EGU General Assembly 2022

EGU22-8030, updated on 08 Aug 2022
https://doi.org/10.5194/egusphere-egu22-8030
EGU General Assembly 2022

Heat Transfer through Grass: A Diffusive Approach

Bas Van de Wiel[1], Steven van der linden[2], Maarten Kruis[1], Oscar Hartogensis[3], Arnold Moene[3], and Fred Bosveld[4]

[1]DELFT University of Technology, Delft, Netherlands (b.j.h.vandewiel@tudelft.nl)
[2]University of Cologne, svanderl@uni-koeln.de
[3]Wageningen University
[4]Royal Dutch Meteorological Institute (KNMI)

Heat transport through short and closed vegetation, such as, grass is modelled by a simple diffusion process. The grass is treated as a homogeneous ``sponge layer'' with uniform thermal diffusivity and conductivity, placed on top of the soil. The temperature and heat flux dynamics in both vegetation and soil are described using harmonic analysis. All thermal properties have been determined by optimization against observations from the Haarweg station in the Netherlands. Our results indicate that both phase and amplitude of soil temperatures can be accurately reproduced from the vegetation surface temperature. The diffusion approach requires no specific tuning to, e.g., the daily cycle, but instead responds to all frequencies present in the input data, including quick changes in cloud cover and day-night transitions. The newly determined heat flux at the atmosphere-vegetation interface is compared with the other components of the surface energy balance. The budget is well-closed, particularly in the most challenging cases with varying cloud cover and during transition periods. We conclude that the diffusion approach is a promising and physically consistent alternative to more ad-hoc methods, like ``skin resistance'' approaches for vegetation and bulk correction methods for upper soil heat storage. However, more work is needed to evaluate parameter variability and robustness under different climatological conditions. From a numerical perspective, the multi-frequency

description allows for studying cases where the atmospheric boundary layer and the top-surface interact on sub-hourly timescales. It would therefore be interesting to couple the current land-surface description to turbulent resolving methods, such as, large-eddy simulations.