



# Unified Model and Science Partnerships

George Pankiewicz, Science Partnerships, Met Office

HPC Wales / C3W: September 2014



# Outline of Presentation

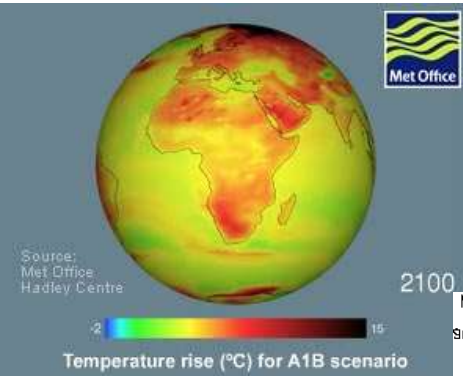
- UM system, suites & configurations
- UM access, JWCRP & MONSooN
- UM partnerships
- Collaborative technical development
- Collaborative scientific development

# UM system, suites & configurations

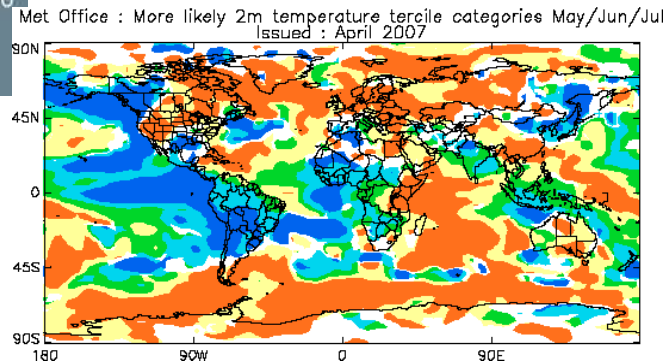


# The Unified Model

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



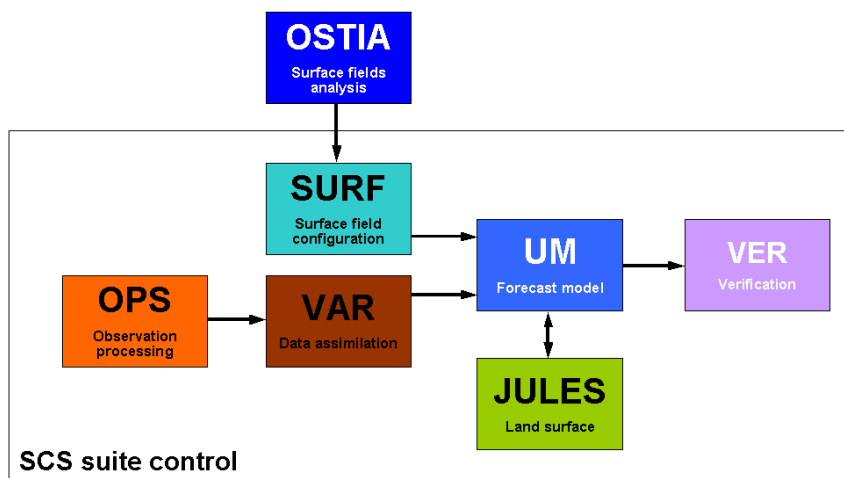
Seasonal forecasting:  
(Coupled Atmosphere-Ocean models)  
For commercial and  
business customers  
1 month -1 year low resolution

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



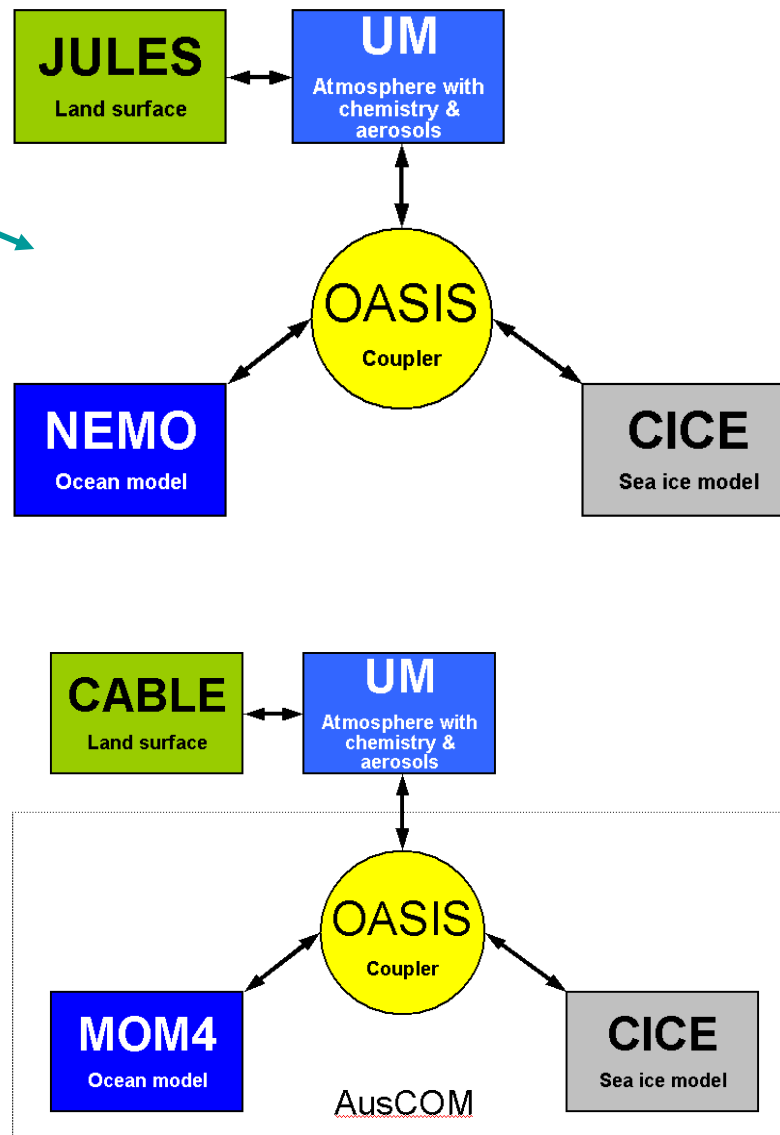
# Suites & components

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



# 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:

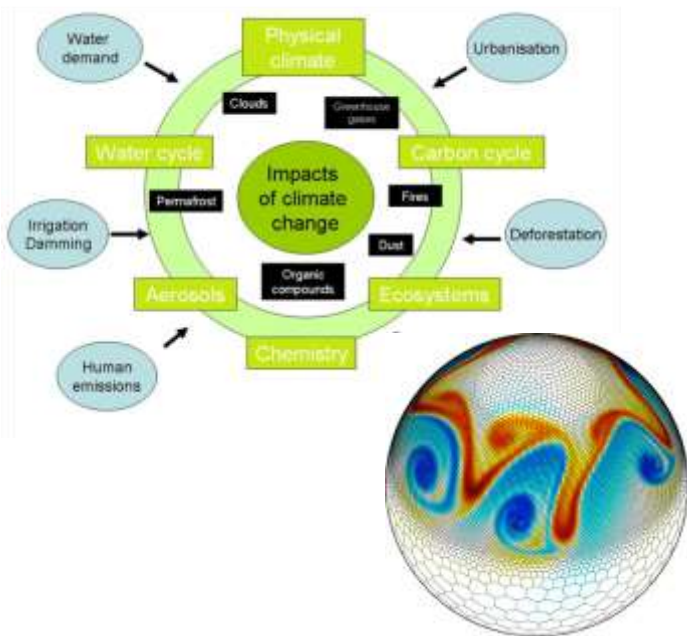
- Research licence / abstract
- Installation / maintenance / local upgrades
- Research licence at Swansea

Shared repository:

- New - technical infrastructure programme



# Joint Weather and Climate Research Programme



## Shared science

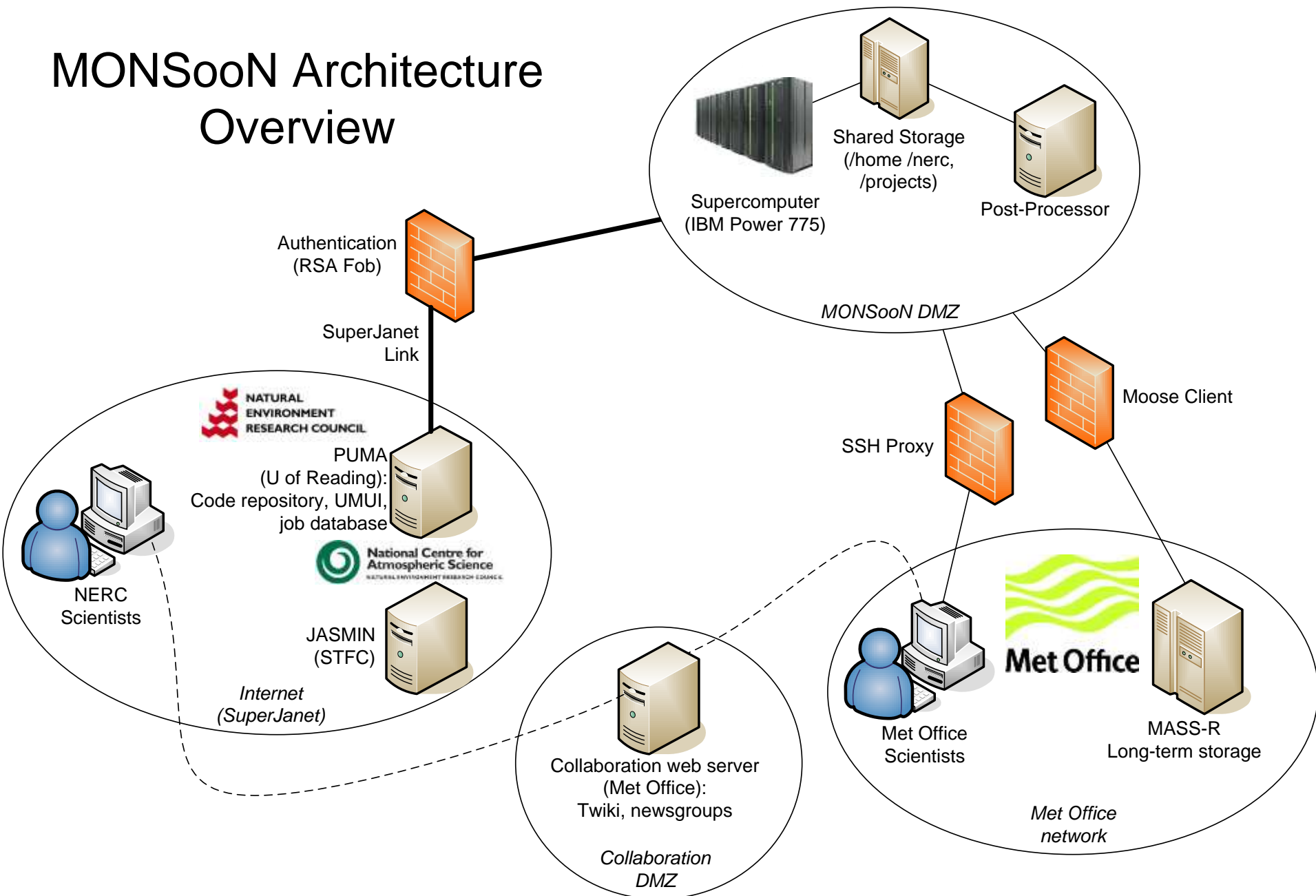
- UK Earth System Modelling Strategy
- Next-generation dynamical cores

## 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](mailto: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



# UM partnerships



# International UM partnerships

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

Shared science, model evaluation and technical development:

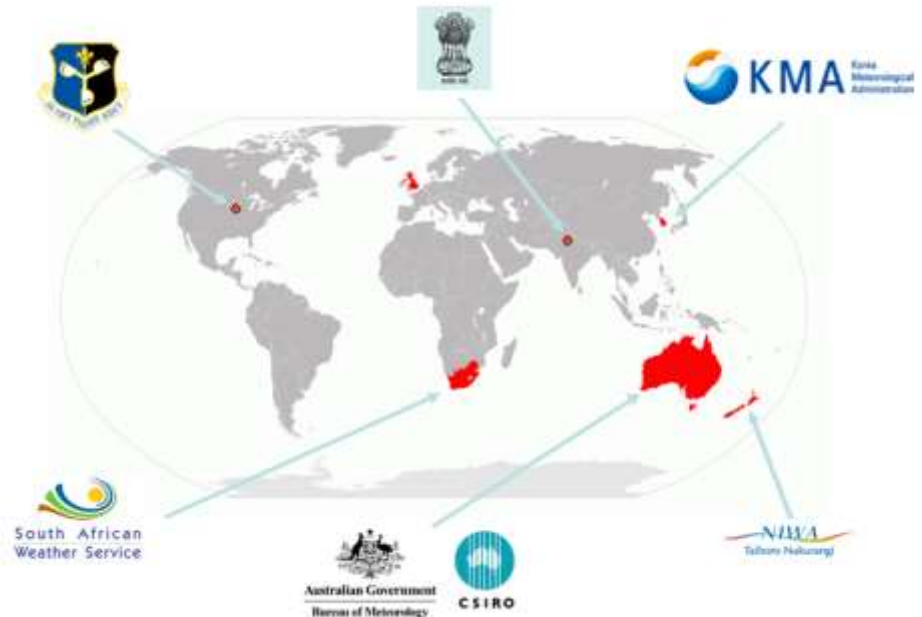
- Joint process evaluation groups
- Technical infrastructure teams
- User workshops & tutorials

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

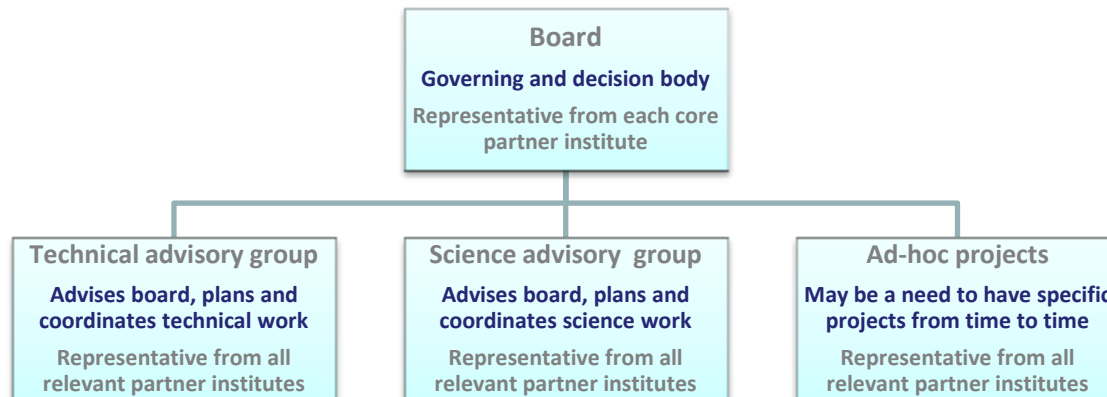
The more a UM partner can invest and support itself, the more a partner can influence strategic direction of model development and own the UM

## 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:

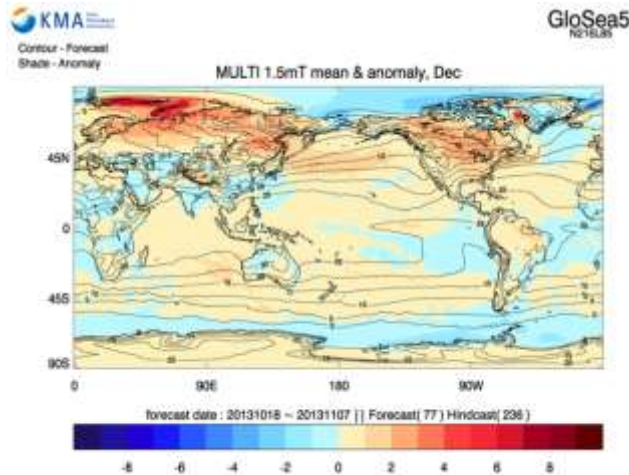
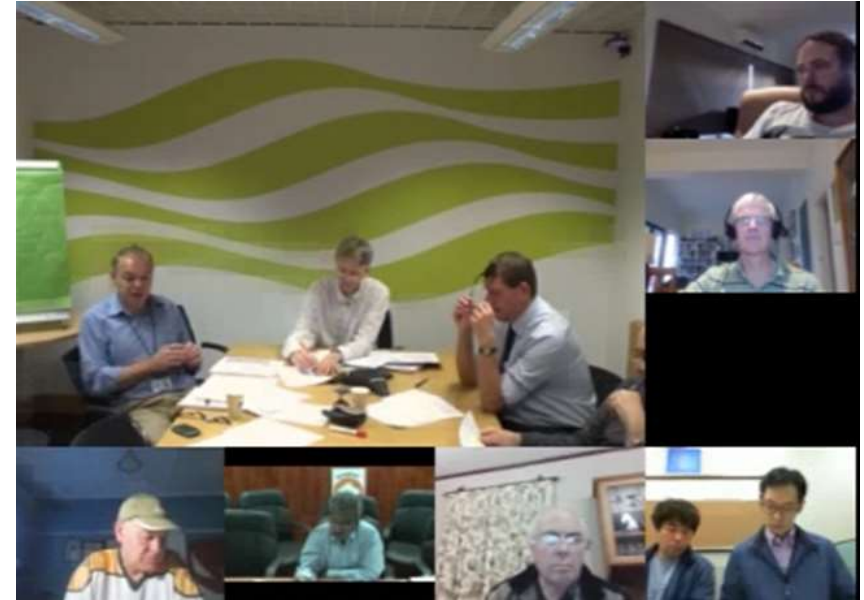
- Non operational users able to commit to joint development
- May fund central support if needed



# 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



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

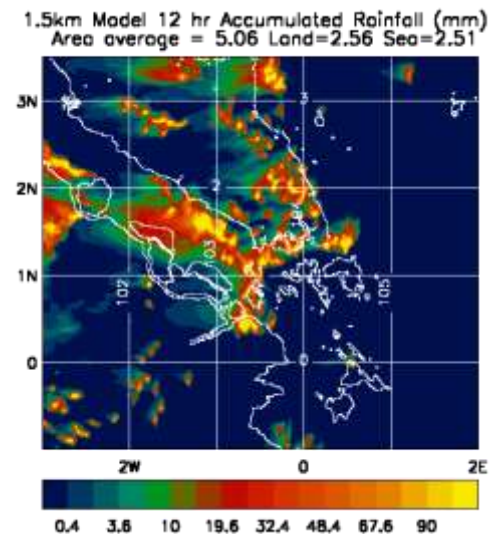
# UM partnerships news 2014

cylc suite management software implemented:

- NIWA, Dec 2013
- Met Office, Jan 2014



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

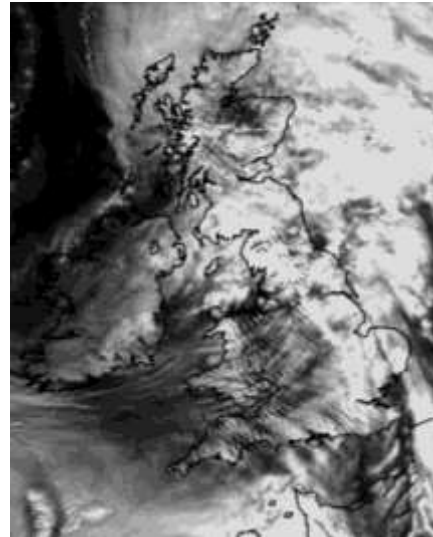
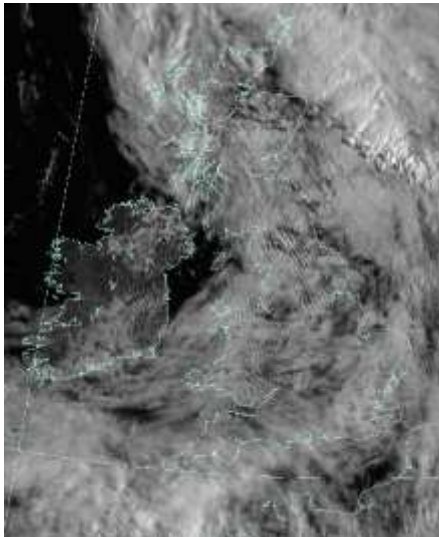




# UM partnerships news 2014

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!)

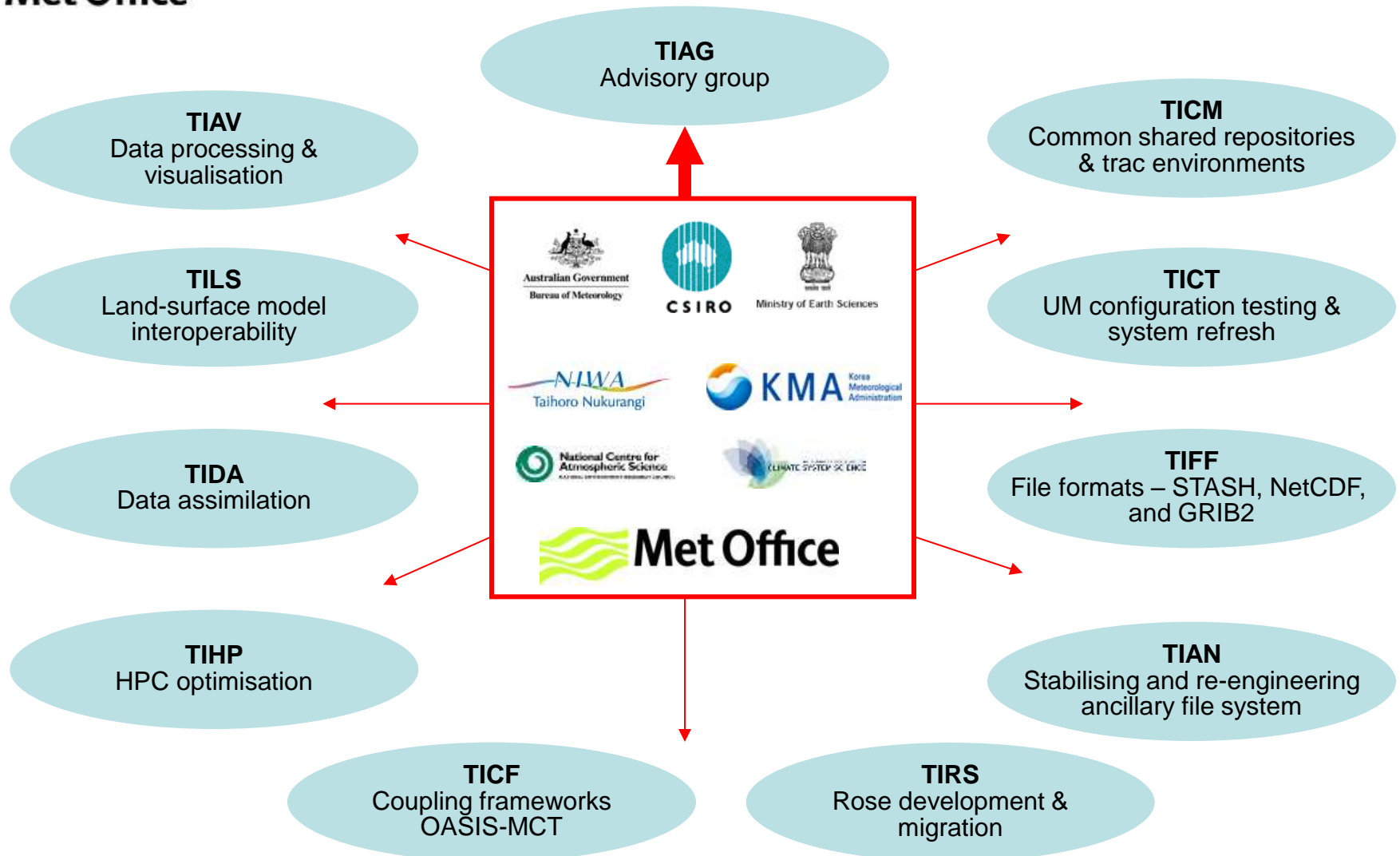




# Collaborative technical development



# 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 ("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)



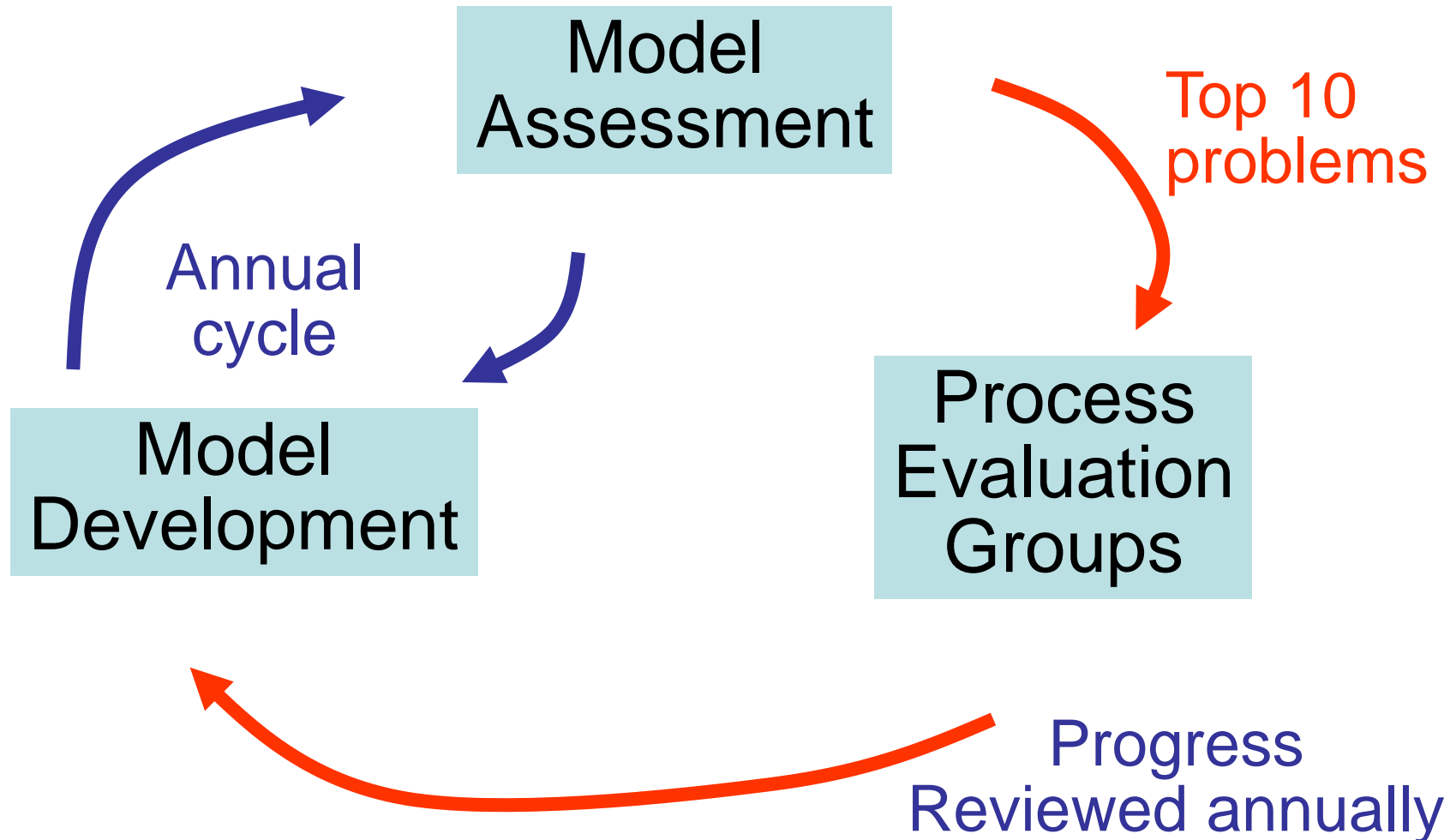
- Delivery of a shared repository capability delivered with production licence for use by September 2014
- Shared repository available for configuring subversion projects with necessary authentication
- Migration of UM9.3 to shared repository due in November 2014
- Migration of remaining key systems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



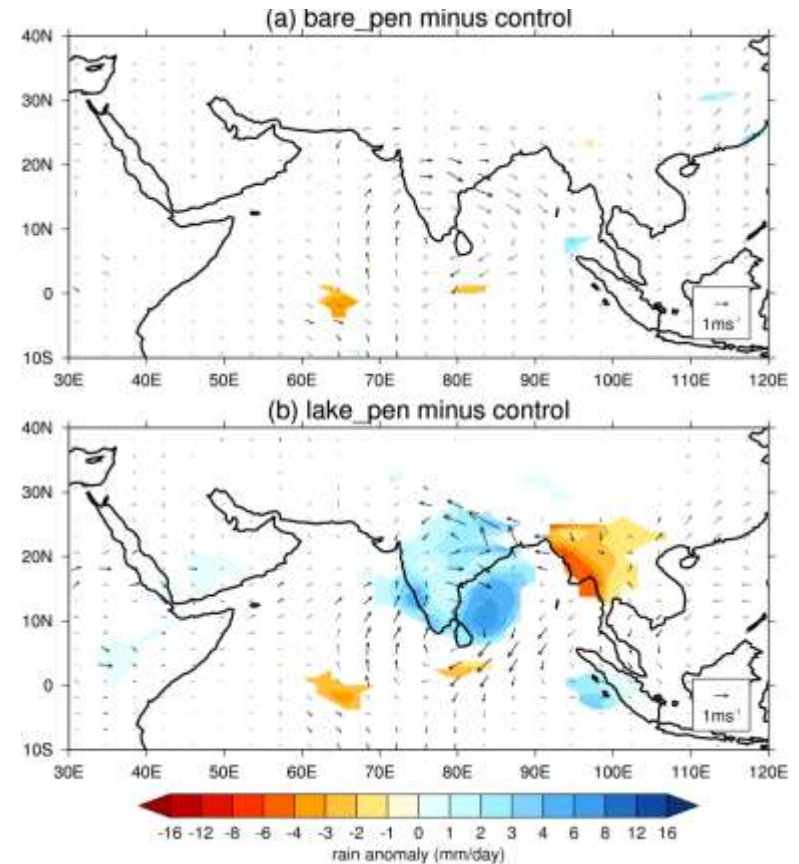
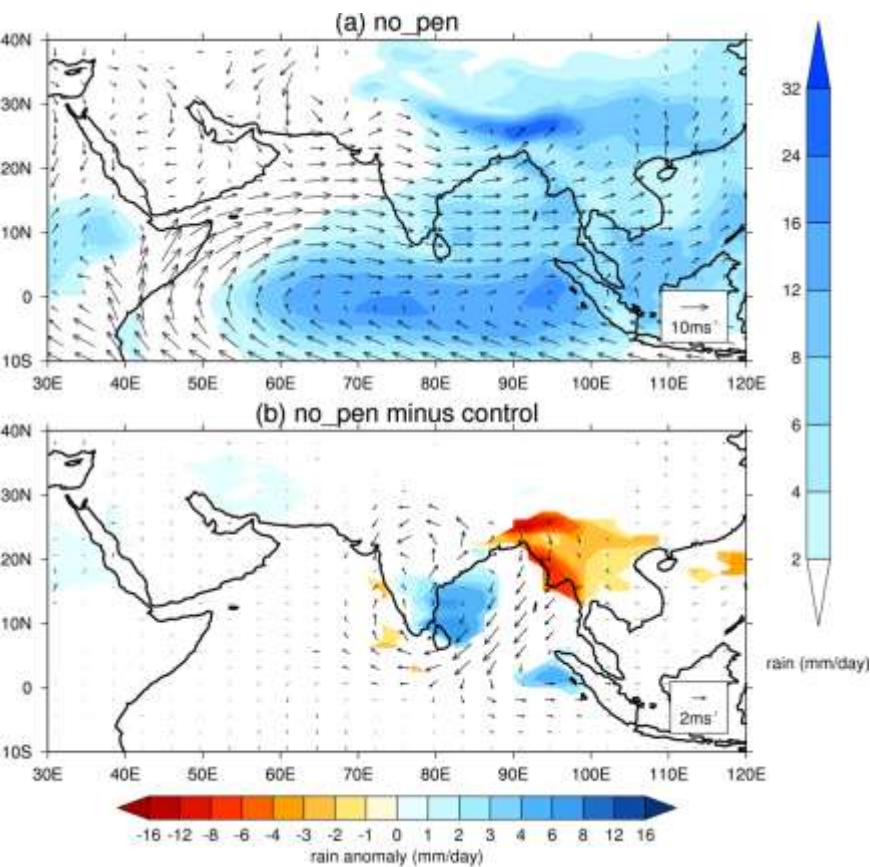
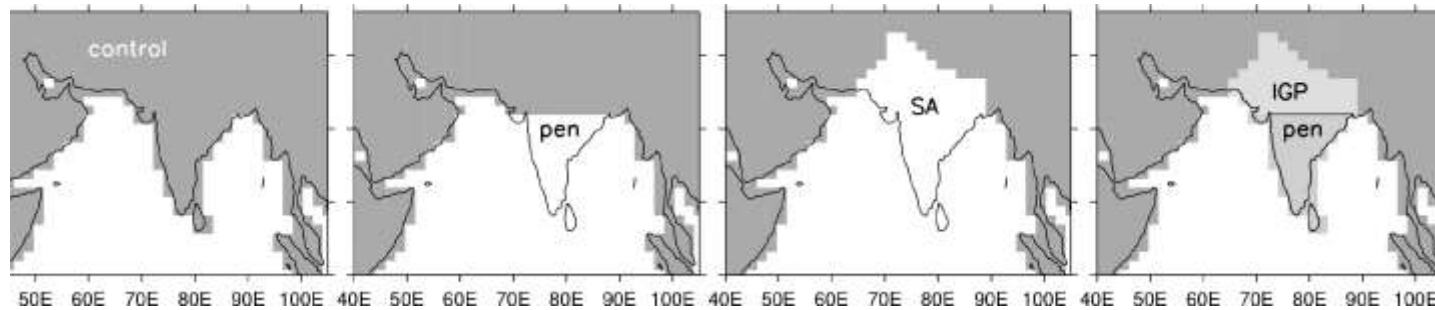
# Current Process Evaluation Groups (PEGs)

- 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)

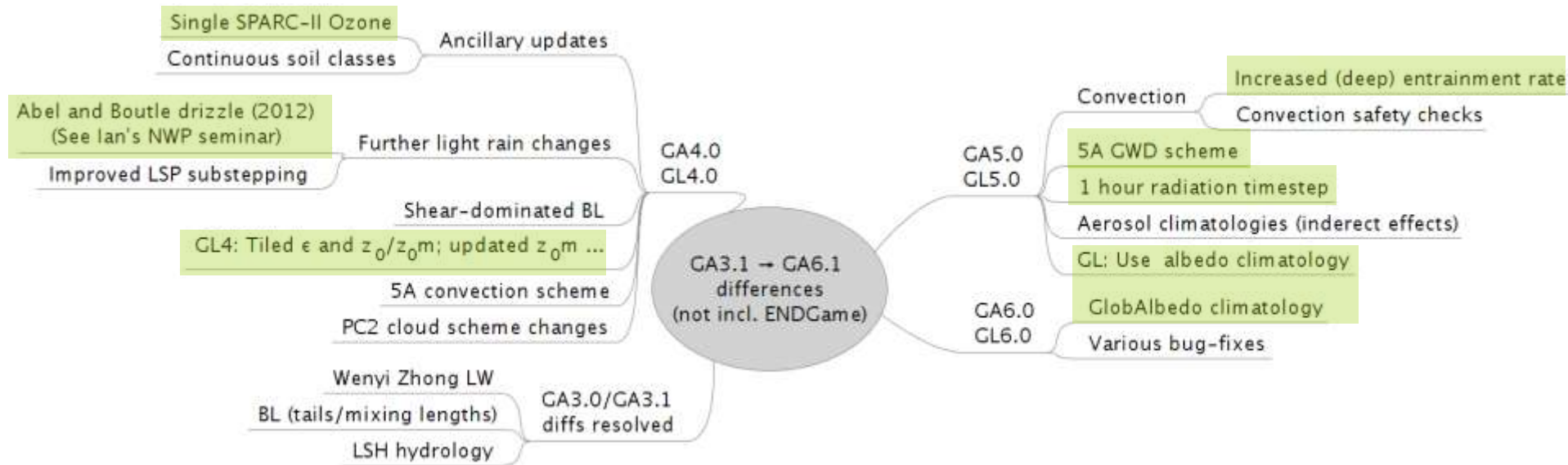
# Monsoon land surface sensitivity: No-peninsula experiments: removal, bare/lake & orography

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

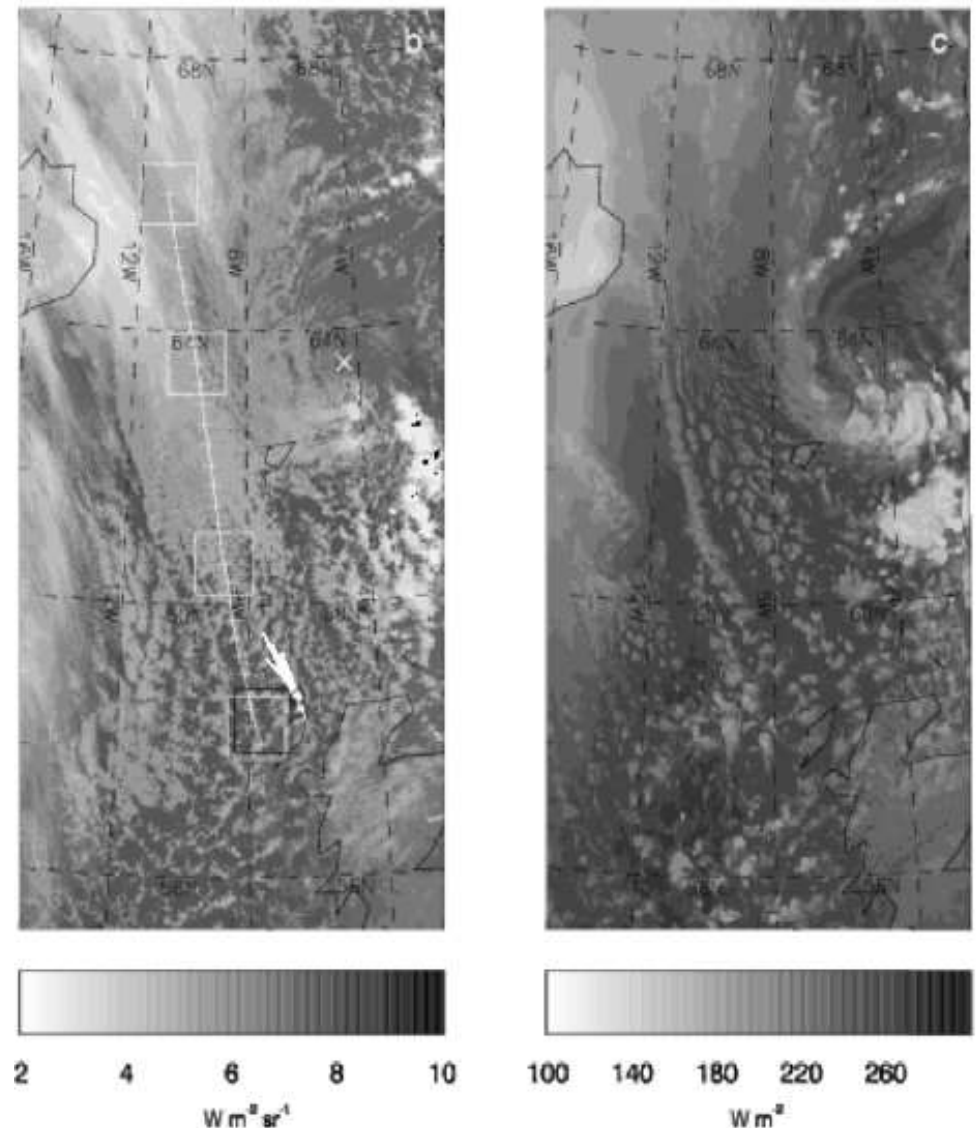


# High-resolution aerosol-cloud coupling in UM

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

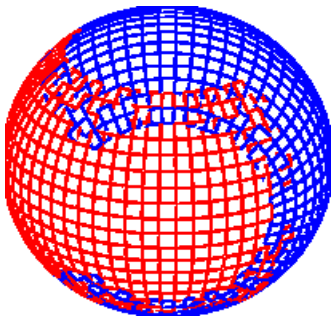
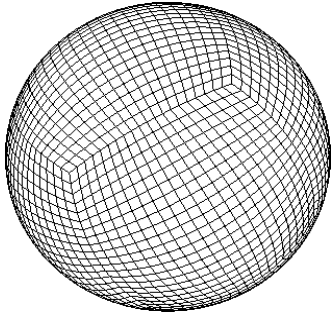
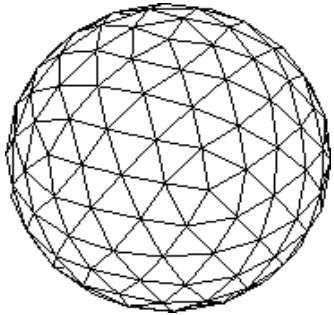




# GungHo!

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



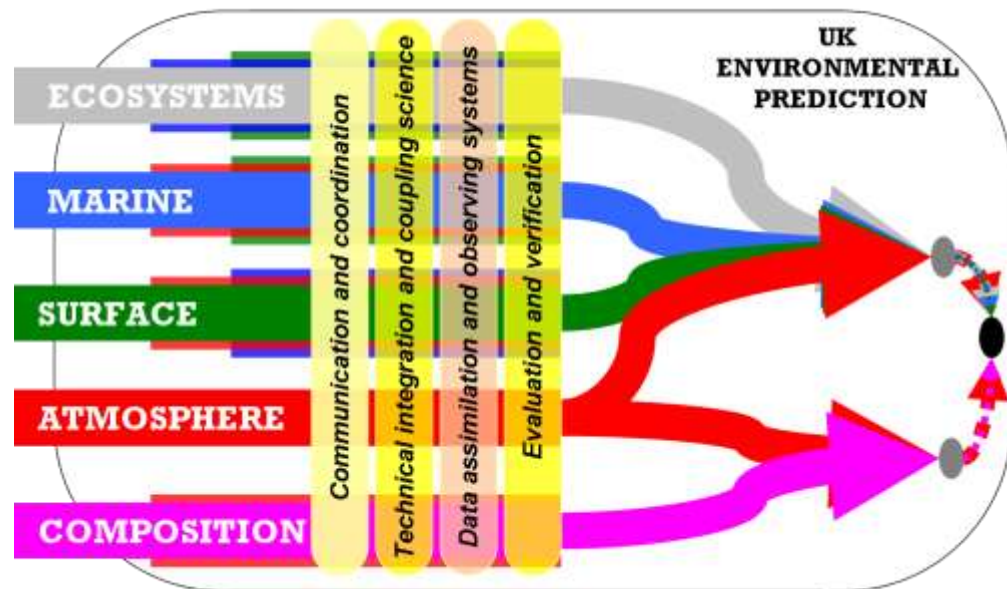
# Toward UK Environmental Prediction

- 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



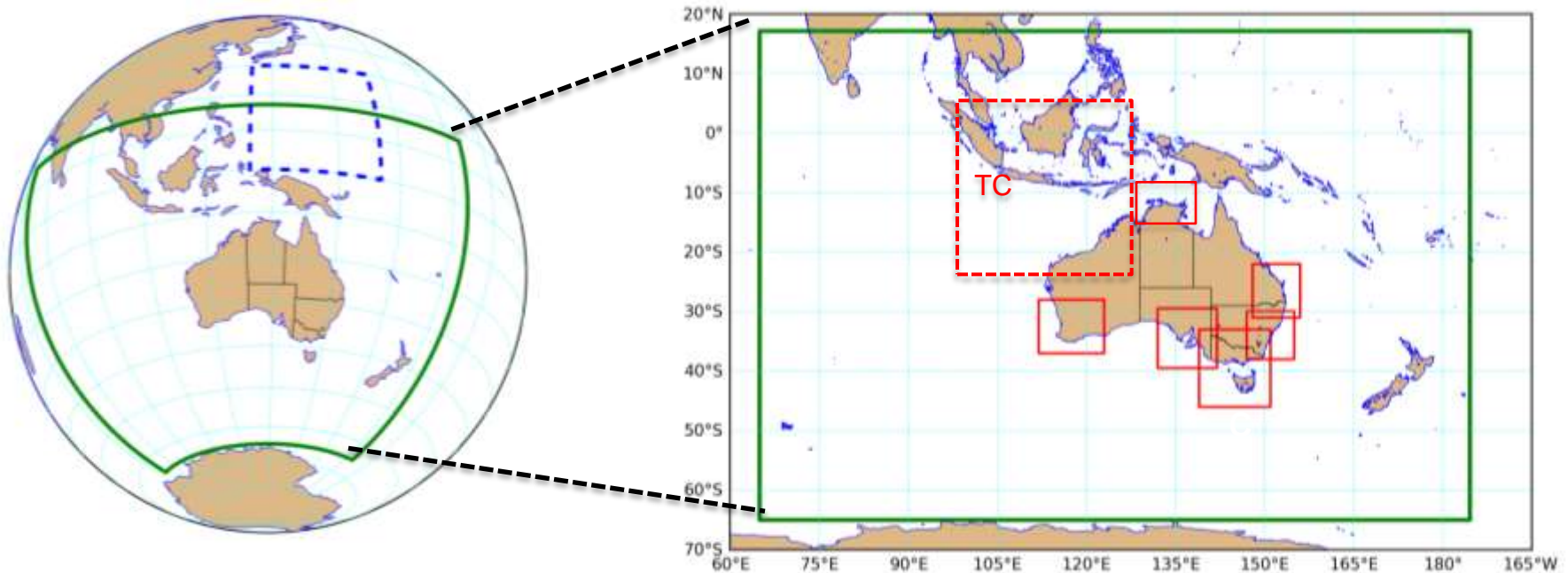
*Putting the pieces together*







# ACCESS NWP Domains



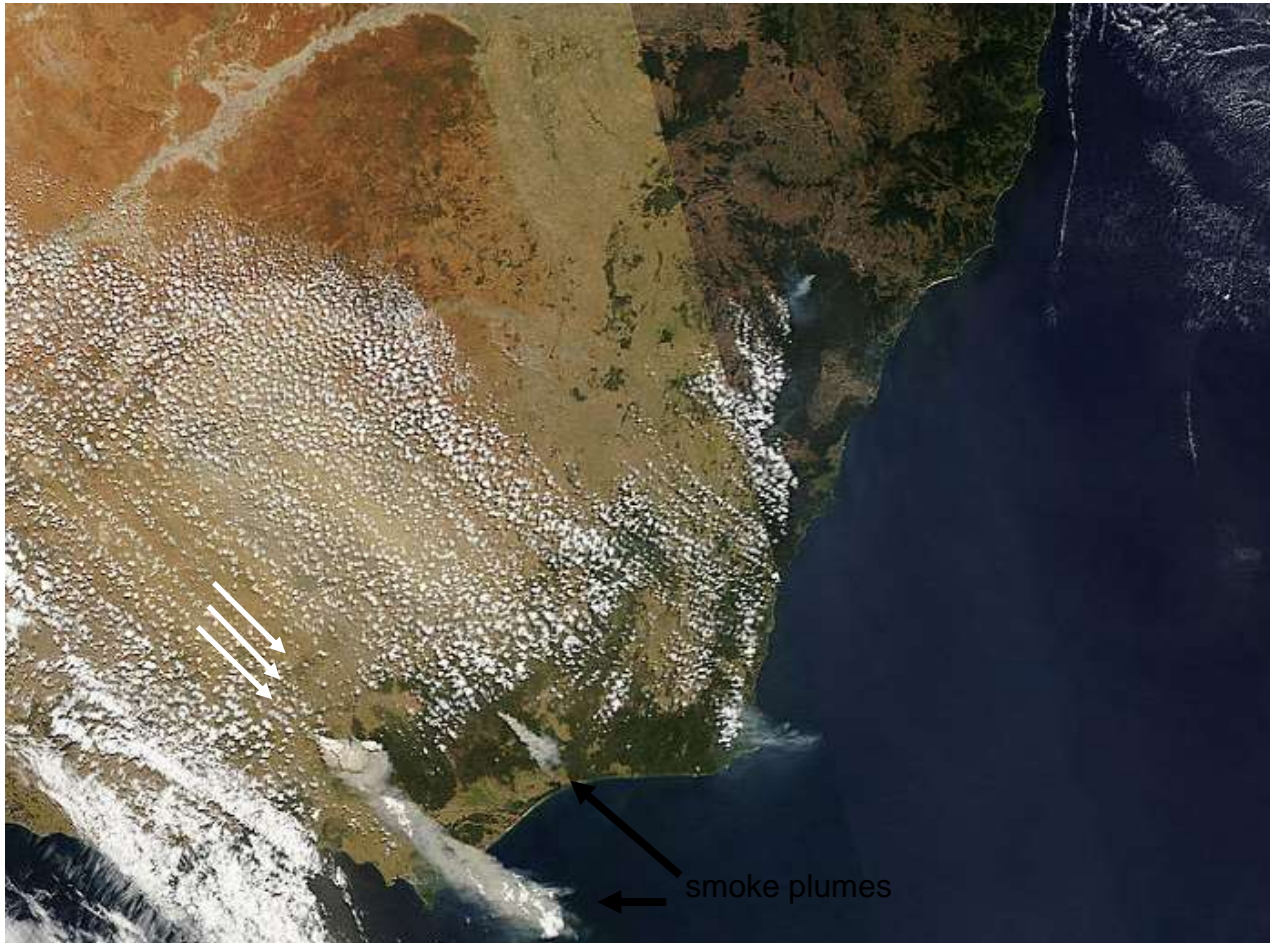
- “APS” = ACCESS Parallel Suite
  - Entire NWP collection

- 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

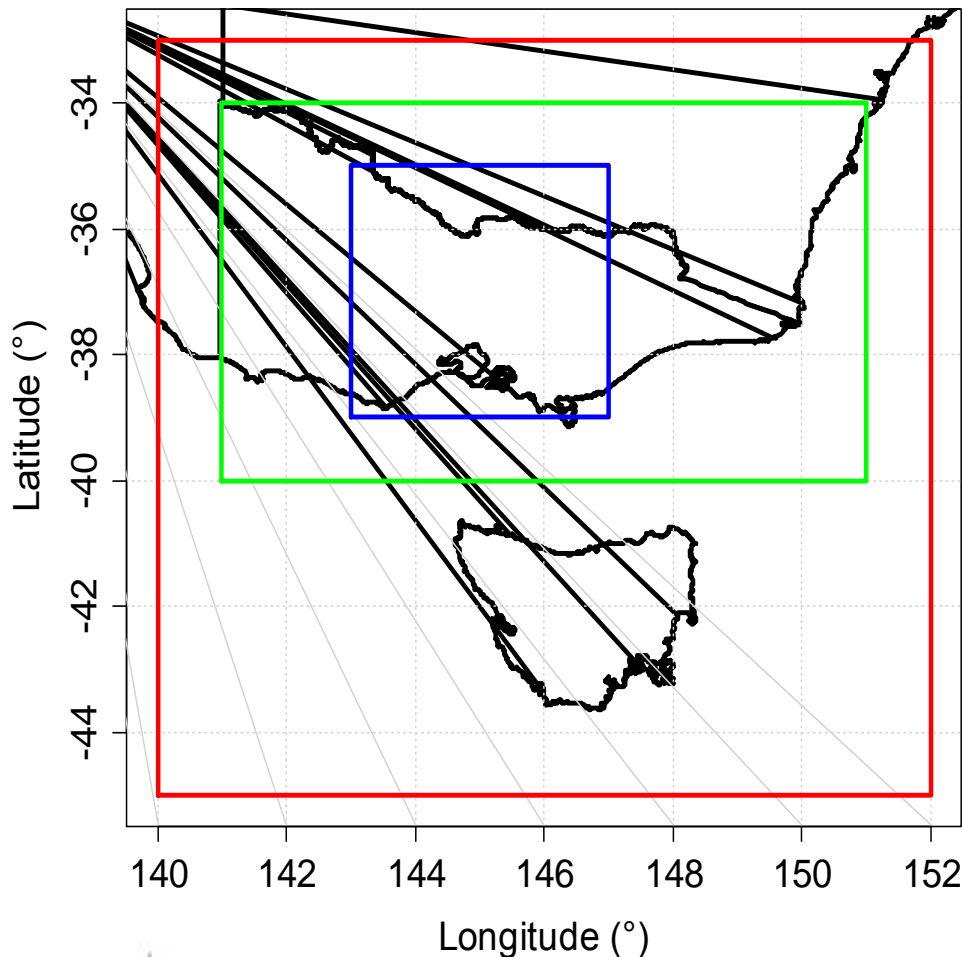
15:50 EDT

*Jeff Kepert  
Robert Fawcett  
Will Thurston*



- 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:

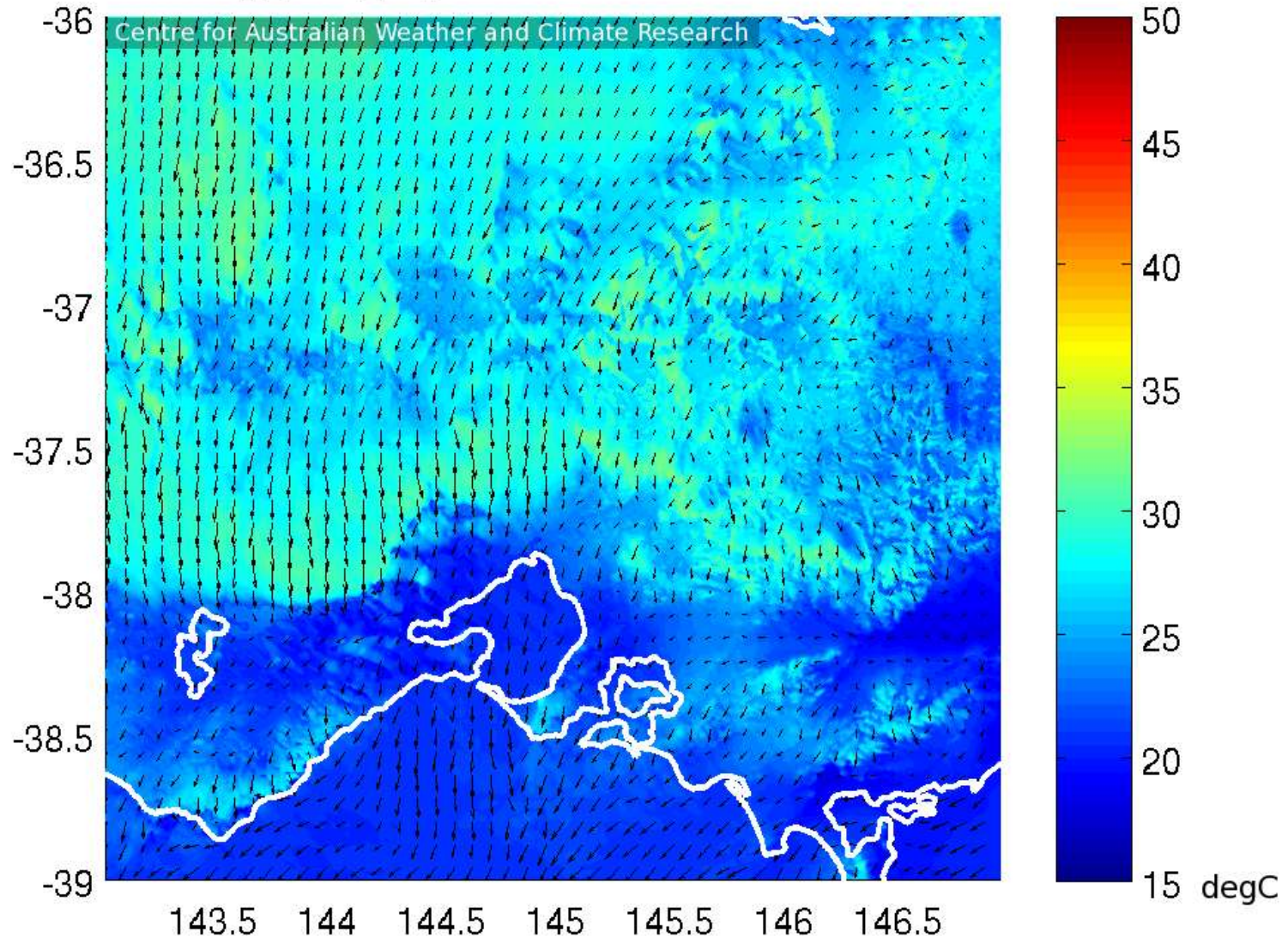
- Global at ~ 40 km
- Australian region at ~12 km
- 1000 km square at ~4 km
- 600 km square at ~1.2 km
- 400 km square at ~400 m






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

temp\_scrn\_degC 07-Feb-2009 06:00:00 EDT





Thank You  
Questions?