# Baltic Sea Research Institute

Warnemuende (IOW)

***Cruise Report***

***No. 44/96/ 04***
***R/V "A.v.Humboldt"***

***MESODYN Cruise***

***01 to 12 March 1996***

*Stolpe Furrow* / Baltic Sea

**This report is based on preliminary data and is subject to changes.**

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MESODYN
Cruise No 44/96/04
r/v "A.v.Humboldt"

Warnemünde, 2 April, 1996

The first scientific cruise in the framework of the Meso-Scale Dynamics (MESODYN) project, which accompanies the Baltic Sea System Study (BASYS) programme, was carried out with r/v "A.v.Humboldt" in the Stolpe Furrow during 1- 12 March, 1996.

Scientific staff participating:

| | |
|---|---|
| Chief scientist: | E. Hagen |
| Participants: | R. Feistel |
| | Ch. Höll |
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**Scientific program:**

Because of its depth, its central location and its relative isolation, the Gotland Basin is within the Baltic Sea the probably most interesting region for theoretical and experimental investigations in the context of thermodynamics and/ or kinetics of oceanic irreversible processes.

Investigations of exchange processes between different basins of the Baltic Sea have been started by CTD-measurements, which were carried out above the Stolpe Furrow. This submarine channel connects the Bornholm - with the Eastern Gotland Basin. Similar campaigns will be carried out in the Bornholm Basin (September, 1996) and in the Arkona Basin (December, 1996). These hydrographic surveys contribute to the data base of the

international, multidisciplinary project ***Baltic Sea System Study*** **(BASYS).** In the following three years, repeated field campaigns will be carried out to profile the same positions with an eddy-resolving station grid on the meso-scale. Thus, sufficient hydrographic data sets will be gathered to describe the patterned mass-field of each basin during each season. Resulting data will be used for the estimation of geostrophic motions in deep layers and associated transports as well as for the setup of numerical circulation models.

In completion of historical data sets (*Baltic Year*, *HELCOM*-monitoring, *Gotland Basin Experiment* (GOBEX), this time CTD measurements with the SeaBird System have been performed from the sea surface to the near bottom layer. The area of investigation is shown in Fig.1. The station spacing was 2.5 nm on a regular station grid, which covers the area between 55°05'- 55°30'N, 16°29.43'- 17°43.67'E , Fig.2. That map involves selected bathymetric contours.

Measurements started in the northeast corner of the grid (station 1) and followed meridional transects to trace the deep water propagation zonally, parallel to the channel axis. The last station (no.198) took place in the northwest corner of the station grid. Six stations (97, 135, 143, 144, 165, 173) must be dropped due to intense fishery activities.

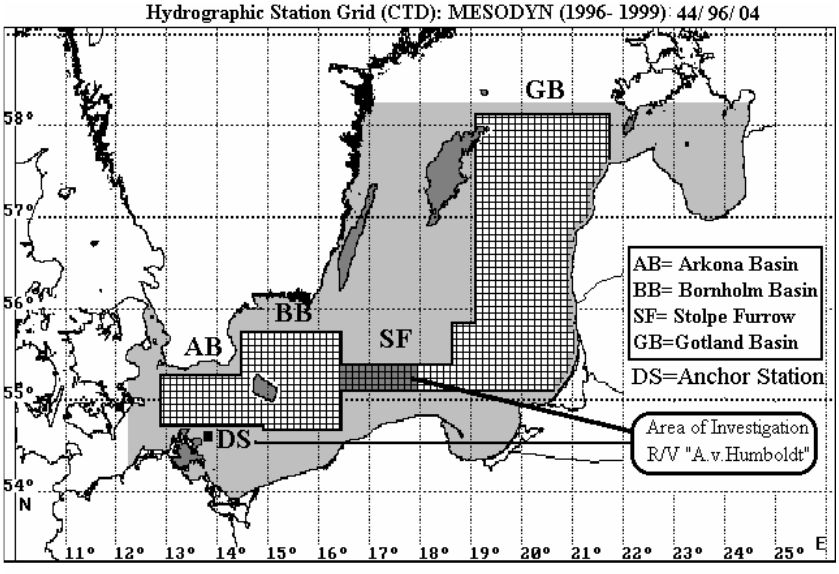


Fig.1 Investigation area of the MESODYN-programme

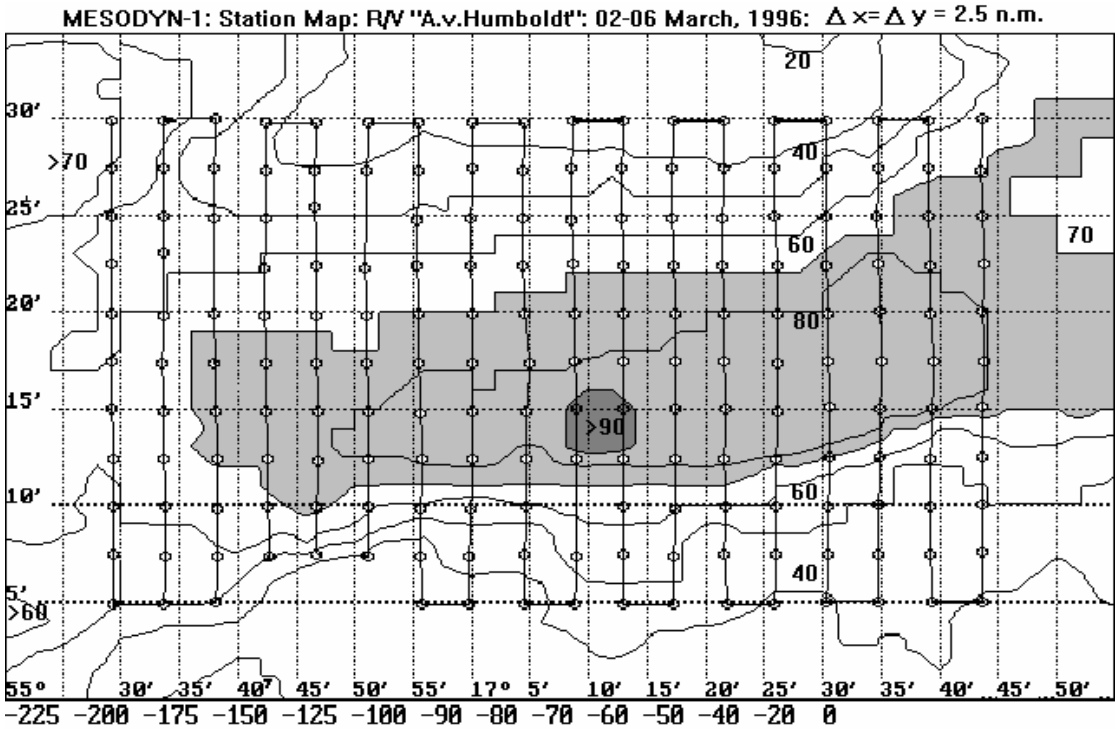


Fig.2 Hydrographic stations (dots) over the rough bottom topography (isobaths in metres)

A total of 192 vertical CTD-profiles was gathered between both thresholds of the furrow. Conductivity (C), temperature (T), and pressure/ depth (D) were vertically profiled by a SeaBird CTD-system. The temperature was controlled by three reversing thermometers at different depths twice a day.

The resulting rms error is 0.001 K without any statistical correlation with the pressure. An analogous procedure was performed for salinity with the aid of salinometer measurements and dissolved oxygen resulting from bottle casts of the same horizons. Its largest rms values are found to be 0.02 PSU and 0.2 ml/l, respectively.

**Preliminary Results**

Moderate winds from east- northeast directions stirred the upper 30m-layer with temperatures between (0.8-1.6)°C and salinity values between (7.4-7.6) PSU. Beneath the depth of 40m, isotherms and isohalines indicate a drastic inclination meridionally. For instance, the 2°C isotherm was found to be near 70m depth at station 103 but near 40m depth at station 108. That isotherm lies in between 7.8 and 8 PSU in the middle part of the furrow. Such inclinations suggest meridional pressure gradients, which geostrophically force motions going

parallel to the channel axis. The inspection of data from all meridional sections indicates the existence of a topographically trapped eddy-like feature on the furrow-scale. Such deep feature influences the net transport through the furrow and, this way, the spreading of water from the Bornholm Basin into the Gotland Basin. Relative warm (>7°C) and saline water (>14 PSU) occurred in the deepest layers of the furrow. Furthermore, isotherms and isohalines reveal a zonal inclination above the deep western part of the furrow. For instance, the 2°C-isotherm is found to be placed at depths of about 50m in the West (station 192) but at 60m depth in the East (station 29). Within near bottom layers, the inclination of such isolines was one order lower ($1.4x10^{-4}$) than normal to the channel axis ($1.3x10^{-3}$) .
Because the width of the furrow is much larger than the mean radius of deformation (5-7 km), it seems to be that the zonal net transport through the channel is mainly determined by baroclinic pressure gradients across the furrow; rather than by down-slope gradients along the channel axis, at least in response of sea-level anomalies caused by easterly winds during winter environmental conditions.

In addition, time series of hourly CTD-profiles have been carried out at the position 54°44.12'N, 13°59.98'E east of Ruegen Island at the water depth of 28m from 7 March (14.00 UTC) until 11 March (30.30 UTC). In the vicinity of the anchor station, currents were recorded by moored current meters (Aanderra RCM-7) at 6, 16, 21, and 26m depth. All current meters were equipped with a temperature sensor while the deepest device also recorded the conductivity. In between those four horizons, four Seamon-Mini temperature recorder were installed at 8, 12, 18, and 23 m depth.
Similar measurements were already performed together with micro-probe profiles at the same position in March, 1995. Using all time series, the Richardson-gradient number will be estimated to check its signal-noise relationship under typical March conditions. This way, we are looking for possibilities to describe the vertical momentum exchange in near-coastal zones. Such measurements are planned for different seasons at the same position and along the edges of Baltic basins.

Dr. E. Hagen
(Chief scientist)