General Response

We sincerely thank the Editor and Reviewers for their careful evaluation, constructive comments, and continued guidance. In response to Reviewer 2's two remaining comments, we strengthened the China-specific validation and added irrigation mapping as a potential application of GACED30. We also streamlined several lengthy passages throughout the manuscript without changing their original meaning, with the aim of improving readability, and expanded the Future Work discussion to include finer cropland categories, complex planting patterns, and field-level mapping.

Response to Reviwer2's Comments

The authors have carefully addressed most of my previous concerns, and the manuscript has been substantially improved. I recommend minor revision, with only two remaining comments.

(1) For the China-specific validation, please consider reporting cropland-specific UA, PA, and F1 in addition to OA. It would also be useful to briefly explain why the area adjustment increases the 2019 estimate from 168.07 to 179.13 Mha, further enlarging the difference from the Third National Land Survey estimate.

> Thank you for this helpful suggestion. We revised the China-specific assessment in the Abstract, Sects. 2.5, 3.5.3–3.5.4, and 4.1.3, and the Discussion and Conclusion, as follows.

(1) Validation. Because the validation samples adopted by CACD originate from the FAST sample library, we now refer to the China validation set consistently as FAST-2015-China and use it throughout the China-specific assessment. Both products operationalize Cropland using categories derived from the FROM-GLC classification system. After retaining the 2015 observations and removing repeated records from the same sites across years, GACED30 achieved OA, UA, PA, and F1 scores of 0.946, 0.838,

0.843, and 0.840, respectively, compared with 0.940, 0.830, 0.810, and 0.820 for CACD. We also added a methodological comparison: GACED30 benefits from the strong CatBoost classifier and temporally harmonized, gap-free observations, whereas CACD achieves stronger spatiotemporal consistency through trajectory segmentation and consistency checking, particularly in complex and changing landscapes. These approaches emphasize year-specific spectral discrimination and temporal coherence, respectively.

(2) Area adjustment. Using FAST-2015-China produced only a minor change in the sample-adjusted 2019 estimate, from 179.13 to 179.70 Mha. The direction of the adjustment is determined by the reference error matrix rather than by proximity to the 3rd NLS estimate: 30.86 Mha of omitted Cropland was added from the much larger mapped Non-cropland area, exceeding the 19.23 Mha removed as commission error and resulting in a net increase of 11.63 Mha. We further introduced GeoWiki2015, a substantially larger reference dataset based on 10 m image interpretation, as a complementary estimate of temporary-crop area. Its adjusted estimate was 149.44 Mha, lower than the raw GACED30 area but still 16.9% above the 3rd NLS cultivated-land area. The raw GACED30 area and both sample-adjusted estimates therefore remain higher than their corresponding 3rd NLS benchmarks. We clarified that this consistent positive difference may reflect the broader remotely sensed Cropland definition as well as differences between 30 m raster mapping and the higher-resolution, parcel-based 3rd NLS survey, including mixed pixels along field boundaries.

The manuscript in Sect. 5.2 has been revised as follows:

"*The FAST-2015-China assessment showed that GACED30 achieved an OA of 0.946 and cropland-specific UA, PA, and F1 of 0.838, 0.843, and 0.840, respectively, compared with 0.940, 0.830, 0.810, and 0.820 for CACD. The two products therefore showed comparable overall performance, with GACED30 achieving slightly higher cropland-specific accuracy. GACED30 mainly benefits from harmonized, gap-free SDC30 observations and the strong classification* *capacity of CatBoost. CACD has a particular methodological advantage in spatiotemporal consistency. By combining annual cropland probabilities with LandTrendr trajectory segmentation, transition rules, and spatiotemporal consistency checking, CACD integrates information across years and neighboring pixels to reduce isolated classification errors and implausible temporal fluctuations. This design produces more coherent annual sequences, especially in heterogeneous agricultural landscapes and areas experiencing complex cropland changes.*

The raw mapped cropland area of GACED30 in China in 2019 was 168.07 Mha. Adjustment using the 2015 FAST-Crop samples increased this estimate to 179.70 Mha, with a standard error of 3.98 Mha and a 95% confidence interval of 171.91–187.50 Mha. The adjustment added 30.86 Mha of estimated omitted cropland from the mapped Non-cropland area and removed 19.23 Mha of estimated commission error, producing a net increase of 11.63 Mha. The adjusted estimate was 31.67 Mha, or 21.4%, higher than the combined cultivated-land and garden-land area of 148.03 Mha reported by the 3rd NLS. In contrast, the GeoWiki2015 adjustment produced a temporary-crop estimate of 149.44 Mha, which remained 21.58 Mha, or 16.9%, higher than the 3rd NLS cultivated-land area of 127.86 Mha.

The consistently higher values from the raw map and the two reference-sample adjustments show that the positive area difference is not specific to one reference dataset. The broader GACED30 definition contributes to this difference, particularly relative to the cultivated-land category alone, but does not fully explain it because the GeoWiki2015 temporary-crop estimate is also higher. Additional differences may arise because GACED30 represents cropland as 30-m raster pixels, whereas the 3rd NLS delineates land-use parcels using higher-resolution imagery and field investigation; mixed pixels along field boundaries can therefore affect the resulting totals. In 2021, the corresponding GACED30 estimate was approximately 180.00 Mha, remaining within the 95% confidence interval of the published CACD estimate of 172.52

± 21.24 Mha.

The AEZ-stratified results further showed that global accuracy was not spatially uniform (Table S4). Across the tropical, subtropical, and temperate strata represented by AEZs 1–15, OA ranged from 0.931 to 0.997 and F1 ranged from 0.631 to 0.913. The warm, humid subtropical stratum achieved the highest F1 score among these zones (0.913), with a UA of 0.905 and a PA of 0.922. The lowest F1 score occurred in the cool, humid tropical stratum (0.631), where the relatively high UA of 0.861 was accompanied by a substantially lower PA of 0.498. This contrast indicates that omission of cropland was the principal source of error in this environment and that its high OA of 0.951 partly reflected the predominance of Non-cropland reference records. The boreal sub-humid and humid strata contained no positive Cropland reference cases and therefore did not support the calculation of cropland-specific accuracy metrics."

(2) The discussion could briefly mention irrigation mapping as an additional application. Cropland extent is a fundamental input to irrigated-area mapping, and cropland-mask errors can propagate into irrigation estimates. Relevant examples include the ESSD datasets LANID and CIrrMap250. GACED30 may therefore provide a useful annual cropland baseline for future irrigation mapping.

> Thank you for this helpful suggestion. We have added irrigation mapping as a potential application in Sect. 5.2 and cited LANID and CIrrMap250 to explain how annual cropland masks can provide a baseline for irrigation mapping and how cropland-mask errors may propagate into irrigated-area estimates.

The manuscript in Sect. 5.2 has been revised as follows:

"*Cropland extent is also a fundamental input to irrigation mapping. LANID uses cropland masks to constrain annual irrigation classification, while CIrrMap250 identifies cropland-mask uncertainty as a source that can propagate into irrigation estimates (Xie et al., 2021; Zhang et al., 2024a). The annual 30 m GACED30 layers may therefore provide a consistent cropland baseline for* *future irrigation mapping and help distinguish changes in irrigated area caused by shifts in cropland extent from changes in irrigation status.*”

References:

[1] Xie, Y., Gibbs, H. K., and Lark, T. J.: Landsat-based Irrigation Dataset (LANID): 30 m resolution maps of irrigation distribution, frequency, and change for the US, 1997–2017, Earth Syst. Sci. Data, 13, 5689–5710, https://doi.org/10.5194/essd-13-5689-2021, 2021.

[2] Zhang, L., Xie, Y., Zhu, X., Ma, Q., and Brocca, L.: CIrrMap250: annual maps of China’s irrigated cropland from 2000 to 2020 developed through multisource data integration, Earth Syst. Sci. Data, 16, 5207–5226, https://doi.org/10.5194/essd-16-5207-2024, 2024.