universität innsbruck

The TEAMx Observational Campaign

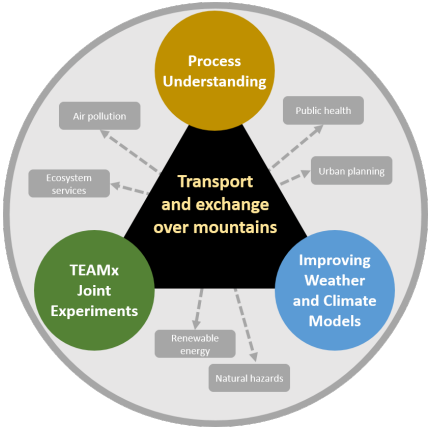
Manuela Lehner

Thanks to the TOC participants and the TEAMx community

IMC 2025, Innsbruck, Austria

TEAMx Goals

- Improving our understanding of transport and exchange processes between the surface and the atmosphere and within the atmosphere
- Evaluating and improving weather and climate models over complex terrain
- Collecting a unique dataset to study the transport and exchange processes
- Supporting weather and climate service providers



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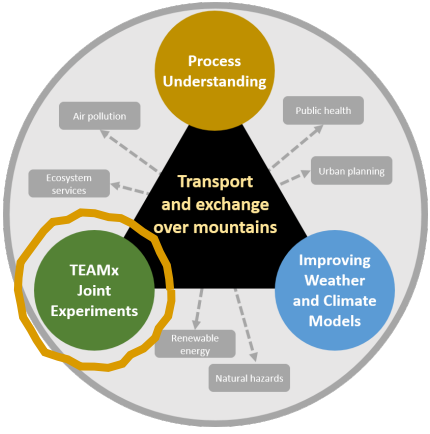
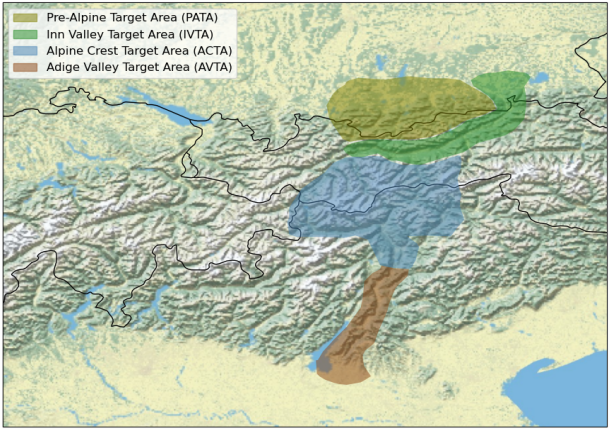


TEAMx Observational Campaign (TOC)

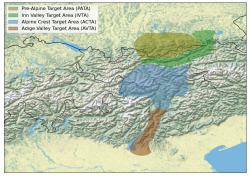


North–south transect through the Alps

- Pre-Alpine Target Area
- Inn Valley Target Area
- Alpine Crest Target Area
- Adige Valley Target Area

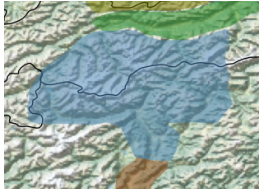
Multi-scale processes

Alpine scale



- Mountain waves
- Mountain-plain wind

Regional scale



- Orographic convection
- Foehn

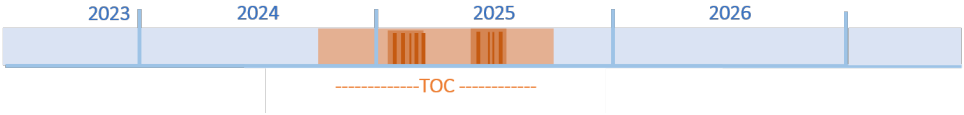
Valley scale

- MoBL structure
- Valley winds
- Mountain venting
- Fog/low stratus

Local scale

- Slope winds
- Turbulence

TEAMx Observational Campaign (TOC)



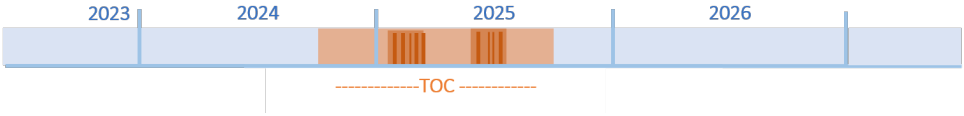
One-year long TOC

- Increase the density of the existing observational infrastructure
- Observations over a longer timescale than most field campaigns


Photo: B. Saunders


Photo: GeoSphere Austria

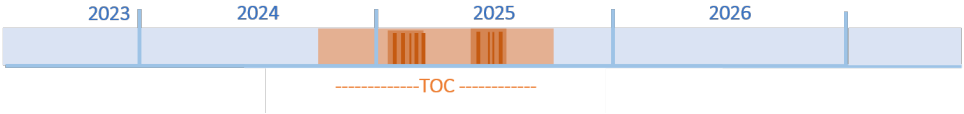
TEAMx Observational Campaign (TOC)



Extended Observational Periods

- Winter EOP (wEOP): 20 Jan–28 Feb
- Summer EOP (sEOP): 16 Jun–25 Jul
- Focus on individual processes
- IOPs targeting specific weather conditions

TEAMx Observational Campaign (TOC)



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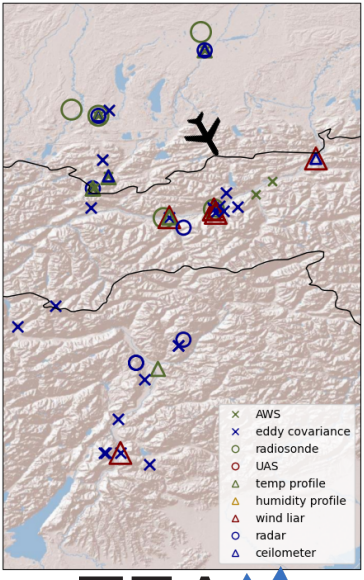
Winter EOP (wEOP)

Target processes

- Mountain waves
- Structure of the mountain boundary layer
- Fog/low stratus evolution
- Slope winds
- Turbulence



wEOP: Downslope winds over a snow-covered slope

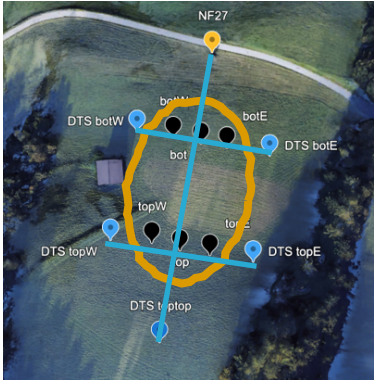
Credit: I. Stiperski, A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)

wEOP: Downslope winds over a snow-covered slope

Vertical profiles

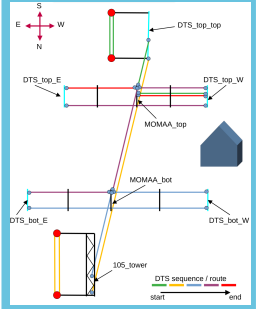
Credit: I. Stiperski, A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)

wEOP: Downslope winds over a snow-covered slope



Spatial structure

Station network



DTS array

Credit: I. Stiperski, A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)

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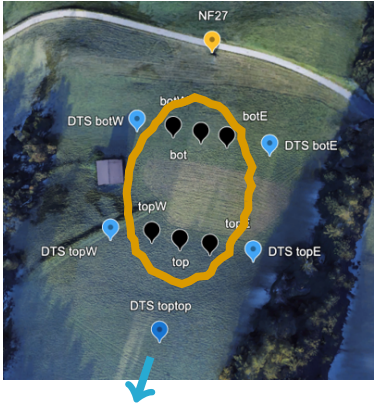
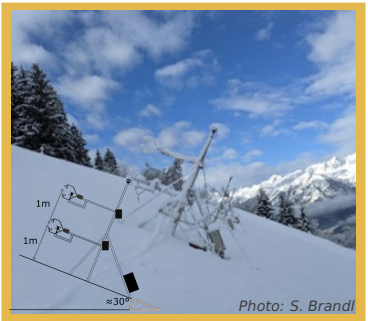
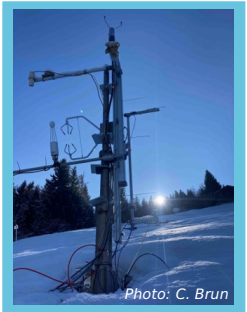


Turbulence



Turbulence station



Pitot tube

Credit: I. Stiperski, A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)

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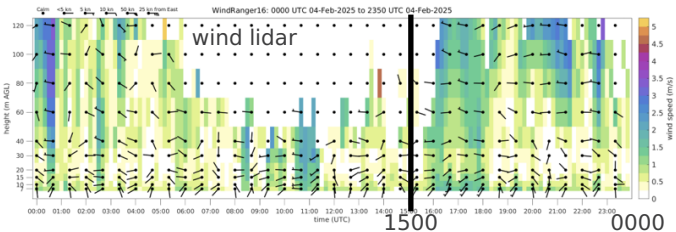

- Shallow katabatic jet
- Transition from downslope (S) to down-valley (W) winds

Credit: A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)

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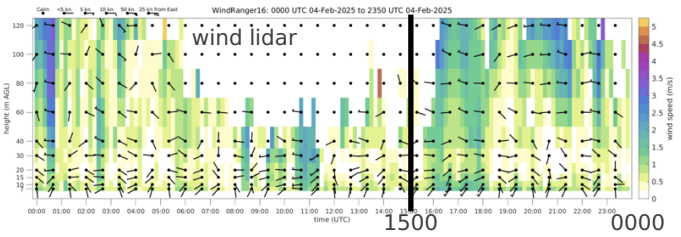
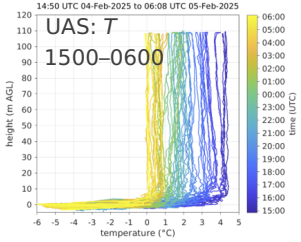
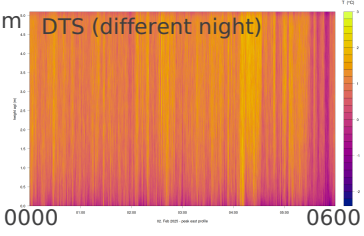




- Shallow katabatic jet
- Transition from downslope (S) to down-valley (W) winds
- Shallow temperature inversion: 5–10 m

Credit: A. Gohm, L. Pfister (Univ. Innsbruck), C. Brun (Univ. Grenoble Alpes)



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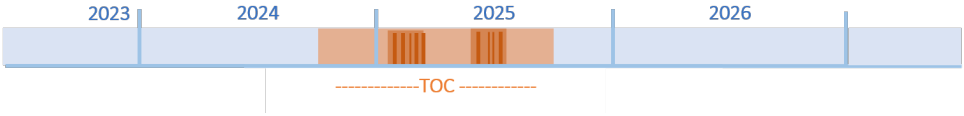

Extended Observational Periods

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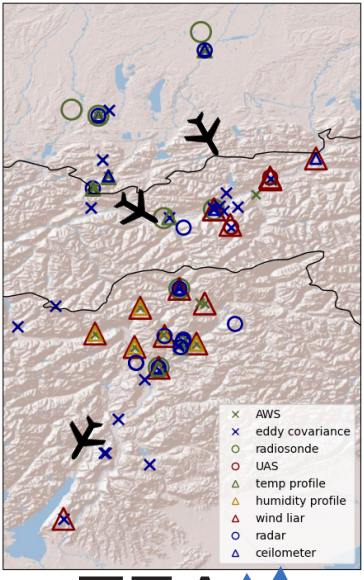
Summer EOP (sEOP)

Target processes

- Mountain waves
- Mountain-plain wind circulation
- Orographic convection
- Structure of the mountain boundary layer
- Valley wind circulation
- Mountain venting
- Slope winds
- Turbulence

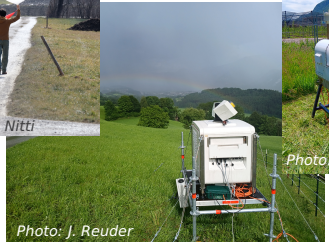


sEOP: Boundary-layer structure

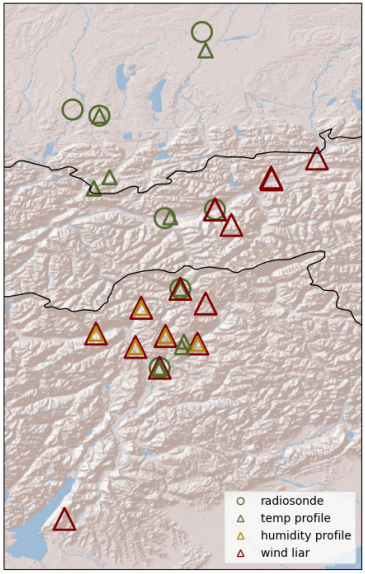
Spatially distributed vertical profiles

Radiosoundings

Temperature/humidity profilers



Wind lidars



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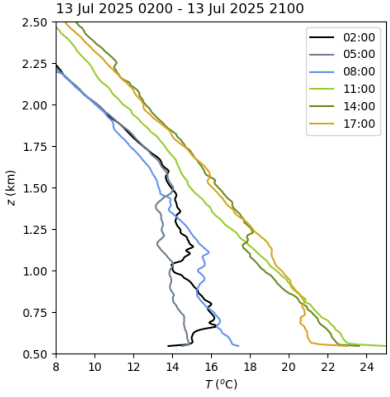
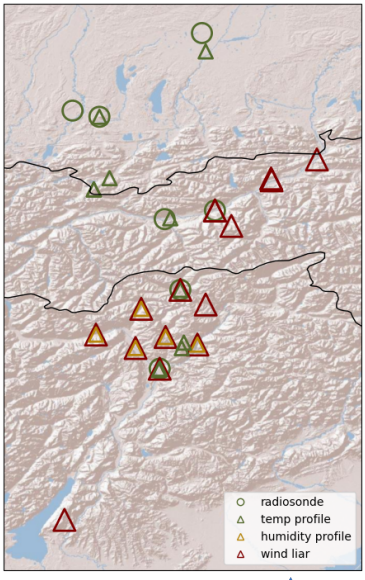




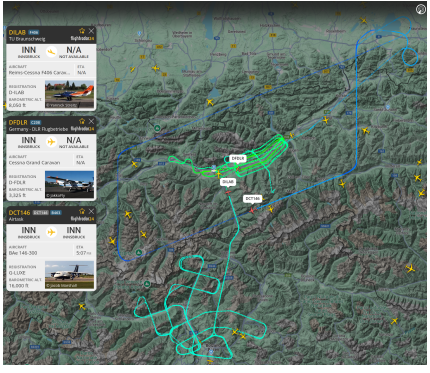
sEOP: Boundary-layer structure

3 research aircraft

- NCAS FAAM BAe146
- DLR Cessna Caravan
- TU Braunschweig Cessna F406

Photo: D. Anderson

Example flight paths



Source: flightradar24.com

sEOP: Boundary-layer structure

3 research aircraft

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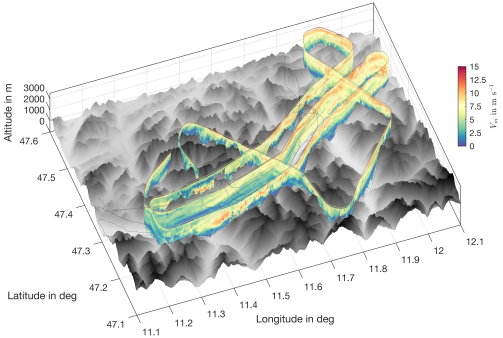
Photo: D. Anderson

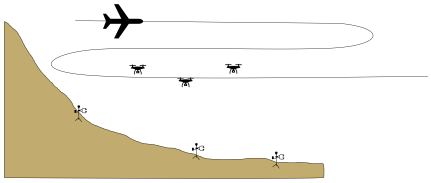
Wind speed below the aircraft flight path (TU Braunschweig Cessna)



Credit: P. Gasch (KIT)

sEOP: Turbulence in the mountain boundary layer

Observing turbulence throughout
the valley atmosphere



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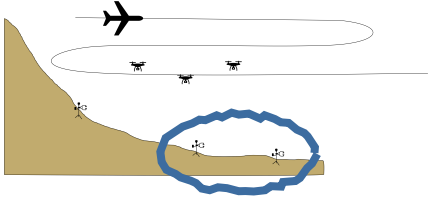
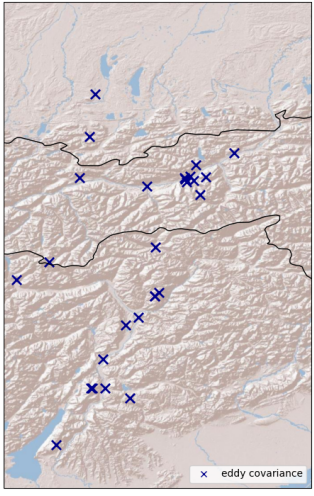
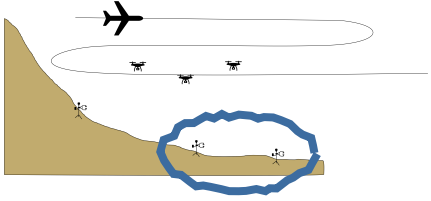


Surface layer: (networks of) eddy-covariance stations



sEOP: Turbulence in the mountain boundary layer

Observing turbulence throughout the valley atmosphere



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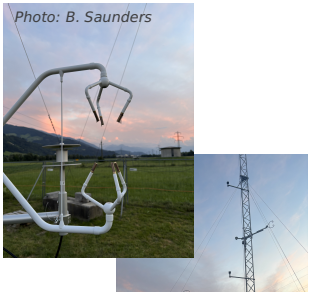

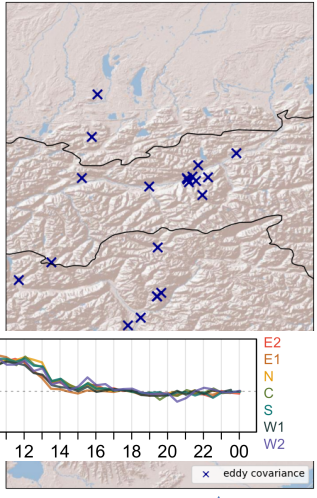

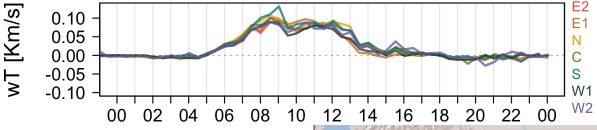

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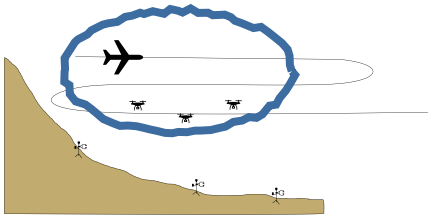


Valley atmosphere: aircraft + (swarms of) UAS

TOC Summary

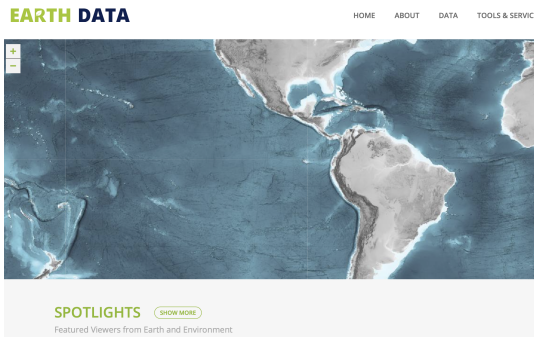
> 25 participating institutions

wEOP	**sEOP**
6 weeks (20 Jan–28 Feb)	6 weeks (16 Jun–25 Jul 2025)
18 IOPs (gravity waves, MoBL, and katabatic winds)	24 IOPs (gravity waves, convection, MoBL, valley-exit jets, slope winds)
1 aircraft (24 flight hours on 3 days)	3 aircraft (>200 flight h on 21 days)
≈250 radiosoundings (4 sites)	≈550 radiosoundings (6 sites)
≈10 profiling sites	≈ 20 profiling sites
hundreds of UAS and tethered-balloon flights	
multiple AWS, eddy-covariance stations, ...	

Data availability

TOC data will be ...

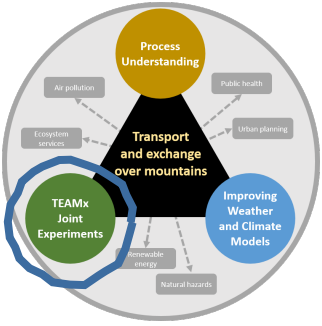
- made publicly available one year after the TOC
- published in public repositories (e.g., PANGAEA, zenodo, ...)
- accessible through the **Earth Data Portal**



https://earth-data.de

TEAMx Observational Campaign (TOC)

- one-year observational campaign in the Alps
- unique dataset to study transport and exchange processes over mountains



TEAMx

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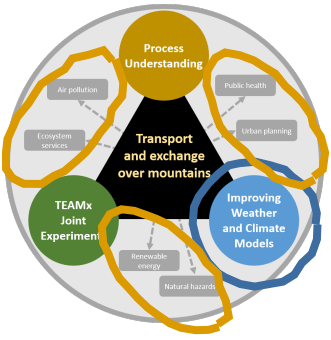

Stefano Serafin: Applications: numerical modeling

Dino Zardi: Applications: Use of TEAMx data in environmental assessments