



From satellite altimetry to operational oceanography and Argo: three revolutions in oceanography (Fridtjof Nansen Medal Lecture)

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The launch of the US/French mission Topex/Poseidon (T/P) (CNES/NASA) in August 1992 was the start of a revolution in oceanography. For the first time, a very precise altimeter system optimized for large scale sea level and ocean circulation observations was flying. Topex/Poseidon revolutionized our vision and understanding of the ocean. It provided new views of the large scale seasonal and interannual sea level and ocean circulation variations. T/P alone could not observe the mesoscale circulation. In the 1990s, the ESA satellites ERS-1/2 were flying simultaneously with T/P. The ERS-1/2 orbit was well adapted for mesoscale circulation sampling but the orbit determination and altimeter performance were much less precise than for T/P. We demonstrated that we could use T/P as a reference mission for ERS-1/2 and bring the ERS-1/2 data to an accuracy level comparable to T/P. This was an essential first step for the merging of T/P and ERS-1/2. The second step required the development of a global optimal interpolation method. Near real time high resolution global sea level anomaly maps were then derived. These maps have been operationally produced as part of the SSALTO/DUACS system for the last 15 years. They are now widely used by the oceanographic community and have contributed to a much better understanding and recognition of the role and importance of mesoscale dynamics.

The unique capability of satellite altimetry to observe the global ocean in near real time at high resolution was essential to the development of global ocean forecasting, a second revolution in oceanography. The Global Ocean Data Assimilation Experiment (GODAE) (1998-2008) was phased with the T/P and ERS-1/2 successors (Jason-1 and ENVISAT) and was instrumental in the development of global operational oceanography capabilities. Europe played a leading role in GODAE. In 1998, the global in-situ observing system was inadequate for the global scope of GODAE. This led to the development of Argo, an initial joint venture between CLIVAR and GODAE. Argo has been an outstanding success. The 3000 Argo profiling floats now provide the most important global in-situ observations to monitor and understand the role of the ocean on the earth climate. This is a third revolution in oceanography.

I was lucky enough to be involved with many colleagues and friends in these three revolutions or breakthroughs in oceanography. The presentation will provide some historical background on the development of the SSALTO/DUACS merged altimeter products and an overview of their utility and use for ocean research and operational oceanography. I will then go through the development of operational oceanography and Argo over the past 15 years focussing on European contributions, in particular, in the framework of the GMES Marine Service, EuroGOOS and the Euro-Argo research infrastructure. Perspectives and new challenges for the integrated global ocean observing system will be finally discussed.