Physical Oceanography Distributed Active Archive Center (PO.DAAC)

G-REALM (Global Reservoirs and Lakes Monitoring) Time Series Data Set - Water Height (MEaSUREs Project)

November 8, 2019

User's Handbook
Version 2.0

Land Surface Hydrology Research Group
University of California Los Angeles, Department of Geography

Dennis P. Lettenmaier (dlettenm@ucla.edu)
Nina Noudjina (nnoujdina@ucla.edu)
Riccardo Tortini (rtortini@ucla.edu)
Samantha Yeo (samyeo@ucla.edu)

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1. Introduction

The purpose of the G-REALM (Global Reservoirs and Lakes Monitoring) Time Series Data Set dataset is to provide surface water height measurements for several hundred lakes and reservoirs across the globe. These time series potentially span a 25 year time period, from late 1992 to 2018, satisfying the project goal of long-term trend analysis and global water dynamics models. This dataset primarily uses G-REALM10, which merges T/P, Jason-1, Jason-2, and Jason-3 time series of relative water surface elevation (WSE) variations with respect to a given Jason-2 reference cycle at 10-day intervals (Birkett, 1995; Birkett and Beckley, 2010; Birkett et al., 2011). Whenever 10-day measurements are not available G-REALM35 is created using the ENVISAT time series of relative water level variations, for which the mean level of ENVISAT retrievals at 35-day intervals is the reference.

A more detailed description of the methods used can be found in Birkett (1995), Birkett and Beckley (2010), and Birkett et al. (2011), whereas Ricko et al. (2012) performed both absolute and relative validations between all the available product types.

2. Methodology

2.1 Lake Locations

We defined the initial spatial extents of water bodies using the vector polygons available as part of the Global Reservoir and Dam database (GRanD; Lehner et al., 2011) and Global Lakes and Wetlands Database (GLWD; Lehner and Döll, 2004), with quality checks ensured by visual comparison with high resolution satellite imagery (i.e., Google Earth, ESRI World Map) and Global Surface Water Explorer (Pekel et al., 2016). Whenever we identified a mismatch (i.e., polygon spatial extent not overlapping properly with the satellite imagery due to inaccurate georeferencing), the polygon was edited to match the expected location. In case a lake was not available as part of either database, a polygon was drawn by hand using high resolution imagery from various sources (e.g., Google Earth, ESRI World Map). Once correctly identified, these locations were used to construct a mask for altimetry data extraction.

2.2 Data Extraction from Altimetry

ΔV monitoring of inland water bodies at the global scale has proved a challenging task (*cfr.* Gao, 2015; Crétaux et al., 2016), and the use of a single WSE data source significantly limits the creation of global ΔV data set. For these reasons, we used G-REALM10 as our primary elevation source for the creation of our global ΔV data set, and supplemented it with DAHITI (Schwatke et al., 2015), LEGOS's HydroWeb data (Crétaux et al., 2011), and G-REALM35 (in this order) whenever G-REALM10 was not available for a specific target. As a result of the altimeter data being a combination of G-REALM, LEGOS's HydroWeb data, and DAHITI, calculating a nominal temporal resolution was a challenge and therefore is dependent upon which data source was used.

2.3 Ice Cover Assessment

WSE accuracy is highly affected by the presence of ice, and for practical purposes, reliable ΔV estimates can only be produced for ice free conditions. We assessed ice-on conditions (i.e., presence of snow-covered ice on the surface of a water body) using the MODIS/Terra Snow Cover Daily Global product (Collection 5 MOD10A1). For each elevation record, we estimated lake ice phenology (i.e., ice-on and

ice-off dates, defined as the beginning and end of the freezing period) as the proportion of frozen pixels identified in the NDSI-based 500 m spatial resolution "Snow_Cover_Daily_Tile" band (Hall et al., 2007), and we determined a threshold for each water body as half of the maximum surface area. This algorithm uses the basic assumption that a water body, when deep and clear, absorbs the solar radiation incident upon it in almost its entirety. Whenever ice was identified, we created a flag that is provided as part of the *ΔV* records. Water bodies with high turbidity, algal blooms, or other conditions of relatively high reflectance from the water (e.g., salt crust) may be erroneously detected as snow/ice covered; in these cases the ice flag is manually removed from data. Data gaps within the freezing period were classified as ice-on for continuity purposes. Additionally, observations during polar darkness were excluded for lack of complete data and assumed ice-on.

3. Data Packaging and Variable Identification

3.1 Sample Surface Area Data (NetCDF format)

Format: netcdf4
Title = '[continent]_[name]_HeightV2_[id].nc'
Example: 'South_America_AguaVermelha_WaterAreaV2_448.nc'

3.2 Variables

variable	dimension	datatype	units	long_name
surface_water_height	time	double	m	surface_water_height_time_series
altimeter_source	time	double	1	altimeter_source_flag
ice_flag	time	double	1	ice_flag
outlier_flag	time	double	1	outlier_flag

3.3 Dimensions

dimension	axis	datatype	units	long_name
time	T	double	days since 1900-01-01T00:00:00	time

3.4 Global Attributes

attribute	comment	example
title	Title for the data in the file	Global Lake/Reservoir Surface Water Height Time Series Data for Lake Agua Vermelha
summary	Summary or abstract for the data in the file	The Global Lake/Reservoir Surface Water Height Time Series is derived from the G-REALM10 lake level product. http://dahiti.dgfi.tum.de/en/. The purpose of this dataset is to provide surface water dynamics for several hundred lakes and

		reservoirs across the globe. These time series potentially span a 26 year time period, from late 1992 to 2018, satisfying the project goal of ESDR creation with a suitable level of quality that supports long-term trend analysis and global water dynamics models. Water level variation is also a key component required for the determination of surface water storages and fluxes. This product is readily accessible and is of direct use to both water managers and the scientific community worldwide, and allows for improved assessment and modeling of the human impact on the global water cycle
keywords	A comma separated list of keywords	TERRESTRIAL HYDROSPHERE, SURFACE WATER PROCESSES/MEASUREMENTS, LAKES/RESERVOIRS, ALTIMETERS, POSEIDON-2, POSEIDON-3, POSEIDON-3b, Jason-class Altimeter, ALT (TOPEX), MEaSUREs
conventions	A comma separated list of conventions	CF-1.6, ACDD-1.3, ISO 8601
doi	Digital object identifier	10.5067/UCLRS-GREV2
uuid	Unique identifier for data set	eee37a41-bc1a-4f36-a741-ddc7931e68ad
history	An audit trail for modifications to the original data	Continuing efforts have been made to improve the quality of lake/reservoir height estimations from previous versions including: identification of which of the lakes/reservoirs undergo winter freezing, identification of data outliers, modeled data, and altimetry source, and focus on extending the 10-day resolution products
source	The method of production of the original data	MEaSUREs UCLA toolbox 2018
processing_level	Description of the processing or quality control level of the data	L2
comment	Useful additional information	Reservoir and lake water elevations were estimated using satellite altimeter-based data. TOPEX/Poseidon and Jason-2 were generally preferential to Jason-1 and Jason-3, however the data was assessed on a case-by-case basis based on the quality of available data
standard_name_vocabulary	CF standard name vocabulary	CF Standard Name Table v27
product_version	Version identifier of the data file or product as assigned by the data creator.	Version 2.0
date_created	Creation date of this version of the data (netCDF)	2019-01-11T01:52:00 AM
creator_name	Name of the person (or creator type) principally responsible for creating this data	MEaSUREs Team (Lettenmaier D., Noujdina N., Tortini R., Yeo S.)
creator_email	Email address of the person (or creator type) principally responsible for creating this data	dlettenm@ucla.edu (Lettenmaier D.), nnoujdina@ucla.edu (Noujdina N.), rtortini@ucla.edu (Tortini R.), samyeo@ucla.edu (Yeo S.)
creator_type	Specifies type of creator	Group
institution	Name of the institution primarily responsible for originating this data	University of California Los Angeles, Department of Geography
creator_institution	The institution of the creator	Land Surface Hydrology Research Group, UCLA

creator_url	The URL of the of the entity principally responsible for creating this data.	http://hydro.ucla.edu/
project		MEaSUREs (Making Earth System Data Records for Use in Research Environments)
program	The overarching program(s) of which the dataset is a part.	NASA Earth Science Data Systems (ESDS)
publisher_name	The name of the entity responsible for publishing the data file or product to users.	PO.DAAC (Physical Oceanography Distributed Active Archive Center)
publisher_email	The email address of the entity responsible for publishing the data file or product to users.	podaac@podaac.jpl.nasa.gov
publisher_url	The URL of the entity responsible for publishing the data file or product to user.	podaac.jpl.nasa.gov
publisher_type	Specifies type of publisher	Institution
publisher_institution	The institution that presented the data file or equivalent product to users.	PO.DAAC
geospatial_lat_min	Describes a simple lower latitude limit	-20.2186955829839
geospatial_lat_max	Describes a simple upper latitude limit	-19.656195845917
geospatial_lon_min	Describes a simple lower longitude limit	-50.3662515859588
geospatial_lon_max	Describes a simple upper longitude limit	-49.1362437634452
geospatial_lat_units	Units for the latitude axis	degrees_north
geospatial_lon_units	Units for the longitude axis	degrees_east
time_coverage_start	Describes the time of the first data point in the data set	2000-02-18T00:00:00
time_coverage_end	Describes the time of the last data point in the data set	2016-10-15T00:00:00
keywords_vocabulary	Identifies the controlled keyword vocabulary used to specify the values within the attribute "keywords"	Global Change Master Directory (GCMD)
platform	Name of the platform(s) that supported the sensor data used to create this data set or product	TOPEX/Poseidon, Jason-1, Jason-2, Jason-3
platform_vocabulary	Controlled vocabulary for the names used in the "platform" attribute	NASA/GCMD Platform Keywords. Version 8.6
instrument	Name of the contributing instrument(s) or sensor(s) used to create this data set or product	TOPEX, Poseidon-2, Poseidon-3, Poseidon-3b

instrument_vocabulary	Controlled vocabulary for the names used in the "instrument" attribute	NASA/GCMD Instrument Keywords. Version 8.6
cdm_data_type	The data type	Station
references	Published or web-based references that describe the data or methods used to produce it	Birkett et al. (2009), From Research to Operations: The USDA Global Reservoir and Lake Monitor, chapter 2 in Coastal Altimetry, Springer Publications, eds. S. Vignudelli, A.G. Kostianoy, P. Cipollini and J. Benveniste, ISBN 978-3-642-12795-3, 2010

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Appendix I: Coverage

Africa (n = 48)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
1431	Sterkfontein	-28.41	29.01	✓			
1439	Shiroro	10.2438	7.162	✓			
81	Chiuta	-14.2645	36.0338	✓		✓	
82	Rukwa	-7.3104	32.9448	✓			
91	Naivasha	-0.6062	36.5082	✓			
93	Turkana	4.7355	36.8737	✓			
314	Owen Falls	0.573	34.9496	✓			
315	Tanganyika	-3.2562	30.977	✓			
317	Malawi	-9.4104	34.8037	✓			
331	Nasser	24.0563	33.6861	✓			
393	Volta	8.9271	0.4069	✓			
394	Kariba	-16.3812	29.0999	✓			
398	Kyoga	2.0063	33.5809	✓			
402	Tana	12.3855	37.7429	✓			
414	Cahora Bassa	-15.4229	32.7652	✓		✓	
416	Mweru	-8.3979	29.2152	✓			
417	Kainji	11.2813	4.8456	✓			
553	Mai-Ndombe	-1.4562	18.7205			✓	
554	Tumba	-0.5145	18.2694			✓	
1499	Lagdo	9.1396	14.1736			✓	
1432	Cyohoha-sud	-2.252	30.2545			✓	✓
4	Edward	-0.002	29.9895		✓	✓	
11	Bangweulu	-10.777	30.1165		✓	✓	
69	Kivu	-1.5062	29.4497		✓	✓	
403	Er Rosieres	11.8855	34.815		✓		
405	Albert	2.4271	31.5219		✓	✓	

535	Selingue	11.748	-7.9478			✓	
543	Yardi	10.3521	40.6427			✓	
574	Massinger Barragen	-23.7437	32.2028			✓	
1471	Buyo	6.9313	-6.8271		✓	✓	
66	Iro	10.2521	19.5686				✓
74	Kisale	-8.0687	26.6702				✓
76	Sibayi	-27.1895	32.7688				✓
88	Nakuwa	1.3813	33.5867				✓
99	Shala	7.6188	38.7314				✓
542	Tiga	11.5521	8.7416				✓
546	Kossou	8.2146	-5.2729				✓
564	Mweru Wantipa	-8.3479	30.3064				✓
580	Vaaldam	-26.727	28.5339				✓
73	Upemba	-8.427	26.6438				✓
1547	ItezhiTezhi	-15.88	26.125				✓
1437	JebelAulia	15.125	32.375				✓
85	Eyasi	-3.58	35.17				✓
97	Abaya	6.45	37.88				✓
79	Chilwa	-15.33	35.72				✓
67	Fitri	12.77	17.52				✓
87	Ihema	-1.88	30.78				✓
60	Qarun	29.45	30.62			✓	✓
Total:				**17**	**6**	**15**	**19**

Asia (n = 119)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
177	Orba	34.6854	81.3708	✓			
285	Ngoring	35.1646	98.4172	✓			
434	Vilyui	63.6146	117.9894	✓			
1534	Mosul	37.0646	43.3163	✓		✓	
121	Pangong	34.0646	79.4068	✓			

189	Dogai Coring	34.7563	89.5702	✓	✓		
433	Ust Ilim	58.0813	107.0634	✓			
479	Kayrakkum	40.5021	70.636	✓			
519	Gandhi Sagar	24.7813	75.973	✓		✓	
583	Bratskoye	56.4688	115.7805	✓			
610	Sarykamyshskoye	42.4521	58.6535	✓			
612	Toktogulskoye	41.9354	73.4278		✓		
615	Zaysan	49.8354	88.5516	✓		✓	
625	Tarbela	34.6896	73.5711	✓			
652	Zhelin	29.4313	115.8485	✓			
166	Dogen	31.8979	91.5179	✓			
152	Cha-jih nan-mu-tso	31.1646	86.3075		✓		
156	Ang-tzu	31.2313	87.6402	✓	✓		
424	Aydar Kol	41.1979	68.4689	✓		✓	
425	Krasnoyarskoye	56.0229	96.9641	✓	✓		
459	Sayano Shushenskaya	52.9271	96.0847	✓			
958	Vallabhsagar	21.598	74.2393				✓
1378	Novosibirskoye	54.9313	83.9157	✓	✓		
1450	Karakaya	38.8896	39.6052	✓			✓
1533	Fengman	43.8688	129.1821	✓		✓	
1619	Three Gorges	31.2188	111.5656	✓			
1723	Bansagar	24.3355	81.4927	✓			
1947	Boguchany	59.0813	106.0961	✓			
1986	Ertan	27.4521	102.4508	✓			
4033	Zhexi	28.4146	112.1269	✓			
972	Lam Pao	17.0563	103.8661	✓			✓
1500	Srisailam	16.423	79.1174	✓			
2282	Xiaolangdi	35.2146	112.8699	✓			
4034	Tehri	30.7021	78.9614	✓			
111	Ercek	38.8188	43.8494	✓			
3849	Jabbul (1)	36.1771	37.7308	✓			
107	Beysehir	38.0604	31.987	✓			

115	Urmia (1)	37.9063	46.4105	✓			
141	La-ang	30.9271	81.5995	✓			
209	Ulungar	47.5063	88.1771	✓	✓		
224	Khanka	45.4271	134.6891	✓			
232	Chany	55.1521	78.9981	✓			
234	Sasykkol	46.7896	81.7687	✓			
238	Zhalauly	53.0688	74.8271	✓			
269	Buhayrat ath Tharthar	34.6313	44.2503	✓			
275	Kara-Bogaz-Gol	42.2979	56.1662	✓			
277	Aral (2)	46.1354	61.7252	✓			
278	Balkhash	46.9188	79.861	✓			
316	Baikal	55.9479	117.3288	✓			
319	Boeng Tonle Chhma	13.3396	105.1129	✓			✓
338	Issyk-kul	42.8479	78.7598	✓			
343	Sanhezha	33.7188	119.7066	✓	✓		
347	Bosten	42.3104	88.2201	✓		✓	
353	Zeyaskoye	54.8396	130.9002	✓			
372	Dorgon	47.9688	94.3594	✓			
385	Hulun	49.4729	119.4808	✓			
411	Har Nuur	48.3354	94.2275	✓			
413	Hovs Gol	51.6938	103.097	✓			
431	Kapchagayskoye	44.0271	78.7104	✓	✓		
449	Gaoyou	33.1896	120.5118	✓			
460	Chardarinskoye	41.3313	68.9973	✓			
587	Chukchagirskoye	52.1979	137.6264	✓			
1442	Aral (3)	46.8896	62.1853	✓			
963	Nagarjuna Sagar	16.748	79.5296			✓	
1454	Ust Khantaika	68.5646	92.049			✓	
2311	Farakka	25.5729	88.5934			✓	
828	Khantayskoye	68.6063	93.4763			✓	
140	Ma-pang yung-tso	30.8688	81.8556		✓		
146	Ta-jo	31.2938	84.5629		✓		

155	Tang-je yung-tso	31.4521	87.2356		✓		
163	Na-Mu	31.0146	91.3248		✓		
179	Lumajangdong	34.2063	82.1347		✓		
185	Dagze	31.8854	88.4336		✓		
205	Ayakkum	37.7188	90.4286		✓		
388	Razazza	33.1979	44.289		✓		
112	Van	39.0813	43.8457		✓		
158	Se-lin	32.0938	89.7462		✓		
201	Qinghai	37.3146	101.8117		✓		
217	Hyargas	49.4229	94.5116		✓	✓	
218	Uvs	50.7646	94.5408			✓	
260	Sevan	40.7104	46.0824			✓	
527	Bahrat Assad	36.8729	39.1707			✓	
653	Poyang	29.8313	117.8369		✓		
661	Tai (1)	31.6229	121.3739			✓	
1438	Ataturk	38.2771	39.4971			✓	
1457	Qadisiyah	34.4938	42.6808		✓		
110	Tuz	39.0521	33.8049				✓
226	Barun-Torey	50.3146	116.735				✓
575	Markakol	48.9188	86.3953				✓
609	Mingechaurskoye	41.1313	47.4831				✓
628	Beas	32.1896	76.5719				✓
632	Han Shui	32.9188	112.0609				✓
639	Kasumiga-ura	36.2438	141.1199				✓
645	Govind Ballabah Pant	24.2855	83.2114				✓
646	Indawngy	25.3438	96.6544				✓
959	Ujjani	18.4646	75.4398				✓
968	Bhumphol K. K. Nam	18.098	99.5302				✓
969	Sirikit	18.2688	100.9616				✓
970	Nam Ngum	18.8771	103.1851				✓
977	Srinagarind	15.1313	99.5448				✓
1005	Senanayake Samudra	7.348	81.6475				✓

387	Habbaniyah	33.4563	43.7812				✓
525	Keban Baraji	39.2563	40.0483				✓
526	Dukan	36.2771	45.2786				✓
1577	Karkheh	32.7104	48.3536				✓
1597	Batman Baraji	38.3479	41.4218				✓
2314	Dez	32.8563	48.8496				✓
2319	Adhaim	34.8604	44.8201				✓
2328	Hammar (1)	31.0354	47.4436				✓
2329	Hammar (2)	31.5188	47.5896				✓
496	Tungabhadra	15.375	76.375				✓
787	Kureiskaya	66.875	88.375				✓
1478	ThaleLuang	7.67	100.23				✓
1568	Wuqiangxi	28.875	110.88				✓
1712	Almatti	16.375	75.875				✓
4286	Baishan	42.625	127.13				✓
2280	Thaphanseik	23.375	95.375				✓
2315	Geheyan	30.375	111.13				✓
1976	Dongjiang	25.875	113.375			✓	
Total:				**60**	**23**	**17**	**36**

Europe (n = 31)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
435	Vygozero	63.9604	36.4707	✓			
505	Paijanne	62.3229	26.8618	✓			
600	Tshchikskoye	45.2563	39.7791	✓		✓	
953	Beloye	60.4063	38.6041	✓			
592	Tsimlyanskoye	48.7146	44.0182	✓			
809	Votkinskoye	58.1854	57.259	✓			
810	Kama	59.5271	59.9408	✓			
1000	Sheksna	59.9979	39.6015	✓			
1341	Gorky	58.1813	45.39	✓			

1376	Kuybyshevskoye	56.2438	53.1985	✓			
1377	Volgograd	52.1646	48.5174	✓			
1462	Saratov Reservoir	53.5563	50.688		✓		
1618	Nizhne Kamskaya	56.9229	55.4761	✓			
590	Krasnooskolskoye	49.6354	38.0317	✓			✓
873	Kakhovskoye	47.9521	35.7501	✓			
397	Saimmaa	62.7104	30.7667	✓			
22	Onega	62.9938	38.846	✓			
26	Vanern	59.4979	14.4437	✓			
221	Peipus	59.0938	29.4022	✓			
223	Rybinskoye	59.3104	40.5369	✓			
340	Ijsselmeer	53.1604	5.8825	✓			
396	Ladoga	61.8646	34.5352	✓			
502	Sivash	46.3729	35.6389	✓			
503	Kremenshugskoye	49.8521	33.9044	✓			
520	Kiyevskoye	51.3021	31.1325	✓			
851	Konstanz	47.8979	9.9403			✓	
1451	Cheboksary	56.7521	48.3837			✓	
956	IlMen	58.5396	32.2572		✓		
601	Kiziltashskiy	45.2646	37.4111				✓
277	Inarinjarvi	69	28				✓
342	Kubenskoye	59.75	39.5				✓
Total:				**24**	**2**	**3**	**4**

North America (n = 113)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
118	Nettiling	67.1146	-70.5805	✓			
222	Nipigon	50.3729	-88.3621	✓			
236	Reindeer	58.2813	-101.2959	✓			
244	Dubawnt	63.7188	-100.9961	✓		✓	
252	Cedar	53.7229	-100.1052	✓			

264	Amadjuak	65.5104	-71.7234	✓			
348	Athabasca	59.7021	-107.1739	✓			
408	Baker	64.3979	-94.9828	✓			
410	Southern Indian	57.7854	-98.283	✓			
412	Martre	63.6688	-118.1587	✓			
420	Great Slave	63.4396	-111.1554	✓			
421	Great Bear	67.1229	-119.6073	✓			
423	Wollaston	59.0021	-103.0125	✓			
436	Becharof	58.1813	-156.821	✓			
440	Aberdeen	64.8229	-98.0559	✓			
443	Napaktuluk	66.6396	-113.1058	✓		✓	
498	Mallery	64.1979	-98.4127	✓		✓	
254	Smallwood	54.7729	-63.6503	✓			
258	Iliama	59.8896	-154.1816	✓			
409	Yathkyed	63.0604	-97.7403	✓			
429	Kasba	60.7479	-102.3265	✓		✓	
453	Toledo Bend	32.0646	-93.9559	✓			✓
470	Gods	54.9396	-93.8488	✓			
706	Falcon	27.0979	-99.2793	✓			✓
341	Angostura	16.4813	-92.2725	✓			✓
441	Claire	58.9521	-112.1942	✓		✓	
442	Nueltin	61.0146	-98.7827	✓			
475	Tehek	65.1688	-95.4537	✓		✓	
484	Dore	55.0021	-107.4129	✓		✓	
504	Manicouagan	52.1771	-68.5824	✓			
512	Ear Falls	50.7979	-91.5629	✓			
678	Bear (2)	42.2646	-111.3416				✓
682	Fort Peck	48.1021	-106.4027	✓			✓
684	Sakakawea	48.2563	-102.1422	✓			✓
1025	Hardish	64.8646	-117.7189	✓		✓	
1031	Aylmer	64.4979	-108.5886	✓	✓		
1053	Schultz	65.0021	-97.3425	✓		✓	

1081	Keller	64.1646	-121.7386	✓			
1118	Ford	63.7396	-97.1247	✓		✓	
1121	Carey	62.3938	-102.9771	✓			
1155	Williston	56.9938	-124.974	✓	✓		
1238	Low	52.9188	-75.9915		✓		
1240	Grande (1)	54.3396	-75.8997	✓			
1241	La Grande (3)	54.0896	-73.7722	✓	✓		
1302	Champlain	45.1771	-73.1144	✓	✓		
1418	Hugh Keenleyside	51.1313	-118.283	✓			
1465	Oahe	47.5729	-101.463	✓	✓		
1469	Baird Inlet	61.0813	-163.9246	✓			
1490	La Grande (4)	54.2813	-72.7732	✓			
1493	Grand Coulee	48.8979	-118.0436	✓			
1516	Mica	52.8646	-119.2472	✓			
1604	Bagnell	38.4063	-92.7713	✓			
669	Libby	49.5521	-115.532	✓			
12	Winnipeg	53.9521	-98.2684	✓			
21	Windsor	21.1313	-73.4673	✓			
42	Manitoba	51.8813	-99.1055	✓			
203	Winnipegosis	53.2688	-100.3346	✓			
266	Woods	49.9979	-94.6067	✓			
333	Erie	43.1854	-78.9427	✓			
334	Ontario	44.5729	-75.7959	✓			
335	Michigan	46.1896	-85.1572	✓			
336	Huron	46.6354	-81.6874	✓			
337	Superior	49.1021	-86.6697	✓			
351	Nicaragua	12.2021	-84.9974	✓			
368	Salton Sea	33.6104	-115.9239	✓			
454	Lesser Slave	55.6563	-115.2274	✓		✓	
462	Powell	37.9979	-110.3725	✓		✓	
480	Winnebago	44.2896	-88.3574	✓			
486	Yellowstone	44.6479	-110.3721	✓			

509	St. Jean	48.9729	-72.0422	✓		✓	
1161	Primrose	55.1104	-109.6926	✓			
1168	Diefenbaker	51.3604	-106.9028	✓			✓
1285	Dale Hollow	36.7521	-85.1944	✓			
506	St. Claire	42.7771	-82.6549			✓	
1009	Teshekpuk	70.8146	-153.9936			✓	
1017	Colville	67.4271	-125.9525			✓	
1019	Maunoir	67.6646	-125.1281			✓	
1111	Kamilukuak	62.6021	-101.8155			✓	
1112	Nowleye	62.5229	-101.1024			✓	
1115	Tebesjuak	64.0063	-98.9539			✓	
721	Izabal	15.8771	-88.7721		✓		
1247	Caniapiscau	54.9979	-69.0915		✓		
19	Great Salt	41.8313	-112.5027			✓	
350	Managua	12.5855	-86.1001		✓	✓	
461	Mead	36.7938	-114.2639		✓	✓	
671	Flathead	48.1688	-114.2003			✓	
715	Chapala	20.4146	-102.6981			✓	
716	Infiernillo	19.0021	-101.5087			✓	✓
720	Malpaso	17.3063	-93.1919		✓	✓	
1297	Okeechobee	27.2813	-80.7041			✓	
14	Eagle (2)	40.8104	-120.7403				✓
28	Peten Itza	17.098	-89.6563				✓
293	Adjuntas	24.148	-98.6972				✓
312	Walker (2)	38.8979	-118.7818				✓
665	Clear (2)	42.0063	-121.1274				✓
701	Alvara Obregon	28.2188	-109.859				✓
717	Miguel Aleman	18.498	-96.4344				✓
1261	Livingston	31.0688	-95.1956				✓
1287	Hartwell	34.8729	-82.8461				✓
1289	Clark Hill	34.1063	-82.395				✓
1290	Murray (2)	34.2438	-81.2642				✓

1291	Marion	33.7604	-80.2769				✓
468	Eufaula	35.5896	-95.5452			✓	
680	Flaming Gorge	41.5563	-109.4224				✓
1164	Montreal	54.6813	-105.7191				✓
1273	Denison	34.1688	-96.5364				✓
1278	Bull Shoals	36.7938	-92.7177				✓
1279	Table Rock	36.8854	-93.5113			✓	
1495	Kentucky	37.0979	-88.2355				✓
1602	Harry Truman	38.4896	-93.5013			✓	
1603	Blakely Mountain	34.7729	-93.2153				✓
1861	Norris	36.5313	-83.6075			✓	✓
1905	Hungry Horse	48.4229	-113.9917				✓
Total:				**71**	**11**	**32**	**28**

South America (n = 53)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
448	Agua Vermelha	-19.6562	-48.915	✓			
51	Poopo	-18.1145	-66.3752		✓		
345	Sobradino	-8.8937	-40.645	✓		✓	
744	Todos los Santos	-40.9687	-71.7789	✓			
754	Viedma	-49.3103	-71.2179	✓		✓	
794	Iepe	-22.4937	-50.2636	✓			✓
439	Colhue Huapi	-45.1729	-67.8664	✓	✓		
753	Argentino	-49.8853	-71.2413	✓			
798	Promissao	-21.0229	-48.6576	✓			✓
1422	Itumbiara	-17.9062	-47.7571	✓			
1479	Sao Simao	-18.2645	-49.3466	✓			
1551	Salto Caxias	-25.3104	-52.8182	✓			
1554	Mascarenhas de Moraes	-20.1437	-46.0879	✓			
1621	Represa Nova Ponte	-18.9645	-46.7788	✓			
1778	Balbina	-0.9354	-59.185	✓	✓		

1419	Emborcacao	-18.1062	-47.3642	✓			✓
1617	La Vueltosa	8.0271	-71.2039	✓			
53	Mangueira	-32.702	-52.3352	✓			
344	Chiquita	-30.0229	-61.5959	✓			
432	Guri	7.9438	-62.4598	✓			
501	Itaipu	-23.9479	-53.5266	✓			
741	Musters	-45.1395	-68.5178			✓	
748	Ranco	-40.0395	-71.82			✓	
1420	Represa de Furnas	-20.4229	-44.9839			✓	
1460	Serra da Mesa	-13.6895	-47.8961			✓	
1548	Tres Irmaos	-20.5187	-49.9147			✓	
1669	Cupari	-2.127	-54.6148			✓	
1670	Xingu	-1.552	-51.5127			✓	
1546	Itaparica	-8.4395	-38.0685			✓	
1589	Iguazu	-24.9104	-54.6395		✓		
37	Buenos Aires	-46.2062	-70.5709		✓	✓	
318	Titicaca	-15.1604	-68.11			✓	
463	Repressa Tres Marias	-18.1104	-44.621		✓		✓
745	Lianquihui	-40.877	-72.0707		✓	✓	
783	Taciula	-4.3604	-60.3852			✓	✓
785	Tucurui	-3.6395	-49.0803		✓	✓	
793	Repressa de Jupia	-18.9395	-50.0008		✓	✓	
726	De Betania	2.7938	-75.3417				✓
732	Rinihue	-39.6895	-71.8336				✓
776	Amana	-2.2687	-64.29				✓
777	Coari	-3.9145	-63.0451				✓
779	Aiapua	-4.277	-61.9664				✓
780	Piorini	-3.2687	-62.9212				✓
796	Barra Bonita	-23.0687	-48.361				✓
802	Juparana	-19.0854	-39.9259				✓
808	Rincon-Bonete	-32.3187	-55.2483				✓
1393	Poco da Cruz	-8.2854	-37.4977				✓

43	Cardiel	-48.7228	-70.6159				✓
773	Brokopondo	5.0896	-54.7053				✓
2309	RepresaDeSamuel	-8.625	-63.375			✓	
346	NahuelHuapi	-45.58	-68.8		✓		
1824	Yacyreta	-27.38	-56.63			✓	
1765	FuroSantaMaria	-1.82	-50.1			✓	
Total:				**20**	**10**	**19**	**17**

Oceania and Pacific (n = 8)

ID	Name	Lat	Lon	GRLM10	LEGOS	DAHITI	GRLM35
1440	Alexandrina	-35.227	139.2733	✓			
1470	Eildon	-36.927	145.8876	✓			
755	Argyle	-15.9895	129.0357			✓	✓
763	Eucumbene	-35.8604	148.5726				✓
1413	George (4)	-34.9145	149.3558				✓
762	Hume	-35.8437	147.3695				✓
998	Murray (1)	-6.602	141.6202				✓
511	Taupo	-38.577	175.8906	✓		✓	
Total:				**3**	**0**	**2**	**5**

Appendix II: Notes and Errors Documentation

Lake ID	Lake Name	Error Type	Notes
2327	Aral (1)	Deleted	Waterbody removed from Version 2
270	Caspian	Deleted	Waterbody removed from Version 2
68	Chad	Deleted	Waterbody removed from Version 2
320	Eyre	Deleted	Waterbody removed from Version 2
415	Kafue	Deleted	Waterbody removed from Version 2
1286	Wolf Creek	Deleted	Waterbody removed from Version 2
332	Torrens	Deleted	Waterbody removed from Version 2
406	Kwania	Deleted	Merged with Kyoga (ID 398)

Appendix III: Acronyms

CF: Climate and Forecast
DAHITI: Database for Hydrological Time Series of Inland Waters
ENVISAT: Environmental Satellite
ESDR: Earth System Data Records
ESDS: Earth Science Data System
ESRI: Environmental Systems Research Institute
G-REALM: Global Reservoir and Lake Monitor
GCMD: Global Change Master Directory
GLWD: Global Lakes and Wetlands Database
GranD: Global Reservoir and Dam Database
Jason: Joint Altimetry Satellite Oceanography Network
L2: Level 2 - processing level for Time Series Data Set for Water Height (Altimetry)
L3: Level 3 - processing level for Time Series Data Set for Water Area (Surface Area)
L4: Level 4 - processing level for Time Series Data Set for Storage (Hypsometry)
LEGOS: Laboratoire d'Etudes en Géophysique et Océanographie Spatiales
MEaSUREs: Making Earth Science Data Records for Use in Research Environments
MODIS: Moderate Resolution Imaging Spectroradiometer
NASA: National Aeronautics and Space Administration
NetCDF: Network Common Data Form
PO.DAAC: Physical Oceanography Distributed Active Archive Center
SRTM: Shuttle Radar Topography Mission
T/P: Topex/Poseidon
TOPEX: Topography Experiment of the ocean
UCLA: University of California, Los Angeles
WSE: Water Surface Elevation