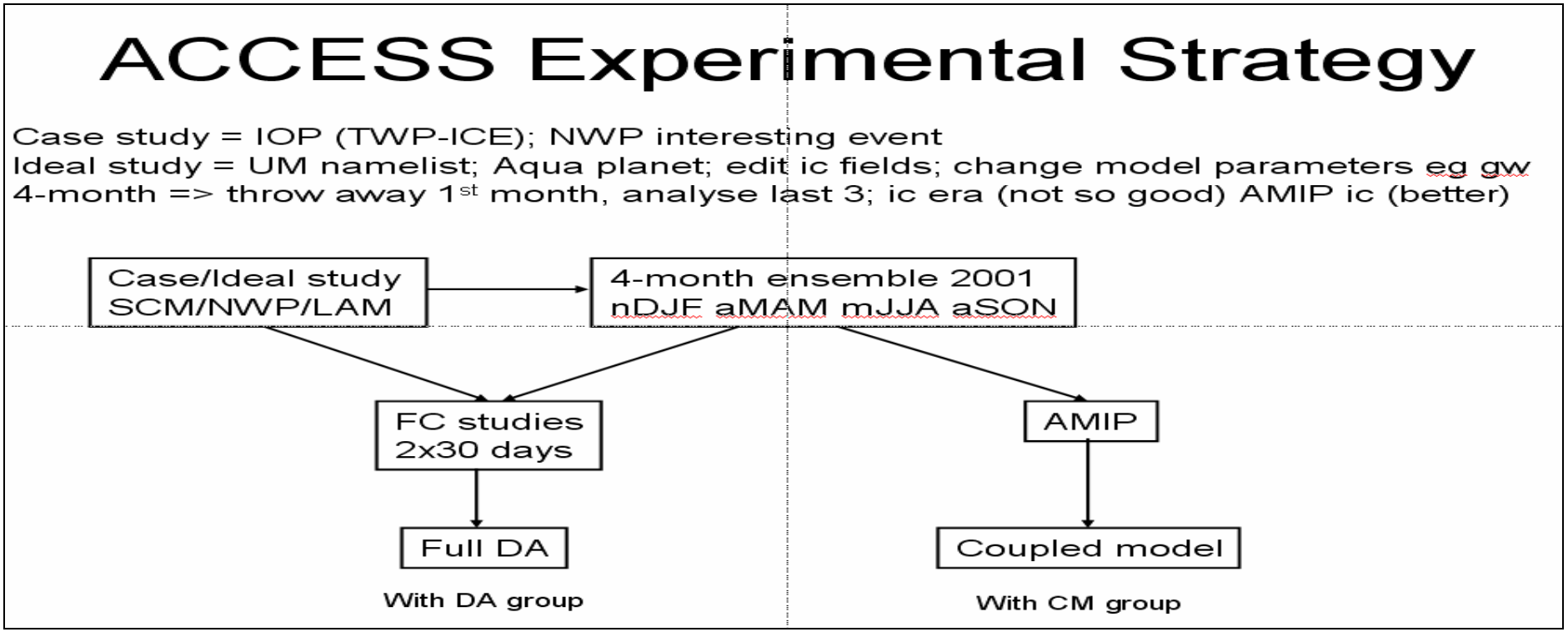
A hierarchy of UM experiments: SCM, Seasonal, AMIP and Ideal

Greg Roff and the ACCESS group
Bureau of Meteorology Research Centre, Bureau of Meteorology, Melbourne
Email: g.roff@bom.gov.au

This is a brief introduction on the hierarchy of UM experiments available ranging from the SCM - which can be run on a notebook - to a full 10 year AMIP run (which cannot!).



UM6.3+PC2 Single Column Model (SCM) experiments

Information on how to set-up processes to get a copy of the SCM and run it with a given namelist input file can be found in the following references:

The Single Column Model, Mike Hughes, November 2004, Unified Model Documentation Paper No. C9, Dynamics Research, Numerical Weather Prediction, Met. Office, http://d2/~access/docs/pum6.0doc/UM_docs/technical.html == scm6.0.

Introduction to the umui and scum, Greg Roff, ACCESS-FAME tutorial, September 2006, http://www.dar.csiro.au/access/tutorial/index.html == scm6.0.

An introduction to the ACCESS UM Single Column Model, Greg Roff, Martin Dix, Kenneth Cheung, Christian Jakob, April 2007, BMRC Research Letter No.6, p17-20, http://www.bom.gov.au/bmrc/pubs/researchletter.htm == r2 not d2.

An introduction to running UM6.3 SCM and UM Seasonal Experiments, Greg Roff, ACCESS-FAME tutorial, *August 2007* , http://www.accessimulator.org.au/tutorial/index.html == SCM and Seasonal Forecasting set-ups.

Single Column Modelling Project Webpage (BMRC,CMAR,CAWCR,MonashUni.,MelbourneUni.) **http://www.bom.gov.au/bmrc/projects/scm/** == at present setup for SCM, but may extend this to encompass SCM, Seasonal, AMIP and Ideal information?.

The SCM is based on the full 3D code whose source can be found on d2 at */bigcommon/access/temp/src_um6.3/trunk/src* and this can be browsed using the UM browser http://d2/~access/docs/UM63browser/index.html.

The SCM, as is the full 3D UM, has been saved within the Flexible Configuration Management (FCM) code management system and can be checked out of this system so that you can have your own copy of the code. Then this code can be extracted and built into an executable using the Unified Model User Interface (UMUI), as can the 3D model. The big advantage of using the FCM, rather than just copying the code to some directory, is that any updates you make can be more easily incorporated back into the main trunk and so further linked to updates by other users. More details on the UM, UMUI and the FCM can be found at the ACCESS UM Wiki site http://d2:8011/um in the presentation files from the 1st of June 2007 ACCESS workshop on these subjects ie [azs 2007-06-28] Presentation files from 1st June '07 Workshop. Information on how this Wiki page works can be found at http://d2.bom.gov.au:8011/tutorial.

One of the main uses of the SCM is to examine the effects of new parameterization schemes. An example of this can be seen in Figure 1 below which is from some work by Charmaine Franklin who used the SCM and the TWP-ICE forcing dataset to examine the impact of the new PC2 cloud scheme on the UM model.

Both schemes seem dryer than observations near the surface and overdo the drying aloft near day 25. However they do capture the drying near day 35 with PC2 doing a better job aloft.

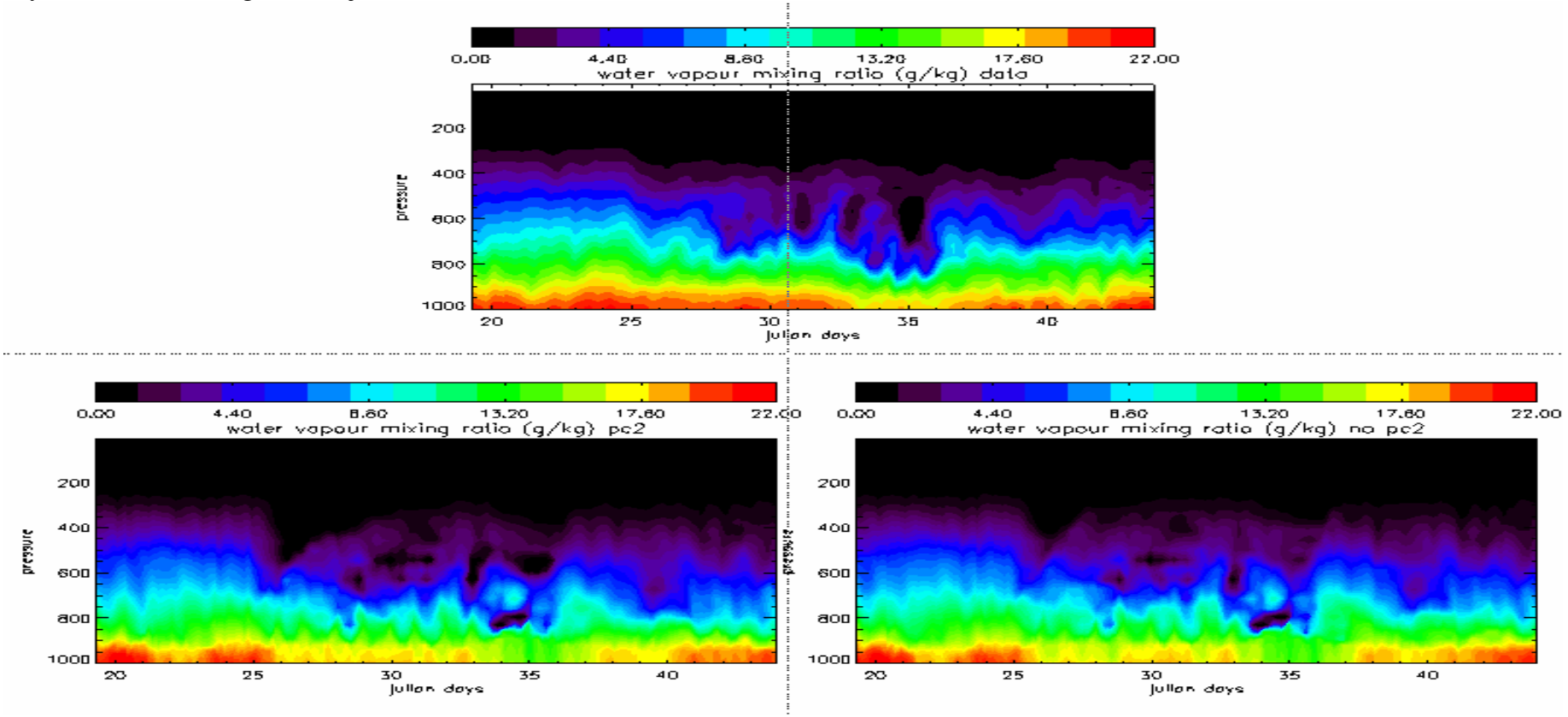


Figure 1 TWP-ICE SCM specific humidity (kg/kg) from the 2006 IOP (top) observations, (left) SCM with PC2; and (right) SCM without PC2.

The SCM is intended to be a strong workhorse in the development of parameterization schemes for the UM, and at present is being used by a growing number of CAWCR and University researchers:

- Charmaine Franklin – cloud structure
- Hongyan Zhu - convection
- Vaughan Barras - Planetary Boundary Layer
- Eva Kowalczyk - CABLE/Land Surface Schemes
- Greg Roff and Alan Protat - Diurnal variability and SCM comparison with radar products
- Ashok Luhar – physic development
- Kathrin Wapler – comparing SCM and CRM results
- Laura Davies and Christian Jacob – clouds and convection

Future work

- Collect a library of IOP namelists to run in the SCM (TWP-ICE, GABLS, ARM,…) **http://www.bom.gov.au/bmrc/projects/scm**
- Develop a program to enable forcings for particular locations and times to be calculated from analyses or forecasts in order to examine particular events within an analysis or forecast run
- Extend the modelling from SCM to NWP - to enable the same physics to be run in 1D and 3D simulations

year	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05
MJO	yes	no	no	no	yes	no	no	yes	yes [1]
GPCP	yes	yes	yes	yes	yes	yes	yes	yes	yes
ISCCP	yes	yes	yes	yes	yes	yes	yes	yes	no
TOA[4]	no	yes	no	no	yes	yes	yes	yes	yes
TRMM[4]	no	yes	yes	yes	yes [2]	yes	yes	yes	yes
ERA40	yes	yes	yes	yes	yes	yes	no	no	no
NCEP	yes	yes	yes	yes	yes	yes	yes	yes	no [3]
GASP	no	no	no	no	yes	yes	yes	yes	yes
SSMI[4]	yes	yes	yes	yes	yes	yes	yes	yes	no

Table 1: A comparison of MJO activity and observational dataset availability from 1996 to 2005. [1] *the MJO appeared late;* [2] *at present TRMM is replaced by GPCP data, so is not required;* [3] *NCEP data is from the Reanalysis2 dataset;* [4] *dataset unavailable within BMRC at present.*

Running UM6.3 Seasonal experiments

These experiments are designed to give relatively fast studies of the full 3D UM under different seasonal conditions. This is complementary to the SCM experiments discussed above in that parameterizations which have been developed within the SCM environment can be easily implemented in the 3D UM model and then run for these short experiments.

The procedure for setting-up a seasonal experiment can be found in the reference:
An introduction to running UM6.3 SCM and UM Seasonal Experiments, Greg Roff, ACCESS-FAME tutorial, *August 2007* == SCM and Seasonal Forecasting set-ups. http://www.accessimulator.org.au/tutorial/index.html

The experiments: experimental periods are the four seasons nDJF, fMAM, mJJA, aSON in 2001, with 2001 selected due to a good range of 'observational' datasets being available then eg see above; the first month is discarded and analyses are made from the last 3 months; ensemble runs can be made by using ic from the 10 days preceding the target period; climatological or variable SSTs could be used; 2hr elapsed time per month N48L50 1cpu; an SCSUI job could be setup to run these automatically (this has been done for NWP jobs). The ic (10 days for each initiation month) can come from ERA-40, but it would be better if we extend the UM AMIP run to get them – then the moisture fields will be in balance. These experiments will be on the UMUI and can be copied and run and an updated document on how to do this is being prepared.

Change the selected period? Can we extend the AMIP run (sst availability)? We have UM analyses from 2005, could use these without re-running AMIP (period when good obs, SST available = 2000)? AMIP standard configuration (N96L50 or N48L50)?

2001 datasets:

- Global Precipitation Climatology Project (GPCP) data, Version 2. Both the monthly mean and daily precipitation (mm/day) from 1979-01-01 to 2004-05-31 on a 2.5^{o}x2.5^o grid. These data were obtained from the University of Washington web site[3]. See (Huffman et al., 1997) and (Huffman et al., 2001) for more detail. These NetCDF files can be found at sam1:/samcrc/gen/glr/g_maccs_obs/gpcp.

- International Satellite Cloud Climatology Project (ISCCP)[4]. This is monthly mean total cloud amount (fraction) from 1996-01 to 2001-12 on a 2.5^{o}x2.5^o grid. See the given website for more detail. These NetCdf datasets can be found at gale:/bm/gdata/lld/isccp9601/isccp9601_ncdf.

- Tropical Rainfall Measuring Mission (TRMM). This can be downloaded from the web, but at present it is replaced by the GPCP product.

- Top of Atmosphere (TOA) data. This satellite data comes from TRMM for 1997-1998, TERRA for 2000-present and AQUA for 2004-present. Have not yet downloaded this from the web.

- National Centers for Environmental Prediction (NCEP). NCEP Re-analysis 2 data from 1979 through 2001 at 4xper day on a 2.5^{o}x2.5^o grid. There is surface data as well pressure level u, v, omega, H, RH and T data on 17 pressure levels (hPa): 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20 and 10. Note the restriction to levels below 10 hPa. These data were obtained from: ftp://ftp.cdc.noaa.gov/Datasets/ncep.reanalysis2/ . As these datasets are large (500MB/field) only the selected year (2001) of data was obtained. These data can be found at sam1:/samcrc/gen/glr/g_maccs_obs/ncep.reanalysis2.

- ECMWF Re-analysis 40 (ERA40). Both monthly means and 4xper day daily datasets are available from 1957-09 - 2002-08, with data up to 1 hPa. The Assimilation group has these on MARS and they can be accessed by going to the web address: http://linux-dev.bom.gov.au:8080/services/archive/d/catalog.

- Global Assimilation and Prediction (GASP) analyses. These are available from 1994 to 2005 with data up to 10 hPa. The 2000 and 2001 year data can be found at: sam1:/samnmc_h/globanal/2000 and sam1:/samnmc_h/globanal/2001.

- Special Sensor Microwave/Imager (SSM/I) Version 5 Data. This consists of monthly mean water vapour (mm) on a .25^{o}x.25^o grid from 1987-07 to 2004-01. We do not have this data yet. These NetCdf files can be found at websites http://www.ssmi.com/ and http://www.cgd.ucar.edu/cas/catalog/satellite/ssmi/ssmi_v5.html.

Running Ideal experiments

The UM comes with an ability to be run from a namelist which can set-up idealized runs to examine various atmospheric situations. The reference for these runs is:
Running the Unified Model in Idealised Model, UM Doc 33, 2004, **http://d2/~access/umdoc_system_pum6.3/UM_docs/scientific.html**

The good news is that UM namelists exist for situations such as: flow over an idealized hill; radiative-convective equilibrium; frontogenesis; baroclinic lifecycle; cyclone vortex.
The bad news is that these seem to be quite version specific ie they do not always work with different UM versions eg 5.5 vs 6.3.
However we have been able to carry out ideal simulations by editing such namelists or ancillary/dump files for a run. Some examples follow.

Example 1: Varying the planetary wave forcing – editing program code and ancillary files

We are using the UM 6.3 full 3D model, with L50 but a top extended to 80km, to examine how planetary waves and the phases of the QBO effect the general circulation. We change the amplitude of the planetary waves by changing the orographic height in an ancillary file and have edited the code to allow relaxation of the zonal wind to easterly or westerly phases of the QBO.

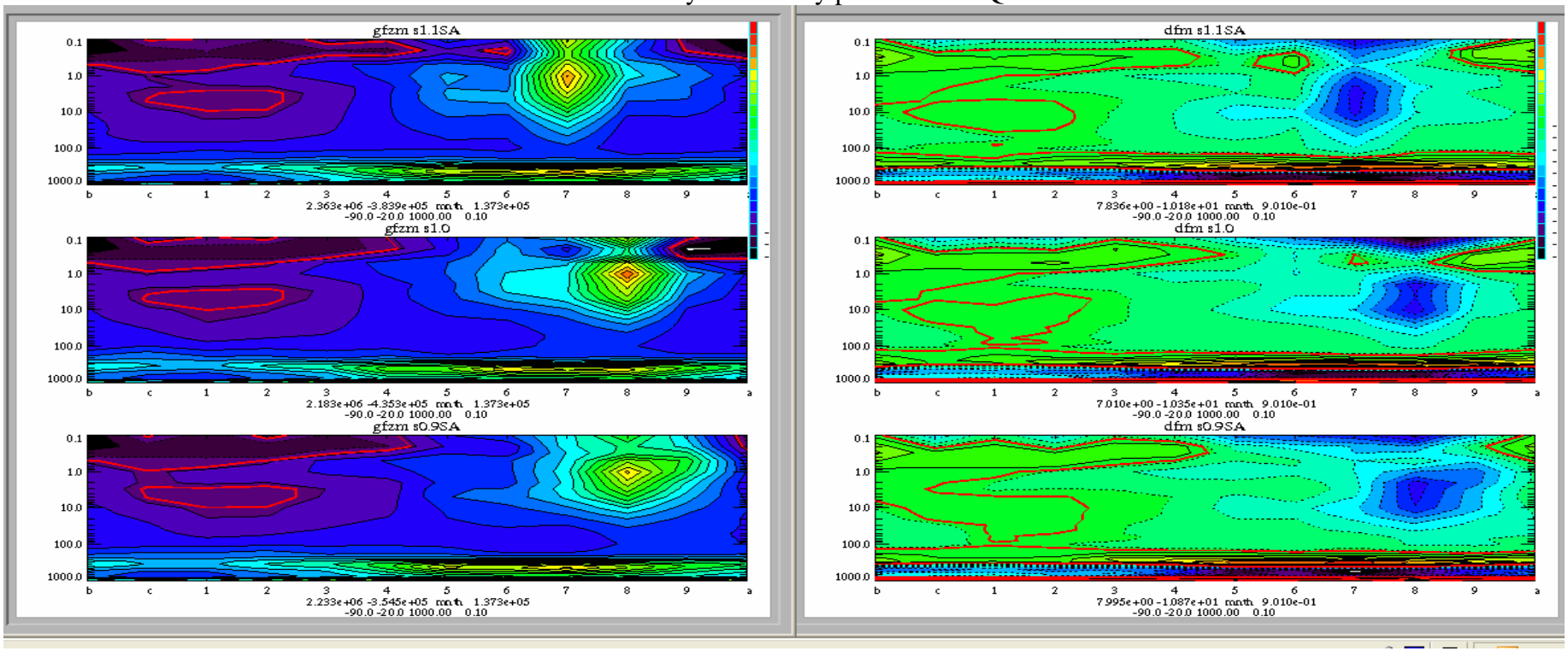
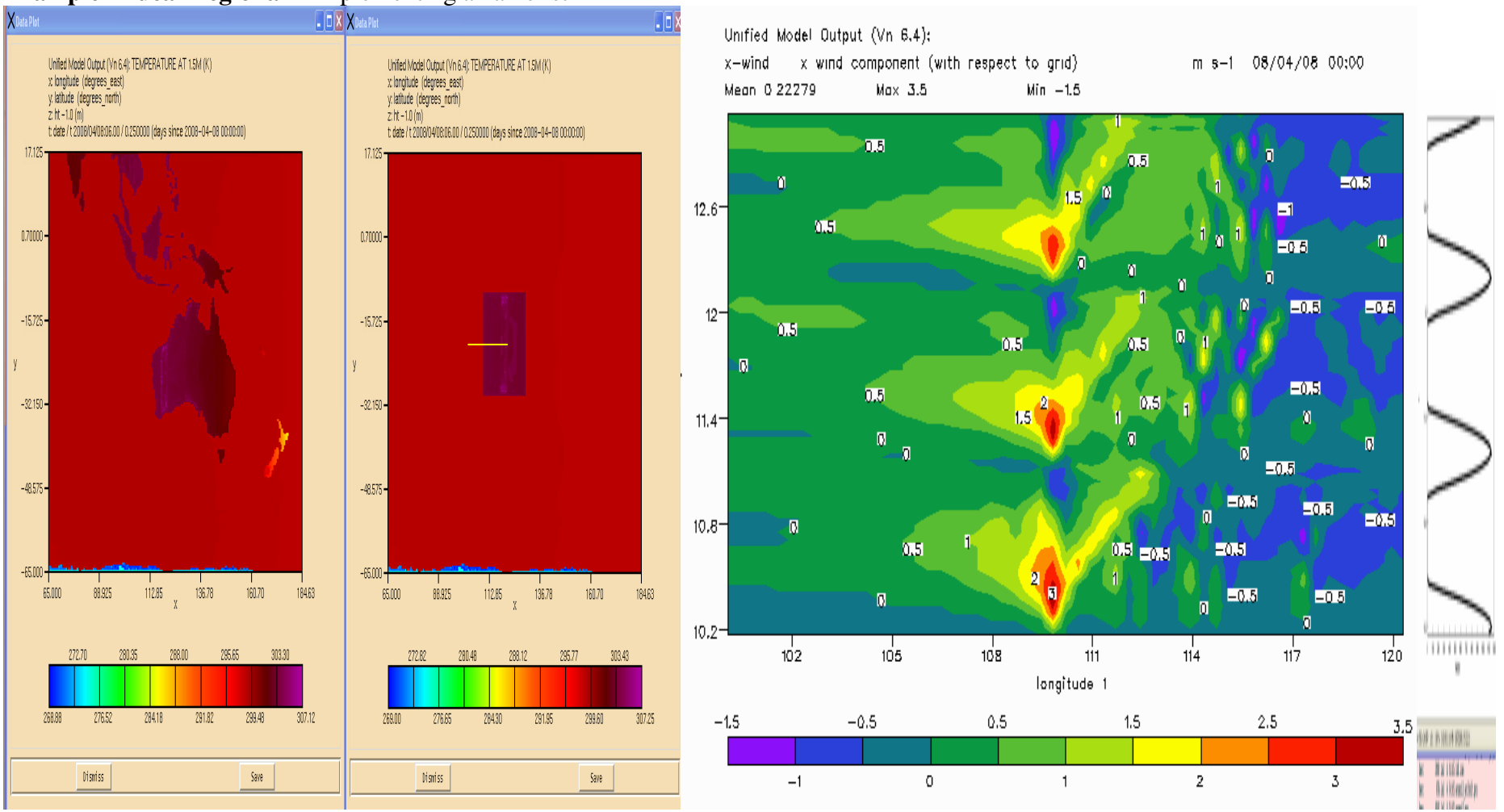


Figure 6 Height(1000-0.1hPa)/time(nov-sep)plot of Southern hemisphere averaged (left) vertical component of the epflux and (right) eflux divergence for the (top) s1.1SA, (middle) standard and (bottom) s0.9SA orography runs.

The hovmoller plot above shows that the flux divergence and large vertical epflux component occurs earlier in the enhanced orography run and is weaker and later in the reduced orography run when compared to the standard orography run.

Example 2 Ideal Regional – implementing a namelist



(a) AUSLAM std orography; (b) 20degX20deg island centred (20S,120E); (c) hovmoller Longitude (100E – 120E) time (day 10 – 13) cross-section plots at 20S and centred over the west coast of surface x-wind; and (d) the corresponding sw radiation at the toa at (20S,110E)

Ideal or focussed 'seasonal' type 3D studies in progress at present are: Planetary wave forcing; stratospheric impact on seasonal prediction; heat lows in Australia; simulating cyclone evolution.

Future work

- Select a year (2000?) and create seasonal ic ie 10 consecutive days before the periods nDJF fMAM mJJA aSON
- Create the SCSUI job to run some/all of the ensemble; update documentation for this procedure
- Create Aqua planet and perpetual January/July runs
- Complete creation of same code experiments for configurations: SCM, UM regional, UM NWP, UM AMIP – (cable) SCM + AMIP = UM6.3+PC2; NWP = UM6.4; working on UM6.3+PC2 for NWP
- Place all documentation on an external web site eg **http://www.bom.gov.au/bmrc/projects/scm**