Maël Es-Sayeh

*Ph.D student in Planetary Science at
the Institut de Physique du Globe de Paris*

27y
Paris, France 75014
✉ *essayeh@ipgp.fr, ORCID: 0000-0002-0643-4323*

Summary

My research focuses on analyzing the 13 years of Cassini/VIMS hyper-spectral observations of Titan in the near-IR to globally map the surface reflectivity. For this, I developed a radiative transfer model to correct for gaseous absorption and aerosol scattering to retrieve the surface albedo. My research covers both observational and theoretical aspects. I have gained experience in reducing and analyzing observational data (Cassini/VIMS, Huygens/DISR, Very Large Telescope, and JWST/NIRSpec and NIRCam), and developing radiative transfer models to interpret these observations.

Actual position

2020 - Now   **Institut de Physique du Globe de Paris, France**,
Ph.D. student in Planetary Science,
Supervisor: Sébastien Rodriguez,
Thesis subject: "Analysis of 13 years of Cassini/VIMS data: global mapping of Titan's surface reflectivity and preparatory studies of JWST and Dragonfly observations".
- Development of a radiative transfer model using up-to-date gaseous abundances profiles, absorption coefficients, and photochemical aerosol optical properties.
- Validation of the model against in-situ observations of the Huygens probe during the descent and once landed.
- Application to Selk crater, the Dragonfly landing area, and interpretation of RGB images of surface albedo band ratios.
- Global mapping of the surface reflectivity using Look-up-tables.
- Proposals (co-PI) and study of JWST observations of Titan.
- Supervision of Bachelor student.

Education

2019-2020   **Paris Observatory, France**,
2nd year - Master Planetary Science, Grade A.

2018-2019   **Paris Observatory, France**,
1st year - Master Astronomy and Astrophysics, Grade A.

2015-2018   **University of Rennes, France**,
Bachelor of Physics, Fundamental physics, Additional Astrophysics courses, Grade A (Rank: 3/44).

Research Experiences

2020
(6 months)   **Oxford University, UK**,
Supervisor: Peter Read,
Subject: "Modeling dynamics and clouds of gas giant planet atmospheres",
Creation of a radiative transfer model with a cloud layer and a convection scheme, integration into the General Circulation Model of Jupiter, study of feed-backs on atmospheric dynamics, comparison with observations.

2019
(3 months)   **Leicester University, UK**,
Supervisor: Leigh Fletcher,
Subject: "Saturn's seasonal variability from ground-based infrared observations",
Reduction and analysis of observations of Saturn from the Very Large Telescope in the thermal infrared, detection of seasonal temperature variations.

2018	**University of Rennes, France**,
(2 months)	*Supervisor: Alexandre Valance*,
	Subject: "Experiments on sand dunes morphodynamics in a hydraulic channel powered by a propeller", Monitoring the movement of the particles using a high-speed camera programmed in Labview, data analysis.

Scholarships

- Ph.D., École Doctorale Step-Up
- Master 2 Internship: Oxford University, AOPP Research Group
- Master 1 Internship: Paris Observatory

Scientific Projects

- 3-D Radiative transfer modeling (ANR RaD^3-net, PI: Sandrine Vinatier).
- JWST observations of Titan in the near-IR: I calibrate the data and provide a radiative transfer model to analyze them.

Supervision

I supervised during 6 months the thesis of Manon Warembourg (Bachelor level) of the Institut de Physique du Globe de Paris.
Title: "Selk crater area on Titan: chemical composition and geomorphological interpretation".
Manon is now a graduate student in remote sensing at Université Paris Cité.

Teaching Experience

At University:
- Electromagnetism, 64h
- Classical mechanics, 64h
- Numerical analysis, 12h
- Atmosphere-Ocean-Climate, 32h
- MOOC "Our planet", 12h

Articles in preparation

- **Es-sayeh M.**, Rodriguez S., Ntinos C., Maltagliati L., Cornet T., Vincendon M., Sotin C., Coustenis A., *Simultaneous mapping of Titan's surface albedo and aerosol opacity from Cassini/VIMS massive inversion*

- Rodriguez S., **Es-sayeh M.**, Rannou P., Coutelier M., Maltagliati L., Cornet T., Le Mouélic S., Sotin C., *Titan's haze photometry from Cassini/VIMS multi-angular observations*

Published Articles

- Blake J.S., Fletcher L.N., Orton G.S., Antuñano A., Roman M.T., Kasaba Y., Fujiyoshi T., Melin H., Bardet D., Sinclair J.A., **Es-sayeh M.** (2023), *Saturn's seasonal variability from four decades of ground-based mid-infrared observations*, Icarus, 392:115347. https://doi.org/10.1016/j.icarus.2022.115347

- **Es-sayeh M.**, Rodriguez S., Coutelier M., Rannou P., Bézard B., Maltagliati M., Cornet T., Grieger B., Karkoschka E., Le Mouélic S., Le Gall A., Neish C., MacKenzie S., Solomonidou A., Sotin C., Coustenis A. (2023), *Updated radiative transfer model for Titan in the near-infrared wavelength range: Validation against Huygens atmospheric and surface measurements and application to the Cassini/VIMS observations of the Dragonfly landing area*, Planetary Science Journal, accepted

Conference Abstracts

- *First Observations of Titan with the James Webb Space Telescope.*
  Nixon C., Achterberg R., Bezard B., Cornet T., **Es-sayeh M.**, Hammel H. et al., 2022 (AGU - San Francisco, USA)

- *Updated radiative transfer model for Titan in the near-infrared wavelength range: Validation on Huygens atmospheric and surface measurements and application to the analysis of the Dragonfly Landing Area.*

Es-sayeh M. et al., 2022 (EPSC - Granada, Spain)

- *Updated Radiative Transfer Model for Titan: Validation on VIMS/Cassini Observations of the Huygens Landing Site and Application to the Analysis of the Dragonfly Landing Area.*
  Es-sayeh M. et al., 2021 (AGU - New Orleans, USA)

- *Regional mapping of aerosol population and surface albedo of Titan by the massive inversion of the Cassini/VIMS dataset.*
  Rodriguez S., **Es-sayeh M.** et al., 2021 (AGU - New Orleans, USA)

- *Updated radiative transfer model for Titan in the near-infrared wavelength range: Validation on Huygens atmospheric and surface measurements and application to the analysis of the VIMS/Cassini observations of the Dragonfly landing area.*
  Es-sayeh M. et al., 2021 (Projet National de Planétologie - École Normale Supérieure de Lyon, France)

- *Saturn's Seasonal Atmosphere: Cassini CIRS contrasts to ground-based observations.*
  Blake J., Fletcher N., Antunano A., Melin H., Roman M., Orton G., **Es-sayeh M.** et al., 2021 (EPSC - Helsinki, Finland)

- *Saturn's Seasonal Atmosphere: Cassini CIRS contrasts to VLT and IRTF observations.*
  Blake J., Fletcher L., Antunano A., Melin H., Roman R., **Es-sayeh M.** et al., 2020 (EPSC - Virtual)

- *Semi-grey radiative modeling of a discrete cloud layer in the atmospheres of Jupiter and other giant planets.*
  Es-sayeh M. et al., 2020 (AGU - San Francisco, USA)

- *Implementing a deep convective thermostat, and its effect on global and local energy balance, in weather-layer models of Jovian planets and exoplanets.*
  Colyer G., **Es-sayeh M.**, Read P., Young R., 2020 (AGU - San Francisco, USA)

- *Saturn's Seasonal Atmosphere Beyond Cassini: VLT and IRTF observations.*
  Blake J., Fletcher L., Antunano A., Melin H., Roman M., **Es-sayeh** M. et al., 2019 (EPSC - Geneva, Switzerland)

Conferences

- 2021 American Geophysical Union Fall Meeting, New Orleans, USA
- 2022 European Planetary Science Congress, Granada, Spain
- 2023 Projet National de Planétologie, Lyon, France
- 2023 (planned) Titan Through Time Workshop, Paris, France - Member of the Scientific Organizing Committee

Communication

- Press release NASA and ESA: "Webb, Keck Telescopes Team Up to Track Clouds on Saturn's Moon Titan" (12/2022)
- Press release Université Paris Cité and Institut de Physique du Globe: "Premières observations de Titan par le télescope spatial James Webb" (12/2022)

Skills

Scientific	Numerical modeling, data reduction and analysis (Very Large Telescope, Cassini/VIMS, Huygens/DISR, JWST/NIRSpec and NIRCam), hyperspectral remote sensing, radiative transfer, IR-spectroscopy, atmospheric physics
Programming	IDL, Python, Fortran, Matlab, Labview, DRM (data reduction manager)
Systems	Linux, Mac OS, Windows
Languages	French (Native), English (Full professional proficiency)