

The changes in cloud top temperatures observed from satellites: a possible link to aerosol thermodynamic effect?

Abhay Devasthale and Patrik Boström

Research and Development Department

SMHI, Norrköping, Sweden

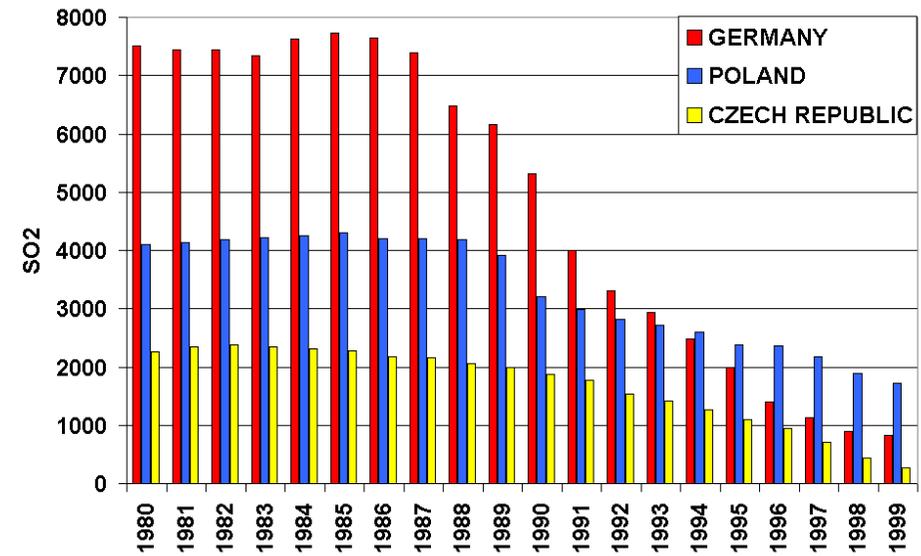
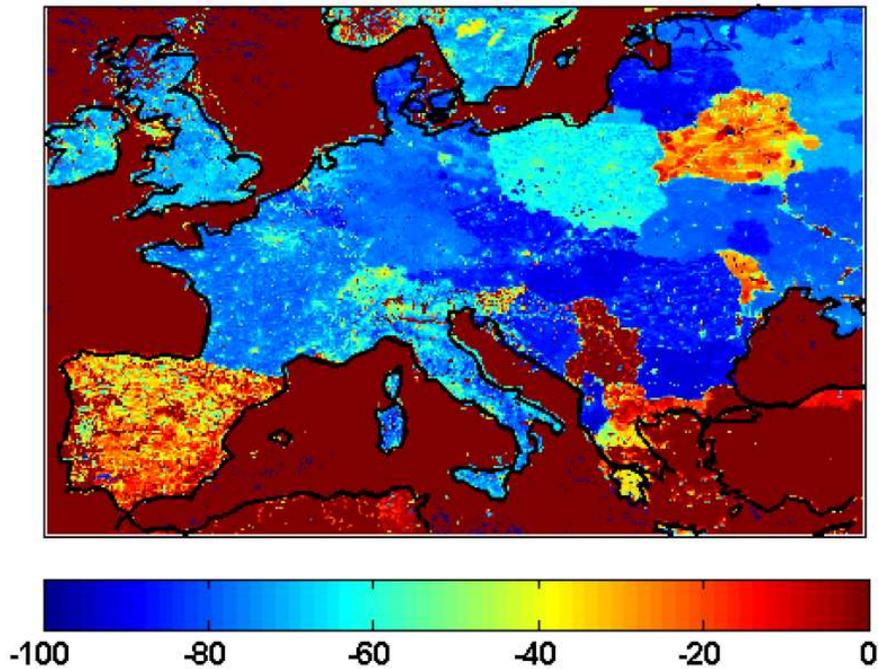
Abhay.Devasthale@smhi.se

18 Dec 2013, Bremen

Background: Systematic and significant change in aerosol loading over Europe during late 1980s

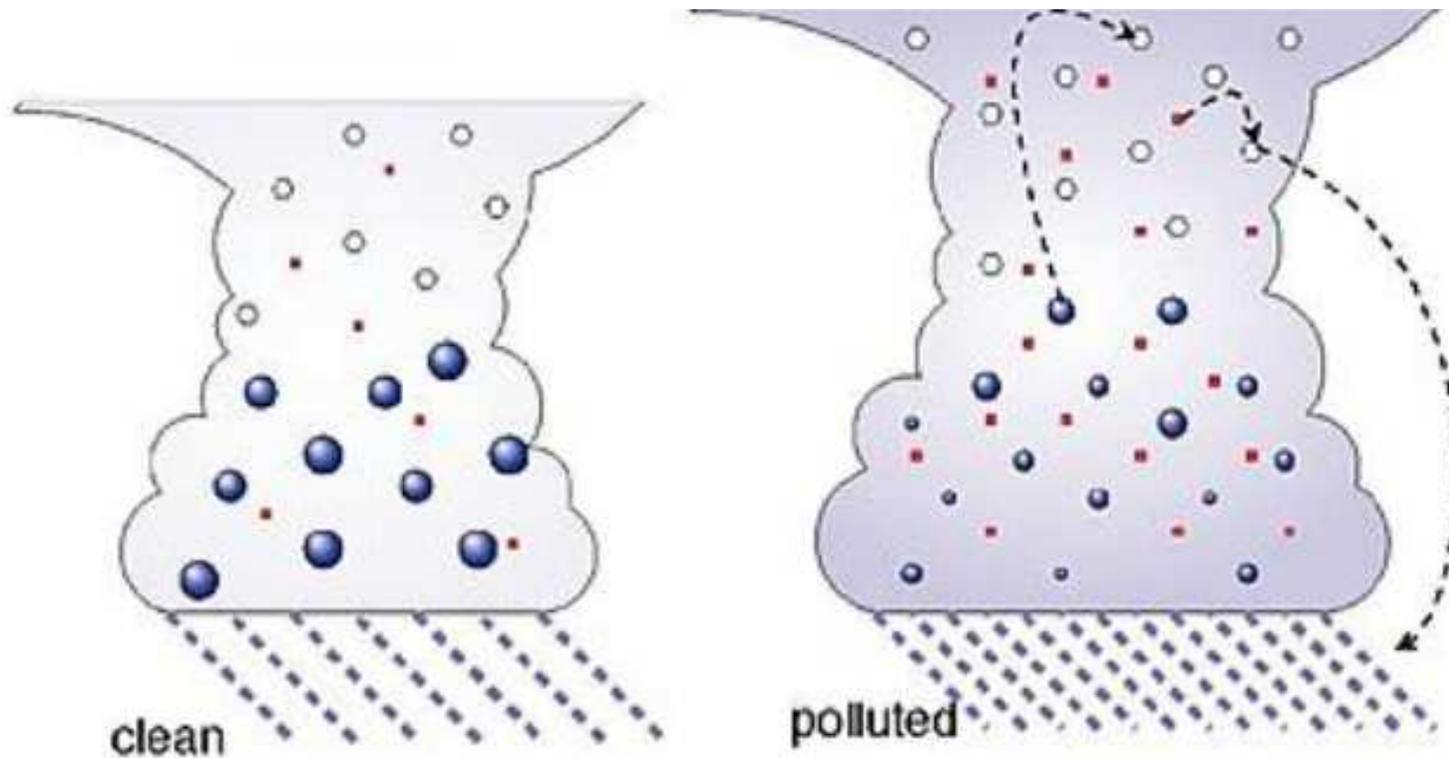
Percentage change in SO₂ emissions (EDGAR)

1990s-1980s



(Umweltbundesamt, 1994)

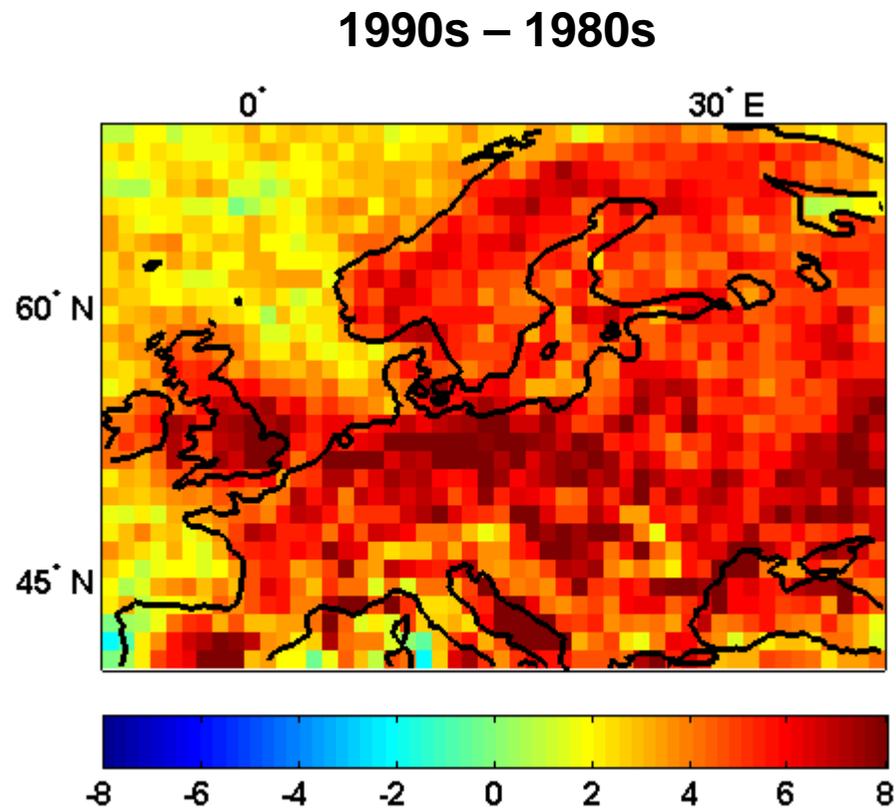
Can this regime change be used to understand aerosol effect on cloud height?



Earliest mention by Pincus and Baker (1994)

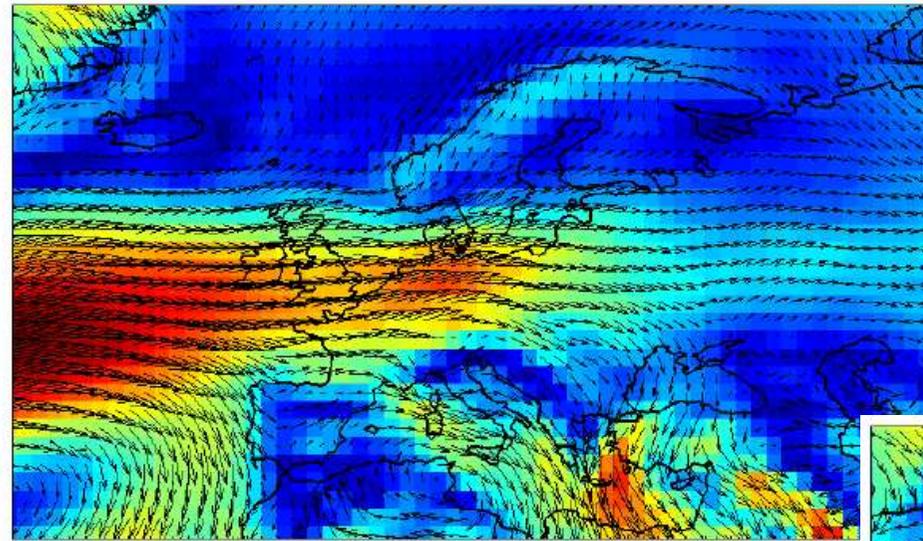
- **CLARA-A1 (CM SAF cLoud, Albedo and RAdiation dataset from AVHRR data) (Karlsson et al., 2013).**
- **Provides global cloud properties for the 28-yr period (1982-2009).**
- **JJA months of 1985-88 and 1997-00 are analysed here.**
- **Liquid and mixed phase clouds investigated (selected using cloud phase product).**
- **Clouds are further screened for possible precipitation.**

Change in summertime cloud top temperatures (K)

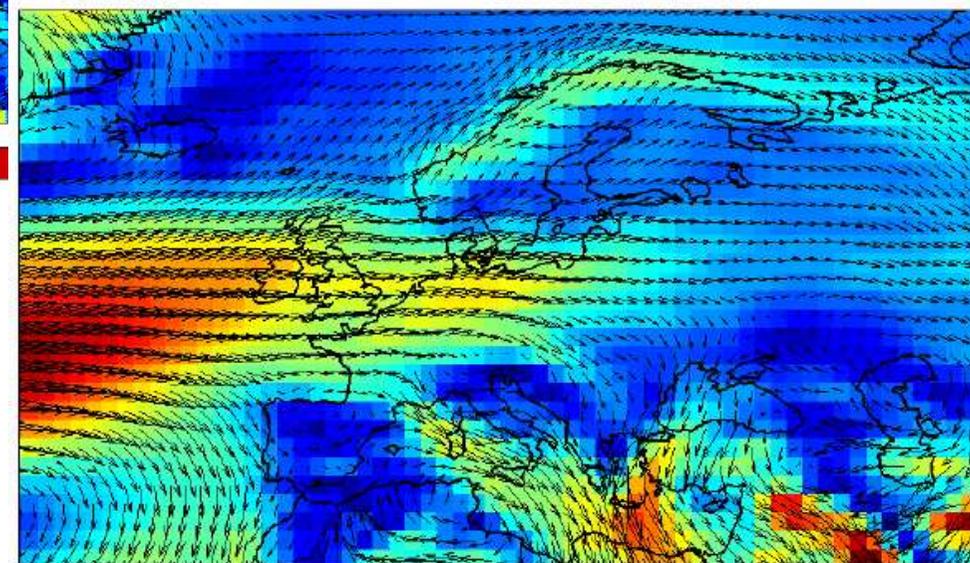
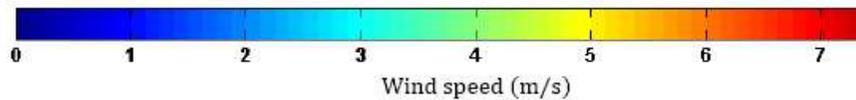


Apart from aerosols, what other factors could influence cloud height?

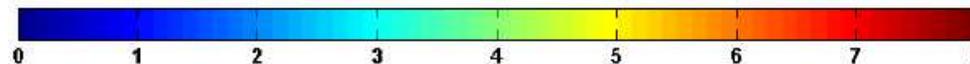
Possible change in atmospheric circulation?



1980s



1990s



Problems due to satellite sensor calibration?

- Intercalibration applied (Heidinger et al, 2012)

Or the results possibly influenced orbital drift?

- nearly same drifting rate for the chosen periods.

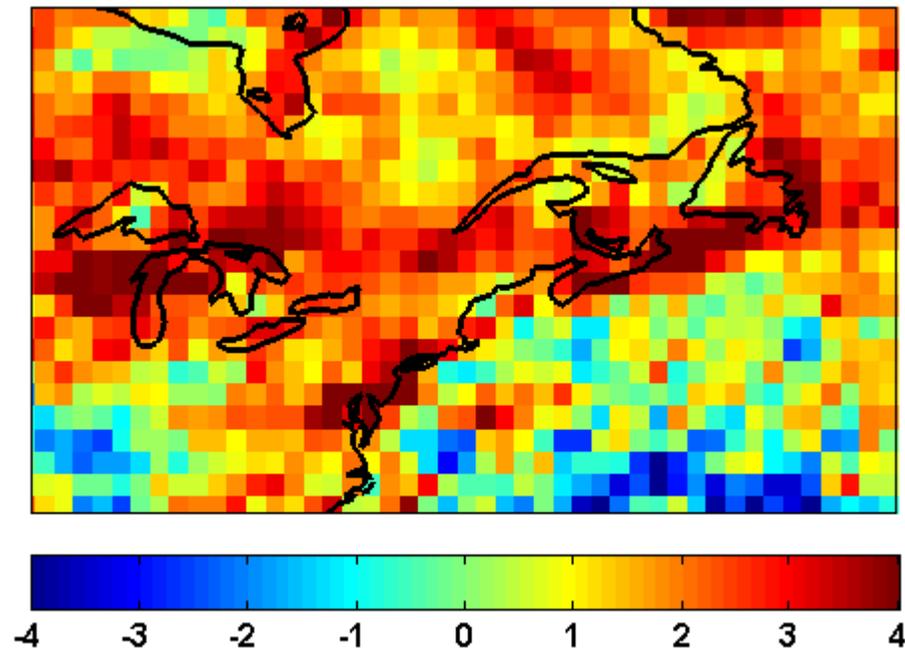
Change in surface temperature and humidity?

- increased surface temperatures and humidity may favour invigorated convection.
- But the surface temperatures are in fact warmer in 90s compared to 80s.

Can we verify similar large-scale signature in CTT change at other corners of the globe?

Eastern North America

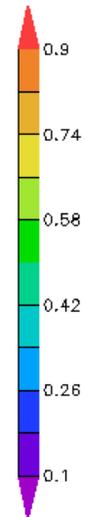
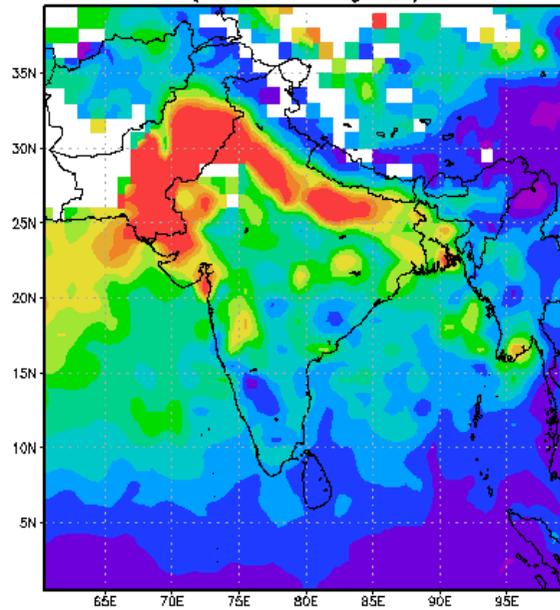
1990s – 1980s



Can we verify similar large-scale signature in CTT change at other corners of the globe?

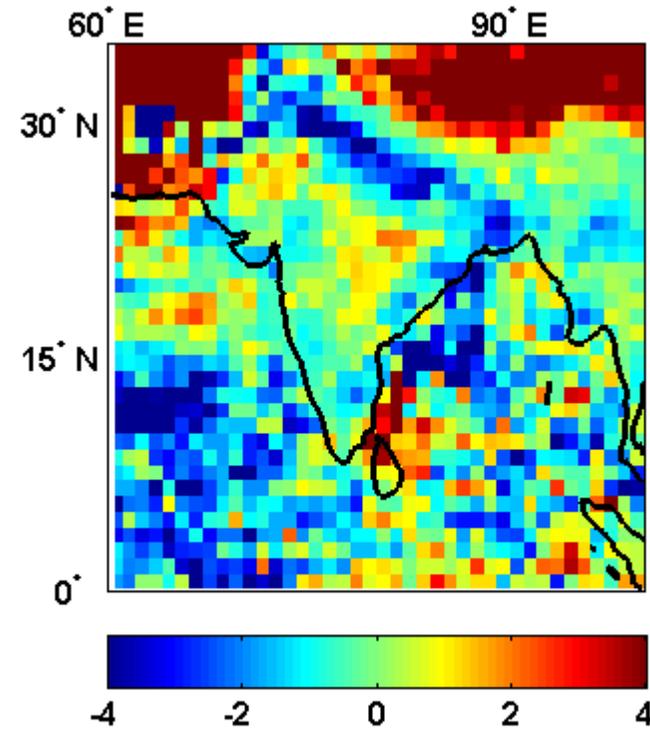
MODIS AOD

MYD08_M3.051 Aerosol Optical Depth at 550 nm [unitless]
(Jun2010 - Aug2010)



India

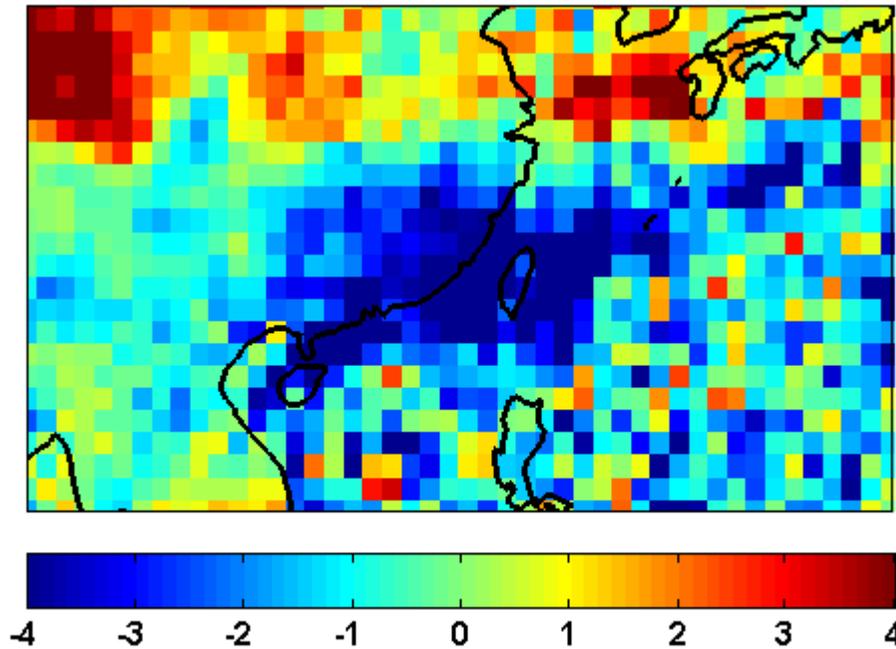
1990s - 1980s



Can we verify similar large-scale signature in CTT change at other corners of the globe?

China

1990s – 1980s



- **The observed changes could be a part of the decadal variability.**
- **Sensitivity to a retrieval algorithm, ancillary data, etc**
- **Investigating other data sets.**
- **.....**

- It is observed that clouds top were colder and higher in the late 80s over Europe compared to the late 90s.
- Using discounting principle, we argue that only changes in aerosol loadings can explain the observed changes in CTTs.
- The changes in CTTs are consistent across other polluted regions.
- Further analysis of pure ice phase clouds is required.