

In Memory of Olivier Jaquet

SESSION 47- From Signals to Structures: Advanced Dynamical and Geostatistical Approaches in Seismology and Earth System Sciences

Conveners

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Session Description

The complexity of natural systems and the growing availability of high-resolution geophysical data demand frameworks capable of capturing the multiscale, non-linear, and non-stationary nature of Earth processes. Modern approaches in signal and data analysis - ranging from non-linear time series and fractal or multifractal methods to wavelet transforms, empirical mode decomposition, and graph-theoretical frameworks - have opened new avenues for understanding dynamical processes in seismology, volcanology and related Earth system sciences.

Building upon this methodological foundation, the proposed session focuses on the integration of advanced signal analysis and geostatistical methodologies for interpreting geophysical observations in both time and space. This is particularly timely in seismological research, where dynamic processes such as stress transfer, fault interaction, fluid migration, and crustal deformation exhibit complex spatio-temporal correlations that require hybrid analytical strategies.

The session is a special tribute to the memory of Olivier Jaquet, whose pioneering contributions to geostatistics and stochastic modeling have profoundly influenced how spatial and temporal uncertainties are quantified and propagated. He applied geostatistics to characterize aquifers and estimate the volcanic and tectonic hazards of nuclear waste deposits. He forecasted (with uncertainty) volcanic activity over different timescales, both in the space and in the time domain, underlying the importance of the concept of the memory of an experimental time series produced by a geo-dynamical system. A time series that does not remember its past long enough cannot forecast its future long enough.



In his spirit, we aim to encourage contributions that bridge data-driven learning, physical modeling and stochastic simulations, emphasizing how these approaches can reveal underlying structures and processes in seismicity, volcanology, crustal deformation, and hazard estimation.

We invite studies that employ or develop methodologies, including, but not limited to:

- Non-linear and non-stationary time series analysis;
- Fractal, multifractal, and scaling analysis of seismic and geophysical data;
- Spatio-temporal geostatistics for the characterization and simulation of heterogeneous media, fault systems, and seismic sources;
- Hybrid methods combining geostatistics, signal analysis, and physics-based models;
- Machine learning and data-driven approaches integrated with statistical and physical constraints;
- Uncertainty quantification and stochastic modeling in tectonic and volcanic contexts;
- Applications to multi-sensor and multi-scale datasets, including not only seismic catalogs but more general geophysical monitoring time series.

The objectives of this session are threefold:

1. To highlight recent advances in the theory and application of spatio-temporal signal analysis and geostatistics in seismology and solid Earth physics;
2. To promote cross-disciplinary dialogue between communities working in nonlinear dynamics, stochastic modeling, and Earth system monitoring;
3. To honor the scientific legacy of Olivier Jaquet, fostering discussions that extend his vision for describing the complexity of the Earth.

