ZILU MENG

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EDUCATION

Ph.D. Student in Climate and Atmospheric Sciences, University of Washington 2023 - Now
Adviser: Gregory J. Hakim & Eric J. Steig
GPA: 3.99/4.0

B.S. in Atmospheric Sciences with Honors, Nanjing University of Information Science and 2019 - 2023
Technology (NUIST)
Adviser: Tim Li
GPA: 95/100 (Ranked 1st/50 in the class with honors)

RESEARCH INTEREST

Paleoclimate Reconstruction, Data Assimilation, Machine learning, Climate dynamics, El Niño and Southern Oscillation

PUBLICATIONS

- **Meng, Z.**, Hakim, G. J., Steig, E. J. (2025). Coupled Seasonal Data Assimilation of Sea Ice, Ocean, and Atmospheric Dynamics over the Last Millennium. Journal of Climate, submitted.

- **Meng, Z.**, & Hakim, G. J. (2024). Reconstructing the Tropical Pacific Upper Ocean using Online Data Assimilation with a Deep Learning model, Journal of Advances in Modeling Earth Systems, 16, e2024MS004422. https://doi.org/10.1029/2024MS004422

- **Meng, Z.**, & Li, T. (2024). Why is the Pacific meridional mode most pronounced in boreal spring? Climate Dynamics, 62(1), 459–471. https://doi.org/10.1007/s00382-023-06914-4.

- Zhu, F., J. Emile-Geay, K. J. Anchukaitis, N. P. McKay, S. Stevenson, and **Z. Meng** , 2023: A pseudo-proxy emulation of the PAGES 2k database using a hierarchy of proxy system models. Sci Data, 10, 624, https://doi.org/10.1038/s41597-023-02489-1.

- **Meng, Z.**, Z. Hu, Z. Ai, Y. Zhang, and K. Shan, 2021: Research on Planar Double Compound Pendulum Based on RK-8 Algorithm. Journal on Big Data, 3, 11–20, https://doi.org/10.32604/jbd.2021.015208.

RECENT EXPERIENCE

Coupled Seasonal Data Assimilation of Sea Ice, Ocean, and Atmospheric Dynamics over the Last Millennium Dec.2023–Now
Supervisor: Prof. Gregory J. Hakim & Prof. Eric J. Steig (University of Washington) *Seattle, WA*

- Developed an "Online" data assimilation (DA) method that integrates forecasts from a coupled ocean-atmosphere-sea-ice model with climate proxy records to create a seasonal-resolution reanalysis dataset of the last millennium.

- Enhanced method accuracy and efficiency by employing a novel season-to-season updating strategy, achieving high correlation with surface temperature reconstructions and other oceanic and sea ice variables.

- Demonstrated method's robustness through direct proxy verification, effectively capturing seasonal evolution of El Niño events and distinct climate phases like the Medieval Climate Anomaly and Little Ice Age.

Reconstructing the Tropical Pacific Upper Ocean using Online Data Assimilation with a Deep Learning model Dec.2023–Dec.2024
Supervisor: Prof. Gregory J. Hakim (University zf Washington) *Seattle, WA*

- Developed a transformer-based deep learning model that outperformed traditional linear inverse models in forecasting accuracy for the tropical Pacific.

- Data assimilation on a sparse network of observations accurately reconstructs the monthly upper ocean spatial fields across observation periods from 1 month to 1 year.
- The superior reconstruction skill of the DL model stems from its enhanced prediction skill.

Why is the Pacific Meridional Mode (PMM) Most Pronounced in Boreal Spring? Sep.2021–June.2023
Supervisor: Prof. Tim Li (University of Hawaii, Manoa) *Honolulu, HI*

- Explore the reason why PMM is strongest in boreal springs by the numerical model and observational data.
- Attribute Northeast trade and North Pacific Oscillation's seasonal intensity to the main reason.
- Redevelop and modify the Zebiak-Cane model for verification.

Prediction of Climate Variability in the Tropical Pacific using ConvLSTM Jul.2021–Dec.2022
Supervisor: Prof. Fei Zheng (Institute of Atmospheric Physics, Chinese Academy of Sciences) *Beijing, China*

- Use ConvLSTM to forecast the climate variability in the Tropical Pacific Ocean.
- Develop a neural network forecasting system capable of predicting ENSO 18 months ahead.
- Analyze the reasons for the bias of ConvLSTM prediction.
- Use the Grad-CAM method to study the attribution of El Niño and La Niña.

SOFTWARE PROJECT

CFR Participated in developing a universal framework for climate field reconstruction . (Try it here)

Sacpy Built an efficient and useful Statistical Analysis module for Climate data in Python. Over 20000 people have used it so far, with 58 stars on Github! (Try it here)

Deep Learning for ENSO Deep learning and Grad-CAM are used to study the cause of El Nino (La Nina). Over 100,000 people have read articles on Zhihu with 48 stars on Github (Try it here)

Prof. John M. Wallace's Website Helped Prof. John M. Wallace to build a personal website. (Try it here)

GRANTS

- Undergraduate Scientific Research Fund, Chinese Academy of Sciences, 2021/06-2023/06 (10,000 CNY, Leader)
- Undergraduate Innovation Fund, NUIST, 2020/04-2021/04 (10,000 CNY, Leading Member)

AWARDS AND SCHOLARSHIPS

- Robert Fleagle Endowed Graduate Support Fellowship, Univeristy of Washington, 2023
- National Scholarship of the Ministry of Education (Top 0.2%)
- Presidential Scholarship, NUIST, 2021 (Top 0.3%)
- Pacemaker to Merit Student, NUIST, 2020,2021,2022 (Top 1%)
- First Prize of National College Students' Higher Mathematics Competition, Chinese Mathematics Association, 2021 (Top 5%)
- First Class Scholarship, NUIST, 2020 (Top 15%)

CONFERENCE PRESENTATION

- AGU Fall Meeting, Washington, D.C., USA, 2024 Dec. Oral Presentation. Title: "Reconstructing the Tropical Pacific Upper Ocean using Online Data Assimilation with a Deep Learning model".
- Graduate Climate Conference, Seattle, WA, USA, 2024 Oct. Title: "Last Millennium Seasonal Reanalysis".
- Nanjing Data Assimilation Workshop, Nanjing, China, 2024 June. Title: "Deep Learning for tropical pacific reconstruction".

- GCC Meeting 2024, Seattle, WA, USA, 2024 May. Title: "Deep Learning for Data Assimilation".
- AGU Fall Meeting, San Francisco, CA, USA, 2023 Dec. Title: "Sacpy: Python Package for Statistical Analysis of Climate".

LEADERSHIP AND SERVICE

Teaching Assistant, University of Washington   Dec. 2024–Mar. 2025

- Served as a Teaching Assistant for ATMS504 Atmospheric Motions II.
- Deliver lectures on laboratory experiments.
- Assisted in grading homework, compiling Python code, and providing academic guidance.

Class Leader, 2019 Elite Class of Atmospheric Science, NUIST   Sep. 2019–June. 2022

- Managed daily class affairs and logistics.
- Earned the title of Excellent Class at NUIST in 2021.

Teaching Assistant, NUIST   Sep. 2020–June. 2021

- Assisted in teaching Advanced Mathematics and in grading assignments.
- Provided academic guidance and support to students.

PEER REVIEW SERVICE

Earth System Science Data	Atmosphere	Radio Science
Climate Dynamics	Frontiers in Earth Science	Plos One
JGR Machine Learning and Computation		

SKILLS

Programming Skills	Python, Fortran, Matlab, Linux Shell
Climate Models	CESM, ECHAM, Cane-Zebiak Model
Machine Learning	TensorFlow, Pytorch, Scikit-learn
Data Assimilation	Ensemble Kalman Filter, 3D-Var, 4D-Var