

TNO innovation
for life



COMPARING BRUTE FORCE AND LABELLING FOR NO_x, NO₂ AND NO ACROSS GERMANY

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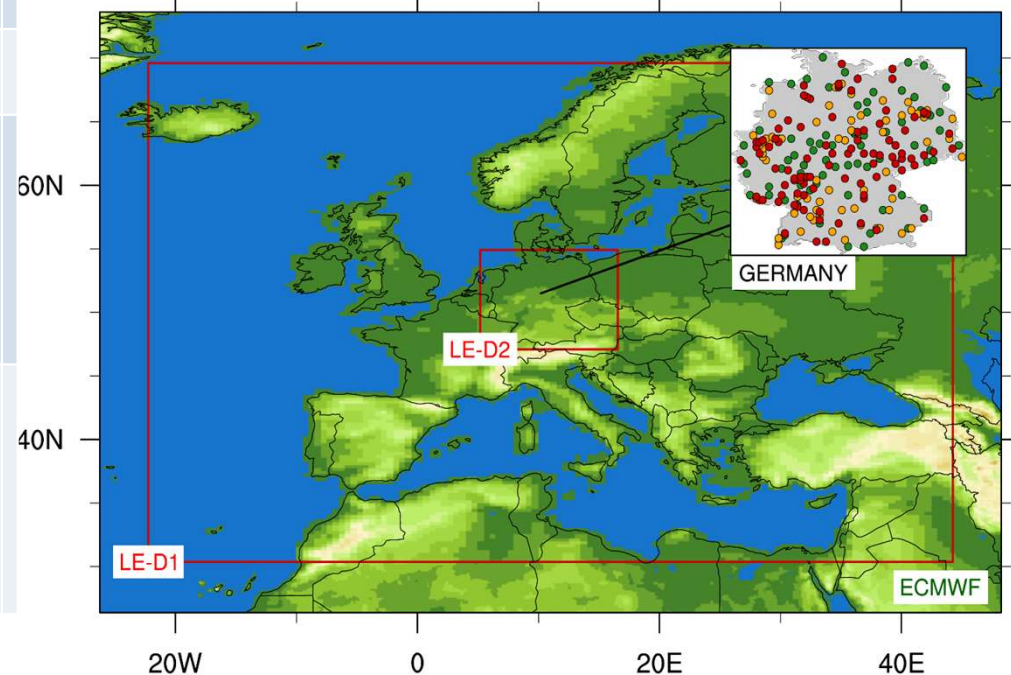
CONTRIBUTIONS FROM R. KRANENBURG, R. TIMMERMANS, A. MANDERS, R. JANSSEN, D. VAN PINXTEREN (TROPOS), S. WEBER (UGA), G. UZU (UGA), A. COLETTE (INERIS), M. PLATT (NILU)

› LOTOS-EUROS MODELLING SET-UP

LABELLING AND BRUTE FORCE CALCULATIONS FOR GERMANY

Simulation	Description of model set-up
BASE	Reference simulation
LA	Source attribution using labelling approach.
RED-X	Brute force emission reduction simulations performed individually for each source category (X = 5, 10, 20, 25, 50, 100%) for NO _x .
COMB-X	Brute force emission reduction simulations in which all source categories were reduced simultaneously (X = 5, 10, 20, 25, 50, 100%) for NO _x .

1 Base case simulation including labelling and 30 + 6 = 36 Brute force simulations for D1 and D2



5 sectors (S) and a rest term

- Road Transport
- Non-Road Transport
- Energy and Industry
- Households
- Others
- Rest
- BASE

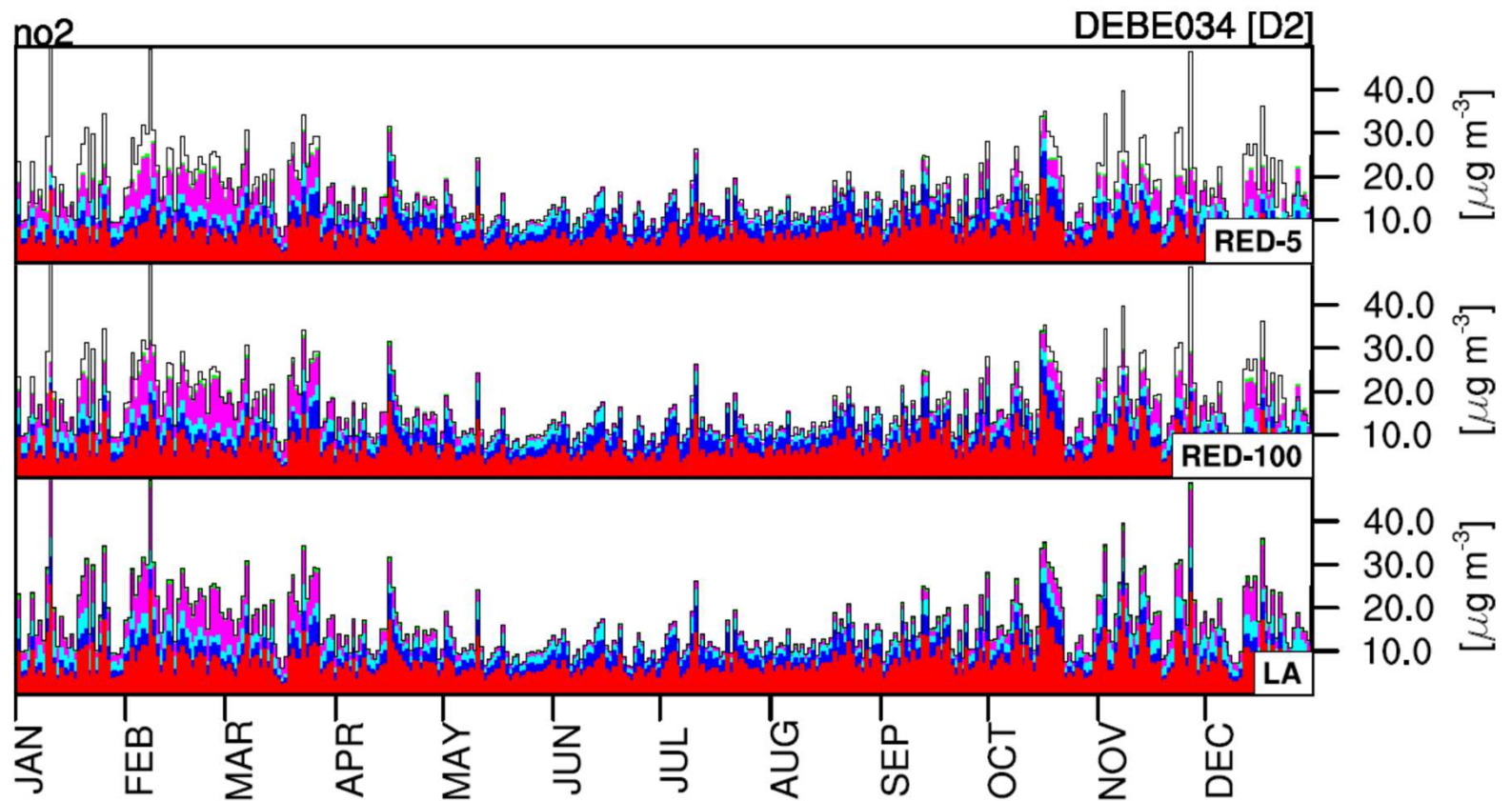
$$PI_{S,X} = \left| I_{S,X} * \frac{100}{X} \right|$$

> LABELING VALIDATION

Non-linear interactions
mainly occur during the
winter period ...

Discrepancy occurs
when all ozone is
titrated away during
stable conditions

- Road Transport
- Non-Road Transport
- Energy and Industry
- Households
- Others

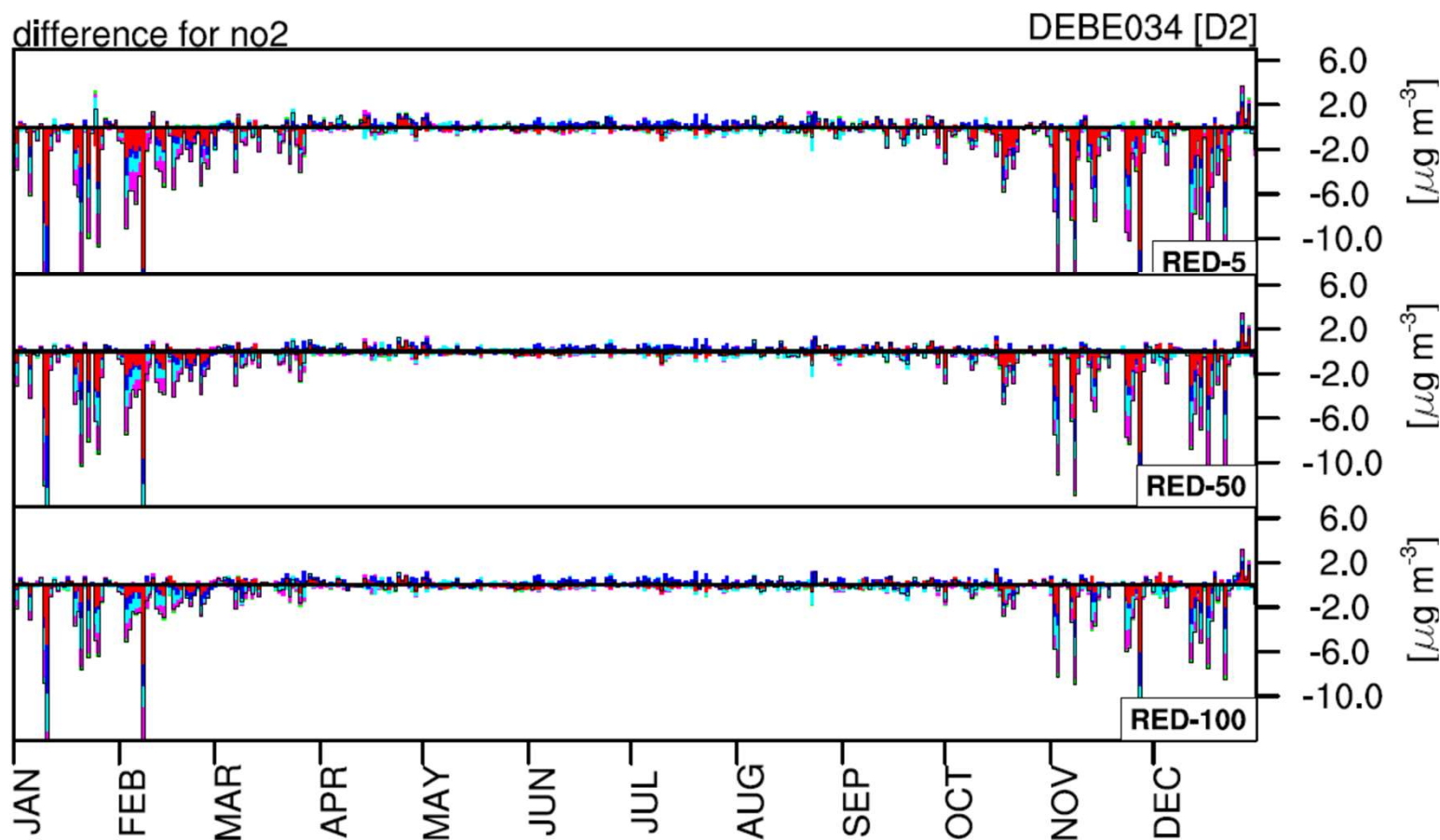


› LABELLING VALIDATION

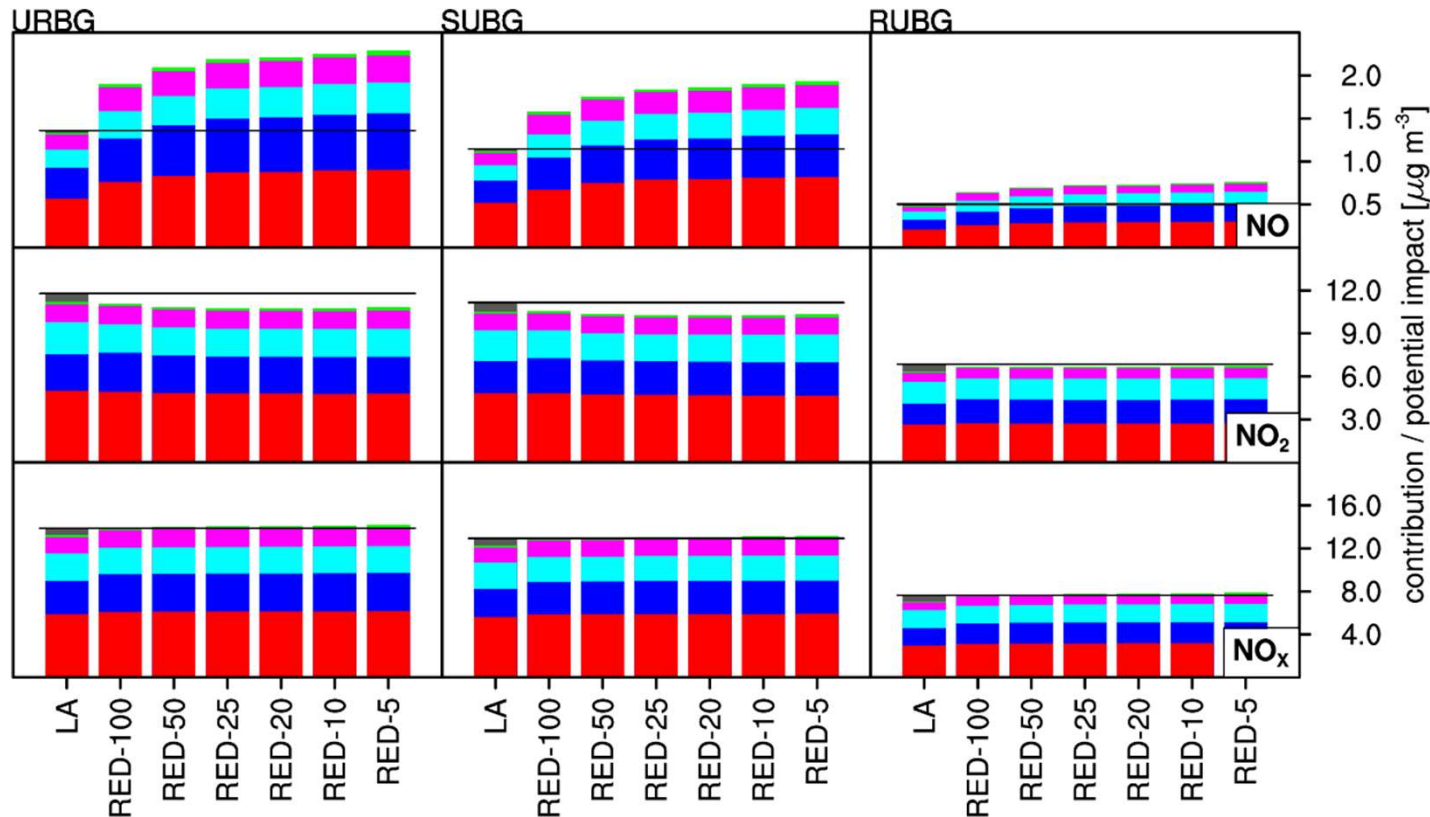
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ANNUAL SOURCE CONTRIBUTIONS AND POTENTIAL IMPACTS



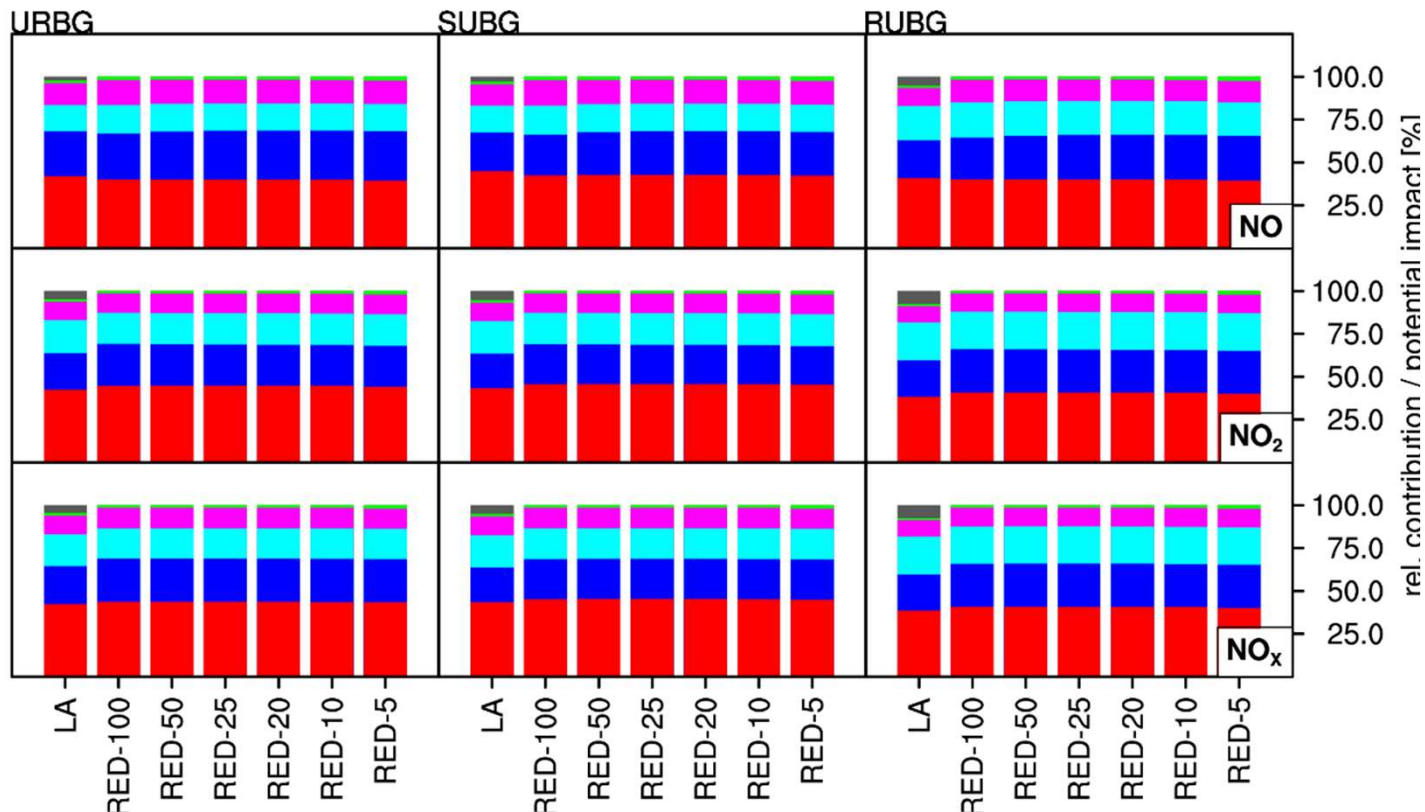
Sum of potential impacts from brute force calculations show systematic larger values than modelled in the base for NO and smaller values for NO₂

Differences are larger for smaller reduction percentages

Differences largest for source regions, e.g. urban background conditions

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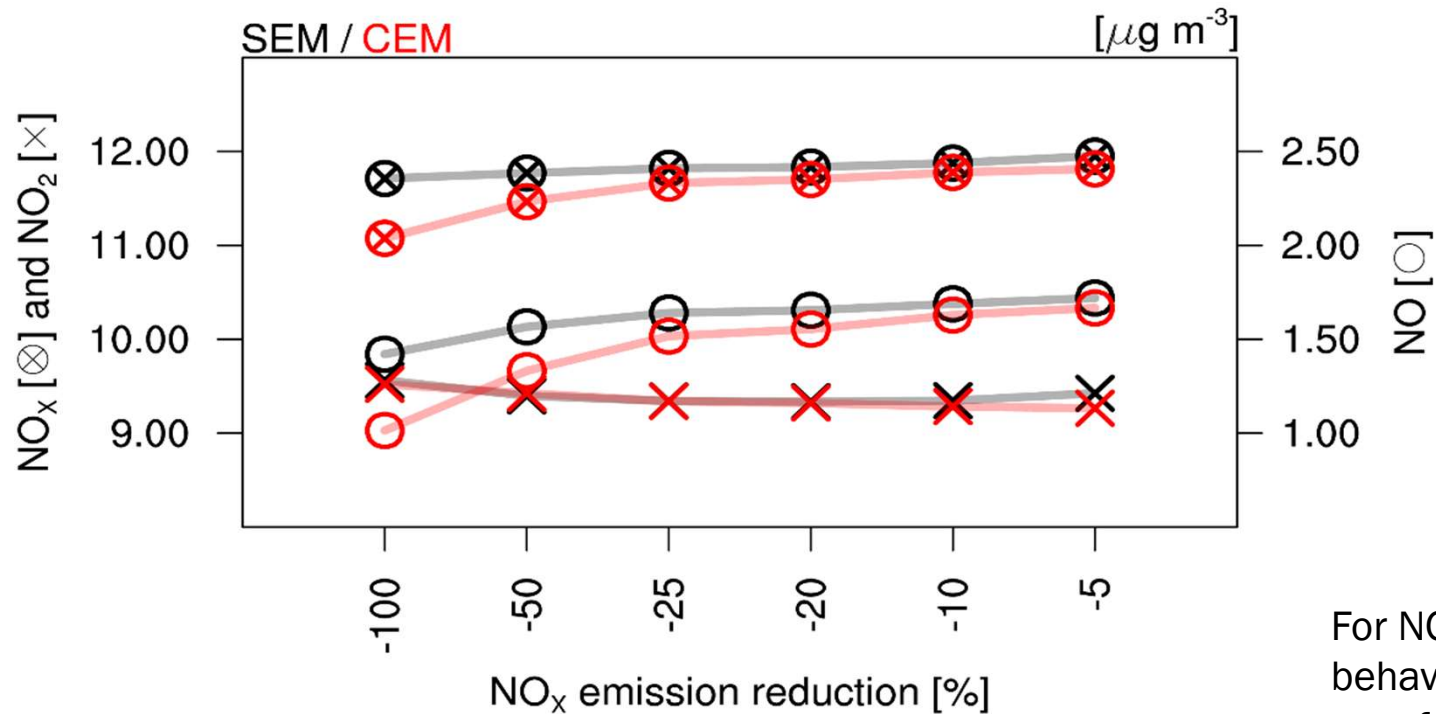
Normalized brute force results are very consistent to labelling results

To assess the relevance of source sectors to ambient NO₂ in urban background conditions labelling is more cost effective than Brute force

Effectiveness of measures should be done with scenarios, but these are normally not so simple as used here

- Road Transport
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ADDITIVE BEHAVIOR OF THE SOURCE ATTRIBUTION FOR THE BRUTE FORCE TECHNIQUE

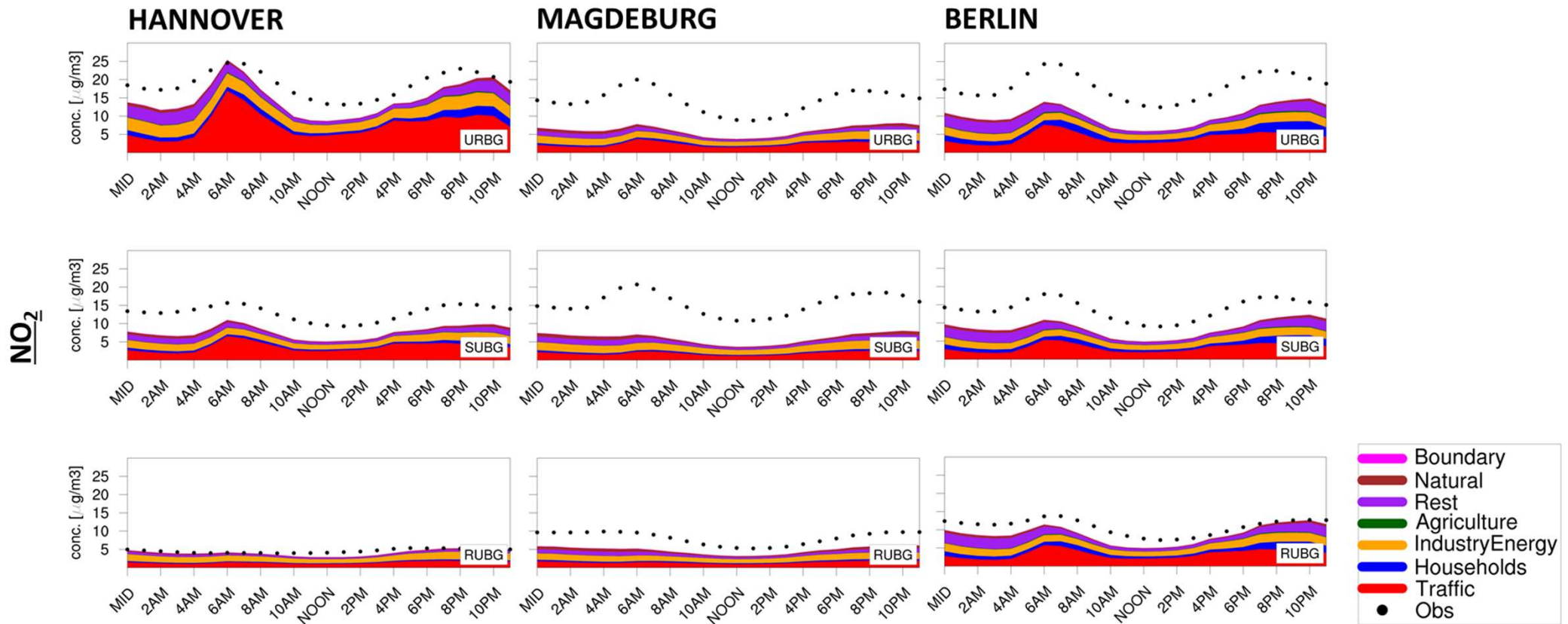


Red: Potential Impact of emission reduction over all sectors (COMB-X),

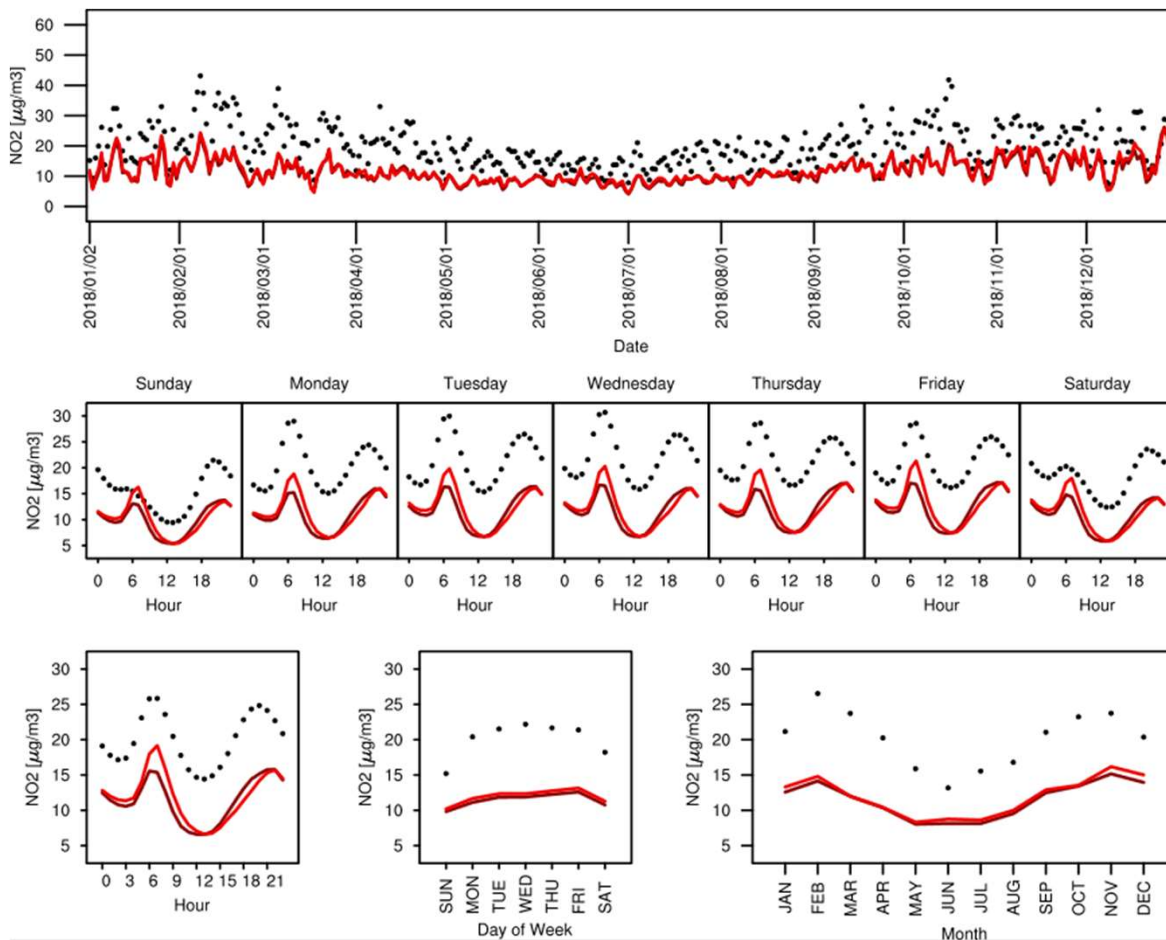
Black: Sum of potential Impacts of all source sectors (RED-X)

For NO₂ the additive behaviour seems warranted over fairly large range of reductions

SYSTEMATIC UNDERESTIMATION OF NO₂ LEVELS



INTEGRATED ACROSS ALL STATIONS

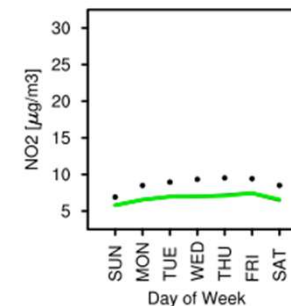
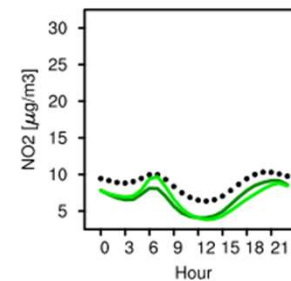
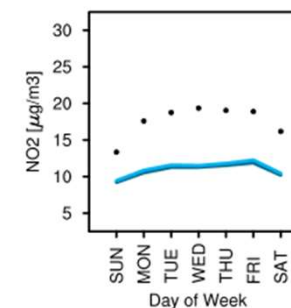
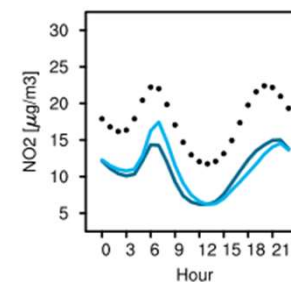


URBG ; SUBG ; RUBG

- ICON light colored

- ECMWF dark colored

NO₂



The absolute impacts and contributions are thus underestimated

ALL EUROPEAN CTMS SHOW THIS BEHAVIOR

CAMS EVALUATION

