OMI O_3 and SO_2 Combo Algorithm

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Why Develop a New Algorithm?

To take full advantage of OMI's hyper-spectral measurements

- improve the accuracy and expand the valid range of SO_2 retrievals
- improve O_3 retrieval quality
- produce a more robust Aerosol Index

Iterative Spectral Fitting (ISF)

- Full OMI Spectral measurements between 310.8 and 333.0 nm
- Assumed profiles: V8 climatology O_3 (Ω), Gaussian for volcanic SO_2 (Ξ) plumes, or average measured USA profile for PBL
- MLER cloud fraction (F_c) determine at λ=333 nm using OMCLDRR cloud pressure
- Spectral dependence of MLER model parameters described by second order polynomial
- Online radiative transfer (TOMRAD) calculations for forward model and weighting function computation
- Online Ring filling-in (σ_{rrs}) taking into Sun-target-viewer geometry and absorber loadings

$$\ln I_{obs} - \ln I = \Delta\Omega \left.\frac{\partial \ln I}{\partial \Omega}\right|_{\Omega = \Omega_t} + \Delta\Xi \left.\frac{\partial \ln I}{\partial \Xi}\right|_{\Xi = \Xi_t} + \mathrm{Ring} \cdot \sigma_{\mathrm{RRS}}$$

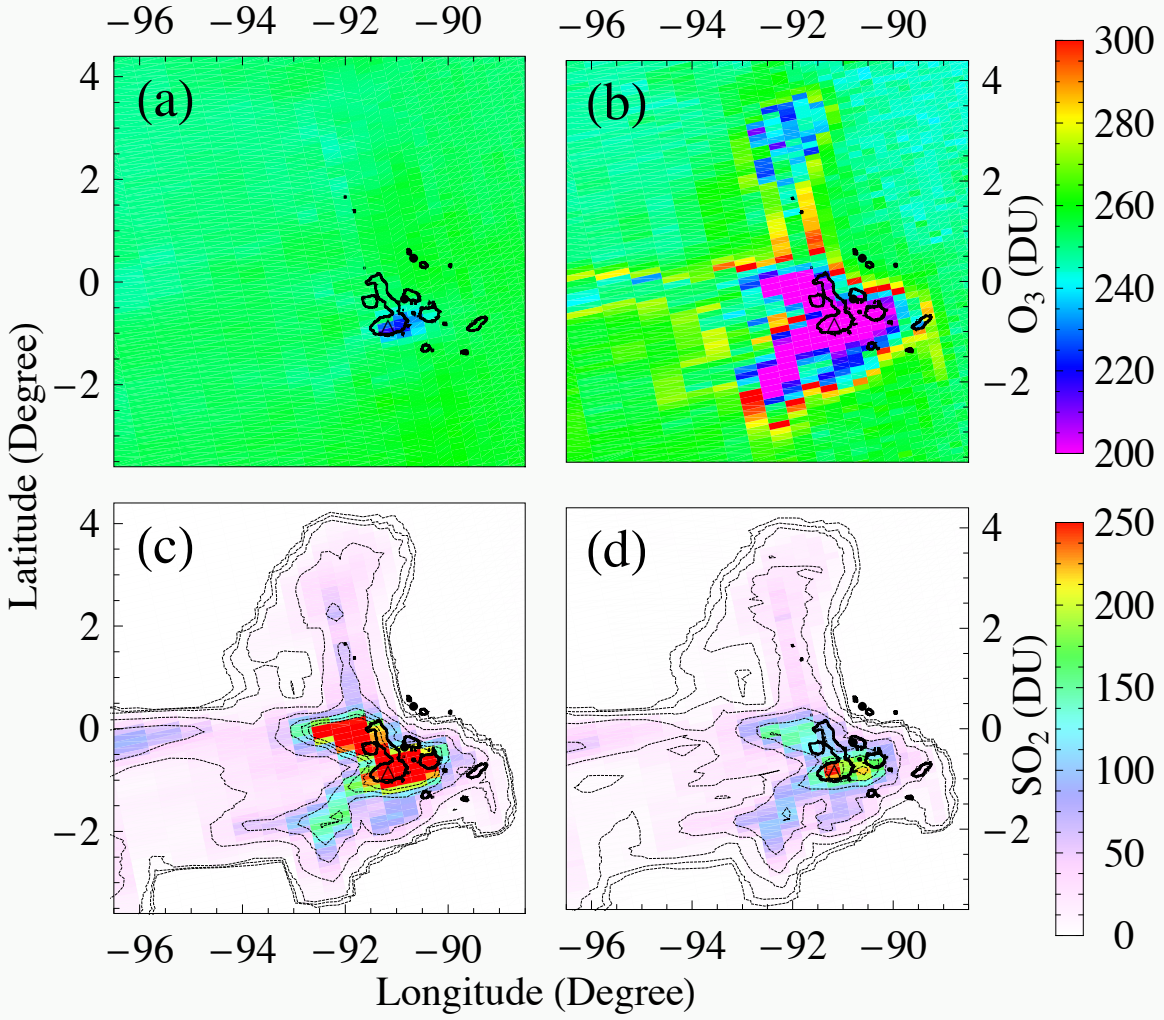
$$+ \left(\Delta F_c + \sum_{i=1}^{N=2} c_i \left(\lambda - \lambda_0\right)^i \right) \left.\frac{\partial \ln I}{\partial F_c}\right|_{F_c = F_0}$$

$$\Omega_{t+1} = \Omega_t + \Delta\Omega, \qquad \Xi_{t+1} = \Xi_t + \Delta\Xi$$

Large SO_2 retrieval: 2005 Sierra Negra Eruption

ISF

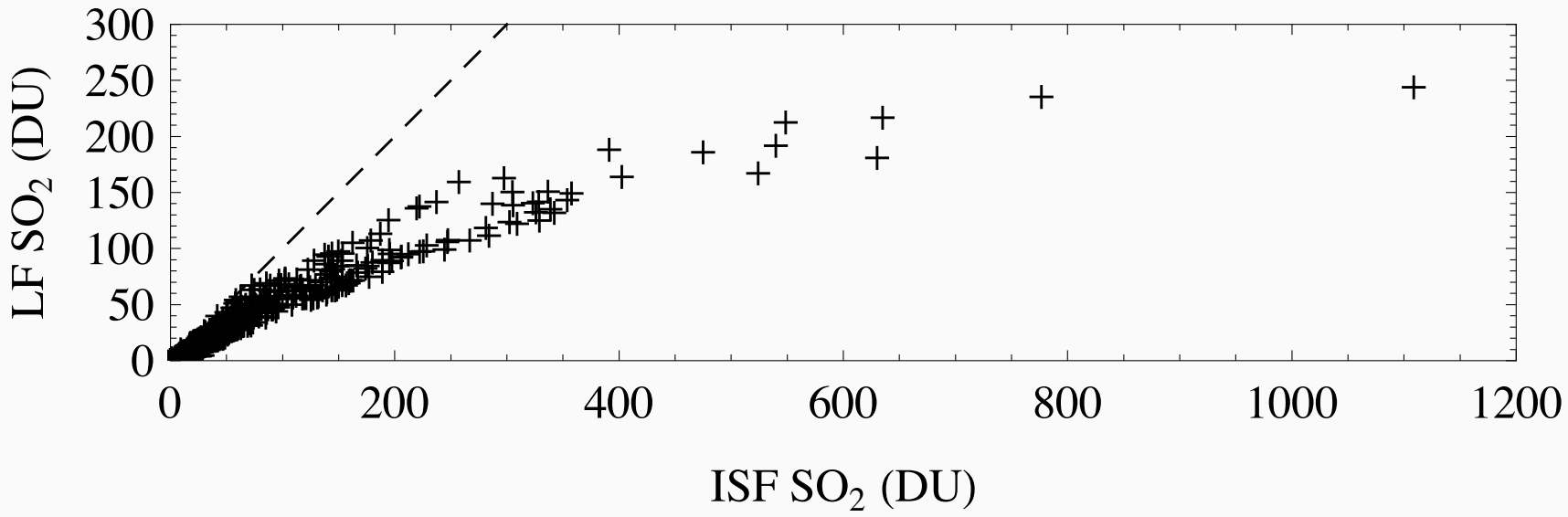
ISF SO_2 Mass
1740 kilotons



OMSO2

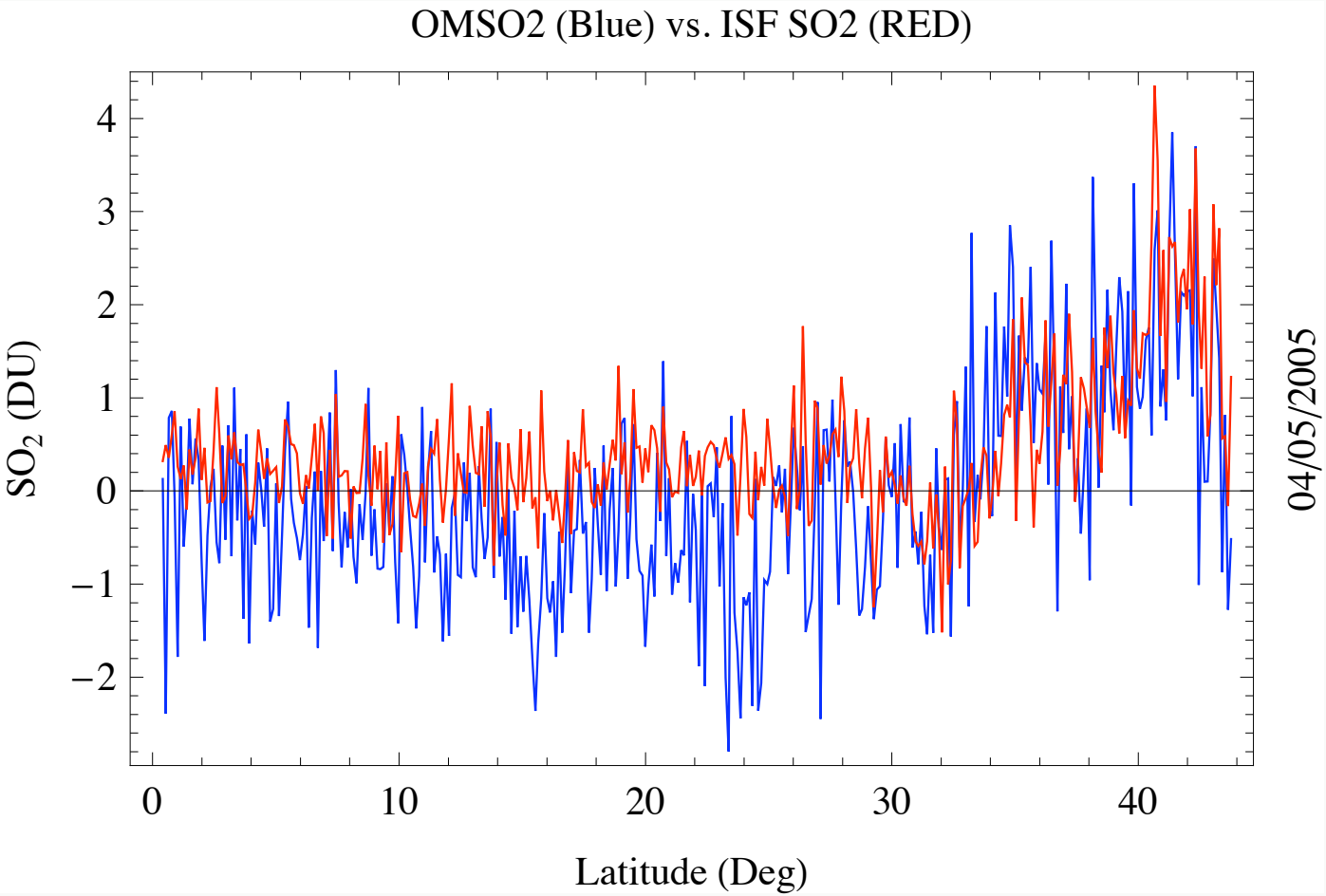
LF SO_2 Mass
950 kilotons
(-45%)

Large SO2 Retrieval (Continued)



ISF properly accounts for non-linear effect, eliminates under estimation.

Low level SO_2 Retrieval

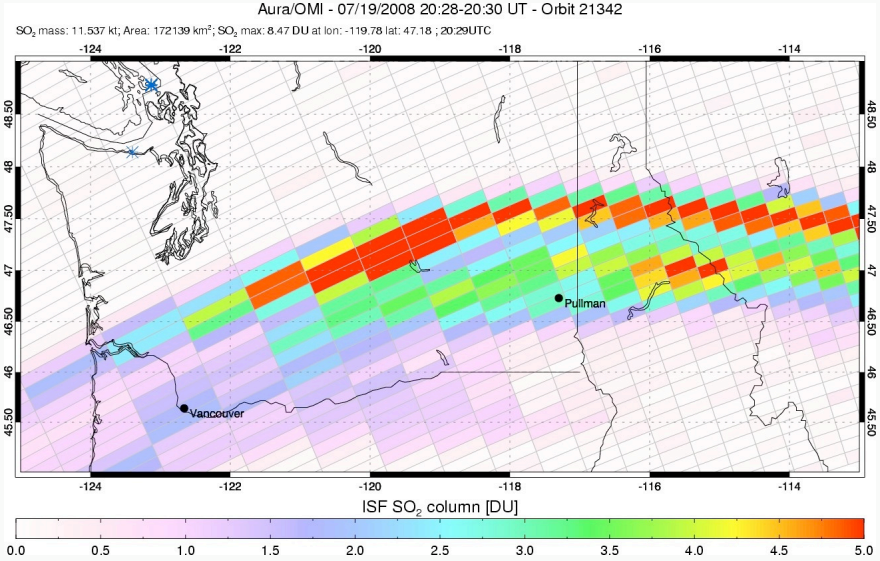


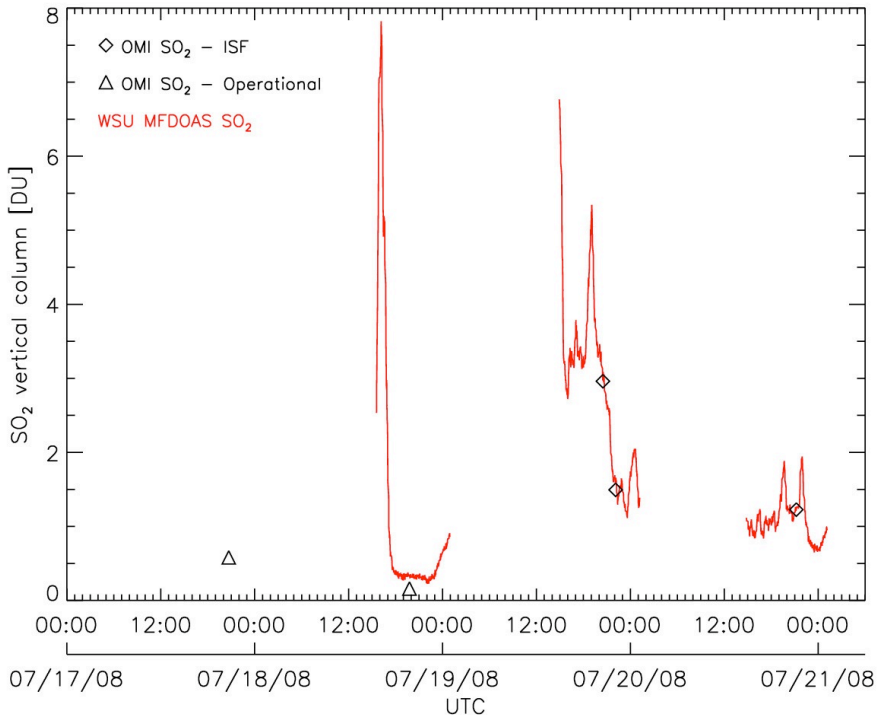
For Data between 0 and 30 degree

ISF: SO2 Average = 0.23 (DU), Standard Deviation = 0.42 (DU)

OMSO2: SO2 Average =-0.45 (DU), Standard Deviation = 0.82 (DU)

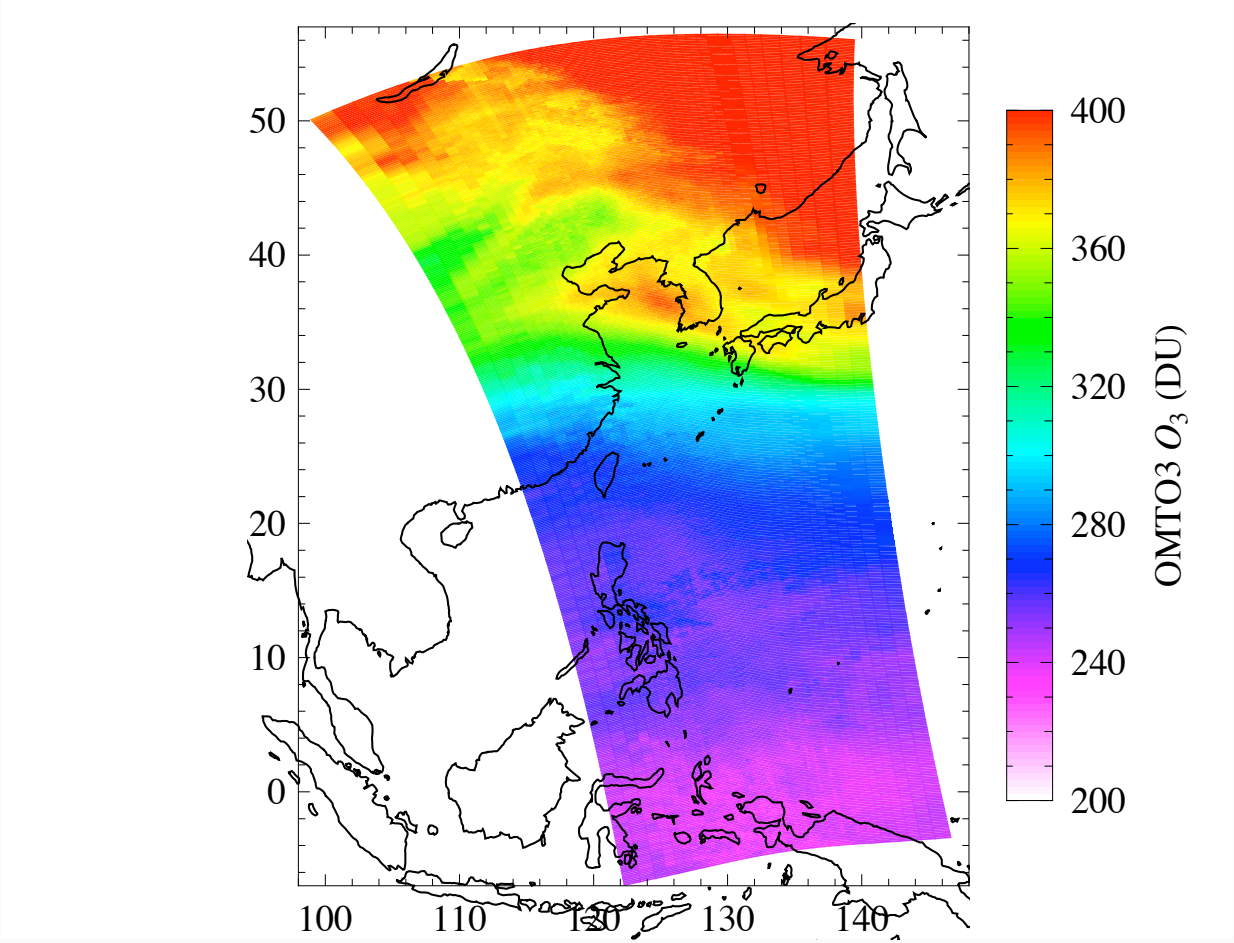
Validation of ISF SO_2: Comparison with MFDOAS Measurements of Okmok Plume



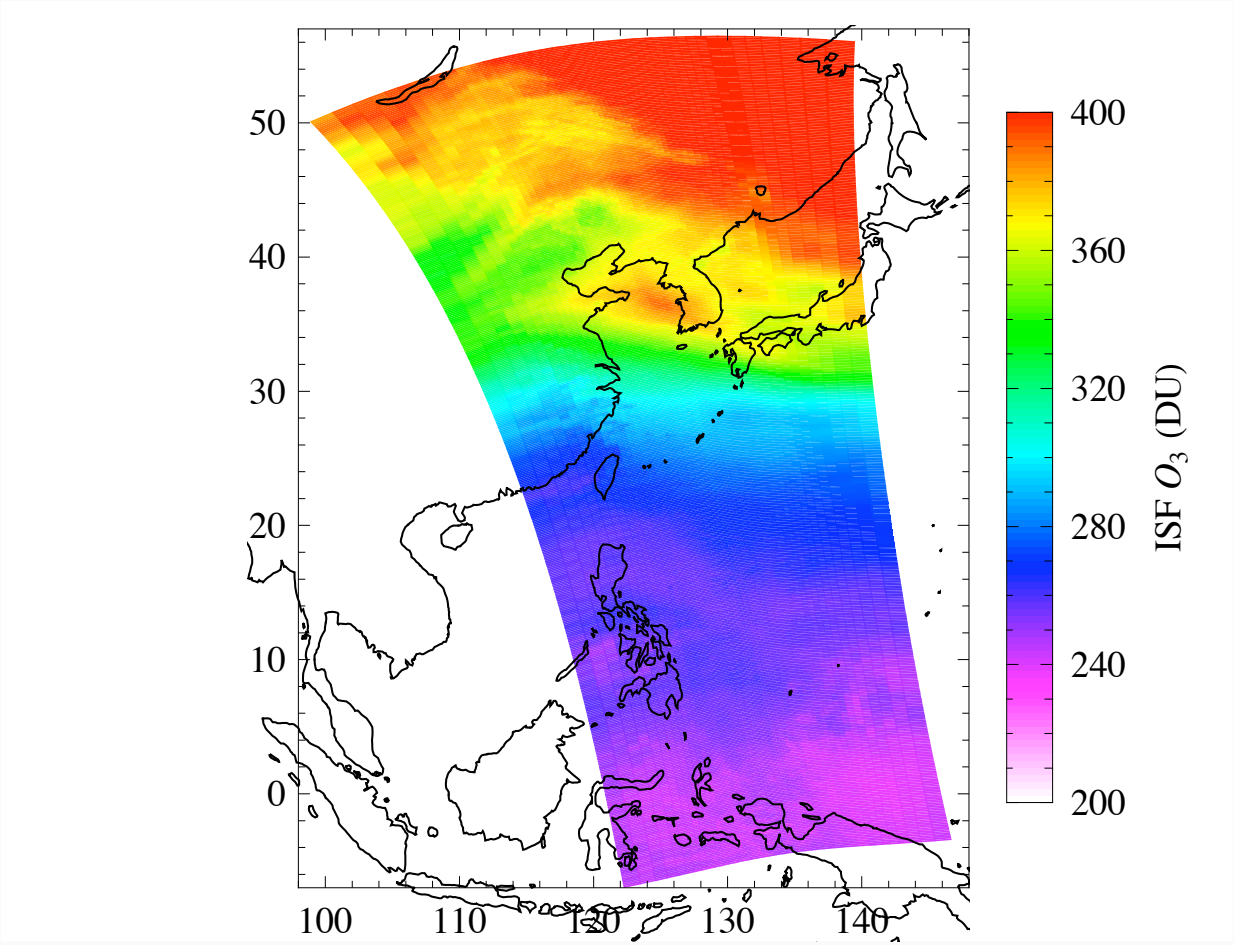


									ISF SO2	MFDOAS
July 19	20:29	21342	11	46.67ºN	117.46ºW	3.346	2.582	3.04	2.961	3.02
July 19	22:07	21343	60	46.70ºN	117.54ºW	1.633	0.925	1.35	1.494	1.64
July 20	21:12	21357	40	46.64ºN	117.45ºW	1.473	1.109	1.33	1.226	1.24

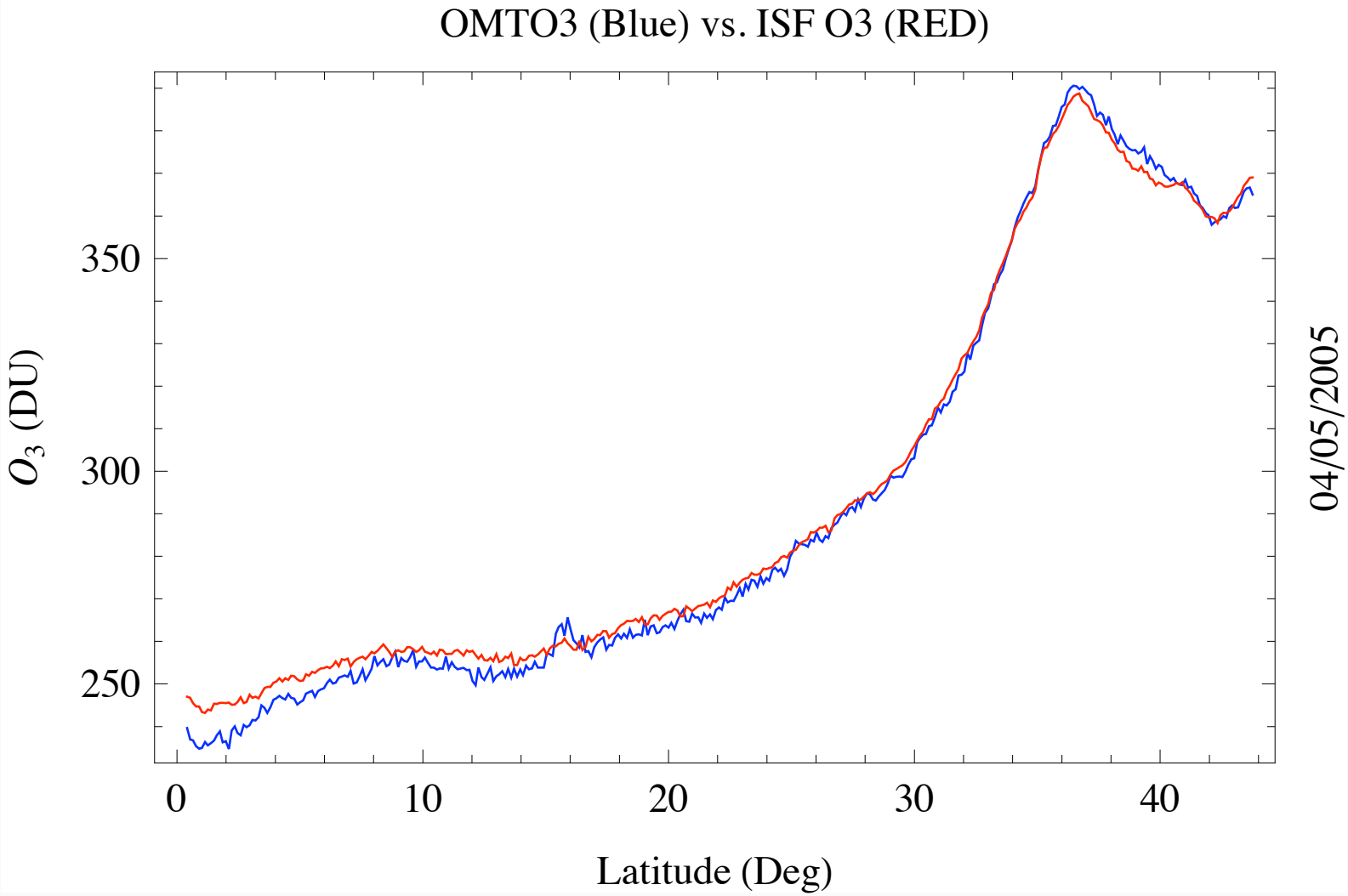
OMTO3 Total Ozone



ISF Total Ozone

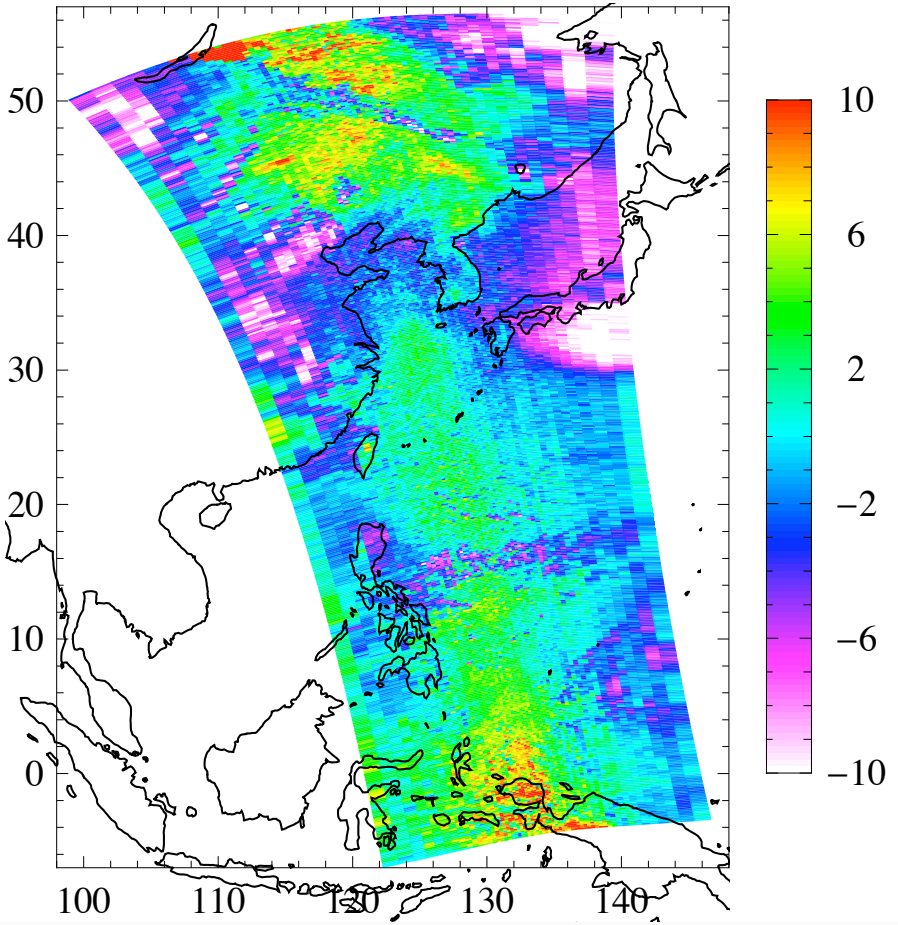


O_3 Improvement

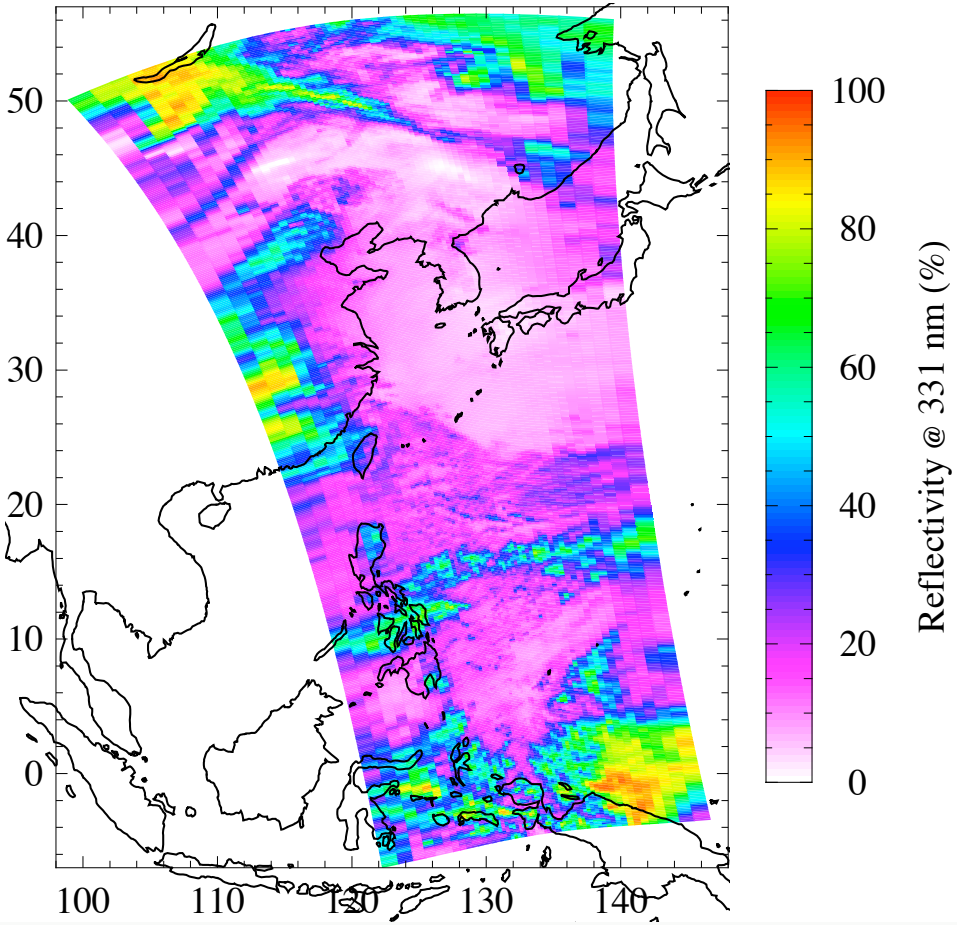


O_3 Improvement (Continued)

ISF O3 - OMTO3



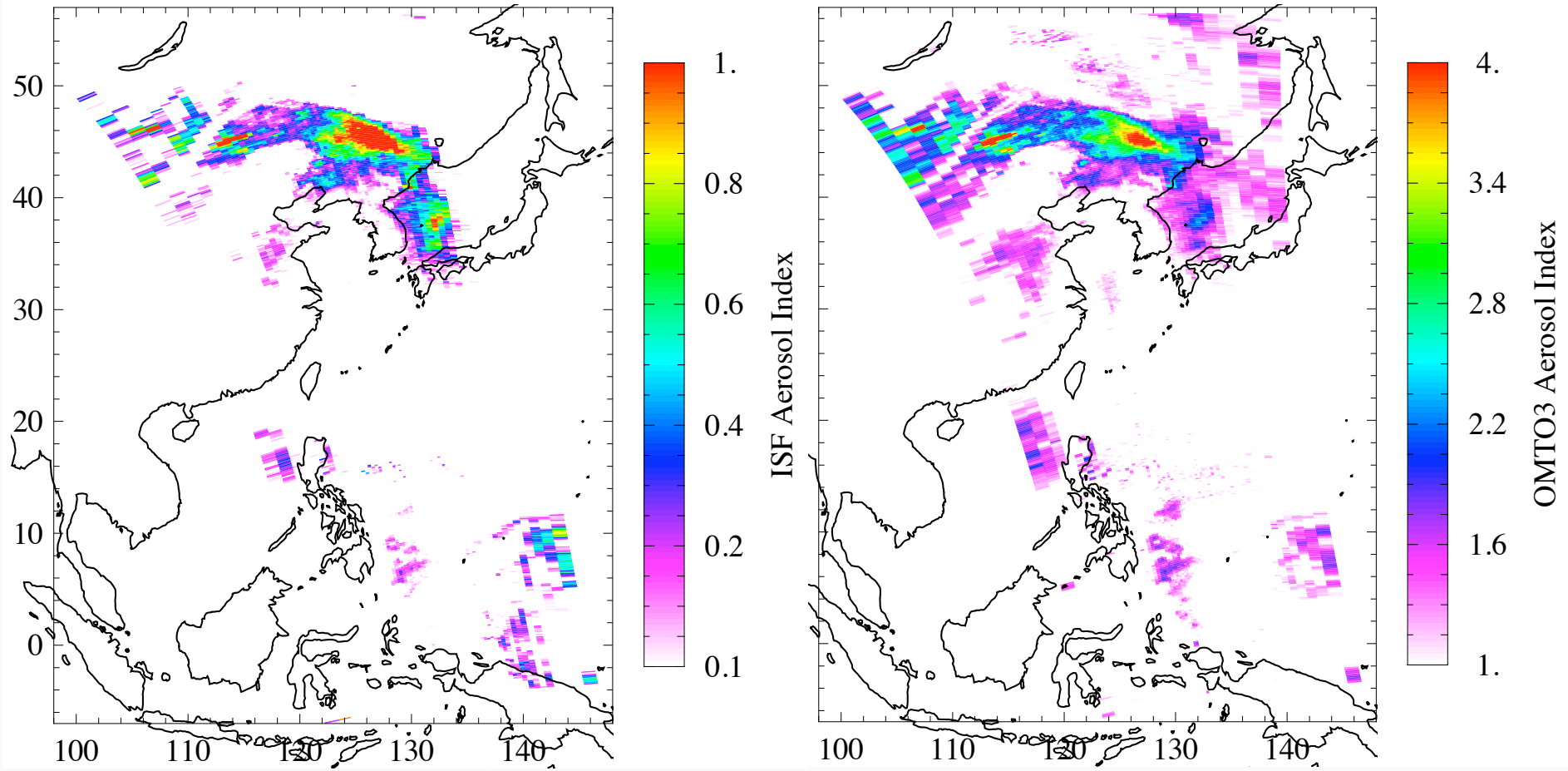
Reflectivity @ 331 nm



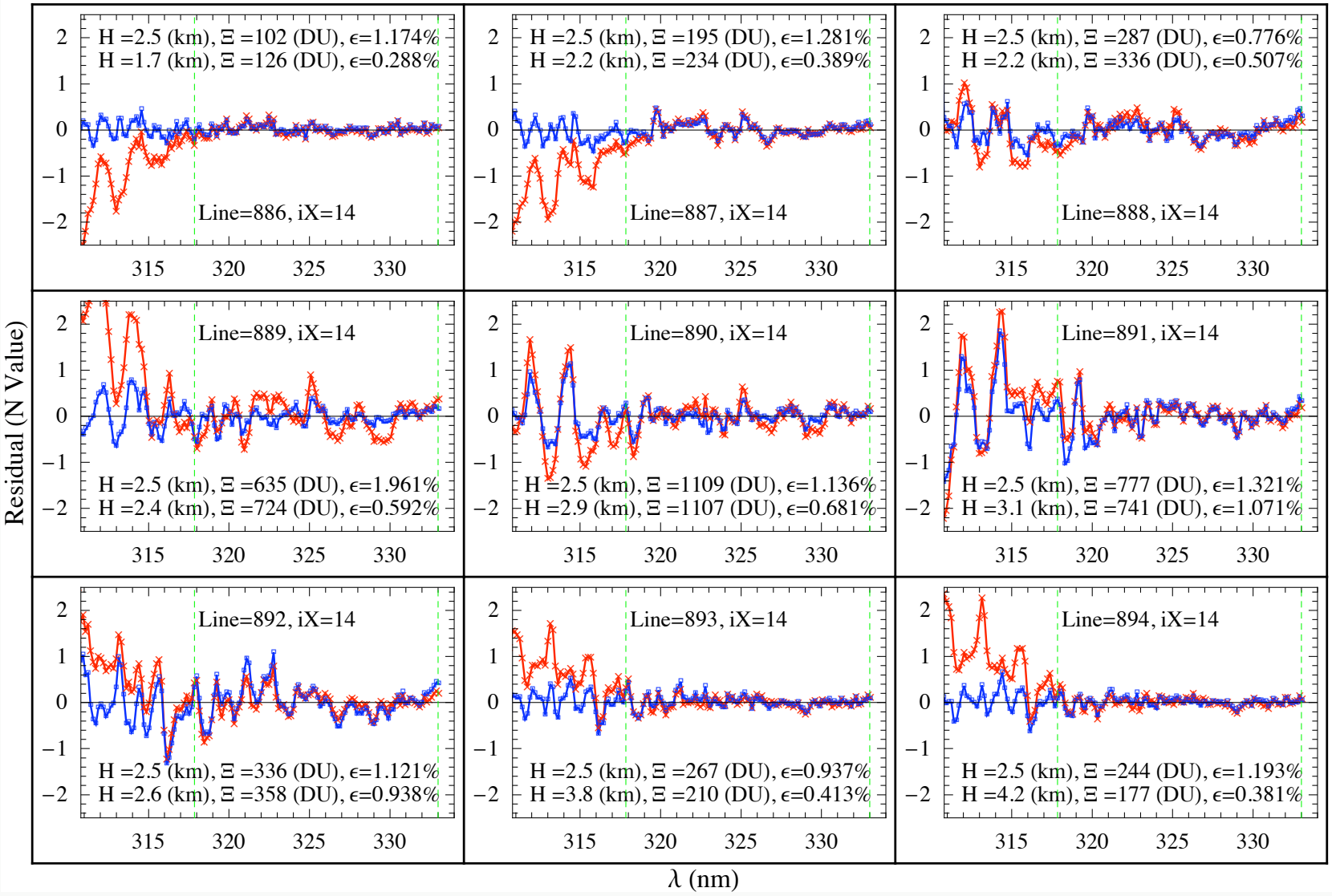
Better Aerosol Index

ISF AI

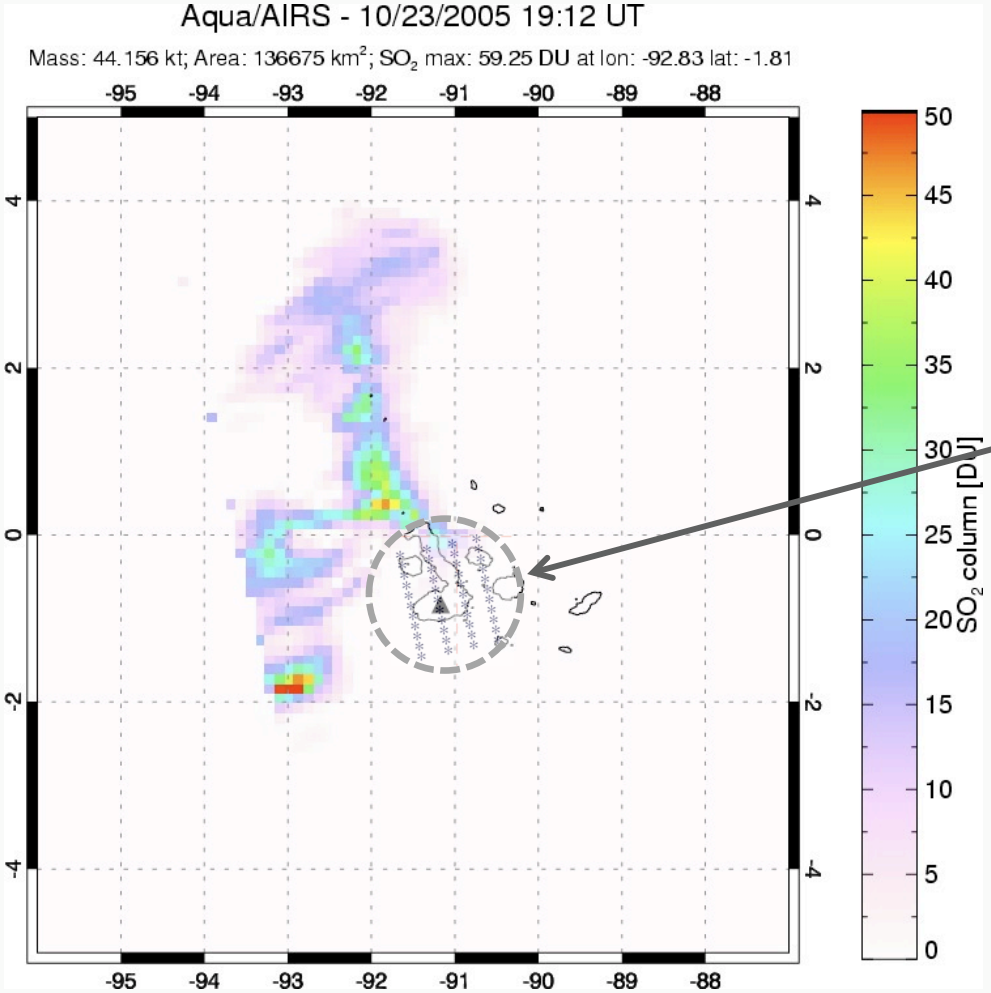
OMTO3 AI

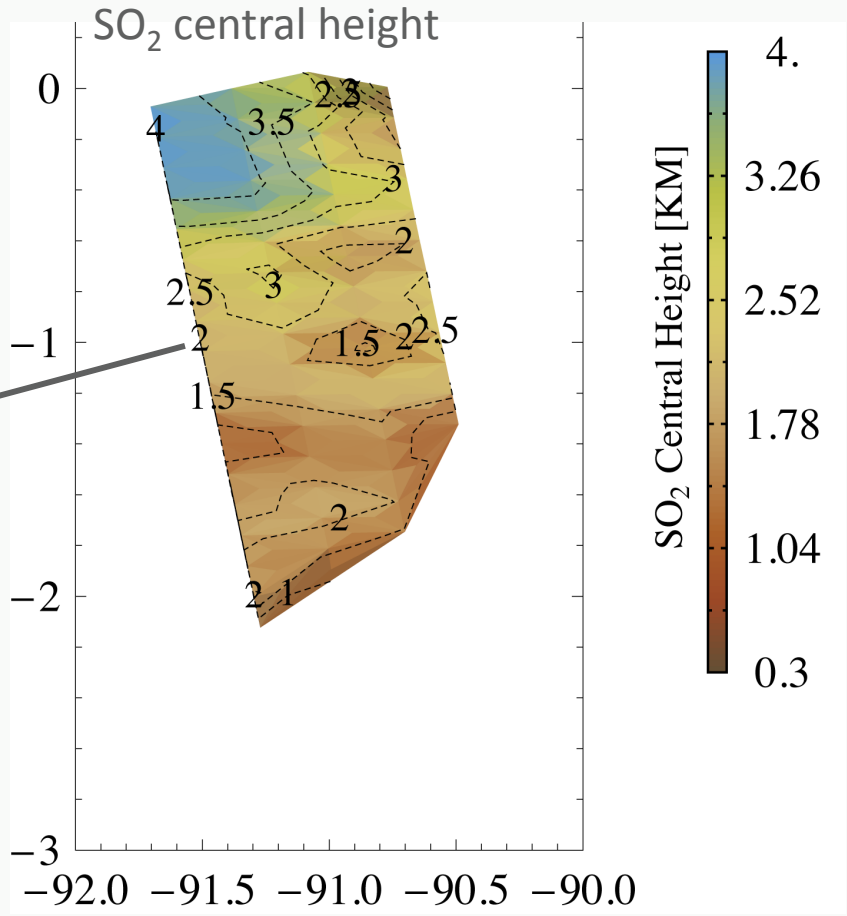


SO_2 Plume Altitude



Plume Altitude: Comparison with AIRS SO_2





Summary

- ISF yields significant improvements for a number of important OMI products: O_3, SO_2, and Aerosol Index.
- ISF provides SO_2 plume height, a critical information needed for accurate quantifying SO_2 amount, and other applications, such as aviation hazard mitigation.