Global Quality Assessment of updated GEOSAT Dataset

V.Koch[1], S.Philipps[1], M.Ablain[1]

[1]CLS, Space Oceanography Division, Toulouse, France

Overview : The U.S. Navy GEOSAT altimetric mission was the first mission to provide global data over a long period (from 1985 to early 1990). During the first 18 months, Geosat was on a geodetic orbit, afterwards it was on a 17-day exact repeat track. The last official Geosat data was released in 1997 (http://ibis.grdl.noaa.gov/SAT/gdrs/geosat_handbook/). Even though the dataset is less precise than recent altimeter datasets such as Jason-2, the Geosat data are interesting as they are the only available global altimeter data before the 1990's. Furthermore, over the years new geophysical standards (ionospheric model, wet and dry tropospheric correction from models, …) have been available. A recent release of precise orbit ephemeris from the National Aeronautics and Space Administration is also available (GSFC 0905). In addition, the geodetic phase was retracked and is available as "20th Anniversary GEOSAT Geodetic Mission Product" (Lillibridge et al. 2006).

Hereafter, the Geosat 1-Hz dataset from the RADS database (http://rads.tudelft.nl/rads/rads.shtml) has been used which contains already the updated standards. The quality of the updated data set is analyzed and compared to the previous dataset (1997). For the GM phase the retracked dataset was used. The different standards used in the old and new data set are show in the box "data standards".

After a quality check of the data, first the impact of this retracking is shown for significant wave high (SWH). Then, performances of the sea surface height (SSH) updated dataset at crossovers is shown and compare to the old dataset.

GEOSAT Mission :

Launched in March 1985 and ended its mission in January 1990 due to degradation of altimeter output power. [1]

1-Geodetic Mission (GM): from March 1985 to September 1986 (18 months).
Main objective: to obtain a density sample map of marine geoid.

2-Exact Repeat Mission (ERM): from November 1986 to January 1990
Main objective: physical oceanography, study of fronts, wave, winds and ice.

Data standards:

*: CLS updated fields.

Fields	RADS updated data-set	Old data-set (1997)
Orbit:	STD0905 Orbit[4] (based on EIGEN_GL04S)	1997- JGM-3 GDR Orbit
Ocean tide:	GOT 4v8	GOT99* or CSR-3(1995)
Load tide:	GOT 4v8	GOT99* or CSR-3(1995)
MSS:	CNES / CLS 2011	CLS 2001* or MSS 1995
Wet tropospheric correction:	ECMWF ERA-int. model	NCEP/NCAR model (1996)
Dry tropospheric correction:	ECMWF ERA-int. model	NCEP/NCAR model (1996)
Sea State Bias	Hybrid SSB	SSB 3 parameters
Ionospheric correction:	Ionospheric correction NIC-09	Ionospheric correction IRI 95 (1997)

The table shows the standards used for the study. Some of the 1997 corrections were already previously updated with some slightly more recent standards. Among several standards available for the same correction in the RADS database, the ones listed in the table were chosen.

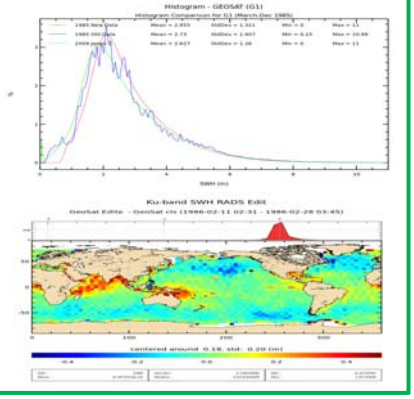
For the GM phase the retracked data (notably the range fib1) were used[2].

Retracking impact on SWH:

During the retracking of the GM phase, several parameters were derived from the waveforms[3]. Hereafter we compare Significant Wave Height (SWH) before and after retracking.

As retracked SWH (red curve) is available with a mm resolution its histogram is much smoother than the old SWH (available only with a cm resolution, blue curve)

Furthermore especially waves in low wave regions have higher values for the retracked data set.



SLA comparison:

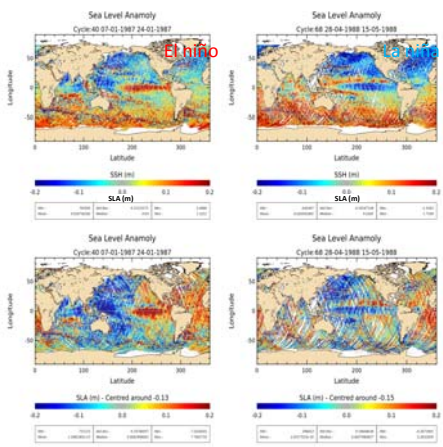
The strong East-West bias visible on sea level maps from 1997 dataset are no longer present in the new dataset.

Climatic phenomena like El Niño and la Niña are now clearly observable in new dataset.

Nevertheless, there are still geographical correlated errors in the dataset (North / South bias).

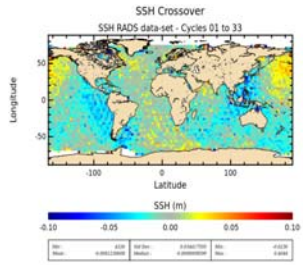
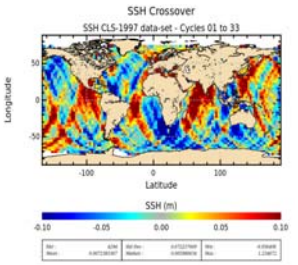
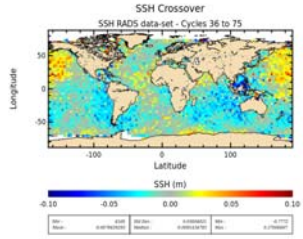
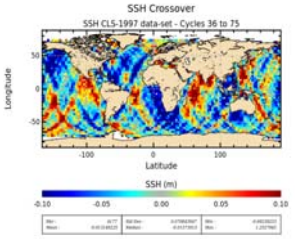
New data set

Old data set



Comparison of SSH performances at crossovers:

SSH differences at crossovers points are compared for ΔT (between ascending/descending tracks) <10 days. Outside areas of high oceanic variability the ocean does not change much over this period and SSH differences between ascending and descending passes should be ideally close to zero. SSH crossover maps of the old dataset show strong geographically correlated orbit errors.

	New dataset	Old dataset
GM Phase (March 1985 to Sept. 1986)		
ERM Phase (Oct. 1986 to Sept 1988)		

Using the new dataset which contains the GSFC orbit (based on EIGEN_GL04S) strongly reduces these biases and show an improved homogeneity between ascending and descending passes.

Long term monitoring:

Cycle per cycle monitoring of mean and standard-deviation of SSH differences at crossovers also show strongly improved performances of the new data set. Standard-deviation is **reduced from 12cm** (old dataset) **to 8.9cm.**

Note that statistics after September 1988 are not shown due to reduced data coverage.

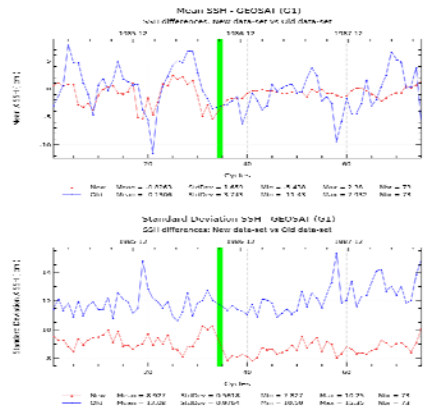
Monitoring

Mean: * *(until degradation)*

I: old data
I: new data

Standard – deviation: * *(until degradation)*

I: old data
I: new data



*: monitoring to cycle 75 (Septembre 1988)

Summary & Conclusions:

The Updated GEOSAT dataset shows a strong improvement (especially thanks to GSFC orbit standard) at crossovers. SSH differences between ascending and descending passes are now much more consistent.

Climatic phenomena such as El Niño and La Niña are now clearly identifiable on Sea Level Anomaly maps.

Nevertheless, a hemispheric North / South effect is present in the new dataset. It is probably related to orbit errors.

References:
1) Nasa geosat: http://ibis.grdl.noaa.gov/sat/gdrs/geosat_handbook/docs/chap_1.htm
2) Retracking method: DavidT. Sandwell and WalterH.F. Smith. Retracking ers-1 altimeter waveforms for optical gravity field recovery. *Geophy.J.Int.* , (163):79-89 , 2005
3) John Lillibridge, Walter H.F Smith, David Sanwell, Remko Scharroo, Frank G. Lemoineand, and NikitaP. Zelensky. « 20 years of improvements to GEOSAT Altimetry », March 2008
4) N. Zelensky et al. Precise orbit determination for Geosat and Geosat Follow-On. Poster OSTST 2010, Lisbon, Portugal. Available at http://www.aviso.oceanobs.com/fileadmin/documents/OSTST/2010/Zelensky.pdf