Notes on a meeting at UEA on 1-2 December 2005-12-08

Present: Erik Buitenhuis (UEA), Corinne Le Quéré (UEA), Bablu Sinha (NOC), Ben Ward (NOC)

Bablu, Ben and Corinne each gave a presentation of relevant ongoing work and progress so far on the QUEST project and discussion followed.

Bablu reported that he had embedded the DGOM model into the OCCAM physical model and done a couple of short runs (of a day or two). The code works, but there is plenty of testing and debugging to do before we can be confident that it is working correctly. He also showed the results from comparisons of performance of different NPZD models embedded in OCCAM against observed station and global grided data.

Ben Ward introduced the work he is proposing to do for his Ph. D. He will run 1-D versions of the biogeochemical models and use optimization methods using a cost function and available station data. One area where he may benefit from advice would be setting bounds on some of the parameters used in DGOM.

Corinne gave an overview of relevant work, much of which was presented at Plymouth earlier this year.

The main topics discussed were:

1) Runs to be conducted

Three runs are envisaged, two conducted at NOC and one at UEA.

NOC will perform one run with DGOM embedded in the OCCAM physical model and one with an NPZD embedded in OCCAM. The physical model will be forced identically in both runs.

UEA will perform a parallel run with DGOM embedded in the OPA model. As far as possible, given the different configurations of the physical models, the external forcing will be kept the same between the OCCAM and OPA physical models.

2) Model Versions

Query: are the versions of the DGOM and OPA models to be used identical to the one used for the Global Change Biology paper? The version of DGOM currently used at NOC has different respiration in the upper and lower ocean. Erik is correcting this at present to unify the treatment throughout the water column. Corinne also has various sources of funding to add in extra PFTs to DGOM in the coming years. We agreed it would be best to use a ‘frozen’ version of the model with the current smaller number of PFTs for this study rather than continually updating the biogeochemical model. If

time is available towards the end, the simulations can be repeated with a more complex version of DGOM.

3) Model Run Length

Probably 1994-2004 would be a good period. This has the advantage that no correction would have to be applied to the initial DIC field.

4) Input files required

We agreed it would be best for us to start from the same initial fields, regridded for each model as required. Some of the fields are already the same (Nitrate, Oxygen are taken from the WOA by both models, Alkalinity and DIC from GLODAP). Corinne and Erik apply a correction to DIC for anthropogenic CO_2. Erik can supply the program used for the correction, but it is basically a linear correction relative to 1994 DIC based on the difference of atmospheric CO_2 concentration between 1994 and the year from which the model simulation starts. Erik can supply initial fields of other model state variables such as phytoplankton and zooplankton.

5) Physical Forcing Files

Both physical models use NCEP-derived surface atmospheric data to calculate the surface heat, momentum and freshwater fluxes required at the ocean surface. OCCAM is currently set up to simulate 1985-2002 (we recycle the forcing repeatedly to do multidecadal runs). The actual fluxes applied will vary depending on the evolving SST. OCCAM applies a weak relaxation to the surface salinity field to compensate for lack of river runoff in the model. OCCAM applies 6-hourly surface forcing for the surface sensible and latent heat fluxes and surface windstresses, whilst OPA uses daily forcing. OCCAM uses a monthly mean climatology for precipitation, incident shortwave radiation flux and cloud cover, although a diurnal cycle is imposed on the incident shortwave flux. OPA has no diurnal cycle. 'OCCAM' and 'DGOM' refer to the versions used or to be used for this study.

6) Biogeochemical Forcing Files

DOGM requires two biogeochemical forcing files, namely dust deposition data (for Fe) at the ocean surface, and riverine input of DIC and DOC (which are converted to inputs of Fe, Si and P during the model run??). The dust files can be easily interpolated to the OCCAM grid and Erik can supply this. The riverine input is a bit more difficult as the data appears at specified coastal points and we must somehow transfer this to the OCCAM grid without altering the total flux. Corinne is investigating the best file to use for the OCCAM run.

7) Technical Questions

Some technical questions on calculations of global sums where discussed. OCCAM runs on a number of processors using a master-slave configuration and the slaves do not communicate with each other (only with the master). This makes it a bit more difficult to perform global sums during the run. These are needed for calculations of denitrification and also initialisation of river inputs. Bablu will have to look into how best to get around this. It is a minor issue.

8) Model-Data comparison

We catalogued sources of data for comparison with the model runs.

Depth of Chlorophyll Maximum: This could be derived from the WOA. Characteristics to examine could be the mean, seasonality and bloom timing, amplitude and duration.

Export flux: The Schlitzer data is available for comparison.

Chlorophyll: Interannual variability could be examined (using SeaWIFS). CPR data could potentially be of use.

Biogeochemical variables: P, N, O_2, DIC and Alk

On the subject of O_2, the Garcia data (published in GRL) could be useful. There are 50 years of data. Lots of variability is present.

Corinne is working on an atmospheric potential oxygen inversion. This work is not published yet, but should be kept in mind.

Ecological behaviour: We could look at such things as zooplankton/phytoplankton ratio, grazing rates etc. We could even calculate gain and loss terms for ecological variables and compare between models (globally or basin-by-basin).

Physics: Some basic comparison between the OCCAM and OPA models should be done.

We could look at the climate modes generated by the physical models (ENSO, NAO, SAM, PDO) and examine the relationship with biogeochemical variability. This would be in the remit of the QUEST project (but perhaps not a priority in the early stages?).

Surface fluxes of CO_2 and O_2: Seasonality would be particularly important to examine.

Iron

We may do model runs with and without Fe to examine its importance regionally and globally (but I guess this is not part of the QUEST proposal as such).

Satellite Estimates of Detritus: This derives from SeaWIFS, using spectral analysis to separate signatures of particulates, water and chlorophyll.

DIC:

Another idea would be to look at Si*, N* and C*. The starred variables are mentioned in Sarmiento's 2004 Nature paper. Si* for instance is essentially the excess silicate over nitrate, and N* the excess N over P. We could use this to identify regions of nitrogen fixation for example.

Corinne suggested doing climate change experiments, for example imposing 2100 climate anomalies (Corinne has these available) on the models (again this would be an extension to the formal QUEST work I guess).

We didn't discuss to much about whether and how we would compare the distribution of the different types of phytoplankton and zooplankton between the models and between observations and models?

I can't remember if we discussed comparisons with station data as well as global distributions? I've also got a feeling we discussed things like primary production but I don't have notes on that.