Pointwise comparison of geostrophic currents of altimetry-derived instantaneous
Ocean Dynamic Topography with in-situ measurements

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Introduction
The time-variable dynamic ocean topography (DOT) along individual ground tracks of altimeter missions (IDOT-profiles) allows to study temporal variations of the DOT. By using the so-called "profile-approach" (Bosch & Savchenko, 2010; Bosch et al., 2013) in a multi-mission scenario a monitoring of meso-scale eddies is possible.

Our aim is to validate the IDOT-profiles with geostrophic velocities derived from surface drifters and ARGO floats. We perform a pointwise comparison by interpolating the IDOT profiles to the positions of the in-situ measurements and converting them to geostrophic velocity vectors.

Recent studies have shown, that the interpolation method causes a smoothing of the IDOT data and yields about two-times smaller geostrophic velocities than the in-situ measurements. In the present investigation we conduct a sensitivity analysis quantifying the impact of the scale factors. Results are presented for the Gulf Stream area and for different periods.

Methodology: Pointwise Comparison
We model the IDOT heights $h_{idot}$ by an inclined plane with respect to a local Cartesian coordinate system $x,y$ centered in the location in each in-situ observations.

$$ h_{idot}(x,y) = c_1 x + c_2 y $$

All IDOT values near the in-situ observation are used to estimate by least squares the coefficients $c_1$. The $c_1$ and $c_2$ coefficients representing the inclination in meridional and zonal direction. The selections of the IDOT data used for interpolation is done by a circular cap with a certain interpolation radius $R$ and within a maximum temporal spacing $T$ around each in-situ observation. These interpolation parameters have a significant impact on the smoothing of IDOT profiles.

In order to get geostrophic velocity vectors we apply the geostrophic equations and derive the geostrophic components

$$ u = -\frac{F}{\rho g} \delta_{x} \text{ and } v = \frac{F}{\rho g} \delta_{y}, $$

where $F$ is the Ekman drift caused by wind and Ekman drifts is necessary. For this purpose, the model of Lagrang et al (1999) is used. Daily wind and wind-stress fields are taken from NOAAS NCDC. Additionally, a one day moving average is applied in order to reduce noise in the drifter data.

Results: Pointwise Comparison
With $T=\pm8$ days and $R=130$ km we can improve the results in both components. However, a scaling factor of 1.37 in $u$ and 1.16 in $v$ is still present. The data distribution of the IDOT-profiles in space and time is affected by an interpolation factor.

Conclusions
• Due to the spatio-temporal sampling of altimetry with repeat orbits the smoothing of DOT-derived geostrophic velocities is unavoidable and manifests itself by scaling factors.
• A sensitivity analysis yields optimal interpolation parameters.
• The optimal choice of the interpolation parameters depends on the altimetry missions and their temporal and spatial resolution.
• In areas with western boundary currents the altimetry-derived geostrophic velocities are less sensitive to strong meandering flow.
• The differences between in-situ and DOT-currents exhibit an almost normal distribution with zero mean and most deviations located inside the interval $\pm 0.10$ m/s.
• The altimetry-derived geostrophic currents mirror in-situ existing current patterns in direction and amplitude quite well.