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How can we parameterize water balance formulas to account for seasonality effects ?

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We define here seasonality as the synchronicity between precipitation and maximum evaporation, and argue that it is, after aridity, a second-order determinant of catchment water yield.
We present a simple synchronicity index and propose a parameterization based on this index for three commonly-used water balance formulas (namely, Turc-Mezentsev, Tixeront-Fu and Oldekop formulas) to account for the seasonality effects. We quantify the improvement of seasonality-based parameterization in terms of the reconstitution of both catchment streamflow and water yield. The significant improvement obtained (reduction of RMSE between 9 and 14% depending on the formula) demonstrates the importance of the synchronicity between precipitation and maximum evaporation in the determination of long-term catchment water balance.