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TNO innovation for life

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Evaluation of a coupled climate – air quality model system

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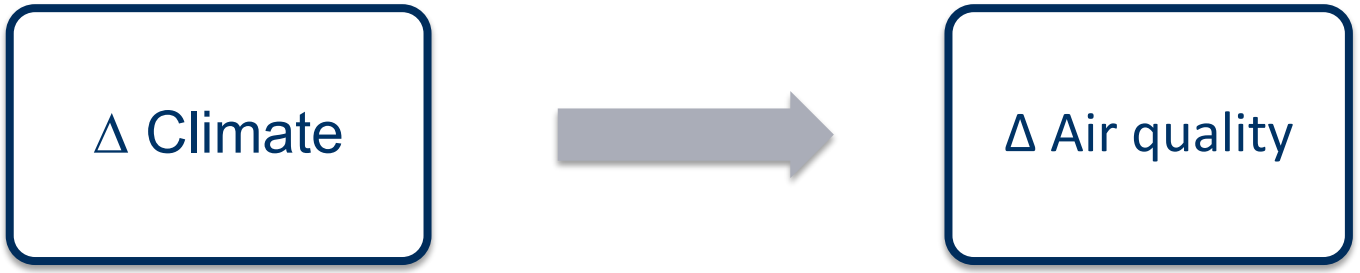
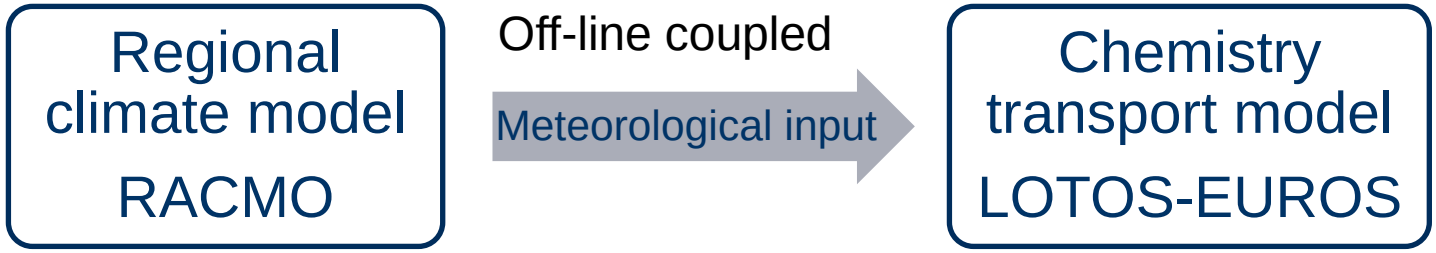
Introduction

Motivation:



Approach:



Question:

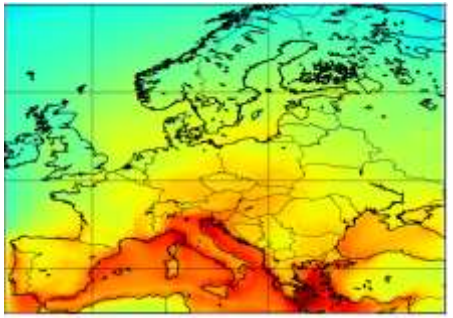
What is the impact of the uncertainties in the climate model on the results of the chemistry transport model?

Models

Model runs:

Time period	Boundary conditions for RACMO	Name
1989-2009	ERA-interim	RACMO_ERA
1970-2060	ECHAM5 A1B	RACMO_ECHAM
1970-2060	MIROC A1B	RACMO_MIROC

Model domain



Horiz. Resolution: 0.5°x0.25°
output: 3h

- Components: Ozone, Nitrogen oxides, Ammonia, precursor gases, PM10
- Fixed anthropogenic emission for LOTOS-EUROS of 2005 (MACC 2005)
- Not taken into account are changes in emission, land use and land cover

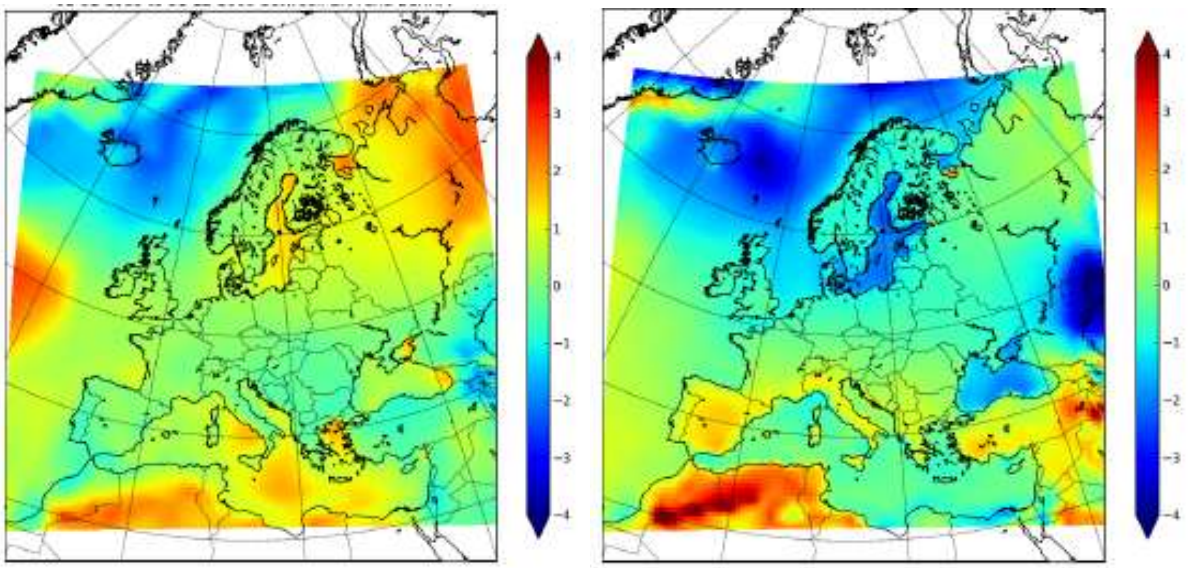
Results

- Present-day period (1989-2009) and future period (2041-2060)
- Focus on ozone and PM10
- Focus on meteorological parameters important for air quality:
  - Temperature + number of summer days (Tmax>25°C)
  - Wind speed + number of calm days (average wind speed<2 m/s)
  - Precipitation + number of wet days (>0.5mm)
- Shown stations represent the model results for a grid cell

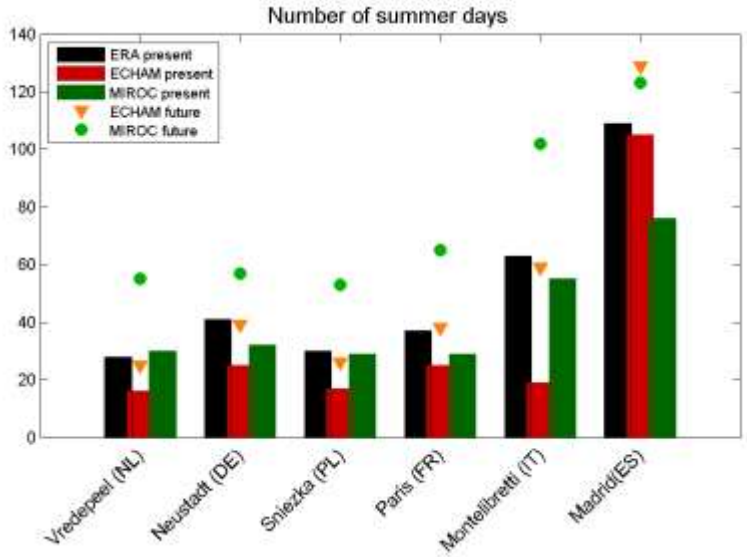
Meteorological input data

RACMO results for averaged temperature and number of summer days

Difference:
RACMO_ERA-
RACMO_ECHAM

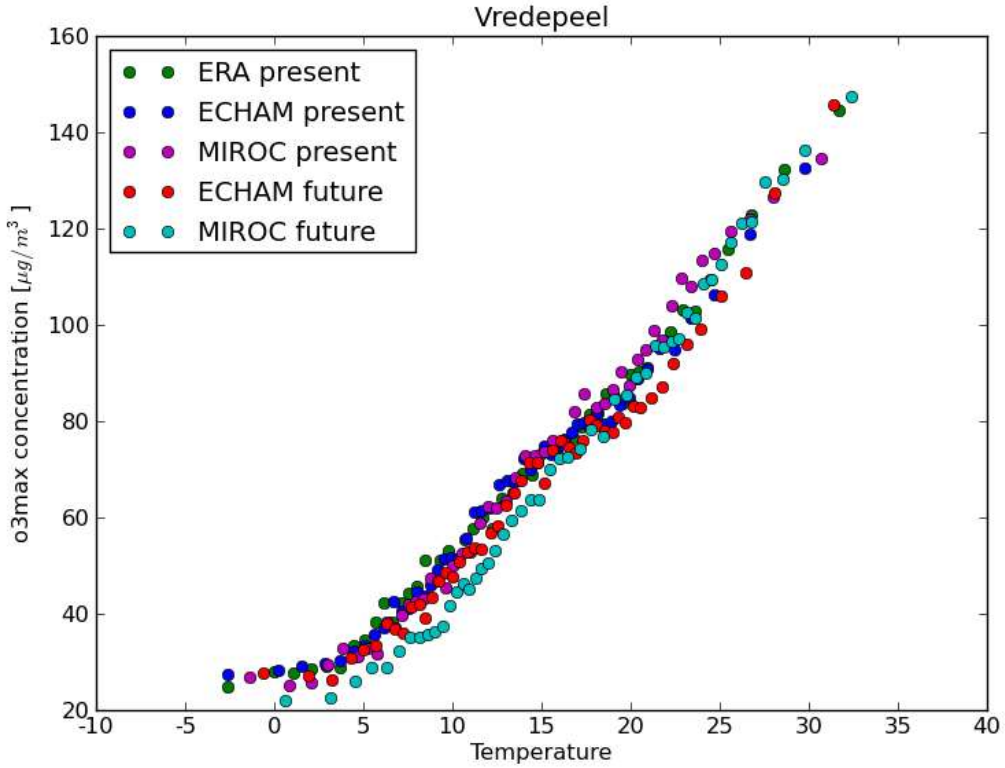


Difference:
RACMO_ERA-
RACMO_MIROC



Impact on modelled ozone concentrations

Relation between ozone concentration and temperature on the station Vredepeel (NL)



Modelled ozone concentrations and the corresponding RACMO output for temperature are sorted along the temperature and then averaged for 50 bins.

Impact on modelled ozone concentrations

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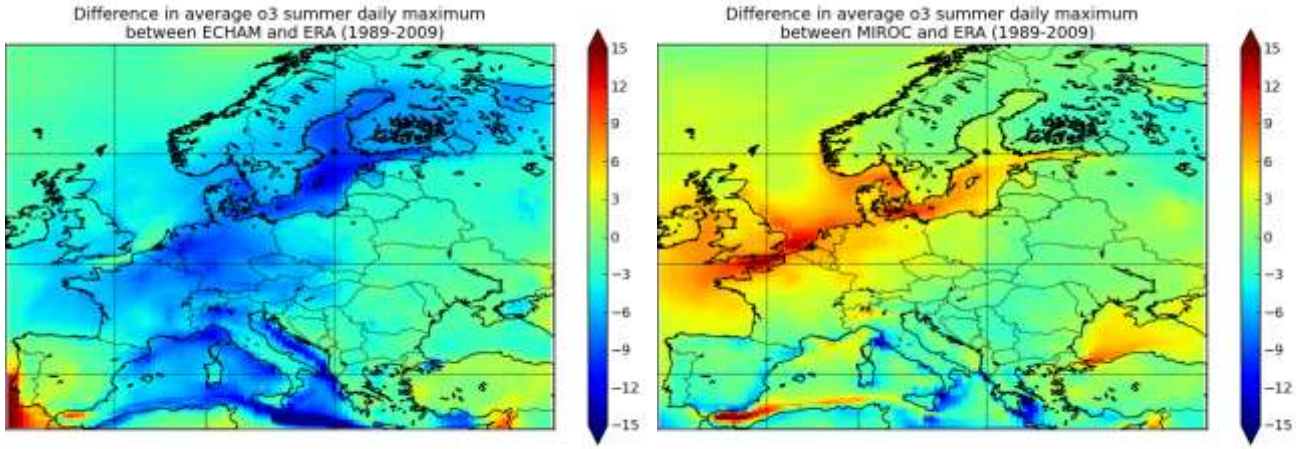
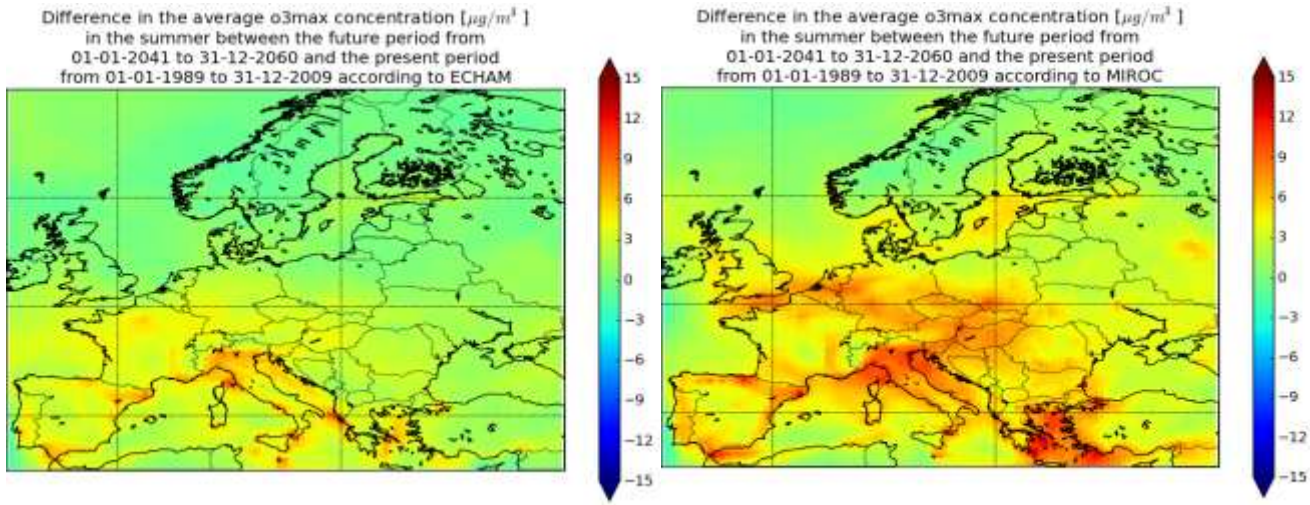
LOTOS_EUROS results for averaged daily maximum ozone concentration

Difference RACMO_ECHAM – RACMO_ERA present-day



Difference RACMO_MIROC – RACMO_ERA present-day

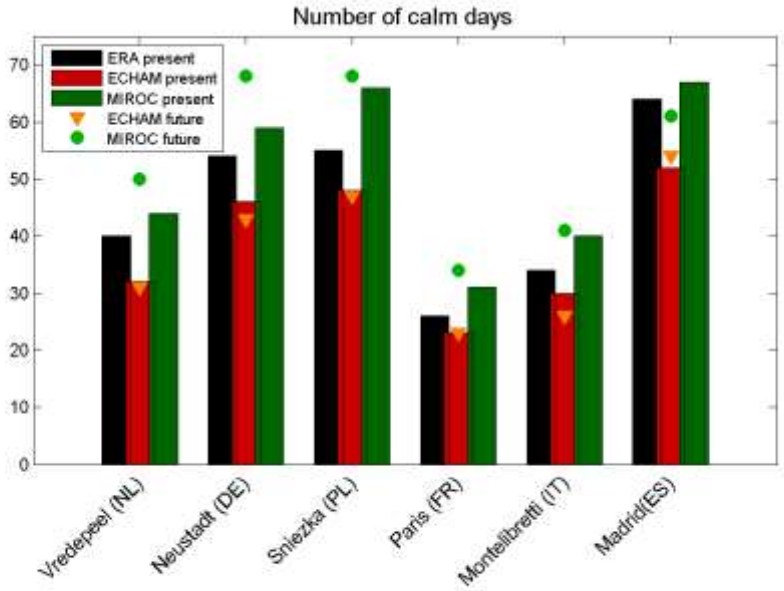
Difference future – present-day RACMO_ECHAM

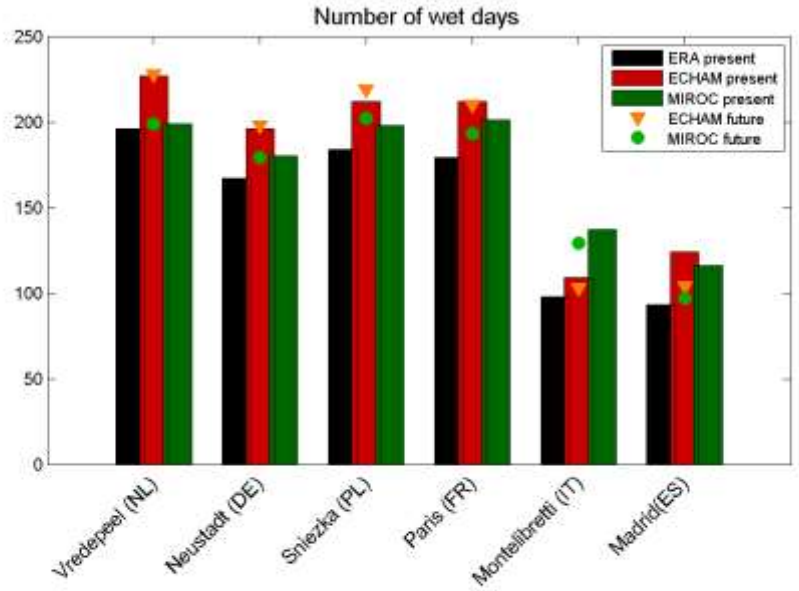


Difference future – present-day RACMO_MIROC

Meteorological input data

RACMO results for number of calm and wet days

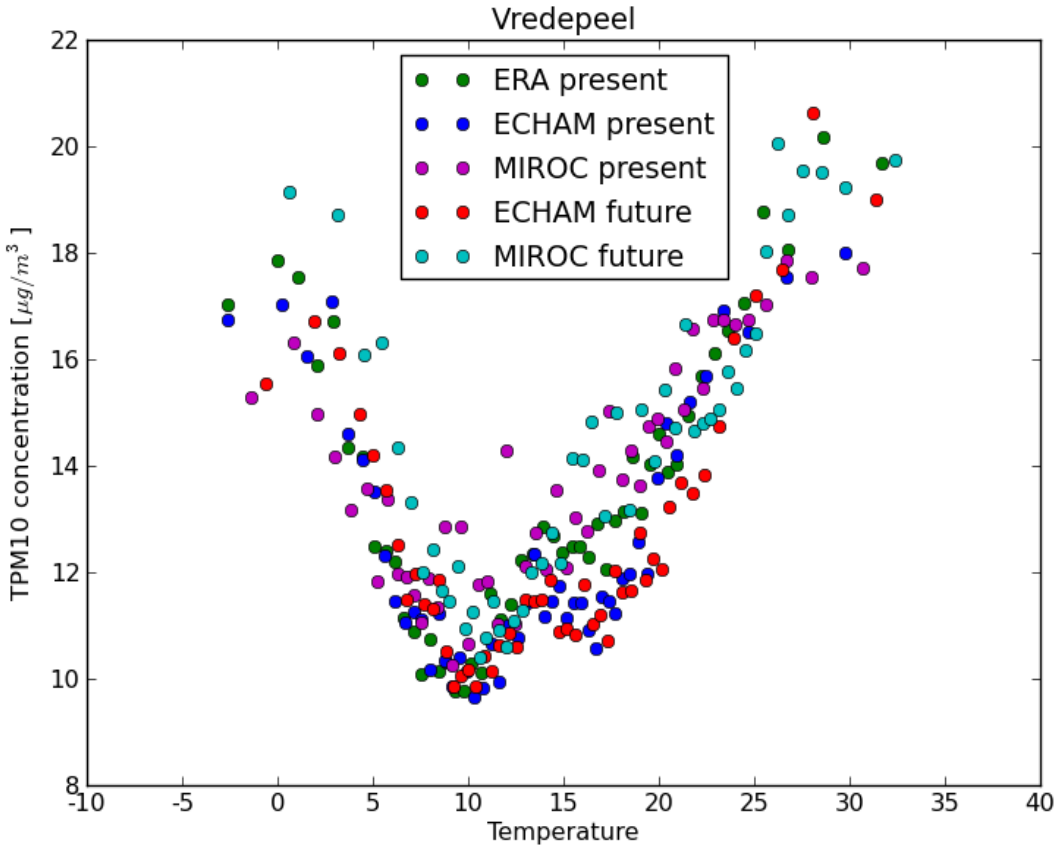




- Important meteorological parameter for PM10

Impact on modelled PM10 concentrations

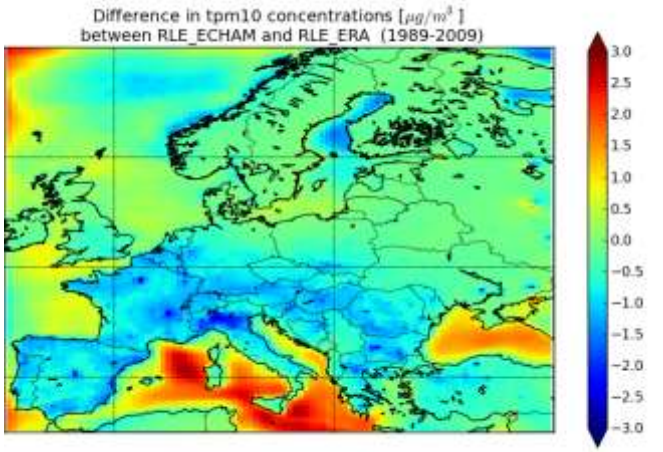
Relation between PM10 concentration and temperature on the station Vredepeel (NL)

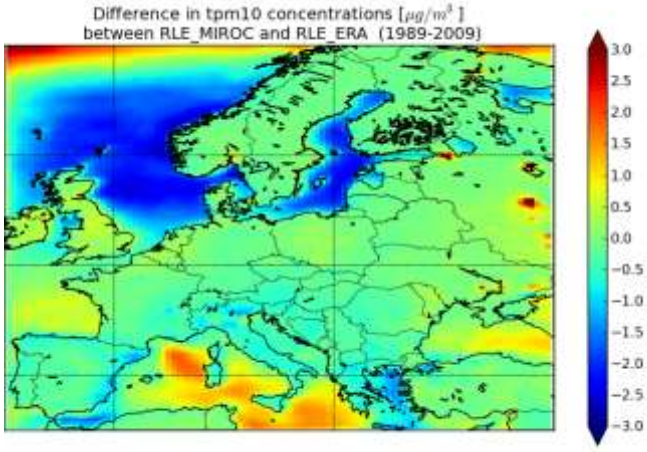


Impact on modelled PM10 concentrations

LOTOS_EUROS results for averaged PM10 concentration

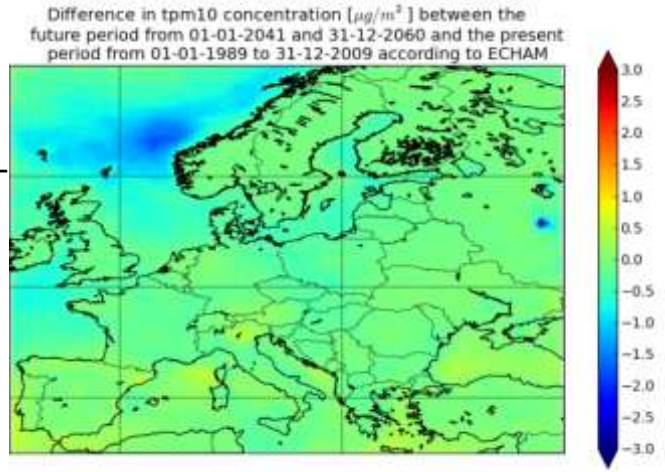
Difference RACMO_ECHAM – RACMO_ERA present-day

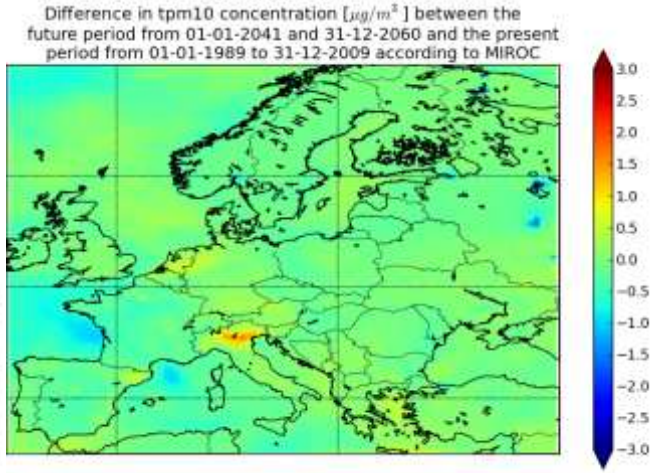




Difference RACMO_MIROC – RACMO_ERA present-day

Difference future – present-day RACMO_ECHAM





Difference future – present-day RACMO_MIROC

Summary & Outlook

- The uncertainties in the RACMO_ECHAM and RACMO_MIROC runs impact the simulations of the CTM and result in different concentrations of ozone and PM10
  - Biases in climate runs with respect to the reanalysis run(RACMO_ERA) differ per global model forcing, meteorological parameter and region
  - Bias correction difficult because several meteorological fields are needed which are related to each other

- Both model versions show differences between present-day and future climate period for air quality parameters
  - For ozone for example they have the same sign but different amount
  - Since PM10 consists of many components the effect of the changing meteorological conditions and the biases on the individual components varies

- Biases in CTMS (uncertainties in variability etc.)
- Study results in more detail (seasons, extreme conditions, etc.)
- Changes in boundary conditions and emissions

Thank you for your attention!