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A combined observational and modeling approach to the study of coastal areas: the case of the Gulf of Trieste

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During the last decade high-frequency (HF) radar systems have been installed operationally throughout the world, and extensive validation efforts have proven their reliability in mapping near-surface currents at high spatial and temporal resolutions. Nowadays, they are considered as a reliable benchmark for the validation of numerical circulation models and of tidal current models. Similarly to HFR data, ocean circulation models are now considered reliable tools that are routinely put into operational use to provide a wide range of products of public interest. To insure the scientific integrity, assessing the skill of the model products is a crucial point, especially in coastal areas where tidal processes (such as currents or mixing) are important, bathymetry and changes in the vertical and horizontal structure of temperature, salinity, and density due either to seasonal variations or impulsive-type freshwater input are also critical. Here we present the case of the Gulf of Trieste, northern Adriatic Sea, a complex coastal region in which circulation is controlled by a number of complex processes that include tides, wind, waves and variations in river discharge with significant temporal variability. By comparing radar observations, data from moorings and coastal tide gauges, with the output of different circulation models (NAPOM -an operational version of Princeton Ocean Model (POM) for the Northern Adriatic; and OTPS, a barotropic tidal model for the Northern Adriatic), we show that: HFR observations and model simulations are complementary tools in complex coastal regions, in the sense that they reciprocally help accounting for their intrinsic limitations (i.e. lack of vertical resolution in HFR data; areas with significant topographic gradients for models); tidal models accurately describe tidal features in the region; and that existing intrinsic data-model discrepancies can be interpreted and used to propose correction to the models.