Reply to comment by S. Nadarajah on “Space-time modeling of soil moisture: Stochastic rainfall forcing with heterogeneous vegetation”

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[1] The comment by Nadarajah [2007] focuses on the spatial correlation function of the rainfall forcing adopted in the theoretical analysis of the soil water balance addressed by Isham et al. [2005] and Rodríguez-Iturbe et al. [2006]. In this expression, we simplified the area of overlap \( C(u) \) of two unit discs (representing the rain cells) with centers distance \( u \) apart by adopting a linear approximation

\[
C_k(u) = \begin{cases} 
\pi - k u & 0 \leq u \leq 2 \\
0 & 2 \leq u,
\end{cases}
\]

where \( k \) is a constant assumed equal to \( \pi/2 \). As shown in Figure 1, this approximation is quite satisfactory. There is only a slight overestimation in the correlation function of the rainfall intensity, as discussed in section 2 of Isham et al. [2005], where the approximated correlation function was compared with the exact solution of the correlation function obtained via numerical integration.

[2] The great advantage of this hypothesis is that it makes the model analytically solvable, providing a simple form for the correlation function of the rainfall field in which dependence on physically meaningful parameters is clearly defined. Nevertheless, the use of the solution proposed by Nadarajah [2007], based on the Bessel and Struve functions, may be useful in further applications of the quoted model.

Figure 1. Comparison between the area of overlap of two unit discs \( C(u) \) and its approximation \( C_k(u) \).

References


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