The University of Edinburgh

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

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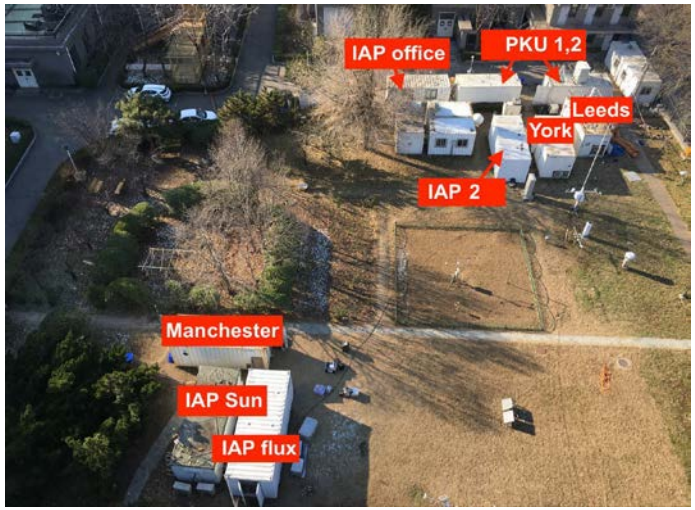
NERC SCIENCE OF THE ENVIRONMENT

Newton Fund

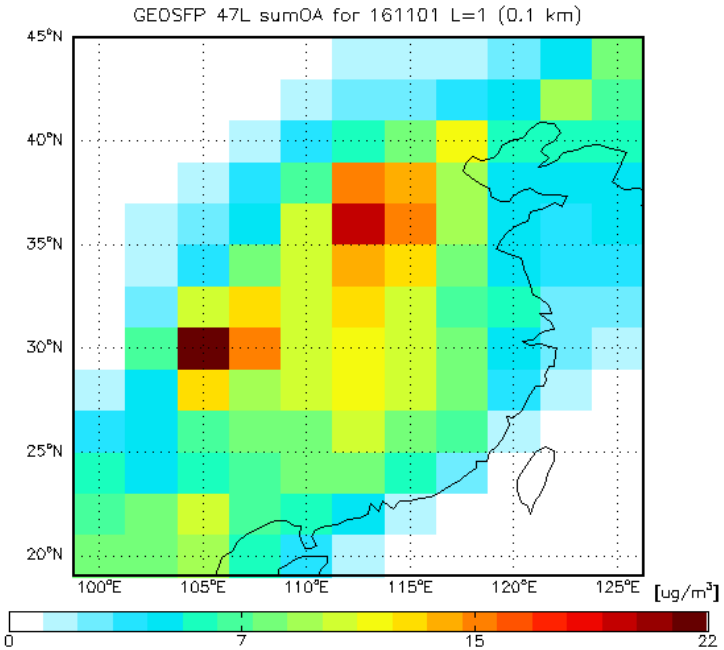
National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

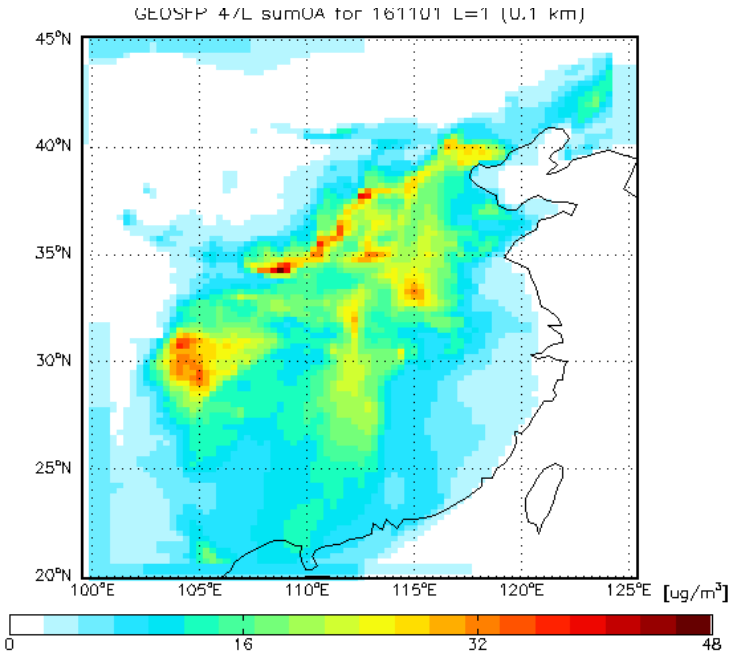
APHH-Beijing

- **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 2º x 2.5º 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 0.25º x 0.3125º grid, for defined East China region (20-45ºN, 100-125ºE)
- 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

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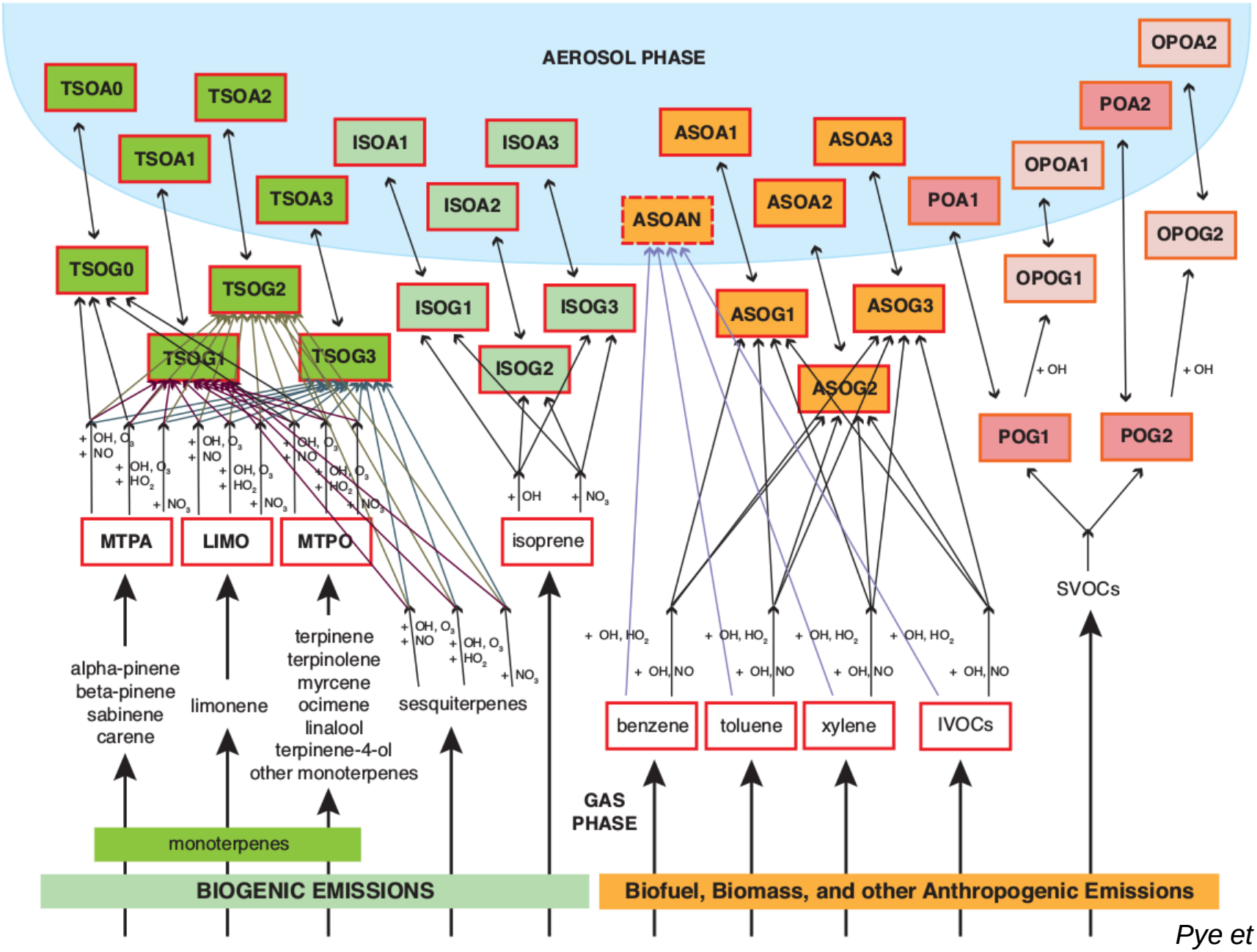
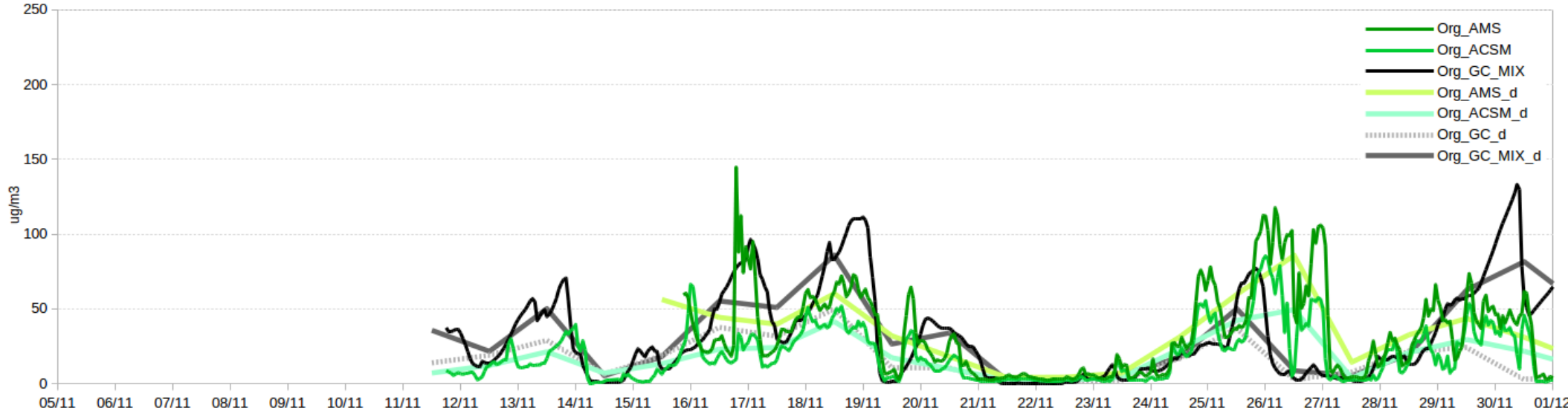
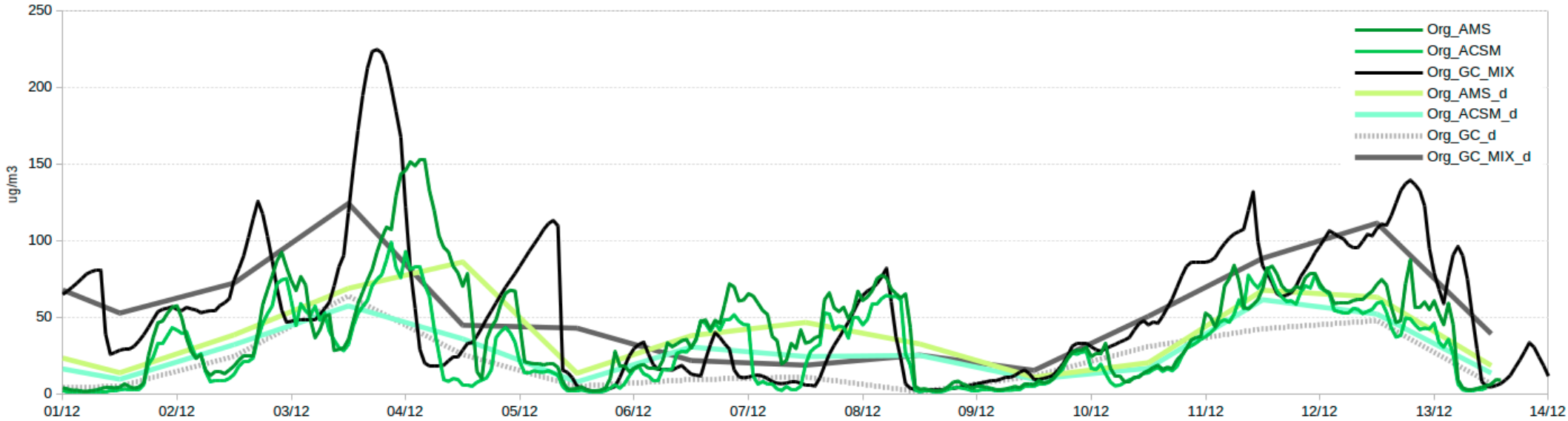
SOA chemistry in GEOS-Chem



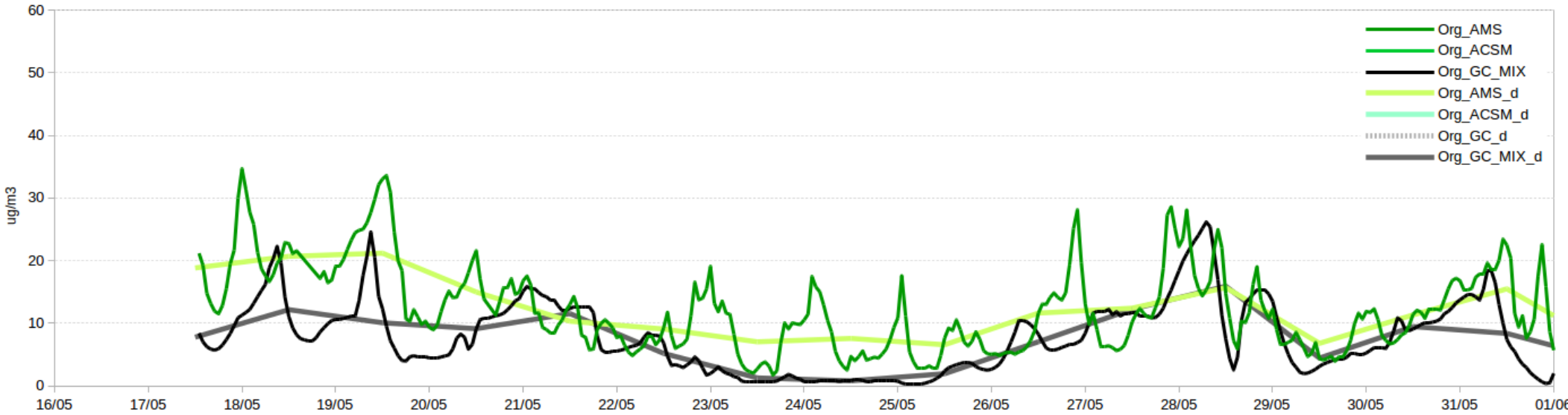
Pye et al., 2010

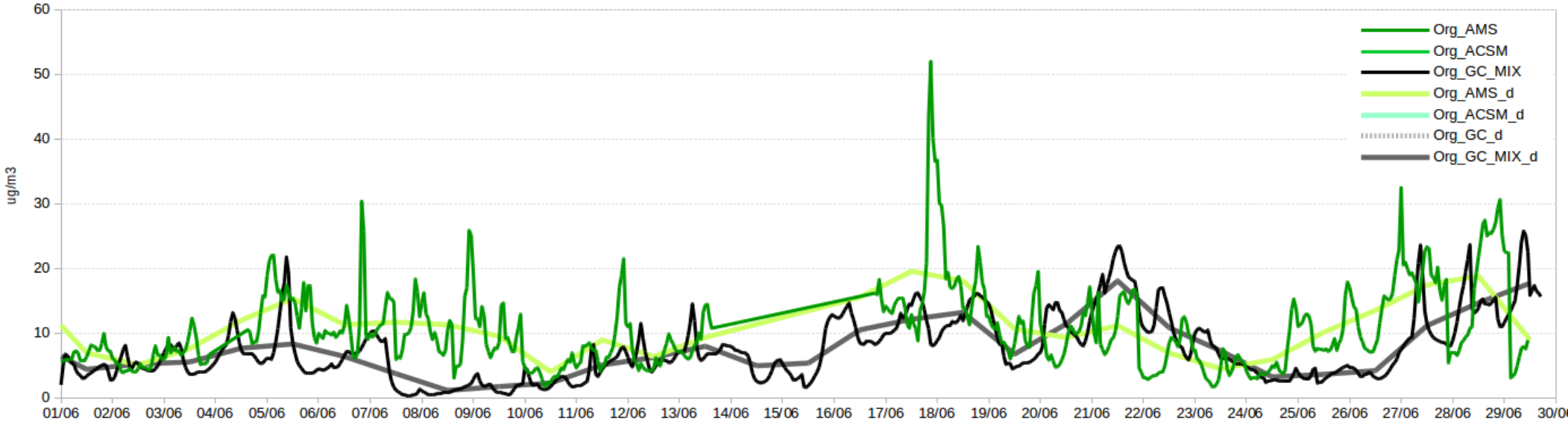
Model – measurement comparison: OA (winter)



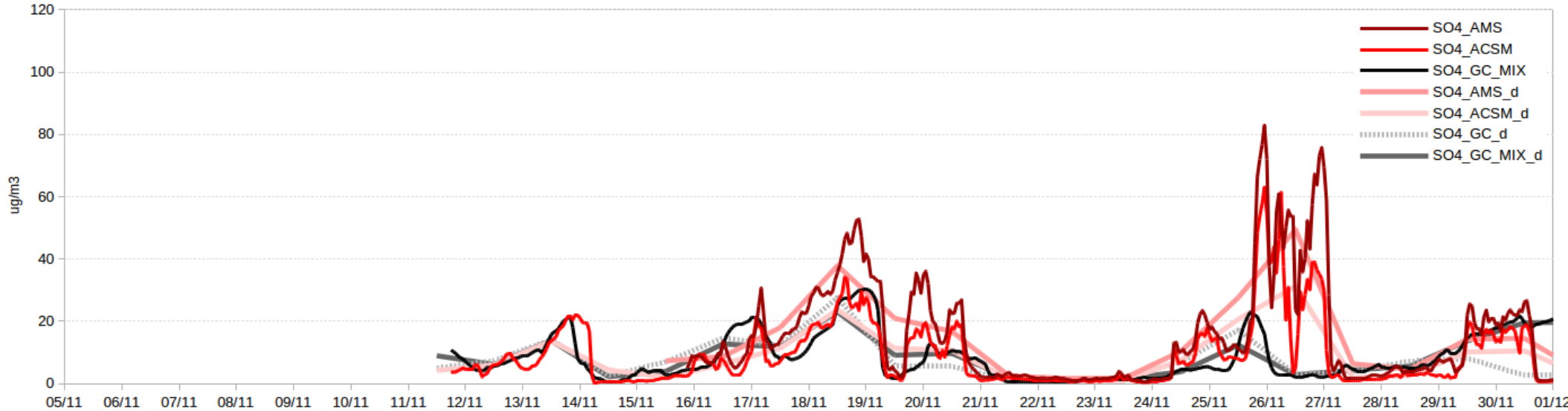


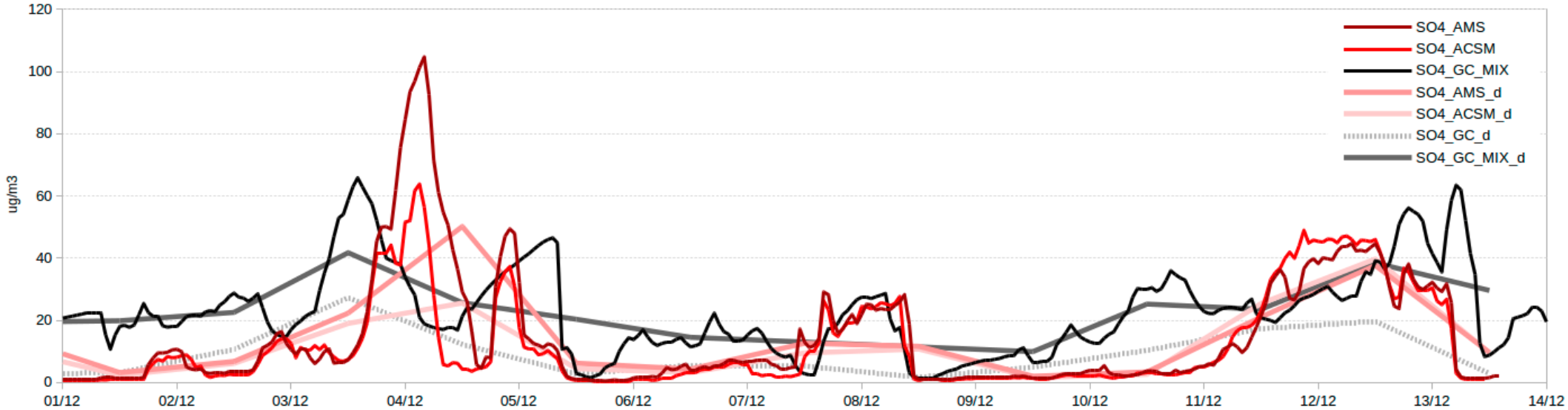
Model – measurement comparison: OA (summer)



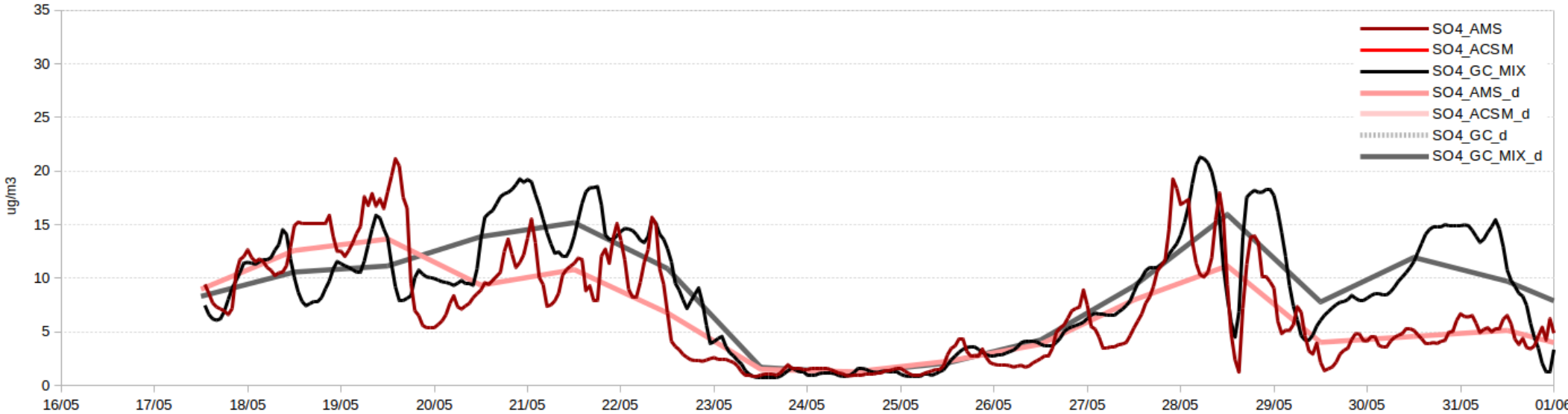


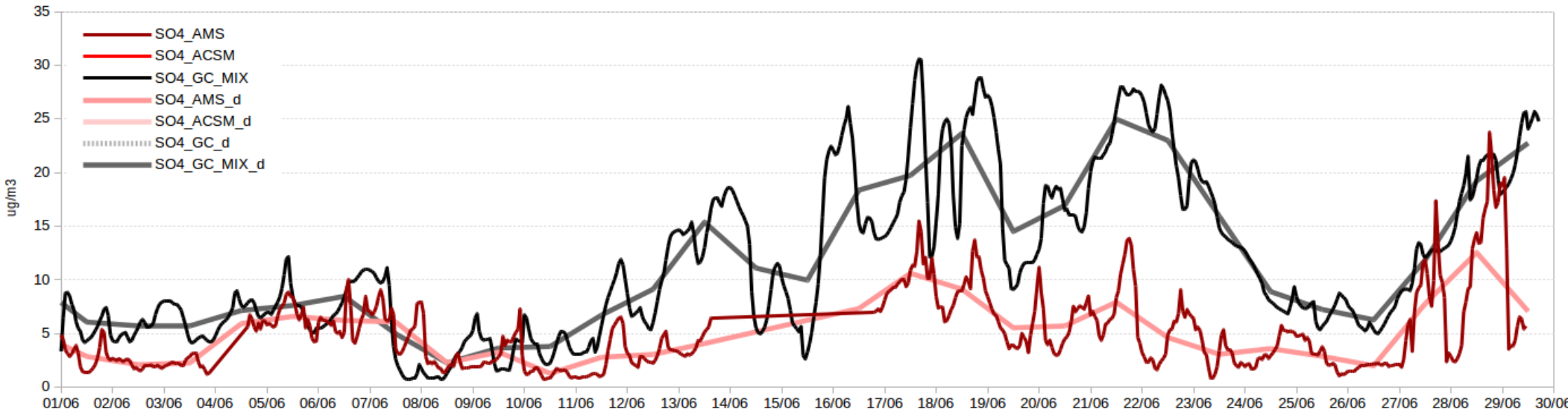
Model – measurement comparison: SO_4 (winter)



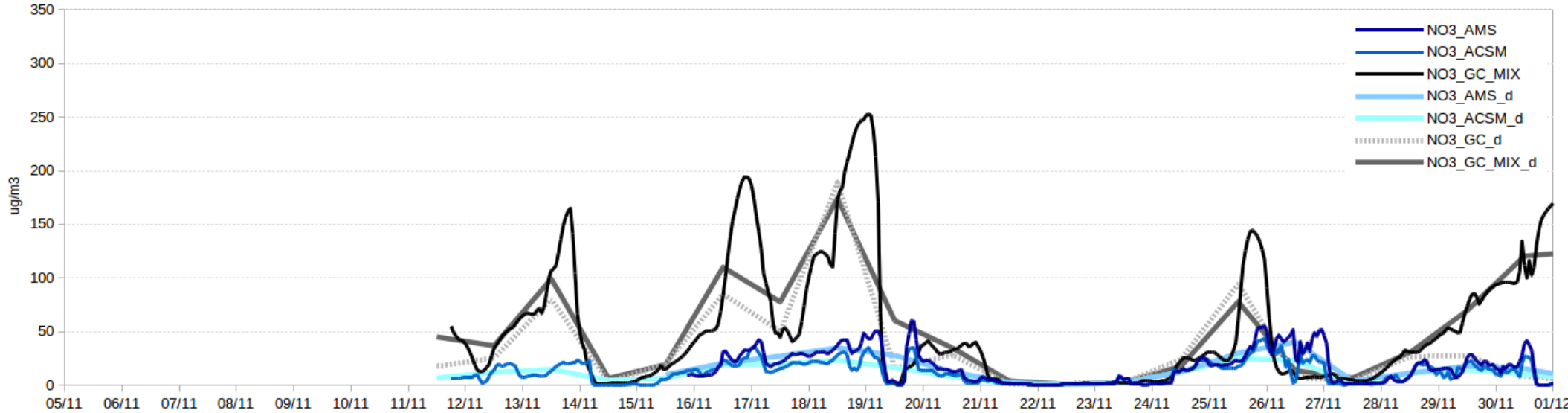


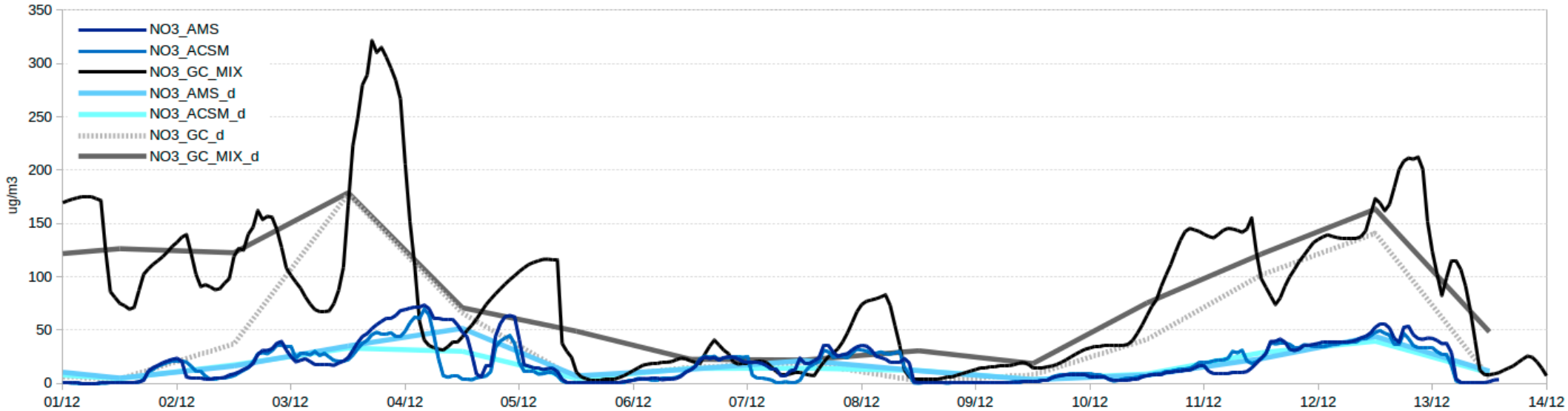
Model – measurement comparison: SO_4 (summer)



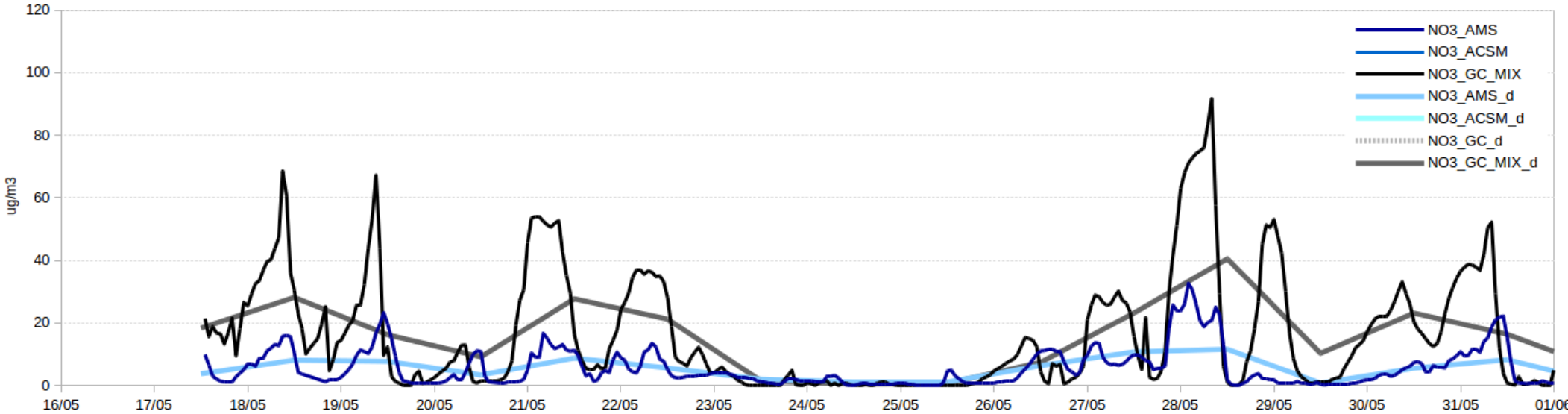


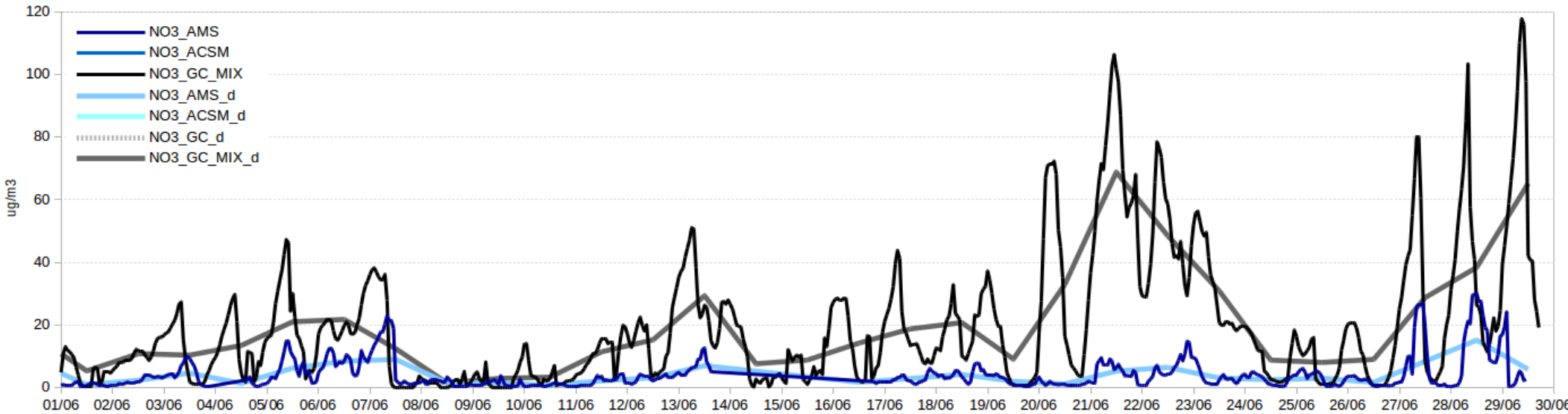
Model – measurement comparison: NO_3 (winter)



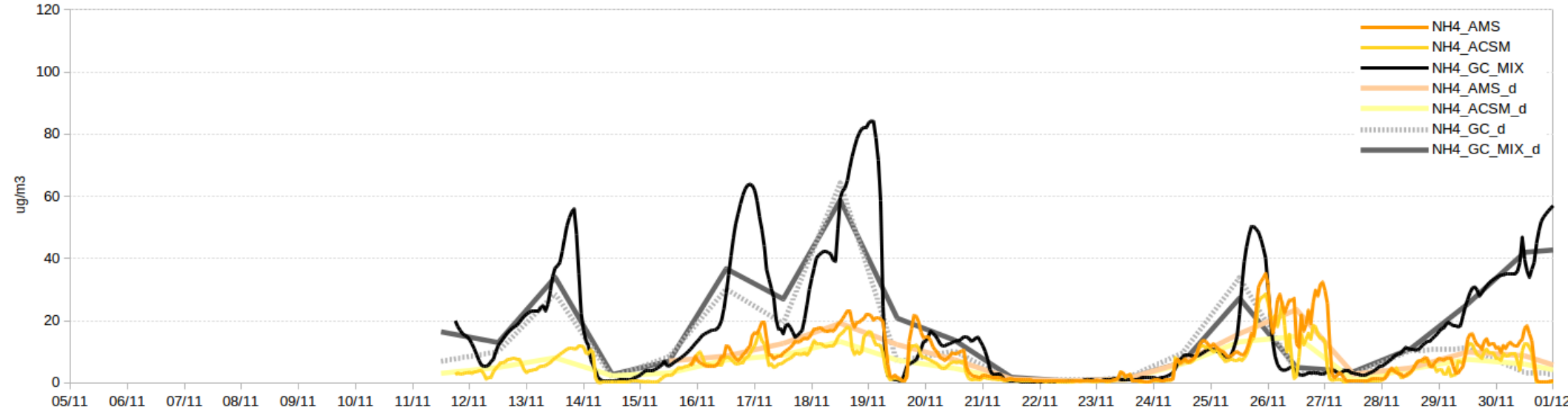


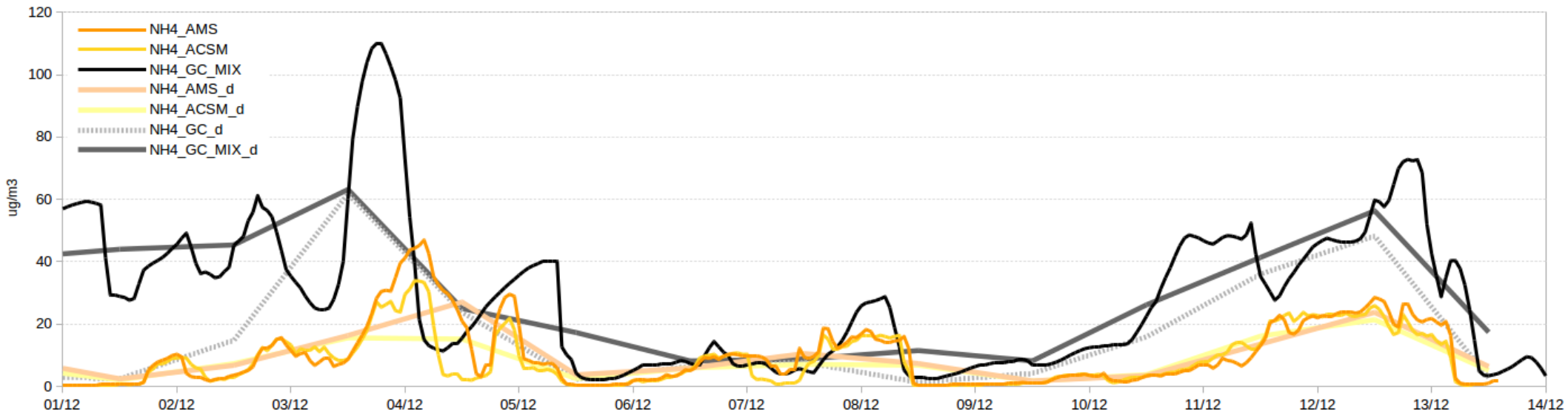
Model – measurement comparison: NO_3 (summer)



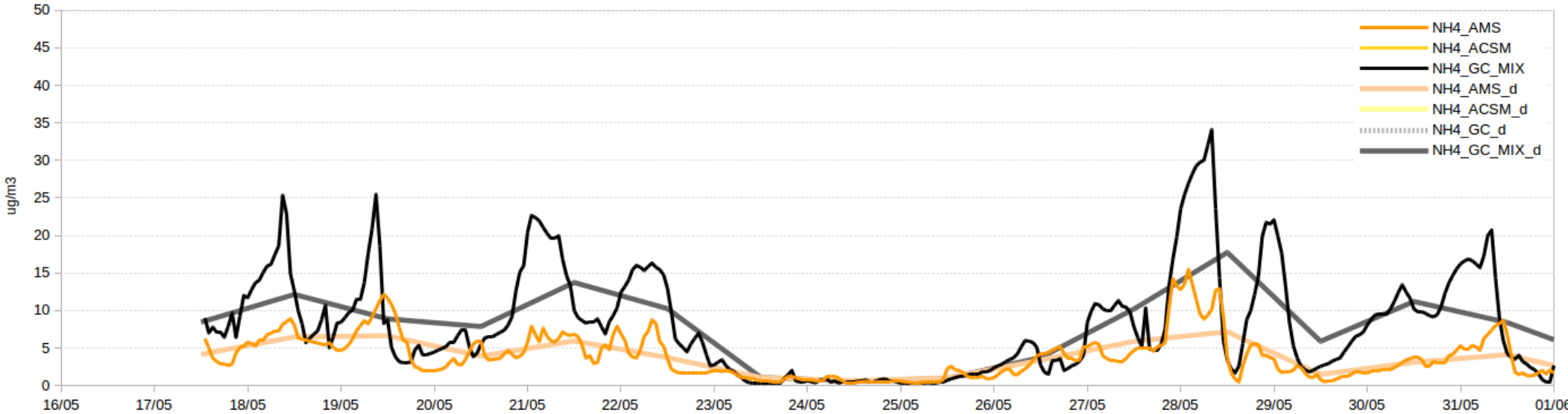


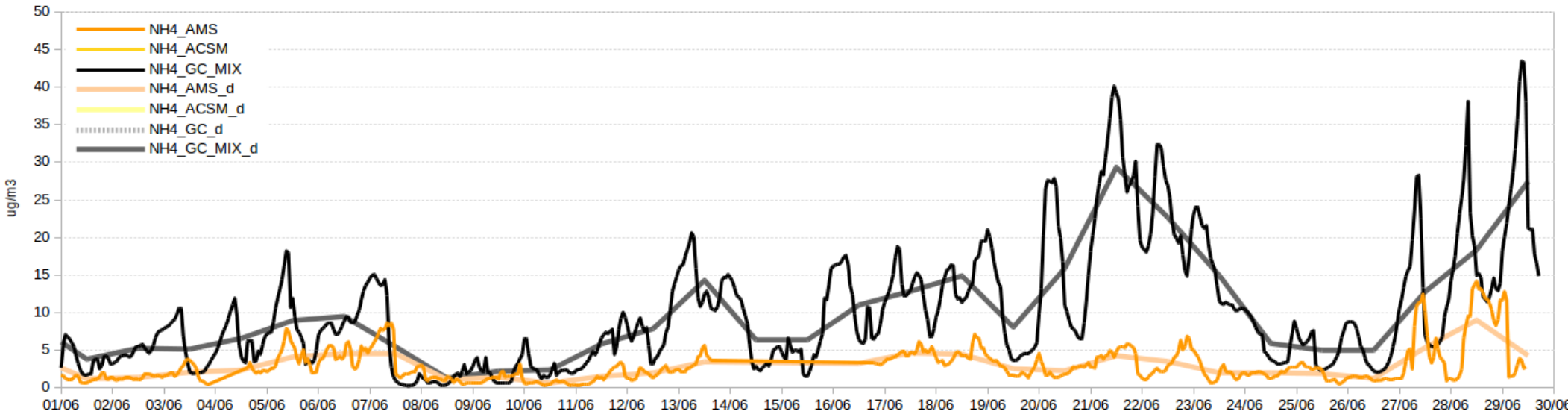
Model – measurement comparison: NH_4 (winter)



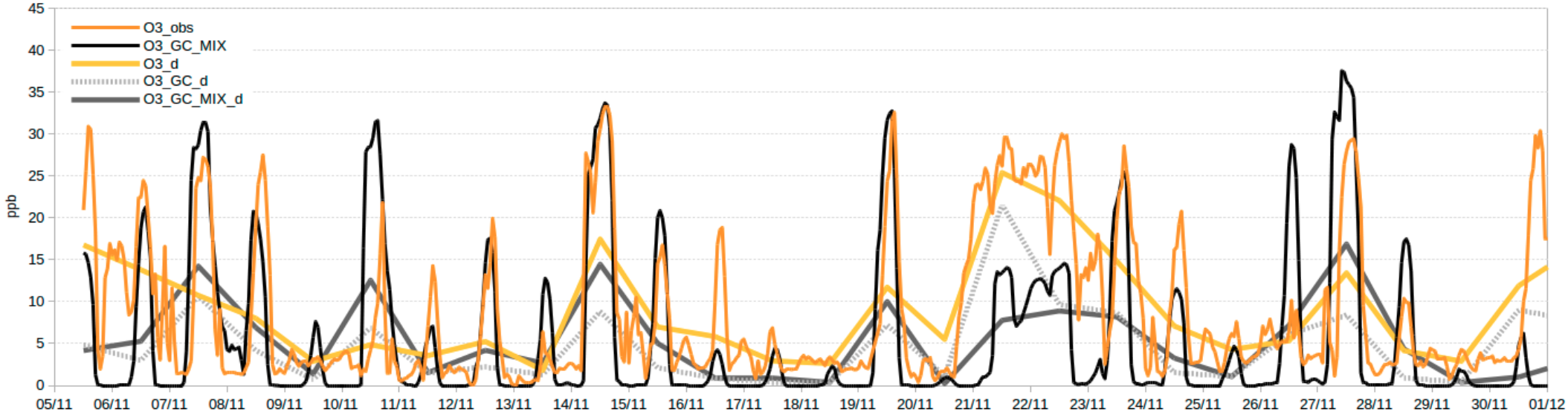


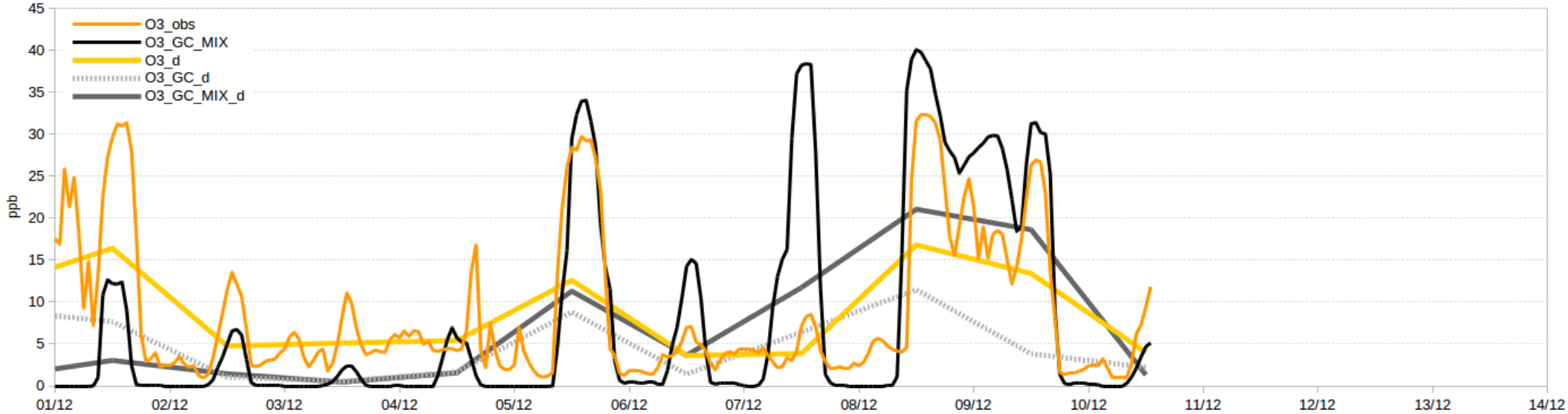
Model – measurement comparison: NH_4 (summer)



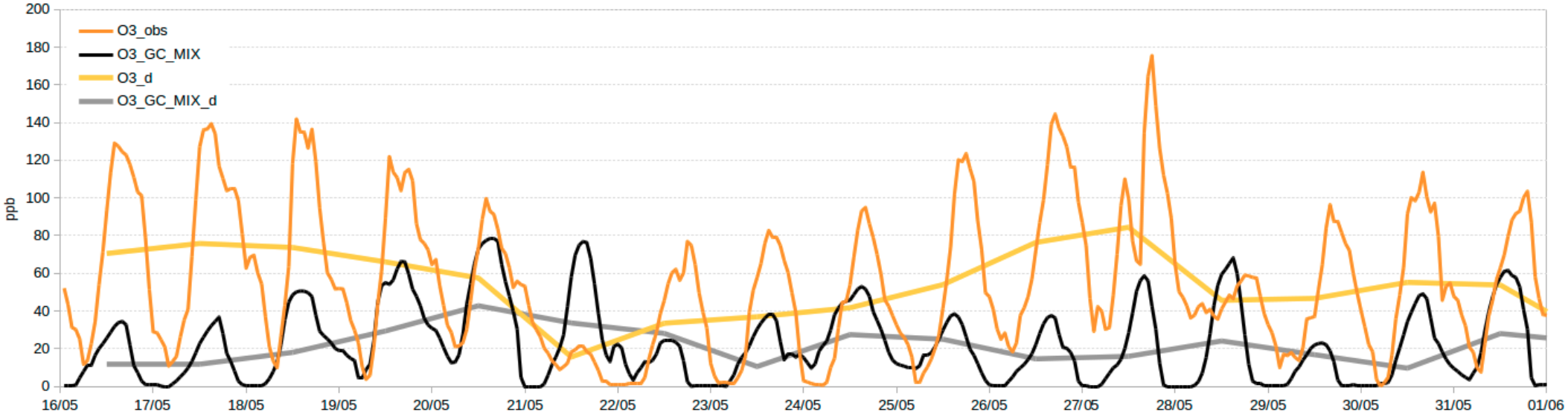


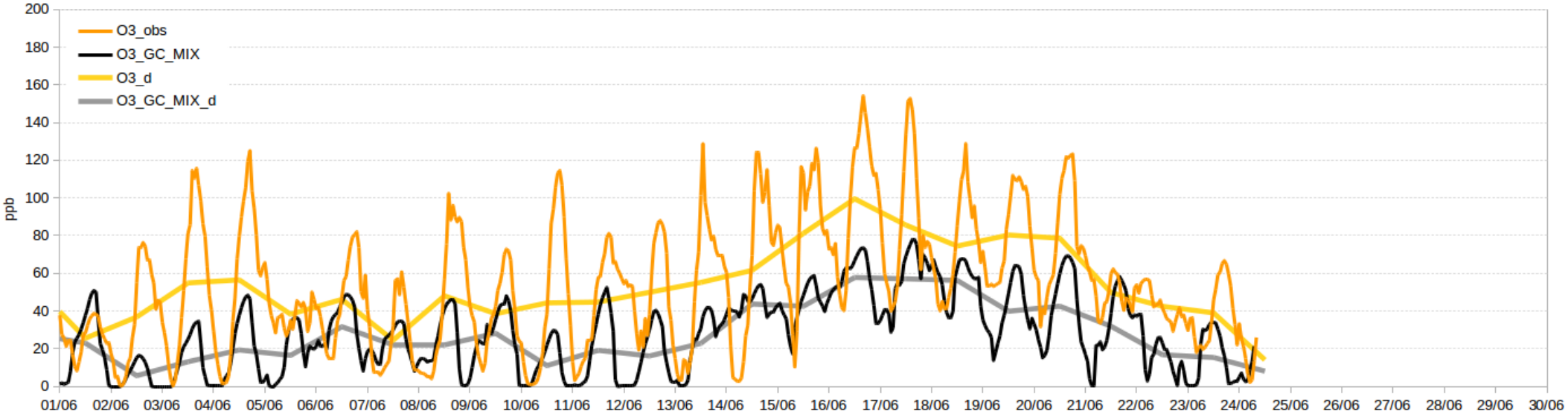
Model – measurement comparison: O_3 (winter)



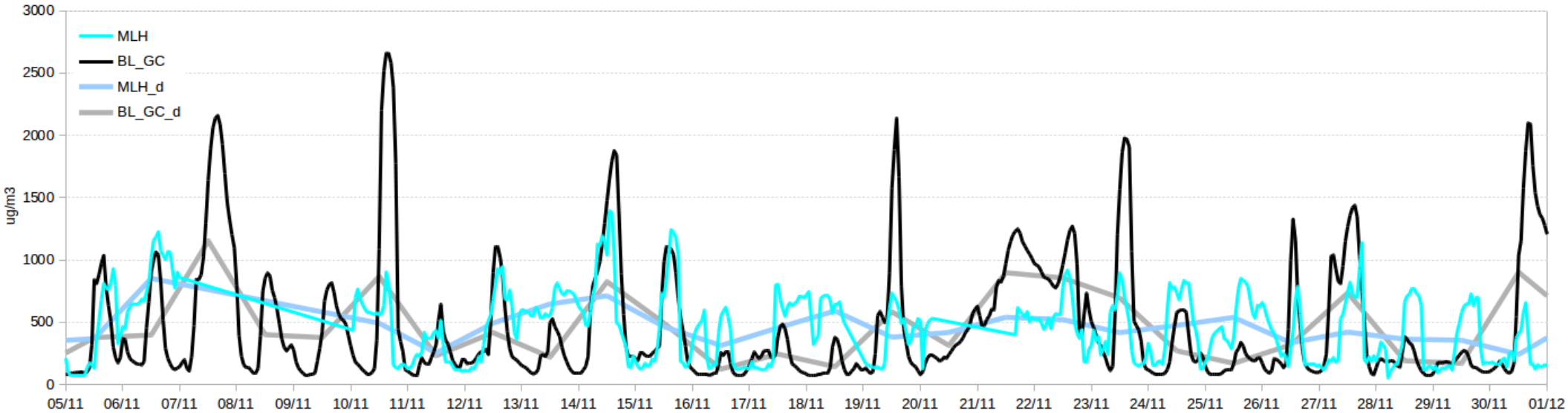


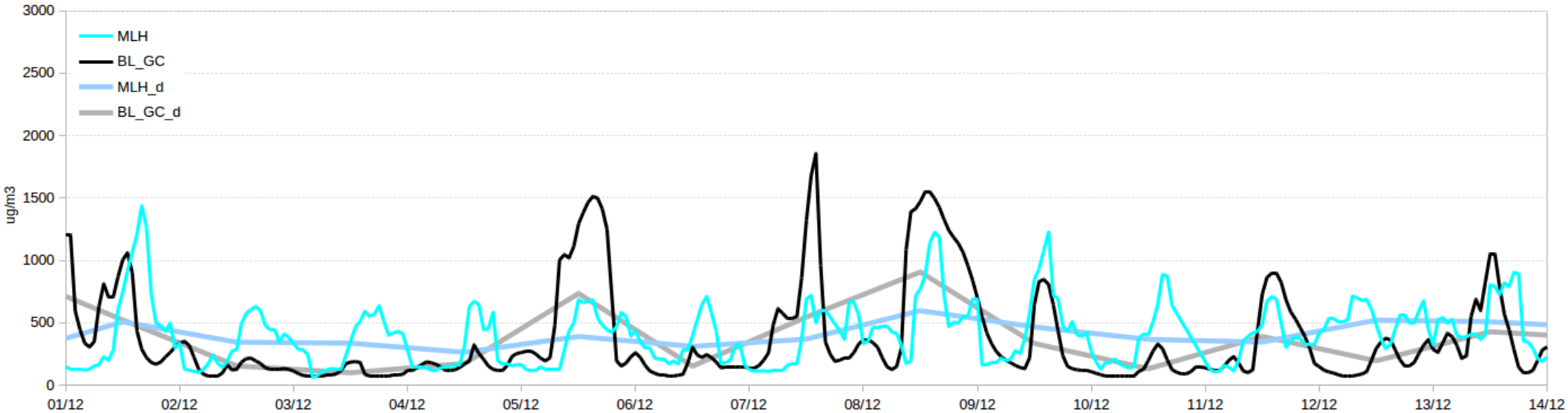
Model – measurement comparison: O_3 (summer)



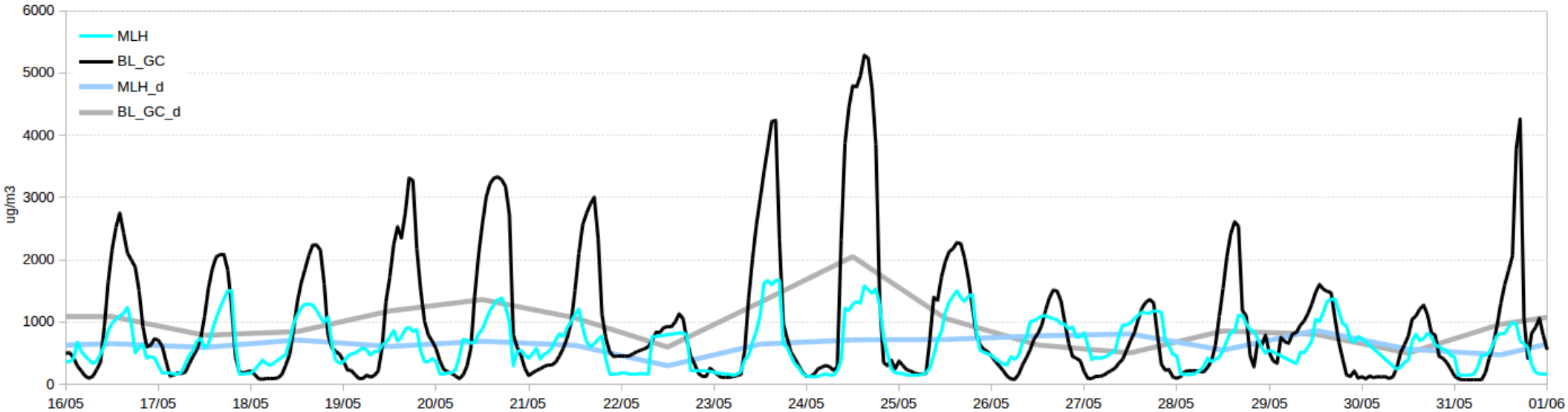


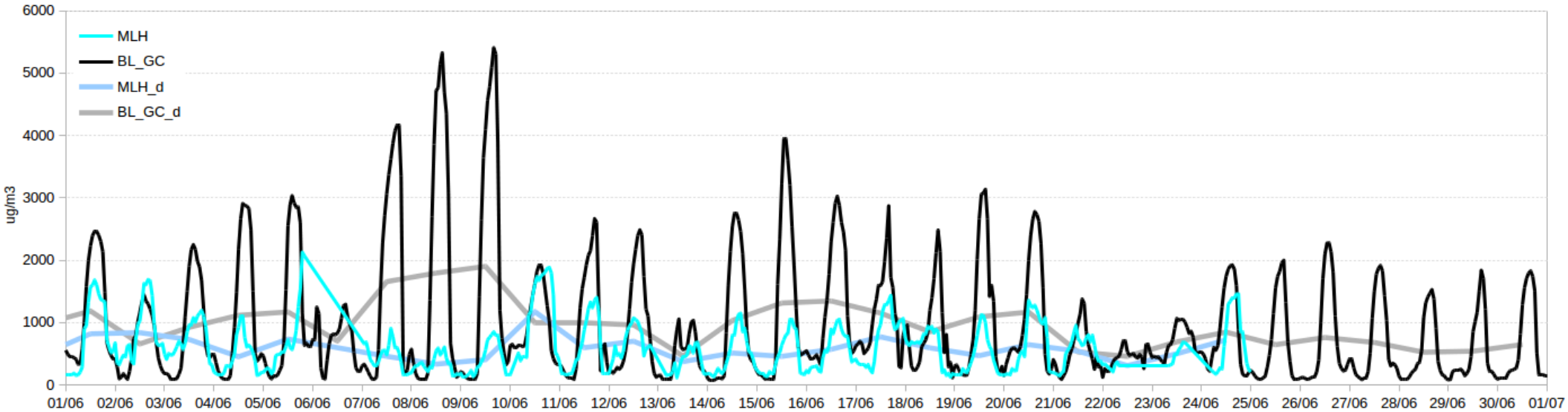
Model – measurement comparison: MLH (winter)



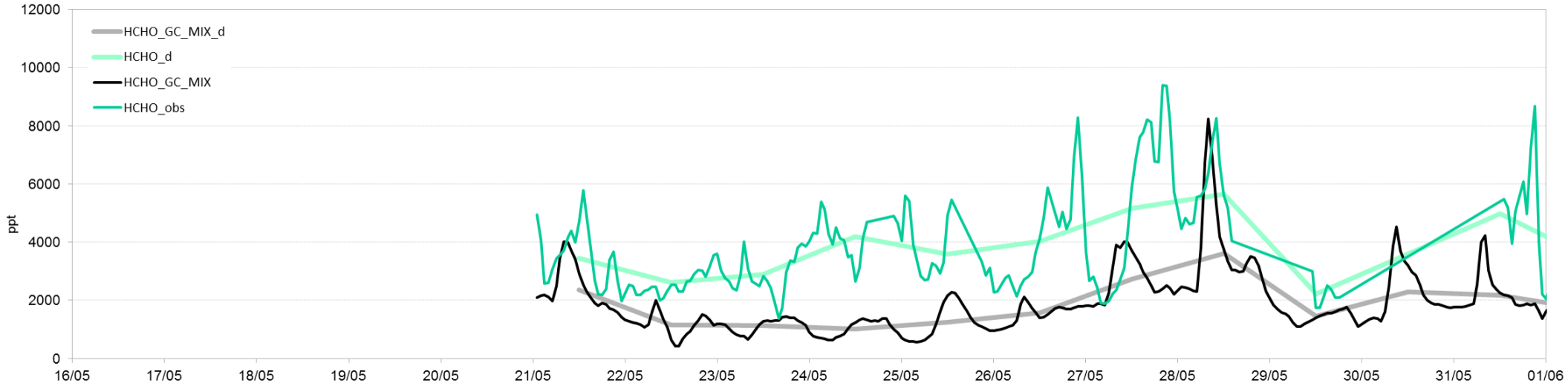


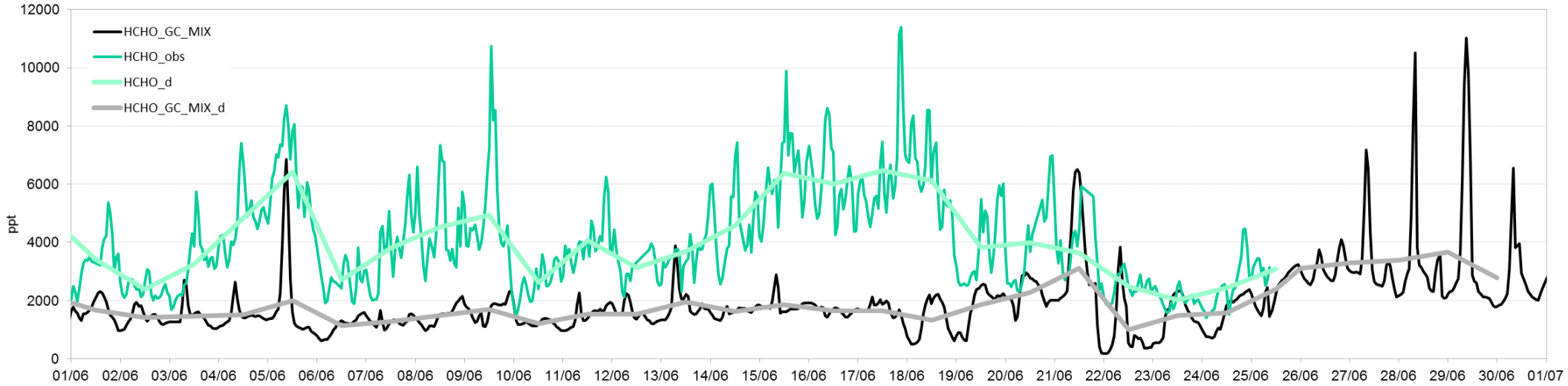
Model – measurement comparison: MLH (summer)



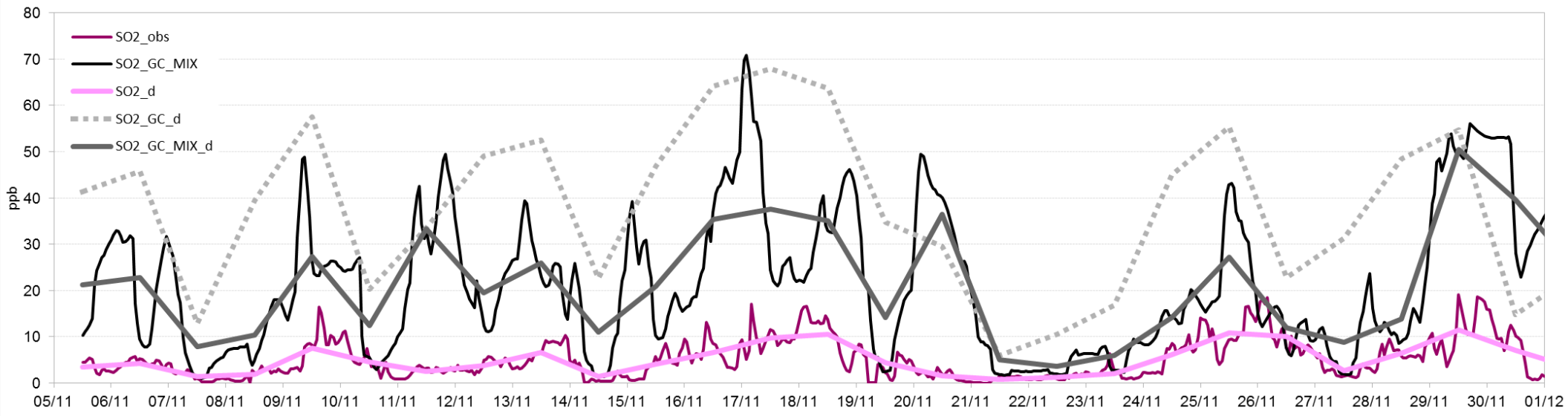


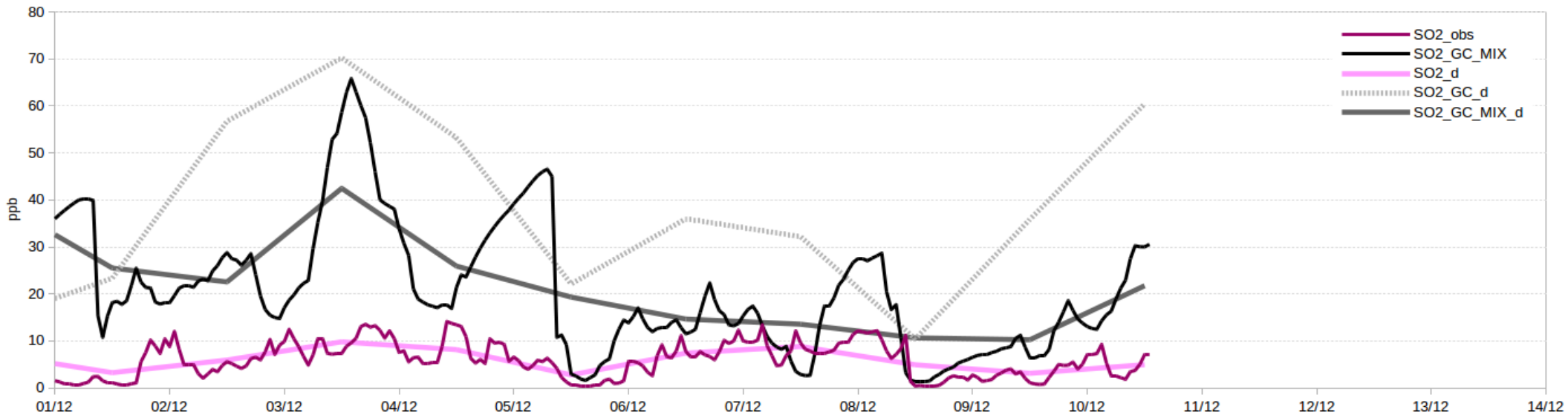
Model – measurement comparison: HCHO (summer)





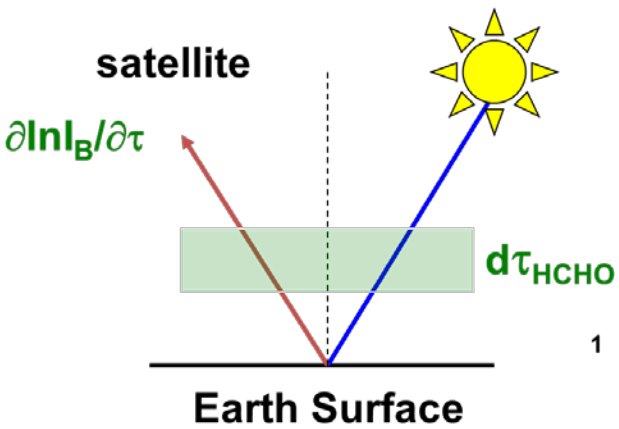
Model – measurement comparison: SO_2 (winter)

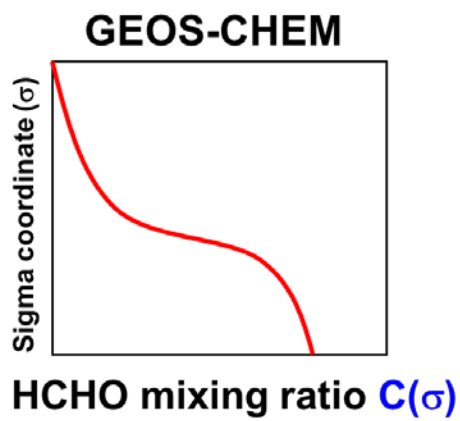




HCHO vertical columns

vertical column = *slant* column /AMF





Scattering weights

$w(\sigma) = -1/AMF_G \; \partial \ln I_B/\partial\tau$

Shape factor

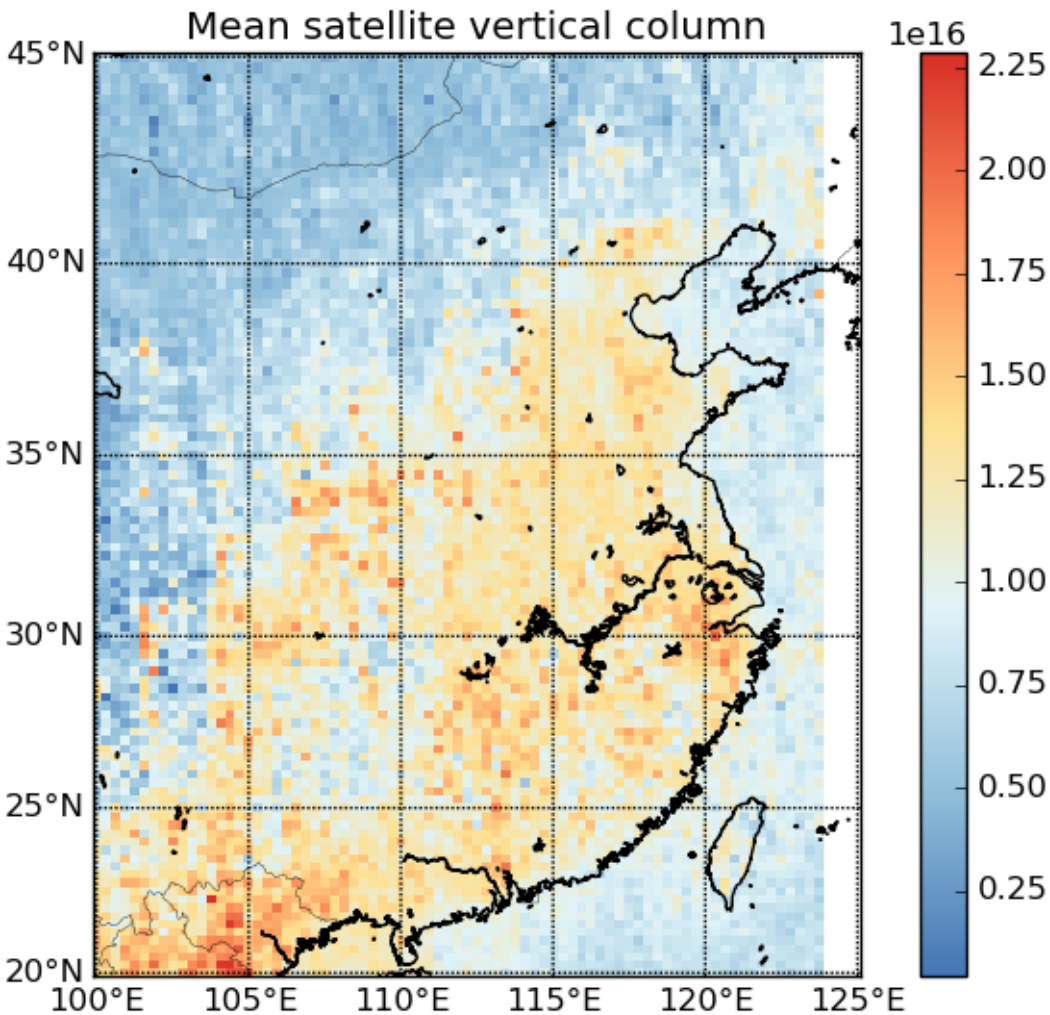
$S(\sigma) = C(\sigma) \; \Omega_{air}/\Omega_{HCHO}$

$$AMF = AMF_G \int^{1} w(\sigma)\, S(\sigma)\, d\sigma$$

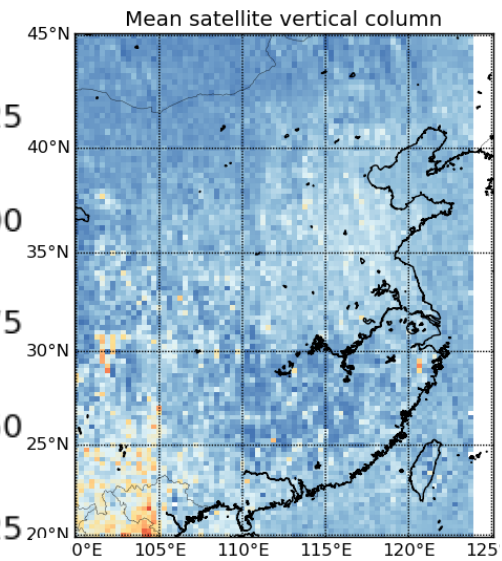
- Slant columns from NASA OMHCHO product from OMI (Aura)
- AMF derived from scattering weights (cloud/aerosol) and GC shape factor
- Filtered by data quality, high column values, detector row anomalies, SZA and cloud fraction
- Remote Pacific background correction applied to account for bias in retrieved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

HCHO vertical columns

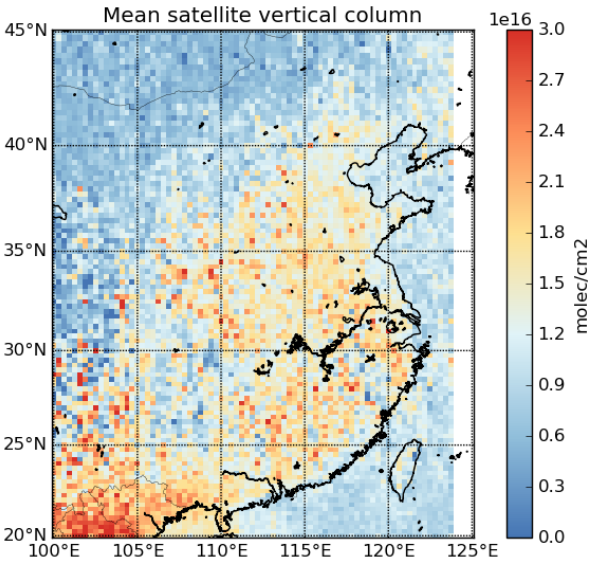
Annual (2016)



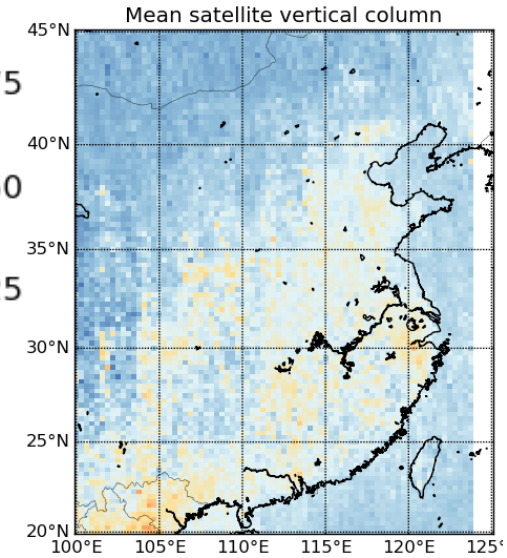
Jan - Mar



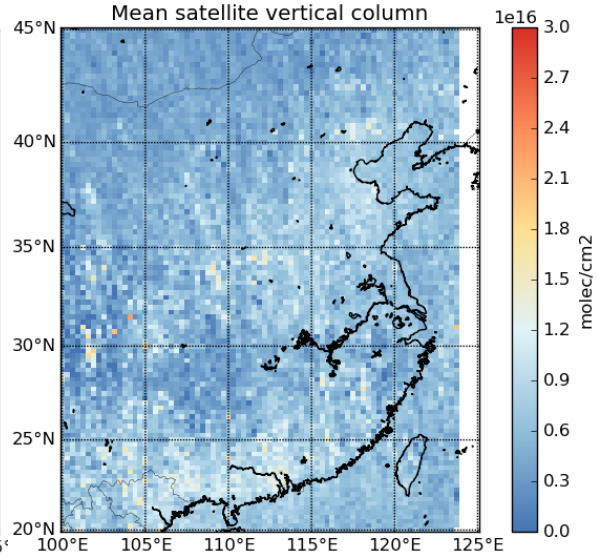
Apr - Jun



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?)**
- **NO_2 columns for 2016/2017**
- **Focus on regional scale modelling**