EGU2020-18274
https://doi.org/10.5194/egusphere-egu2020-18274
EGU General Assembly 2020

Detection of precipitation and snow cover trends in the the European Alps over the last century using model and observational data

Julien Beaumet[1], Martin Menegoz[1], Hubert Gallée[1], Vincent Vionnet[2], Xavier Fettweis[3], Samuel Morin[4], Juliette Blanchet[1], Nicolas Jourdain[1], Bruno Wilhelm[1], and Sandrine Anquetin[1]
[1]CNRS, Université Grenoble Alpes, Institut de Géosciences de l'Environnement (IGE), 38000 Grenoble, France (julien.beaumet@univ-grenoble-alpes.fr)
[2]Environmental Numerical Research Prediction, Environment and Climate Change Canada, Dorval, QC, Canada (vincent.vionnet@canada.ca)
[3]F.R.S.-FNRS, Laboratory of Climatology, Department of Geography, University of Liège, 4000 Liège, Belgium (xavier.fettweis@uliege.be)
[4]Univ. Grenoble Alpes, Université de Toulouse, Météo-France, CNRS, CNRM, Centre d'Études de la Neige, 38000 Grenoble, France (samuel.morin@meteo.fr)

The European Alps are particularly sensitive to climate change. Compared to temperature, changes in precipitation are more challenging to detect and attribute to ongoing anthropic climate change mainly as a result of large inter-annual variability, lack of reliable measurements at high elevations and opposite signals depending on the season or the elevation considered. However, changes in precipitation and snow cover have significant socio-environmental impact mostly trough water resource availability. These changes are investigated within the framework of the Trajectories initiative (). The variability and changes in precipitation and snow cover in the European Alps has been simulated with the MAR regional climate model at a 7 km horizontal resolution driven by ERA20C (1902-2010) and ERA5 (1979-2018) reanalyses.

For precipitation, MAR outputs were compared with EURO-4M, SAFRAN, SPAZM and E-OBS reanalyses as well as in-situ observations. The model was shown to reproduce correctly seasonal and inter-annual variability. The spatial biases of the model have the same order of magnitude as the differences between the three observational data sets. Model experiment has been used to detect precipitation changes over the last century. An increase in winter precipitation is simulated over the North-western part of the Alps at high altitudes (>1500m). Significant decreases in summer precipitation were found in many low elevation areas, especially the Po Plain while no significant trends where found at high elevations. Because of large internal variability, precipitation changes are significant (pvalue<0.05) only when considering their evolution over long period, typically 60-100 years in both model and observations.

Snow depth and water equivalent (SWE) in the French Alps simulated with MAR have been compared to the SAFRAN-Crocus reanalyses and to in-situ observations. MAR was found to simulate a realistic distribution of SWE as function of the elevation in the French Alpine massifs,

although it underestimates SWE at low elevations in the Pre-Alps. Snow cover over the whole European Alps is evaluated using MODIS satellite data. Finally, trends in snow cover and snow depth are highlighted as well as their relationships with the precipitation and temperature changes over the last century.