Comments for ESSD-2022-210

This manuscript attempts to propose a novel model to fill the gap among filed harvested AGB, UVA photos and MOIDS images. With the application of the novel model, the AGB in whole QTP was projected from 2000 to 2019. Moreover, the spatial-temporal pattern was also analyzed. The results of this manuscript can provide a baseline for further studies which focus on the estimation of AGB in QTP. But, there still are some issues in the revised manuscript. The suggestions and comments are as follows.

P2, lines 36-37 and P34, line 639, the initial letter of the author's family name should be Ó.

P2, line 38, insert "of livestock" after "sustainable development"

P2, line 44, insert "sensors" after "satellites", because sentinel, landsat and modis are sensors. Satellite is a general term.

P2, line 57, insert "images" after satellites

P2, lines 58-59, change "the satellite resolution" to "the resolution of satellite image"

P2, line 60, change "satellite" to "satellited"

P2, lines 59-60, maybe "therefore, retrieving fine-resolution satellite images that match the filed samples is key to improving the accuracy of satellited AGB estimation" is better, because whole this paragraph is mainly talking about the satellite's images.

P2, line 63, listing the author (Yang et al.) is not suggested in this sentence. In order to respond the above sentence, maybe "five years and ?? labors were spent in completing the collection…." is better.

P2, line 65, change "expand the sample size" to "increase the sample amount", because the size of filed sampling is fixed (as shown in line 52, 0.5 × 0.5 m or 1 × 1m).

P3, line 67, does the author means quart size, plot size and harvested methods?

P3, lines 69-70, change this sentence to "as a linkage/bridge between filed observation and satellites detecting for grassland biomass, the development

and popularity of unmanned aerial vehicle (UAV) technology has provided a new solution to the abovementioned two issues".

P3, line 70, give the full name of FVC, because it was addressed in the body for the first time.

P3, line 70, 75, change "UAV images" to "UAV photograph"

P3, line 71, insert "two" after "following"

P3, line 76, change "small-scale, with few regional-scale studies" to "conducted on small scale, but few studies on regional scale".

P3, line 77, 84, gap cannot be reduced, only can be filled. So, change "reduce" to "fill".

P3, line 78, change this sentence to "there is short of multi-years validation…due to the limited sample amount in previous studies"

P3, line 81-82, change this sentence to "….combining traditional ground sampling, UAV photograph, and satellite image to produce…..".

P3, line 85, insert "estimation" after "AGB", and delete "Qinghai-Tibetan Plateau" and "()".

P3, line 92, delete "of China".

P3, line 94, change "Grassland type data was" to "Grassland types were", and insert a blank after Colon.

P3, line 95, delete the blank between "data" and "set".

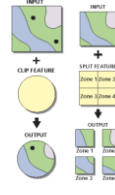
P4, line 97, other grassland types map? Change "combined" to "regrouped"

P4, line 98, change "resampled to 250 m" to "resampled this regrouped vector to grid with 250 m spatial resolution".

P4, figure 1, in the map, if you use the Graticule, please do not insert a north arrow, which both indicate the direction.

P4, line 105; P5, line 106, insert "(250 m)" after "MODIS pixel scale", because there is other spatial resolution for MODIS images, such as 500 m, 1 km et al.

P5, figure 2, the color sub-figures (AGB values at MODIS pixel-scale and AGB values at photo-scale) were placed at the inverse location. Because it is

an upscaling from photo-scale to MODIS pixel-scale. Moreover, please pay more attention to the terms used in this figure, such as "clip" and "average",

maybe the "split" and "merge" are more suitable. , please see the difference between "clip" and "split", which was addressed in the help document in Arcmap.

P6, line 124, change "reliable" to "sufficient".

Table 1, suggest change the format of date listed in the column "Acquistition time", change dot format to forward slash. And, change "Acquistition time" to "Acquistition date", change "routes" to "route".

Table 1, in the next paragraph and figure 3, the GRID and BELT modes were applied in your research, but in this table, the RECTANGLE and GRID modes were listed in the column "Flight Mode". Please check and correct this issue.

P6, line 128, change "commonly" to "widely".

P7, line 133, change "Typically" to "Normally".

P7, line 134; P8, lines 147-148, 155, change "frame" and "frames" to "quadrat" and "quadrats", respectivity.

P7, line 135, delete "flight".

Figure 3, suggest label the length and width for all the sub-figures (a-f). in figure 3, sub-figures (a, b) only label the length, and sub-figures (e, f) only label the width. However, sub-figure (c) both label the length and width, sub-figure (d) both miss the labels of length and width. Meanwhile, the authors can label the height at the bottom of each sub-figure like c-f.

P8, line 144, change "designed" to "conducted".

P8, line 145, change "implementation" to "four".

P8, line 146, "three waypoints were randomly selected..", but seen from the figure 3a, the waypoints were regularly selected (points6, 9, 12). Insert "flight" before "mode".

P8, line 148, change "four frames mentioned above" to "four abovementioned quadrats".

P8, lines 148-149, change "at the end of all flights" to "after the implementation of all fights".

P8, line 149, delete "AGB".

P8, line 158, delete "vegetation".

P8, line 162, what does inversion mean? Maybe "detecting" is more suitable.

P8, line 165, change "stitched" to "mosaiced".

P8, line 165, does "corresponding vegetation indices" mean both the NDVI and EVI were used in your research? If so, how do the authors overcome the difference between NDVI and EVI?

P8, line 166, change "time" to "date". Because time includes the hour, minute and second.

P8, line 167, delete "index".

P8-P9, lines 173-174, why not abbreviate the three meteorological factors as MAT (mean annual temperature), MAP (mean annual precipitation) and TASR (total annual solar radiation)? Actually, these three abbreviations are widely used in a lot of literatures.

P9, line 175, insert the hyperlink address of website (http://data.cma.cn) after "China".

P9, line 176, because the original meteorological datasets are stored with points attached with attributes. So, checking and eliminating the anomalous values of attributes is the first step. Summing the daily values of precipitation and temperature to calculate the annual precipitation and annual temperature is the second step. Averaging the annual temperature to calculate mean annual temperature is the third step. Using the interpolation method to project the raster datasets is the last step. So, interpolation is the last step. It should be placed after averaging.

P9, Line 177, change "1000 meters" to "1 km".

P9, line 179, insert "raster" before "datasets" and change "resampled" to "regridded". Please give out the version and company of software.

P9, line 180, change "data" to "image".

P9, line 182, change "digital elevation model (DEM)" to "altitude". So, this sentence can be modified with "Terrain factors including altitude, slope and aspect, were derived from digital elevation model (DEM) using the terrain analysis tool of Arc GIS software".

P9, lines 182-183, change "derived" to "retrieved", and change "resampled" to "regridded".

P9, lines 183-184, delete this sentence.

P9, line 186, change "satellite" to "MODIS".

Figure 4, give out the length of quadrat; change "Satellite Pixel" to "MODIS pixel"; the grid covering on the photo is not same, which may be caused by the different distance among vertical lines; the photos were not aligned in one line at vertical line and horizontal line; please rename the three steps, the authors can use the gerund as the starting for a phrase, for example, Step1: harvesting grassland AGB at quadrat scale; Step 2: merging the quadrats at photo scale; Step 3: merging the photos at MODIS pixel scale; place a note of "a MODIS pixel includes 16 UAV photos" at the bottom of sub-figure of MODIS pixel scale; "about" and "~" are the same meaning. Delete the aircraft photo and its dash lines and notes, et al. in the sub-figure of MODIS pixel scale.

P10, line 190, change "Modeling method" to "Random forest model".

P10, line 193, change "namely" to "named".

P10, line 194, change "first" to "firstly".

P10, line 196, change "increase" to "increased".

P10, lines 200-201, change "predictor variables" to "predictors"; delete "index".

P10, line 207, insert "MODIS" before "pixel".

P10, line 208, change "the large sample size" to "its large size".

P10, line 209, change "cross-year" to "multi-year".

P10, formula (1), the symbol "‾" is far away "y_i". please use the formula editor.

P10, line 217, delete the second "to", and change "frames" to "quadrats".

P10, line 218, change "of quadrat-scale UAV-field AGB observation" to "between filed harvested AGB and UAV sub-photos".

P10, line 219, delete "data"; delete blank between "1" and "a". in the figure 1a, there is no red dot. Please check and revise.

P10, Line 220, change the format of measuring unit from "g/m^2" to "$g \cdot m^{-2}$".

P11, line 221, change "image" to "photo".

P11, lines 224-225, change "first" and "second" to "firstly" and "secondly".

P11, line 227, change "images" to "photos"; the number is 37487, but in table 1, it is 37864. what is the reason caused the missing of 377 photos?

P11, line 228, are more than 74 million AGB values based on the filed harvested biomass?

P11, figure 5, from the figure 5a, we can see that filed harvested AGB at 0 $g \cdot m^{-2}$ accounting the largest frequency in 2019, but in the figure 5b, the UVA-estimated AGB at 200 $g \cdot m^{-2}$ accounting the largest frequency in 2019, what results in this difference?

P11, line 235, insert "MODIS" before "pixel", and "area" before "of".

P11, line 236, change this semi-sentence to "the average value of 16 or 12 UVA photos' AGB was taken as the AGB value of the corresponding MODIS pixel".

P11, line 237, change "From" to "During".

P11, line 238, insert "MODIS" before "pixel".

P11, line 240, change "time" to "date" and insert a blank before "3)".

P12, line 241, change "the extracted spatial indices" to "MODIS vegetation indices".

P12, line 242, change "the" to "MODIS" and "algorithm" to "model".

P12, line 244, do the authors mean "regression coefficient between vegetation indices and estimated AGB". If so, please change "vegetation indices" to "regression coefficient between vegetation indices and estimated AGB".

P12, line 249, change "randomly" to "regularly".

P12, line 250, insert a double quotation mark for "true". Change "results from" to "between", and "or" to "and".

P12, line 254, change the second "of" to "in".

P12, line 259, change "in" to "provided by".

P12, lines 262, 264, insert "MODIS" before "pixel".

P12, line 263, change "6" and "4" to "six" and "four", respectively.

P13, line 268, change colon to dot. Please check the style, because there is a dot in the title of table 1.

Table 2, please rearrange the variables in the last column and delete the last comma after "R".

P13, line 273, insert a blank before and after "=" and "<".

P13, line 275, change "p=0.51>0.05" to "$p > 0.05$".

P13, lines 277-278, change this sentence to "it may be caused by the relatively small samples of more than 200 g · m^{-2}, only accounting for 8.5% of whole samples".

P13, line 278, change "size" to "amount".

P13, line 279, delete the first "from" and change the first "to" to "by". Insert "UVA-" before "photos".

P13, line 281, 284, insert "$p < ????$" and "$p > 0.05$" after "a strong linear relationship" and "no significant differences", respectively.

P13, 287, change "~" to "-".

P13, lines 285-286, it is confused me a lot, please revise this sentence.

P14, lines 298-299, change "the traditional sampling method" to "that between MODIS-estimated AGB and filed harvested AGB".

P14, line 300, whose correlation between a single UVA image was higher than that between NDVI and filed harvested AGB?

P14, line 301, increased with the increasing or decreasing number of UAV photos? Whose number increased from 1 to 4?

P14, line 305, change "photographs" to "photos".

P17, line 322, change "biomass" to "AGB".

P17, line 324, please check the format of comma.

P17, line 326, change "between…and…" to "from…to….".

P17, line 327, please correctly address the format of unit. For example, $gm^{-2}a^{-1}$.

P17, lines 330-331, change "some degradation" to "a decreasing trend". Because only based on the decreasing trend, we cannot get a conclusion that the grassland, in these regions, are experiencing degradation.

Figure 9a, why the mean AGB in 2015 is much lower than that in other years.

P20, line 351, change "influence" to "impacting".

P20, lines 356, 373, change "reduce" to "fill".

P20, lines 357, 358, change "first" and "then" to "firstly" and "secondly", respectively.

P20, line 362, delete "the traditional" and the third "the".

P22, line 379, change "image" to "photo". Delete "vegetation and".

P22, line 381, delete ", to avoid overestimation". Change "true" to "suitable".

P22, lines 382-383, suggest delete these two sentences. The non-vegetation background can be taken as a baseline for detecting AGB. But, in the filed sampling, it is unnecessary to do a sample without grassland vegetation. In fact, we always do the samples at different grassland types, such as alpine meadow (high coverage), alpine grassland (median coverage), and sparse grassland (low coverage).

P22, lines 390-393, change "image" to "photo" and "images" to "photos".

P22, line 401, change "reducing" to "filling".

P22, line 402, change "AGB" to "technology". Insert "photos" and "MODIS" before "matching" and "pixel", respectively.

P22, line 403, change "cross-year" to "multi-year".

P22, line 404, p23, line 428, change "size" to "amount".

P22, line 406, does "abnormal white balance" mean "abnormal white gap"? in the figure A5, the abnormal white gap is not clear.

P24, line 443, give the full name of "ANN".

P24, lines 445-446, insert "(2017)" before "compared" and delete "(Wang et al., 2017)".

P24, line 453, as we know, it is very difficult for spectrum images to detect the height of grassland species. Recently, some lidar images were used to detect the height of forest species. However, in QTP, the grassland species are much lower than forest species in tropical regions.

P24, lines 451-454, suggest revise these two sentences.

P24, line 459, change "difference" to "gap". Change "errors" to "uncertainties".

P24, line 460, change "of" to "in".

P25, line 463, delete the blank between "data" and "set".

P25, line 466, change "limited" to "poor".

P29, table A1, there may be issues for reclassifying the grassland types. Suggest reclassify the eight grassland types into "meadow", "steppe" and "desert". Because the lowland meadow and temperature steppe do not be characterized with alpine climate. These two grassland types normally located in the southern Himalaya and south-eastern QTP. So, the climate in these regions is not cool, but warm. Moreover, there still are grassland species in the desert, for example the short-life species. When the temperature and precipitation are suitable, the grassland species grow sharply. But, as the temperature and precipitation decrease at a certain extent, the grassland species die. Normally, we call these short-life grassland species as annual plant.