Session G

Strategy for Field Experiments

Moderators:

Vanda Grubišić (NCAR) and Alexander Paci (MeteoFrance)

Strategy for Field Experiments

Topics of Interest: Ground based in-situ measurement and remote sensing of the mountain boundary layer and the free atmosphere over mountains. Airborne measurements. Target areas. Intensive and extended observation periods. Supersites. Useful observational datasets from past field campaigns.

Goals of the Session:

Refine the TEAMx White Paper

Identify essential observational systems and platforms for reaching scientific objectives

Define observational strategy and experimental design

TEAMx

11:00 – 11:15	**Introduction (incl. short overview presentation). All together.**
11:15 – 13:00	**Part 1: Observational objectives. Five parallel groups** (cf. next page).
13:00 – 14:00	Lunch break
14:00 – 14:45	Debrief from Part 1. Formation of Part 2 breakout groups. All together.
14:45 – 16:00	**Part 2: Instrumentation and measurement strategies. Five parallel groups.**
16:00 – 16:30	Coffee break
16:30 – 17:00	Part 2 discussions continued. Five parallel groups.
17:00 – 17:30	Debrief from Part 2. All together.
17:30 – 18:30	***Part 3: Experimental design. All together.***

Session G Part 1
Groups 1-5

Group 1: Aerosols, trace-gases and air pollution

Group 2: Orographic moist convection

Group 3: Land-atmosphere exchange

Group 4: MoBL and mesoscale flow interactions (1)

Group 5: MoBL and mesoscale flow interactions (2)

Session G Part 2
Groups 1-4

Group 1: Ground-based, in situ measurements – **Jean-Martial Cochard**

Group 2: Ground-based, remote-sensing measurements – **Nevio Babić**

Group 3: Airborne: Aircraft and UAS

Group 4: Satellite and non-standard measurements

Session G Part 1 Participants

Group 1	Group 2	Group 3	Group 4	Group 5
Jean-Luc Baray	Adriana Raudzens Bailey	Karmen Babić	**Bianca Adler**	Nico Cimini
Piero di Carlo	Paolo Di Girolamo	Sean Burns	Nevio Babić	Claudine Charrondiere
Henry Diemoz	Manfred Dorninger	**Jean-Martial Cohard**	Xuelong Chen	Alexander Gohm
Marco Falocchi	Bart Geerts	Joan Cuxart	Stephan DeWekker	Maxime Hervo
Markus Furger	Carlos Hoyos	Werner Eugster	Vanda Grubišić	Julie Lundquist
Thomas Karl	Norbert Kalthoff	Leonrado Montagani	Sebastian Hoch	**Marie Lothon**
Stephen Mobbs	**Daniel Kirshbaum**	Holly Oldroyd	Silvana Di Sabatino	Ned Patton
Alexander Paci	Agostino Manzato	Ivana Stiperski	Andrew Elvidge	Ian Renfrew
		Helen Ward	Gudrun Nina Petersen	Dino Zardi
		Georg Wohlfahrt		

1.1 Aerosols, Trace-gases and Air Pollution

Thomas Karl

Pressing research questions:

1) Improve understanding of the interaction between dynamics and chemistry on relevant scales.
2) Sources and chemical processing of aerosols and precursors (e.g. aging of aerosols) and their influence on microphysics
3) Does gravity wave breaking have significant influence on the bi directional exchange of gases (e.g. H2O,CH4, CFC)?

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Observational Platforms:

1) In-situ supersites/platforms that can house complex state-of-the art chemistry instrumentation. Small-to-mid size aircraft for flying within valleys. Drones too complex.
2) Chemical remote sensing: New Copernicus platforms will have the resolution to start resolving valleys: Need validation (aircraft, GB networks already in existence, scanning lidars)
3) Need 2 aircraft (high altitude and low altitude aircraft)

1.2 Orographic Moist Convection

Dan Kirshbaum

What we would really like:

- 3D gridded field of the full state of the atmosphere at 10-m spatial and 10 s time resolution

Range of Scales to Cover:

- Broad
- Scale interactions many, convection is an inherently multi-scale problem

What is (hopefully) feasible observationally:

- 2D variation of thermodynamics, kinematics and convective parameters (CAPE, CIN, LI, Entraining CAPE/midlevel humidity)
- Type of measurement broken down by the scale (from meso-alpha to micro-scale(s)

1.3 Land Surface Exchange

Jean-Martial Cohard

Scales to Cover and Science Objectives

- Local: Slopes, valley bottoms – a comprehensive list of scientific objectives
- Valleys: valley boundary fluxes
- Regional (Alps): a partial view of surface exchange for specific episodes at regional scale

Observational Needs at Slope Scale

Definition of a super site including :

- several turbulent stations close by (some tenth of meters)
- high z resolution sensor distribution (less than a meter close to the surface) ➔ smaller sensors ➔ trisonica
- Measure heat fluxes but also water, CO2, or tracers isotopes … which can be related to other local surface processes, Lidar (profilers, 3D) tethered balloon, measurements

Need review the existing sites and existing initiatives to design such a super site

1.4 MoBL and Mesoscale Flow Interactions (1)

Bianca Adler

Scales to Cover

- Large-scale: north-south transect through Alps linking convec ve precipita on and boundary-layer processes) using aircra , radiosoundings and opera onal networks
- Major valley system (like Inn Valley)
- Tributary valley (width and depth order of 1 km, less complex geometry than major valley)
- Slopes (microscale)

How to Capture All These Scales

- Use of existing operational networks (e.g. e-profile, network of wind profiler and ceilometer, GPS network for IWV)
- Integrated observation platforms with surface and profiling measurements (e.g., KITcube (mobile) and permanent (i-Box)
- Explore new technologies (e.g., NCAR WV DIAL (NCAR), Raman lidar, soil moisture from GPS stations (GFZ), swarms of drones/UAS)
- Non-traditional measurements (e.g. pressure from smart phones, sensors on gliders)

To justify new field experiment we need unique measurement strateg(ies)

1.5 MoBL and Mesoscale Flow Interactions (2)

Marie Lothon

Larger Scale Features

- - **mean state spatial variability** (advection, vertical structure) wind, temp, humidity, ozone
- - **Pressure and temperature** gradients across the mountain distribution of pressure across the mountain – scale dependent of obj
- - **Large scale subsidence** – convergence over the mountain, subsidence on the side → need for site on the side
- - **Upwind** conditions (profile)
- - Plain-to mountain circulation versus valley breeze transport vertical profiles of mean variable and fluxes
- - BL depth and low troposphere layers spatial variability, BL top topography
- Observation of the **cloud and deeper convection systems** – synergy of the instrumentations

Smaller Scale Features

- Need to map **temperature and moisture heterogeneity.** Observational challenge. Push development of scanning
- -Crucial element **Fluxes (x,y,z,t)** energy, (would be nice : CO2, O3)
- Very solid **high density of towers**, including radiation and surface characteristics
- Fractal way to deploy the stations – log- or spiral-
- High resolution **surface map vegetation and land-use**
- Vegetation characteristics (season growth and how it changes)
- Crucial : **Moisture spatial variability**
- Resolution requirements ? 100 m

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Group 3: Airborne: Aircraft and UAS

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2.3 Airborne: Aircraft

Mathias Rotach

Need for different of type aircraft (altitude, range, payload)
Long lead time for aircraft request/approval process
Lead PIs for the aircraft needed in each of the countries that operate these aircraft

Candidate Aircraft:
High-altitude: HALO (German G550), Falcon (German and/or French?), HIAPER (NSF/NCAR GV)
Mid-troposphere/larger payload: FAAM Bae146 , NSF/NCAR C-130
Low-altitude: US (U Wyo King Air), EU (France: ATR 42, CH: MEtair, Germany: DLR Dornier etc.)
Instrumentation:
Chemistry, remote-sensing, in situ sensors (high frequency for turbulence)

2.4 Satellite and Non-Standard

Joan Cuxart

1) Uses of satellite to get surface information:
LST: MSG (5 km, 15 min), MODIS (1 km, twice daily), ASTER (LST & emissivity, 90m, 16 days), Landsat (30m, 16 days)
Soil Moisture: low resolution products, upper part of the soil
Surface/vegetation properties including snow cover and T: MODIS
(see https://modis.gsfc.nasa.gov/data/dataprod/ for a complete list of products)

2) Satellite-derived profiles:
IASI (microwave: T, RH), ADM-AEOLUS (wind, aerosols), Earth-care (aerosols), MODIS...
Meteosat 3rd generation profiling coming

3) Non-standard measurements:
airplane take-off and landing profiles (TAMDAR), nanosatellites, integrated moisture from GPS, GMS for soil moisture, low-cost meteorological stations and networks (crowdsourcing), UAVs horizontal transsects including LST, UAVs for low ABL atmosphere profiles