



## **In phase or not in phase? Exploring the spatial structure of long term components of multivariate hydrological time series**

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Runoff time series are known to contain long term structures on interannual to decadal time scales. Investigating spatial patterns of long term structures is a way to elucidate the relationship between external forcings and watershed properties. This would be a valuable contribution to an improved water resources management. Singular System Analysis (SSA) is a powerful technique to identify and extract significant long term components from time series. However, many observations from natural systems are prone to missing data that hamper many analysis techniques, including the SSA in its original formulation. Therefore we apply an improved variant of SSA recently proposed to deal with time series containing missing values, which provides a gap-filling procedure exploiting the full dynamics as revealed by SSA. We can demonstrate that the modified SSA is able to cope with data containing up to 30

This setup of methods is applied to a set of 387 time series from the United States. SSA reveals that 93

The framework developed is applicable to any set of regionally connected hydroclimatic time series. Based on our results for the USA, it is to be expected that other regions also show extended synchronous behaviour, and that a new classification of hydrological dynamics can be based on the corresponding proximity matrices.