Current state of TEAMx

Mathias W. Rotach

….. Marco Arpagaus[2], Joan Cuxart[3], Stephan De Wekker[4], Vanda Grubisic[5], Norbert Kalthoff[6], Dan Kirshbaum[7], Manuela Lehner[1], Stephen Mobbs[8], Alexandre Paci[9], Elisa Palazzi[10], Stefano Serafin[11], Christoph Wittmann [12], Dino Zardi[13]

[1]University of Innsbruck, [2]MeteoSwiss, [3]University of the Balearic Islands[4]University of Virginia, [5]NCAR EOL, [6]Karlsruhe Institute of Technology, [7]McGill University [8]National Centre of Atmospheric Sciences, [9]Meteo France, [10]ISAC CNR, [11]University of Vienna [12]ZAMG, [13]University of Trento

Outline

➢ Second TEAMx Workshop (May 10-12, 2021)
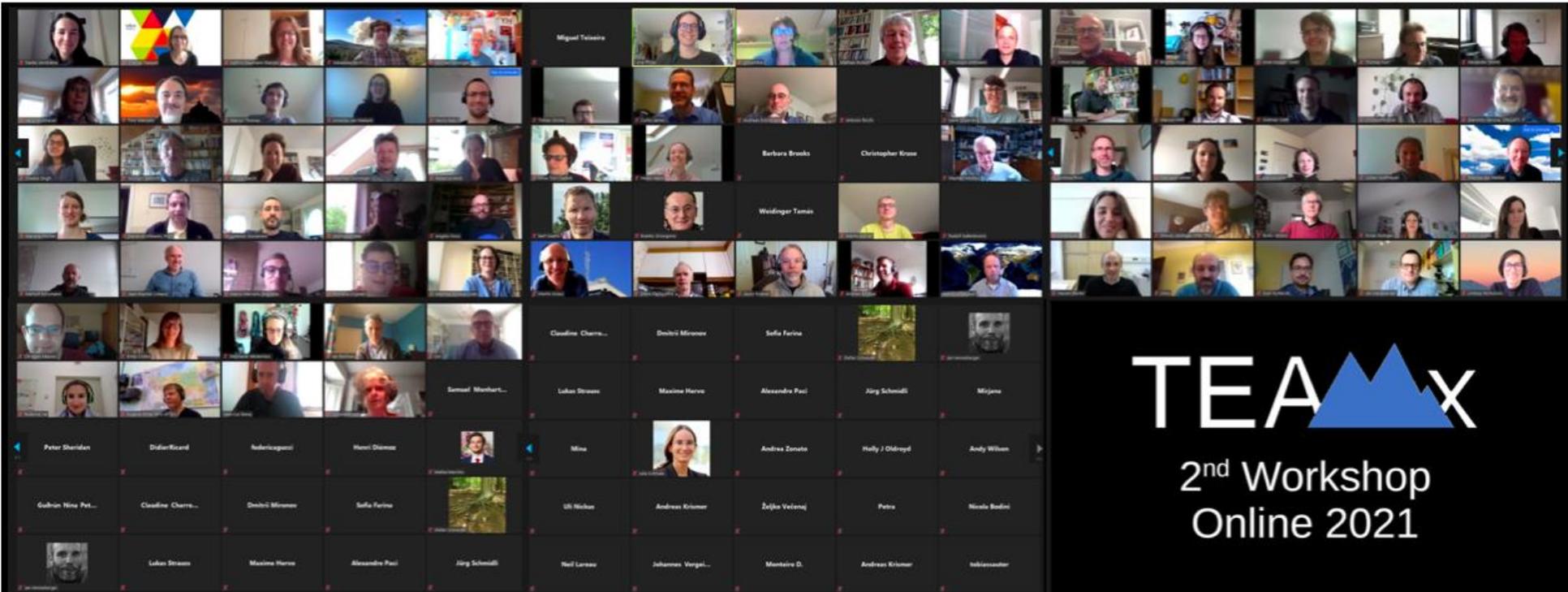
Achievements

....before the workshop

→ TEAMx becomes Crosscutting
   Project within the GEWEX
   Hydroclimatology Panel (GHP)

→ endorsed by WWRP

→ many new signatories of the TEAMx MoU

Achievements

→ CROSSINN campaign (PI Bianca Adler, KIT [CIRES])

→ ASTER: EUREGIO project between UIBK [PI Manuela Lehner], U Trento, U Bolzano

→ kmMountains PRACE (PI Nikolina Ban, UIBK)

→ Unicorn (ERC Consolidator Grant, PI Ivana Stiperski)

→ more running and submitted

Adler et al 2020, BAMS

Activities
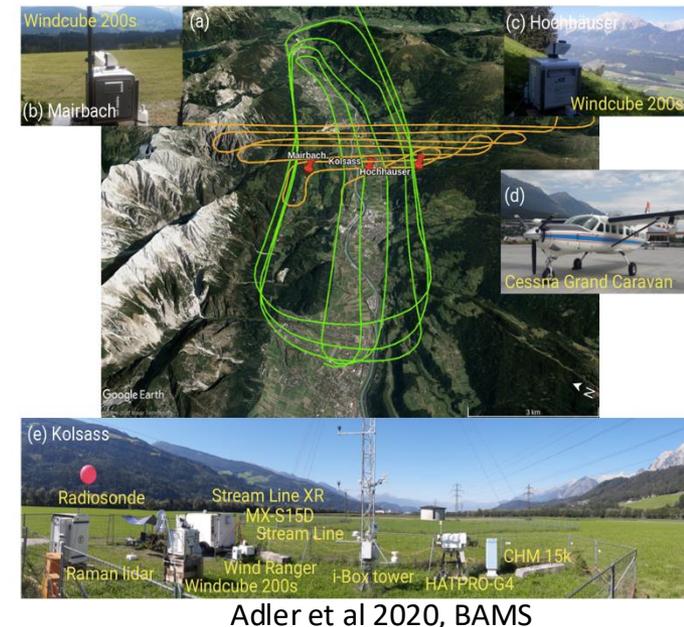
→ publication of the White Paper

→ establishment of working groups

→ establishment of committees:
Field Observations and Numerical
Modeling

Serafin et al 2020,
ISBN 978-3-99106-003-1

Planning for the TEAMx Observational
Campaign and TEAMx numerical modeling
activities

→ more information http://www.teamx-programme.org

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Programme for the Second TEAMx Workshop

Mon 10 - Wed 12 May 2021, 16:00-19:00 CEST [UTC+2]

Time	Mon 10 May	Tue 11 May	Wed 12 May
15:45	*Connection and coffee*	*Connection and coffee*	*Connection and coffee*
16:00	1.1 Welcome and Introduction (Mathias Rotach) 1.2 **Overview of the TEAMx Observational Campaign (TOC)** (Helen Ward)	2.1 Welcome (Mathias Rotach) 2.2 **TOC plan and WG needs:** summary report (Norbert Kalthoff)	3.1 Welcome (Mathias Rotach) 3.2 **Observations:** summary report (Christoph Wittman)
16:15		2.3 **TOC plan and WG needs:** further discussion *Chair: Marco Arpagaus, co-chair: Brigitta Goger*	3.3 **Observations:** further discussion *Chair: Vanda Grubišić, co-chair: Ivana Stiperski*
16:30	1.3 **Target Area (TA) tours** *Chair: Helen Ward, co-chair: Stefano Serafin* ▲ Adige Valley Target Area (Dino Zardi)	2.4 **Keynote presentation** ▲ Towards a more scale-aware orographic gravity wave drag parametrization (Annelize van Niekerk)	3.4 **Keynote presentation** ▲ Atmospheric dispersion of pollutants in complex terrain: understanding and modelling (Silvia Trini

The focus of the workshop is on the <u>draft plan</u> for the <u>TEAMx Observational Campaign (TOC)</u>

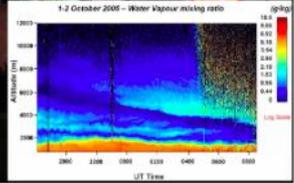|			
17:30	1.5 **TOC plan and WG needs:** presentations and discussion *Chair: Marco Arpagaus, co-chair: Brigitta Goger* *Rapporteur: Norbert Kalthoff* ▲ Mountain Boundary Layer WG (Manuela Lehner)	*Rapporteur: Christoph Wittman* ▲ FAAM aircraft (Stephen Mobbs) ▲ SAFIRE fleet (Jean-Christophe Canonici) ▲ UW King Air (Bart Geerts)	▲ Waves and Dynamics WG (Andy Elvidge) ▲ Orographic Convection WG (Dan Kirshbaum) ▲ Mountain Climate WG (Nikolina Ban) Discussion [30 min]

17:45	▲ Surface-atmosphere Ex. WG (Lorenzo Giovannini)
	▲ Atmospheric Chemistry WG (M Graus/M Hirtl)
	    Discussion [30 min]
		▲ NSF/NCAR aircraft (Vanda Grubišić)
		▲ DLR (Sonja Gisinger)
		▲ KIT/TU Braunschweig (Philipp Gasch)
		    Discussion [30 min]	

18:00			▲ Atmospheric Chemistry WG (M Graus/M Hirtl) ▲ Surface-atmosphere Exchange WG (Helen Ward) ▲ Mountain Boundary Layer WG (Stefano Serafin) Discussion [30 min] → <u>research plans and ideas slides</u>
18:15	▲ Mountain Climate WG (Sven Kotlarski)	2.6 **Observations (major facilities):** pres. and discussion *Chair: Vanda Grubišić, co-chair: Ivana Stiperski* *Rapporteur: Christoph Wittman*	
18:30	▲ Orographic Convection WG (M. Marcello Miglietta) ▲ Waves and Dynamics WG (Annelize van Niekerk) Discussion [30 min]	▲ KITcube (Andreas Wieser) ▲ TEAMx-US/North America (Stephan De Wekker)	
18:45		▲ TEAMx-UK (Barbara Brooks) Discussion [15 min] → <u>'marketplace' of observational resources</u>	3.6 Summary and close (Helen Ward, Mathias Rotach)
19:00	*Close*	*Close*	*Close*

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2ⁿᵈ workshop

- ➢ >150 (online!) participants
- ➢ Online resources

TEAMx marketplace for observational resources

This 'marketplace' has been established to communicate the observational resources from various groups that are available (or potentially available) during the TEAMx Observational Campaign.

The document, …

Marketplace
(observational resources)

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> ➢ >150 (online!) participants
> ➢ Online resources

The document,…

Research plans & ideas

TEAMx research plans and ideas

As part of the Second TEAMx Workshop, these one-slide summaries have been submitted by working group members to communicate the research plans and ideas for TEAMx. The aim is to facilitate collaboration across TEAMx and ensure that the range of TEAMx projects is well balanced across the programme goals. There will be the opportunity to ask questions on these resources during the workshop.

Atmospheric exchanges due to low-level mountain gravity wave processes and associated flows

Andrew Elvidge, Ian Renfrew,…
University of East Anglia
a.elvidge@uea.ac.uk

UEA University of East Anglia

Aims
- Observe and characterise the low-level redistributions of momentum, heat and moisture due to mountain gravity waves and embedded flows e.g. foehn.
- Establish their role in dictating flow characteristics.
- Assess the capacity of high resolution numerical models to reproduce these redistributions and how this varies with model resolution.

Tools:
- Upwind profiles: sonde, aircraft
- Leeside 4-D sampling of bulk fields: ground stations; aircraft profiles / sawtooth legs; remote sensing of winds (doppler radar / LIDAR / wind profilers).
- Leeside turbulence and fluxes: aircraft straight and level flux legs; doppler radar
- NWP and Lagrangian modelling

Funding: TBD

mountain waves, foehn, turbulence, turbulent fluxes
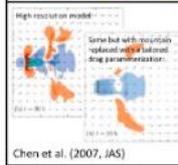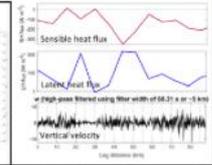
Chen et al. (2007, JAS)

Aircraft observations of heat exchanges in the lee of an Icelandic Peninsula in stably stratified flow (preliminary results); and (bottom left) strong wind perturbations in high resolution models are underrepresented in coarse resolution models even with an "optimally tuned" orographic drag scheme.

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2nd workshop - outcome

➢ closer to Version 1.0 of the experimental plan – backed by the TEAMx community

➢ key outcomes
  → spring '24 – spring '25 confirmed
  → summer / winter EOPs
  → 3 Target Areas

➢ additional needs identified

  additional sites, instruments, data sources, …. required.

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Vertical profiling
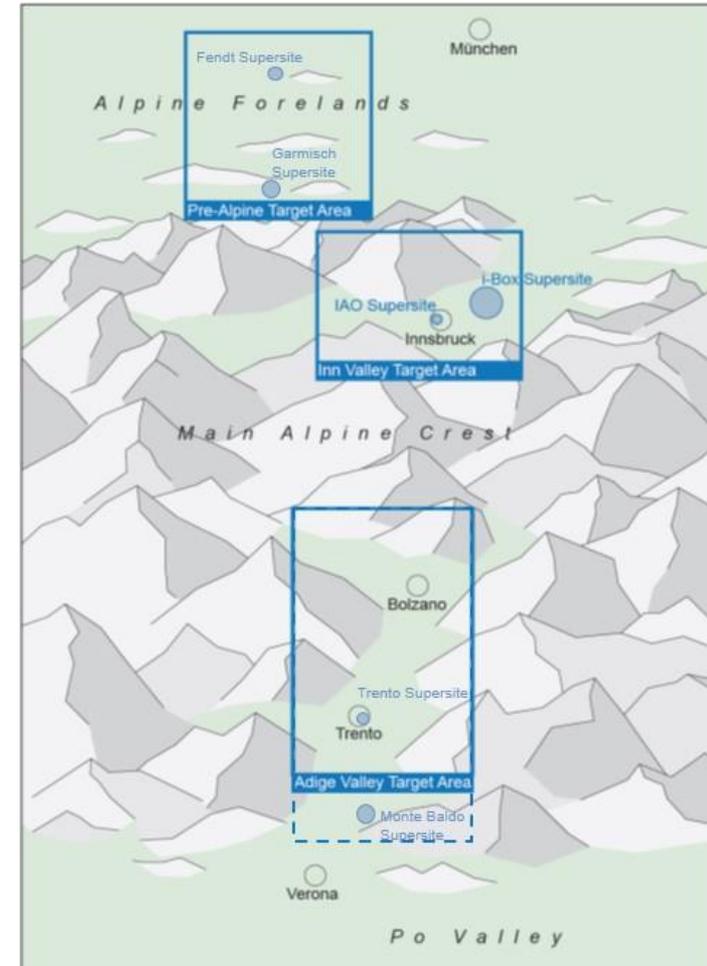
➢ relevant for most aspects of TOC

➢ starts to become 'standard' equipment – but not yet in the
   design of big field campaigns
   → network of wind/T/RH lidars
   → TOC might become a 'role model'

➢ crucial for the determination of the height of the Mountain
   Boundary Layer

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MoBL height

Traditionally, the boundary layer is defined…

'The *Atmospheric Boundary Layer* is that part of the troposphere that is **directly influenced** by the presence of the **earth's surface**, and responds to surface forcing with a **timescale of about an hour or less**'.

<div align="right">Stull (1988)</div>

Suggested definition **Mountain Boundary Layer** (MoBL)

The Mountain Boundary Layer is *the lowest part of the troposphere that is directly influenced by the mountainous terrain, responds to surface and terrain forcings with timescales of about one to a few hours, and is **responsible for the exchange of energy, mass, and momentum** between the mountainous terrain and the free troposphere.*

<div align="right">Lehner and Rotach (2018)</div>

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MoBL height

unstable stratification (daytime)
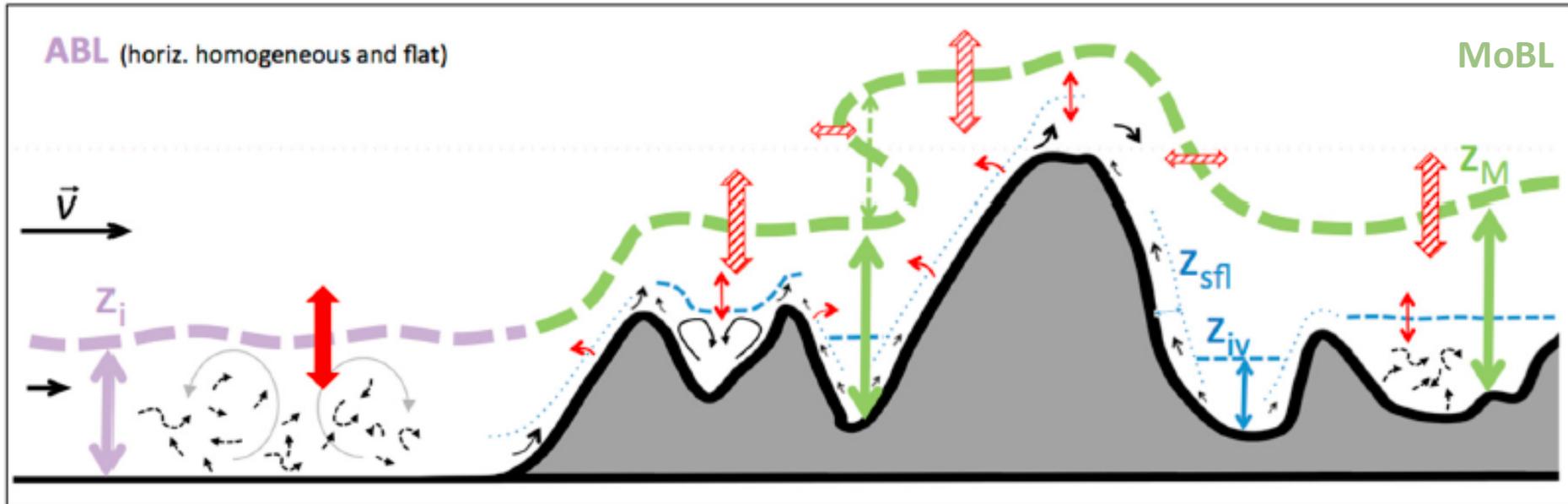
ABL height detection:
1) turbulence $\rightarrow 0$ $at\ zi$
2) consequences of 1)

MoBL height detection:
1) yields only the local (turbulent) part.

   $\rightarrow$ scale interactions neglected
2) consequence of 1)

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MoBL height detection

1) turbulence $\rightarrow 0$ $at\ zi$

$\rightarrow$ Ri, TKE (variance) criteria, ….

$\rightarrow$ yields only the local (turbulent) part

$\rightarrow$ seems to be true even over the slopes / complex structures…..
    (will require further evidence)

vertical velocity variance

lidar spectral width
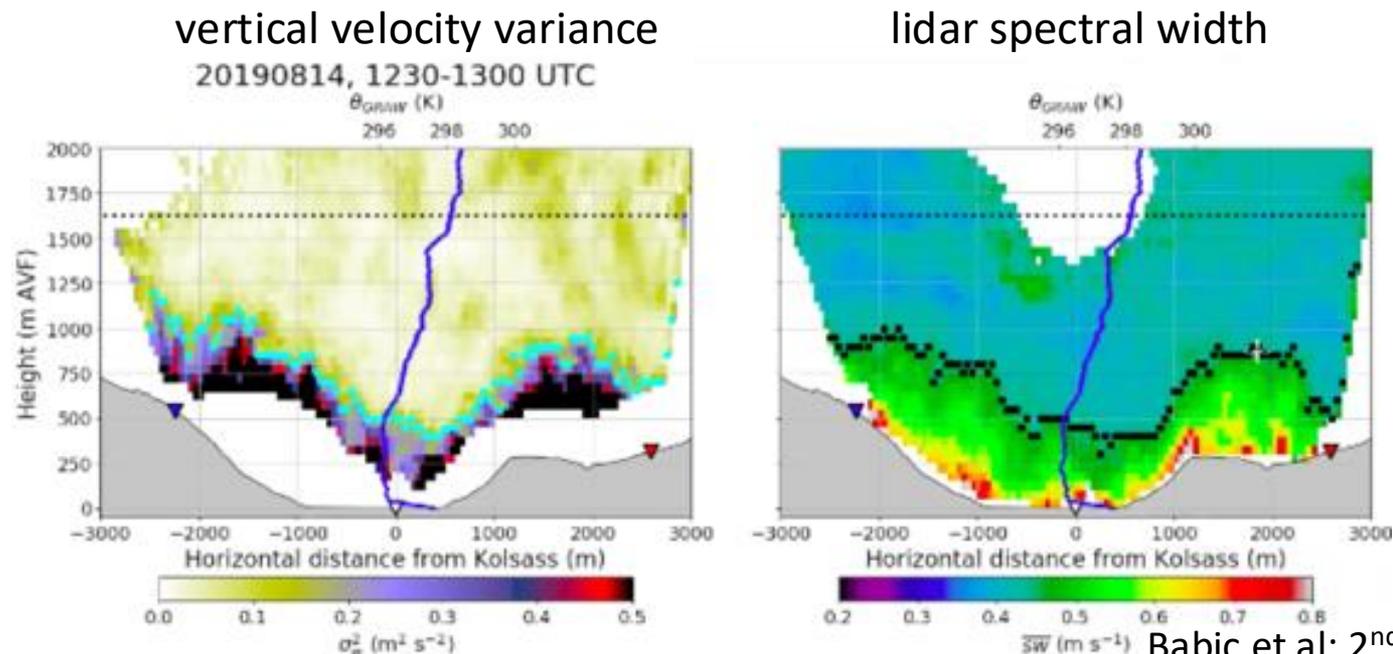
Babic et al: 2nd TEAMx Workshop

MoBL height detection

1) turbulence $\rightarrow 0$ at zi

$\rightarrow$ promising case studies – generalization needed

$\rightarrow$ even a 'CBL energetics model' (Batchvarova and Gryning, 1991) gives relatively good results…

HATPRO

RaSo
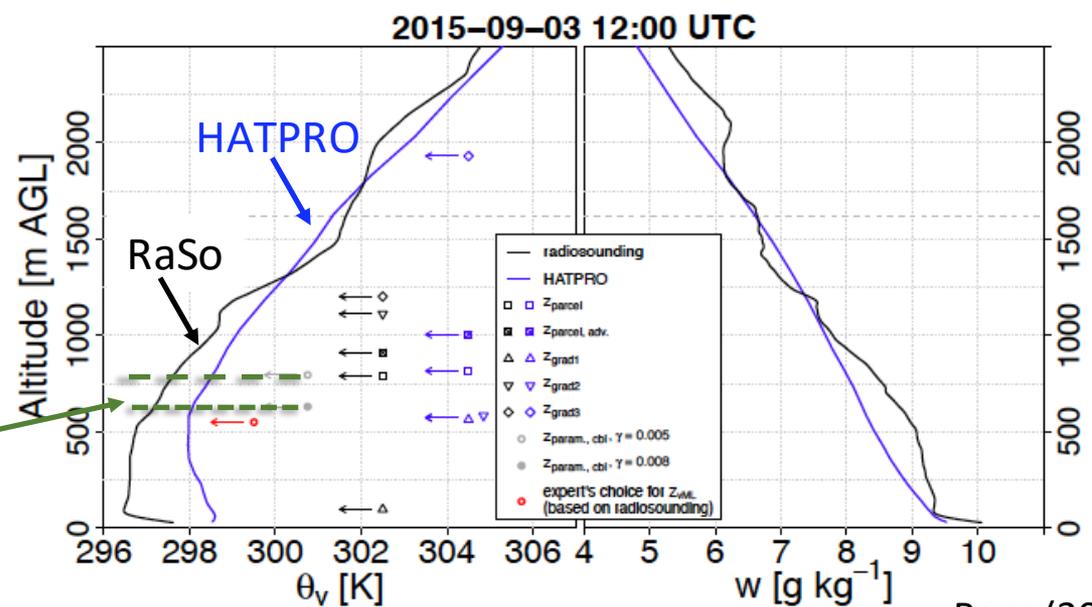
B&G model
[different parameters]

Inn Valley
2015 09/03, 12 UTC

Baer (2018), MSc thesis ACINN

MoBL height detection

1) turbulence $\to 0$ at zi

$\to$ night-time stable conditions?
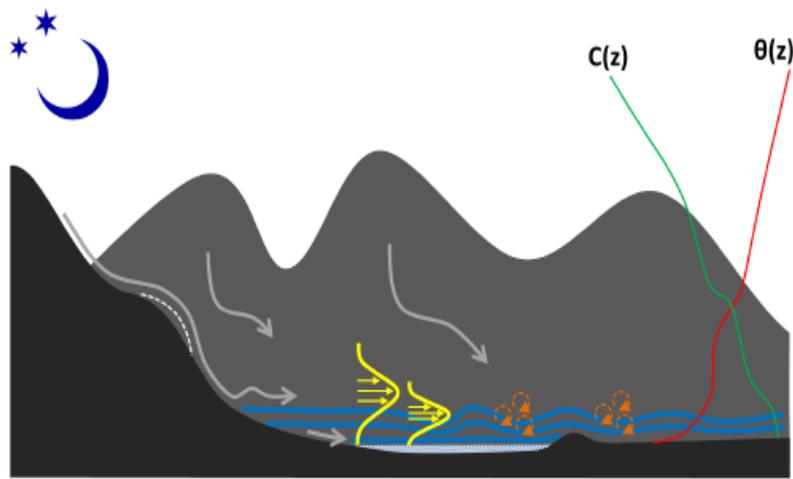
Serafin et al (2018)
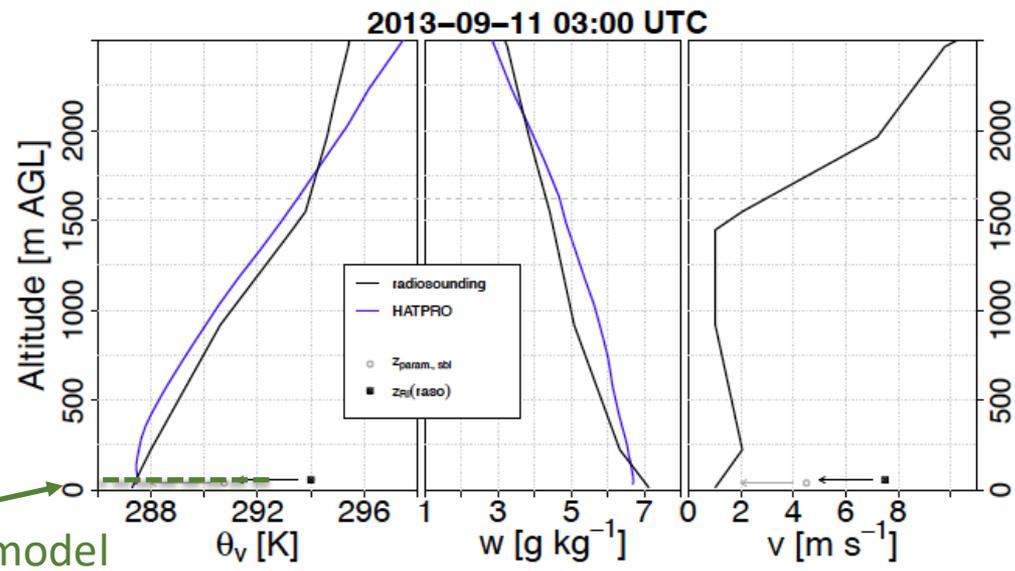
Ri$_c$ & parametric model

Baer (2018), MSc thesis ACINN

MoBL height detection

1) turbulence $\rightarrow 0$ $at\ zi$

Consequences for TEAMx

$\rightarrow$ limitations due to vertical range (if not RaSo)
$\rightarrow$ not MoBL height, but **local ABL** / CBL / (SBL) **height**
$\rightarrow$ further investigate lidar retrievals
$\rightarrow$ especially: stable (nighttime, …) conditions
$\rightarrow$ use other variables?

MoBL height detection

2) consequences of 1: turbulence $\rightarrow 0\ at\ zi$

$\rightarrow$ near-surface turbulent mixing **plus interaction** with meso-scale flows ('....*directly influenced by the mountainous terrain ...*)

MoBL
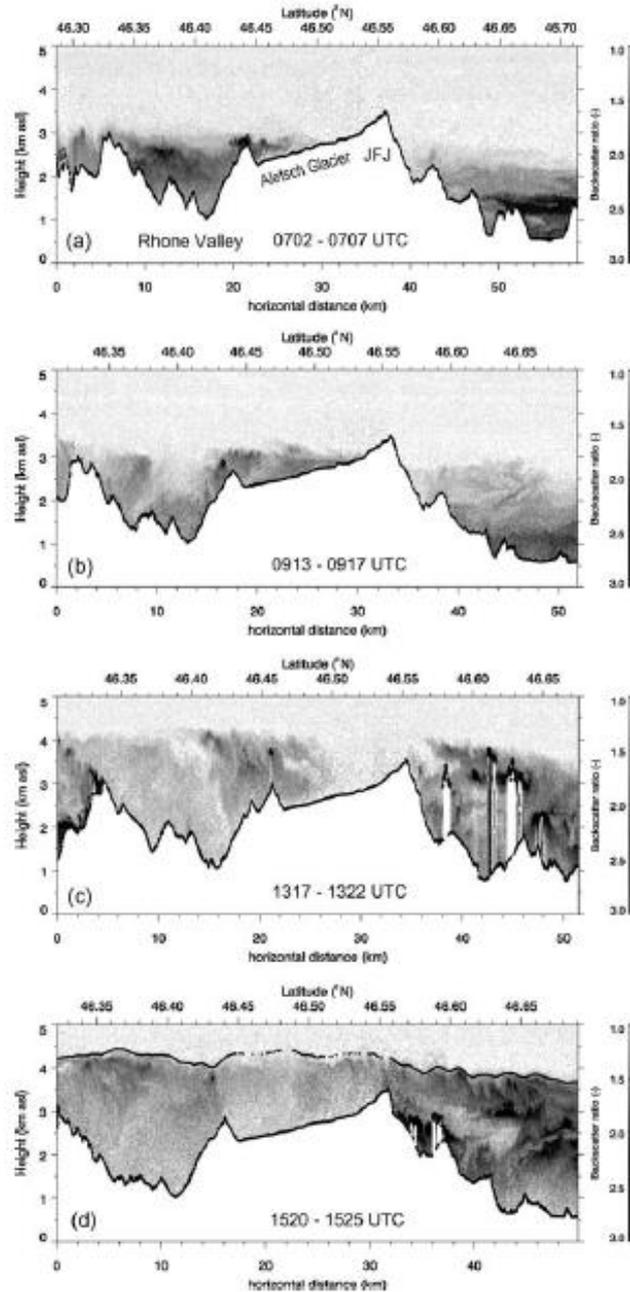
TEA▲▲x

De Wekker et al (2004)

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MoBL height detection

2) consequences of 1: turbulence $\to 0$ $at\ zi$

$\to$ near-surface turbulent mixing **plus interaction** with meso-scale flows ('*....directly influenced by the mountainous terrain ...)*

mixing of tracers (aerosols, water vapor, others?)

$\to$ Raman lidars, DIALs

$\to$ aerosol lidars

$\to$ ceilometers

Basilicata Raman lidar system

Wulfmeyer et al (2015)

Ceilometer

a) 2015-03-04 b) 2016-03-13 c) 2018-01-25 d) 2018-02-26

Cloudy days

Clear-sky days

Legend:
- * Ceilometer - Minimum Gradient
- ○ Ceilometer - Maximum Variance
- + Ceilometer - Wavelet Transform
- × Multisensor - Richardson Number

Herrera-Mejìa and Hoyos, 2019

Aburrà Valley, COL

→ ceilometer methods: local ABL

→ information on MoBL (?)

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ICAM2021| Rotach -TEAMx| 8.6. 2021

MoBL height detection

2) consequences of 1: turbulence $\to 0 \; at \; zi$

$\to$ near-surface turbulent mixing **plus interaction** with meso-scale flows ('....*directly influenced by the mountainous terrain ...)*

➢ mixing of tracers (aerosols, water vapor, others?)

➢ **daily cycle** ('influenced by the mountainous surface...')
   $\to$ small daily variation for $z > z_{MoBL}$

MoBL height detection

TEAMx

$\Delta\theta$: *daily amplitude of* θ

1000 m
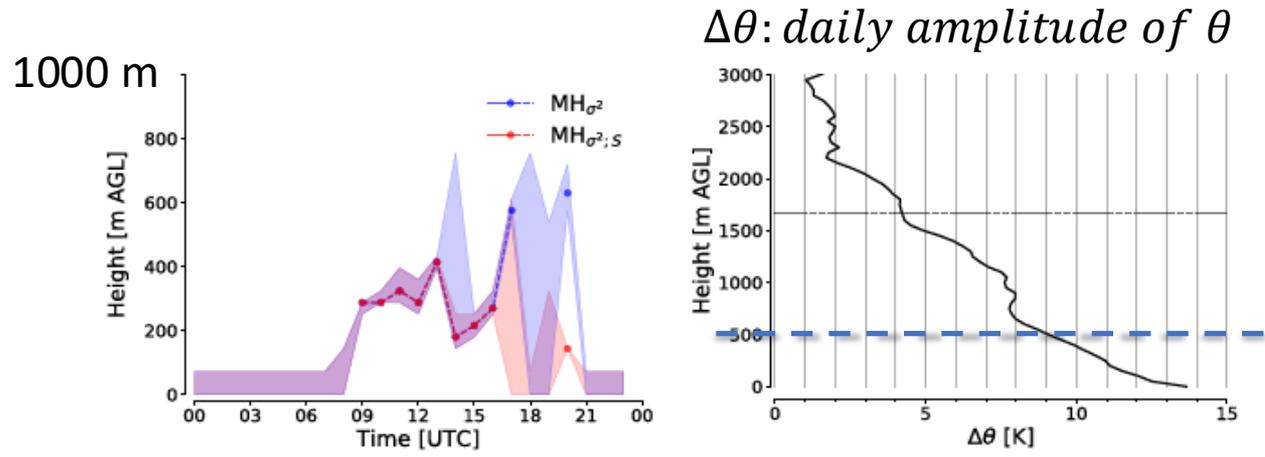
3 hrly $\Delta\theta$ over 50 m layers from RaSo

→ warming above MH ($\sim$ 500 m) too large to be explained by advection

(e)

1000 m
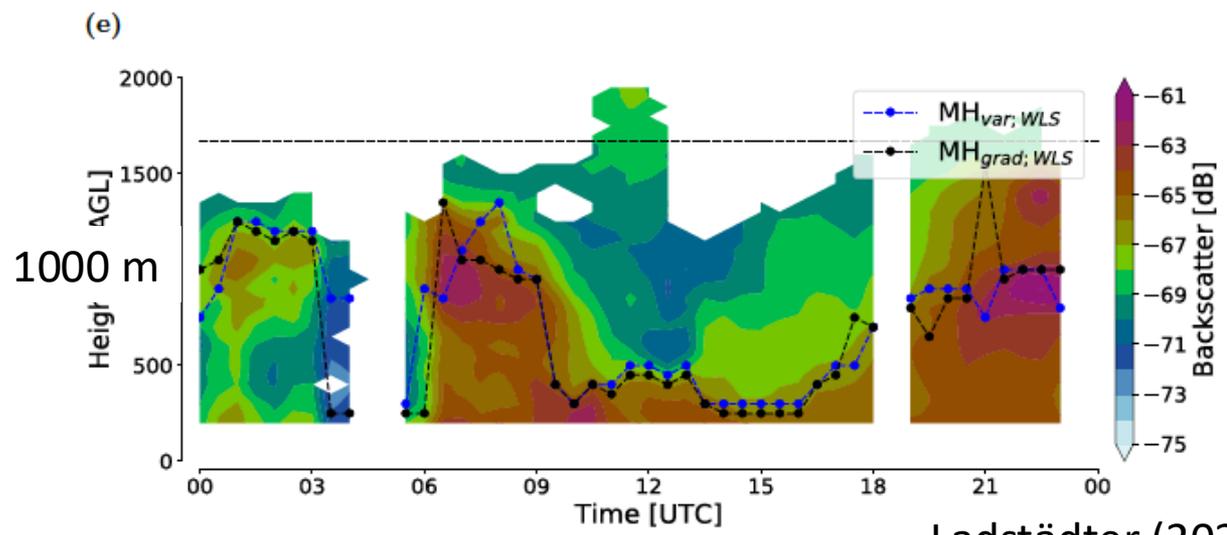
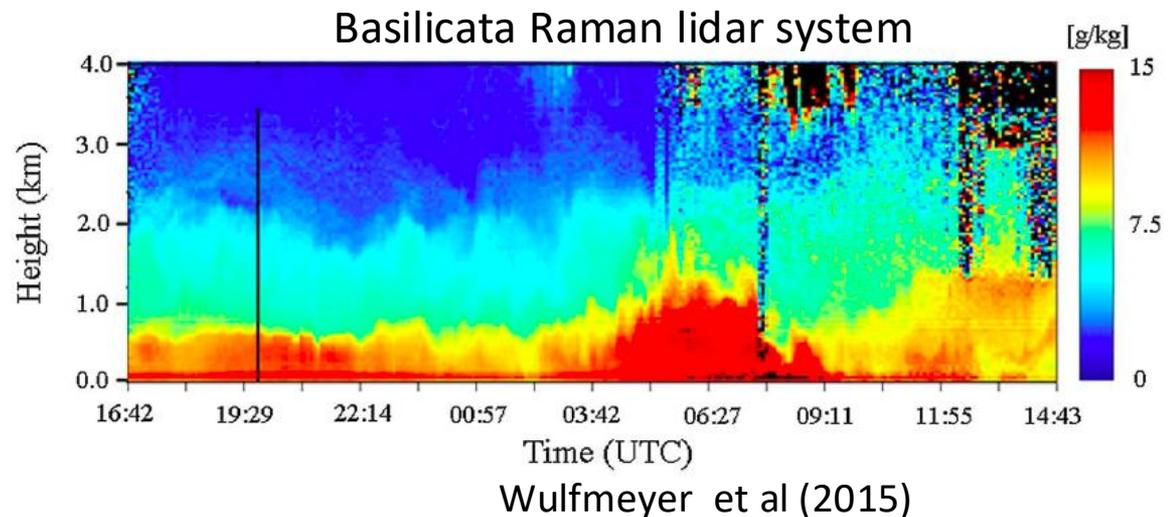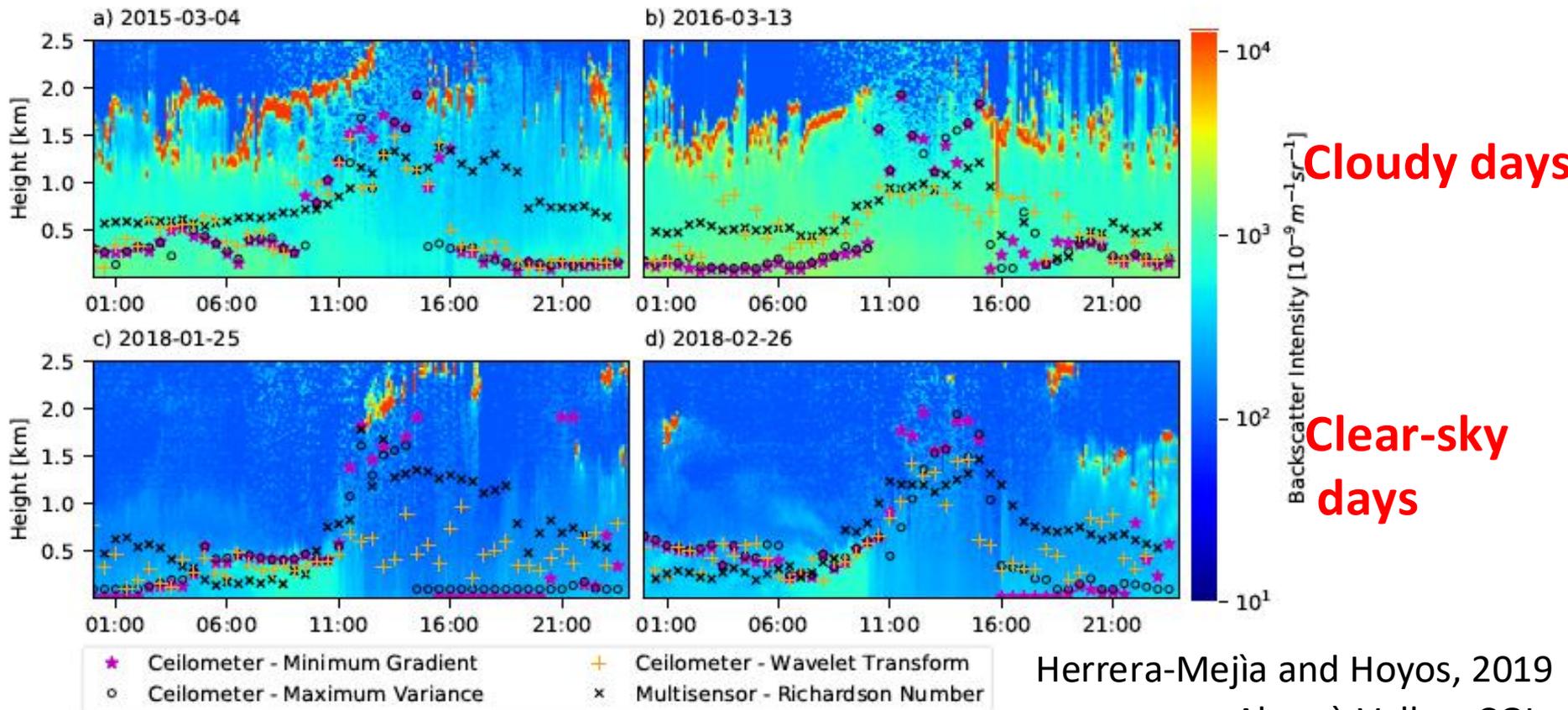Ladstädter (2020) MSc thesis ACINN

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MoBL height detection

2) consequences of 1: turbulence $\rightarrow 0\ at\ zi$

$\rightarrow$ near-surface turbulent mixing **plus interaction** with meso-scale flows ('….*directly influenced by the mountainous terrain …)*
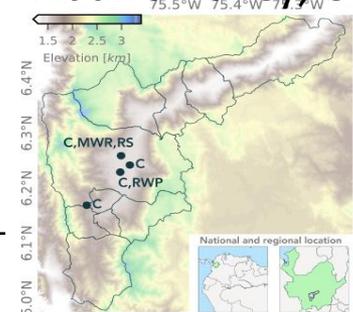
Consequences for TEAMx (TOC)

$\rightarrow$ downward looking lidar retrievals from airborne
   instruments
$\rightarrow$ large enough vertical range of sfc based instrumentation
$\rightarrow$ establish ceilometer 'network' (like AWS….')
$\rightarrow$ further develop / test methods to determine z_{MoBL}

Summary

- *State of TEAMx (after the 2nd WS)*

$\rightarrow$ many new projects / contributions / ideas

$\rightarrow$ a lot remains to be prepared for the TOC

- MoBL height

$\rightarrow$ current methods yield local ABL height

$\rightarrow$ z_{MoBL} needs our attention, especially under stable conditions

$\rightarrow$ mixing of aerosols (other?)

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Thank you for your attention!

➢ TEAMx Website: http://www.teamx-programme.org

Literature

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