Climate Change and Air Quality

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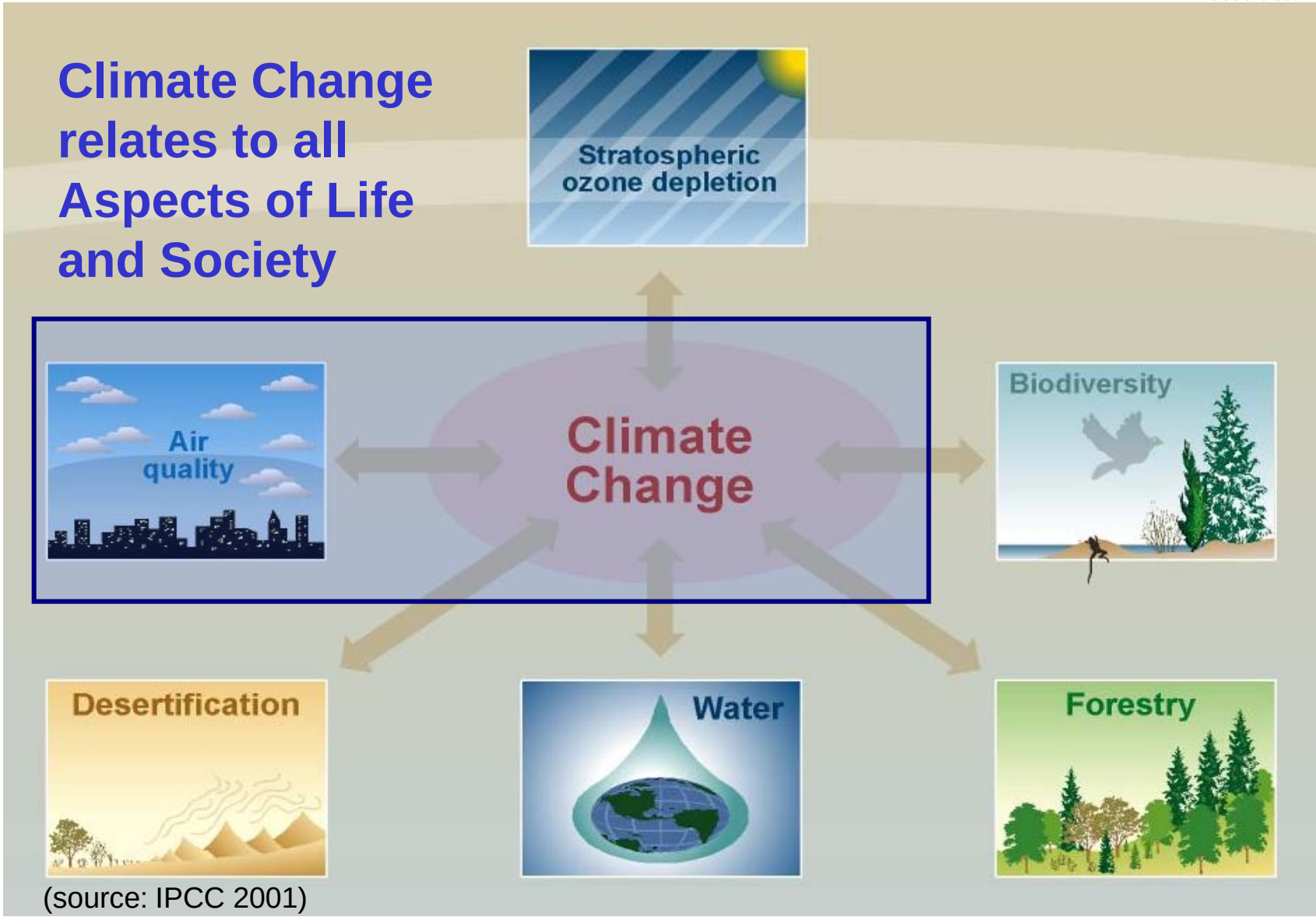
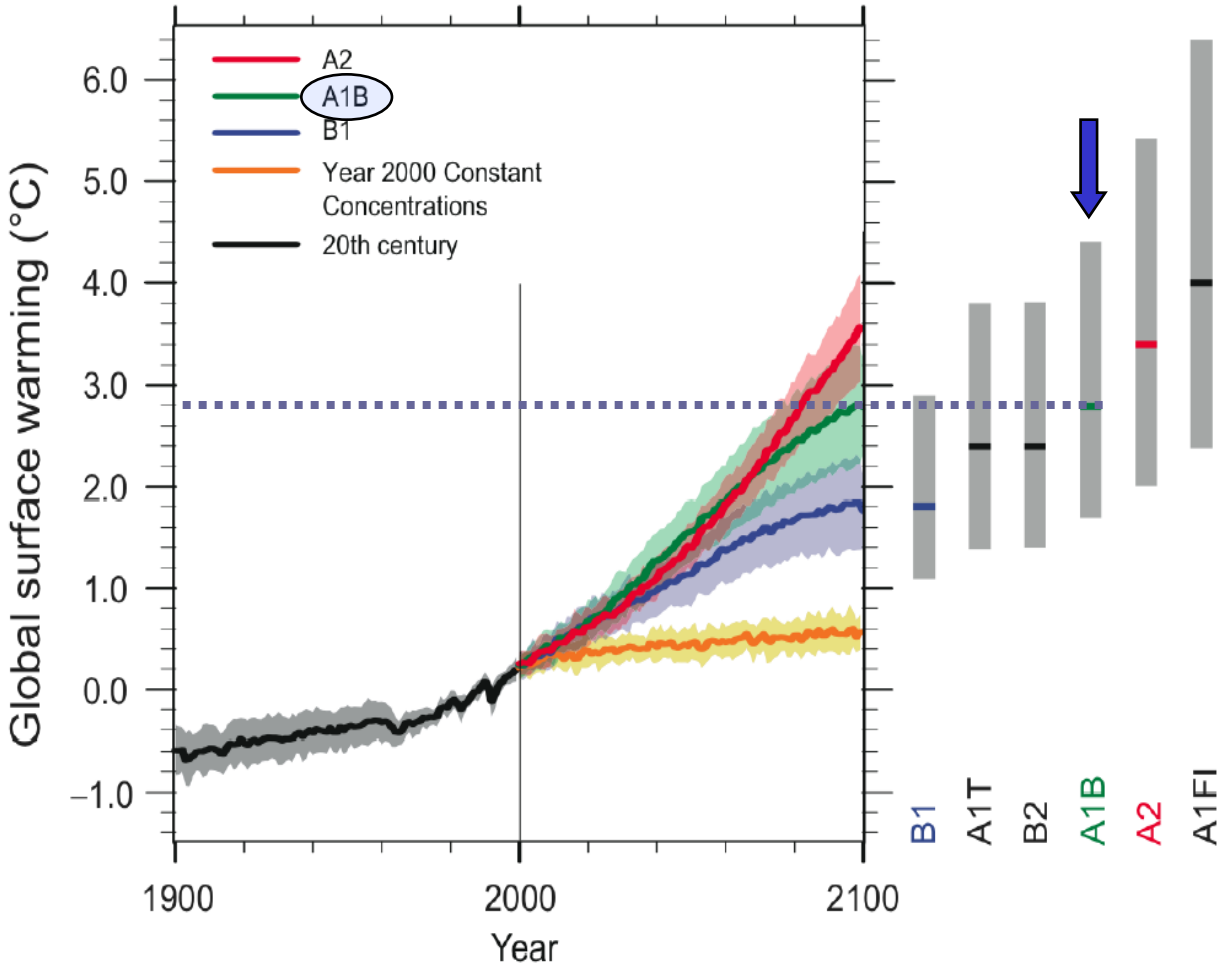
Climate Change and Air Quality



(source: IPCC 2001)

Climate Change and Air Quality

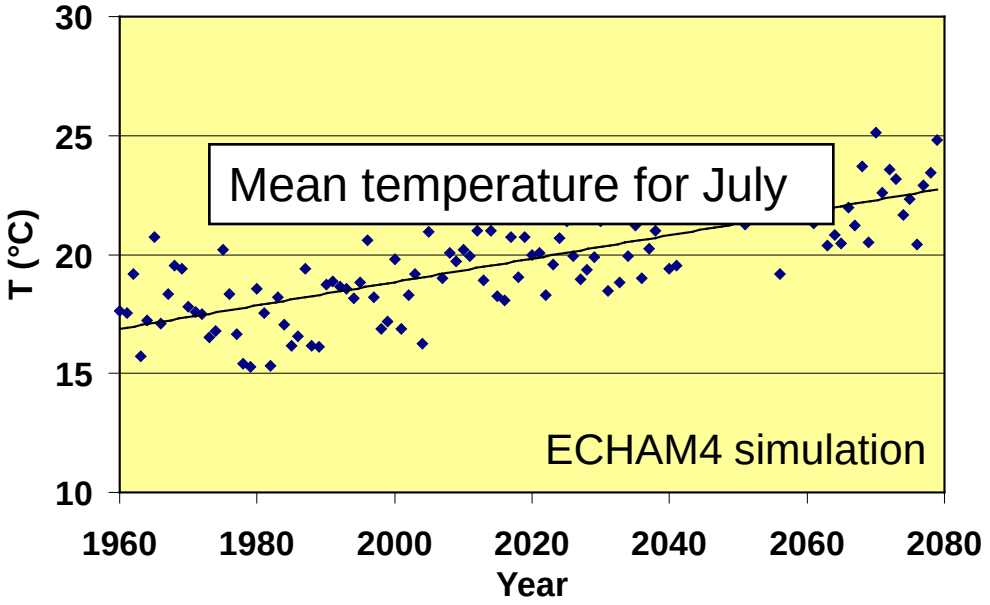
Global Climate Change: Scenarios lead to Climate Projections



(source: IPCC 2001)

Climate Change and Air Quality

Global models indicate an **increase of global mean temperature**, and also **for southern Germany**



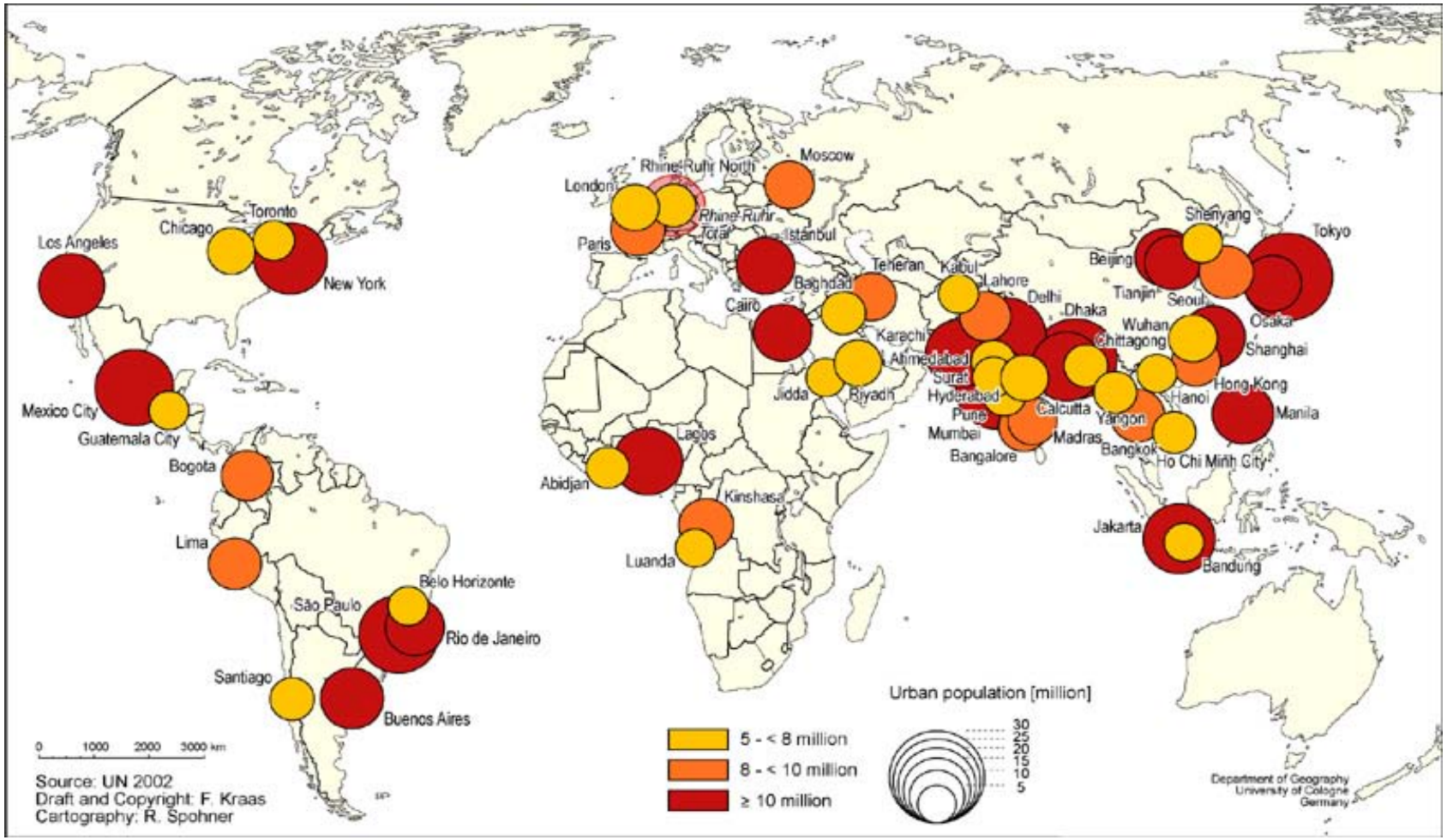
Global climate change results in regional effects on

- cloud cover, visible and UV radiation
- temperature, thermal stratification
- wind fields
- frequency and intensity of precipitation

Changed Climate impacts Air Quality

Climate Change and Air Quality

Air Quality: Primarily an Urban Problem ...
and Increasingly a Developing World Problem



Climate Change and Air Quality

Air Quality – affected by:

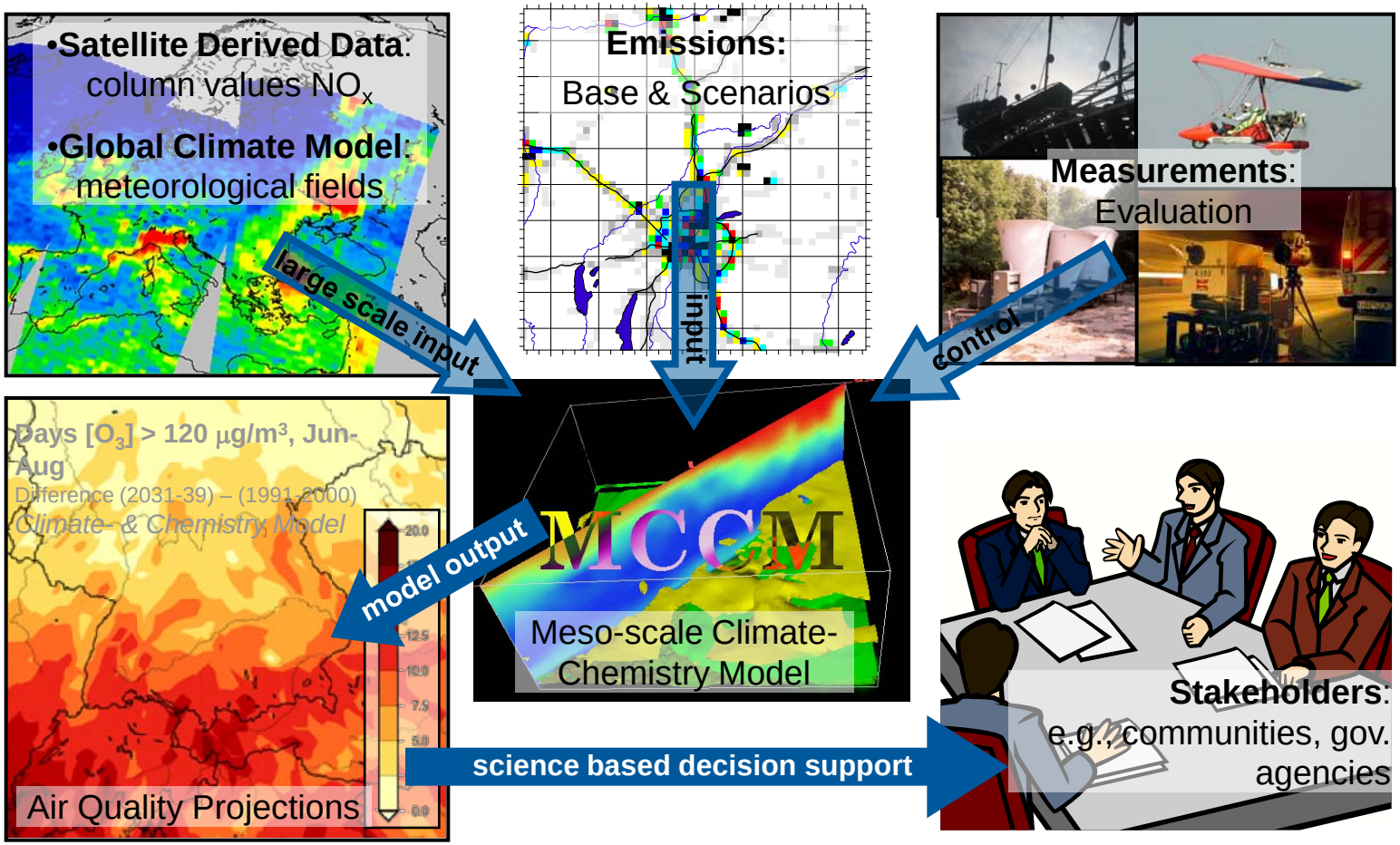
- Climate
- Land Use / Land Cover
- Energy Production
- Mobility

- **Air Quality**
- Health

Assessment Requires Integrated Approach

Climate Change and Air Quality

Coupled Mesoscale Climate Chemistry Model (MCCM): **integration of models & observations for air quality mitigation decision support**



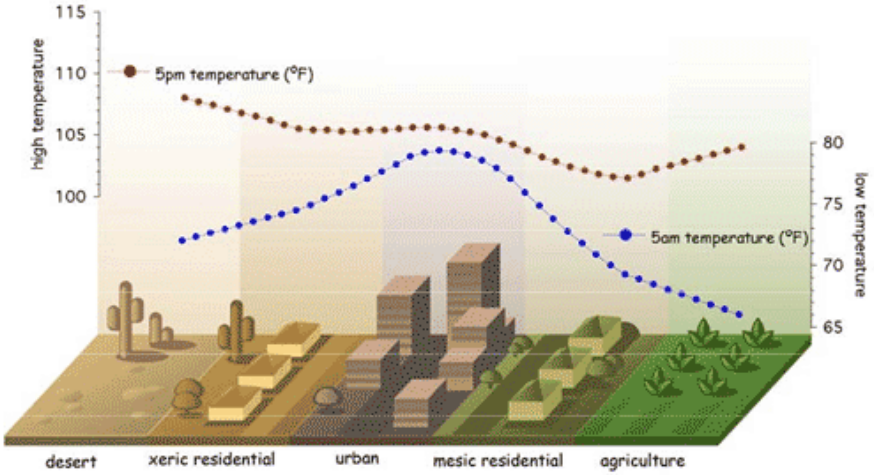
Climate Change and Air Quality

Effect of land use changes

Mexico City	2005
Population	19,410,000
Urbanized area (km²)	1800
Population density (p / km²)	10,800
Population growth (% / y)	~1,28

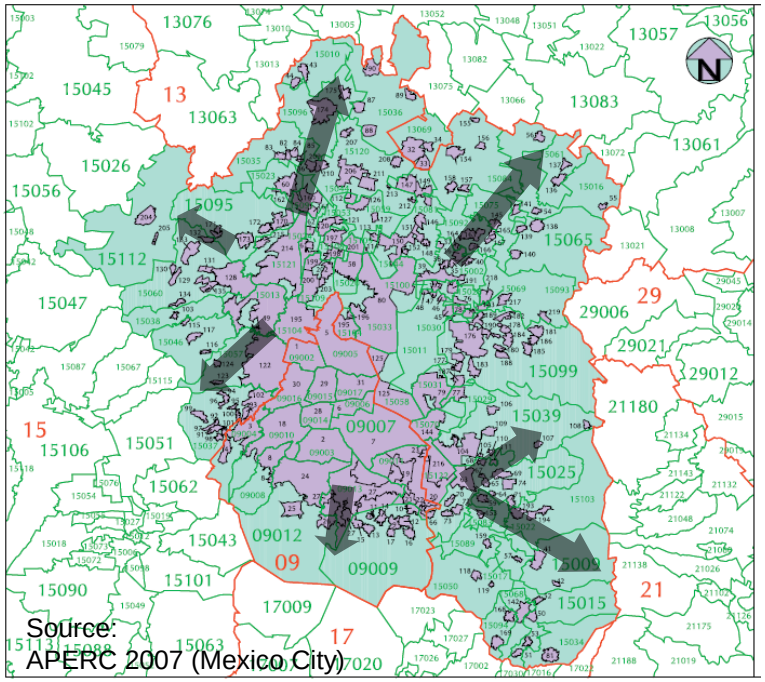
Estimated expansion by 2010

➔ **stronger Urban Heat Island**



(http://censam.mit.edu)

Application to Mexico City



Source:
APERC 2007 (Mexico City)

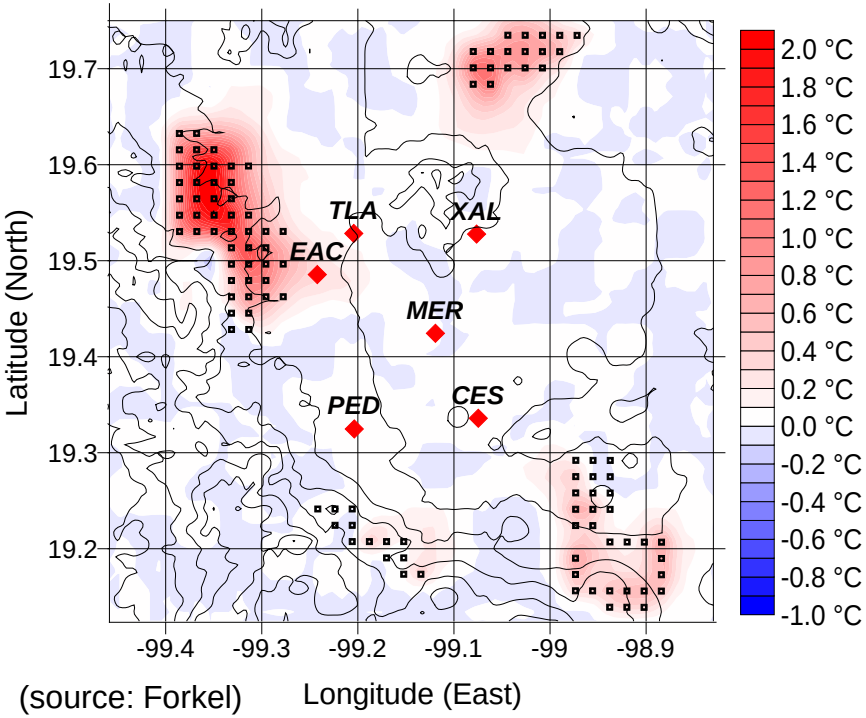
Land Use Change leads to Regional Climate Change

Climate Change and Air Quality

Effect of land use changes

Application to Mexico City

Temperature difference with and without urban sprawl

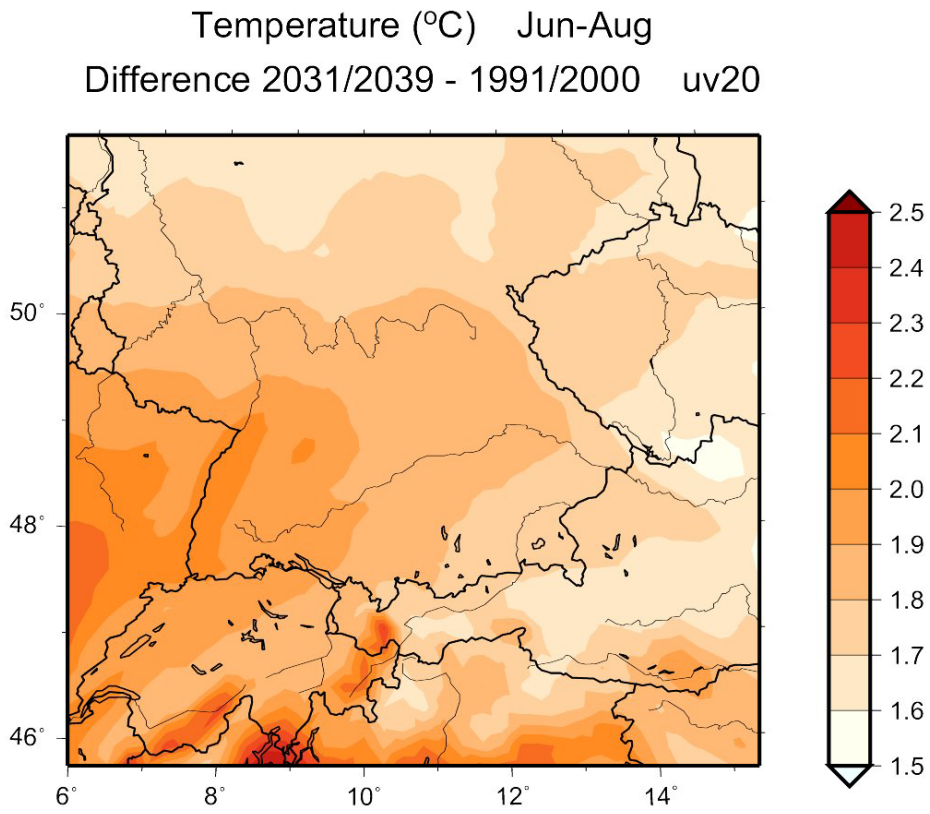


(source: Forkel)

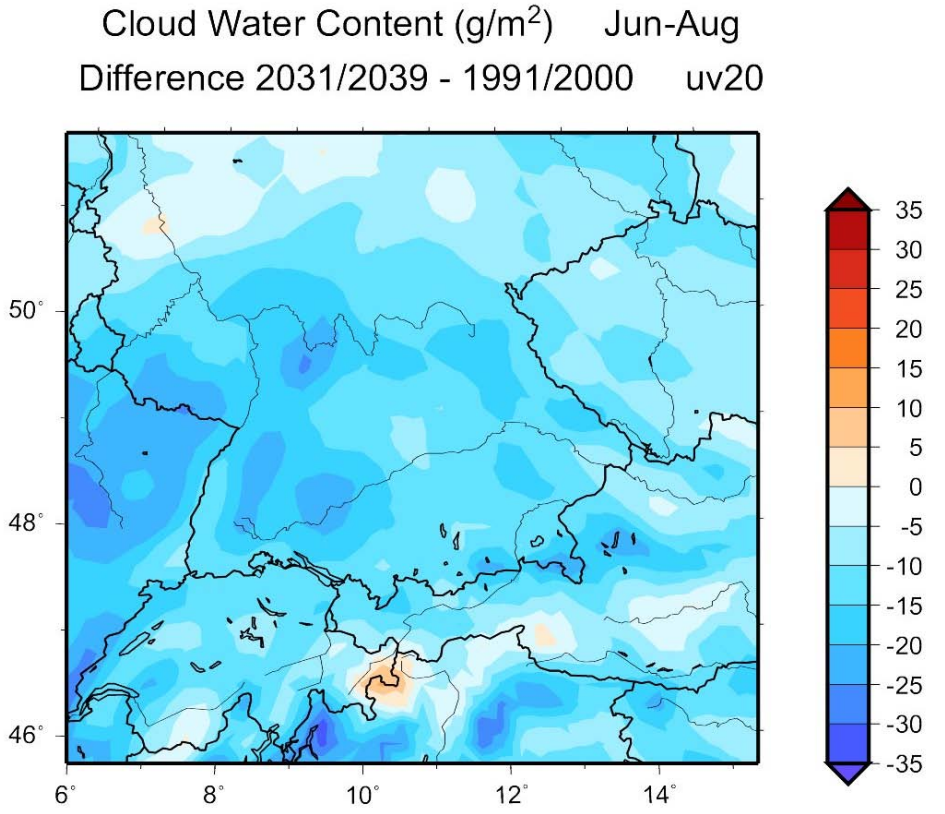
land use change combines with climate change:
can enhance or offset air quality ramifications

Regional Climate Change in Southern Germany

Temperature



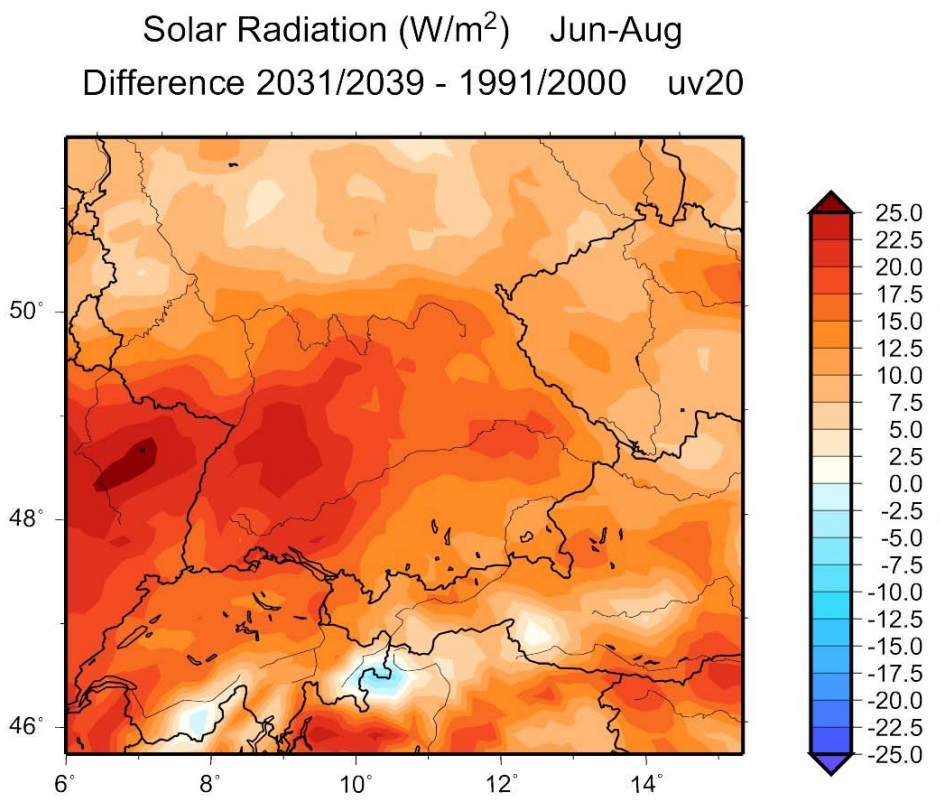
Cloud Water



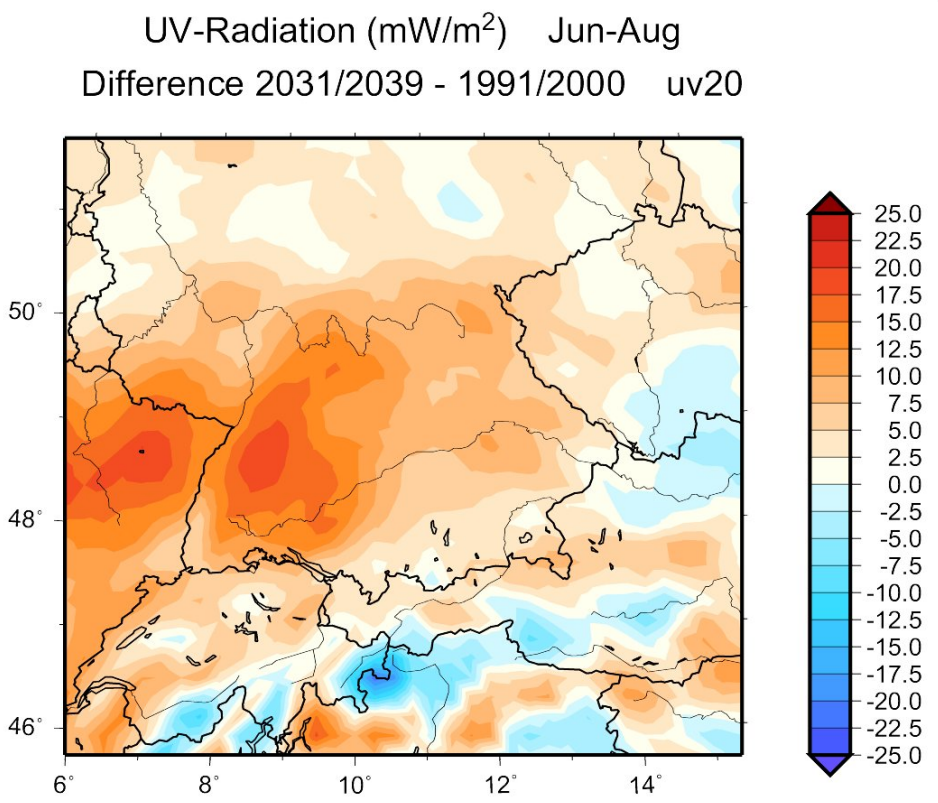
(Forkel & Knoche, 2006. JGR)

Regional Climate Change in Southern Germany

Solar Radiation



UV Radiation



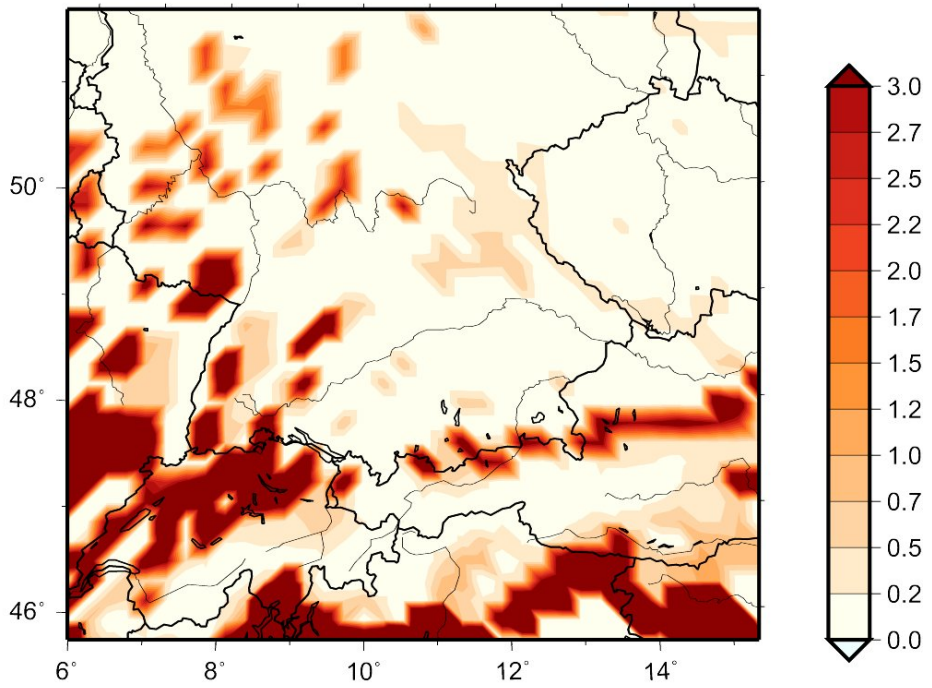
(Forkel & Knoche, 2006. JGR)

Regional Air Quality change in Southern Germany

Isoprene Emission

Isoprene emission (μg/m²/min) Jun-Aug

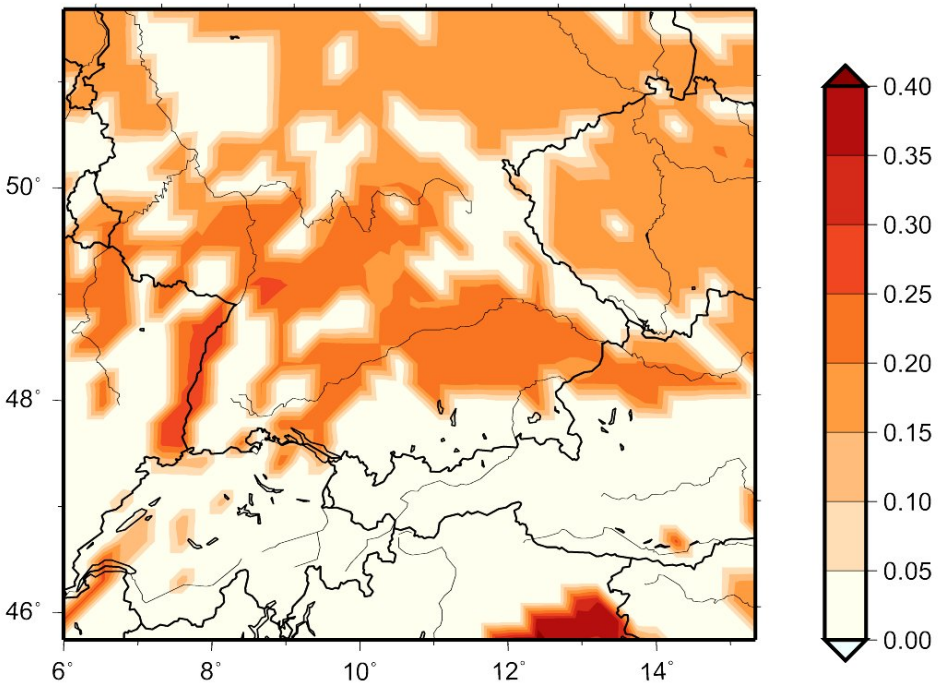
Difference 2031/2039 - 1991/2000 uv20



Soil NO Emission

NO emission (μg/m²/min) Jun-Aug

Difference 2031/2039 - 1991/2000 uv20



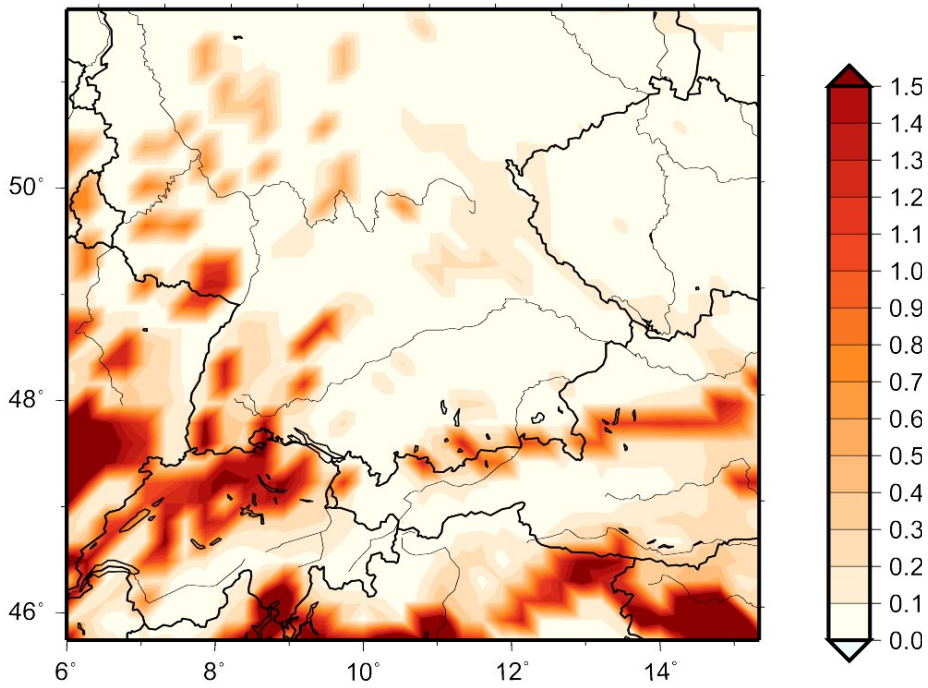
(Forkel & Knoche, 2006. JGR)

Regional Air Quality change in Southern Germany

Isoprene Mixing Ratio

Isoprene (ppb) Jun-Aug

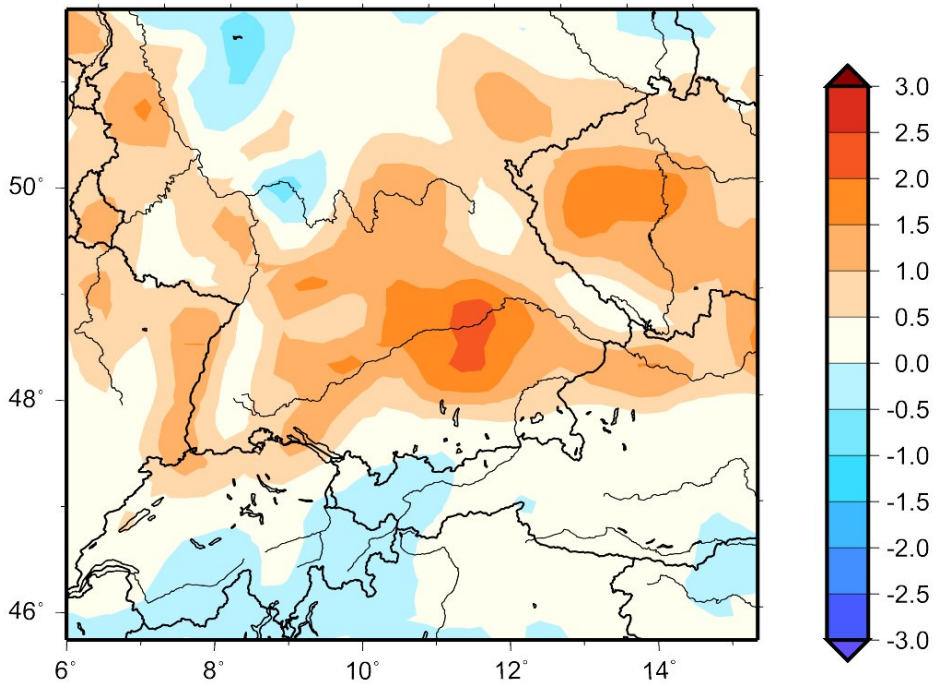
Difference 2031/2039 - 1991/2000 uv20



NO_x Mixing Ratio

NO_x (ppb) Jun-Aug

Difference 2031/2039 - 1991/2000 uv20



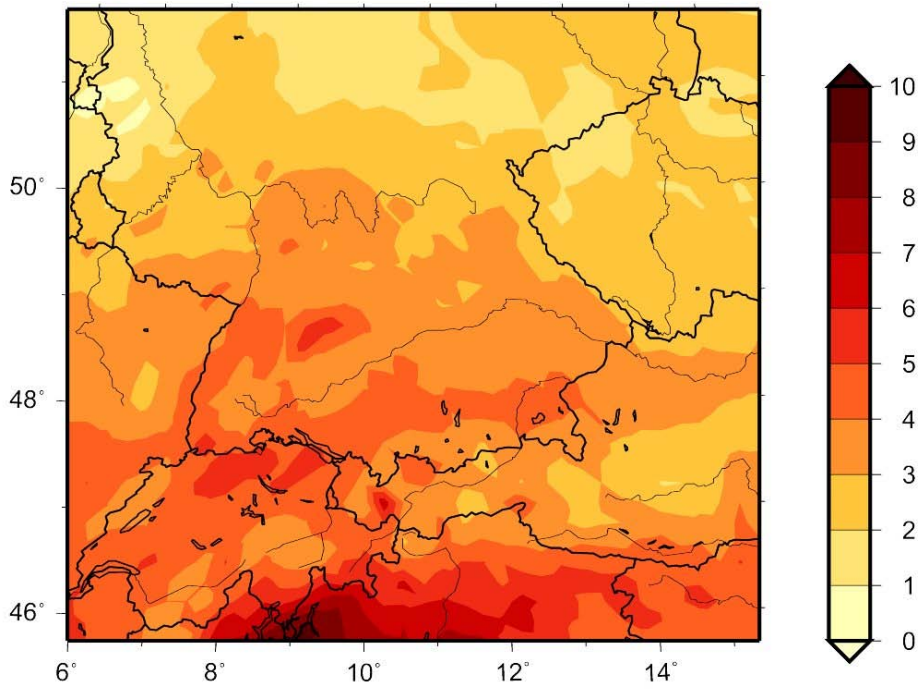
(Forkel & Knoche, 2006. JGR)

Regional Air Quality change in Southern Germany

Ozone Maximum

Daily Ozone Maximum (ppb) Jun-Aug

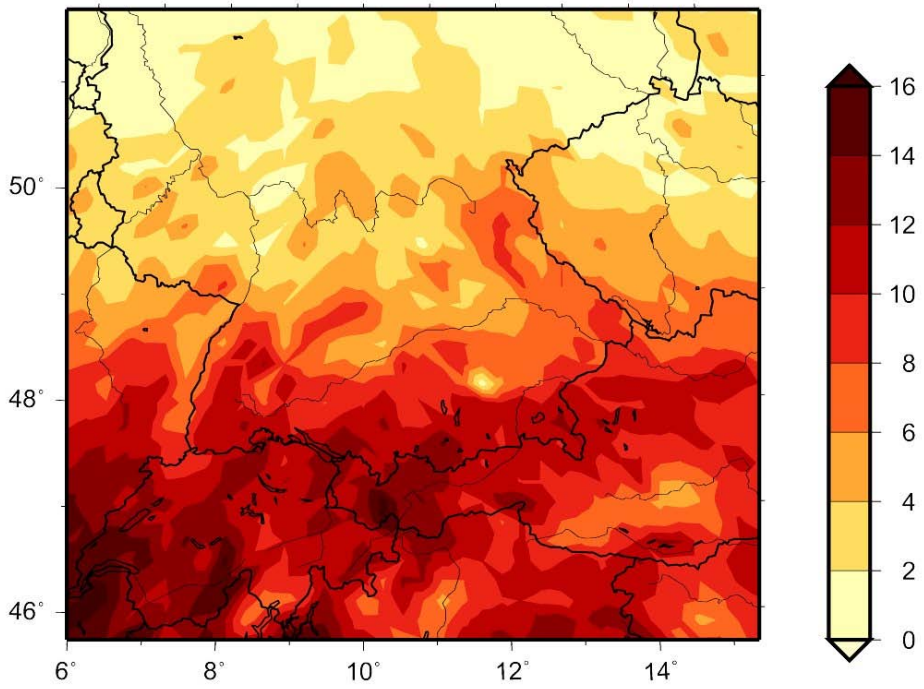
Difference 2031/2039 - 1991/2000 uv20



O_3 Exceedance Days

Days with Threshold Exceedance Jun-Aug

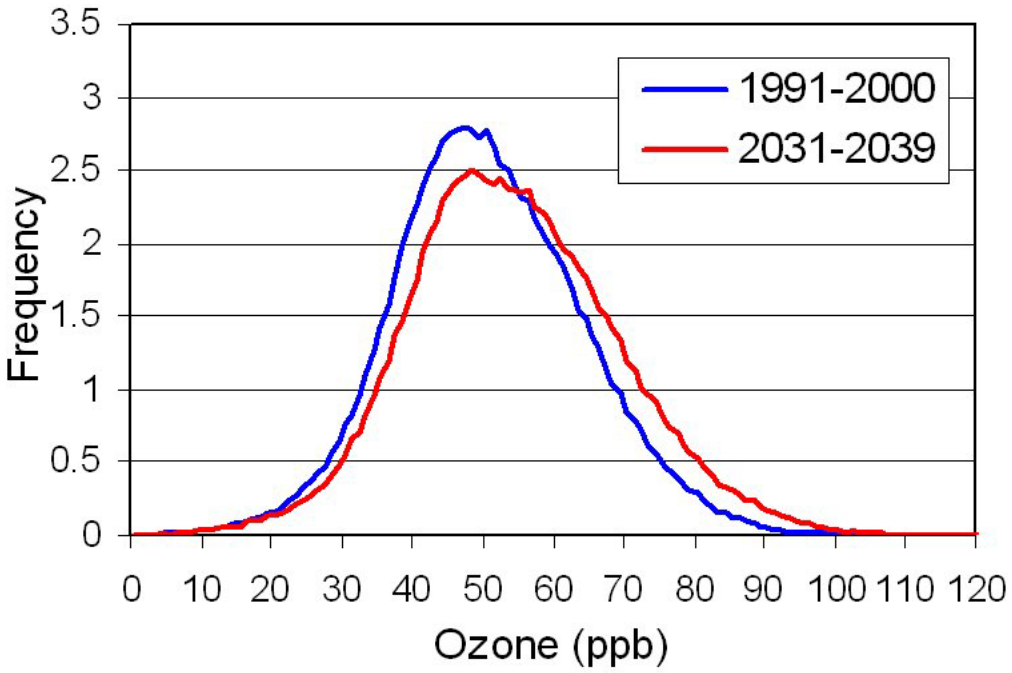
Difference 2031/2039 - 1991/2000 uv20

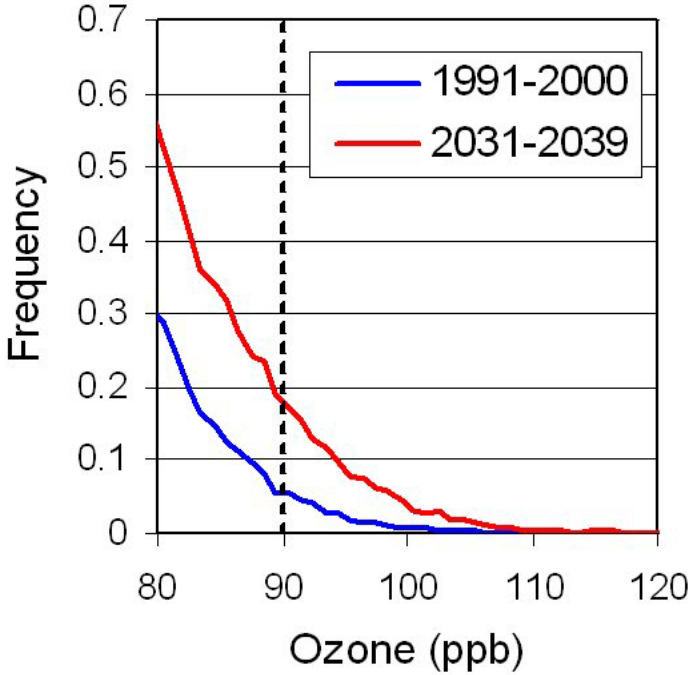


(Forkel & Knoche, 2006. JGR)

Regional Air Quality change in Southern Germany

Distribution of daily Ozone Maxima





(Forkel & Knoche, 2006. JGR)

Occurrence of max. [O_3] > 180 μg/m³ increases 4-fold

Summary of Results

- global climate change has pronounced regional expression (e.g., Alps, Urban Areas)
- land use change can amplify or offset climate change
- climate change affects thermal / humidity / radiation environment in which air pollutants evolve (and precursors are emitted)
- climate change can strongly affect air quality at a regional scale (~10^2 – 10^3 km)
- Example - Northern Pre-Alpine (D, CH, A): expect 4-fold Number of Ozone Days

Climate Change and Air Quality

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