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Stabilizing high-order, non-classical harmonic analysis of NDVI data for average annual models by damping model roughness

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Abstract

Fourier series and related harmonic methods have been demonstrably effective for identifying and characterizing the seasonal behaviour, or phenology, of a variety of terrestrial vegetation communities using Normalized Difference Vegetation Index (NDVI) time series from Earth-orbiting satellites. The ultimate temporal resolution of such applications has been limited, however, by the common practice of truncating, or low pass filtering, harmonic series to relatively low order terms, in order to suppress spurious oscillations in the model results. The temporal resolution of these techniques can be significantly improved if, along with a weighted minimization of the sum of the squared data residuals tracking the upper envelope of observed data, we also enforce an expectation of minimum model roughness to dampen spurious oscillations in

predicted values. The resulting annual models have resolutions consistent with the application of special transcendental forms, such as asymmetric Gaussian and logistic (sigmoidal) functions, recently reported in the literature.

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