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Supplement of

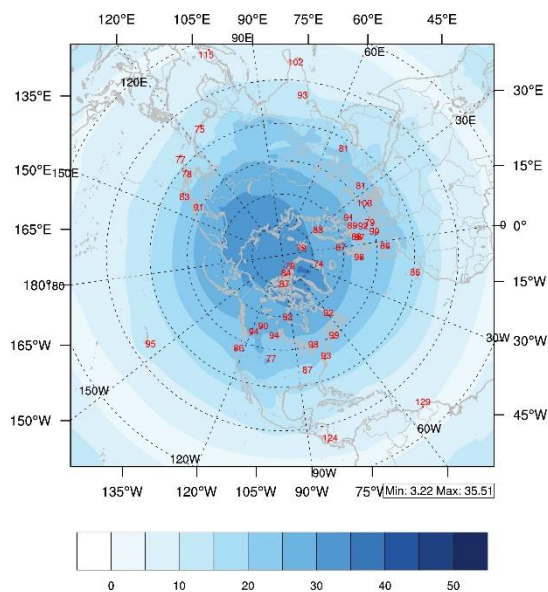
Representing the effects of stratosphere–troposphere exchange on 3-D O₃ distributions in chemistry transport models using a potential vorticity-based parameterization

Jia Xing et al.

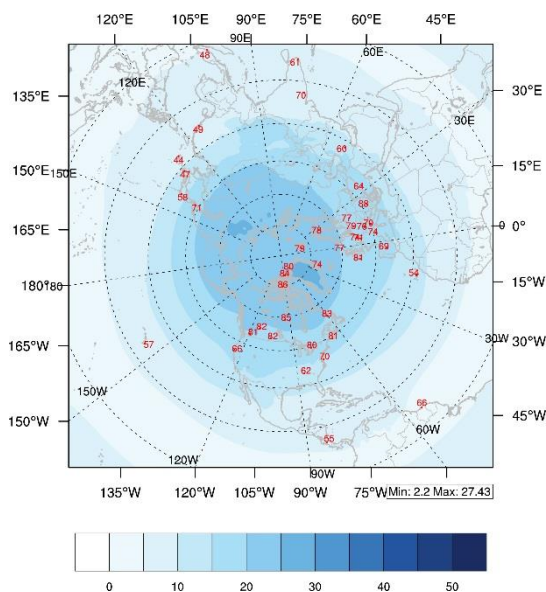
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1st (top) layer (mid-layer pressure=58hPa)



2nd layer (mid-layer pressure=76hPa)



3rd layer (mid-layer pressure=95hPa)

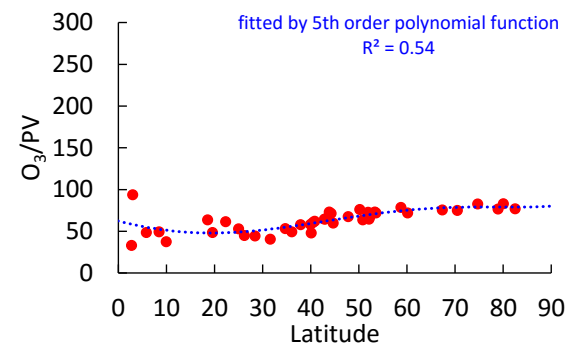
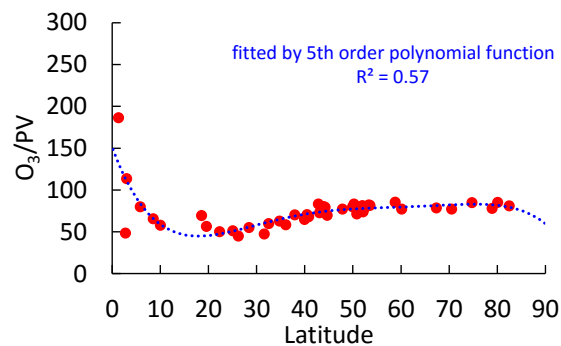
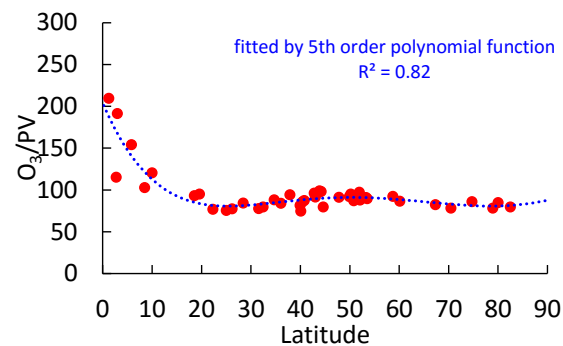
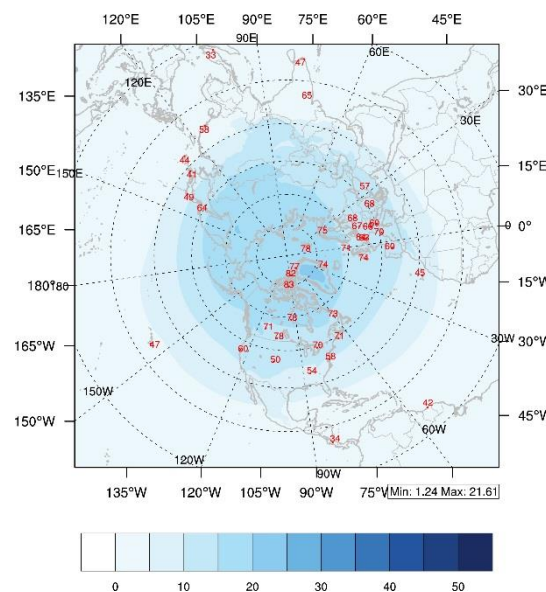


Figure S1 Sensitivity of O₃/PV to spatial location (1st row: background represents the value of PV in PVu averaged for 1990-2010, dots represents the ratio of O₃/PV in ppb/PVu; 2nd row: scatter plot of O₃/PV vs latitude)

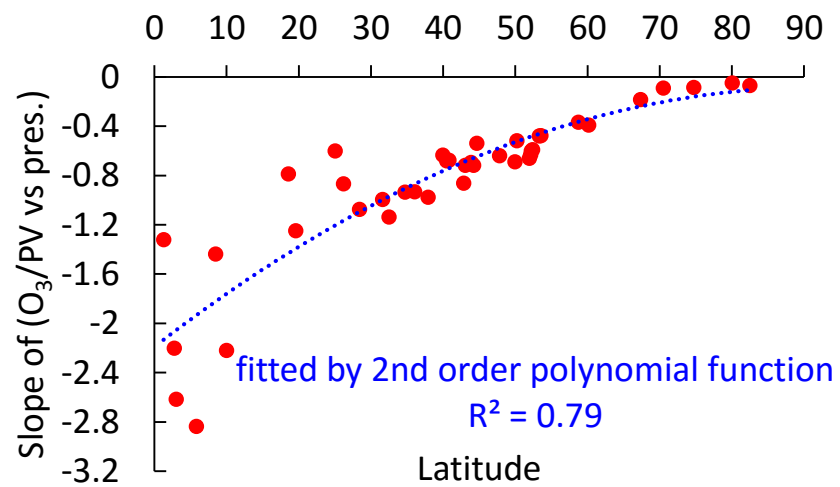


Figure S2 Correlations between the slopes of O₃/PV vs pressure (in hPa) and latitude

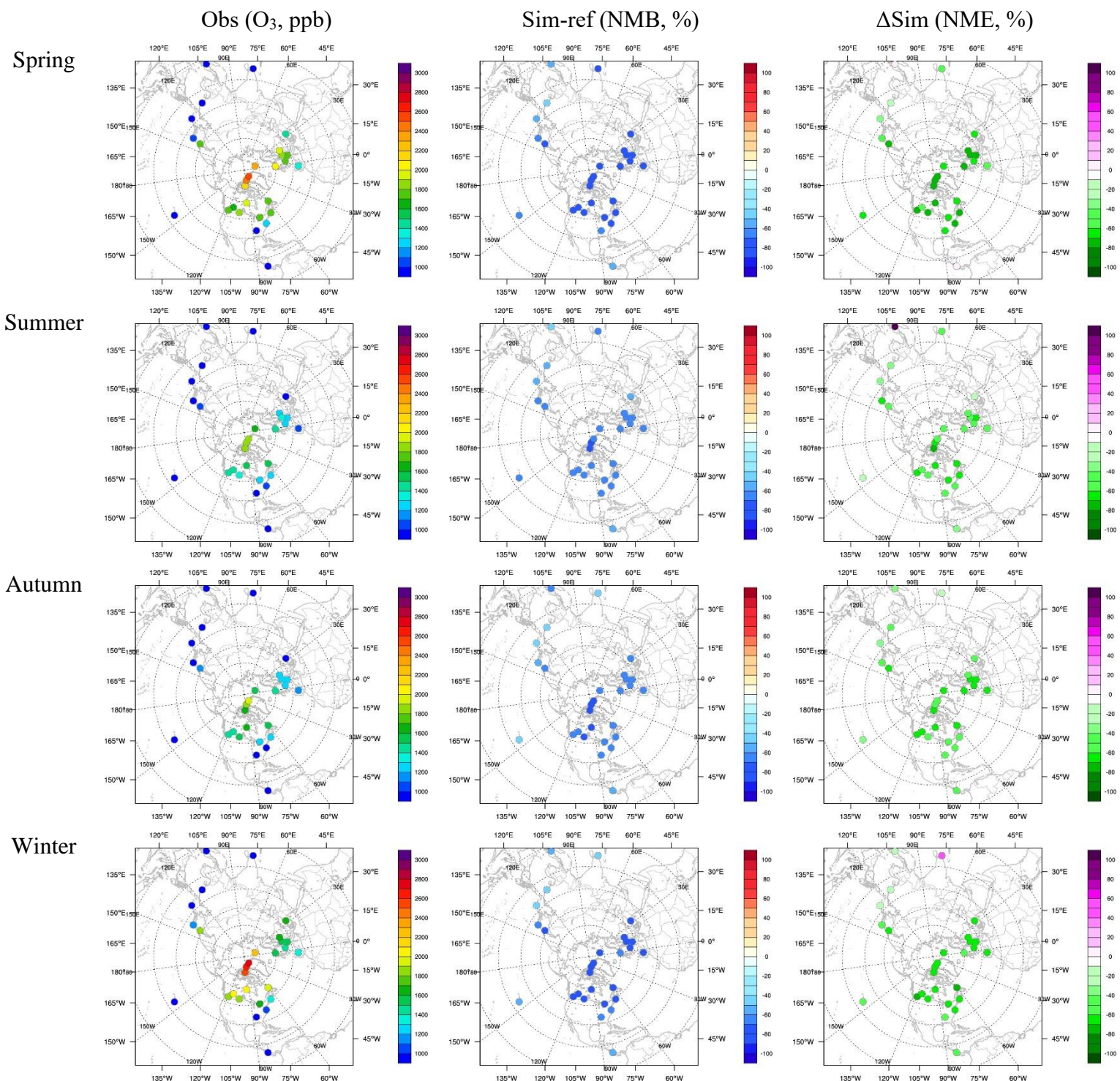


Figure S3 Comparison with WOUDC O₃ sonde at high layers (Pressure < 100hPa)
 (ΔSim= Sim-new minus Sim-ref in NME)

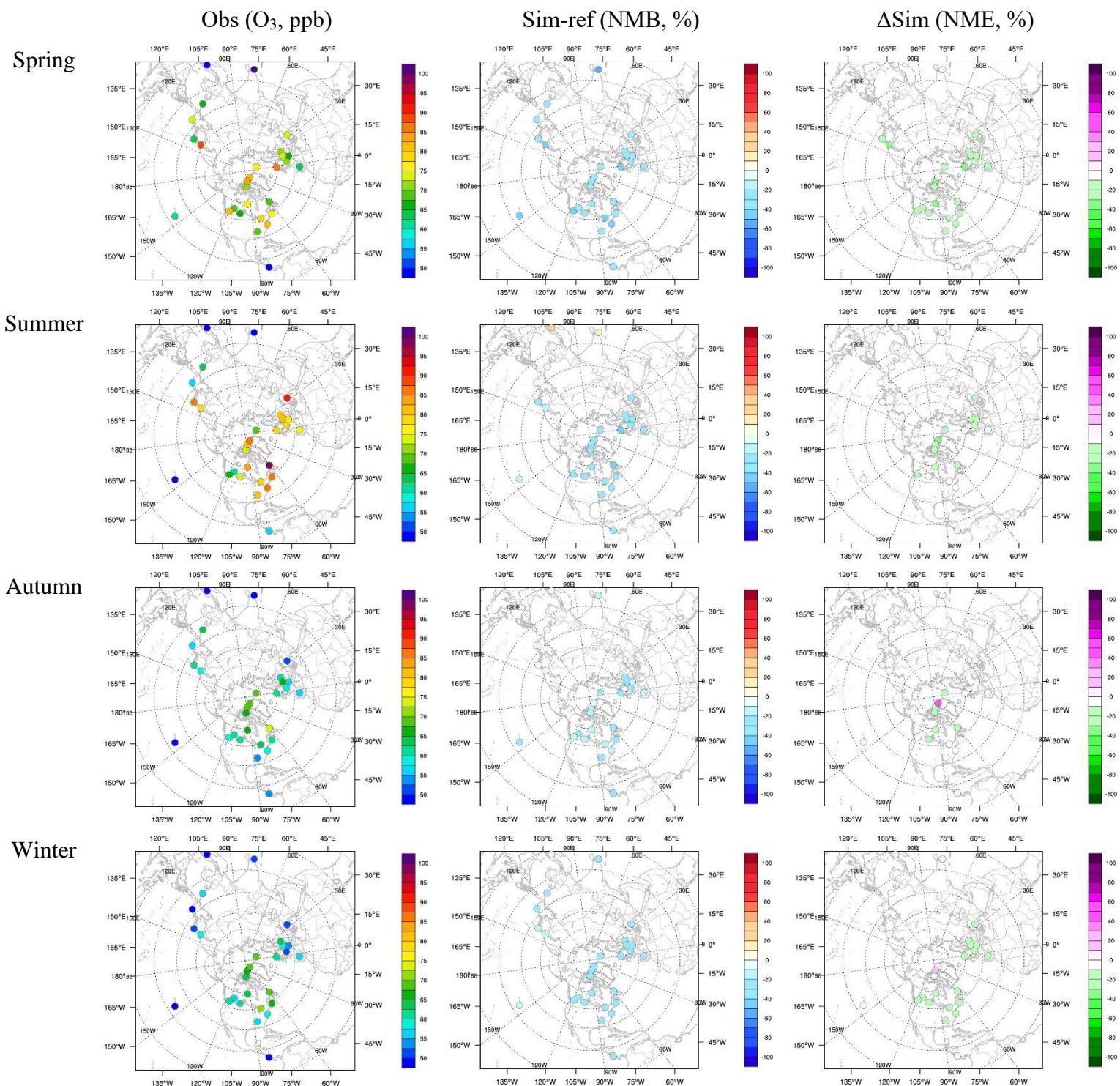


Figure S4 Comparison with WOUDC O₃ sonde at middle layers (300hPa < pressure < 500hPa)
 (ΔSim = Sim-new minus Sim-ref in NME)

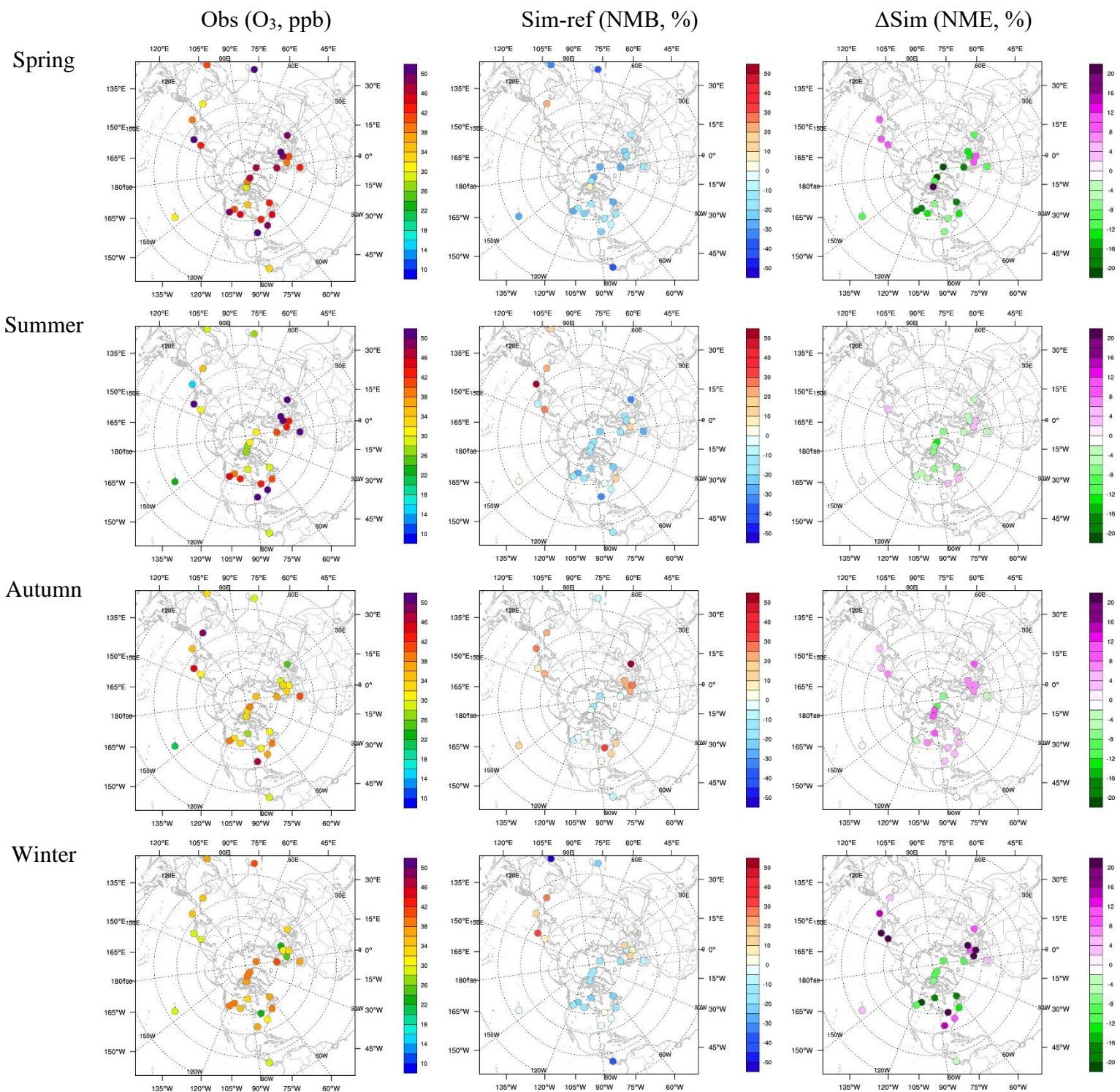


Figure S5 Comparison with WOUDC O₃ sonde at low layers (Pressure > 800hPa)
 (ΔSim= Sim-new minus Sim-ref in NME)

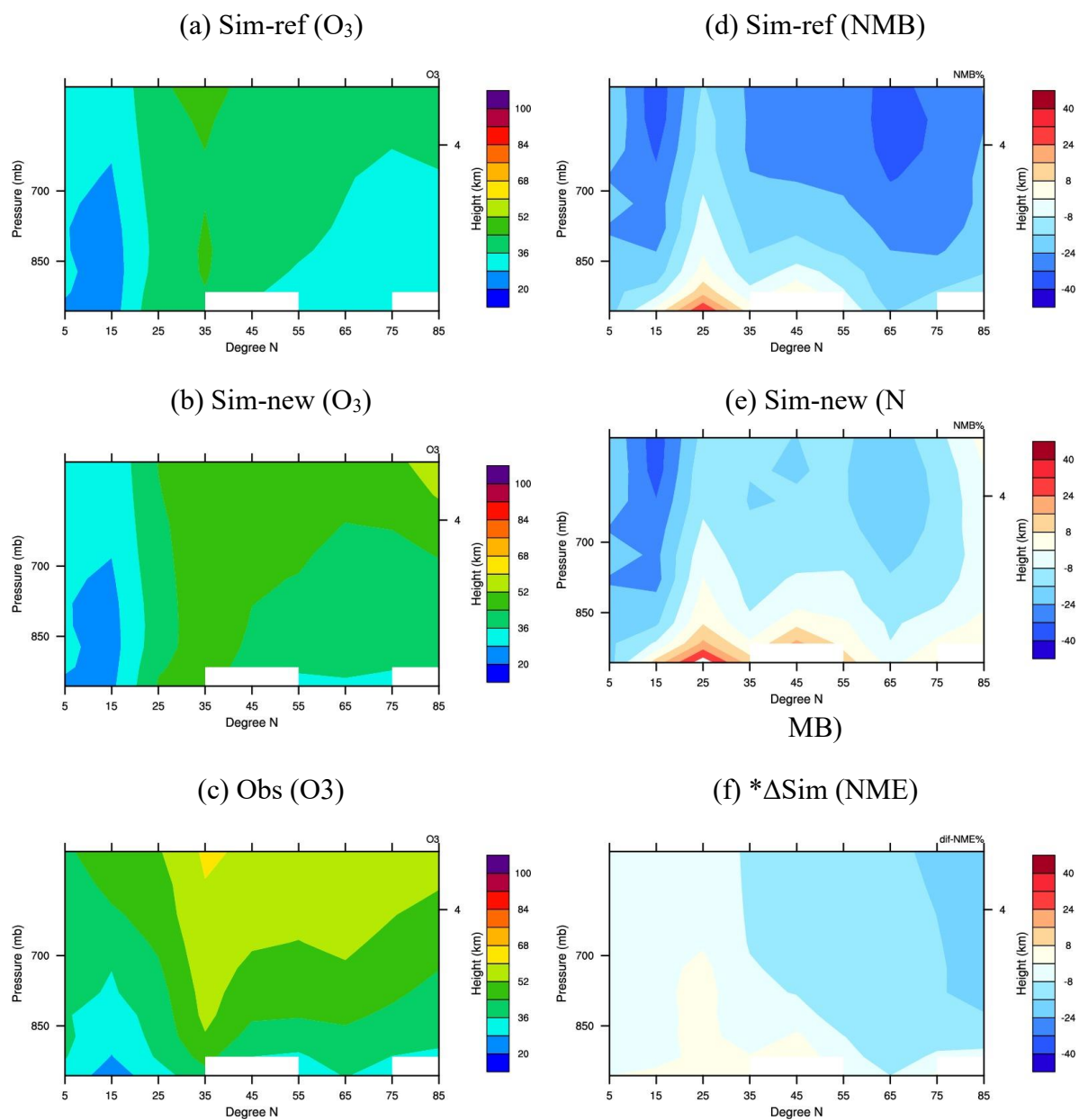


Figure S6. Zonal mean profiles of ozone and error metrics for the different cases in free troposphere (pressure > 500 mb). (a) Simulated ozone profile in reference case; (b) Simulated ozone profile in new case with updated O_3 -PV parameterization; (c) Observed ozone profile, the annual mean of measurement time period for each WOUDC site across the northern hemisphere; (d) Normalized Mean Bias in the reference simulation; (e) Normalized Mean Bias in the new simulation with updated O_3 -PV parameterization; (d) Difference in Normalized Mean Errors between the new simulation and reference simulation (unit: ppb, 2006 Jan-Dec; NMB- Normalized Mean Bias; NME- Normalized Mean Error; $*\Delta\text{Sim} = \text{Sim-new} - \text{Sim-ref}$ in NME)

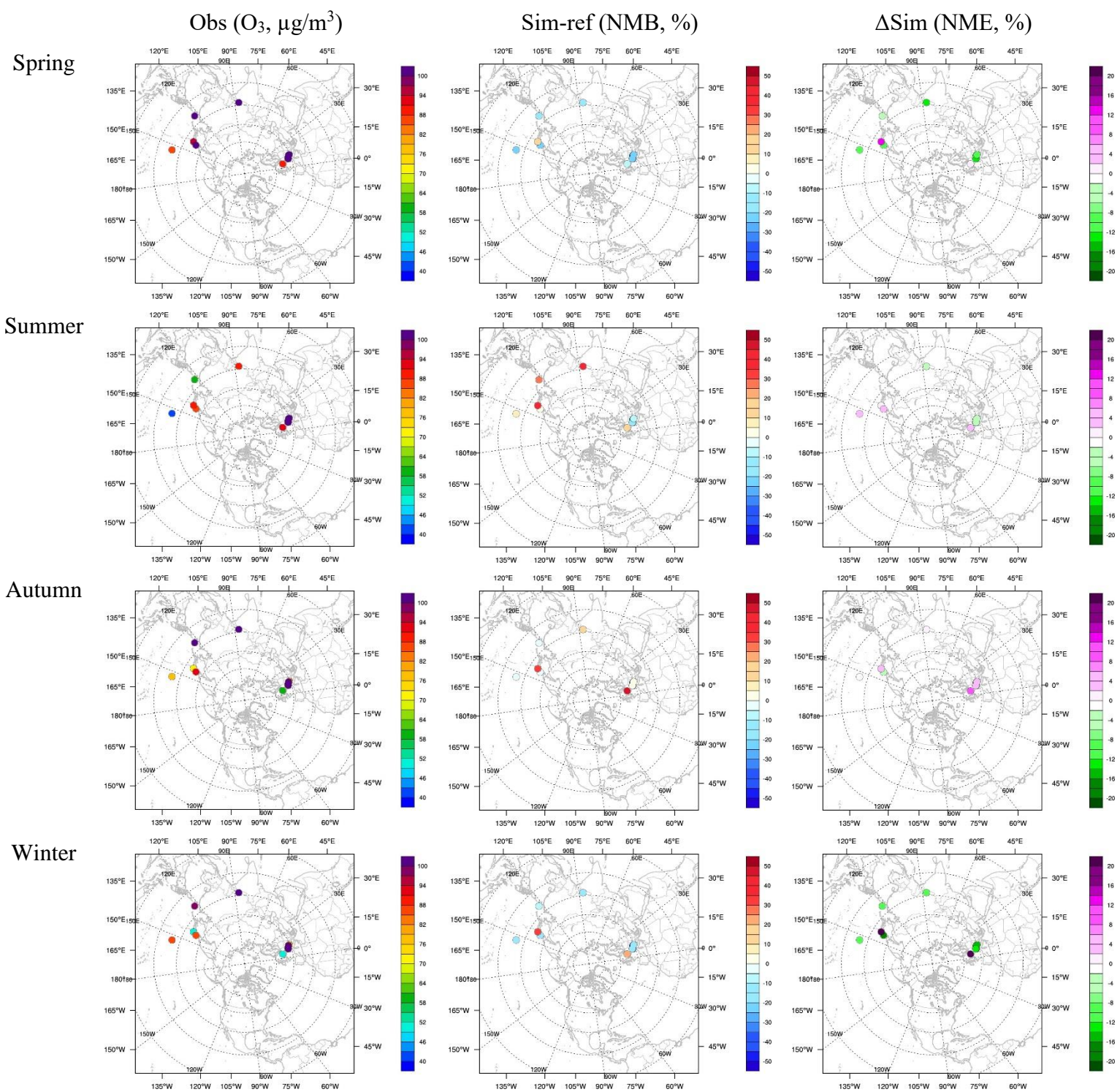


Figure S7 Comparison with WDCGG surface daily maximum 8-h average O₃ concentration (ΔSim= Sim-new minus Sim-ref in NME)

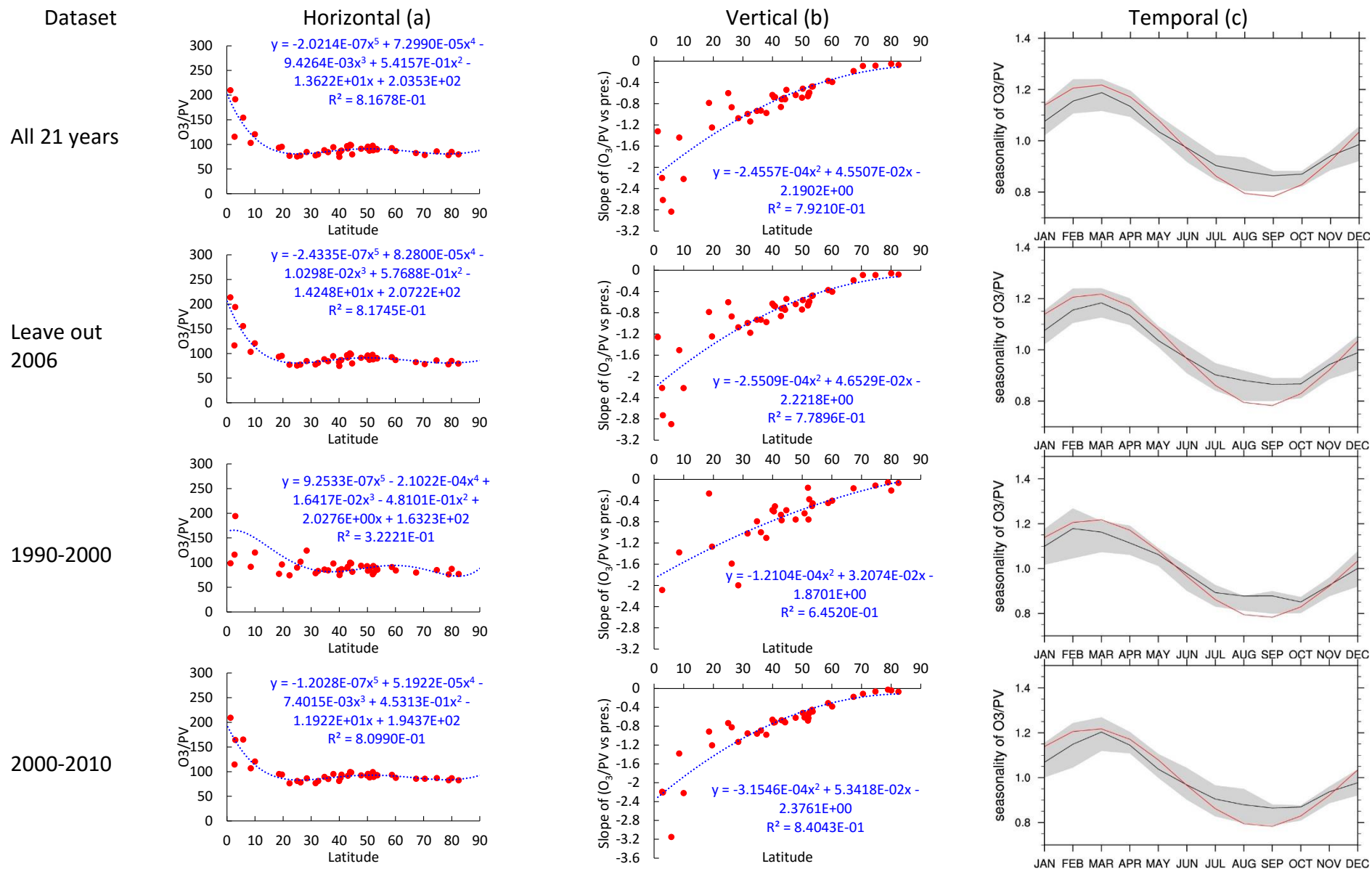


Figure S8 Sensitivity analysis for the PV function

