Geophysical Research Abstracts
Vol. 19, EGU2017-16054, 2017
EGU General Assembly 2017

The representation of snow in the EC-Earth climate model: the impact of horizontal resolution

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The representation of the mountain cryosphere in climate models is critical owing to the scale mismatch between the snow-related processes, occurring at scales considerably smaller than 1 km, and the coarse grid of climate models, in the order of 10 and 100 km resolution. For instance, elevation gradients affect locally the air temperature which in turn controls the partition between solid and liquid precipitation, snowpack internal processes and snow melt at local scale. An adequate representation of the drivers of snow processes (e.g., temperature, snowfall), therefore, calls for high-resolution simulations. Moreover, a quantification of the uncertainty on snowpack estimates related to the coarse model resolution is of prime importance to correctly interpret the snow outputs of the large-scale models, e.g. those included in Coupled Models Intercomparison Project experiments.

This study aims to quantify the impact of the horizontal resolution on the simulation of snow-related variables focusing on the Greater Alpine Region (4-19°E, 43-49°N). We exploit a set of 5 simulations performed with the Global Climate Model EC-Earth run at increasing spatial resolutions, from $\sim$125 to 16 km, and we assess the differences (i) in the climatologies of the drivers of snow processes (air temperature, total precipitation, snowfall) and (ii) in the climatologies of the snow water equivalent distribution. Preliminary results show that in the finest resolution runs a slightly higher amount of snow precipitation leads to significantly thicker snow depths.

We also investigate the future expected changes of snow resources (mid 21st century, RCP8.5 scenario) and we quantify the discrepancies among the EC-Earth simulations run at the different horizontal resolutions. Finally we compare the results obtained with the EC-Earth model to those obtained in a previous study in which we considered the full ensemble of CMIP5 models.