



Unified Model and Science Partnerships

George Pankiewicz, Science Partnerships, Met Office

HPC Wales / C3W: September 2014



Outline of Presentation

- UM system, suites & configurations
- UM access, JWCRP & MONSooN
- UM partnerships
- Collaborative technical development
- Collaborative scientific development

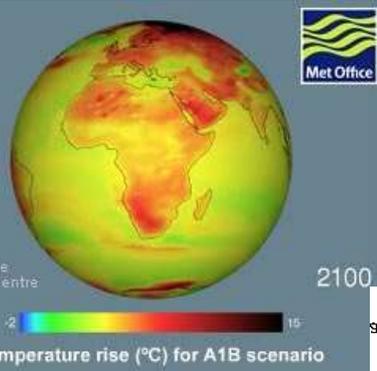


UM system, suites & configurations

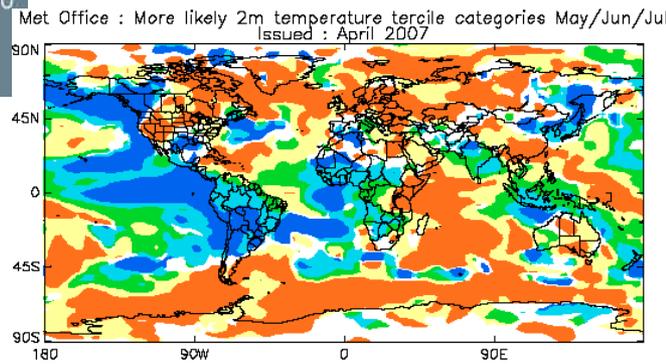


The Unified Model

Supports all atmospheric modelling. Spatial and temporal scales cover climate and seasonal requirements through to global and local weather prediction requirements



Climate modelling: input into IPCC reports
(Coupled Atmosphere-Ocean models)
1 year – 100 year, low resolution



Seasonal forecasting:
(Coupled Atmosphere-Ocean models)
For commercial and business customers
1 month -1 year low resolution

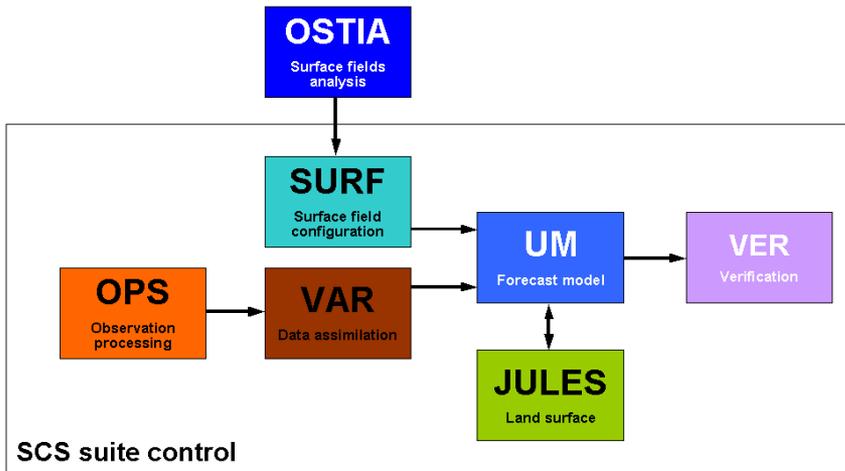
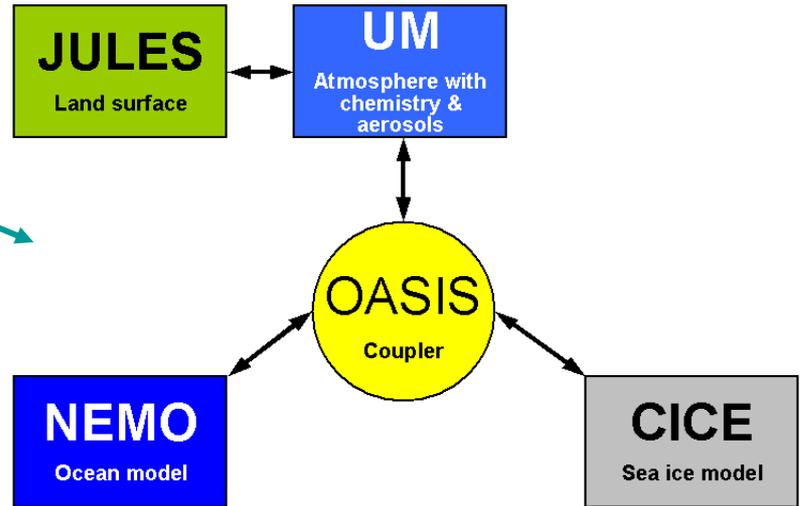
NWP
Atmosphere model
Public Weather, Aviation, Commercial
6 hours to 2 weeks high resolution





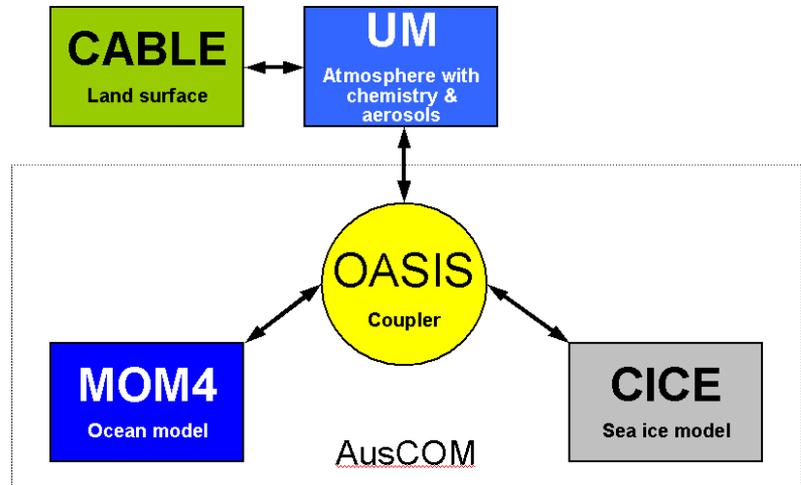
Suites & components

HadGEM example



NWP suite

ACCESS coupled model





Model Configurations

- Defines the model physics
- A given configuration will run on more than one version of the model code
- Labels for the different components and for the combined coupled configuration
- GA / GL / GO / GSI / GC





Met Office



UM access, JWCRP & MONSooN



UM access for research

MONSooN through PUMA / NCAS-CMS:

- Joint NERC/ Met Office facility: part of JWCRP
- Research configs supported by Met Office

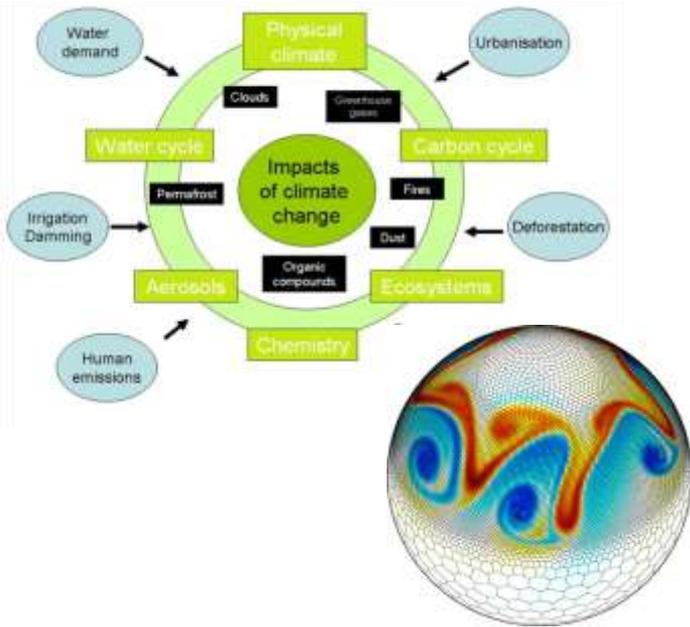
Local installation:

- Research licence / abstract
- Installation / maintenance / local upgrades
- Research licence at Swansea

Shared repository:

- New - technical infrastructure programme

Joint Weather and Climate Research Programme



Shared science

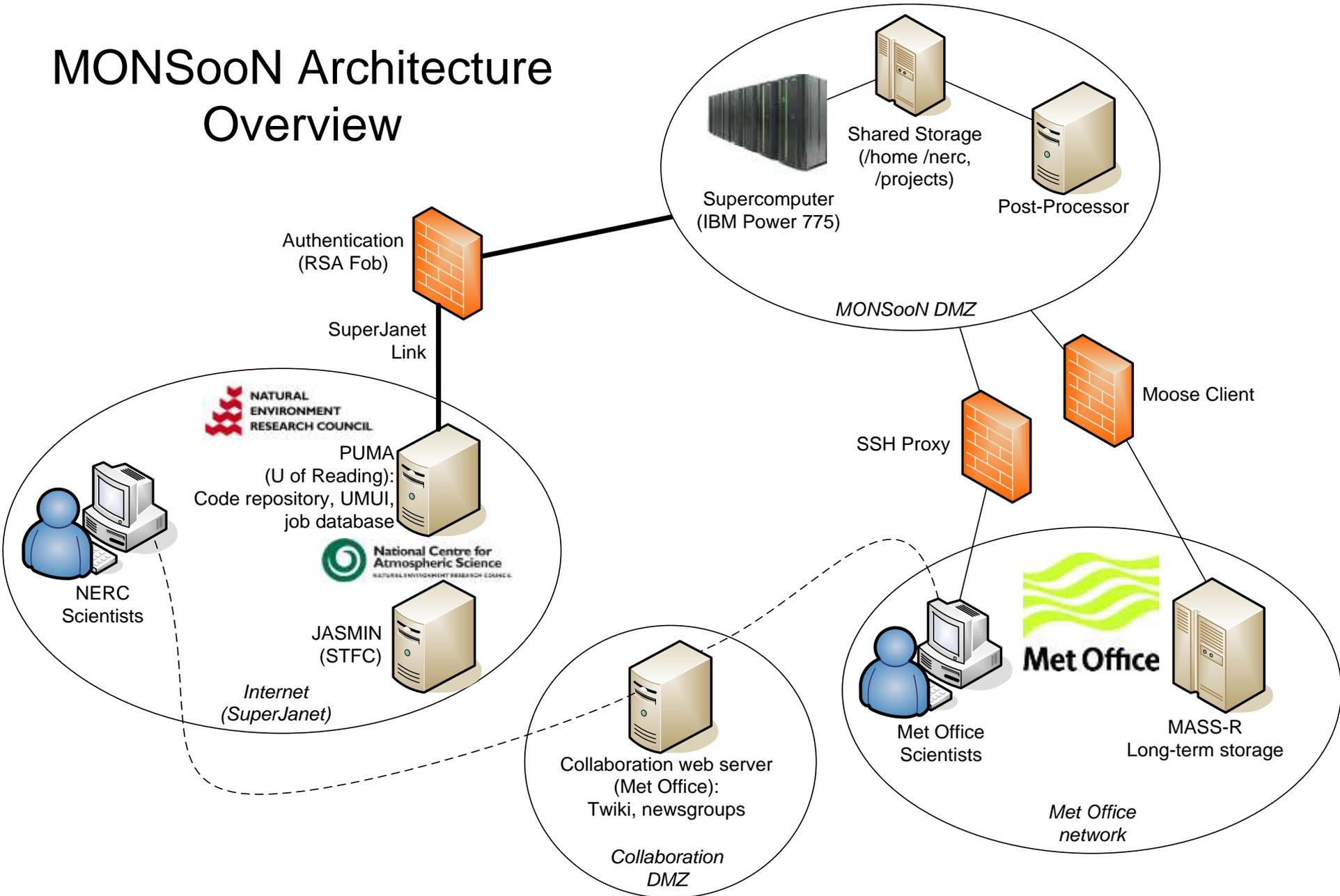
- UK Earth System Modelling Strategy
- Next-generation dynamical cores

Shared research facilities

- MONSooN
- FAAM



MONSooN Architecture Overview





Why use MONSooN?

- Common access to UM for all scientists
 - at Met Office, NERC sites or UK universities
- Sharing of configurations, data and jobs
- Ease of entry for new users
 - UM is already set up and verified on MONSooN
- Access to dedicated UM support
 - from NCAS-CMS and Met Office



The MONSooN Team:

- Technical - TIS

Katie Kerr - Service Manager

AJ Watling - Technical Lead

John Whitlock - Service Owner

- Support Teams

- FSD ServiceDesk

- Supercomputer

- Linux

- Networks

- Storage

- Scientific

- Met Office

- Science Collaboration

- Climate Science Applications

- Weather Science Applications

- NERC

- NCAS - PUMA

- BADC / CEDA - JASMIN





How to interact with the team:

- Incidents: Service Desk – Remedy
- Changes, Queries, Discussion – Service Manager

monsoon@metoffice.gov.uk

- Projects: Applications, changes, closure
- Ongoing requirements (e.g. Node hours, Quota)
- Liaison with **Tech PI**
- Tech Lead
 - Liaison with other technical groups
 - Tactical work and strategy
 - Planning & Development
- MONSooN Management Group - Strategy and escalation



Met Office



UM partnerships



International UM partnerships

Jointly developing a world leading seamless modelling system in a coordinated way

Shared science, model evaluation and technical development:

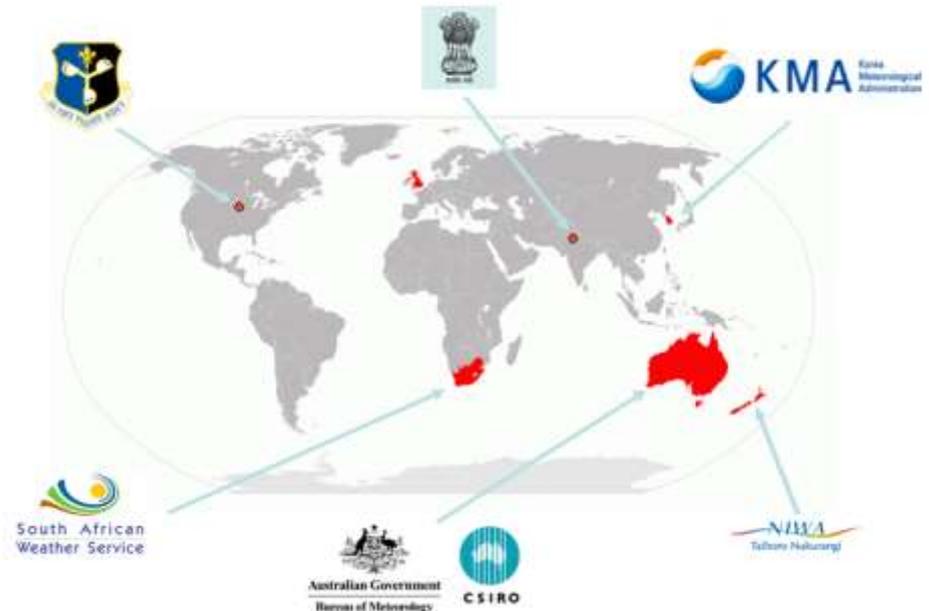
- Joint process evaluation groups
- Technical infrastructure teams
- User workshops & tutorials

A foundation for relationships with other organisations:

- Science & model development
- Weather & climate services
- Jointly growing our businesses

Operational users complemented by:

- research partners in national / international universities & organisations
- capacity building consultancy projects with other partners





Principles of UM partnerships

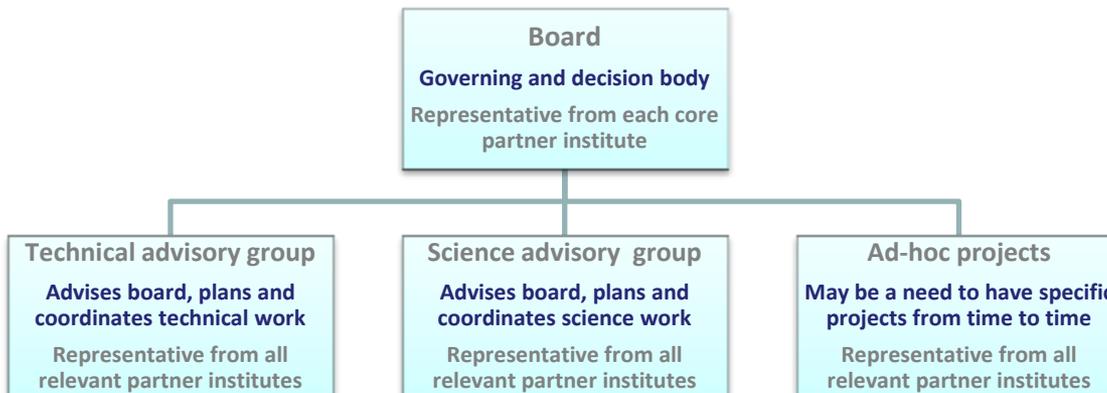
The more a UM partner can invest and support itself, the more a partner can influence strategic direction of model development and own the UM

Core partners:

- Commit 4FTE to joint development
- Locally able to run and support operations & upgrades and fund central support
- Member of board sets direction of joint work, controls funds & influences decisions on model development

Associate partners:

- Some commitment to joint development
- Locally able to run and support operations & upgrades and fund central support
- Feed views to the board



Research partners:

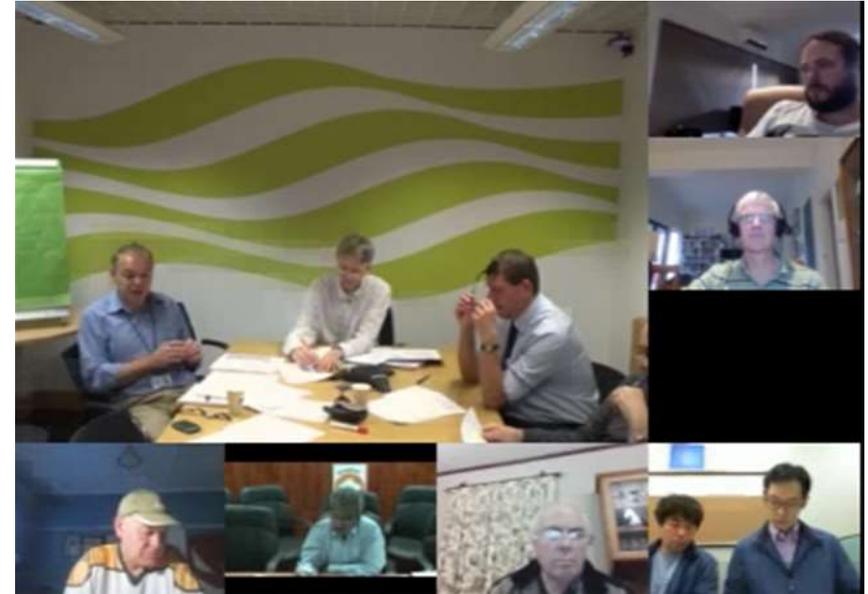
- Non operational users able to commit to joint development
- May fund central support if needed



UM partnerships news 2014

Joint technical infrastructure programme launched June 2013:

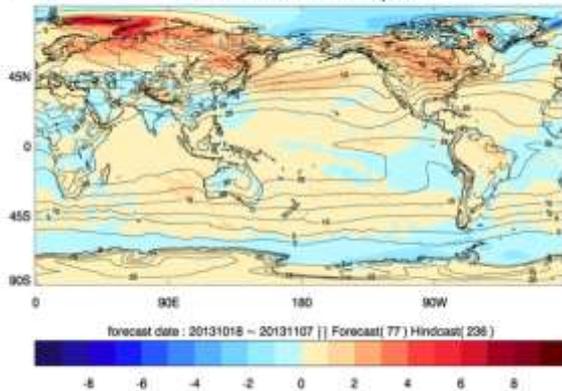
- Rose development & migration
- Common shared repository
- Convergence on use of observation processing software
- Modified version of JULES ready for CABLE science



KMA
Contour - Forecast
Shade - Anomaly

GloSea5
Re1500

MULTI 1.5mT mean & anomaly, Dec



Joint Met Office KMA seasonal forecast system:

- Coupled N216L85 ORCA 0.25 L75 model ported to KMA
- Model data exchange in autumn 2013 allowed an expanded ensemble of products enabling collaborative research



UM partnerships news 2014

cylc suite management software implemented:

- NIWA, Dec 2013
- Met Office, Jan 2014



CYLC
SUITE ENGINE

Cylc ("silk") is a **suite engine** and **meta-scheduler** that specializes in suites of cycling tasks for weather and climate forecasting and related processing (it can also be used for one-off workflows of non-cycling tasks, which is a simpler problem). Cylc was released by NIWA under the GNU General Public License v3 in 2011.

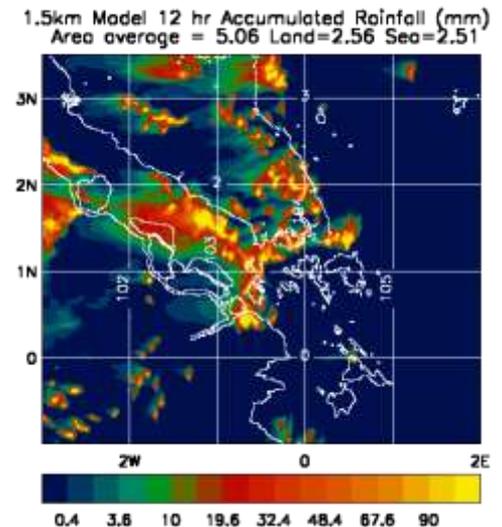
NIWA
Taihoro Nukurangi

Current Version: 5.3.0 (2013-06-14) changes

Cylc was selected as a finalist in two categories for the 2012 New Zealand Open Source Awards.

[Overview](#)

Convective scale UM configurations ported to MSS Singapore to allow local trials to be run as part of the SINGV project

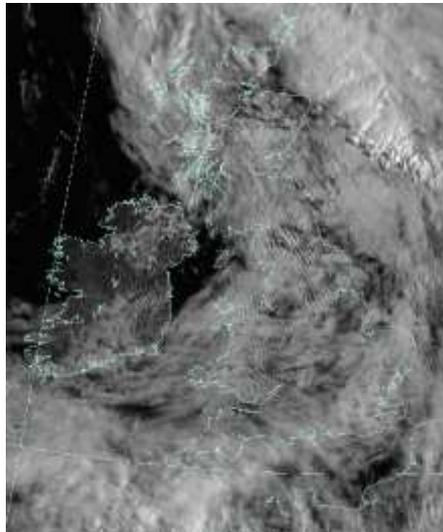




UM partnerships news 2014

Initial core partner agreement between Met Office, CAWCR & KMA signed March 2014

ENDGame being used in NIWA's NZCSM configuration as part of the DEEPWAVE experiment to study the dynamics of gravity waves, June to July 2014 (ND & EG over UK below!)

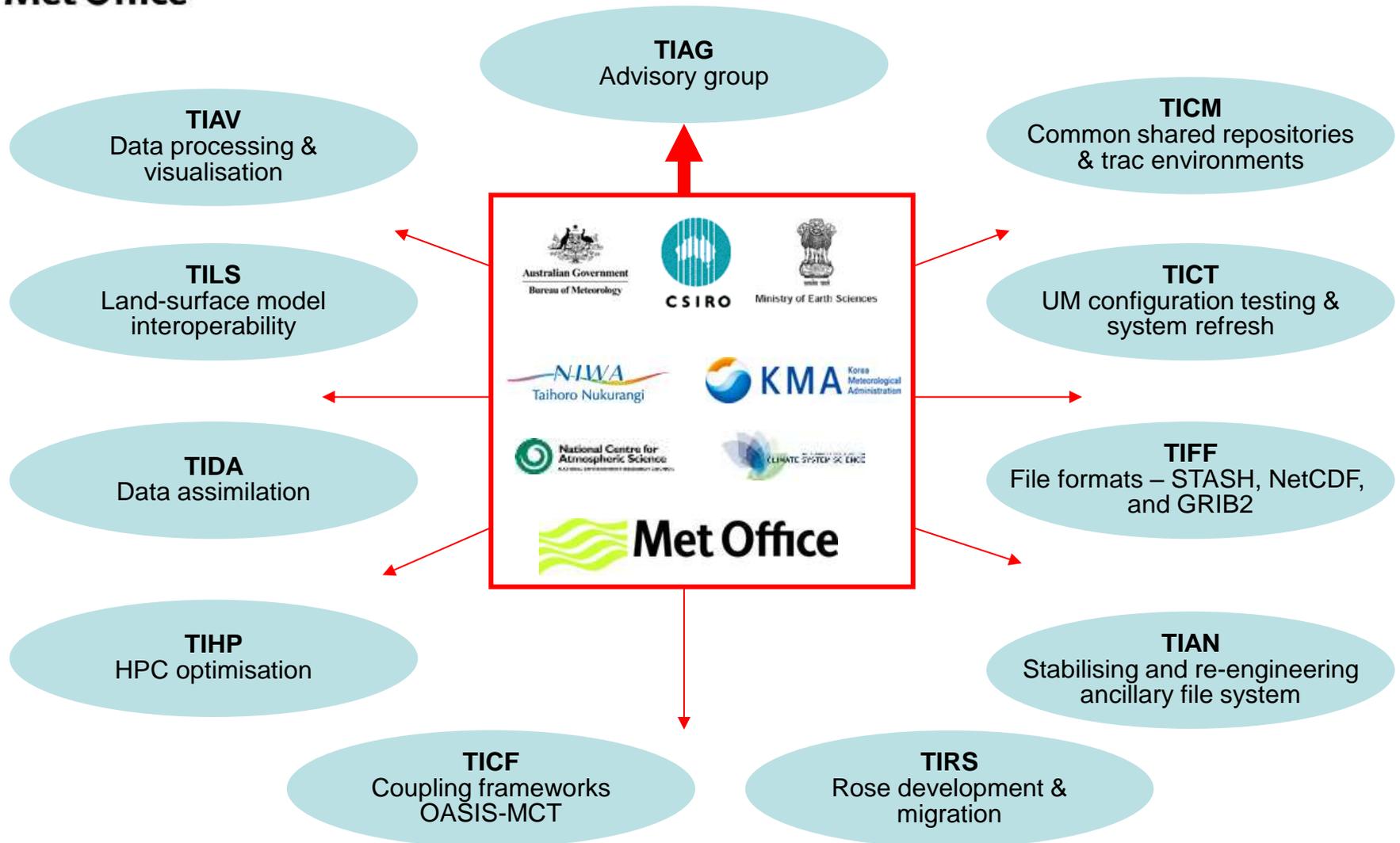




Collaborative technical development



Technical Infrastructure programme launched June 2013





Rose development and migration (TIRS)

Support uptake & migration to Rose/cylc across UM partners



Rose

A framework for managing and running meteorological suites.

Use

[New to Rose?](#) | [Rose New User Guide](#) | [Training info](#) | [Training Schedule](#) | [Trainees](#)

[⇒ Rose/Cylc/FCM Documentation](#) | [⇒ Rose Documentation @ Github](#) | [⇒ Tips for Met Office Users](#) | [⇒ Rose FAQ](#) | [⇒ Suite Design Best Practice](#)

[⇒ Rose Bush](#) | [⇒ Rose Bush \(Test\)](#) | [⇒ Rose Bush \(OS\)](#) | [⇒ Rosie Web](#) | [⇒ Rosie Repository for Normal Use](#) | [⇒ Rosie Repository for Testing](#) | [⇒ FCM](#)

Support

[⇒ Rose Team](#) <- **contact us directly to report problems and request features.**

[⇒ met-office.fcm.general](#) (⇒ archive) | [⇒ met-office.fcm.announce](#) (⇒ archive) | [⇒ met-office.rose.general](#) (⇒ archive) <- **please check at least daily.**

[⇒ Rose at Github](#) | [⇒ cylc-dev at Google Groups](#)

[⇒ Operational Suite Support Centre OS33](#)

Admin

[Procedures](#) | [Work Flow](#) | [Looking After Rose](#) | [Rosie Install](#)

[Ross Log](#) | [⇒ rose-install \(SVN\)](#) | [⇒ rose-meta-install](#) | [⇒ github-clones-update](#) | [⇒ github-issues-backup](#) | [⇒ git-archive-install](#)

[⇒ Rose @ www.metoffice.gov.uk](#)

CYLc
SUITE ENGINE

Cylc ("silk") is a **suite engine** and **meta-scheduler** that specializes in suites of cycling tasks for weather and climate forecasting and related processing (it can also be used for one-off workflows of non-cycling tasks, which is a simpler problem). Cylc was released by NIWA under the GNU General Public License v3 in 2011.

NIWA
Taihoro Nukurangi

Current Version: 5.3.0 (2013-06-14) changes

Cylc was selected as a finalist in two categories for the 2012 New Zealand Open Source Awards.

[Overview](#)

Common shared repositories and trac environments (TICM)



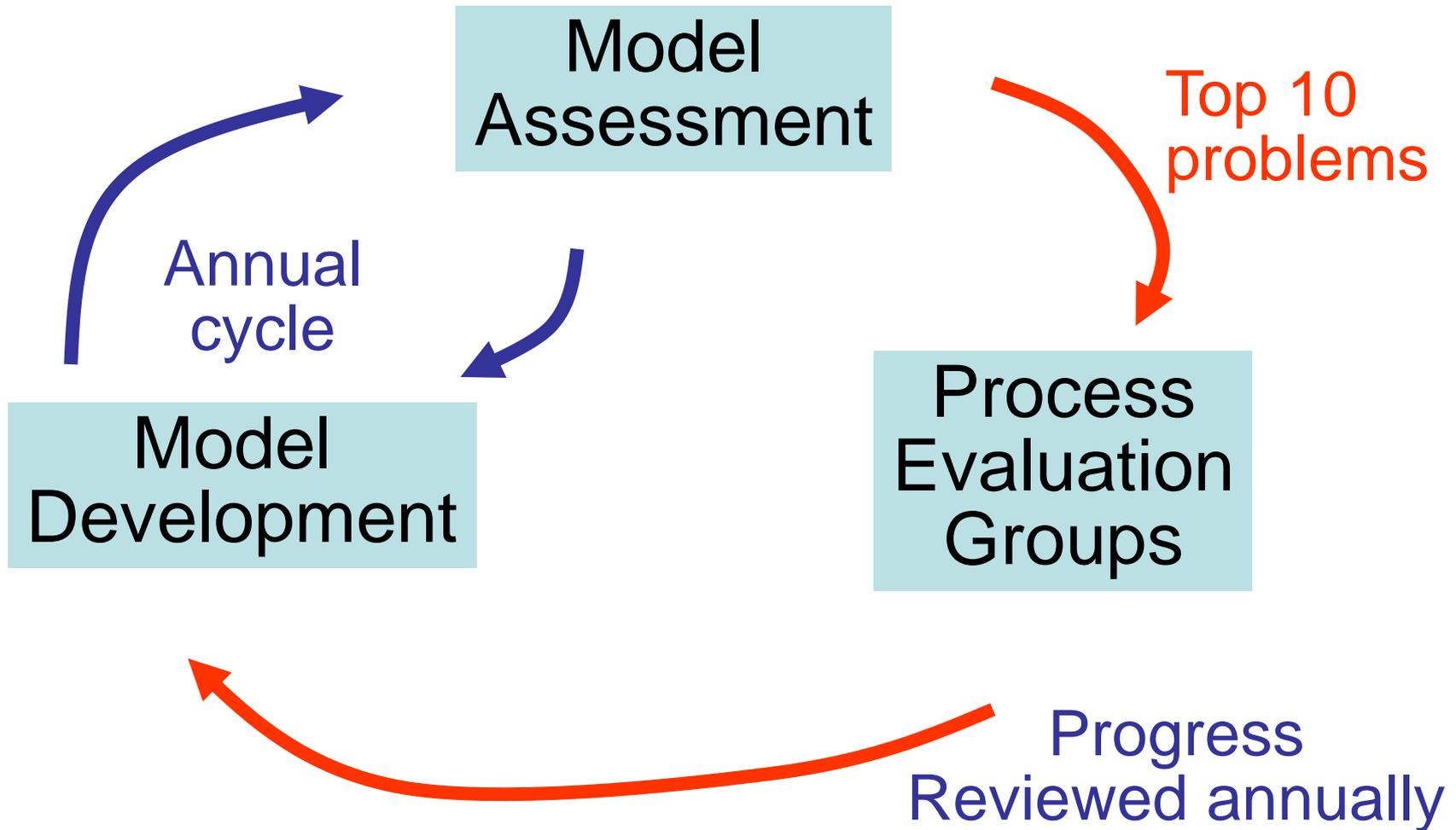
- Delivery of a shared repository capability delivered with production licence for use by September 2014
- Shared repository available for configuring subversion projects with necessary authentication
- Migration of UM9.3 to shared repository due in November 2014
- Migration of remaining key systems to shared repository aim to be completed by end of 2014



Collaborative scientific development



GA/GC development process





Key model errors 2013

Priority: Critical (4 matches)

Ticket	Summary	Priority ▲	Keywords
#3	Southern Ocean warm SST & sea ice bias	Critical	SOceanBiases
#7	Dry precipitation bias over India	Critical	Monsoon
#27	Energy conservation issues	Critical	Conservation
#33	Tropical tropopause warm bias	Critical	Stratosphere

Priority: High (10 matches)

Ticket	Summary	Priority ▲	Keywords
#1	Summertime warm bias over mid-latitude continents	High	ContinentalTbias
#6	Tropical rainfall: Active versus break periods	High	Africa
#8	Lack of propagating MJO	High	MJO
#15	MOC too low	High	NAtlanticBiases
#17	Precipitation - Evaporation imbalance	High	Conservation
#19	Blocking biases	High	StormsAndBlocking
#20	NWP evaluation of mid-latitude cloud biases	High	Clouds
#32	Biases over the maritime continent	High	Maritime
#34	Sahel dry bias / AEW rainfall coupling too weak	High	Africa
#38	Low rainfall over Indian mainland during the onset phase of monsoon in UM-NWP	High	Monsoon

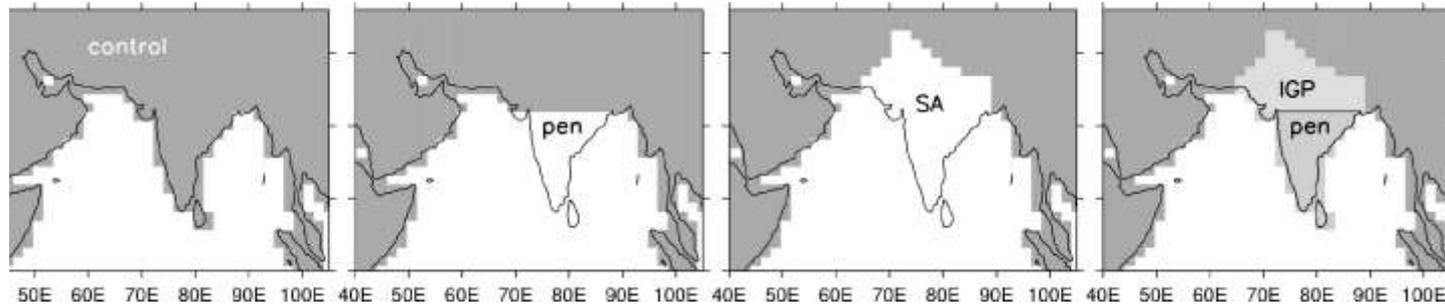


Current Process Evaluation Groups (PEGs)

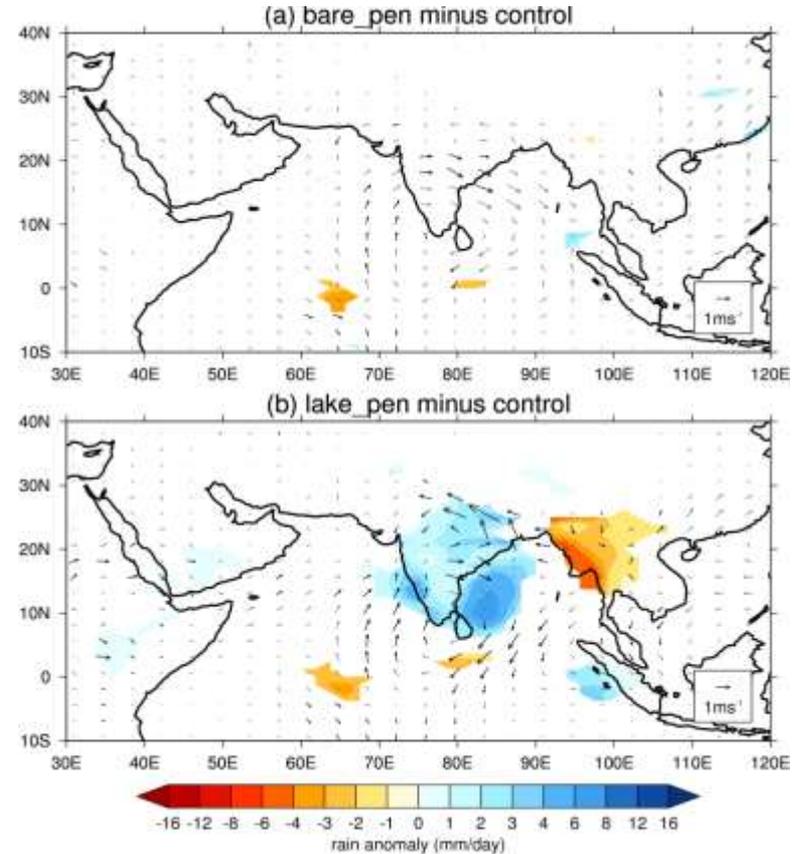
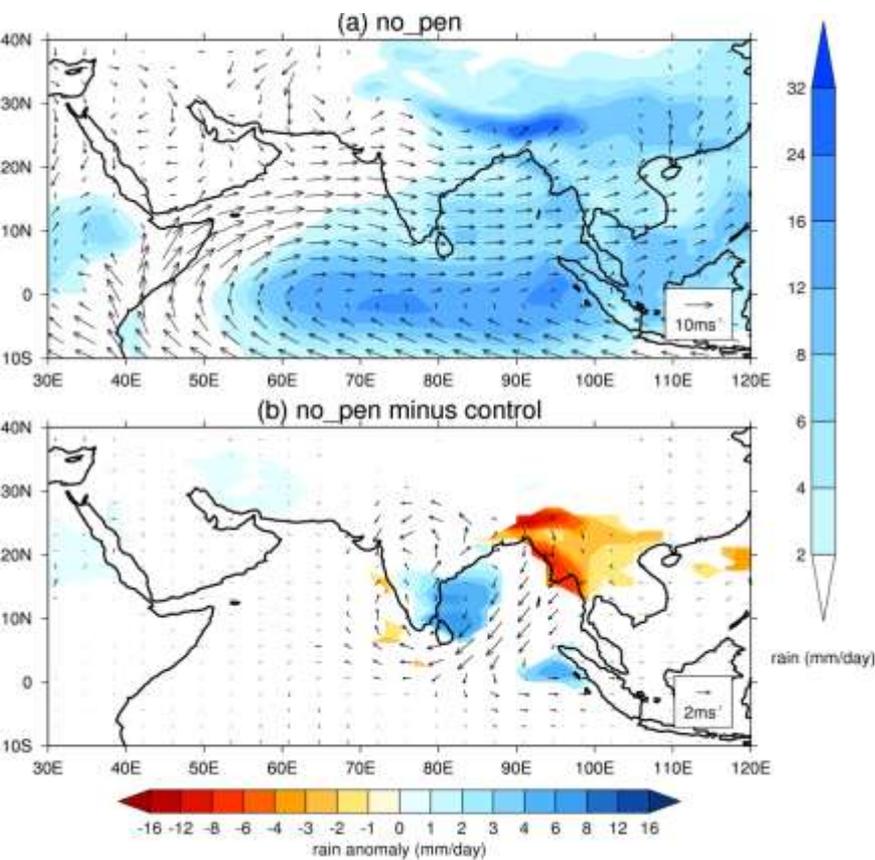
- S. Asian Monsoon (Richard Levine)
- Blocking and Storm Tracks (Tim Woollings)
- MJO and its teleconnections (Prince Xavier)
- North Atlantic Ocean Biases (Tim Graham)
- Southern Ocean Biases (Pat Hyder)
- Cloud Evaluation (Keith Williams)
- Africa (Caroline Bain/Cathryn Birch)
- Continental Surface Biases (Sean Milton)
- Conservation (Steve Derbyshire)
- Tropical Tropopause Temperature Bias (Steven Hardiman)
- Maritime Continent Biases (Jing-Jia Luo & Harun Rashid)

Monsoon land surface sensitivity: No-peninsula experiments: removal, bare/lake & orography

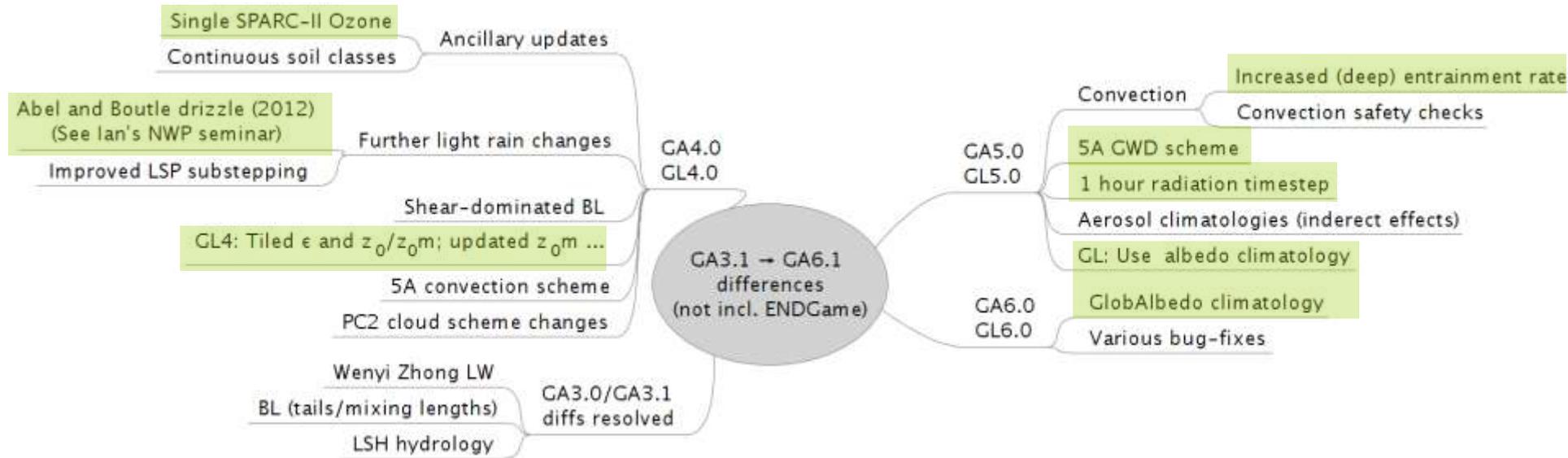
courtesy Andy Turner (NCAS / University of Reading)



Replacing Indian peninsula by sea and lake strengthens monsoon rainfall over "India"



Significant physics differences between GA3.1 and GA6.1:



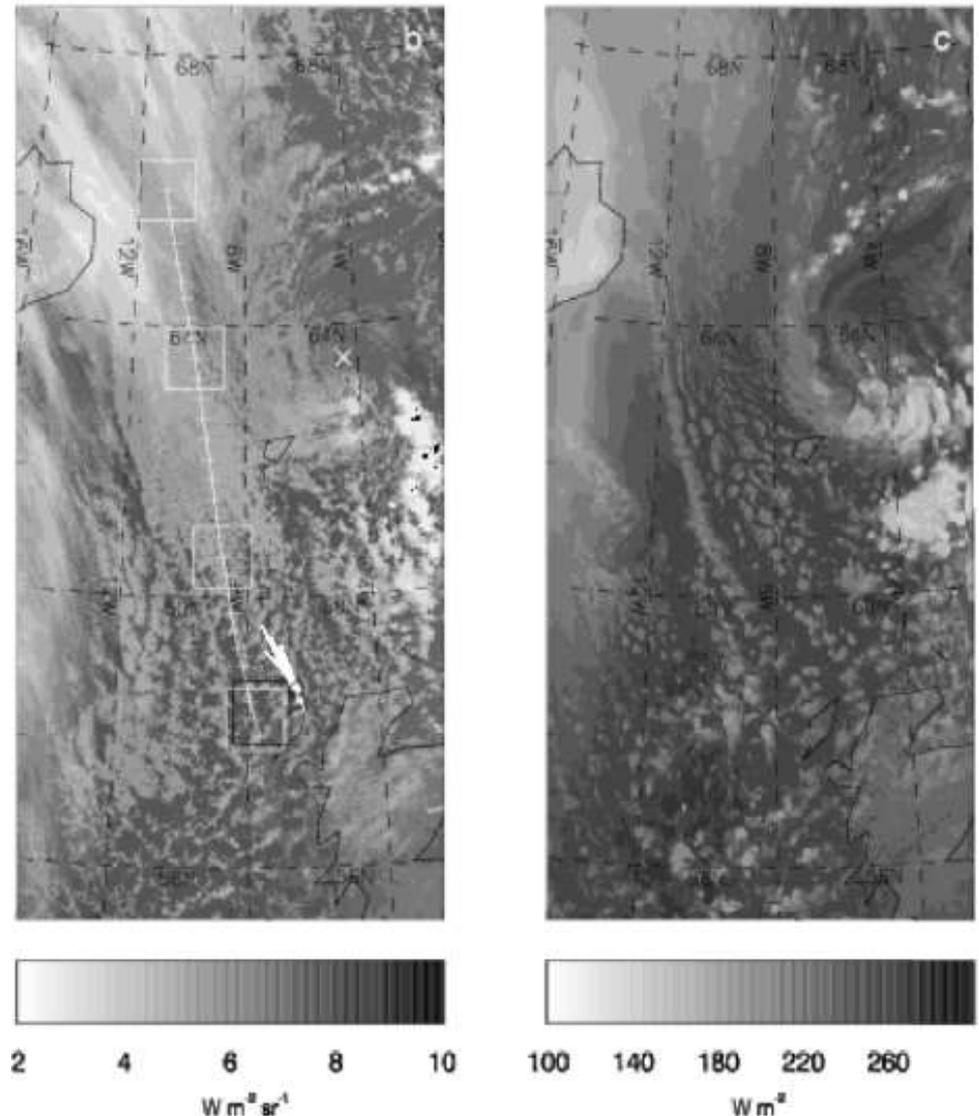
Total of 66 tickets (including ENDGame) in GA4, GA5 and GA6

High-resolution aerosol-cloud coupling in UM

Collaboration of Leeds and Met Office (Field/Shipway/Hill) to develop a **nested UKCA aerosol-cloud model** down to 100m resolution.

Nested UM-UKCA with new 4A cloud microphysics building & submitted to MONSOON. N216->12km->4km->1km

Model still in development but range of projects planned to investigate aerosol-cloud interactions

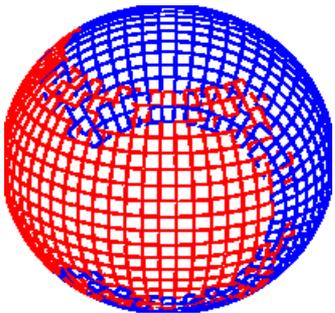
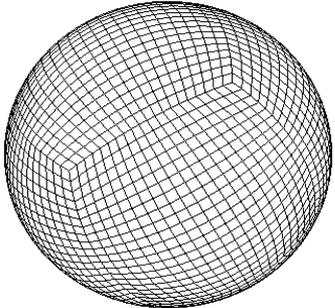
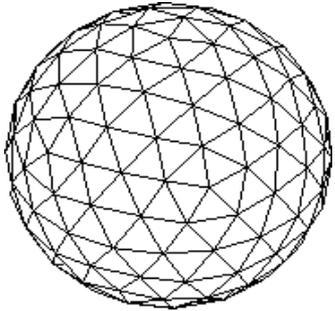




GungHo!

Globally **U**niform **N**ext **G**eneration **H**ighly **O**ptimized

- UM dynamical core being rewritten (Gung Ho)
 - improved scaling using quasi-uniform spherical grid
 - for future exascale architectures
 - collaborative effort
 - Met Office, NERC, STFC, Bath, Exeter, Imperial, Leeds, Manchester, Reading, Warwick
- UM replacement being developed (LFRic)
- Both use MONSoon as a development platform





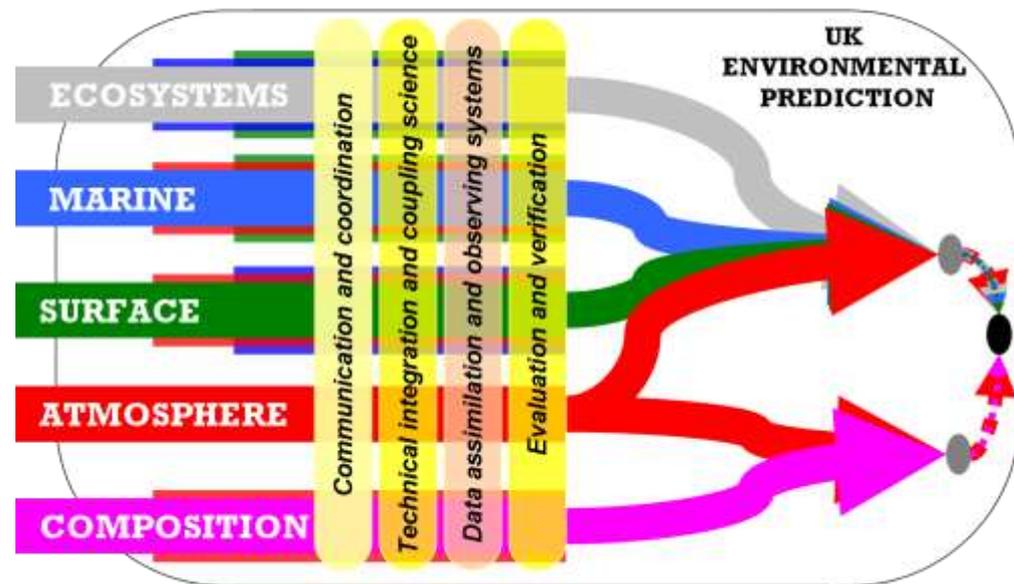
Toward UK Environmental Prediction

- Improving flood, storm surge, water quality, coastal weather, urban weather forecasts ...
- Includes development of prototype;
- Collaboration with CEH and NERC Centres
- Synergy with Climate Science (e.g. water cycle).

Hazard Impact Model with NHP

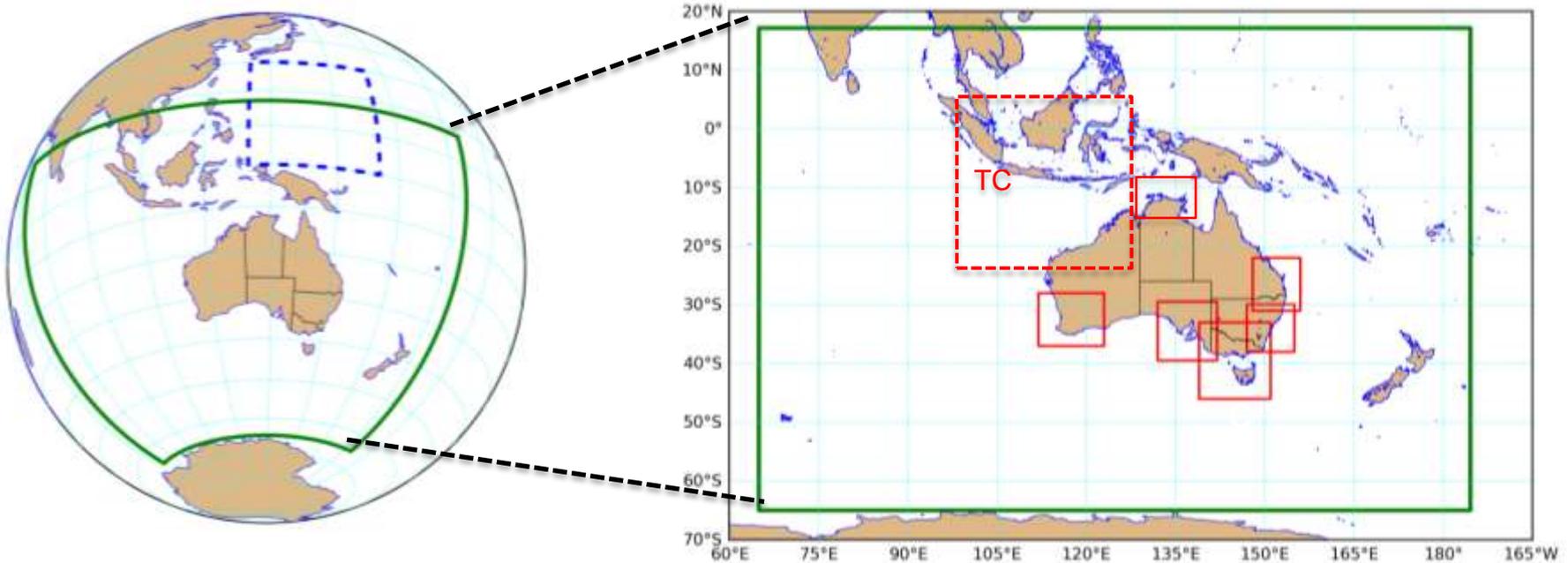


Putting the pieces together





ACCESS NWP Domains

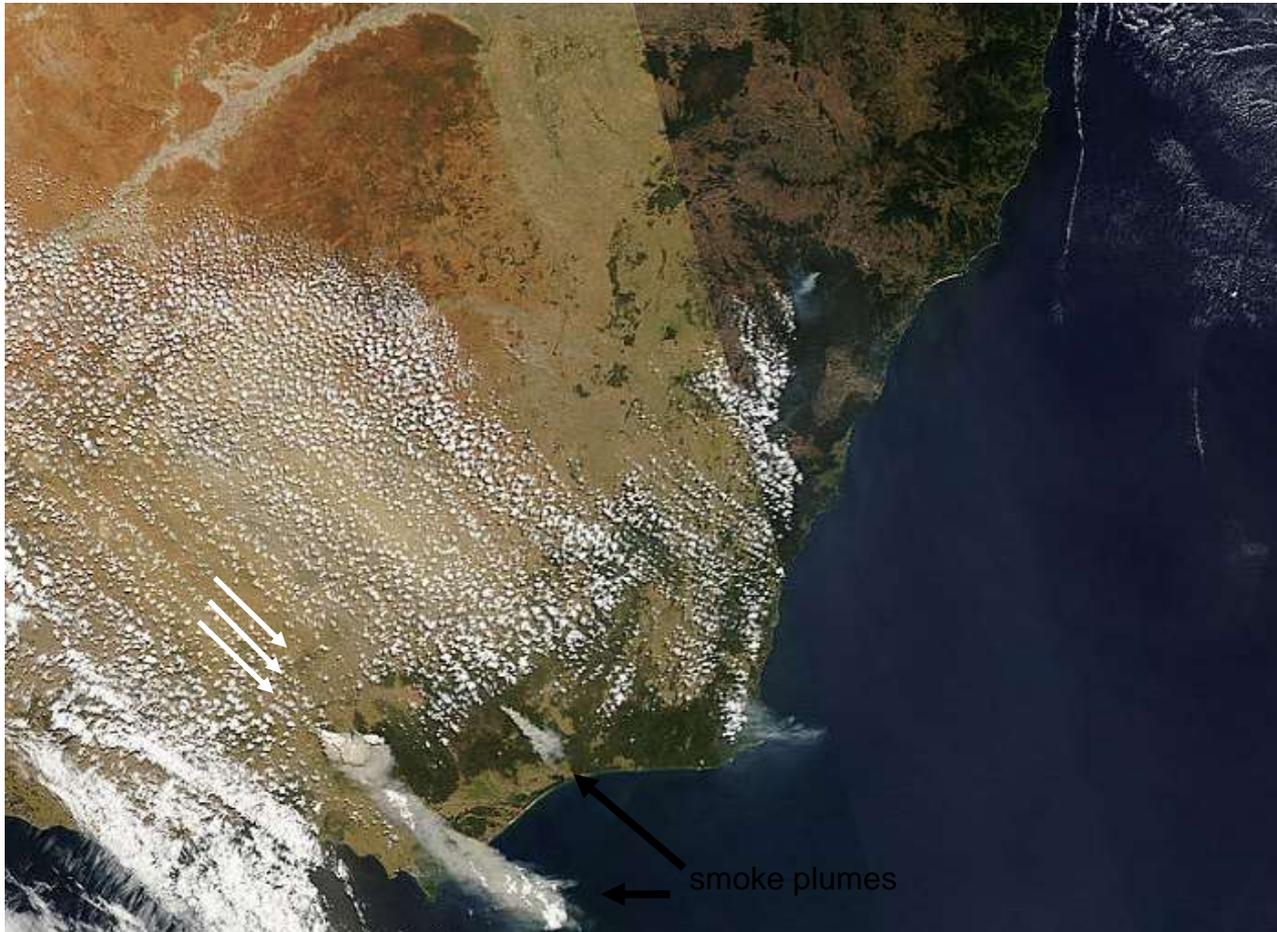


- “APS” = ACCESS Parallel Suite
 - Entire NWP collection

- APS1 ACCESS-G (40km)
- APS1 ACCESS-R (12km)
- APS1 ACCESS-TC (12km)
- APS1 ACCESS-C (4km)
- SREP / Expt / On-Dem (~1.5km)

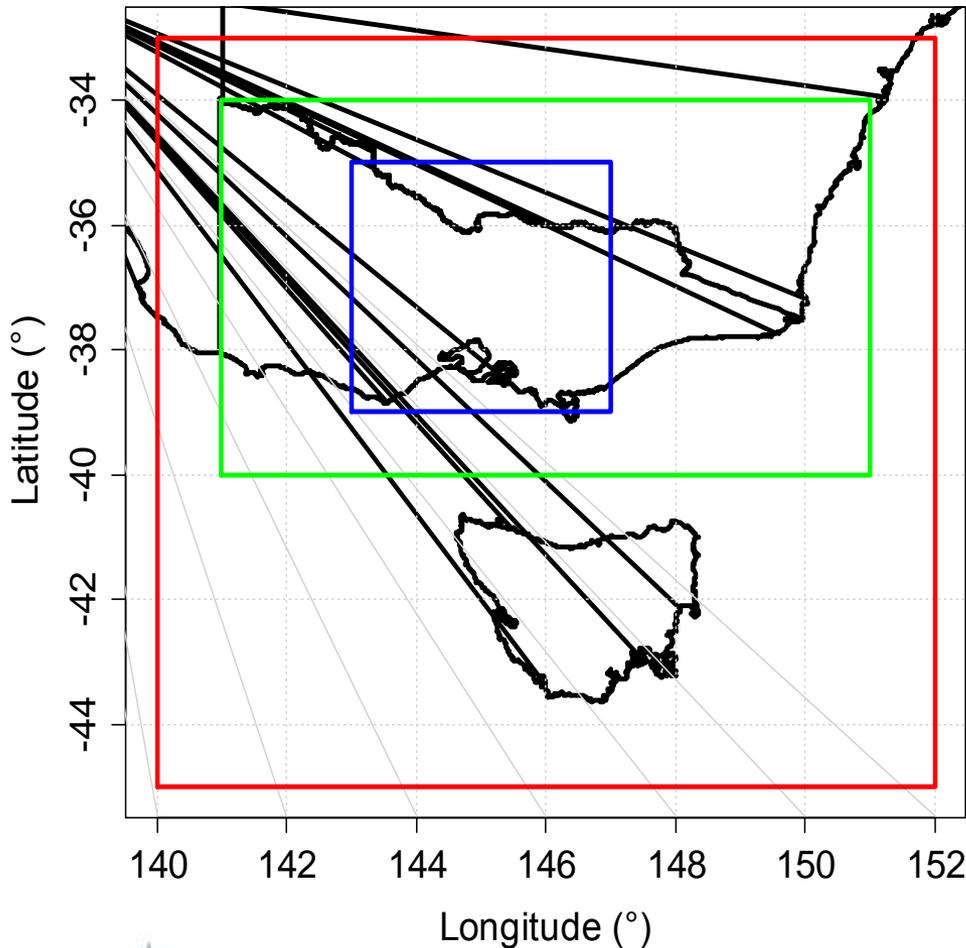
Black Saturday 7 Feb 2009 MODIS Aqua 04:50 UTC

15:50 EDT



- 170 lives lost
- 2000 houses destroyed
- Kinglake, Marysville towns devastated
- Royal Commission
- Record temperatures
- Wind change
- Ember transport as far as 34 km ahead of fire front

Nesting to higher resolution



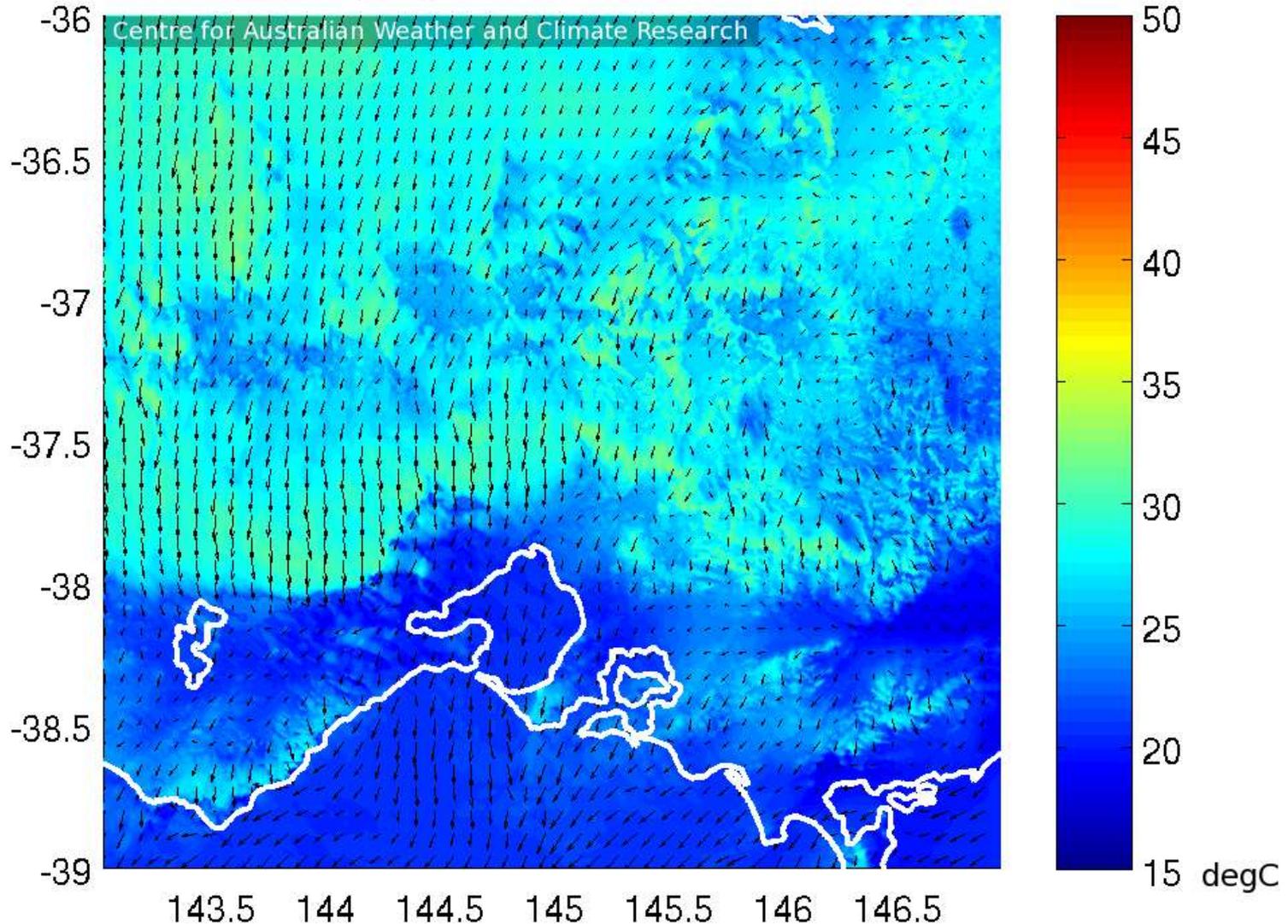
Nesting:

- Global at ~ 40 km
- Australian region at ~12 km
- 1000 km square at ~4 km
- 600 km square at ~1.2 km
- 400 km square at ~400 m



Northerly wind & extreme high temperature ahead of strong south-westerly wind change

temp_scrn_degC 07-Feb-2009 06:00:00 EDT





Met Office

Thank You
Questions?