Yi Zhuang (庄逸)

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Education

Institute of Atmospheric Physics, Chinese Academy of Sciences 2021 – 2026 (Expected)
Ph.D. in Meteorology

UC Berkeley 2020 Spring
Exchange student in Mechanical Engineering

University of Chinese Academy of Sciences 2017 – 2021
B.Eng. in Theoretical and Applied Mechanics

Bio

I am 26-year-old PhD student at Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP-CAS). At the intersection of planetary science and nonlinear dynamic, my research focus on **the predictability of the Martian atmosphere**. Aside from main research works, I often dive into personally interested mathematical, physical or technical problems and summarize with blogs. For future research, I am willing to explore **planetary atmosphere dynamics, numerical modelling, predictability and nonlinear dynamic** topics.

Publications

1. Yi Zhuang, Wansuo Duan, Li Dong. **Season-dependent weather predictability barrier phenomenon in the Martian Atmosphere**. *Geophysical Research Letters*. Under review.

I also published a book on study guides for high school mathematics in 2017.

Conferences

1. **Mars Through Time**. 2025/10. Paris. France. *Poster*. Yi Zhuang, Wansuo Duan, Li Dong. Season-dependent Weather Predictability Barrier phenomenon in the Martian atmosphere.
2. **8th Symposium on Nonlinear Atmospheric and Oceanic Science**. 2025/08. Inner Mongolia, China. *Outstanding Poster* (Top 6/32). Yi Zhuang, Wansuo Duan, Li Dong. Season-dependent Weather Predictability Barrier phenomenon in the Martian atmosphere.
3. **Distinguished Lectures on Planetary Atmospheres 2023-2025**. 2023-2025. Peking University, China.
4. **AOGS-2025**. 2025/07. Singapore. *oral*. Yi Zhuang, Wansuo Duan, Li Dong. Season-dependent Weather Predictability Barrier (S-WPB) phenomenon in the Martian atmosphere.
5. **2024 National Planetary Science Conference**. 2024/10. Nanjing, China.
6. **2nd, 3rd Summer School on Nonlinear Optimization Methods**. 2020-2021. Online.
7. **2020 BASC Symposium**. 2020/02. UC Berkeley, USA.

Awards and Honors

Merit Student of University of Chinese Academy of Sciences (UCAS) 2024/2019 2025/05, 2019/12
Outstanding President of the LASG Student Union Presidium 2024/03
Freshman Scholarship of IAP-CAS 2020/07
Guo Yonghuai Mechanics Honors Scholarship and Competition-Based Scholarship of UCAS 2019/09

Research Experiences

The predictability of Martian Atmosphere Since 2022/09
Ph.D. Thesis Supervisor: **Prof. Wansuo Duan**

- By applying Bred Vector (BV) method in the LMD Mars PCM model, we reveal a **season-dependent weather predictability barrier** phenomenon in the Martian atmosphere. We identify a water ice-radiation positive feedback and propose a novel condensation potential index peculiar to Martian atmosphere to uncover its underlying mechanism and origin of its spatiotemporal dependence.
- We build numerical optimization program adapting the Spectral Projection Gradient method to **solve the Conditional Nonlinear Optimal Perturbation (CNOP)** in the LMD Mars model. The CNOP represents initial errors which induce largest forecast error, and indicates predictability limit for Martian atmosphere.
- With the help of CNOP, We conduct Observing System Simulation Experiment (OSSE) to quantify the improvement of forecast level through **assimilation with targeted observation**. (*planned*)

Effects of Topography on Nonlinear Internal Wave in Three-layer Flows 2020/09 – 2021/06

Bachelor's Thesis Supervisor: **Prof. Zhan Wang**

- Through asymptotic analysis, we derive governing equations for weakly nonlinear long wave (KdV and KP equation up to 5^{th} order) in a three-layer shallow water model with topography. Then, we illustrate numerical results with selected representative topography settings.

Material Transport of Flows induced by Nonlinear Internal Wave 2019/07 – 2020/12

Undergraduate Research Practice Supervisor: **Prof. Zhan Wang**

- We derived the mathematical expression for material transport by wave-induced flows. Then, we explore the characteristics of flows induced by KdV, MCC and DJL type internal waves, and discuss their ability in material transport and contributing factors respectively.

Professional Skills

- **Conduct Experiments with LMD Mars Planetary Climate Model**
  - Develop Python and Shell scripts or modify model codes to achieve diverse objectives.
  - Develop simple assimilation scheme and EGB-SPG optimization program for CNOP calculation.
- **Process data and Conduct Numerical Experiments with Python and MATLAB**
  - Obtain data from Martian Climate Database (MCD) through Python interface.
  - Post-process and visualization of atmospheric reanalysis and model experiment data.
  - Explore topics numerically, e.g. ENSO recharge ossillator, DJL internal wave simulation.
- **Profound Understanding of Research Fundamentals**
  - Predictability study, origin of forecast errors, concept and application of CNOP.
  - Characteristics and key processes of Martian atmosphere.
  - Normal and stochastic dynamical system, PDF evolution governed by Liouville equation.
  - Mathematical skills for solving ODE/PDE and deriving atmospheric equations.
- Language: English (TOEFL 100), Novice French (CEFR-early A1) and Japanese.
- Other practiced technical skills: LaTeX, Git, Vue.js, Mathematica, WordPress, etc.

Transferrable Skills

- Managed research group's **multimedia equipment** to ensure seamless hybrid (online/offline) meetings.
- Assisted in **hosting 3 visiting international scholars**, coordinating their tours and gift exchanges.
- As a member of the **LASG Student Union Presidium**, lead information collection and equipment management for commencement ceremonies and graduate academic forums.
- Participate in **conference logistics** including registration, materials distribution, and poster mounting.