2.022 Wintertime photochemistry in Beijing: Observations of ROx radical concentrations in the North China Plain during the BEST-ONE campaign.

Early Career Scientist

Presenting Author:
ZhaoFeng Tan, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany, zh.tan@fz-juelich.de

Co-Authors:
Franz Rohrer, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Keding Lu, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Xuefei Ma, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Birger Bohn, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Hendrik Fuchs, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Andreas Hofzumahaus, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Frank Holland, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Xin Li, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Ying Liu, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Yuhan Liu, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Anna Novelli, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Min Shao, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Haichao Wang, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Yusheng Wu, College of Environmental Sciences and Engineering, Peking University, Beijing, China
Limin Zeng, College of Environmental Sciences and Engineering, Peking University, Beijing, China
**Min Hu**, College of Environmental Sciences and Engineering, Peking University, Beijing, China  
**Astrid Kiendler-Scharr**, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany  
**Andreas Wahner**, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany  
**Yuanhang Zhang**, College of Environmental Sciences and Engineering, Peking University, Beijing, China

**Abstract:**

The first wintertime in-situ measurements of hydroxyl (OH), hydroperoxy (HO$_2$) and organic peroxy (RO$_2$) radicals (RO$_x$=OH+HO$_2$+RO$_2$) in combination with observations of total reactivity of OH radicals, $k_{\text{OH}}$, for the Beijing area are presented. The field campaign “Beijing winter finE particulate STudy - Oxidation, Nucleation and light Extinctions” (BEST-ONE) was conducted at the suburban site Huairou near Beijing from January to March 2016. It aimed to elucidate the mechanism of formation of secondary pollutants in the North China Plain (NCP) during wintertime. Unexpectedly high OH radical concentrations were observed during the campaign with noontime average concentration values of about 2.8×10$^6$ cm$^{-3}$, with a slight difference in relatively clean (3.6×10$^6$ cm$^{-3}$) and severely polluted days (2.4×10$^6$ cm$^{-3}$). The Beijing winter OH concentration is nearly two-fold larger than what was observed in Birmingham, Tokyo, and New York City during wintertime. The simultaneous measurements of nitrogen monoxide NO and of the total reactivity of OH, $k_{\text{OH}}$, allows constraining the production and destruction rates in the radical chain reactions. During this campaign, the total primary production rate of RO$_x$ radicals was dominated by the photolysis of nitrous acid accounting for 46% of the identified primary production pathways for RO$_x$ radicals. Other important radical sources were alkene ozonolysis (28%) and photolysis of oxygenated organic compounds (24%). An observation based model was used to simulate the OH, HO$_2$ and RO$_2$ concentrations, which was capable of reproducing the observed RO$_x$ concentrations during clean days. However, it largely underestimated HO$_2$ and RO$_2$ concentrations during pollution episodes. The HO$_2$ and RO$_2$ observed-to-modeled ratios increased with increasing NO$_x$ concentrations, both during clean and polluted periods, implying that the current chemical mechanism has difficulties in the high NO$_x$ regime.