



Research vessel CCGS Martha L. Black



Figure 1. The Atlantic Zone Monitoring Program map showing the positions of standard transects and fixed oceanographic sites in the Gulf of St. Lawrence.

Oceanographic Conditions in the Gulf of St. Lawrence during year 2000

Background

The waters of the Gulf of St. Lawrence are subject to variation in physical properties such as temperature and salinity. These fluctuations occur at various space and time scales in response to variation in physical processes. Interaction between the atmosphere and the ocean (heat exchange, precipitation, evaporation, transport) has a major influence on the variability of the physical environment which, in turn, may affect directly or indirectly the distribution, growth and reproduction of fish and invertebrate stocks in the Gulf of St. Lawrence.

Physical oceanographic conditions (temperature and salinity) are measured during research vessel surveys as part of the **Atlantic Zone Monitoring Program (AZMP)**. These data are used, with additional hydrographic and meteorological data obtained from a variety of sources, to produce an annual overview of the environmental state of the Gulf of St. Lawrence. This report presents the information for year 2000.

Summary

- Mean annual air temperature over the Gulf was warmer than average.
- Mean annual precipitation was at an average value, but with a strong seasonal heterogeneity.
- The areal extent of the ice cover was below average.
- The mean flow of the St. Lawrence River at Quebec City was slightly below average.
- The minimum temperature within the cold intermediate layer (CIL) warmed to 0.15 °C and was above average for the first time since 1983.
- In the southern Gulf, the area with bottom temperature below 1 °C slightly decreased but the area with bottom temperature below 0 °C slightly increased.

Air temperature

Mean annual air temperature (Environment Canada; www.msc-smc.ec.gc.ca/ccrm/bulletin/index.html) over the Gulf was slightly above the 1951-1980 average. During winter (December 1999 to February 2000) and spring (March to May), the departures were about 1 °C higher than average. Air temperature remained warmer than average during summer (June to August) in the northeastern part of the Gulf but were average west of Anticosti Island. In autumn (September to November), departures of about 0.5 °C above average were observed in the southern area and over the St. Lawrence Estuary.

Precipitation

The mean annual precipitation (Environment Canada; www.msc-smc.ec.gc.ca/ccrm/bulletin/index.html) over the Gulf was average but there was a strong seasonal heterogeneity. During winter, precipitation were average over the Gulf but the area extending from the St. Lawrence Estuary to the Great Lakes was dryer than average. In spring, about 20 % more precipitation than average was observed over the St. Lawrence Valley and Newfoundland. The southwestern part of the Gulf was dryer than average in summer while up to 30% less precipitation than average were observed over the drainage basin of the St. Lawrence in autumn.

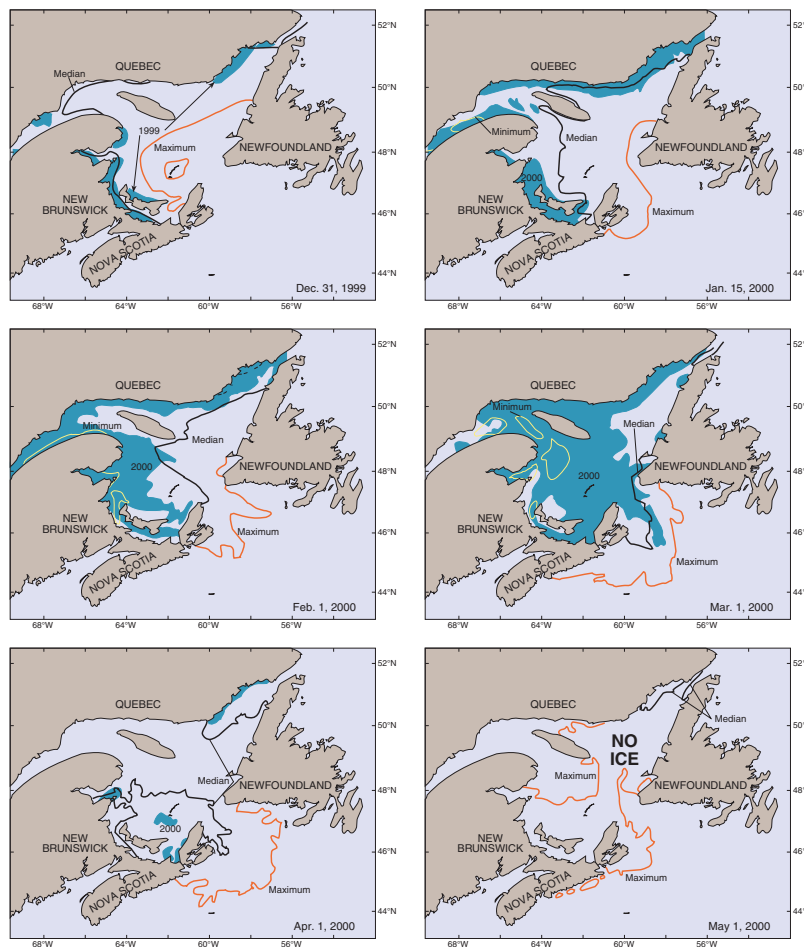


Figure 2. Ice-covered regions (shaded) in the Gulf of St. Lawrence at the dates shown on the maps. The minimum, median and maximum ice edge positions at these dates for the 1962-1987 period are also shown for reference. (Source: K. Drinkwater).

Sea ice

During the year 2000 ice season, the areal extent of the ice cover (Drinkwater *et al*, 2001) was well below the 1962-1987 maximum conditions (Figure 2). On January 15 and February 1, the ice edge position was slightly upstream of the median position. By March 1, the ice edge position was nearly at the median position but the ice cover remained below the 1962-1987 median value for the rest of the season. By May 1, the ice cover had disappeared everywhere. The earlier retreat of the ice cover during spring is consistent with the warmer-than-average air temperature observed during this season.

Freshwater discharge

The mean annual flow of the St. Lawrence River at Quebec City (Bourgault, D. and V. G. Koutitonsky, 1999) was slightly below the 1961-1990 average during 2000 (Figure 3). The same pattern is observed with the RIVSUM index, computed as the sum of freshwater flows of the St. Lawrence River at Cornwall, the Ottawa River and the Saguenay River.

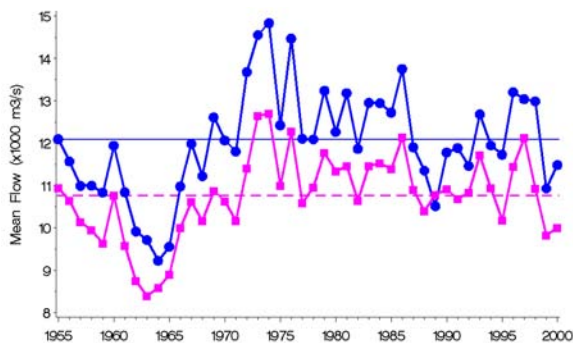


Figure 3. Mean annual flow of the St. Lawrence River at Quebec City (dots) and the RIVSUM index (squares). Horizontal lines showing the 1961-1990 average of the flow at Quebec City (solid) and the 1961-1990 average RIVSUM (dashed). (Source: D. Bourgault; D. Lefavre).

Monthly mean flow at Quebec City were closed to the 1961-1990 monthly average

throughout the year which contrasts with the large anomalies observed in spring during 1998 and 1999 (Figure 4). In 1998, larger-than-average monthly mean flows were observed in March and April while in 1999, negative anomalies were observed in April and May.

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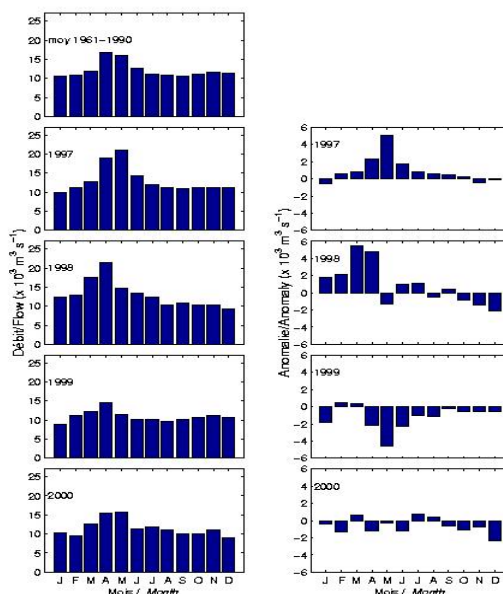


Figure 4. Monthly mean flow of the St. Lawrence River at Quebec City for the 1997-2000 period (left), monthly 1961-1990 average flow (top left) and monthly flow anomaly for the period 1997-2000 (right). (Source: D. Bourgault).

Cold intermediate layer

A prominent feature of the waters of the Gulf of St. Lawrence is the presence of a cold intermediate layer (CIL) which persists throughout the summer. The minimum temperature of the CIL is subject to variations of about plus or minus 1 °C on decadal time scales (Gilbert and Pettigrew, 1997). Vertical profiles of temperature collected during the August shrimp and groundfish survey indicated that during

1999, the CIL minimum temperature warmed by 0.6 °C relative to 1998, but remained below the 1961-1990 average (Figure 5). This warming trend persisted and the CIL minimum temperature warmed to 0.15 °C in 2000. For the first time since 1983, the CIL minimum temperature was above the 1961-1990 average.

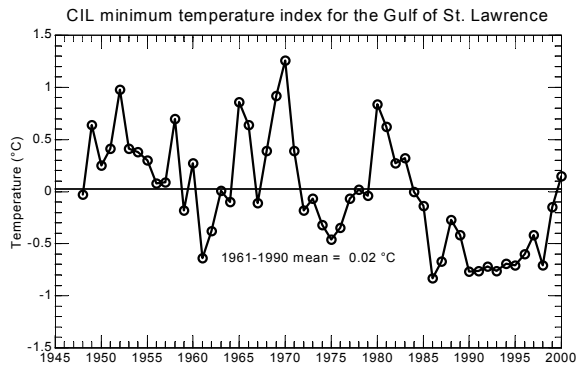


Figure 5. Composite index of CIL core temperature anomaly in the Gulf of St. Lawrence (1961-1990 mean = 0.02 °C). (Source: D. Gilbert).

Bottom temperature in the southern Gulf

In the southern Gulf, a large expanse of the seabed lies within the depth range of the cold intermediate layer. In September 1999, the area with bottom temperature lower than 0 °C and 1 °C decreased relative to 1998 (Figure 6), interrupting the colder-than-average conditions established in the early 90's. In year 2000, the area (K. Drinkwater, Fisheries and Oceans Canada, Dartmouth, pers. comm.) with bottom temperature lower than 1 °C slightly decreased while the area with bottom temperature below 0 °C slightly increased. In both case however, the area of the southern Gulf covered by cold waters in 2000 was smaller than what was observed between 1989 and 1998.

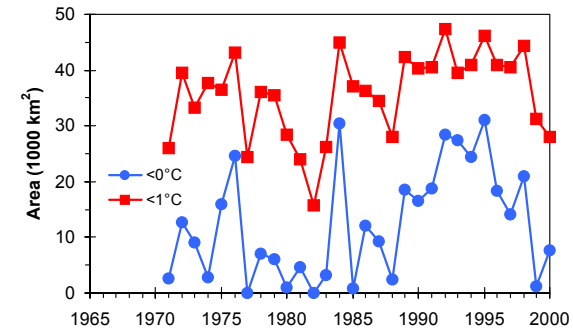


Figure 6. Area with bottom temperature lower than 0 °C (circle) and 1 °C (square) in September in the southern Gulf of St. Lawrence. (Source: K. Drinkwater).

Layer-averaged temperatures

The temperature measurements from the shrimp and groundfish survey were analysed by dividing the water column into three layers: a cold intermediate layer (30 to 100 m), a transition layer (100 to 200 m), and a warm and salty deep layer (200 to 300 m). Average temperatures within these layers (Figure 7) were calculated for the Gulf as a whole (D. Gilbert, Fisheries and Oceans Canada, Mont-Joli, pers. comm.). All of these layers were slightly warmer in 2000 relative to 1999. The mean temperature of these layers were slightly above the 1961-1990 average.

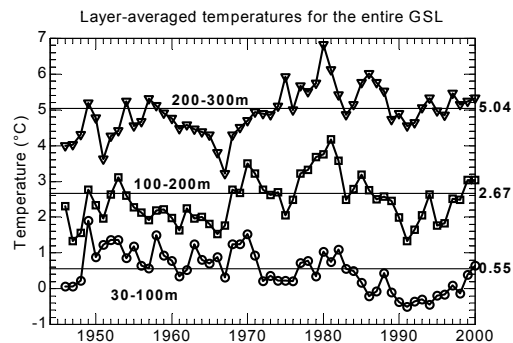


Figure 7. Layer-averaged temperatures for the whole Gulf of St. Lawrence. The horizontal lines indicate the 1961-1990 means. (Source: D. Gilbert).

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