RESPONSE TO REVIEWER COMMENTS
Effect of the Revisit Interval on the Accuracy of Remote Sensing-based Estimates of Evapotranspiration at Field Scales (hess-2016-273)

Note: The responses follow the reviewers' comments and I highlighted using red text. Excepted text from the revised manuscript is shown in blue with the changes underlined when appropriate.

REVIEWER 2:
- The manuscript addresses a key challenge in the estimation of evapotranspiration from satellite data, during the interval of satellite overpasses, i.e., the temporal interpolation question. This is an important topic and has many practical implication, including water management.

The authors would like to thank the reviewer for the kind words and suggestions.

- The main shortcoming of this paper it limits the analysis to the statistical approach only without clear discussion of the physical interpretation of (cli- mate and surface) processes involved. E.g., how will ET varies between two satellite overpasses, and why?

Although a comprehensive review of the physical processes and factors controlling ET is be the scope of this paper, the introduction has been expanded to outline the key physical processes and factors controlling evapotranspiration as a foundation for understanding how ET varies over time and why temporal upscaling is needed.

Page 3, Line 2:
As one component of a complex network of interconnected processes, evapotranspiration (ET) is influenced by numerous factors such as available energy, soil moisture, vegetation density, and humidity (Farquhar and Sharkey 1982; van de Griend and Owe 1994; Alves and Pereira 2003; Alfieri et al. 2007). For example, the amount energy available to drive ET depends on atmospheric properties, such as humidity and aerosol content, which influence atmospheric transmissivity (Brutseart 1975; Bird and Riordan 1986). The available energy is also controlled by surface properties, such as the type and density of vegetation cover and soil moisture, which influence not only the surface albedo and emissivity (Wittich 1997; Asner etal. 1998; Myneni et al.1989; Song et al. 1999; Lobell and Asner 2002), but also impact the amount of energy conducted into the ground (Friedl and Davis 1994; Kustas et al. 2000; Abu-Hamadeh 2003; Santanell and Friedl 2003). Moreover, the magnitude of the moisture flux can vary over a range of timescales in response to changes in the environmental conditions influencing ET. One example of this, which has been pointed out by Williams et al. (1998), Scott et al. (2014), and others, is the rapid and often persistent change in ET in response to a rain event.

Such discussions may allow for more physically based upscaling methods than statistical. E.g., it is well possible to compute daily ET0 using climate data measured at ground stations, which then can be used to upscale ETa (actual) evapotranspiration derived from satellite data, e.g., see Allen et al. (2001), Mohamede al. (2004).

The authors agree Reference ET (ETo) may be a useful quantity for temporal upscaling and a close parallel to the approach the reviewer suggests here is discussed in the manuscript; Reference ET is one of the quantities evaluated in the study. In contrast to Allen et al. (2001) and Mohamede al. (2004), however, ETo was not scaled by a crop coefficient. This was done in recognition that a crop coefficient, which have been derived for only a limited number of plant species, may not be available even when the vegetation composition of the remotely-sensed scene is known.

- P4, l20, a bit lengthy paragraph to confirm a known fact that it is erroneous to assume clear sky condition, if it is not!

Per the reviewer's suggestion, the paragraph, which repeats information provided previously, has been deleted for the sake of conciseness.

- P5, l13, would be good to give map of sites to easily see different climate zones

A figure showing the location of the Ameriflux sites used in this study has been added.

Figure 1 Map showing the location of the Ameriflux sites used in this study.

- P5, l15, give year from .... to .....

The study period for each of the sites is now included as a part of Table 2.

- P6, l3, Eq. 2, would have been easier to follow if the Penman-Monrtieth equation is written complete as given in the reference (Eq. 6, p24 of Allen et al., 1998), and then give the new derivation.

The authors respectfully disagree. Other than a few simplifications, such as expressing the absolute temperature as T_k rather than T+273 or the vapor pressure deficit as D rather than e_s-e_a, Eq.2 is the same equation as presented by Allen et al. expressed in terms of energy, i.e. as a latent heat flux (λE), instead of equivalent depth. The conversion between the two expressions of the moisture flux is trivial and well known.

- P6, l3, Eq. 2, what is the difference between λv and λ

It is not clear what the reviewer is referring to here. The letter λ appears in conjunction with the subscript v as λv denoting the latent heat of vaporization and in combination with the letter E as λE, the commonly-used term denoting the latent heat flux.

- P6, l14, would be good to briefly describe the interpolation methods, linear, spline, and hermite. Also the description of some parameters seems very short in some places, e.g., the autocorrelation calculation.

Per the reviewer's suggestion, additional information describing the algorithms and implementation of the interpolation methods has been added to the manuscript.

Page 8, Line 28:

As the name implies, the piecewise linear interpolation estimates *f* using a family of $n - 1$ linear relationships defined such that the linearly-interpolated *f* ($\hat{f}_L$) at time *t* is determined according to:

$$\hat{f}_{L_i}(t) = f_i + (t_{i+1} - t_i)m_i h \quad t_i \leq t \leq t_{i+1} \tag{4}$$

where *n* is the number of observed data points, f_i is the known *f* at time t_i, m_i is the slope of straight line relationship for the period between t_i and t_{i+1} defined as $m_i = (f_{i+1} - f_i)/(t_{i+1} - t_i)$, and *h* is the time normalized between 0 and 1 and is defined as $h = (t - t_i)/(t_{i+1} - t_i)$. The piecewise cubic spline interpolation function is family of n - 1 cubic polynomials defined such that the interpolated *f* ($\hat{f}_S$) at time *t* is determined according to:

$$\hat{f}_{S_i}(t) = f_i + a_i[(t_{i+1} - t_i)h]^3 + b_i[(t_{i+1} - t_i)h]^2 + c_i[(t_{i+1} - t_i)h] \quad t_i \leq t \leq t_{i+1} \tag{5}$$

where the coefficients a_i, b_i, and c_i are determined by simultaneously solving the series of $n - 1$ equations with the constraints that the interpolation function, as well as its first and second derivatives, must be continuous and pass exactly through the known values of *f*. Similarly, the final interpolation technique, piecewise hermite cubic spline, defines the

$$\hat{f}_{H_i}(t) = (2h^3 - 3h^2 + 1)f_i + (-2h^3 - 3h^2)f_{i+1} + \cdots \quad h(h^2 - 2h + 1)(t_{i+1} - t_i)s_i + h(h^2 - h)(t_{i+1} - t_i)s_{i+1} \quad t_i \leq t \leq t_{i+1} \tag{6}$$

where s_i is the slope of the curve at time t_i (De Boor, 1994). For this study, it is calculated according to:

$$s_i = \frac{1}{2}\left(\frac{f_{i+1} - f_i}{t_{i+1} - t_i} + \frac{f_i - f_{i-1}}{t_i - t_{i-1}}\right) \tag{7}$$

and the variables are defined as above (Moler, 2004).

- P 7, l10, would also be good to give the % of the RMSE.

It is unclear what is meant here. The text referred to by the reviewer is describes the calculation of RMSE.

-P10, l25, it would have been interesting to test the statistical results derived from the analysis against actual upscaling of satellite-based ET results - There is some spelling and grammar errors

While we agree with the reviewer in principle that such an analysis has the potential to provide many useful insights, there is no remote sensing-based data set with a sufficiently high temporal resolution available. Thus, as is discussed in the manuscript, as well as other such as Ryu et al. (2012) and Cammalleri et al. (2014), in-situ observations are a necessary proxy for studies investigating the temporal upscaling of remote sensing-based flux estimates.

References:

- Allen, R.G., Bastiaanssen, W.G.M., Tasumi, M., Morse, A., 2001. Evap- otranspiration on the watershed scale using the SEBAL model and Landsat images, ASAE Meeting Presentation, Paper Number 01-2224, Sacramento, California, USA, July 30–August 1, 2001,.

-Mohamed, Y.A., Bastiaanssen, W.G.M., Savenije, H.H.G., 2004, Spatial variability of evaporation and moisture storage in the swamps of the upper Nile studied by remote sensing techniques. J. Hydrology 289:145–164.