Modelling Activities at CAWCR, 2012

Presenter: Gary Dietachmayer, on behalf of colleagues throughout CAWCR and beyond

WGNE-28
Toulouse, 5-9 November 2012
Overview

• NWP
  • By System:
    • Operational upgrades
    • Current research systems
  • Look towards next-next system

• Climate
  • Progress on CMIP5 with ACCESS 1.0/1.3

• Computing
  • SuperComputer upgrade
  • Move of research to NCI
  • “Virtual Laboratory”
ACCESS-TC Operational

- Last year: “Will be operational for 11/12 TC season”
  - Went operational, Friday 11 Nov 2011.

- 12km, relocatable-grid, nested within ACCESS-T.
- Uses synthetic vortex specification.
- “APS0” configuration.

Left:
2011/2012 Aust Reg
6 TCs

Right:
2012 NW Pac (to Oct)
16 TCs
ACCESS NWP: APS1 Plan

**Rationalisation**, higher resolution

**Phase 1 (APS0):**
- Current domains

**Phase 2 (APS1):**
- $R + A \rightarrow \text{“R12”}$
- No TXLAPS equivalent
- City: $5\text{km} > 4\text{km}$ (consistency)
ACCESS-G APS1: Operational 28-March 2012

• Compared to APS0:
  • Aprox UKMO analogue: PS17  ->  PS24
  • Horizontal-res: N144 (80km)  ->  N320 (40km)
  • Vertical: 50  ->  70 levels (top at 80km or 0.009 hPa)

• Model: UM 6.4  ->  7.5
  • PC2 (prognostic cloud scheme)

• Assimilated: IASI, GPSRO, (AIRS, ATOVS, ASCAT, AMV, SYNOP, SHIP, BUOY, AMDARS, AIREPS, TEMP, PILOT)
  • Potential “APS 1.5”: SSMI/S and WINDSAT scatt (dependent on ingestion into operational MARS)
Performance: APS1 v APS0

Around 12hrs skill improvement at three days
Previous 30 days:
- ec_gridded 14.133
- uk_gridded 16.218
- access-g_gridded 16.672
- us_gridded 16.811
- jma_gridded 17.501

Previous 30 days:
- ec_gridded 92.888
- uk_gridded 90.053
- access-g_gridded 89.925
- us_gridded 89.682
- jma_gridded 87.283

APS1: operational 18Z 28 March 2012
Operational verification, April – July 2012

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Operational verification, Aug – Oct 2012 (96Hr-FC)
Aust-Trop performance – the end of ACCESS-T
Case Study: 2011/2012 Monsoon
TC Grant: 6.5 days
ACCESS-TC Research

- ACCESS-TC upgrade required (T-APS0 -> G-APS1 transition)
- Difficulties with APS1-based ACCESS-TC
  - Compromise: nest TC-APS0 inside G-APS1 (improved track performance)
  - “TC10” – planned for TC season 12/13

- *Early* results of impact of changes to surface parameterisation (variable Charnock-prm, plus Andreas/Kepert spray scheme) are encouraging.

TC Yasi, base-time 12UTC
30-Jan-2012
ACCESS-R12 (APS1) Research

• Tropical stability mods (last year) appear effective.

• Initially struggled to get comparable performance to APS0 (R, A) systems.
  • Configuration error corrected: 4.5 v full 6hr assimilation window.
  • Introduction of R12-specific covariances.
    • Improved performance, but T-850 biases remain.
ACCESS-R12 (APS1) Research

Note: Assimilation improvements, June-6

Sonde

Sonde

TEMP 850 bias +48 h user defined grid

ACCESS-A  ACCESS-R12  ACCESS-R  ACCESS-G1
ACCESS-R12 (APS1) Research

MSLP $\sigma_1$ user defined grid 2012090500-2012102412

MSLP $\sigma_1$ +48h user defined grid

MSLP $\sigma_{ms}$ user defined grid 2012090500-2012102412

MSLP $\sigma_{ms}$ +48h user defined grid

ACCESS A  ACCESS-R12

ACCESS: A  ACCESS-R12

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ACCESS-R12 (APS1) Research

- System currently in trial with NMOC
- Scheduled for operations by end of cal-year.
  - May be delayed by new domain request
ACCESS-C (APS1) Research & SREP

- Defer most of the SREP (1.5km res) discussion to the DA and High-res NWP discussions.
- ACCESS-C strategy (FC-only) retained, modest resolution increase (5km -> 4km), significant model upgrade UM6.4 -> UM 7.6.

Neighbourhood verification
Gives indication of “accurate resolution”

6 hour forecasts
FSS, Sep2011-Jun2012

1.5km+3dVAR+LHN
ACCESS-A 12km
ACCESS-SY (APS0)
ACCESS-SY (APS1)
ACCESS-C/G (APS1/2) Research

- ACCESS-C APS1 operational plan: Feb 2012

- Just started work on ACCESS-G component of APS2
  - N512, L70
  - UM 8.2 OPS/VAR 29.1
  - Two versions to trial:
    - “Standard” (approx PS30)
    - “Aspirational” (local mods, similar to climate ACCESS1.3 (without CABLE)
**Atmosphere**: N96 – 1.875° lon x 1.25° lat; 38 levels
**Ocean and sea ice**: 1° x 1° grid, enhanced tropical, high latitudes; 50 levels
Two versions of the ACCESS coupled model have been completed:

ACCESS1.0  – our “basic” version
  – Standard atmospheric physics options
  – MOSES land surface model (MetOffice)

ACCESS1.3  – our “aspirational” version
  – New atmospheric physics options including CAWCR modifications
  – CABLE Australian community land surface model
ACCESS – Coupled model simulations done for IPCC AR5

ACCESS1.0 and 1.3 – simulations performed

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Length</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preindustrial Control</td>
<td>500 yr</td>
<td>complete</td>
</tr>
<tr>
<td>Historical</td>
<td>1850-2005</td>
<td>complete</td>
</tr>
<tr>
<td>RCP 4.5</td>
<td>2006-2100</td>
<td>complete</td>
</tr>
<tr>
<td>RCP 8.5</td>
<td>2006-2100</td>
<td>complete</td>
</tr>
<tr>
<td>1%/yr CO₂ increase to 4x</td>
<td>140 yr</td>
<td>complete</td>
</tr>
<tr>
<td>Abrupt 4xCO₂ increase</td>
<td>150 yr</td>
<td>complete</td>
</tr>
<tr>
<td>AMIP (atmosphere only)</td>
<td>1979 - 2008</td>
<td>complete</td>
</tr>
</tbody>
</table>
The results from ACCESS have been published on the “Earth Systems Grid” (ESG) for use in IPCC AR5 analysis studies, and in the Coupled Model Intercomparison Project phase 5 (CMIP5).

- ACCESS1.0 – results published February 2012
- ACCESS1.3 – results published May 2012

After extensive checking and quality control

- Secondary priority fields are still being checked and published
Global, Average Temperature at 1.5m (anomalies relative to 1860-1899)
Climate Modelling / CMIP5

ACCESS 1.0

ACCESS 1.3

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology
Skill scores – global patterns, mean for 4 seasons (historical 1975-2004)

- Both ACCESS1.0 and 1.3 are better than CSIRO Mk3.5 in most/all cases.
- ACCESS1.0 tends to be slightly better than ACCESS1.3
Tropical Cloud evaluation using COSP: radar dBZ (small/med/large): $\omega_{500}$

Franklin (2013, in prep.)
SuperComputing

- Bureau committed to the extension of HPC system until 2015/16
  - Background preparations for next HPC investment and options in 2015/16

- SOLAR HPC upgrade pending discussions with Oracle
  - Expectations in 2013 are…
    - Upgraded HPC based on Intel Sandy Bridge processors
    - Upgraded HPC located in Bureau’s Second Data Centre (SDC), Melbourne

- (2013-2015) NCI Petascale HPC System
  - 1.2 petaflop Fujitsu PRIMERGY HPC system
    - New data centre power mains turned on 8th – 12th October 2012
    - Fujitsu to complete and report Top500 Linpack measurement by 1 November
    - Expected availability in January 2013 if no significant issues arise

- Single 10 GigE network link for Bureau’s staff
  - From Bureau’s Head Office to NCI data centre
  - Expected CAWCR availability by December 2012
### Shares at NCI (Anticipated for 2013)

<table>
<thead>
<tr>
<th>Partner Organisation</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian National University</td>
<td>15.96%</td>
</tr>
<tr>
<td>CSIRO</td>
<td>21.38%</td>
</tr>
<tr>
<td>Bureau of Meteorology</td>
<td>18.95%</td>
</tr>
<tr>
<td>Geoscience Australia</td>
<td>3.40%</td>
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<tr>
<td>Intersect Australia</td>
<td>3.81%</td>
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<tr>
<td>QCIF</td>
<td>0.68%</td>
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<tr>
<td>University of Adelaide</td>
<td>1.70%</td>
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<tr>
<td>ANU (LIEF Share)</td>
<td>1.70%</td>
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<tr>
<td>Monash University</td>
<td>1.70%</td>
</tr>
<tr>
<td>University of New South Wales</td>
<td>1.70%</td>
</tr>
<tr>
<td>University of Queensland</td>
<td>1.70%</td>
</tr>
<tr>
<td>University of Sydney</td>
<td>1.70%</td>
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<tr>
<td>Discretionary Board Share</td>
<td>7.40%</td>
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<tr>
<td>Priority (Other Purposes)</td>
<td>1.52%</td>
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<tr>
<td>Merit Allocation Scheme (<em>pro bono</em>)</td>
<td>11.52%</td>
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<tr>
<td>ARC MAS Supplement</td>
<td>2.72%</td>
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<tr>
<td>Director’s Share</td>
<td>2.50%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
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~40% of 1.2 PF (about 484 TF)

- CSIRO ~ 255 TF
- Bureau ~ 228 TF

Bureau share (Solar x 5.7)

CSIRO share (Vayu x 7.9)
NCI Transfer Project

- To establish CAWCR research computing on NCI Petascale HPC system
  - Underway now – have prototype ACCESS-C system running under SMS on Vayu

- To remove CAWCR computing from Bureau’s operational HPC system
  - Increases NMOC operations usage from 20% to 50% of Solar
  - Remaining 50% of Solar for operational trials and transitions

- Improve CAWCR software and data repository and management practices
Objective:
The virtual laboratory is a new community project to establish an integrated national facility for research in climate and weather simulation and analysis.

Location:
Australian National University’s National Computational Infrastructure (NCI)

Development Organizations:
Australian Bureau of Meteorology (www.bom.gov.au)
Australian National University (nci.org.au)
CSIRO Marine and Atmosphere Research (www.csiro.au/cmar)
Centre for Australian Weather and Climate Research (www.cawcr.gov.au)
ARC Centre of Excellence for Climate System Science (www.climatescience.org.au)

Goals:
• To reduce the technical barriers to using state of the art tools,
• To facilitate the sharing of experiments, data and results,
• To reduce the time to conduct scientific research studies, and
• To elevate the collaboration and contributions to the development of the Australian Community Climate Earth-System Simulator (ACCESS)
Nectar WP1: Vision

• **Goal is to improve the ease of use, reproducibility, support and sharing of code, data and experiments**

• Creation of a library of supported and documented standard experiments
  • Including climate, NWP, idealised

• Provide improved user interface and experiment configuration database for the coupled model

• Implement ACCESS NWP research systems at NCI and make them available for wider community

• Adoption of new Met Office technical infrastructure (ROSE, Iris, cylc, etc)

• Integration with the archiving and analysis services in the other WPs

• ** Better access to BOM data**

• Timeline: Sept 2013 for WP1
Nectar WP1: Planned library of supported examples

- ACCESS 1.0 & 1.3 configurations
  - Coupled, AMIP, single column model
- ACCESS APS1 NWP configurations (forecast-only initially)
  - Global 40 km
  - Australian region 12 km
  - City scale 5 km, 1.5 km
  - Ensemble
- Seasonal prediction / climate model run from NWP analyses
- Regional climate (nested)
- UKCA (chemistry)
- Met Office GA4.0 configurations (and GA5.0 when available)
- “ACCESS2” experimental versions
Nectar WP1: Progress thus far

- APS1 city system running at NCI
- Development of NWP system using cylc
- Prototype coupled model suite running under cylc
- Prototype UI for ocean component of ACCESS coupled model using ROSE
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Thank you  

www.cawcr.gov.au