Homework #6
Geology 4113 (Remote Sensing)
Assigned Mar. 2, 2018
Due Mar. 9, 2018

1. Thermal Skin Depth. (10 points) Suppose that you compare day and night thermal images of a region which consists of bedrock covered by varying depths of sand. In some parts of the images you obtain a very low apparent thermal inertia, because the sand is deep. However in other regions you see a higher thermal inertia because the sand is thin enough that the thermal effects of the (thinly buried) bedrock are starting to show through. Using equations from the lecture which estimate how deep a 1-day period thermal wave will penetrate, estimate roughly how thick the sand is in the regions where you just start to see the effect of the underlying bedrock. For material properties, use the "sandy soil" values from Sabins Table 5-2. (True sand will probably be slightly less conductive.)

2. Diurnal Temperature Variation (10 points) For a black surface with the sun directly overhead (and ignoring the atmosphere) the amount of absorbed sunlight would be 1360 W m^{-2}. However when we consider that the sun is lower in the sky, the sandy soil in the above problem may reflect most of the sunlight, and the surface is convecting or radiating away a good fraction of this energy, a rough estimate would be that the surface is absorbing a net flux of $1/10^{th}$ this (so 136 W m^{-2}) at noon, and radiating this amount extra at midnight. To make the math simple we'll assume we can represent this flux variation as a sine wave with "Amplitude" F_0=136 W m^{-2}. Using equations from the lecture and the thermal properties for sandy soil, estimate the amplitude of the temperature variation expected from night to day. (So the total change will be twice this amplitude.) Note you will need to convert the sandy-soil constants from Table 5-2 from the calorie units they use to the mks system before you use those equations.