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Mean and profile-based dynamic ocean topography determination in the Mediterranean Sea within the GOCE+++ project

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A composite part in the synergy between geodesy and oceanography is the determination of the dynamic ocean topography (DOT), the latter being the deviation of the Mean Sea Surface (MSS) relative to the geoid. The advent of satellite altimetry during the last twenty years has allowed the determination of MSS models with even increasing accuracy and resolution, while the latest operational capabilities of the SAR and SAR-in modes have enabled the use of altimetric data close to the coastline and at distances as short as a few km. The limiting factor for the determination of rigorous, in the sense of resolution and accuracy, DOT models was the insufficient knowledge of the marine geoid, which suffered from both long- and medium-wavelength errors. Both stem from the fact that the satellite data had poor resolution, thus limiting the maximum resolvable harmonic degree, while marine gravity data are of varying accuracy and by no means cover all Earth's oceans. The advent of GOCE and GRACE missions, resulted in high-accuracy observations of the Earth's potential with uniform distribution over the entire Earth, so that the geoid signal can be resolved with comparable accuracy as is the case with altimetry-derived MSS models. The main scope of this work is the determination of DOT models for the Mediterranean basic following two approaches. The first one treats both the MSS and the geoid as purely static fields, so that a mean DOT model is determined through the difference between the DTU2015 MSS and the GOCO05c geoid model. For the determination of this static DOT, various filtering options such as boxcar, wiener, and cosine-tapper are applied, along with wavelet multiresolution analysis with selective filtering. All filters intend to remove or at least reduce the geoid omission and commission errors present in the differences between the MSS and the geoid. In the second approach, the DOT is treated as a varying field, so that Cryosat2-derived sea surface heights (SSHs) are used with GOCO05c-dervied geoid heights to deduce an along-track DOT with a variation of 35-days. This DOT is much more meaningful, since the resulting circulation should primary monitor not only mesoscale currents but smaller eddies and gyres as well. For the along-track filtering, IIR and FIR filters are tested and the selection of the proper cut-off frequencies is based on an evaluation relative to the RIO_MED synthetic DOT and the latest CNES16 DOT models. Finally, the Mediterranean circulation is derived in the form of geostrophic currents, while the DOT models are assessed in terms of their ability to resolve the main known currents in the region.