Session D

Orographic Flow Dynamics

Session Chair and Rapporteur:

Vanda Grubišić (NCAR)

Session D Participants (12)

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5 Gs (Observations)
7 Hs (Num. Simulations)

15:00 – 15:15	**Introductions and organization of the session (incl. short overview presentation. All together.**
15:15 – 16:00	**Part 1: Discussion of dynamical processes.** All together.
16:00 – 16:30	Coffee break
16:30 – 17:00	Wrap-up of Part 1. All together.
17:00 – 18:00	**Part 2: Discussion of the observational, modelling and combined approaches.** Possibly two groups or All together.
18:00 – 18:30	Wrap up of Session D. All together.

Topics of Interest Covered in WP 1.0

1) Gravity-wave-induced orographic phenomena (e.g, foehn, downslope winds in general, lee waves, rotors, etc.) and their impact on surface exchange processes and surface energy budget,
2) Turbulent fluxes of heat, moisture and other atmospheric constituents associated with GWB or other non-linear aspects of IGW dynamics; spatial inhomogeneity of turbulent transport due to the 3D variability of mountain flows,
3) Advances in orographic drag parameterizations (form drag and gravity wave drag).

Topics of Interest Covered in WP 1.0

All the issues in Section 2.1.5 are based on numerical models!

Either what high(er and higher)-resolution models are predicting or need for better/more physical representations of processes that global models (still) cannot resolve.

We need higher-resolution measurements!
(for processes studies, model verification, parameterization development, etc.)

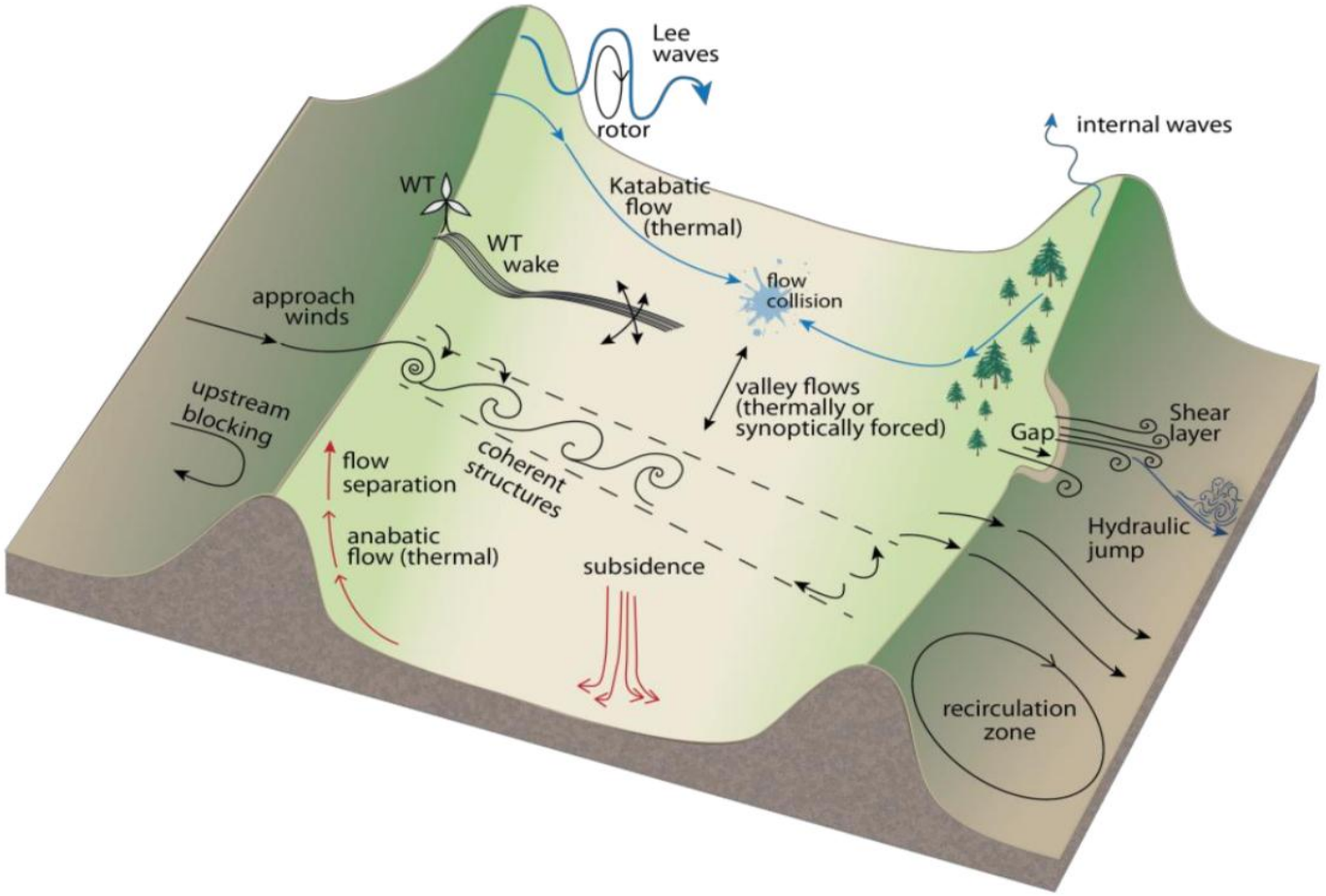
Previous Campaigns

T-REX, BLAST, Perdigão,…

Perdigão
Dec 15, 2016 – June 15, 2017

EU & US collaboration, embedded in the ERANET+ project, focus on BL processes and harvesting of wind energy in complex terrain

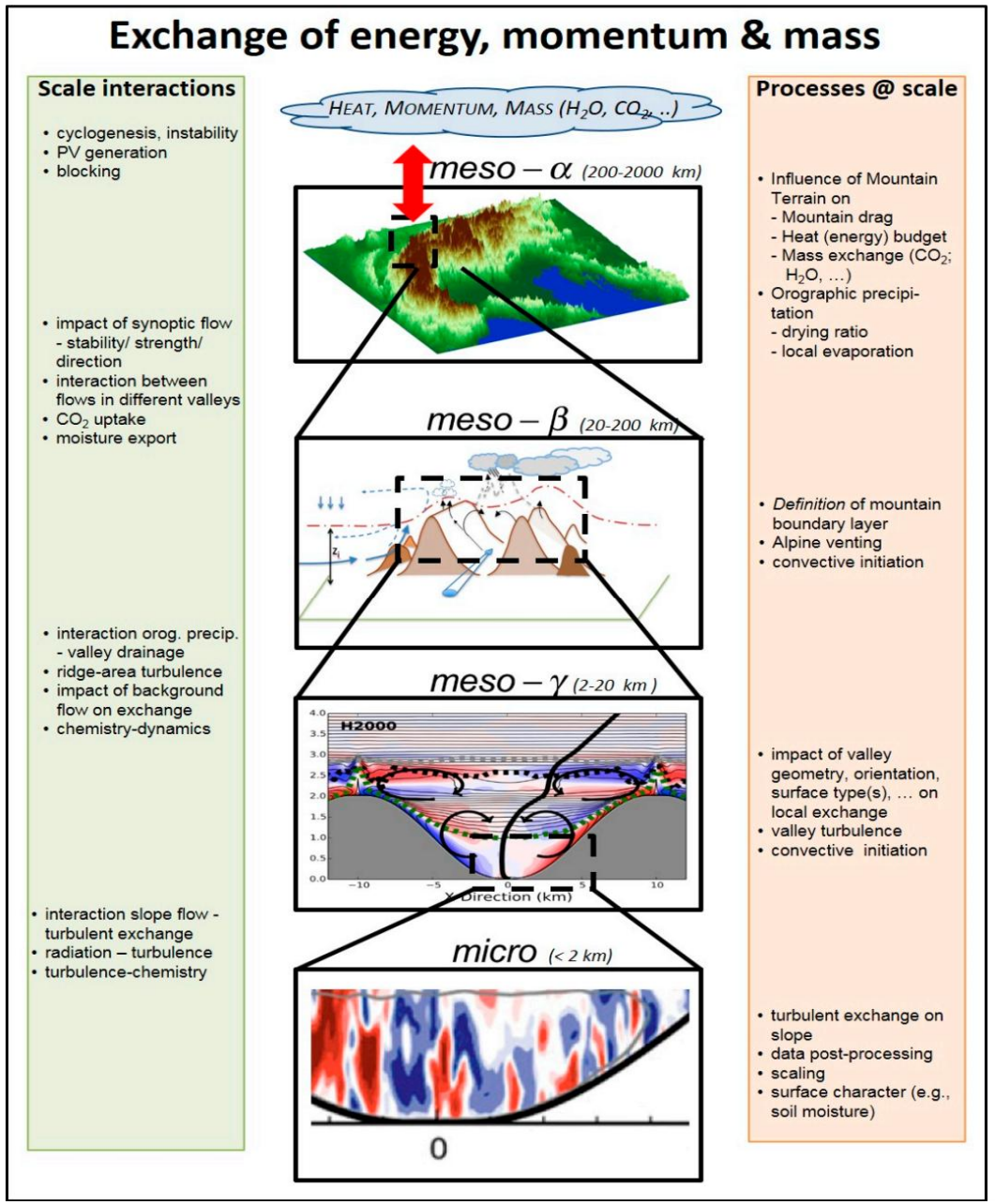
US team supported by NCAR/EOL



PERDIGÃO
Field experiment

Multi-scale Interactions in Orographic Flows

- Range of spatial scales from micro- to meso-α
- Two-way interactions
- Processes and their interactions are complex and often strongly non-linear: Small differences in initial or BC may cause very different outcomes



Lehner and Rotach (2018)

Additional Topics of Interest Beyond WP 1.0

1) Downslope winds – impact of processes within the MoBL (e.g., surface heat flux, thermally-forced flows, channeled flows, etc.) on the onset of downslope winds,
2) Mountain venting,
3) Quantifying predictability of complex terrain flows,
4) Troposphere-stratosphere exchange (e.g., related to GWB below or above the tropopause)
5) Orographic drag parameterizations – partitioning of the form and gravity-wave drag and the related role of small spatial scales

Observational Approach

1) Coordinated airborne and ground-based measurements, both in situ and remote sensing, multitude of temporal and spatial scales
2) Airborne platforms (manned aircraft, UAS, dropsondes, etc.) – high-frequency measurements needed for fluxes
3) Ground-based: scanning and profiling lidars (winds and WV), scintillometers, wind profilers, soundings,…
4) Use of tracers (WV and carbon isotopes, chemical tracers, chaff, etc.)
5) Target area: Many arguments for the Alps (multitude of scales, existing operational observing networks, long measurements records, existing supersite(s))

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5) Target area: Many arguments for the Alps (multitude of scales, existing operational observing networks, long measurements records, existing supersite(s))... but a complementary site in the tropics would be nice (Hawaii?)

Numerical Approach(es)

1) Ensemble forecast approach for predictability,
2) Idealized numerical simulations (high-resolution, potentially down to LES scales), in conjunction with the weather forecasting centers performing inter-comparison and assessment of orographic drag parameterizations,
3) High-resolution Lagrangian models, in conjunction with the tracer work for mountain venting,
4) GEWEX-type inter-comparisons (single-column models vs. high-resolution models) for momentum, heat and mass fluxes