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Improving ocean and climate forecasting

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Summary

Atmospheric and oceanic forecasting systems require a vast quantity of input data collected from satellites, ocean buoys, aircraft and shipping, radiosondes, radar and ground stations. These data are incorporated into complex multi-scale models using data assimilation techniques. Improvements in such techniques developed at Reading enable better use of this expensively-acquired data to produce more accurate weather and climate predictions.

Background

Models of ocean circulation, in conjunction with numerical weather prediction models, are essential in forecasting over long time periods, from one week to many decades, because ocean transport accounts for much of the energy that drives weather and climate systems. However, numerical models can never completely describe the complex physical processes underlying the behaviour of the real-world dynamical system, and errors in the representation of the ocean circulation in computational models affect the forecast validity on daily, seasonal and decadal timescales. Improved data assimilation methods reduce uncertainty in the forecast accuracy and help identify systematic bias errors within models. Doing so highlights where model forecasts may be consistently incorrect in relation to physical observations.

How is University of Reading research contributing?

Research undertaken by the University of Reading investigated systematic model errors resulting from data assimilation schemes embedded in the key processes used to predict ocean circulation. A new pressure correction technique was developed for use that alleviates these errors. This correction, derived from differences between the model and observations, improved model dynamics by reducing or eliminating spurious deep ocean overturning circulations and restoring temperature and salinity balances in the ocean system. As a result of the new assimilation scheme, the final model outputs are corrected for inherent model errors.

What impact has our research had?

Significant improvements in the accuracy of forecasts of ocean dynamics have resulted from this work, together with better use of expensively acquired satellite and in-situ data. Improvement in ocean, weather and climate forecasting has impacts on economic, commercial and organisational elements of society as well as on the environment, and this research has made important contributions to such advances. Good forecasts enable good planning, and research on data assimilation at Reading continues to bring significant benefits to the whole community.

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