



FALL MEETING

Washington, D.C. | 10-14 Dec 2018

WS34: Emerging Data Science and Machine Learning Opportunities in the Weather and Climate Sciences

Thursday, 13 December 2018

08:00 - 16:00

📍 *Grand Hyatt - Constitution AB and B Corridor*

Workshop Agenda

This full-day open workshop is organized in three sections that will provide an information exchange and communication platform for a diverse group of participants. It brings together weather and climate researchers, data scientists, statisticians, engineers, tech companies, program managers, educators, students, and other stakeholders to discuss newly emerging data science and machine learning opportunities for the atmospheric sciences.

Early and late morning sessions:

A) Grand Challenges, Science Drivers and Methods (Technical Forum)

1. Overview of data science approaches for the atmospheric sciences

Automated detection, classification and tracking of extreme weather and climate events

Causal discovery & relationship mining & teleconnections

Future-generation atmospheric models with embedded data-science concepts

High-impact weather and climate: Data science concepts for risk assessments & weather warning systems & impact studies

Review of atmospheric data challenges, statistics challenges, High-Performance Computing (HPC) and cloud computing aspects

2. Machine Learning (ML) vs Traditional Approaches in the Atmospheric Sciences

Opening the black box: Understanding the physical implications of ML

Differences in assumptions & representation

Juxtaposition of scalability with big data

Comparison of flexibility in incorporating various data sources

3. Feature Engineering in the Atmospheric Sciences

Spatio-temporal feature engineering

Spatial feature engineering (Geo-enrichment) in the atmospheric sciences

Example: Feature engineering for extreme event modelling

4. Model Visualization & Refinement

Assessing quality metrics for machine learning models of atmospheric phenomena

Global metrics

Spatial metrics

Spatio-temporal metrics

Improving an inferential model: which ML methods are wrong for which atmospheric phenomena and which are useful

Early afternoon session:

B) Key atmospheric science machine learning activities & interests & experiences (Stakeholder Forum)

Machine learning application exemplars and discussion of emerging trends from a weather and climate sciences/geoscience perspective: Collection of short presentations from a broad range of stakeholders including Academia

U.S. National Laboratories and Funding Agencies: NCAR, NOAA, DoE, NASA, NSF, USGS, EPA, Open-Data Providers

Industry partners like IBM's Weather Company, start-up companies, ESRI, cloud service providers (Amazon, Microsoft Azure/GEOAI, Google)

Late afternoon session:

C) Open Mic Session, Discussions in break-out groups, and Networking Forum / Mixer:

What are the emerging data science and machine learning frontiers for weather and climate research, applications and education?

Suggested topics with foci on opportunities and challenges

Physics-informed machine learning

Data science collaborations and partnerships, community-building across academia & industry

Educational, outreach, diversity and knowledge transfer activities

Statistics & data management & HPC, including Big Data aspects

Open atmospheric data: Current sources and future directions

Niche atmospheric machine learning model visualization challenges

Forms of prescriptive machine learning in the atmospheric sciences for decision making

Workshop Description

The disciplines of atmospheric science and data science are at a crossroads and about to experience scientific breakthroughs that are comparable to the revolution in bioinformatics over the last decade. Increasing volume and variety of weather and climate data has been driving the analysis towards scalable data-driven methods to complement and in some instances to replace traditional approaches. This multidisciplinary workshop brings together weather and climate researchers, data scientists, statisticians, engineers, tech companies, program managers, educators, students, and other stakeholders to discuss newly emerging data science and machine learning opportunities for the atmospheric sciences. In particular, high-impact weather and climate events will serve as the science driver to motivate the novel field of physics-aware, theory-guided data science.

Event For

Atmospheric Sciences, Earth and Space Science Informatics, Global Environmental Change, Hydrology, Natural Hazards, Nonlinear Geophysics, Ocean Sciences

Submitter

Christiane Jablonowski

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Presenters

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*Virginia Polytechnic Institute
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*National Center for
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Karthik Kashinath

*Lawrence Berkeley National
Laboratory*

John Williams

*The Weather Company, an
IBM Business*

Joshua Hacker

Jupiter

Onsite Contact**Christiane Jablonowski**

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Learning Objectives:

Workshop participants will learn how novel data science, data mining, and artificial intelligence techniques can innovate and inform atmospheric modeling practices, physical process studies, knowledge discovery, and the use of massive datasets and observational studies. Particular attention will be paid to machine learning concepts, and how machine learning techniques can be enhanced to become aware of physical constraints. The workshop is highly interdisciplinary. Tutorial-like overview talks will first outline the data science and machine learning opportunities and challenges for the atmospheric sciences. These concepts will then be further explored via short application examples and case studies. Participants will come from academia, U.S. national research laboratories and funding agencies, international institutions, and industry. This will provide a diverse and stimulating discussion forum to foster future collaborations and partnerships.

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