

## ***Interactive comment on “New interpretation of the role of water balance in an extended Budyko hypothesis in arid regions” by C. Du et al.***

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Major comments:

Section 2.3: Equation (9) of the abcd model is a Budyko equation. Wang and Tang (2014) derived a one-parameter Budyko equation base on the generalized proportionality hypothesis originated from the SCS method. This Budyko equation has the same functional form of abcd model for monthly water balance.

In abcd model,  $P+S_0$  is partitioned into  $E+S_1$  and  $Q$ .  $S_0$  is initial storage for a month;  $S_1$  is the ending storage of the month.  $E+S_1$  has an upper bound  $b$ ; but  $Q$  has no upper bound. Equation (9) is for  $(E+S_1)/(P+S_0)$  versus  $b/(P+S_0)$ , i.e., a Budyko equation at the monthly scale.

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For mean annual water balance,  $P$  is partitioned into  $E$  and  $Q$ , where  $E$  has an upper bound of  $(E_0)$  but  $Q$  has no upper bound. Budyko equation is for  $E/P$  versus  $E_p/P$ .

When  $S_0=0$  and  $S_1=0$ ,  $b$  becomes  $E_p$  and Equation (9) becomes Budyko equation for mean annual water balance. Therefore, the original Budyko equation for mean annual water balance is a special case of Equation (9) for monthly water balance. The meaning of the parameter for mean annual water balance is explained in Wang and Tang (2014).

Minor comments

I suggest that the authors conduct a thorough type-editing. A few suggestions are listed below:

Lines 18-19 on page 11015: “These equations with parameters” to “These equations with a single parameter”

Line 5 on page 11016: “expand” to “expanded”?

Line 8 on page 11016: “so large-scale human actives” to “large-scale human activities”

Line 23 on page 11016: “and found that” Line 2 on page 11017: “grant” to “grand”?

Line 11 on page 11017: “flowing” to “flow”?

Line 14-22 on page 11017: The sentence is too long. It is can be break into short sentences.

Line 11 on page 11018: “interference” to “interferences”

Line 20 on page 11018: I am not convinced by the definition of available water in equation (2), i.e.,  $\delta_G$  is not included for the definition of  $P_e$ . See my comment on abcd model.

Equation (4) on page 11019: Remove “C” in the equation?

Line 16 on page 11019: “separating the local precipitation” to “mean annual ET”?

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Equation (8): It will be helpful to explain the meaning of  $\lambda$ .

Lines 17-18 on page 11021: Actually, the abcd model was originally developed and applied for monthly water balance instead of annual.

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