Baoxiang Pan

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EDUCATION

PostDoc Researcher 2019.7-present
Lawrence Livermore National Laboratory
Advisor: Doctor Donald Lucas
Subseasonal to seasonal climate forecast

Ph.D. in Civil Engineering 2015.9-2019.4
University of California, Irvine
Advisor: Professor Soroosh Sorooshian, Kuolin Hsu, and Amir AghaKouchak
Thesis: Advancing Subseasonal to Seasonal Forecast using a Composite of Models and Data

- Combining dynamical simulation and machine learning to predict unresolved atmospheric processes.
- Deep neural network enhanced Monte Carlo for optimization and data assimilation.
- Prediction and predictability through a continuous temporal spectrum.

M.A. in Hydraulic Engineering 2012.9-2015.6
Tsinghua University, China
Advisor: Professor Zhentao Cong
Thesis: Uncertainty Analysis in Hydyrological Simulation based on Extended Stochastic Soil Moisture Model

- Stochastic modeling of catchment hydrological processes.
- Uncertainty estimation using information theory and statistical learning.

B.A. in Hydrology and Water Resources Engineering 2008.9-2012.6
Wuhan University, China
Supervised by: Professor Lihua Xiong
Thesis: A Comparison of Conceptual Hydrological Models for Monthly Runoff Forecast

RESEARCH PROJECTS

Modeling, Analysis, Predictions, and Projections Program 2016-present
Founded by: *National Oceanic and Atmospheric Administration (NOAA)*

We carried out a systematical evaluation on general circulation models (GCMs) prediction skill for short- to extended-range period. We also evaluated the impacts of key sources of predictability on weather/climate variation and models' prediction skills. Our results benefit (1) comprehensive understanding of *where we are* in dynamical prediction of the weather system through a continuous temporal spectrum, (2) clarification of

GCMs' achievements/deficiencies in realizing the potential of key predictability sources for extended-range forecast, (3) leveraging multi-model multi-ensemble forecast with an explicit consideration of model uncertainties.

Advancing Drought Onset Detection and Seasonal Prediction Using a Composite of NASA Model and Satellite Data 2015-present

Founded by: *National Aeronautics and Space Administration (NASA)*

We tested the impact of key climate indexes on subseasonal-to-seasonal (S2S) precipitation variation along the west coast United States. The test was carried out using a composite of classical machine learning approaches, including tree models, ensemble-based models, kernel models, Gaussian Process, and neural network models. Results suggest no significant informative signal is found for predicting the baroclinic system at S2S scale.

A promising exception lies in the teleconnection between the the Madden-Julian Oscillation (MJO) and landfalling atmospheric rivers along the west coast. We expect the teleconnection to be better illustrated through *learning* informative representations of tropical convection patterns, rather than depending on existing MJO indexes only. Currently we are applying deep recurrent neural network to go through the tropical dynamic field, exploiting more expressive representation of the teleconnection signal, and more accurate prediction for the land-falling location of atmospheric rivers.

Precipitation Estimation from Multi-Satellite Observations and Numerical Model Variables Using Deep Neural Networks Under approval

Potentially Founded by: *NASA*

Precipitation estimation constitutes a critical aspect in both earth observation remote sensing (RS) and numerical weather modeling (NWM). We propose to apply deep neural networks to merge the RS and NWM information for our next-generation precipitation estimation product (PERSIANN: Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks). Progresses could be achieved through (1) using information from multi-satellite multi-spectral RS images and NWM resolved dynamic fields, (2) explicitly encoding the spatiotemporal structure of the precipitating clouds with advanced deep learning architectures.

Integrated Research on the Eco-hydrological Processes of the Heihe Basin, Project Nos. 91225302, 91425303 2013-2015

Founded by: *National Science Foundation of China*

We made a line-by-line derivation of the stochastic process equation that characterizes the soil moisture dynamics for an inhomogeneous catchment. The analytic model blends the combined Poisson process stochastic soil moisture model with the variable infiltration capacity hydrologic model. Based on this framework, we applied information theory to attribute the uncertainty to different aspects in hydrologic modeling.

SKILLS

Languages	Mandarin Chinese (mother tongue) English (fluent)
Coding	MATHEMATICA(Proficient in data processing, drawing and modeling) PYTHON (Fluent and familiar with deep neural network libraries) LaTeX(Proficient for academic writing and presenting) BASH (Fluent for efficient file operations) LISP (Proficient) MATLAB (Fluent)

	C (Fluent) Julia (Basic)
Software	WRF, Jupyter, Microsoft Office, and Git
Operating System	Proficient in Unix, MacOS, and Windows Experienced with high-performance computing cluster environment Experienced in GPU computation for deep neural network training

PUBLICATIONS

- Journal Papers
  - **Pan B.**, Hsu K., AghaKouchak A., Sorooshian S., and Higgins W., 2018, Precipitation Prediction Skill for West Coast United States – From Short to Extended Range, **Journal of Climate**, 32.1 (2019): 161-182.
  - **Pan B.**, Hsu K., AghaKouchak A., Sorooshian S., 2018, Improving Precipitation Estimation Using Convolutional Neural Network, **Water Resources Research**, 2019/1, doi: 10.1029/2018WR024090
  - **Pan B.**, Anderson G., Goncalves A., Lucas D., Bonfils C., Lee J., Tian Y., Ma H.Y., 2021, Learning to correct climate projection biases, **Journal of Advances in Modeling Earth Systems**, under print
  - **Pan B.**, Anderson G., Goncalves A., Lucas D., Bonfils C., Lee J., 2021, Improving seasonal forecast using probabilistic deep learning, **Journal of Advances in Modeling Earth Systems**, under review
  - **Pan B.**, Cong Z., 2016, Information Analysis of Catchment Hydrologic Patterns across Temporal Scales, **Advances in Meteorology**, 2016 (2016), doi: 10.1155/2016/1891465.
  - Ma Y., Zhang Z., Ihler A., and **Pan B.**, Estimating Warehouse Rental Price using Machine Learning Techniques. **International Journal of Computers, Communications** & **Control.** 13.2 (2018), doi: ijccc.2018.2.3034.
  - **Pan B.**, Hsu K., AghaKouchak A., Sorooshian S., 2018, Improving Hourly Precipitation Forecast using a Neural1 Encoder-Decoder Model. Prepared to submit to **Water Resources Research**.
- Meeting Presentations
  - **Pan B.**, Hsu K., AghaKouchak A., Sorooshian S., 2017, The Use of Convolutional Neural Network in Relating Precipitation to Circulation. **AGU Fall Meeting Abstracts**, 2017.
  - Ma Y., Zhang Z., **Pan B.**, 2017, Attributing Crop Production in the United States Using Artificial Neural Network. **AGU Fall Meeting Abstracts**, 2017.
  - **Pan B.**, Cong Z., 2014, Monthly Hydrological Model Evaluation through Mapping the Hydrological Pattern to Information Space. **AGU Fall Meeting Abstracts**, 2014.