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COMPARISON OF MEASURED AND MODELLED WATER TEMPERATURE FOR THE SOUTHERN BALTIC SEA DURING 1998-2001

Summary

The article presents results of verification of water temperature forecasts from HIROMB model, which were compared with every-day measurements from some selected IMGW coastal hydrological stations during 1998-2001. In addition to that the model results were also confronted with CTD measurements from the Gdańsk Deep.

1. Introduction

HIROMB (High Resolution Operational Model for the Baltic) was created as a result of the co-operation between BSH (Bundesamt für Seeschifffahrt und Hydrographie) from Hamburg and SMHI (Swedish Meteorological and Hydrological Institute) from Norrköping, which was begun in 1994. The model supplies us with the values of the following parameters: water temperature, salinity, current direction and speed, water level, ice concentration and thickness, ice drift direction and velocity. The current horizontal grid resolution is 3 nautical miles with 24 vertical layers but the one-mile version is already prepared [7] and will be soon operationally available, probably in 2002. The model is capable of giving 48-hour forecasts. The system of reception and processing of the HIROMB data, which had been implemented in IMGW Maritime Branch in 1998, was modernised and some of the forecasts, covering the Polish economic zone of the Baltic Sea, are operationally presented in the Internet [4]. Since 1995, when the model was started, several studies on verification of its forecasts have been made [1, 2, 3, 5, 6]. The following article is another comparison between forecasts and measurements however made for quite a long period of the last three years (1998-2001).

2. Research objective and method

The main research objective was to find major differences between computed and measured sea temperatures and to identify their causes.

The HIROMB forecasts were compared to daily sea surface temperature measurements (at 12:00 UTC) from three selected coastal hydrological IMGW stations: Kołobrzeg, Władysławowo and Gdańsk (Fig. 1). For comparison forecasts for 12:00 UTC were chosen (24-hour forecasts for 01/08/1998-30/09/1999 and 12-hour forecasts for 01/10/1999-31/08/2001). The model records were output from the nearest grid points to the above mentioned stations. Additionally, the data collected at Gdańsk Deep (station P1) were compared to the model results.

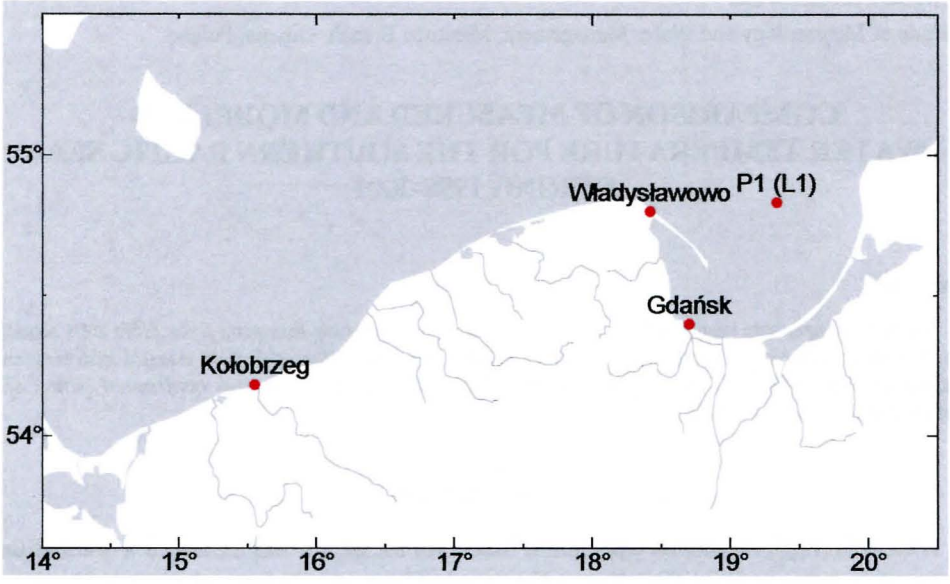

Fig. 1. Chosen IMGW stations

3. Results

The mean overestimation of HIROMB was +0.8°C in Gdańsk and +1.0° in Kołobrzeg and Władysławowo. However seasonal variability of differences can be easily noticed. In winter, the model corresponded well to the real data. The highest differences between measured and modelled temperatures occurred during upwelling (up to +8.4°C) and spring warming (up to +7.4°C). Upwelling can cause a fast decrease of coastal sea temperature and is typical for the majority of the Polish coast, especially in the central part between Kołobrzeg and Władysławowo. Unfortunately, in the model data this process is hardly visible (Figs. 2-7). Water temperature, in spring, generated by HIROMB, increased faster than in the coastal stations.

Comparison of vertical profiles showed, that modelled gradients are much lower than in the measured thermocline (Fig. 8), so the vertical mixing of the model needs further improvement. On the other hand, water temperature values in the near-bottom layer were clearly underestimated in the HIROMB forecasts. It indicates that, the transport of saline and relatively warm water from the Bornholm Basin (or even from the North Sea?) is probably not reflected in the model.

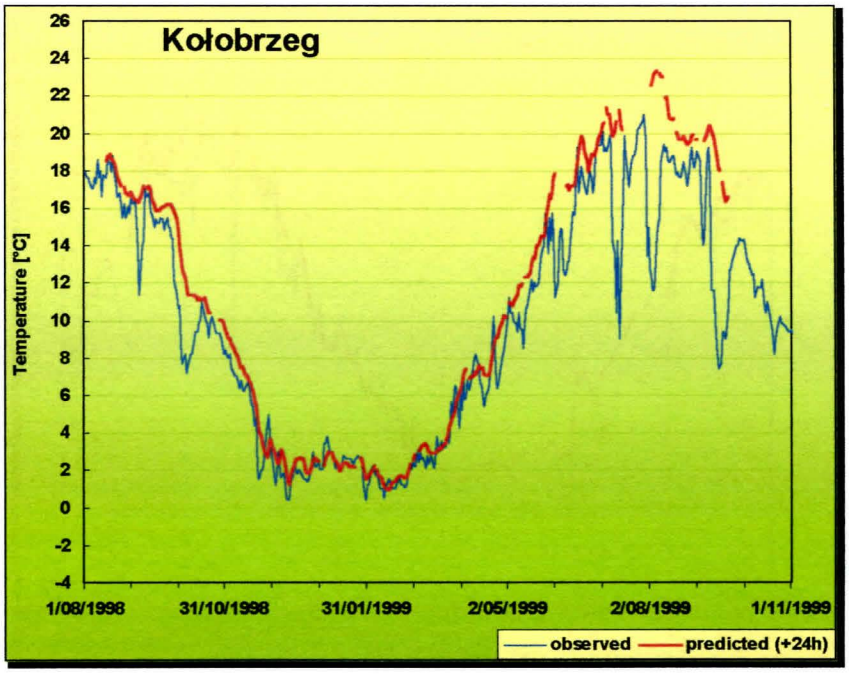

Fig. 2. Comparison of measured and modelled sea surface temperature in Kołobrzeg during 1/08/1998-30/09/1999

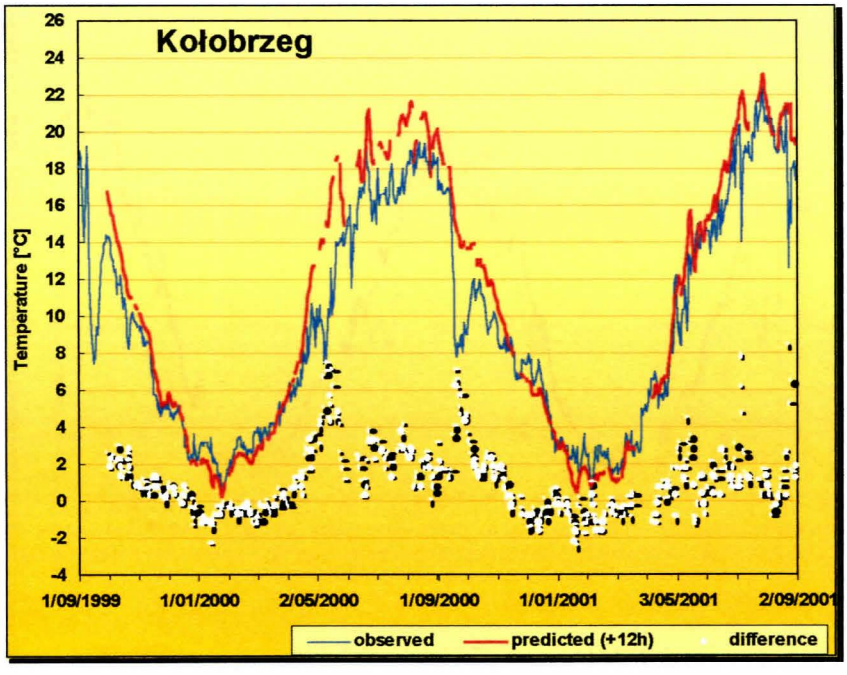

Fig. 3. Comparison of measured and modelled sea surface temperature in Kołobrzeg during 1/10/1999-31/08/2001

Fig. 4. Comparison of measured and modelled sea surface temperature in Władysławowo during 1/08/1998-30/09/1999

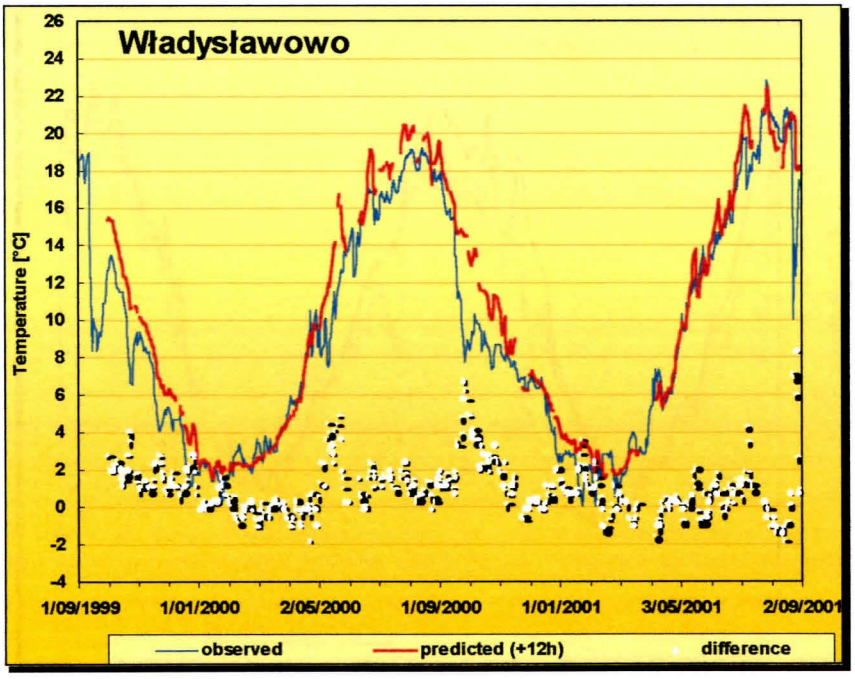

Fig. 5. Comparison of measured and modelled sea surface temperature in Władysławowo during 1/10/1999-31/08/2001

Fig. 6. Comparison of measured and modelled sea surface temperature in Gdańsk during 1/08/1998-30/09/1999

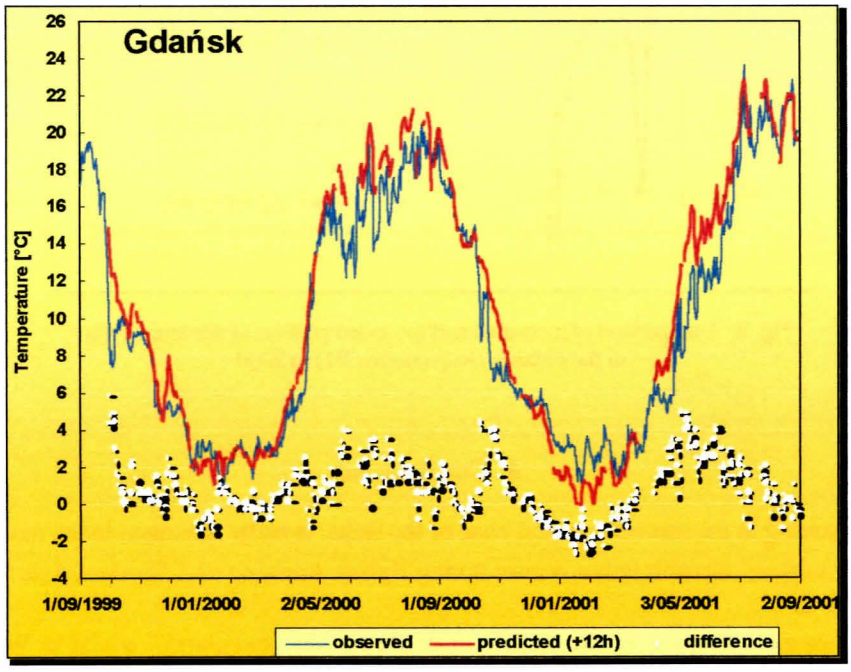

Fig. 7. Comparison of measured and modelled sea surface temperature in Gdańsk during 1/10/1999-31/08/2001

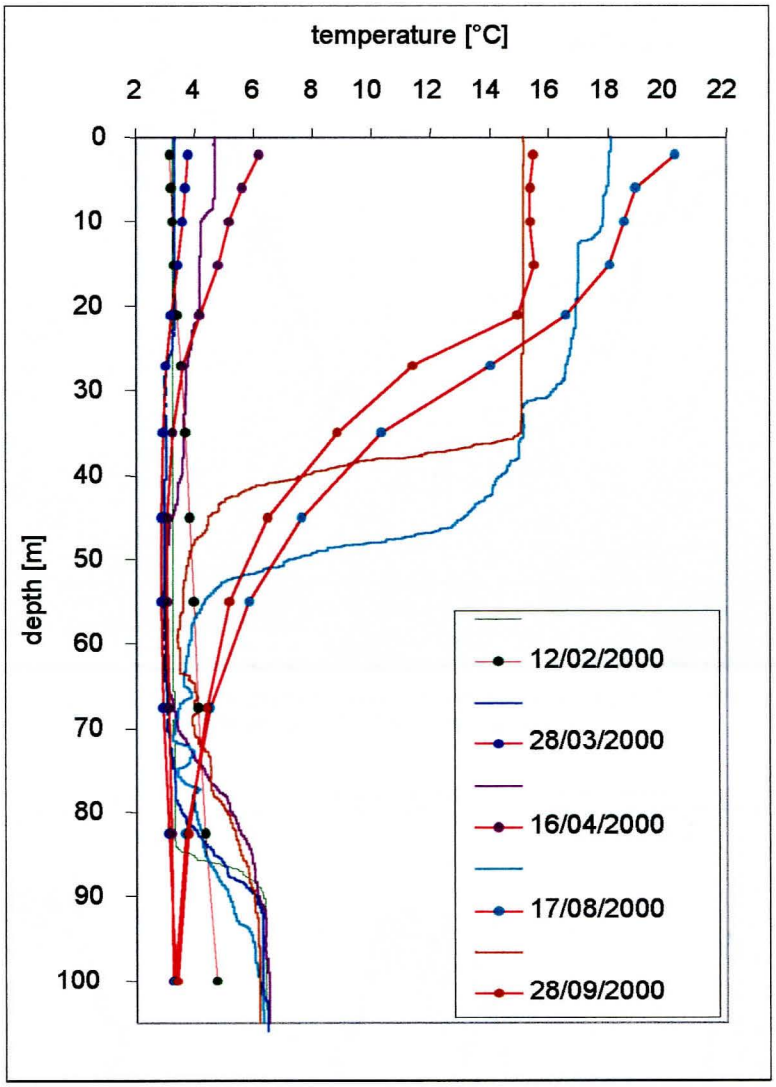

Fig. 8. Comparison of measured and modelled profiles of sea temperature in the Gdańsk Deep (station P1) in 2000

4. Conclusions

- Upwelling in the southern coastal zone of the Baltic is badly described in the model.
- The highest overestimation occurs during Spring warming and Summer/Autumn upwelling.
- In Summer, forecasts of the surface layer are usually "too warm", whilst in Winter - "too cold".
- Modelled gradients in the thermocline are lower than measured.

References

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