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A comparison between sea-bottom gravity and satellite altimeter-derived gravity in coastal environments: A case study of the Gulf of Manfredonia (SW Adriatic Sea)

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In this study, we present a comparative analysis between two types of gravity data used in geophysical applications: satellite altimeter-derived gravity and sea-bottom gravity.

It is largely known that the marine gravity field derived from satellite altimetry in coastal areas is generally biased by signals back-scattered from the nearby land. As a result, the derived gravity anomalies are mostly unreliable for geophysical and geological interpretations of near-shore environments.

To quantify the errors generated by the land-reflected signals and to verify the goodness of the geologic models inferred from gravity, we compared two different altimetry models with sea-bottom gravity measurements acquired along the Italian coasts from the early 50s to the late 80s.

We focused on the Gulf of Manfredonia, located in the SE sector of the Adriatic Sea, where: (i) two different sea-bottom gravity surveys have been conducted over the years, (ii) the bathymetry is particularly flat, and (iii) seismic data revealed a prominent carbonate ridge covered by hundreds of meters of Oligocene-Quaternary sediments.

Gravity field derivatives have been used to enhance both: (i) deep geological contacts, and (ii) coastal noise. The analyses outlined a “ringing-noise effect” which causes the altimeter signal degradation up to 17 km from the coast.

Differences between the observed gravity and the gravity calculated from a geological model constrained by seismic, showed that all datasets register approximately the same patterns, associated with the Gondola Fault Zone, a major structural discontinuity traversing roughly E-W the investigated area.

This study highlights the importance of implementing gravity anomalies derived from satellite-altimetry with high-resolution near-shore data, such as the sea-bottom gravity measurements available around the Italian coasts. Such analysis may have significant applications in studying the link between onshore and offshore geological structures in transitional areas.