PT-SAINT
Proposal for extension to 12/2020

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During the course of the priority task project SAINT (Snow cover Atmosphere INTERactions) a new multi-layer snow cover scheme was developed for the numerical weather prediction and climate models COSMO and ICON. Currently this new scheme is available as a stand-alone version, which shows comparable performance to a more sophisticated snow cover, i.e. the Swiss snow cover model SNOWPACK (Fig.1). For the remaining 3 months until June 2020 we plan to implement the scheme into COSMO (Version 6.0) and perform initial verification as well as testing as outlined in the original proposal.

However, crucial parts before such a snow cover scheme can become operational are still pending. This includes a thorough verification of the scheme as well as a pre-operational test phase. We therefore kindly ask for an extension of 6 month until the end of December 2020 as outlined in Table 1. The required tasks can be mainly divided into three phases namely verification, testing and closing, which will be briefly described in the following.

Phase 1 (Verification): Once the snow cover scheme has been successfully implemented into the current version of COSMO, standard verification has to be performed in order to assess the quality of the scheme and potential improvements compared to the old single layer snow scheme. It is almost certain that the new scheme will have a strong negative impact on the COSMO performance. Therefore, adjustments to the scheme and in particular within COSMO, e.g. 2m air temperature diagnostics, have to be made. However, the full impact and its extent remains unknown for the time being and will require a thorough verification and validation to identify potential shortcomings.

Phase 2 (Testing): In order to ensure a production ready snow-cover scheme a pre-operational test phase is required. It needs also to be ensured that the new scheme can be embedded in the operational production, which requires testing and adjusting the operational setup. This is especially true for the currently used snow analysis which needs to be adjusted to the new scheme. Since the new scheme should be made available for the next winter season, i.e. 2020/21 at MeteoSwiss, one needs to be pre-operational early October before the first snow. Therefore Phase 1 and Phase 2 have to run somewhat in parallel.

Phase 3 (Closing): This phase starting in October overlaps with Phase 2 by one month. This is to ensure that unforeseen obstacle during Phase 2 can to be addresses. Other than that, Phase 3 can be seen as a consolidation phase, where further adjustments and improvements of the operational setup can be made if need be. In addition, a full documentation as well as potential publication can be and will be written during this phase.

Table 1: Proposed time table of the three phases 1) Verification, 2) Testing and 3) Closing.

Phase	2020					
	Jul	Aug	Sep	Oct	Nov	Dec
Verification	██	██	██			
Testing		██	██	██		
Closing				██	██	██

Resources:
Resources for the proposed developments are secured. Funding is done by MeteoSwiss and SLF/Davos.
- Coordination by Sascha Bellaire and Jean-Marie Bettems
- Development by
  - 6 months internship, 100% occupation (Louise Braud)
  - 24 months PostDoc, 50% occupation (Varun Sharma). Note that Varun will start working on PT SAINT proposed extension, and will work afterwards on a new PT aiming at transferring SAINT to ICON and consolidating the SAINT model.
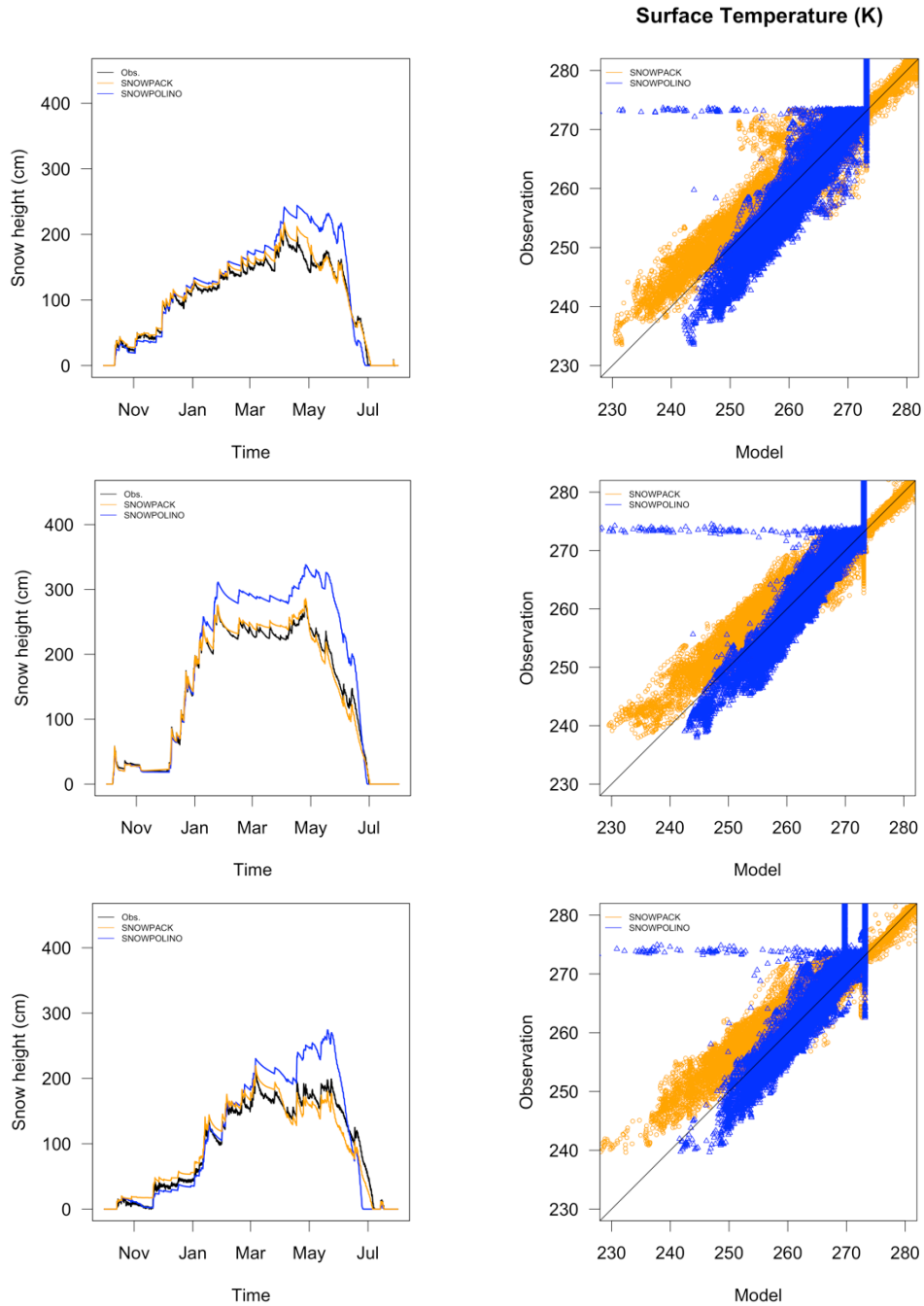
Figure 1: Comparison of measured and modelled snow heights (left pane) and surface temperature (right pane) for three winter seasons 2009/10 (top), 2011/12 (mid) and 2015/16 (bottom) at Weissfluhjoch experimental site Davos, Grison, Switzerland. **Left pane:** colors show the observed snow height (black) as well as the modelled snow height by SNOWPACK (orange) and by the new snow cover scheme (SNOWPOLINO, blue). **Right pane:** Comparison of modelled and observed surface temperature for SNOWPCK (orange) and SNOWPOLINO (blue).