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The Budyko framework beyond stationarity

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The Budyko framework provides a well established, simple, first order functional relationship to assess interactions and feedbacks of the mean climate state on the land water and energy cycle at catchment scales. However, a major downside of the Budyko framework is its limitation to steady state conditions, being a result of the assumption of a closed land water balance. Nonstationary processes coming into play at other than mean annual catchment scales are thus not represented. Here we propose an analytically derived new formulation of the Budyko curve including an additional parameter being implicitly related to the nonlinear storage term of the land water balance. Despite its simplicity, the obtained model is able to represent monthly and seasonal dynamics at gridbox to point scales. Evaluation of the model against different sources of observational data reveals an overall good performance.