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On the predictability of snow conditions in the European Alps, from meteorological to seasonal time scales

Samuel Morin (1), Carlo Carmagnola (1), Matthieu Lafaysse (1), Matthieu Vernay (1), Christian Viel (2), Lauriane Batté (3), and Jean-Michel Soubeyroux (2)

(1) Météo-France - CNRS, CNRM, CEN, Grenoble, France (samuel.morin@meteo.fr), (2) Météo-France, DCSC, Toulouse, France, (3) Météo-France - CNRS, CNRM, Toulouse, France

Snow on the ground, either naturally occurring or artificially produced, is the critical resource for the ski industry. The possibility to produce machine-made snow depends on favourable conditions (wet-bulb temperature and wind conditions), in addition to constraints associated to water management, energy and human resources. Several time-scales come into play in the optimization of the timing and amount of snow which needs to be produced to support the operation of ski resorts. Improving such decisions is a potent lever of the socio-economic and environmental impact of the ski industry at the European scale. The H2020 climate services project PROSNOW (2017-2020) ambitions to develop a decision making framework for the optimization of snow management, based on in-situ snow observations on ski slopes, meteorological and seasonal predictions. The key hypothesis behind PROSNOW is that adequately combining in-situ observations of the snow conditions on ski slopes, which form the starting point of any forecast, with atmospheric predictions spanning meteorological to seasonal time scales in a seamless manner, will provide added value for operational decision making.

This contribution will assess the partitioning of the predictability of snow conditions (natural and managed, i.e. including grooming and snowmaking), due to either starting conditions, i.e. the impact of the memory of snow, and the upcoming weather conditions. While the ultimate goal of PROSNOW is to apply the method across the European Alps (starting from 8 pilot ski resorts), this contribution will focus on a representative location in the Northern French Alps, combining short term (4 days lead time) ensemble meteorological forecast (ARPEGE ensemble NWP) with climatologically based seasonal forecast. Preliminary results based on winters 2014-2015, 2015-2016 and 2016-2017, show significantly better predictions at long range lead time, when using actual meteorological forecasts at the early stages of the long-term prediction framework, instead of relying on climatological data from the first day of prediction. In addition, the benefit of using current snow conditions to initialize the predictions is also significant even using climatologically-driven predictions, based on an experiments using multiple winter seasons, using data from 1990 to 2016.

The configuration used for this contribution will be upgraded, at a latter stage, by using extended meteorological forecasting periods (ECMWF medium range forecasts) and actual seasonal predictions. Nevertheless, the current set-up already makes it possible to address the relative role of starting and future conditions on the forecast of snow on the ground in general terms. This makes it possible to establish the evaluation framework of upcoming developments, and, thereby, directly forming a significant fraction of the underpinning science of the H2020 PROSNOW project. Initial results based on forecasting skills will be introduced, and applications of this seamless framework within and beyond the PROSNOW framework will be discussed.