

## ***Interactive comment on “Bringing it all together” by J. C. I. Dooge***

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Received and published: 28 February 2005

BRINGING IT ALL TOGETHER

INTERACTIVE DISCUSSION

Response by Author to comment by J.P.J. O’Kane

This comment provides an excellent example of the manner in which analytical results from other disciplines can be combined with empirical knowledge based on field experiments to extend the coherent corpus of knowledge in both theoretical and applied hydrology. It supplements the discussion in the original paper on the simplification of the switching between four distinct phases of unsaturated flow in the unsaturated due to alternate wet and dry periods as shown in figure 3 of that paper.

This original simplification demonstrates that the soil moisture profile due to the succession of (1) atmosphere-controlled infiltration before surface saturation (C to D) followed

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by (2) soil-controlled infiltration after surface saturation (D to A) to be closely approximated by a simpler computation based on the classical analytical solution based on instantaneous ponding Philip (1957) combined with an appropriate time shift. The justification for this simplification from the original four alternating phases of atmosphere-control and soil-control during precipitation is given by Kuhnel et al (1990) of which the commentator is a joint author. A similar reduction can be derived for the other two phases of evaporation, (A to B) and (B to C) thus reducing the original four phases to two phases separated by a switching between a downward flux and an upward flux.

The comment on the paper describes how this approach can be extended to cover the phenomenon of hysteresis between the soil-wetting and soil drying areas discussed in classical hydrology. Essentially this extension involves the advance from a single switching based on the direction of the surface flux to the operation of multiple switching operations on changing from a wetting phase to a drying phase and vice-versa. This particular development provides an excellent headline for the stimulation of similar ventures in other aspects of the operation of hydrologic processes and systems.

References Philip J.R.(1957) The theory of infiltration. Soil Science. 83: 345-357, 435-448; 84: 163-178, 257-264.

Kuhnel, V., Dooge, J.C.I., Sander, G.C. and O’Kane, J.P.J. (1990) Duration of atmosphere-controlled and soil controlled phases of infiltration for constant rainfall at a soil surface *Annales Geophysicae* 8(1), pp. 11-20

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Interactive comment on Hydrology and Earth System Sciences Discussions, 1, 41, 2004.

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