The Veneto Region Modeling System

for Air Quality Assessment

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HARMO 11 Conference
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Atmospheric Dispersion Modelling for Regulatory Purposes
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arpav

TerrAria s.r.l.

The Po' Valley

VENETO REGION

Apenines

Alps

Adriatic Sea

Photochemical model: **CAMx (version 4.0)**;

Meteorological input:

CALMET (version 5.5): temperature field, horizontal wind (u, v), vertical diffusivity;

pressure and water vapour concentration: interpolation of radio-soundings data;

Grid emissions:
TD approach with disaggregation at municipality level integrated with **BU emission inventory** for the industry near or inside the Venice Lagoon Catchment's Basin. Large industry treated with plume in grid module.

Boundary conditions: CHIMERE output of 0.5x0.5 degrees
(Copyright (C) 2004 PREVAIR, Pierre-Simon Laplace Institute, INERIS, LISA, C.N.R.S.):

- initial: 3D variable in space (x,y,z);
- boundary: function of (z, t) for the four borders;
- top: one constant value for each specie.

Other input:

- landuse and albedo: CORINE LAND-COVER (250m x 250m);
- haze (AErosol RObotic NETwork - NASA);
- ozone column (TOMS - NASA);
- photolysis rate.

The outcome

The modelling system had been run for one year starting from the 1° of July 2004. Resolution 4km x 4km.

The two major outcomes we wish to obtain from the output are:

1. An assessment of the air quality levels in the Veneto Region;

2. An assessment of the deposition fluxes of nutrients within the Lagoon and the Lagoon Catchments Basin (SIMAGE project).

Subset of monitoring stations for gases and PM

- Uniformly distributed over the region

- the majority are classified as Urban Background

- ● 03, NOx, SO2
- ● PM10

Feltre

Conegliano

Bassano del Grappa

Schio

TV – Via Lancieri

S. Donà di Plave

VI – Quartiere Italia

VI – Parco Querini

VE – Parco Bissuola

VR - Cason

VE – Sacca Fisola

San Bonifacio

PD - Mandria

Chioggia

Legnago

Castelnovo Bariano

Adria

RO - Borsea

Porto Tolle

Mean quantities
Good Agreement
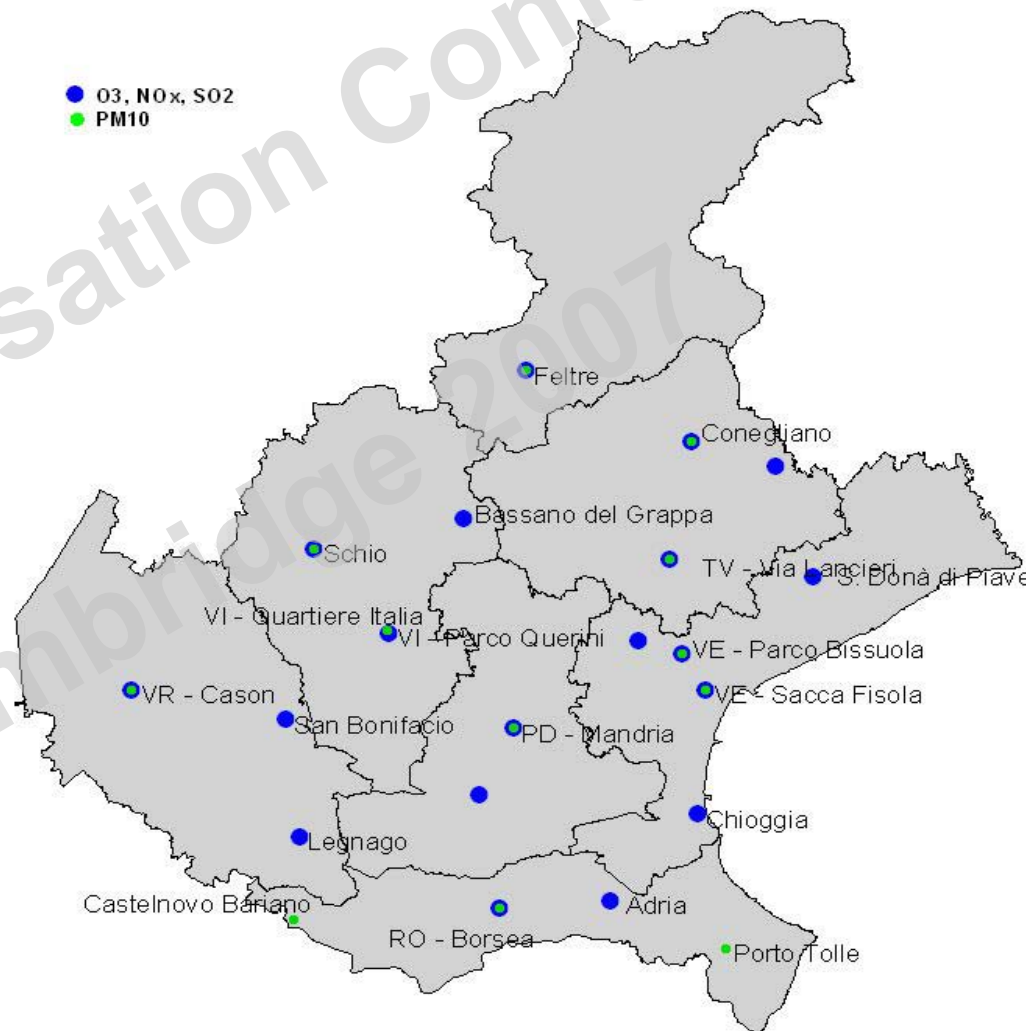
NO$_2$: Annual mean [μg/m^3]
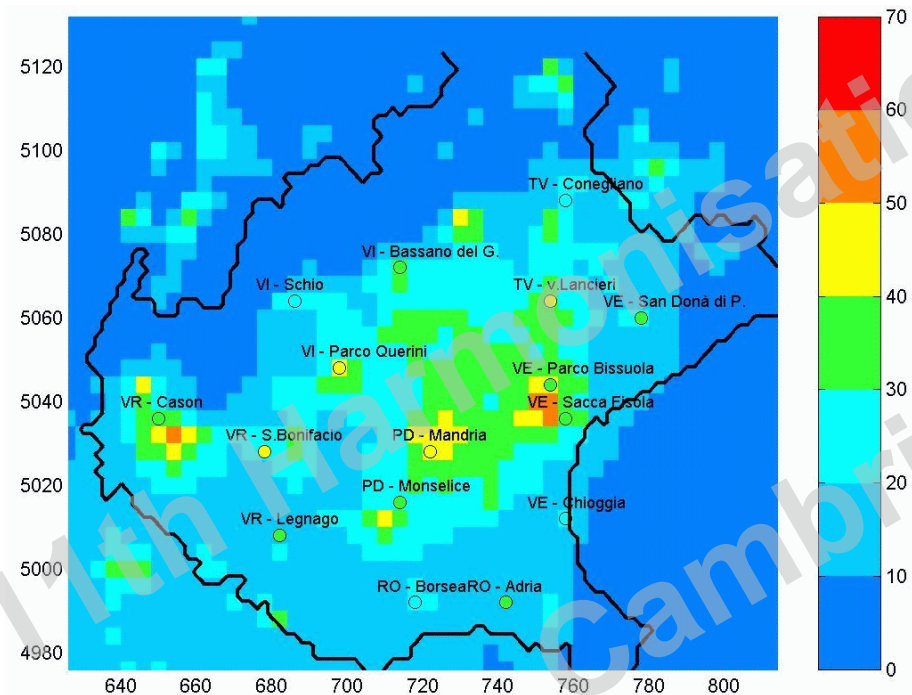
O$_3$: 5-months average of daily maximum [μg/m^3]
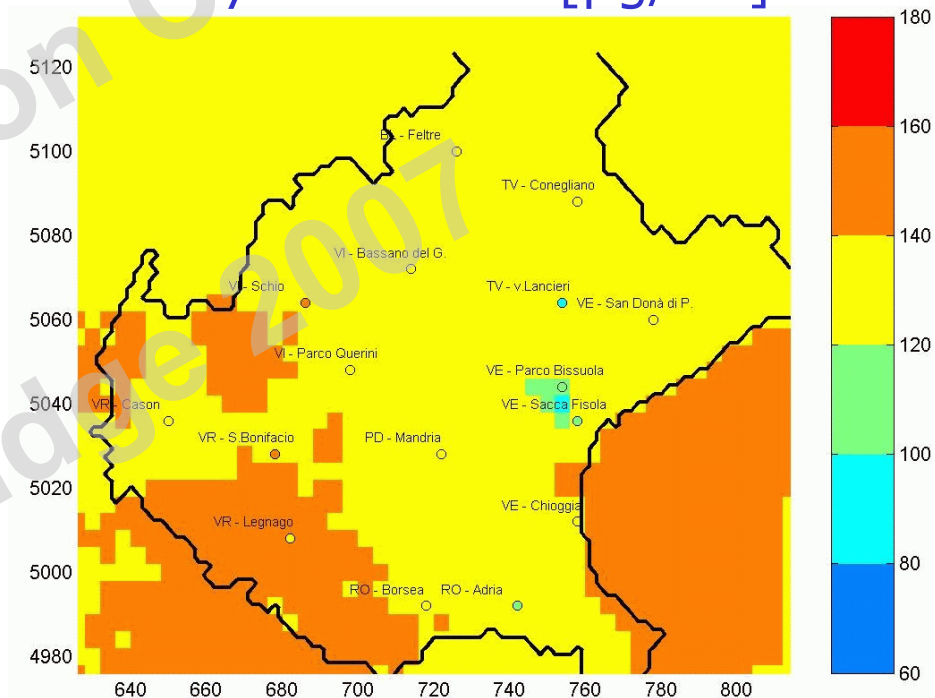
1 year run of CAMx at 4kmx4km resolution

Daily average PM10 in a rural background site
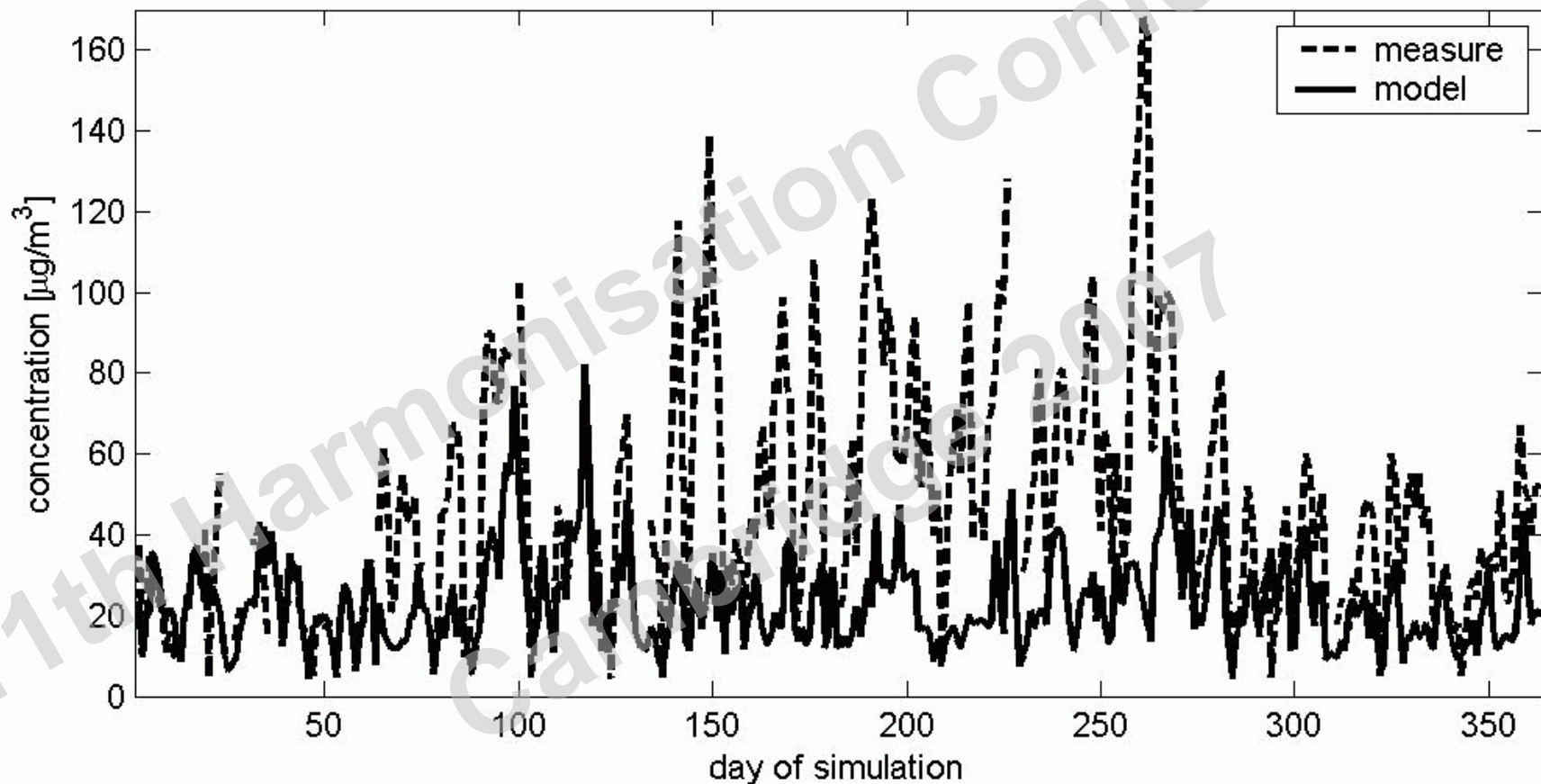
July 2004   winter 2004-2005   June 2005

arpav   TerrAria s.r.l.

Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NO₂	0.50	0.48	0.60	0.58	0.54	0.36	0.40	0.63	0.52	0.49	0.44	0.38	0.34	0.54	0.30	0.37
O₃	0.73	0.76	0.84	0.85	0.83	0.78	0.76	0.84	0.80	0.73	0.83	0.82	0.87	0.74	0.81	0.60
PM10	0.65	0.68	0.49	0.51	0.70	0.67	0.68	0.62	0.46	0.56	0.45					
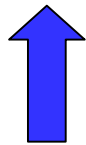
- Correlation

NO₂ from 0.3 to 0.6
O₃ from 0.6 to 0.87
PM from 0.45 to 0.70

- Bias

NO₂ / O₃ both signs
SO₂ overestimated
PM underestimated
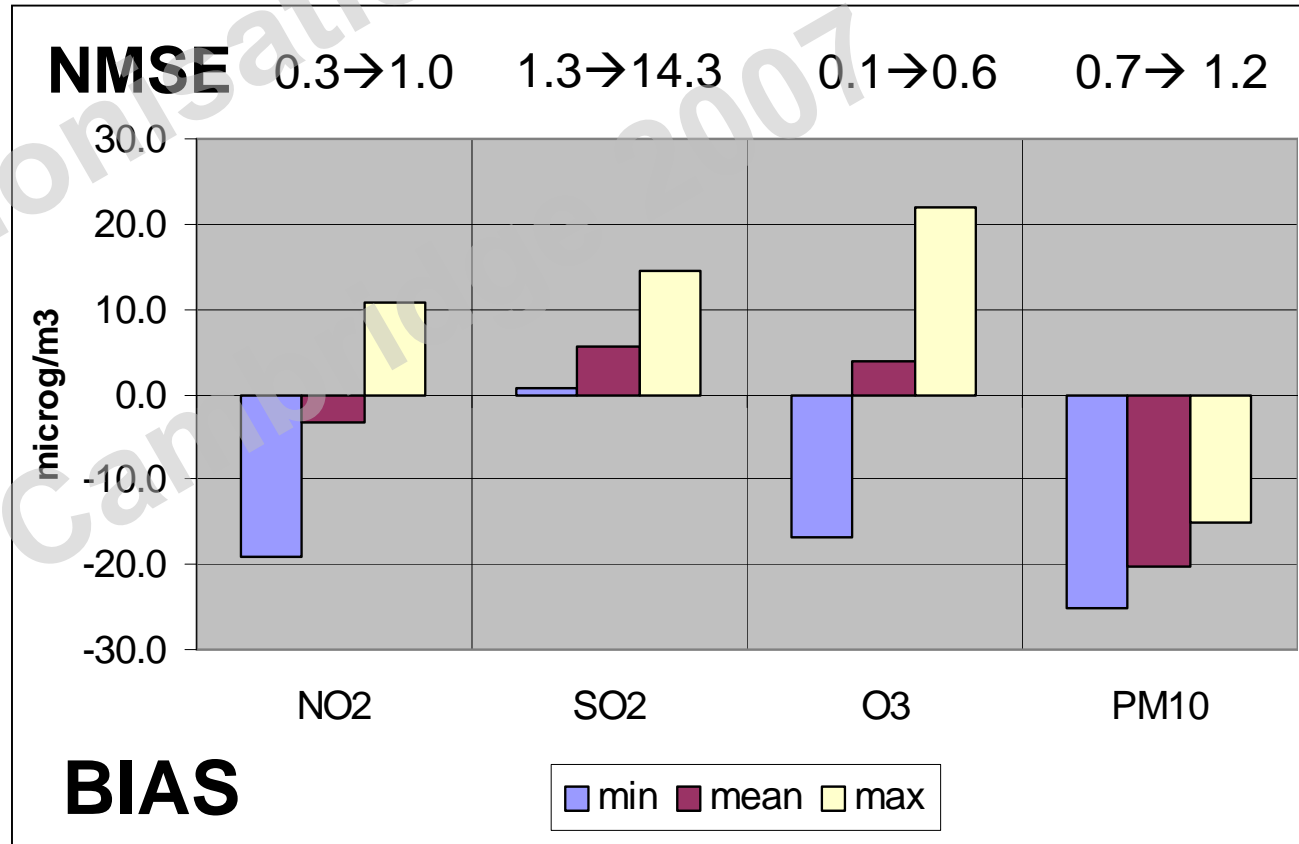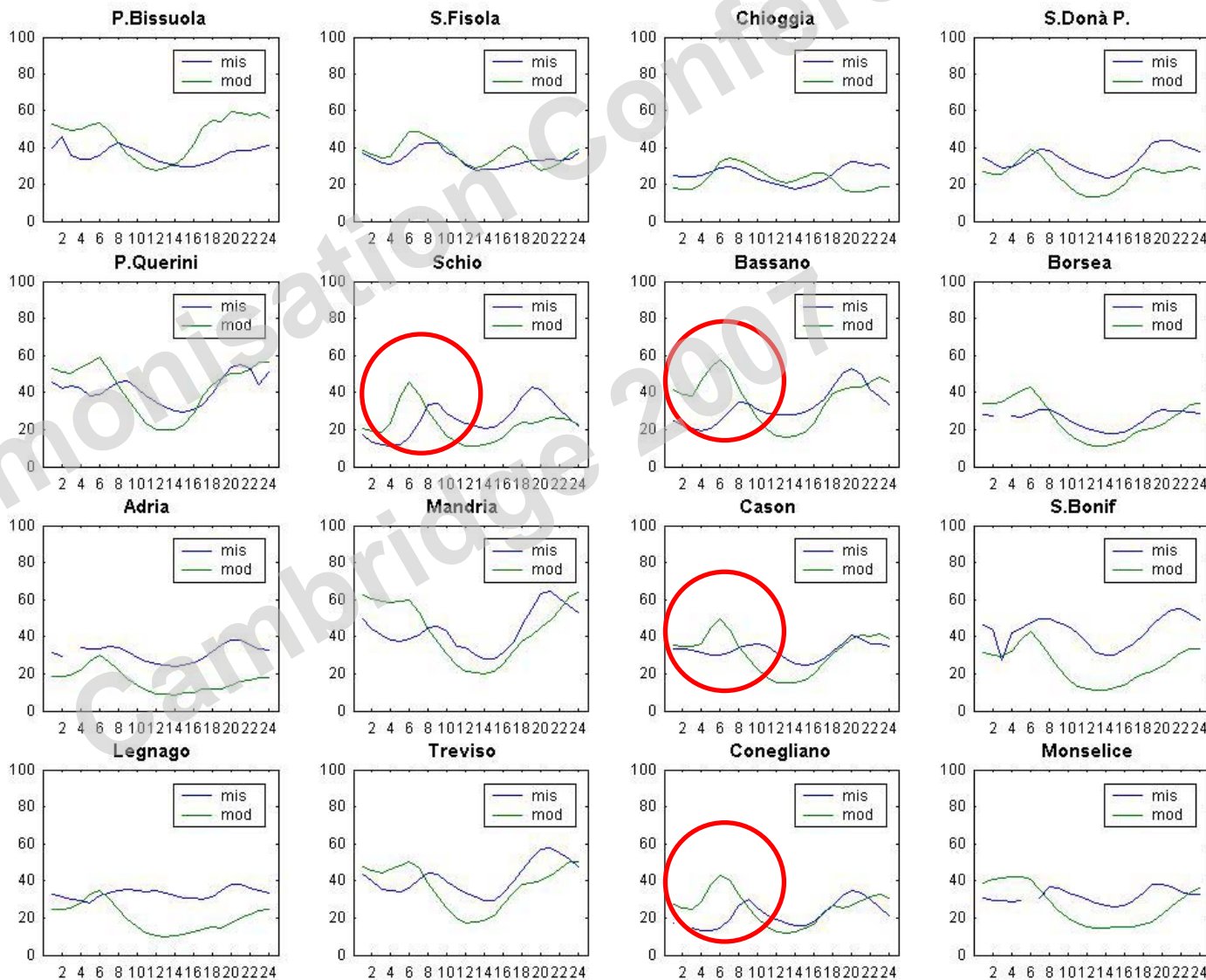
NMSE   0.3→1.0   1.3→14.3   0.1→0.6   0.7→ 1.2

BIAS

min mean max

NO$_2$ typical day

Overestimation of morning peak

Underestimation of daily minimum

NO₂ typical day
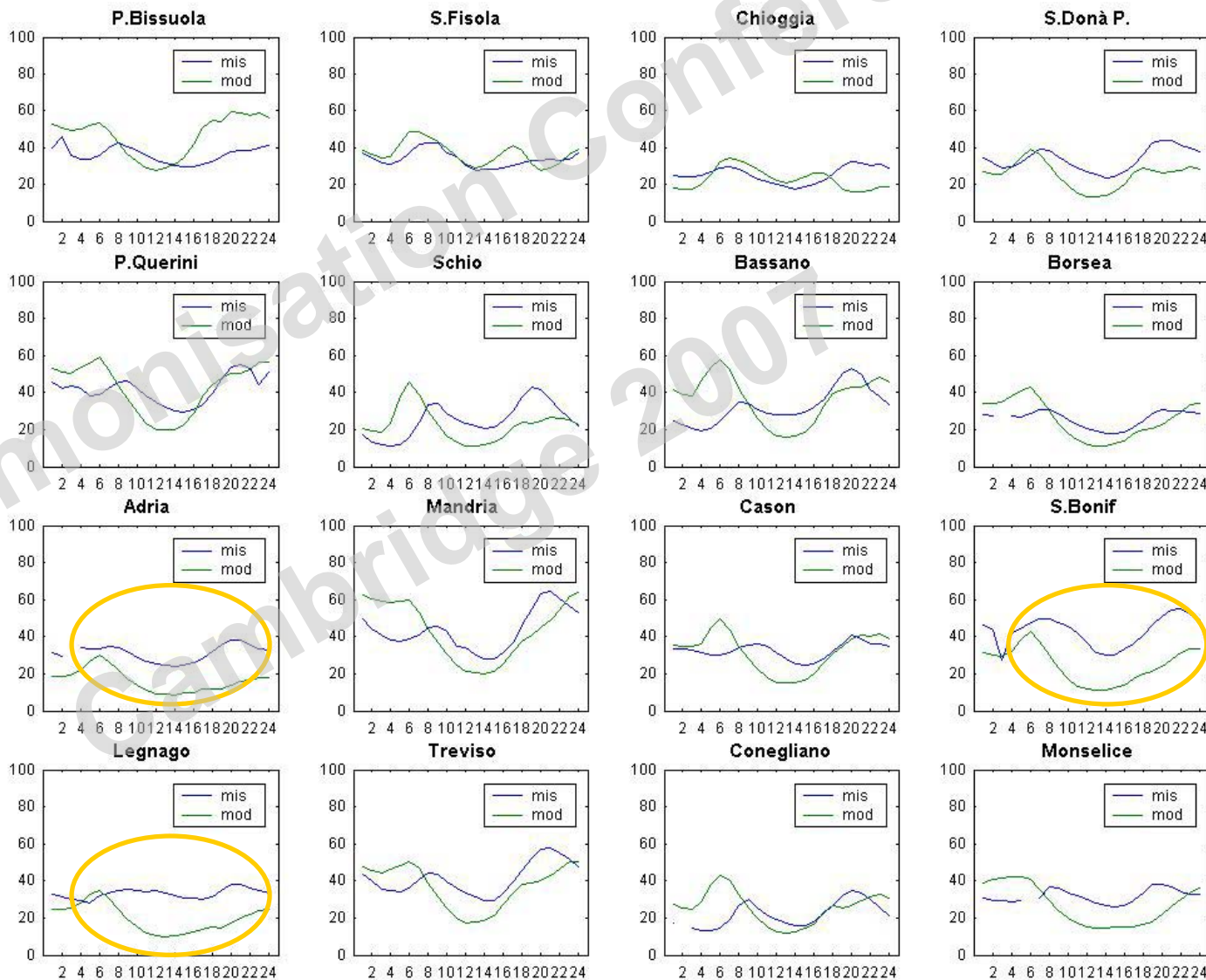
Overestimation of morning peak

Underestimation of daily minimum

Ability to model the vertical diffusivity?

Bad timing on morning peak emissions?
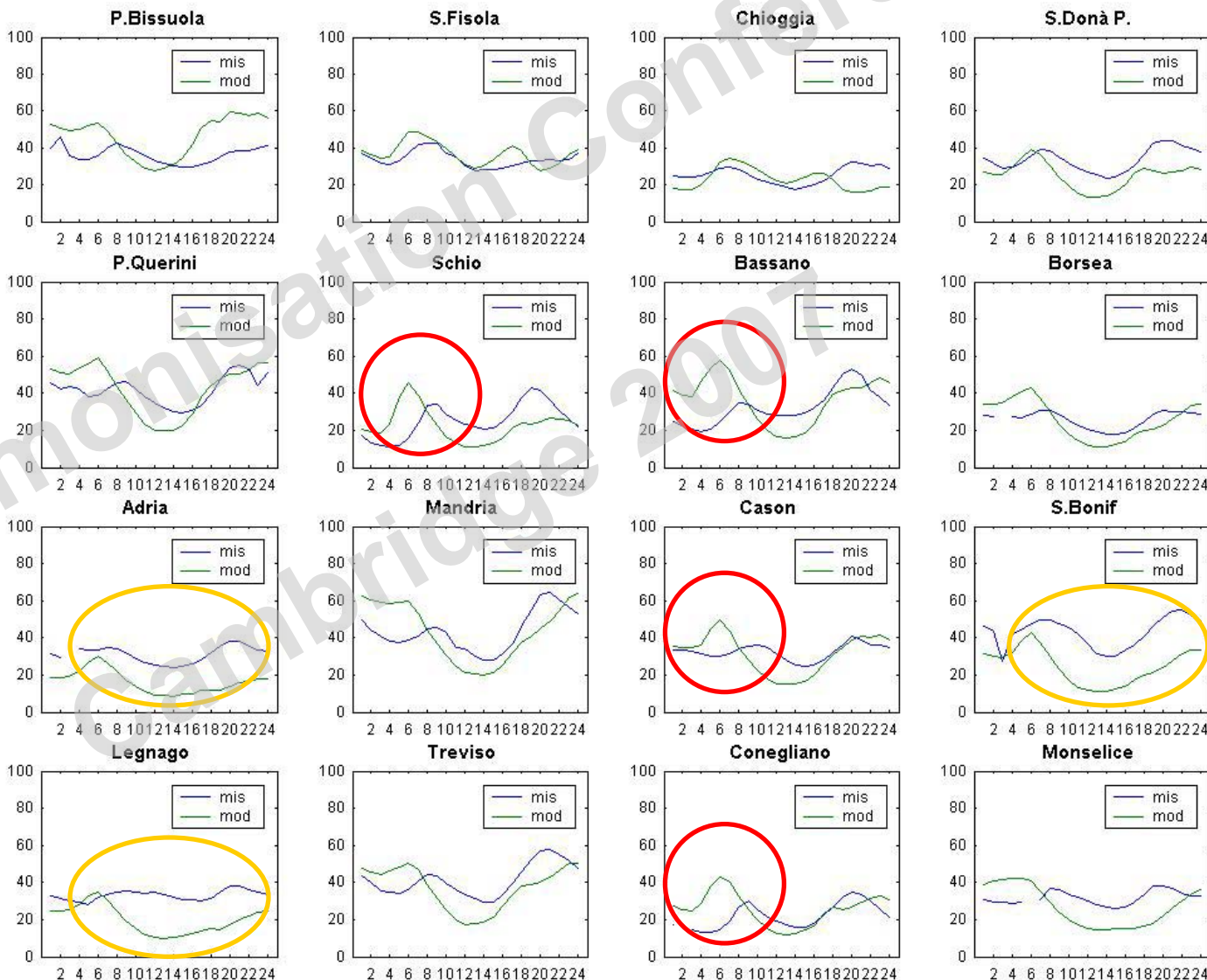
Deposition

Measurement sites

- **Bulk deposition**

- **12 monthly campaigns (6 in lagoon site)**

Deposition

Sulphates as S
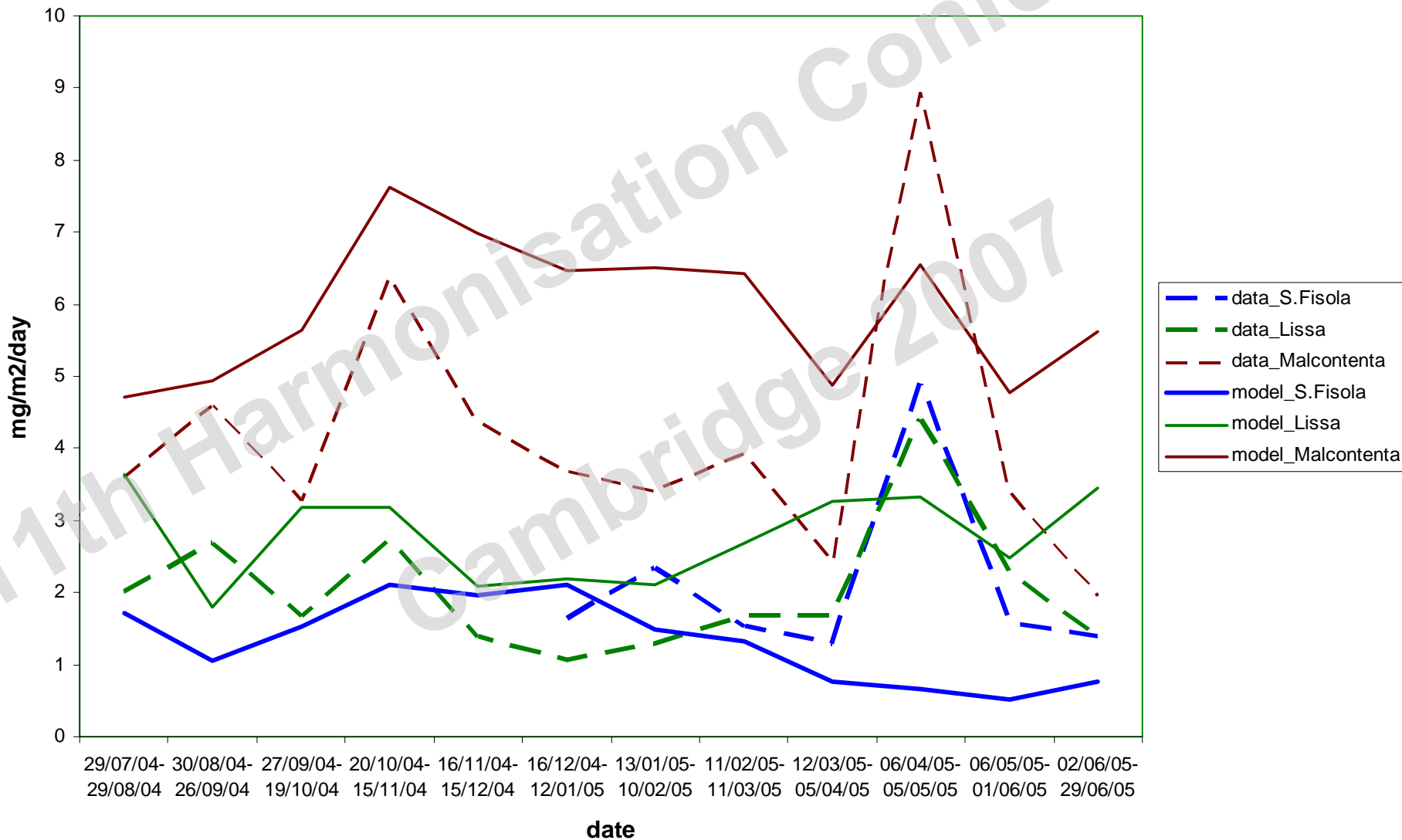
Deposition
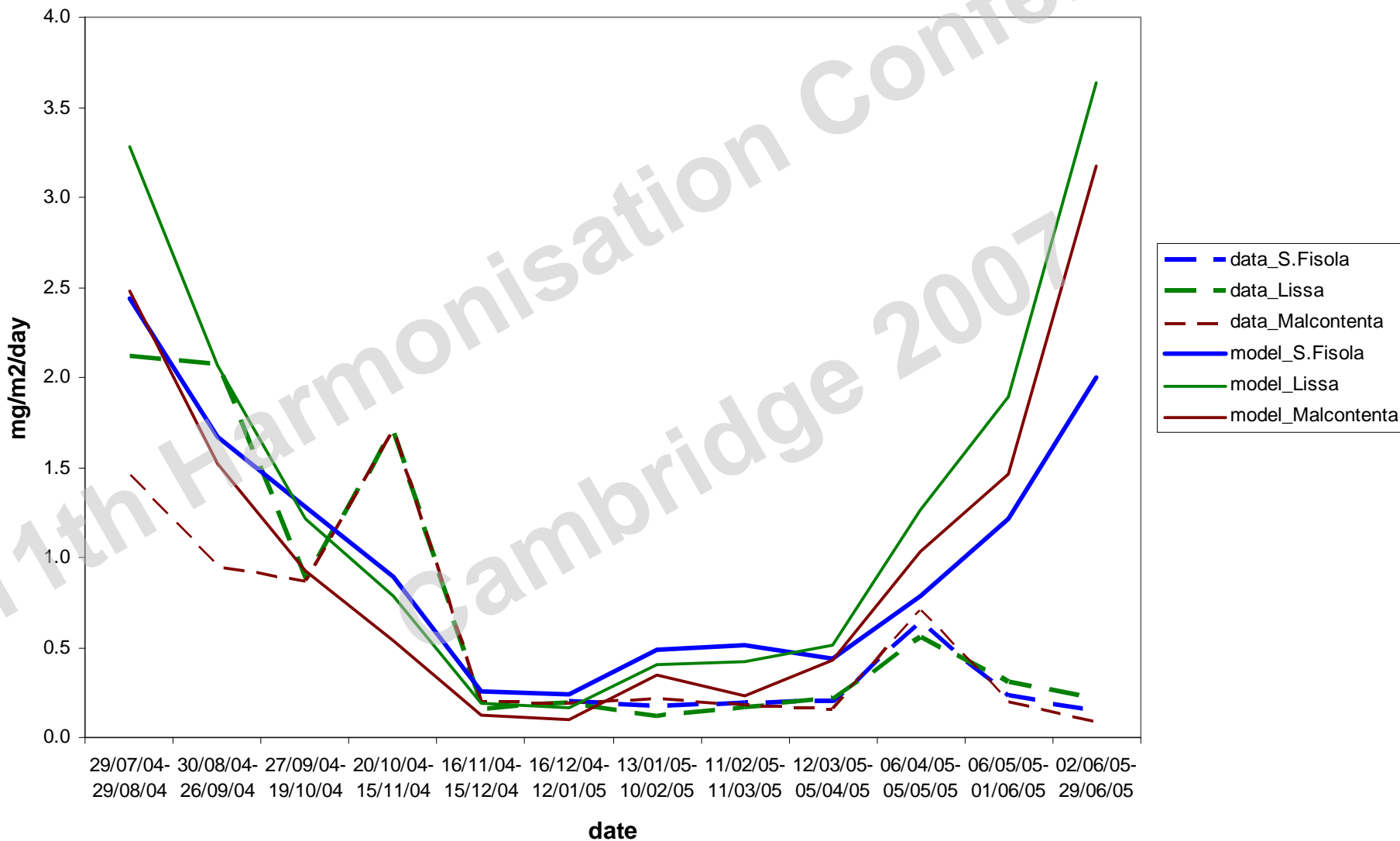
Nitrates as N

Deposition

Nitrates deposition
[mg/m²/yr]
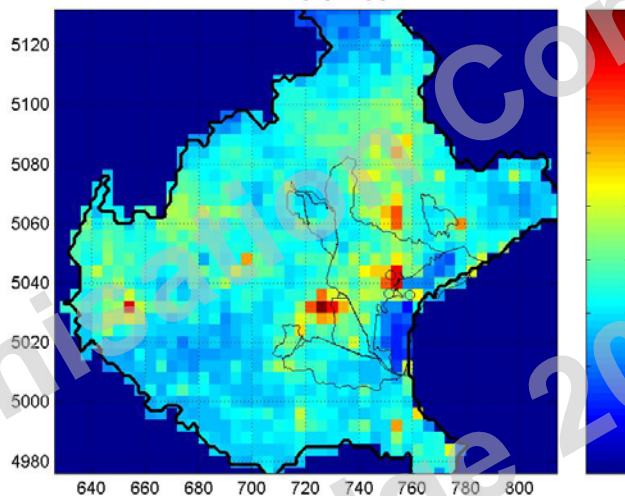
Dry deposition

Wet deposition

Conclusions
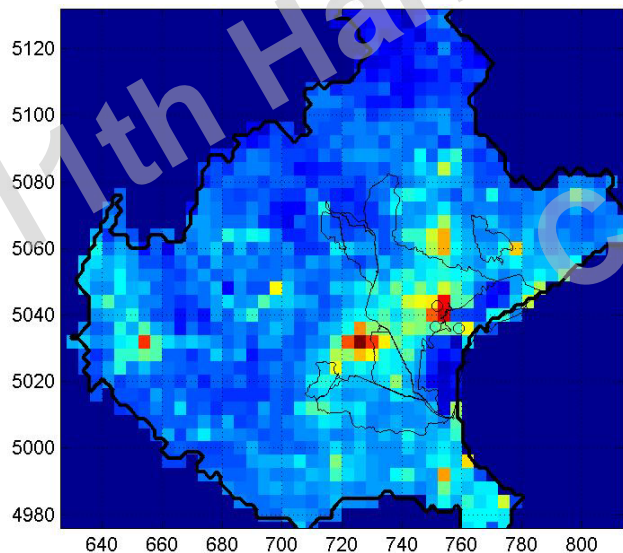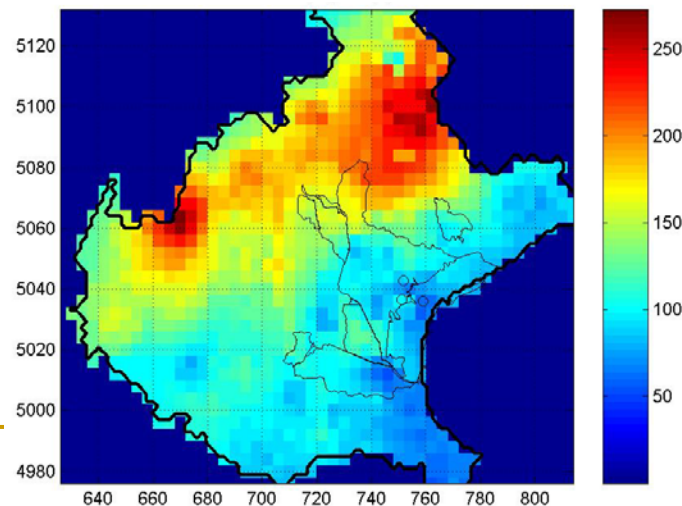
SURFACE CONCENTRATIONS

1) Good mean values
2) Satisfying correlation **(better in summer and during the day for NO_2 and O_3)**
3) Not good typical day **(NO_2 early morning peak and nocturnal underestimation)**
4) SO_2 overestimation **(due to also large values in Boundary Conditions)**

DEPOSITIONS

5) Good average values
6) Good spatial variability
7) Satisfying seasonal variability

Problems

- Vertical diffusion parameterization?

  [Conclusion (2) and (3)]

- SO_2 emissions too high?

  [Conclusion (4)]

Remedies

- Use a prognostic meteorological model output in synergy with CALMET

- Update/Revision emission inventory

Thank you for your patience

for more information:

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THE END

Deposition

Annual mean [mg/m2/day]	Sulphur S.Fisola	Sulphur Lissa	Sulphur Malcontenta	Nitrogen S.Fisola	Nitrogen Lissa	Nitrogen Malcontenta
Measure	2.1	2.0	4.2	1.9	2.4	3.0
Model	1.3	2.8	5.9	2.0	3.6	5.1

Annual mean [mg/m^2/day]	S.Fisola	Lissa	Malcontenta	Lagoon	Basin
Sulphates as S	1.3	2.8	5.9	1.3	1.8
Total N	2.0	3.6	5.1	1.4	2.6

TOTAL (WET) DEPOSITION [ton/yr]	Veneto Region	Basin	Lagoon
Nitrates as N	5535 (2200)	940 (282)	128 (43)
Ammonia as N	7290 (2220)	1354 (281)	136 (30)
Sulphates as S	7380 (3281)	1795 (569)	256 (104)
Total N	14292 (4420)	2668 (563)	283 (73)
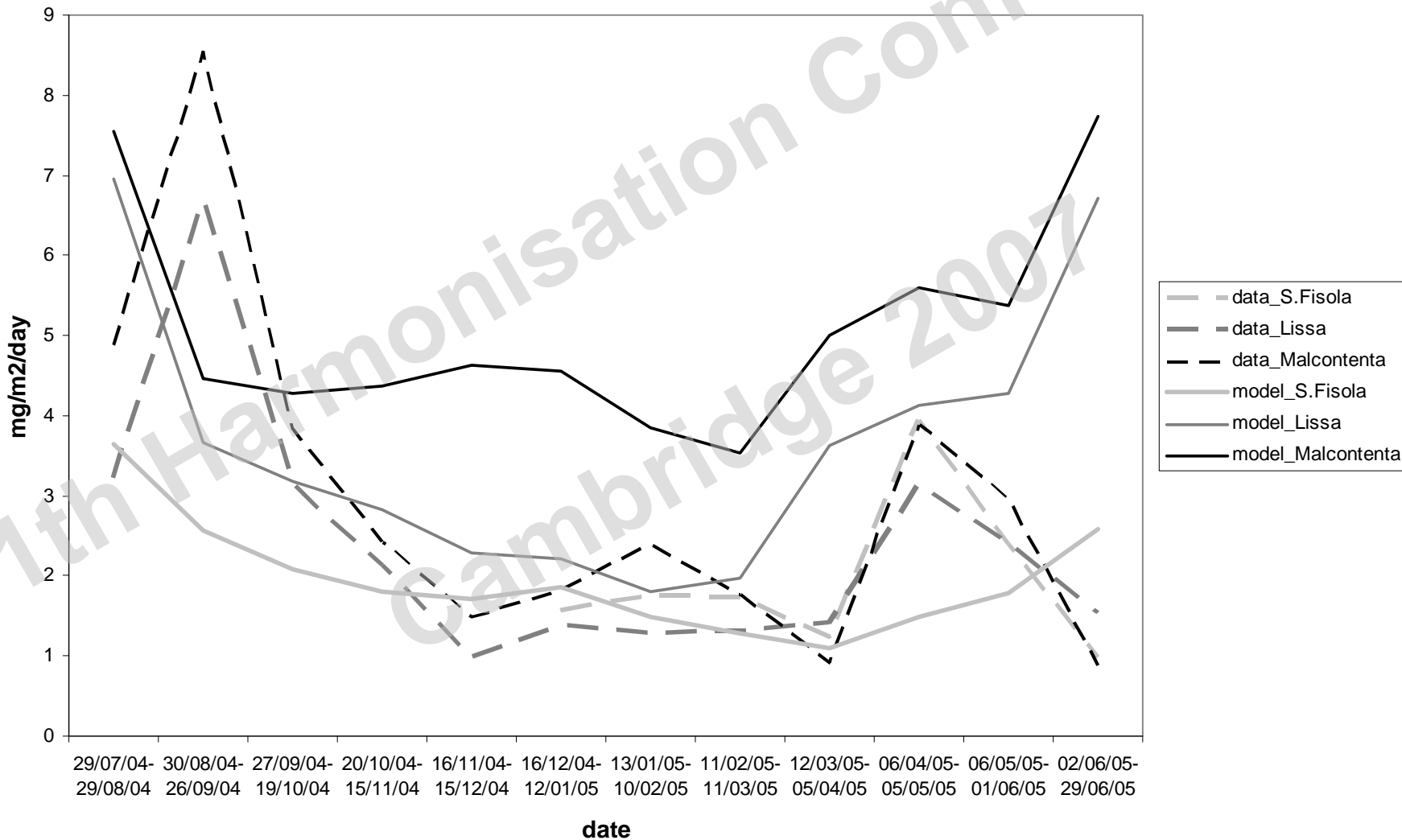
Deposition

Total Nitrogen

Large overestimation on certain sites
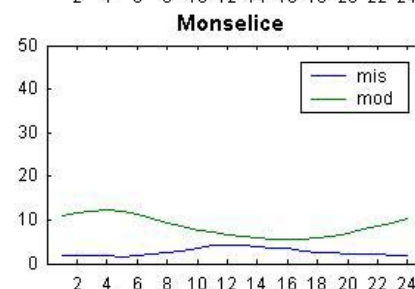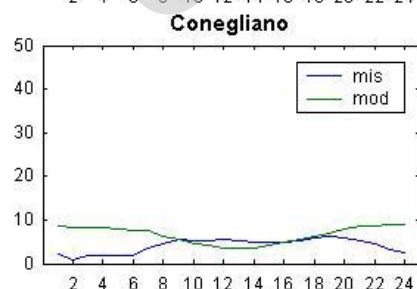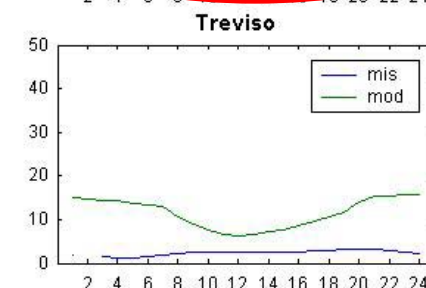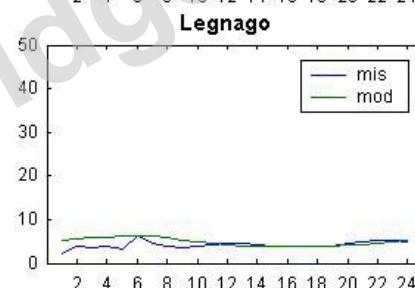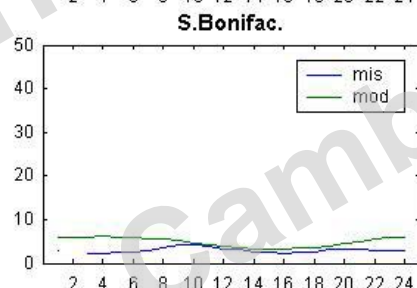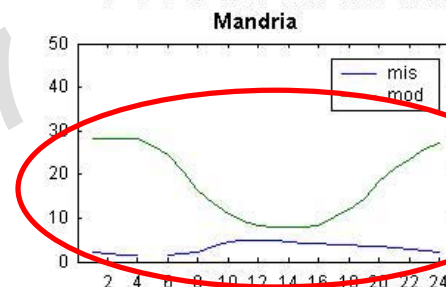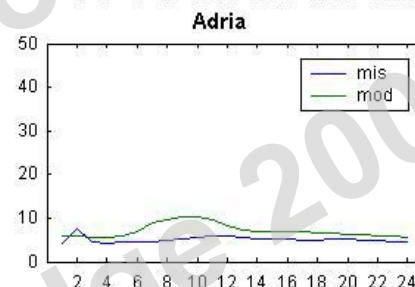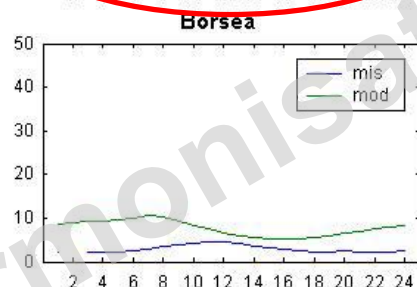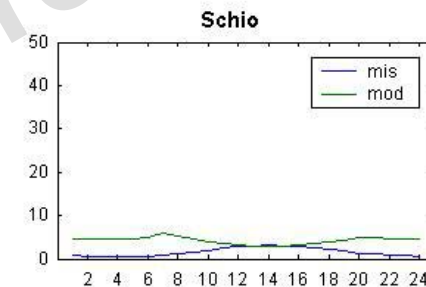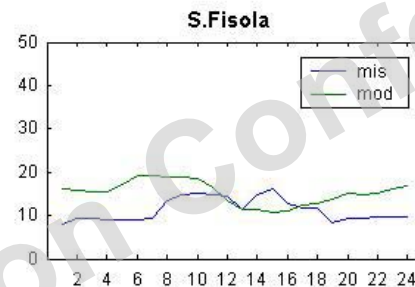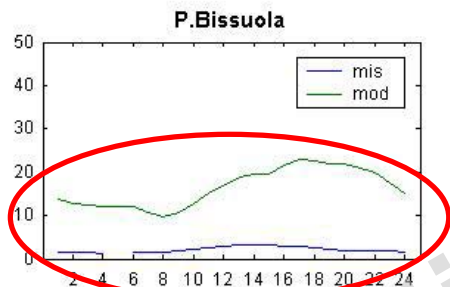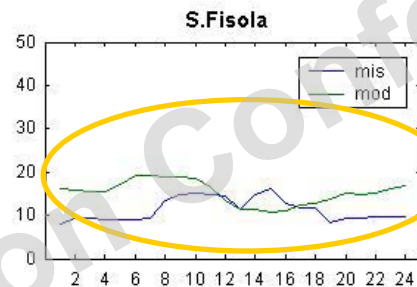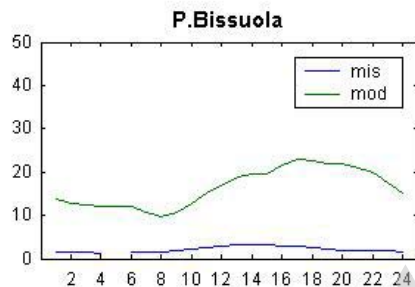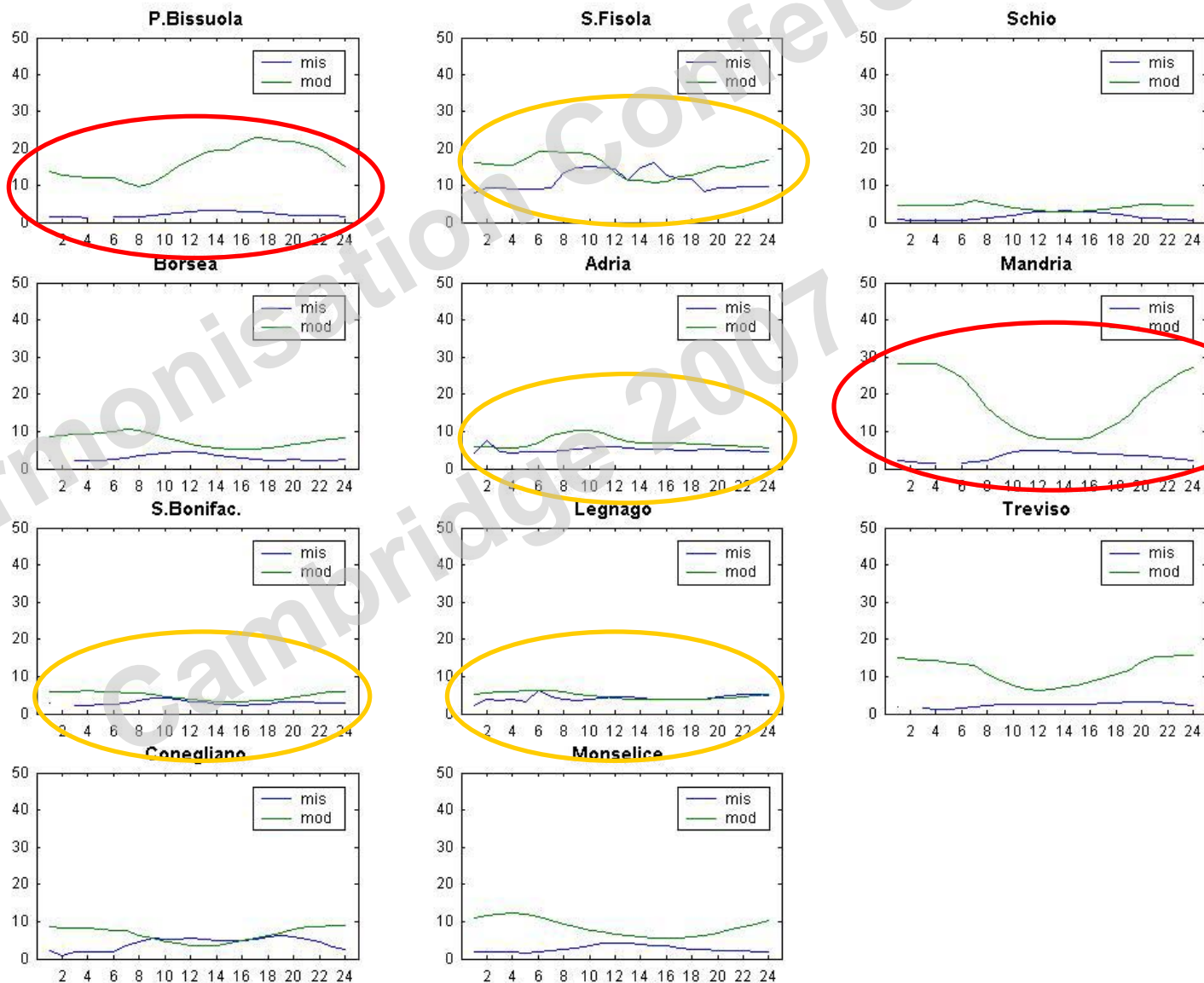
SO2 typical day

Generally good agreement
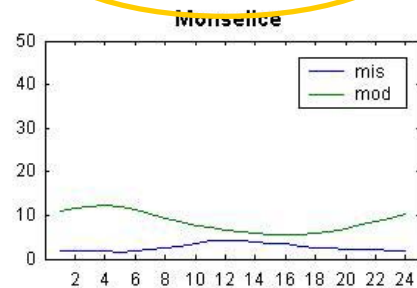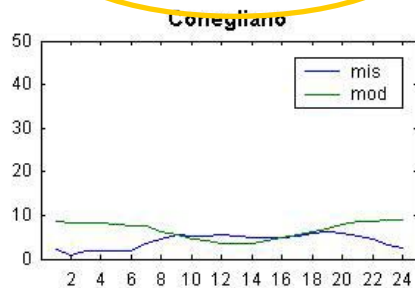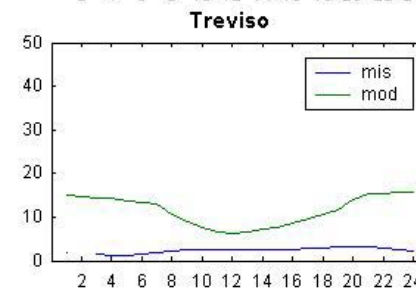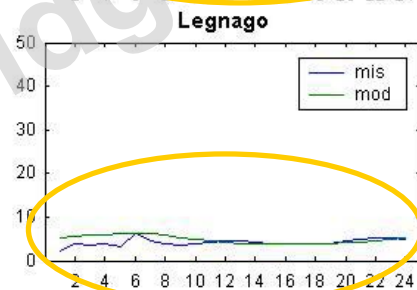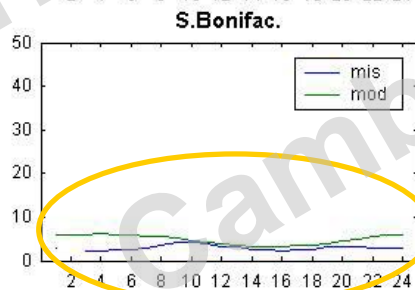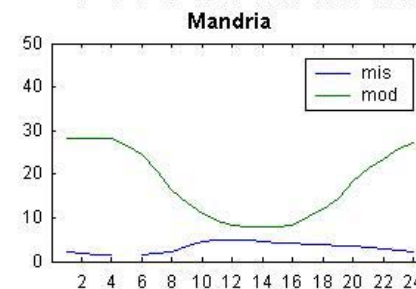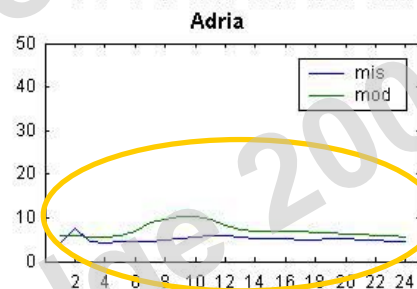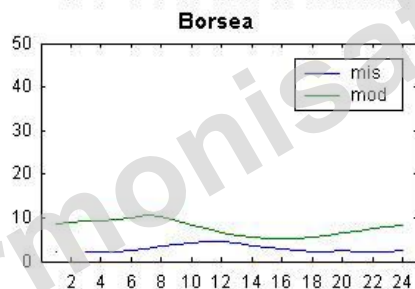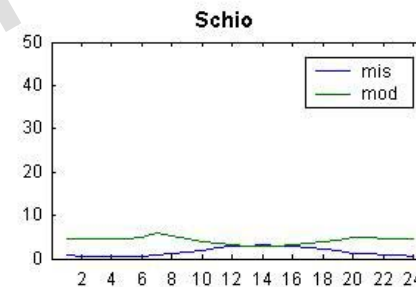
Large overestimation on certain sites

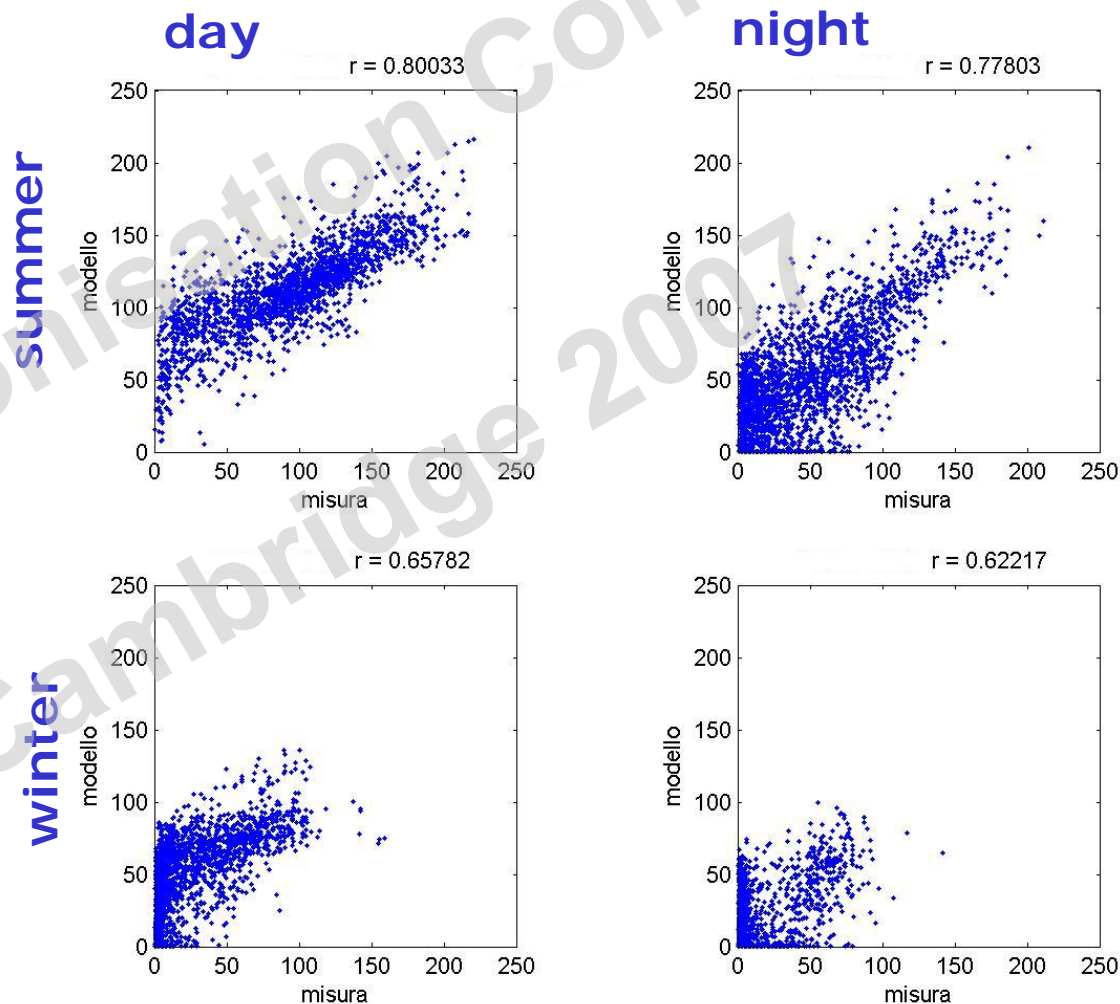Generally good agreement

Need to update the emission inventory?

Seasonal and daily trends

- Correlation of O_3:

 Summer better than winter

 Day better than night
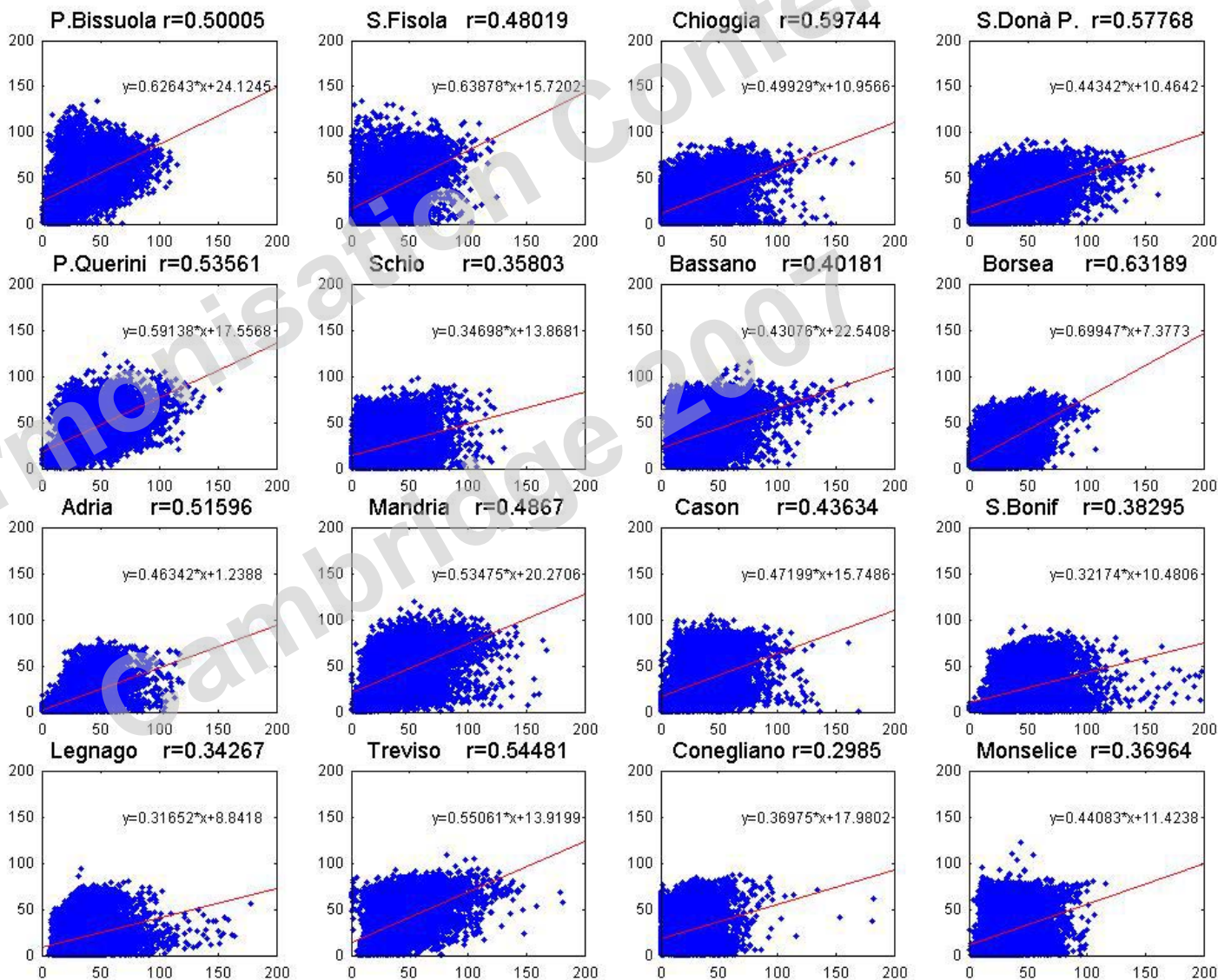
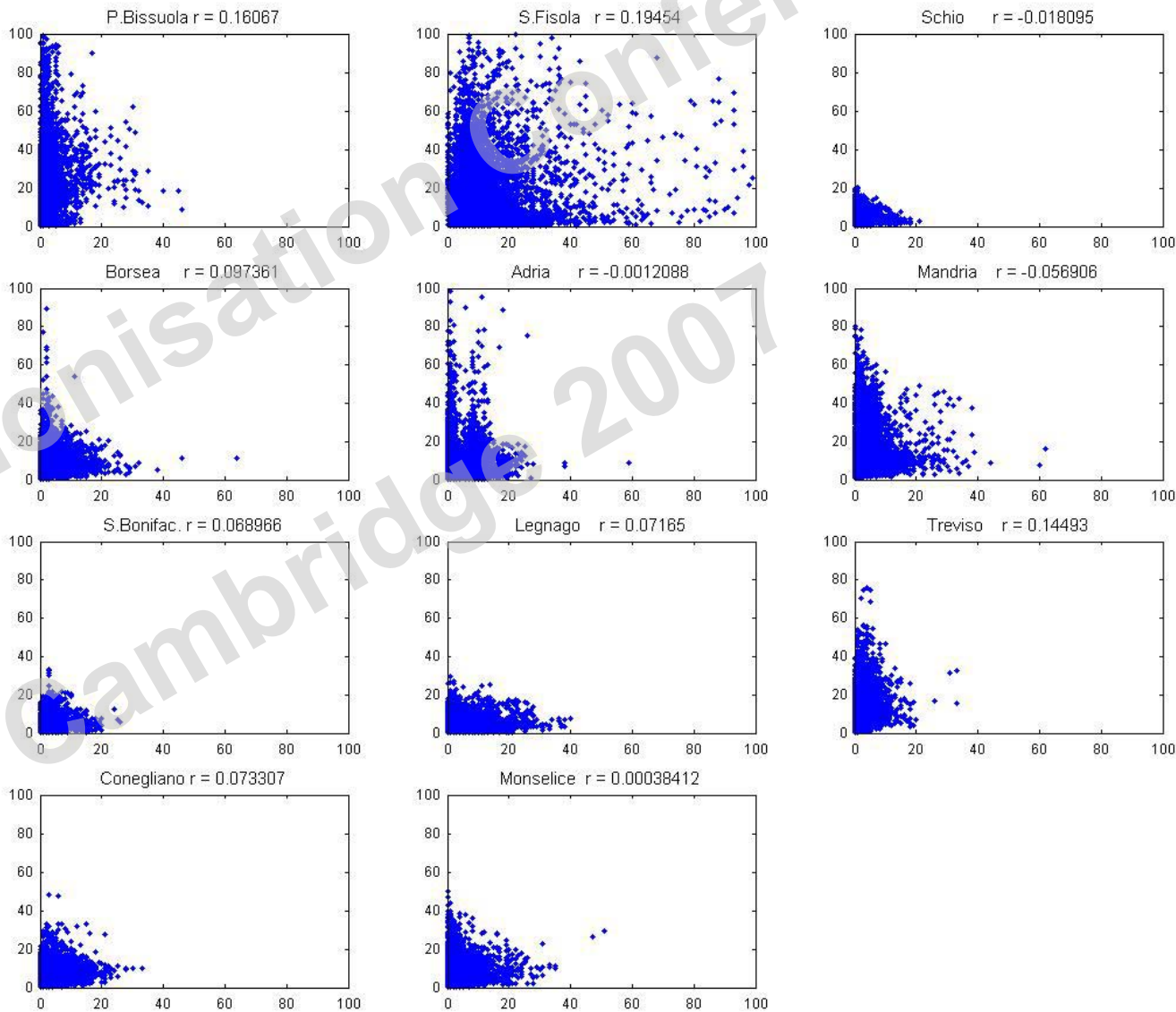Ability to model the vertical diffusivity?

- Scatter plot:

The measures (x-axis) are equally overestimated and underestimated
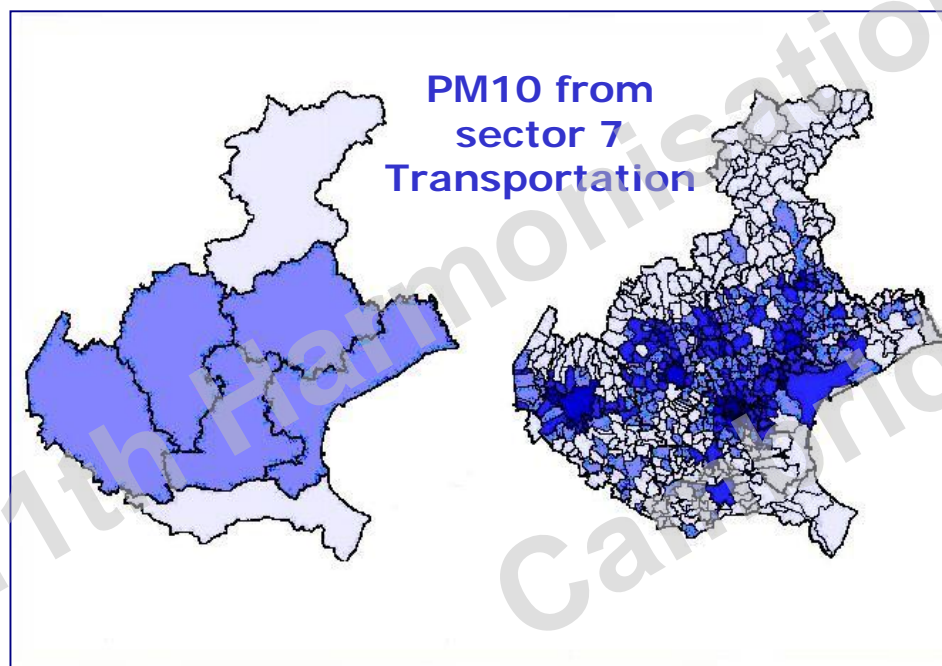
Scatter plot have a square shape

• Scatter plot:

basically no correlation or even an autocorrelation, due to also the lack of a strong diurnal cycle as it is for NO2 or O3

The emissions

An example of the
Top-Down Inventory 2000

An example of the
Bottom-Up Industrial
Inventory

PM10 from
sector 7
Transportation

SO2 from
industries