Workshop Output WS 1.1.B

Title of workshop: Climate modeling in Mountain regions

Prepared by

Moderators	Nikolina Ban, Fabien Maussion
Participants*	Workshop participants and audience in a lively discussion

* Workshop participants that have submitted contributions to the workshop

General questions to please be answered in the workshop reporting

1) What was the focus of the workshop? Methodological issues and advancements or thematic issues (systems knowledge, transformation knowledge, target knowledge). Please check and fill in the matrix in the output section.

Methodological issues and advancements	Thematic issues		
	System knowledge	Transformation knowledge	Target Knowledge
Representation of mountains in climate models			
Uncertainties of climate models in mountain regions			
Understanding climate changes in mountain regions with the help of models			
How to use climate model output for various applications: impact models, climate services...			
Is there a need for targeted community effort addressing those questions?			

2) Which key points were discussed in the workshop as a whole? (This should be more a synthesis and not simply a summary of the key points in each presentation)

- **Main messages of the discussion from the moderators perspective:**
    - **Climate models have <u>greatly improved</u> over the recent past: increase in spatial resolution (km scale) and complexity (e.g., more complex snow model and explicit**

simulation of convection). Also, <u>more data is becoming available</u> via coordinated projects (e.g. CORDEX) and data portals.

- **This is a great opportunity, but there is a <u>need for user guidance</u> about how to appropriately interpret and use climate models <u>in mountain regions.</u>**
- **One (or several) <u>review papers could address these needs</u>. They would also confederate the larger community of modelers and users around the central topic of mountain climate.**
- **The hierarchy of models (GCM -> RCM -> Downscaling / Bias Correction -> Impact models -> People/Stakeholder/Communities) will remain in the years to come. Research efforts need to be spent not only on the tools themselves, but how to best connect between them**
- **Large uncertainties are associated with mountain regions. Understanding of the mountain climate and how it would change with the warming is getting better, but needs to be further addressed. Furthermore, in order to properly validate the models, there is a need for reliable observations at high spatial and temporal resolution.**

- Other Notes:
  - In the course of the discussions it was acknowledged that in the IMC audience there were many more "users" than "modelers"
  - "Mountain climate modelling" is more than only "modellers": modelers and users need to meet and talk more often
  - A review paper synthesizing the development and use of climate models specifically in mountain environments. The aim will be to guide users about how to deal with uncertainties of different climate models (GCMs/RCMs) in their applications and to summarize the various methods and products downscaling and bias correcting model output.
  - Model improvements and developments should not target only one type of model (GCM, RCM, downscaling) but all of them -> they all will continue to be useful in the future.
  - Model evaluation should not target only "standard" variables (e.g. 2m temperature, 10m winds), but also dynamical components and their interpretation (e.g. Foehn index, weather types...)
  - Model transferability: certain mountain regions have more data than others for validation. Can it be shown that e.g. validating in the European Alps make a model applicable in the Andes?
  - There should be no model tuning toward mountain regions -> the model need to be improved for better results everywhere.
  - We discussed community building schemes (CORDEX-FPS, TEAMx), but no concrete action was decided. The review paper received more positive and active responses and will be followed.

3) What is your opinion on the current state of knowledge concerning your topic(s) (focusing on mountain regions)? *Please check and fill in the matrix on the following page.*

Not applicable

<u>Ideas for questions to potentially be answered by the moderators after the workshop in the reporting (please delete what is not useful):</u>

1) Were there any new insights and/or findings presented? If yes, which ones?
2) What was the main message/consensus of your workshop?

See summary above.

3) Were major uncertainty issues identified and discussed? If yes, which ones?
4) Was there any significant controversy (if so, what?) that requires new data (or further exploration of existing data) to resolve the issue? (explain)

The question of proper validation of climate models was raised several times. There is a need for more in-situ data for important variables (radiation, wind, precipitation, evaporation were cited very often)

5) Were new research questions raised? If yes, would working on these questions need to involve other disciplines (which ones)?

Maybe not research questions, but a need for a guidance review paper about climate modelling in mountain regions emerged.

6) Did the workshop identify research topics (e.g. environmental drivers other than climate) that are, in your opinion, currently greatly underrepresented in mountain research, but should urgently be addressed?

Further Comments