



Met Office
Hadley Centre

Aerosols in decadal prediction

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Has there been a trend in aerosols?

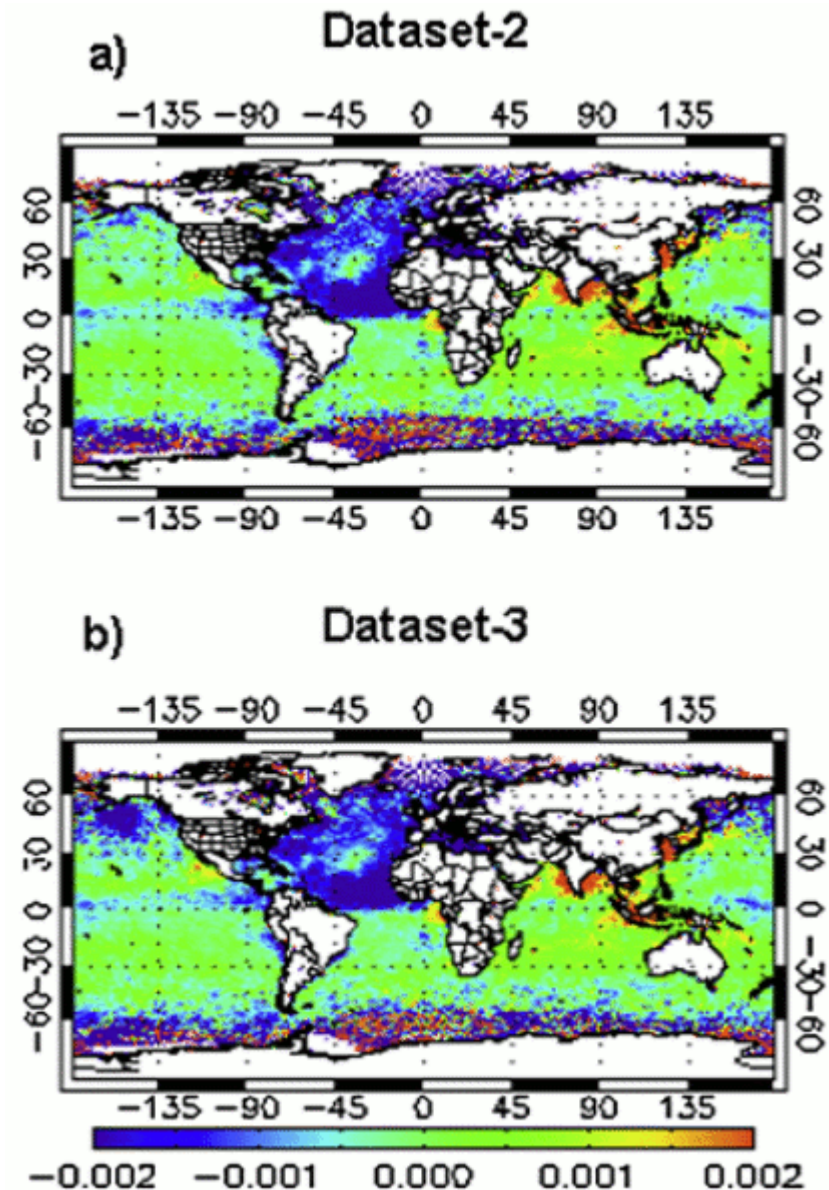
Globally: there is a small negative trend in AVHRR data but this needs to be confirmed.

Regionally: yes.

Linear long-term trend (unit AOD/year) from PATMOS-x over period 1981-2004 but without years of stratospheric aerosols.



From Zhao et al (2008)



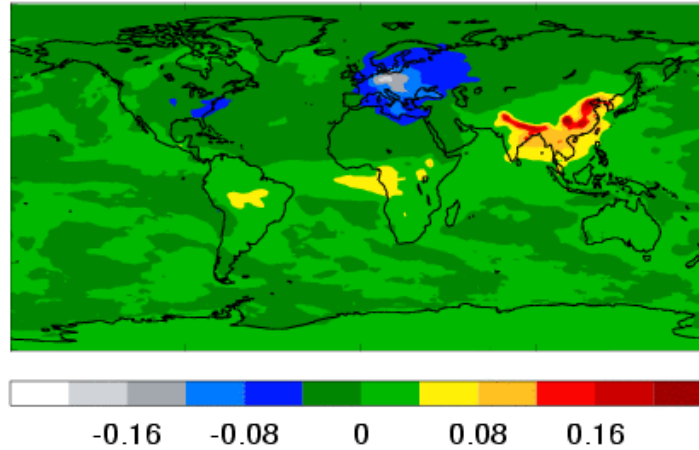
Results from HadGEM1

Regional patterns are consistent with model results given best knowledge on emissions.

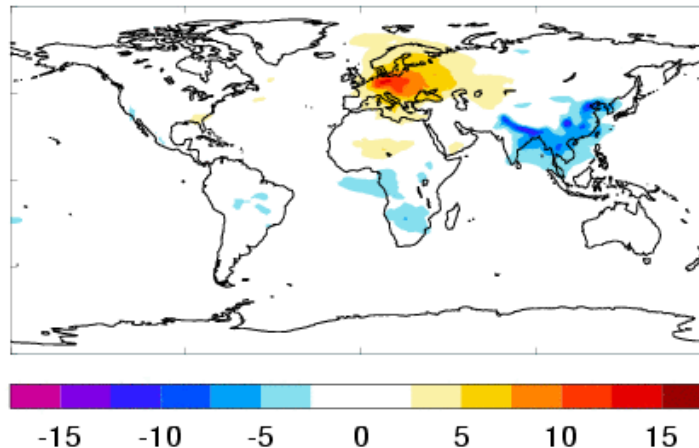
Trends over land > trends over ocean

→ New historical emissions developed for AR5 are probably best.

Jones/Bellouin, MOHC



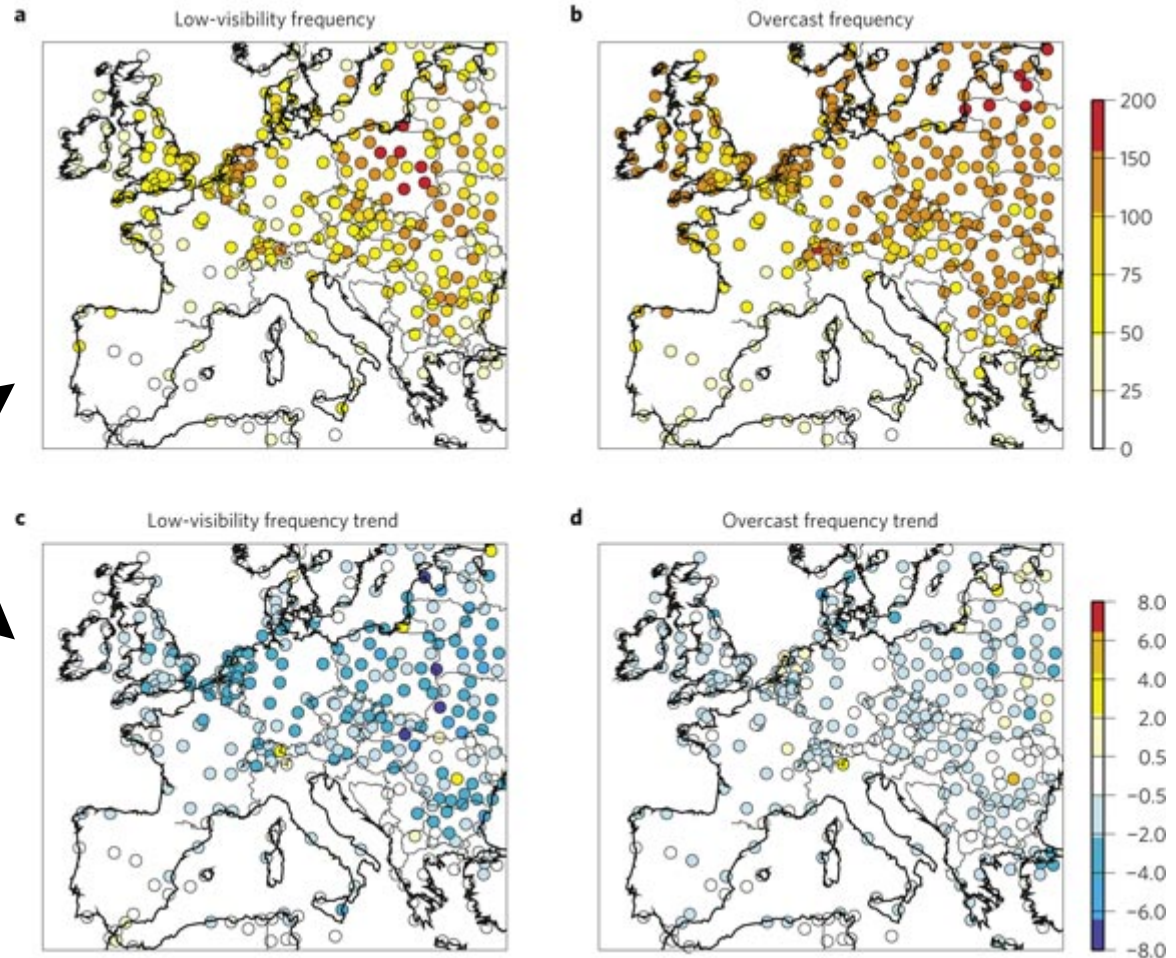
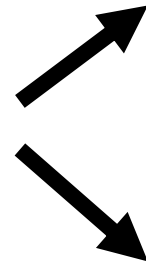
Total AOD
2000 – 1980



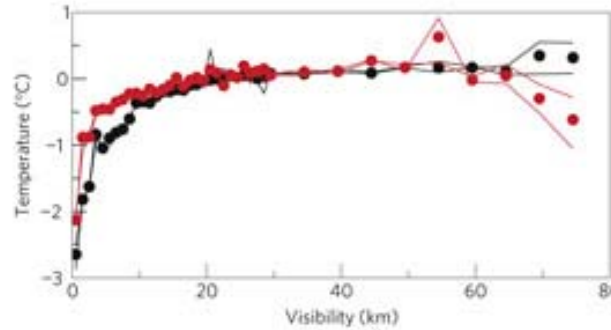
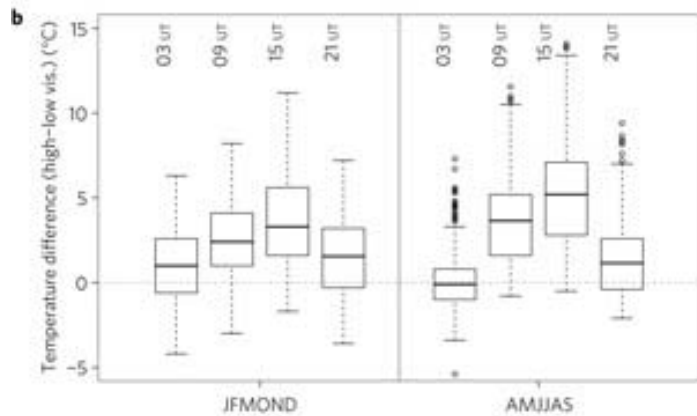
Surface
SW radiation
2000 – 1980

Trends in visibility over Europe

Negative trend
in low-visibility
events over
Europe over the
last 30 years

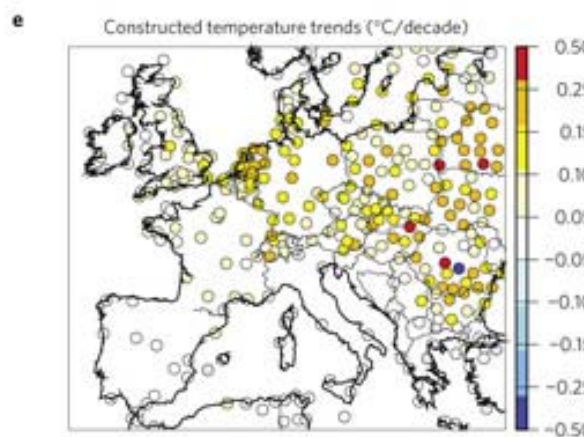
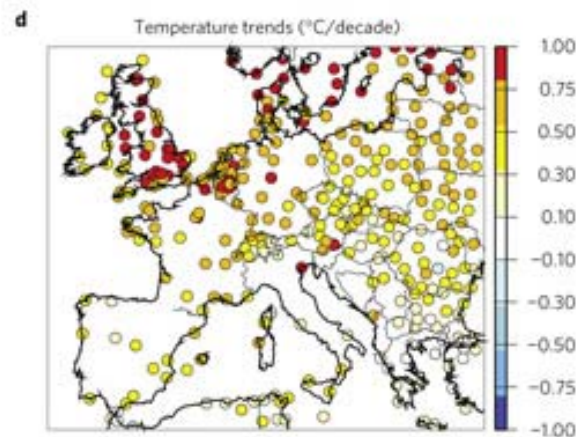


Vautard et al.
Nature Geoscience
2009



Red: 3UTC
Black: 15UTC

Vautard et al.
Nature Geoscience
2009



Autumn-winter T trend
(°C/decade)

Observed T trend (15UTC)

T trend due to increasing visibility (15UTC)

A significant fraction of the daytime (15UTC) warming over Europe is likely to be due to the brightening effect.



Some evidences that aerosols have affected rainfall regionally

Rotstayn and Lohmann (2002): anthropogenic aerosols have caused a southward shift in rainfall, including a drying of the Sahel.

Cox et al (2008): decreasing aerosol pollution over the North Atlantic could increase risk of Amazonian drought.

Rotstayn et al (2008): Asian haze has increased rainfall over Northwestern and central Australia.

➔ In these studies changes in rainfall occur through changes in circulation rather than through the aerosol indirect effect on precipitation.



Conclusions

- Tropospheric aerosol and ozone radiative forcings are significant, vary regionally on timescales of decades and are therefore highly relevant to decadal climate prediction
 - Hindcast: satellite data, GEMS / MACC reanalysis, climate simulations
 - Forecast: RCP scenarios supposedly better than SRES
- Stratospheric aerosols are important as well
 - In principle MACC should also monitor stratospheric aerosols in NRT thus providing a way to initialise decadal prediction but this has been delayed and there is no limb sounder for stratospheric aerosols at the moment!



- 2003-2007 aerosol reanalysis (GEMS)
- New, longer aerosol reanalysis will be produced for MACC
- NRT aerosol forecasts are available
- Spin-off product to be produced under MACC
 - Aerosol direct RF
 - Aerosol indirect RF

<http://www.gmes-atmosphere.eu/>

http://data-portal.ecmwf.int/data/d/gems_reanalysis/