COMPARING THE CLIMATES OF MARS AND EARTH

A Look at Current Global Models

By Camille Cowan, Daniel Marsh, and Falko Judt

OVERVIEW

- Better models of Mars' atmosphere improves further exploration, answers fundamental questions about Earth's evolution, and may give clues as to how to Earth will continue to evolve
- The Mars Climate Database (MCD)
  - With this database, we measured 20 characteristics of Mars' atmosphere, including pressure, temperature, wind speeds, and composition.
- From these measurement, we discovered jet streams and a thermal gradient, similar to Earth's
- These data were compared to data produced by MPAS, used to model of the Earth

MODELING DATABASES

The Mars Climate Database (MCD)

- The MCD is a meteorological database created from the General Circulation Model (GCM) numerical models of Mars' atmosphere
- 109 output arguments, including temperature, density, pressure, wind speeds, and composition

The Model for Prediction Across Scales (MPAS)

- MPAS is a framework which uses unstructured Voronoi meshes and C-grid discretization to develop earth-systems simulations for atmosphere, ocean, and land and sea ice

ATMOSPHERIC CHARACTERISTICS OF MARS VS EARTH

Average Yearly Value	Mars	Earth
Temperature	176 K	287 K
Pressure	6.16 hPa	985 hPa

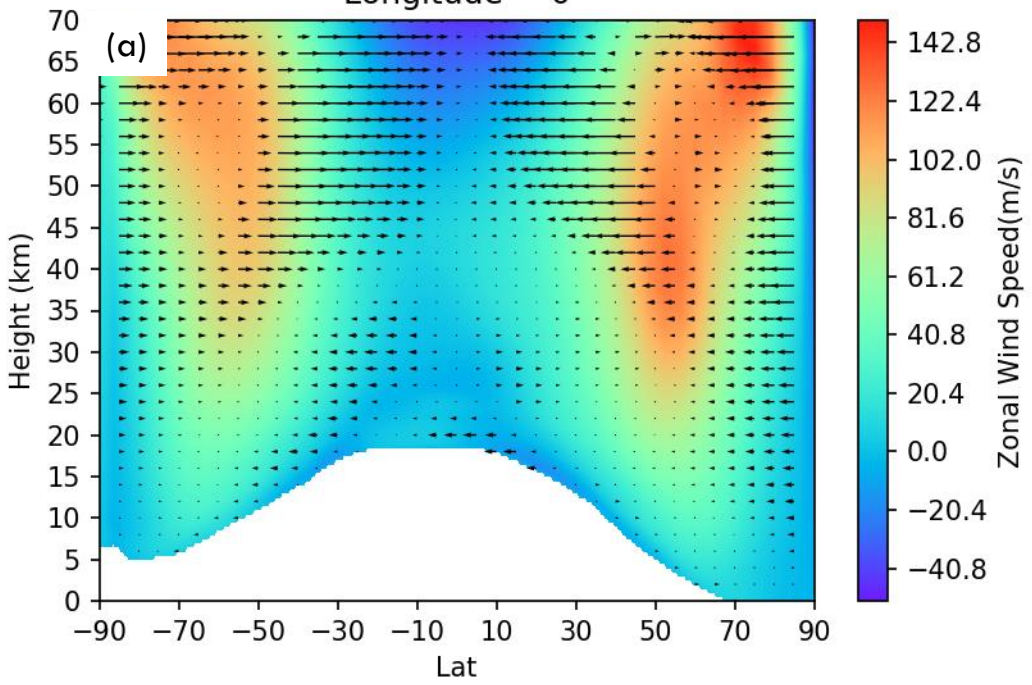
CO_2	94.9%	00.04%
N_2	2.6%	78.1%
Ar	1.9%	00.9%
Others	.6%	20.96%

EXTREME OUTPUTS OF MARS VS EARTH

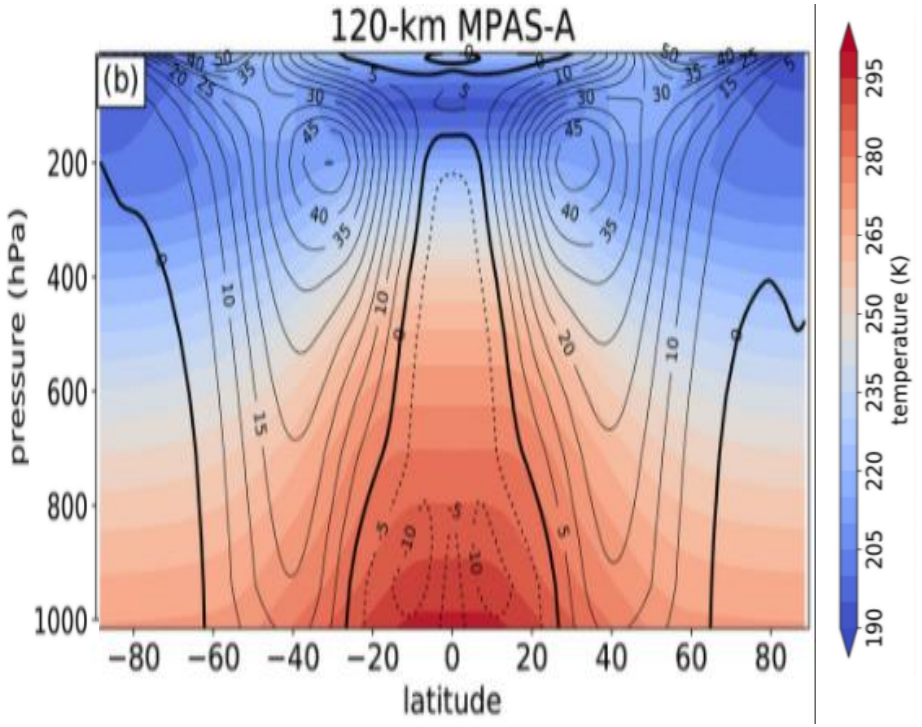
	Mars	Earth
Highest Temperature	222 K	331 K
Lowest Temperature	142 K	184 K
Highest Surface Pressure	13.06 hPa	1085 hPa
Lowest Surface Pressure	1.44 hPa	870 hPa

VERTICAL STRUCTURE OF WIND AND JET STREAMS

Wind Speeds on Mars



Wind Speeds and Temperature on Earth



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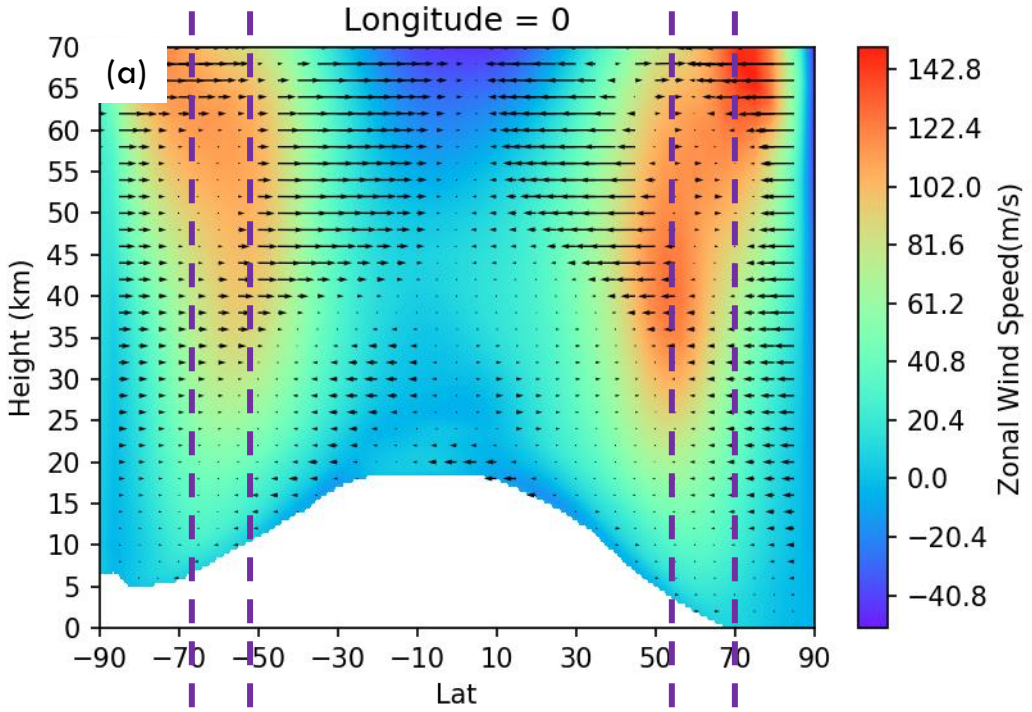

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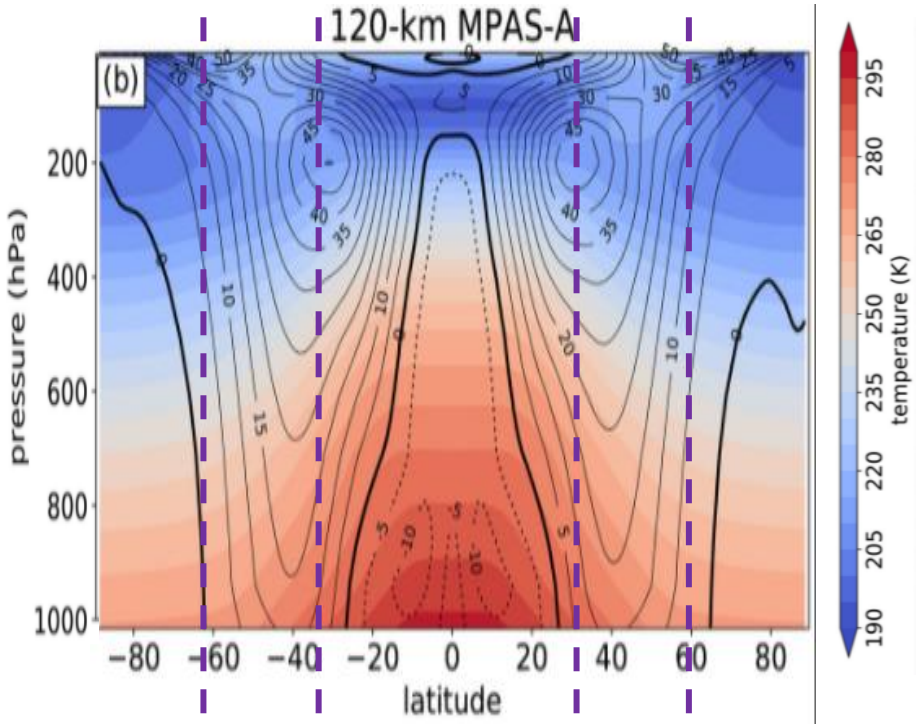

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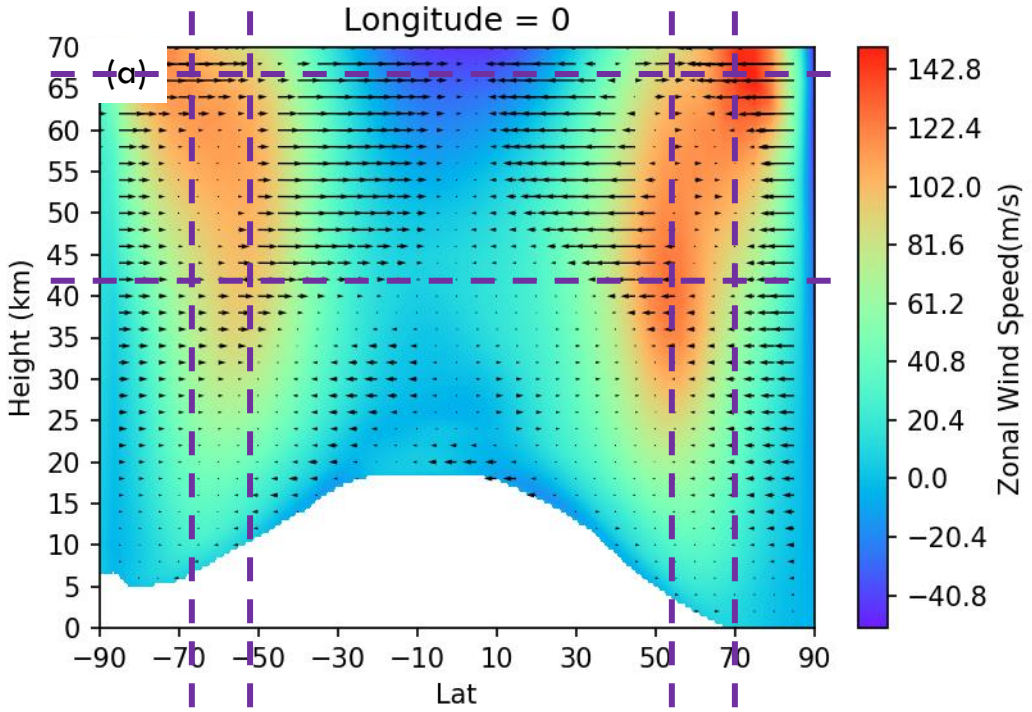

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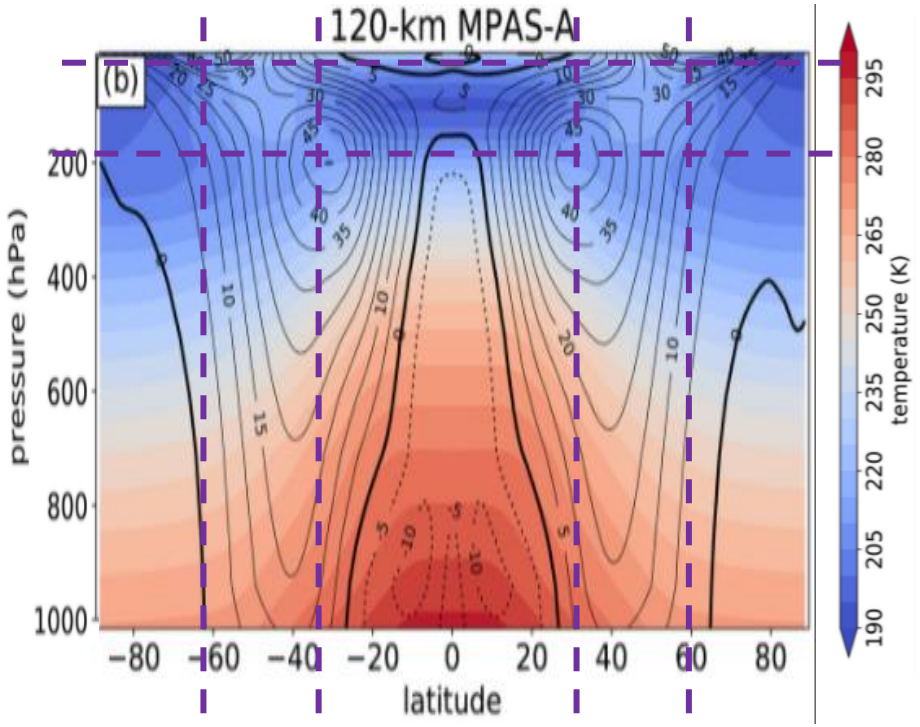

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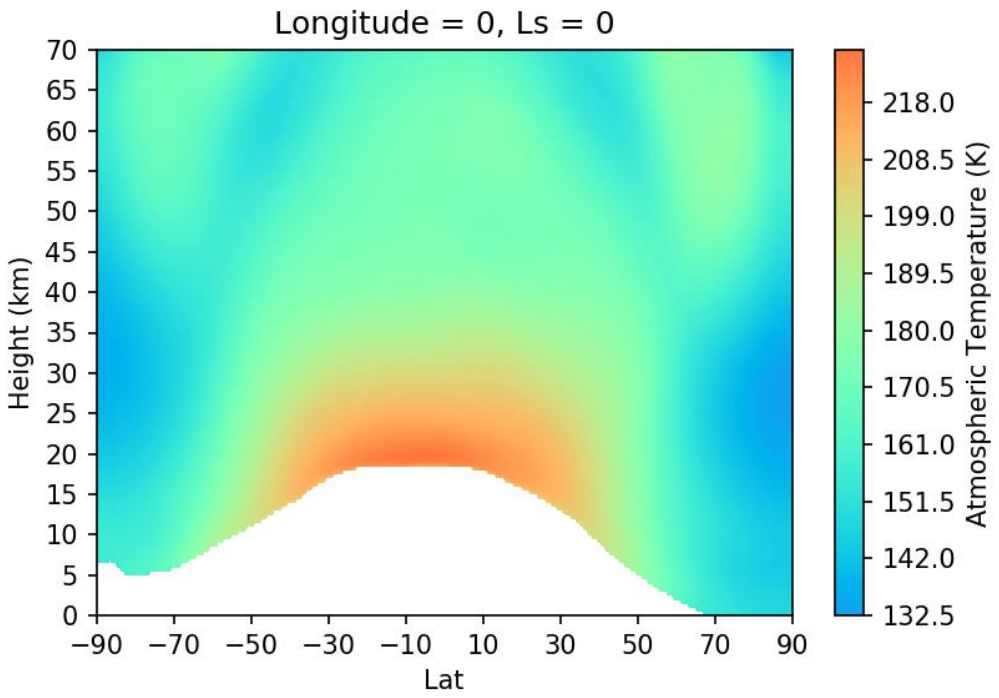
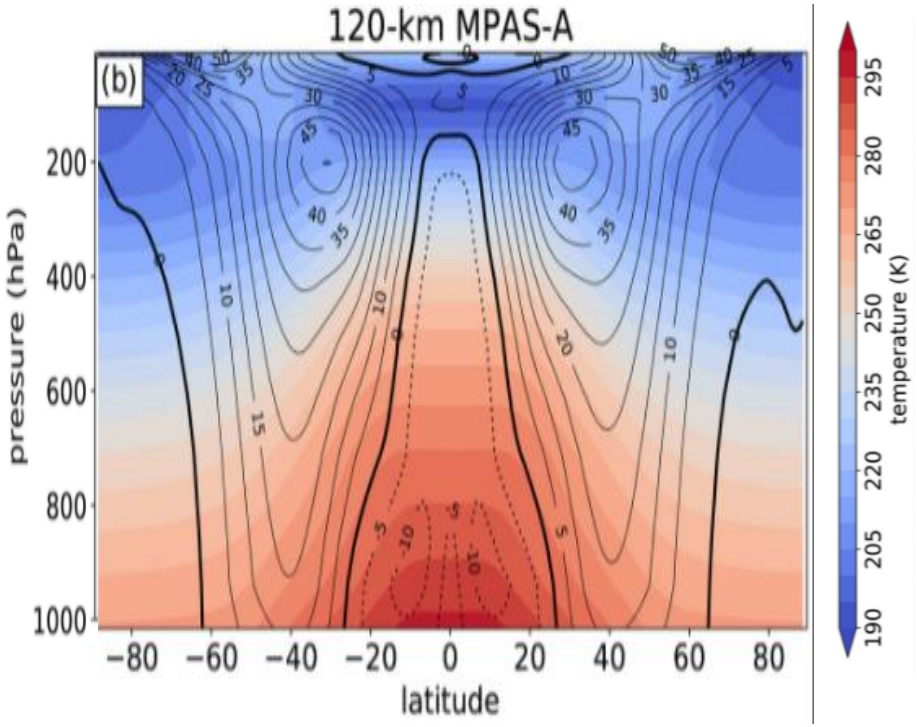
Temperature on Mars



Wind Speeds and Temperature on Earth



VERTICAL STRUCTURE OF TEMPERATURE

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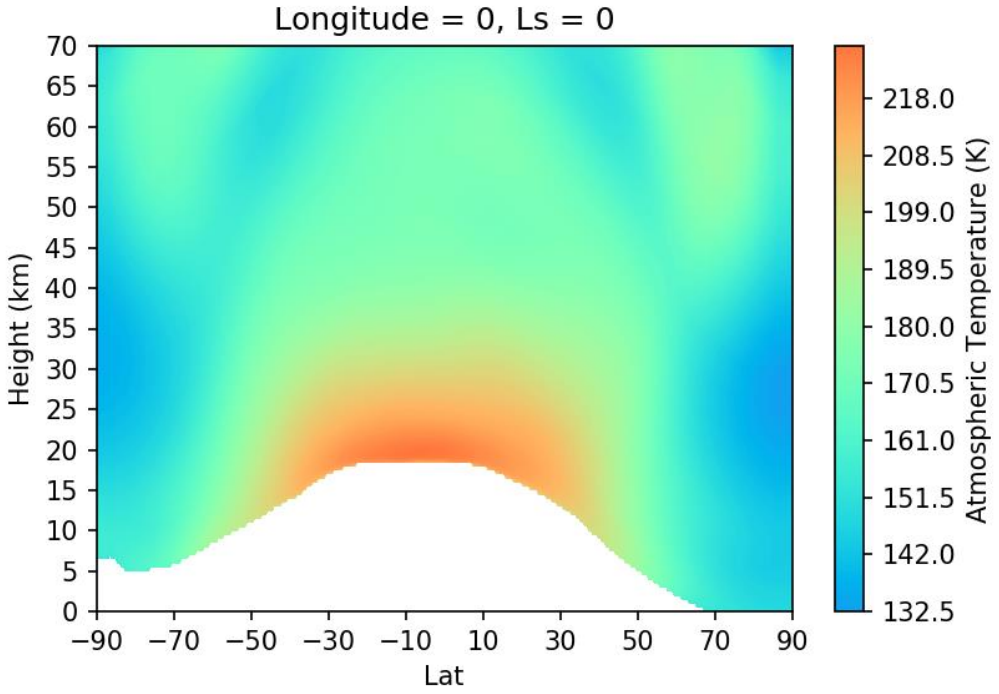

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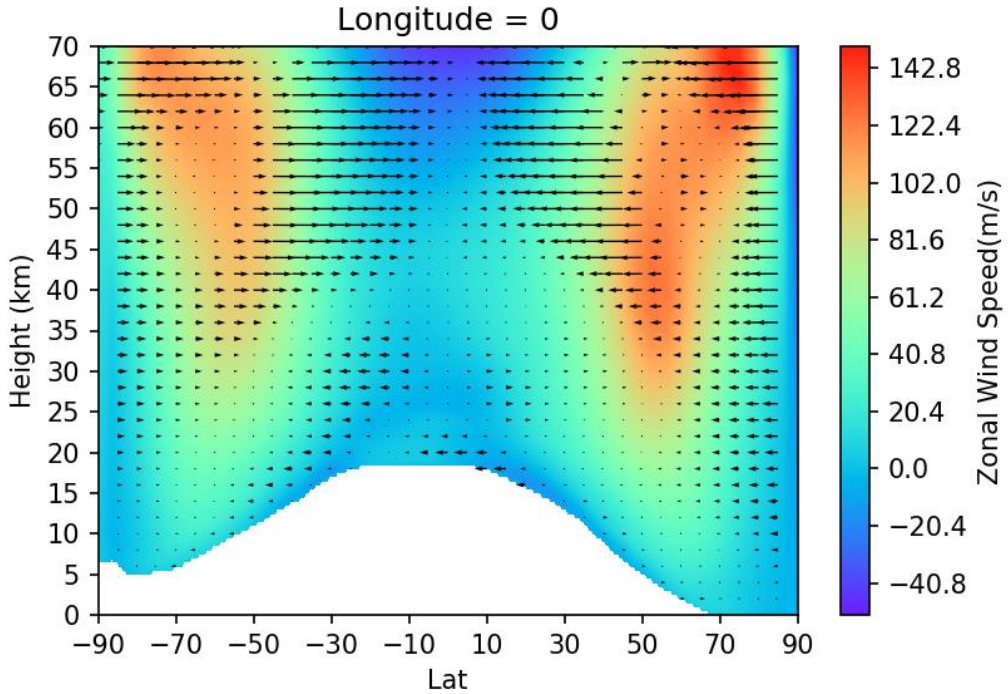
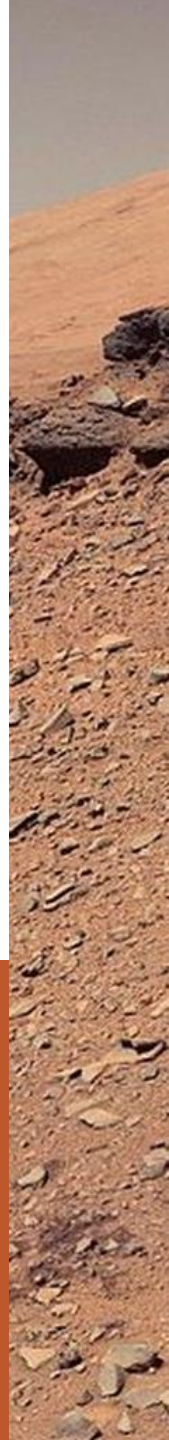
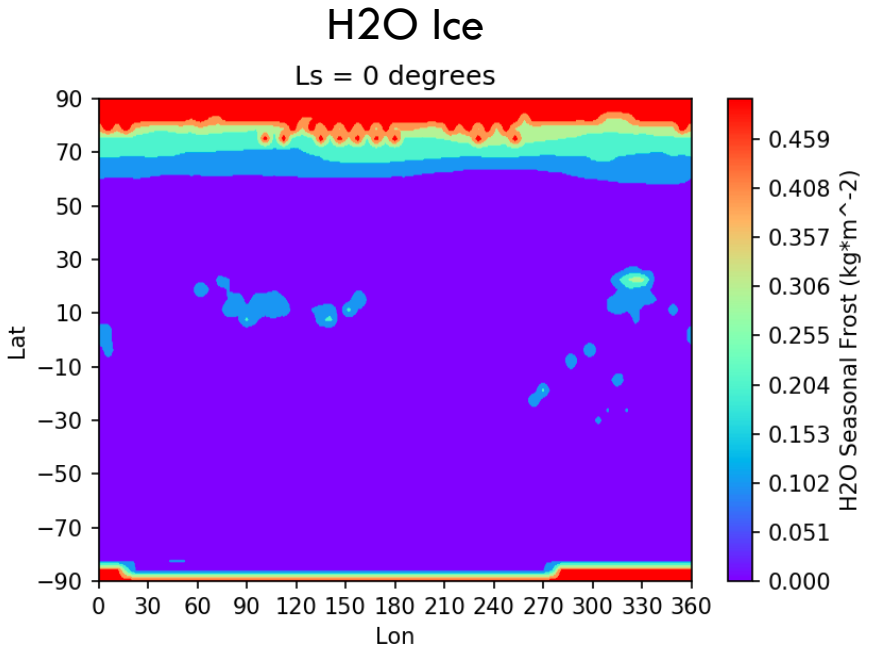
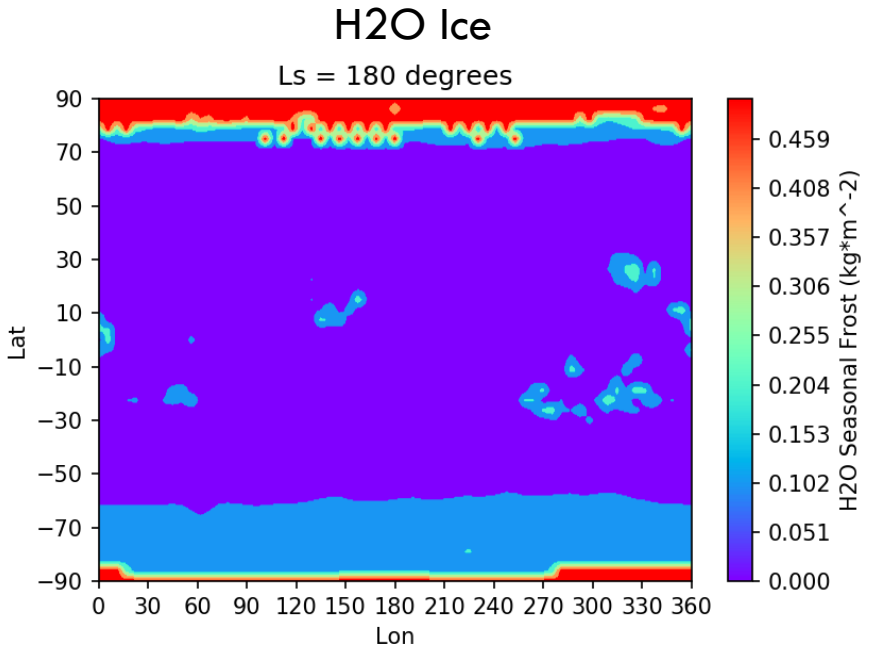


COMPARING TEMPERATURE GRADIENT WITH JET STREAM LOCATION



ICES


H2O Ice
Ls = 0 degrees
Lat
Lon
H2O Seasonal Frost (kg*m^-2)
90
70
50
30
10
−10
−30
−50
−70
−90
0 30 60 90 120 150 180 210 240 270 300 330 360
0.459
0.408
0.357
0.306
0.255
0.204
0.153
0.102
0.051
0.000


H2O Ice
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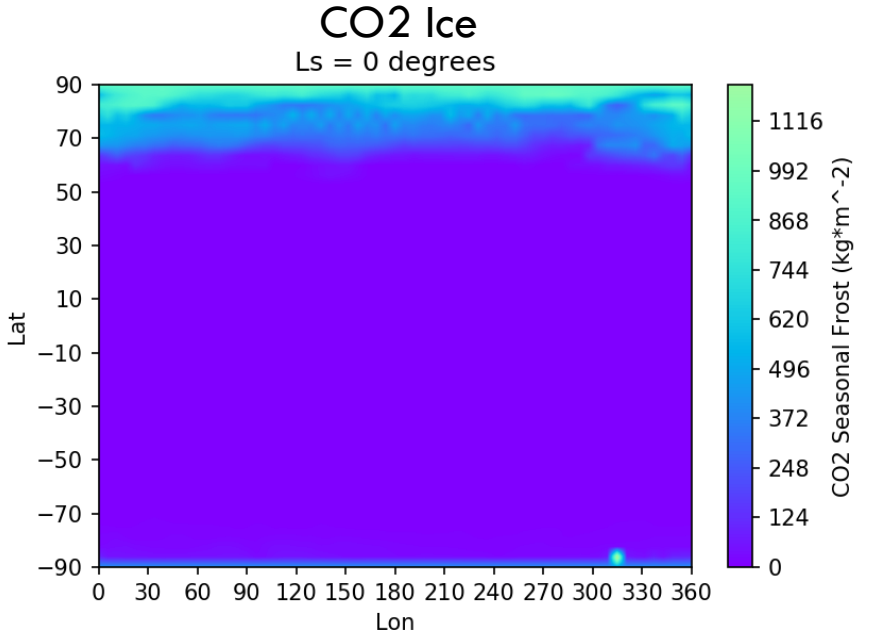
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−50
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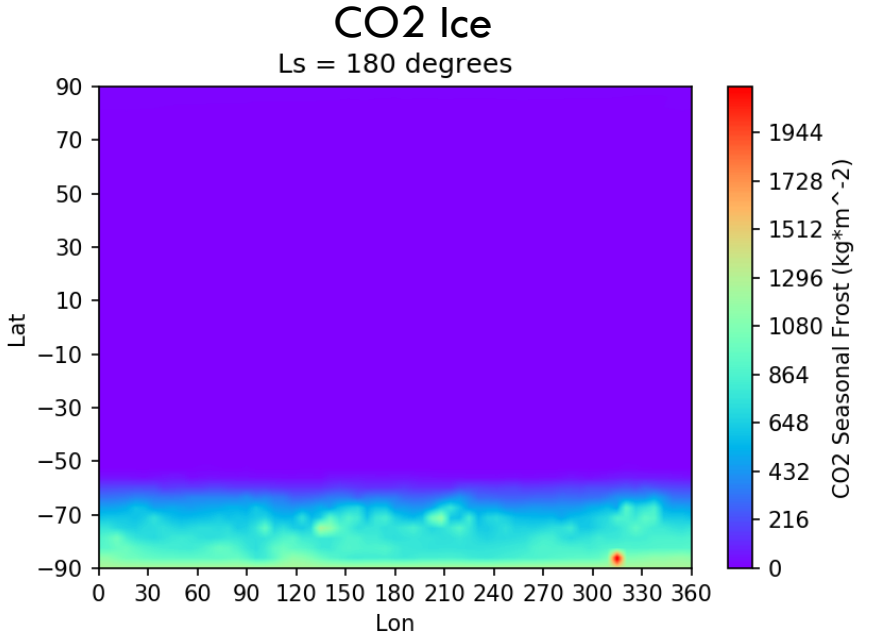
−90
0 30 60 90 120 150 180 210 240 270 300 330 360
1116
992
868
744
620
496
372
248
124
0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30
10
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0 30 60 90 120 150 180 210 240 270 300 330 360
1944
1728
1512
1296
1080
864
648
432
216
0

SUMMARY, NEXT STEPS, FURTHER INVESTIGATION

- Modeling a planet's atmospheric characteristics improve our understanding of physical processes, the planet's history, and physical mechanics
- With the MCD, we were able to produce hundreds of datasets modeling Mars' atmosphere
- There are many similarities, such as the thermal gradient and presence of jet streams; however, there are also many differences to be further investigated, such as the location and altitude of the jet streams
- Further Investigation:
  - Modifying MPAS-A to work for a Mars aquaplanet
  - Why are the jet streams located where they are?
  - Why do we see higher temperature at Jetstream locations on Mars, but not on Earth?