Reviewer's Report for ESSD-2024-2

CIrrMap250: Annual maps of China's irrigated cropland from 2000 to 2020 developed through multisource data integration

Author: Zhang et al.

General summary:

This study presents the development of a multi-year (2000-2021) irrigated cropland map for China, named CIrrMap250. The authors employ a semi-automatic training approach integrating remote sensing data (vegetation indices, hybrid cropland products, and paddy field maps), county-level irrigation statistics and surveys, and an irrigation suitability map. Utilizing a threshold-calibration method and the random forest algorithm, the CIrrMap250 map is evaluated against reference sites and other large-scale irrigation maps, demonstrating superior accuracy. The study reveals a consistent net expansion of irrigated croplands in Northeast and Northwest China, with over 60% deemed unsustainable due to severe water stress. The CIrrMap250 map holds significant application potential for water resource management and food security. I have some comments below and please address them before this article can be published.

Major comments:

1 L74-81: China's vast agricultural landscape comprises diverse cropping systems and associated irrigation methods, such as rice paddies in the South and Northeast, and corn/wheat rotations in the North China Plain and Northwest. The study does not adequately address this diversity. It would be beneficial for the CIrrMap250 to provide detailed mappings for irrigation methods for associated crop types, if possible. Moreover, the integration of county-level yearbook data on irrigated crop types and rotations could enhance the map's specificity and utility. Clarifying how different cropping systems and crop types are distinguished would significantly improve the comprehensiveness of the methodology. For example, L123 - Mapping 30-m CCropLand30 cropland layer (available every 5-year) - does this dataset also tell you which crop type is associated with each pixel?

2 Although the CIrrMap250 is purportedly an annual dataset, the primary analyses are based on three specific years (2000, 2010 and 2020). Although Figure 9 presents 20-year timeseries of irrigated croplands in different regions, it is crucial to present the interannual variability of irrigation areas. Analyzing annual data across the entire 20-year period can reveal the influence of climatic factors, such as temperature and precipitation, on irrigation trends. Additionally, showcasing irrigation transitions in various regions, beyond the highlighted area between CSC and NC, would provide a more comprehensive view of national trends.

3. Since this data product is a fusion of data from multiple sources - would it be good and necessary to quantify uncertainties of different sources? Such as the assumption outlined in 2.2.1, L151-155, and also in 2.2.2 L164-184. Section 5.2 L486-502 discussed the uncertainties

and limitations, what are the limitations associated with integrating multiple sources? For example, for the same region, how are remote-sensing indices, statistics and survey data differ from each other (or not)? In which regions does each index perform better? Please give some discussion as it may be useful to evaluate CIrrMap250 product and future user's information.

4. The study employs numerous data products and indices, yet lacks clear definitions and descriptions. A detailed table in the main text or supplementary material, listing all data products used, indices defined, could enhance clarity. Including equations for calculating indices such as PET, aridity index, Water Scarcity Index (WSI), NDVI, EVI, and GI is essential for transparency. Defining WSI and its components, including whether groundwater pumping in North China is considered, would further elucidate the methodology. Providing detailed and comprehensive information, similar to the content in Tables S1-S3, would greatly benefit readers.

5. 3.1 L219 - can you also give a brief description of the threshold-calibration method, instead of stating "following the previous studies" - let the readers of this paper understand your method is important. Particularly Equation 5 - how do you determine threshold? Since you have 20-year data, is this threshold constant? Or it changes year-by-year, please elaborate.

6. L223-226, please elaborate on this statement - "Cropland with lower elevation, gentler slope and higher aridity index was hypothesized to have higher irrigation suitability and potential" - is this statement a hypothesis? Or has already been demonstrated in Liu et al. It is not clear by now.

7. L275-280 the description of Figure 2c and in the figure caption don't match - Figure 2c shows 2010, but the texts indicate 2020. Please check your texts and figure captions.
Also, since you can identify the center pivotal system, can you also provide an irrigation method map, distinguishing between sprinkler irrigation (mostly in North China) and flood irrigation (more common in South China)?

8. L337-340, please define WSI. What are the major water resources used in WSI? How about considering pumping groundwater for irrigation in North China, is it a part of WSI calculation and evaluation of the irrigation map?

9. Figure 5, please give a scale legend for region A, B, C, and D. i.e. how big are these four regions?

10. Figure 8. The transition only shows three years ,2000, 2010, and 2020. What about the interannual variability, since you have 20-year annual data. It would be good to show an interannual timeseries of irrigation transitions across China.
Figure 8 highlights an area between CSC and NC, how about other regions in China? What are the transitions across regions over the 20-year period?

11. Please also discuss the potential use of CIrrMap250, who will be interested in using this data? Science communities, Hydrologic models? Climate models?, or water resource managers?

Minor comments:

1: L17-20: “...reconciled them with remote sensing data … integrated with multiple remote sensing data …” These two sentences seem redundant.
2: L94: “both cropland and other land use”
3: 231 “with the assumption that”
4: 3.3 L265-270 and 3.3.3 L310-323, these texts seem similar and redundant.