Unit 6 ATM478/678 Mesoscale Dynamics

1. Graduate students: Assume an irrigated farm in the middle of a dry grassland (steppe) during summer. For the farm and steppe assume daytime Bowen ratios of 0.5 and 2, where the Bowen ratio is the ratio of sensible to latent heat flux. Further assume for the shortwave radiation $R_{sw\downarrow}= R_{sw,max\downarrow}\sin(\pi\, t/\tau)$ with $R_{sw,max\downarrow}= 800\ Wm^{-2}$, τ=14h (i.e., sunrise at 0500 LT, sunset at 1900 LT) at sunrise t=0. The long-wave radiation flux density is $R_{lw,net}= -80\ Wm^{-2}$ (i.e., constant net loss of energy per unit surface area), and a typical assumption of $G = 0.1R_{net}$ for the ground heat flux density where R_{net} is the net radiation. Assume an albedo of α= 0.2 and emissivity of 0.98. Determine the time at which R_{net} becomes positive. Plot the temperature as a function of time for both the steppe and irrigated land. Discuss how the two area will affect buoyancy and create a mesoscale circulation.
2. Undergraduate students: Discuss how irrigation affects buoyancy. How will the effect of irrigation affect the creation of a non-classical mesoscale circulation with the type of crops? Not more than a page. A sketch will be sufficient too.