



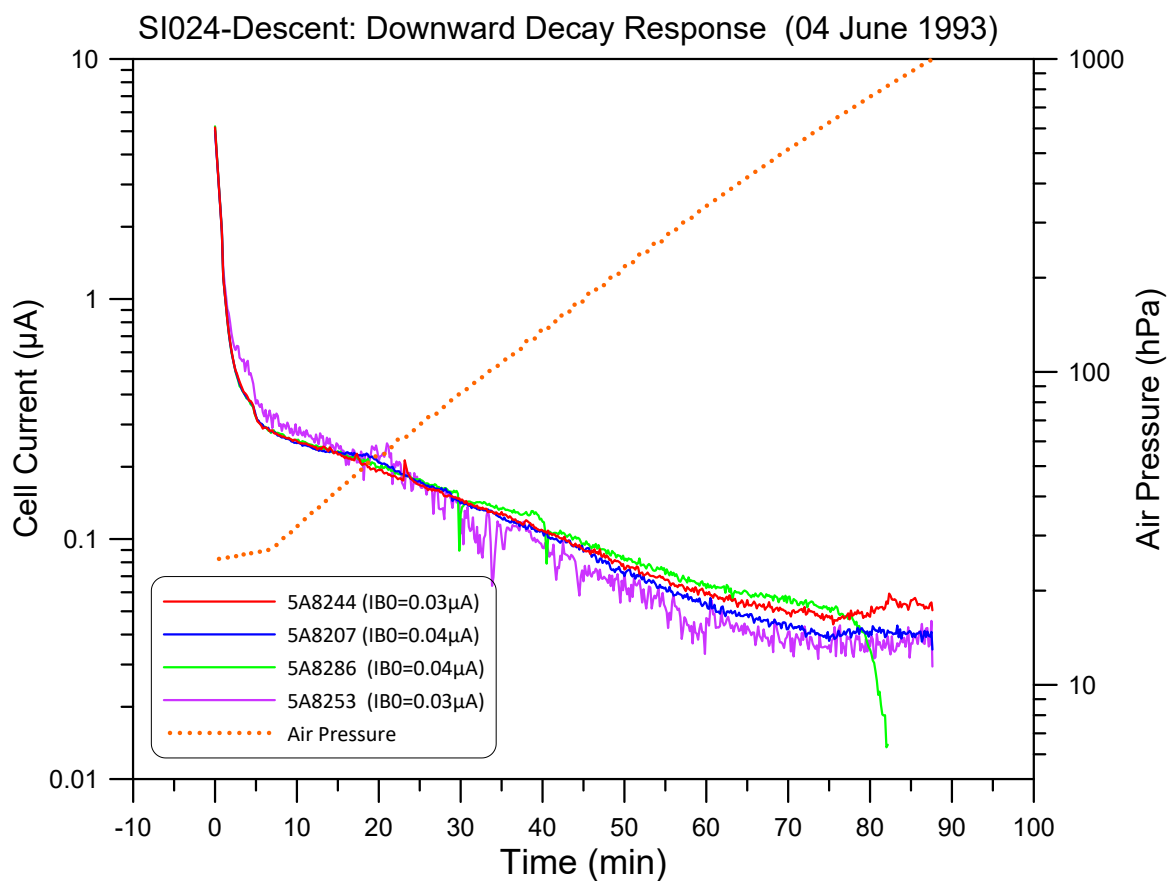
*Supplement of*

## **New insights from the Jülich Ozone Sonde Intercomparison Experiment: calibration functions traceable to one ozone reference instrument**

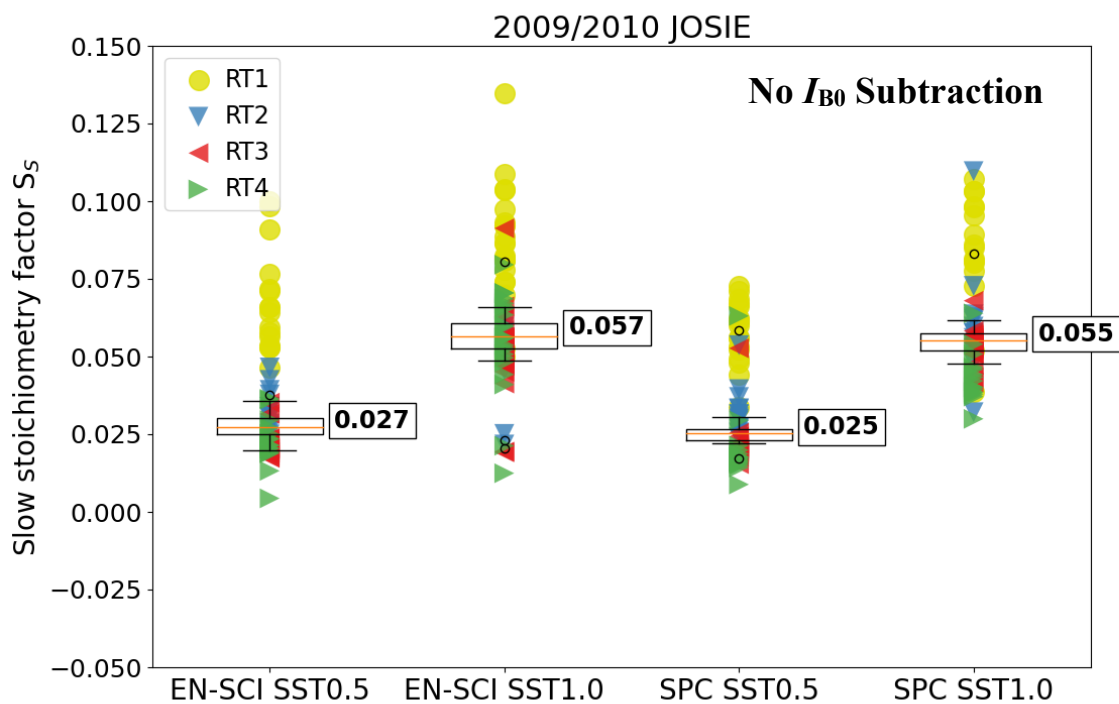
**Herman G. J. Smit et al.**

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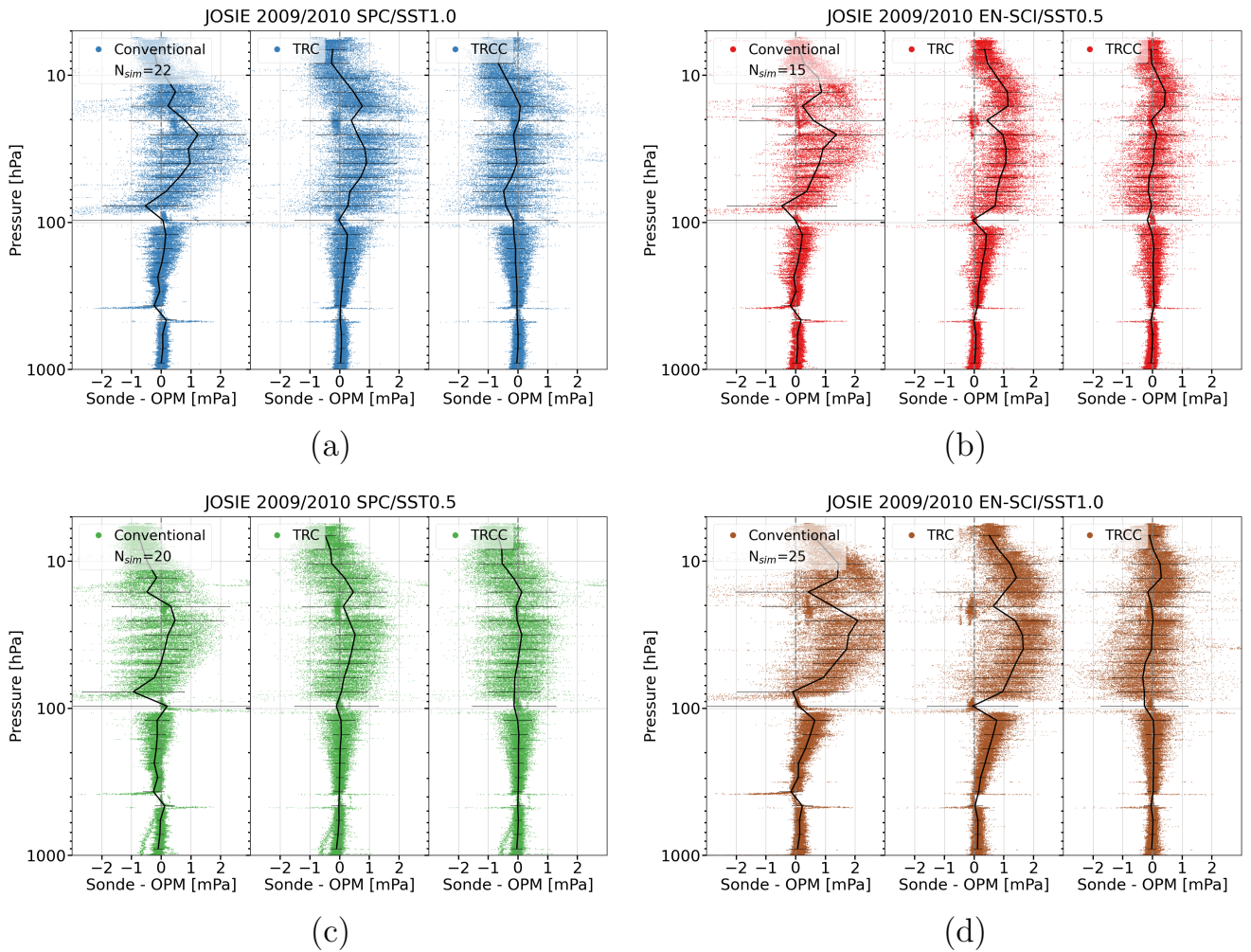
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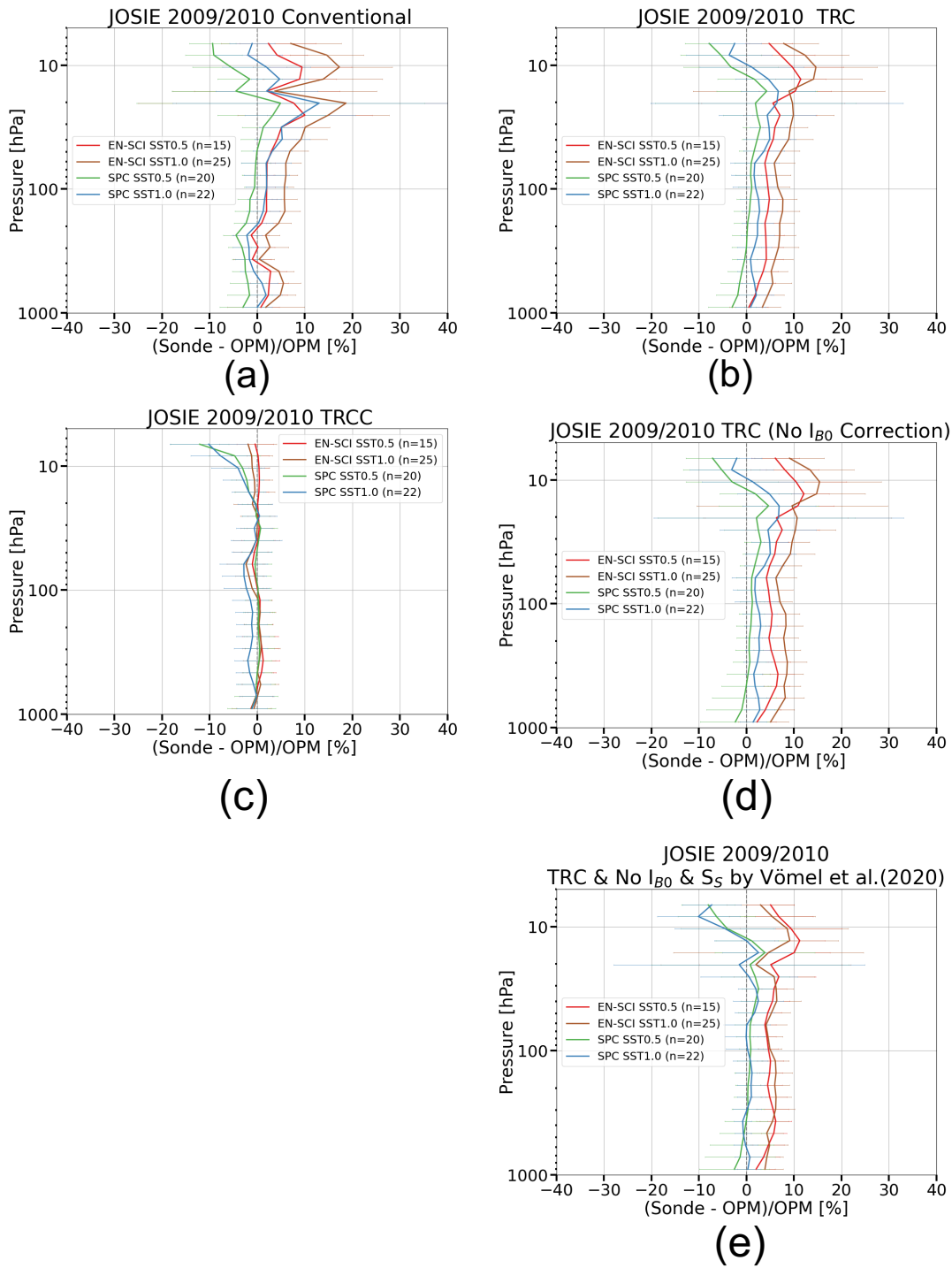
**Figure S1.** Downward decay response of four ECC (SPC-5A) cell currents as function of time during a descent simulation experiment flushing the ECC-sensors with zero ozone in the environmental simulation chamber at WCCOS in June 1993 (SI024). Before the cells have undergone an ascent simulation of a tropical ozone profile. Co-existing chamber air pressure in orange dotted line. Failing performance of 5A8286 sonde after 75 minutes. After about 75 minutes, the cell currents remain constant at a level of about  $0.04 \mu\text{A}$ , which corresponds to  $I_{B0}$  (background current before ozone exposure), measured during the preparation prior to the simulation experiment.



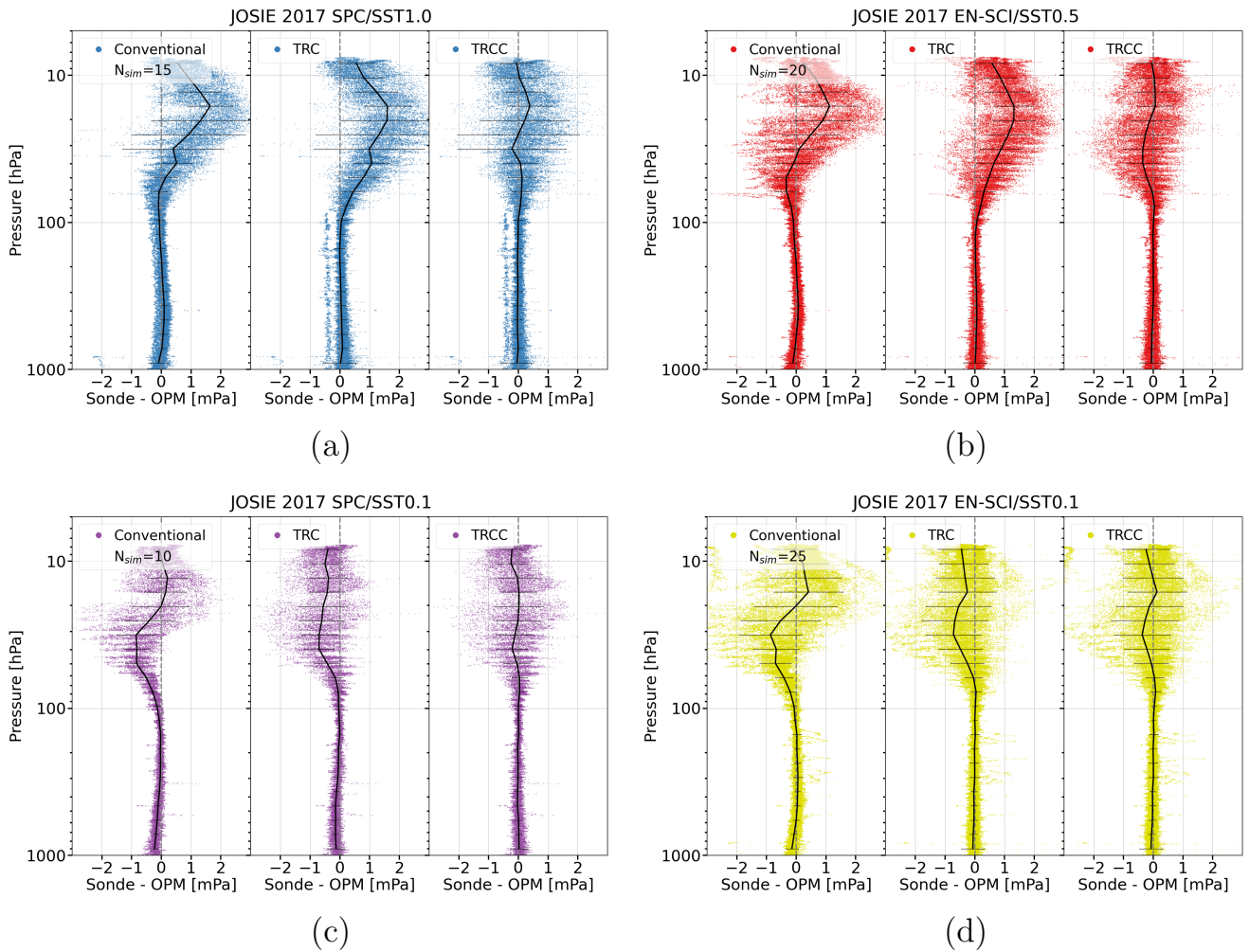
**Figure S2.** Box-whisker plots of the slow stoichiometry factor  $S_s$  as the ratio of the measured  $I_M$  (here NOT corrected for  $I_{B0}$ ) to the 25 min convolved OPM current ( $I_{OPM,C}$ ) obtained from JOSIE 2009 and 2010 for EN-SCI and SPC ozonesondes operated with the sensing solution types SST0.5 and SST1.0. The yellow dots and triangle symbols (blue, red and green) represent the individual values obtained from the four response tests RT1, RT2, RT3 and RT4, respectively. Thus, every ozonesonde profile is represented four times in the graph. The Box-whisker plots are represented here by median plus the 25 and 75 percentiles (horizontal orange and black lines for each pair of sonde type – SST combination).



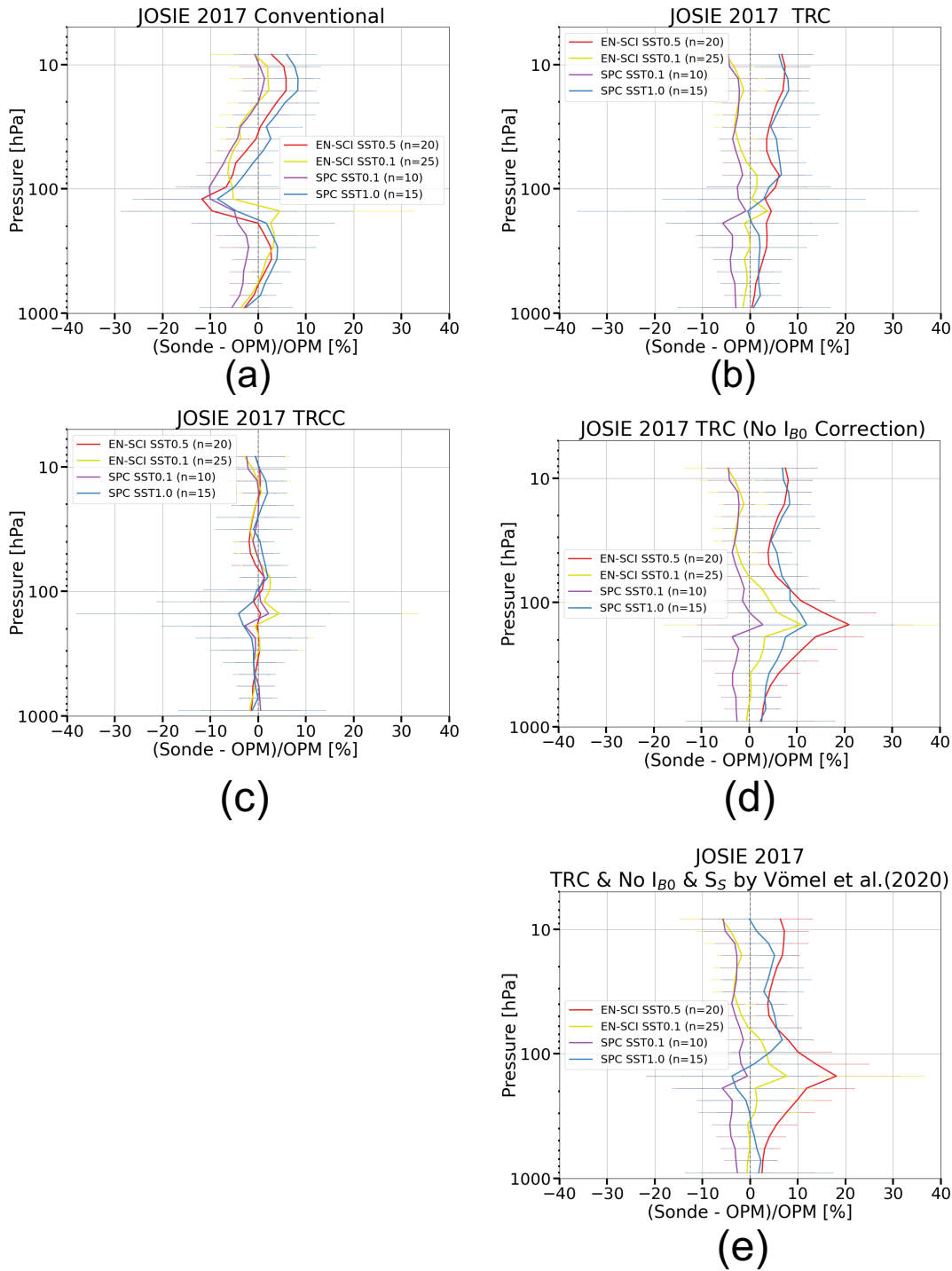
**Figure S3.** JOSIE 2009 and 2010: absolute differences [mPa] with the OPM for the conventionally processed (left part of each panel), TRC processed (middle part of each panel), and TRCC (TRCC denotes TRC + the application of calibration functions) processed (right part of each panel) ozonesonde profiles for four pairs of sonde type and SST, shown as scatterplots in four different colours in panels (a)-(d): SPC6A-SST1.0 (a, blue dots), EN-SCI-SST0.5 (b, red dots), SPC6A-SST0.5 (c, green dots), and EN-SCI-SST1.0 (d, brown dots), respectively. In each diagram for both methods the mean and 1 $\sigma$ -standard deviation of the absolute differences are included (solid black line).



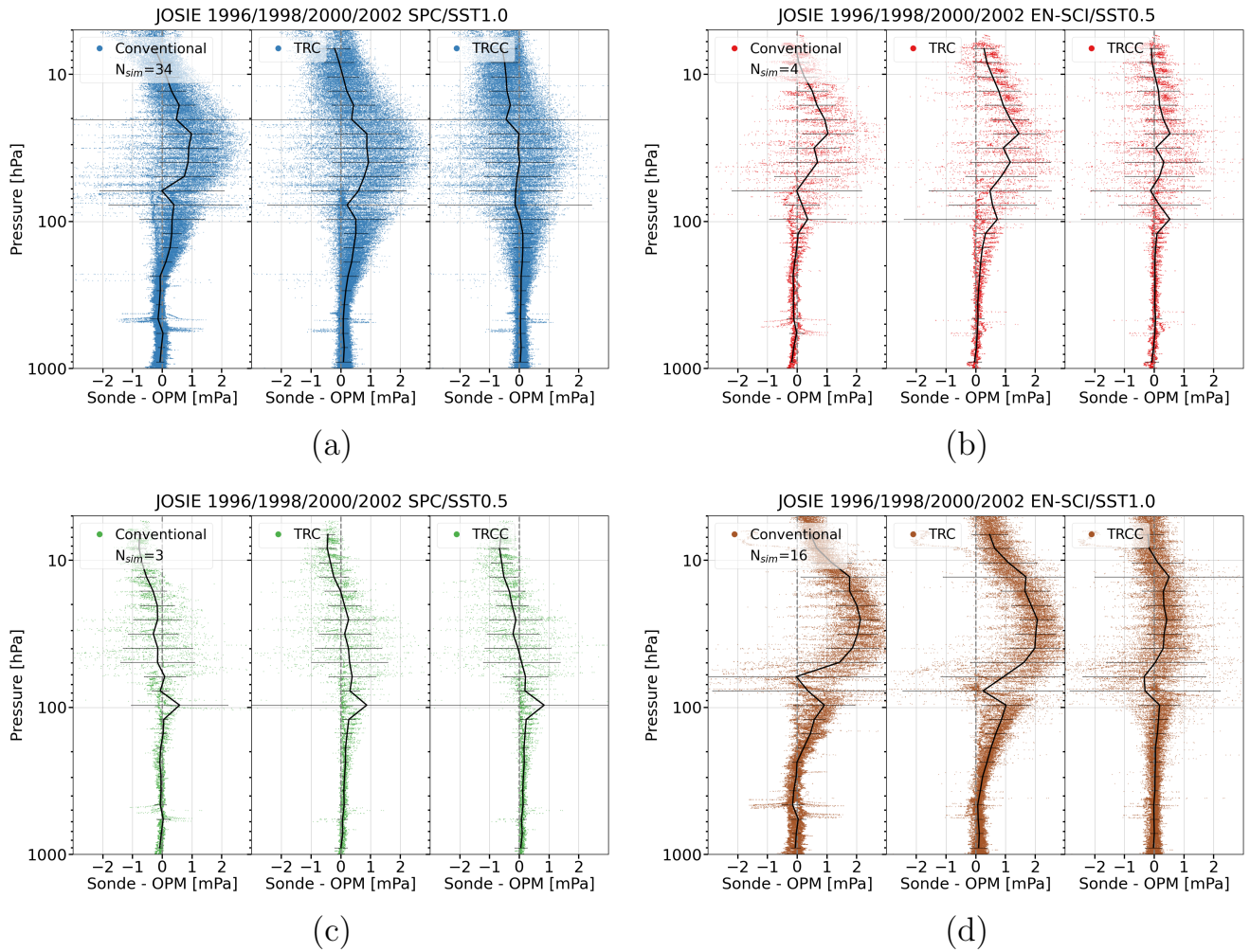
**Figure S4.** JOSIE 2009 and 2010: Summary of the mean relative differences with the OPM for four pairs of sonde type and SST: SPC6A-SST1.0 (blue line), EN-SCI-SST0.5 (red line), SPC6A-SST0.5 (green line), and EN-SCI-SST1.0 (brown line) with ozonesonde profiles processed according: (a) conventional; (b) TRC ; (c) TRCC; (d) TRC, but No  $I_{B0}$  correction; (e) TRC, but No  $I_{B0}$  correction and using  $S_S$  values from Vömel et al. (2020).. The  $1\sigma$ -standard deviations are represented by the horizontal lines at the pressure grid levels.



**Figure S5.** JOSIE 2017: absolute differences [mPa] with the OPM for the conventionally processed (left part of each panel), TRC processed (middle part of each panel), and TRCC (TRCC denotes TRC + the application of calibration functions) processed (right part of each panel) ozonesonde profiles for four pairs of sonde type and SST, shown as scatterplots in four different colours in panels (a)-(d): SPC6A-SST1.0 (a, blue dots), EN-SCI-SST0.5 (b, red dots), SPC6A-SST0.1 (c, purple dots), and EN-SCI-SST0.1 (d, yellow dots), respectively. In each diagram for both methods the mean and 1 $\sigma$ -standard deviation of the absolute differences are included (solid black line).

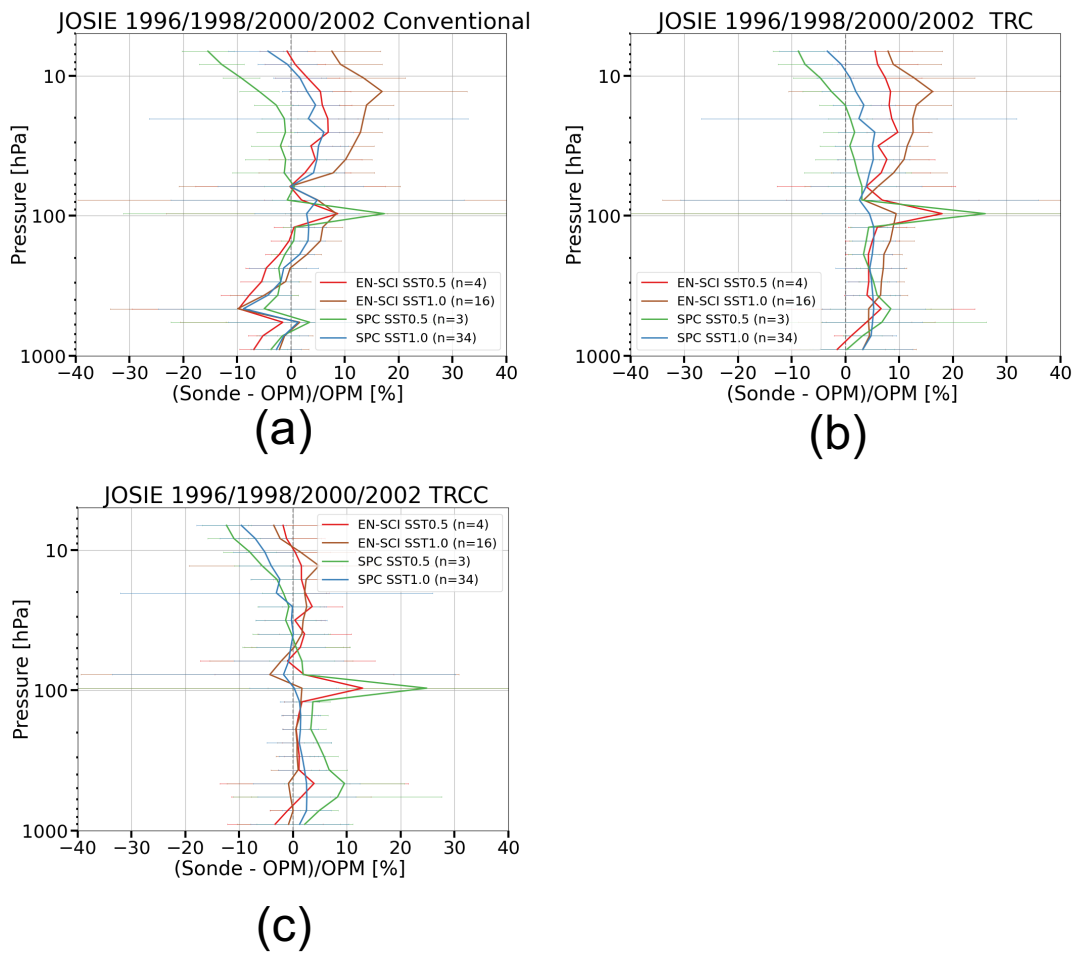


**Figure S6.** JOSIE 2017: Summary of the mean relative differences with the OPMS for four pairs of sonde type and SST: SPC6A-SST1.0 (blue line), EN-SCI-SST0.5 (red line), SPC6A-SST0.1 (purple line), and EN-SCI-SST0.1 (yellow line) with the ozonesonde profiles processed according: (a) the conventional; (b) TRC; (c) TRCC; (d) TRC, but No  $I_{B0}$  correction; (e) TRC, but No  $I_{B0}$  correction and using larger  $S_5$  values from Vömel et al. (2020). The  $1\sigma$ -standard deviations are represented by the horizontal lines at the pressure grid levels.

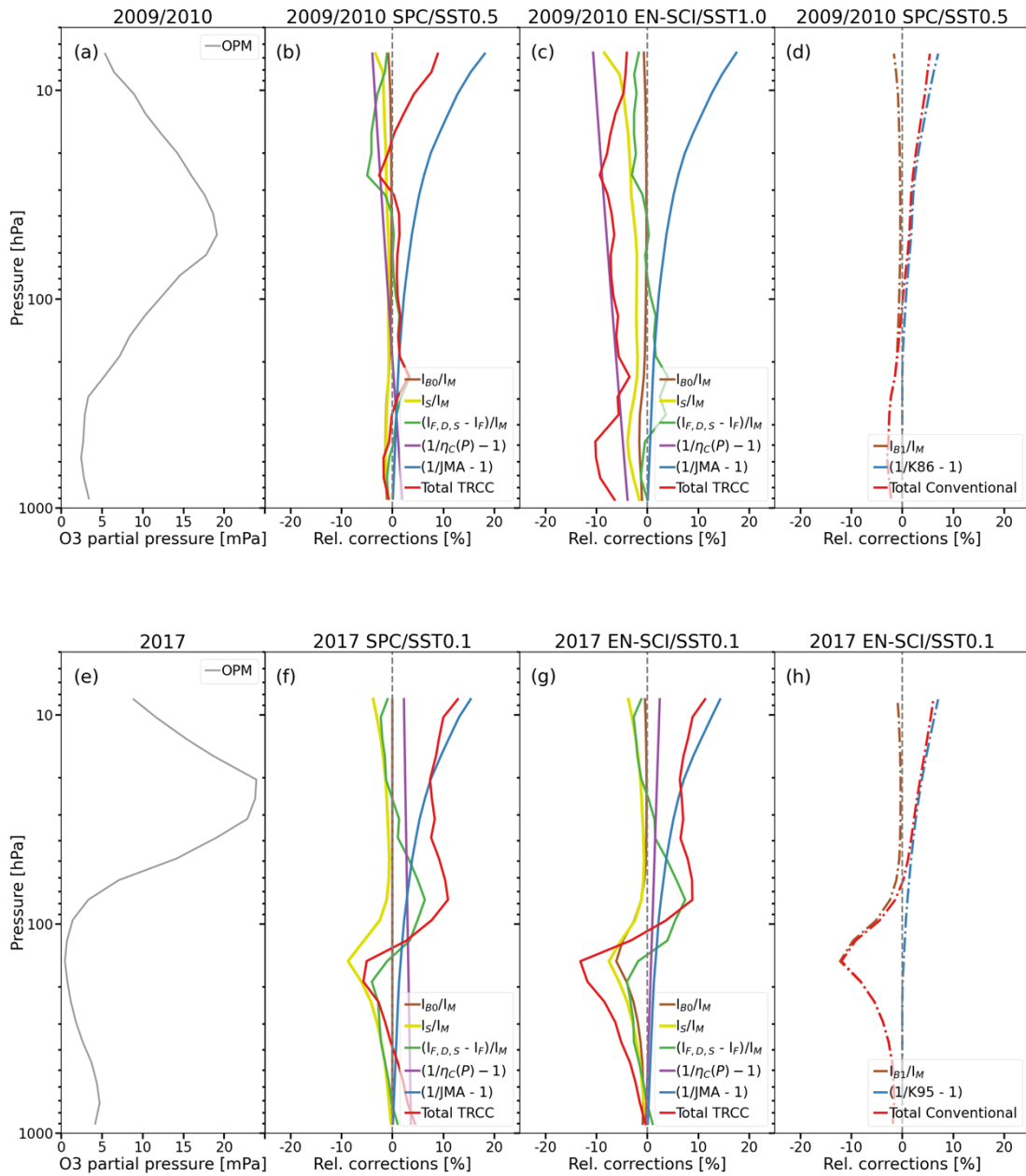


**Figure S7.** JOSIE 1996 + 1998 + 2000 + 2002: absolute differences [mPa] with the OPM for the conventionally processed (left part of each panel), TRC processed (middle part of each panel), and TRCC (TRCC denotes TRC + the application of calibration functions) processed (right part of each panel) ozonesonde profiles for four pairs of sonde type and SST, shown as scatterplots in four different colours in panels (a)-(d): SPC6A-SST1.0 (a, blue dots), EN-SCI-SST0.5 (b, red dots), SPC6A-SST0.5 (c, green dots), and EN-SCI-SST1.0 (d, brown dots), respectively. In each diagram for both methods the mean and 1 $\sigma$ -standard deviation of the absolute differences are included (solid black line).

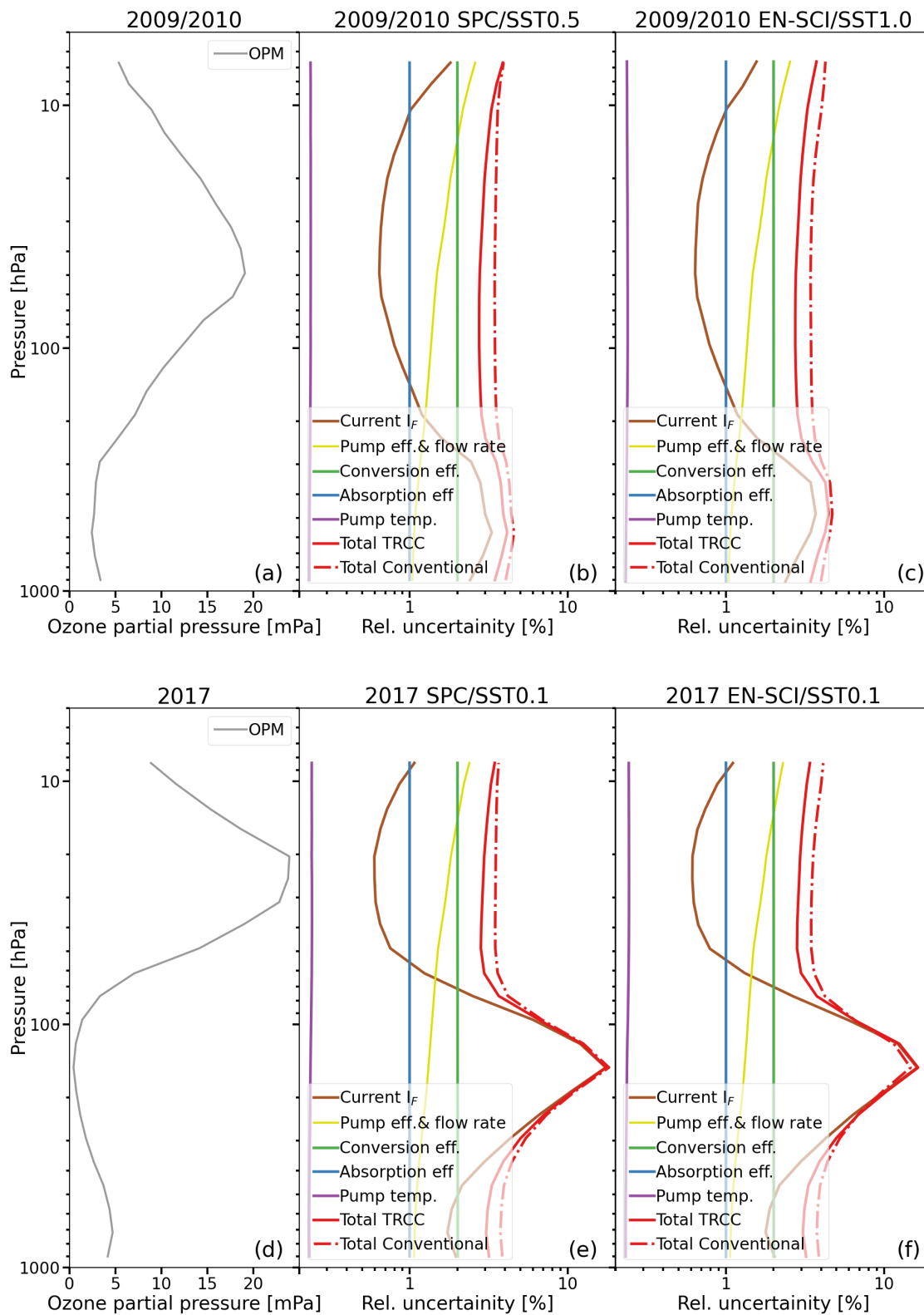




**Figure S8.** JOSIE 1996 + 1998 + 2000 + 2002: Summary of the mean relative differences with the OPM for (a) the conventional, (b) TRC, and (c) TRCC processed ozonesonde profiles for four pairs of sonde type and SST: SPC6A-SST1.0 (blue line), EN-SCI-SST0.5 (red line), SPC6A-SST0.5 (green line), and EN-SCI-SST1.0 (brown line). The 1 $\sigma$ -standard deviations are represented by the horizontal lines at the pressure grid levels.



**Figure S9.** Relative corrections of the TRCC method for typical mid-latitude (a-c: JOSIE 2009 and 2010) and tropical (e-g: JOSIE 2017) ozonesonde profiles showing the influence of the different correction steps for the new TRCC method for JOSIE 2009 and 2010: SPC-SST0.5 (b) and EN-SCI-SST1.0 (c), and for JOSIE 2017: SPC-SST0.1 (f) and EN-SCI-SST0.1 (g). The total correction (red line) consists of: (i)  $I_{B0}$  (brown line); (ii)  $I_S$  (yellow line); (iii) the de-convolved and smoothed  $I_F$  (green line); (iv) true pump efficiency (blue line: Nakano and Morofuji, 2023); (v) the calibrated conversion efficiency (purple line). Panel (d) and (h) show the relative corrections of the conventional method for JOSIE 2009 and 2010 (SPC-SST0.5) and JOSIE 2017 (EN-SCI-SST0.1), respectively; the total correction (red line) consists of: (i)  $I_{B1}$  (brown line); (ii) empirical effective efficiency (blue line: Komhyr (1986) for SPC and Komhyr et al. (1995) for EN-SCI, respectively).



**Figure S10.** Uncertainty budget of a mid-latitude (panels **a-c**: JOSIE 2009/2010) and tropical (panels **d-f**: JOSIE 2017) ozonesonde profile, showing the influence of the different uncertainty source terms listed in Table 5 for the TRCC method for JOSIE 2009 and 2010: SPC-SST0.5 (**b**) and EN-SCI-SST1.0 (**c**) and JOSIE 2017: SPC-SST0.1 (**e**) and EN-SCI-SST0.1 (**f**). Total uncertainty (solid red line) consists of (i) the corrected cell current (brown line:  $I_F = I_M - I_{B0} - I_S$  (TRC)); (ii) the pump efficiency and flowrate (yellow line); (iii) the conversion efficiency (green line); (iv) the absorption efficiency (blue line); (v) the pump temperature (purple line). In addition: Total uncertainty conventional method (dashed red line) according ASOPOS 2.0 (GAW Report No. 268)