

Inferring Mars Dust Devil Statistics from InSight Lander Data and Local Field Research

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Introduction

Dust Devils are a common naturally occurring phenomenon that appear on Earth as well as Mars, but, the knowledge of the how and whys of Martian Dust Devil is still a work in progress but their occurrence rates and minimum wind speed value to loft dust was found? in this study.

What are Dust Devils and why are they important?

Dust devils are small whirlwinds made visible by lofted dust and sand. The heating of the near-surface called Insolation (heating by the sun) causes this upward moving spiral. We give the name Dust Devil to this process to distinguish them from other vortices/gusts of wind that don't cause this spiral or are too weak to loft dust and sand.

Dust Devils occur in arid regions, Mars is a arid planet therefore they occur everywhere. They also affect the climate by heating up the atmosphere with dust particles. Finally they help define the Planet Boundary Layer, the maximum altitude where thermal and mechanical process on the surface affect the atmosphere.



Figure 1: 20 km Dust Devil on Mars

InSight Lander

The InSight Lander has been on Mars for hundreds of Mars Sols (Sol is a Martian Day) collecting plenty of data to help better understand the boundary layer of Mars and in turn, the temperature, wind, and pressure models on Mars, three core data sets to have to learn more about Dust Devils.

Methodology

By using the TWINS instrument, we could collect temperature, wind, and, pressure data and compare and contrast the data to create models to predict the occurrence rate and minimum wind speed.

Wind Advective Speeds

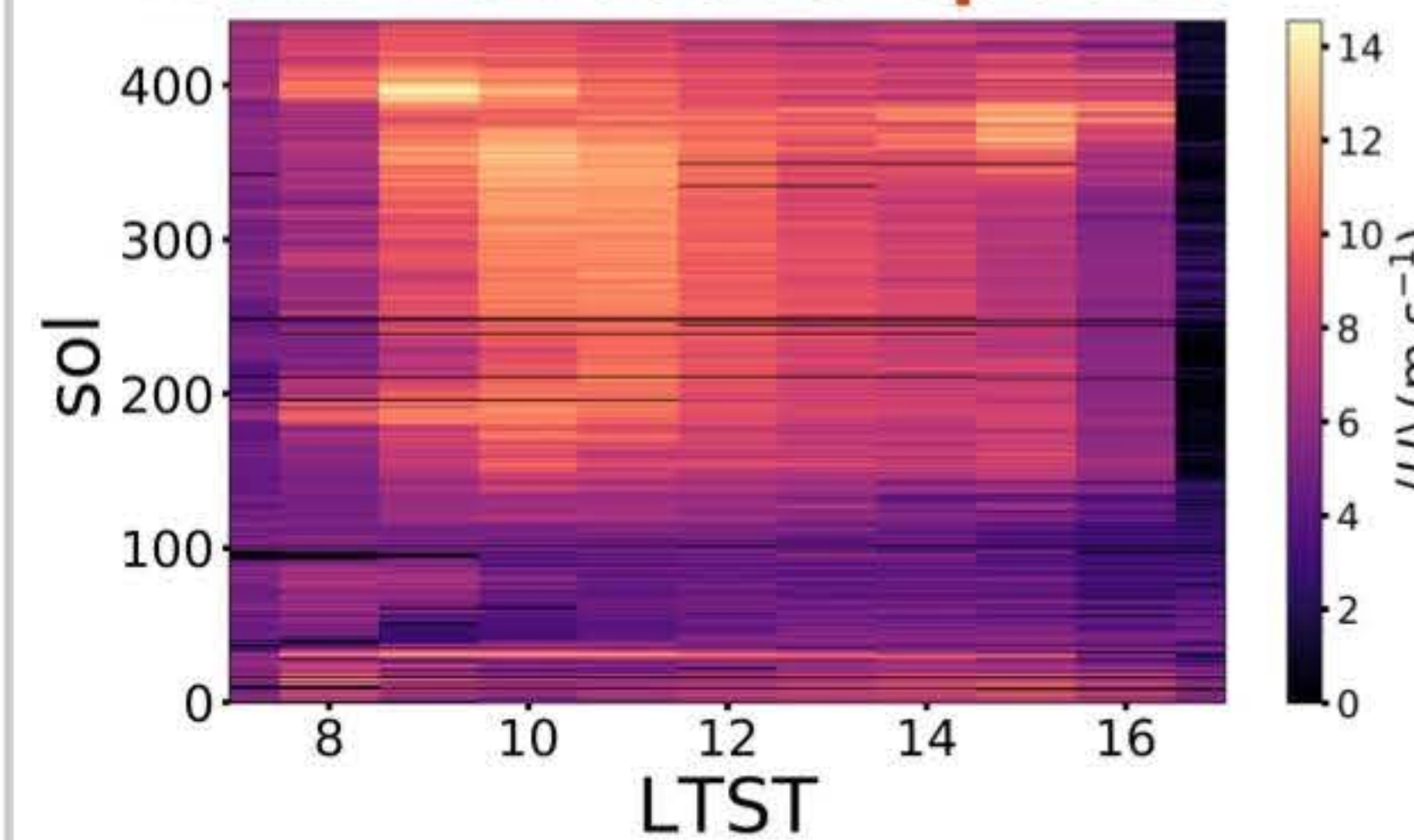


Figure 2: Wind Advective Speeds over 400 Sols

Conclusions

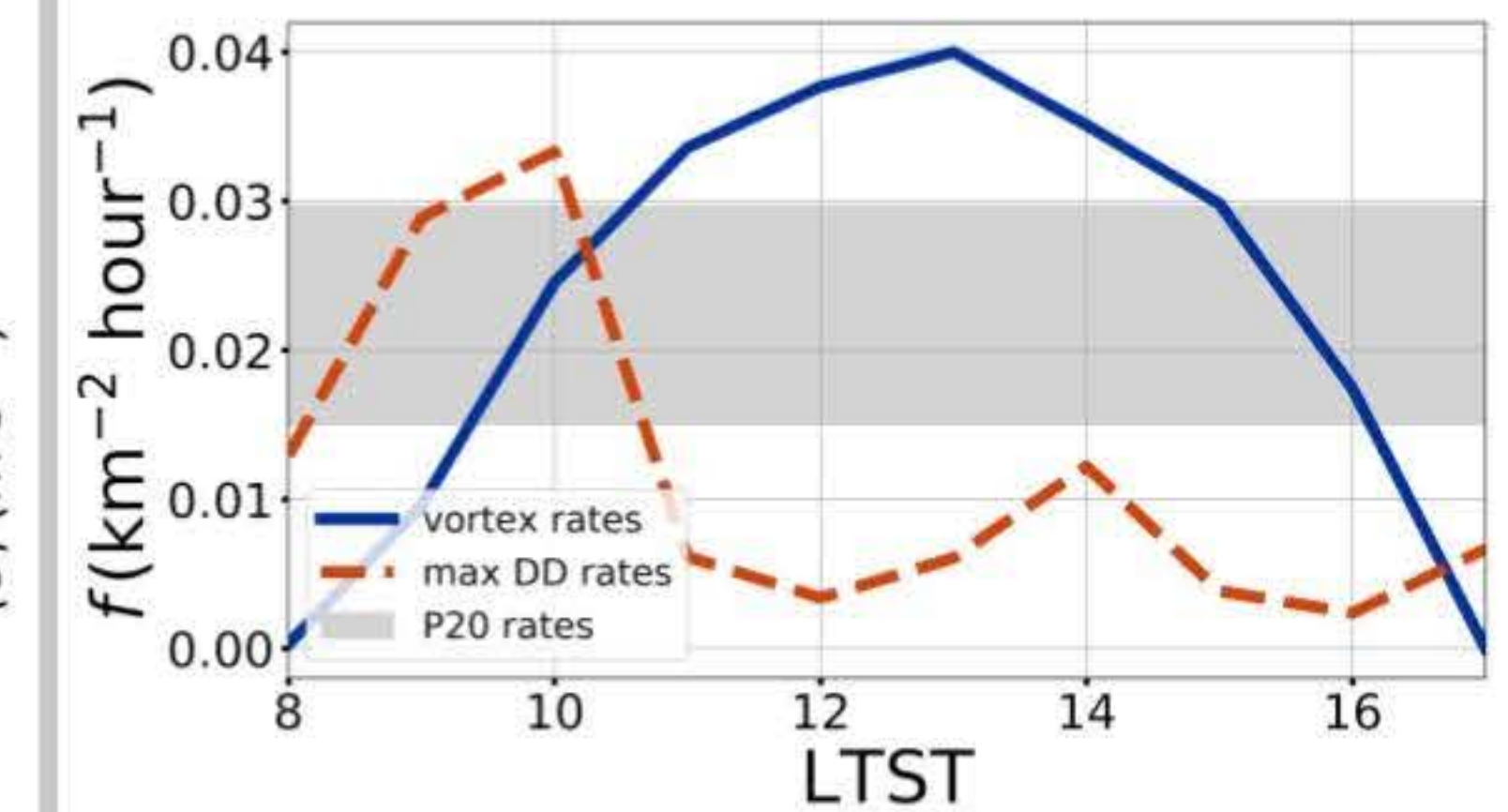


Figure 4: Occurrence Rate of Dust Devils

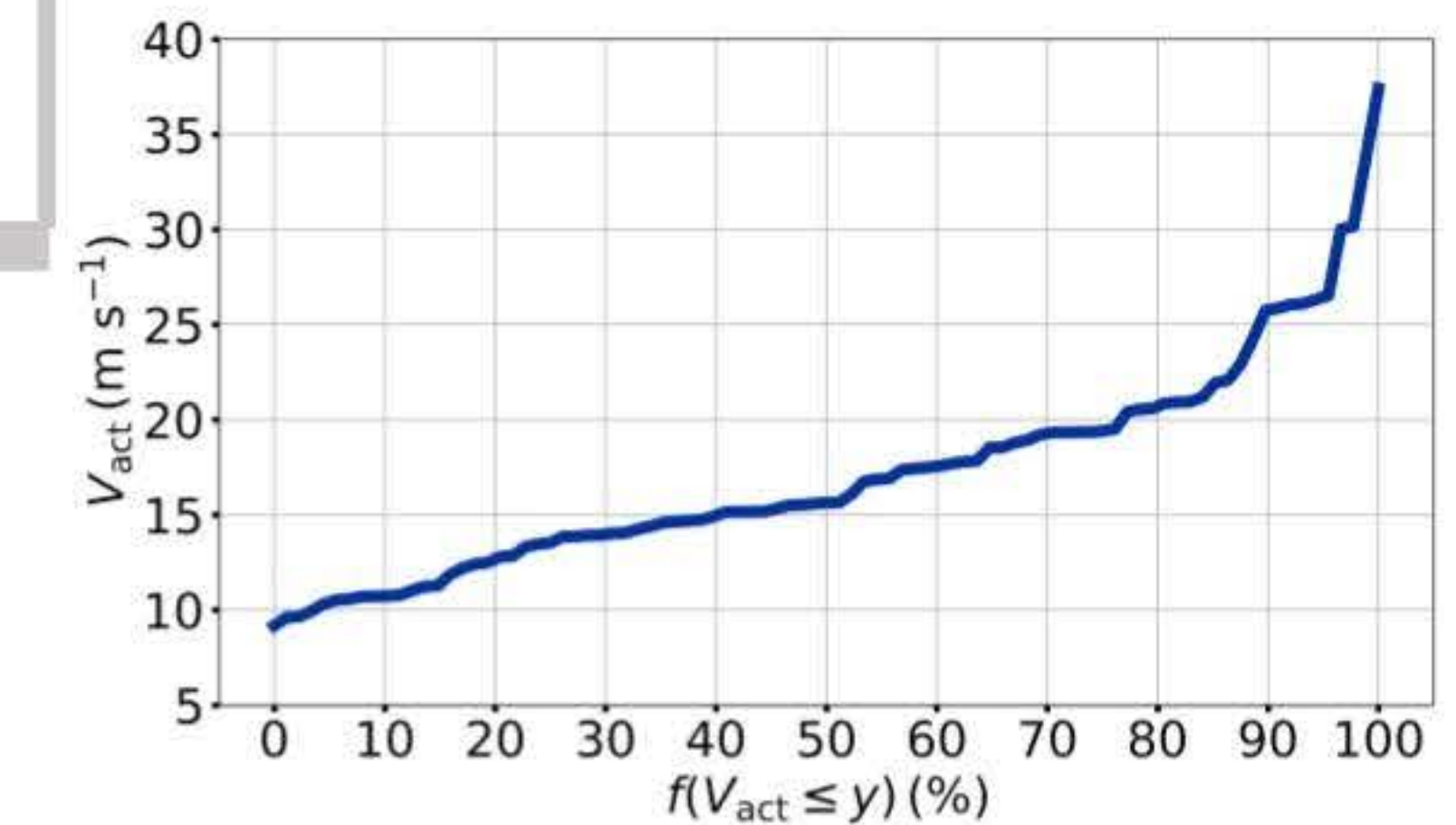


Figure 5: Minimum Wind Speed Rate

Occurrence Rate: ≈ 35%
Minimum Wind Speed Rate: ≈ 20m/s

InSight Lander TWINS Pressure Data

Pressure logs helped find vortices that occurred by the lander. Whenever the pressure suddenly dipped, we knew there was a vortex.

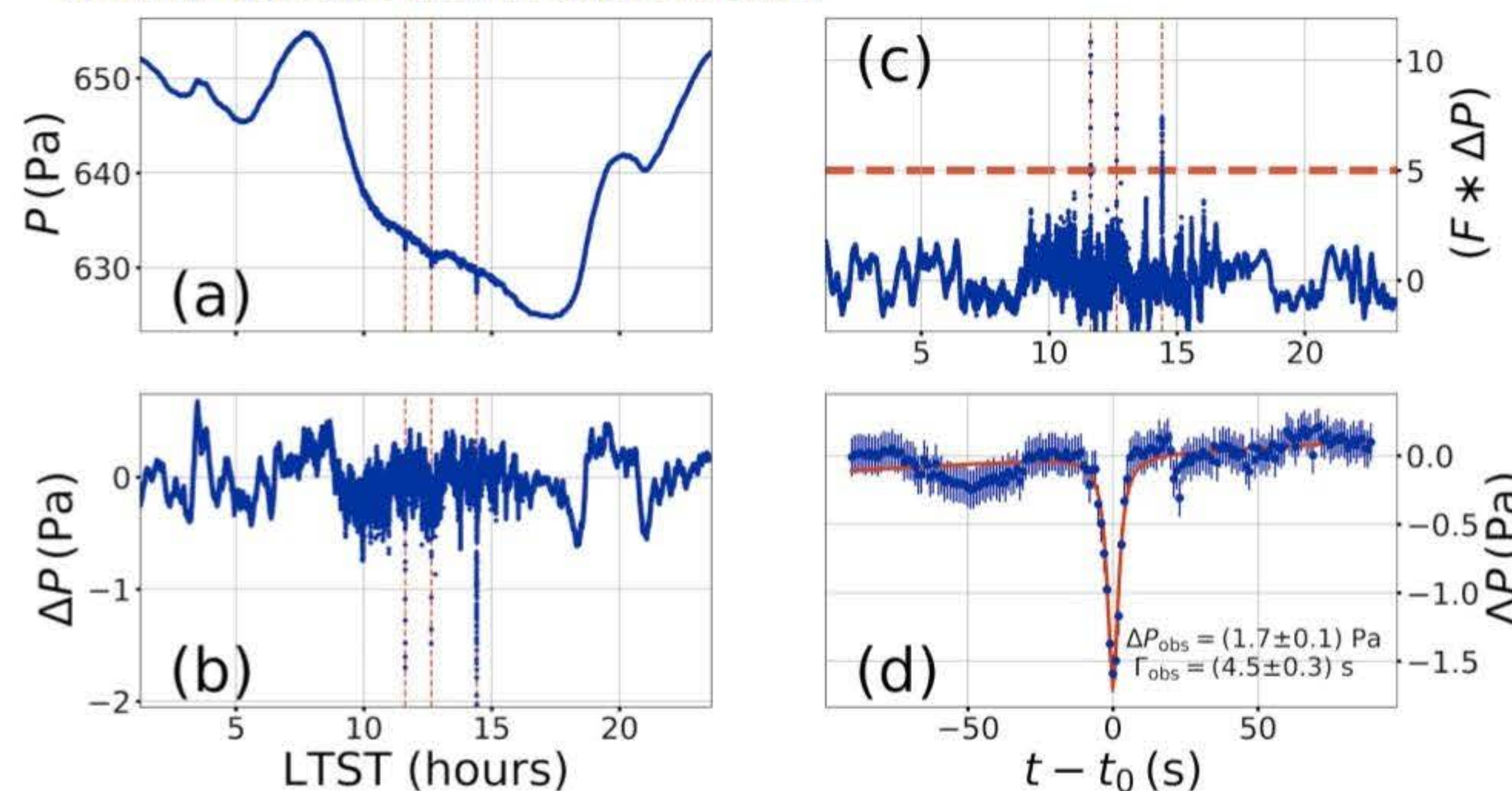


Figure 3: Pressure time-series models of Sol 395. X-axis is time and Y-Axis is pressure

References

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- Jackson, B., Crevier, J., Szurgot, M., & Battin, R. (2020). Inferring Vortex and Meteorological Statistics from the InSight Mission. *Bulletin of the AAS*, 52(6). Retrieved from <https://baas.aas.org/pub/2020n6i308p03>