Analysis of the sources influencing ground-based observations of CO<sub>2</sub>, CO and CH<sub>4</sub> at Xianghe, China using WRF-GHG simulations

Sieglinde Callewaert<sup>1</sup>, Martine De Mazière<sup>1</sup>, Minqiang Zhou<sup>2</sup>, Emmanuel Mahieu<sup>3</sup>, Pucai Wang<sup>2</sup> isieglinde.callewaert@aeronomie.be

# **XIANGHE SITE**

China is the world's largest emitter of greenhouse gases

Beijing-Tianjin-Hebei megalopolis is one of the largest economic regions in North China with over 110 million inhabitants

The Xianghe site lies in a suburban area, surrounded by cropland



Ground-based insitu at 60 m above the ground

- Picarro CRDS analyzer
- sampling local air
- $CO_2$  and  $CH_4$

#### Ground-based remote sensing (FTIR)

- part of TCCON
- total column averaged mole fractions
- only during the day, clear sky XCO<sub>2</sub>, XCH<sub>4</sub>, XCO





**OBSERVATIONS** 

Observations carried out by Institute of Atmospheric Physics of the Chinese Academy of Sciences

Two instruments measure the atmospheric concentrations of CO<sub>2</sub>, CH<sub>4</sub> and CO

#### MODEL

WRF-GHG: regional atmospheric transport model with passive tracers







Observed timeseries show lots of variability



#### SIMULATIONS



Hourly 3D concentrations



Good accuracy with observations

Resolution of 27 km – 9 km – 3 km

Boundary conditions: ERA5 and CAMS reanalysis

## SECTOR CONTRIBUTIONS

Main contributing sectors: CO<sub>2</sub>: Energy – Industry – Biosphere – Residential – Transportation



CH<sub>4</sub>: Energy – Residential & Waste – Agriculture



**CO:** Industry – Residential – Transportation



# concentrations in Xianghe?





### **AND OTHER INSIGHTS**

Diurnal cycle (median)

Insitu observations are strongly influenced by the variation of the planetary boundary layer height (PBLH) Highest concentration during the night and early morning





Hour of day (local time) Hour of day (local time)

Column concentrations are much higher when upper winds coming from WSW, and

#### All contributions are visible both in the column and insitu observations

Monthly median sector contributions to the columns



<sup>1</sup> Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium <sup>2</sup> Institute of Atmospheric Physics, Chinese Academy of Science (IAP-CAS), Beijing, China <sup>3</sup> University of Liège, Liège, Belgium

1900 - 1920 E > 1920

lower when winds are coming from NNW

SW winds bring polluted airmasses from the highly populated North China Plain to Xianghe

Model bias for XCO<sub>2</sub> is likely caused by CAMS reanalysis

XCH4 (ppb)

< 1840

For CH<sub>4</sub>, WRF-GHG bias is similar for insitu and column, so likely caused by incorrect emissions



0.02