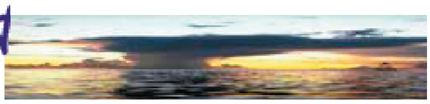
Coupled Ocean-Atmosphere Processes and European Climate

COAPEC



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Newsletter No 5: March 2005

The fifth of an irregular series of Newsletters with brief reports on meetings and projects associated with the NERC's COAPEC directed programme

Programme News

COAPEC is now entering it's final phase - with papers rolling out from the many successful projects, and COAPEC researchers taking their skills into the wider community.

It is particularly encouraging to see the quality of the results from the COAPEC students - as examples, there are articles from Glen Richardson and Susan Leadbetter in this issue.

Look out for a special issue of Journal of Climate later this year, which will have a collection of papers from across the range of COAPEC science. There will also be a more accessible summary of the programme published in May, highlighting the major findings of the projects, students and core team.

Meetings Diary

The Final Science Meeting of the COAPEC programme is on **24-25th May 2005**. This meeting is somewhat different to the previous COAPEC annual meetings as it is an open meeting, designed to present the research outcomes to the wider community. The meeting will also include a session focusing on the "User Oriented" projects funded through COAPEC.

There is also a joint Hadley Centre - COAPEC Workshop on HadCM3 diagnostics, on 22-23rd March.

See later in the Newsletter for further details of both meetings.

Student Opportunities

For students funded by COAPEC, there are still funds allocated to help with unforeseen travel or training costs. These have been used in previous years to fund students on the Cambridge GEFD course and to fund a student to travel to the US. If you have a proposal to use these funds, simply contact the Science Co-ordinator (h.snaith@soc.soton.ac.uk) with details.

The beowulf cluster is also available for use by students on any related research - see the details later in the newsletter.

Short-term Climate Response to a Freshwater Pulse in the Southern Ocean

Glen Richardson (g.richardson@uea.ac.uk), Martin Wadley, Dave Stevens, Karen Heywood, UEA, Norwich and Helene Banks, Hadley Centre, the Met Office

Of all the COAPEC projects, this one casts the net wider than any other in the quest for factors that may affect European climate. We have used the Hadley Centre Climate Model (HadCM3) to see if events that might happen around Antarctica could potentially affect European (and global) climate on decadal timescales.

Inspired by the recent Hollywood movie (and to a lesser extent scientific papers), which depicted what might happen if the surface of the North Atlantic were to suddenly get fresher, we decided to see what might happen if we simulated a similar event in the Southern Ocean. Our initial experiment was of quite simple design. Following the technique of Dong and Sutton (2002)'s North Atlantic experiment, we freshened the surface layers of the ocean everywhere south of 65°S, and then let the model run for 10 years. Dave Stevens likes to call this the sledgehammer approach. It is an entirely unrealistic amount of water to dump into the system instantaneously, but if this fails to produce a response, then we can be fairly confident that any realistic pulse of meltwater wouldn't have much of an impact either.

But we did get a response. Sea-surface and surface air temperatures were reduced significantly almost everywhere south of 40°S (figure 1) and Antarctic sea-ice grew in thickness and extent. These changes are thought to be due to the freshwater cap inhibiting vertical motion in the Southern Ocean, thus trapping the relatively warm Circumpolar Deep Water below and cutting the surface off from this heat source. There were also impacts in the Northern Hemisphere, with

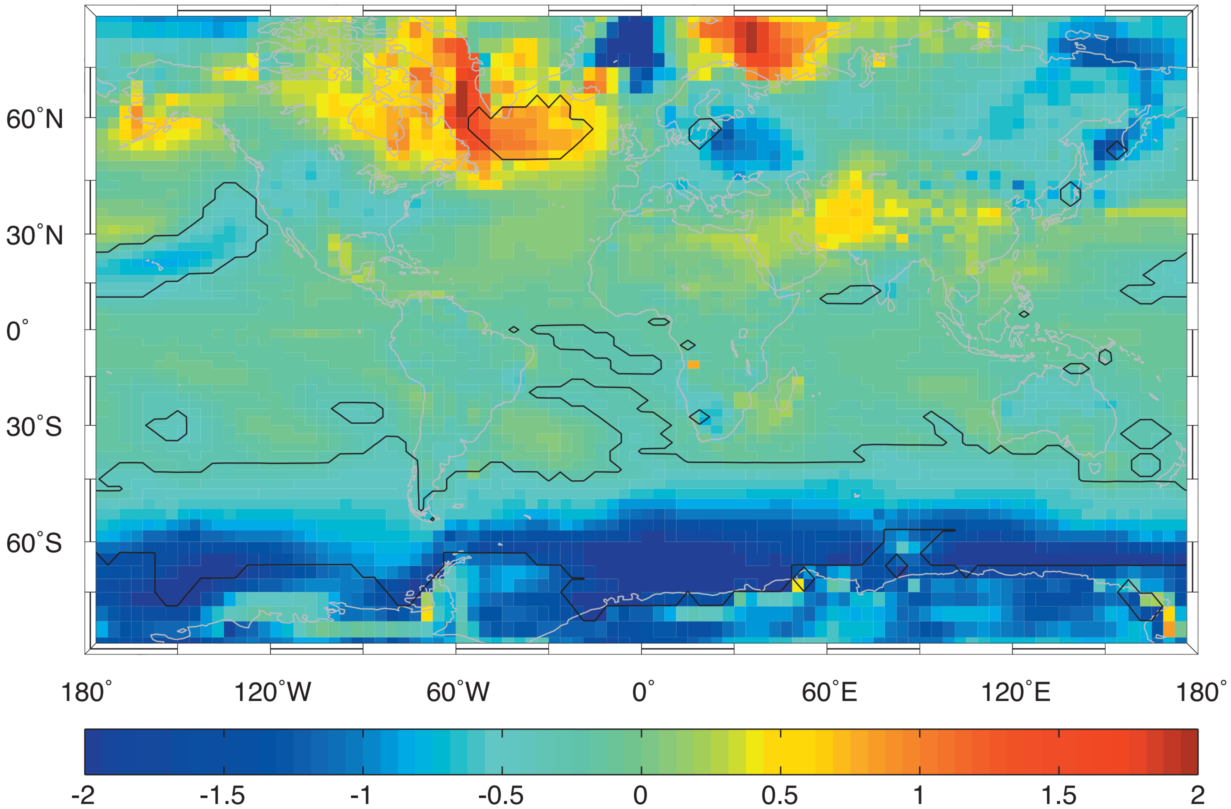

Figure 1. Surface air temperature differences (perturbed – control), averaged over years 6-10 after freshwater pulse. Contour outlines regions where differences are significant at 95% level.

pressure and temperature changes indicative of a shift to the negative phase of the North Atlantic Oscillation. The signal is thought to have reached the Equatorial Pacific by means of a barotropic Rossby wave, similar to that proposed by Ivchenko *et al*. (2004), followed by transmission through the atmosphere to the Northern Hemisphere.

We have now begun to investigate the details of these teleconnections, and what happens beyond the first decade.

For a more extensive account of our initial experiment, see our recent GRL publication (Richardson *et al*., 2005).

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Richardson, G., M.R. Wadley, K.J. Heywood, D.P. Stevens and H.T. Banks (2005) Short-term climate response to a freshwater pulse in the Southern Ocean. ***Geophys. Res. Lett.***, **32** (3), doi: 10.1029/2004GL021586.

Spatial patterns of North Atlantic Warming - a Combined Model-Data Study

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Over the past fifty years a widespread warming of the atmosphere has been observed. The subtropical and tropical regions of the North Atlantic have also warmed over the same period, but there is evidence of cooling in the subpolar gyre (Lozier and Moore, 2003; Dickson *et al*., 2003). The subpolar cooling has been accompanied by a significant freshening, and the subtropical warming by an increase in salinity. The aim of this study is to examine the spatial patterns of changes in ocean temperature and salinity both horizontally and vertically, and then use an isopycnic ocean model to identify controlling mechanisms for this change.

A comparison of depth-averaged heat content between two twenty year periods over the North Atlantic has shown that there is a clear boundary between warm-

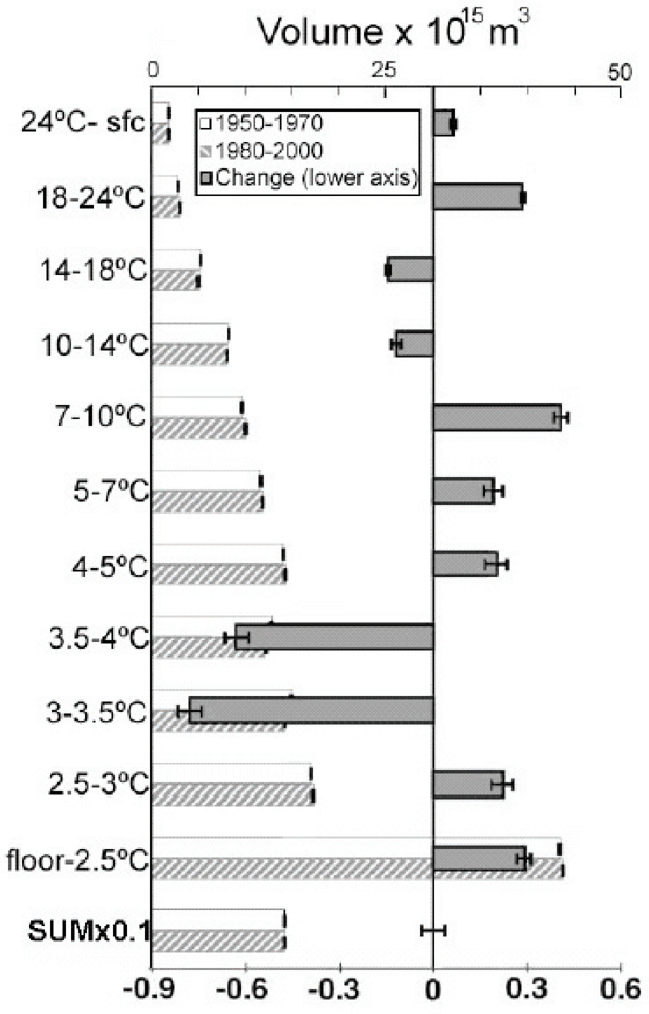

Figure 2. An isothermal volume census from the floor to the surface of the North Atlantic diagnosed from historical data. The top axis gives the total volume of each temperature layer in 1950-1970 and 1980-1200, whilst the lower axis is the scale for the volume change between the two twenty year periods (latter minus former) (from Lozier and Moore, 2003).

ing and cooling. This boundary is concurrent with the boundary between increasing and decreasing salinity and the subtropical / subpolar boundary (Lozier and Moore, 2003). Figure 2 shows the total volume for 11 temperature layers in 1980-2000 and 1950-1970 and the difference between the two (lower axis). This profile of volume changes highlights the complex depth structure of the warming patterns and suggests the importance of advection in ocean warming as compared to pure surface-down warming where the warmer layers would gain volume the cooler layers lose it.

MICOM, an isopycnic ocean model, has been integrated with different atmospheric forcing regimes in order to gain a better understanding of the heat content changes. The model is forced at the surface by windstress, heat flux and precipitation compiled from the last fifty years of data (ECMWF ERA-40 and COADS, precipitation only). The model has a resolution of 1.4 degrees at the equator and has 15 isopycnic layers and a surface mixed layer. Rivers are included as freshwater fluxes and the northern, southern and Mediterranean Sea boundaries are relaxed towards climatology. After a 60 year spin up the model was run on for 20 years with four different perturbation runs and a reference climatological run.

Firstly, two perturbation runs were forced with monthly mean forcing fields from years 1950-1970 and 1980-2000 in order to examine the temporal changes in the volume difference between the two periods (see figure 3, blue bars). In the warmer layers, (down to 4°C), the model demonstrates good agreement with the data, with expansion of the warmest layers, (greater than 18°C), and those with temperatures between 7-10°C, and contraction of the layers between these. The accumulation of these volume differences in the model is non-linear since the volume differences by year 20 are not a linear amplification of the signal by year 5) emphasising the importance of advection in the evolution of the heat content anomalies.

The two twenty year periods examined in this model were each dominated by a single phase of the North Atlantic Oscillation (NAO) with mainly negative index years between 1950 and 1970, and positive index years between 1980 and 2000. Additional perturbation experiments were carried out to compare the differences between the two twenty year periods with an NAO+/NAO- forcing regime, defined by years with an NAO index greater than 1.0 (NAO+), and less than -1.0 (NAO-). The volume differences between the NAO+ and NAO- runs are the green bars in figure 3. There is good agreement between the volumetric differences from the NAO+/NAO- integration and the 1980-2000/1950-1970 integration, (particularly in layers warmer than 4°C), suggesting that a significant part of the observed heat content changes can be explained in terms of NAO phases. The volume difference between the NAO+ and NAO- runs also evolves with time non-linearly.

Further work is currently being carried out to determine the role played by windstress in comparison to surface fluxes of heat and freshwater and to obtain a more mechanistic view of the observed changes.

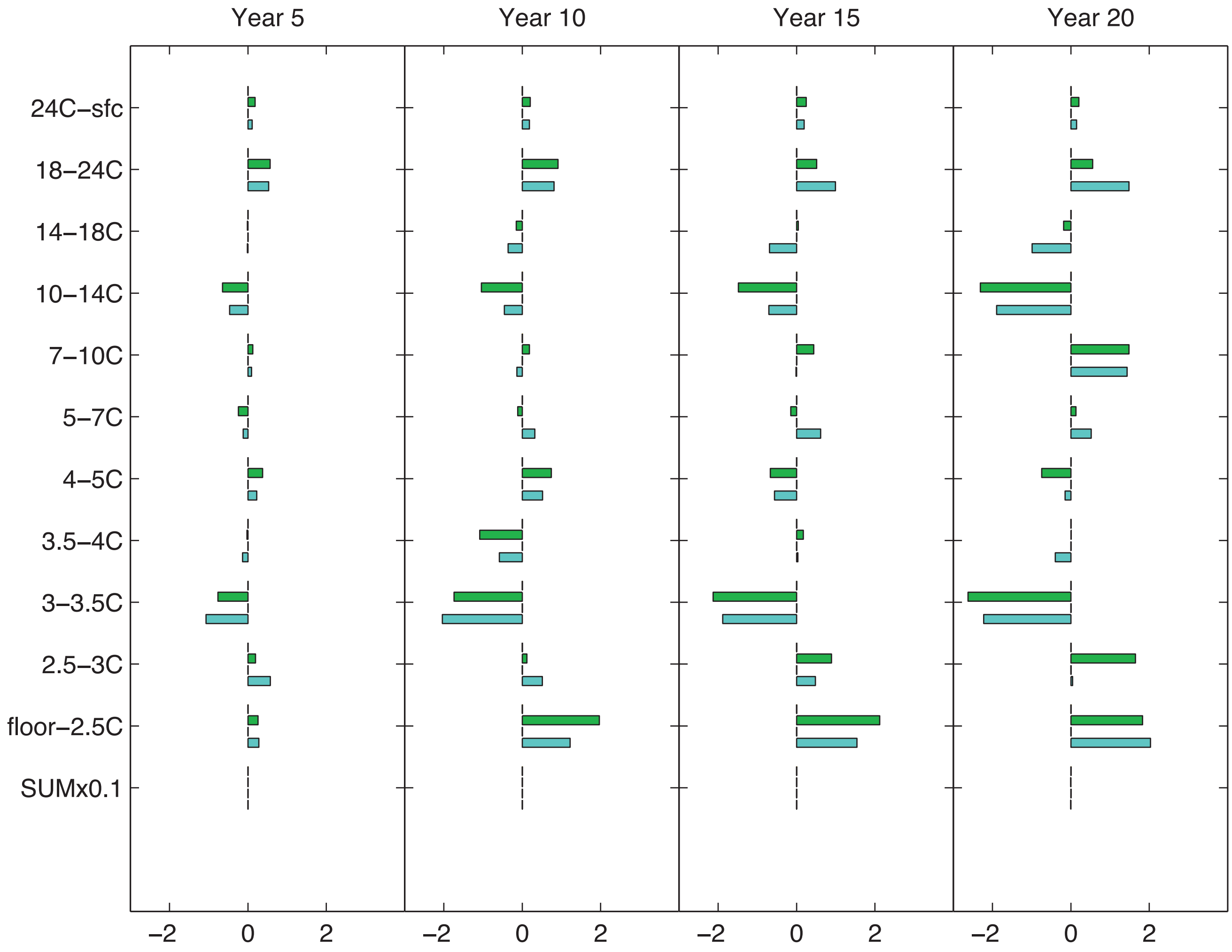

Figure 3. Volume changes of 11 temperature layers diagnosed at 5-year intervals from isopycnic model integrations. The blue bars represent the volumetric difference, 1980-2000 minus 1950-1970 and the green bars represent the volumetric difference, NAO+ minus NAO-.

Conclusions

Diagnostics of data collected over the last 50 years reveal a clear boundary between subpolar cooling and freshening and subtropical warming and salinity increases. There is also a complex structure of vertical temperature changes with volume increases of waters of temperature 18-24°C and 7-10°C.

Isopycninc model experiments for two twenty year periods and NAO+/NAO- surface forcing demonstrate broadly similar signals to the data, which reflect changes in the phase of the NAO.

The twenty year accumulation of volume changes in the model studies is not simply an amplification of the five year volume changes emphasising the importance of advection in the oceans response to global warming.

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Climate Information for the UK Health Sector

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The excess of winter over summer mortality in the UK lies between 20000 and 50000, which makes the UK one of the most winter sensitive countries in Europe in terms of health. Furthermore, the inter-annual variability of excess winter mortality appears to be related to winter climate severity. This is because frequent exposure to cold causes a rise in mortality risk factors for circulatory disease through increasing blood pressure and viscosity, vasoconstriction, heart rate and angina. Consequently, the seasonal variation of circulatory disease mortality is often explained in relation to the climatological occurrence of cold weather in winter. Moreover, diseases such as Ischaemic Heart Disease, for which cold weather is a risk factor, have been estimated to cost the UK economy double that for any other single disease. Production losses from death in those of working age not only greatly contribute to the overall financial burden of this disease, but significant costs are also due to hospitalisation and the health care system in general.

The graphs in figure 4 provide strong motivation for exploring mortality and winter climate links at the monthly to seasonal time-scale, as such links could form the basis of empirical seasonal climate prediction informed health forecasts (HF). These could lay the foundations for developing a user-relevant decision support tool to assist the health sector with emergency service and capacity planning and the implementation

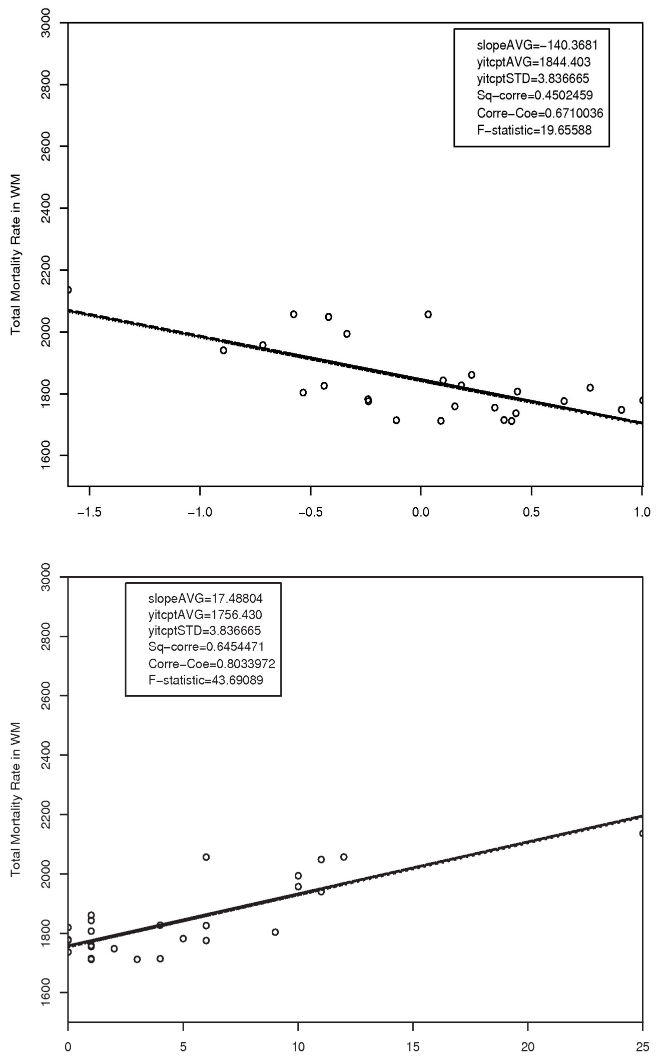

Figure 4. The relationship between standardised mortality for December and (above) monthly standardised mean temperature and (below) the number of days below the monthly mean temperature.

of intervention strategies for the mitigation of winter related mortality and morbidity and thus the reduction of the overall winter burden of disease. Given this the purpose of the COAPEC CIHS project is to answer the question "can winter season climate predictions be used for estimating the likely levels of winter mortality"? To answer this question, researchers in the School of Geography, Earth and Environmental Sciences at The University of Birmingham have been exploring the extent to which the inter-annual variability of winter mortality is climate sensitive. Further, in association with the Hadley Centre they have been assessing just how predictable health sensitive climate variables and thus general mortality levels are at the intra-seasonal to seasonal timescales.

Study results have shown that high levels of natural all cause winter mortality at the monthly to seasonal scale for some regions of England are strongly associated with anomalous cold as described by standardised anomalies of Tmin and Tmax and the number of days below a given standardised temperature threshold (figure 4). Given this winter mortality levels would appear to be potentially predictable. However because of problems relating to the prediction of winter climate at the monthly to seasonal timescale, currently reliable forecasting of mortality appears to be only a possibility for the month of February. This is because this month possesses the greatest degree of predictability of a range of health sensitive climate indices.

The role of P-E in forcing "Great Salinity Anomalies"

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Grant Bigg, Department of Geography,
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"Great Salinity Anomalies" (GSAs) were first described by Dickson *et al*. (1988), and are characterised by the propagation of anomalously low salinity around the North Atlantic sub-polar gyre. Similar features have been found in the HadCM3 control integration (Wadley and Bigg, 2004). It was thought that the mechanism behind GSAs was the advection of anomalously low salinity water around the gyre, triggered by low salinity conditions in the Greenland

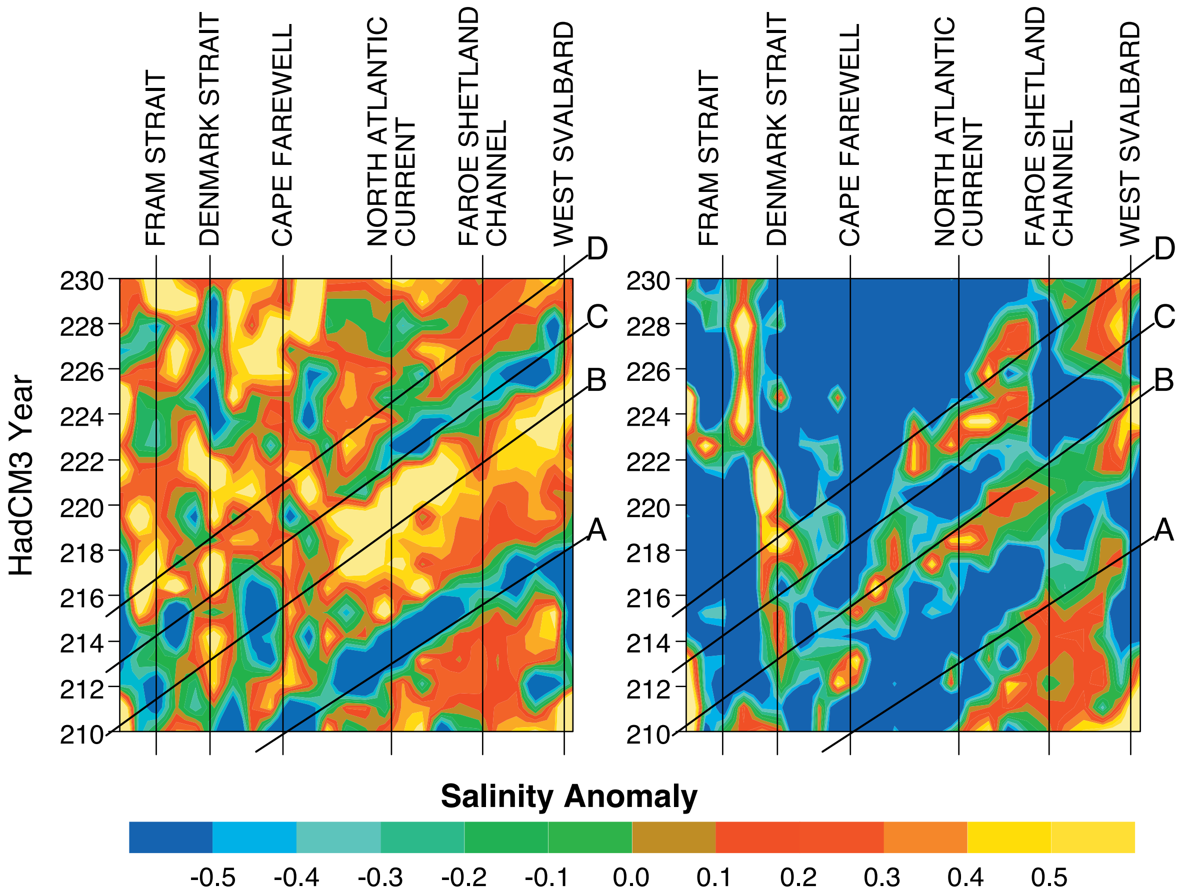

Figure 5. Hovmöller plots for monthly sea surface salinity anomalies around the sub-polar gyre from CONTROL (left) and MEANP-E (right) integrations of the HadCM3 model. Four GSA-type events are highlighted, A and C being low salinity anomalies, and B and D high salinity anomalies in CONTROL. These can be seen to occur in MEANP-E against a background of freshening, although A occurs somewhat later

or Labrador seas. However, in the HadCM3 model at least, this has been shown not to be the case. Wadley and Bigg (2005) added passive tracer to low salinity anomalies in the Greenland and Labrador seas and found that the tracer advected no more than ~1000 km in the mixed layer, before being vertically advected and mixed to ultimately become incorporated into the model's North Atlantic Deep Water. Thus the surface salinity signature could not result from the advection of a parcel of water with anomalously low salinity.

Another potential mechanism for producing GSAs is through variations in the surface fresh water flux. Surface salinity anomalies are also accompanied by sea surface temperature (SST) anomalies of the same sign (~1°C per unit salinity). Thus the presence of a low salinity anomaly, and its associated low SST, would act to locally increase the Precipitation-Evaporation (P-E) flux, enhancing the salinity anomaly. It is also possible that there may be more remote impacts on the P-E flux, associated with changes in the storm track.

We have investigated this by removing the feedback between SST and P-E flux in the HadCM3 model. A 20 year re-run of the HadCM3 model encompassing several GSA-type features was used as a control state (CONTROL). The monthly mean P-E fields were then calculated from a 100 year period of the original HadCM3 integration, and applied to the ocean in place of those generated within the coupled model, and the model run for the same 20 year period (MEANP-E).

The evolution of the salinity anomalies around the sub-polar gyre is shown in figure 5. The changes in sea surface salinity (SSS) are large, showing that the surface P-E flux is an important forcing on SSS. In run MEANP-E there is a large freshening of the north-west Atlantic region in the latter part of the run. However, the basic structure of propagating salinity anomalies remains essentially unchanged (A to D on figure 5), although anomaly A occurs some two years later. Thus the propagation mechanism behind GSAs does not seem to be driven by feedbacks involving the P-E flux, either locally or at a larger scale.

It has also been shown that in these integrations anomalies in the North Atlantic Current do not originate from the sub-tropical gyre. Also, in a similar experiment substituting the coupled model's wind stress forcing to the ocean with the HadCM3 monthly mean windstresses, it was found that the monthly variations in wind stress had very little impact on the evolution of the SSS field, with GSAs propagating around the sub-polar gyre virtually unchanged. It therefore appears that GSAs are generated within the ocean, without feedbacks with the atmosphere, by an as yet unexplained mechanism.

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Comparisons between the CHIME Coupled Climate Model and HadCM3

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The CHIME (Coupled Hadley-Isopycnic Model Experiment) model is identical to the Hadley Centre's IPCC-class HadCM3 coupled climate model, except for its use of a hybrid-coordinate ocean model instead of HadCM3's z-coordinate (constant depth levels) ocean model. Both models contain atmosphere and ocean components with full physics, and these are free to interact without any flux corrections. The hybrid coordinate system in CHIME comprises constant-density layers in the ocean interior, and z-levels near the surface, and offers potential advantages (such as better preservation of water masses) over a purely z-level model. CHIME has therefore been developed at SOC to investigate the effects of changing the vertical discretisation of the ocean component of a climate model.

We have now completed a 120-year spin-up run of CHIME and the first stage of analysis of the project, namely comparison of the mean state and drift of the model with those of HadCM3, is well underway. Overall, the overturning circulation of the two models is perhaps surprisingly similar: the mean meridional overturning in the North Atlantic, for instance, is similar in both magnitude and spatially to that of HadCM3. In addition, the heat transports in CHIME

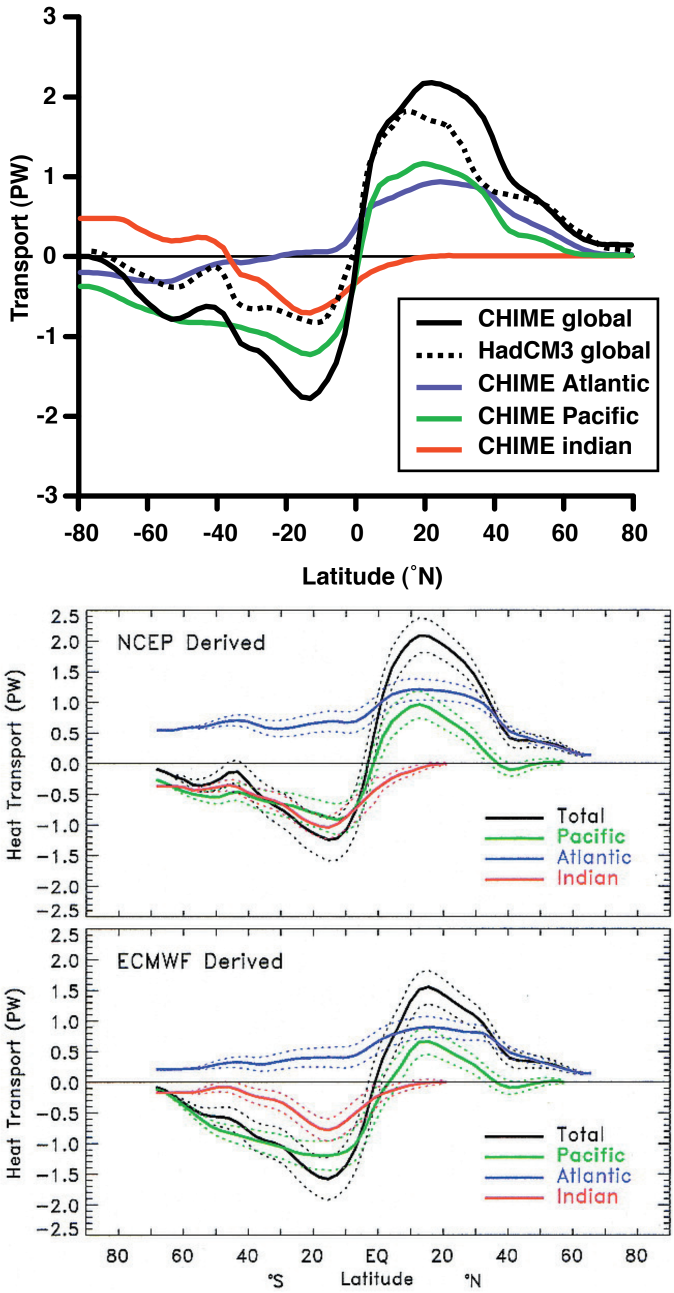

Figure 6. The northward ocean heat transport in the last 40 years of CHIME and HadCM3 (top), and from analyses of flux climatologies (below, from Trenberth & Caron, 2001).

(figure 6) are generally within the bounds of the estimates of Trenberth and Caron (2001), though CHIME transports slightly more heat in the midlatitudes than does HadCM3.

Overall, however, the CHIME global ocean temperature rises by about 0.2°C over the 120-year run, whereas that in HadCM3 is nearly constant. This has been traced to a warming of 1-2°C of the upper 800 m or so of the ocean, which occurs at least in part in the northern subtropical gyres in the Atlantic and Pacific. This may be related to a difference in the positions of the North Atlantic Current (NAC) and the Kuroshio and its Extension (KE), these in CHIME being further north than in HadCM3, leading to larger subtropical gyres in the former. We are currently working to elucidate the precise mechanism for this. However, the path of the NAC seems to be more realistic in CHIME, while the KE in HadCM3 is displaced southwards relative to both that in CHIME and observations. This latter could plausibly be related to the 3-4°C North Pacific cold bias in HadCM3, which is not seen in CHIME.

The surface waters of the Southern Ocean are also too warm in CHIME (by 2-3°C). This may well be due at least in part to the use of the KPP vertical mixing scheme in the model, which has been shown to give a similar bias when implemented in HadCM3, by mixing insufficiently in near-surface waters.

Finally, both models show a similar slow cooling of about 0.1°C per century below 1000 m. However, CHIME has a negligible drift in deep ocean salinity compared to that in HadCM3, which has a positive drift of 0.04 PSU per century. This is consistent with the tendency of CHIME to preserve the salinity of internal watermasses such as Antarctic Bottom Water more faithfully than does HadCM3.

References

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Influence of May Atlantic Ocean initial conditions on subsequent North Atlantic winter climate

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Seasonal forecasting relies on the impact of the slowly changing oceans on the evolving atmosphere. Although the predominant effect controlling global variability is ENSO in the Pacific, observational and modelling studies have also shown European climate to be sensitive to Atlantic Ocean conditions in earlier seasons. Modelling studies (*e.g*. Sutton *et al*, 2001) have identified sea surface temperature (SST) anomalies in the tropical Atlantic as being of key importance. However, these have generally relied on atmosphere-only models, requiring assumptions to be made regarding the persistence of SST anomalies; here we present results using a coupled model.

Our main methodology is a composite analysis: we project May mean SSTs onto a reference pattern whose main feature is a latitudinal gradient in the subtropical north Atlantic, to obtain composites of years with strong positive or strong negative projection, and then examine the evolution in subsequent seasons compared to the control (which consists of all other years). This is done both for observations, namely SSTs from HadISST and atmospheric fields from NCEP reanalyses, and for model output from the 500-year HadCM3 control run on the COAPEC Beowulf cluster.

SST anomalies in both observational and model composites are dominated by a tripole pattern which

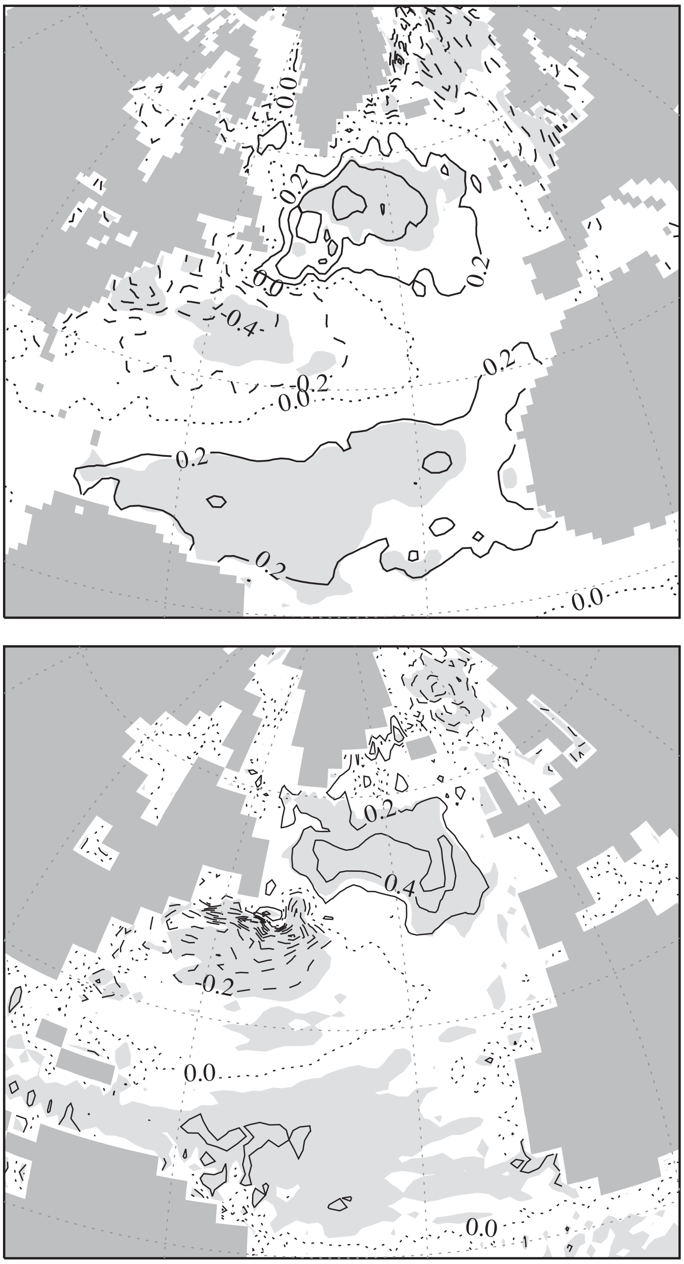
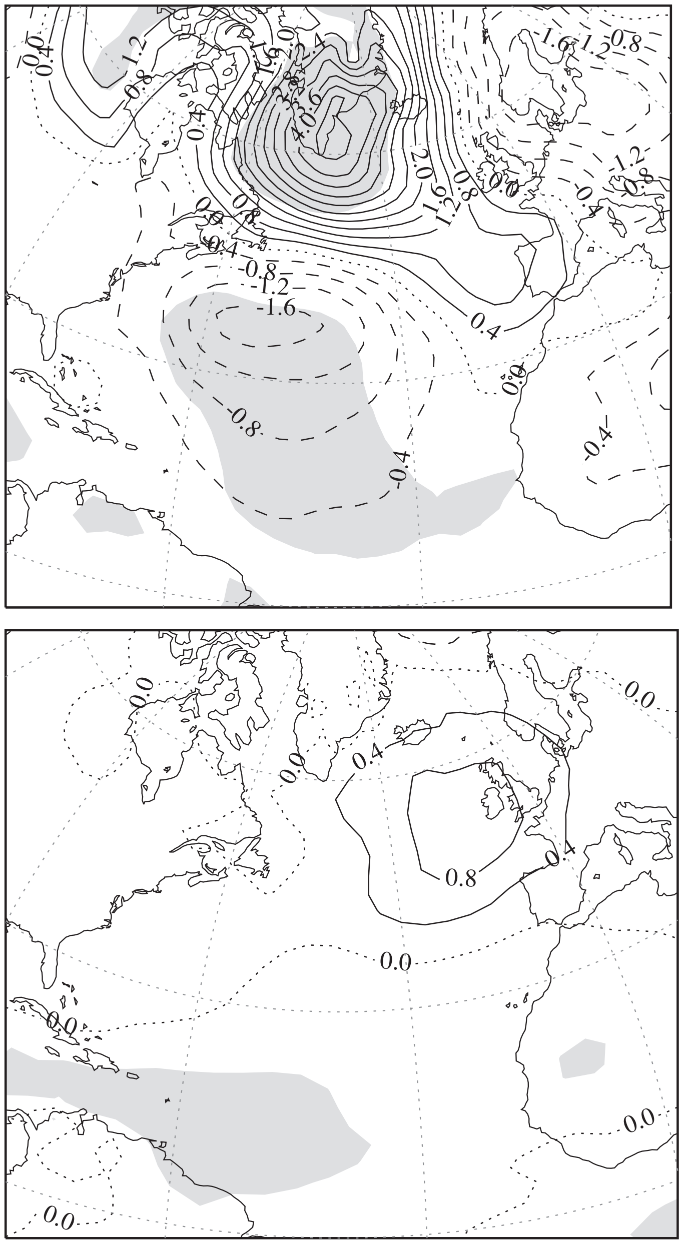


Figure 7. SST anomalies (in K) in composites from observations (above) and model (below), December-January mean. Shading denotes anomalies which are locally statistical significant at the 5% level.

persists through into the winter. See for example December-January mean SST anomalies from the observations (figure 7, upper panel) and from the model (figure 7, lower panel), shown for the positive projection composite -- similar results (with opposite sign) are obtained for the negative composite. Note, however, that the tropical part of the tripole is under-represented in the model compared to observations. It is found from timeseries that observations show evidence of re-emergence of SST anomalies in December / January, whereas the model shows monotonic decay with time at the surface (even though beneath the surface large anomalies are found to persist into the winter). This is consistent with the findings of Frankignoul *et al*. (2004) that HadCM3 tends to over-damp tropical SST anomalies.

In the atmosphere, both observational and model composites show signals with less coherence between seasons than those in the SSTs, although for the observational composites coherence can be improved a little by removing years with ENSO events. Also the signals in the model tend to be weak and poorly correlated with observations. As an example of this, see sea-level pressure anomalies from observations (figure 8, upper panel) and the model (figure 8, lower panel) -- shown for the positive composite (as above) but here for October-November, the period with strongest signals in the observations. We hypothesise that the weak signals in the model are due to the under-representation of tropical SSTs.

Additionally we have performed experiments where we obtain a stronger atmospheric signal in the model by examining only selected years with particularly strong projection of May SST anomalies (4 years of each sign), but to obtain good statistical significance we run 20-member atmospheric initial-condition ensembles of seasonal HadCM3 integrations from 1st May for each of these years, and combine these to form 80-member grand ensembles. Although results from these ensemble integrations do not have a direct equivalent in observations that they can be validated against, they do show much more coherent significant atmospheric signals than in the above composites -- at least for the positive projection grand-ensemble, where the main feature is a dipole in sea-level pressure in winter leading to enhanced westerlies over western Europe.



Figures 8. sea-level pressure anomalies (in hPa) in composites from observations (above) and model (below), October-November mean. (Significant anomalies shaded.)

Our results, particularly from the ensembles, provide evidence of some seasonal predictability into winter associated with May Atlantic SSTs. The signal-to-noise of related seasonal forecasts could probably be substantially improved if the problem of over-damping of tropical Atlantic SSTs in the model is corrected.

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Meetings and Workshops

Hadley Centre / COAPEC Joint HadCM3 Diagnostics Workshop

The 4th in a series of workshops focused on key COAPEC topics will be a Joint Met Office / COAPEC Workshop on "HadCM3 Diagnostics".

The workshop will be held at the Met Office, Exeter, and will run from 1 pm on Tuesday 22nd to 1 pm on Wednesday 23rd March 2005, allowing time to travel to and from Exeter. Overnight accommodation can be arranged adjacent to the Met Office, please see the web site for more details

Aims of the Workshop:

- Present latest results in the broad COAPEC area (*i.e.* seasonal-decadal climate variability and predictability)
- Describe novel analysis methods, developed during COAPEC, with a focus on HadCM3 data.
- Share analysis tools and look for new approaches to problems.
- Identify areas for collaboration / synthesis.
- Discuss relevance of results and methods to future climate research / climate models (*e.g.* HadGEM).

This will be an excellent opportunity to discuss and disseminate COAPEC work. Particular emphasis will

Programme

Tuesday 22nd March		
13:10	Welcome, Introduction and Local Arrangements	Adam Scaife and Bablu Sinha
13:20	Overview of COAPEC activities	Helen Snaith SOC
14:00	Examining the nature of the tropical Atlantic dipole in HadCM3	Adam Blaker SOC
14:20	Diagnosing water mass conversion and related causal processes in HadCM3	Chris Old Edinburgh Uni.
14:40	Results from the CHIME coupled climate model	Alex Megann SOC
15:00	Tea	
15:20	North Atlantic forcing of climate: important timescales and model validation	Mark Rodwell ECMWF
16:00	A performance assessment of GloSea, the Met Office's HadCM3-based seasonal prediction system	Richard Graham Hadley Centre
16:20	Decadal prediction of European climate	Doug Smith Hadley Centre
16:40	Calibration of Probabilistic seasonal forecasts from GCM ensemble output	Andrew Colman Hadley Centre
17:00	BADC services and datasets for climate models	Ag Stevens BADC
17:20	Discussion	
18:30	Dinner at The Trout Inn, Bickleigh	

Wednesday 23rd March		
09:00	Using HadCM3 to simulate the last 500 years	Simon Tett Hadley Centre
09:40	Distant ENSO teleconnections	Thomas Toniazzo Hadley Centre
10:00	Changes of Walker circulation and cloud structure associated with El Nino	Buwen Dong Hadley Centre
10:20	Bjerknes Compensation and the Decadal Variability of Energy Transports in HadCM3	Len Shaffrey Reading Uni.
10:40	Weather regimes and SST	David Fereday Hadley Centre
11:00	Tea	
11:20	Atlantic Ocean Forcing of Multidecadal Variations in North American and European Summer Climate	Rowan Sutton Reading Uni.
12:00	HadCM3 transient experiments and simulated 20th century changes in the North Atlantic	Peili Wu Hadley Centre
12:20	Quick response of the equatorial ocean to a salinity/sea-ice anomaly in the Southern Ocean	Neil Wells SOC
12:40	Discussion	
13:00	Lunch and close	

be put on the innovative approaches and methods developed during COAPEC and their relevance to current and future Met Office research.

We would urge all those who have been working with HadCM3 to attend this workshop. In addition even if you haven't used HadCM3, (perhaps you have been using other models or observational data) but feel the workshop would benefit from your input then please let us know.

COAPEC will cover travel and subsistence expenses for all COAPEC researchers and will also consider requests for expenses for non-COAPEC attendees on a case-by-case basis.

Please register your attendance with one of the workshop organisers:

Adam Scaife (adam.scaife@metoffice.gov.uk)

or

Bablu Sinha (bs@soc.soton.ac.uk)

Final Science Meeting

The final science meeting of the COAPEC programme is our opportunity to present the findings of all the projects, including the studentships, to the widest possible community. All the projects will be represented by at least one presentation. A draft programme is available on the coapec web site, along with full details and online registration. There is also a flyer for the meeting on the back page of this newsletter. Please advertise the meeting as widely as you can - this is our opportunity to celebrate the success of the programme.

Core Team News

As we approach the close of the COAPEC programme, the core team are beginning to develop new avenues of research, taking COAPEC findings through to a variety of other research, including NERCs Rapid, SOLAS and QUEST programmes and its core strategic research. The Core Team finish their COAPEC contracts at the end of August 2005, and so you need to get your support requests in soon,

This doesn't mean that the core team are abandoning the COAPEC programme yet though. They are still available to provide support across the range of COAPEC objectives. Please feel free to contact the core team for support requests or suggestions for collaborations. There is also an online form to request support from the core team - just click on the link from the COAPEC home page (if you don't have a note of the user id and password, just email me).

The Core team are always keen for your feedback on how they are doing. If you would like to comment on how they are doing, then please email me.

Climate Model Brochure

As part of the COAPEC education remit, Emily and Rowan, in conjunction with the steering committee, have produced a brochure entitled "Climate Models: Tools for understanding the Earth System". This brochure is aimed at scientists outside the climate research field, science journalists, science policy advisors and anyone with a science background you wants to know more about why, and how, climate models are used in research. If you would like a copy, or have suggestions as to who might be interested in a copy, please contact the science coordinator.

Beowulf Cluster

The COAPEC beowulf cluster, at RAL, will be available for use by any COAPEC researchers, or students on related projects, until at least April 2006. We hope the cluster will be upgraded in the near future, with more memory and local disk storage, to allow a wider range of models to be run. It is hoped that the cluster will be available beyond this date, subject to a suitable host organisation being found. Be aware that after the end of August this year, we will no longer be able to rely on Alan Iwi's expertise in porting models to the cluster and supporting software on the system. So if you have plans to use the cluster later this year, please speak to Alan now regarding how much support he thinks it will need.

Notes from the Editor

If you have comments on the newsletter, or requests for further copies, then please send them to me, the Science Coordinator :

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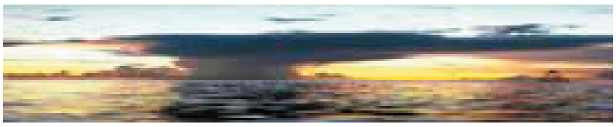
For any further information on the COAPEC programme, also contact me, or check the COAPEC web site:

http://coapec.nerc.ac.uk

COAPEC



Coupled Ocean Atmosphere Processes and European Climate

Final Meeting and Presentation of Results

Tuesday 24th and Wednesday 25th May 2005
Regent's College, Regent's Park, London

The end of the 5-year COAPEC programme will be marked by a two-day meeting, which will present all aspects of COAPEC science. The meeting will address the following questions, which have formed the focus of COAPEC:

- What are the observed characteristics of seasonal-to-decadal climate variability in the Atlantic Sector?
- How do the mean climate and climate variability in the Atlantic Sector simulated by a Coupled General Circulation Model differ from that observed? How do we correct model deficiencies?
- What are the physical mechanisms that determine the mean climate and seasonal-to- decadal climate variability in the Atlantic Sector?
- What processes determine the predictability of climate fluctuations in the Atlantic- European region?
- How can the gap between scientific output and societal needs be bridged?

There will be a dedicated session on the wider societal applications of COAPEC research, including seasonal forecasting and its application to end-users.

The meeting will be open to everybody with an interest in COAPEC science, and thus will provide an opportunity for all COAPEC funded projects and students to present the findings of their research to the wider community.

The meeting will be held at Regent's College, Regent's Park, London on Tuesday 24th and Wednesday 25th May 2005. The session on the wider societal applications of COAPEC research will be held on the afternoon of 24th May.

There will be an evening reception with buffet on 24th May at Regent's College.

Registration is free to all participants.

For further details and online registration, see www.soc.soton.ac.uk/coapec/FM.php or contact the Science Coordinator:

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NATURAL ENVIRONMENT RESEARCH COUNCIL