GCSS WG4 Activities

ARM/CERES/WG4 meeting

Jon Petch, Wednesday 3rd November

Steve Woolnough, Wojtek Grabowski, Martin Willett,
Peter Bechtold, Ricky Wong

Detailed but interesting result

Contents

- Important issues for WG4
  - Scientific focus
  - Participation
- Ongoing previous case
  - Case 4 (LBA – diurnal cycle)
- New case: Case 5 – transition of tropical convection
  - Description & motivation
  - Preliminary results
    - CRM, SCM and NWP

GCSS

Global Energy and Water Cycle Experiment

GEWEX

WCRP

Cloud System Studies

- Develop the scientific basis for the parameterization of cloud processes.
- Highlight key issues and encourage other relevant programs to address them.
- Promote the evaluation and intercomparision of parameterization schemes for cloud processes.

Super parametrization

BAMS: 2003, 84,455-468.

CONFRONTING MODELS WITH DATA

The GEWEX Cloud Systems Study

BY DAVID RANDALL, STEVEN KRUEGER, CHRISTOPHER BRETHERTON, JUDITH CURRY, PETER DUYNKERKE,* MITCHELL MONCRIEFF, BRIAN RYAN, DAVID STARR, MARTIN MILLER, WILLIAM ROSSOW, GEORGE TSELIOUDIS, AND BRUCE WIELICKI

A group of cloud modelers and global modelers has gradually learned how to make the most of the available observations.

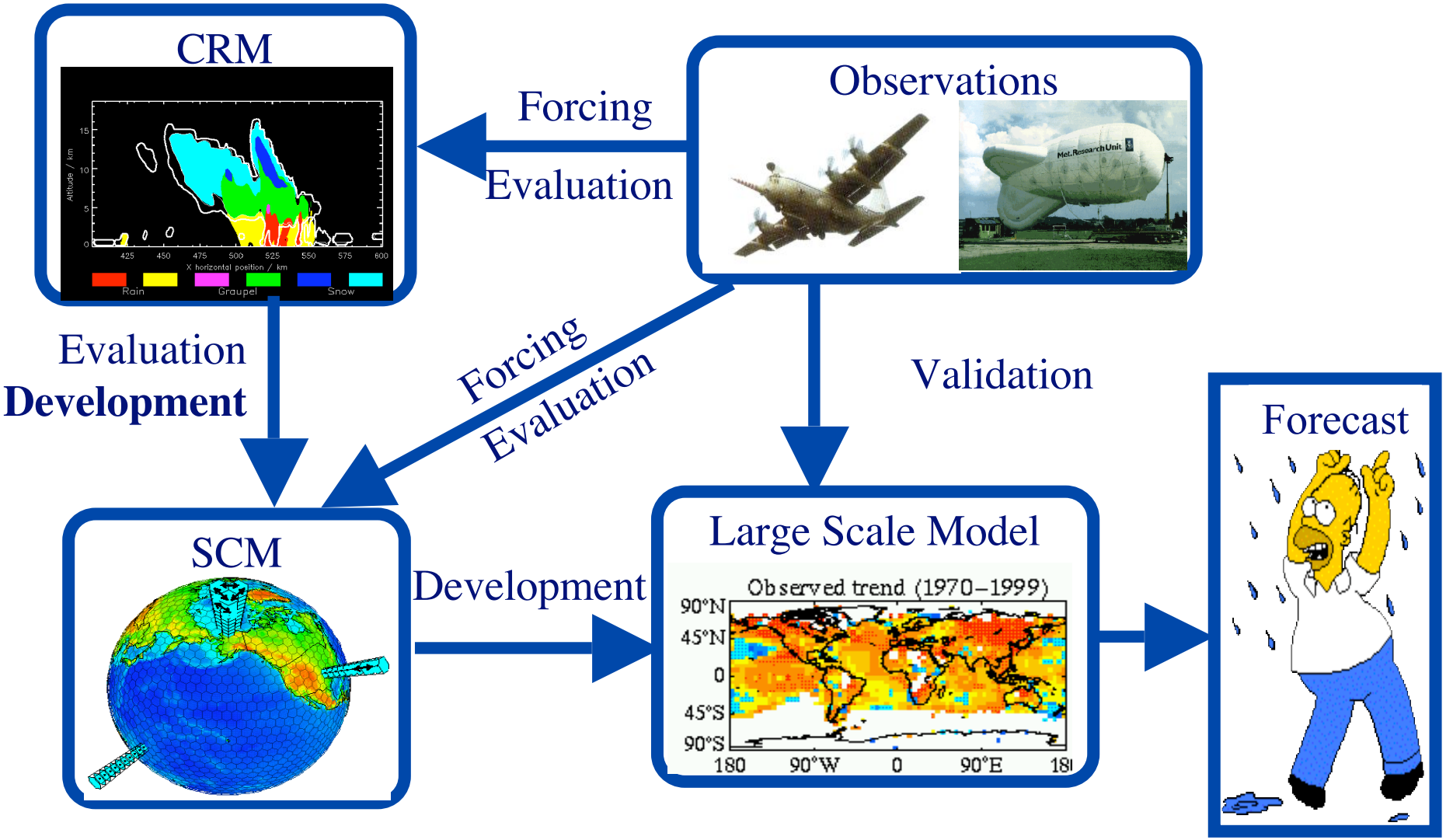
Focus for GCSS Working group 4

Scientific focus of WG4

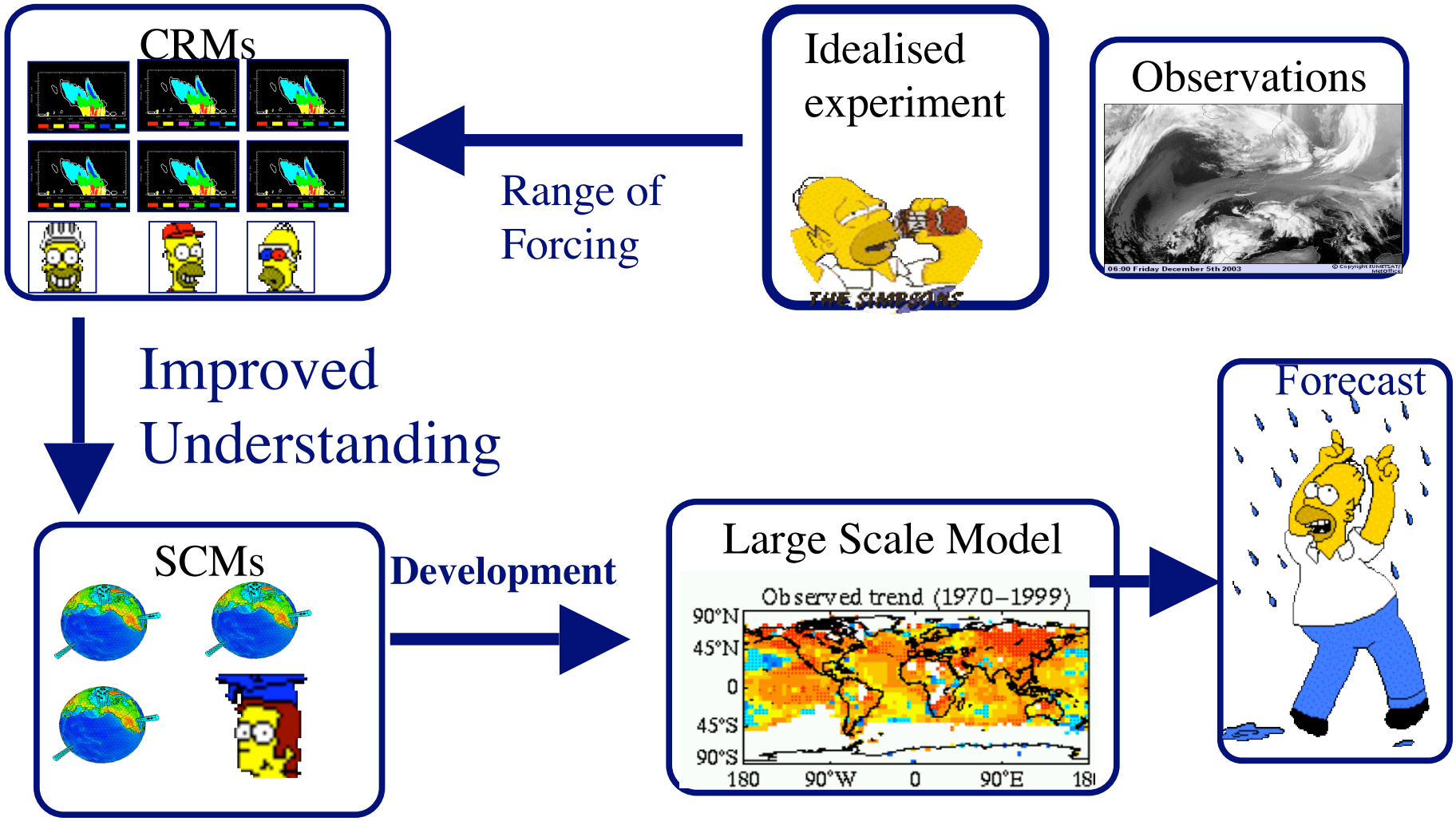
♣ The goal of GCSS Working Group 4 (WG 4) is to improve the parametrization of precipitating convective cloud systems in global climate models and numerical weather prediction models through an improved physical understanding of cloud system processes.

Strengthen

Working group 4 methodology



Different uses of a CRM: Indirect - Improved physical understanding



Active numbers in WG4

- There has been a decline in the active participants of WG4, including intercomparison studies
  - Case 2
    - 8 CRMs; 9 SCMs
  - Case 3 (joint with ARM)
    - 10 CRMs; 15 SCMs
  - Case 4
    - 5 CRMs; 2 SCMs (EC & MO); 1 NWP-CRM (MO)

Active numbers in WG4

- Attempts to address this in new work
  - Stronger focus on responding to NWP/Climate centre requirements
  - An expanded experimental framework for case 5
    - CRMs; SCMs; LAMs; Global NWP models
  - This presentation to ARM!

News from GCSS Panel meeting

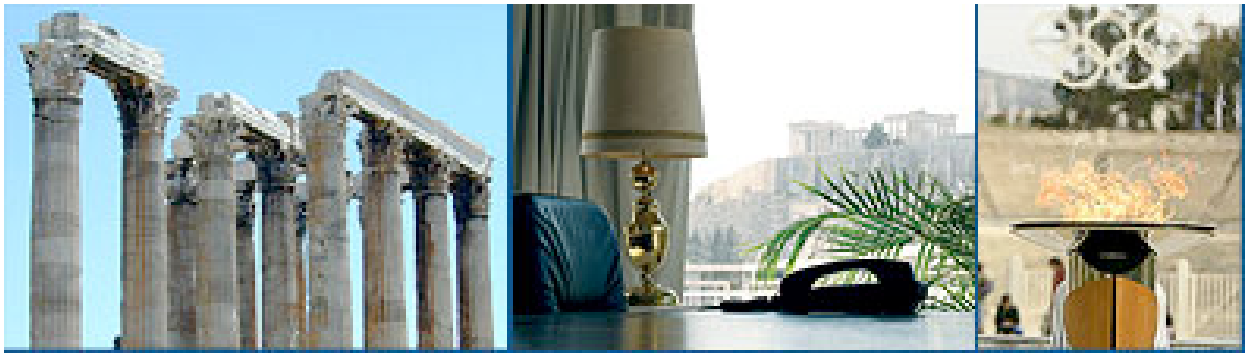
- **Pan-GCSS meeting in Athens 16-21 May 2005**
- All Welcome
- Call for papers soon
- Poster based with selected papers chosen for talks too (ARM style?)
- Invited guest speakers:
  - Julia Slingo, Dennis Hartmann, Judy Curry, Rob Wood
  - Tony DelGenio, Ulrike Lohmann, Adrian Tompkins
  - Dave Randall, Chris Bretherton, Ed Zipser

Pan-GCSS meeting

♣ The Royal Olympic's delightfully situated just across from the Temple of Zeus, within walking distance from the Acropolis, the Old Town (Plaka) and the central shopping district.

Olympic Palace

Royal Olympic Hotel



Good views

Communication

- e-mail list
  - Not overly used!
- Regularly updated web page for WG4
  - News section
  - Project plan for new case
  - Links to show where WG4 fits in to WCRP
  - Links to DIME

WG4 web page – www.convection.info

MX MH MW AP Me R C E BN N&S MO ? Wthr Met Lib UM AV Comp More NEW

GCSS - Working Group 4

Precipitating convective cloud systems

Contact information		Structure	Key links related to WG4
GCSS Chair	Christian Jakob c.jakob@bom.gov.au	WCRP	GCSS Dime
WG4 Chair	Jon Petch jon.petch@metoffice.gov.uk	GEWEX (GMPP)	EUROCS
WG4 mail list	gcsswg4@metoffice.gov.uk	GCSS WG4	SCM Page (CSU)

Home page

Recent news

- **[07/09/04]** New page: Joint CPT/WG4 case - Idealized Walker Circulation RCE SCM/CRM intercomparison [html]
- **[20/08/04]** Message from Steve Klein about the ARM/CERES/WG4 meeting[txt]
- **[02/08/04]** A presentation of the RCE case made at ICCP (work in progress;do not use without permission of Chris Bretherton)[pdf]
- **[27/07/04]** A presentation of the tropical case made at ICCP (please do not without the permission of Jon Petch)[ppt]
- **[27/07/04]** Summary of WG4 meeting at ICCP 2004 (e-mail to WG4)[txt]
- **[13/07/04]** Plans & meetings update (e-mail to WG4)[txt]
- **[21/05/04]** Plans for coming meetings (e-mail to WG4)[txt]
- **[5/5/04]** Quick survey about meetings (e-mail to WG4)[html]
- **[28/4/04]** News update (e-mail to WG4)[html]
- **[16/3/04]** News update (e-mail to WG4)[html]
- **[1/3/04]** New WG4 mail list address and automatic (un)subscription procedure[html]
- **[29/1/04]** Summary of responses to letter of 13/1/04 [html]
- **[13/1/04]** Message to WG4 mail list canvasing opionion on future meetings [txt]

WG4 work

- Intercomparisons (links to current and past WG4 intercomparison pages
  - Case 5: Transition of tropical convection: [html]
  - Joint CPT/WG4 case: Idealized Walker Circulation Radiative Convective Equilibrium SCM/CRM intercomparison [html]
- Published work (not recently updated but a good starting point)
- Meetings (future and past)

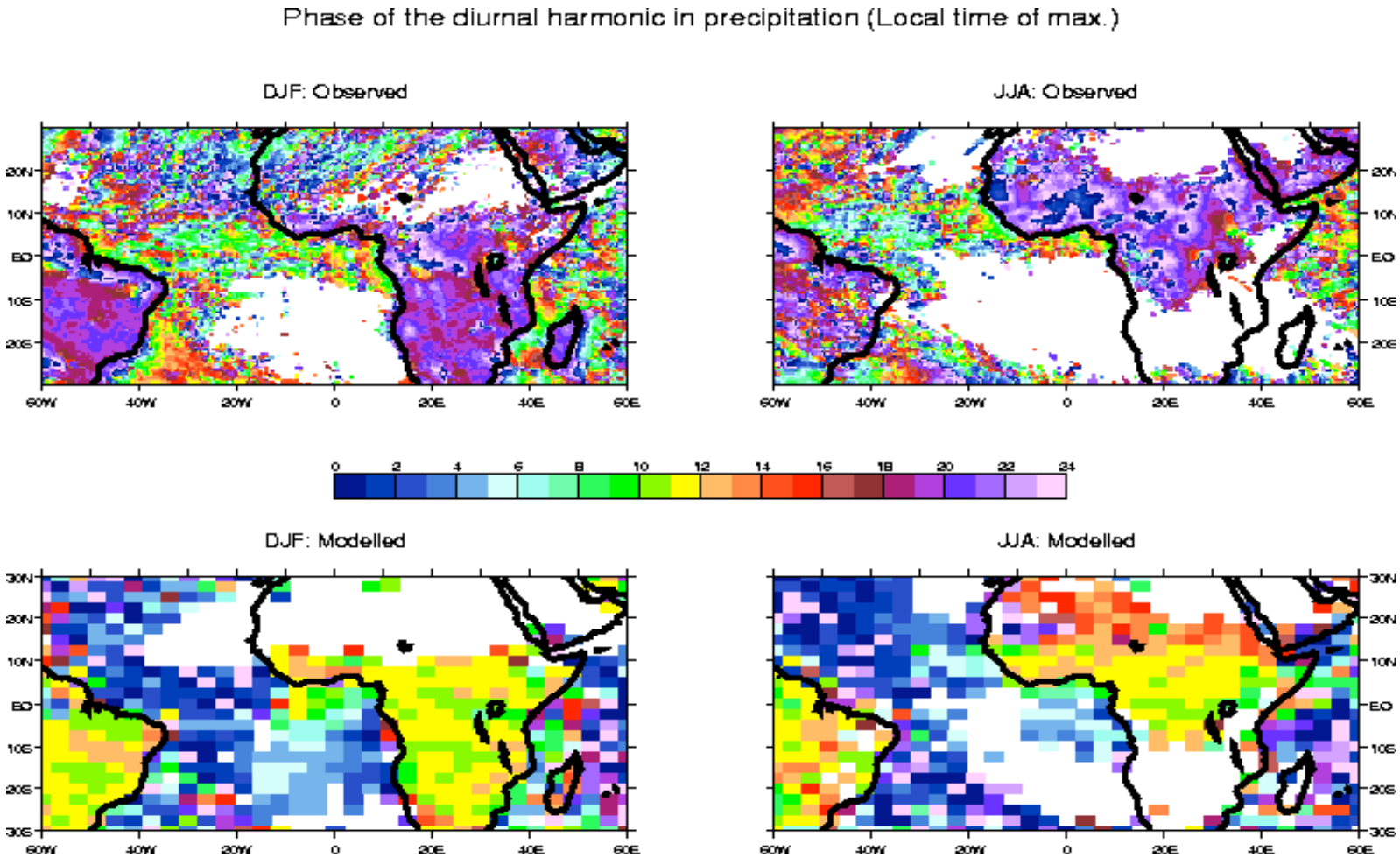
About GCSS WG4

The goal of GCSS Working Group 4 (WG 4) is to improve the parametrization of precipitating convective cloud systems in global climate models (GCMs) and numerical weather prediction models through an improved physical understanding of cloud system processes. The main tools of GCSS WG 4 are:

Diurnal cycle case EUROCS and GCSS WG4 Case 4

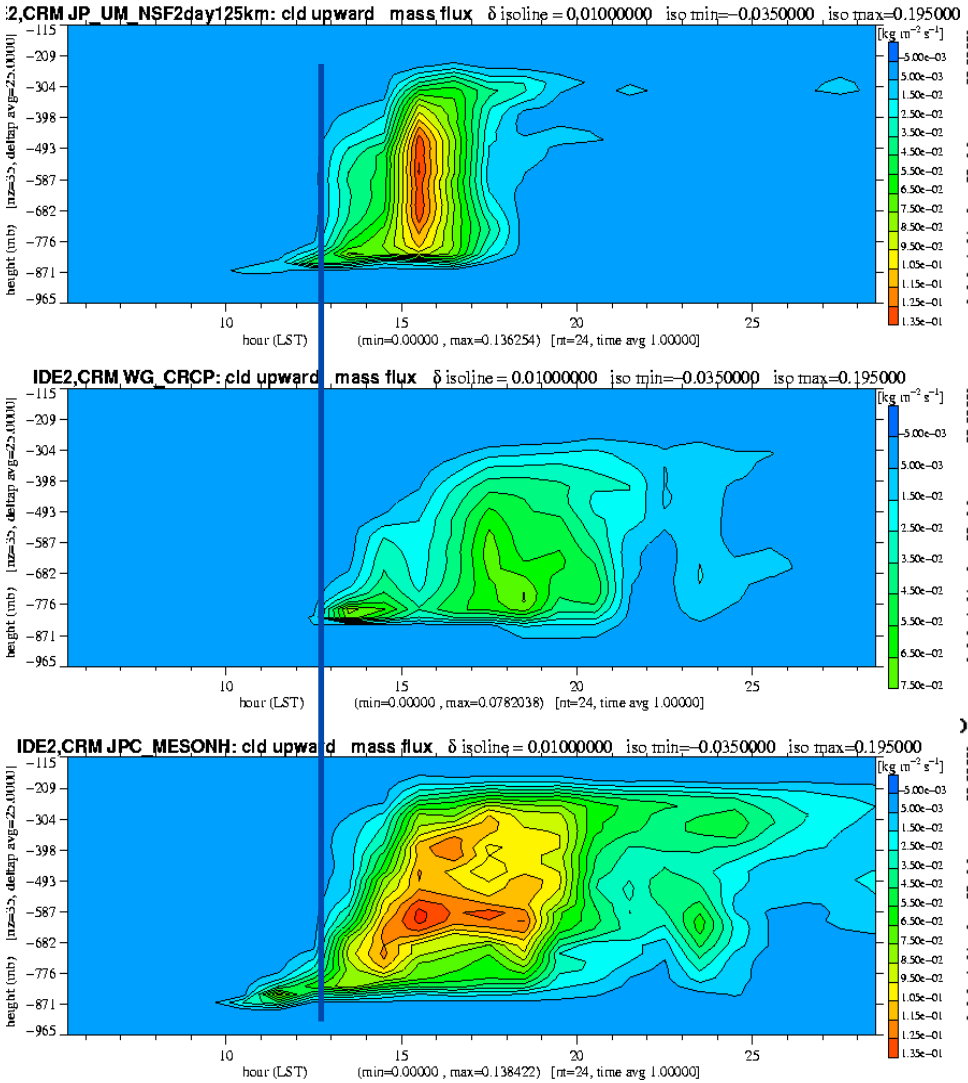
The diurnal cycle over land

♣UM: Yang and Slingo 2001

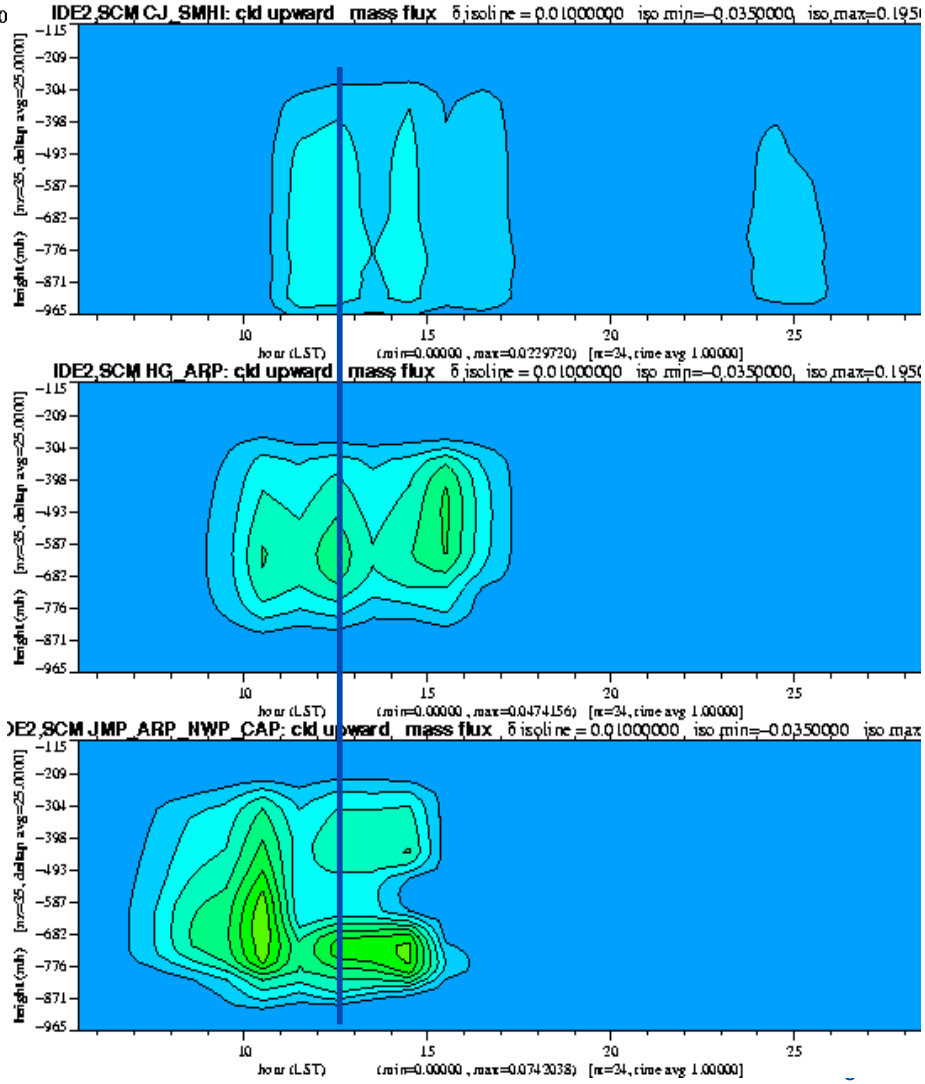


CRM/SCM Intercomparison

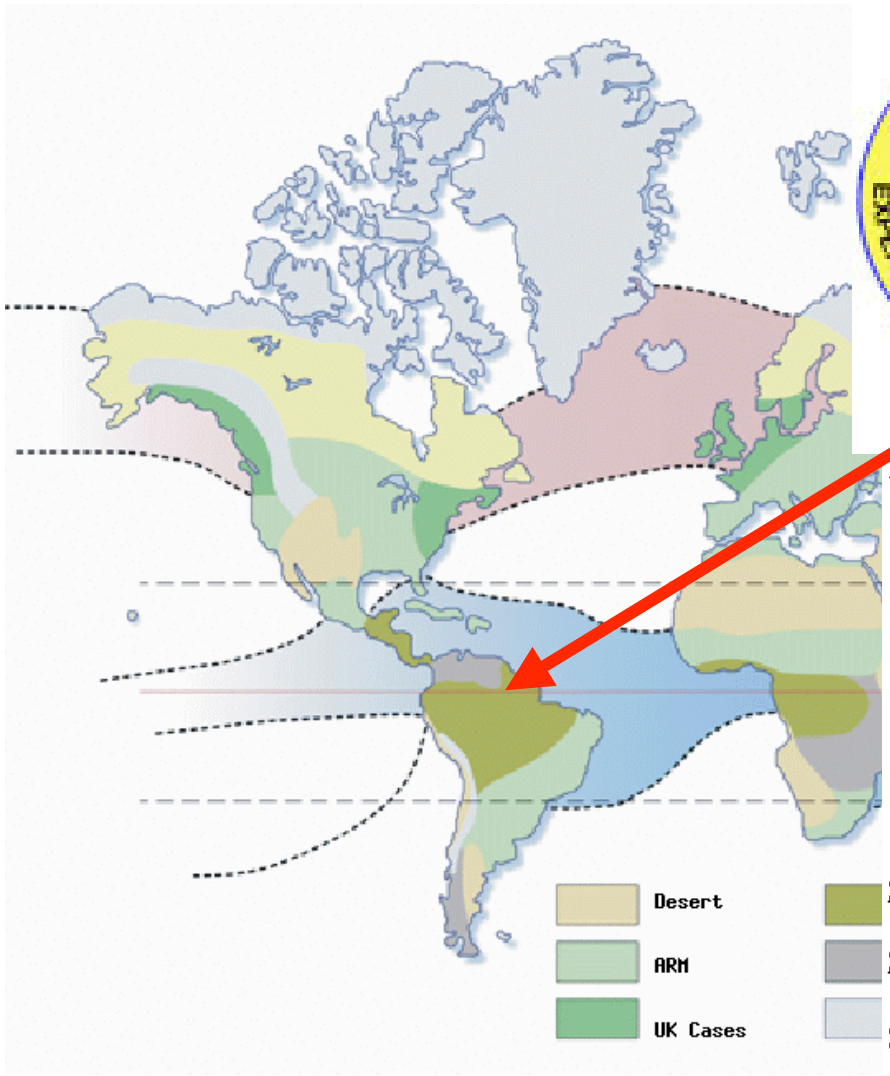
CRMs : massflux_up , 1h avg

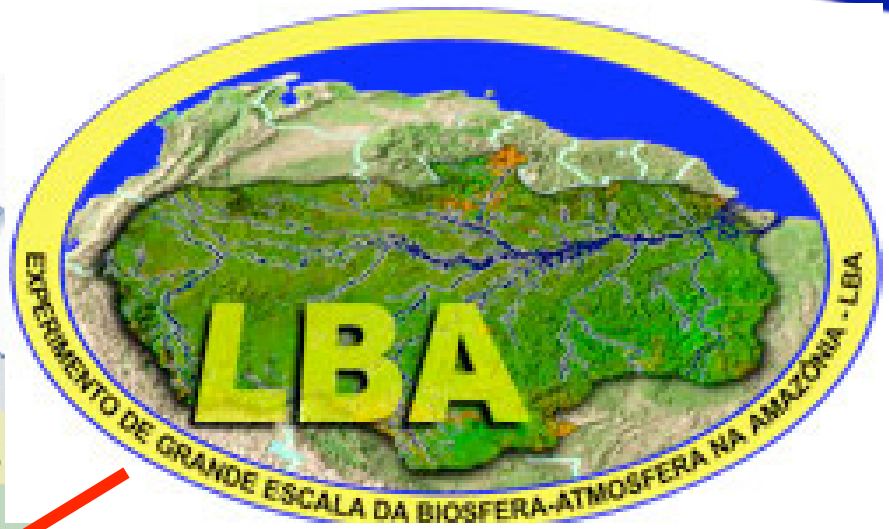


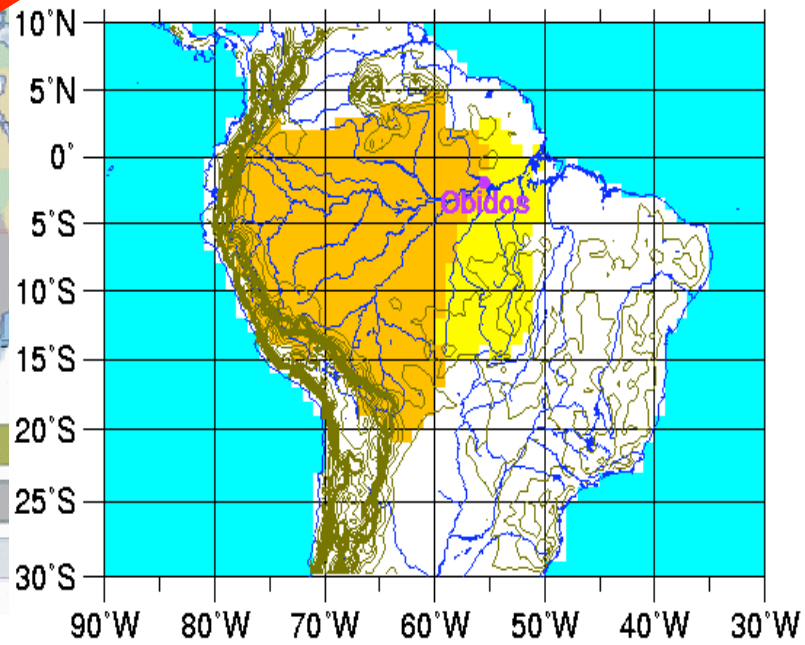
SCMs : mas



GCSS Case 4 (LBA)







On-going previous case

- **Case 4 (W Grabowski): LBA diurnal cycle**
  - Paper submitted October 2004
    - Benchmark LES type simulation
    - SCMs deepen too early and too quickly
    - Some CRMs improve with higher resolution
  - Plans to expand comparison to investigate surface processes using interactive surface schemes in a year

The submitted paper

Q. J. R. Meteorol. Soc. (2005), **131**, pp. 1–999 doi: 10.1256/qj.04.?

Daytime convective development over land: a model intercomparison based on LBA observations

By W. W. GRABOWSKI[1]* P. BECHTOLD[2], A. CHENG[3], R. FORBES[4], C. HALLIWELL[4], M. KHAIROUTDINOV[5], S. LANG[6], T. NASUNO[7] J. PETCH[8], W.-K. TAO[6], R. WONG[8], X. WU[9], AND K.-M. XU[3]

[1] *NCAR, Boulder, Colorado, USA*
[2] *ECMWF, Reading, UK*
[3] *NASA Langley, Hampton, Virginia, USA*
[4] *Met Office JCMM, Reading, UK*
[5] *CSU, Fort Collins, Colorado, USA*
[6] *NASA Goddard, Greenbelt, Maryland, USA*
[7] *FRSGC, Yokohama, Japan*
[8] *Met Office, Exeter, UK*
[9] *ISU, Ames, Iowa, USA*

(October 2004)

Submitted October 2004

Submitted October 2004

SUMMARY

This paper investigates daytime convective development over land and its representation in single-column models (SCMs) and cloud-resolving models (CRMs). A model intercomparison case is developed based on observations of the diurnal cycle and convection during the rainy season in Amazonia. The focus is on the 6-hr period between sunrise and early afternoon which was identified in previous studies as critical for the diurnal cycle over summertime continents in weather prediction and climate models.

New case: Transition of tropical convection

Case 5: motivation

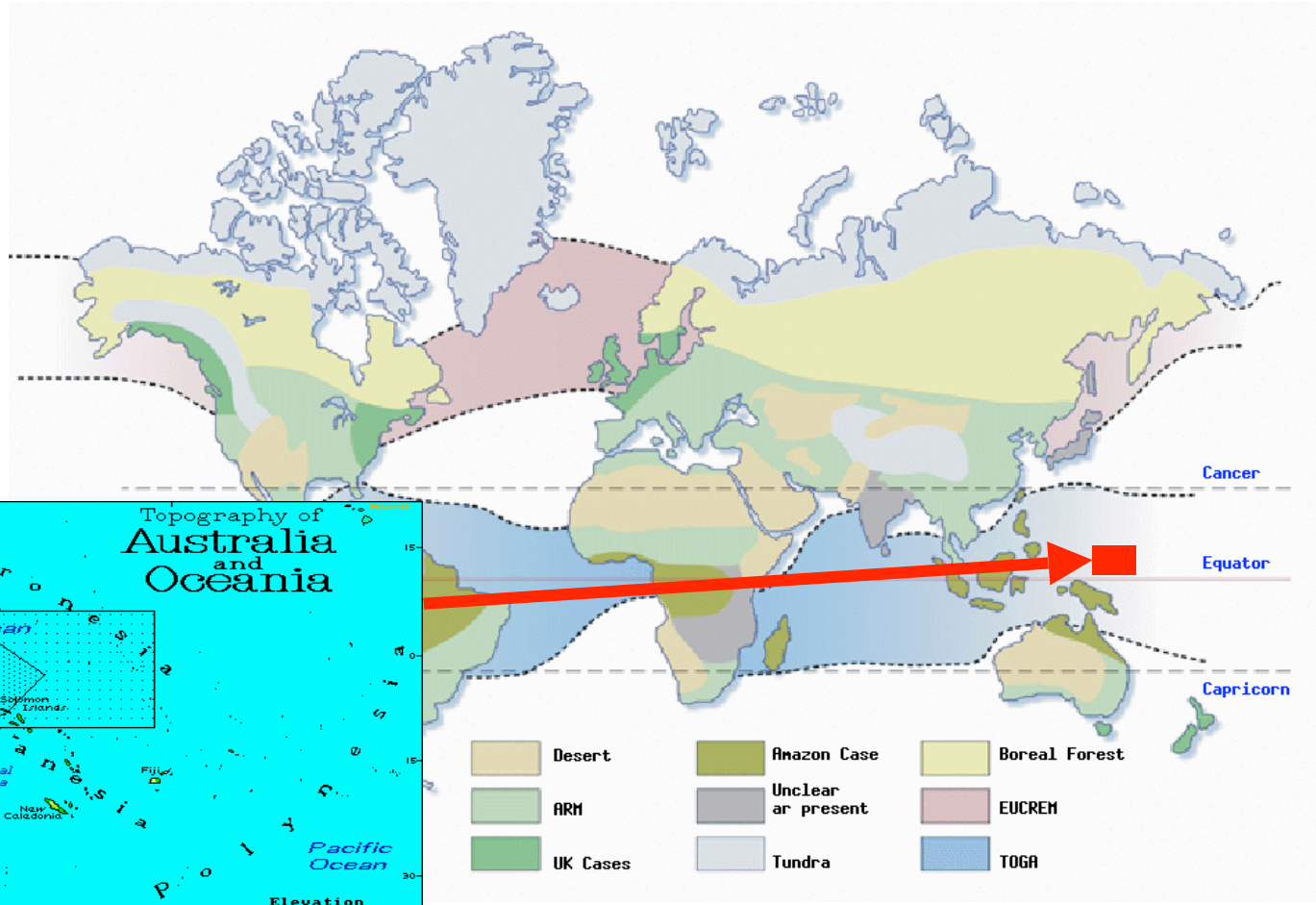
- Transition of tropical convection (TTC)

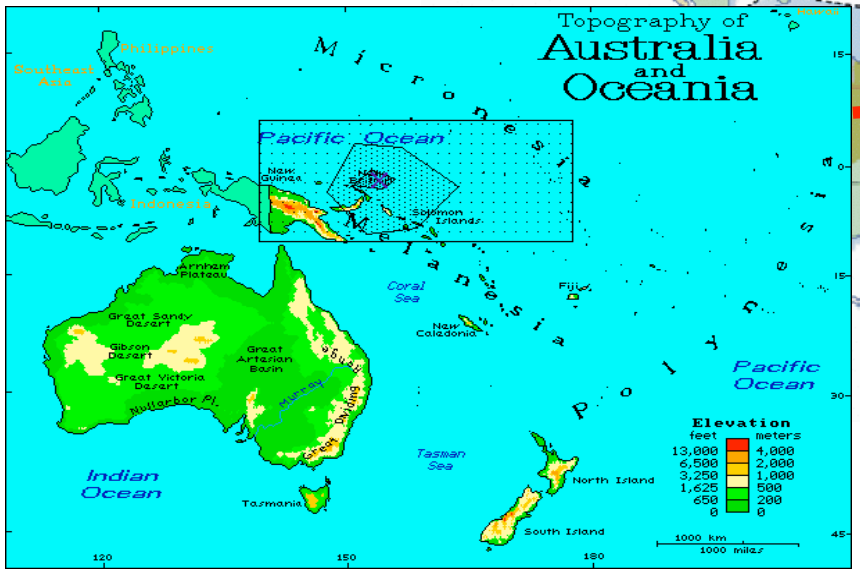
- Parametrization of convection in the tropics is important for NWP and climate
- Suppressed period of convection, especially congestus, can be difficult to parametrize
  - Important process in the MJO
  - Mechanism for moistening mid-troposphere
  - Transition to deep also difficult to parametrize
- Make closer links between the SCM/CRMs and full GCMs

Case 5: description & goals

- Transition of tropical convection (TTC)
-
- Simulate suppressed and active convection using a range of numerical models: CRMs, SCMs and NWP
  - Active deep convection to spin up CRMs
  - Suppressed period dominated by shallow cumulus and congestus
  - Transition to more active deep convection after a couple of days
- Goals
  - Improved understanding of links between SCM and NWP results
  - Improved understanding of processes involved during congestus activity and transition to deep
  - Identification of key deficiencies in current convection or cloud schemes for representing congestus and transition to deep
    - Driven by NWP centres (NCAR, GFDL, Met Office and ECMWF)

Tropical West Pacific : TOGA-COARE





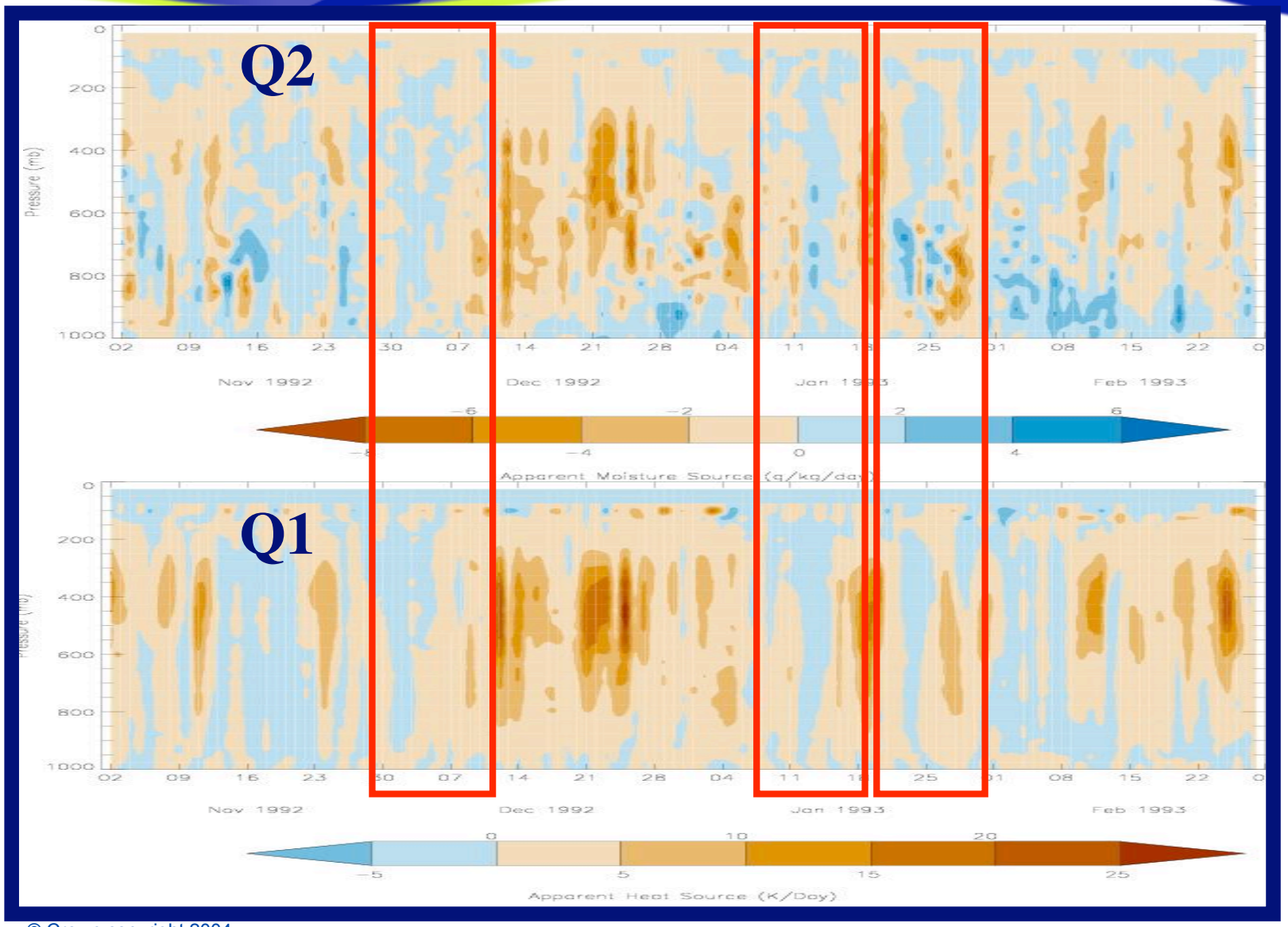
Overall plan: The forcing

- **Simulation of up to three periods from TOGA-COARE**
  - At least 2 will be strongly forced followed by suppressed period and then strongly forced again
- **NWP**
  - Initialization from ECMWF reanalysis
  - 24-48 hour forecasts from chosen periods
  - *Use nested model down to 1km grid length to produce LAM and CRM/SCM forcing data*
- **CRMs & SCMs**
  - Initialize and drive with observational forcing (Ciesielski or Zhang?)
  - SCMs run free for 10 days and as NWP (24-48 hour forecasts)
  - CRMs run free only?
  - (Some) CRMs and SCMs forced with NWP dataset

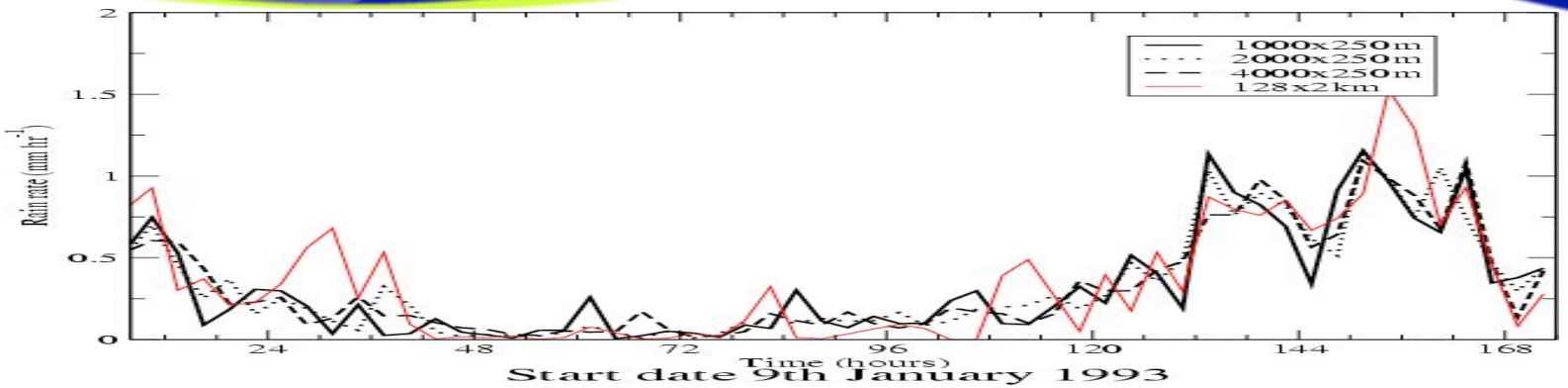
Preliminary results

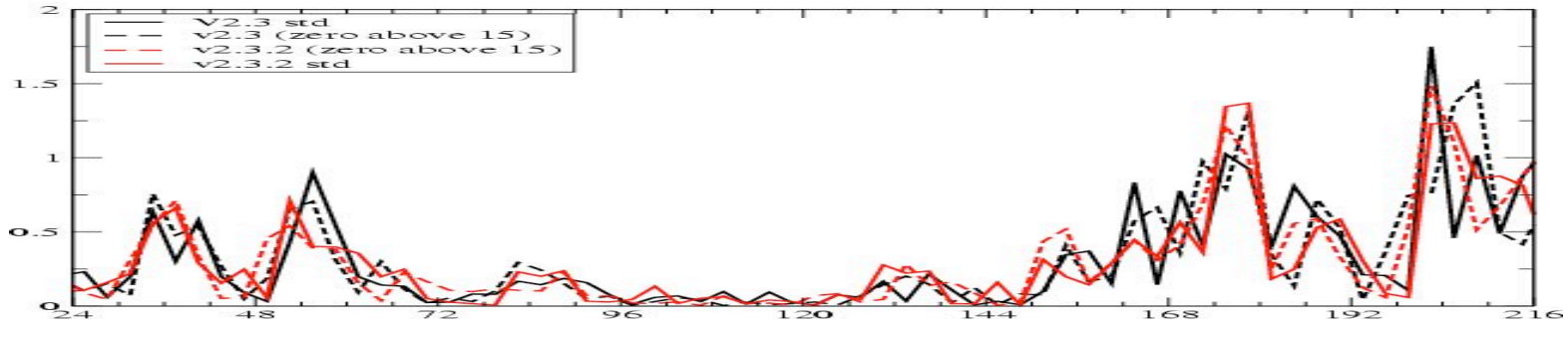
- **CRM and SCM & 2 NWP models**
  - CRM is 2D; 500m horizontal grid length or better; 250km domain or bigger
  - SCM run free and 24-48 hour forecast mode
    - uses standard physics of climate and NWP model
  - NWP models run from ERA 40 data
    - ECMWF
    - Met Office

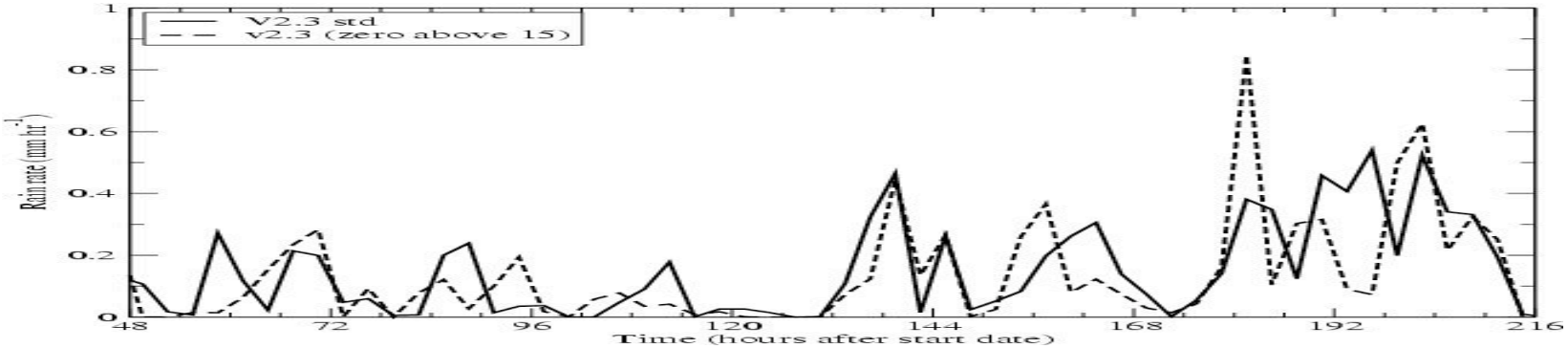
3 periods: Q1 and Q2



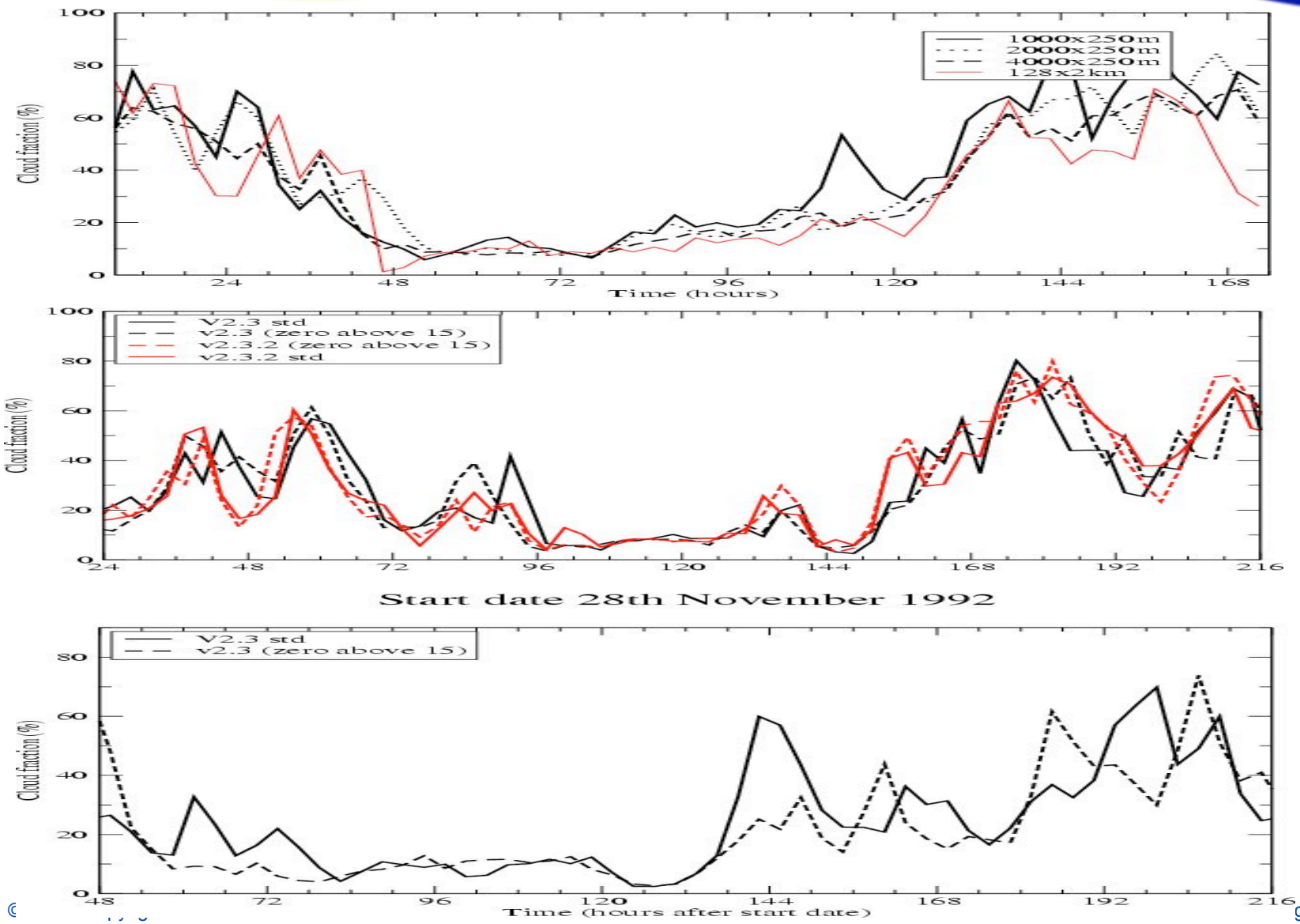
Rain rate from CRM: 3 periods



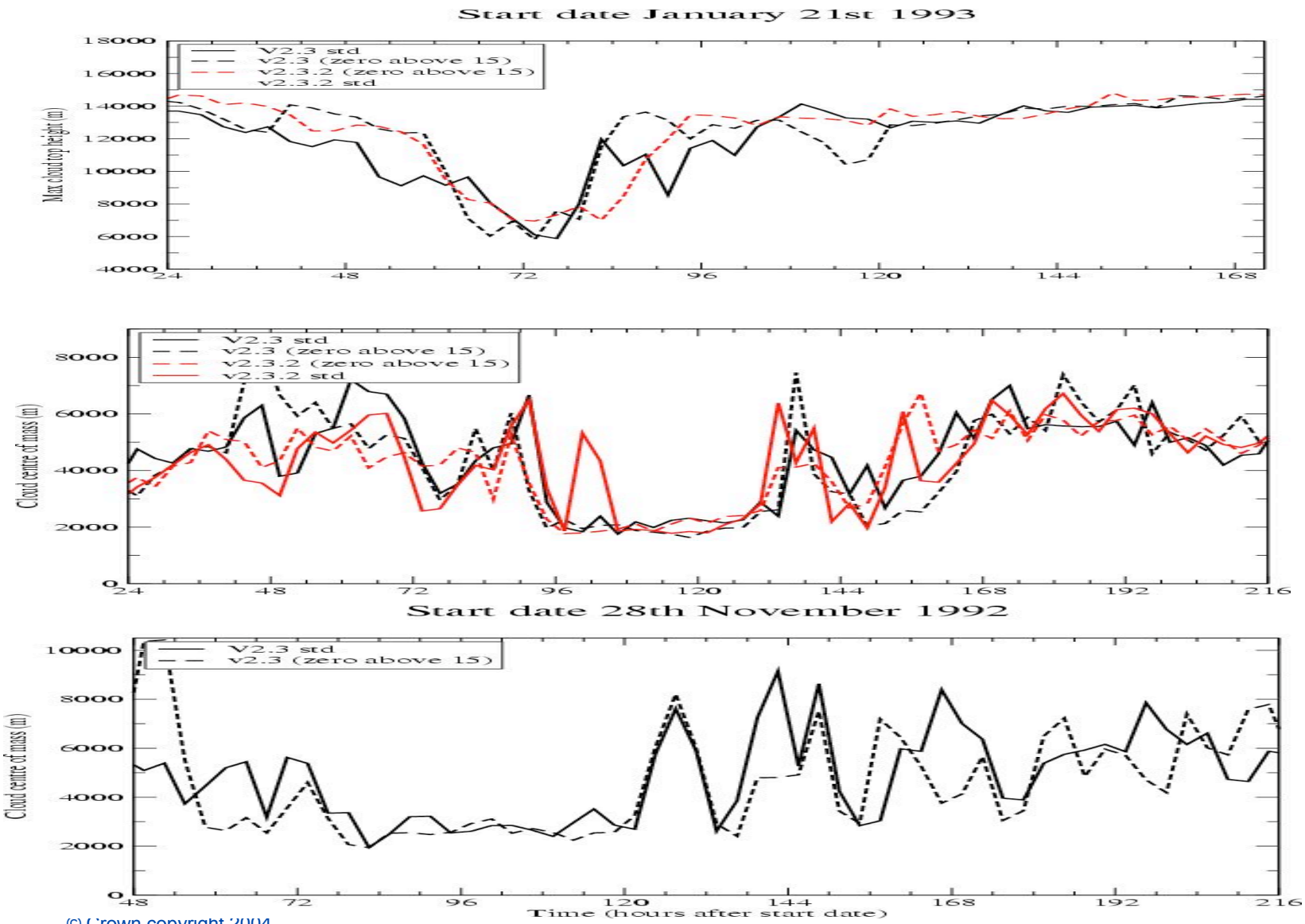




Cloud fraction 3 periods

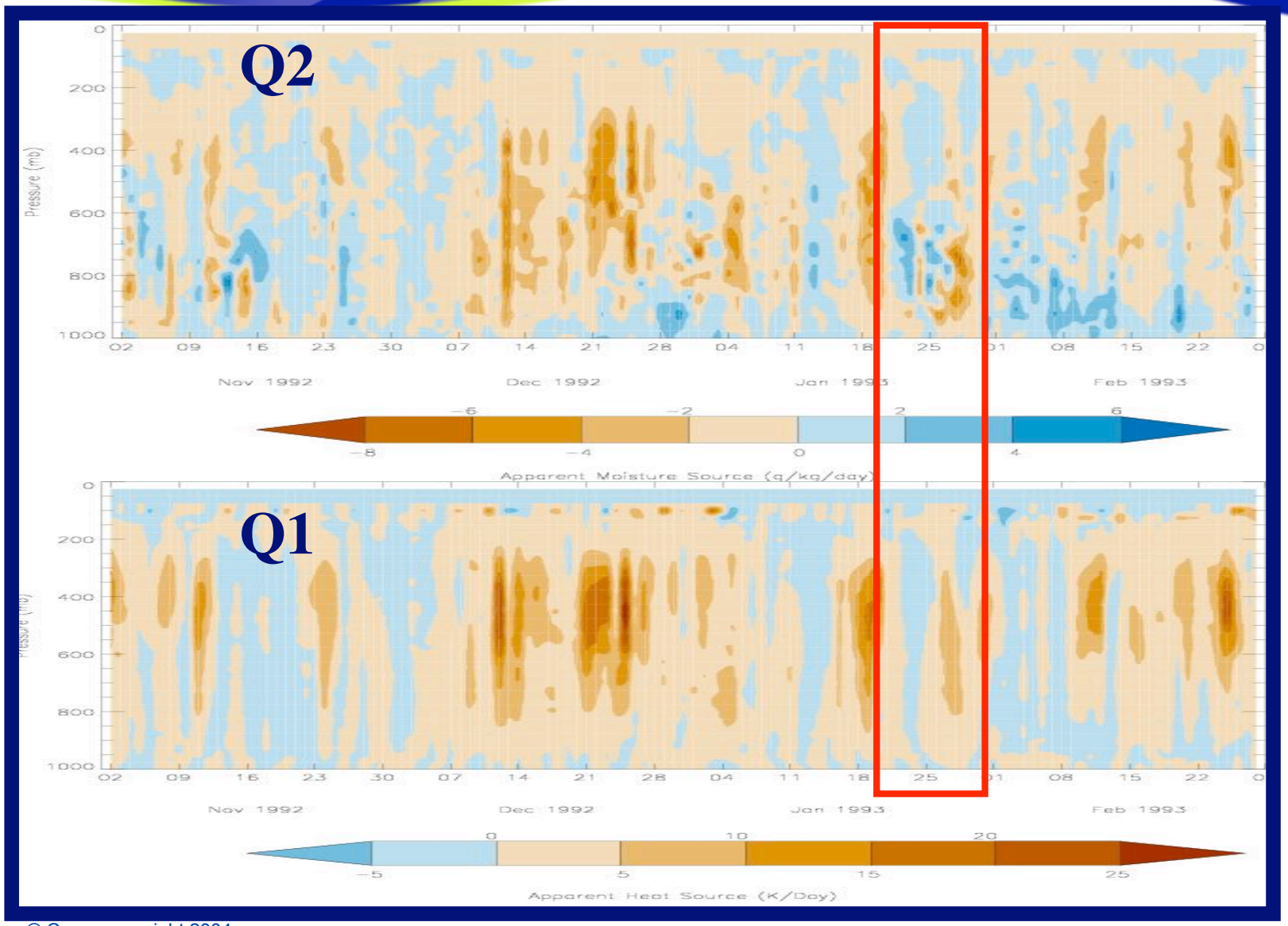


Cloud top height 3 periods

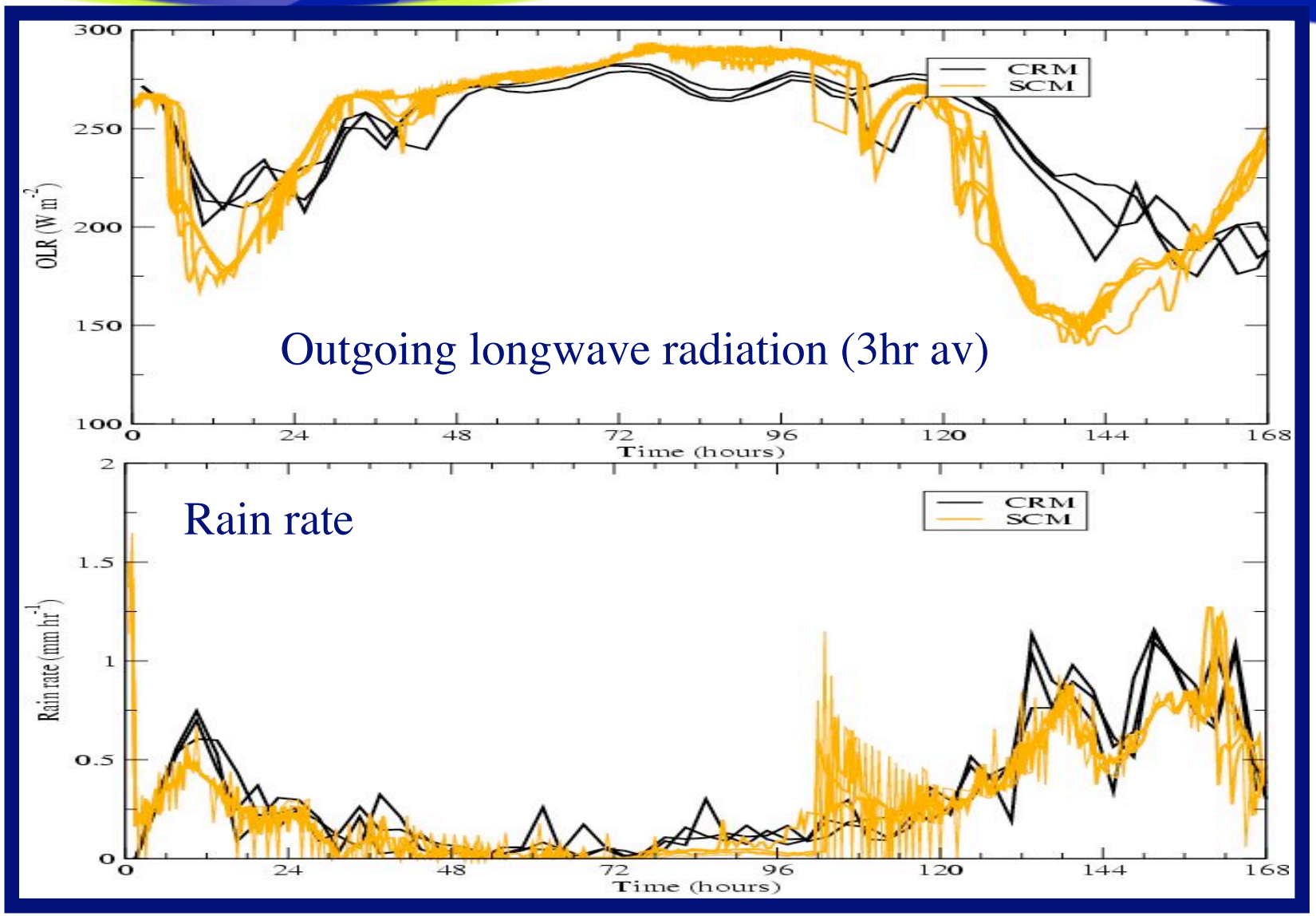


CRM & SCM comparisons

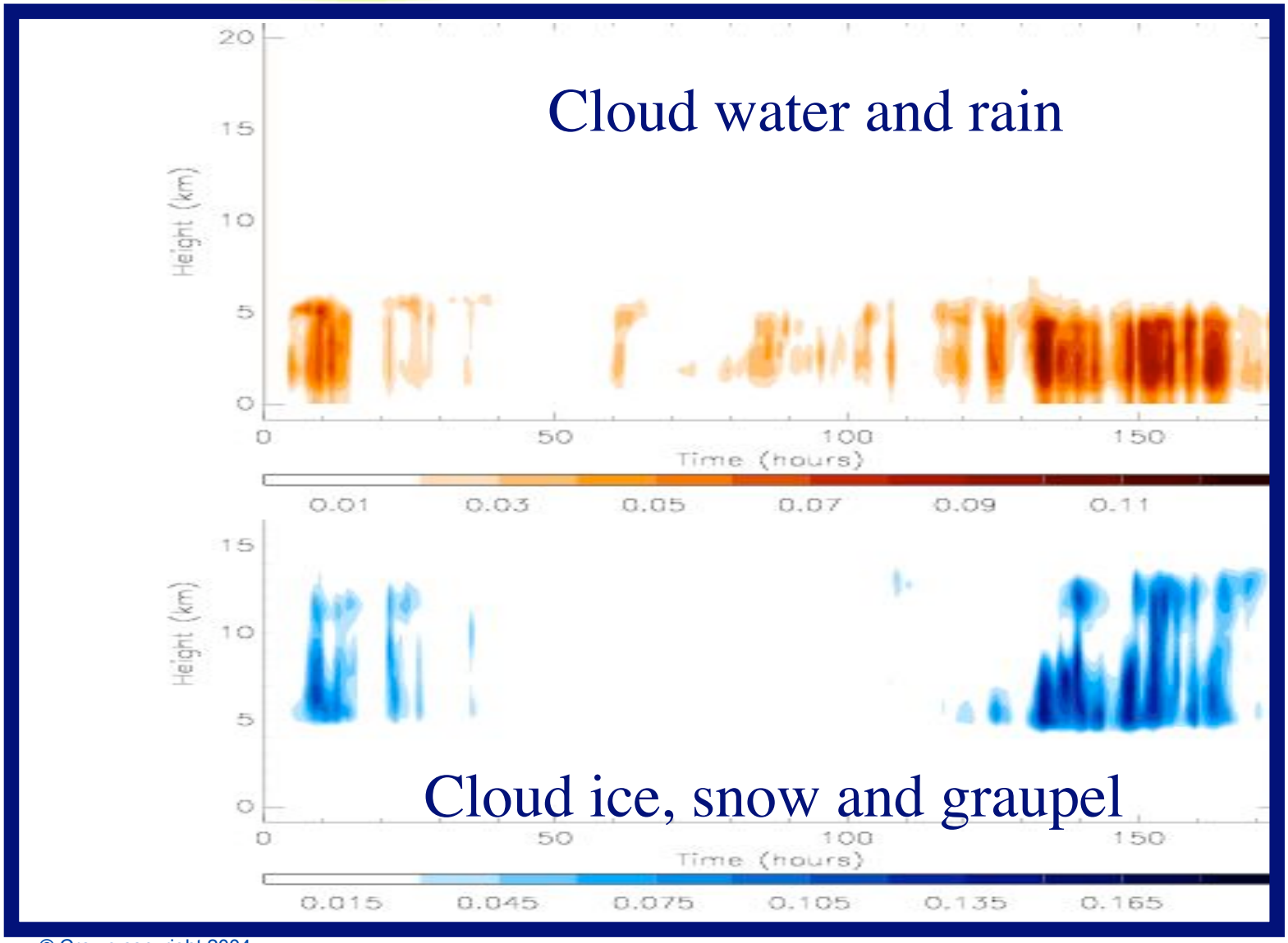
One 7 day period: Q1 and Q2



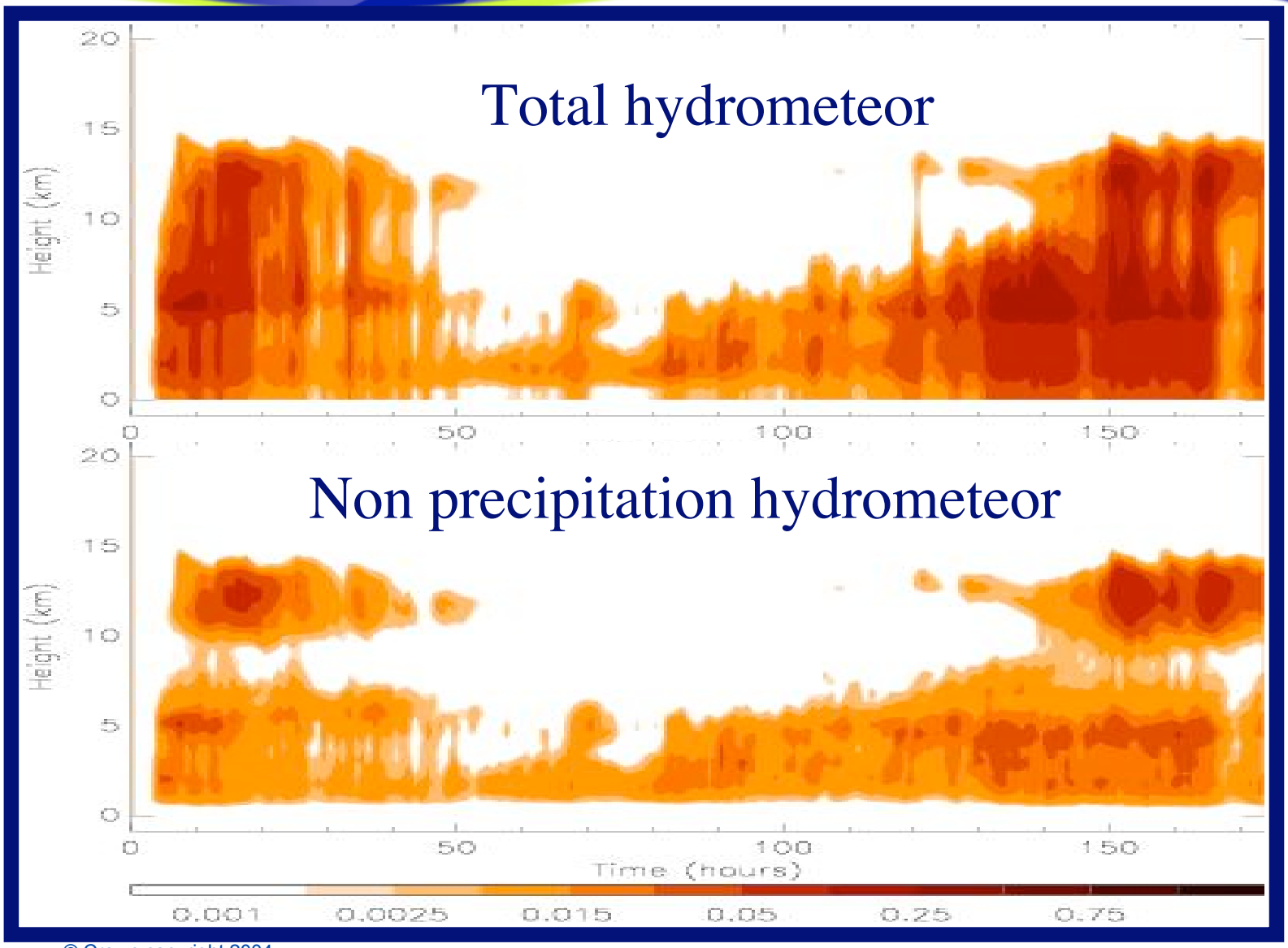
Timeseries of OLR and rain rate: CRM vs SCM



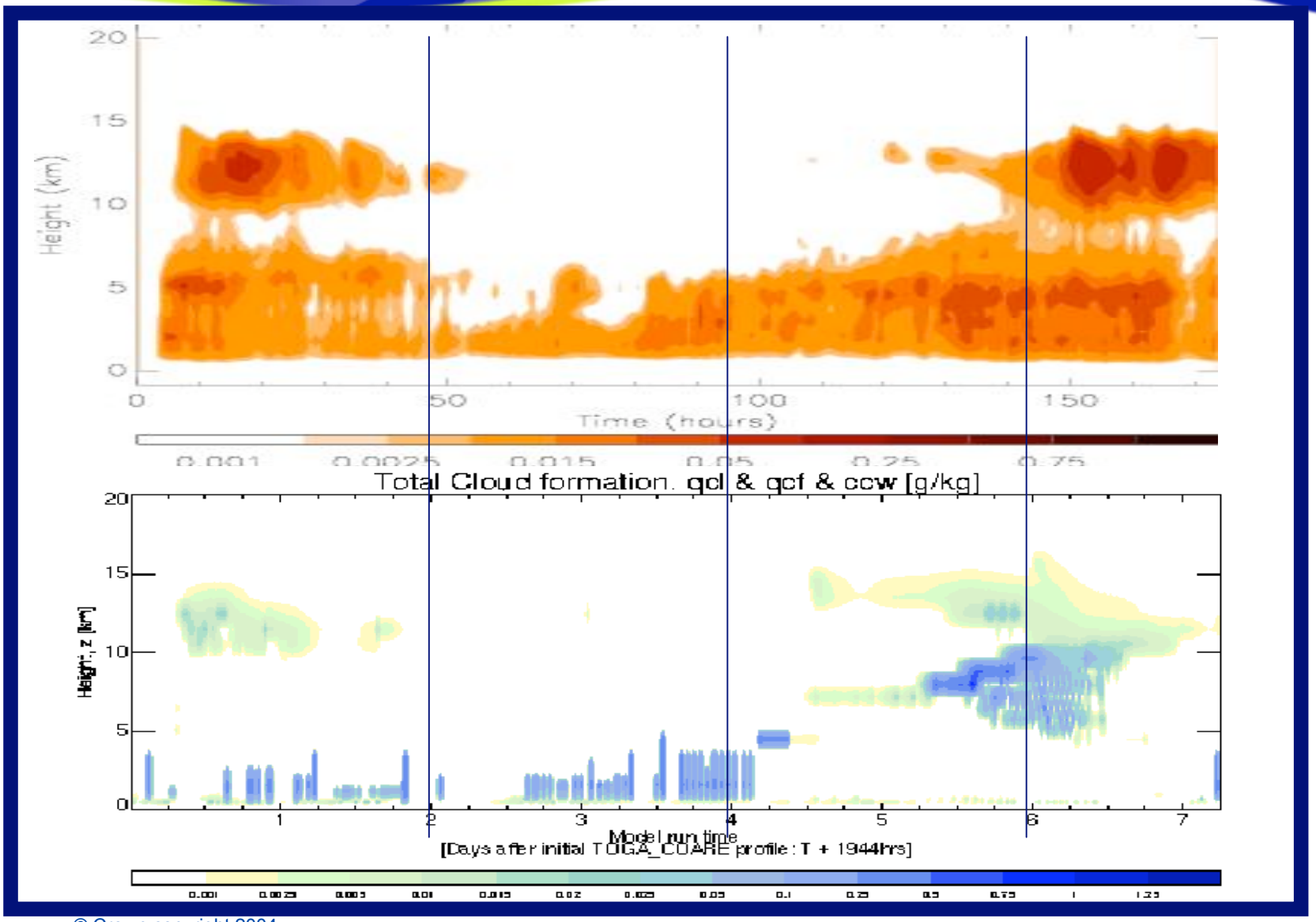
Clouds (domain average; linear scale)



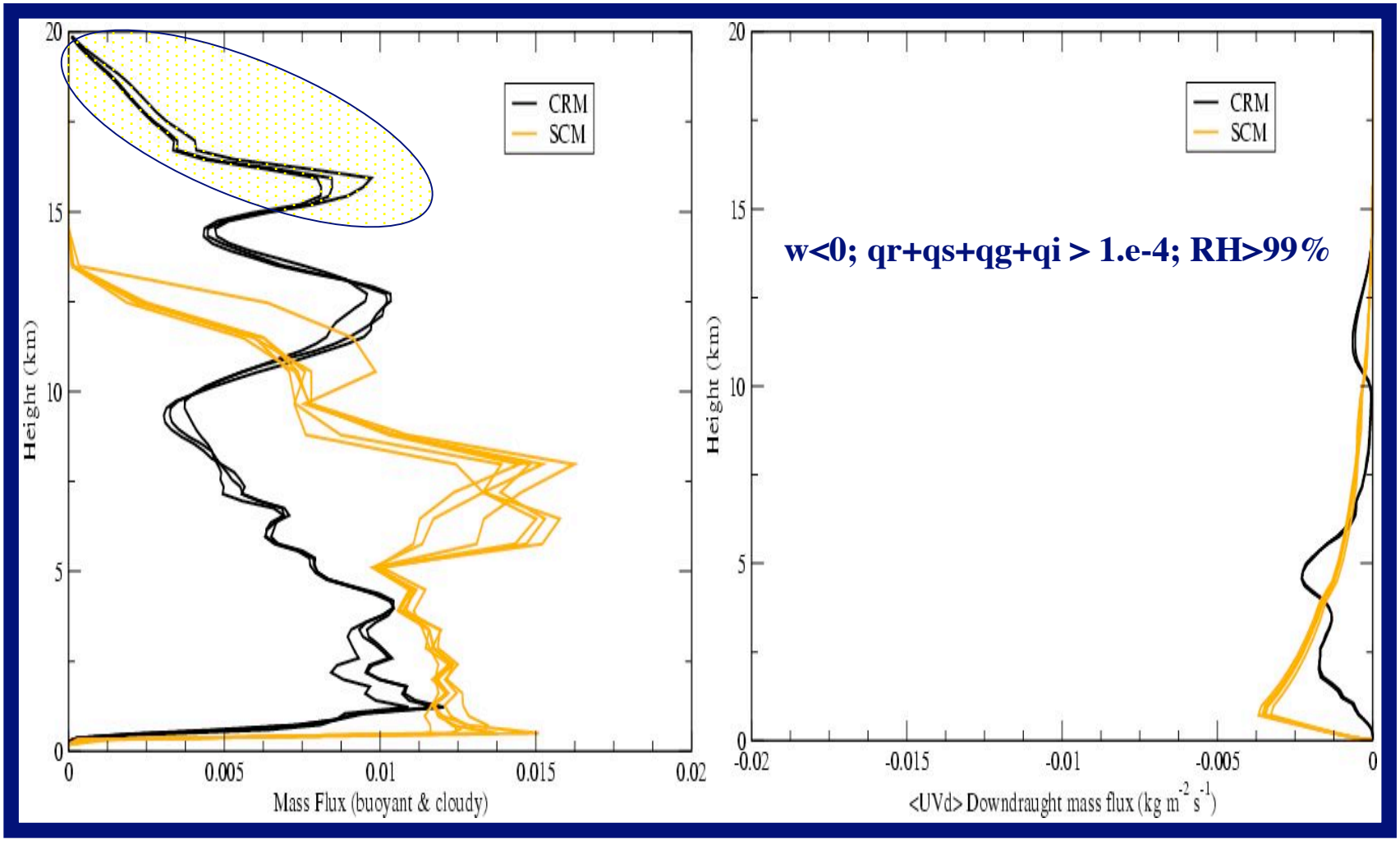
Clouds (domain average; non-linear scale)



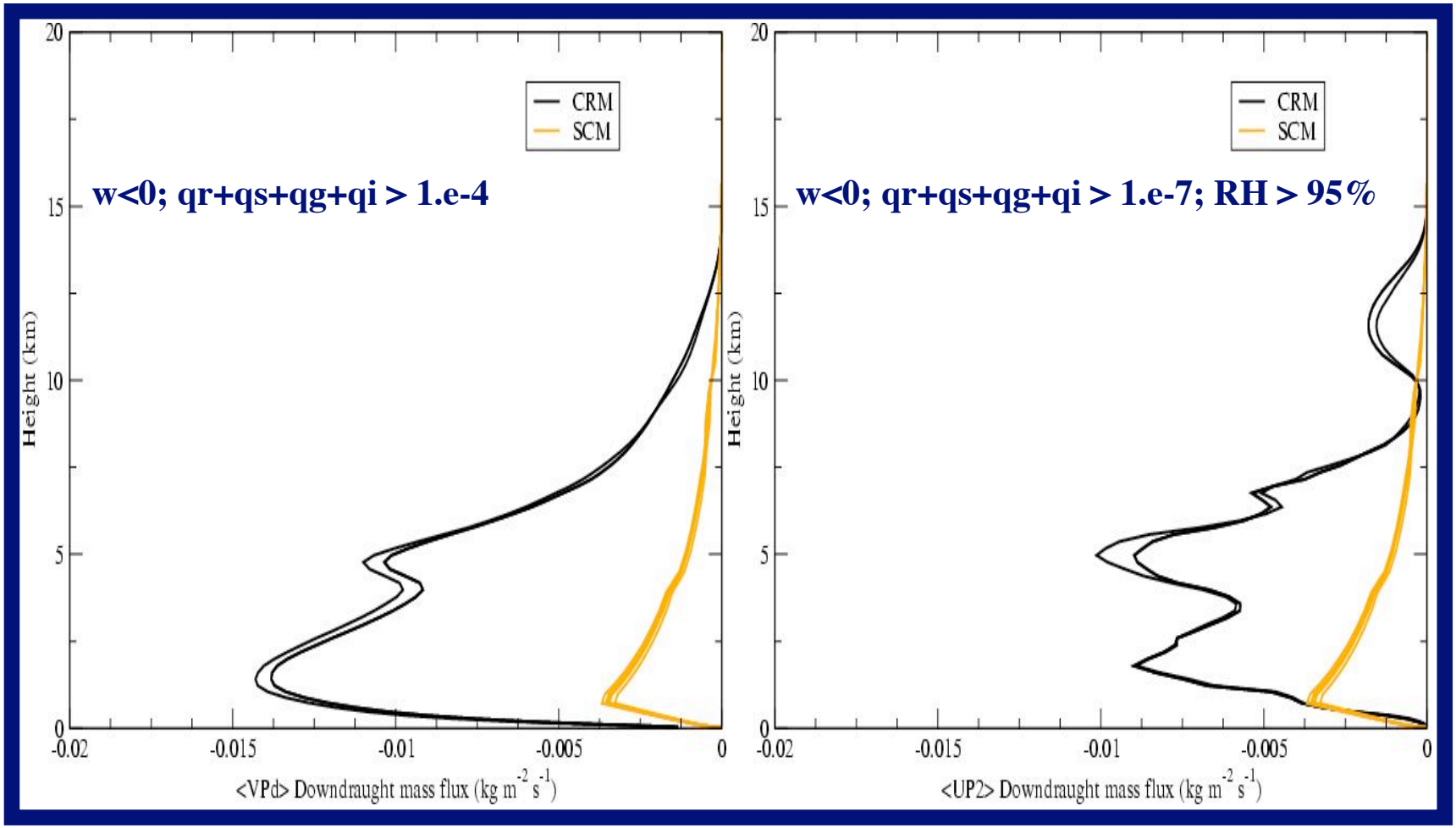
Time height contours of clouds (CRM vs SCM)



7 day mean mass fluxes



Other downdraught definitions

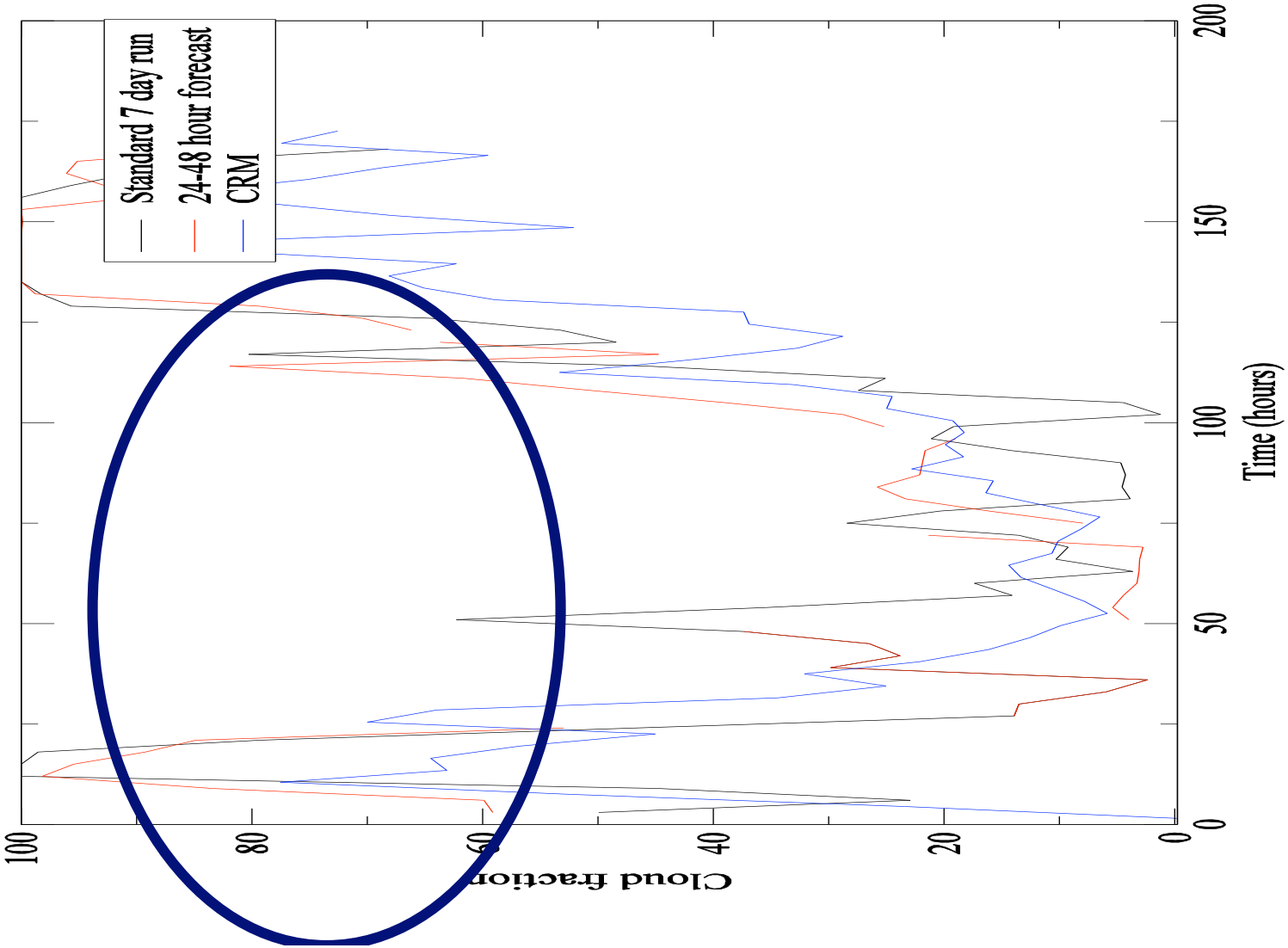


SCMs in forecast mode

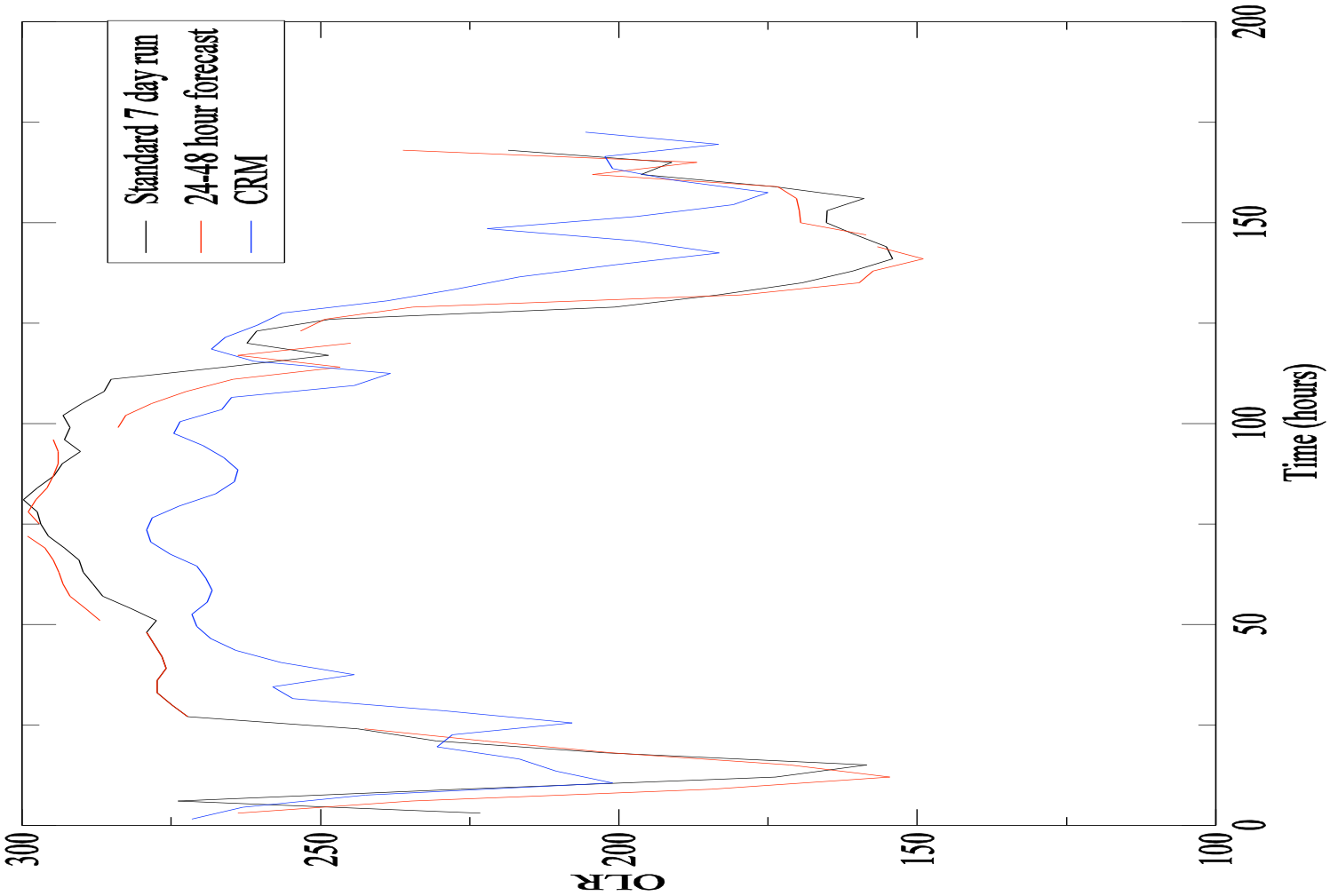
(Met Office SCM 24-48hr)

Ricky Wong

SCM in forecast mode: Cloud fraction



SCM in forecast mode: OLR

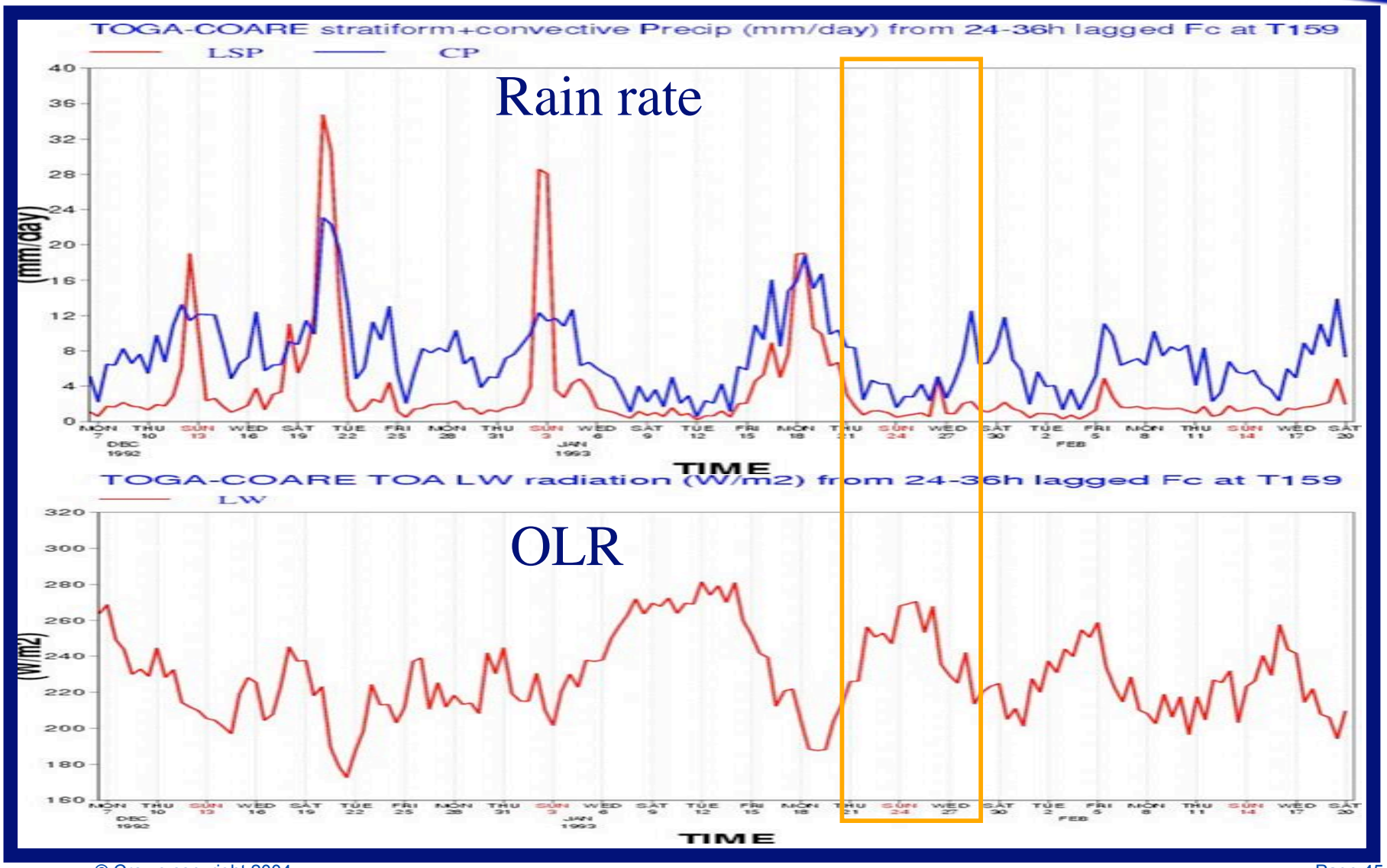


Some NWP results

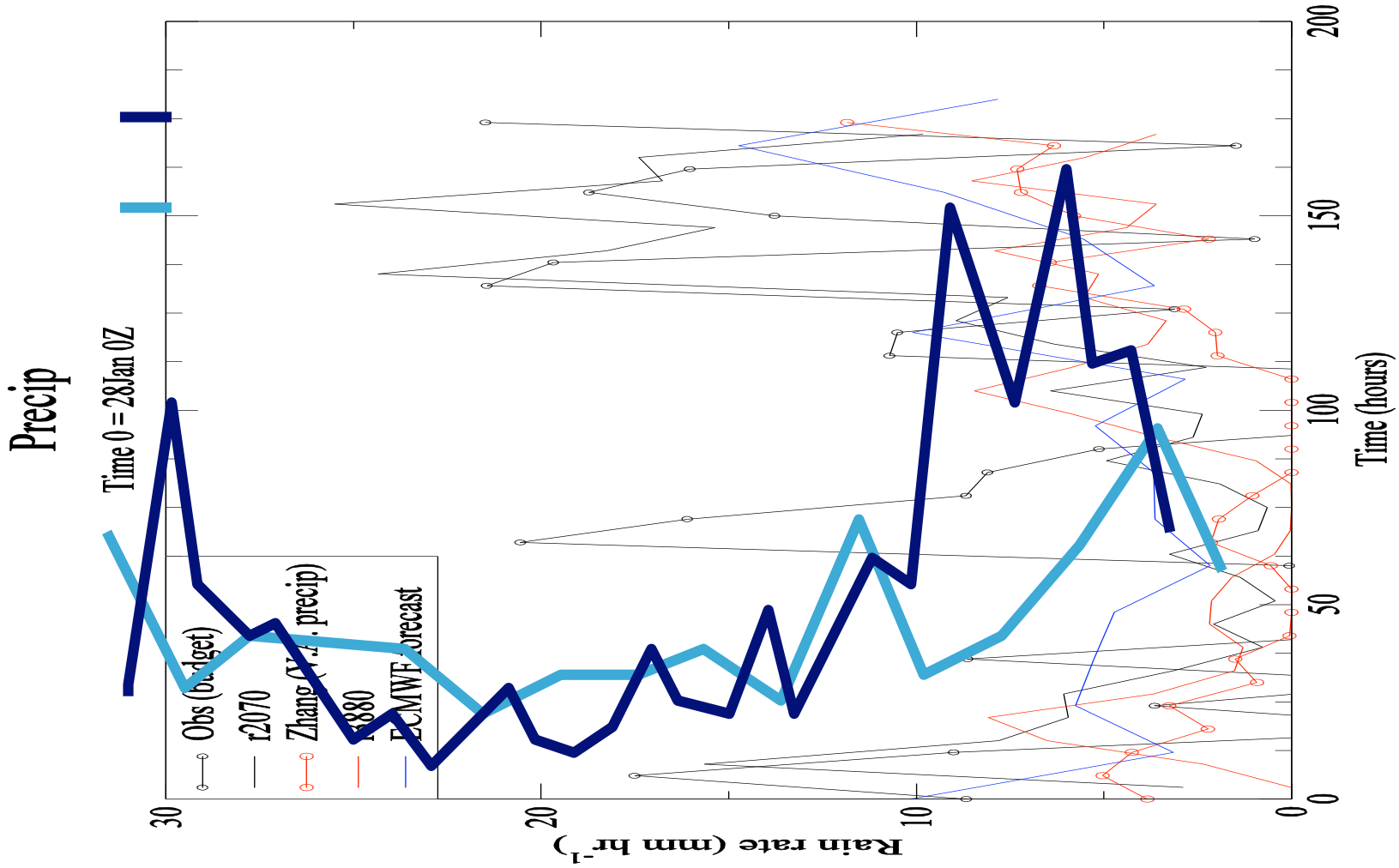
ECMWF NWP output averaged over IFA (12-36hr)

Peter Bechtold

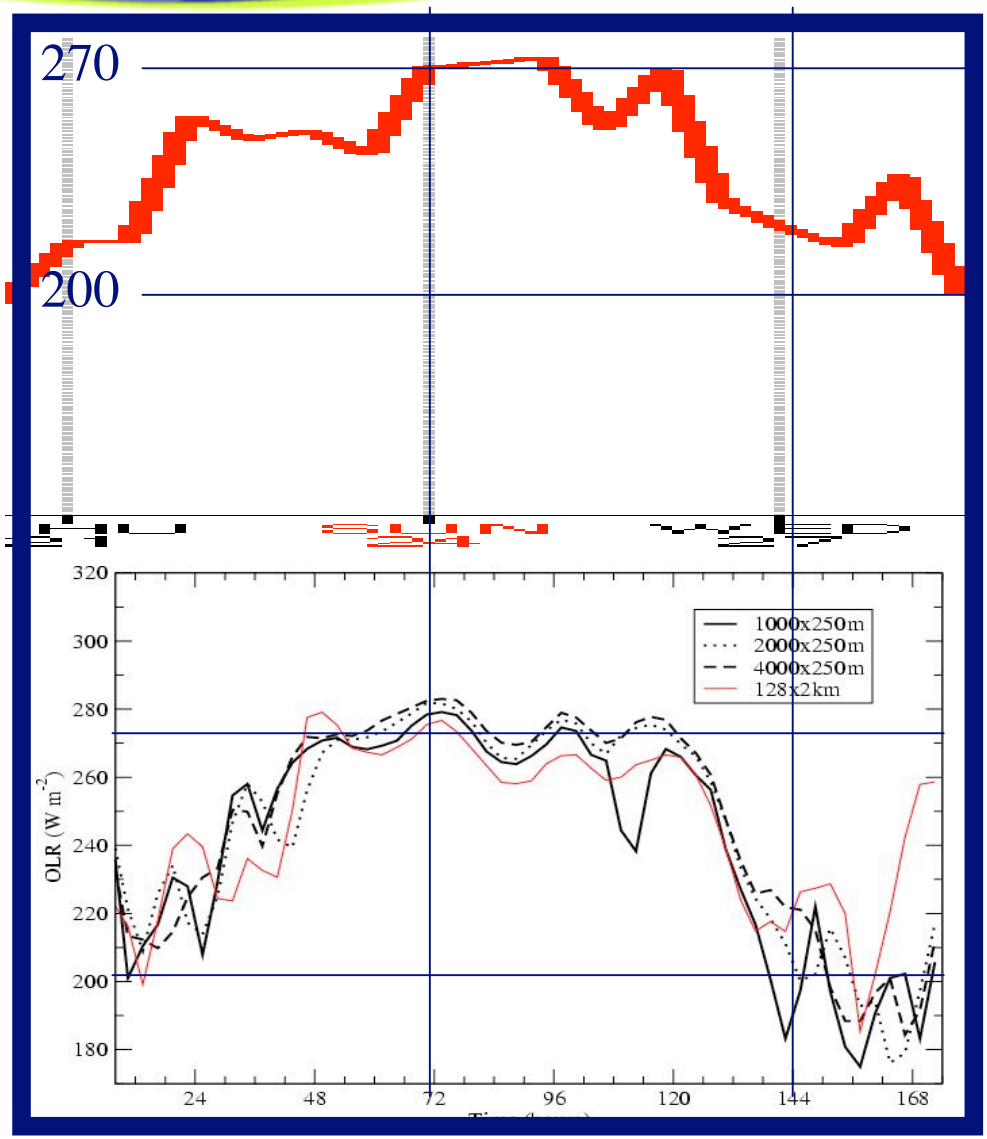
NWP runs with ECMWF model



ECMWF model v CRM: rain rate – Jan 21st



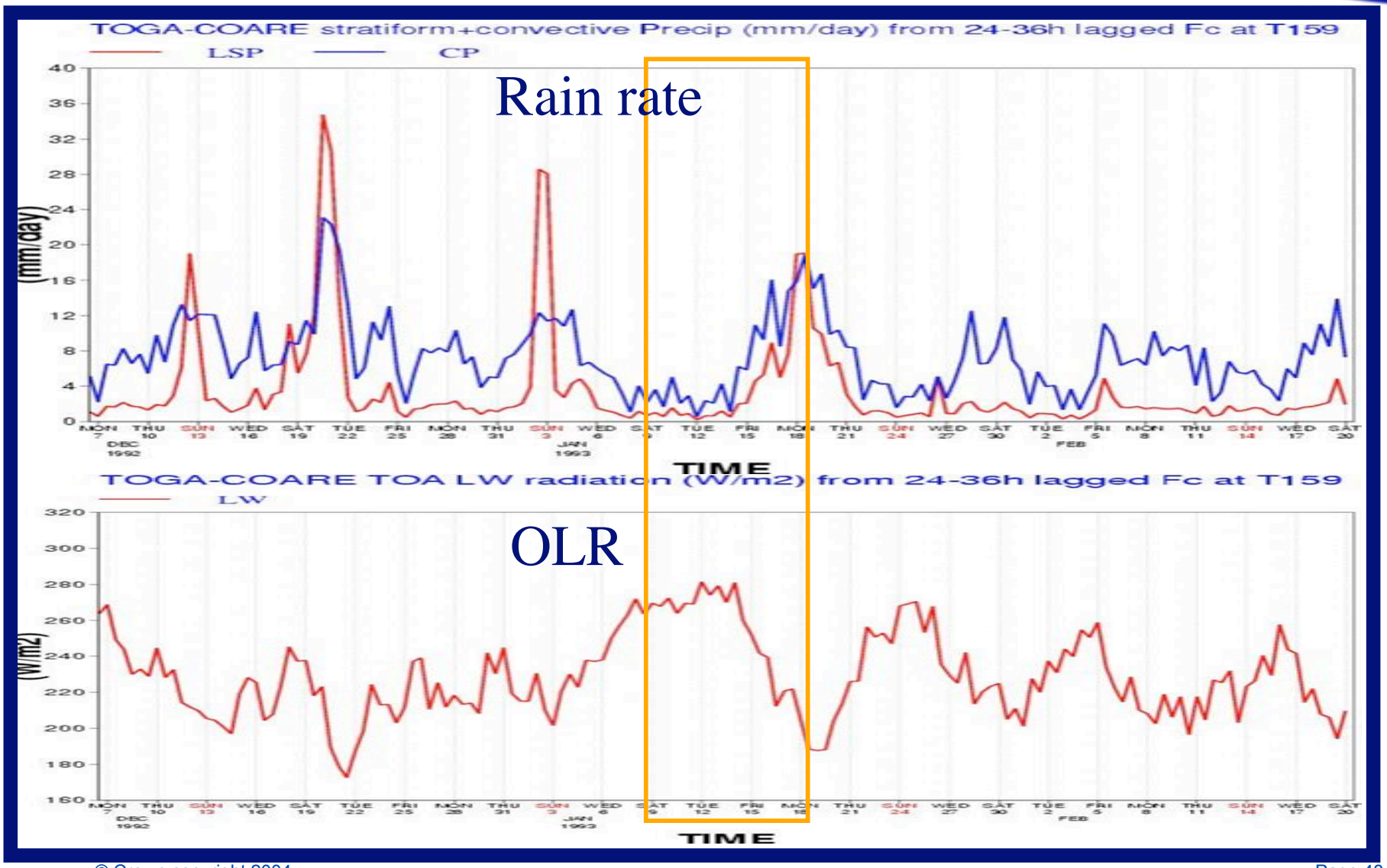
ECMWF model v CRM: OLR – Jan 21st



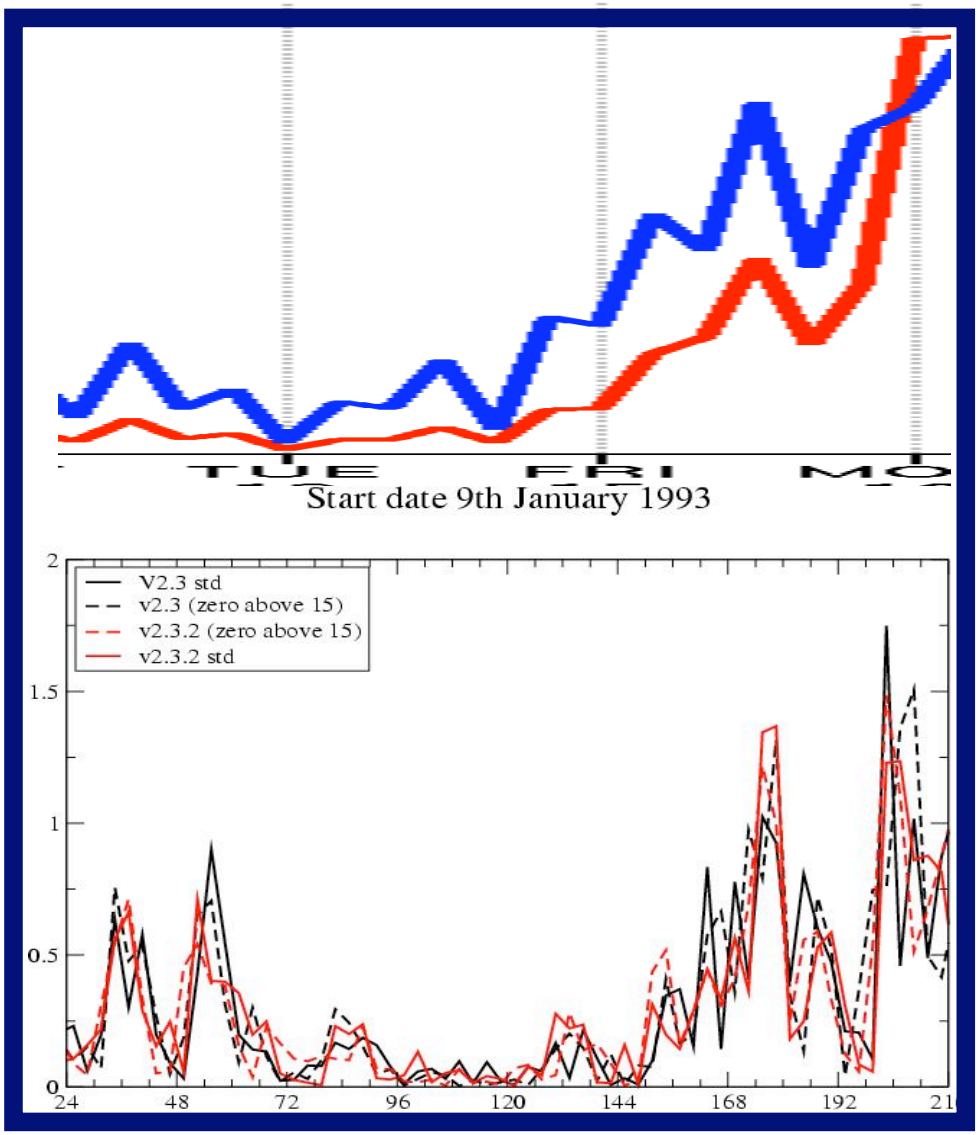
ECMWF

CRM

NWP runs with ECMWF model



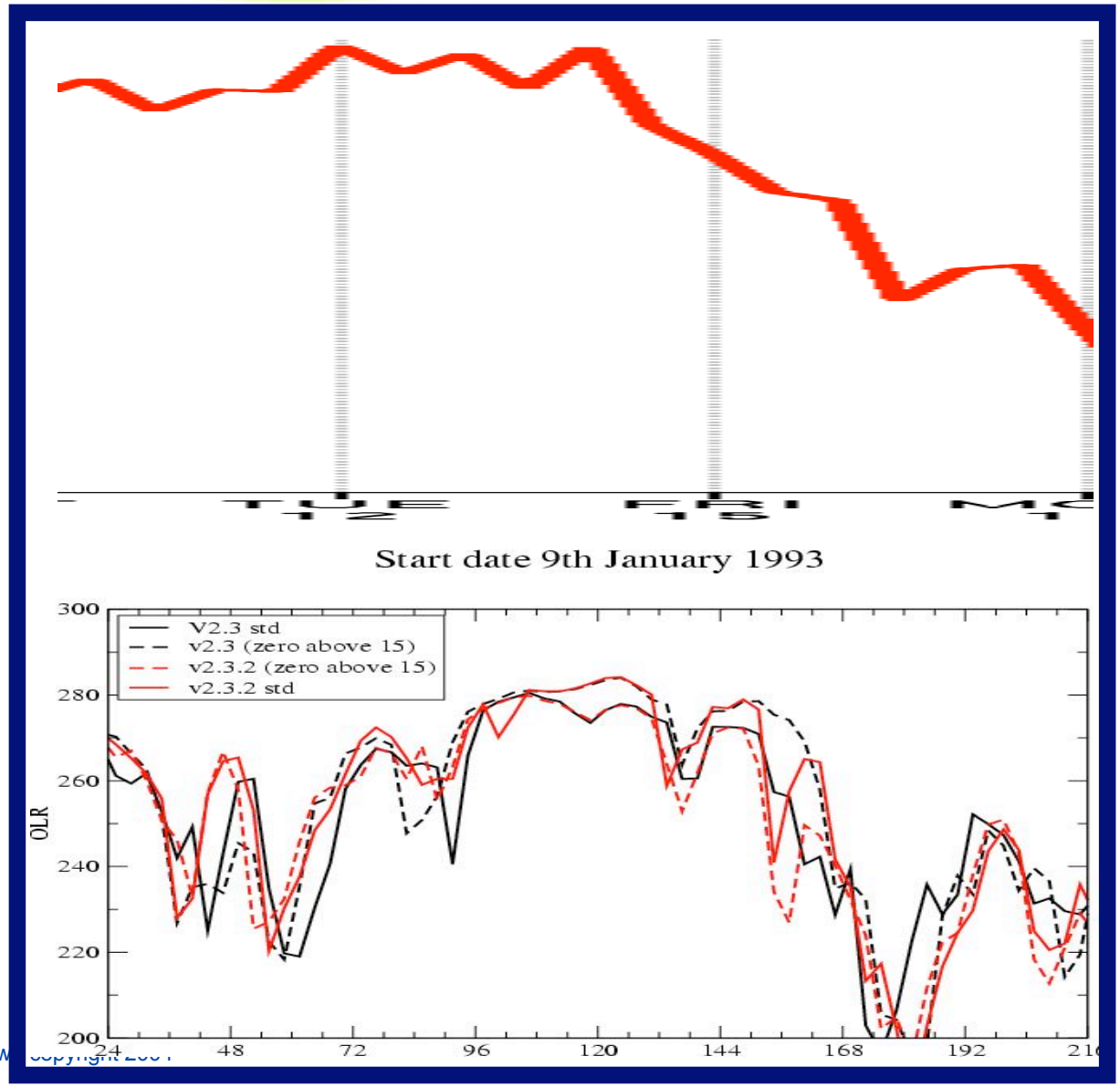
NWP vs CRM – Rain rate - January 9th



ECMWF

CRM

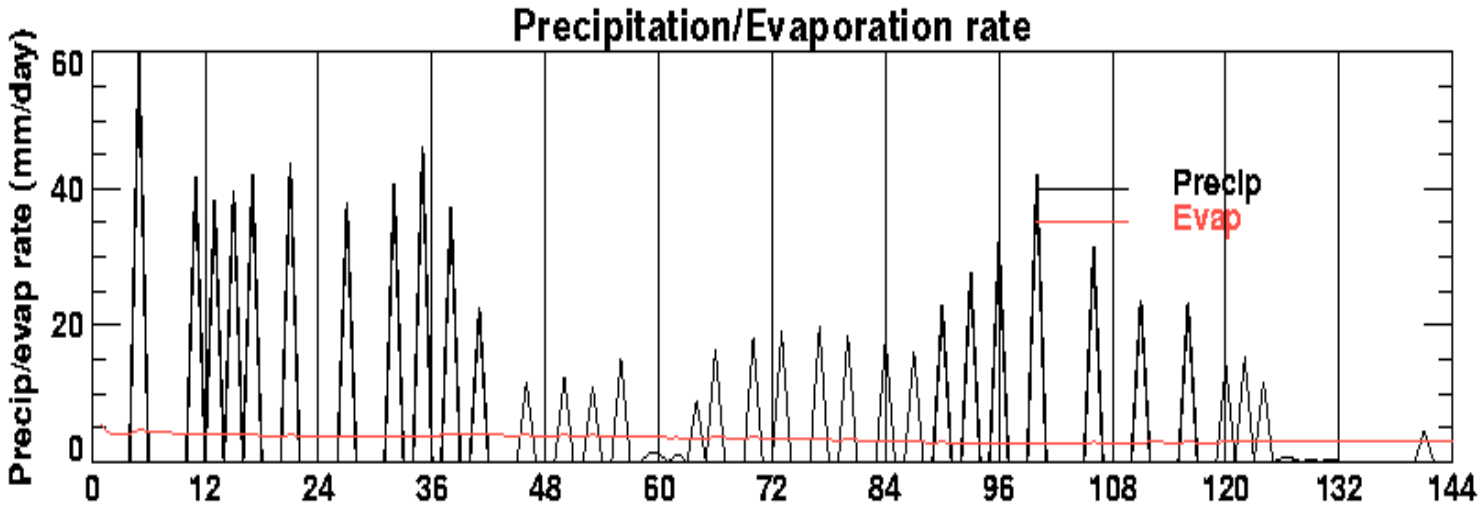
NWP vs CRM – OLR - January 9th

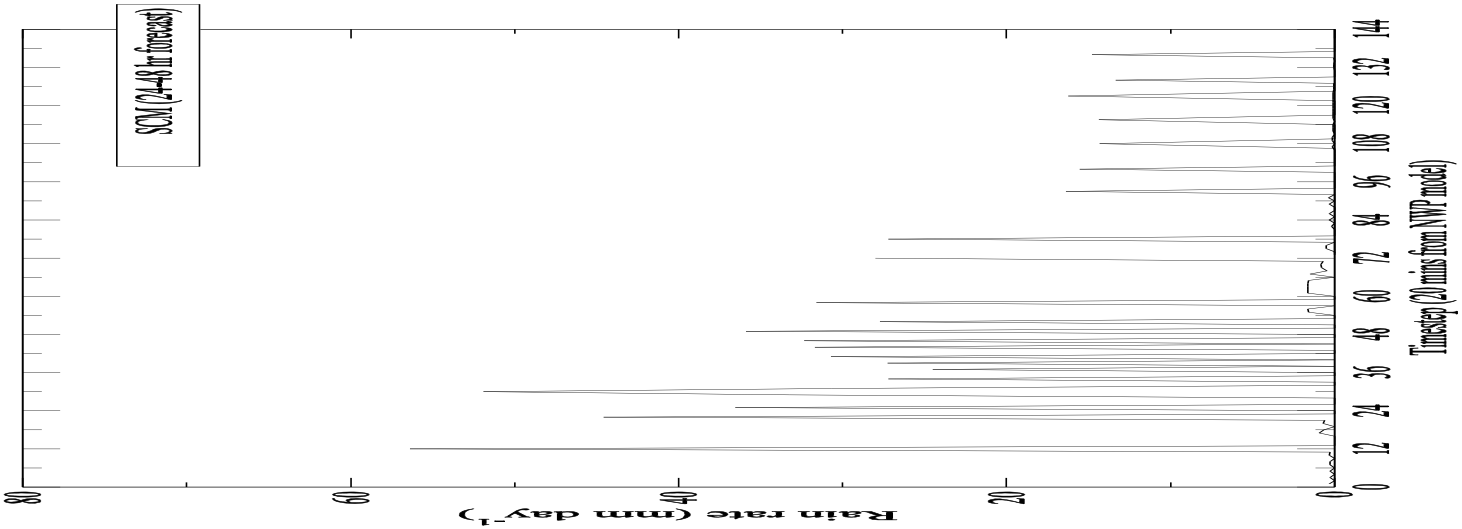


ECMWF

CRM

Comparison of NWP model and SCM

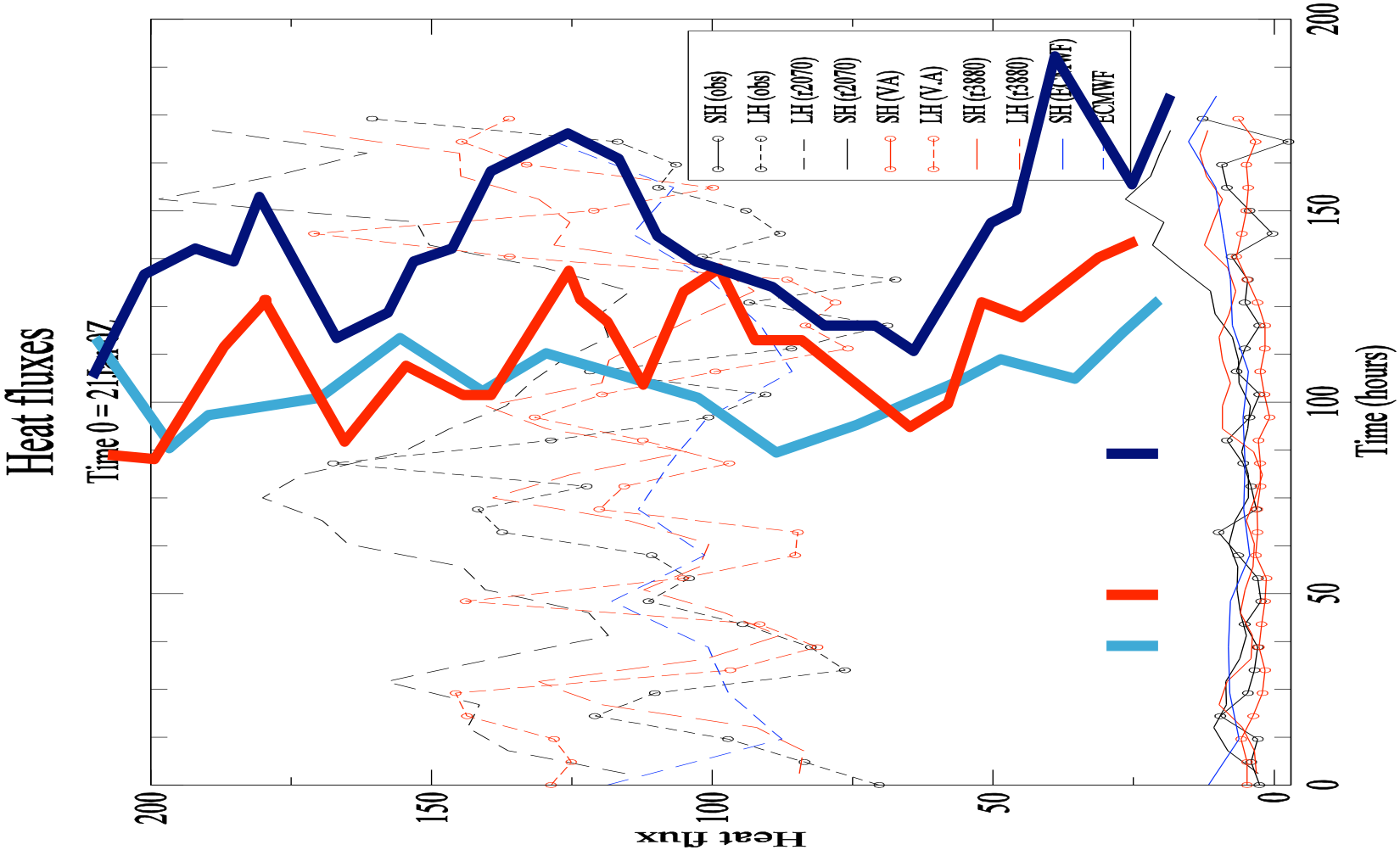




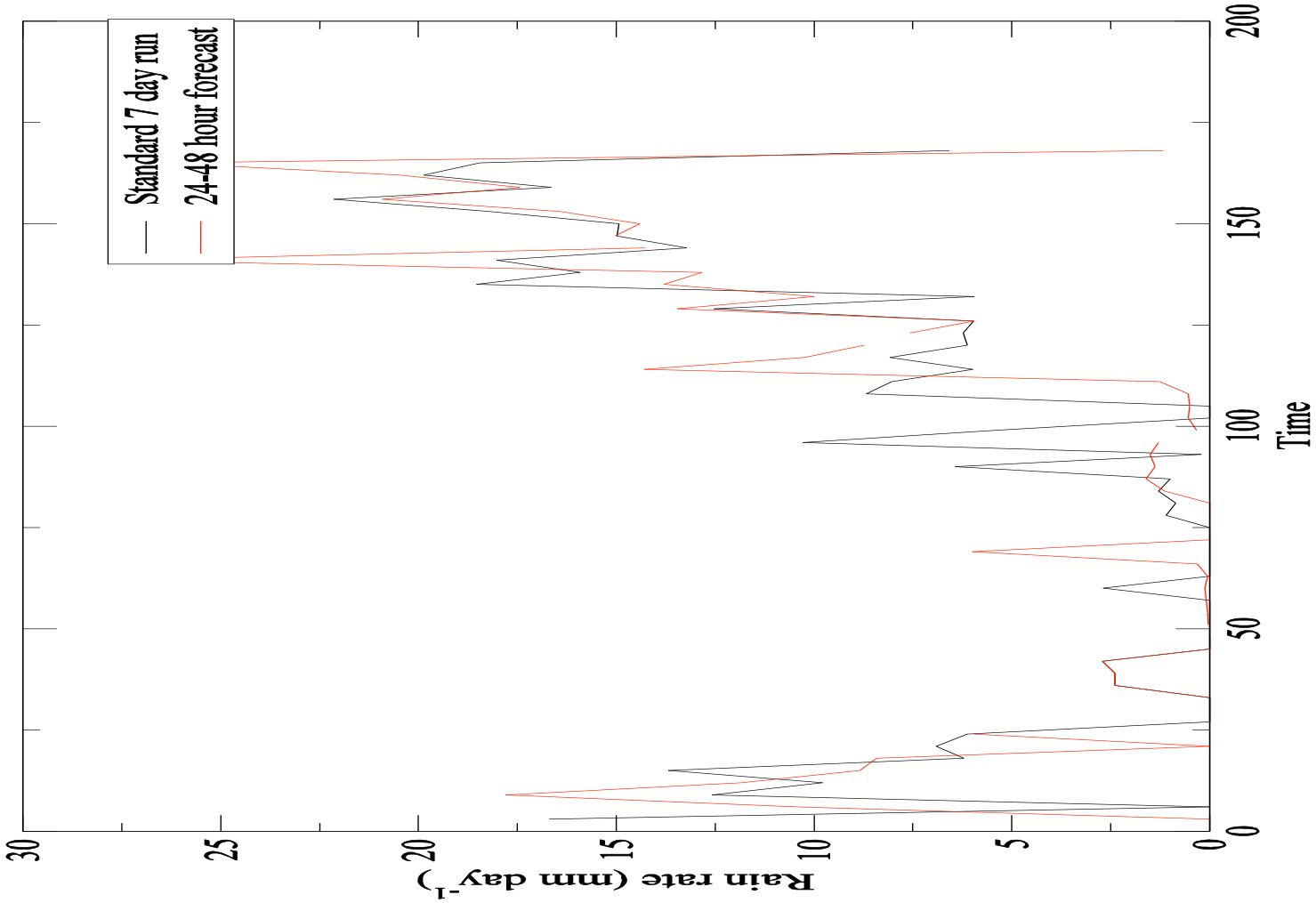
Summary

- Active numbers were falling
  - ARM SCMs welcome!
- New case includes CRM, SCMs, NWP and LAMs
  - An exciting new “framework”
  - A step away from the traditional WG4 experiments
  - Find out more tomorrow 1030 upstairs
- Work on previous cases continues
  - Early draft of a paper for Case 4
  - Plans to expand case 4 in the future

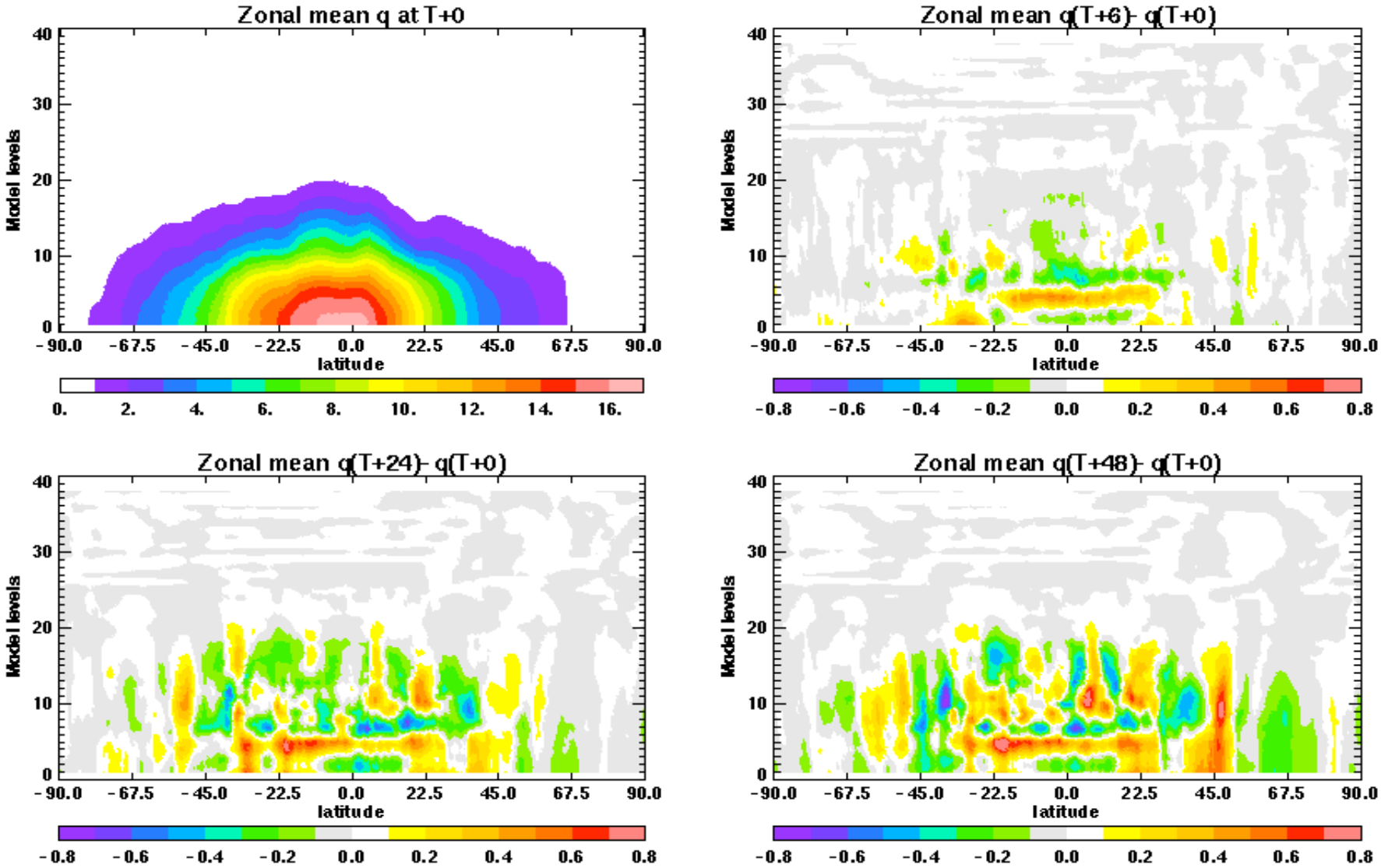
ECMWF model v CRM: rain rate



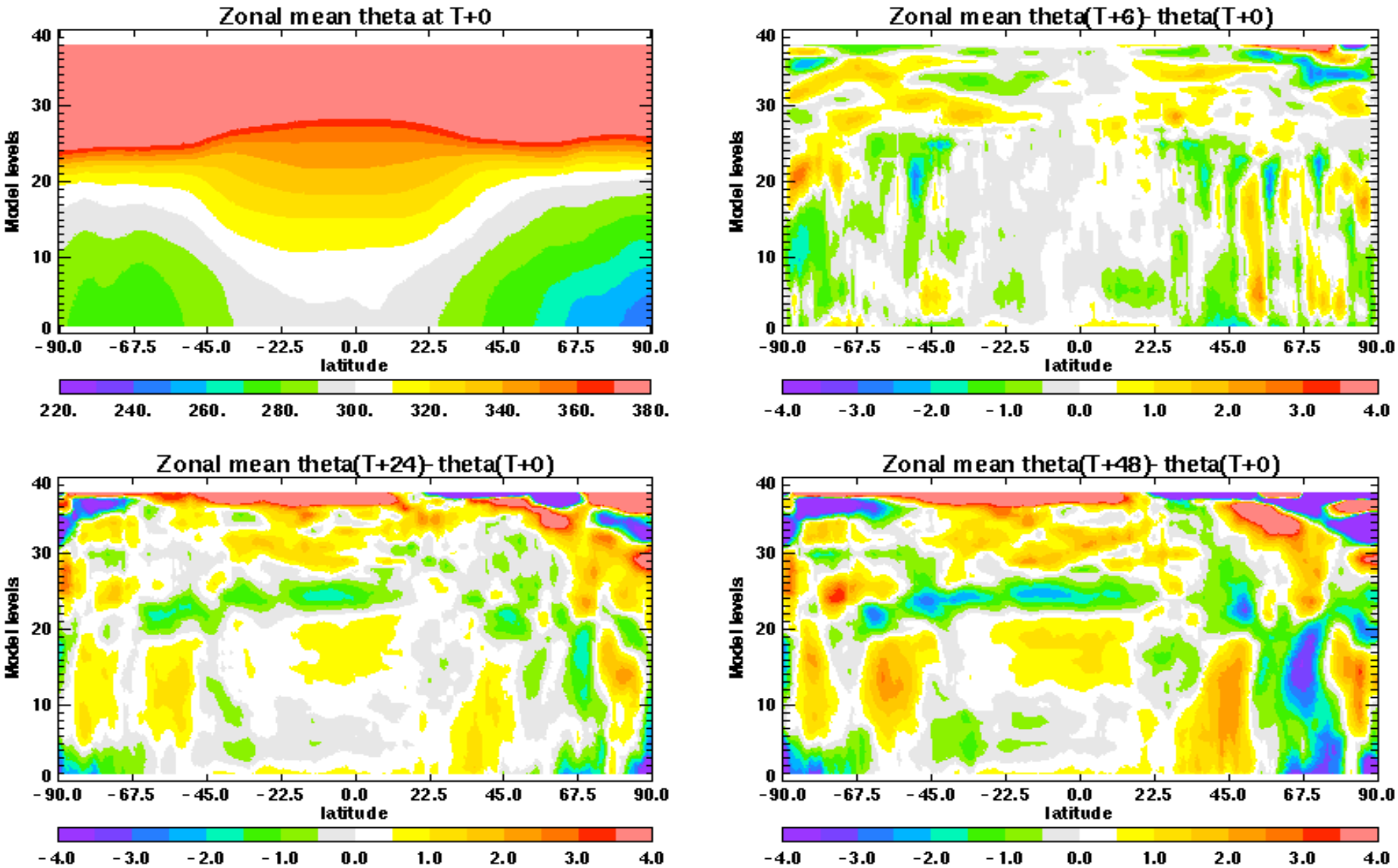
SCM in forecast mode: rain rate



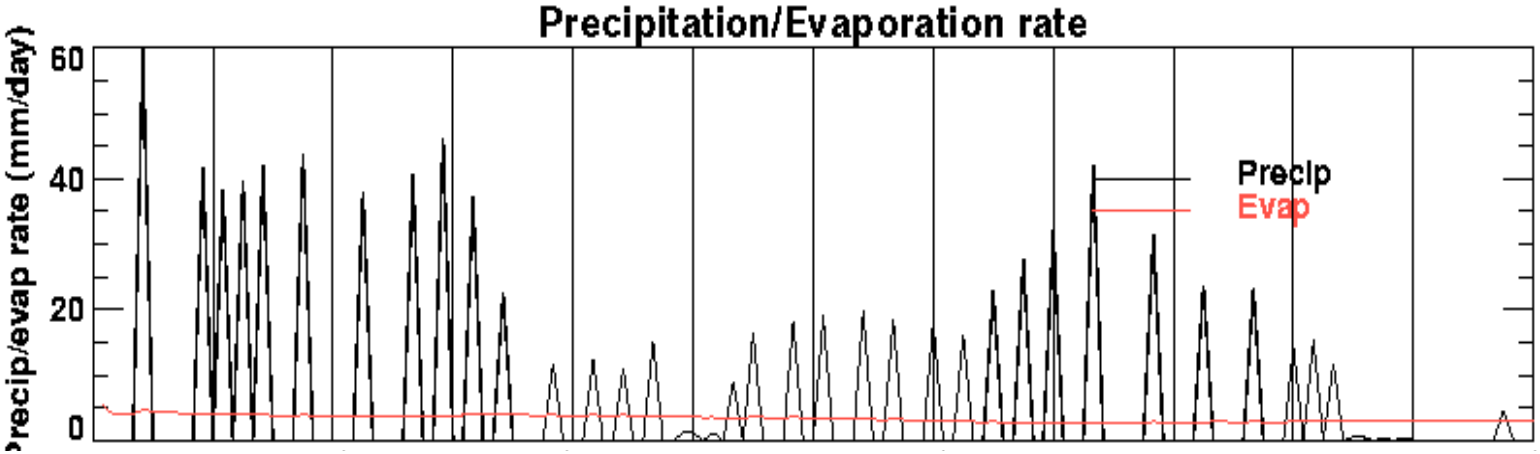
Met Office NWP model during spin up

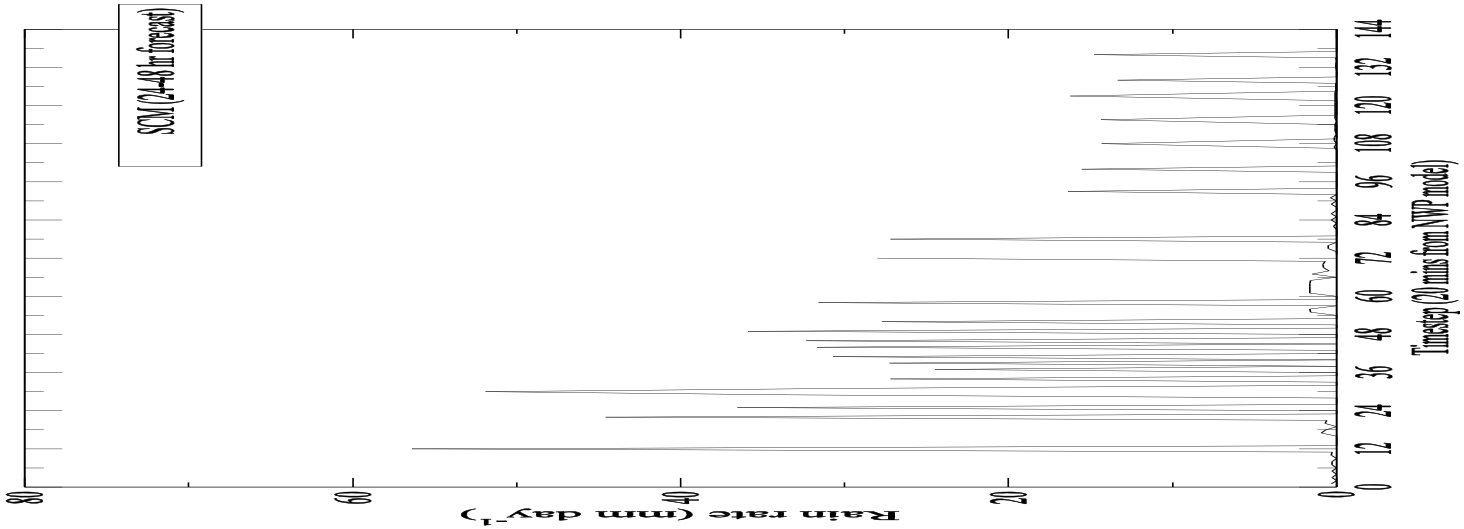


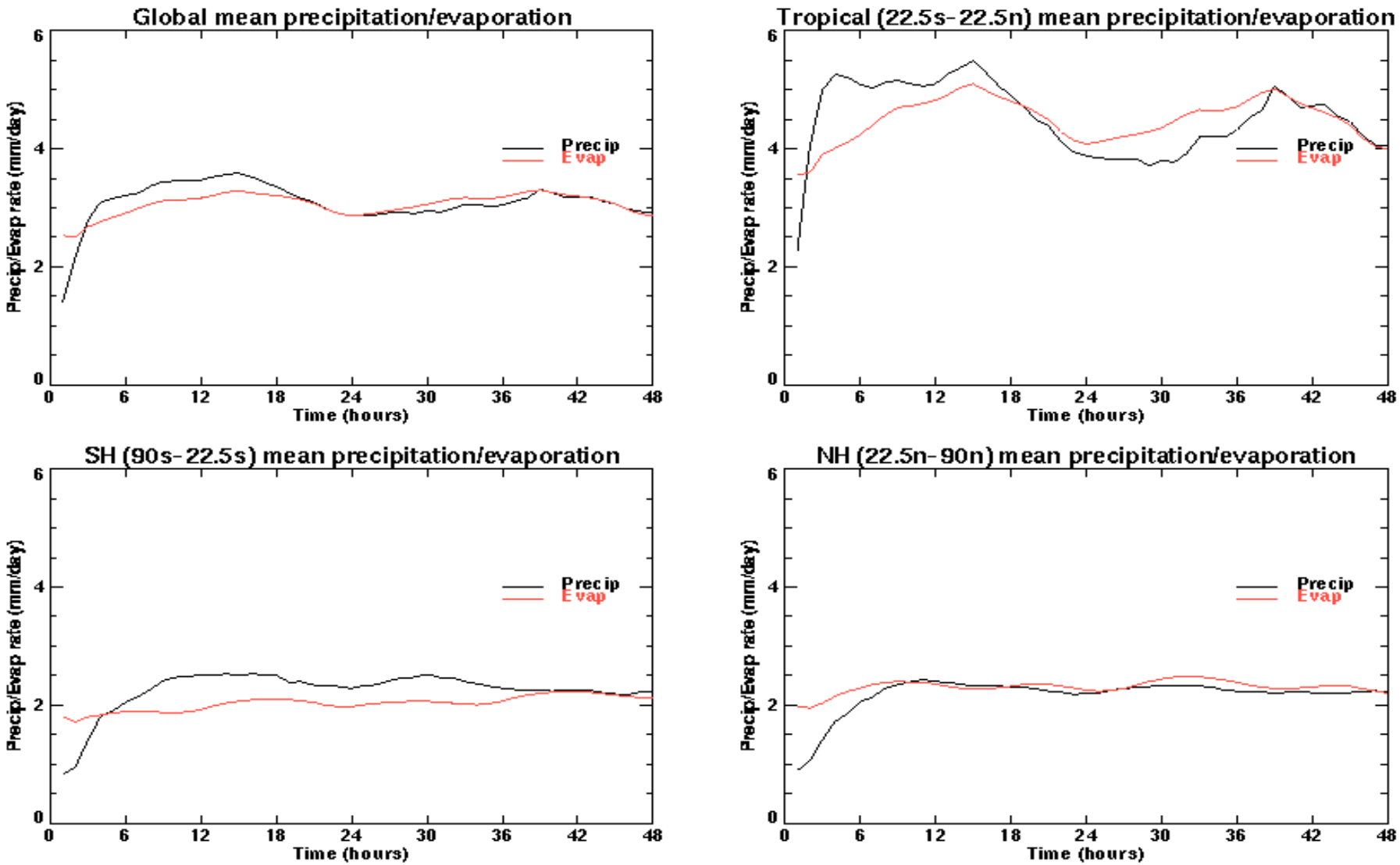
Met Office NWP model during spin up



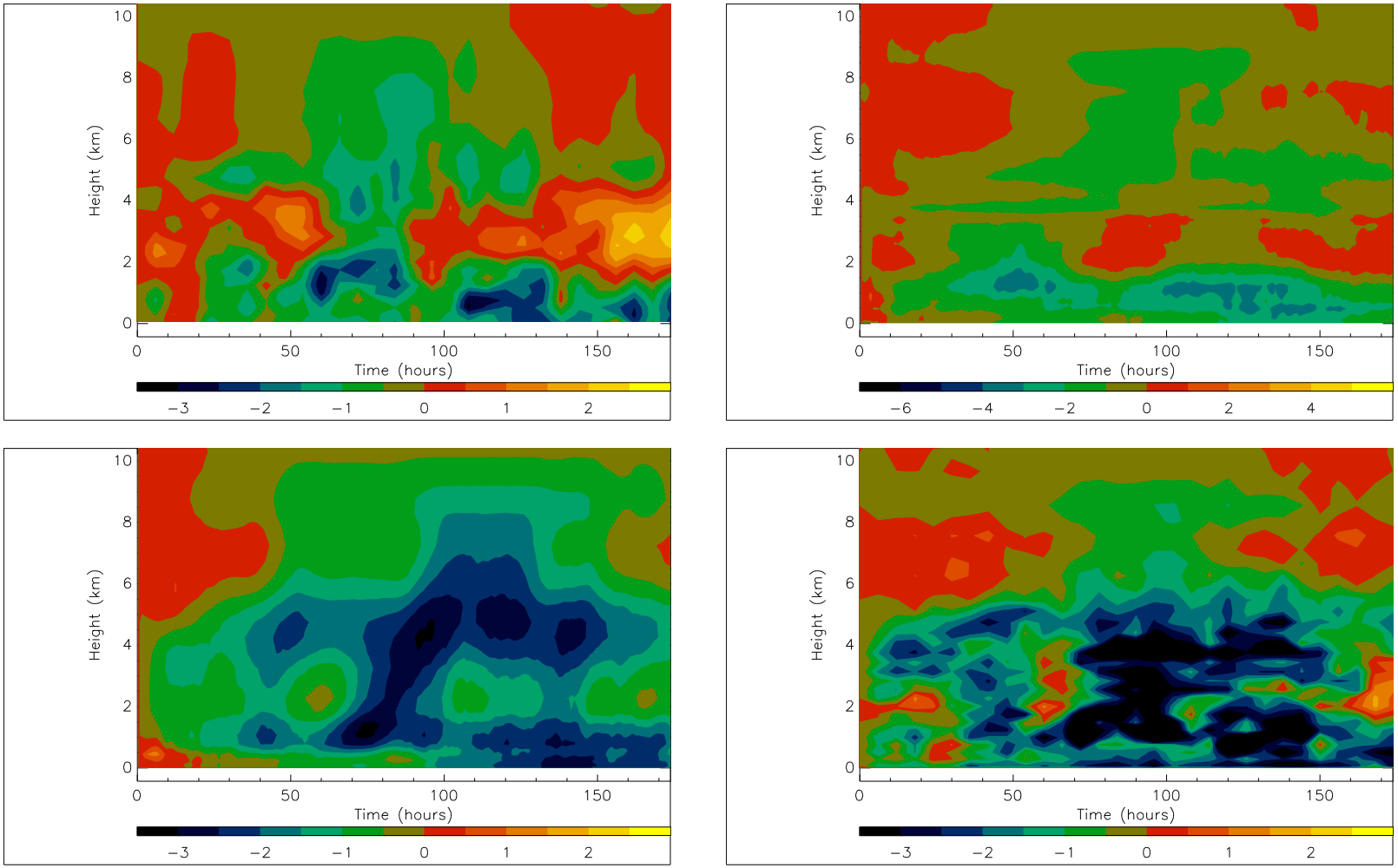
Comparison of NWP model and SCM



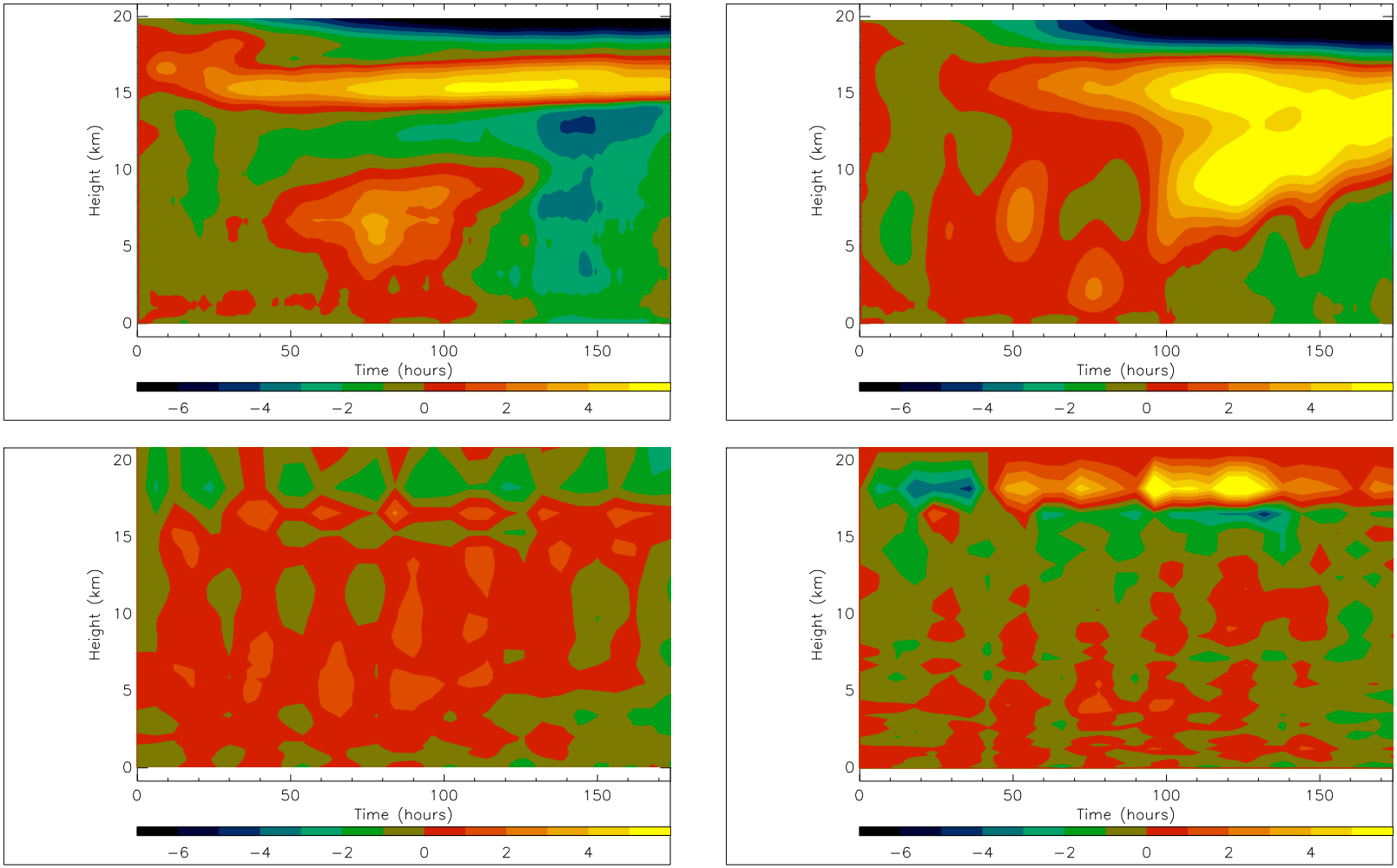



Global mean precipitation/evaporation
Tropical (22.5s-22.5n) mean precipitation/evaporation
SH (90s-22.5s) mean precipitation/evaporation
NH (22.5n-90n) mean precipitation/evaporation
Precip/Evap rate (mm/day)
Time (hours)
Precip
Evap
0
2
4
6
0
6
12
18
24
30
36
42
48

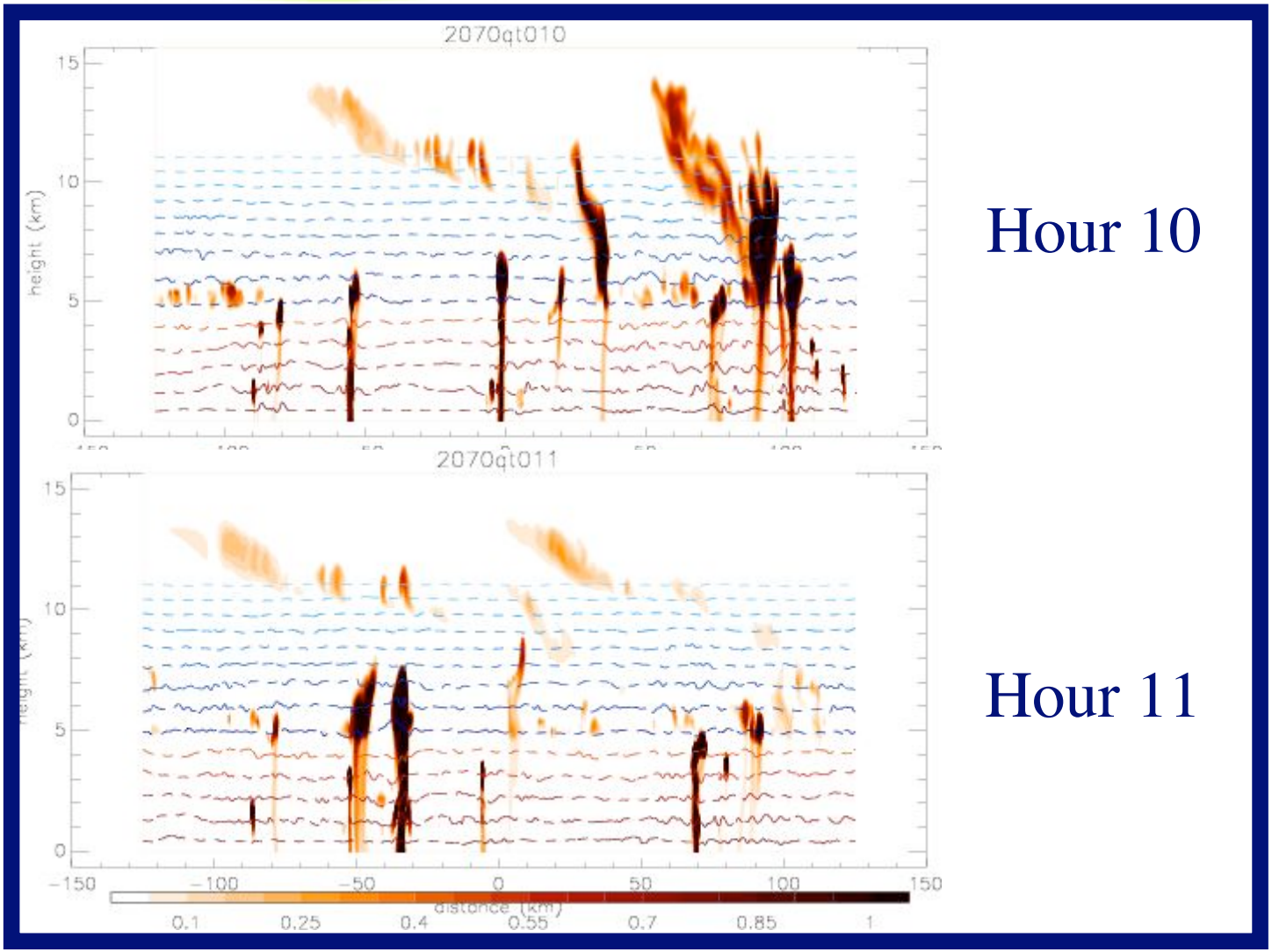
Zhang vs std: Q



Zhang vs std forcing: Temperature



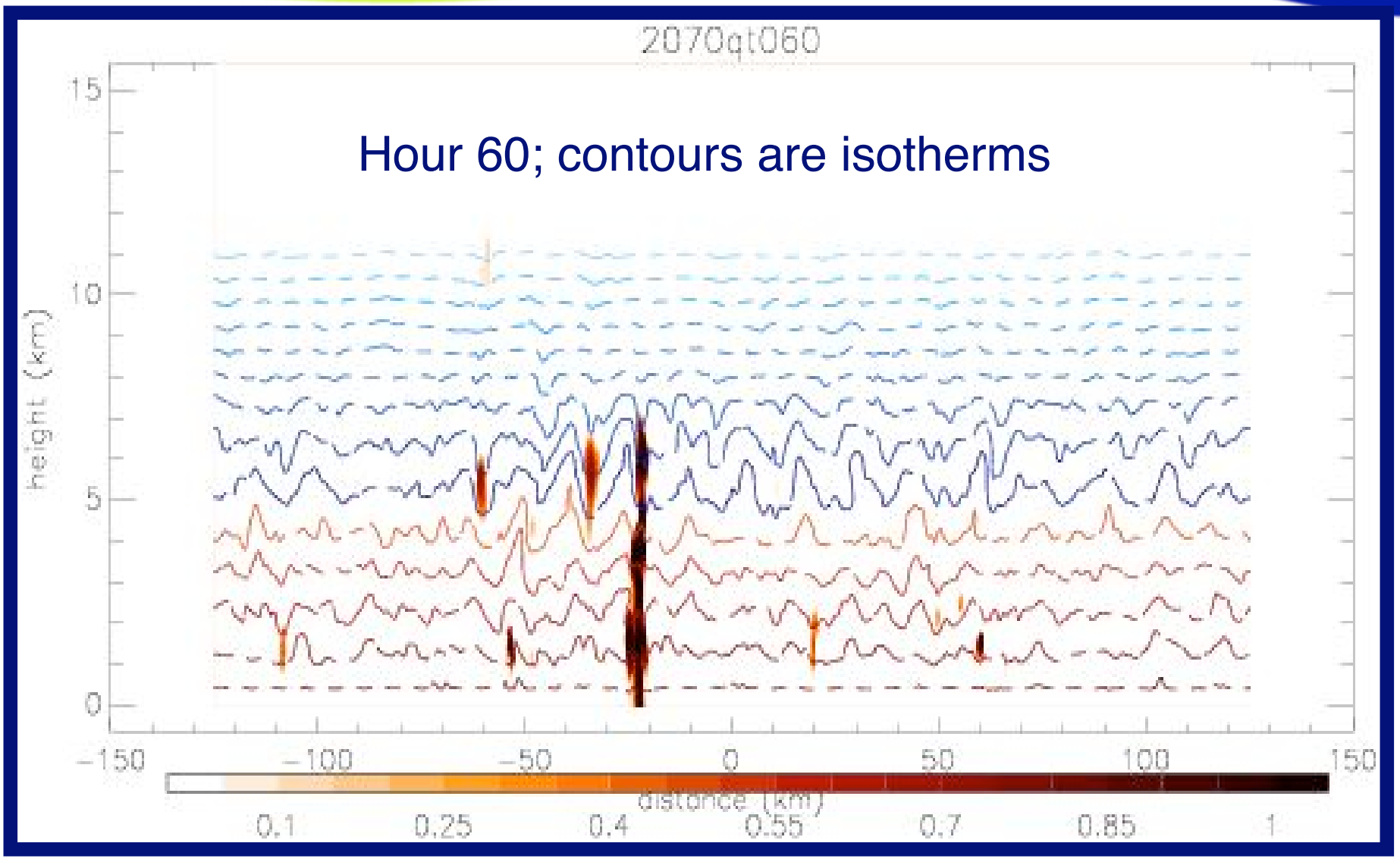
Cloud properties – initial burst



Hour 10

Hour 11

Some congestus and gravity waves



Vote USA

The ARM election meeting