Sulfates From the Get-go in Stratospheric Volcanic Eruptions

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Thanks to René Servranckx, Pat Kablick

AGU Chapman Conference on Stratospheric Aerosol: March 2018

Climate-volcano factors:

* Injection height, duration
* Total sulfur mass

Current Observational Weaknesses

* Injection height, duration
* Total sulfur mass

Outstanding Science Questions

? Can satellite data accurately characterize eruption parameters ?
? How close to the truth is satellite-based sulfur information ?
? How well do we know volcanic sulfur processing?
? What is the best approach for answering the above questions ?

Revisiting Robock and Matson (1983)

"Circumglobal Transport of the El Chichón Volcanic Dust loud

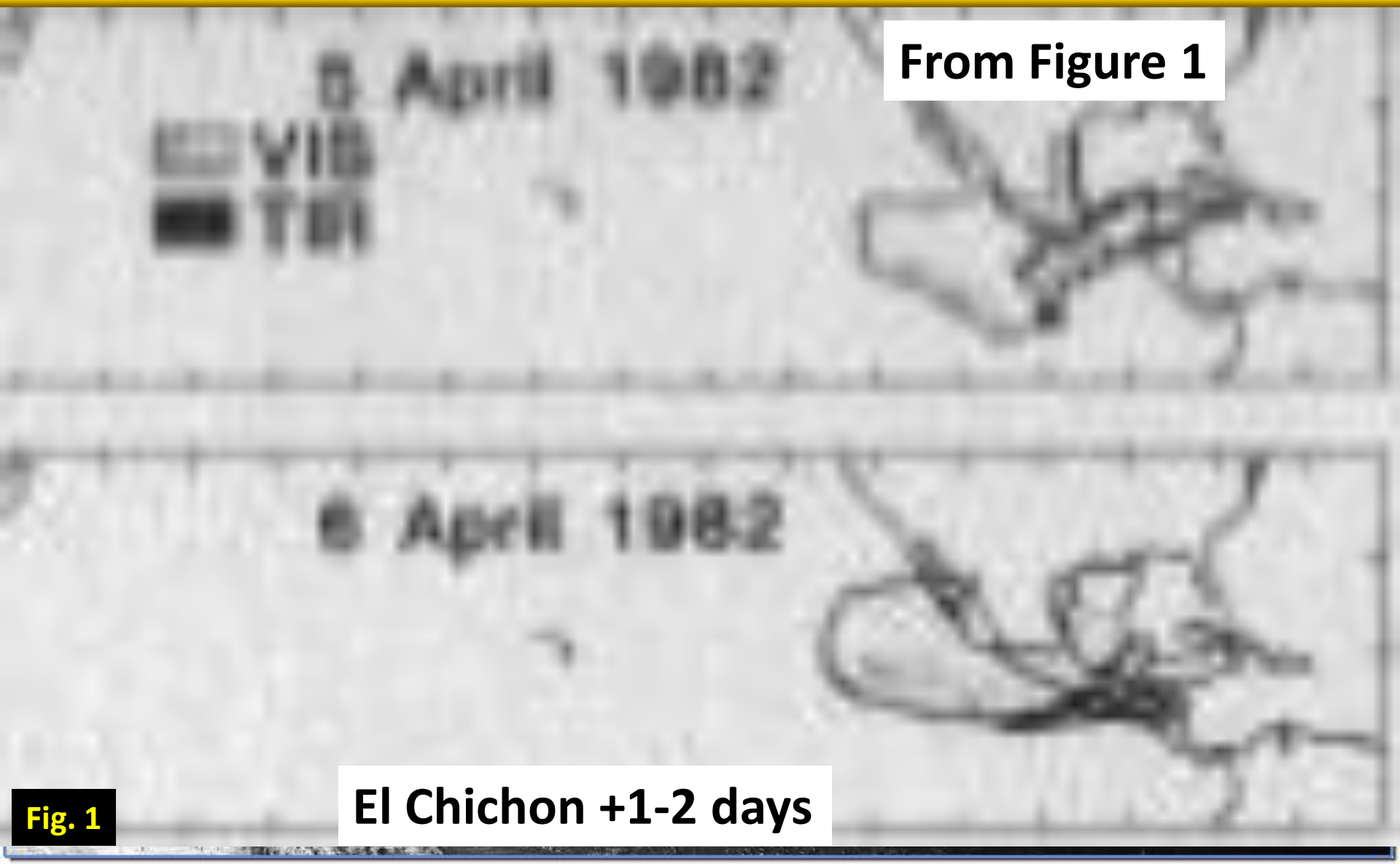
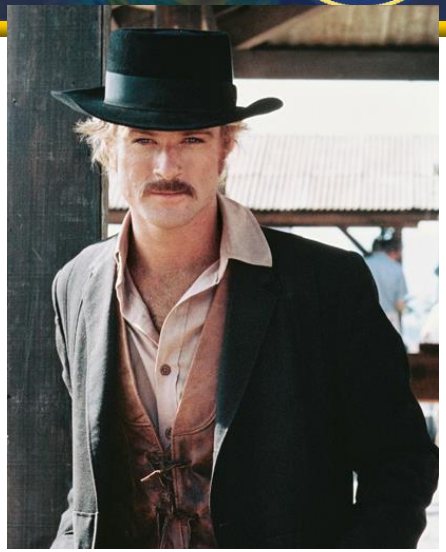


Fig. 1

Revisiting Robock and Matson (1983)

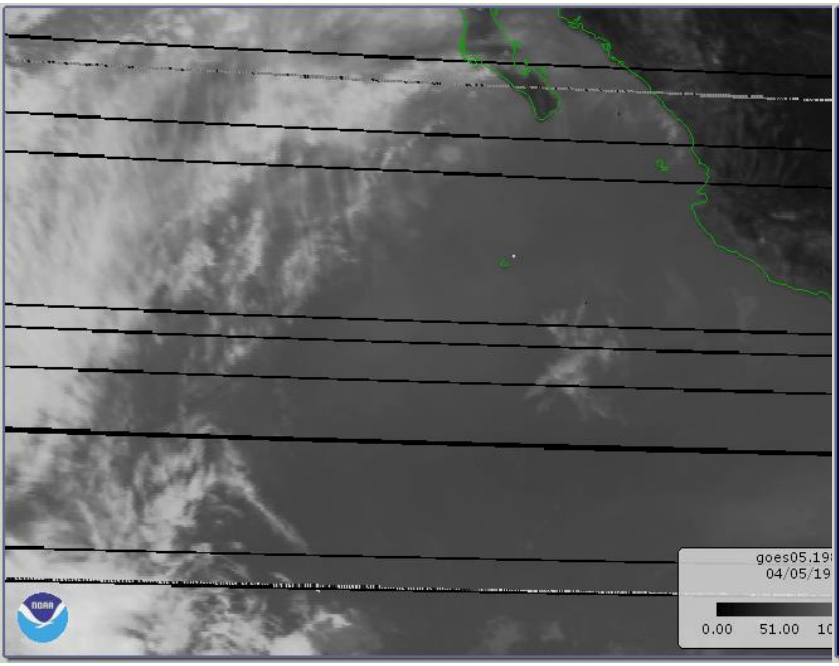
“I’m better when I move.”

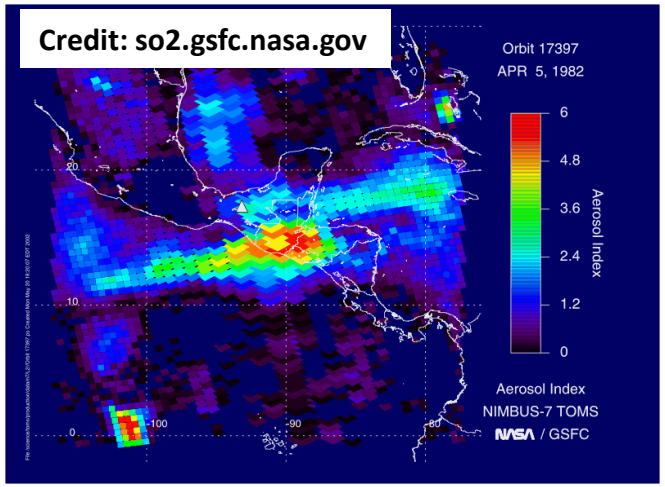
- The Sundance Kid (Robert Redford)



IR Vis

Animation



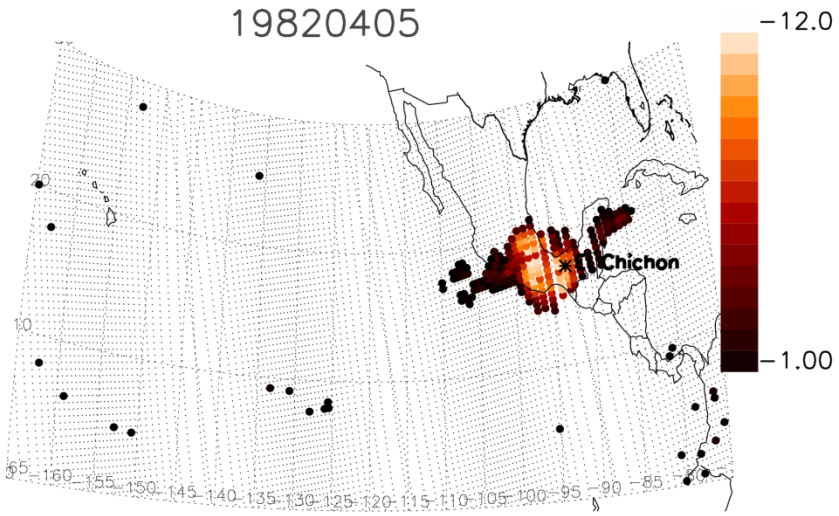


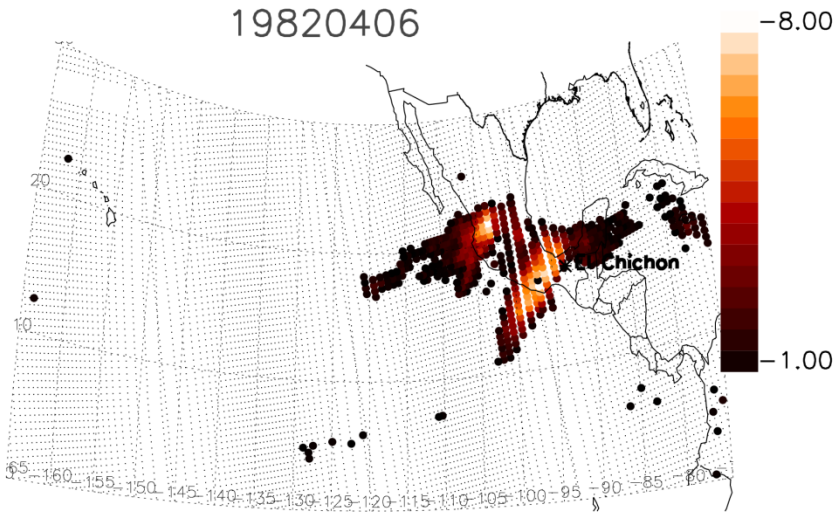
Nimbus 7 TOMS UV Aerosol Index (AI)

Scattering aerosol
- liquid sulfates

Absorbing aerosol
- dust, ash, smoke

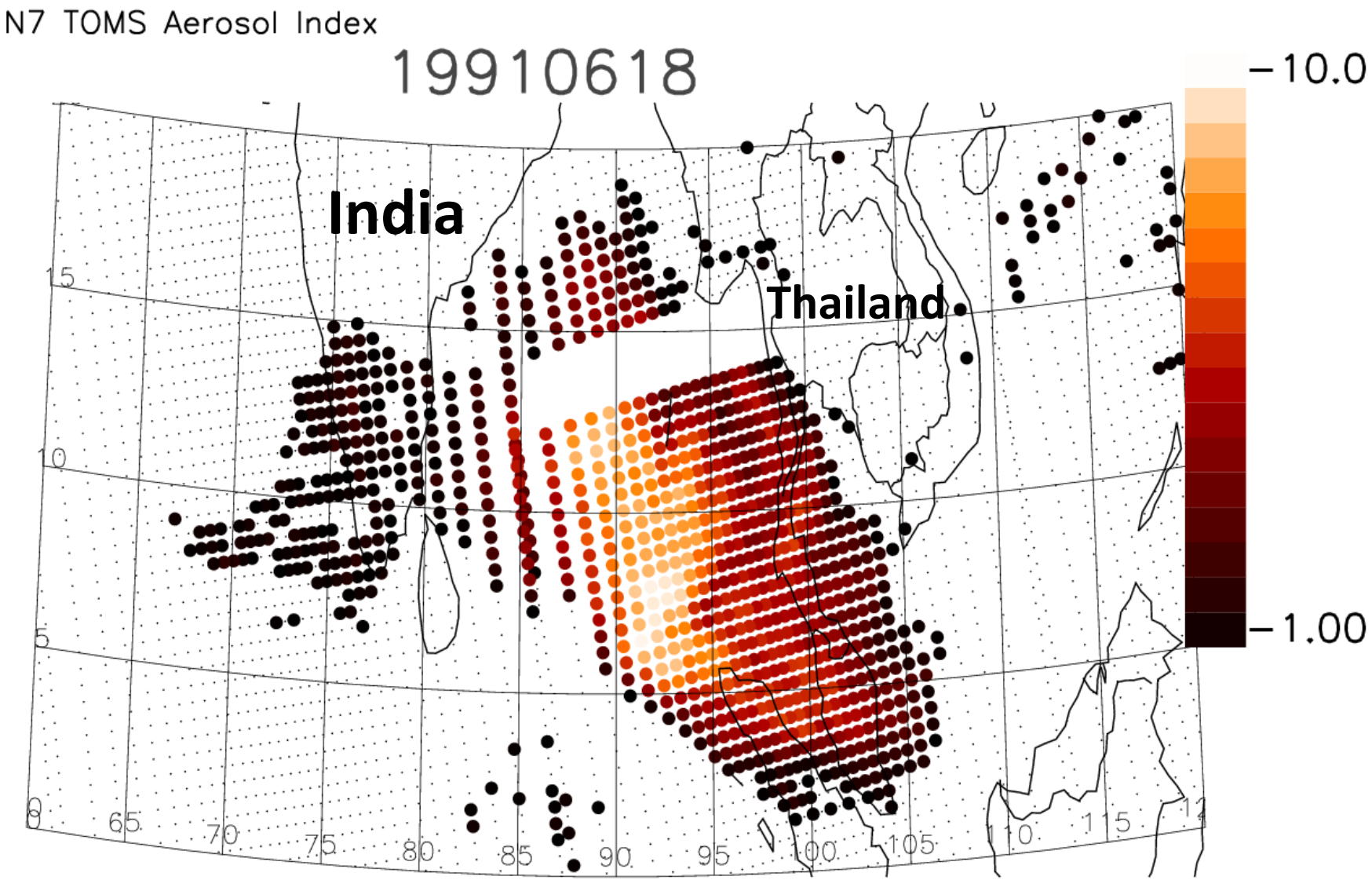
cloud





El Chichon: 5-6 April 1982

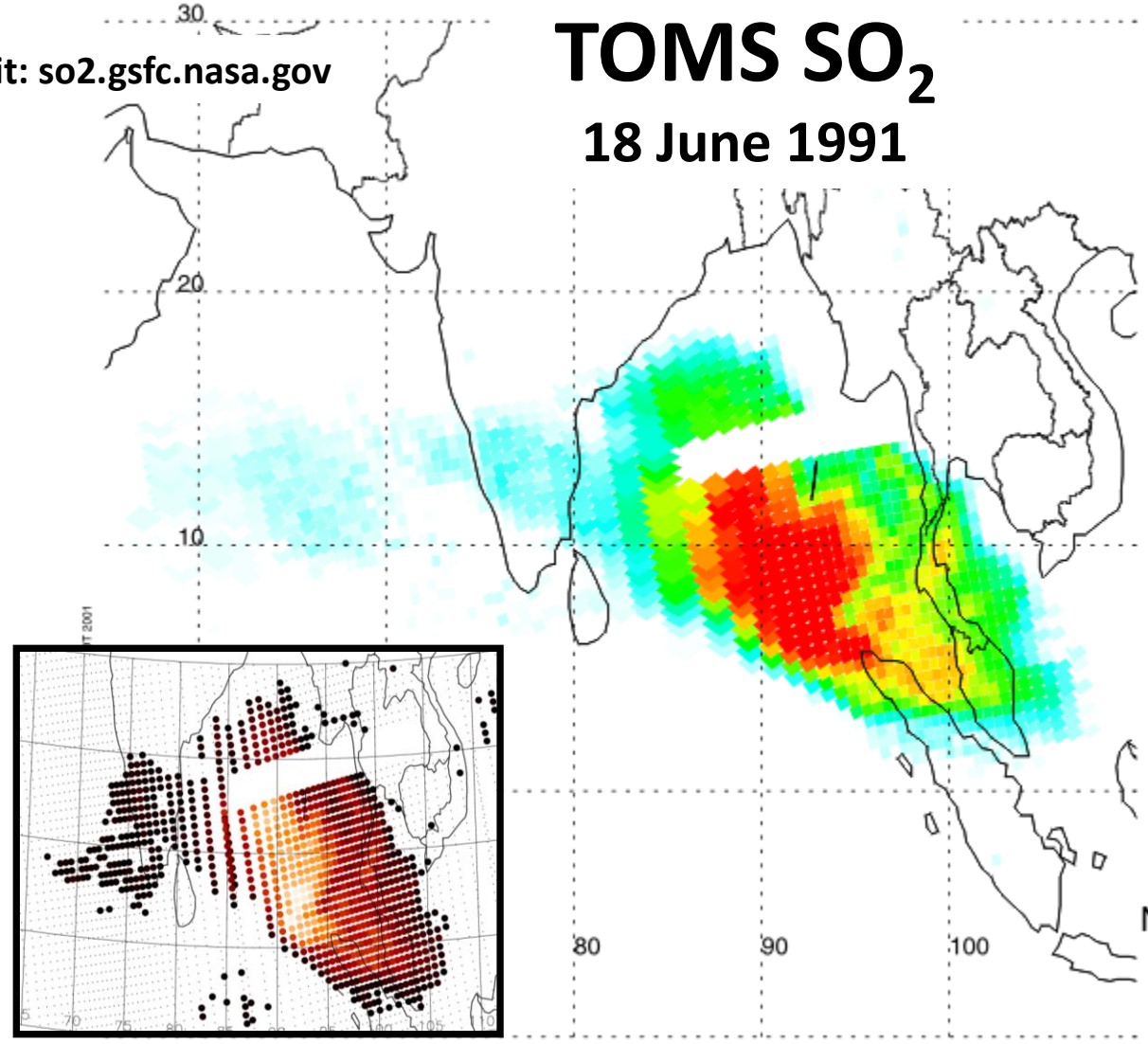
Now to Mount Pinatubo



Credit: so2.gsfc.nasa.gov

TOMS SO_2

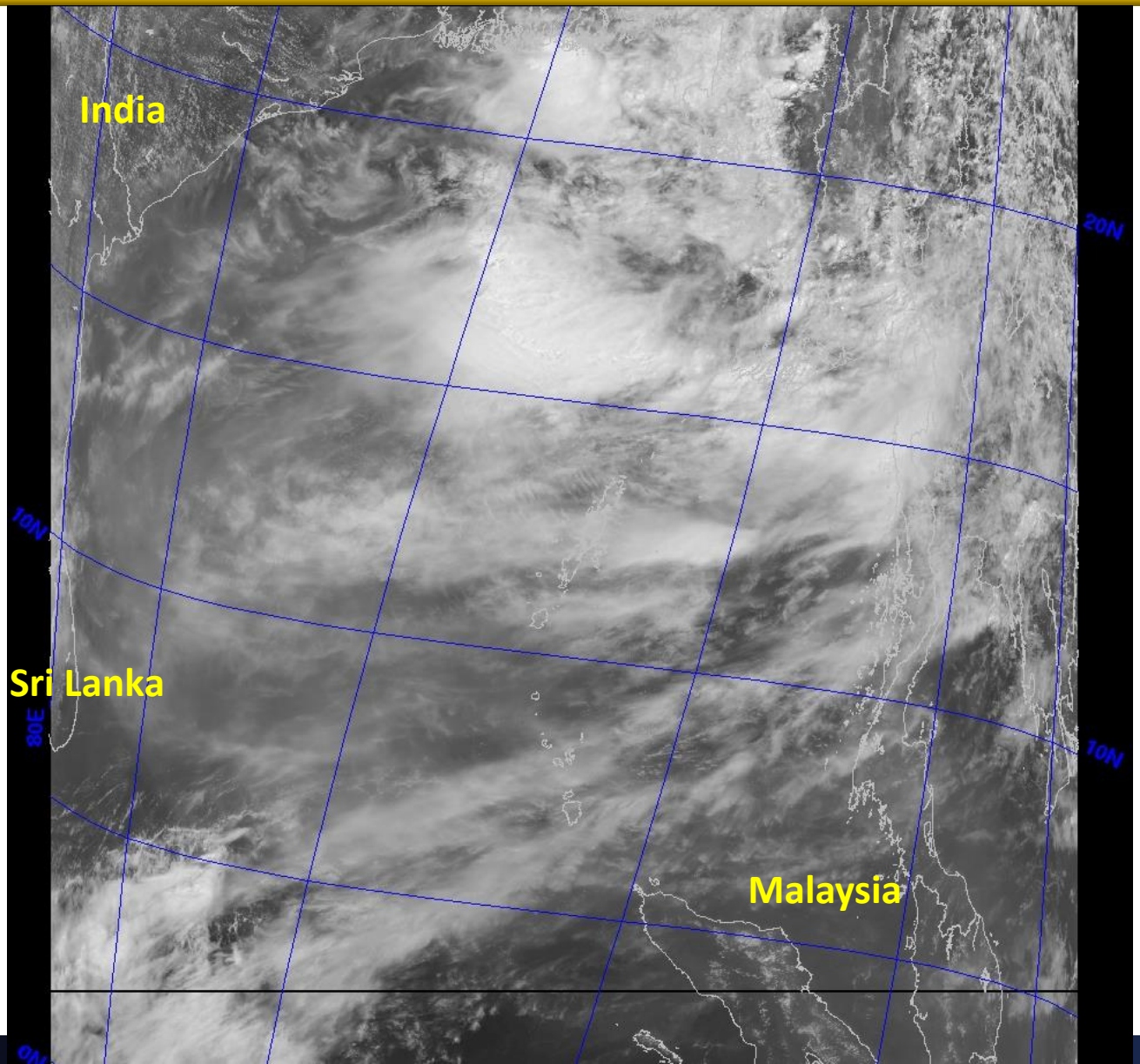
18 June 1991



AVHRR Visible

18 June 1991
08:11 UTC

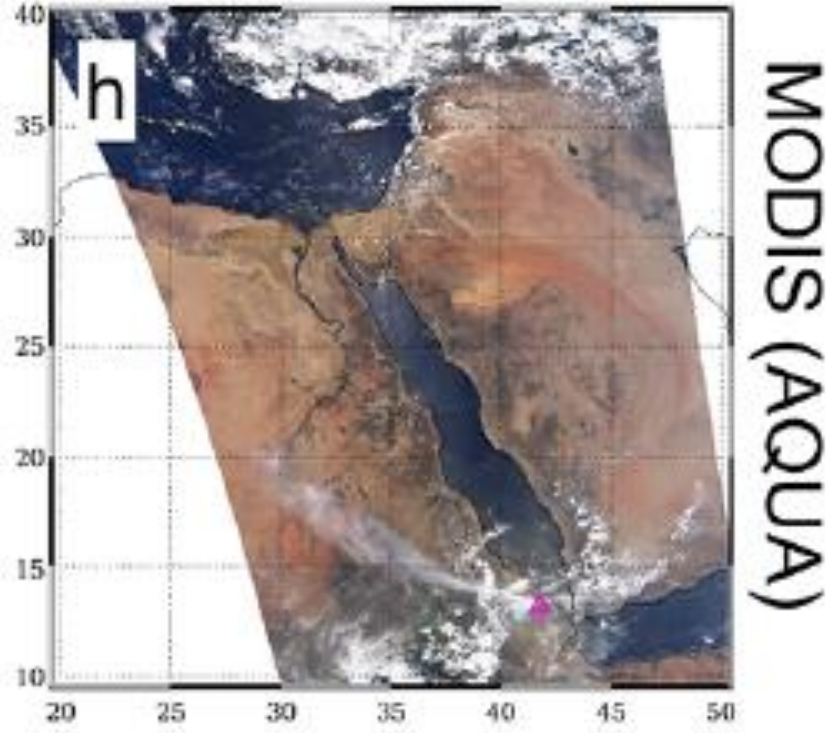
Stratospheric VOG!

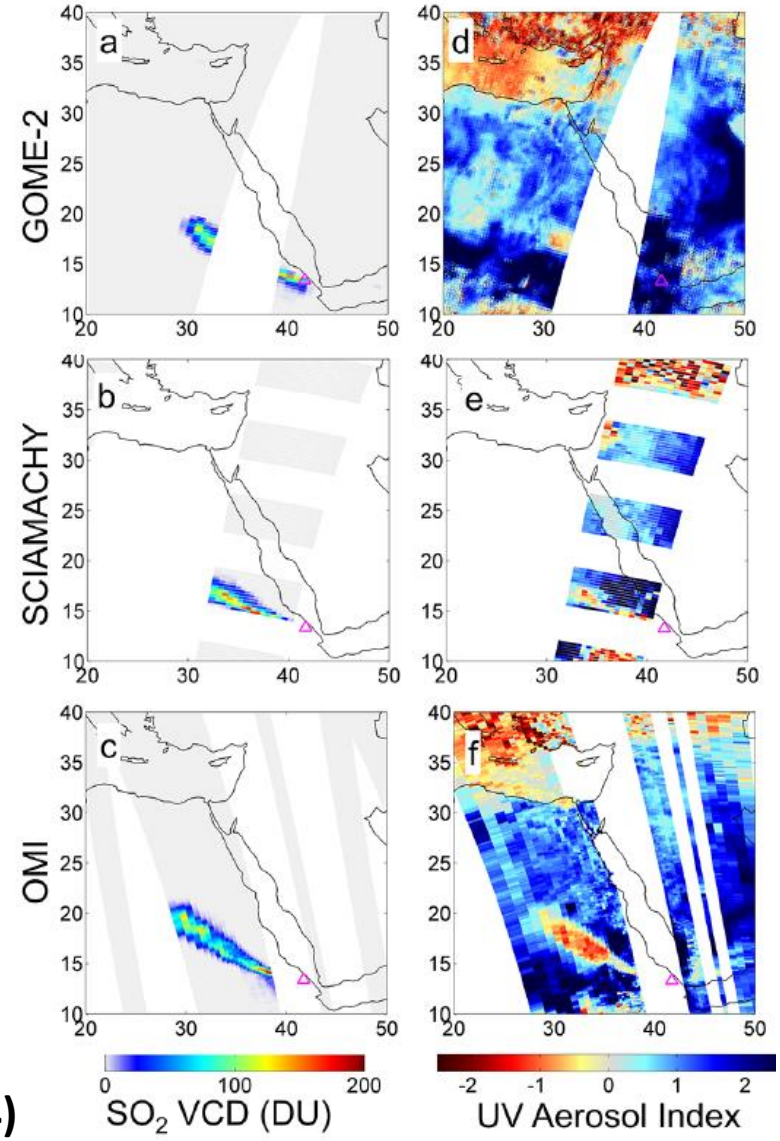


Nabro

13 June 2011

True color, SO_2, AI

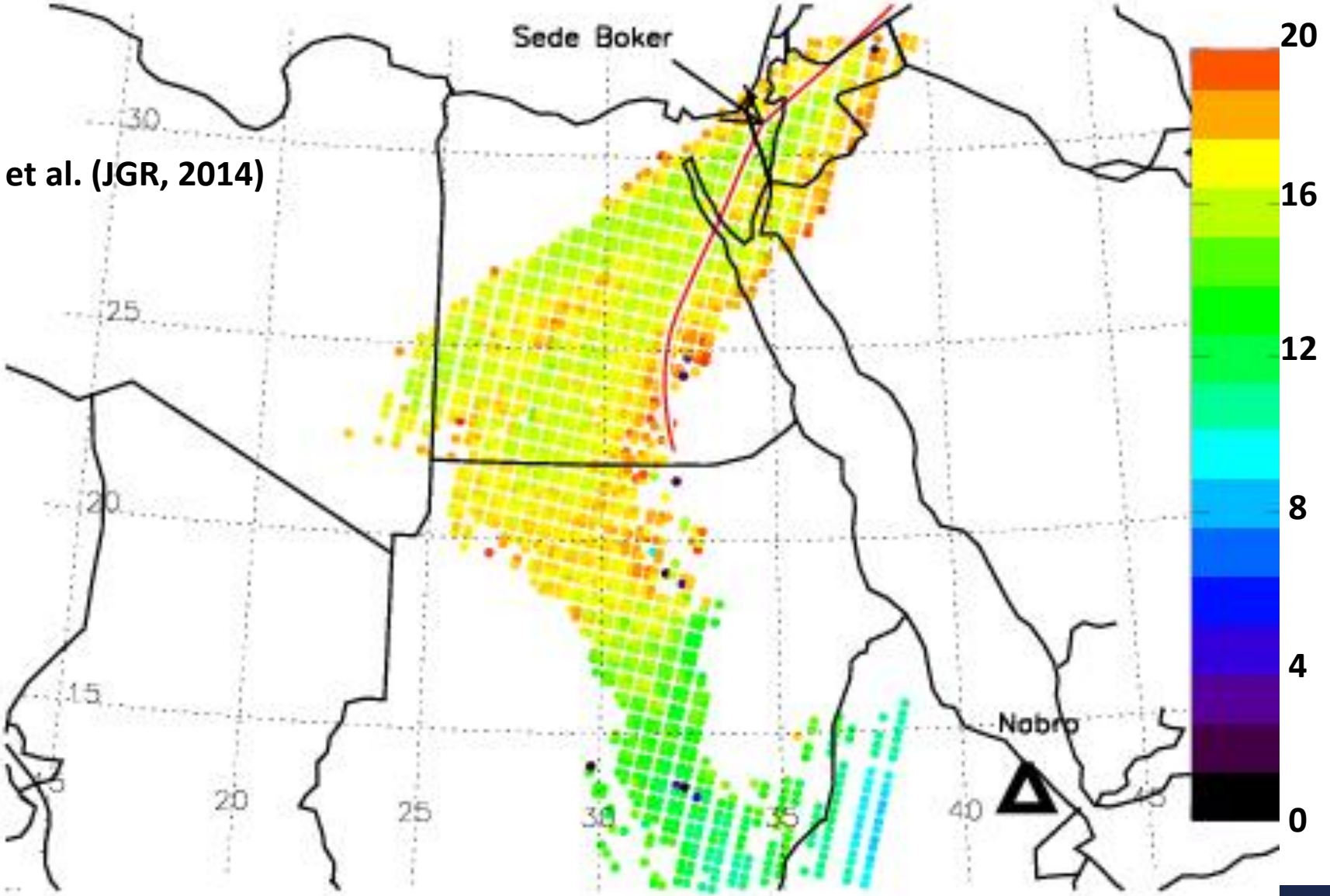




Penning de Vries et al. (ACP, 2014)

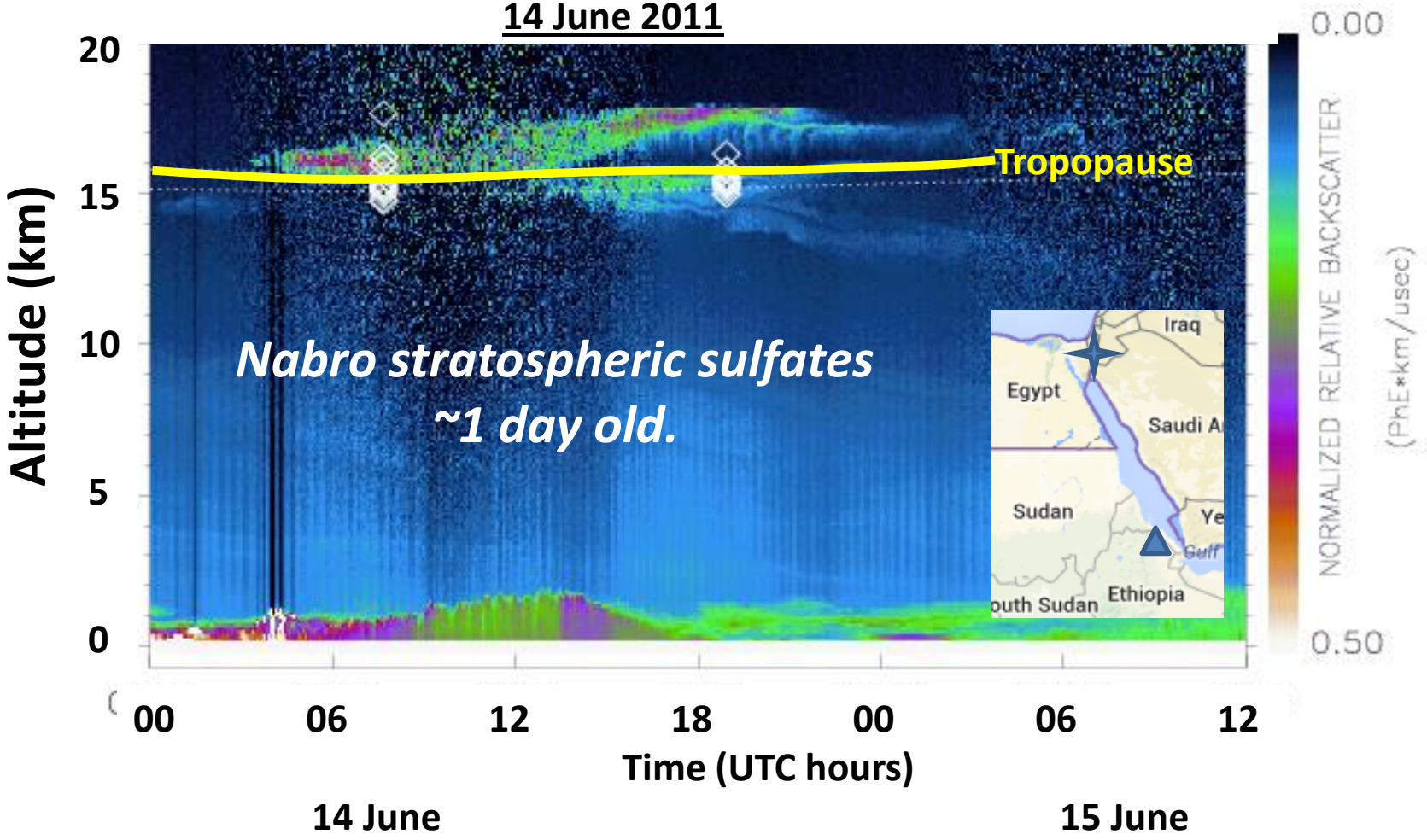
IASI SO_2 Height (km)
14 June 2011
Hyperspectral IR

Fromm et al. (JGR, 2014)



Micropulse lidar, Sde Boker, Israel, the day after Nabro

14 June 2011



Fromm et al. (JGR, 2014)

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, D21212, doi:10.1029/2010JD014447, 2010

Observations of the eruption of the Sarychev volcano and simulations using the HadGEM2 climate model

James M. Haywood,[1,2,3] Andy Jones,[2] Lieven Clarisse,[4] Adam Bourassa,[5] John Barnes,[6] Paul Telford,[7] Nicolas Bellouin,[2] Olivier Boucher,[2] Paul Agnew,[8] Cathy Clerbaux,[9] Pierre Coheur,[4] Doug Degenstein,[5] and Peter Braesicke[7]

[16] While strong extinction was found due to volcanic ash in the spectra of 15–17 June, this eruption also allowed some rare infrared observations of sulfuric acid aerosols.

Acknowledgement that IASI can detect sulfates at the same wavelengths as SO_2. Does this suggest the potential for aerosol contamination of SO_2 retrievals in the IR method?

Is it possible for there to be sulfate aerosol contamination of UV SO_2 retrievals?

Or…is particulate and gaseous sulfur additive?

Wrapping it up…

* Key climate ingredient, sulfur burden, still a major uncertainty.

* Sulfates from the get-go are the rule, not the exception.
    * the eye doesn't lie☺ And neither does lidar.

* SO_2 retrievals positively correlated with sulfate aerosol index.
    * UV- *and* IR-based SO_2 retrievals

* If there is aerosol-gas contamination, historic sulfur budgets are compromised.

* If no contamination, particulate sulfur must be added to SO_2.

* **Synergistic use of satellite data is key to answering this question…and more.**