The estimation of groundwater storage changes at climatic time scales from low streamflow observations

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Abstract. During periods of no precipitation or artificial inputs, the water flow observed in a river can be assumed to result primarily from drainage of groundwater from the upstream riparian aquifers in the catchment. Groundwater storage in a basin goes through various high and low phases during any given year depending on the antecedent precipitation inputs over the region; hence, an objective way to track the long term evolution of this storage over many years is to monitor its lowest level each year, that is, when it reaches "rock bottom", or the non-depleted reserve, which is available for the next year. Because the groundwater drainage into the river system is directly related to the water stored in the upstream aquifers, observations of the trends of the annual lowest flows can serve to deduce quantitative estimates of the basin-scale groundwater storage trends over the period of the streamflow record. The proposed method was implemented and validated with streamflow and groundwater level observations in two basins in Illinois, and then applied with streamflow data in a large basin in Mongolia, where it could be compared with other measures of a changing hydrologic cycle.