

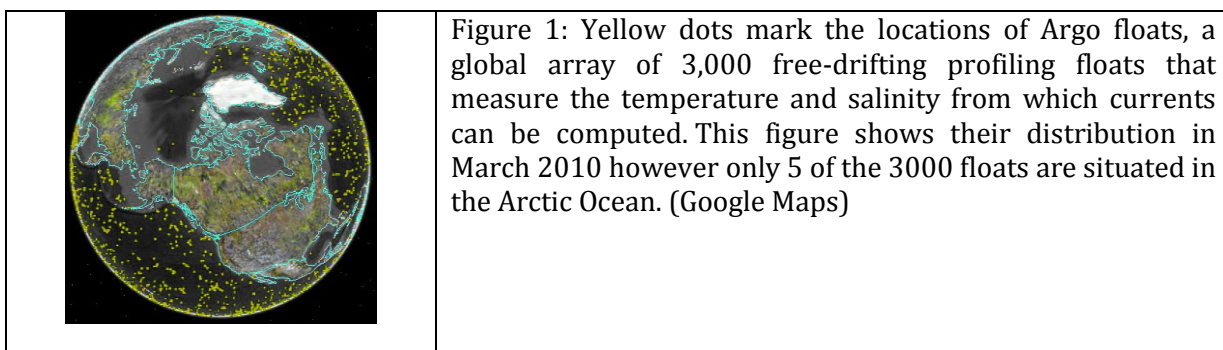
Arctic Ocean mean dynamic topography from satellite altimetry and gravity measurements.

Supervisor: Seymour Laxon

Co-Supervisor: Katharine Giles

External Advisor: Dave McAdoo, NOAA laboratory for Geosciences measurements.

The Arctic is thought to be one of the areas most sensitive to climate change, with climate models predicting the greatest warming, due to anthropogenic sources, in the polar regions. It is well known that the Arctic sea ice cover is currently in a state of decline, which will not only alter the Earth's radiation balance, but also effect the ocean circulation. Changes to the ocean circulation may affect the fresh water flux out of the Arctic Ocean, and hence the wider global ocean circulation and may also accelerate the retreat of ice cover. Therefore, it is important to understand the Arctic Ocean circulation. Historically, the Arctic Ocean has relatively few measurements of ocean currents, unlike the rest of the world's oceans (figure 1), due to its harsh climate, ice cover and dark winters.



Over the rest of the world's oceans satellite radar altimetry has been used to measure the sea surface height (SSH), which, when combined with the Earth's geoid (which the ocean would follow if at rest), can be used to derive the mean dynamic topography and hence mean ocean circulation (figure 2). This technique has not been used over the Arctic because, prior to the ERS-1 mission, satellite coverage excluded the Arctic Ocean and the presence of sea ice prevented standard methods for measuring the SSH from being used. New processing techniques, developed at UCL, mean that we now have a continuous series of more than 15 years of satellite radar altimetry measurements of SSH over the Arctic (up to 81.5°N) from the European Space Agency (ESA) missions ERS-1, ERS-2 and Envisat. In addition, the successful launch of CryoSat2 (figure 3) in April 2010, means that we now have coverage of the Arctic Ocean up to 88°N for the first time.

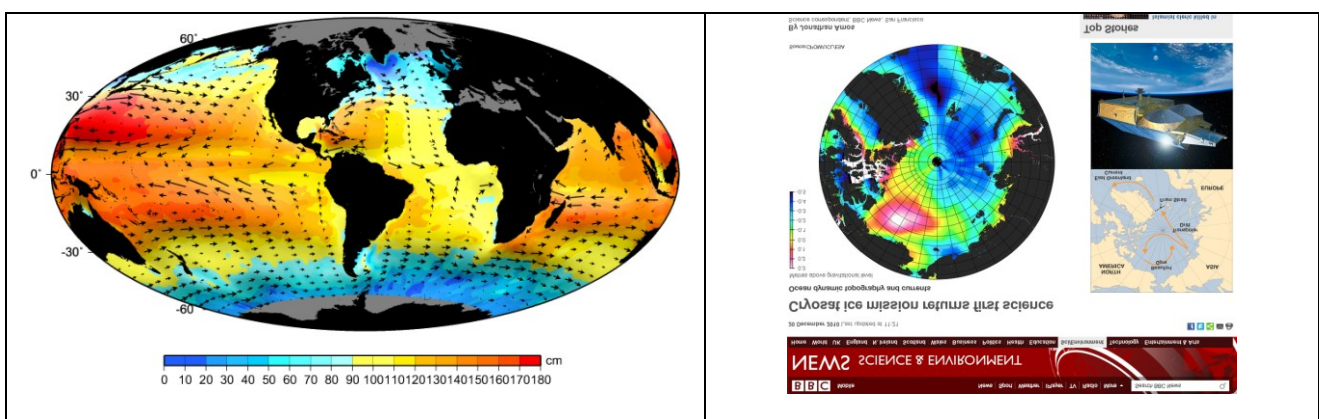


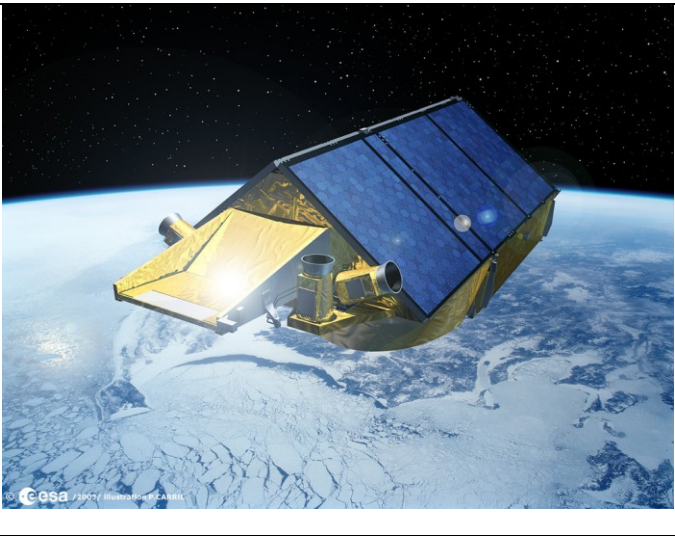
Figure 2a: Mean dynamic topography derived from Topex Poisedon Satellite and CHAMP satellite gravity measurements (AVISO). This project will exploit more accurate data from the GOCE and CryoSat2 satellites to calculate the mean dynamic topography

Figure 2b: Preliminary Arctic ocean dynamic topography derived from a combination of CryoSat2 and Envisat data with the EGM08 geoid.

in the Arctic.	
----------------	--

This studentship will aim to calculate the Arctic Ocean mean dynamic topography by combining satellite radar altimetry data and new, high resolution, estimates of the geoid from ESA's GOCE gravity mission (<http://www.esa.int/SPECIALS/GOCE/>). GOCE provides measurements of the geoid, or a gravitational equipotential surface equivalent to the sea surface if there were no circulation and the altimeter provides measurements of the SSH. To calculate the mean dynamic topography the geoid must be subtracted from a mean sea surface height calculated by averaging the altimeter data in time. The first step of the project will be to apply a geographic (spatial) filter the gravity data to smooth out artifacts caused by the orbit sampling pattern. A second approach will involve sampling the altimeter data in the same way as GOCE and then combining the data at this more fundamental level. The new maps of ocean currents will then be tested with in-situ data including sub-sea moorings in the Beaufort Sea (<http://www.whoi.edu/beaufortgyre/>). The project will initially use data from the Envisat radar altimeter but later exploit data from CryoSat2 once sufficient data have been gathered. Ultimately this data will be used to test whether the mean Arctic Ocean circulation is correct in climate models.

The student will receive training in satellite geodesy, mathematical analysis of geophysical fields and error propagation. This project will be integrated with the CPOM research programme and the student will work closely with existing CPOM postgraduate and postdoctoral researchers. It will also involve collaborations with ESA and the wider polar research community. Past CPOM students have gone on to research and faculty positions in the US (U. of Alaska, NOAA, NASA) and UK (BAS, Hadley Climate Centre).

	<p>Figure 3. ESA's CryoSat-2 mission is the first dedicated satellite radar altimeter to provide measurements of the Earth's land, marine ice and ocean surface height to 88N for the first time (www.esa.int/export/esaLP/cryosat.html). CryoSat-2 was launched in April 2010 (the Centre for Polar Observation and Modelling at UCL provides the scientific leadership for the mission).</p>
---	---

Key References:

Peacock, N. R., and S. W. Laxon (2004), Sea surface height determination in the Arctic Ocean from ERS altimetry, *Journal of Geophysical Research-Oceans*, 109(C7), -.

Wingham, D. J., et al. (2006), CryoSat: A mission to determine the fluctuations in Earth's land and marine ice fields, *Natural Hazards and Oceanographic Processes from Satellite Data*, 37(4), 841-871.

Student Prerequisites: The student needs to be competent in mathematical analysis and should have a reasonably strong physics background. Programming, data analysis experience and oceanography courses taken as part of their degree would be an advantage.

