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Geoscientific Model Development Discussions

Interactive comment on "Using satellite-based estimates of evapotranspiration and groundwater changes to determine anthropogenic water fluxes in land surface models" *by* R. G. Anderson et al.

Anonymous Referee #2

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General comments This paper introduces a new method to account for irrigation water management in land surface models using optical and gravimetry satellite data. This is an important topic because it will help analyzing the impacts of irrigation water abstraction on the hydrological and the climate system.

The method is developed for the Central Valley in California that is probably a very unique irrigated region with a lot of available data and large irrigated fields that are easily 'seen' by the remote sensing ET products. In many other regions in the world where plot sizes are and perhaps irrigation intensity is much smaller the signal might not be as strong, and the approach might not work at all. Some methods use absolute values as thresholds and it is not clear how they will be determined elsewhere. To be

more relevant for the problem, it would be interesting to see at least some discussion on how the approach can be applied in other regions with different irrigation practices and hydro-geolocial conditions. Ideally, the approach should be tested in another region. Some of the methods are not sufficiently well justified and should be clarified for somebody who is not familiar with the CLM modeling system (see detailed comments below).

Specific questions and technical corrections

Section 2.1. A bit more information on the irrigation practices would be useful :Fraction of total area irrigated, main crops, number of crops per year, irrigation infrastucture (canals, sw reservoirs, etc) , water use as fraction of total available water resources ? Parts of section 3.2 could be moved here.

Section 2.2. Somehow it is unclear why the ensemble ET is superior to any of the individual products. What is the spatial resolution of the ET, Precip, and the CLM grid cell resolution ? There are significant uncertainties in the remote sensing estimates that should at least be discussed and perhaps the ET ensemble should not be called 'observed' values (later in the manuscript). What is meant by uncertainty of ET (line 1).

Section 2.3. Some more details for the CLM (spatial and temporal resolution) and a justification for the use of the 9 member ensemble would be interesting. Eq. 5 assumes that all water abstracted from ground and surface water becomes ET. In reality, a considerable amount is returned to the soil and gw storage, as loss. It is probably not relevant on monthly time steps if you consider the net abstraction only but at least it should be mentioned. Line 24 on 3572 and Fig.2 seem to suggest that the abstraction (delta ET) will be added to precipitation in the model, in which case it will be redistributed. Will this violate the grid cell water balance ? Why is deltaET in Eq. 5 taken as the 6 year mean ? There should be considerable differences between wet and dry years that are worth exploring. This can be seen in figure 3a and 3b.

The 'grid search' is unclear. Is there is search distance or is water only taken from

the same grid cell ? If so, the amount of water available from surface water will highly depend on the resolution of the model. The 'trial and error' approach in figure 5 is not clear and needs a better explanation. What is the justification for using values between 5 and 20 mm ? Are these values related to the total Central valley area or only the irrigated areas ? Here and elsewhere in the manuscript it would be worthwhile to report number (irrigation depth etc) related to the irrigated area, and not averaged over the entire area.

Section 3.2. The mean deltaET (376mm) needs to be put into perspective with total water use and available water. Can you add a figure showing the monthly time series of reported (inventory) and simulated abstraction from gw and sw ? What would be interesting is the different partioning of the two in response to drought conditions.

Figure 3.a Explain the range of the shaded regions. The thick lines are mean values ? Figure 3.c. Should "time" be replaced by "month" ? Figure 6 needs a better legend. Align the color schemes in figures 6 and 7.

Interactive comment on Geosci. Model Dev. Discuss., 8, 3565, 2015.