Geophysical Research Abstracts
Vol. 14, EGU2012-6270, 2012
EGU General Assembly 2012

Wavelet based directional analysis of the gravity field: evidence for large-scale undulations

M. Hayn (1), I. Panet (2,3), M. Diament (3), M. Holschneider (1), M. Mandea (4), and A. Davaille (5)

(1) Institute for Mathematics, University of Potsdam, Am Neuen Palais 10, 14469 Potsdam, Germany, (2) Institut Geographique National, Laboratoire de Recherche en Geodesie, GRGS, ENSG, 6/8, av. Blaise Pascal, Cite Descartes, Champs/Marne, 77455 Marne-la-Vallee Cedex 2, France, (3) Univ Paris Diderot, Sorbonne Paris Cite, Institut de Physique du Globe de Paris, CNRS, Bat. Lamarck, Case 7011, 35, rue Helene Brion, 75205 Paris Cedex 13, France, (4) Centre National d'Etudes Spatiale, 2, place Maurice Quentin, 75039 Paris, France, (5) Laboratoire FAST (CNRS / Univ. P-Sud / UPMC), Batiment 502, rue du Belvedere, Campus Universitaire, 91405 Orsay, France

In the eighties, the analysis of satellite altimetry data lead to the major discovery of gravity lineations in the oceans, with wavelengths between 200 km and 1400 km. While the existence of the 200 km scale undulations is widely accepted, undulations at scales larger than 400 km are still a matter of debate.
In our work, we revisit the topic of the large scale geoid undulations over the oceans in the light of the satellite gravity data provided by the GRACE mission, considerably more precise than the altimetry data at wavelengths larger than 400 km.

First, we develop a dedicated method of directional Poisson wavelet analysis on the sphere with significance testing, in order to detect and characterize directional structures in geophysical data on the sphere at different spatial scales. This method is particularly well-suited for potential field analysis.
We validate it on a series of synthetic tests, and then apply it to analyze the gravity model EGM2008, as well as a bathymetry dataset independent from gravity.

Our analysis confirms the existence of gravity undulations at large scale in the oceans, with characteristic scales between 600 and 2000 km. Their direction correlates well with present-day plate motion over the Pacific ocean, where they are particularly clear, and associated with a conjugate direction at 1500 km scale.
A major finding is that the 2000 km scale geoid undulations, which has never been so clearly previously observed, dominate. We discuss these results in terms of geodynamic and mantle convection.