

## 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. **A Season-dependent weather predictability barrier phenomenon in the Martian Atmosphere**. *Journal of Geophysical Research: Planets*. Under Consideration.

## RESEARCH EXPERIENCES

### The Predictability Barrier of Martian Atmosphere and its Mechanism 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.
- The CNOP method proves superior in capturing initial atmospheric instabilities, revealing **a novel mechanism involving water ice, dust, and shortwave radiation**. Its further application demonstrates the characteristics of fast-growing initial errors across different sizes and forecast lengths.

### 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<sup>th</sup> 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.

## 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. **8<sup>th</sup> 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. **2<sup>nd</sup>, 3<sup>rd</sup> Summer School on Nonlinear Optimization Methods.** 2020-2021. Online.
7. **2020 BASC Symposium.** 2020/02. UC Berkeley, USA.

## 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 & optimization program (EGB-SPG) 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, e.g. Model experiment and reanalysis data, Lorenz energy cycle.
  - Explore physical topics numerically, e.g. ENSO recharge oscillator, 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 in 2020), Novice French (CEFR-early A1) and Japanese.
- Other practiced technical skills:  $\text{\LaTeX}$ , Git, Vue.js, Mathematica (Certified), etc.

## TRANSFERRABLE SKILLS

- I **published a book** on study guides for high school mathematics in 2017.
- Managed research group's **multimedia equipment** to ensure seamless hybrid (online/offline) meetings.
- Assisted in **hosting visiting international scholars** 3 times, 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.

## 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