Global and Regional ocean thermosteric sea level change from in-situ data: Influence of sampling, complementarities with satellite data, role of salinity

**-I- Objectives**

Global and regional sea level anomalies from altimeter measurements and thermosteric and steric sea level from in-situ T and S profiles for the layers (0-1000) m are studied in order to quantify:

- the influence of sampling of the in-situ data set
- the complementarities between the in-situ and altimeter measurements
- the role of salinity

**-II- Data sets**

Data sets involved in this study include:

- Delisted mode maps of SLA from the SLALTO/DUACS center (5° horizontal grid, weekly) (Sea Level Analysis Center, 2006)

**-III- Mapping method**

Before all analysis, global maps of thermosteric sea level are constructed at a monthly period from the individual T profiles. The mapping method is very similar to the one developed by Larnicol et al. (2006). It is based on an optimal interpolation method with:

- temporal correlation scale of 45 days;
- spatial correlation scale of 1500 km at the equator to 700 km at 50°N;
- error associated to each in-situ measurement equal to 20% of the variance of the TSADTOUCAS SLA maps, in order to take into account error associated to aliasing of the mesoscale variability.

The time-mean and seasonal cycle were removed from the altimeter and in-situ data prior to mapping.

**-IV- Error on the global ocean thermosteric sea level**

Error on the global ocean thermosteric sea level have been estimated in a very similar way as in Lyman et al. (2006):

- 13 Reference fields : 1993 to 2005 annual means of SLA maps
- 13 sets of simulated observations : each reference fields sub-sampled by the 1993-2004 in-situ T profiles (clim and position)
- 13 sets of reconstructed fields : monthly SLA maps calculated from the simulated observations from 1993 to 2004

- **Test 1 (black curve) : reconstructed fields using complete global averaged value calculated only on the reconstructed area**
- **Test 2 (blue curve) : reconstructed fields using maps have been completed by zero values where missing**

**-V- Global ocean thermosteric sea level**

Three tests have been performed in order to calculate the Global mean thermosteric sea level variability:

- **Test 1 (black curve) : from non global in-situ mapped fields**
- **Test 2 (green curve) : from global in-situ mapped fields completed by the time-mean field of the in-situ profiles field during the whole period**
- **Test 3 (blue curve) : from global in-situ mapped fields completed by “steric” SLA fields of time-variable fields**

The “steric” SLA fields are deduced from regression coefficients computed from a global altimeter-in-situ comparison study (Guinehut et al., 2006)

**-VI- Regional ocean thermosteric/steric sea level**

International variability of thermosteric sea level is studied in North Atlantic and North Pacific regions which are very well sampled by T measurements during the past 14 years (90% of ocean reconstructed). Thus results for Test 1 to Test 3 are very similar and associated error assumed to be small.

North Atlantic and North Pacific thermosteric sea level show very strong interannual variations:

- Particularly, the 2.6 cm drop from 2003 to 2005 in the Atlantic seems to compensate the 2000-2007 2.6 cm rise.

**-VII- Global ocean steric sea level**

At a global scale, it is also only possible to calculate steric sea level since the year 2003:

- steric sea level calculated from T and S in-situ profiles have to be compared to estimate from delayed mode maps of SLA from the SSALTO/DUACS center (1/3° horizontal grid, weekly)

**-VIII- Conclusions and Perspectives**

- Errors on the ocean mean/thermosteric sea level variability can be estimated from the % of the reconstructed ocean by the given array
- Very strong interannual variability associated to basin dynamics are observed in the North Atlantic and Pacific basins
- Since the year 2003, it is possible to include the salinity effect in the steric sea level calculation
- The salinity reduces the global cooling and the steric sea level is rising since 2003
- Thanks to the_Argo array, it should be possible to study the steric sea level variations for the (0-1000) m layer
- Steric sea level calculated from T and S in-situ profiles have to be compared to estimate from combined GRACE and Jason 1 data (Lennard et al., 2000)

**References**


