

Homework problem for ESS 431

4 October 2007. Due Thursday 11 October

1. Suppose it takes 10,000 years to melt the North American ice sheet from a volume of 60 meters sea-level equivalent (or $2.5 \times 10^7 \text{ km}^3$ of ice) to zero. Calculate the latent heat associated with the conversion of this volume of ice into liquid water. What imbalance of radiation energy (Watts per square meter) averaged over the earth's surface would be necessary to supply this amount of latent heat? Compare this number to the uncertainty in the present measurements of earth's radiation budget (absorbed solar radiation \approx outgoing longwave radiation = 240 ± 7 Watts per square meter).

2. Ice skates can move rapidly across ice because there is little friction between the skate blade and the ice. It has been suggested that the lack of friction under an ice skate is due to pressure-melting. Consider a 70-kg person skating on ice of temperature -5°C (23°F). The skate blade is 300 mm long and 1 mm wide.
 - (a) What is the contact area of the skate with the ice?
 - (b) What is the pressure exerted on the ice?
 - (c) By how many degrees is the melting temperature reduced?
 - (d) Argue for or against pressure-melting as the explanation for the low friction.