ERS-2 mission reprocessing for long-term continental surfaces studies

Legrésy (1,2,3), Niño (2), Blarel (2), Frappart (2), Birol (2), Fleury (2), Fuller (2)

(1)- CSIRO Oceans and Atmosphere Flagship, Hobart Tasmania, Australia
(2)- LEGOS/CTOH, UMR5566 CNRS-CNES-IRD-Université de Toulouse III.
(3)- ACE-CRC, Hobart, Tasmania, Australia

Satellite altimetry has been a very powerful tool in oceanography and continental surface studies over the last 25 years. While instrument processing and retracking techniques have been improved over the years for all satellite missions towards ocean applications, less effort has been put for continental studies. ESA's ENVISAT mission has been updated a few times, improving the quality of processing of continental data, unlike the ERS missions.

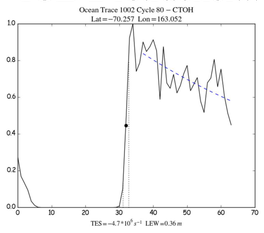
Goals

At CTOH, we processed the ERS-2 waveforms (WAP data) with a new implementation of the Ice-2 retracker algorithm, adding improvements and corrections to make it compatible and homogenous with the ENVISAT mission, hence providing suitable grounds for continuity and long-term altimetry data analysis. ESA recently released the REAPER product which represents the first version of GDR-like ERS product available globally (Femenias et al., 2014).

Some differences with the REAPER ERS-2 product are: we fine tuned the algorithm and made the resolution sharper, used the newer Rudenko et al. (2014) orbit product, a dry troposphere correction using ERA fields valid over all surfaces (Blarel and Legresy, 2013), and a new Doppler correction valid over all surfaces using range rates (Blarel and Legresy, 2012). We also developed a set of bias and large scale corrections to make the product compatible and usable together with ENVISAT. All these aspects have significant impact over continental surfaces.

ICE-2 retracker

ICE-2 retracker...



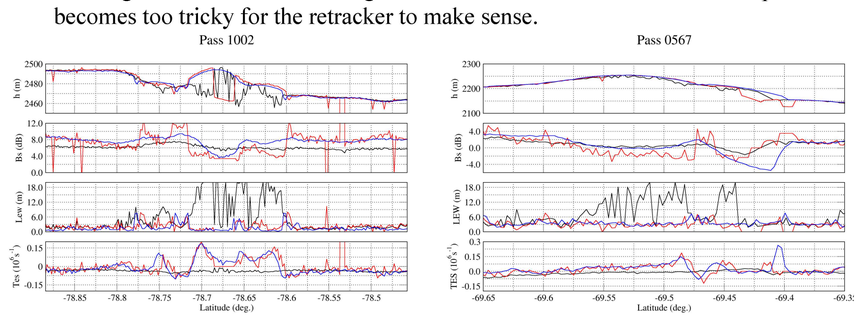
The principle of the ICE-2 retracker follows from the ocean, Brown-type analysis, except that, in order to make it more robust to describe the echo shape over much more various type of surfaces, the Error function is only fitted to the leading edge part and the trailing edge is treated separately. 4 main parameters are derived the retracking (range used to derive h), Backscatter (Bs) Leading edge width (LEW), Trailing edge slope (TES).

The implementation involve some empirical tuning to establish the leading and trailing edge work windows which will be mission dependent tuned.

With this approach actually a lot of radar echoes can be found to make sense provided some homogeneity within the early footprint size (few km for LRM).

More tricky surfaces will show the result more sensitive to the tuning. Note that too complex surfaces (e.g. mountains) may give senseless parameter values.

Two segments of tracks over MegaDunes in Antarctica where the echo shape becomes too tricky for the retracker to make sense.

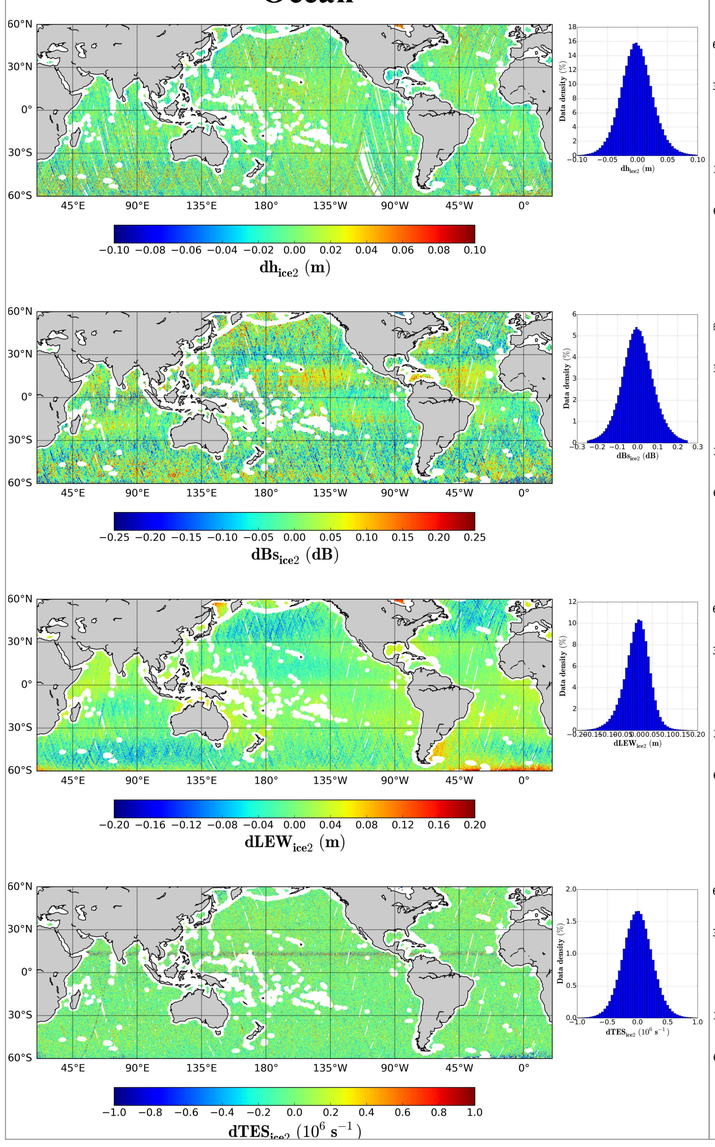


ERS-2/EnviSat Cross-Validation results

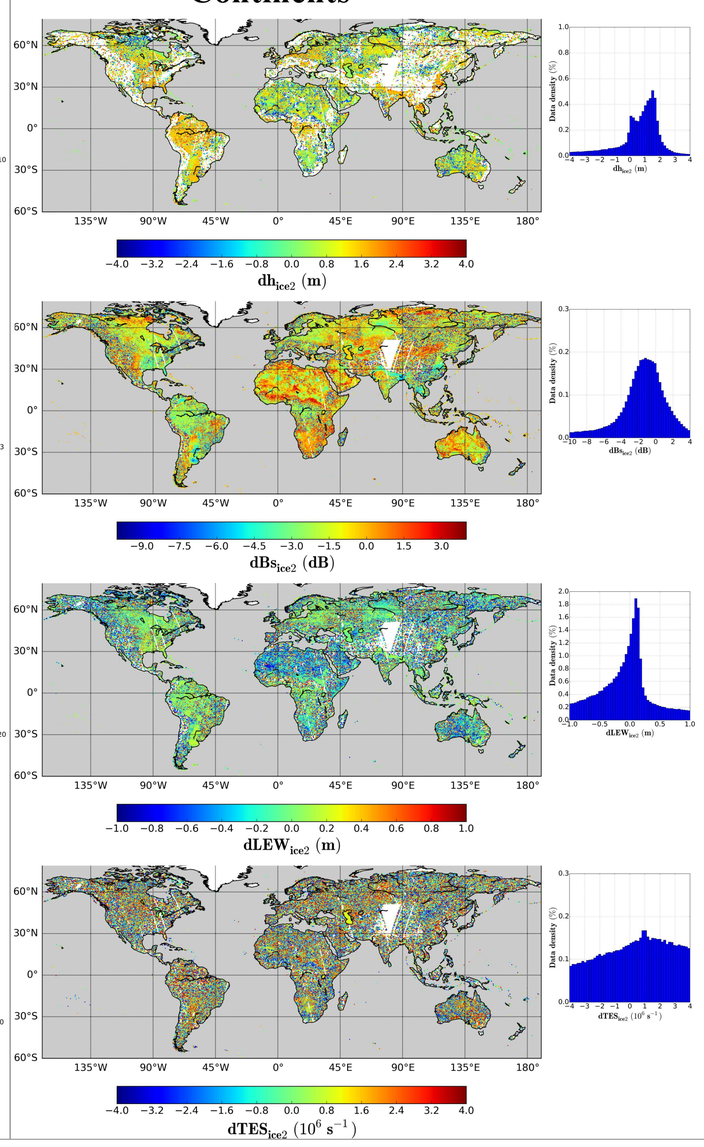
ERS-2/Envisat mission continuity is tested by cross-validating data obtained during the tandem phase when they flew with 30 minutes time separation. We show here the main validation and cross-validation of the two missions. We find a good general agreement, but some differences in the ice-2 retracker behavior over continental surfaces which we discuss.

We show a global validation, as well as of the actual height and radar measurements over the continents, over inland water bodies and over ice sheets.

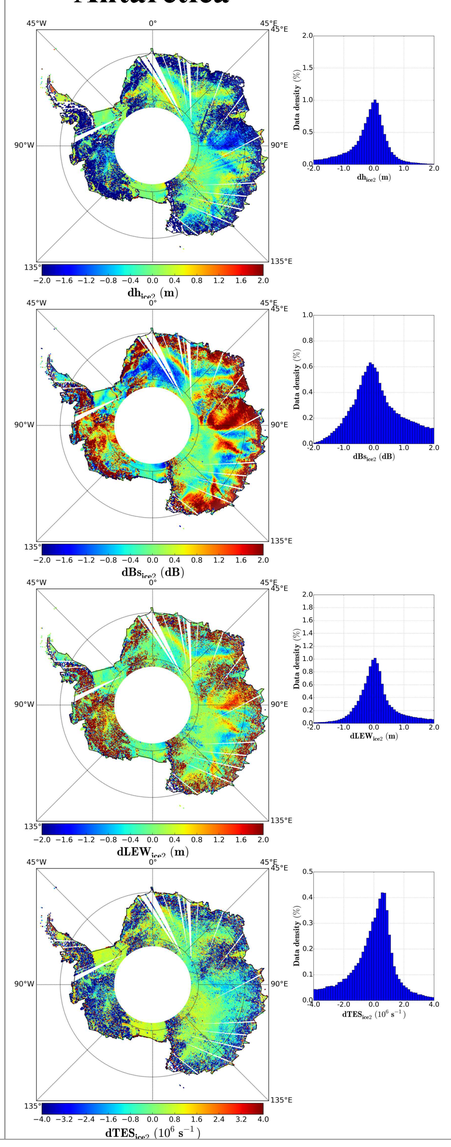
Ocean



Continents

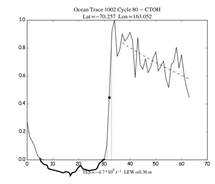


Antarctica



Analysis results points :

- **We manage to have a product highly compatible with ENVISAT RA2 for long term studies.**
- **The retracker has been well tuned (good statistics) and can be rerun for future versions easily.**
- **The product includes corrections of bias and large scale differences to ENVISAT relating mainly on the orbit and for the inter-mode bias.**
- **It also includes specifically home made corrections (doppler, tropo, ...where needed).**
- **I also include updated corrections (e.g. orbit, tides).**
- **There is a systematically odd behavior of the instrument around the 13N Latitude (corresponding to the orbit low point)**
- **We suspect a thermally driven affect of the instrument leading to both the 13N anomaly and large scale effects.**
- **We suspect the instrument to have cut the radar echoes low. This results on anomalously short LEW and must impact the height.**



The next ENVISAT-RA2 reprocessing should include :

- **A better tune of the ICE-2 retracker for the leading edge**
- **Stop using the leakage gates in the TES calculation.**

CTOH ERS-2 product

The data are available on CTOH web site: http://ctoh.legos.obs-mip.fr/products/ers-2. The users have to fill request form to have access to this ERS-2 data product is identified using a Digital Object Identifier (DOI): doi:10.6096/CTOH_ERS-2_2015_01.

References

•CTOH. 2015. « Dataset: Altimetric data of the ERS-2 mission ». *OMP-INSU-UPS-IRD*. doi:10.6096/CTOH_ERS-2_2015_01

•Legresy, Benoit, Fabrice Papa, Frederique Remy, Gaetan Vinay, Mathias van den Bosch, et Ouan-Zan Zanife. 2005. « ENVISAT radar altimeter measurements over continental surfaces and ice caps using the ICE-2 retracking algorithm ». Remote Sensing of Environment 95 (2): 150-63. doi:10.1016/j.rse.2004.11.018.

•Legrésy, B., F. Frappart, F. Nino, F. Blarel, N. Fuller, S. Fleury, et F. Birol. 2015. « *An ERS-2 altimetry product compatible with ENVISAT for continental and ice surface studies.* ». Remote Sensing of Environment.

OSTST, October 2015, Reston, United States of America

http://ctoh.legos.obs-mip.fr