some inferences from the EUROCS project

EUROCS: european project on cloud systems in NWP/climate models

- European Component of GCSS (GEWEX cloud system studies) concentrating on basic problems of cloud representation in NWP & climate models
- Funded for 3 years (2000-2003) by EC and National Institutions
- 10 European 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)
- Special QJRMS Issue (2004)

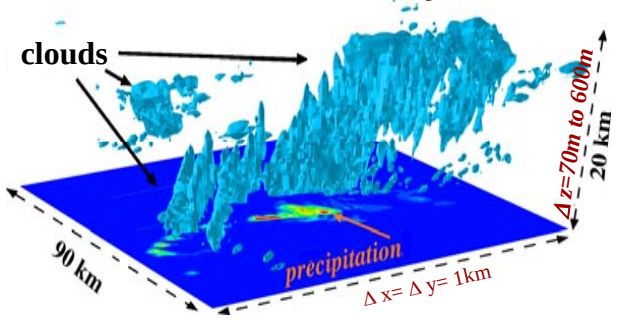
coordinated by J.-L. Redelsperger http://www.cnrm.meteo.fr/gcss/

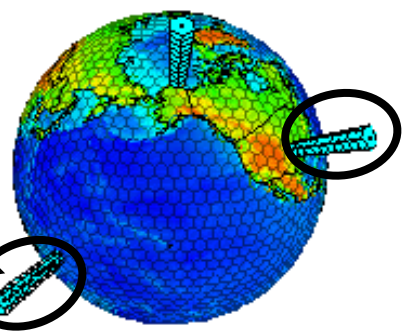
summary

- A strategy based on a hierarchy of models & observations
- A consortium linking the cloud modelling European community
- Issues chosen by European GCM groups, identified model defficiencies (*versus* choices issued from the LES/CRM community)

- ✓ stratocumulus over ocean
- ✓ diurnal cycle of cumulus over land
- ✓ sensitivity of deep convection development on the moisture profile
- ✓ diurnal cycle of precipitating deep convection over land
- ▪ added afterwards: Pacific cross-section

obs ⟺ LES & CRMs --- SCMs --- RCMs & GCMs ⟺ ***obs***





GCM picture from Colostate web page

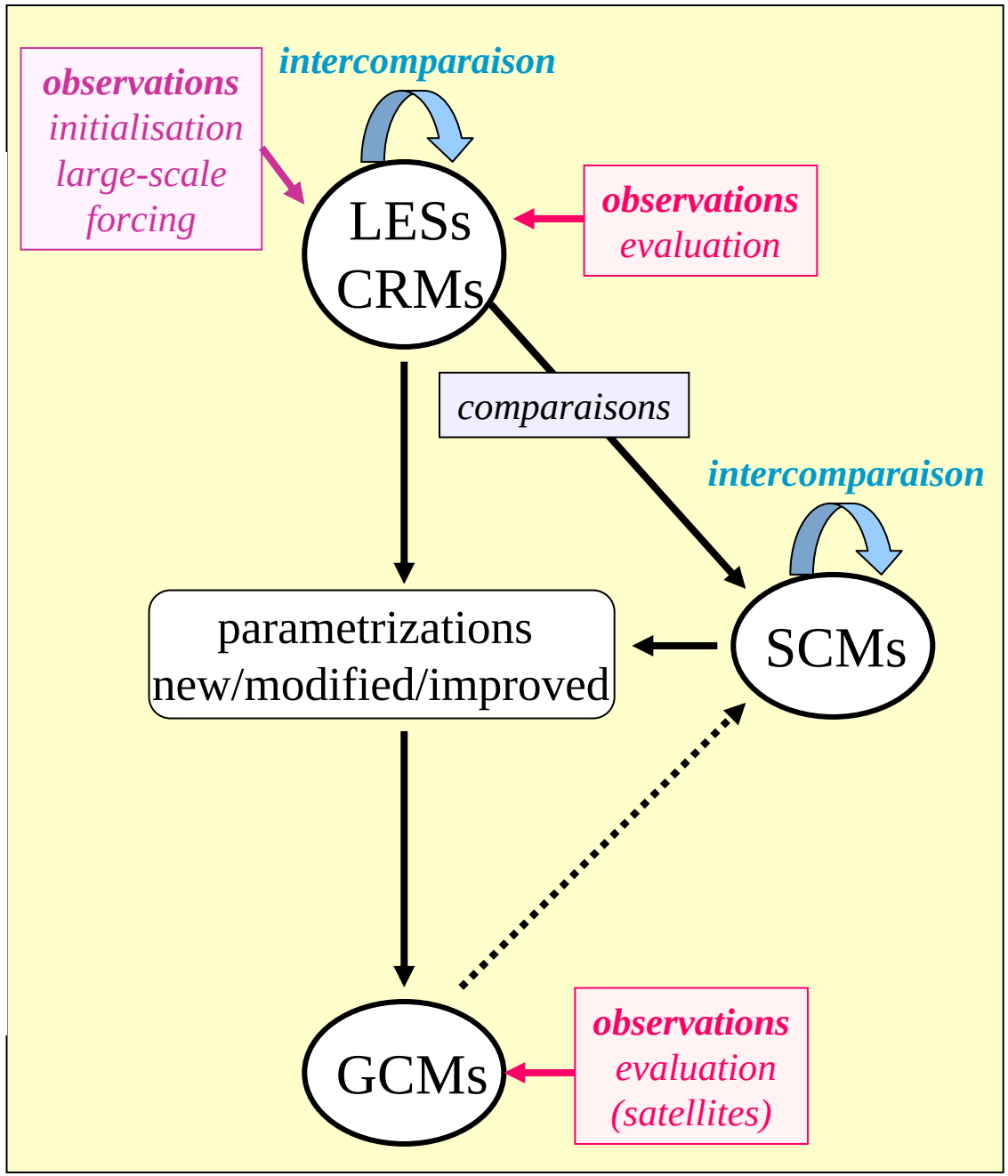
LES: Large Eddy Simulation
CRM: Cloud Resolving Model
SCM: Single Column Model
RCM: Regional Climate Model
GCM: General Circulation Model

STRATEGY

based on the use of a
hiérarchy of models

process analysis
direct comparison of
explicit versus parametrized
treatments
via a single column model
« interface link»

focus on identified
GCM problems
diurnal cycle of convection
stratocumulus
convection-humidity links



intercomparison exercises,
and beyond, a frame for
collaborations & exchanges (understanding)

comments about case-studies

very useful

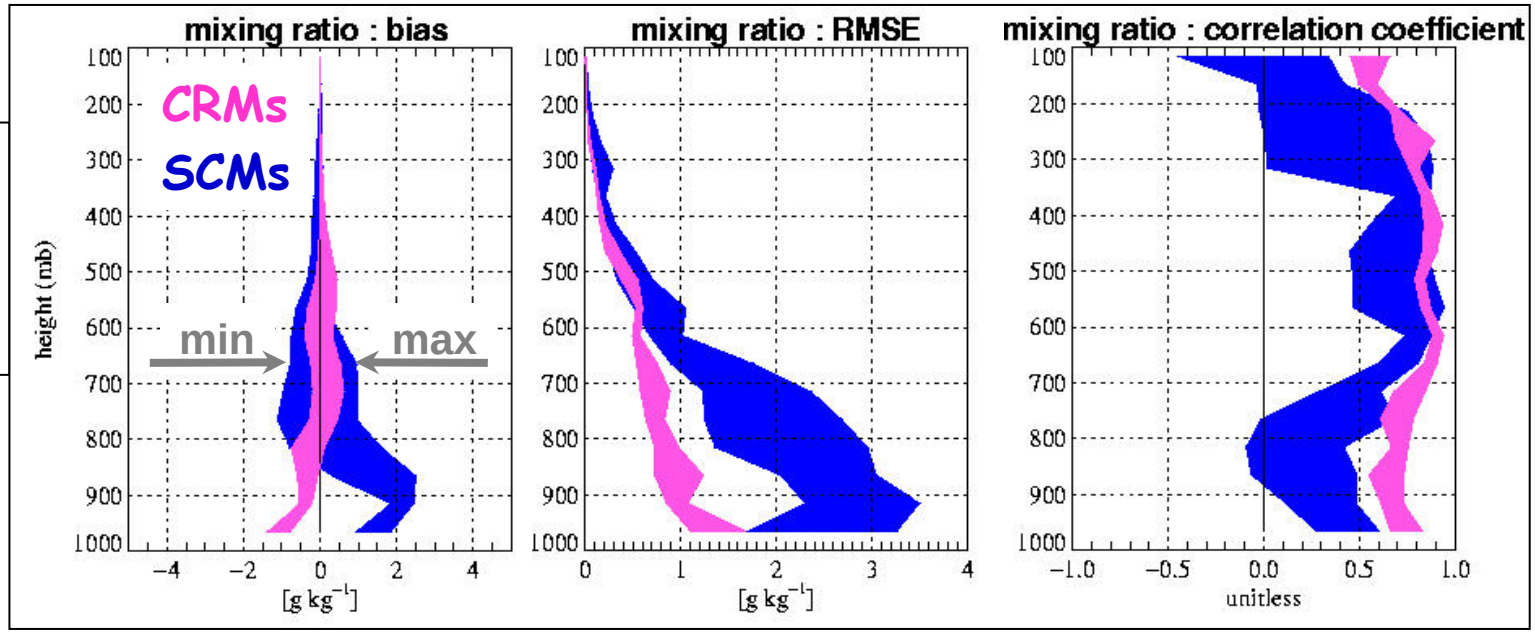
intercomparisons: frame to learn more about models

setting-up case-studies, running models, correcting bugs, analysing outputs, deriving diagnostics from model outputs, all this takes time

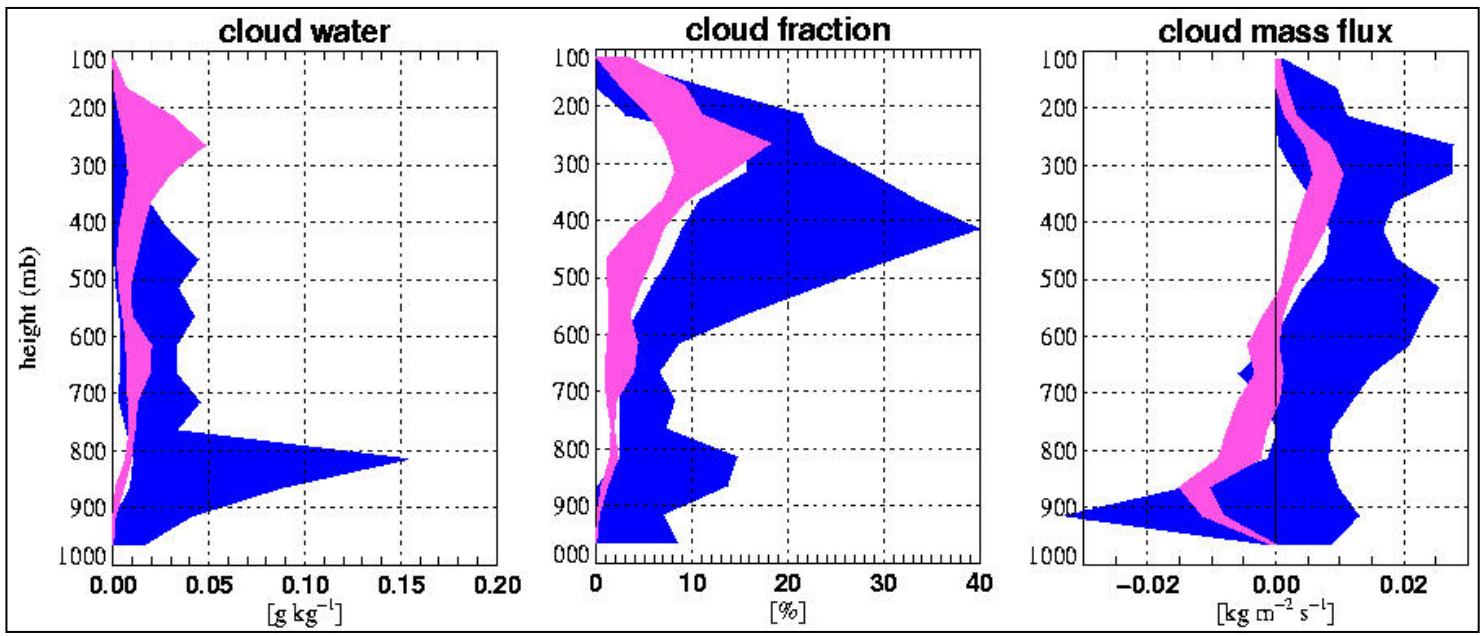
really useful to try to formulate what we expect (or not) from them before

spaghetti plots

comparaison modeles-observations



comparaison CRMs SCMs (no available observation)

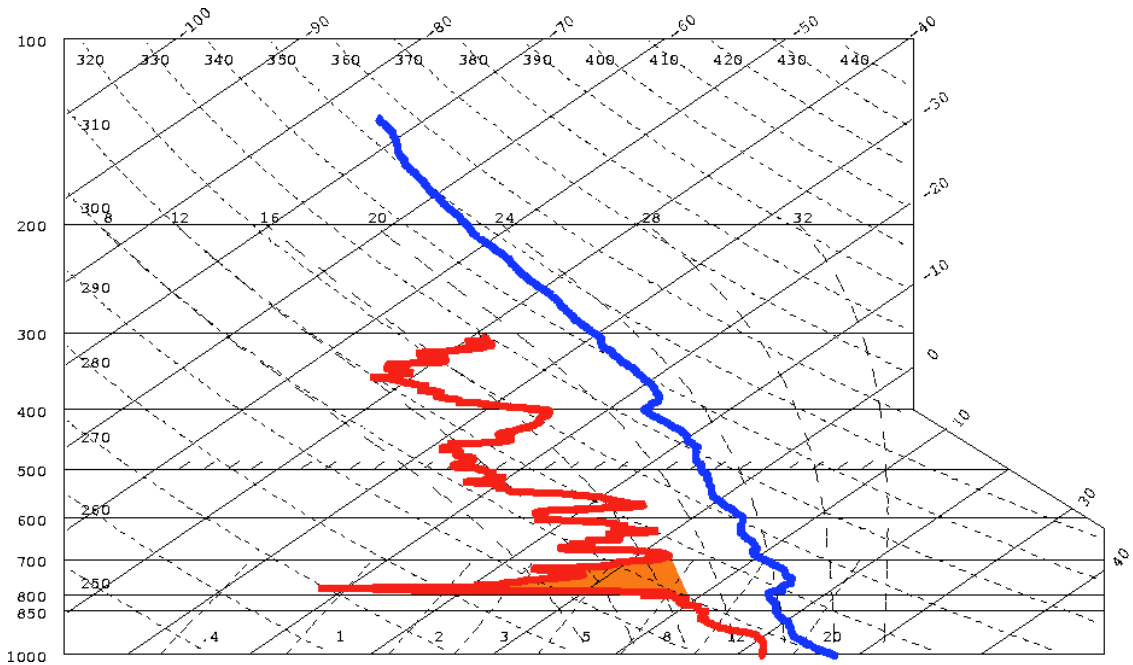


sensitivity of moist convection to mid-tropospheric humidity

dry layers in the tropical mid-troposphere are often observed

different contrasting mechanisms of interaction with moist convection:

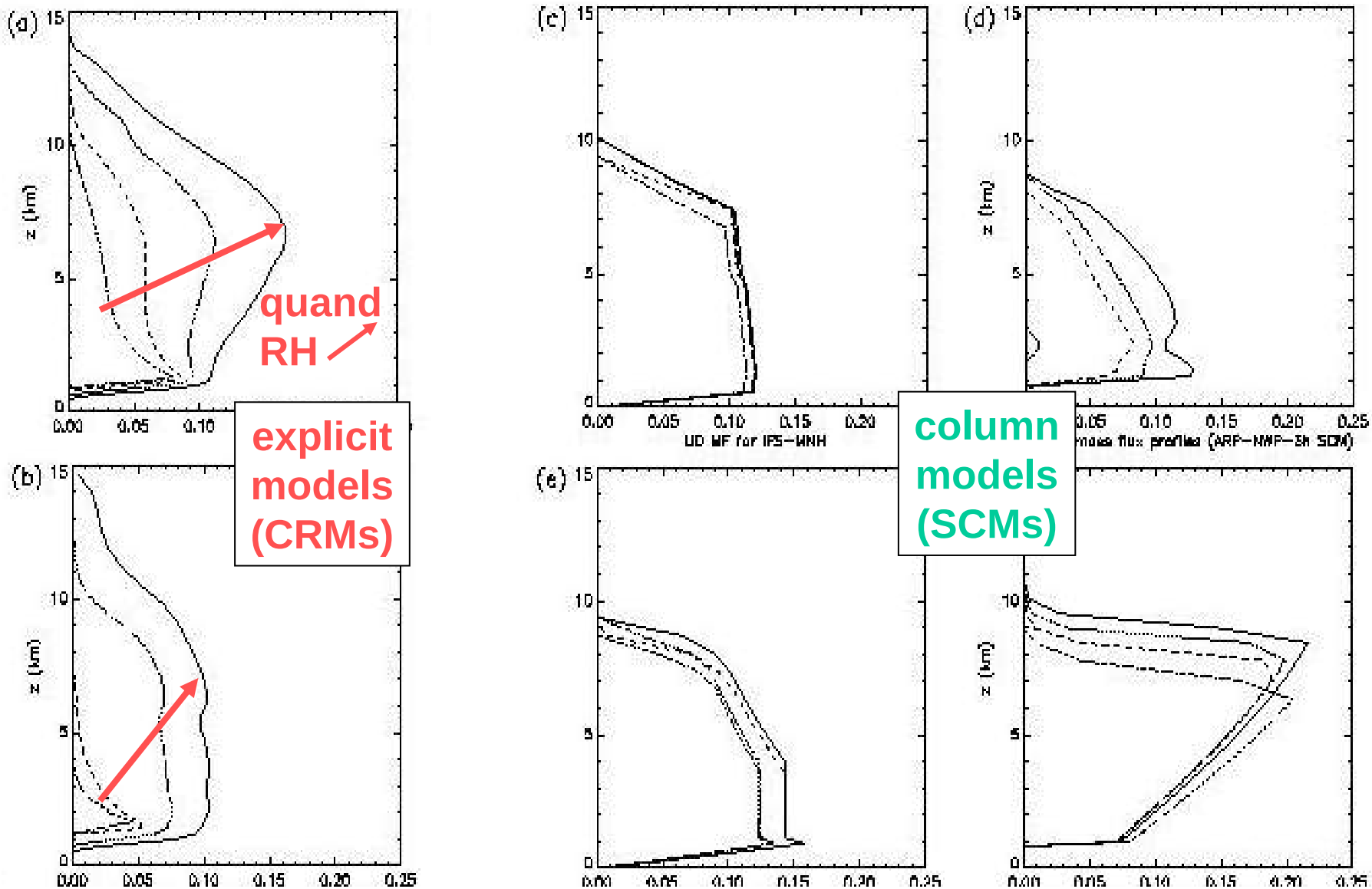
suppression (dry period during COARE, tropical Pacific)
enhancement of convective downdraft strenght



Redelsperger et al. (2002)

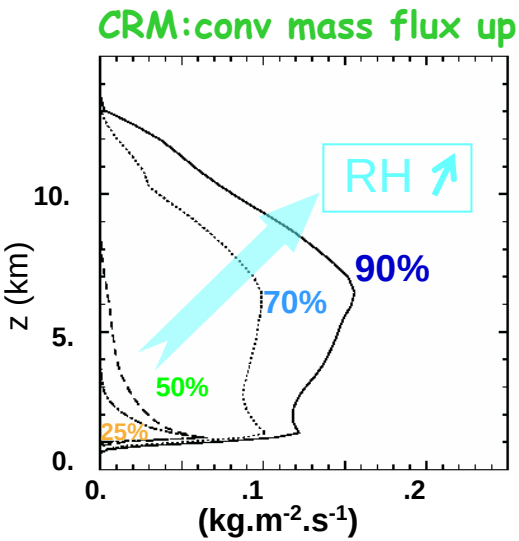
sensitivity to environmental humidity, Derbyshire et al.(2004)

upward convective mass flux

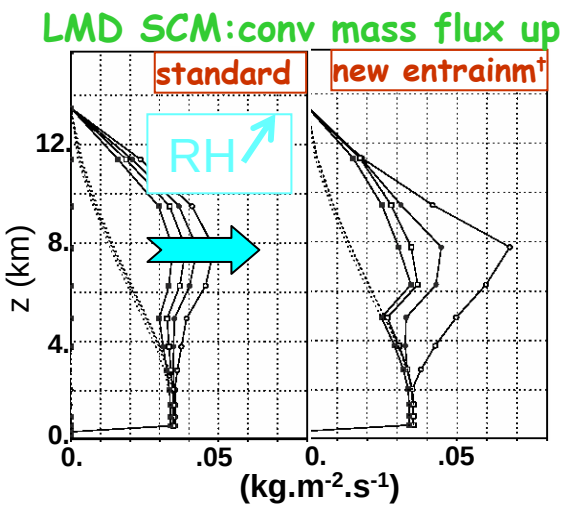


Derbyshire et al. (2004)

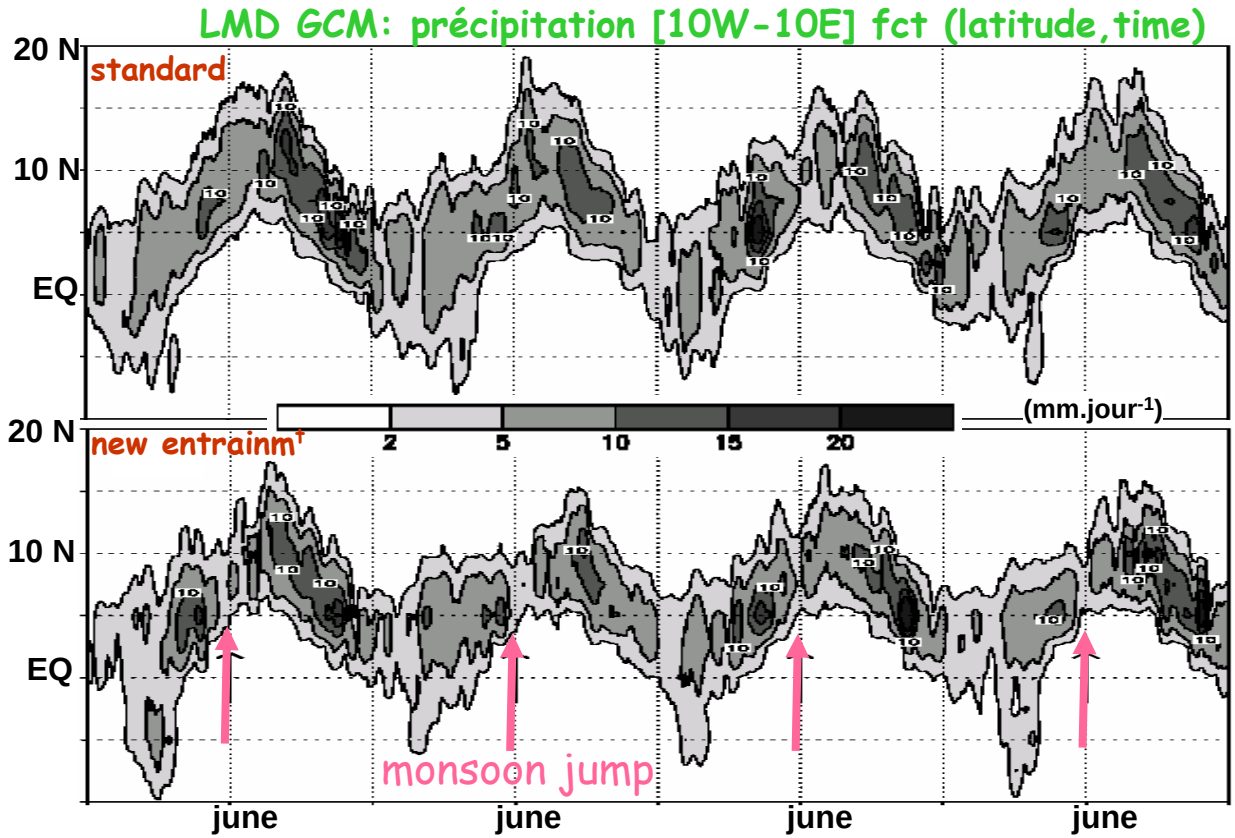
sensitivity of convection
to the humidity field



Grandpeix et al. (2004)



Grandpeix et al. (2004)

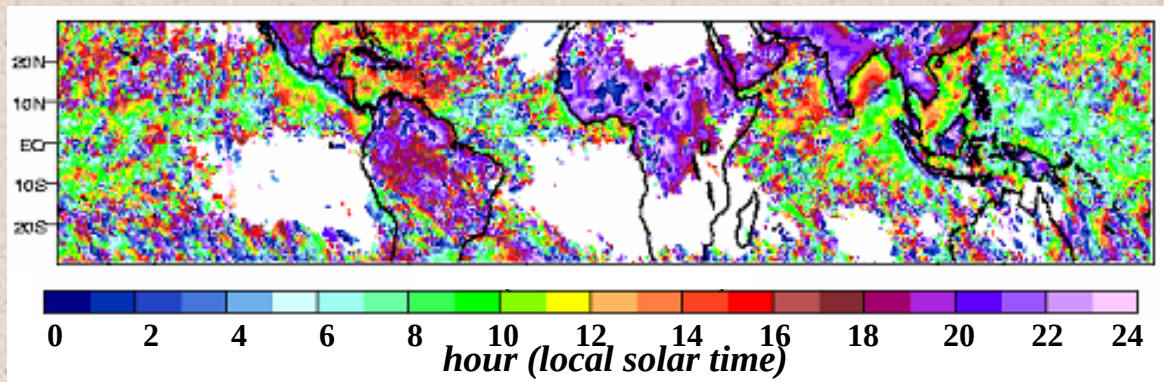


comparaison of the phases of the diurnal harmonic of rainfall in obs & 3 GCMs

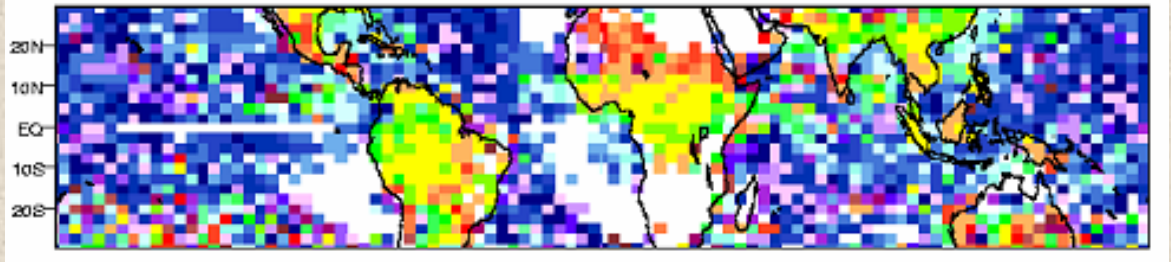
(J. M. Piriou)

Yang & Slingo (2000)

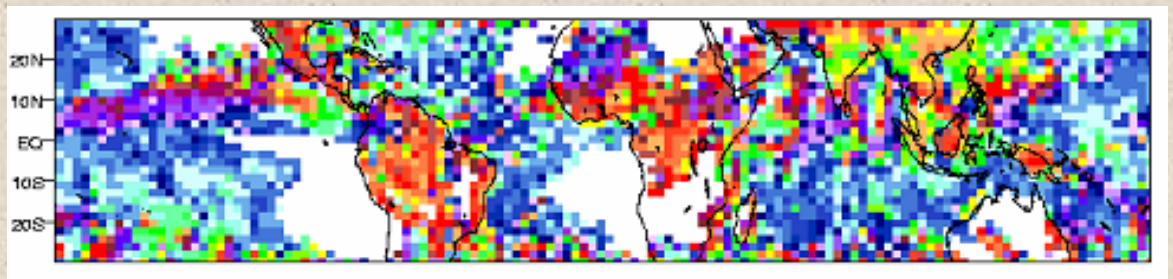
observations
satelite data CLAUS



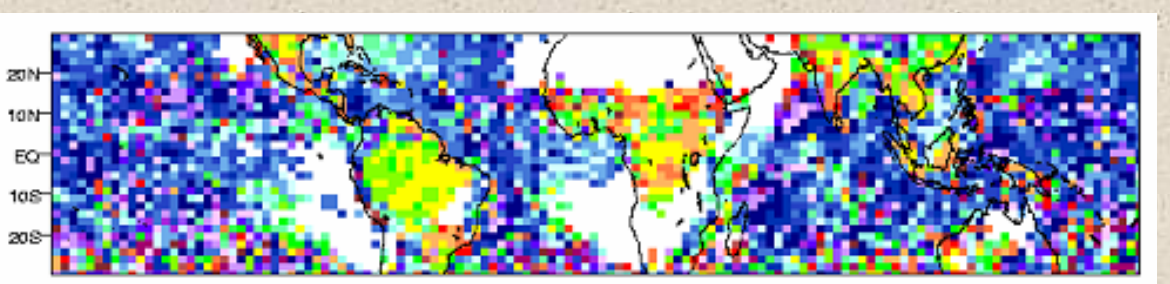
Unified Model
(Met Office)



ARPEGE NWP
(J.-M. Piriou)



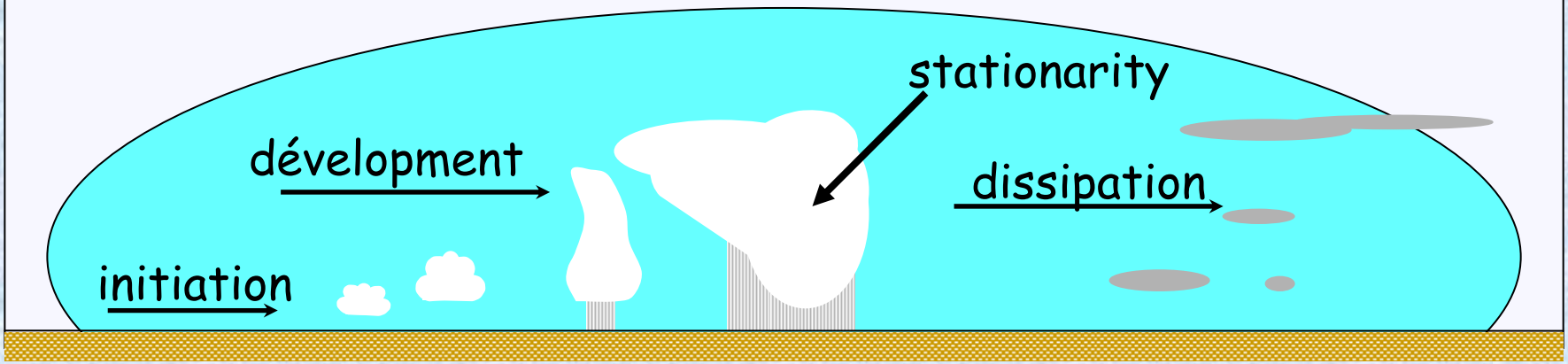
ECMWF IFS
(provided by A. Beljaars)



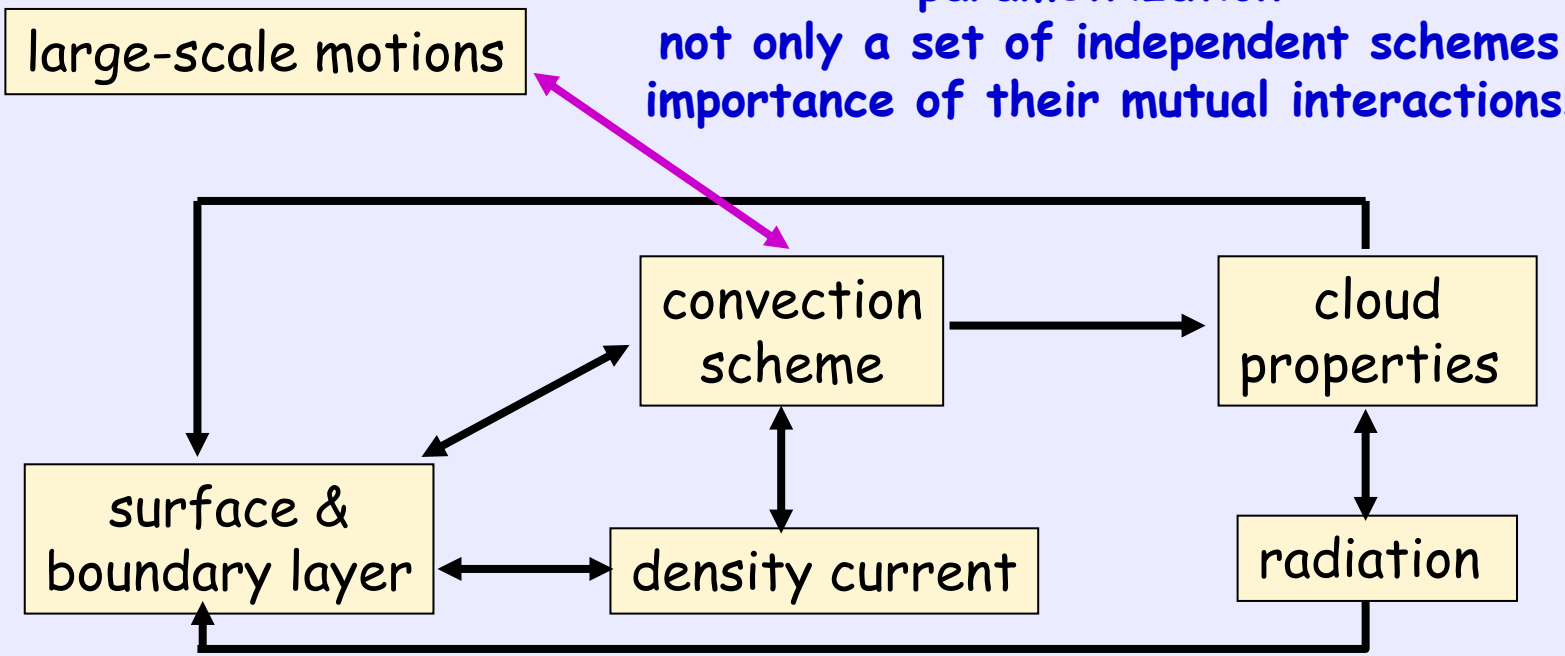
question of the amplitude not to be neglected either

diurnal cycle of convection

life cycle, transitions, régimes



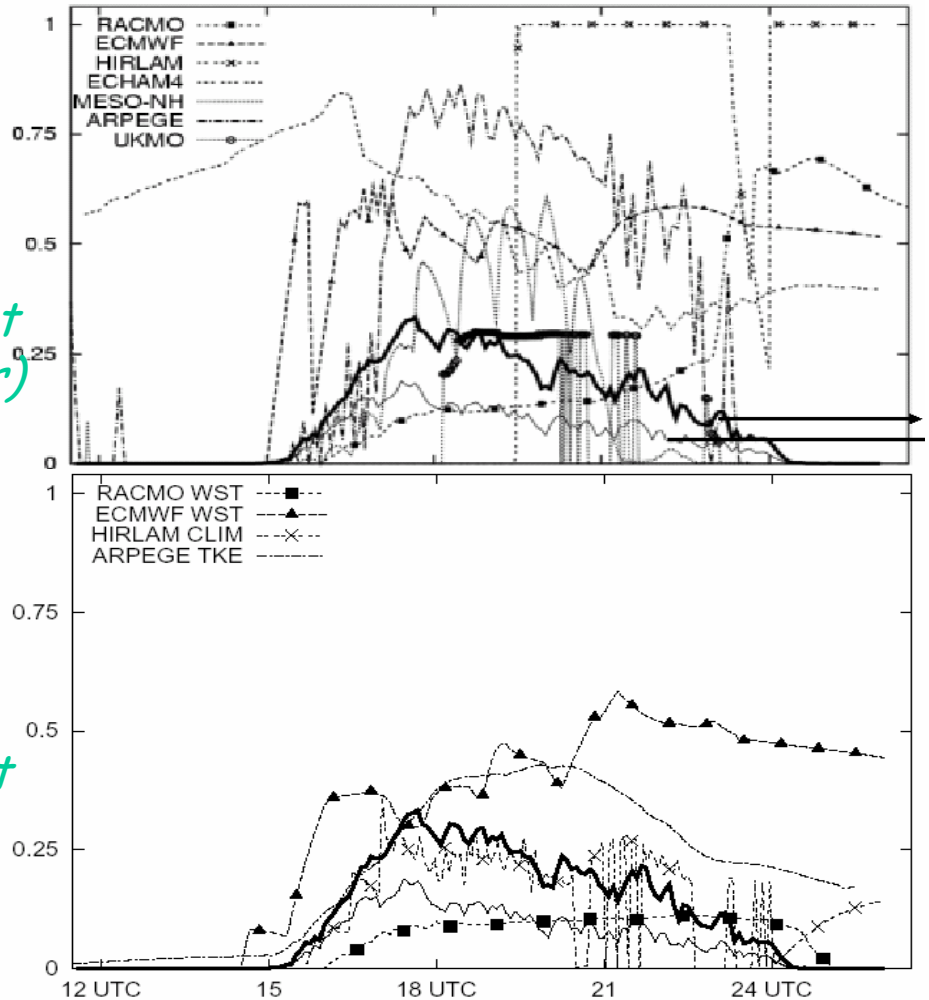
parametrization:
not only a set of independent schemes
importance of their mutual interactions!



diurnal cycle of shallow cumulus

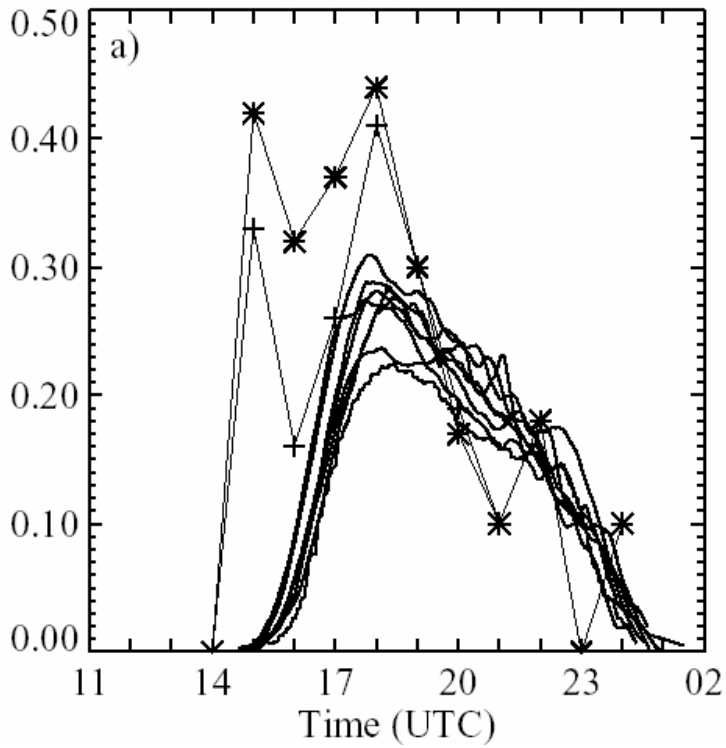
start of the project (+1year)

end of the project



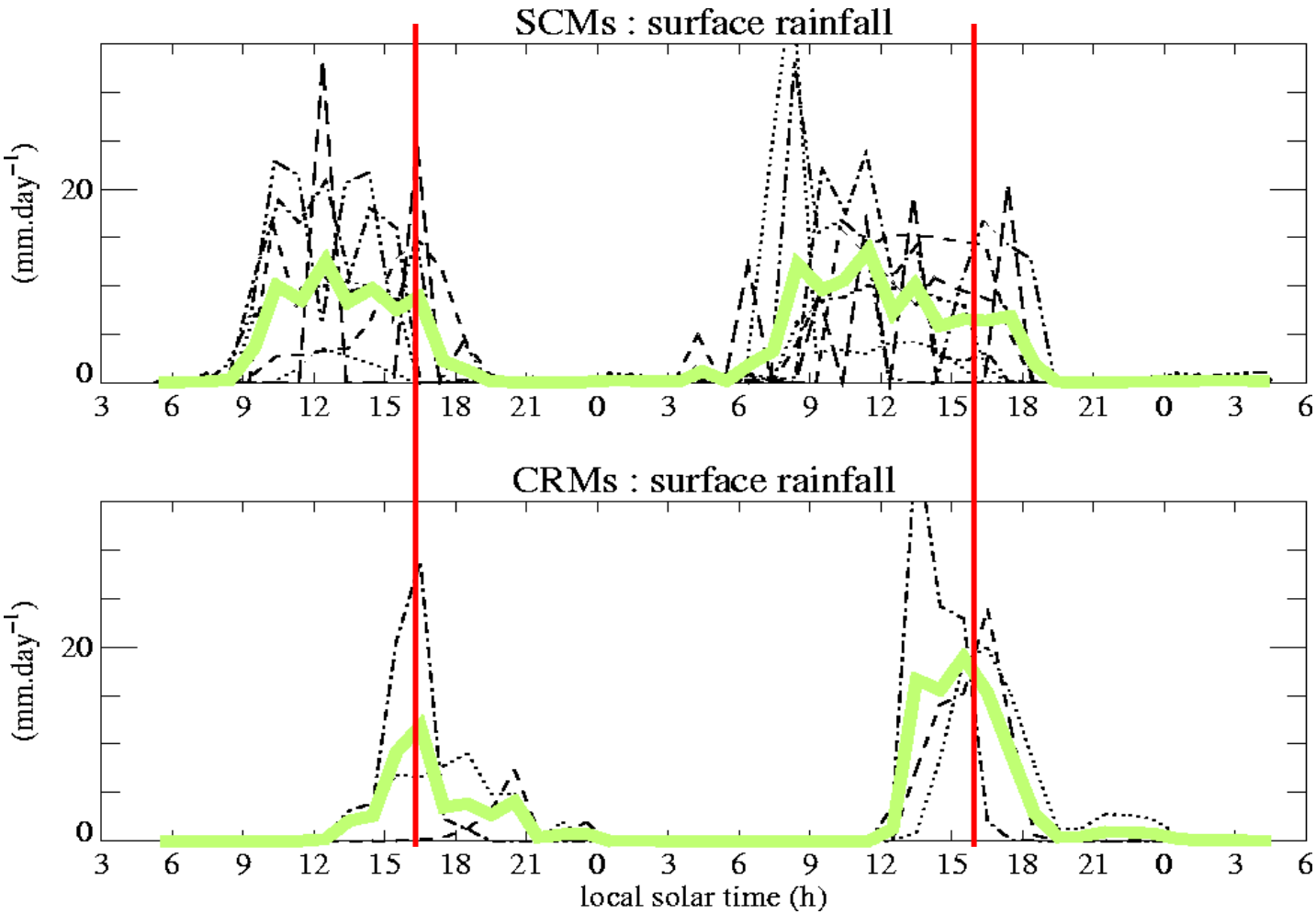
Lenderink et al.(2004)
intercomparaison SCMs

cloud fraction



Brown et al.(2002)
intercomparaison LES

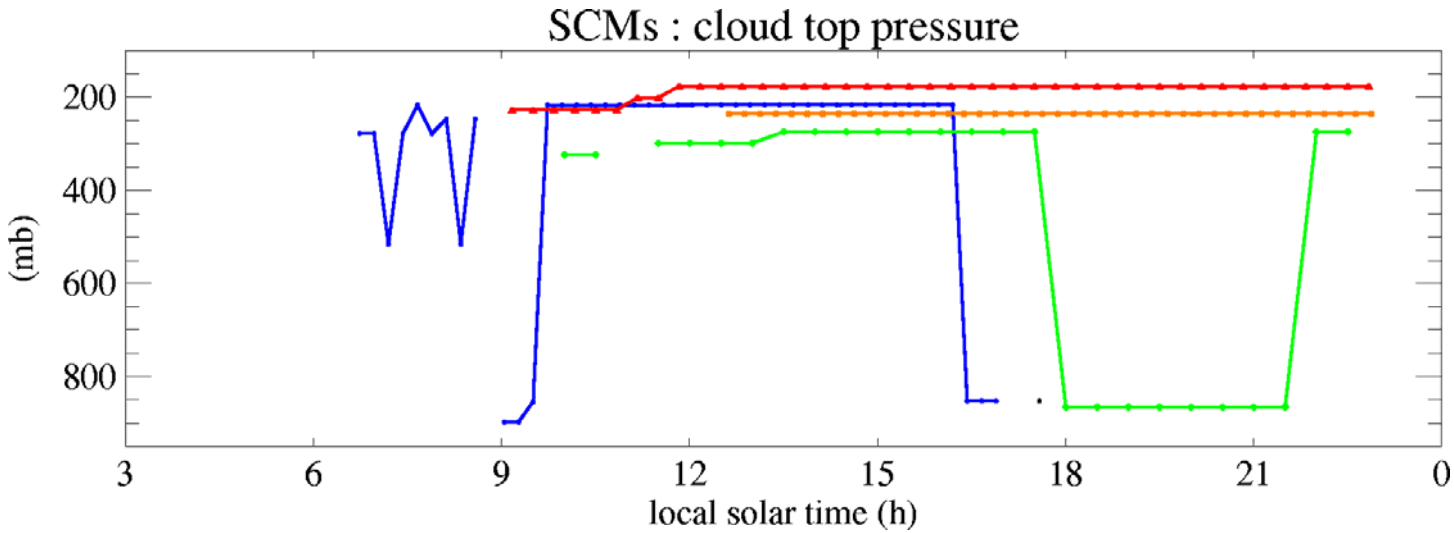
crucial role of how BL & cumulus parametrization are coupled!

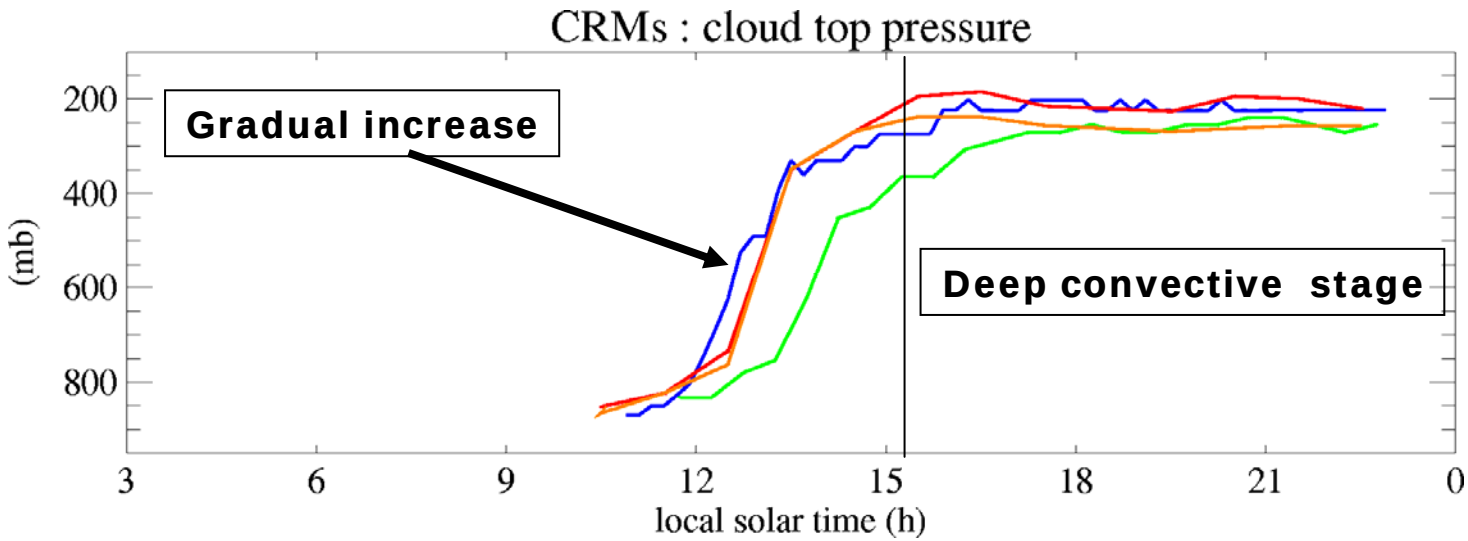


- Large spread in the amount of predicted rainfall but…
  the phase error found in GCMs is reproduced
- Deep convection starts later in CRMs

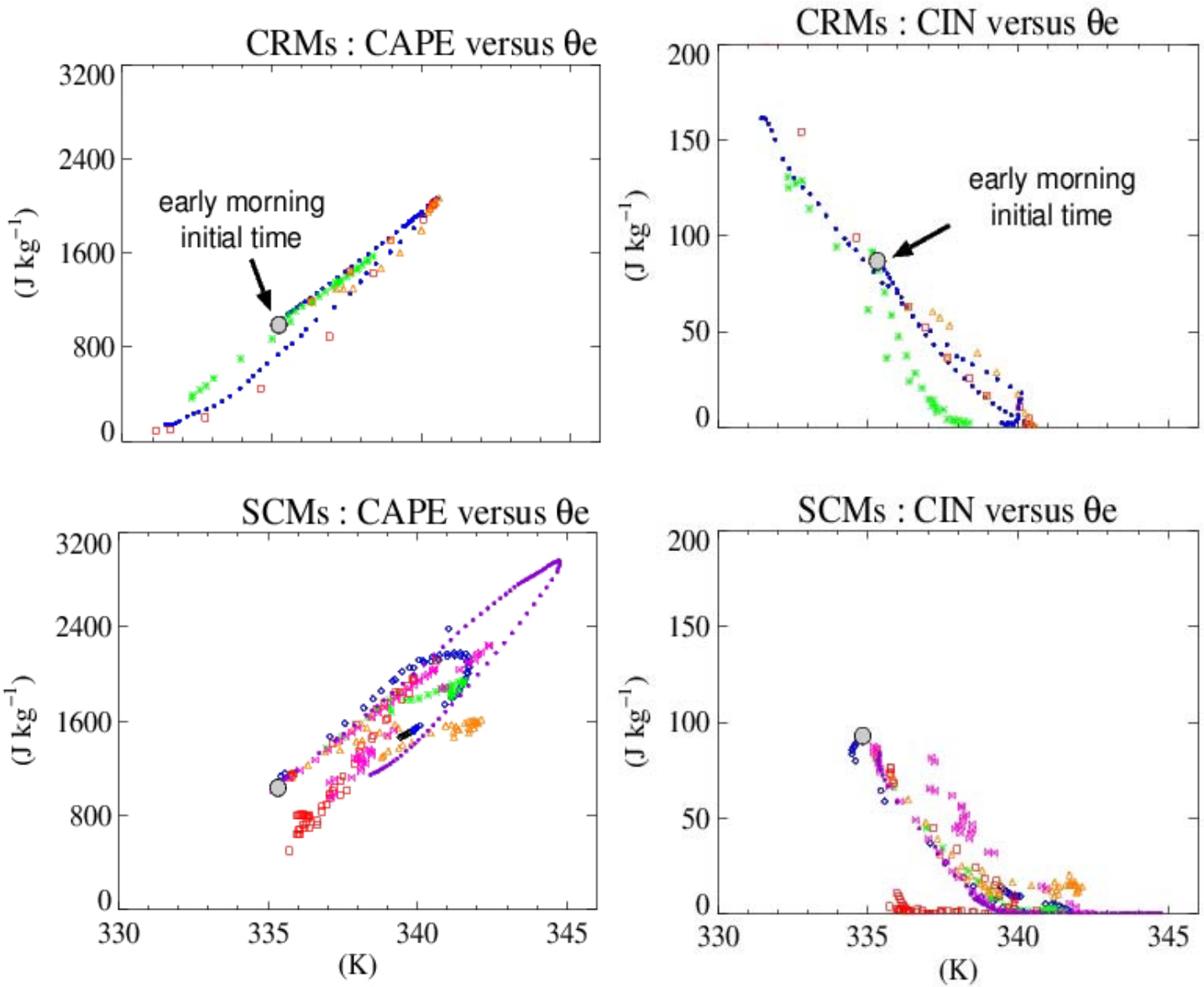
Guichard et al.(2004)

Cloud tops

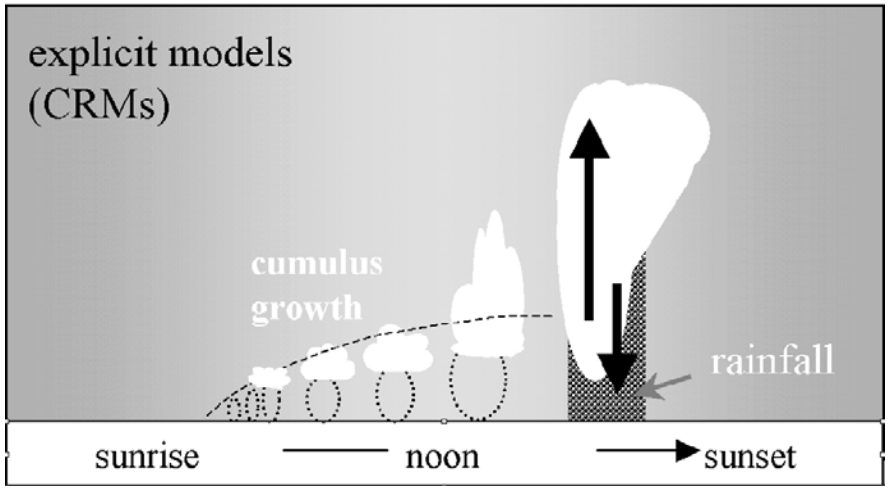

SCMs : cloud top pressure
200
400
600
800
(mb)
3
6
9
12
15
18
21
0
local solar time (h)

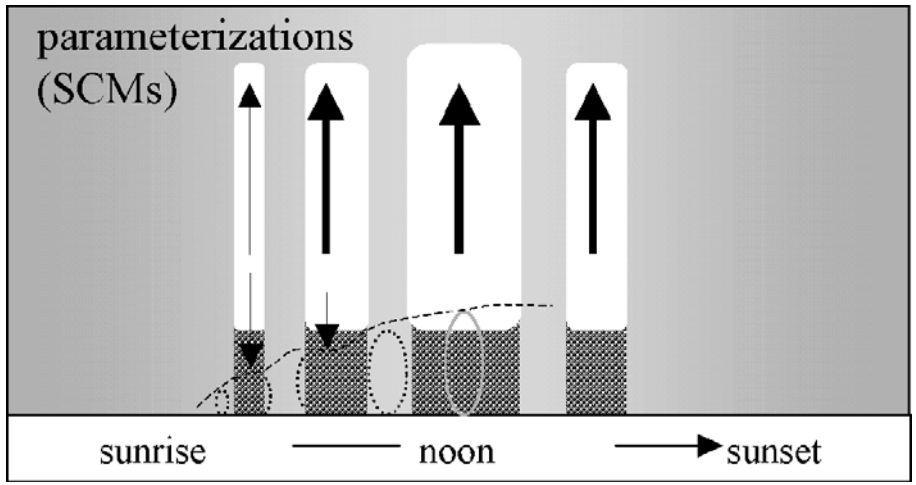

CRMs : cloud top pressure
Gradual increase
Deep convective stage
200
400
600
800
(mb)
3
6
9
12
15
18
21
0
local solar time (h)

synthetic diagnostic of PBL-convective functionning



Guichard et al. (2004)





- ✓ 3 regimes during daytime: dry, shallow and deep
- ✓ case-study allowed to address GCM major weakness for this type of situation:
  - lack of sensitivity of convection schemes to humidity
  - lack of gradual transition regime
  - triggering function issue: better account of PBL convection needed
  - pb with parametrization convective downdraughts

about *strategy for modelling improvement* within AMMA

questions to large-scale modellers:
are there some large-scale modelling aspects over WA that you think require special consideration?
if yes, is a case-study well adapted?
then, various ways to design such a case-study, which way:
1D SCM runs?
2D (lat,height) framework?
(2D well suited for feedback loops analyses)
....

not talking about surface representation (nor aerosols) here,

question of diurnal convection & its interaction with surface processes
issue of propagating convective systems
cloud anvils?
specific need for boundary layer?
convective & nocturnal boundary layer, heat low convection, interaction with moist convection
...