Geophysical Research Abstracts
Vol. 16, EGU2014-15423, 2014
EGU General Assembly 2014

Towards an estimation of water masses formation areas from SMOS-based TS diagrams

Marlene Klockmann (1), Roberto Sabia (2), Diego Fernandez-Prieto (1), Craig Donlon (3), and Jordi Font (4)

(1) European Space Agency (ESA), ESRIN, Frascati, Italy, (2) Telespazio-Vega UK Ltd for European Space Agency (ESA), ESTEC, Noordwijk, the Netherlands, (3) European Space Agency (ESA), ESTEC, Noordwijk, the Netherlands, (4) SMOS Barcelona Expert Centre, Barcelona, Spain

Temperature-Salinity (TS) diagrams emphasize the mutual variability of ocean temperature and salinity values, relating them to the corresponding density. Canonically used in oceanography, they provide a means to characterize and trace ocean water masses. In [1], a first attempt to estimate surface-layer TS diagrams based on satellite measurements has been performed, profiting from the recent availability of spaceborne salinity data. In fact, the Soil Moisture and Ocean Salinity (SMOS, [2]) and the Aquarius/SAC-D [3] satellite missions allow to study the dynamical patterns of Sea Surface Salinity (SSS) for the first time on a global scale.
In [4], given SMOS and Aquarius salinity estimates, and by also using Sea Surface Temperature (SST) from the Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA, [5]) effort, experimental satellite-based TS diagrams have been routinely derived for the year 2011. They have been compared with those computed from ARGO-buoys interpolated fields, referring to a customised partition of the global ocean into seven regions, according to the water masses classification of [6]. In [7], moreover, besides using TS diagrams as a diagnostic tool to evaluate the temporal variation of SST and SSS (and their corresponding density) as estimated by satellite measurements, the emphasis was on the interpretation of the geographical deviations with respect to the ARGO baseline (aiming at distinguishing between the SSS retrieval errors and the additional information contained in the satellite data with respect to ARGO). In order to relate these mismatches to identifiable oceanographic structures and processes, additional satellite datasets of ocean currents, evaporation/precipitation fluxes, and wind speed have been super-imposed.
Currently, the main focus of the study deals with the exploitation of these TS diagrams as a prognostic tool to derive water masses formation areas. Firstly, following the approach described in [8], the surface density flux (i.e. the change in density induced by surface heat and freshwater fluxes) is computed, characterizing how the buoyancy of a water parcel is being transformed, by increasing or decreasing its density. Afterwards, integrating over a certain time/space and deriving with respect to density, the formation (in Sv) of water masses themselves can be computed, pinpointing the range of SST and SSS in the TS diagrams where a specific water mass is formed. A geographical representation of these points, ultimately, allows to provide a relevant temporal series of the spatial extent of the water masses formation areas (in the specific test zones chosen). This can be then extended over challenging ocean regions, also evaluating the sensitivity of the performances to the datasets used. With this approach, known water masses can be identified and their formation traced in time and space. Longer time series will give further insights by helping to identify inter-annual water mass formation variability and trends in the TS/geographical domains. Future work aims at exploring additional datasets and at connecting the surface information to the vertical structure and to buoyancy-driven ocean circulation processes.

References

[1] Sabia, R., J. Ballabrera, G. Lagerloef, E. Bayler, M. Talone, Y. Chao, C. Donlon, D. Fernández-Prieto, J. Font, "Derivation of an Experimental Satellite-based T-S Diagram", In Proceedings of IGARSS '12 , Munich, Germany, pp. 5760-5763, 2012.
[2] Font, J., A. Camps, A. Borges, M. Martín-Neira, J. Boutin, N. Reul, Y. H. Kerr, A. Hahne, and S. Mecklenburg, "SMOS: The challenging sea surface salinity measurement from space," Proceedings of the IEEE, vol. 98, pp. 649-665, 2010.
[3] Le Vine, D.M.; Lagerloef, G.S.E.; Torrusio, S.E.; "Aquarius and Remote Sensing of Sea Surface Salinity from Space," Proceedings of the IEEE , vol.98, no.5, pp.688-703, May 2010, doi: 10.1109/JPROC.2010.2040550.
[4] Sabia, R., M. Klockmann, D. Fernández-Prieto, C. Donlon, E. Bayler, J. Font, G. Lagerloef, "Satellite-based T/S Diagrams and Surface Ocean Water Masses", SMOS-Aquarius Science Workshop, Brest, France, April 2013.

[5] Donlon, C. J., M. Martin, J. D. Stark, J. Roberts-Jones, E. Fiedler and W. Wimmer, “The Operational Sea Surface Temperature and Sea Ice analysis (OSTIA)”, Remote Sensing of the Environment. doi: 10.1016/j.rse.2010.10.017 2011.
[6] Emery, W. J., “Water Types and Water Masses”, Ocean Circulation, Elsevier science, pp 1556-1567, 2003.
[7] Sabia, R., M. Klockmann, C. Donlon, D. Fernández-Prieto, M. Talone, J. Ballabrera, “Satellite-based T-S Diagrams: a prospective diagnostic tool to trace ocean water masses”, Living Planet Symposium 2013, Edinburgh, UK, September 2013.
[8] Speer, K., E. Tzipermann, “Rates of Water Mass Transformation in the North Atlantic”, Journal of Physical Oceanography, 22, 93 – 104, 1992.