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NO_2 measurements from GOME: Identification and Quantification of Sources

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Sources of tropospheric NO_2

(Lee 1997)

source	best estimate	uncertainty
industry & traffic	23	16-30
biomass burning	8.5	4-16
soil emissions	5	3-8
lightning	6.5	3-25

[Tg N / year]

one order of magnitude!

Power of satellite data

- global view
- long time series
- huge amount of data (good statistics)
- new, independent approach to the estimation of source strengths

So: what do we see?

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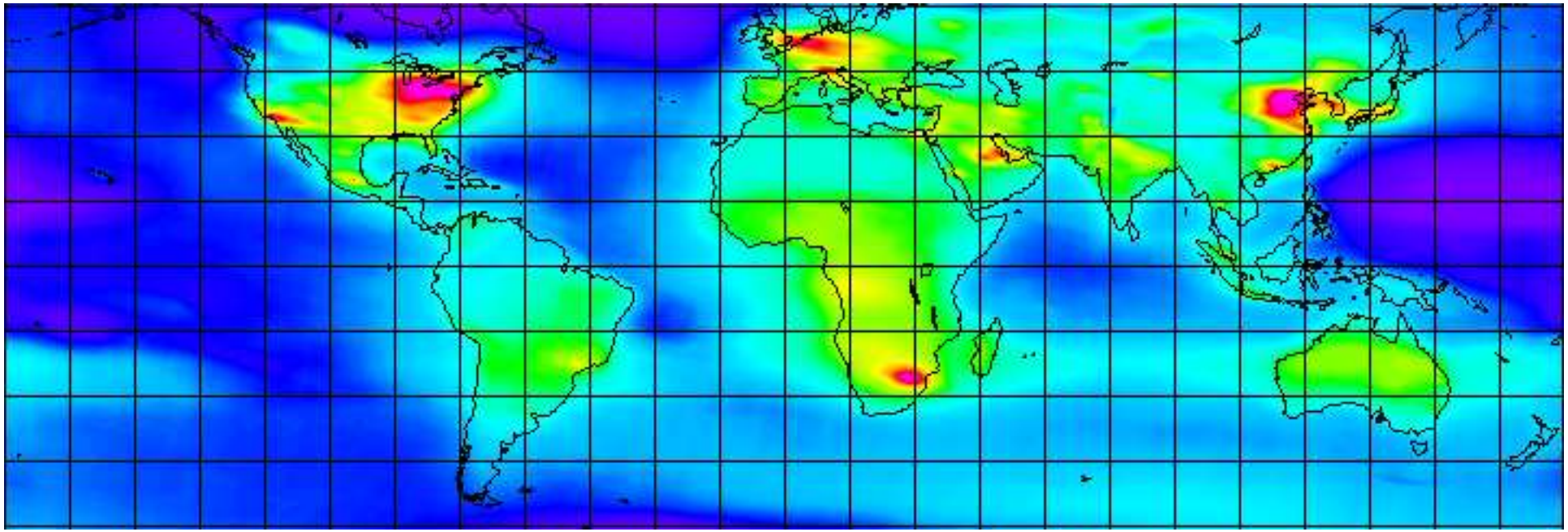
Tropospheric NO_2

GOME-Data, 1996-2001



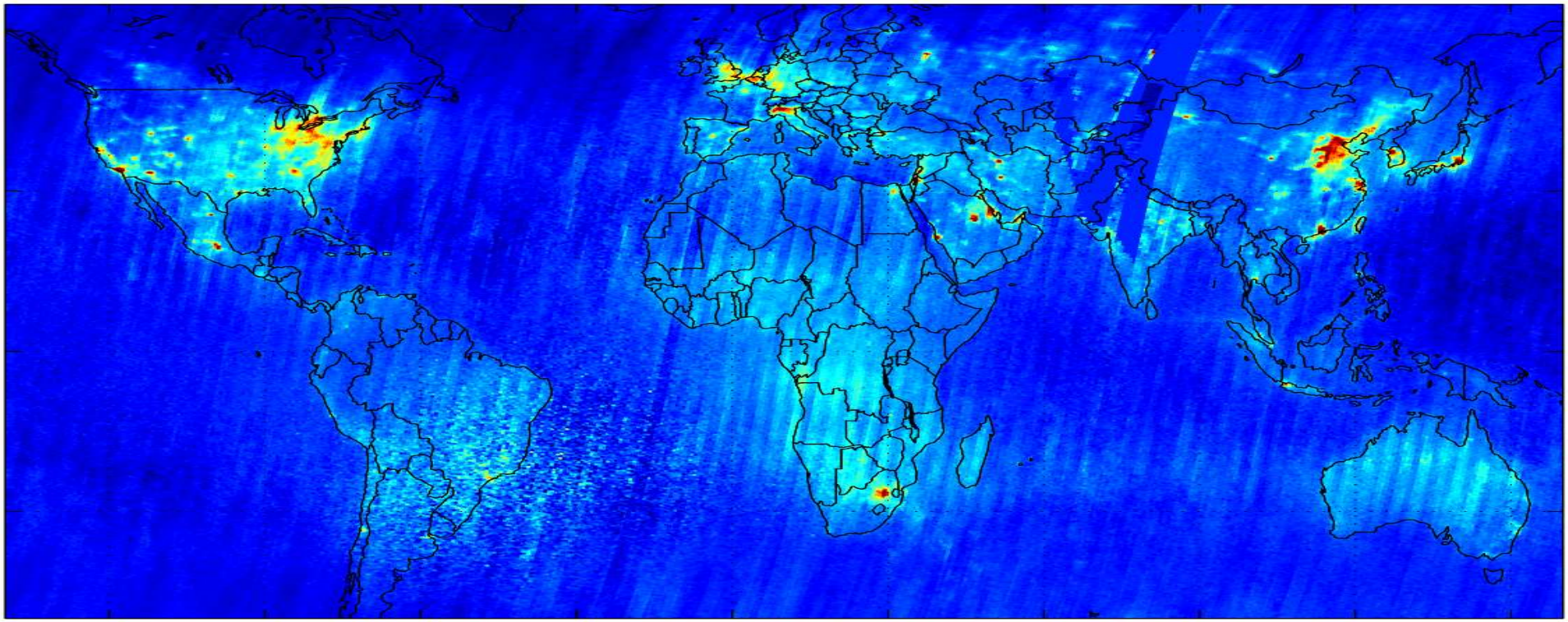
- Reference Sector Method for Estimation of Stratosphere
- New Cloud Correction in work (see M. Grzegorski)

Future: SCIAMACHY

(better spatial resolution)

Presence: GOME

GOME-Data, 1996-2001, Narrow viewing mode pixels



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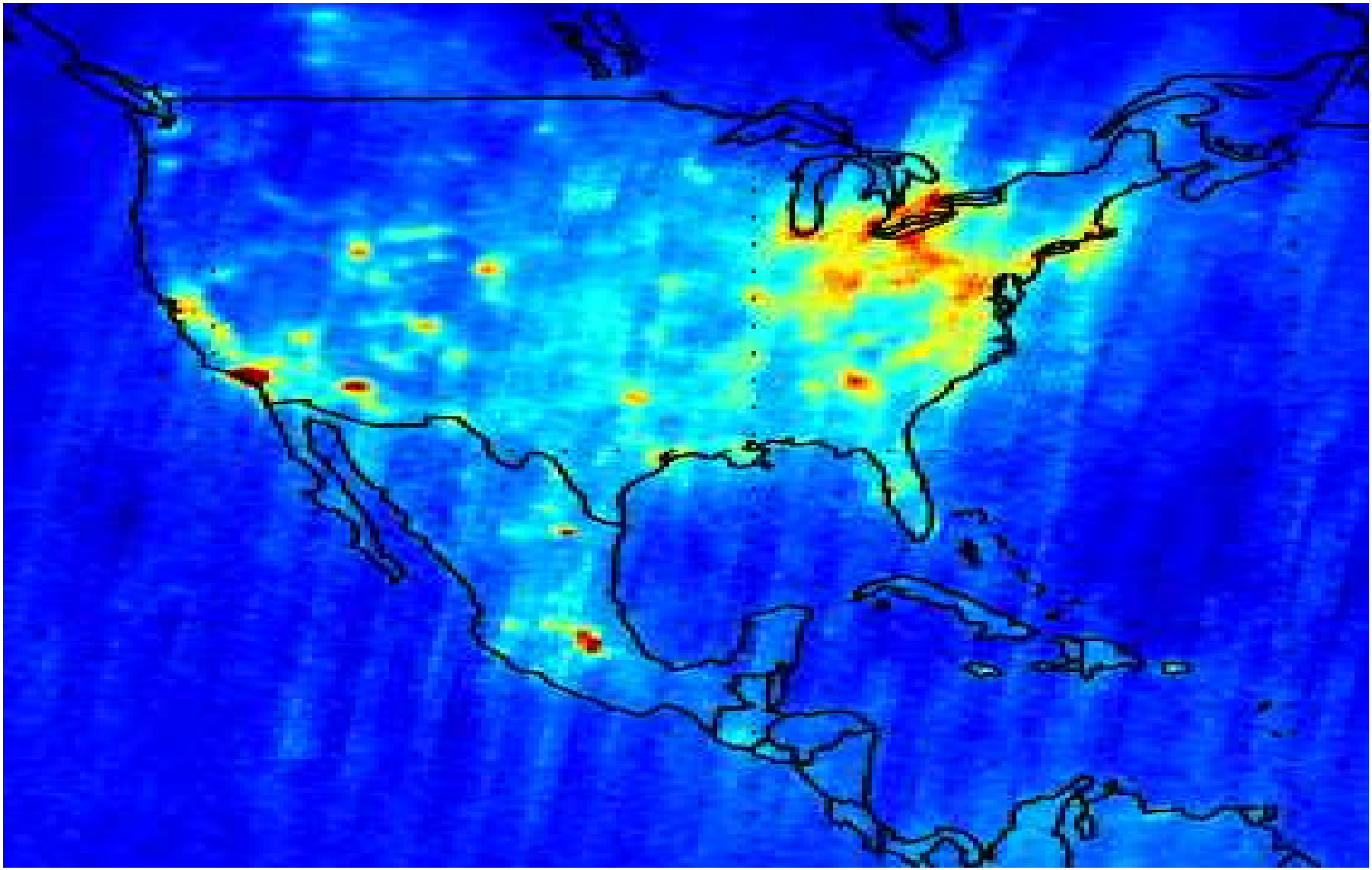

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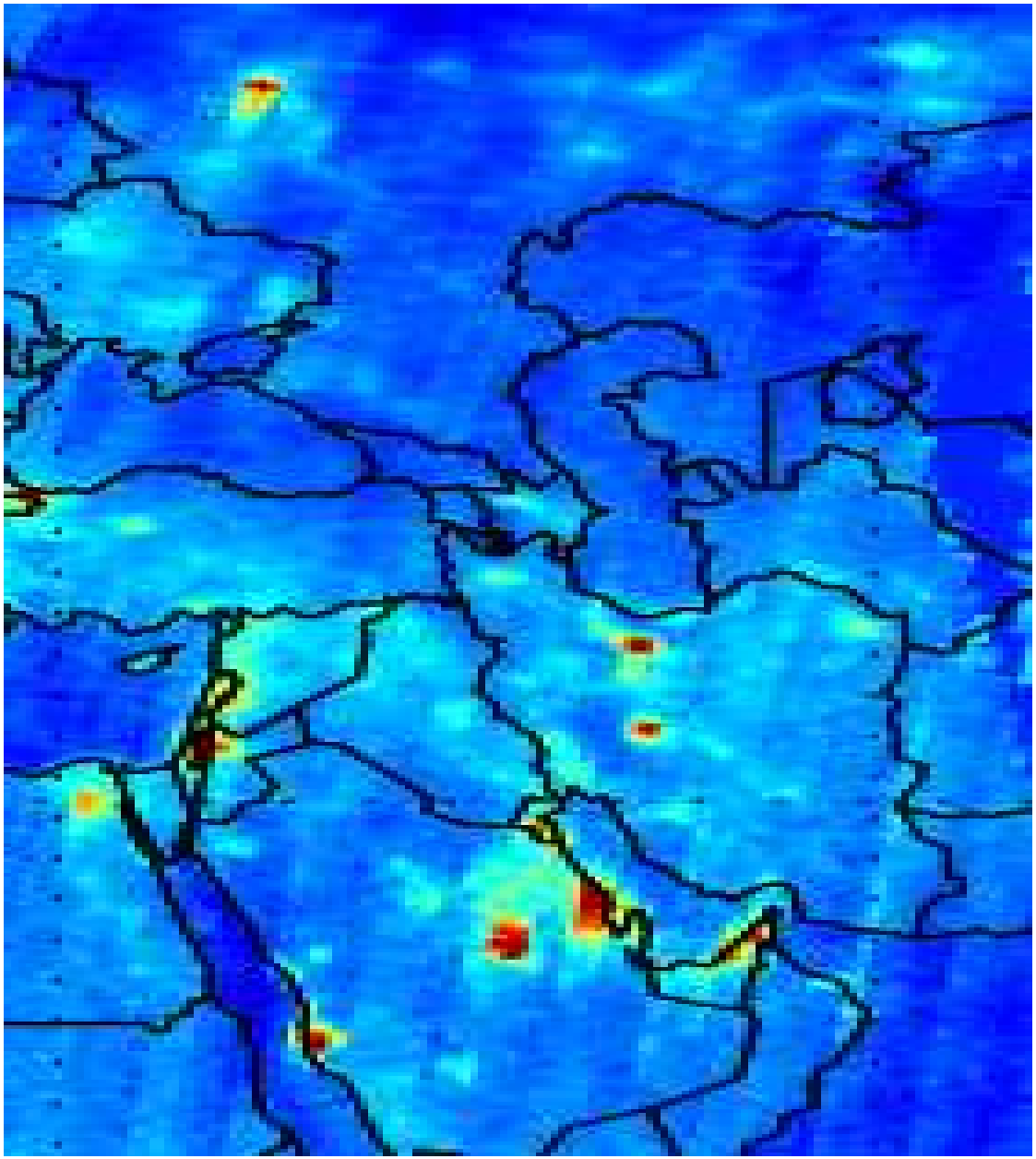

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Identification and Estimation of NO_x-Sources

1. Biomass Burning
2. Lightning
3. Anthropogenic

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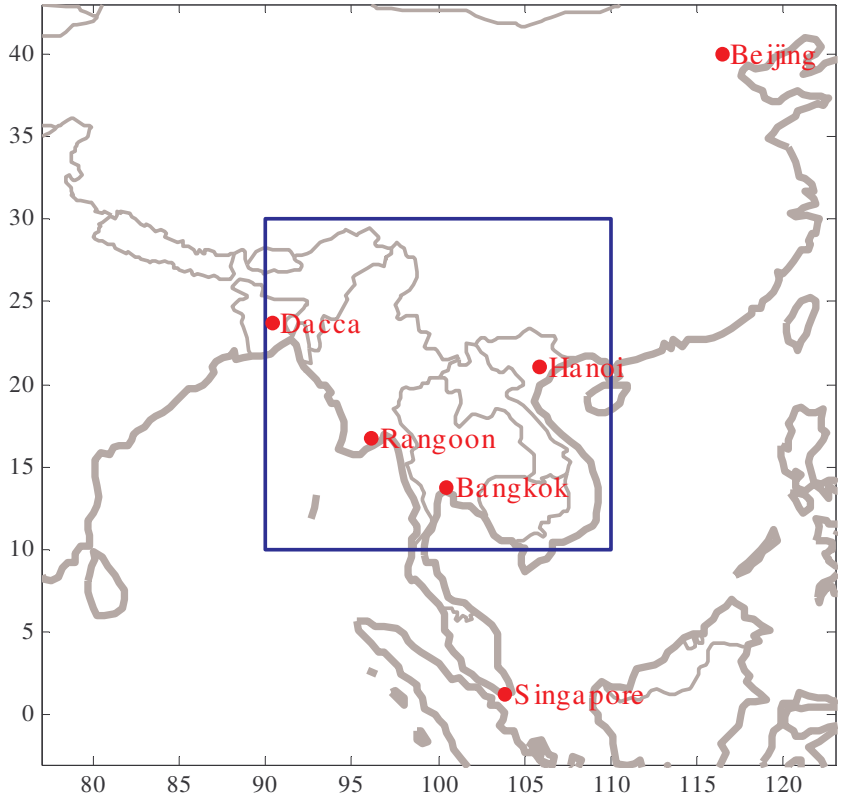
Biomass burning in South East Asia



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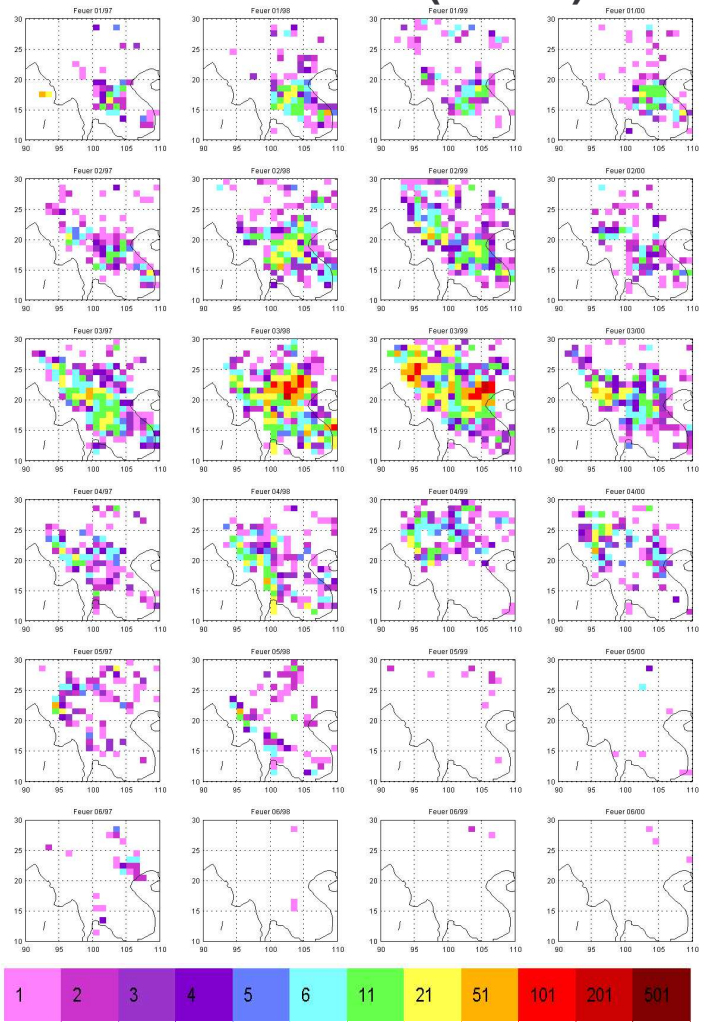
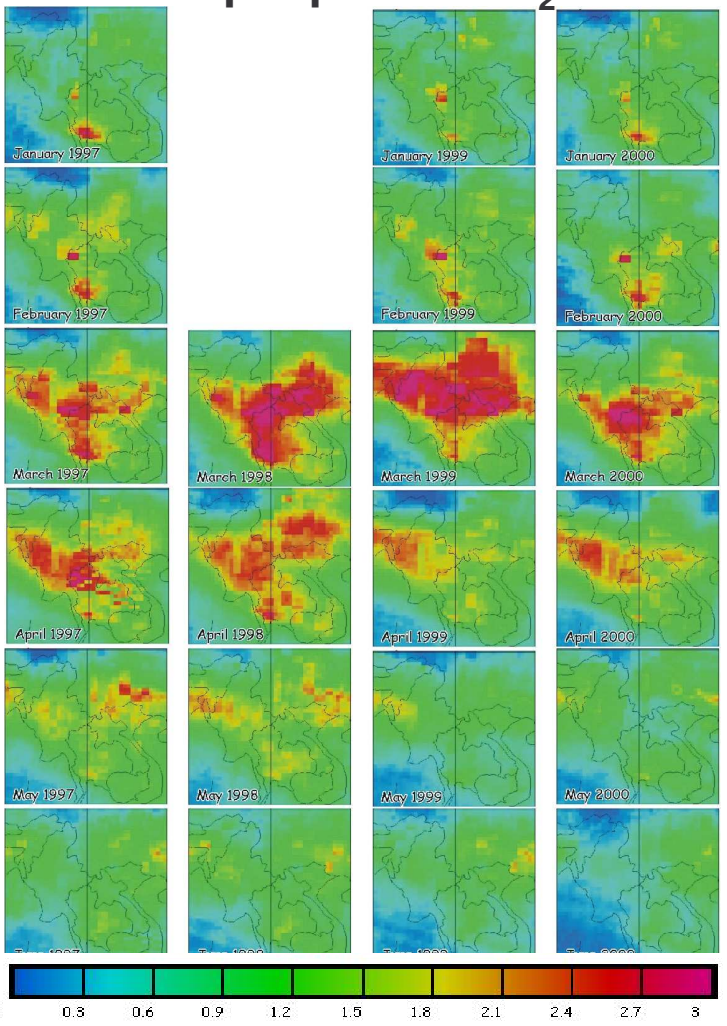
Fire counts (ATSR)



Tropospheric NO_2



$x10^{15}$ molec/cm^2

Outlook 1

- More case studies
- Combination with Transport Models

(N. Spichtinger, A. Stohl, TUM)

Identification and Estimation of NO_x-Sources

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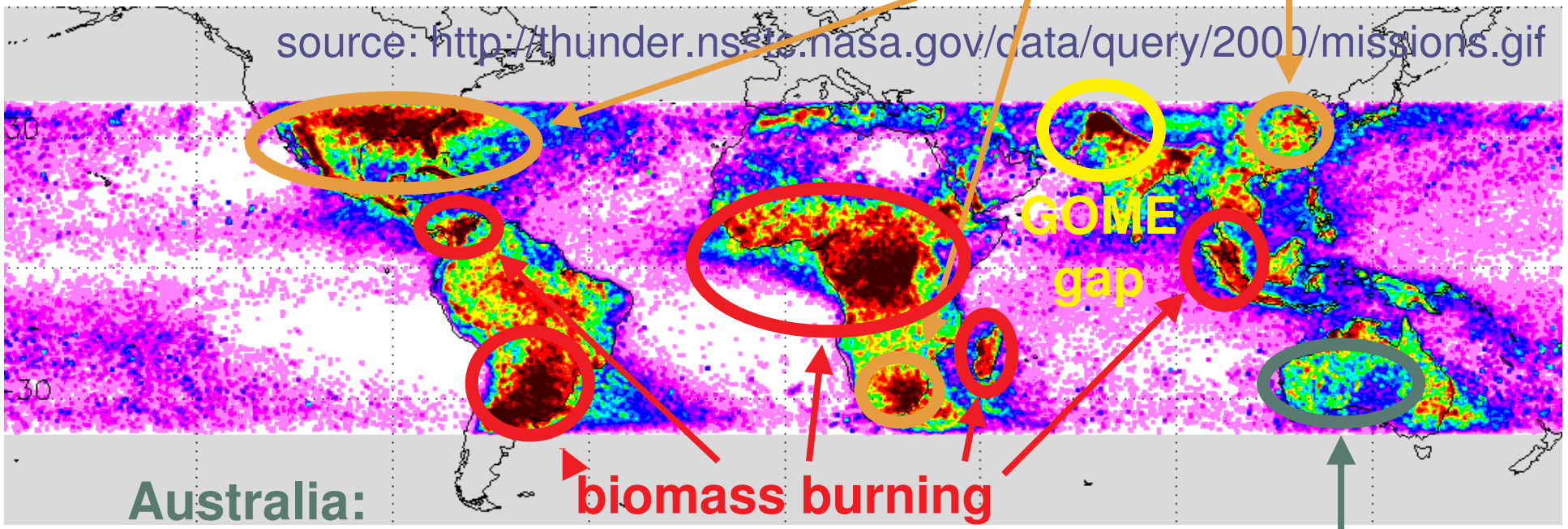
Lightning seen by LIS

Dec 1997 – Dec 2000



Australia:

- lightning
- no anthropogenic sources
- almost no biomass burning

?

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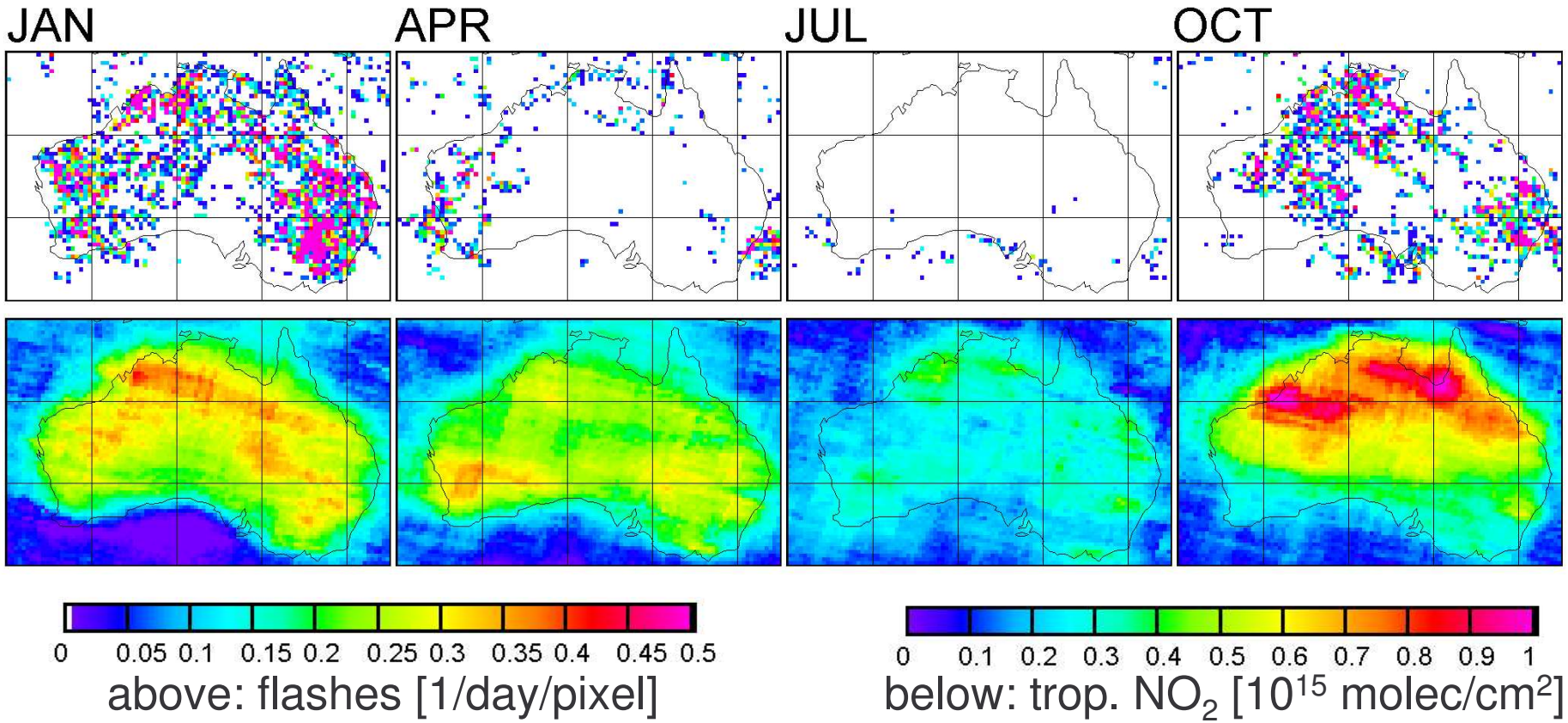
Case study 1: Lightning activity and GOME-NO_2 in Australia in 1999



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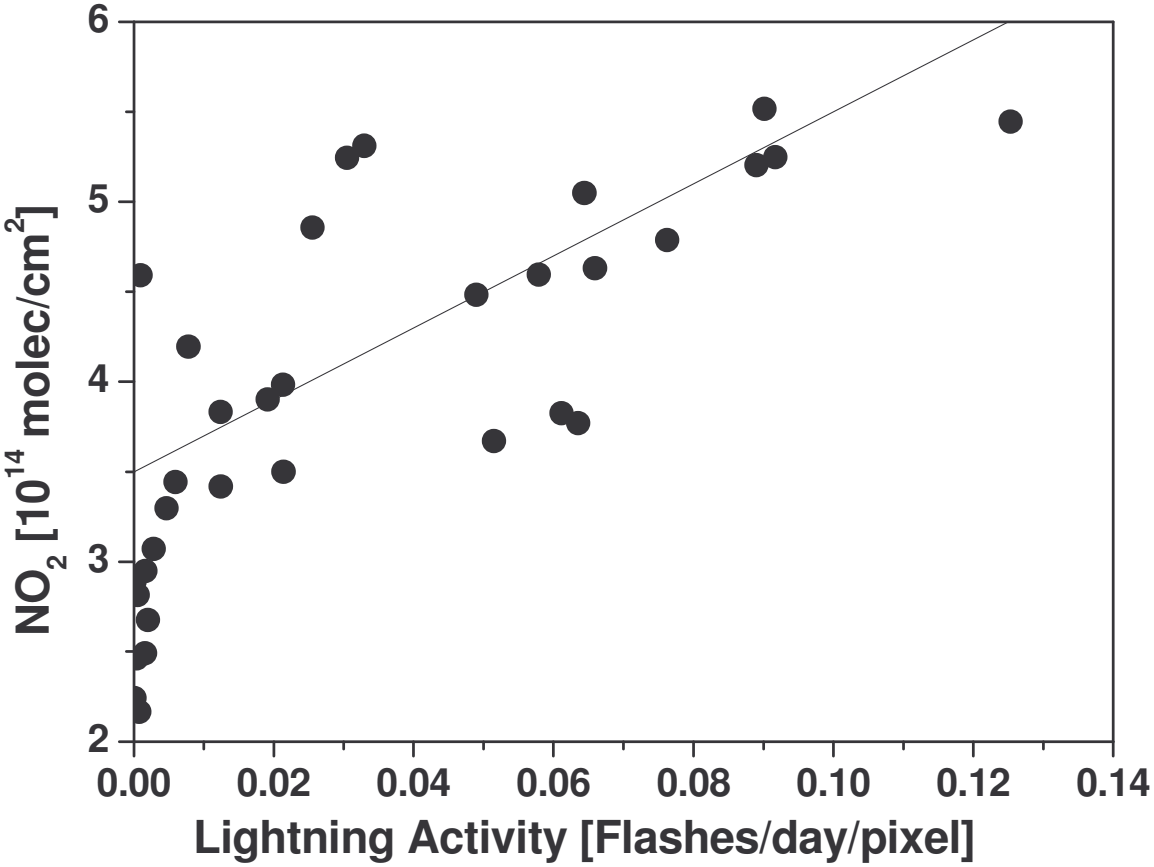
Correlation of lightning activity and tropospheric NO_2 (monthly means)



Estimation of NO_x from lightning

- lightning activity of 0.1 flashes per day and pixel
  ➔ enhancement of NO_2 by about $2*10^{14}$ molec/cm^2
- assumptions: valid for all flashes seen by LIS
  ➔ worldwide NO_x production by lightning of 5 Tg N/yr.
- additional cloud and air mass factor correction:
  ➔ higher value of factor 2 – 4 expected.
- Lee: 5 (2 – 20) Tg N/yr
  Price: 12.2 (5 – 20) Tg N/yr
  Huntrieser: 4 (0.3 – 22) Tg N/yr
  This study: ~ 10 – 20 Tg N/yr

Outlook 2

- Better time resolution (weekly means)
- Cloud- and AMF-correction
- Considering other regions

Identification and Estimation of NO_x-Sources

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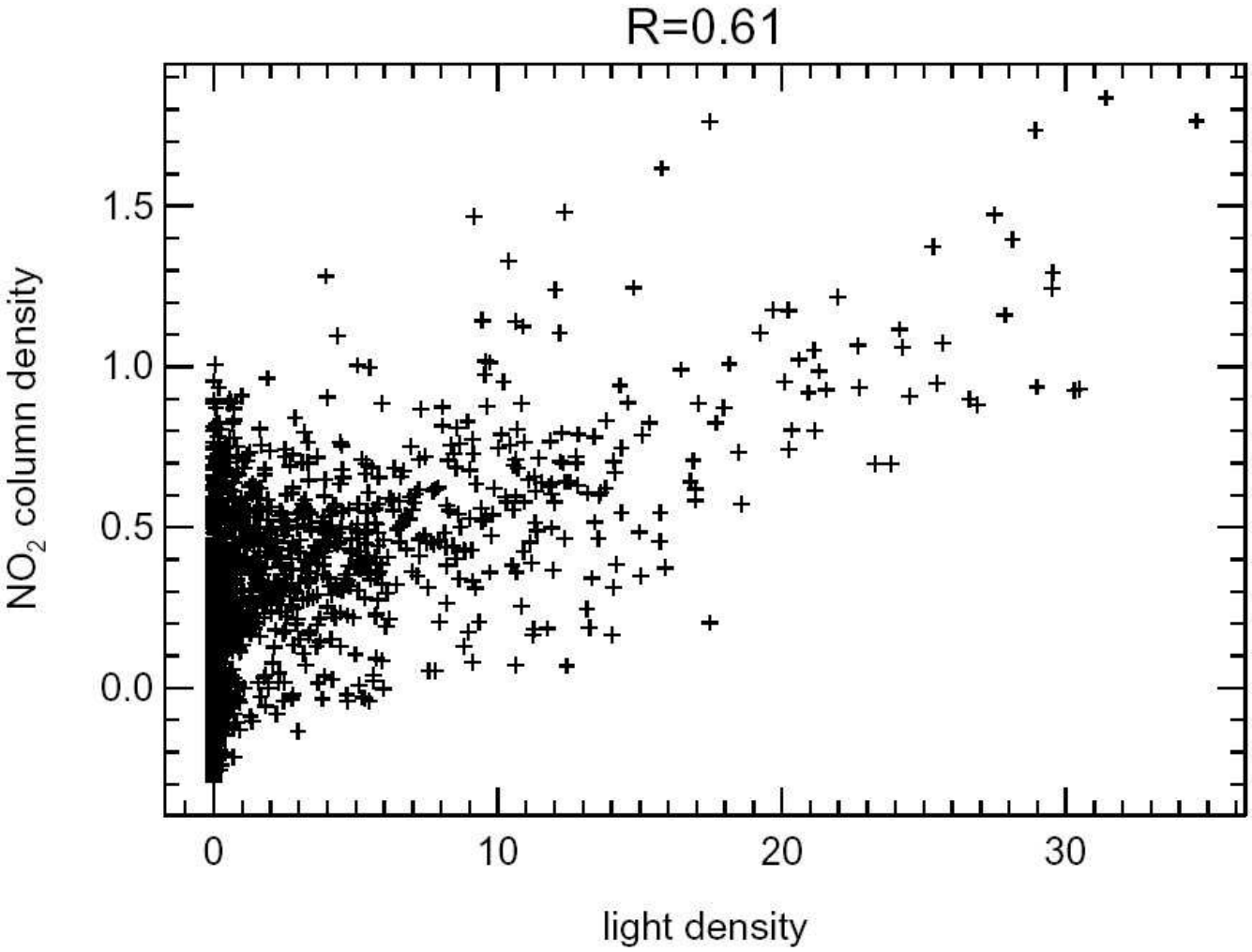
a) Light Pollution



(F. Rohrer, Jülich)

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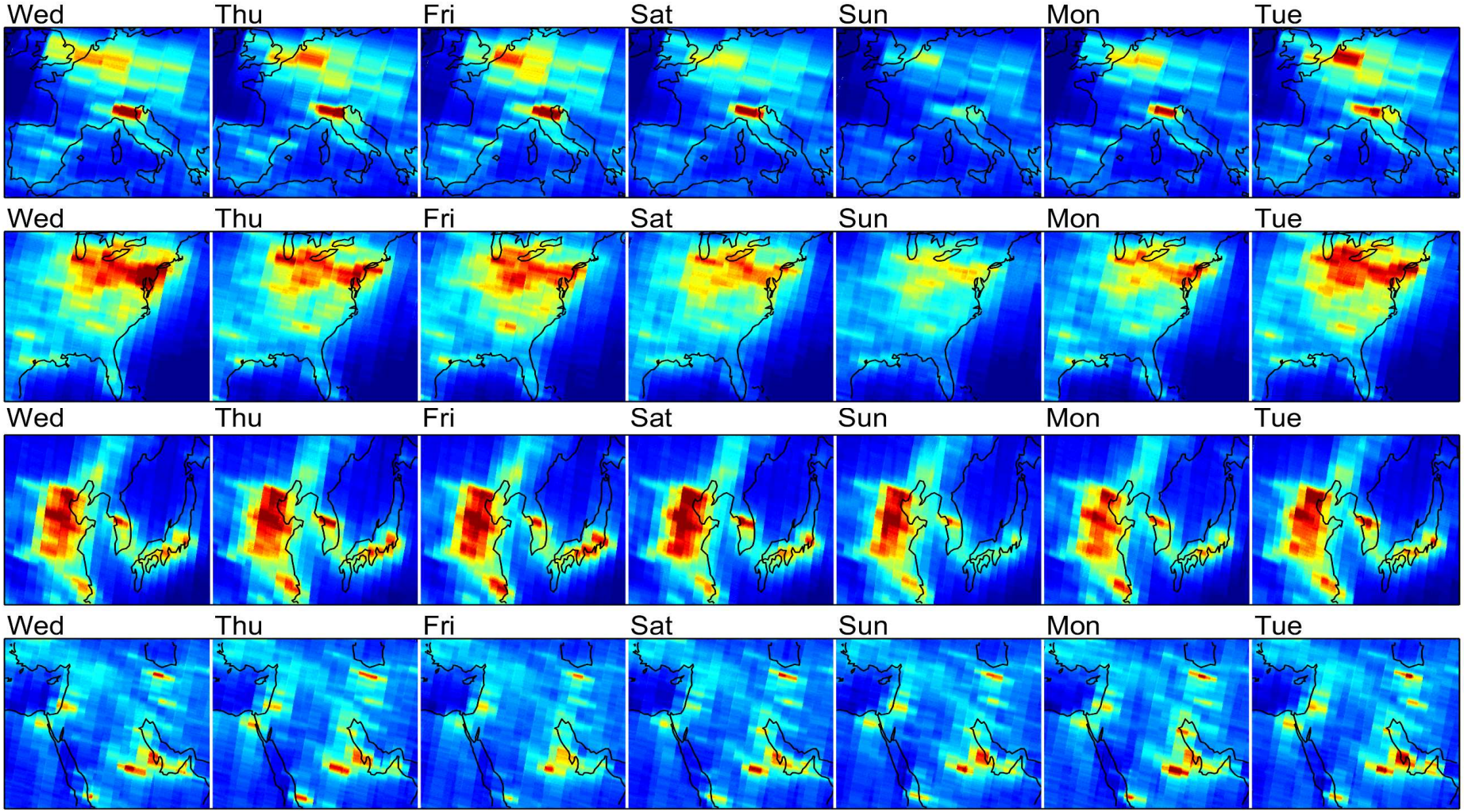
b) Weekly Cycle of NO_2 VCD



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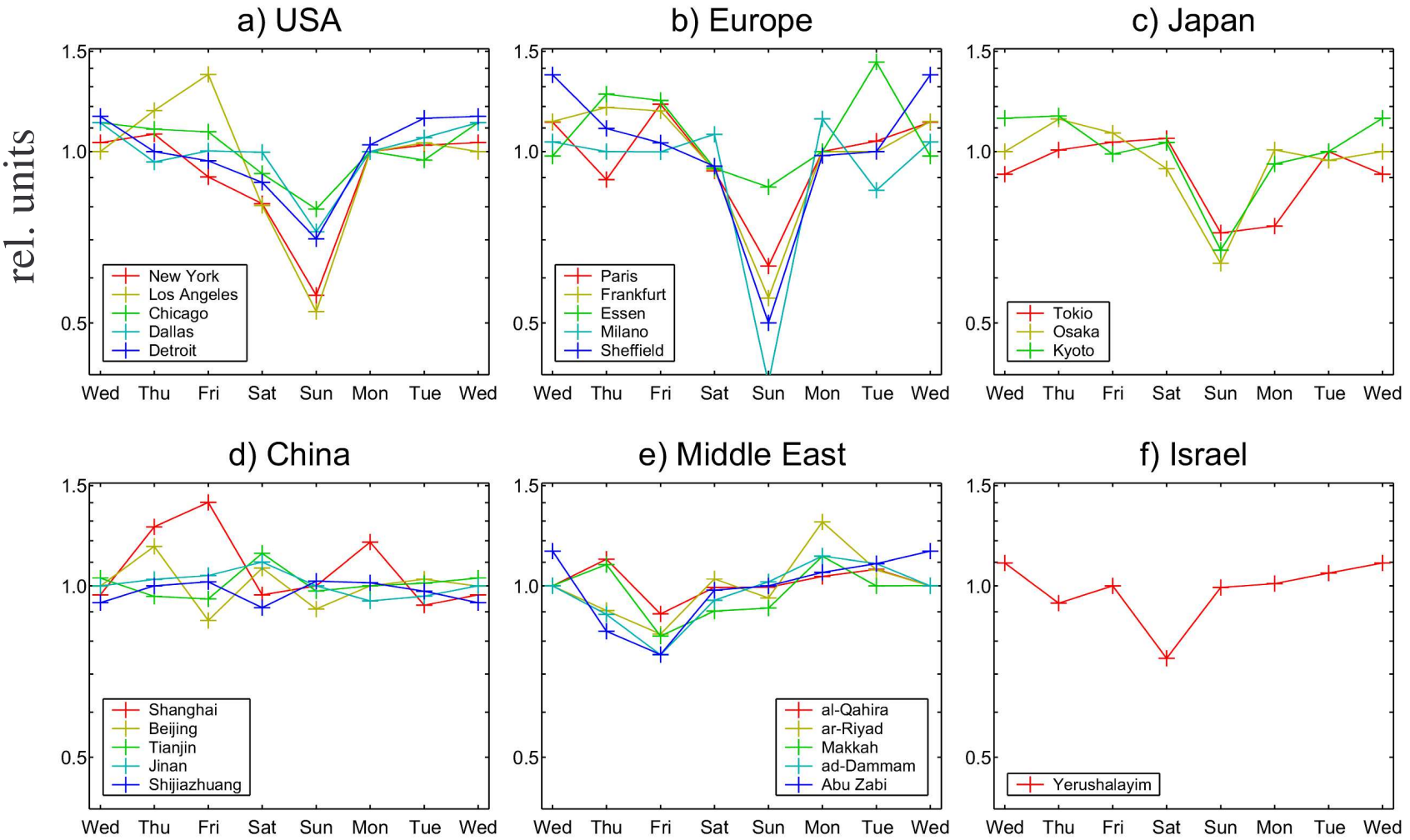
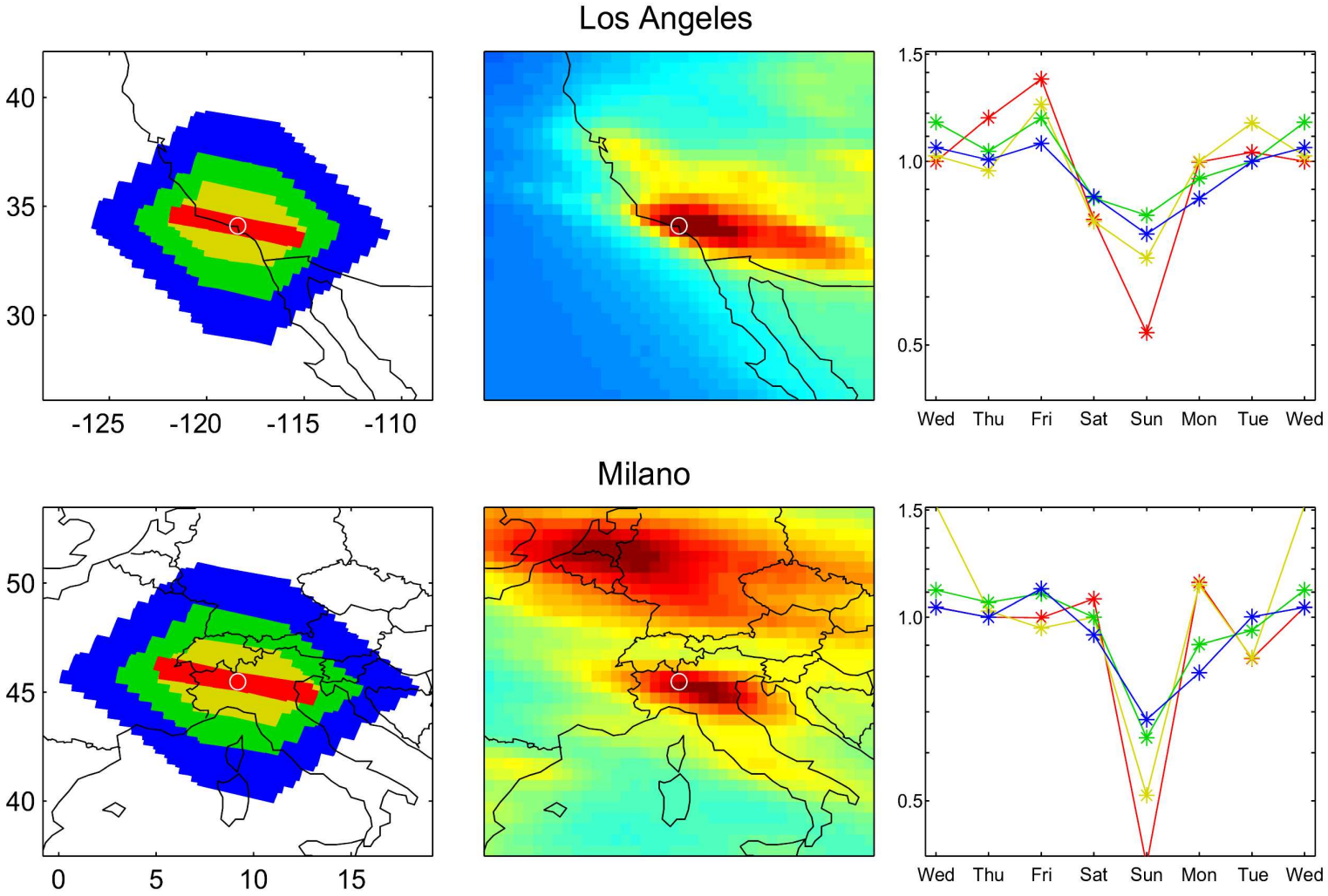


Influence of regarded area: a key for lifetime estimation?



Further points of emphasis concerning NO_2

- Total Column:
  - Improvements in Data Qualitiy

    (New fit, Radiation Transport Modelling, Problem of Solar reference)
- Stratosphere:
  - Yearly Cycle, Trend (M. Wenig)
  - Correlation of trop. height and VCD (N. Spichtinger)
- Tropospheric NO_2:
  - Regional trends

The satellite group Heidelberg:

Thomas Wagner, Steffen Beirle, Nicolas Dross, Christian Frankenberg, Christoph von Friedeburg, Michael Grzegorski, Jens Hollwedel, Muhammad Fahim Khokhar, Stefan Kraus, Sven Kühl, Suniti Shangavi, Mark Wenig, Walburga Wilms-Grabe, Ulrich Platt

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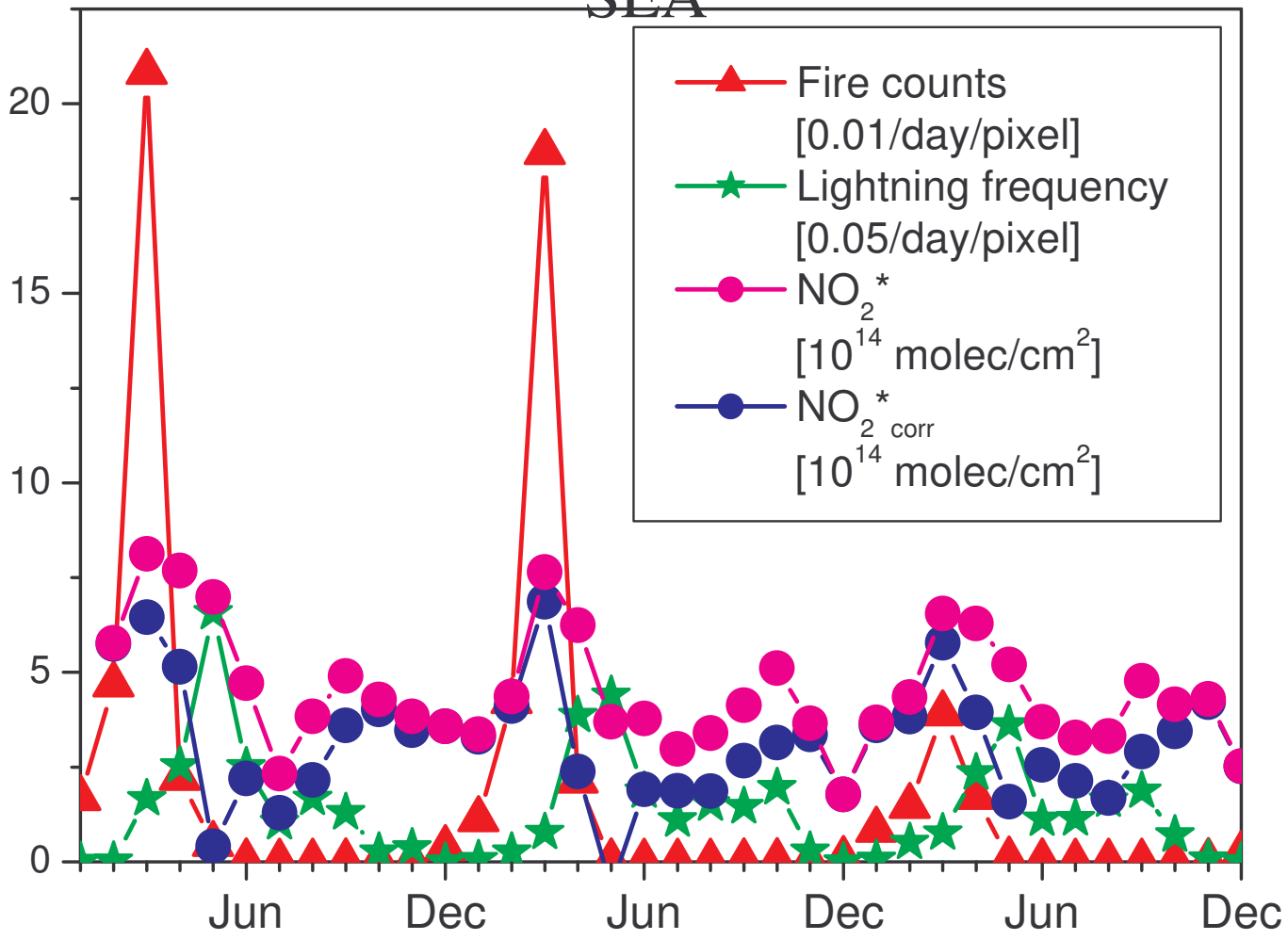
Yearly cycle of biomass burning, lightning and NO_2 in SEA



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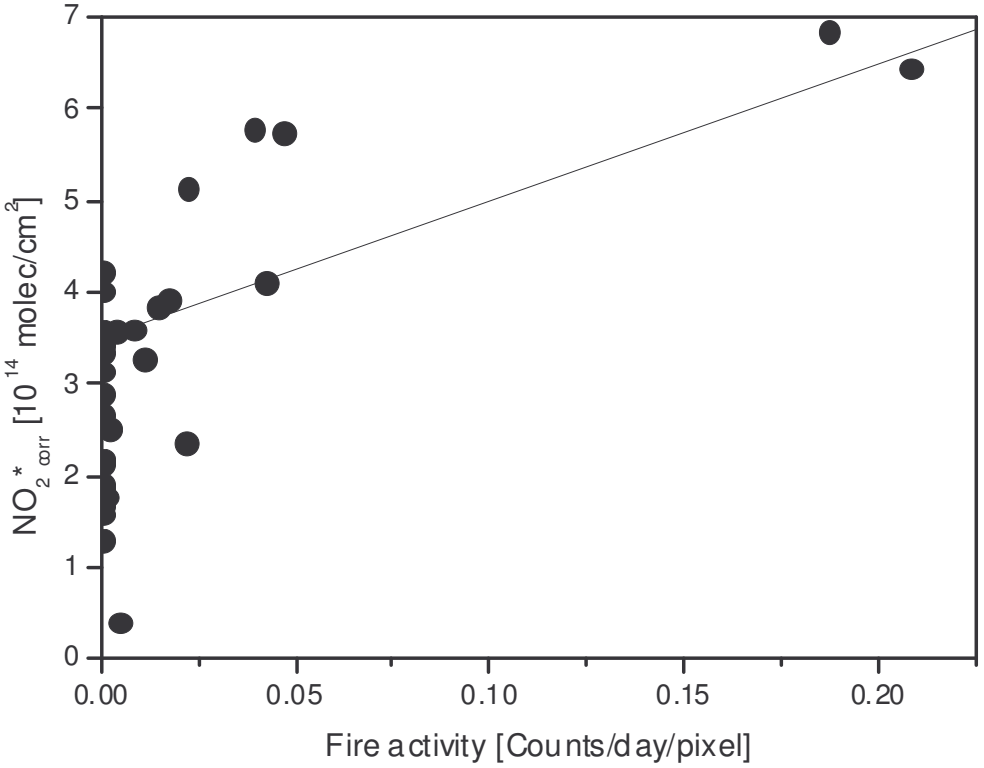

Estimation of NO_x by biomass burning

- using the same method as above leads to a global value of 0.2 Tg N/yr.
- values are much to small:

  - shielding effect

  - “Fire” ≠ “fire” (more information about the type and intensity is needed)

  - air mass factor correction shall have more influence than in the case of lightning