

Linkages between climate and air pollution

Climate change and local air quality risks
Augustin Colette, EMEP-TFMM
Marie-Eve Héroux, WGE-TFH

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Convention on Long-range Transboundary Air Pollution

emep

Co-operative programme for monitoring and
evaluation of the long-range transmissions
of air pollutants in Europe



Impact of Climate Change on Air Quality at the Regional Scale

- ▶ Impact of geophysical climate change alone (e.g. « warming ») excluding future climate policy and any change in air pollutant emissions
- ▶ => so-called « climate penalty » that would act in addition to other factors such as
 - ▶ Emission changes
 - ▶ Intercontinental import of air pollutant
- ▶ In general assessed with offline chemistry-transport models
 - ▶ Forced by climate fields, or sensitivity experiments (ex: +2deg)

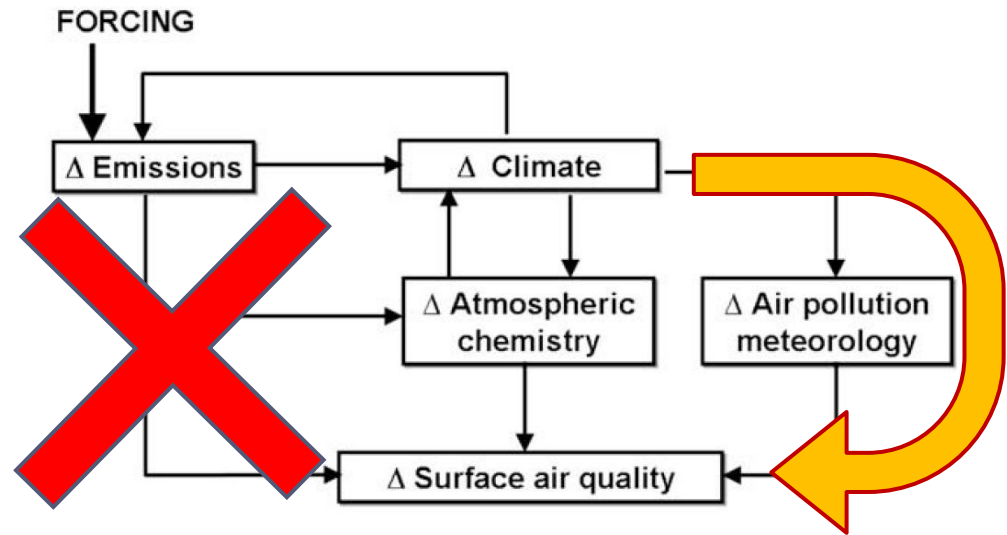


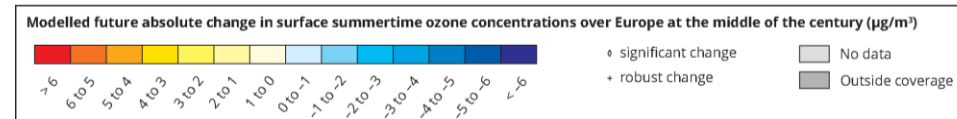
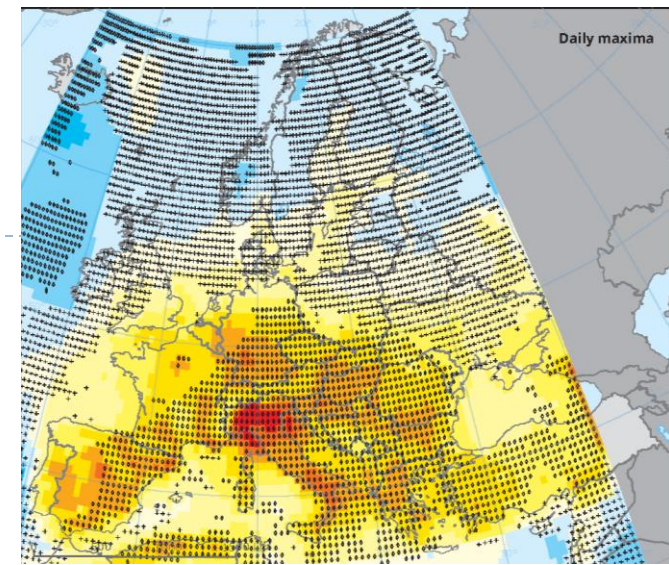
Table 1
Dependence of surface air quality on meteorological variables.^a

Variable	Ozone	PM
Temperature	++	-
Regional stagnation	++	++
Wind speed	-	-
Mixing depth	=	--
Humidity	=	+
Cloud cover	-	-
Precipitation	=	--

Climate Ozone Penalty

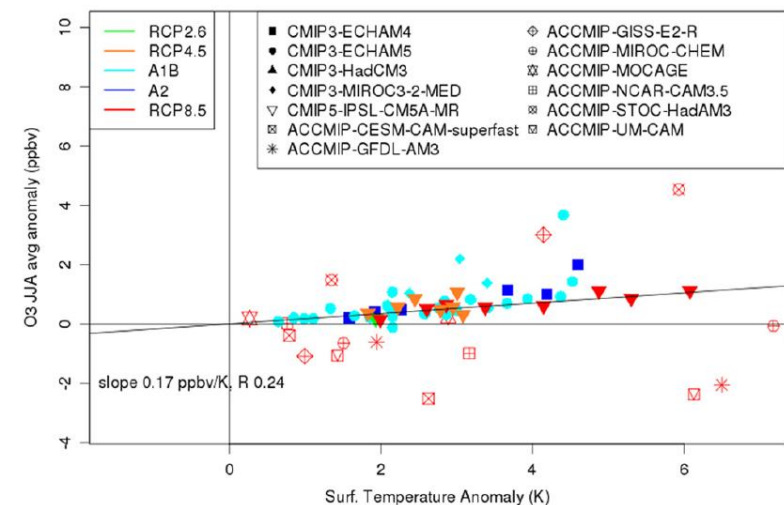
- ▶ **Meta-analysis:**
 - ▶ Several publications since 2007 confirm the penalty.

- ▶ **Magnitude of the penalty**
 - ▶ +3ppb locally by 2050 in medium scenario,
 - ▶ +2ppb widespread in Europe if global warming reach 4K
 - ▶ NB: the average reduction in mean O3 is 2ppb since 10yr with ambitious emission reductions !



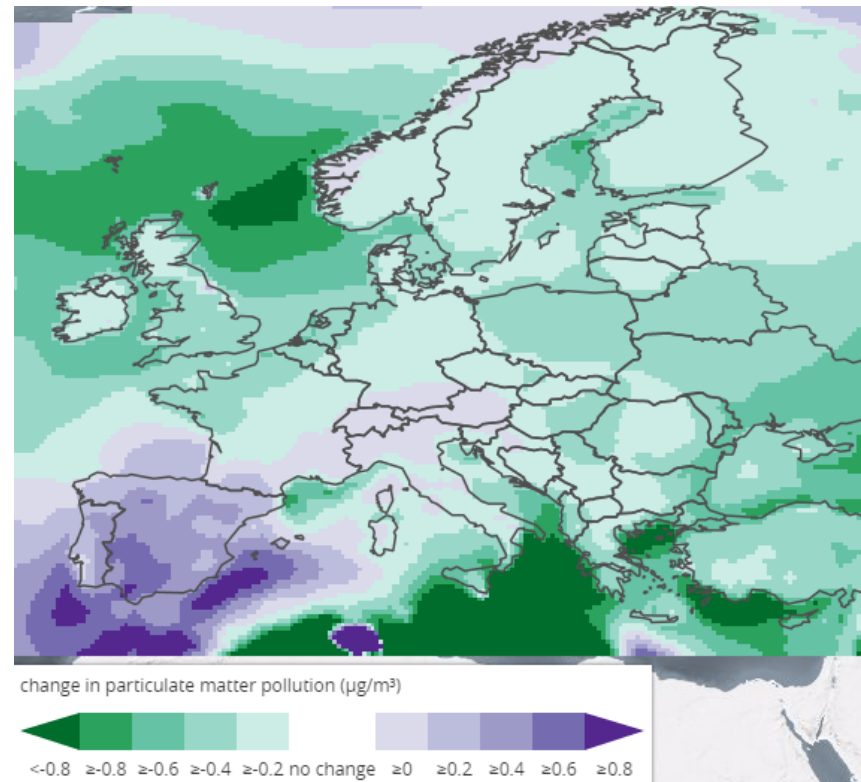
<http://www.eea.europa.eu/data-and-maps/indicators/air-pollution-by-ozone-2/assessment>

- ▶ **Remaining uncertainties**
 - ▶ How would peak / metrics evolve ?
 - ▶ Some compensation between:
 - ▶ A decrease in global models (water vapor)
 - ▶ An increase in regional models



Impact of Climate on PM10

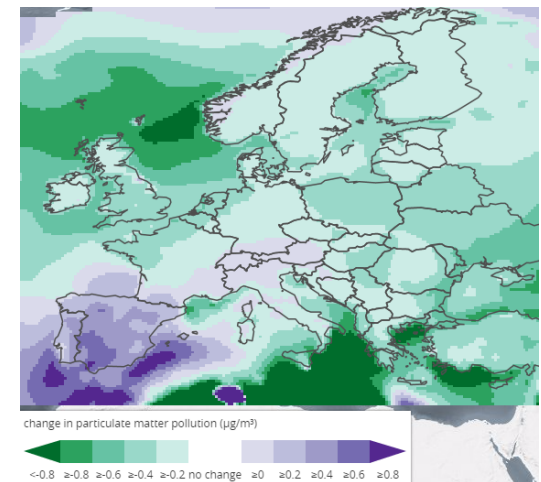
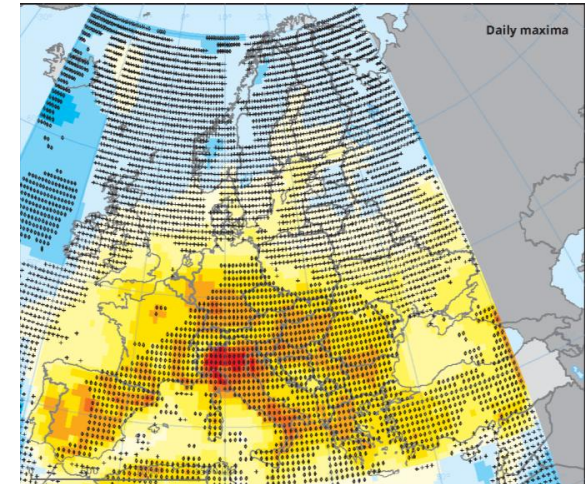
- ▶ Impact 2C: 4 model ensemble
- ▶ Robust decrease over most of Europe
 - ▶ precipitation changes
 - ▶ warmer temperature
- ▶ Increase over Southern Europe:
 - ▶ Precipitations
 - ▶ landuse / dust



PM10 change under +2C climate
<https://www.atlas.impact2c.eu>

Impact of Climate Change on Air Quality at the Regional Scale

- ▶ Main messages:
 - ▶ increase in average ozone risk
 - ▶ decrease for PM over most of Europe, except mediterranean (dust)
- ▶ Remaining knowledge gaps
 - ▶ Ozone :
 - ▶ More quantitative metrics: exceedances, exposure proxies
 - ▶ Compensation between hemispheric/regional processes
 - ▶ PM
 - ▶ Impact of dust quite uncertain
 - ▶ Episodes / exceedances not documented
 - ▶ Quantitative comparison with other factors
 - ▶ Emission changes
 - ▶ Intercontinental transport





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Climate change and local air quality risks – health impacts

Marie-Eve Héroux
WHO European Centre for Environment and Health
Bonn, Germany



Climate change and local air quality risks – health impacts (1/3)

- Air pollution → related climate change impacts
 - SLCFs (EC/BC), SO₂, ozone have warming and/or cooling impacts on climate
 - EC/BC vs. PM mass?
 - New evidence on long-term (seasonal) ozone effects?
 - New evidence on SO₂?
- Climate change → impacts on air quality
 - Increases in ozone (through increased UV/sunlight and biogenic VOCs)
 - Expected changes in PM mass



Climate change and local air quality risks – health impacts (2/3)

- Frequency of extreme weather events and relationship with health / vulnerability of populations
 - Extreme heat
 - Desert dust episodes
 - Wildfires
 - ...
- Adaptation of populations
 - Focus on long-term reduction of air pollution
 - In the meantime, can we recommend interventions to reduce personal exposure to air pollutants (use of protective equipment, use of air filters, behavioural recommendations)?



Climate change and local air quality risks – health impacts (3/3)

- **Need to ensure consistent mitigation and adaptation policies for air quality and climate**
 - **Residential heating (wood)**
 - **Vehicle emissions (diesel)**
 - **Others?**

