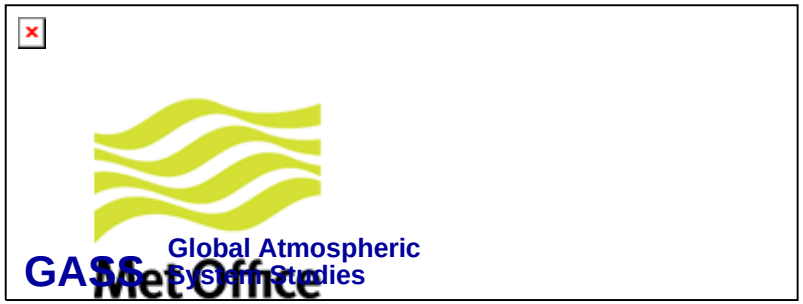
GCSS overview

CFMIP/GCSS/EUCLIPSE Meeting on Cloud Processes and Climate Feedbacks

June 2011

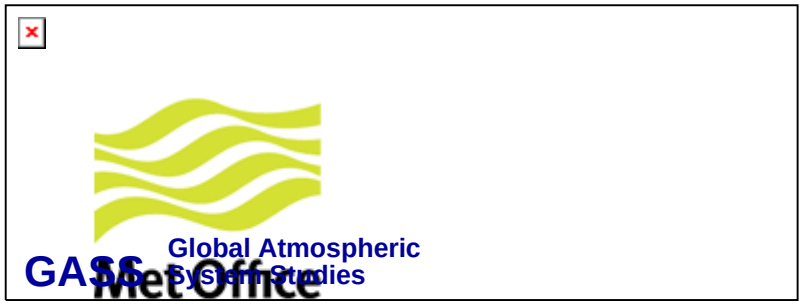
Jon Petch (thanks to Pier Siebesma et al.)



On behalf of GCSS

Thanks to all the organisers of what looks set to be an excellent meeting.

In particular Mark Webb and Adrian Lock.

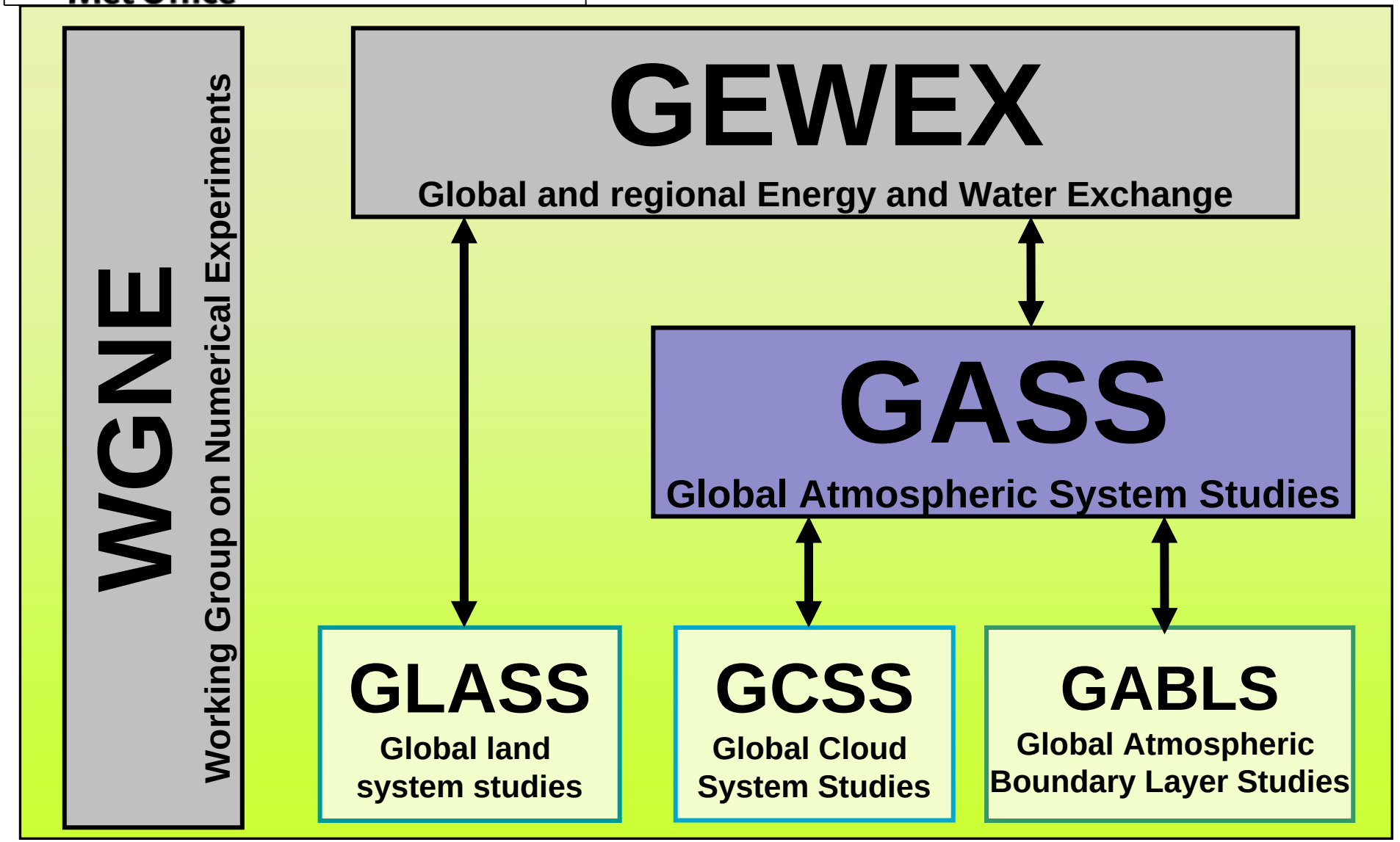


Some changes - GASS?

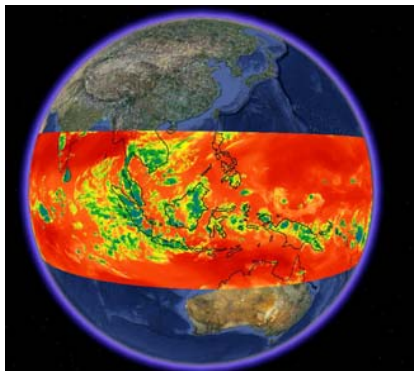
- GCSS and GABLS will work more closely as part of one group – GASS: Global Atmospheric System Studies
- Keep GCSS and GABLS “names” for now as they are well recognised in the community

A community who carry out and use observations, process studies and model experiments with a **focused goal of developing and improving the representation of the atmosphere** in weather and climate models.

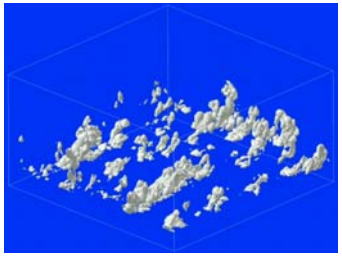
The world of acronyms



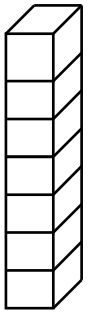
Brining things together – GASS working methods



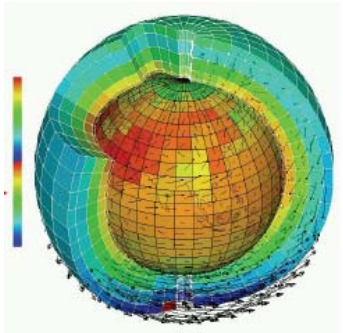
LAMs



LES/CRMs

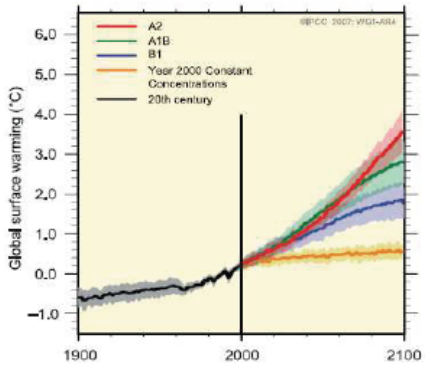


Single Column Models

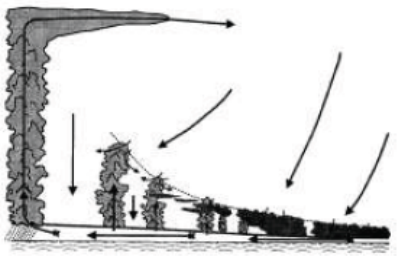


Climate Models NWP Models

WGCM (CFMIP1)



Model Projections



Analysis & Understanding cloud feedbacks

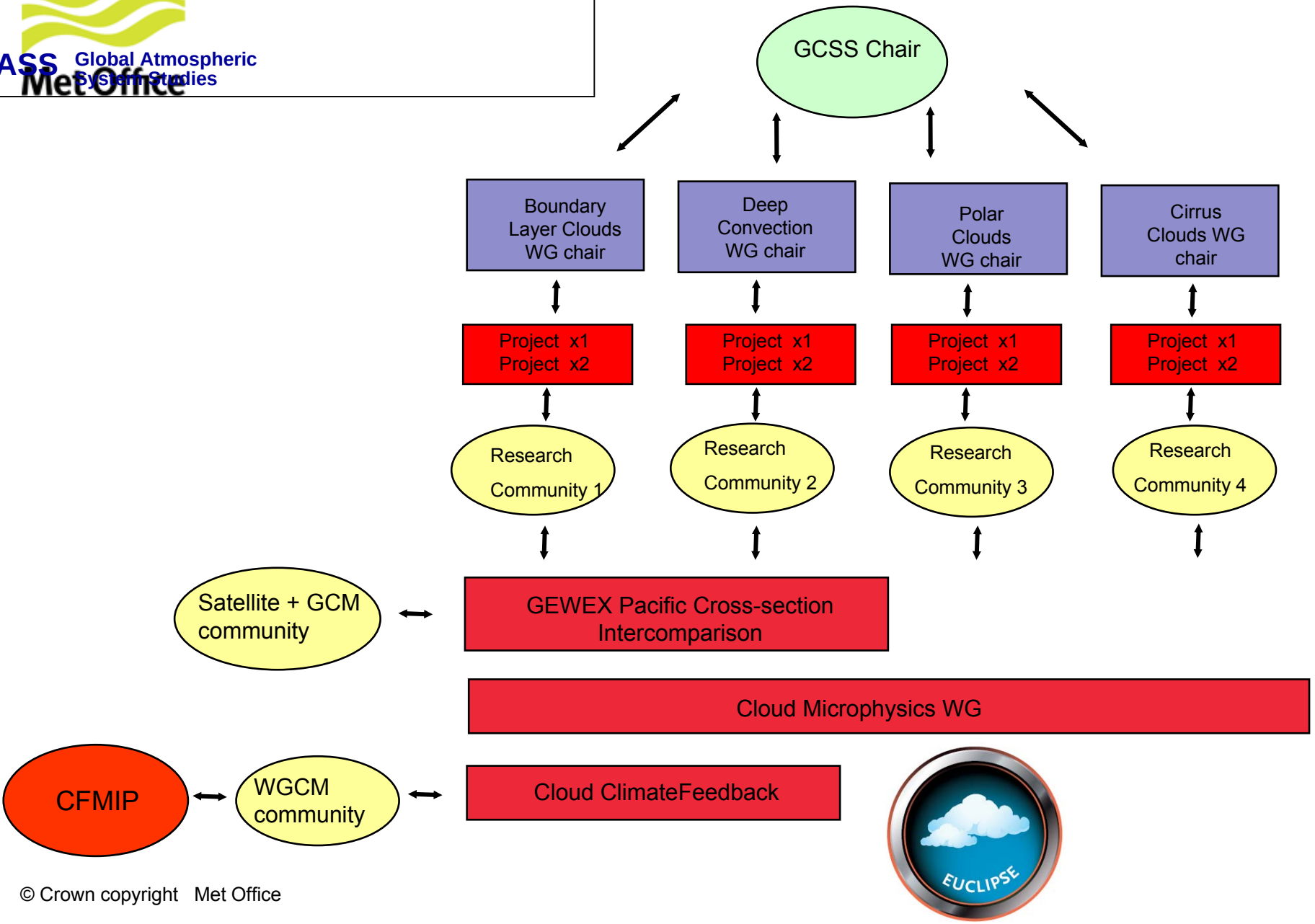
Field Campaigns

Instrumented Sites

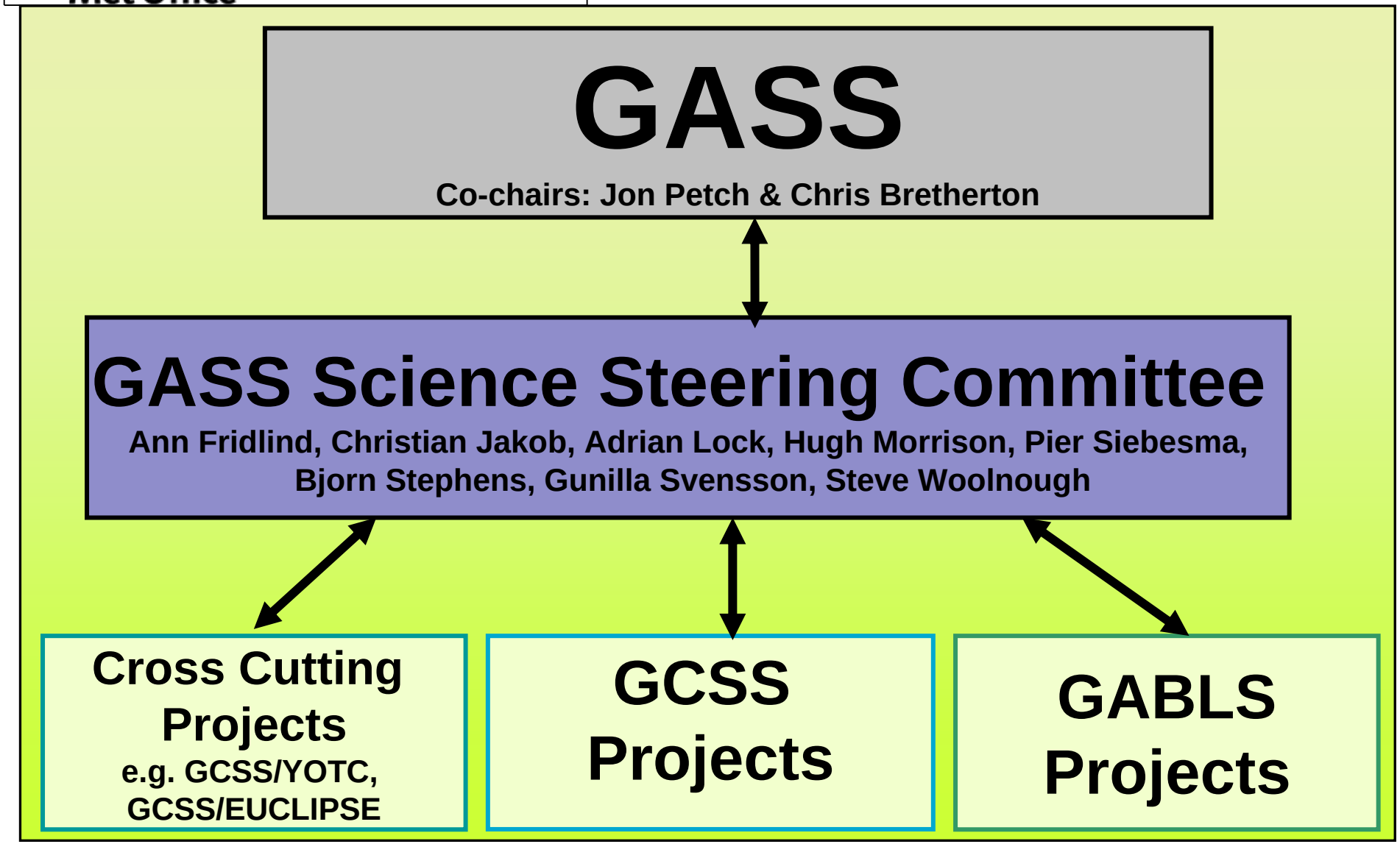
Global Observational Data sets

GASS Global Atmospheric System Studies

Met Office



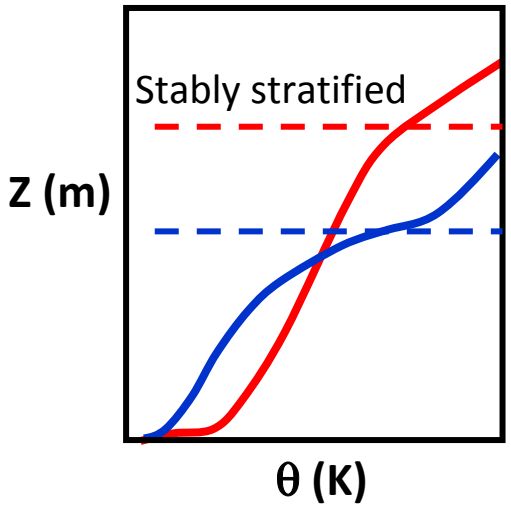
Global Atmospheric System Studies (GASS)



Active and future projects

- Boundary layer studies
- **Boundary layer clouds – see this meeting!**
- Polar clouds – also more this meeting.
- Deep convection - TWP-ICE
- **The MJO**
- Microphysics
- **Grey-Zone project (WGNE)**

NWP too deep night-time mixing

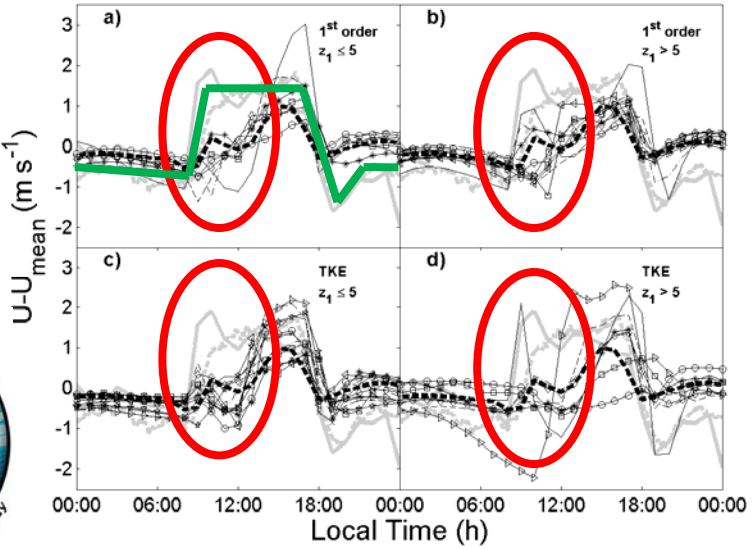


NWP models

LES

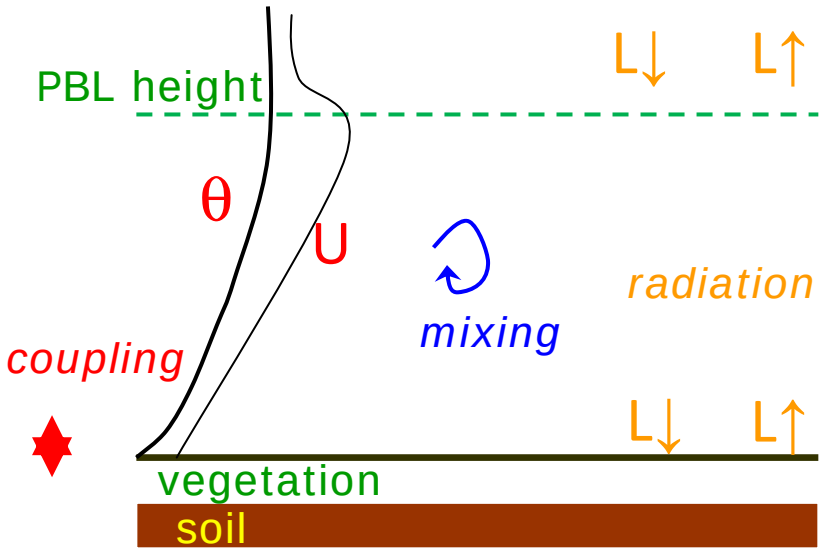
Research models

Diurnal cycle in wind too weak



- Paper on GABLS2 soon in BLM
- GABLS3 results in a special issue of BLM
- Summary paper of the first three GABLS projects
- ECMWF/GABLS Workshop on **Diurnal cycles and the stable atmospheric boundary layer**, 7-10 November 2011, ECMWF, Reading

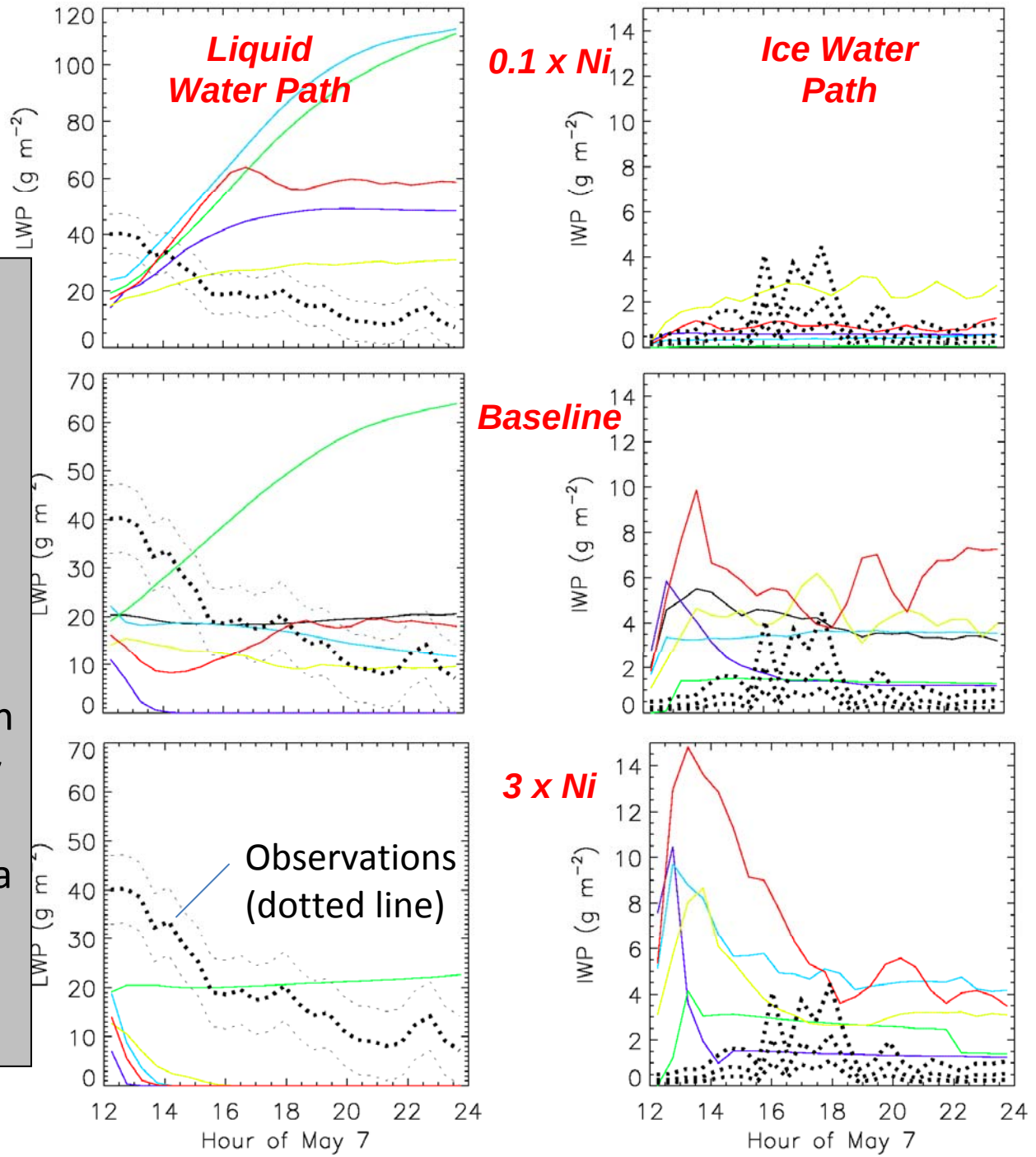
Coupling with surface and radiation

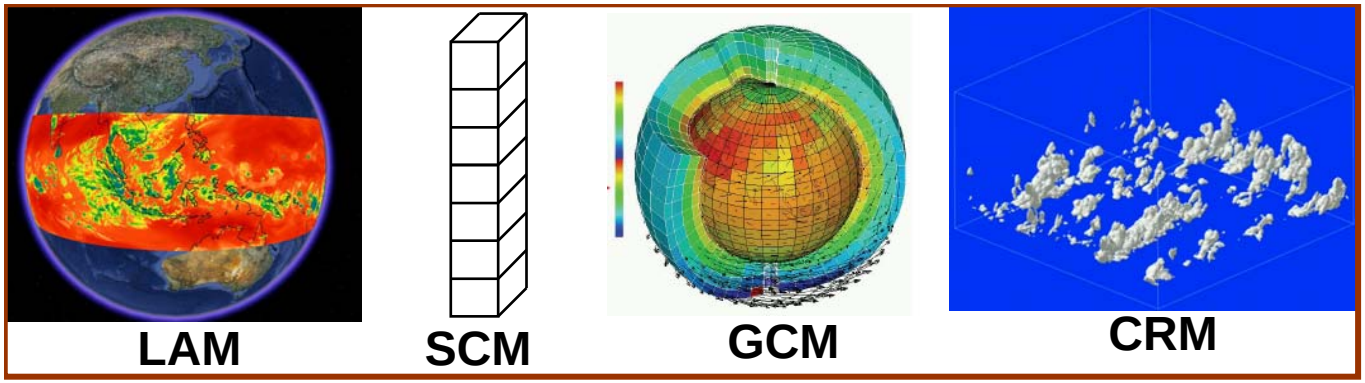


Polar clouds – Hugh Morrison

- LES and cloud model intercomparison based on Arctic mixed-phase clouds observed during **SHEBA**
  - Paper is currently in press (Morrison et al. 2011; JAMES)

- Follow-up intercomparison study is currently underway (led by Mikhail Ovchinnikov), based on data from the ISDAC Arctic field campaign
  - **More this week…**





TWP-ICE

From a GCSS perspective, this is our first case:

- with ensemble forcing (SCM; CRMs 2D)
- with a comparison of LAMs
- With a land-ocean mix in the domain (represented in the LAMs and NWP models)

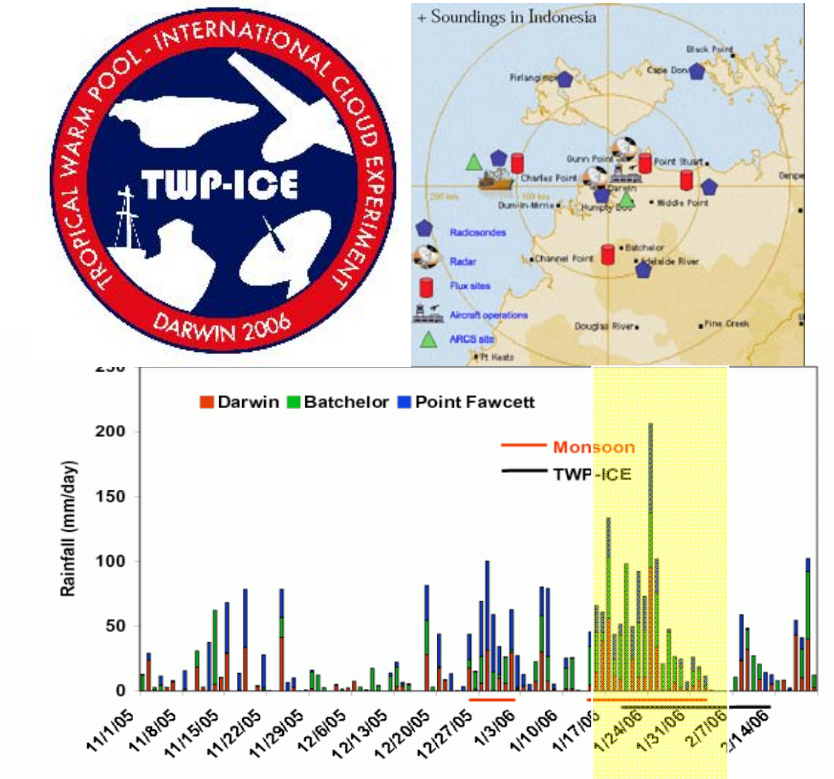


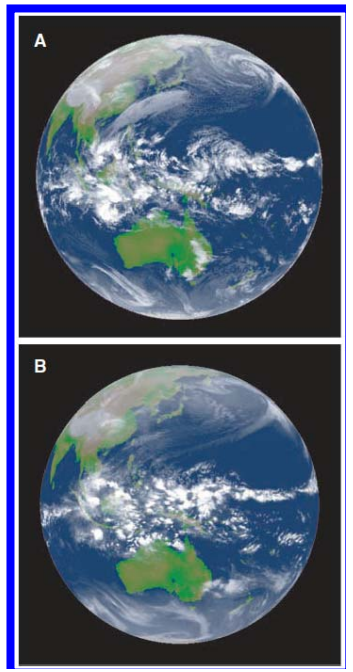
Figure 3. Cumulative rainfall at three locations in the Northern Territory during the 2005-2006 monsoon season. Figure courtesy of Lori Chappel, Australian BOM.

WCRP-THORPEX MJO-TF/GCSS model comparison

Seamless modelling of the diabatic heating structures of the MJO during YOTC

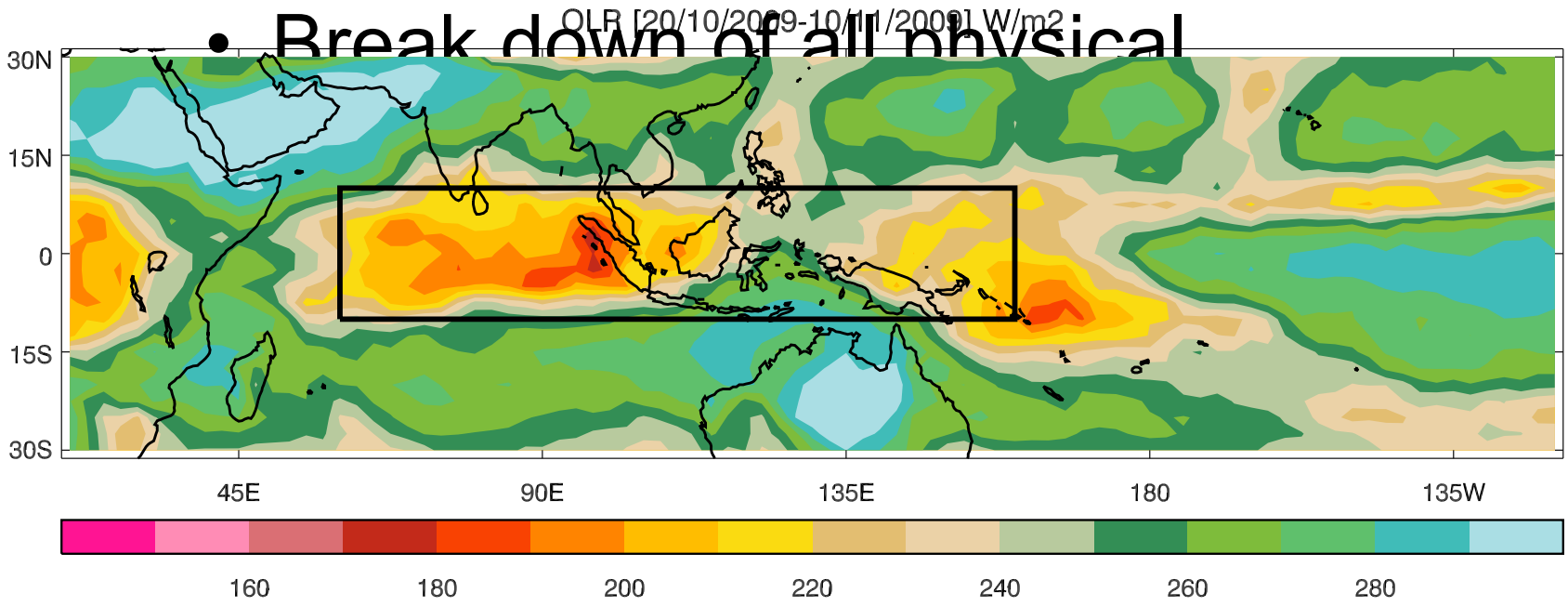
Three experimental components are:

- **1. climate simulation** – multi-year simulations
  - How well does the model capture the diabatic structures of the MJO?
- **2. short range hindcasts** – daily 36hr forecasts during ~20 days of the MJO
  - What are the physical tendencies (moisture, heat and momentum) while model is close to analysis?
- 2b (opt) **medium range hindcasts** - several 10 day forecasts
  - How does the MJO spin down



Part 3: the IAA (Intensive Analysis Area)

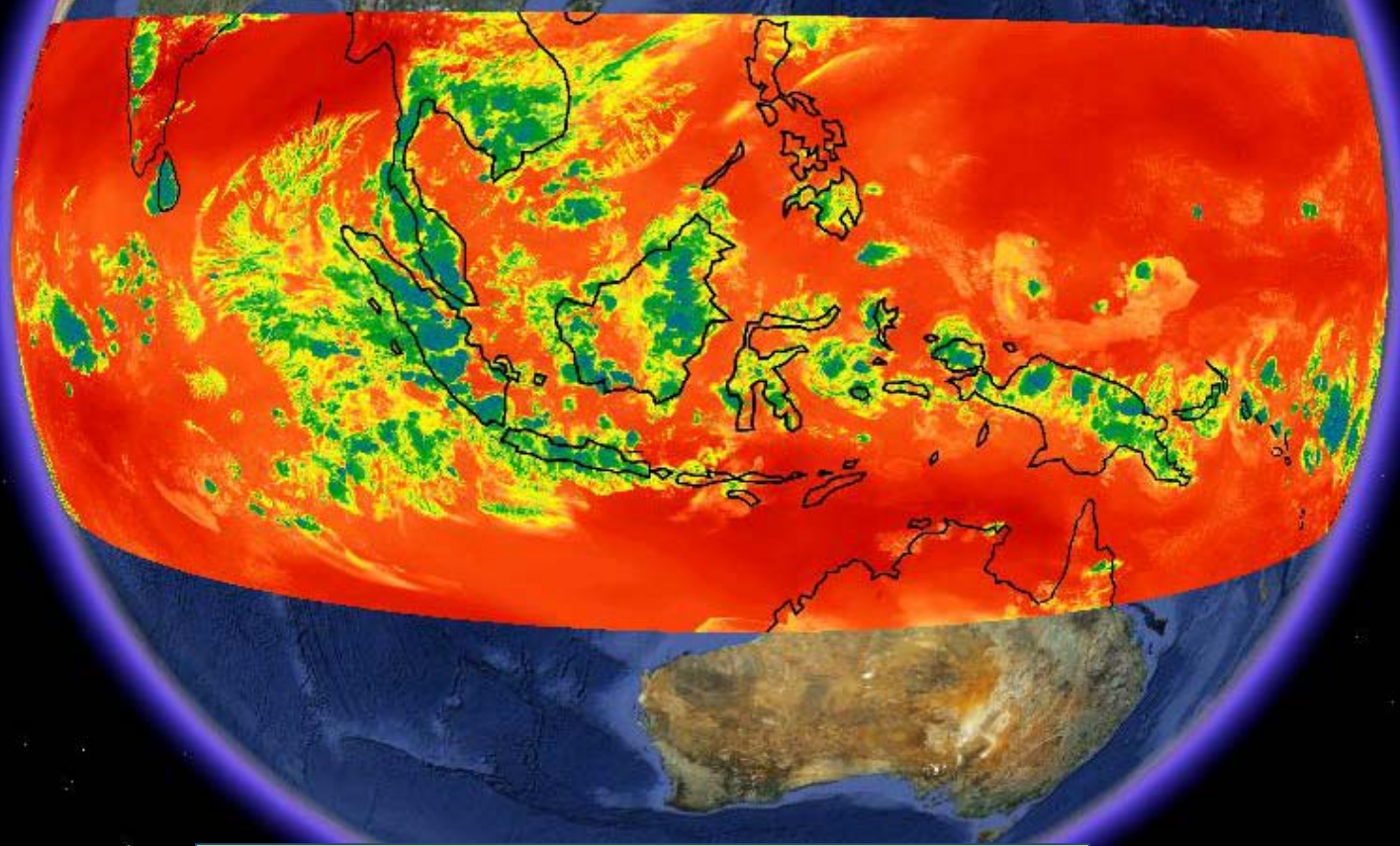
- High temporal sampling (model timestep?)
- Vertical profiles
- Break down of all physical



Once we learn from the climate models we can design a focused a hierarchical modelling effort.

e.g. CASCADE MJO runs: 2 billion grid points

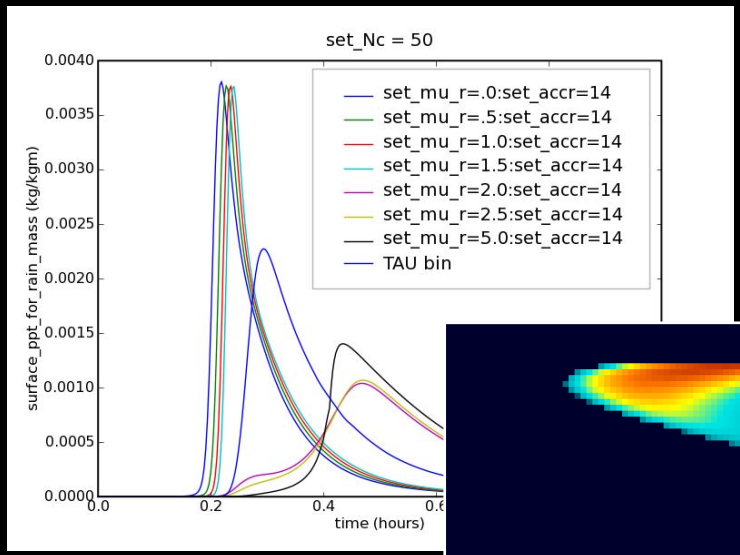
- Domain: 140° lon and 40° latitude
- 1.5km resolution (70 levs)

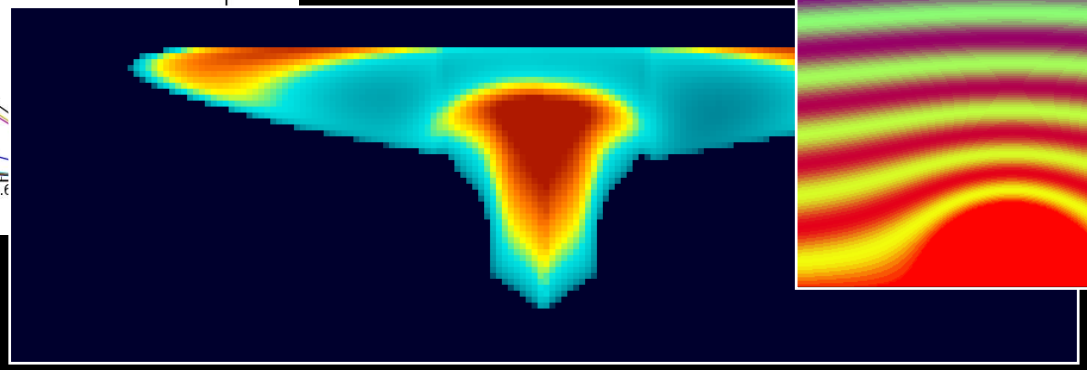


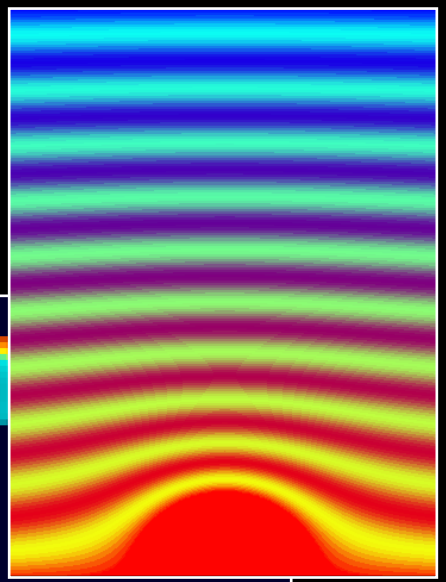
•Google Earth image of OLR from model

Microphysics

- The KiD model has been upgraded to provide 2-D forcings as well as 1-D (to be released soon).
- Ice-L (wave cloud) case being investigated at Leeds Uni (Dearden) with view to possible intercomparison
- 2-D intercomparison is also a possibility (Hill)
- Moreover, KiD should be considered as a tool to run alongside when developing full model intercomparison cases which may have strong microphysical dependence.





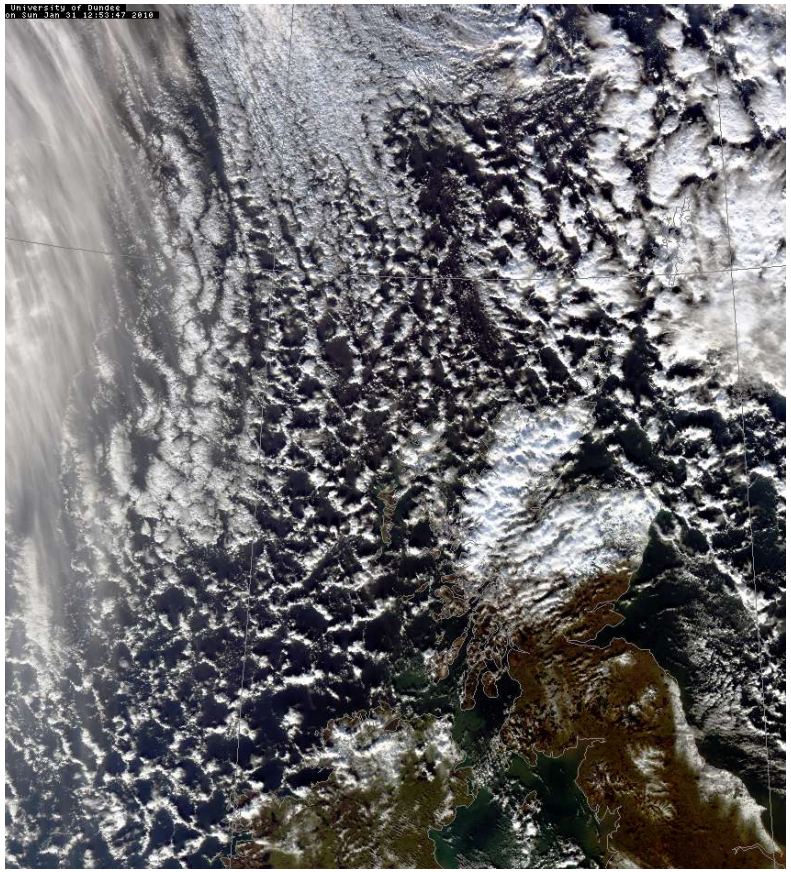


How to parametrize physical processes in the “grey-zone” (1-10km grid lengths)?

- Of interest to
  - Operational mesoscale NWP
    - Many already running at resolutions of a few km but room for more systematic testing to complement existing assessments of parametrization choices?
  - Future global models
    - What to do as global models enter this range?
  - Regional climate models

Proposed first case: cold-air outbreak

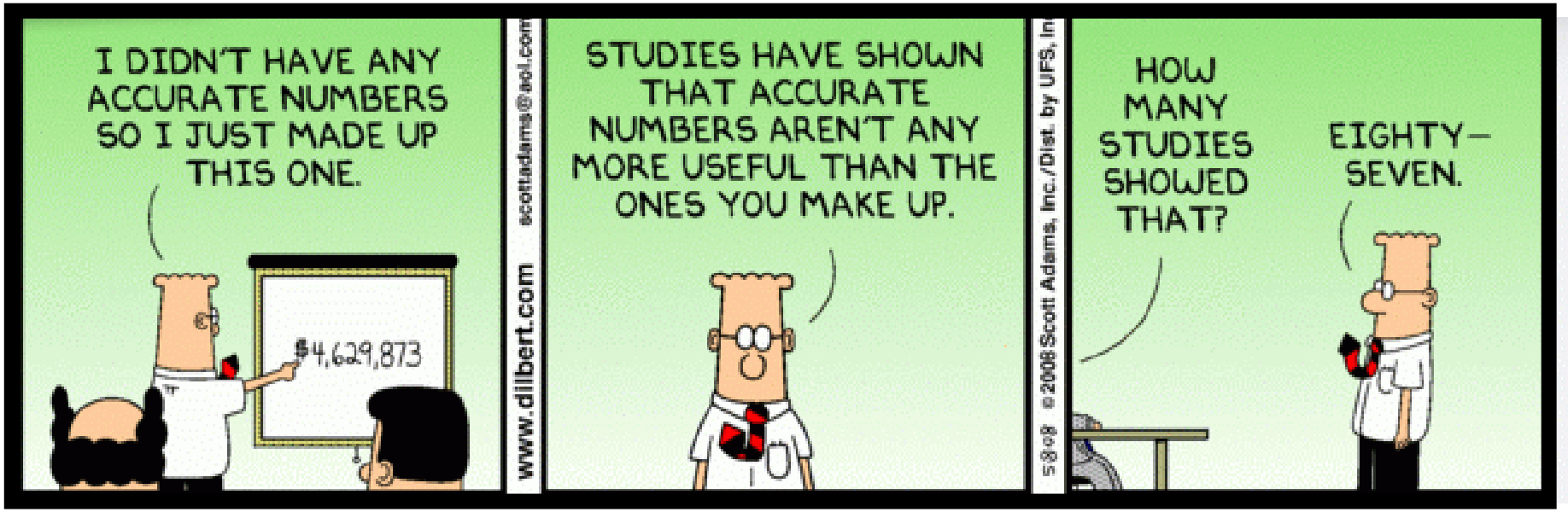
- Designed to be relevant to and to engage as broad a range of communities as possible
  - Mesoscale modellers
  - Global modellers
  - LES/CRM/parametrization development community (GCSS)
- Case to be run across whole range of resolutions (from convection resolved to fully parametrized)
  - Back diagnose fluxes at different resolutions from high resolution ‘truth’
- Idealized case with periodic boundary conditions
- Looking at parallel inflow-outflow option for mesoscale models for which the above is difficult



Summary

- There have been some changes to how we organise GCSS/GASS
- However, there is still a large community doing excellent work to support model development under the GCSS/GABLS banner
- Enjoy the meeting

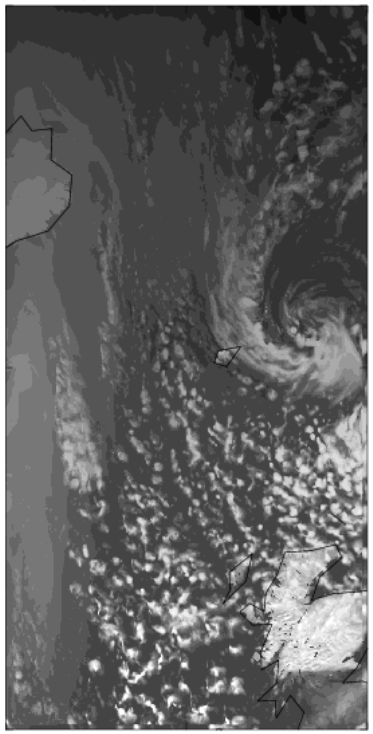
Summary

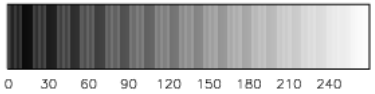


Spares

Met Office

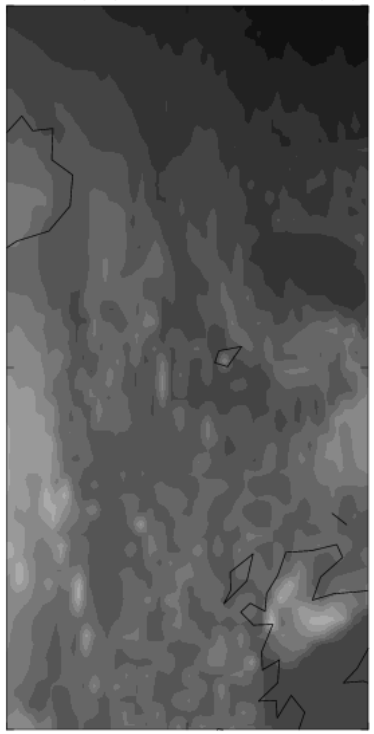
DIAFK Top of atmosphere Atmos outgoing sw rad flux (toa)
At 12Z on 31/ 1/2010, from 05Z on 31/ 1/2010

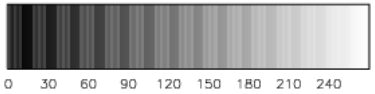




1.5 km

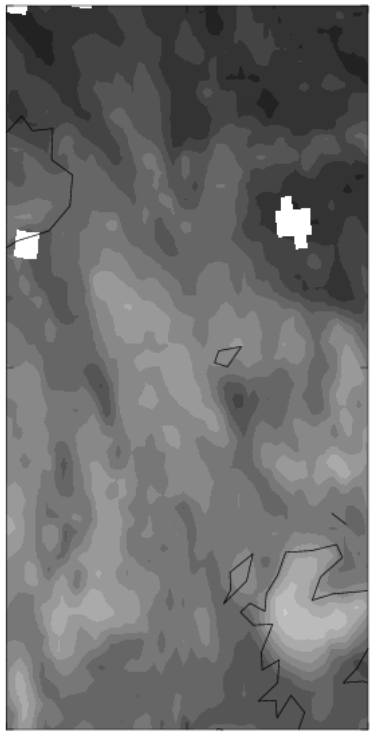
DIAFD Top of atmosphere Atmos outgoing sw rad flux (toa)
At 12Z on 31/ 1/2010, from 06Z on 31/ 1/2010

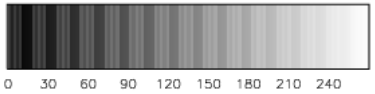




Global

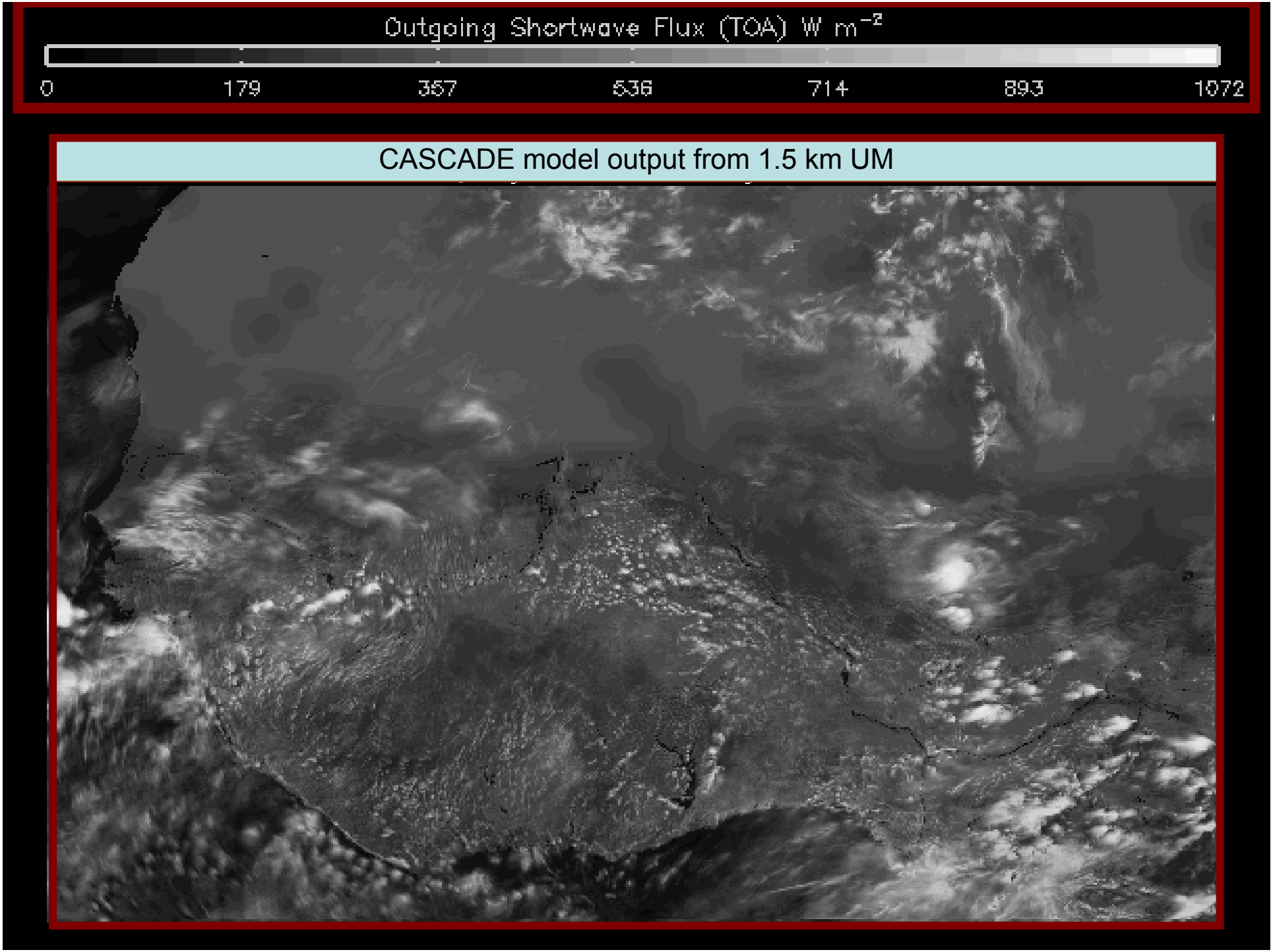
Atmos specific humidity after timestep
At 12:34Z on 31/ 1/2010





Ceres

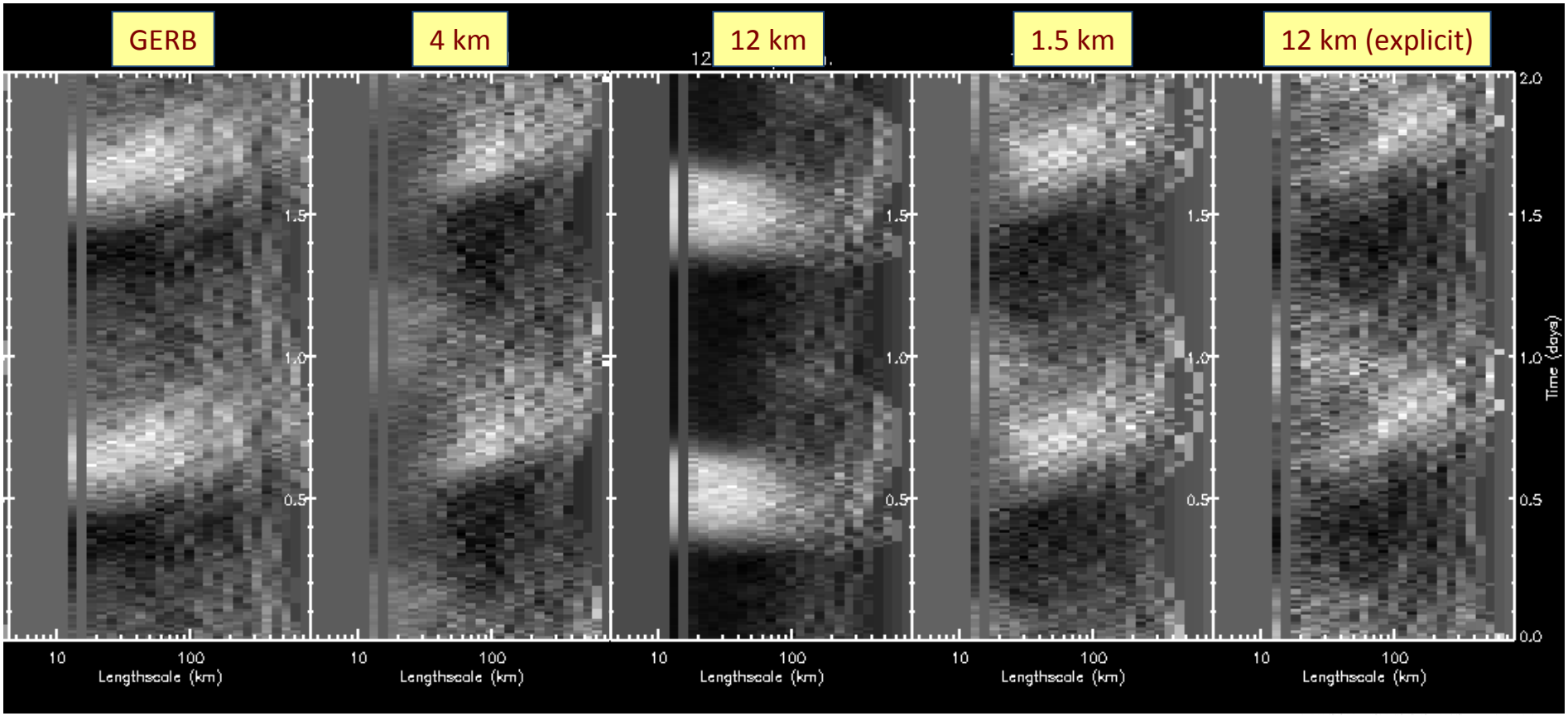
MODIS


Outgoing Shortwave Flux (TOA) W m^{-2}
0
179
357
536
714
893
1072
CASCADE model output from 1.5 km UM

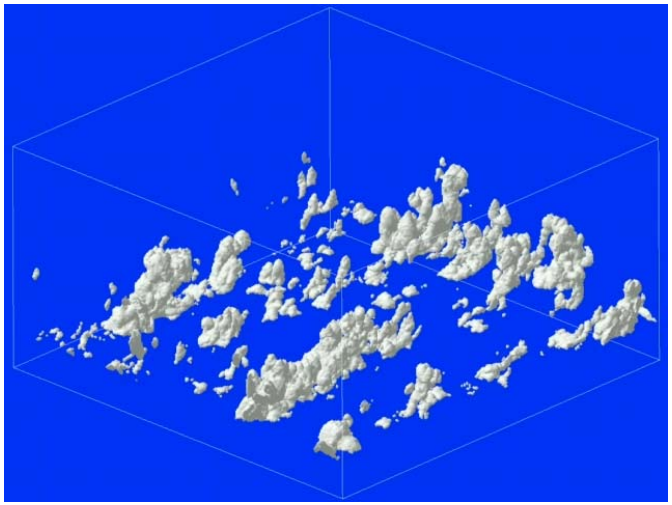
Cascade

The diurnal cycle over West Africa (Pearson, Dixon and Parker)

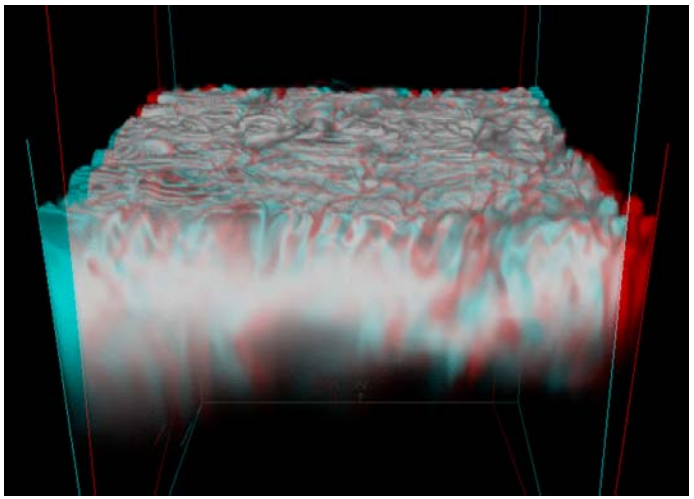
Diurnal Cycle in Frequency of High Cloud (OLR<150Wm^{-2}) as a function of size (Area^{½})



Large Eddy Simulation (LES) especially has been succesfully applied to study the dynamics of boundary layer clouds, which has led for guidance for improving parameterizations on: *top-entrainment, lateral entrainment and detrainment, mass flux closure, triggering, cloud schemes including cloud microphysics*



Fair weather cumulus



stratocumulus

512^3 grid points

A Pan-GCSS meeting

- Attendees at PAN-GCSS meetings:
  - 1998 Reading : ~ 80
  - 2002 Kananaskis: ~ 100
  - 2005 Athens: ~150
  - 2008 Toulouse: ~235
  - 2012? ????

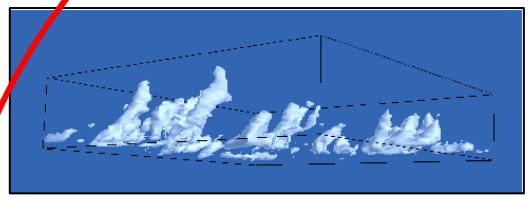
Toulouse 2008

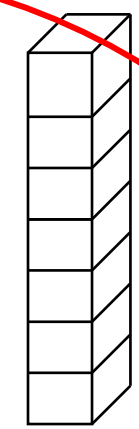
GEWEX Atmospheric Boundary Layer Study

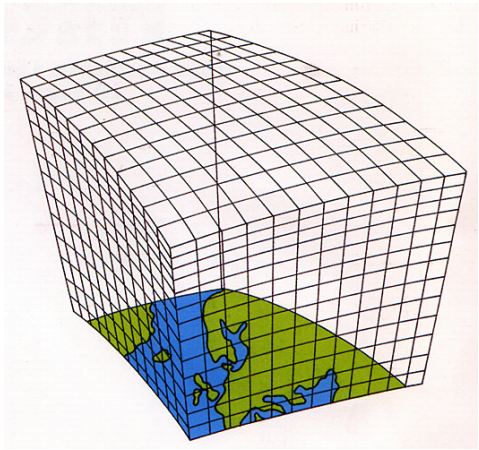
Enhance understanding and improving representation of boundary-layer processes in weather forecast and climate models

GABLS1	GABLS2	GABLS3
		
LES as reference	Data (CASES99)	Data (CABAUW)
Artificial	Idealized forcings	'Exact' forcings
Prescribed T_s	Prescribed T_s	Coupling with surface
No Radiation	No Radiation	Radiation
Turbulent mixing	Diurnal cycle	LLJ + transitions
LES and SCM	SCM	LES and SCM

(20th century) Working Strategy of GCSS/GABLS







Large Eddy Simulation (LES) Models

Cloud Resolving Models (CRM)

Single Column Model

Versions of Climate Models

3d-Climate Models

NWP's

Observations from Field Campaigns

Global observational Data sets

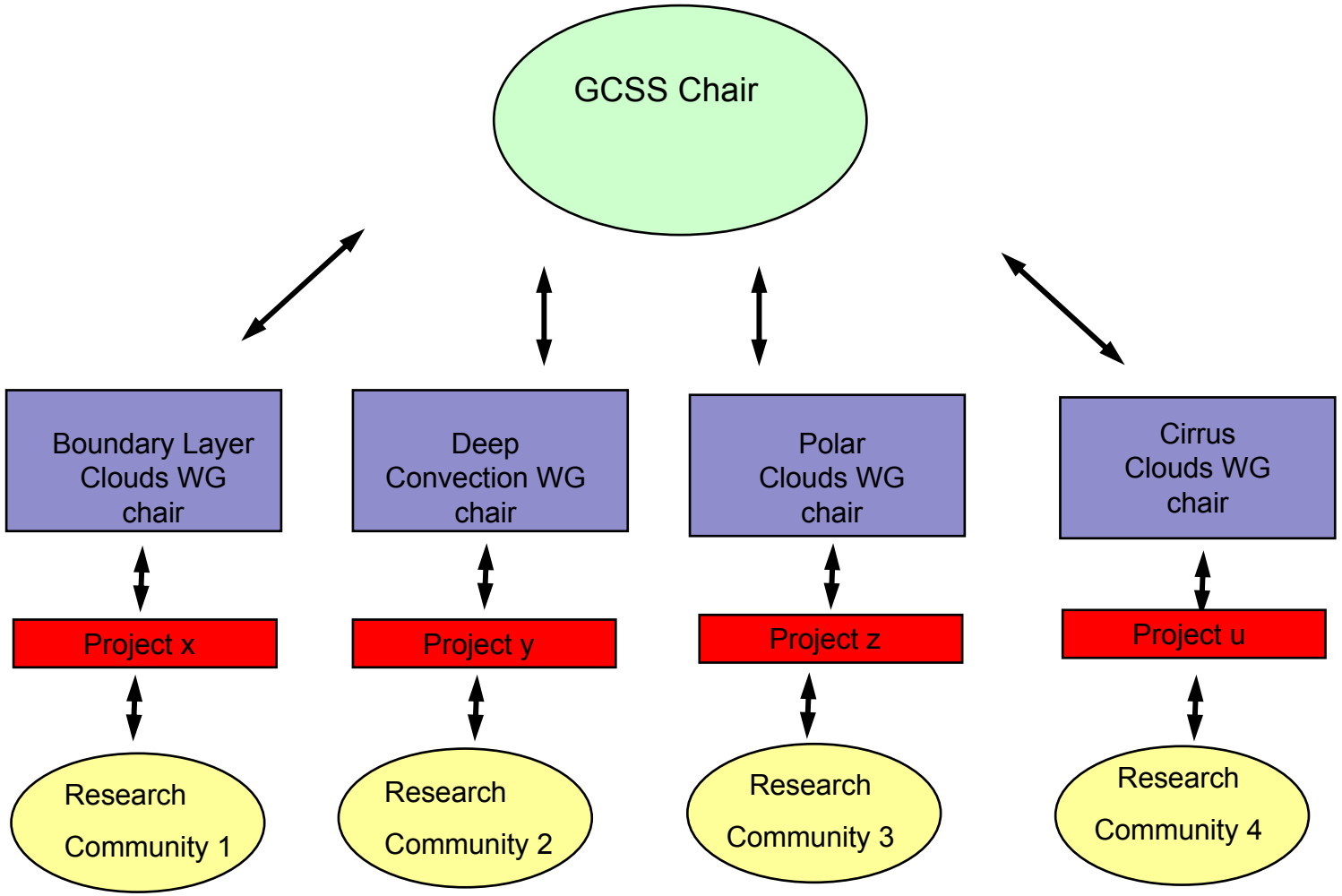
Development

Testing

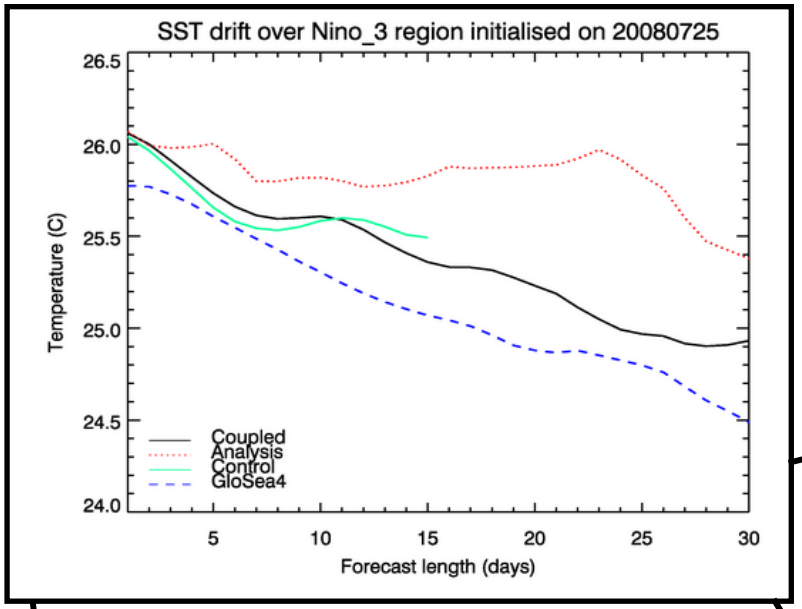
Evaluation

Global Atmospheric Systems Studies

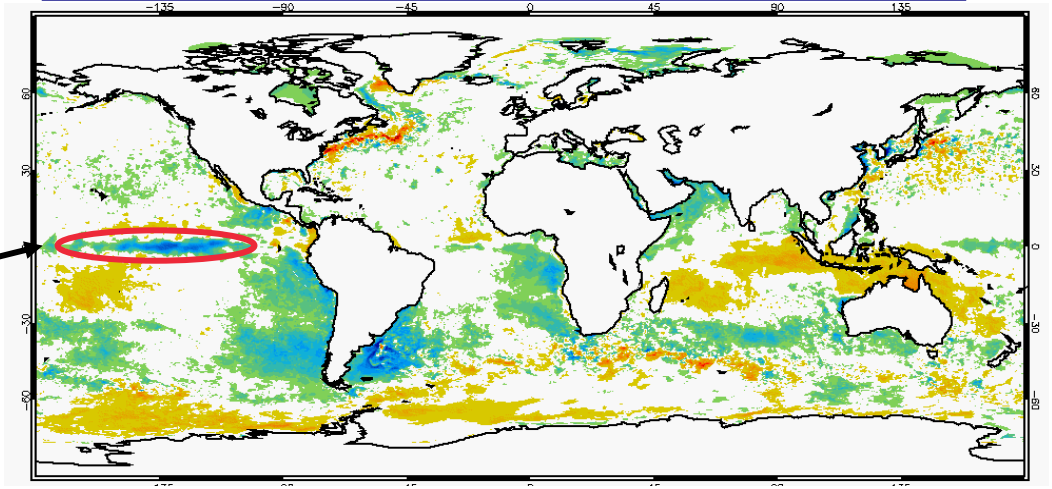
GASS Met Office



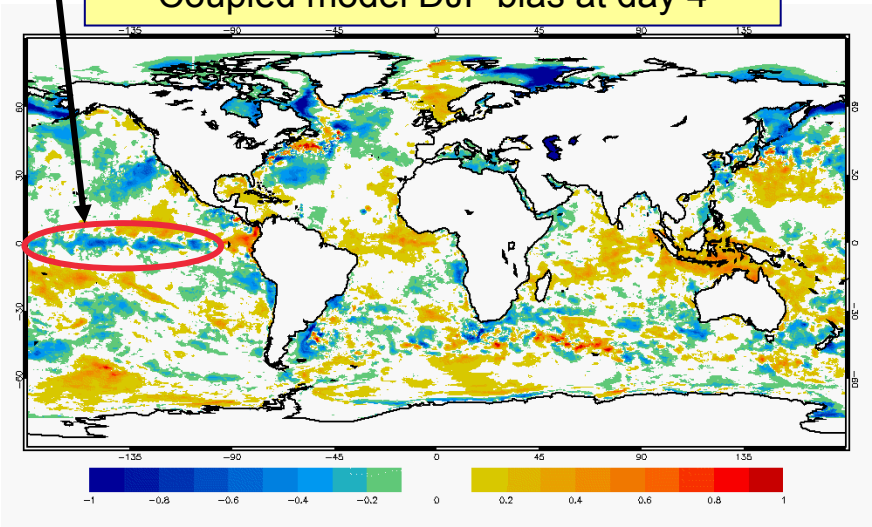
Bias is at short range as well as longer – knowing this this helps development



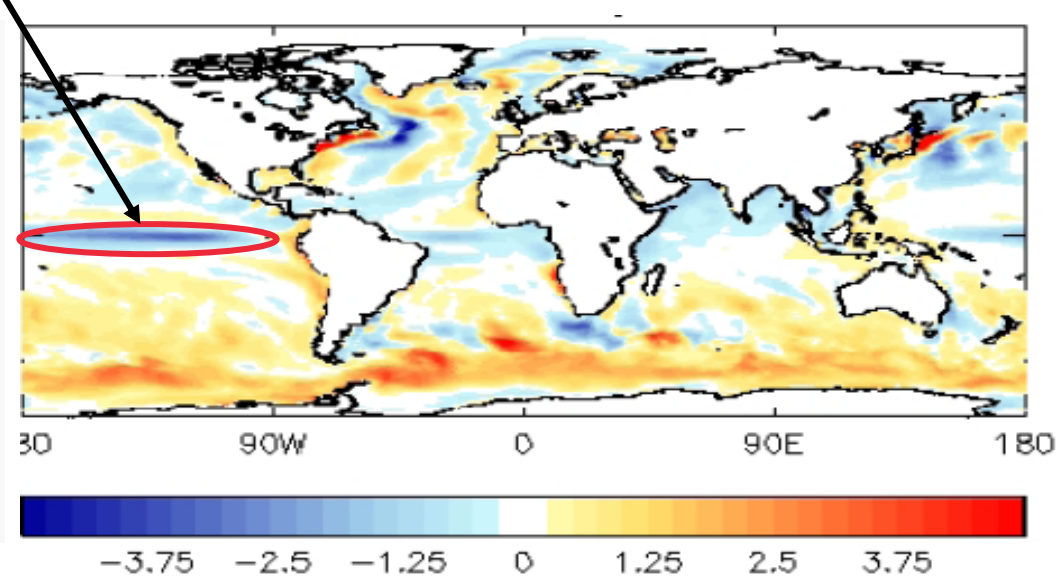
Coupled model DJF bias at day 30



Coupled model DJF bias at day 4



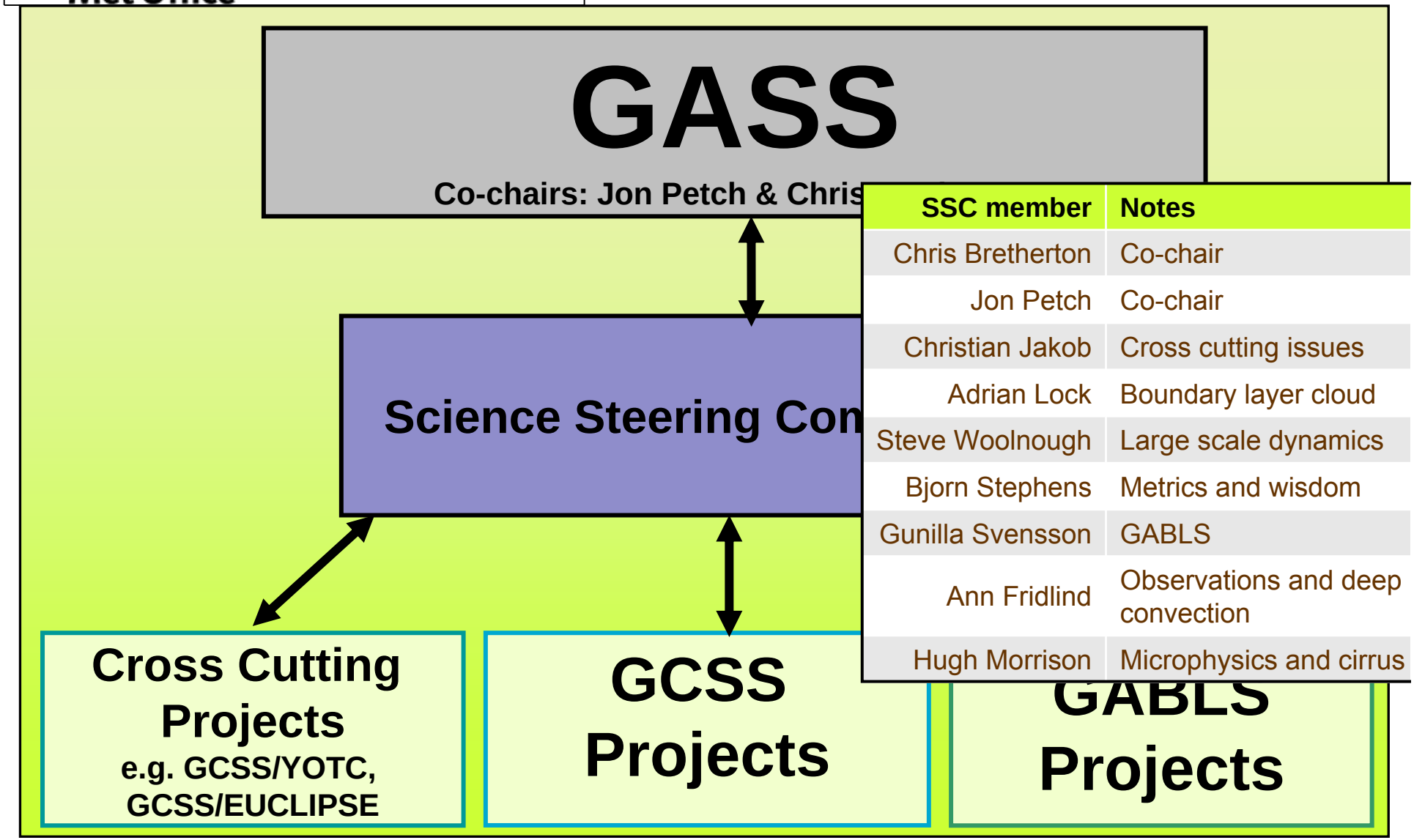
Seasonal DJF bias



Interest on participation on the Grey Zone Project

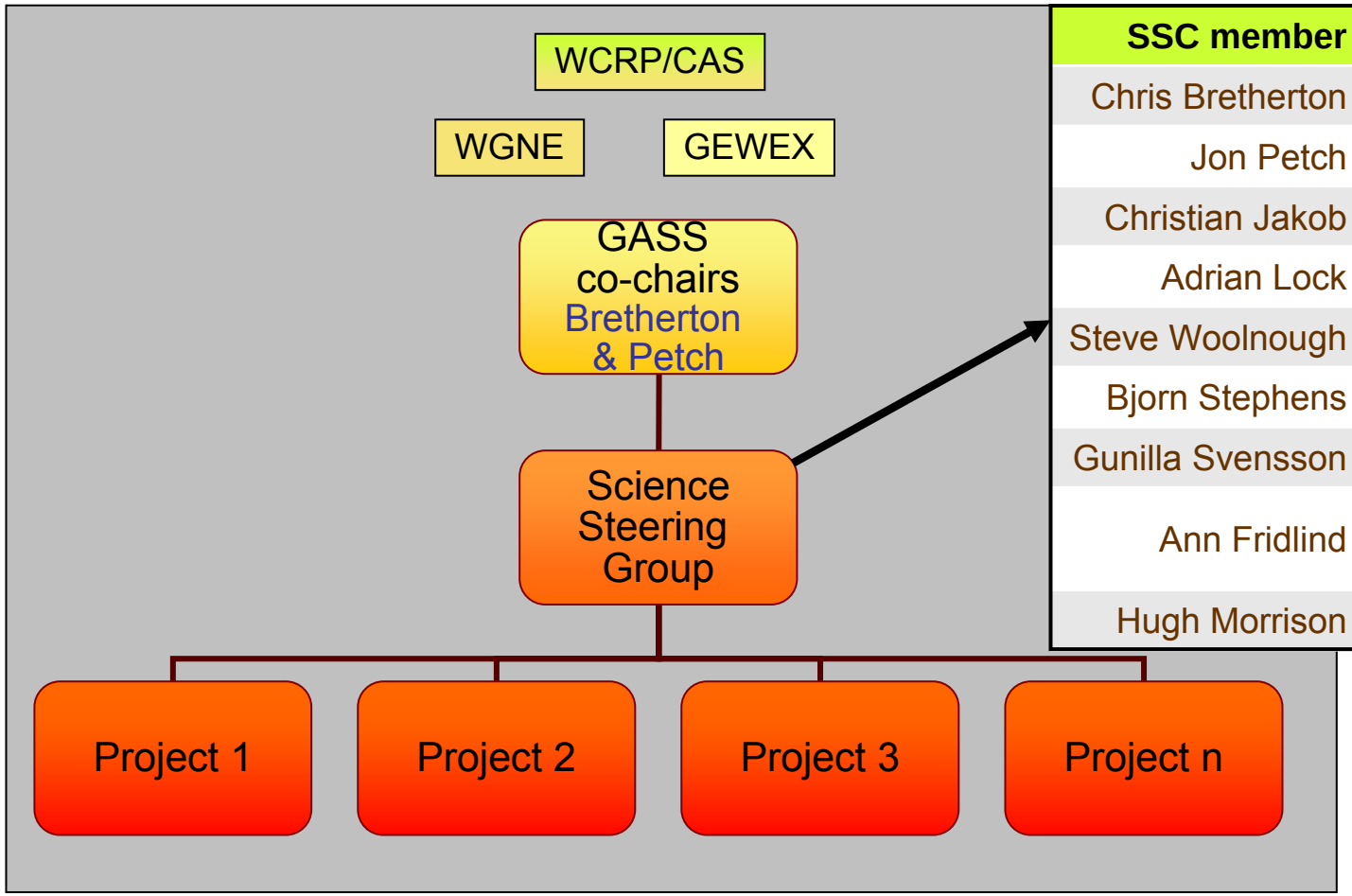
	global	Meso Operational	Meso idealised	LES	contacts
MetO	MetO globa Model (p)l	MetO meso model	MetO meso model	MOLEM	Paul Field
Meteo France	Arpege	AROME MesoNH	AROME MesoNH (p)	MesoNH	Bouysel
DWD (MPI-H)	ICON	COSMO-EU COSMO-DE	COSMO-EU COSMO-DE	UCLA-LES	Martin Kohler Axel Seifert
Met Service Canada		Canadian LAM		Canadian LES	Vaillancourt Jason Milbrandt Aytron Zadra Stephan Belair
NCAR		WRF	WRF (p)	WRF(p)	Jim Dudhia
ECMWF	IFS (p)				Anton Beljaars
KNMI		HARMONIE	HARMONIE (p)		Wim de Rooy
TU Delft				DALES	Stephan de Roode
		Alaro	Alaro		J-F Geleyn
JMA Univ. of Tokyo	NICAM	JMA model	JMA model	LES	Kazuo Saito Niino Kimoto

Global Atmospheric System Studies (GASS)



SSC member	Notes
Chris Bretherton	Co-chair
Jon Petch	Co-chair
Christian Jakob	Cross cutting issues
Adrian Lock	Boundary layer cloud
Steve Woolnough	Large scale dynamics
Bjorn Stephens	Metrics and wisdom
Gunilla Svensson	GABLS
Ann Fridlind	Observations and deep convection
Hugh Morrison	Microphysics and cirrus

Global Atmospheric System Studies (GASS)



SSC member	Notes
Chris Bretherton	Co-chair
Jon Petch	Co-chair
Christian Jakob	Cross cutting issues
Adrian Lock	Boundary layer cloud
Steve Woolnough	Deep convection
Bjorn Stephens	Metrics
Gunilla Svensson	GABLS
Ann Fridlind	Observations and deep convection
Hugh Morrison	Microphysics and cirrus