

# An interactive tool for visualizing aerosol trends

Michael Schulz<sup>1</sup>, Augustin Mortier<sup>1</sup>

*with contribution of*

J. Griesfeller<sup>1</sup>, C. K. Myhre<sup>2</sup>, and W. Aas<sup>2</sup>

<sup>1</sup> MetNo (Norwegian Meteorological Institute)



<sup>2</sup> NILU (Norsk Institutt for Luftforskning)



*Convention on Long-Range Transboundary Air Pollution*

*17th Task Force on Measurements and Modelling Meeting:*

*Utrecht - May 18<sup>th</sup> to May 20<sup>th</sup>, 2016*

# Introduction

- ACTRIS-2 (WP13) / AeroCom → Development of an **online interface**: <http://aerocom.met.no/trends>
- Visualization of aerosols trends from **observational networks** and atmospheric **models** and individual **time series**.

## Motivations

- **Regional/global trends**
  - Can we identify some regional/global patterns in aerosols trends?
  - For which parameters?
  - Consistency in the observed trends?
- **Models validation**
  - What is the ability of the models in reproducing the observed trends?



# Available Dataset (presently)

Network	Parameter	Observation	Model	
			ECMWF (2003-2010)	EMEP <sup>1,2</sup> (2002-2012) <sup>1</sup> (1990-2014) <sup>2</sup>
AERONET	AOD	✓ 1, 2	✓	✓
	AE	✓ 1, 2	✗	✗
	$\omega_0$	✗	✗	✗
	FMF	✗	✗	✗
GAW/TAD	SO <sub>4,wet</sub>	✓ 1, 2, 3, 4, 5	✗	✗
	SO <sub>2</sub>	✓ 1, 2, 3, 4, 5	✗	✗
	SO <sub>4,aer</sub>	✓ 1, 2, 3, 4, 5	✗	✗
GAW/IMPROVE/ACTRIS	Scat. Coef.	✓ 1, 2	✗	✗
	Black Carbon	✓ 1, 2	✗	✗
	Nb. Conc.	✓ 1, 2	✗	✗
EARLINET	$\beta_{355}$	✓ 2, 6	✗	✗
	$\beta_{1064}$	✓ 2, 6	✗	✗
	$\sigma_{355}$	✓ 2, 6	✗	✗
	$\sigma_{532}$	✓ 2, 6	✗	✗

1: [1995-2014]; 2: [2002-2012]; 3: [1980-2013]; 4: [1990-2013]; 5: [2000-2013]; 6: [2000-2014]

<sup>1</sup>: EMEP\_rv4\_2599\_Rep2013trend.EECCA\_AERONETSun2.0\_20150321

<sup>2</sup>: EMEP\_rv4\_2982\_AERONETSun2.0\_160312

# Coming Dataset

## Observation

- *Ground-based:*
  - $PM_{2.5/10}$
  - *N wet deposition (Reduced/Oxidised)*
  - $NO_2$
  - ...
- *Space-borne(?):*
  - *MODIS*

## Models

- *ECLIPSE*
- *HINDCAST*
- *ECHAM*
- *SPRINTARS*
- *TM5*
- *MERRA*
- ...

# Methodology (1/2)

- **Representativeness of the observations**

**7 years** (not necessarily consecutive) is the minimum duration required for providing trends information.

- **Averages**

The trends are computed for the **yearly** and **seasonal** averages.

- Spring: March, April, May
- Summer: June, July, August
- Autumn: September, October, November
- Winter: December, January, February

*Season available: Min. **10 measurements.***

*Year available: **Four seasons.***

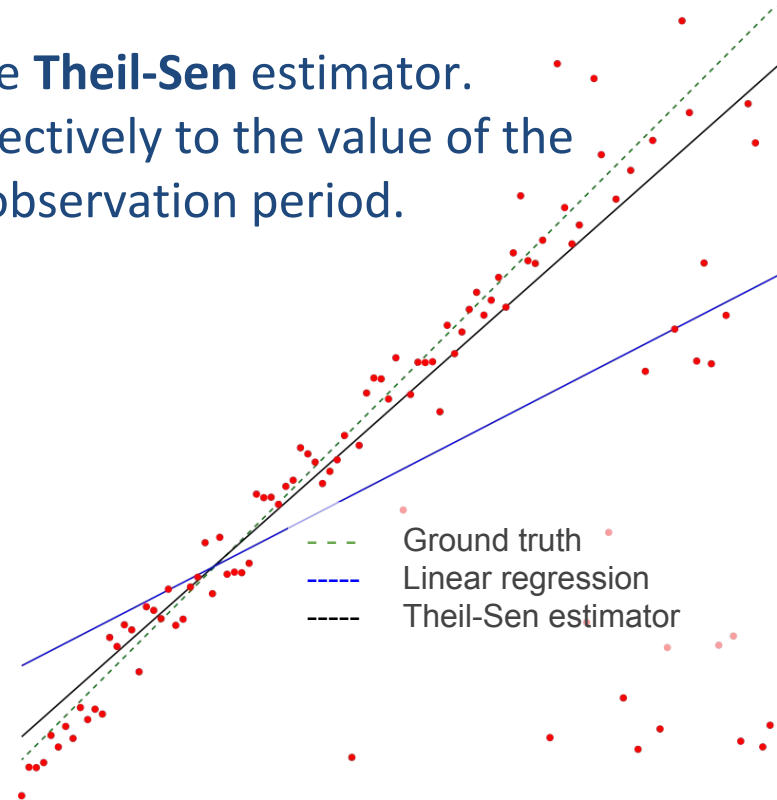
# Methodology (2/2)

- **Significance**

The detection of the trends is performed with the **Mann-Kendall** test with a significance of 90% (p-value below 0.10).

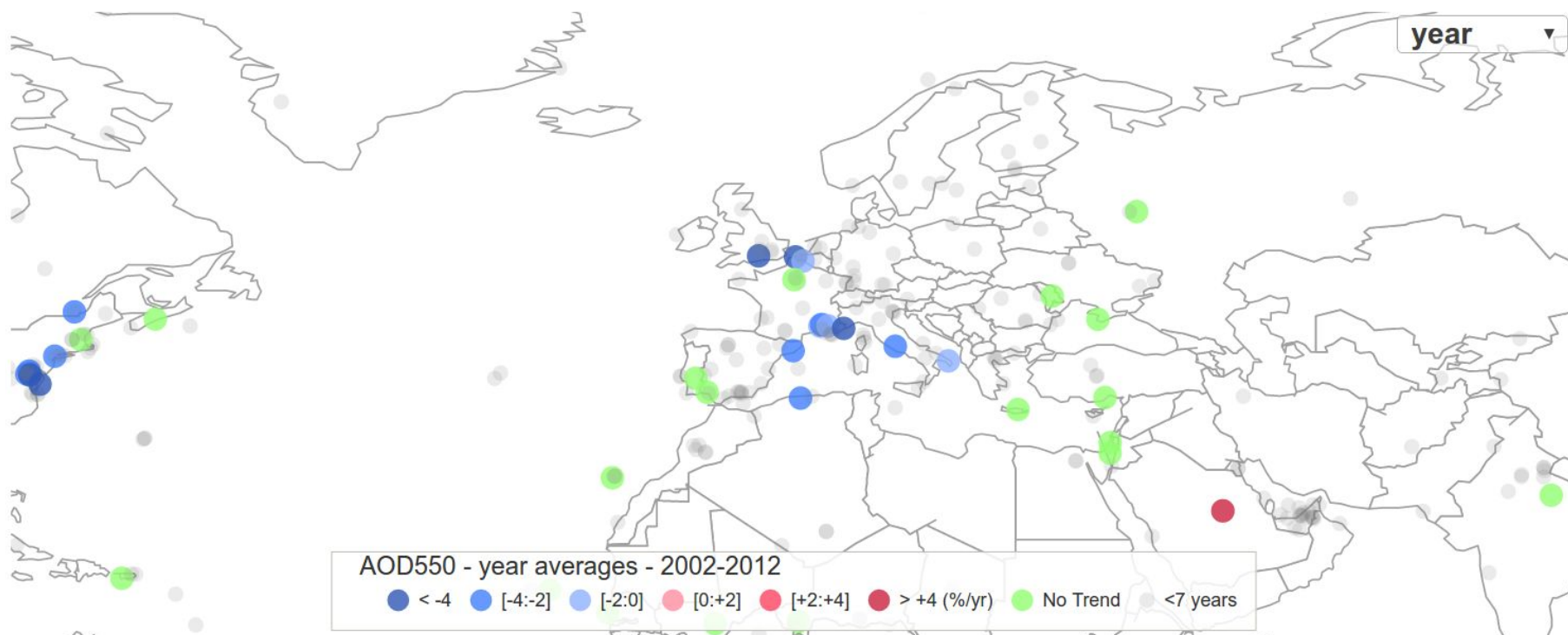
- **Trends quantification**

- Linear regression is performed with the **Theil-Sen** estimator.
- The trend is provided in **% / year**, respectively to the value of the regression line at the first year of the observation period.



# Some examples

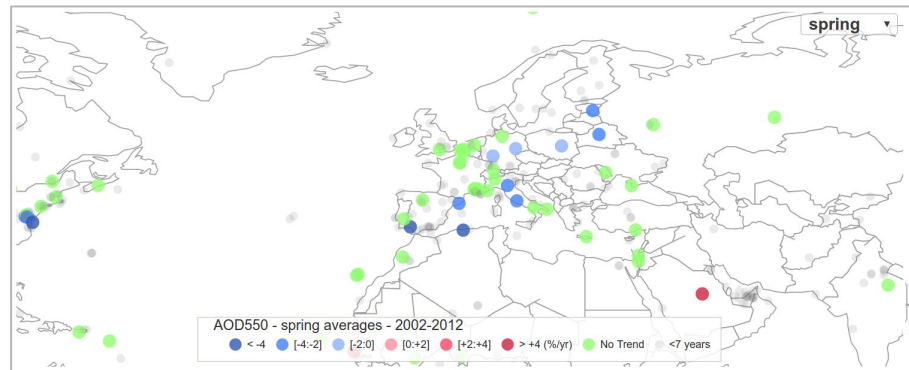
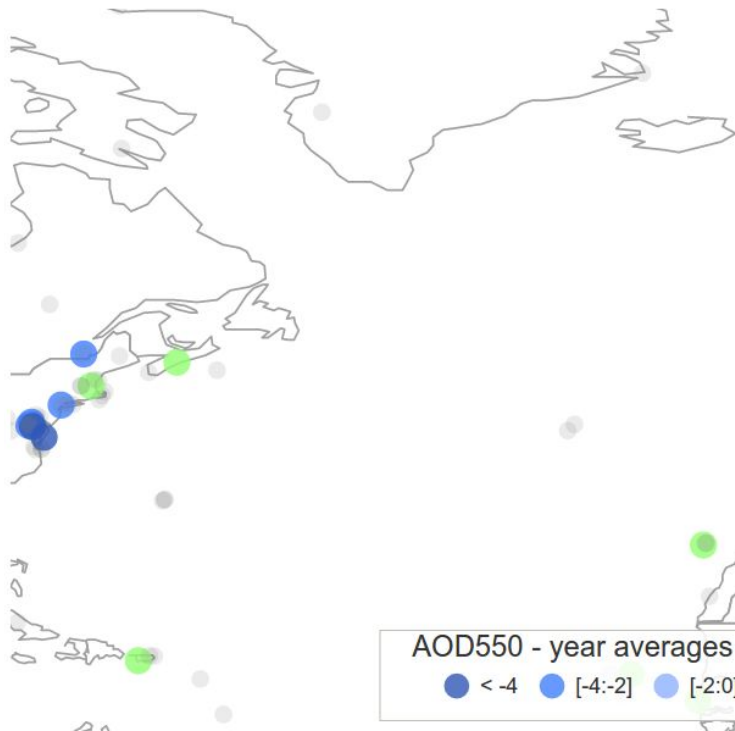
## AOD (2002-2012)



(extracted from the web interface)

# Some examples

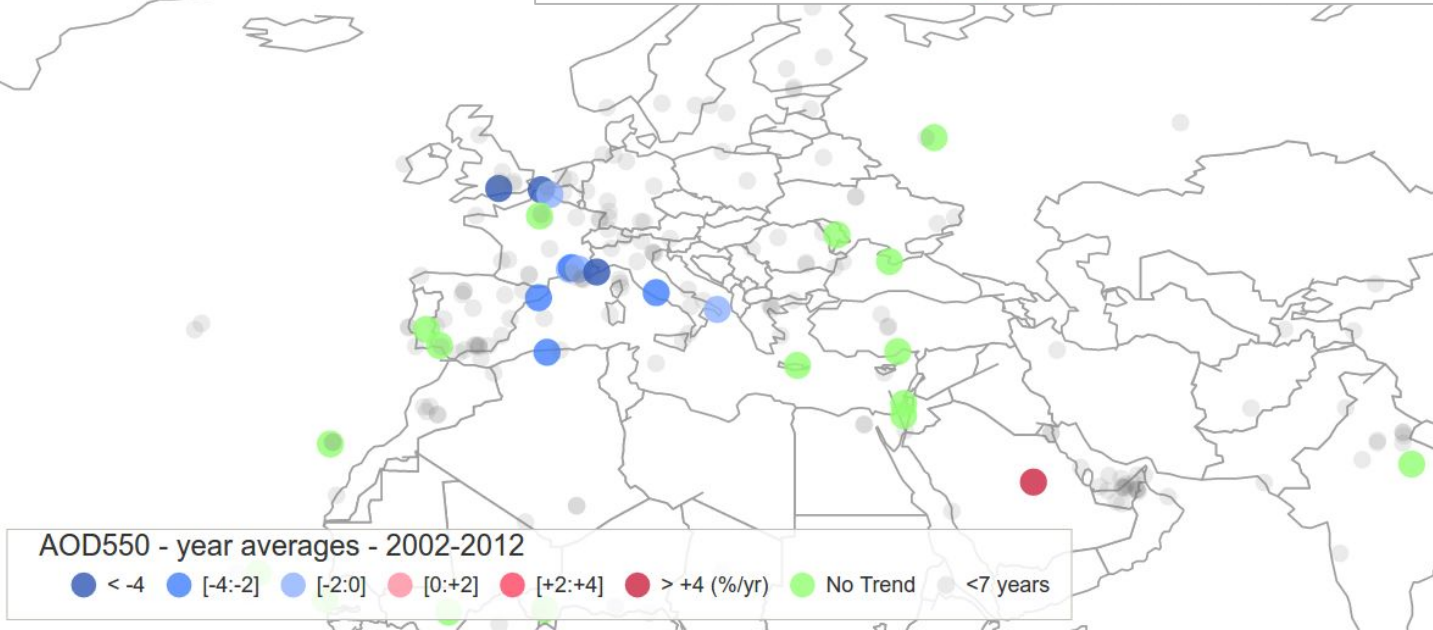
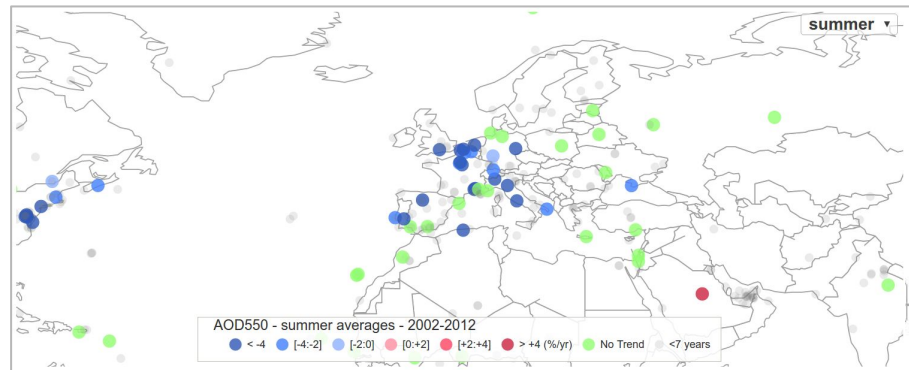
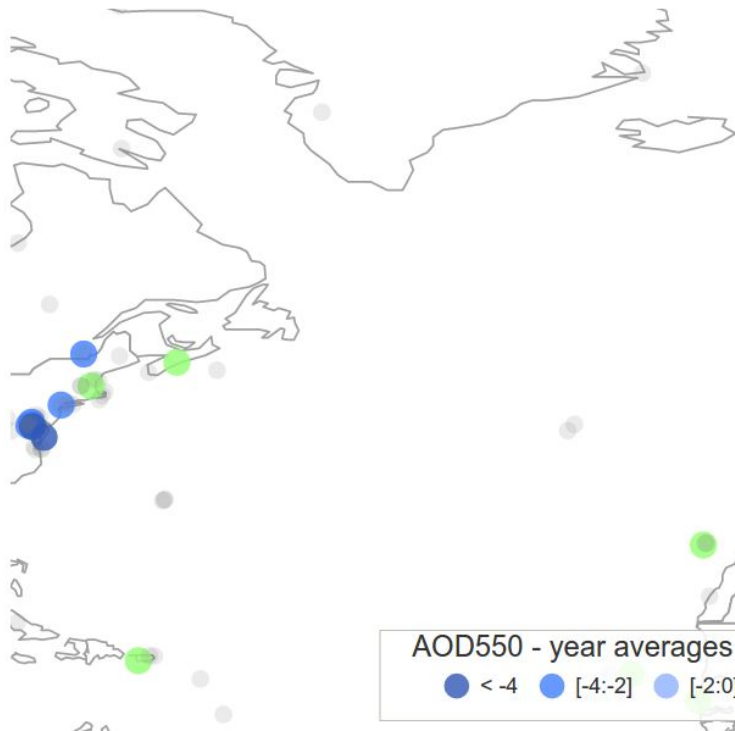
## AOD (2002-2012)





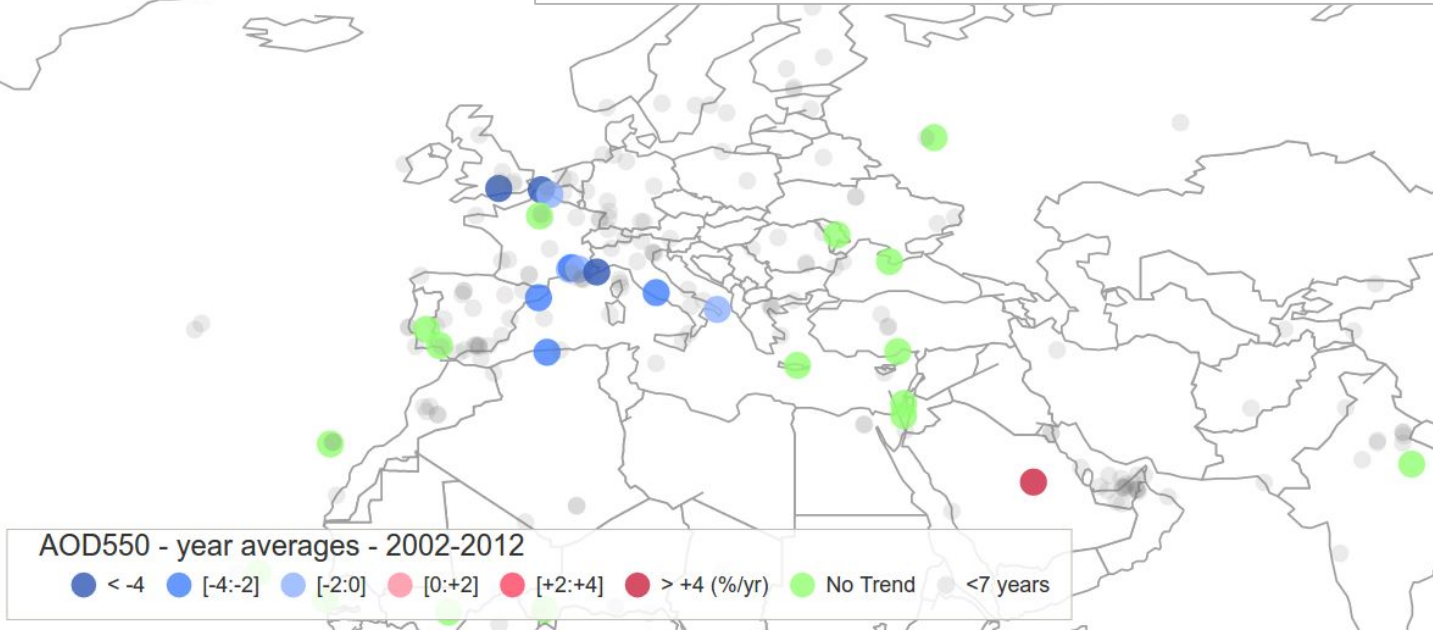
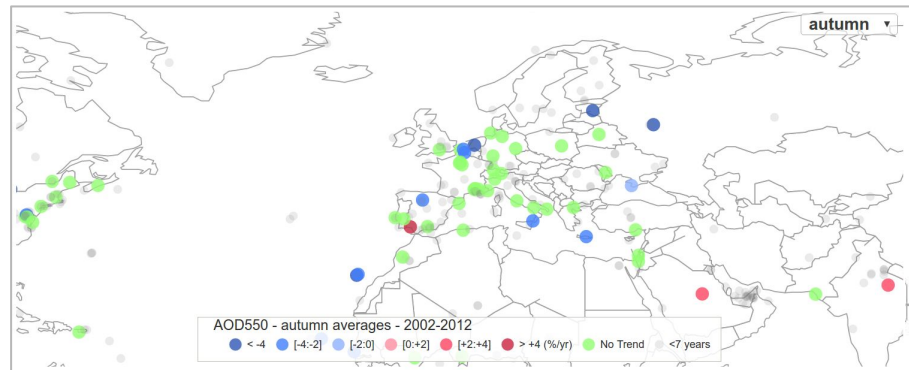
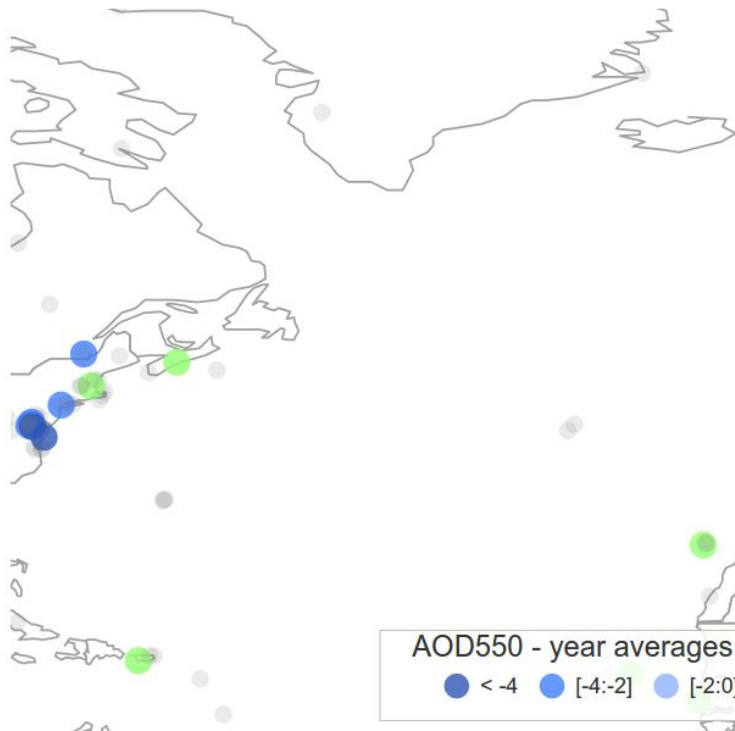
# Some examples

## AOD (2002-2012)



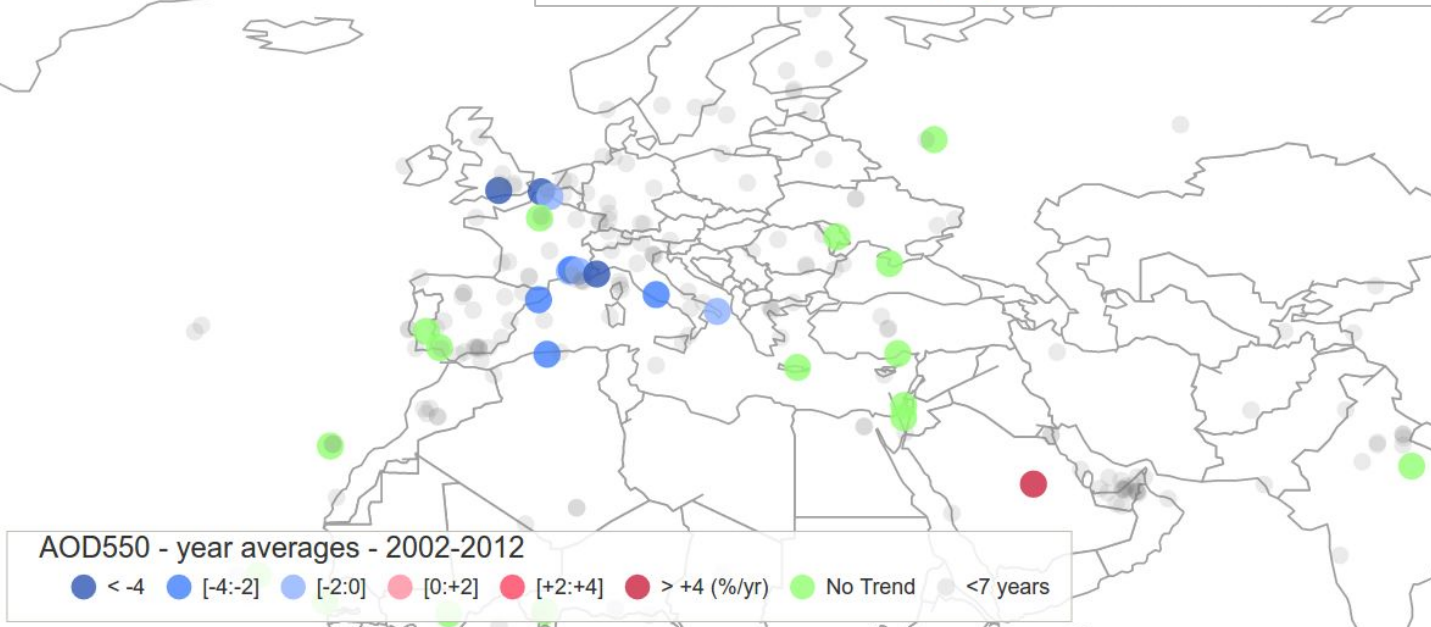
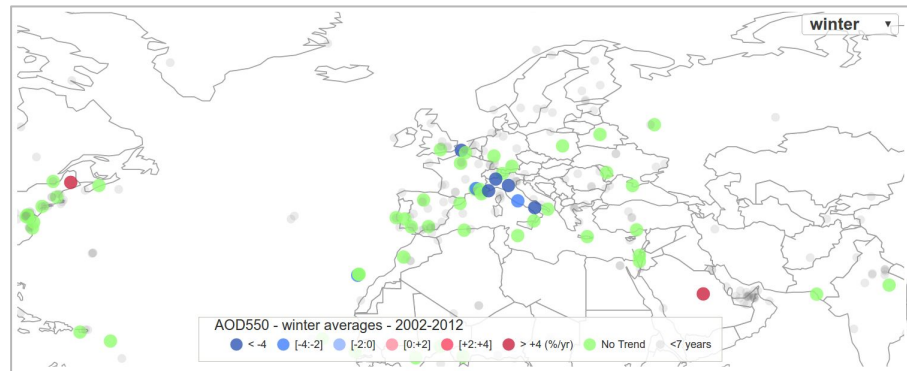
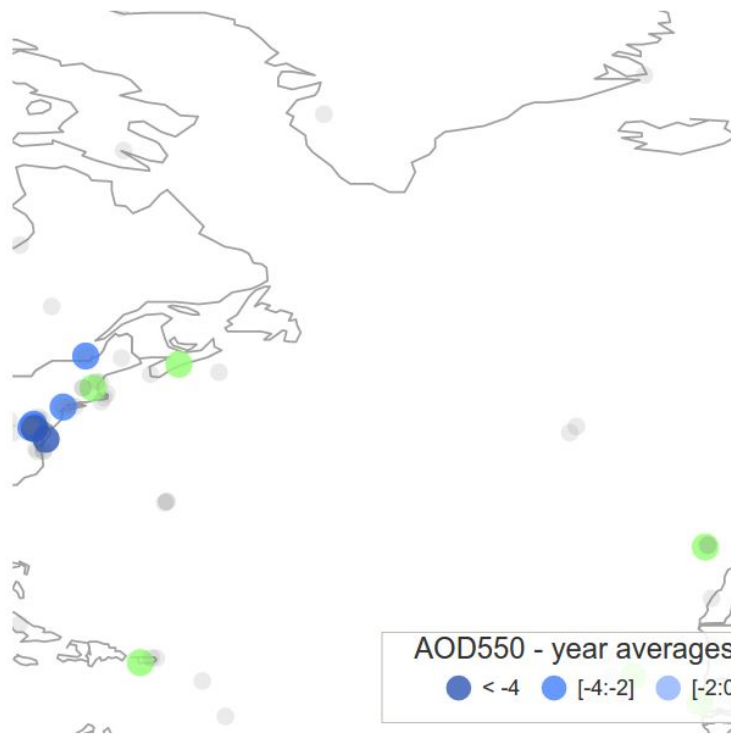
# Some examples

## AOD (2002-2012)



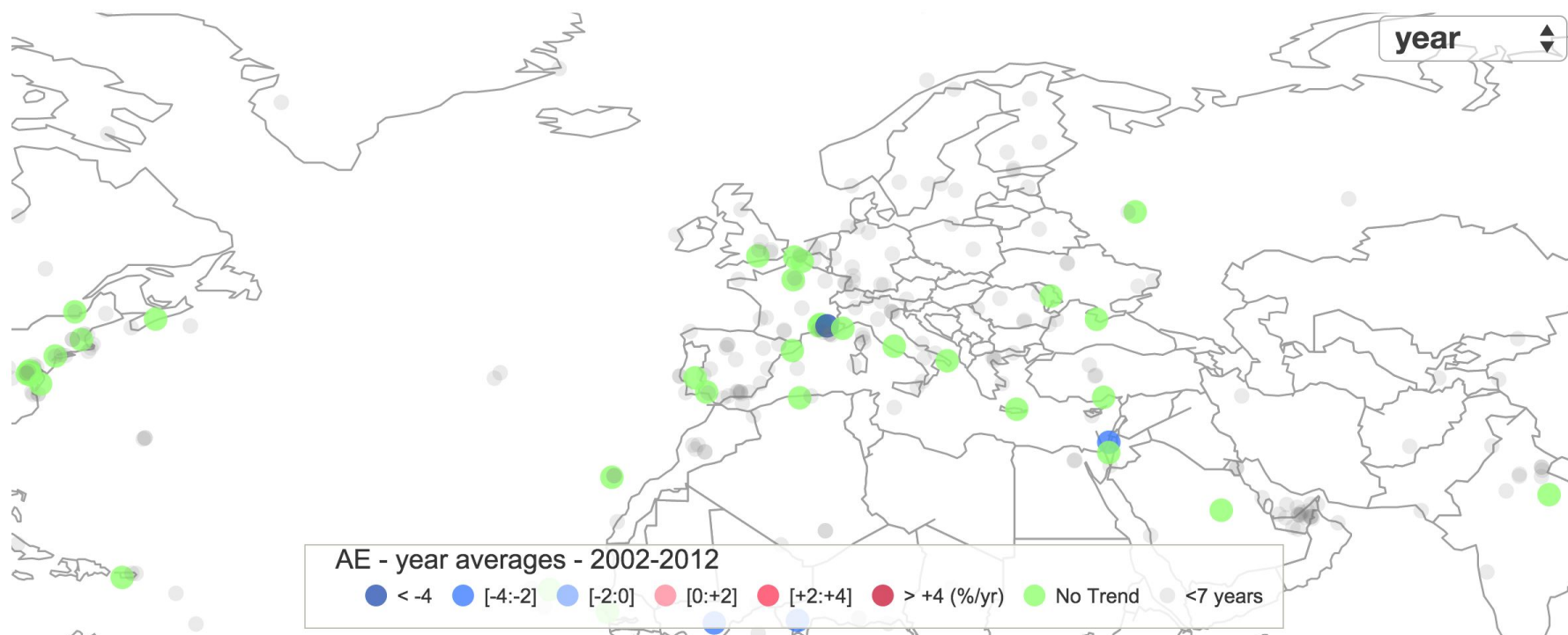
# Some examples

## AOD (2002-2012)



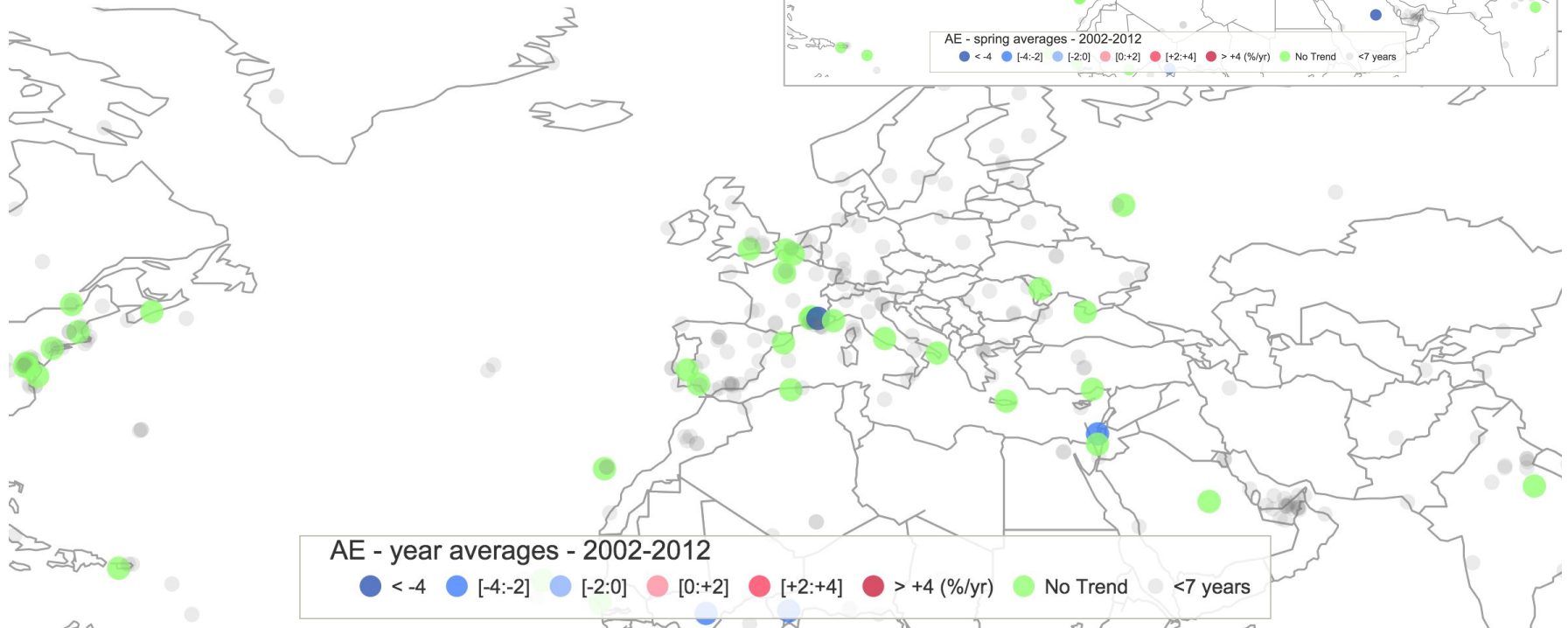
# Some examples

## AE (2002-2012)



# Some examples

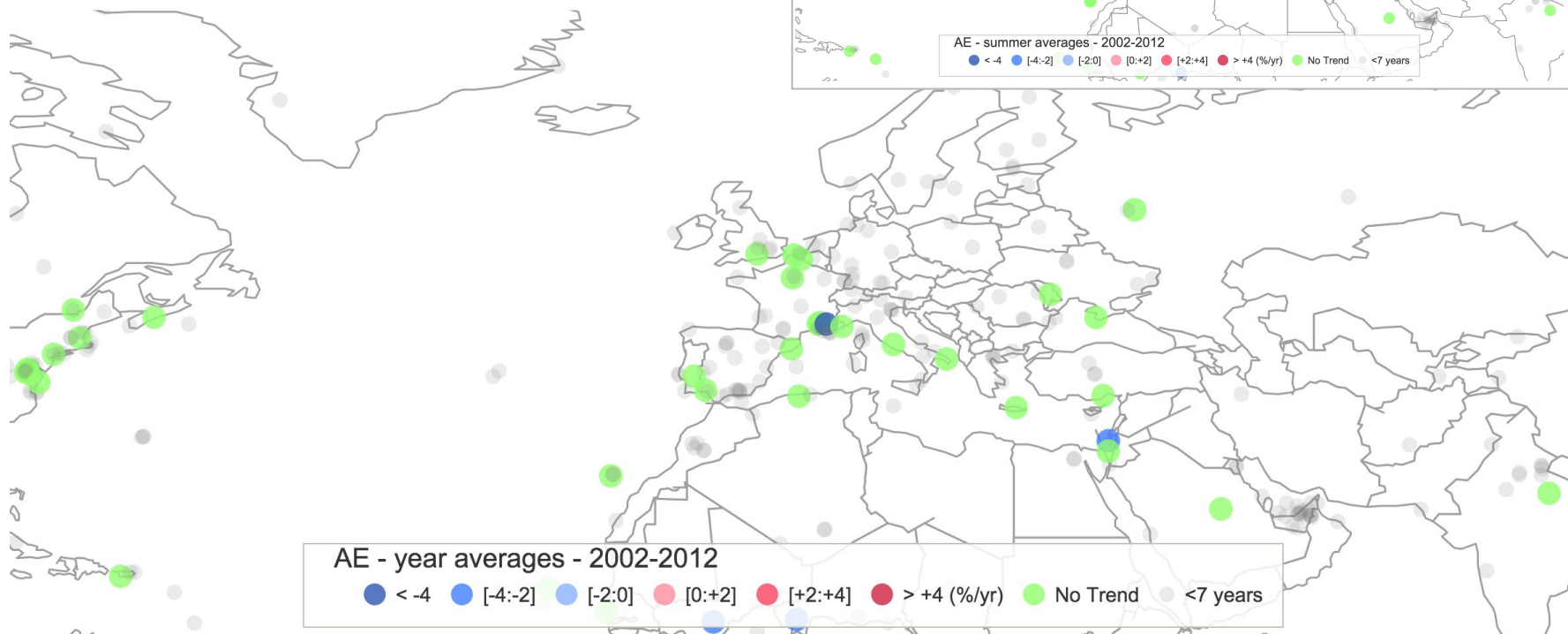
## AE (2002-2012)





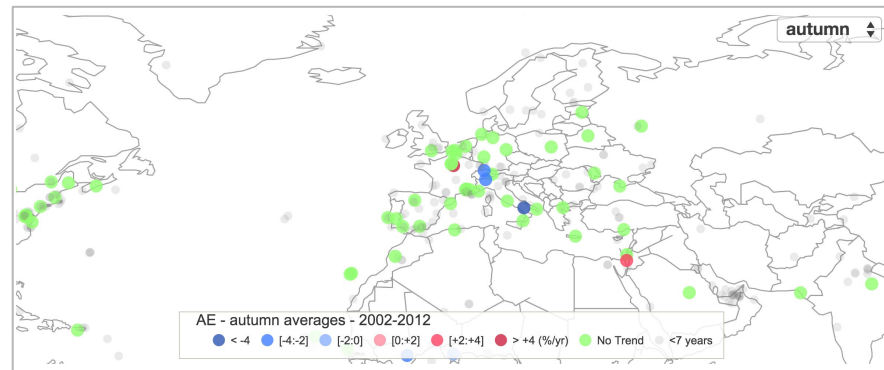
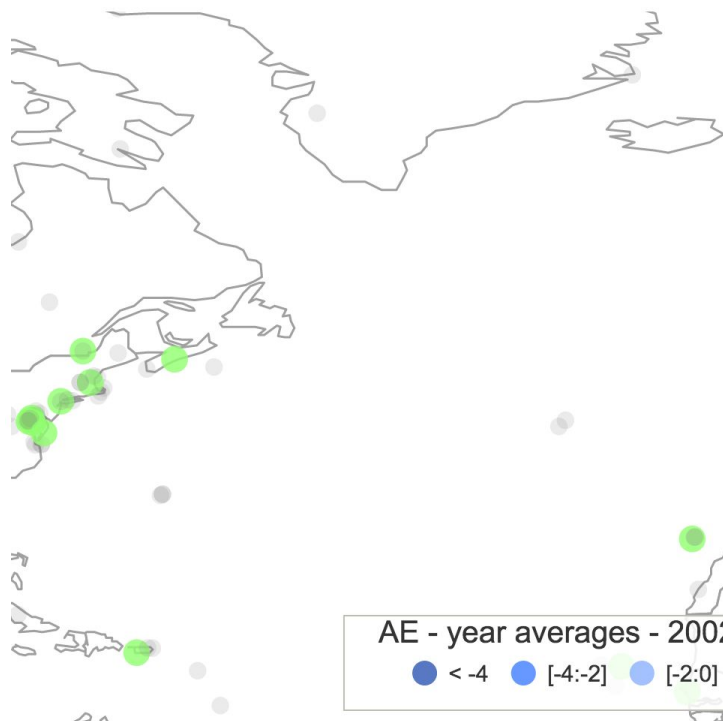
# Some examples

## AE (2002-2012)



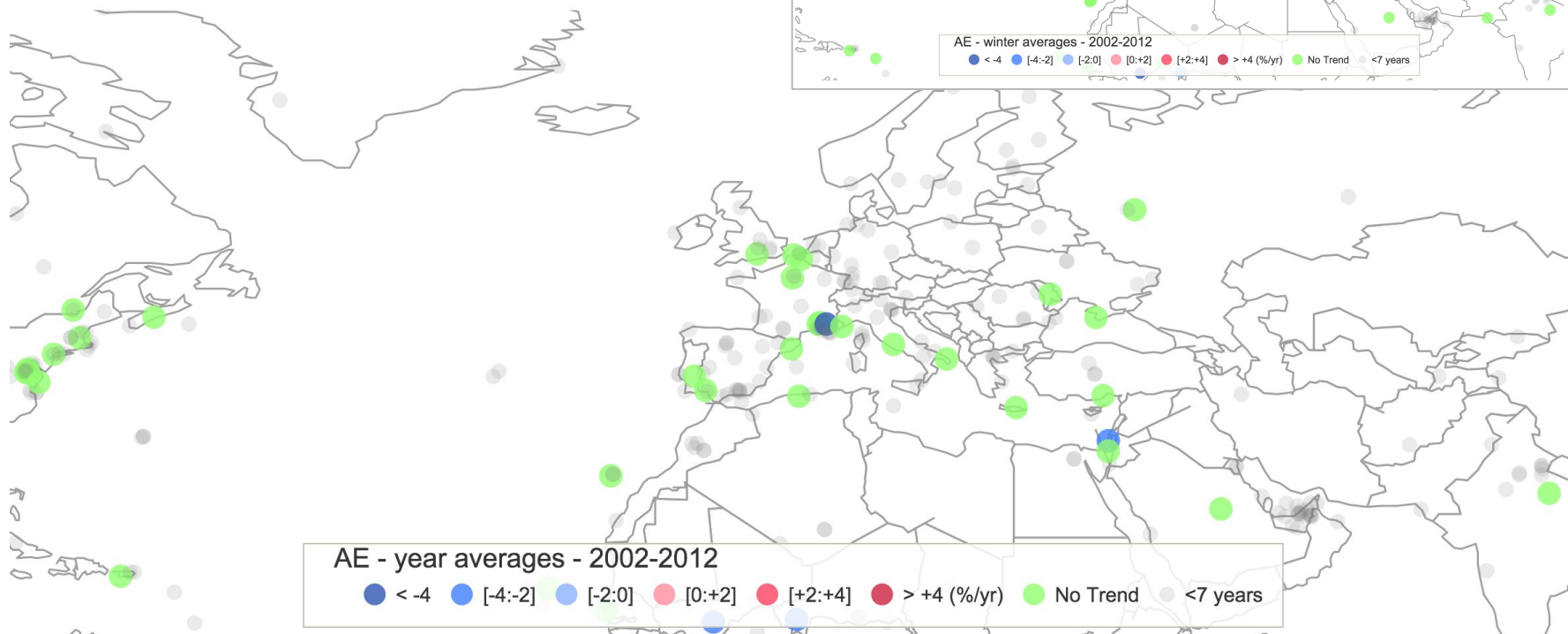
# Some examples

## AE (2002-2012)



# Some examples

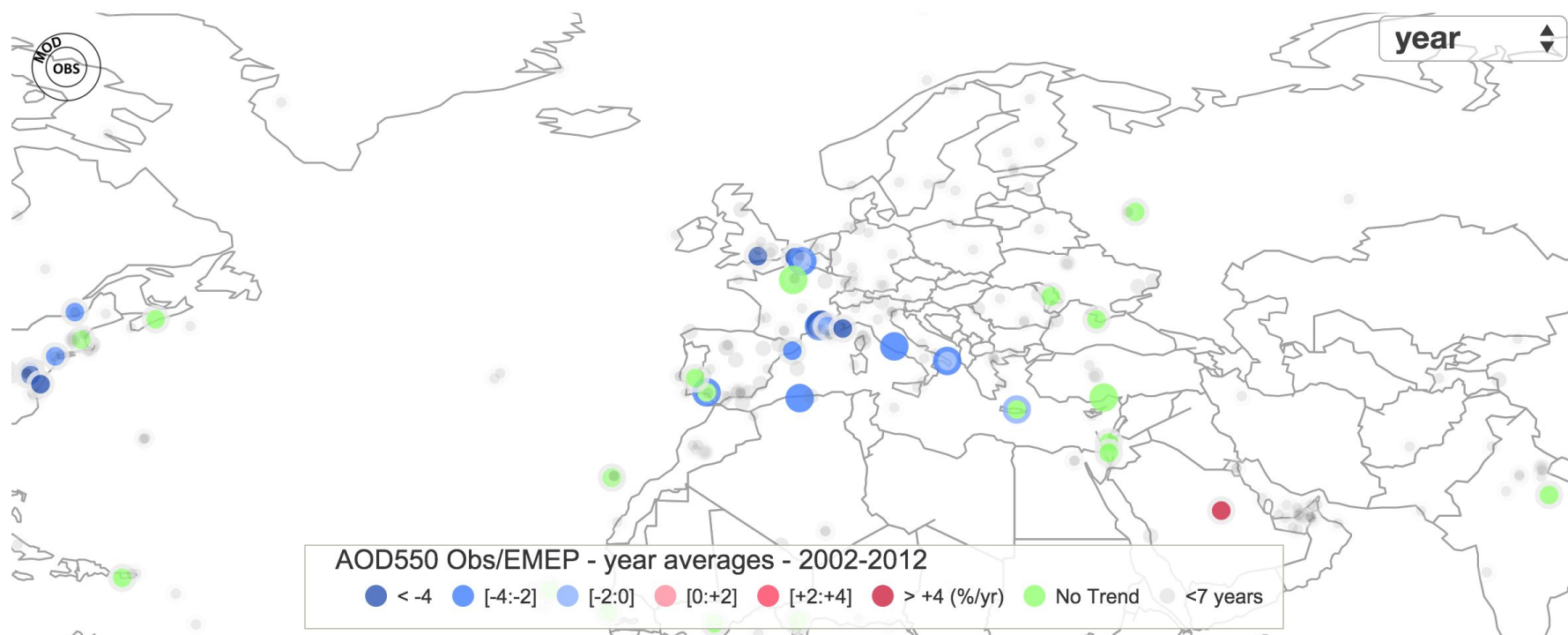
## AE (2002-2012)





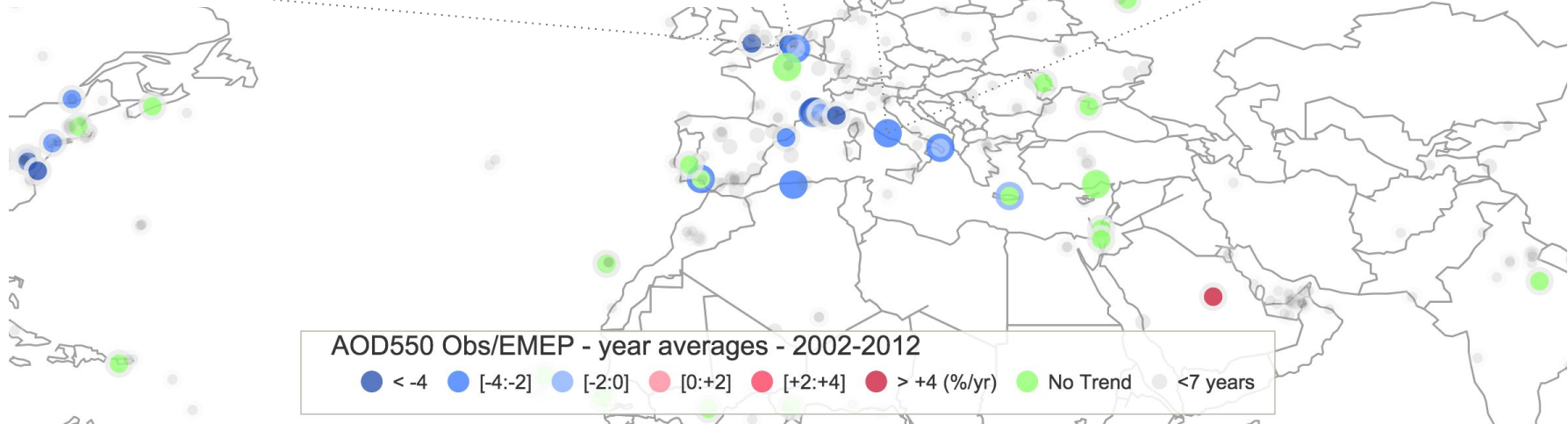
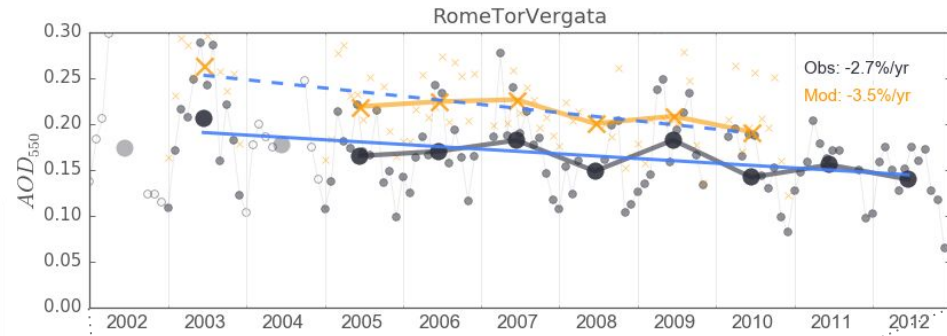
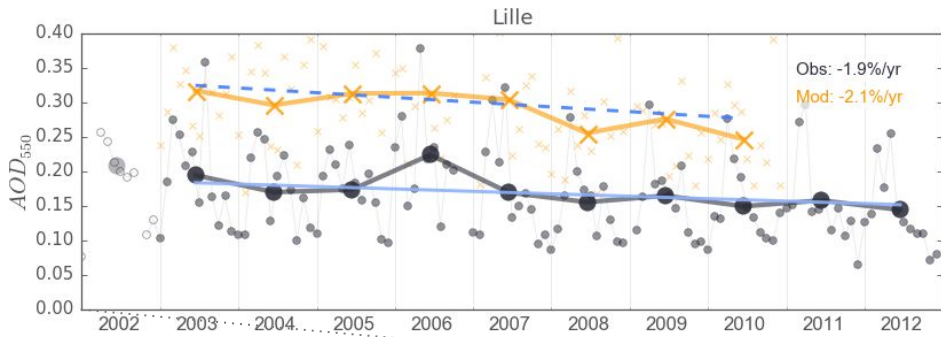
# Some examples

## AOD / EMEP<sup>1</sup> (2002-2012)



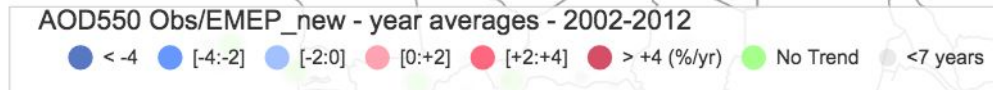
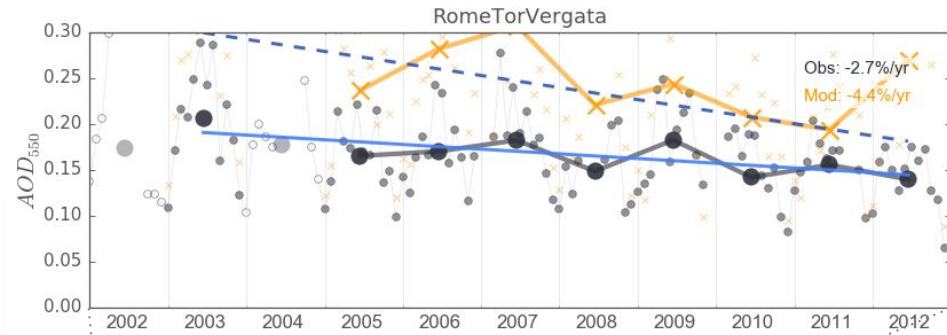
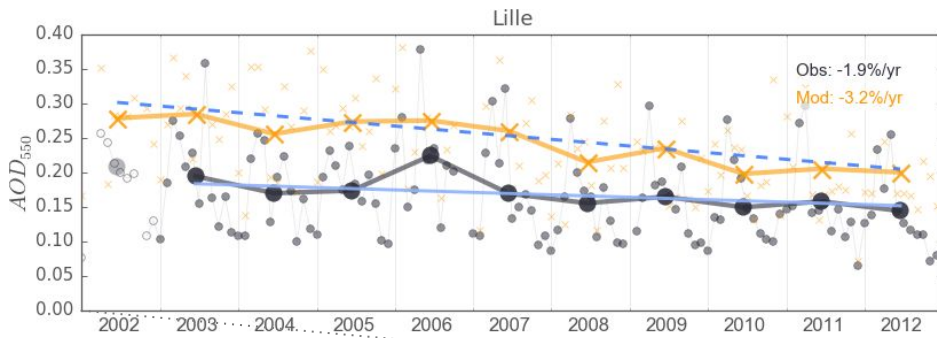
# Some examples

## AOD / EMEP<sup>1</sup> (2002-2012)



# Some examples

## AOD / EMEP<sup>2</sup> (2002-2012)

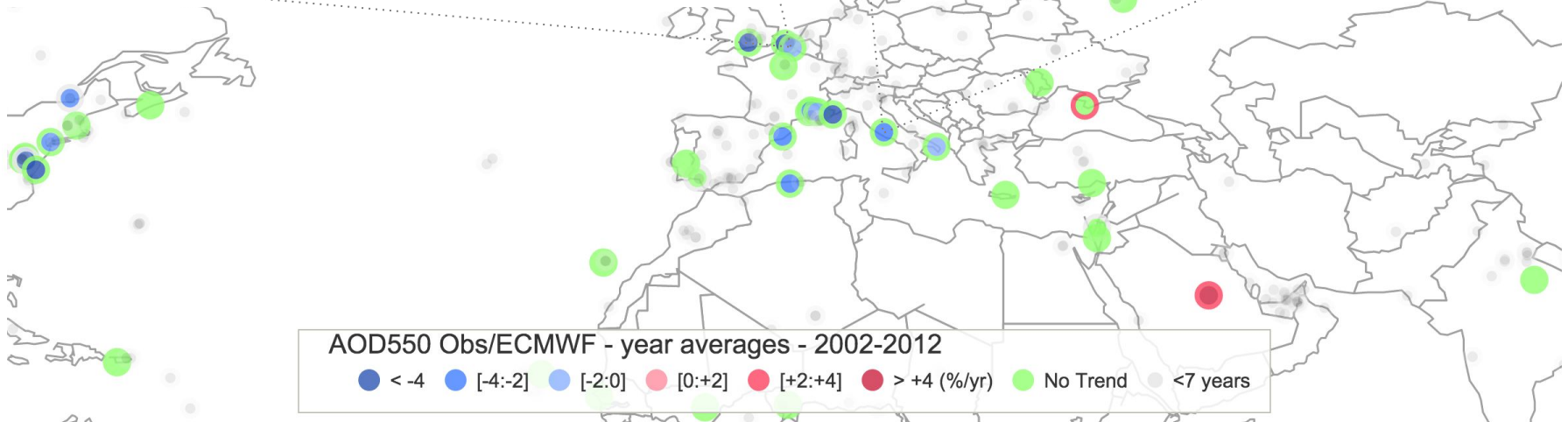
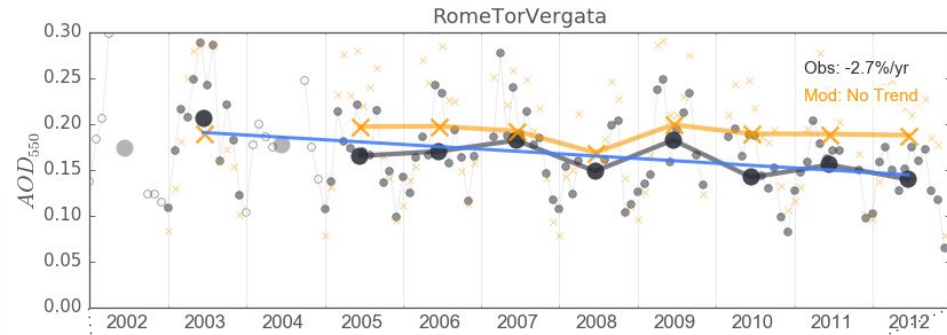
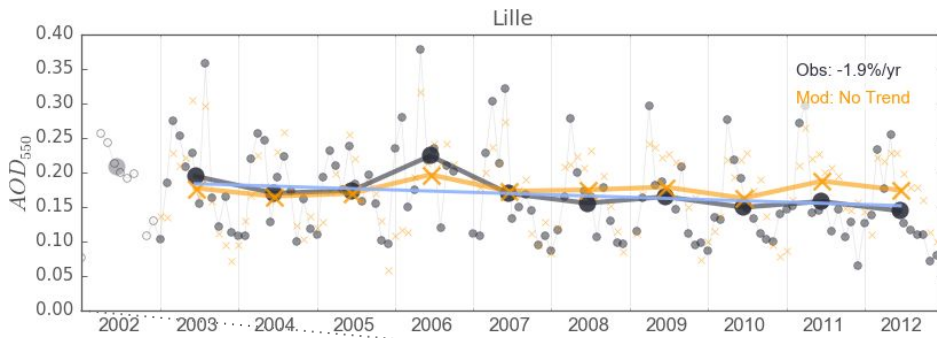


AOD550 Obs/EMEP\_new - year averages - 2002-2012

● <-4 ● [-4:-2] ● [-2:0] ● [0:+2] ● [+2:+4] ● >+4 (%/yr) ● No Trend ● <7 years

# Some examples

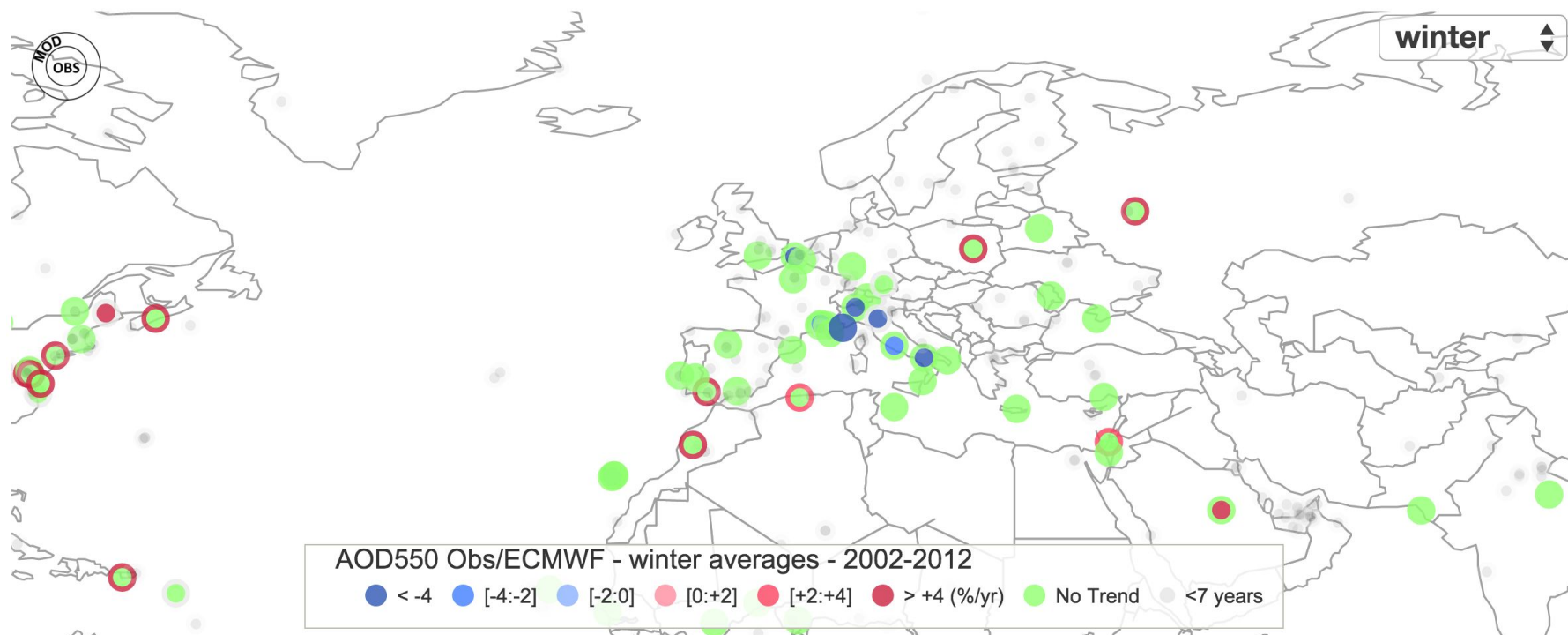
## AOD / ECMWF (2002-2012)





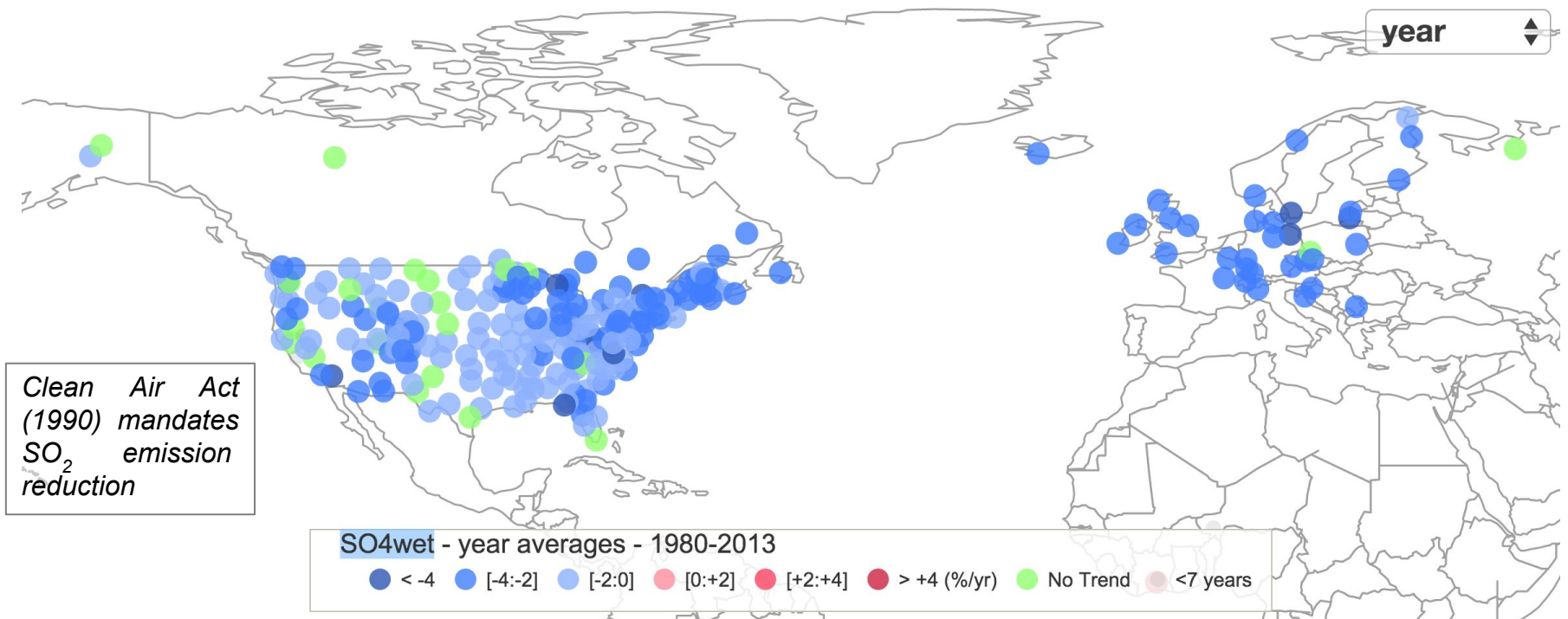
# Some examples

## AOD / ECMWF (2002-2012)



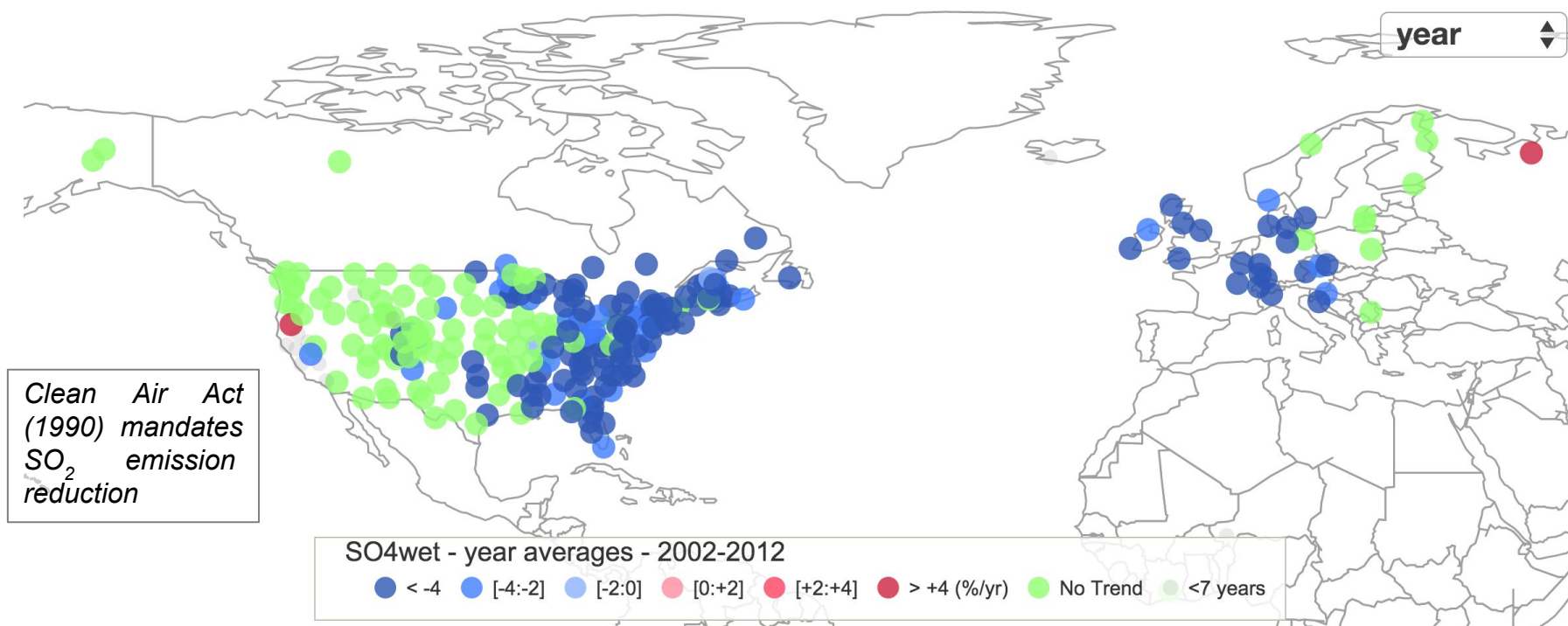
# Some examples

## SO4 (1980-2013)



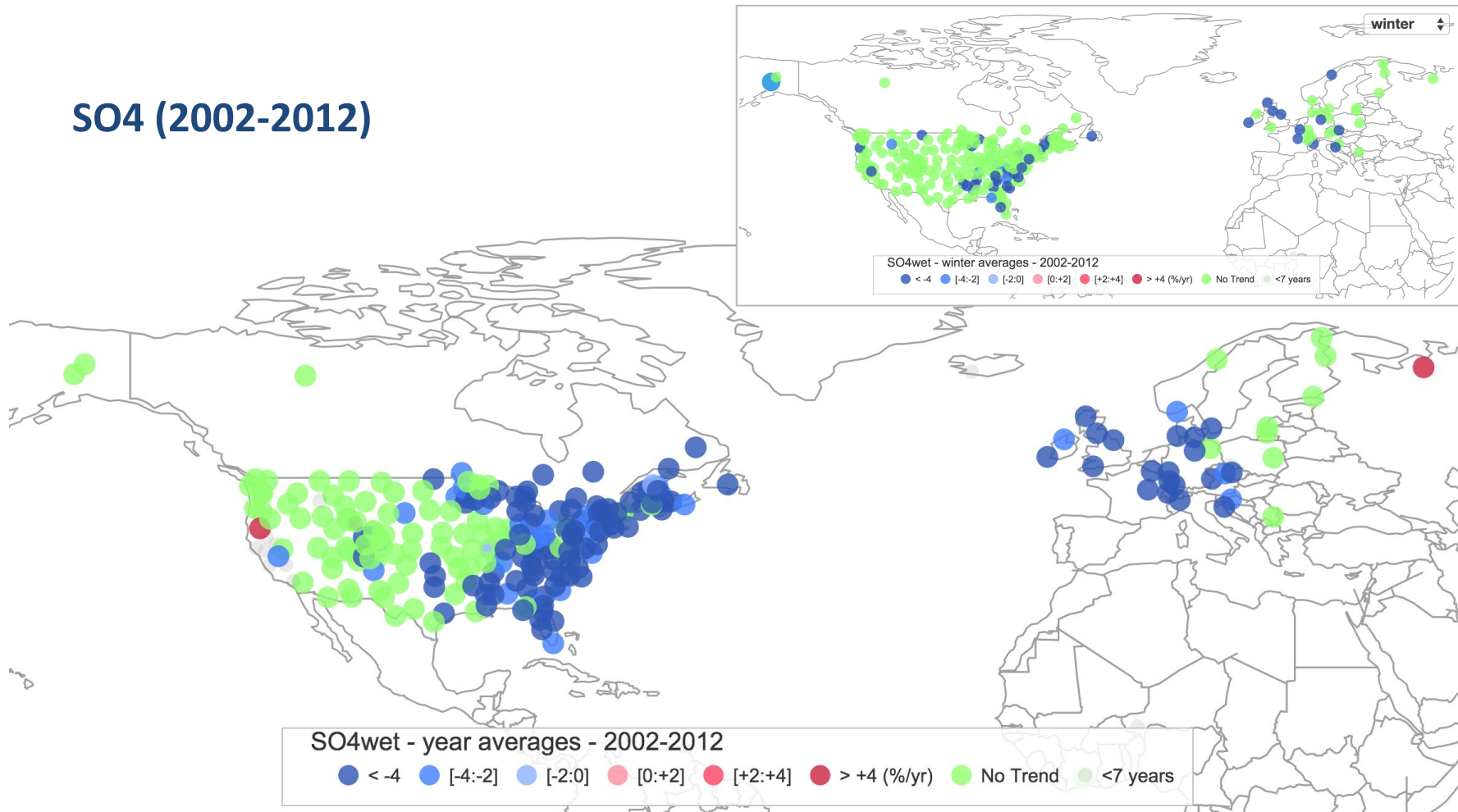
# Some examples

## SO4 (2002-2012)



# Some examples

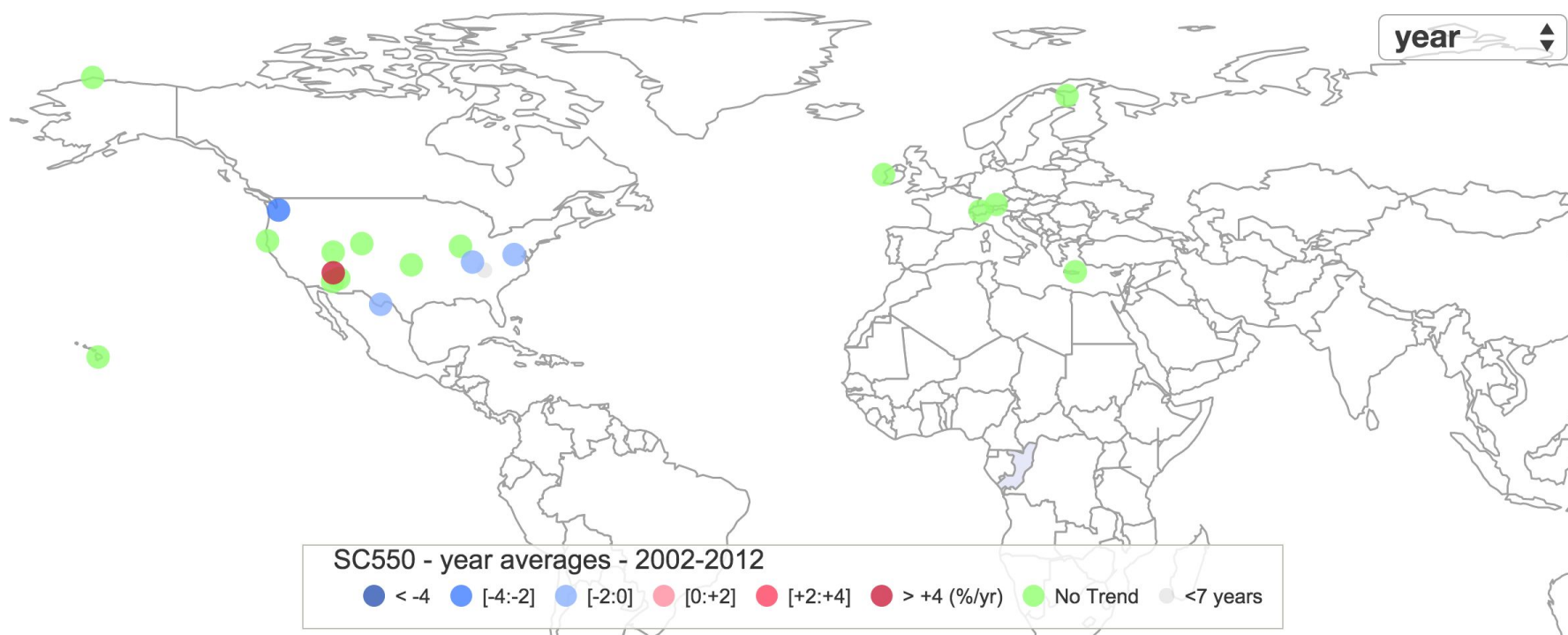
## SO4 (2002-2012)





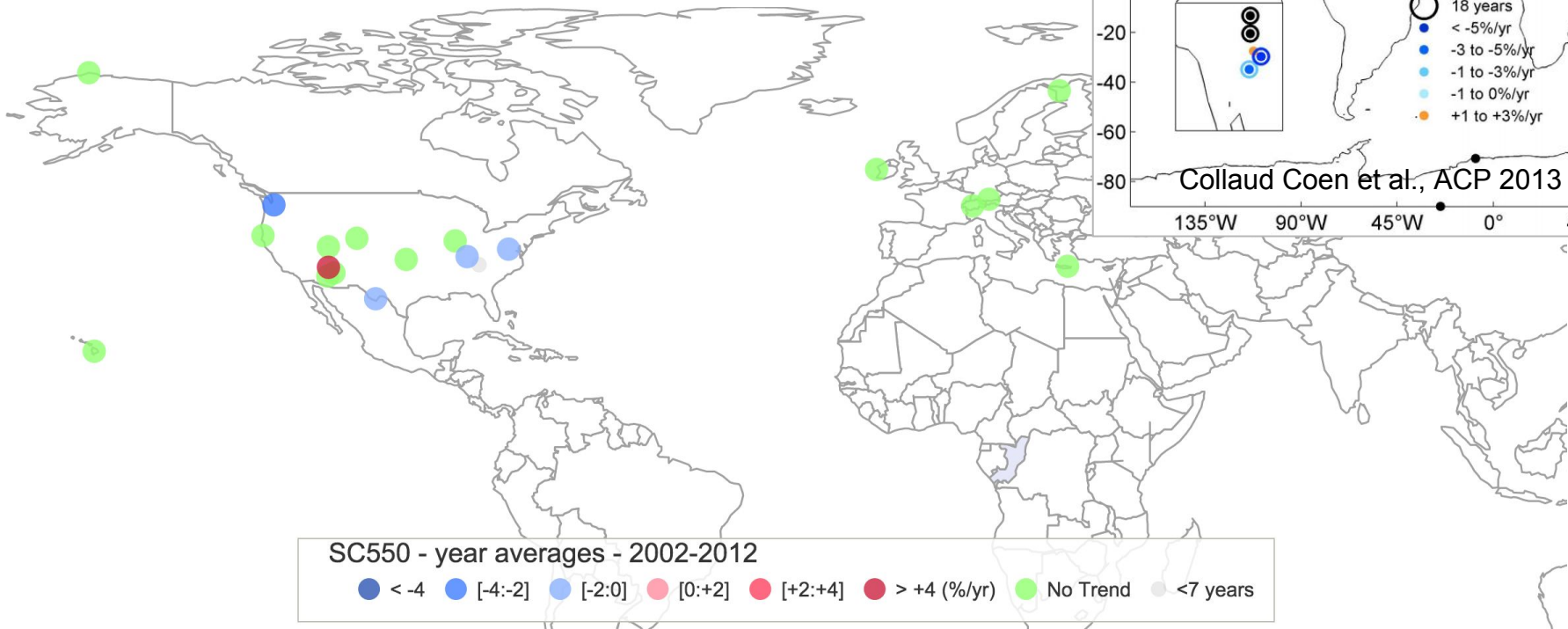
# Some examples

## SC (2002-2012)

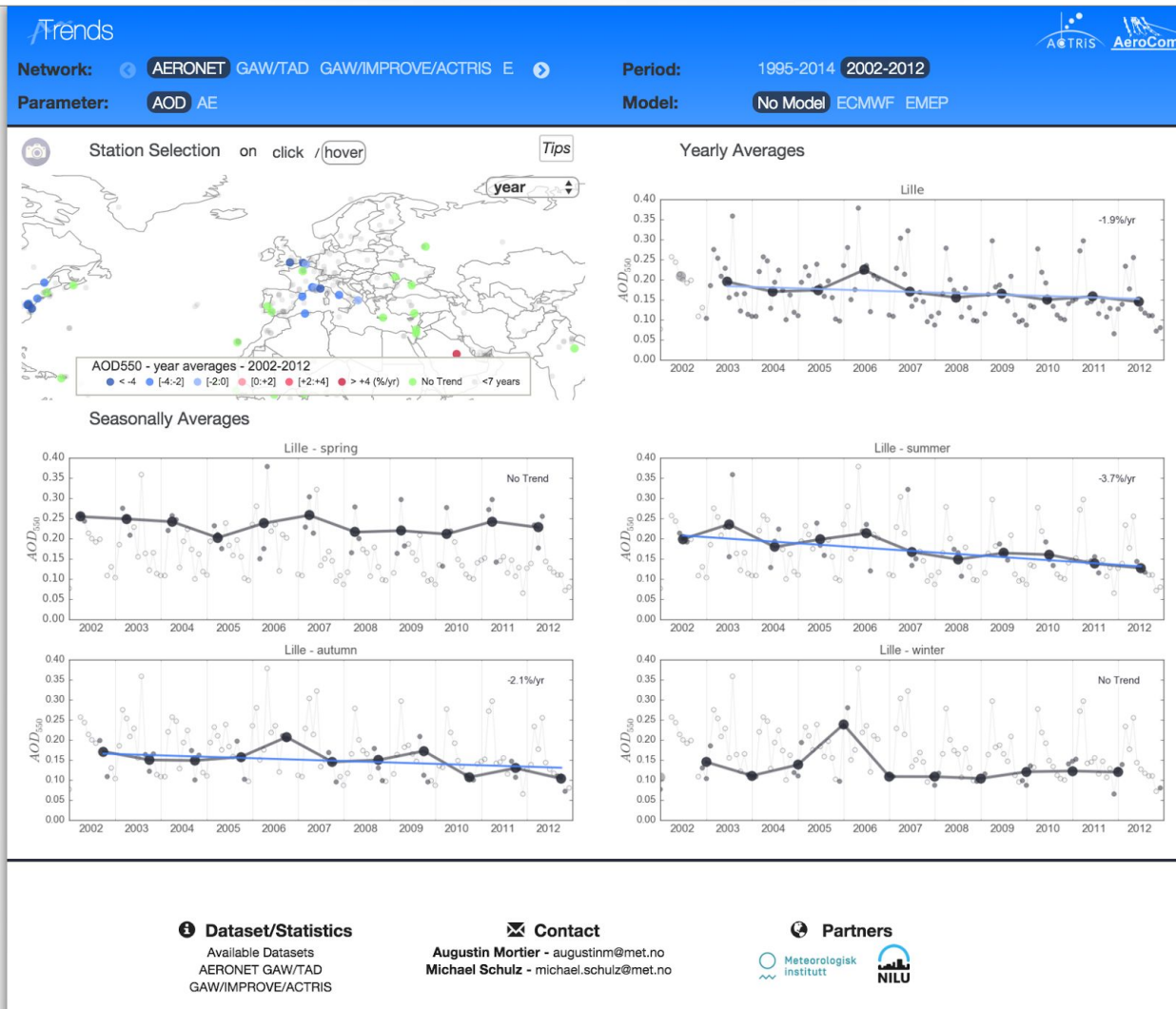


# Some examples

## SC (2002-2012)



# Interface



<http://aerocom.met.no/trends>