universität innsbruck

TEAMx

TEAMx and its relation to applications in Earth system modelling

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Outline

- TEAMx in a nutshell
  - what is it?
  - ‘who’ is it?
  - what do we do?
- Weather and Climate Service providers

TEAMx – what is it?

Multi-scale Transport and
Exchange Processes in the
Atmosphere over
Mountains

Programme and experiment

- ...a bottom-up financed research programme on weather, climate & air pollution in mountain areas
- In the 'tradition' of international mountain meteorology programmes (ALPEX, PYREX, MAP)
- Institutional 'crowd funding' for a Programme Coordination Office (*PCO* - @ UIBK)

TEAMx – what is it?

Multi-scale Transport and
Exchange Processes in the
Atmosphere over
Mountains
Programme and experiment

- Embedded in international programmes
  → Crosscutting project within the GEWEX Hydroclimatology Panel (GHP)
  → endorsement sought within WWRP (pending)
  → WMO High Mountain Summit
- Coordination with other international activities
  → e.g., COST action PROBE

TEAMx – 'who' is it?

- A group of institutions…
- 'crowd funding' for a Programme Coordination Office (PCO)

  → **sponsors**: Karlsruhe Institute of Technology KIT, Météo France, MeteoSwiss, National Center for Atmospheric Science (NCAS), University of Innsbruck, University of Trento, ZAMG, Center for Climate Systems Modeling (C2SM)

  → Progamme Coordinator: Helen Ward (UIBK)

TEAMx – 'who' is it?

- A group of institutions…
- Memorandum of Understanding
  - → signed by interested institutions
  - → support research topic, liaise projects, contribute to discussion, workshops, …..
  - → open for signature (contact Helen)

presently….

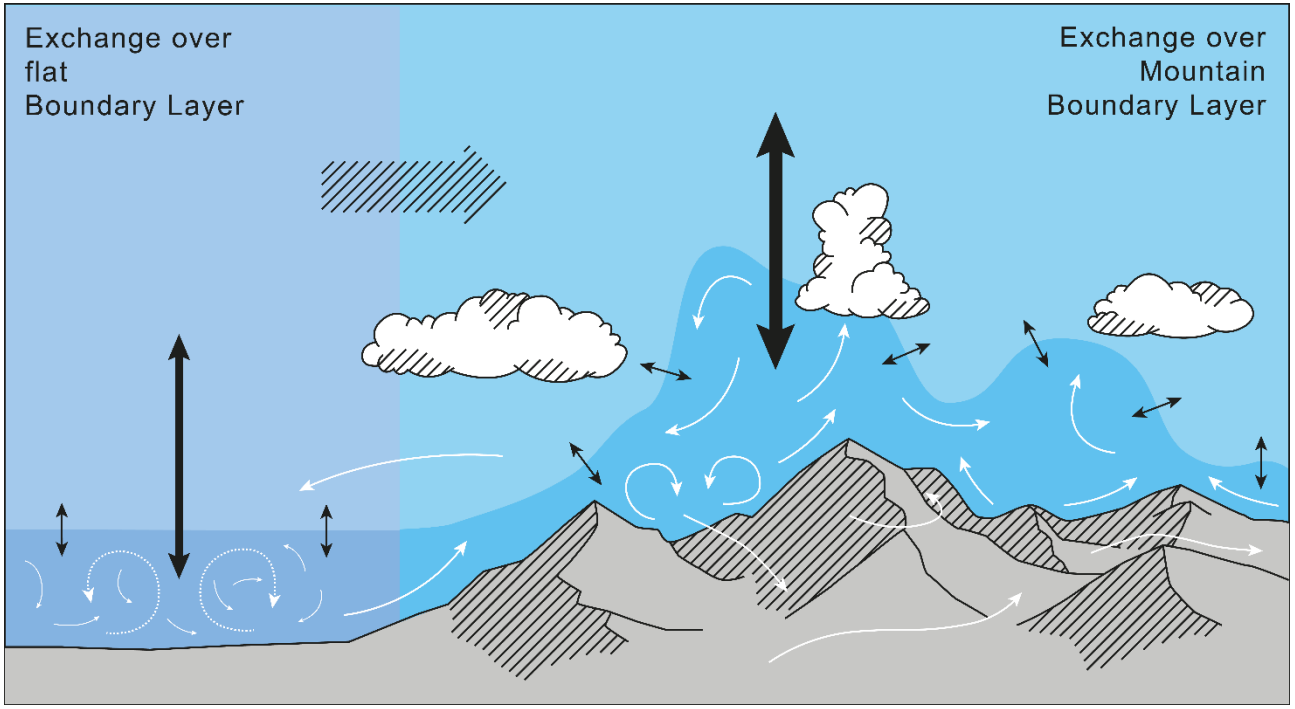
TEAMx – 'who' is it?

- Coordination and Implementation Group (CIG)
- Individuals from (mostly) sponsoring insitutions
  - Marco Arpagaus, MeteoSwiss
  - Joan Cuxart, Universitat de les Illes Balears
  - Stefan De Wekker, University of Virginia
  - Vanda Grubišić, NCAR
  - Norbert Kalthoff, Karlsruhe Institute of Technology (KIT)
  - Daniel Kirshbaum, Mc Gill University
  - Manuela Lehner, University of Innsbruck
  - Stephen Mobbs, University of Leeds (NCAS)
  - Alexandre Paci, Meteo France (CNRS)
  - Elisa Palazzi, ISAC CNR
  - Mathias Rotach, University of Innsbruck (chair)
  - Stefano Serafin, University of Innsbruck (former PC)
  - Dino Zardi, University of Trento
- ‚runs the programme'

TEAMx – 'who' is it?

TEAMx – what do we do?

- foster research on **Multi-scale Transport and Exchange Processes in the Atmosphere over Mountains**



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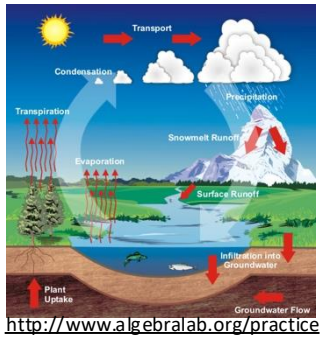
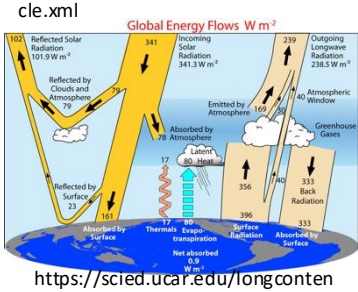


http://www.algebralab.org/practice/practice.aspxfile=Reading_WaterCycle.xml

→ orography impacts the atmospheric flow
→ the global water cycle
carbon cycle
energy budget
momentum budget
→ meso-scale flow modification
→ local exchange processes
→ orography creates conditions for air pollution



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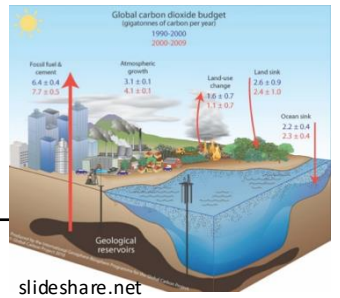

slideshare.net

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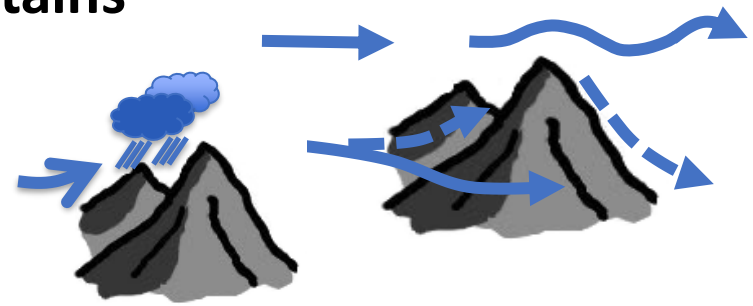
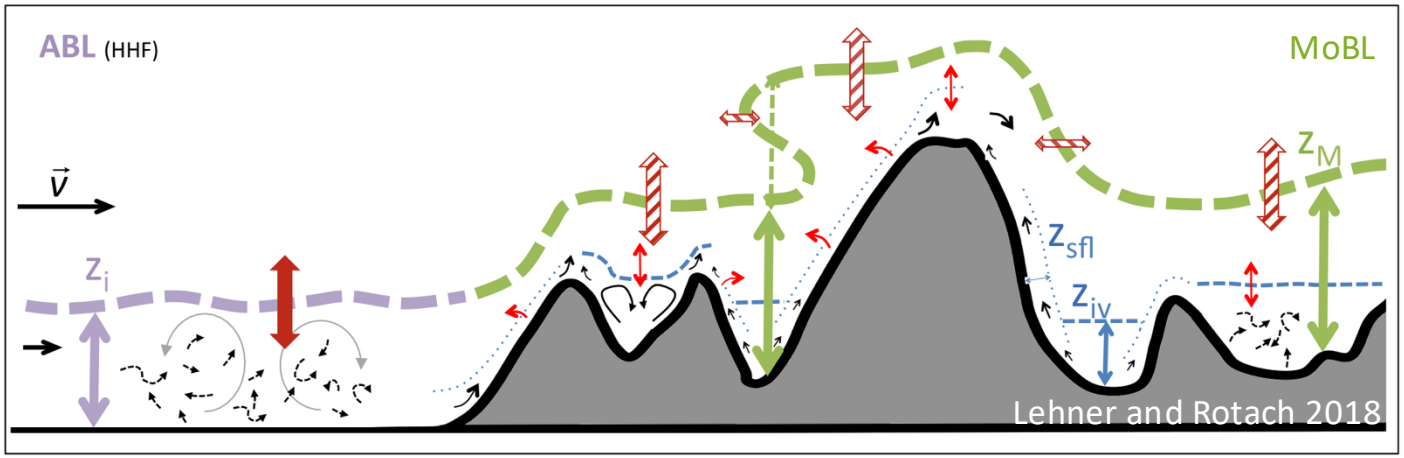


- Many of the atmospheric processes over mountains
  → gaps in knowledge
  → especially with respect to exchange processes

unstable stratification (daytime)



Exchange processes over mountains

- Many of the atmospheric processes over mountains
  → gaps in knowledge
  → especially with respect to exchange processes
- Boundary Layer → **M**ountain **B**oundary **L**ayer (MoBL)
  → layer influenced by surface (trad) & mesoscale processes
- Numerical models
  → parameterize exchange using an assumption of *horizontally homogeneous and flat*


http://www.panoramio.com/photo/1724212


Photo: mwr, i-Box site Kolsassr

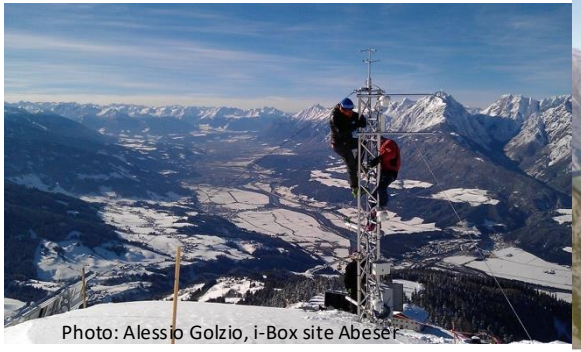
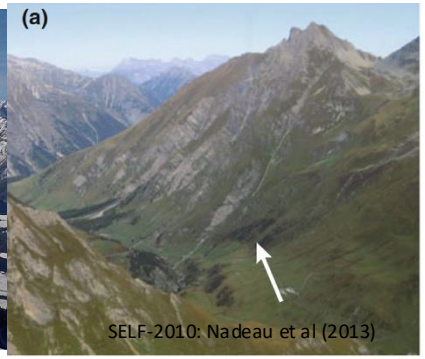


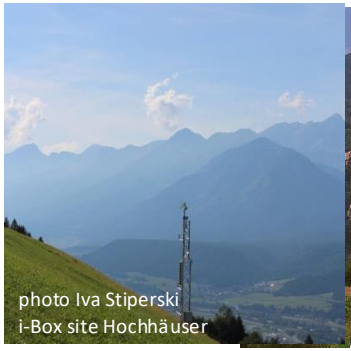
Photo: Alessio Golzio, i-Box site Abesetr

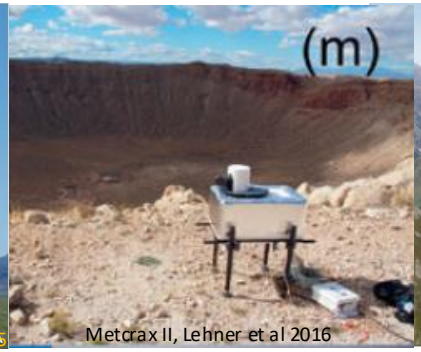


SELF-2010: Nadeau et al (2013)

Exchange processes over mountains

- Boundary Layer → **M**ountain **B**oundary **L**ayer (MBL)
  → layer influenced by surface (trad) & mesoscale processes
- Numerical models
  → parameterize exchange using an assumption of
  horizontally homogeneous and flat
- Data sets are sparse
  → inhomogeneity <-> data density
  → especially turbulence data





TEAMx – what do we do?

- Knowledge gaps
  - → White Paper (Serafin et al. 2020), soon on the website
  - → working groups on specific processes (land-atmosphere exchange, MoBL, convection, mountain climates, …)
- Prepare for a joint observational experiment
  - → 2023-2024, yearlong observational programme
  - → summer and winter IOP
  - → 3 ‘superboxes’ (target areas) – north/south of the Alps
  - → seek obs. support from outside Europe
- Numerical experimentation
  - → idealized & real-terrain modelling
  - → reference cases
  - → short and long time scales

Overarching objectives

Objective	Primary Focus	Target
Process understanding	Micro- and meso-scale processes within and above the *mountain boundary layer* (MoBL); Interaction between scales.	Quantitative understanding of momentum, energy and mass exchange over mountainous terrain
TEAMx Joint Experiment(s)	Collaborative use of multi-platform instrumentation to sample the spatial heterogeneity of turbulence and mesoscale circulations over and near mountains	Quality-controlled observational data pool, available for process investigation, high-resolution model verification, parameterization development
Improving Weather and Climate Models	*Models right for the right reason*, i.e., identification and reduction of model biases and uncertainties over complex terrain	Weather forecasts and climate simulations over mountains as good as over flat terrain, and less reliant on model output post-processing
Support to Weather and Climate Service Providers	Air pollution, hydrology, climate change scenarios (e.g., elevation-dependent warming).	Smaller uncertainty of impact models, due to reduced errors in weather and climate information.

Serafin et al. 2020, TEAMx-White Paper

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W&C Services over mountains

- Depend on exchange processes
  → not only PTU (but also turbulence, meso-scale flow, interaction)
- air pollution / hydrology / renewable energy / climate diagnostics / health / weather diagnostics / agricultural & ecological modelling / … *over mountains*
- today's topic…

Goals for today

- Learn from Earth Systems Service providers
  → most urgent needs
  → critical variables / data sets / physical processes
- Foster potential collaboration
  → among/ across disciplines
  → specific (data) needs for experiment / numerical modelling
- Discussion: how can the community of Earth System Service providers [in mountain areas] be involved in TEAMx?


photo: PLANAT, 2005 (Switzerland)


AP Photo/Steve Griffin


photo: Galtür AT (wetteronline.ch)


photo: Oliver Maire Swisswinds


source: www.valdisole.net

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TEAMx

Thank you for your attention!

- TEAMx Website: http://www.teamx-programme.org
- PCO: Helen (→ see web site for contact information

Funding

- TEAMx is bottom-up financed
- While applying for funding, project PIs may request TEAMx “endorsement”. Endorsement implies contributing and accessing to common data pool. Data policy in preparation.
- Projects can be individual, bi- or multi-lateral.
- TEAMx CIG/PCO supports coordination and initiation of new collaborative projects.

Exchange of energy, momentum & mass

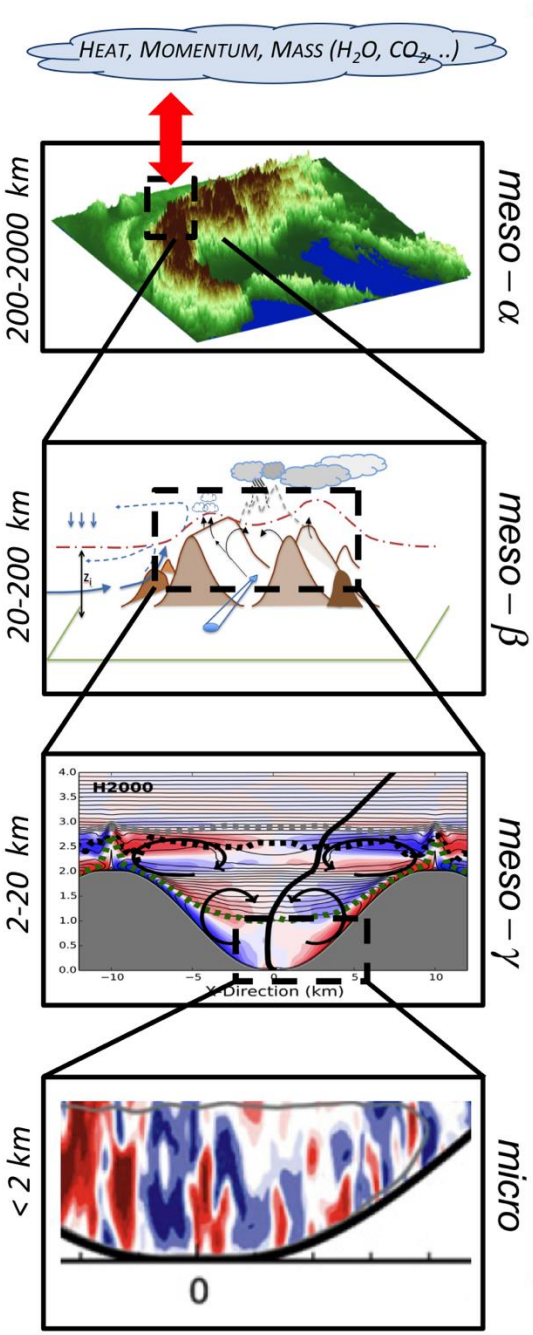
Scale interactions

- cyclogenesis, instability
- PV generation
- blocking

- impact of synoptic flow - stability/ strength/ direction
- interaction between flows in different valleys
- CO_2 uptake
- moisture export

- interaction orog. precip. - valley drainage
- ridge-area turbulence
- impact of background flow on exchange
- chemistry-dynamics

- interaction slope flow - turbulent exchange
- radiation – turbulence
- turbulence-chemistry



Processes @ scale

- Influence of Mountain Terrain on
  - Mountain drag
  - Heat (energy) budget
  - Mass exchange (CO_2; H_2O, …)
- Orographic precipitation
  - drying ratio
  - local evaporation

- *Definition* of mountain boundary layer
- Alpine venting
- convective initiation (CI)

- impact of valley geometry, orientation, surface type(s), … on local exchange
- valley turbulence (TKE)
- convective initiation (CI)

- turbulent exchange on slope
- data post-processing
- scaling
- surface character (e.g., soil moisture)