Reviewer #1 Comment on essd-2022-422 (Anonymous Referee #1)

Dear Anonymous Referee #1,

We have carefully reviewed your comments and have made the necessary revisions to our manuscript. Please find attached a point-by-point response to your feedback, marked in purple. We hope that our revised manuscript (in red) can help the readers to better understand our study.

Kind regards.

General comments

Shen et al. presented a very comprehensive reservoir dataset for China, Res-CN. The new dataset includes water area, water level, storage variations, and corresponding catchment characteristics that derived from multiple sources (i.e., satellite, reanalysis, and observation, etc). The authors also validated Res-CN with in-situ observations at selected reservoirs to demonstrate the accuracy of the dataset. It provides valuable information for hydrological modelers to investigate water managements and the impacts on (eco)hydrological cycle. Although I think Res-CN represents a significant contribution to improve our understanding of reservoir dynamics and water management in hydrological modeling, some parts were not clearly presented /explained in the main text because Res-CN contains extensive information. Additionally, some figures were missing in the supplementary materials. So, I recommend revision before publication. Please find my comments in the following.
R1C0: We thank you for your thoughtful review of our manuscript and for recognizing the comprehensive nature of our Res-CN dataset for China. We are pleased to hear that you agree that our dataset, which includes a variety of data sources such as satellite, reanalysis, and observation, can provide valuable information for hydrological modelers to better understand water management and the (eco)hydrological cycle.
We appreciate your feedback on the presentation of our work and understand that the extensive information included in Res-CN may have led to some parts being less clearly explained in the main text and supplementary. We have carefully reviewed your comments and made the necessary revisions to improve the clarity of our manuscript. We have also corrected some mistakes in the supplementary materials.
We thank you for the opportunity to revise our manuscript before publication, and we hope that our updated version meets the standards of the journal. We hope that our Res-CN dataset can serve as an important resource for hydrological modelers and researchers in the field, and we appreciate your time and effort in reviewing our work. If you have any further suggestions or comments, please do not hesitate to let us know.

Major Comments

1. The authors mentioned in the introduction Line 99 that in-situ data of 138 reservoirs were used to validate the Res-CN, but the validations at a few reservoirs are shown in the result section, with summary in the main text. It is necessary to show the validations explicitly for all the 138 reservoirs that demonstrate the accuracy of Res-CN.

R1C1: We apologize for the inadvertent omission of the validation figures for the 138 reservoirs in our Res-CN dataset. We have taken corrective measures by uploading the figures to the link of our Res-CN data product (https://doi.org/10.5281/zenodo.7664489), and we kindly request that you access them from there.

Considering the extensive information contained within the supplementary file, we recognize the potential benefits of incorporating the validation figures - which, due to their size, span multiple pages - in our data product to facilitate user access and convenience. However, we also recognize the importance of maintaining a balance between completeness and conciseness in the main text. Consequently, we have presented only a subset of validations for select reservoirs alongside the overall evaluation accuracy. Nevertheless, we would like to assure users that all validation information is available in the data products. We are confident that this balance between completeness and conciseness is in line with the expectations of our readers, and we encourage them to refer to the data products for more detailed information.

The validation figures for all 138 reservoirs can be found in the "validation_figures" folder, which includes the time series of reservoir water level, water area, storage variation, and evaporation. In the "water level" directory, the time series of reservoir water level are available in two modes, i.e., high rate product and standard rate, along with their comprehensive evaluation reports and figures in PDF and TXT files. The "water area" directory provides the monthly area time series of reservoirs, accompanied by their comprehensive evaluation Excel files, including CC values compared with satellite-based water level, in situ water level, and other areal time series from other studies. Finally, the "storage variation" directory includes the time series and comprehensive evaluation figures in PDF files, which include statistical metrics.

Thank you for your feedback, and we hope that the inclusion of these validation figures will facilitate the use of our Res-CN dataset.

2. There are a lot of information provided by Res-CN, but some are not clearly explained. It mentioned in the introduction that 3,254 reservoirs were presented in this dataset, but in Table 2, the topography are available for 3,689 reservoirs**.** Table S10

summarized 18 attributes of topography, but it listed 19 attributes in Table 2. I can find 23 attributes in Table S13 for land cover. In addition, please clarify how the 173 is estimated from Table S14-S15 for the Soil & Geology. And how the 288 attributes are identified from Table S16 for Anthropogenic activity? Please clarify Table 2 and clearly link to the supplementary materials.

R1C2: Thank you for bringing up your concerns regarding the Table 2 and tables in the supplementary.

1. For attributes of topography, we indeed provided 19 attributes and made corrections in Table S10, and associated texts in the main text section 3.4.1.

Please find the modified Tables below.

Table S10. Attributes of topography provided in the Res-CN.

Attribute	Unit	Description	Data source and reference
length	m	The length of the main stream measured from the basin outlet to the remotest point on the basin boundary. The main stream is identified by starting from the basin outlet and moving up the catchment.	Subramanya (2013)
area	km^2	Calculated catchment area	Merri-Hydro (Yamazaki et al., 2019), GeoDAR (Wang et al., 2022)
elev	m	Mean catchment elevation	Merit-DEM (Yamazaki et al., 2019)
elev_max	m	Maximum catchment elevation	See above
elev_min	m	Minimum catchment elevation	See above
elev_std	m	Standard deviation of elevation in catchment	See above
elev_range	m	Range of catchment elevation (maximum minus minimum elevation)	See above
slope	m km^{-1}	Mean catchment slope, Horn (1981)	See above
mvert_dist	km	Horizontal distance from the farthest point of the catchment to the corresponding gauge (length axis)	Merri-Hydro (Yamazaki et al., 2019)
mvert_ang	degree	Angle between the north direction and connection from farthest point of catchment to the corresponding gauge (length axis); e.g., direction from north (farthest catchment point) to south (gauge):180 degree, direction from east to west: 270 degree	See above
elongation_ratio	-	Ratio: elongation ratio, i.e., ratio between the diameter of an equivalent circle and the area of the catchment area to its length, Schumm (1956)	Subramanya, K. (2013)
strm_dens	km km^{-2}	Ratio: stream density, i.e., ratio of lengths of streams and the catchment area	See above

resArea	km^2	reservoir area.	Wang et al. (2022)
form_factor	-	Ratio: catchment area / $(length)^2$	Subramanya, K. (2013)
shape_factor	-	Ratio: $(catchment\ length)^2$ / catchment area	See above
circulatory_ratio	-	Ratio: perimeter of the catchment / perimeter of the circle whose area is that of the basin	See above
compactness_coefficient	-	Ratio: perimeter of the catchment / perimeter of the circle whose area is that of the basin	See above
resArearatio	-	Ratio: reservoir area / catchment area	Merri-Hydro (Yamazaki et al., 2019), GeoDAR (Wang et al., 2022)
relief	-	Ratio: mean catchment elevation / Maximum catchment elevation	See above

Main text: 19 topographic attributes are provided in Res-CN (Table S10).

2. For attributes of land cover, we indeed provided 23 attributes as shown in Table S13, we have corrected it to 23 in Table 2.
3. A total of 173 attributes pertaining to soil and geology are provided. Specifically, Table S14 presents 28 distinct soil attributes while Table S1 describes 19 geology attributes. Within the 28 soil attributes, 21 are represented across 7 levels encompassing six soil layers as well as the entire soil layer. An instance of this is the cation exchange capacity (CEC) of the soil, which has 7 associated attributes denoted as cec_1, cec_2, ..., cec_6, and cec, indicating the CEC of the first to sixth soil layers and the entire soil layer. More explanations are added in the supplementary tables.

Please find the modified Tables below.

Table S14. Attributes of soil provided in the Res-CN.

Attribute	Unit	Description	Data source
bdod*	kg dm-3	Bulk density of the fine earth fraction	SoilGrids250 m (Hengl et al., 2017)[a]
cec*	cmol kg^{-1}	Cation exchange capacity of the soil	See above
soc*	g kg^{-1}	Soil organic carbon content in the fine earth fraction	See above
phh2o*	10	Soil pH	See above
pdep	cm	Soil profile depth	Shangguan et al. (2013)
cl	%	Percentage of clay content of the soil material	See above
sa	%	Percentage of sand content of the soil material	See above
por	$cm^3\ cm^{-3}$	Porosity	See above

si	%	Percentage of silt content of the soil material	See above
grav	%	Rock fragment content	See above
som	%	Soil organic carbon content	See above
log_k_s*	cm d^{-1}	Log-10 transformation of saturated hydraulic conductivity	Soil hydraulic and thermal parameters (Dai et al., 2019)[a]
theta_s*	cm^3 cm^{-3}	Saturated water content	See above
tksatu*	W m^{-1} K^{-1}	Thermal conductivity of unfrozen saturated soils	See above
csol*	$J/(m^3K)$	Volumetric heat capacity of soil solids in a unit soil volume	See above
lambda*	-	Pore size distribution index for the Campbell model	See above
log_vgm_n*	-	Log-10 transformation of a shape parameter for the VG model	See above
psi_s*	cm	Saturated suction for the Campbell model	See above
tkdry*	W m^{-1} K^{-1}	Thermal conductivity of dry soils	See above
tksatf*	W m^{-1} K^{-1}	Thermal conductivity of frozen saturated soils	See above
vf_clay_s*	cm^3 cm^{-3}	Volumetric fration of clay	See above
vf_gravels_s*	cm^3 cm^{-3}	Volumetric fration of gravel	See above
vf_om_s*	cm^3 cm^{-3}	Volumetric fration of SOM	See above
vf_quartz_mineral_s*	cm^3 cm^{-3}	Volumetric fration of quartz within mineral soils	See above
vf_sand_s*	cm^3 cm^{-3}	Volumetric fration of sand	See above
vf_silt_s*	cm^3 cm^{-3}	Volumetric fration of silt	See above
vgm_alpha*	cm^{-1}	The inverse of the air-entry value for the VG model	See above
vgm_theta_r*	cm^3 cm^{-3}	Residual moisture content for the VG model	See above

* Within the aforementioned 28 soil variables, 21 variables marked with * are represented across 7 levels encompassing six soil layers as well as the entire soil layer. An instance of this is the cation exchange capacity (CEC) of the soil, which has 7 associated attributes denoted as cec_1, cec_2, ..., cec_6, and cec, indicating the CEC of the first to sixth soil layers and the entire soil layer, i.e., at six layers of 0–0.05, 0.05–0.15, 0.15–0.30, 0.30–0.60, 0.60–1.00, and 1.00–2.00m, as well as the whole soil layer. In this sense, we provided 154 soil attributes.

Main text: Res-CN provided 154 attributes to characterize physical and chemical properties of soil (Tables S14).

4. A total of 288 attributes pertaining to soil and geology are provided. Within the population category, there are five included attributes, namely population_2000, population_2005, population_2010, population_2015, and population_2020. As for the Nighttime light category, which comprises of “avg_vis”, “stable_lights”, “cf_cvg”, and “avg_lights_x_pct”, both the mean and

sum values for each variable are provided for all available time frames. To illustrate, the variable mean_cf_cvg_101994 denotes the mean value of cf_cvg for the month of October in 1994. Accordingly, a total of 288 anthropogenic attributes have been provided. More explanations are added in the supplementary tables.

Please find the modified Tables below.

Table S16. Attributes of anthropogenic activity provided in the Res-CN.

Attribute	Unit	Description	Data source
population*	-	Population for the years 2000, 2005, 2010, 2015, and 2020	Gridded Population of the World (GPW) database v4.11
avg_vis*	-	The average of the visible band digital number values with no further filtering	DMSP-OLS Nighttime Lights v4 dataset (Doll, 2008)
stable_lights*	-	The cleaned up avg_vis contains the lights from cities, towns, and other sites with persistent lighting, including gas flares. Ephemeral events, such as fires, have been discarded. The background noise was identified and replaced with values of zero	See above
cf_cvg*	-	Cloud-free coverages tally the total number of observations that went into each 30-arc second grid cell. This band can be used to identify areas with low numbers of observations where the quality is reduced.	See above
avg_lights_x_pct*	-	The average visible band digital number (DN) of cloud-free light detections multiplied by the percent frequency of light detection. The inclusion of the percent frequency of detection term normalizes the resulting digital values for variations in the persistence of lighting. For instance, the value for a light only detected half the time is discounted by 50%. Note that this product contains detections from fires and a variable amount of background noise	See above
reproject_grip4_total_dens_m_km2	m km^{-2}	Road density	Global Roads Inventory Project (GRIP) dataset (Meijer et al., 2018)
reproject_hfp2009	-	The Human Footprint camp of cumulative pressures on the environment in 2009	Global Human Footprint v2 dataset (Venter et al., 2016)
reproject_hfp1993		The Human Footprint camp of cumulative pressures on the environment in 1993	Global Human Footprint v2 dataset (Venter et al., 2016)

* Within the population category, there are five included attributes, namely population_2000, population_2005, population_2010, population_2015, and population_2020. As for the Nighttime light category, which comprises of avg_vis, stable_lights, cf_cvg, and avg_lights_x_pct, both the mean and sum values for each variable are provided for all available time frames. To illustrate, the variable mean_cf_cvg_101994 denotes the mean value of cf_cvg for the month of October in 1994. Accordingly, a total of 288 anthropogenic attributes have been provided.

5. Yes, we indeed provide all data for 3254 reservoirs. In this study, we delineated reservoir upstream catchment and provided two types of catchments, i.e., full

catchment and intermediate catchment. Res-CN provides 3254 full catchments and 435 intermediate catchments (See Fig. 2). So, that's why for catchment-level attributes the number should be 3254 full catchments + 435 intermediate catchments.

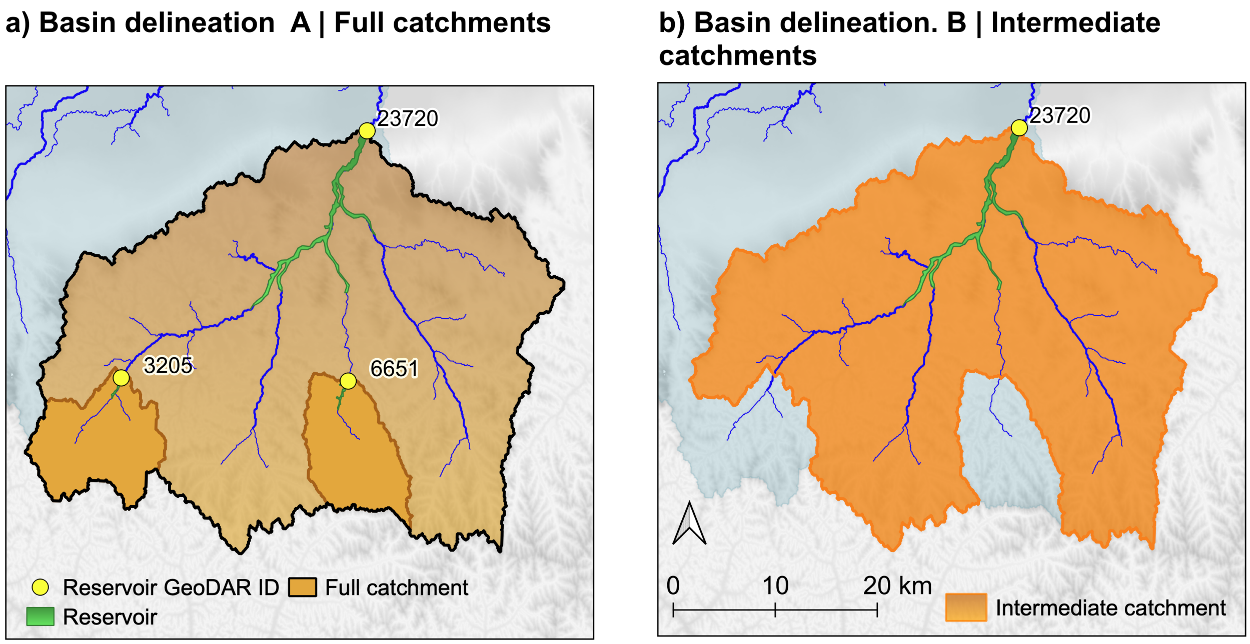

Figure 2. Types of catchment delineation in Res-CN shown with an example. (a) Catchment delineation A: full catchments, which are defined as the full upstream contributing area of a reservoir. In plot (a), the area of reservoir 23720 overlaps with that of reservoir 3205 and that of 6651. (b) Catchment delineation B: intermediate catchment. In plot (b), all upstream contributing areas of the upstream reservoirs (3205 and 6651) are removed from the full catchment of reservoir 23720, thus, we get the intermediate catchment of reservoir 23720 (in black boundary). Background in light blue indicates other catchments not shown in this example. Source of background: MERIT Hydro and MERIT DEM (Yamazaki et al., 2019).

In summary, we have carefully checked and made corrections in the Table 2 and all tables in supplementary. Please find the modified Table 2 as well.

Table 2. Summary of the data provided in the Res-CN.

	Variable	Number of (reservoirs/catchments)	Description
Time series of reservoir states	Water level (SR, a total of 650 reservoirs)	54	From Jason-3 mission, 10-days, 2016-2022, with 3 retracking algorithms
		192	From Sentinel-3A mission, 27-days, 2016-2022, with 5 retracking algorithms
		194	From Sentinel-3B mission, 27-days, 2018-2022, with 5 retracking algorithms
		215	From ICESat-2 mission, 90-days, 2019-2022, with 1 retracking algorithm
		347	From CryoSat-2 mission, 369-days, 2010-2022, with 3 retracking algorithms

		229	From SARAL/AltiKa mission, 35-days, 2016-2022, with 5 retracking algorithms
	Water level (HR)	250	High rate (HR) product by merging SR products, from 2010-2020, sub-monthly or monthly
	Water area	3214	Monthly from 1984-2021
	Storage variation	2999	Monthly storage variation from 1984-2021
	Evaporation	3185	Monthly evaporation rate and volume from 1984-2021
Catchment-level attributes	Reservoir and catchment shapefile	3254 full catchments, 435 intermediate catchments	Two types of reservoir upstream catchments, catchment shapefile attributes (Tables S9-10)
	Topography	3254 full catchments, 435 intermediate catchments	19 attributes (Table S10)
	Climate data	Same as above	11 climatic attributes and daily time series of metrological data with 15 variables from 1980-2022 (Tables S11-12)
	Land cover	Same as above	23 attributes (Table S13)
	Soil & Geology	Same as above	173 attributes (Tables S14-15)
	Anthropogenic activity	Same as above	288 attributes (Table S16)

3. It will be useful to add more details for the water areas at line 88. For example, the range of 0.004-1373.77 [km^2] is very wide. A histogram of the water areas will be useful for the end-users because researchers have different focuses. For example, a watershed hydrologist may be interested in relatively small reservoirs, but an Earth system modeler may only need large reservoirs. Also, it will be helpful to list some major reservoirs based on the water areas (e.g., first ten or twenty?). As argued by the author, the largest reservoir area is 1,373.77 [km^2], but this number is not consistent with my source.

R1C3: We have added the histogram of the water areas and listed out top 10 reservoirs based on the water areas in the supplementary file. In the data product, apart from the shapefile, we added one more excel file to list all reservoirs attributes such as reservoir's area, Chinese name, and GeoDAR ID.

See added figure below:

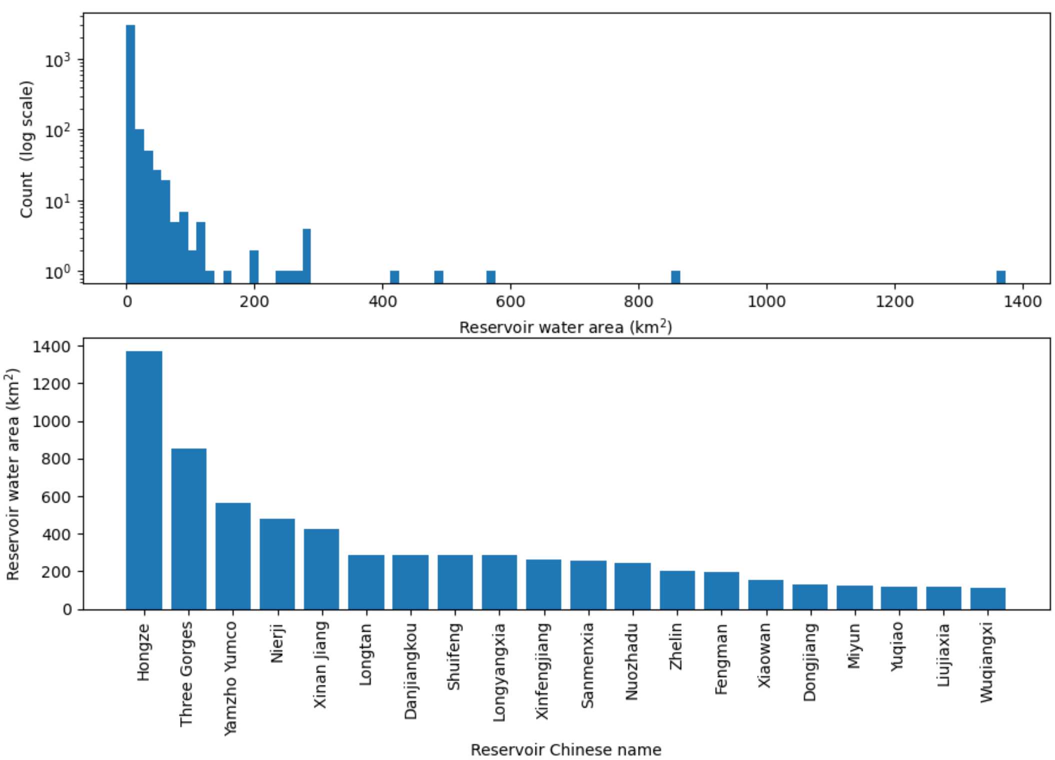

Figure S7. Distribution of reservoir area values and Top 20 reservoirs based on area size in our data product. For more information such as area, name and ID of all reservoirs, please refer to our data product.

In this study, we focused on reservoirs for which are mapped and available from the newest global GeoDAR database (Wang et al., 2022, https://doi.org/10.5281/zenodo.6163413). We checked the GeoDAR again, and found that the largest reservoir area in China is 1,373.77 [km^2]. To clarify this issue, we changed the text as follows:

In this study, we constructed reservoir-catchment characteristics for 3254 reservoirs recorded in the GeoDAR database (Wang et al., 2022), with water areas ranging from 0.004 and 1373.77 km^2(Fig. S7), with a total water storage capacity of 682,595 km^3 accounting for 73.2% Chinese reservoir water storage capacity.

References:

Wang, J., Walter, B. A., Yao, F., Song, C., Ding, M., Maroof, A. S., Zhu, J., Fan, C., McAlister, J. M., Sikder, S., Sheng, Y., Allen, G. H., Crétaux, J.-F., and Wada, Y.: GeoDAR: georeferenced global dams and reservoirs dataset for bridging attributes and geolocations, Earth Syst. Sci. Data, 14, 1869–1899, https://doi.org/10.5194/essd-14-1869-2022, 2022.

Minor Comments:

Line 42, Please capitalize **E**arth.

Changed as suggested.

Line 76-78: "In addition, there is no systematic assessment of whether reservoir water levels or water areas from previous studies and databases agree with one another, as shown in this study by many reservoirs whose in situ measurements are available.". I don't understand this statement, are you trying to argue your results suggests the results from previous studies are biased when compared to in-situ measurements?

Yes, rather than biases, to be fair, we just mentioned that there are some differences among these datasets. Thus, we say try our best to do some cross comparison and validation against gauged measurements.

For example, for our area dataset that using a algorithm developed by Donchyts et al. (2022), we compared them with water level time series (in situ and altimetric measurements) and the water level of two other, similar areal datasets: i.e., GRSAD (Zhao and Gao, 2018) and ReaLSAT (Khandelwal et al., 2022). Based on all the compared reservoirs available, we found that our SWA time series show good agreement to values in GRSAD (median CC value of 0.64, rBIAS = −9 %, rRMSE = 26 %, and n = 338) and ReaLSAT (median CC value = 0.68, rBIAS = −10 %, rRMSE = 22 %, and n = 47) datasets. See figure Fig. S3 below: Overall, these comparisons suggest a good level of trustworthiness in our water area time series.

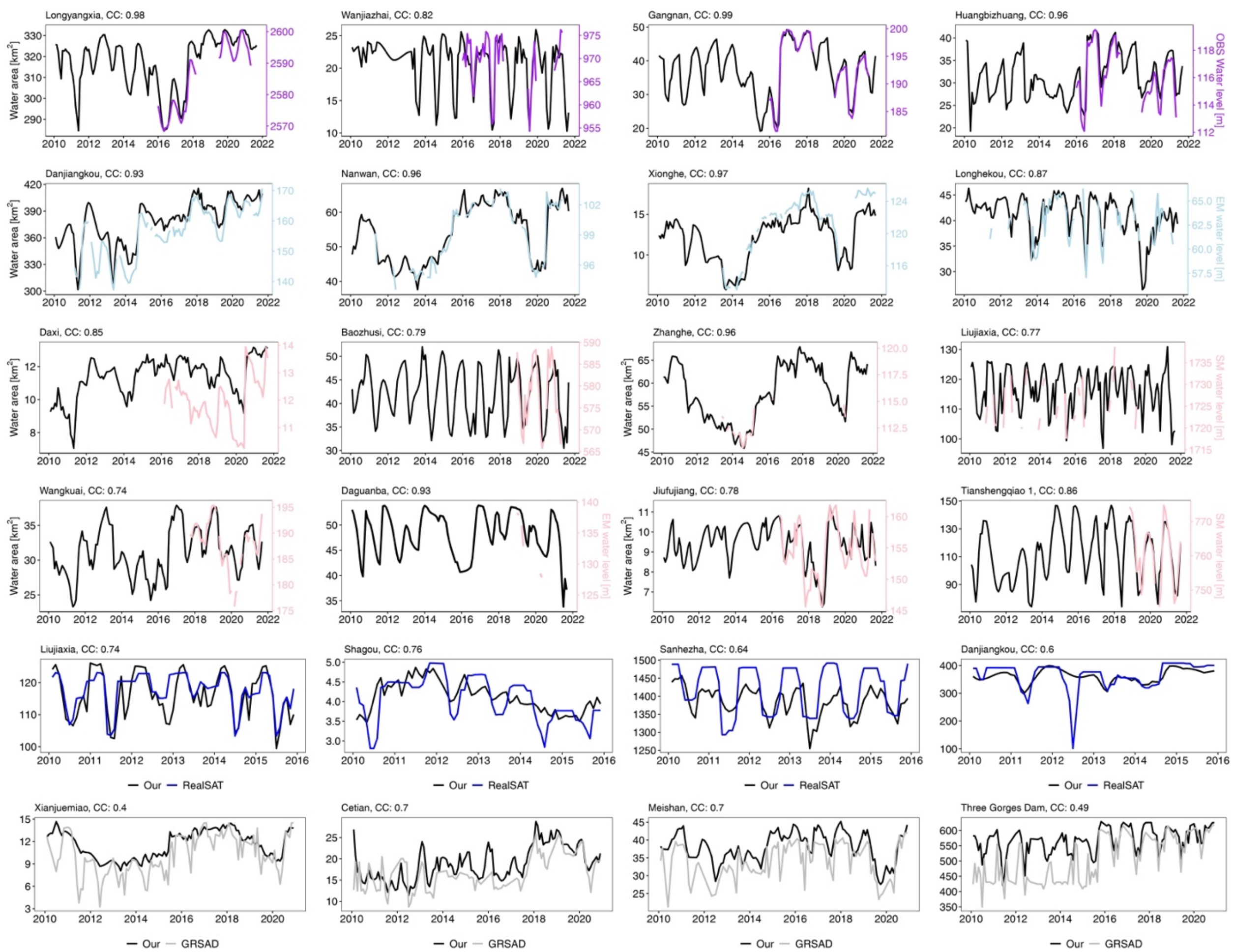

Figure S3. Graphs showing reservoir water area time series against in situ water levels, altimetric water levels from high and standard rates, and GRSAD and ReaLSAT area time series for a sample of reservoirs of varying areas.

For water level, we validation against in situ data and three similar datasets, finding some differences, see figure Fig. S2 below. We argue that some differences can be found when comparing them together. some large discrepancies can be found in certain reservoirs, e.g., the Shuifeng reservoir (Fig. S2. 16) did not show a clear fluctuation pattern as captured by G-REALM, for the periods in 2020 between our dataset and Hydroweb at the Fengman reservoir (Fig. S2. 3). Our datasets are denser than Hydroweb over most reservoirs (Fig. S2. 5) and can be less noisy. These advantages would benefit the continuity and accuracy of the remotely sensed WSE and RWSC. Overall, this comparison demonstrated that performance of our datasets approximates accuracy of existing global altimetry datasets.

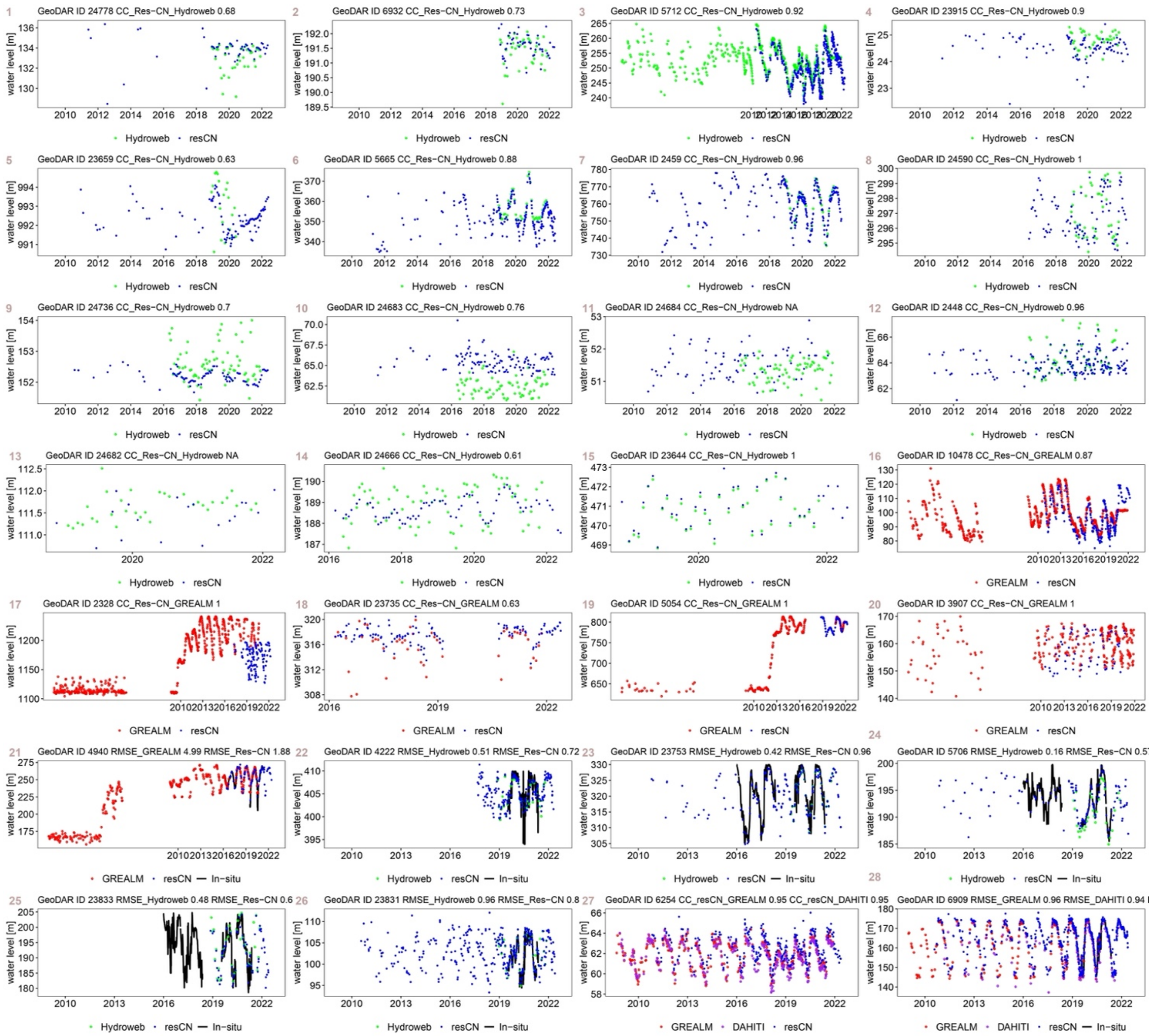

Figure S2. Comparison between our water level time series and other existing similar databases.

References:

Donchyts, G., Winsemius, H., Baart, F., Dahm, R., Schellekens, J., Gorelick, N., Iceland, C., and Schmeier, S.: High-resolution surface water dynamics in Earth's small and medium-sized reservoirs, Sci. Rep., 12, 13776, https://doi.org/10.1038/s41598-022-17074-6, 2022.

Khandelwal, A., Karpatne, A., Ravirathinam, P. Ghosh, R., Wei. Z., Dugan, H. A., Hanson, P. C., and Kumar, V.: ReaLSAT, a global dataset of reservoir and lake surface area variations, Sci. Data, 9, 356, https://doi.org/10.1038/s41597-022-01449-5, 2022

Zhao, G. and Gao, H.: Automatic Correction of Contaminated Images for Assessment of Reservoir Surface Area Dynamics, Geophys. Res. Letters, 45, 6092–6099, https://doi.org/10.1029/2018GL078343, 2018.

Line 80: “there are approximately 30 Chinese” Do you mean there are approximately 30 reservoirs from China?

Changed as: there are approximately 30 Chinese reservoirs.

Line 106: Please provide the source or reference for the number of 98,000.

Yes, we added the reference below.

References:

MWR: Hydrologic Data Yearbook, Ministry of Water Resources (MWR), ISBN 9771009737167, 2016.

Line 109: Are the 3,254 reservoirs from GeoDAR?

Yes, we used the reservoirs shapefiles from GeoDAR.

Line 135: What is your criteria for reservoirs with large variations.

The threshold used in our study was obtained based on previous research (Jiang et al. 2017 RSE). However, as our study covers many reservoirs, some of which may experience water level fluctuations exceeding 40 meters, we adjusted the threshold for certain reservoirs. In fact, we set a series of thresholds, such as 20, 30, 40, and 50 m, for each reservoir. We found that this parameter was not sensitive because the method used in the next step estimates along-track water level in the presence of outlying measurements (Nielsen et al. 2015).

References:

Liguang Jiang, Karina Nielsen, Ole Baltazar Andersen, Peter Bauer-Gottwein, CryoSat-2 radar altimetry for monitoring freshwater resources of China, Remote Sensing of Environment, 200, 2017, 125-139, https://doi.org/10.1016/j.rse.2017.08.015.

Nielsen, K., Stenseng, L., Andersen, O. B., Villadsen, H., and Knudsen, P.: Validation of CryoSat-2 SAR mode based lake levels, Remote Sens. Environ., 171, 162–170, https://doi.org/10.1016/j.rse.2015.10.023, 2015.

Line 165: I am confused about this statement. Is this “768 reservoirs” from this study? If so, please clarify it. If not, please cite reference to support it.

No, these reservoirs are from Spain, India, South Africa, and the USA, and the algorithm is validated using data from 768 reservoirs located in these four countries. We have revised the sentence as follows:

The algorithm has been applied to map water areas in 768 reservoirs of different sizes and climate zones located in Spain, India, South Africa, and the USA, and there is strong evidence to suggest that it performs well in this regard (Donchyts et al., 2022).

References:

Donchyts, G., Winsemius, H., Baart, F., Dahm, R., Schellekens, J., Gorelick, N., Iceland, C., and Schmeier, S.: High-resolution surface water dynamics in Earth's small and medium-sized reservoirs, Sci. Rep., 12, 13776, https://doi.org/10.1038/s41598-022-17074-6, 2022.

Line 243-244: Add reference or results to show the validation of delineation for the 1,398 catchments.

Yes, we added the reference below.

References:

Xie, J., Liu, X., Bai, P., and Liu, C.: Rapid watershed delineation using an automatic outlet relocation algorithm, Water Resour. Res., 58, e2021WR031129, https://doi.org/10.1029/2021WR031129, 2022.

Line 305-306: The authors explain the large errors occurs in 55 catchments are because the size of the catchments is small. But Figure 3d and f show the large errors also occur in large reservoirs. The spatial map is not very clear to show where the errors from. Consider plotting the comparison with the reference dataset using the scatter plot.

A scatter plot is added in our supplementary file. The explanations can be found below.

Main text: To compare Res-CN with GRanD and LakeATLAS, we spatially joined reservoir shapefiles from both datasets, matching reservoirs that overlapped for greater than 90% of their extent. Based on this subset of reservoirs, we found that catchment areas delineated in this study corresponded relatively well to catchment areas in both GRanD (CC = 0.999, n = 910) and LakeATLAS (CC = 0.910, n = 2147), which proves the reliability of our delineated catchments. Large discrepancies occur in 55 catchments, whose absolute relative error is greater than 100% (Fig. 3e, f). Small reservoirs located near confluences between rivers of different sizes are more likely to be affected by this issue, as a minor spatial mismatch can assign a reservoir to the small catchment of the tributary stream rather than the large catchment of the mainstream, and vice versa (Fig. S8). The differences in catchment delineation between these datasets result from differences in both DEM and methods for flow direction correction and depression filling and pour points correction. In this study, the widely verified MERIT Hydro flow directions are used, and we suggest that cautions should be taken when using catchments with large error discrepancies with LakeATLAS, which is based on the drainage direction grids of HydroSHED (Fig. S8a).

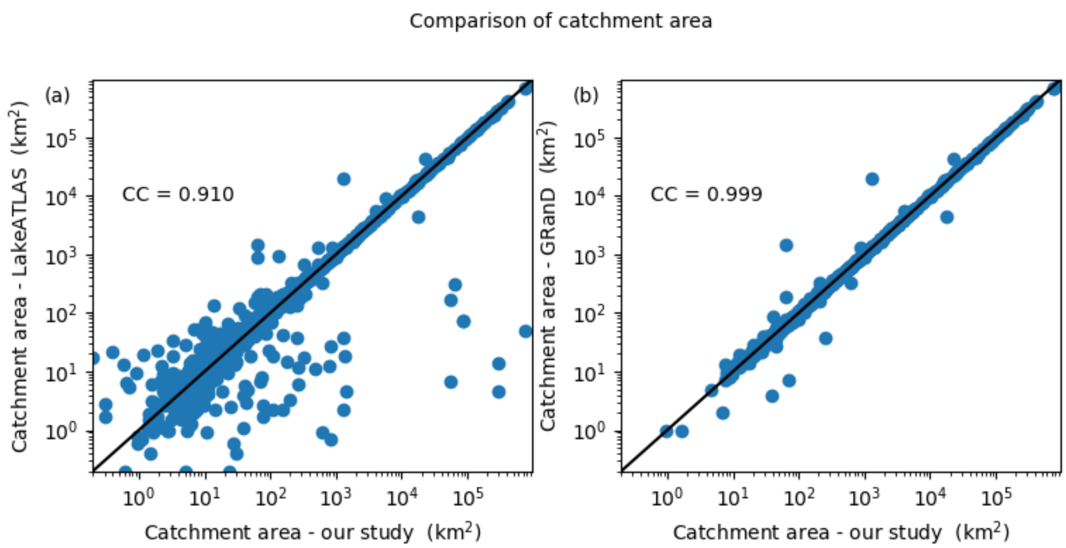

Figure S8. Comparison of the areas of delineated catchments in this study with those of LakeATLAS (Lehner et al., 2022), and those of GRanD reported value (Lehner et al., 2011).

References:

Lehner, B., Messager, M. L., Korver, M. C. and Linke, S.: Global hydro-environmental lake characteristics at high spatial resolution. Sci. Data, 9, 351, https://doi.org/10.1038/s41597-022-01425-z, 2022.

Lehner, B., Liermann, C. R., Revenga, C., Vörösmarty, C., Fekete, B., Crouzet, P., Döll, P., Endejan, M., Frenken, K., Magome, J., Nilsson, C., Robertson, J. C., Rödel, R., Sindorf, N., and Wisseret, D.: High-resolution mapping of the world's reservoirs and dams for sustainable river-flow management, Front. Ecol. Environ., 9, 494–502, https://doi.org/10.1890/100125, 2011.

Line 326-328: I am not sure if RMSE is a good metric to indicate error for the water level. The magnitude of water level varies with reservoir size. So, RMSE = 0.3m is considered as small error for a large reservoir, but it can be significant for a small reservoir. Since the time series of water levels are compared, some evaluation metric like NSE or KGE can provide more information about the evaluation.

I partially agree with your suggestions. The root mean square error (RMSE) is a common practice in satellite altimetry research, as evidenced by several references listed below. It is important to note that satellite altimetry measurements have a relatively coarse resolution, usually on a monthly or sub-monthly basis, which is why other metrics such as the Nash-Sutcliffe efficiency (NSE) or Kling-Gupta efficiency (KGE) are seldom used in this field. Nonetheless, we provide users with both the correlation coefficient (CC) value and time series of PDF figures for each reservoir to consider.

References:

Gao, H., Birkett, C., and Lettenmaier, D. P.: Global monitoring of large reservoir storage from satellite remote sensing, Water Resour. Res., 48, W09504, https://doi.org/10.1029/2012WR012063, 2012.

Jiang, L., Nielsen, K., Dinardo, S., Andersen, O. B., and Bauer-Gottwein, P.: Evaluation of Sentinel-3 SRAL SAR altimetry over Chinese rivers, Remote Sens. Environ., 237, 111546, https://doi.org/10.1016/j.rse.2019.111546, 2020.

Tourian, M. J., Elmi, O., Shafaghi, Y., Behnia, S., Saemian, P., Schlesinger, R., and Sneeuw, N.: HydroSat: geometric quantities of the global water cycle from geodetic satellites, Earth Syst. Sci. Data, 14, 2463–2486, https://doi.org/10.5194/essd-14-2463-2022, 2022.

Vu, D. T., Dang, T. D., Galelli, S., and Hossain, F.: Satellite observations reveal 13 years of reservoir filling strategies, operating rules, and hydrological alterations in the Upper Mekong River basin, Hydrol. Earth Syst. Sci., 26, 2345–2364, https://doi.org/10.5194/hess-26-2345-2022, 2022.

Line 330: There is no Fig. S7 in supplementary materials.

Sorry for this. It should be Fig. S1.

Line 335: There is no Fig. S8 in supplementary materials.

Sorry for this. It should be Fig. S2.

Line 372-373: Fig.6a and b plot the water areas comparisons from all the reservoirs and months, then what does the median CC mean? Did you also estimate the CC for each reservoir? Please clarify what does the median CC mean. Also, it is critical to show the evaluation at site level to demonstrate the accuracy of Res-CN.

Hope the R1C1 reponse addressed your concern. The validation figures for all 138 reservoirs can be found in the "validation_figures" folder. We hope that the inclusion of these validation figures will facilitate the use of our Res-CN dataset.

For each reservoir, we calculate the correlation coefficient (CC) value and determine the median value of all the CC values. Therefore, the median CC refers to the median of these individual CC values.

Line 384: NRMSE, CC and RMSE have median values of 21%,0.53, and 0.03 km^3, respectively.

Changed as suggested. Thank you very much.

Line 391: Please specify the number of available reservoirs when using the water areas and water levels to derive the storage variations. Are they the same reservoirs that used the DEM’s area-storage model?

We have added this information in the sentence:

To solve this problem, we provide another type of storage variation estimates for 335 reservoirs using satellite water areas and water levels (see section 2.3, Shen et al., 2022b).

Yes, they are the same reservoirs as all reservoirs have the storage variation estimates that used the DEM's area-storage model.

Line 412: Please clarify this sentence:" Long-term mean meteorological variables calculated the evaporation rates are available in Fig.S9."

The figure should be Fig. S3. We have added this information in the sentence:

Long-term mean meteorological variables that were used to calculate the evaporation rates are depicted in Fig. S3.

Line 424: Consider changing the colormap for Figure 8b, because the map doesn't show any variation of water areas (e.g., only blue shows up).

We have replotted this figure as follows.

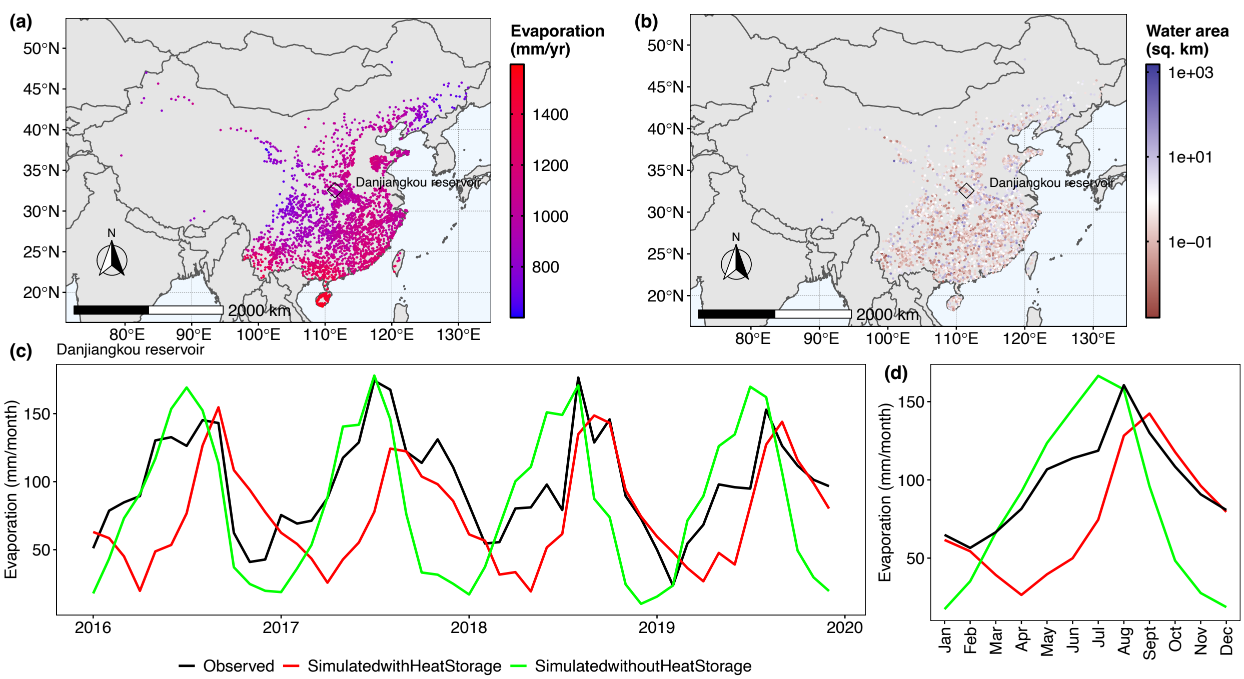

Figure 8. Validation of reconstructed monthly reservoir evaporation values. (a and b) Long-term mean evaporation rates and water areas during 1984-2020. (c) Comparison between constructed monthly reservoir evaporation and observed pan evaporation values at the Danjiangkou reservoir. (d) Seasonal cycle.

Line 533: Were machine learning methods used in this study to derive the soil properties at different depths? If so, please specify what algorithm was used and how it was applied in this study. If machine learning methods were used in existing dataset to derive the soil properties, please clarify it.

Yes, we just used the existing dataset that are based on the machining learning methods. Sorry for the confusion and we have clarified the sentences as follows.

The SoilGrids250 dataset predicted soil properties at six different soil layers (i.e., 0-0.05m, 0.05-0.15m, 0.15-0.3m, 0.3-0.6m, 0.6-1m, and 1-2m) using machine learning techniques, utilizing data from approximately 150,000 soil profiles and 158 environmental covariates derived from remote sensing data on a global scale.

Line 593: “Earth”.

Changed as suggested.