

Matthieu Mercier

Personal Information

Family name, First name: Mercier, Matthieu.

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Researcher ID/ORCID: H-4278-2012 (Research ID), 0000-0001-9965-3316 (ORCID)

Date of Birth: 29/10/1983.

Nationality: French.

Current position (since 2015): CNRS Researcher (Chargé de Recherche) at “Institut de Mécanique des Fluides de Toulouse” (IMFT) - UMR 5502 (Toulouse, France).

Research interests

Fluid dynamics, stratified and buoyancy-driven flows, internal waves, fluid-particle interactions, suspension dynamics, dynamical systems (and chaos), experimental techniques, numerical simulations.

Previous positions

2013-2015 Post-doctorate fellowship through ANR funding F-PISE.

2010-2013 Post-doctorate at the Dept. of Mechanical Engineering, MIT on stratified fluids and convection based propulsion, with Pr. T. Peacock

Education

2007-2010 PhD Thesis, Physics Laboratory, “Ecole Normale Supérieure de Lyon” (ENSL)
Supervisor: T. Dauxois (CNRS Researcher).

Title: Experimental investigation of the generation of nonlinear structures in stratified fluids.

2006-2007 Master (2nd year) in Physics at ENSL, major in Nonlinear Physics.

2006 Success at the National Teaching Exam in Physics, rank 79/135.

2004-2005 Master (1st year) in Physics at ENSL.

2003-2004 Licence in Physics at ENSL.

Fundings, Fellowships and Awards

2018-2019 TTIL (local, INP-ISAE) “Plasticount”, on marine plastic litter estimates. 10k€.

2016-2017 IDEX (local) funding for young scientists. 14k€.

2013-2017 Principal Investigator of ANR funding (national), on Fluid-Particles Interactions in Stratified Environment at IMFT. 210k€.

2011 M. A. Abkowitz Travel Award.

2009,2014 APS-DFD Travel and Child Care Grants.

2008 Atmospheric Sciences (EGU) Young Scientist Outstanding Poster Presentation (YSOPP).

2003-2007 ENS Fellowship (“Normalien”) after success at national competitive exam for ENSL, prestigious school specialized in Education and Research.

Supervision

2017-2020 1 PhD student (M. Poulain) at IMFT on plastic particles distribution in the oceans.

2016-2017 1 Post-doctorate (R. Maurin) at IMFT on suspension dynamics in wakes of moving bodies.

2014-2019 10 MS students at IMFT on settling objects and gravity currents in stratified fluids.

2008 1 BS student at ENSL on the dead-water phenomenon.

Teaching

since 2016 Instructor (~15h/year), ISAE (Engineering School, Toulouse). *Geophysical Flows class.*

since 2014 Instructor (~45h/year), Dept. of Fluid Mechanics, ENSEEIHT (Engineering School, Toulouse).
Lab instructor, Wave Dynamics class.

2007-2010 Instructor (64h/year), Dept. of Physics, Master (1st year) level and Specialized Classes to take the Teaching Exam at the ENSL (Lyon).

Lab instructor, oral examiner, practice exam writing and correction.

2006-2008 Oral Examiner, Physics & Chemistry, 1st and 2nd years at university (Lyon).

Institutional responsibilities

- 2016-2020** Elected faculty member at IMFT laboratory council.
2014-2015 Organizer of internal seminar, research group HEGIE, IMFT.
2010-2012 Lab manager and consultant for ENDLab facilities renewal, MIT.
2009 Organizer of internal "PhD days", Physics Laboratory, ENSL.
2007-2010 Lab manager, Internal Waves Team, Physics Laboratory, ENSL.

Commissions of trust

- 2014,2016** Scientific evaluation of proposals for the National Science Foundation (USA) and the "Association Nationale de la Recherche et de la Technologie" (France).
2010-... Reviewer for J.Fluid Mech., Phys.Fluids, Geophys. Res. Lett., J. Geophys. Res.-Oceans, J. Phys. Oceanogr., J. Atmos. Sci.

Memberships of scientific societies

- Current American Physical Society, Association Française de Mécanique, Société Hydrotechnique de France.
Former American Geophysical Union, European Geophysical Union, Society for Industrial and Applied Mathematics, The Oceanography Society.

Publications

- ... **J. Magnaudet, M. J. Mercier**. Particles, drops and bubbles moving across sharp interfaces and stratified layers, *submitted to Annual Review of Fluid Mechanics*.
... **J. Zhang, M. J. Mercier, J. Magnaudet**. Unraveling the mechanisms of drag enhancement of bodies settling in a stratified fluid, *submitted to Journal of Fluid Mechanics*.
... **M. J. Mercier, S. Wang, J. Pemeja, P. Ern, A. Ardekani**. Sedimentation of disks in a linearly stratified fluid, *in revision for Journal of Fluid Mechanics*.
9. **M. Poulain, M. J. Mercier, L. Brach, M. Martignac, C. Routaboul, J. Gigault, E. Perez, M.-C. Desjean, A. ter Halle**, Important contribution of small microplastic in the North Atlantic subtropical gyre, *Environmental Science and Technologies*, **53**(3), 1157–1164 (2019).
8. **Matthew H. Alford, Thomas Peacock, and IWISE co-authors (including Matthieu J. Mercier)**. The formation and fate of internal waves in the South China Sea, *Nature*, **521**, 65–69 (2015).
7. **Matthieu J. Mercier, Arezoo M. Ardekani, Michael R. Allshouse, Brian Doyle, Thomas Peacock**. Self-Propulsion of Immersed Objects via Natural Convection, *Physical Review Letters*, **112**, 204501 (2014).
6. **Matthieu J. Mercier, Louis Gostiaux, Sasan Ghaemsaïdi, Joel Sommeria, Henri Didelle, Samuel Viboud, Karl Helfrich, Thierry Dauxois, Thomas Peacock**. Large-scale, realistic laboratory modeling of M_2 internal tide generation at the Luzon Strait, *Geophysical Research Letters*, **40**, 5704–5709, doi:10.1002/2013GL058064 (2013).
5. **Matthieu J. Mercier, Manikandan Mathur, Louis Gostiaux, Theo Gerkema, Jorge M. Magalhães, José C. B. da Silva, Thierry Dauxois**. Soliton generation by internal tidal beams impinging on a pycnocline : laboratory experiments, *Journal of Fluid Mechanics*, **704**, 37–60 (2012).
4. **Matthieu J. Mercier, Romain Vasseur and Thierry Dauxois**. Resurrecting Dead-water Phenomenon, *Nonlinear Processes in Geophysics*, **18**, 193–208 (2011).
3. **Matthieu J. Mercier, Denis Martinand, Manikandan Mathur, Louis Gostiaux, Thomas Peacock, and Thierry Dauxois**. New wave generation, *Journal of Fluid Mechanics*, **657**, 308–334 (2010).
2. **Thomas Peacock, Matthieu J. Mercier, Henri Didelle, Samuel Viboud, Thierry Dauxois**. A laboratory study of low-mode internal tide scattering by finite-amplitude topography, *Physics of Fluids*, **21**, 121702 (2009).
1. **Matthieu J. Mercier, Nicolas B. Garnier and Thierry Dauxois**. Reflexion and Diffraction of Internal Waves analyzed with the Hilbert Transform, *Physics of Fluids* **20**, 086601 (2008).

Proceedings

7. **Marie Poulain, Alexandra ter Halle, Matthieu Mercier.** Distribution de particules en turbulence de surface : Application à la pollution plastique océanique, *24^e Congrès Français de Mécanique* (2019).
6. **Matthieu Mercier.** Dynamique de suspension dans un fluide linéairement stratifié, *22^e Congrès Français de Mécanique*, <http://hdl.handle.net/2042/57454> (2015).
5. **Laurent Lacaze, Olivier Thual, Matthieu Mercier, Alexandre Paci.** Ondes internes topographiques dans un fluide à deux couches. *XXI^{ème} Congrès Français de Mécanique*, <http://hdl.handle.net/2042/52321> (2013).
4. **Matthieu Mercier, Thomas Peacock, Sasan Saidi, Samuel Viboud, Henri Didelle, Louis Gostiaux, Joel Sommeria, Thierry Dauxois and Karl Helfrich.** The Luzon Strait Experiment. *VII International Symposium on Stratified Flows* (08/2011).
3. **Theo Gerkema, Louis Gostiaux, Matthieu J. Mercier, Manikandan Mathur, Jorge Magalhães, Thierry Dauxois and José Da Silva.** Generation of interfacial solitons by internal-wave beams, *HYDRALAB III Joint User Meeting* (02/2010).
2. **Theo Gerkema, Louis Gostiaux, Manikandan Mathur, Matthieu Mercier, Nicolas Grisouard.** Génération de solitons dans une pycnocline par un faisceau d'une onde interne, *XIX^{ème} Congrès Français de Mécanique*, n°958 (2009).
1. **Matthieu Mercier, Nicolas Garnier and Thierry Dauxois.** Démodulation complexe de signaux expérimentaux appliquée aux ondes internes, *Comptes-Rendus de la 11^{ème} Rencontre du Non-Linéaire*, 125–130 (2008).

General communications

- <http://physics.aps.org>, Synopsis section, *Sailing on convection*, 21/05/2014.
- Earth Magazine, *Scientists recreate huge underwater waves in the lab*, n° 59 no. 6, p. 26-27, 06/2014.
- <http://www.usatoday.com>, Tech section, *Underwater waves are the Earth's 'lumbering giants'*, 22/05/2014.
- <http://www.cnrs.fr/inp>, Actualités Scientifiques, *Comment se forment les tsunamis sous-marins en mer de Chine ?*, 07/02/2014.
- <http://www.scientificamerican.com>, *Long a Mystery, How 500-Meter-High Undersea Waves Form Is Revealed*, 15/01/2014.
- Le Monde, science & médecine, *"Les mystères des tsunamis sous-marins"*, n° 21429, p. 2, 11/12/2013.
- Le Monde, science & médecine, *"Méfiez-vous de l'eau qui dort"*, n° 21429, p. 2, 11/12/2013.
- <https://sourceforge.net/projects/itides>, *iTides: a Matlab GUI for internal tide generation*, 31/01/2012.
- Quò, *"Esto no es un juego"*, n° 162 p. 98, 03/2009.
- <http://culturesciencesphysique.ens-lyon.fr>, *Phénomène d'eaux mortes*, 15/06/2009.
- <http://www.newscientist.com>, *Mysterious "dead water" effect caught on film*, 21/08/2008.

Add-on value/Technology transfer

- Open-source "iTides" on internal wave generation by topography (<https://sourceforge.net/projects/itides>)
- Open-source "PLASTICOUNT" on prediction of plastic concentration in the water column for towing net experiments in the ocean (<https://sourceforge.net/projects/plasticcount>)

Organization of colloquiums/events/workshops

- 07/2018** Workshop "Expedition 7th Continent" at l'IMFT, in collaboration with A. Ter Halle (IMRCP). *How to evaluate environmental risks due to marine plastic litter?*
- 07/2018** 2 invited sessions at ESOF, with A. Ter Halle (IMRCP). *Plastic pollution in the ocean: environmental perspectives*, and *Scientists and citizens unite to combat plastic pollution in the ocean*.
- 05/2017** Workshop "Waves and Flows in Stratified and Rotating Fluids" at l'IMFT.
- 01/2017** Training Workshop for the Next Generation of Researchers (Hydralab+) at l'IMFT, organized by F. Moulin (IMFT). *New Scaling issues in hydraulic models and optical measurement techniques*.

Conferences/Seminars

- 01/2019** Environmental Fluid Dynamics: Confronting Grand Challenges (Les Houches), poster. *Vertical motions of particles in a linearly stratified fluid*.
- 07/2018** 7th Conference on Bluff Body Wakes and Vortex-Induced Vibrations (Carry-le-Rouet), oral and poster. *Wake of a vertically moving sphere in a linearly stratified fluid*, et *Pair of spheres settling in a linearly stratified fluid*.

- 06/2018 Institut Universitaire des Systèmes Thermiques Industriels (Marseille), seminar. *Settling particles in a stratified fluid.*
- 05/2017 Workshop Waves and Flows in Stratified and Rotating Media (Toulouse), oral. *Particles in stratified Fluids.*
- 06/2016 Conference on Mathematical Geophysics (Paris), oral. *Large-scale realistic laboratory modeling of internal tide generation at the Luzon Strait.*
- 11/2015 APS Division of Fluid Dynamics Meeting (Boston), oral. *Interaction of two spheres settling in a linearly stratified fluid.*
- 10/2015 Workshop New Wave: New Challenges in Internal Wave Dynamics (Lyon), oral. *Internal waves patterns in the wake of a 3D body towed in a two-layer fluid.*
- 09/2015 Dispersed Two-Phase Flows (Toulouse), oral. *Suspension dynamics in a linearly stratified fluid.*
- 08/2015 Congrès Français de Mécanique (Lyon), oral. *Dynamique de suspension dans un fluide linéairement stratifié.*
- 11/2014 APS Division of Fluid Dynamics Meeting (San Francisco), orals. *Settling dynamics of disks in a linearly stratified fluid, and Self-propulsion via natural convection.*
- 11/2014 Rencontres Niçoises de Mécanique des Fluides (Nice), seminar. *Settling dynamics in stratified fluids.*
- 09/2014 GdT Math-Ocean (IMT, Toulouse), seminar. *Generation d'ondes internes linéaires et non-linéaires: du sillage de bateau aux solitons océanique.*
- 05/2014 Training school (CISM, Udine) on 'Collective dynamics of particles: from viscous to turbulent flows', oral. *Settling dynamics in stratified fluids.*
- 03/2014 Institut Universitaire des Systèmes Thermiques Industriels (Marseille), seminar. *Propulsion par convection naturelle.*
- 02/2014 LadHyX (Polytechnique, Palaiseau), seminar. *Propulsion par convection naturelle.*
- 05/2013 Symposium OGOA (Lyon), oral. *De Luzon au laboratoire: modéliser la marée interne.*
- 10/2012 Institut de Mécanique des Fluides de Toulouse (IMFT, Toulouse), seminar. *De Luzon au laboratoire: modéliser la marée interne.*
- 07/2012 GFD Lectures, (WHOI, Woods Hole), seminar. *From the Luzon Strait to the laboratory: modeling the internal tides.*
- 06/2012 SIAM Conference on nonlinear waves and coherent structures (Seattle), oral. *How nonlinear are the internal tides in the Luzon Strait?.*
- 05/2012 Dynamics Group Seminar, Geophysical Fluid Dynamics Laboratory (GFDL, Princeton), seminar. *From the Luzon Strait to the laboratory: modeling the internal tides.*
- 03/2012 Institut de Recherche des Phénomènes Hors-Equilibre (IRPHE, Marseille), seminar. *Ondes internes non-linéaire au laboratoire: du phénomène des eaux-mortes au détroit de Luzon.*
- 03/2012 Centre National de Recherche Météorologique (CNRM, Toulouse), seminar. *Ondes internes non-linéaire au laboratoire: du phénomène des eaux-mortes au détroit de Luzon.*
- 03/2012 Fluides, Automatique et Systèmes Thermiques (FAST, Orsay), seminar. *Du détroit de Luzon au laboratoire: modélisation expérimentale de la marée interne.*
- 03/2012 Graduate School of Oceanography, University of Rhode Island (Narragansett), seminar. *From Luzon Strait to the lab: experimental modeling of internal tide generation.*
- 02/2012 Ocean Sciences Meeting (Salt Lake City), poster. *Internal tide generation in a large-scale laboratory experimental study of the Luzon Strait.*
- 09/2011 Institute of Oceanography, National Taiwan University (Taiwan), seminar. *Laboratory experiments on internal waves generated by tidal forcing.*
- 08/2011 VII International Symposium on Stratified Flows (Rome), oral. *The Luzon Strait Experiment.*
- 06/2011 Atmosphere and Ocean Science Days, MIT (Cambridge), oral. *The Luzon Strait Experiment.*
- 04/2011 Dept. of Applied Mathematics, MIT (Cambridge), seminar. *Internal and Interfacial Waves in Stratified Fluids.*
- 01/2011 IWISE Meeting (Taipei), oral. *The Luzon Strait Experiment.*
- 11/2010 Institut de Mécanique des Fluides de Toulouse (Toulouse), seminar. *Internal waves generated by tidal forcing: scattering and soliton generation.*
- 06/2010 PhD defense (ENS Lyon). *Étude expérimentale de la génération de structures linéaires et non-linéaires (solibores, solitons) en milieu stratifié.*
- 04/2010 Nonlinear Dynamics Seminars, Center for Nonlinear Dynamics (Austin), seminar. *Internal wave generation: controlling spatial structures to investigate specific oceanic issues.*
- 04/2010 Coordinated Mathematical Modeling of Internal Waves (Banff), oral. *Dead Water Phenomenon.*
- 02/2010 Hydralab III: Young Reseachers Workshop (Hannover), oral. *New (internal) Wave Generation.*

- 11/2009** APS Division of Fluid Dynamics Meeting (Minneapolis), oral. *Internal-Tide Scattering by 2D Topography: Experimental Study.*
+ Gallery of Fluid Motion: M. Mathur, M. Mercier, T. Dauxois and T. Peacock, *arXiv:0910.3438v1*
- 05/2009** Waves and instabilities in geophysical and astrophysical flows (Porquerolles), oral. *Interfacial waves (generated by a boat) in stratified fluids.*
- 04/2009** EGU General Assembly (Wien), oral. *Experimental Study of Internal-Tide Scattering by 2D Topography.*
- 11/2008** APS Division of Fluid Dynamics Meeting (San Antonio), oral. *Analyzing emission, reflection and diffraction of internal waves using the Hilbert transform.*
+ Gallery of Fluid Motion: R. Vasseur, M. Mercier and T. Dauxois, *arXiv:0810.1702v1*
- 04/2008** EGU General Assembly (Wien), poster. *Hilbert transform applied to internal waves issues.* Received the "AS (Atmospheric Sciences) EGU Young Scientist Outstanding Poster Presentation (YSOPP)" award.
- 03/2008** Rencontre du Non-Linéaire (Paris), oral. *Démodulation complexe de signaux expérimentaux appliquée aux ondes internes.*

Short term research activities

- 03/2018 & 03/2019** *Projet Ingénierie Entreprise (ISAE): Modelling/Predicting localization of marine plastic debris*, in connection with NGO "Expédition 7th Continent".
- 09/2011** Research cruise with J. Nash, L. Rainville and J. Mickett on RV Ocean Researcher 1 (NTU), *Mooring recovery during The Internal Waves In Straits Experiment (IWISE).*
- 09-12/2010** Collaboration with T. Dauxois, K. Helfrich, L. Gostiaux, T. Peacock and J. Sommeria at the Coriolis Turntable (Grenoble),
Internal tides generated by a realistic topography: The Luzon Strait Experiment.
- 06-07/2009** Research cruise 64PE308 with H. V. Haren on RV Pelagia (NIOZ),
Monitoring of oceanic internal waves in Canary and Brazilian Basin.
- 09/2008** Collaboration with T. Gerkema at the Coriolis Turntable (Grenoble),
Generation of interfacial solitons by internal-wave beams.
- 01-02/2008** Collaboration with T. Peacock at the Coriolis Turntable (Grenoble),
Laboratory study of internal-tide scattering.
- 04-07/2007** Training program at the ENSL, Physics Laboratory, supervisor T. Dauxois,
Characterization and Exploitation of a Novel Internal Waves Wavemaker.
- 05-07/2005** Training program at the University of Bristol, Applied Mathematics Laboratory, supervisor S. Wiggins,
Dynamical Systems Theory Applied to a Kinematic Model of a Meandering Jet.
- 06-07/2004** Training program at the Acoustics Center, Ecole Centrale de Lyon, supervisor M. A. Galland,
Algorithm Development for the active control of hybrid absorbers.

Collaborators, current and past.

M. Abbas	LGC (FR)	Suspension dynamics
A. Aguilar Corona	Uni. Michoacana (Mex.)	Suspension dynamics
A. Ardekani	Purdue Univ. (USA)	Particles in stratified flows
T. Bonometti	IMFT (FR)	Gravity currents and particles in stratified fluids
E. Climent	IMFT (FR)	Particles at low Reynolds in stratified flows
T. Dauxois	ENS Lyon (FR)	Internal waves
P. Ern	IMFT (FR)	Settling objects in fluids
T. Gerkema	NIOZ (NL)	Interfacial and internal waves
L. Gostiaux	LMFA (FR)	Internal waves and gravity currents
A. ter Halle	IMRCP (FR)	Plastic pollution in the oceans
K. Helfrich	WHOI (USA)	Nonlinear internal waves
L. Lacaze	IMFT (FR)	Suspension dynamics and stratified flows
L. Maas	Utrecht Univ. (NL)	Barotropic/baroclinic conversion at topographies
J. Magnaudet	IMFT (FR)	Instabilities in stratified wakes
R. Maurin	IMFT (FR)	Suspension dynamics
J. Morris	CCNY (USA)	Suspension dynamics
T. Peacock	MIT (USA)	Internal waves and convection-based propulsion
F. Simatos	ISAE (FR)	Plastic pollution in the oceans
J. Sommeria	Coriolis Platform-LEGI (FR)	Rotating and stratified Flows
O. Thual	IMFT (FR)	Waves in stratified fluids
J. Zhang	Xi'an Jiaotong Univ. (CH)	Instabilities in stratified wakes