Current topic for a Master's Thesis

Validation of coastal sea level measurements

Satellite altimetry has provided a continuous record of sea levels for more than 30 years. Thanks to significant progress and refinements in data processing, it has become possible to extend these records to within just a few kilometers of the coast. At DGFI-TUM, data records from all altimetry missions are stored in a uniform format, enabling direct comparisons of the performance of different algorithms used for data processing. Furthermore, DGFI-TUM applies its own algorithms to the original waveforms from these missions to facilitate further improvements. One particularly relevant approach is the application of the ALES algorithm (Passaro et al., 2014), which has been extensively utilized and has enabled various coastal applications, such as a global coastal sea level trend analysis conducted within the framework of the European Space Agency's Sea Level Climate Change Initiative.

In recent years, the traditional processing algorithm used in standard altimetry (MLE4) has been replaced by the so-called "Adaptive algorithm" (Tourain et al., 2021). This new algorithm aims to reduce the noise of retrievals and improve coastal performance. Sea level measurements retrieved with this algorithm are now part of the official records of the Jason-3 and Sentinel-6 missions.

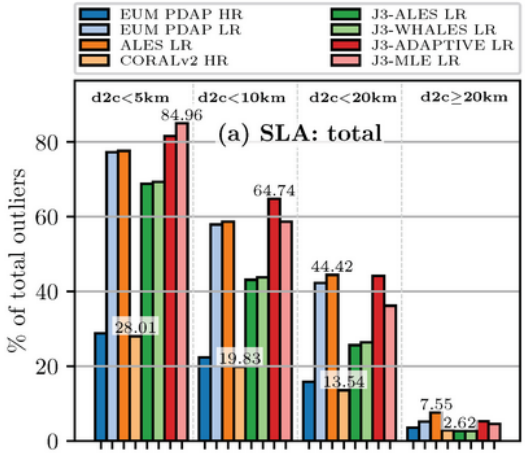

Figure 1: Number of outliers in sea level records for different processing strategies with respect to the distance to the coast (Passaro et al., 2023)

In this thesis, the performance of the ALES and Adaptive processing algorithms will be investigated in comparison with the standard altimetry dataset for the Jason-3 and Sentinel-6 missions. In situ data, particularly tide gauge data from the GESLA3 archive (www.gesla.org), will be used as ground truth. The analysis will evaluate the impact of proximity to the coast on the quality and quantity of the data using typical statistical measures such as correlation and the percentage of outliers. In addition, the student will perform a direct comparison between Jason-3 and Sentinel-6 retrievals using the "tandem" phase, in which the two satellites collected data on the same tracks.

Main tasks:

- Understanding the measurement principle of sea level from satellite altimetry and tide gauges
- Design a validation strategy to evaluate data with respect to the distance from the coast
- Evaluate and describe benefits and drawbacks of the use of different processing algorithms for Jason-3 and Sentinel-6 altimetry missions and compare the results with existing literature

References:

Passaro M., Cipollini P., Vignudelli S., Quartly G., Snaith H.: ALES: A multi-mission subwaveform retracker for coastal and open ocean altimetry. Remote Sensing of Environment 145, 173-189, 10.1016/j.rse.2014.02.008, 2014

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Tourain, C., Piras, F., Ollivier, A., Hauser, D., Poisson, J. C., Boy, F., ... & Tison, C. (2021). Benefits of the adaptive algorithm for retracking altimeter nadir echoes: Results from simulations and CFOSAT/SWIM observations. IEEE Trans. Geo.and Remote Sensing, 59(12), 9927-9940.

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