

# 2018 Mars Global Dust Storm – Effects of Airborne Dust and Particle Deposition on Mars Science Laboratory SAM (Sample Analysis at Mars)<sup>AB</sup> Inlet Cover Actuators Temperatures

B. D. Prats<sup>1,2</sup>, D. Archer<sup>3,4</sup>, Melissa Trainer<sup>1</sup>, C.A. Malespin<sup>1</sup>, S. Teinturier<sup>1,5</sup>, S. Guzewich<sup>1</sup>, P.R. Mahaffy<sup>1</sup>, M. Lemmon<sup>6</sup>, G. Martinez<sup>7</sup> and K. Gonter<sup>8</sup>

<sup>1</sup>NASA Goddard Space Flight Center, Benito.D.Prats@Nasa.Gov, <sup>2</sup>eINFORMe, <sup>3</sup>NASA Johnson Space Center, <sup>4</sup>Jacobs, <sup>5</sup>USRA, <sup>6</sup>Space Science Institute, <sup>7</sup>U of Michigan, <sup>8</sup>NASA Jet Propulsion Laboratory

## Introduction

- Recent Temperature Sensor Measurements From SAM Inlet Cover Actuators Aboard Mars Science Laboratory, Providing Data From Mars Since 2012, Show Global Dust Storm Effects.
- Actuator Sensors During The Storm Show Less Extreme, More Benign Temperatures Beneficial To Mechanism Performance.
- These In-Situ Measurements Can Guide Robotic And Manned Mission Instrument, Actuator And Mechanism Development.

## Actuators

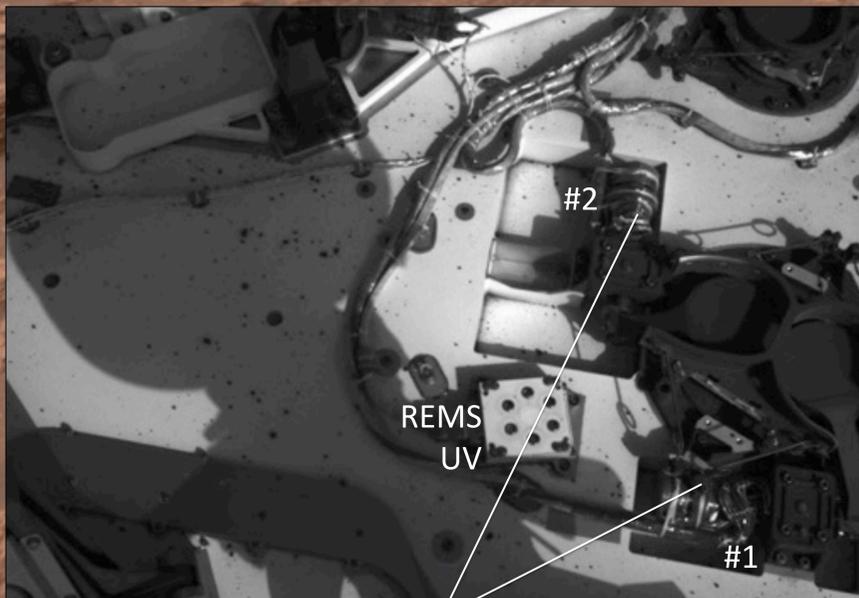


Figure 1. SAM Inlet Cover Actuators w/Embedded Temp. Sensors, Sol 36

- Sensors Allow Heater Control To -40°C For SAM Inlet Cover Operation During Cold Nighttime Conditions. See Figure 1.

## Measurements During Dust Storm

- Deck-Mounted Actuators Saw Drastic Temp. Range Reduction From a Normal Of 70°C Range To a 35°C Range. See Figure 2.
- Max. Temp. Around +10°C Was Reduced To -10°C Due To Cooler Daytime Air Temp. & Attenuation Of Solar Flux Due To Increased Opacity Resulting In Less Heat Absorbed By Actuator.
- Min. Temp. Of -60°C Increased To -45°C Due to Warmer Nighttime Air Temp. & Enhanced Downwelling Atmospheric Radiation at Surface Also Caused by Dust Lofted in The Air.
- Onset to The Min. Temperature Range Was Sudden At 10 Sols.
- Return To Normal Was Longer At 100 Sols As Shown In Figure 2.
- Figure 3 Shows Sudden Increase In Aerosol Opacity (MastCam).
- Figure 4 Shows Semi-Logarithmic Relation of Aerosol Opacity Vs. Temperature Range Of SAM Inlet Cover Actuator Motors.

### REMS Comparison

- Figure 5 Shows Similar Temperature Range For Air And Ground REMS Measurements<sup>C</sup> And Actuator During Global Dust Storm.
- Typically, w/o Dust, Actuator & Air Temp. Ranges Also Similar.
- Ground Temp. Max w/o Dust Similar To Max Actuator Temp.

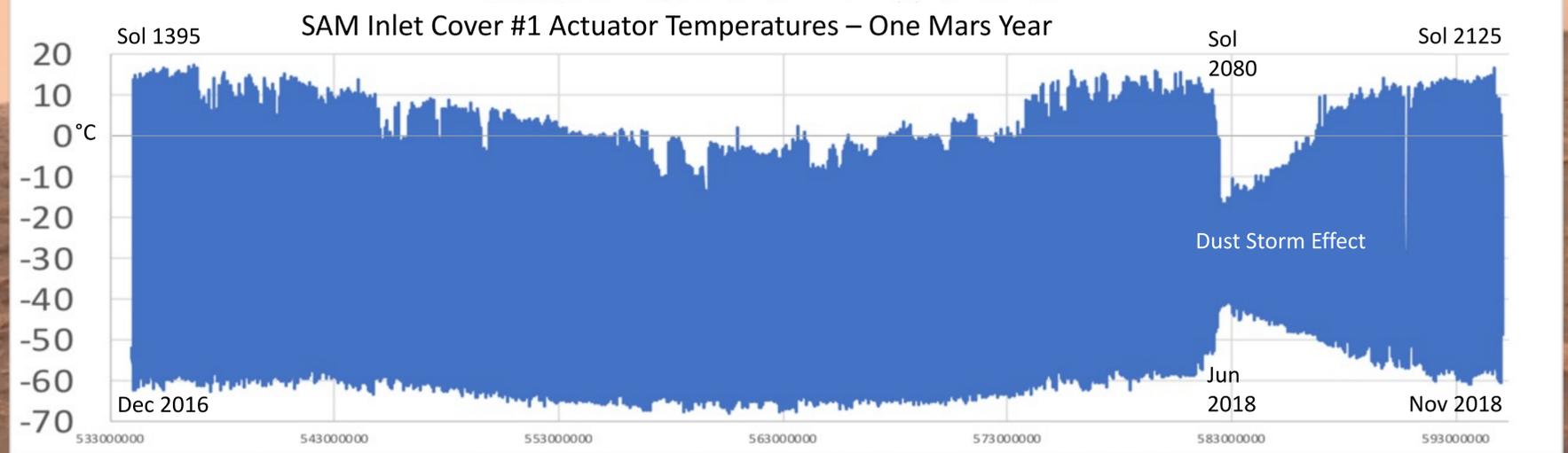


Figure 2. SAM Inlet Cover #1 Actuator Motor Temperature Measurements Over One Mars Year Showing Dust Storm Effect

- Min. Temp. Influenced By Enhanced Downwelling Atmospheric Radiation, Wind, Local Air & Ground Temp.
- Max. Temperatures Influenced By Solar Flux, Mast Shadow, SAM Experiments And Local Air Temperatures.
- Min. Temperature Data Show Increase Due To Reduction of Nighttime Radiation To Space Due To The Dust.
- Max. Temperature Data Show Decrease Due To Reduction of Solar Flux Due Increased Opacity Of The Dust.
- Both Min & Max. Temp. Affected By Changes In Local Air And Ground Temperatures Due To Dust Storm.

## Optical Depth – Tau & Temp. Range

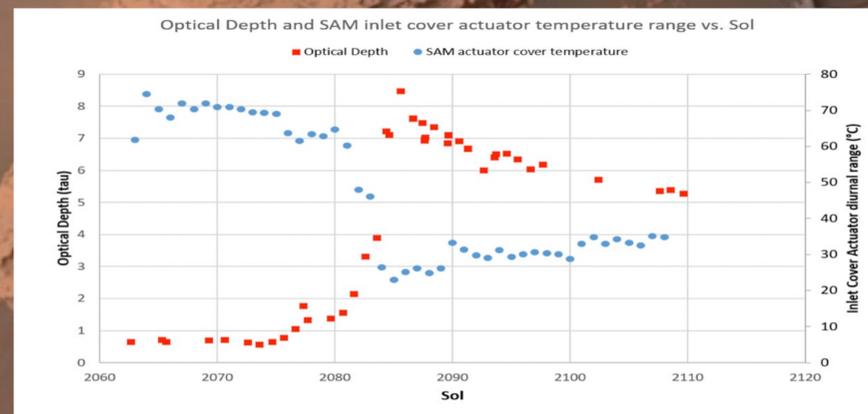


Figure 3. Drop In Temp. Range (Blue), Increase In Tau (Red) Vs. Sol

- Figure 6 Shows Dust On SAM Inlet Covers And Actuator After The 2018 Mars Global Dust Storm. Compare With Figure 1.

## REMS Comparison Before/During Storm

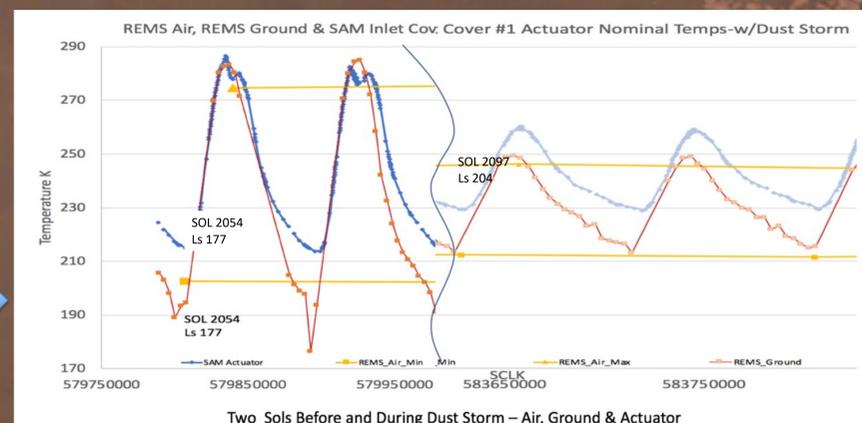


Figure 5. Actuator (Blue), Air (Gold), Ground (Orange) Vs. Time

## Optical Depth – Tau vs Temp.

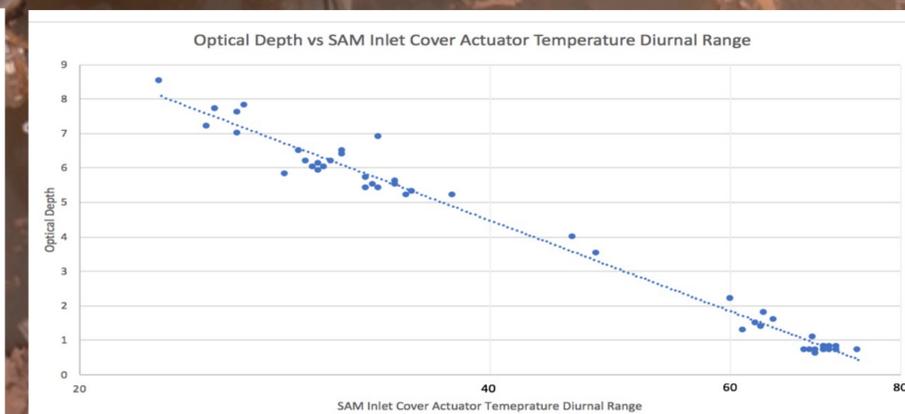


Figure 4. Semi-Logarithmic Relation Of Tau Vs. Temperature Range

## Actuator & Inlets After Storm

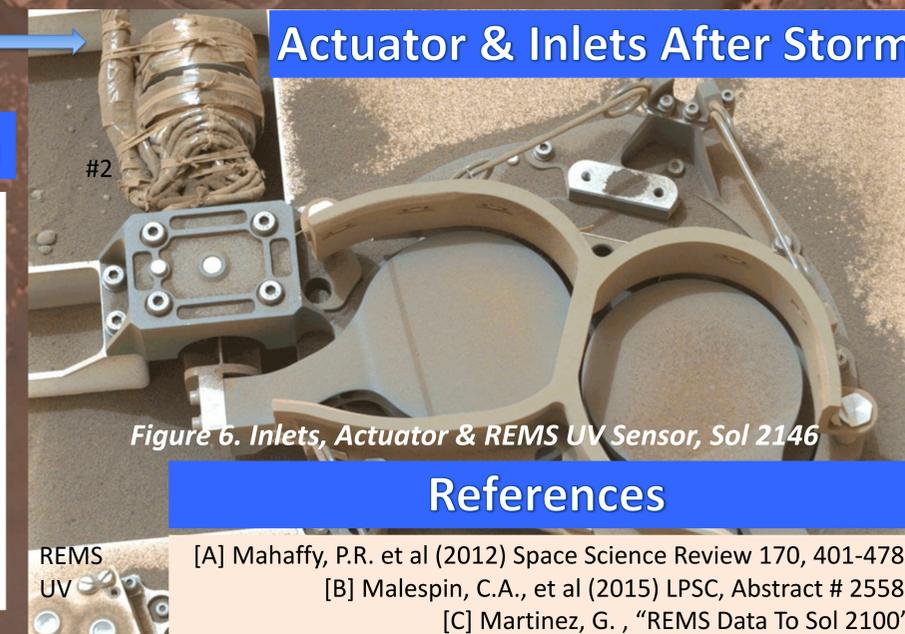


Figure 6. Inlets, Actuator & REMS UV Sensor, Sol 2146

## References

- [A] Mahaffy, P.R. et al (2012) Space Science Review 170, 401-478.
- [B] Malespin, C.A., et al (2015) LPSC, Abstract # 2558.
- [C] Martinez, G., "REMS Data To Sol 2100"