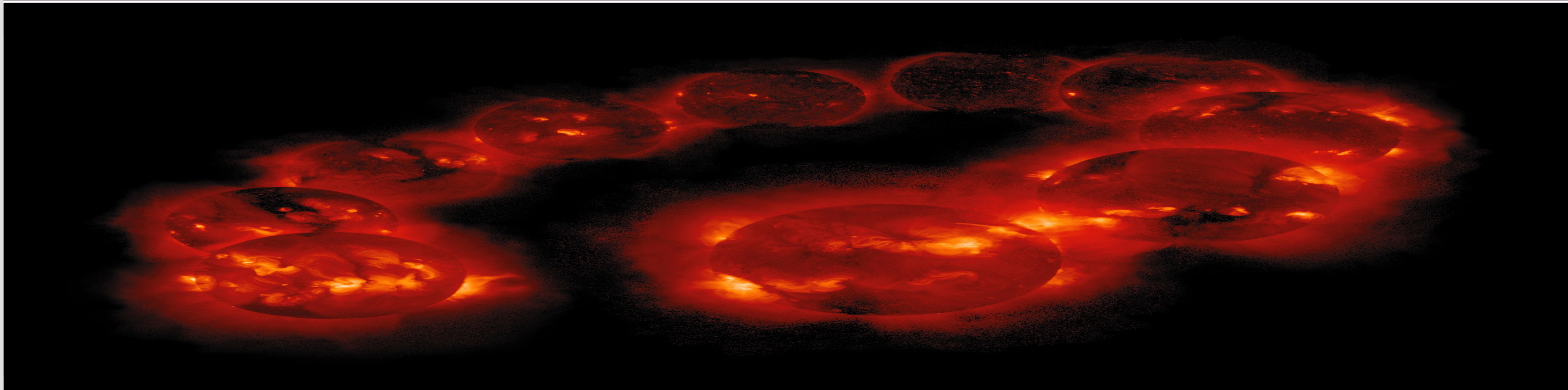


A solar signal in lower stratospheric water vapour?

Tobias Schieferdecker, Stefan Lossow, Gabriele Stiller and Thomas von Clarmann

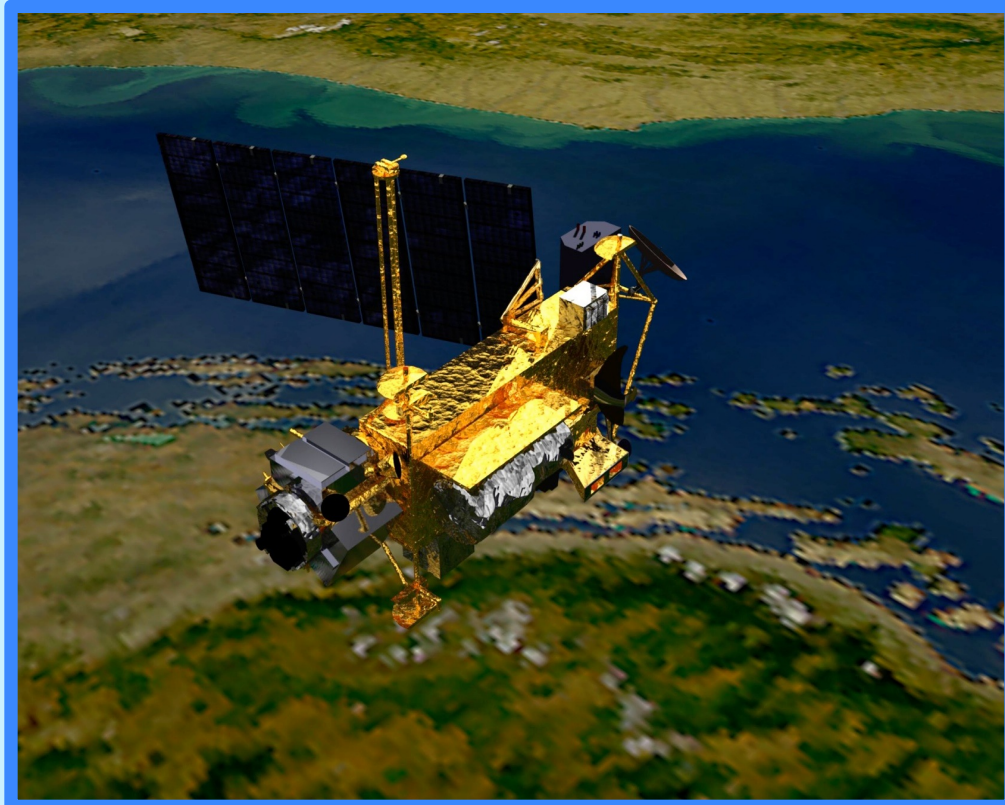


Outline

- ▶ Data sets
- ▶ Results
- ▶ Possible explanations

Data sets

Data sets



HALOE aboard UARS

observational period
1991 - 2005

solar occultation
attenuation of solar light
30 observations/day



MIPAS aboard Envisat
full spectral resolution

observational period
2002 - 2004

limb
thermal emission
~1000 observations/day



MIPAS aboard Envisat
reduced spectral resolution

observational period
2005 - 2012

limb
thermal emission
~1300 observations/day

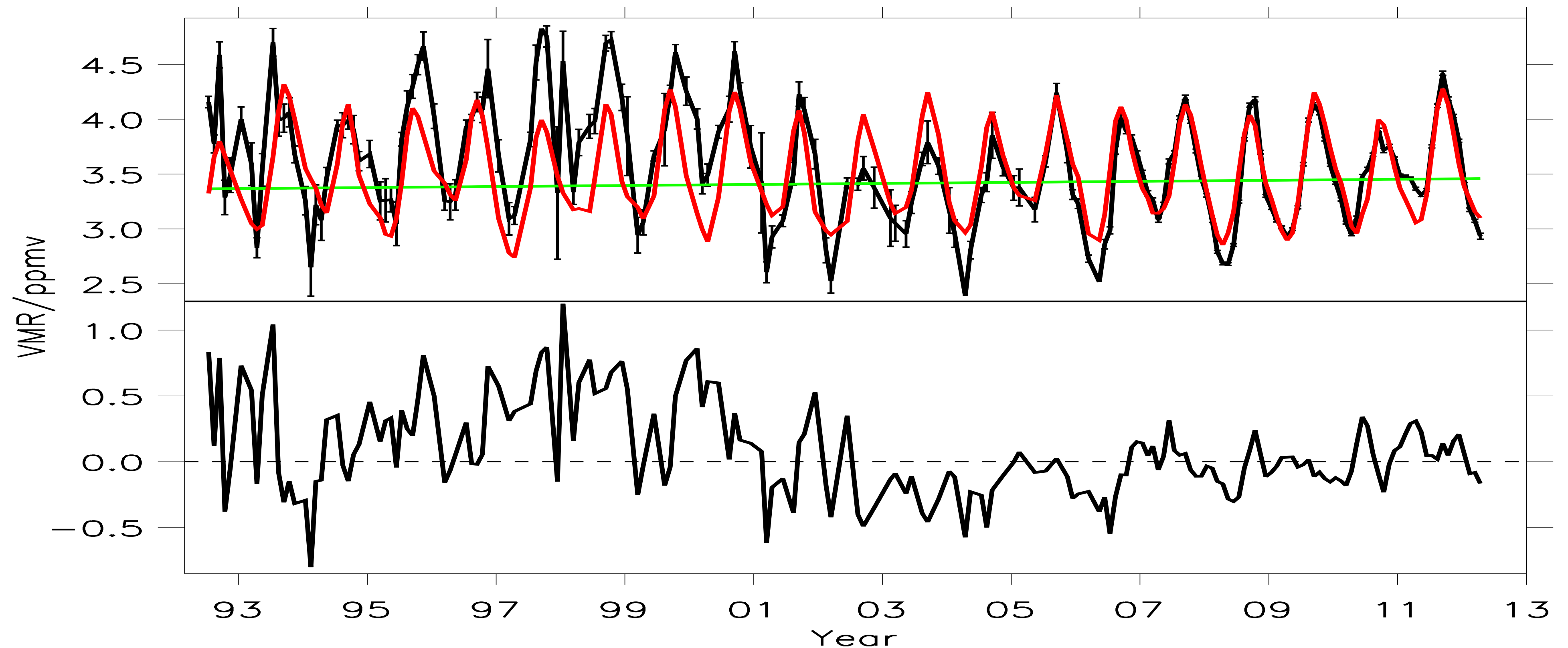
- ▶ Merging accounts for biases, differences in vertical resolution and volcanic influences
- ▶ Considered time period: March 1992 - April 2012

Results

Simple regression

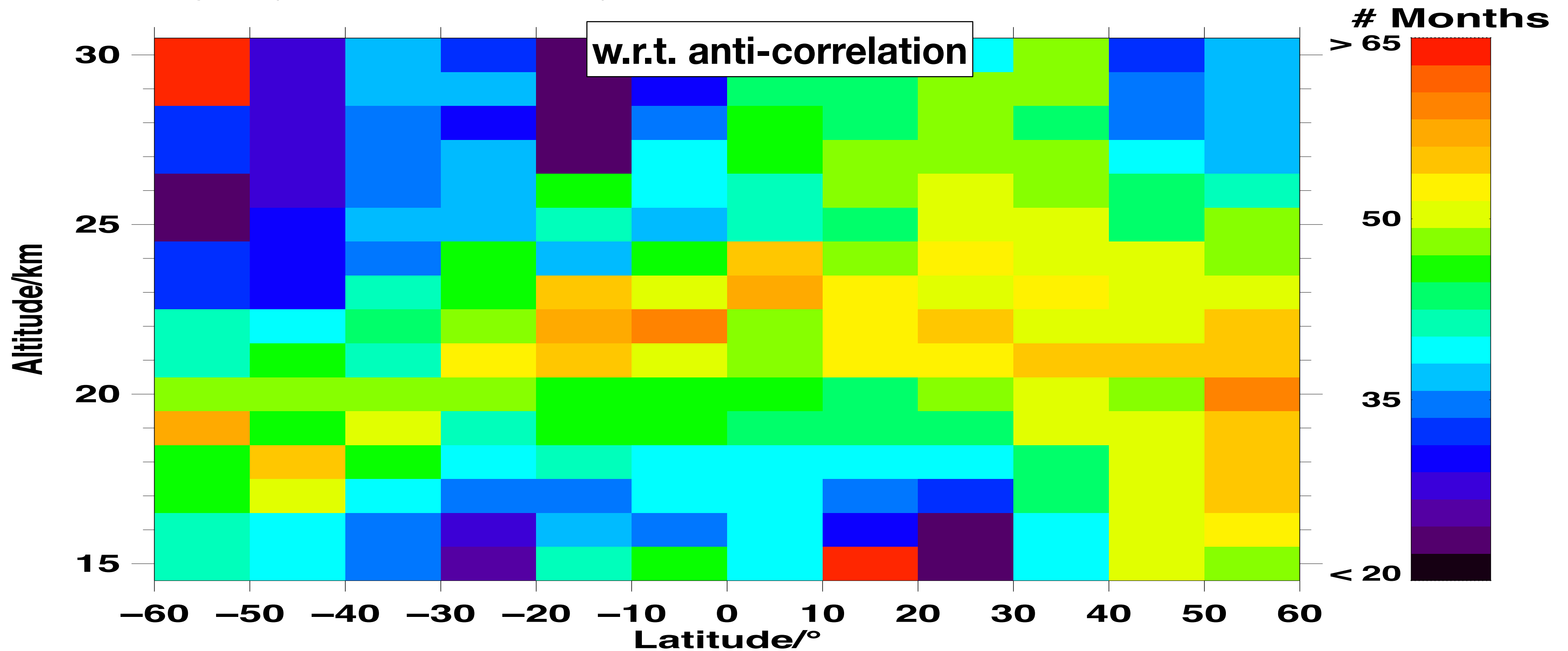
fit = offset + linear term + annual cycle (12, 6, 4, 3 months) + QBO + ENSO (AoA shifted)

Example: 10°S - Equator @ 17 km



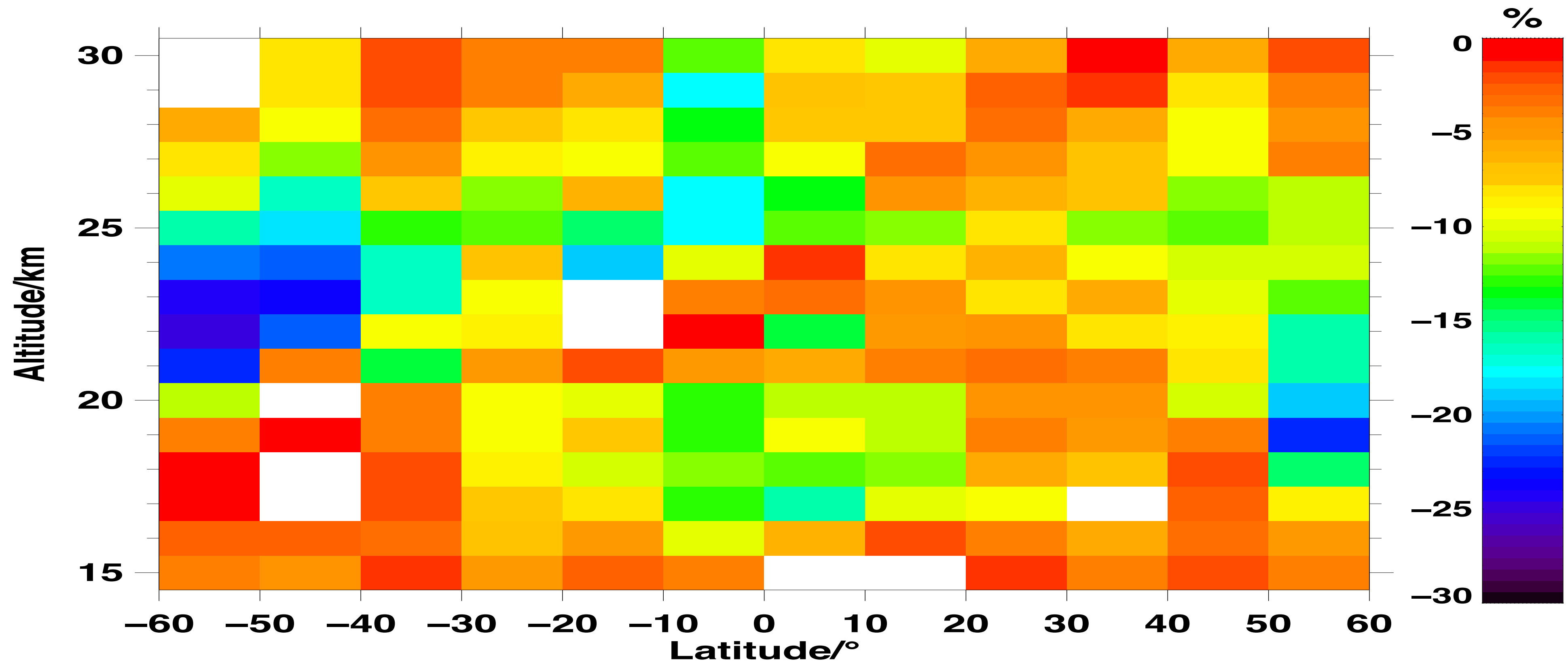
Phase

fit = offset + linear term + annual cycle (12, 6, 4, 3 months) + QBO + ENSO (AoA shifted) + solar cycle (127 and 63 months)

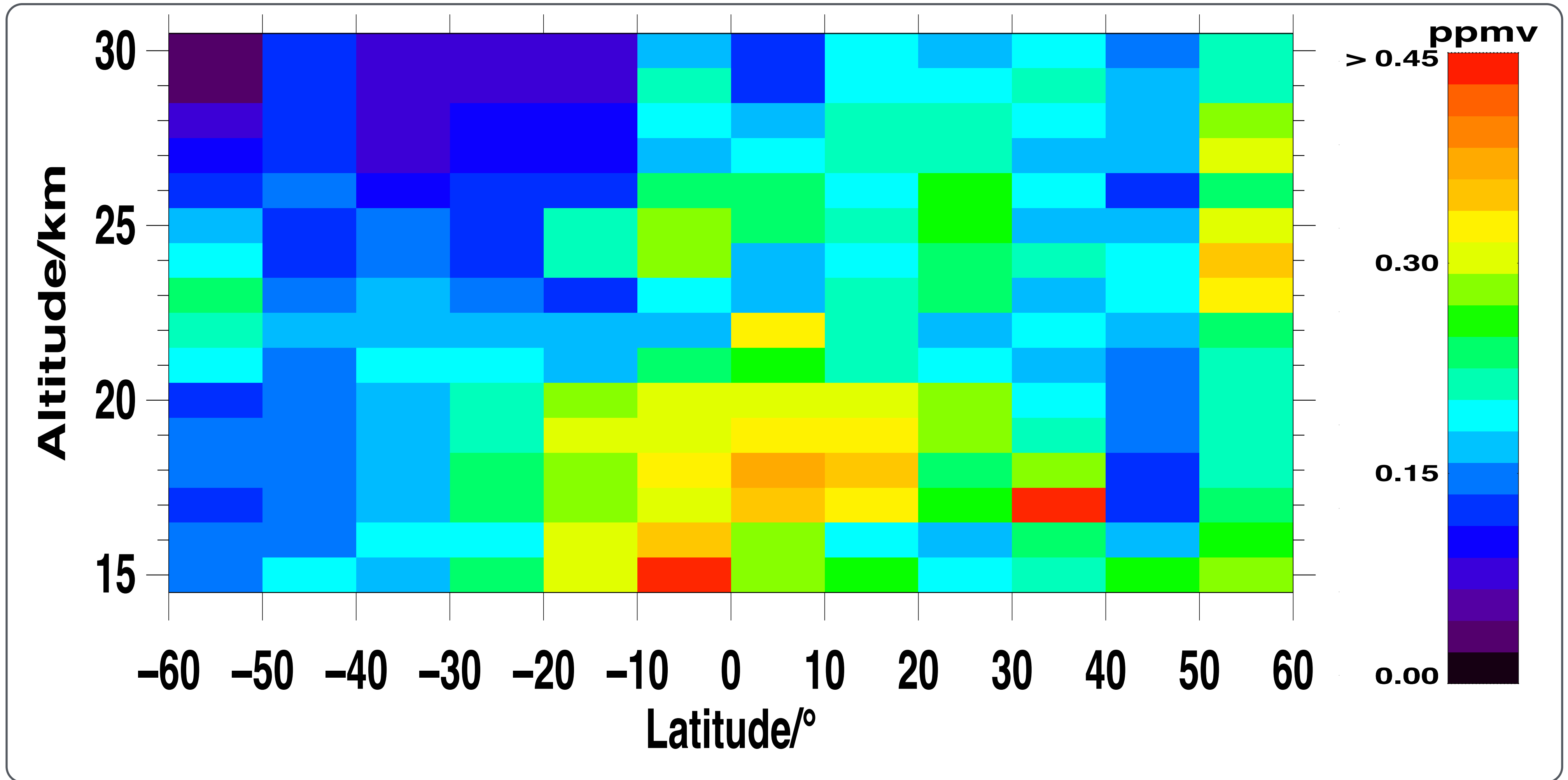


Regression fit improvement

fit = offset + linear term + annual cycle (12, 6, 4, 3 months) + QBO + ENSO (AoA shifted) + solar cycle (F10.7 phase shifted based on 127 and 63 months sine/cosine results)



Amplitude

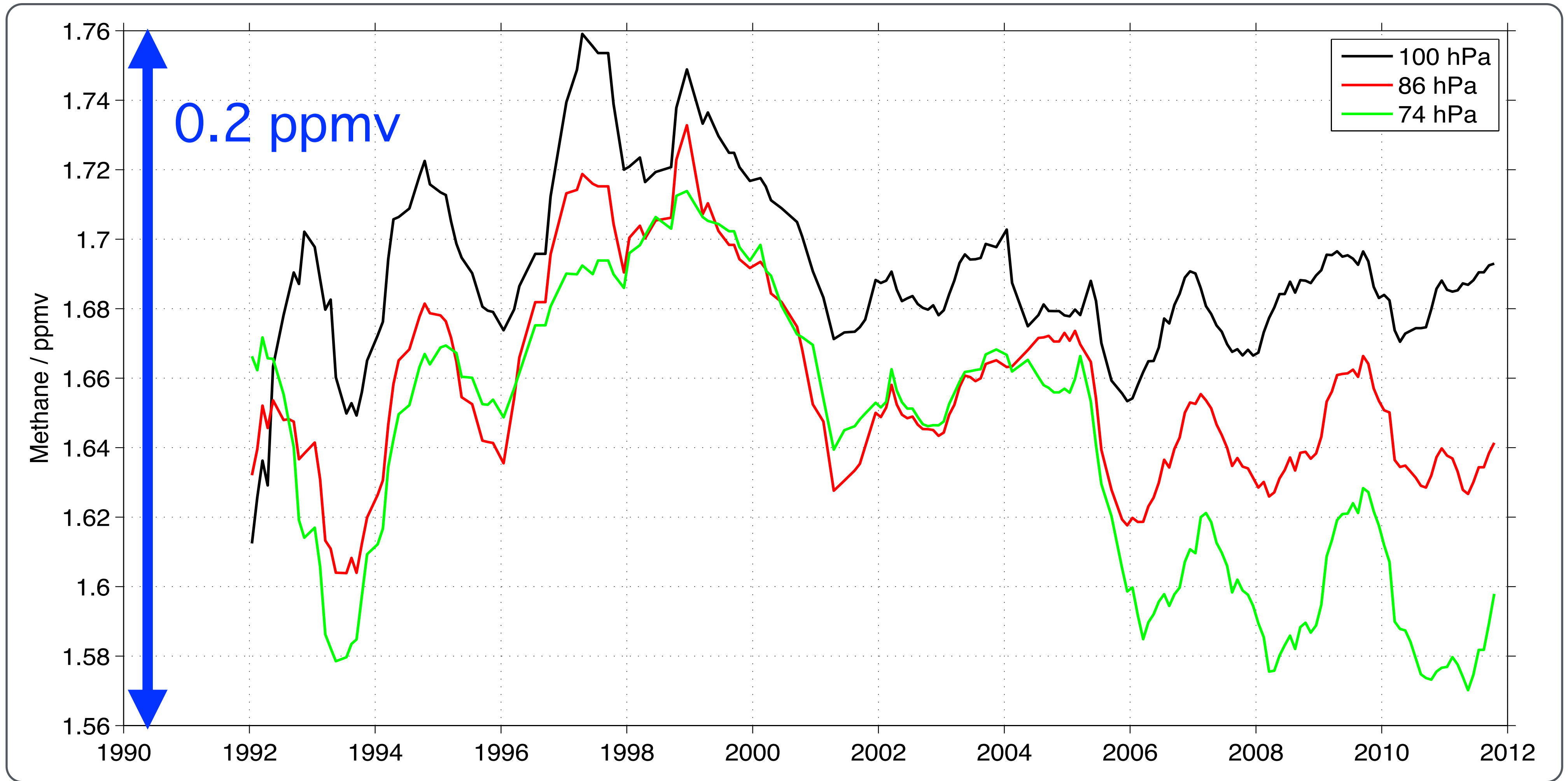


Possible explanations

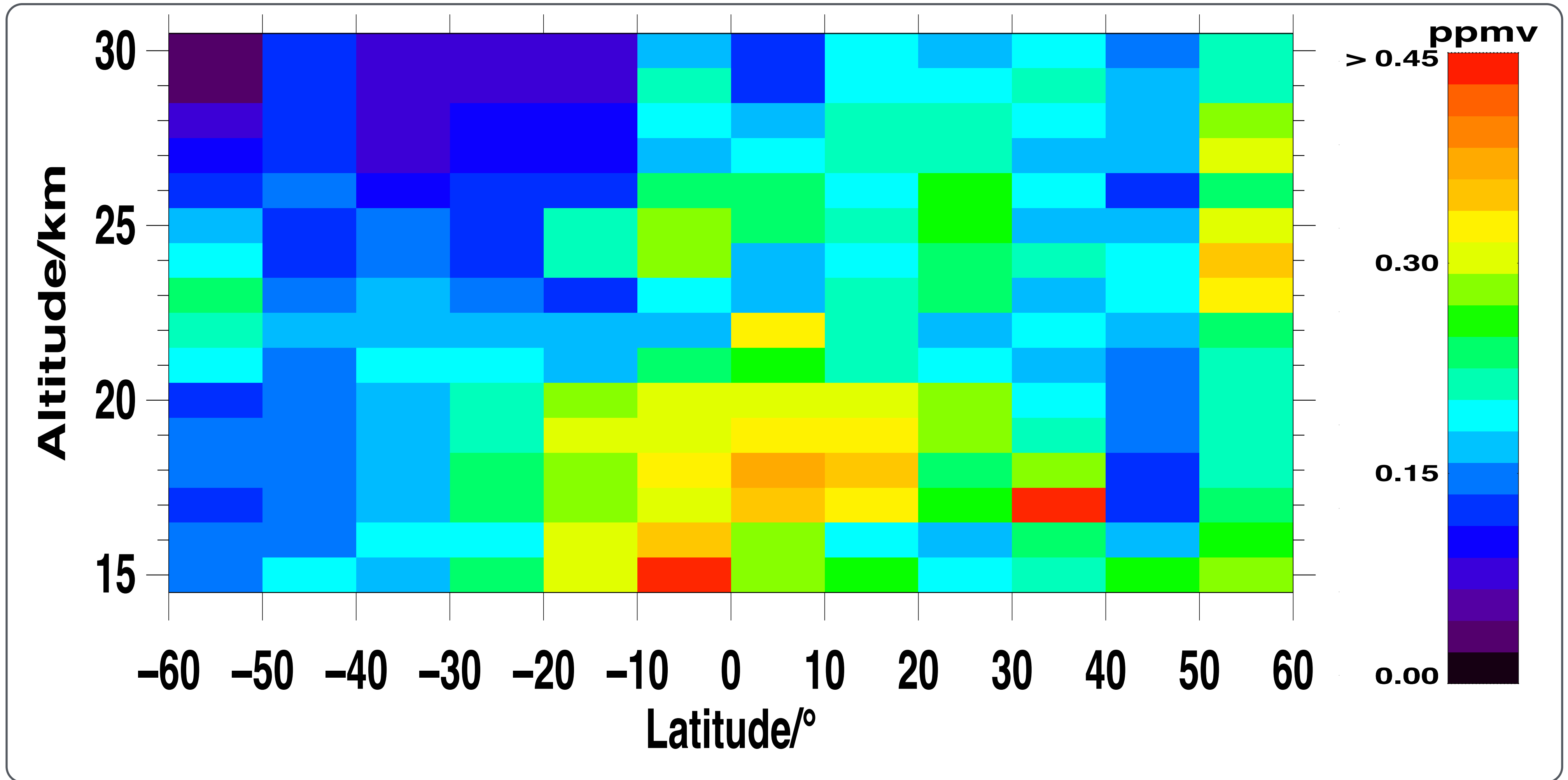
Possible explanations

1. Coincidence
2. Methane oxidation
3. Transport from the troposphere
4. Other

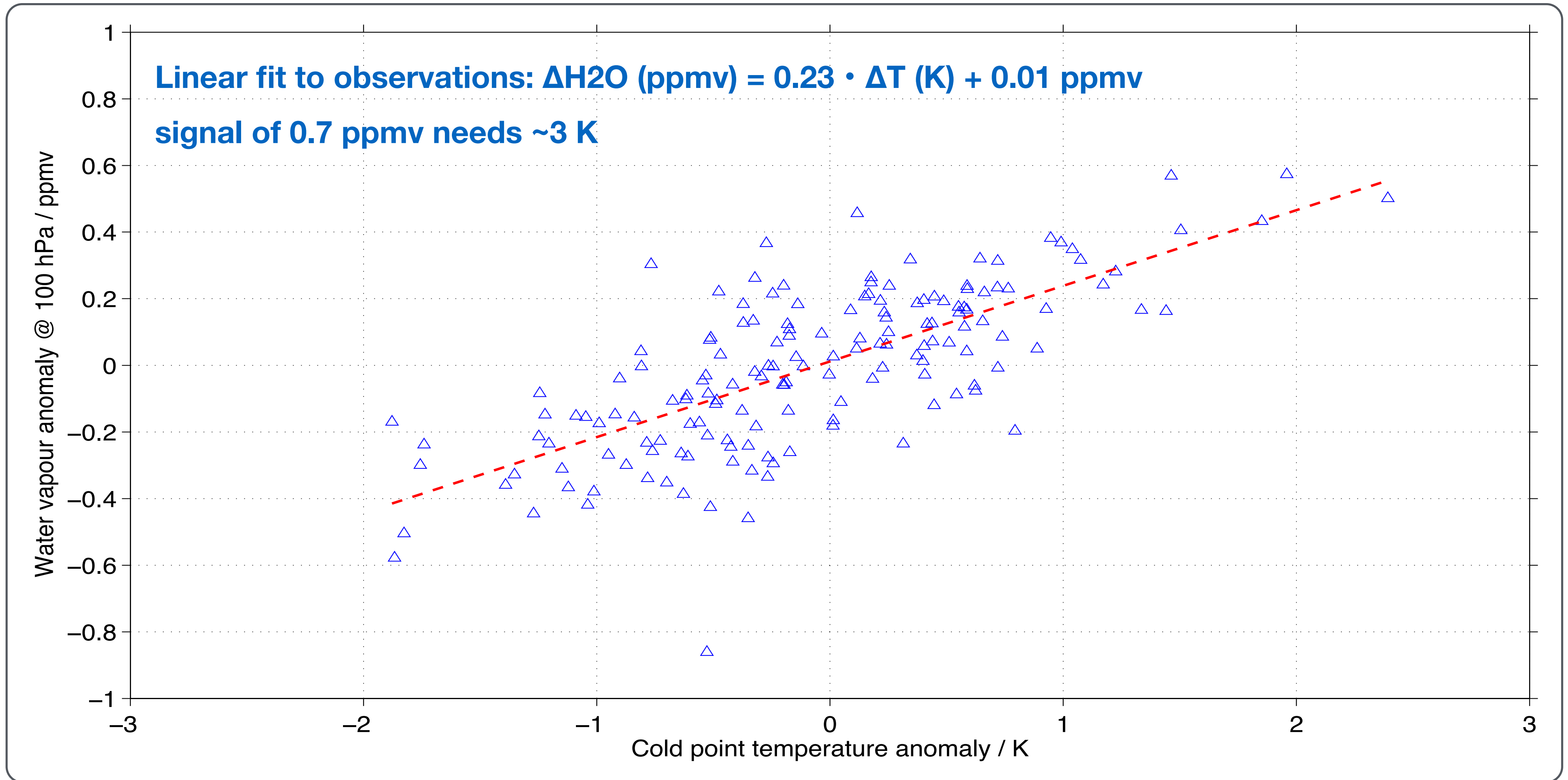
Role of methane



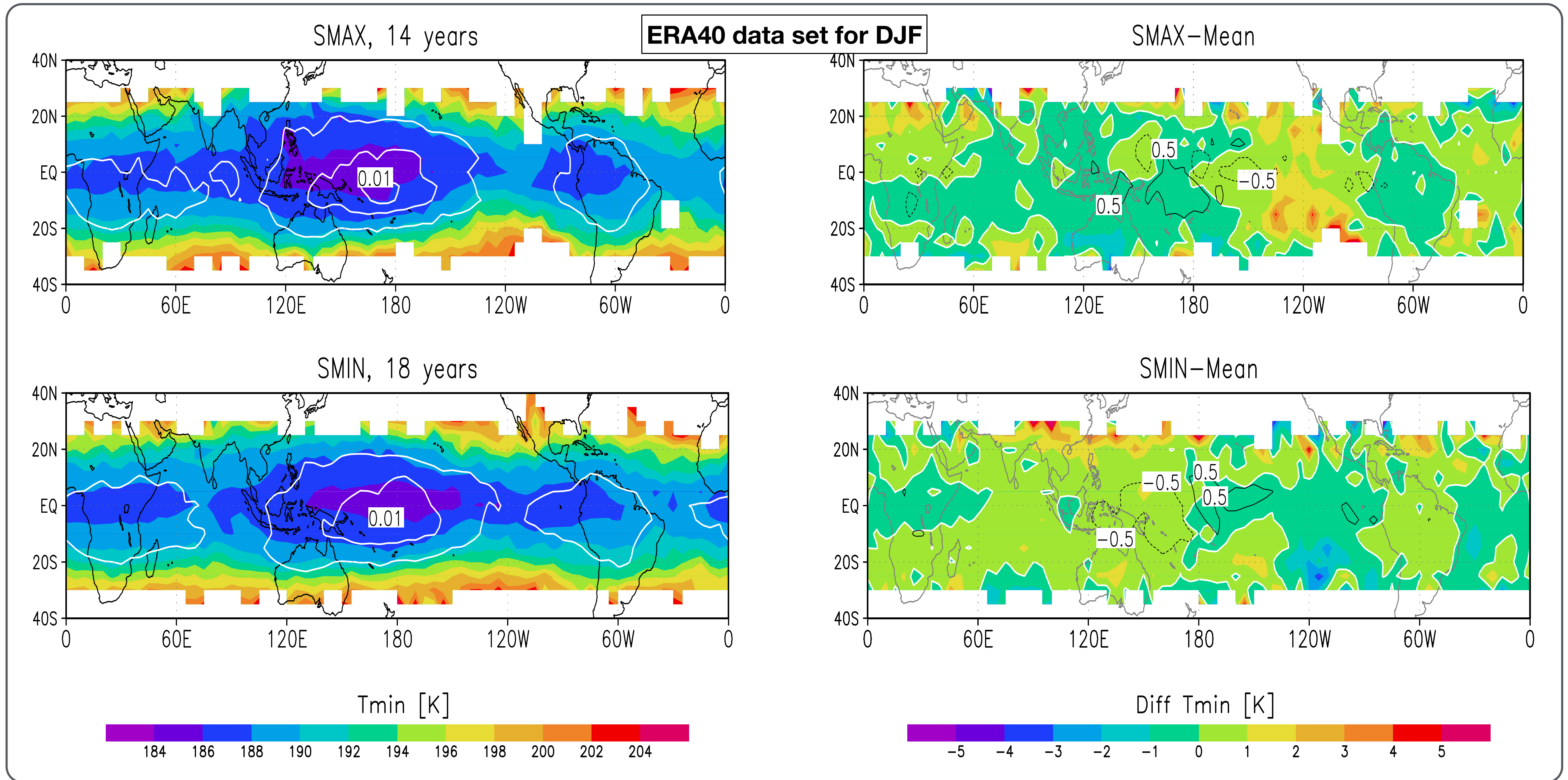
Transport from the troposphere



What temperature signal would we need?

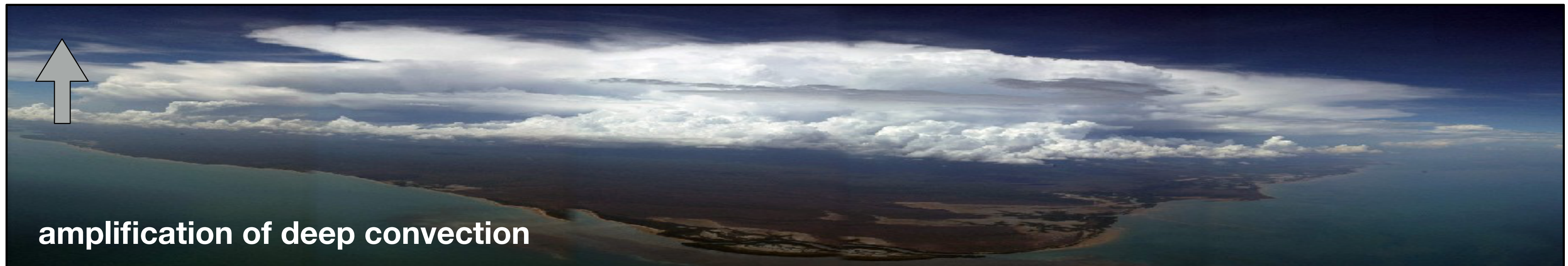
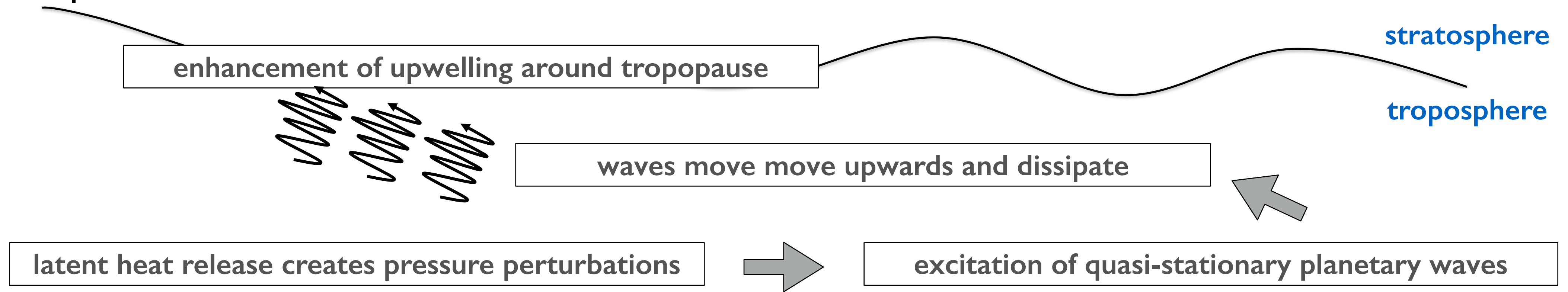


What do we find in the literature?



Krüger et al., Atmospheric Chemistry & Physics (2008)

A possible mechanism



Summary

- ▶ a combined UARS/HALOE and Envisat/MIPAS data set indicates a decadal variation in the lower stratosphere
- ▶ hypothesis is that this variation is a solar influence
- ▶ amplitude is largest in the lowermost tropical stratosphere and decreases towards higher latitudes and altitudes
- ▶ signal is phase-shifted to the apparent solar cycle by 2 - 3 years and anti-correlated, i.e. water vapour minimum follows apparent solar cycle maximum
- ▶ one possible explanation could be a solar cycle influence on the tropical tropopause temperature that regulates water vapour transport into the stratosphere from from SST changes

Thank you!

Trend estimates

