SAGE III ISS
Utilization of Disturbance Monitoring Package in Data Products
SAGE III/ISS Science Team Meeting at NASA LaRC

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13 October 2022
The DMP is a Honeywell Miniature Inertial Measurement Unit comprised of three orthogonal ring laser gyros to measure angular rates in three orthogonal axes.

The SAGE III science retrieval algorithm requires precise pointing knowledge with respect to Earth and the radiant target.

The DMP’s primary requirement was to flag periods when vibration conditions can negatively impact the science data product.
Utilization of DMP in Data Products

Charles Hill

DMP Overview
What is it?
Where is it?
Daily Observations
How are we using it?

Transmission
Aerosol Products
384 nm Aerosol
676 nm Aerosol
756 nm Aerosol
1021 nm Aerosol

Species
O3
NO2
H2O

Products Summary

What is next?

Questions

SAGE III ISS

Sensor Assembly (SA)
Hexapod Mechanical Assembly (HMA)
Contamination Monitoring Package (CMP)
Disturbance Monitoring Package (DMP)

Instrument Control Electronics (ICE)
Hexapod Electronics Unit (HEU)
Contamination Monitoring Package (CMP)
Interface Adapter Module (IAM)
ExPRESS Payload Adapter (ExPA)
The Stratospheric Aerosol and Gas Experiment (SAGE) III is an external payload on the International Space Station (ISS) launched on SpaceX CRS-10 on 19 February 2017 and robotically installed on ExPRESS Logistics Carrier-4 (ELC-4). First light was acquired on 17 March 2017.
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O₃
NO₂
H₂O

Products Summary

What is next?

Questions
Quiescent Day as Observed from ELC-4

09 October 2018 No Commanded Attitude Maneuvers

ISS Mean Rotation Rate: 0.06481 deg/s

Power Spectral Density (deg^2/Hz)

Frequency (Hz)

Total Rotation Rate (deg / s)

Time (UTC)

00:00 04:00 08:00 12:00 16:00 20:00

Species

O_3
NO_2
H_2O

Products Summary

What is next?
Questions
SAGE III Boresight Coordinates

Utilization of DMP in Data Products
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756 nm Aerosol
1021 nm Aerosol

Species
$O_3$
$NO_2$
$H_2O$

Products Summary

What is next?
Questions
Elevation Correction Improves Transmission Noise

![Graph showing elevation correction improvement in transmission noise](image)

DMP Overview
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  - 676 nm Aerosol
  - 756 nm Aerosol
  - 1021 nm Aerosol

Species
- O₃
- NO₂
- H₂O

Products Summary

What is next?

Questions
Elevation Correction Improves Transmission Noise

DMP Elevation (arc seconds)

Transmission Bin RMSE (w/o DMP)

Transmission Bin RMSE (w DMP)

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O₃
NO₂
H₂O

Products Summary
What is next?

Questions
Elevation Correction Improves Transmission Noise

DMP Elevation (arc seconds)

Transmission Bin RMSE (w/o DMP)

Transmission Bin RMSE (w DMP)
Correlation With Elevation Vibration

DMP Correlation
# Events: 30082

Transmission Bin RMSE (w/o DMP)

Elevation (asec)

Elevation Offset (asec)
Utilization of DMP in Data Products

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Species
O3
NO2
H2O

Products Summary

Transmission Uncertainty
April 2018
PG 86

435 Sunrise Events (w/o DMP)
Alt (km)

435 Sunrise Events (w DMP)
Alt (km)

464 Sunset Events (w/o DMP)
Alt (km)

464 Sunset Events (w DMP)
Alt (km)

Relative Uncertainty (%)
Utilization of DMP in Data Products

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1021 nm Aerosol

Species
O_3
NO_2
H_2O

Products Summary

What is next?

Questions

384 nm Aerosol NO DMP Correction
Utilization of DMP in Data Products

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Transmission
Aerosol Products
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Species O₃ NO₂ H₂O

Products Summary

What is next?

Questions

384 nm Aerosol With DMP Correction
384 nm Aerosol Uncertainty NO DMP Correction
Utilization of DMP in Data Products

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1021 nm Aerosol
Species
O₃
NO₂
H₂O
Products Summary
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Questions

384 nm Aerosol Uncertainty With DMP Correction
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756 nm Aerosol
1021 nm Aerosol

Species
O<sub>3</sub>
NO<sub>2</sub>
H<sub>2</sub>O

Products Summary

What is next?
Questions

676 nm Aerosol NO DMP Correction
Utilization of DMP in Data Products

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Transmission
Aerosol Products
384 nm Aerosol
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756 nm Aerosol
1021 nm Aerosol

Species
O$_3$
NO$_2$
H$_2$O

Products Summary

What is next?

Questions
Utilization of DMP in Data Products

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1021 nm Aerosol

Species
O$_3$
NO$_2$
H$_2$O

Products Summary

What is next?
Questions

676 nm Aerosol Uncertainty NO DMP Correction
Utilization of DMP in Data Products

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Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions
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756 nm Aerosol
1021 nm Aerosol

Species
O₃
NO₂
H₂O

Products Summary

What is next?
Questions
756 nm Aerosol With DMP Correction

Utilization of DMP in Data Products

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How are we using it?

Transmission
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1021 nm Aerosol

Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions
Utilization of DMP in Data Products

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DMP Overview
What is it?
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Transmission

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676 nm Aerosol
756 nm Aerosol
1021 nm Aerosol

Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions

756 nm Aerosol Uncertainty NO DMP Correction
Utilization of DMP in Data Products

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Where is it?
Daily Observations
How are we using it?
Transmission
Aerosol Products
384 nm Aerosol
676 nm Aerosol
756 nm Aerosol
1021 nm Aerosol

Species
O$_3$
NO$_2$
H$_2$O

Products Summary

1021 nm Aerosol NO DMP Correction

Questions
1021 nm Aerosol With DMP Correction
Utilization of DMP in Data Products

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Transmission

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756 nm Aerosol
1021 nm Aerosol

Species
O$_3$
NO$_2$
H$_2$O

Products Summary

What is next?
Questions
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Where is it?
Daily Observations
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Transmission
Aerosol Products
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676 nm Aerosol
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1021 nm Aerosol

Species
O$_3$
NO$_2$
H$_2$O

Products Summary

What is next?
Questions

1021 nm Aerosol Uncertainty With DMP Correction

km$^{-1}$

Altitude [km]

Date

Jun 2017
Apr
Jan 2019
Oct 2020
Oct

km$^{-1}$

10$^{-3}$

10$^{-5}$

10$^{-6}$
Utilization of DMP in Data Products

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756 nm Aerosol
1021 nm Aerosol

Species
O₃
NO₂
H₂O

Products Summary

What is next?
Questions

O₃ Product NO DMP Correction
Utilization of DMP in Data Products

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O₃
NO₂
H₂O

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Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions

O₃ Uncertainty With DMP Correction
NO$_2$ Product NO DMP Correction

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- 1021 nm Aerosol

Species
- O$_3$
- NO$_2$
- H$_2$O

Products Summary

Questions
NO$_2$ Product With DMP Correction

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Species
O$_3$
NO$_2$
H$_2$O

Products Summary

What is next?
Questions

35 / 44
NO$_2$ Uncertainty NO DMP Correction

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Species
O$_3$
NO$_2$
H$_2$O
Products Summary
What is next?
Questions
NO$_2$ Uncertainty With DMP Correction
Utilization of DMP in Data Products

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Transmission

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1021 nm Aerosol

Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions

H₂O Product NO DMP Correction
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Species
$O_3$
$NO_2$
$H_2O$

Products Summary

What is next?

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Species
O$_3$
NO$_2$
H$_2$O

Products Summary

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1021 nm Aerosol

Species
O_3
NO_2
H_2O

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Questions

H_2O Uncertainty With DMP Correction
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Species
O₃
NO₂
H₂O

Products Summary

What is next?

Questions
Disturbance Monitoring Package (DMP)

What is next for the DMP Team?

► Submit a paper with details about the DMP correction to the SAGE III product
► Release a DMP-corrected version of the SAGE III product
► Comparisons with ISS LVLH attitude quaternion time series to assess truss deflections
► Absolute attitude product
  • Improved latitude/longitude/altitude registration for limb scattering measurements by implementing the SAGE III attitude Kalman Filter
  • Payload vibration environment at ELC-4 beneficial to ISSP and external payload community