Some Outcomes of the WP1 break-session

- **Within WP1**
  - **Discussion of each Task (10):** Participants, work plan, scientific questions, organization…
  - **Small WG:** to define "setup and outputs of SCMs experiments" (formats…) M2
  - SCM setup of the 1st case to be provided asap ~M3
  - **Small WG:** to define "Q1, Q2 computation"
  - MJO: + momentum issue Q3 (not only Q1 and Q2)
  - Meeting before 2012 summer
  - Mailing list/ Work Task

- **Outside WP1**
  - **For WP4:**
    - **Wish list of metrics + Contacts concerning**
      - **Diurnal Cycle and triggering versus surface moisture**
      - **Tropical ISV/MJO**
      - **Monsoon (West African and Indian)**
      - **Clouds → link with EUCLIPSE**

EMBRACE Kick Off meeting
Nov 22-23 2011

WP1-Atmosphere overview

"Improving atmospheric moist convections and tropical climate"

Coordinated by

Jean Philippe LAFORE and Steve DERBYSHIRE

WP1 / Two Main Aims

A. **assess and improve** the **physical realism** of the parameterizations of moist atmospheric convection used in ESMs, based:
   - on **process studies**,
   - and on the comparison of ESM results with field campaign **observations and LES/CRM simulations**

B. **better understand**
   - how the representation of atmospheric convection at the process level (parameterizations) affects the simulation of **large-scale circulation regimes in the tropics** (monsoons, Hadley-Walker circulation, modes of variability and troposphere-stratosphere interactions),
   - and how errors at the process level translate into **systematic errors** in ESMs.

WP1 / Tasks

Goal A

Task 1.1 Improve the **physical realism** of parameterizations of moist atmospheric convection: **Real Cases** CNRM, NERC, IPSL, SMHI, KNMI, METUK

Task 1.1.1 Diurnal cycle of convection over the Sahel *Fleur Couvreux*

Task 1.1.2 Daytime deep convective triggering over West Africa: *Françoise Guichard & Chris Taylor*

Task 1.2 Improve the **physical realism** of parameterizations of moist atmospheric convection: **Idealized cases** CNRM, LMD, SMHI, KNMI, METUK

Task 1.2.1 Radiative-Convective-Equilibrium (RCE) *J-Y Grandpeix*

Task 1.2.2 Radiative-Convective-Equilibrium with Weak Temperature Gradient (RCE-WTG) *Gilles Bellon*

Goal B

Task 1.3 Coupling of atmospheric moist convection and tropical climate variability: **Monsoon Circulations**

Task 1.3.1 Linking parameterized diabatic heating profiles and the dynamics of monsoon circulations METUK, CNRM, LMD, SMHI *Gill Martin*

Task 1.3.2 Assessing simulated monsoon processes and their sensitivity to model **resolution** SMHI

Task 1.4 Intraseasonal variability over **tropical oceans** ECMWF, USPLIT, CNRM, IPSL, SMHI

Task 1.4.1 Local or large-scale processes inhibiting the convection in the simulation of the tropical ISV/**MJO** IPSL *J-P Duvel*

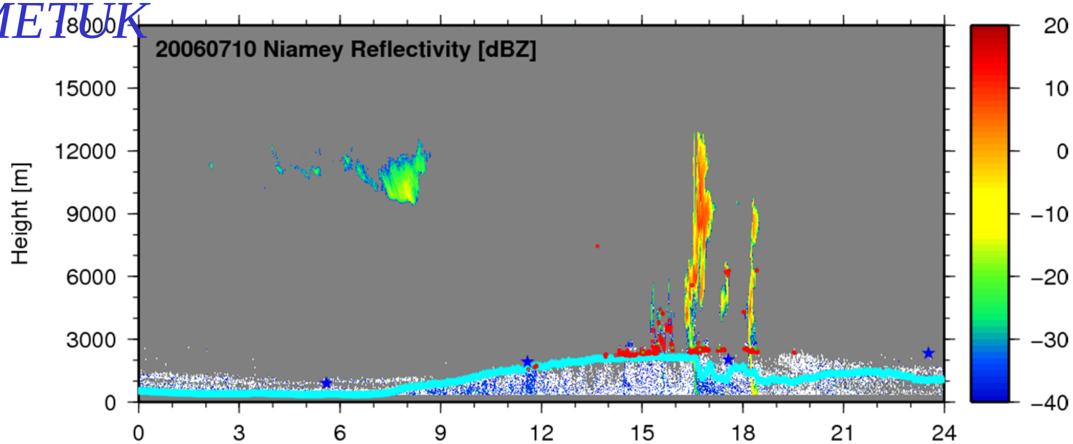
Task 1.4.2 **Aquaplanet** experiments to understand the impact of convection on CCEWs and the ISV/MJO.
CNRM, ECMWF, USPLIT, IPSL, SMHI *Gilles Bellon*

Task 1.4.3 **Reduced-Planet Aquaplanet** simulations with resolved and parameterized convection: Analysis of convection-wave interactions ECMWF, USPLIT *P. Bechtold*

Task 1.5 Convectively forced **Gravity waves** and their **impact on the upper troposphere and stratosphere** IPSL, METUK *F. Lott, Stuart Webster, Andrew Bushell*

Task 1.1.1: Diurnal cycle of convection over the Sahel *F. Couvreux*

CNRM, NERC, IPSL, SMHI, KNMI, METUK



Well documented case of AMMA:
10 July 2006 *Lothon et al. 2011*

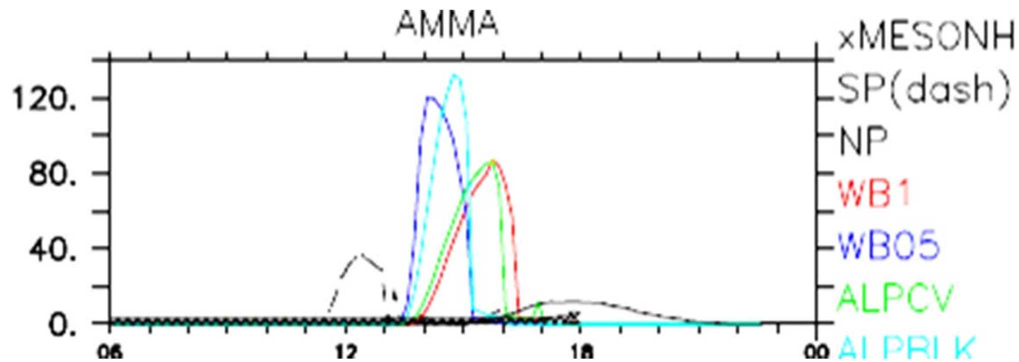
Main questions

- Initiation of convection in a **semi-arid** environment (Bo~10, decreasing CAPE in the afternoon…) : a relatively **unknown** environment, challenging for models
- Diurnal cycle of convection (triggering, intensity)
- Impact of cold pools

Methodology: intercomparison of SCM against LES → 3 configurations

I. Prescribed fluxes	LES done	*Couvreux et al. 2011*
II. Interactive surface	LES done	
III. With surface heterogeneities	LES to be done	

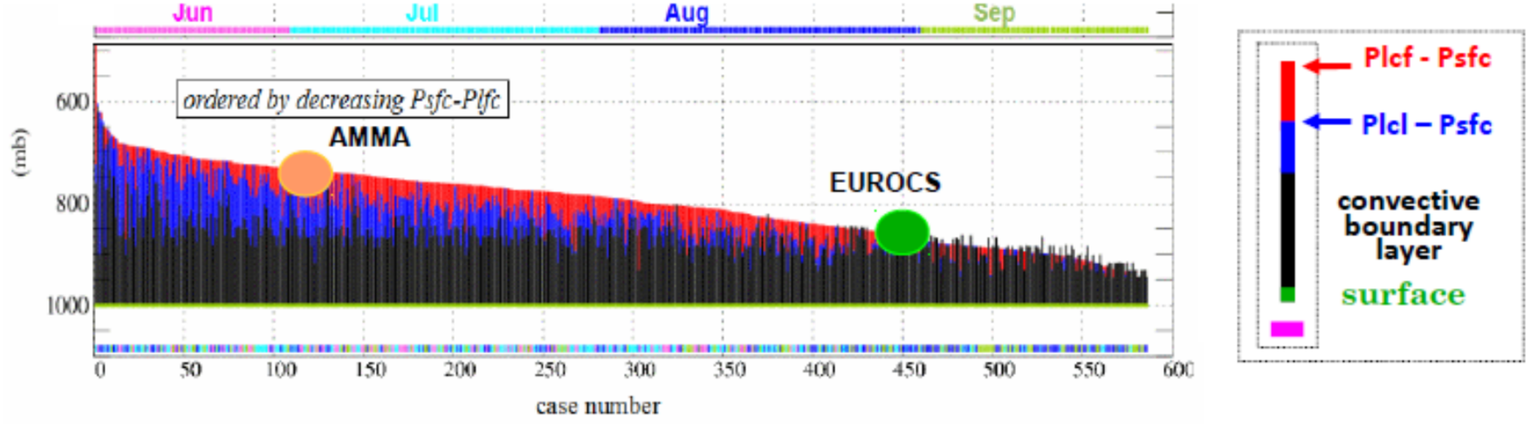
Already run by SCMs:
LMDz → *Rio et al., Clim Dyn, 2011*



Task 1.1.2: Daytime deep convective triggering over West Africa:

F. Guichard (CNRM), C. Taylor (CEH)

AMMA statistical analysis (> 2000 cases) convection, surf. (MSG, AQUA), atm. (ECMWF)



Main questions

- strong sensitivity to mesoscale soil moisture heterogeneities ← Taylor et al 2011
- *is convection trigged or not in models for these cases?why? how? timing, duration...*
- *sensitivity of results to surface patterns, atmospheric conditions, parameterizations*

Aims: design of a 1D modelling set-up (multi-cases)

evalute the skill of SCMs to trigger convection **against observations**

Steps:

Identify different regimes of triggering as fct of surf. and atm. condition

Set of generic cases covering those regimes

Setup for SCM simulations

Task 1.2.1: Radiative Convective Equibrium (RCE) *"no forcing" cases*

J-Y Grandpeix LMD, CNRM, SMHI, METUK

Objectives: Establish a **signature of physical package of each model**, especially concerning its sensitivity to surface conditions

Basic features:

- Full set of parameterizations (including radiation and clouds)
- Forced uniform and constant geostrophic wind
- Sensitivity to surface conditions

Oceanic case

No diurnal cycle

Main questions

- Study of the equilibrium state
- Contribution over the various parametrization

SCM Simulations

- Prescribed SST (290K, 295K, 300K, 305K)
- Simulation 2 to 4 months long (to reach equilibrium)

Land case

Strong diurnal cycle and strong coupling with surface processes.

Main questions

- Study of the equilibrium state
- Contribution over the various parametrization

SCM Simulations

- Tropical latitude
- Soil temperature nudged toward a fixed value at 10 cm depth
- Using a simple land surface model (aridity coefficient)
- Simulation 2 to 4 months long (to reach equilibrium)

Task 1.2.2: RCE with Weak Temperature gradient *G Bellon CNRM, CNRM, SMHI, METUK*

Objectives:

- Built a **reference CRM simulation** for the RCE-WTG (Méso-NH model)
- SCMs simulation on the RCE-WTG
- Establish the signature of physical package of each model
- Use those simulations to understand differences in Aquaplenet runs (Task 1.4.2)

Basic features:

- Full set of parameterizations (including radiation and clouds)
- Forced uniform and constant geostrophic wind
- Sensitivity to different prescribed SST
- Sensitivity to different physical packages

Task 1.3.1: Linking parameterized diabatic heating profiles and the dynamics of monsoon *METUK, CNRM, LMD, SMHI; Gill Martin et al.*

- **Aim:** Link diabatic heating to monsoon dynamics
- Both W African and S Asian monsoons. Built on past/recent work
  - AMMA
  - Work on intraseasonal variability over India and dynamical interactions
- Key modelling components
  1. CMIP5 model results (collaboration with WP4)
  2. Re-run AMIP runs with diagnostics to derive Q1 and Q2 profiles (MetUM, ARPEGE, LMDz, EC-Earth)
  3. Use of archived Q1, Q2 to drive dynamical core models (MetUM and LMDz)
  4. Exploit and test SCM results from Tasks 1.1 and 1.2 in the 3D models

Task 1.3.2: Assessing simulated monsoon processes and their sensitivity to model resolution *SMHI, Colin Jones, Klaus Wyser*

- AMIP simulations with EC-Earth AGCM resolution T159 to T1269 (~1.125-0.11°)
- Impact on WA and Indian Monsoons (circulation, ISV)
- Strong link with WP4 (coupling with ocean at ~0.25-0.5°)

Task 1.4.1: Local or large-scale processes inhibiting the convection in the simulation of the tropical ISV/MJO *J-P Duvel et al. LMD*

- **Background**
  - Current Atmospheric GCMs have problems in simulating the intraseasonal variability and the MJO
  - These problems are in a large part related to the closure of the convective scheme. A scheme that inhibits more the convection generally gives more variances at intraseasonal timescales.
  - Difficulties to obtain at the same time a realistic MJO and a realistic average tropical climate
- **Work**
  - Implement different closures (convergence, CAPE) for a given convective scheme and a given model (LMDZ).
  - Evaluate the ISV/MJO using the approach described in Duvel et al, 2011. Evaluate the role of non linear intraseasonal variability in the average state.
  - Use TOGA and CINDY-DYNAMO datasets to evaluate local basin-scale perturbations.
- **Related work in WP4**
  - Evaluate the ISV/MJO for *different models* (including aquaplanets) using the approach (LMA) described in Duvel et al, 2011
- **Possible link** with the **Joint MJO Task Force - GASS** Model Experiment on Diabatic Processes. Case studies based of **YOTC MJO events**

Task 1.4.2: Aquaplanet experiment (APE) to understand impact of convection on CCEWs and the ISV/MJO *CNRM, ECMWF, USPLIT, IPSL, SMHI Gilles Bellon et al.*

- **Work:**
  - Aquaplanet simulations with 3 AGCMs (EC-Earth, CNRM, IPSL)
  - Different SST configurations (symmetric and “oceanic monsoon profiles)
  - Wave analysis to characterized CCEWs and the ISV/MJO
  - Characterize and understand the impact of parametrizations (original and improved ones) on CCEW and ISV/MJO
  - Complement the RCE simulations with and without WTG (tasks 1.2)

Task 1.4.3: Reduced-Planet APE simulations with resolved and parameterized convection *ECMWF, USPLIT Peter Bechtold et al.*

- **Work:**
  - Run IFS on small Aqua planet for resolutions T159 (125 km) -T1279 (16 km) with A=1/10 (R=640 km) corresponding to 12.5 – 1.5 km effective resolution with and without parametrized deep convection
  - Conserve characteristic non-dim numbers: Ro, R (also still numerical issues with conservation of advection scheme)
  - Evaluate results in terms of mean climatology, wave spectra (including MJO diagnostics and gravity wave momentum fluxes), statistics on cyclones, model variability and precipitation for different resolution → link with Tasks 1.4.2 and 1.5
  - Develop method to adapt or downscale existing mass flux convection to allow "transition" to explicit representation or generally optimal model results in grey zone.

Task 1.5: Convectively forced G-Waves in upper tropo- and stratosphere *CNRS-LMD, METUK; Francois Lott et al., Neal Butchart et al.*

- **Aim:**
  - Install and test parametrizations of convective generation of gravity-waves
  - Impact on upper tropo- and stratosphere (QBO, TTL, equatorial waves…)
  - Related vertical resolution issue
- **Based on:**
  - Theoretical work
  - Observations: Vorcore, SCOUT and TC4 campaigns
  - ECMWF analysis
  - **Hi-res simulations at 1-2km** over India (Stuart Webster)
  - Using essentially the CASCADE model (hi-res version of the MetUM cf. also UKV)

Work done at LMD in preparation of the EMBRACE Task 1.5

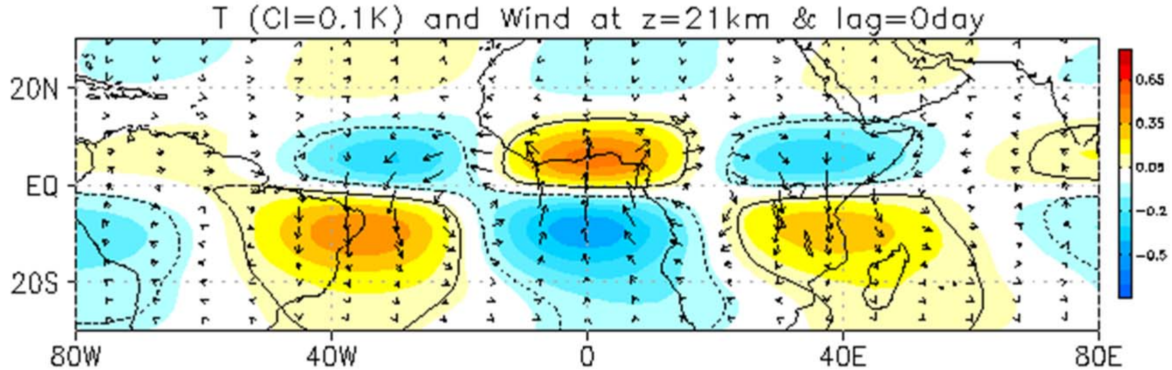
F. Lott, thanks to L. Guez and P. Maury

When the mean flow becomes more realistic because of the parametrised waves, the explicit waves are also improved (or at least affected) in return. They need to be looked at as well. This task will be done at LMD but using datas from IPSL and UKMO models.

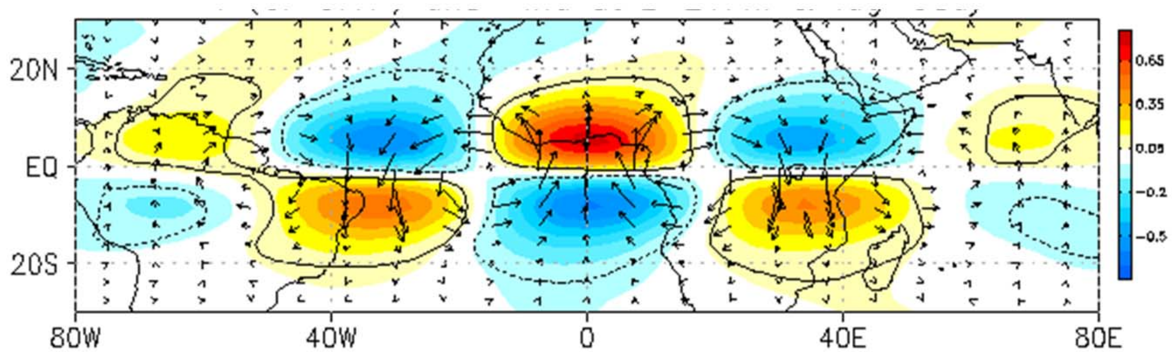
The explicit waves are also related to the convection variability in the troposphere, this relate this stratospheric task to the more tropopheric ones (T1.3 and T1.4)

Here a composite of the Rossby-Gravity wave (the Yanai wave) in the LMDz-model before and after the introduction of the non orographic gravity wave drag routine (Alt. 21km).

“Standard” stratospheric Version of LMDz (50 vertical levels)



LMDz with new GWD and enhanced vertical resolution



WP1 / Main Timelines

- By **~end of year 3** to provide “improved parameterizations”
- So about **3 years** for the following steps
  - Propose the setup of case studies for SCMs and specific AGCM experiments
  - Run SCMs and AGCMs, treat and interpret results
  - Develop and implement new parametrizations
  - Improve parametrizations
  - Sensitivity experiments and new SCMs and AGCMs experiments to test improvements and new developments
- **Last year** for final tests and to discuss and interpret the impact of “improved parameterization” and draw conclusions and final reports

WP1 / Dependencies on other WPs

- **Strong dependency on WP4 (EVAL)**
  - At the **project start** (year 1) to characterized ESM behaviours and biases
  - By **~end of year 3** to provide "improved parameterizations" to perform new AMIP type simulation for all ESMs.
  - **Year 4** to discuss and interpret the impact of "improved parameterization" on the AMIP type runs
  - Crucial to answer to the question: how errors at the process level translate into systematic errors in ESMs
- Weak dependency on other WP
- **NB:** Interactions with WP1 must be strong: *i.e*. the 10 tasks are not independent

WP1 / Needs (simulation, observations)

- **LES**
  - **CNRM:** AMMA 10 Jul 2006: 3 configurations (T1.1.1)
- **CRM**
  - **CNRM:** RCE-WTG with Méso-NH (T1.2.2)
  - **ECMWF:** reduced planet Aqua-Planet (T1.4.3)
  - **METUK:** Indian sub-continent → Convectively forced GW (T1.5): other uses?
- **AGCM diagnostics** (strong link with WP4)
  - Q1 and Q2: ← rerun of AGCMs
  - Waves and ISV/MJO
- **Observations**
  - **AMMA:** CNRM and NERC (CEH) (T1.1.1, T1.1.2)
  - Dynamo-Cindy, YOTC → ISV/MJO
  - Vorcore, SCOUT and TC4 campaigns → CGW (T1.5)

WP1 / Collaborations outside EMBRACE

- The hi-res model configuration is closely linked to **CASCADE**
- **EUCLIPSE:** open EMBRACE SCMs cases to EMBRACE
- **COMBINE:** evaluation of CMIP5
- Extension beyond Europe: **GASS** (GCSS)
- Joint MJO Task Force **- GASS** Model Experiment on Diabatic Processes
- Various links to **YoTC**: MJO events

Outline

1. *A recap on the main WP aims (both big picture aims and more specific details, plus any recent developments/activities you deem important to include)*
2. *A recap on the main timelines of the WP*
3. *Dependencies on other WPs*
4. *Model integrations needed, observations needed (these we can maybe try to organize somehow for ease of access to all, e.g. via WP-EVAL)*
5. *Other activities (National, European, International) where the WP can benefit from, contribute to, should collaborate with etc.*