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Time-scale dependency of patterns in ecosystem fluxes

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Ecosystem-level response functions of CO_2, water, and energy fluxes to meteorological drivers are highly non-linear. Artificial Neural Networks (ANNs) are one means to represent responses of this kind and characterize the influence of various hydrometeorological factors and their interactions. However, the "gross response functions" are hardly interpretable given that the fluxes are integrators of various sub-processes within the ecosystem. Hence, in this contribution, we first separate the ecosystem fluxes and drivers into modes of variability that add up to the observed time series using Singular Spectrum Analysis (SSA). Only then are the ANNs used to extract the multivariate dependencies and identify the climatic controls. This allows us to separate the response surfaces corresponding to the different subcomponents of the ecosystem processes. The results show how the ecosystem responses depend on the time scale but also indicate across-scale interactions which may limit the use of purely statistical approaches for pattern extraction.