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On the cyclo-stationarity of the time-variable Kaula rule

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Stochastic filtering of the monthly fields of GRACE time-variable gravity requires the computation of a signal covariance model, which is usually computed as a power-law from the GRACE data itself. The computation of the power-law involves the averaging of the degree variance models of all the available months of data, and fitting a straight line to the logarithm of the degree variances. Such signal variance models tend to under-represent the inherent annual behaviour of the signal. In this contribution, we demonstrate the need to calculate a cyclo-stationary signal variance model, which represent the stochastics of the signal more truthfully. Further, we show that when cyclo-stationarity of the signal variance is ignored, the filtered fields are under-/over-smoothed. Due to the fact that every month uses a different signal variance model, the resolution of the filter kernels keeps changing over the time-series. Therefore, the time-series of maps generated by such filter kernels will not share a common resolution, and hence, we homogenize the resolution using isotropic filers. Finally, we will compare the time-series of GRACE fields, filtered using both stationary and cyclo-stationary signal variance models, with observed hydrological data.