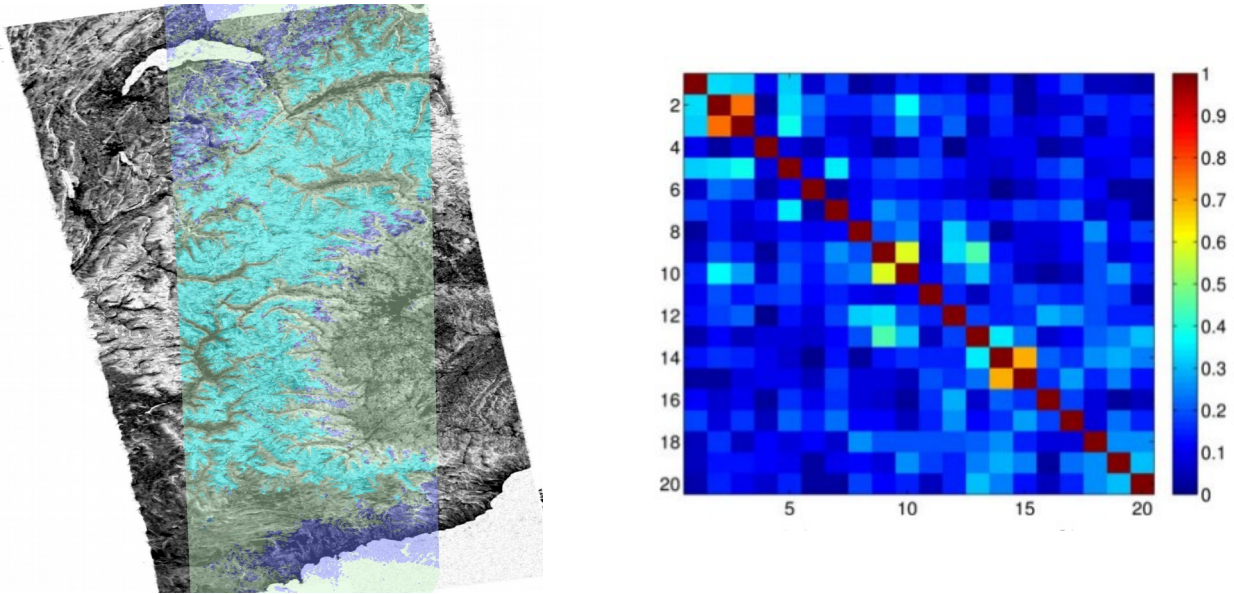


Learning surface state changes in the Alps from non-local covariance matrices of time series



(a) InSAR temporal coherence and snow cover (25/04/2018) (b) ex. of full cov. matrix for 20 dates.

Context: Multi-temporal InSAR (interferometric synthetic aperture radar), a combination of radar acquisitions, can measure the ground surface deformation by looking at differential phase signals at an accuracy up to mm/yr (millimeters/year) for densely sampled time-series. It is extensively used in natural deforming areas such as volcanoes, landslides and faults. The general goal of the project is to improve the accuracy of the measures by studying the full covariance matrix, summarizing the amplitude and phase correlation of small spatial subregions between all pairs of images in the time series.

Goal of the internship: By taking the French Alps as region study (already studied at ISTerre and processed by the locally developed software NSBAS), we first aim at studying the full covariance matrix for different types of land cover. The idea is that the coherence patterns across time are of different nature in case of snow (rapid but reversible decorrelation between summer and winter), vegetation growth (slow decorrelation, maybe causing some bias), changes of crop yields, etc. We will be able to cluster and classify the type and the state change of the land cover by machine learning (ML, such as convolutional n. nets) from the full covariance matrix. In order to improve the surface deformation measure, the goal is then to 1) automatically remove the bias caused by the slow decorrelation of some types of land states 2) determine which elements of the covariance matrix can be avoided in the computation while assuring the same accuracy. Some other studies, like defining an order 3 matrix, wrt the current order 2 covariance matrix and that could lead to more information, can also be investigated according to the intern's interests.

Pre-requisites: Some strong computer science and mathematics background is expected, especially some image processing knowledge. Knowledge or interest in machine learning, as well as in remote sensing, would be a plus. A strong interest towards the applicative aspects of methodological developments in AI and a curiosity towards important processes in earth sciences will be

appreciated. As the work environment is interdisciplinary, communication and facilitation skills will be required.

Environnement: This project is funded by MIAI, the Multidisciplinary Institute in Artificial intelligence of Grenoble Université, and is highly interdisciplinary. The intern will be based in ISTerre, the large Earth science laboratory of Grenoble, and will have strong connections with the LISTIC (Laboratoire d'Informatique, Systèmes, Traitement de l'Information et de la Connaissance) in Annecy: some travels between the laboratories will be funded. In ISTerre, he/she will be supervised by Sophie Giffard-Roisin (expert in AI using remote sensing for natural hazards) and Marie-Pierre Doin (geoscientist expert in InSAR imaging and land deformation for natural phenomena). In LISTIC, the intern will benefit from the knowledge of Yajing Yang (expert in remote sensing and InSAR, temporal series teledetection and statistics) and Abdourrahmane Atto (expert in mathematics and machine learning for remote sensing).

Duration: 4-6 months

Start date: from Dec. 2020 to April 2021

How to apply: Send a CV and a motivation letter asap to sophie.giffard@univ-grenoble-alpes.fr