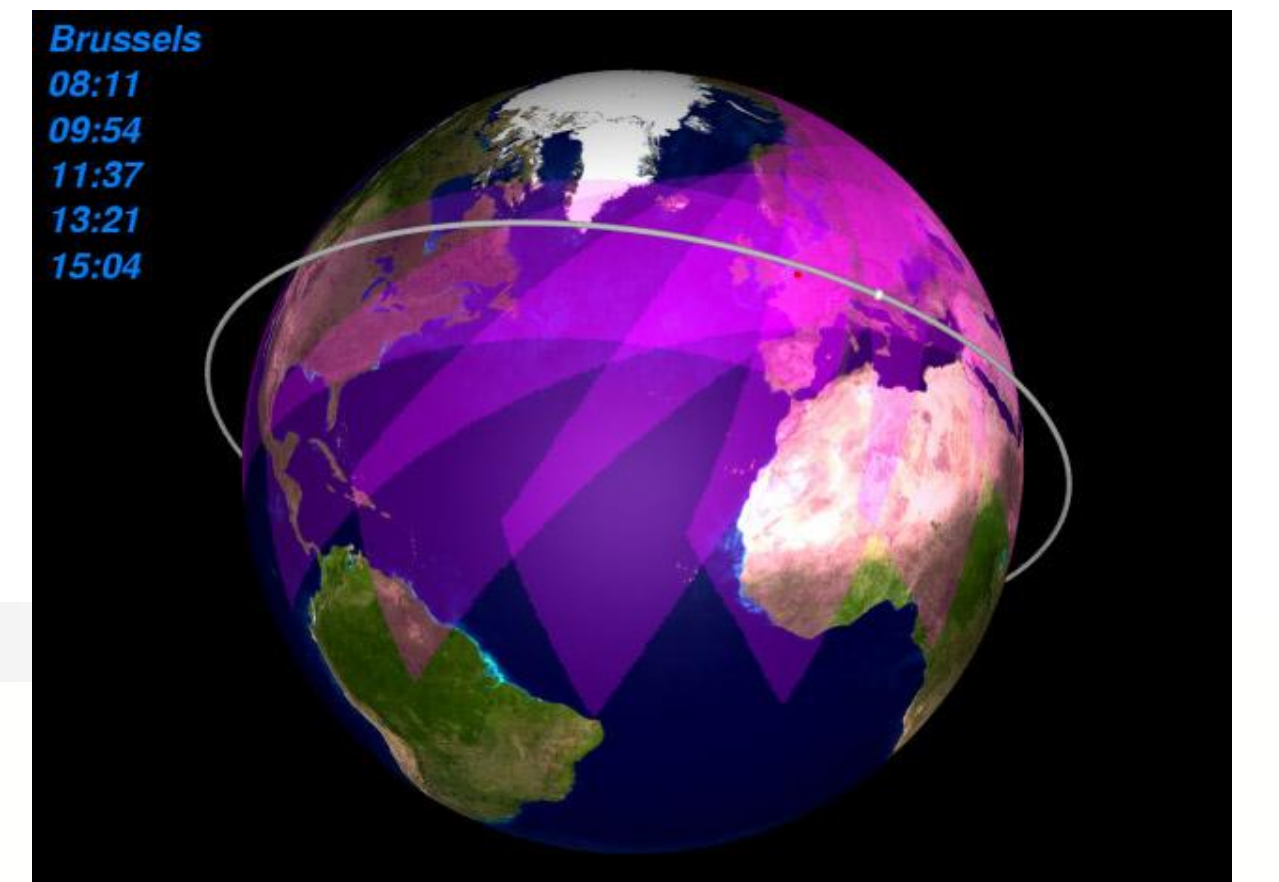# Geophysical data requirements for AQ satellite missions: A correlation analysis using model output
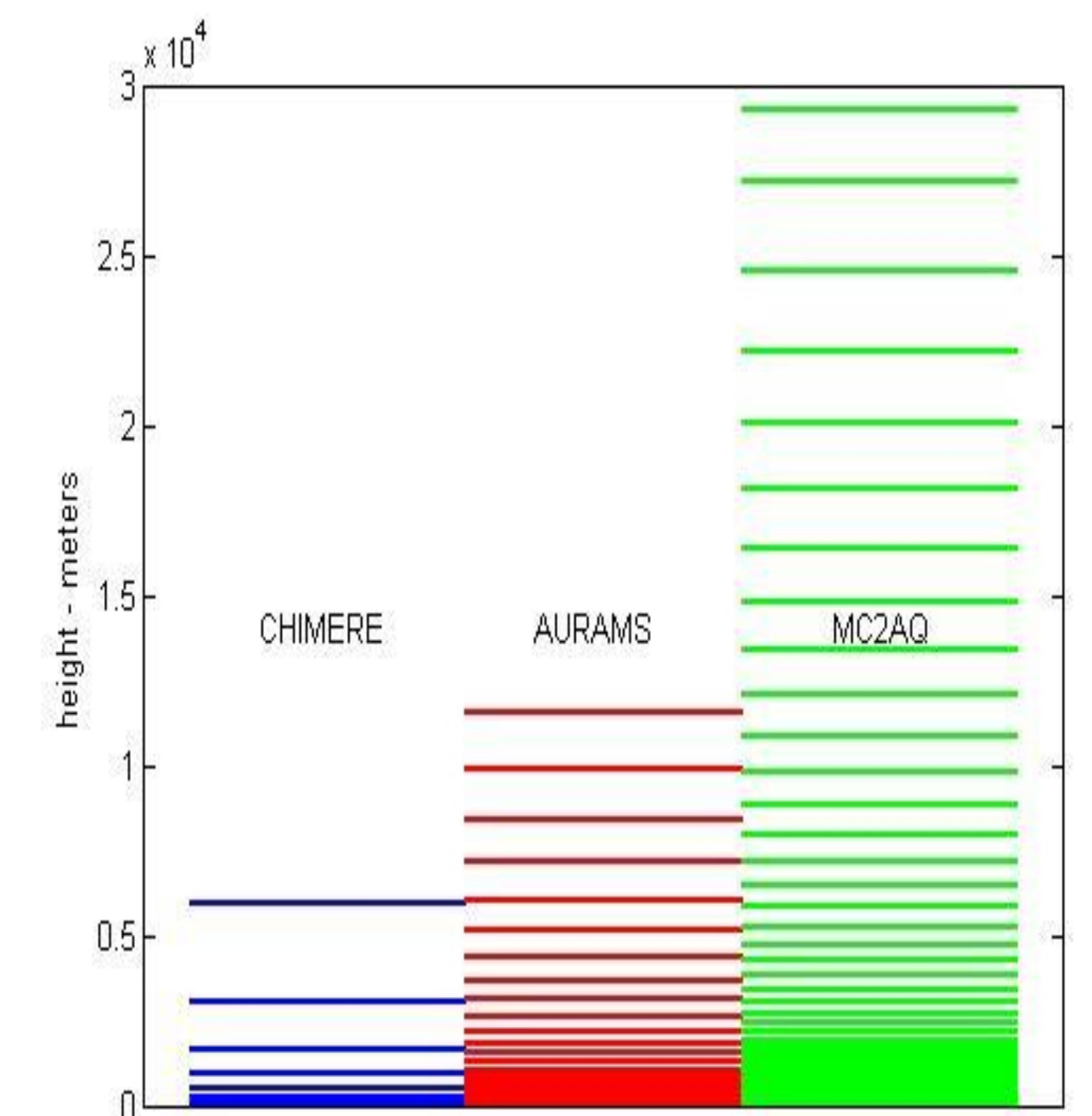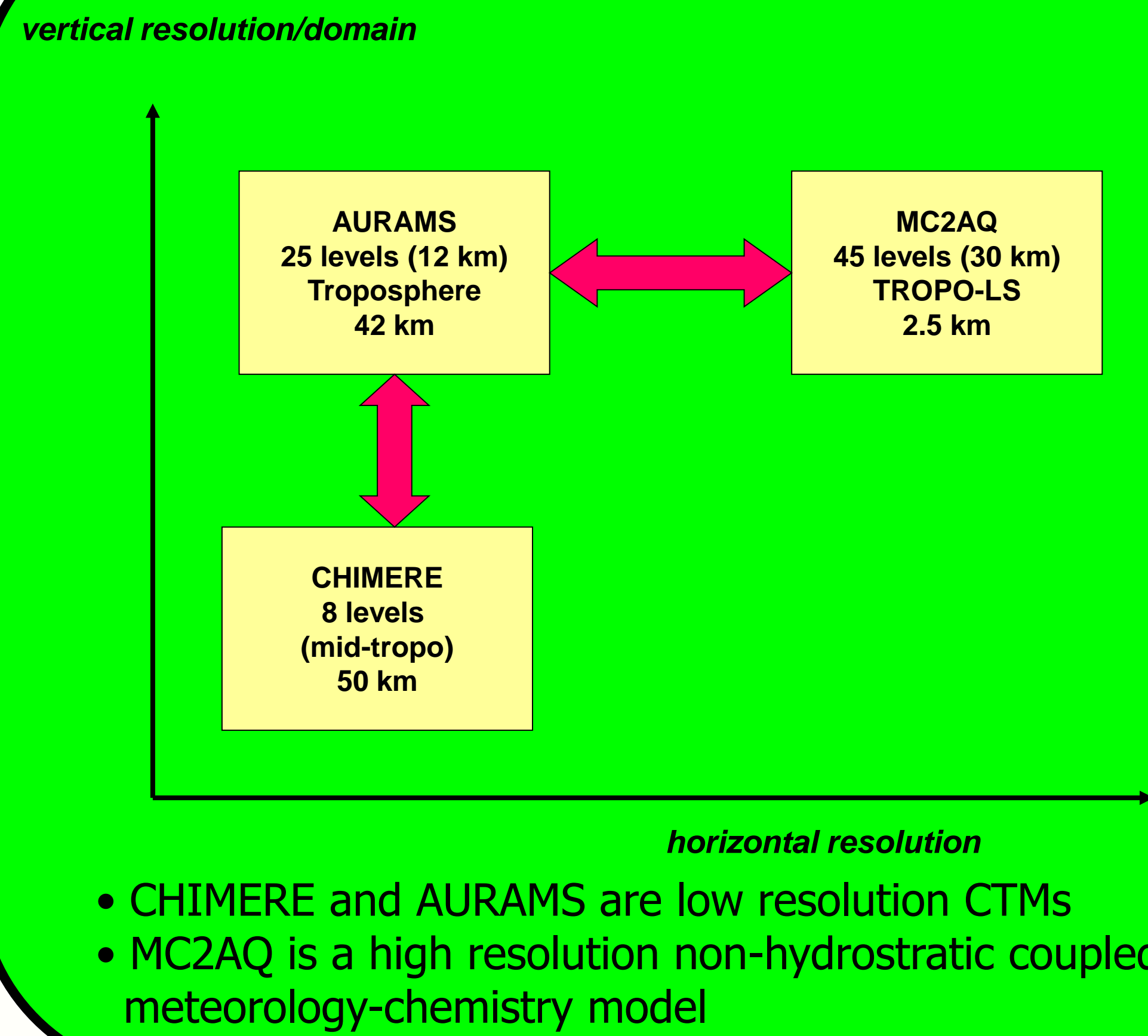
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Abstract

A number of satellites dedicated to air quality are expected to be launched during the next decade. We present a derivation of spatial and temporal resolution threshold requirements for air quality gases based on auto-correlation analysis using model output of different resolution and configuration. The decorrelation length scale provides a measure beyond which data gaps becomes unavoidable. Sensitivity of this analysis with respect to background pollution, spatial and temporal averaging has also been conducted. The results show that the correlation analysis is able to capture the different mechanisms and physical processes in the model for the different constituents and, in addition, provide an assessment of the importance of model resolution. In a snapshot, the correlation analysis provide valuable information of the model behaviour.

The models

vertical resolution/domain

AURAMS
25 levels (12 km)
Troposphere
42 km

MC2AQ
45 levels (30 km)
TROPO-LS
2.5 km

CHIMERE
8 levels
(mid-tropo)
50 km

horizontal resolution

- CHIMERE and AURAMS are low resolution CTMs
- MC2AQ is a high resolution non-hydrostratic coupled meteorology-chemistry model

Effects of vertical extent and resolution – Comparison AURAMS / CHIMERE

Horizontal Correlations O_3
at noon (+/- 1 hour)

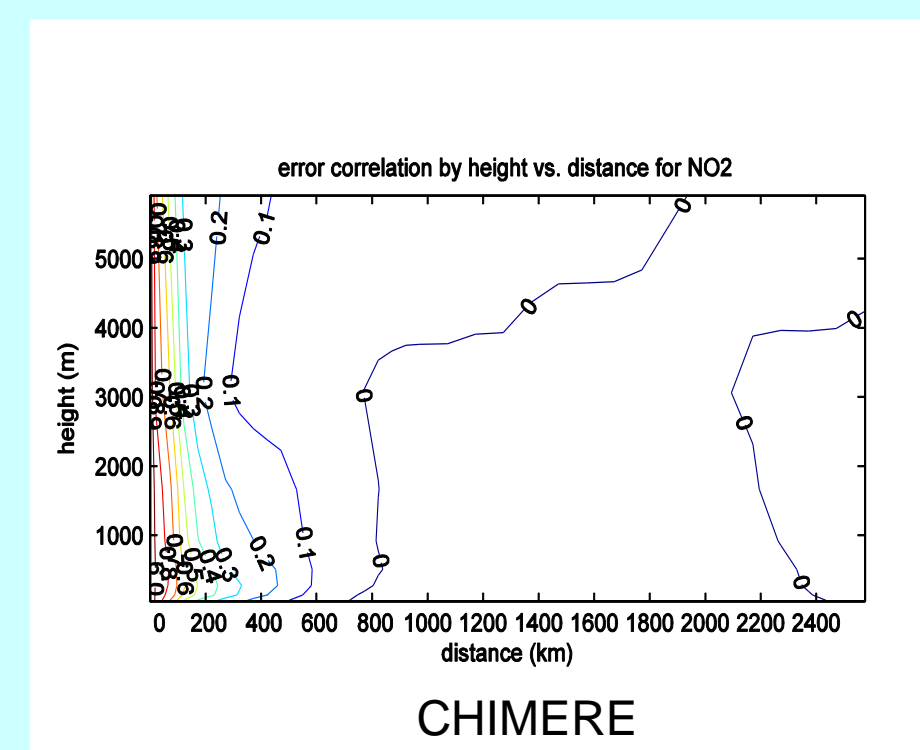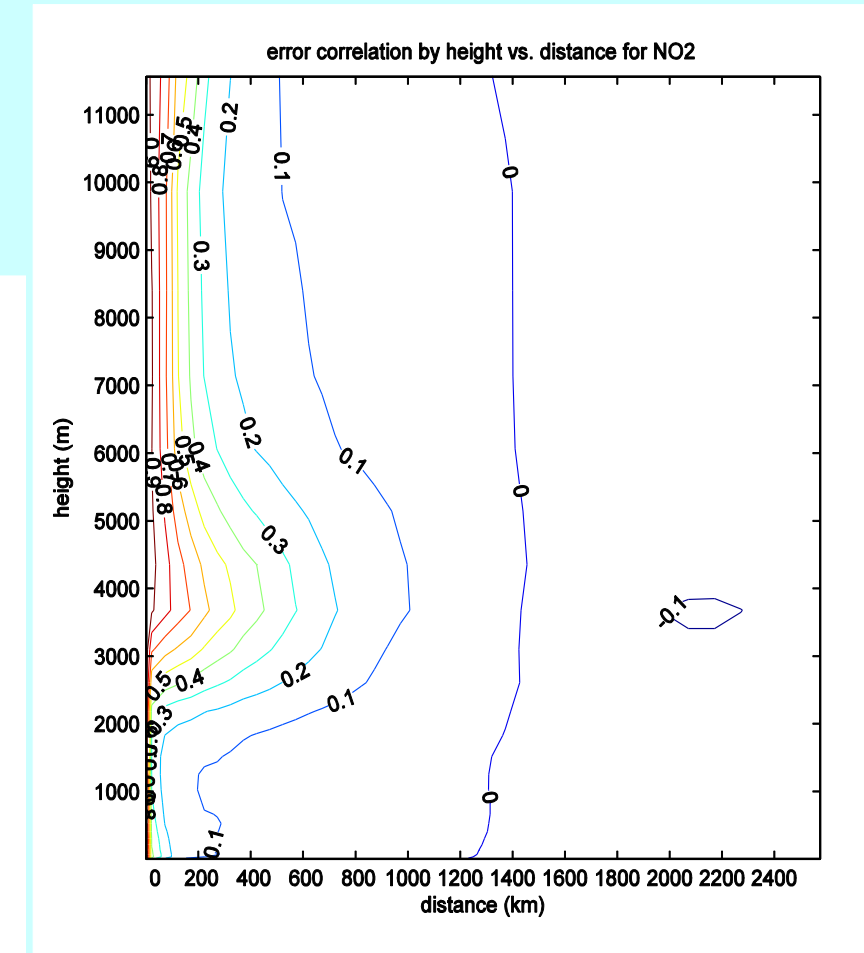➢ horizontal domain average
➢ ~ 12 day average
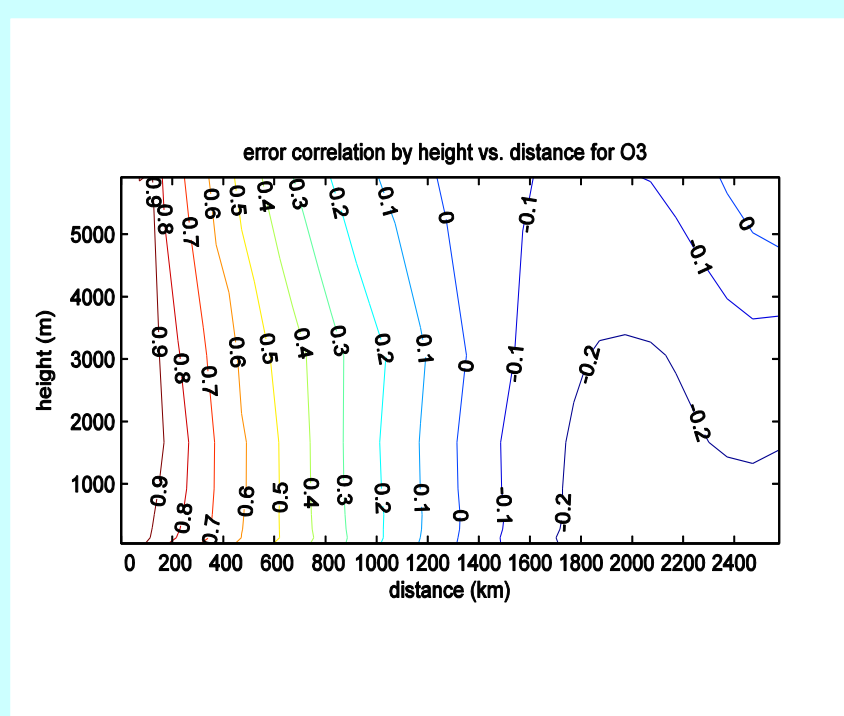
CHIMERE
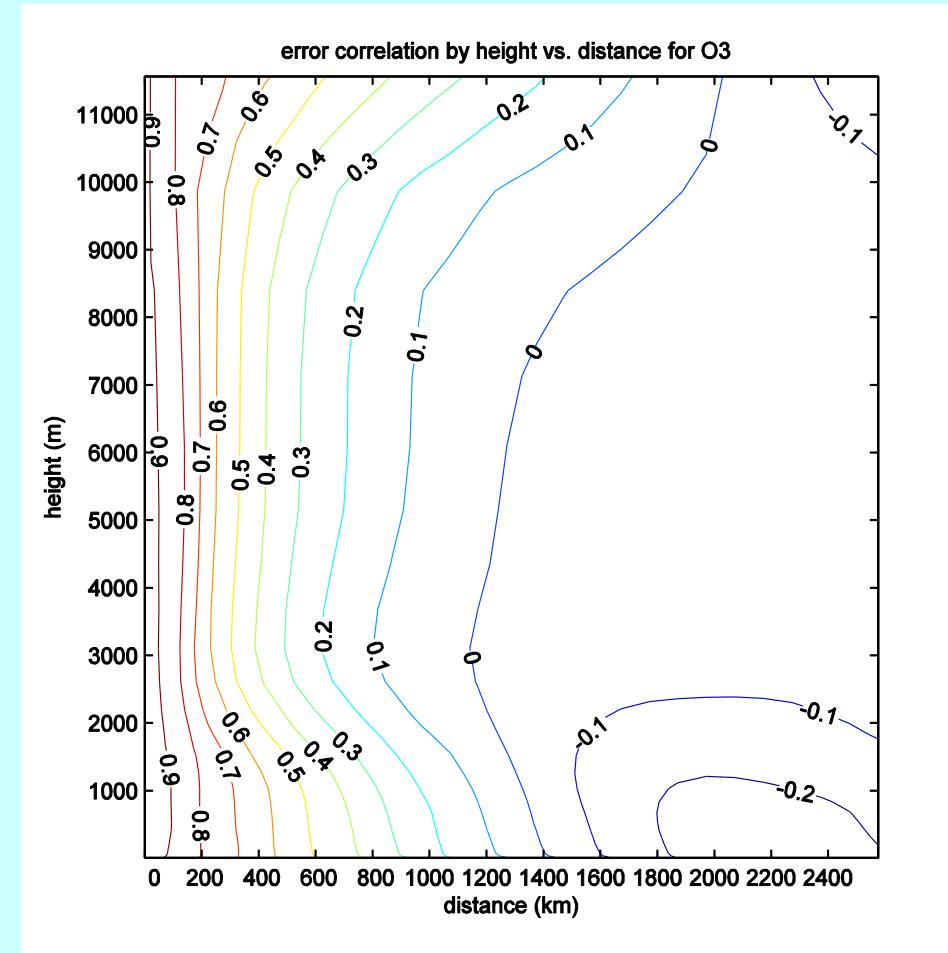
AURAMS
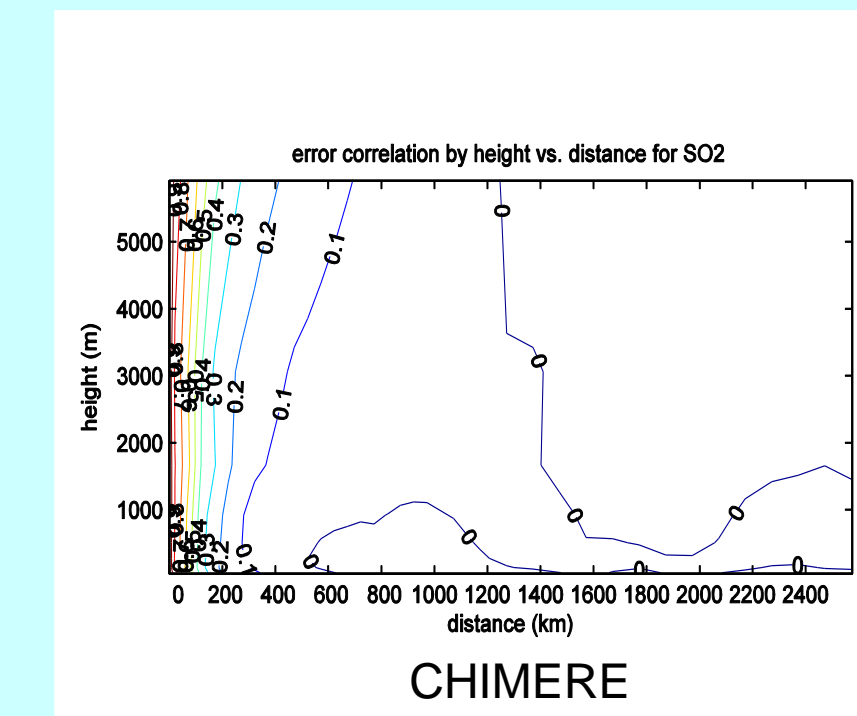
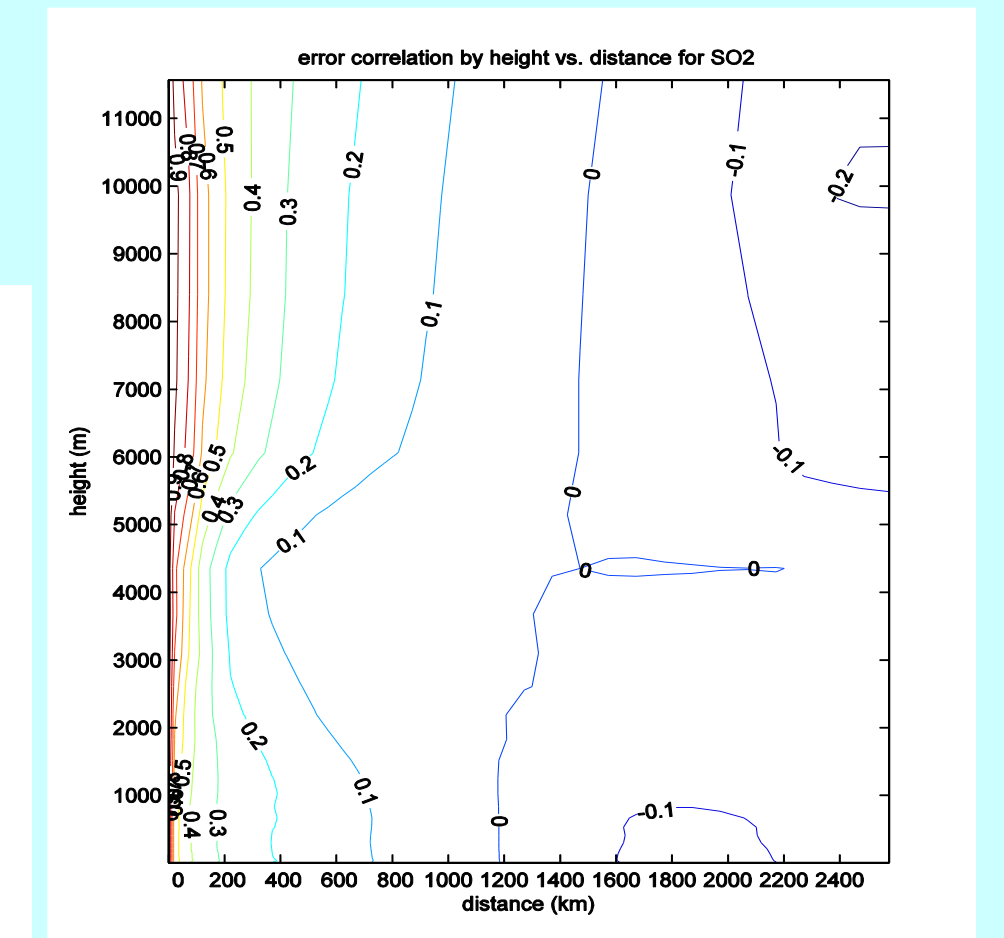Horizontal Correlations NO_2
at noon (+/- 1 hour)

CHIMERE

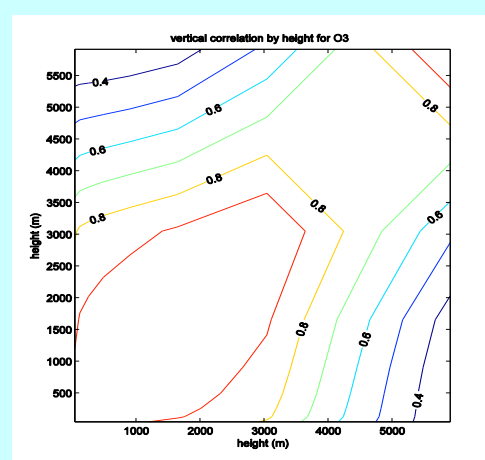AURAMS

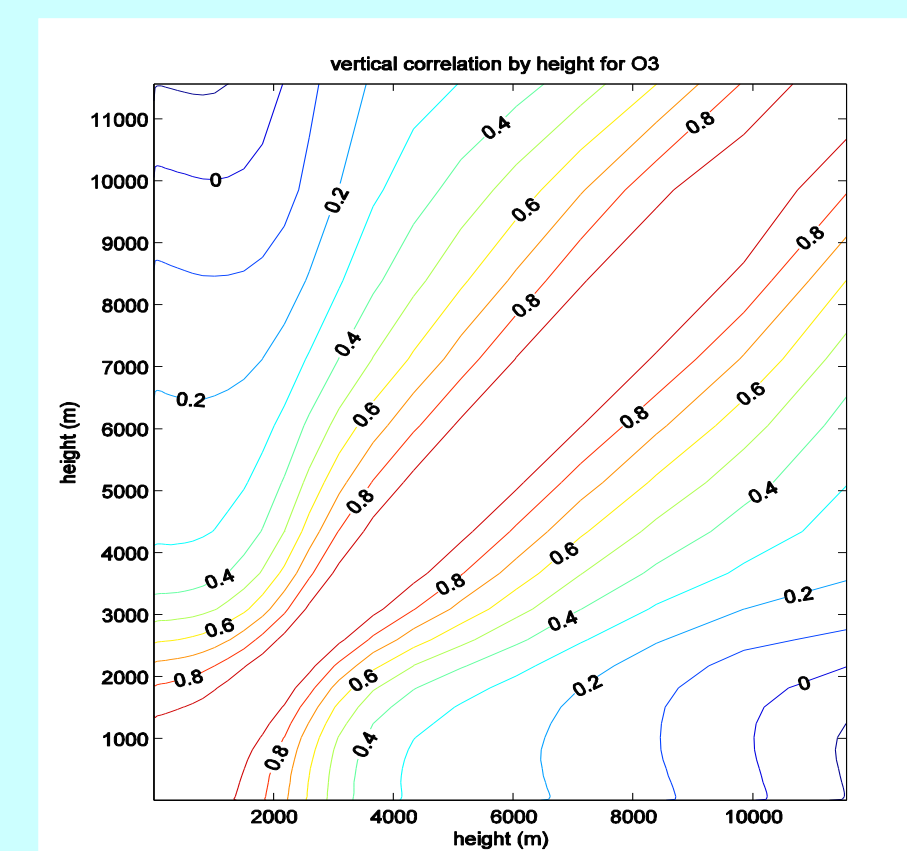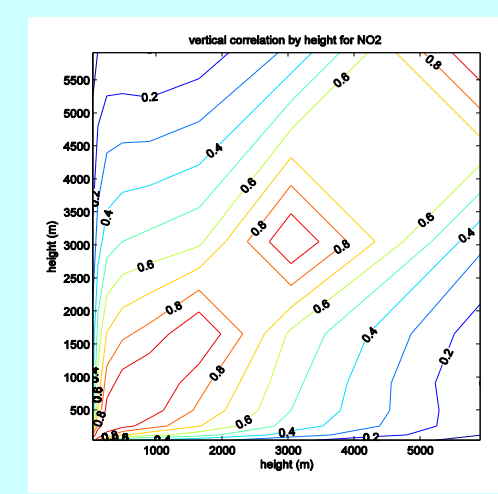Horizontal Correlations SO_2
at noon (+/- 1 hour)

CHIMERE

AURAMS

Vertical correlation O_3
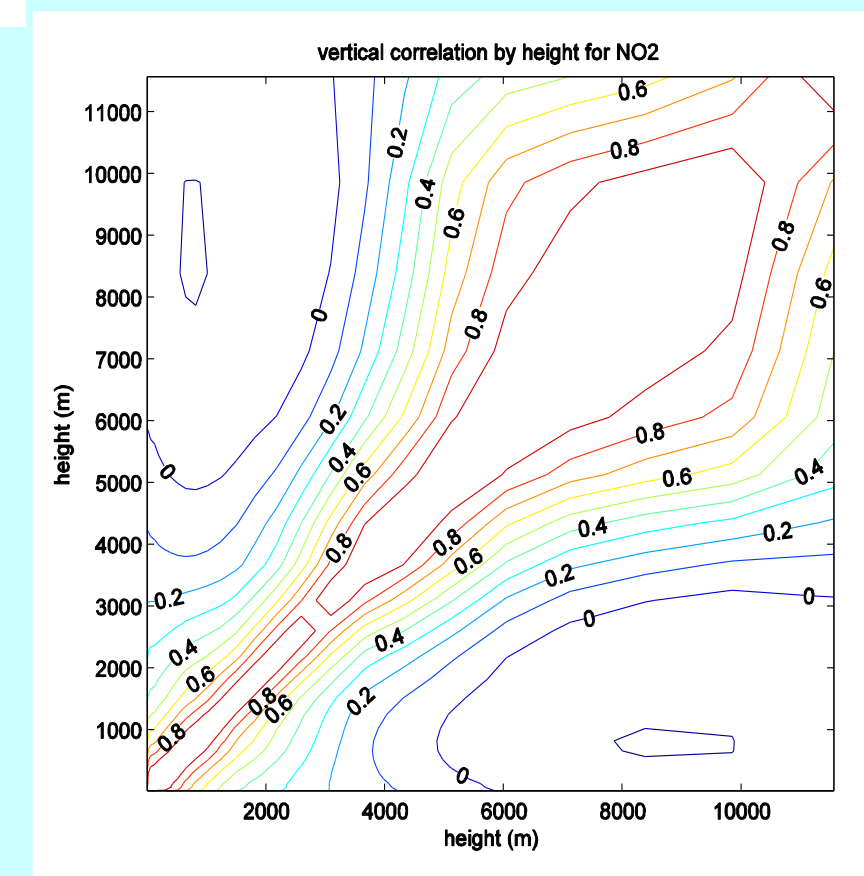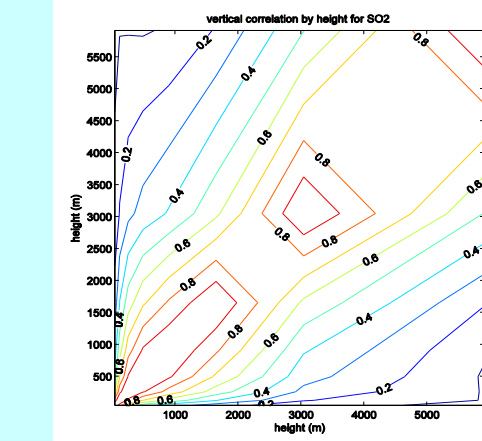at noon (+/- 1 hour)

CHIMERE

AURAMS

Vertical correlation NO_2
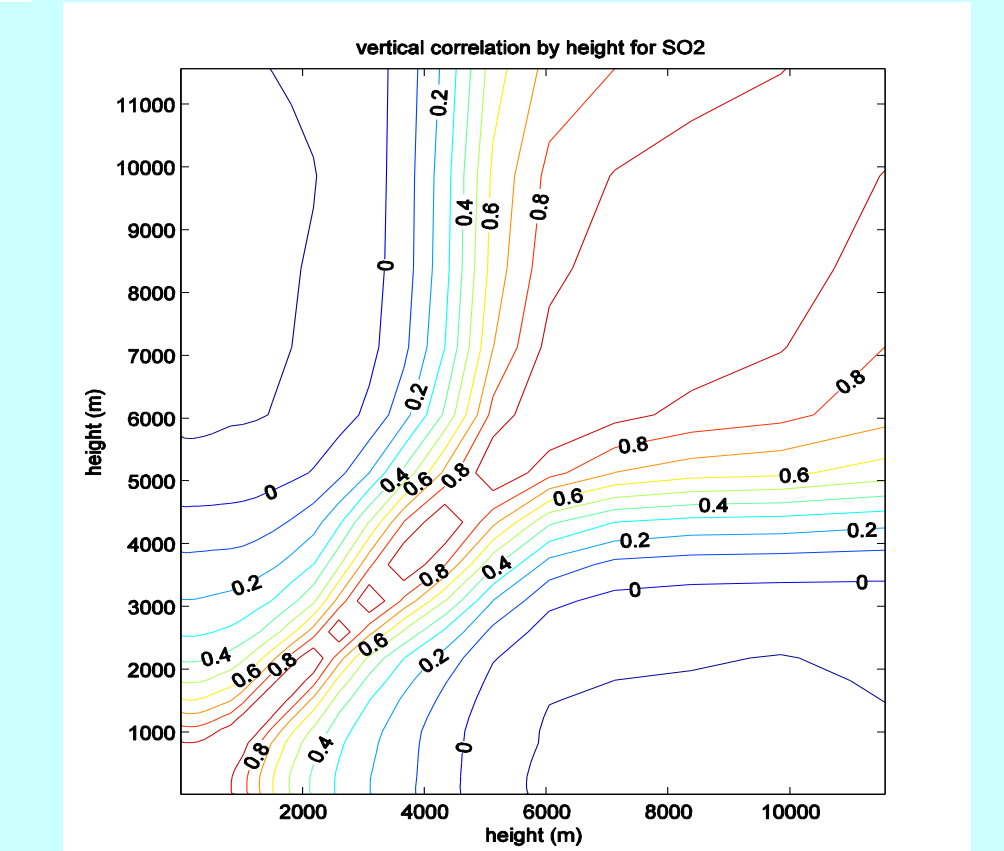at noon (+/- 1 hour)

CHIMERE

AURAMS

Vertical correlation SO_2
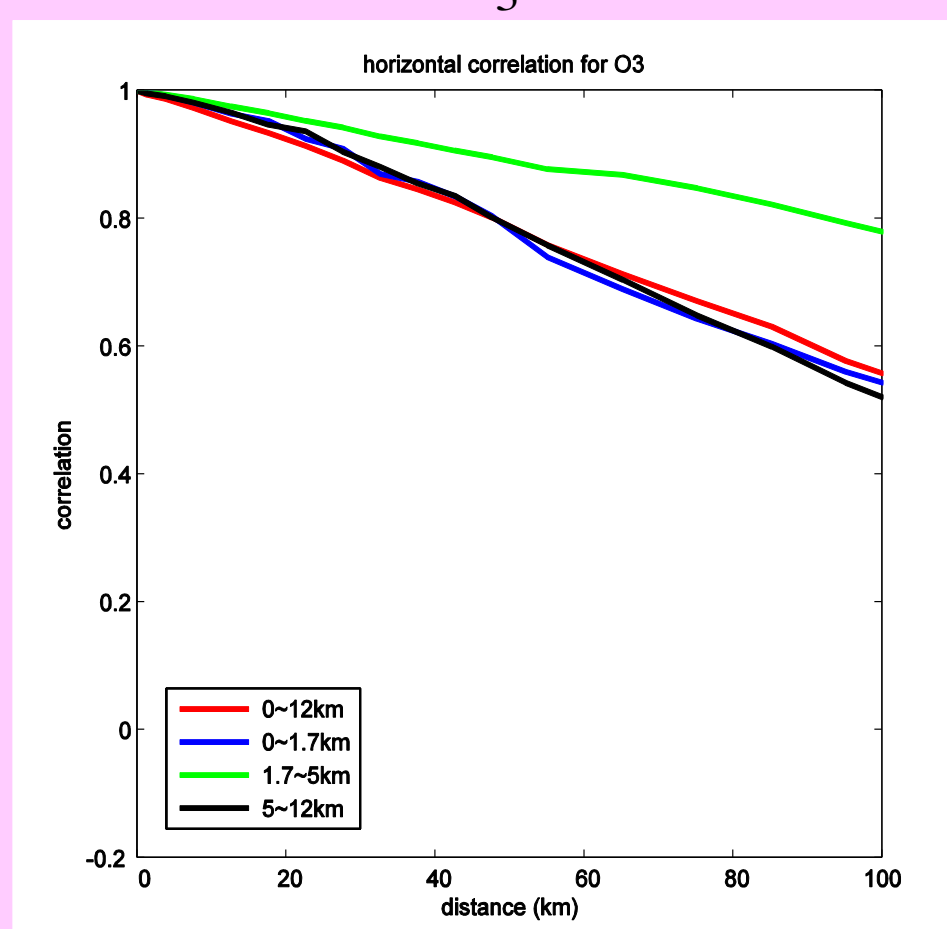at noon (+/- 1 hour)
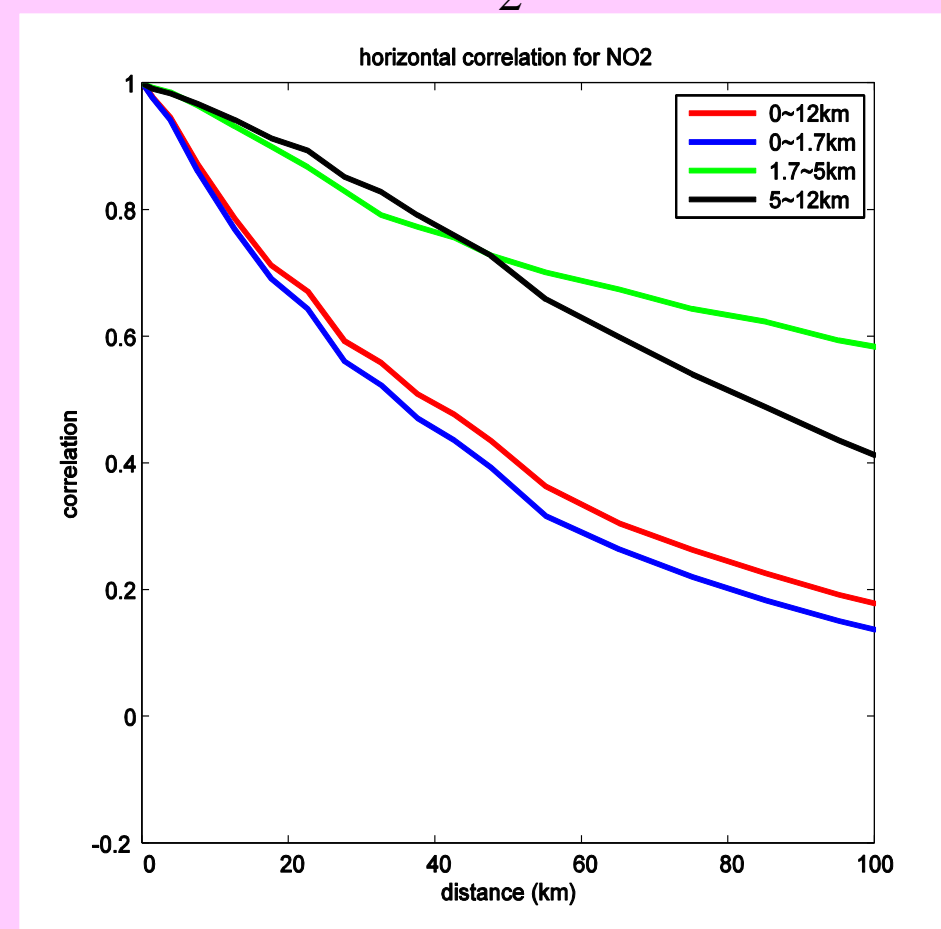

CHIMERE

AURAMS

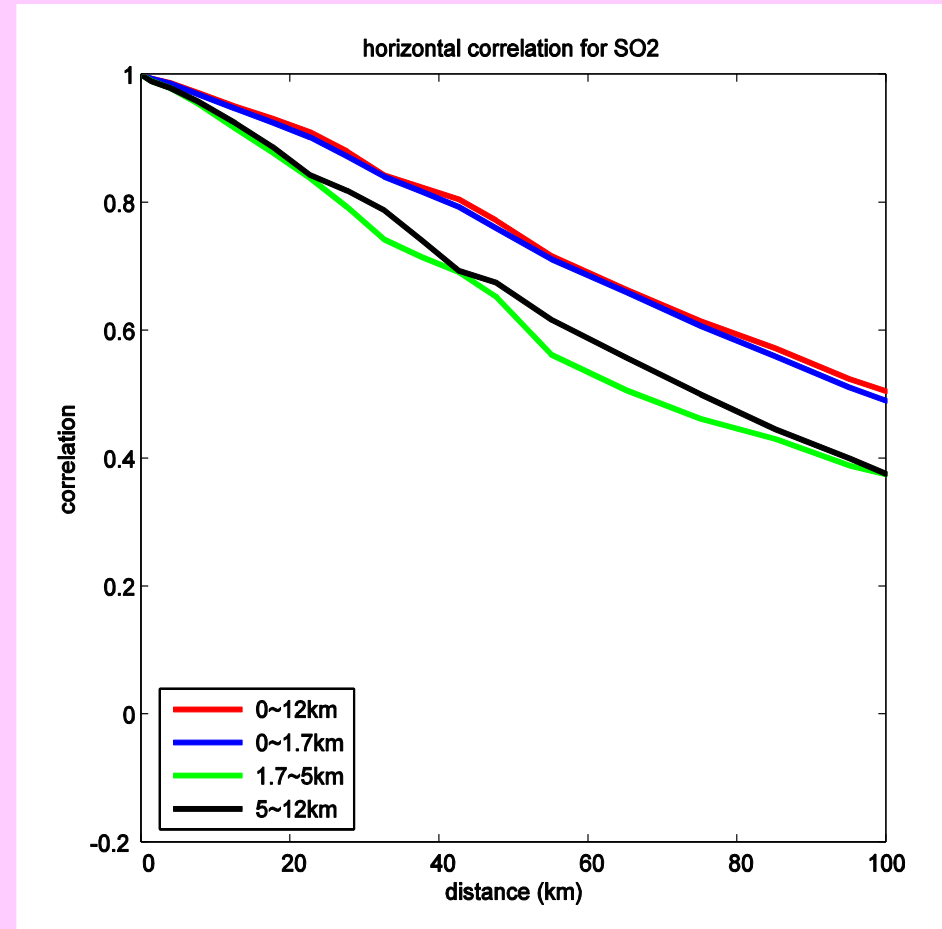## Very high resolution model MC2AQ (2.5 km)

O_3

AURAMS ~500 km for O3
MC2AQ ~100 km

NO_2

AURAMS ~120 km for NO2
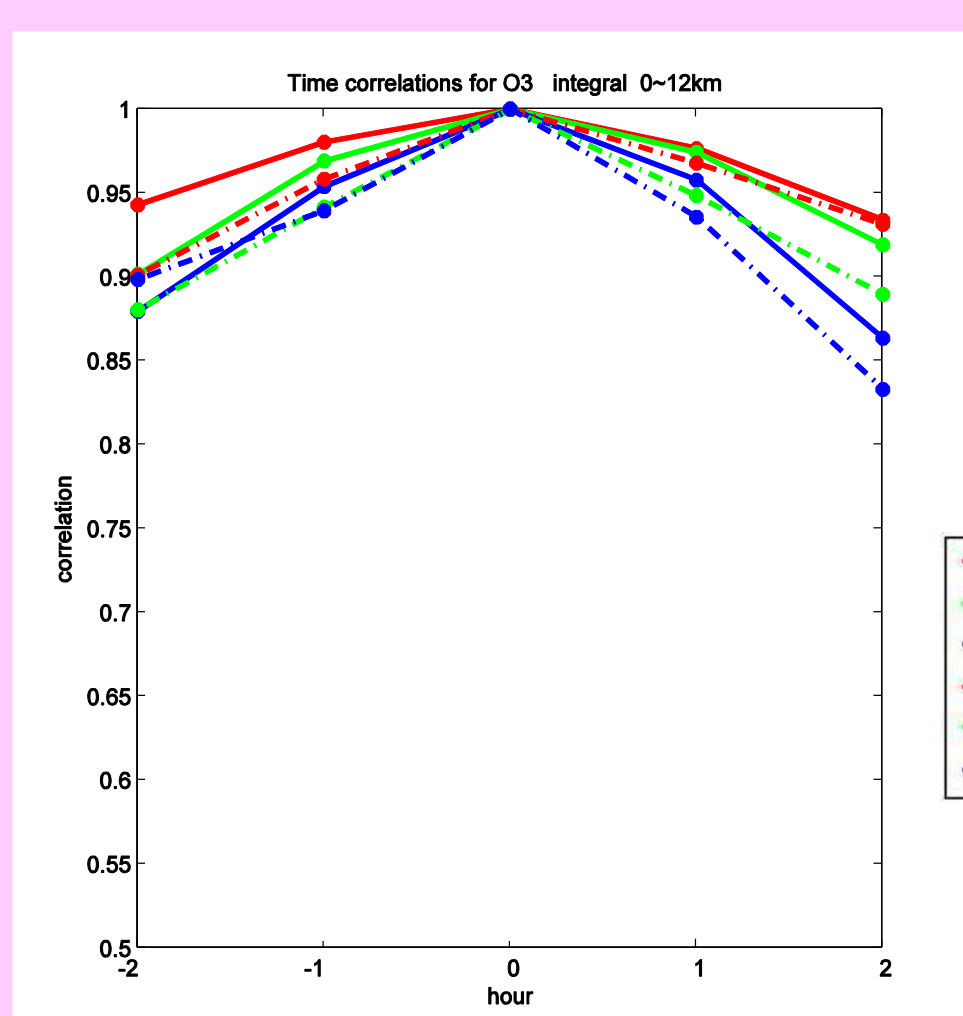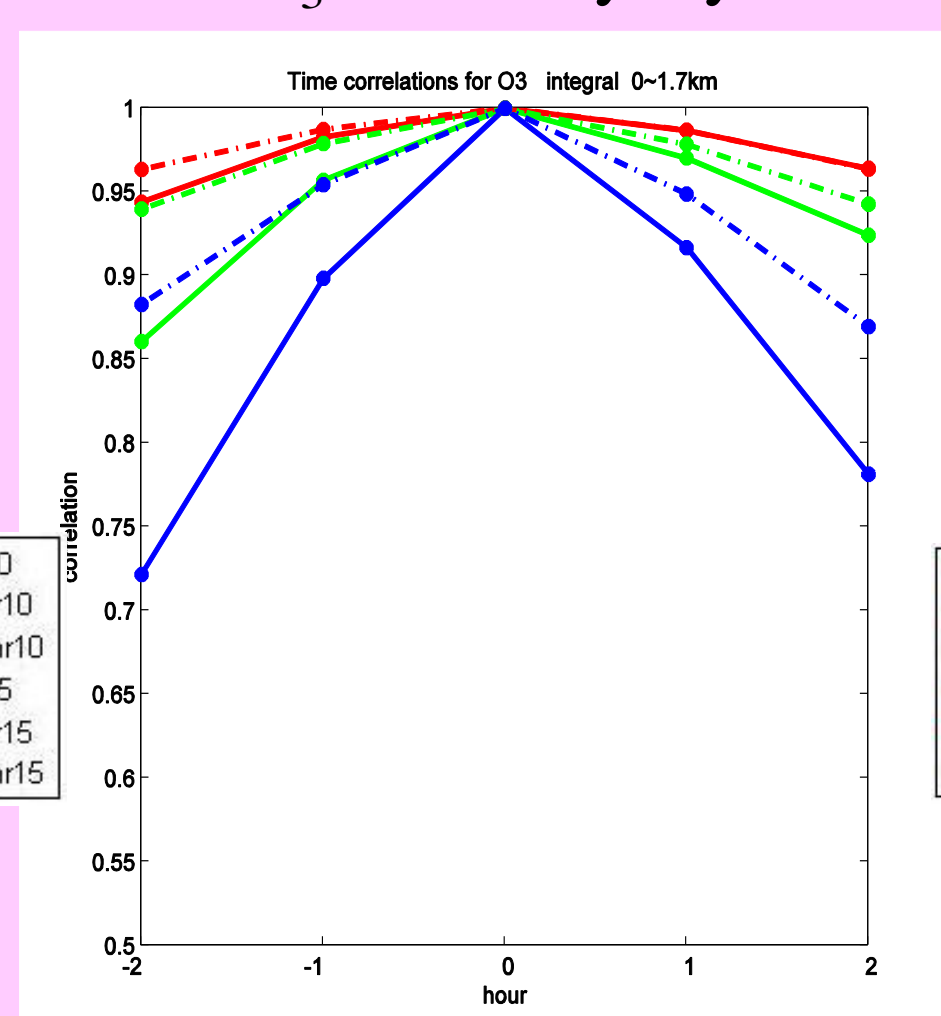MC2AQ ~ 30 km

SO_2

AURAMS ~100 km for SO2
MC2AQ ~ 60 km

Time decorrelation at 10 AM and 3 PM : MC2AQ
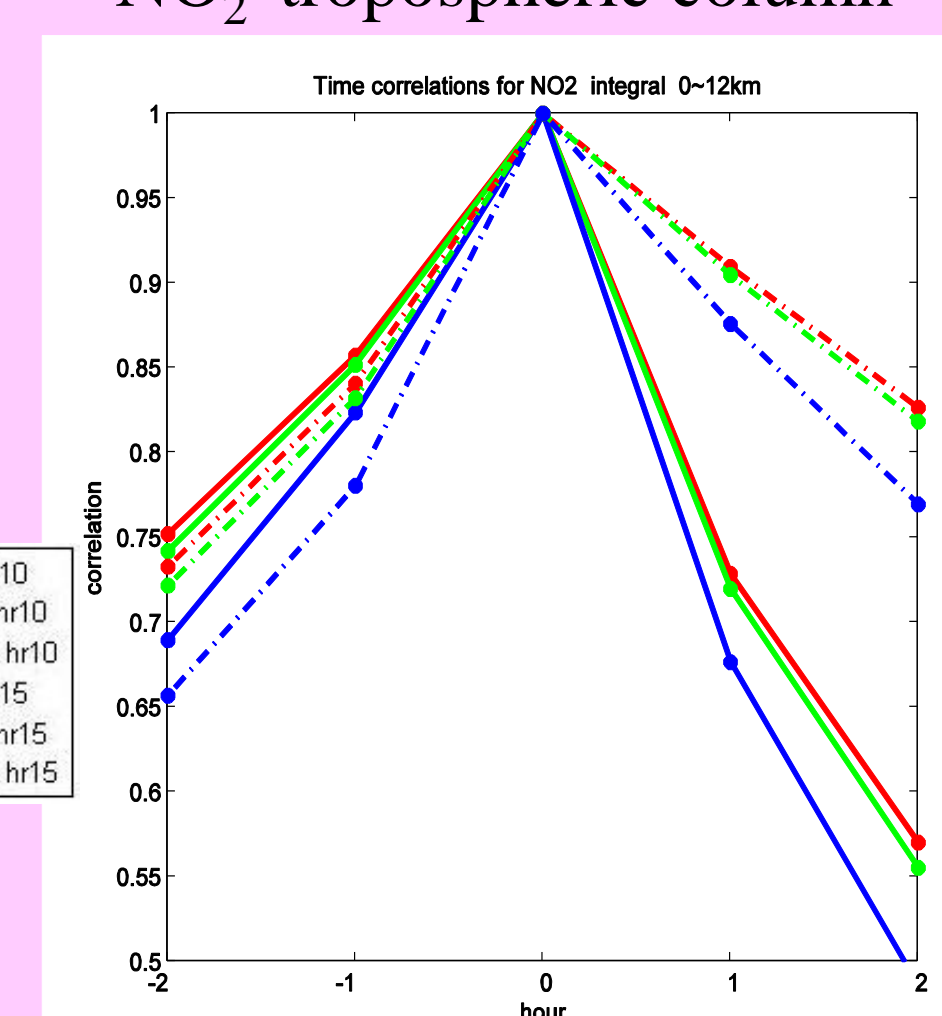
O_3 tropospheric column

O_3 boundary layer

NO_2 tropospheric column

Conclusions

An analysis of the spatial and temporal autocorrelation function with and without background pollution has been conducted for the each model levels and for layer averages of O_3, NO_2, NO, SO_2, HCHO and aerosols. Only a few species are presented here. This analysis shows that:

- The resolution of model has an impact on the correlation length scales. Lowering the model resolution increases the correlation length scales

- The fluctuations of the statistics of one day to the next do not present a systematic effect on the correlation length scales (results not shown)

- The vertical resolution and extent of the model is important to capture the effect of different processes that affect the correlation length scales, such as the moist processes of SO_2 in clouds reducing the horizontal length scale

- The threshold temporal sampling requirement for NO_2 is about 2 hours, whereas for O_3 is about 6 hours