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The week started stormy, but on the weekend the winds calmed down, and last night's transition from the Roaring Forties to the Furious Fifties was relatively quiet, because we currently steam along a crest between an intense storm centre north of us and a weak low pressure system in the south. Tomorrow (Monday) evening we will reach the first sea ice patches and then the intense phase of this expedition starts with a continuous science programme around the clock until we leave the ice again in the middle of October.

In the past week we deployed three more sensors on the ocean floor. Along our track between 37° S and 46° S there are now four so-called PIES (Pressure sensor equipped Inverted Echo Sounder) sitting at the sea floor at depths between 3700 and 5000 m measuring water pressure and acoustic travel-time from the bottom to the ocean surface and back, somewhat similar to a shipboard echo sounder.

The aim of these measurements is to validate satellite observations of Earth's gravity field. It is interesting to note that Earth's gravity field is not spherical, i.e. gravity at different locations maybe quite different, even though their distance to the centre of the Earth is the same. Gravity depends on the mass distribution in the interior of the Earth, which is not rotationally symmetric, but exhibits a pronounced depression over India and the Indian Ocean and a huge bump over the north-east Atlantic. The mass distribution of the Earth is not constant but changing in time, e.g., during the monsoon season, the gravity over India increases by an amount equivalent to an additional 20 cm thick layer of water, since the soil is saturated with water, and rivers reach flood levels. Since 2002, the "GRACE" satellite mission measures the gravity field of the Earth accurately enough to determine such variable mass fluxes on the surface (GRACE = Gravity Recovery And Climate Experiment).

However, over the oceans, gravity changes due to regional variations of sea surface height or ocean currents are much smaller (1 – 5 cm), which is close to the accuracy limits of GRACE. A global network of moored pressure sensors shall be used to correct the GRACE data to finally allow space born observation of ocean currents and associated mass fluxes. Together with two further PIES that will be deployed near the Greenwich meridian on our way back to Cape Town, the moorings form a large triangle which is needed to appropriately compare the PIES point measurements with the satellite data averaged over several hundreds of kilometres.

In addition to the validation of GRACE, PIES data deliver valuable information about the oceanic water column: From acoustic travel time and bottom pressure it is possible to derive both sea surface height and the mean temperature of the water above the PIES. Further, pressure differences between two PIES are proportional to the mean current velocity between both

locations. Hence, a few moorings spaced 1000 km apart from each other suffice to monitor transport variability of the Antarctic Circumpolar Current, which is the largest ocean current worldwide. If everything works as planned, the PIES will be acoustically released from their anchor weight during a future cruise of Polarstern in 2009, rise to the surface, and will be recovered for data retrieval and analysis.

Many greetings from the cloudy Southern Ocean on behalf of all participants of the expedition,
Yours Peter Lemke

Polarstern, 51°39’S, 20°48’W