LMDZ Training December 2021

Who are you ?

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

Alizée CHEMISON
3rd year PhD
LSCE, CEA

Supervisors: Gilles Ramstein, Cyril Caminade

CLIMATIC INSTABILITY AND DISPLACEMENT OF INFECTIOUS VECTOR-BORNE DISEASES

GOAL: SIMULATION WITH LMDZ-ZOOM

For a higher resolution imaging at the impact of melting ice sheet on disease:

- Malaria in Asia
- Rift Valley Fever in Africa

Cycles du méthane et autres cycles connectés avec un GCM. Des observations de CASSINI à l'exploration de DRAGONFLY.

Bruno DE BATZ DE TRENQUELLEON
Doctorant au GSMA - Université de Reims Champagne-Ardenne

Sous la tutelle de P. Rannou (GSMA) & S. Lebonnois (LMD)

Parcours

→ *2015 - 2018 :* Licence de Physique Fondamentale (Univ. Paris-Saclay)

→ *2017 - 2020 :* Magistère de Physique Fondamentale (Univ. Paris-Saclay)

→ *2019 - 2020 :* Master A&A (Observatoire de Paris)

→ *2021 - 2024 :* Doctorat en planétologie (GSMA)

Intérêts

→ Doctorat sur la **microphysique** dans le **GCM** de **Titan** : *Planétologie, Titan, GCM, Microphysique, nuages, méthane*

→ Utilisation (et amélioration) du GCM-Titan développé au LMD *Insertion du modèle microphysique de nuages et des processus liés aux cycles du méthane (convection, interface surface / atmosphère, etc.)*

GSMA

UNIVERSITÉ DE REIMS CHAMPAGNE-ARDENNE
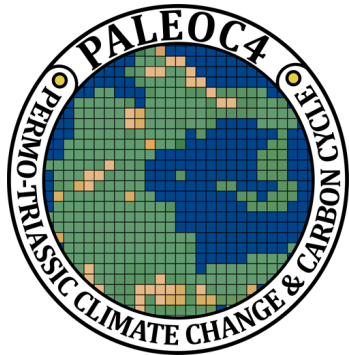
UNIVERSITÉ
DE GENÈVE

FACULTÉ DES SCIENCES
Département de physique appliquée

Maura Brunetti

Senior Research Scientist

Group of Applied Physics & Institute for Environmental Sciences

University of Geneva, Switzerland

My research interests:

Tipping points in the climate system:

- Regions of multistability in general circulation models (including ocean dynamics)
- Noise induced transitions between multiple steady states
- Effect of changing the external forcing (solar irradiance, CO_2 content…)

Applications:

- Simplified configurations (aquaplanet, simplified bathymetry…)
- Paleoclimate (Jurassic, Permian-Triassic boundary (PTB)…)
- Present-day climate on Earth
- Exoplanets

SNF Sinergia Project on PTB:
https://www.unige.ch/paleoc4/

Until now: **MITgcm** -> very good ocean dynamics

BUT 5-layer atmosphere with present-day chemical composition

Why LMDZ?

- Better description of atmospheric dynamics
- Possibility of changing atmospheric chemical composition

Noé CLÉMENT

PhD Student (2021-2024)
Laboratoire d'Astrophysique de Bordeaux
1st year

PhD subject : *Understanding the climate and storms on Uranus and Neptune*

Numerical modelling of atmospheres with a Mesoscale model, using LMDZ model for boundary conditions and other features...

Supervisor : Jérémy Leconte
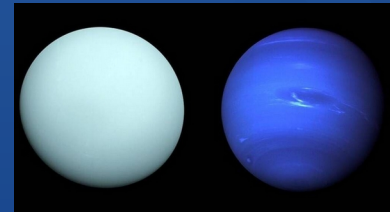
Clément Dehondt

- ✓ Etudiant à **CentraleSupélec**, actuellement en dernière année en spécialité **Efficacité Energétique.**

- ✓ Réalise une alternance avec **Jérôme Servonnat** sur la comparaison intermodèles et les biais.

- ✓ S'intéresse à LMDZ afin de comprendre plus finement la **modélisation atmosphérique, sa paramétrisation physique et les biais** qui peuvent en découler. Le graal de mon alternance serait d'expliquer physiquement les biais des modèles et d'apporter d'éventuelles corrections en les justifiant.

PDF

CV_Dehondt_Clement

CentraleSupélec

LA FRESQUE DU CL!MAT

LSCE

Diane Segalla

PhD Student with Gilles Ramstein at LSCE, CLIM team, subject of the thesis : Cryosphere-climate interaction in a warmer world with pCO2 concentrations. Analysis of the Antarctica's dynamic and feedbacks.

Already participated at this lesson last year but don't have the time to use LMDZ yet so a little refresh is necessary. I will run some simulations next year and work with an ice sheet model at the same time.
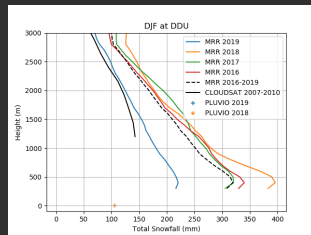
The water and atmosphere above the Antarctic ice sheet

LMD

- What ? Precipitations and clouds
- Where ? Antarctica
- How ? Simulations for synoptic meteorology and climate study (evaluations/observations + parametrisations)
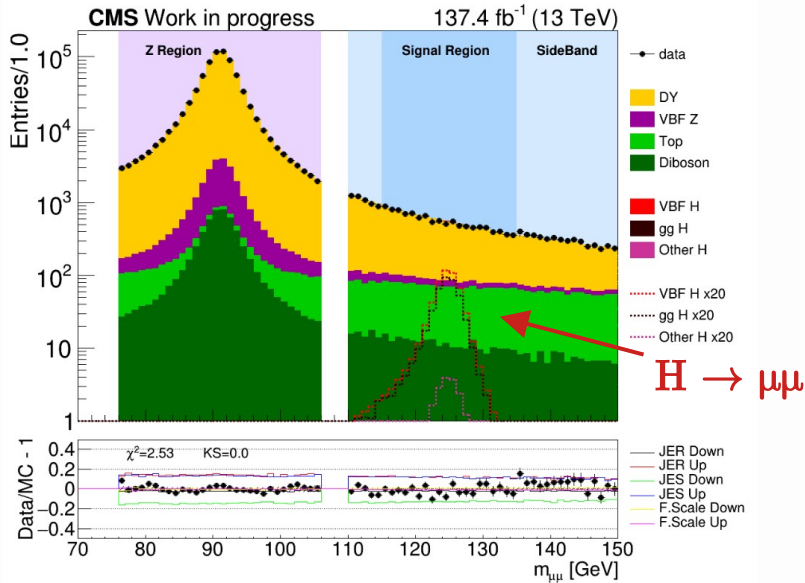
PhD student


★ Total snowfall during DJF at DDU (mm)

Before LMD	At LMD

Before LMD

PhD: "Search for the Higgs boson decaying into two muons with the CMS experiment"

• Search of H → μμ with CMS at LHC

• 4 Higgs production channels combined

• ML techniques to reduce the background
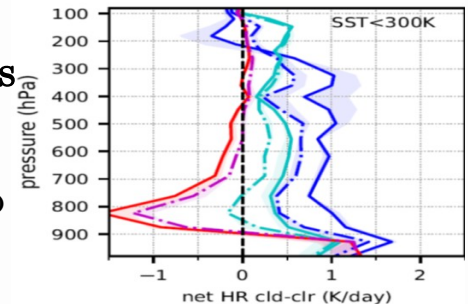
• excess of 3 std wrt the background

At LMD

- Rain Rate indicator from ML in the tropical region.
- Organization of rain studied in detail in the period 2007-2018 with AIRS and IASI data.
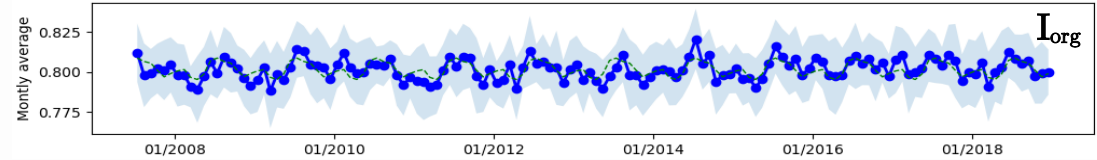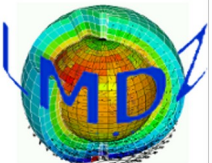

Cloud vertical structure from cloud and atmospheric properties

Heating rate profile from CALIPSO-CloudSat extended to the entire tropics trought DNN

Quantification of the climate system dynamical response to atmospheric heating.

- Forcing the climate system with the 3D atmospheric heating / cooling

- response of the atmospheric circulation

Habitability of planets in the light of climate multistability

Siddharth Bhatnagar[1,2], Emeline Bolmont[1], Maura Brunetti[2], Jerome Kasparian[2]
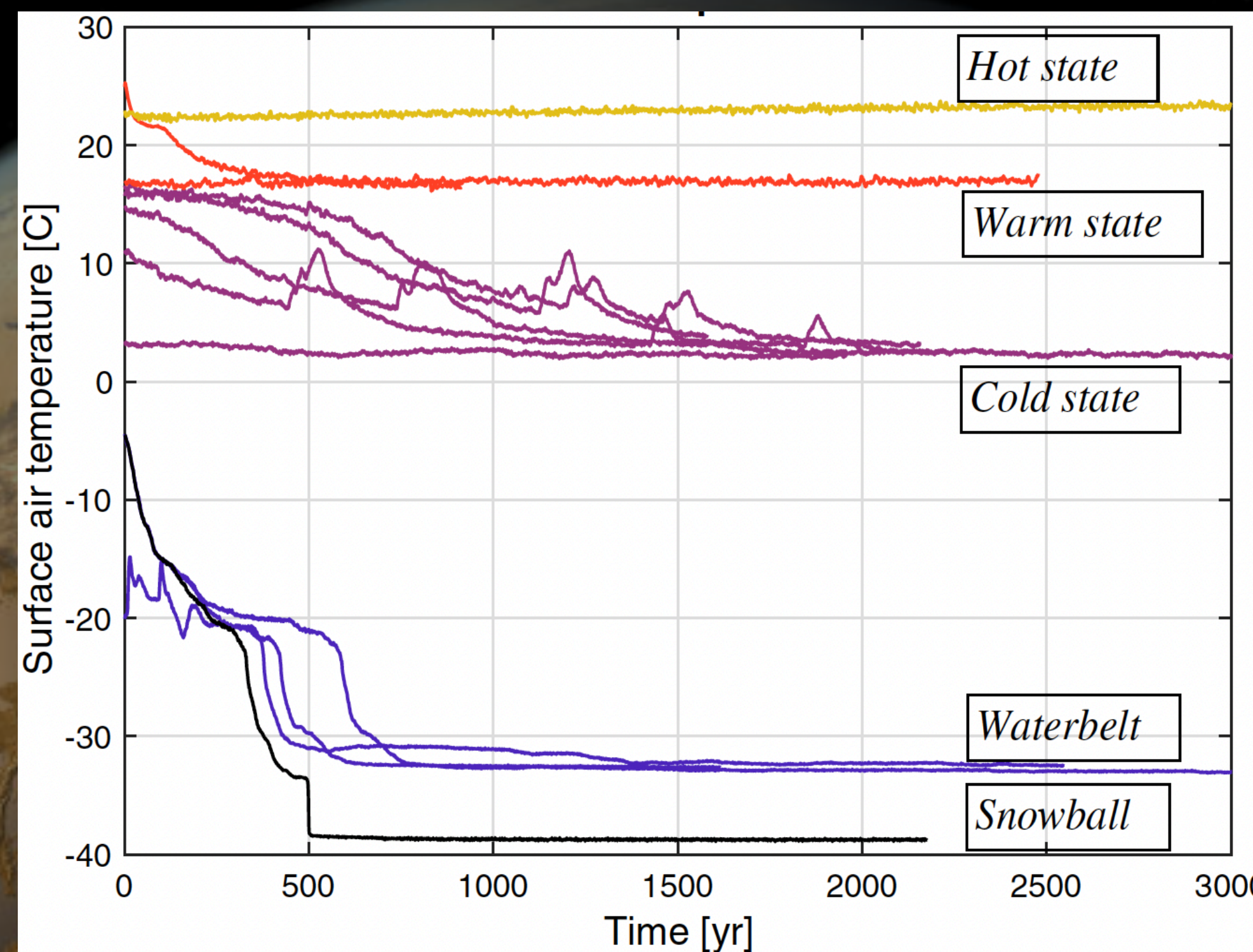[1] Department of Astronomy, University of Geneva, Switzerland
[2] Group of Applied Physics and Institute for Environmental Sciences, University of Geneva, Switzerland
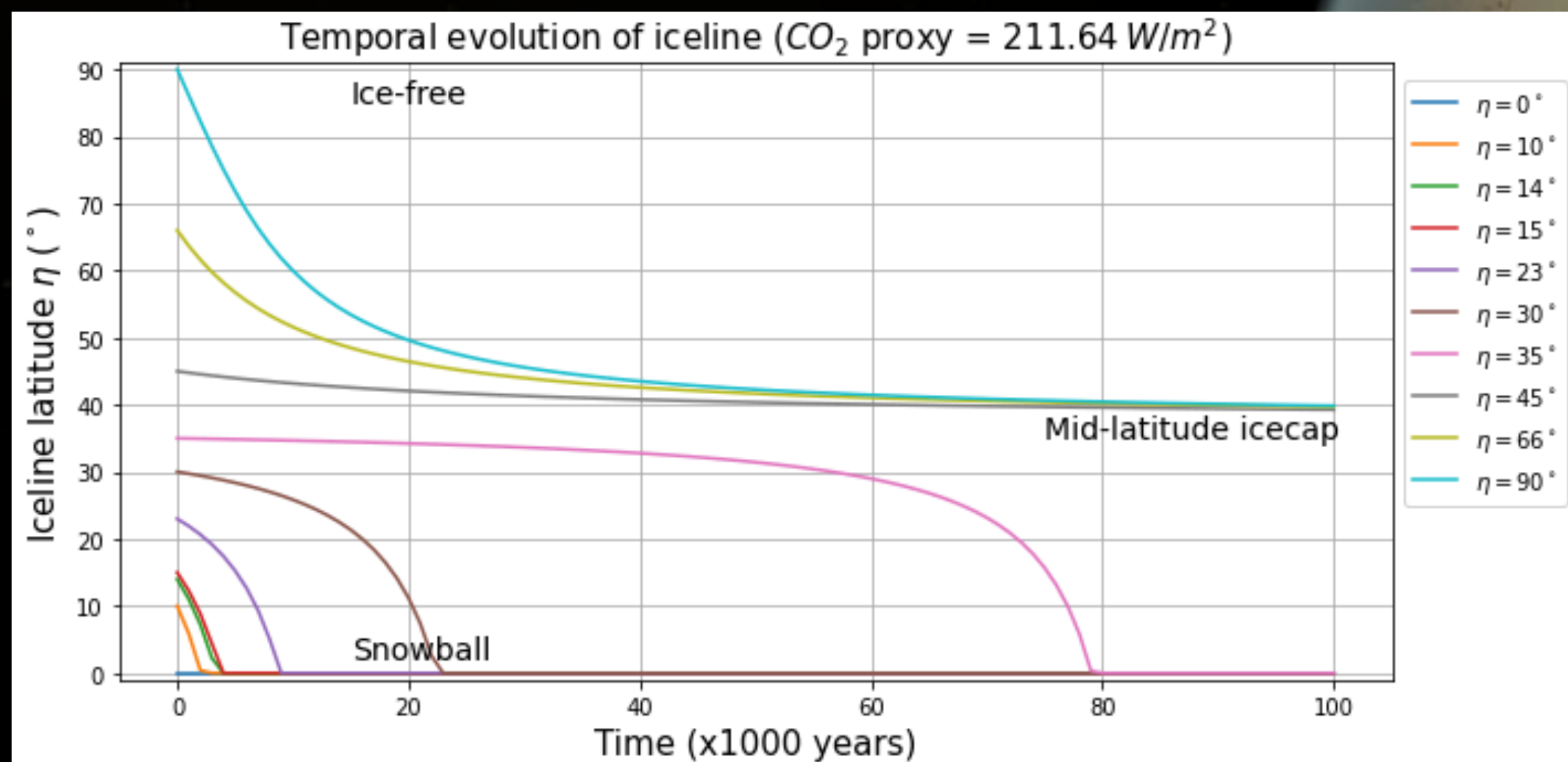
The Big Picture

- Investigating **MULTISTABLE states** (same external forcing, *slightly* different initial conditions)
- Assessing MULTISTABILITY with **different external forcing**
- Defining an **extended habitable zone**

3-D GCM **?**
1-D EBM ✓

Extended temperature range

Hot state
Warm state
Cold state
Waterbelt
Snowball

Brunetti et al. 2019 (uses the MITgcm)

Temporal evolution of iceline (CO_2 proxy = 211.64 W/m^2)

Ice-free

$\eta = 0°$
$\eta = 10°$
$\eta = 14°$
$\eta = 15°$
$\eta = 23°$
$\eta = 30°$
$\eta = 35°$
$\eta = 45°$
$\eta = 66°$
$\eta = 90°$

Mid-latitude icecap

Snowball

The Budyko-Widiasih model (a 1-D EBM)

Why MULTISTABILITY?

- **Earth's climate** features *multiple* MULTISTABLE sub-systems
- **Strongly impacts life**
- Interpretation for **mass extinctions**

Why LMDZ?

- Excellent Earth-centric model (good baseline)
- **Earth as an exoplanet**
- Flexibility - running on personal computers/clusters

Abhishek JK- LMDZ training slide

- Name: Abhishek JK

- Job: Payload Scientist

- Institution: Vikram Sarabhai Space Centre(VSSC), ISRO(https://www.vssc.gov.in/scientificPayloads.html)

- LMDZ project- Understand Sputtered Escape on Mars using LMD-MGCM. I hope this LMDZ training session will help me understand the LMD model framework so that I can use MGCM in the future.

Patryk Kiepas, Research Engineer in the Project AWACA

- In the project since October 2021
- PhD in Compilation and Programming Languages
- New to the Climate Modelling and Simulation
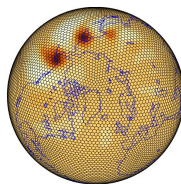
- **AWACA** = Atmospheric Water Cycle over Antarctica
- **Main project goal**: improve the understanding of the Antarctic water cycle
- **LMDZ goal**: coupling LMDZ with MAR (regional atmospheric model) and DYNAMICO (massively-parallel fluid solver)
- **Other goals**: understand how LMDZ works and how model configurations are prepared and managed

Pascal Rannou (GSMA – Université de Reims Champagne-Ardenne)

→ Sciences planétaires : Titan, Mars, Pluton, Géantes glacées

→ Microphysique (aérosols/nuages)

  + Transfert radiatif

→ Utilisation des GCM du LMD :

  1997-2010 : Version 2D du GCM Titan
(insertion μ-physique + optique)

  2010-2020 : GCM 3D •
Développement μ-physique en moments
insertion du modèle d'aérosols

  2021-2024 : GCM 3D • insertion du modèle de
nuages + processus afférent aux cycles du méthane

  2023-2025 : GCM 3D Transfert radiatif 3D
sphérique/inhomogène (WP3 ANR Rad³-Net)

→ Enseignant-chercheur

→ Parcours

1992-1993 : DEA Océanologie,
Météorologie, Env., U. Paris 6

1993-1996 : Doctorat au Service
d'Aéronomie, U. Paris 6

1996-1997 : Post-doc NASA Ames

1997-2007 : Service d'Aéronomie,
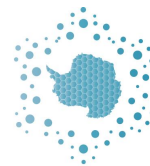UVSQ

2007-2021 : GSMA, U. Reims

• J. Burgalat
J. Vatant d'Ollone

• B. de Batz de Tranquélléon

Valentin WIENER

Doctorant 1ère année au LMD avec Christophe Genthon

AWACA
Atmospheric WAter Cycle over Antarctica
past, present & future

❄️ Instrumentation et Modélisation de la météorologie de surface en Antarctique

❄️ Etude de la turbulence atmosphérique et de la neige soufflée par le vent dans LDMZ

❄️ Zoom, guidage, comparaison aux observations, études de sensibilité

❄️ Couplage avec SISVAT ou développement de paramétrisation

❄️ Utilisation de Dynamico

~23 km² en 64x64x95

$\sqrt{Aire}$ (km)
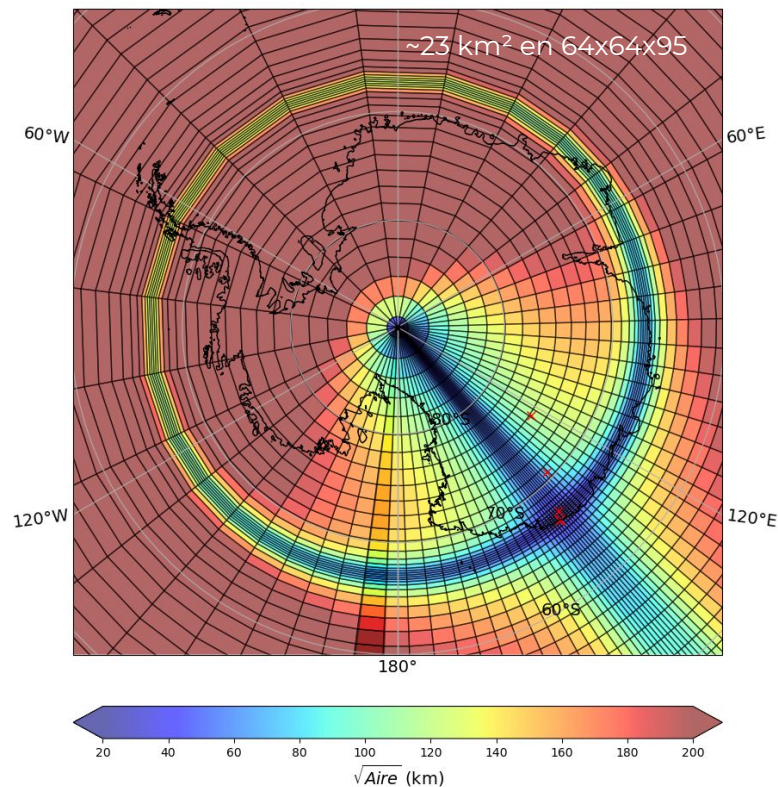
Lucas Teinturier

- French Engineer (Ecole Centrale de Lyon, Ecole CentraleSupelec)
- Master degree in Applied Physics and Optics (Université de Lorraine)

- Internship at LATMOS (1/2) : Modeled the Martian CO_2 ice clouds during the polar nights with LMDZ GCM.
- Internship at LATMOS (2/2) : Helped with the data analysis of the TGO-ACS spectrometer of the Mars 2016 Mission.

Now : 1st year PhD student at LESIA : *3D modelling of the atmospheres of hot exoplanets and brown dwarfs*
-> LMDZ GENERIC
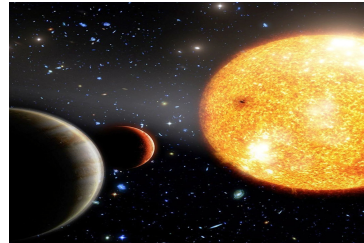
- Internship at McGill Space Institute : Developed a framework/method to map the surface albedo of rocky, partially cloudy exoplanets
- Internship at IAP : Modeled the atmosphere of L/T transitioning Brown Dwarfs using data from the Hubble Space Telescope.

PRÉSENTATION PARTICIPANT / FORMATION LMDZ 2021

Prénoms : Mamadou Lamine
Nom : THIAM

Master 2 de recherche en Météorologie Océanographie et Gestion des Milieux Arides (MOGMA) obtenu au LPAOSF.

Doctorant en 1ère année au Labortaoire de Physique de l'Atmosphère et de l'Océan Siméon Fongang (LPAOSF/Université de Dakar) et au Laboratoire de Météorologie Dynamique (LMD/SU)

Thématique de recherche :

Modélisation des émissions de poussières en interaction avec le climat ouest-africain

Utilisation LMDZ

- Améliorer la représentation des poches froides dans le modèle LMDZ et leur prise en compte dans les soulèvement de poussières en Afrique de l'Ouest
- Réaliser des simulations de poussières à l'aide du modèle pour des études d'impact sur la qualité de l'air en Afrique de l'Ouest.

Name: Di WANG

Ph.D student in co- culture by LMD and Institute of International River and Eco-Security, Yunnan University

Stable isotopic signals preserved in natural precipitation archives, such as ice cores, provide information on past climatic changes. When measured in the water vapor, water isotopes bear information on large-scale transport, convective and cloud processes. We made in-situ observation of the vertical profiles of atmosphere vapor isotopes up to the upper troposphere (from the ground surface at 3856m up to 11000m a.s.l.) by implementing specially-designed unmanned-aerial-vehicle system during pre-monsoon, monsoon and post-monsoon periods in the southeast Tibetan Plateau. We plan to compare our observations and simulations of LMDZ. If LMDZ can capture the observed characteristic of isotopes, the analysis in more detail will help a better understanding of the physical processes controlling the vertical distribution of vapor isotopes, including large-scale transport, microphysical processes, and convective mixing.

⇒ Thèse : Couche limite atmosphérique et ondes orographiques.
(Encadrée par François Lott)

Ondes piégées
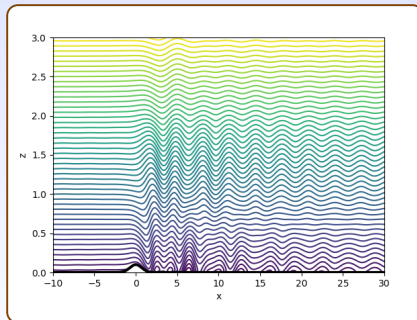
Flottabilité

Ségolène CROSSOUARD

Pré-doc IPSL d'octobre à décembre 2021
Thèse au LSCE à partir de janvier 2022

Titre :
Machine Learning pour la modélisation du climat : potentiel et écueils

Directrice :
Masa KAGEYAMA - LSCE

Co-directeurs :
Thomas DUBOS - LMD
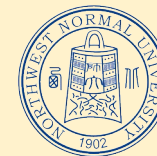Mathieu VRAC - LSCE

LMDZ au coeur de ma thèse :
Utilisation des résultats obtenus via le modèle de circulation générale atmosphérique pour y appliquer des méthodes d'apprentissage automatique

Shengjie WANG

Associate Professor, Dr.
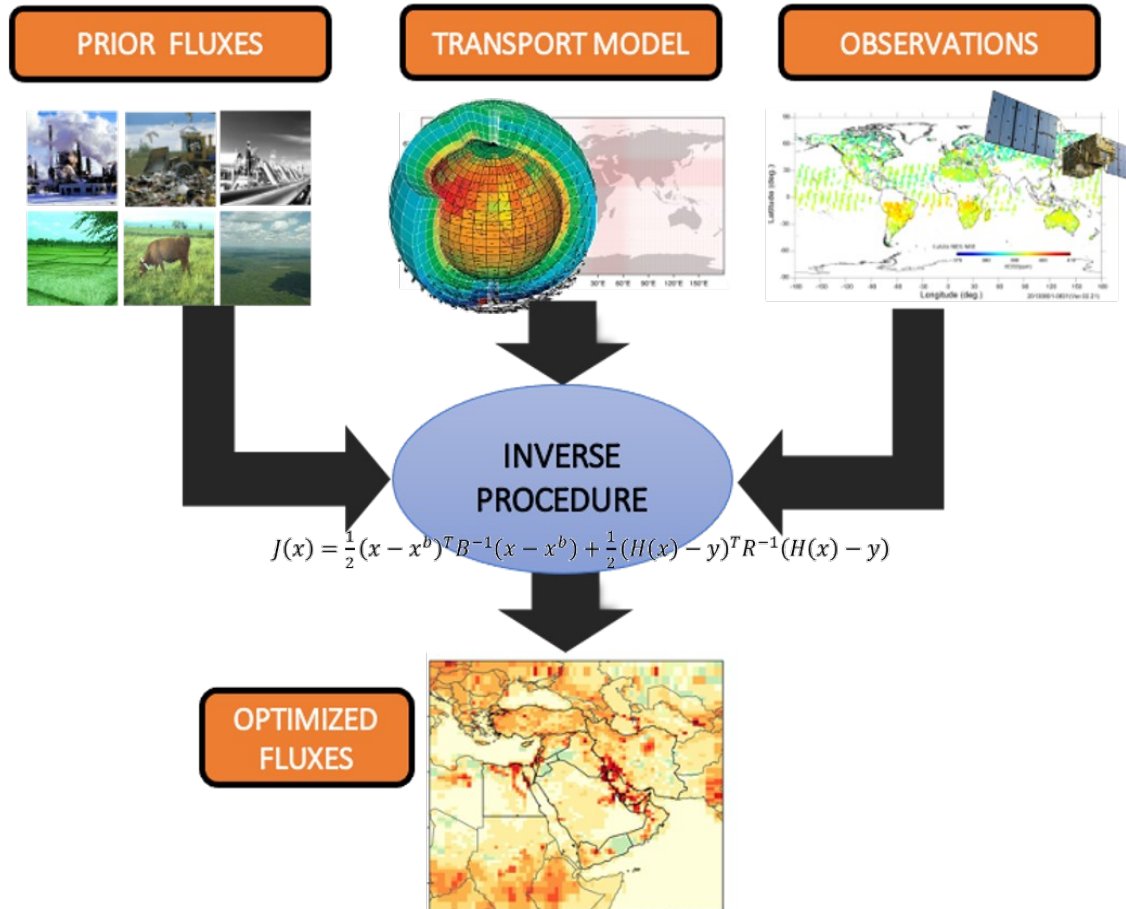College of Geography and Environmental Science,
Northwest Normal University
Lanzhou, China

Research interests:
Stable water isotopes (^{18}O and ^{2}H) in arid central Asia: climatology and hydrology

LMDZ projects:
Stable isotopes in precipitation and water vapor using isotope-enabled LMDZ

- Xin Lin, PhD

- Postdoc at LSCE

- Research area
  - Global and regional greenhouse gas budget estimates based on atmospheric-based approach

- Project
  - Inverse modeling of CH_4 fluxes over Eastern Mediterranean and Middle East

- How do I use LMDZ
  - Online simulation of mass fluxes with zoom configurations
  - Offline tracer transport in the inverse system

- Why do I join the training
  - Improve understanding of the model in both theoretical and practical ways
  - Follow recent model development

GENERAL INFORMATION
 Name: Vinita Deshmukh
 DOB: 5th March 1998
 Nationality: Indian
 Phone: +91 7276451080 / +33-754501550

PhD on Precursors and dynamics of atmospheric blocking leading to European temperature extremes (Ecole Normale Supérieure)   October 2021 (In progress)

- within the European project EDIPI (European weather Extremes: Drivers, Predictability and Impacts). EU-Research Framework- H2020 / Marie Skłodowska-Curie Actions. (https://edipi-itn.eu/).
- Work: Laboratoire de Météorologie Dynamique (LMD, Paris, France) which depends on CNRS, Ecole Normale Supérieure (ENS), Paris Sciences Lettres (PSL) university, Ecole Polytechnique, and Sorbonne Universités.

Project Abstract: The project under the supervision of **Dr. Gwendal Rivière from LMD and Dr. Sébastien Fromang from LSCE.**

- Investigating the dynamics and medium-range predictability (up to ~15 days) of atmospheric blocking and explain the existence of preferred paths toward blocking, which often leads to European winter cold spells and summer heat waves.
- With the use of the IPSL model DYNAMICO-LMDZ. I will initially consider the dry version of DYNAMICO and will analyses a long-term (~100 years) simulation in which the model forcing is designed to obtain a realistic climatology for a given season (perpetual winter and perpetual summer simulations will be considered). Statistics of blockings and weather regimes will be provided and compared to re-analysis datasets. Preferred transitions toward and from the blocking regime will be more specifically investigated.
- In order to investigate synoptic and large-scale precursors of these transitions, the PhD student will detect all the large-scale circulation analogues of blocking onsets in the long-term reference simulation.
- In order to investigate synoptic and large-scale precursors of these transitions, I will detect all the large-scale circulation analogues of blocking onsets in the long-term reference simulation. To better understand why some large-scale analogues do not lead to blocking, many short-term sensitivity experiments will be performed by initializing the model with various combinations of these large-scale analogues and synoptic disturbances.

Completed Master's from Dept. of Atmospheric & Space Sciences, Savitribai Phule Pune University (SPPU)

June 2019 – June 2021

Master's in Atmospheric science - Secured **8.85 GPA**

Studied subjects like Physical Meteorology, Atmospheric Dynamics, Cloud Physics & Atmospheric Electricity, Thermodynamics and Radiation, Oceanography, Satellite and Radar Meteorology, Space weather, Planetary Boundary Layer Meteorology, Numerical Weather Prediction, Mesoscale-Modelling (WRF), Climate Physics and Modelling Basics.

- **Cassien Diabe Ndiaye, doctorant, LOCEAN,**
  Improve my knowledge on climate models for my projection after my phd.

- **Cedric Langue, doctorant, LATMOS,**
  I am working on meteorological extreme events over West Africa.

- **Cong Sun, doctorant, USTC, China,**
  Mars climate long trend simulation

- **Huawu Wu, researcher, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences**
  Use of LMDZ-iso model to explore the hydrometeorological processes on water isotopes, and identify the interaction between surface and atmoshpere.

- **Javier Ramírez, researcher, Universidad de Chile**
  Really interested to improve my knowledge in LMDZ to develop research in Change Climate and Inversion Framework

- **Jhaswantsing Purseed, postdoc, IPSL,**

- **Jiandong Liu, post-doc, LMD,**
  To compare with MAVEN observations

- **Jie Zhang, researcher,**
  planetary atmospheres, to verify my findings of vertical coupling in Mars.

- **Morgane Lalonde-Le Pajolec, doctorante, IPSL (METIS and LATMOS),**
  Impact de l'urbanisation et du changement climatique sur l'hydrologie de différents bassins versants
  .

.
- **Neha Gupta, doctorant,**
  study sputtering in Mars atmosphere using LMD-GCM

- **Padraig Donnelly, post-doc, LMD,**
  general interest as my work focuses on the outputs of DYNAMICO for Saturn and Jupiter

- **Rémi Gaillard, doctorant, Laboratoire de Géologie de l'ENS**
  I work on the role of permafrost in carbon-climate feedbacks using coupled atmosphere - surface - ocean simulations. I will couple ORCHIDEE with permafrost activated (physical and carbon processes) to the other parts of the IPSL model, among which LMDZ. Surface processes are coupled to the atmosphere and I need to better know LMDZ in order to understand how the coupled model behaves at the interface.

- **Rodrigo San Martin, doctorant, LSCE**
  simulations couplees Orchidee-LMDZ avec des configurations differents (test avec différentes cartes des PFTs construites à partir des produits de couverture de surface à plus haute résolution - 10m au lieu de 300m - et un possible essai de tourner ORCHIDEE-LMDZ avec le module SPITFIRE qui simule les incendies à la fin de ma thèse)

- **Xiaoni Wang, Ingénieure de Recherche, LSCE**
  Travaille sur ORCHIDEE. Je serai intéressée par le couplage LMDZ et ORCHIDEE, et aussi le tuning des paramètres

- **Yang SU, post-doc, INRAE,**
  uses OCHIDEE model, and wish to learning more about LMDZ model

- **Yitong Yao, doctorant, LSCE,**
  PhD student (research topic: modeling plant hydraulics with ORCHIDEE)