cloud modelling within AMMA

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haboob, 23 august 2004, Hombori Mali (15N,1W) (*F. Guichard & L. Kergoat*)

African Monsoon Multidisciplinary Analyses

Analyses Multidisciplinaires de la Mousson Africaine

Afrikanischer Monsun: Multidisziplinäre Analysen

Analisis Multidiciplinar de los Monzones Africanos

...

international program, european project, links with CLIVAR, GEWEX...

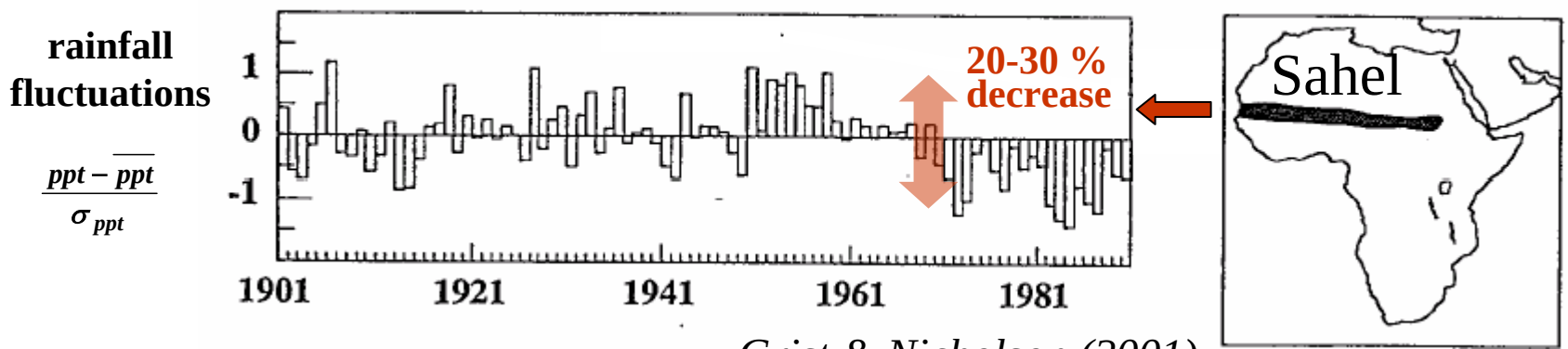
muti-(time & space) scales approach / multidisciplinary : hydrology, vegetation, chemistry...

LOP, EOP & SOPs in 2006 with aircrafts, sounding network, radars, lidars, surface data...

more info here: http://medias.obs-mip.fr/amma/

contacts: Lebel, Polcher, Redelpserger & for parametrizations/ model evaluation: Frédéric Hourdin

« most dramatic example of [measured] multidecadal variability » (Hulmes 2001)



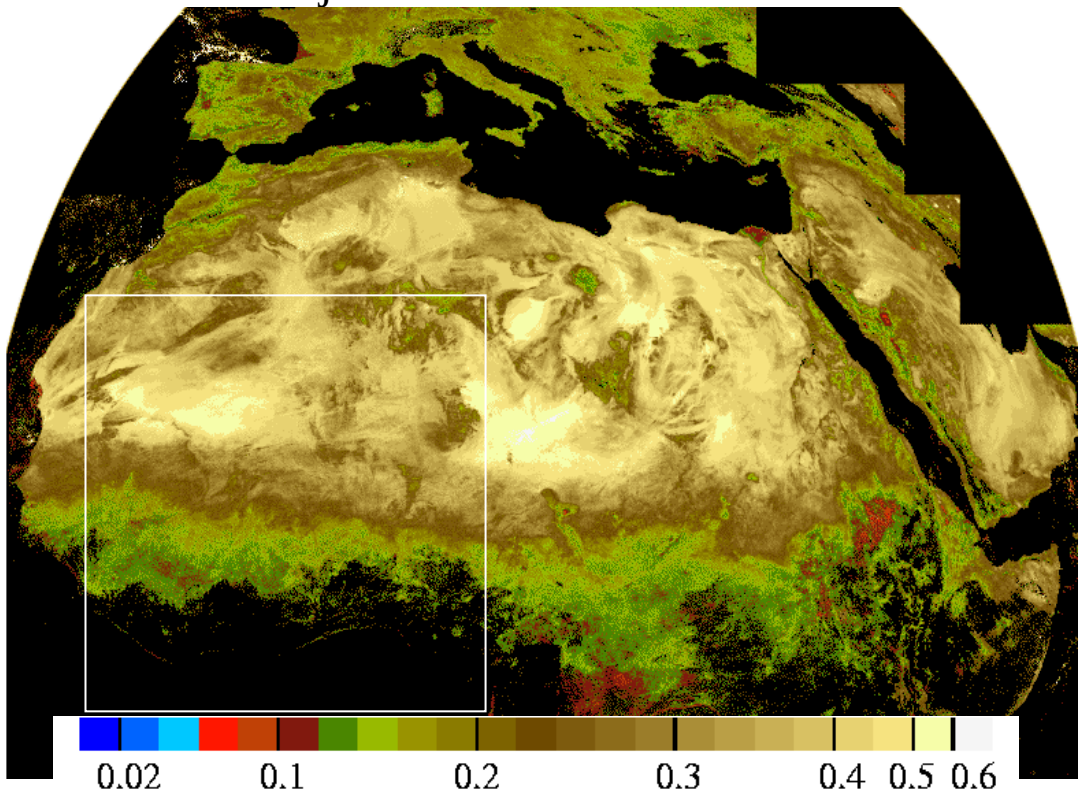
Grist & Nicholson (2001)

causes not well understood

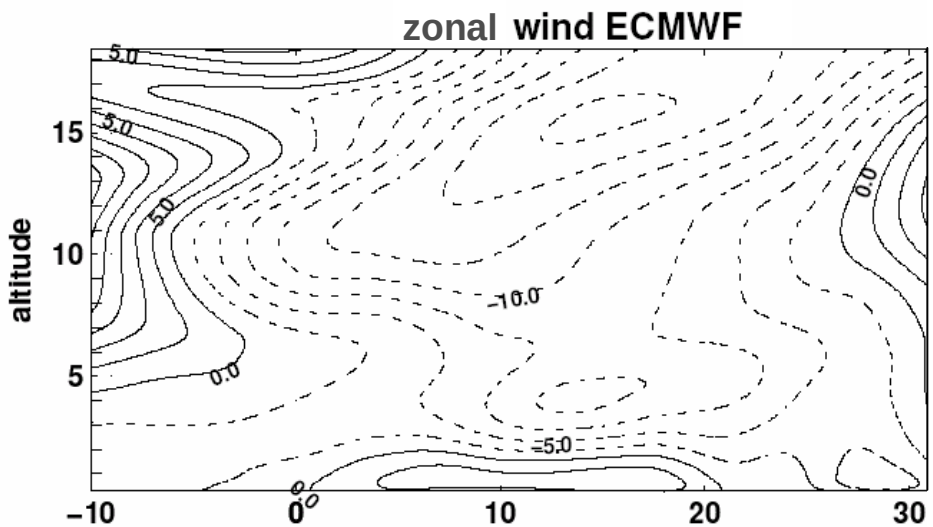
characteristics of the area at large scale

well defined
strong meridian surface gradients

albedo juin 1996 EUMETSAT/JRC



specific circulations
African easterly jet



[10W,10E]
July
2000-2001

specific to west-african moist convection

« spectacular » moist convective activity

✓ very deep convection, intense lightning activity, transport of dusts/aerosols

✓ importance of MCSs ▶ explain most of the precipitation (~ 80%) with role of / modulation by AEWs although AEWs alone do not account for observed rainfall

✓ coupled to patchiness of rainfall
(down to 10 km scale + extending to seasonal timescales ▶)
questions: links/couplings with the surface & boundary layer processes?

✓ deep convection & very weak rain, significance of rain evaporation?

✓ strong diurnal cycles of moist convection & clouds
diurnal cycle of rainfall: region dependent, involves propagation of MCSs

*context: rainfall critical (*Sahel *means* shore*)*
existing observational network is sparse

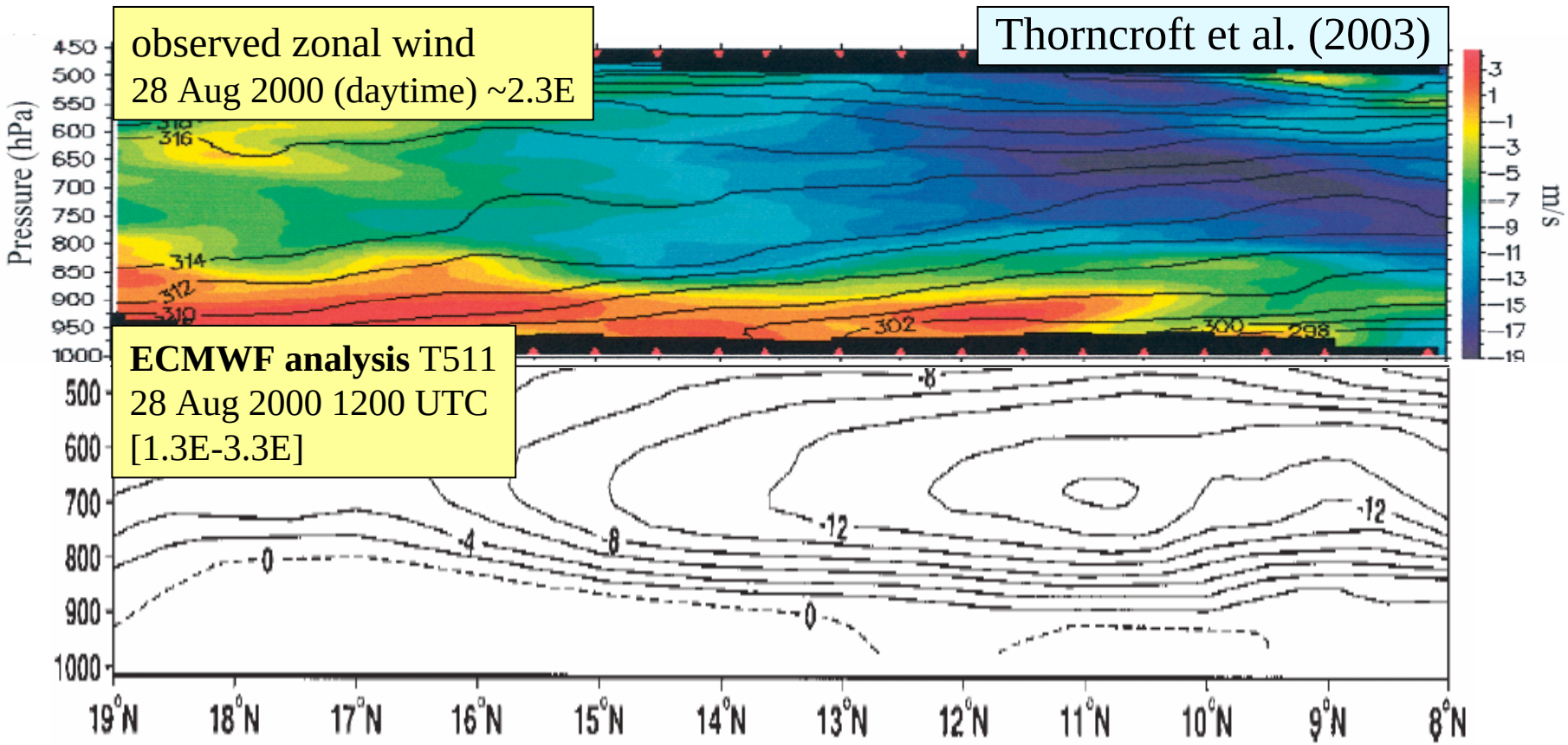
general & specific problems with large-scale modelling of the WAM

problems with representation of the diurnal cycle of convection

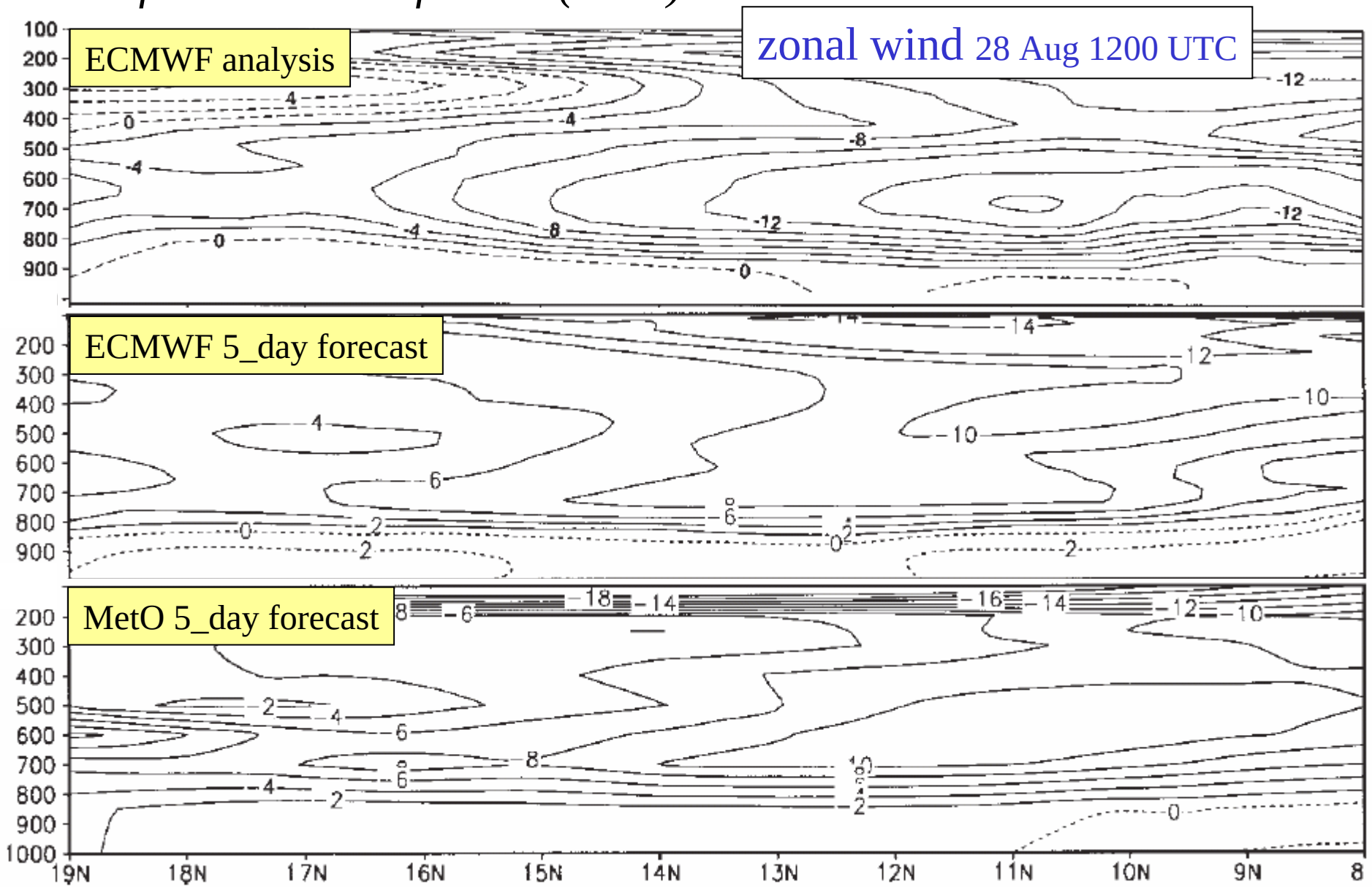
most convection schemes not designed to handle MCSs

too far north migration/extension of the rainbelt (rainfall in the Sahara!)

more broadly: issues with the representation of the regional dynamics & its links / coupling with the treatment of subgrid-scale processes



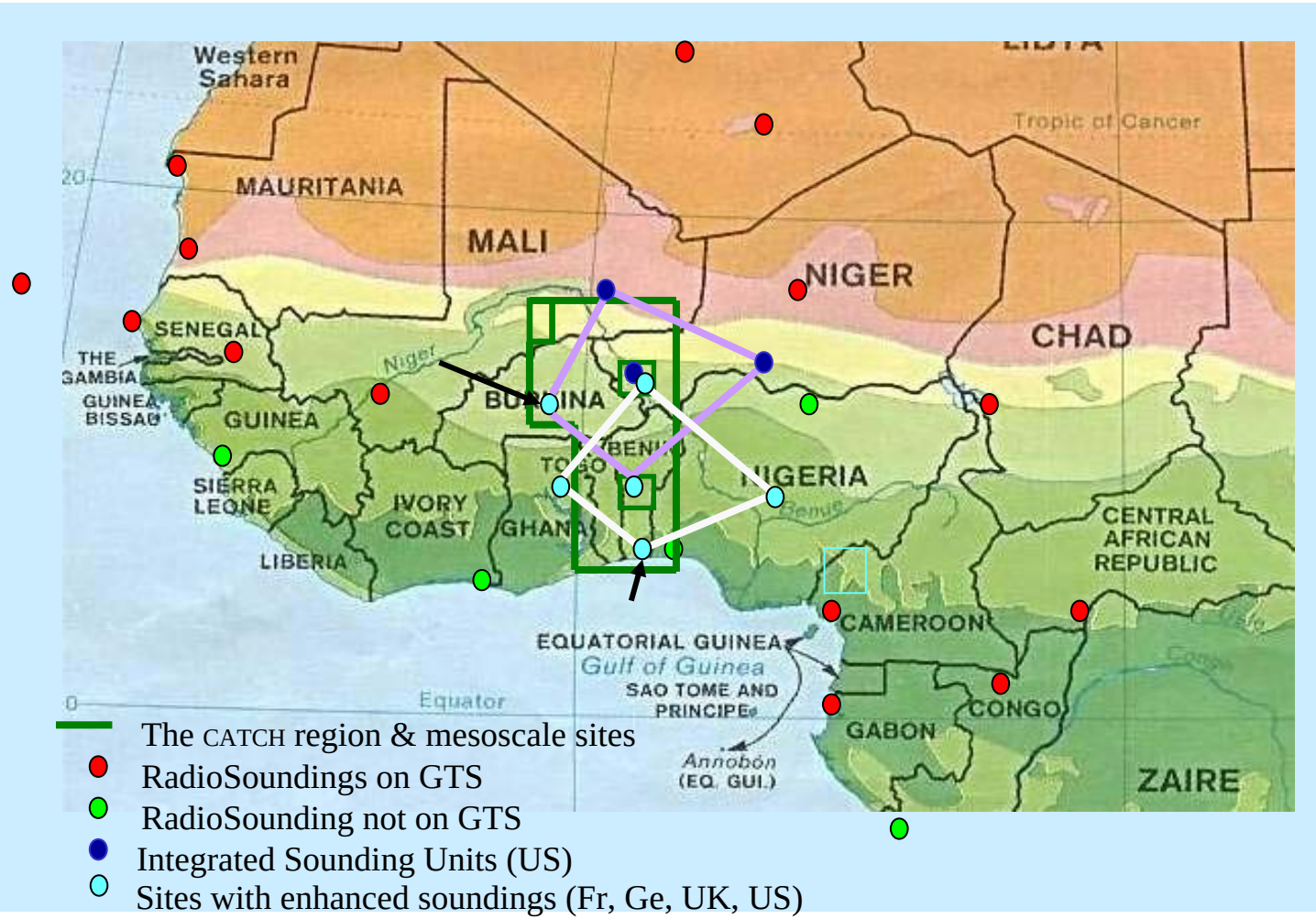
from Thorncroft et al. (2003)



after 5 days, significant drift in both models (likely not alone...)

expected data from the SOP 2006 for GCSS-type case-studies

- boundary conditions from enhanced sounding network (lateral boundaries, *large-scale forcing*) and LDAS (surface) ...



- further data for validation of cloud-resolving simulations

some on-going AMMA-related activity about cloud & convection modelling before 2006

not exhaustive

budgets from existing simulations (for case-studies)
investigation of convective transports (tracers)

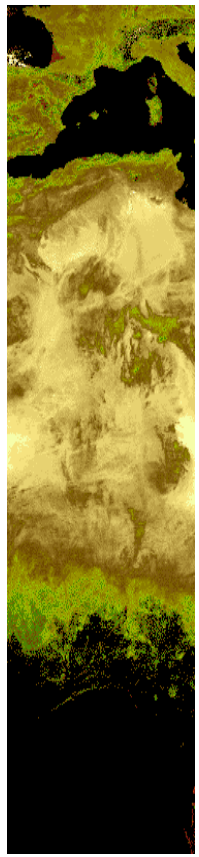
parametrizations & the WAM in large-scale models

following the path of the Pacific transect, a WA transect
(only started)

a 2D modelling framework for investigation of feedbacks

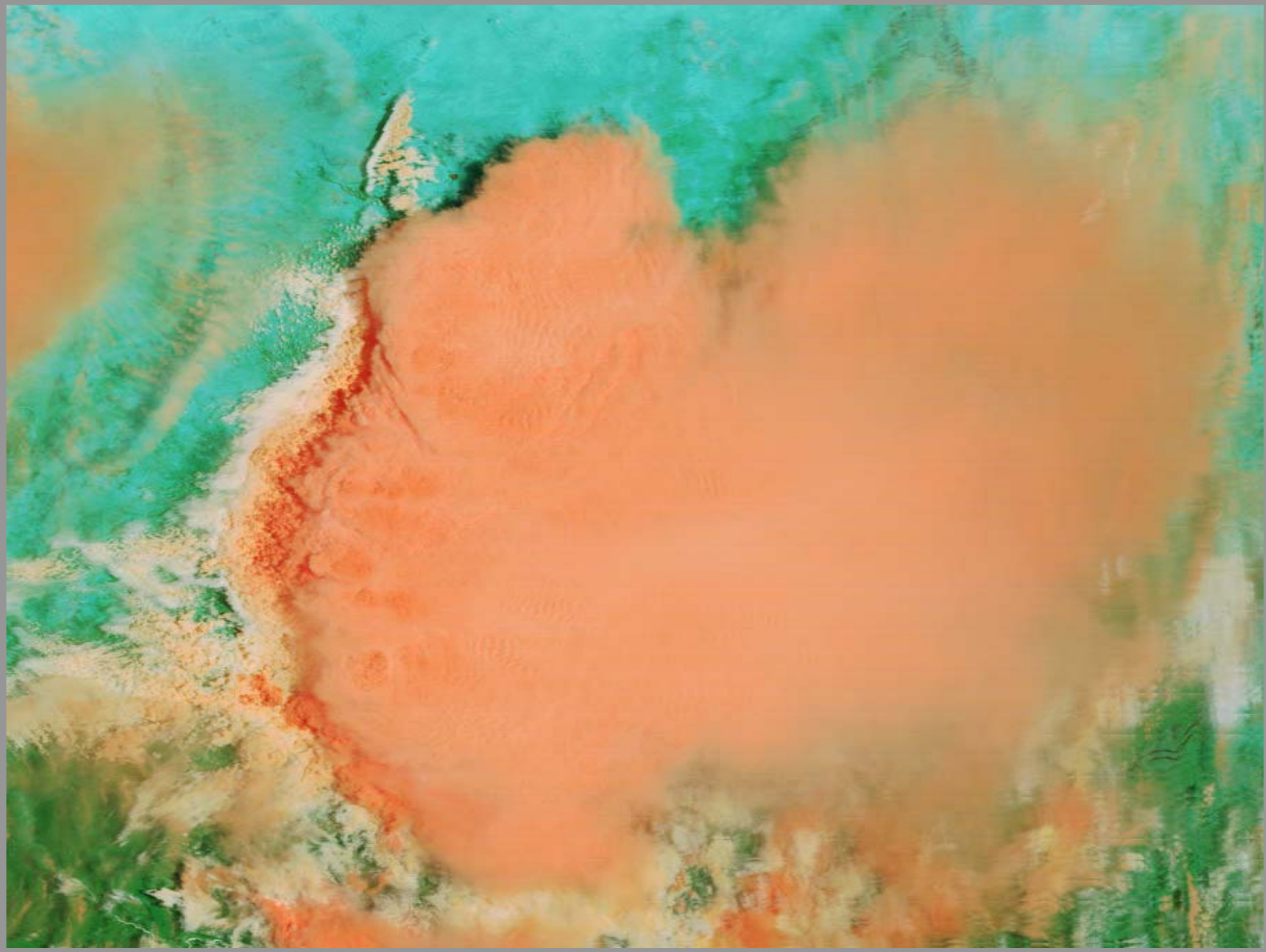
dry runs from some NWP centres in 2005

North



South

scales : typically a few to several hundreds of km, several hours to a day

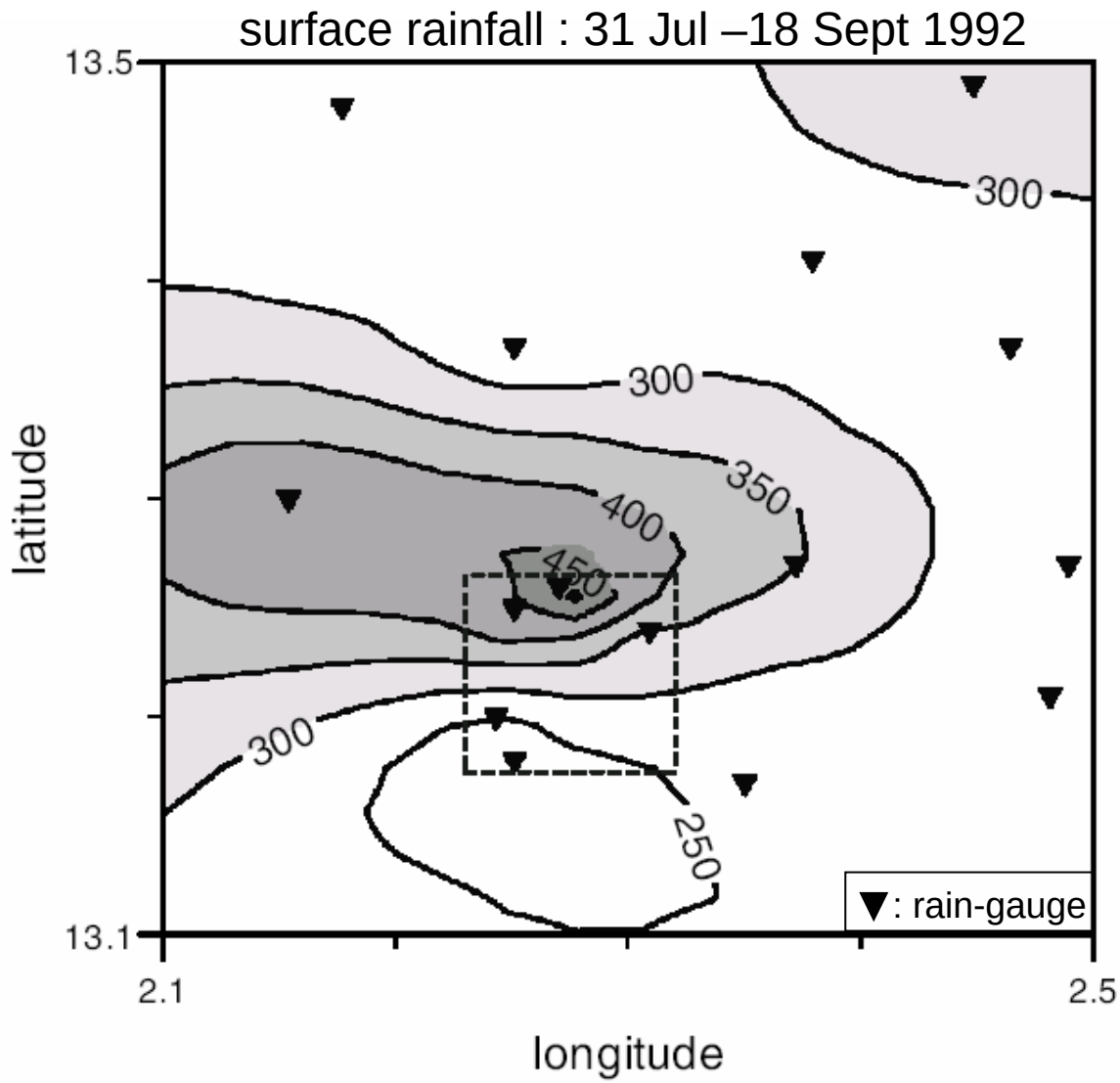


MODIS 2004 day 244 1130 UTC

from Taylor et al. (1997)

HAPEX-Sahel experiment

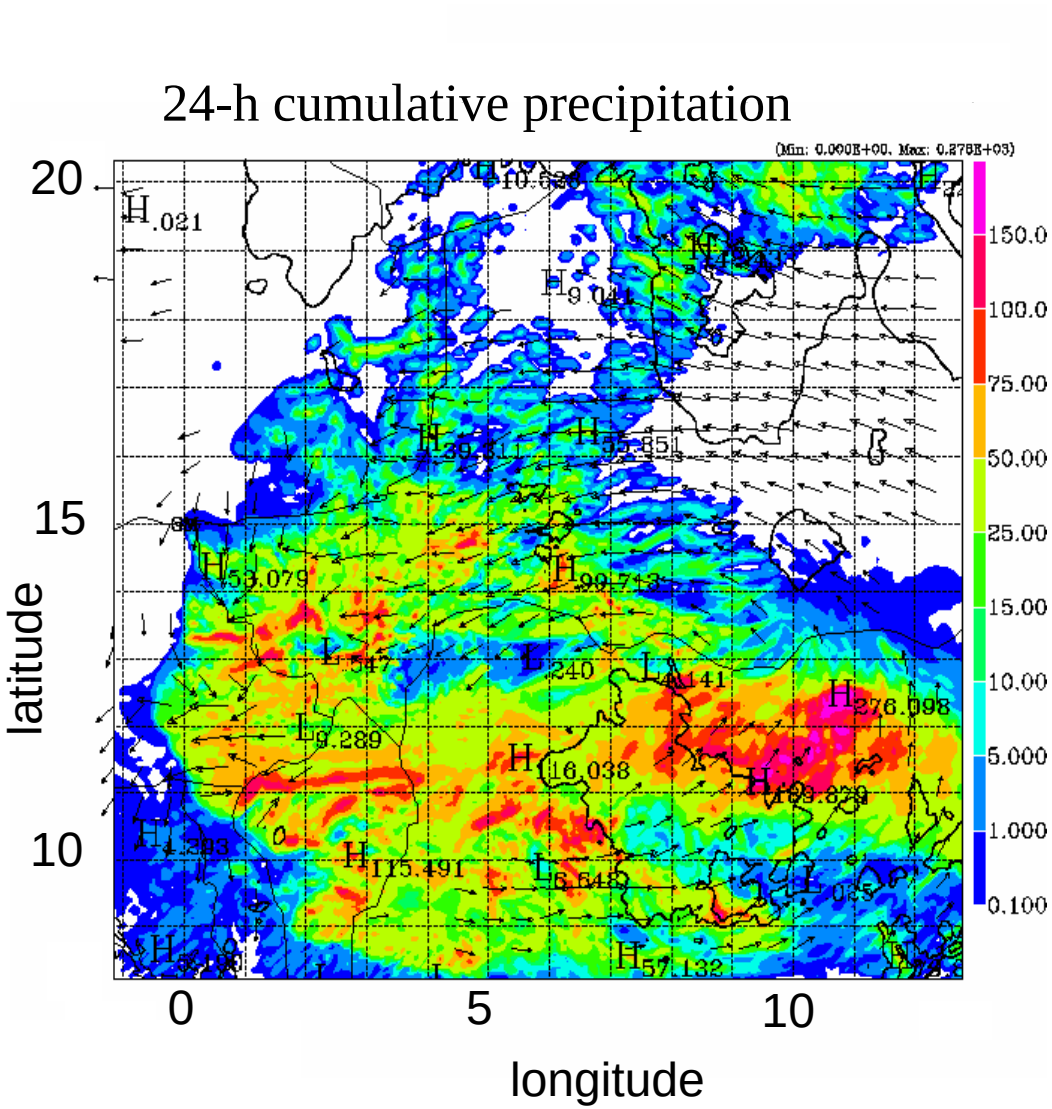
gradient 200 mm/10 km



same type of pattern for other years but not at the same place

need to assess in depth the validity of simulated fields

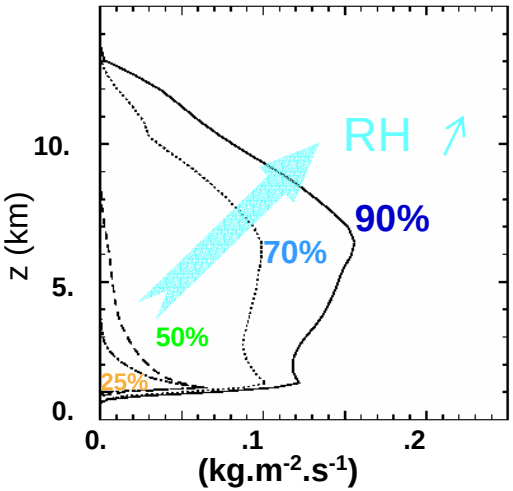
Diongue et al. (2002) case-study



Derbyshire et al. (2004)

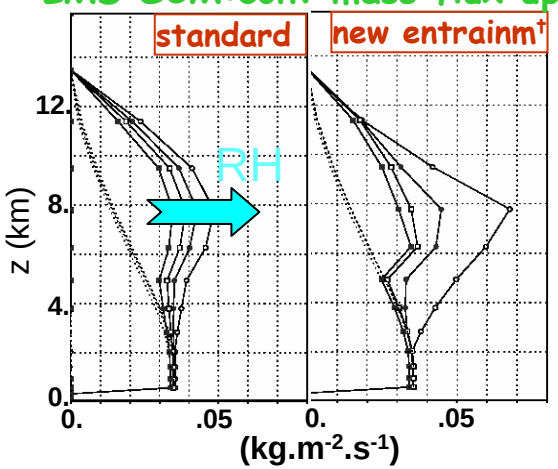
sensitivity of convection to the humidity field

CRM:conv mass flux up

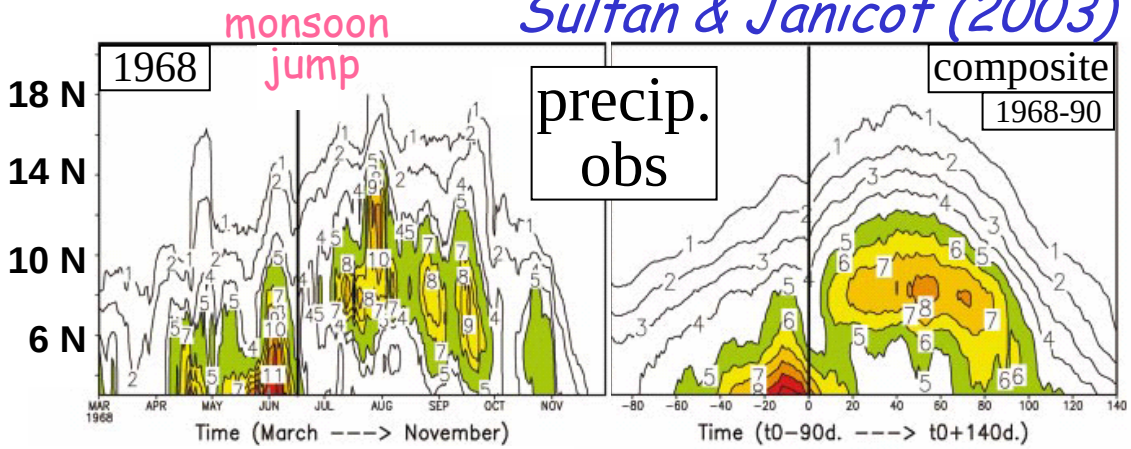


Grandpeix et al. (2004)

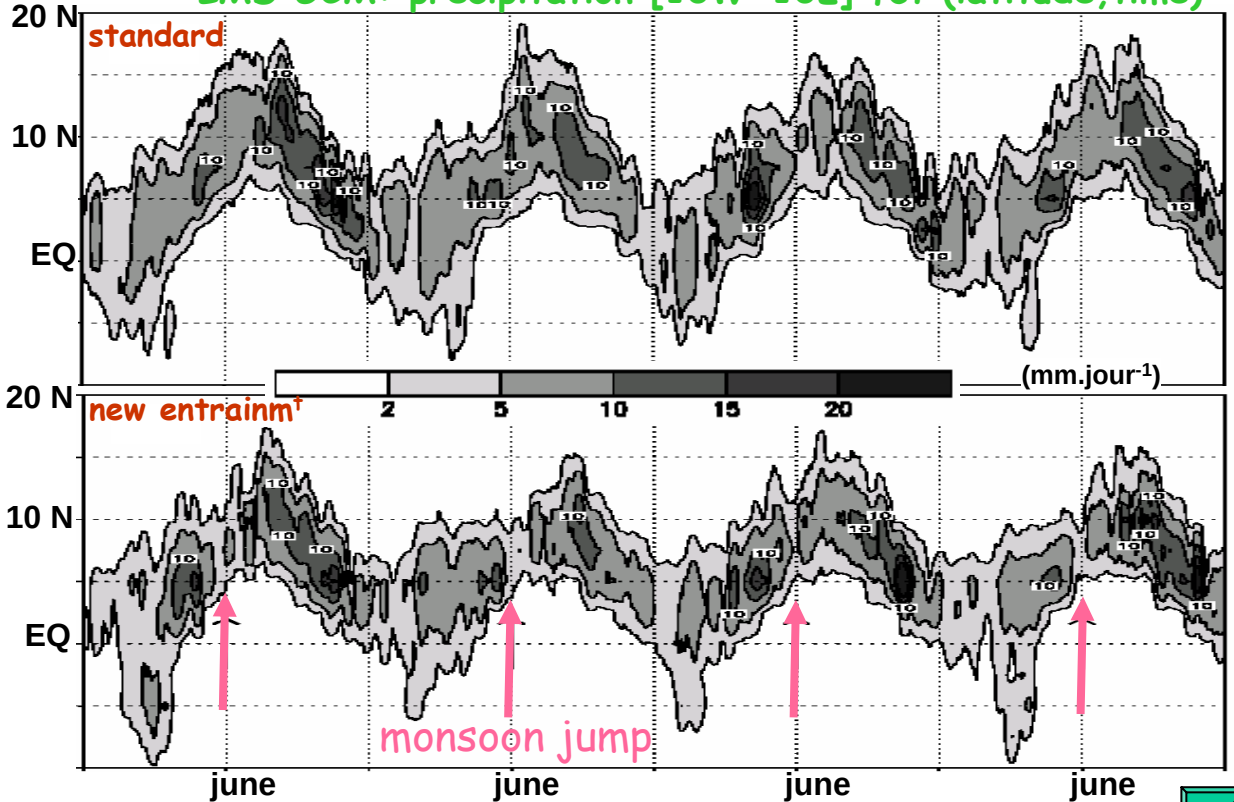
LMD SCM:conv mass flux up



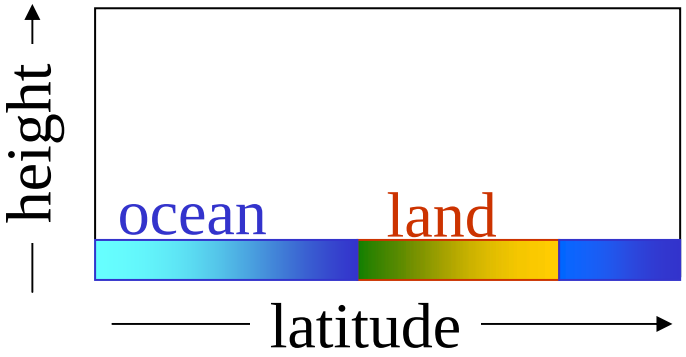
Sultan & Janicot (2003)



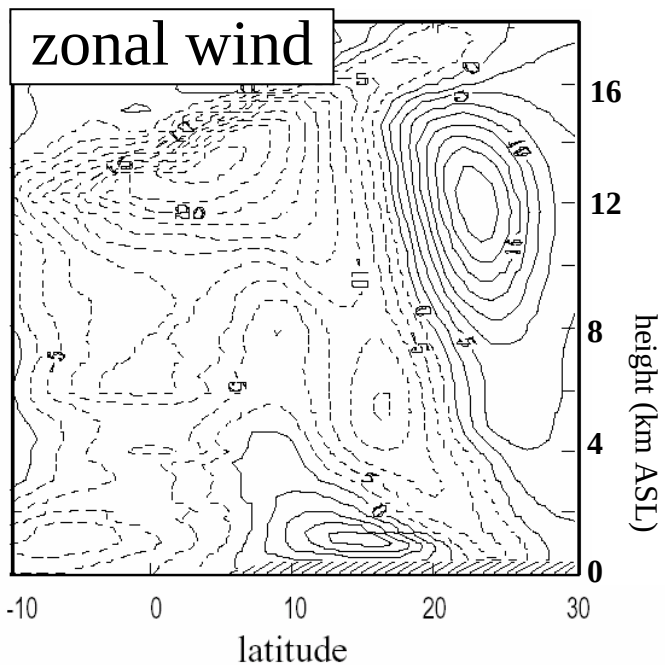
LMD GCM: précipitation [10W-10E] fct (latitude,time)



a 2D toy-model (Peyrillé et al. 2004)

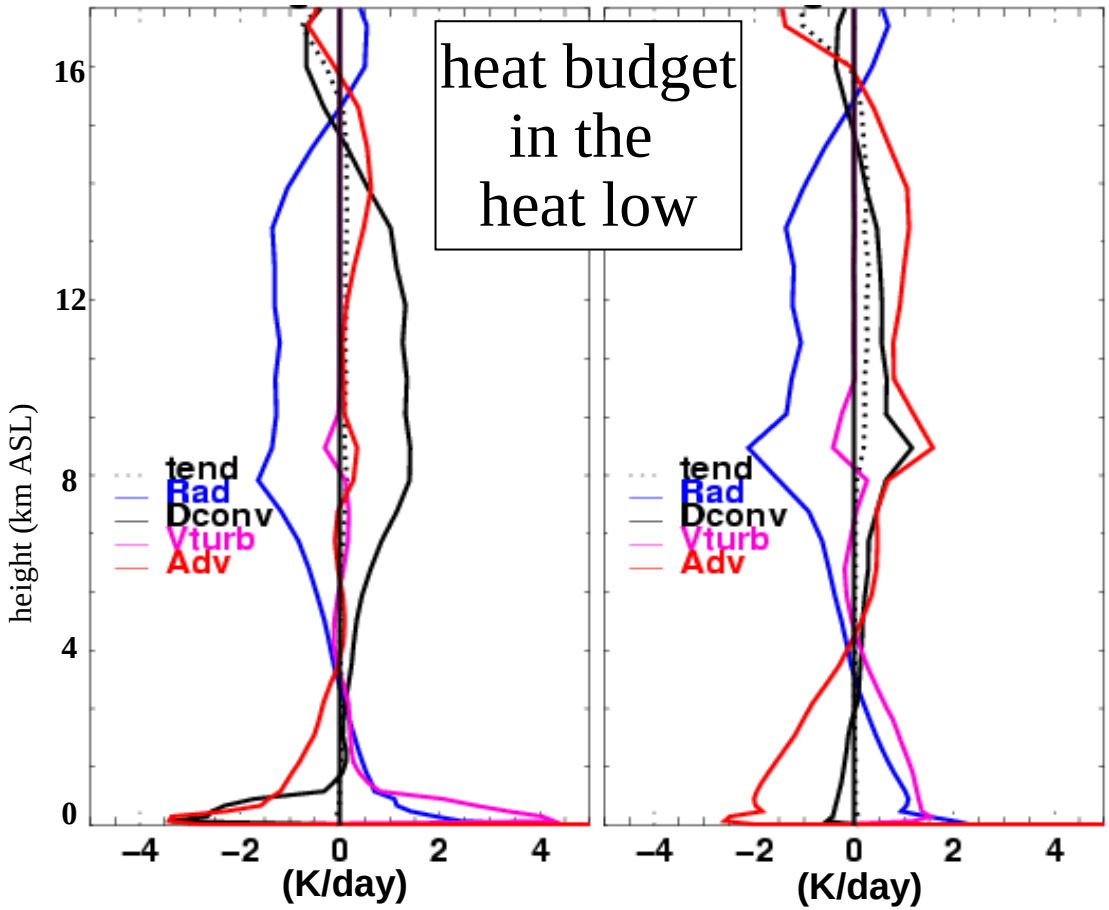


able to capture basic
WA monsoon features



« play » with it

sensitivity to the convection scheme
(here evaporation of rainfall)



convective-radiative equilibrium → convective-radiative-advective equilibrium