ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
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A long-term re-analysis of atmospheric composition and air quality

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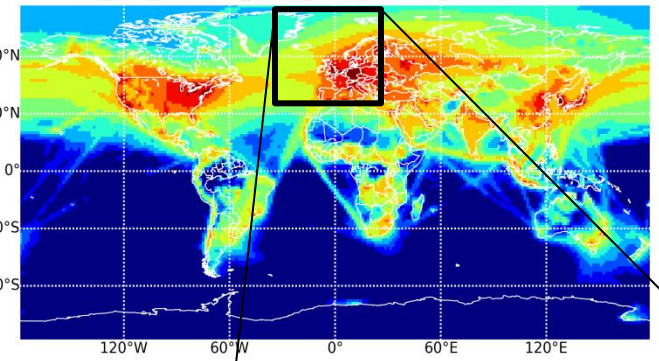
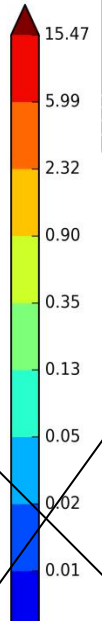
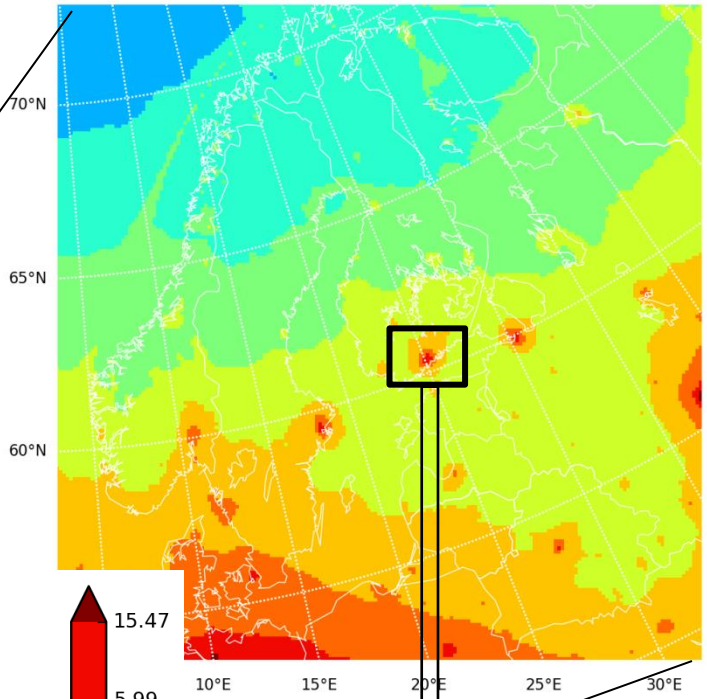
Dataset 1: long-term reanalysis

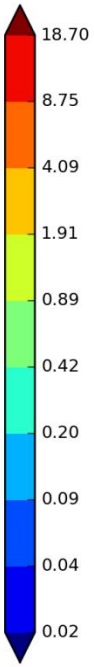
Globe (PEGASOS)	Europe (PEGASOS, APTA)	Finland (APTA)
Setup AQ: CB4 gas-phase stratosphere acid-basic + PM SOA	Setup AQ: CB4 gas-phase acid-basic + PM, SOA pollen (DA, trends)	Setup AQ: CB4 gas-phase acid-basic + PM, SOA pollen
1980 – 2015 1.44^{o} x 1.44^{o}	1980 – 2015. 0.5^{o} x 0.5^{o}	1980 – 2015. 0.1^{o} x 0.1^{o}
Meteo: ERA-Interim	Meteo: ERA-Interim	Meteo: BaltAn HIRLAM + ECMWF
Emission: MACCity / ACCMIP + MEGAN + EDGAR + GEIA lightning & aircraft	Emission: MACCity / ACCMIP + MEGAN + EDGAR + GEIA lightning & aircraft	Emission: EDGAR + MEGAN + ACCMIP + GEIA lightning & aircraft

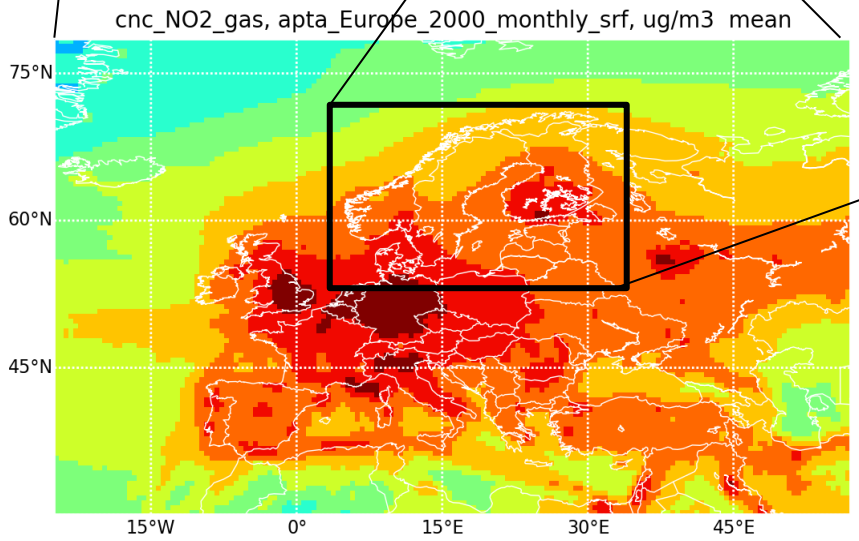
SILAM v.5.5: deposition, wind-blown dust, SOA, DMS, updated 4D-VAR

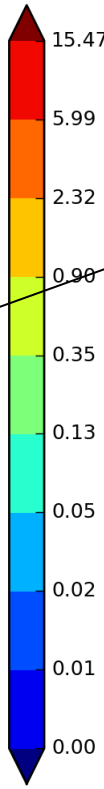










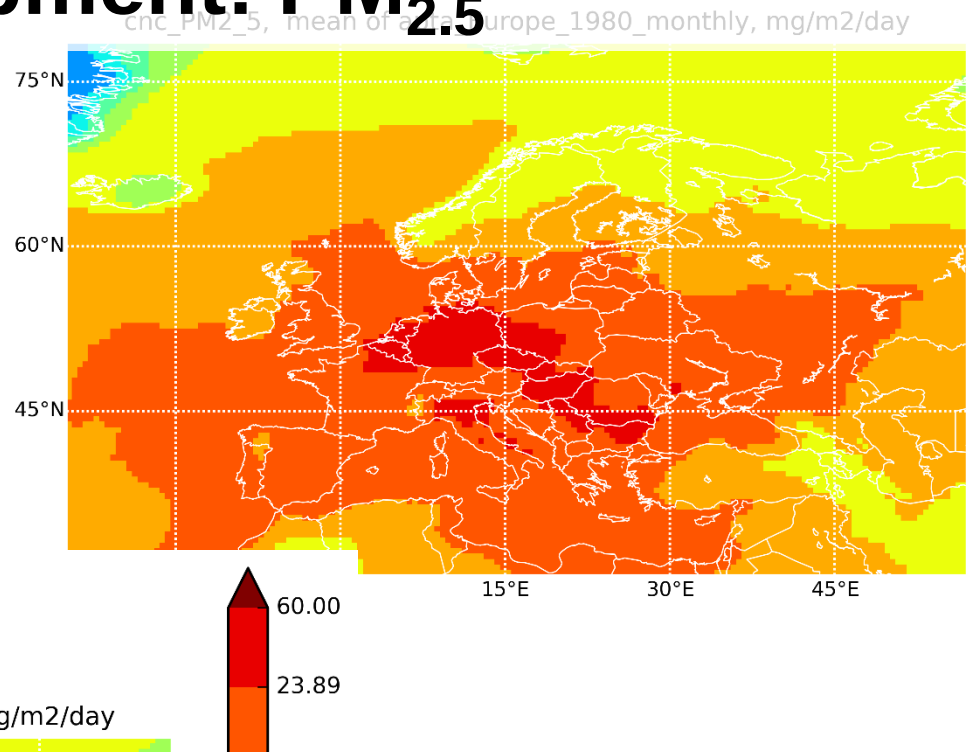


Boundaries for city-scale CAR-FMI

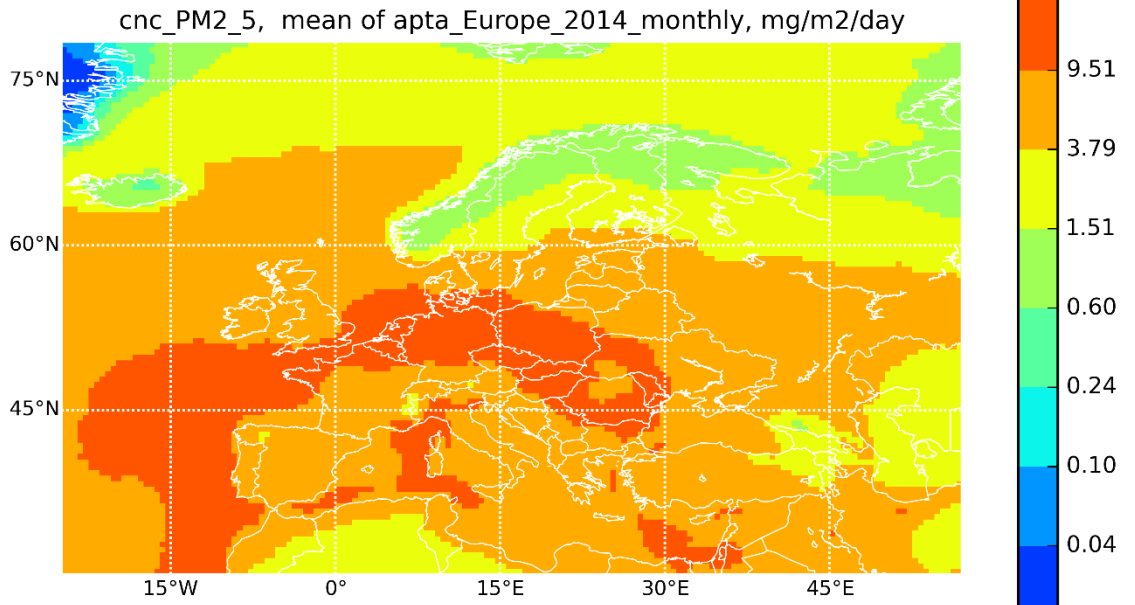
Pictures:
mean annual NO_2, 2000

Temporal development: $PM_{2.5}$

1980



2015

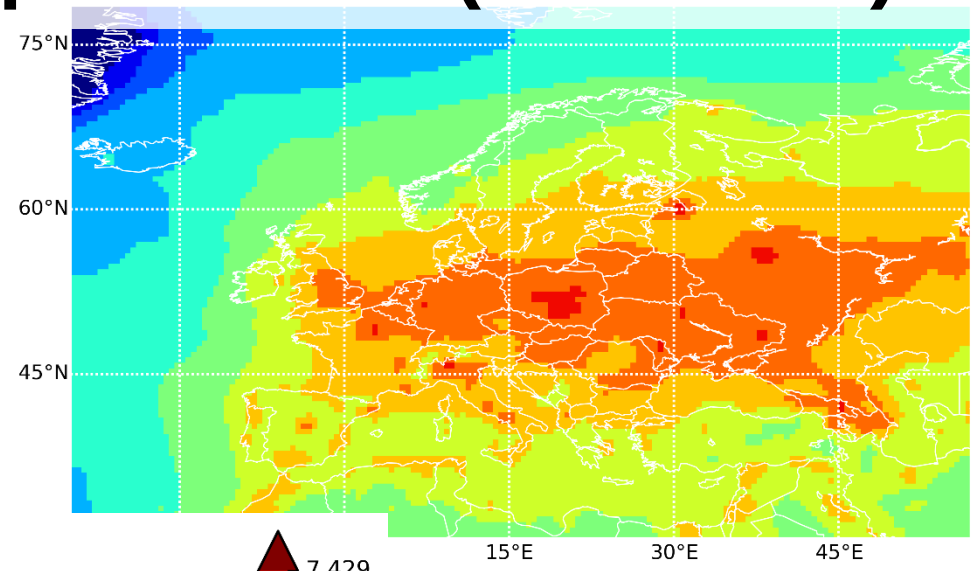


Mean annual $PM_{2.5}$ concentrations [$\mu g\ m^{-3}$]

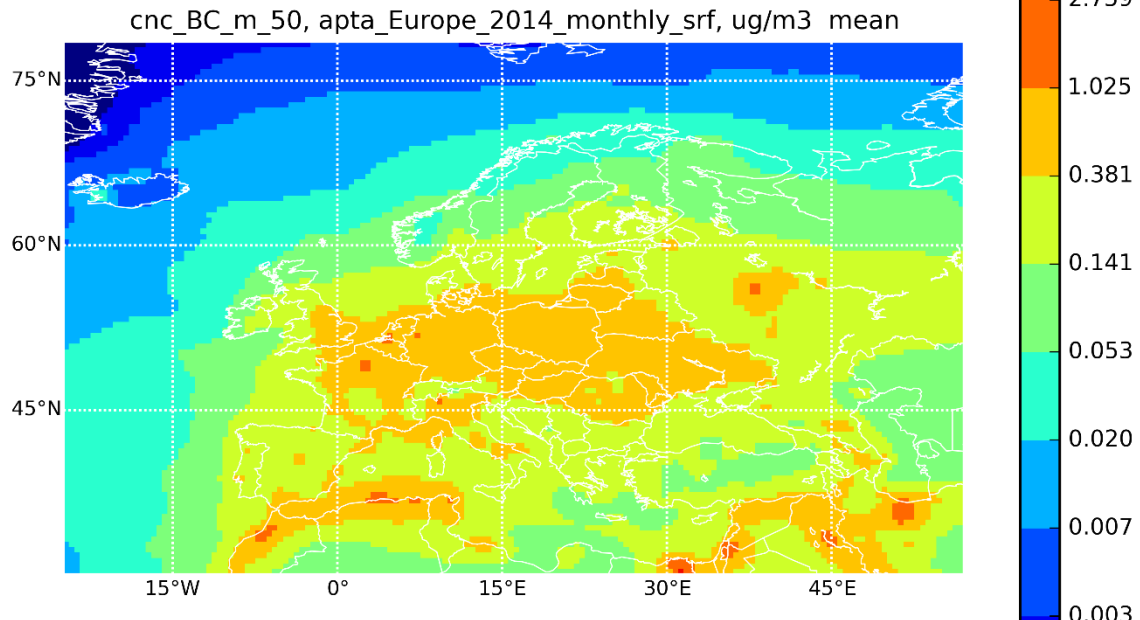
no desert dust

Temporal development: BC (MACCITY)

1980



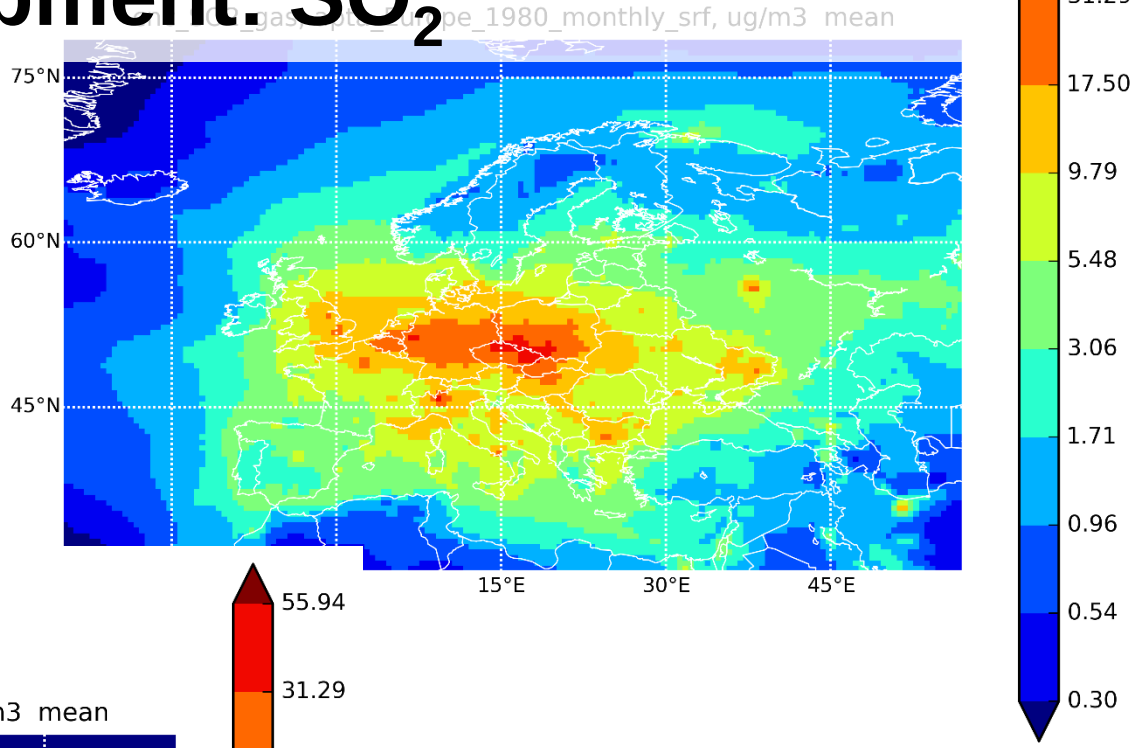
2015



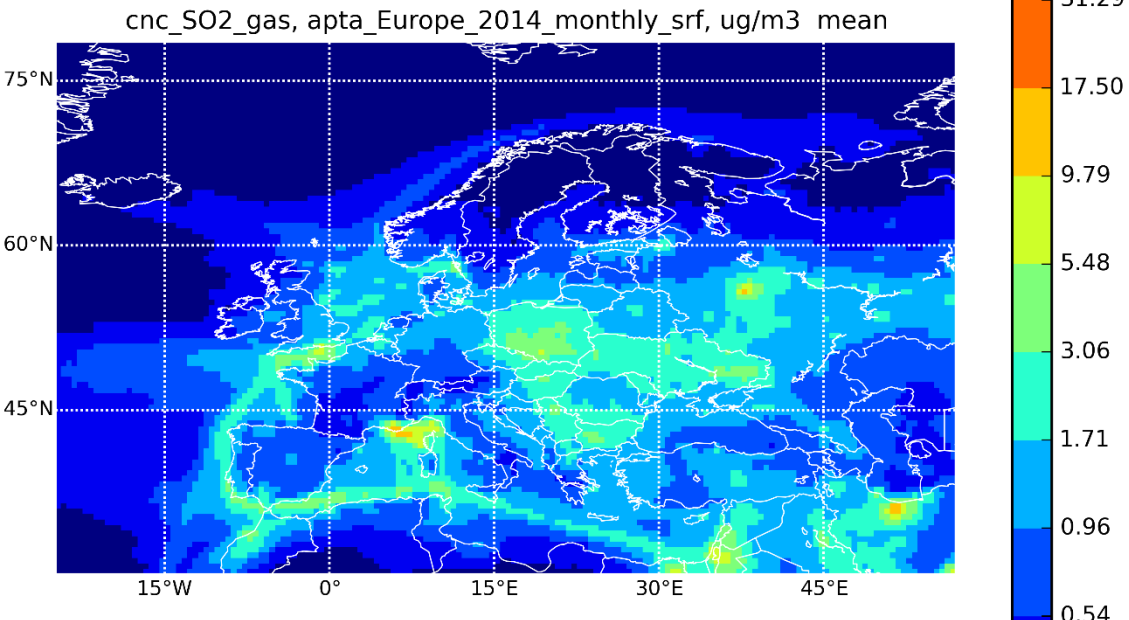
Mean annual BC concentrations [µg m^{-3}]

Temporal development: SO_2

1980



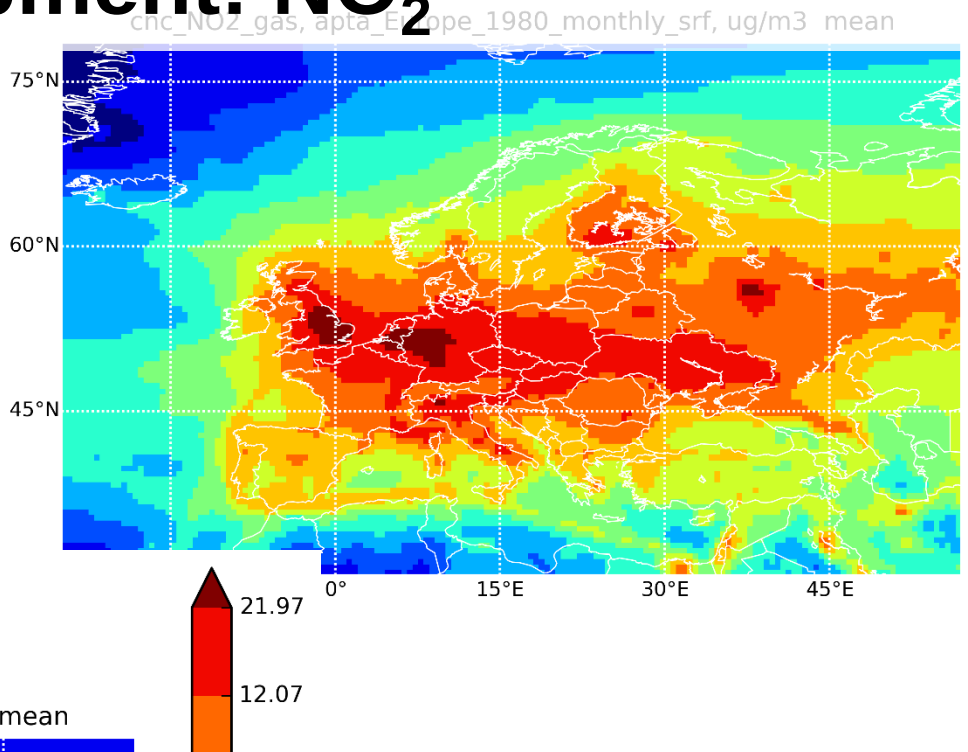
2015



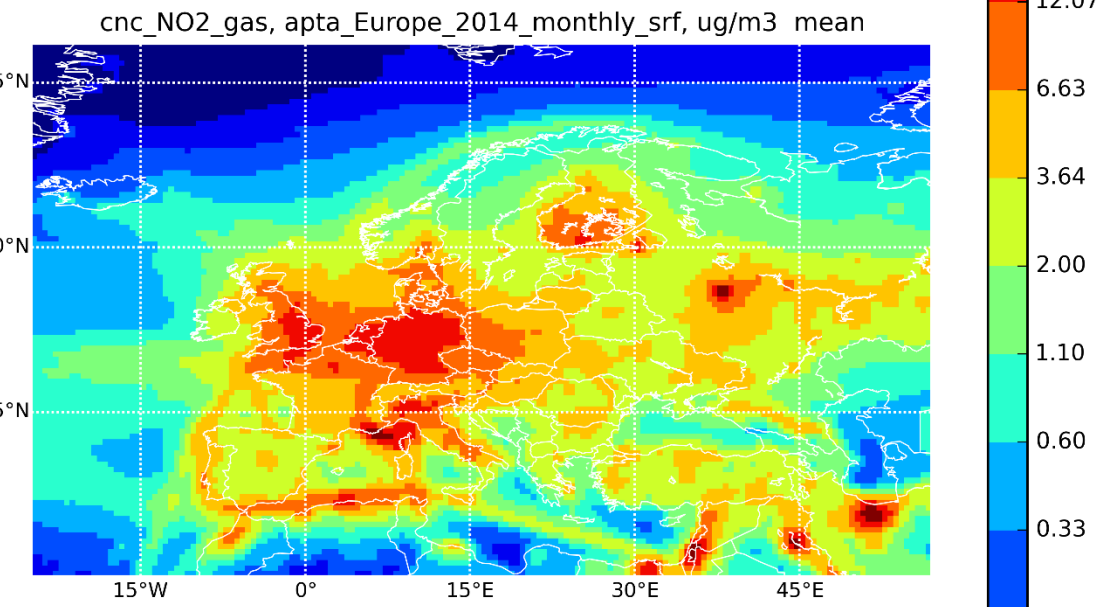
Mean annual SO_2 concentrations [$\mu g\ m^{-3}$]

Temporal development: NO_2

1980



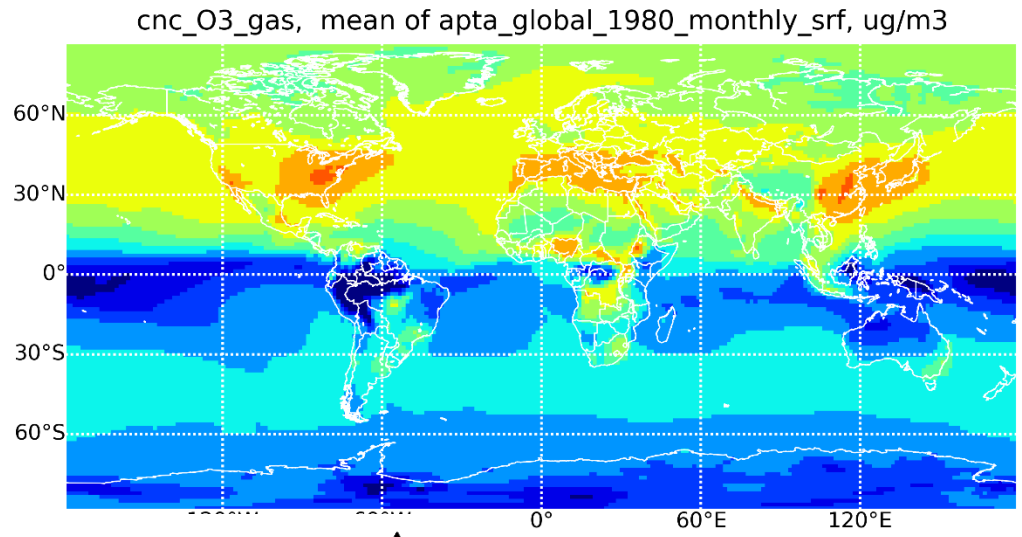
2015



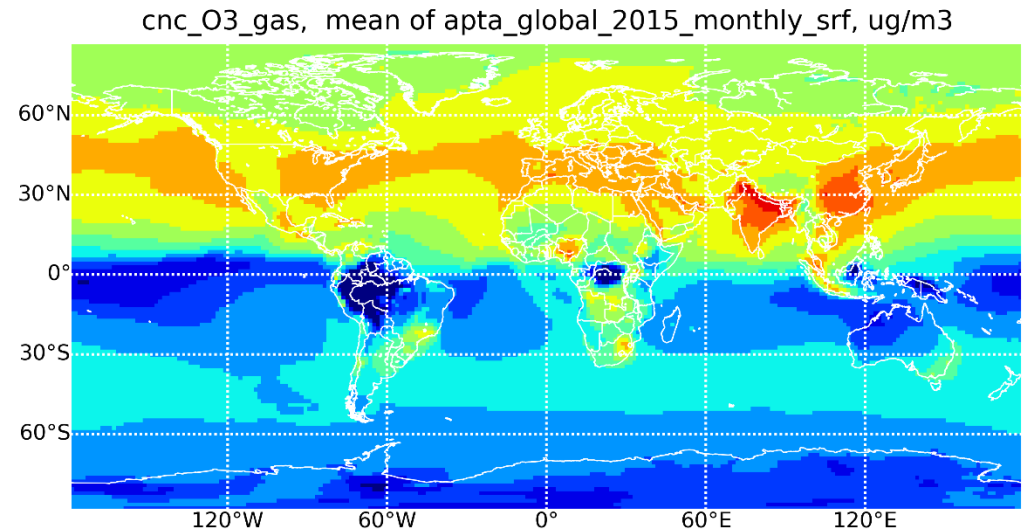
Mean annual NO_2 concentrations [$\mu g\ m^{-3}$]

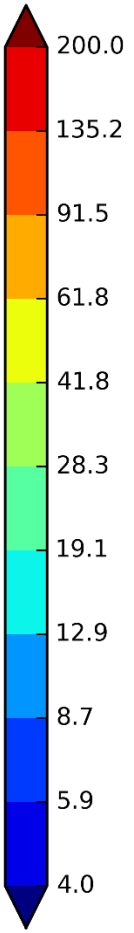
Temporal development: O_3

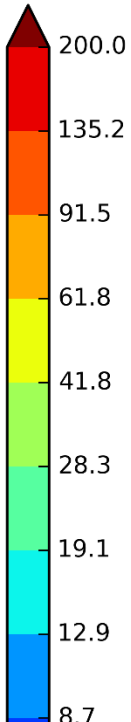
1980



2015

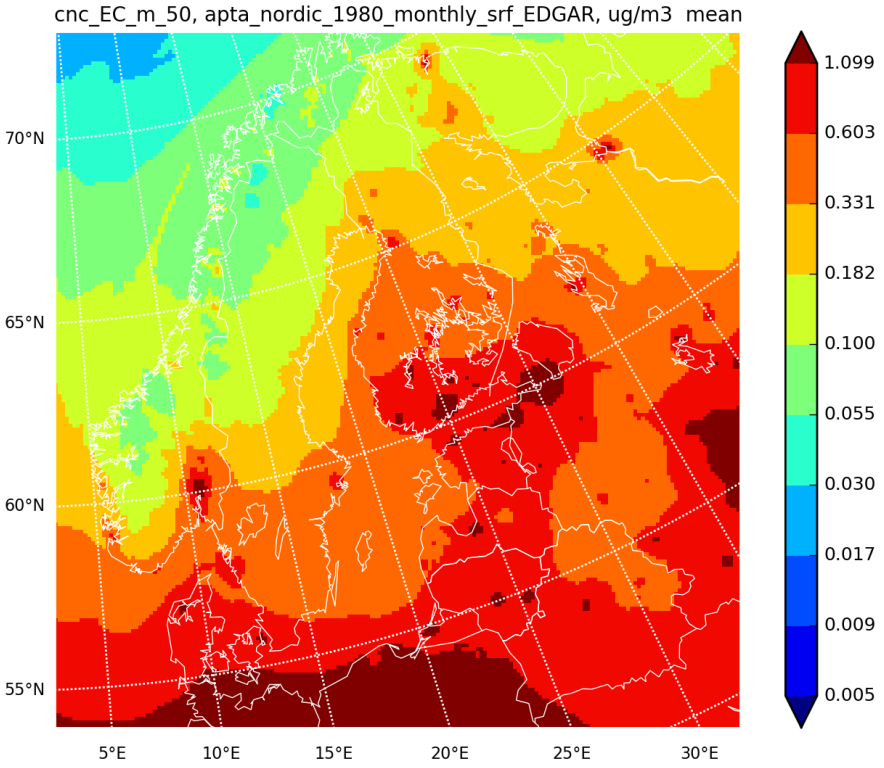






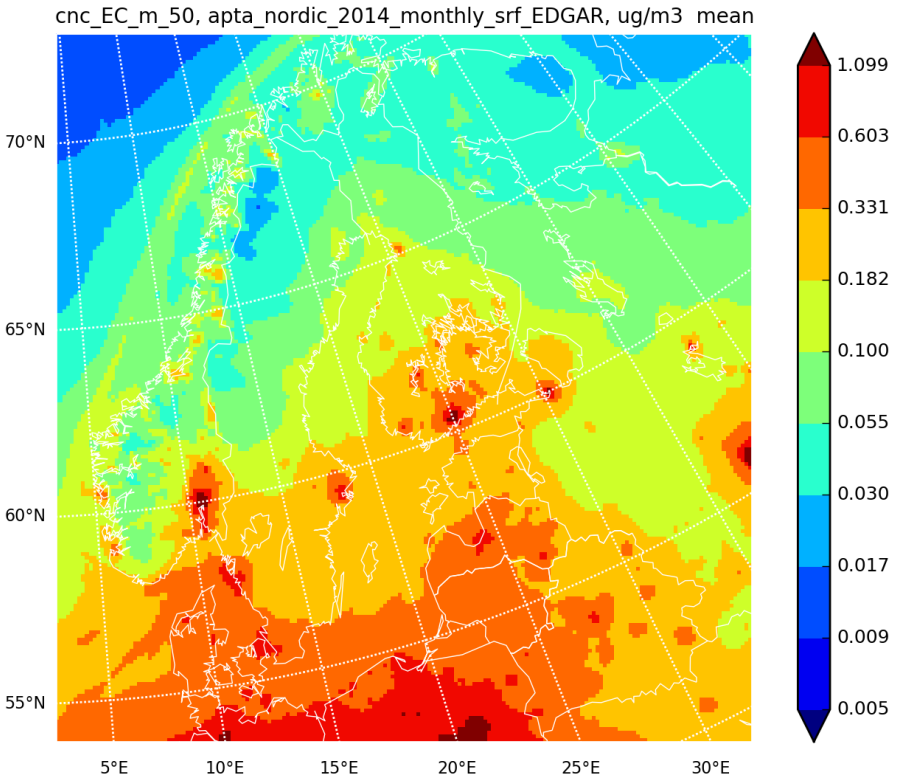
Mean annual O_3 concentrations [µg m^{-3}]

Nordic zoom (EDGAR / BaltAn): BC



1980

2014



Mean annual concentration of elemental carbon, μg/m3

Evaluation: on-going

- Stratospheric components
  - VMR profiles: GOMOS retrievals for O3, NO2, NO3, PM
  - Total ozone column
- Asian monsoon
  - A powerful vacuum cleaner for Asian pollution
  - Arguably one of the most-important paths of tracers (aerosols, SO2, but also possibly, water, NO2) to the stratosphere
  - Effect visible just above the tropopause as reduced O3 level
- Tropospheric/regional evaluation
- Based on PEGASOS-APTA setup, global AQ forecast has been set; it is routinely evaluated against satellites

Considerations for IHKU

- Two datasets: the long-term reanalysis and the 1-year high-resolution simulations
- The baseline high-resolution run: size matters
  - Suggested: 1 km, 1 year, 3hrs output.
  - MARPOL global run: 3600 x 1780 horizontal grid, 3 hrs output step → 8 TB annual output, ~300 hours runtime
  - Finland 1km 1200 x 500 grid. Anticipated: 1 TB output / scenario, about-same runtime (internal time step is 10 times shorter).
- Sensitivity runs: 5 + 1
  - 1 year, 10 km, 1 month (year?) output.
- Available meteo data:
  - ECMWF: 2012 10km, 2015 9km
  - HARMONIE: 2015 2.5km (~10 TB of input, completeness to check)
  - UERRA on-going, 10km, eventually 1980-2015, access asked

Considerations for IHKU 2

- Things to compute
  - 1 baseline run with 1km
  - 5 runs with realistic mitigation scenarios, 10km
  - PNC today has no reasonable description in any regional model. Thoughts go around, nothing practical until mid-2017 in the best case.
  - Emission: inventory vs modelling
  - Output: annual or, e.g., day-night, winter-summer separation? Concentration distribution?