Measurements of OClO, BrO, HCHO, and CHO-CHO from the Ozone Monitoring Instrument on EOS Aura

or

Who's on First?!

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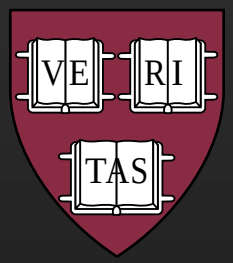
Harvard-Smithsonian Center for Astrophysics
Cambridge, MA



Aura Science Team Meeting
Den Haag, 8-10 November 2005

The SAO Products

Operational Data Products

- OClO slant column
- BrO total column
- HCHO total column

Validation release (⟶AVDC) of all products scheduled
(awaiting approval of README files)

Off-line Science Product

- CHO-CHO (glyoxal)

The Retrieval Algorithm

- Based on non-linear least-squares, direct fitting
- Direct fitting:

  $I = (I_0\, e^{-Absorbers} + Ring + Pol_1) * Pol_2$

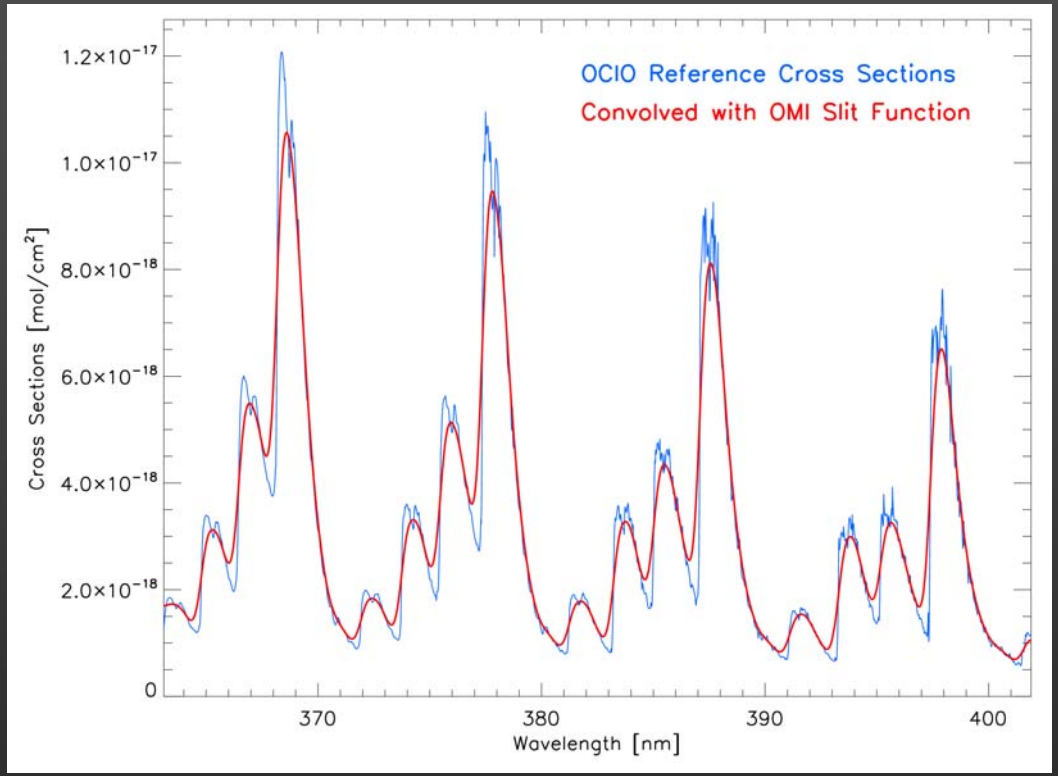
  I_0: solar spectrum for BrO, OClO
  radiance spectrum for HCHO, CHO-CHO
- Performs solar and radiance wavelength calibration
- Proceeds by individually fitting all ground pixel radiances

Includes

- undersampling correction
- on-line de-striping (L1 data, during fitting process)
- post-processing de-striping (L2 column data)

OClO

- Chlorine is an element in the destruction of stratospheric ozone
- Significant (observable) abundance only during Arctic/Antarctic polar vortices

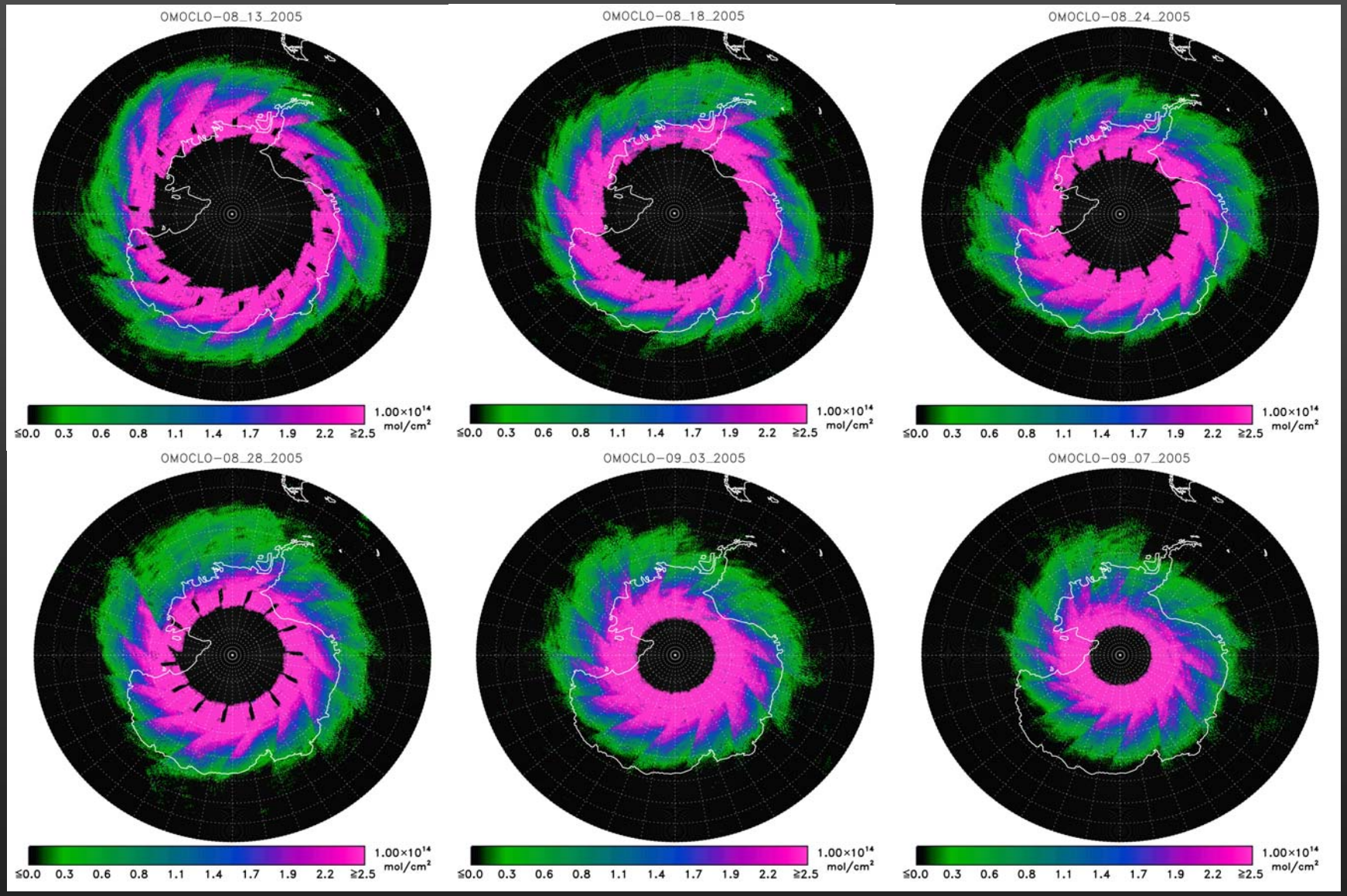


Fitting window: 363–402 nm

Observed by OMI during the recent Antarctic polar vortex (Aug/Sep 2005)

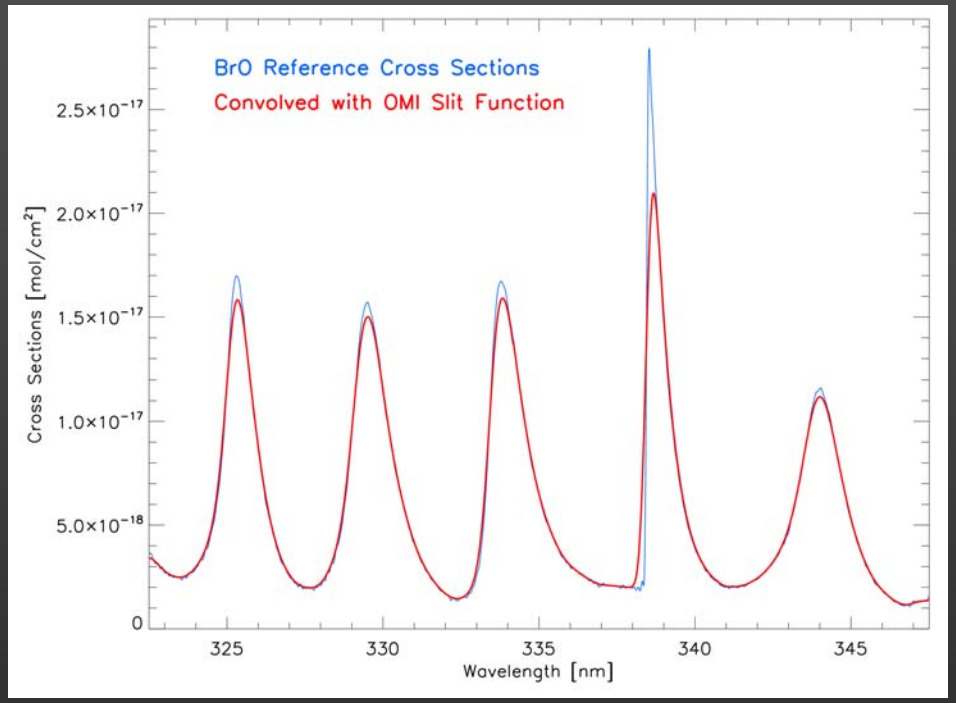
Fitting Uncertainties: large

OClO Selected Days (8/13-9/7/05) during the Antarctic Polar Vortex



BrO

- Bromine is an element in the destruction of stratospheric ozone
- Large abundance of BrO makes catalytic Br+O_3 cycle 40-100 times more efficient than that of Chlorine
- Relatively uniform global distribution, with stratospheric minimum at the equator: 2-4×10^{13} mol/cm^2
- Troposphere: Shelf Ice, Salt Lakes, Volcanoes



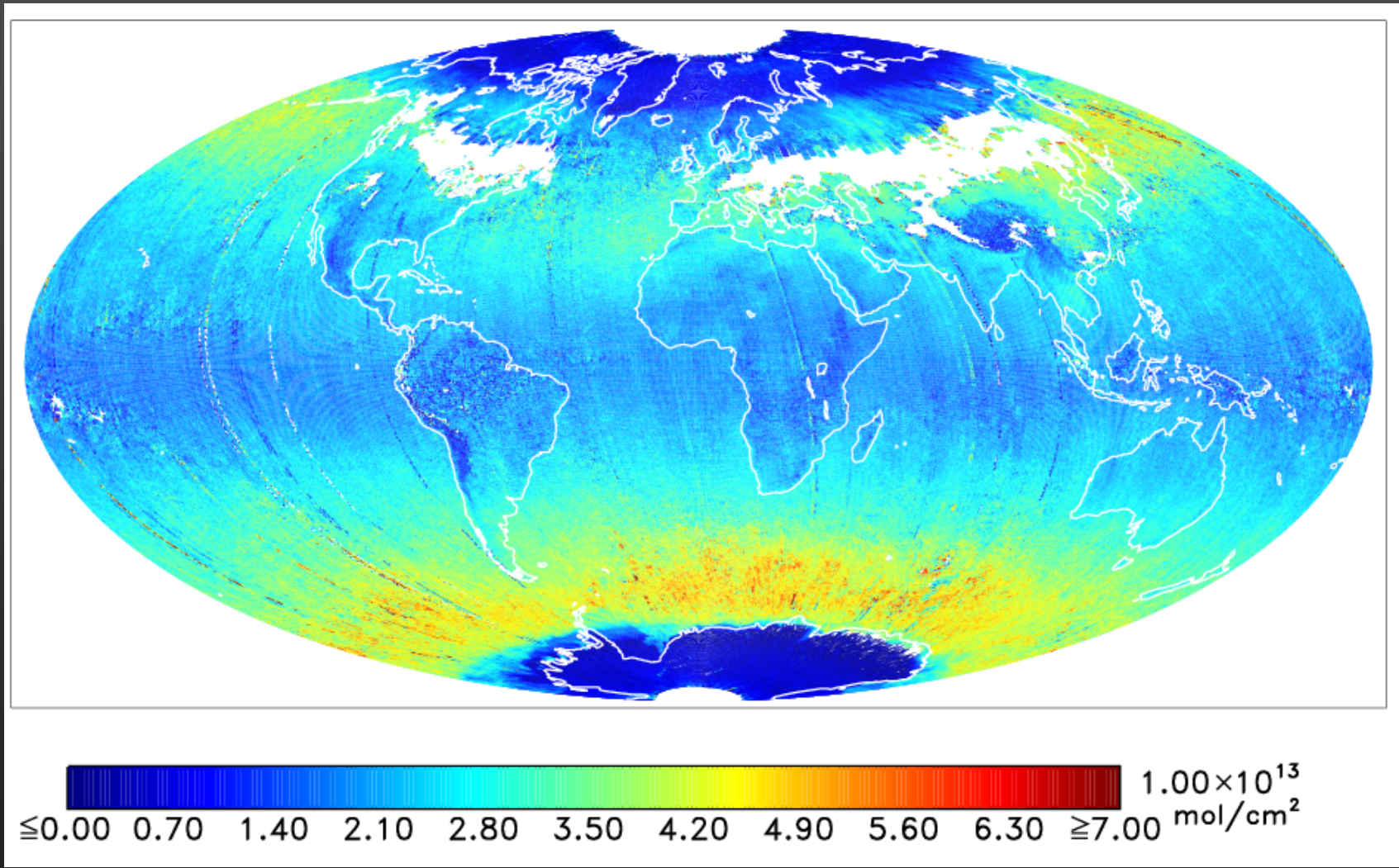
Fitting window: 323 – 347 nm

Currently the most advanced (stable) of OMI/SAO data products

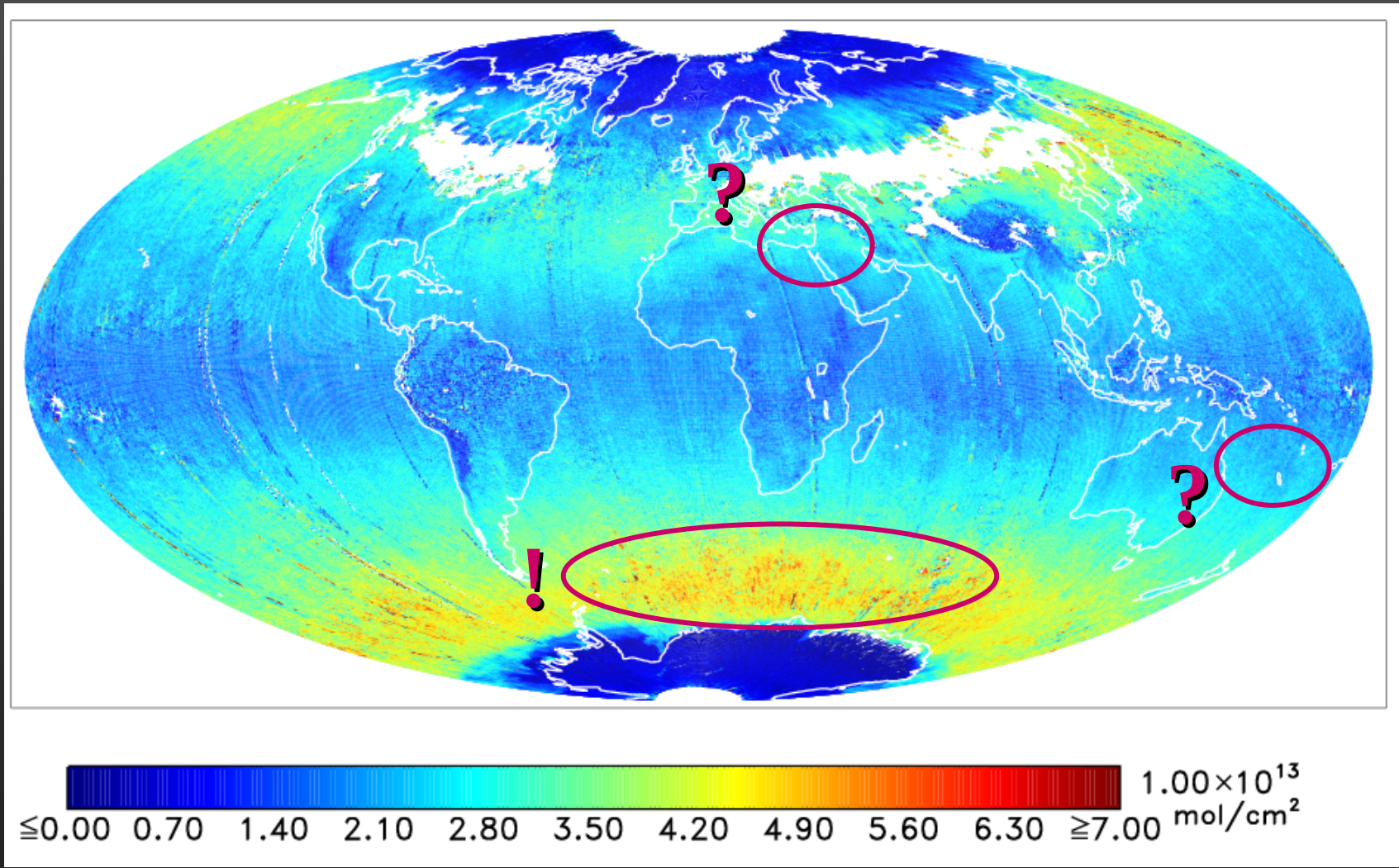
Fitting Uncertainties:

5% (hot spots) to 50% (background); ~0.5-1.5×10^{13} mol/cm^2

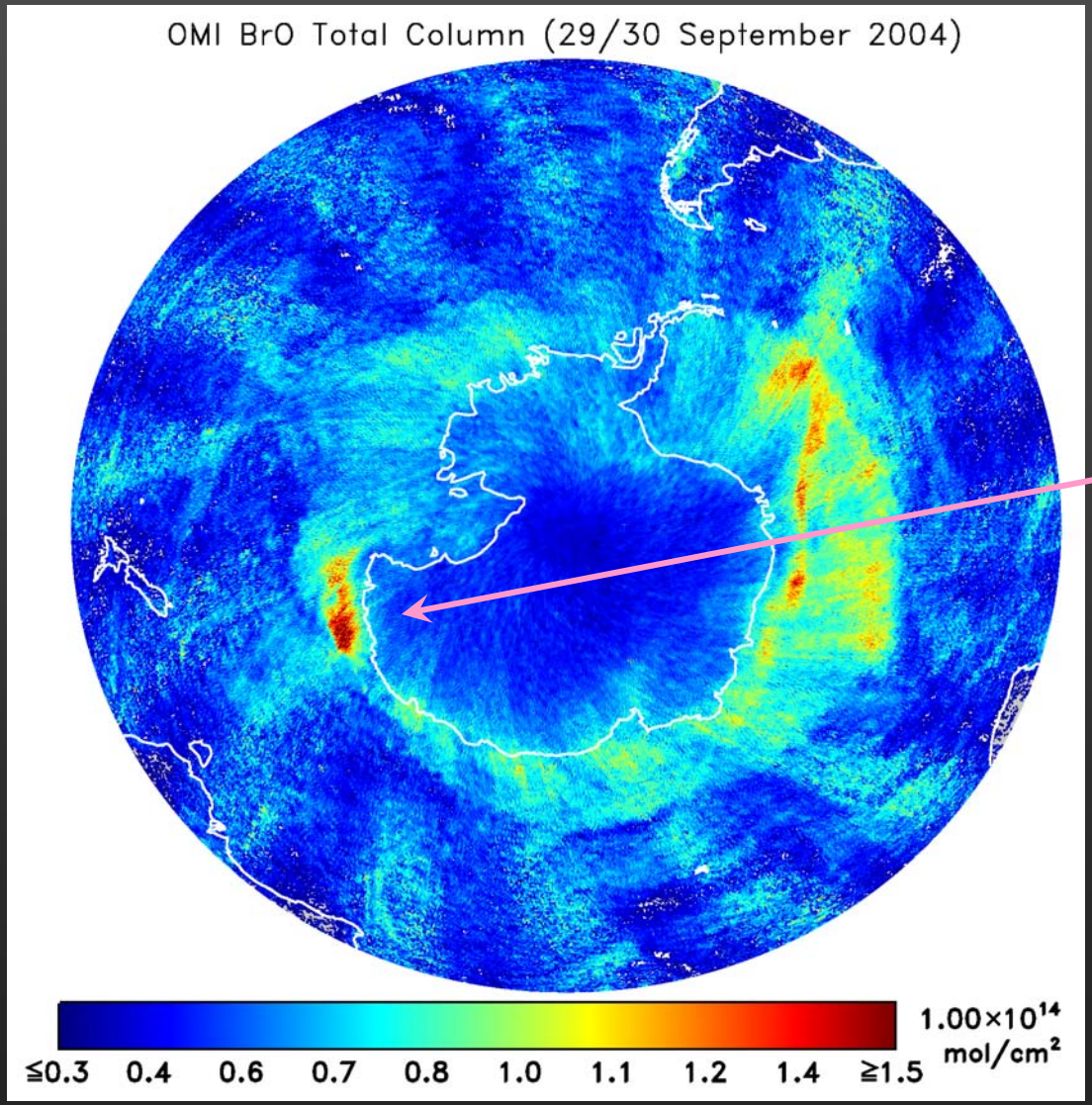
BrO Global Monthly Average February 2005

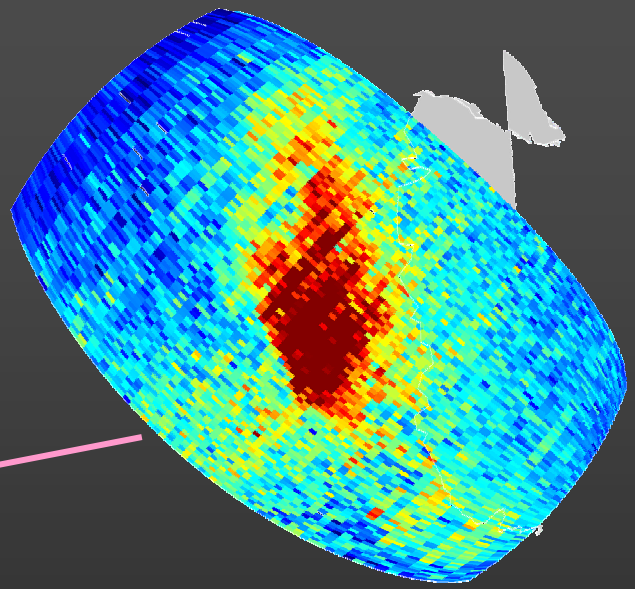


BrO Tropospheric !?



BrO Tropospheric Shelf Ice … Yes!

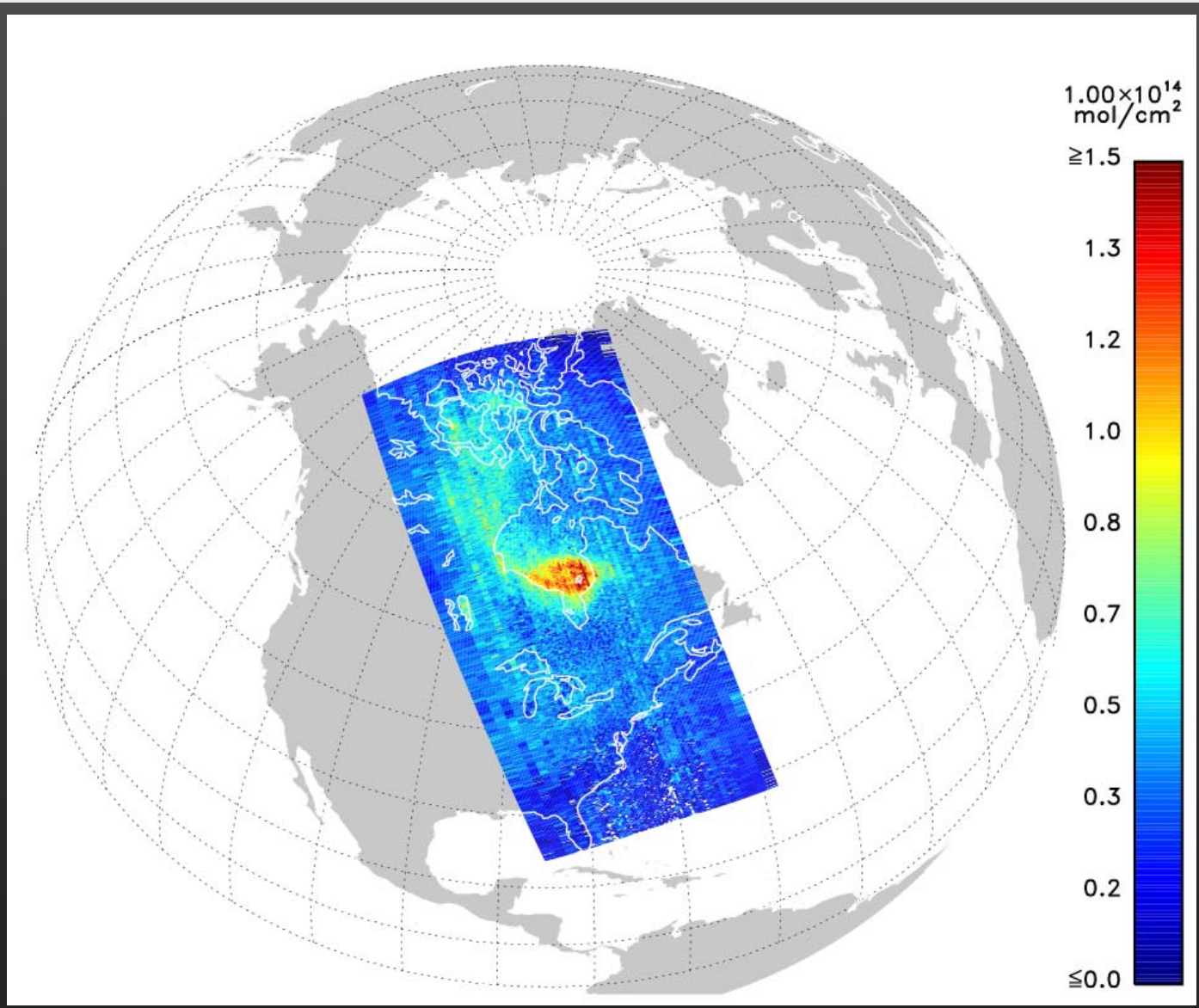




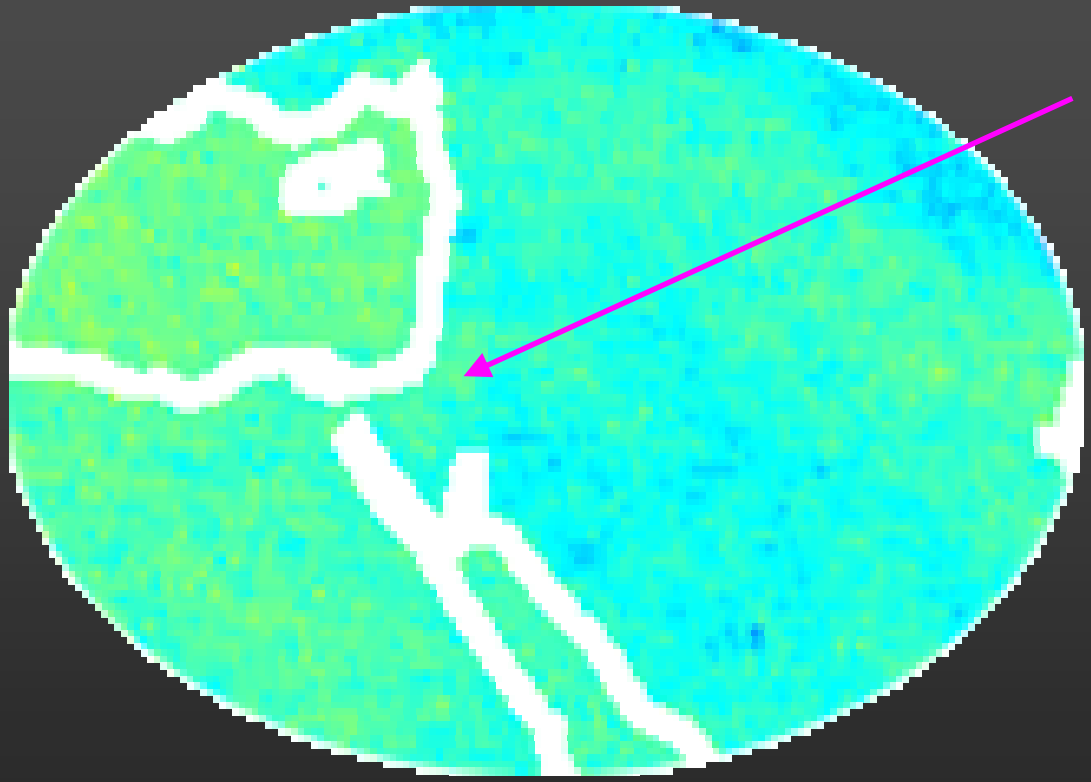
First observed from GOME:

K. Chance, Analysis of BrO Measurements from the Global Ozone Monitoring Experiment, GRL 25, 1998

BrO Hudson Bay, Columns (11 March 2005)



BrO Tropospheric Salt Lakes ... ?

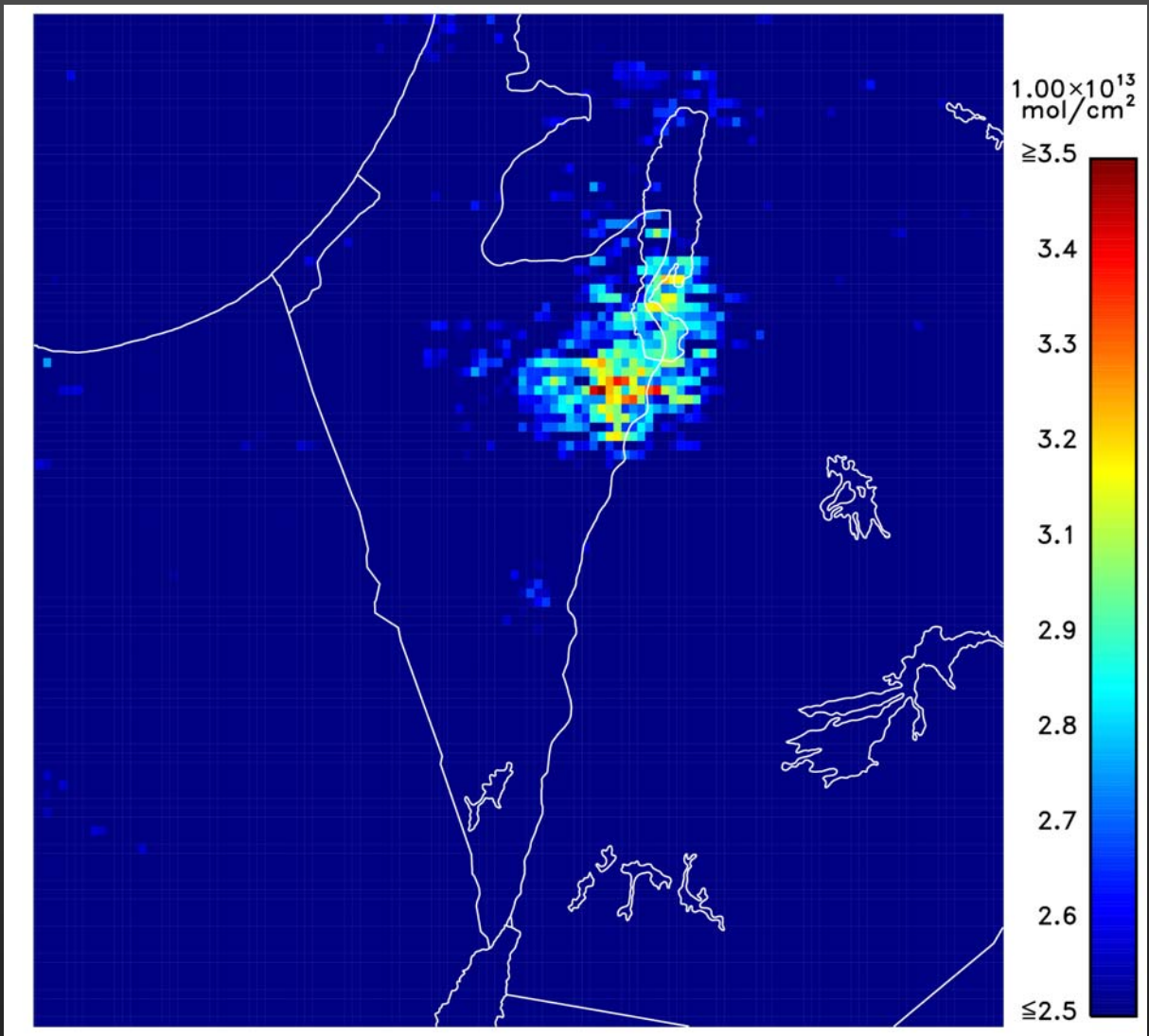


Dead Sea, July 2005
(monthly average)

Ground-based:

Tas *et al.*, Frequency of bromine oxide formation over the Dead Sea, JGR 110, 2005

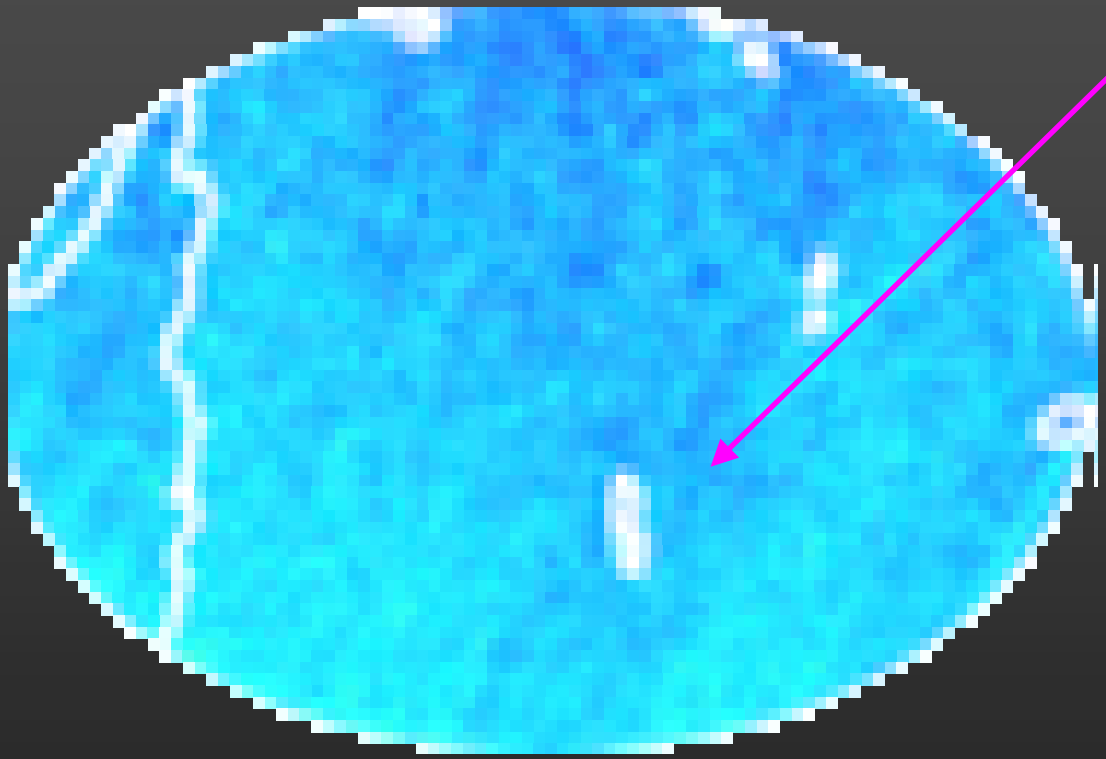
BrO Tropospheric Salt Lakes ... YES!



First satellite-based observation of BrO from Salt Lakes!

(July 2005, monthly average)

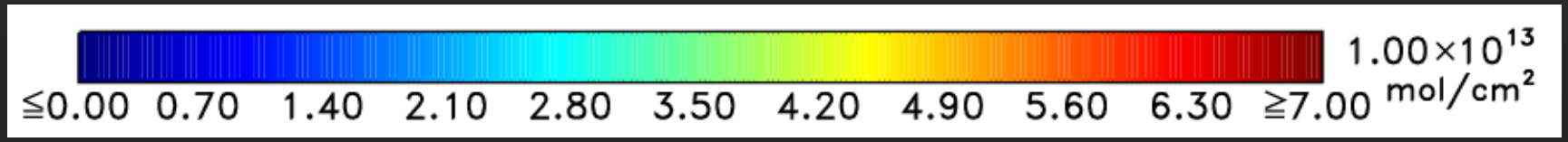
BrO Tropospheric Volcanoes ... ?



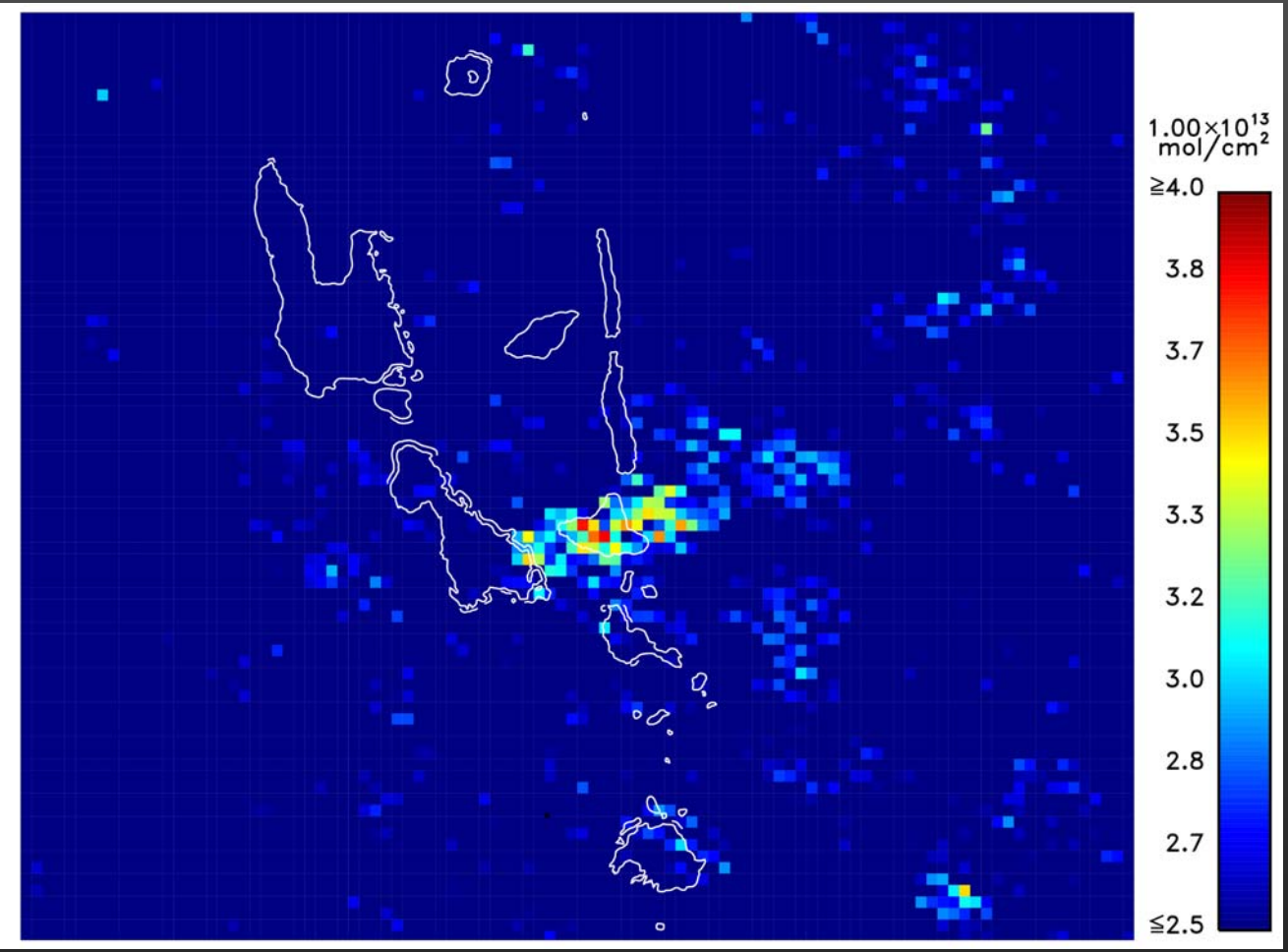
Ambrym on Vanuatu,
February 2005
(monthly average)

Ground-based:

Bobrowski *et al*, Detection of bromine monoxide in a volcanic plume, Lett. Nature 423, 2003



BrO Tropospheric Volcanoes ... YES!

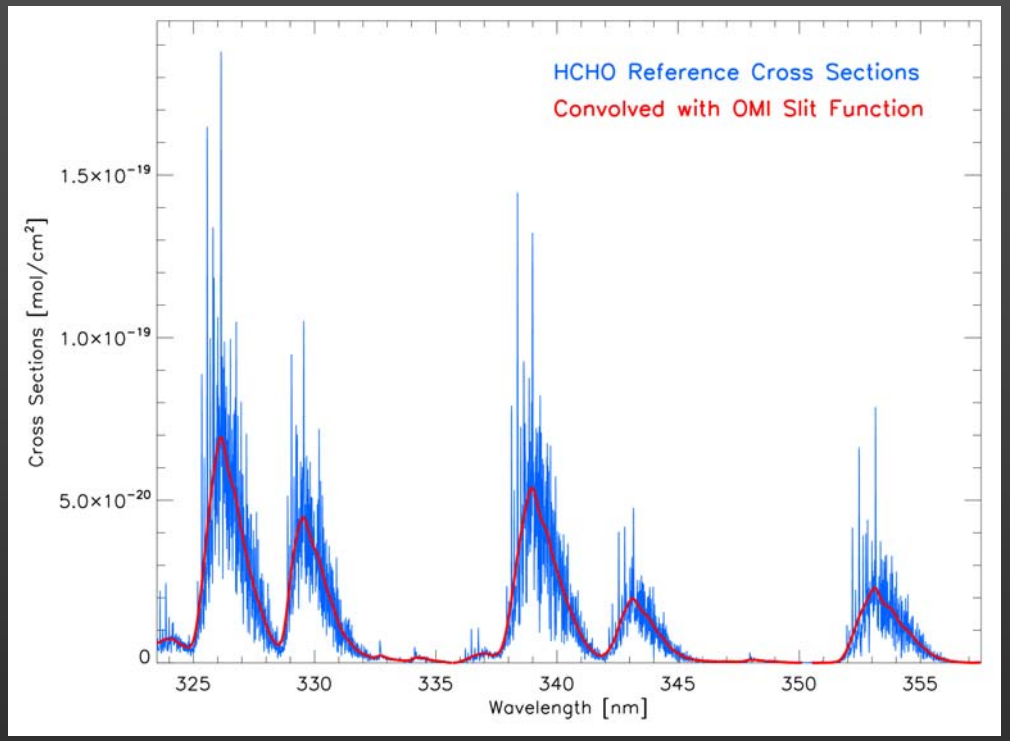


First satellite-based observation of BrO from volcanoes!

(February 2005, monthly average)

HCHO

- Volatile Organic Compound
- Produced from Methane oxidation, isoprene emissions
- Indicator for Air Quality
- Average lifetime: ~4 hrs
- Main sinks: Photolysis, reaction with OH

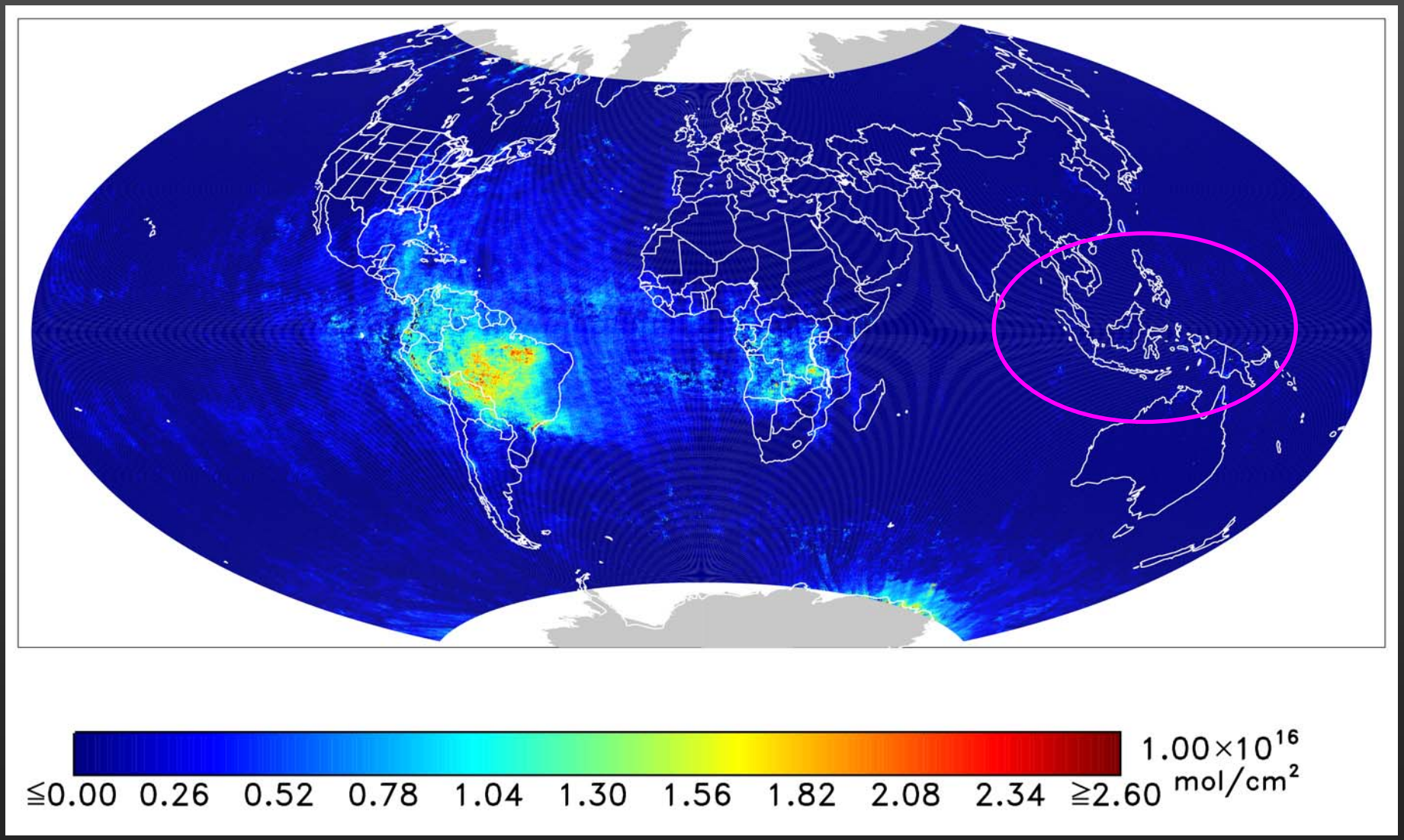


Fitting window: 324 – 357 nm

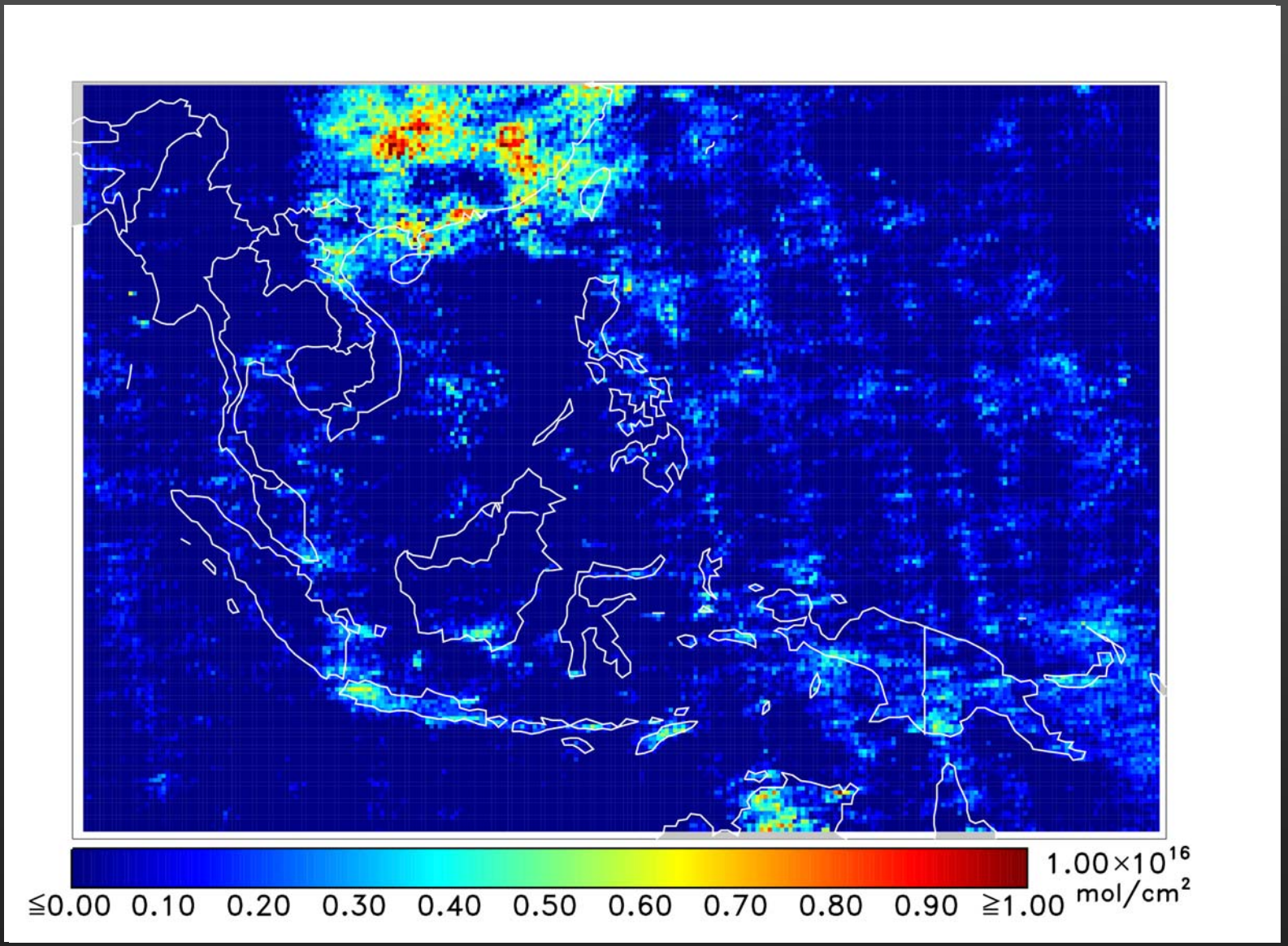
Success Story for GOME:
Large number of science studies in collaboration with the Harvard Modeling Group -- Paul Palmer (now Leeds, UK), Daniel Jacob

OMI monthly HCHO product has emerged, daily product is shaping up
Fitting Uncertainties: 50-100%

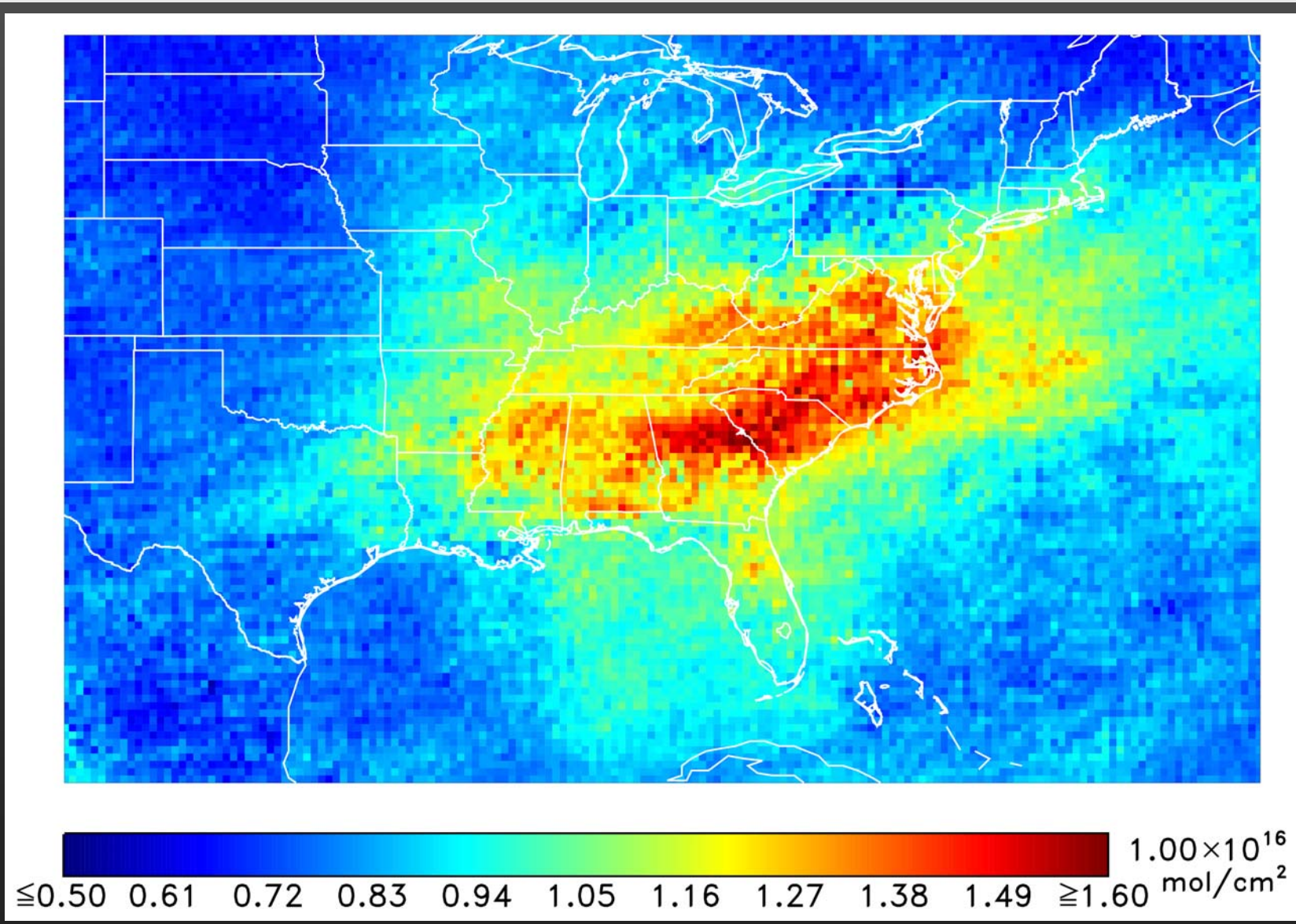
HCHO Global Monthly Average October 2005 smoothed column



HCHO Global Monthly Average October 2005 SE Asia

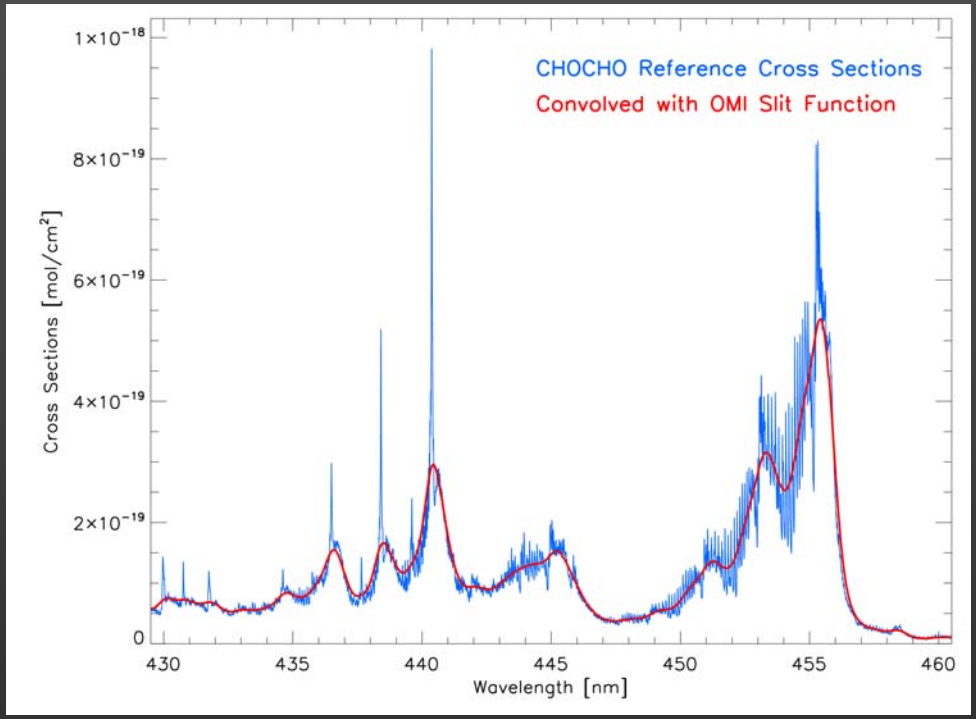


HCHO Global Monthly Average July 2005 Eastern US



CHO-CHO (glyoxal)

- Volatile Organic Compound recently observed in Mexico City (Volkamer et al., 2005)
- Produced from oxidation of a large number of other VOCs
- Unlike HCHO not affected by direct vehicle emission, hence a better indicator for VOC oxidation (photochem. smog)
- Average loading about 8% of NO_2: ~1.5×10^{15} mol/cm^2
- Average life-time: ~1.3 hrs
- Primary sinks: Photolysis, reaction with OH

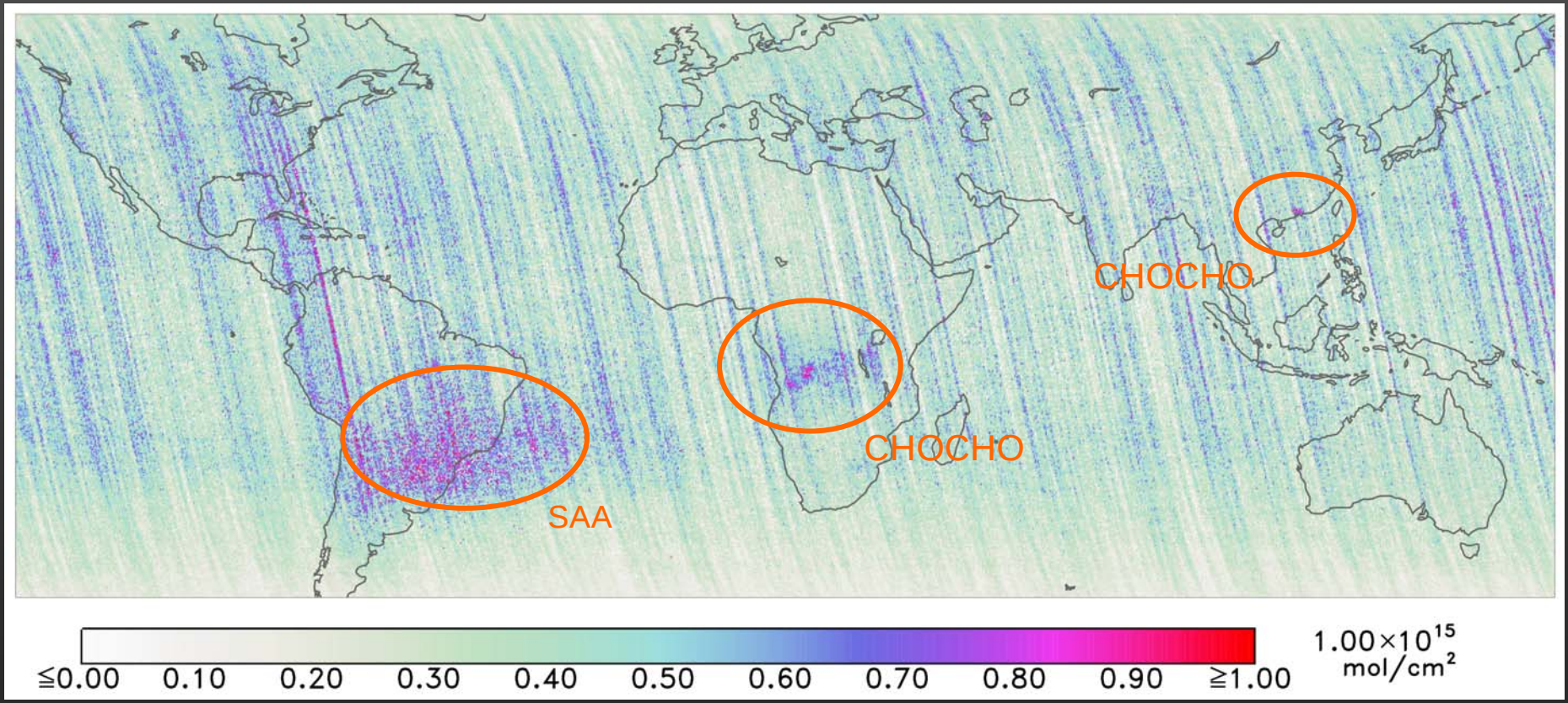


Fitting window: 430 – 460 nm

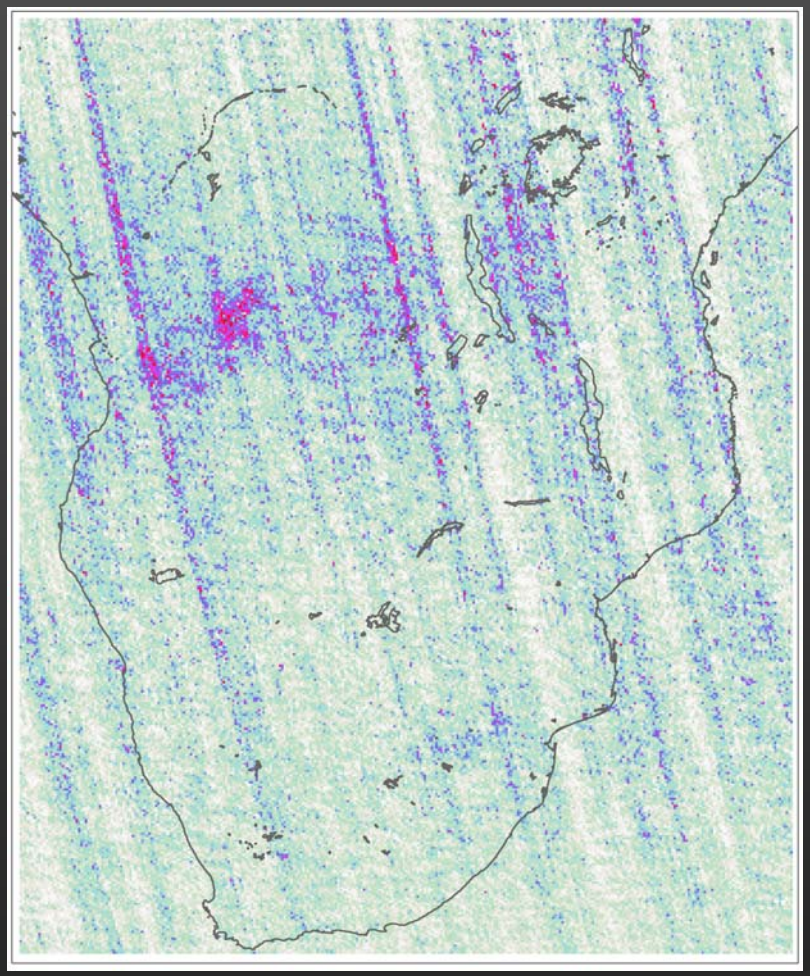
First satellite-based observation from OMI!

Ground-based: Volkamer *et al.*, DOAS measurements of glyoxal as an indicator for fast VOC chemistry in urban air, GRL **32**, 2005

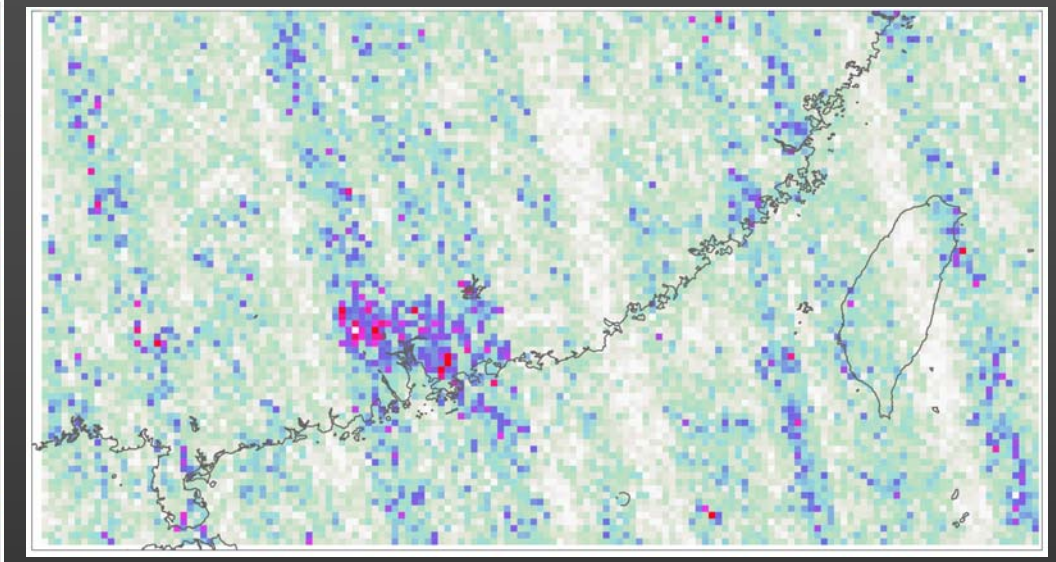
CHO-CHO Geometric Vertical Column CHO-CHO for July 2005



CHO-CHO Geometric Vertical Column CHO-CHO for July 2005



Central Africa



Hongkong

Indication of CHO-CHO from OMI is strong.

CHO-CHO retrievals from SCIAMACHY (10:15h) are currently inconclusive.