Historical Climate Change Impacts on the Hydrological Processes of the Ponto-Caspian Basin

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The Ponto-Caspian basin is one of the largest basins globally, composed of a closed basin (Caspian Sea) and open basins connecting to the global ocean (Black and Azov Sea). Over the historical time period (1850-present) Caspian Sea levels have varied between -25 and -29mbsl (Arpe et al., 2012), resulting in considerable changes to the area of the lake (currently 371,000 km^2). Given projections of future climate change and the importance of the Caspian Sea for fisheries, agriculture, and industry, it is vital to understand how sea levels may vary in the future. Hydrological models can be used to assess the impacts of climate change on hydrological processes for future forecasts. However, it is critical to first evaluate such models using observational data for the present and recent past, and to understand the key hydrological processes driving past changes in sea level.

In this study, the Terrestrial Hydrological Model (THMB) (Coe, 2000, 2002) is applied and evaluated to investigate the hydrological processes of the Ponto-Caspian basin for the historical period 1900 to 2000. The model has been forced using observational reanalysis datasets (ERA-Interim, ERA-20) and historical climate model data outputs (from CESM and HadCM3 models) to investigate the variability in the Caspian Sea level and the major river discharges. We examine the differences produced by driving the hydrological model with reanalysis data or climate models. We evaluate the model performance compared to observational discharge measurements and Caspian Sea level data. Secondly, we investigated the sensitivity of historical Caspian Sea level variations to different aspects of climate changes to examine the most important processes involved over this time period.