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Constraining the recent increase of the North Atlantic CO_2 uptake by bringing together observations and models

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The North Atlantic Ocean is one of the strongest sinks for anthropogenic carbon dioxide (CO_2) on the planet. To predict the North Atlantic response to the on-going increase in atmospheric CO_2, we need to understand, with robust estimates of uncertainty, how it has changed in the recent past. Although the number of sea surface pCO_2 observations has increased by about a factor 5 since 2002, the non-uniform temporal and spatial distribution of these measurements makes it difficult to estimate basin-wide CO_2 uptake variability. To fill the observation gaps, and generate basin-wide pCO_2 estimates, Multi Linear Regression (MLR) mapping techniques have been used (e.g. Watson et al., 2009). While this approach is powerful, it does not allow one to directly estimate the uncertainty in predictions away from the location of observations. To overcome this challenge we subsample, then using the MLR approach, predict, the CMIP5 model data, data for which we know the 'true' pCO_2 and can therefore quantify the error in the prediction. Making the assumption that the CMIP5 models are a set of equally plausible realisations of reality, we use this approach to assign an uncertainty to a new basin-wide estimate of North Atlantic CO_2 uptake over the past 20 years. Examining this time-series we find that the real world exhibits a strong increase in CO_2 uptake, which is not matched by any of the CMIP5 models.