Using satellite measurements of tropospheric NO\textsubscript{2} and fire radiative power to derive biome-specific fire emission rates of NO\textsubscript{x}

Stefan F. Schreier\textsuperscript{1}, Andreas Richter\textsuperscript{1}, Johannes W. Kaiser\textsuperscript{2} and John P. Burrows\textsuperscript{1}

\textsuperscript{1} Institute of Environmental Physics/Remote Sensing, University of Bremen, Germany
\textsuperscript{2} Max Planck Institute for Chemistry, Mainz, Germany
Email: schreier@iup.physik.uni-bremen.de

Motivation

Biomass burning is a major source of nitrogen oxides (NO\textsubscript{x} = NO + NO\textsubscript{2}) NO\textsubscript{x} radicals play key roles in atmospheric chemistry, air pollution, and climate

How to measure?

NO\textsubscript{x} amounts and distributions are retrieved by passive and active remote sensing techniques

Aim of this study

To establish an empirical relationship between FRP and TVC NO\textsubscript{x} as a tool to estimate fire emissions of NO\textsubscript{x}

How to estimate globally?

bottom-up approach
aggregate diverse local statistics

top-down approach
inversion and partitioning of satellite-derived tropospheric NO\textsubscript{x}

Conversion of TVC NO\textsubscript{x} into production rates of NO\textsubscript{x}

The emissions of NO\textsubscript{x} from vegetation fires are much lower than anthropogenic emissions on the global scale. However, biomass burning is the major source of NO\textsubscript{x} in large tropical and subtropical regions.

Results I – Biome-specific FERs

Results II – Seasonal variability of FERs

Conclusions and Outlook

- a simple statistical approach has been developed to estimate NO\textsubscript{x} emission rates using the strong correlation between TVC NO\textsubscript{x} and FRP
- conversion of the TVC NO\textsubscript{x} into mass concentrations of NO\textsubscript{x} by assuming constant NO\textsubscript{x}/NO\textsubscript{2} ratio and lifetime of NO\textsubscript{x} = very good agreement with GFEDv3.1 NO\textsubscript{x}
- biome-specific FERs, but also differences among the selected regions
- seasonal variability of FERs – decreasing towards the end of the dry (fire) season
- future work will focus on other regions (e.g. boreal regions)

Acknowledgements

GOME-2 h\textsuperscript{1} data have been provided by EUMETSAT
OMI lv2 data were provided by http://disc.sci.gsfc.nasa.gov/Aura/data/SPIE, 35, 2002
MODIS data have been retrieved from http://disc.ves.gatech.edu/eclipse/fire, global land cover classification was provided by http://glcf.umd.edu/data/landcover/
S. F. Schreier gratefully acknowledges funding by the Earth System Science Research School (ESSeR)

Selected References

Justice C.O. et al., in: Remote Sensing of Environment, 63, 244-262, 2002
Cahyadi J. et al., in: Proceedings of SPIE, 5549, ar, no. 07, 60-70, 2004
Wang P. et al., in: Atmospheric Chemistry and Physics, 6, 5685-6776, 2006

Satellite instruments and Data retrieval

Global Ozone Monitoring Experiment-2
- on board MetOp-A (EUMETSAT) since October 2006
- local equatorial crossing time: 9:30 a.m.

Differential Optical Absorption Spectroscopy (DOAS)
- to retrieve the Slant Column Densities (SCDs) fitting window: 405-485 nm (GOME-2) and 405-465 nm (OMI)

MODerate resolution Imaging Spectroradiometer
- on board Terra (10:30 a.m.) and Aqua (1:30 p.m.) satellites (NASA)
- MODIS fire product includes the radiative component of energy release, the Fire Radiative Power (FRP)

Relationship between TVC NO\textsubscript{x} and FRP

The emissions of NO\textsubscript{x} from vegetation fires are much lower than anthropogenic emissions on the global scale. However, biomass burning is the major source of NO\textsubscript{x} in large tropical and subtropical regions.

Results I – Biome-specific FERs

Results II – Seasonal variability of FERs

Conclusions and Outlook

- a simple statistical approach has been developed to estimate NO\textsubscript{x} emission rates using the strong correlation between TVC NO\textsubscript{x} and FRP
- conversion of the TVC NO\textsubscript{x} into mass concentrations of NO\textsubscript{x} by assuming constant NO\textsubscript{x}/NO\textsubscript{2} ratio and lifetime of NO\textsubscript{x} = very good agreement with GFEDv3.1 NO\textsubscript{x}
- biome-specific FERs, but also differences among the selected regions
- seasonal variability of FERs – decreasing towards the end of the dry (fire) season
- future work will focus on other regions (e.g. boreal regions)