

Courtney Batterson

Creighton University

NASA Nebraska Space Grant

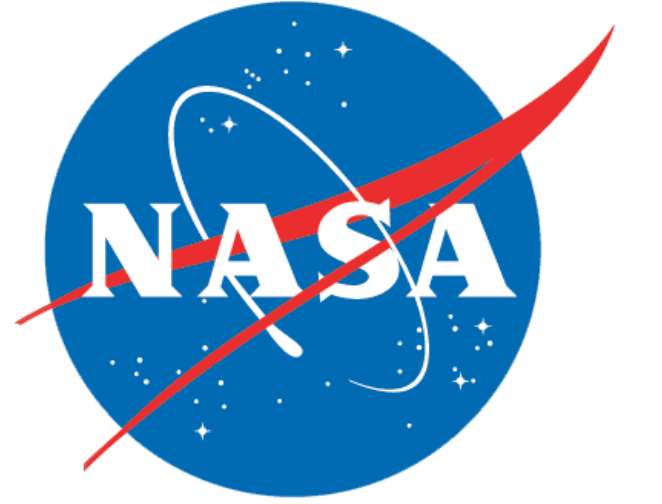
Undergraduate
Intern

Mentor: Melinda Kahre
Code: SST
Branch: Planetary Systems Branch

The Effect of CO₂ Ice Cap Sublimation on Mars' Atmosphere

Sublimation of the polar CO₂ ice caps on Mars is an ongoing phenomenon that may be contributing to secular climate change on Mars. The transfer of CO₂ between the surface and atmosphere via sublimation and deposition may alter atmospheric mass such that net atmospheric mass is increasing despite seasonal variations in CO₂ transfer. My study builds on previous studies by Kahre and Haberle that analyze and compare data from the Phoenix and Viking Landers 1 and 2 to determine whether secular climate change is happening on Mars. In this project, I use two years worth of temperature, pressure, and elevation data from the MSL Curiosity rover to create a program that allows for successful comparison of Curiosity pressure data to Viking Lander pressure data so a conclusion can be drawn regarding whether CO₂ ice cap sublimation is causing a net increase in atmospheric mass and is thus contributing to secular climate change on Mars.

CO₂ Ice Cap Sublimation and Deposition: Secular Climate Change on Mars



National Aeronautics and Space Administration

Introduction

The transfer of CO₂ between Mars' surface and atmosphere may be leading to net sublimation of the South Polar Residual CO₂ Ice Cap. The increasing gaseous CO₂ content resulting from such processes may be increasing Mars' atmospheric mass, which would suggest Mars is undergoing secular climate change. MSL scientists Melinda Kahre and Robert Haberle previously attempted to quantify the net change in pressure that occurred between the Viking Lander and Phoenix missions. However, a definitive conclusion could not be reached due to uncertainties in the data (Haberle & Kahre, 2010). In an attempt to complete their research, I use data from the MSL Curiosity rover to generate an elevation-corrected pressure dataset that can be used to quantify the net change in pressure since the Viking Lander missions.

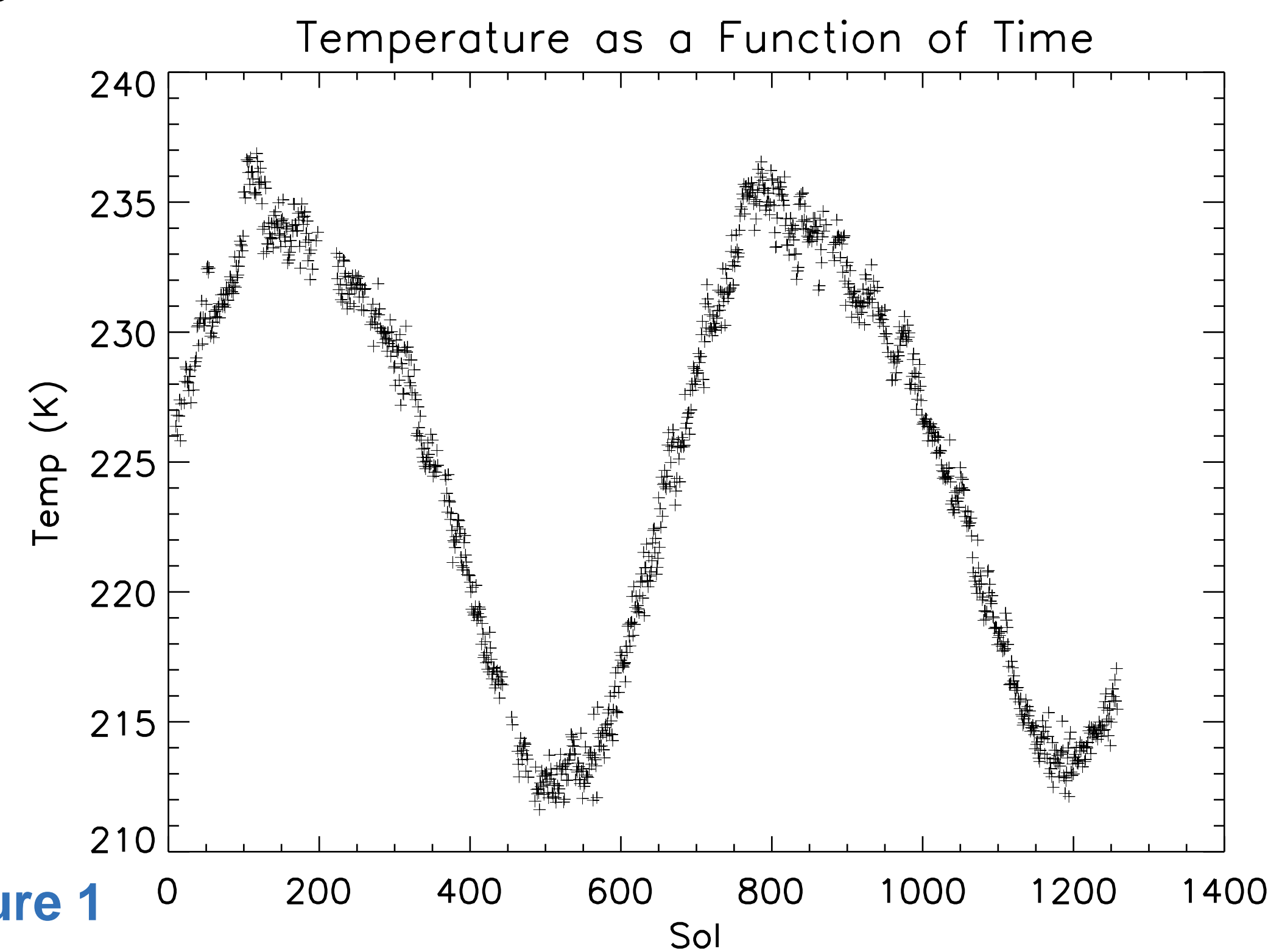


Figure 1

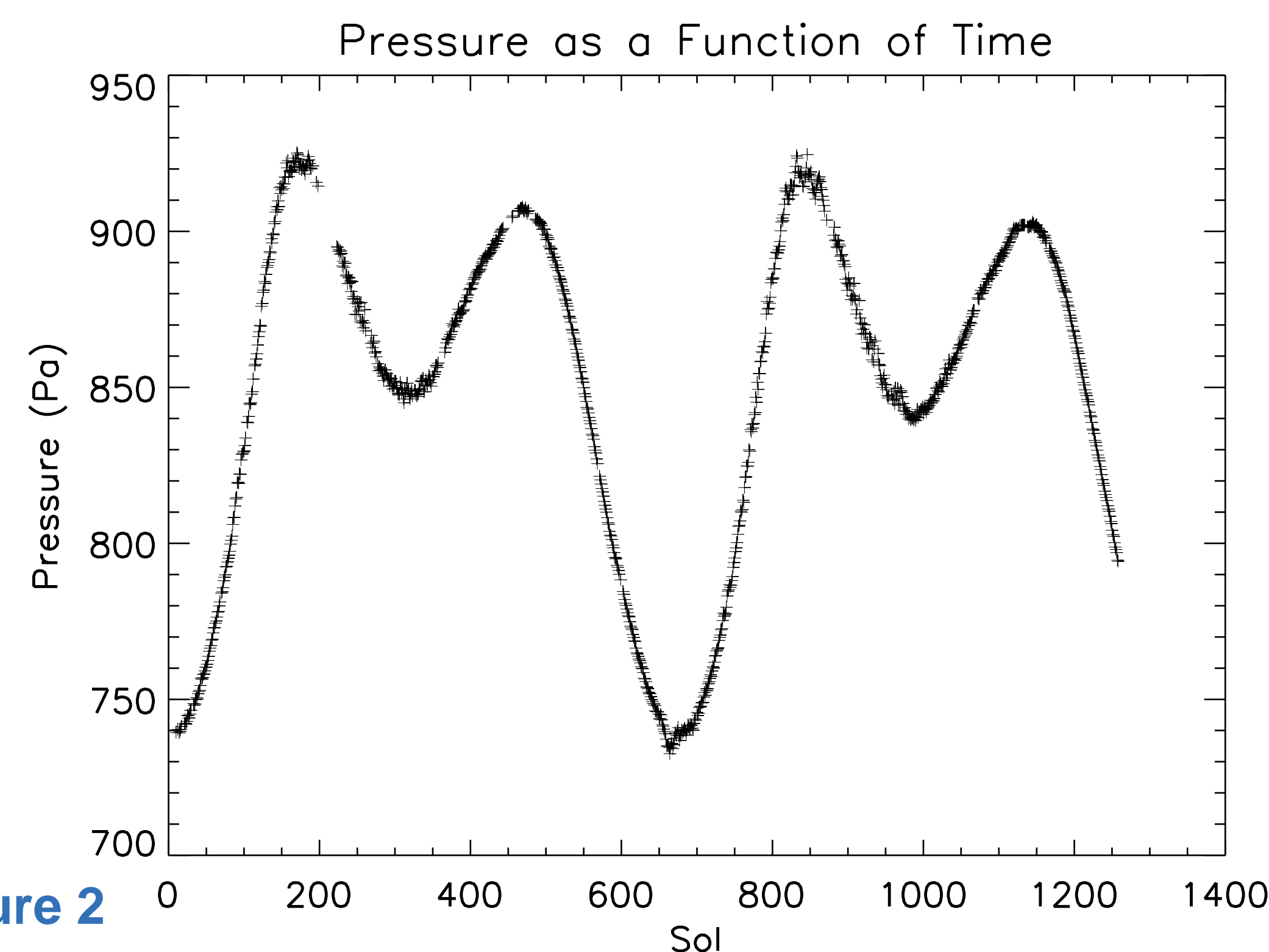


Figure 2

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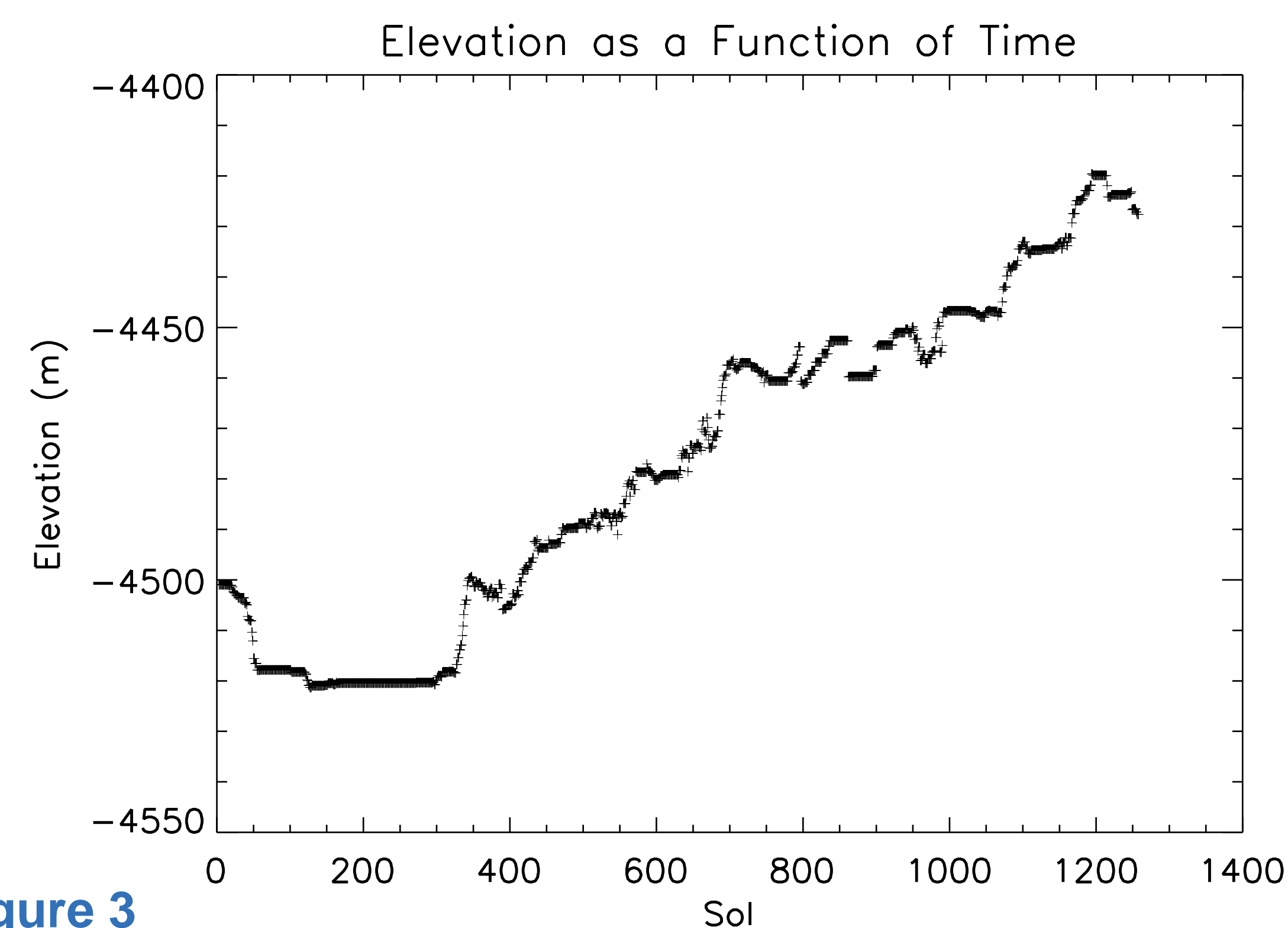


Figure 3

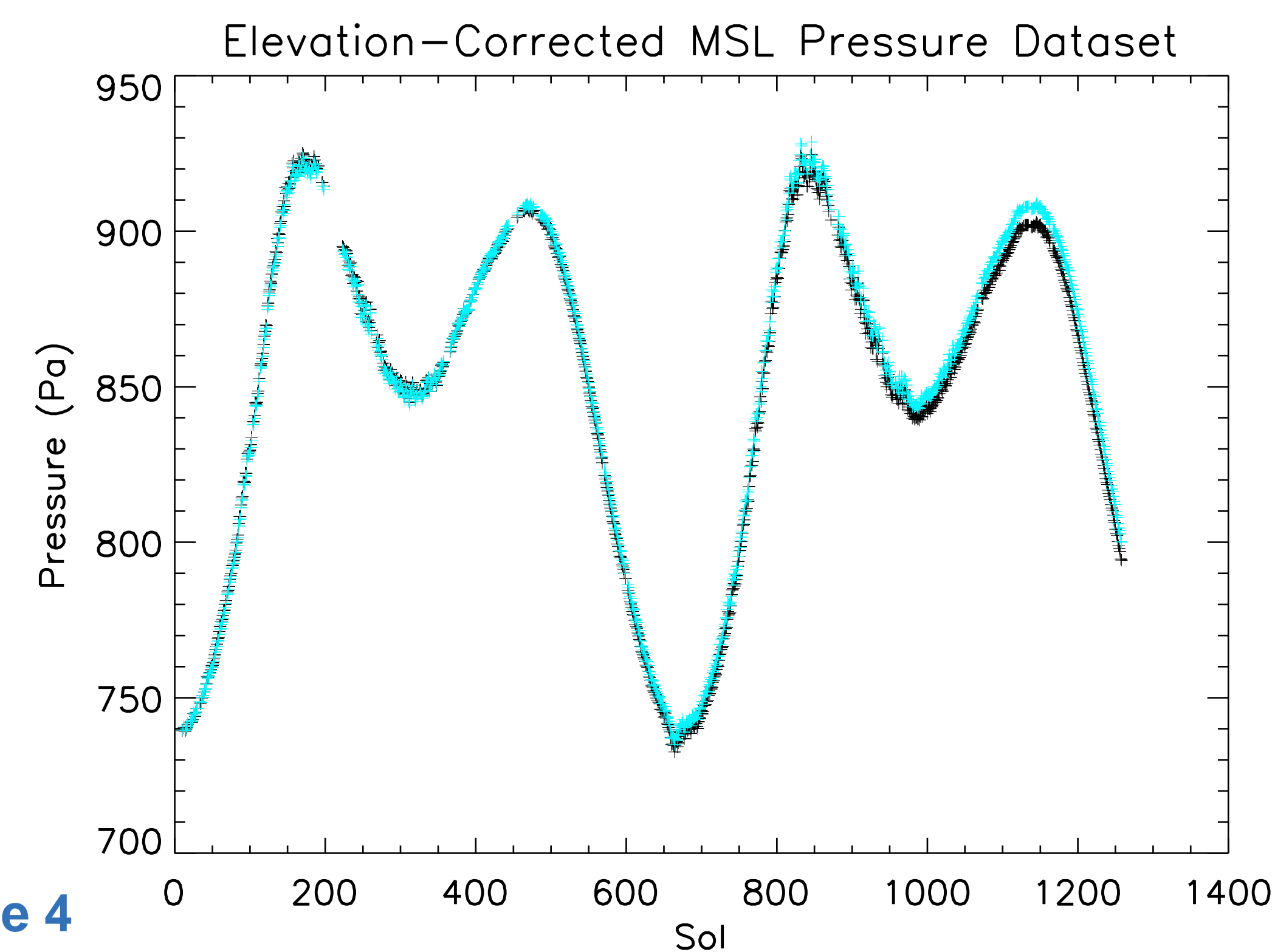


Figure 4

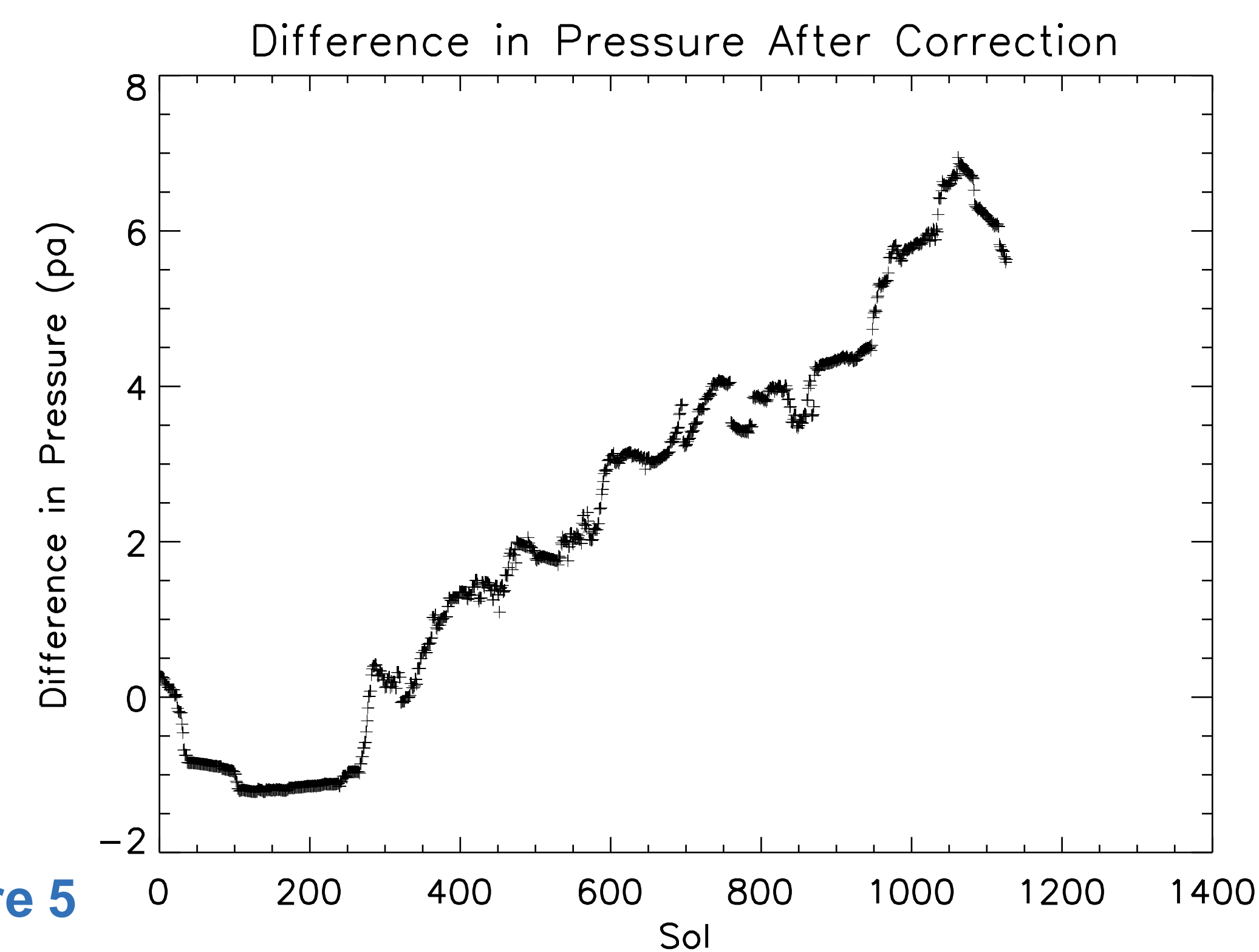
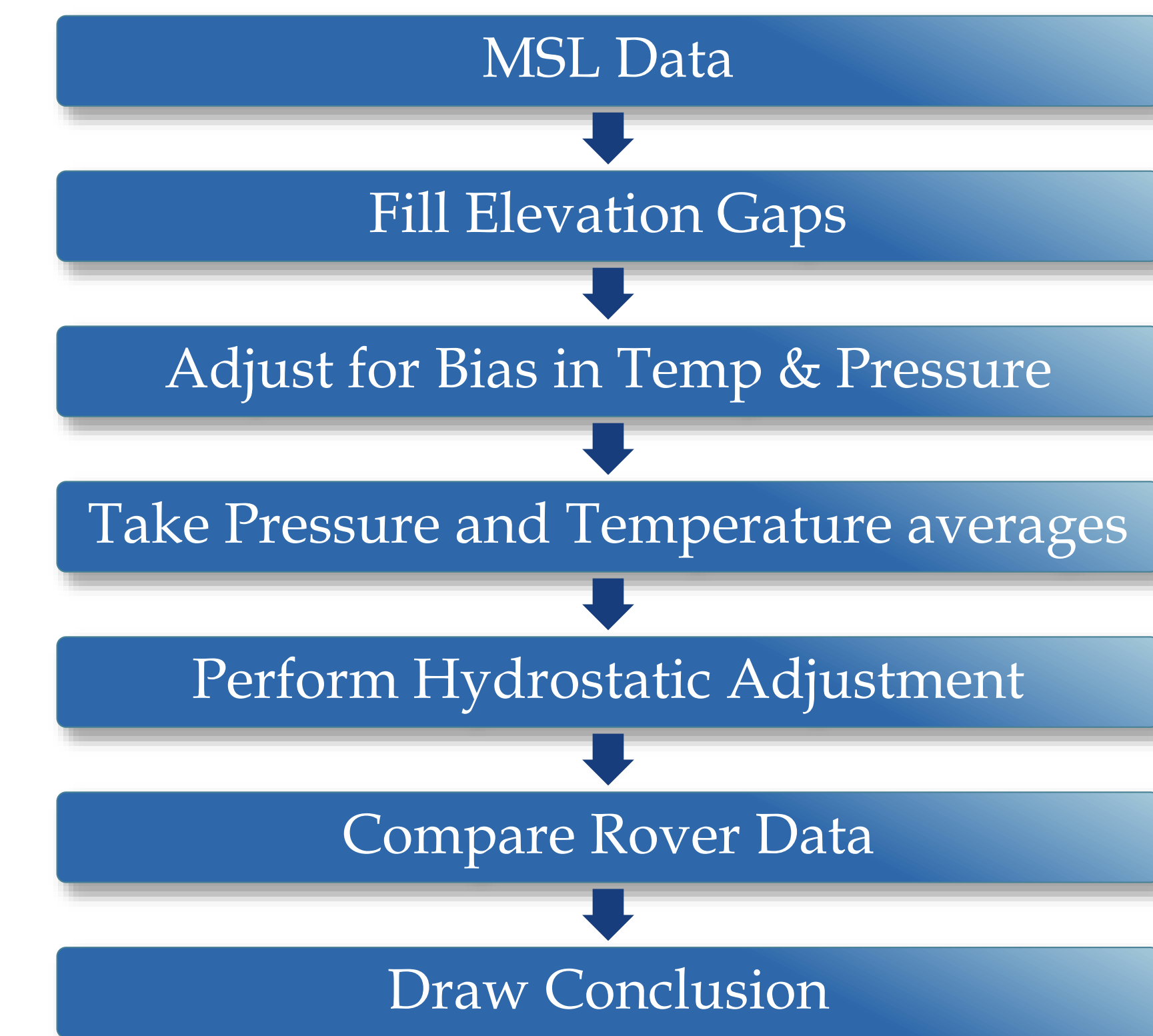


Figure 5

Process



Project Goals

- Generate an elevation-corrected pressure dataset for the MSL data
- Quantify the net change in pressure that occurred between the Viking Lander mission and the current MSL Curiosity mission
- Determine definitively whether secular climate change is occurring on Mars

Results

- **Figure 1:** Raw temperature binned by hour then averaged by day. Not corrected for elevation.
- **Figure 2:** Pressure data binned by hour then averaged by day. First three minutes of data excluded as it gives inaccurate pressure readings. Not corrected for elevation.
- **Figure 3:** Elevation plotted as a function of time. Gaps in the data occur on sols when Curiosity is stationary. These are filled with elevation data from the previous day as it is assumed Curiosity has not moved during this time.
- **Figure 4:** Pressure data as a function of time after correcting for elevation. These data will be compared to Viking Lander and Phoenix data (also elevation-corrected) to determine whether secular climate change is occurring on Mars.
- **Figure 5:** The difference in pressure after the elevation adjustment.

A huge thanks to Melinda Kahre for this opportunity and for guiding my research

