



Met Office  
Hadley Centre

# Status of EUCLIPSE simulations for HadGEM2-ES

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# Acknowledgements

## Particular thanks to:

Alejandro Bodas-Salcedo

Marie Doutriaux-Boucher

Tim Hinton

William Ingram

Chris Jones

Yoko Tsushima

Ricky Wong

Keith Williams

Jonny Williams

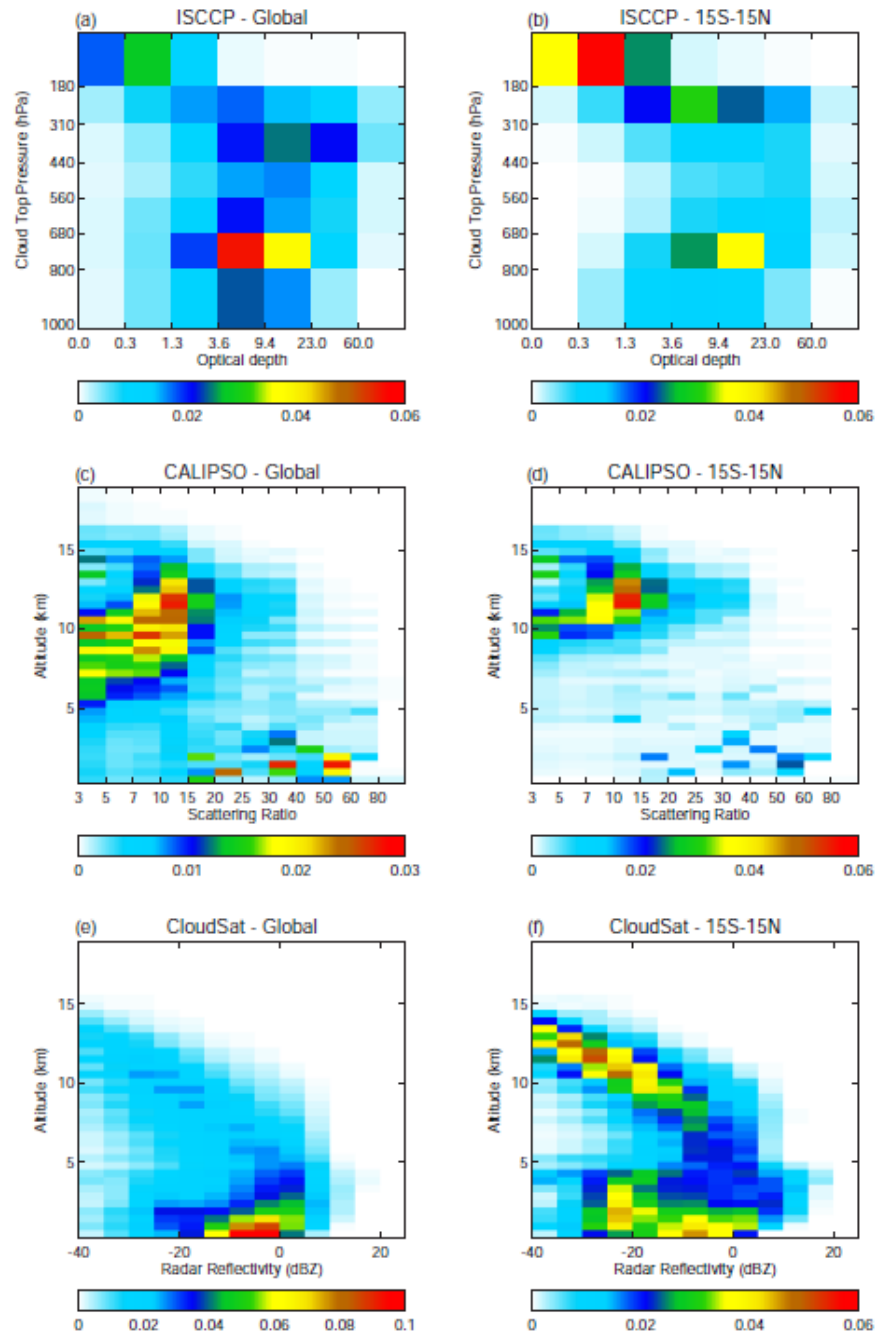


# HadGEM2-ES Status - Outline

- Status of CFMIP-2 diagnostic package implementation
- Status of CMIP5/CFMIP-2 idealised experiments
- Climate sensitivity and transient climate response

<b>CFMIP/CMIP5 Diagnostic Package Implementation in HadGEM2</b>	<b>Table</b>	<b>Status</b>
CMIP5 standard output (Amon, Amon 2D etc)	aMon	DONE
CFMIP monthly 3D -- Clouds, temperature, humidity etc on model levels	cfMon	DONE
CFMIP monthly inline -- monthly mean in line ISCCP/CALIPSO/PARASOL simulator output	cfMon	DONE
CFMIP daily 2D -- daily mean 2-D fields including inline ISCCP/CloudSat/CALIPSO/PARASOL simulator output	cfda	DONE
CFMIP daily 3D -- daily mean 3-D fields on model levels plus CALIPSO and ISCCP cloud fractions	cfda	DONE
CFMIP 3-hourly orbital offline -- CloudSat/CALIPSO /PARASOL simulator output in orbital curtain format	cf3hr	DONE
CFMIP monthly offline -- monthly mean gridded simulator output based on 3-hrly orbital offline	cfOff	DONE
CFMIP timestep station data -- 2-D and 3-D fields on model levels at 20 to 30 minute intervals at 119 point locations.	cfSites	DONE
CFMIP monthly 3D -- Clouds, mass fluxes, internal radiative fluxes, tendencies temperature, humidity and cloud.	cfMon	DONE
CFMIP 3-hrly inline -- Instantaneous 3 hourly global 'snapshots' for future COSP development	cf3hr	DONE
CFMIP monthly 4CO2 2D -- monthly mean TOA radiative fluxes calculated by instantaneously quadrupling CO2.	cfMon	DONE
CFMIP monthly 4CO2 3D -- monthly mean 3-D radiative fluxes calculated by instantaneously quadrupling CO2.	cfMon	DONE

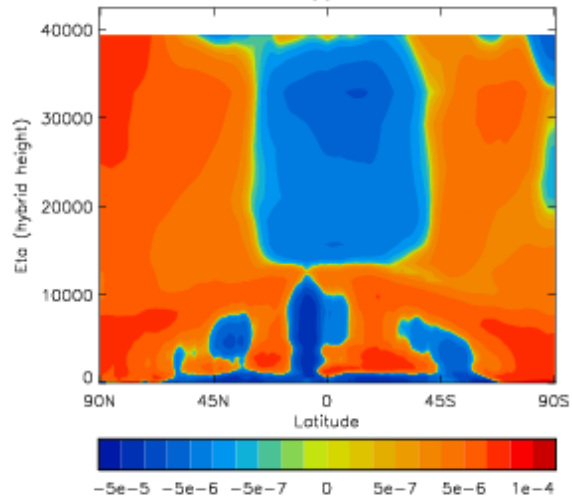
# HadGEM2-ES Test COSP output Preindustrial control July 15N-S



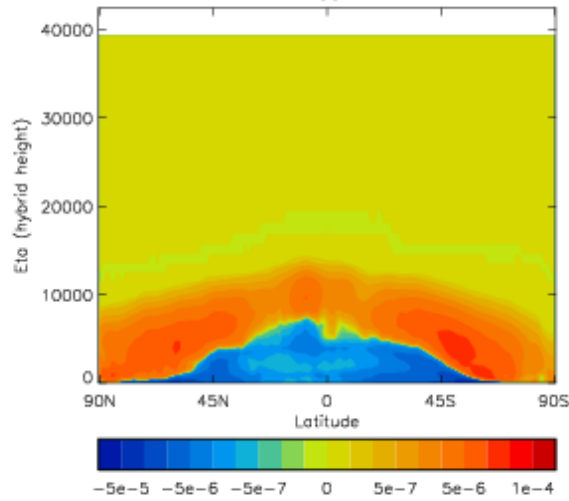
**Figure 1.** COSP outputs from one July of an atmosphere-ocean coupled simulation of HadGEM2 with preindustrial forcings. The left-hand side column shows globally-averaged results, and the right-hand side column shows averages over the tropical belt (15°S-15°N): (a,b) ISCCP histograms. (c,d) CALIPSO

Alejandro Bodas-Salcedo

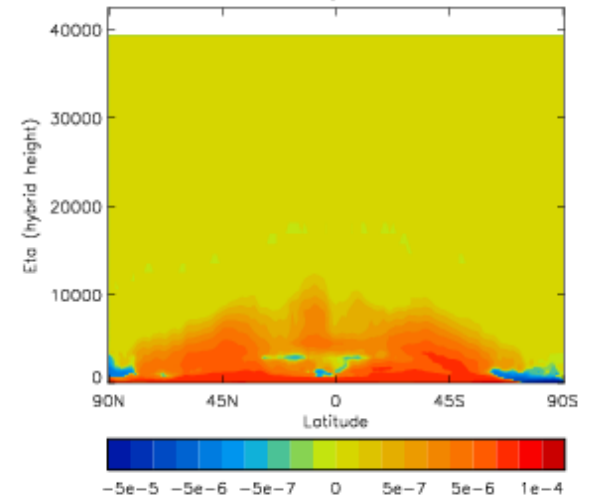
**Advective  
Temp Tendency**



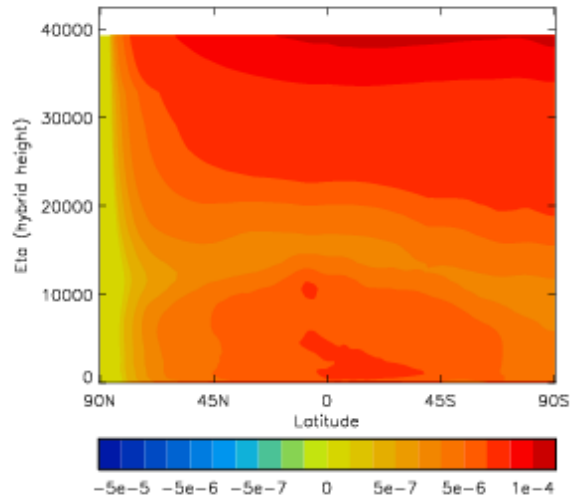
**Large Scale Cloud  
Temp Tendency**



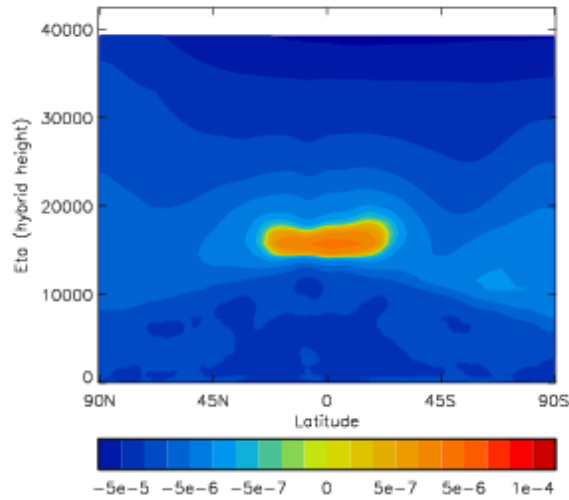
**Boundary Layer  
Temp Tendency**



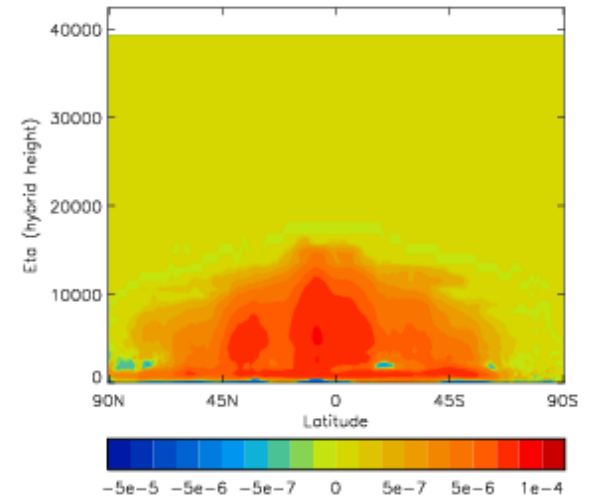
**SW Radiation  
Temp Tendency**

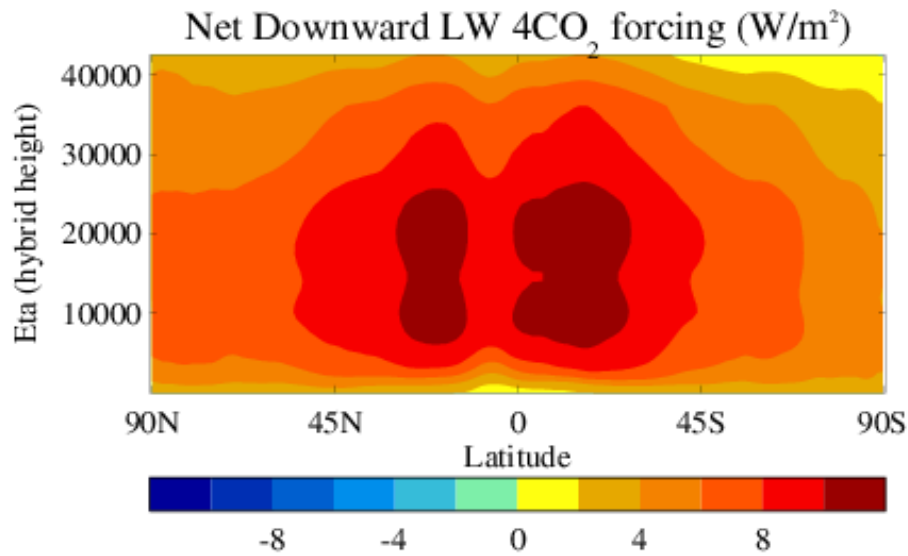
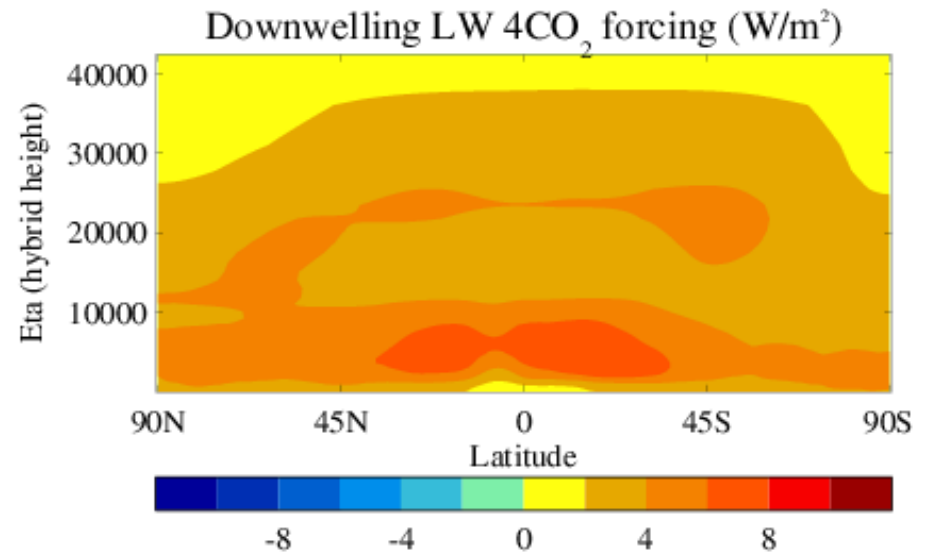
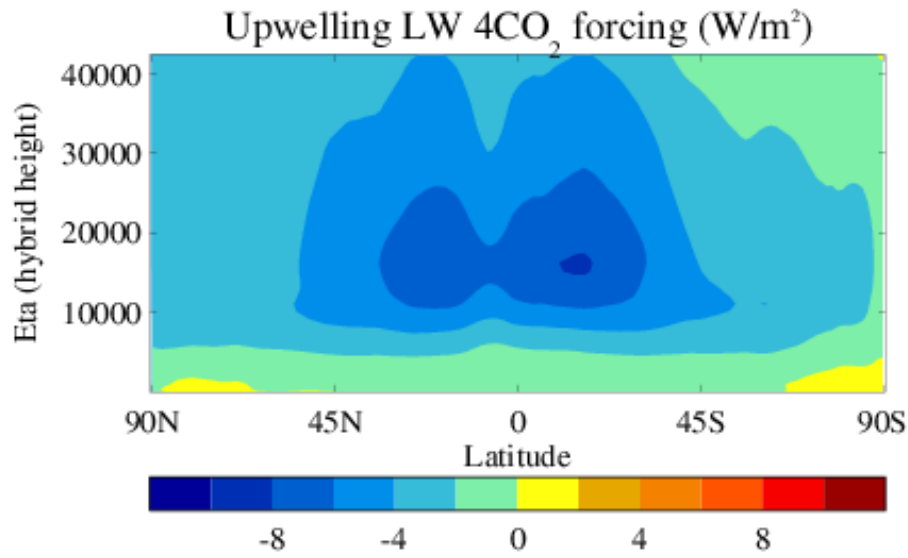


**LW Radiation  
Temp Tendency**



**Convection  
Temp Tendency**

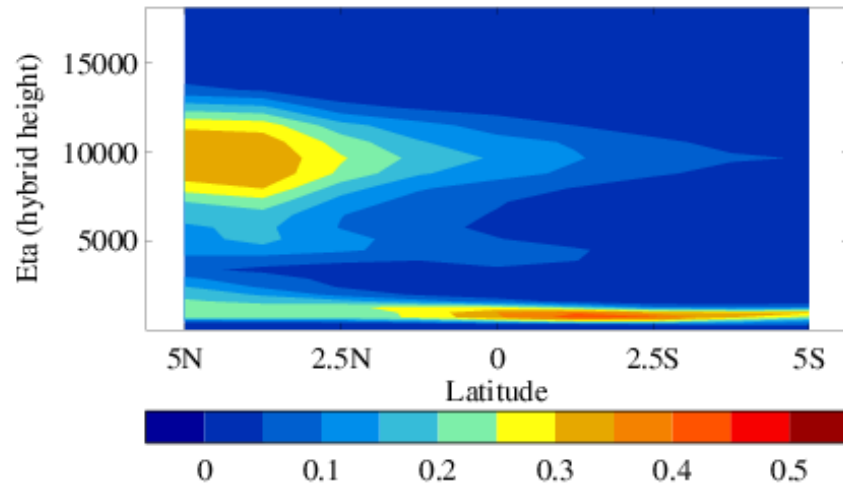




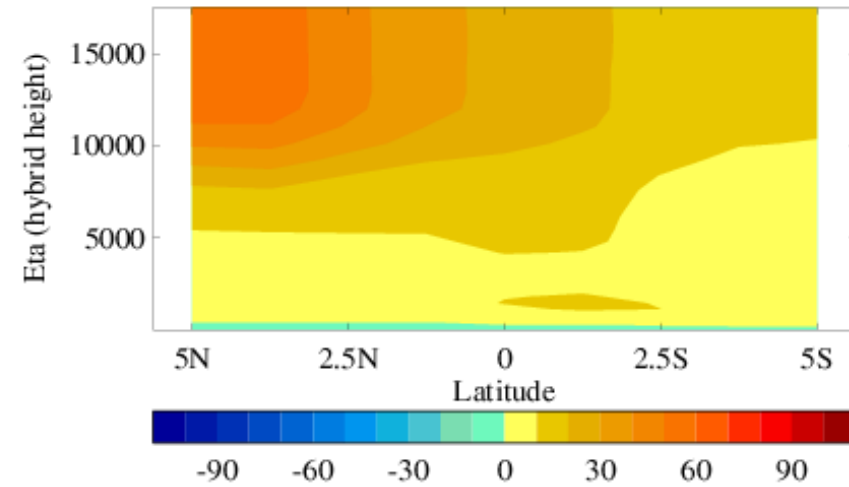
Internal Atmospheric  $4\text{CO}_2$  forcing

William Ingram

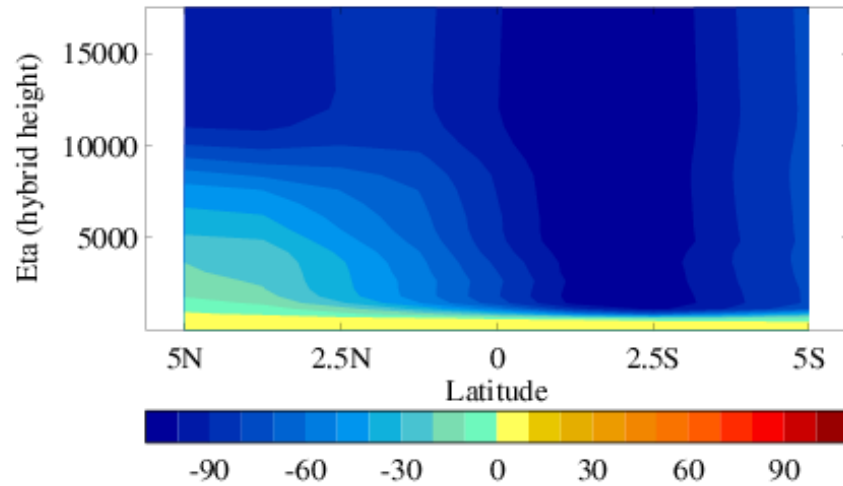
Cloud Fraction on Model Levels  
Tropical East Pacific 80-90W October



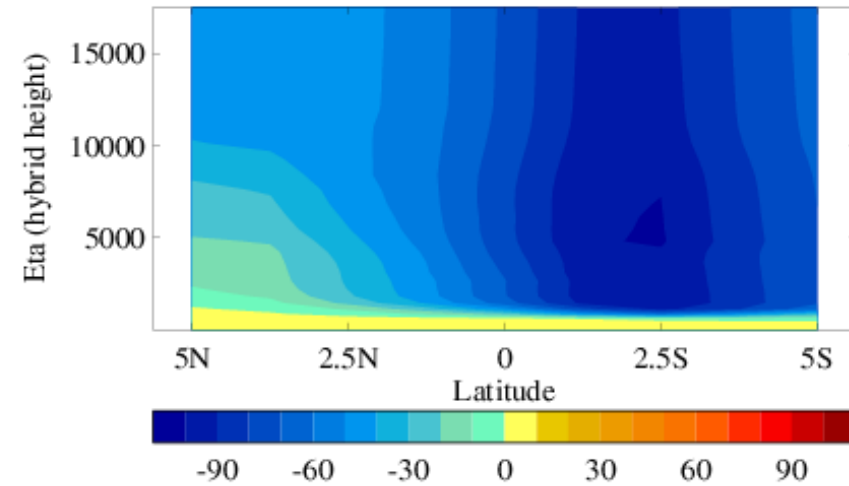
Longwave Cloud Radiative Effect on Model Levels ( $W/m^2$ )  
Tropical East Pacific 80-90W October



Shortwave Cloud Radiative Effect on Model Levels ( $W/m^2$ )  
Tropical East Pacific 80-90W October



Net Cloud Radiative Effect on Model Levels ( $W/m^2$ )  
Tropical East Pacific 80-90W October

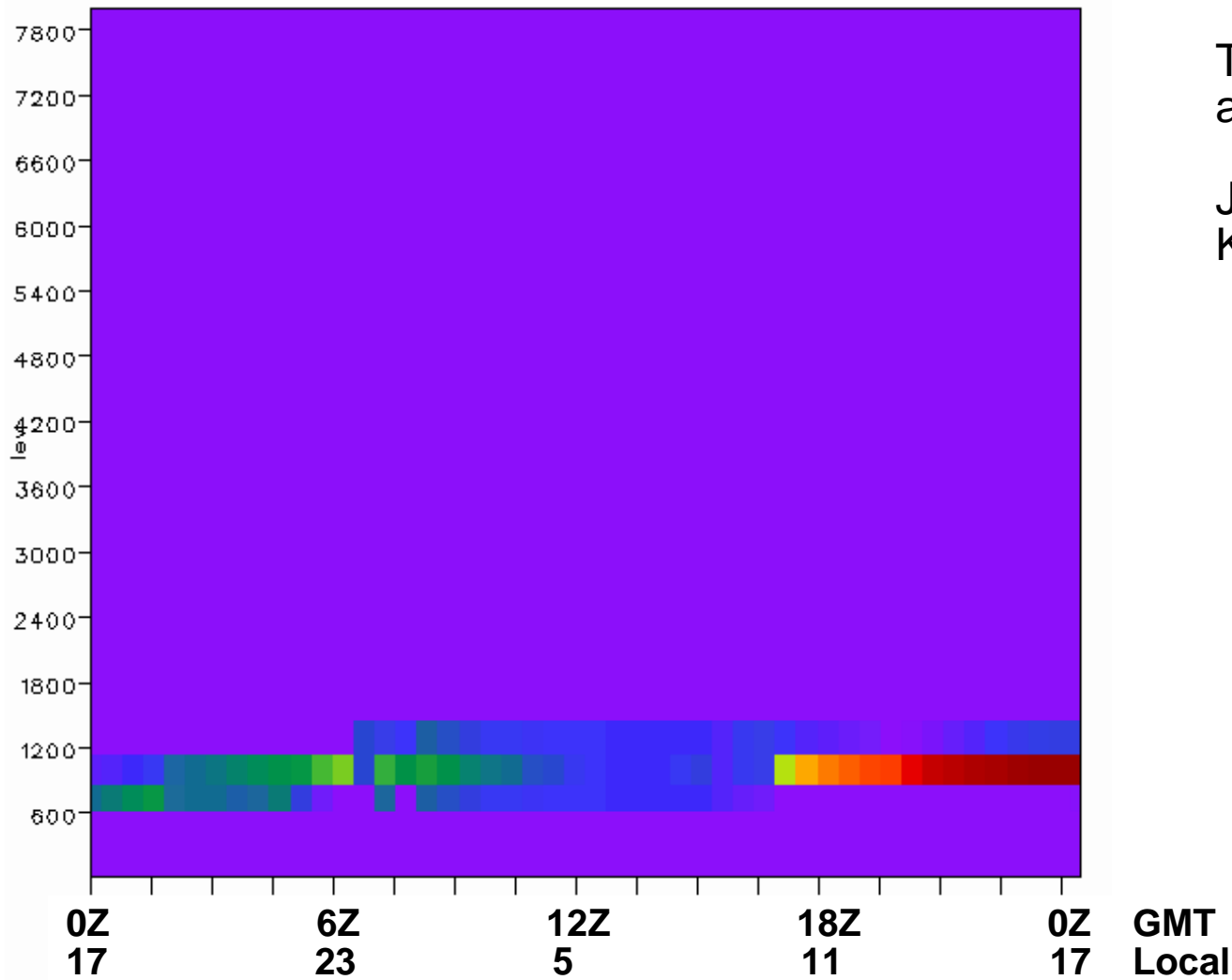


Internal Atmospheric Radiative Fluxes

William Ingram, Alejandro Bodas

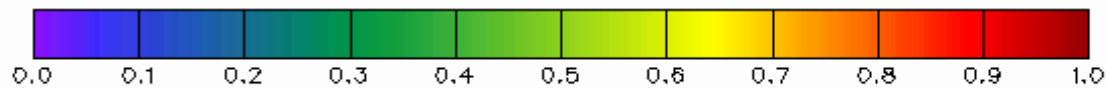


# HadGEM2 AMIP Cloud Fraction on Model Levels (April) CFMIP2 point 65 DYCOMSII [ 31.5N, 122W] California



Time series outputs  
at fixed locations

Jonny Williams  
Keith Williams

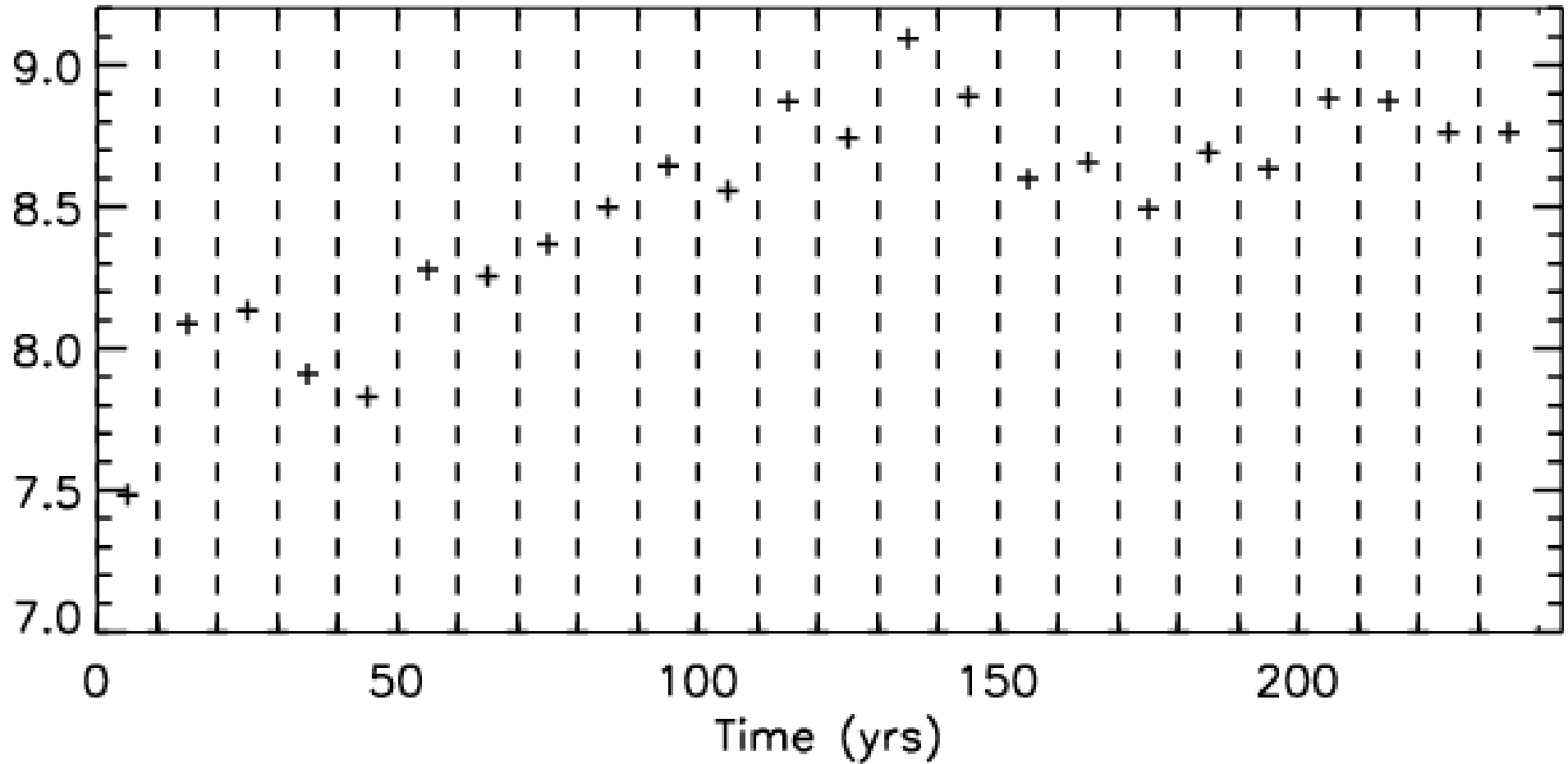


# CFMIP2/CMIP5 Experiment Hierarchy

<i>Pre-industrial</i>	<i>Historical/ present</i>	<i>CO<sub>2</sub> forcing / adjustments</i>	<i>Climate feedbacks</i>	
<p><b>3.1 ESM pre- industrial control</b></p>	<p><b>3.2 ESM historical</b></p> <p><b>3.3E AMIP SST</b></p>	<p><b>6.3,6.3E ESM Abrupt 4CO<sub>2</sub></b></p>		<p><b>6.1 ESM 1% per year CO<sub>2</sub></b></p>
<p><b>6.2a ATM + control SST climatology</b></p>	<p><b>6.4a/b ATM + control SST, present aero</b></p>	<p><b>6.2b ATM + control SST 4CO<sub>2</sub></b></p>	<p><b>CMIP5 Experiments with COSP</b></p>	
<p><b>CFMIP /CMIP5 Expts with full CFMIP outputs</b></p>	<p><b>3.3 ATM AMIP SST</b></p> <p><b>6.7a ATM Aquaplanet control</b></p>	<p><b>6.5 AMIP + 4CO<sub>2</sub></b></p> <p><b>6.7b ATM Aquaplanet + 4CO<sub>2</sub></b></p>	<p><b>6.8 AMIP uniform +4K</b></p> <p><b>6.7c Aquaplanet Uniform+4K</b></p>	<p><b>6.6 AMIP +4K SST pattern</b></p> <p><i>no carbon cycle or interactive vegetation</i></p>
<p><b>CGILS Experiments SCM &amp; LES</b></p>	<p><b>3 GPCI points AMIP SST</b></p>		<p><b>3 GPCI points AMIP SST+2K</b></p>	

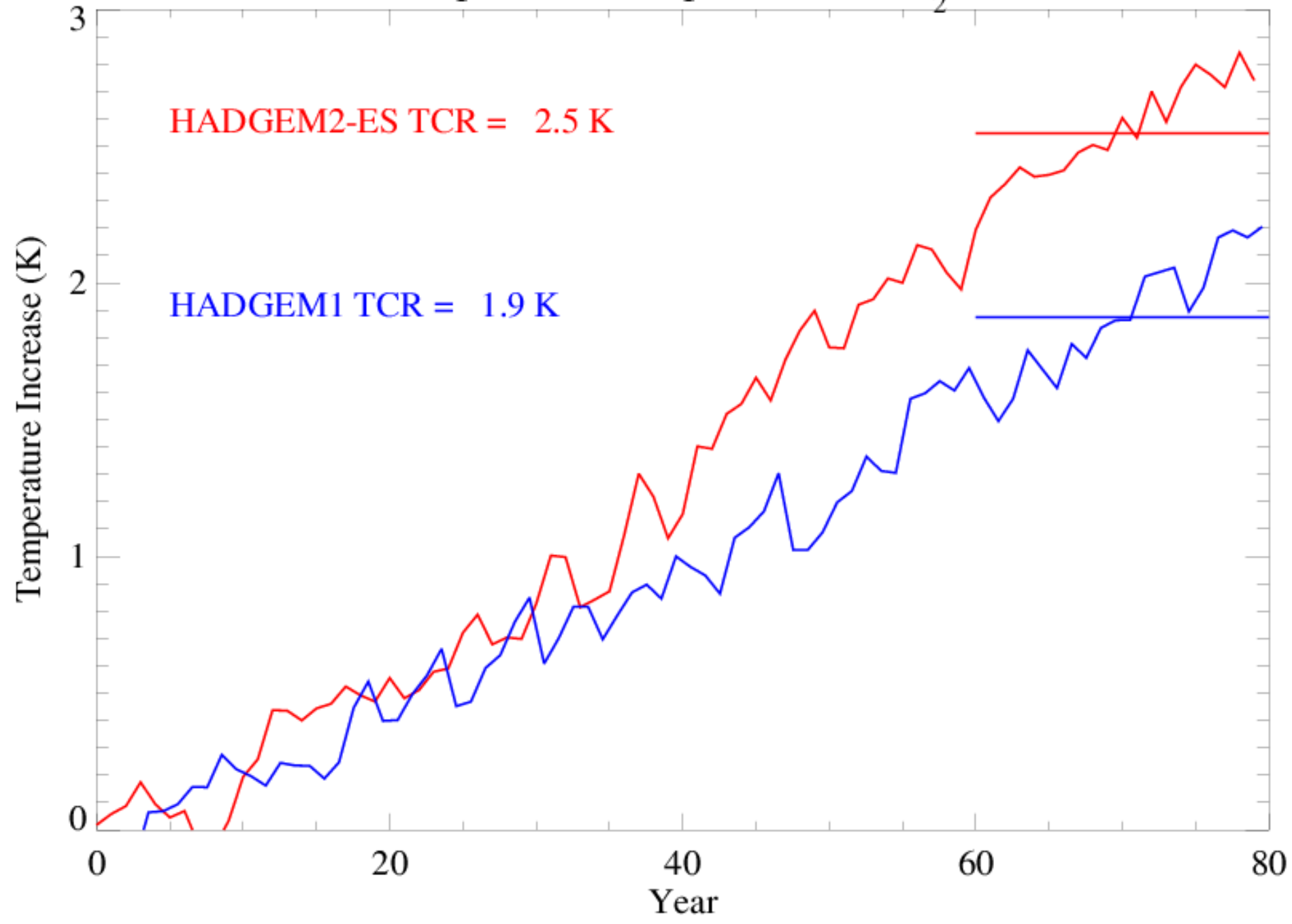
<b>CMIP5 Experiment Name</b>		<b>Status</b>
CFMIP2 AMIP	3.3	Due Q4/10
CFMIP2 4xCO2 AMIP	6.5	Due Q4/10
CFMIP2 AMIP plus 4K pattern	6.6	Due Q4/10
CFMIP2 AMIP plus uniform 4K	6.8	Due Q4/10
CFMIP2 Aqua planet control	6.7a	Due Q4/10
CFMIP2 4xCO2 aqua planet	6.7b	Due Q4/10
CFMIP2 Aqua planet plus 4K	6.7c	Due Q4/10
AOGCM pre-industrial control	3.1	CMIP5 Done, CFMIP 20 yr Sections Q4/10
AOGCM historical	3.2	CMIP5 Done, CFMIP 20 yr Sections Q4/10
AOGCM 1 percent per year CO2	6.1	CMIP5 Done, CFMIP 20 yr Sections Q4/10
Abrupt 4XCO2	6.3	CMIP5 Done, CFMIP 20 yr Sections Q4/10
Abrupt 4XCO2 11x5 years	6.3-E	Due Q4/10
Control SST climatology	6.2a	Due 2011
Control SST + 4CO2 forcing	6.2b	Due 2011
Control SST+ present aerosol	6.4a	Due 2011
Control SST+ present sulp. aerosol	6.4b	Due 2011

# HadGEM2-ES Effective 4CO<sub>2</sub> sensitivity

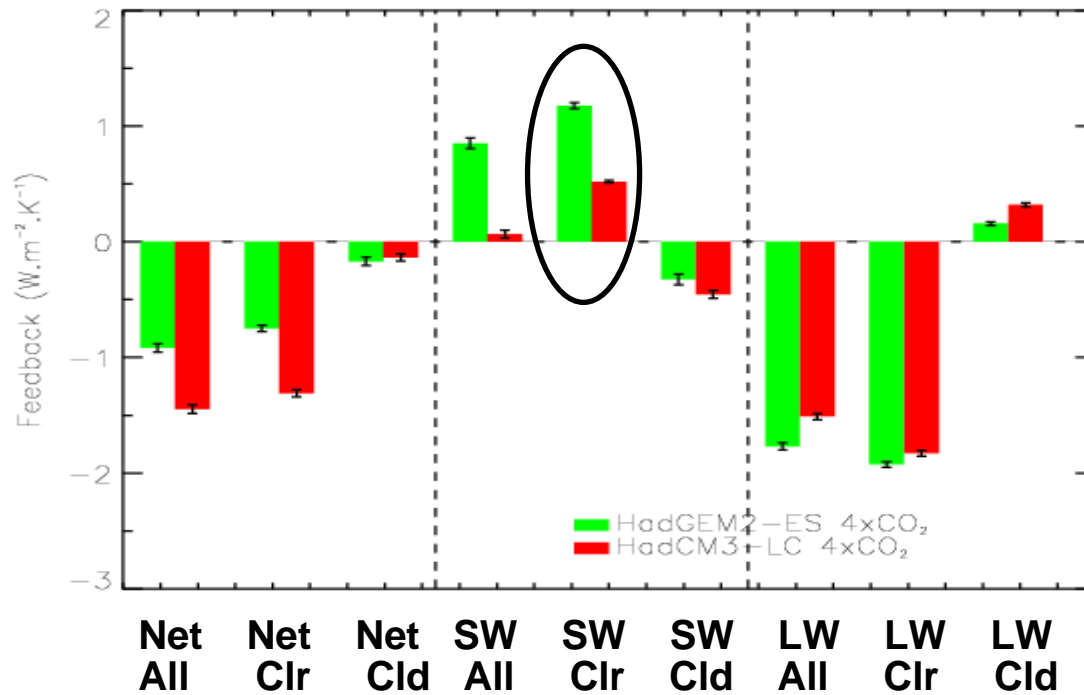


Marie Doutriaux-Boucher

Global Temperature Response 1% CO<sub>2</sub> Scenario.



■ HadGEM2-ES  
■ HadCM3



Higher climate sensitivity due to SW clear sky feedback

Sea ice or aerosol feedback?

Marie Doutriaux-Boucher



# Summary

HadGEM2 CFMIP-2 diagnostic development work completed

CMIP5 idealised AOGCM 'parent' experiments completed

Complete set of CFMIP-2 experiments on target for completion by Jan 2011

Climate sensitivity and transient climate response looks to be higher than HadGEM1/HadCM3 AOGCMs ( around 4.5 K )



# Supplementary slides



<b>Estimated dates for implementation of CFMIP diagnostic packages</b>	<b>CMIP5 table</b>	<b>UKMO - HadGEM2</b>	<b>ECHAM6-MPIOM</b>	<b>CNRM-CM5</b>	<b>IPSL CM5a/b</b>	<b>KNMI EC-Earth</b>
CMIP5 standard output (Amon, Amon 2D etc)	aMon	DONE	Q4/10	DONE	Q4/10	Q3/10
CFMIP monthly 3D -- Clouds, mass fluxes, internal radiative fluxes, tendencies temperature, humidity and cloud.	cfMon	DONE	PART	PART	Q4/10	Q4/10
CFMIP monthly 4CO2 2D -- monthly mean TOA radiative fluxes calculated by instantaneously quadrupling CO2.	cfMon	DONE	Q4/10	Q3/10	Q4/10	Q4/10
CFMIP monthly 4CO2 3D -- monthly mean 3-D radiative fluxes calculated by instantaneously quadrupling CO2.	cfMon	DONE	Q4/10	Q3/10 Net	Q4/10	Q4/10
CFMIP monthly inline -- monthly mean in line ISCCP and CALIPSO/PARASOL simulator output from COSP	cfMon	DONE	Q4/10	DONE off-line	Q4/10	Q4/10
CFMIP daily 2D -- daily mean 2-D fields including inline ISCCP/CloudSat/CALIPSO/ PARASOL simulator output	cfda	DONE	Q4/10	DONE off-line	Q4/10	Q4/10
CFMIP daily 3D -- daily mean 3-D fields on model levels plus CALIPSO and ISCCP cloud fractions	cfda	DONE	Q4/10	DONE off-line	Q4/10	Q4/10
CFMIP 3-hourly orbital offline -- CloudSat/CALIPSO /PARASOL simulator output in orbital curtain format	cf3hr	DONE	Q4/10	Q4/10	Q4/10	Q4/10
CFMIP 3-hrly inline -- Instantaneous 3 hourly global 'snapshot' data for future simulator development	cf3hr	DONE	Q4/10	DONE	Q4/10	Q4/10
CFMIP monthly offline -- monthly mean gridded simulator output based on CFMIP 3-hrly orbital offline	cfOff	DONE	Q4/10	Q4/10	Q4/10	Q4/10
CFMIP timestep station data -- 2-D and 3-D fields on model levels at 20 to 30 minute intervals at 118 point locations.	cfSites	DONE	Q4/10	Not known	Q4/10	Q4/10



# Outline

## Hadley Centre Global Environment Model 2

Fully coupled Earth System Model (N96 L38)

- Atmosphere, ocean, sea-ice, land surface
- Land ecosystems: dynamic vegetation, soil carbon
- Ocean ecosystems: NPZD, diatoms, non-diatoms, DMS
- Aerosols: sulphate, black & organic carbon, dust, sea salt
- Tropospheric chemistry: ozone, methane, oxidants