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CSTools: the MEDSCOPE Toolbox for Climate Forecasts postprocessing

Núria Pérez-Zanón[1], Louis-Philippe Caron[2], Silvia Terzago[3], Bert Van Schaeybroeck[4], Lauriane Batté[5], M. Carmen Alvarez-Castro[6], Susana Corti[3], Marta Dominguez[7], Federico Fabiano[3], Silvio Gualdi[6], Jost von Hardenberg[3,8], Llorenç Lledó[1], Nicolau Manubens[1], Paola Marson[5], Stefano Materia[6], Eroteida Sánchez[7], Verónica Torralba[6], Deborah Verfaillie[1], and Danila Volpi[3]

[1]Barcelona Supercomputing Center (BSC) (nuria.perez@bsc.es)
[2]Ouranos, Montreal, Quebec
[3]National Research Council of Italy, Institute of Atmospheric Sciences and Climate (CNR-ISAC), Italy
[4]Royal Meteorological Institute of Belgium
[5]MeteoFrance/DCSC/AVH, France
[6]Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (CMCC), Italy
[7]Delegación territorial (DT) Cantabria, Agencia Estatal de Meteorología (AEMET)
[8]Dept. of Environment, Land and Infrastructure Engineering, Politecnico di Torino, Italy

Climate forecasts need to be postprocessed to obtain user-relevant climate information, to develop and implement strategies of adaptation to climate variability and to trigger decisions. Several postprocessing methods are gathered into CSTools (short for Climate Service Tools) for forecast calibration, bias correction, statistical and stochastic downscaling, optimal forecast combination and multivariate verification, as well as basic and advanced tools to obtain tailored products.

Besides an overview of the methods and documentation available in CSTools, a practical example is demonstrated. The objective of this practical example is to postprocess a seasonal forecast with a set of CSTools functions in order to obtain the required data to produce forecasts of mountain snow resources. Quantile mapping bias-correction and RainFARM stochastic downscaling methods are applied to raw seasonal forecast daily precipitation data to derive 1 km resolution fields. Bias-adjusted and downscaled precipitation data are then employed to drive a snow model, SNOWPACK, and generate snow depth seasonal forecasts at selected high-elevation sites in North-Western Italian Alps.

The computational resources required by CSTools to process the forecasts will be discussed. This assessment is relevant given the memory requirements for the use case: while seasonal forecast data occupies ~10MB (8 x 8 grid cells, 215 forecast time steps for 30 different initializations with 25 members each), the data post-processed reaches ~1TB (the RainFARM downscaling requires a refinement factor 100 for the SNOWPACK model increasing the spatial resolution to 800 x 800 grid cells and creating 10 stochastic realizations for each ensemble member). In addition to one strategy using conventional loops, startR is introduced as an efficient alternative. startR is an R package that allows implementing the MapReduce paradigm, i.e. chunking the data and processing them either locally or remotely on high-performance computing systems, leveraging multi-node and multi-core parallelism where possible.