**Supplementary Material**

**Towards a more realistic representation of surface albedo in NASA CERES-derived surface radiative fluxes: a comparison with the MOSAiC field campaign**

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**Figure S6.** The relationships between bias of CERES SYN1deg-Hour and spatial variability in MOSAiC measurements for (a) downward shortwave flux (SW\_down); (b) upward shortwave flux (SW\_up); (c) downward longwave flux (LW\_down); (d) upward longwave flux (LW\_up); (e) net shortwave flux (SW\_net) and (f) net longwave flux (LW\_net). The spatial variability (%) is defined as the ratio between the absolute variance and the average of all available MOSAiC measurements, while the absolute difference is the maximum difference among each pair of measurements at a given time.

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**Figure S8.** The validation of CERES SYN1deg input to Fu-Liou radiative transfer model by MOSAiC surface measurements during April - September 2020 under high sea ice concentrations (>80%) for (a) surface albedo; (b) surface pressure; (c) surface skin temperature derived from surface longwave fluxes; (d) surface water vapor mixing ratio and (e) surface wind speed. The correlation (Corr) with p-value in parenthesis, absolute bias relative to the mean value of MOSAiC measurement (Bias) with relative bias (%) in parenthesis and root-mean-squared-error (RMSE) are provided for each variable. The point-by-point comparison is shown between MOSAiC observations and SYN1deg only if there are at least two measurements available among ASFS30, ASFS50 and Met City. The MOSAiC observations are obtained by averaging all available measurements at a given time.

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**Table S1.** The relative bias of shortwave fluxes to the mean value from MOSAiC measurements in Fu-Liou Radiative Transfer Model control run and surface albedo perturbation runs calculated from all data points and points with sea ice concentration is greater than 80%. The relative change in each perturbation run to control run is provided in parenthesis. Note that the values in parentheses for experiment A7 are the relative changes to A6.

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Chart, scatter chart

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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Experiment | SW\_down | | SW\_up | | SW\_net | |
| All data points | Sea ice > 80% | All data points | Sea ice > 80% | All data points | Sea ice > 80% |
| Control run | +4.31% | +5.11% | -14.1% | -10.9% | +51.2% | +51.7% |
| A1 | +9.58%  (+5.27%) | +9.38%  (+4.27%) | +1.14%  (+15.3%) | +0.69%  (+11.6%) | +31.0%  (-20.1%) | +34.8%  (-17.0%) |
| A2 | +7.86%  (+3.55%) | +8.34%  (+3.23%) | -1.75%  (+12.4%) | -0.39%  (+10.5) | +32.3%  (-18.8%) | +34.2%  (-17.5%) |
| A3 | +8.61%  (+4.30%) | +9.21%  (+4.10%) | +1.88%  (+16.0%) | +3.47%  (+14.3%) | +25.7%  (-25.4%) | +26.0%  (-25.7%) |
| A4 | +8.88%  (+4.57%) | +9.19%  (+4.08%) | +2.68%  (+16.8%) | +4.25%  (+15.1%) | +26.7%  (-24.5%) | +24.7%  (-27.1%) |
| A5 | +8.05%  (+3.74%) | +8.73%  (+3.62%) | -0.18%  (+14.0%) | +1.86%  (+12.7%) | +29.0%  (-22.2%) | +28.8%  (-22.9%) |
| A6 | +6.38%  (N/A) | +8.63%  (N/A) | -13.5%  (N/A) | -6.70%  (N/A) | +44.4%  (N/A) | +41.9%  (N/A) |
| A7 | +5.36%  (-1.02%) | +7.36%  (-1.27%) | -16.1%  (-2.61%) | -9.84%  (-3.14%) | +46.4%  (+2.00%) | +44.7%  (+2.77%) |