4.5 DVS and bathymetric observations (M. Dengler, V. Hormann)

The Werum central data distributor (DVS) system continuously records a large set of oceanographic and atmospheric parameters from several sensors throughout the cruise. In order to complete the data set obtained from CTD/LADCP measurements and the Ocean Surveyor, several parameters were post-processed and calibrated. These variables were sea-surface temperature (SST) and salinity (SSS) from the thermosalinograph, meteorological parameters including wind speed, wind direction, air temperature, air pressure and humidity as well as bathymetry. The post-processed dataset will be made available to the public by submitting the data to appropriate international data centers.

4.5.1 Thermosalinograph data

a) post-processing and sensor calibration

Sea-surface temperature and salinity were measured by a thermosalinograph with an intake at the ships hull at 4m depth. The device was equipped with an OTS-sensor manufactured by ME-Meerestechnik Elektronik GmbH. The thermosalinograph worked well throughout the cruise.

In post-processing, the temperature and salinity records were calibrated against CTD temperature and salinity data from 4m depth collected during the cruise. Several possible calibration dependencies were tested. However, a constant offset in thermosalinograph temperature and salinity were most adequate (Fig. 4.5.1), being -0.027°C for thermosalinograph temperature and 0.173 psu for salinity. The standard deviation of the temperature differences between the CTD and thermosalinograph was 0.011°C. This value can be viewed as the statistical measurement error of the thermosalinograph SST measurements due to the much higher accuracy of the temperature measurements by the CTD

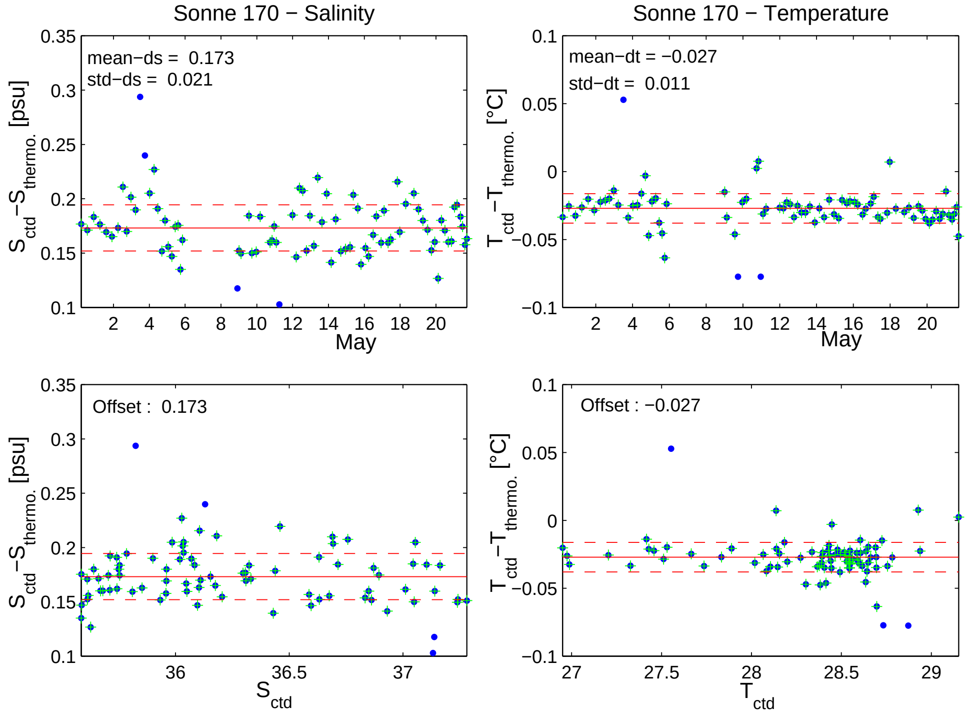

Fig 4.5.1 (calib2.eps) Differences between CTD and thermosalinograph temperature (left panels) and salinity (right panels) data against time (upper panels) and against corresponding CTD data (lower panels).

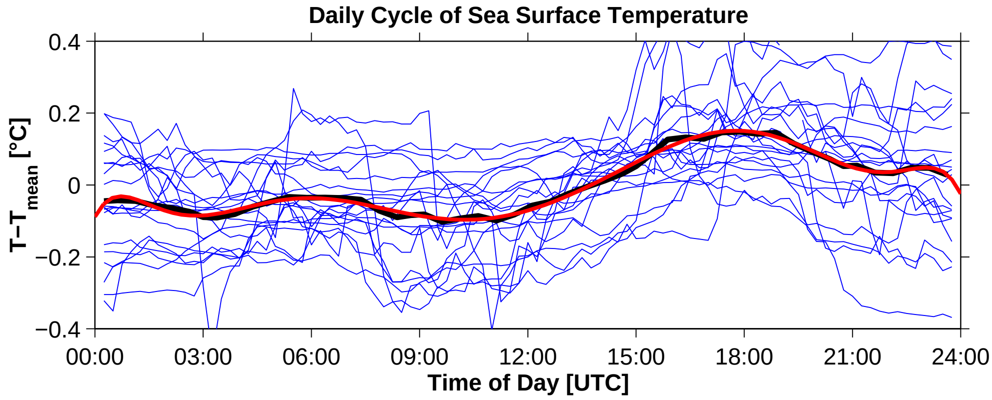

Fig. 4.5.2 (daily_cycle.eps) Daily temperature cycle during SO170. Thin blue lines show the daily temperature anomaly, thick black lines the average daily anomaly and the red line a polynomial fit to the average daily anomaly.

sensors. The standard deviation of the salinity differences was somewhat larger, being 0.021 psu, which again reflects the measurement error of the thermosalinograph salinity. For archiving, the constant offsets in temperature and salinity were removed and the data were averaged to five-minute ensembles. The dataset will be submitted to the global Sea Surface Salinity Data Assembly Center (DAC) located at the Center IRD in Brest, France.

b) observations

Due to the warming of the sea surface by the sun, the sea surface temperature has an additional dependency on the time of day at which the measurements were performed. To limit this temporal dependence, the average daily temperature variation was computed. As shown in figure 4.5.2, SST is on average about 0.2°C warmer during the local afternoon (17:00-20:00 UTC) than during nighttime. The SST distribution, corrected for the average daily cycle, along the cruise track is shown in figure 4.5.3. During the cruise, sea surface temperatures were higher south of the equator, where values are generally above 28°C. The highest SSTs are found close to the Brazilian coast at 7°S.

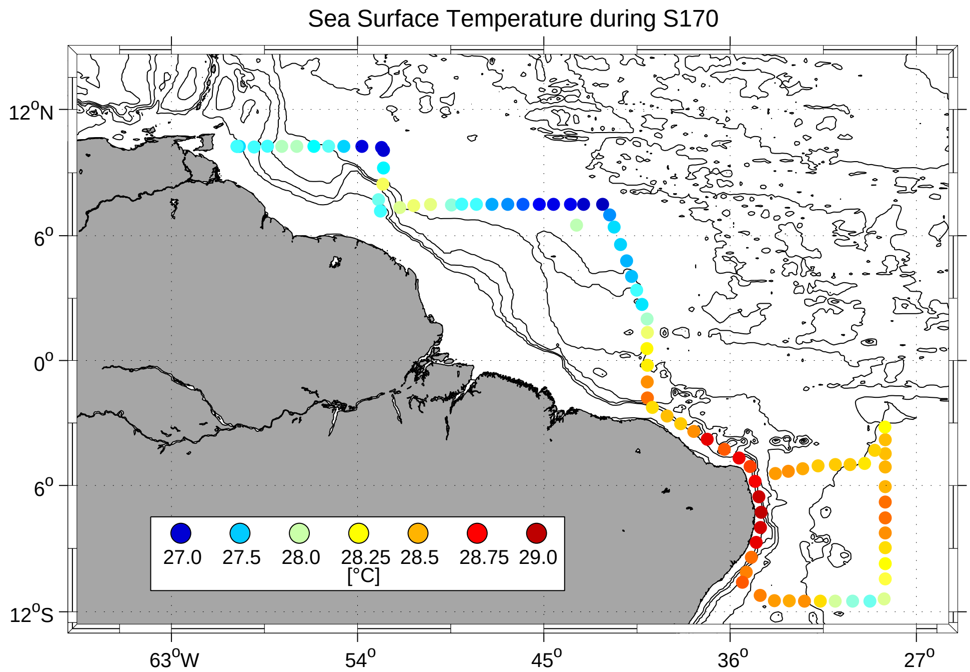

Fig. 4.5.3 (temp_plt.eps) Sea surface temperature from the thermosalinograph.

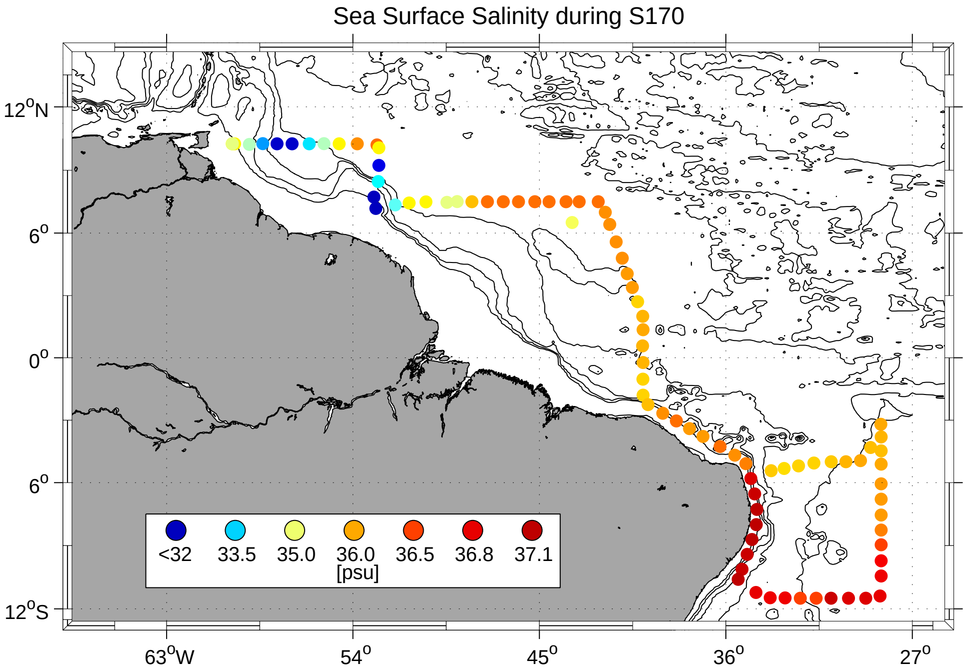

Fig. 4.5.4 (salt_plot.eps) Sea surface salinity from the thermosalinograph.

The distribution of sea surface salinity is presented in figure 4.5.4. Again, larger SSS values are found in the tropical southern hemisphere than north of the equator. Very low SSS patches were observed north of 6°N having values below 29 psu. CTD-Temperature profiles indicate that these patches are limited to the upper 10m of the water column. Presumably, these low salinity lenses have enclosed fresh water from the Amazon River, which is slowly mixing with the ambient saline water.

4.5.2 *Meteorological data*

a) Data acquisition and post-processing

On R/V Sonne, meteorological parameters are recorded by an Aanderaa weather station 2700 with a sensor scanning unit 3010. The sensors for air temperature, humidity, pressure, wind speed and wind direction are attached to the first platform of the main mast at 21 m above sea level and about 1 m to port from the vessel's center line.

The Werum DVS automatically calculates true wind speed and direction from relative wind presumably by using the geographical positions from the differential GPS system. During post-processing, on station winds were compared with underway wind measurements just before and right after stations. However, no significant dependence of true wind on ship speed was found, making a post-calibration unnecessary. Thus, after removing outliers, the meteorological parameters true wind speed and direction, air temperature, humidity and pressure were averaged into 5-minute ensembles. The meteorological data set will be submitted to the Research Vessel Surface Meteorology Data Center at the Center for Ocean-Atmospheric Prediction Studies, Florida State University.

b) observations

After leaving Port of Spain, the north-east trade winds grew stronger until reaching 6 Bft. (11-12 m/s) on April 27 (Fig. 4.5.5). These conditions prevailed to May 3 where Sonne had already moved close to the equator on 40°W. A shift in wind direction from north-east to south-east in conjunction with lighter winds occurred just south of the equator at about 1°S on May 5. The south-east trades of moderate strength (4-5 Bft.) were then encountered for the rest of the cruise. The cross-section Ekman transport calculated from the wind observations is also included in figure 4.5.5.

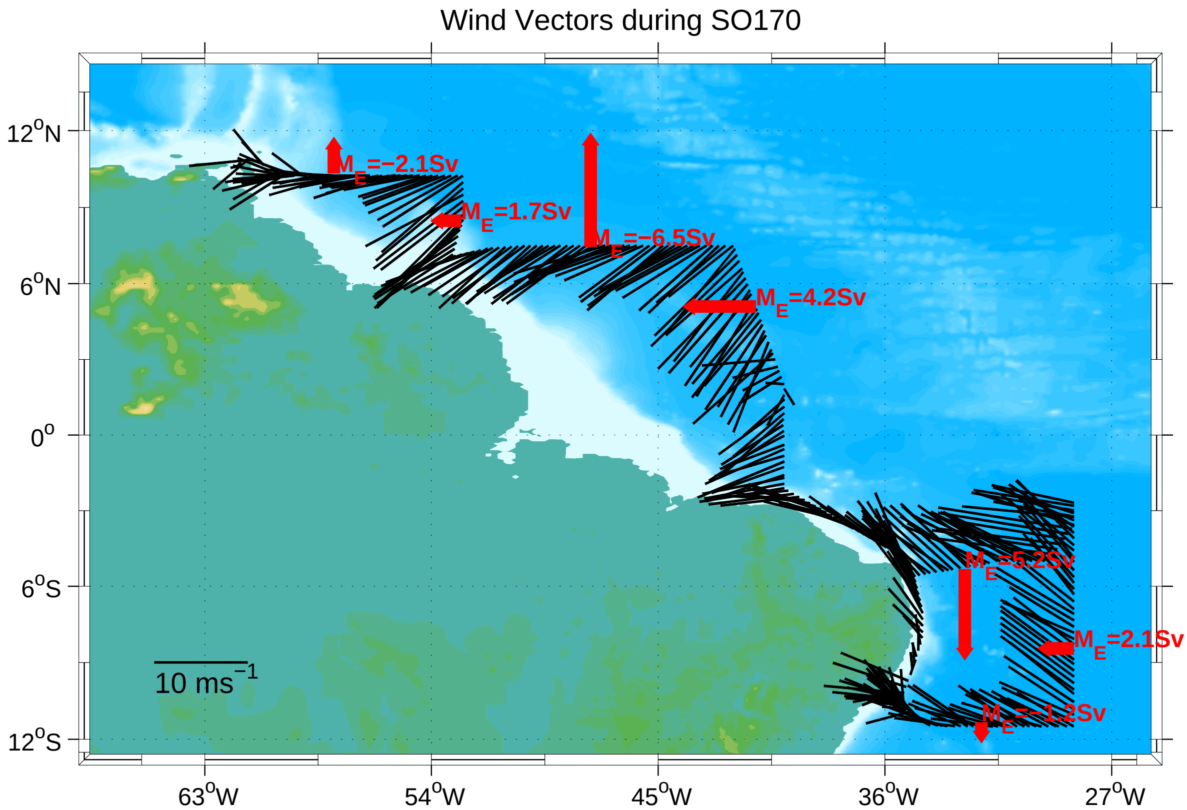

Fig. 4.5.5 (wind_plot2.eps) Wind vectors (black thin lines) and cross-section Ekman transports (red arrows) during SO170.

4.5.2 *Bathymetry data*

Since June 2001, a Kongsberg Simrad EM120 multibeam echo sounder system is installed on Sonne. Apart from increased measurement accuracy, this new system has the advantage of an increased cross-track measurement range compared to its predecessor, the Hydrosweep system. The new system allows to accurately survey the ocean floor with a horizontal range of 4 to 5 times the water depths (Fig. 4.5.6), which greatly facilitates the scanning of the seafloor prior to mooring deployments.

To obtain an accurate data set, several different sound speed profiles, calculated from high quality CTD data, were loaded into the EM 120 operating station during the cruise. During post-processing, the center beam data was edited for outliners and averaged onto a ¼' longitude or latitude grid. The multibeam data will be sent to the Bathymetric Data Center of the Bundesanstalt für Schifffahrt und Hydrographie in Rostock.

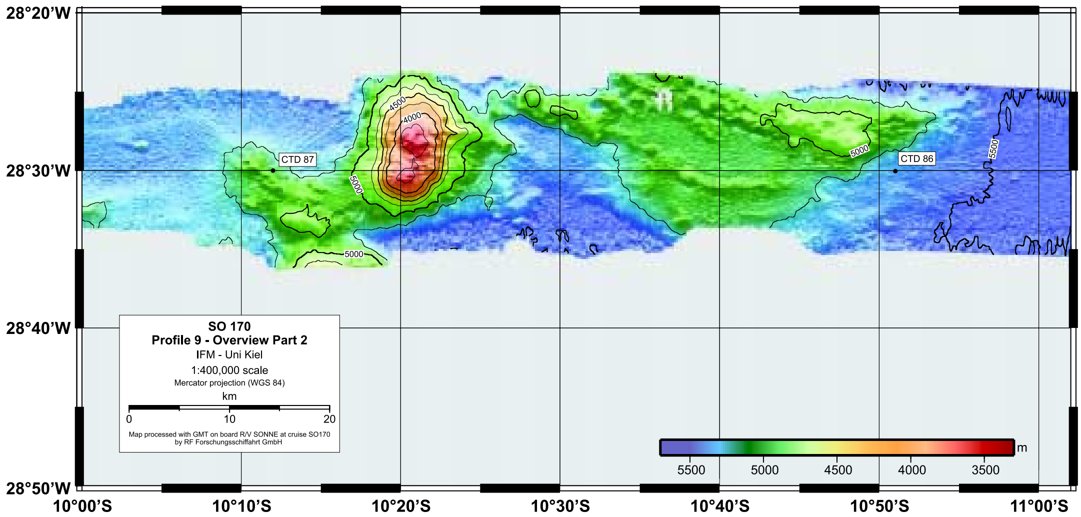

Fig. 4.5.6 (seamount1.eps) Bathymetry from the Simrad multibeam echosounder along 28.5°W.