6 months internship at the Laboratoire d'Océanographie Physique et Spatiale (Plouzané)

Title: Mechanisms of sea surface salinity variability from satellite and in situ observations

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Subject

The most intense branches of the hydrological cycle of the planet are the evaporation (E) and precipitation (P) flux over the ocean[1]. These surface freshwater fluxes leave a strong imprint on the ocean surface salinity leading to high salinity values in subtropical regions where evaporation dominates, and low salinity values in tropical and high latitudes' regions where precipitation and river runoff dominates (Left panel, Figure 1). It is expected that under global warming, the water-holding capacity of the air will increase and that regions of net precipitation will become wetter and regions of net evaporation will become dryer. These trends in P and E fluxes over the oceans are however difficult to observe directly, and the last IPCC report assigned ``low confidence'' to the globally averaged trends in P-E over the 20th century. To circumvent this problem, the possibility to use the sea surface salinity (SSS) as a proxy for the intensity and change of the ocean hydrological cycle has therefore become an active subject of research. Unlike the limited direct measurements of P and E fluxes, long-term in situ observations of SSS have been available since the 1950s through research vessels and voluntary observing ships. Overall, SSS increases in high-salinity regions and decreases in low-salinity regions. These trends are consistent with the hypothesis of an intensifying global hydrological cycle.

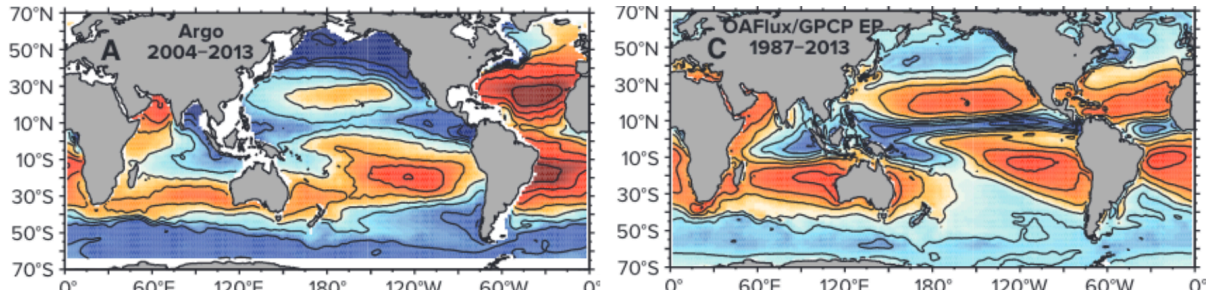

Figure 1:Left time averaged SSS from Argo floats observations (2004-2013). Right: observed E-P evaporation minus precipitations. Adapted from[2]

However, SSS is influenced not only by surface freshwater fluxes but also by ocean dynamics, which play a crucial role in shaping and maintaining the global salinity distribution (see the differences between the left and right panels in Fig. 1, suggesting an important role of the oceanic circulation in controlling SSS.). Depending on whether the SSS is directly controlled by the surface freshwater fluxes or by ocean dynamics or by a combination of both, the use of the SSS as a direct proxy of the surface freshwater fluxes may be limited [3,4]. Enhancing our comprehension of the mechanisms governing sea surface salinity (SSS) variability would significantly improve our ability to elucidate the complex relationship between SSS fluctuations and surface freshwater fluxes.

This project will apply a novel diagnostic[5] based on sea surface salinity (SSS) variance budget to enhance our understanding of SSS variability mechanisms. This diagnostic allows to determine which mechanisms act to maintain or dampen the SSS variability and will be applied here to multiple observational sources: new satellite observations of SSS, velocities derived from satellite altimetry and Argo floats measurements. The first part of the project will focus specifically on seasonal time scales, which are an important contributor to SSS variability in the tropical Atlantic and Indian Oceans, and the second part will extend the analysis to longer time scales, which dominate the SSS variability in the tropical Pacific Ocean.

References

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