

LMDZ Training January 2024



Who are you ?

You might want to think about forming groups with people with shared interests for tutorial 2

Elias Daouk

Maitre de conférence à l'UTC

Département Génie des procédés

Laboratoire Transformations Intégrées de la Matière Renouvelable (TIMR)

Équipe Interfaces et milieux divisés (IMiD)

Recherche : simulation et modélisation multi-physique des procédés (CFD, DEM, CFD-DEM), conversion thermo-chimique de la biomasse

Enseignement : mécanique des fluides, transfert de chaleur, contrôle des procédés, simulation des opérations en GP, énergie et machines thermiques

Autres : label IS, bilan carbone du laboratoire, fête de la science

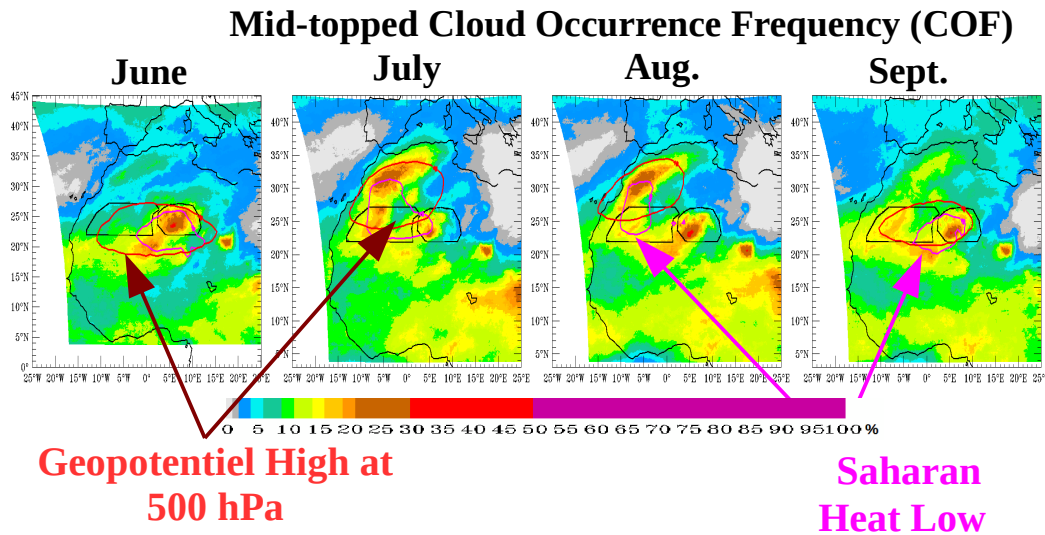
Utilisation LMDZ : approfondir mes propres connaissances, initier des projets avec des étudiants, l'inclure dans nos enseignements ?

Geneviève Sèze (LMD/collaborateur bénévole Sorbonne Université) -

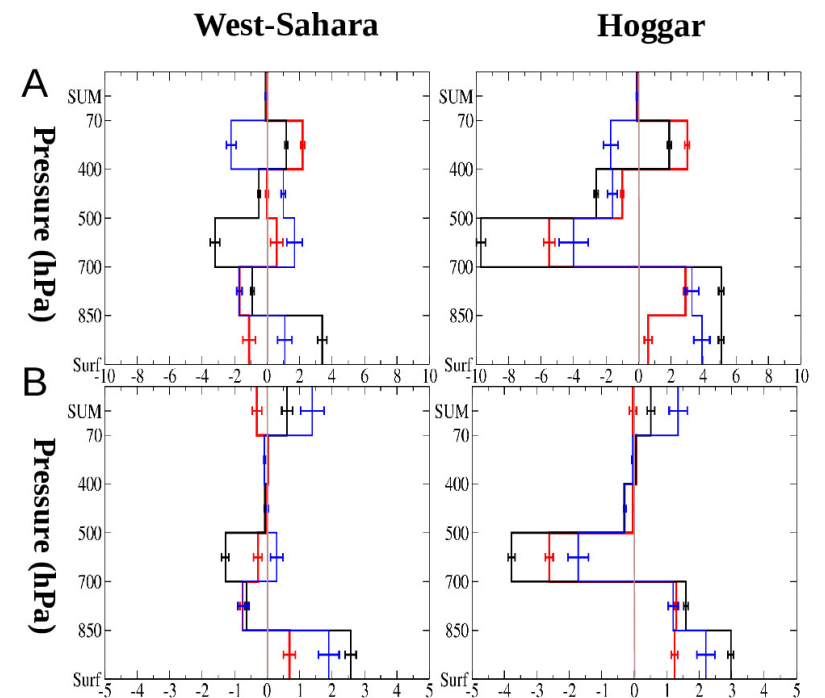
Etude de la **distribution 3D de la couverture nuageuse** et de sa **variabilité spatiale et temporelle à l'échelle globale et régionale** à partir des données satellites et plus particulièrement des données des satellites géostationnaires. Les radiomètres visible et infrarouge des satellites géostationnaires fournissent des données avec une résolution spatiale de l'ordre de 1kmx1km à 5kmx5km et temporelle de 30' et 10' ou 15' pour la nouvelle génération. Utilisation de ces données dans des études régionales afin de relier les caractéristiques de la couverture nuageuse à la circulation atmosphérique.

Etude du **rôle des nuages au-dessus du Sahara**, en interaction avec les poussières et la vapeur d'eau, sur la force de la dépression thermique Saharienne et sur la distribution des précipitations au Sahel. Les résultats attendus sont, d'une part, une meilleure **compréhension de ce rôle en utilisant les ré-analyses ERAI** et, d'autre part, une **évaluation des simulations LMDZ guidées zoomées**, préalable à l'utilisation de ce modèle pour la compréhension des processus observés.

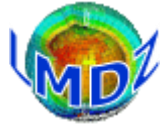
Utilisation des données du radiomètre SEVIRI à bord du satellite MSG et des données ERAI sur la période 2008-2014.



Selami N, Sèze G, Gaetani M, Grandpeix J-Y, Flamant C, Cuesta J, Benabadi N., Cloud Cover over the Sahara during the summer and Associated circulation Features. Atmosphere .2021; 12(4):428
doi:<https://doi.org/10.3390/atmos12040428>



A: mean vertical profile of horizontal mass flux in kg/m²/s
B: mean vertical profile of horizontal water vapor flux rate value in kg/m²/d



Myriam Besson – doctorante LMD ENS (DPA) depuis 09/23

*Caractéristiques des **dépressions arctiques** dans les modèles de climat et leur rôle dans le climat polaire*

Avec Gwendal Rivière (LMD ENS) et Sébastien Fromang (LSCE)

Ma thèse ?

Intérêts pour
LMDZ ?

Idée de ma thèse : comparaison de tracking de cyclones arctiques dans des réanalyses ERA5 et des **sorties de modèles DYNAMICO-LMDZ**.

Actuellement, utilisation des simulations HRMIP.

Peut-être utilisation de sorties de nouvelles simulations plus tard, notamment des projections futures avec DYNAMICO-LMDZ.

Que fais-je avec
les modèles ?

Julien GARGANI

Université Paris-Saclay (Orsay)

UMR Geops (CNRS/Univ Paris-Saclay), membre de la fédération IPSL

Enseignant-chercheur

Géomorphologue (indiscipliné)

1) Caraïbes (Saint-Martin/Saint-Barthélemy)

=> Ouragan Irma 2017, 10 morts, >3 milliards d'euros de dégâts, migration temporaire/définitive de population

=> submersion marine, vent, érosion, pluviométrie (pas seulement évènements extrêmes), en 2050-2100

2) Estuaire/marais salant => submersion marine, T°-pluviométrie-évènements extrêmes, 2050-2100

=> Estuaire de la Loire (Saint-Nazaire-Guérandes)

=> Estuaire du Rhône (Camargue/Saintes-Marie de la mer)

Iman Toghraei

- **Post-doc (Sep. 2023-)**: Parameterization of Gravity Waves in the atmosphere

Advisors: François Lott (LMD), Riwal Plougonven (LMD), Albert Hertzog (LMD) and Aurélien Podglagen (LMD)

Objectives:

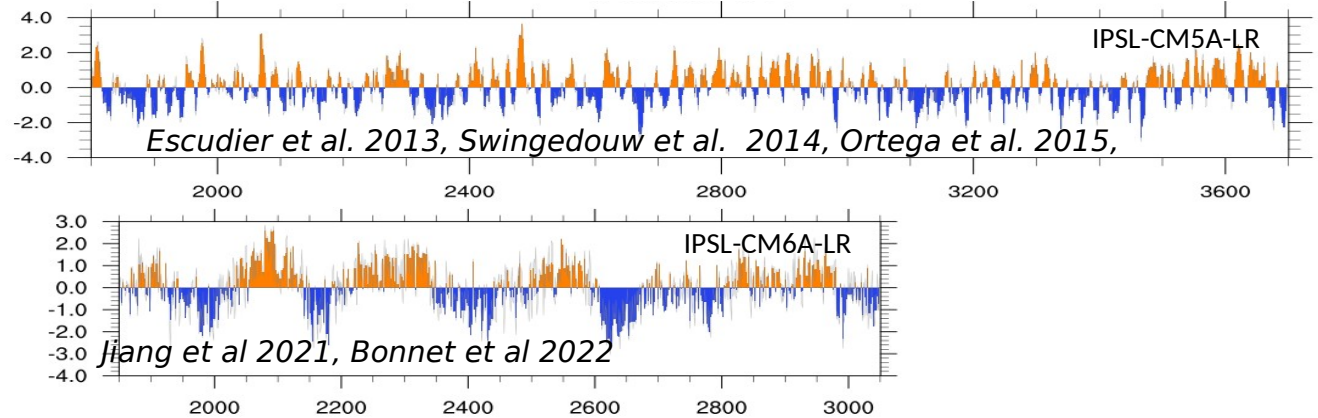
- Compare gravity waves predicted by parametrizations to high resolution models
- Emulate and calibrate gravity wave parameterization
- Test the impact of the optimized parameterizations

- **PhD (2023)**: Dynamics of a stratified rotating vortex under the complete Coriolis force
Supervisor: Paul Billant (Ladhyx, Ecole polytechnique)

My research interest: climate modulations at the decadal timescale, role of the ocean

My main tool: climate models and in particular the IPSL climate model

Modulations of the large scale SST anomalies in the North Atlantic (Atlantic Multidecadal variability)



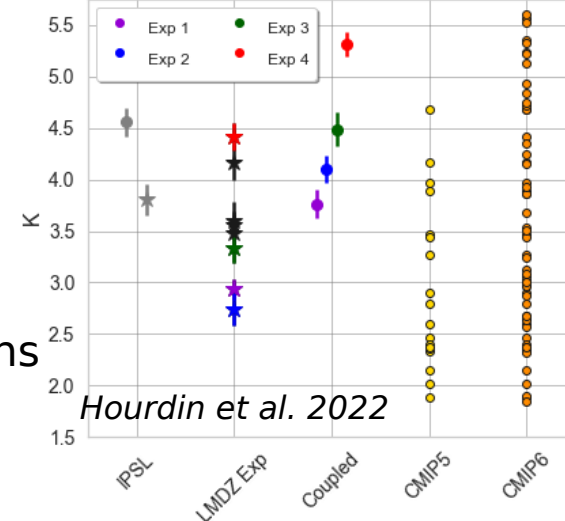
➤ I want and I need to understand what is in the model

My current question: Could the origin of these differences come from modelling choices in the model components?

Differences in climate sensitivity at least could indeed at least partly come from different parameter values in the atmospheric component

➤ I want and I need to understand what is in the atmospheric component

Equilibrium climate sensitivity (ECS) of various configurations of the IPSL and LMDZ model




Kazem Ardaneh


Kazem Ardaneh is a computer scientist and physicist holding a PhD in computer science. His expertise is dedicated to tackling multidisciplinary challenges. His focus lies in the development of parallel numerical codes designed for solving complex multi-physics problems, executed with on supercomputers. Since September 2022, he has been a part of the IPSL climate modeling centers, actively contributing to the porting of IPSL climate models onto heterogeneous architectures and optimizing the land surface model.

Filip Kiałka

PhD – Quantum physics @ University of Vienna

Now – Postdoc with Bertrand Guenet @ Lab. de Géologie, ENS

Soil hydrology in ORCHIDEE –  **HoliSoils**
Working together for forest soils

Land-atmosphere interactions – 

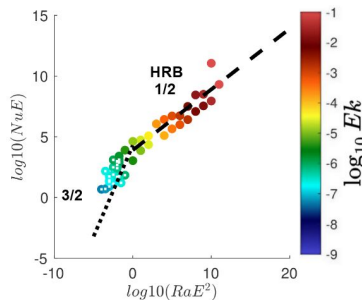
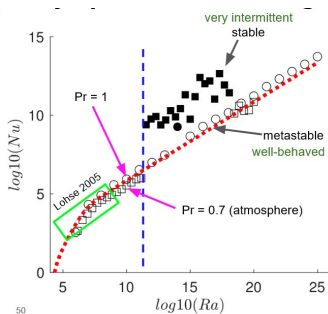
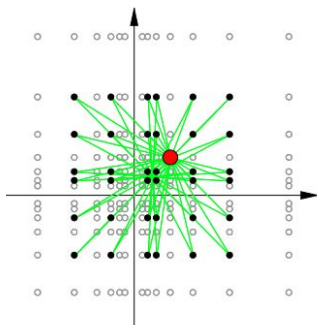
Amaury Barral – PhD



- PhD: “A numerical framework for geophysical flows on logarithmic lattices”, 2020-2023



Sparse models for simulating fluid dynamics on large ranges of scales



B. Dubrulle
SPEC/CEA



S. Fromang
LSCE/CEA

- Feb 2024+: Research Engineer @ LMD Jussieu on orchestrating various climate model tasks within LMDZ





Scientific activities and research areas

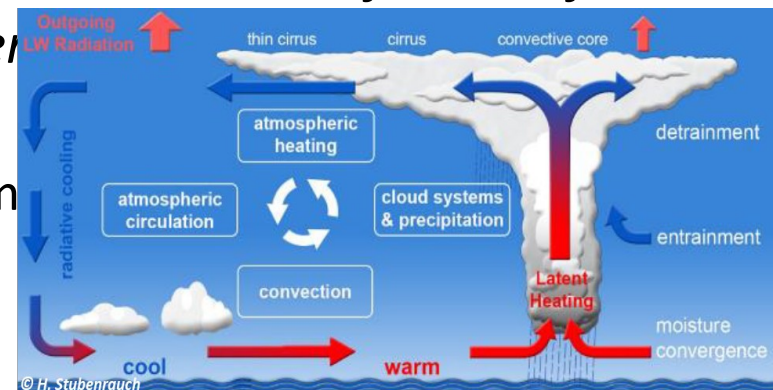
- Satellite cloud climatologies (updated GEWEX cloud assessment database)
- Understanding the role of UT clouds in the modulation of climate (GEWEX Process Evaluation Study on Upper Tropospheric Clouds & Convection)
To identify the most influential feedback mechanisms, large-scale modelling is necessary; the representation of UT clouds (microphysics, precipitation and detrainment efficiency, organization of convection) in GCMs not yet satisfactory
-> improve, develop and assess parameterizations

Stubenrauch et al., JAMES 2019: New Cloud System Metrics to Assess Bulk Ice Cloud Schemes in a GCM

Next project (with Laurent Li & Xiaoting Chen of LMD):

simulation experiments, using observational 3D diabatic HR fields to force climate system & study changes in atmospheric situations of convective organization

-> quantify dynamical response of climate system to atmospheric heating



Hugo Cayla (vidéaste scientifique)

Training

- Engineering school at Institut d'Optique (2011-2014)
- PhD thesis in experimental quantum physics « cold atoms » at Laboratoire Charles Fabry (2015-2018)

Activity (since 2019)

- Scientific communication/diffusion of public research (LCF, LKB, ISMO, Pprime, C2N, LULI, LuMin, LAC, Université Gustave Eiffel, Paris Saclay, Paris Cité...)
- Director of Scientific documentaries (Youtube channel « PHOTONS JUMEAUX », 10k subscribers)
- Teaching (electronics, optics, quantum physics, signal processing)

Goals

- Learning about climate science, especially General Circulation Models
- Be able to communicate on those topics for a general audience



Xiaoting Chen

PhD student (2nd year)



Supervisor: Claudia Stubenrauch **Laboratory:** LMD **Group:** ABCt

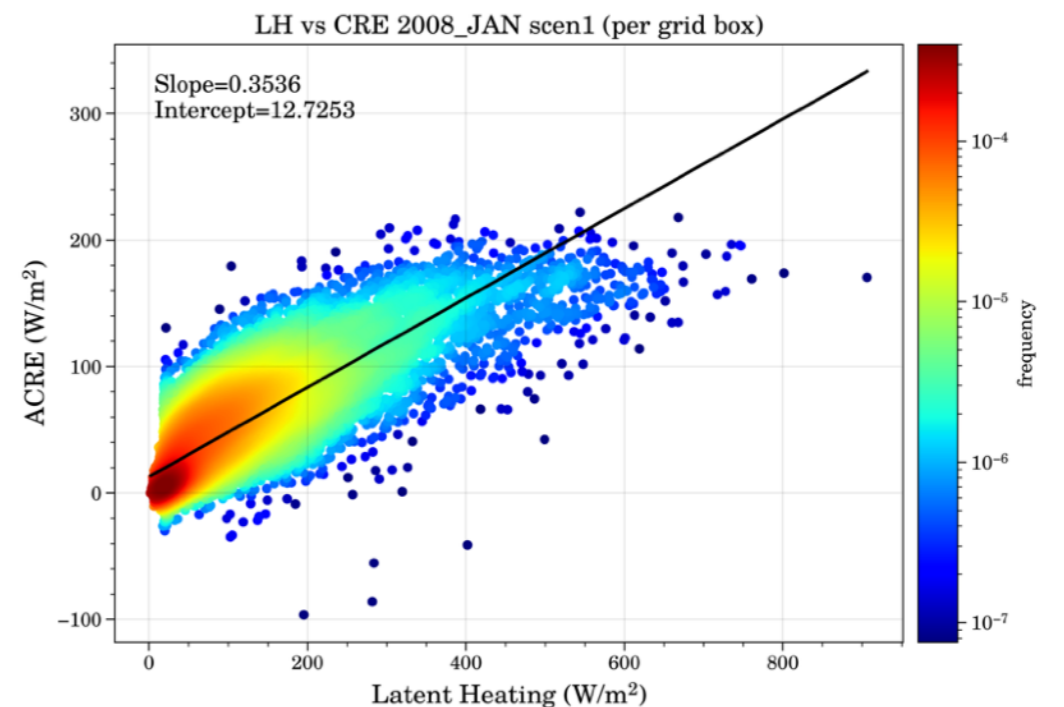
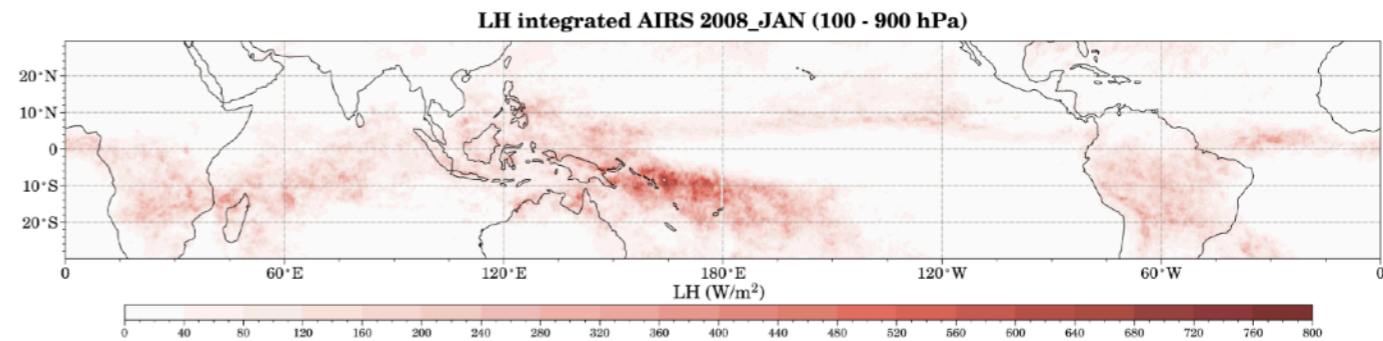
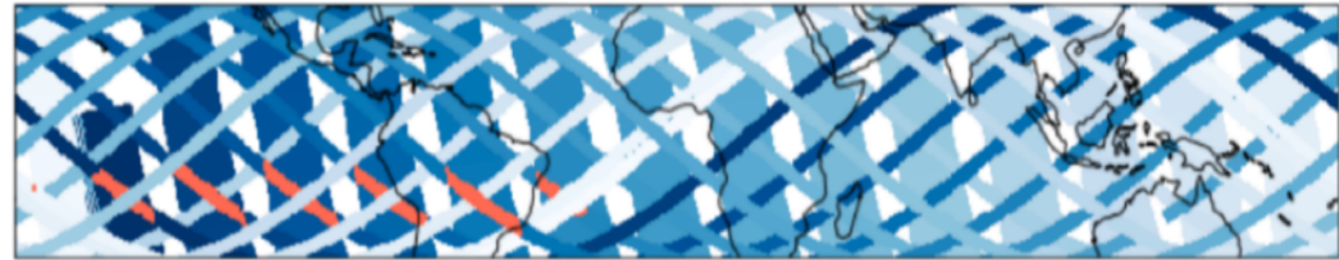
Research topic: Impact of diabatic heating of upper tropospheric clouds on general atmospheric circulation and climate

Current work:

- Expand *latent heating rate* across UT cloud systems & environment by machine learning
- Study the relationship between latent and radiative heating fields in the tropics from synergistic satellite data

Next step:

Quantify the dynamical response of the climate system to atmospheric heating from these UT cloud systems (by using **LMDZ** zoomed-in version)





Research engineer

Institut des Géosciences de l'Environnement
Grenoble



- ▶ Currently working on coupling the Elmer/Ice ice sheet model with LMDz within the IPSL modeling framework (ESM2020 project)
- ▶ Previous experience:
 - ▶ Adjoint sensitivity analysis with chemical transport models
 - ▶ Project management for an air quality monitoring organization
- ▶ More broadly: interested in numerical modeling of environmental flows, high-performance scientific computing

Yangcheng LUO

B.S. @ Peking University 2018, Atmospheric Science

M.S. @ Caltech 2020, Environmental Science & Engineering

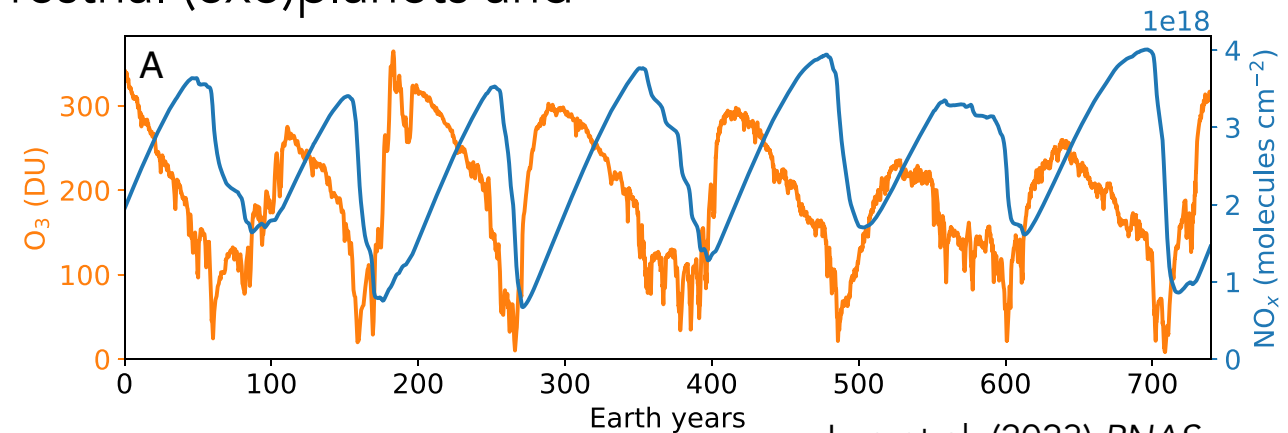
Ph.D. @ Caltech 2023, Planetary Science

Postdoc @ LMD since 2023



Research Interest:

- 3D modeling for photochemistry in planetary atmospheres
 - For now: recent Mars at high and low obliquities
 - For future: diverse atmospheres of terrestrial (exo)planets and paleo-Earth
- Bistability and self-oscillations in nonlinear photochemical systems
- Biosignatures and habitability
- The methane conundrum on Mars



Luo et al. (2023) PNAS

Xiaojun Wu



I come from **China** and am currently a **visiting doctoral student** at LMD. My tutor is Laurent Li. My research interests focus on regional climate change. Previously, I studied the WRF model, and I am also interested in LMDZ. I have learned that LMDZ has extensive applications in large-scale studies. Therefore, I wish to learn and acquire more knowledge about LMDZ to **broaden and enrich my understanding and research.**

I have a very limited understanding of LMDZ and hope to learn and comprehend more through this training. I am very grateful for the opportunity to participate in this learning experience, and I am happy to get to know everyone. Thank you.

Xiaohe HUAN

Visiting PhD student at LMD
3rd year PhD student at School of Ocean and
Earth Science, Tongji University



- PhD subject: Atmospheric forcing and response to Arctic sea ice
- Why join LMDZ training?
 - Learn how to run LMDZ
 - Learn the basics of climate modelling
 - Learn to couple LMDZ with other models (e.g. oceanic model)

Alice MAISON

- 2016 – 2019: Engineer in agricultural, environmental and climate sciences



- 2019 – 2020: M2 in atmospheric physics and chemistry



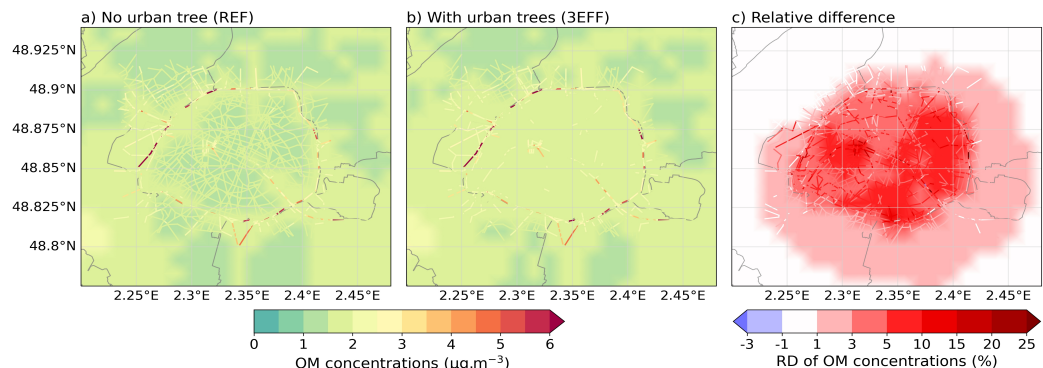
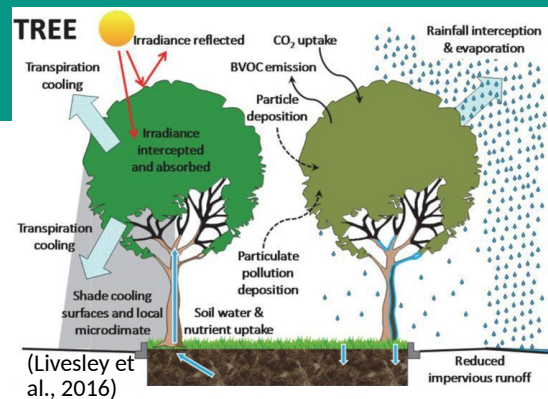
- 2020 – 2023: PhD
Modeling the impacts of trees on air quality from the street to the city level



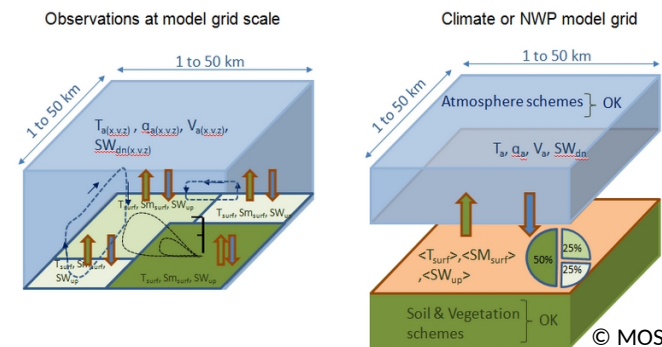
- 2024 – 2025: Post-doctoral position at LMD
MOSAI project



Parameterization of the impact of sub-mesh surface heterogeneities on the mechanical coupling between the continental surface and the atmosphere in climate models -> LMDZ



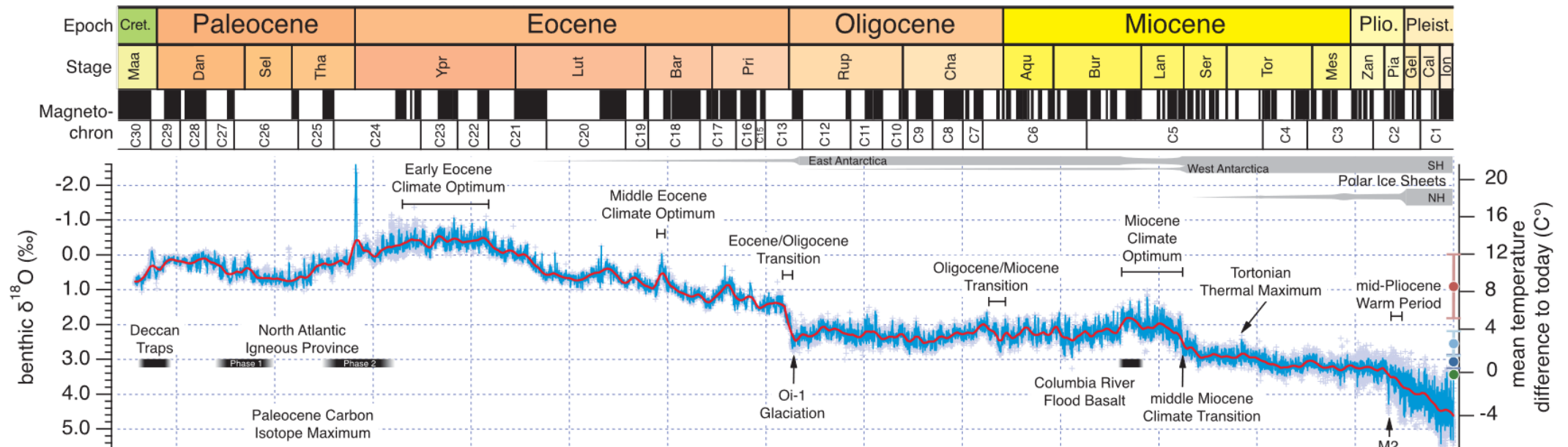
Average organic fine particles concentrations a) without and b) with urban trees and c) relative difference simulated with CHIMERE-MUNICH (06/06-31/07/22)

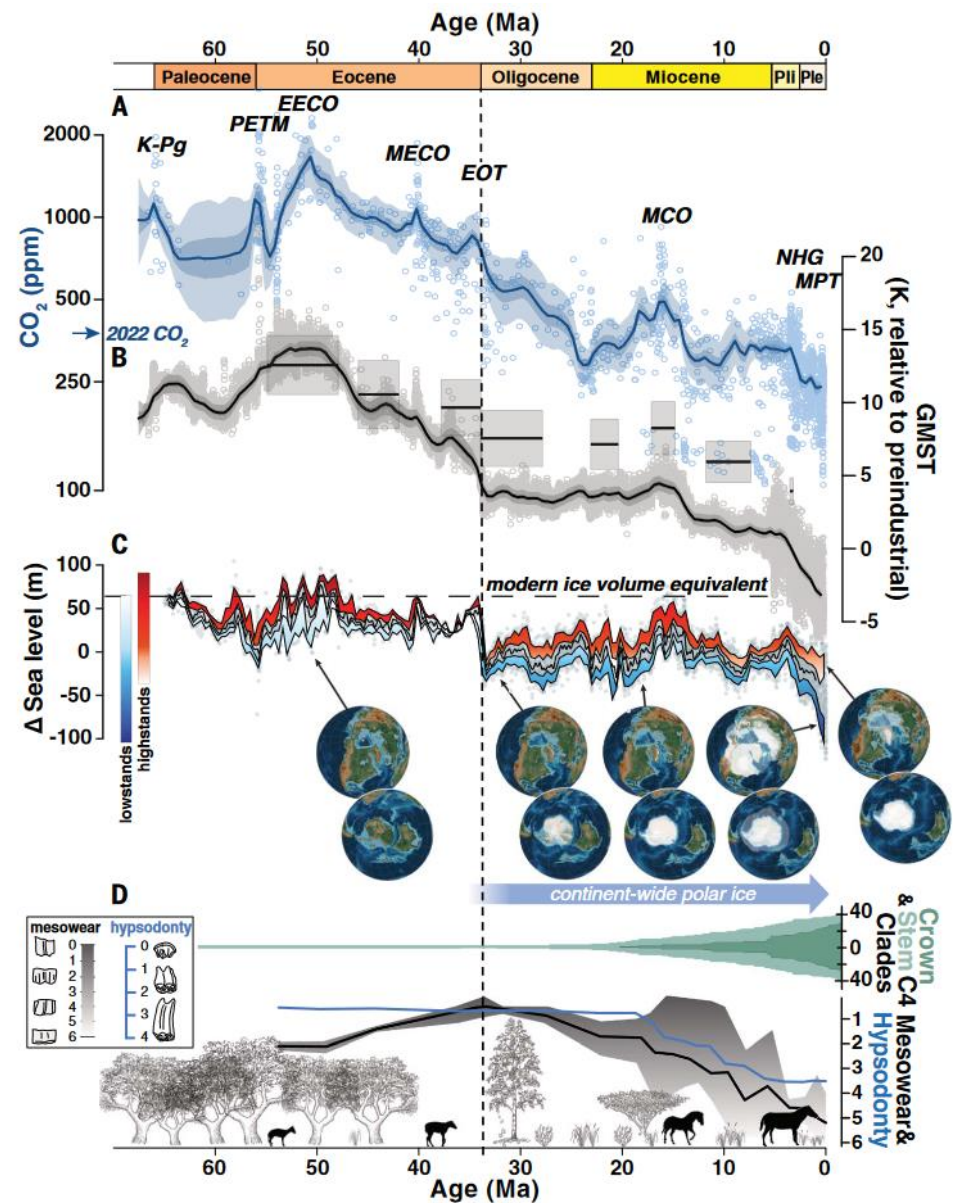
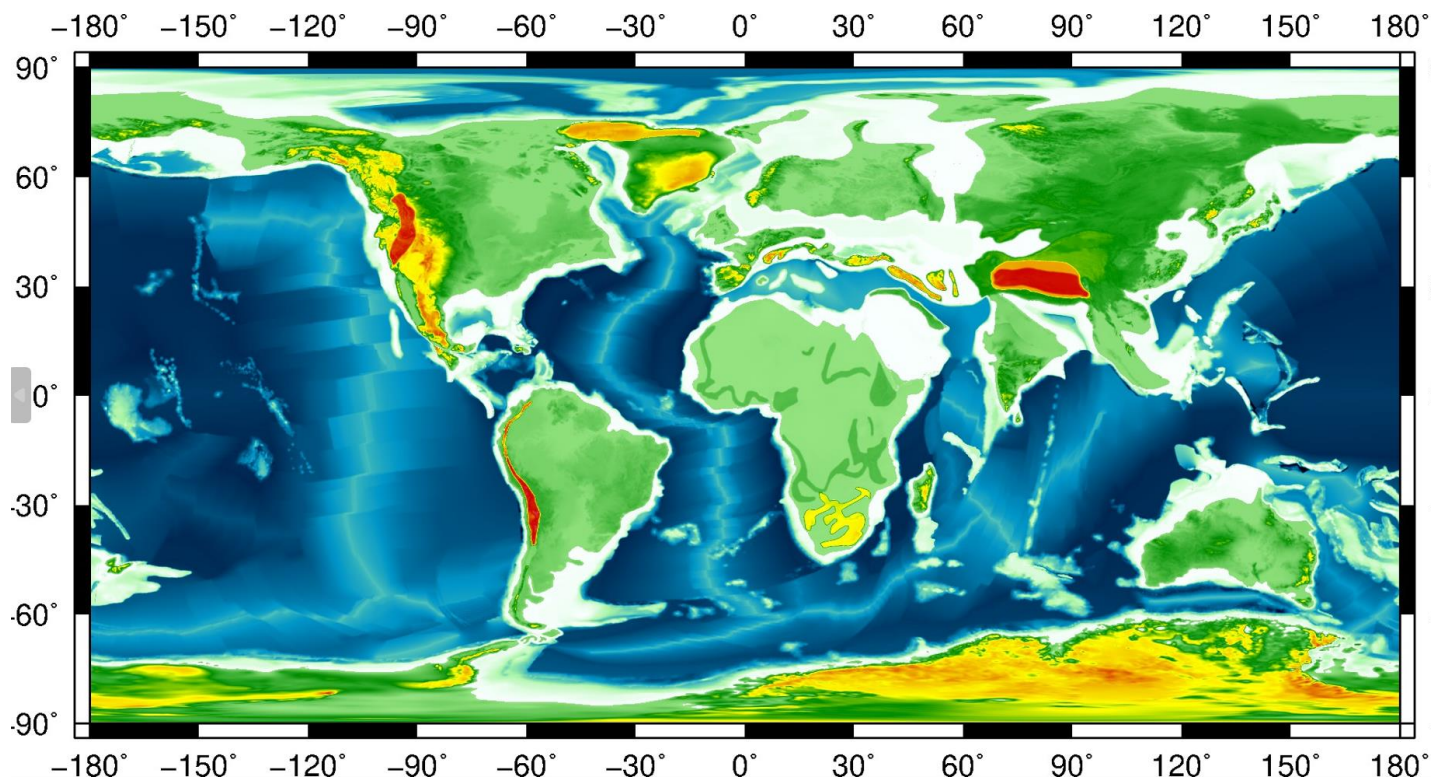


Emma FABRE : Thésarde au LSCE (1^{ère} année)

Impact des passages océaniques sur la circulation et le cycle du carbone lors de la transition Eocène-Oligocène

Thèse supervisée par Jean-Baptiste Ladant (LSCE), Pierre Sepulchre (LSCE) et Yannick Donnadieu (CEREGE)





Elsa Mohino:

- Associate Professor at Universidad Complutense Madrid
- Visiting LOCEAN for the entire term 2023-24

Main research interest:

- Tropical climate variability
- West African Monsoon
- Air-sea interactions

Interest on LMDZ model:

- Get to know better the model (already experience with analysis of outputs)
- Being able to run own sensitivity experiments on SST impacts (already experience with SPEEDY and UCLA models, and LMDZ many years ago)

Gaëlle de Coëtlogon : maître de conférence
Sorbonne Université au LATMOS-IPSL.



Thème de recherche : étude du couplage
océan-atmosphère en Atlantique Tropical
via des analyses statistiques ou la modélisation.

Intérêt pour cette formation LMDZ : je souhaite mettre en place une série
d'expériences pour tester la façon dont le modèle répond à des anomalies de
température de surface océanique prescrites à l'échelle intrasaisonnière.

Exemples :

- langue d'eau froide équatoriale => démarrage des précipitations côtières en juin le long de la côte nord du golfe de Guinée (Afrique de l'Ouest) ?
- émergence de l'upwelling côtier guinéen en juillet => arrêt des précipitations côtières (« petite saison sèche ») et « saut de mousson » ?
- influence de la température de surface en Atlantique Tropical Nord-Est sur la mousson d'été au Sahel occidental (juillet à septembre).

Adrien Martinez

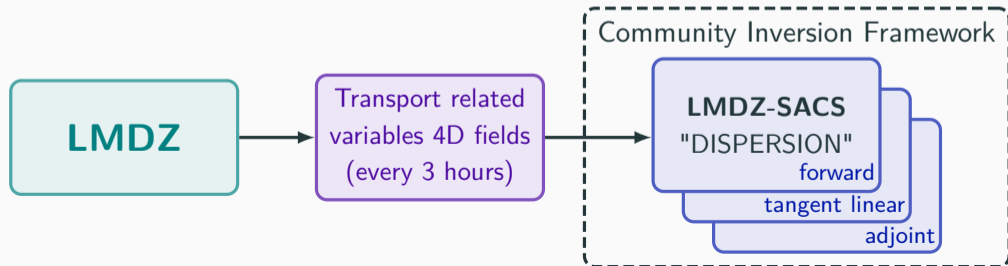
PhD Student

LSCE – Laboratoire des Sciences du Climat et de l'Environnement



I work with Marielle Saunois, Antoine Berchet and Frédéric Chevallier from LSCE's SATINV team.

My usage of LMDZ: Generating inputs for our “offline” CTM derived from LMDZ in order to perform **atmospheric inversions** of trace gas fluxes.





Alban Lhotte, PhD student of Camille Risi (LMD-Jussieu), 2nd year

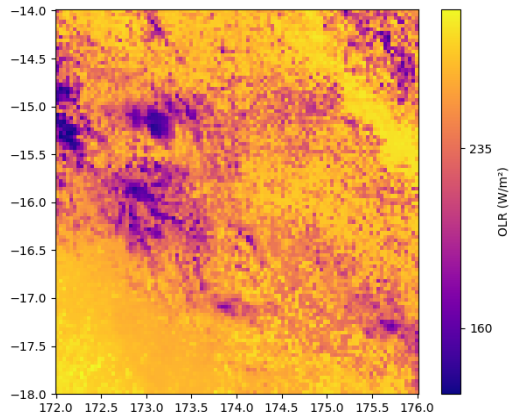


Topic : Impact of convective organization on tropospheric humidity: mechanisms and contributions

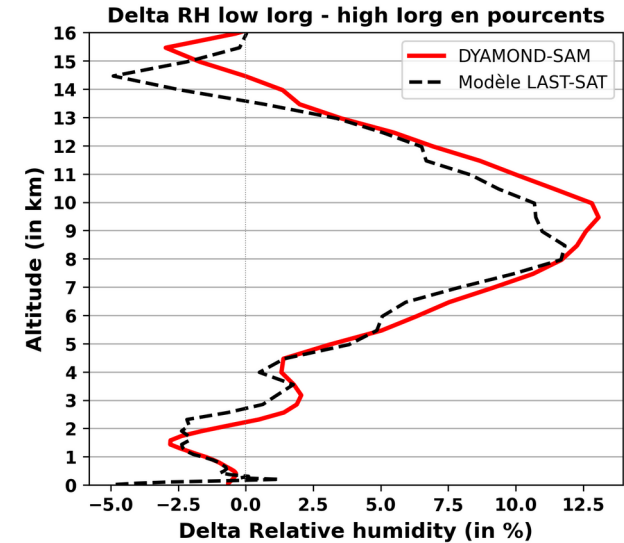
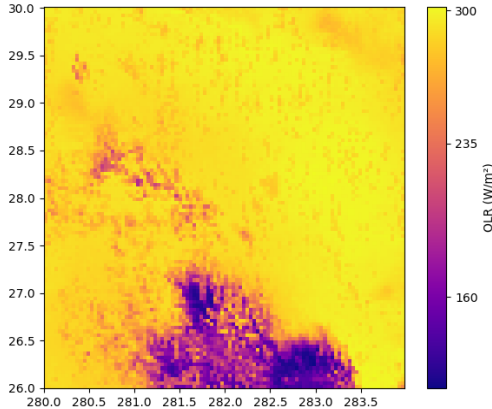
**SORBONNE
UNIVERSITÉ**

Goal : To reproduce the variation of relative humidity observed in DYAMOND-SAM simulation when I_{org} changes with Last-Saturation model

Disaggregated case (low I_{org})



Aggregated case (high I_{org})

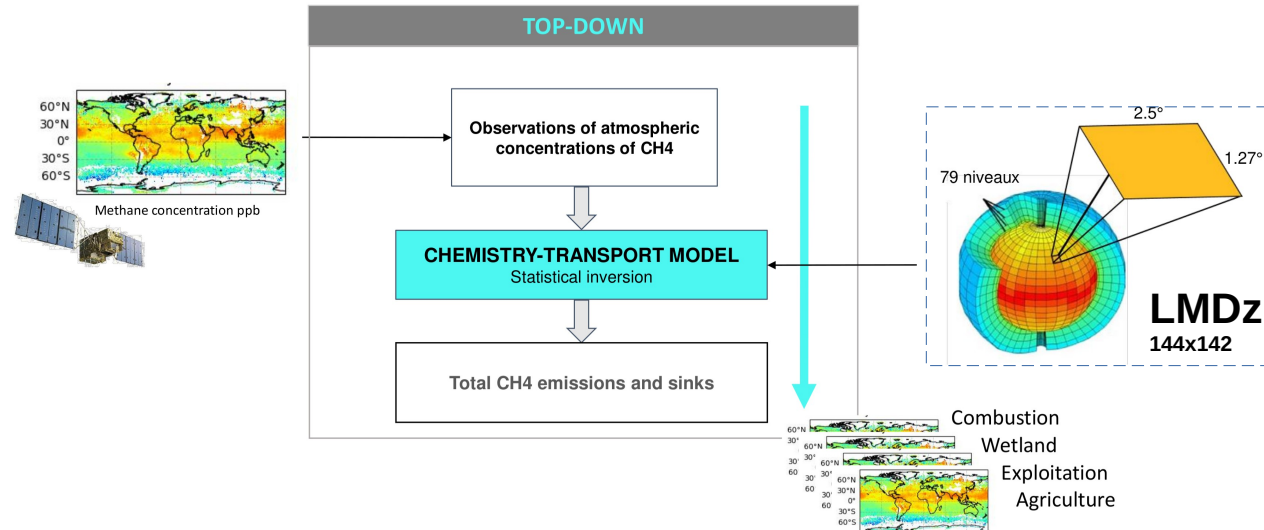


- ⇒ My Last-Saturation model can partially reproduce this delta RH with I_{org}
- ⇒ Is it relevant for LMDZ to represent this variation ? If yes, how define I_{org} with LMDZ and the impact on RH ?

Nicole Montenegro. PhD student in 2nd year at LSCE (Laboratoire des Sciences du Climat et de l'Environnement). SATINV Team (Modélisation INverse pour les mesures atmosphériques et SATellites).

Thesis supervisor: Marielle Saunois (UVSQ/LSCE) and Antoine Berchet (UVSQ/LSCE).

Thesis topic: Estimation of methane sources and sinks by assimilation of satellite data in an atmospheric inversion system





LSCE

Luis Olivera - PhD in land surface modeling (U. Toulouse III)

Post-doc at LSCE in the MOSAIC Team (Modélisation des Surfaces et Interfaces Continentales)

Supervisors: Catherine Ottlé & Philippe Peylin

Recent subject: Assimilation of Land Surface Temperature from satellite data into ORCHIDEE

Next subject: Assess the impact of land cover uncertainties on the surface-atmosphere transfers using the coupled ORCHIDEE-LMDZ model



IMT Mines Albi-Carmaux
École Mines-Télécom

Formation LMDZ

Simon Eibner

IMT Mines Albi, laboratoire RAPSODEE
9-11 janvier 2024

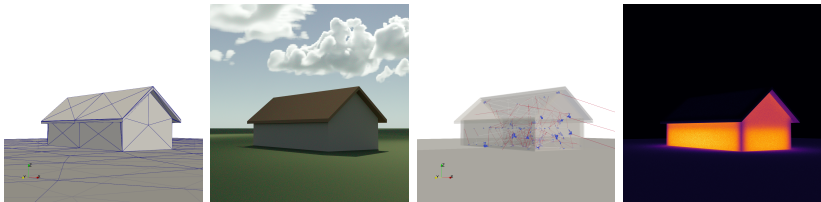


Figure – Thermique du bâtiment : 1) géométrie 2) rendu visible, 3) simulation thermique en chemins, 4) rendu infrarouge

- Code htrdr¹ : résolution de l'équation de transfert radiatif dans l'atmosphère
- Code stardis² : résolution de l'équation de la chaleur
- Couplage entre un GCM et la thermique du bâtiment ?

1. <https://www.meso-star.com/projects/htrdr/htrdr.html>

2. <https://www.meso-star.com/projects/stardis/stardis.html>

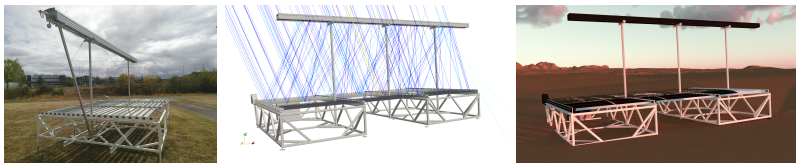


Figure – Concentrateur de Fresnel : 1) prototype (10m²) 2) calcul de la puissance reçue, 3) rendu visible

- Code htrdr³ : résolution de l'équation de transfert radiatif dans l'atmosphère
- Code solstice⁴ : calcul de la puissance reçue
- Couplage avec un GCM pour calculer le productible ?

3. <https://www.meso-star.com/projects/htrdr/htrdr.html>

4. <https://www.meso-star.com/projects/solstice/solstice.html>

Anni Määttänen

Directrice de recherche (CNRS) au LATMOS

Ma recherche passée en lien avec la formation:

- Modélisation des nuages dans les atmosphères planétaires (Mars, Vénus)
- Développement des modules microphysiques pour les Planetary Climate Models de l'IPSL (basés sur le LMDZ)
- Intérêt récent sur les processus stratosphériques terrestres

Mes projets LMDZ:

- Sujet de thèse sur l'impact des lancements de satellites et des réentrées de débris spatiaux dans l'atmosphère:
 - Utilisation du LMDZ pour modéliser le transport de la masse injectée par les activités spatiales, l'évolution des particules formées et leur impact sur la couche de particules strato
- Comparaison des modules microphysiques du LMDZ (StratAer) et du module nuages du PCM Vénus (MAD-VenLA): validation du MAD-VenLA
- Simulations des injections de soufre dans la stratosphère (géo-ingénierie solaire)



ALESSANDRA STOPPELLI

Who I am

- PhD student at LOCEAN (1st yr)
- Varclim team
- supervisor: Jérôme Vialard and Juliette Mignot

What I do

- Investigate tropical ocean heating patterns.
- Use LMDz to explore atmosphere–ocean interactions in the tropical Pacific.
- Analyze large–scale circulation dynamics, including cloud, radiation, and ocean processes.
- Assess model–observation discrepancies to improve future climate projections' credibility.

- Auguste GAUDIN
PhD student, LOCEAN
- Beyrem Jebri
Post Doc, LOCEAN
- Cesar Alberto Rosales-Alcantar
Postdoctoral Researcher, involved in some projects about inferring greenhouse gases sources and sinks in Latin America and Caribbean.
- Lei ZHU
PhD student in both Sorbonne and Tsinghua university. Land surface model developement in Amazon forest
- Gianluca Meneghello
Professor, ENS-PSL, Study high latitude boundary layers over the ocean
- Nathan Philippot
PhD student working on convection parametrization with sub-grid scale orography. Laboratories : CNRM and IGE
- Raj Rani
post-doctoral researcher
- Saurav Raj
PhD, IIT Delhi, India, Using AI/ML and LMDZ model for parameterization-related studies and improvement and other atmospheric processes