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Landslide Data in Riviere Frorse Basin Triggered by Haiti Earthquake on 12 January 2010

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Abstract: As secondary effects, a series of landslides were triggered by the earthquake that occurred in Haiti on January 12, 2010. From the epicenter to Port au Prince, triggered landslides mainly distributed in upper reaches of Riviere Momance, the Riviere Frorse basin, the north slope of Morne Saint-Laurent and so on. Among these regions, the amount of landslides in Riviere Frorse basin was the most. It was also the primary region to influence the densely populated areas in the downstream area of the Riviere Frorse due to potential debris flow. By using the Word View-2 of pre-earthquake, GeoEye-1 of post-earthquake, as well as the Google Earth images, the Landslide data in Riviere Frorse Basin triggered by Haiti earthquake on 12 January 2010 (HaitiEQ_LS_2010data for short) was developed .The data was archived in .shp data format with the compressed data size of 650KB.

Keywords: **Haiti; Earthquake; 2010; Riviere Frorse Basin; Landslide**

1 Introduction

The Republic of Haiti locates in the Caribbean island of Hispaniola. On January 12, 2010, it was reported that a magnitude 7 earthquake struck the country at 21:53:10(UTC). The centroid of this earthquake was 18.457°N, 72.533°W[1]. Because it was very near to Port au Prince which is a densely populated area, thousands of persons were dead or injured. On January 18, the National Aeronautics and Space Administration (NASA) distributed a potential landslide map based on the EO-1 images. From January 18 to January 19, post-earthquake images of Haiti were published by American GeoEye company and American Digital Global company. Almost during the same time the images of Haiti regions were updated by Google Earth. On January 19, the Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), the World Resources

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Research, College of Resources Science & Technology, Beijing Normal University and the Institute of Remote sensing and Digital Earth (RADI), CAS interpreted the distribution locations and types of landslide in the key places in Haiti based on the above images.

Riviere Frorse Basin locates between the epicenter of this earthquake and Port au Prince, which is one of the densest region of triggered landslides. Figure 1 shows the geographic location map of Riviere Frorse Basin.

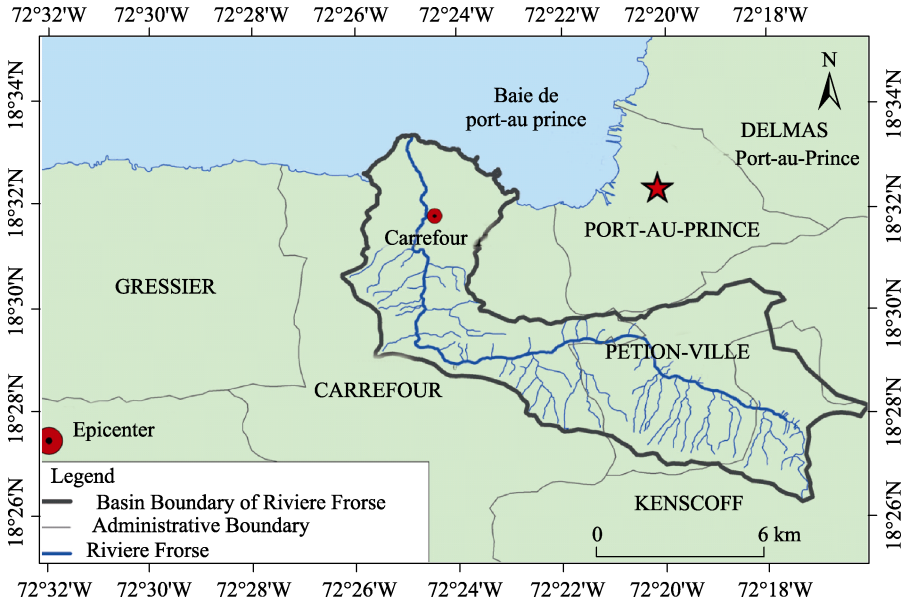


Figure 1 Geographic location map of Riviere Frorse Basin

2 Metadata of the dataset

The descriptions of the HaitiEQ_LS_2010data[2] are recorded. These information include the dataset full name, dataset short name, authors, geographical region of the dataset content, year of the dataset, number of the dataset tiles, dataset spatial and temporal resolution, dataset format and size, data publisher, and data sharing policy (Table 1).

3 Method

Visual interpretation of remote sensing images has become an important method to identify landslides. In this paper landslides were identified from Word View-2 images of pre-earthquake and GeoEye-1 images of post-earthquake images. Table 2 shows the technical specification of used remote sensing data.

The basic procedure of the dataset development is shown in Figure 2. After analyzing the remote sensing images of study area, relatively lighter tone of the slide area than the adjoining stable area, vegetation differences, detached large blocks of rocks have been used as indicators for landslide interpretation[4-5].The results were cross-checked between different work groups.

After analyzing characteristics of different landslides, two categories were divided: new added

Table 1 Summary of the HaitiEQ_LS_2010data metadata

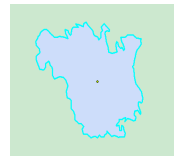
Items	Description
Dataset full name	Haiti Earthquake (2010) Landslides Dataset in Riviere_Frorse Basin
Dataset short name	HaitiEQ_LS_2010data
Authors	Lv, T. T. R-8978-2016, Institute of Remote sensing and Digital Earth, Chinese Academy of Sciences, lvtt@radi.ac.cn Liu, C. L-3684-2016, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, lchuang@radi.ac.cn Zhao, J. L. A-4856-2017, Henan University, China, aling0123@163.com Dai, L. J. A-4836-2017, Texas State University, USA, 40081944@qq.com Wang, J. N. E-2431-2017, Institute of Remote sensing and Digital Earth, Chinese Academy of Sciences, jwang@radi.ac.cn Gu, X. F. L-7328-2016, Institute of Remote sensing and Digital Earth, Chinese Academy of Sciences, guxf@radi.ac.cn
Geographical region	18.4°N -18.5°N, 72.32°W - 72.48°W
Time	2010
Data format	.shp, .zip
Data size	650 KB in compressed file
Data files	The dataset consists of two data files. They are: 1.HTI_Landslide_Point.zip，this is the ARC/GIS .shp compressed file of the landslide points triggered by 2010 earthquake in Riviere Frorse Basin. 2.HTI_Landslide_Polygon.zip，this is the ARC/GIS .shp compressed file of the landslide polygons triggered by 2010 earthquake in Riviere Frorse Basin.
Foundation	Chinese Academy of Sciences (CXIOG-D04-03)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing, 100101, China
Data sharing policy	*Data* from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). *Data* sharing policy includes: (1) *Data* are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use *Data* subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute *Data* subject to written permission from the GCdataPR Editorial Office and the issuance of a *Data* redistribution license, and; (4) If *Data* are used to compile new datasets, the 'ten per cent principal' should be followed such that *Data* records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset [3].

and old landslides. Those landslides were further divided into four types as listed in table 3, namely new landslides, extended landslides based on the old landslides, not obviously changed old landslides and recovered landslides .

Table 2 Technical specification of used remote sensing data

Satellite	Country	Compny	Sensor	Spatial resolution	Revisit cycle	Acquisition time	Website
Geo-Eye-1	USA	GeoEye, Inc. Nasdaq	Panchromatic Multispectral	0.41m（Nadir） 1.65m（Nadir）	3days	January 13, 2010 January 16, 2010	http://www.google.com/relief/haitiearthquake/geoeye.html
World View-2	USA	DigitalGlobe	Panchromatic Multispectral	0.61m（Nadir） 2.44m（Nadir）	1–6 days	December 13, 2009	http://dgl.us.neolane.net/res/dgl/survey/CES_H.jsp

Table 3 Definition and corresponding description of landslide types

Code	Before event image	After event image	Vector landslides	Type
A				New landslides
B				Extended landslides based on the old landslides
C				Not obviously changed old landslides
N				Not completely Recovered landslides

4 Dataset compositions

Figure 3 shows the spatial distribution of landslides in Riviere Frorse Basin. A total of 165 landslides were interpreted. There were 98 new landslides, 35 landslides expanded on the original basis, 24 landslides which were changed not significantly after the earthquake and 8 not completely recovered landslides. Table 4, table 5, table 6 and table7 are statistics of the location and area of different types of landslide. From these tables we can see that the area of new landslides (type A) is 54,132 m^2 which account for 59.6% of the area of total landslides. The area of 35 landslides (type B) expanded from the 163,819 m^2 to 40,315 m^2.The area of not obviously changed old landslides(type C) after earthquake is about 186,962 m^2 and the area of the recovered landslides(type C) is about 5,618 m^2.

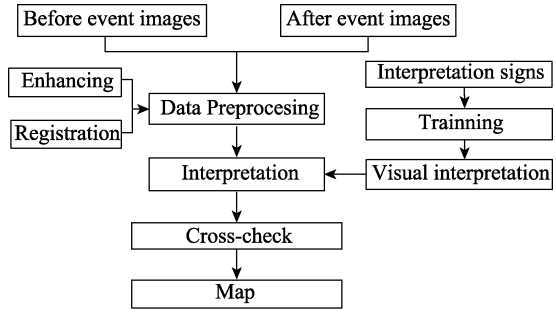


Figure 2 Procedure of the dataset development

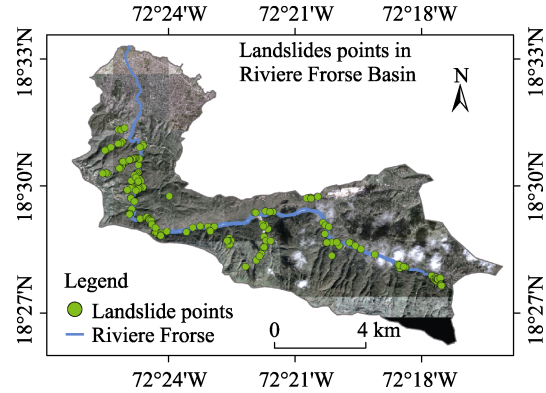


Figure 3 shows the spatial distribution of landslides in Riviere Frorse Basin

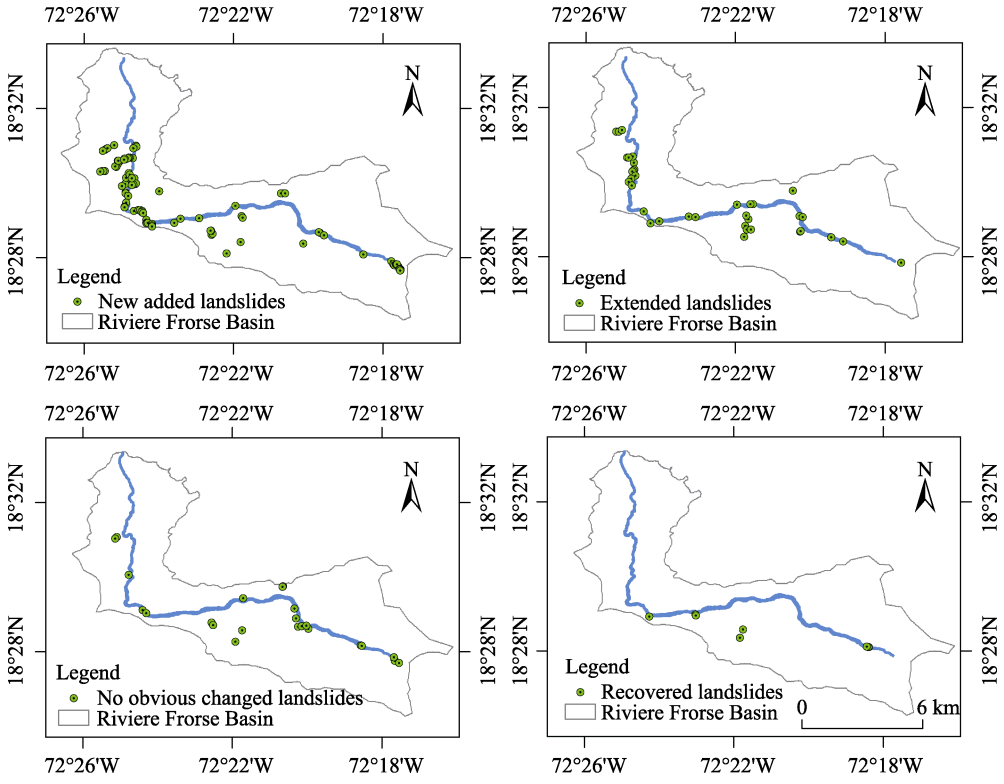


Figure 4 Spatial distribution map of landslides of four types in Riviere Frorse River Basin

Table 4 Spatial distribution and area statistics of new added landslides

Code	Longitude	Latitude	Area（m^2）	Code	Longitude	Latitude	Area (m^2)
A-1	–72.410023	18.517005	1,227	A-85	–72.414524	18.511089	1462
A-2	–72.409911	18.516559	459	A-87	–72.4147	18.502667	2302
A-3	–72.411403	18.515828	384	A-88	–72.41627	18.499076	256
A-9	–72.410848	18.502558	94	A-89	–72.417292	18.510066	71
A-12	–72.413726	18.500876	894	A-90	–72.418292	18.508785	152
A-13	–72.412961	18.50046	61	A-91	–72.41851	18.508511	426
A-14	–72.413147	18.500278	74	A-92	–72.418864	18.507587	117
A-15	–72.414106	18.500331	21	A-93	–72.419413	18.507676	113
A-17	–72.414525	18.500234	82	A-94	–72.418287	18.510309	191
A-18	–72.414898	18.499817	70	A-95	–72.41796	18.510391	42
A-19	–72.411442	18.500714	239	A-96	–72.399644	18.49666	5601
A-20	–72.410864	18.500128	419	A-97	–72.411566	18.51141	83
A-21	–72.410406	18.500055	539	A-98	–72.413005	18.511654	61
A-22	–72.41005	18.500153	289	A-99	–72.413289	18.511703	104
A-23	–72.411364	18.49967	1,505	A-100	–72.413797	18.51152	43
A-24	–72.411915	18.499461	479	A-103	–72.415171	18.511227	55
A-26	–72.414733	18.496194	209	A-104	–72.415425	18.510932	47
A-27	–72.414811	18.49584	71	A-105	–72.425117	18.505668	210

(*To be continued on the next page*)

(***Continued***)

Code	Longitude	Latitude	Area（m^2）	Code	Longitude	Latitude	Area（m^2）
A-28	–72.413499	18.494566	1,820	A-106	–72.424035	18.505656	88
A-29	–72.414576	18.49155	93	A-107	–72.424693	18.505803	60
A-30	–72.415183	18.489767	28	A-108	–72.425966	18.505561	69
A-31	–72.415326	18.489536	64	A-111	–72.419899	18.517228	272
A-32	–72.411163	18.48783	128	A-112	–72.424073	18.51538	3579
A-33	–72.408867	18.488362	332	A-113	–72.423267	18.51568	1339
A-34	–72.408381	18.488465	261	A-114	–72.422789	18.51591	358
A-35	–72.40731	18.487899	412	A-115	–72.425038	18.514647	150
A-36	–72.40765	18.487549	36	A-116	–72.390341	18.484392	509
A-38	–72.406816	18.486959	223	A-120	–72.362893	18.485649	3981
A-39	–72.405553	18.48397	426	A-121	–72.362535	18.484869	2083
A-40	–72.405431	18.482665	96	A-129	–72.363419	18.473738	215
A-41	–72.405217	18.482574	632	A-131	–72.369663	18.468884	2210
A-42	–72.405237	18.482239	195	A-134	–72.344852	18.495708	601
A-45	–72.40472	18.482578	203	A-135	–72.345413	18.495726	488
A-46	–72.402901	18.482051	120	A-136	–72.343778	18.495654	808
A-47	–72.403029	18.481368	28	A-138	–72.335524	18.473274	1346
A-48	–72.403038	18.481019	82	A-148	–72.413437	18.504888	98
A-49	–72.392923	18.482494	26	A-151	–72.376395	18.477268	1216
A-52	–72.381927	18.484673	169	A-152	–72.375885	18.477568	403
A-56	–72.365625	18.490172	1,671	A-153	–72.376545	18.479031	163
A-66	–72.30877	18.468511	959	A-154	–72.376855	18.478965	118
A-68	–72.296273	18.465213	63	A-155	–72.412875	18.504097	359
A-71	–72.295276	18.463979	848	A-156	–72.412059	18.50242	1093
A-72	–72.29484	18.463523	513	A-163	–72.328117	18.478238	781
A-75	–72.292914	18.462871	657	A-112	–72.328635	18.478328	669
A-77	–72.292023	18.461747	108	A-164	–72.326217	18.477004	262
A-78	–72.291989	18.461484	188	A-171	–72.292781	18.464173	40
A-81	–72.29425	18.463956	34	A-172	–72.292382	18.461997	1497
A-82	–72.29382	18.464076	76	A-173	–72.292405	18.461719	170
A-83	–72.293723	18.464032	92	A-174	–72.292185	18.461316	71
Total				54132 m^2			

Table 5 Spatial distribution and area statistics of extended landslides

Code	Longitude	Latitude	Area pre-earthquake (m^2)	Area post-earthquake (m^2)	Changed area (m^2)
B-4	–72.411870	18.509008	29,716	33,158	3,442
B-5	–72.411839	18.505923	1,252	1,321	69
B-6	–72.412271	18.505496	1,229	1,601	372
B-7	–72.412581	18.504923	1,844	2,446	602
B-8	–72.411330	18.503267	5,897	6,777	880

(*To be continued on the next page*)

(*Continued*)

Code	Longitude	Latitude	Area pre-earthquake (m^2)	Area post-earthquake (m^2)	Changed area (m^2)
B-11	–72.413063	18.501734	3,288	3,846	558
B-16	–72.414192	18.500304	32	29	–4
B-25	–72.412801	18.498849	7,029	13,184	6,155
B-37	–72.407522	18.487241	61	401	340
B-43	–72.404595	18.481929	248	210	–38
B-50	–72.387408	18.484879	9,260	11,584	2,323
B-51	–72.384476	18.484730	899	1,518	618
B-55	–72.366027	18.490210	1,190	1,778	588
B-59	–72.338008	18.485133	1,939	3,748	1,808
B-60	–72.336677	18.484604	20,223	30,957	10,734
B-62	–72.337896	18.478077	1,728	1,945	217
B-86	–72.412421	18.511778	291	410	119
B-101	–72.414969	18.511205	399	320	–79
B-102	–72.414301	18.511263	85	86	2
B-117	–72.400669	18.482798	450	637	186
B-118	–72.360785	18.483721	13,052	13,656	604
B-119	–72.361793	18.485346	3,865	5,707	1,841
B-122	–72.362305	18.480712	21,882	22,525	643
B-123	–72.361465	18.479159	8,656	10,623	1,967
B-124	–72.359610	18.479021	10,872	11,743	872
B-125	–72.362750	18.475673	634	1,680	1,046
B-137	–72.341020	18.496429	6,517	7,171	654
B-159	–72.358730	18.490508	464	476	11
B-160	–72.359841	18.490348	214	527	314
B-161	–72.337603	18.478393	538	524	–14
B-165	–72.323940	18.475698	838	1,004	166
B-166	–72.318504	18.473757	75	829	755
B-176	–72.419742	18.522877	5,662	6,154	492
B-177	–72.418623	18.522813	3,208	4,528	1,320
B-178	–72.417332	18.523535	282	1,035	752
Total			163,819	204,134	40,315

Table 6 Spatial distribution and area statistics of no obvious changed landslides

Code	Longitude	Latitude	Area（m^2）	Code	Longitude	Latitude	Area（m^2）
C-10	–72.412863	18.501215	1,431	C-109	–72.418118	18.518096	9,199
C-57	–72.361743	18.490807	31,603	C-110	–72.418841	18.517488	3,976
C-58	–72.338924	18.486236	33,352	C-127	–72.362198	18.476573	310
C-61	–72.338237	18.481781	65,831	C-130	–72.365359	18.471379	3,509
C-63	–72.337153	18.477987	662	C-132	–72.344007	18.496005	863
C-64	–72.335631	18.478325	11,503	C-133	–72.344351	18.495922	616
C-65	–72.332556	18.477222	12,595	C-149	–72.376024	18.480018	1,001
C-67	–72.309452	18.469791	883	C-150	–72.375313	18.478775	2,104
C-73	–72.294380	18.463437	1,094	C-157	–72.406567	18.485567	272
C-74	–72.293993	18.462937	91	C-158	–72.405055	18.484251	272
C-76	–72.292098	18.462071	975	C-167	–72.308894	18.469529	887
C-80	–72.294420	18.464629	557	Total			186,962
C-84	–72.333484	18.478565	3,376				

5 Conclusion and discussion

By using remote sensing images with high spatial resolution before and after the earthquake in the Riviere Frorse basin, four types of landslides were identified. There were 98 new landslides (the area is 54,132 m^2), 35 landslides was expanded on the original basis (the original area was 163,819 m^2 and added area was 40,315 m^2). In addition, there were still 24 landslides which were changed not significantly after the earthquake and 8 not recovered old landslides by vegetation. The landslides above mainly distributed above 25 degree slope. The ARC/GIS datasets of landslides and related analysis report were submit to UN-SPIDER and UNPAN by the GAID e-SDDC team (Scientific Data Sharing in Developing Countries Community Activities, Global Alliance for Information and Development, UNDESA) on February 2, 2012 and we received good feedback from them.

Table 7 Spatial distribution and area statistics of recovered landslides

Code	Longitude	Latitude	Area (m^2)
N-44	–72.404253	18.482336	440
N-53	–72.383776	18.483057	707
N-54	–72.383440	18.482848	1,013
N-126	–72.362449	18.476512	350
N-168	–72.306310	18.468512	491
N-169	–72.306530	18.468694	791
N-170	–72.307095	18.468773	1,677
N-175	–72.363948	18.472975	149
Total			5,618

Author contributions

Liu, C. , Wang, J. N. and Gu X. F. were responsible for the overall project design. Lv, T. T., Zhao, J. L. and DAI, L. J. finished the both data processing and landslides extraction. Lv, T. T. wrote this paper. Liu, C. reviewed both the dataset and the data paper, Liu, C. submitted the data and paper to UN-SPIDER and UNPAN.

References

[1] USGS Magnitude 7.0 - Haiti Region [OL], http://earthquake.usgs.gov/earthquakes/recenteqsww/Quakes/us2010rja6.php.

[2] Lv, T. T., Liu, C., Zhao, J. L., *et al*. Haiti Earthquake (2010) Landslides Dataset in Riviere_Frorse Basin [DB]. *Global Change Research Data Publishing & Repository,* DOI: 10.3974/geodb.2014.02.10.V1.

[3] GCdataPR Editorial Office. GCdataPR Data Sharing Policy. DOI:10.3974/dp.policy.2014.05.

[4] Temesgen, B., Mohammed, M. U. Natural hazard assessment using GIS and remote sensing methods, with particular reference to the landslides in the Wondogenet Area [J]. *Ethiopia Phys. Chem. Earth*, 2001, 26(9): 665-675.

[5] Zhao, J. L., Liu, C., Lv, T.T., *et al*. Identification of landslide spatial distribution and their types along the Riviere Frorse Drainage Basin triggered by the earthquake in Haiti on 12 January 2010 [J]. *Disaster Advances*，2012, 5(1): 5-13.