Supplement of New Insights From The Jülich Ozone-Sonde Intercomparison Experiments: Calibration Functions Traceable To One Ozone Reference Instrument

Herman G.J. Smit[1], Deniz Poyraz[2], Roeland Van Malderen[2], Anne M. Thompson[3,4], David W. Tarasick[5], Ryan M. Stauffer[3], Bryan J. Johnson[6], Debra E. Kollonige[3,7]

[1]Forschungszentrum Jülich, Institute of Energy and Climate Research, IEK-8: Troposphere, Jülich, 52425, Germany

[2]Royal Meteorological Institute of Belgium & Solar-Terrestrial Centre of Excellence, Uccle, Belgium

[3]Atmospheric Chemistry and Dynamics Laboratory, NASA/GSFC, Greenbelt, MD, USA

[4]University of Maryland Baltimore County, Baltimore, MD, USA,

[5]Environment and Climate Change Canada, Downsview, ON, Canada

[6]Global Monitoring Laboratory, NOAA Earth System Research Laboratory, Boulder, CO, USA

[7]Science Systems and Applications, Inc, Lanham, MD, USA

Correspondence to: Herman G.J. Smit (h.smit@fz-juelich.de)
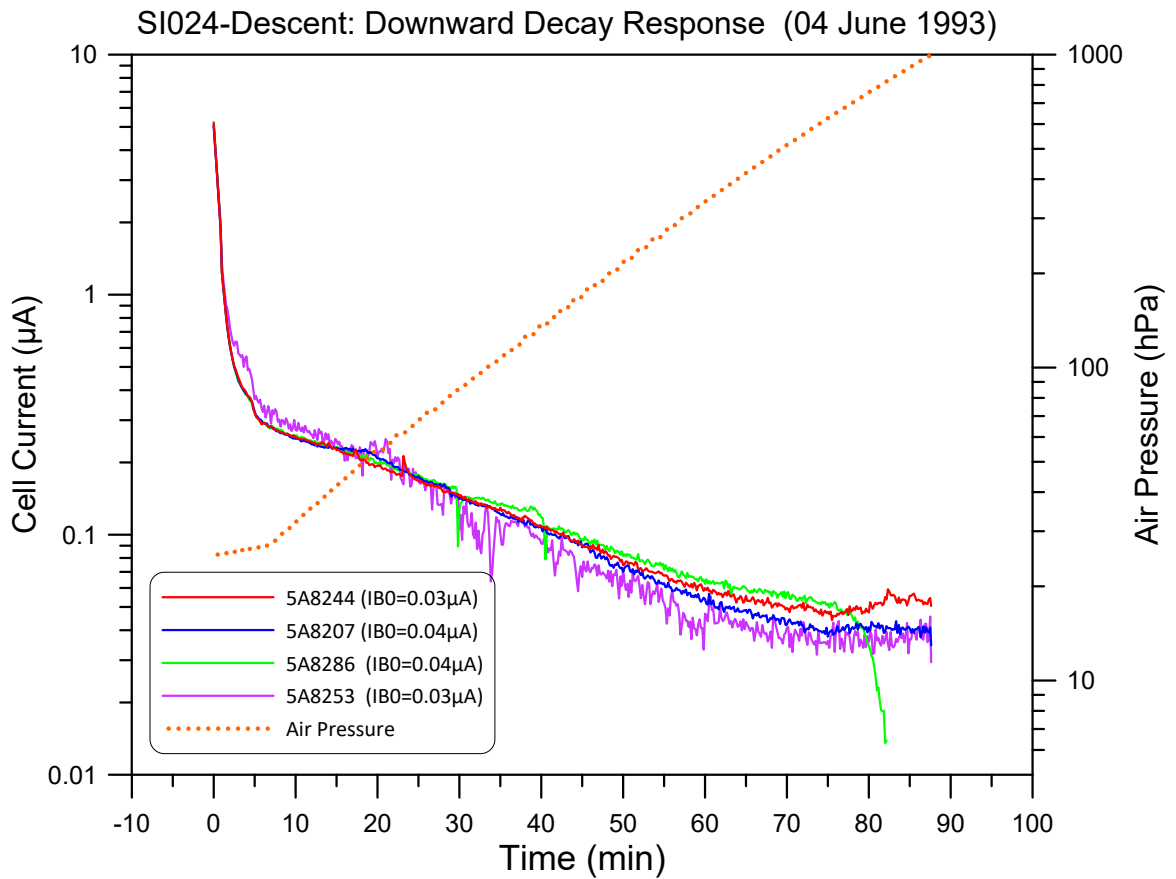
Figure S1. Downward decay response of four ECC (SPC-5A) cell currents as function of time during a descent simulation experiment flushing the ECC-sensors with zero ozone in the environmental simulation chamber at WCCOS in June 1993 (SI024). Before the cells have undergone an ascent simulation of a tropical 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 µA, which corresponds to I_{B0} (background current before ozone exposure), measured during the preparation prior to the simulation experiment.
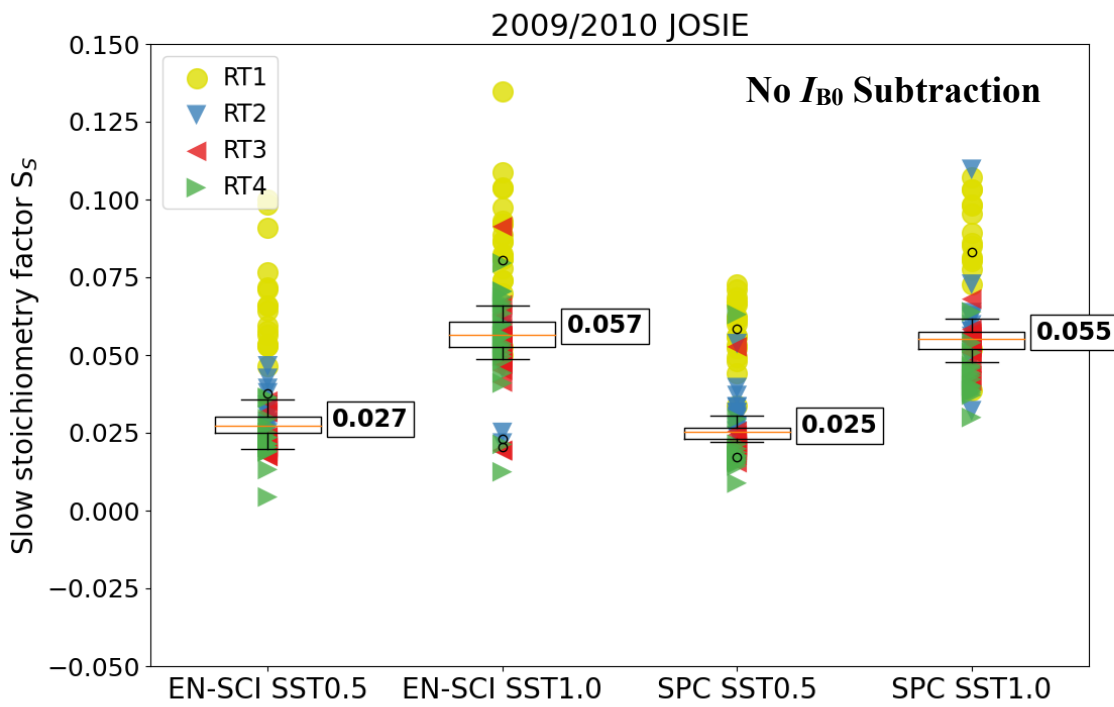
Figure S2. Whisker plots of the slow stoichiometry factor S_S as the ratio of the measured I_M (here NOT corrected for I_{B0}) to the 25 min convolved OPM current ($I_{OPM,C}$) obtained from JOSIE 2009 and 2010 for EN-SCI and SPC ozonesondes operated with the sensing solution types SST0.5 and SST1.0. 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. Whisker plots are represented here by median plus the 25 and 75 percentiles (resp. orange and black horizontal lines in the Whisker plots), whereby before for each ozonesonde profile the average over the four SS values has been determined from the individual RT1-RT4.

(a)

(c)

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(d)
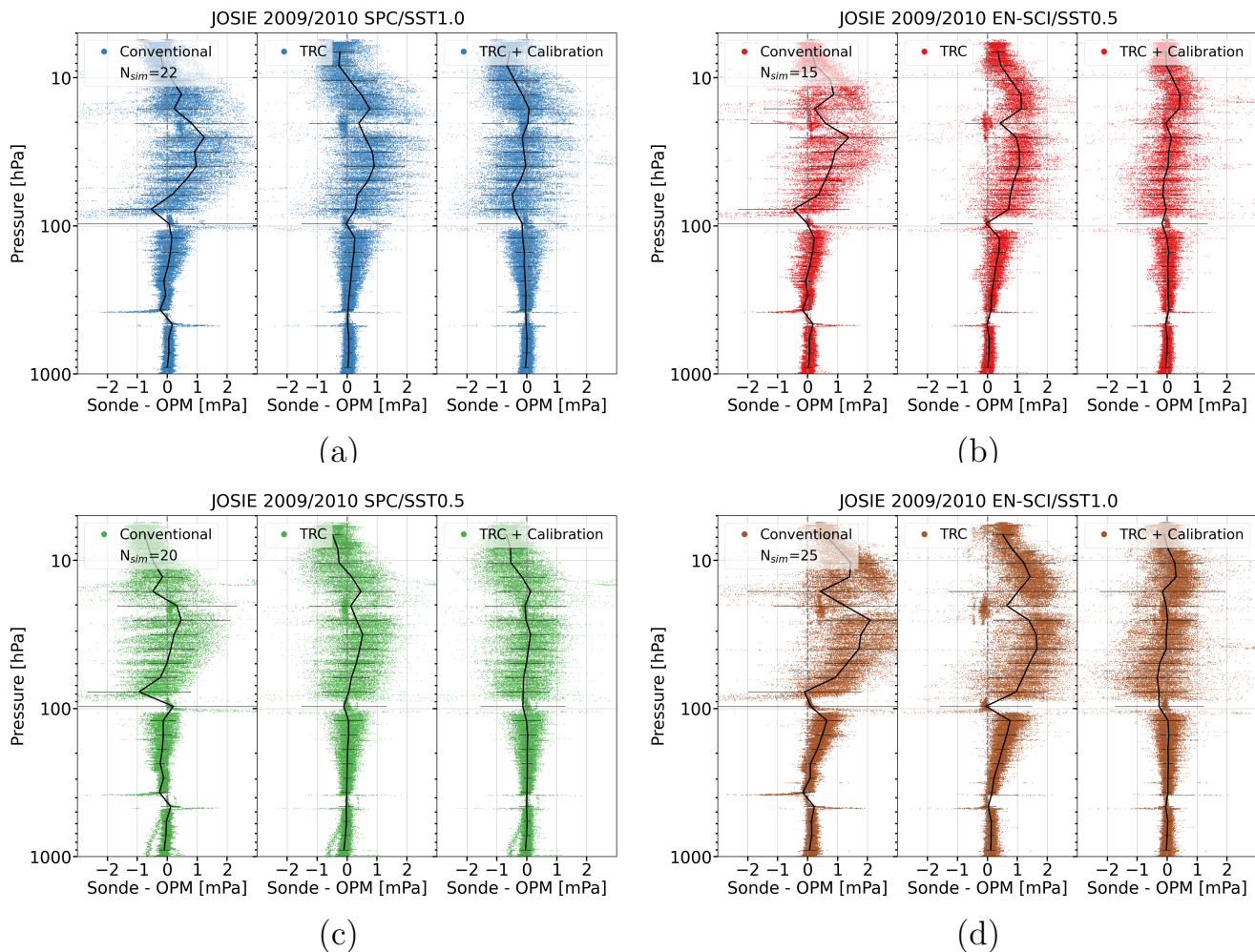
Figure S3. JOSIE 2009/2010: Absolute differences [mPa] with the OPM for the "conventional" (left diagram of panels a..d), "TRC" (middle diagrams of panel a..d), and "TRC + application of calibration functions" (right diagram of panels a..d) processed ozonesonde profiles for four pairs of sonde type and SST, shown as scatter plots in four different colors in the 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 1σ-standard deviation of the absolute differences are included (solid black line).

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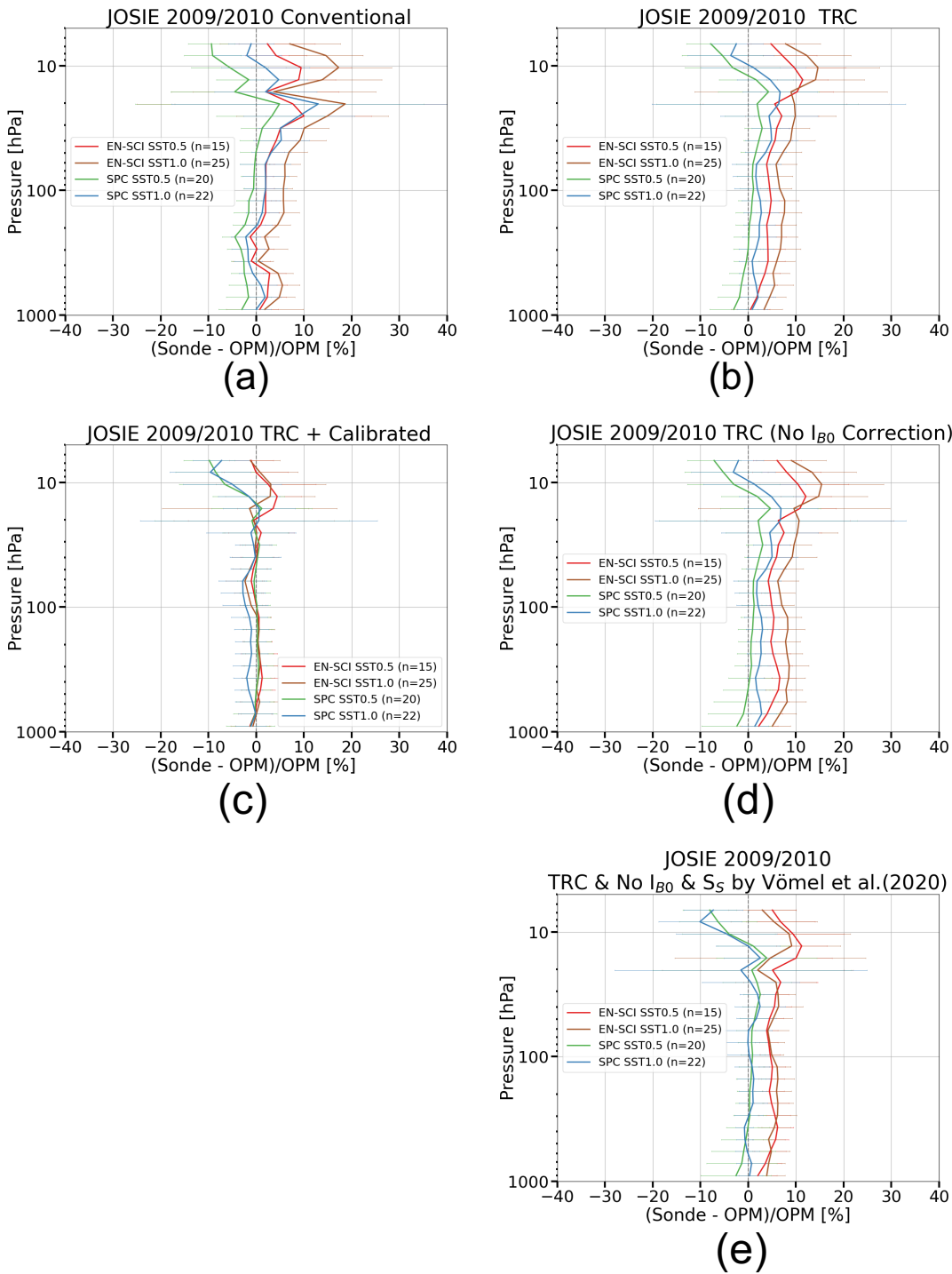


Figure S4. JOSIE 2009/2010: Summary of the mean relative differences with the OPM for four pairs of sonde type and SST: SPC6A/SST1.0 (blue line), EN-SCI/SST0.5 (red line), SPC6A/SST0.5 (green line), and EN-SCI/SST1.0 (brown line) in case in case the ozonesonde profiles are data processed according: (a) the conventional; (b) TRC ; (c) TRC+Calibrated; (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 1σ-standard deviations are represented by the horizontal lines at the pressure grid levels.

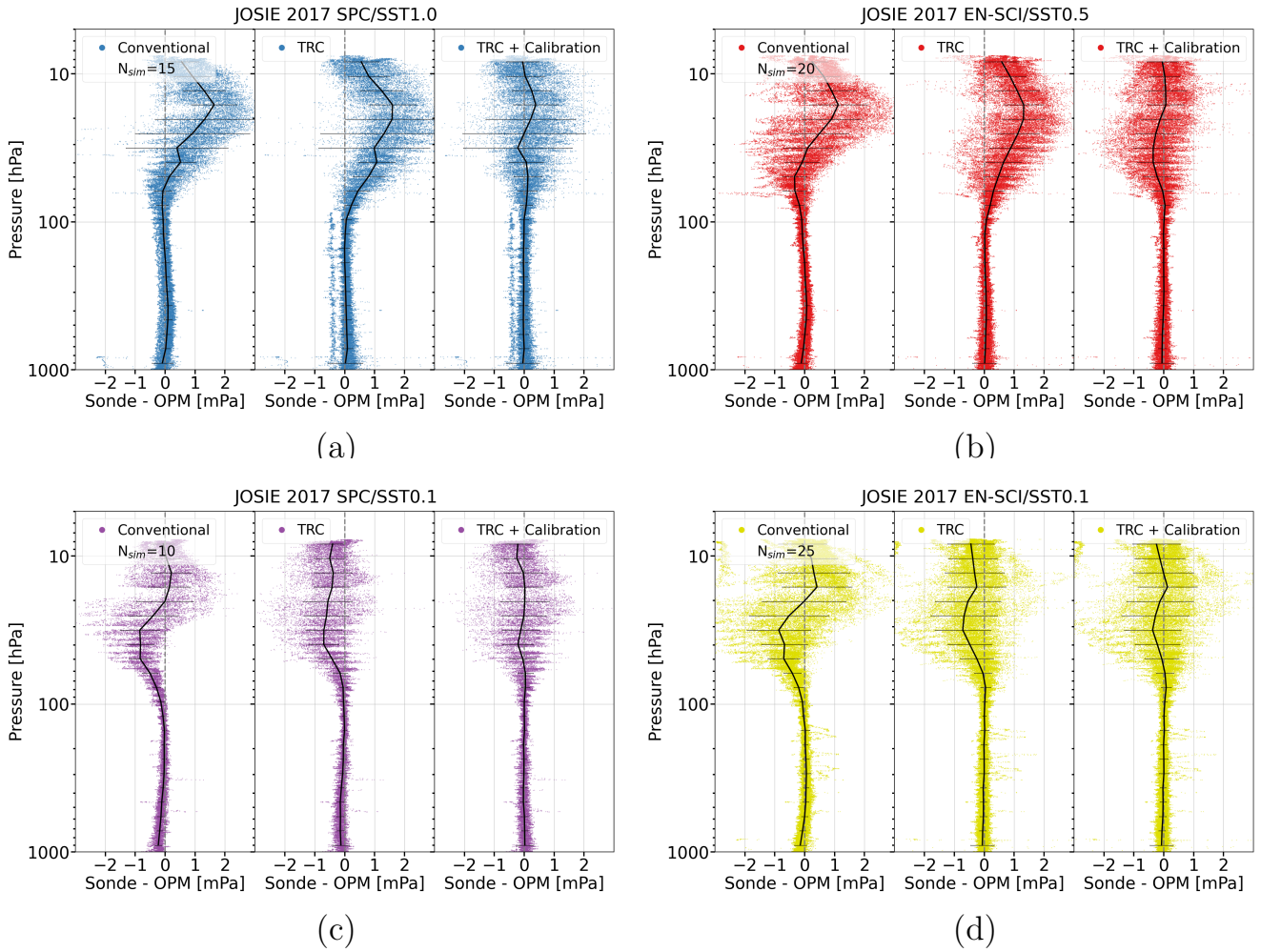



Figure S5. JOSIE 2017: Absolute differences [mPa] with the OPM for the "conventional" (left diagram of panels a..d), "TRC" (middle diagrams of panel a..d), and "TRC + application of calibration functions" (right diagram of panels a..d) processed ozonesonde profiles for four pairs of sonde type and SST, shown as scatter plots in four different colors in the 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: lemon dots), respectively. In each panel for both methods the mean and 1σ-standard deviation of the absolute differences are included (solid black line).

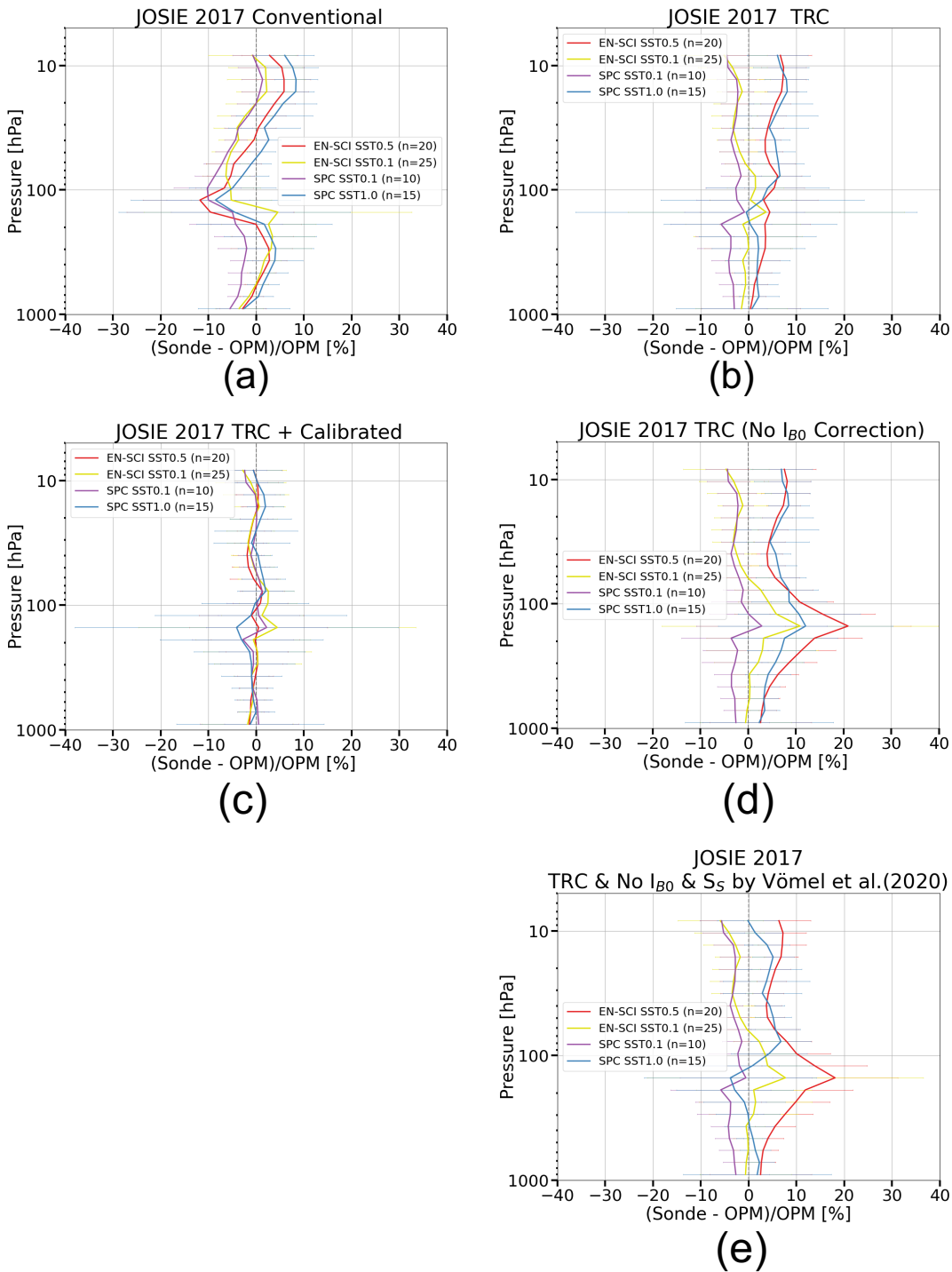



Figure S6. JOSIE 2017: Summary of the mean relative differences with the OPM for four pairs of sonde type and SST: SPC6A/SST1.0 (blue line), EN-SCI/SST0.5 (red line), SPC6A/SST0.5 (green line), and EN-SCI/SST1.0 (brown line) in case the ozonesonde profiles are data processed according: (a) the conventional; (b) TRC; (c) TRC+Calibrated; (d) TRC, but No I_{B0} correction; (e) TRC, but No I_{B0} correction , and using larger S_S values from Vömel et al. (2020). The 1σ-standard deviations are represented by the horizontal lines at the pressure grid levels.

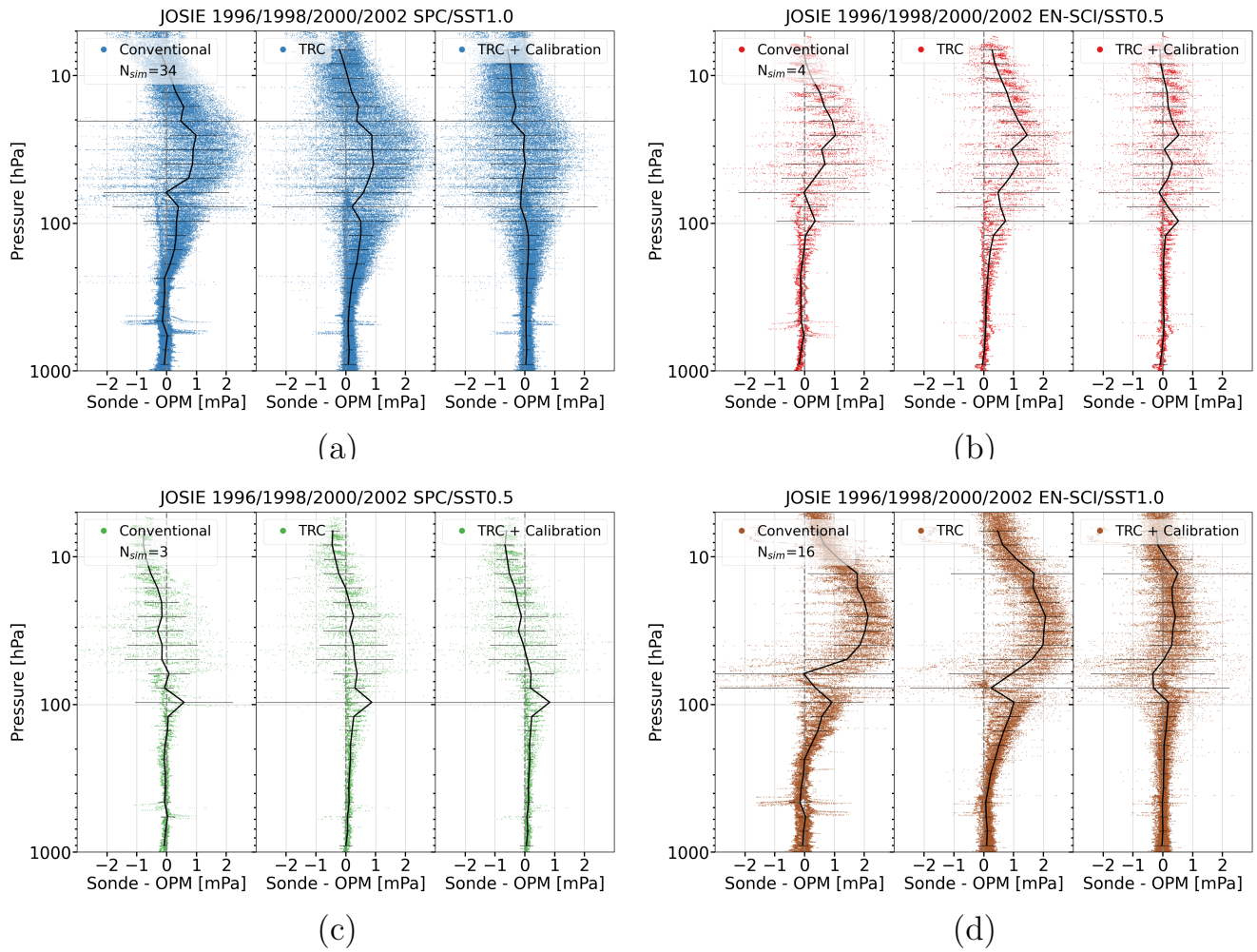



Figure S7. JOSIE 1996/1998/2000/2002: Absolute differences [mPa] with the OPM for the "conventional" (left diagram of panels a..d), "TRC" (middle diagrams of panel a..d), and "TRC + application of calibration functions" (right diagram of panels a..d) processed ozonesonde profiles for four pairs of sonde type and SST, shown as scatter plots in four different colors in the 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 panel for both methods the mean and 1σ-standard deviation of the absolute differences are included (solid black line).

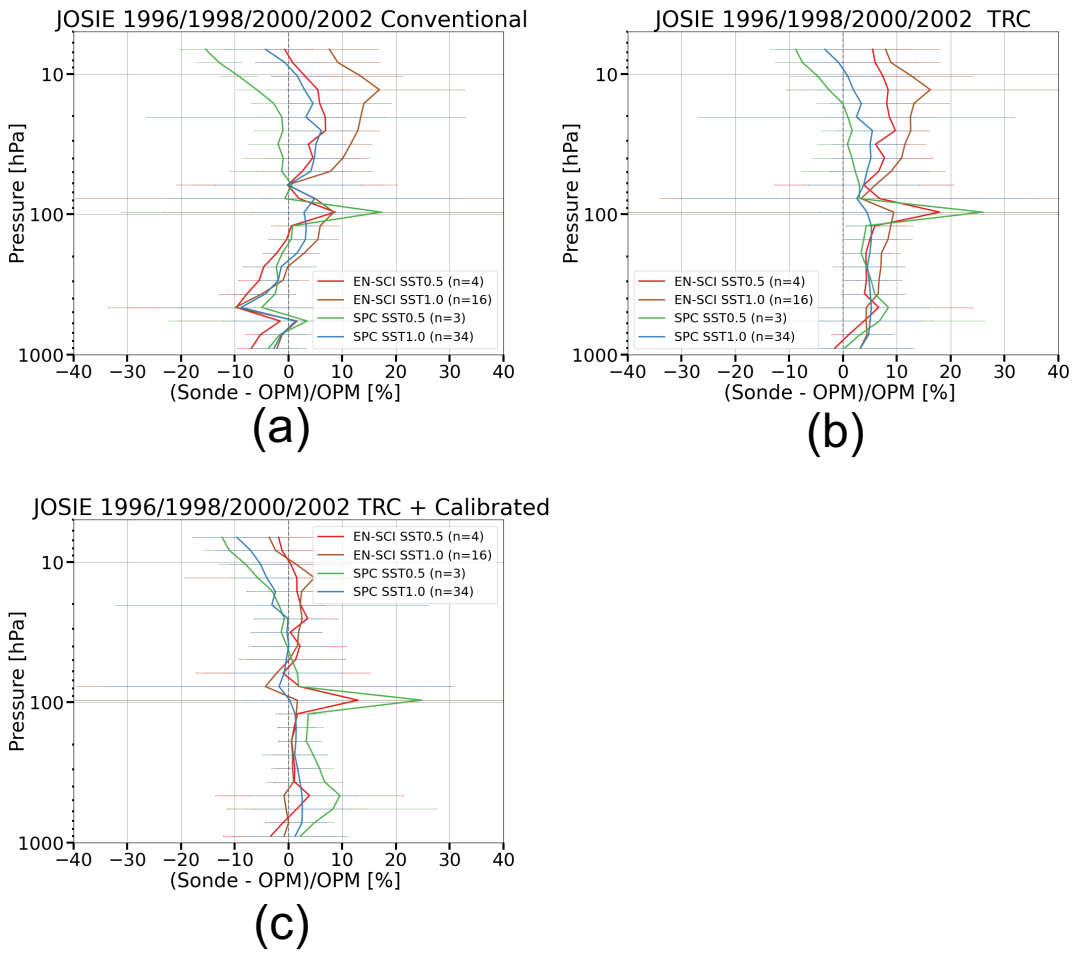



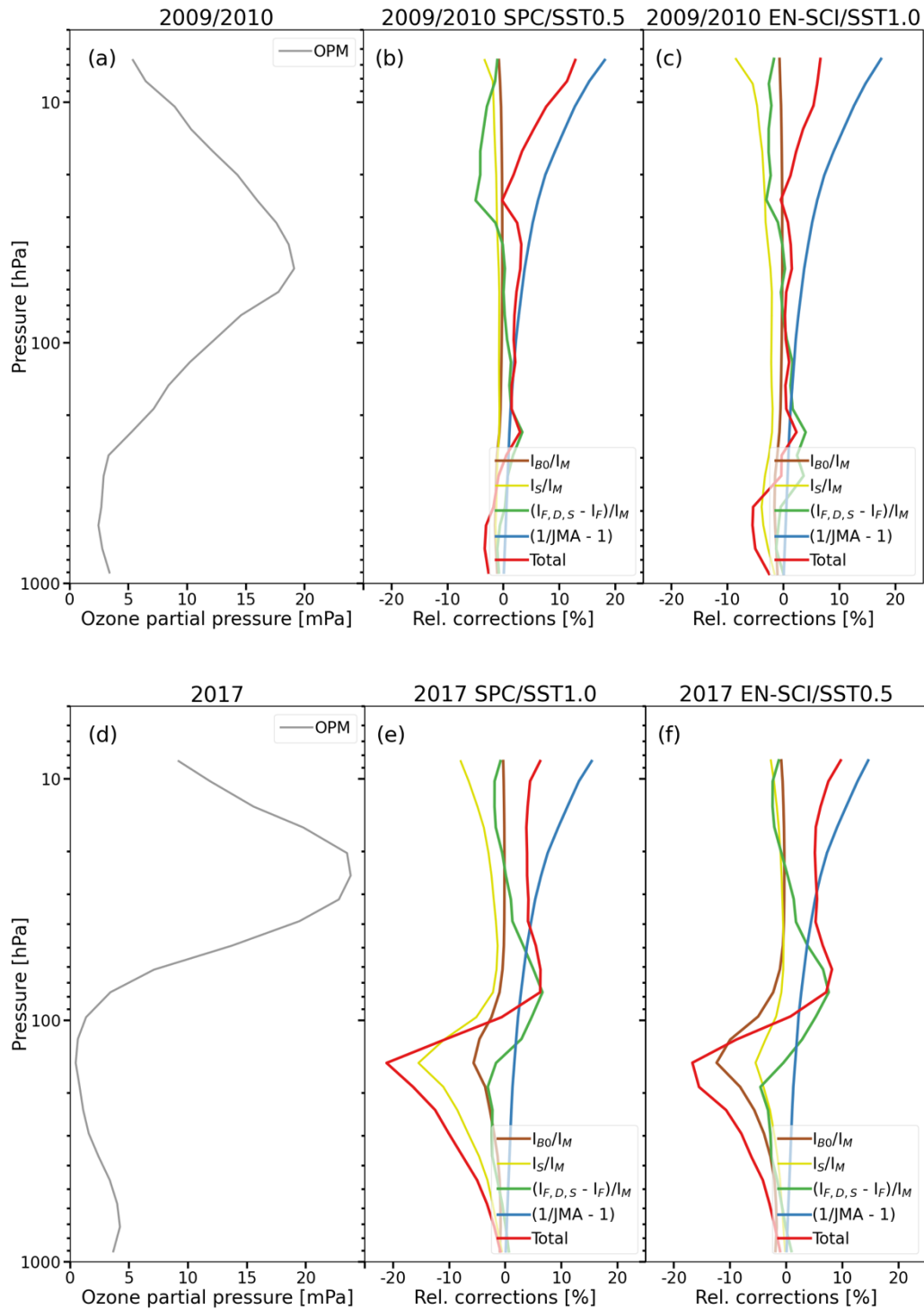
Figure S8. JOSIE 1996/1998/2000/2002: Summary of the mean relative differences with the OPM for (a) the conventional, (b) TRC, and (c) TRC+Calibrated processed ozonesonde profiles for four pairs of sonde type and SST: SPC6A/SST1.0 (blue line), EN-SCI/SST0.5 (red line), SPC6A/SST0.5 (green line), and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

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Figure S9. Relative corrections of TRC method (upper panel: (a), (b), (c) JOSIE 2009/2010) and tropical (lower panel: diagrams (d), (e), (f) JOSIE 2017) ozonesonde profile, showing the influence of the different correction steps for the new TRC method for SPC SST0.5 (middle diagrams b and e) and EN-SCI SST1.0 (right diagrams c and f). Total correction (red solid line) consists of: (i) I_{B0} (brown line); (ii) I_S (yellow line); (iii) De-convolution I_F (green line); (iv) Pump efficiency (blue

110   line: Nakano et al., 2023).
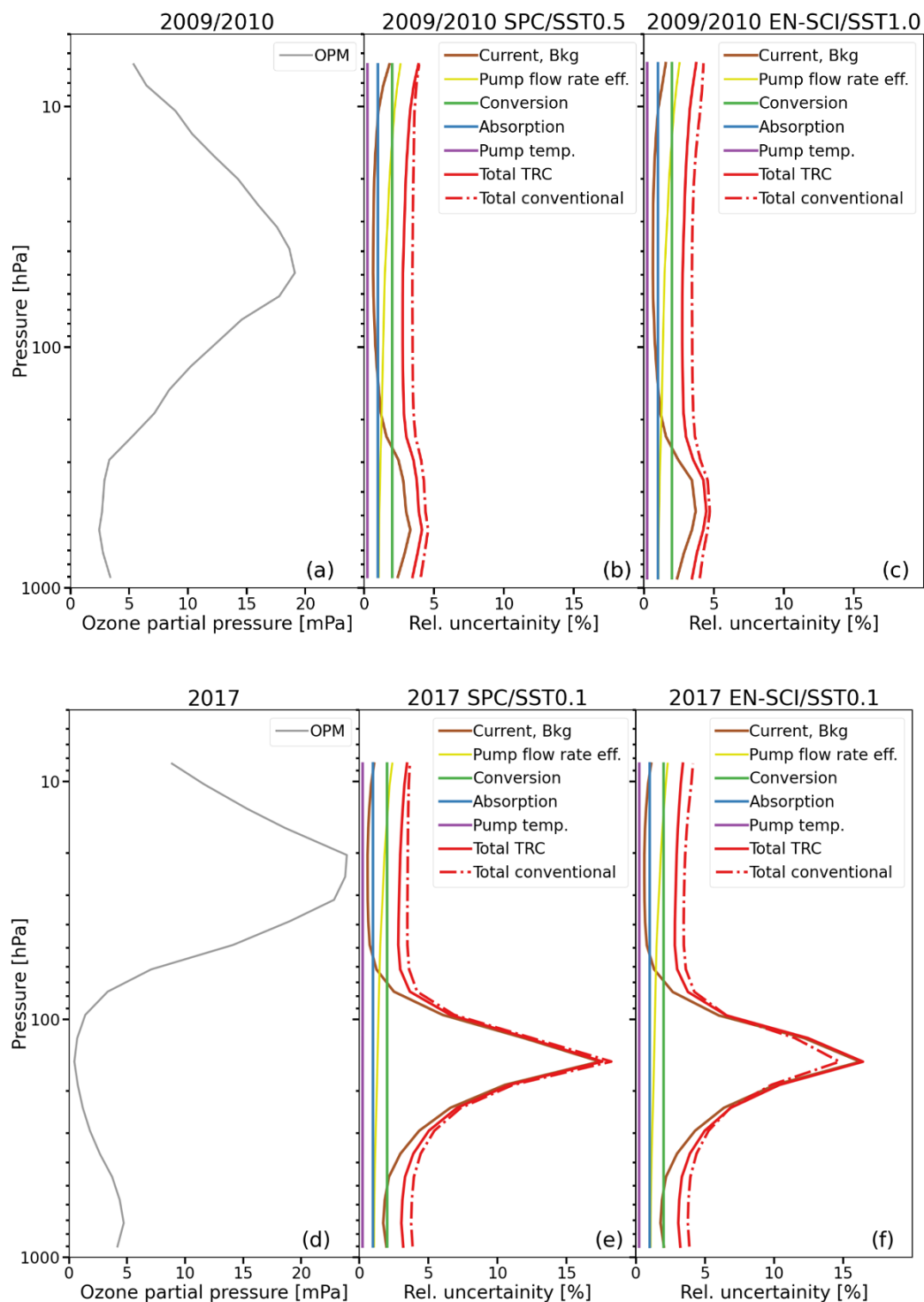
Figure S10. Uncertainty budget of a mid-latitude (upper panel: diagrams (a), (b), (c): JOSIE 2009/2010) and tropical (lower panel: diagrams (d), (e), (f): JOSIE 2017) ozonesonde profile, showing the influence of the different uncertainty source terms

115 listed in Table 5 for the new TRC method. JOSIE 2009/2010: SPC/SST0.5 (b) and EN-SCI SST1.0 (b). JOSIE 2017: SPC/SST0.1 (e) and EN-SCI SST0.1 (f). Total uncertainty (red solid line) consists of (i) Corrected cell current (brown line: I_M-I_{B0}-I_S (TRC)); (ii) Pump flow (yellow/green line: flow rate + efficiency); (iii) Conversion efficiency (green line); (iv) Absorption efficiency (blue line); (v) Pump temperature (purple line). In addition: Total uncertainty conventional method (dashed red line) according ASOPOS 2.0 (GAW Report No. 268)

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