

Aerosol Microphysics at High Spatial Resolution

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- TOMAS aerosol microphysics
 - In standard code as option
 - all components have dynamic size distributions
 - explicit aerosol N conservation equation → budgets
- Useful: indirect effect, CCN, ultrafines, other studies where size distribution matters
- Past
 - development, major sensitivities, basic evaluations vs observations
- Future
 - applications and advanced comparisons to observations



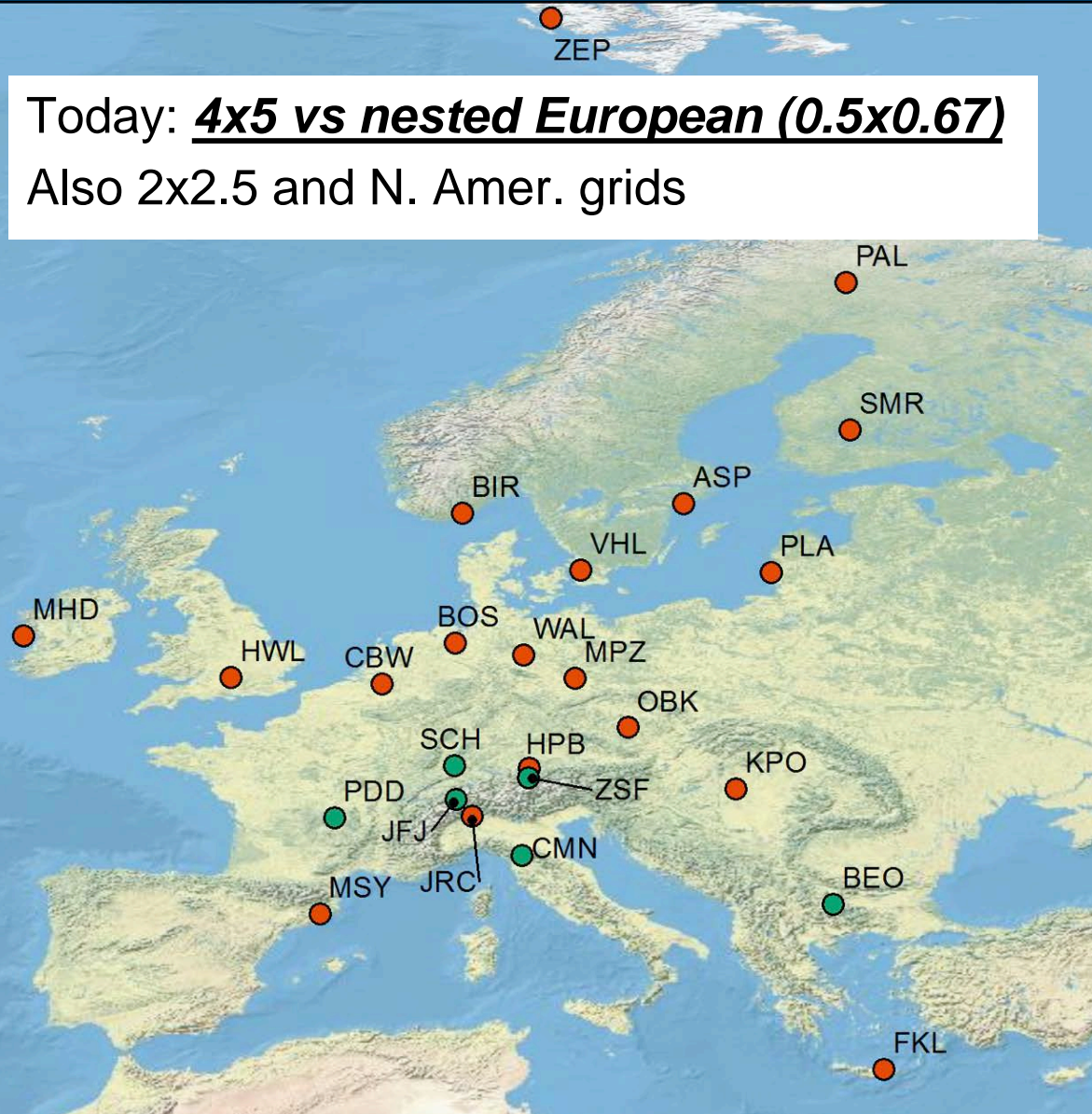
- **Motivation**: Aerosol number concentrations more variable than mass concentrations
- **Goal**: Enable better comparison to observations by taking advantage of nested capabilities
- **Questions**
- How much variability is hidden inside a 4x5 grid cell?
- Biases between 4x5 and nested models?
- Does nested model lead to better predictions vs observations?

EUSAAR Data: Size and Number



Today: **4x5 vs nested European (0.5x0.67)**

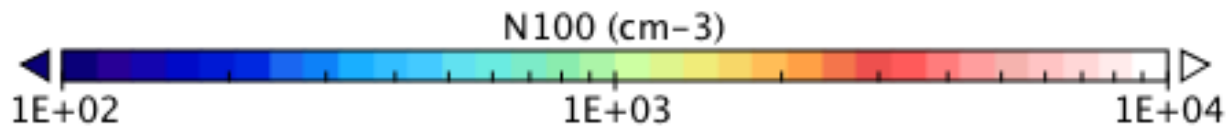
Also 2x2.5 and N. Amer. grids



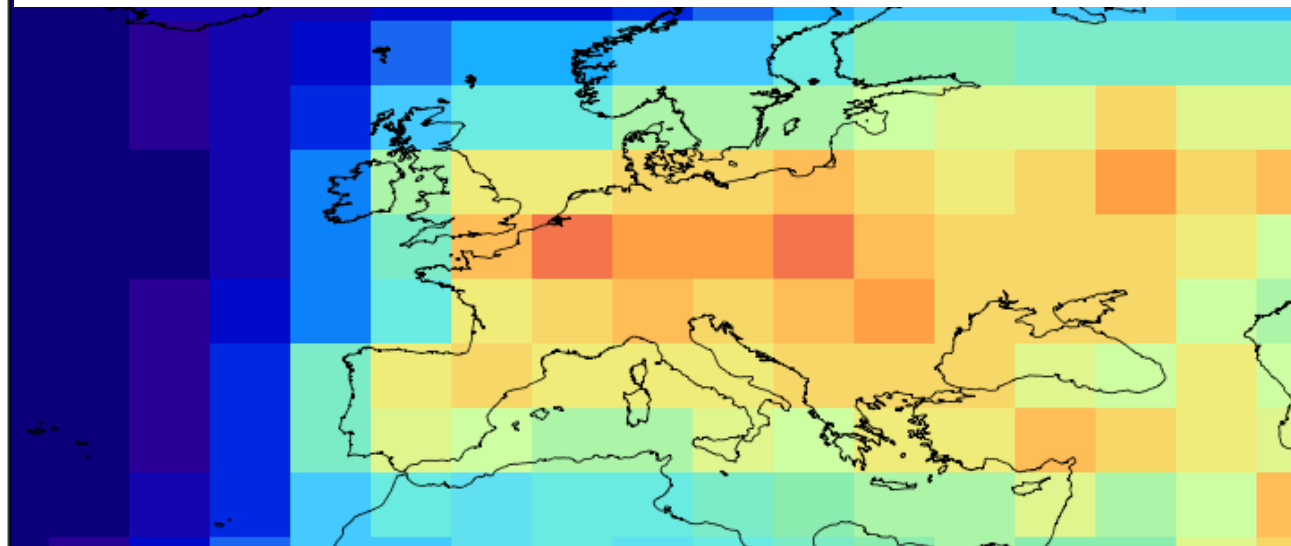
	stations
ASP	Aspreveten
BIR	Birkenes
BOS	Bosel
CBW	Cabauw
FKL	Finokalia
HPB	Hohenpeissenberg
HWL	Harwell
JRC	JRC-Ispra
KPO	K-puszt
MHD	Mace Head
MPZ	IFT-Melpitz
MSY	Montseny
OBK	Kosetice
PAL	Pallas
PLA	Preila
SMR	Hyytiala
VHL	Vavihill
WAL	Waldhof
ZEP	Zeppelin Int'l

	high-altitude stations
BEO	BEO Moussala
CMN	Mt Cimone
JFJ	Jungfrauoch
PDD	Puy de Dome
SCH	Schauinsland
ZSF	Zugspitze

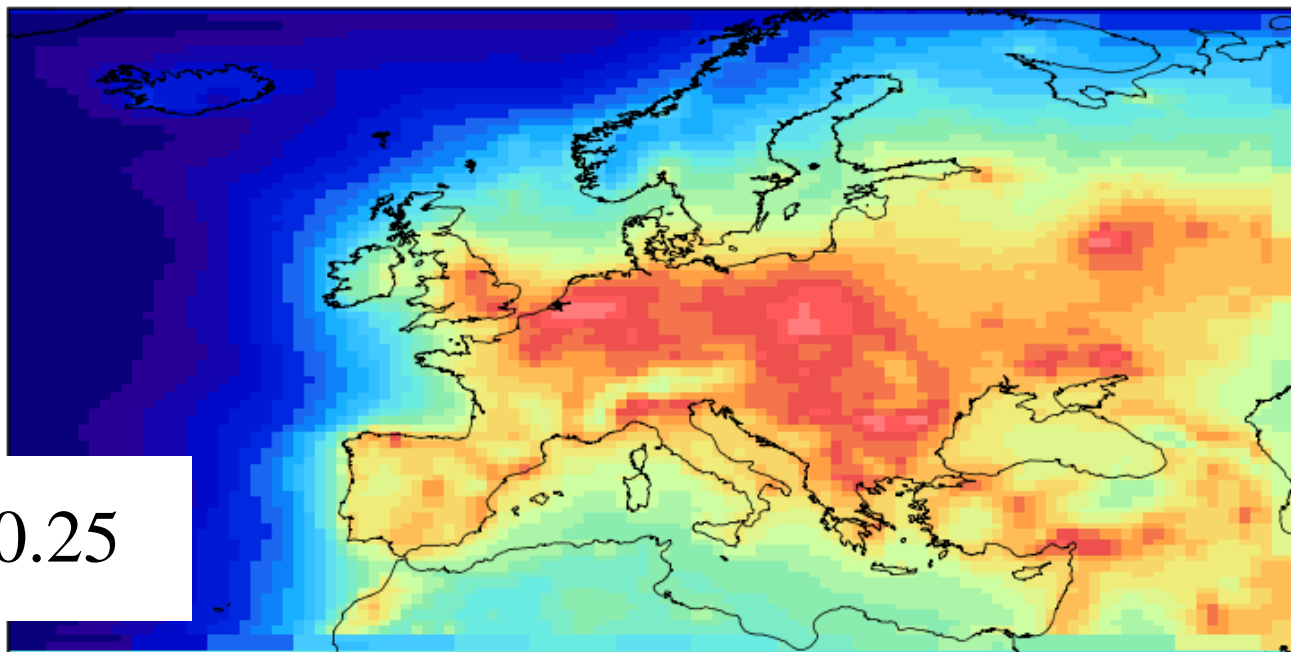
N100 Spatial Variability



4x5



EU nested

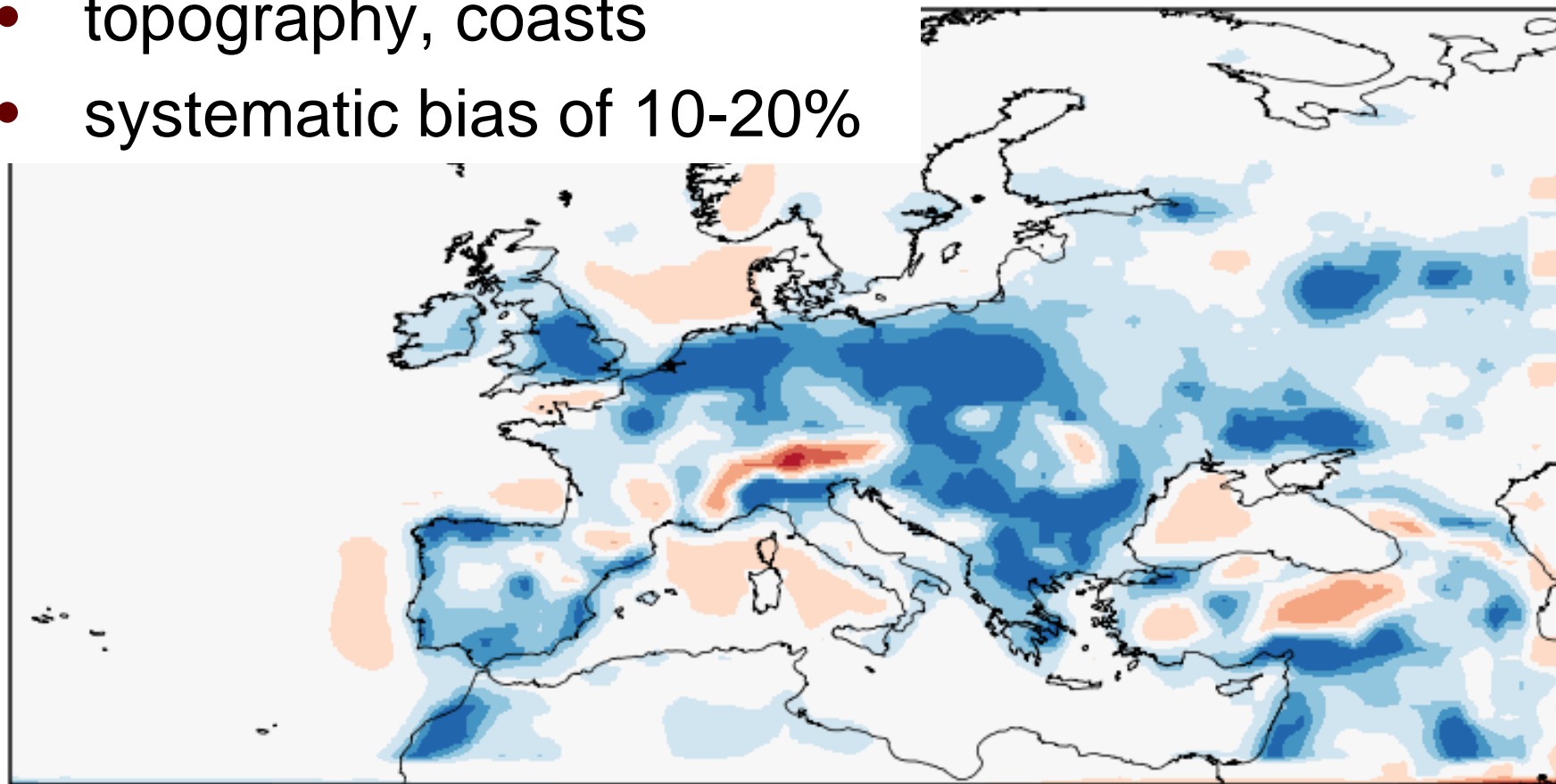


$$\frac{\sigma(\text{within } 4 \times 5)}{\mu(\text{over } 4 \times 5)} > 0.25$$

N100: (Global - Nested) Difference



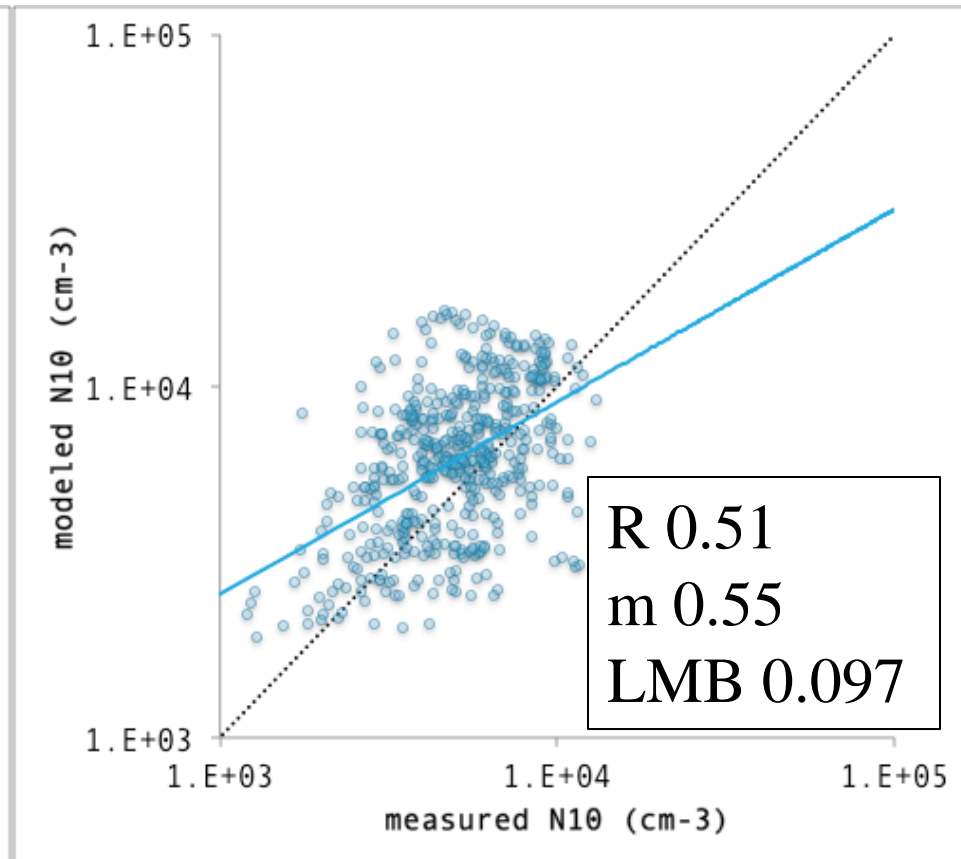
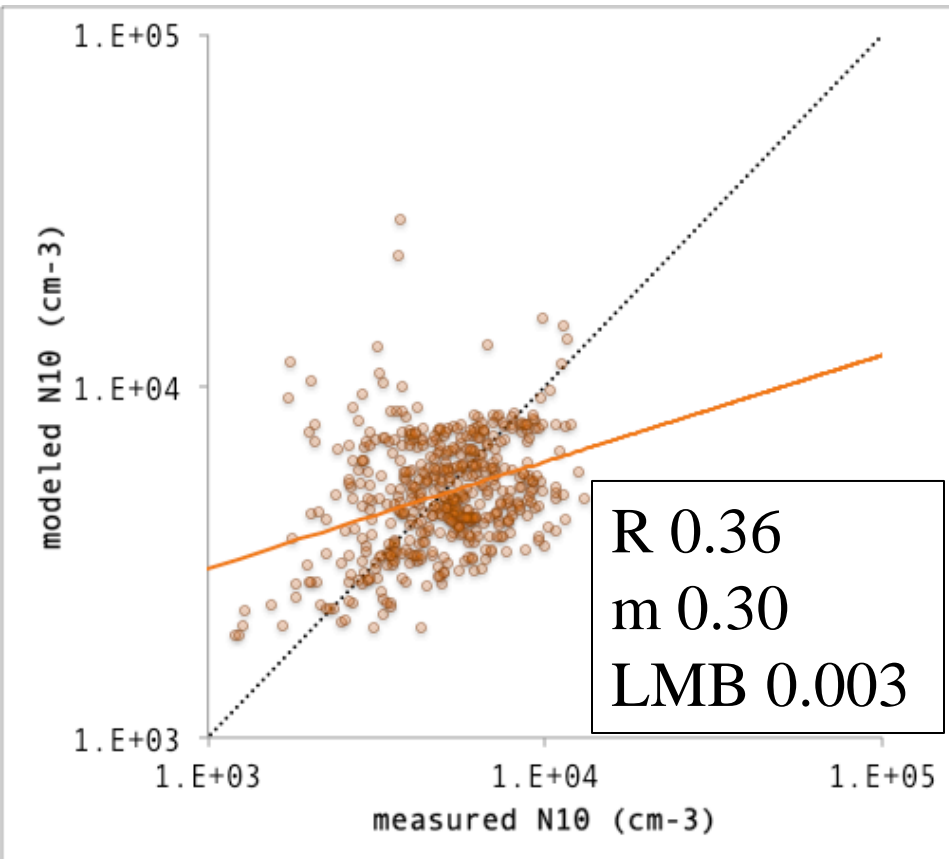
- topography, coasts
- systematic bias of 10-20%



global - nested N100 (cm⁻³)

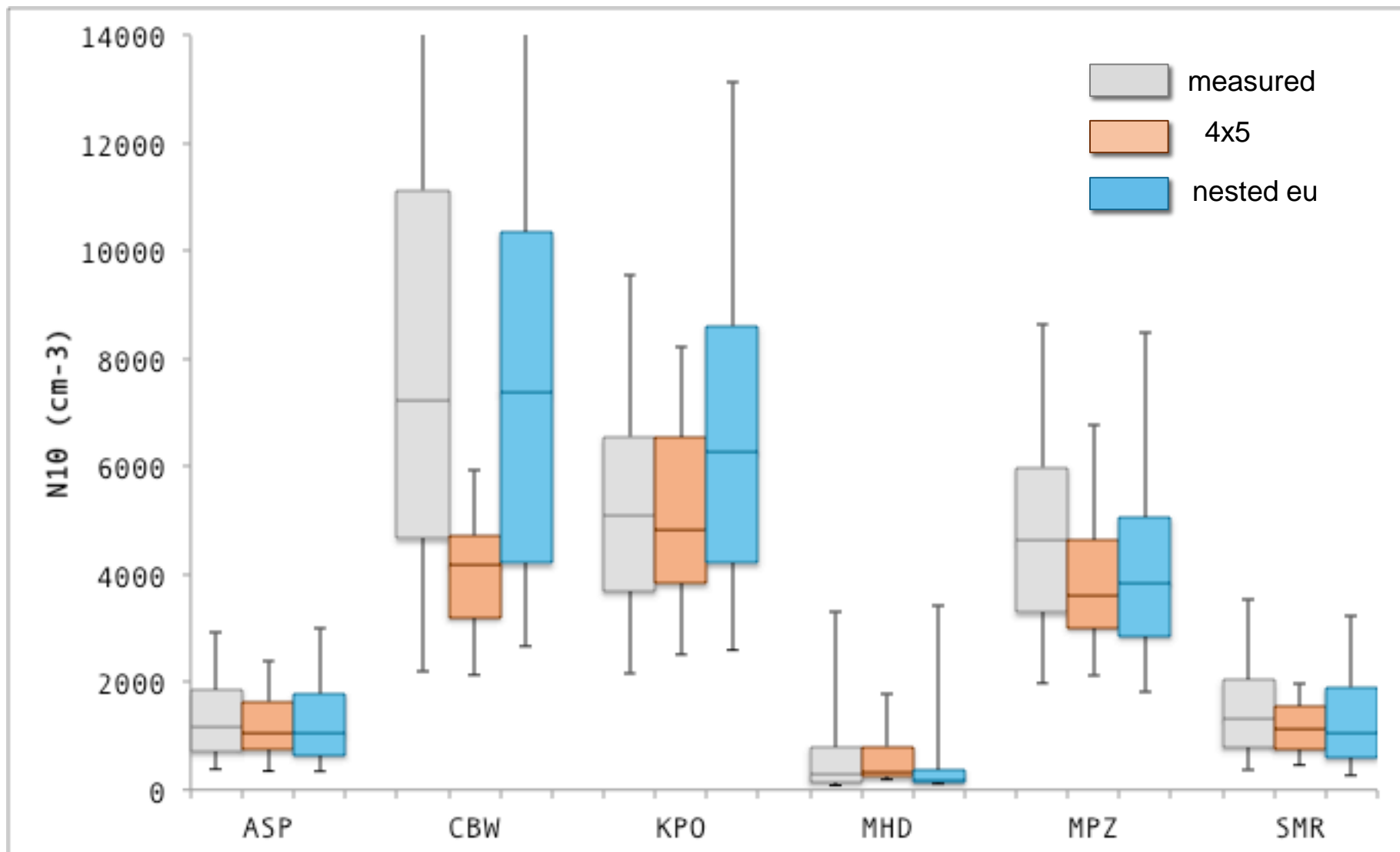


Time Variability: N10 Scatterplot



N10: Nested has better variability 11 of 12 times
N100: Nested has better variability 12 of 12 times

N10: Time Variability



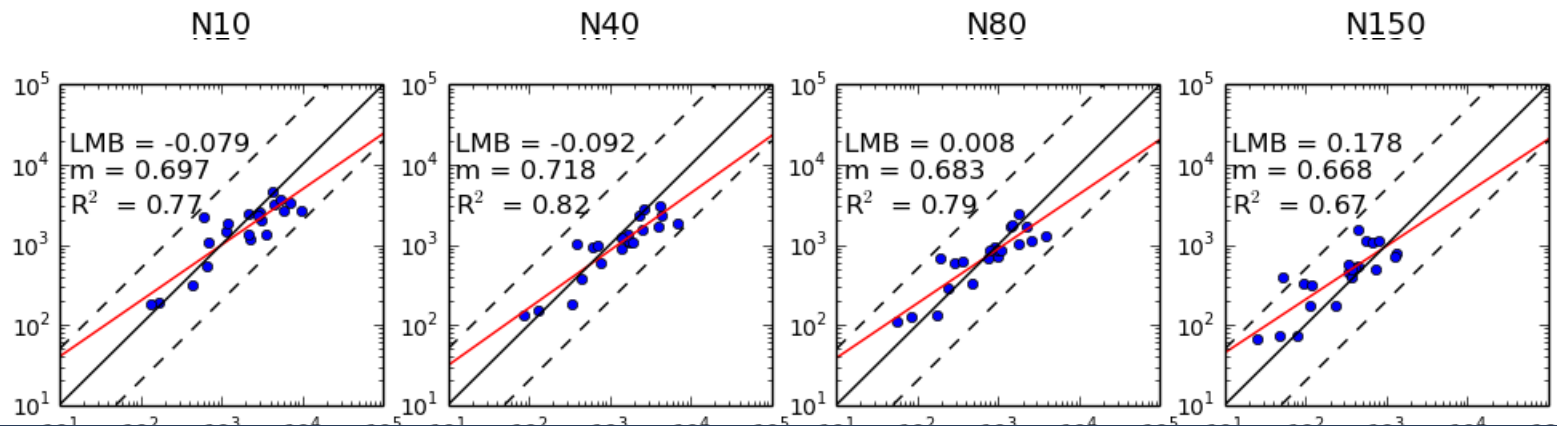


Simulated Number of Particles (cm⁻³)

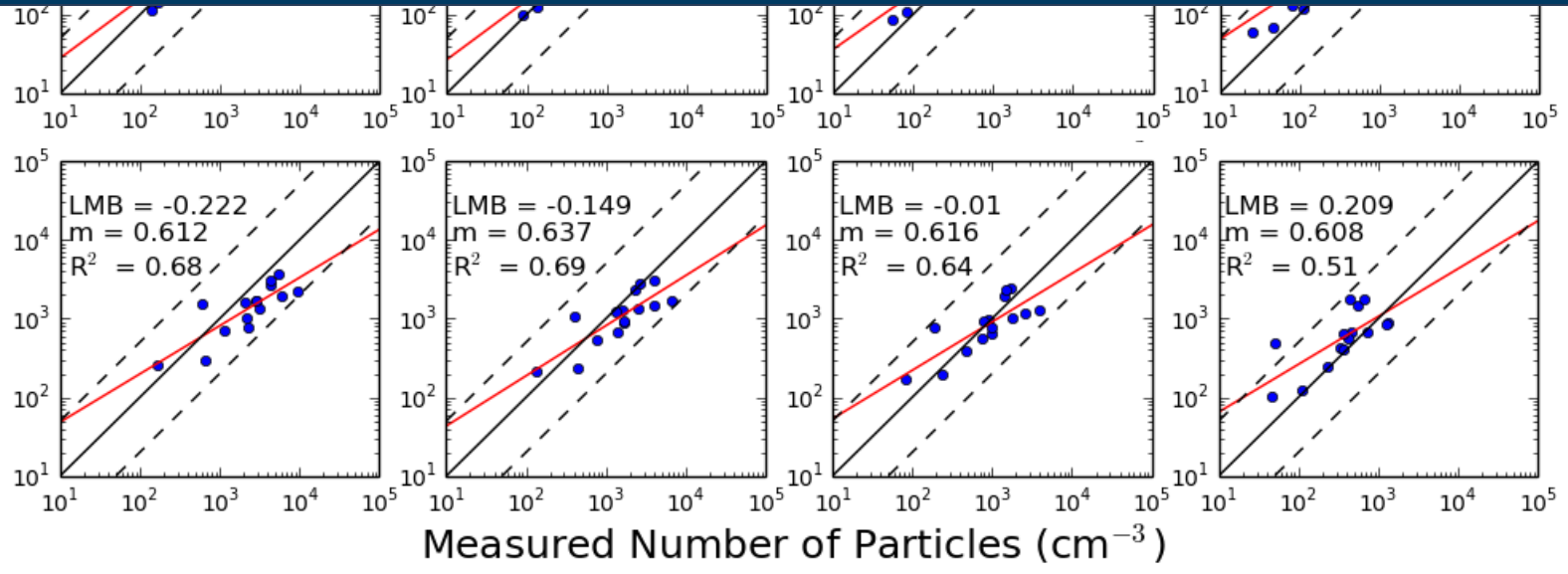
4x5

5

EU



Prediction of EUSAAR number concentrations generally degraded slightly



Measured Number of Particles (cm⁻³)



- Aerosol number concentrations highly variable in space and time
- Nested model demonstrably better in capturing this
 - Topography, coasts, and high episodes better resolved
- Observational comparisons relying on time variability will need nested simulations
- CCN (and N10) concentrations systematically biased by 10-20% in global vs nested
 - Prior good agreement likely fortuitous/tuning