Supplementary Material

Table S1. Mean DC depth, temperature and bias by depth band for *θ*(DC), *θ*(sat) & *θ*(TSEA).

|  |  |  |  |
| --- | --- | --- | --- |
| **Month** | **θ(DC15) - θ(sat) /°C** | **θ(DC15) - θ(TS15) /°C** | **θ(sat) - θ(TS15) /°C** |
| 1 | -0.3±1.21 | -0.7±1.3 | -0.4±0.8 |
| 2 | -0.4±0.92 | -0.6±1 | -0.2±0.6 |
| 3 | -0.3±0.85 | -1±0.9 | -0.7±0.6 |
| 4 | -0.3±0.9 | -0.9±1 | -0.6±0.7 |
| 5 | -0.2±0.94 | -0.3±1.2 | -0.1±0.8 |
| 6 | -0.1±1.09 | -0.5±1.2 | -0.5±0.9 |
| 7 | -0.6±0.96 | -1.1±1.3 | -0.5±0.7 |
| 8 | -0.3±1.12 | -0.7±1.2 | -0.3±0.8 |
| 9 | -0.5±1.12 | -0.9±1.12 | -0.4±0.6 |
| 10 | -0.4±0.92 | -0.8±1.2 | -0.4±0.7 |
| 11 | -0.4±1.13 | -0.8±1.5 | -0.5±1 |
| 12 | -0.3±1.22 | -0.1±1.6 | 0.2±0.9 |
|  | **θ(DC30) - θ(sat) /°C** | **θ(DC30) - θ(TS30) /°C** | **θ(sat) - θ(TS30)/°C** |
| 1 | -0.3±0.8 | -0.5±1 | -0.2±0.7 |
| 2 | -0.2±1.03 | -0.5±1.1 | -0.4±0.5 |
| 3 | -0.3±0.9 | -0.7±0.9 | -0.4±0.6 |
| 4 | -0.3±1.11 | -0.6±1.1 | -0.2±0.7 |
| 5 | -0.56±0.95 | -0±1.2 | 0.5±0.9 |
| 6 | -0.5±1.07 | -0.3±1.2 | 0.3±0.9 |
| 7 | -0.7±1.09 | -0.1±1.2 | 0.6±1 |
| 8 | -0.8±1.14 | -0.1±1.2 | 0.7±0.8 |
| 9 | -0.5±1.28 | -0.1±1.3 | 0.4±0.7 |
| 10 | -0.4±0.96 | -0.4±1.2 | 0±0.8 |
| 11 | -0.3±0.99 | -0.7±1.4 | -0.4±1 |
| 12 | -0.6±1.21 | -0.2±1.7 | 0.3±1 |
|  | **θ(DC40) - θ(sat) /°C** | **θ(DC40) - θ(TS50) /°C** | **θ(sat) - θ(TS50) /°C** |
| 1 | -0.7±0.85 | -0.3±1.3 | 0.4±0.9 |
| 2 | -0.2±0.91 | -0.6±1.2 | -0.4±0.8 |
| 3 | -0.5±0.73 | -0.5±0.9 | 0±0.7 |
| 4 | -0.5±0.88 | -0.2±1 | 0.3±0.9 |
| 5 | -1.1±1.04 | 0.4±1.3 | 1.5±1 |
| 6 | -0.7±1.33 | 1±1.4 | 1.8±0.9 |
| 7 | -1.3±1.47 | 1.4±1.5 | 2.7±1 |
| 8 | -1.3±1.43 | 1.5±1.3 | 2.8±0.7 |
| 9 | -0.8±1.42 | 1.3±1.4 | 2.2±0.8 |
| 10 | -0.5±0.98 | 1.1±1.1 | 1.6±0.8 |
| 11 | -0.5±0.93 | -0.4±1.4 | 0.1±1.2 |
| 12 | -0.7±1.08 | -0.6±1.5 | 0.1±1 |

# Weekly resolution

60 – 67% weeks had absolute mean bias ≤ 0.5 °C: 35/52 weeks (*θ*(DC) - *θ*(sat)), 31/52 weeks (*θ*(DC) – *θ*(TS)), 34/52weeks (*θ*(sat) - *θ*(TS)). Slope was comparable across all datasets (Fig. S1).

Chart, scatter chart

Description automatically generated

c

b

a

Fig. S1. Solid line shows York regression on mean weekly bias for a) θ(sat) - θ(DC), b) θ(TS) - θ(DC) and c) θ(sat) - θ(TS), showing intercept *α*, slope *β* and *R̂*2. Dashed line is 1 to 1 (for visual reference). Error bars are standard deviation for a given month / dataset, across all years.

Absolute mean bias ranged from (0.1±1.1) °C to (1.0±1.4) °C (*θ*(DC) – *θ*(sat)), (0±1.4) °Cto (1.3±1.2) °C (*θ*(DC) – *θ*(TS)) and (0.1±0.6) °C to (1.3±1.5) °C (*θ*(sat) – *θ*(TS)). (Table S2, Fig. S2) Seasonal patterns can be seen in *θ*(DC), *θ*(sat) and *θ*(TS) and align with the *(region)* both by week and annually across datasets (Fig. S2).



Table S2. Weekly biases for *θ*(DC) - θ(sat), *θ*(DC) - θ(TS) and *θ*(sat) - θ(TS)

| **week** | ***θ*(DC) - *θ*(sat) /°C** | ***θ*(DC) - *θ*(TS) /°C** | ***θ*(sat) - *θ*(TS) /°C** | **n** |
| --- | --- | --- | --- | --- |
| 1 | -0.5±0.9 | 0.1±1.1 | 0.6±0.7 | 58 |
| 2 | -0.2±0.8 | -0.3±1 | -0.1±0.6 | 79 |
| 3 | -0.7±0.9 | -1±1.1 | -0.3±0.5 | 56 |
| 4 | -0.1±1.2 | -0.7±1.2 | -0.6±0.6 | 54 |
| 5 | -0.3±0.9 | -1.1±0.7 | -0.8±0.7 | 38 |
| 6 | -0.4±0.7 | -0.5±0.7 | -0.1±0.6 | 65 |
| 7 | -0.3±0.7 | -0.7±0.9 | -0.4±0.6 | 86 |
| 8 | -0.2±1.1 | -0.6±1.3 | -0.4±0.7 | 131 |
| 9 | -0.2±1.1 | -0.6±1.2 | -0.3±0.4 | 96 |
| 10 | -0.3±0.8 | -0.8±0.9 | -0.5±0.5 | 142 |
| 11 | -0.4±0.9 | -0.7±0.9 | -0.3±0.8 | 189 |
| 12 | -0.3±1 | -0.7±1 | -0.4±0.6 | 128 |
| 13 | -0.3±0.8 | -0.6±0.9 | -0.3±0.7 | 147 |
| 14 | -0.1±1.1 | -0.7±1.2 | -0.5±0.5 | 199 |
| 15 | -0.5±0.9 | -0.9±1 | -0.3±0.6 | 181 |
| 16 | -0.3±0.9 | -0.5±1 | -0.3±0.9 | 155 |
| 17 | -0.4±1.1 | -0.3±1 | 0.1±0.9 | 231 |
| 18 | -0.6±0.9 | -0.8±1.1 | -0.2±1.1 | 194 |
| 19 | -0.9±1.1 | -0.4±1.1 | 0.4±1 | 250 |
| 20 | -0.6±0.9 | -0.1±1.1 | 0.5±0.8 | 290 |
| 21 | -0.3±1 | 0.5±1.1 | 0.8±0.8 | 316 |
| 22 | -0.7±1.1 | 0.3±1.4 | 1±1.1 | 214 |
| 23 | -0.3±1.2 | -0.4±1.3 | -0.1±1 | 212 |
| 24 | -0.3±1.1 | -0.1±1.3 | 0.2±1.1 | 194 |
| 25 | -0.8±1.2 | 0±1.4 | 0.9±1.1 | 157 |
| 26 | -0.5±0.8 | 0.5±1.3 | 1±1.1 | 164 |
| 27 | -1±1.2 | -0.6±1.4 | 0.4±1.4 | 144 |
| 28 | -1±1.2 | -0.6±1.4 | 0.4±1.1 | 116 |
| 29 | -0.7±1 | 0.5±1.5 | 1.3±1.5 | 144 |
| 30 | -0.5±1.2 | 0.7±1.2 | 1.2±1.3 | 150 |
| 31 | -1±1.3 | 0.1±1.1 | 1.1±1.2 | 128 |
| 32 | -1±1.4 | 0.2±1.4 | 1.2±1.3 | 214 |
| 33 | -0.8±1.2 | 0.4±1.6 | 1.2±1.2 | 161 |
| 34 | -0.7±1 | 0.1±1.2 | 0.8±1.1 | 127 |
| 35 | -0.6±1.3 | -0.1±1.7 | 0.5±1.4 | 116 |
| 36 | -0.5±1.2 | 0±1.4 | 0.5±1.1 | 175 |
| 37 | -0.4±1.3 | 0.1±1.3 | 0.6±1.1 | 296 |
| 38 | -0.8±1.3 | 0±1.6 | 0.7±1.1 | 238 |
| 39 | -0.4±1.2 | -0.1±1.5 | 0.3±1.1 | 234 |
| 40 | -0.3±1 | 0.1±1.2 | 0.4±1 | 273 |
| 41 | -0.4±0.7 | 0.1±1.1 | 0.5±1 | 232 |
| 42 | -0.4±1 | -0.2±1.2 | 0.2±0.9 | 310 |
| 43 | -0.5±1 | -0.1±1.6 | 0.4±1.2 | 292 |
| 44 | -0.4±0.9 | -0.2±1.3 | 0.1±0.9 | 247 |
| 45 | -0.4±0.9 | -0.2±1.2 | 0.2±1 | 292 |
| 46 | -0.4±0.9 | -0.5±1.5 | -0.1±1.1 | 283 |
| 47 | -0.4±1.1 | -0.9±1.3 | -0.6±0.8 | 237 |
| 48 | -0.4±1.2 | -1±1.7 | -0.6±1.3 | 280 |
| 49 | -0.3±1 | 0.4±1.4 | 0.7±0.9 | 228 |
| 50 | -0.8±1.6 | -0.7±1.9 | 0.2±0.9 | 153 |
| 51 | -0.4±1.2 | -0.7±1.4 | -0.3±0.5 | 67 |
| 52 | -0.8±0.9 | -1.3±1.2 | -0.5±0.8 | 105 |

Chart, histogram

Description automatically generated

Fig. S2. Mean weekly temperatures for θ(DC), θ(sat) and θ(TS) compared with weekly *(region)* a) all years, b) an example year (2015)

