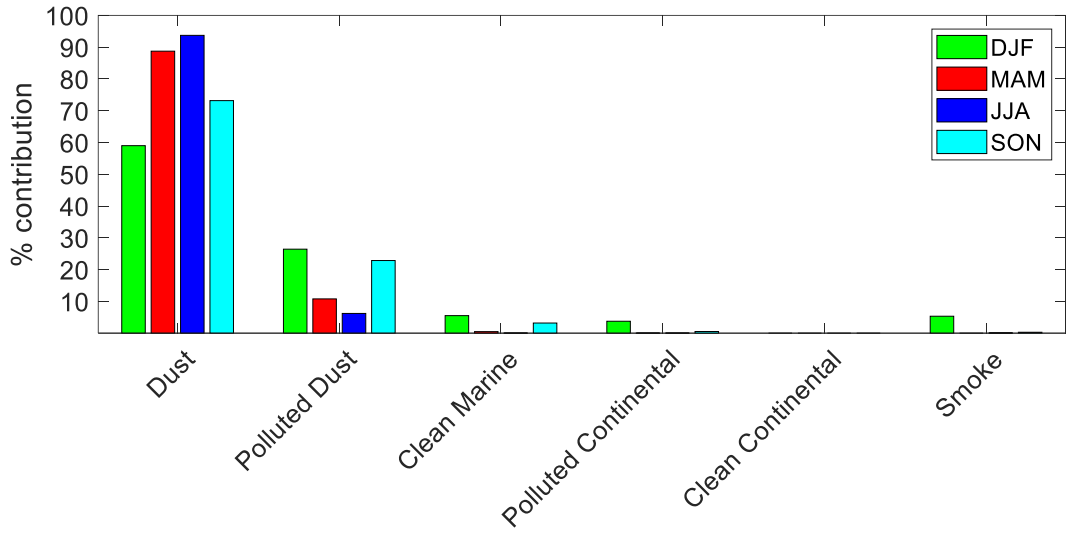

Figure S1. Percentage contribution of aerosol type from CALIOP data; calculated from the total number of aerosol samples having a particular aerosol type summed up during each season and in all vertical levels at KAUST grid cell.

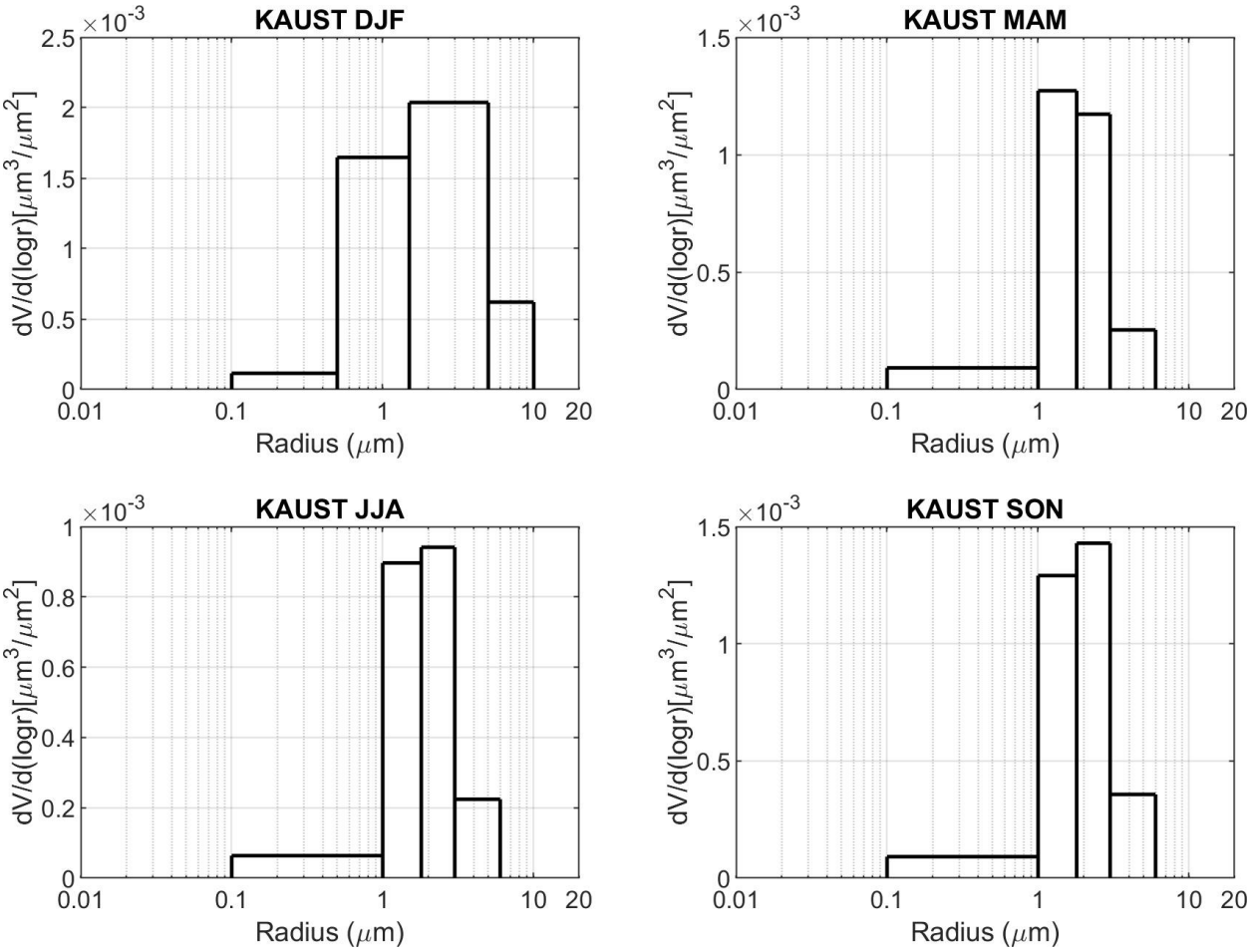

Figure S2. Particle size distribution of sea salt aerosols at KAUST from model simulations.

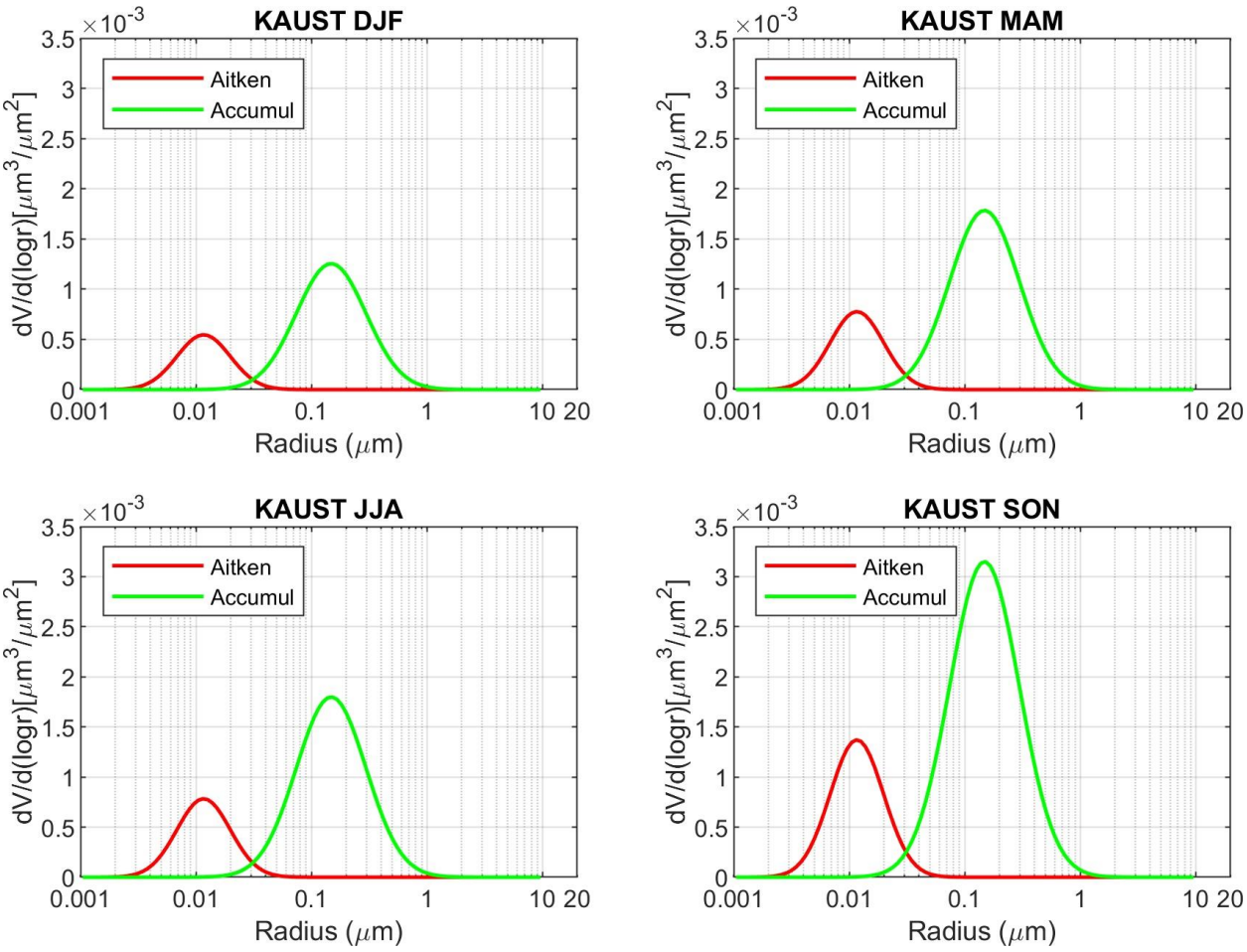

Figure S3. Particle size distribution of sulfate aerosols at KAUST from model simulations.

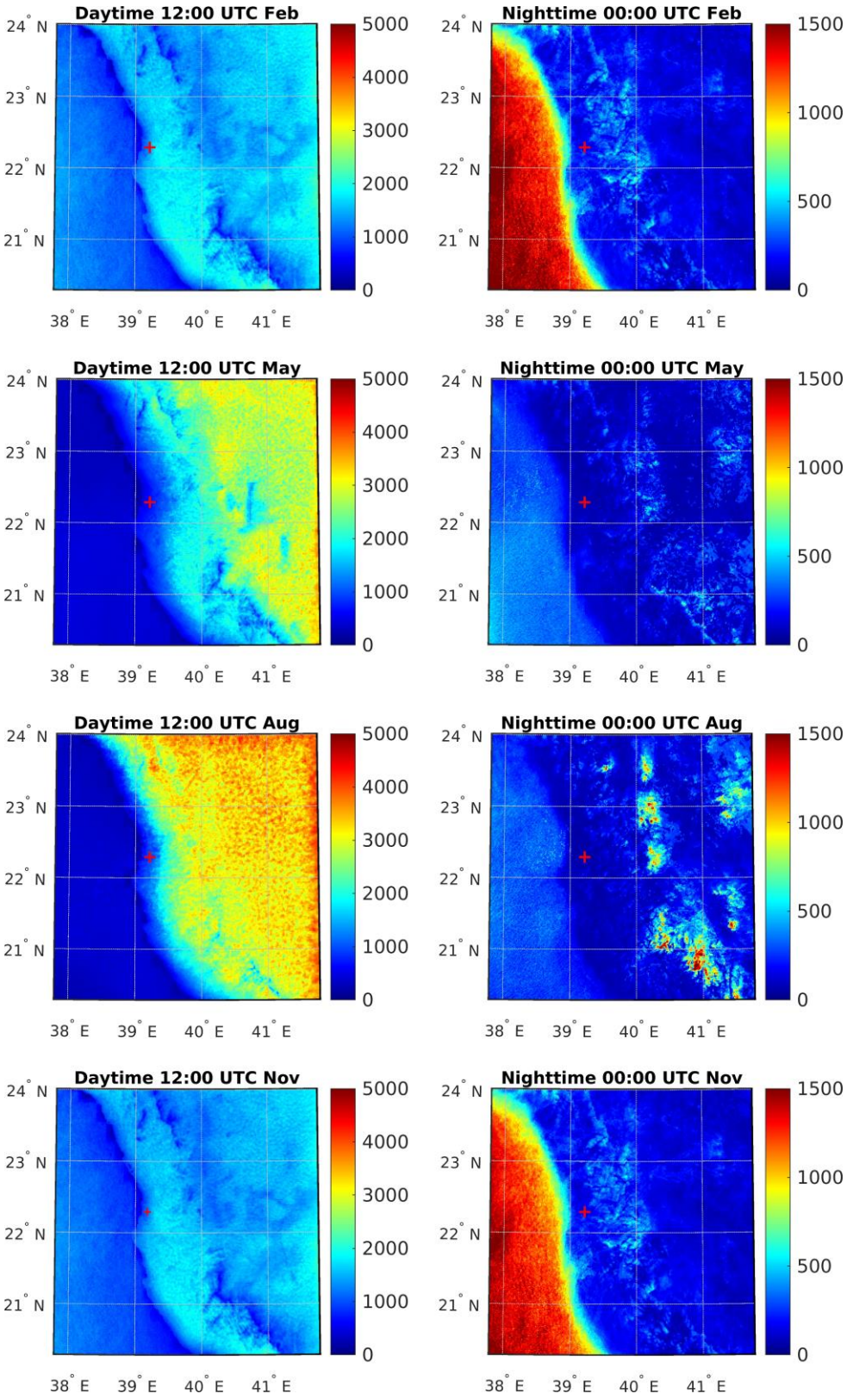

Figure S4. Planetary boundary layer height (PBLH) from the model in different seasons at two different times of day and night.

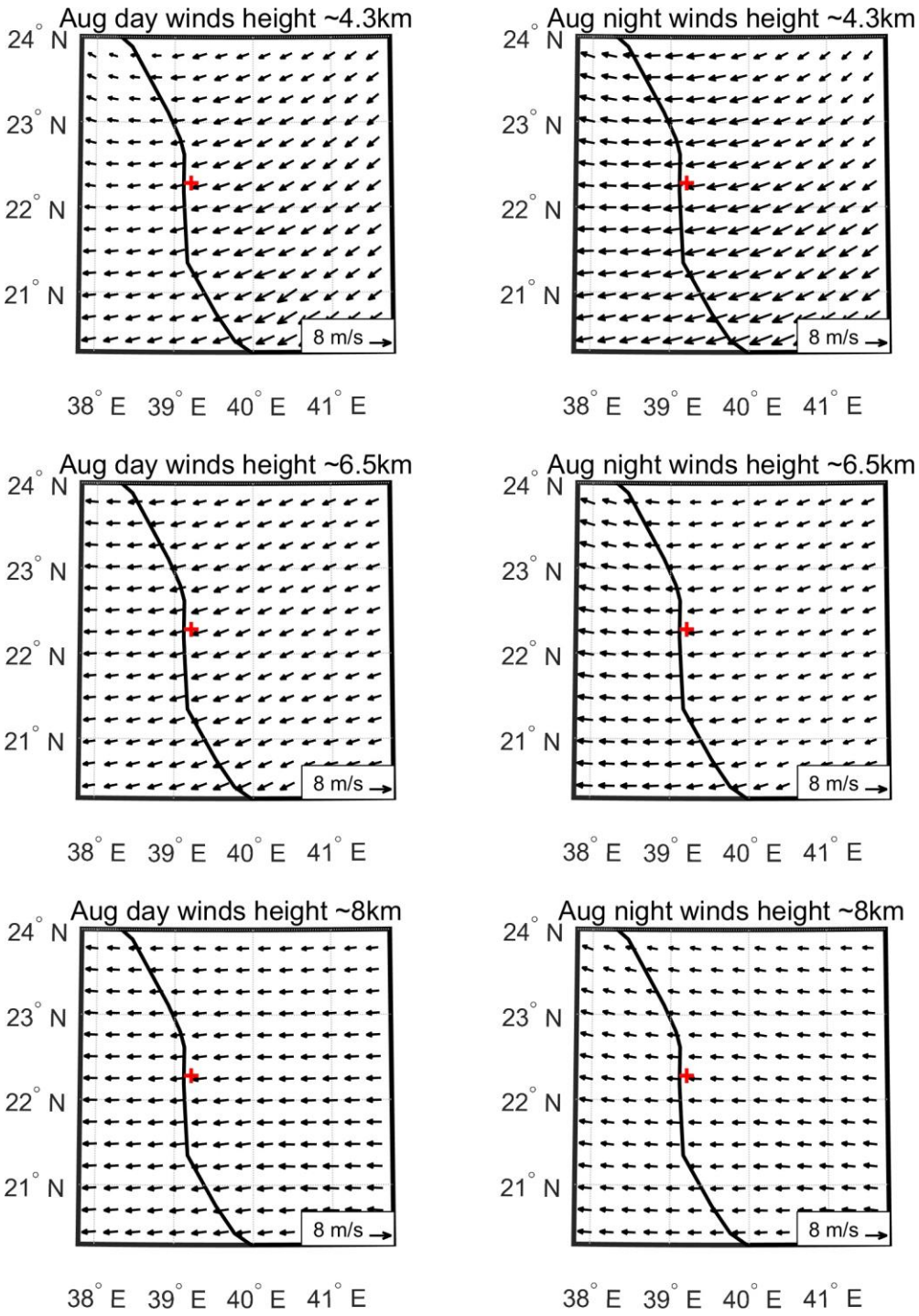

Figure S5. Comparison of winds above the boundary layer during the day and night in summer. At ~6-8km, tropical easterly low-level jets (LLJ) are observed, which are strongest in summer. At a lower height, the winds are northeasterly trade winds.

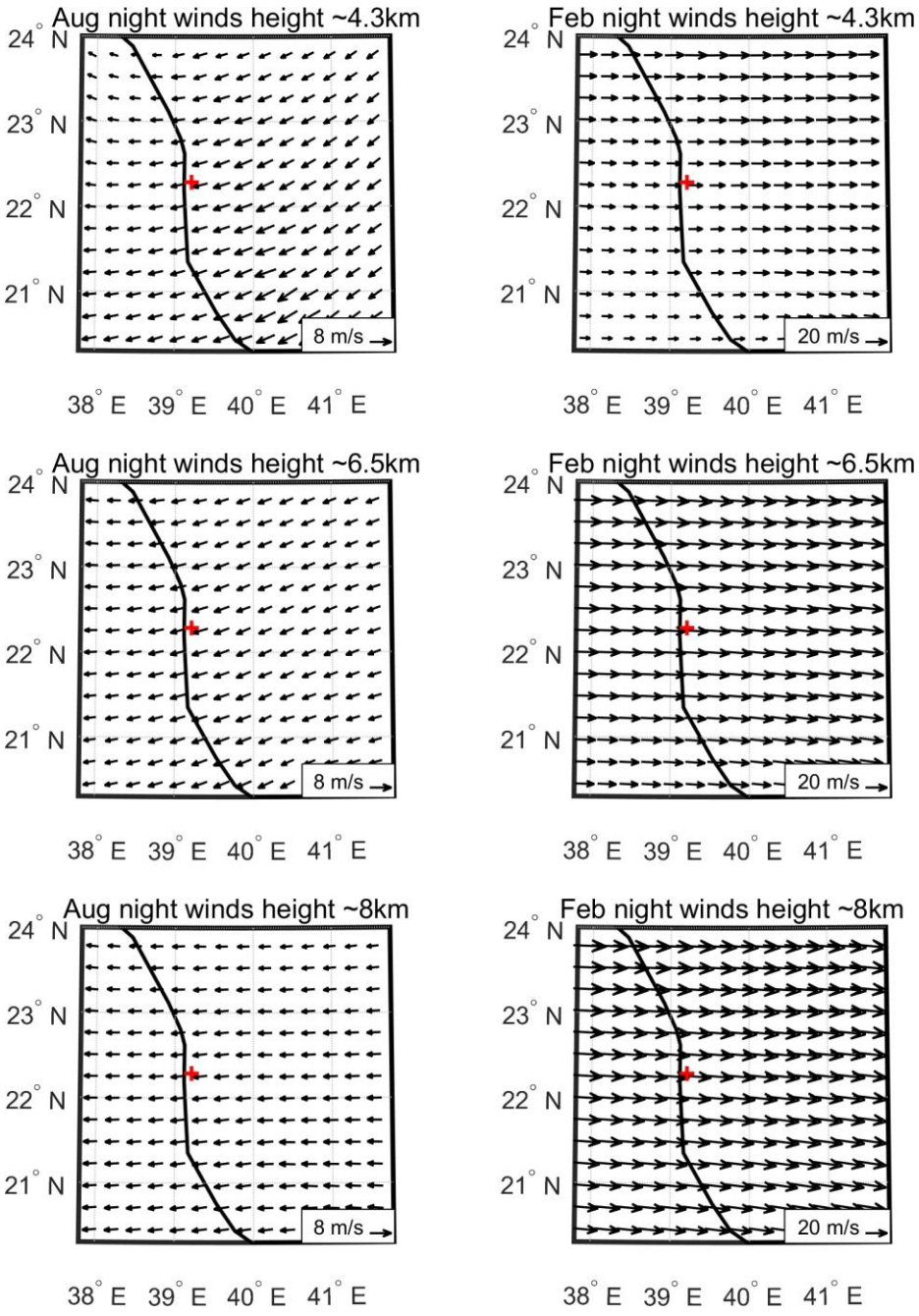

Figure S6. Winds at different elevation for two representative months of summer and winter. In summer, tropical low level easterly jets (LLJ) are observed. In winter, upper-level subtropical westerly jets (commonly called westerlies) are observed in the upper levels, which are strongest in winter.