Geophysical Research Abstracts
Vol. 21, EGU2019-10659, 2019
EGU General Assembly 2019

A novel methodology for merging different gridded precipitation products and ground-based measurements

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In many developing countries, an accurate representation of the spatio-temporal variability of precipitation is challenging because of the sparsely distributed network of rain gauge stations. For this reason, the representation of the spatial and temporal variability of rainfall when only ground-based measurements are used is subject to large uncertainties. Several precipitation products have become operational, however, these products have shown that multiple sources of errors are still present making their application difficult for operational purposes. We present a novel merging methodology based on the Random Forest technique with the aim of improving the spatio-temporal characterisation of the distribution of precipitation in data-scarce regions. This novel methodology combines different state-of-the-art satellite and reanalysis-based precipitation products with ground-based measurements and a digital elevation model. Two different products at daily temporal scale were computed over Chile for the period 2000-2016 using 258 rain gauge stations (∼70\%) for the model training, and the rest (111 stations) for validation purposes. The product MERGED-3P used information from three different precipitation products (PERSIANN-CDR, ERA-Interim, and CHIRPSv2) while the MERGED-5P used information from five (PERSIANN-CDR, ERA-Interim, CMORPHv1, CHIRPSv2, and TRMM 3B42v7). The objective of computing 2 different merged products is related to their temporal coverage; the MERGED-5P uses products that start in 1998 while the temporal coverage of the MERGED-3P product can be extended to 1983. In addition, we used MSWEP2.2 to compare the performance of both merged products to the current best precipitation dataset at the global scale.

Our results revealed that both merged products performed similarly, showing the best results between all the precipitation datasets when evaluated with both, continuous and categorical indices at different temporal scales (i.e. daily, monthly, seasonal, and annual). The methodology was able to improve the linear correlation, bias, and variability when compared to ground-based measurements. The merged products showed an increased probability of detection, and a reduced false alarm ratio and frequency bias for all the different rainfall intensities. The methodology has shown its ability to improve the spatio-temporal representation of precipitation over the complex topography and diverse climate gradients of Chile, therefore, we are confident that the same methodology can be applied globally and is expected to derive an improved characterisation of the spatio-temporal distribution of precipitation.