Dust observations made by LPW at Mars

L. Andersson, F. Thayer, T. D. Weber, D. Malaspina, R. E. Ergun, and C. M. Fowler

LASP, CU, Boulder, USA

Layout

Introduction to Mars and the MAVEN mission

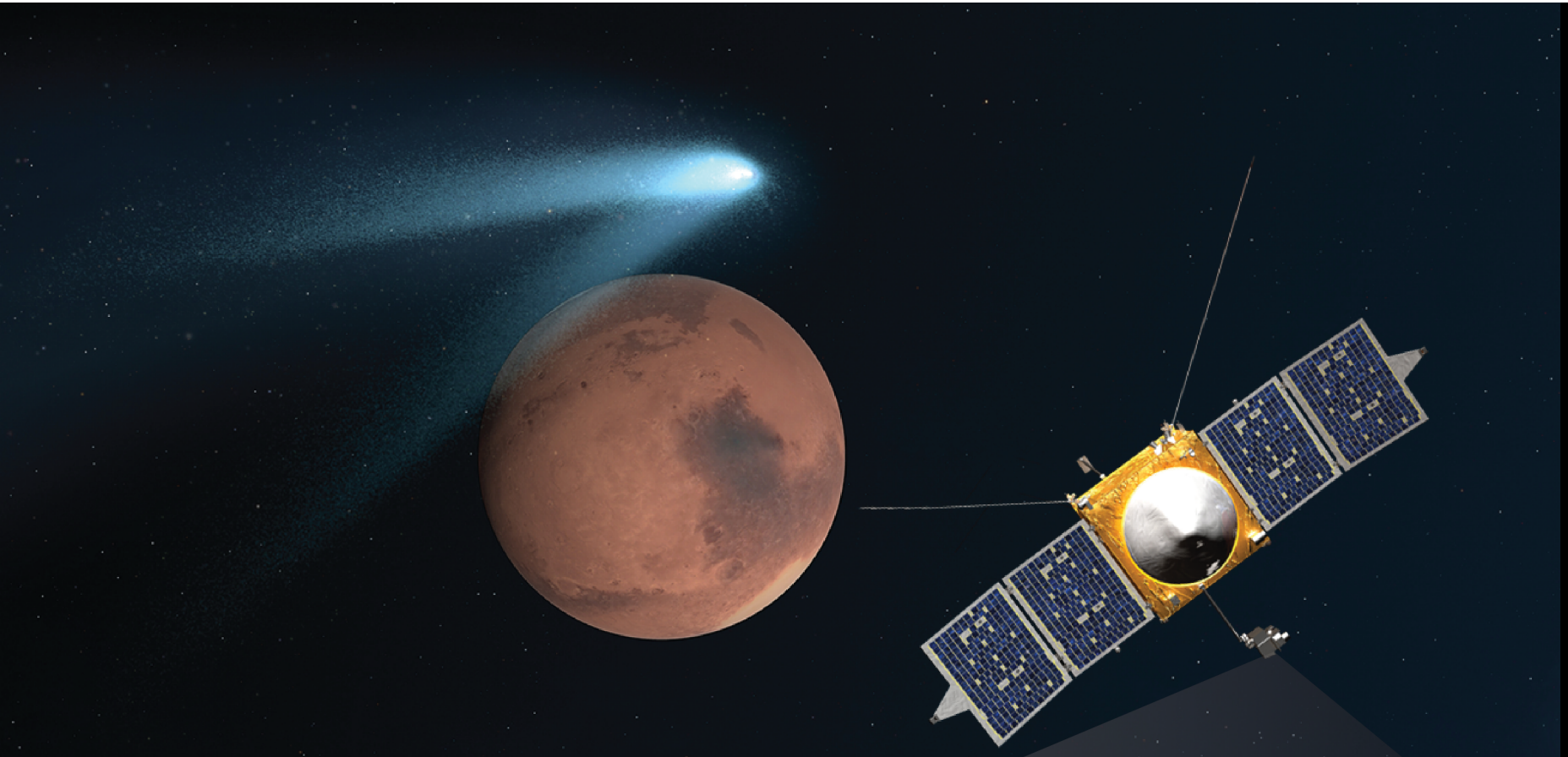
Different signatures of dust hits

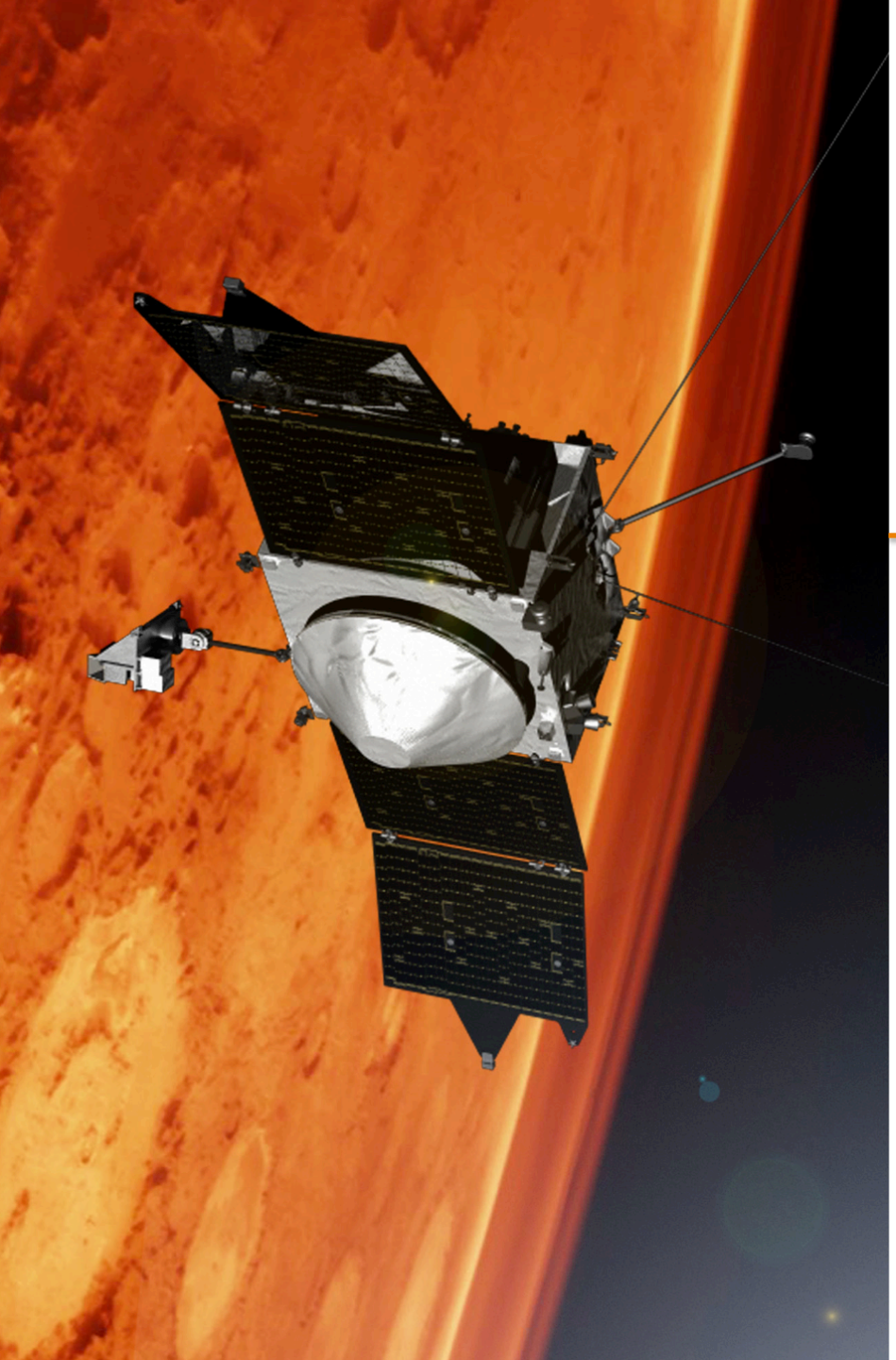
Time history example CSS

Statistics ~ 9 months of HSBM-MF

Statistics V1/V2

Summary





Dust at Mars

Mainly 3 sources considered:

-Within the system (such as the moons as previous presentation discussed)

-Outside the system (such as beta dust)

-The surface (as one nature paper has suggested based on optical observations)

Mars Atmosphere and Volatile EvolutioN

Mission in orbit since September 2014

- Periapsis 130-160 km
- Apoapsis 6500 km
- Orbit period ~4.5 h

Plasma and neutral instruments:

NGIMS	– in-situ metal ions
IUVS	– remotely metal ions
LPW	– in-situ dust

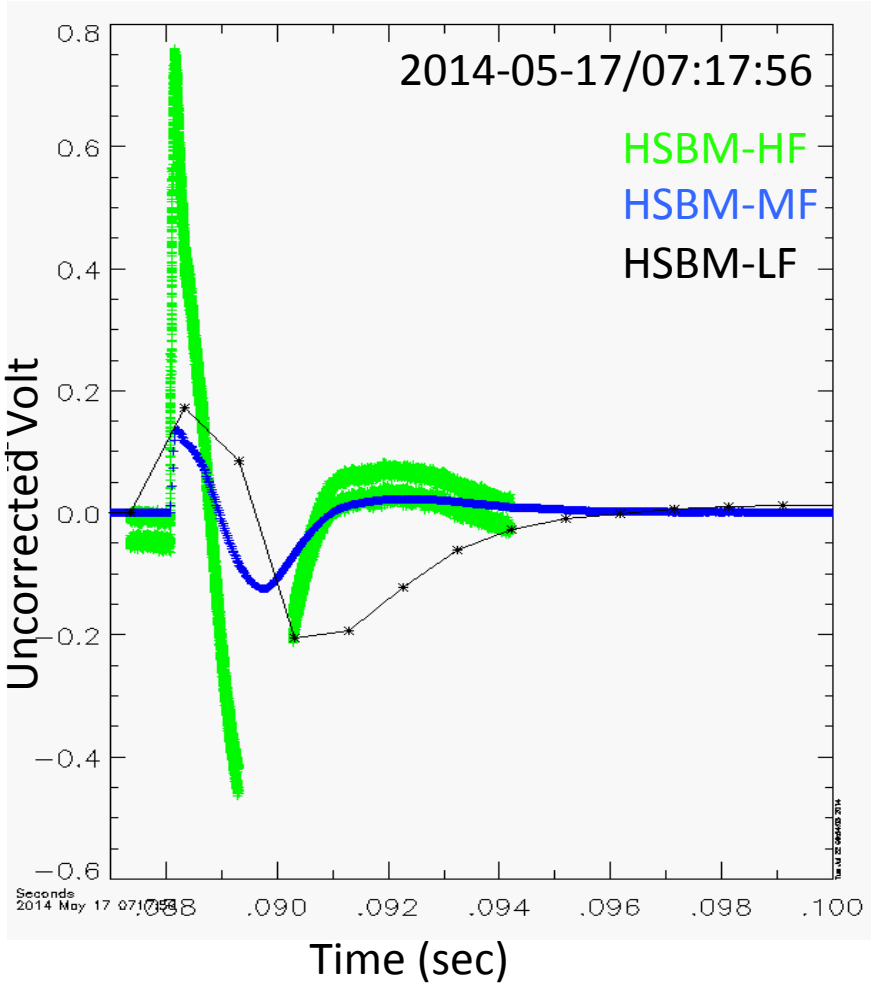
Langmuir Probe and Waves (LPW) instrument

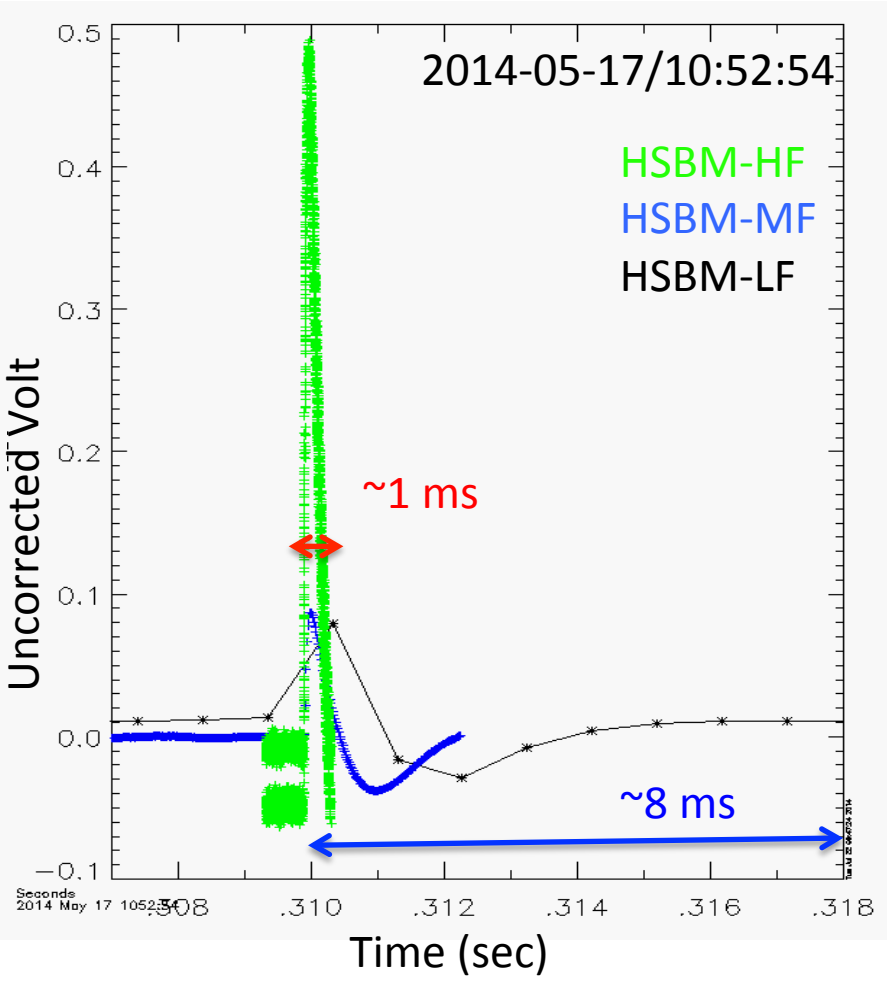
Measurement products:
-V1/V2 - all subcycles
-E12-DC
-E12 HSBM - burst system LF, MF and HF
Waves mode: Di-pole
Dust mode: Mono-pole

Prime science operation:
-Cycle between Langmuir probe and waves measurements.
-Special events Dust mode.
-Master cycle length variable

Signature: Cruise Phase Stoved Booms

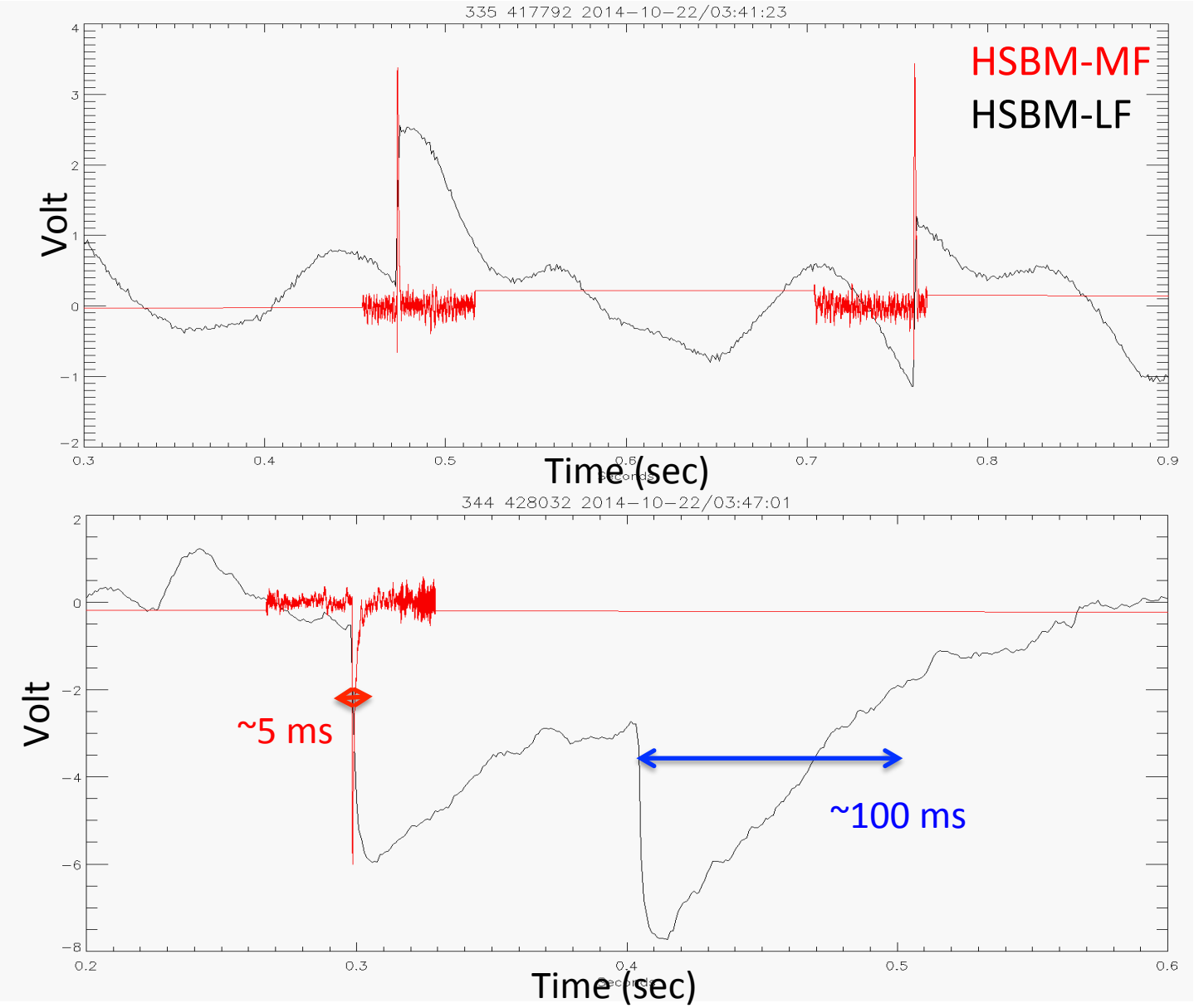
Mode: Dust (mono-pole)
Burst data (3 different filters)





Signature: Deployed booms

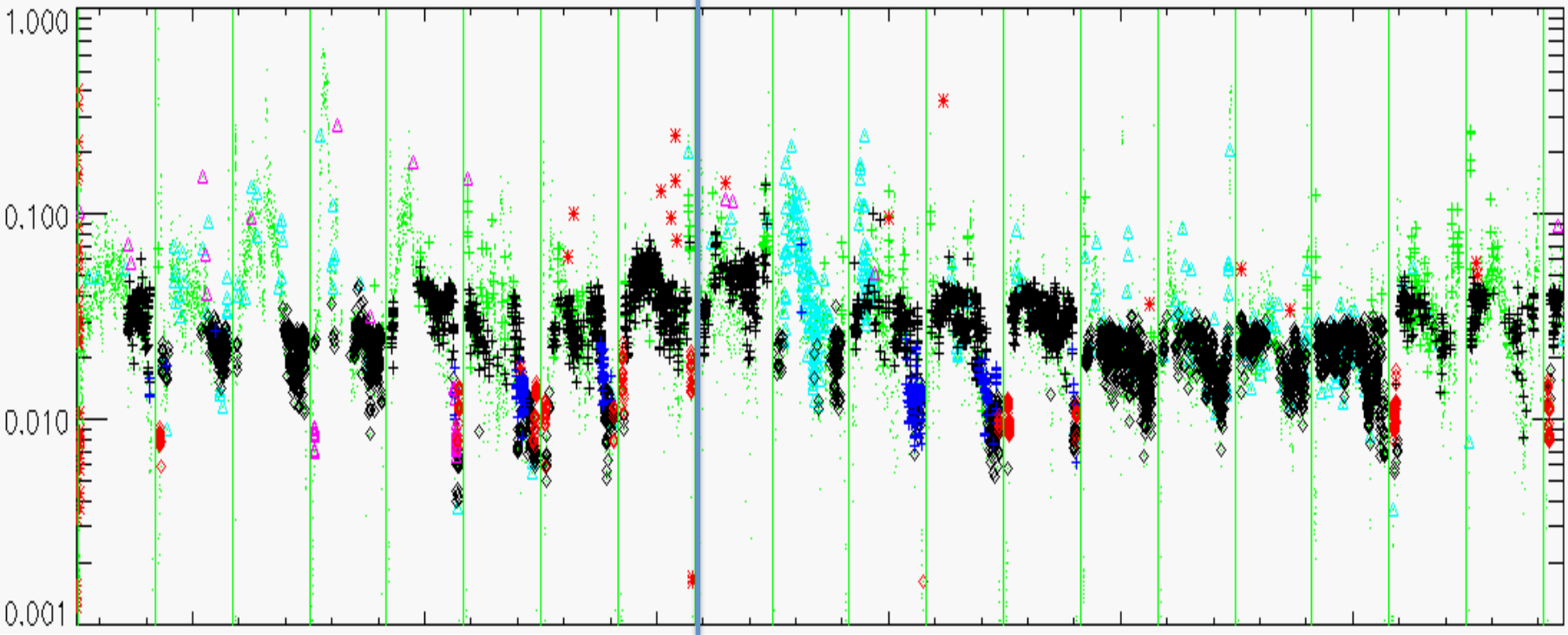
HSBM mode Dust - monopolar



Time History: Observations during CSS

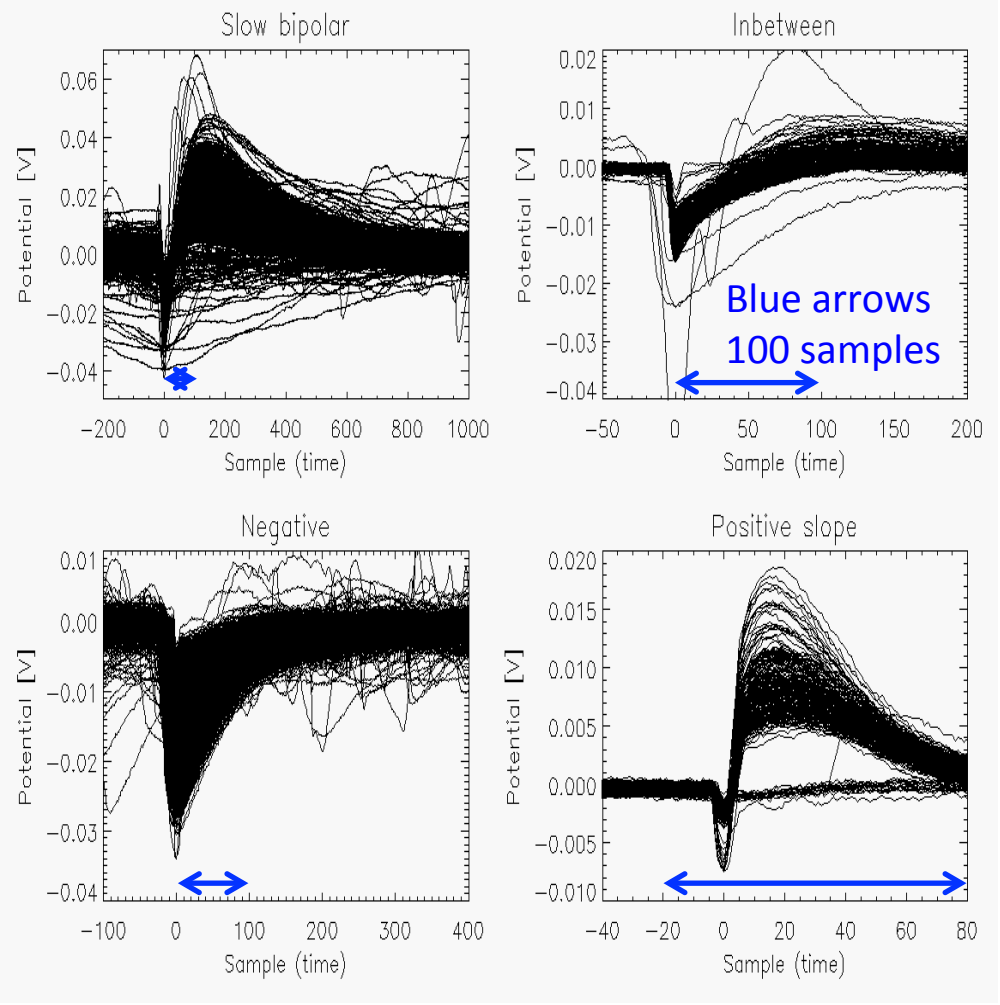
Green/light blue HSBM waves
All the other colors - Dust

Periapsis when the CSS passed Mars

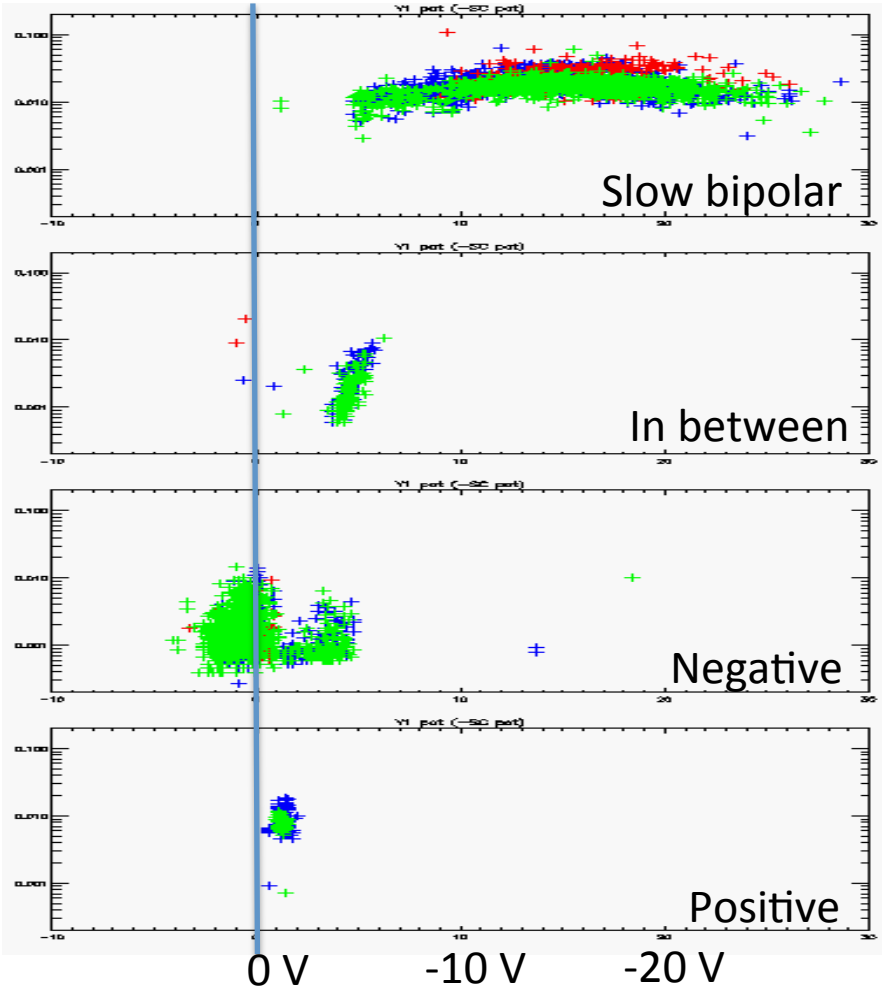


Green lines: Periapsis ~4.5 hours apart
No measurements was made at periapsis

Signature: Dust mode (during CSS)



Dust amplitude versus SC potential (V1)



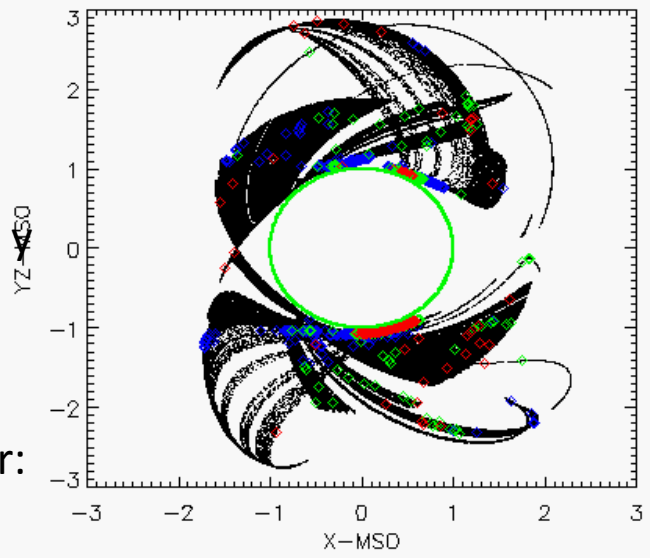
This verified by Collette et al. 2015 result's in the laboratory

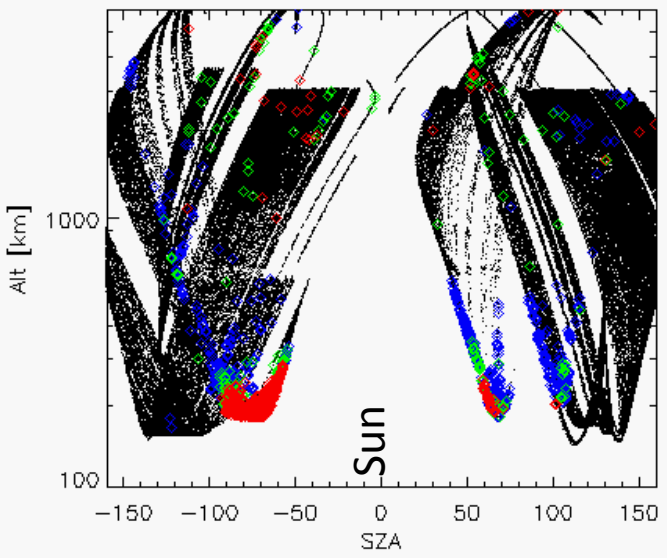
Statistics: 9 months of Dust observations HSBM-MF

MSO:
x vs yz
yz sign after Y

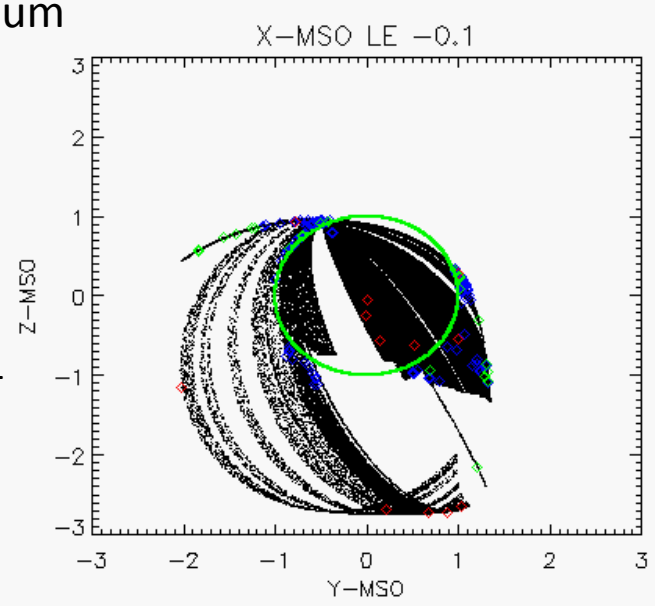
Dust in color:
Blue small
Green medium
Red large

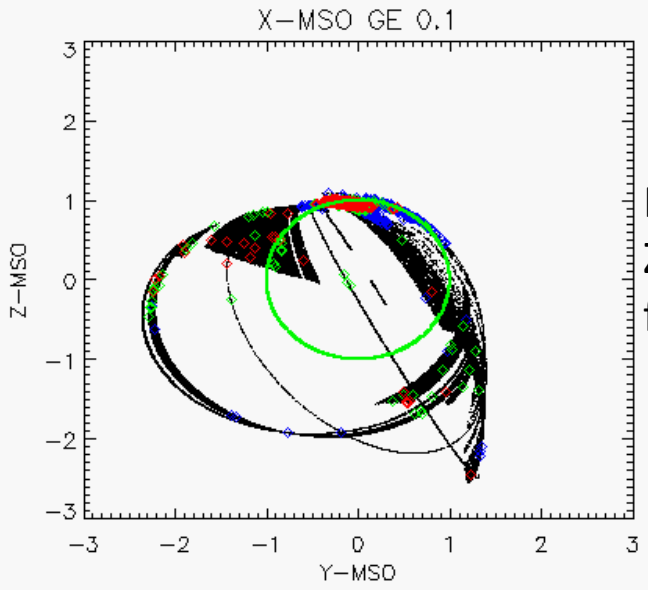
MSO:
Z vs Y
for X LE -0.1





Altitude
vs SZA





MSO:
Z vs Y
for X LE +0.1

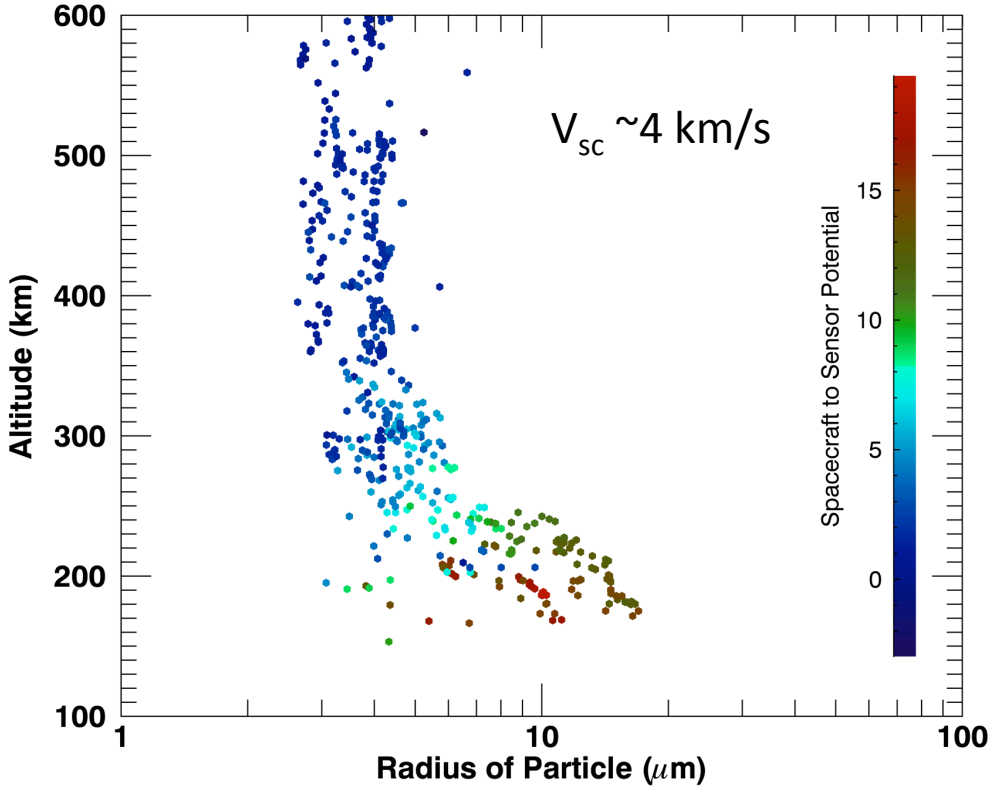
Statistics: Dust Size/Mass

From HSBM-MF Mode dust

Assumed mass density
of ~2.5 g/m^3

Using SC speed **4 km/s**:
Dust size of ~4 to 20 mm
Mass of ~5x10^{-10} to 5x10^{-8} g

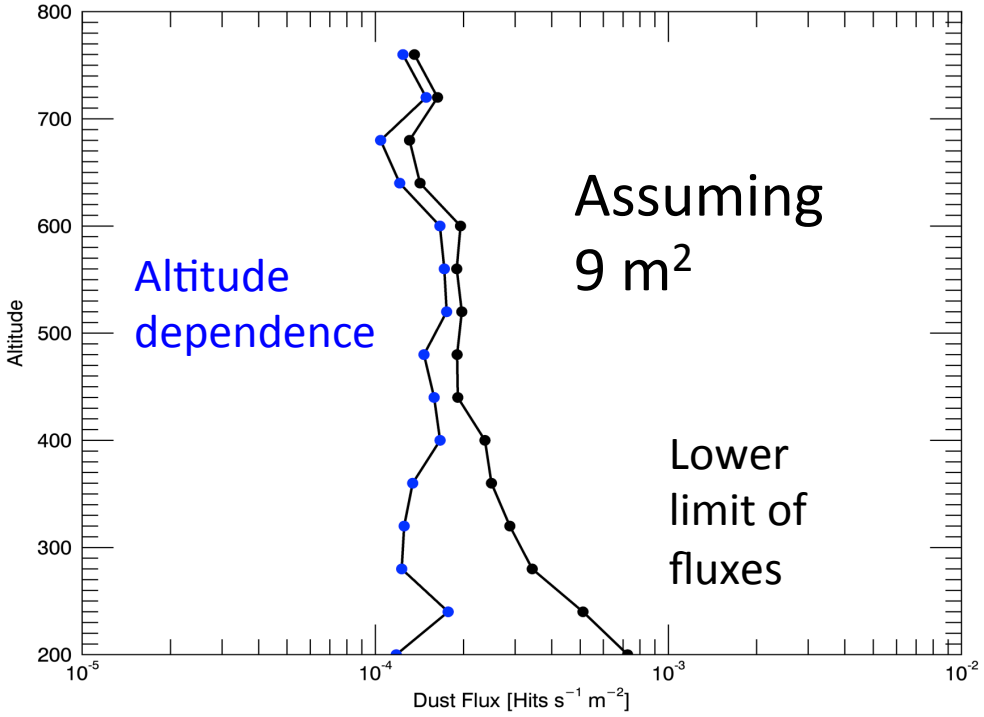
Using interplanetary dust speed into the atmosphere **18 km/s**:
Dust size are ~0.7 to 4 mm
Mass of ~5x10^{-12} to 5x10^{-10} g



Spacecraft potential can impact the observations

Andersson et al., 2015

Statistics: Dust Fluxes

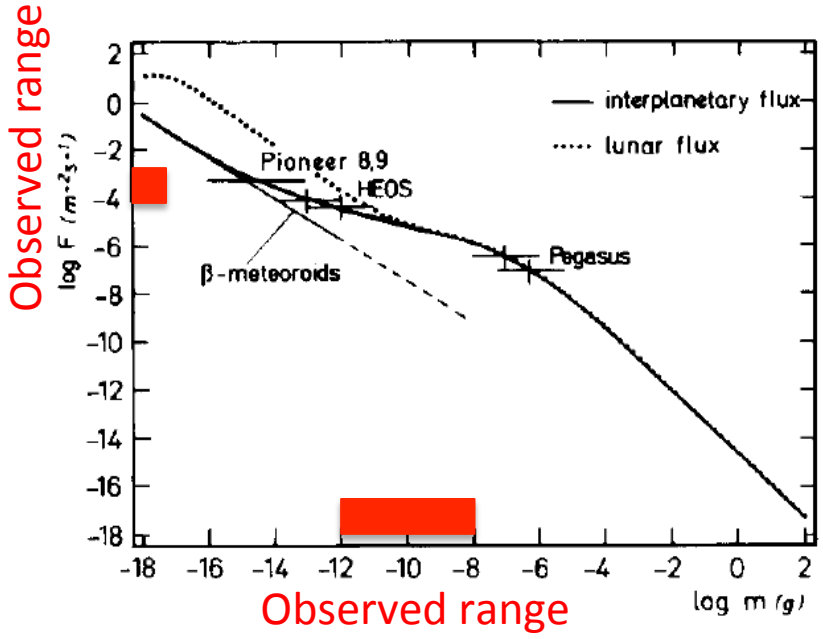


From HSBM-MF Mode dust

- Interplanetary dust can explain the fluxes
- No direct latitude trend observed using the first months in mission – no support for dust ring

Andersson et al., 2015

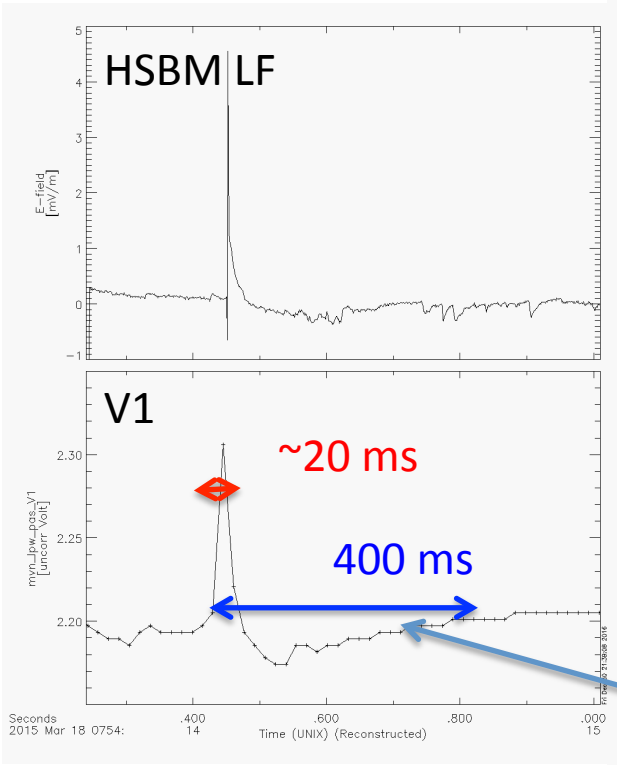
Interplanetary Dust Flux

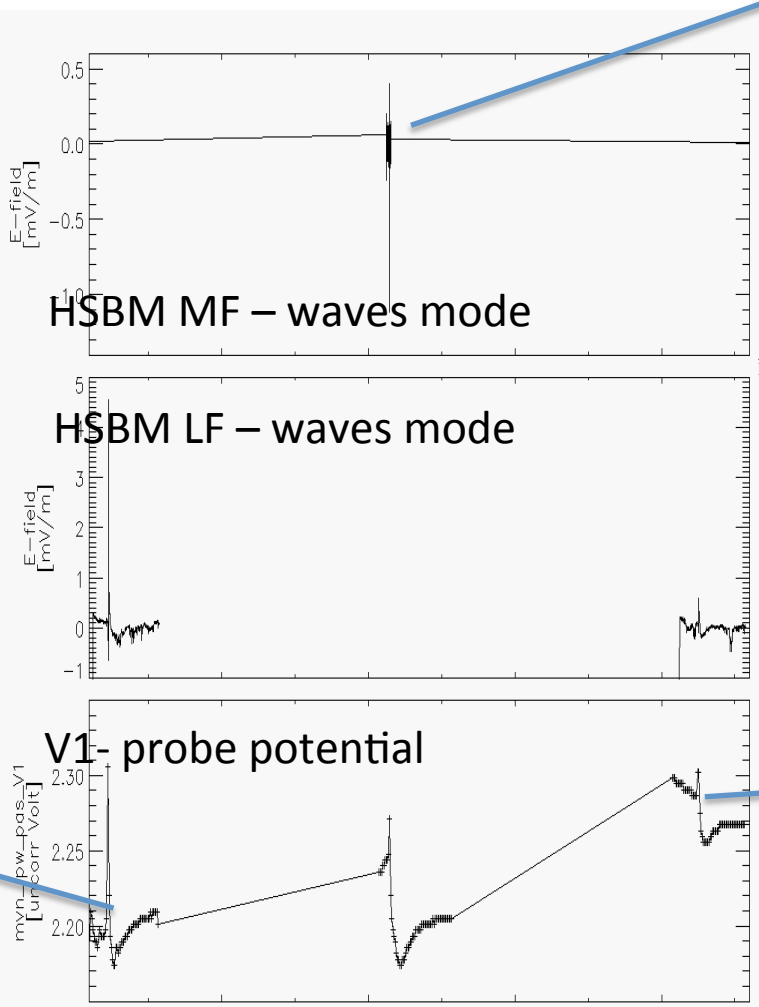


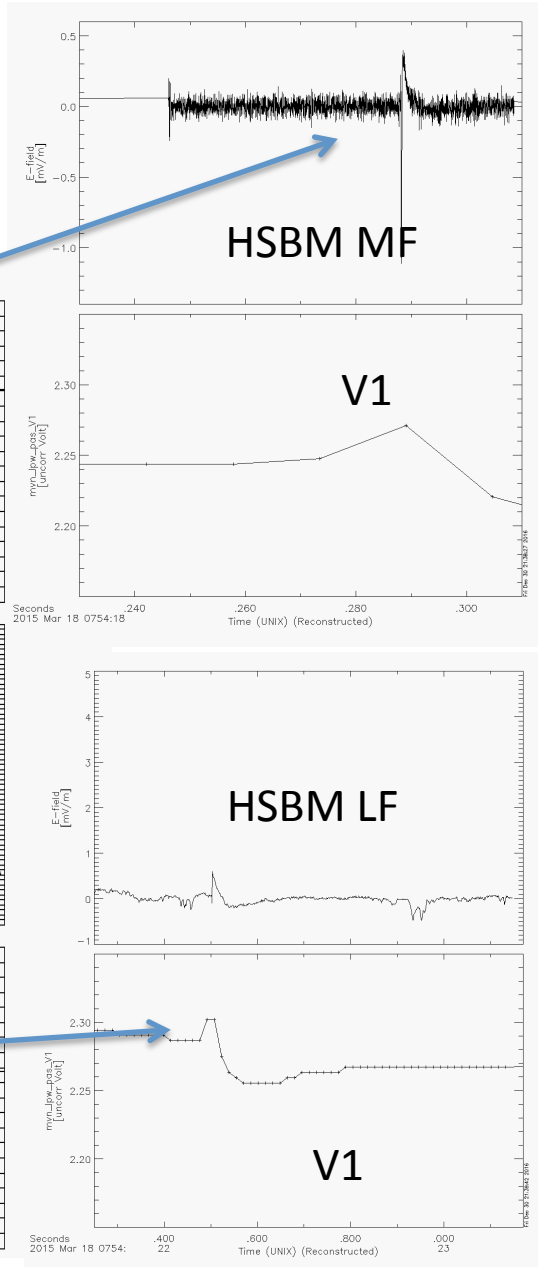
Grun et al. 1985

Signature: Deployed booms mode Waves

i.e. HSBM is in dipolar configuration

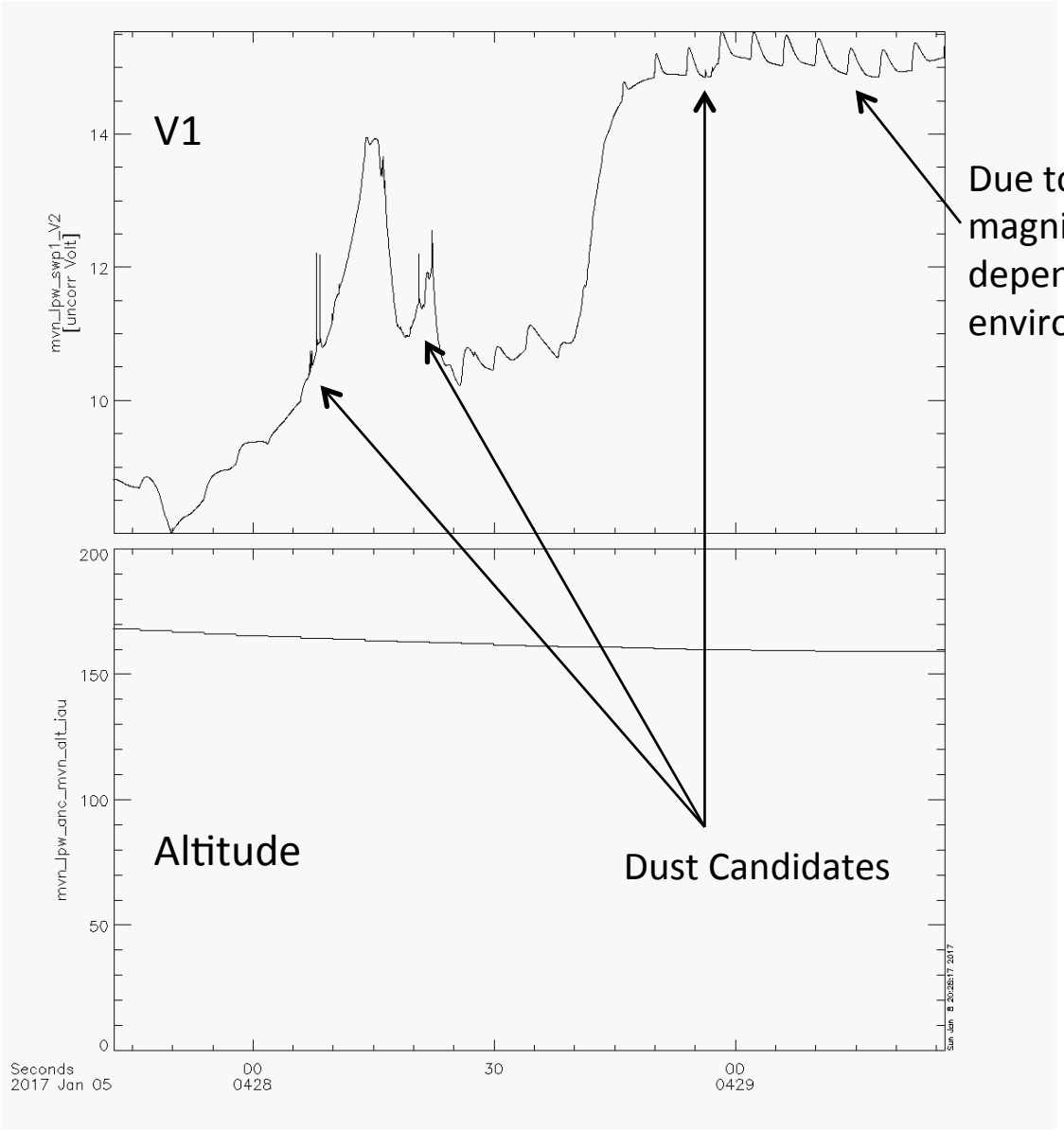






Signature: Deployed booms mode Waves

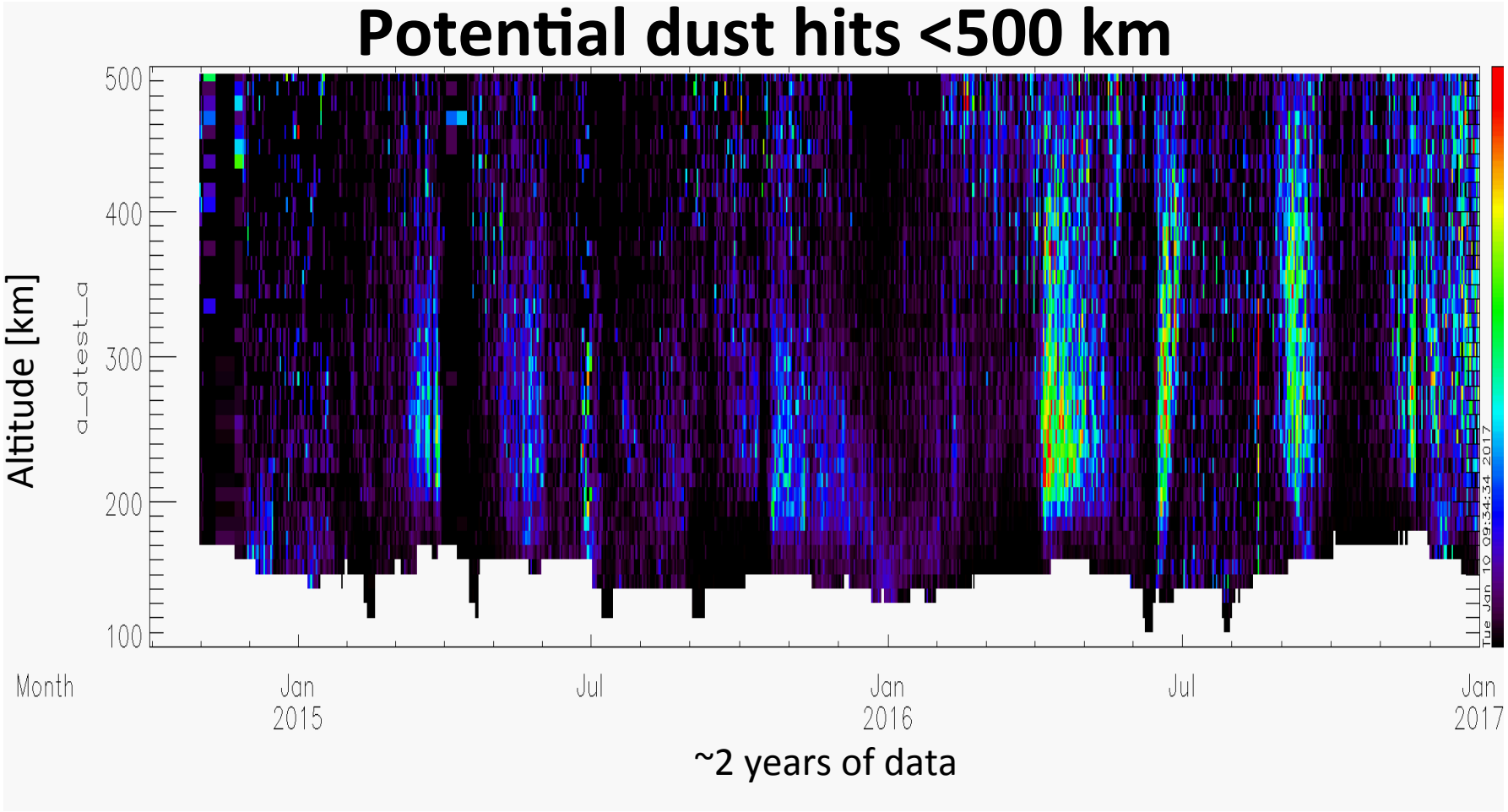
Difficult to make a automatic algorithm for detecting V1/V2 signature



Date: 2017 Jan 05

Statistics: Using V1/V2

Note: Difficult to make a automatic algorithm for detecting this signature. The presented results are only preliminary



Verify identification, Identify location, Explain relative velocity

Summary

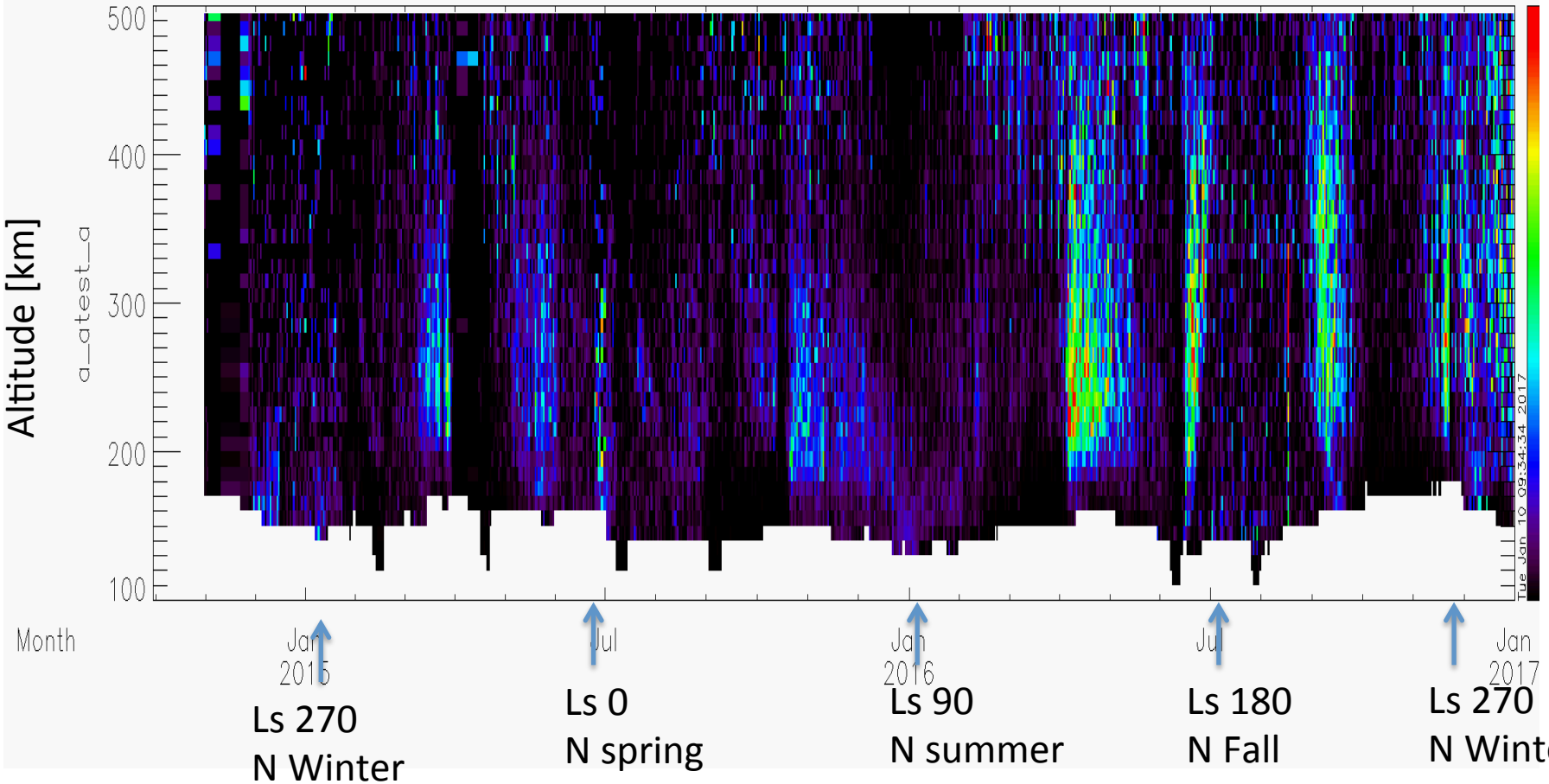
- There are dust at Mars
- NGIMS and IUVS observes the effect of the ‘meteoric’ metal layer
- LPW observes at least the interplanetary dust
- LPW show how the dust signal change with different configurations
- LPW do not show any indication of observing dust from the ‘rings’
- A new set of data from LPW is under investigation

Statistics: Using V1/V2

Note: Difficult to make a automatic algorithm for detecting this signature. The presented results are only preliminary

1 second | 4 seconds

Potential dust hits <500 km



Verify identification, Identify location, Explain relative velocity