

Supplementary Materials of

Derive the error profile of the combined product:

Step1: calculate the max and min of MLS retrieval profiles in all pressure levels.

$$\max(X_{MLS}) = X_{MLS} + \varepsilon_{MLS},$$

$$\min(X_{MLS}) = X_{MLS} - \varepsilon_{MLS},$$

$$\max(\ln(X_{TES})) = \ln(X_{TES}) + \ln(\varepsilon_{TES}),$$

$$\max(X_{TES}) = e^{\ln(X_{TES}) + \ln(\varepsilon_{TES})},$$

$$\min(\ln(X_{TES})) = \ln(X_{TES}) - \ln(\varepsilon_{TES}),$$

$$\min(X_{TES}) = e^{\ln(X_{TES}) - \ln(\varepsilon_{TES})},$$

where X is retrieval profile, ε is the error profile of the X ("O3Precision" in MLS and TES files), \max and \min are upper limit and lower limit of the variable, respectively.

Step2: calculate the maximum and minimum values for error profiles of the combined profiles by substituting the max and min of error profiles of MLS and TES retrievals into the combination algorithm derived in this study.

$$\max(X_{combined}) = F(\max(X_{MLS}), \max(X_{TES})),$$

$$\min(X_{combined}) = F(\min(X_{MLS}), \min(X_{TES})),$$

where F is the combination algorithm.