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Assimilating Compact Phase Space Retrievals (CPSRs): Comparison with Independent Observations (MOZAIC in situ and IASI CO retrievals) and Extension to Assimilation of Truncated Retrieval Profiles

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Assimilation of atmospheric composition retrievals presents computational challenges due to their high data volume and sparce information density. Assimilation of compact phase space retrievals (CPSRs) meets those challenges and offers an innovative new approach for assimilating satellite observations for air quality analysis and prediction. Comparison of CPSR assimilation results with assimilated observations (MOPITT CO) and with independent observations (MOZAIC in situ CO and (IAIS CO) shows that they perform as well or better than assimilation of raw or quasi-optimal retrievals (reductions of ~60% for root-mean square error (RMSE) and bias when compared to assimilation of raw retrievals) at a substantially reduced computational cost (reductions of ~35% for MOPITT CO and ~50% for IASI CO). CPSRs offers great promise because they can be applied to any retrieval profile obtained by optimal estimation.

One result from the independent observation comparisons is that assimilation of MOPITT CO CPSRs degrades the fit/skill in the upper troposphere (p < 300 hPa) when compared with not assimilating MOPITT CO and verified against IASI CO. That result is likely due to the assimilation of biased retrievals in the upper troposphere. In this talk, we propose discarding/not assimilating the biased retrievals and extending CPSRs to assimilation of truncated retrieval profiles. Our results show improvement in the upper troposphere but degradation in the middle and lower troposphere. That degradation is likely due to: (i) ~17% reduction in the information content of the assimilated observations, and (ii) substantial reduction in the amplitude of the transformed averaging kernels (reductions of ~70% for Mode 1, ~18% for Mode 2, and ~6% for Mode 3).