TEAMx

Multi-scale transport and exchange processes in the atmosphere over mountains
Programme and experiment

About 30% of the land surface is occupied by complex orography, and an even larger fraction of the world's population depends on water resources originating in the mountains. Mountainous regions determine the availability of water for billions of people in densely populated lowlands, through stratiform and convective orographic precipitation, evapotranspiration and water storage in the cryosphere. These complex-terrain processes have a major impact on the global cycle of water.

Similar considerations apply for the carbon cycle (where CO_2 uptake by the biosphere in mountainous terrain may be one of most uncertain elements of the global budget) and for the global atmospheric circulation (where momentum fluxes related to mountain waves and orographic blocking are poorly constrained by observations and poorly parameterized, degrading forecast accuracy at all scales).

Inspired by these arguments, TEAMx research focuses on exchange processes across the mountain boundary layer (MoBL). Specifically, these include land-atmosphere interaction, as well as transport and mixing within the MoBL and between the MoBL and the free atmosphere. The exchanged quantities are momentum, heat, water and trace constituents, pollutants included. Decades of mountain meteorology research have shown that exchange processes over mountains are more complex, in terms of the relevant scales of motion, than over flat and homogeneous terrain. It remains to be understood whether the larger spectrum of scales of motion enhances land-atmosphere exchange over mountains, and whether increased exchange efficiency explains the observed stronger sensitivity of mountainous areas to climate change.

The two pillars of TEAMx are: (i) A field campaign, planned for 2023-2024 in the European Alps, with large-scale deployment of micrometeorological instrumentation, ground-based profiling instruments and airborne sensors; (ii) Coordinated model evaluation studies, combining a hierarchy of tools from large-eddy-simulation to regional models to improve exchange parameterizations (land-atmosphere exchange, turbulence, convection, gravity wave drag) across modelling grey zones.

Focus on the Alps is motivated by their extremely complex orography, the abundant precipitation and heteorogenous land-use, the already existing dense meteorological observation network and the high population density, implying a large variety of weather-sensitive human activities.

In a long-term perspective, TEAMx research outcomes will contribute to: (i) reducing uncertainties and systematic errors in numerical weather predictions and climate simulations, in particular concerning high-impact weather events over mountains; (ii) understanding the dynamical and chemical processes that determine the exposure of humans and mountain ecosystems to air pollution; (iii) estimating carbon uptake over complex orography more accurately for a better quantitative knowledge of the global carbon cycle; (iv) estimating the vulnerability of mountainous areas to hydrological risk in present and future climate.