Martian Water Cycle

Numerical Modeling Studies

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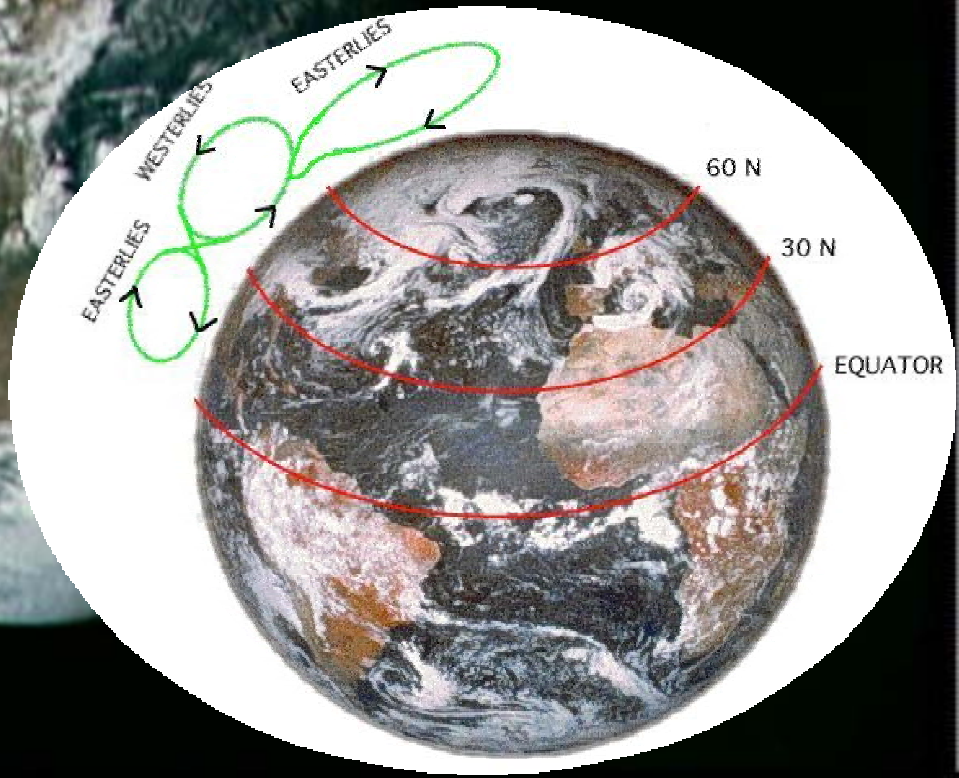
Earth

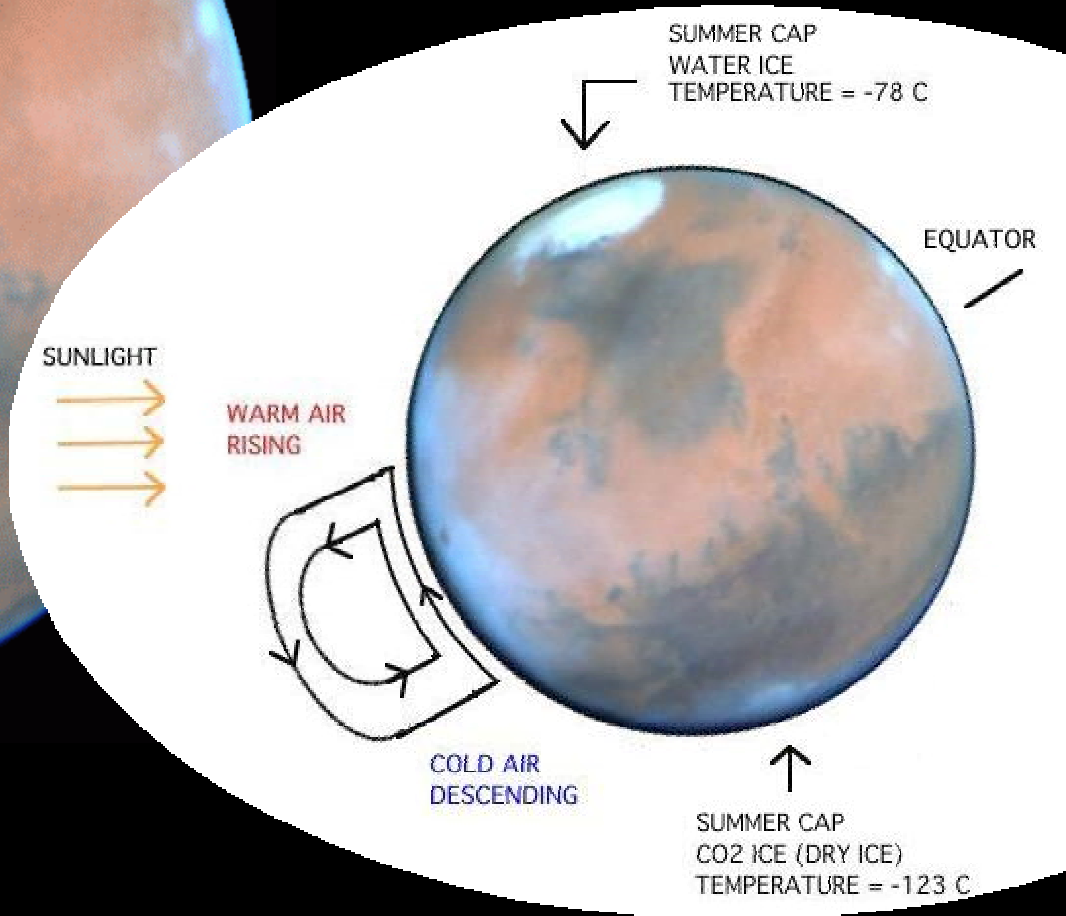
- Radius 6378 km
- Pressure 1013 mbars
- Avg. Temp. 15° C
- Distance 1 AU



- Atmosphere:
  - 75% N_2
  - 23% O_2
  - 1.3% Ar
  - 0.001% CO_2

Mars

- Radius 3398 km
- Pressure 6 mbars
- Avg. Temp. -60˚ C
- Distance 1.5 AU



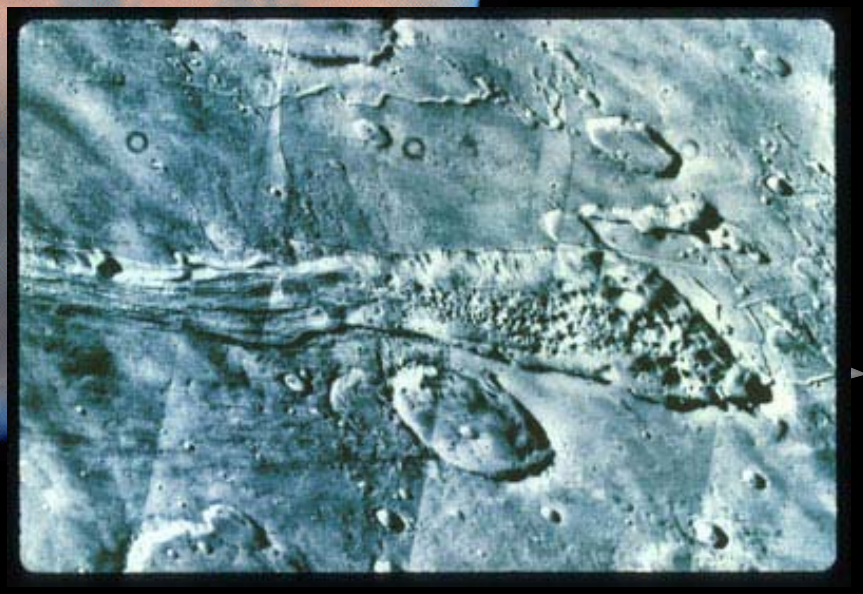
- Atmosphere:
  - 95% CO_2
  - 3% N_2
  - 1.6% Ar

Importance of the Water Cycle

- One of 3 main seasonal cycles
- Plays important role in the absorption of solar radiation and distribution of Sun's energy
- Directly aids in removal of atmospheric dust
- Evidence of warmer, wetter past teases us with the possibility for the past existence of life on Mars

150x200km

180x120km

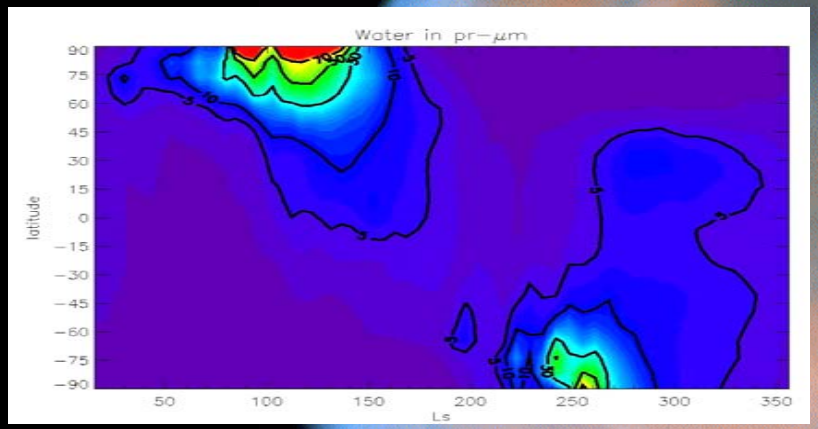


Project

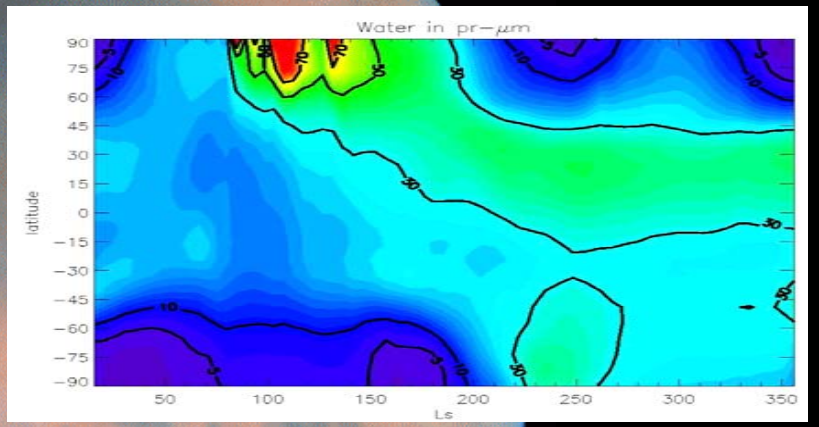
- GOAL: Determine the role the water cycle plays in the interannual variability of the Martian atmosphere when coupled with the dust cycle
- Previously, the dust and water cycles were treated separately in general circulation models
- I have condensed water onto dust particles to form clouds, thereby coupling the two cycles
- Looking for differences in dust/water distribution

Modeled water cycle

Cloudless Model

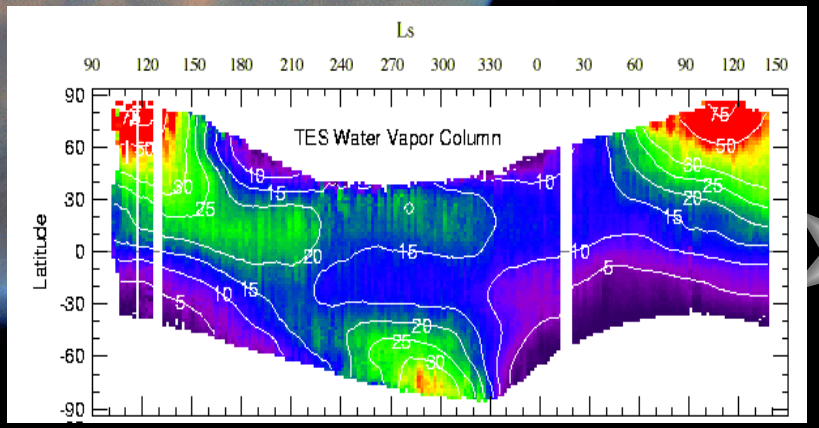


Cloudy Model



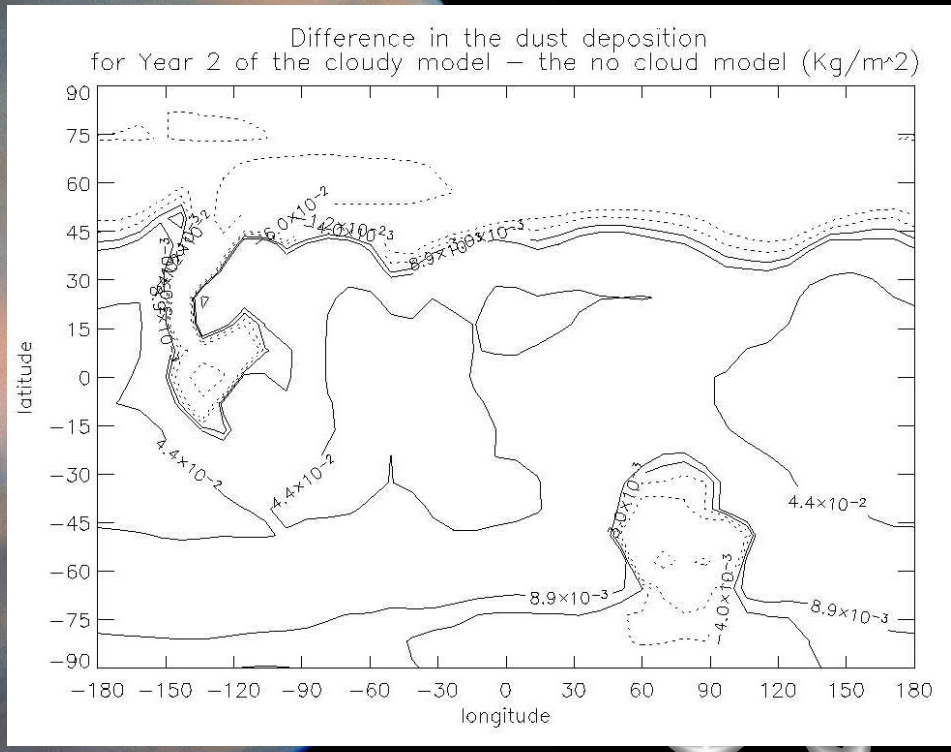
- Cloudless model underestimates atmospheric water
- Cloudy model more representative of observed water cycle

Observational



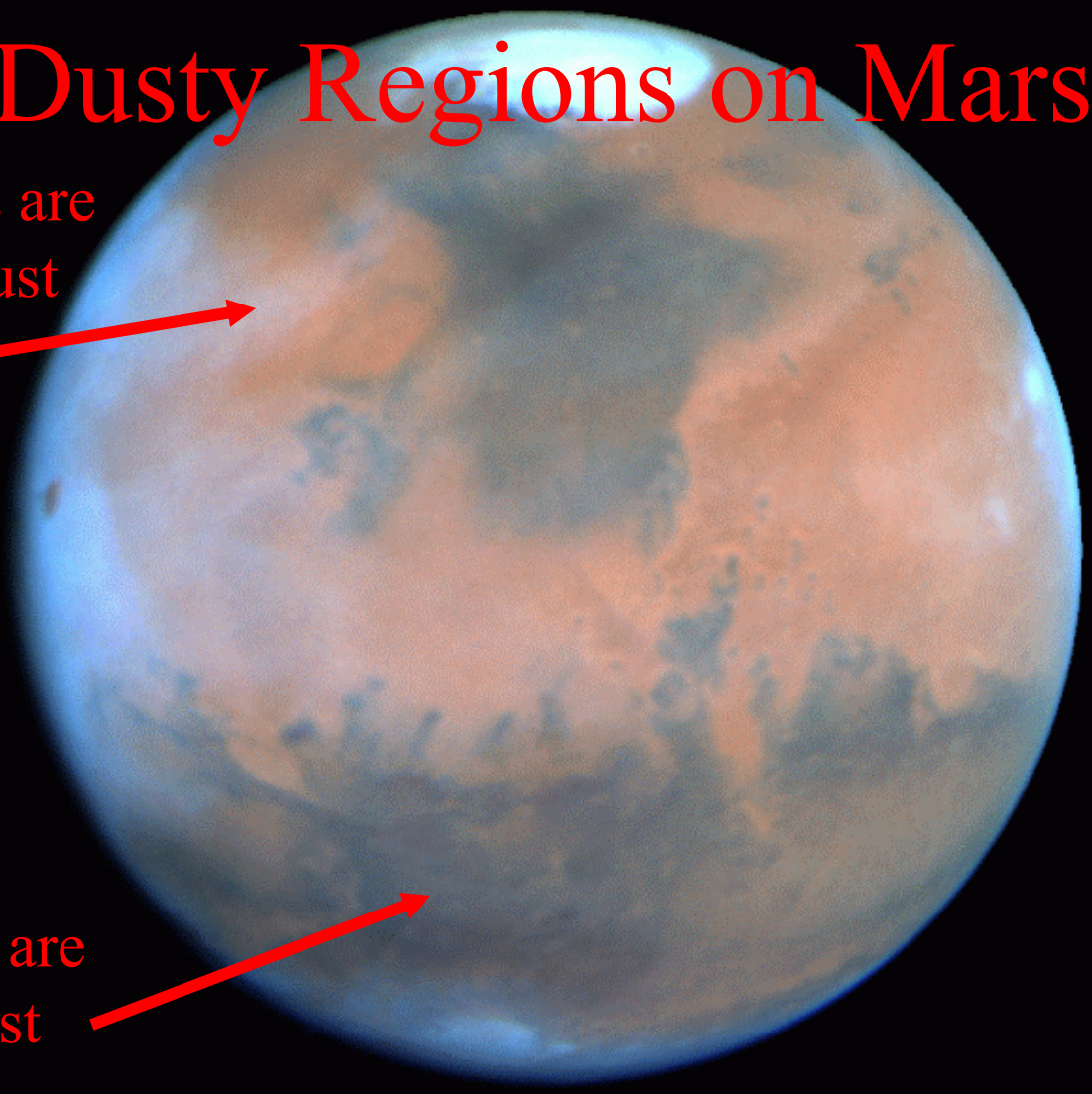
Difference in Dust Deposition

- Plot compares dust deposition in the cloudy model vs. the cloudless model
- Solid lines are excess in the cloudy model
- Dashed lines are depletion in the cloudy model



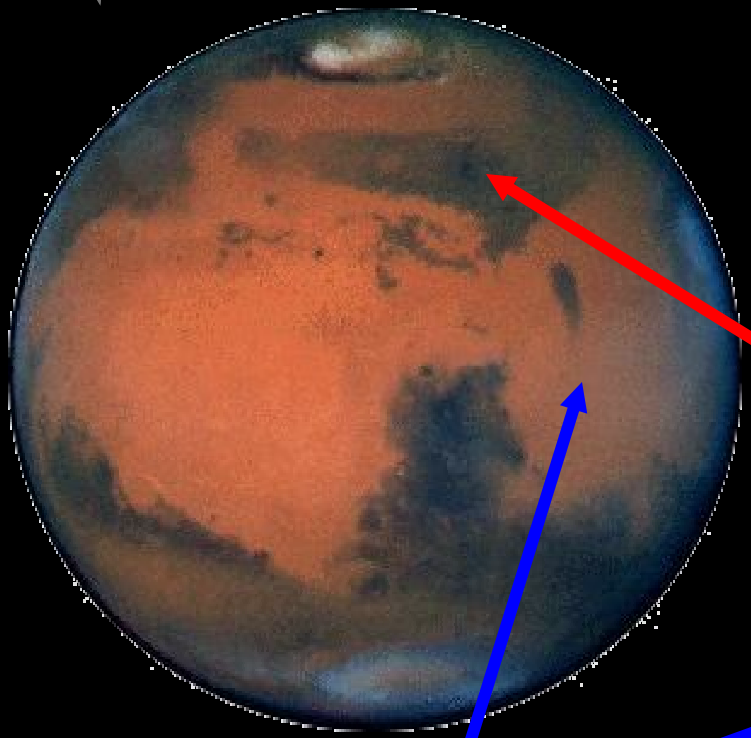
Dusty Regions on Mars

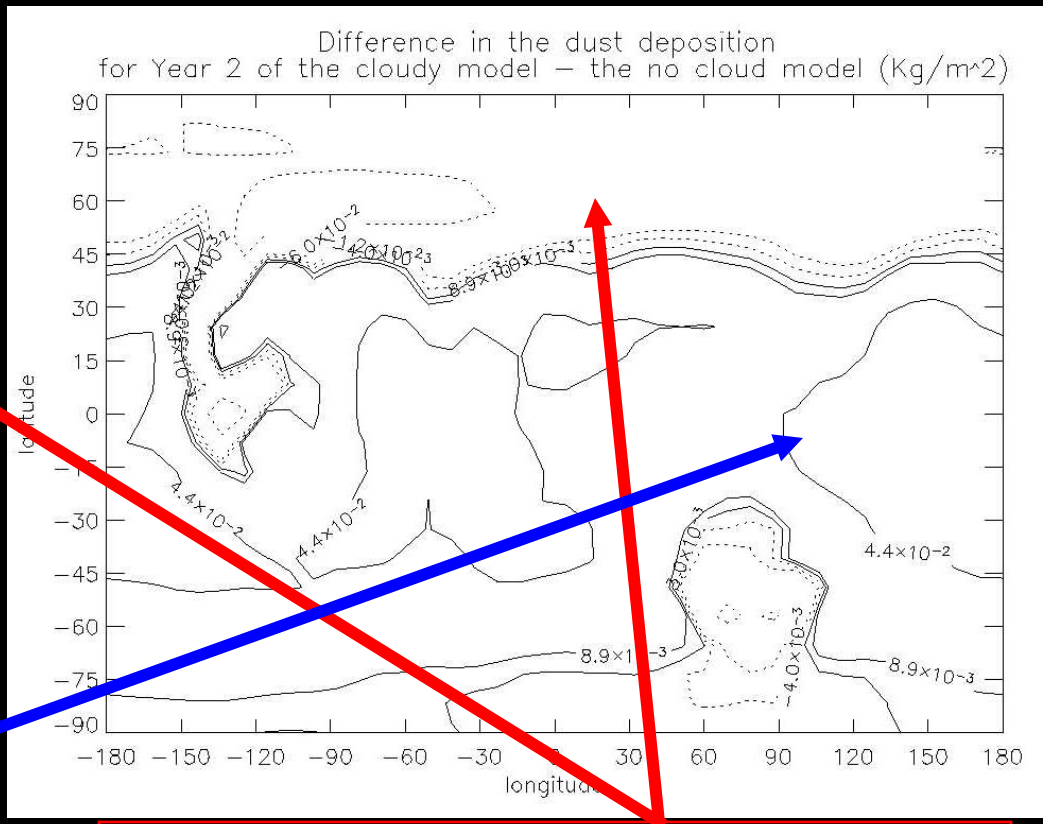
- Light regions are areas of high dust content



- Dark regions are areas of low dust content

Cloudy Model Resembles Mars



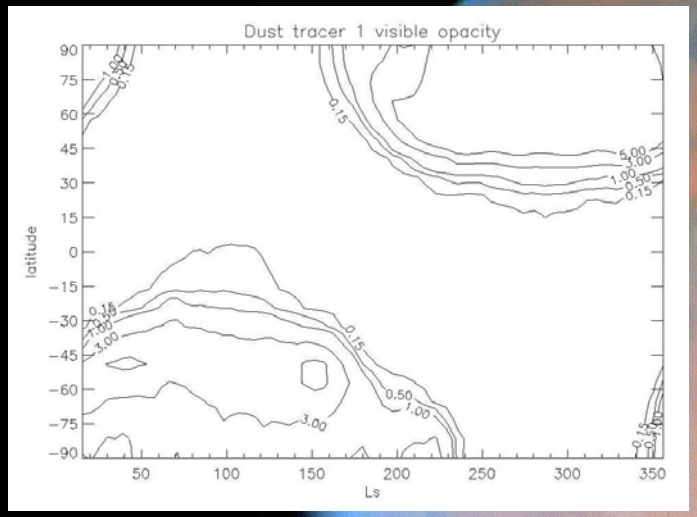


This bright patch coincides with a local maximum of dust deposition on the plot

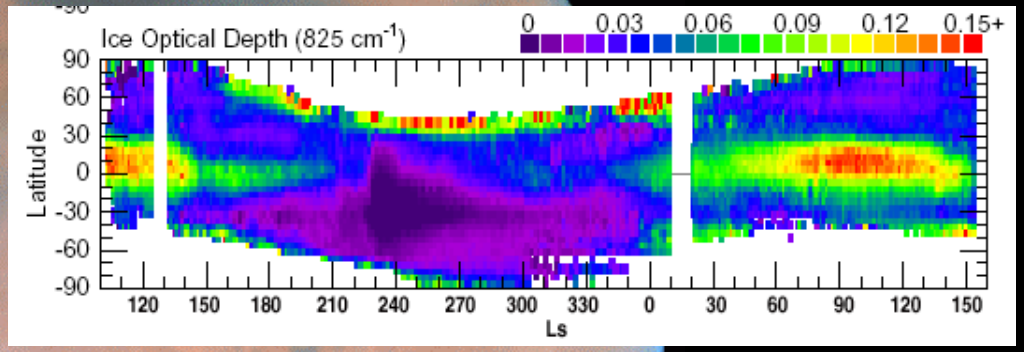
This dark region at 60° N latitude matches the area on the plot where the cloudy model is depleted in dust deposition

Martian Clouds

Cloudy Model



Observation



- The model extends the winter cloud hood too far off the pole
- The model is currently unable to recreate the Northern Hemisphere summer cloud belt

Future Work

- Add capability for model to handle more than one cloud size
- Adjust amount of heat held in and light reflected at the poles.
- Improve water input into model to more accurately reproduce the water cycle