# Sensitivity of the global submarine hydrate inventory to scenarios of future climate change: Supplementary information

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**Abstract**

The global submarine inventory of methane hydrate is thought to be considerable. The stability of marine hydrates is sensitive to changes in temperature and pressure and once destabilised, hydrates release methane into sediments and ocean and potentially into the atmosphere, creating a positive feedback with climate change. Here we present results from a multi-model study investigating how the methane hydrate inventory dynamically responds to different scenarios of future climate and sea level change. The results indicate that a warming-induced reduction is dominant even when assuming rather extreme rates of sea level rise. Over the next century modelled hydrate dissociation is focussed in the top ∼100 m of Arctic and Subarctic sediments beneath <500 m water depth. Modelled dissociation rates are particularly sensitive to the vertical hydrate distribution within sediments. Under the worst case business-as-usual scenario (RCP 8.5), global sea-floor methane fluxes could exceed estimates of natural levels by 2100, although subsequent oxidation in the water column could reduce peak atmospheric release rates to 0.7 to 1.4 Tg $CH_4$ $yr^{-1}$.

*Keywords:* methane hydrate; anthropogenic; climate change

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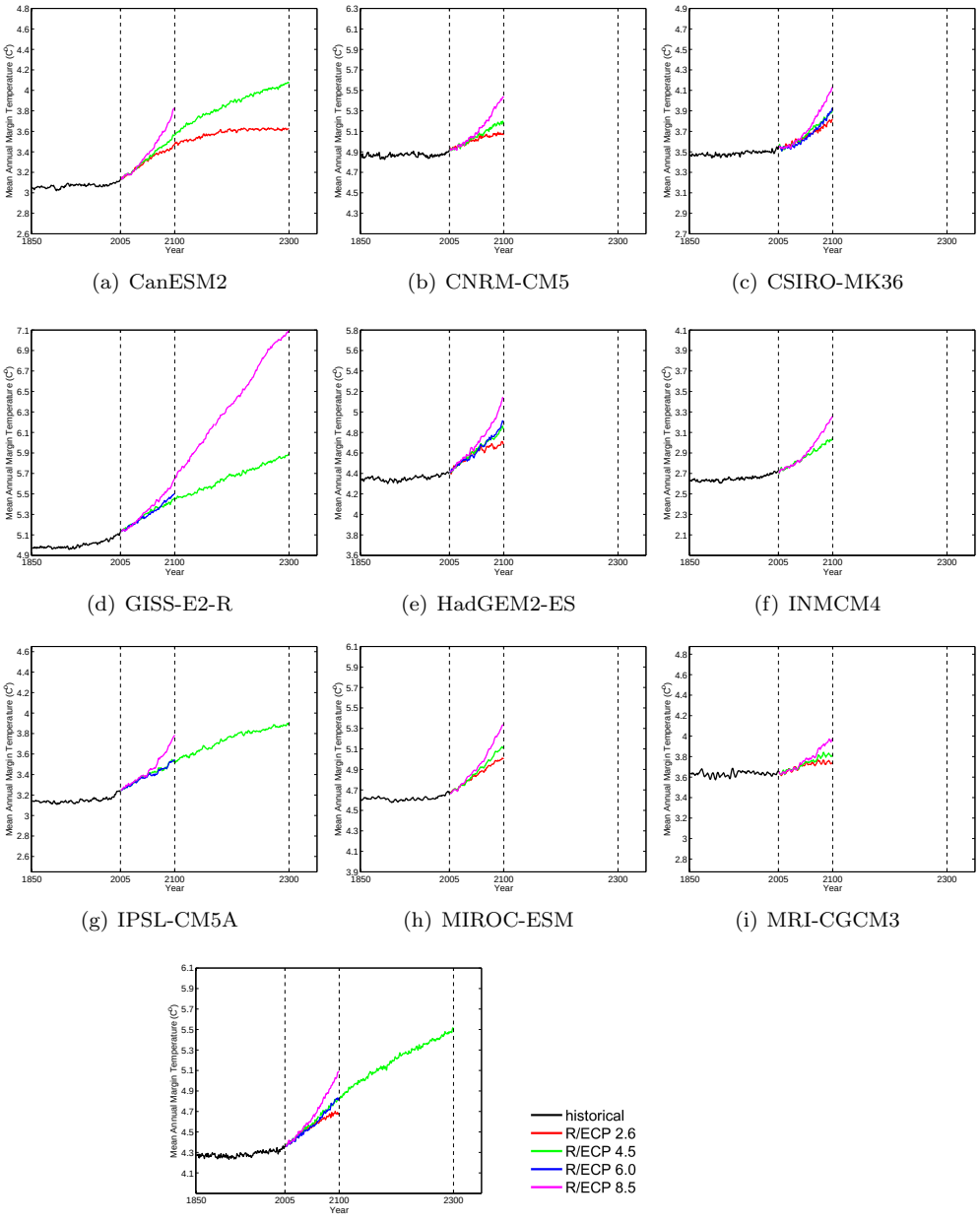


(a) CanESM2 (b) CNRM-CM5 (c) CSIRO-MK36

(d) GISS-E2-R (e) HadGEM2-ES (f) INMCM4

(g) IPSL-CM5A (h) MIROC-ESM (i) MRI-CGCM3

(j) NorESM1-M

Figure 1: Modelled globally-averaged bottom water temperature integrated over the margins for the historical, RCP and ECP scenarios. For comparison the vertical axis coverage is equivalent.

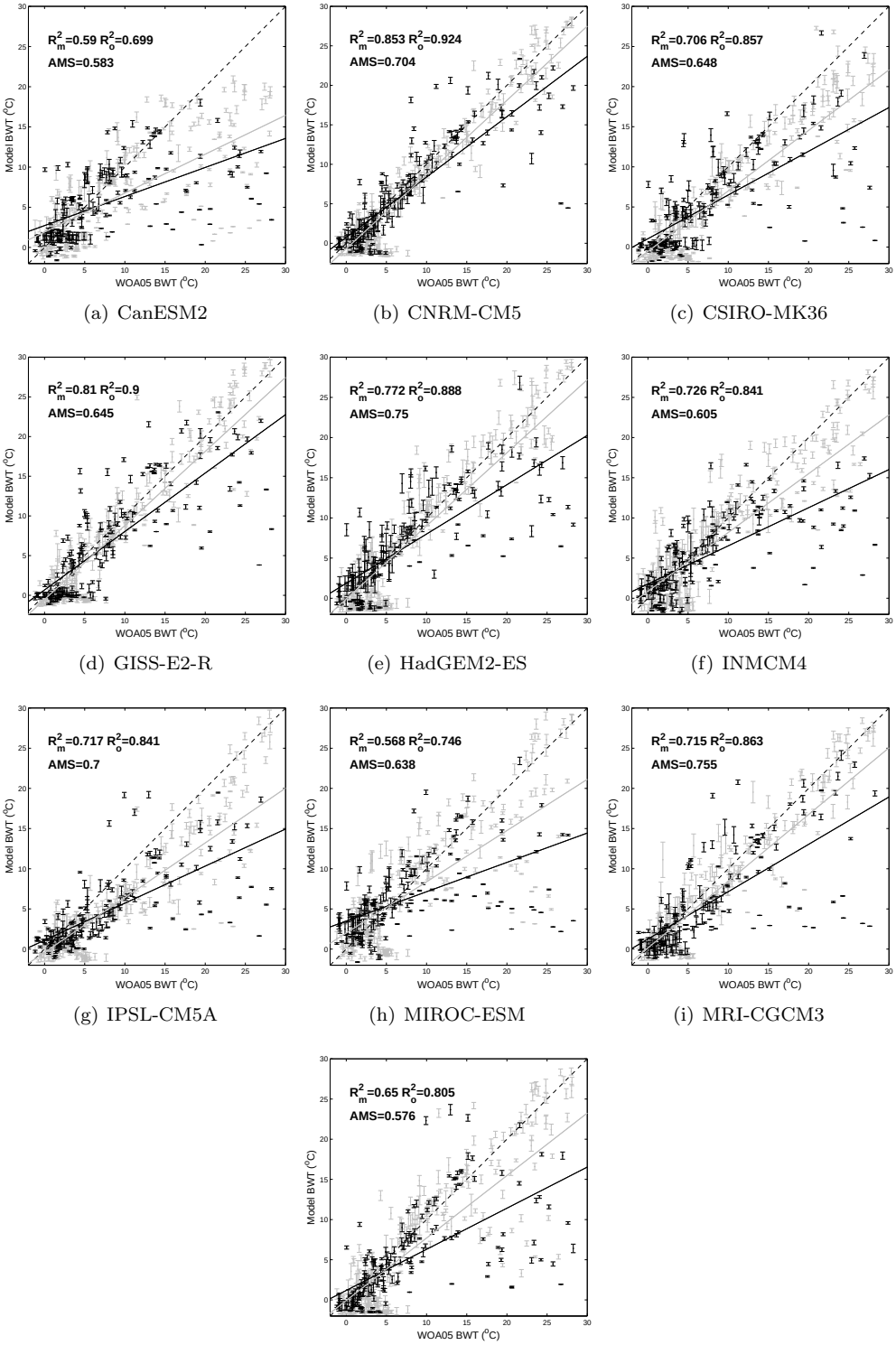


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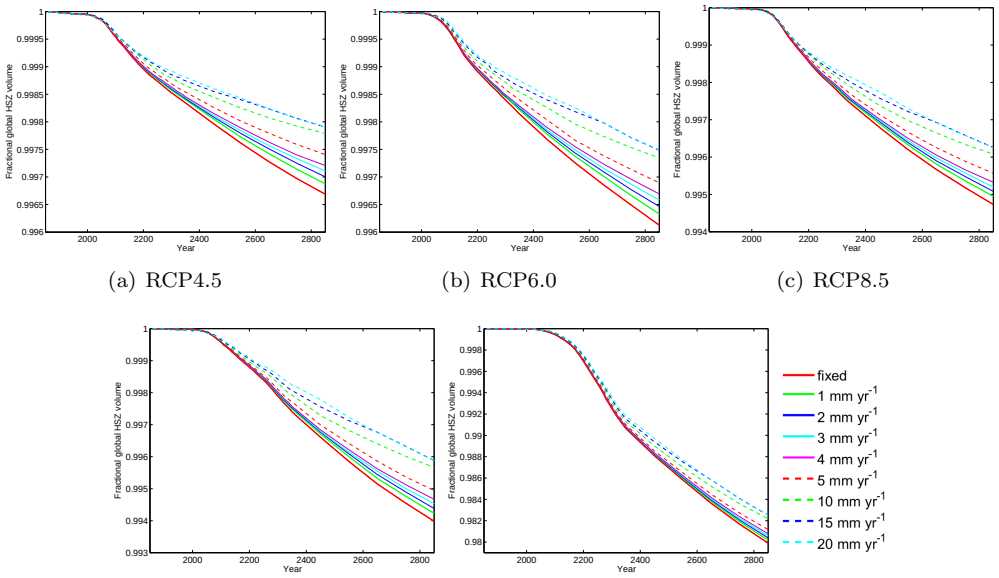
Figure 2: Point-wise evaluation of modelled in-situ bottom water temperatures against the WOA05 observational data set (Locarnini et al., 2006) carried out on the $2 \times 2°$ grid. Black data points represent data from the continental margins whilst grey data points are from the remaining ocean. Dotted line corresponds to 1:1 trend in data-model correspondence, and the grey and black lines are the least-squares fits for the margins and whole ocean respectively.




(a) RCP4.5 (b) RCP6.0 (c) RCP8.5

(d) ECP4.5 (e) ECP8.5

Figure 3: Multi-Model Mean Fractional change in the envelope of global hydrate stability zone volume (gHSZv) under the linear sea level models. gHSZv defined as the globally integrated product of lateral cell area and Hydrate Stability Zone (HSZ) thickness. Note changes in vertical axis.

Locarnini, R. A., Mishonov, A. V., Antonov, J. I., Boyer, T. P., Garcia, H. E., 2006. World Ocean Atlas 2005, Volume 1: Temperature. In: Levitus, S. (Ed.), NOAA Atlas NESDIS 61. U.S. Government Printing Office, Washington, DC.