

Using UKCP09 to perform a marine spatial assessment



Author/Organisation

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Introduction

Special Areas of Conservation (SACs) are strictly protected sites designated under the EC Habitats Directive by the nation within which that territory falls. Progression towards full adoption by the EU as a SAC includes a number of steps. No offshore sites are full SACs as yet but in continental UK shelf waters shallower than 200m five sites are currently 'Possible SACs' (pSAC – status means they have been formally advised to UK Government, but not yet submitted to the European Commission). One additional site on the shelf is at an earlier stage as a 'Draft SAC' (dSAC) as an area suitable for selection as SAC, but not formally approved by government as sites for public consultation. Further Information is available through the JNCC.

UK SAC/SCI sites summary <http://www.jncc.gov.uk/page-1456>

SACs in UK offshore waters http://www.jncc.gov.uk/protectedsites/sacselection/SAC_list.asp?Country=OF

The UKCP09 Coastal and Marine Scenarios will enable an improved assessment of potential future climate change both within the water-column and the atmosphere above the offshore SACs.

Figure 1 shows the nine Sea Areas for which the UKCP09 probabilistic scenarios have been collated for atmospheric parameters. The five pSACs are shown in red where the UKCP09 grid approximately coincides with each region, the one dSAC at Dogger Bank is also shown (and noted in *italic*). Of the 6 sites both the Scanner and Braemar pockmarks lie just outside of the UKCP09 model grid, but the projections from the 'Northern North Sea' area would provide a best approximation to atmospheric changes at these sites. The majority of the dSAC at Dogger Bank would be outside of the grid but the projections from the 'Southern North Sea' area can similarly be reasonably applied. The water-column marine scenario is gridded at a higher resolution (12 km) and covers the entire shelf around Great Britain and Ireland. Changes in temperature, salinity, stratification and currents can be examined at all six of the sites. This Case study examines the two sites within the Southern North Sea area under a medium emissions scenario.

Figure 1: Sea Areas for UKCP09
Probabalistic Climate projections and
approximate corresponding grid coverage
of marine on shelf possible SACs and the
UK component of one draft SAC (*italics*).

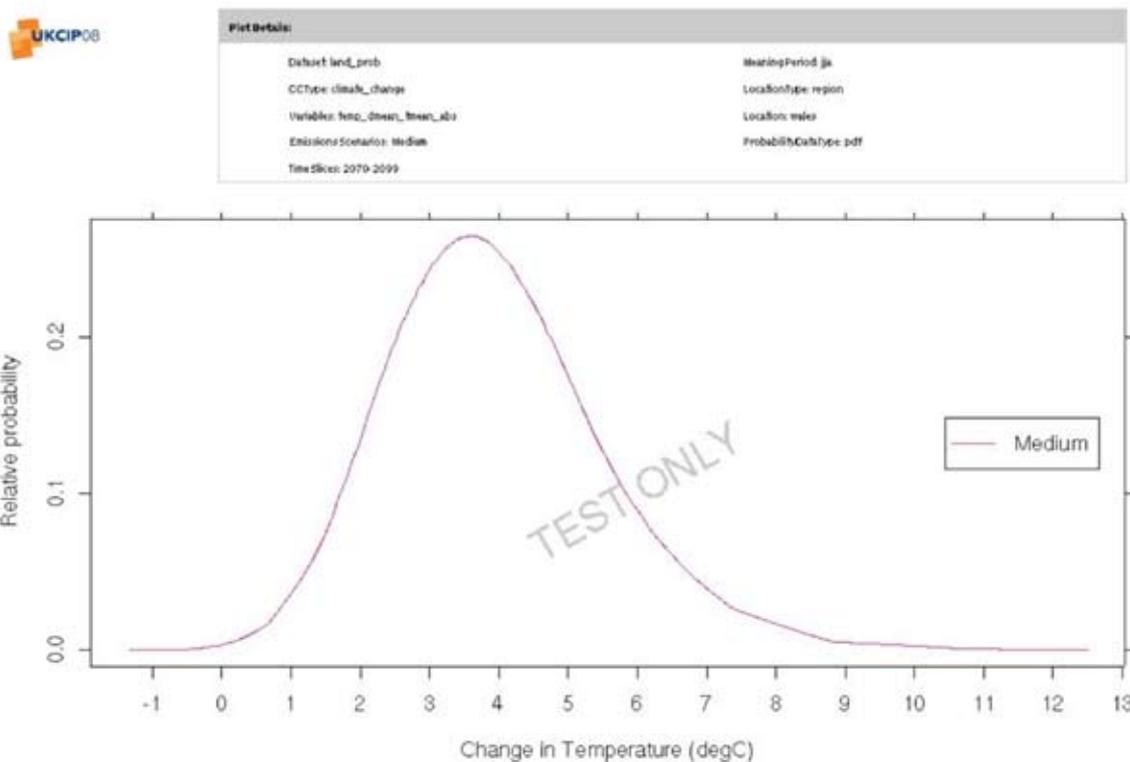
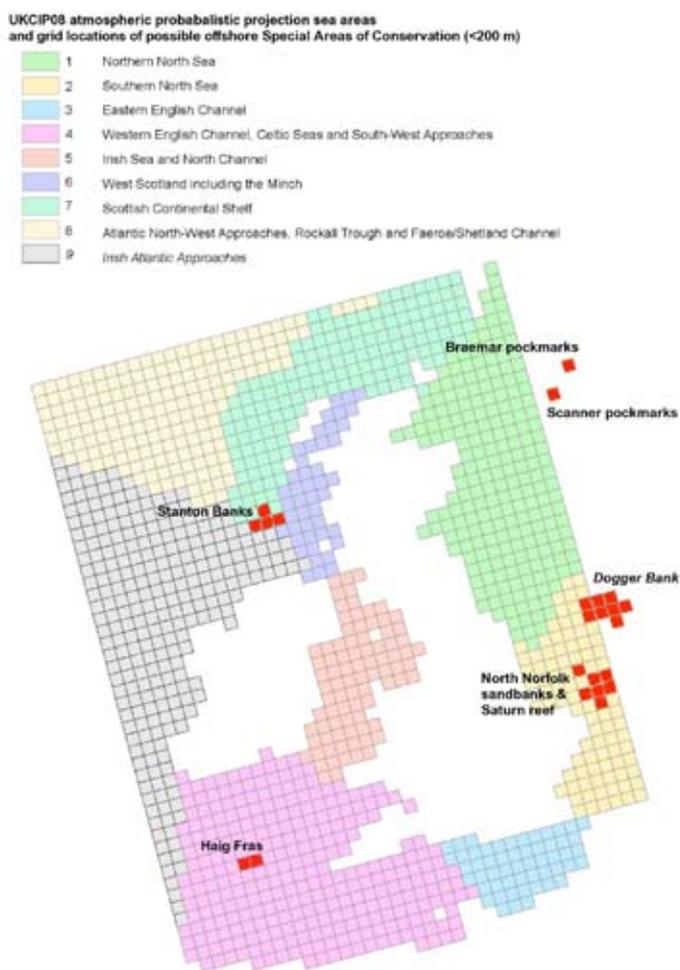


Figure 2 (above): Probabalistic Projection for Summer (JJA) Change in Temperature by the 2070s (2070–99) over the Southern North Sea. [Dummy] The probability distribution of modelled surface air temperature change.

Table 1: UKCP09 Medium emissions scenario increases in Air Temperature over the Southern North Sea, (10%, 50% and 90% probability levels) relative to the 1970s [Dummy data].

	Unlikely to be less than	Central Estimate	Unlikely To Exceed
2020s	0.5 °C	0.95 °C	1.5 °C
2050s	1.0 °C	2.4 °C	3 °C
2080s	2.0 °C	3.82 °C	6.1 °C

Case Study

Probabilistic Scenarios: Change in conditions above the surface of the sea at the pSAC North Norfolk Sandbanks and Saturn Reef (Saturn) and at the dSAC Dogger Bank (Figure 1).

In Figure 2 we show [dummy] projected probability distribution showing the full model uncertainty for near surface air temperature for summer (Jun–August) by the 2080s under a medium emissions scenario. Table 1 summarises the projections for the three periods 2020s (2011–2040), 2050s (2041–2070) and 2080s (2070–2099). By the 2080s under a medium emissions scenario, based on current understanding and the UKCP09 model methodology, the central estimate of change in summer mean temperature is 3.82 °C, the change is unlikely to be less than 2.0 °C, and unlikely to exceed 6.1 °C. These changes are relative to the climate for the period 1961–1990 (1970s).

On launch of the UKCIP Scenarios this analysis will be extended to a winter season, and if possible an analysis of changes in winds.

Changes within the water-column:

The UKCP09 marine scenarios include a medium emissions scenario projection for the water-column properties in the 2080s on a 12 km grid including the entire UK shelf sea area. When the full dataset is available each SAC site can be assessed for changes in temperature, salinity, currents and stratification timing. Figures 3–5 show the changes in water column thermal properties for the southern North Sea, with the two SACs shown.

Winter changes (February — Figure 3) across the region are broadly homogenous with a fully mixed water column everywhere, at Saturn and Dogger the increase in temperature is an average of 2.1 and 2.2 °C respectively. Figures 4 and 5 illustrate the different seasonal behaviours of the two sites.

Saturn remains predominantly well mixed throughout the year, with average change in the bottom temperature matching the surface temperature. Only 5% of this site stratifies for more than 7 days per year under 1970s conditions with a slight increase to 13% under 2080s medium emission scenario conditions. Virtually none (less than 1%) of the Saturn area stratifies for more than 28 days under present or future conditions.

Dogger includes areas which the model suggests are well stratified for significant periods of the year and others that are generally well mixed. Average change in the bottom temperature is less than that at the surface showing some increase in the strength of stratification. Only 7% of this site stratifies for less than 28 days per year under 1970s conditions decreasing to 0% under 2080s forcing,

Figure 3: Change in February surface and bottom temperature by the 2080s relative to 1970s

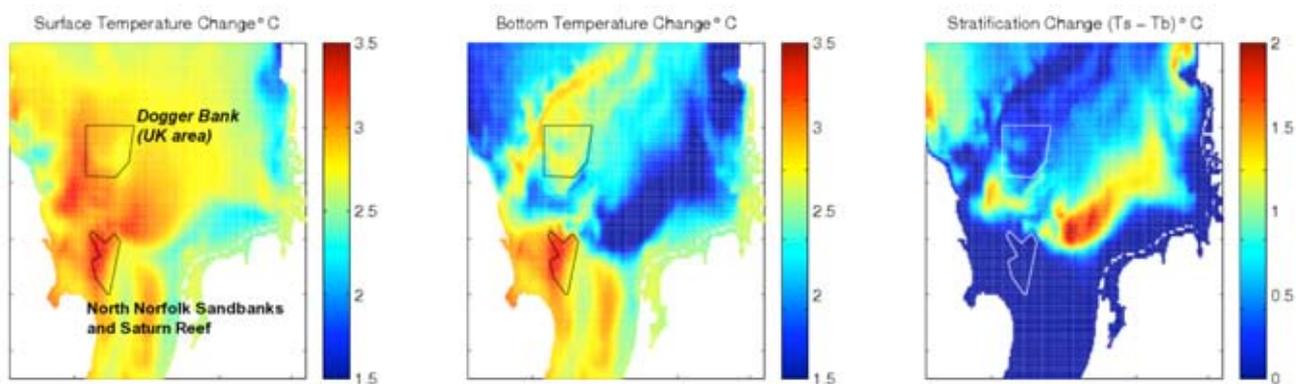
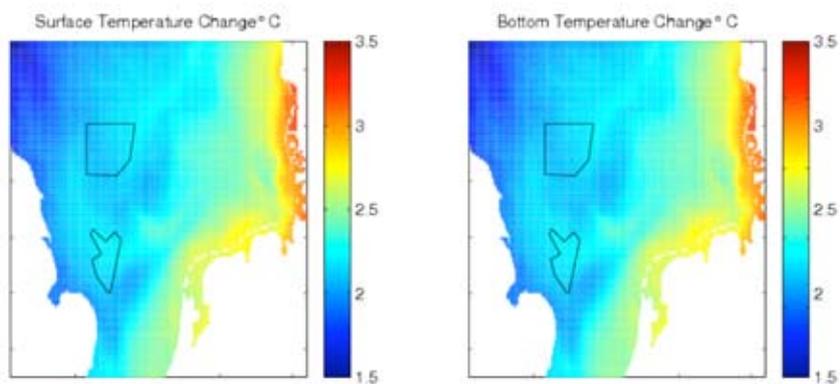
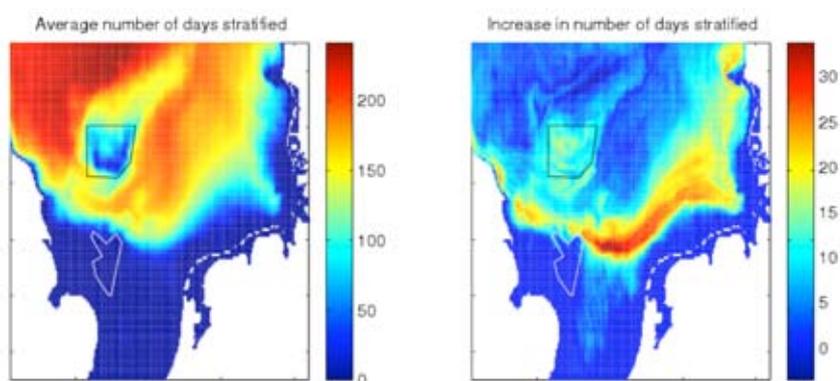


Figure 4: Change by the 2080s relative to 1970s in average August surface, bottom temperature and surface to bottom temperature difference. The areas of the SAC locations are shown, boundary co-ordinates for North Norfolk Sandbanks and Saturn Reef (pre- consultation v1.1 12/05) and Dogger Bank (estimated).

Figure 5: Average annual number of days where the water column is well stratified (surface to bottom temperature difference exceeds 1 °C). Left panel — modelled average for 1970s; right panel — the number of additional days stratified by the 2080s.



for the 1970s around 40% of the area stratifies for more than 90 days per year increasing to 55% under 2080s medium emission scenario conditions. None of the Saturn area stratifies for less than 7 days under present or future conditions in the model.

Table 2: UKCP09 Medium emissions scenario summary changes in water column properties at the two Southern North Sea SACs. The changes are calculated by averaging all the grid points of the model domain within the area.

	August average surface temperature increase °C	August average bottom temperature increase °C	February average temperature increase °C	Change in area stratified ($T_s - T_b > 1$ °C) for more than 90 days per year
Dogger Bank (dSAC)	2.9	2.6	2.1	15%
North Norfolk Sandbanks and Saturn Reef (pSAC)	3.1	3.1	2.2	0