

# Curriculum vitae

**Francois FORGET**

*CNRS Planetary Scientist*

- Laboratoire de Météorologie Dynamique, Institut Pierre Simon Laplace,  
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- **Employment**

- **Since 2016:** Deputy Director of the Laboratoire de Météorologie Dynamique (LMD).
- **Since 2010:** Research Director at **CNRS** .
- **2004-2005:** Researcher at **NASA** Ames Research Center, California, USA.
- **1998-2010:** Scientist at CNRS, LMD.
- **1996-1998:** CNES (French Space Agency) post-doctoral fellow.
- **1993-1996:** PhD student at LMD, University of Paris 6.
- **1992-1993:** NASA (Ames Res. Center ). CNES engineer on the “Mars Balloon” project.
- **1991-1992:** Offshore engineer (La Défense). Submarine pipelines.

- **Education**

- **2007:** Habilitation (“Habilitation a diriger les recherches”) University Pierre et Marie Curie, Paris.
- **1996:** **PhD**, Université Pierre & Marie Curie.
- **1991:** **DEA** "Oceanology, meteorology and environment" at the University of Paris 6.
- **1988-1991:** Engineer, “Grande Ecole” ENSTA (National College for Advanced Technologies).

- **Honors**

- **2022:** CNRS Silver Medal
- **2019:** ERC Laureate, project *Mars through Time* (Advanced Grant, European Research Council)
- **2017:** Elected to the French Academy of Sciences.
- **2014:** *David Bates Medal* (EGU) “for exceptional contributions to planetary and solar system sciences”.
- **2007:** Award: *Fondation del Duca* (Institut de France).
- **2002:** *Zeldovich Medal* , Committee on Space Research (COSPAR)
- **2001:** CNRS Bronze Medal

**For supervised PhD students:**

- **2020 :** Best PhD thesis of the SFE ( *French Society of Exobiology* ) for **Martin Turbet**
- **2019 :** Best PhD thesis of the SF2A ( *French Society of Astronomy and Astrophysics* ) for **Martin Turbet**, also accessit of the Daniel Guinier prize of the SFP ( *French Society of Physics* )
- **2018 :** PhD Thesis prize from the Chancellery of the Universities of Paris ( “*Aguirre-Basualdo*” prize in *material sciences, physics, chemistry, sciences of the universe, technology* ) for **Tanguy Bertrand**.
- **2015 :** Best PhD thesis, *National Committee. French from Geophys. and Geodesy* (CFNGG) for **B. Charnay**
- **2009:** EADS Prize for the best PhD thesis in “Earth, Space and Universe” for **Aymeric Spiga**.

- **Management and Service to the Community**

**Management and advisory activities.**

- **2016 - present:** **Deputy Director**, Laboratoire de Météorologie Dynamique ( in charge of the Jussieu site ).
- **2018 - present :** Member of the Paris Observatory *High Scientific Committee* (HCS).
- **2009 - 2017:** Head of the *Solar System division* of the Pierre Simon Laplace Institute (140 researchers and engineers). Member of the Board of Directors of IPSL

- **2003-2017 : Creator and leader of the “ Planetology ”** team of the Laboratoire de Météorologie Dynamique (15 to 20 researchers and engineers)

## Space Program:

- **2019-2024:** Member of the *Scientific Programs Committee ( CPS )* of CNES: Advisory activities and evaluation of scientific programs in Earth, Universe, Life and Materials Science.
- **2021:** Editor of the column "*The french government should not turn away from space research under the pretext of promoting industrial innovation* " published in *Le Monde* on December 28, 2021, co-signed by 3 Nobel Prizes and 5 CNRS Gold Medals. [https://web.lmd.jussieu.fr/~forget/recherche\\_spatiale](https://web.lmd.jussieu.fr/~forget/recherche_spatiale)
- **2014-2017:** Member of the *ESA Space Science Advisory Committee ( SSAC )*: Advisory activities and evaluation for the ESA scientific program (solar system, astrophysics, fundamental physics).
- **2017-2020: Scientific representative in CNES-ISRO** negotiations (Indian Space Agency). Mission to Bangalore in February 2017 & regular videoconferences.
- **2009-2010:** Member of the "NASA/National Academy of Science *Planetary Science Decadal Survey* " (Panels defining NASA's exploration strategy for 2013-2022; 3 non-American members out of 77).
- **2007-2010:** Member of the Scientific Council, *International Space Science Institute ( ISSI , Bern)*.
- **2008-2009:** Member of the *NASA Mars Architecture Tiger Team* (a team of 16 experts who met three times to define the “NASA Mars program” then in crisis. The only non-American).
- **2004-2006:** Member of the *Solar System Working Group* of the European Space Agency
- **2001-2004:** Member of the *CNES Solar System Group* .

## Teaching Editing & Conferences organization (selection) :

- **2003-present:** Co-founder of *Master 2 Planetology and Space Exploration* . Head of the UE10 teaching unit “Climate systems and evolution of planetary surfaces” (30h).
- **2011-2017: Associate Editor** of the *Journal of Geophysical Research - Planet* .
- **2003-present:** Creator and organizer of the series of **international conferences “Mars atmosphere modeling and observation ”**. <http://www-mars.lmd.jussieu.fr/marsconf> . 200 participants at the last edition in Paris (June 2022). Previously: 2003 and 2006 in Granada (Spain), 2008 in Williamsburg (USA), 2011 in Paris (France), 2014 in Oxford (UK), 2017 in Granada.

## • Summary of research activities and publications

- François Forget has created a research team around the development of 3D numerical models of the climate systems of other planets (solar system and exoplanets). The scientific applications are countless. The results of these reference models are used by hundreds of teams around the world. They can also be used to test and improve the terrestrial models used to understand climate change. On this basis, F. Forget has been involved in space exploration, observation analysis and instrumental development .
- **Author or co-author** of
  - 310 refereed articles (including 11 *Nature* , 9 *Science* , 10 *Nature xx* ) . h-index 70 (NASA ADS, 04/2023)
  - 3 books and 20 book chapters.
  - 84 guest lectures at international congresses.
- **Space mission science teams membership:** *Mars Express* (ESA), *Mars Reconnaissance Orbiter* (NASA), *New Horizons* (to Pluto, NASA), *Exomars 2016* (ESA, Roscosmos), *Insight* (to Mars, NASA), *Hope* (to Mars, United Arab Emirates), *Exomars 2022* (ESA-Roscosmos), *DAVINCI* (towards Venus, NASA). **Field research in Antarctica** .
- Numerous activities in **scientific outreach** (books, popular articles, conferences for the general public, exhibitions, TV documentaries, podcasts, media interviews).

# Activities

## 1) Modeling of planetary climates

### • Mars :

**Development of the LMD Global Martian climate model (GCM)** which has become the world reference, developed by several teams in Europe, the USA, China, Israel, and supported by ESA and CNES.

The model reference paper ( *Forget et al. 1999* ) is the fourth most-cited paper in the history of the *Journal of Geophysical Research-Planet* (840 citations in April 2023)

#### Current climate :

- Responsibility for the ***Mars Climate Database project: Reference tool based on GCM outputs used for the design of most missions to Mars and the analysis of their observations*** . Web version at <http://www/mars.lmd.jussieu.fr/> . Pro version delivered to more than 600 teams in 27 countries. Many studies on the planet Mars and its climate use these simulations (an automatic online search finds ~700 articles citing the *Mars Climate Database* in their abstract or acknowledgments).
- Study and simulation of the **martian dust, water, CO<sub>2</sub> cycles**, key to the climate on Mars.
- **Meso and micro-scale (LES)** atmospheric models ( *Spiga and Forget, 2009*, many publications since)
- Development of the first coupled Martian **atmosphere-thermosphere model** (with M. Angelats i Coll, F. Gonzalez-Galindo and J-Y. Chaufray, postdocs at LMD).
- **3D photochemical** model of the Martian atmosphere (project led by F. Lefevre, LATMOS). Investigation of the Martian atmospheric methane enigma ( *Lefevre and Forget, Nature 2009* ), one of the objectives of ESA's Trace Gas Orbiter ( *Korablev et al., Nature 2019* )

#### Paleoclimates and geology

- Explanation of **glacial and periglacial structures** on Mars by climatic variations linked to variations in obliquities and orbital parameters (eg: *Forget et al. Science 2006, Forget et al. 2017*).
- Explanation of the formation of the famous **Martian gullies** (“gullies”) by the sublimation of dry ice, rather than by liquid water as previously assumed (“Formation of gullies on Mars by debris flows triggered by CO<sub>2</sub> sublimation”, *Pilorget and Forget, Nature Geosciences 2016* ).
- Modeling to solve the **early Mars climate enigma**, 3.8 billion years ago.
  - Discovery of the scattering greenhouse effect of CO<sub>2</sub> ice clouds (*Forget and Pierrehumbert, Science 1997*).
  - Suggestion of the “Icy Highland Scenario” ( *Forget et al. 2013, Wordsworth, Forget et al. 2013*), subject of intense debate in the community (eg *Wordsworth et al. Nature geo, 2018* ).
  - Modeling of the effect of impacts, reduced gases, outflow channels (with M. Turbet, PhD student) and of a potential late ocean ( *Turbet and Forget, Nature sci. Report., 2019* )
- This paleoclimate research is now the subject of the ERC advanced ***Mars Through Time* project** (2019-2024) which aims at understanding the environment on Mars for the past 4 billion years.
- **Invention of a new type of planetary climate model: the “Planetary Evolution Model”**. The ERC *Mars Through Time* consists in particular in developing a model of formation and evolution of water and ice reservoirs (CO<sub>2</sub>, H<sub>2</sub>O) by asynchronously coupling the Mars GCM (timescale of a few years) with a evolution model of cryology, hydrology, permafrost, etc. (thousands or even millions of years). This concept will have many applications on all worlds where the location of volatile reservoirs and their evolution is to be defined, such as on exoplanets.

### • Exoplanets and primitive atmospheres.

Creation of a **new type of “generic” 3D climate model** designed to simulate any atmosphere on any planet, including exoplanets (*Forget and Leconte, 2014*) and primitive atmospheres, now used for multiple studies around the world.

#### *A few applications of the generic model :*

- Resolution of the “**Faint young Sun paradox**” on the Earth (with B. Charnay, Phd student)

- First 3D simulations of the "**Runaway greenhouse effect**": Investigation on the long term future of the Earth and the edge of the "Habitable zone" (with J. Leconte)
- Among many cases: demonstration that Gliese 581d was the first discovered terrestrial planet in the habitable zone (with R. Wordsworth). Study of the environment on Proxima Centauri-b et on the worlds around Trappist-1 (with M. Turbet), etc.
- This model was recently used for a major result in planetary sciences: the impossibility of condensing oceans on primitive Venus ( *Turbet et al., Nature, 2021* )
- Application of this model to the atmospheres of **giant planets** (project led by Aymeric Spiga and Sandrine Guerlet at LMD): Jupiter, Saturn, Uranus, Neptune, exoplanets

#### **Reflection on the nature of the atmospheres of exoplanets and their habitability .**

- Edition of the reference book *Understanding the Diversity of Planetary Atmospheres* ( *Forget et al. Springer, 2021, 591 pages* )
- Invitation to colloquia for "reviews" on habitability and some publications on this subject.
- Creation (with J. Leconte) of a diagram speculating on possible exoplanetary atmospheres (Fig. 5 in *Forget and Leconte, 2014* ). This diagram has become a reference and was notably key in the *Ariel* space telescope proposal selected by ESA (launch in 2026).

#### • **Pluto.**

- Explanation of the distribution of the N<sub>2</sub>, CH<sub>4</sub> and CO glaciers and frosts observed on **Pluto** by the New Horizons mission in 2015, with an accelerated climate model to simulate the evolution of volatiles ( *Bertrand and Forget, Nature 2016, Bertrand, Forget et al. 2019, 2020, Nature Com. 2020* )
- Development of a 3D model of the general circulation of **Pluto's atmosphere** (circulation, methane cycle) to explain the observations of the New Horizons mission ( *Forget et al. 2017* ).  
→ Invitation to write the chapter "*Dynamics of Pluto's atmosphere*" ( *Forget et al. 2021* ) of the reference book "*Pluto after New Horizons* " (Arizona press, 2021). Only non-American 1<sup>st</sup> author.
- Development of the first general circulation model of the atmosphere of **Triton** (moon of Neptune, analogue of Pluto), observed by Voyager in 1989 (thesis by M. Vanvichith, 2013)

#### • **Venus**

- Initiation of the first 3D climate model of **Venus** (project led by S. Lebonnois, LMD) and of a brand new *Venus Climate Database* (VCD) derived from the Mars Climate Database (MCD)
- Member of the team proposing the DAVINCI atmospheric probe, selected by NASA to descend to the surface of Venus (launch: 2029).

- **National Observation Service (SNO) Planetary Climates Database** . François Forget is the head of this INSU-certified service which aims to provide tools and products for simulations of planetary climates, including the MCD and the VCD ( <http://www-planets.lmd.jussieu.fr> ).

## **2) Involvement in space missions .**

- **Mars Express** (European Space Agency, since 2004).
  - "*Interdisciplinary Scientist*" (IDS) in charge of atmospheric sciences (involvement in multiple observational studies: ~60 publications)
  - *Co-investigator* (co-I) of the OMEGA spectro-imager and the SPICAM spectrometer.
    - First observational climatology of the Martian mesosphere ( *Forget et al. 2009* )
    - First measurements of atmospheric pressure by remote sensing ( *Forget et al. 2007* ).
- **Mars Reconnaissance Orbiter** (NASA, since 2005): *Co-I* of the Mars Climate Sounder instrument.
- **New Horizons** (NASA) : Flyby of **Pluto** on July 14, 2015, "*Mission Collaborator*" .
- **Exomars 2016** (ESA) around Mars since October 19, 2016.
  - *Interdisciplinary Scientist* (IDS) on the **Trace Gas Orbiter** (TGO)
  - *Co-Principal Investigator* of the AMELIA experiment (descent data from the Schiaparelli lander).
  - *Co-investigator* of ACS (*Atmospheric Chemistry Suite* , PI, O. Korablev). Analysis of the atmospheric soundings of the TIRVIM thermal channel with Sandrine Guerlet and postdoc Siteng Fan at the LMD.

- *Responsible* for the characterization of the environment for the "Entry Descent and Landing" of the lander: Contracts with Thales-Alenia Space Italia.
- **INSIGHT** (NASA Lander, 2018): Member of the scientific team, in charge of large-scale meteorology ( *Forget et al., 2022 , Banfield et al., Nature, 2020* and 13 other publications)
- **Emirates Mars Mission (Hope)**: United Arab Emirates orbiter in orbit since 2021, dedicated to observing the Martian atmosphere. Named “ *Interdisciplinary Scientist* ”. Only European member of the scientific team.
- **Tianwen-1** (China). Contribution to the landing of the *Zhurong rover* (mission in Beijing and training of two engineers from the *Institute of Spacecraft System Engineering* at LMD in December 2017).
- **Exomars** (ESA-Roscosmos, launch now planned in 2028) with the “*Rosalind Franklin*” Rover :
  - *Member* of the Landing Site Selection Committee ( “*LSSWG*” )
  - *Responsible* for the characterization of the atmospheric environment for the landing in 2023 (contracts with Thales-Alenia Space Italia)
- **DAVINCI Venus** Descent and Landing Module (NASA, Launch: 2029) .
  - *Co-investigator* (the LMD is the only non-American institute involved).
- **ARIEL** ( *Atmospheric Remote-sensing Infrared Exoplanet Large-survey* ) *Member of the proposing team* . Characterization of exoplanetary atmospheres (ESA; launch in 2028).
- **Development of sub-millimeter sounding on Mars.** (with LERMA, Paris Observatory).
  - *Principal Investigator (PI)* of the *Mars Atmosphere Brightness Observer (MAMBO)* *selected for the CNES-NASA Mars Premier* mission , canceled at the end of phase B in 2002.
  - *Co-PI, Submm Observation for Atmospheric Research* (SOAR) proposed for the Trace Gas Orbiter, 2011.
  - *Co-I* of the *Climate Orbiter for Mars Polar Atmospheric And Subsurface Science (COMPASS)* including the *WAVE sub-millimeter sounder*, submitted to the NASA Discovery 2019 program.

### 3) Research in Antarctica

- Co-responsible (with P. Bretel) of the CALVA program (created by Christophe Genthon), French Polar Institute IPEV. CALVA aims at monitoring the local climate to provide reference datasets for the CALibration and VALidation of climate models and satellite remote sensing in East Antarctica. Meteorological stations, Lidar, Radar in Adélie Land (Dumont d'Urville base, D17 on the glacier) and at Dome C, 1200 km inside the continent (Concordia base).
- 3-month stays at Dumont d'Urville and Concordia in 2019-2020, planned for 2023-2024.

### 4) Other adventures

(<https://web.lmd.jussieu.fr/~forget/adventure.html>)

- **Mountaineering and polar exploration:** Numerous light expeditions in the Arctic (Greenland, Svalbard, Iceland, Alaska, Lapland, Pakistan etc). Thousands of kilometers traveled on skis and sleds. Pioneer of expeditions towed by kites.
- **Scubadiver** and diving instructor (E3, CMAS \*\*, Professional Diploma "Brevet Professionnel Educateur Sportif"). About 2000 dives in many seas and oceans, cold and warm.

### 5) Outreach

- **Media** : regular appearances on radio and TV shows and in the press. About 50 interviews per year. Regular participation in " *C dans l'air* " (France 5), " *L'info du vrai* " (Canal +), *La méthode scientifique* (France Culture), *La Terre au carré*, *Les Ptits Bateaux* (France Inter).
- **Conferences for the general public** ( ~10/year).
- **Polpular books and articles** :
  - Author of the **book *Planet Mars, story of another world*** (Forget, F., F. Costard, P. Lognonne). **Prize:** “*best scientific book 2004*” (Orsay festival). Translated into English, Dutch, Japanese.

- Co-author of the book "*L'Espace*", published by EPA, by Nicolas Martin (2020). **Prix Ciel & Espace du livre d'astronomie 2021.**
- Co-author of the general public book *Solar System and Planets* (Ellipses Edition, 2009).
- "**Pour la Science**": Coordination of the special "**Mars, immediate boarding**" (July 2014).
- Writing of **20 popular articles** on Mars, Pluto or life in the universe for *Pour la Science, la Recherche, Ciel et Espace*, etc. 7 online articles for *newobs.com*
- **Exhibition :**
  - Creation of the exhibition *Climates, water, life: the Earth, an exception in the Universe?* (2010): Multi-site poster exhibition designed for high schools, colleges, media libraries. (<http://expoplanetes.ipsl.jussieu.fr/>). About 150,000 students have seen the exhibition in France, Belgium, Israel, Quebec and Morocco.
  - Scientific advisor for the new permanent exhibition *Humans in Space* at the Cité des sciences et de l'industrie (La Vilette, Paris).
  - Scientific curator of "Objectif Mars" exhibition planned with the *Institut du Monde Arabe* for spring 2023. Budget: €4 million
- **Audiovisual media**
  - One of the five researchers/astronauts portrayed in "*Les arpenteurs de l'Espace*", a documentary produced for Arte by Gerald Caillat (scheduled to be released in the fall of 2022).
  - **Scientific advisor** (with Roland Lehoucq) of the series of 4 documentaries "*The Interstellar Odyssey*" on extrasolar planets (broadcast on August 11 and 17, 2019 at 9 p.m. on Arte TV).
  - **Scientific advisor** of the documentary *Et si la Terre était Unique ?* (90', France TV) broadcasted on September 24, 2020 at 9 p.m.
  - Chronicle on **YouTube** "*L'Homme a-t-il vraiment marché sur la Lune?*" (France Info - France Culture, 2018). 133,000 views and 1,000 comments (from conspirators!) as of 09/01/2022.
  - Contribution to the creation of **documentaries** *Entre Terre et Ciel* (ep.4 ARTE, 2014), *Mondes* (2020) and *Système* (2023) by Baptiste Blanpain (Commune Image Media – Connaissance du mode, 2020), *Exomars: Conquest of the Red Planet* (2016) and *Exomars, The Impossible Mission* (2023) by François Pomes (National Geographic).
  - **Podcasts:** Contribution to many podcasts in France and Canada. For example, the series "*Olma*" (France Inter, by M. Vidard and L. Sarfaty) for which François Forget was the guest of the first two episodes (with then H. Reeves, E. Klein, C. Clerbaux, etc.)