



Deriving the Stratosphere-Troposphere Exchange of Ozone (2007-2010): Reanalyses vs. Observations.

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Motivation

Stratosphere-troposphere exchanges (STEs) of ozone impact the global tropospheric ozone budget and surface ozone levels. However, modern reanalyses show considerable uncertainty in ozone STEs. This study derives STEs of air mass and ozone using observational datasets from COSMIC-1 (temperature), Aura MLS (ozone), and CALIPSO/CloudSat/MODIS (radiation fields). We compare these results with MERRA2 and ERA5 STEs across three regions.^{3,4,5}

Key Points

- Discrepancies in reanalysis derived STE of ozone demands validation against observational datasets.
- The accurate temperature profiles with high vertical resolution from radio occultation are a key component in accurately deriving the STE of ozone from observations.

Data and Methods

We employ a **mass-budget approach with a fitted isentropic surface** to derive the net flux across the tropopause.^{1,2}

$$F_{trop_net} = \frac{dO_3}{dt} + F_{FI} - CTO_3$$

The diabatic flux across the fitted isentropic surface is defined by,

$$F_{FI} = \iint Q\sigma O_3 dA$$

Where Q, diabatic heating and σ , isentropic density are as follows,

$$Q = R(\theta/T) \quad \sigma = -g(\partial p/\partial \theta)$$

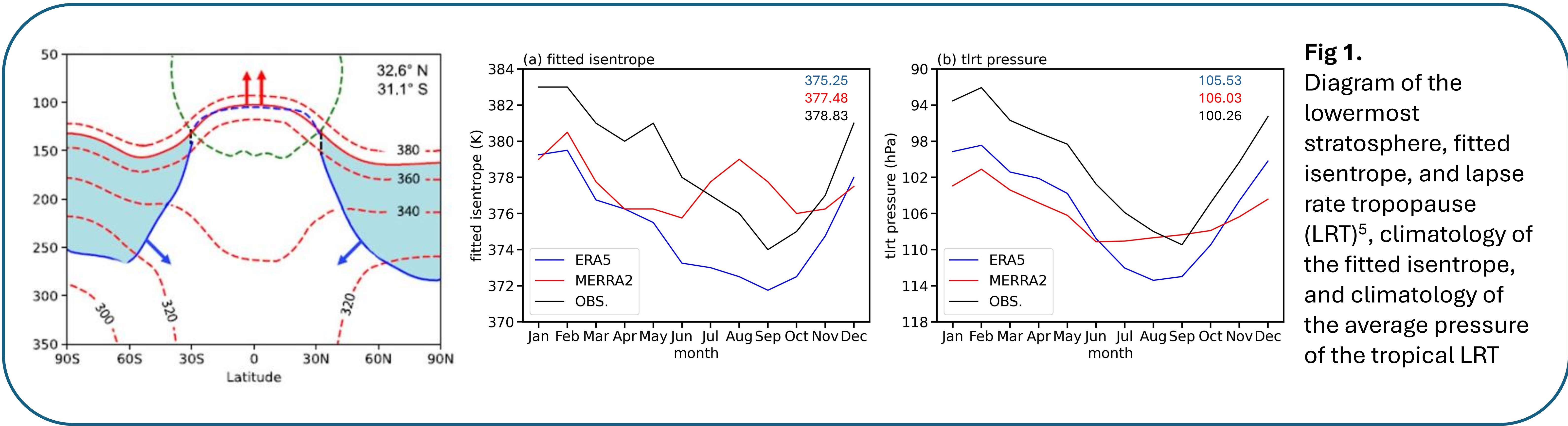


Fig 1. Diagram of the lowermost stratosphere, fitted isentropes, and lapse rate tropopause (LRT)⁵, climatology of the fitted isentropes, and climatology of the average pressure of the tropical LRT

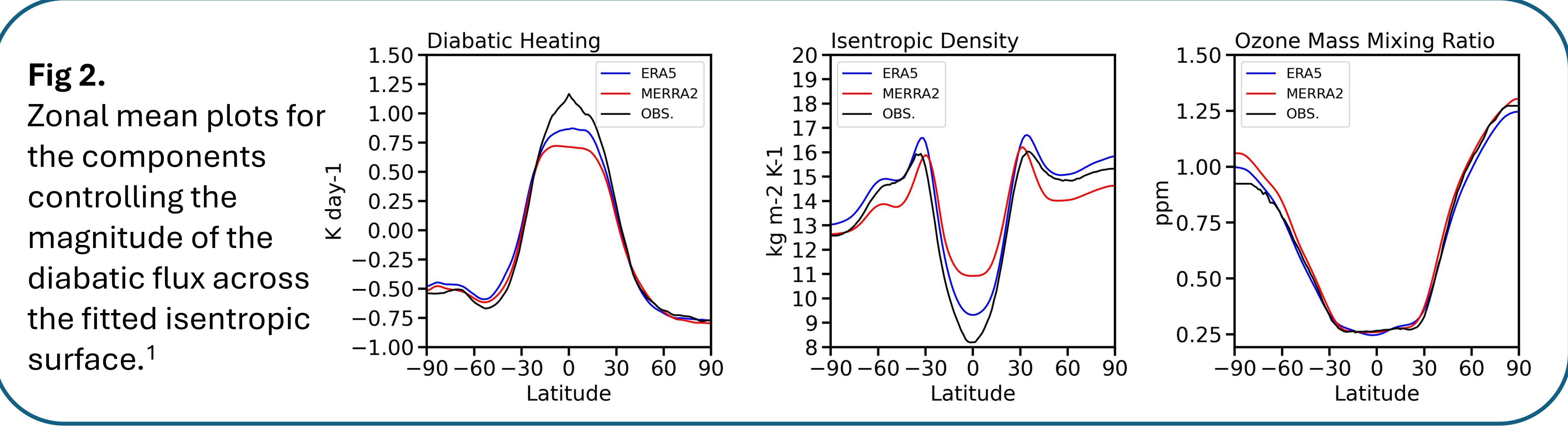
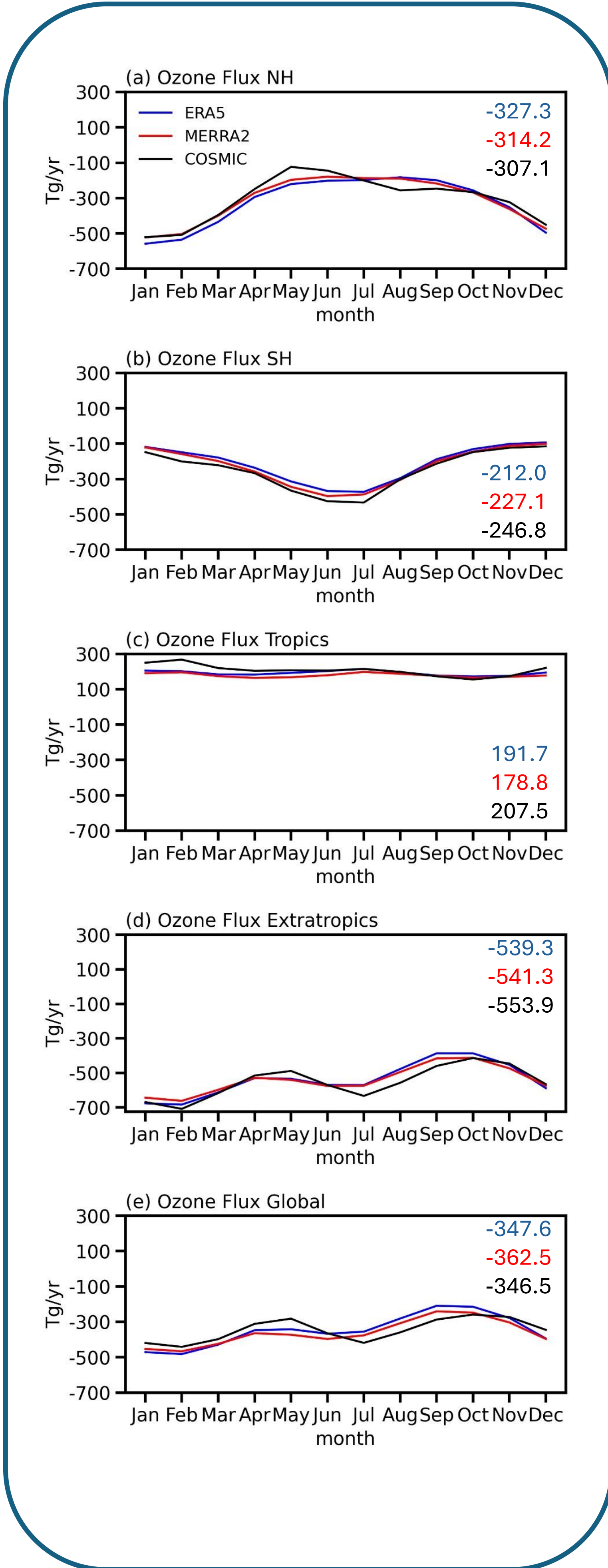


Fig 2. Zonal mean plots for the components controlling the magnitude of the diabatic flux across the fitted isentropic surface.¹

- ## Future Work
- Get radiative heating rates using observations including temperature profiles from RO
 - Re-derive the STE of air mass and ozone using our newly obtained radiative heating rates.
 - Expand the observationally derived STE to longer time periods

Fig 3. Climatologies of observationally derived STEs of ozone compared to those derived from reanalyses from 2007 to 2010 for 5 regions.

References

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