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Why you should remember what TEAMx means

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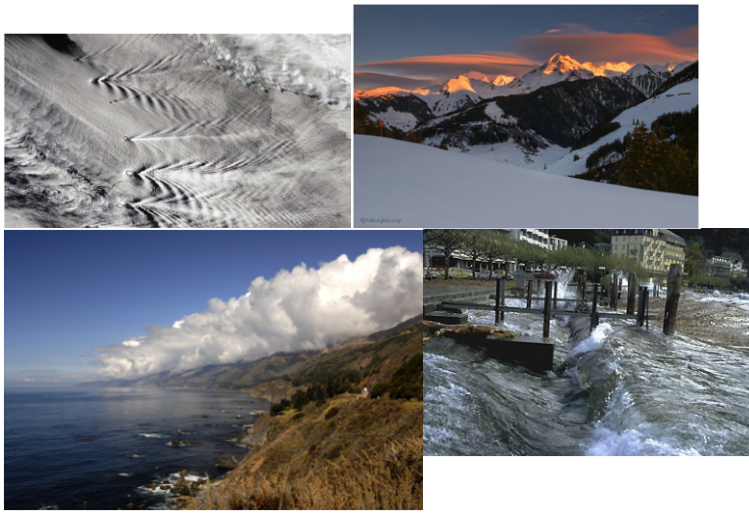
Gegründet im Jahr 1669, ist die Universität Innsbruck heute mit mehr als 28.000 Studierenden und über 4.500 Mitarbeitenden die größte und wichtigste Forschungs- und Bildungseinrichtung in Westösterreich. **Alle weiteren Informationen finden Sie im Internet unter: www.uibk.ac.at.**

Mountain Weather and Climate

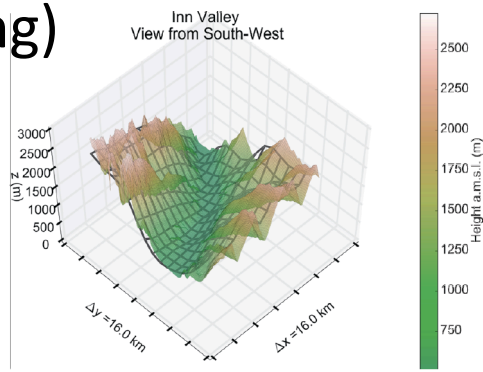
- traditionally: impact of mountains on *weather*
  - → orographic precipitation
  - → gravity waves, ~ breaking
  - → blocking, Föhn, Bora & co
  - → dynamic features



- Alpex, Pyrex, MAP, ….

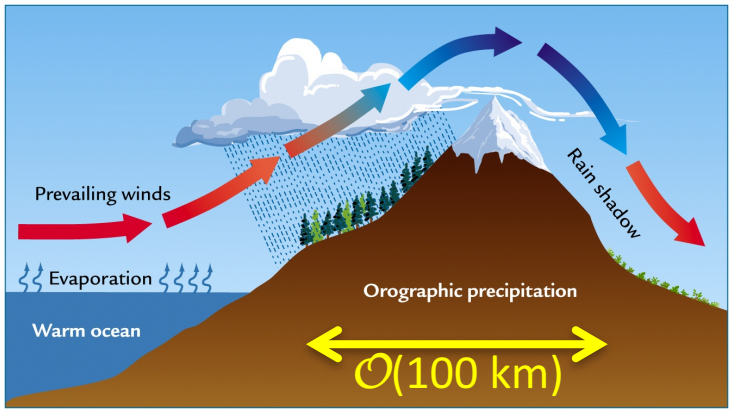
Recent developments (since MAP):

- *climate* change additionally in the focus
  - → requires models able to (also) realistically reproduce mountain climate (impact modeling)
- model resolution ↑ - but not (?) corresponding physics
- new observational possibilities
  - → commercial Doppler wind lidars, satellites

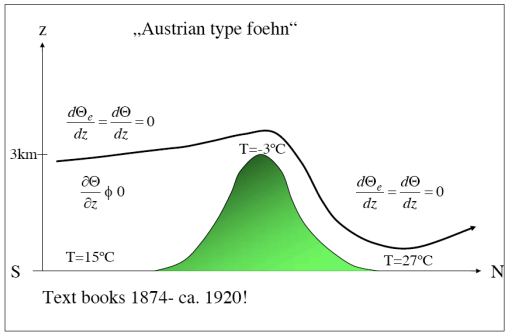


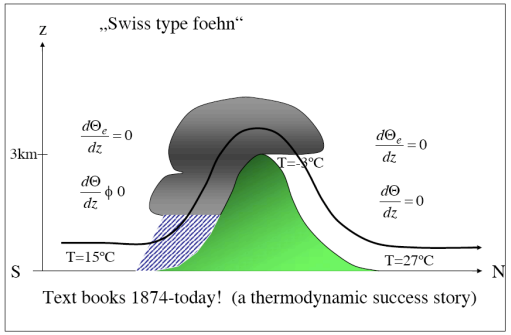
Mountain Weather → Climate

- **weather (traditional):** mountain → atmosphere perspective
  → how does 'the mountain' modify the precipitation regime
  → how does 'the mountain' trigger downslope wind storms
  → surface characteristics of $\mathcal{O}$(100 km)



http://kbkb-wx.blogspot.co.at/2014/04/orographic-precipitation.html





Steinacker et al. (2005)

Mountain Weather → Climate

- **climate** (and climate change)
  → treats the same atmosphere...
  → requires impact modeling
  → need: (e.g.*) the right temperature* at moutain surface (not only the mtn. sfc. temperature that yields the 'right precipitation')
- mountain ⟷ atmosphere perspective
- how does 'the mountain' influence the atmosphere?
- what near-surface atmosphere is produced close to the mountain?
  → impact modeling

Schmelzender Riese: Die Pasterze, mit ca. 17 Quadratkilometer Ausdehnung Österreichs größter Gletscher. – (c)

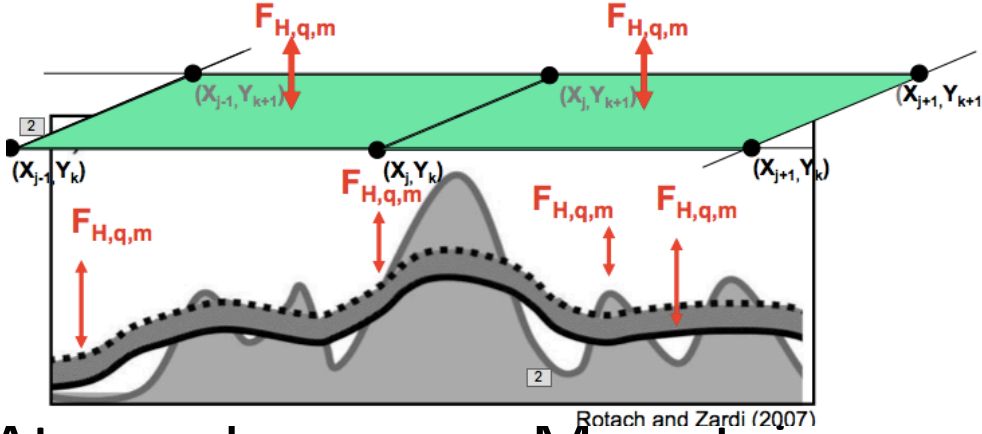
http://www.1815.ch/news/wallis/aktuell/lawin-grossversuch-im-wallis-gegluecckt/

Mountain Weather → Climate

- climate/atmosphere system:
  → 'mountain' is part of the surface
  → character of the surface

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

- character of the surface
  → determines the *exchange* between the atmosphere and the earth
  → *coupling* of the atmosphere with the surface

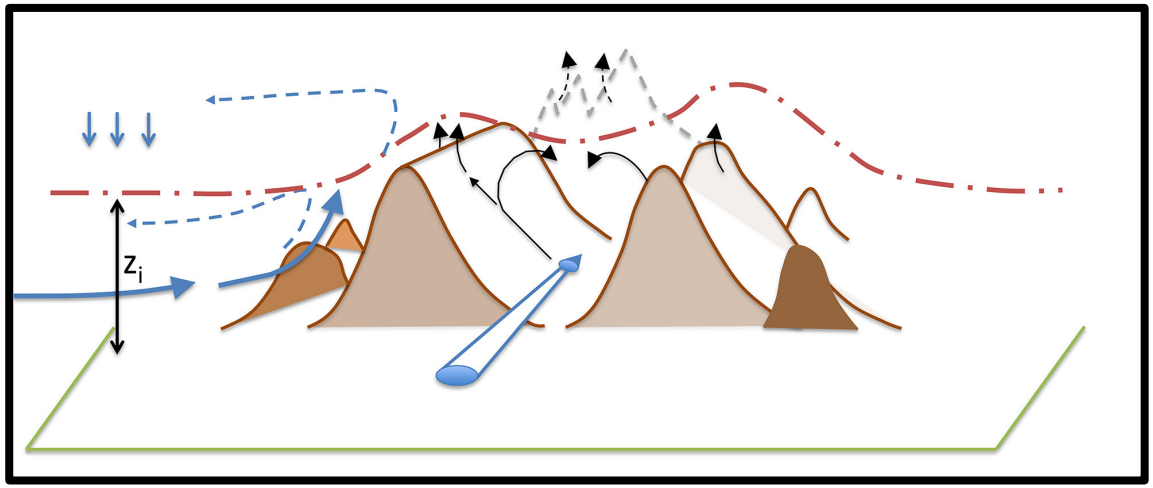


Rotach and Zardi (2007)

Exchange processes in the Atmosphere over Mountains

Mountain ⟷ Atmosphere perspective

- Exchange
  → heat, mass and momentum *at the surface*
- traditionally: this is the role of the boundary layer
  → transport to the ground / away from the ground
- over mountainous surface
  → interaction with meso-scale mountain flows



Rotach et al. 2015

→ 'Mountain Boundary Layer'

A new international initiative

TEAMx

Transport and Exchange processes in the Atmosphere over Mountainous terrain - programme and eXperiment


Innsbruck, 4.9. 2015

- discussion started: after ICAM-2015
- meetings aside conferences
- **C**oordination and **I**mplementation **G**roup established (9/2017)
- White Paper in preparation, special issue 'Atmosphere'
- *Program Office:* @UIBK ('crowd funded')

  → coordination;

  → int. embedding – WWRP, WCRP;

  → joint projects (H2020, …);

Exchange of energy, momentum & mass

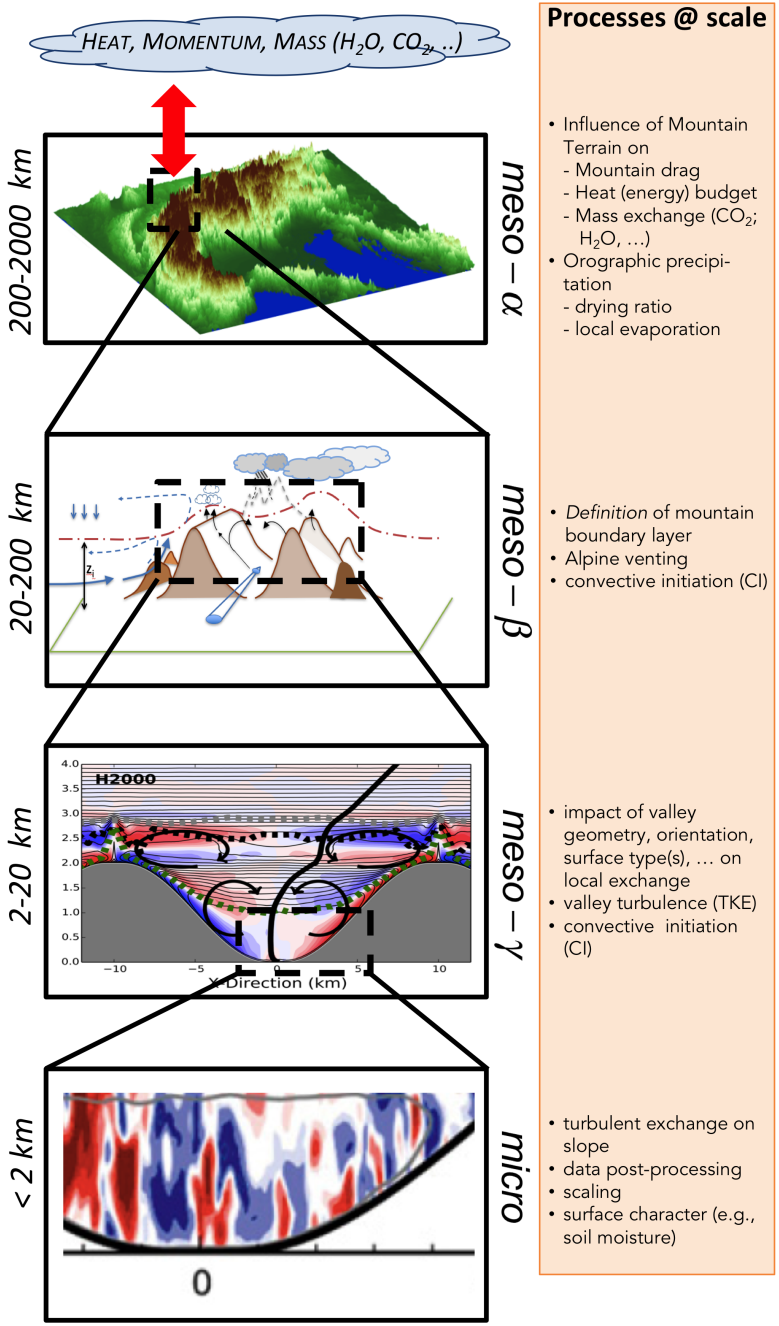
Scale interactions

- 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)

topics:

- BLs in complex terrain
- thermally driven flows
- dynamic transport (waves, breaking, …)
- convection & orography
- impact on orogr. precip.
- stable BLs
- pollutant transport and dispersion

→ ***and their interactions***

Exchange of energy, momentum & mass

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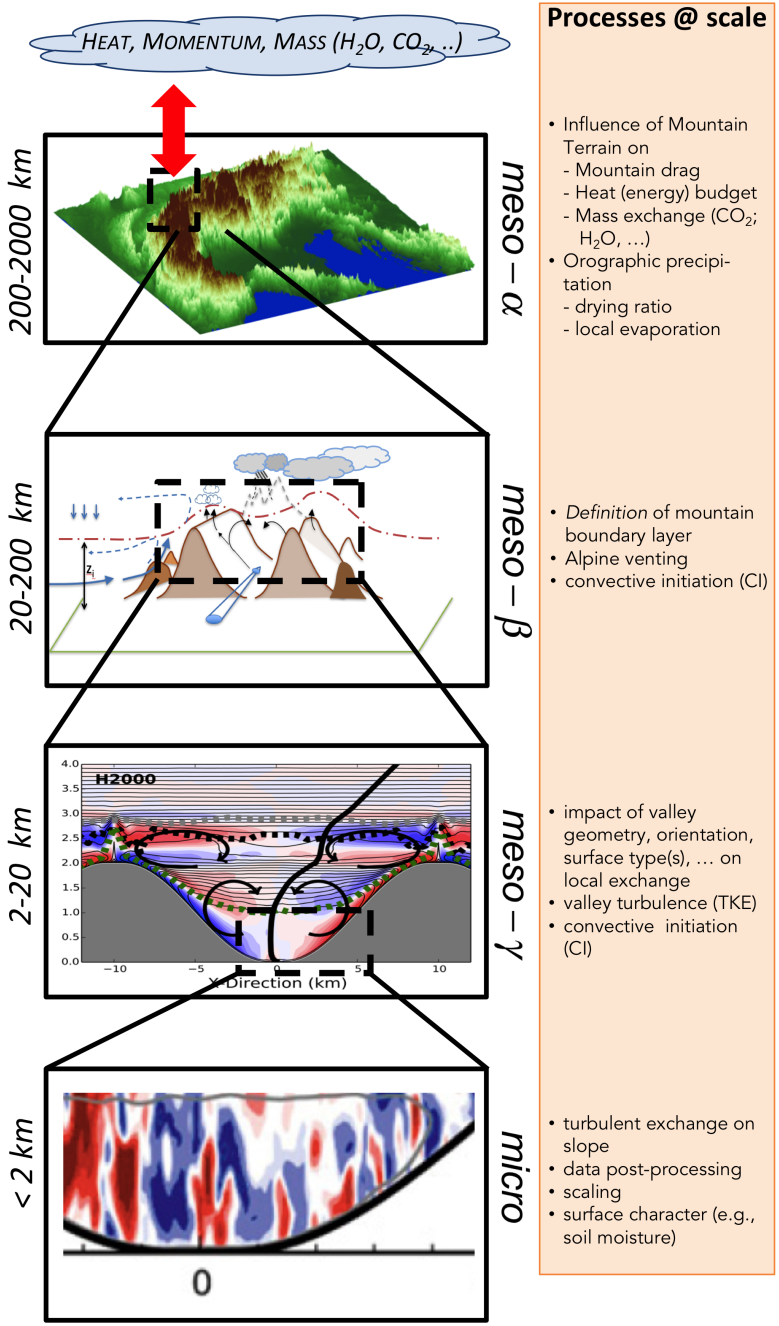

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methods:

- numerical modeling
  - → NWP (km scale, LES)
  - → regional climate
  - → processes and parameterizations
- observations
  - → turbulent exchange
  - → Lidar, scintillometer
  - → obs strategies

goal:

→ coordinated *experiment*

TEAMx

Research questions

→ how does mountainous terrain impact *exchange* to the free atmosphere of energy, mass and momentum? (which processes, interaction, abundance, ...)

→ do we understand the relevant processes quantitatively?

→ are current models (regional climate, NWP) able to adequately reproduce these processes?

→ do we need a sgs-parameterization (*as for gravity wave drag*) for $\mathcal{O}$(10 km) grid spacing models?

→ how does mountainous terrain affect air quality?

TEAMx

partners (so far…)**:**

- University of Innsbruck
- Karlsruhe Institute of Technology (KIT)
- Mc Gill University
- University of Leeds (NCAS)
- University of Trento
- University of Virginia

- MeteoSwiss
- Meteo France (CNRS)
- NCAR
- ZAMG

Additioal partners with innovative ideas and commitment (very) welcome!

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TEAMx

- Memorandum of Understanding
  - → states importance of topic
  - → signatories concur with general 'need for action'
  - → founding members (Partner list A) sign it
  - → as many supporting institutions as possible (Partner list B) sign as well (ICAM 'countries' / institutions, AMS MM Committee, GEWEX, individual institutions, departments, ..)

- Support of TEAMx-seed (program office @UIBK)
  - → bilateral contracts
  - → tasks / deliverables specified
  - → two years ('seed')