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To the Origin of a Wintertime Screen-Level Temperature Bias at High Altitude in a Kilometric NWP Model

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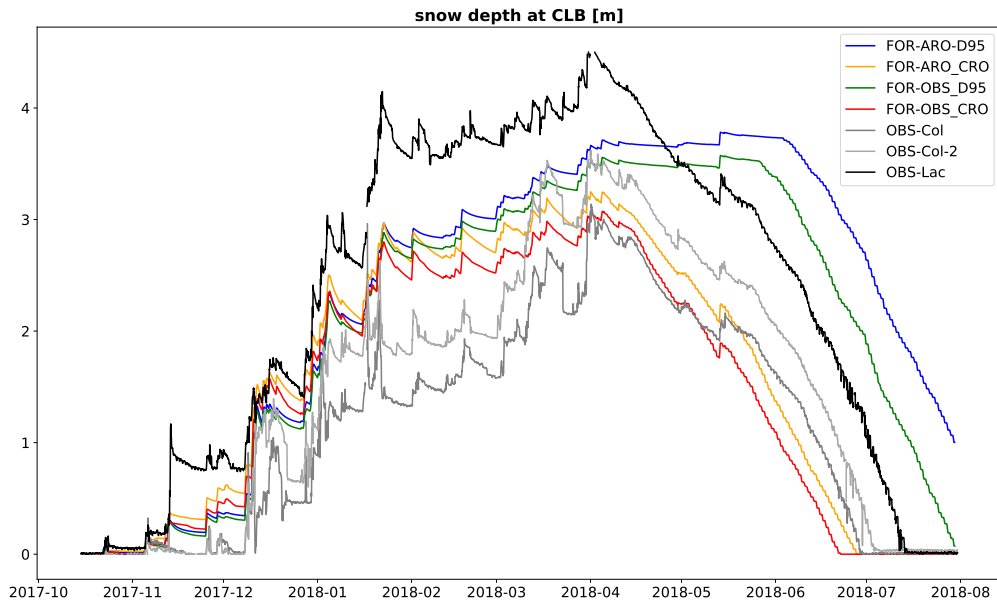
11 **1. Analysis of the effect of bias reduction in the forcing on the snow structure at the Lautaret**
12 **(LAUT) site**

13 At the LAUT site over the winter 2017-2018 (Fig. S6), the snowpack is much wetter than at
14 CLB, in part due to a lower altitude. Differences in atmospheric forcings between simulations
15 with FORARO ('Biased simulation') and FORBOS ('Reduced bias') also induce quite significant
16 differences in the simulated stratigraphies, with biased simulations leading among others to an
17 increased persistence of weak layers, most notably during January and February at about 1 m
18 height in the snowpack. The mechanism at play here is however different to the ones involved at
19 CLB: a more excedentary surface energy balance in the reduced-bias simulations induces more
20 melt in the mild temperature periods within the winter, and the percolating meltwater reaches and
21 transforms the dominant weak layer at around 1 m in the snowpack. Due to reduced melt in the
22 biased simulations, this weak layer persists one month longer.

23 **2. Complementary Figures**

44 **References**

45 Vionnet, V., I. Dombrowski-Etchevers, M. Lafaysse, L. Quéno, Y. Seity, and E. Bazile, 2016:
46 Numerical weather forecasts at kilometer scale in the french alps: evaluation and application for
47 snowpack modeling. *Journal of Hydrometeorology*, **17** (10), 2591–2614.



24 FIG. S1. Observed and simulated snow depths at CLB in different numerical experiments and observations.
 25 Observations are given at different subsites to give an insight into the spatial variability of snow at this highly
 26 wind-blown site: two locations at the pass (Col) and one location at the Lac where radiation is measured. The
 27 two stations located at the pass tend to be exposed to wind-induced erosion and show limited snow accumulation
 28 whereas the station at the location of the radiation sensor is situated in an area prone to accumulation of
 29 wind-blown snow. The one-dimensional snowpack simulations used in our study does not take into account
 30 wind-induced snow redistribution, and the simulated snow depth at Col du Lac Blanc fall in between the snow
 31 depth observed at the pass and at the location of the radiation sensor.

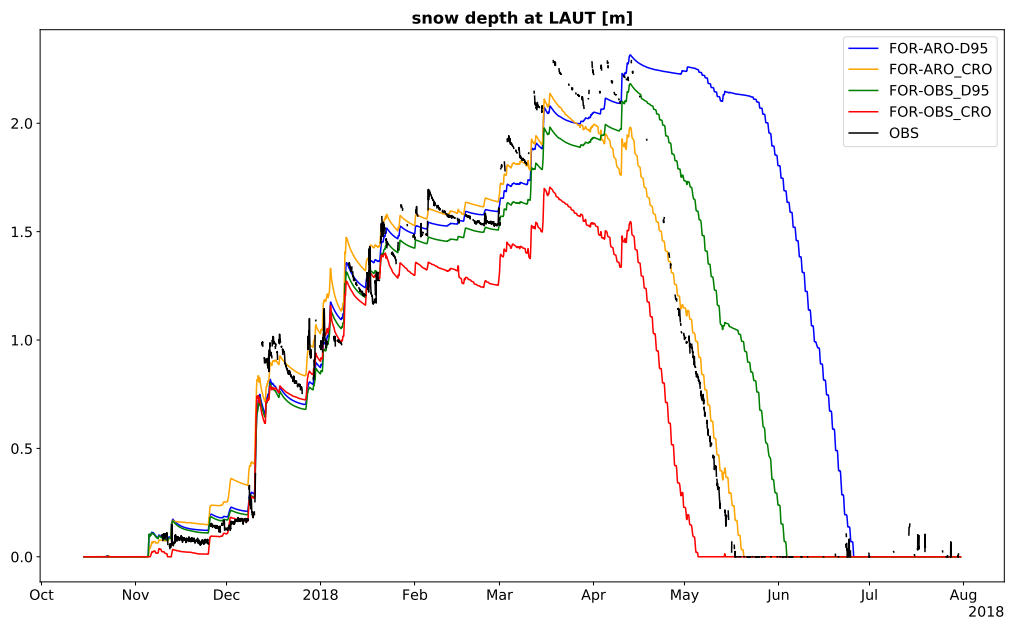
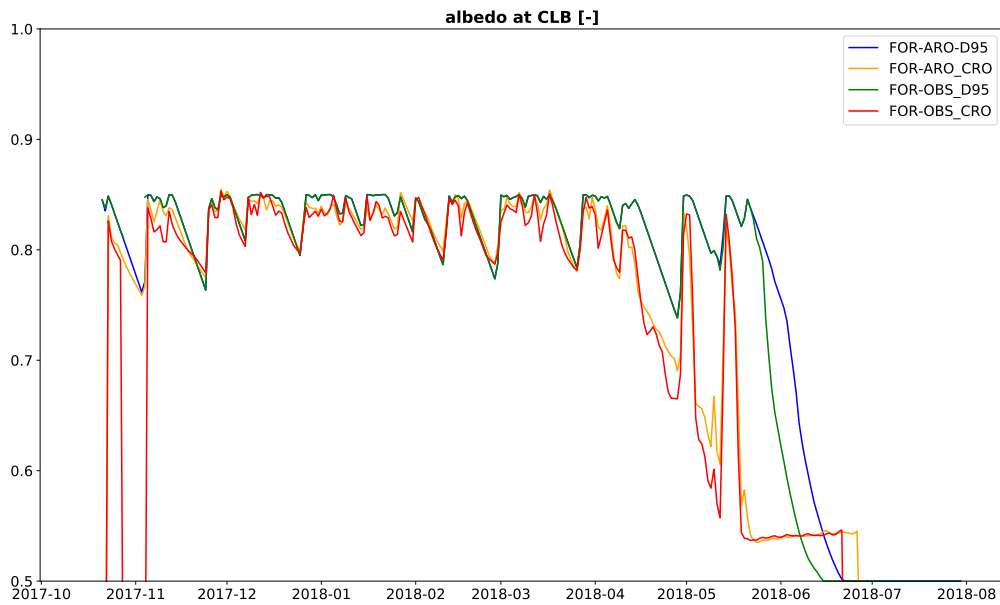
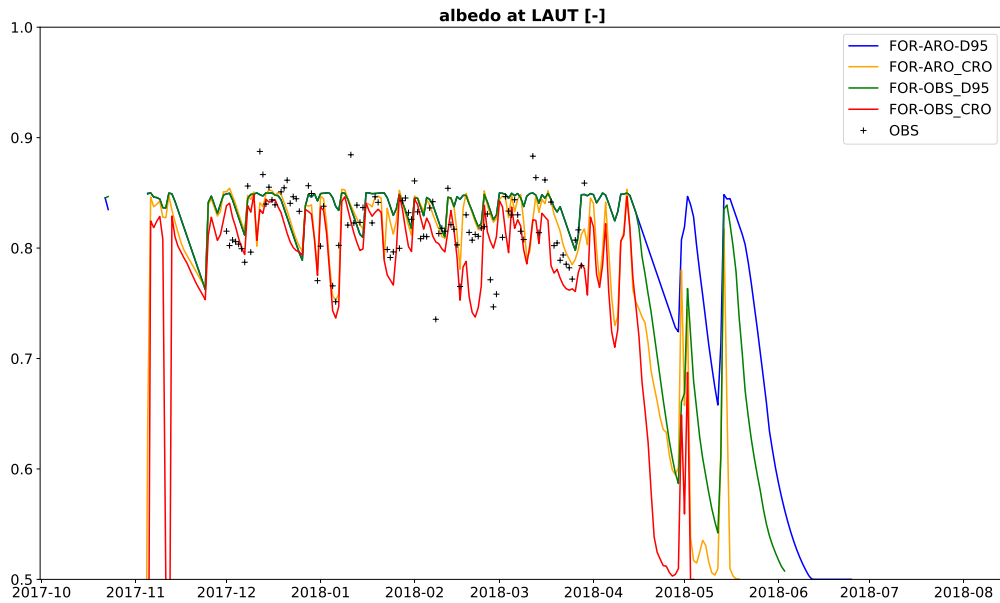


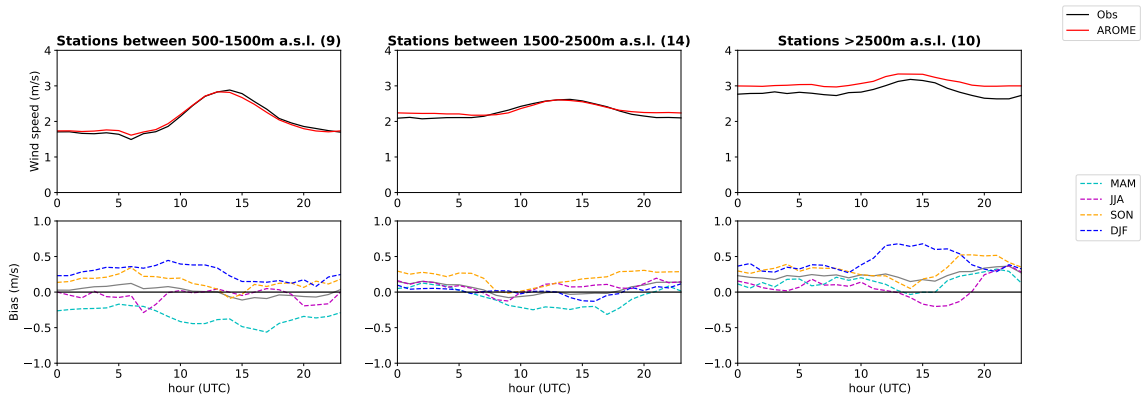
FIG. S2. Observed and simulated snow depths at LAUT in different numerical experiments and observations.



32 FIG. S3. Daily albedo at CLB in different simulations. The quality of outgoing shortwave radiation observations
 33 at CLB did not allow the derivation of a consistent albedo. Maximum difference in simulated mean albedo over
 34 the study period is lower than 0.01.

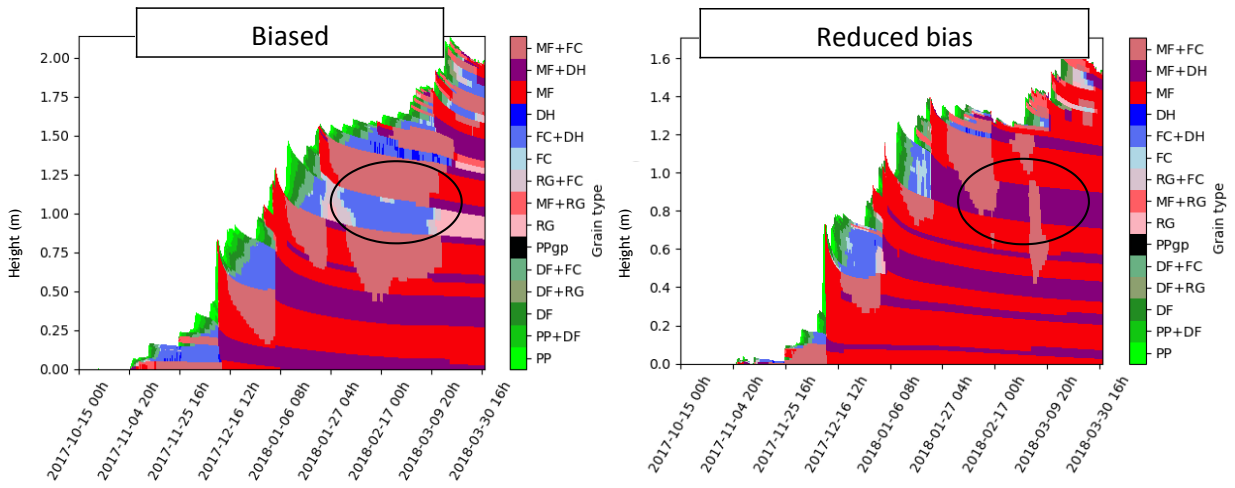


35 FIG. S4. Daily albedo at LAUT in different simulations, and as retrieved from observations (OBS). Maximum
 36 difference in simulated or observed mean albedo over the study period is 0.03.



37 FIG. S5. Diurnal cycles of AROME and observed wind speeds at mountain stations of the French Alps over
 38 the period from 2017-11-01 to 2019-03-31 (top). Diurnal cycles of AROME wind speed biases per season
 39 (bottom). The number of stations used in each altitude range is mentioned in brackets. At low and mid-altitudes
 40 less stations are used than in Vionnet et al. (2016) as we selected only stations measuring both wind speed and
 41 snow height, to correct for the height of the wind sensor using a logarithmic profile.

Stratigraphies at the LAUT, winter 2017-2018



42 FIG. S6. Stratigraphies simulated at LAUT by the Crocus snow model in a configuration with biases (FORARO,
 43 left) and with reduced biases (FOROBS, right)