Constraining the Water Production Rate and Impact on Mars' Ionosphere of Comet Siding Spring

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C·S·P

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BOSTON UNIVERSITY

C/2013 A1 (Siding Spring)

- Oort Cloud Comet
- Closest approach on 19 October 2014 at 18:29 UT
- ~130,000 km

Water from the comet was predicted to effect atmosphere and ionosphere of planet.

Goals

To constrain the

1. water production rate,
2. perturbations to the neutral atmosphere, and
3. perturbations to the ionosphere

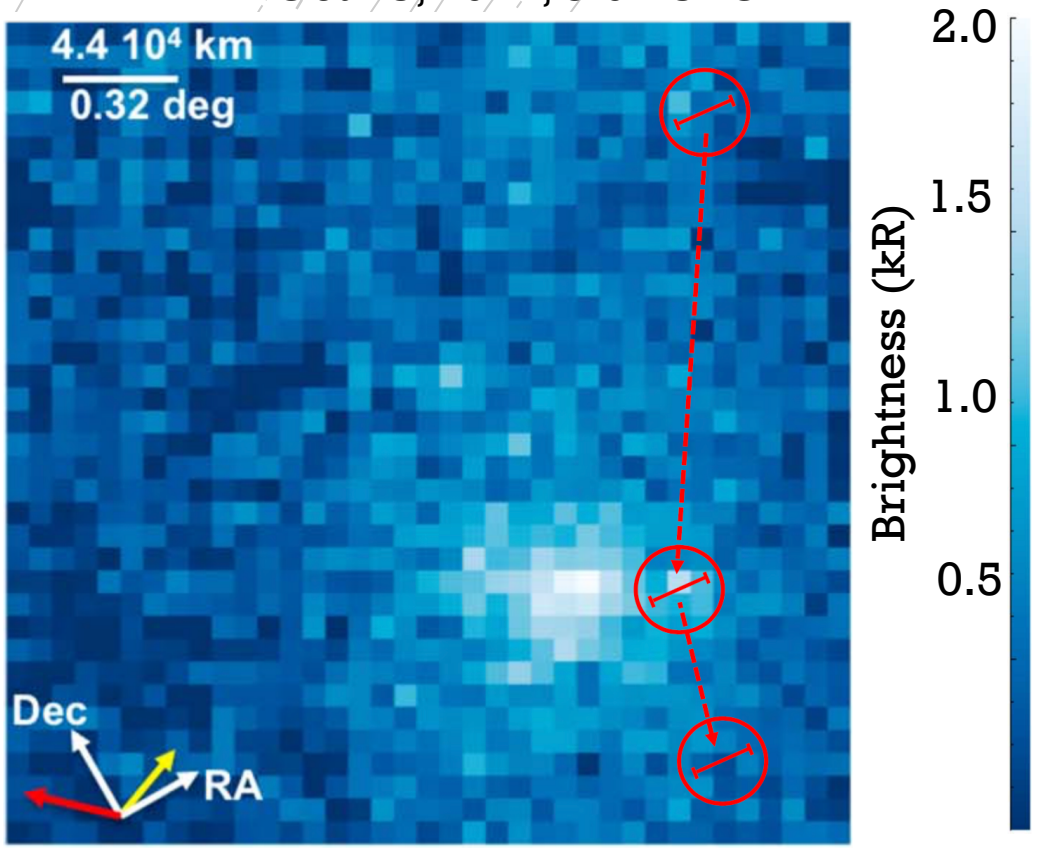
due to comet by using observations from MAVEN (IUVS and NGIMS) and models (IPH, Comet, and Mars Ionosphere).

Comet Siding Spring Water Production Rate

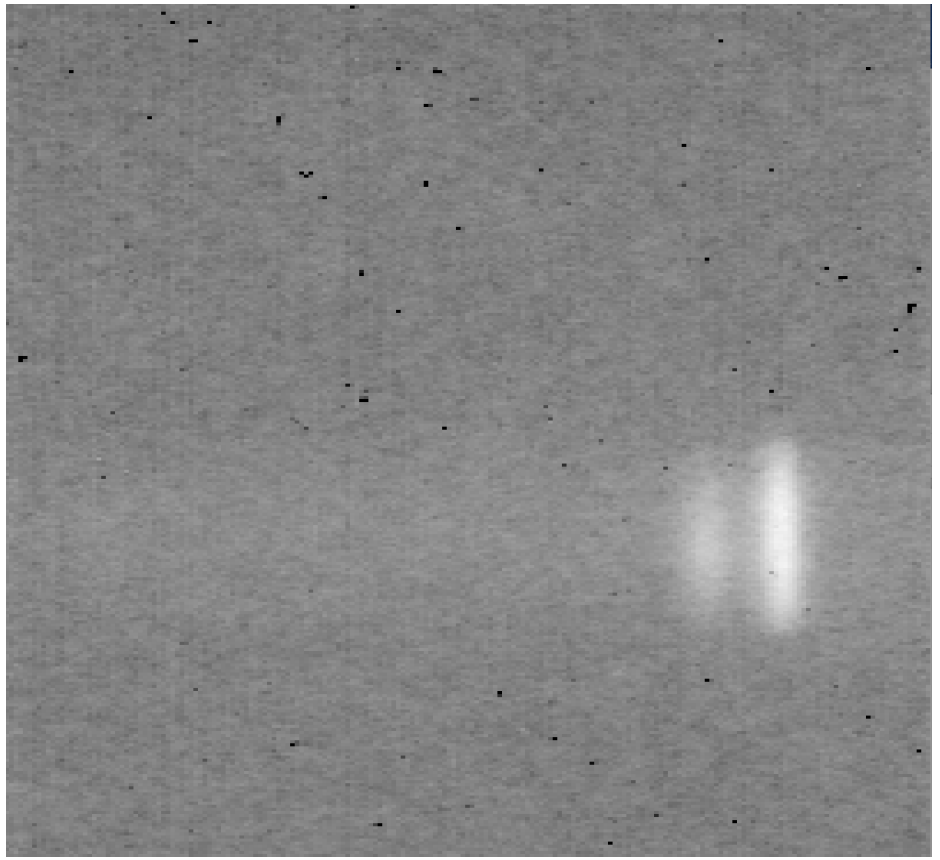
$\sim 10^{27} - 10^{29}\ s^{-1}$

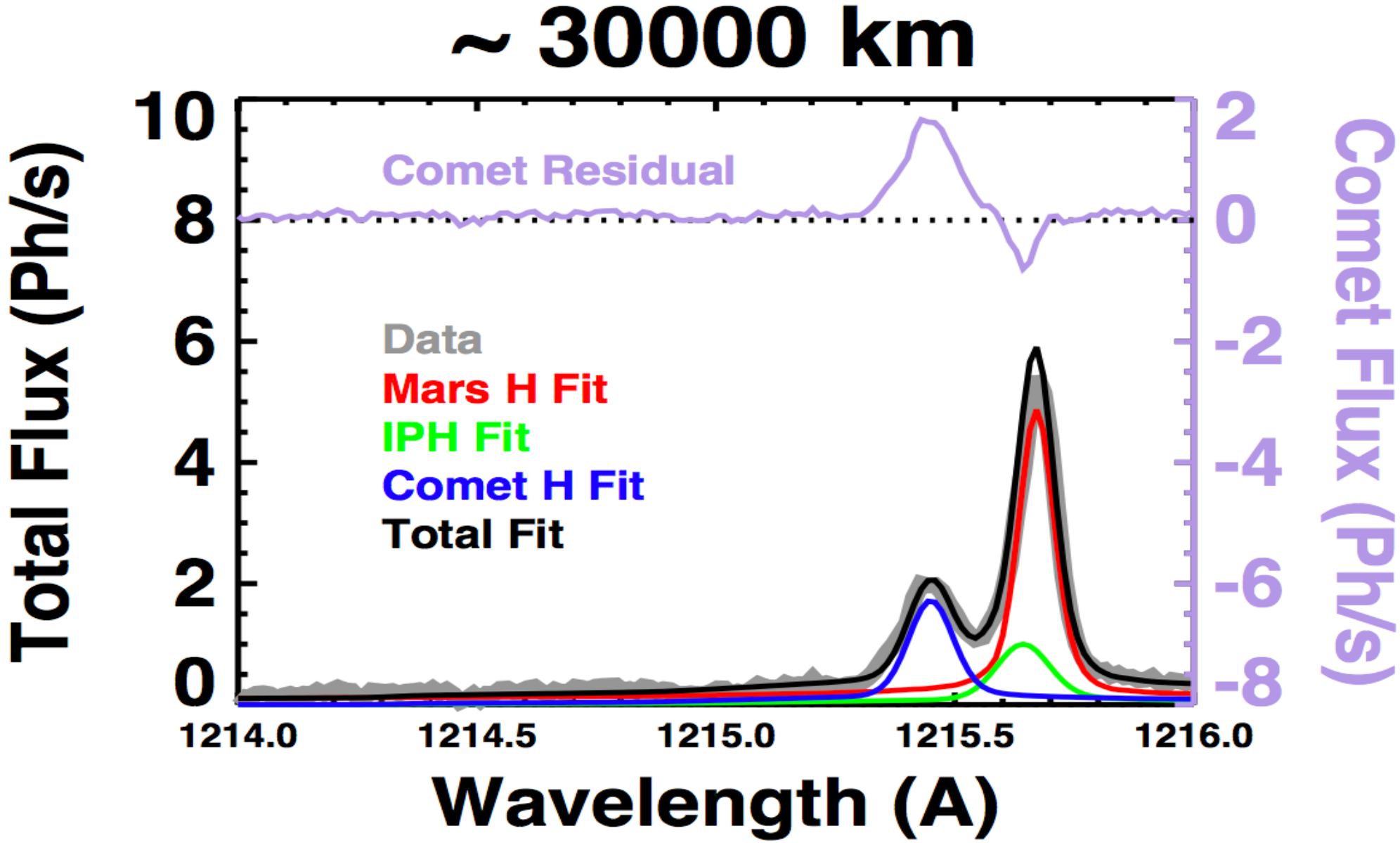
predicted to measureably perturb neutral and ionized atmosphere of Mars.

Oct 18, 2014, 3:02 UTC



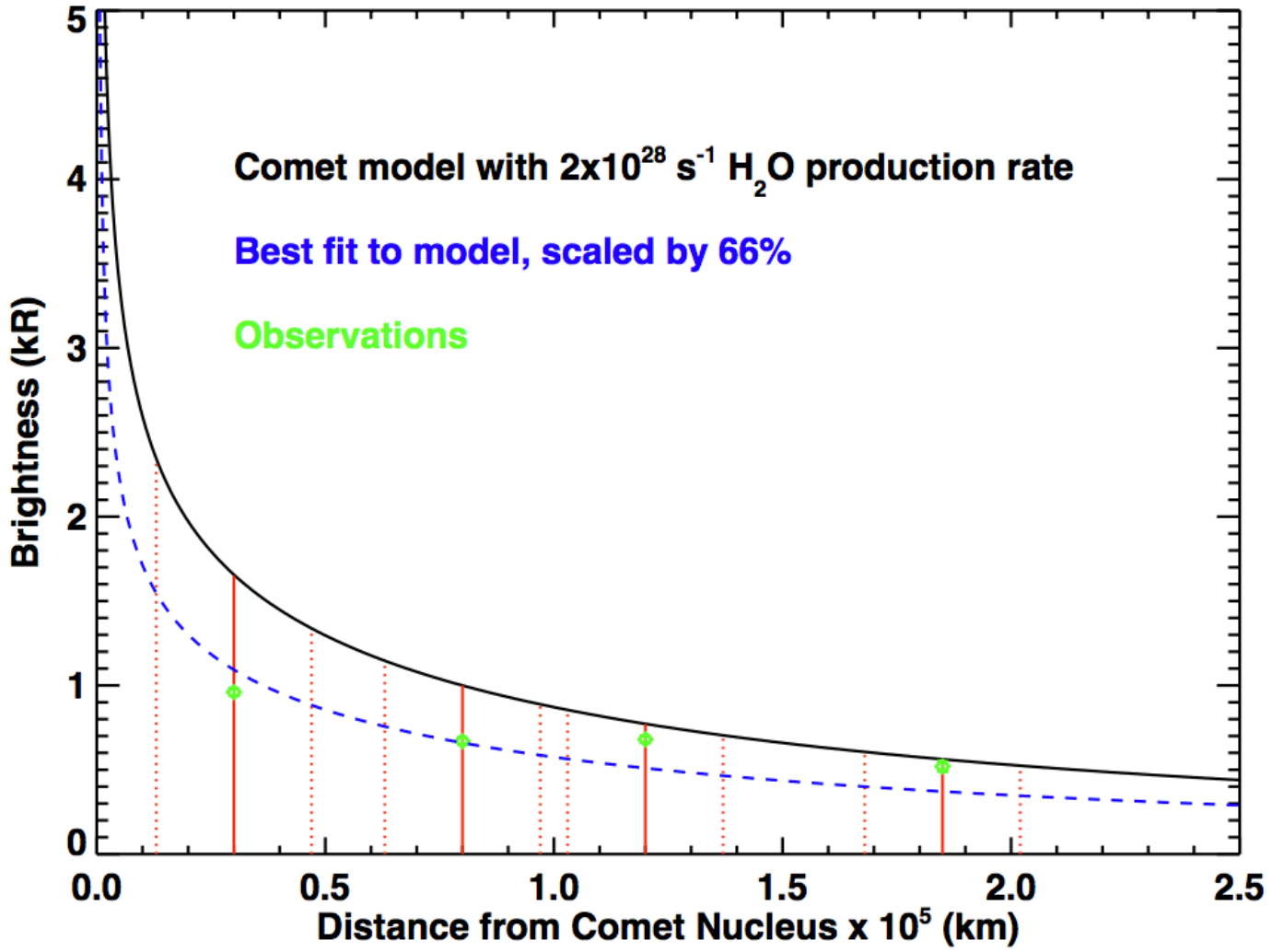
Crismani et al., [2015]

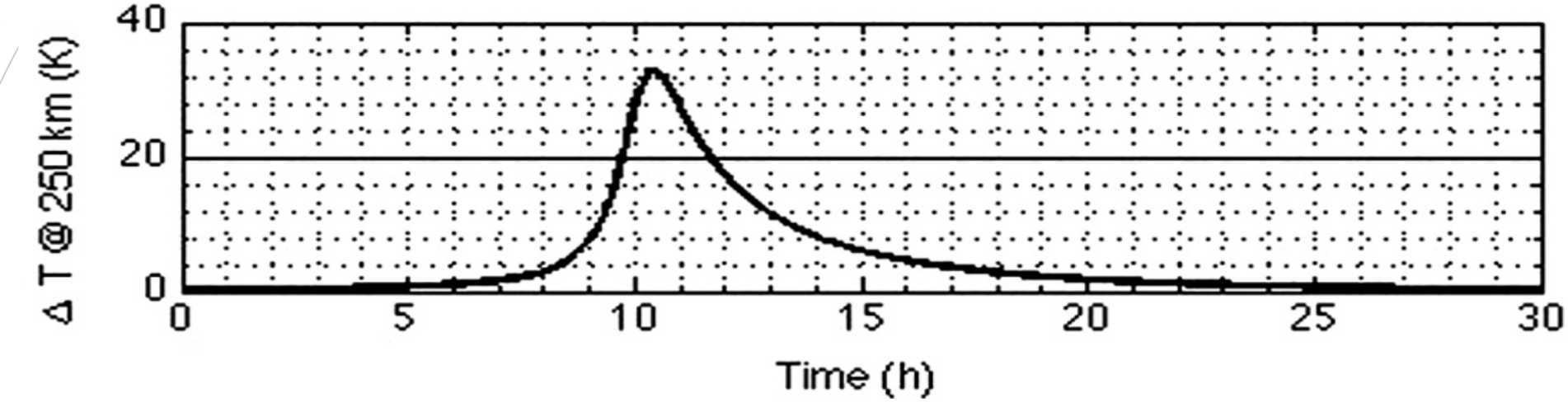


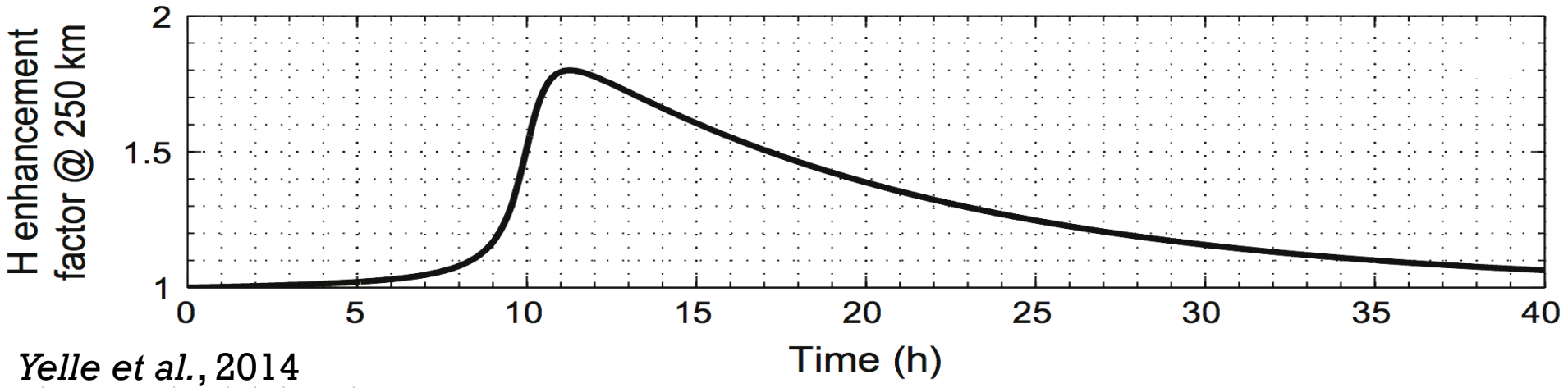

~ 30000 km
Total Flux (Ph/s)
Comet Flux (Ph/s)
Comet Residual
Data
Mars H Fit
IPH Fit
Comet H Fit
Total Fit
10
8
6
4
2
0
2
0
-2
-4
-6
-8
1214.0
1214.5
1215.0
1215.5
1216.0
Wavelength (A)

Derived Water Production Rate

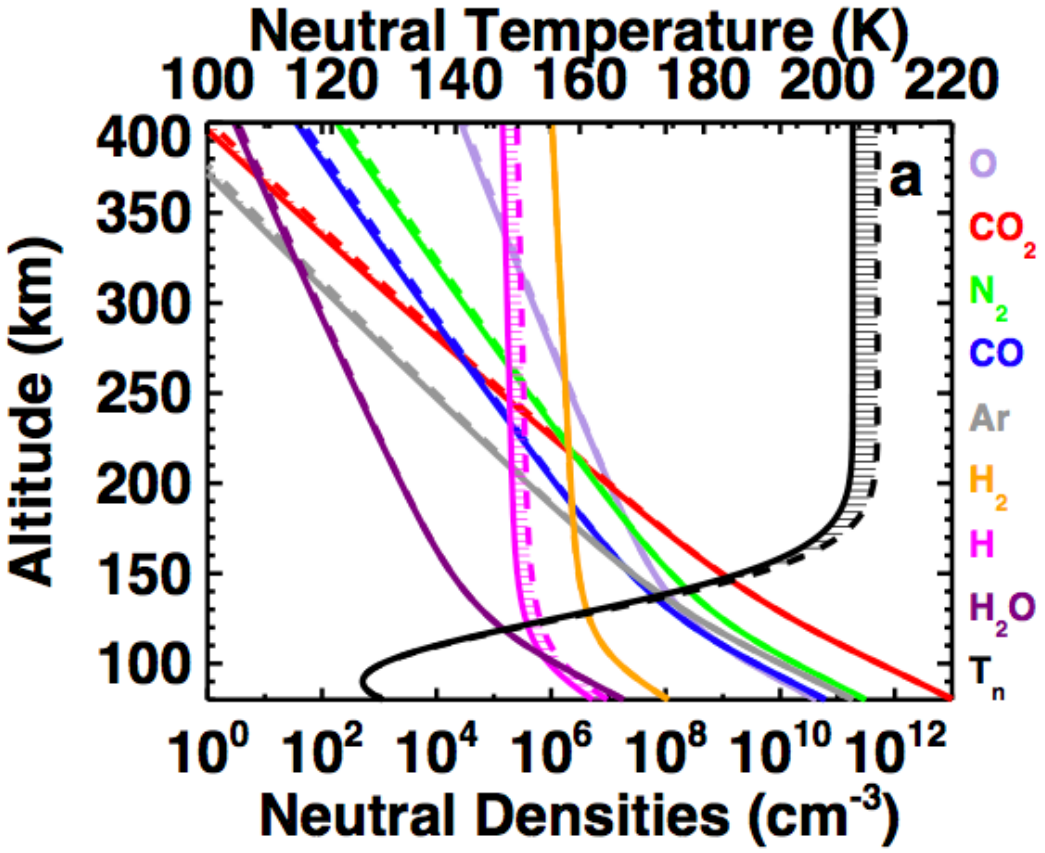
1.3×10^{28} s^{-1}

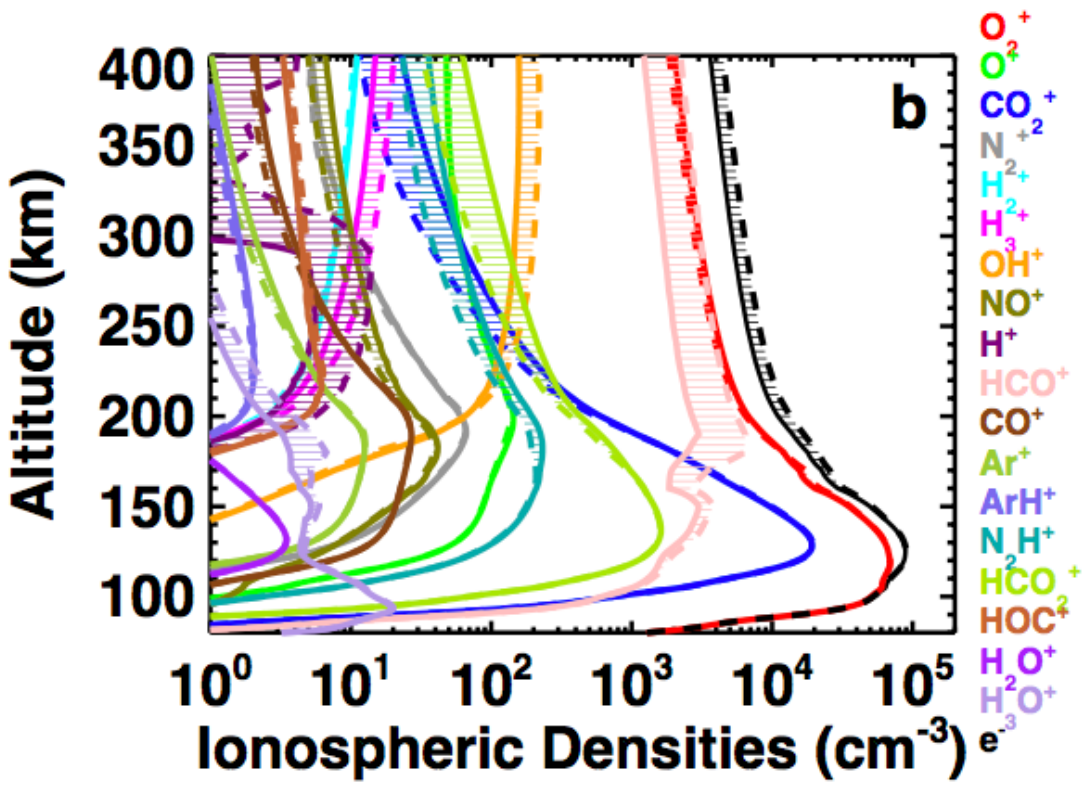




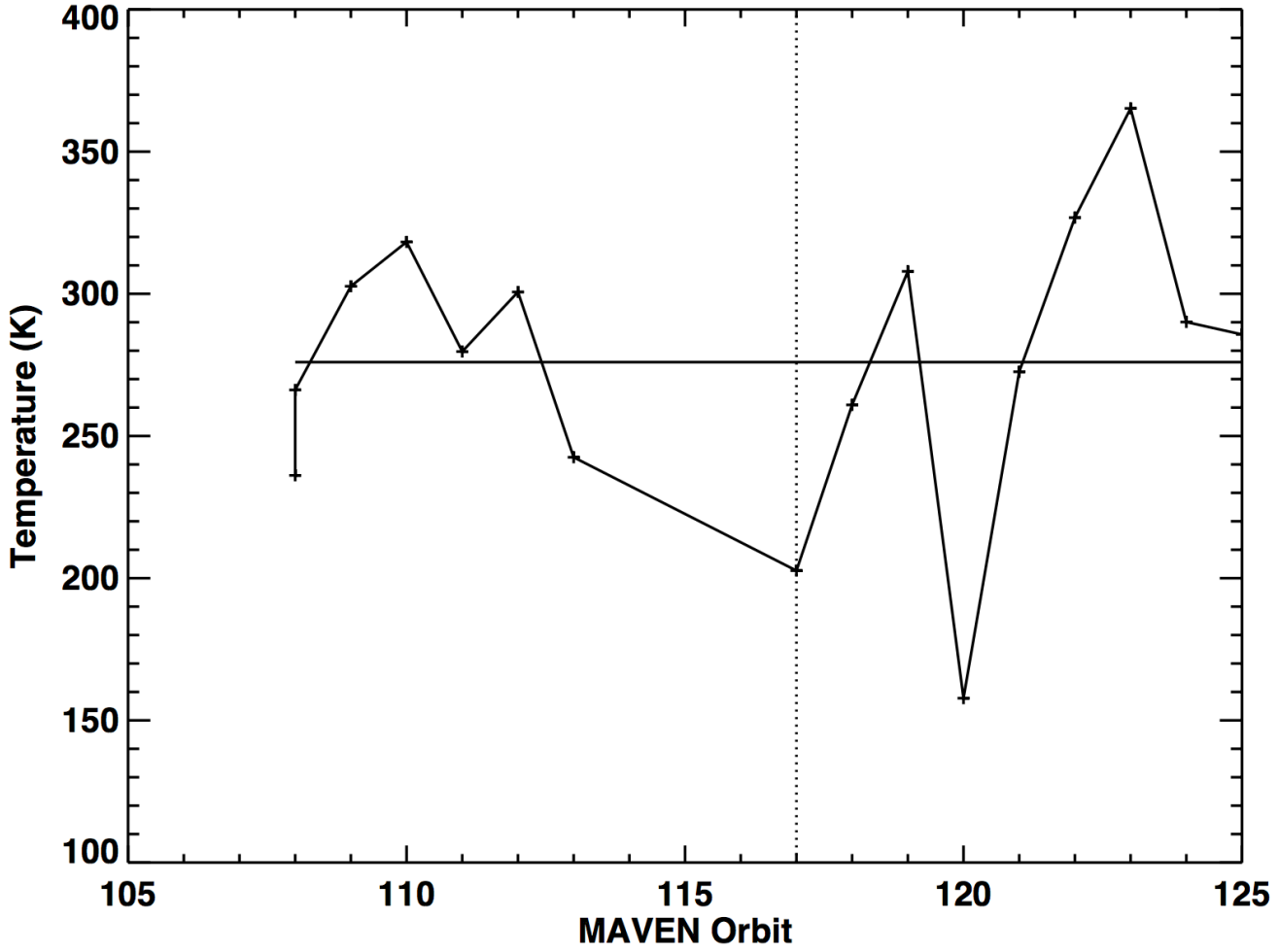


Yelle et al., 2014


Neutral Temperature (K)
100 120 140 160 180 200 220
Altitude (km)
400
350
300
250
200
150
100
a
O
CO2
N2
CO
Ar
H2
H
H2O
Tn
10^0 10^2 10^4 10^6 10^8 10^10 10^12
Neutral Densities (cm^-3)

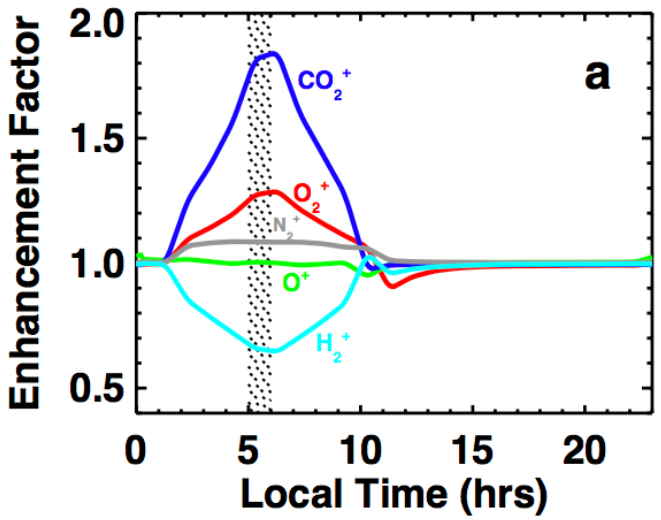

Altitude (km)
400
350
300
250
200
150
100
b
O2+
O+
CO2+
N2+
H2+
H3+
OH+
NO+
H+
HCO+
CO+
Ar+
ArH+
N2H+
HCO2+
HOC+
H3O+
H2O+
e-
10^0 10^1 10^2 10^3 10^4 10^5
Ionospheric Densities (cm^-3)

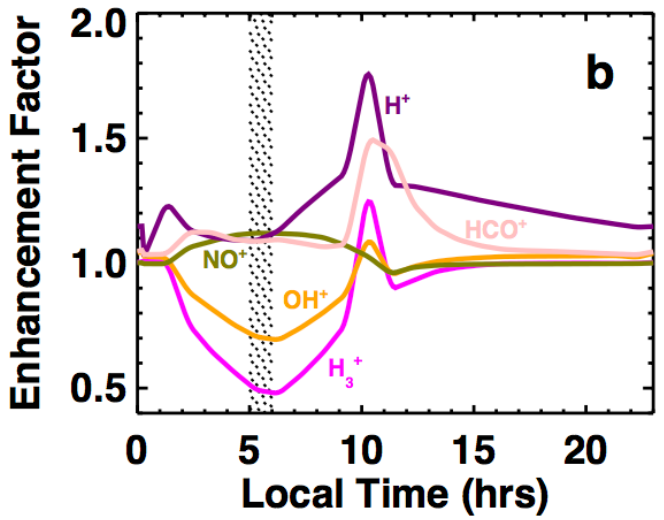
Comparison to NGIMS measurements

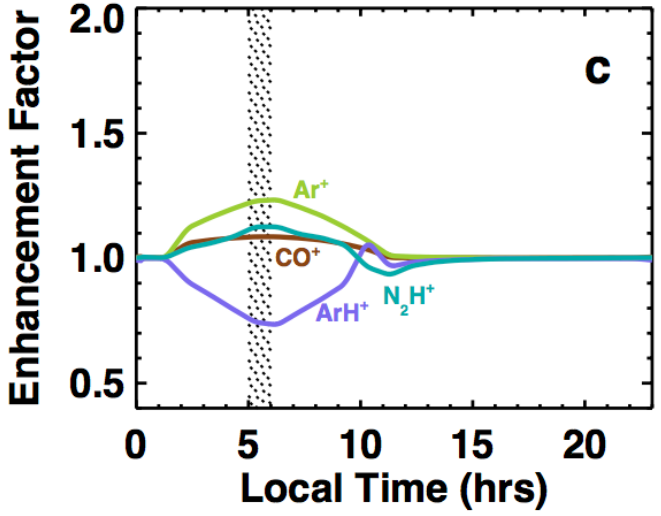


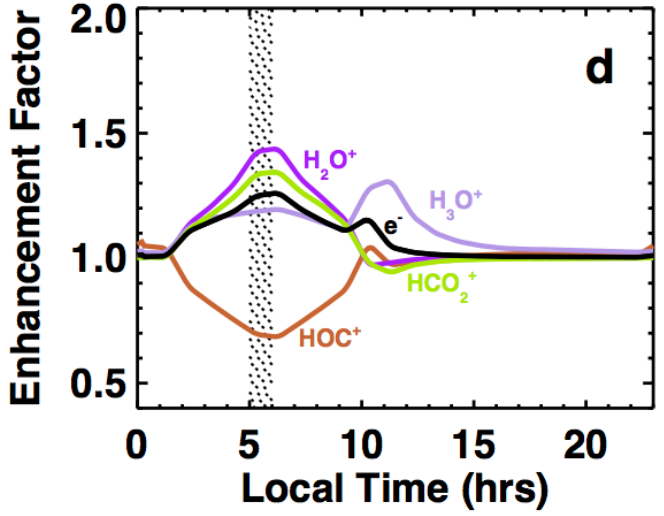
T_n variability at 200 km using NGIMS Ar and CO_2 neutral densities at the lowest altitude scale height.

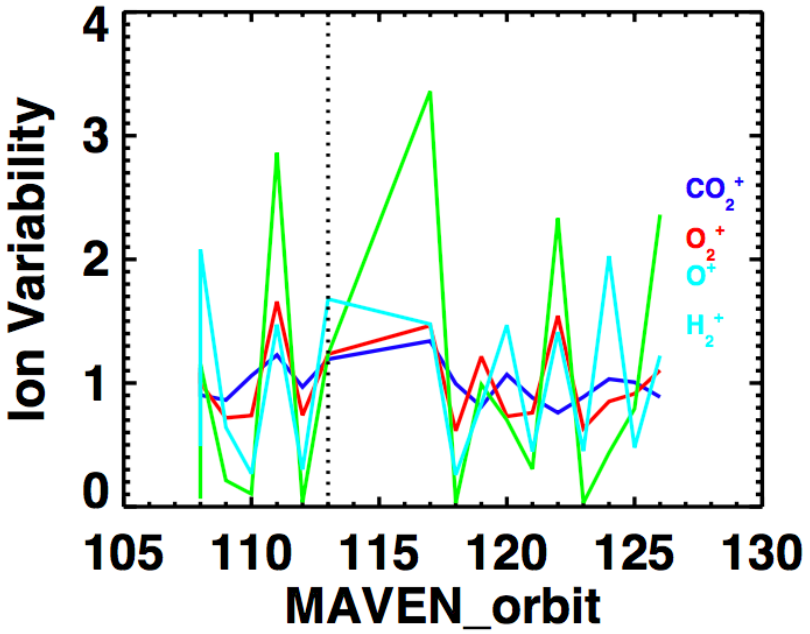
Candidate Ions:
O2+, CO2+, O+, OH+, NO+, Ar+, ArH+, H2+, H3+, H2O+ & H3O+

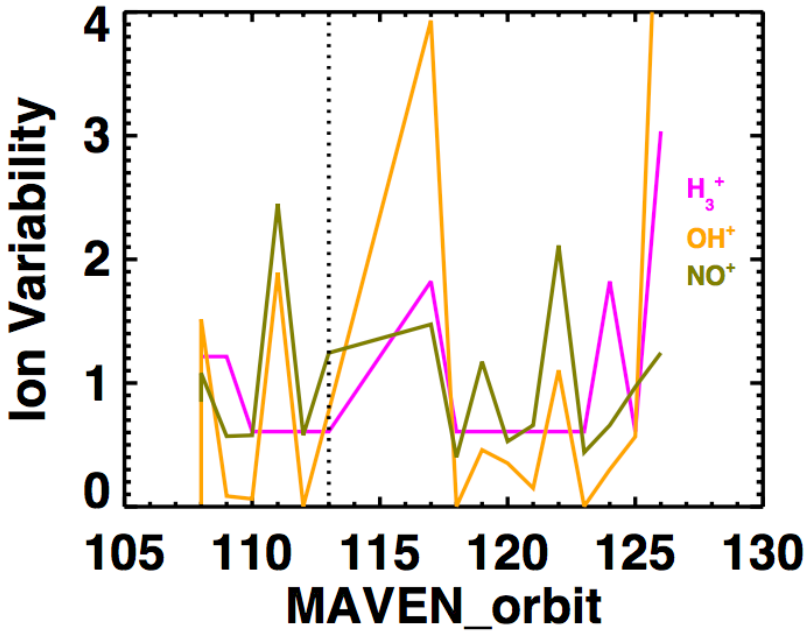


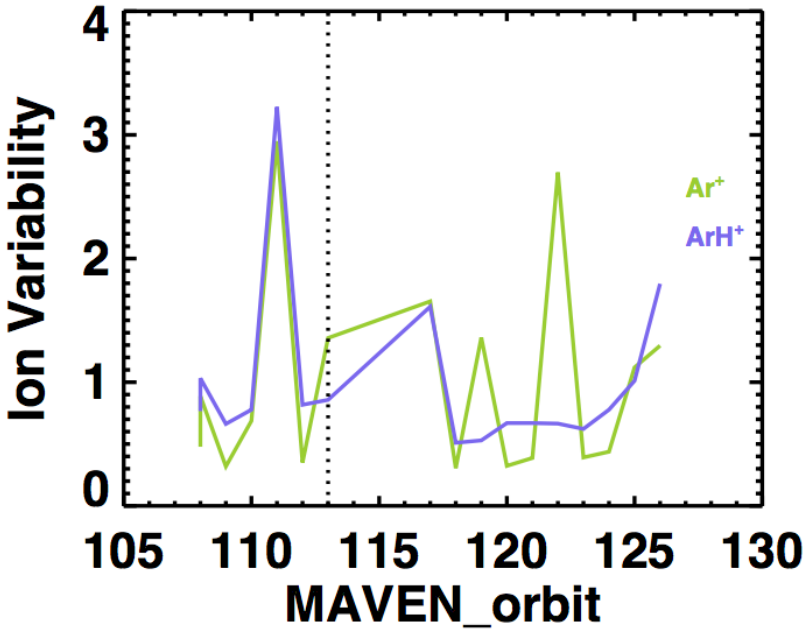


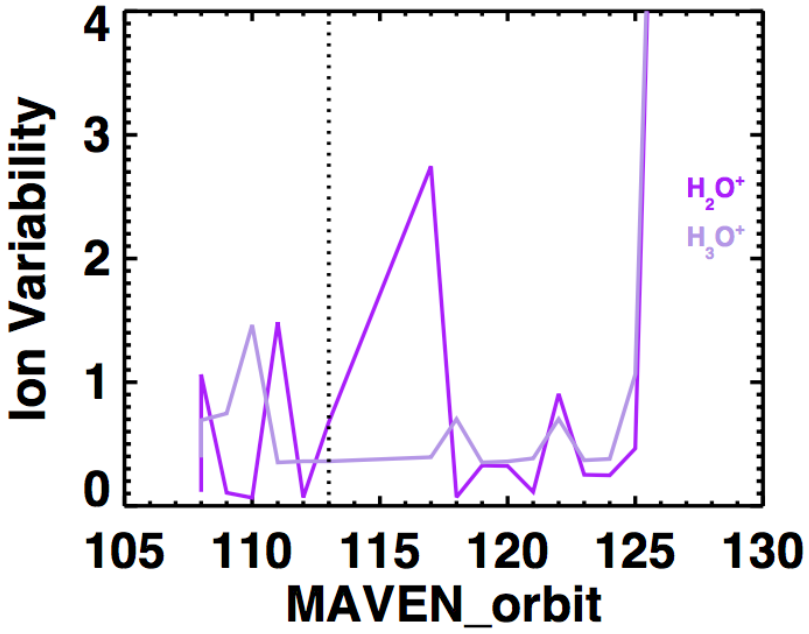





Ion Variability
MAVEN_orbit
CO_2^+
O_2^+
O^+
H_2^+


Ion Variability
MAVEN_orbit
H_3^+
OH^+
NO^+


Ion Variability
MAVEN_orbit
Ar^+
ArH^+


Ion Variability
MAVEN_orbit
H_2O^+
H_3O^+

Results

- Model the observations by orbit track
- Broaden data analysis for added statistics