PROBLEM SET 4

EPS 253

Consider the following measurements made at a weather station on the surface of the glacier.

- Incoming shortwave radiation, 200 W/m^2
- Albedo, 0.4
- Incoming longwave radiation, 280 W/m^2
- Sensible heat flux, 30 W/m^2

Furthermore, assume that several thermistors measure the temperature of a surface firn layer with these properties/observations:

- Layer thickness, 10 cm
- Layer density, 500 kg/m^3
- Rate of temperature change averaged over the entire layer, 0.17°C/hr
- Temperature right at the surface, 0°C (a positive energy flux goes causes melting)

Recall that the latent heat of fusion is 334 kJ/kg, the latent heat of vaporization is 2,883 kJ/kg, and the specific heat of ice is 2.108 kJ / (kg °K).

Considering these observations (and only these observations), please address the following questions.

(1) How much energy is available for melting?
(2) How much melting occurs during a 24-hour period if these conditions remain constant for that amount of time?
(3) The given positive sensible heat flux could occur if a warm air mass was present over the glacier. What would the surface energy balance be if the sensible heat flux changed sign?
(4) Following the previous question, how much melting would occur?