Marc Federer

Postdoctoral Fellow, MIT Department of Earth, Atmospheric, and Planetary Sciences

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Research Interests

My research focuses on how moisture and diabatic processes shape the midlatitude storm tracks, and how individual weather systems drive large-scale climate variability. I combine theory, reanalysis diagnostics, and idealized modeling to study Rossby wave dynamics, the atmospheric energy cycle, and extreme weather in current and future climate.

Education

PhD, Atmospheric and Climate Science — ETH Zurich Dec 2021 – Mar 2025
Thesis: *A synoptic perspective on available potential energy*
Advisors: Dr. Lukas Papritz, Dr. Michael Sprenger, Prof. Heini Wernli
Collaboration: Dr. Christian Grams and Dr. Marta Wenta (KIT, Germany)

MSc, Environmental Science — ETH Zurich Sep 2019 – Sep 2021
Focus: Atmospheric and Climate Science
Thesis: *Predator-prey behaviour of storm tracks*
Advisors: Prof. Sebastian Schemm, Dr. Lukas Papritz

BSc, Environmental Science — ETH Zurich Sep 2016 – Jul 2019
Focus: Atmospheric and Climate Science
Thesis: *Subseasonal ensemble prediction of sudden stratospheric warmings*
Advisors: Prof. Daniela Domeisen, Dr. Ole Wulff, Dr. Bernat Jiménez Esteve

Funding

PI, SNSF Postdoc.Mobility Fellowship 2025–2027
Swiss National Science Foundation, $170,000.
The role of moisture in Rossby wave breaking and midlatitude storm track organization.
Host: Prof. Talia Tamarin-Brodsky, MIT.

Publications

M. Federer, S. Le May, M. Sprenger, and L. Papritz, "Collapses of hemispheric available potential energy," *Geophysical Research Letters*, 53, e2025GL119424, doi:10.1029/2025GL119424, 2026.

J. Riboldi, R. Noyelle, E. Agayar, H. Binder, **M. Federer**, K. Hartmuth, M. Sprenger, I. Thurnherr, and S. Vishnupriya, "Storm Boris (2024) in the current and future climate: a dynamics-centered contextualization, and some lessons learnt," *Weather and Climate Dynamics*, 7, 65–87, doi:10.5194/wcd-7-65-2026, 2026.

M. Federer, L. Papritz, M. Sprenger, and C. M. Grams, "Synoptic perspective on the conversion and maintenance of local available potential energy in extratropical cyclones," *Weather and Climate Dynamics*, 6, 211–230, doi:10.5194/wcd-6-211-2025, 2025.

M. Federer, L. Papritz, M. Sprenger, C. M. Grams, and M. Wenta, "On the local available potential energy perspective of baroclinic wave development," *Journal of the Atmospheric Sciences*, 81(5), 871–886, doi:10.1175/JAS-D-23-0138.1, 2024.

M. Wenta, C. M. Grams, L. Papritz, and **M. Federer**, "Linking Gulf Stream air–sea interactions to the exceptional blocking episode in February 2019: a Lagrangian perspective," *Weather and Climate Dynamics*, 5(1), 181–209, doi:10.5194/wcd-5-181-2024, 2024.

Awards

Editor's Choice Paper Award, Weather and Climate Dynamics 2024

For "Synoptic perspective on the conversion and maintenance of local available potential energy in extratropical cyclones."

Research Experience

Postdoctoral Fellow — MIT EAPS Sep 2025 – present
SNSF Postdoc.Mobility Fellow in the group of Prof. Talia Tamarin-Brodsky.

Postdoctoral Researcher — ETH Zurich Apr 2025 – Aug 2025
Group of Prof. Heini Wernli.

Energy Meteorologist — Axpo Solutions AG Nov 2020 – Sep 2021
Extended-range forecasting research using reanalysis and NWP data for the energy trading desk.

Teaching

Courses taught (Teaching Assistant, ETH Zurich, 2022–2024):
Global Atmospheric Circulation (Graduate) · Weather Discussion (Graduate) · Environmental Fluid Dynamics · Seminar in Atmospheric Science · Applied Mathematics · Practical training: SwissMetNet

Student supervision (ETH Zurich, co-supervised):

Sacha Le May, MSc — *Local dynamics of sudden hemispheric collapses of available potential energy* 2024
Andrea Leuthard, MSc — *Objective identification and characteristics of local APE anomalies* 2023

Professional Service

Field campaign forecasting: NAWDIC (North Atlantic Waveguide, Dry Intrusion, and Downstream Impact Campaign), Shannon, Ireland, Feb 2026. Forecast briefings and flight planning.

Workshop organization: Remote hub organizer for "US CLIVAR Blocking and Extreme Weather in a Changing Climate," ETH Zurich, Mar 2024. Attended by 15 colleagues from six European institutions.

Committee service: Weather Discussion Steering Committee, ETH Zurich, 2024–2025.

Peer review: Atmospheric Research, Climate Dynamics, Journal of the Atmospheric Sciences, Weather and Climate Dynamics, Journal of Geophysical Research: Oceans.

Selected Presentations

Collapses of hemispheric available potential energy (poster), **AMS Annual Meeting**, Houston	Jan 2026
The local contribution of storm tracks to hemispheric collapses of APE, **Stormtracks 2025**, Bergen	Jun 2025
Extratropical cyclones and the energetics of the global atmosphere (poster), **10th European Storms Workshop**, Bern	Feb 2025
Synoptic perspective on APE in extratropical cyclones, **MIT EAPS Seminar**, Cambridge	Oct 2024
Synoptic perspective on APE in extratropical cyclones, **20th Cyclone Workshop**, Montreal	Oct 2024
Local APE conversion and maintenance in extratropical cyclones, **EGU General Assembly**, Vienna	Apr 2024
Local APE perspective of baroclinic wave development, **IUGG**, Berlin	Jul 2023
Local APE perspective of baroclinic wave development, **University of Oxford Seminar**, Oxford	Mar 2023
APE perspective on North Atlantic weather regimes (poster), **EMS Annual Meeting**, Bonn	Sep 2022