Multi-scale transport and exchange processes in the atmosphere over mountains – Programme and experiment

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on behalf of the TEAMx *Coordination and Implementation Group*

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[1]University of Innsbruck, [2]MeteoSwiss, [3]University of Virginia, [4]Karlsruhe Institute of Technology, [5]McGill University, [6]National Centre of Atmospheric Sciences, [7]Meteo France, [8]ISAC CNR, [9]Univerisity of Vienna, [10]GeoSphere Austria, [11]University of Trento

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TEAMx Project Report 2022

➢ TEAMx in (not even) a nutshell

➢ TEAMx news

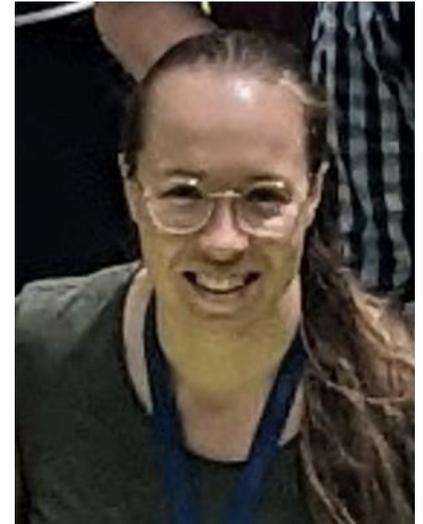➢ Working Group **Objectives**, **Goals** & **Accomplishments** during Reporting Period

TEAMx – what is it?

Multi-scale Transport and
Exchange Processes in the
Atmosphere over
Mountains
Programme and ex**periment**

➤ …a bottom-up financed research program on weather, climate & air pollution in mountain areas

➤ in the 'tradition' of international mountain meteorology programs (ALPEX, PYREX, MAP → **TEAMx**)

➤ Institutional 'crowd funding' for a Programme Coordination Office (*PCO* - @ UIBK)

TEAMx news

➢ TEAMx has a new Project Coordinator, Stephanie Westerhuis
→ 'bridged' the time from Oct 2022 – March 2023 (20%)
→ full power since April 2023 (i.e., 60%)

➢ A new Science Advisory Board has been formed
  o Susanne Crewell, University of Köln
  o Joan Cuxart, University of the Balearic Islands
  o Vanda Grubišić, NOAA
  o Petra Klein, University of Oklahoma
  o Christoph Schär, ETHZ
  o Simon Vosper, UK MetOffice

Objectives, Goals & Accomplishments during Reporting Period

Goals for 2022:

➢ updated version of the TEAMx Experimental Plan
  → which has been reviewed by the TEAMx community
  → includes the Plan for the TEAMx Observational Campaign (draft currently in revision)
  → includes the TEAMx Numerical Modelling Plan (first draft currently in preparation)

➢ Organization of the 3rd TEAMx Workshop in mid-2022
  → postponed to 2023 (due to proposal submission phase)

3rd TEAMx Workshop

State end 2022 (report):

➢ planning ongoing …

➢ Workshop 'in connection' with ICAM (International Conference on Alpine Meteorology', June 19-23 2023, St. Gallen, Switzerland
→ 3rd TEAMx Workshop: June 15/16 Zurich, Switzerland

3rd TEAMx Workshop

State mid 2023 (i.e., now):

➢ workshop is already history...
  → some 60+ (onsite) + 30 (online)
     participants

➢ topics:
  → discussion of/ work on
     > experimental plan
     > numerical modelling plan
  → first draft of Implementation plan

...the onsite participants left on Friday 5 pm ...

Objectives, Goals & Accomplishments during Reporting Period

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Experimental plan

State end 2022:

➢ A revised draft of the Plan for the TEAMx Observational Campaign was shared via the website in May 2022

➢ The draft Numerical Modelling Plan is continuing to be developed thanks to the efforts of the Numerical Modelling Committee. However, progress continues to be slow due to a lack of time available to work on this substantial document (PCO!).

Experimental plan

State mid 2023 (i.e., now)**:**

➢ Numerical Modelling Plan (NMP-V1) has been completed
    → discussed/adjusted during the workshop

➢ Plan for the TEAMx Observational Campaign:
    → version of 2022 shared with the participants
    → substantial changes …

➢ recall: TEAMx is bottom-up financed…
    → two of the major contributions to the TOC declined: TEAMx-US (NSF proposal),
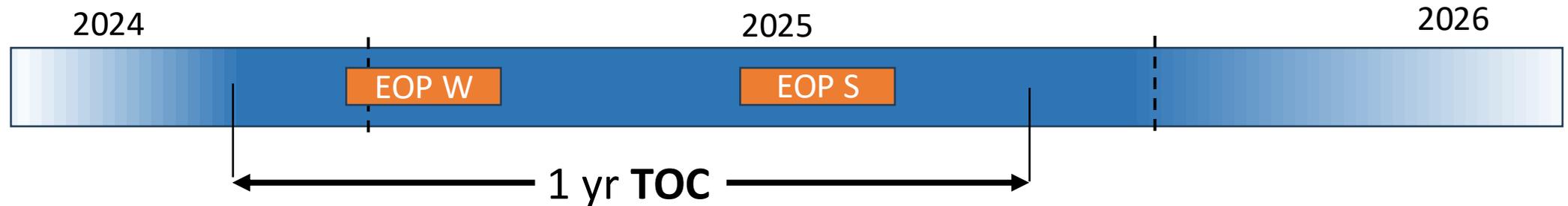   TEAMx-UK (NERC proposal)

➢ re-shaping the resources

Experimental plan

State mid 2023 (i.e. now)**:**

➢ re-shaping the resources, based on

→ secured contributions

→ original experimental concept

→ timing

TEAMx Observational Campaign (TOC)

Autumn 2024 - autumn 2025 (EOPs and IOPs):

TOC: 1 year duration - operational plus semi-operational networks
- additional deployments (> 'an additional AWS')

Extended Operations period Winter (EOP W): 4-6 weeks
- additional deployments - project based
- IOPs (airborne observations, RaSo, …)

Extended Operations period Summer (EOP S): 4-6 weeks
- additional deployments – project
- IOPs (airborne observations, RaSo, …)

Experimental plan

Joint TEAMx Observational Campaign (TOC)

➢ TOC: autumn 2024 - autumn 2025

➢ substantial funded (3rd party) and secured (internal resources of the partner institutions) contributions (instrumentation and personnel)

→ KIT cube
→ TEAMx-UIBK
→ TEAMx-UTrento
→ GeoSphere Austria   'secured – TOC'   → pending/additional resources will
→ MCH   be integrated
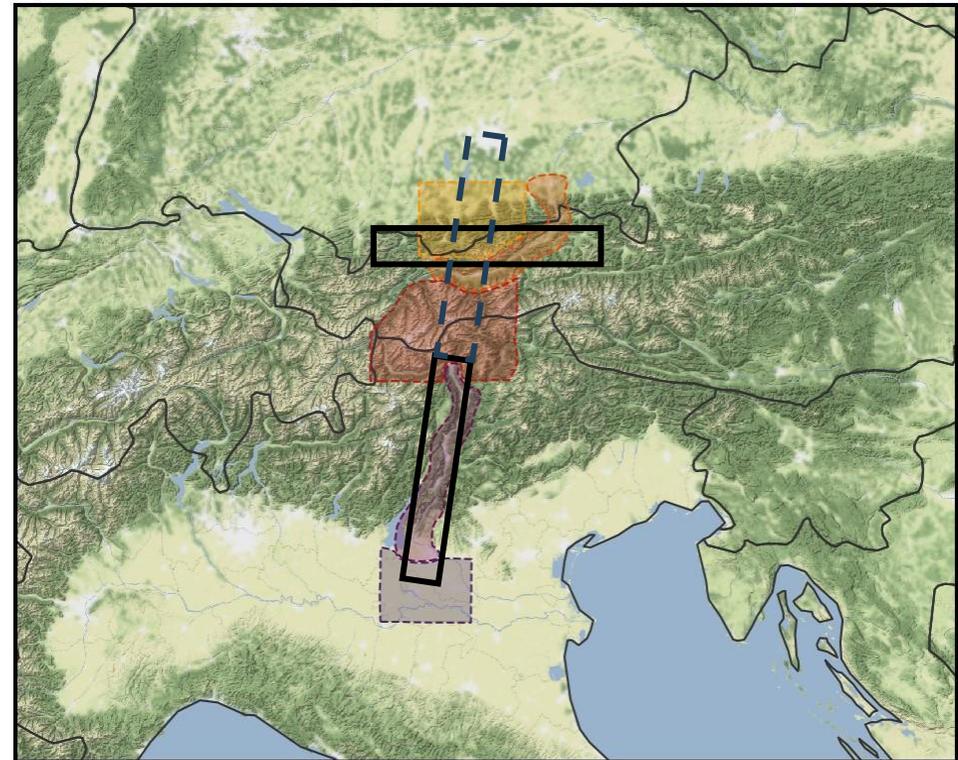→ KIT Garmisch
→ DLR
→ …

'Secured TOC'

➢ keep the T-bone layout

➢ EW valley (north, Inn Valley)
SN valley (south, Adige Valley)

➢ add / complement the Alpine
cross-section

All this: very preliminary
→ ongoing discussions and planning
→ expected: finalizing soon

Original experimental layout

Objectives, Goals & Accomplishments during Reporting Period

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➢ Organization of the 3rd TEAMx Workshop in mid-2022.
  → postponed to 2023 (due to proposal submission phase)

➢ Further develop the network of mountain weather and climate research projects. Activity for 2022 will mainly be to systematically expand the information to areas outside Europe and establish forms of communication exchange within the network.
  → collection of 'entries' / no systematic work

Objectives, Goals & Accomplishments during Reporting Period

Other Science Highlights (2022):

➢ A BAMS Essay paper published
→ overview of the motivation behind TEAMx and the aims of the programme.

A Collaborative Effort to Better Understand, Measure, and Model Atmospheric Exchange Processes over Mountains

Mathias W. Rotach, Stefano Serafin, Helen C. Ward, Marco Arpagaus, Ioana Colfescu, Joan Cuxart, Stephan F. J. De Wekker, Vanda Grubišic, Norbert Kalthoff, Thomas Karl, Daniel J. Kirshbaum, Manuela Lehner, Stephen Mobbs, Alexandre Paci, Elisa Palazzi, Adriana Bailey, Jürg Schmidli, Christoph Wittmann, Georg Wohlfahrt, and Dino Zardi

ABSTRACT: In this essay, we highlight some challenges the atmospheric community is facing concerning adequate treatment of flows over mountains and their implications for numerical weather prediction (NWP), climate simulations, and impact modeling. With recent increases in computing power (and hence model resolution) numerical models start to face new limitations (such as numerical instability over steep terrain). At the same time there is a growing need for sufficiently reliable NWP model output to drive various impact models (for hydrology, air pollution, agriculture, etc.). The input information for these impact models is largely produced by the boundary layer (BL) parameterizations of NWP models. All known BL parameterizations assume

https://doi.org/10.1175/BAMS-D-21-0232.1

Objectives, Goals & Accomplishments during Reporting Period

Other Science Highlights (2022):

➢ **preliminary campaign** in the Inn Valley summer 2022
  → testing of instrumentation and exploration of flow phenomena

➢ First results & lessons learnt presented in the workshop and ICAM

Objectives, Goals & Accomplishments during Reporting Period

Other Science Highlights :

➢ **WGs have worked out** model intercomparison cases
   → cold air pool / thermally driven flows / moist convection / orographic drag
   → some (first) results were presented at ICAM

TEAMx Project report 2022

....and all the rest is in the document....

TEAMx discussion

➢ I haven't explicitly included [in my report] TEAMx contributions to the **GEWEX Science Goals ...**

→ many of them are explicitly addressed by TEAMx – but 'for mountains only'

→ example:
"**Goal # 2 (GS2)**: Quantify the inter-relationships between Earth's energy, water and carbon cycles to advance our understanding of the system and our ability to predict it across scales.

2. ABL process representation:

- To what extent are the properties of the atmospheric boundary layer (ABL) defined by sensible and latent energy and water exchanges at the Earth's surface versus within the atmosphere (i.e., horizontal advection and ABL-free atmosphere exchanges)? "

→ how can these results be transferred in an effective way to the GEWEX community?