Geophysical Research Abstracts
Vol. 21, EGU2019-9683, 2019
EGU General Assembly 2019

Improving reliability and skill of medium-range hydrological ensemble forecasts over South America using EMOS

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Because of the uncertainties cascading from numerical weather to hydrological models, raw hydrological ensemble forecasts are often biased and characterized by dispersion errors, thus limiting their use for decision making. Statistical postprocessing can help in reducing these shortcomings by improving the consistency between forecast probabilities and their corresponding observed frequencies, with the aim of producing forecasts that are sharp as possible. The Ensemble Model Output Statistics (EMOS), for instance, is a regression-based postprocessing method commonly used in atmospheric sciences to estimate predictive distributions based on past forecast errors, and has been recently applied for hydrological purposes with promising results (Hemri et al., 2015). Here we assess the performance of postprocessed ensemble hydrological forecasts over South America region using the EMOS method. Medium-range (15 days), bi-weekly precipitation re-forecasts from the 11-member ECMWF EPS (0.2º grid resolution) were acquired between 1996 – 2014 and were used to force the MGB hydrologic-hydrodynamic model developed for the continental domain (Siqueira et al., 2018). To derive postprocessed univariate predictive distributions, discharges were first transformed to an approximate Gaussian space through box-cox transformation, and then a truncated EMOS model fitted with subsets of training data according to the season (DJF, MAM, JJA, and SON) was applied using a leave-one-year-out approach. In addition, as univariate methods such as EMOS do not account for spatial and/or temporal dependence structures, the Ensemble Copula Coupling (ECC) technique was further applied to each EMOS distribution in order to produce realistic ensemble trajectories by preserving the statistical coherence among different lead times. The performance of hydrological forecasts was evaluated using appropriate metrics and a reference simulation instead of observed data, the latter derived from a long-term MGB run using historical precipitation as input. Results show that in many cases EMOS-ECC is able to reduce bias and improve reliability in comparison with the raw ensemble, but the skill improvement of postprocessed hydrological forecasts varies according to the region and forecast lead time.

References

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