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# A quantitative, multi-proxy assessment of hydrological results from coupled ocean-atmosphere models: Present Day and Maastrichtian examples

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The accuracy of hydrological results from General Circulation Model experiments is difficult to assess quantitatively. This reflects three main issues: i. scale (due to the short de-correlation distance for hydrological variables – 10's kilometres – compared with model resolution); ii. the limitations of the observational record (sparse spatial and, especially, temporal cover of station data, the degree to which human activity has perturbed the 'natural' signal, and the logistical problems of directly measuring variables such as evaporation); iii. the paucity of quantitative geological proxies of hydrology (with most proxies either being only broadly defined, "wet" or "arid", or defined with variables that reflect auto-correlation rather than direct descriptions: e.g. the use of precipitation cut-offs for evaporation products rather than relative humidity or P-E). The latest coupled ocean-atmosphere GCM experiments indicate that increased atmospheric $CO_2$ results in a concomitant enhancement of the hydrological system. Given the importance of such results for future predictions of environmental change (viz., flooding) and for geological applications such as palaeodrainage and reservoir facies prediction in the oil and gas exploration (viz., sediment fluxes), it is essential to be able to quantitatively define the validity of such results and their associated uncertainties.

In this study we have compared the output from two Present Day model experiments (using the HadCM3 GCM) with modern observational datasets (UEA CRU interpolated grids, compiled climate station data) and an extensive global dataset of geological proxies (including evaporites, soils, vertebrates, floras, biomes, stratigraphy, clay mineralogy, geochemistry). For each climate proxy we have identified the critical en-

vironmental variables, the position of each in climate space, and potential sources of error or uncertainty based on the observational datasets. For comparison we have then defined the climate space for each as indicated by the model results. Consequently, we can not only examine the global differences between model results and station data, but also investigate the effects of sampling, interpolation, and whether there are systematic differences in ‘errors’ between each climate proxy. Based on the results of this, we have then compared the results of a series of Maastrichtian experiments (again using the HadCM3 model) with palaeoclimate proxies.