Curriculum 1

PhD SDC
EARTH SYSTEM AND ENVIROMENT

Earth system processes and new perspectives in environmental development

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PhD SDC
SUSTAINABLE DEVELOPMENT AND CLIMATE CHANGE

Earth system processes and new perspectives in environmental development

Key topics:

- Climate and paleo-climate
- Environmental risks and impacts
- Physical and chemical processes
- Numerical modelling
- Greenhouse gas emissions
- Probability approaches and extremes

Description

The PhD candidates will study different biological, chemical, geological, physical, mathematical and environmental aspects of climate change and sustainability. The impacts and risks of climate change, including extreme events, will be investigated.

The candidates will study key processes and scale interactions related to the atmosphere, oceans, the land surface and the sub-surface, and the cryosphere which determine the Earth's climate.

Multi-disciplinary approaches will be applied to understand the interplay between natural and human processes, and between greenhouse gases and ecosystems. Hierarchies of coupled models will be developed and used to understand the role of different processes in determining the Earth's climate and its evolution. Observations from conventional and satellite platforms will be leveraged to understand phenomena, and design and diagnose model performance. Observations and model simulations will be applied to disentangle the relative role of natural variability and human activities on the Earth's climate.

Modelling will be used to explore the interaction between global, large-scale, low-frequency phenomena and local, small-scale and high-frequency events (including extremes), and to assess the potential impacts of different adaptation and mitigation strategies. In particular, the socio-economic impacts of climate change will be investigated and quantified.

Changes detected over the last decades will be compared with changes that have occurred in the most recent and very distant past, including the paleo climate, to identify possible similarities and differences and to help to predict how the climate will evolve in the future. Changes in surface variables, such as temperature, wind and precipitation, in terms of both their average and their differences, will be studied. Particular emphasis will be placed on understanding past and future changes in the frequency and intensity of extreme events that populate the tails of the probability distribution functions. Sophisticated statistical techniques will be used to analyse available data and extract signals. Probability theory and stochastic calculus will be applied to improve the simulation and propagation of initial (e.g., linked to observations) and model uncertainties.

The impact of climate change on land surfaces and the sub-surface, on ecosystems and the energy, water and chemical (carbon, methane) cycles will be investigated. The impact of changes in the concentration of chemical species, in particular, of carbon and nitrogen compounds, on the ecosystems will be analysed. Greenhouse gas emissions will be monitored and quantified using observation and data assimilation systems, and numerical experiments will be designed and performed to investigate their propagation, from the local source area to the global region.

Combined analysis of past and present climates and application of multi-disciplinary approaches will allow estimation of future risks and identify the most effective adaptation and mitigation strategies.