

TEMPERATURE CHANGES

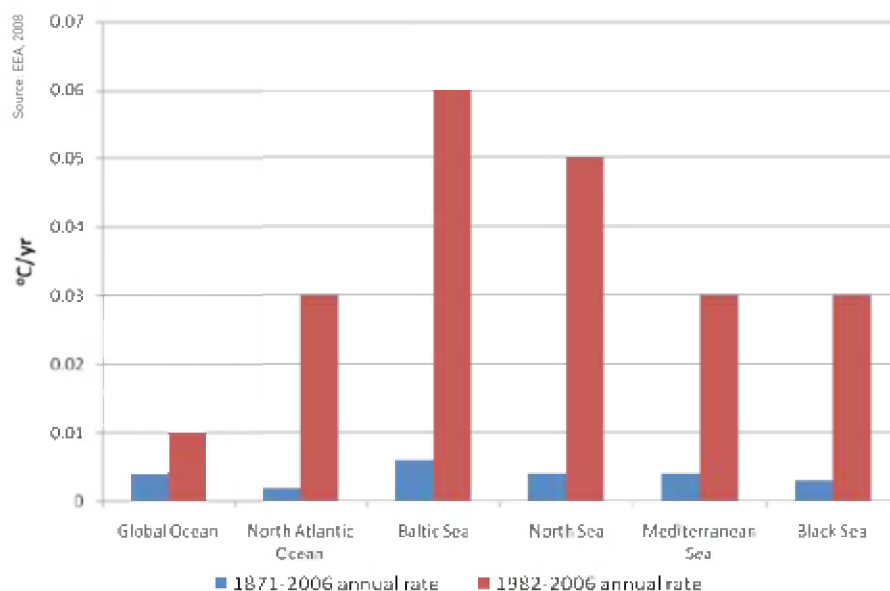
FACT SHEET

Observations of the Sea Surface Temperature (SST) (both *in situ* and remote sensing) that have been available for the last 150 years, show an overall increasing trend in oceans surface temperature. The average rate of SST rise in the last 25 years is approximately 10 times faster than the average of the past century.

Accurate detection and modelling of SST patterns and trends is critical for understanding the potential response of the climate system to increased greenhouse forcing. The speed at which water masses are warming up, however, differs considerably for different regions. Winter and summer SST data also show different trends, resulting in a complex spatio-temporal pattern of temperature changes in European waters. Aside from changes at the sea surface, there is evidence of subsurface and deep water temperature changes in European regional seas.



Rising sea water temperatures could impact local fisheries



Observed annual warming rate of Sea Surface Temperature for global and European Seas

FUTURE CLIMATE PROJECTIONS

At a global scale, an increase of 2°C in SST is expected by the end of this century. This is derived from coupled and non-coupled atmosphere – ocean circulation climate models and based on existing emission scenarios. Warming in the North Atlantic will be slower than the global average.

At a local and regional scale, the estimates differ significantly between different areas. For example, a rise of 2-4°C in SST is expected for the Baltic and 1.7°C for the North Sea by the end of the 21st century. These estimates are based on downscaled regional climate models in combination with 3D baroclinic ocean models.

THE POSSIBLE DANGERS OF SEA TEMPERATURE RISE

Warming of the air and sea surface affect critical physical conditions and the biological processes of living organisms. This is expected to stimulate the migration of species towards the poles. Species migration can influence both the food chain and community structure, which may lead to changes in the composition of fish species with potential impacts on local fisheries. These kinds of regime shifts have already been reported in the North Atlantic, North Sea and the central Baltic Sea.

FACT SHEET

A number of EU and national projects and initiatives have contributed to a better understanding of temperature change, both in global oceans and European regional seas. The main focus of research has been on:

- Increasing the predictive capacity of models by coupling the various parameters which influence temperature changes;
- Providing quality controlled long-term observation products;
- Intercomparison of regional climate models.



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FURTHER READING

- Ådlandsvik B [2008]. Marine Downscaling of a Future Climate Scenario for the North Sea. *Tellus* 60A: 451-458.
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- IPCC [2007]. Climate change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge Univ Press, Cambridge, UK, p 996.

This fact sheet is based on a chapter of the CLAMER / Marine Board Synthesis Report *Effects of Climate Change on Marine Environments* [Deliverable 1.2] written by **Jun She** of the Danish Meteorological Institute (DMI), Denmark

RESEARCH GAPS AND PRIORITIES

The current coupled atmosphere - ocean models still show substantial regional biases in the SST distribution. These biases are sometimes larger than the simulated SST warming in the late 20th century (IPCC, 2007).

To make sensible projections of sea temperature for future climate scenarios, more knowledge is required on:

- SST-related processes in atmosphere and ocean models (cloud feedback, aerosol forcing and ocean - atmosphere interaction, waves-induced mixing and light attenuation, etc);
- The possible change of deep convection and related atmosphere - ocean - ice interactions in melting Nordic and Arctic oceans.

To improve this knowledge, there is a need to:

- Identify and reduce the SST and sea-ice related uncertainty in climate modeling;
- Increase the resolution and number of coupled regional atmosphere - ocean circulation models;
- Improve the parameterization of dominant processes for accurate SST simulation in coupled climate models, both in global and regional scales; and
- Develop reliable 3D baroclinic ocean climate models for climate study.