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TEAMx

From research projects to the operational availability of cryosphere products

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Prerequisite

Subtitle for topic 5

–opportunities, requirements, challenges, **lessons learned** from YOPP and **TEAMx**

TEAMx is not even ‘close to its end’ ….
→ lessons learned from the planning process…

TEAMx – not even a nutshell....

Multi-scale Transport and
Exchange Processes in the
Atmosphere over
Mountains
Programme and experiment

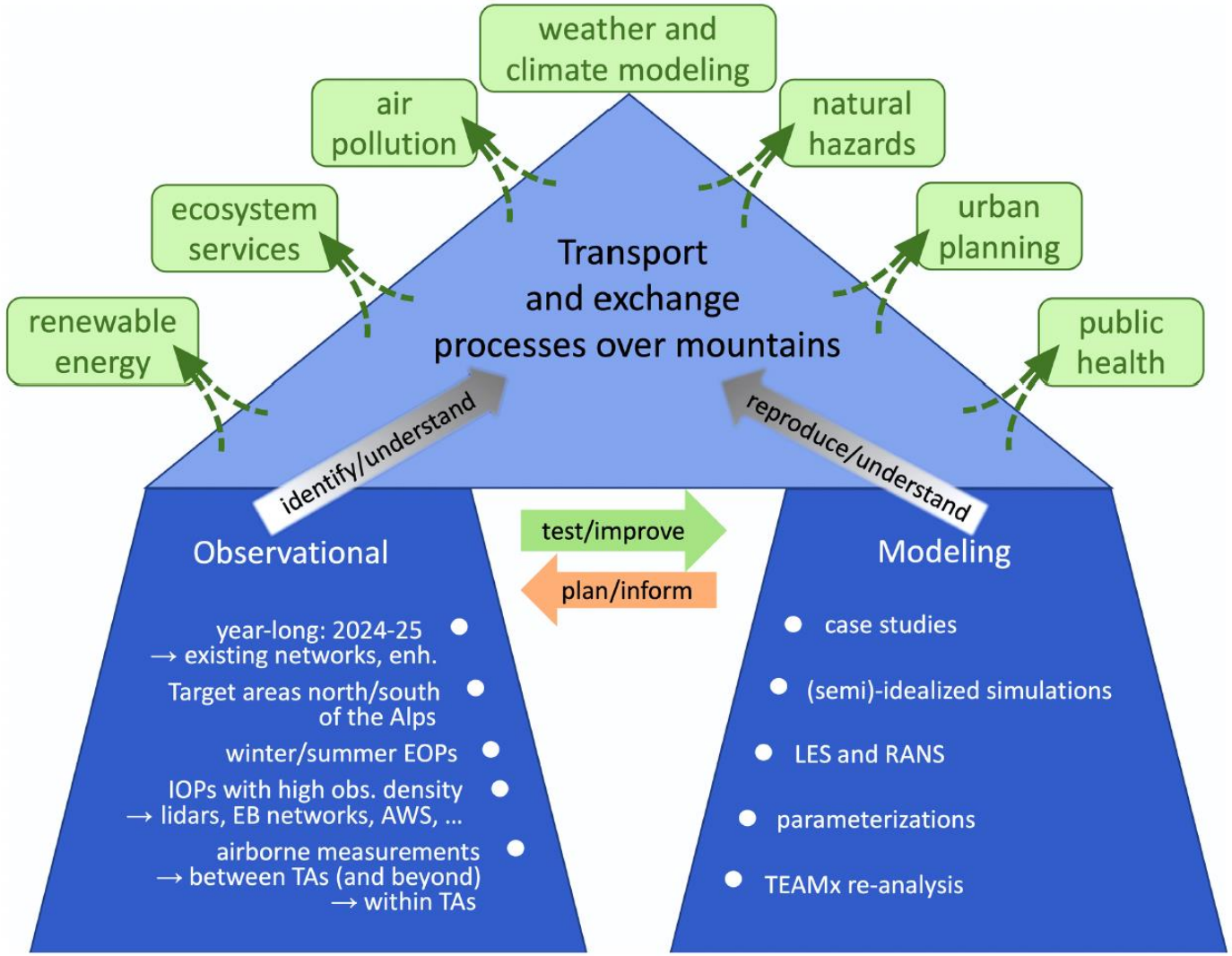
- ...a bottom-up financed research program on weather, climate & air pollution in mountain areas
- endorsed by WWRP
- crosscutting project within the GEWEX Hydroclimatology Panel (GHP)
- go to www.teamx-programme.org for more information

TEAMx Science Plan

Objective	Primary Focus	Target
Process understanding	Micro- and meso-scale processes within and above the *mountain boundary layer* (MoBL); Interaction between scales.	Quantitative understanding of momentum, energy and mass exchange over mountainous terrain
TEAMx Joint Experiment(s)	Collaborative use of multi-platform instrumentation to sample the spatial heterogeneity of turbulence and mesoscale circulations over and near mountains	Quality-controlled observational data pool, available for process investigation, high-resolution model verification, parameterization development
Improving Weather and Climate Models	*Models right for the right reason*, i.e., identification and reduction of model biases and uncertainties over complex terrain	Weather forecasts and climate simulations over mountains as good as over flat terrain, and less reliant on model output post-processing
Support to Weather and Climate Service Providers	Air pollution, hydrology, climate change scenarios (e.g., elevation-dependent climate change).	Smaller uncertainty of impact models, due to reduced errors in weather and climate information.

Serafin et al. 2020

Observational & numerical activities



Rotach et al. (2022) - BAMS

Research → operations

Requirement	TEAMx
(SG-Cryo Recommendation #10: Roadmap for Research to Services for Polar and High-Mountain Regions)	
➢ '…incorporate lessons learned, e.g. user engagement in the design phase	→ 3 NMHSs in the core group → 2nd TEAMx workshop (2020) was on 'user needs'

→ the end users (e.g. NMHSs) must *internally* exchange knowledge/ data/ information

→ end users as β-tester during the ‚experiment' (→ MAP D-PHASE)

→ NMHS must assign personnel resources to this task (personal commitment ← HErZ)

Research → operations

Requirement

(SG-Cryo Recommendation #10: Roadmap for Research to Services for Polar and High-Mountain Regions)

- '…must lead to … improvements …..e.g. the optimization of observing and data systems in data sparse regions, improved models, etc.

→ see above: design phase….

→ also see above: end users must adopt it

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→ WG 'Sfc-atm exchange' recently established a cryo-subgroup

→ many of the science topics correspond to this requirement (e.g., the modeling/processes 'column')

Research → operations

Requirement

(~~SG-Cryo Recommendation #10: Roadmap for Research to Services for Polar and High-Mountain Regions~~)

→ more general comment ….

- Combine modeling and measurements
  - → in polar and high mountain regions we can never have enough data …
  - → models are optimal ‘interpolators’
  - → data assimilation (DA) / REA

→ data must be near-real time transmittable (DA)

→ data denial experiments and OSSEs

→ include satellite products (3rd dimension) – also their evaluation in data sparse regions

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→ planned TEAMx-REA (MCH&DWD driving forces)

→ with a ‘training (DA)’ during the TOC (see above: β-tester)

→ high-resolution (target: 100 m) ‘optimal atmosphere’ (3d) for the year-long TOC

Research → operations

- Combine modeling and measurements
  → in polar and high mountain regions we can never have enough data …
  → models are optimal ‘interpolators’
  → data assimilation (DA) / REA

- this corresponds to harvest low hanging fruit…
- this corresponds to improve existing products

research projects:

- must assess the underlying assumptions / generality / applicability (new products)
- based on existing modeling approaches / DA / .. (existing products)


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Thank you!
comments – questions - discussion

This last point
→ recommendation # 3

Recommendation 3

Infrastructure roadmap to a fully integrated cryosphere in Earth system models

Noting the goal of Earth system monitoring, modelling and prediction at the core of the WMO strategy, SG-CRYO recommends that INFCOM task GCW-AG and SC-ESMP to coordinate the development of a roadmap for infrastructure to support the fully coupled cryosphere in Earth system models (atmosphere-cryosphere-terrestrial-ocean), as a prerequisite to effective information services, at regional to global levels, as noted in sections 3 and 4 of this report.

Consultations with relevant WMO structures and partners are needed, to efficiently build on current and relevant initiatives, identify pilot projects, and reflecting user needs. A report on progress should be tabled at the next ordinary session of the Commission.

SG-CRYO prepared a non-exhaustive list of key areas for consideration in this process, including:

- Dynamical and statistical downscaling for modelling of cryospheric, hydrologic, and oceanographic processes, as relevant to local and regional stakeholders.
- Closing the gaps between NWP and seasonal prediction, in support of the generation of operational hydrological and climate products for polar and high-mountain regions, e.g. support to the implementation of TPRCC-Network.
- Data assimilation and model prediction capabilities for extreme cryospheric events and risk assessment of cryosphere hazards (e.g. ice jams, landslides, avalanches, GLOFs, icebergs, etc.).
- Coupling NWP and hydrological modelling with advanced downscaling methods (air temperature, radiation, precipitation amount and phase, etc.), and provision of high-Resolution atmospheric forcing to stand-alone hydrological and glaciological models.
- Operationalization of existing glacio-hydrological models, i.e. for daily to seasonal meltwater runoff predictions.
- Cryosphere data access, quality control, and curated datasets for data assimilation and model validation.
- Advancing the understanding of the associated uncertainties (also inconsistency and representativeness) in cryosphere observations and data, and foster their operational use, including to constrain models.
- Exploitation of cryosphere satellite observations in Earth system models, including increased capacity to assimilate satellite cryosphere products.
- Advancing the understanding of biases and uncertainties (including inconsistency and representativeness) in cryosphere observations and data, and foster their operational use, including to constrain models, e.g. quantifying uncertainties in solid precipitation for basin water budget analysis and hydrological models.
- Evaluate standards for high-Resolution (sub-km) cryospheric observations for initializing, verifying, and downscaling weather and Earth system models; promote research and observational campaigns to generate such datasets.