



Supplement of

Influence of cloudy and clear-sky partitions, aerosols, and geometry on the recent variability in surface solar irradiance components in northern France

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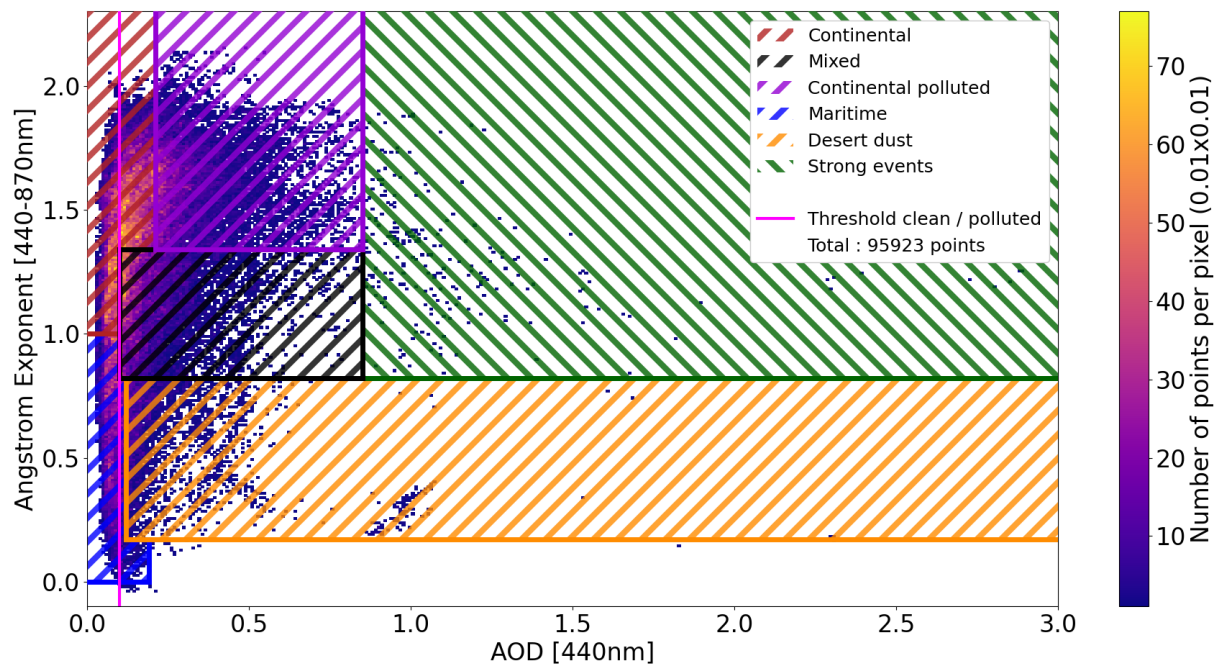


Figure S1. Scatter plot of AOD_{440} against $AE_{440-870}$ for all AERONET level 2.0 measurements in Lille from 2010 to 2022. Colored boxes represent the class thresholds from Table 2.

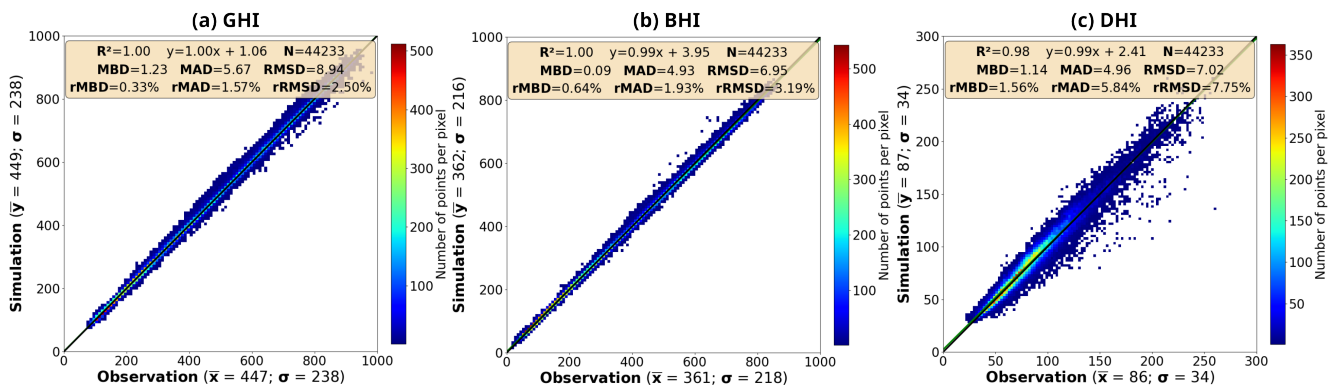


Figure S2. Scatter plot of SOLARTDECO simulations, based on level 2.0 AERONET inputs, against corresponding measurements of (a) GHI, (b) BHI and (c) DHI performed in Lille over the period 2010-2022. These results were obtained for SOLARTDECO simulations based on a different system of two equations, involving both AOD_{440} and AOD_{870} , instead of the original AOD_{440} and $AE_{440-870}$ system. The black line represents the 1:1 line. Mean irradiance values and associated standard deviations are shown for both simulations and observations on their respective axes. Absolute and relative values of MBD (Mean Bias Difference), MAD (Mean Absolute difference) and RMSD (Root Mean Square Difference) are also displayed in the beige box included in the different figures. Only observations that coincide with clear-sky flux measurements (identified by the algorithm presented in Section 2.2.1) and performed between sunrise plus 30 minutes and sunset minus 30 minutes are considered for these comparisons.

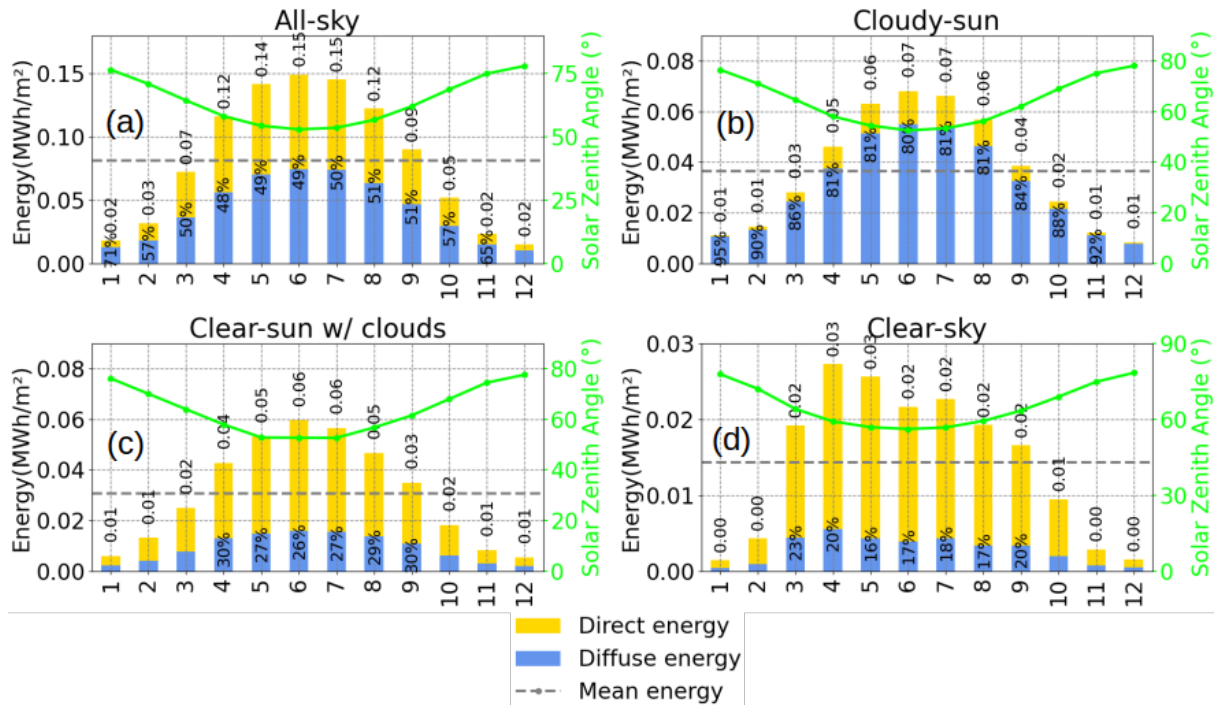


Figure S3. Multi-monthly variations over the period 2010-2022 of the solar zenith angle (green line) and cumulative yearly energies for different cloud cover states: (a) all-sky, (b) cloudy-sun, (c) clear-sun with clouds and (d) clear-sky. Only values during daytime between [sunrise + 30 minutes; sunset - 30 minutes] are considered. The global energy is represented as columns with the lower blue part corresponding to the diffuse energy and the upper yellow part to the direct energy. The grey dashed lines represent the yearly energy over 2010-2020. Note that the percentages reflect the diffuse fraction of the overall yearly energy which values are reported above each column.

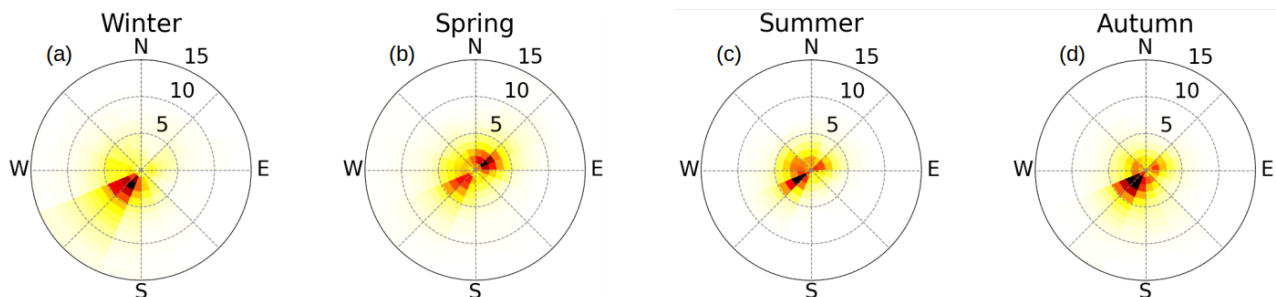


Figure S4. Seasonal wind roses based on additional ATOLL measurements over the period 2010-2022. Note that these wind roses correspond to clear-sun conditions as only observations coincident with AERONET measurements are considered here.

SZA (°)	AOD₅₅₀	SSA₅₅₀	ff	H_{aer} (km)	RH (%)	PWV (cm)	O₃ (DU)	O₂ (ppmv)	CO₂ (ppmv)	α
61.71	0.13	0.93	0.72	2	55	1.46	341	209 000	407	0.15

Table S1. Mean values observed in clear-sky conditions over the period 2010-2022 of the input parameters used for the sensitivity analysis of Section 2.4.2 based on SOLARTDECO simulations.