Supplement for: An Overview of the Vertical Structure of the Atmospheric Boundary Layer in the Central Arctic during MOSAiC
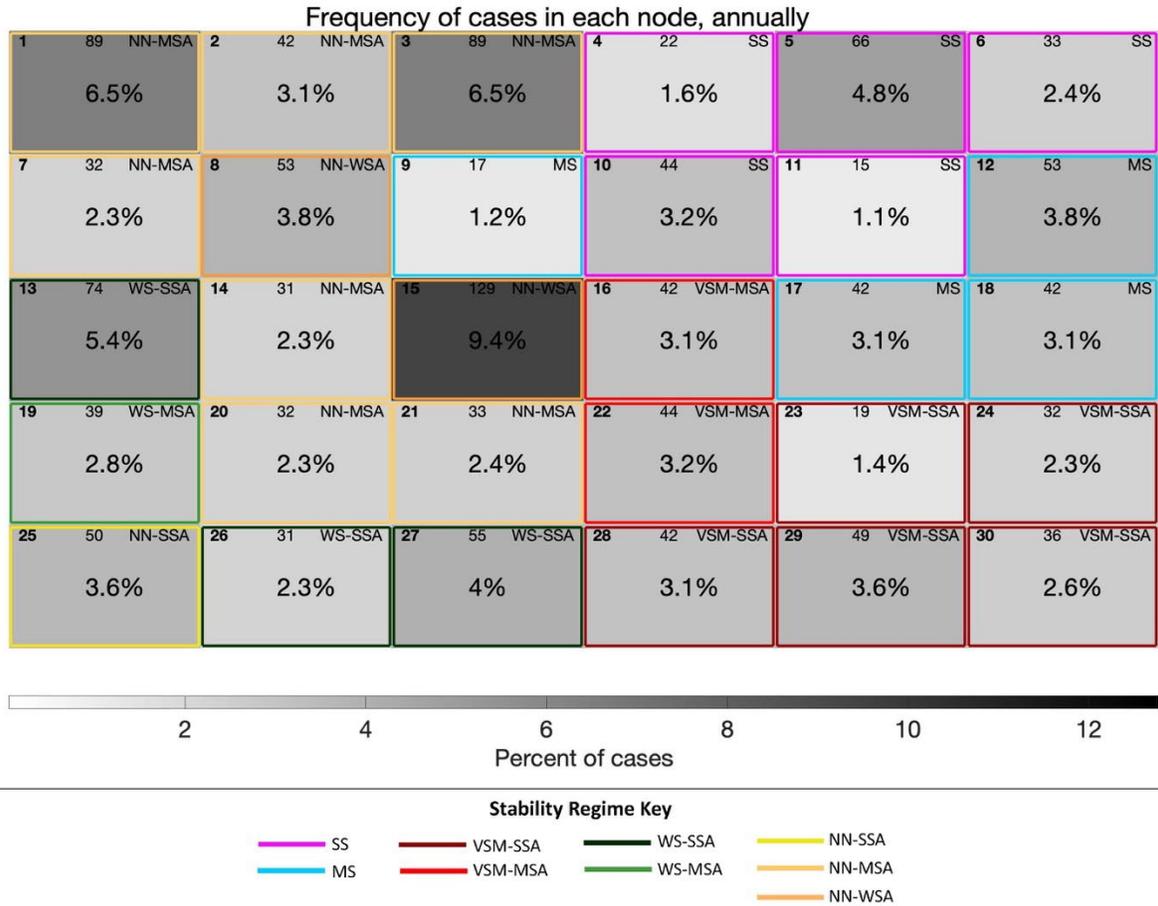
Figure S1. Grid plot following the same layout as the SOM, indicating the annual frequency of cases in each SOM pattern. The greyscale color bar corresponds to the percent of cases in each pattern, where darker grey signifies a higher percent of cases. The bold number in the upper lefthand corner of each subplot is the number of that pattern (1 through 30), the number in the upper center of each subplot is the number of radiosonde profiles which map to that pattern, and the letters in the upper righthand corner of each subplot indicates that pattern's stability regime. Stability regime is also indicated by the color of the border for each subplot, following the colors given in the "Stability Regime Key".
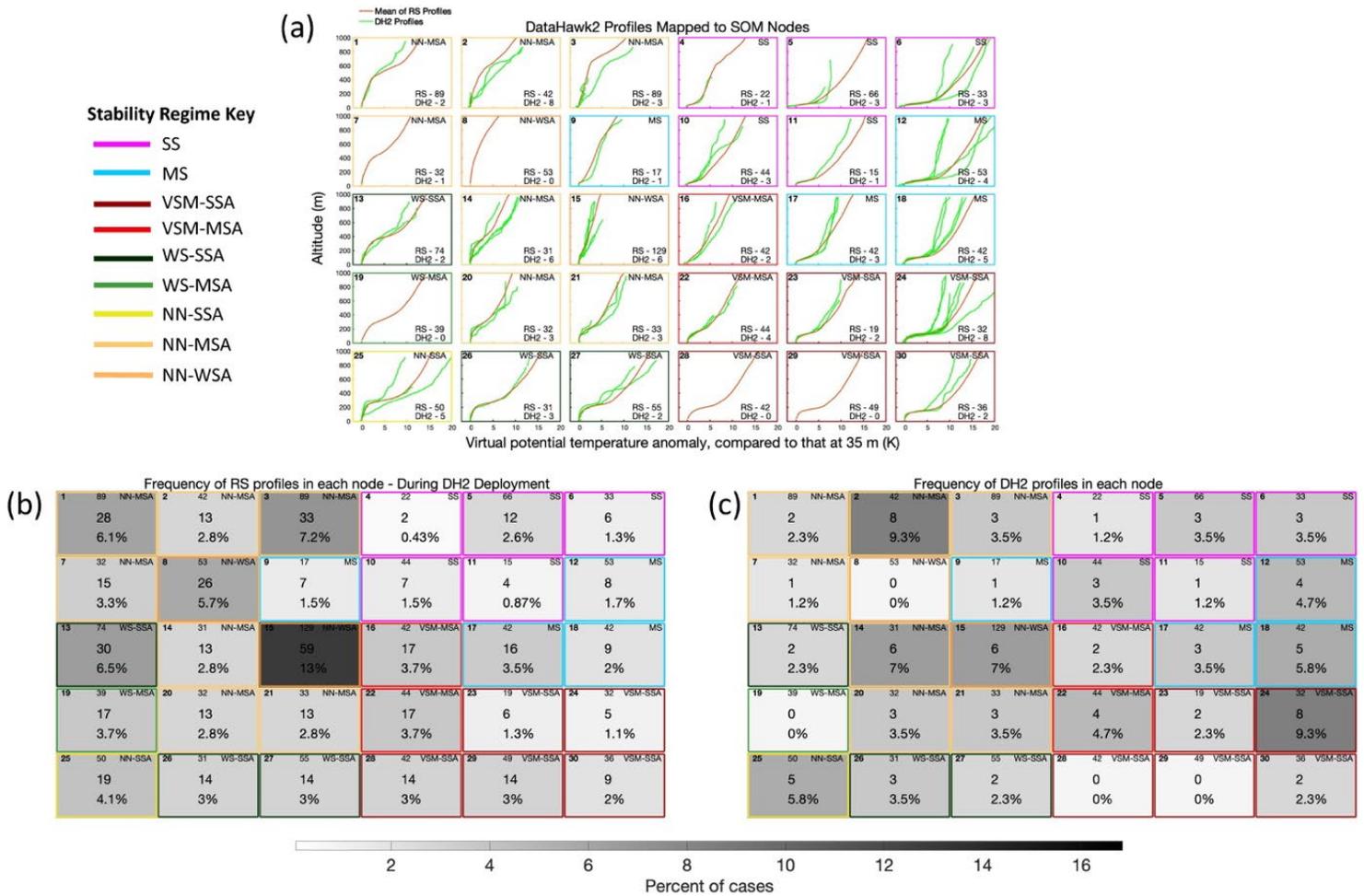
Figure S2. Top: (a) In each subplot, the orange line is the average virtual potential temperature (θ_v) anomaly profile with respect to that at 35 m for all radiosondes mapped to that SOM pattern, and the green lines are the θ_v anomaly profiles for all DH2 profiles mapped to that SOM pattern. Bottom: Grid plots following the same layout as the SOM indicating the number (upper middle of each subplot) and frequency (lower middle of each subplot) of cases in each SOM node, using all (a) radiosonde profiles and (b) DataHawk2 profiles which occurred during the time period in which the DataHawk2 was flown (23 March – 26 July 2020). The greyscale color bar corresponds to the percent of cases in each pattern, where darker grey signifies a higher percent of cases. For a-c, the bold number in the upper lefthand corner of each subplot is the number of that pattern (1 through 30), the number(s) in the upper center (in b and c) or lower righthand corner (in a) of each subplot is the number of radiosonde (in b and c) and DH2 (in a) profiles which map to that pattern, and the letters in the upper righthand corner of each subplot indicates that pattern's stability regime. Stability regime is also indicated by the color of the border for each subplot, following the colors given in the "Stability Regime Key".

Statistical significance of ABL features
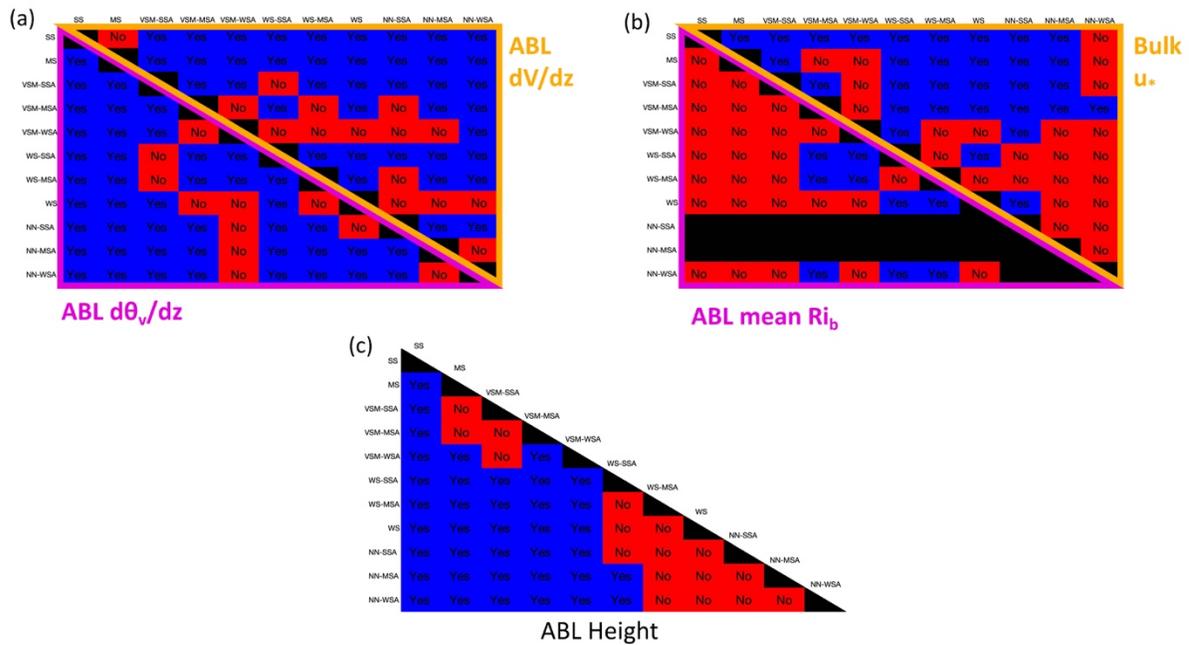
Figure S3. Grid plots indicating whether the means of a certain variable are statistically significantly different between stability regimes, where blue shading and the word "yes" indicate that the means are significantly different and red shading and the word "no" indicate that the means are not significantly different. (a) shows significance for $d\theta_v/dz$ (pink outline) and dV/dz (yellow outline) over the depth of the ABL, (b) shows significance for mean Ri_b within the ABL (pink outline) and bulk u_* from the meteorological tower (yellow outline), and (c) shows significance for ABL height.

30
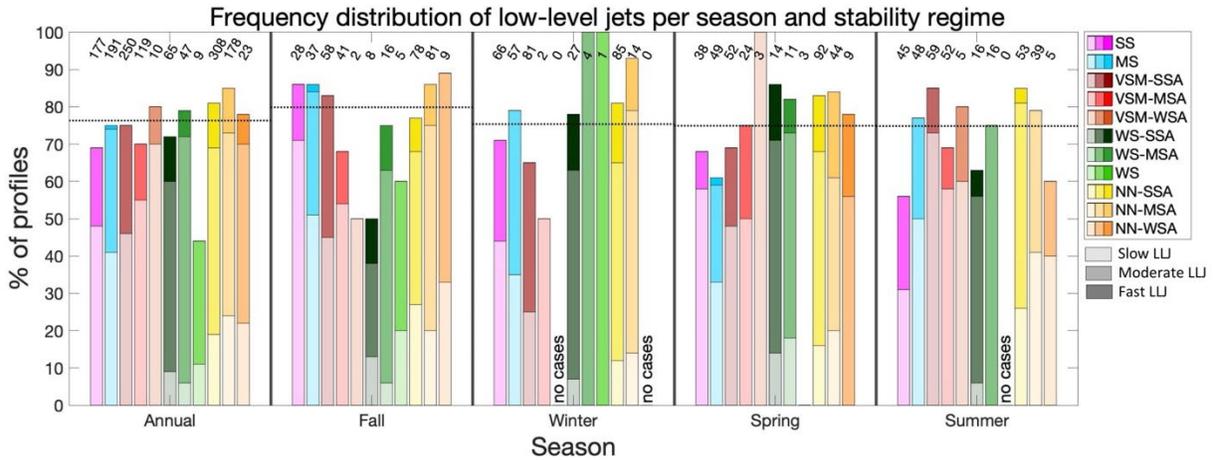
Figure S4. Annual and seasonal frequency distribution showing the percent of radiosonde profiles in each stability regime with an LLJ present, separated into slow (LLJ speed $\leq$ 10 m s^{-1}), moderate (10 m s^{-1} < LLJ speed $\leq$ 20 m s^{-1}), and fast (LLJ speed > 20 m s^{-1}) LLJs. For the seasonal sections, the percent shown is with respect to the total number of radiosonde profiles in that season. The numbers along the top of the plot, above each bar, indicate the total number of radiosonde profiles of that stability regime and season. The horizontal dotted black lines in each section indicate the overall frequency of LLJs when considering all radiosonde observations annually, and per season.
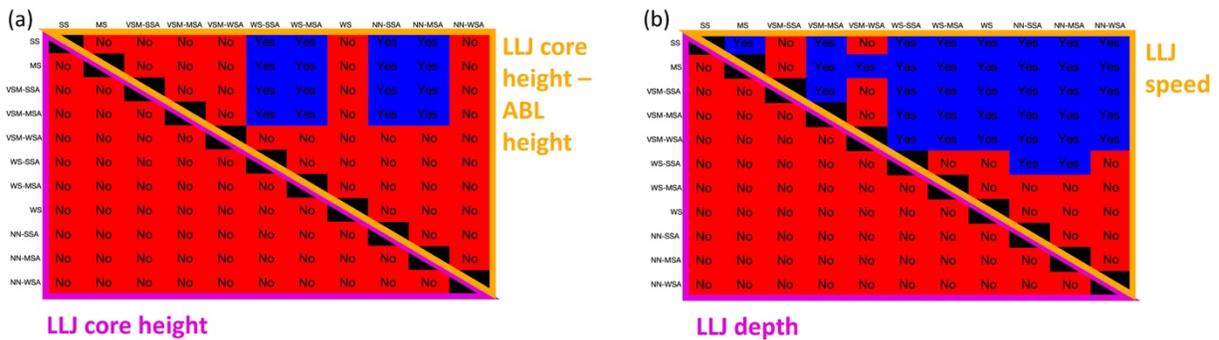
Figure S5. Grid plots indicating whether the means of a certain variable are statistically significantly different between stability regimes, where blue shading and the word "yes" indicate that the means are significantly different and red shading and the word "no" indicate that the means are not significantly different. (a) shows significance for LLJ core height (pink outline) and difference between LLJ core height and ABL height (yellow outline) and (b) shows significance for LLJ depth (pink outline) and LLJ speed (yellow outline).
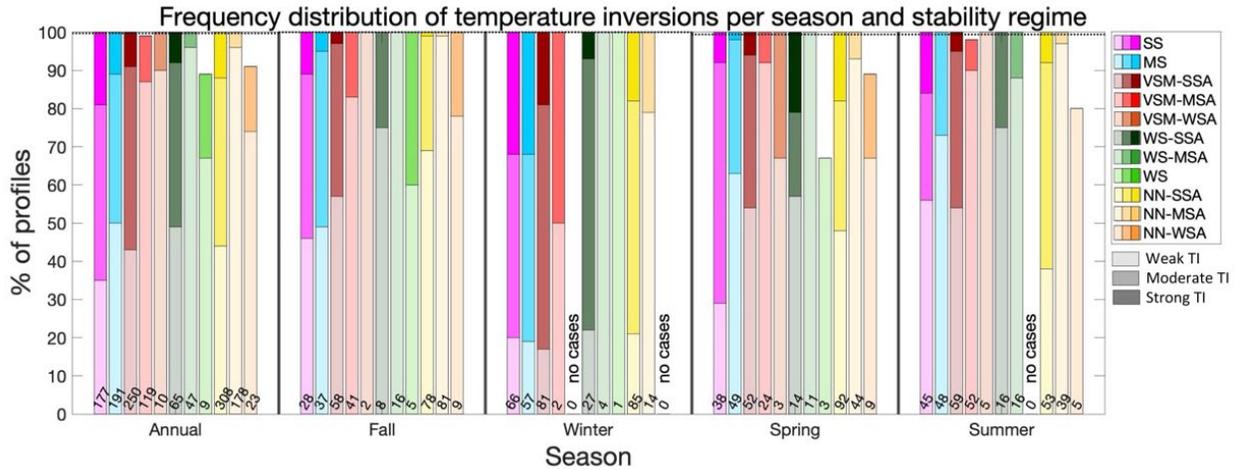
Figure S6. Annual and seasonal frequency distribution showing the percent of radiosonde profiles in each stability regime with a TI present, separated into weak (TI intensity ≤ 5 °C), moderate (5 °C < TI intensity ≤ 10 °C), and strong (TI intensity > 10 °C) TIs. For the seasonal sections, the percent shown is with respect to the total number of radiosonde profiles in that season. The numbers along the bottom of the plot indicate the total number of radiosonde profiles of that stability regime and season. The horizontal dotted black lines at the top of each section indicate the overall frequency of TIs when considering all radiosonde observations annually, and per season.
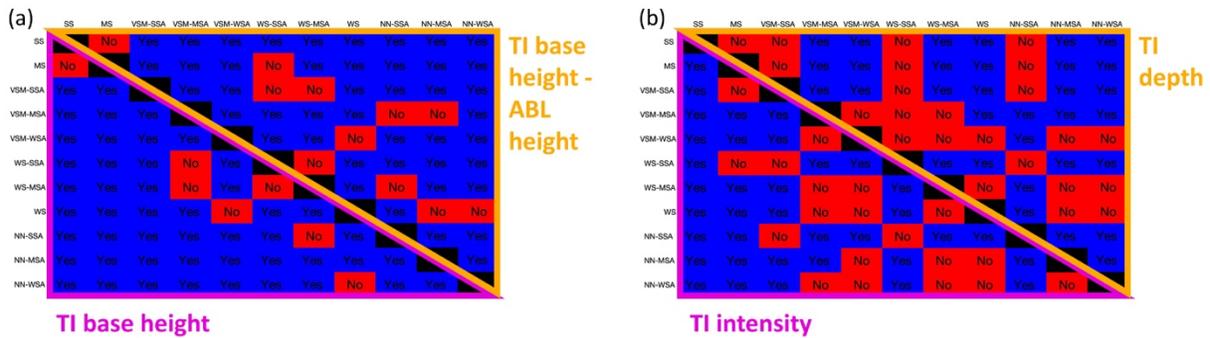
Figure S7. Grid plots indicating whether the means of a certain variable are statistically significantly different between stability regimes, where blue shading and the word "yes" indicate that the means are significantly different and red shading and the word "no" indicate that the means are not significantly different. (a) shows significance for TI base height (pink outline) and the difference between TI base height and ABL height (yellow outline) and (b) shows significance for TI intensity (pink outline) and TI depth (yellow outline).

Statistical significance of moisture features
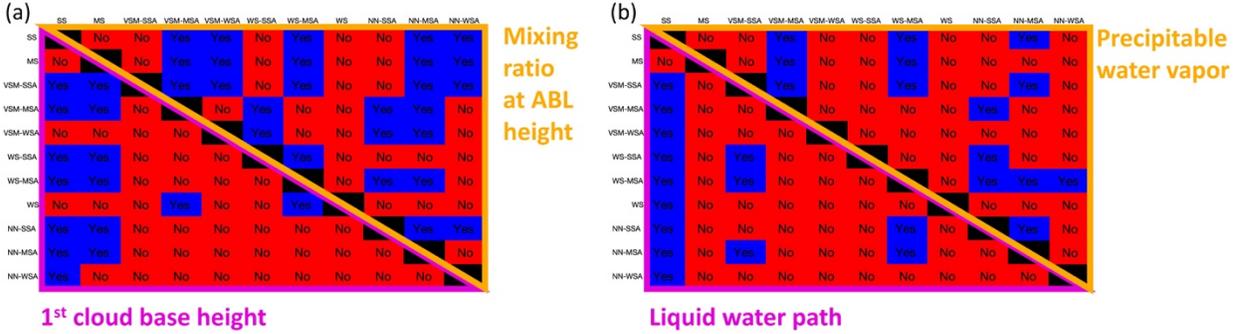
Figure S8. Grid plots indicating whether the means of a certain variable are statistically significantly different between stability regimes, where blue shading and the word "yes" indicate that the means are significantly different and red shading and the word "no" indicate that the means are not significantly different. (a) shows significance for first cloud base height (pink outline) and mixing ratio at ABL height (yellow outline), and (b) shows significance for liquid water path (pink outline) and precipitable water vapor (yellow outline).