A HINDCAST OF SURFACE OCEAN PCO_2 AND AIR-SEA CO_2 FLUX PRODUCED BY A DATA-ASSIMILATING OGCM WITH EXPLICIT BIOGEOCHEMISTRY.

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ABSTRACT
The primary aim of the Centre for Observation of Air-sea Interactions and Fluxes (CASIX) is to estimate accurately the air-sea fluxes of CO_2. Under CASIX, a high resolution ocean general circulation model, coupled to an ocean biogeochemistry model, has been used to provide estimates of surface ocean pCO_2 and air-sea fluxes of CO_2 for the year 2003. An initial global simulation was run at 1 degree horizontal resolution, providing boundary conditions for a limited area North Atlantic model at 1/3 degree resolution. Observed temperature and salinity data were assimilated into the model. Temporal variability in the resulting pCO_2 fields are compared to observations, and the primary production and pCO_2 results of the two different resolution runs are compared.

INTRODUCTION
One goal of the CASIX project is the development of a pre-operational model of ocean biogeochemistry. This is being achieved by coupling a high resolution general circulation model, the Forecast Ocean Assimilation Model (FOAM), and the Hadley Centre Ocean Carbon Cycle (HadOCC) model [*Palmer and Totterdell*, 2001]. The FOAM system consists of a series of ocean models that use data assimilation to produce daily analyses and forecasts of ocean parameters up to five days ahead. The data assimilation component in FOAM uses *in situ* as well as satellite-derived observations. The results presented here are from a hindcast forced with 6-hourly fluxes from the Met Office's Numerical Weather Prediction (NWP) system, for the year 2003. The global version of FOAM has a horizontal resolution of 1º x 1º, nested within which is a regional (North Atlantic) version at 1/3 degree horizontal resolution. HadOCC is a simple Nutrient-Phytoplankton-Zooplankton-Detritus ecosystem model with a variable carbon:chlorophyll ratio. The model uses nitrogen as its currency but also calculates carbon flows through the ecosystem.

DISCUSSION
Figure 1 shows a time-series of the simulated pCO_2 and primary production, averaged over an area bounded by 48N, the Greenland-Iceland-Scotland ridge, and the mouth of the Labrador Sea. Each series is constructed from instantaneous values sampled every five days, and the results from both 1 degree and 1/3 degree resolution models are shown. The modelled fields display very similar temporal variability, which is to be expected as the physics driving the biogeochemical processes are assimilating the same observed data. One feature of Figure 1 is the reduction in surface pCO_2 during the period mid-April to mid May. A reduction in surface pCO_2 can result from depletion of dissolved inorganic carbon (DIC) due to biological activity or, from a change in the carbon chemistry associated with changes in temperature and salinity. The co-incident peak in primary production at this time would indicate that this reduction is due to phytoplankton removing DIC from the surface ocean, resulting in a corresponding reduction in the partial pressure of CO_2. In contrast, the decay in pCO_2 from October onwards is consistent with the sea-

surface temperature reducing with the onset of winter, rather than as a result of biological activity. The simulated pCO_2 fields have been compared with pCO_2 data measured in the Central Irminger Sea (CIS) under the ANIMATE project. Figure 2 demonstrates that the models both produce pCO_2 values generally consistent with the observations, particularly during the last two months of the year.

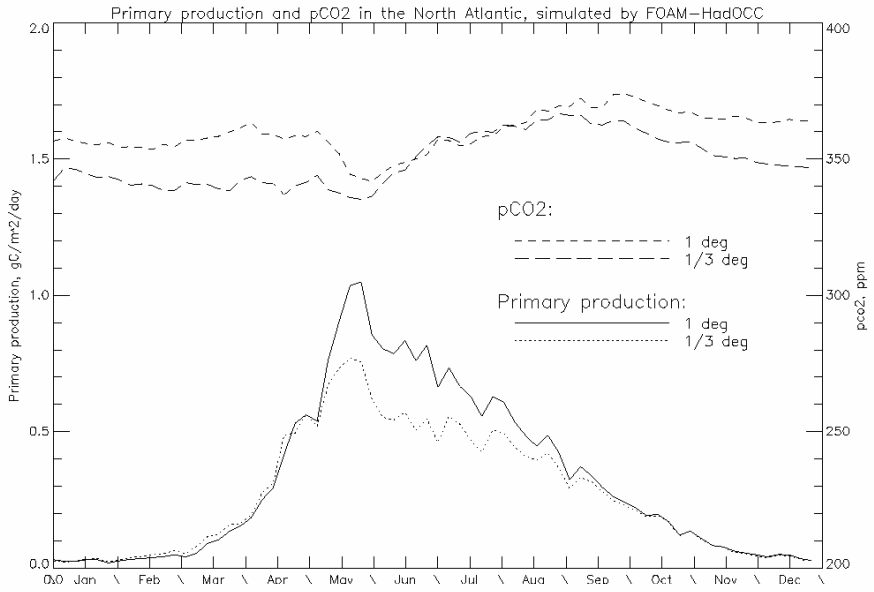

Fig. 1. Time-series of primary production and pCO_2 simulated by the FOAM-HadOCC system for the year 2003, at two different resolutions, averaged over an area of the N.Atlantic.

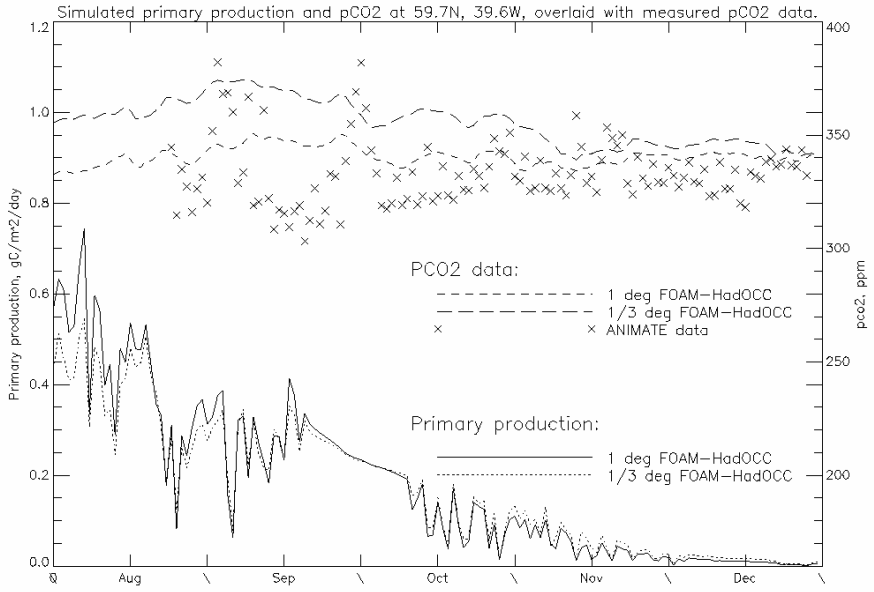

Fig. 2. Modelled pCO_2 and primary production fields from FOAM-HadOCC at 59.7N, 39.6W. Overlaid are the observed pCO_2 data from the CIS leg of ANIMATE which ran from August to December, 2003, at the same location.

ACKNOWLEDGEMENTS

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REFERENCES

Palmer, J.R. and I.J. Totterdell (2001), Production and export in a global ocean ecosystem model. *Deep-Sea Research I, 48*, 1169—1198, 2001