Sulfate aerosols on Mauna Loa: A Perceptible Asian Influence?

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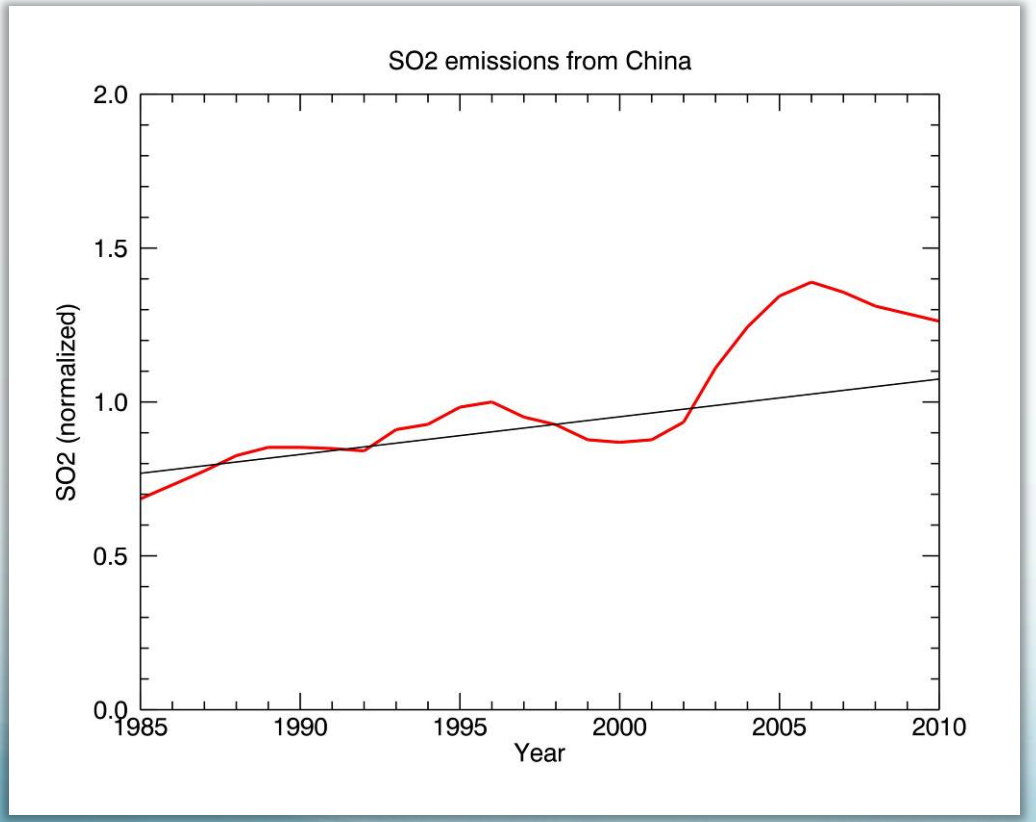
https://thelavazone.wikispaces.com/Mauna+Loa

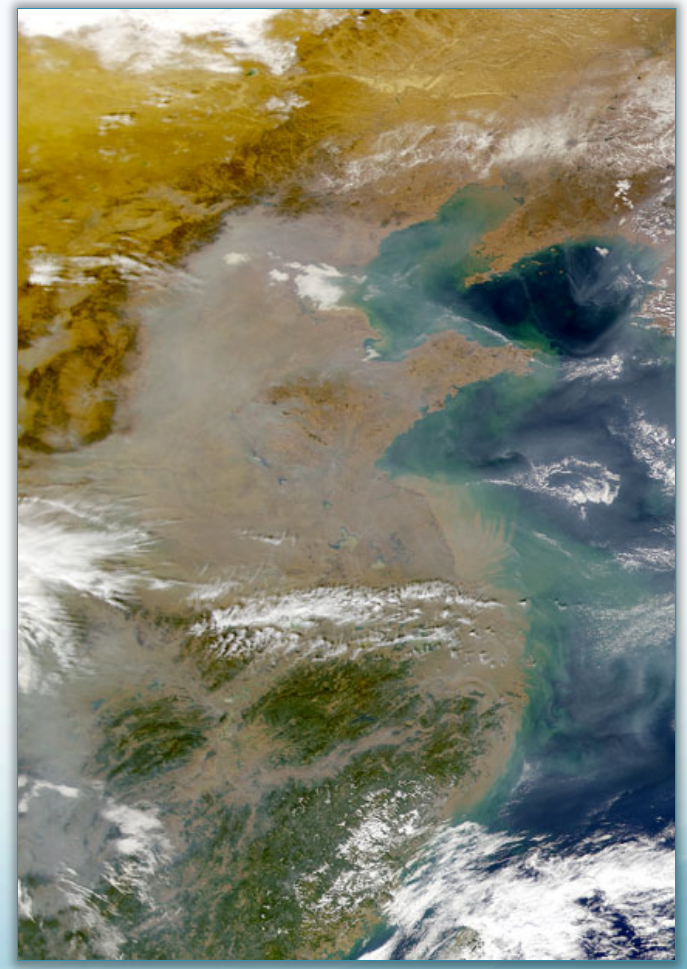
Who am I?

- 2011 Colorado College graduate
- Environmental Science major, French minor

Purpose of Research

- Identify pollution from Asia without local contamination

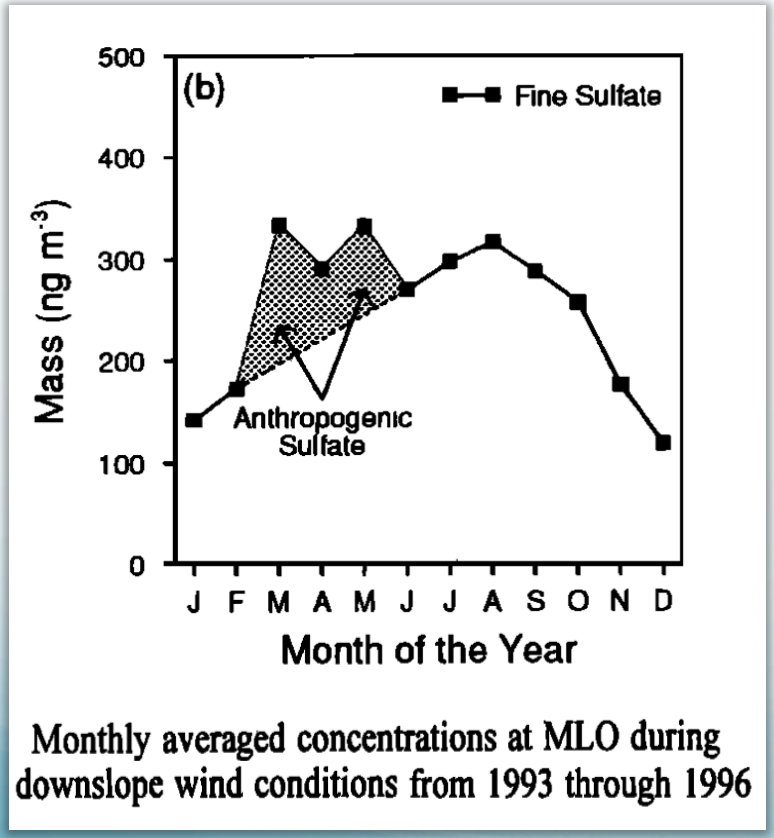




http://newswatch-media.nationalgeographic.com/files/2009/08/china-pollution-picture.jpg

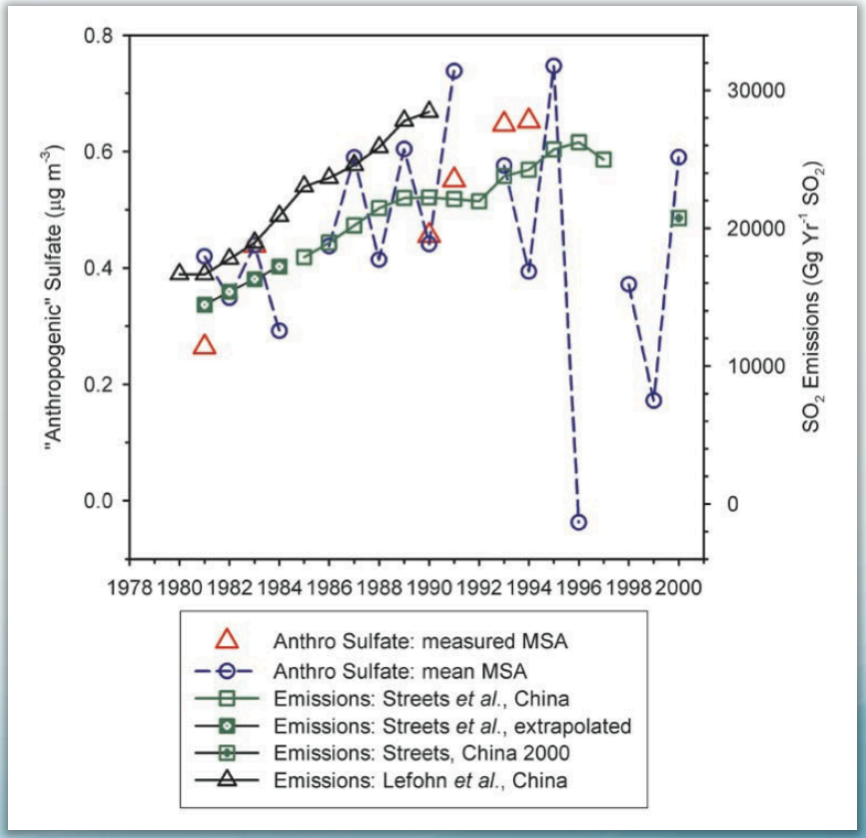
Previous Research

- Perry et al., 1999
  - MLO



Monthly averaged concentrations at MLO during downslope wind conditions from 1993 through 1996

- Prospero et al., 2003
  - Midway Island



Data Sets

- MLO Data (3.4 km asl)
  - **University of Hawaii**
    - **1989-2009**
  - IMPROVE MALO2
    - 1995-2000
- Other Hawaii Data
  - IMPROVE HACR1 (2.16 km)
    - 2007-2010
  - IMPROVE HALE1 (1.15 km)
    - 1991-2010
  - IMPROVE HAVO1 (1.26 km)
    - 1988-2010

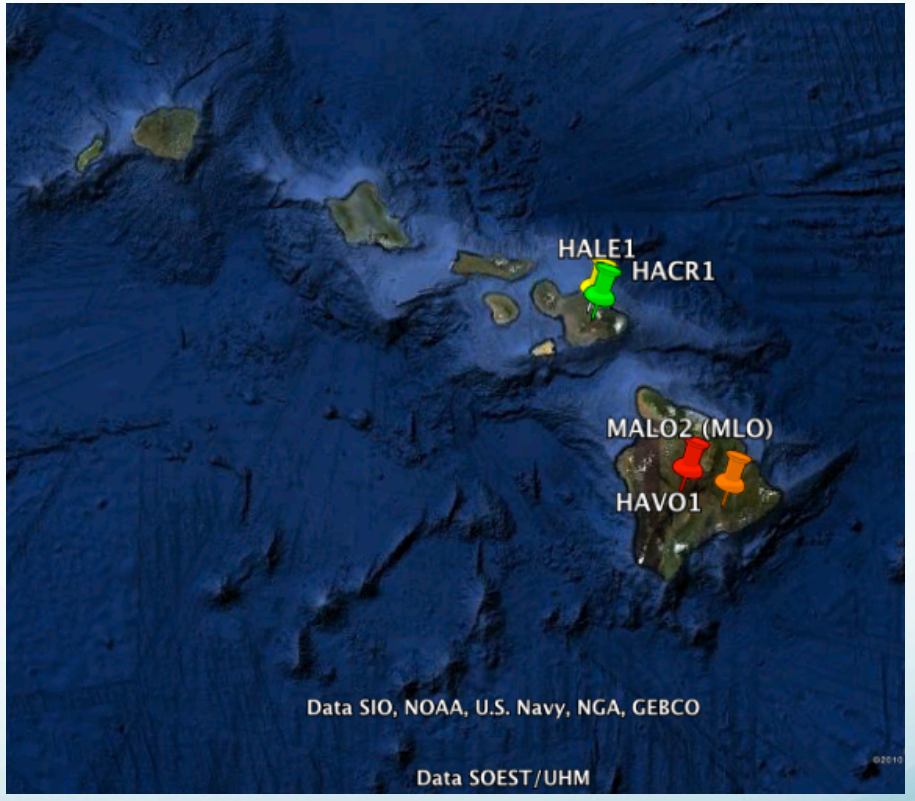
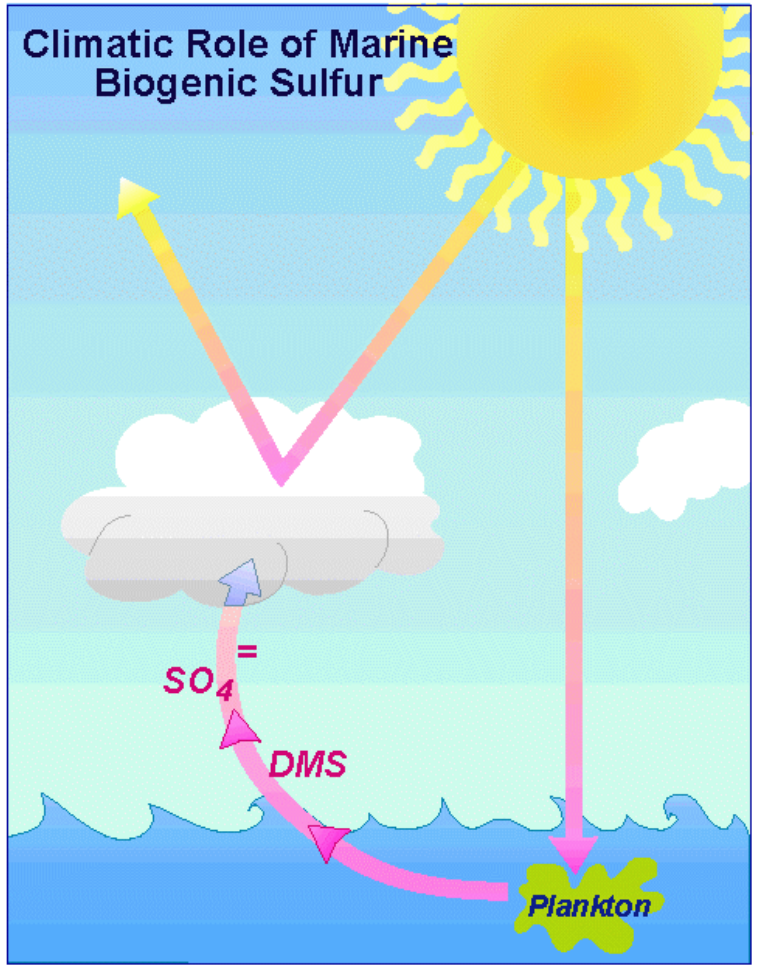


Image: Google Earth

Identifying Asian Pollution



http://oceanmotion.org/images/background/role-big.gif

- Sulfate (SO_4^{2-}) may be a good representative of pollution
  - SO_2 emissions result in the production of SO_4^{2-} aerosols
  - Other sources of SO_4^{2-} as well (e.g. DMS, sea salt)
- Necessary to trace source of SO_4^{2-}
  - Dust may be a good tracer of certain transport pathways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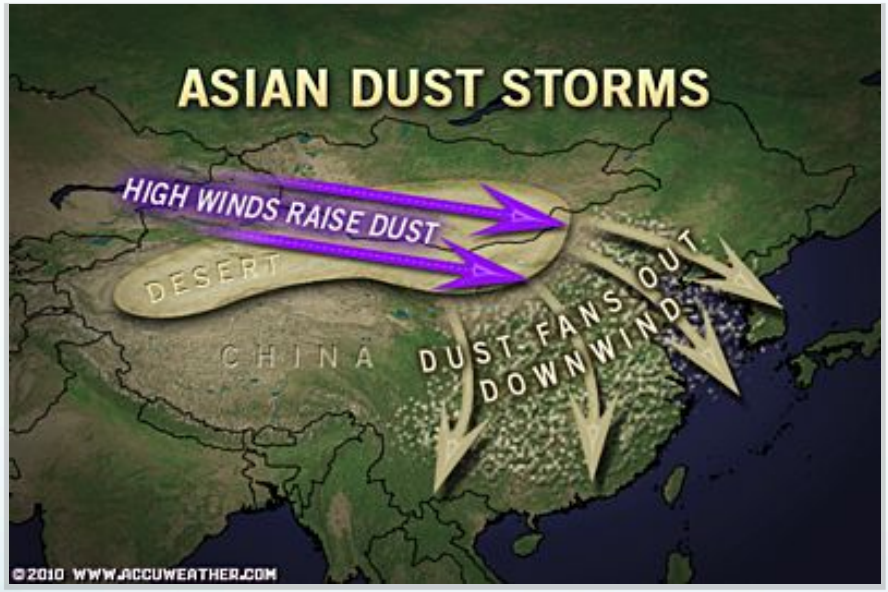
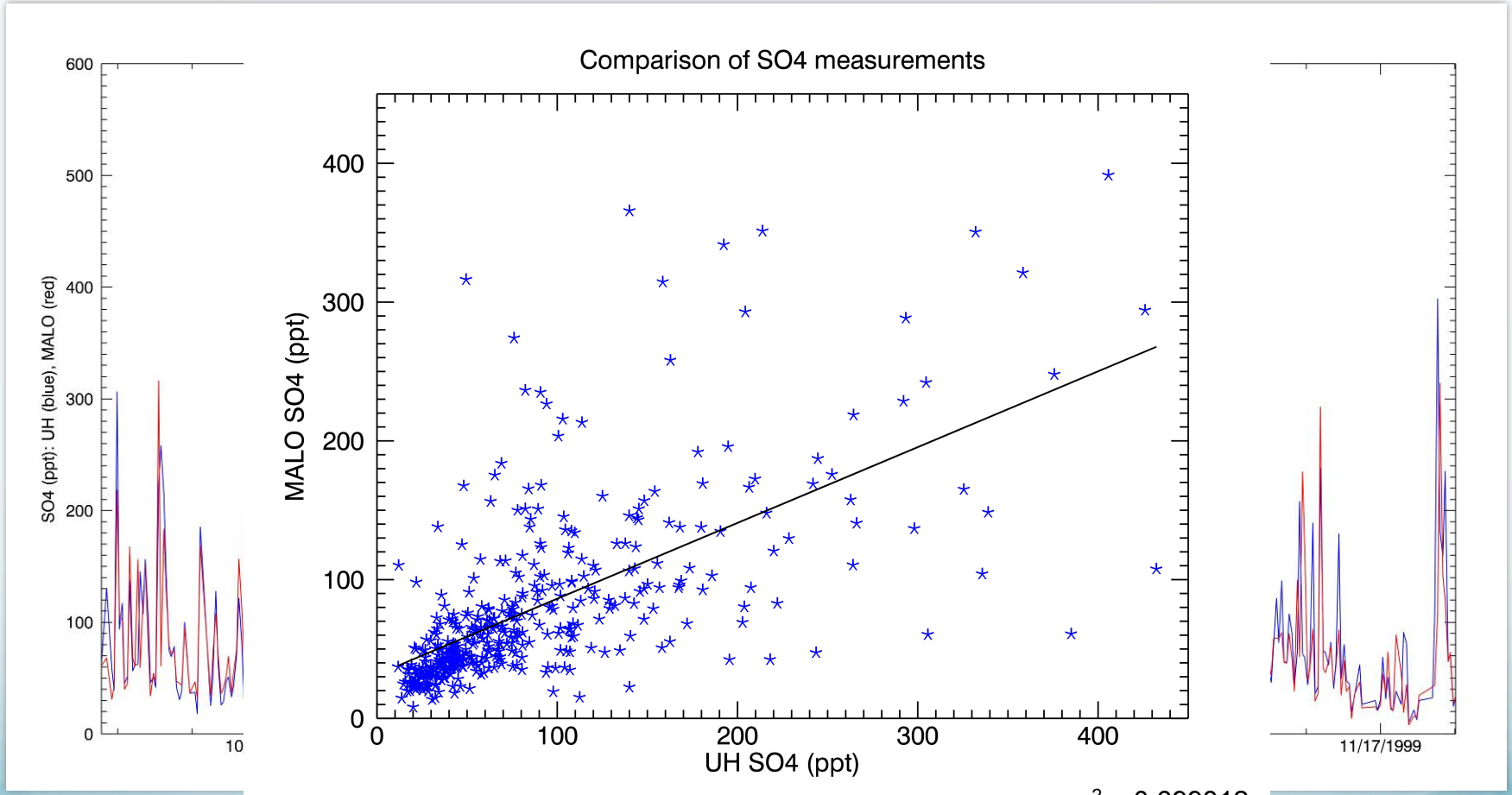
http://i.dailymail.co.uk/i/pix/2010/05/31/article-1282835-09D4DC72000005DC-787_964x621.jpg

Asian Dust


ASIAN DUST STORMS
HIGH WINDS RAISE DUST
DESERT
CHINA
DUST FANS OUT DOWNWIND
©2010 WWW.ACCUWEATHER.COM

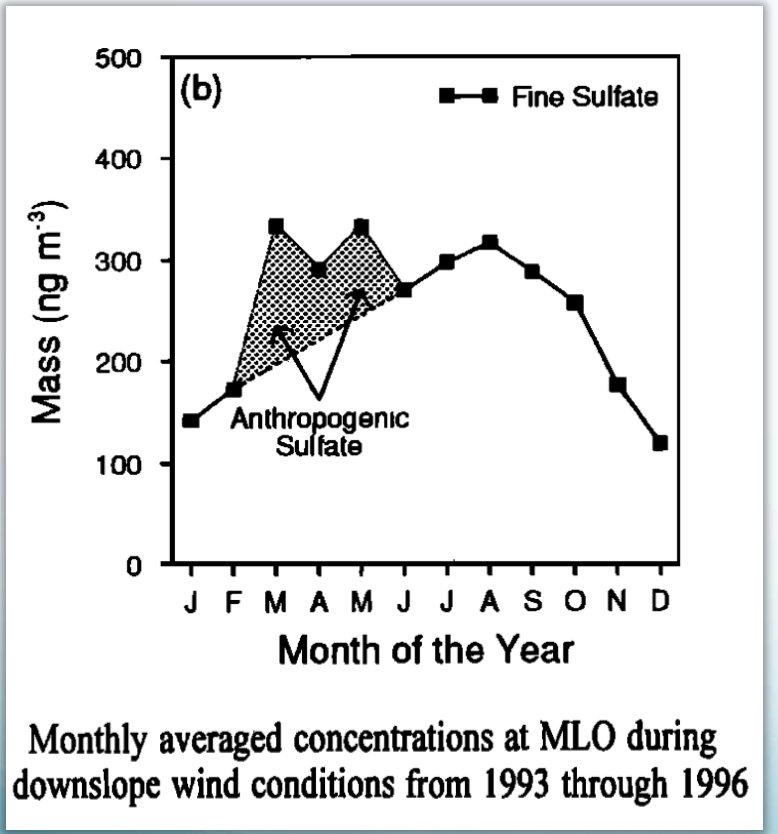
Verifying the UH Data

Comparing UH and MALO



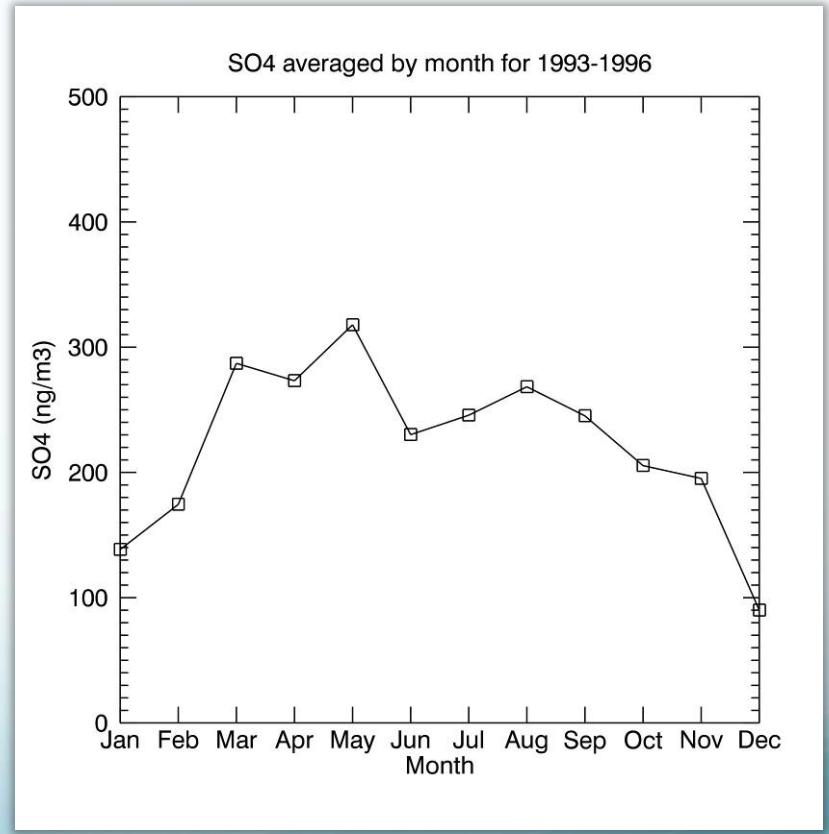
Comparing data to Perry et al.

Figure 5(b) from Perry et al., 1999



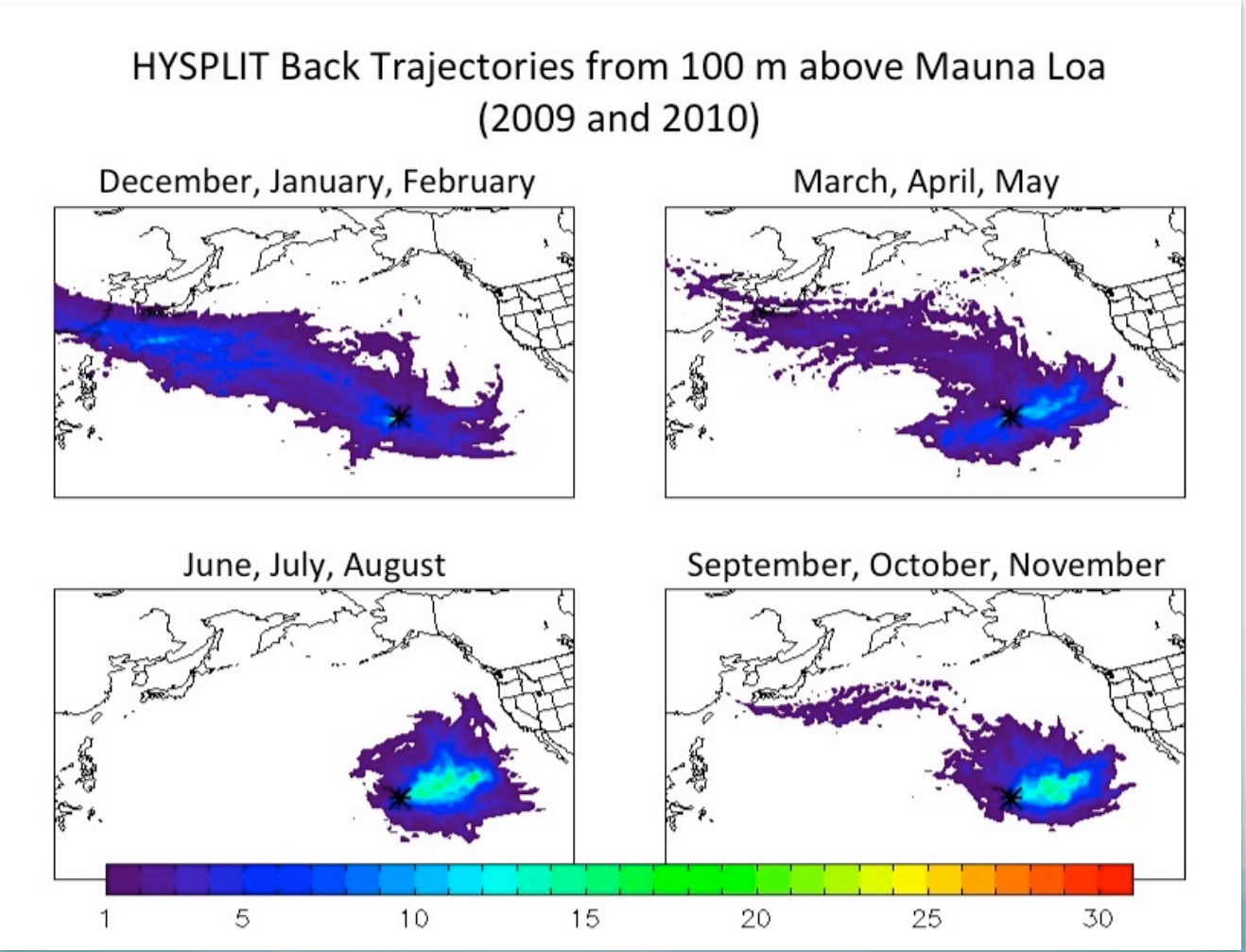
Monthly averaged concentrations at MLO during downslope wind conditions from 1993 through 1996

Recreated figure with University of Hawaii data

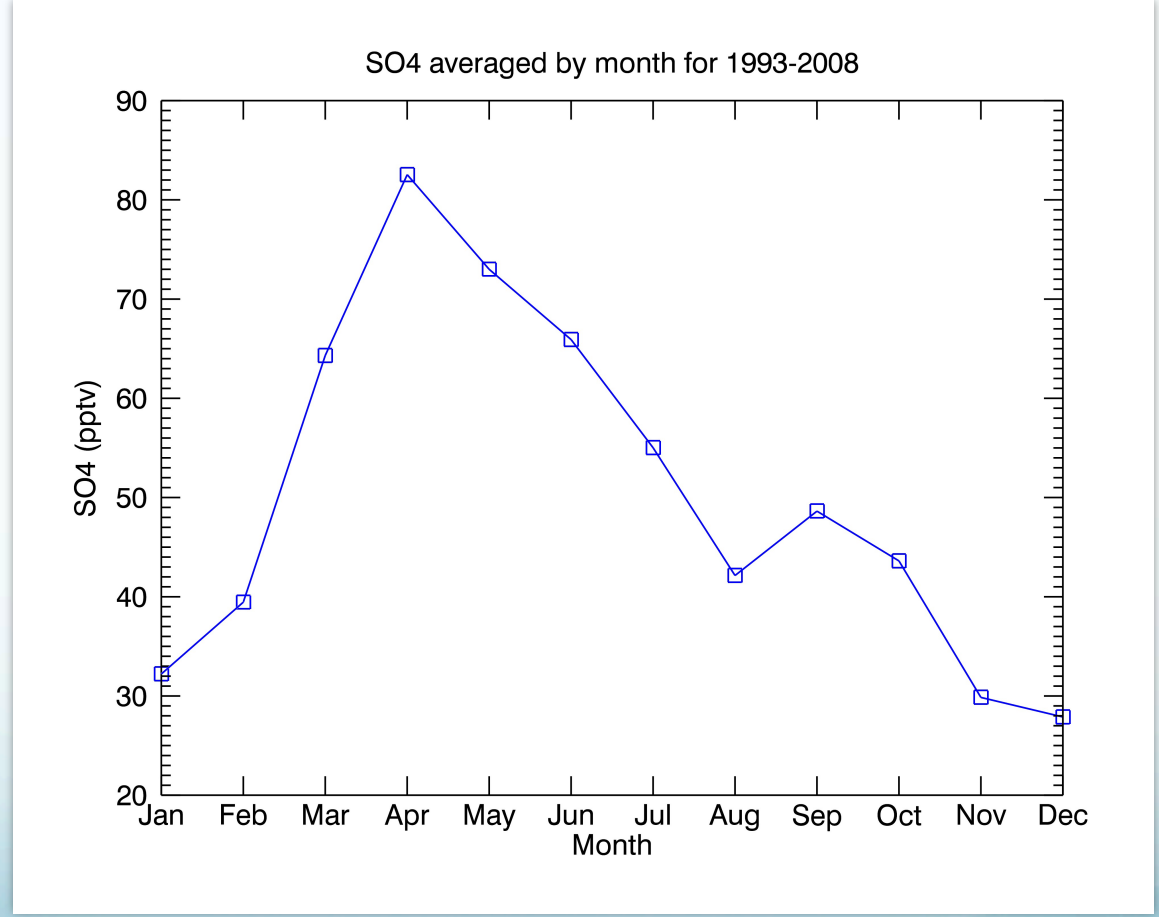


Analysis of UH Data

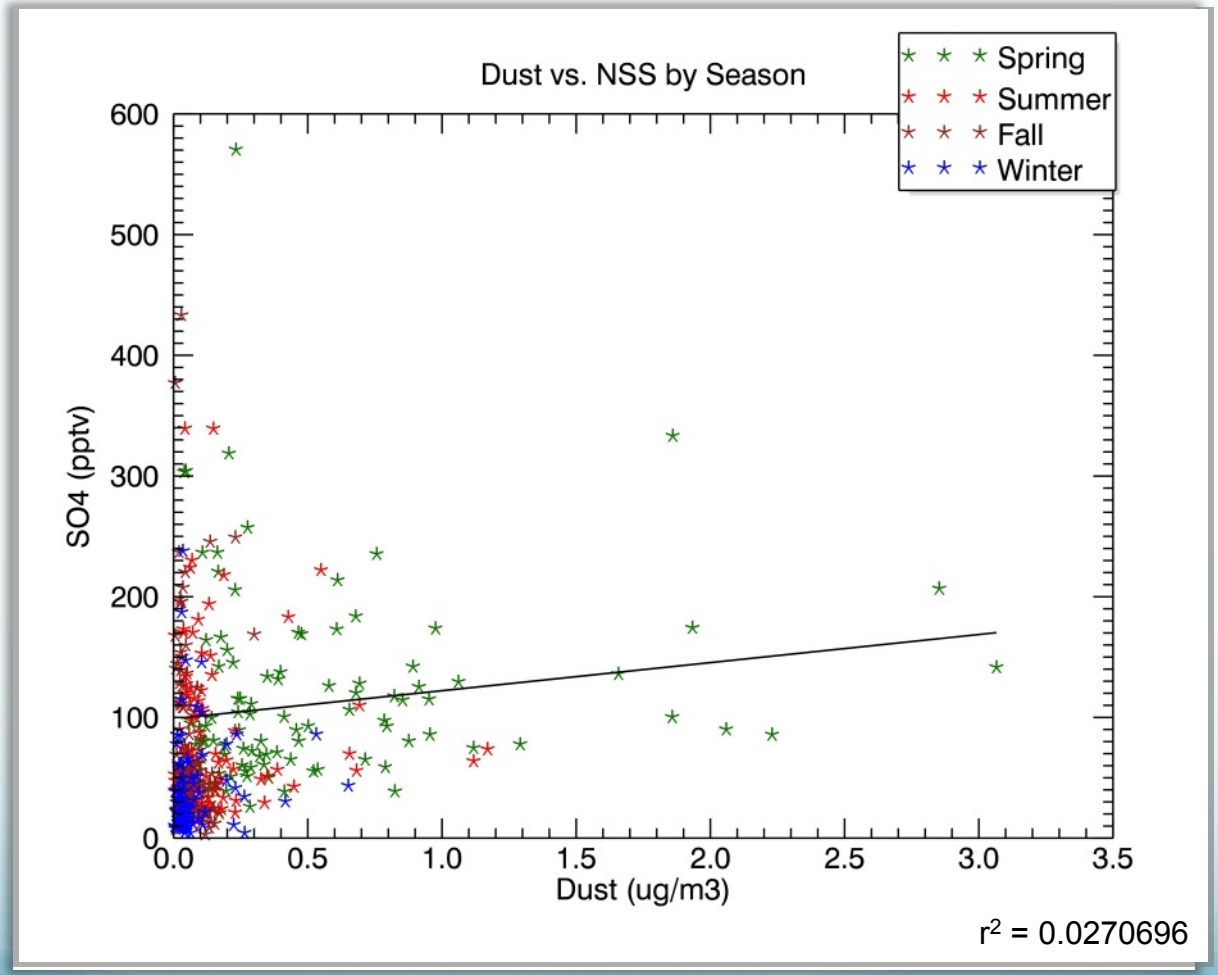
Transport from Asia



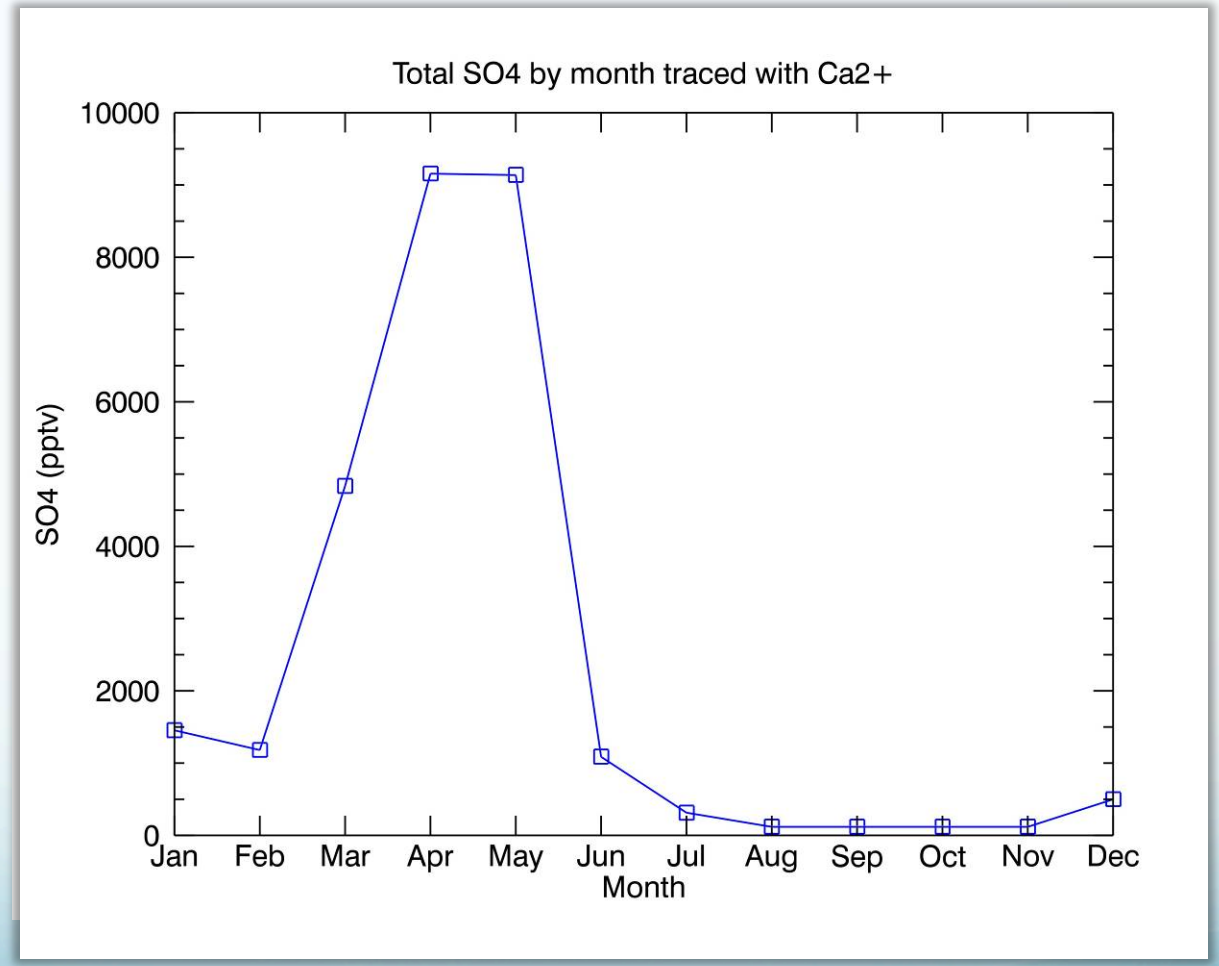
Seasonal Variability



Using dust as an indicator



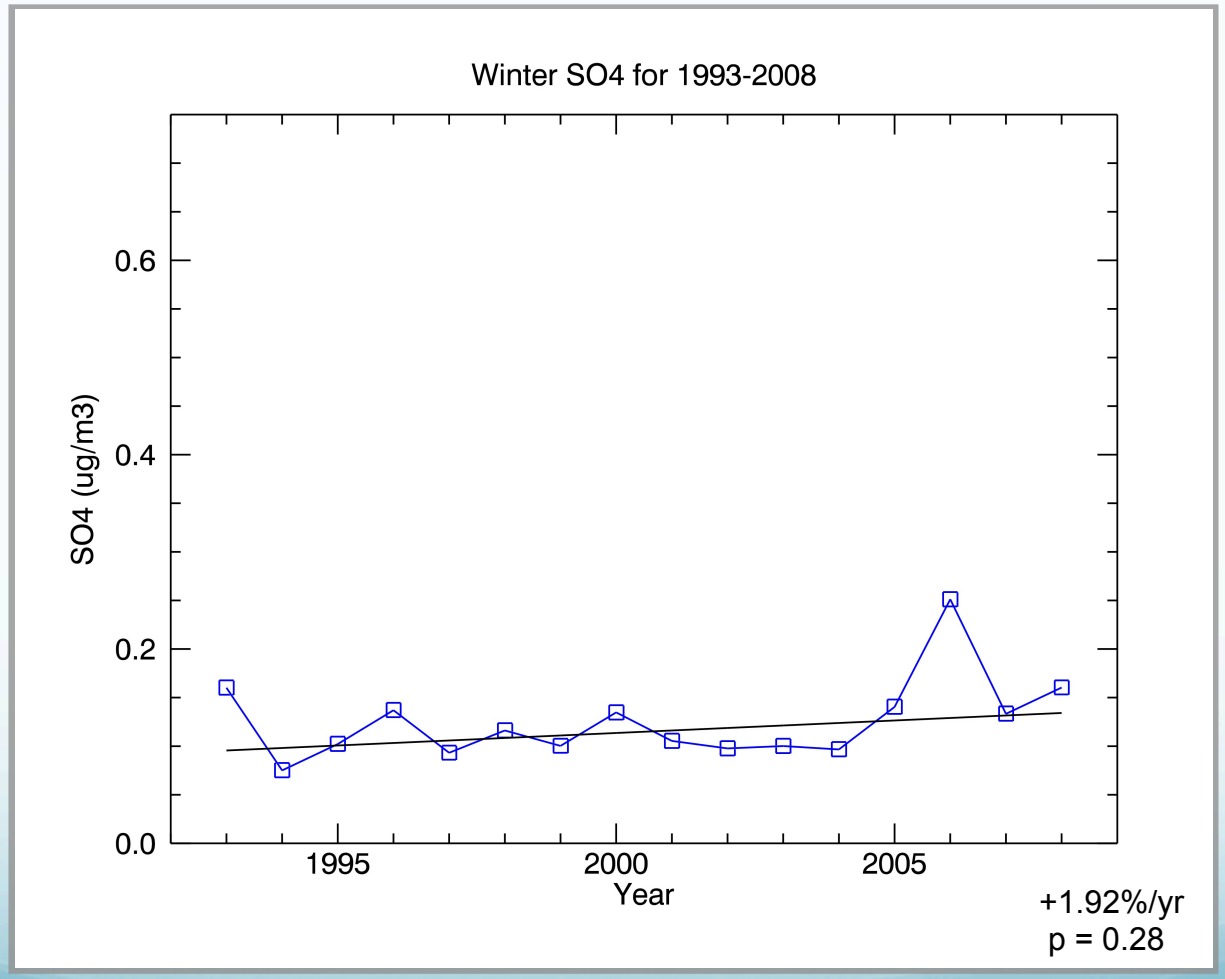
Comparing Ca^{2+} and SO_4^{2-}



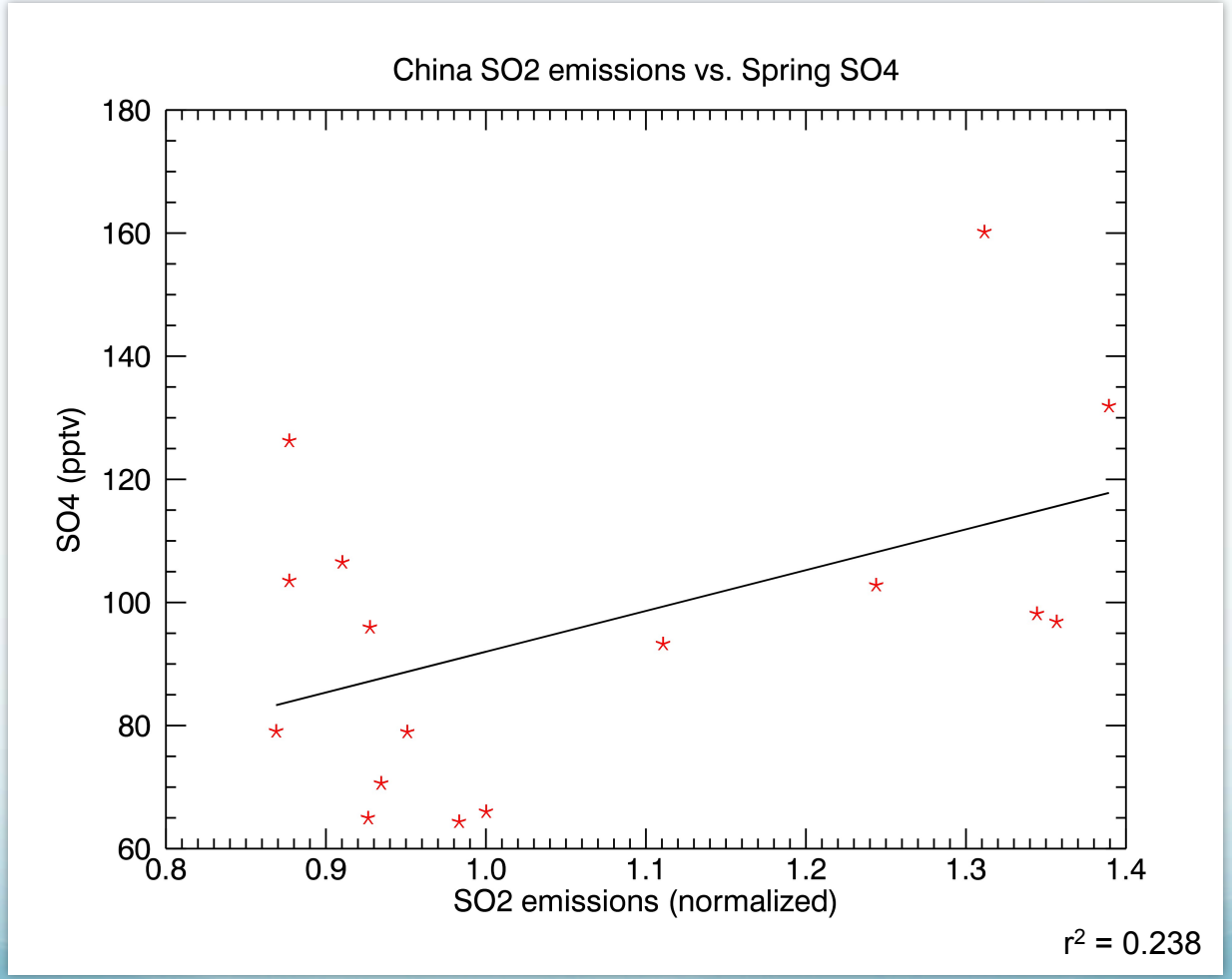
Quick Recap

- Major dust transport occurs in the spring
- High levels of dust are linearly related to SO_4^{2-}
- The SO_4^{2-} measurements that are related to high levels of dust were recorded primarily in the spring (and some in winter)
- Moral of the story:
  - Should focus on **spring** and **winter**

Trends in SO_4^{2-} over time



SO_2 vs. SO_4^{2-}


China SO2 emissions vs. Spring SO4
SO4 (pptv)
180
160
140
120
100
80
60
0.8
0.9
1.0
1.1
1.2
1.3
1.4
SO2 emissions (normalized)
r2 = 0.238

Conclusions

- There does seem to be a perceptible Asian signature in SO_4^{2-}
  - Although the spring is a major time for transport, some winter transport also occurs
- Spring SO_4^{2-} has been significantly increasing at Mauna Loa since 1993
  - This is likely related to increasing SO_2 emissions from China

Acknowledgements

- Barry Huebert and Steve Howell, University of Hawaii
- IMPROVE
- Lu et al., 2010; Lu and Streets, 2011
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Questions?