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A Comparison of Ticosonde-SHADOZ Ozone Profiles to Large-Scale Analyses and Satellite Data

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ECC ozone profiles have been made by the Ticosonde/SHADOZ project in San José, Costa Rica [10°N, 84°W] since July 2005 on a near-weekly basis. We use them here to assess the fidelity of the MLS v4.2 ozone profiles in the UT/LS as well as profiles from the NASA MERRA2 reanalysis and the NASA GMI CTM.

For the statistical comparisons here, each of the large-scale datasets is sampled on sonde dates over a 4° x 16° region centered at San José. At most levels, there are approximately 400 ECC-pairings in each comparison.

10-year average ECC and MLS v4.2 O_3 profiles at Costa Rica

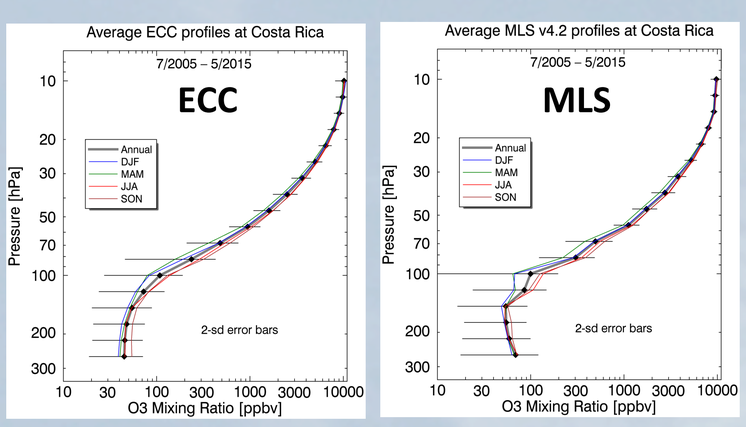

Fig. 1: **(left)** Year-round and and seasonally-stratified averages of [10°N, 84°W], 7/2005-5/2015; **(right)** same as (left), but for MLS 4° x 16° cluster medians, sampled on ECC dates (up to 398 pairs)

MLS/ECC variability comparison and percentage differences

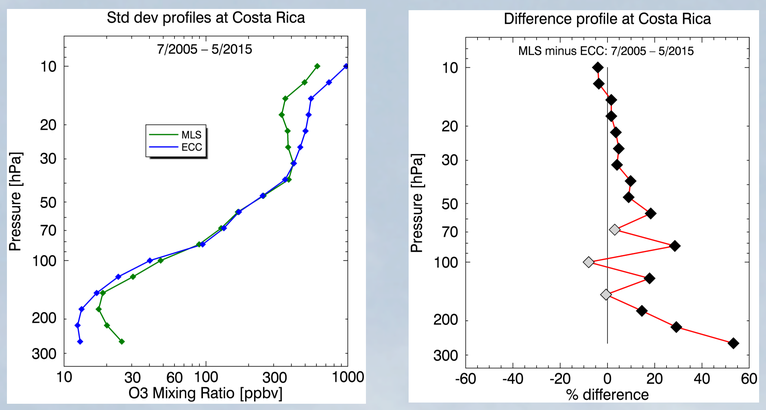

Fig. 2: **(left)** Profiles of year-round standard deviations of ECC (blue) and MLS cluster medians (green); **(right)** average (year-round) MLS minus ECC, in percentage difference. Black diamonds are significant at 99.9%.

Pressure level timeseries and scatter of MLS and ECCs

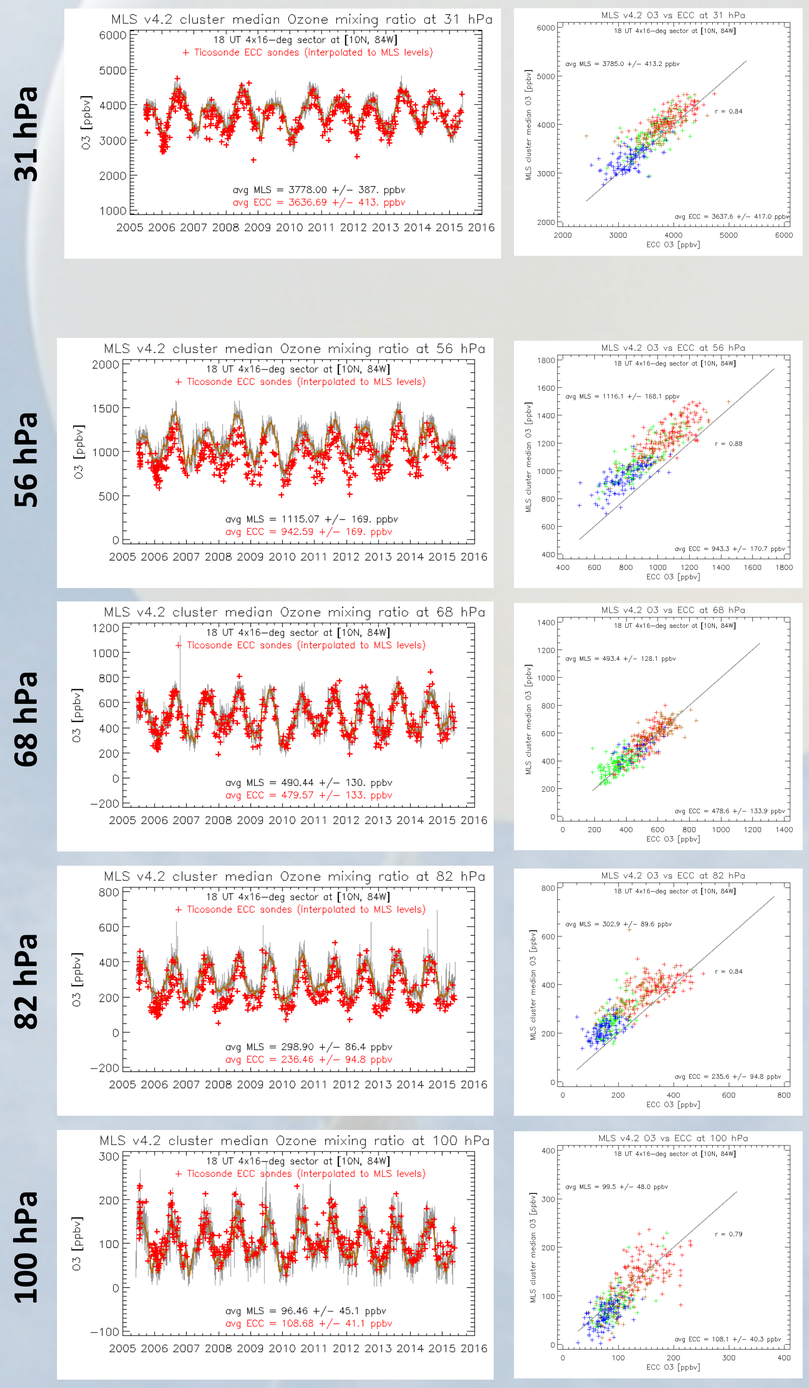

Fig. 3: (left) Full MLS cluster timeseries at 31 hPa and 56-100 hPa with ECC superposed; **(right)** Scatter diagram of MLS clusters vs ECC, color coded for season: DJF/MAM/JJA/SON; MLS vertical axis, ECC horizontal.

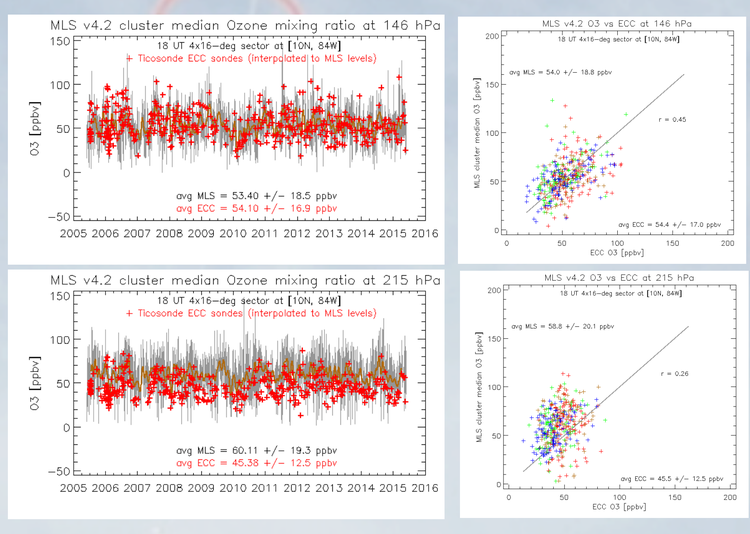

Fig. 4: As in Fig. 3, but for 146 and 215 hPa.

MAIN POINTS:

(1) MLS v4.2 has reduced though not entirely eliminated the oscillatory behavior in MLS v3 in lower stratosphere.

(2) MLS increases downward in the troposphere. Not observed in the soundings.

(3) Throughout the lower stratosphere, MLS and ECC variablity are comparable.

(4) MLS v4.2 and ECC are well, even tightly, correlated in the lower stratosphere despite oscillation of the mean MLS with height.

(5) MLS cannot follow ECC at 215 hPa, but clearly does better at 146 hPa.

(6) GMI CTM does better than the reanalysis in the upper troposhere.

The MERRA-2 ozone profiles are an assimilated quantity, and MLS ozone is a primary input. Therefore MERRA-2 profiles should exhibit many of the features seen in the MLS profiles. Differences from MLS should be attributable to the effects of the three-dimensional wind fields. The GMI CTM does not assimilate ozone. Instead, the ozone field is driven by off-line chemistry and the internal dynamics of the model.

10-year average MERRA2 and GMI profiles

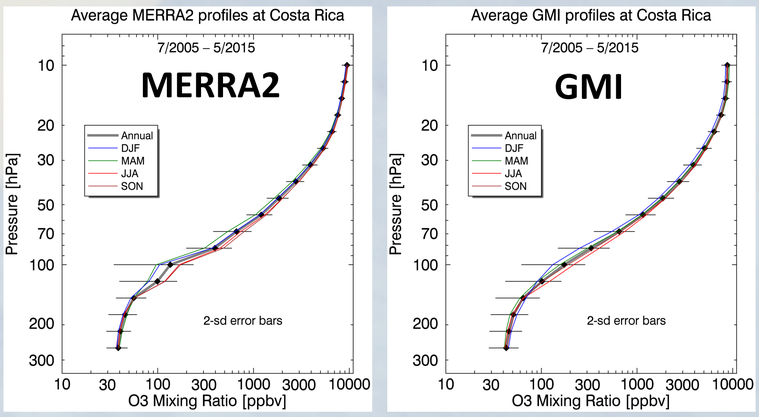

Fig. 5: (left) Average of MERRA2 4°x 16° sector means centered at Costa Rica and sampled on ECC date; **(right)** Same as (left) but for GMI hindcast run

MERRA-2 and GMI vs ECC

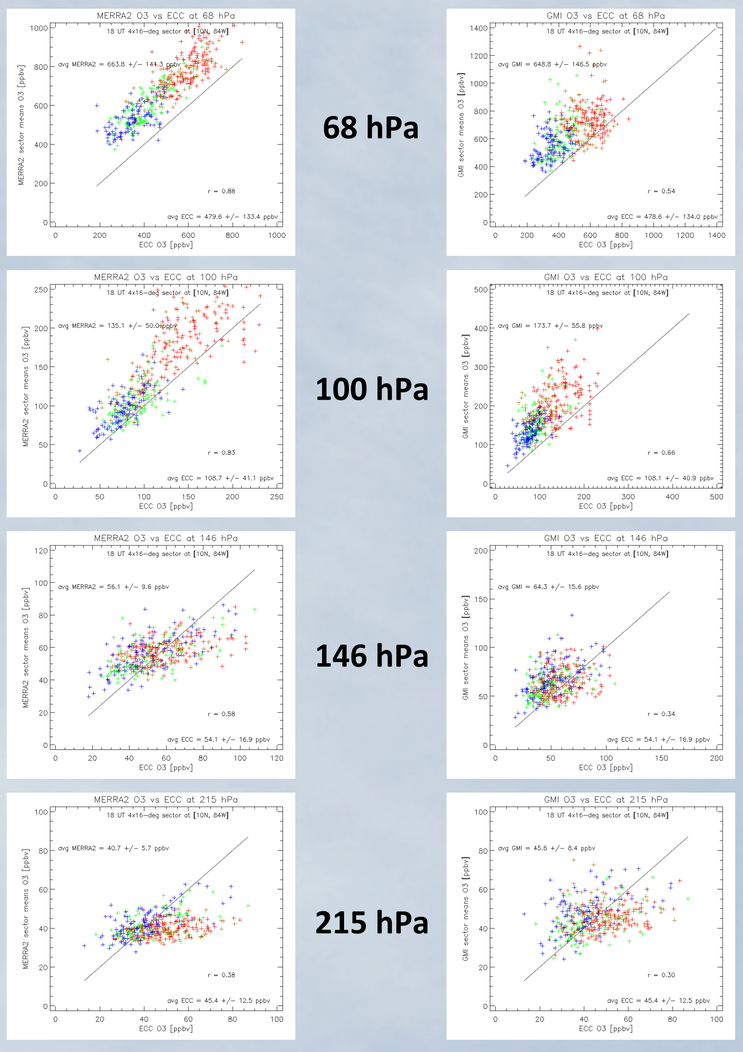

Fig. 6: Scattergrams as in Figs. 3 and 4, but for MERRA-2 (left) and GMI (right).

(7) Despite very different factors affecting ozone, <u>both</u> the CTM and the reanalysis are biased high in the lower stratosphere.

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