The Expedition ARKTIS-IX/1 of RV "Polarstern" in 1993

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Remark: the ice core drilled for the installation is stored at the AWI with id. no. R9107302
6 Pt-100 sensors without mounting
Measuring heights relative to upper ice surface: +0.00, +0.09, +0.18, +0.26, +0.34, +0.42 m (= snow surface at 15 March)

3.3.3. Preliminary results of surface-layer flux measurements (M. Claussen)

During the period of Monday 15th till Thursday 18th of March, many instruments worked properly allowing a preliminary, nevertheless comprehensive diagnosis of surface-layer momentum and energy fluxes.
The most prominant feature found in the data is the dominant influence of atmospheric radiation on the surface-layer dynamics. Two distinct cases have been identified in which clouds appeared or disappeared leading to a sudden increase or decrease in atmospheric radiation of some 60 W/m^2. As a consequence the skin temperature of snow increased or decreased by up to 4 K, respectively. This change in skin temperature in turn triggered a change in sensible heat flux. For cloudless sky, the surface layer was generally stably stratified with a downward heat flux of approximately -10 W/m^2. When clouds appeared, stratification changed sign, and the heat flux was directed upward with maxima of roughly 25 W/m^2. (The fast temperature sensors generally yield smaller amplitudes of heat fluxes than the ultra sonic sensors.) This change in stratification is also recognized in variations of momentum flux. Furthermore, the sudden increase or decrease of skin temperature gave rise to a temperature wave into the snow. The influence of atmospheric radiation on surface-layer momentum and energy fluxes is seen in all turbulence sensors at all heights.
Estimates indicate that, due to the winterly conditions experienced during the drift phase of RV *POLARSTERN* , the sensible heat flux over open water should have reached 1000 W/m^2 and the latent heat flux, 250 W/m^2 approximately. Often, strong sea smoke was observed at larger distances from the experiment site (and on Thursday, March 18 also in its vicinity). Unfortunately, during the period of intensive measurements, the leads were frozen. Hence no internal boundary layers of temperature or humidity could be identified in the data. Moreover, when leads opened (during Thursday, March 18) the wind came across the 3 km wide ice floe.
The ice floe was covered with pressure ridges varying in height and spatial density. The western rim of the ice floe was heavily rafted with ridges up to 3-4 m high, while the central part of the ice floe was rather flat with few, small ridges. Roughness lengths have been computed from the uppermost and lowest ultrasonic anemometer at the 15-m mast, mounted at 15.7 m and 3.7 m, respectively. First results (see Figure 3.8) indicate that roughness lengths vary with wind direction being strongest or smallest when the wind was directed from the west rim (between 270 and 330°) or the central part of the ice floe (between 330 and 30°), respectively. Estimates of roughness lengths agree in their magnitude with data reported in literature for rough, rafted ice and flat snow fields. Rather small values of roughness lengths are computed from the uppermost sensor for directions between 350 and 30° during the 16th of March. It turns out that snowfall was reported for these wind directions which would lend support to the theory of drag reduction over surfaces with sand or snow drift. The data from the lowest sensor for the same period are to be taken

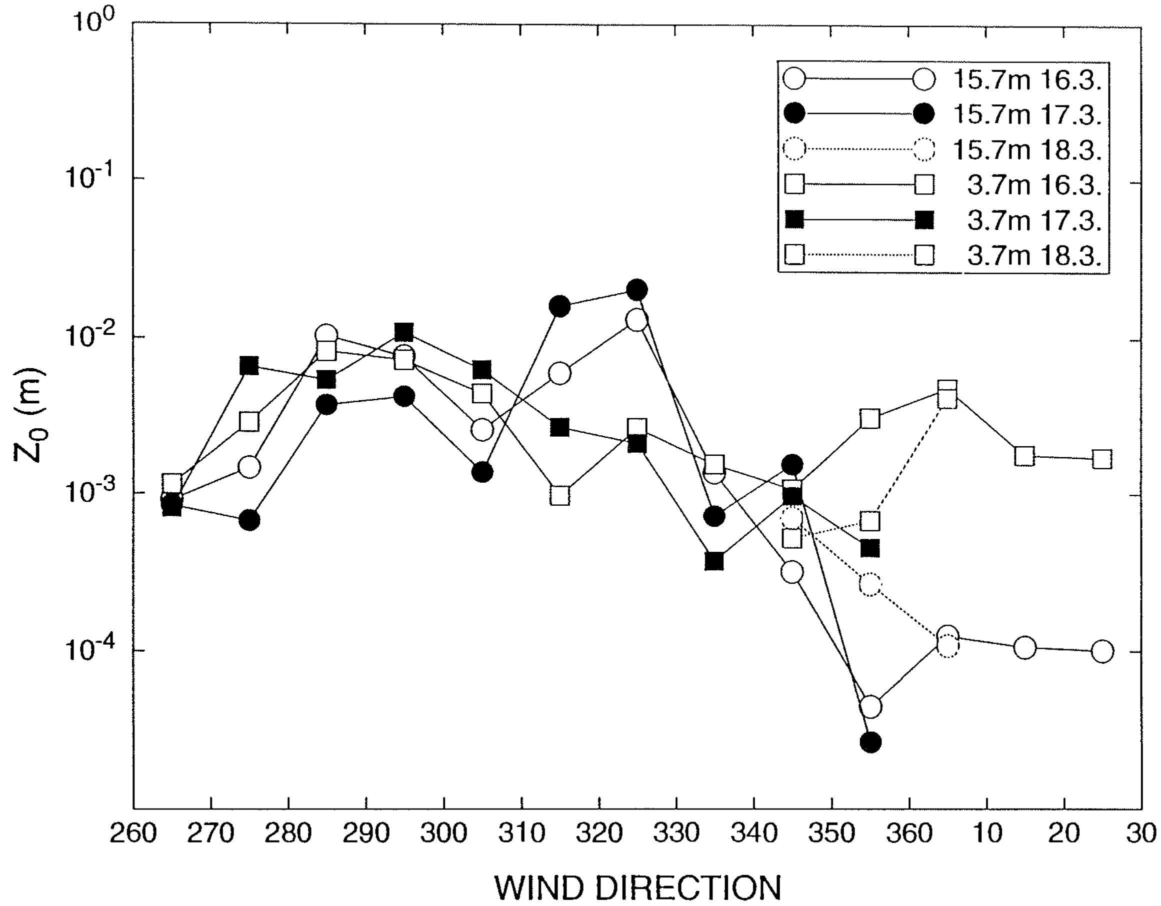

Figure 3.8: Roughness length as function of wind direction computed from the uppermost (15.7 m) and lowest (3.7 m) ultrasonic sensor at the 15-m mast. Roughness lengths are averaged for each 10° interval (e.g. for the interval between 260 and 270°, and so on).

with care because this sensor could not eliminate data failures due to drifting snow flakes.
Altimeter data from the laser mounted to the helicopter have no yet been examined. A first look at the recordings revealed, however, quite often an echo failure, presumably due to malfunctions of the laser at low temperatures.