Common numerical experiments to assess the climate sensitivity of alpine snow and glacier regimes around the world

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John Pomeroy (JP): From the presentations is possible to see very different levels of resilience for different study areas. In general, most of the changes are in seasonal regimes. Necessity to discuss approaches to assess changes and sensitivities

Matthias Bernhardt (MB) considers we have very contrasted topographies and climatologies that permit carry out this type of experiment

JP: Creating a simplified and standard virtual basin (3 HRUs: low, north facing and south facing)) and move it around all the experimental sites may be a good approach. In places with different observatories may be moved at different elevations, and add glacier in the catchment or remain ice-free. Compare plots of response of hydrology for changing temperature and precipitation is interesting, or simply to indicate changes for the +2ºC warming goal. In case of glaciated basins if glacier disappears is interesting to assess what replace it: grassland, forest, lake?

MB: It is also interesting to consider an uncertainty frame for different parameters (i.e. albedo).

Tobias Jonas (TJ): He wonders if a basin with associated parameters may work properly in different environments

George Kaser (GK): Necessity to not forget detection of changes, but also attribution, this a clear demand of the scientific community. As an example, not all glaciers are responding to anthropogenic warming, but also to long-term memory. It would be interesting to force with natural and anthropogenic forcings.

Masaki Hayashi (MH): Need to consider also interface with groundwater and permafrost.

JP. Perhaps not only one single basin, but also one with great storage and other without or very limited. It is necessary to introduce ground ice changes in CRHM.

Isabelle Zin: Need for introducing feedbacks if we want to go further to short term responses. It is also necessary considering tipping points.

JP: Also considering how climate warming will affect snow blowing by wind as consequence of higher snow cohesion.

MB: To look also for possible changes in uncertainties when measuring precipitation as a consequence of changes in precipitation phase (undercatch reduction).

TJ. Perhaps a delta method is an excessive simplification. Differential changes in Tmax and Tmin would be more realistic

JP: If participants offers their datasets, it is possible to start experiments. Not only perturbing meteorological data, but also physical characteristics.

MB: Interesting to compare different downscaling approaches (different degrees of complexity.

Ethan Gutmann: Necessity to perform ensembles of predictions

JP: Analyse impact of changes in wind speed and elative humidity

GK- rising temperature and humidity is true globally but not locally. A possibility is using weather generators for sensitivity analyses.

-? Importance of consider seasonality in precipitation changes

JP: also important the clustering of precipitation events.

All these discussion tasks should be the topic of the next INARCH workshop.
It is suggested that a small group write a summary of the experiment to be done, and circulate it amongst participants.