On the state of the i-Box
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INTRODUCTION

- Turbulence structure and exchange processes in the atmospheric boundary layer over truly complex mountainous terrain (TCMT) substantially contribute to the ‘earth-atmosphere interaction’ over such terrain, i.e. the exchange of energy, mass and momentum from and to the free atmosphere.
- Boundary layers in TMCT are at the very forefront of boundary layer research. Their understanding is limited due to their complexity (inhomogeneity, slope, many scale of motion...) and limited observational datasets/systematic modelling efforts which leads to the lack of theory of turbulent exchange in such a setting.

THE i-BOX CONCEPT

i-Box is a platform for studying boundary layer processes in TCMT. i-Box concept rests on integrating:
- multi-year measurements at representative sites - consisting of turbulence towers and surface based remote sensing
- very high resolution numerical modelling - reproducing full flow characteristics and forcing fields for certain flow situations
- short term intensive campaigns - SOPs for a more in depth investigation of specific phenomena with additional observational efforts

DATA SETS

- i-Box observations are performed in a ‘box’ due to 3D nature of phenomena under investigation.
- Core measurement area is located in Inn valley, Austria, with 6 core turbulence sites (CS).
- Locations for individual sites were chosen according to surface characteristics to cover characteristic locations with respect to (mainly) slope, exposition and land use.
- Measurements at some core sites span more than 3 years.

CHALLENGES AND MEASUREMENT ADVANCES

- Operating instrumentation in TCMT is challenging due to instrumentation assumptions (e.g. surface layer scaling, homogeneity, footprint) and post-processing (e.g. coordinate rotation, low frequency motions). See Stiperski and Rotach (2015)
- For a passive Microwave T/RH profiler in TCMT to properly resolve high level inversions: extensive radio-sounding dataset and additional measurements from mountain stations are necessary (Massaro et al. 2015)
- Large aperture scintillometer was operated across the valley during SOP1.
- Non-contiguous fluxes over the height of the tower (1 day) show that tower is also outside Surface Layer.
- On second day fluxes were constant up to 60m.

LOCAL SCALING

- Data do not conform to Monin-Obukhov Similarity Theory (MOST) but imply local scaling.
- Larger scatter than over HHF.
- In the free convection limit the -1/3 slope is observed as predicted over HHF.
- Magnitude of negative non-dimensional temperature fluctuations is larger than for HHF and from another steep slope, possibly due to proportionally larger momentum fluxes in TCMT.
- Non-dimensional wind speed gradients show large departure from MOST due to katabatic winds.

NUMERICAL MODELLING

- Real terrain simulations with COSMO 1 numerical model (1.1 km, 80 vertical levels).
- Modeled and measured magnitude of TKE show very good fit for CS-VF0 and NF27 during daytime. During nighttime TKE is underestimated and in evening transition overestimated.
- Contributions to TKE budget (shear, buoyancy, dissipation) reproduced well. One dimensional TKE scheme not sufficient for TKE in TCMT

REFERENCES


FIRST RESULTS

DATA AVAILABILITY

<table>
<thead>
<tr>
<th>Station Name</th>
<th>Identification</th>
<th>Slope</th>
<th>Angle</th>
<th>Characteristic</th>
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<table>
<thead>
<tr>
<th>Type of measurement</th>
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<tbody>
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<td>Wind speed profile</td>
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<td>Ground heat flux</td>
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<tr>
<td>Soil temperature</td>
<td>CS-VF0</td>
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