From Air Quality modelling to Air Quality policy

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General Public

Scientists

Policy Makers

Environment

Air Quality

- Usually considered as a local problem to be assessed/solved with local tools/measures

- More awareness during the last few decades about long-range transported air pollution

- Peaks vs. background levels

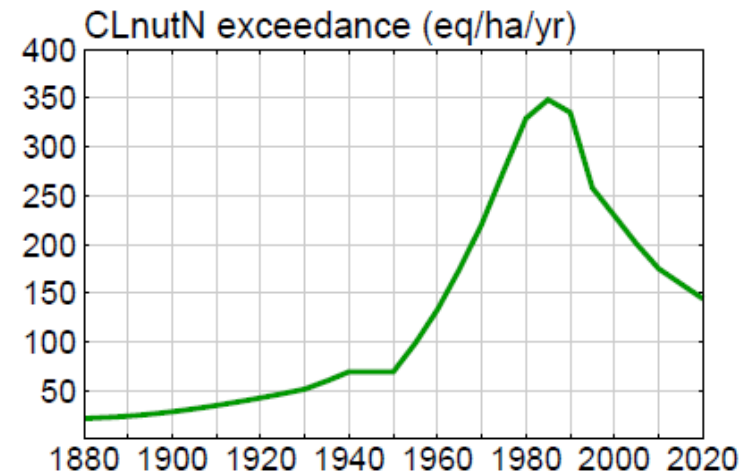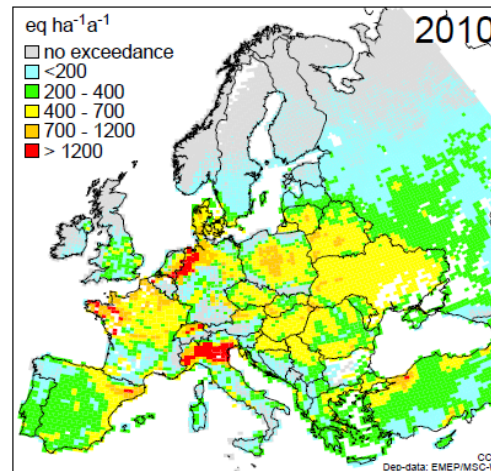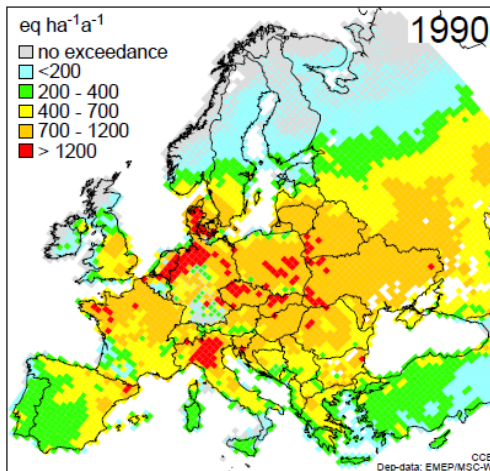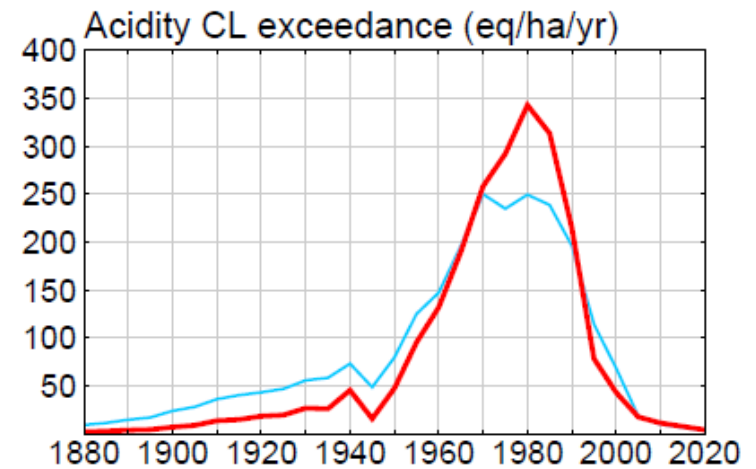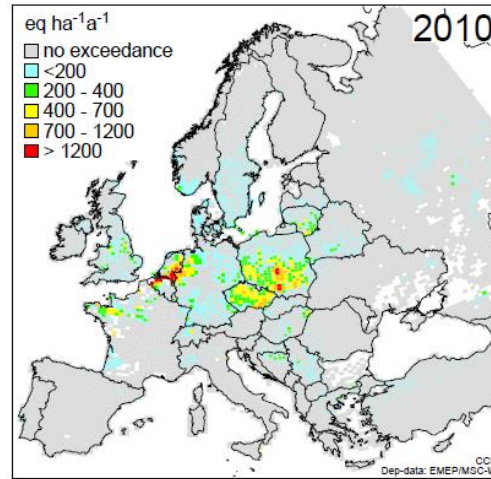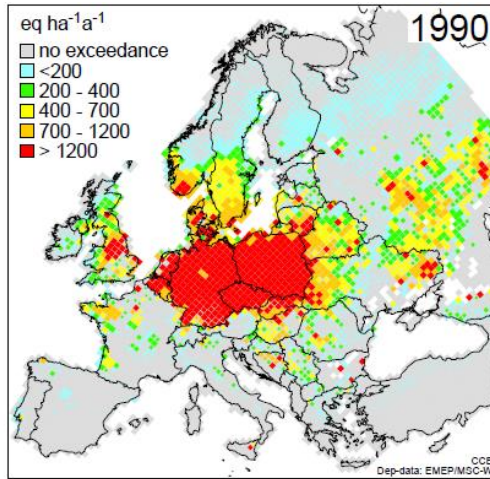- Health effects are difficult to quantify

Photo Credit: Kyodo News

1980s : acid rain in Europe - transboundary air pollution

…the situation has improved since the 1980s, but the problem is not fully solved. There are still many exceedances of *critical loads* (especially eutrophication).

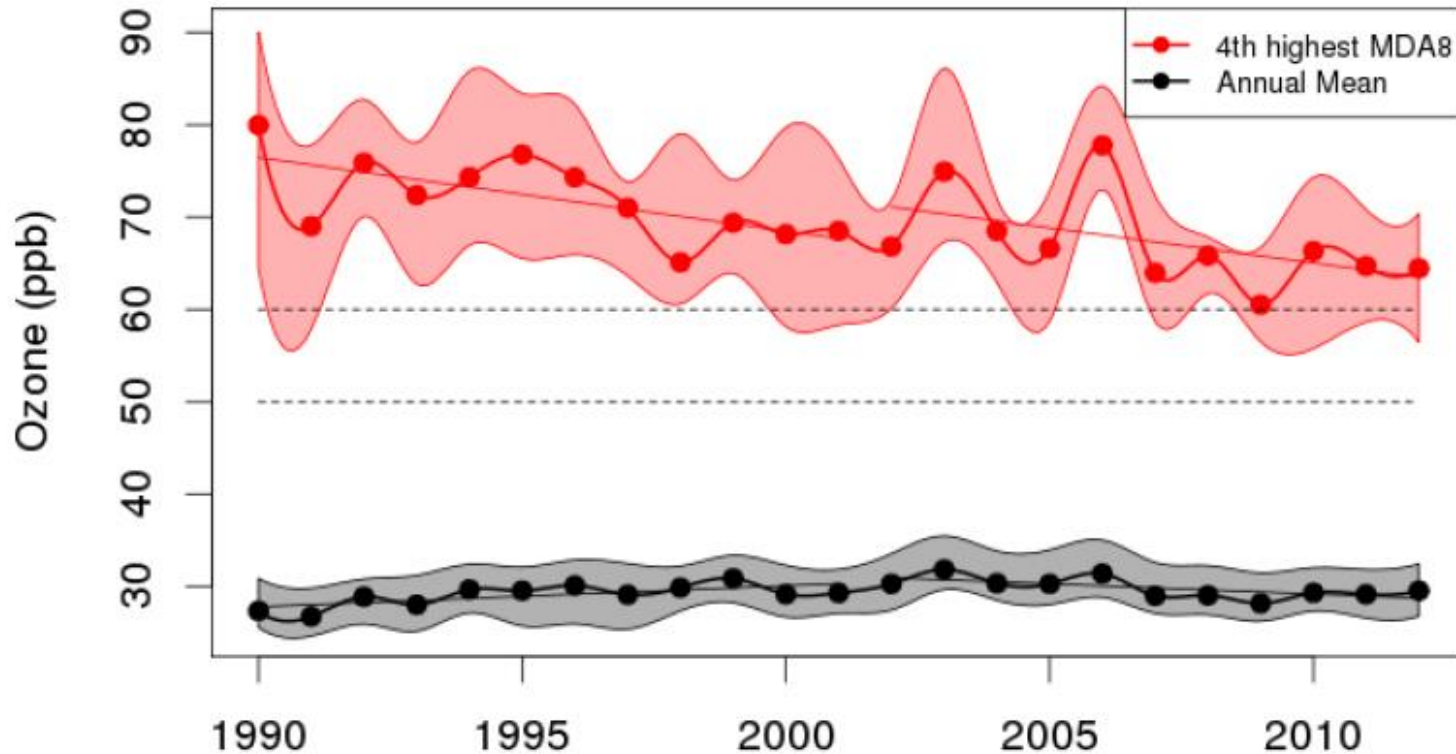# Trends in air concentrations and depositions in Europe (1/2)

Trends in critical load exceedance. Top: acidification, bottom: eutrophication.

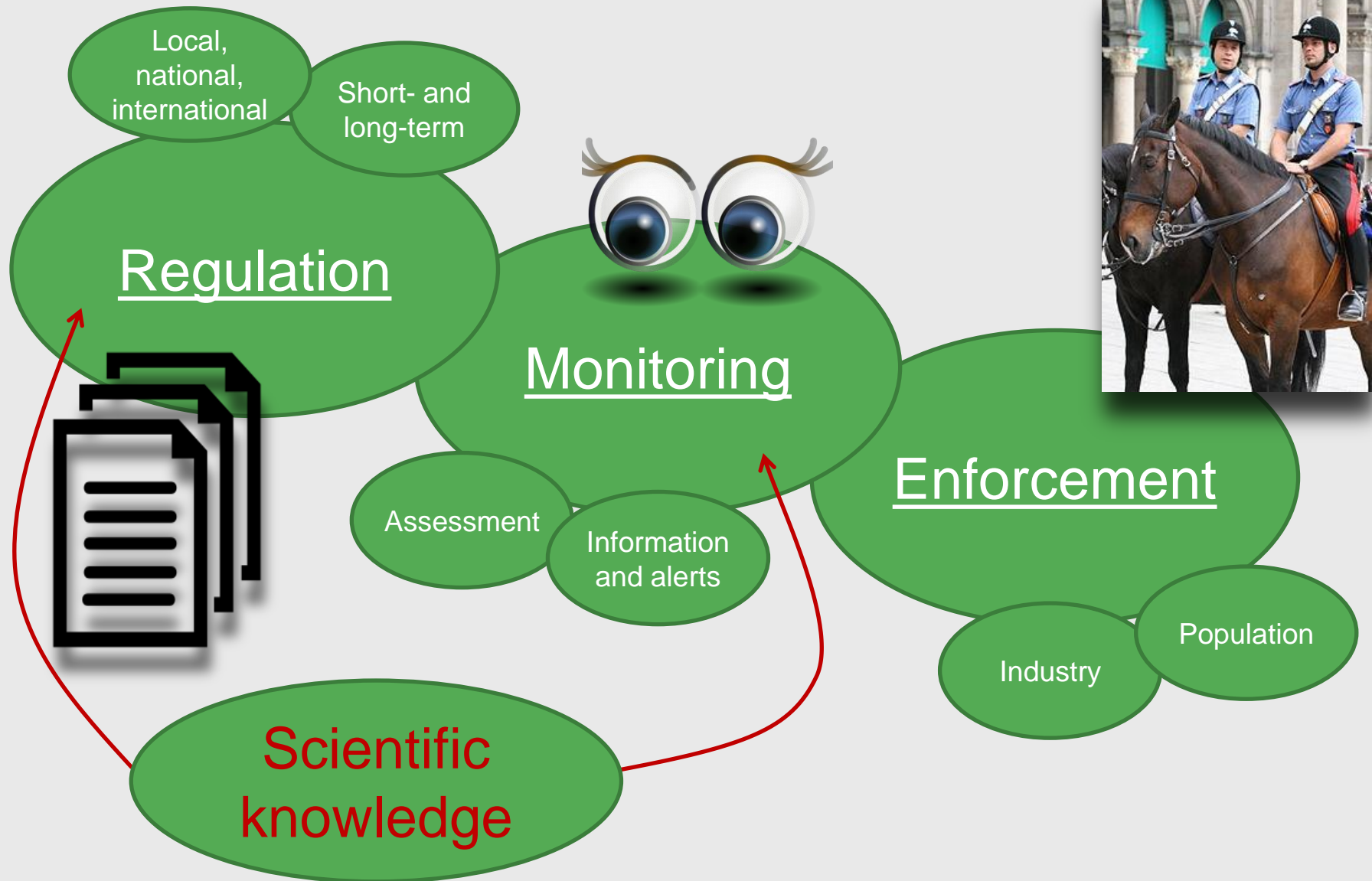*From: ICP Waters report 125/2015*
http://www.icp-waters.no/

Trends in air concentrations and depositions in Europe (2/2)

Annual mean ozone (black) and 4th highest MDA8 (red) ozone recorded at EMEP rural monitoring sites between 1990 and 2012.

The thick line is the network-wide annual median and lower/higher bounds of the shaded areas are for the 25th and 75th percentiles.

What is "Air Quality Policy"?

Regulation

Local, national, international

Short- and long-term

Monitoring

Assessment

Information and alerts

Enforcement

Industry

Population

Scientific knowledge

The Environmental Kuznets Curve

(1991)

Source: Ausubel and Waggoner, 2009

But: The world is not as simple!

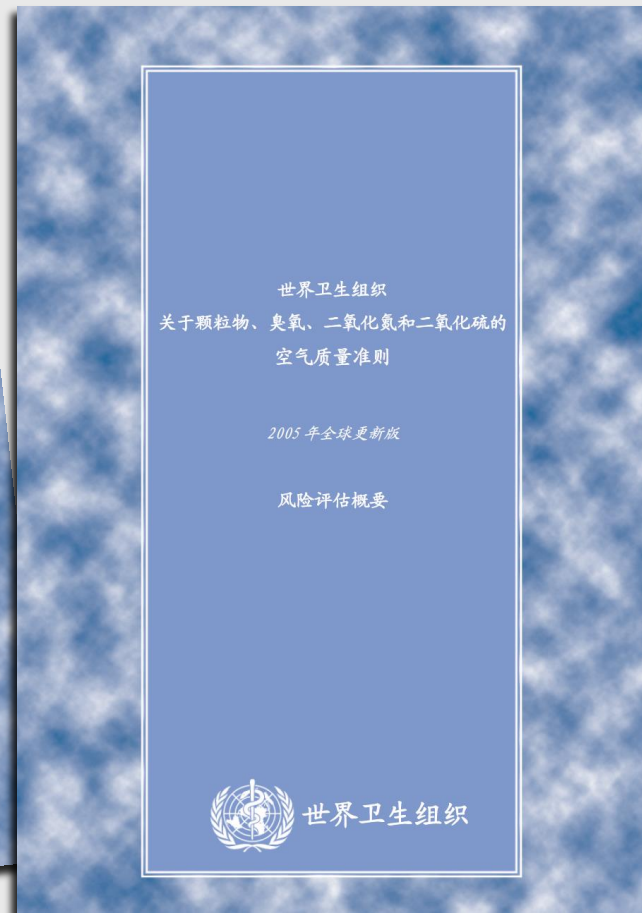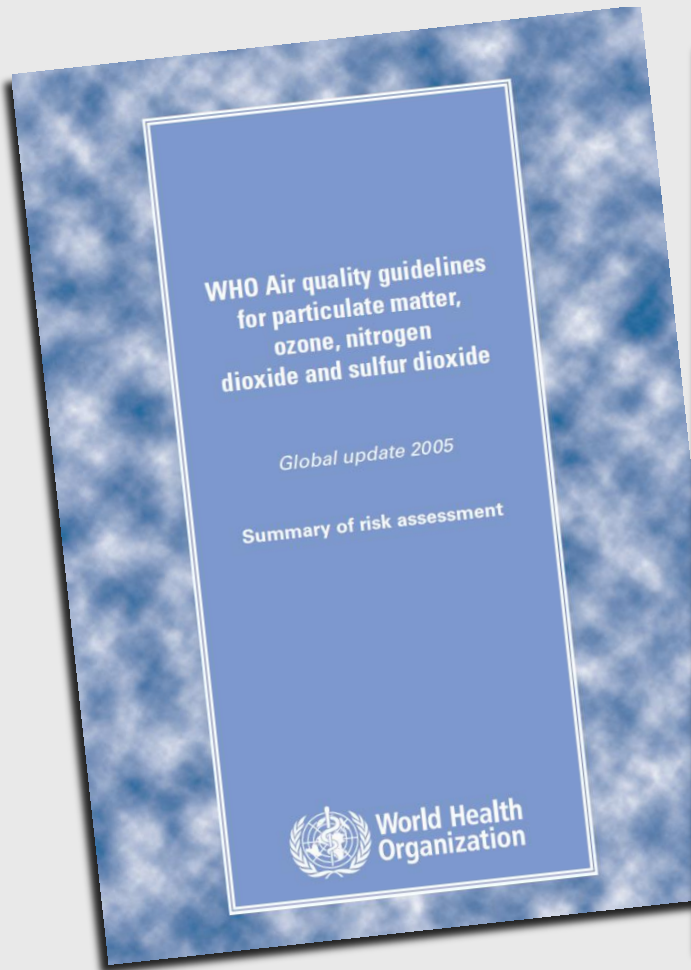Question: How is environmental technology brought about?
Who has to push for it?

How does environmental improvement come about?

- Voluntary changes, e.g. in public behavior, based on scientific knowledge? (air pollution predictions, WHO guidelines, etc.)
- Scientific endeavor?
- Environmentalists?
- Changes as a response to catastrophic air pollution?

- Air quality policy? (rules, taxes, incentives, fines, …)
    - And if so, how does Air Quality Policy come about? (economic cost, public awareness, severe air pollution episodes, …)

World Health Organization (WHO)

Ambient

Air Quality

Guidelines

http://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/

From AQ guidelines to AQ standards: PM

		WHO guideline	EU limit / target	US Primary / Secondary	China Grade I / Grade II
Annual mean ($\mu g/m^3$)	**PM$_{2.5}$**	10	25 / 25	12 / 15	15 / 35
	PM$_{10}$	20	40 / -	- / -	40 / 70
24-hour mean ($\mu g/m^3$)	**PM$_{2.5}$**	25	- / -	35 / 35	35 / 75
	PM$_{10}$	50	50 / -	150 / 150	50 / 150

Standards can have different criteria for how many times they may be exceeded
(e.g. EU limit for 24-hr PM$_{10}$ not to be exceeded more than 35 times in a calendar year;
US limit for 24-hr PM$_{10}$ not to be exceeded more than once a year)
Values between EU/US/China not strictly comparable (differences in definitions and enforcement).
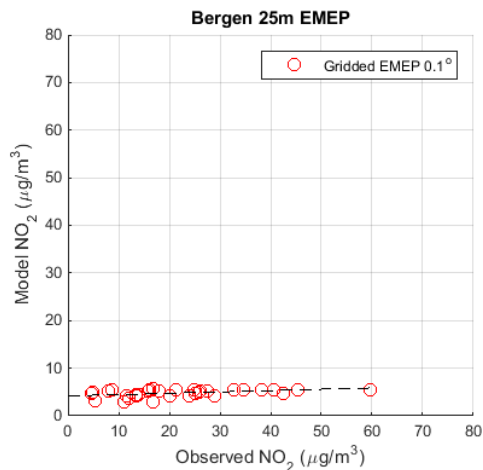
The 'PM2.5' indicator is a compromise between health relevance and monitoring capabilities.
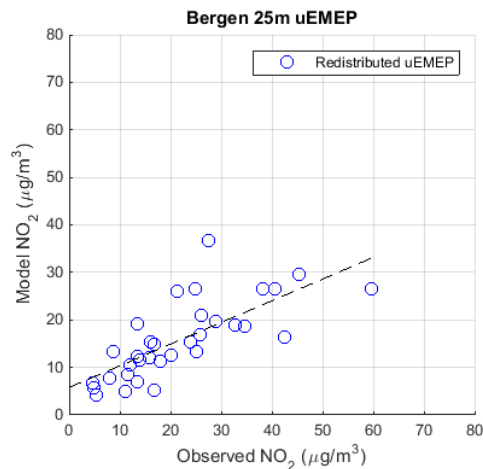
From Research to Operational Services

The Copernicus Atmosphere Monitoring Service (CAMS)

- http://atmosphere.copernicus.eu
- http://policy.atmosphere.copernicus.eu/SourceAllocation.html
- http://policy.atmosphere.copernicus.eu/ControlScenarios.html
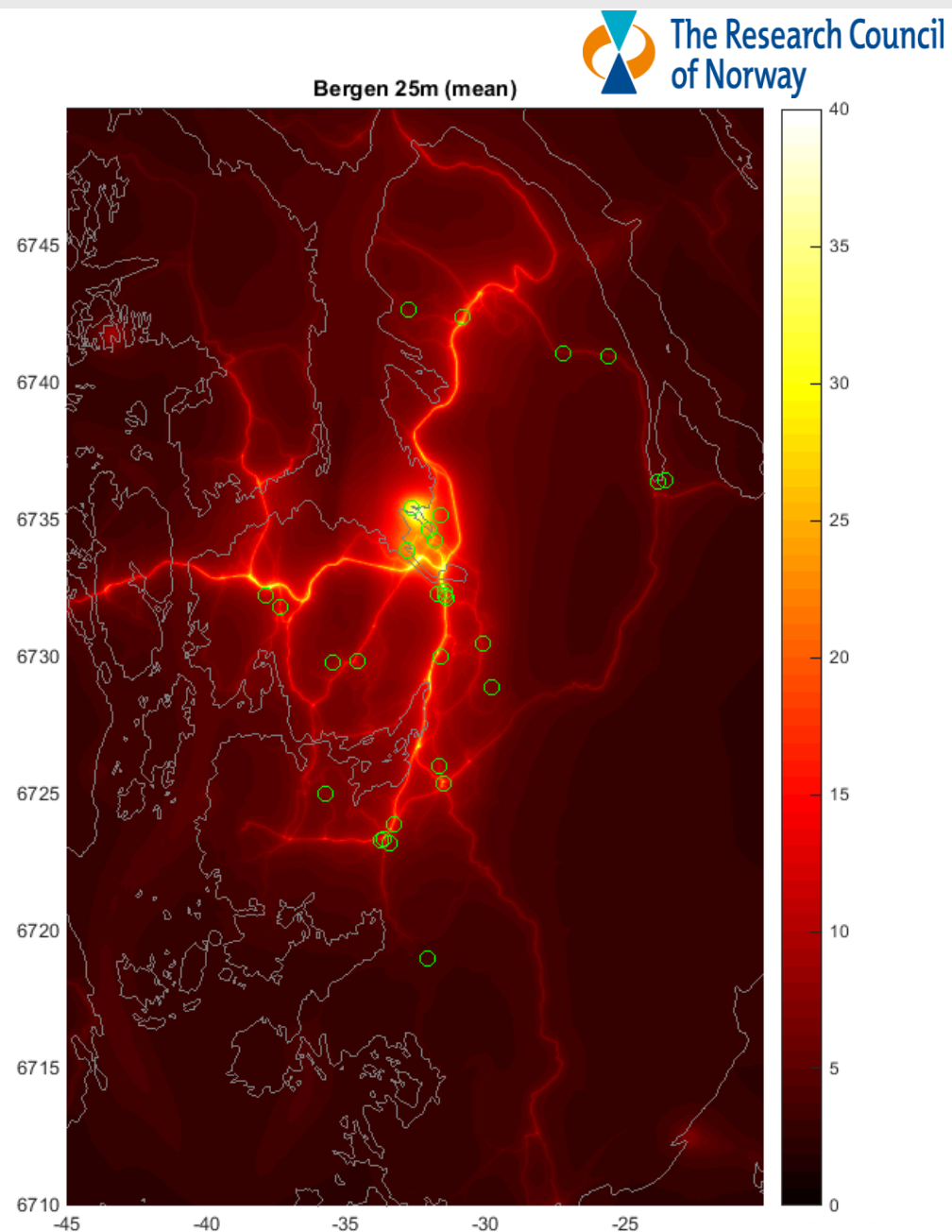- http://macc-raq-op.meteo.fr

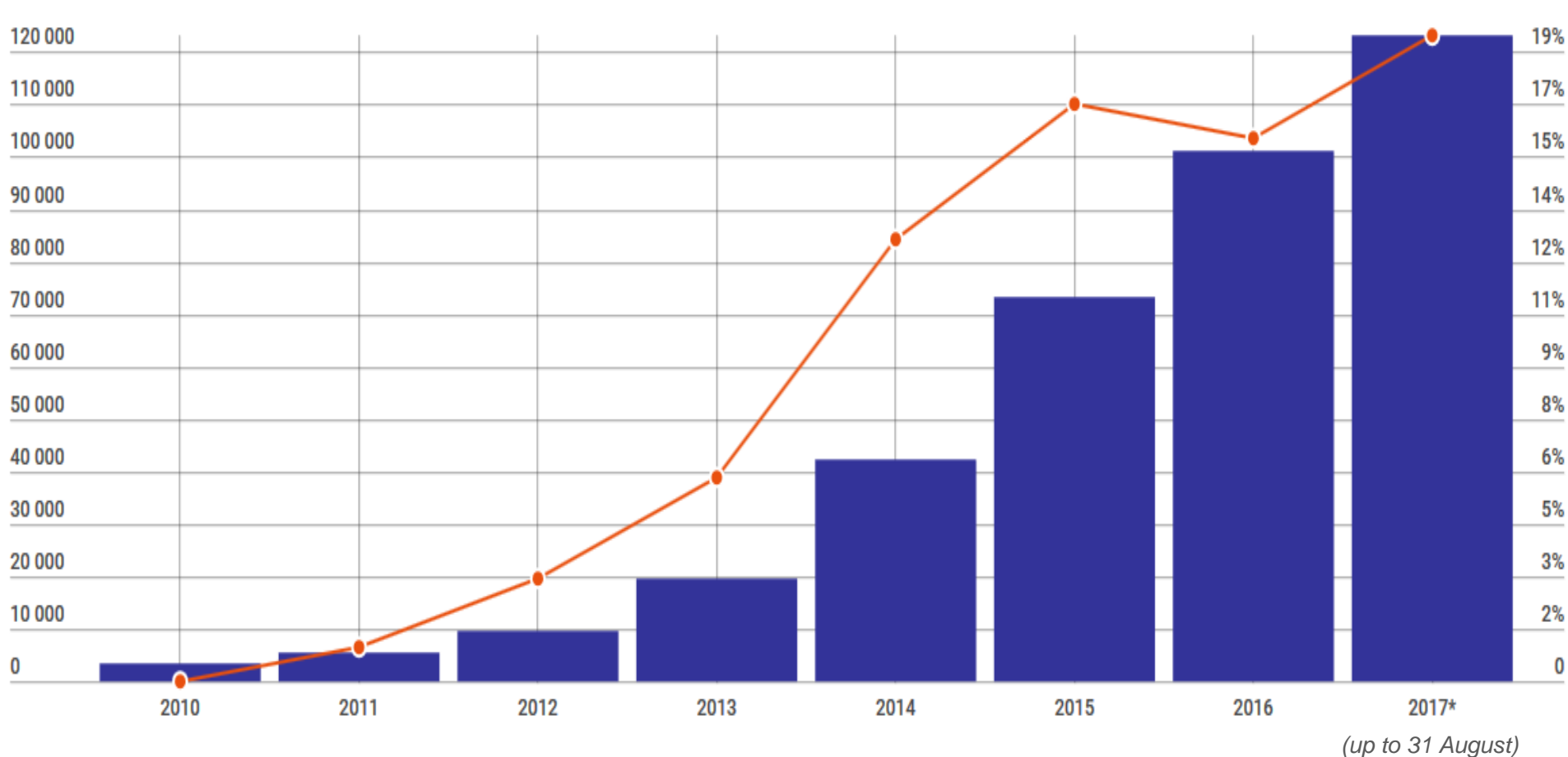# Bergen NO$_2$ (2013)

EMEP 0.1º (2013)

*u*EMEP 25 m (2013)

Slide provided by **Bruce R. Denby**, MET Norway

Electric cars in Norway

(up to 31 August)

Blue bars: Total number of electric vehicles
Red curve: Market share in new cars

from https://elbil.no/elbilstatistikk/ (20 Sep 2017)

Conclusions

- Air Quality is still an important issue in Europe, although long-term health and ecosystem effects remain difficult to quantify
- The state of air quality research has evolved from being mainly academic towards numerous operational services

- Important challenges
  - correctly model atmospheric transport and chemical processing of air pollutants on different spatial scales (from global to local)
  - design and maintain stable measurement networks
  - obtain reliable emission data, especially on local scales
  - correctly calculate population exposure and dose-response relationships

- Future directions
  - improve science-policy interface, e.g. through improved advise on air quality legislation (short term and long term measures, green scenarios)
  - quantification of human and ecosystem health benefits
  - improve quality of life, not only in big cities