Paleolimnology* 51(4): 469-483
- Laniaka G. F, Olchin G., Goodall J., Voinov A., Hille M., Glynne P., Whelana G., Gellerf G., Quinng N., Blindh M., Peckhami S., Reaney S., Gaberk N., Kennedy R., Hughesm A. “Integrated environmental modeling: A vision and roadmap for the future” *Environmental Modelling & Software* Volume 39, January 2013, Pages 3–23

Thematic Issue on the Future of Integrated Modeling Science and Technology

Zhang M, Yue P, Wu Z, Ziébelin D, Wu H, Zhang C “*Model provenance tracking and inference for integrated environmental modelling*” Article in Environmental Modelling and Software 96:95-105 · October 2017 DOI: 10.1016/j.envsoft.2017.06.051

Ziébelin D., Hobus K., Genoud P., Bouveret S. “*Heterogeneous Data Integration Using Web of Data Technologies*” Article in Lecture Notes in Computer Science 10181 – p35-47, 2017

## **ELIGIBILITY CRITERIA**

Applicants:

- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration),

The ideal candidate holds an MS degree in computer science or a related field and is able to consider both theoretical and practical implementation aspects in her/his work. Fluent English communication, French language is a plus, but not a requirement and interest for developing software solutions. The candidate should have experience and commitment to work on one of the following fields:

- \* semantic web technologies, linked data and data integration
- \* knowledge representations and ontology engineering
- \* spatial and temporal knowledge representation and reasoning

Applicants will have to send their cv, last diploma, and a short presentation of their scientific project (2 to 3 pages max) via email to [Danielle.Ziebelin@imag.fr](mailto:Danielle.Ziebelin@imag.fr) , [Sandrine.Anquetin@univ-grenoble-alpes.fr](mailto:Sandrine.Anquetin@univ-grenoble-alpes.fr) and [cdp.trajectories@univ-grenoble-alpes.fr](mailto:cdp.trajectories@univ-grenoble-alpes.fr) prior to the deadline.

Letters of recommendation are welcome.

## **Selection process**

Application deadline: **16/11/2017** at 17:00 (CET)

Applications will be evaluated through a three-step process:

1. Eligibility check of applications in 17/11/2017
2. 1st round of selection: a Review Board will evaluate the applications 22 November 2017. Results will be given in 22/11/2017.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session, on 27 November – 1 of December 2017 week.

TYPE of CONTRACT: temporary-3 years of doctoral contract

JOB STATUS (Full time or part time): Full time

Hours per week: 35

Offer starting date: 08/01/2018

Application deadline: 16/11/2017

Salary: between 1769 € and 1989.80€ bruts per month (depending on complementary activity or not)