

## **Response to Referee #2**

Referee #2 has argued that the result is well known and has all been done before.

We agree that the underlying mathematical theory is well known. It was derived centuries ago.

We also agree with the referee that the mathematical theory has been applied previously in the evaporation field and other areas of biophysics. We cited nine papers (starting on page 6205, line 2) to that effect. We could add the two papers noted by the referee (Koster and Suarez 1999; Choudhury 1999) to that list. But neither of those papers addressed the more general question about scaling.

However, we have not seen any evidence that the practical consequences that follow have begun to influence the practice of Hydrologists and other Earth System Scientists. For example, one regularly sees statements in the literature that it is better to calculate some quantity using hourly data (than say daily data) but it should be generally okay using say daily means. See the FAO-56 handbook for an excellent example. This thinking is widespread and models are routinely parameterised at a particular time step. When the time step is altered the model must be re-parameterised.

Our manuscript shows that it is theoretically justified to calculate something using daily (or monthly or ...) means provided the appropriate covariances are known. If that result was as well known and accepted as implied by the referee then we would regularly see tables of data routinely reported with the associated covariances between key model variables. For example, in evaporation studies we would see the covariance between say vapour pressure and wind. We have yet to see a single example of that in any environmental physics publication. (There is one exception - the processing of eddy-flux data where covariances play an integral role in the theory as noted by Referee #1).

In that spirit our manuscript takes a step back to explain exactly why a model parameterised at one time resolution might (or might not) have a bias when used at a different temporal resolution. By explaining that, our intention is to provide a clear justification (and example) for why the covariances matter and to hopefully encourage scientists to report the covariances. If this fails then we are simply left in the situation of having to re-parameterise models for specific temporal resolutions.