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Ozone assimilation in the UTLS: Value of limb-viewing sounders and resolution-dependent analysis of nadir data

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The paper discusses aspects of the resolution-dependent analysis of ozone satellite data in the Upper Troposphere and Lower Stratosphere (UTLS) region. In this region the sharp positive and negative vertical ozone gradients are frequently observed by insitu measurements and simulated by chemistry-climate models, showing so-called ozone laminas. With sufficient vertical resolution of limb-viewing sensors, such as MLS and HIRDLS on Aura/NASA spacecraft, this information on ozone dynamics in thin vertical layers can be accepted by data assimilation systems constraining layered vertical ozone structures across the tropopause. For these scenes, the ozone-sensitive information from the nadir sensors (SBUV, GOME, TES, AIRS, OMI, IASI) characterized by restricted vertical resolution should be properly projected from the data space to the analysis grid preserving the non-observable (but forecasted) ozone vertical structures. Several illustrations for analysis of nadir-only ozone data (SBUV-2) that can "diffuse" ozone laminas in the extra-tropical UTLS are discussed. To overcome this negative impact of analysis of nadir data, the resolution-dependent analysis schemes (RDAS) of retrievals (characterized by kernels) or/and radiances are suggested. The vertical inverse mapping performed by RDAS ensures constraining only scales observable by data preserving the non-observable short-scale vertical structures of ozone. As illustrated by comparisons of MLS and HIRDLS data with analyzed ozone fields (GEOS-5 and ECMWF), the other geophysical scenes influenced by inadequate assimilation of nadir retrievals may include: a) the high-latitude ozone hole and mini-holes; b) seasonal and quasi-biennial ozone oscillations in the tropical stratosphere; c) movements of high and low ozone air masses across the transport barriers. These comparisons demonstrate the value of MLS and HIRDLS limb data in constraining of ozone for monitoring atmospheric composition and climate. The current plans for analysis of MLS radiance data in GEOS-5 data assimilation system are highlighted along with resolution-sensitive assimilation of ozone partial columns provided by nadir sensors.