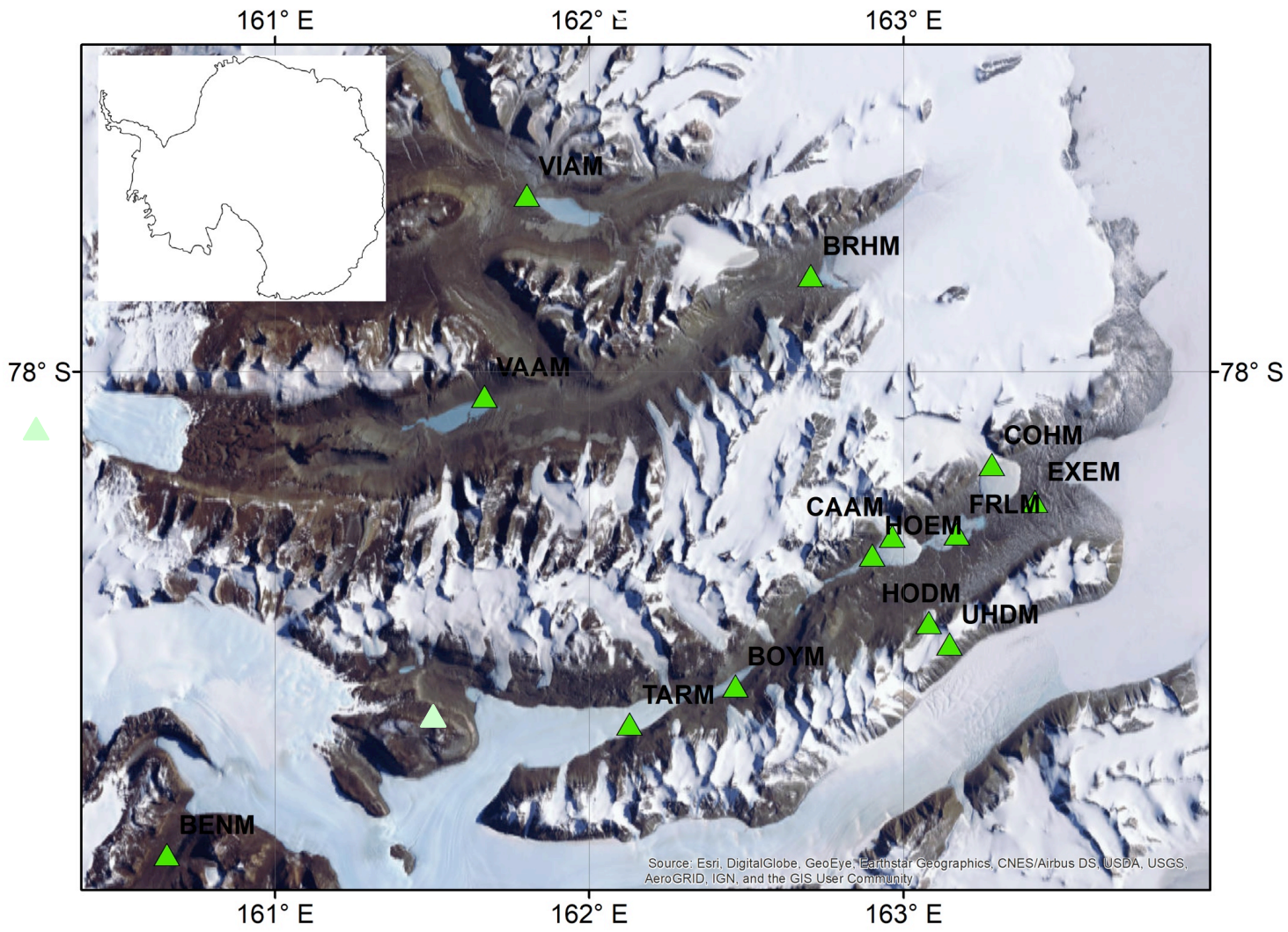
Climate update from the McMurdo Dry Valleys Long Term Ecological Research project:

Surface air temperature and solar radiation trends

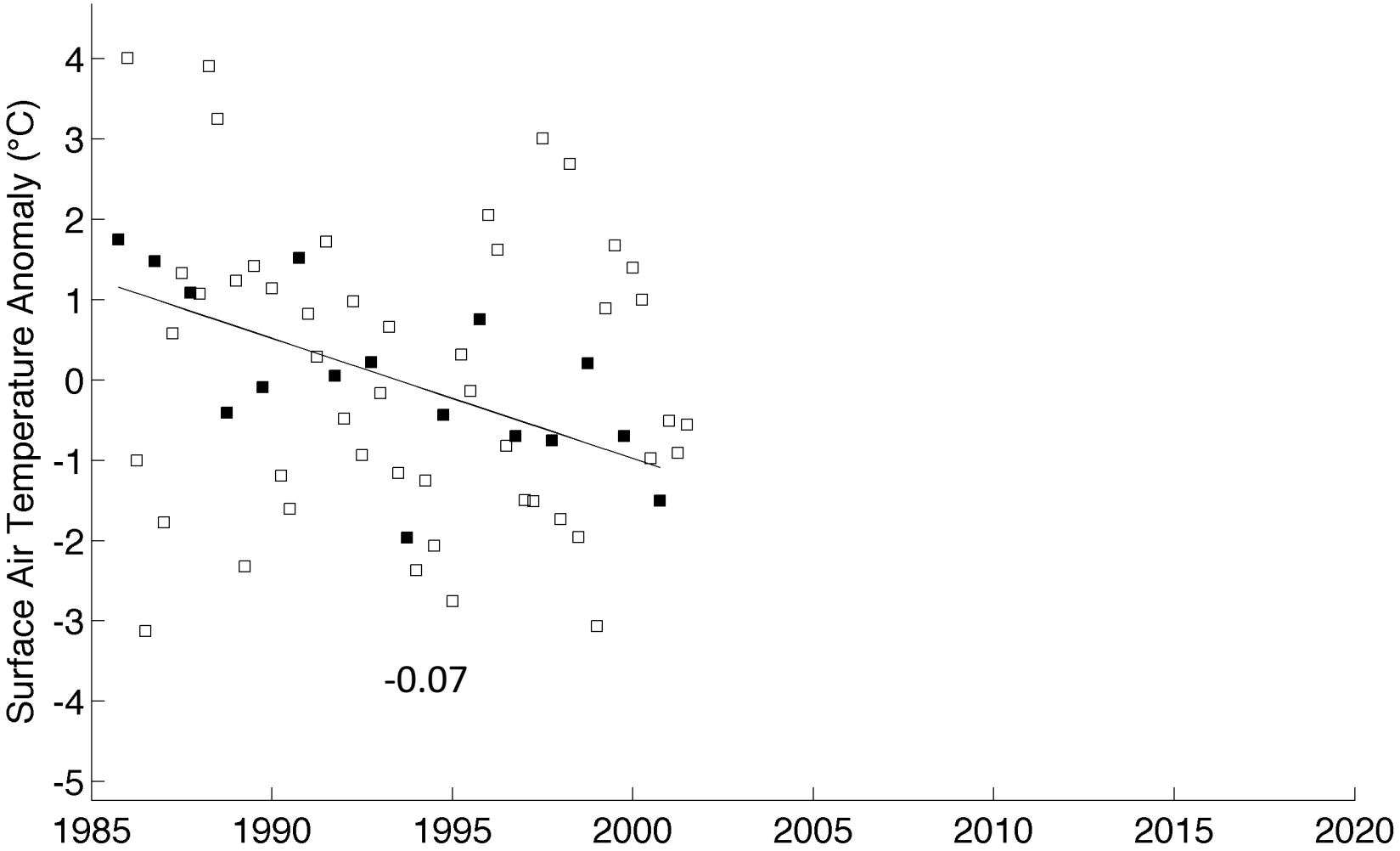
Maciej Obryk, Andrew Fountain, Peter Doran, Luke Winslow

MDVs LTER met station network



- Surface air temperature (Obryk et al., in prep)
  - Temperature anomaly
  - Seasonal trends
  - Trend shift – pivot year
- Solar radiation (Obryk et al., 2018)
  - Drivers explained
  - Global dimming and brightening
  - Sulfate aerosols
  - Local minima and maxima explained

Temperature anomaly at Lake Hoare



Doran et al., 2002

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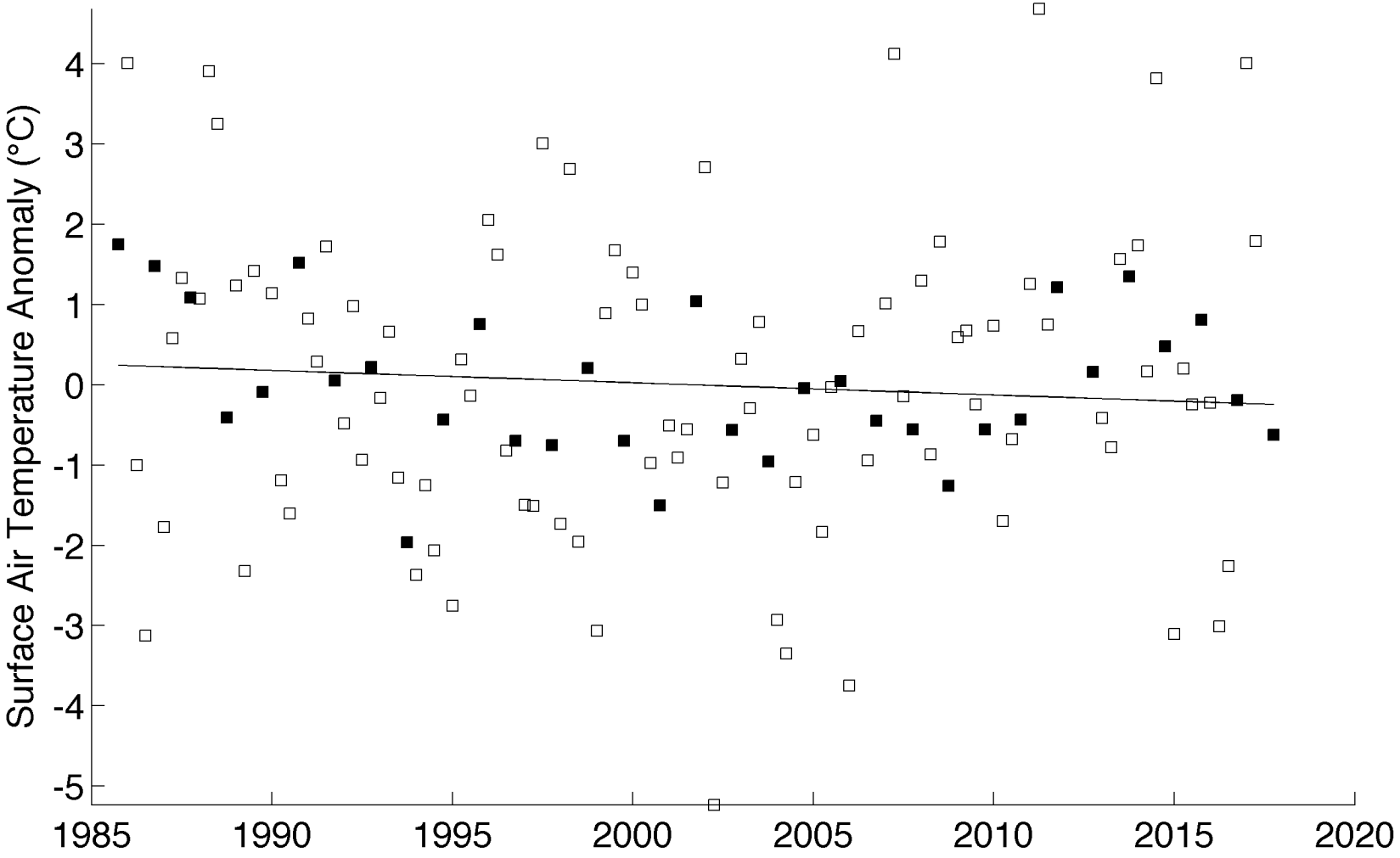
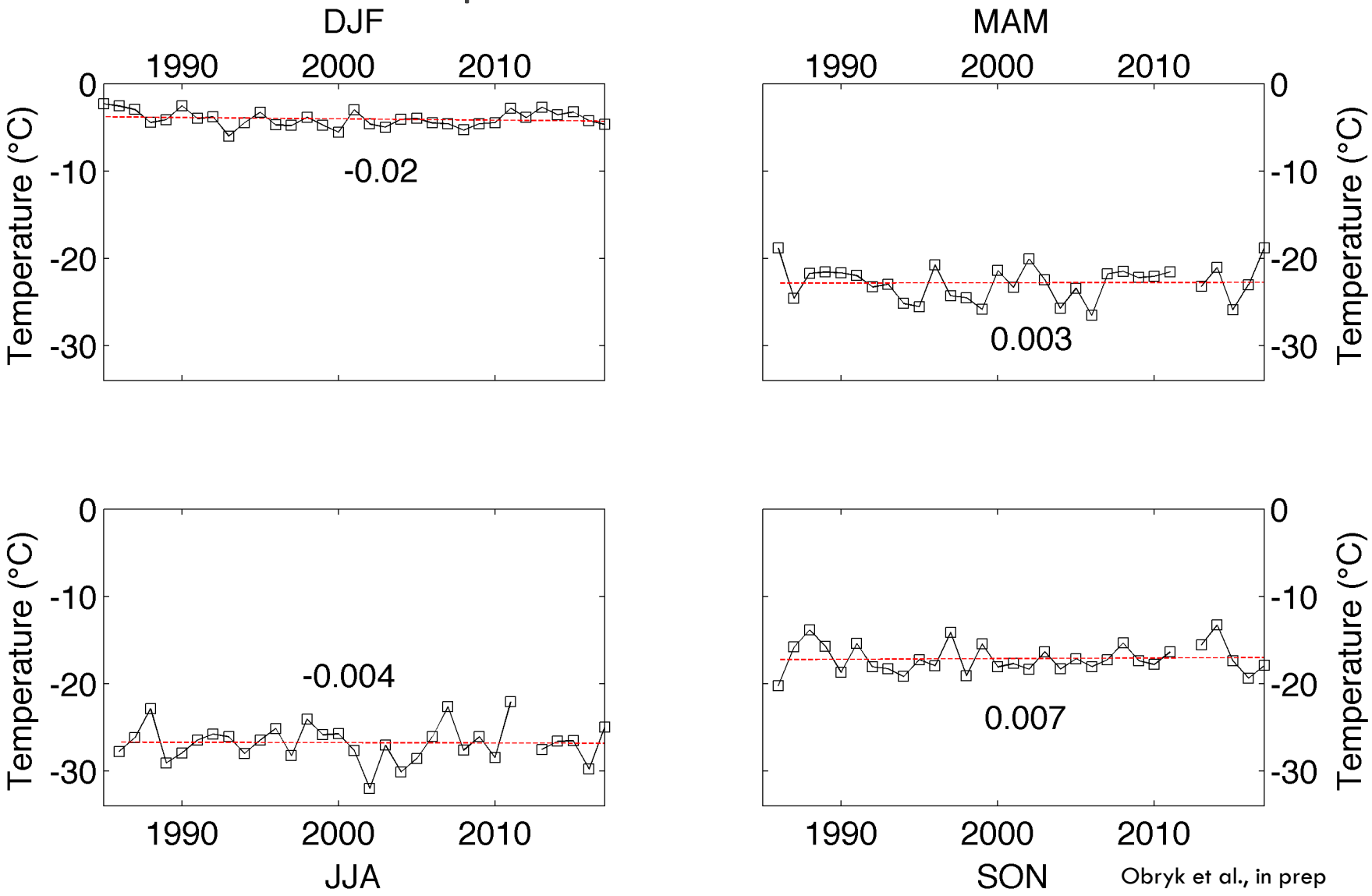


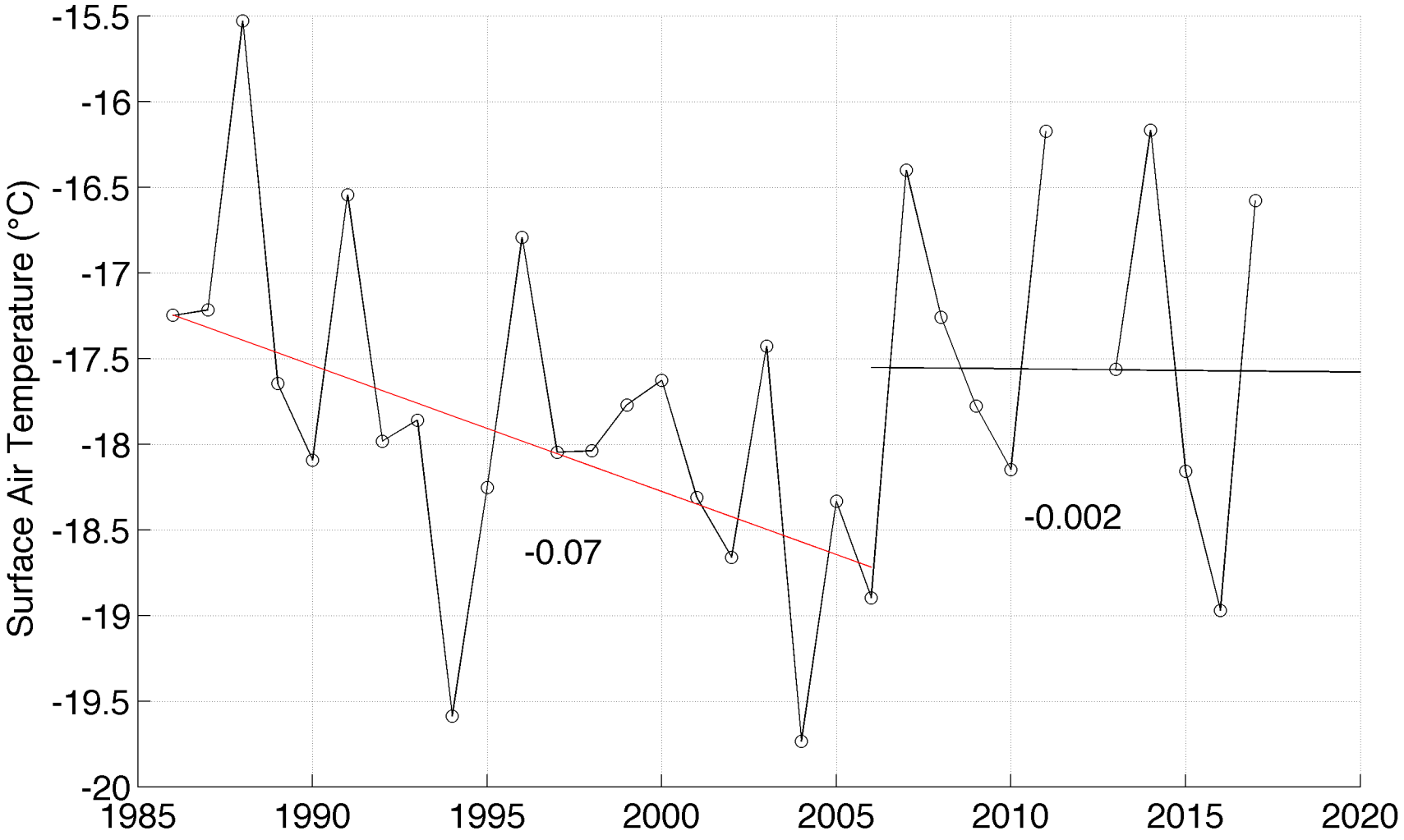
Obryk et al., in prep

Seasonal Temperature trends at Lake Hoare



Obryk et al., in prep

Annual temperature trends at Lake Hoare Pettitt and modified Mann-Kendall statistics



Obryk et al., in prep

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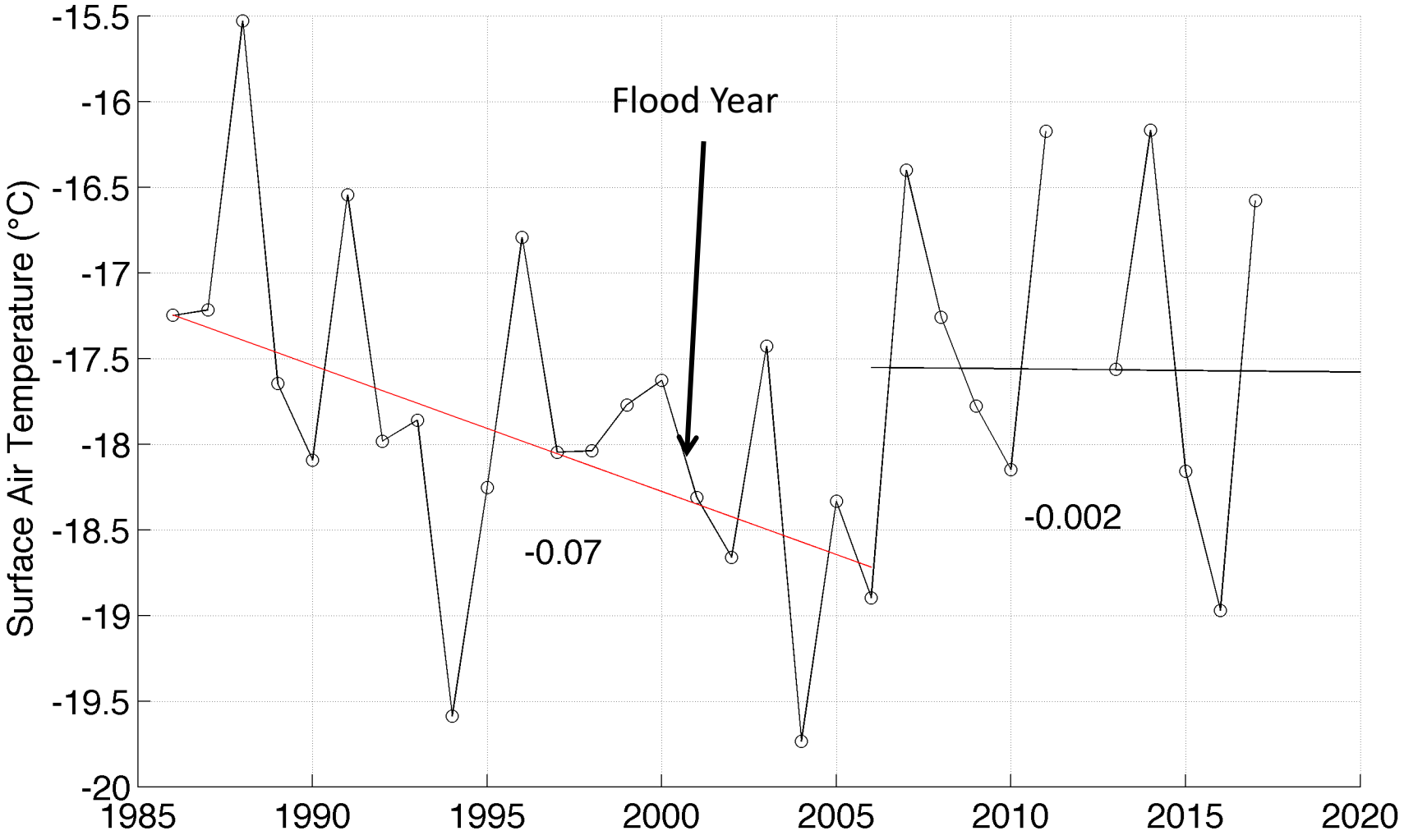

Obryk et al., in prep

Temperature pivot year across MDV – Pettitt stats

	Station code	Station name	Pivot year	p value
Taylor Valley	EXEM	Explorer's Cove	2004	0.22
Taylor Valley	FRLM	Lake Fryxell	2006	0.09
Taylor Valley	HOEM	Lake Hoare	2006	0.56
Taylor Valley	BOYS	Lake Bonney	2006	0.54
Taylor Valley	TARM	Taylor Glacier	2006	**0.02**
Wright Valley	BRHM	Lake Brownworth	2004	0.08
Wright Valley	VAAM	Lake Vanda	2006	0.13
Victoria Valley	VIAM	Lake Vida	2010	1.45

Obryk et al., in prep

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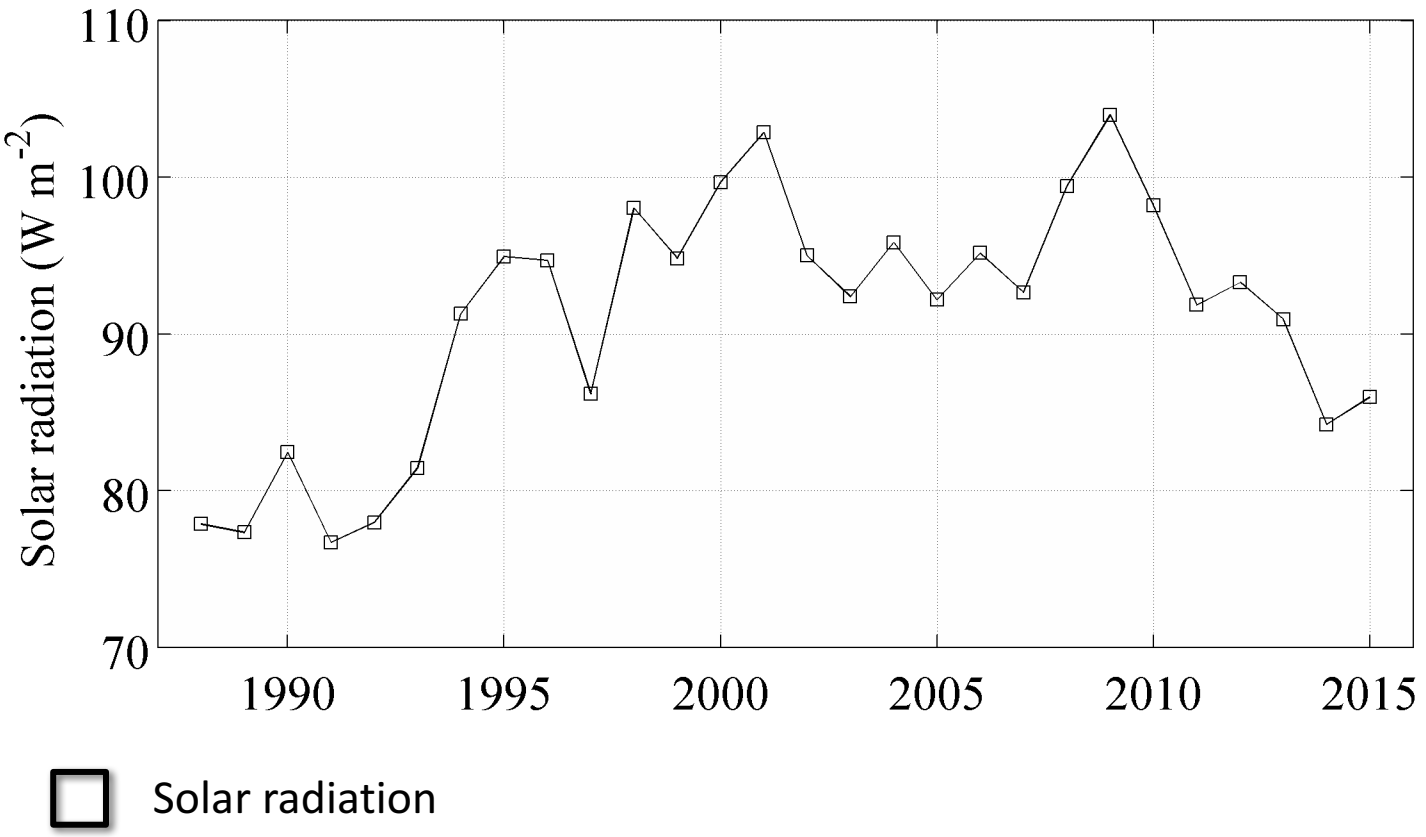
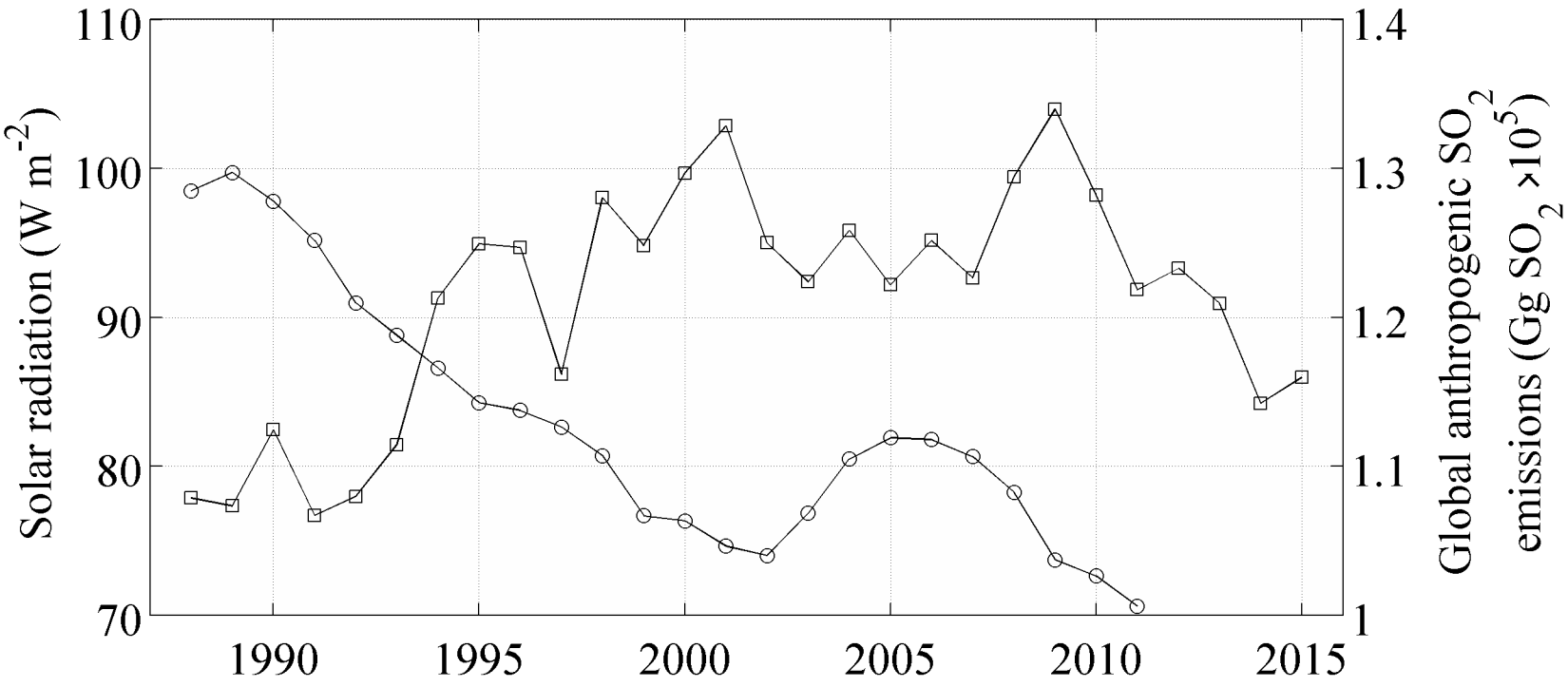
Solar radiation



Obryk et al., 2018

Driver of solar radiation



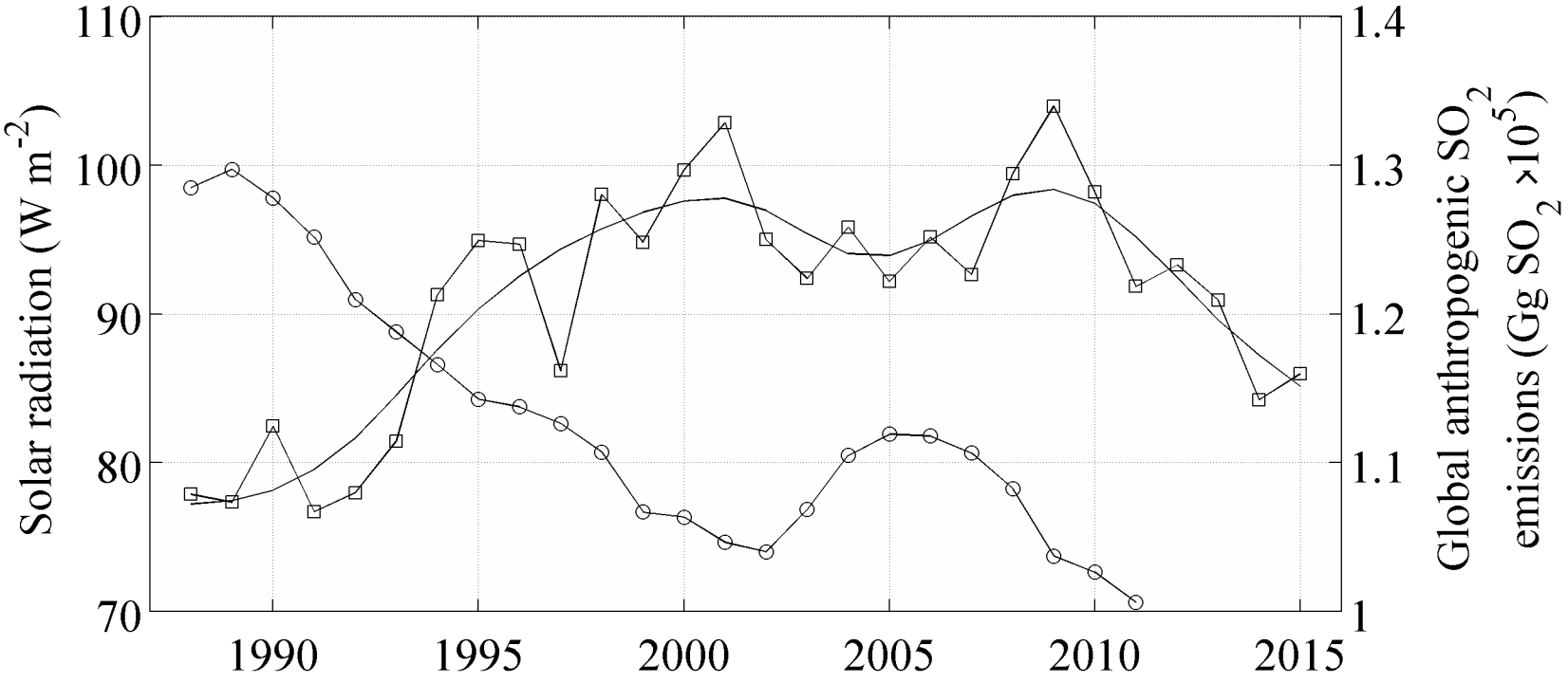
Solar radiation

SO_2 emissions

r = -0.86, p < 0.001

Obryk et al., 2018

Driver of solar radiation



Solar radiation

SO_2 emissions

r = -0.86, p < 0.001

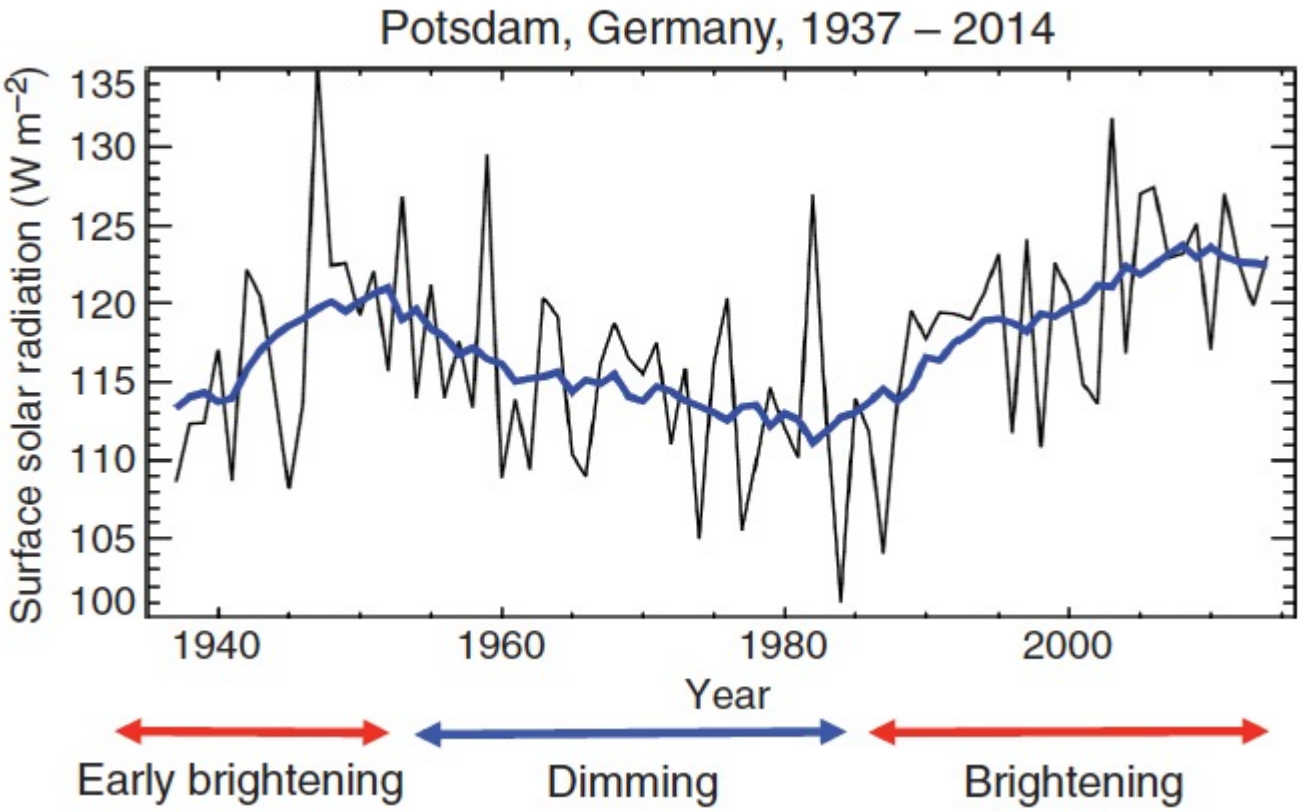
Solar radiation – moving average

SO_2 emissions

r = -0.94, p < 0.001

Obryk et al., 2018

SO_2: global dimming and brightening

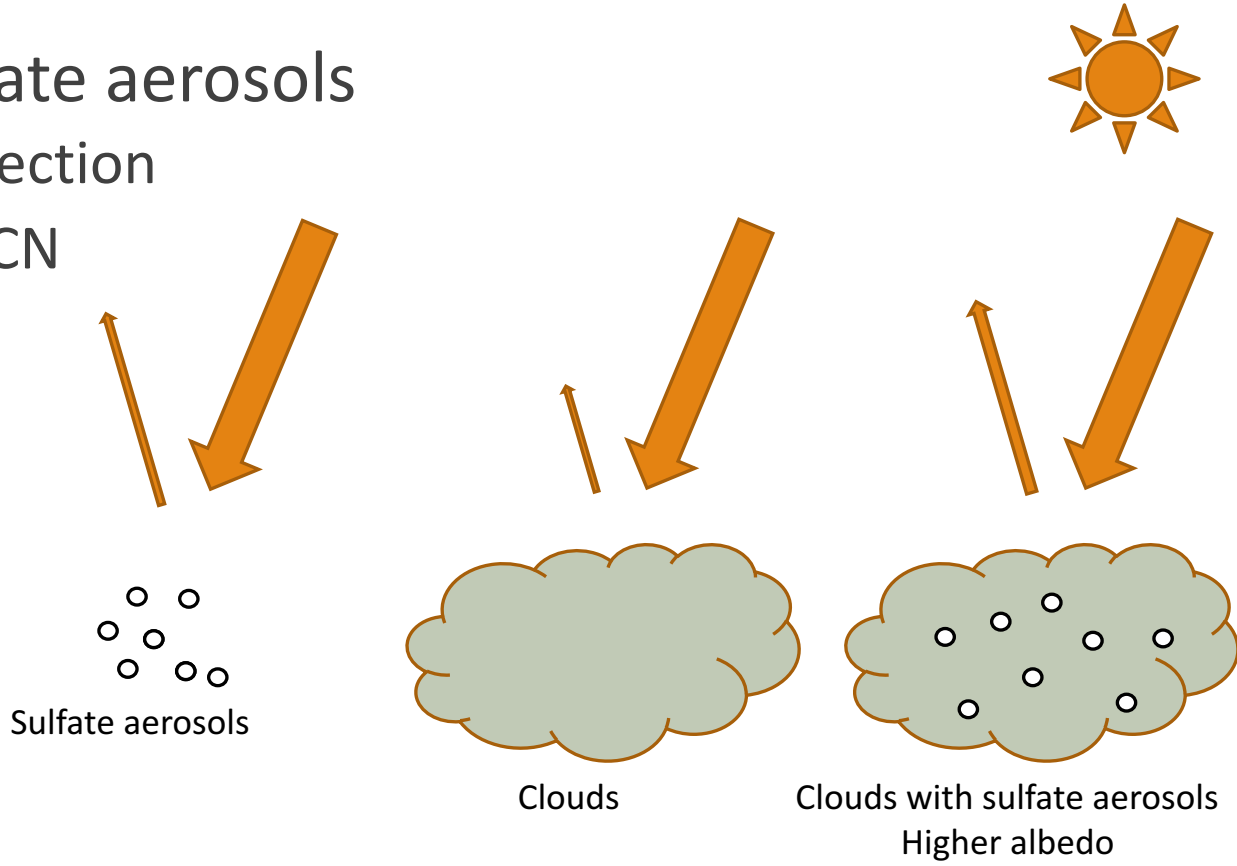


Wild et al

SO_2: global dimming and brightening

Sulfur dioxide -> sulfate aerosols

- Direct influence – reflection
- Indirect influence – CCN



SO_2: global dimming and brightening

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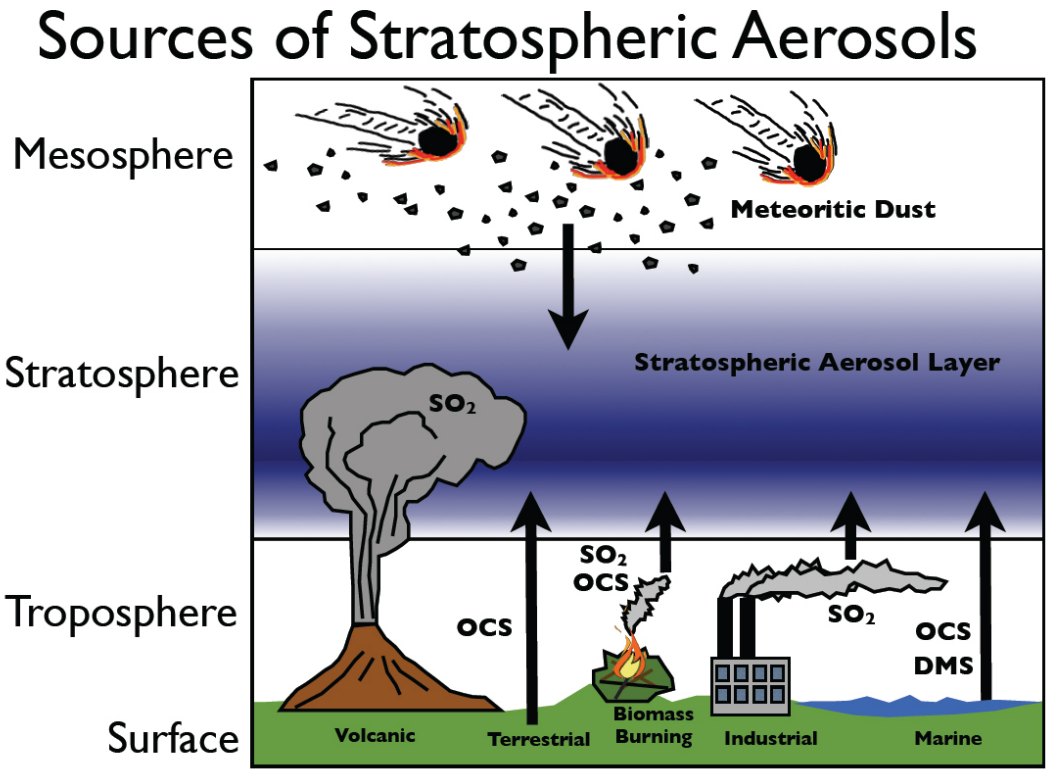
Sources

- Natural
- Anthropogenic



Source: NOAA

SO_2: global dimming and brightening

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Sources

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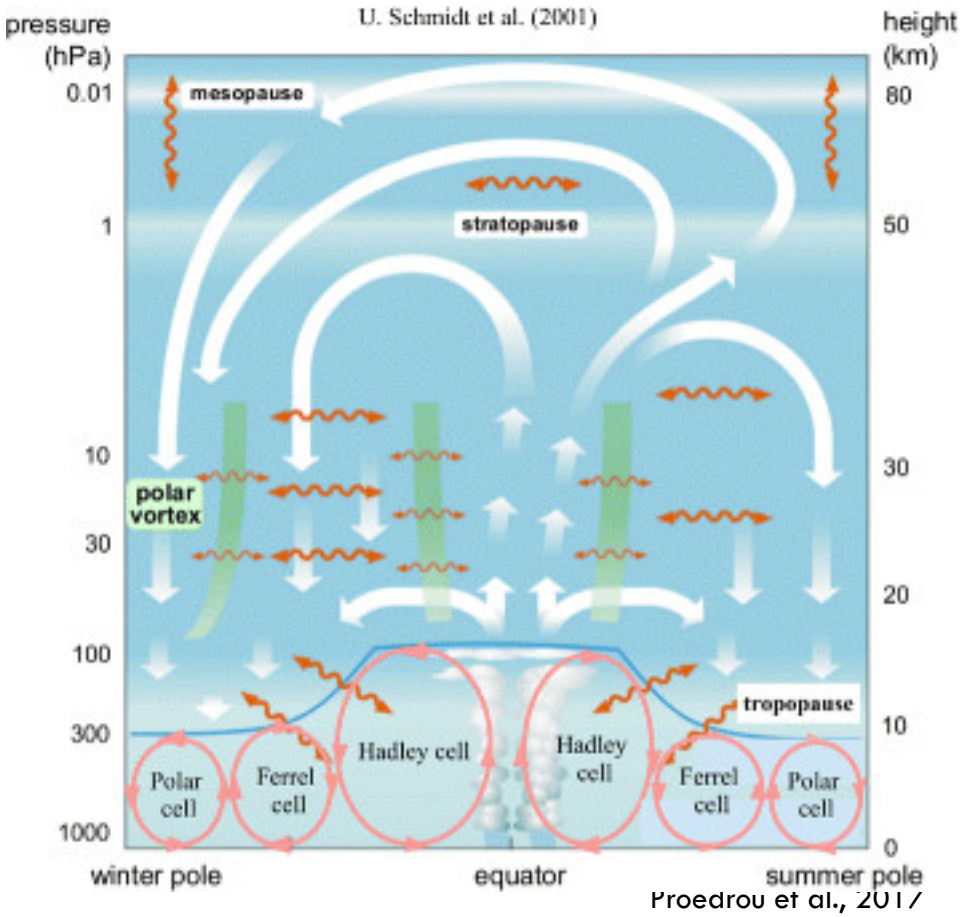
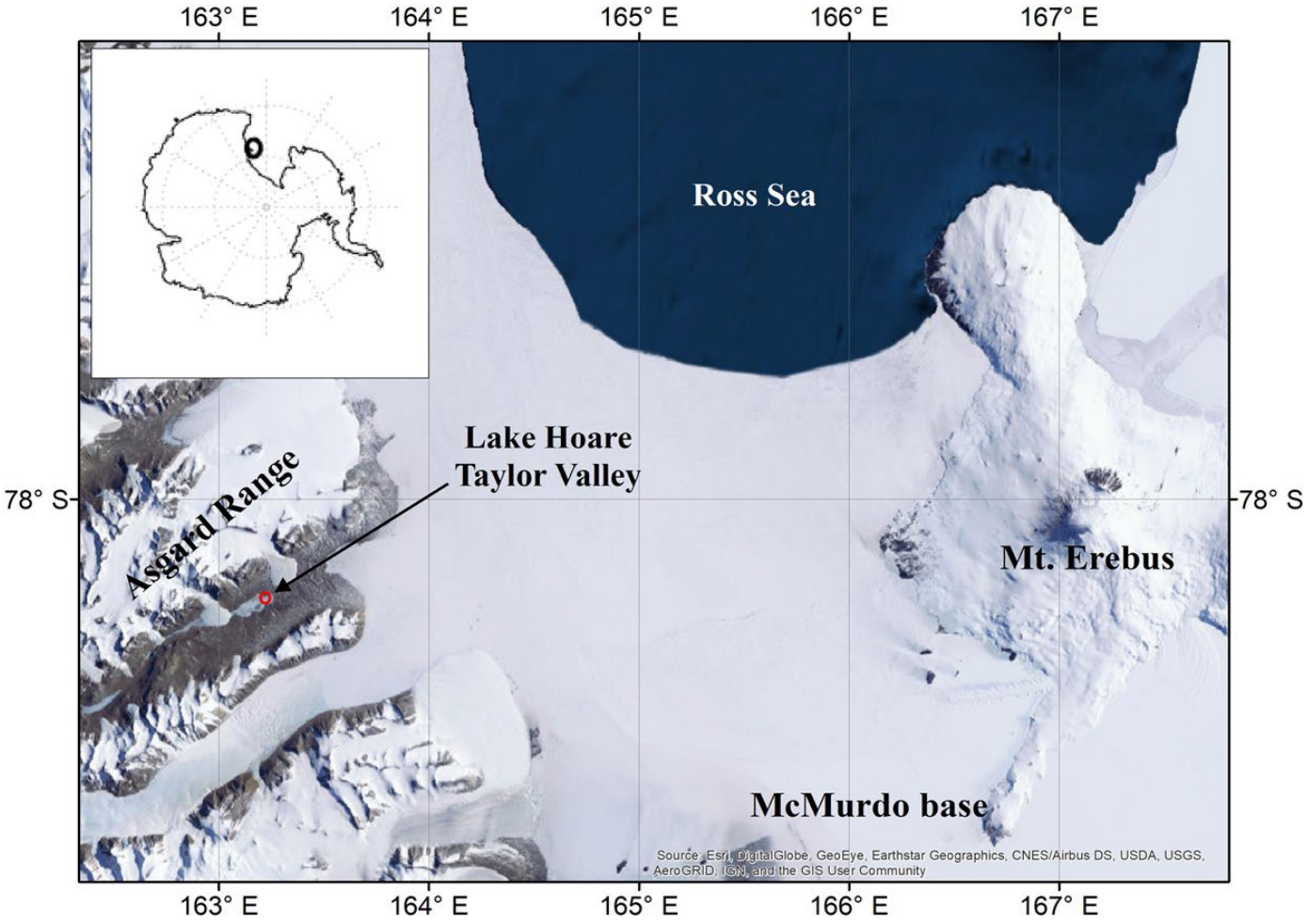
Residence time

- Troposphere – short lived
- Stratosphere – long lived



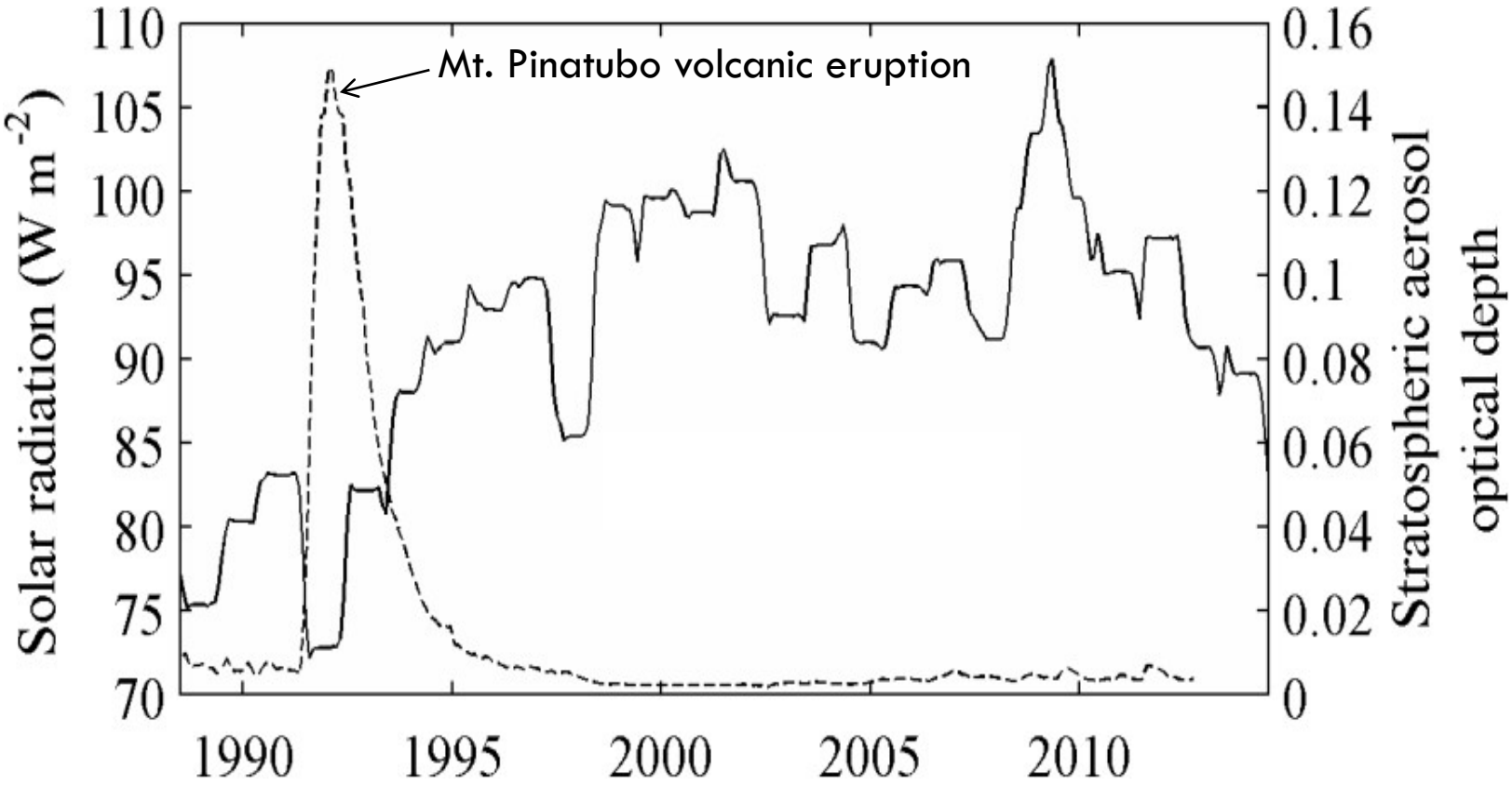
Proedrou et al., 2017

Local SO_2 sources



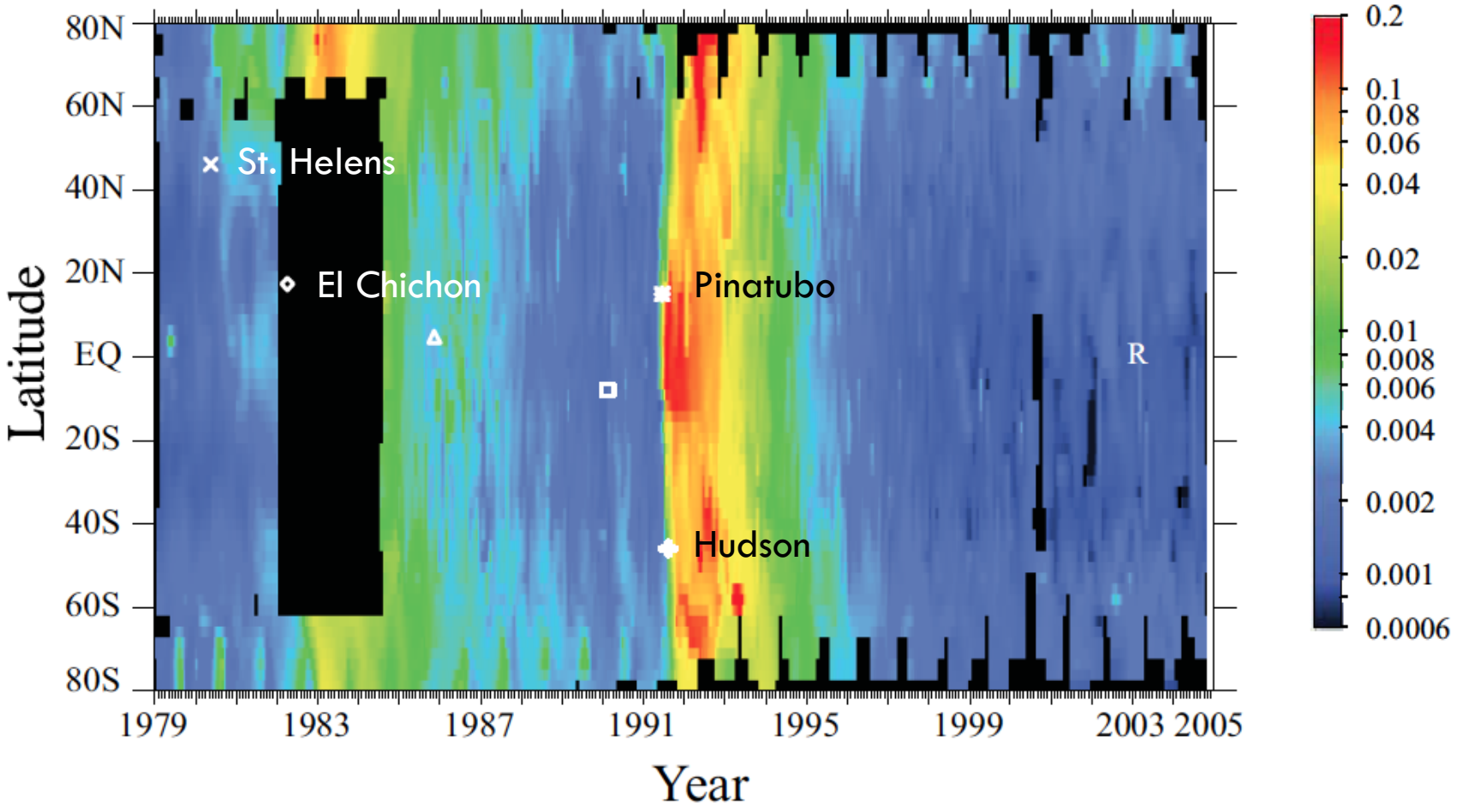
Obryk et al., 2018

Stratospheric Aerosol Optical Depth: Mount Pinatubo



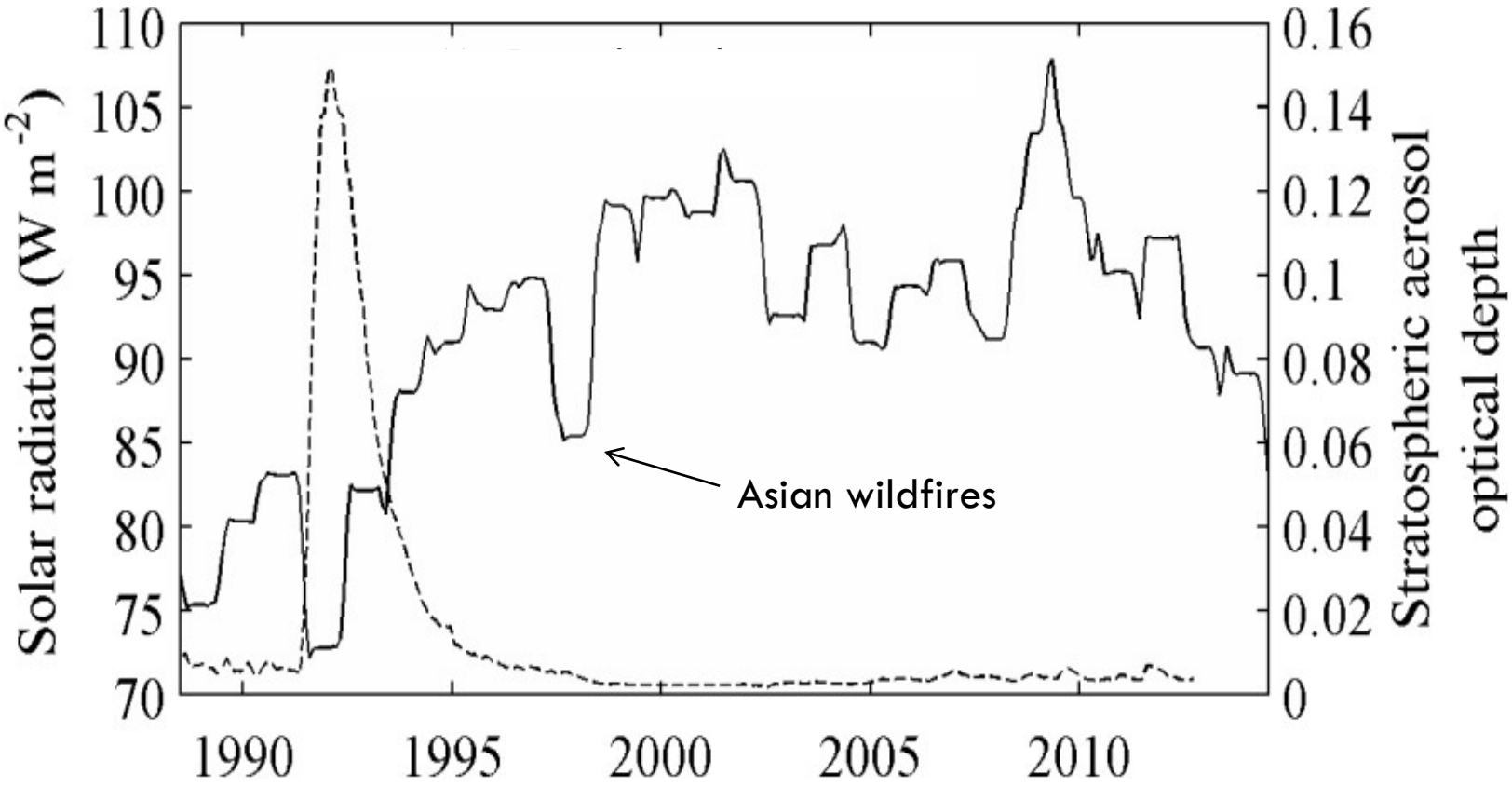
Obryk et al., 2018

Stratospheric Aerosol Optical Depth: global perspective



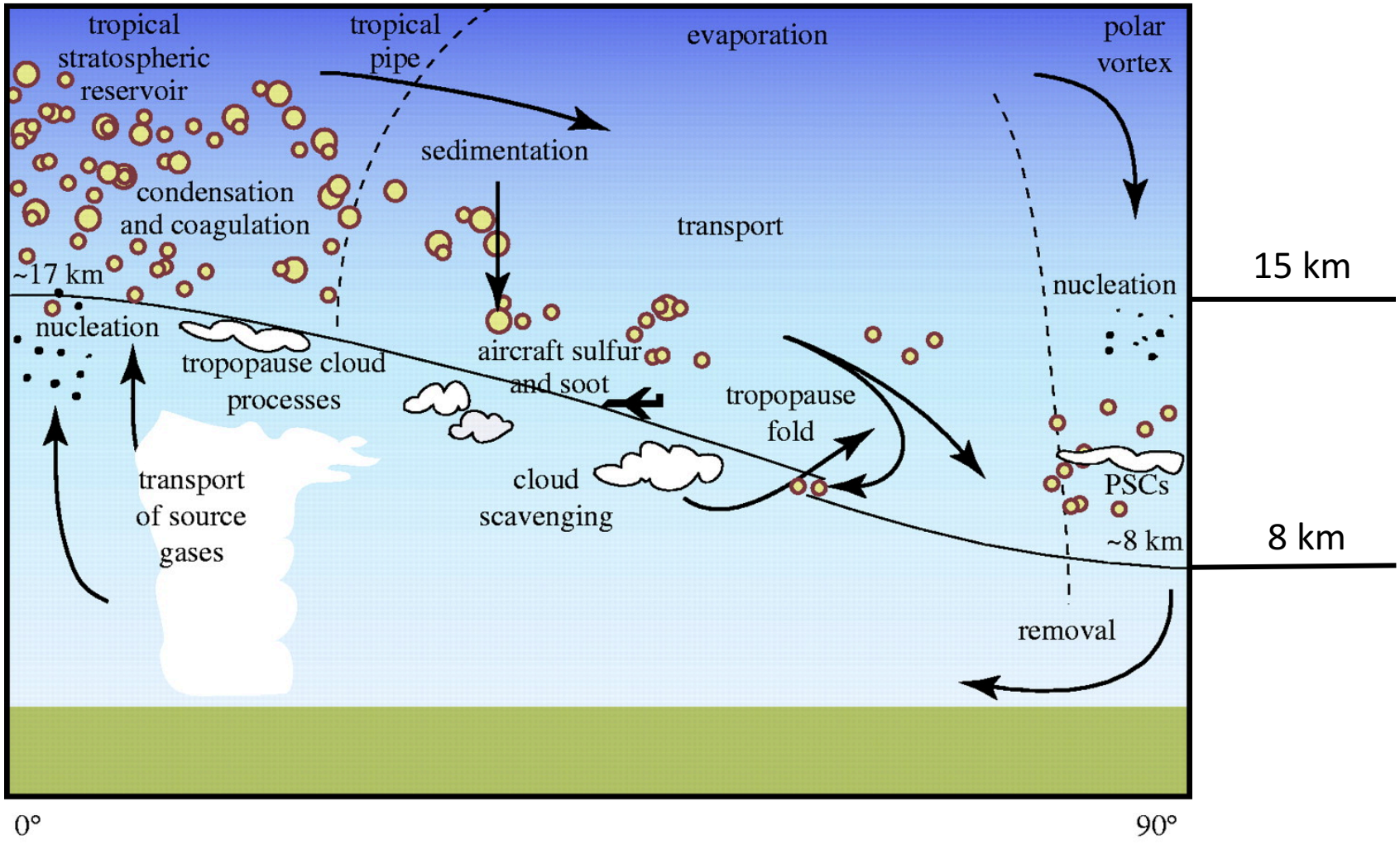
Thomason et al., 2008

Stratospheric Aerosol Optical Depth: Asian wildfires



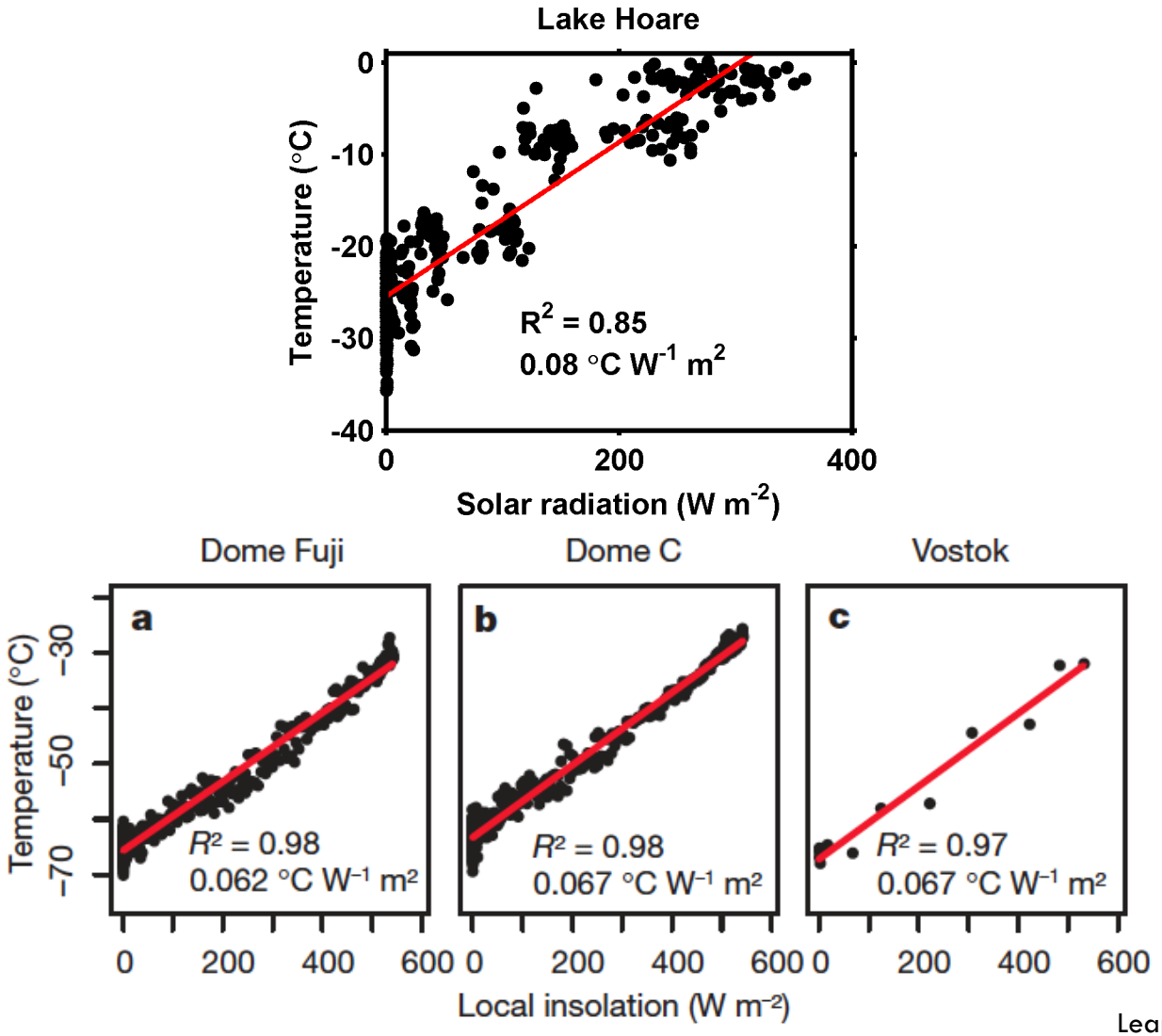
Obryk et al., 2018

Bias in optical depth data



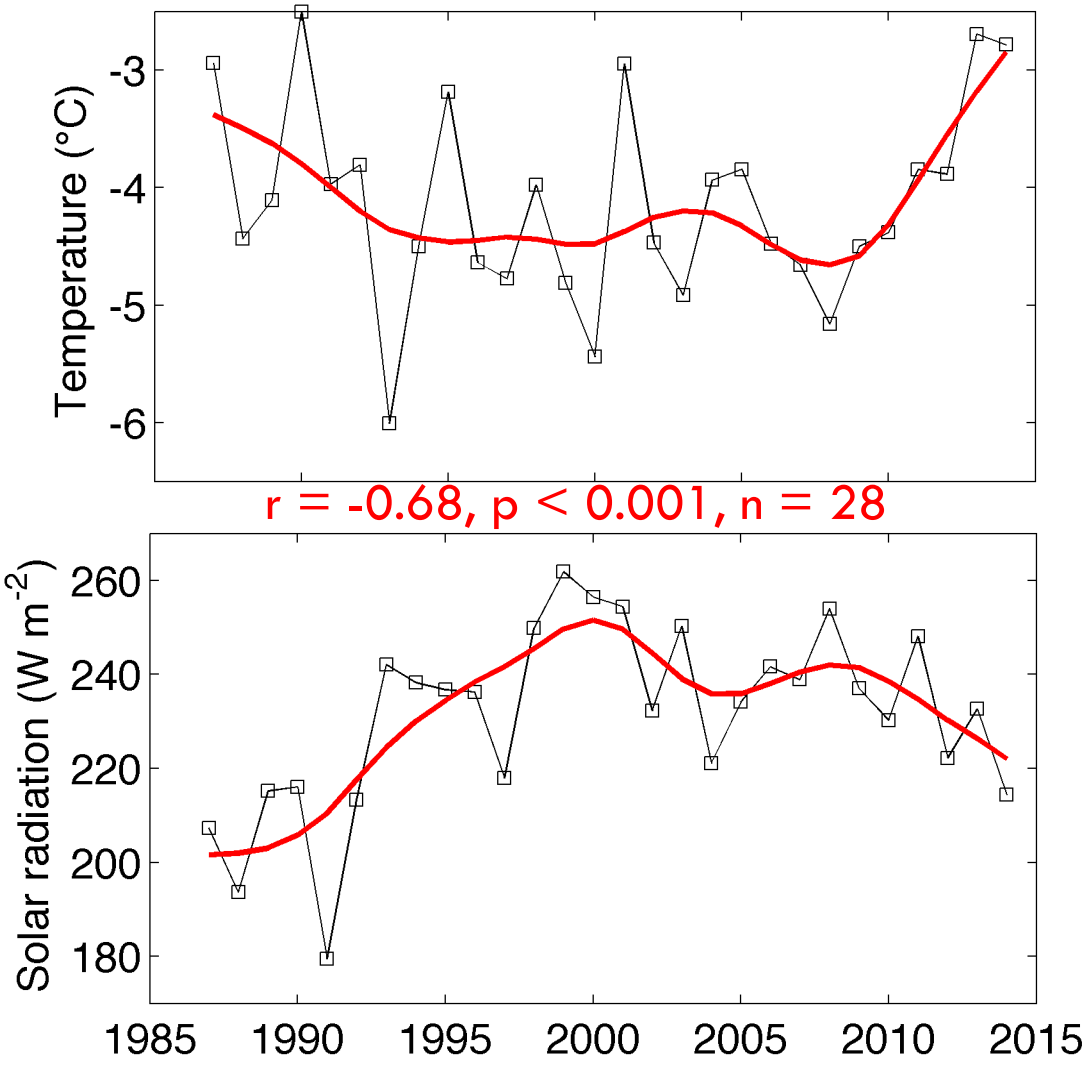
SPARC., 2006

Monthly surface air temperature and solar radiation



Leapple et al., 2011

DJF trends at Lake Hoare



Obryk et al., in prep

Conclusions

- Surface air temperatures have been cooling until 2006 and the flood year is not indicative of climate shift in the region
- Solar radiation in Antarctica is driven by global sulfate aerosols emissions, and
- can be used as proxy for anthropogenic sulfur dioxide emissions