Geophysical Research Abstracts
Vol. 21, EGU2019-14247, 2019
EGU General Assembly 2019

Demystifying the origin of stripes in GRACE mission gravity field models

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The Gravity Recovery and Climate Experiment (GRACE) gravity models suffer from a dominant systematic error, usually referred to as “longitudinal stripes”. These stripes contaminate useful geophysical signals and limit the spectrum of geoscience applications that can be benefited from GRACE and from the recently launched GRACE-Follow On. We perform a thorough analysis on the spatiotemporal structure of the stripes and estimate their spectral and geospatial characteristics. Spectral analyses of stripe longitudinal profiles from monthly solutions show dominant half-wavelengths at 168.1km, 202.9km and 210.5km. We prove that the stripes are spatially non-stationary showing a travelling-wave pattern that shifts proportionally to the ground track eastward drift. Following this evidence, we employed data analytics and simple physics principles to show for the first time since the launch of GRACE in 2002 that the stripes are highly coherent at 80% - 90% level with the ground tracks that “bundle” in a wave-like travelling pattern creating constructive and destructive Moiré fringes. This finding opens a new era in space gravity missions and ultimately to stripe-free GRACE-based gravity field models. It also shows the way to study and eliminate stripe-like patterns in other LEO missions with similar orbital characteristics such as SWARM.