1   **<u>Response to Reviewer #1</u>**

2

3   **General comments**

4

5   [G1] The authors present a method for the derivation of a global crop calendar based on a

6   combination of census and Earth Observation data. Global crop calendars provide important

7   information for the description of land surface processes not only in agronomical but also in

8   hydrological and climatological context. The presented paper thus well meets the scope of the

9   HESS journal. However, the manuscript should be carefully revised in order to enable the

10   scientific community to benefit from its findings.

11   Response: Thank you for the encouraging comment.

12

13   [G2] The idea of using simple (and thus easily globally applicable) remote sensing techniques

14   for the derivation of crop cycles is not entirely new. Especially the use of simple multispectral

15   vegetation indices such as the NDVI is very critically discussed among the remote sensing

16   community, because VIs only provide relative estimations and must rely on a high degree of

17   empiricism, if land surface information shall be provided by them. However, the authors have

18   compiled a data set that holds some potential for future applications. Due to reasons of data

19   scarcity, the authors resort to averaged data from three consecutive years (2004-2006). The

20   data product generated from this study therefore is of limited use for the direct

21   parameterization of global growth models. However, taking the current development in Earth

22   Observation into account (e.g. the development of ESA's Sentinel series), data scarcity will

23   soon be less critical compared to now. The proposed method represents a simple and thus

24   easily applicable approach that can potentially make use of large amounts of temporally

25   highly resolved global optical Earth Observation data and may provide interesting input

26   parameters for global land surface models.

27   Response: We agree with you that VIs only provide relative estimations. As we noticed this

28   characteristics, we proposed normalized NDVI (i.e., nNDVI) to estimate the CC using the two

29   CC parameters (nNDVIpl and nNDVIhv). Our algorithm therefore is easily applicable to the

global cropland and additional satellite observations. We will state it clearly in the revised manuscript. Thank you for point it out.

[G3] The main conclusion of the paper is that using Earth Observation data opens new grounds towards current spatially highly resolved data on land surface processes compared to census-based approaches, while their applicability for future or climate change studies is limited. Although this is a quite substantial insight, it is not very surprising.

Response: We agree with you that our conclusion is substantial and not very surprising. However, we think that our paper is worth publishing as the first global-scale crop calendar based on satellite-derived observation.

[G4] I experienced some difficulties with understanding the paper. Some of them surely were due to language and style, while others were rather due to a too unspecific description of the approach. Nonetheless, I think that the methods and assumptions in general are valid. The authors, however, should concentrate on precise and unmistakable phrasing. Reading some passages, I have gained the impression that the authors mean to describe the right thing, but resort to unfavourable terms. For example, the authors should more clearly discriminate between "food" and "biomass" or between "growth" and "vegetation vitality" etc. (please, above all, see my detailed comments in the manuscript).

Response: We apologize for some difficulties with understanding the paper. Also we would like to express our deeply thanks for your giving us many suggestions in the supplemental file. We are going to revise the manuscript following the suggestions.

[G5] True validation is hard to achieve in global studies. The authors therefore compare their results to the MIRCA2000 data set and analyse the disagreement. Deviations between the two data sets are very large in some regions (up to 4,5 months). However, it is hard to decide which data set is closer to the truth. I also think that neglecting triple cropping systems (only two crops during one growing cycle are taken into account by the presented algorithm) will lead to errors in some parts of the globe. This should be taken into account in the discussion section. Also, the fact that bimodal distributions of NDVI may occur on agricultural sites that

are not part of a managed cultivation cycle, e.g. in the case of volunteer crops, is not discussed.

Response: Following the suggestion, effect of neglecting triple cropping systems will be discussed in the revised manuscript. We will add the discussion about difference between the satellite-derived cropping intensity and climate-derived cropping intensity (e.g., Zabel et al. 2014). Also we will include the discussion about effect of bimodal distribution of NDVI in the discussion session. Such bimodal distribution may cause some errors in identifying crop intensity and cultivation season.

[G6] From my point of view, it is hard to follow how the involved empirical thresholds were generated (e.g. which assumptions led to their determination). It is e.g. mentioned in section 2.3 of the manuscript that "*The values of two CC parameters nNDVIpl and nNDVIhv are determined for each crop to minimize the errors between planting/harvesting dates of determined and MIRCA2000 over pure grids.*" However, it is not described how this optimization was performed (automated or manually), which statistical indicators were analysed to determine the error, which thresholds of confidence were applied etc. Also the determination of other empirical parameters, such as NDVIparam used for noise suppression, is not explained.

Response: We will add an appendix to describe how to identify the two CC parameters (nNDVIpl and nNDVIhv). Some of the parameters (e.g., NDVIparam) were empirically determined. We will describe it in the revised manuscript.

[G7] The authors discuss that the major benefit of the proposed approach lies in the high spatial resolution compared to other global products. A second benefit of a remote-sensing-based method is that actual current vegetation activity is monitored. It would be interesting to compare the findings of the presented study on actual growth cycles with results on growth cycles based on the agroecological potential (e.g. Zabel et al. (2014)). Such a comparison could provide interesting information on the current global distribution of cropping intensity.

Response: Thank you for the invaluable suggestion. We will add the comparison of crop intensity with Zabel et al. (2014) in the revised manuscript.

1 [G8] I think the title in its current form is somewhat redundant and limits the application of

2 the SACRA crop calendars to pure agricultural simulations. From my point of view the title

3 could be shortened and should be revised, e.g.: "SACRA – A Method for the Estimation of

4 Global High-Resolution Crop Calendars from satellite-sensed NDVI" or something similar.

5 Response: We will revise the title following the suggestion.

6

7 [G9] The abstract should be more precise. Instead of adjectives/adverbs like "many", "well",

8 "similar" etc. the obtained results should be mentioned in numerical form the abstract.

9 Response: We will revise the abstract following the suggestion.

10

11 [G10] In my opinion, the paper should be partly restructured. For example, the crop types

12 taken into account are mentioned at a very late point in the manuscript (section 2.3, Page 8).

13 This should be stated more clearly at the beginning. Also, the authors should focus on

14 avoiding general and elusive adjectives, such as "large", and rather include concrete results

15 in numerical form into the text. Subscripts should be explained without exception next to the

16 equations. Some figure captions should provide more detail (e.g. the labels of Figure 6 are

17 described in the text but not in the caption, the stand-alone figure thus cannot be understood).

18 Response: We will reconstruct the manuscript following suggestions by the two anonymous

19 referees. Also we will carefully revise the manuscript by modifying unfavorable terms and

20 figure captions.

21

22 [G11] Not being a native speaker of English myself, I don't feel fully qualified to judge

23 English Language and style. The manuscript nonetheless seems a little bit hastily prepared, as

24 indicated by a high number of typos. Trying to comprehend the manuscript, I therefore

25 inserted some proposals for possible improvement while reading it.

26 Response: Thank you for many specific comments and suggestions. We will revised the

27 manuscript following proposals. Also, we will check the manuscript more carefully before the

28 re-submission.

29

[G12] The Equations should be carefully checked. In some cases (e.g. Eqs. 3 and 4) not all of the subscripts are explained. Adding a comma between equation and equation numbering is potentially confusing.

Response: The Equations will be carefully revised in the revised manuscript. Thank you for pointing it out.

[G14] The authors cite 35 appropriate sources in their manuscript. However, I would like to encourage the authors to have a look at: Waha, K., van Bussel, L.G.J., Müller, C., Bondeau, A. (2012). Climate-driven simulation of global crop sowing dates. Global Ecology and Biogeography, 21(2), pp.247-259, doi: http://dx.doi.org/10.1111/j.1466-8238.2011.00678.x Zabel, F., Putzenlechner, B., Mauser, W. (2014). Global Agricultural Land Resources – A High Resolution Suitability Evaluation and Its Perspectives until 2100 under Climate Change Conditions. PLoS ONE 9(9): e107522. doi: 10.1371/journal.pone.0107522

Response: Thank you for your suggestion. We will add further discussion by comparing our results with those researches.

[G15] No supplementary material was provided with the paper. The authors, however, state that the data sets resulting from the presented algorithm will be accessible through their website. I think this would be a nice and welcome contribution.

Response: Thank you for the encouraging comment.

Specific comments

Thank you for many specific comments and suggestions in the supplemental file. We will revise the manuscript following the suggestions. Here, we reply to specific comments which needs our responses.

[S2] Page 1335, line 9: Which crop types? Maybe add a table?

Response: Following the suggestion, we will add a table in the revised manuscript.

[S3] Page 1335, line 10: This is hard to follow. Does MIRCA2000 provide subscale information on crops? Did you perform majority filtering? The spatial resolution of MIRCA2000 and SACRA is identical at 5 min...

Response: MIRCA2000 provides subscale information on crops. At each grid, we identified a dominant crop that has the largest "maximum monthly harvested area" in MIRCA2000. We will revise the manuscript to avoid the misunderstandings.

[S4] Page 1335, line 15: This is a major drawback, because sowing dates of winter crops largely affect the yield potential. Although I understand that the derivation of sowing dates is not possbile with the proposed approach, information on sowing dates of winter crops would be very important for improving yield estimations of winter crops. This should be highlighted in the discussion section.

Response: Following the suggestion, we will highlight the disadvantage of our algorithm in the discussion section.

[S5] Page 1336, line 13: Is this an automated optimization process? What are the regulations for the optimization?

Response: We manually optimized the parameters. Further explanations will be described in the revised manuscript.

[S6] Page 1336, line 25: This is too vague. What are the error sources?

Response: With time series of NDVI, we determined sowing dates with NDVIpl and harvesting dates with NDVIhv. Therefore, cultivation period (from sowing date to harvesting date) are largely affected by shape of the NDVI (e.g., kurtosis of the NDVI curve). We will describe it in the revised manuscript.

[S7] Page 1338, line 13: How do you define "large" here? The legend of Fig. 6. (a) indicates that "large = red = 3,5-4,5 months of disagreement between both data products. Please be more specific in the text.

1 Response: We will specify the definition of "large" in the revised manuscript.

2

3 [S8] Page 1339, line 6: Actually, this cannot be seen very well in Fig. 6 b-1 and b-2. Although

4 the histogram of the sowing months indicates two growing seasons, SACRA only detects one

5 season in Arizona and Uzbekistan and "misses" the second peak. Or is only one of the

6 detected seasons shown in Fig. 6? Please clarify.

7 Response: In Fig. 6b, only one dominant CC was shown as the SACRA. We will revise the

8 Fig. 6b to demonstrate diversity of CC detected by SACRA.

9

10 [S9] Page 1340, line 3: I think "downscaled" is the wrong term here. Surely SACRA would

11 have to be recalculated with higher resolution remote sensing data (e.g. from future Sentinel-

12 2) rather than downscaled, if higher resolution land cover maps become available.

13 Response: We will revise the manuscript following the suggestion. Thank you for pointing

14 out.

15

16 [S10] Page 1340, line 11: Actually, yearly information on CC would provide very interesting

17 input data for global growth modelling, while averaged CC can be nice for the analysis of

18 long-term patterns. I think this should be included in the discussion.

19 Response: Thank you for the suggestion. It would be interesting to compare averaged CC and

20 yearly CC. We will discuss it in the revised manuscript.

21

22 [S11] Page 1340, line 19: This is only feasible, if SACRA is not applied on data averaged

23 from several years...

24 Response: We can obtain annual crop calendar by applying the SACRA algorithm to the

25 annual NDVI data sets. Also, data scarcity will soon be less critical compared to now by the

26 current development in Earth Observation. We will state it in the revised manuscript.

27

28 [S12] Page 1340, line 21: The wavelengths required for the calculation of the NDVI are

29 relatively easy to measure from satellite sensors. The error in NDVI measurements therefore

1 is rather small. I think the accuracy of SACRA is mainly determined by the temporal

2 resolution of adequate observations, which again depends on the availability of sensors, the

3 revisiting time of the applied systems and last but not least the weather (cloud cover).

4 Response: We agree with you that the accuracy of SACRA was mainly determined by not

5 NDVI measurement but temporal resolution and mixture of other phenology (e.g., forest,

6 minor crops and volunteer crops). We will describe it in the revised manuscript.

7

8 [S13] Page 1347, Table 3: What "judgement" is meant here? Since the SACRA algorithm

9 only is applied on regions that have already been identified as cropland from census-based

10 data, here no discrimiation between managed and natural surfaces is required. The decision

11 rather is, wheather the managed land is currently cultivated or temporarily disused.

12 I therefore would rather settle for: "Detection of current cultivation activiy" or somethong

13 similar..

14 Response: We would like to use the " detection of current cultivation activiy" in the revised

15 manuscript.

16

17 [S14] Page 1348, Figure 1: Figure 1 is not entirely clear:

18 The numbers inside the boxes indicate the sections of the paper, where the different

19 processing steps are described.

20 The numbers outside of the boxes indicate the spatial resolution of the respective data sets.

21 This should be explicitly mentioned in the caption.

22 Response: Following the suggestion, we will state them in the caption of Figure 1.

23

24 [S15] Page 1352, Figure 5: Did you chose this subset for a reason? Are the differences

25 between SACRA and MIRCA2000 especially visible in South Asia or are Figs. a-2 and b-2

26 just an arbitrary example to highlight the higher spatial variability in the SACRA results?

27 Response: We chose the region arbitrary to highlight the higher spatial variability in the

28 SACRA results. We will state it clearly in the revised manuscript.

29

1   [S16] Page 1353, Figure 6: Figure (a) only shows positive values. The shown differences
2   therefore must be absolute differences. However, the direction of the deviation would be
3   interesting. Is SACRA signalling earlier or later sowing dates compared to MIRCA2000?
4   How are the results compare to the agroecological potential.? Do farmers sow/harvest early or
5   late compared to the agroecological optimum?

6   Response: We will check whether the SACRA is signalling earlier or later by revising the
7   legend of Figure 6-a (i.e. to include both negative and positive values). We will compare the
8   satellite-derived cropping intensity with climate-derived cropping intensity (Zabel et al. 2014)
9   in the discussion session. Also, we will compare the SACRA with model-based crop calendar
10 (e.g. Hanasaki et al. 2008; Waha et al. 2012) to see difference from the agroecological
11 optimum.

12

13 **Response to Reviewer #2**

14

15 **General comments**

16

17 [G1] I fully agree to Anonymous Referee 1 comments "The authors present a method for the
18 derivation of a global crop calendar based on a combination of census and Earth Observation
19 data. Global crop calendars provide important information for the description of land surface
20 processes not only in agronomical but also in hydrological and climatological context. The
21 presented paper thus well meets the scope of the HESS journal. However, the manuscript
22 should be carefully revised in order to enable the scientific community to benefit from its
23 findings."

24 Response: Thank you for the encouraging comment. We are going to revise the manuscript
25 following the comments.

26

27 [G4] As Anonymous Referee 1, I also experienced some difficulties understanding the
28 manuscript, first due to language and style, but mostly due to the often too short, rather vague
29 and often repetitive description of the approach and methods, while the approach in general
30 appears to be valid. Also, I often missed precise and unmistakable wording. Like for

Anonymous Referee 1, while reading the text it appeared to me that the authors want to express the right aspect, but use unfavourable phrases and wording, e.g. unspecific terms or various terms for the same meaning. E.g. "typical crop" should be replaced by a better term, e.g. "dominant crop" which also includes the meaning of the maximum area covered per grid cell.

Response: We apologize for the difficulties in understanding the manuscript because of insufficient and vague descriptions. We will revise the manuscript following the suggestions. We also agree with you that several terms should be replaced in the revised manuscript.

[G5-1] As Anonymous Referee 1, I agree on the difficulty of global-scale validation, e.g. always regions with mismatch occur. In the comparison of crop calendars of remotely-sensed SACRA to MIRCA2000, it is hard to tell which one is better. While SACRA uses more current information, MIRCA2000 rather states average conditions and possibly conditions of nearby administrative units, used because of lack of more detailed reference information. So it would be possible that both are correct, e.g. if they referred to different time periods. The authors should also state why they preferred crop calendars of MIRCA2000 to the ones of Sacks et al. 2010, as the latter ones possibly might be better suited.

Response: We agree with you that both MIRCA2000 and SACRA can be correct. We will state it in the revised manuscript. We selected the MIRCA 2000 arbitrarily as one census-based CC. To see the characteristic of SACRA from different aspects, we will compare SACRA with climatology-based crop calendar (e.g., Hanasaki et al. 2008 and Waha et al. 2012).

[G5-2] One important aspect is also no discussed: MIRCA2000 delivers crop calendars for either irrigated or rainfed crops, which possibly, but not necessarily coincide for a given administrative calendar unit. How is this fact represented in the evaluation or validation/ comparison?

Response: As pointed out, we did not distinguish CC for irrigated and rainfed crops. We assumed that the two CC parameters (NDVIpl and NDVIhv) are depending on crop species. We also assumed that the two CC parameters are independent on cropping style (i.e., irrigated

1 or rainfed). The CC of SACRA can be different from CC of irrigated/rainfed crops of
2 MIRCA2000. We will state the assumption in the revised manuscript.

3

4 [G5-3] Anonymous Referee 1 mentions the importance of triple cropping. I am not sure to
5 what extent triple cropping is really important, but multiple cropping occur with the
6 cultivation of different crops on the same fields, especially in countries with intensive
7 cropland use like India or China. How does the SACRA algorithm / analysis of NDVI deal
8 with that?

9 Response: We will add an appendix to explain how to identify the multiple cropping in the
10 SACRA algorithm. Thank you for point it out.

11

12 [G5-4] In the case where two crops with nearly identical area in MIRCA2000, to what extent
13 would the selection of the dominant crop influence the validity?

14 Response: As we described in the original draft, we assumed that NDVI-Filled represents the
15 phenology of the dominant crop at an administrative unit. As pointed out, selection of the
16 dominant crop can affect the validity in the case here two crops with nearly identical area in
17 MIRCA2000. With Fig. 6, we will discuss it to seek for error source of sowing dates
18 compared to MIRCA2000. Thank you for point it out.

19

20 [G5-5] In Fig. 6, the differences in planting months of MIRCA2000 and SACRA are only
21 broadly shown, but not discussed on the basis of the specific dominant crops.

22 Response: We will add the further discussion about Fig.6 on the basis of dominant crops.

23

24 [G9] Line 21: Why is the peak date of importance? With a monthly crop calendar, this
25 probably refers to peak NDVI or derived vitality. The indication of a possible application or
26 usefulness, e.g. reference for vegetation modelling, would be helpful.

27 Response: Some of crop-growth models simulates growing stage (e.g. Horie et al. 1987). Peak
28 date can be useful to simulate peak date accurately by calibrating model parameters. Such
29 possible applications will be stated in the revised manuscript.

[G10] Again, I agree to Anonymous Referee 1 that the manuscript should be partly restructured. Especially the selection of the considered crops should be mentioned before section 2.4 (page 1336).

I think that the aim of the manuscript on page 1332 is clearly stated, but afterwards the description flattens considerably. Especially Figures 1, 4, and 6 are not very clearly produced or commented.

Response: We will reconstruct the manuscript following the suggestions from two anonymous referees. Also, we will state the all figures sufficiently in the revised manuscript.

[G11] Some more precise wording would be appreciated to bring in more clarity and the ability to fully understand.

Response: We also agree with you that several terms should be replaced in the revised manuscript. We will revise the manuscript following the comments by two anonymous referees.

[G15] No supplementary material is currently provided with the manuscript. A freely available data set via a website would be probably greatly appreciated by many scientists involved in global modelling. I suggest to introduce some version numbering, as it seems to me that some probably necessary update of methodology will provide new calendars or regional improvements. Then the version number (e.g. of the method) would held distinguish the different resulting data sets.

Response: Thank you for the invaluable comment. The version number would be added when we open the SACRA to science community.

Specific comments

[S1] Page 1334, line 2 : In Eq. (1) the case of t=tpv is not exactly defined.

Response: We will correct the manuscript. Thank you for point it out.

1

[S2] Page 1334, line 11: It is not clear how NDVI-filled is produced. This is critical for the later evaluation. It would be nice to know the percentage of grid cells occupied by either NDVI-Crops or NDVI-Filled.

Response: We will add an appendix to explain how to produce NDVI-Filled. Also, we will add a figure to present the percentage of grid cells occupied by NDVI-Crops and NDVI-Filled.

[S3] Page 1335, line 11: Typical crop is the crop with the most crop area in MIRCA2000. Is the distinction of irrigated and rainfed areas important? Is it the maximum monthly area (growing area) or is it the harvested area. These might be different in grid cells with multiple cropping systems, e.g. of wheat and rice in India. What about the effect of mixed pixels when aggregating for NDVI calculation?

Response: At each grid, we identified a dominant crop that has the largest "maximum monthly harvested area" in MIRCA2000.

About the distinction of irrigated and rainfed areas, please see our replies to the general comment G5-2.

About the effect of mixed pixels, Please see our replies to the general comment G5-4.

[S4] Page 1335, line 20 "reanalysis temperature" of Hirabayashi et al. 2011. It would be nice if you mentioned/discussed the data source (ERA40, ...) behind that source, but especially how you used the 0.5 resolution of that data set within your 5 arc-min resolution, e.g. some necessary downscaling.

Response: We will add the further explanations about the reanalysis forcing data.

[S5] Page 1335, line 25: "Because we define winter crops by temperature, cultivated wheat in Australia and Northern India is defined as spring wheat. Regions having the minimum monthly-averaged temperature below 5.0 in Fig. 4c are categorized as winter wheat or fodder (permanent crop) in Fig. 4a."

1 This wording is totally confusing, and it remains unclear when or whether you speak about

2 (existing) MIRCA2000 or (new) SACRA, or of both, and whether Fig. 4 (a) is MIRCA or

3 SACRA, and if it were MIRCA, how Fig. 4(c) would relate to Fig. 4(b) or what you want to

4 show via Fig. 4(c).

5 Response: We apologize for insufficient explanation. We will add an appendix to describe

6 how to identify dominant crop and distinguish summer and winter crops.

7

8 [S6] Page 1336, line 6: The author mention they consider crops "spring wheat, maize, rice,

9 soybean, and cotton", but later (line 19) they refer to winter wheat which calendar is replaced

10 by the one of summer wheat. But how this important aspect is done, remains unclear. And

11 how grid cells with MIRCA2000 winter wheat are treated with possibly observed summer

12 crop calendars. But does not Fig. 2 (page 1349) show that winter crops are somehow treated /

13 treatable? Fig. 4 (a) (b) (page 1351) obviously depict MIRCA2000 (or not ?) e.g. also

14 specifying in Fig. 4 (b) sngWinter crops, but this is not stated in the figure caption.

15 Response: The CC of winter wheat was not replaced by the CC of summer wheat. We

16 substituted two CC parameters (NDVIpl and NDVIhv) of spring wheat for those of winter

17 wheat. We will revise the manuscript to avoid such misunderstandings. Also, we will revise

18 the caption of Fig. 4b following the suggestion.

19

20 [S7] Page 1338: USDA 1994 is missing in the list of references.

21 Response: We will add the reference of USDA 1994.

22

23 [S8] Line 23 "multiple usages of the two products are useful to take into consideration the

24 uncertainty of the CC." I do not understand the meaning of this sentence, please be more

25 specific.

26 Response: In the application of a CC for agricultural simulations (e.g., estimations of food

27 production and irrigation water usage), we would think about uncertainty of the CC. We

28 intended to describe that multiple usages of CCs are useful to reduce the uncertainty of the

29 application studies. We will state it in the revised manuscript.

30

1 [S9] Page 1346, Table 2: How do you compare monthly calendar (MIRCA2000) (planting:
2 possibly first day of month, harvest: possibly last day) with daily calendar (SACRA)? Do the
3 pure grids (5 arc-min?) include multi-cropping? If yes, which season do you consider? Are
4 there grid cells with triple rice cropping of MIRCA2000 included?

5 Response: We apologize for insufficient explanations. The comparison of monthly calendar
6 (MIRCA2000) and daily calendar (SACRA) are also related to the identification of two CC
7 parameters (NDVIpl and NDVIhv). We will state them in the appendix together. The pure
8 grids do not include multi-cropping (P1336,Line7).

9

10 [S10] What about the distinction of calendars for rainfed and irrigated in MIRCA2000? How
11 is this important for this analysis?

12 Response: Please see our replies to the general comment G5-2.

13

14 [S11] How do you calculate the average error? Isn't it the average difference (in days)? Then
15 again the question about the used reference date at MIRCA2000 is important (first day, 15th
16 of each month,...)

17 Response: The question relates to the identification of the two CC parameters (NDVIpl and
18 NDVIhv). We will describe it in an appendix.

19

20 [S12] It would be nice to have a map / see the location of the pure grid cells, e.g. in Fig. 5 or
21 Fig. 6.

22 Response: Following the suggestion, we will add a map to see the location of the pure grid
23 cells.

24

25 [S13] It is strange that the differences ("errors") here are below one month, while in Fig. 6 (a)
26 and (b) considerable areas have differences larger than 1.5 months. How can this phenomenon
27 be explained, given also the monthly resolution in MIRCA2000? Perhaps one reason is the
28 assumption of centred planting/harvesting days in MIRCA?

1   Response: The difference ("error") in Table 2 represents the error among the pure grids. We

2   will describe how to compute error between MIRCA2000 and SACRA in an appendix.

3

4   [S14] Page 1347, Table 3: The crop calendars (CC) should be more explicit where they are

5   for more than one crop (MIRCA2000) as SACRA is only for the dominant crop for a given

6   unit. Also perhaps distinguish between calendars of MIRCA2000 and Sacks et al. 2010?

7   Response: We will state it explicitly in the revised manuscript. Also, we will perform further

8   comparisons with climate-based crop calendar (e.g., Hanasaki et al. 2008 and Waha et al.

9   2012).

10

11   [S15] Page 1348: Fig. 1 is not clear. You do not distinguish between detection of dominant

12   crop and the crop calendar. Is SACRA-Filled the result of SACRA? What is the difference

13   between NDVI-Filled and SACRA-Filled? What do you do with discontinuities of SACRA

14   and SACRA-Filled (page 1337, line 9) because of filling? How does this filling influence the

15   comparison in Fig. 6, for the selected regions?

16   Response: Following the suggestion, we will revise the Fig. 1. We apologize for confusing

17   terminology of SACRA-Filled and NDVI-Filled. Since SACRA-Filled were not used in the

18   discussion, we will remove the description of SACRA-Filled in the revised manuscript.

19

20   [S16] How is SACRA cultivation period adjusted to MIRCA (page 1338, line 2-3)?

21   Response: We will add an appendix to describe how to adjust SACRA cultivation period to

22   MIRCA2000.

23

24   [S17] Page 1350, Fig. 3 (a) and (b): NDVI in (b) for 2004-2006 is smoother than in (a) (only

25   2004). It would be interesting to see the inter-annual variability, too.

26   Response: We will add the annual NDVI (2004, 2005, and 2006) in Fig. 3.

27

28   [S18] Fig. 3 (b): Why is nNDVI for period 2 smaller than zero for September to December?

29   Probably because NDVIbas of period 2 is defined in June. But shouldn't negative nNDVI be

avoided? Or at least suppressed, for better subsequent treatment, which might be corrupted through? It would help to have tpl, tpk, and thv as in Fig. 2 also for this more complex case.

Response: We do not need to avoid negative nNDVI in our algorithm. Following the suggestion, we will add tpl, tpk, and thv in Fig. 3. Thank you for the suggestion.

[S19] Page 1353, Fig. 6 (a) the unit for the comparison of the crop calendars are missing (probably months as units). How are planting months in different years considered, e.g. seen in Fig. 6 (b-3 Mongolia) and (b-8 Shandong)? Again as for Table 2: How do you compare monthly calendar (MIRCA2000) (planting: 1st day of month) with daily calendar (SACRA)? How are daily data of SACRA transferred to monthly calendars in Fig. 6 (b)? Why not specifying differences in days, too, as done in Table 2 (page 1346), rather than months, as days would yield more precise differences? It would be nice to have the differences as positive and negative deviations, as proposes by Anonymous Referee 1. Are then the differences MIRCA - SACRA or SACRA - MIRCA? In Fig. 6 (b) the dominant crops that are used should be specified. Without this information, an interpretation of differences is not possible. The case of Fig. 6 (b-1) needs to be explained: Two NDVI peaks get only one cultivation season in SACRA, without considering the major peak for the season? Are the crops perhaps defined differently (one rainfed, the other irrigated)?

Response: We will revise the Fig.6 as follows.

(1) The unit will be clearly described.

(2) We will check whether the SACRA is signalling earlier or later by revising the legend of Figure 6-a (i.e. to include both negative and positive values).

(3) The dominant crop will be described in Fig. 6b.

(4) SACRA allows that several CCs can exist in the same administrative unit. We intended to describe the diversity of CCs in SACRA with the bars of Fig. 6b, which turned out to confuse readers. We will include the all CC and NDVI in the same administrative unit in Fig. 6b in the revised manuscript.

(5) We will describe how to compare monthly CC (MIRCA2000) and daily CC (SACRA) in an appendix. Please see our replies to the general comment G5-2.

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