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Coastal SAR Altimetry: An Experiment in the Northern Caspian Sea

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As it has been already shown by previous works (Dinardo et al., 2011, 5th Coastal Altimetry Workshop proceedings), the CryoSat-2 SAR Echoes behave very well in accordance with the waveform physical models even in the very proximity of the coastline in case of favourable conditions (ground-tracks orthogonal to the coastline) whereas they can be still heavily land-contaminated in case the ground-track runs parallel to the coast line.
This anisotropic effect is due to the shrinkage of the spatial resolution in SAR mode that occurs just in along-track direction, leaving unchanged the across-track resolution.
As a consequence of this footprint shrinkage, the advent of SAR Mode promises to revolutionize the coastal zone satellite altimetry.
Anyway, nowadays, all the current more mature SAR Re-tracking methodologies (SAMOSA and CNES/CLS CPP) are designed to offer the best performances over open ocean surfaces (diffusive surface scattering mechanism).
Notwithstanding, they may perform also very well in coastal zones unless:

1) the echoes suffer a really "heavy" contamination from the surrounding land
2) the echoes originate from very shallow and still coastal waters (specular surface scattering mechanism).

This second case is not very frequent in coastal zones but it may be observed now more often because in SAR mode we have finally the possibility, in favourable conditions, to really reach the shoreline where a still water scenario can be encountered.
Following the initial work presented at 6th Coastal Altimetry Workshop (2012), we will attempt to adapt the original open ocean SAMOSA SAR Echo Model to a coastal still water scenario.
Indeed, the SAMOSA SAR Echo Model is a “water” model and can be used to reproduce a SAR Echo originated either from rough water surface (open ocean) either from standing water surface (bays, wetlands, lakes and rivers).
The model adaptation to coastal still water scenario will be operated estimating the water surface rms slope (RMSSS) from the backscattered power distribution vs. Doppler beam angle as achieved integrating the SAR STACK’s power echoes. This RMSS parameter is an indicator of how much specular or diffusive is the surface illuminated by the radar.
The RMSS parameter will be hence fed as input in the SAMOSA Physical Model in order to adapt the model itself automatically to the changed water scenario conditions, turning the model’s classic long-tail SAR waveform into a very peaky waveform.
THE SAMOSA model will be implemented in its full analytical formulation (zero-order and first-order term), neglecting only the effect of the water surface skewness.
The benefit of this methodology is that we use either for open ocean conditions either for coastal still water conditions the same model and re-tracker scheme, avoiding hence any bias or discontinuity in height, typically occurring when one swaps waveform model or re-tracker scheme during the same pass.
The experiment will be run at the wetlands of the Volga’s Delta in the Northern Caspian Sea in summer time. CryoSat-2 is covering the area in SAR mode and along the passes, the instrument is facing an abrupt transition from diffusive open sea condition to very specular water conditions over the Volga’s Delta wetlands. Hence, this seems to be the ideal environment where to test the proposed methodology.