Characteristics of multiple tropopauses in data assimilation systems as a context for analysis of satellite-based trace gas measurements

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The extra-tropical tropopause region is dynamically complex, with frequent occurrences of multiple tropopauses and of a "tropopause inversion layer" of enhanced static stability just above the tropopause. This tropopause structure is zonally-asymmetric and time-varying and, along with the UTLS jets, it defines the barriers and pathways that control UTLS transport. Data assimilation systems such as GEOS-5.2 or ECMWF-interim provide realistic temperature, PV and wind fields from which tropopause and jets may be identified. These in turn provide a context in which satellite-based measurements of trace gases in the extra-tropical tropopause region may be understood. Mid-latitude secondary tropopauses are typically extensions of the tropical tropopause across the subtropical jet. They can cover a large region, at times extending poleward beyond 60 degrees latitude, and may reach the polar subvortex, particularly during SSW events. In the upper part of these inter-tropopause layers, above the layer of enhanced static stability, air is found to have characteristics suggesting low-latitude, often tropospheric, origin. We examine MLS, HIRDLS and ACE-FTS UTLS trace gas profiles in the context of extra-tropical tropopause and UT jet structures identified from GEOS-5 fields to gain understanding of UTLS trace gas distributions and transport barriers. Some comparisons will be made with products from other data assimilation systems.

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