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Analysis of temporal and spatial variability of water balance components in a Mediterranean river basin: the Spanish part of the Duero basin

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Water balances have been identified as an effective tool for assessing the amount of water and its availability in a region. In particular, the System of Environmental-Economic Accounting for Water (SEEA-W) has emerged as one of the most complete methodologies to undertake this action. Despite the great effort made to offer a common methodology for elaborating the SEEA-W tables, there are multiple aspects that prevent its standardization in a generalized way. This leads both to multiple approaches in the realization of water balances and to the introduction of high uncertainty in the accounts obtained.
The data series variability, both temporal and spatial, is one of the factors that can introduce large uncertainty into the water balances if they are not correctly evaluated. This aspect has not yet been specifically studied, and most of the case studies in the literature only provide the water balance values for a short period (usually a natural or hydrological year) and for a specific basin. In the case of having data corresponding to several years, average values are typically used to elaborate the calculations.
In the present study, the SEEA-W methodology was applied to the Spanish part of Duero river basin. Each component of the water asset accounts was calculated using simulated data from three models: SIMPA (rainfall-runoff model), ASTER (snow-related processes model) and SIMGES (water allocation and management model). These models were developed and calibrated by different Spanish entities. Then, the uncertainty associated with the temporal and spatial irregularity of the data series was also estimated.
The Duero basin is located in a semi-arid Mediterranean region, where hydrological processes are affected by high intra- and inter-annual variability. To analyse this issue both monthly and annual resolutions were used. The first allowed identifying a significant intra-annual variability. The second was analysed using a period of 26 years, from 1980 to 2006. The results show a high variability for certain hydrological components which can lead to a great degree of uncertainty. In addition, each hydrological year was classified as dry, average or wet and water balances were calculated under the same classification. This approach would improve the estimation of water resources including the prediction of future climate changes scenarios.
Regarding the spatial variability, the water resources of the basin, like many of the large Mediterranean rivers, are not evenly distributed and showed large differences in hydrological processes. These differences are caused by climatic and geomorphological differences (the area comprises an extensive central plateau with a peripheral mountain arch). In addition, the analysis considers the different human activities coexisting within the basin and the heterogeneity of their spatial distribution. The water balances split into a more disaggregated territorial units could help to detect the areas with both positive and negative balances and improve the water resources management in the whole basin.