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Selective incorporation of trend into seasonal streamflow climatology

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Abstract: Probabilistic climatology forecasts of seasonal streamflow up to 12 months ahead are incredibly useful for water resource planning (Anghileri et al., 2016), informing risk-based management strategies. However, the assumption of a stationary distribution for such climatology forecasts fails to account for observed trends present in many streamflow gauge records (Marhaento et al., 2021; Yeh et al., 2015), which can result in unnecessary bias and excessive spread in the forecasts. For example, where drying trends have led to reduced flow, water resources may be overestimated based on a higher historical mean flow. While trended climatology forecasts are sometimes far better than un-trended climatology forecasts, most of the time they are worse, in part due to the additional parameter uncertainty from trend estimation (Shao et al., 2022).

Here we present an approach to selectively adopt trended climatology forecasts based on observed trends in the training period (Graham et al., 2025). We use a high-quality hydrological station network covering a broad range of hydroclimate conditions to compare trended and un-trended climatology and evaluate our proposed approach to selective adoption of trended climatology. We found trended climatology forecasts provided high skill relative to the un-trended climatology baseline when negative trends were present, especially when those trends were significant. We also observed negative skill in around half the cases, especially where positive trends were present, highlighting the necessity for selective application. We recommend the adoption of trended climatology for seasonal streamflow forecasting whenever there is a fair chance of a negative trend present (and not when a positive trend is present), particularly in applications that require conservative estimates of long-term flows (e.g., allocation of annual water accounts).

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