Ocean Salinity Stratification during the 2002-2016 period as derived from the ISAS13 Argo atlas

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MOTIVATIONS

From the studies by Maes (2008) and Maes and O’Kane (2014a, b), we propose to follow the perspective and methodology for describing the impact of the salinity on the static stratification of the ocean upper layers. This perspective recognizes that the stabilizing effect of the salinity operates near the bottom of the mixed layer but that its effect could be expanded down to the main pycnocline, and to regions where both the salinity and temperature are mixed over the same depths. Hence, we consider a methodology that treats the salinity stratification in a simple partitioning of the thermal and haline effects in the vertical profiles of N(T, S), the Brunt Vaisali frequency (see on the right). Note that, in contrast to the classical approach of the salinity barrier layer, the Ocean Salinity Stratification (OSS) retains the idea of a single definition for the OSS as the part of the stabilizing effect due to salinity, whatever the counterpart of the temperature effect could be.

... to global perspectives

The In Situ Analysis System (ISAS) was developed to produce gridded fields of temperature and salinity that preserve as much as possible the time and space sampling capabilities of the Argo network of profiling floats. ISAS produces global monthly fields from Argo data merged with observations from other networks, on a 0.5° grid and with a vertical resolution of 125 levels from 0 to 2000m. ISAS is based on an optimal estimation method (OE), it is developed and used in research at LPO in close collaboration with Coriolis data center, one of the Argo Global Data Assembly Center (GDAC). ISAS is a re-analysis of the 2002-2012 period made at LPO. NRTOA is a similar configuration (and allows us to create composite time series as shown below).

VARIABILITY OF THE OCEAN SALINITY STRATIFICATION FROM ISAS-13

The OSS field has been designed to understand the behavior of the western Pacific Warm Pool (WPWP) edge, and in particular the imprint of the ENSO variability. As expected, the variability in such a region is large and zonal displacements could be associated with the interannual variability (see the Niño3.4 index). Note also that both other basins exhibit some important variability at interannual time scales.

The NRTOA computations from ISAS also allows us to depict the most recent conditions at the global scale, and to see the ongoing large impact of the ENSO conditions along the equatorial Pacific Ocean during the 2014-2016 period. Note : all the OSS fields are plotted in cycle per hour (cph), and the black lines show the contours at 34.8 and 36.1 for the Sea Surface Salinity.

THE COMPENSATED STRATIFICATION PART

The Turner angle, $\Theta_u$, is closely related to the density ratio $\Delta
$. The Turner angle represents a measure of the relative contribution of salinity and temperature related stratification to the density stratification. Here is shown a computation of the bulk Turner angle within the 50m depth below Kolodziejczyk and Gaillard (2012):

$$\Theta_u = \frac{\alpha (\Delta S T + \beta \Delta S S)}{\alpha \Delta S T - \beta \Delta S S}$$

where $\alpha_{ST}$ and $\alpha_{SS}$ are the differences between surface (10m depth) and 50m depth temperature and salinity, respectively, and $\beta$ are the upper 30m averaged thermal expansion and haline contraction coefficients.

$\Theta_u$ ≈ Bulk Turner Angle in the upper 30m depth as computed with ISAS during March 2013 (black lines) and August 2013 (cruised water, lower panel). Black lines are identical to the above figures.

REFERENCES


Maes, C., and T. J. O’Kane (2014b), Upper ocean salinity stratification in the Tropical on derived from N2, the buoyancy frequency, AGOR2015OC/01/2015OCEANOG02, 18, 15-19 April 2014.

PERSPECTIVES

Perspectives of this work include:
- Study the variability of the OSS in relation with the climatic variations at the global scales.
- Replace the operational CORIOLIS Near-Real Time product obtained with ISAS in a dynamical framework.