Geophysical Research Abstracts
Vol. 19, EGU2017-15819, 2017
EGU General Assembly 2017

Clock measurements to improve the geopotential determination

Guillaume Lion (1,2), Isabelle Panet (2), Pacôme Delva (1), Peter Wolf (1), Sébastien Bize (1), Christine Guerlin (1,3)

(1) LNE, SYRTE, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités, UPMC Univ. Paris 06, France, (2) LASTIG LAREG, IGN, ENSG, Univ Paris Diderot, Sorbonne Paris Cité, France, (3) Laboratoire Kastler Brossel, ENS-PSL Research University, CNRS, Collège de France, UPMC-Sorbonne Universités, France

Comparisons between optical clocks with an accuracy and stability approaching the 10^{-18} in term of relative frequency shift are opening new perspectives for the direct determination of geopotential at a centimeter-level accuracy in geoid height. However, so far detailed quantitative estimates of the possible improvement in geoid determination when adding such clock measurements to existing data are lacking.

In this context, the present work aims at evaluating the contribution of this new kind of direct measurements in determining the geopotential at high spatial resolution (10 km). We consider the Massif Central area, marked by smooth, moderate altitude mountains and volcanic plateaus leading to variations of the gravitational field over a range of spatial scales. In such type of region, the scarcity of gravity data is an important limitation in deriving accurate high resolution geopotential models.

We summarize our methodology to assess the contribution of clock data in the geopotential recovery, in combination with ground gravity measurements. We sample synthetic gravity and disturbing potential data from a spherical harmonics geopotential model, and a topography model, up to 10 km resolution; we also build a potential control grid. From the synthetic data, we estimate the disturbing potential by least-squares collocation. Finally, we assess the quality of the reconstructed potential by comparing it to that of the control grid. We show that adding only a few clock data reduces the reconstruction bias significantly and improves the standard deviation by a factor 3. We discuss the role of different parameters, such as the effect of the data coverage and data quality on these results, the trade-off between the measurement noise level and the number of data, and the optimization of the clock data network.