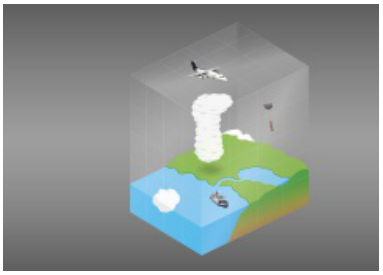

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# Modelling and observing the atmospheric boundary layer over mountains

The exchange of heat, momentum, and mass in the atmosphere over mountainous terrain is controlled by synoptic-scale dynamics, thermally-driven mesoscale circulations and turbulence.

Exchange processes at the land surface and within the atmospheric boundary layer are represented in numerical weather prediction and climate simulation models by empirically tuned and inherently uncertain parameterization schemes. The effects of sub-grid-scale turbulent processes are represented using concepts from boundary-layer meteorology (e.g., scaling based on dimensional analysis), which work reasonably well over flat and homogeneous terrain but often prove too simplistic over mountainous terrain. Because about 30% of land is occupied by complex orography, the implications of suboptimal modelling are likely to be large.

The mountain boundary layer (MBL) is persistently subject to processes other than turbulence, e.g., breeze systems. These produce complex patterns of variability in three dimensions, which are hard to observe and model, and have a direct impact on surface exchange. The present contribution briefly outlines a few key aspects of recent MBL research that are relevant to parameterization development: limitations of Monin-Obukhov surface-layer scaling, importance of horizontal boundary-layer exchange and spatial heterogeneity in exchange processes, challenges in determining the mixing height.

Much of the recent knowledge on MBL processes stems from high-resolution idealized numerical simulations, and there is a critical need for novel observational data to support theory and model development. Examples of usage of long-term observations from the "Innsbruck Box"(i-Box) for model evaluation are presented. Preliminary plans for a larger-scale observation campaign are also sketched.

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