Session: C43 Poster: Th223A

Projected changes in components of the hydrological cycle in French river basins during the 21st century and associated uncertainties

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In this study, we assess the impacts of climate change on the hydrological cycle of the main French river basins during the 21st century and the different uncertainties at stake. In particular, the relative importance of modeling uncertainty versus that of downscaling uncertainty is investigated. A large ensemble of climate scenarios from the Coupled Model Intercomparison Project Phase 3 project are statistically downscaled in order to force a hydrometeorological model over France. Then, the main changes in different variables of the hydrological cycle are studied. Despite large uncertainties linked to climate models, some robust signals already appear in the middle of the 21st century, with in particular a pronounced decrease in mean discharges in summer and fall. The low flows generally become much more frequent but generally weak and uncertain changes in the intensity of high flows are simulated. To evaluate downscaling uncertainties and assess the robustness of the results obtained with the statistical downscaling method, two other downscaling approaches are used. The first one is a dynamical downscaling methodology based on a variable resolution atmospheric model, with a quantile-quantile bias correction of the model variables. The second approach is based on the so-called anomaly method, that simply consists of perturbing present climate observations by the climatological change simulated by global climate models. After hydrological modeling, some discrepancies exist among the results from the different downscaling methods. However they remain limited and generally substantially smaller than climate model uncertainties.