MCCIP Marine Climate Change Impacts Partnership

Topic

Marine Air Temperature

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Organisation(s) represented

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Executive summary

Marine air temperature measurements made by **Voluntary Observing Ships** have been used in a new dataset of daily air temperatures and other marine meteorological variables currently under development at the National Oceanography Centre, Southampton. This dataset shows that the air temperature over the seas near the UK (7W:3E and 50N:60N) has risen over the period 1970 to 2006 at a similar rate to the **Central England Temperature** (CET, Parker *et al.* 1992). However, there are strong regional variations in the linear warming trend over UK territorial waters. Marine air temperatures have risen faster than the CET in the Eastern English Channel and across the majority of the North Sea. The Scottish Continental Shelf, North-West Approaches and Northern North Sea have seen a slower rise than CET and the Irish Sea, South-West Approaches and the Western Channel have seen marine air temperature increasing at a comparable rate to CET. Marine air temperature spatial gradients are thus increasing in the Northern North Sea. As for sea surface temperature (Holliday *et al.* 2007), air temperature in the winter of 2005/6 was colder than recent years, but the second part of 2006 saw some of the warmest average monthly temperatures in the record.

Due to a decline in the number of reports from Voluntary Observing Ships our confidence in the estimates of marine air temperature has decreased over the last decade, both in UK waters and globally.

Sea surface temperature linear trends within UK Coastal Waters are broadly similar to marine air temperature in both magnitude and spatial pattern.

Full review

Marine air temperature over the ocean is measured from ships, buoys and marine platforms. Near-surface air temperature is not accurately retrievable from satellites. Hence we use marine air temperature from a new dataset under development at the National Oceanography Centre, Southampton, which presents daily air temperatures on a 1˚ grid (although the true spatial resolution is somewhat coarser than 1˚). The NOCS dataset uses night time only data[1] to avoid spurious daytime heating (e.g. Berry *et al.,* 2004) and has been corrected to account for the changes in ship size and air temperature observing height (e.g. Kent *et al.,* 2007).

Figure 1 shows the 25-year trend[2] in marine air temperature (°C / decade) estimated from the new dataset for the Northeast Atlantic and UK waters. The warming is greatest in the Eastern English Channel and over the Central and Southern North Sea, with warming rates of up to 0.5 – 0.6 °C per decade. Lower warming rates are found for the Scottish Continental Shelf, North West Approaches and the Northern North Sea with warming of around 0.3 – 0.4 °C per decade. The region of warming to the south west of Iceland is a region of high uncertainty in the data, hence our confidence in the warming trends shown to the south and south west of Iceland is low.

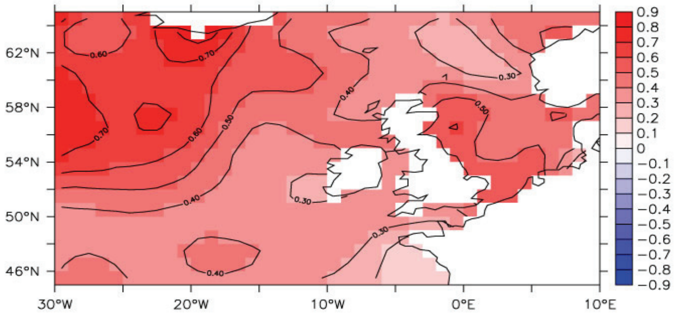

Figure 1. 25-year linear trend in air temperatures estimated over the period 1982 – 2006 (°C / decade) from the new NOCS dataset

Figure 2 compares the time series for the UK coastal waters (7W – 3E, 50N – 60N, black), a 2x2 degree box in the North Sea, a 2x2 degree box to the north east of Scotland and the Central England Temperature (CET, blue). The agreement between the time series for the UK shelf waters and the CET gives confidence to the new dataset. This is further strengthened by the agreement between the new dataset and HadMAT[3] (Rayner et al., 2003) shown in the

[1] The previous report card used an adjusted daytime air temperature version of the dataset from NOCS. Currently only the night time version has been updated to 2006.

[2] The trend estimates start after the period of cooling during the 1970s and longer trend estimates, such as those presented in the previous report card, will report lower trends. The period 1982 – 2006 has been chosen as the almost linear trend begins at the start of the 1980s.

[3] HadMAT uses the same VOS observations and similar gridding procedures but on different time and space scales (monthly and 2.5 degree grid compared to daily and a 1 degree grid for the NOCS OI dataset) and with different quality assurance and bias corrections applied.

previous report card (Kent et al., 2006). The stronger warming in the North Sea compared to the CET can be seen together with the weaker warming to the north east of Scotland.

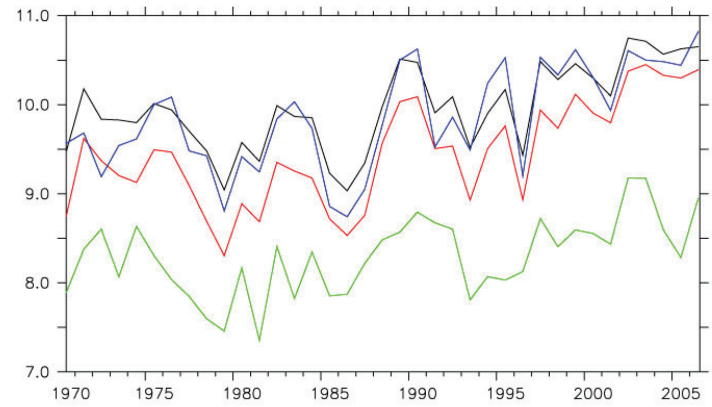

Figure 2. Time series of yearly mean marine air temperature estimated from the NOCS dataset for UK shelf waters (7W – 3E, 50N – 60N, black), a 2x2 degree box in the North Sea (1W-1E, 56N-58N, red), a 2x2 degree box to the north east of Scotland (1W-1E, 60N-62N, green) and the Central England Temperature (CET, blue)

Figure 3 shows the annual cycle of the monthly mean values ± 1 standard deviation over UK coastal waters for the period 1970 – 1979, 1997 – 2006 (green hatching) and the monthly mean air temperatures for 2006 (black line). The cold winter of 2005/2006 can be seen, with a 10-year low monthly mean marine air temperature in March 2006. The air temperature then warms rapidly through to July before a relative cooling off in August, and remains warmer than average through the autumn. Of the 12 monthly values in the annual cycle all are warmer for the later period, with 6 significantly warmer at the 90% confidence level. Similar results are seen in comparisons of the CET (Figure 3, lower panel) and the SST (Holliday *et al.,* 2007).

Although relying on **Voluntary Observing Ships** (VOS) for information on marine air temperature we note that the number of observations collected, in UK waters and globally, has declined in recent years. Figure 4 shows the uncertainty in the monthly mean air temperature (°C) averaged over the period 2002 – 2006 (top) and the difference between the average uncertainty for this period and the uncertainty averaged over 1970 – 1975 (bottom). The highest confidence (lowest uncertainty) in our air temperatures can be found over the North Sea, English Channel and South West Approaches whilst the lowest confidence in the air temperature values can be found to the south and south west of Iceland. There has been little change since 1970 in the uncertainty in the air temperature for the regions where we have highest confidence whilst the uncertainty in regions where we have low confidence has increased. This is due to changes in the shipping patterns and a declining number of VOS.

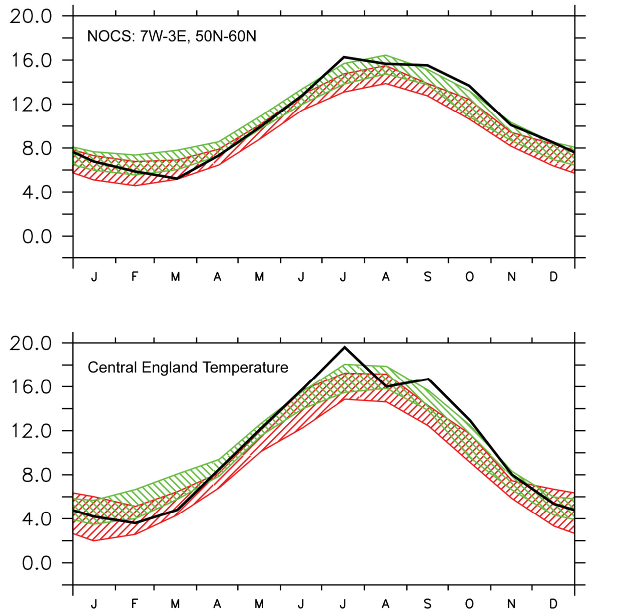

Figure 3. Monthly mean air temperatures ± 1 standard deviation from the NOCS dataset for UK coastal waters (7W-3E, 50N – 60N, top) and for the CET (bottom) for the periods 1970 – 1979 (red), 1997 – 2006 (green) and 2006 (black line).

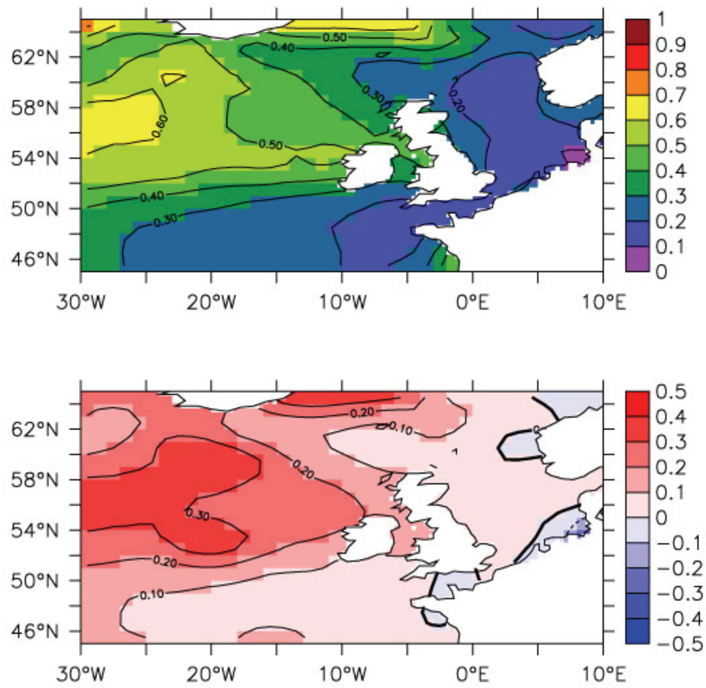

Figure 4. Average uncertainty in the monthly mean air temperature (°C) for the period 2002 – 2006 (top) and the change in uncertainty (°C) for the period 2002 – 2006 compared to 1970-1974 (bottom).

Confidence assessments

'What is already happening' - High

Agreement with independent measurements of SST and the CET give a high level of confidence in the marine air temperature data.

Knowledge gaps

As noted in supporting evidence, uncertainty in marine air temperature fields has increased in recent years due to reduced sampling.

Commercial impacts

Not stated

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