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Geophysical patterns in tropical tropospheric ozone by TROPOMI, OMI, GOME-2B and ozonesonde

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Ecosystems and human health are severely harmed by elevated concentrations of tropospheric ozone, in the short and the long term. Monitoring ozone at all relevant spatial and temporal scales simultaneously is a challenge for a global observing system due to the large variability of ozone levels in the troposphere. Space-based sensors provide near-global coverage at the synoptic scale, but their accuracy is limited since the large stratospheric O3 column shields the view on the relatively small tropospheric ozone concentrations. In contrast, in-situ soundings by balloons are sparse, but these are more accurate and at a high vertical resolution. As a result, the geophysical information that can be inferred from tropospheric ozone data records differs.

We present a comprehensive comparison of the spatial and temporal patterns in tropical tropospheric ozone column observations by nadir-viewing satellite sensors (Sentinel-5 Precursor/TROPOMI, EOS-Aura/OMI and Metop-B/GOME-2) and ozonesondes for the period 2018-2020. We discuss how each data record perceives well-known structures and cycles such as the zonal wave-one, the seasonal cycle and biomass burning periods. Imprints of (sensor-dependent) sampling characteristics are generally less relevant on large scales. However, these can dominate the uncertainty budget when satellite data are used at their finest sampling resolution. Nonetheless, we recognise the signature of the Madden-Julian Oscillation and hints of Kelvin wave activity.

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