Impact of internal tide correction on the DUACS maps accuracy

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Internal tide = pollution of CMEMS/DUACS maps
Correction & Assessment methodology
Results & discussion
Residual tidal variability has been detected in Sea Level Anomalies (SLA) gridded products (e.g., AVISO 2014 release) by E. Zaron et al. – 1 cm – that could be reduced by filtering SLA or/and correcting internal tides prior to gridding procedure.

⇒ A study was implemented to check the effect of the IT correction on the maps quality and quantify the impact

⇒ Study perform on DT2018 configuration
Pollution is mitigated by 2 processing in DUACS:

1) Along track filtering process: **Remove noise & small scale signal**

   => cut of wavelength=60 to 200km at equator

2) Optimal Interpolation used to merge all the altimeter measurements and reconstruct the SLA over a regular grid

   ⇒ Zonal correlation scales - 100 to 400km at equator

   ⇒ Observation error => **increased in DT2018 vs DT2014 which reduced the effect of the IT pollution**

See DUACS processing description in *Taburet et al DUACS DT-2018: 25 years of reprocessed sea level altimeter products, 2019, Accepted in Ocean Science, CMEMS spécial issue*
Correction & Assessment methodology

- **Zaron (2018) model for IT correction**
- 4 waves M2, K1, O1 and S2 waves
- Local impact expected function of the amplitudes and wavelength

- **Experimental map time series (preparation of future DT2021 reprocessing)**
- Year 2015 processed in 3-mission configuration: 
  *Altika, Hy2A & Jason2*
- 2 datasets produced
  - map = processed without IT correction (DT2018 like)
  - map_corr = processed with IT correction
- **Cryosat-2** kept as independent dataset

**Assessment methodology:**
- Assessment with independent data
- Regional spectral analysis
- Impact on EKE
Variance [Map_corr – Map] (cm²) - wave used: M2 only
Variance [Map_corr – Map] (cm²) - wave used: M2, K1, O1 and S2
Assessment to independent mission

- Methodology described in Ballarotta, 2019 (Ocean science)
- Cryosat-2 independent dataset
- Variance difference is reduced in most part of the globe (blue)
- Low in average, but locally > 1cm² => map/along track difference reduced by 5%
- Highest reduction in East China
- Local degradation, around Madagascar, Benga Gulf
Assessment to independent mission

Variance \([\text{Map}_{\text{corr}}-\text{C2}] - \text{Var}[\text{Map-}\text{C2}]\)
Bump of energy at ~150km also visible on the maps, but attenuated
Spectral analysis

PSD along track and maps

PSD along track corr
PSD map
PSD map corr

Bump of energy at ~150km also visible on the maps, but attenuated

Same wavelength impacted on along-track and maps (100-200km)

The IT pollution represents 33% of the corrected map signal at these scales
Impact on Eddy Kinetic Energy

- 2 series of geostrophic current computed
- Mean Eddy Kinetic Energy deduced from the two series

- The map variance decreases by 10-20 cm² in region of high IT
- Homogeneous decrease (more than in SLA) => smaller wavelength in geostrophic fields
Impact on Eddy Kinetic Energy

- 2 series of geostrophic current computed
- Mean Eddy Kinetic Energy deduced from the two series

\[
\frac{[\text{EKE [Map corr]} - \text{EKE [Map]}]}{\text{EKE [Map corr]}} \times 100\% 
\]

- Normalizing by the EKE variance maps changes the distribution
- The reduction represents 10% of the total EKE in some areas.
Conclusion

• **Positive impact of Ed Zaron IT models on maps quality** (DT2018 mapping configuration)
  • better consistency of corrected Maps with independent measurements (Cryosat-2)
  • Error reduction is low in average but locally >1cm²
  • Hawai focus: the signal removed represents 33% of the variance of the corrected map on main IT wavelength
  • EKE reduced by up to 20cm²s⁻², representing 10% of the signal in some areas

• Transition to operation
  • IT correction **already available in 5Hz DUACS “High resolution” products on Aviso**
  • Inclusion in Level 2 in progress (Jason GDR F, S3...)
  • Full reprocessing of the DUACS maps foreseen in 2021 will include IT model among other changes

• Future developments
  • Improvement of IT models might be possible using corrected DUACS maps (iterative loop)
  • Tune the mapping by relaxing the observations error
  • This correction will get more and more important as we intend to increase the resolution of the maps
  • **R&D work to improve internal tide solution is crucial**