Problems for Week 7: Resolution

1) How is the along-track resolution of ice penetrating radar is dependent on
    a. The radar system wavelength?
    b. The radar system bandwidth?
    c. The processing preformed?
    d. The target being observed?

2) Assume that an ice penetrating radar has a center frequency of 60 MHz, a bandwidth of 15 MHz, an antenna pattern with a 15 degree central lobe, and a survey height of 500m. Calculate the size of the following for the ice surface.
    a. The beam limited footprint
    b. The pulse limited footprint
    c. The first Fresnel zone
    d. The along-track resolution after coherently summing over 20 m
    e. The along-track resolution after '1D' focusing with a 100 m aperture
    f. The along-track resolution after '2D' focusing with a 2 km aperture

3) Assume that an ice penetrating radar has a center frequency of 60 MHz, a bandwidth of 15 MHz, an antenna pattern with a 15 degree central lobe, a survey height of 500m, and a 4 km ice depth. Calculate the size of the following at the bed.
    a. The beam limited footprint
    b. The pulse limited footprint
    c. The first Fresnel zone
    d. The along-track resolution after coherently summing over 20 m
    e. The along-track resolution after '1D' focusing with a 100 m aperture
    f. The along-track resolution after '2D' focusing with a 2 km aperture

4) Assume that you are trying to distinguish distinct types of regions on the ice surface using radar that had been coherently integrated across C pulses and then incoherently averaged across N. The regions have distinct surface morphologies at a resolution of 50 m or better and distinct radar reflectivity that produce returns differing by 3 dBm. If initial processing yields 20 m along track resolution and 4 dBm radiometric resolution, how could the same data be reprocessed to best allow the two region types to be distinguished?

5) Assume that you have an ice penetrating radar system with a center frequency C, a bandwidth B, a survey height of H, and an ice depth Z.
    a. Under what conditions would the pulse limited footprint on the surface be larger than the first Fresnel zone on the surface?
    b. Under what conditions would the first Fresnel zone on the bed be larger than the pulse limited footprint on the bed?
    c. Under what conditions would the first Fresnel zone on the bed be larger than the first Fresnel zone on the surface?