

Mathematics and Machine Learning for Earth System Simulation

Monday February 2, 2026

- 8:00–8:55 *Check-in/Breakfast (hosted by IPAM)*
- 8:55–9:00 *Welcome and Opening Remarks*
- 9:00 *Session Chair: Adam Rupe*
- 9:00–9:50 **Katherine Breen** (NASA)
Foundation Models as a New Backbone for Medium-range Forecasting and Data Assimilation
- 10:00–10:15 *Break*
- 10:15–11:05 **Tom Beucler** (University of Lausanne)
Artificial Intelligence Pathways from Weather to Climate
- 11:15–11:30 *Break*
- 11:30–12:20 **Noah Brenowitz** (NVIDIA)
Does progress in Earth System Modeling require more data, more compute, or both?
- 12:30–2:30 *Lunch (on your own)*
- 2:30 *Session Chair: Kathy Breen*
- 2:30–3:20 **Michael Ghil** (Ecole Normale Supérieure)
Global warming and global weirding: Nonautonomous dynamics for chaotic and noisy systems
- 3:30–4:00 *Break*
- 4:00–4:50 **Johan Mathé** (Atmo.AI)
Earth System Symmetries: Geometry, Groups, and the Limits of Structure in Machine Learning
- 5:00–5:20 *Lightning Poster Round*
- 5:20–6:50 *Poster Session & Reception (Hosted by IPAM)*

Tuesday February 3, 2026

- 8:00–8:55 *Check-in/Breakfast (hosted by IPAM)*
- 9:00 *Session Chair: Milan Curcic*
- 9:00–9:50 **Marcus van Lier-Walqui** (Columbia University)
Clouds in weather and climate models: uncertainties and how to quantify, constrain, and propagate them with deterministic and stochastic approaches.
- 10:00–10:15 *Break*

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- 10:15–11:05 **Tapio Schneider** (California Institute of Technology)
Hybrid Physics/AI Modeling of Turbulence, Convection, and Cloud Feedbacks in the CliMA Climate Model
- 11:15–11:30 *Break*
- 11:30–12:20 **Damian Rouson** (Lawrence Berkeley Laboratory)
Learning cloud microphysics via progressive refinement mimicking maximal information entropy
- 12:30–2:30 *Lunch (on your own)*
- 2:30 *Session Chair: Marcus van Lier-Walqui*
- 2:30–3:20 **Dimitris Giannakis** (Dartmouth College)
Operator-theoretic approaches to feature extraction and statistical modeling of climate dynamics
- 3:30–4:00 *Break*
- 4:00–4:50 **Adam Rupe** (Pacific Northwest National Laboratory)
A complex systems perspective on machine learning for Earth science.

Wednesday February 4, 2026

- 8:00–8:55 *Check-in/Breakfast (hosted by IPAM)*
- 9:00 *Session Chair: DJ Gagne*
- 9:00–9:50 **Milan Curcic** (University of Miami)
Deterministic AI Agents for Downstream Tasks & Example Application to Hurricane Forecasting
- 10:00–10:15 *Break*
- 10:15–11:05 **Donifan Barahona** (NASA)
Synthesizing Observations, Simulations, and In Situ Data into a New Class of Atmospheric Retrievals
- 11:15–11:30 *Break*
- 11:30–12:20 **Maria Molina** (University of Maryland)
Learning Without Labels: New Insights into Climate and Extremes
- 12:30–12:40 *Group Photo*
- 12:40–2:30 *Lunch (on your own)*
- 2:30 *Session Chair: Dimitris Giannakis*
- 2:30–3:20 **Michael Fischer** (University of Miami)
A Machine Learning Approach to Estimate the Three-Dimensional Tropical Cyclone Kinematic Structure
- 3:30–4:00 *Break*
- 4:00–4:50 **Eduardo Siman** (Worldsphere.ai)
Image-to-Image Tropical Cyclone Wind Field Diagnosis

Thursday February 5, 2026

- 8:00–8:55 *Check-in/Breakfast (hosted by IPAM)*
- 9:00 *Session Chair: Tom Beucler*
- 9:00–9:50 **Po-Lun Ma** (Pacific Northwest National Laboratory)
Encoding microphysics in Earth system modeling with artificial intelligence
- 10:00–10:15 *Break*
- 10:15–11:05 **Mohamed Iskandarani** (University of Miami)
Uncertainty Quantification in Ocean-Atmosphere Simulations Using Polynomial Chaos Methods and Gaussian Process Regression
- 11:15–11:30 *Break*
- 11:30–12:20 **Claire Valva** (California Institute of Technology)
Koopman operator methods for analysis of tropical climate variability
- 12:30–2:30 *Lunch (on your own)*
- 2:30 *Session Chair: Maria Molina*
- 2:30–3:20 **Gary Froyland** (University of New South Wales)
Operator-theoretic methods for earth systems: atmosphere, ocean, and ML.
- 3:30–4:00 *Break*
- 4:00–4:50 *Open Discussion*

Friday February 6, 2026

- 8:00–8:55 *Check-in/Breakfast (hosted by IPAM)*
- 9:00 *TBA*
- 9:00–9:50 **Haiwen Guan** (Pennsylvania State University)
LUCIE: A Lightweight Uncoupled Climate Emulator with long-term stability and physical consistency
- 10:00–10:15 *Break*
- 10:15–11:05 **Franca Hoffmann** (California Institute of Technology)
Efficient calibration for black-box physics-based models
- 11:15–11:30 *Break*
- 11:30–12:20 **David John Gagne** (National Center for Atmospheric Research (NCAR))
Physics and Uncertainty in the Community Research Earth Digital Intelligence Twin

