

Introduction au modèle LMDZ pour les journées utilisateurs

Frédéric Hourdin pour l'équipe LMDZ

~ 6 Ingénieurs

~ 10 chercheurs (dont 3 planéto)

1. Un modèle / des configurations
3. La nouvelle physique et les configurations CMIP
3. Nouveau noyau dynamique

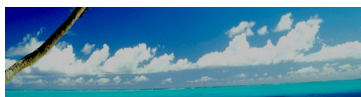
LMDZ : Un modèle / des configurations

Coeurs 3D

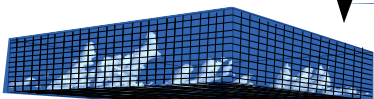
- Longitude-latitude
- Icosaèdre
- (bientôt disponible)
- Aire limité
- (en préparation)

Cas 1D (Dephy/High-Tune)

- LES à disposition
20 aine de cas
- Convection
 - RCE
 - Nuages bas
 - Couplage surf.



Campagne

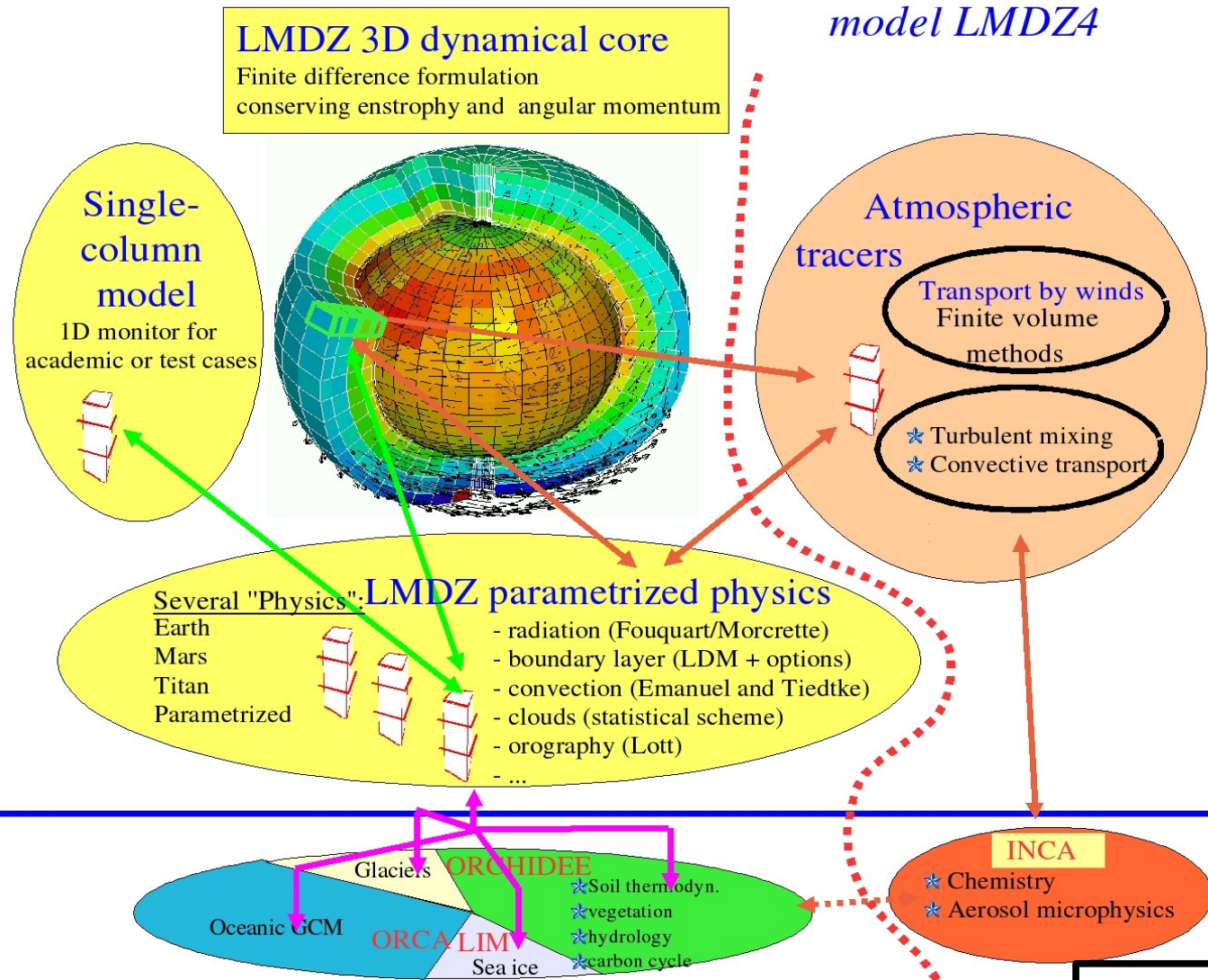


3D explicite (LES)



Modèle uni-colonne

Atmospheric component of the IPSL integrated climate



Mode d'utilisation 3D

- Climatique couplé ou non
- Zoomé
- Guidé ou initialisé
- Aqua ou terra planète

IO/Evaluation :

- Multi-atlas sur ciclad
- Pilotage xml de XIOS
- Simulateurs satellite

Couplage en surface (4 sous surface/maille)

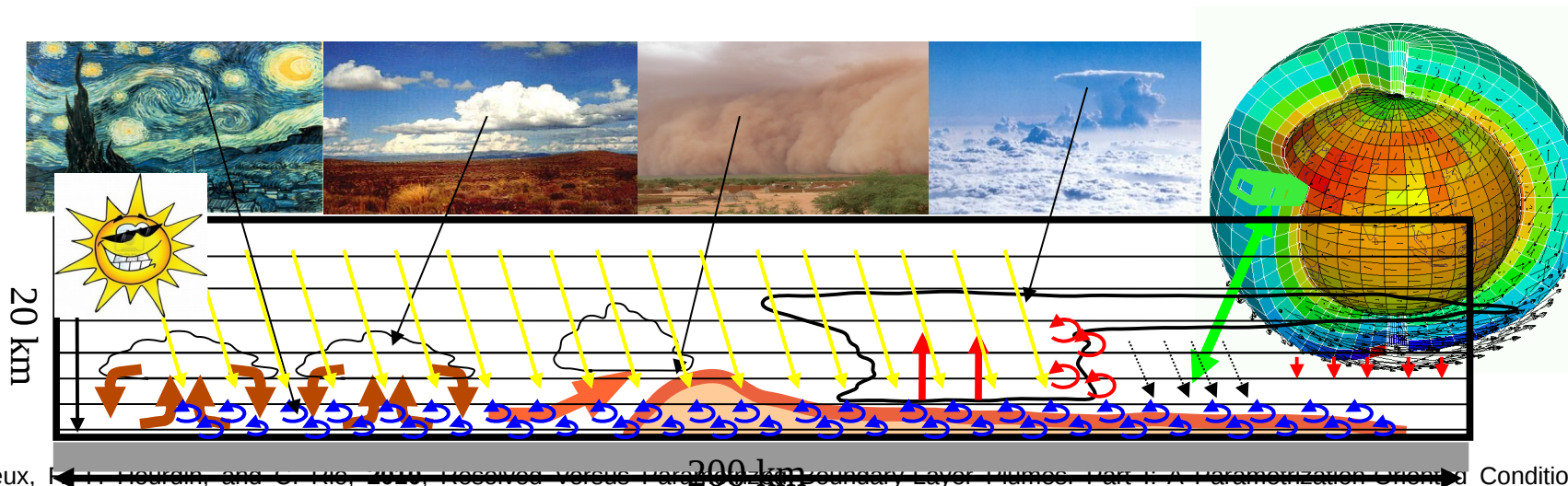
- Océan : SST forcées, **Nemo**, Océan slab
- Banquise : imposée (conduction LMDZ), **Lim**, slab
- Continents : **Orchidee**, bucket, betaclim
- Glaciers : bucket ajusté

Composition

- **Inca** (chimie/aérosols)
- **Reprobus** (chim./strato)
- LMDZaer (arérosols)
- Isotopologues de l'eau

LMDZ : 15 ans d'investissement collectif sur les paramétrisations

Nouvelle physique identifiant 4 éléments pour le transport vertical et les nuages : 1/ turbulence, 2/ convection de couche limite (**« modèle du thermique »**), 3/ profonde orageuse, 4/ **« poches froides »**.



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Les configurations de référence : grille + contenu + tuning

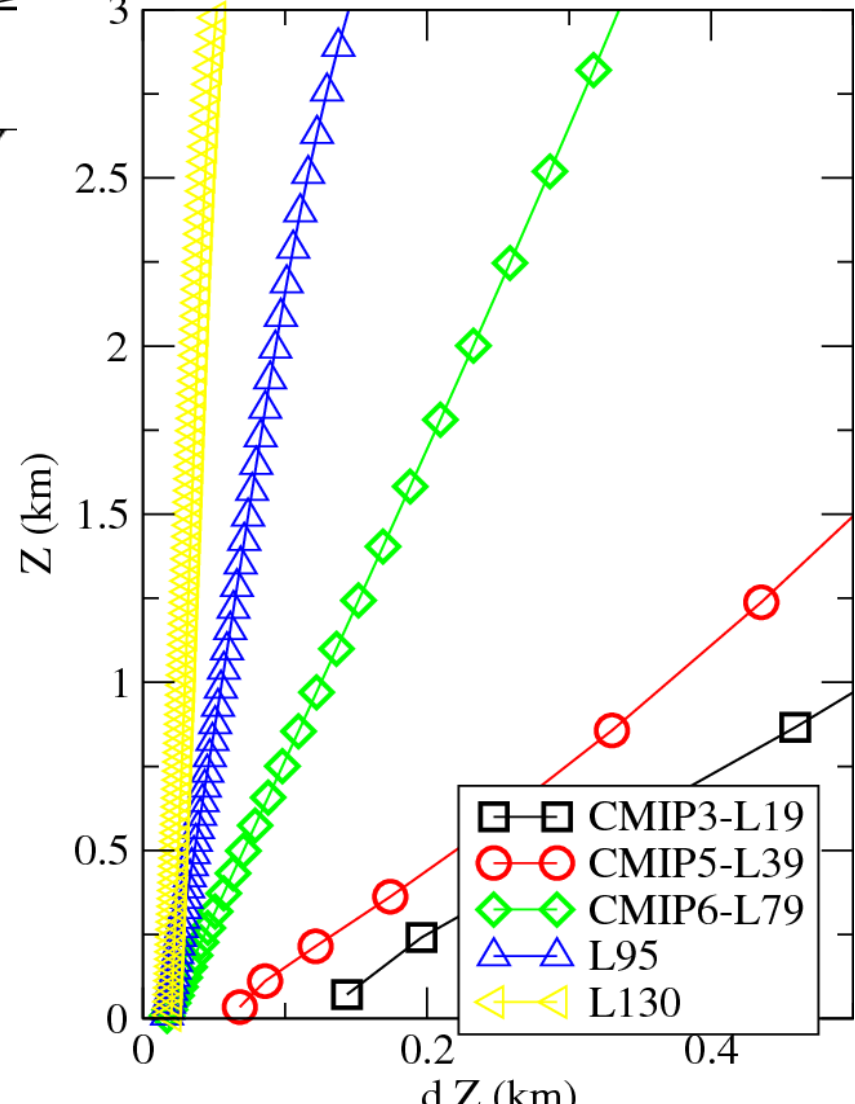
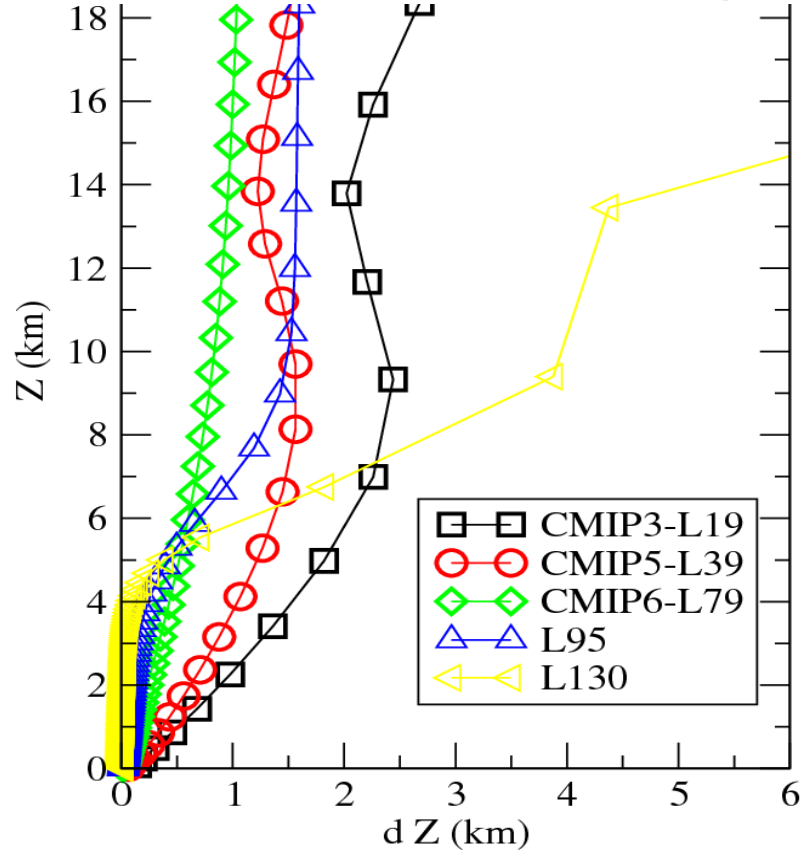
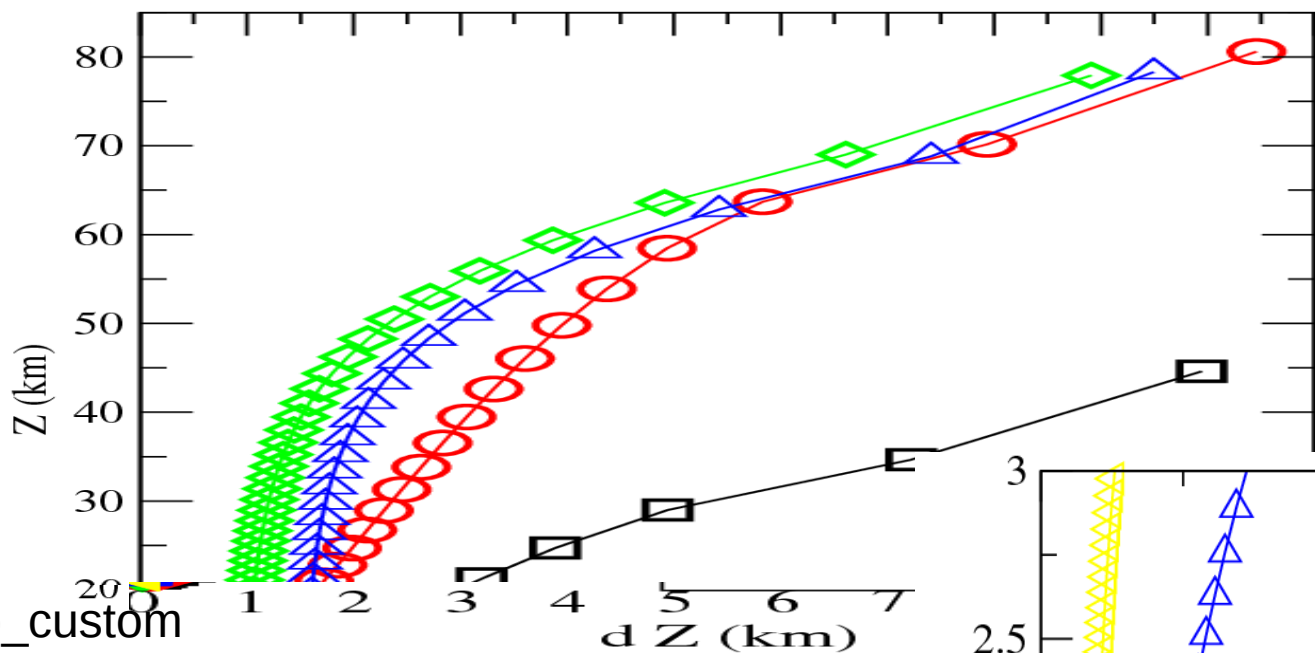
	Vertical resolution	Horizontal grid	Physical parameterizations	Name
CMIP3	L19	96x71	New convection scheme (Emanuel) Subgrid scale orography	IPSL-CM3 LMDZ4
CMIP5	L39 Extension to the stratosphere	LR = 96x95	2 versions Standard Physics (SP) same as CMIP3	IPSL-CMX LMDZX 5A-LR/MR
		MR = 144x143	New physics (NPv3) with thermal plumes and cold pools	5B-LR
CMIP6	L39	VLR = 96x95	VLR = 96x95, SP	5A2-VLR
	L79	LR = 144x143	NPv3 +	6A-LR
	- For PBL clouds dZ/Z < 0.1 Jusqu'à 3 km - For QBO dZ=1km Jusqu'à 50km	MR=280x280 HR=512x360 (50km)	- New radiation (RRTM) - Stochastic closure - stratocumulus from thermals - Ice thermodynamics³ - Surface couplings (continents&ocean)^{2,4} - gravity waves (including non orogr., QBO)¹	
	XHR=1024/720 (25km)			

¹François Lott, ²Frédérique Cheruy, ³Jean-Baptiste Madeleine, ⁴Jean-Louis Dufresne

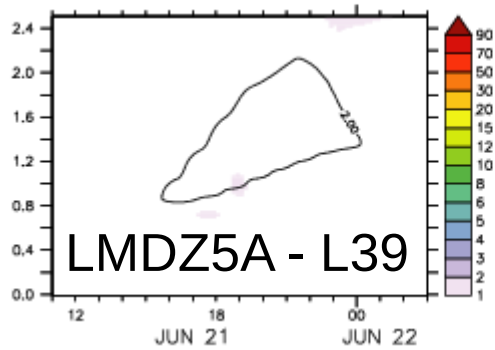
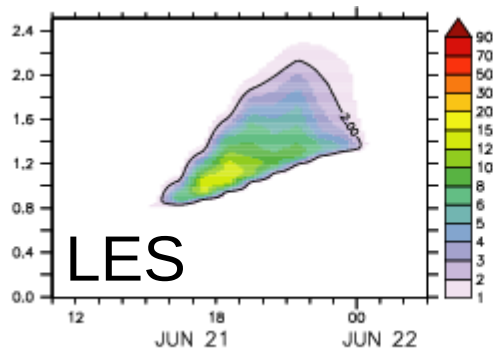
CMIP3 : L19
CMIP5 : L39
 (strato)
CMIP6 : L79
 (Strato et CL)

Disponibles
 L95
 L130 (CL)

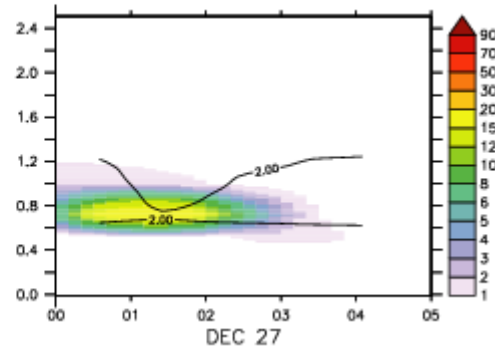
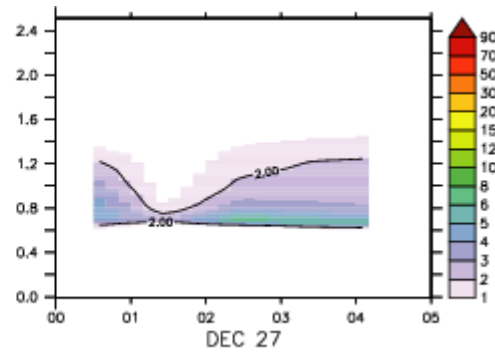
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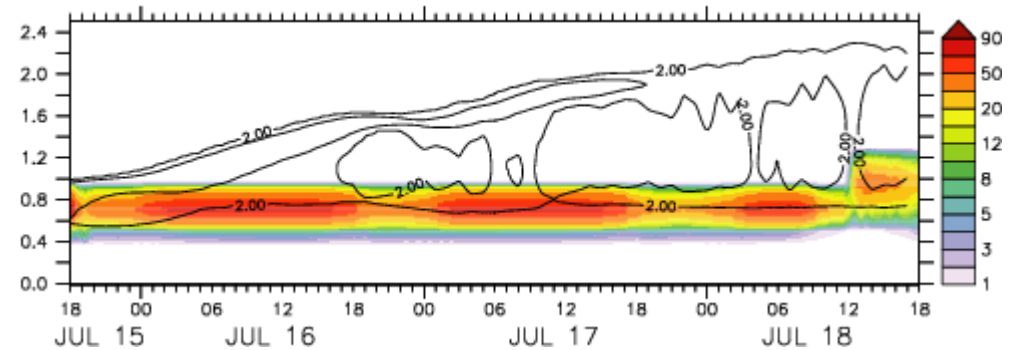
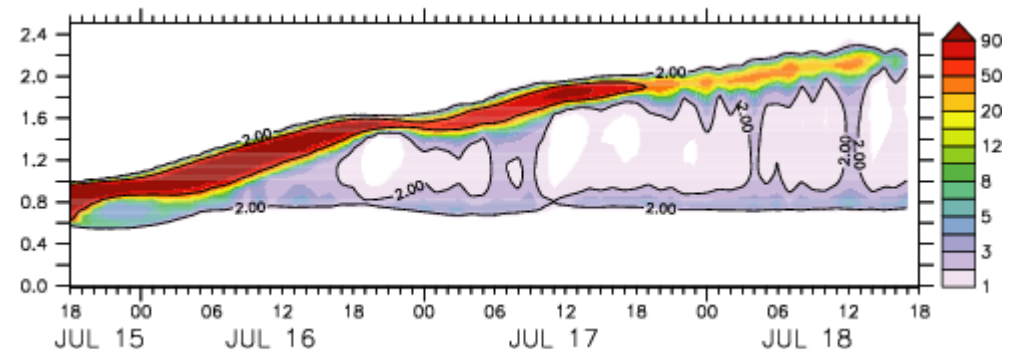
Arm cumulus
continental fair
weather cumulus



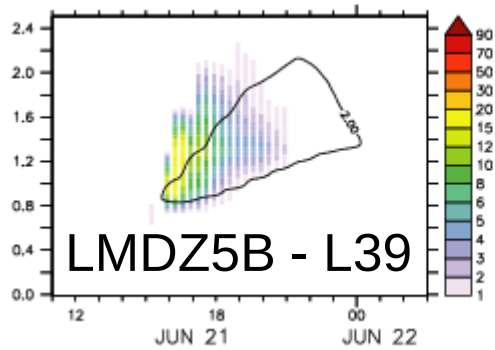
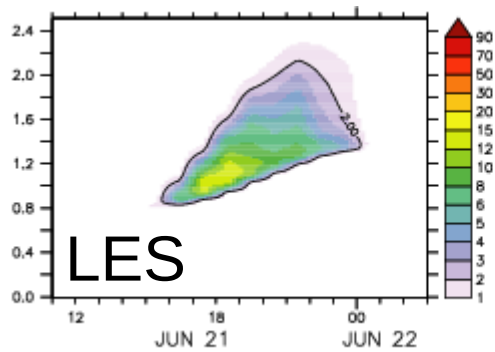
Rico
Trade wind
cumulus



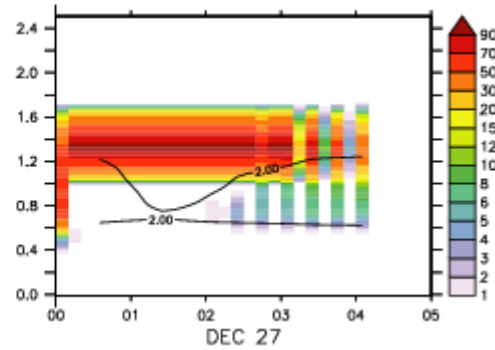
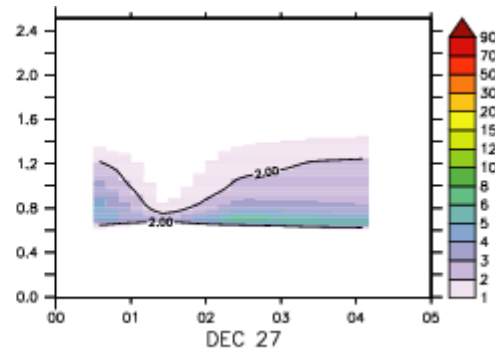
Sandu fast
Transition from stratocumulus
to cumulus



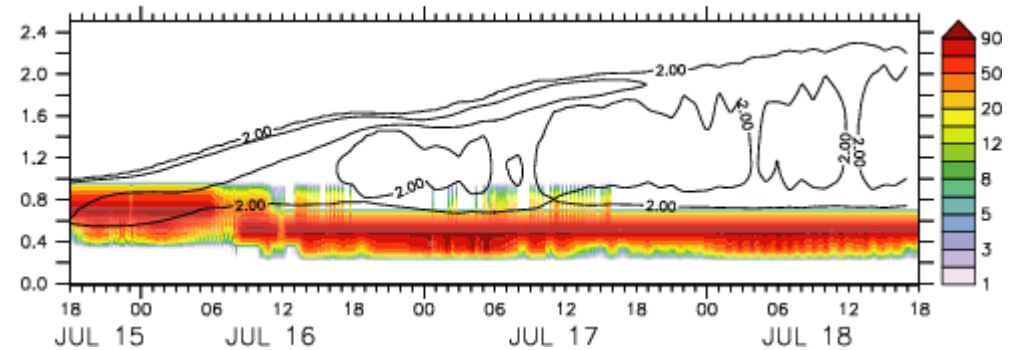
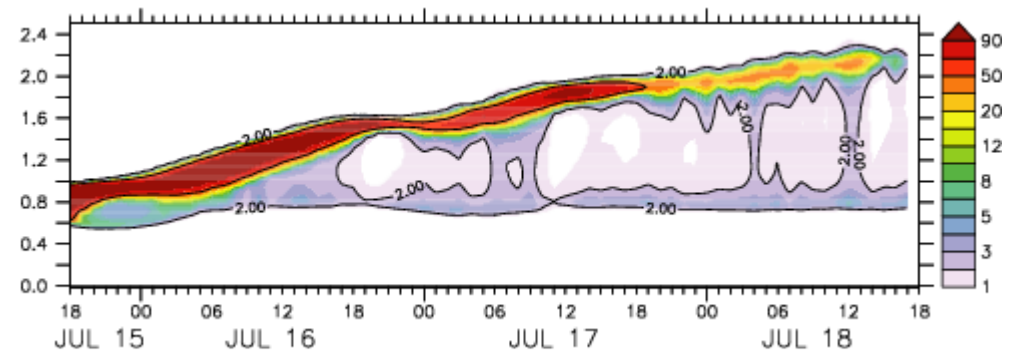
Arm cumulus
continental fair
weather cumulus



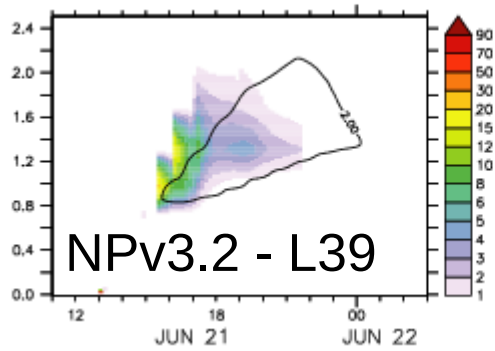
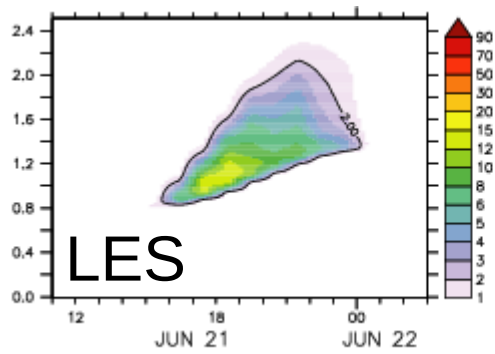
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Trade wind
cumulus



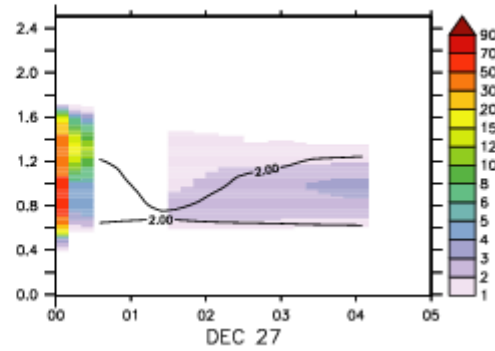
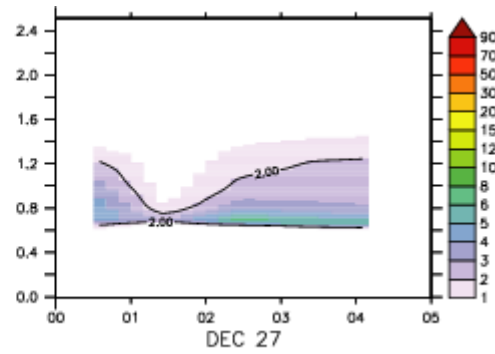
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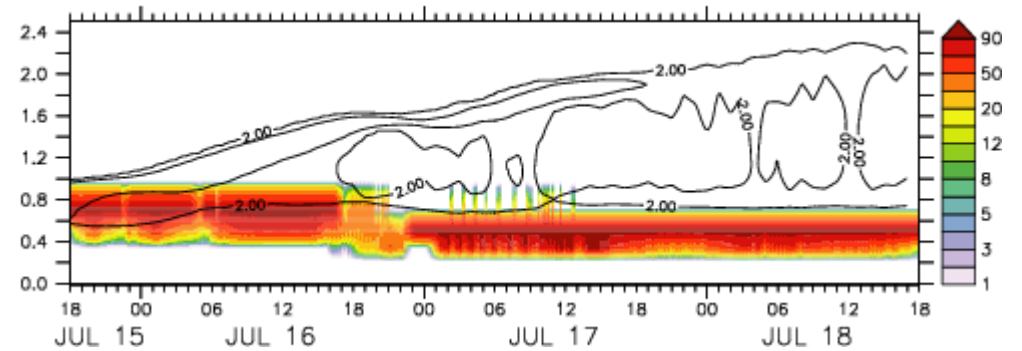
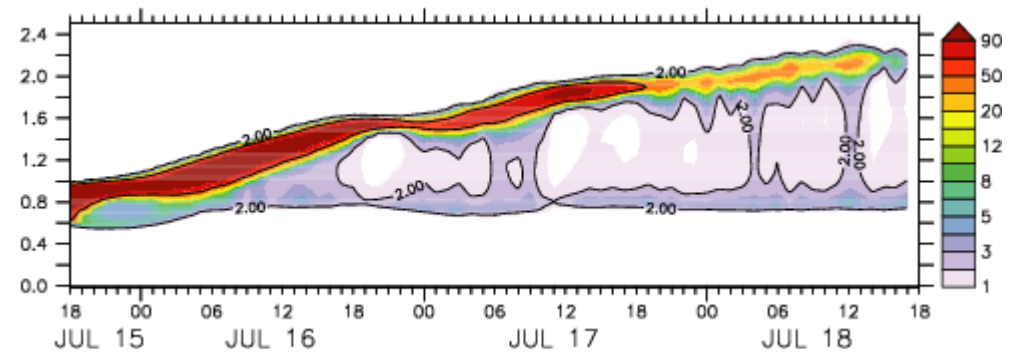
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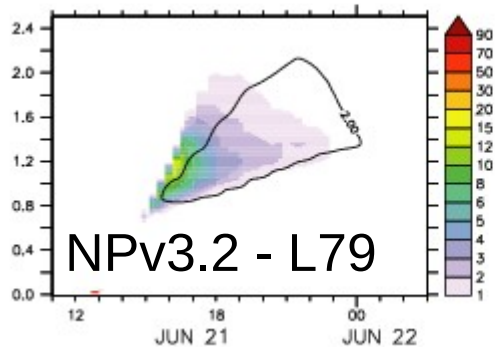
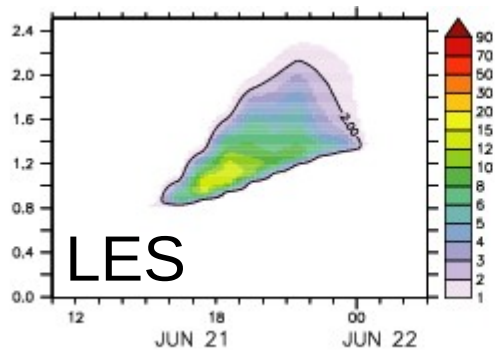
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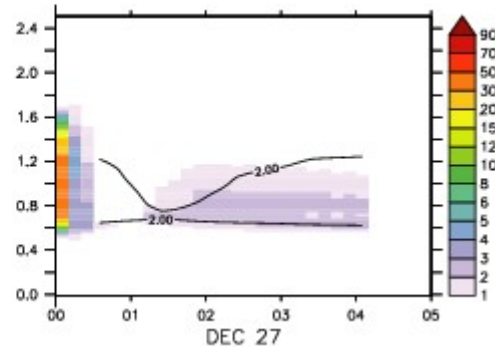
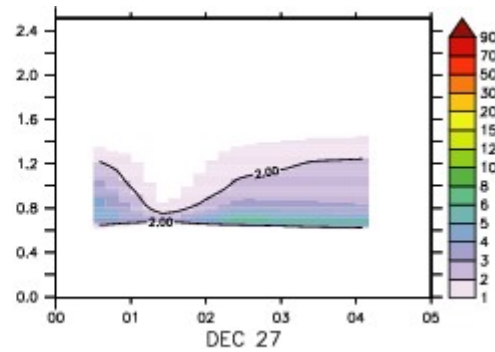
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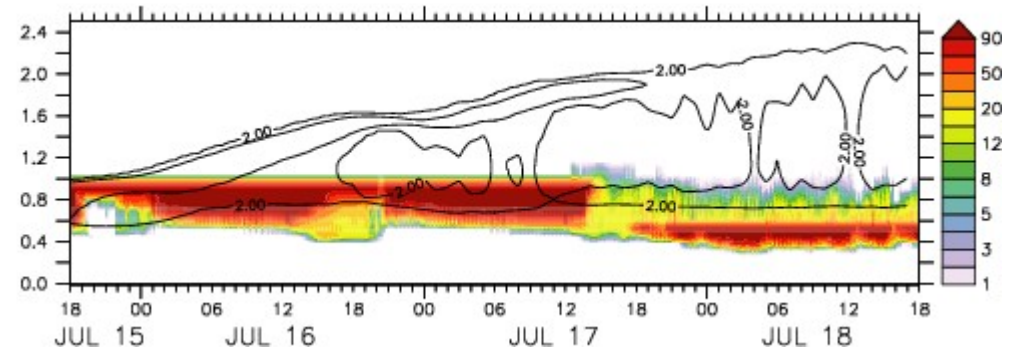
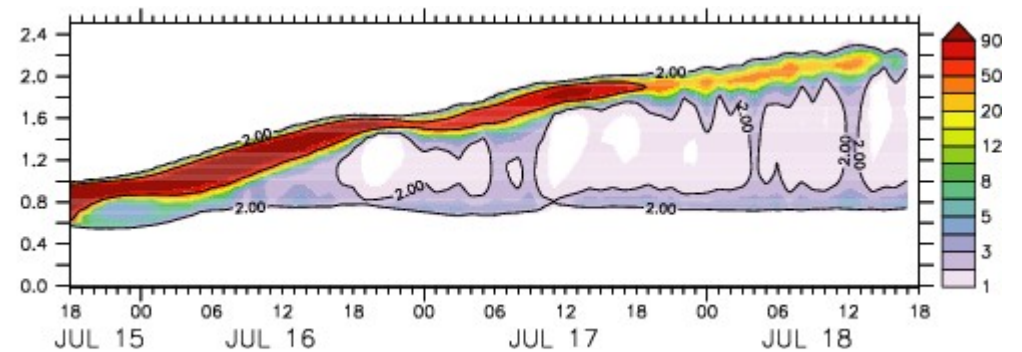
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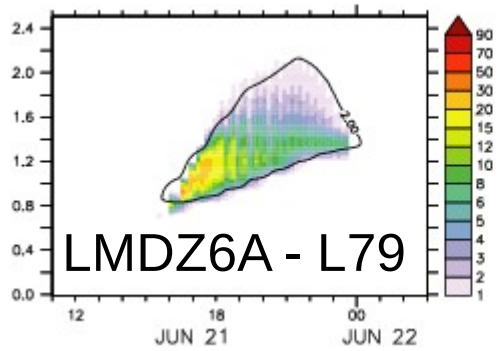
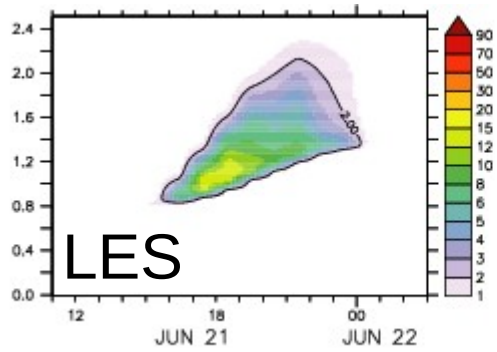
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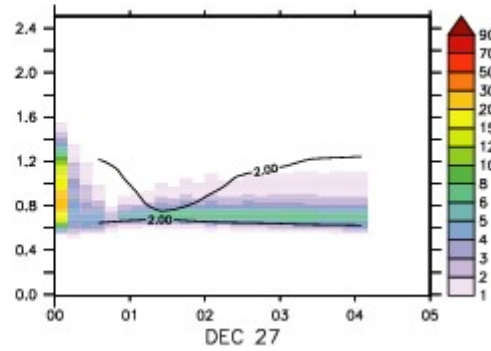
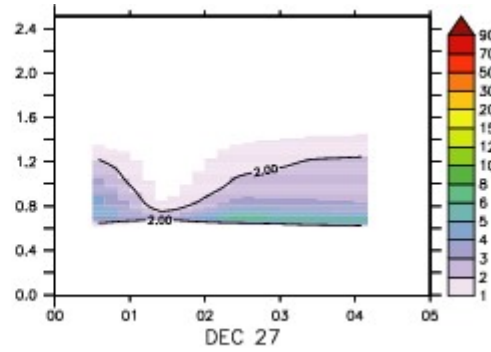
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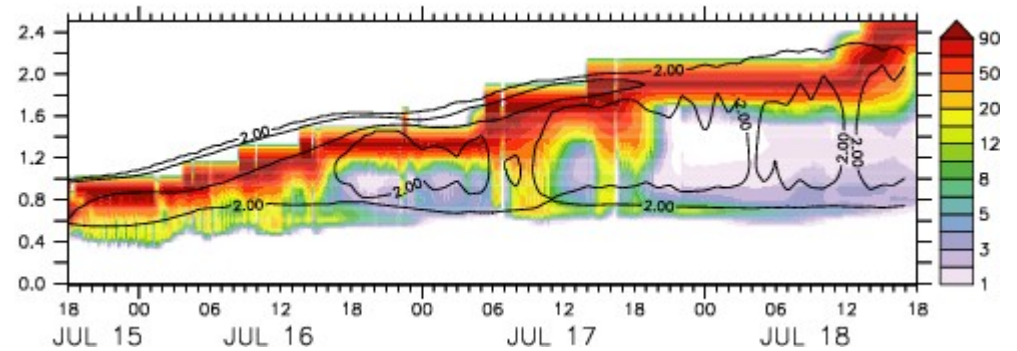
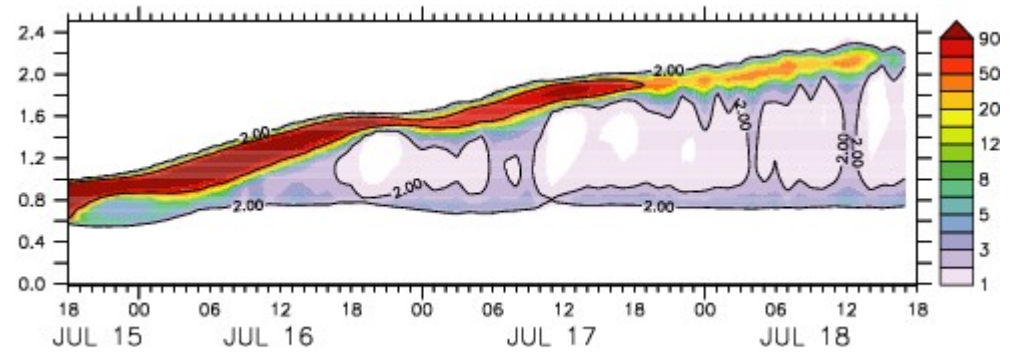
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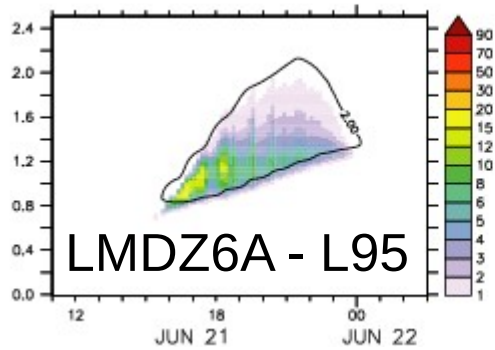
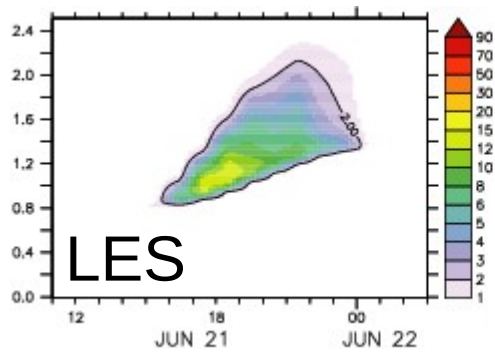
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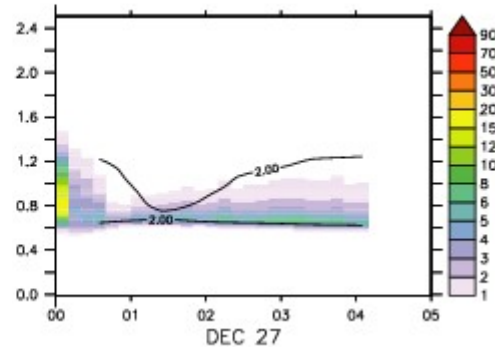
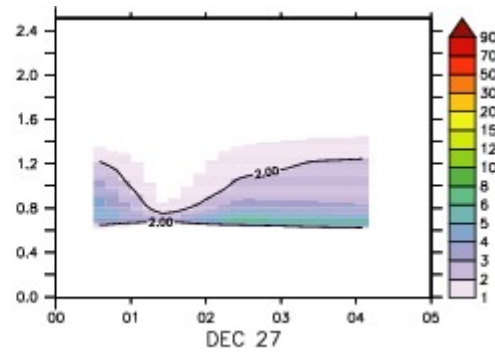
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Transition from stratocumulus
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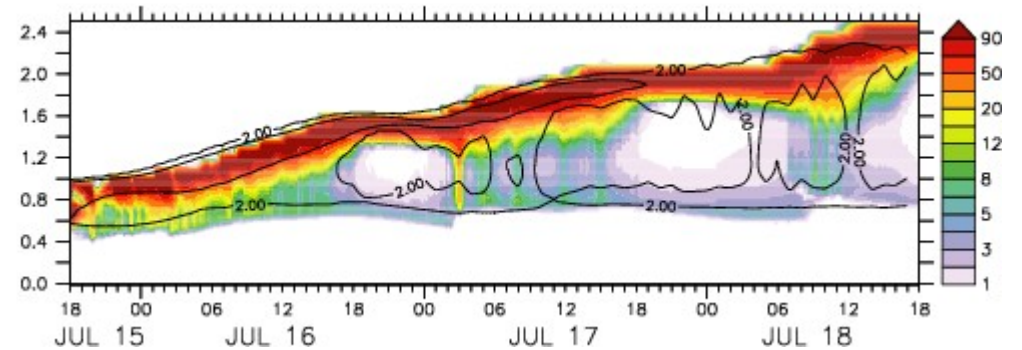
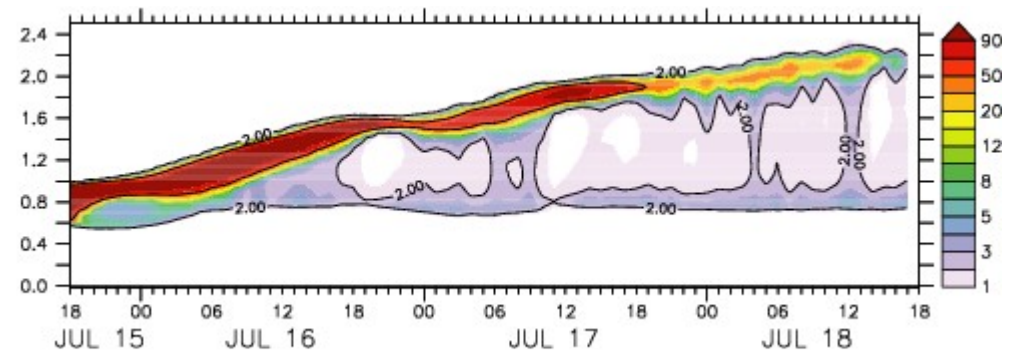
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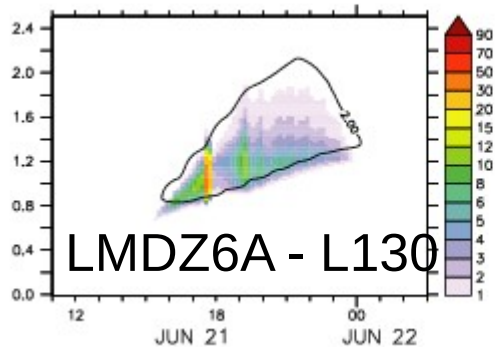
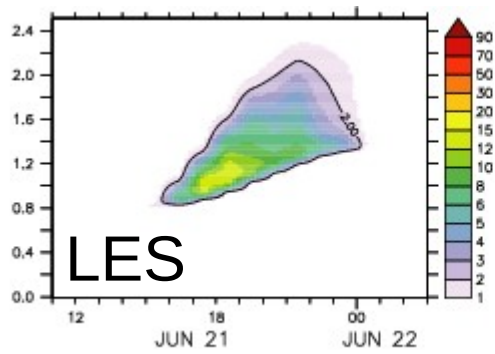
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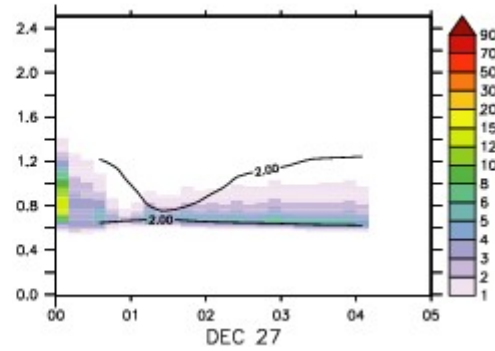
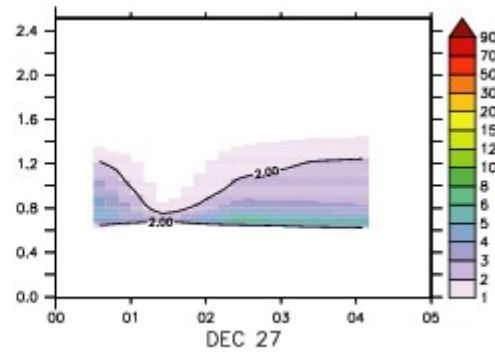
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Transition from stratocumulus
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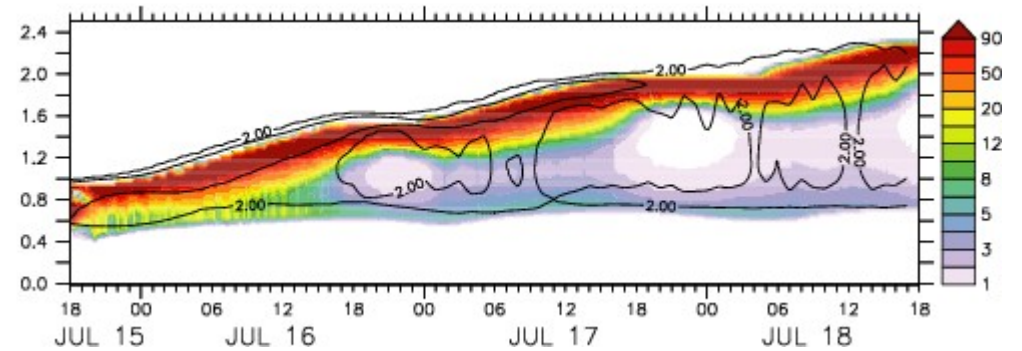
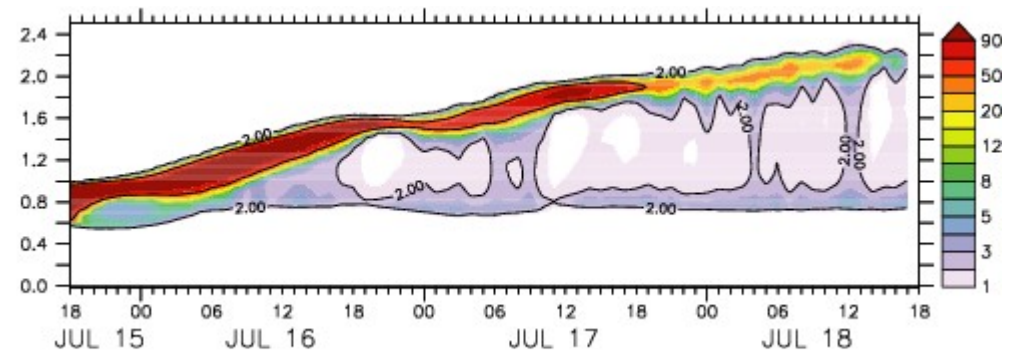
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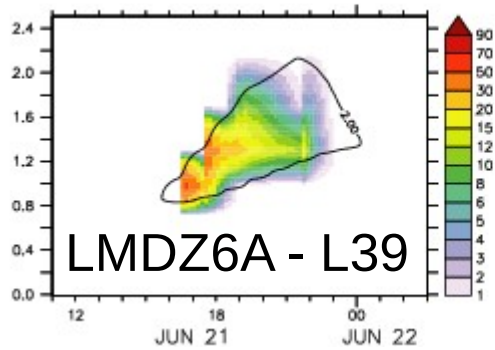
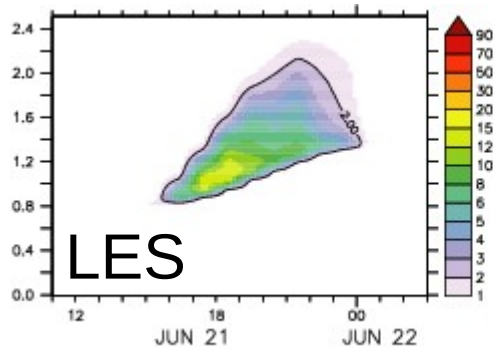
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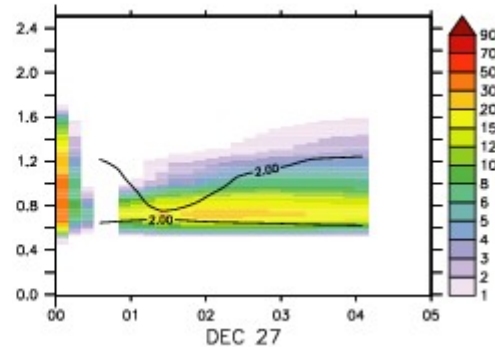
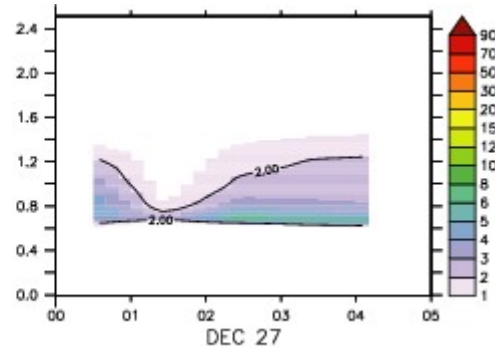
Sandu fast
Transition from stratocumulus
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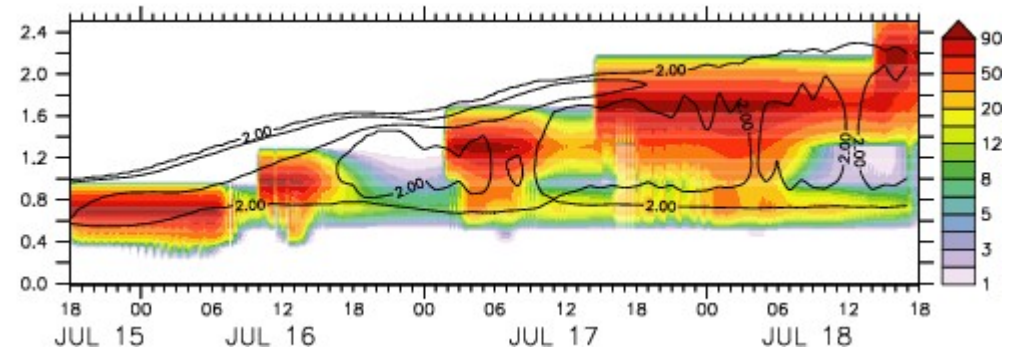
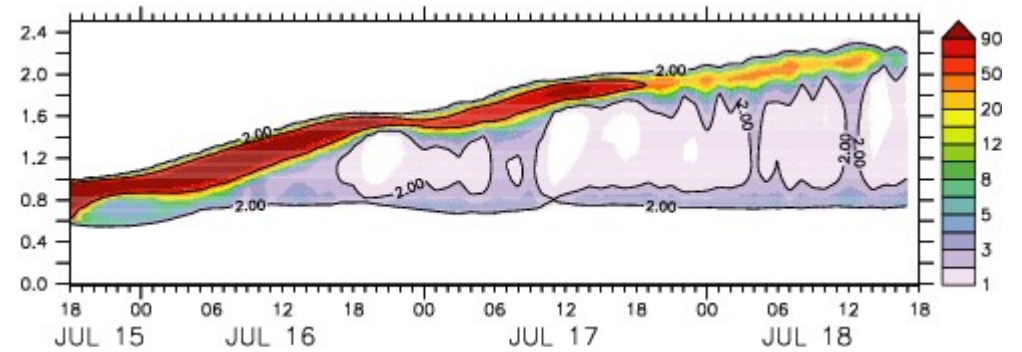
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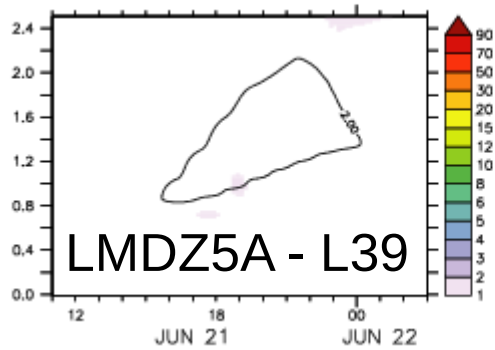
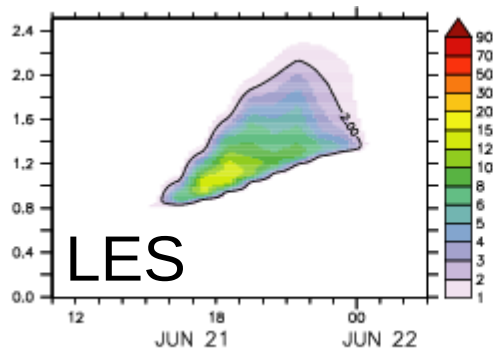
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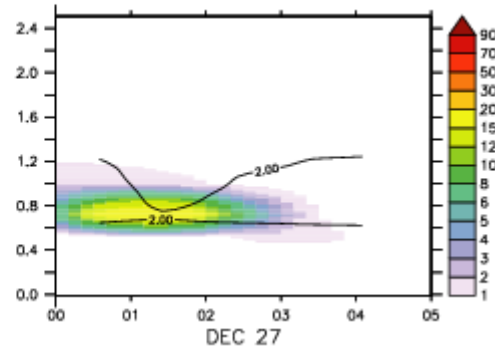
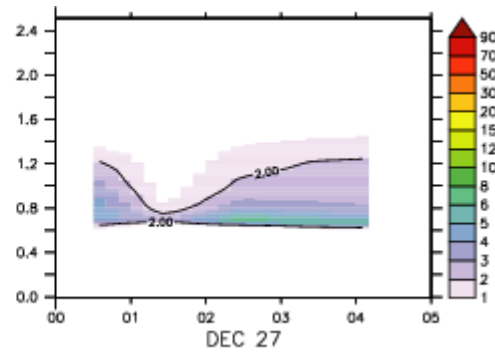
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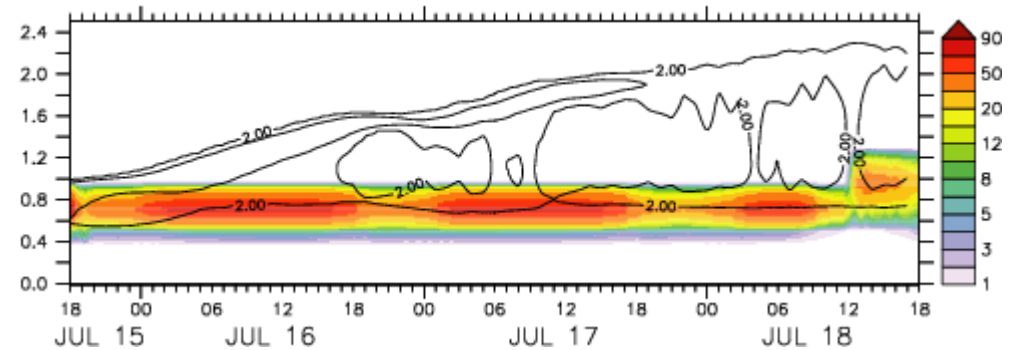
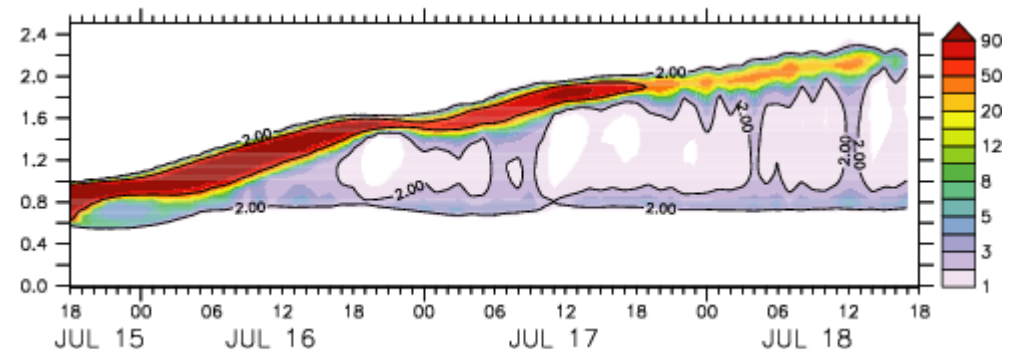
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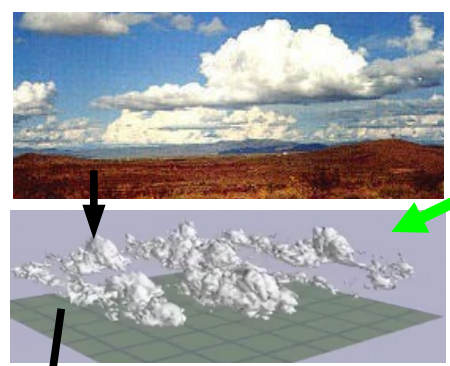
Sandu fast
Transition from stratocumulus
to cumulus



Amélioration/évaluation des paramétrisations : apport du « modèle du thermique » dans LMDZ

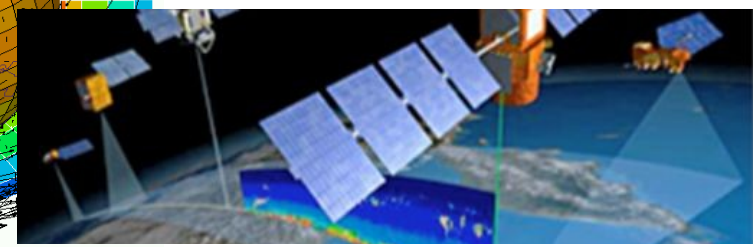
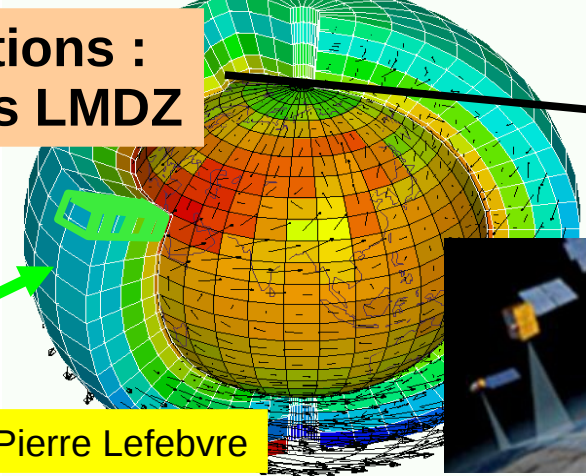
2/ dans le modèle climatique 3D vs satellites

1/ en mode uni-colonne (SCM) vs simulations explicites (LES)

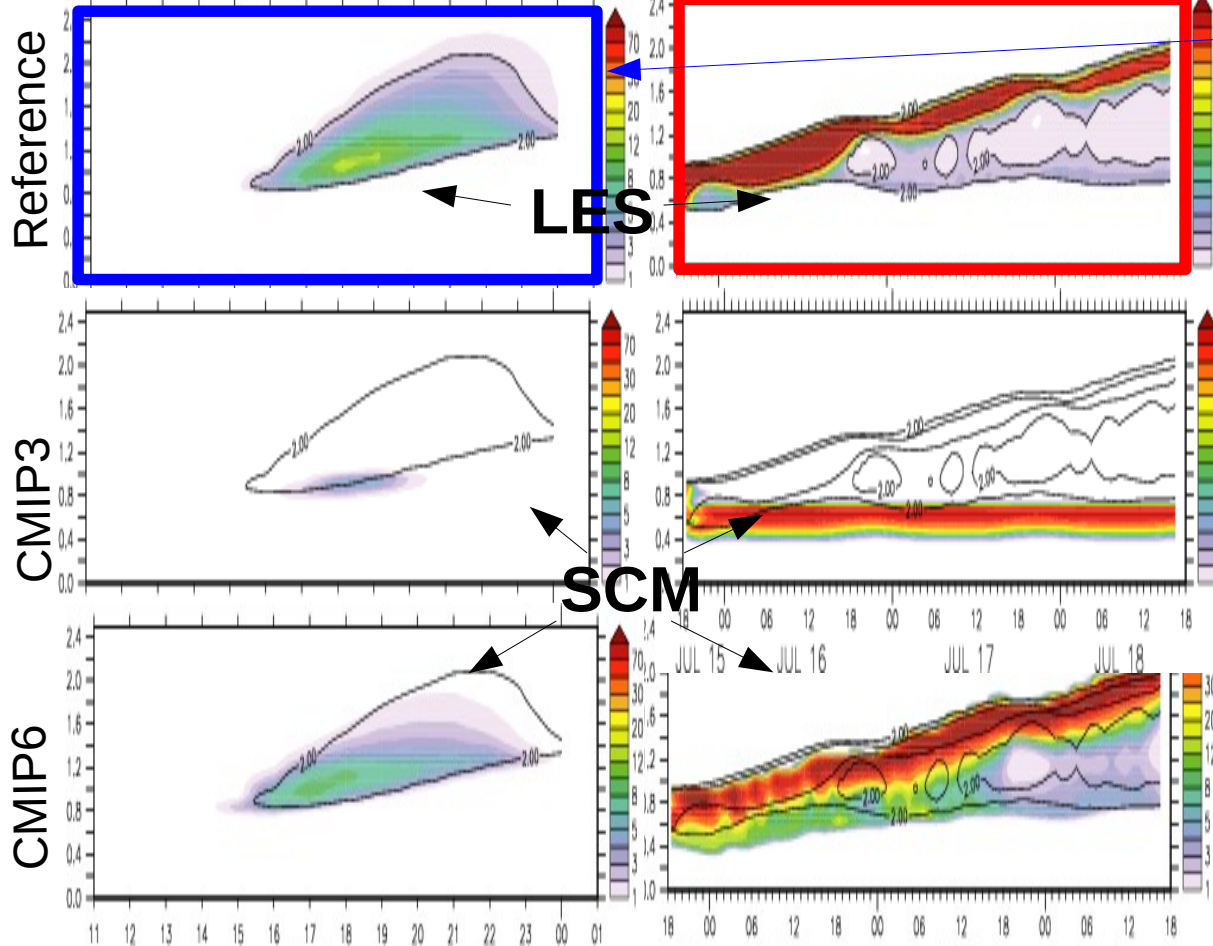


Marie-Pierre Lefebvre

Cas « sandu »
Transition strato cumulus → cumulus

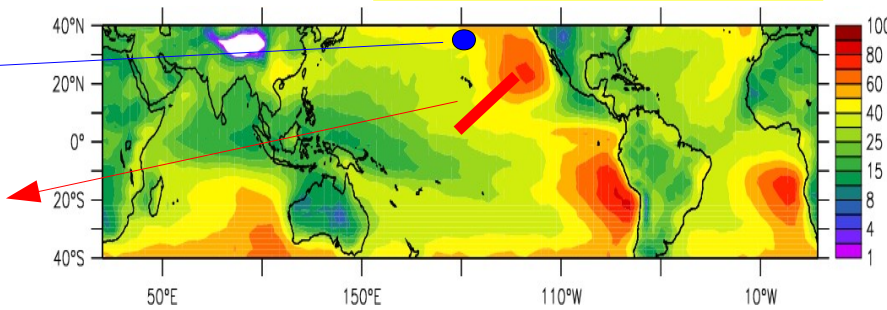


Cas ARM (Oklahoma) de cycle diurne de cumulus

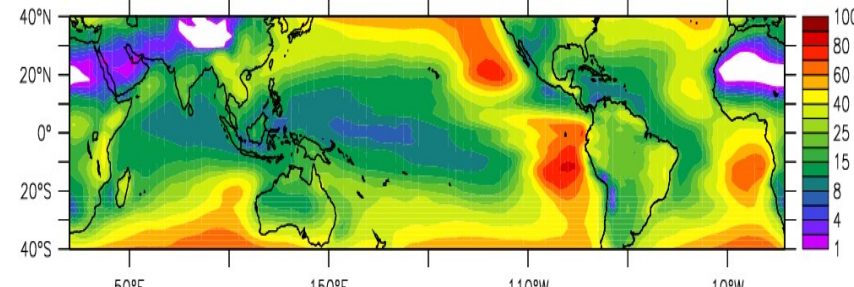
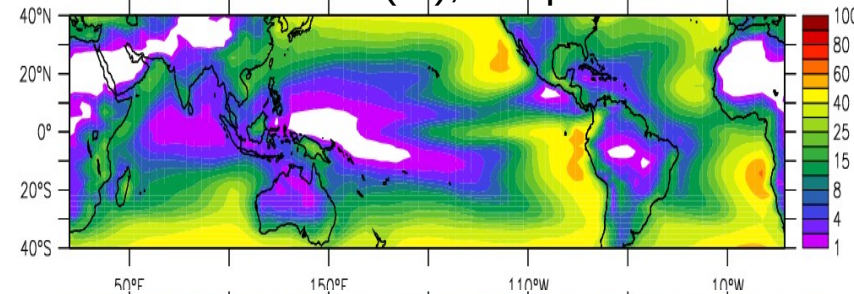


Low cloud cover (%), annual mean
Calipso lidar

Abderrhamane Idelkadi

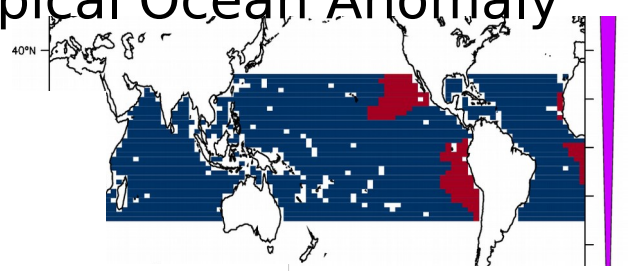
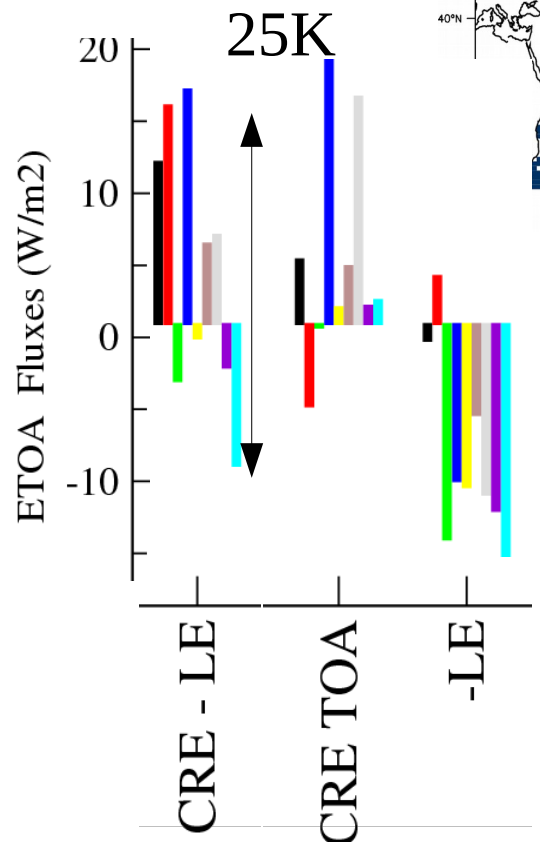
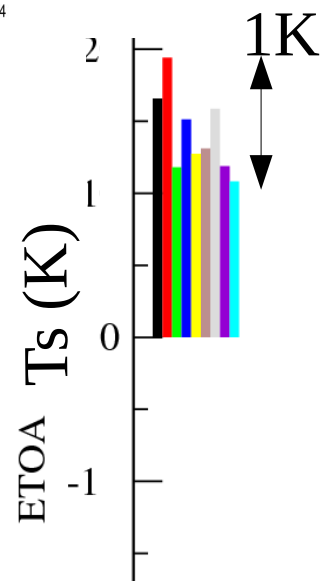
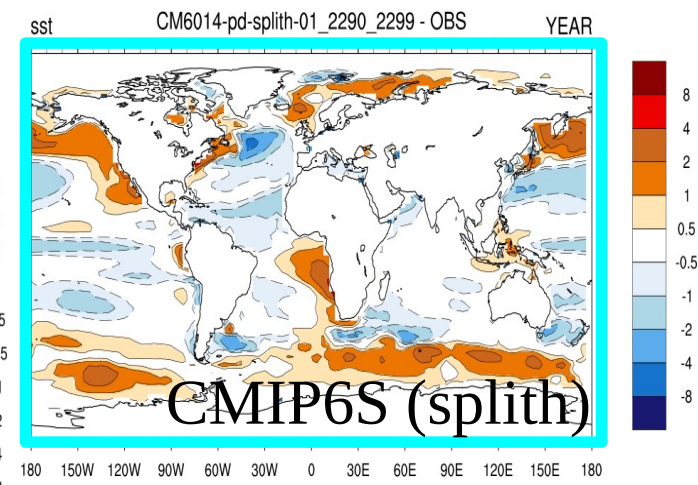
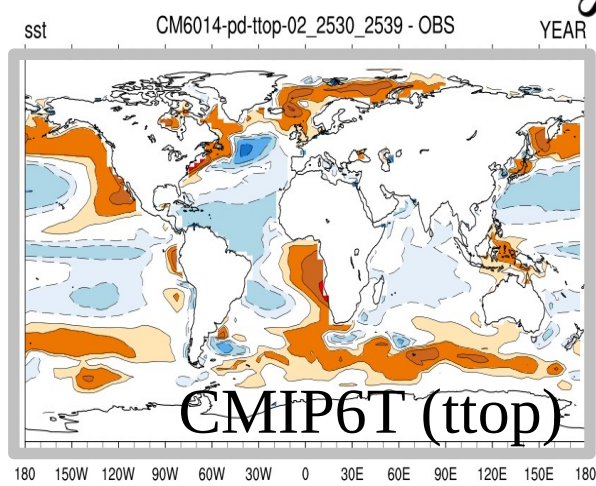
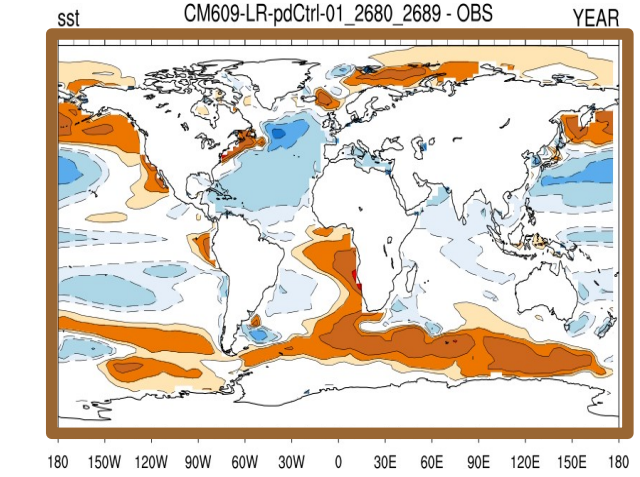
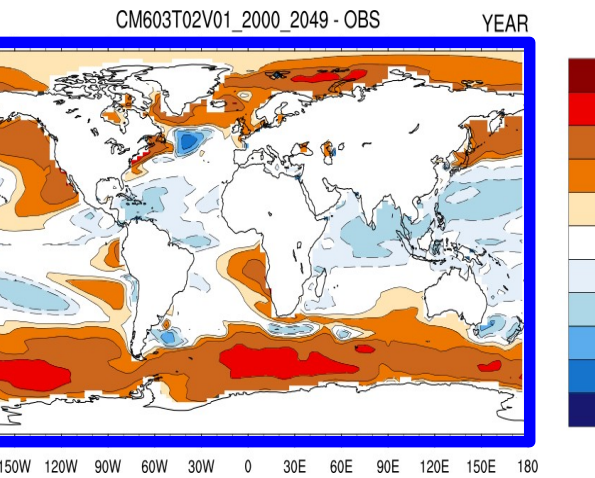
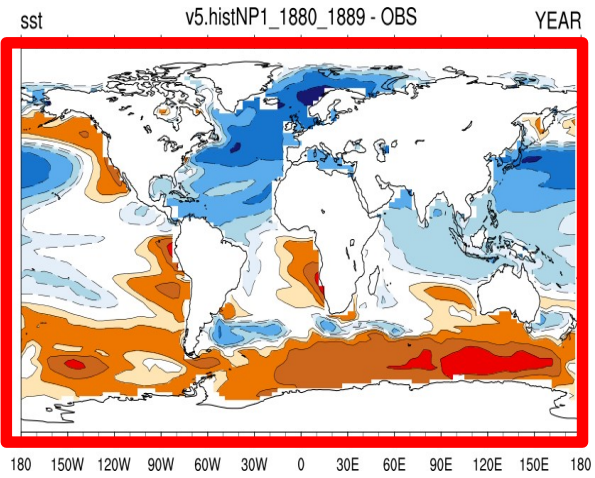


3D climate simulation (annual mean)
Low cloud cover (%), Calipso simulator



Cibles pour la réduction des biais de températures océaniques

East Tropical Ocean Anomaly

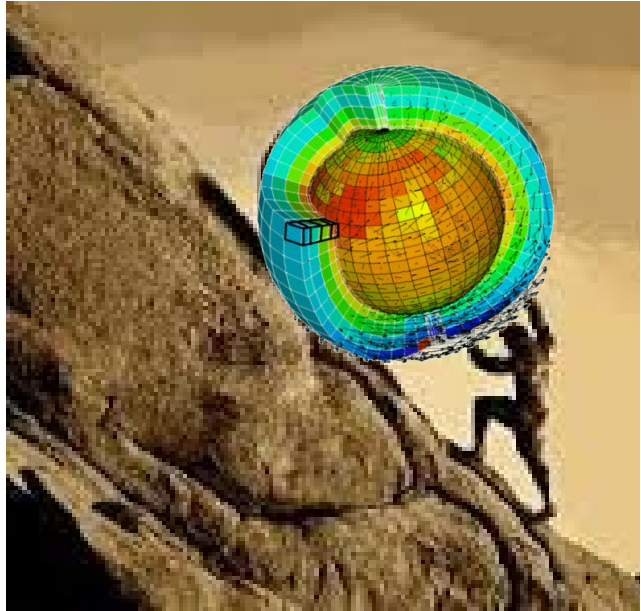


- LMDZ5A
- LMDZ5B : « NP »
- LMDZ6.0.1
- LMDZ6.0.3
- LMDZ6.0.5
- LMDZ6.0.9
- LMDZ6.0.14ttop
- LMDZ6.0.14splith
- LMDZ6.0.14splith

Du 1D au climat global : ajustement des paramètres

SCM/LES
 New parameterizations
 Inspiration
 Developpement
 Assesment

**New for IPSL CM6 tuning
 (for CMIP6)
 Ionela Musat**



Coordintate successive versions of CMIP atm. models like Sysiphus ("We must imagine happy sisyphus", A. Camus)

**Systematic 1D tests
 of new set of free
 parameters**

**3D simulations
 With imposed large
 scale circulation (wind
 nudging)**

Lidia Mellul

3D (LMDZ-Orchdee) Imposed SST
 Tuning of atmospheric balance
 Latitudinal variation of fluxes
 Mean rainfall
Increased number of metrics

Ionela Musat

**Define constraints for the
 atmosphere alone
 model**

Laurent Fairhead

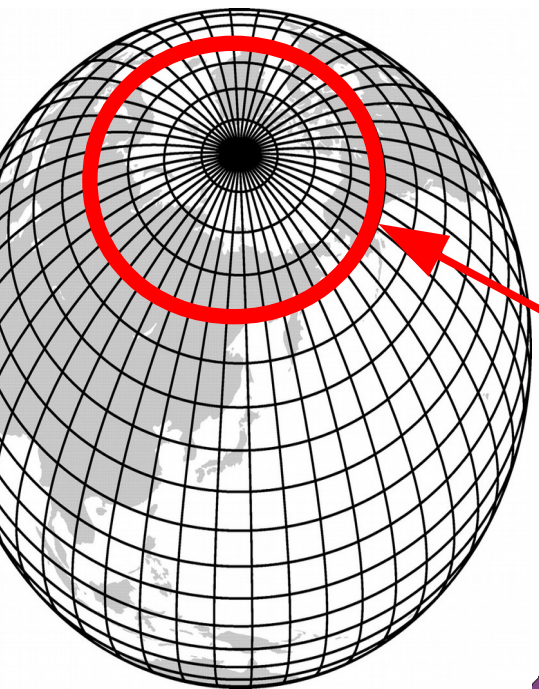
3D coupled Atm./Ocean
 Conservation
 Coupled properties
 Enso, THC, sea ice

- 738 Mutli-atlas (diagnostic suite rich and heterogeneous)
- 2600 simulations: forced 2-30 years, coupled 50-300 yrs

And much more people involved !

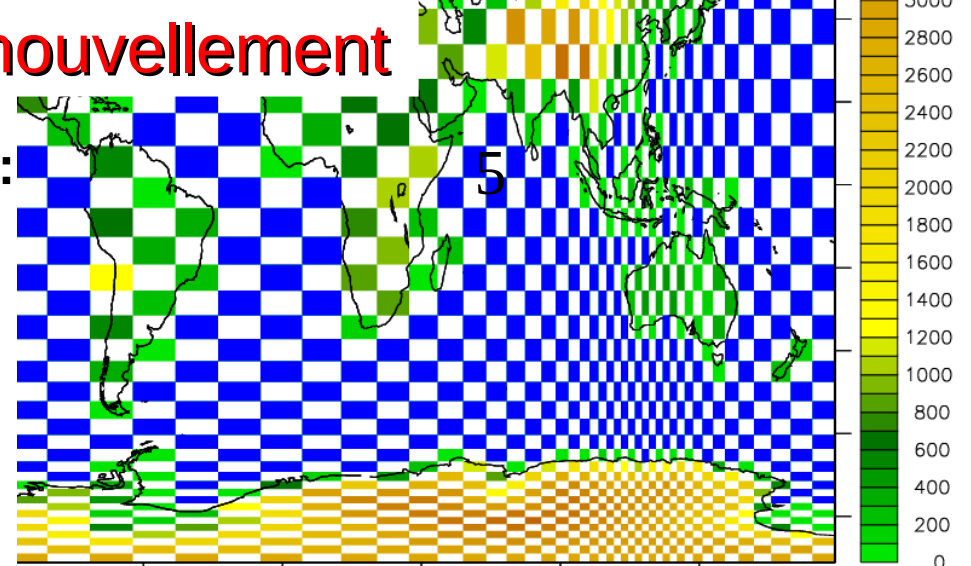
IPSL, LSCE, LOCEAN, LMD hors équipe LMDZ
 Arnaud Caubel, Sébastien Denvil, Marie-Alice Foujols, Josefine Ghattas, Anne Cozic, Jérôme Servonnat, Christian Ethé, Thibaut Lurton, Clément Rousset, David Cugnet
 Julie Dehaye, Juliette Mignot, Guillaume Gastineau, Martin Vancophlen, Olivier Boucher

LMDZ : des noyaux dynamiques en renouvellement

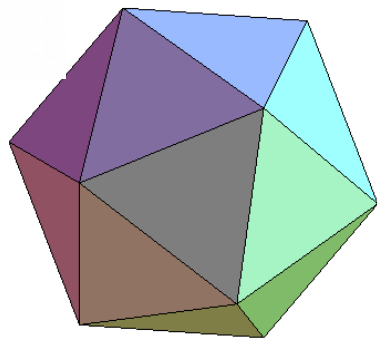


Noyau dynamique standard :
Longitude-latitude
Possibilité de zoom

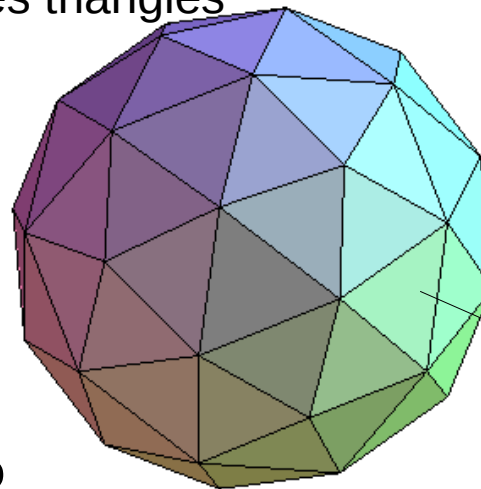
Filtre longitudinal près des pôles
Défavorable à la parallélisation
par découpage de domaine



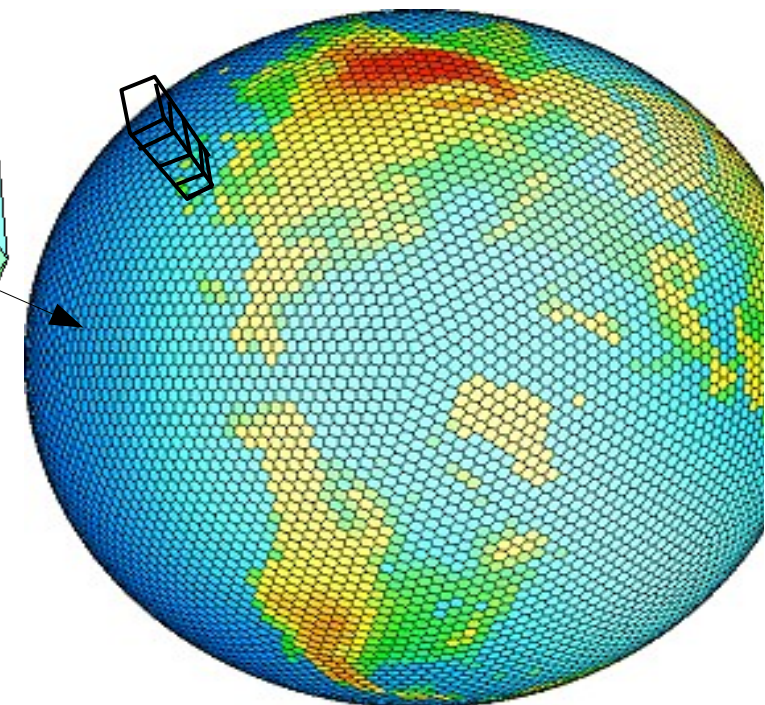
icosaèdre



Raffinement itératif
des triangles



Maillage dual



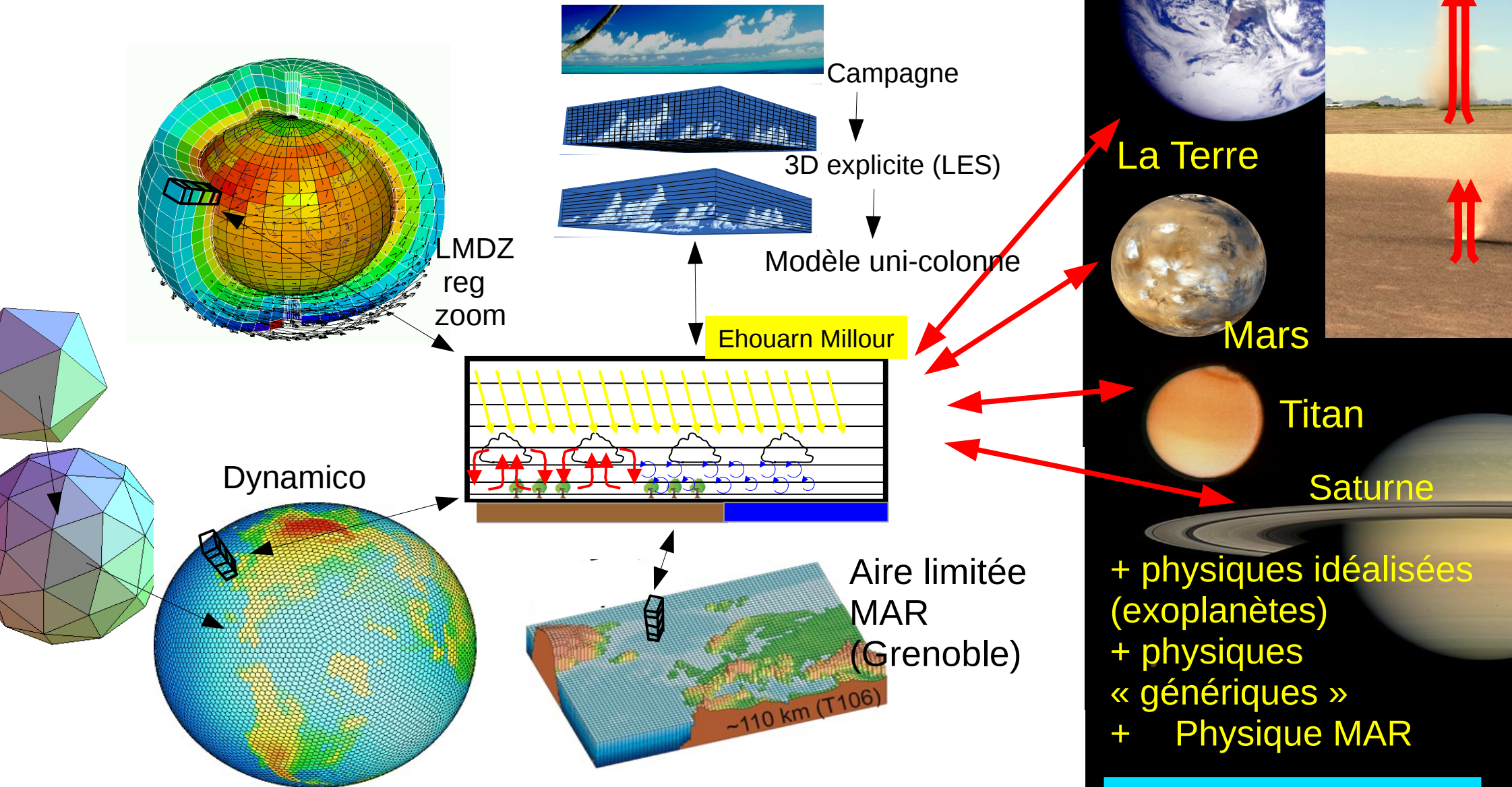
Nouveau noyau dynamique **Dynamico**

- Base icosaédrique, raffiné en triangle → dual hexagones
- Couplage avec la physique de LMDZ effectué.
- En cours d'intégration dans la svn LMDZ
- OpenMP momentanément indisponible
- Couplage orchidee en cours
- Noyau à aire limité en gestation

Thomas Dubos

Yann Meurdesoif

LMDZ : rendez-vous autour du découpage physique/dynamique



LMDZ : principaux enjeux à moyen terme

Contenu physique :

- advection des poches froides
- micro-physique
- brises
- rayonnement
- meilleure prise en compte des hétérogénéités de surface
- Physique non hydrostatique

Noyaux dynamiques / HPC

- convergence sur le nouveau noyau dynamique
- anticiper l'arrivée des nouvelles architectures
- nouveau noyau à aire limité

Tuning automatique = Détermination de métriques et barres d'erreur
+ outils automatiques de lancement et diagnostics
+ construction d'émulateurs

Labellisation