Sulfates From the Get-go in Stratospheric Volcanic Eruptions: *Synergistic Application of Satellite Remote Sensing*

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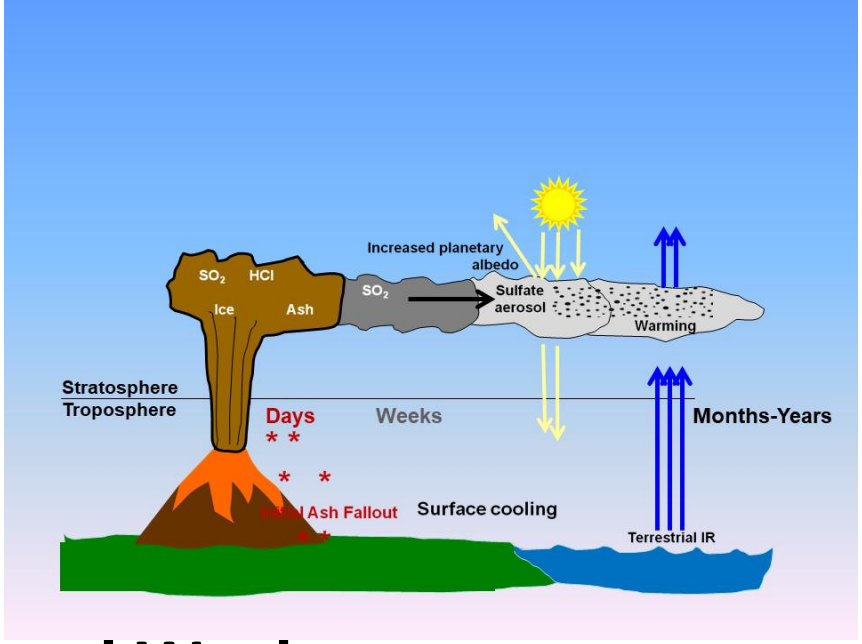
Thanks to René Servranckx, Pat Kablick

AOS Applications Seminar*: 27 October 2022*

Climate-volcano factors:

* Injection height, duration
* Total sulfur mass

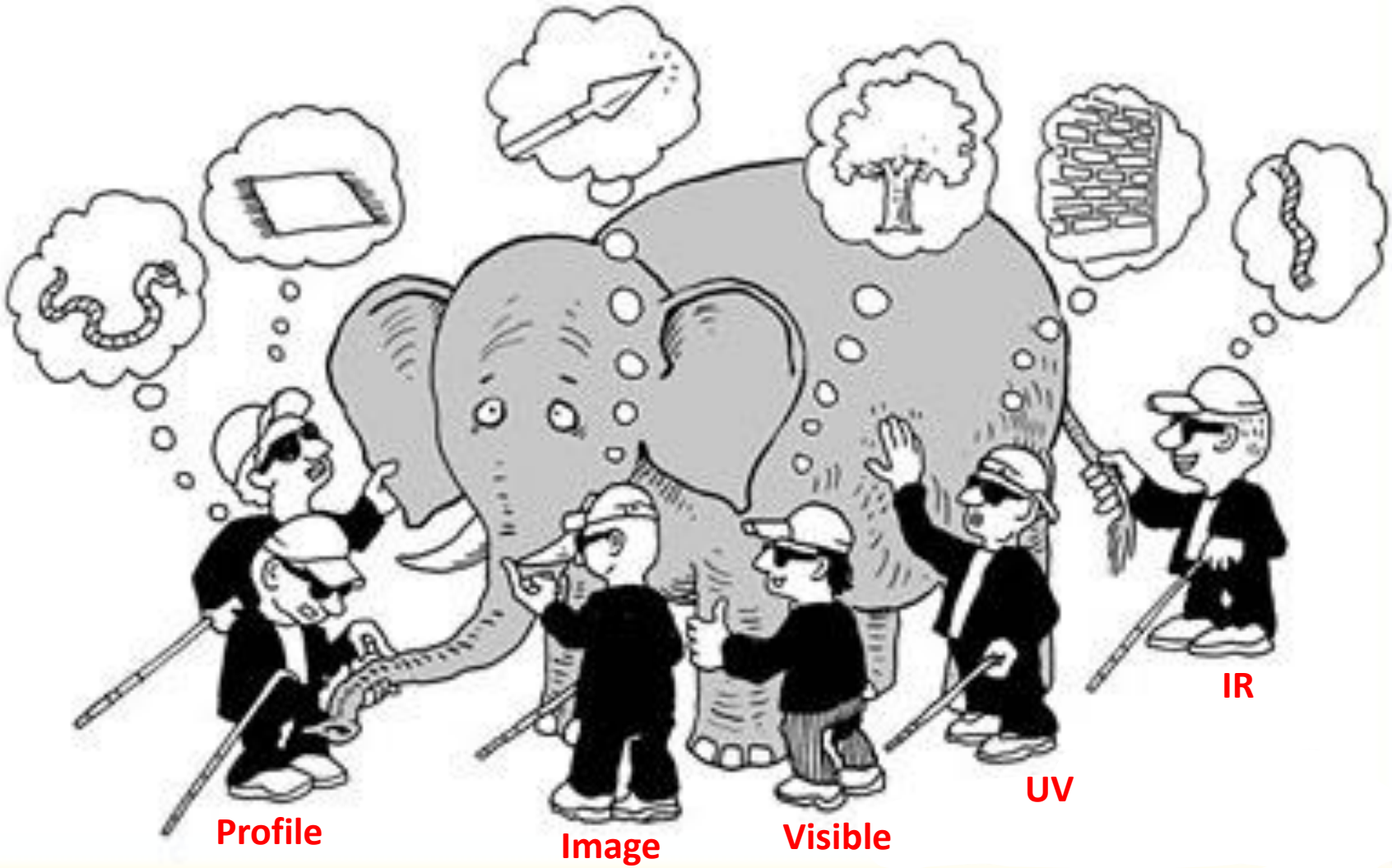


Current Observational Weaknesses

* Injection height, duration
* Total sulfur mass

Outstanding Science Questions

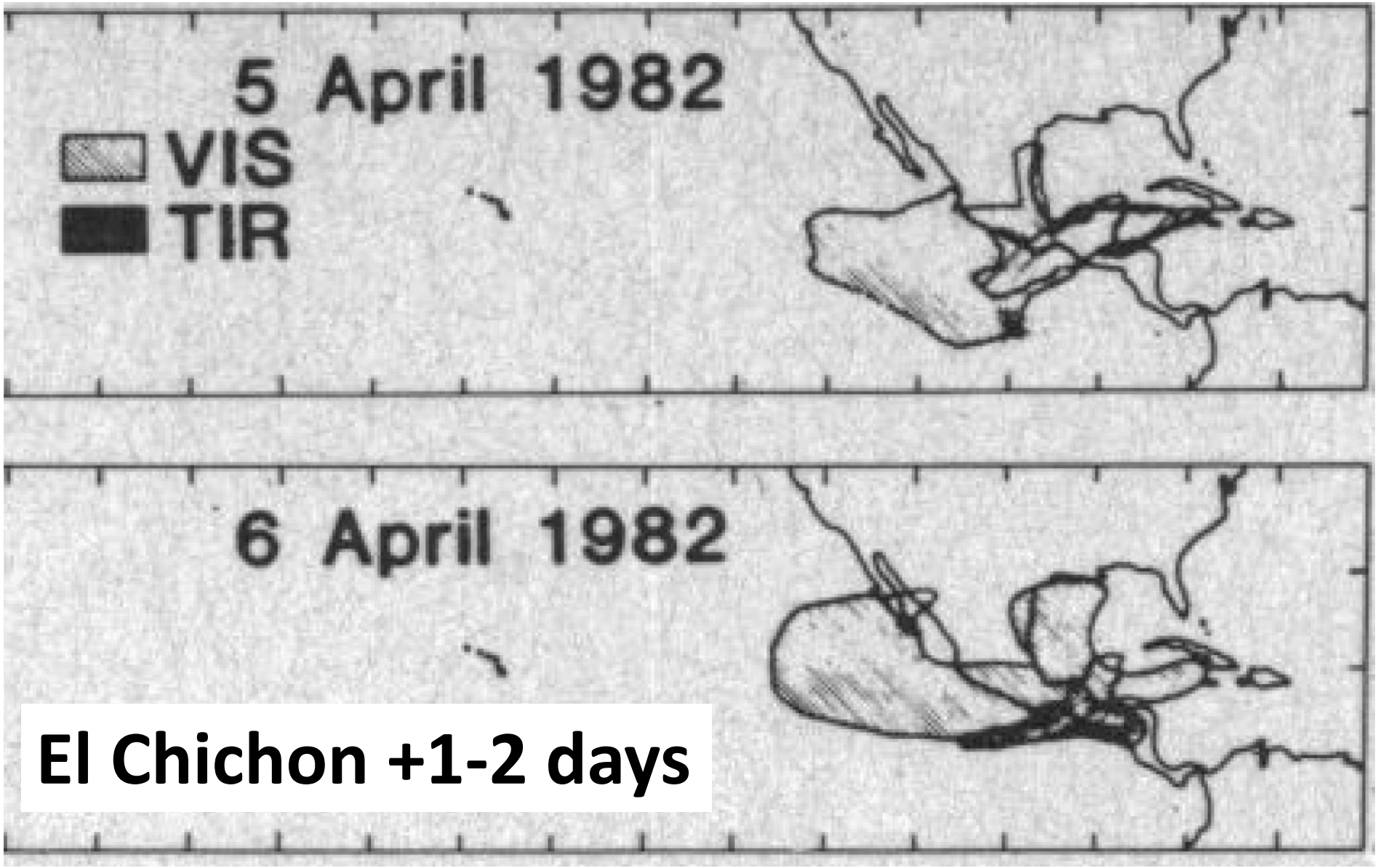
? Can satellite data accurately characterize eruption parameters ?
? How close to the truth is satellite-based sulfur information ?
? How well do we know volcanic sulfur processing?
? What is the best approach for answering the above questions ?


Profile
Image
Visible
UV
IR

Revisiting Robock and Matson (1983)

"Circumglobal Transport of the El Chichón Volcanic Dust loud

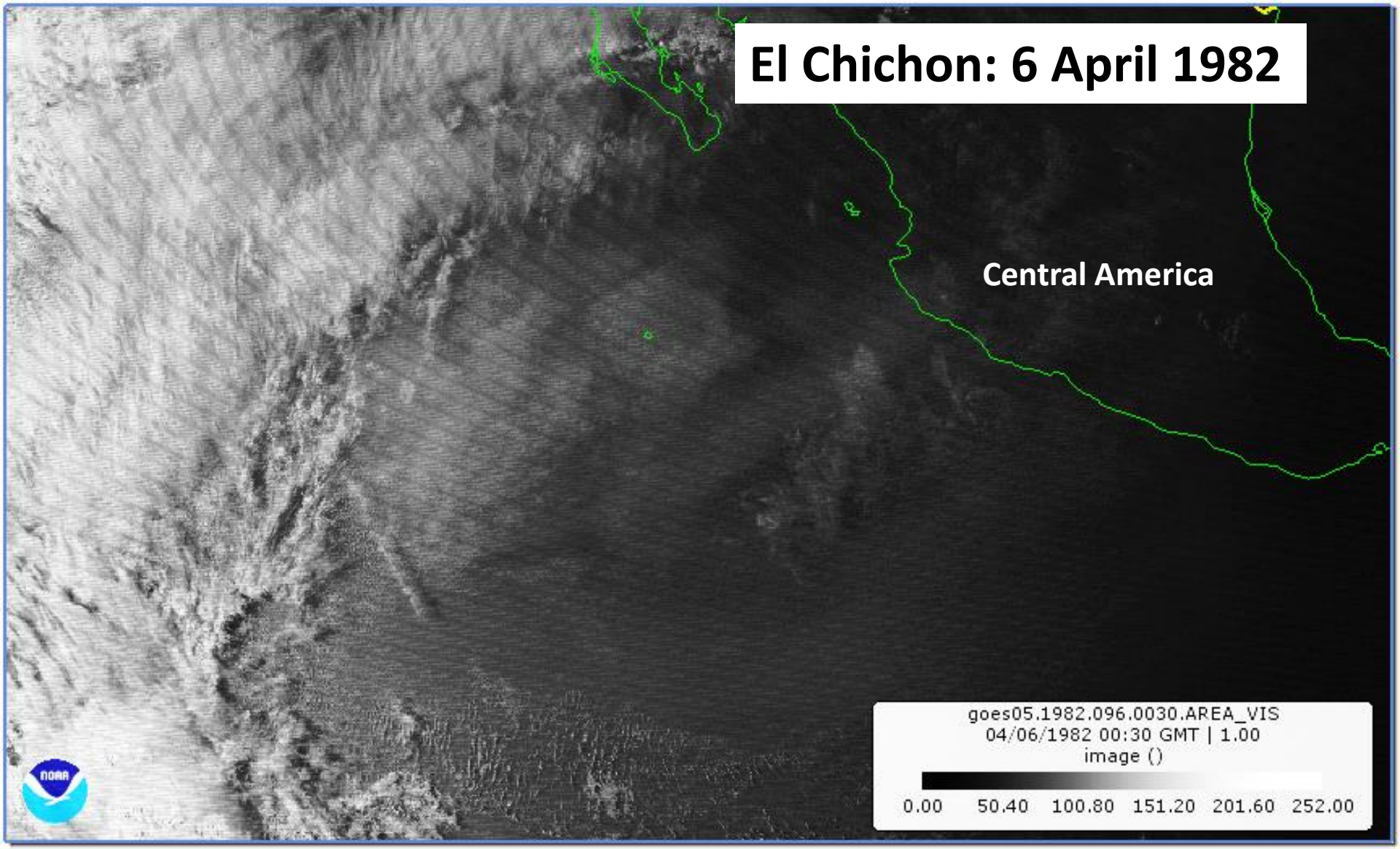
From Fig. 1



El Chichon +1-2 days

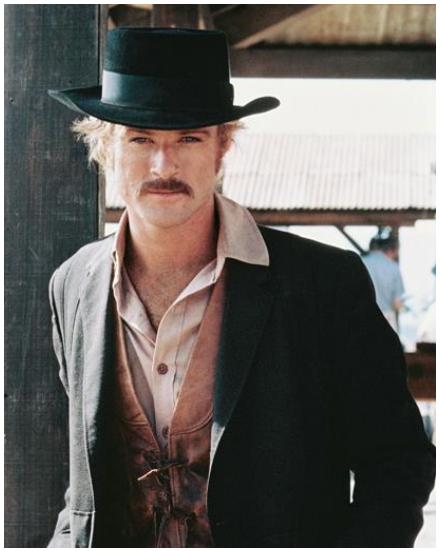
Revisiting Robock and Matson (1983)

“Circumglobal Transport of the El Chichón Volcanic Dust loud



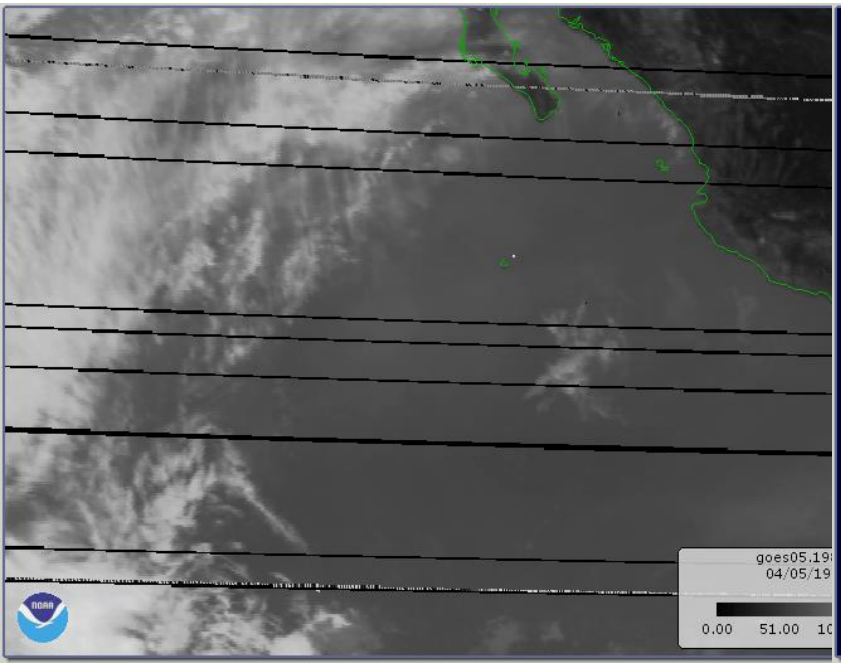
“I’m better when I move.”

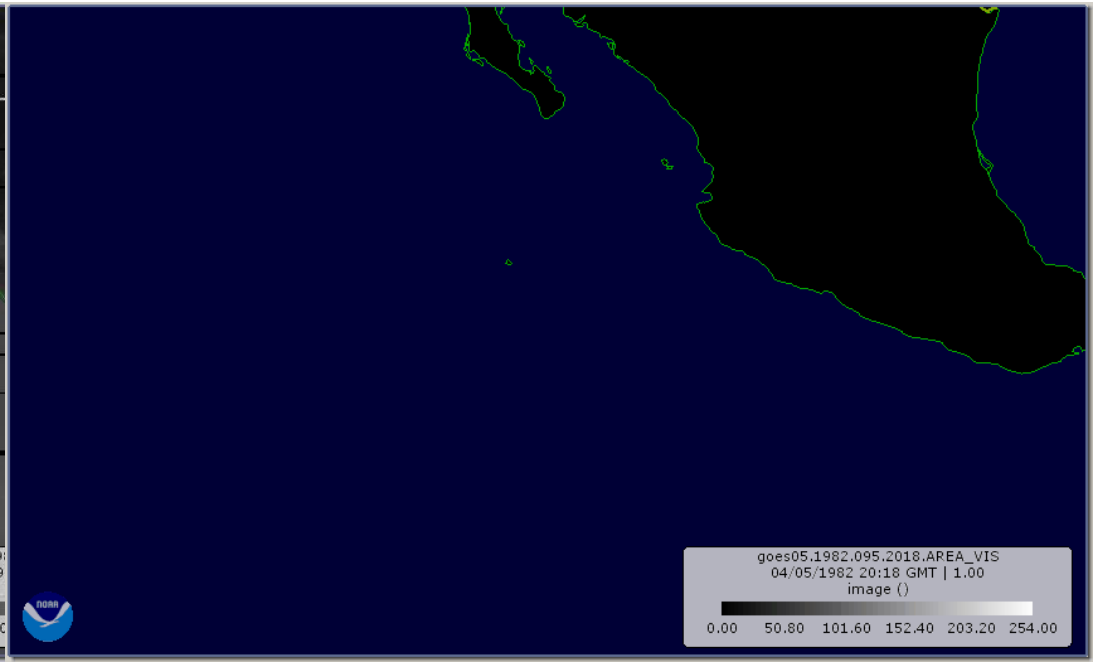
- The Sundance Kid (Robert Redford)

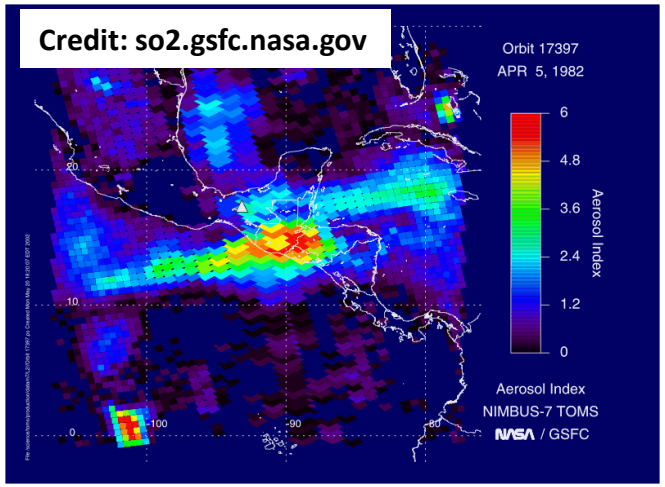


IR Vis

Animation





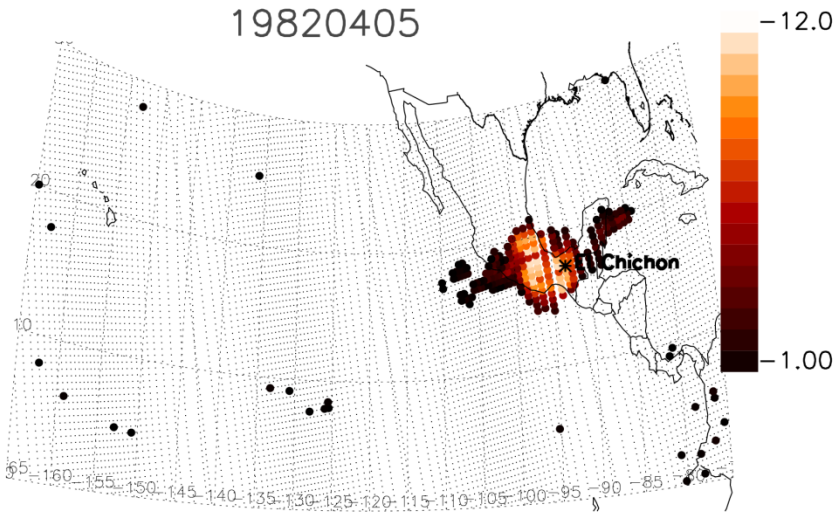


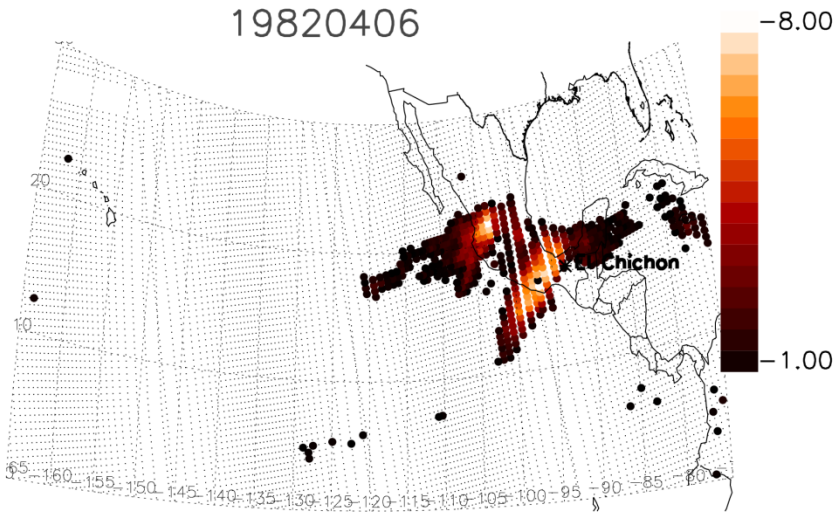
Nimbus 7 TOMS UV Aerosol Index (AI)

Scattering aerosol
- liquid sulfates

Absorbing aerosol
- dust, ash, smoke

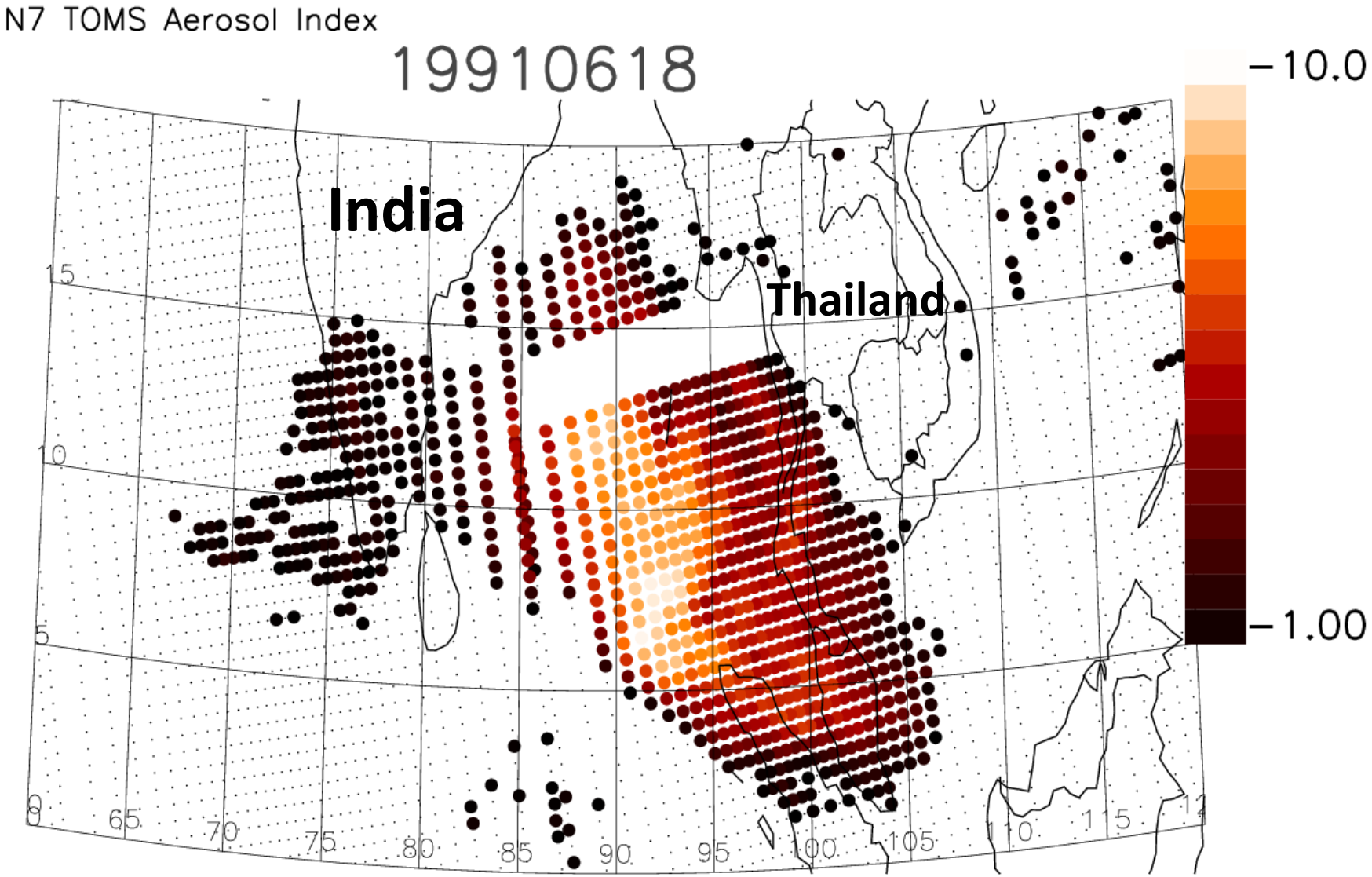
cloud





El Chichon: 5-6 April 1982

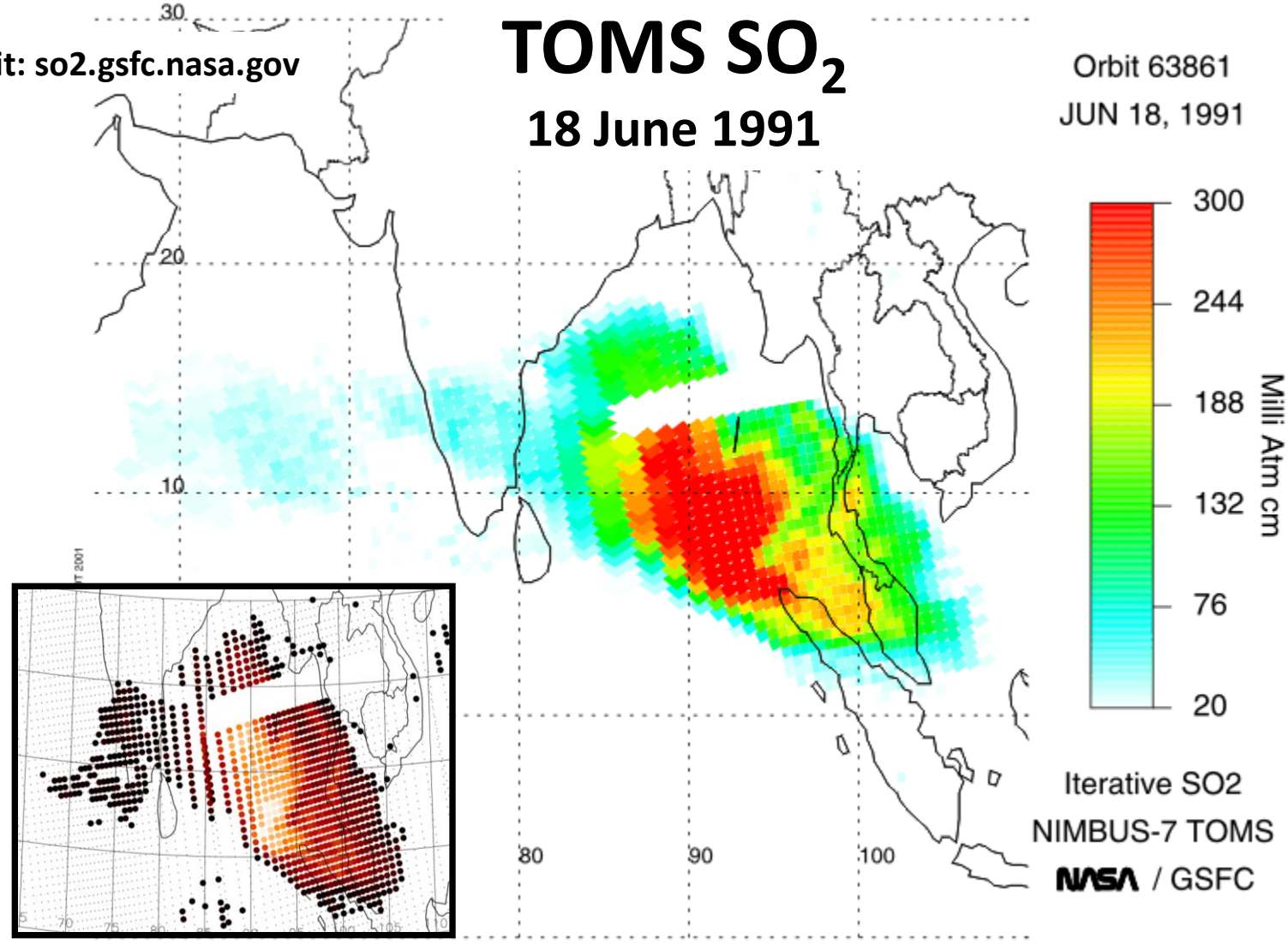
Now to Mount Pinatubo



Credit: so2.gsfc.nasa.gov

TOMS SO_2

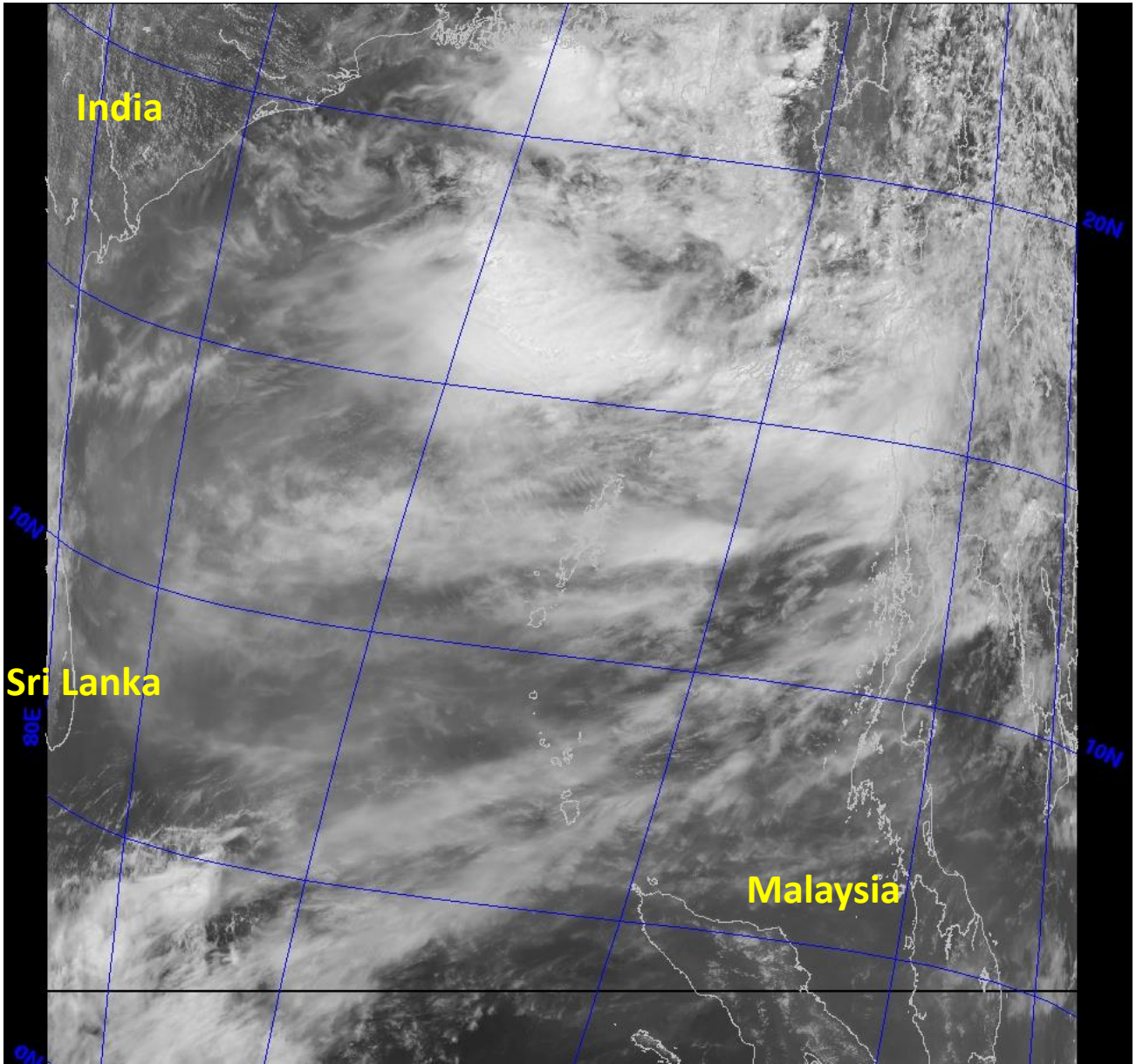
18 June 1991



AVHRR Visible

18 June 1991
08:11 UTC

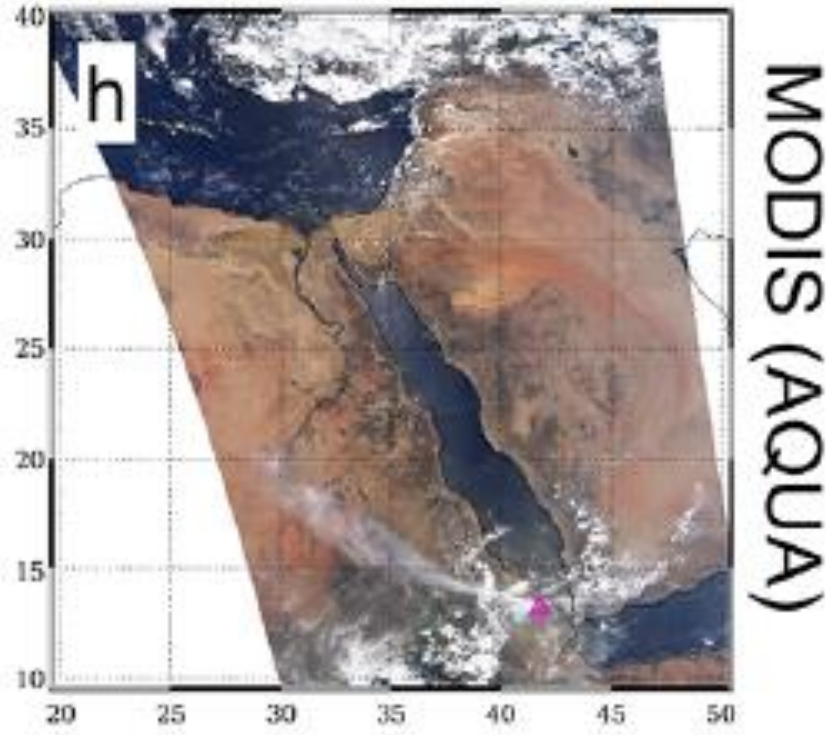
Stratospheric VOG!

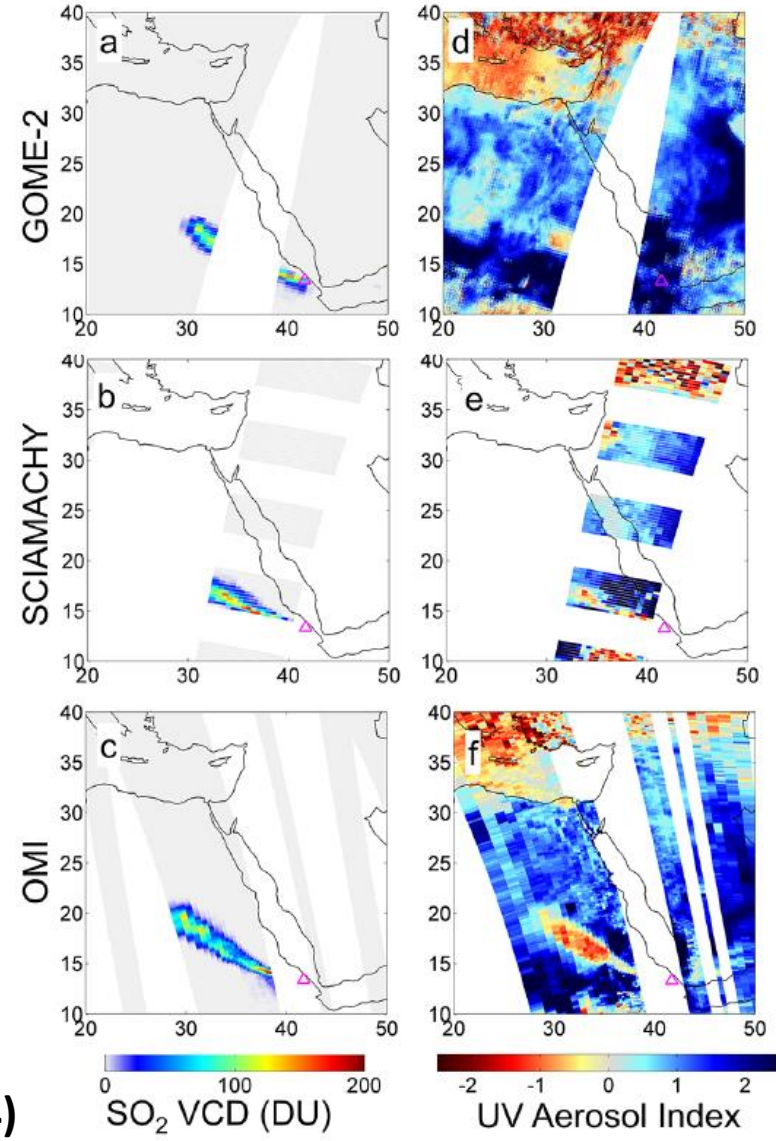


Nabro

13 June 2011

True color, SO_2, AI





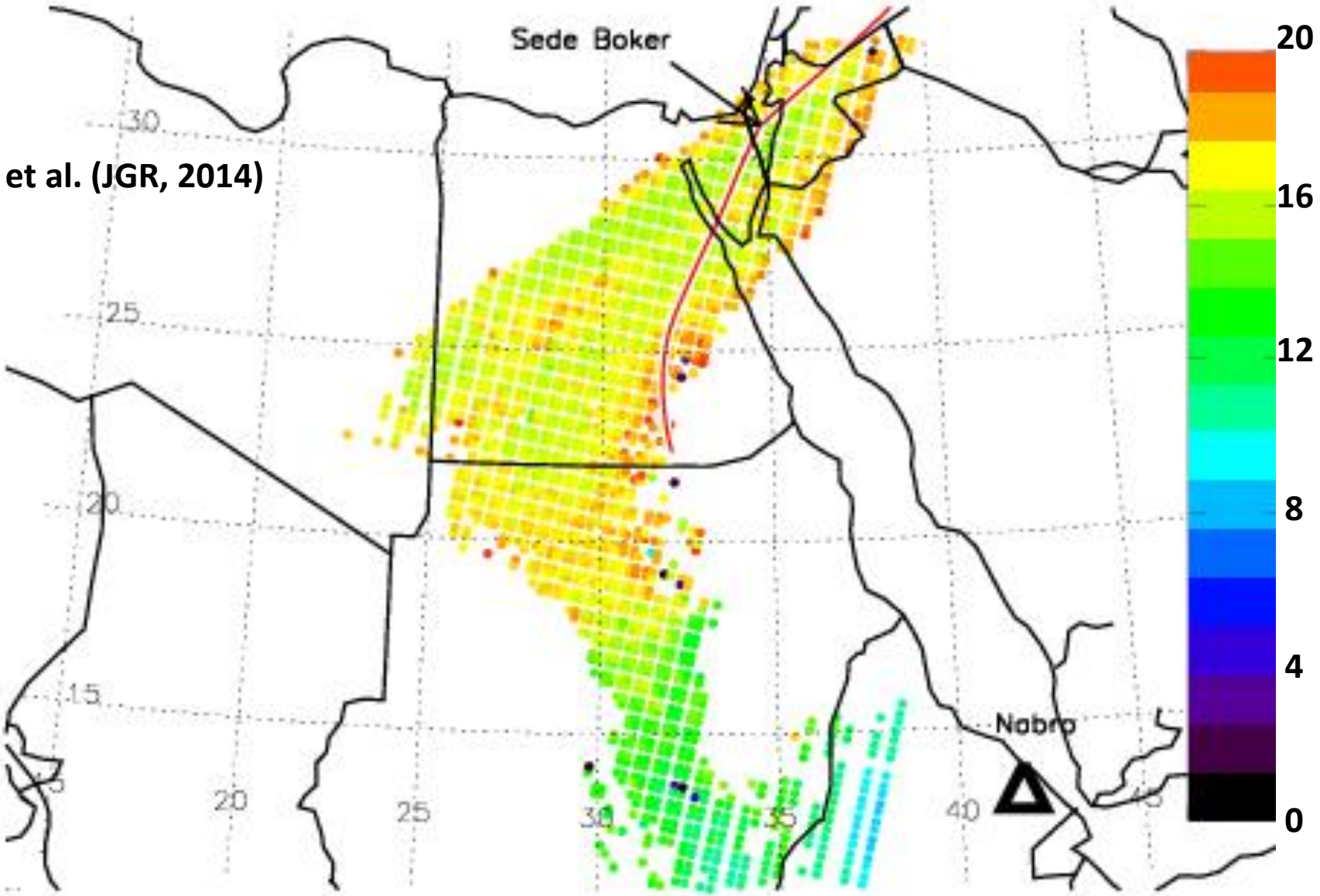
Penning de Vries et al. (ACP, 2014)

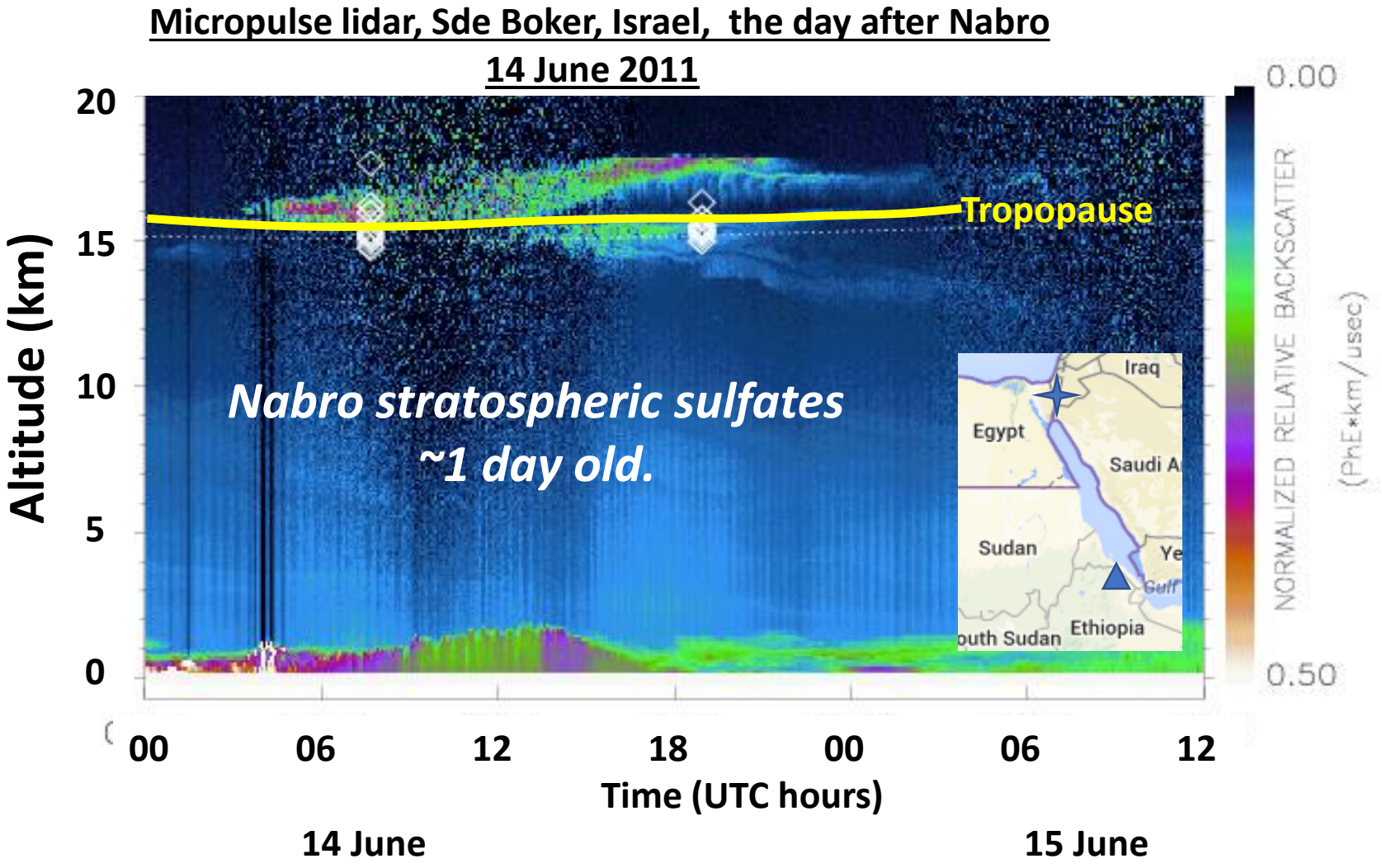
IASI SO_2 Height (km)

14 June 2011

Hyperspectral IR

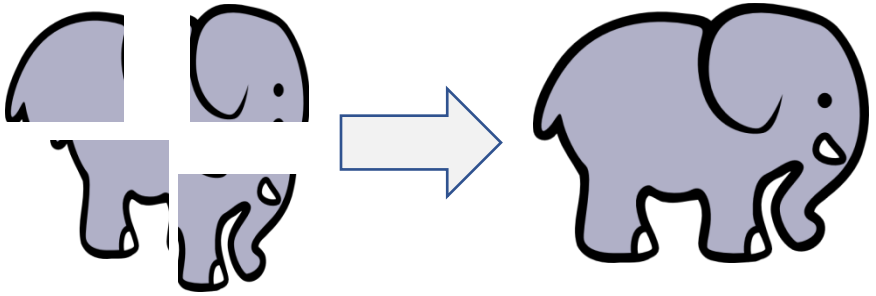
Fromm et al. (JGR, 2014)





Fromm et al. (JGR, 2014)

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.**