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# Atmospheric Dynamics @IMGI

**Mathias W Rotach** & dynamics group

Leopold Franzens-University, Innsbruck

**Meteorologentagung Feldkirch, 7.-8.November 2013**

# Overview

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# Overview

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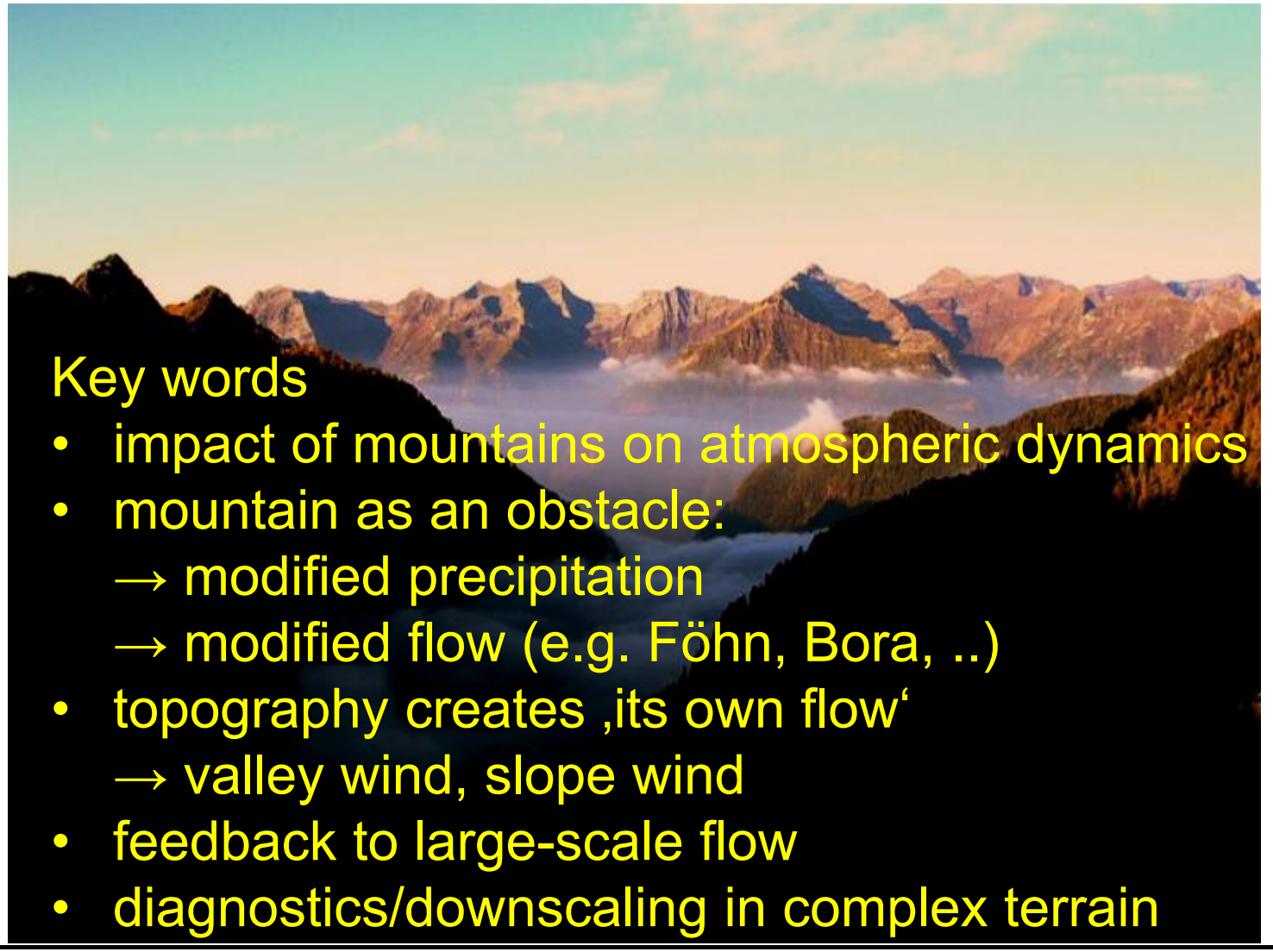

Key words

- impact of mountains on atmospheric dynamics
- mountain as an obstacle:
  → modified precipitation
  → modified flow (e.g. Föhn, Bora, ..)
- topography creates ‚its own flow'
  → valley wind, slope wind
- feedback to large-scale flow
- diagnostics/downscaling in complex terrain

# Dynamic modification: e.g. Föhn

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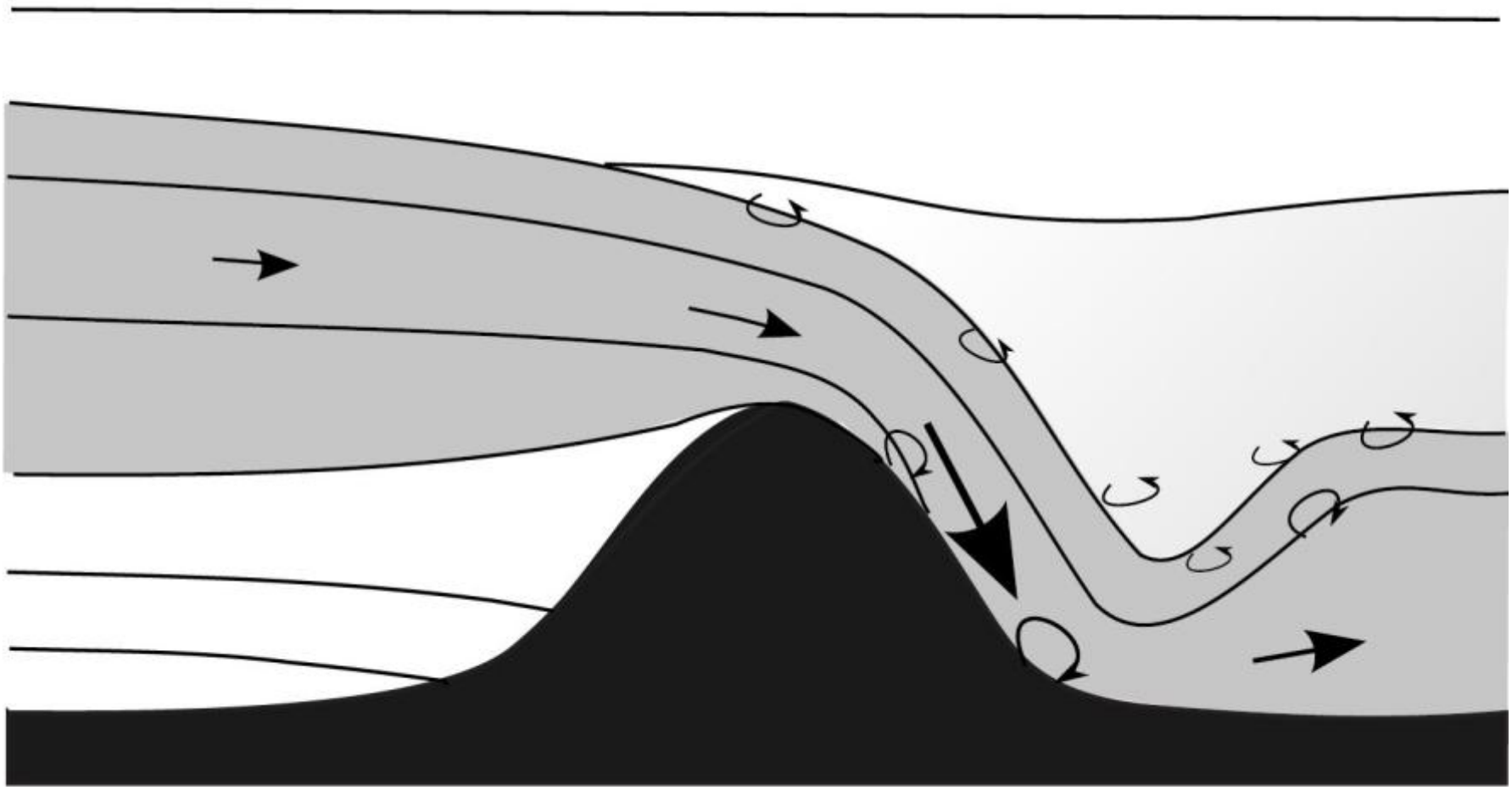

Mayr and Föst, 2009

# Dynamic modification: Projects

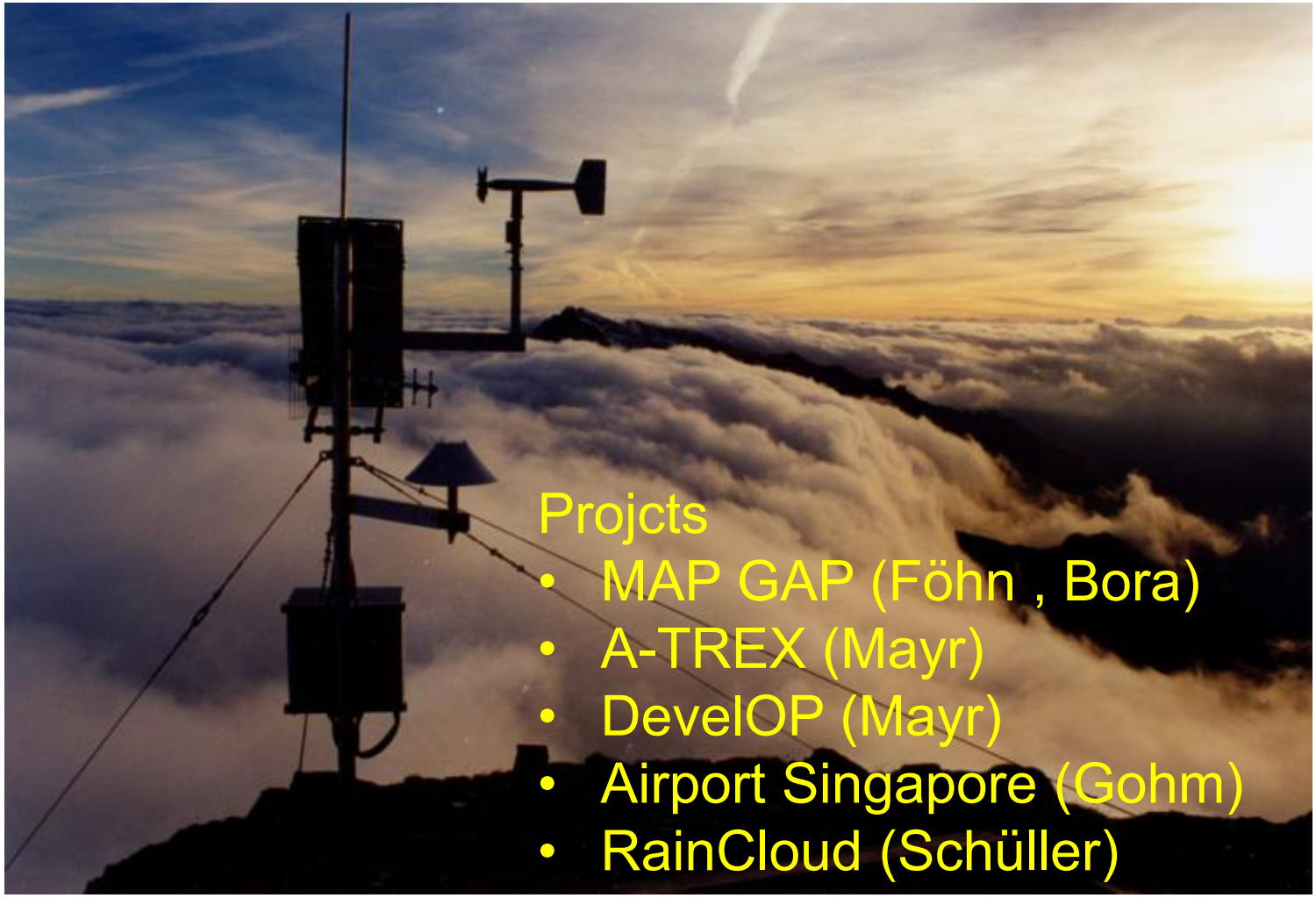


Photo: Johannes Vergeiner

# Thermally driven flows

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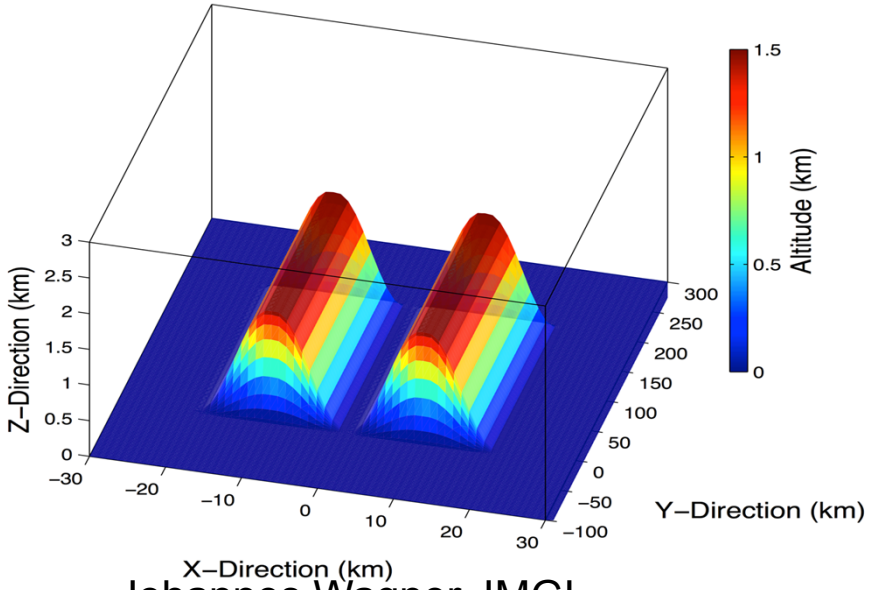
- Idealized topography
  → process understanding
  → mechanisms
- LES simulations (WRF-ARW)
  → down to dx=50m

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# Simulation: idealized valley

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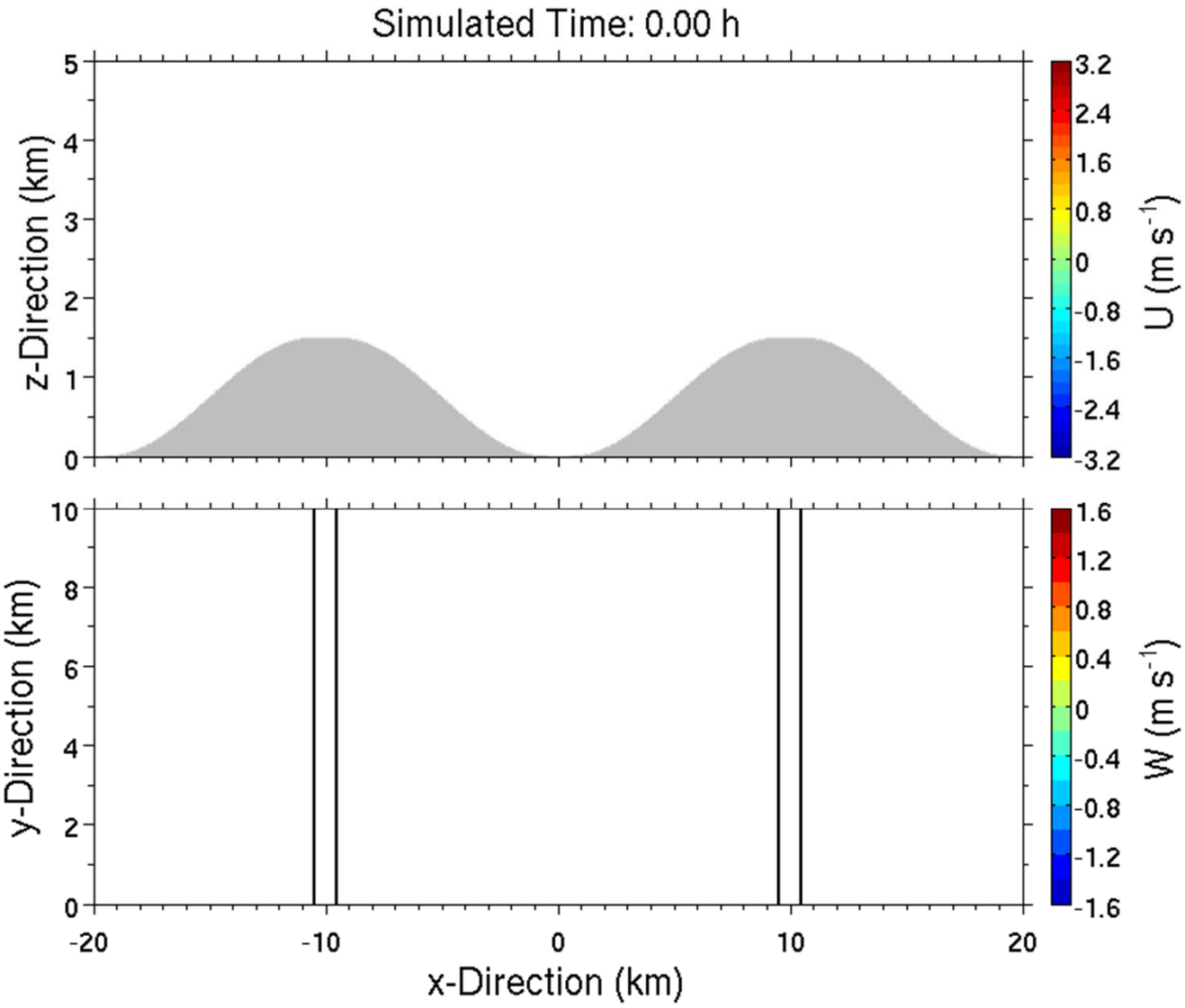


Johannes Wagner

# Thermally driven flows

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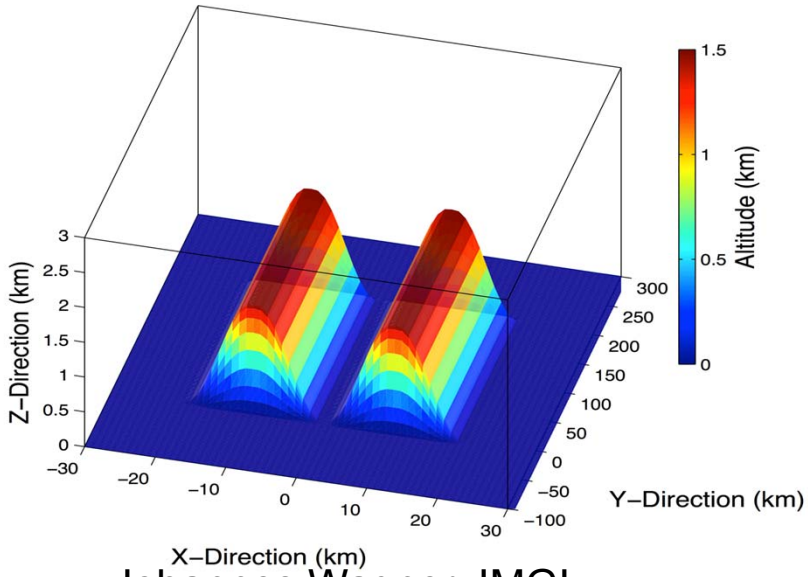
- Idealized topography
  → process understanding
  → mechanisms
- LES simulations (WRF-ARW)
  → down to dx=50m
- projects
  → QUEMOUNT (Gohm)
  → Secondary orography, BL separation and rotors Stiperski)
- → poster Leukauf et al.




Johannes Wagner, IMGI

# Exchange processes

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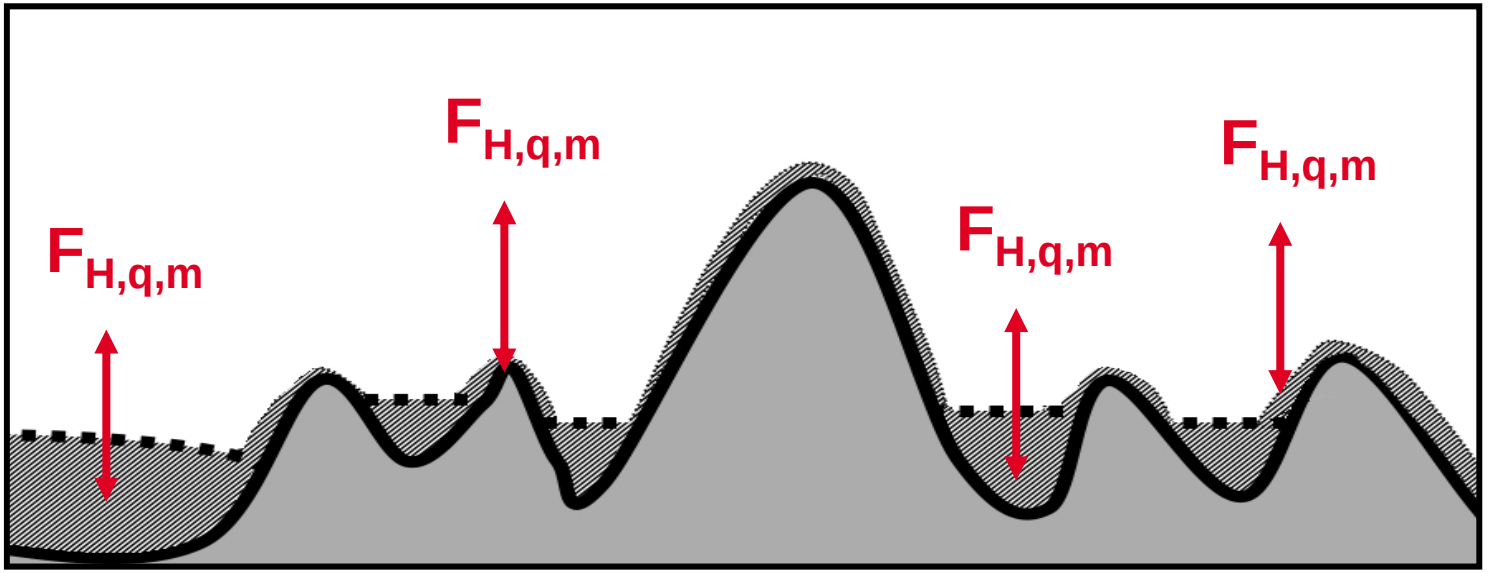
## Feedback to large scale flow




Rotach and Zardi (2007)

→ boundary layer structure in complex terrain

# Exchange processes

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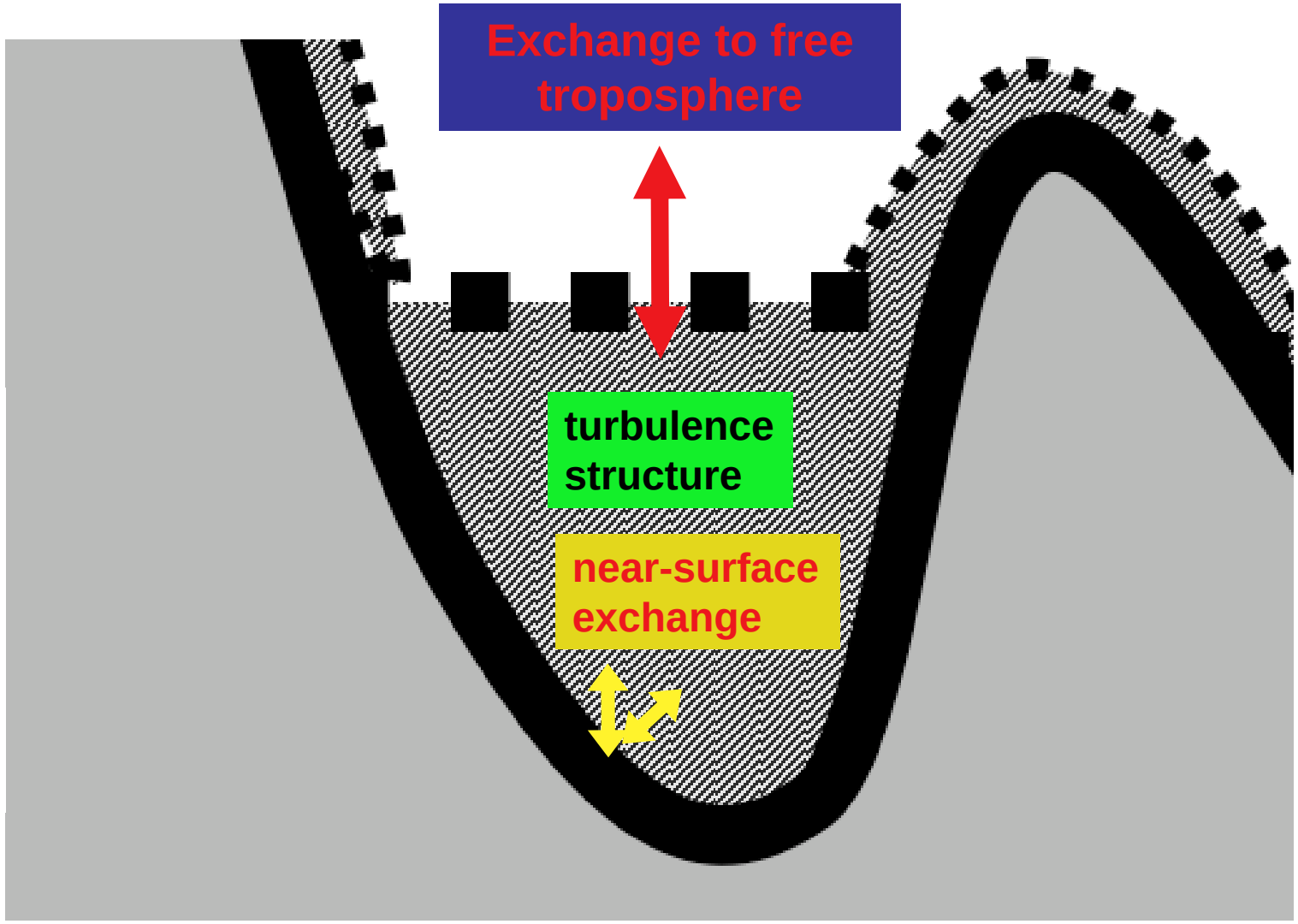

# Exchange processes

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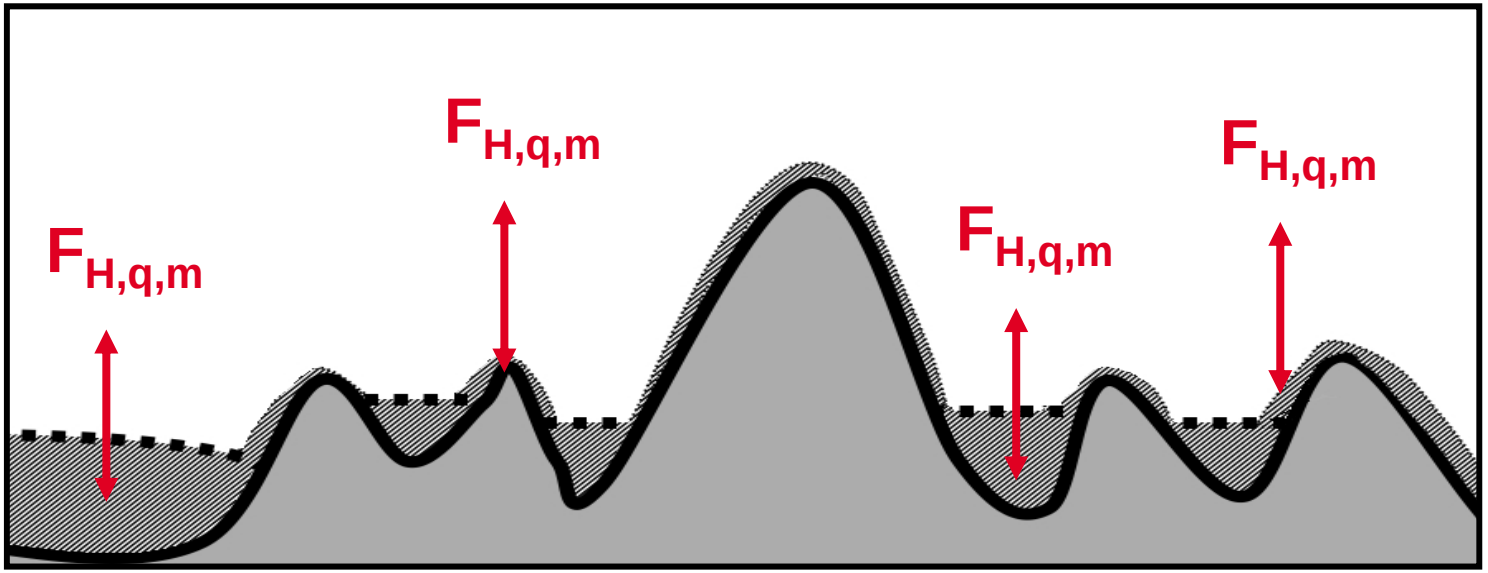
## Feedback to large scale flow




Rotach and Zardi (2007)

→ boundary layer structure in complex terrain

→ near-surface exchange

→ after all: exchange to free troposphre

# Exchange processes

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- Projects
  - → Svalbard glaciers and climate change (Obleitner)
  - → SAINT (Bellaire, Rotach)
  - → CARDEX COMTOP (Reif, → poster)
    ($CO_2$ exchange in idealized valley)
  - → i-Box (Rotach)
    (INHOM-CT, Turb-i-Box)

- overall approach:
  - → combination of measurements and numerical modeling

# i-Box approach

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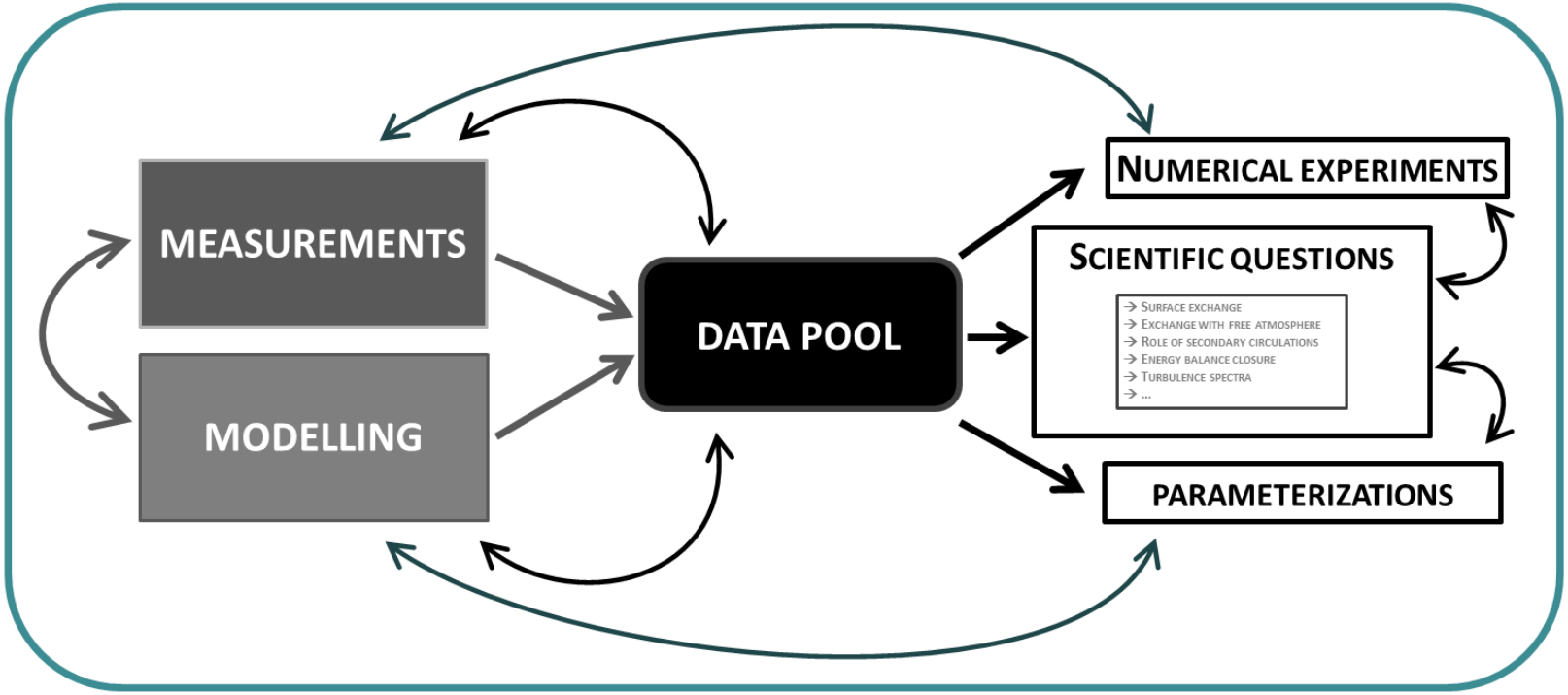
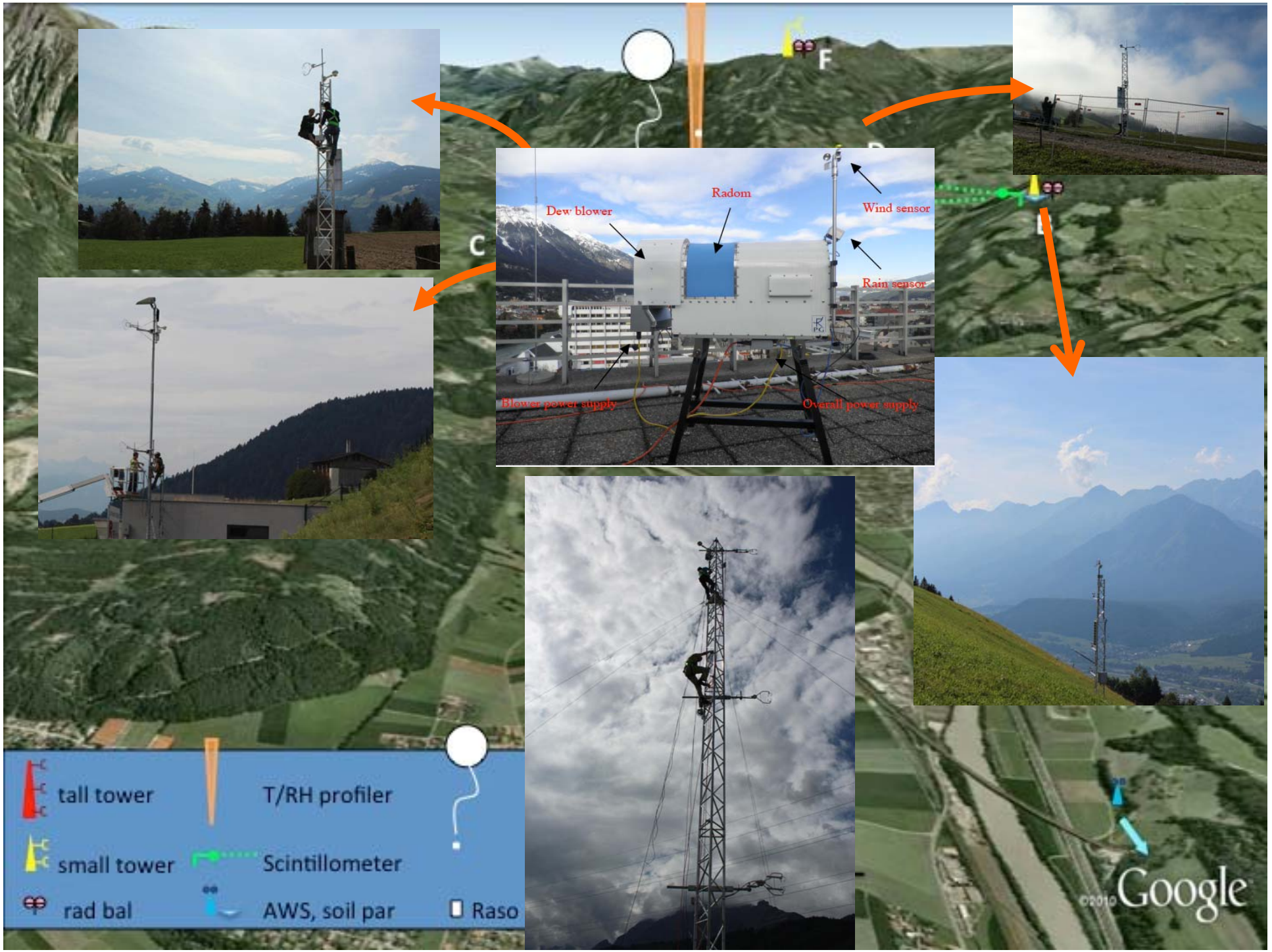
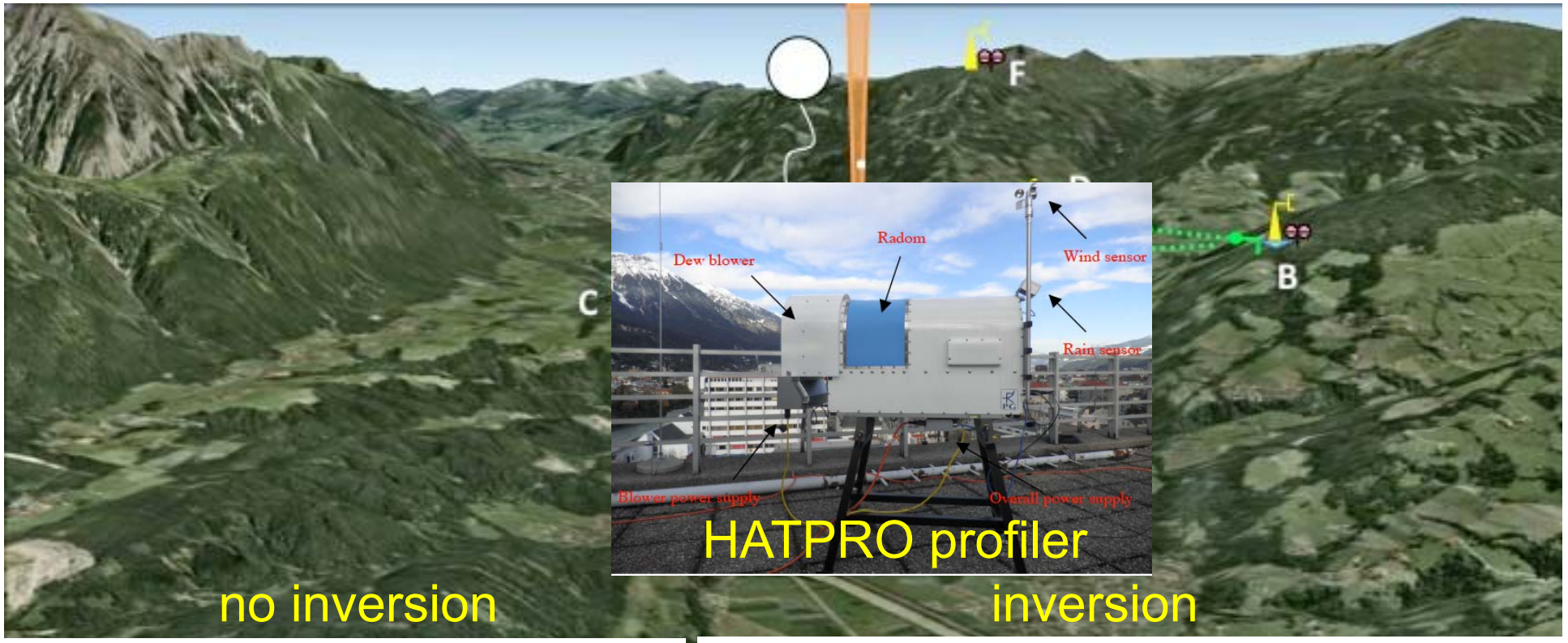
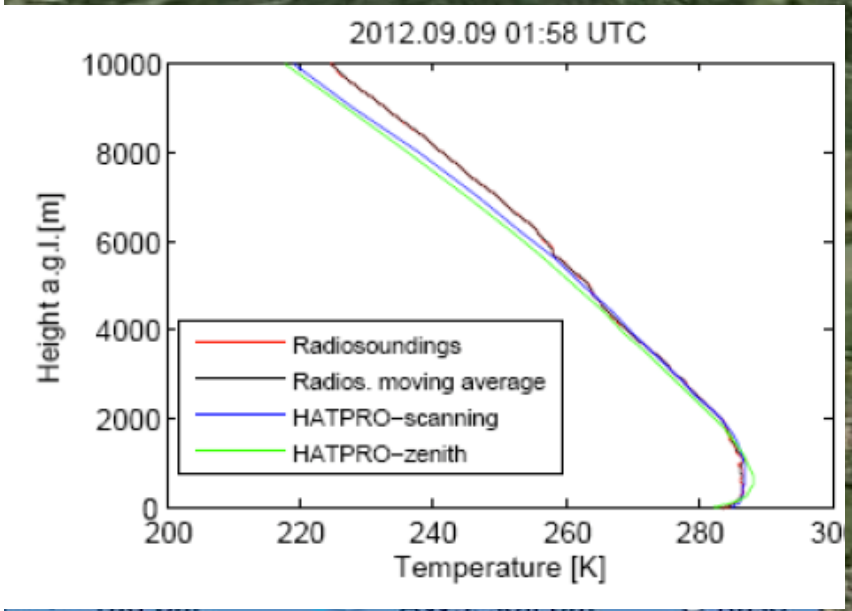


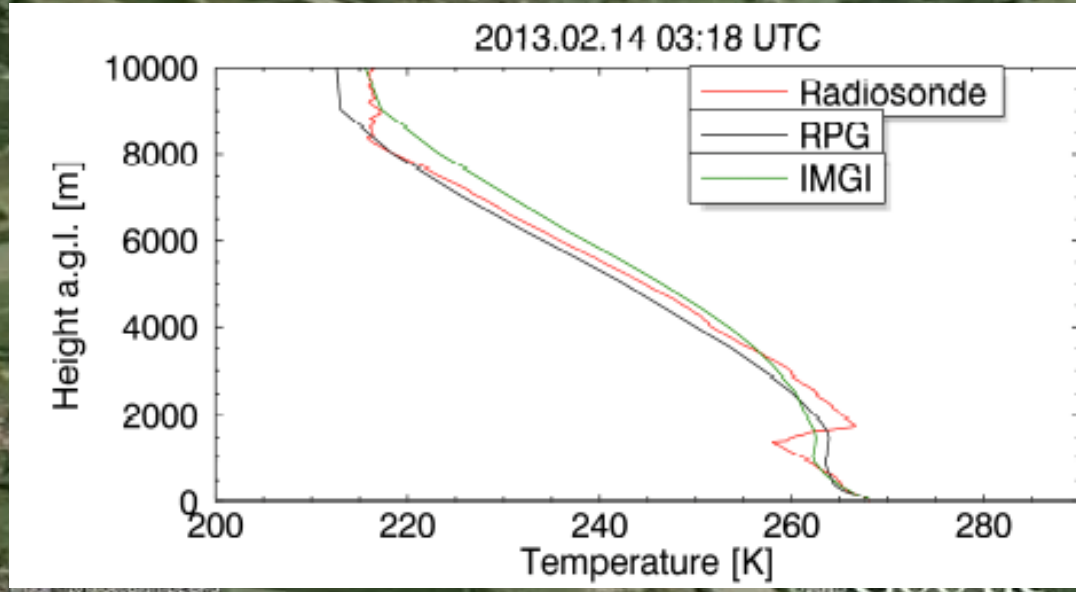

→ **measurement**: processes; (model) validation @particular points)

→ **model**: additional 'variables' (e.g. budget terms)>; sensitivity runs, 3d picture

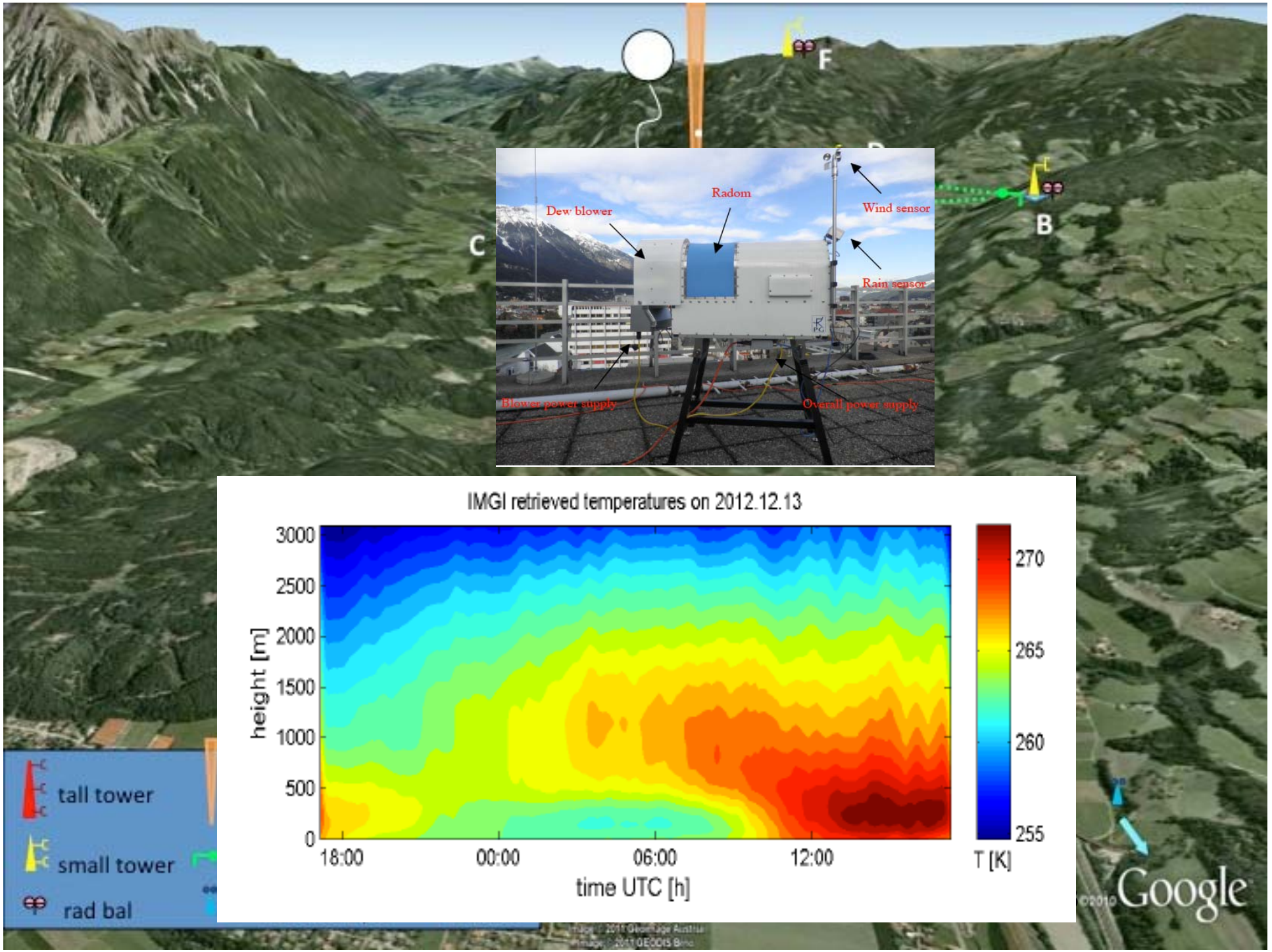

F
C
Radom
Dew blower
Wind sensor
Rain sensor
Blower power supply
Overall power supply
tall tower
T/RH profiler
small tower
Scintillometer
rad bal
AWS, soil par
Raso
©2010 Google

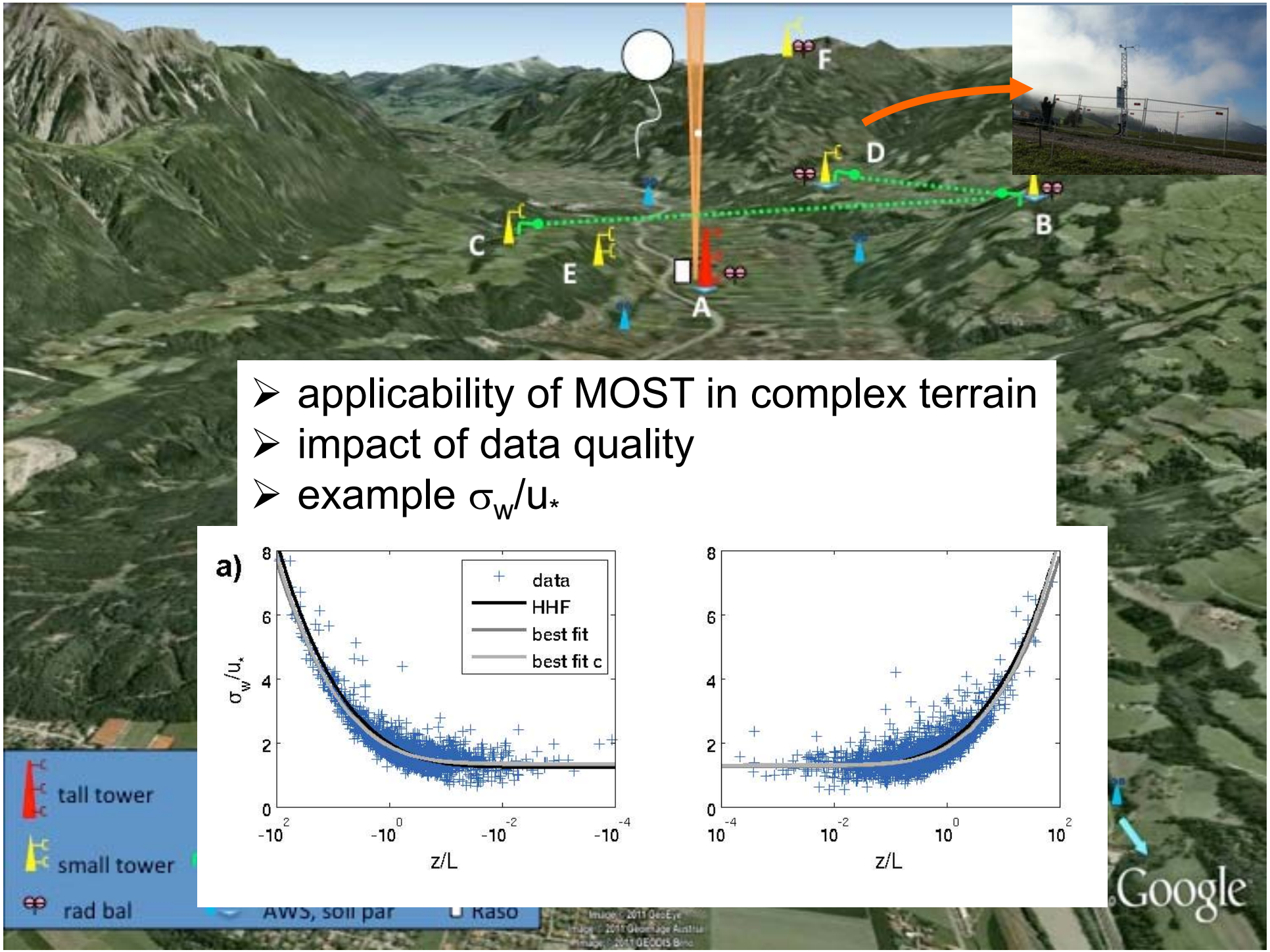


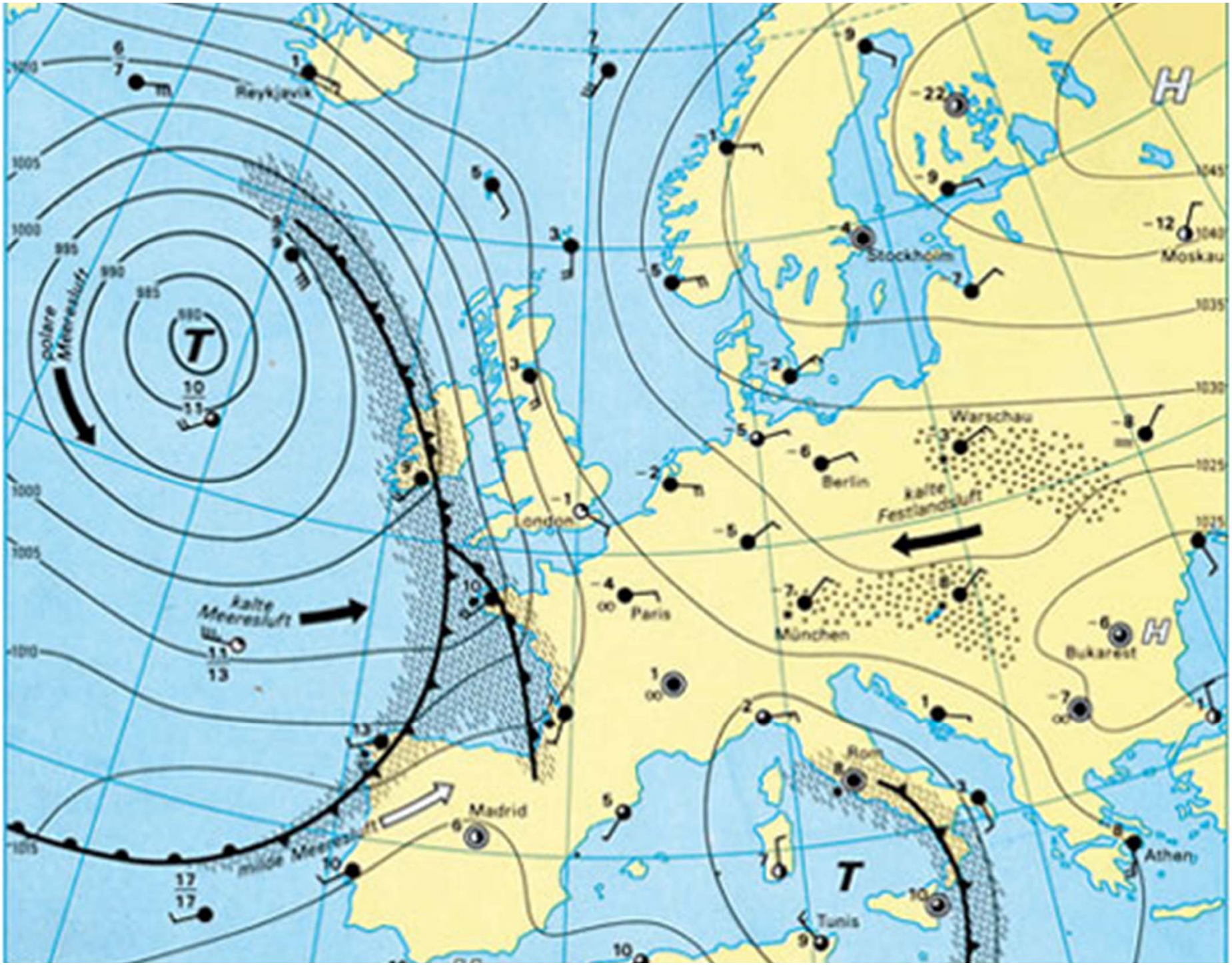




MSc Massaro 2013


F
B
C
Radom
Dew blower
Wind sensor
Rain sensor
Blower power supply
Overall power supply
IMGI retrieved temperatures on 2012.12.13
height [m]
3000
2500
2000
1500
1000
500
0
18:00
00:00
06:00
12:00
time UTC [h]
270
265
260
255
T [K]
tall tower
small tower
rad bal
Google




- applicability of MOST in complex terrain
- impact of data quality
- example $\sigma_w/u_*$


Reykjavik
Stockholm
Moskau
Warschau
Berlin
London
Paris
München
Bukarest
Rom
Athen
Madrid
Tunis
polare Meeresluft
kalte Meeresluft
kalte Festlandsluft
milde Meeresluft
T
H

# Diagnostics for wind power

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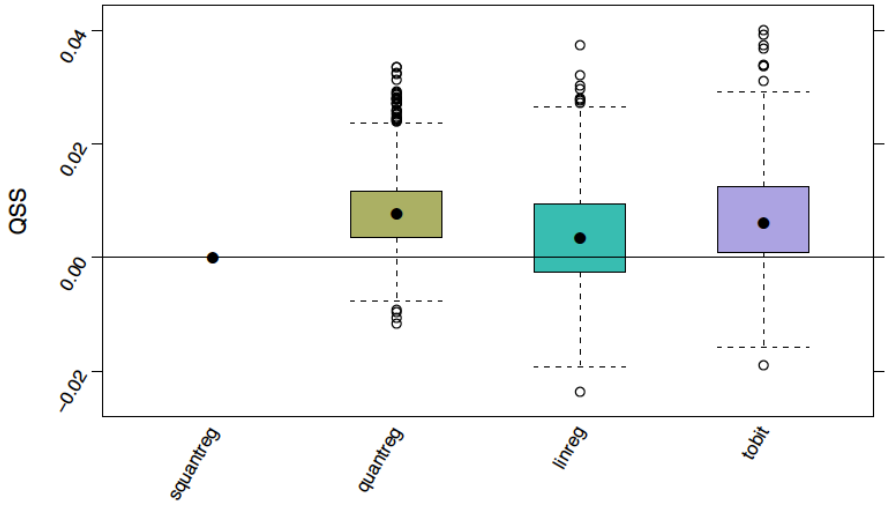
- Goal: accurate prediction of wind power
- methodology:
  → model output statistics
  → statistical relationships between power production and output from NWP models




comparison of different statistical models
→ non-linearity
→ length training data set

# Weather forecasting

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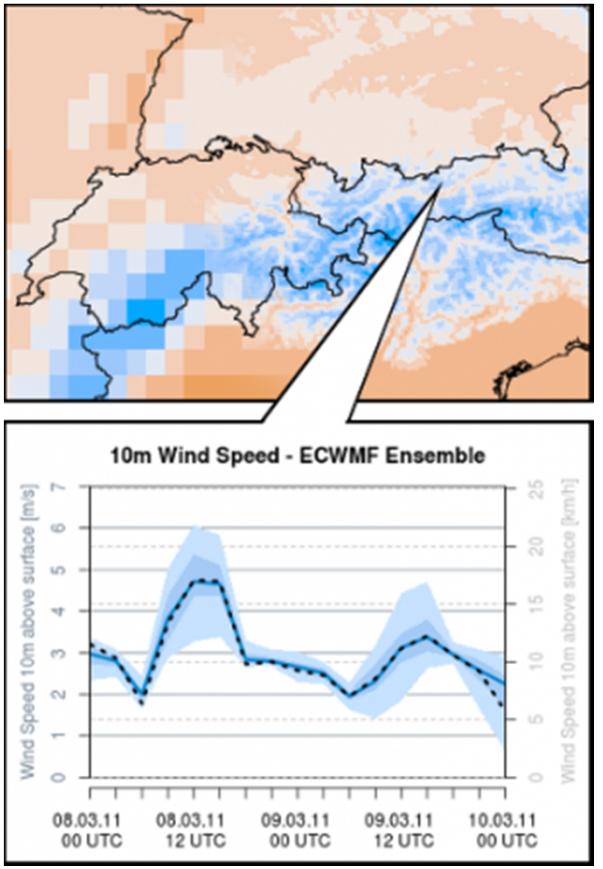
- diagnostics / downscaling
  → MOS
- statistical methods
- applications in energy meteorology (wind energy)
- projects
  → RainCloud (Schüller)
  → WindFX (Mayr)




Thank you for your attention!
Bild Bernd Willinger, 28.7. 2013