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Comparison of Vertical Distribution of Ozone Profiles between Ozonesondes and the GMI Merra II model

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NOAA has completed a homogenization using consistent reprocessing of the long-term vertical ozonesonde profile record which includes ozonesonde uncertainty (Sterling et al., 2018). In this work we used an hourly Hindcast simulation of the NASA Global Modeling Initiative (GMI) chemistry transport model (CTM, PI S. Strahan) to show the relative bias with the vertical distribution of the homogenized ozonesonde profiles. The vertical resolution for ozonesondes and the GMI model are 0.1 and 0.75 km, respectively. In this study we used pressure interpolation with roughly a 1.0 km vertical resolution for all comparisons. We summarized the bias of the ozone mixing ratio with the GMI model at Boulder, CO (BDR) and Mauna Loa Observatory, HI (MLO) and South Pole, Antarctica (SPO) since 1985.

1. Difference between Ozonesonde and GMI model

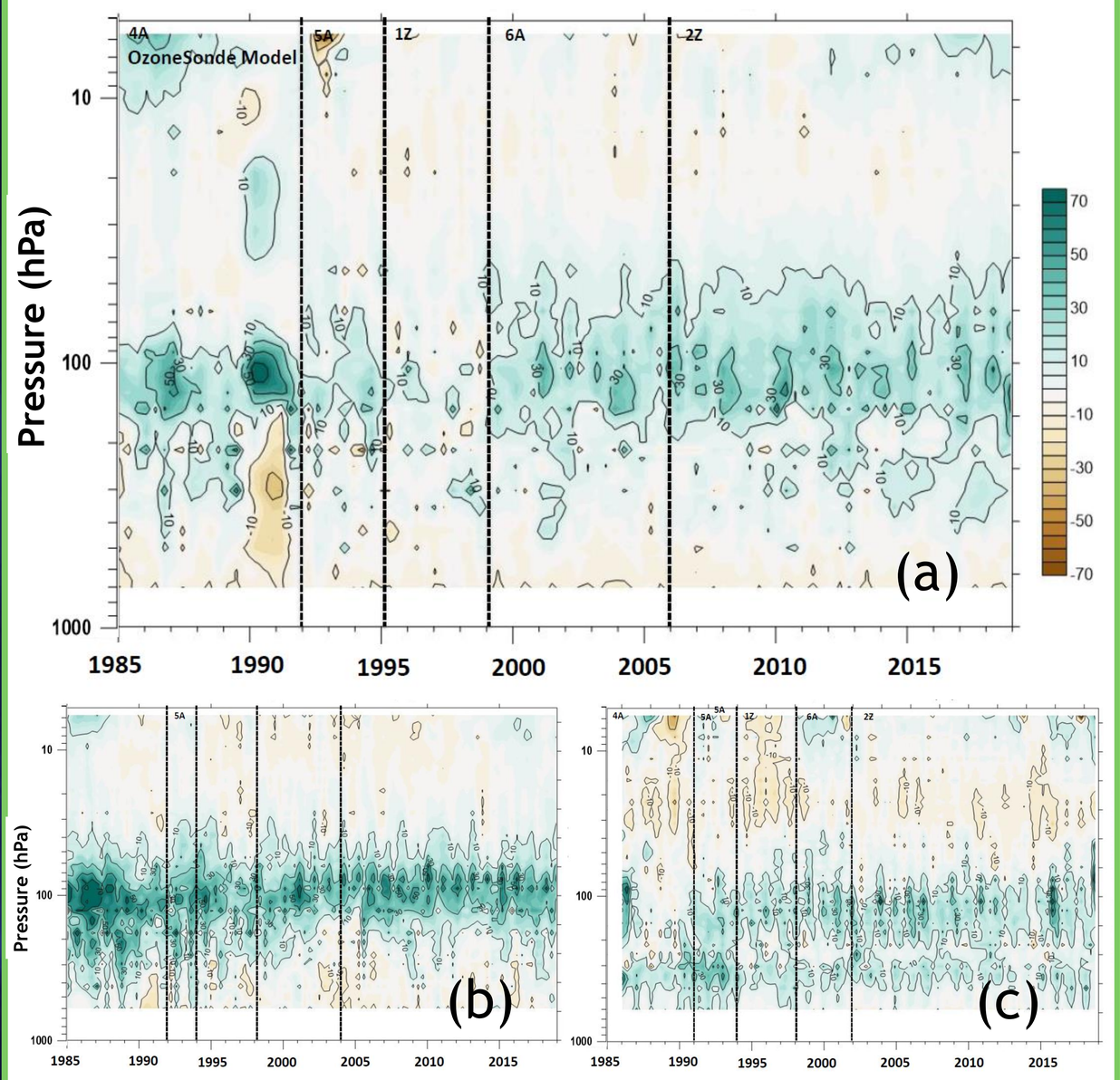

Figure 1. Shown above are the percent differences (GMI-SND) in the ozone monthly mean time series between the GMI model (Ver.2) and ozonesonde observations. The vertical bars denote an ozonesonde model change. The time series is from 1985 to 2018. The ozonesonde matched within 1 hour with GMI. (a) BDR (b) Hilo (c) SPO.

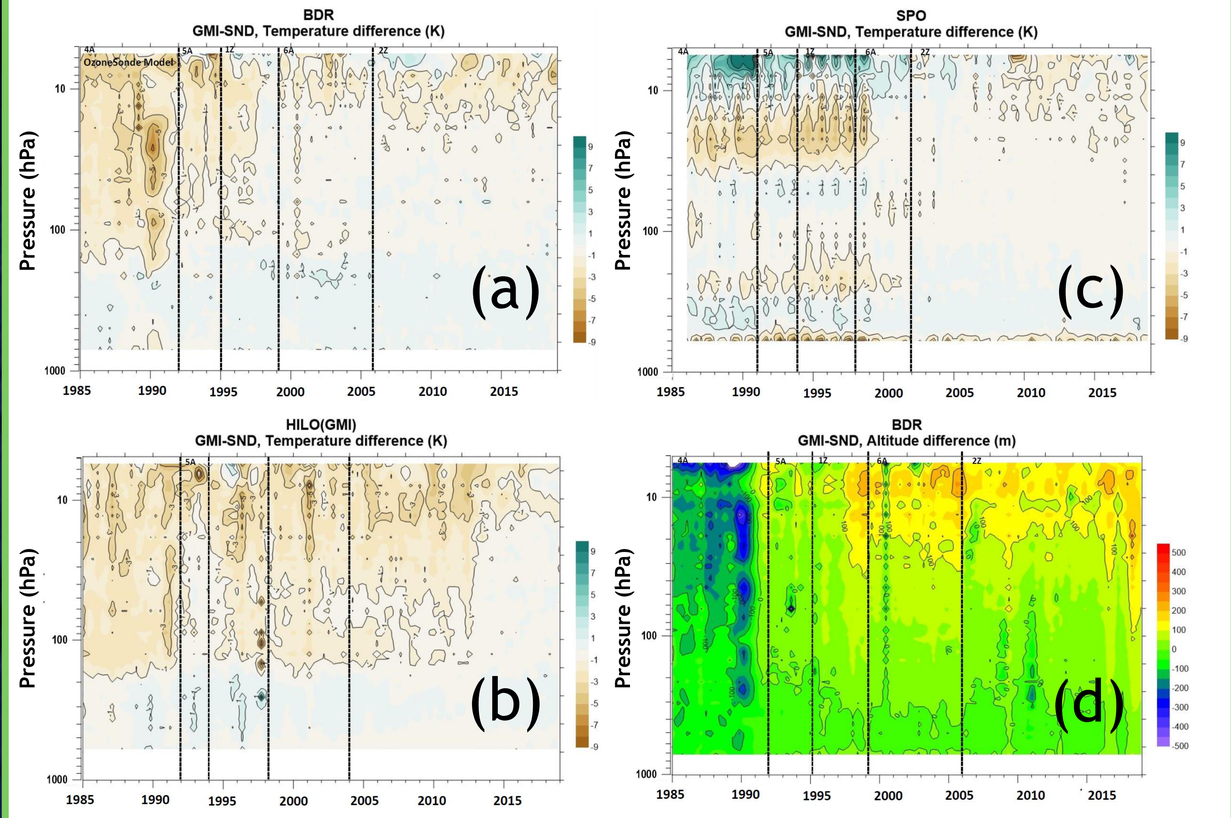

Figure 2. Same as Figure 1, but temperature and altitude difference are shown. (a) temperature in BDR, (b) in Hilo, (c) in SPO , (d) altitude in BDR.

2. Cross-Correlation obtained in different periods

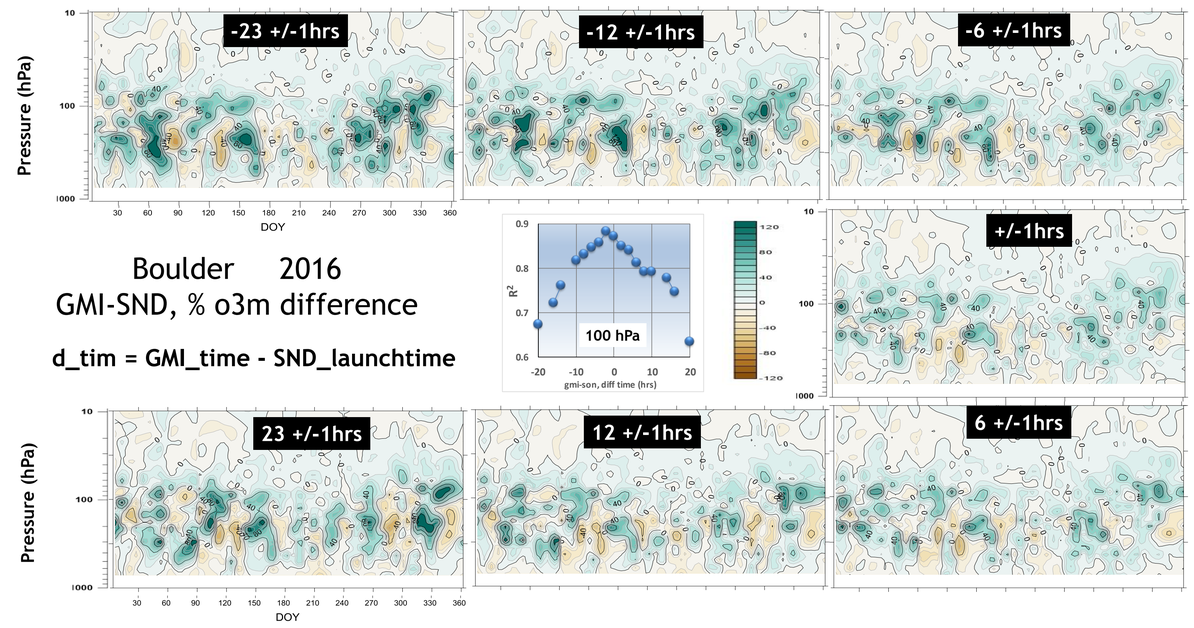

Figure 3. Based on ozonesonde launching time, correlation with the different periods of GMI model hours is shown in Boulder.

3. Discussion and Conclusions

- The bias is approximately 30% around the tropopause (~100 hPa) where ozone values have quick transitions from low to high concentrations in a short vertical range.
- The model shows good agreement above and below the area surrounding the tropopause.
- Different models of ozonesondes have been used throughout the record and show these transitions along with the biases that still remain even after homogenization.
- However, the GMI model may still have bias before and after 2000 in the troposphere (see Fig. 4, 7).

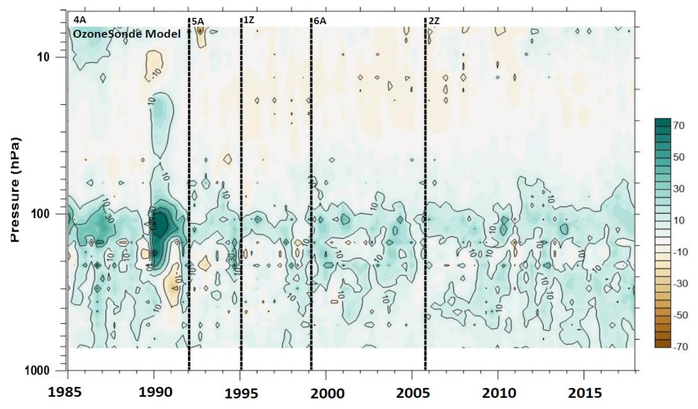

Figure 4. Same as Figure 1a, but shown by different M2GMI ozone based on the GMI chemistry model.

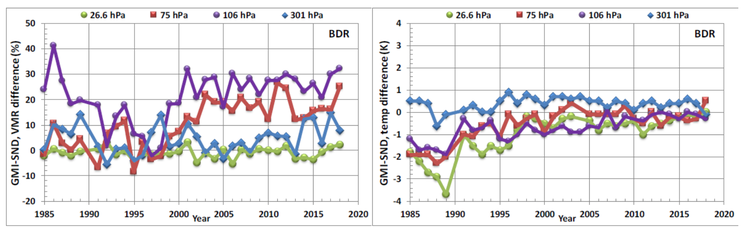

Figure 5. Time series of ozone and temperature in yearly average difference from GMI model in BDR.

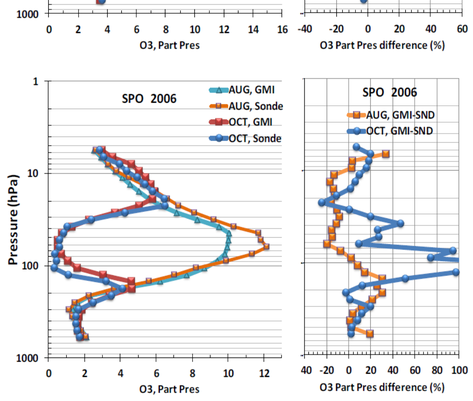

Figure 6. Case study of the profile of ozonesonde and GMI model.

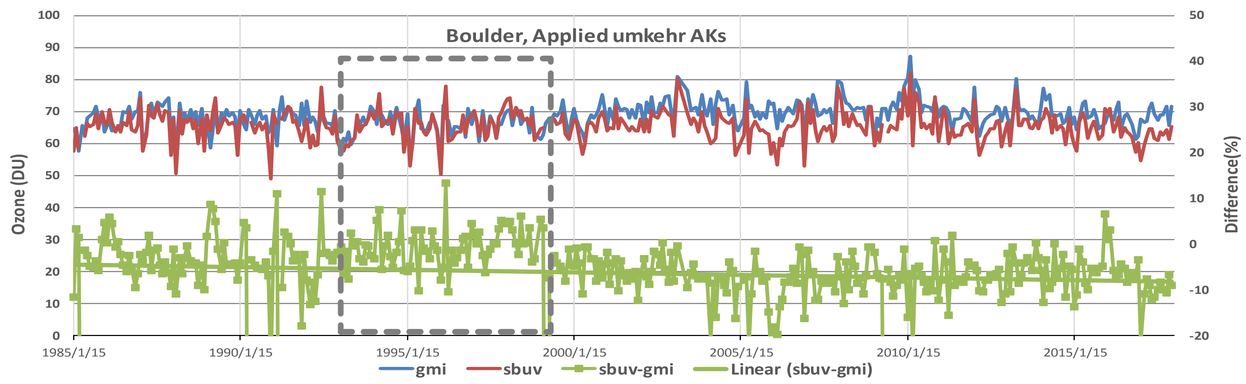

Figure 7. Time series of the SBUV ozone and GMI model at Umkehr layer 4 (63~32 hPa). The ozone value applied smoothing using Umkehr AKs.