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On the interpretation of catchment-scale parameters in terms of spatial versus temporal variations

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The Budyko framework formulates catchment-scale energy and mass transfers in terms of a balance between supply (i.e. precipitation) and demand (i.e. evaporative demand). Modern versions of this formulation include a catchment parameter that can be "tuned" to reproduce historical records. In practice, that tuned value can be used to make predictions about the sensitivity of a catchment to changes in climate. However, as a matter of principle, the "catchment parameter" might change over time. How can we estimate it? In this paper we present a qualitative framework to describe how the catchment parameter in the widely used Budyko framework might change with some typical forcings (e.g. changes in atmospheric CO2, etc.) We subsequently identify a very interesting problem where changes in the spatial distribution of the catchment-scale forcings can lead to temporal changes in catchment-scale parameters.