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Seasonal recurrence in storage and other hydrological variables at river basin scale for regime classification

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The hydrological cycle is one of the most important Earth Systems for human civilizations. As part of the Earth System, it is dependent on different periodical cycles of different geophysical source which determine different hydrological regimes. Following these periodicities and regimes, recurrent patterns specific to seasonal scale can be observed in the main hydrological variables (precipitation, evaporation, runoff and storage). In this study, we use multi-model output from Water Model Intercomparison Project (WaterMIP) part of the Water and Change (EU-WATCH) from the European Union, to investigate the recurrence of the main hydrological variables through their lagged autocorrelation. We define recurrence as a state that repeat itself time after time. We studied 20 large basins across the globe testing the recurrence of the four main hydrological variables. A basin classification method was derived taking the recurrence or non-recurrence of storage as first order criteria. Under the two main groups hierarchical subdivisions were created in the order of: precipitation, evaporation and runoff. A total of eight regimes were found using this criterion on the selected basins. The differences from group to group are further explained by assessing basic hydrological processes like climatologies, evaporation and runoff ratios and different storage component volumes. We propose this classification as a first attempt of including storage interaction and weighing on hydrological processes. Under this classification we were able to identify the most important storage components and how the storage function of a basin converts collection of precipitation into release through runoff. The analysis of the recurrence in hydrological variables further explains the natural equilibrium of a basin, basic understanding of most importance for water managers. This methodology is proposed as a method to test the resilience of basins as tipping points for regime changes can be analysed.