**Research page for Karim Mohamed El-Sharkawy**

Regular Meetings: TBA.

* Graduate Mentor: Zhaoyu Liu
* One-credit Hour. Office keys received. Box for file sharing.

Research objectives (sent to Lei on June 3):

My research objective has some short-term goals that I’d like to achieve by the end of this research mini-project, but also has an ultimate long-term goal I’d like to achieve with all my research projects over my lifetime. My short-term goals are to better my understanding of the climate of Mars and planetary climates in general. Another short-term goal is for me to gain understanding on how to conduct research. My long-term goal is to ultimately be able to help atmospheric scientists understand the climate of Earth by comparing them to the climates of other planets (even if they may be vastly different). Ultimately, I want this mini-project to kickstart my research career in planetary climates and I want to gain this experience from studying mars and apply it to other planets.

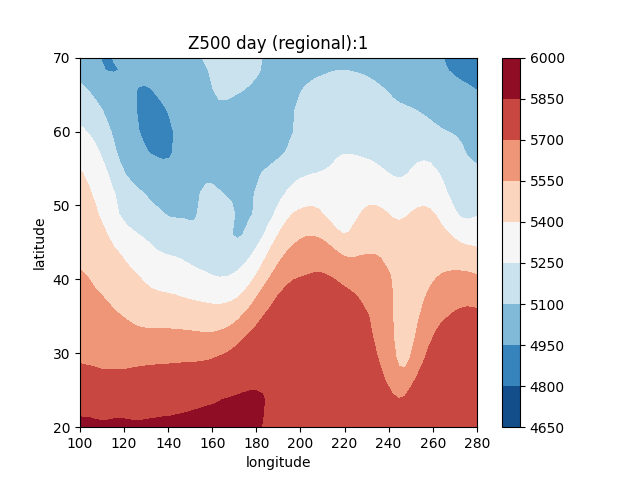
I will be focusing on annular modes and how to quantify them using the EMARS and MACDA data sets. My question will be: **“How can the Annular modes of Mars be accurately quantified?”.**

My short-term plan is to read more on Annular modes and their effects on the dust activity on Mars. I hope to read more of Joe Michael Battalio’s research on the subject and specifically his paper with Juan M. Lora titled “Annular Modes of Variability in the Atmospheres of Mars and Titan”. I also plan to derive an equation for the Annular modes using the dust activity along with other quantities like perhaps temperature, areocentric longitude, sols after the last Martian vernal equinox, etc. I plan to derive this equation or set of equations using manipulation of variables and the data sets already mentioned. There is some vagueness in this plan that I hope to figure out after I become more familiar with this topic.

My long-term plan is more vague because I don’t really know how I’ll be improving in this field yet. By now I think I’d have dived deep into annulars modes and started studying the interactions between all the different waves.

**Meeting May 13, 2022:**

* Regular meeting Friday afternoon 4pm.
* Preparation One: understand the type of the data: **netCDF**
* Sample python code ([link](https://www.dropbox.com/s/v4xa9a7r9u34swj/read_Z500.py?dl=0)) and sample data ([link](https://www.dropbox.com/s/xvbs2t9tivki1ql/Z500_ens1.nc?dl=0)). take a screen snapshot of your plot and paste here below.
* Preparation Two: understand the vertical structure of the Earth atmosphere.
* access the textbook ([link](https://purdue.primo.exlibrisgroup.com/discovery/fulldisplay?vid=01PURDUE_PUWL:PURDUE&tab=Everything&isFrbr=true&docid=alma99169784198901081&searchScope=everything&context=L&lang=en)) and read carefully the entire chapter one.
* In particular, please understand the Figure 1.3 and Figure 1.4.
* Task: put your questions in writing via email;



**Meeting May 20, 2022:**

* please watch the tutorials by Lei from last year ([link](https://docs.google.com/document/d/1F5-DdUqNRC2vhcRTYS-HWrmbzXFaazpR1L6EKOsfdVY/edit)).
* you are already read martian-atmosphere channel in discord and have played the data. please write one paragraph of your research interests. please write that here, and then notify Lei via Discord or Slack.
* Please reach out to Audrey to develop a strategy to work and have conversations.
* Consider the three options: (1) help Audrey with her research activity; (2) develop a mini-project of your own, including a hypothesis, an approach to test that hypothesis; (3) focus on literature, read 1 paper a week and then share reflections.
* Your experience with the GFD bootcamp.
* Textbook: Planetary climate [link](https://purdue.primo.exlibrisgroup.com/discovery/fulldisplay?docid=alma99169235589801081&context=L&vid=01PURDUE_PUWL:PURDUE&lang=en&search_scope=MyInst_and_CI&adaptor=Local%20Search%20Engine&tab=Everything&query=any,contains,planetary%20climate&facet=rtype,exclude,reviews,lk&facet=rtype,exclude,reference_entrys,lk)
* AGU abstract deadline August 2, 2022. [link](https://www.agu.org/Fall-Meeting)
* office HAMP 4267

My research interests concerning atmospheric science are anything related to other planetary bodies. At the current moment, I'm very interested in other planetary atmospheres (within our solar system and exoplanets) as well as exoplanet and even exomoon detections (however, this is more astronomy related). My motivation for this is the very fact that our understanding of other climates affects the understanding of our own. In other words, studying atmospheres can help us understand our own even better and be able to perhaps see a factor that we were missing in Earth’s climate. I am obviously only looking at Mars for this 1 credit research, but I’m very interested in the climates of the icy planets in our solar system and the climates of hot Jupiters (exoplanets). While I am also a mathematics major, my interests in mathematics (only real analysis at the moment) don't seem obviously related to my interests in the Planetary Climate sciences. However, this is subject to change as I learn more about math. I would love to combine these interests one day in the future.

**Meeting May 25, 2022:**

* Explore the database for AGU fall conference 2017-2022
* For example, the 2021 AGU meeting has this [link](https://agu.confex.com/agu/fm21/meetingapp.cgi/Home/0).
* Identify presentations (talks and posters) that touch on martian atmosphere and dynamics.

Planetary Climates

- history of planetary climates

- planets I'm interested in: Uranus (difficult), Neptune (difficult), Saturn (easier), moons of any planets, and any exoplanets!

- Mars' climate:

1. How has the planet's climate changed over time?

2. Is there a good climate model for mars' climate?

3. What was the past climate of mars (do we have a climate model of it say 350 million years ago)?

4. How does the distance from the sun affect its climate and how has it affected its past climates?

5. Is the climate on Mars different from location to location, and why so? What are the factors (time, distance from sun, orbital period, obliquity, precession, loss of mass due to specific particles being lost, etc.)?

6. Areography

7. dust whirlwinds

8. perhaps look at the difference between the different poles.

**Meeting June 1, 2022:**

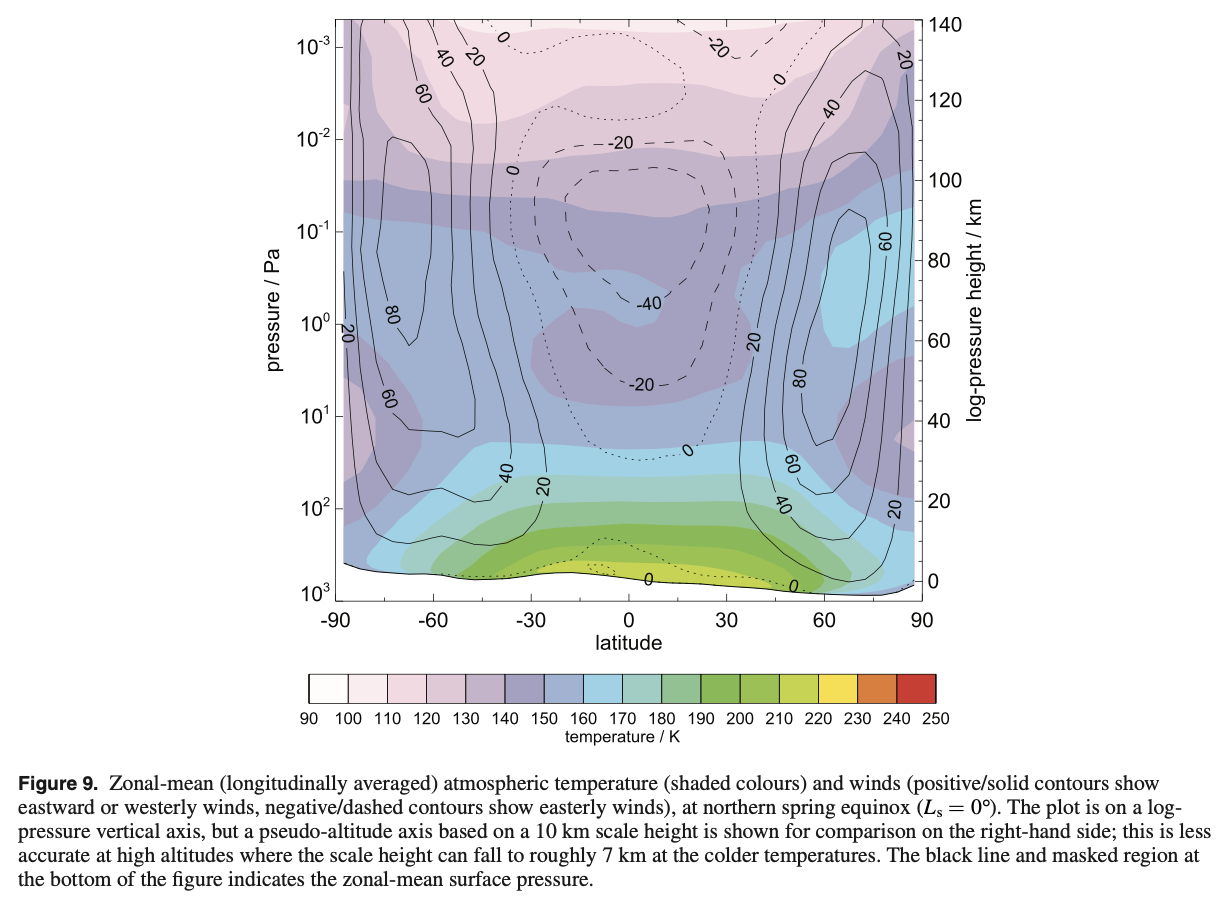
* Take a quick look of this paper ([link](https://journals.ametsoc.org/view/journals/atsc/79/2/JAS-D-21-0038.1.xml)) and the recent works by the same author.

**Cross group presentation reflections June 9, 2022:**

* I loved this meeting! Before the meeting I had thought that there was no need to message anyone outside of my group. Wow, did this meeting completely change that! I already messaged one of the machine learning folks and I hope to message the others.
* I really liked that Professor Wang asked us what we liked and disliked about our experiences so far. This short time was a good time of reflection for me because of what the other students mentioned. The good points that they mentioned made me more grateful for the things the Professor did or the other group members did. I hope to do things like that again.

**Meeting June 10, 2022:**

* Fall 2022.
* this paper [link](https://people.earth.yale.edu/sites/default/files/battalio_lora_2021_annular_modes_of_variability_in_the_atmospheres_of_mars_and_titan.pdf)
* Reproduce the Read\_2015.pdf [link](https://app.box.com/s/z4p2tktc4pv1bvrh7x5w0bp5xeyi6bx9) Figure 9



Shading: the zonal-mean temperature

Contour: the zonal-mean zonal winds

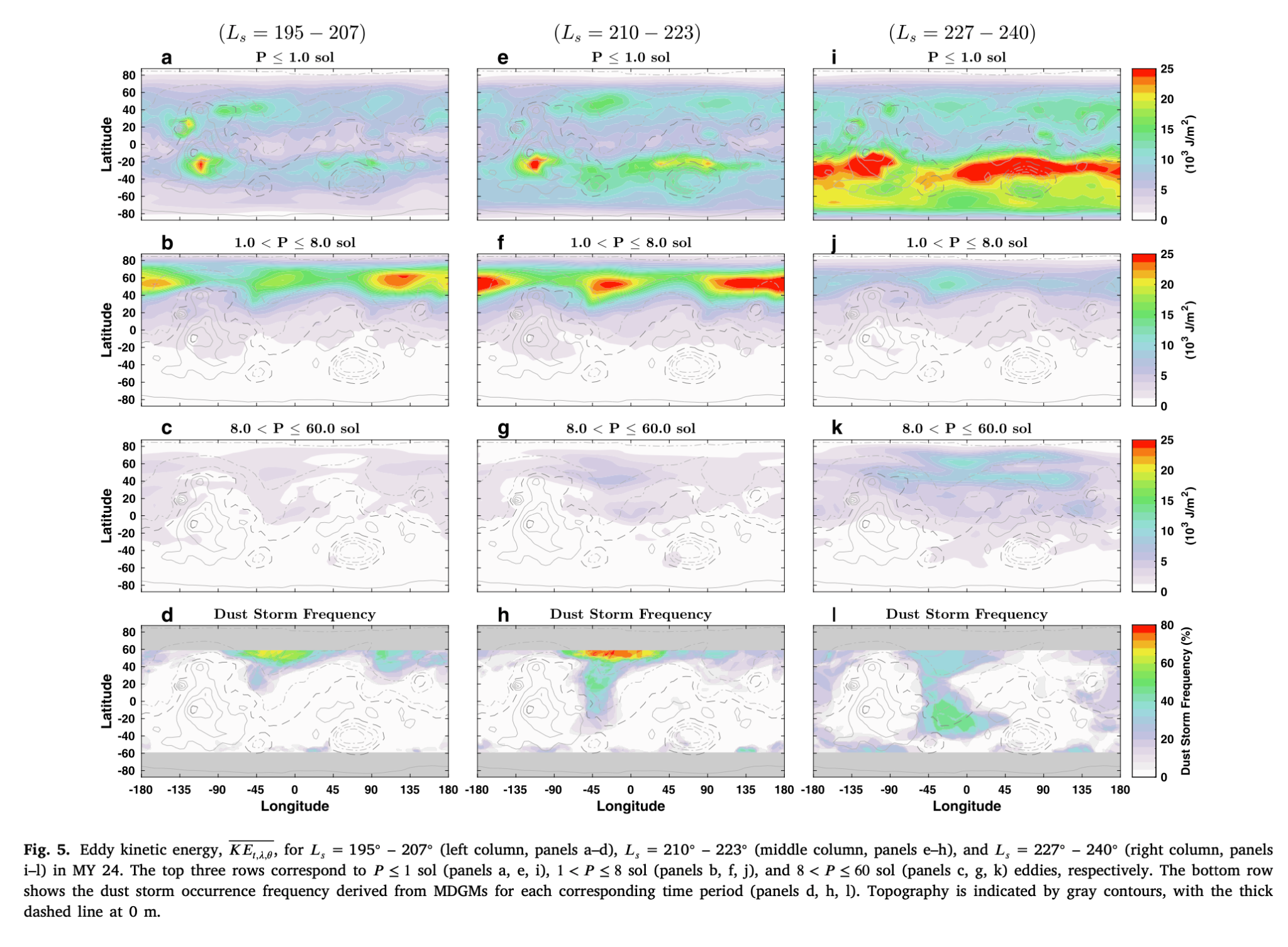
make sense of the y-axis

**Meeting August 3, 2022:**

* We need to submit the abstract which is due midnight today August 3.
  + First, please sign up and register for a student membership with AGU ([link](https://www.agu.org/Fall-Meeting)).
  + Please watch your emails.
* Our AGU abstract

**Meeting Sept 7, 2022:**

* Hourly Rate process.
* Present a paper in group meeting paper 1 [link](https://pdf.sciencedirectassets.com/272593/1-s2.0-S0019103520X00157/1-s2.0-S001910352030405X/main.pdf?X-Amz-Security-Token=IQoJb3JpZ2luX2VjEIT%2F%2F%2F%2F%2F%2F%2F%2F%2F%2FwEaCXVzLWVhc3QtMSJIMEYCIQCxbQGu7R4ZaJB4u8iY%2BcnJZcXjHzBXD1rCzGZtvBudnQIhANdyWInfiOOzYCqCDIe6SMzCeUudRLUU%2F%2FYdsSwxLUWBKswECBwQBRoMMDU5MDAzNTQ2ODY1Igzu8dmUH6%2FrmuswVbsqqQR%2FFjqTQg3CW2MF2Gr6LtvqnCXHg%2Bwvcpmc4eHM4lHlo8H2UbzO%2F99tQkg4yFMZmOXB7S89z6RvT%2BmXIE5lxKUZZYWecQK5QkpQZfGkc17RNL%2BWxv9sl2YL9p1Sqp7xoSy5NAV%2B1sbUCvREQSOVKvepmZCgkKm%2F0zLWTxNgOpQ9F5SALPuBiHLuQrGtSDnQ9u3kjmovUOxU3ZYKe1h37pXVR6Ng%2FkzoQCy6oFTccbVO48dg9NVWdOzAiwbK2tfj4JX0OddimD5321IA6jRRYCU1rnj2ZFOcDgort9B4lCnVJgDX02slRDicwQ1s19sKnKG1pRtnMaBd6L%2BPW1TmJ7ZNaoo8SZdExkCSXmZSCKxXUfbWlOtB%2Bm8a%2BoHapqlSkJBMG%2BVzwJji%2Fm%2BmPvylcyi0OMOgnHyNF%2Fc7lIfsh7AK0zfJf%2BFDe69glHpLdwbACvnkqrG1SclFoyVpzhPPUA2tWzCKQSP94N39nk%2F%2F8JYChSbI3GdQkrZp8RmFE0ZhuK6M%2Fo2gvkAhSL6comH0aMqApR8XGEhxugbEGNTakNdl6oJjFh6nozUlTUiFjE7KgKPL7M2hgJn3VsnNMKGyfHZcqA5zMvvgxy6K6vfHT8PtAIp%2Ff3ceYfU6%2FDUY%2B7%2B88w%2BX8Zm37c%2B42weXd2sVVOkjJxUp1UKonhSe5%2Bo0DgFektdeFIvUB6%2BXRdtwRhF%2BEBAWu%2BokXBuXTZBcRKabcnfuVDIBCI8HaQB2MJ3d45gGOqgBZIviF7t3qssUyRu1nBeHZ6VjzoK4SQO9OhjIc4F7x66u6tZxesf9Tt5iwv0AKRzcMOQg4sm%2Btucq9MVcwicCUjEr5J3KgRgM0gWfaGxk1GHWhwNmWCRqUq%2BRiyo1Ukd86J8AZm%2BcHQCtrXxpQ3adYoLD9lMyxjLAVOxjhgbHxTU%2BpjPEPjfSOG%2FzzvyVYbZgWroCpvZ1Qfa6pSn%2BcYZCTrTbEBll77Gp&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Date=20220907T202944Z&X-Amz-SignedHeaders=host&X-Amz-Expires=300&X-Amz-Credential=ASIAQ3PHCVTYXZONGQEY%2F20220907%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Signature=f16ad2af72438c37f6e144fa77296f75548233656c4041e994b6899b456e3b30&hash=0683ece4a10ba995f43eb0937a98882a711de6e8e455452546581a372b45af91&host=68042c943591013ac2b2430a89b270f6af2c76d8dfd086a07176afe7c76c2c61&pii=S001910352030405X&tid=spdf-61baef3c-009a-4f0c-8d3c-b80666d7da81&sid=8b6e22d683002642559bc2934f1cf40545aagxrqa&type=client&ua=5457585552520d0302&rr=747232befe0a20b5) and paper 2 [link](https://www-sciencedirect-com.ezproxy.lib.purdue.edu/science/article/pii/S0019103519302763?via%3Dihub).
* Mars atmosphere: (1). identify the counterpart of Z500 on Mars. (2). extract the data to make a single netcdf file. (3) reproduce a key figure Fig 5.
* Lei will collect a series of travel funds for UG researchers to subsidize the AGU costs.
* **For Karim**, please focus on simple theory: (1) for zonal wavenumber one, creating a wave propagation pattern for the Mars atmosphere based on linear dispersion relationship. And add more wavenumbers. (2) plot wave propagation pattern from the Mars reanalysis products.



**Meeting September 26, 2022:**

* We have regular weekly meetings on Mondays at 4:00pm via Zoom.
* Karim will present the two papers on the Group Meeting on Friday October 7th at 3pm.
* To prepare for our next meeting, there are three things:
  + (1) read the proposal abstract ([link](https://docs.google.com/document/d/1ZwoNKqbU0DuDf7cTBP7f-X8oT4D27QeoTy1aCxc5Iq0/edit?usp=sharing)) and come up with one question.
  + (2) learn a key atmospheric diagnostic called local wave activity by watching this recording ([link](https://www.dropbox.com/s/qxtxclpgmetc8i4/GMT20220623-Zhaoyu_LWA.mp4?dl=0)) by Zhaoyu.
  + (3) talk to / communicate to Audrey to learn more about the dust storm datasets ([link](https://battalio.com/mars-dust-activity-database/)), and prepare a 1-min version of elevator speech to lei.