



Supplement of

A numerical sensitivity study on the snow-darkening effect by black carbon deposition over the Arctic in spring

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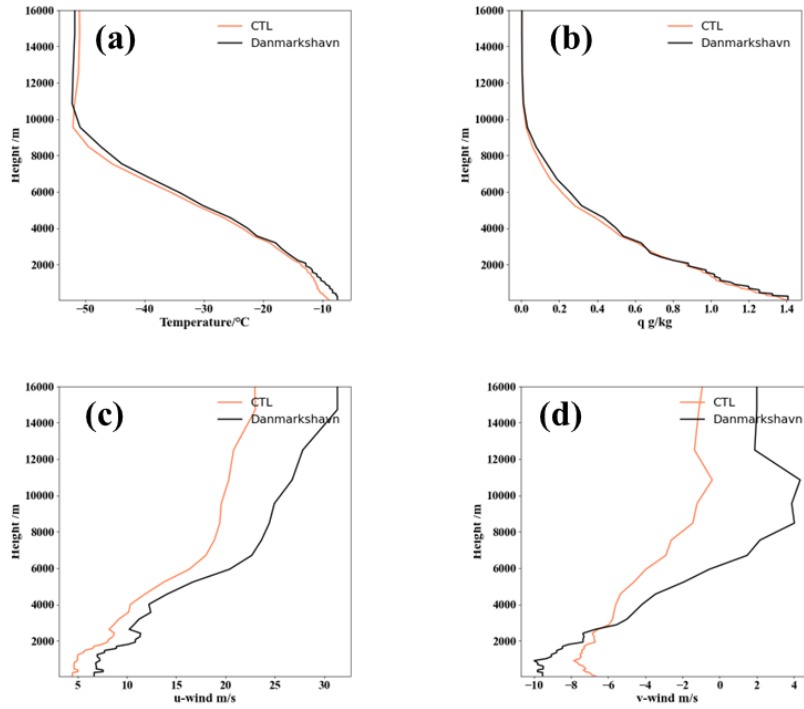


Figure S1. Vertical profiles of simulated (in orange lines) and observed (in black lines) (a) temperature ($^{\circ}\text{C}$), (b) specific humidity (g kg^{-1}), (c) u-wind speed (m s^{-1}) and (d) v-wind speed (m s^{-1}) at the Danmarkshavn station at 00:00 and 12:00 (UTC) averaged from 15 April to 15 May 2020.

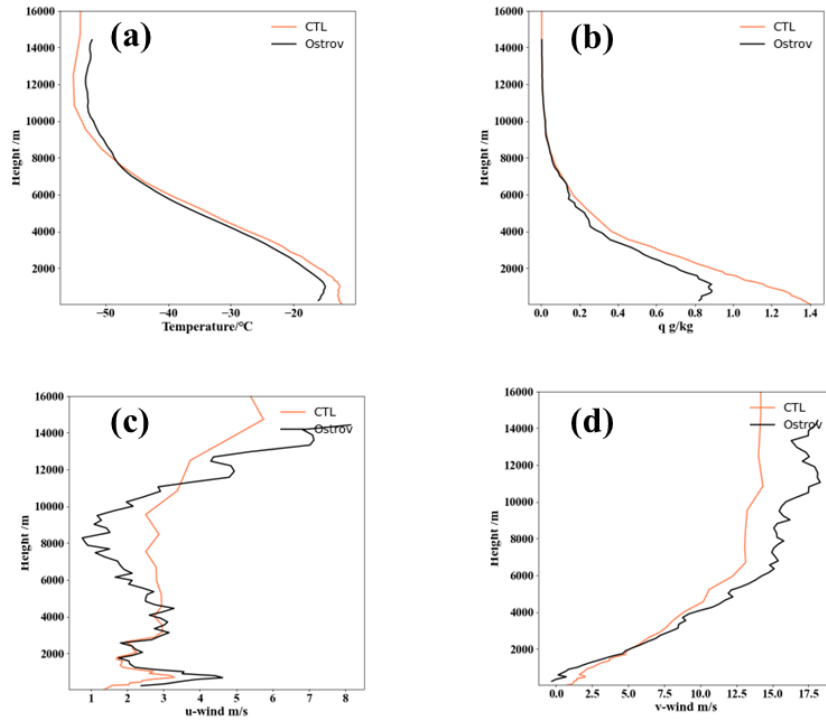


Figure S2. Vertical profiles of simulated (in orange lines) and observed (in black lines) (a) temperature ($^{\circ}\text{C}$), (b) specific humidity (g kg^{-1}), (c) u-wind speed (m s^{-1}) and (d) v-wind speed (m s^{-1}) at the Ostrov station at 00:00 and 12:00 (UTC) averaged from 15 April to 15 May 2020.

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Table S1. Statistics for observed and simulated meteorological fields (T2, RH2, WS10 and WD10) from 15 April to 15 May 2020 at Barrow and Summit stations.

| | Barrow | | | Summit | | |
|----------------------------|--------|------|------|--------|------|------|
| | MB | R | RMSE | MB | R | RMSE |
| T2 ($^{\circ}\text{C}$) | 2.08 | 0.97 | 2.48 | 2.58 | 0.89 | 4.88 |
| RH2 (%) | -2.97 | 0.81 | 5.95 | 0.59 | 0.68 | 6.06 |
| WS10 (m s^{-1}) | -0.23 | 0.81 | 1.65 | -0.87 | 0.93 | 1.71 |
| WD10 ($^{\circ}$) | -5.52 | 0.63 | 80.1 | -27.5 | 0.56 | 57.4 |

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Table S2. Statistics for observed and simulated surface energy balance (SW, HS, and LH) from 15 April to 15 May 2020 at Alaska.

| | MB | R | RMSE |
|-----------------------------------|--------------|-------------|--------------|
| SW ($W m^{-2}$) | 0.24 | 0.88 | 53.21 |
| HS ($W m^{-2}$) | 3.12 | 0.57 | 17.39 |
| LH ($W m^{-2}$) | -0.96 | 0.58 | 3.24 |

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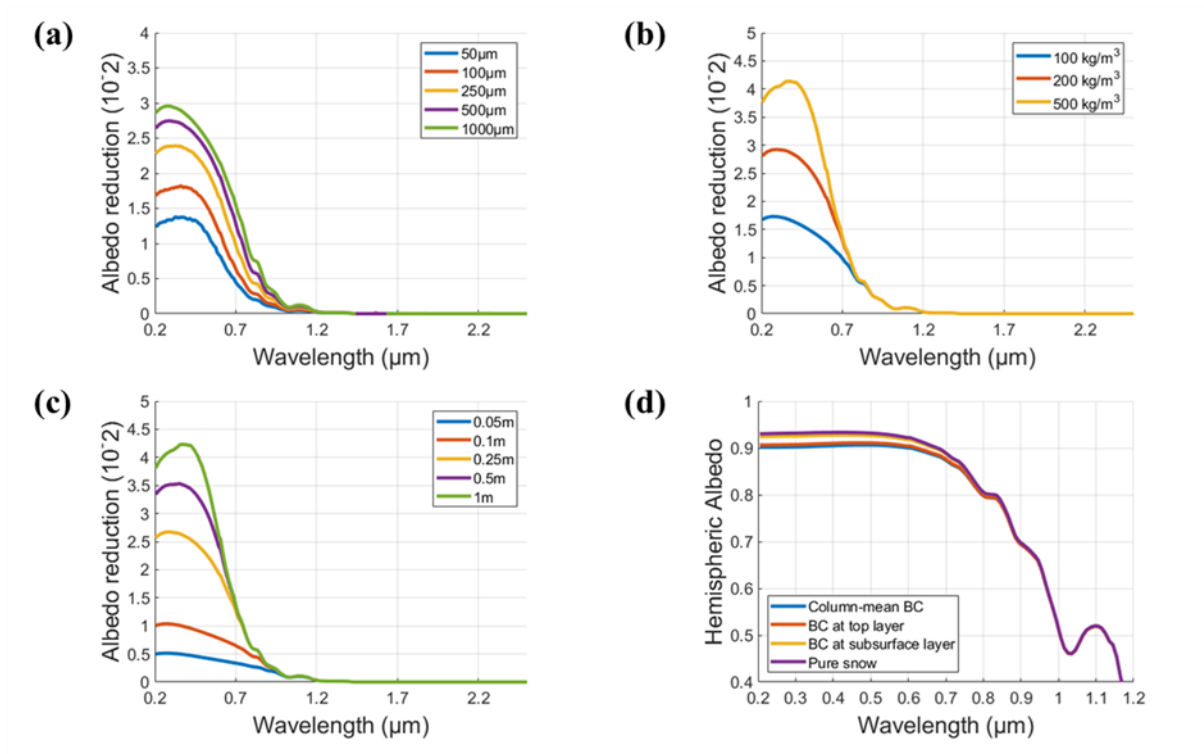


Figure S3. Spectral albedo reduction by BC with different (a) snow effective grain radii (μm), (b) snow densities ($kg m^{-3}$), (c) snow depths (m), and (d) vertical profiles of BC in snow.