Responses to Referee 1

Authors appreciate you very much for your constructive comments on our manuscript. We have tried to respond to all your comments point by point and to revise our manuscript accordingly. We hope our responses clarify all questions and concerns. All revisions were colored in red on the revised manuscript.

Summary: An interesting modified Priestley Taylor equation is utilized to map actual ET using satellite thermal and optical data. The authors utilize a wetness index WI, from 0-1 to scale the wet environment Priestley Taylor (P-T) value of potential ET to estimate actual ET.

Comments: The authors state that this a complementary based model for mapping land surface ET in the title, and yet the background of complementary theory and why this model is indeed complementary is not mentioned anywhere in the paper. In fact, the word complementary is only mentioned in the title, and once in the text referencing Granger's paper. I would suggest that this paper be called "Evaluation of a Priestley-Taylor model for mapping land surface evapotranspiration."

Response: As the referee suggested, the title was changed to "Evaluation of a Priestley-Taylor model for mapping land surface evapotranspiration". The derivation of the equation from Granger's complementary relationship (Granger, 1989) was added in section 2.1.

*After all ET =F * ET(P-T), correct?*

Response: The equation derived by Venturini et al. (2008) is $\mathrm{ET} = \alpha \left(\frac{F\Delta}{F\Delta + \gamma} \right)(R_\mathrm{n} - G)$,

where *F* is a dimensionless coefficient, varying from 0 to 1. When F = 0, ET = 0; when *F* = 1, the derived equation is presented as the original P-T equation, and ET is wet environment evapotranspiration. Therefore, the derived equation of ET is reasonable. This conclusion was also validated in this study. However, the parameterization of *F* proposed by Venturini et al. (2008) seems questionable. This is the motivation of our study.

What is complementary about the way F is computed?
Response: In the Venturini equation, *F* is defined as a ratio of actual ET to potential ET

(ET_p). The way F is computed has no relation with the complementary relationship. The F is empirically determined using a "virtual" temperature, land surface temperature, and dew point temperature in Venturini et al. (2008). It is suggested to be computed using remotely sensed land surface wetness index in this study.

What is complementary about using the P-T equation by itself?

Response: The P-T equation is a simplified version of the Penman-Monteith equation, so the P-T equation by itself has no relation with the complementary relationship. However, the modified version of P-T equation proposed by Venturini et al. (2008) was derived from Granger's complementary relationship (Granger, 1989), and the original P-T equation was used to calculate wet environment ET.

By using the P-T equation as the limit of ET the authors assume negligible impacts of advection on ET. ET in most irrigated environments surrounded by non-irrigated or non-well watered environments is well above the P-T value due to advection (i.e. drying power of air). The larger the scale for analysis (i.e. using MODIS 1km pixels), the impact of ignoring advection in prediction of ET is reduced. In this case the authors use high resolution ASTER data (90m thermal pixels) to estimate ET. At this field scale there is most certainly advection, and the P-T equation does not hold.

Response: The P-T equation has its inherent limit of neglecting impacts of advection on ET. For potential conditions, Priestley and Taylor (1972) obtained a value of $\alpha =1.26$ in absence of advection. Priestley and Taylor (1972) and Singh and Taillefer (1986) stated that α tends to be great than 1.26 in the presence of horizontal warm air advection. Higher values of α, ranging up to 1.74, have been recommended for estimating potential evapotranspiration in desert regions (ASCE, 1990). However, there is general agreement that an average value of 1.26 is applicable for potential conditions in humid or semi-humid climates (De Bruin and Keijman, 1979; Stewart and Rouse, 1977; Shuttleworth and Calder, 1979). This maybe a reason why a value of $\alpha =1.26$ is widely used whereas the advection effect is sometimes neglected.

Since authors' study area has a semi-humid climate, the value of $\alpha =1.26$ could be applicable in the study area based on prior recommendations (De Bruin and Keijman, 1979; Stewart and Rouse, 1977; Shuttleworth and Calder, 1979), and results in this study also support the recommendation of $\alpha =1.26$. One of reasons is that advection is relatively weak over open homogenous croplands.

The P-T equation is a simplified version of the Penman-Monteith equation. Both of them are bulk models, and cannot consider the effect of advection on ET (Figuerola and Berliner, 2005). Most remote sensing applications of the P-T equation and the Penman-Monteith equation ignore the advection effect on ET to date. In arid and semi-arid heterogeneous landscapes in which irrigated fields are surrounded by arid areas, however, the advection of sensible heat flux from dry surfaces is a significant source of energy that has to be taken into consideration when evaluating the evaporation from crops growing in these areas (Figuerola and Berliner, 2005). This advection impact may be reduced over open homogenous croplands in this study. The ASTER-based ET estimates (238.25 W/m^2 and 183.41 W/m^2) of the Jiang equation and the improved Venturini equation are close to the ground ET measurement (194.01 W/m^2). Referee's comments inspire authors to improve the P-T equation to consider the effect of advection in future studies. One possible strategy is to calibrate the value of α. However, this is out of the scope of this study.

Authors thank referee 1 for your comments, and statements regarding the effect of advection on ET were added in the "Introduction", "Results and discussions", and "Conclusion" sections.

The authors state that the P-T coefficient for "all environments" was determined from the scatter plot of remotely sensed vegetation index and surface temperature. What was it, are there areas where alpha is above 1.26? The authors provide no details how this was determined, or what it means.

Response: The term of "all environments" was specified as "non-wet environments" in the context. Response regarding alpha of above 1.26 (advection impact) was addressed above.

The Jiang equation used a two-step linear interpolation in a remotely sensed vegetation index and surface temperature scatter plot to determine alpha for non-wet environments. Jiang and Islam (1999) and Tang et al. (2010) have addressed it in details. A schematic diagram was given below to show the estimation of α for non-wet environments. The figure and a brief description of the two-step linear interpolation were also added in the context.
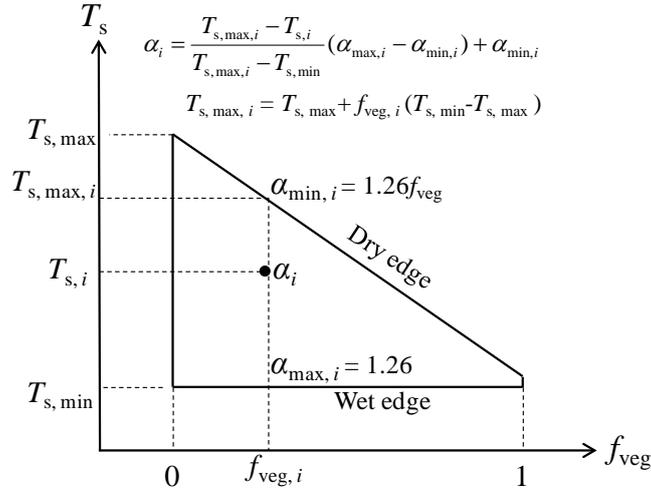
$$\alpha_i = \frac{T_{s,\max,i} - T_{s,i}}{T_{s,\max,i} - T_{s,\min}}(\alpha_{\max,i} - \alpha_{\min,i}) + \alpha_{\min,i}$$

$$T_{s,\max,i} = T_{s,\max} + f_{veg,i}(T_{s,\min} - T_{s,\max})$$

T_s

$T_{s,\max}$

$T_{s,\max,i}$

$\alpha_{\min,i} = 1.26 f_{veg}$

Dry edge

$T_{s,i}$ — $\bullet \alpha_i$

$\alpha_{\max,i} = 1.26$

$T_{s,\min}$

Wet edge

0 $f_{veg,i}$ 1 f_{veg}

Fig. 1. Schematic diagram of the f_{veg}-T_s space for α estimation for non-wet environments (upper and lower lines respectively represent dry and wet edges from remotely sensed data). (After Tang et al., 2010).

The authors do not detail how ET is estimated at a daily time step using ASTER. It is unclear if their ET comparisons using ASTER are in fact instantaneous estimates. With a title so broad and grand, details about complementary theory, scale, implications of using this approach in irrigated and natural vegetation environments, and issues about how ET is estimated at the instantaneous, daily, and seasonal time step should at least be discussed at a very minimum. At the current state, I recommend rejection until sufficient detail and background can be provided.

Response: ASTER images obtained on the polar-orbited Terra satellite platform can only provide "snap-shot" observations, so daily ET or seasonal ET cannot be derived only from ASTER images. There are some approaches extrapolating instantaneous ET rates to daily values, and interpolating to seasonal values (e.g., Delogu et al., 2012). This research topic is out of the scope of this paper. ASTER ET estimates in this paper were highlighted as instantaneous values in the context. As suggested by the referee, a short discussion regarding daily ET and seasonal ET was added in the section of "**Conclusions**".

Issues regarding "complementary" were clarified above.

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