Response to Referee #1

General Comments

My main comment is there are still some works worth being discussed, though this review is overall complete: 1) The perspective of Lhomme and Guilioni (2006, 2010) which relates potential evaporation to surface resistance. 2) Aminzadeh et al. (2016)'s CR with Ep defined by a surface temperature Also, there are a few latest CR studies in 2019 that are highly relevant to the submitted manuscript, e.g., Anayah & Kaluarachchi (2019) and Brutsaert et al. (2019). Could the authors discussed a little bit?

Response: Thanks for the Referee's suggestions. We will discuss these publications in the revised manuscript.

In Lhomme and Guilioni (2006, 2010)'s perspective of CR, the surface resistance is related to the equilibrium evaporation and potential evaporation. We found that it is a linear function relating E/E_{Pen} to E_{rad}/E_{Pen} without intercept in the normalized form. Thus, we will add following paragraph to Section "Normalized complementary functions" in the revised manuscript: "Based on the examination of the CR using a model of the convective boundary-layer with entrainment (Lhomme, 1997), Lhomme and Guilioni (2010, 2006) recommended a form of CR through the effective surface resistance of the region. Integrating this CR into Penman–Monteith equation and the normalization by E_{Pen} lead to

$$\frac{E}{E_{Pen}} = (1+\omega)\frac{E_{rad}}{E_{Pen}}, \qquad (1)$$

where ω is a positive coefficient accounting for the entrainment of dry air within the ABL. Equation (1) is a linear function without intercept, but was not verified and applied using observed data."

Aminzadeh et al. (2016) derived a steady state surface temperature via the surface energy balance at which the sensible heat flux is zero, and calculated E_{pa} and E_{po} using a mass-transfer type reference evaporation corresponding to current and saturated surface water content. We will discuss it in addition to the works of Morton (1983) and Szilagyi and Jozsa (2008) in the revised manuscript.

The latest studies of using CR for global ET estimation will be discussed in the revised manuscript. "B2015 by setting c=0 was applied to estimate global terrestrial evaporation with calibrated α as a function of aridity index (Brutsaert et al., 2019). The modified Granger's model was also applied for estimating global evaporation with 30 min spatial resolution and monthly time steps (Anayah and Kaluarachchi, 2019)."

Specific Comments:

Line 19: Is the boundary condition here specified to the wet environment?

Response: Yes. We will add “under wet environments” after it in the revised manuscript.

Line 40: Recent publications using GCR in 2019 for estimating evaporation should be added here.

Response: We will add Brutsaert’s latest work here.

Brutsaert, W., Cheng, L., and Zhang, L.: Spatial Distribution of Global Landscape Evaporation in the Early Twenty First Century by Means of a Generalized Complementary Approach, J Hydrometeorol, 10.1175/jhm-d-19-0208.1, 2019.

Line 87: “while” should be replaced by “whereas”?

Response: It will be revised.

Line 107: the “realistic” is compared to the former model. I think adding “more” here may be better.

Response: “more” will be added here.

Line 110: “wss”??

Response: We are sorry for the typo. It should be “was”

Line 167: “The asymmetric CR is widely used”, please revised this sentence

Response: We will replace this sentence by “The asymmetric CR is a significant improvement of the symmetric CR, and the opposite changes of E/E_{po} and E_{pa}/E_{po} against E/E_{pa} were treated as an enhanced illustration of the CR (Hu et al., 2018; Zhang et al., 2017; Ma et al., 2015; Brutsaert et al., 2019; Szilagyi, 2007).” and revised this paragraph.

Line 179: More statements on the asymmetric CR should be added, including the negative relationship between E/Epo and Epa/Epo was treated as an extension of the original CR, and the validation in several locations.

Response: More statements will be added, as “The asymmetric CR is a significant improvement of the symmetric CR, and the opposite changes of E/E_{po} and E_{pa}/E_{po} against E/E_{pa} were treated as an enhanced illustration of the CR (Hu et al., 2018; Zhang et al., 2017; Ma et al., 2015; Brutsaert et al., 2019; Szilagyi, 2007). The performances on evaporation estimation are improved by calibrating the asymmetry parameter *b* (Kahler and Brutsaert, 2006; Han et al., 2008; Huntington et al., 2011; Ma et al., 2015). Efforts have also made to calculate *b* by using the meteorological variables, which enhance the predict ability of the CR (Szilagyi, 2015;

Szilagyi, 2007; Aminzadeh et al., 2016). However, the changes in *b* imply a potential nonlinear characteristic of the CR Han (2008); Lintner et al. (2015). The observed values of E/E_{po} and E_{pa}/E_{po} even exhibit a positive correlation under wet conditions at several flux sites, which challenges the CR (Han and Tian, 2018). But previous studies on the validity of CR have two limitations. First, the true correlation between Epa+ and E+ would be masked when they are both plotted against moisture index (Pettijohn and Salvucci, 2009; Lintner et al., 2015). Second, the wet conditions where the two curves of E/E_{po} and E_{pa}/E_{po} approach were seldom focused, which may hide the true correlation under wet environments."

Line 246: "Han and Tian (2018) further validated the sigmoid feature": Please state the work more detailed because there are still controversies on it.

Response: We will revised this sentence as "Han and Tian (2018) further validated the sigmoid feature according to the much larger regression slopes of E/E_{Pen} upon E_{rad}/E_{Pen} in the middle stage than those in the other two stages with smaller or larger values of E_{rad}/E_{Pen} by using 22 eddy covariance towers from the FLUXNET (Baldocchi et al., 2001) dataset which includes representative biomes of grasslands, croplands, shrublands, evergreen needleleaf forests, deciduous broadleaf forests, and wetlands."

Line 270: What is the essential difference between B15 and H12? Is "B15 inherits all three types of evaporation dated from the original CR"? Please rearrange these sentences.

Response: The two generalized complementary approaches, H12 and B15, are essentially different, with completely different normalized variables (Table 3). B15 inherits the concept of the three types of evaporation dated from the original CR, and its boundary conditions and analytical form are derived for $x_B = E_{po}/E_{pa}$ and $y_B = E/E_{pa}$. By contrast, H12 goes much further from the original CR. The boundary conditions and the analytical form of H12 are derived for $x_H = E_{rad}/E_{Pen}$ and $y_H = E/E_{Pen}$. We will add a new subsection "Comparisons between the two generalized complementary approaches" to discuss the essential difference between B15 and H12.

Line 304: The varying characteristics of the PT coefficient should be introduced here

Response: We will introduce it here, as "the Priestley-Taylor coefficient varies with several factors, such as the relative transport efficiency of turbulent, or the surface/air temperature (Assouline et al., 2016; Szilagyi, 2014)."

Line 359: Brutsaert's recent work by using c=0 and varying PT coefficient should be added. Check Brutsaert et al. (2019).

Response: We will add it here.

The Conclusion part could be improved. I wonder are there any outlooks for future studies on CR could be summarized using a few sentences here?

Response: We will rearrange the conclusion part and add three points about future studies: 1) Integrating the complementary principle with other approaches for future development; 2) Assessing the generalized complementary functions over varied places with gradient climate and landscape features; and 3) increasing the accuracy of evaporation estimation while reducing the burdens of parameterization.

Reference:

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