# Modelling Activities at CAWCR, 2012

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

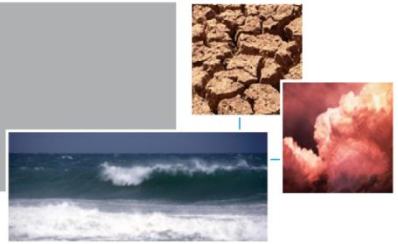
WGNE-28
Toulouse, 5-9 November 2012

Australian Government
Bureau of Meteorology

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

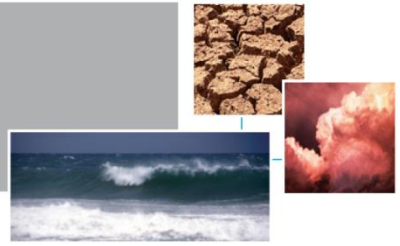
CSIRO

# 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

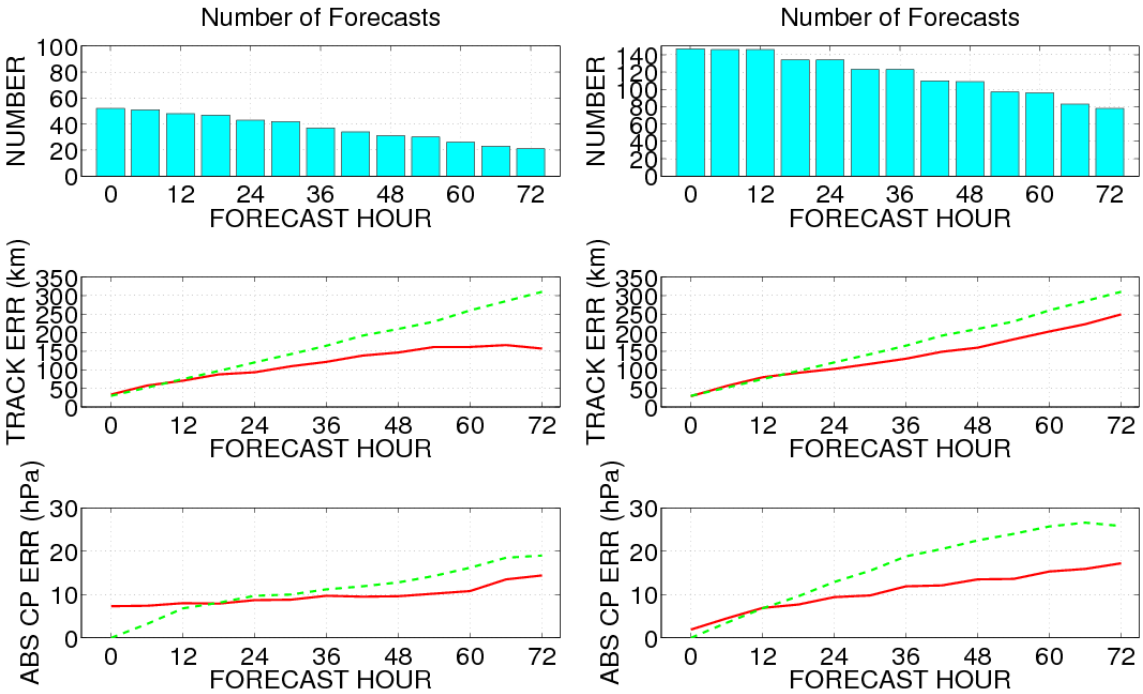


- Last year: “Will be operational for 11/12 TC season”
  - Went operational, Friday 11 Nov 2011.

- 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





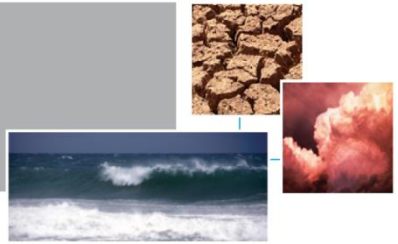

Australian Government
Bureau of Meteorology

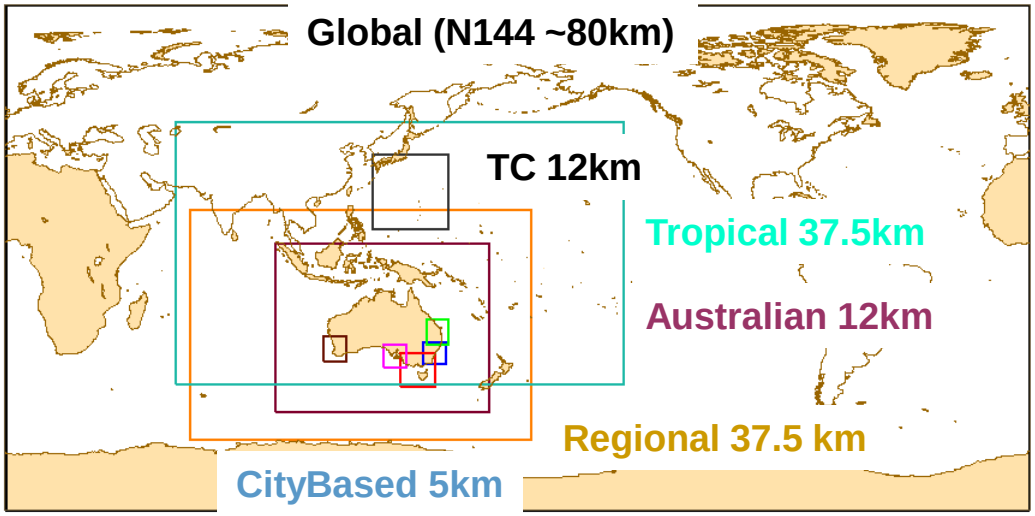
The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

CSIRO

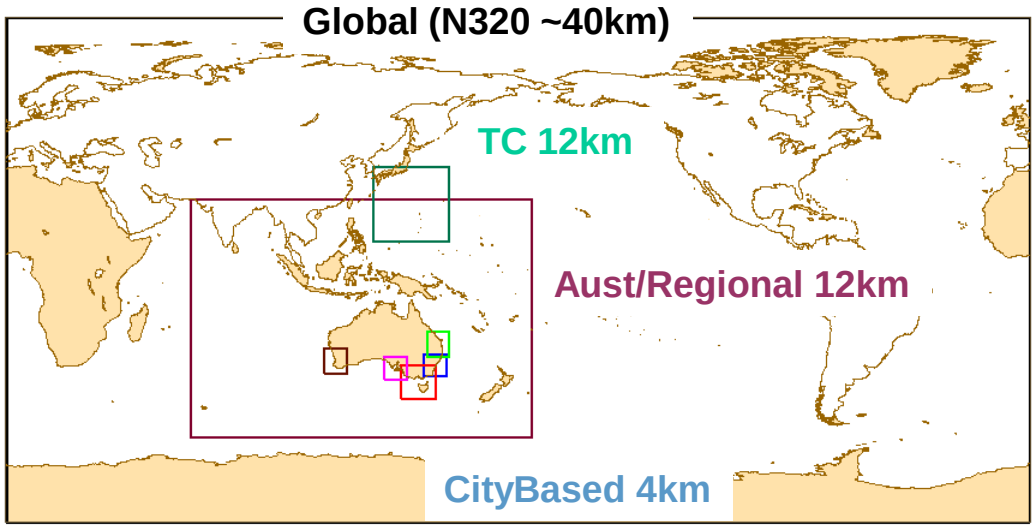
# ACCESS NWP: APS1 Plan

## *Rationalisation,* higher resolution





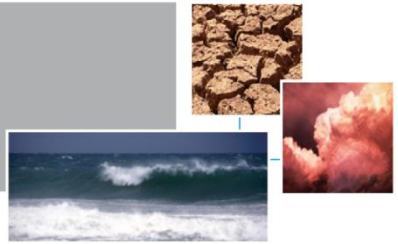

**Phase 1(APS0):**
**Current domains**




**Phase 2 (APS1):**

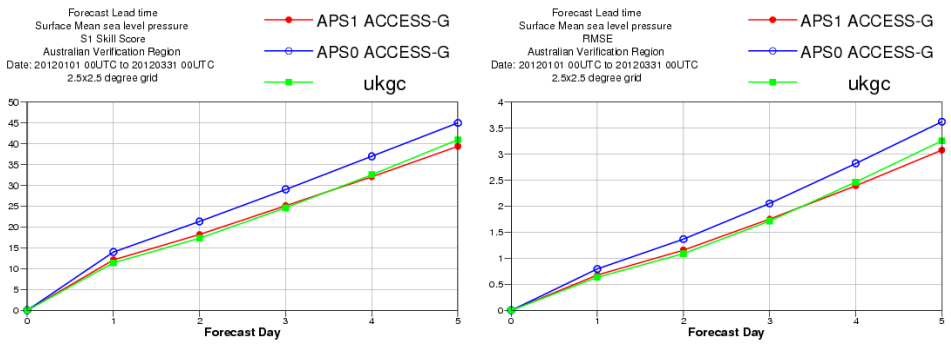
- **R + A -> "R12"**
- **No TXLAPS equivalent**
- **City: 5km > 4km (consistency)**

# ACCESS-G APS1: Operational 28-March 2012



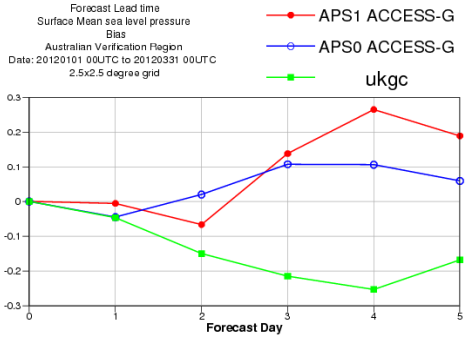
- Compared to APS0:
  - Aprox UKMO analogue: PS17 -> PS24
  - Horizontal-res: N144 (80km) -> N320 (40km)
  - Vertical: 50 -> 70 levels (top at 80km or 0.009 hPa)
  - Model: UM 6.4 -> 7.5
    - PC2 (prognostic cloud scheme)
  - Assimilated: **IASI, GPSRO,** (AIRS, ATOVS, ASCAT, AMV, SYNOP, SHIP, BUOY, AMDARS, AIREPS, TEMP, PILOT)
    - Potential “APS 1.5”: SSMI/S and WINDSAT scatt (dependent on ingestion into operational MARS)

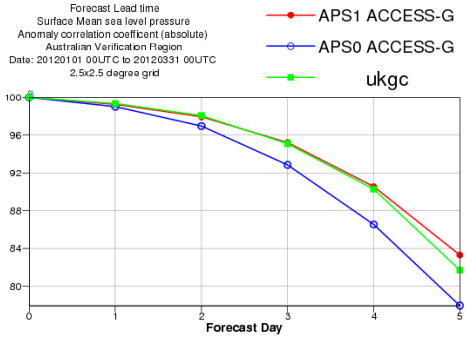
# Performance: APS1 v APS0







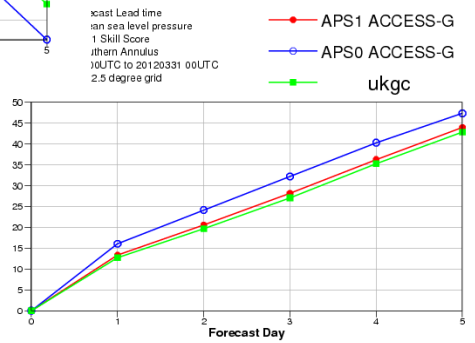


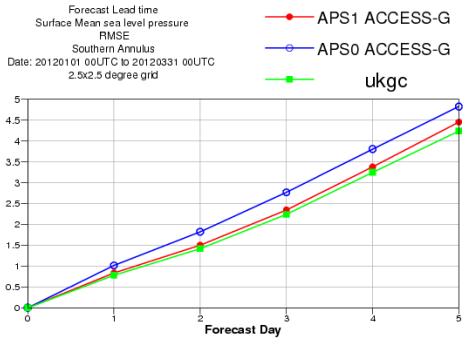



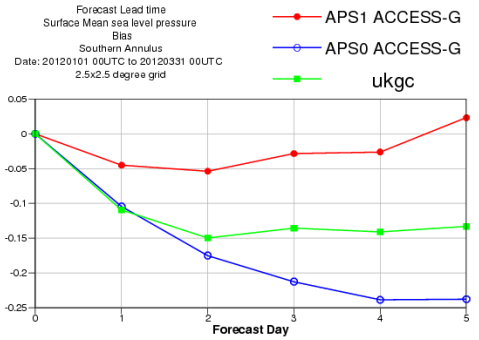

Aust

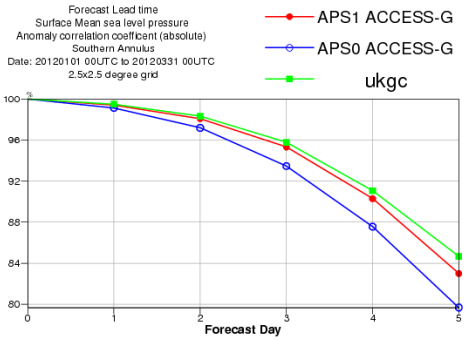
Around 12hrs skill improvement at three days

SH

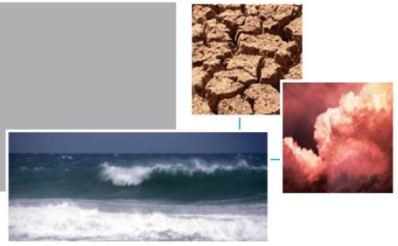


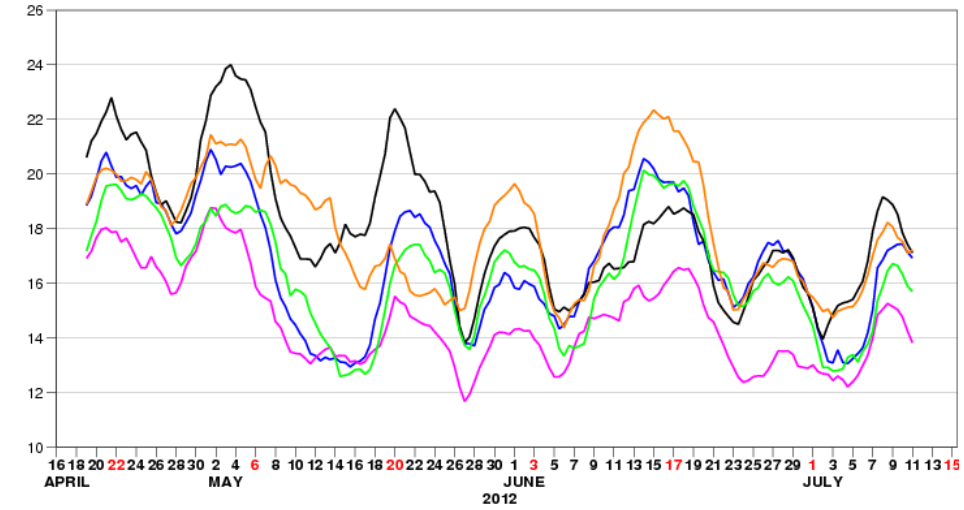



# APS1: operational 18Z 28 March 2012
# Operational verification, April – July 2012



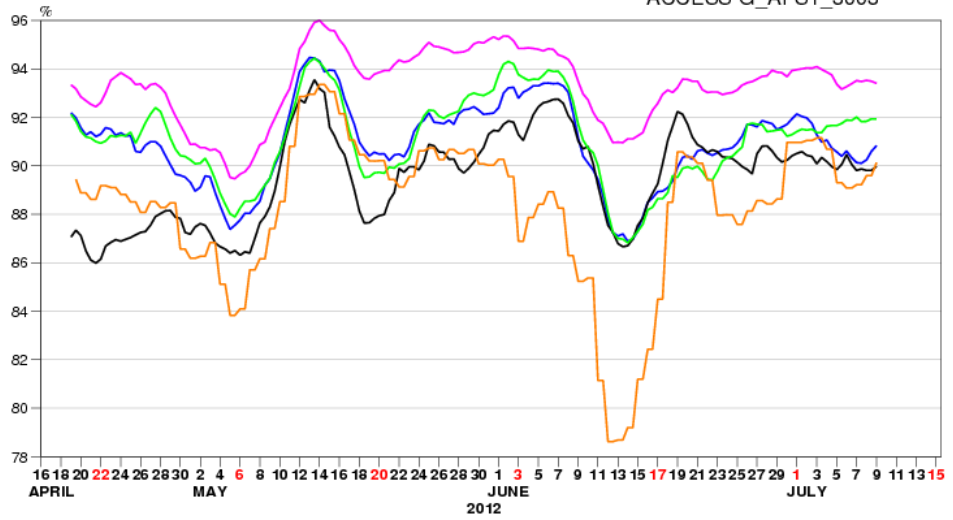
S1 Skill Score
Mean sea level pressure
Australian Verification Region
48hr Forecast
Date: 20120416 00UTC to 20120715 12UTC

ACCESS-G
ECSP
USAVM
UKGC
JMAGSM
ACCESS-G_APS1_3001
ACCESS-G_APS1_3003




Anomaly correlation coefficent (absolute)
Mean sea level pressure
Southern Annulus
96hr Forecast
Date: 20120416 00UTC to 20120715 12UTC

ACCESS-G
ECSP
USAVM
UKGC
JMAGSM
ACCESS-G_APS1_3001
ACCESS-G_APS1_3003



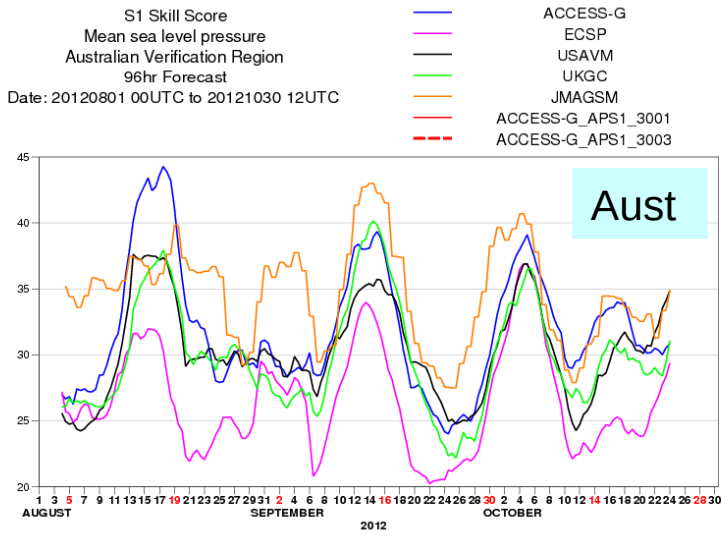

**Previous 30 days:**

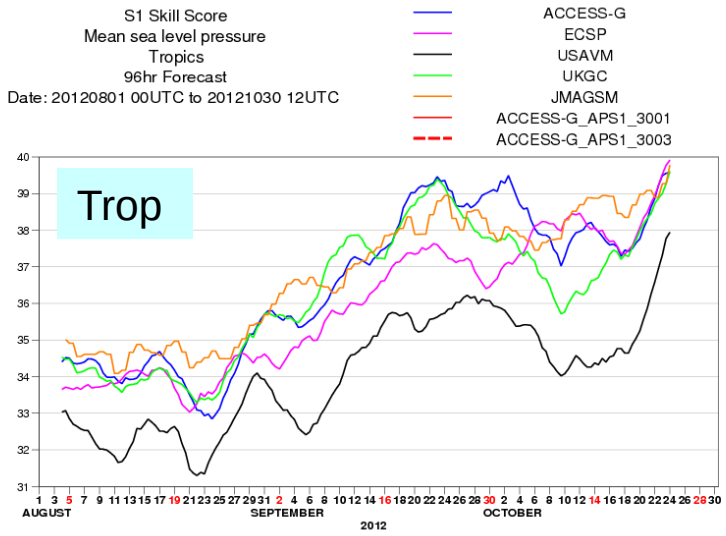
```
ec_gridded   14.133
uk_gridded   16.218
access-g_gridded   16.672
us_gridded   16.811
jma_gridded   17.501
```

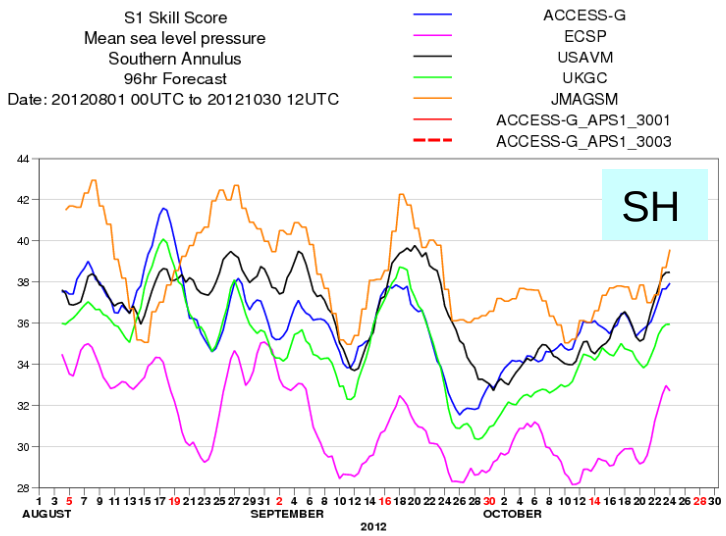
**Previous 30 days:**

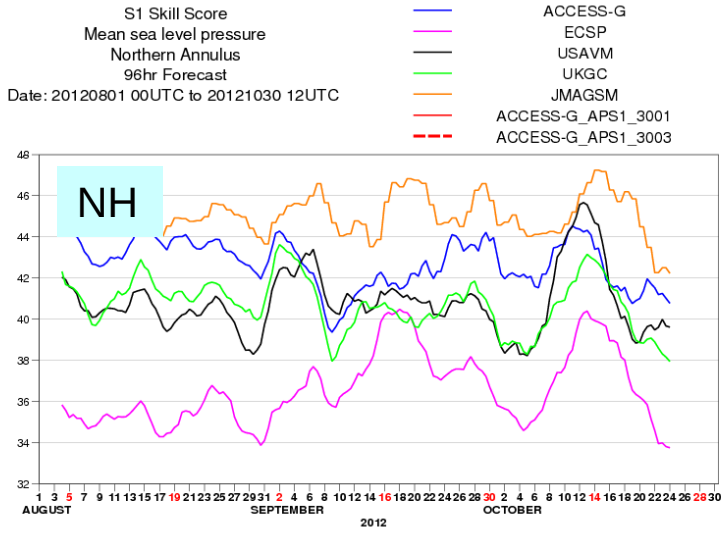
```
ec_gridded   92.888
uk_gridded   90.053
access-g_gridded   89.925
us_gridded   89.682
jma_gridded   87.283
```

# Operational verification, Aug – Oct 2012 (96Hr-FC)

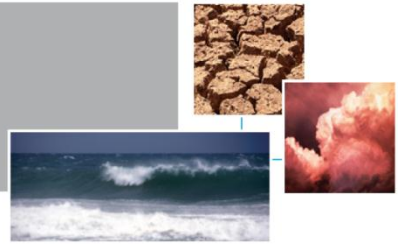


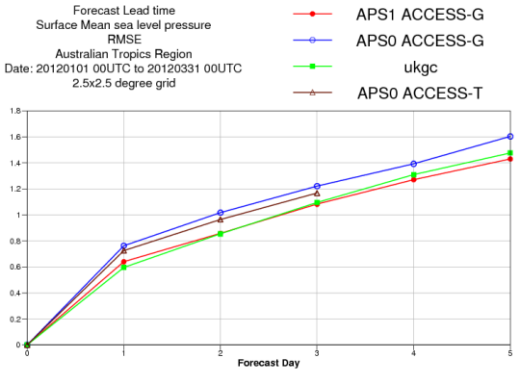



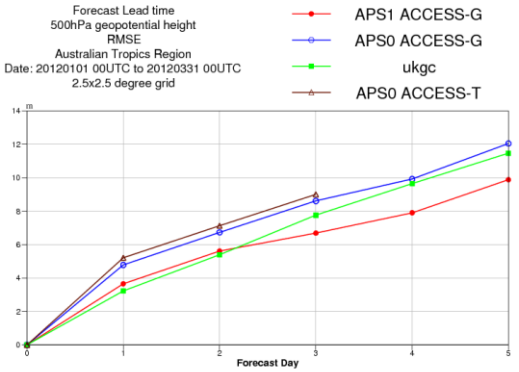



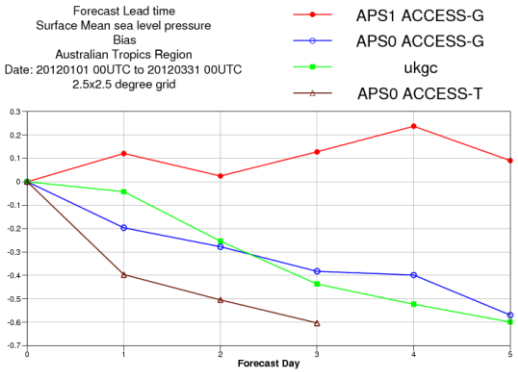



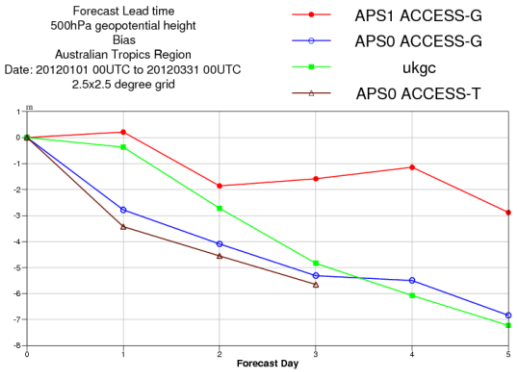
# Aust-Trop performance – the end of ACCESS-T



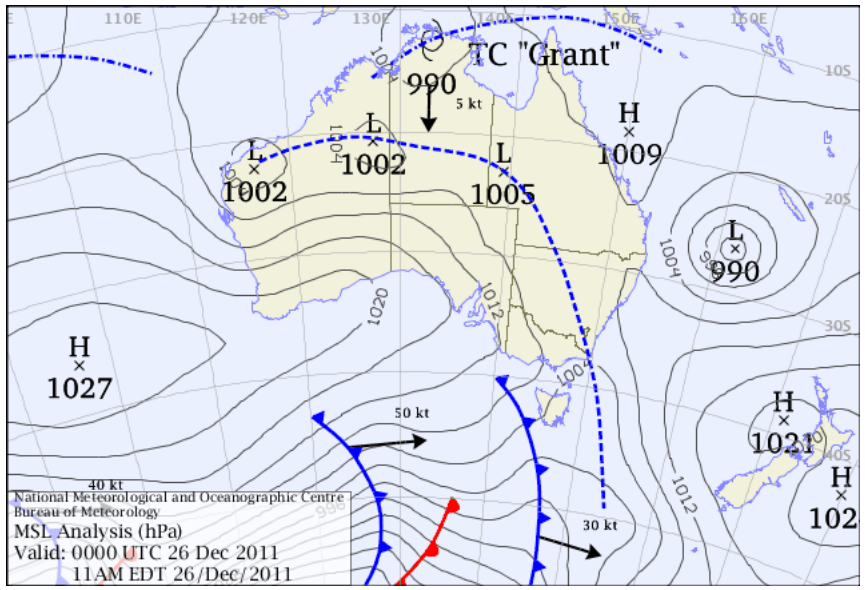


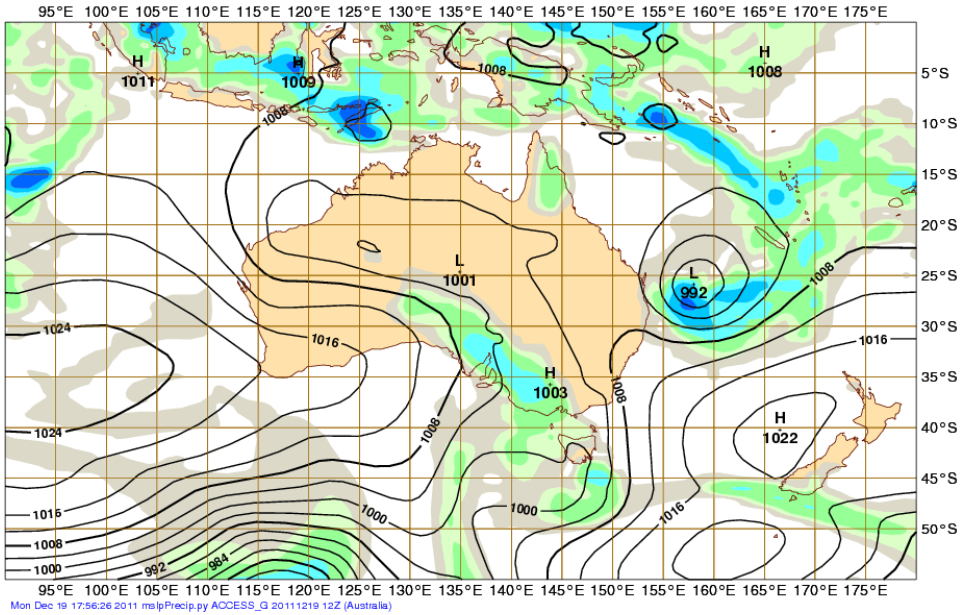



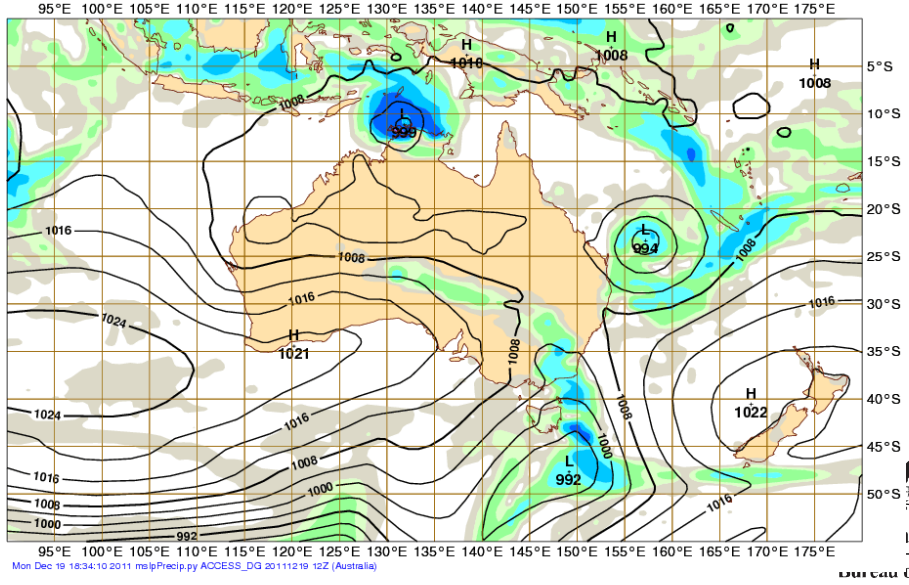



# Case Study: 2011/2012 Monsoon
# TC Grant: 6.5 days



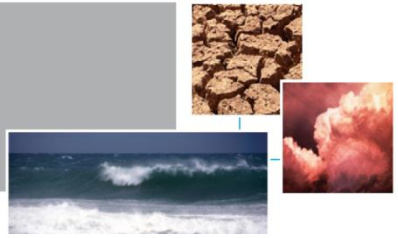




**APS0**

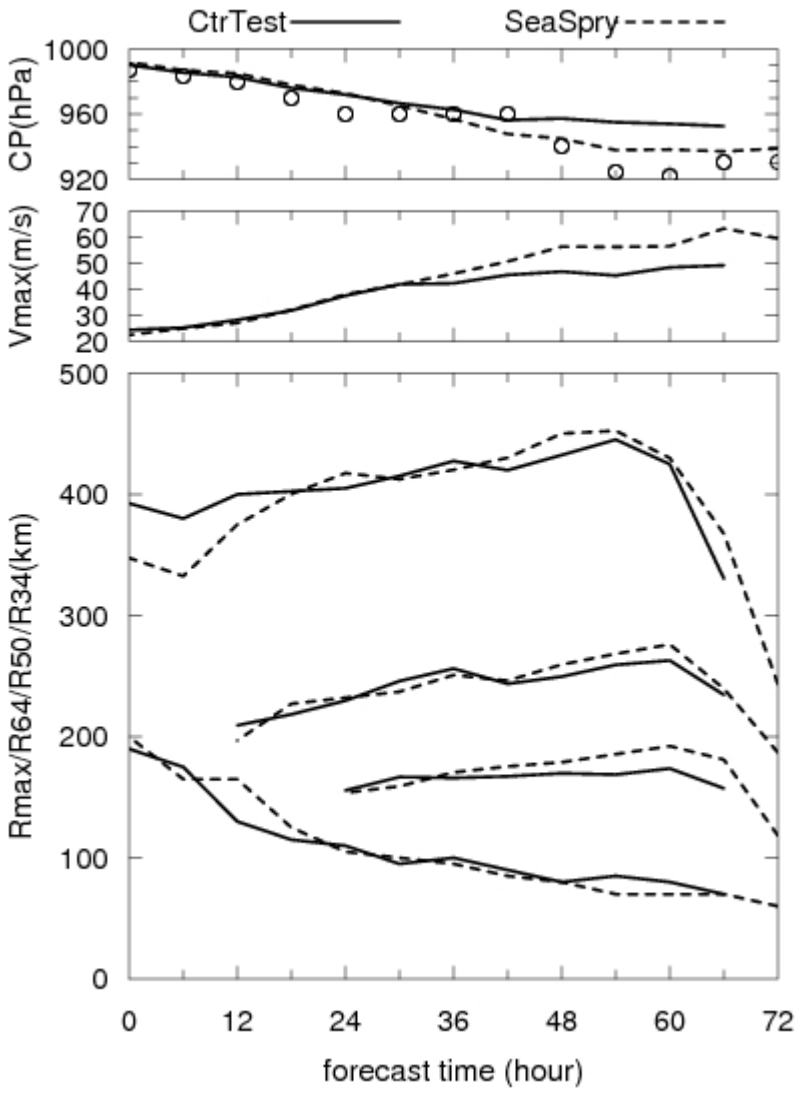



**APS1**

# ACCESS-TC Research

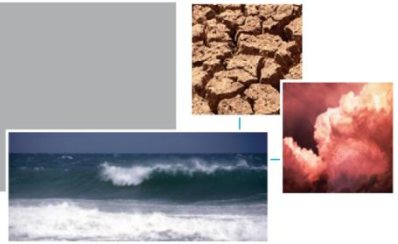


- ACCESS-TC upgrade required (T-APS0 -> G-APS1 transition)
- Difficulties with APS1-based ACCESS-TC
  - Compromise: nest TC-APS0 inside G-APS1 (improved track performance)
  - "TC10" – planned for TC season 12/13
- *Early* results of impact of changes to surface parameterisation (variable Charnock-prm, plus Andreas/Kepert spray scheme) are encouraging.




TC Yasi, base-time 12UTC 30-Jan-2012

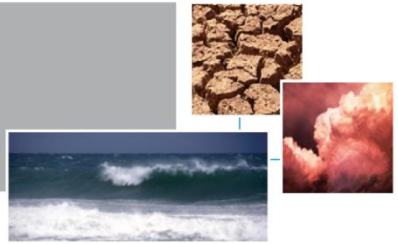
# ACCESS-R12 (APS1) Research

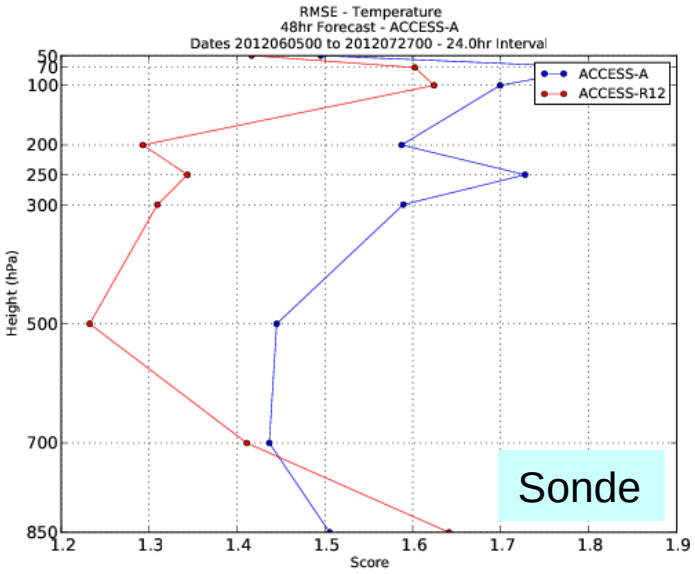


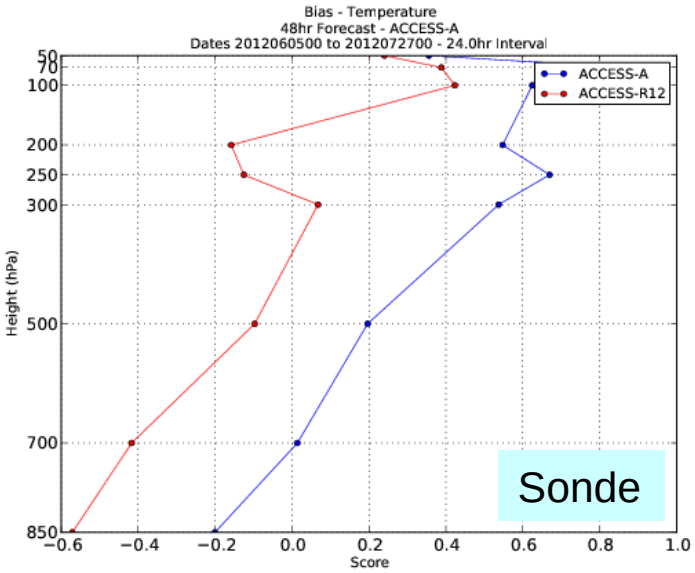
- Tropical stability mods (last year) appear effective.

- 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.

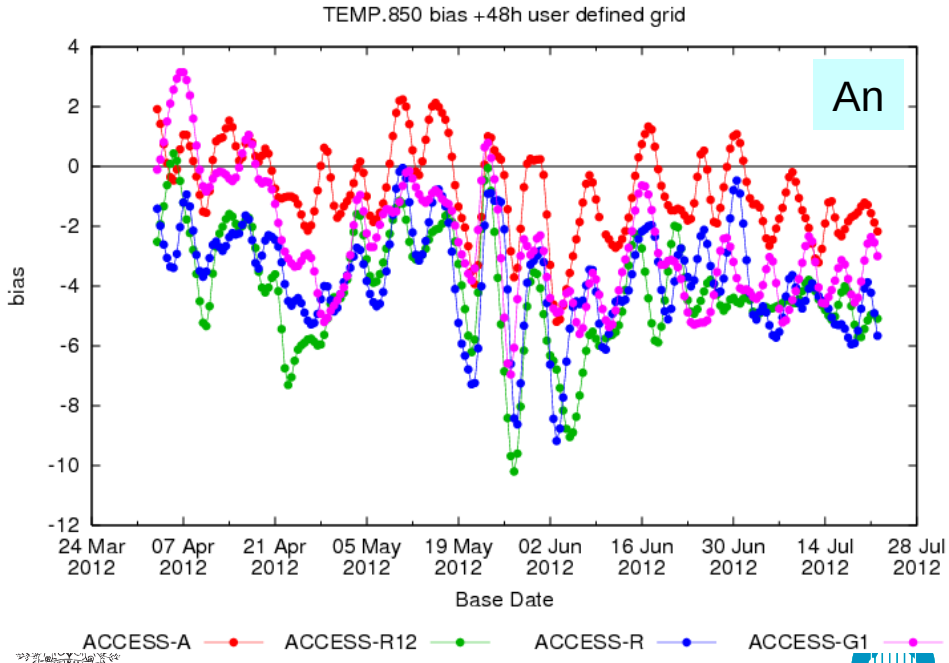
# ACCESS-R12 (APS1) Research



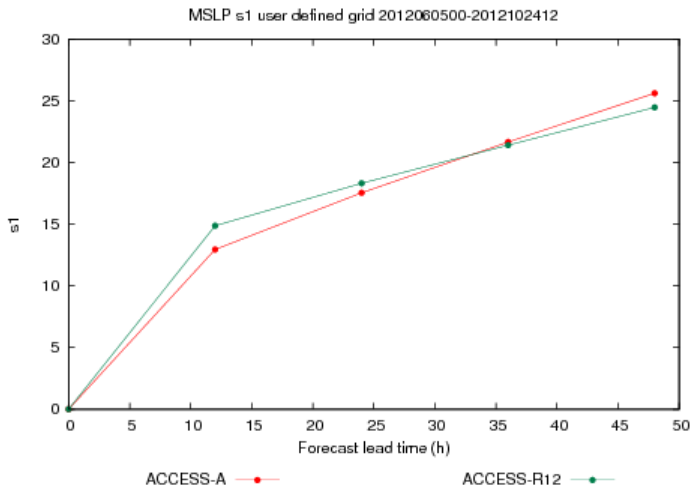


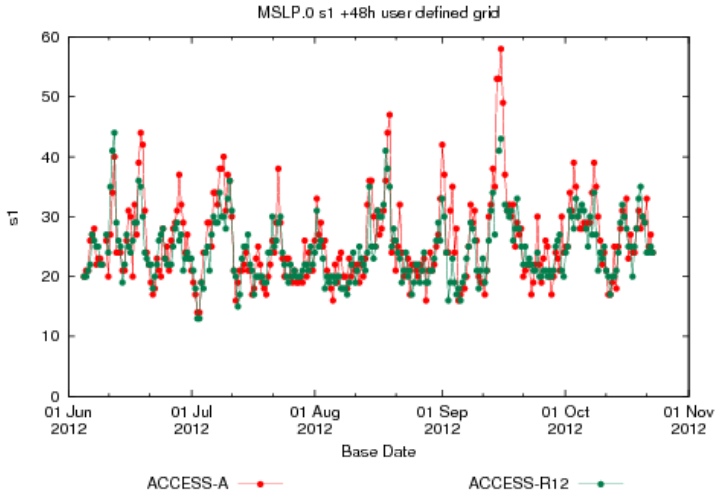



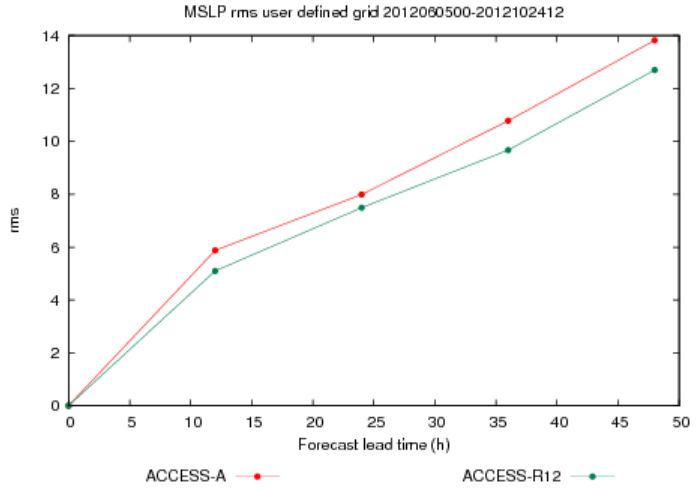

Note: Assimilation improvements, June-6

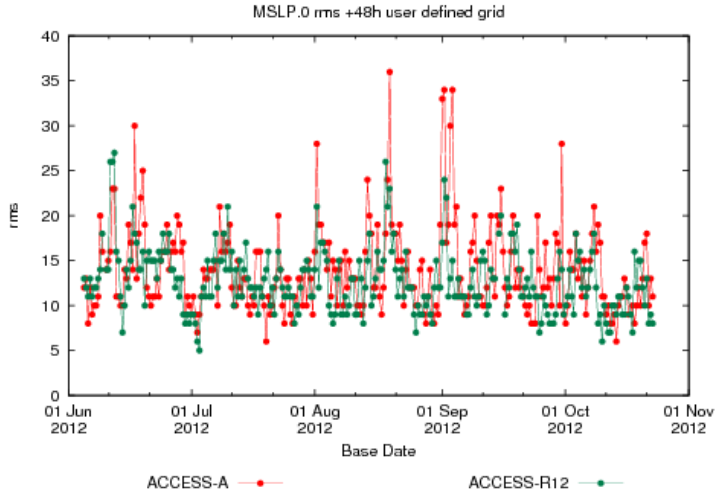


# ACCESS-R12 (APS1) Research



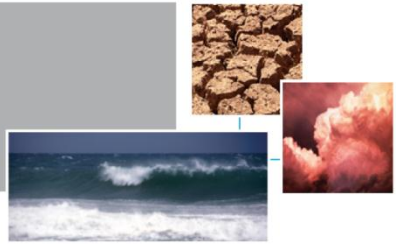


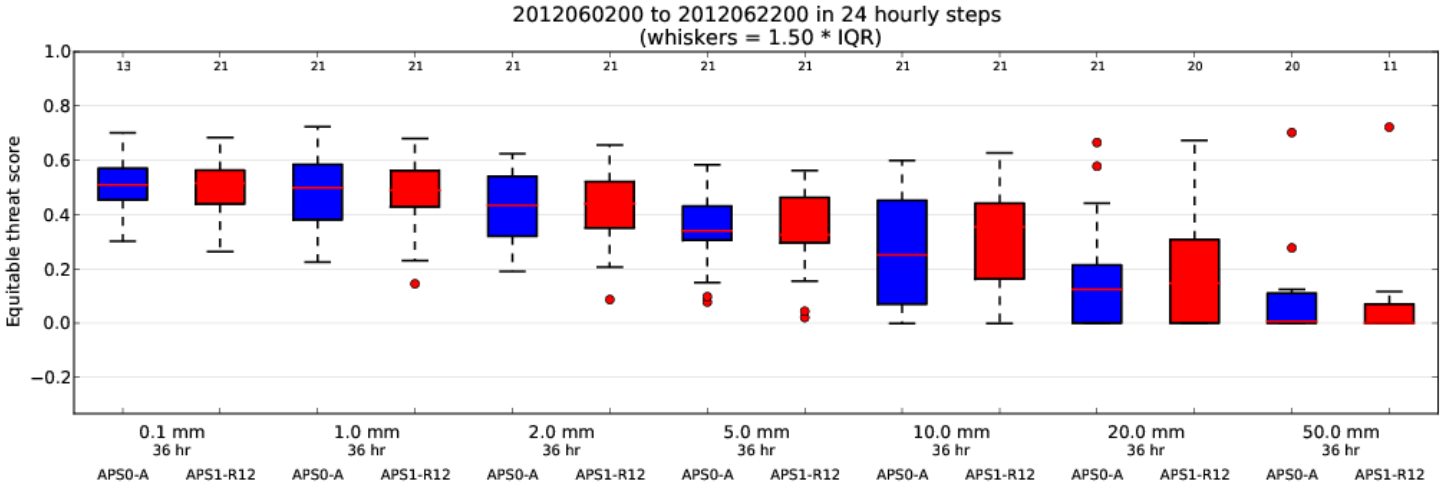

Australian Government
Bureau of Meteorology

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

CSIRO

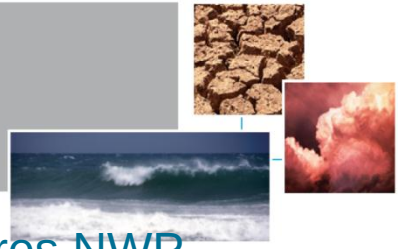
# ACCESS-R12 (APS1) Research






- 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



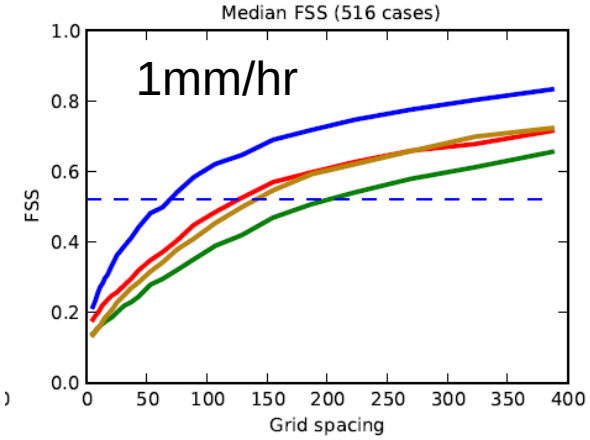
- Defer most of the SREP (1.5km res) discussion to the DA and High-res NWP discussions.
- ACCESS-C strategy (FC-only) retained, modest resolution increase (5km -> 4km), significant model upgrade UM6.4 -> UM 7.6.

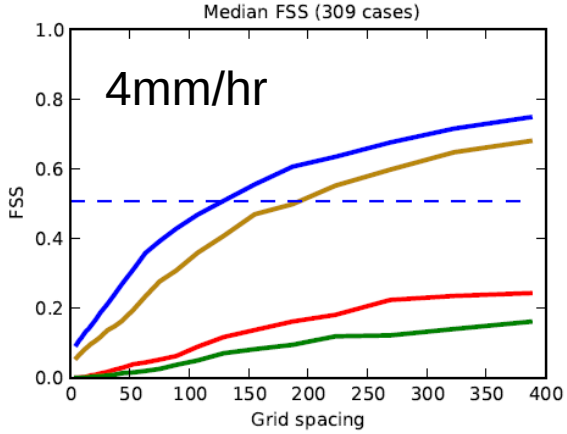
Neighbourhood verification

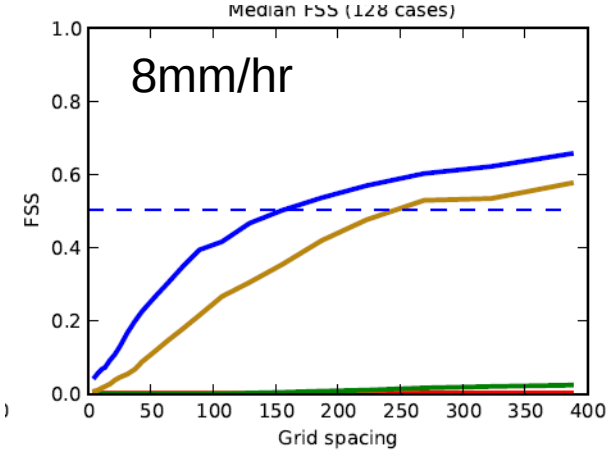
Gives indication of "accurate resolution"

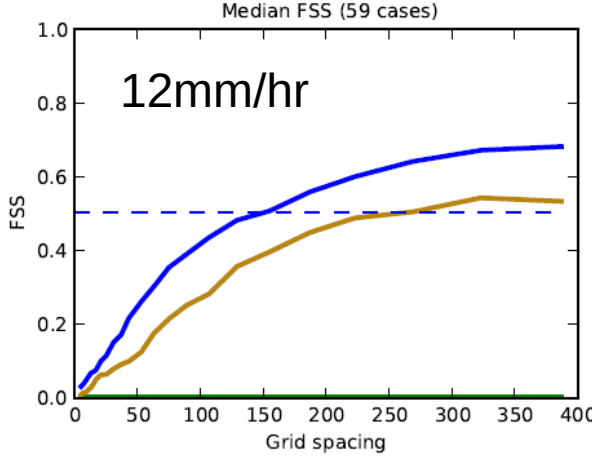
6 hour forecasts FSS, Sep2011-Jun2012

**1.5km+3dVAR+LHN**
**ACCESS-A 12km**
**ACCESS-SY (APS0)**
**ACCESS-SY (APS1)**

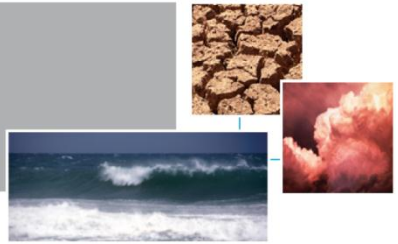


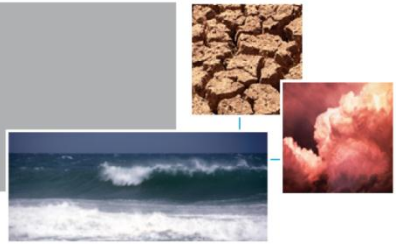
# ACCESS-C/G (APS1/2) Research

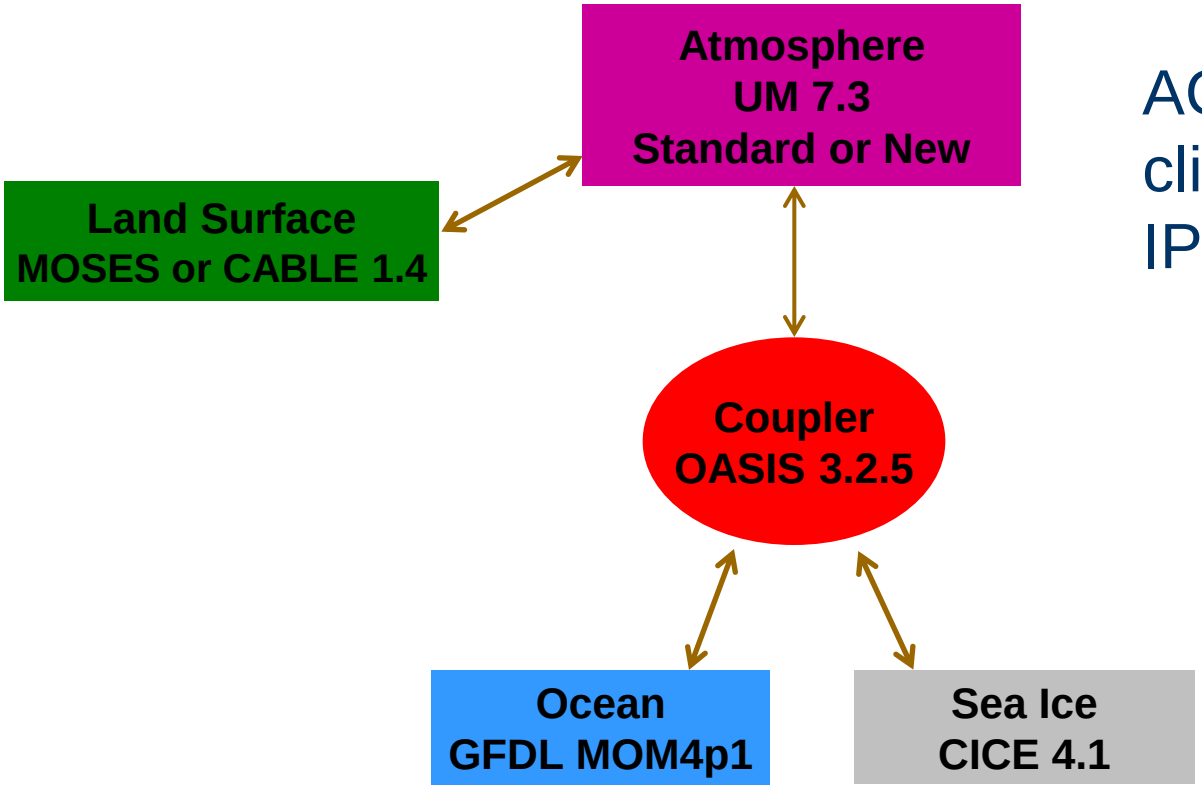


- ACCESS-C APS1 operational plan: Feb 2012

- 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)

# Climate Modelling / CMIP5



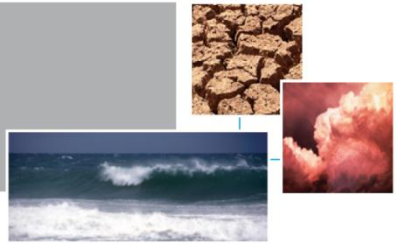



ACCESS coupled climate model for IPCC AR5

**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

# Climate Modelling / CMIP5

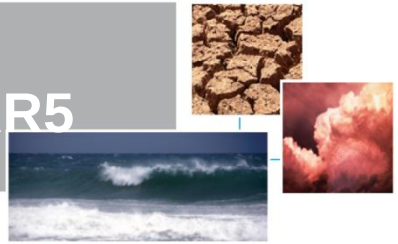


Two versions of the ACCESS coupled model have been completed:

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

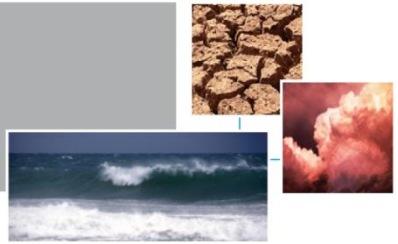
# ACCESS – Coupled model simulations done for IPCC AR5



## ACCESS1.0 and 1.3 – simulations performed

| Experiment | Length | Status |
|---|---|---|
| Preindustrial Control | 500 yr | complete |
| Historical | 1850-2005 | complete |
| RCP 4.5 | 2006-2100 | complete |
| RCP 8.5 | 2006-2100 | complete |
| 1%/yr $CO_2$ increase to 4x | 140 yr | complete |
| Abrupt 4x$CO_2$ increase | 150 yr | complete |
| AMIP (atmosphere only) | 1979 - 2008 | complete |

# Climate Modelling / CMIP5



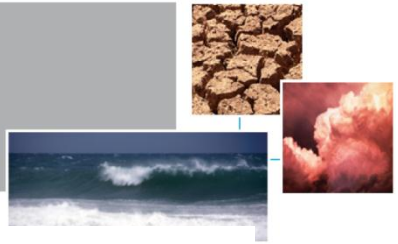
- The results from ACCESS have been published on the “Earth Systems Grid” (ESG) for use in IPCC AR5 analysis studies, and in the Coupled Model Intercomparison Project phase 5 (CMIP5).

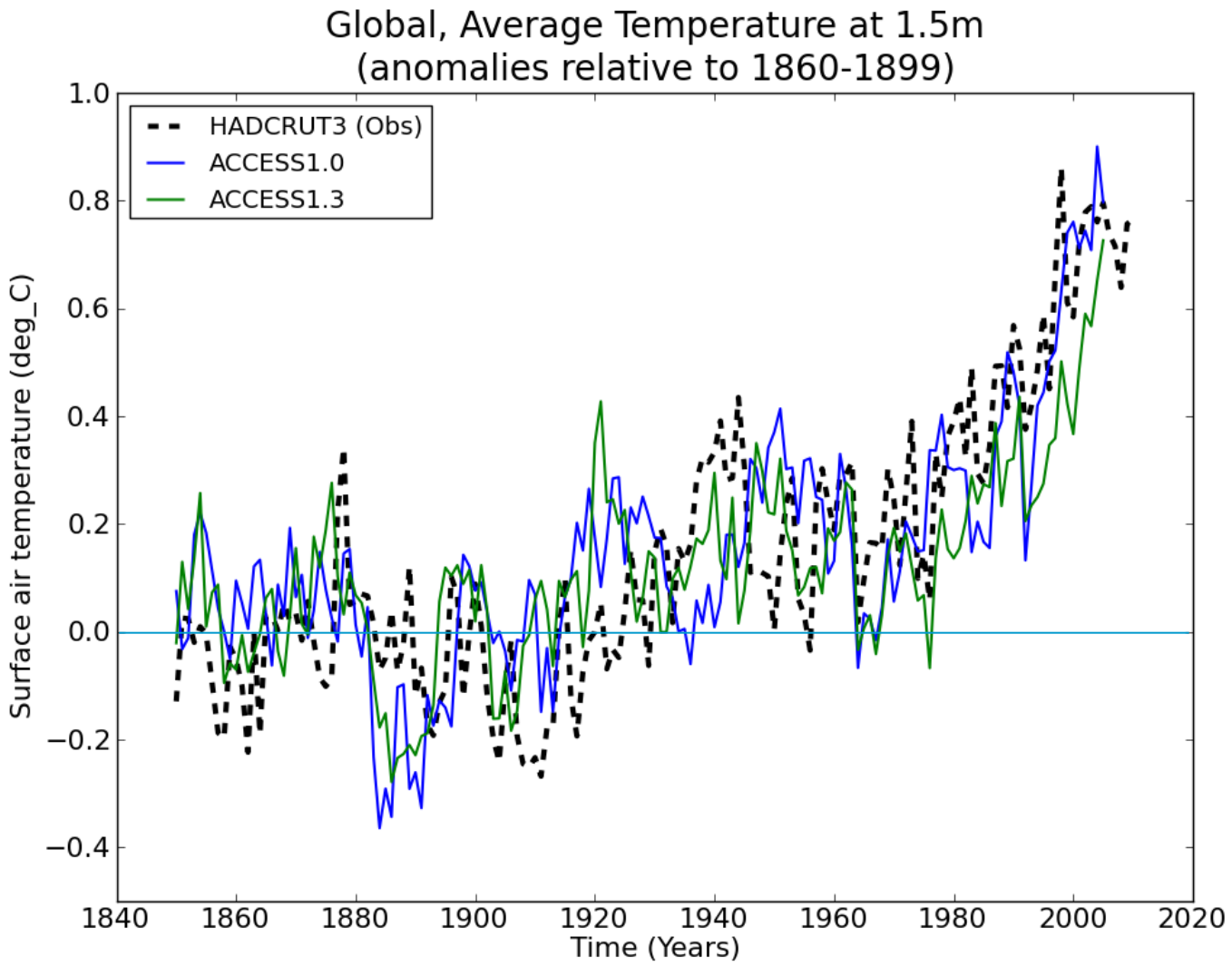
- ACCESS1.0 – results published February 2012
- ACCESS1.3 – results published May 2012

➢ After extensive checking and quality control

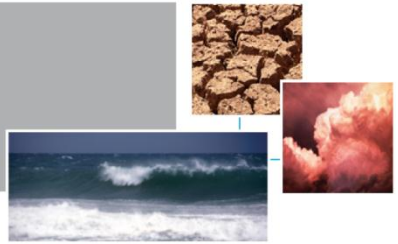
- Secondary priority fields are still being checked and published

# Climate Modelling / CMIP5

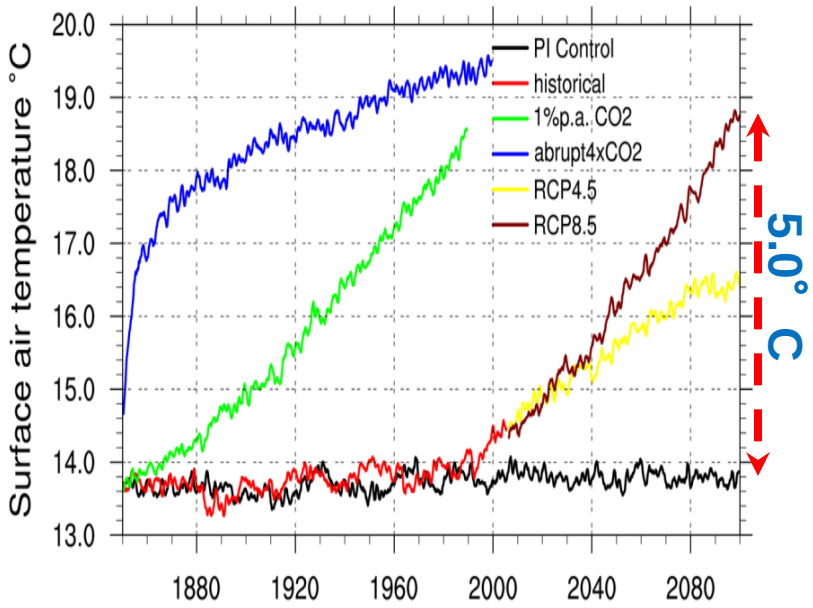




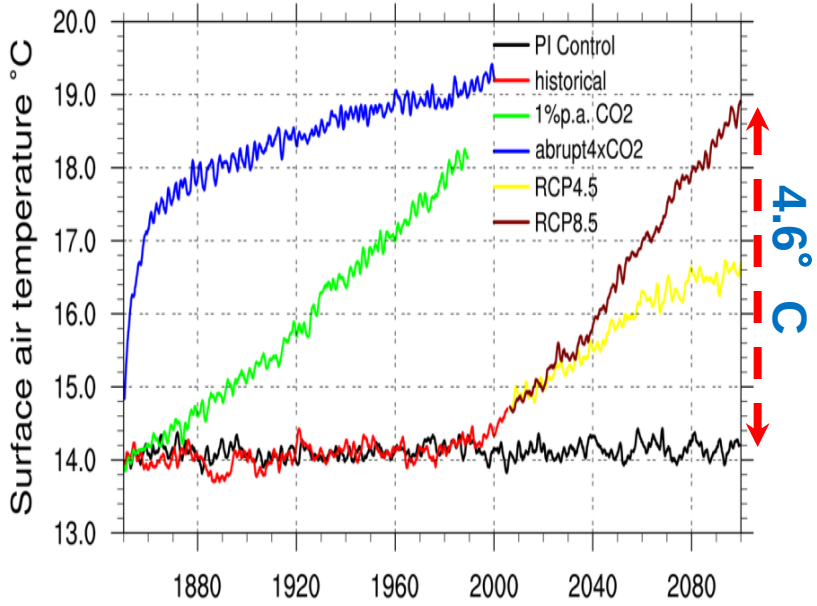
# Climate Modelling / CMIP5



ACCESS 1.0

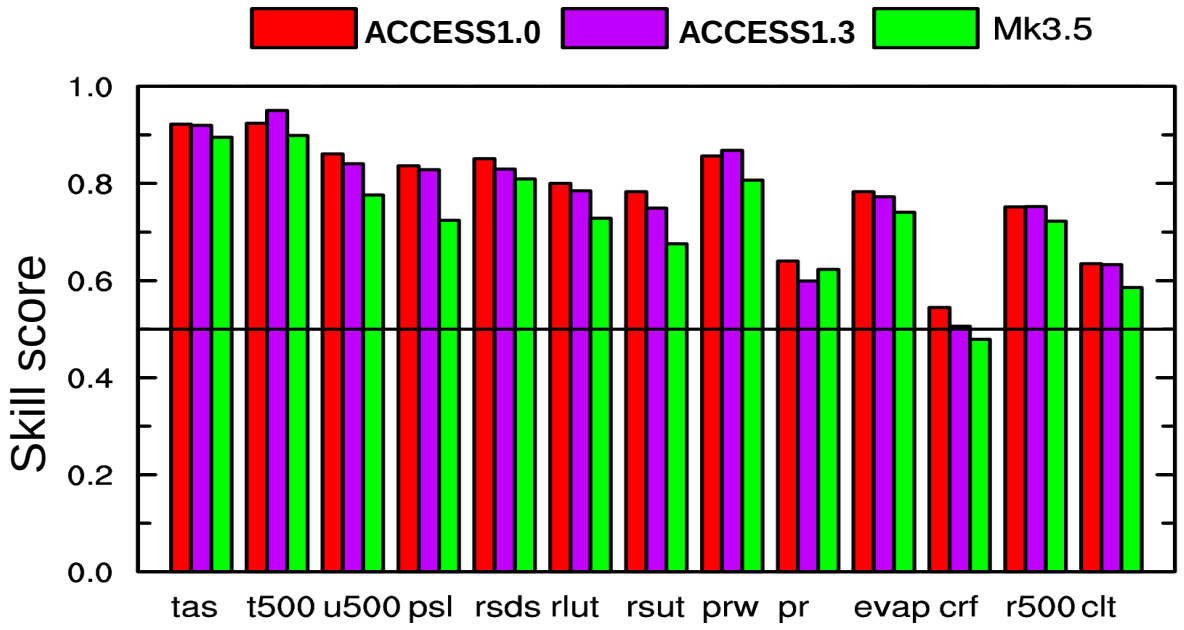



ACCESS 1.3



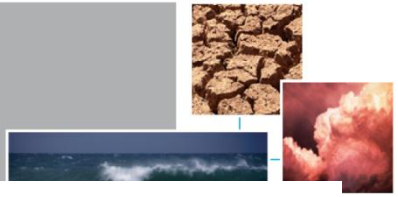
# Climate Modelling / CMIP5

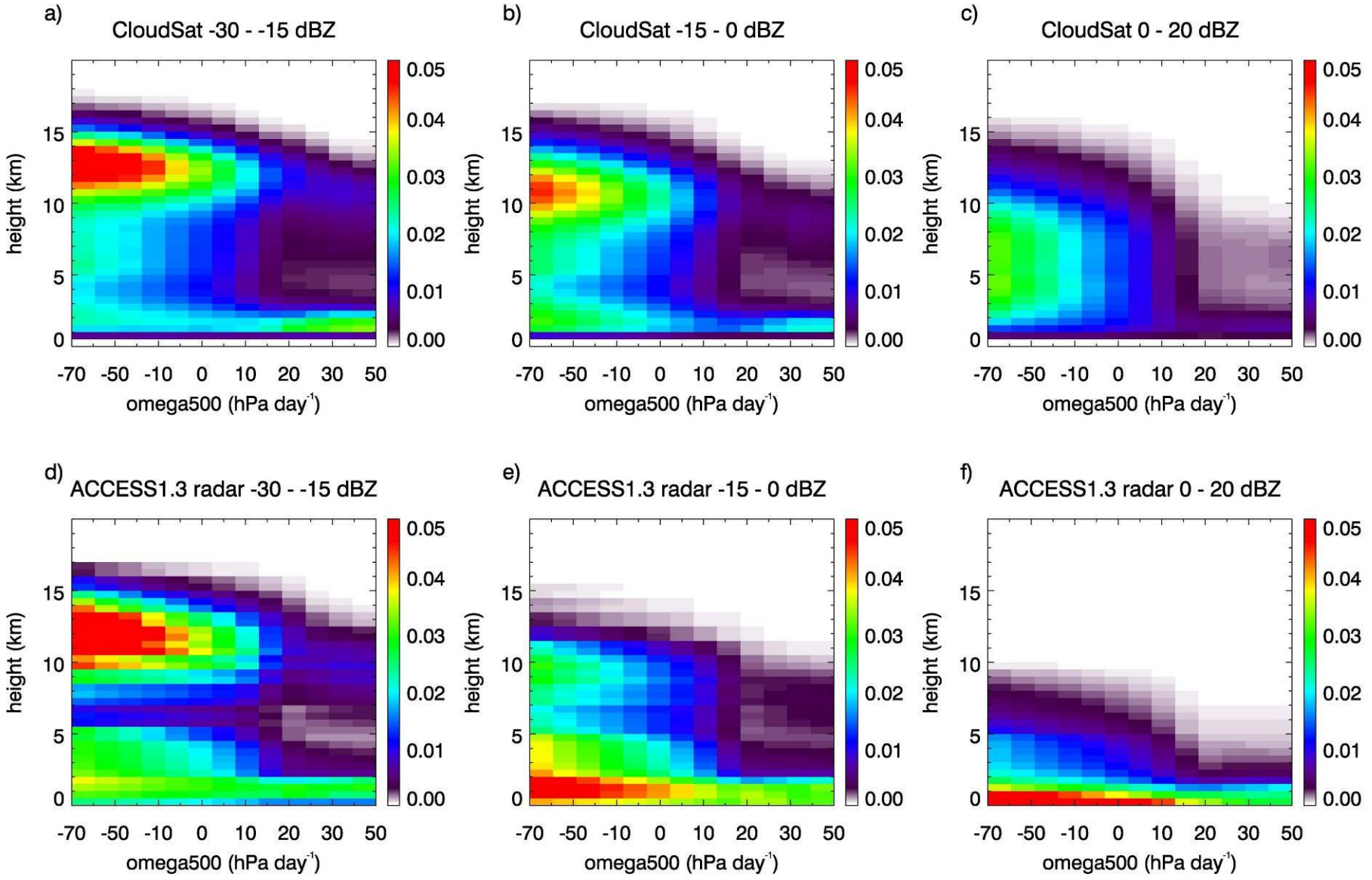
## Skill scores – global patterns, mean for 4 seasons (historical 1975-2004)




- 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

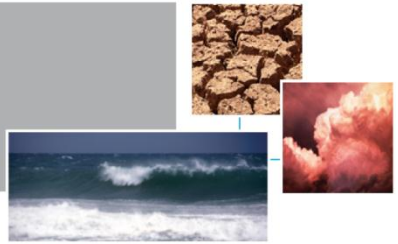
# Tropical Cloud evaluation using COSP: radar dBZ (small/med/large): $\omega_{500}$






**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

# SuperComputing

## Shares at NCI (Anticipated for 2013)

NCI

| Partner Organisation | Share (%) |
|---|---|
| Australian National University | 15.96% |
| CSIRO | 21.38% |
| Bureau of Meteorology | 18.95% |
| Geoscience Australia | 3.40% |
| Intersect Australia | 3.81% |
| QCIF | 0.68% |
| University of Adelaide | 1.70% |
| ANU (LIEF Share) | 1.70% |
| Monash University | 1.70% |
| University of New South Wales | 1.70% |
| University of Queensland | 1.70% |
| University of Sydney | 1.70% |
| Discretionary Board Share | 7.40% |
| Priority (Other Purposes) | 1.52% |
| Merit Allocation Scheme (*pro bono*) | 11.52% |
| ARC MAS Supplement | 2.72% |
| Director's Share | 2.50% |
| **Total** | **100.00%** |

~40% of 1.2 PF
(about 484 TF)

---

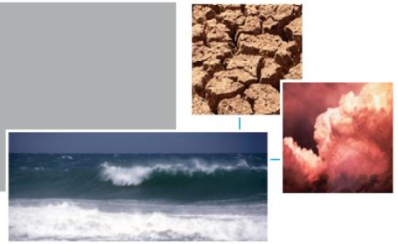
CSIRO ~ 255 TF
Bureau ~ 228 TF

---

Bureau share
( Solar x 5.7 )
CSIRO share
( Vayu x 7.9 )

www.nci.org.au

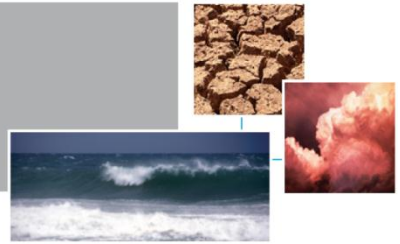
# NCI Transfer Project



- 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

# Climate & Weather Science Laboratory

a virtual laboratory for the Australian research community



nectar

CSIRO

Australian Government
Bureau of Meteorology

NCI

**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)

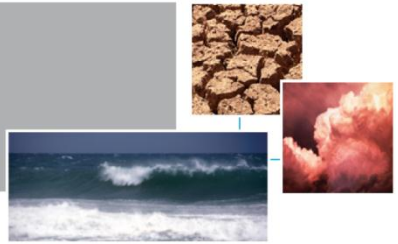
ARC CENTRE OF EXCELLENCE FOR CLIMATE SYSTEM SCIENCE

Australian Government
Bureau of Meteorology

The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

CSIRO

# Nectar WP1: Vision

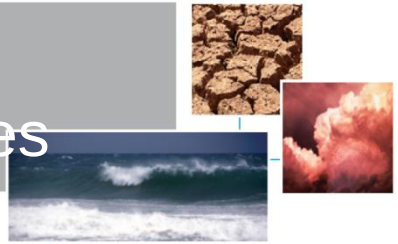


- **Goal is to improve the ease of use, reproducibility, support and sharing of code, data and experiments**

- 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*

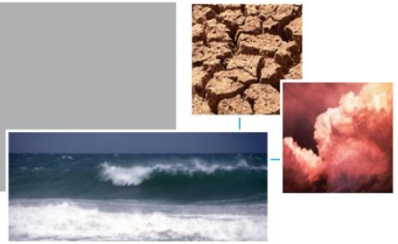
- Timeline: Sept 2013 for WP1

# 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

Gary Dietachmayer
ESM Atmospheric Modelling Team

Phone: 03 9669-4749
Email: g.dietachmayer@bom.gov.au
Web: www.cawcr.gov.au

# Thank you

www.cawcr.gov.au