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Temporal variability in phosphorus transfers: classifying concentration–discharge event dynamics

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Abstract. The importance of *temporal* variability in relationships between phosphorus (P) concentration (C_p) and discharge (Q) is linked to a simple means of classifying the circumstances of C_p–Q relationships in terms of functional types of response. New experimental data at the upstream interface of grassland soil and catchment systems at a range of scales (lysimeters to headwaters) in England and Australia are used to demonstrate the potential of such an approach. Three types of event are defined as Types 1–3, depending on whether the relative change in Q exceeds the relative change in C_p (Type 1), whether C_p and Q are positively inter-related (Type 2) and whether C_p varies yet Q is unchanged (Type 3). The classification helps to characterise circumstances that can be explained mechanistically in relation to (i) the scale of the study (with a tendency towards Type 1 in small scale lysimeters), (ii) the form of P with a tendency for Type 1 for soluble (i.e., <0.45 µm P forms) and (iii) the sources of P with Type 3 dominant where P availability overrides transport controls. This simple framework provides a basis for development of a more complex and quantitative classification of C_p–Q relationships that can be developed further to contribute to future models of P transfer and delivery from slope to stream. Studies that evaluate the *temporal* dynamics of the transfer of P are currently grossly under-represented in comparison with models based on *static/spatial* factors.

Keywords: phosphorus, concentration, discharge, lysimeters, temporal dynamics, overland flow

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