# An AeroCom intercomparison exercise on state-of-the-art organic aerosol global modeling

Kostas Tsigaridis, Nikos Daskalakis, Maria Kanakidou

+68 more authors from 44 institutions
with 31 models and >1000 measurement locations

# Aim

- Document global organic aerosol modeling
- Quantify robustness of model parameterizations

- Why models differ
- Why models are the same

- How do models compare with measurements
- How we can use measurements to improve models

# Status of the paper – Sep 18

- 87 pages (1.5 spaced)
- 5 tables
- 19 figures (more to come)
- 7 supplementary figures (more to come)

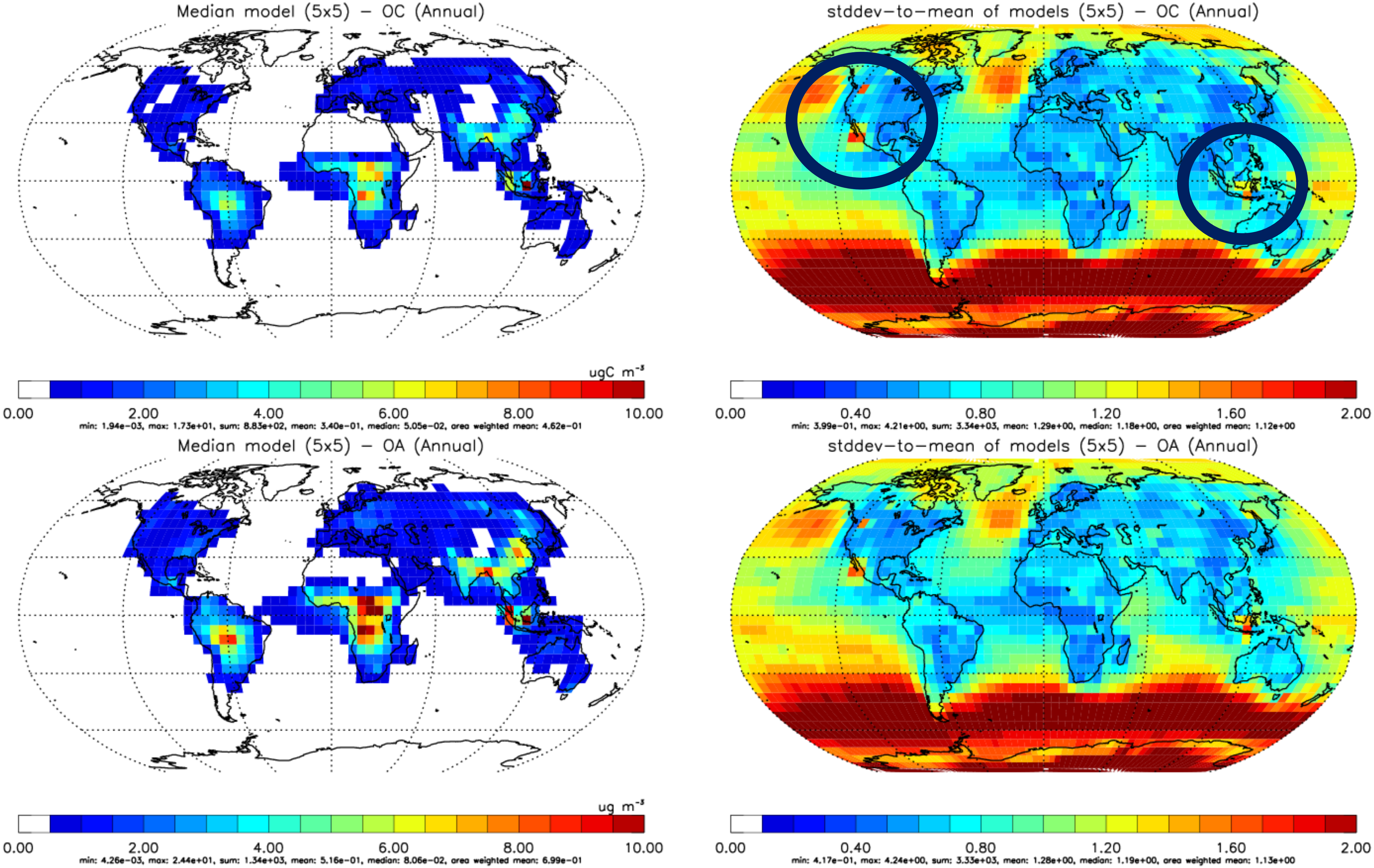
Manuscript almost ready for distribution!

One month reading time will be provided

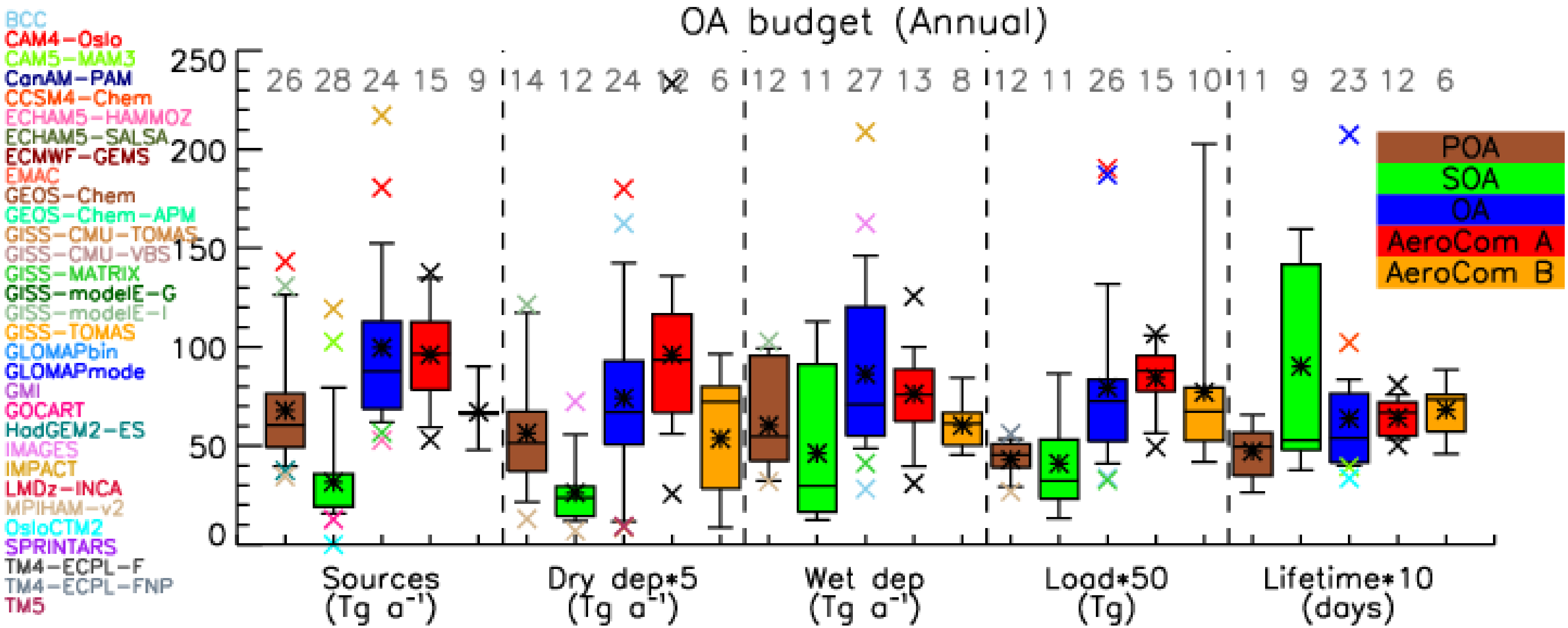
# 31 models

BCC
CAM4-Oslo
CAM5-MAM3
CanAM-PAM
CCSM4-Chem
ECHAM5-HAMMOZ
ECHAM5-SALSA
ECMWF-GEMS
EMAC
GEOS-Chem
GEOS-Chem-APM
GISS-CMU-TOMAS
GISS-CMU-VBS
GISS-MATRIX
GISS-modelE-G
GISS-modelE-I
GISS-TOMAS
GLOMAPbin
GLOMAPmode
GMI
GOCART
HadGEM2-ES
IMAGES
IMPACT
LMDz-INCA
MPIHAM-v2
OsloCTM2
SPRINTARS
TM4-ECPL-F
TM4-ECPL-FNP
TM5

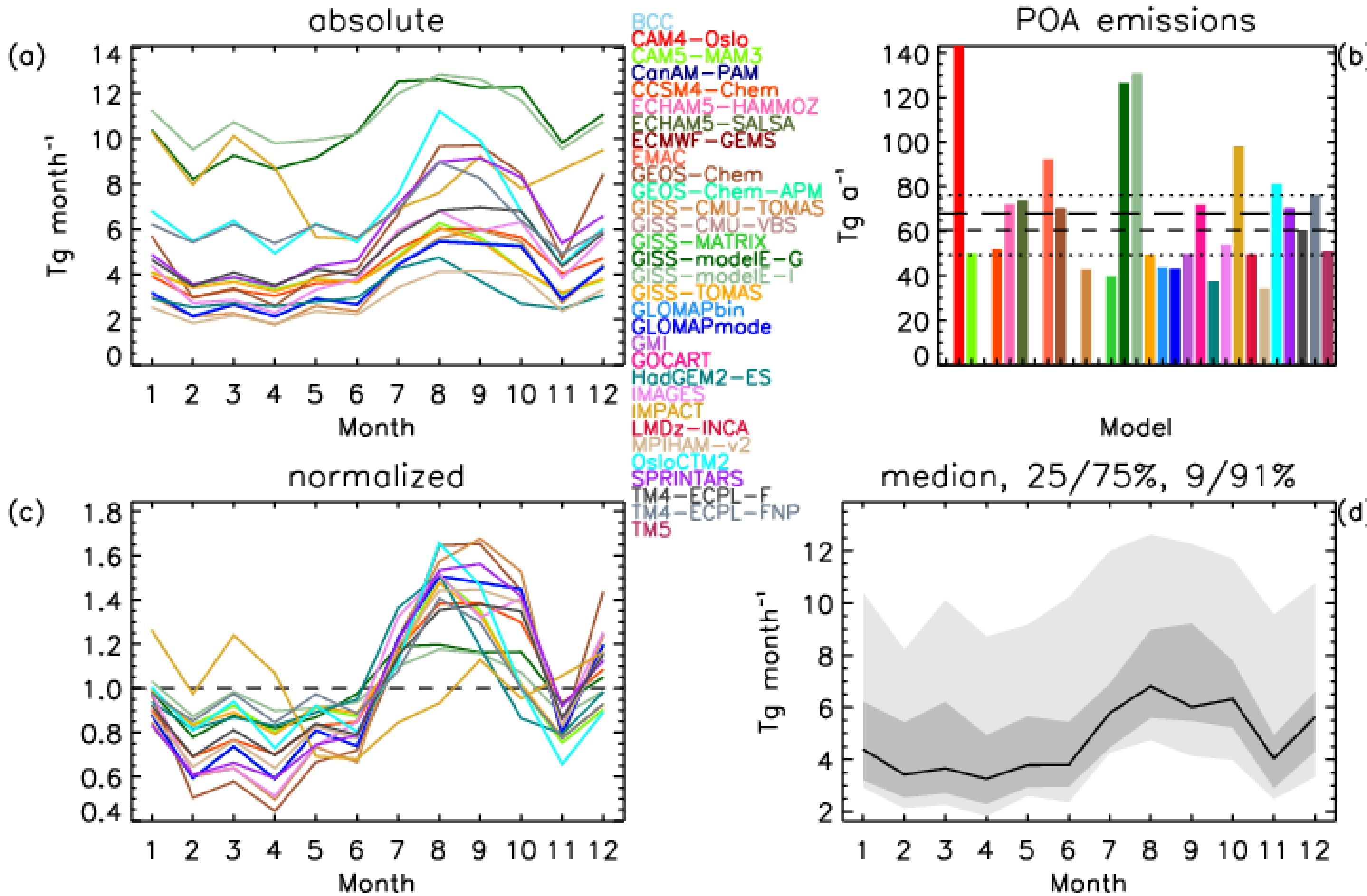
# of OA tracers : 1 - 62
# of SOA tracers: 0 - 22



Median model (5x5) – OC (Annual)
ugC m-3
0.00
2.00
4.00
6.00
8.00
10.00
min: 1.94e-03, max: 1.73e+01, sum: 8.83e+02, mean: 3.40e-01, median: 5.05e-02, area weighted mean: 4.62e-01
stddev-to-mean of models (5x5) – OC (Annual)
0.00
0.40
0.80
1.20
1.60
2.00
min: 3.99e-01, max: 4.21e+00, sum: 3.34e+03, mean: 1.29e+00, median: 1.18e+00, area weighted mean: 1.12e+00
Median model (5x5) – OA (Annual)
ug m-3
0.00
2.00
4.00
6.00
8.00
10.00
min: 4.26e-03, max: 2.44e+01, sum: 1.34e+03, mean: 5.16e-01, median: 8.06e-02, area weighted mean: 6.99e-01
stddev-to-mean of models (5x5) – OA (Annual)
0.00
0.40
0.80
1.20
1.60
2.00
min: 4.17e-01, max: 4.24e+00, sum: 3.33e+03, mean: 1.28e+00, median: 1.19e+00, area weighted mean: 1.13e+00




AeroCom I → AeroCom II: higher complexity + higher model diversity due to SOA


absolute
(a)
Tg month⁻¹
Month
POA emissions
(b)
Tg a⁻¹
Model
normalized
(c)
median, 25/75%, 9/91%
(d)
Tg month⁻¹
Month
BCC
CAM4−Oslo
CAM5−MAM3
CanAM−PAM
CCSM4−Chem
ECHAM5−HAMMOZ
ECHAM5−SALSA
ECMWF−GEMS
EMAC
GEOS−Chem
GEOS−Chem−APM
GISS−CMU−TOMAS
GISS−CMU−VBS
GISS−MATRIX
GISS−modelE−G
GISS−modelE−I
GISS−TOMAS
GLOMAPbin
GLOMAPmode
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GOCART
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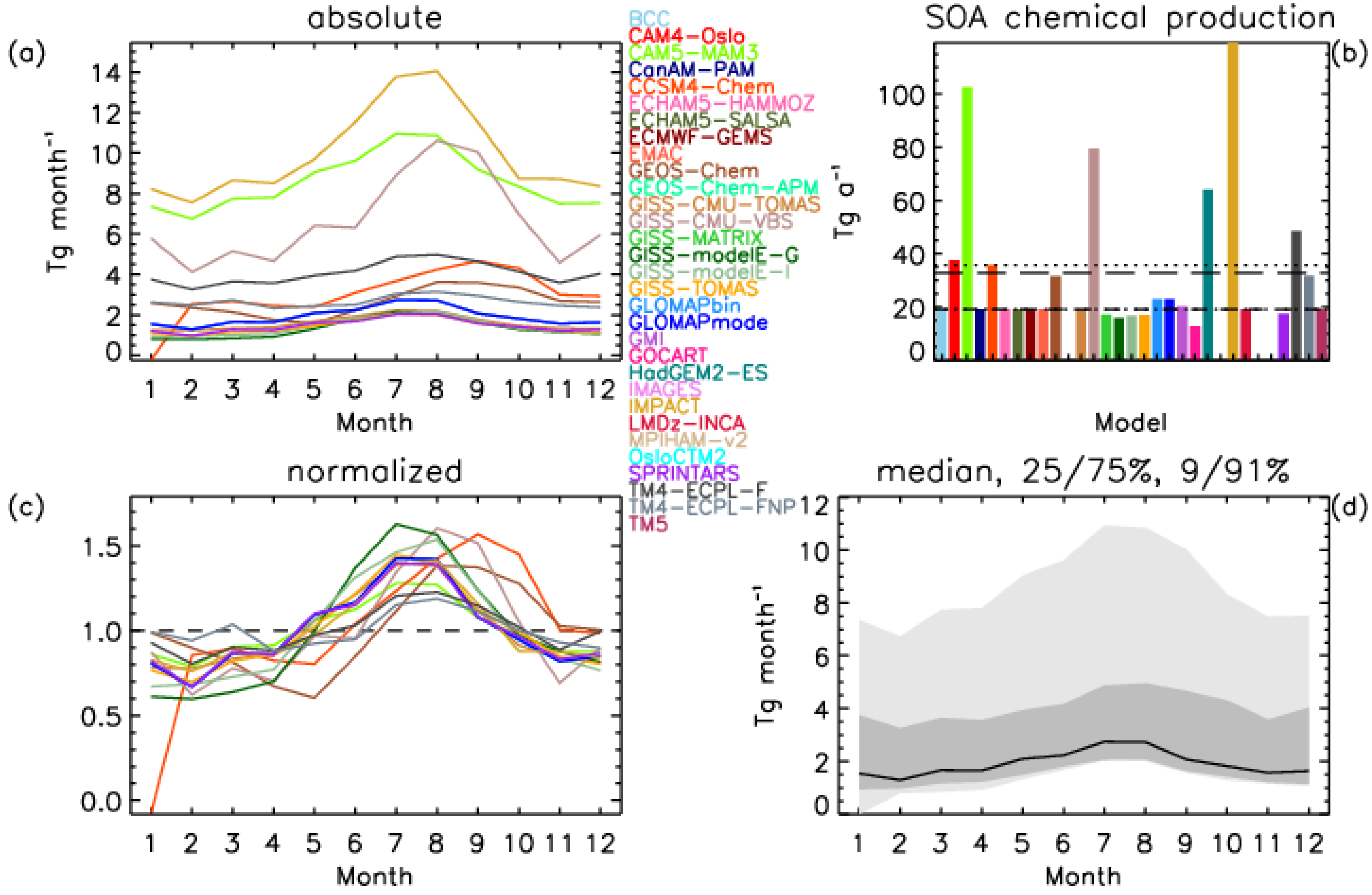
IMAGES
IMPACT
LMDz−INCA
MPIHAM−v2
OsloCTM2
SPRINTARS
TM4−ECPL−F
TM4−ECPL−FNP
TM5



absolute
(a)
Tg month⁻¹
Month
BCC
CAM4−Oslo
CAM5−MAM3
CanAM−PAM
CCSM4−Chem
ECHAM5−HAMMOZ
ECHAM5−SALSA
ECMWF−GEMS
EMAC
GEOS−Chem
GEOS−Chem−APM
GISS−CMU−TOMAS
GISS−CMU−VBS
GISS−MATRIX
GISS−modelE−G
GISS−modelE−I
GISS−TOMAS
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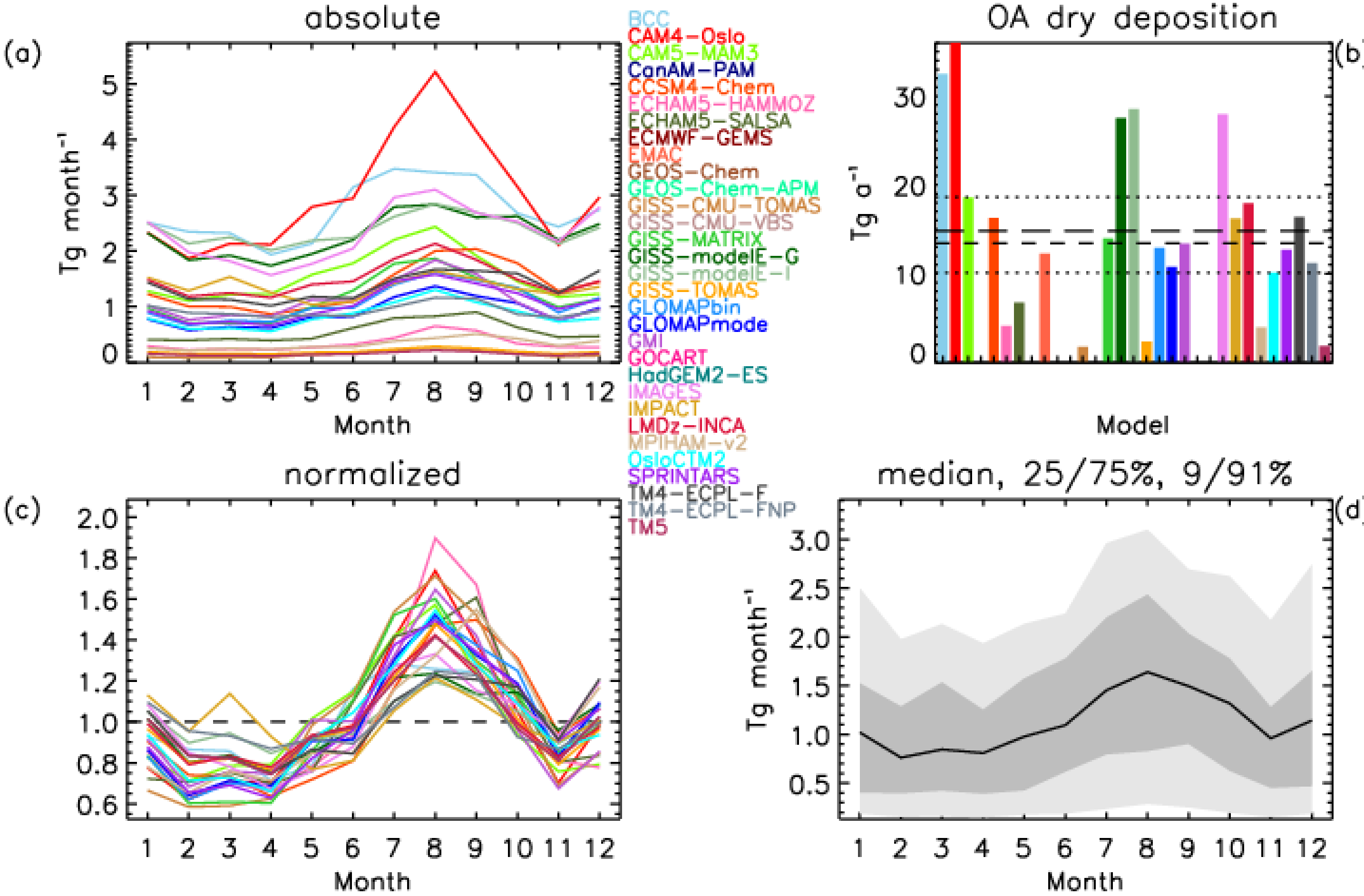
IMAGES
IMPACT
LMDz−INCA
MPIHAM−v2
OsloCTM2
SPRINTARS
TM4−ECPL−F
TM4−ECPL−FNP
TM5
SOA chemical production
(b)
Tg a⁻¹
Model
normalized
(c)
Month
median, 25/75%, 9/91%
(d)
Tg month⁻¹
Month



absolute
(a)
Tg month⁻¹
Month
OA dry deposition
(b)
Tg a⁻¹
Model
normalized
(c)
Month
median, 25/75%, 9/91%
(d)
Tg month⁻¹
Month
BCC
CAM4−Oslo
CAM5−MAM3
CanAM−PAM
CCSM4−Chem
ECHAM5−HAMMOZ
ECHAM5−SALSA
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GEOS−Chem
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GISS−CMU−TOMAS
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GISS−MATRIX
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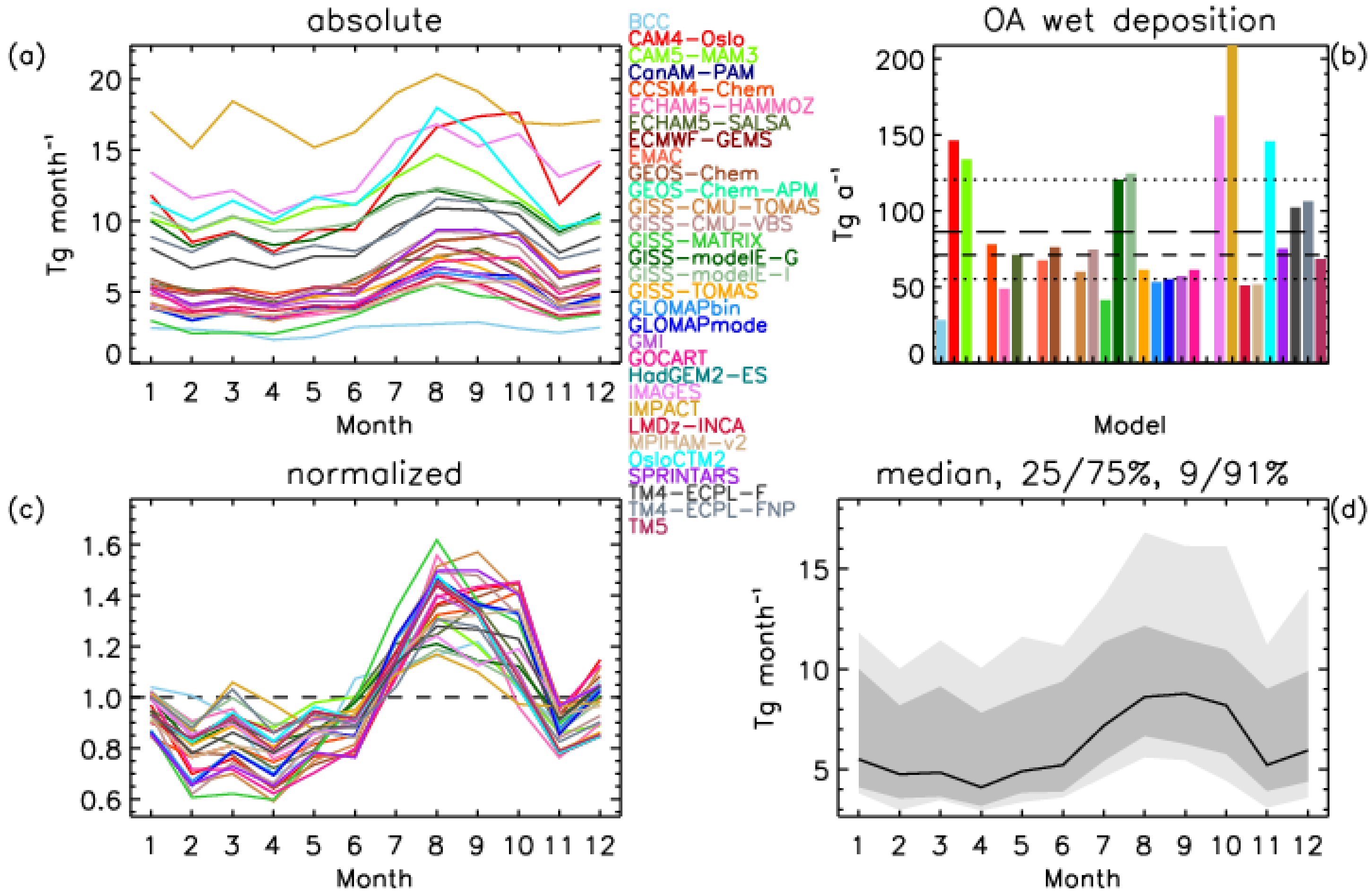

absolute
(a)
Tg month⁻¹
Month
BCC
CAM4−Oslo
CAM5−MAM3
CanAM−PAM
CCSM4−Chem
ECHAM5−HAMMOZ
ECHAM5−SALSA
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GISS−CMU−TOMAS
GISS−CMU−VBS
GISS−MATRIX
GISS−modelE−G
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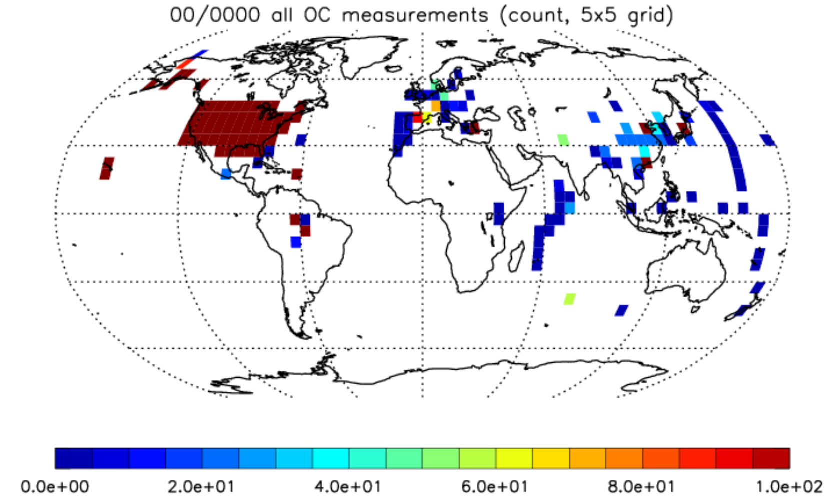
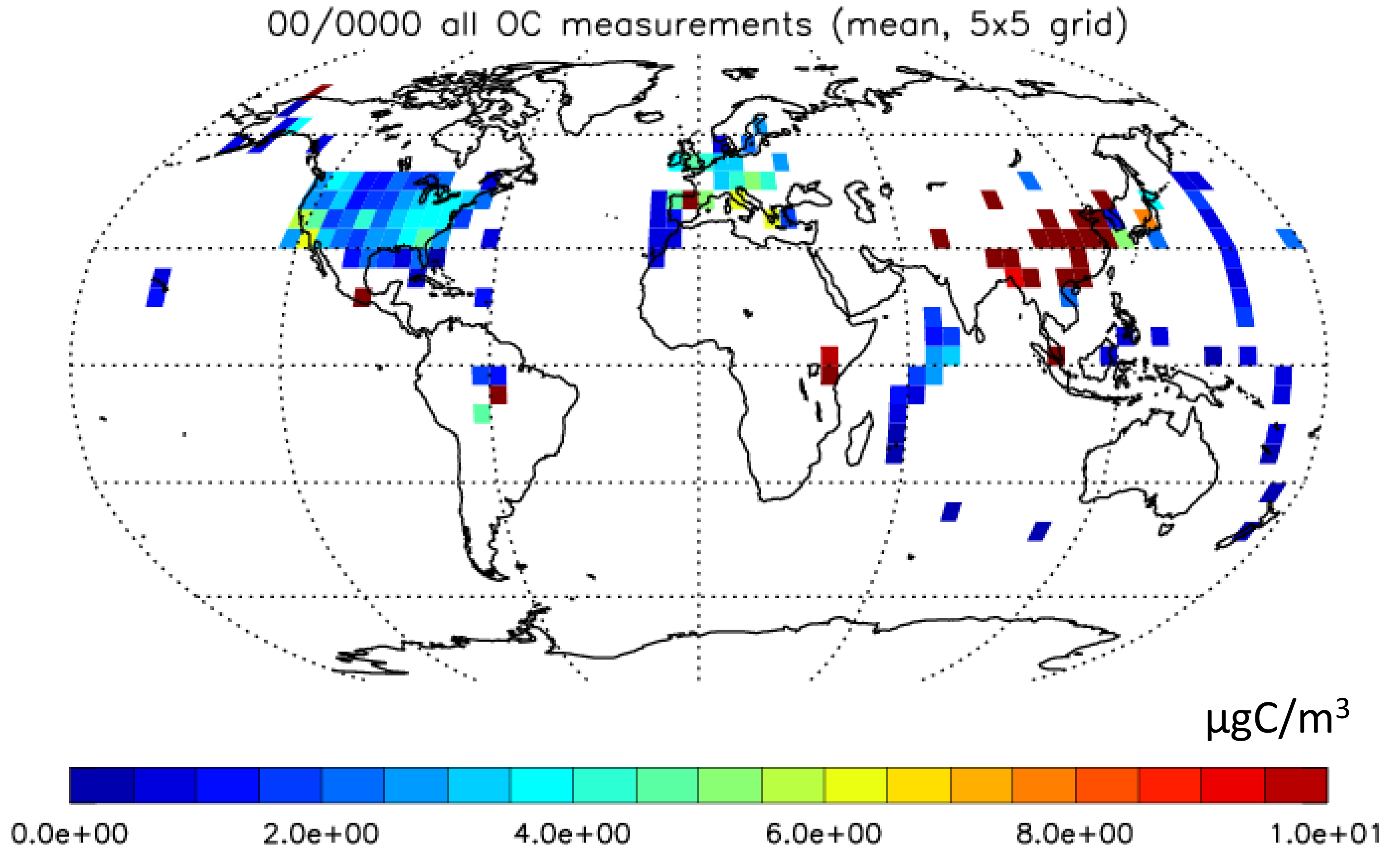
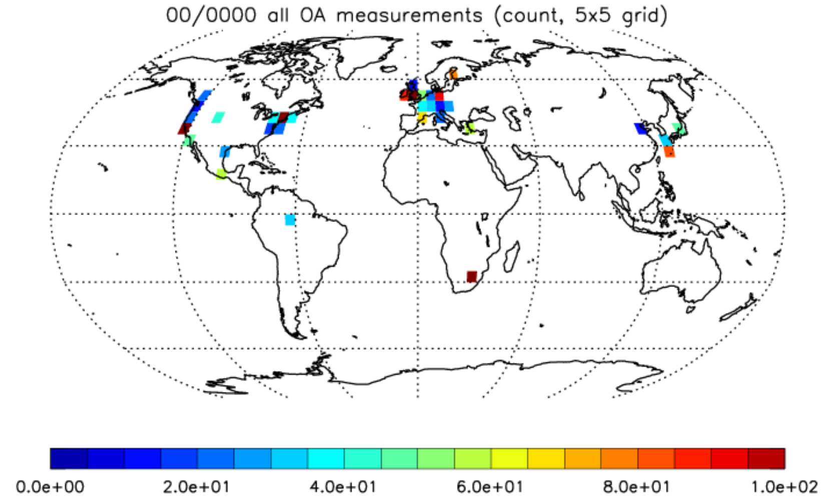
IMAGES
IMPACT
LMDz−INCA
MPIHAM−v2
OsloCTM2
SPRINTARS
TM4−ECPL−F
TM4−ECPL−FNP
TM5
OA wet deposition
(b)
Tg a⁻¹
Model
normalized
(c)
Month
median, 25/75%, 9/91%
(d)
Tg month⁻¹
Month

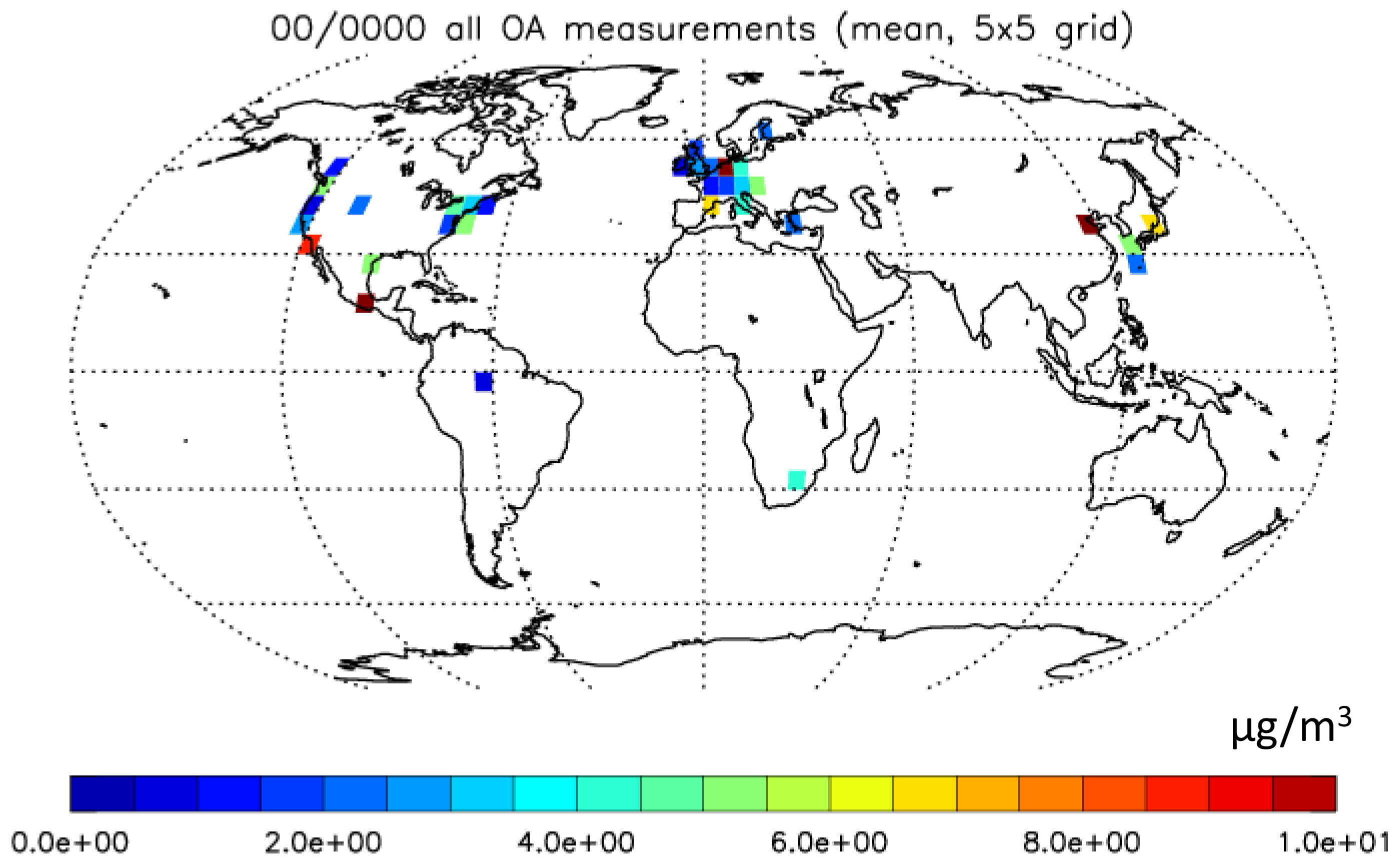
# Organic Carbon observations



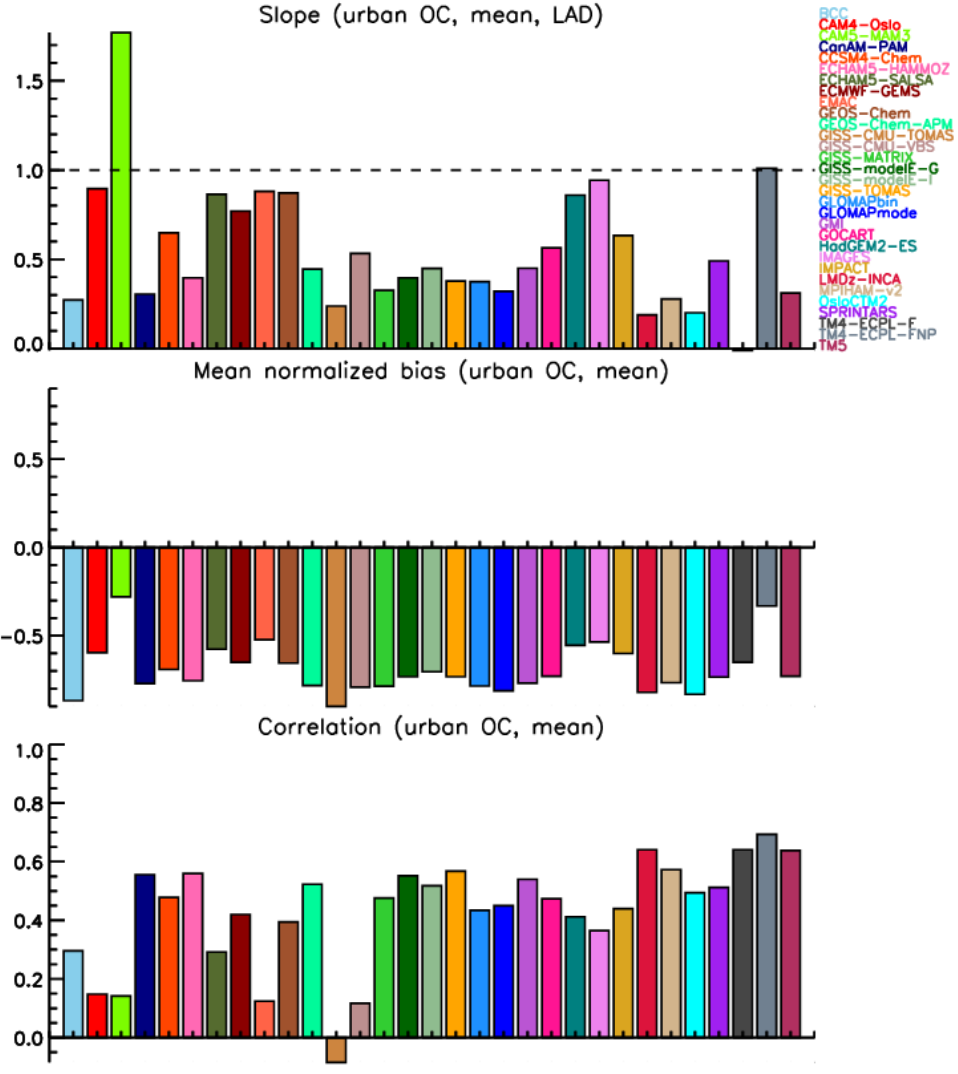



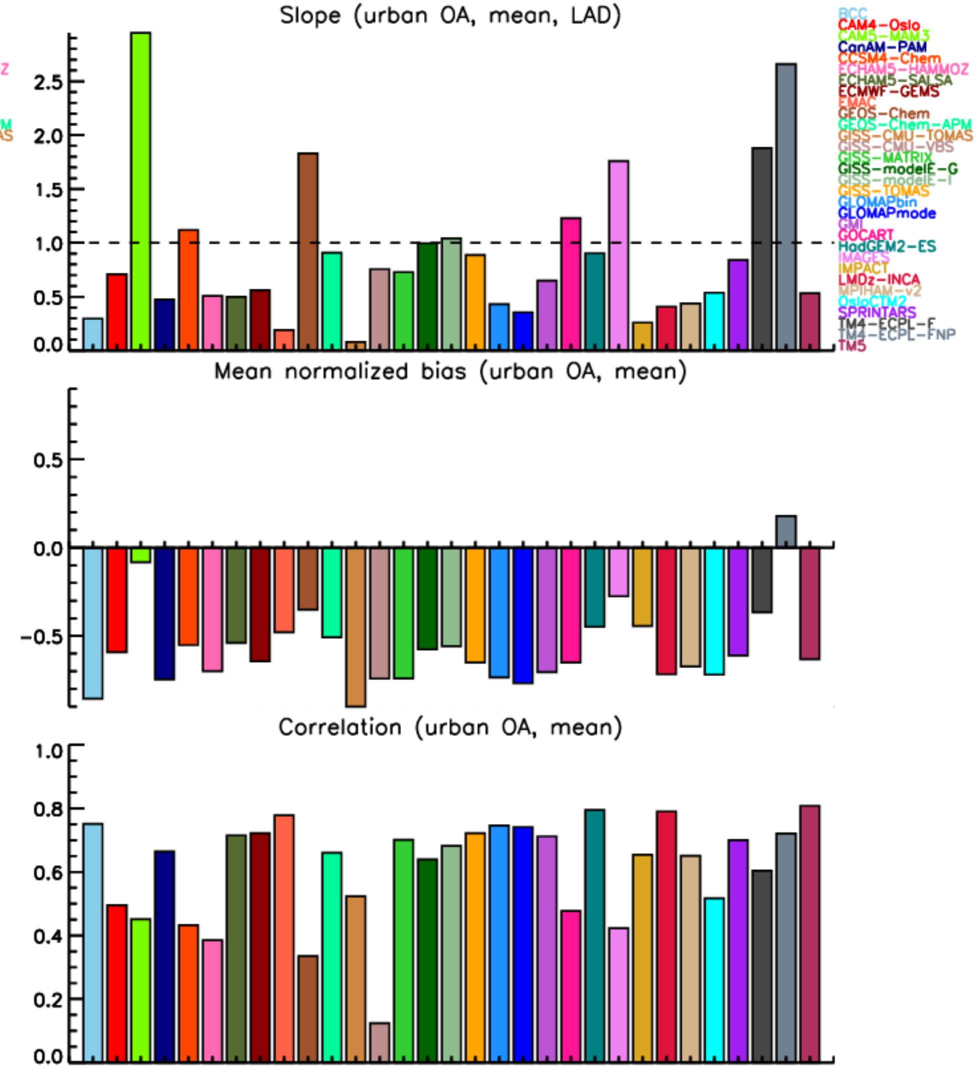
# Organic Aerosol observations



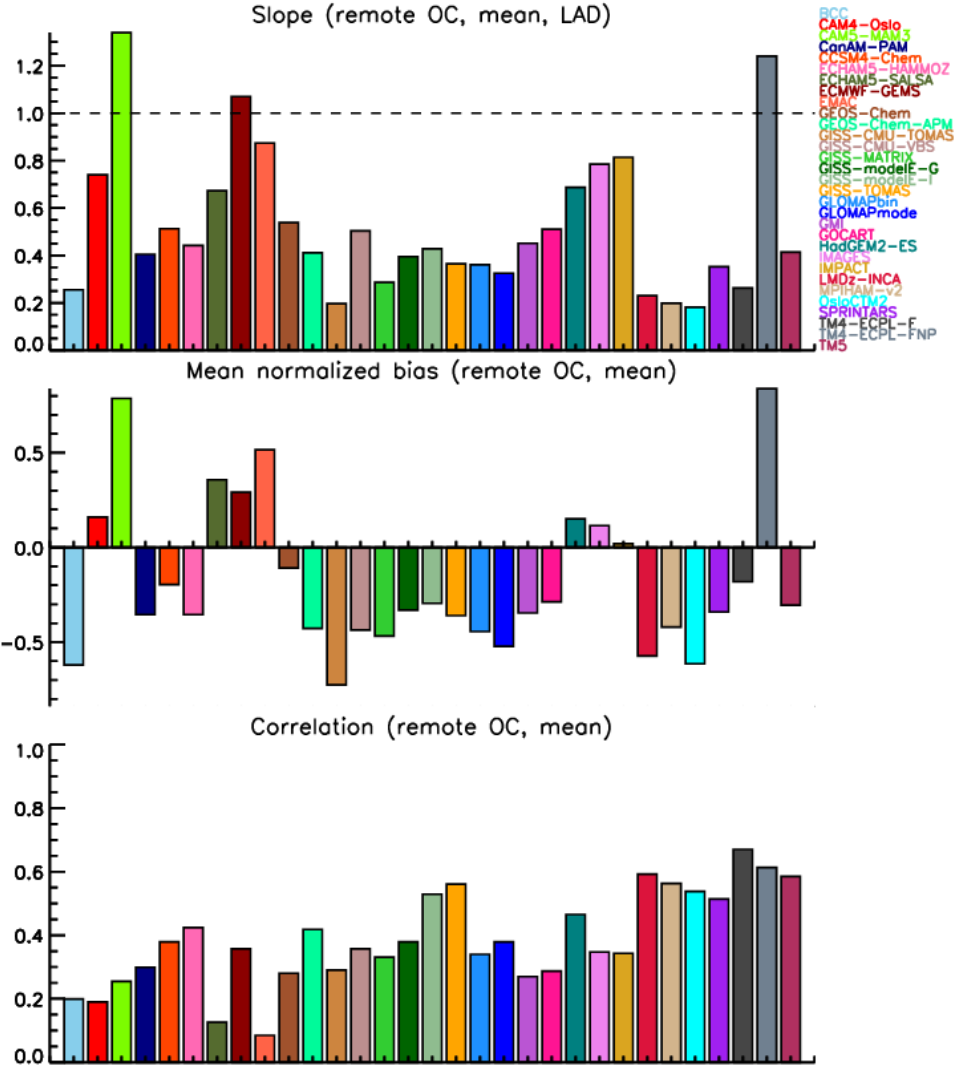
# OC URBAN OA




LAD: Least Absolute Deviation

OC REMOTE OA


Slope (remote OC, mean, LAD)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
BCC
CAM4-Oslo
CAM5-MAM3
CanAM-PAM
CCSM4-Chem
ECHAM5-HAMMOZ
ECHAM5-SALSA
ECMWF-GEMS
EMAC
GEOS-Chem
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GISS-CMU-TOMAS
GISS-CMU-VBS
GISS-MATRIX
GISS-modelE-G
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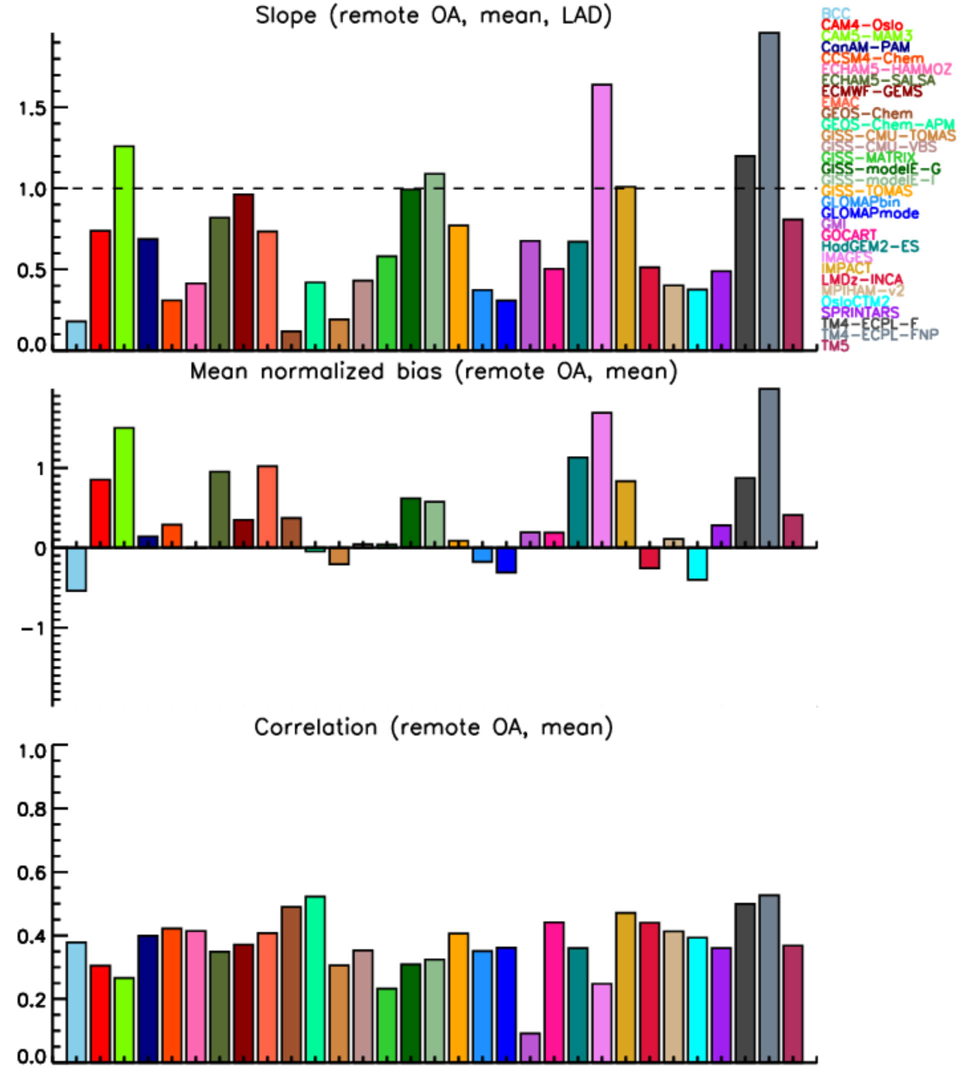
MPIHAM-v2
OsloCTM2
SPRINTARS
TM4-ECPL-F
TM4-ECPL-FNP
TM5
Mean normalized bias (remote OC, mean)
0.5
0.0
-0.5
Correlation (remote OC, mean)
1.0
0.8
0.6
0.4
0.2
0.0


Slope (remote OA, mean, LAD)
1.5
1.0
0.5
0.0
BCC
CAM4-Oslo
CAM5-MAM3
CanAM-PAM
CCSM4-Chem
ECHAM5-HAMMOZ
ECHAM5-SALSA
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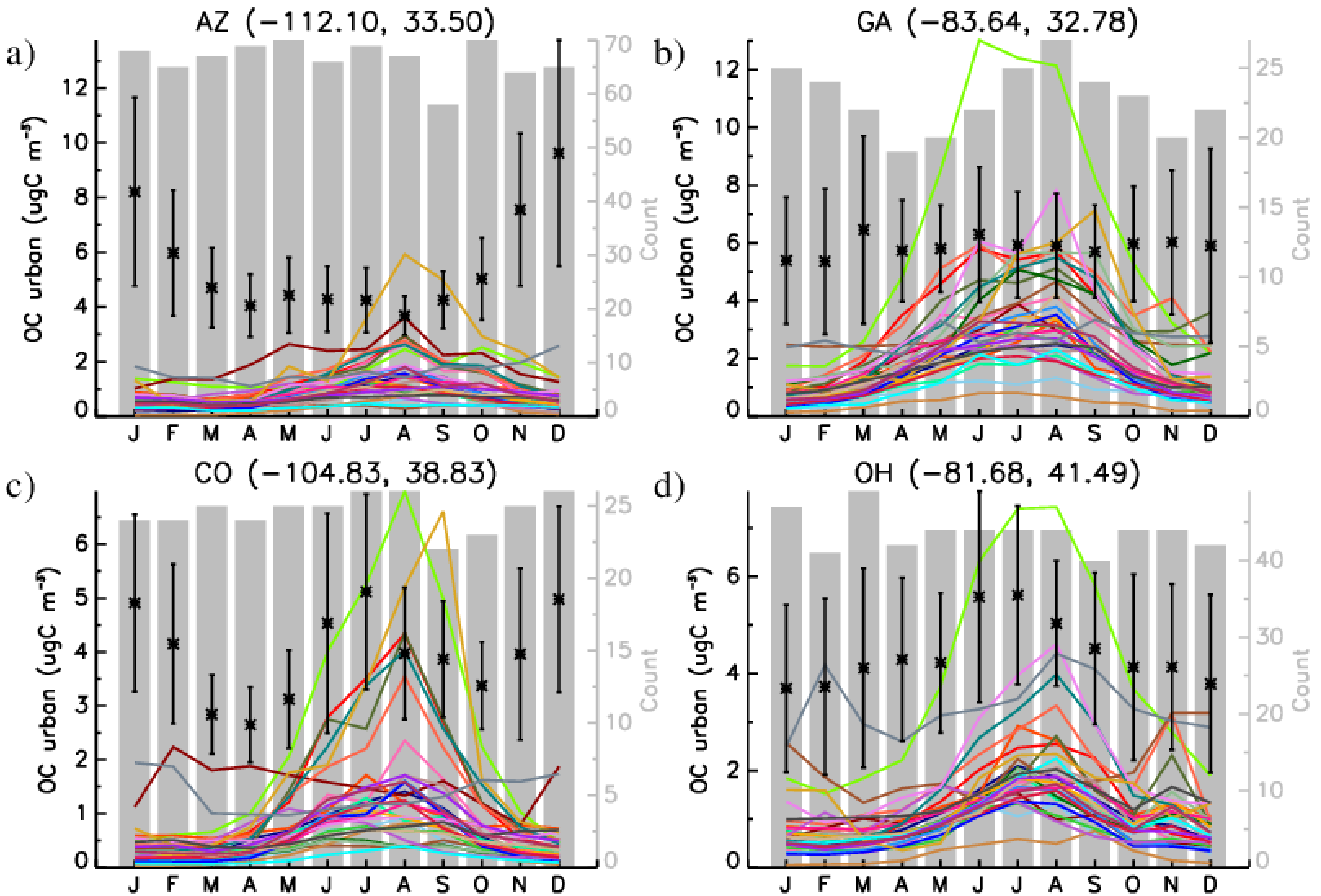
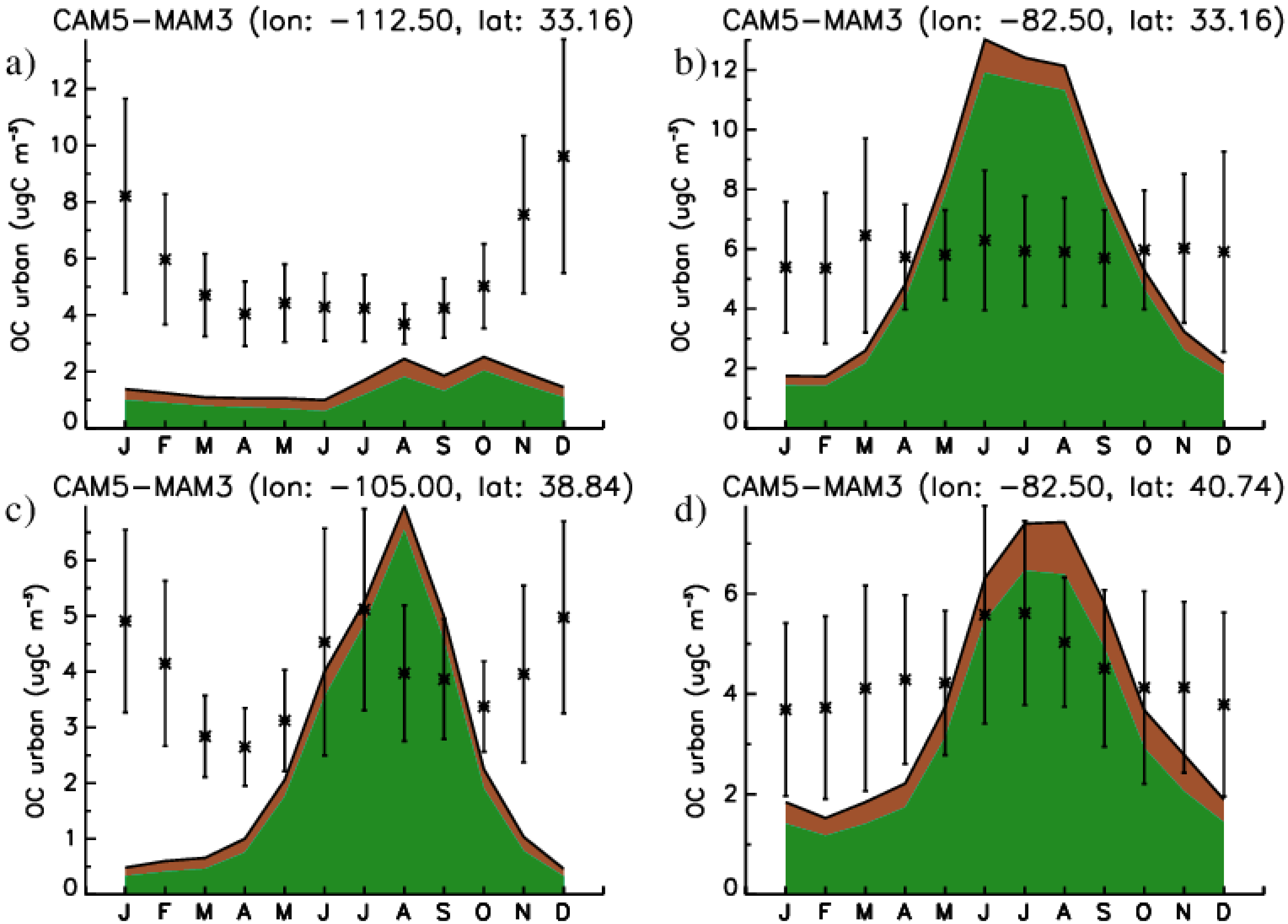
IMAGES
IMPACT
LMDz-INCA
MPIHAM-v2
OsloCTM2
SPRINTARS
TM4-ECPL-F
TM4-ECPL-FNP
TM5
Mean normalized bias (remote OA, mean)
1
0
-1
Correlation (remote OA, mean)
1.0
0.8
0.6
0.4
0.2
0.0

# US urban stations

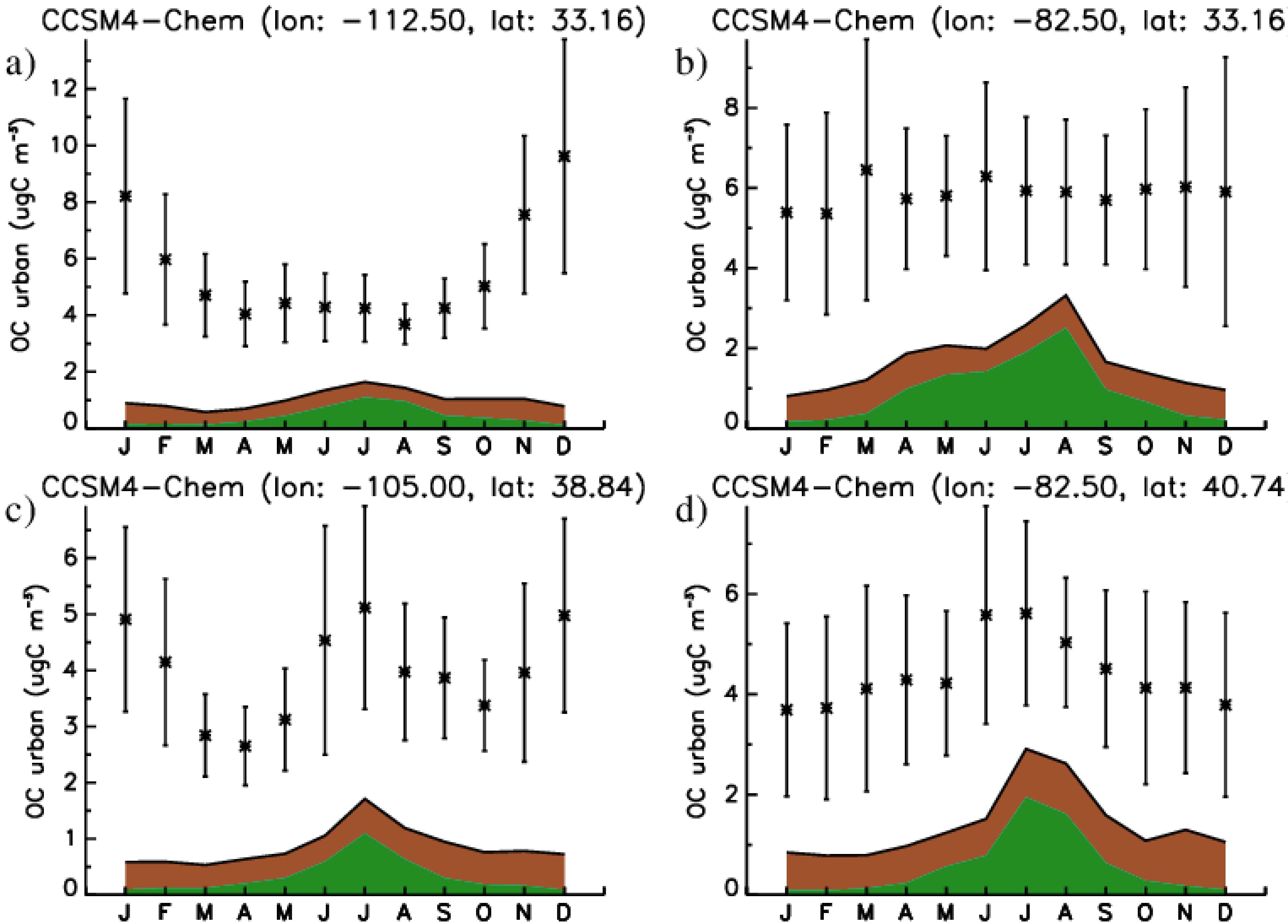


# US urban stations

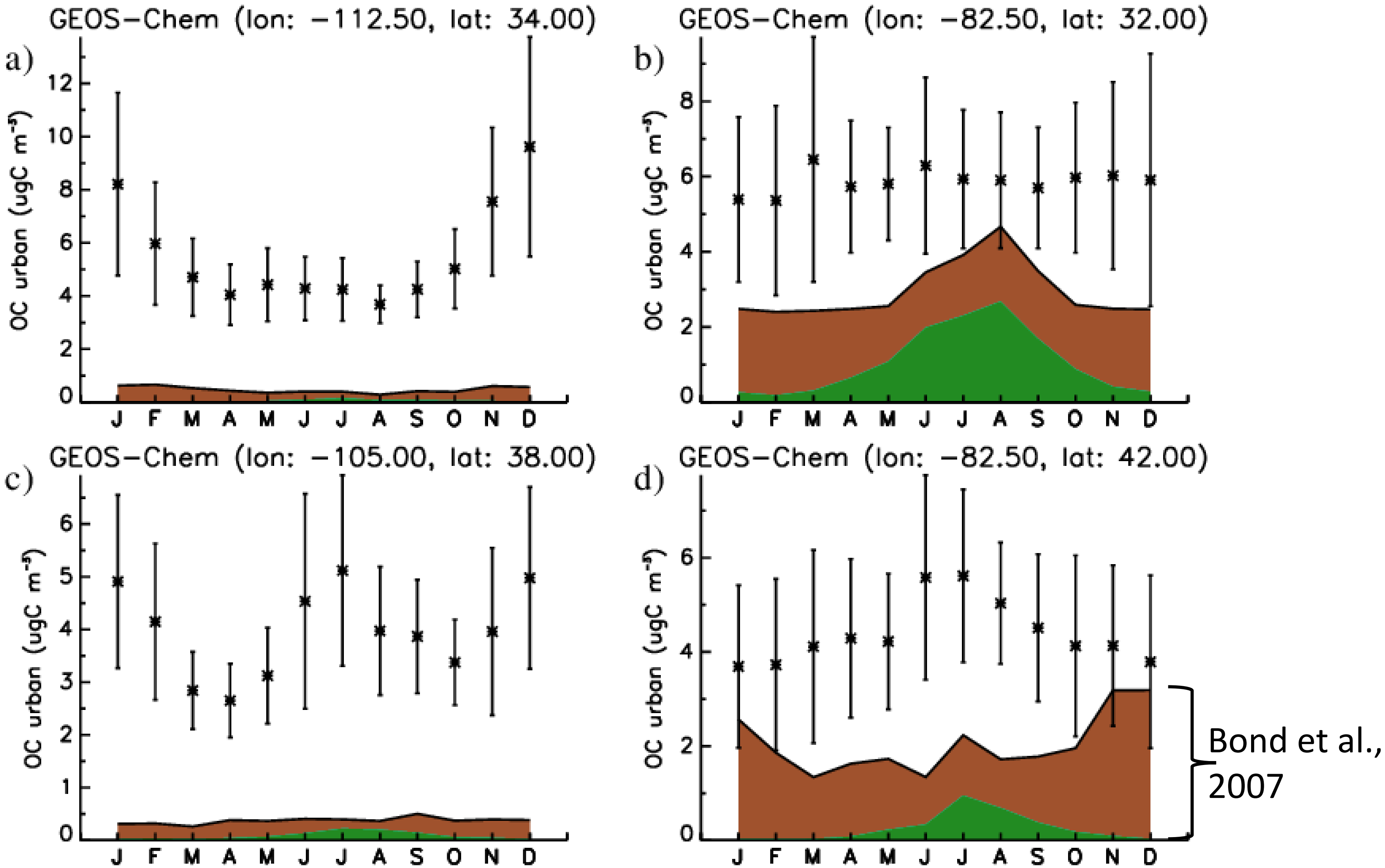



SOA production +50%

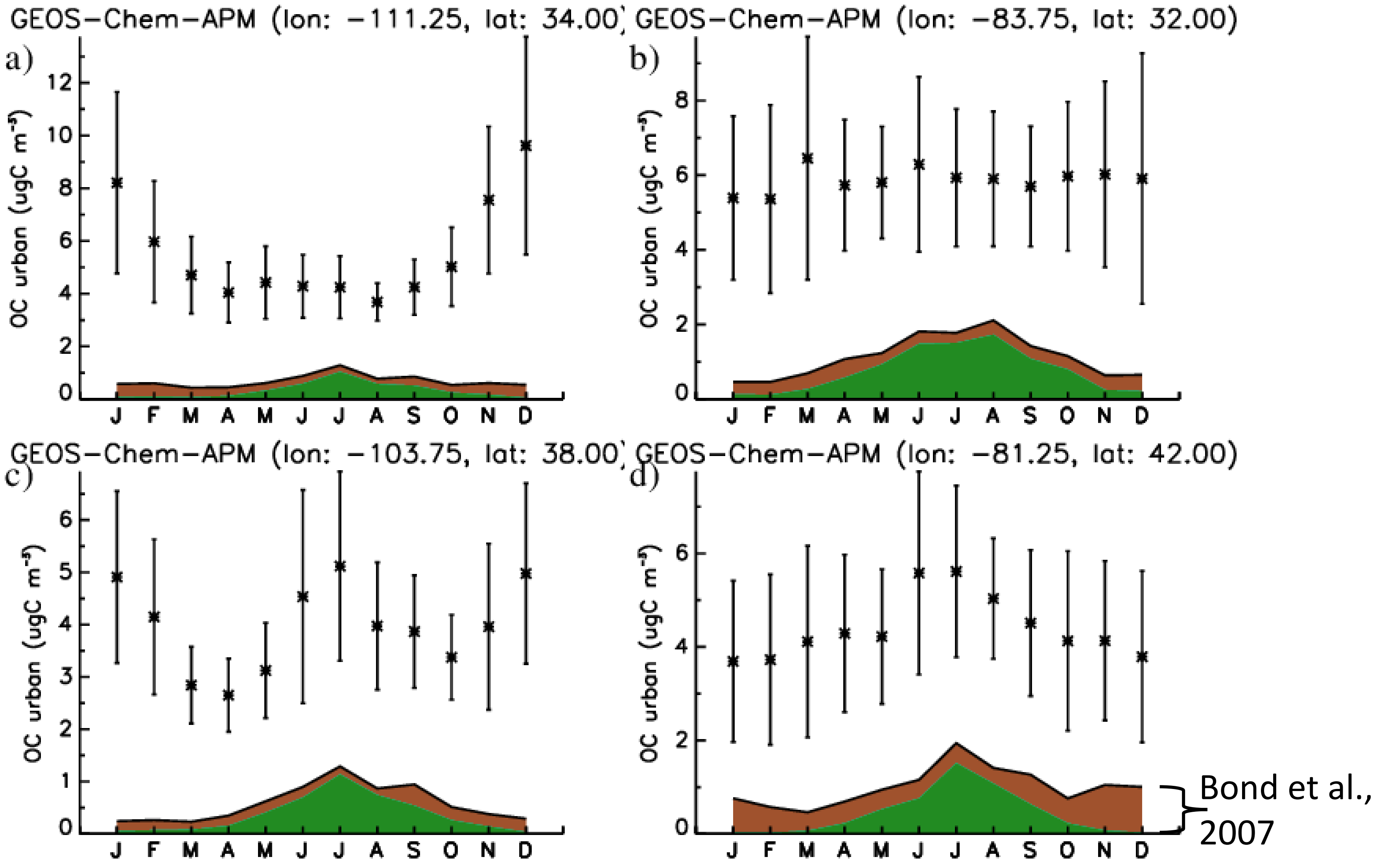
# US urban stations



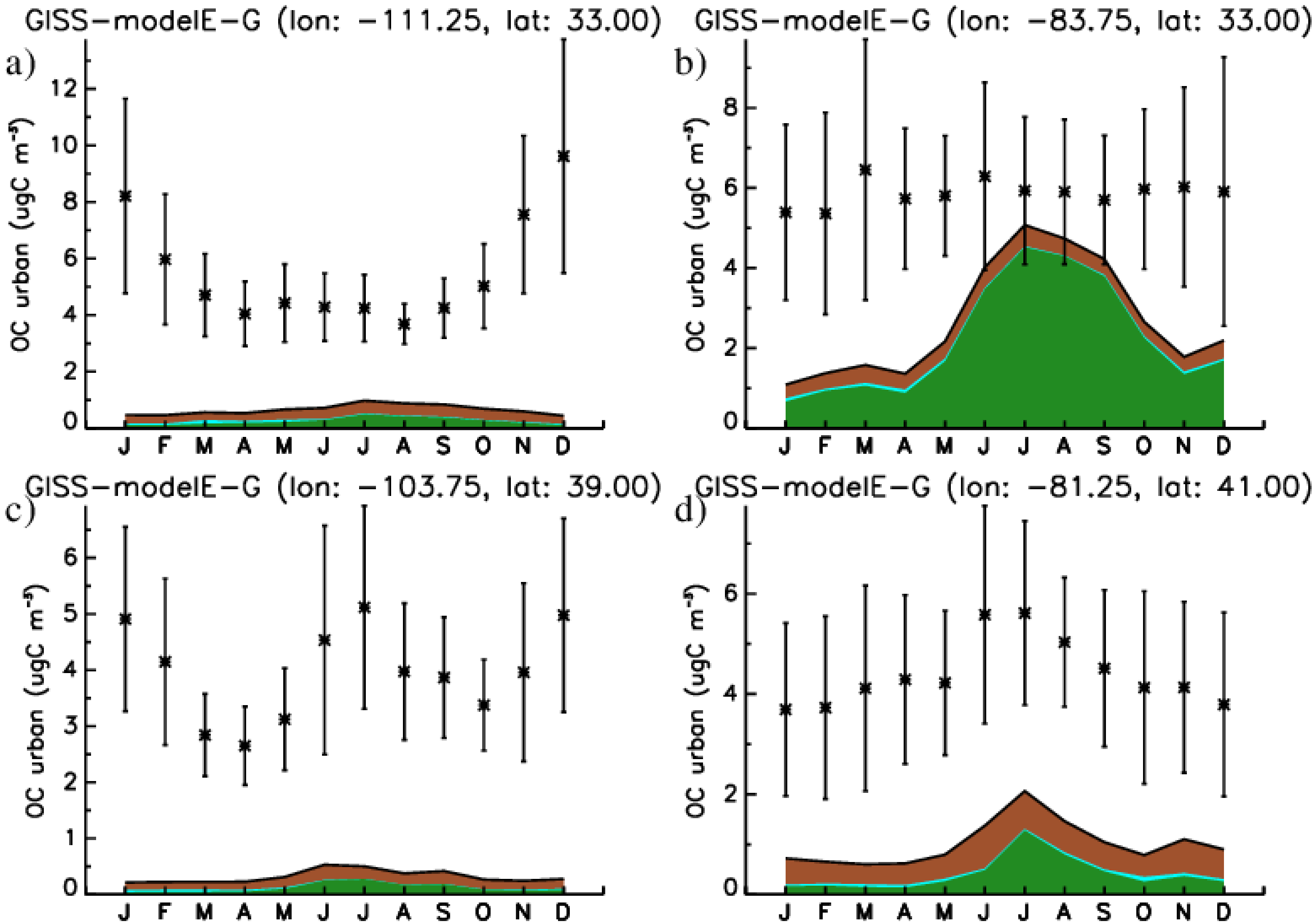
# US urban stations



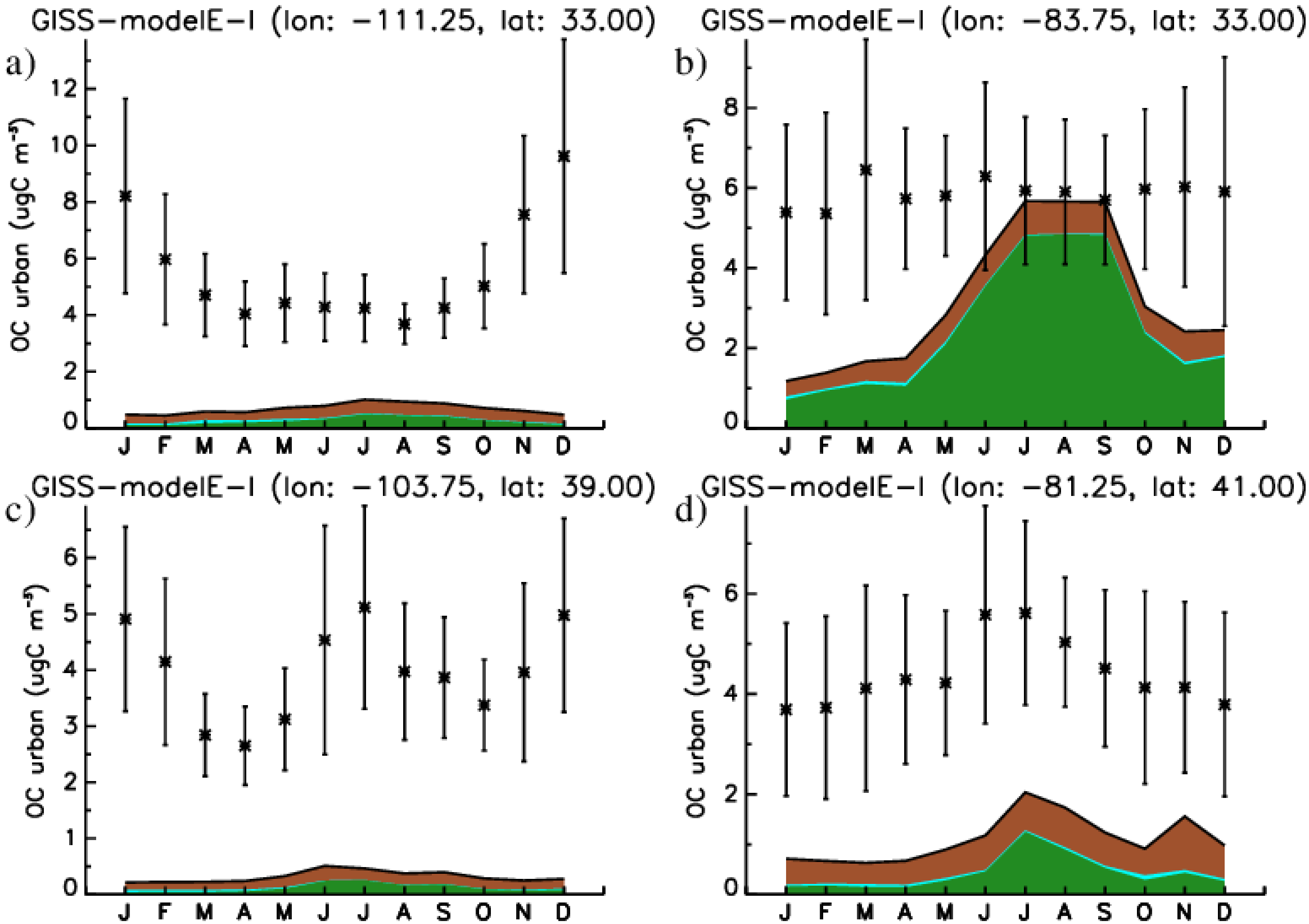
# US urban stations



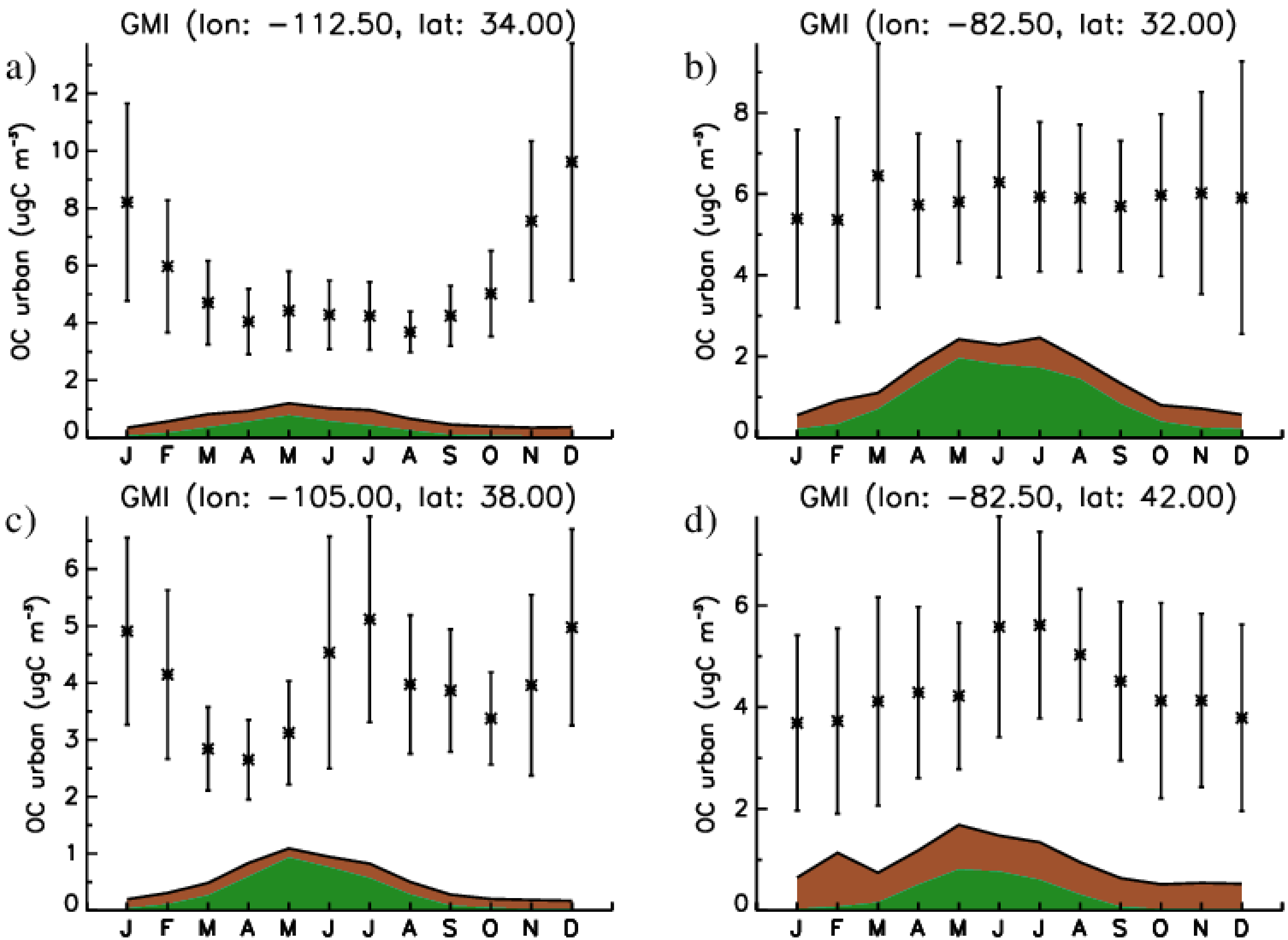
# US urban stations



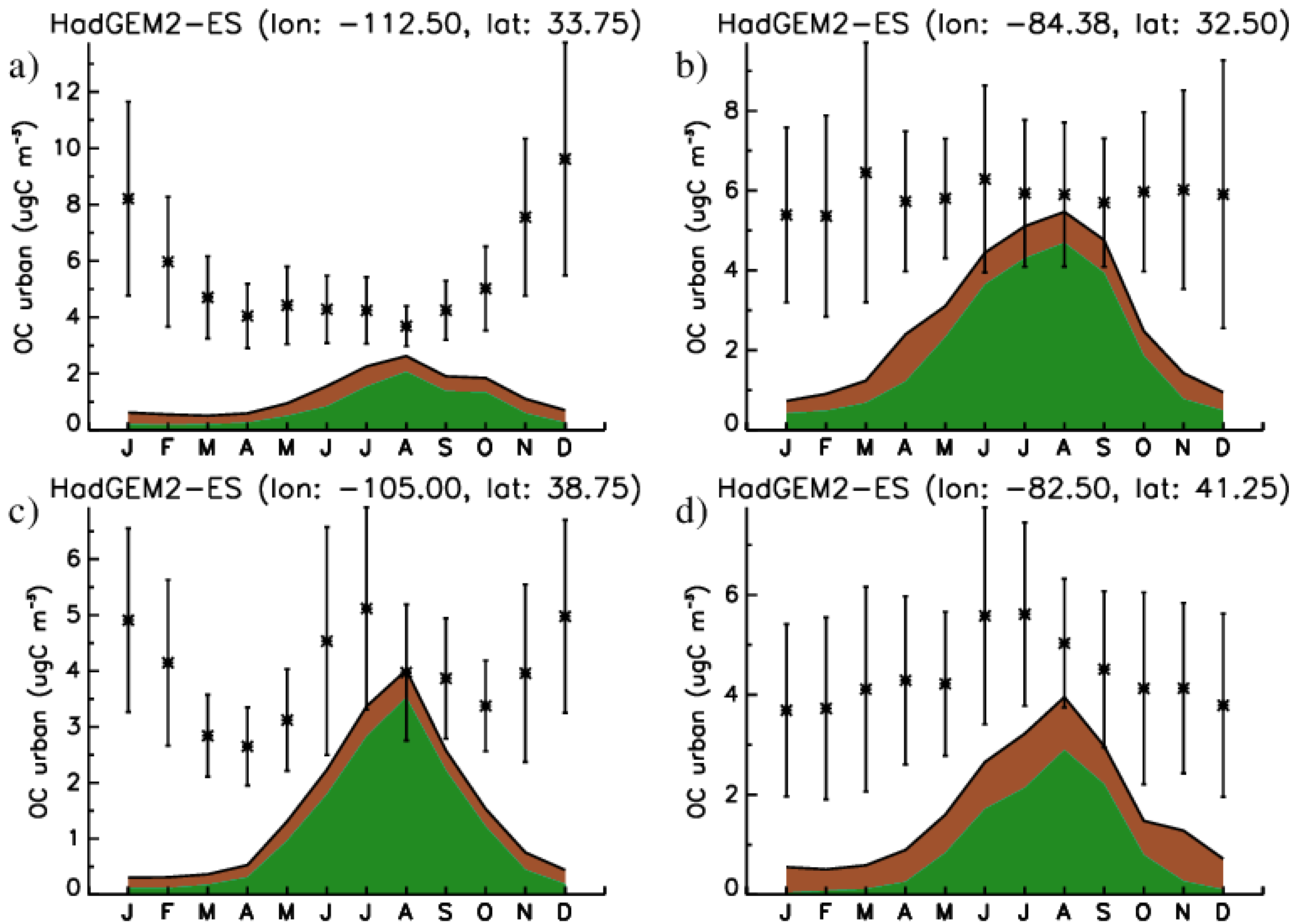
# US urban stations



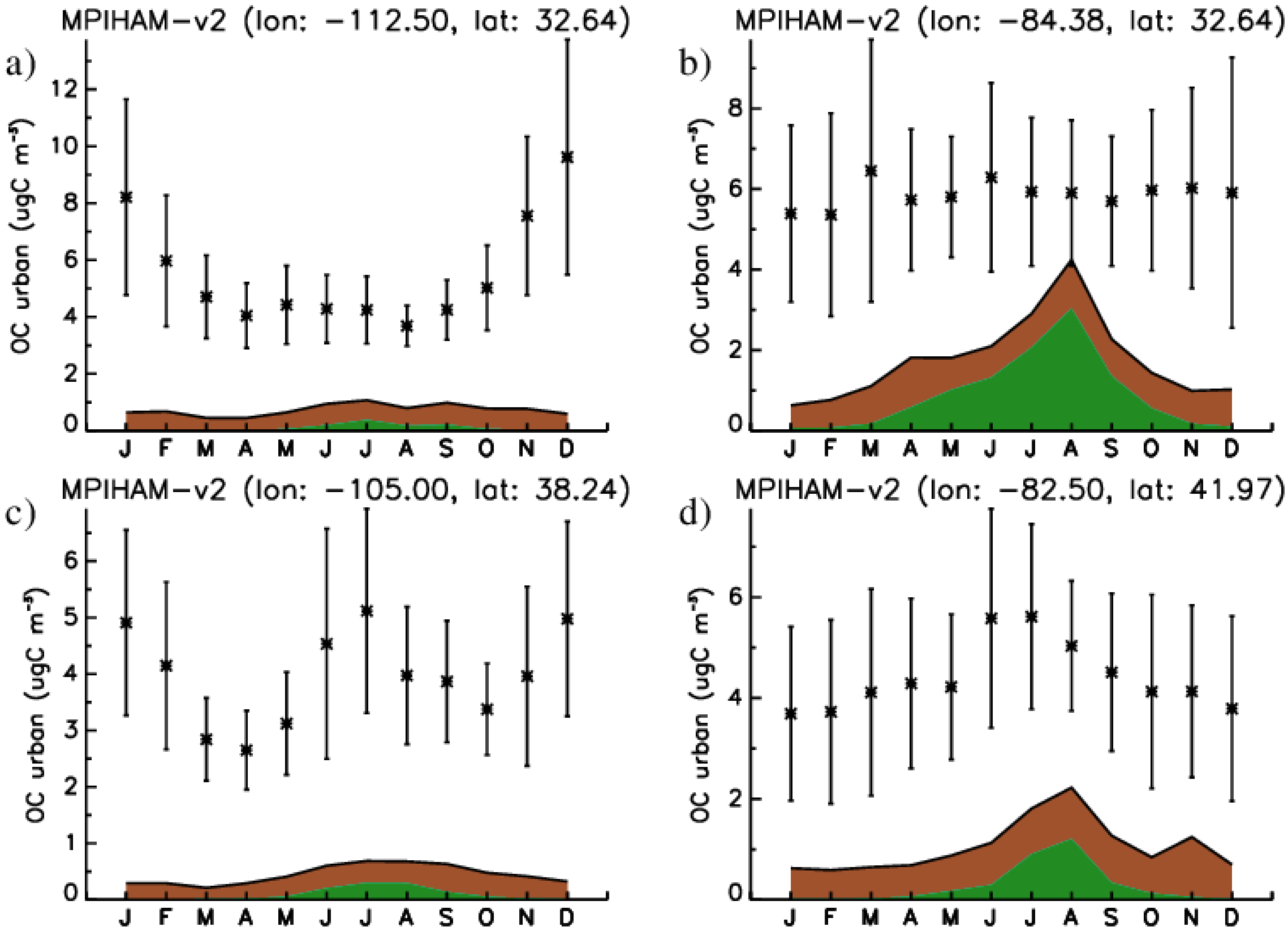
# US urban stations



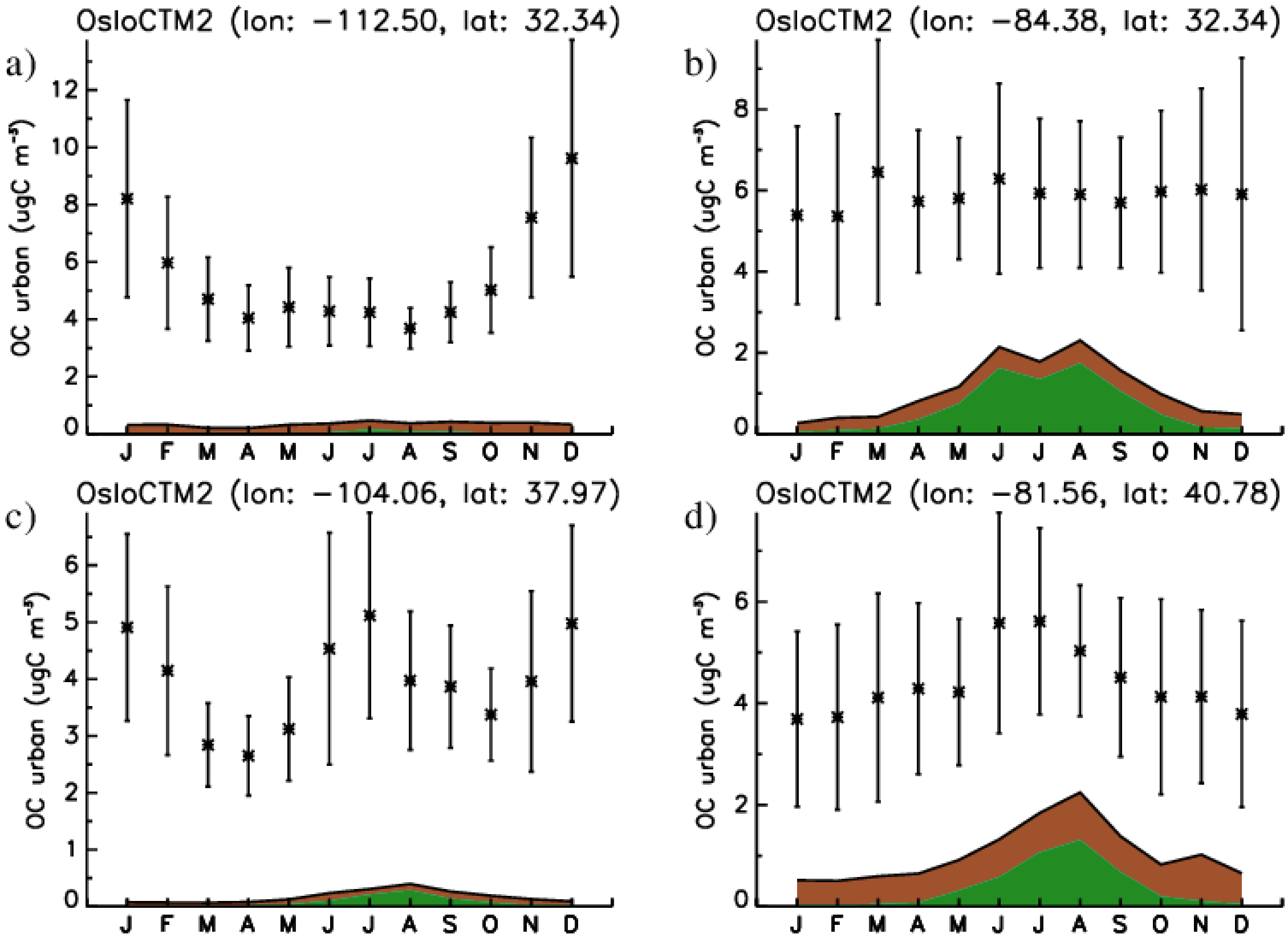
# US urban stations



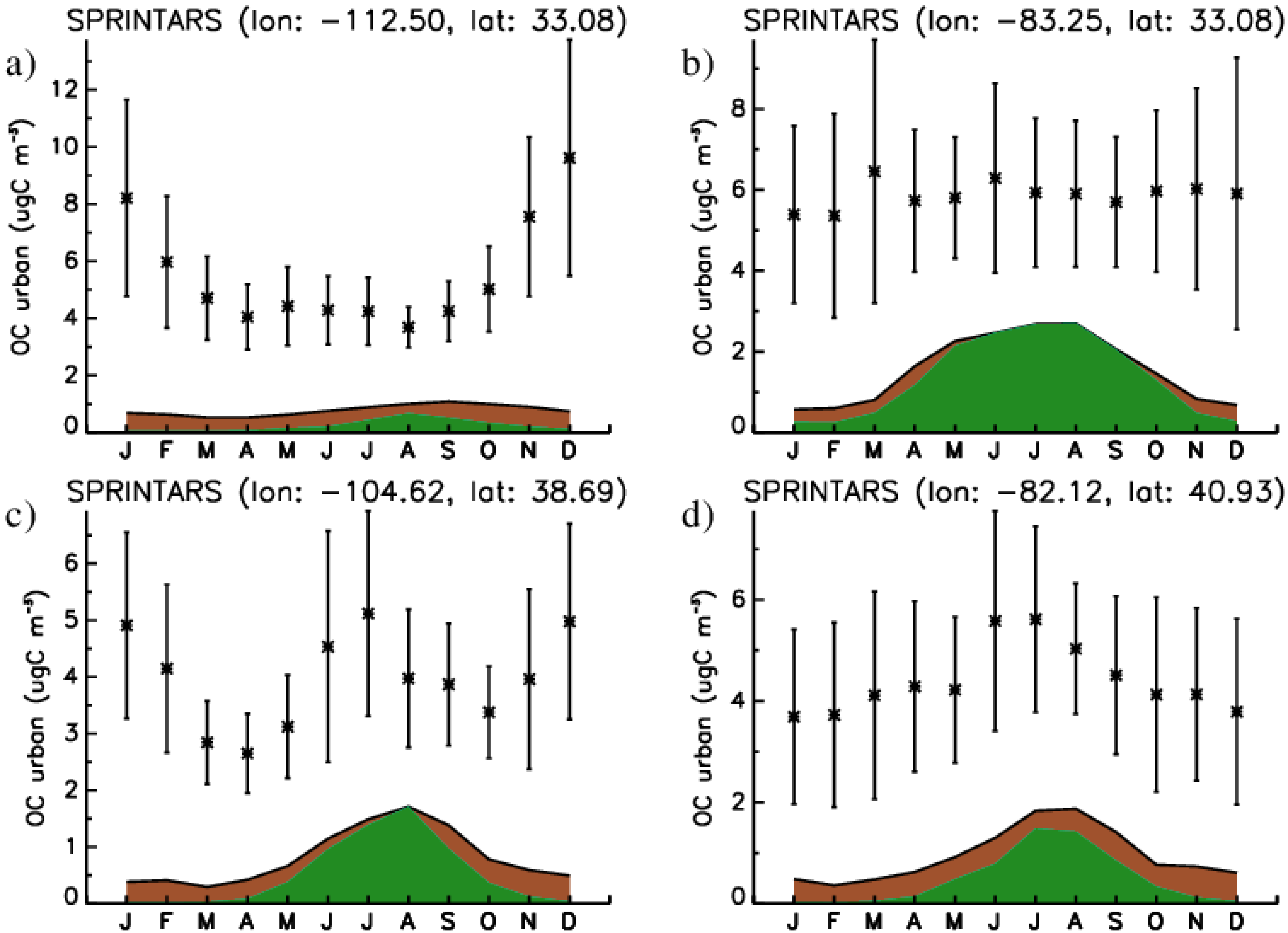
# US urban stations



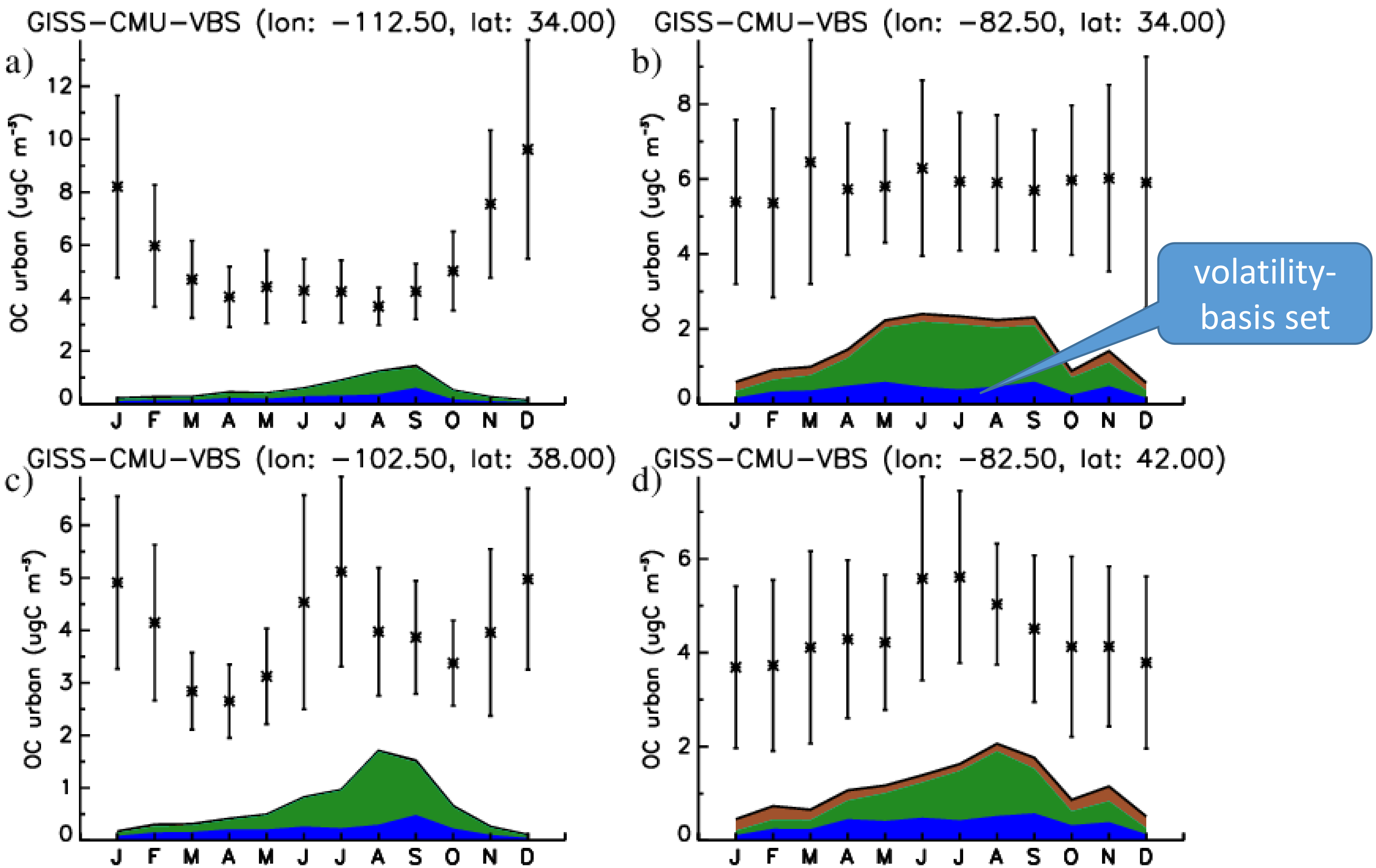
# US urban stations



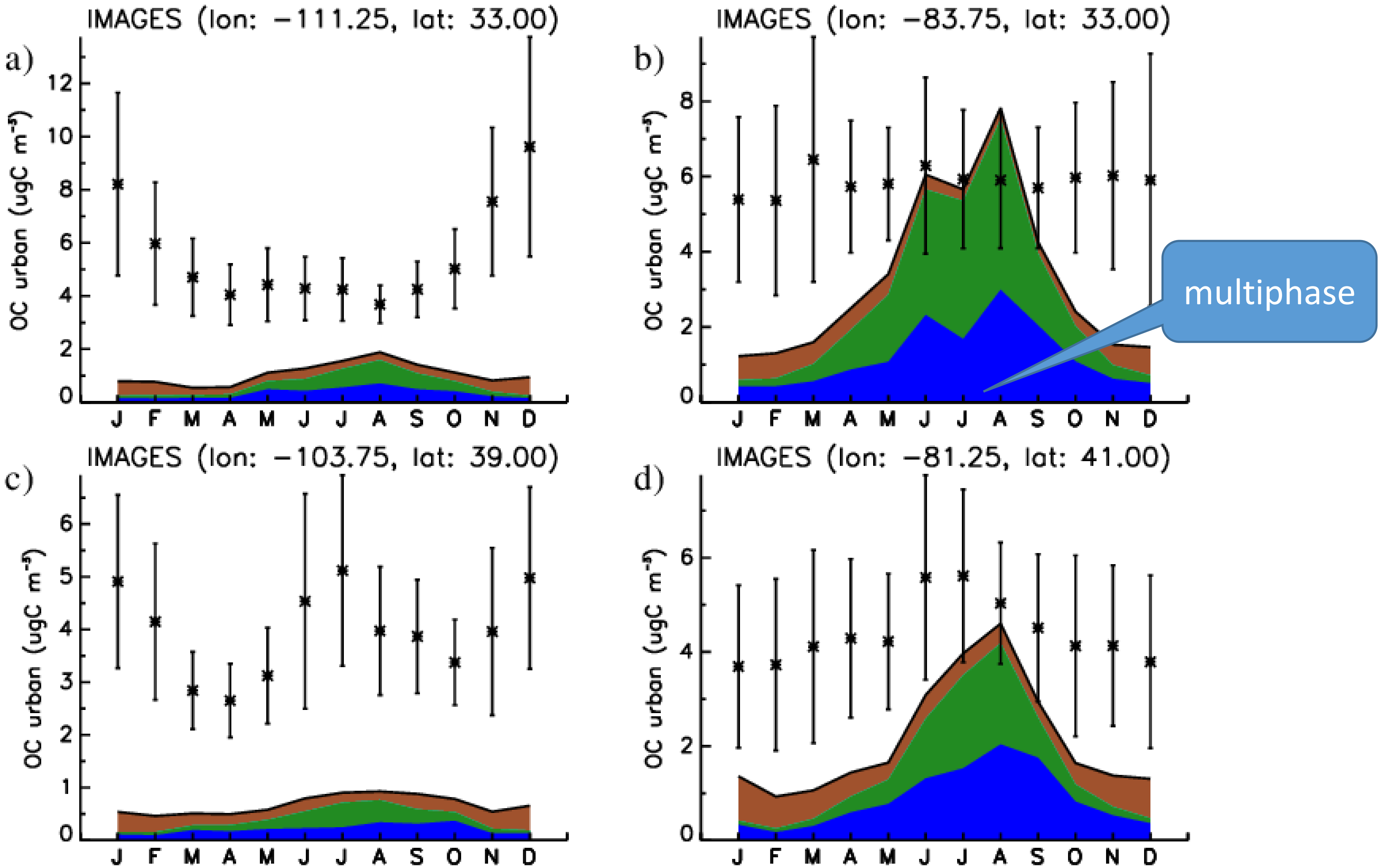
# US urban stations



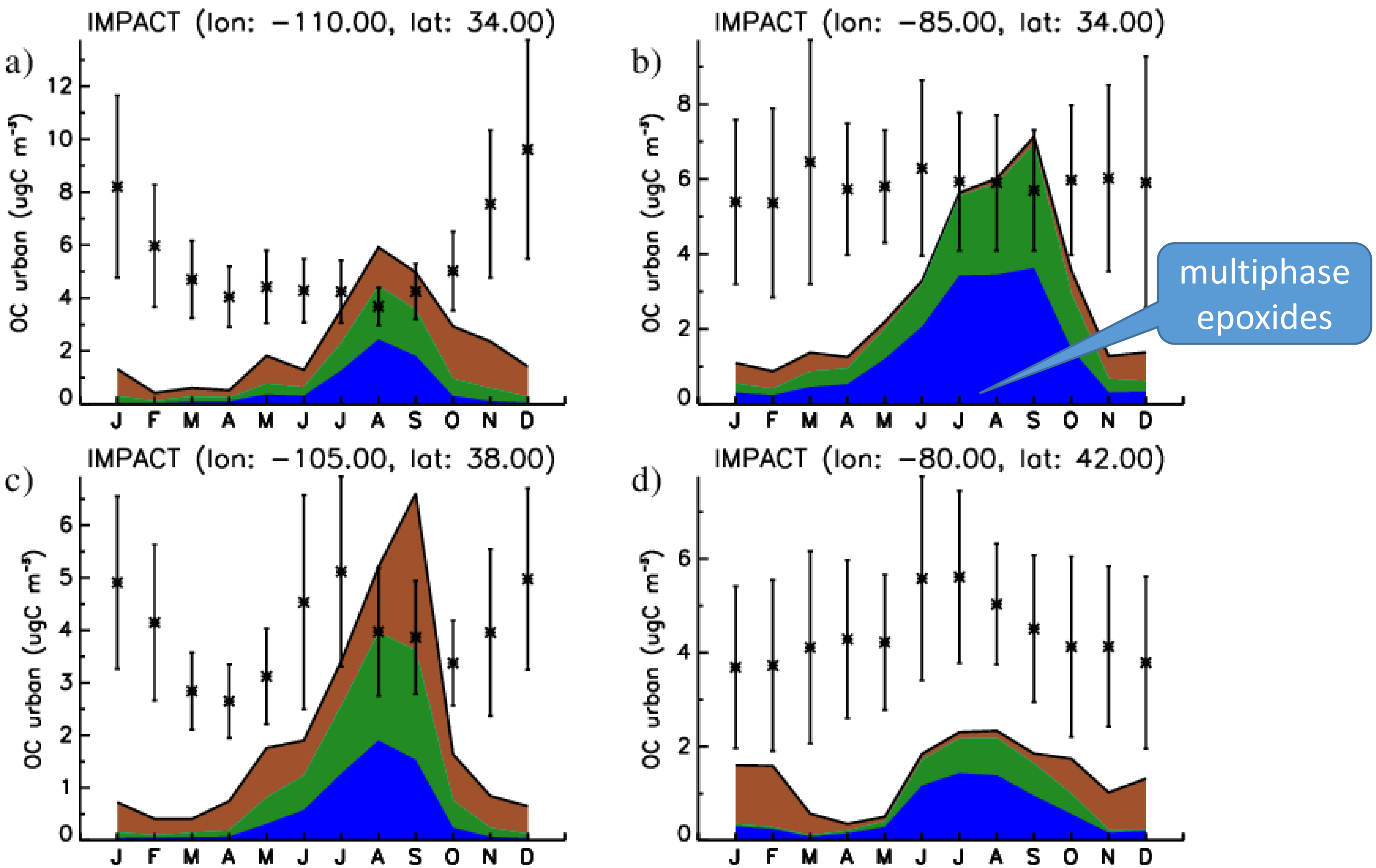
# US urban stations



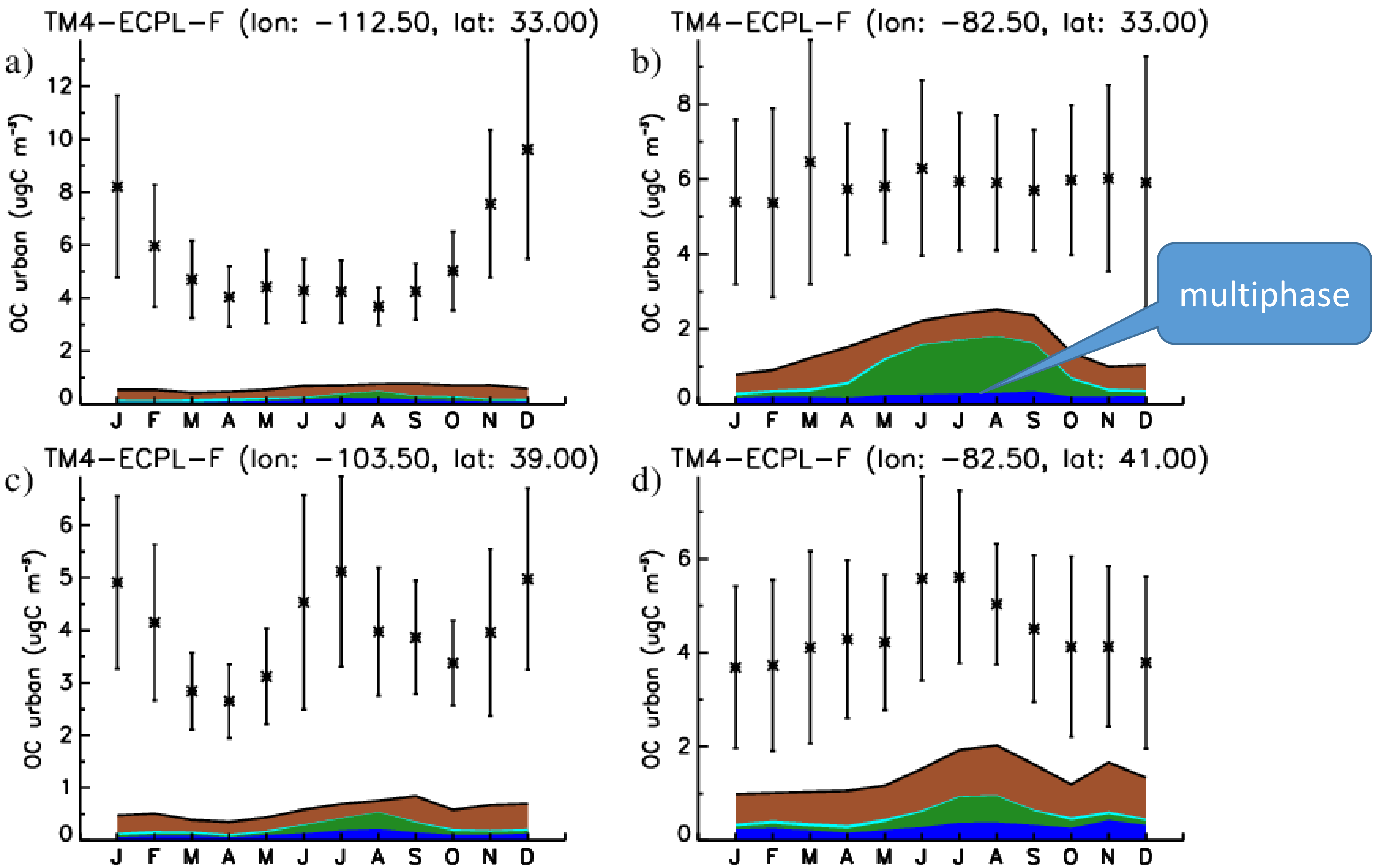
# US urban stations



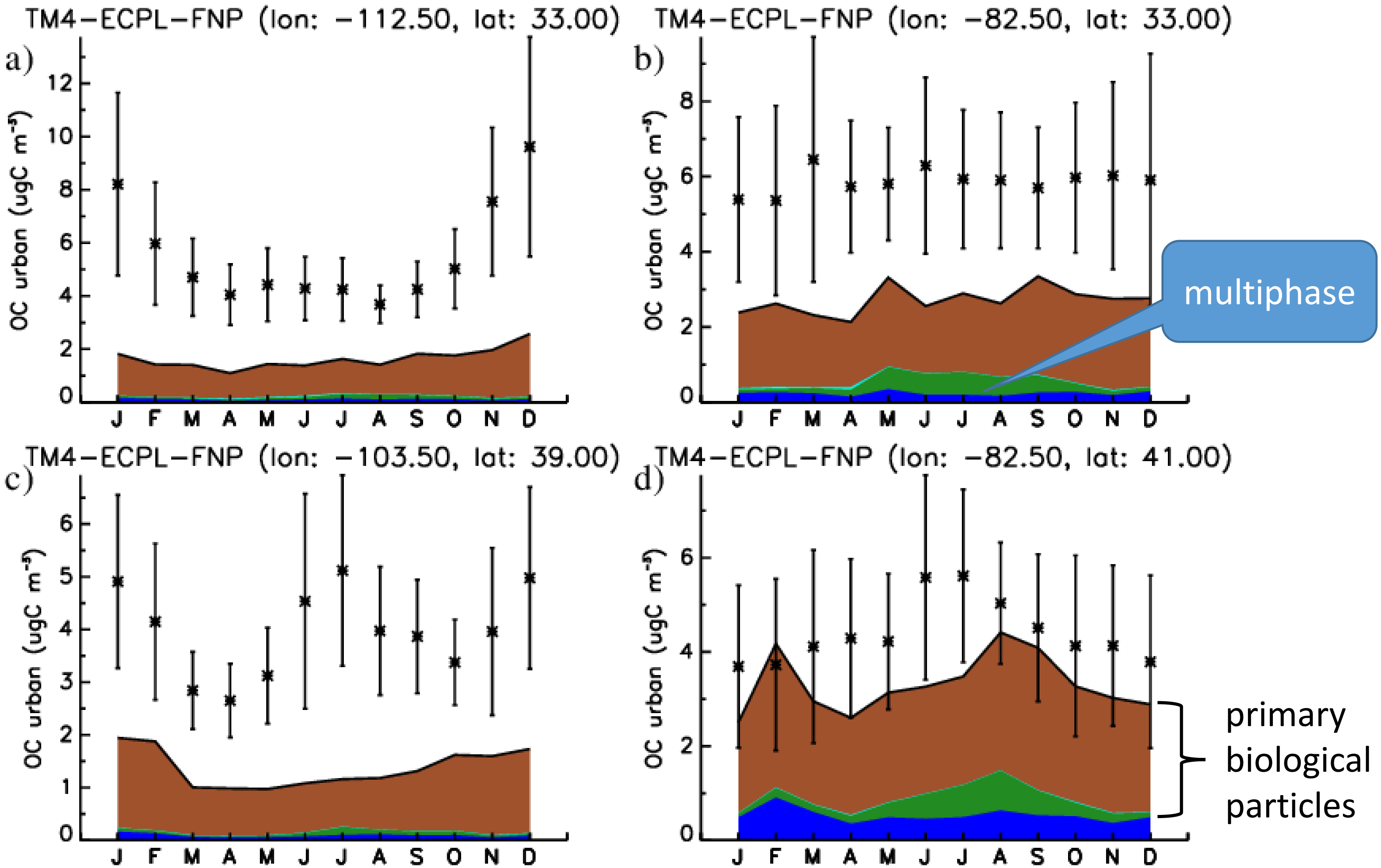
# US urban stations



# US urban stations

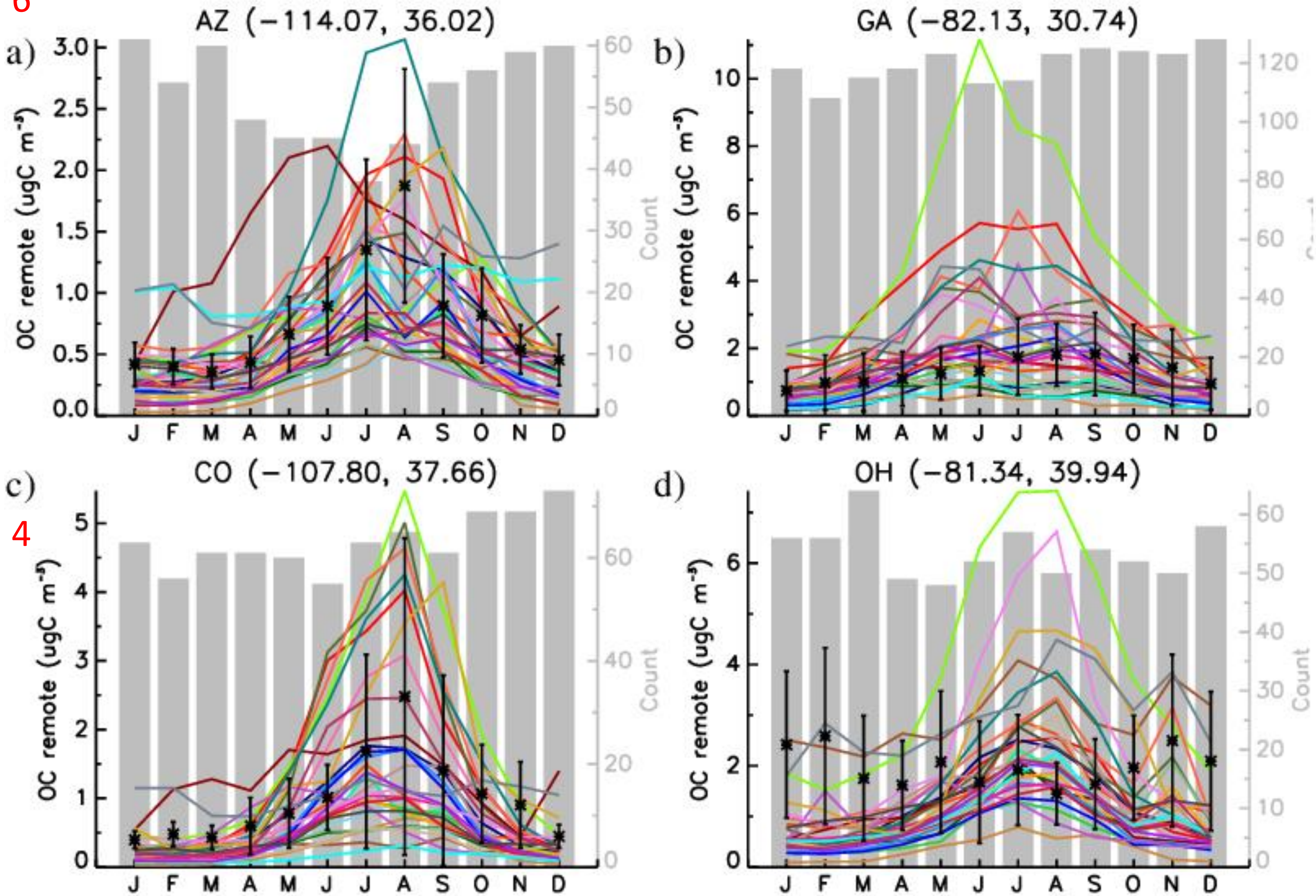


# US urban stations



# US remote stations

Urban: 6




Urban: 4

# Conclusions

- Diversity increased since AeroCom phase I.
- Missing OA source can be either anthropogenic or biogenic.
- OA/OC assumption affects model skill; OA appears to be better compared with measurements.

- More data are needed, spatial coverage still poor.

- more to come in ‘future plans’ presentation