GEOS-Chem simulations and formaldehyde column observations during APHH-Beijing

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APHH-Beijing

- APHH-Beijing is an extensive collaboration between UK and Chinese research groups to study air pollution sources and associated health impacts
- Involves 30 institutions, 200 participants and nearly 200 instruments
- Programme of intensive measurement campaigns, flux observations, remote sensing and chemical transport modelling
- Measurement campaigns undertaken in autumn 2016 (7/11 - 9/12), and spring 2017 (16/5 – 30/6)
- Ground-based measurement at IAP site in central Beijing (39°58’28”N,116°22’16”E), and on meteorological tower
- Additional deployment at background site in Pinggu district, NE of Beijing
GEOS-Chem simulations

Initial:-

- Global 2° x 2.5° resolution, 47 vertical levels
- GEOS-FP meteorological data for 2016
- SOA SV-POA chemical mechanism – 115 species including OPOA, OPOG, SOA from terpene, aromatic, isoprene and IVOC oxidation products (naphthalene)

Update:-

- Nested 0.25° x 0.3125° grid, for defined East China region (20-45°N, 100-125°E)
- Simulations run for both campaign periods (Nov-Dec 2016 and May-Jun 2017)
- 1hr ND48 time series output for IAP site
- HCHO vertical column retrievals using full 12 month model output for 2016
- Using MIX emission inventory for China
SOA chemistry in GEOS-Chem

Pye et al., 2010
Model – measurement comparison: OA (summer)
Model – measurement comparison: $SO_4$ (winter)
Model – measurement comparison: SO$_4$ (summer)
Model – measurement comparison: NO₃ (winter)
Model – measurement comparison: NO$_3$ (summer)
Model – measurement comparison: NH$_4$ (winter)
Model – measurement comparison: NH$_4$ (summer)
Model – measurement comparison: O₃ (summer)
Model – measurement comparison: MLH (winter)
Model – measurement comparison: MLH (summer)
Model – measurement comparison: HCHO (summer)
Model – measurement comparison: SO$_2$ (winter)
HCHO vertical columns

vertical column = slant column / AMF

- Slant columns from NASA OMHCHO product from OMI (Aura)
- AMF derived from scattering weights (cloud/aerosol) and GC shape factor
- Filtered by data quality, high column values, detector row anomalies, SZA and cloud fraction
- Remote Pacific background correction applied to account for bias in retrieved columns
HCHO vertical columns

Annual (2016)

Mean satellite vertical column

Jan - Mar

Apr - Jun

Jul - Sep

Oct - Dec
Future work

- Boundary layer issue – urban vs. rural comparison
- Some outstanding data (OA fractions for winter/summer, ACSM for summer, aerosol from Pinggu)
- Implement MEIC emission inventories
- HCHO column retrievals for 2017 (refine to resolve anthropogenic sources?)
- NO₂ columns for 2016/2017
- Focus on regional scale modelling