RECENT CHANGES IN THE BLACK SEA PYCNOCLINE

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Possible changes in the Black sea pycnocline has been investigated by many authors (BLATOV *et al.*, 1984; CODISPOTI *et al.*, 1991, MAMAEV *et al.*, 1994; MURRAY *et al.*, 1991; BUESSELER *et al.*, 1994). Recent CDT measurements (basin-wide and partial surveys within the context of the CoMSBlack program and TU-Black Sea Project) in the Black sea provide a unique opportunity to study pycnocline structure and to understand the role of different mechanisms in its ventilation.

Direct ventilation appears to be confined above the mean position of the pycnocline (σ_t = 14,5 - 14,7) where convection and subsequent isopycnal injection is thought to be the major water mass formation mechanism (BLATOV *et al.*, 1984; MURRAY *et al.*., 1991; OVCHINNIKOV, 1981). Some ventilation of the upper pycnocline (down to σ_t = 15,6) appears to occur in winter in the central parts of the sea (IVANOV *et al.*,1994). Similarly, ventilation of the lower pycnocline can occur by entrainment of the Cold Intermediate Water (CIW) into the Mediterranean water near the Bosphorus and the subsequent injection below the pycnocline (σ_t = 15,8 - 16,2) intrusions of the resulting shelf modified waters (BUESSELER *et al.*, 1991).

The position of selected σ_t surfaces and the corresponding values of temperature are presented in the following for recent surveys. Both values are basin averaged quantities, filtering effects of local dynamics.

σ_t	average depth (m)				average temperature (°C)			
	1991	1992	1993	1994	1991	1992	1993	1994
14,8	65,6	70,4	72,1	74,7	7,30	6,94	6,33	6,58
15,0	71,0	76,5	80,5	81,4	7,50	7,20	—	—
15,2	77,0	82,1	86,5	87,7	7,66	7,53	7,31	7,18
15,4	84,0	88,8	92,8	94,2	7,81	7,76	7,62	7,47
15,6	92,5	96,9	100,2	101,8	7,96	7,95	7,88	7,74
15,8	102,5	107,0	109,0	111,4	8,13	8,10	8,08	7,98
16,0	115,9	119,8	121,6	124,8	8,30	8,27	8,25	8,19
16,2	135,1	138,2	139,3	143,3	8,46	8,43	8,42	8,38

The table shows considerable interannual variability in the thermohaline structure of the pycnocline. Gradual deepening of the isopycnal interfaces since 1991, together with cooling and freshening, has been registrated. Meteorological data reveal a decrease in the average winter air temperature for the region in 1991-1993. Although the winter of 1994 was warmer, the cooling in the lower part of the pycnocline appears to have continued during this period as a delayed response to the earlier surface cooling.

The cooling between σ_t = 15,2 -16,2 surfaces is partly due to Bosporous influence, evident from the isopycnal temperature distribution in the vincinity of the Strait. In 1994, when the most dramatic changes were observed, the mean temperature in the central part of the sea was higher than for the whole area. It is estimated that lateral advection along isopycnals from the near Bosphorus region resulted in 0,03°C temperature decrease for the lowerpart of the pycnocline. This allows to estimate the volume of laterally injected water in 1993-1994 to be about 2500km^3. More than 50% of temperature decrease is estimated as due to vertical mixing.

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