**Consideration of Diffuse Radiation in the Noah Land Surface Model**

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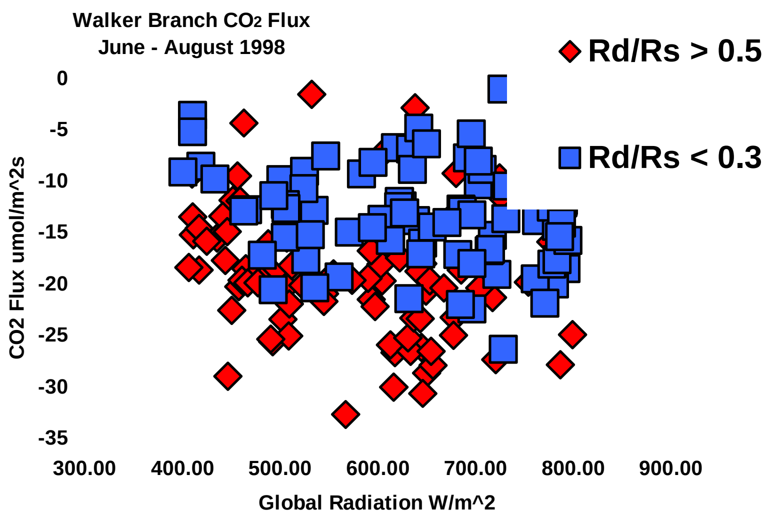
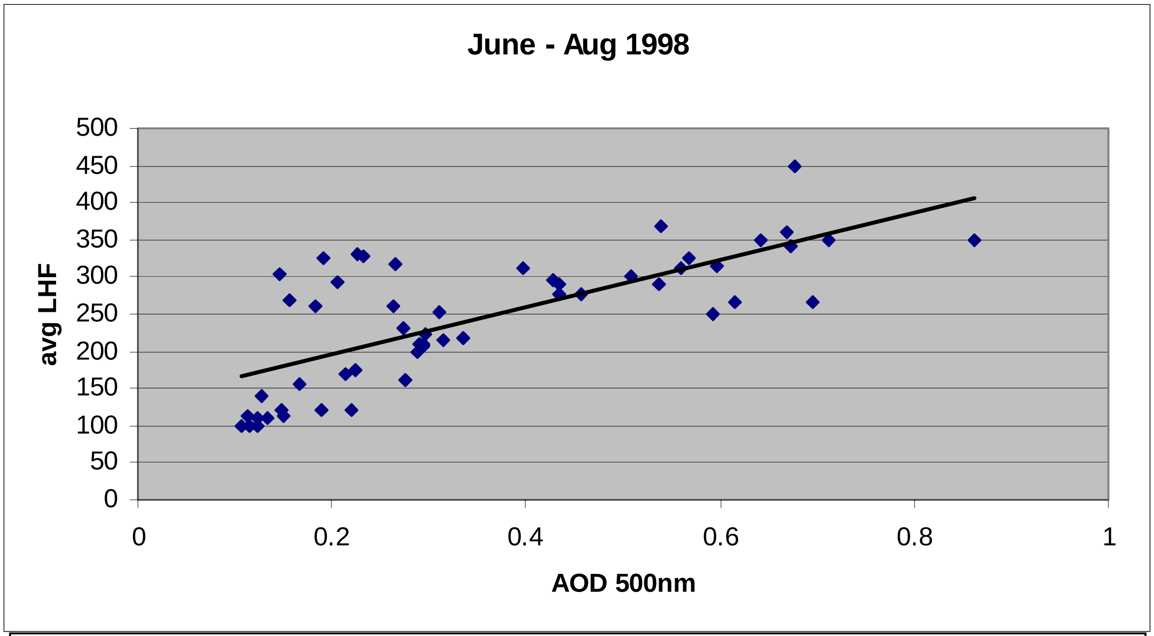
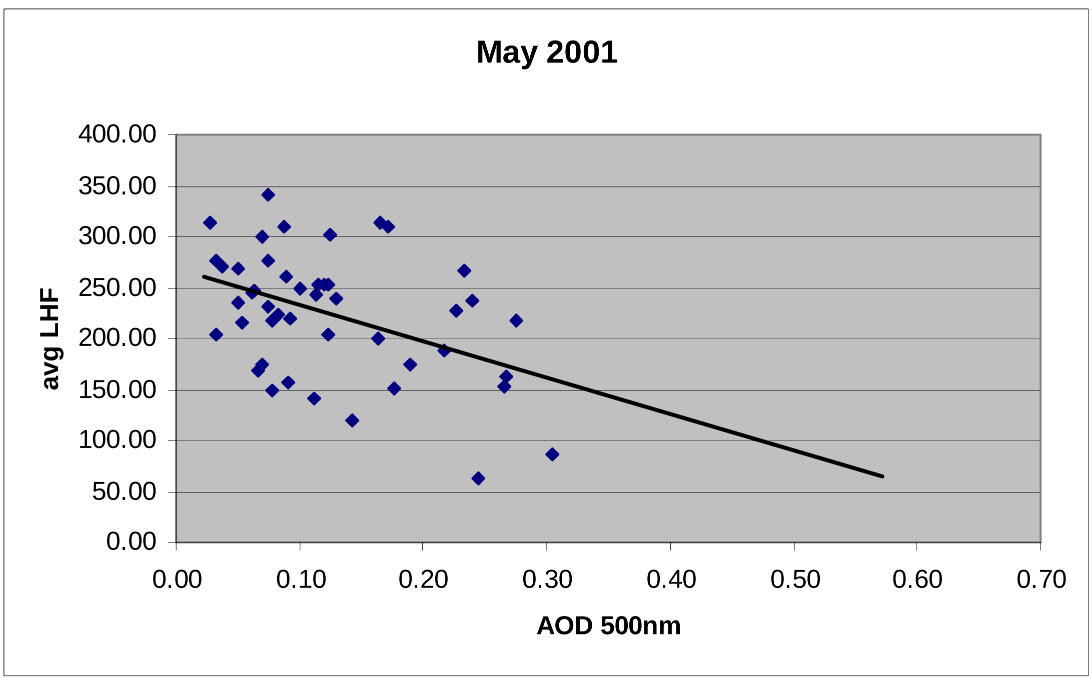
Field observations across different landscapes globally show that the vegetation response such as transpiration and photosynthesis are correlated to the diffuse to direct ratio of the incoming solar radiation. The observations indicate an increased photosynthesis rate for increasing diffuse radiation fraction. The increased photosynthesis rate in some cases is also related to increased transpiration, though in some case it is expected that plant's water use efficiency increases under diffuse radiation regimes and the transpiration changes may be damped. However, there is increasing evidence that diffuse radiation changes, both because of increasing cloud cover or increasing aerosol / haze is a significant atmospheric forcing which needs to be considered in the land surface models.
In this study we hypothesize that diffuse radiation feedback is an important process mechanism that needs to be considered in the terrestrial exchanges in the Noah LSM and in the coupled WRF model to better represent land-atmospheric interactions. For this, we first test the hypothesis using observations obtained from AmeriFlux network (where surface energy fluxes, and concurrent diffuse radiation observations are available). This will be then rested over a similar dataset over the eastern China region.
The basic concept that the canopy processes are a cumulative feedback effect of both direct beam and diffuse component of atmospheric radiation is well established in the literature. In addition, observational studies exist, particularly from forest ecosystems, which suggest an increase in efficiency of net ecosystem exchange with an increase in the diffuse fraction of radiation.
Aerosols and clouds are abundant in the environment both as a result of natural and anthropogenic sources, and the 'direct' and 'indirect' effects of aerosols on climate are well known and relatively well understood. Considering that clouds and aerosols are known to both absorb and scatter incoming solar radiation, an increase in aerosol loading can lead to more diffuse radiation in the atmosphere The impact of these clouds, aerosols and particles can affect the radiative flux at the top of atmosphere, and even more profoundly at the surface and thus affect the biospheric processes. Thus, changes in the diffuse radiation fraction, have the potential to impact the efficiency of the canopy exchanges including transpiration.




*Observed increase in the CO2 flux (-ve flux is towards the ground) corresponding to the higher diffuse radiation fraction.*




*Sample analysis for latent heat flux with aerosol optical depth at 500 nm. The optical depth can be taken as a measure of diffuse radiation fraction under cloud-free conditions. For High LAI (> 3) in the Walker Branch AmeriFlux site, a positive correlation is seen.*




*Example of a similar analysis but for low LAI (start of the season). A negative correlation is seen between AOD (diffuse radiation) and latent heat flux.*