GLOSCAL:

IN-SITU DATASETS AND GRIDED FIELDS FOR CALIBRATION AND VALIDATION OF SMOS

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ABSTRACT

Providing reliable in-situ surface temperature and salinity data over the world ocean within short delays is critical for the calibration and validation of SMOS. This work is a contribution to the GLOSCAL project (Global Ocean Surface Salinity Calibration and Validation), which aims at calibrating and validating the SSS data from SMOS by a systematic and global comparison with available in-situ data. These observations are used to set quality flags on the satellite data, they are also needed to improve the algorithms and monitor sensor drifts and biases. We aim at providing in near real time, for the cal/val SMOS needs, both monthly gridded field of sea surface salinity and temperature and the In-Situ Dataset used to process it. The data and method used are detailed here.

1. DATASET: TEMPERATURE AND SALINITY

The in-situ observations used to build our dataset are provided by the Coriolis data center, and are mainly composed of ARGO measurements. CTD, buoys and mooring (such as TAO/PIRATA in the tropics) complete the set. Thermosalinograph are surface dedicated equipments, a special focus has been made on these data which are now ready to integrate the dataset.

4.1. Argo, CTD, buoys and moorings

The Argo array coverage is nominal since late 2007. Argo measurements are vertical profiles that start between 4-5m and 10m, and reach depths from 1000 to 2000m. All the data downloaded from Coriolis are checked against climatology before use. For the need of cal/val SMOS, a near-real time data flux has been implemented: monthly dataset are provided by the Coriolis data center. Fig.1 presents all the data available since january 2010.

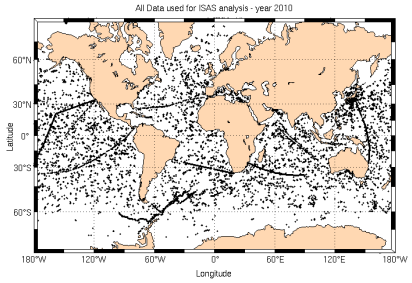

Figure 1. Data coverage since January 2010

4.2. Thermosalinographs

A fleet of commercial ships and research vessels operating all year long over various areas of the world are equipped with TSG. They transmit data in real time.

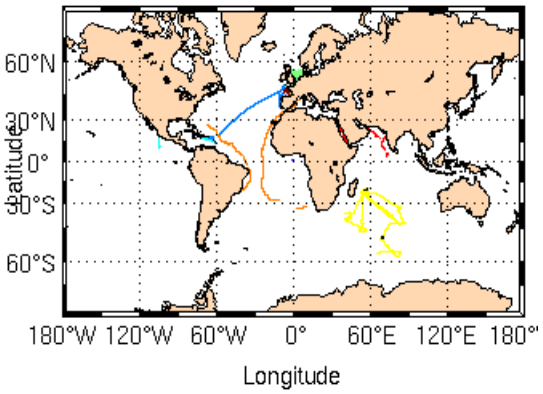

Figure 2. TSG coverage since January 2010

Equipments are rigorously calibrated and water samples taken on board at regular intervals are analyzed in order to infer and correct the salinity drift that may occur due to the fouling an/or scouring.

Fig.2 shows the TSG data available until now for 2010. For this period, data from ORE-SS opportunity ships are not yet available as they have not been delayed mode quality controlled, so the map shows only those from French research vessels and a few sail ships implicated in scientific projects.

Delayed mode data are processed by the scientists (LPO, ORE-SSS) using the soft TSGQC developed at IRD. There is two levels of control: quality flags and corrections. The quality flags depends on the quality of the data with respect to the climatology, spikes, noise, etc. Then if needed, the timeserie is adjusted to fit better with the external data. External data come from two sources: Argo data colocalised along the tracks of the TSG (dataset prepared at LOCEAN), and water sample taken on board and analysed later.
TSG data are a contribution to the GOSUD project and are available in NetCDF Gosud format.

2. OBJECTIVE ANALYSIS: ISAS

All these data are then merged to produce gridded fields of temperature and salinity using optimal estimation. This final process constitutes an additional control in the sense that it allows us to check with a single processing the consistency of simultaneous datasets and the agreement with climatology. ISAS (In Situ Analysis System) has been developed by Gaillard et al. (JAOT 2009), as a tool to produce these gridded fields from objective analysis of in-situ data coming from multiple sources.

2.1 The ISAS tool

The ISAS grid covers the globe from 80°S to 90°N with 1/2° Mercator resolution, on 151 standard depth levels between 0 and 2000m. A priori statistics are needed for the analysis: they were obtained from a previous analysis of the period 2002-2008 (von Schuckmann, et al. 2010), providing the following reference fields:

- a mean seasonal cycle, or climatology, of temperature and salinity representative of the period ;
- the corresponding variances (deviation between profiles and monthly mean field) (see Fig.3.).
- spatial scales deduced from the Rossby radius of the annual climatology (see Fig.3.).

These reference fields and statistics are used by ISAS for preliminary controls on the dataset and by the CATDS for the real time validation of SMOS data .

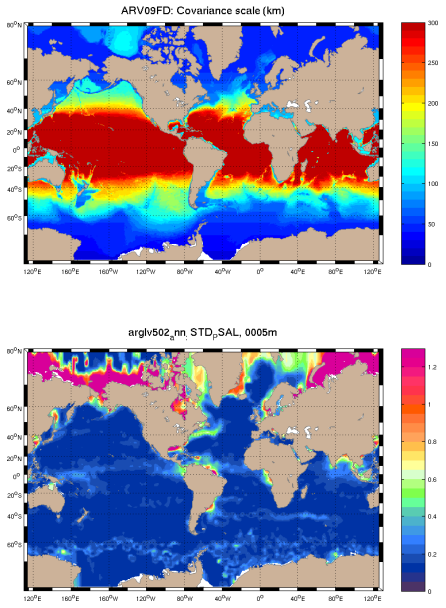

Figure 3. top: Covariance scales, bottom: a priori variance of salinity.

2.2 Surface Analysis

In the context of cal/val SMOS, we want to provide extended and validated in-situ data and gridded field at the sea surface level. As ISAS has not been specifically developed for the surface, a preliminary work has been required to adapt it to this need.
The dataset has been reprocessed to better describe the surface. We have considered a surface layer extending from 0 to 20 meter. For profile data, the surface layer is assumed perfectly mixed above the level of the last measurement, which is repeated up to the surface. For thermosalinograph data, the level sampled by the instrument is assumed to represent the whole surface layer and is repeated over this layer. Most of the time the thermosalinographs measure temperature and salinity between 3m and 15m depending on the vessel. The error associated with extrapolated data is increased proportionally to the distance from the measurement level.
Then the analysis tool has been adapted to take thermosalinographs into account. Tests are underway for tuning the analysis parameter in that case.

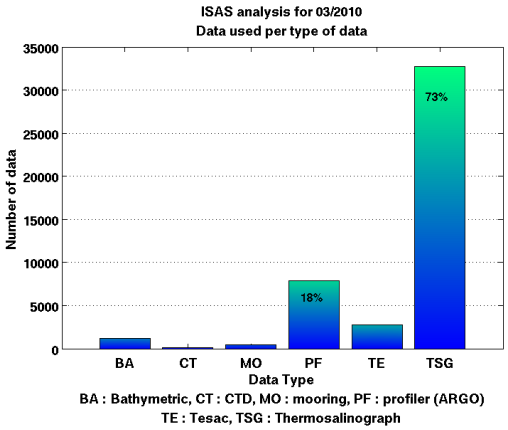

Figure 4. Analysis of march 2010: repartition of data according to their source.

Until now, these data were not properly used as they require special quality control, even though huge amount of information can be extracted from this kind of data. The Fig.4 shows the repartition of the in-situ data used for the analysis of March 2010 according to their type. We note that TSG data represent 73% of the total amount of data. Preliminary results show that include the TSG data improve the final analysis (Fig.5).

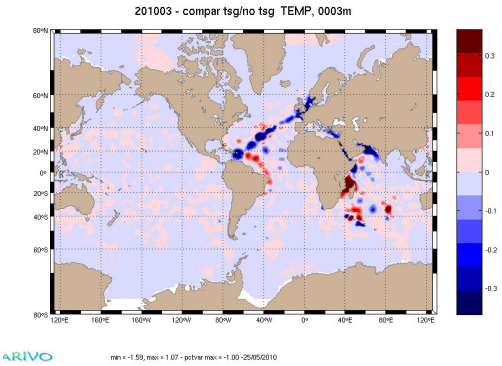

Figure 5. Difference at 3m between an analysis with and without TSG. Analysis of march 2010

2.3. Near Real Time analysis

In the context of cal/val SMOS, our goal is to provide in near real time monthly gridded fields of SSS and SST and the corresponding dataset using as many validated observation as possible. For that purpose, we process the delayed mode quality control of TSG data every month. Since January 2010, we provide the gridded field and dataset based on Coriolis data to the CATDS cal/val team (see Fig. 6). TSG data will be integrated in the June in the analysis. Our products have already been used to evaluate the real time SMOS data, detect biases in order to improve the algortithms (Boutin et al. , 2010 and Reul et al. 2010).

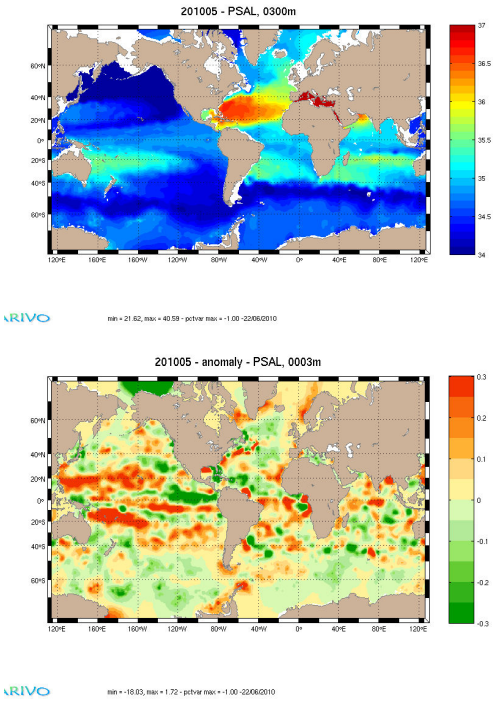

Figure 6. Salinity at 3m, for the Analysis of may 2010. top: gridded field, bottom: anomaly

3. REFERENCES AND LINKS

Coriolis: http://www.coriolis.eu.org/

Crest-Argo: http://www.ifremer.fr/lpo/observation/crest_argo

Gosud: http://www.ifremer.fr/gosud/

Isas Tool: http://www.ifremer.fr/lpo/la_recherche/projets_en_cours/arivo_2/isas_tool , june 2010.

Sea Surface Salinity Observation Service, *Monitoring Sea Surface Salinity in the Global Ocean from Ships of Opportunity*, http://www.legos.obs-mip.fr/observations/sss/, May 2010.

Gaillard, F., E. Autret, V.Thierry, P. Galaup, C. Coatanoan, and T. Loubrieu, 2009, Quality control of large Argo data sets. JAOT, Vol. 26, No. 2. 337–351.

von Schuckmann, K., F. Gaillard, and P.-Y. Le Traon (2009), Global hydrographic variability patterns during 2003-2008, J. Geophys. Res., 114, C09007, doi:10.1029/2008JC005237.

See the two presentations from session 3.1.3 at ESA Living Planet Symposium (28 june to 2 july 2010 – Bergen):

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