

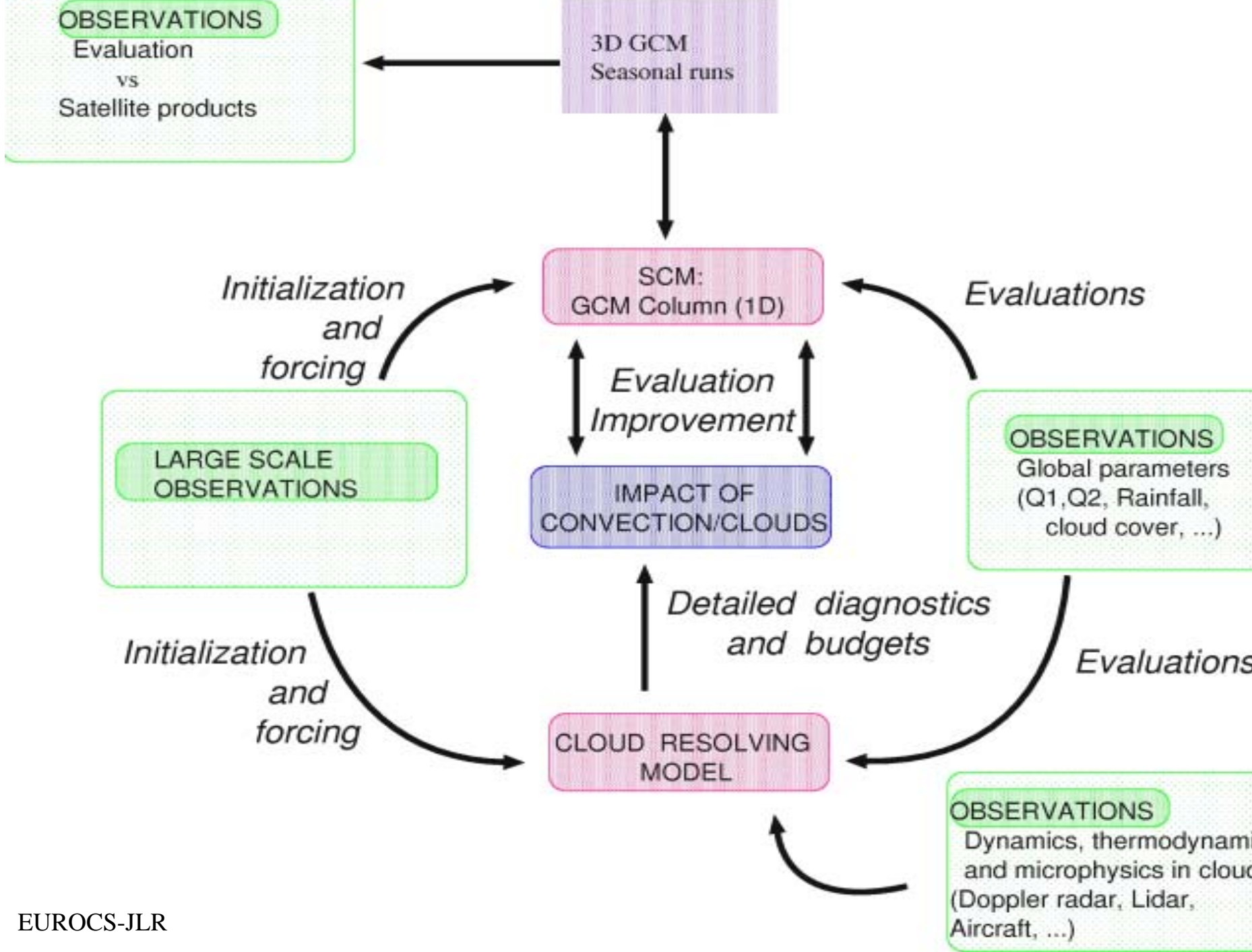
# EUROCS: EUROPEAN PROJECT on CLOUD SYSTEMS IN NWP/CLIMATE MODELS

<http://www.cnrm.meteo.fr/gcss/>

- **Major European Component of GCSS (GEWEX Cloud System Studies) concentrating on basic problems of cloud representation in NWP & climate models**
- **Funded on 3 years (2000-2003) by EC and National Institutions**
- **10 groups**
  - CNRM/GAME (France) (Coordinator)
  - ECMWF European Centre for Medium-range Weather Forecasts
  - INM Instituto Nacional de Meteorologia (Spain)
  - LMD Laboratoire de Météorologie Dynamique (France)
  - MPI Max-Planck-Institut fuer Meteorologie (Germany)
  - MO Meteorological Office (UK)
  - KNMI Royal Netherlands Meteorological Institute (Netherlands)
  - SMHI Swedish Meteorological and Hydrological Institute (Sweden)
  - University of Lisbon (Portugal)
  - University of Utrecht/IMAU (Netherlands)

# “EUROCS Recipe”

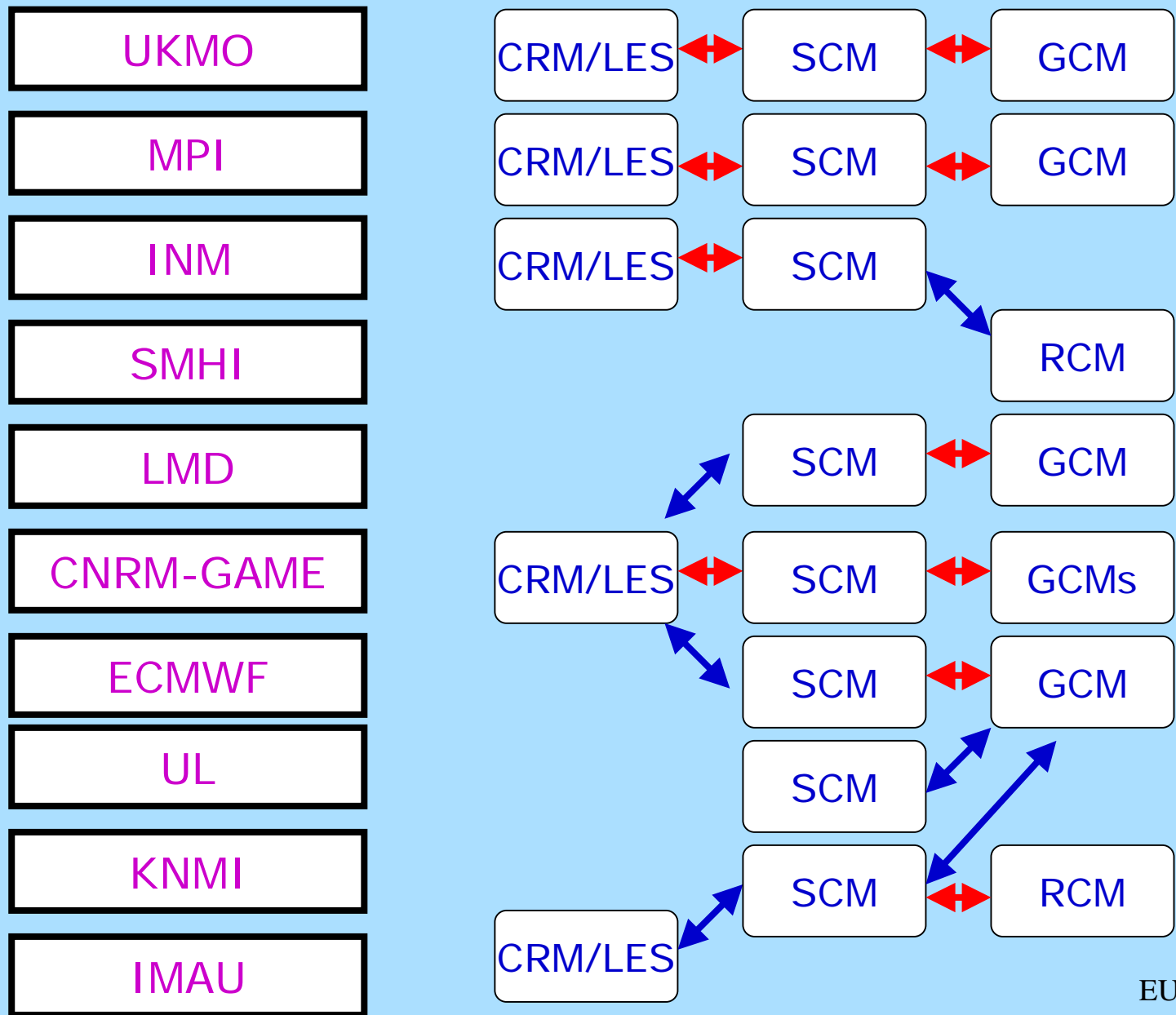
- A **strategy** based on model hierarchy & observations



# “EUROCS Recipe”

- A **strategy** based on model hierarchy & observations
- A **consortium linking** the cloud modelling european community

# Main EUROCS model links



# “EUROCS Recipe”

- A **strategy** based on model hierarchy & observations
- A **consortium linking** the cloud modelling european community
- **Issues chosen by European GCM groups** : Boundary layer clouds, Precipitating Deep convective Clouds, Pacific case

# EUROCS: BASIC CLOUD PROBLEMS

## BOUNDARY LAYER CLOUDS

- Diurnal cycle of marine stratocumulus (eastern part of subtropical oceans)

Usually underprediction of Sc in GCMs and Model Analysis

→ Overestimation of Net Heat Flux into ocean

Warm SST biases (5K) in coupled models

Effects on Tropical circulation (Sc damps it)

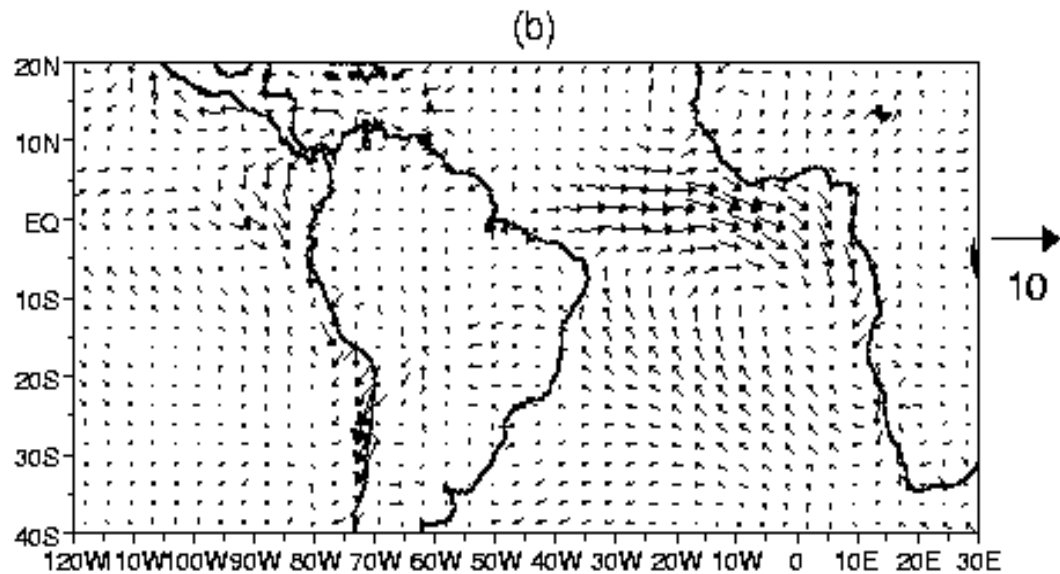
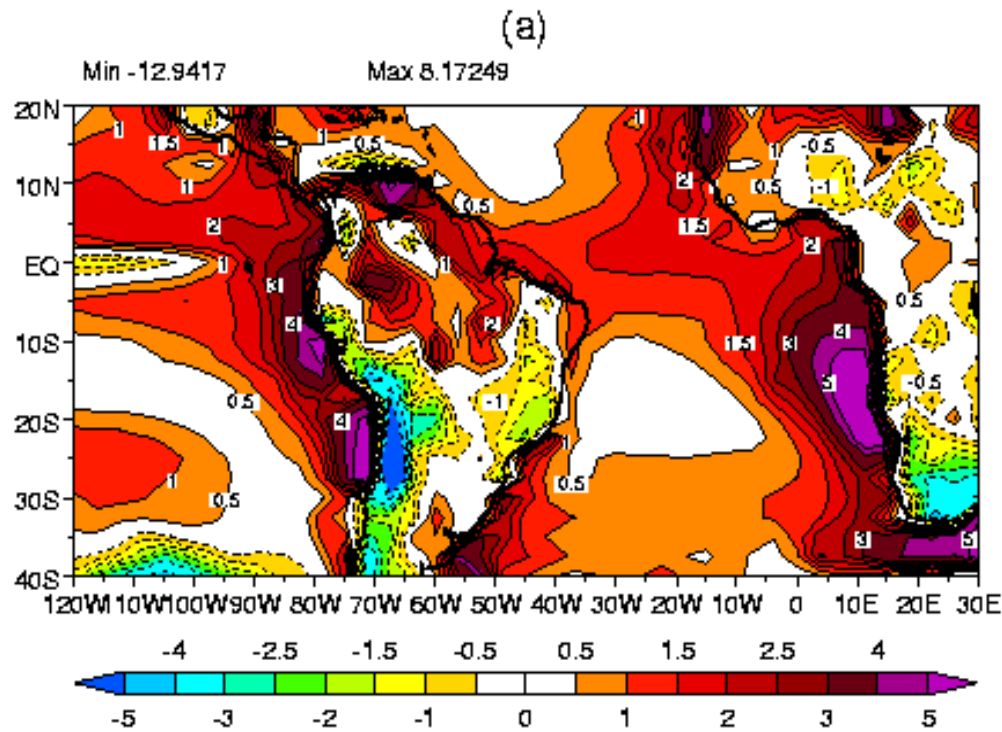
**Selected Case: Sc diurnal cycle of FIRE I**

**Leaders: P. Duynkerke, S. De Roode, H. Grenier**

# UKMO coupled UM Systematic errors (MAM)

Courtesy R. Neale

**SST**  
(UM *minus* Climatology)



**Surface Winds**  
(UM *minus* ERA)



# EUROCS: BASIC CLOUD PROBLEMS

## BOUNDARY LAYER CLOUDS

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**Selected Case: Sc diurnal cycle of FIRE I**

**Leaders: P. Duynkerke, S. De Roode, H. Grenier**

- **Diurnal cycle of cumulus over land**

Poor representation in GCMs: Amplitude & phase errors, Too high cloud fraction

→ Problems in behavior of boundary layer

→ Problems in surface energy budget

→ Further consequences on deep convection

**Selected Case: Cu diurnal cycle of ARM**

**Leaders: P. Siebesma & G. Lenderink**

# EUROCS: BASIC CLOUD PROBLEMS

## PRECIPITATING DEEP CONVECTIVE CLOUDS

### ■ Sensitivity to humidity of cloud development and transports

Dry layers often observed in the tropical mid-troposphere

Advection from deserts, stratospheric intrusions, ... :

TOGA-COARE, CEPEX, INDOEX, West Africa...

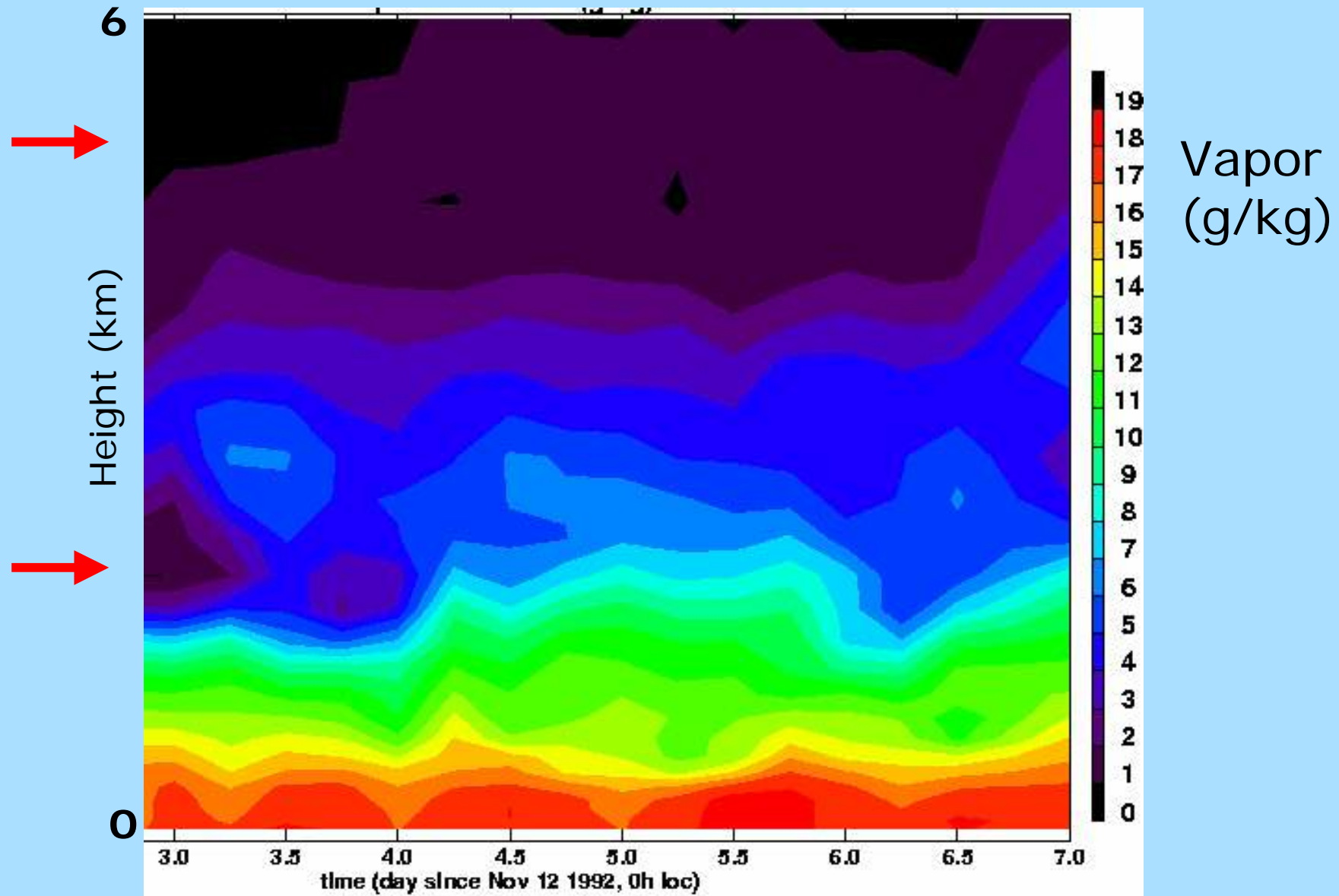
→ Suppressed or reduced convective periods (Link to MJO), precipitating shallow convection mostly present over Warm Pool, downdraft intensity, ...

→ Poor confidence in current convective schemes

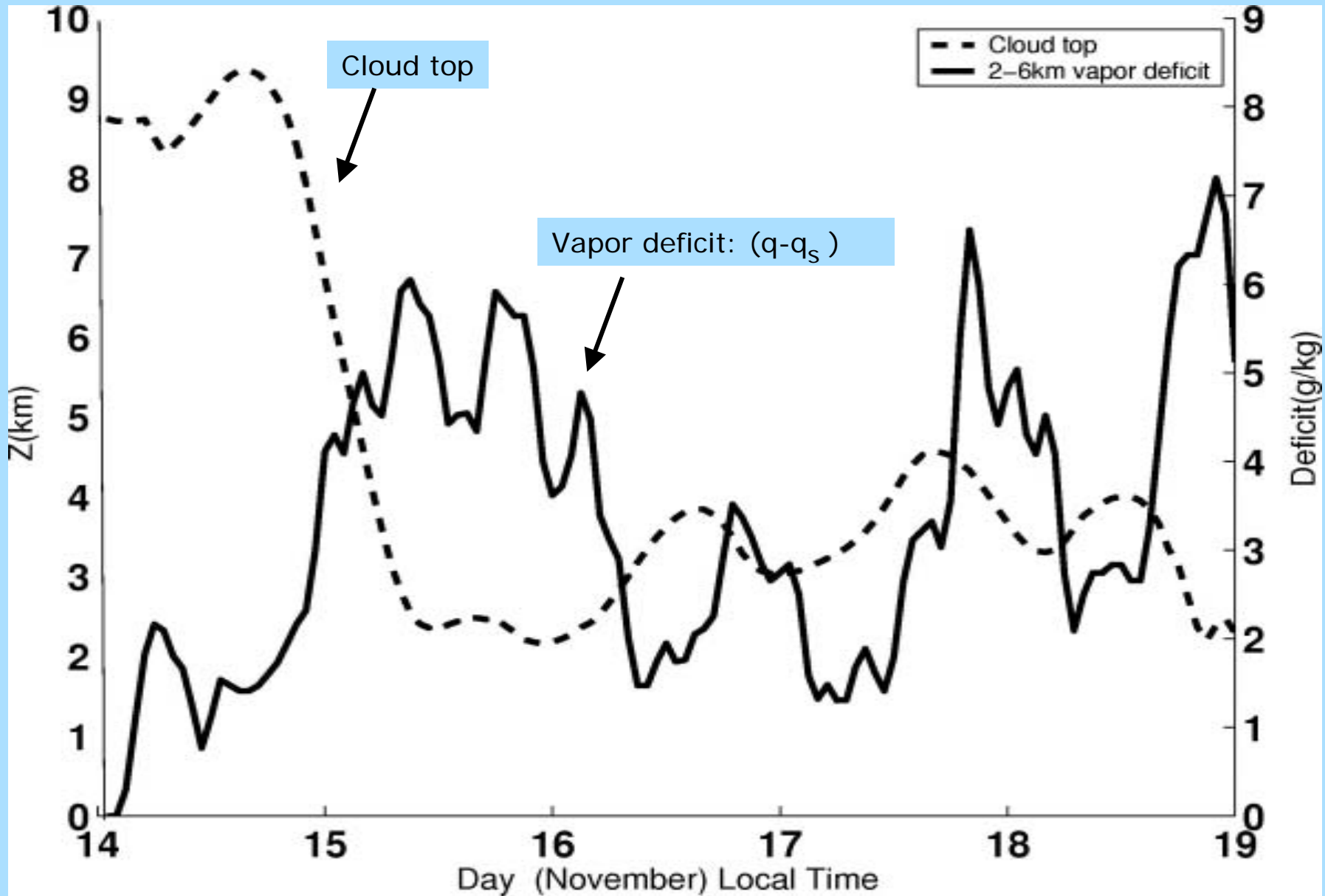
**Selected Case: Idealized case with different HU profiles**

**Leader: S. Derbyshire**

# Dry air intrusions observed over the Warm pool

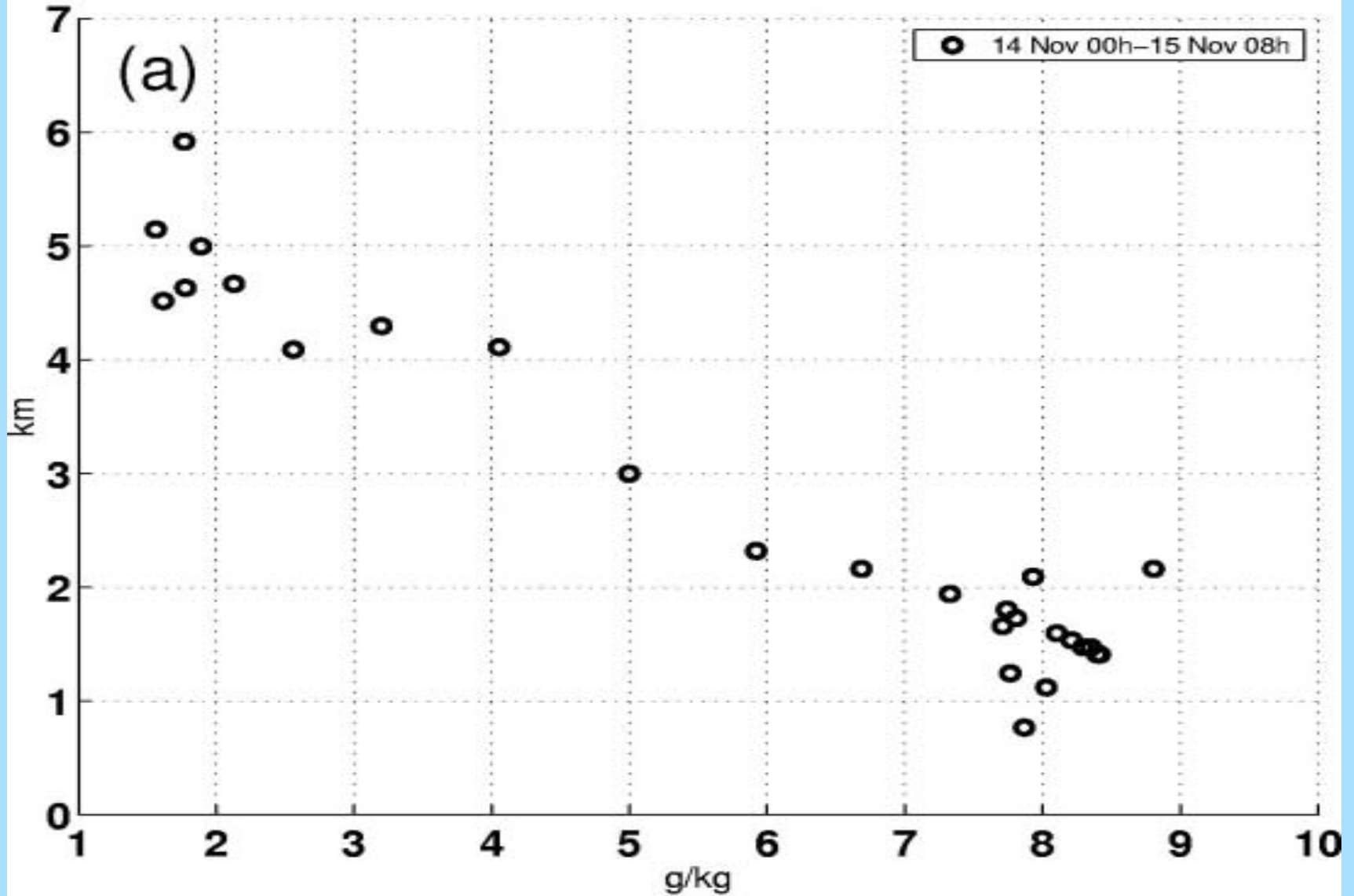


# Relationship between dry air & cloud top



# Relationship between dry air & cloud top

cloud top vs 1.4–3km vapor deficit



# EUROCS: BASIC CLOUD PROBLEMS

## PRECIPITATING DEEP CONVECTIVE CLOUDS

### ■ **Sensitivity to humidity of cloud development and transports**

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Advection from deserts, stratospheric intrusions, ... :

TOGA-COARE, CEPEX, INDOEX, ...

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**Selected Case: Idealized case with different HU profiles**

**Leader: S. Derbyshire**

### ■ **Diurnal development of precipitating convection over land**

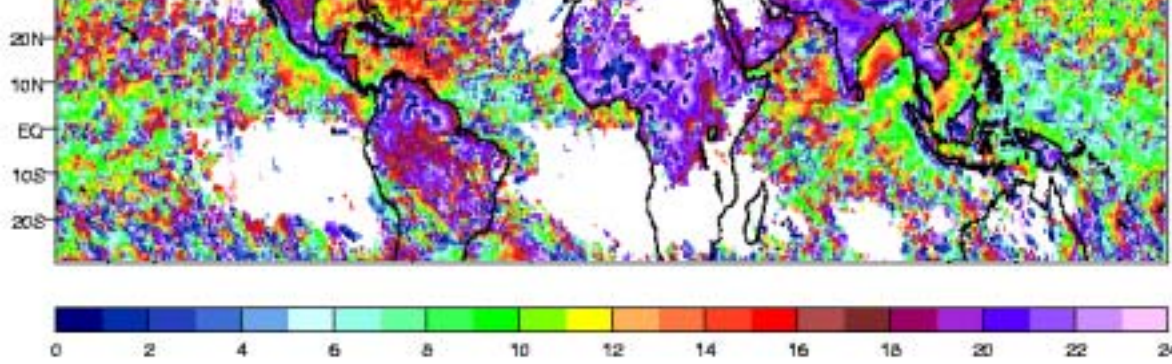
Very poor representation in GCMs: Amplitude and phase errors (Too early)

→ Radiative budget at top of atmosphere and surface

→ Problems in surface energy budget; sfc T & q bias, precip forecasts, ...

**Selected Case: Idealized case of local development of Cb**

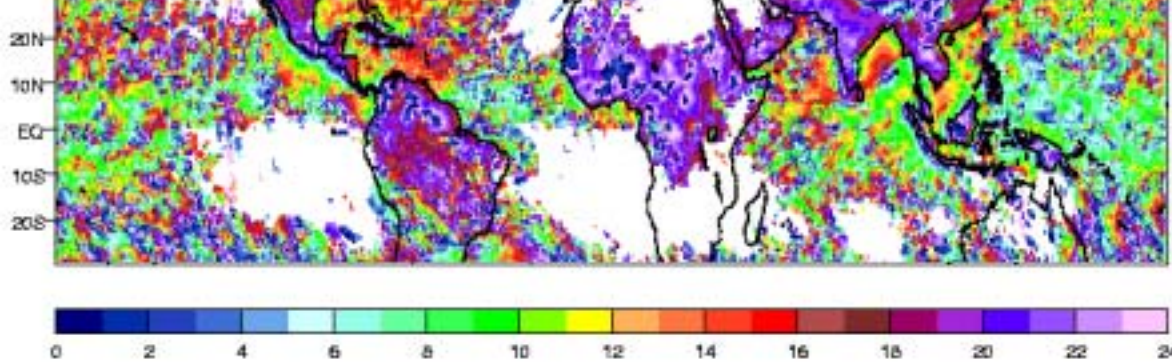
**Leaders: F. Guichard & J. Petch**



# Diurnal cycle of convection / JJA

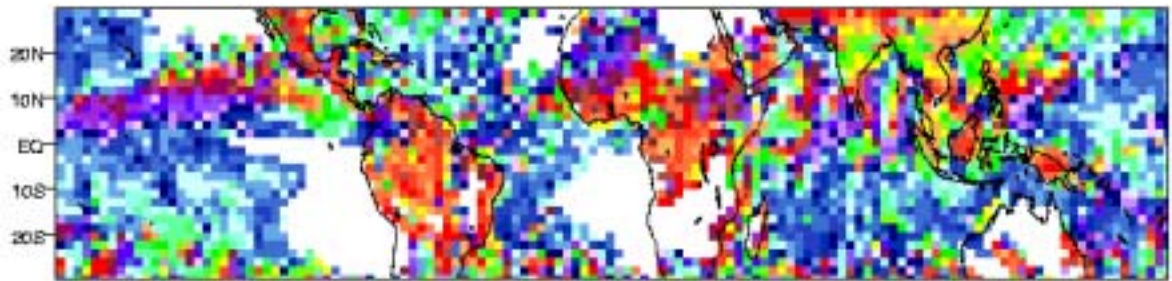
Observations  
(CLAUS Archive)  
Yang and Slingo MWR 200

Local time of precipitation maximum

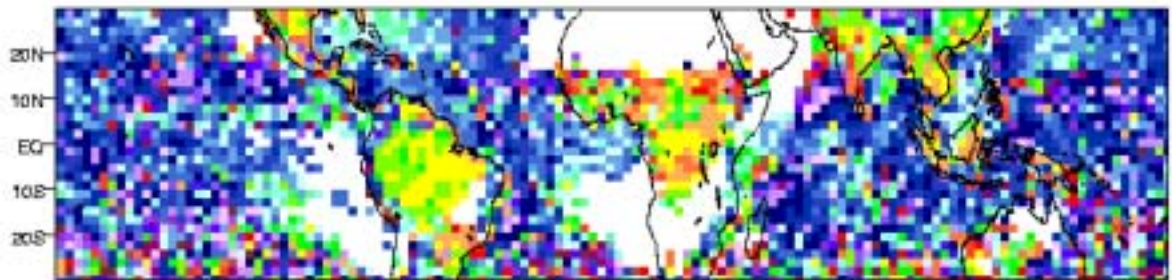


# Diurnal cycle of convection / JJA

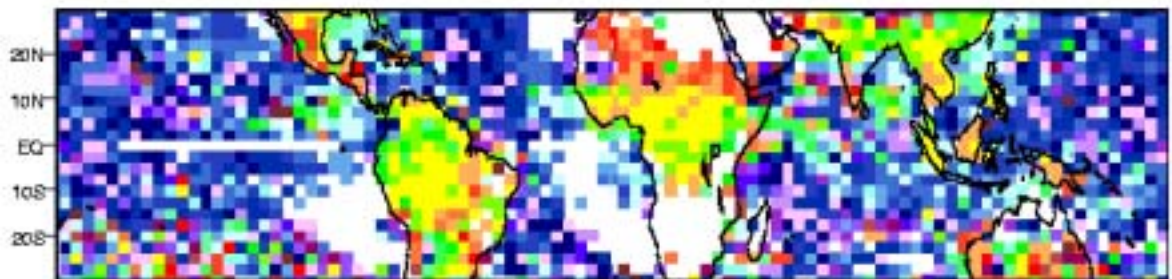
Observations  
(CLAUS Archive)  
Yang and Slingo (MWR 2000)



ARPEGE NWP Model  
J.M. Piriou 2002



ECMWF  
Beljaars 2002



UK Unified Climate Model  
Yang and Slingo (MWR 2000)



# EUROCS: GCM TESTS

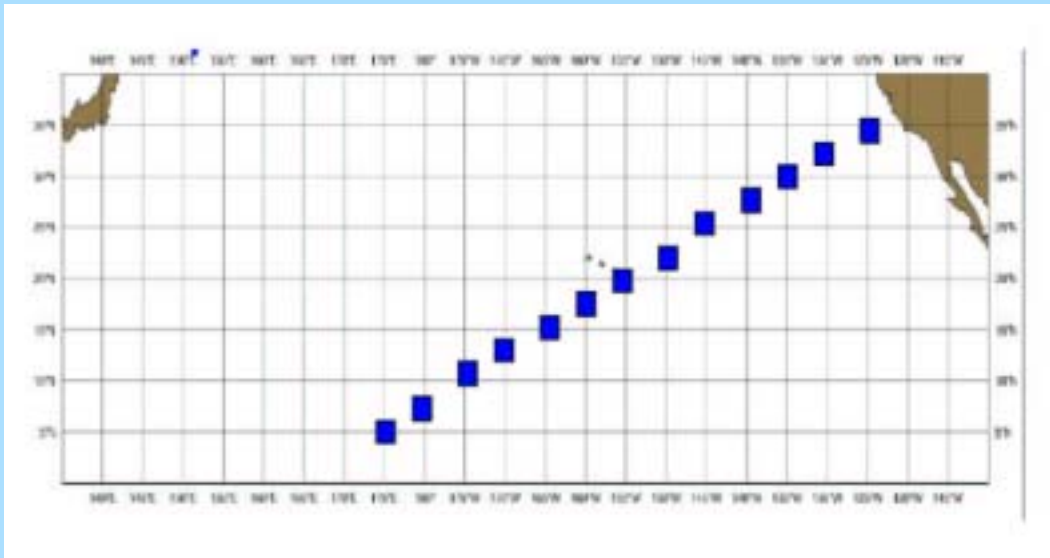
## PACIFIC CROSS-SECTION

### ■ Full 3D GCM: Sc to Cu to Cb transition

Complementary to selected cases

Leaders: P. Siebesma & C. Jakob

**Initial selected cross-section JJA98: [35N,125W] to [5N,175E]**



0D parameters: OLR, SLR, TOA\_SW, LWP, R, ....

1D parameters: q, W, U, Lwc, Iwc, ...

Satellite observations (ERBE, ISCCP, ...)

# CONCLUSIONS

- **EUROCS brings together a critical mass of the scientific community working in various areas but with a same goal**
  - Communities working on processes & GCM, Communities working on PBL & Deep convection (Transition Cu→Cb, Diurnal cycle), ...
  
- **To focuss on major deficiencies of GCM cloud parameterizations in proposing**
  - Physically-grounded corrections of current schemes
  - A new generation of parameterizations  
(specially for boundary layer clouds)