

Repeated XBT sections in the framework of WOCE

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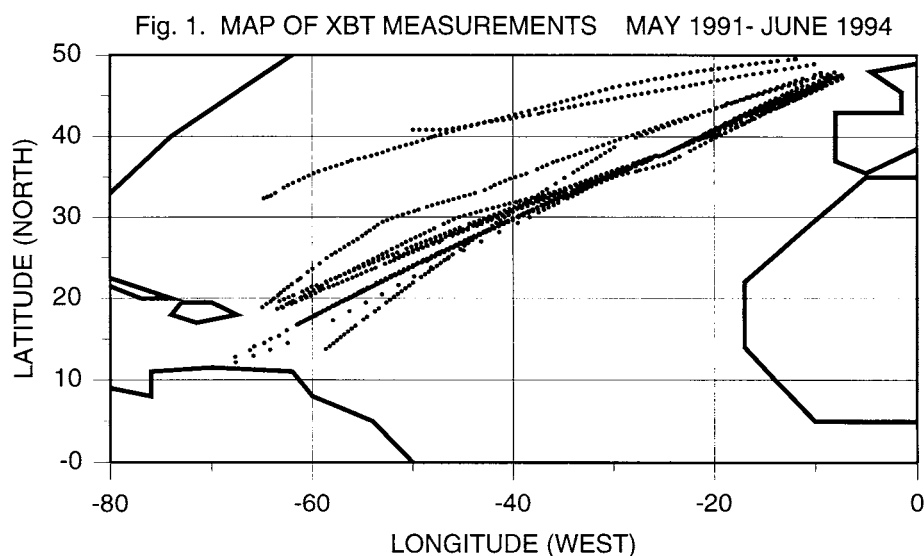
The upper layers of the ocean have an important role in the coupled ocean-atmosphere system. They exchange heat with the atmosphere on seasonal and interannual time scales and the meridional transport a substantial part in the global heat budget is via the upper layers of the oceans. In the observational programmes of TOGA and WOCE special attention is given to a co-ordinated system of regular observations of the thermal structure of the upper ocean by means of XBT (eXpendable BathyThermograph) measurements.

XBT observations can be made from ships underway. The XBT sonde consists of a thermistor probe that is launched from the ship and that sinks with a well-known falling speed, transmitting its temperature signal to the recorder on board via a thin unwinding copper wire. As a result a temperature-depth registration is obtained down to depths of about 400, 700 or 1800 m (depending on the type of probe). When completely unwound the wire breaks. The advantage of this method is that data can be obtained by "ships of opportunity" without interfering with their normal duties.

TABLE 1. Overview of XBT measurements in the joint Navy-NIOZ project.

Royal Netherlands Navy frigate	Period	Number of XBT's		
		Total	T7	T5
Banckert	14-05-91 / 24-05-91	85	85	0
Piet Heyn	25-05-91 / 04-06-91	82	82	0
Kortenaer	05-11-91 / 13-11-91	113	94	19
Banckert	17-11-91 / 26-11-91	117	94	23
Philips van Almonde	19-05-92 / 29-05-92	114	94	20
Kortenaer	31-05-92 / 09-06-92	104	78	26
Callenburgh	03-11-92 / 12-11-92	115	93	22
Philips van Almonde	16-11-92 / 24-11-92	108	91	17
Bloys van Treslong	25-05-93 / 01-06-93	95	75	22
Callenburgh	07-06-93 / 15-06-93	106	91	15
Karel Doorman	09-11-93 / 18-11-93	111	88	23
Bloys van Treslong	21-11-93 / 30-11-93	116	92	24
Willem van der Zaan	17-05-94 / 23-05-94	92	72	20
Karel Doorman	04-06-94 / 08-06-94	61	61	0
Karel Doorman	22-11-94 / 30-11-94	114	91	23
Willem van der Zaan	05-12-94 / 13-12-94	125	104	21
Total:		1658	1385	273

Naval ships normally make XBT observations in connection with anti-submarine programmes, but as a rule not at high spatial resolution. The programme reported here is a co-operation between the Royal Netherlands Navy and the Netherlands Institute of Sea Research, with support from the VvA-3 programme. The regular relieving of the frigates stationed at Curaçao offers an opportunity to carry out XBT observations (T-7 probes, down to 700 m) on the route English Channel-Antilles (the WOCE AX-5 section) at 30 miles intervals, twice in spring and in fall. This spatial density ("high-density mode") resolves much of the meso-scale structure, while the time schedule gives an opportunity to investigate seasonal variability in heat content and heat transport.



Since the beginning of the programme in 1991 16 sections have been accomplished (see Table 1). Figure 1 shows the tracks followed. Although for operational reasons the routes followed by the ships may differ, most of them are sufficiently close together to permit comparison and analysis of variability in time.

Figure 2 shows a typical spring and autumn section. Features that can be recognized are the stratified (spring) and vertically mixed (autumn) conditions northeast of longitude 25°W, the frontal structure near the Azores near 35°W, the thickness of the 18° mode water in the Sargasso Sea and the shallow thermocline in the Antilles area, southwest of 50°W.

In addition to the T-7 probes intermittently T-5 probes, that go down to 1800 m are launched along the NE part of the section. These observations (not represented on the results shown here) show the extent of the Mediterranean outflow.

Preliminary results are published as NIOZ data reports [1].

A programme like this has its potential in its continuation over many years. Similar programmes should make part of a future ocean component of the GCOS (Global Climate Observing System).

1. T.F. de Bruin, R.X. de Koster, S.Ober and L. Otto, 1992.

Netherlands XBT programme along the WOCE AX-5 section. NIOZ Data-report 1992-3.

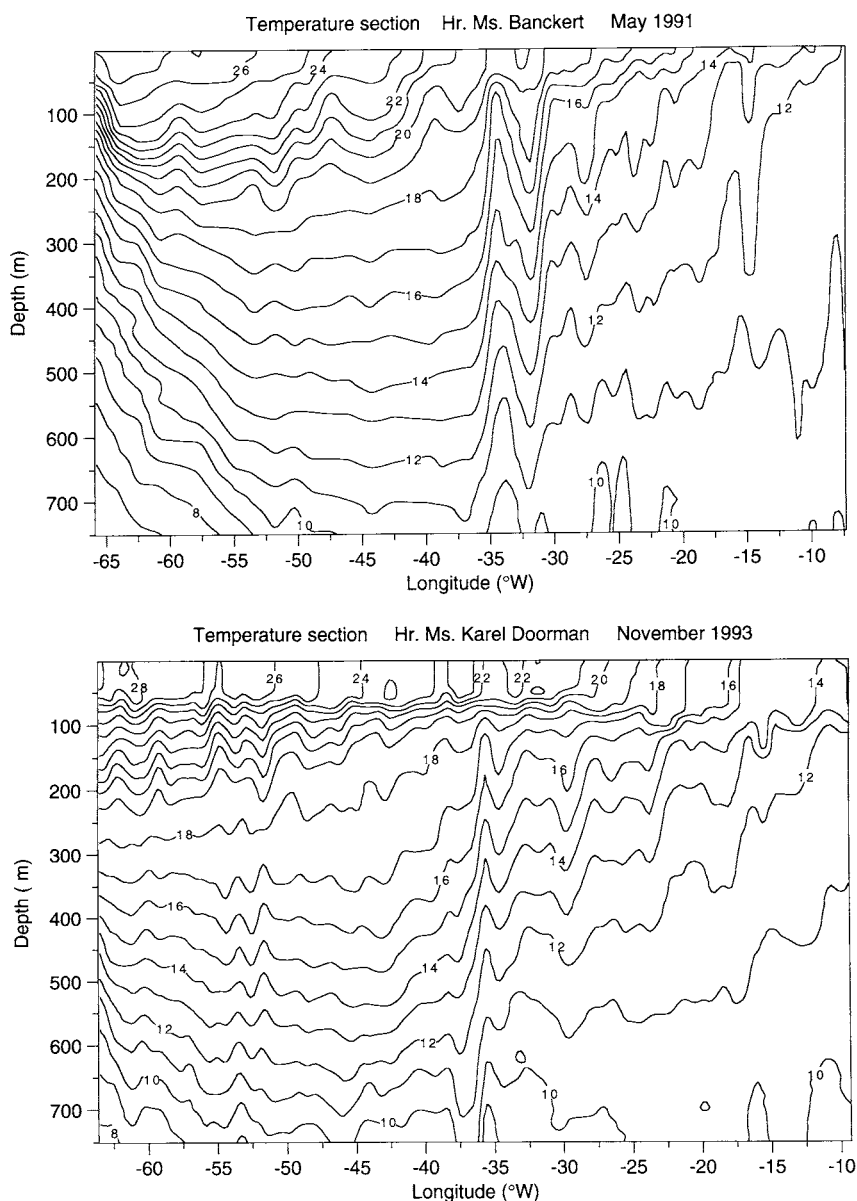


Figure 2. Typical spring (top) and fall (bottom) temperature contourplots. The main difference between these plots is the clear presence of a well mixed surface layer of about 70 meters during the fall. The sharp frontal structure at about 35 °W is the Azores Front. The cold water at 60 - 65 °W is Antarctic Intermediate Water (AAIW), transported northwards along the South-American east coast into the Caribbean Sea.