EGU24-19066, updated on 14 Aug 2024
https://doi.org/10.5194/egusphere-egu24-19066
EGU General Assembly 2024

Integrating Geostationary Satellite Data for Advanced Air Quality Modeling: Evaluating GEMS NRT Observations within the ECMWF's IFS system for the HE CAMEO Project

Zoi Paschalidi[1], Antje Inness[1], Johannes Flemming[1], and Roberto Ribas[2]
[1]European Centre for Medium-Range Weather Forecasts (ECMWF) , Research Department, (zoi.paschalidi@ecmwf.int)
[2]European Centre for Medium-Range Weather Forecasts (ECMWF) , Forecast Department

The advent of new satellite technologies has ushered in a promising era for trace gas and aerosol observations, offering advanced data quality and temporal resolution. Low Earth Orbit (LEO) satellites have markedly heightened our ability to generate accurate air quality forecasts. The Geo-Ring, comprising the geostationary satellites of GEMS over East Asia, TEMPO over North America and the imminent Copernicus Sentinel-4 over Europe, promises to unlock unprecedented possibilities in atmospheric monitoring.

The Horizon Europe CAMEO (CAMS EvOlution) project coordinated by the European Centre for Medium-Range Weather Forecasts (ECMWF) is dedicated to upgrading the quality and efficiency of the Copernicus Atmosphere Monitoring Service (CAMS). By integrating new satellite retrievals of atmospheric composition into the Integrated Forecast System (IFS), CAMEO aims to augment the data assimilation and inversion capabilities of the global and regional CAMS production system, thereby improving the quality of atmospheric composition analyses and forecasts.

During the initial year of CAMEO, the IFS was prepared to assimilate geostationary data alongside polar orbiting retrievals. This integration aims to optimise air quality modeling and provide a more accurate depiction of the diurnal cycle of O3, a pivotal component of atmospheric composition. The assimilation of a substantial volume of geostationary air quality data into the CAMS system poses challenges, necessitating the further development of the super observation software. Following updates to the IFS model and additional technical improvements, experiments were conducted using IFS version CY48R1 and the more recent CY49R1 to monitor and evaluate the Near Real-Time v.2. GEMS NO2 and O3 observations from April to December 2023.

Preliminary results reveal a notable positive bias in the GEMS NO2 tropospheric column data, consistently exceeding the model's first-guess and TROPOMI satellite observations. In urban and populated areas like Beijing, while similarities in structures and patterns of NO2 data between GEMS and TROPOMI are identified, significant discrepancies persist. The GEMS NO2 data also exhibit noticeable noise attributed to factors such as stratospheric correction, cloud treatment, and unspecified measurement errors. In the case of O3, GEMS demonstrates better performance than NO2 when compared to TROPOMI and the model's first guess, with no significant bias

identified. Nonetheless, the current data version features large O3 gaps due to quality control measures. These findings offer crucial insights for refining the assimilation of geostationary air quality data, thereby enhancing forecasting and monitoring of atmospheric composition in CAMS. Upcoming releases, such as v.3. GEMS data, are anticipated to address the identified data issues, further amending the usefulness of the GEMS data for air quality applications.