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

Lv, T. T.[1*] Liu, C.[2] Zhao, J. L.[3] Dai, L. J.[4] Wang, J. N.[1] Gu, X. F.[1]

1. Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China;
2. Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing 100101, China;
3. Henan University, Kaifeng 475004, China;
4. Texas State University, San Marcos 78666, USA

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 650 KB.

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 Re-

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***Corresponding Author:** Lyu, T. T. R-8978-2016; Institute of Remote sensing and Digital Earth, CAS, lvtt@radi.ac.cn
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sources Research (IGSNRR), Chinese Academy of Sciences (CAS), the World Resources 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.

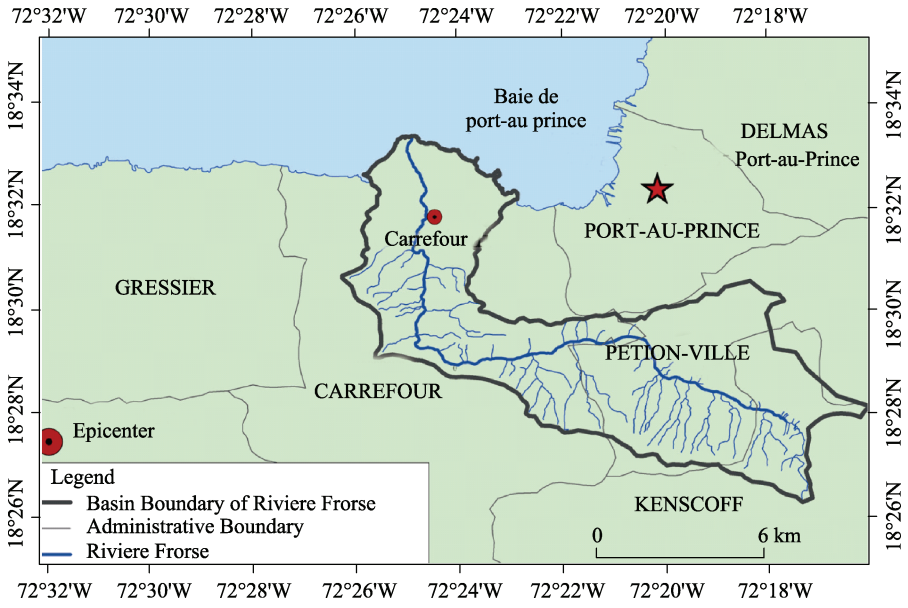


Figure 1 Geographic location map of Riviere Frorse Basin

2 Metadata of 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 Methods

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

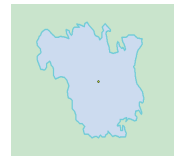
Items	Description
Dataset full name	Haiti Earthquake (2010) Landslides Dataset in Riviere_Frorse Basin
Dataset short name	HaitiEQ_LS_2010data
Authors	Lv, T. T. R-8978-2016, Institute of Remote sensing and Digital Earth, Chinese Academy of Sciences, lvtt@radi.ac.cn Liu, C. L-3684-2016, Institute of Geographic 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(s)	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	0.41 m（Nadir） 1.65 m（Nadir）	3days	January 13, 2010 January 16, 2010	http://www.google.com/relief/haitiearthquake/geoeye.html
World View-2	USA	DigitalGlobe	Panchromatic Multispectral	0.61 m（Nadir） 2.44 m（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. Figure 3 shows the spatial distribution map of landslides of four types in Riviere Frorse River 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.

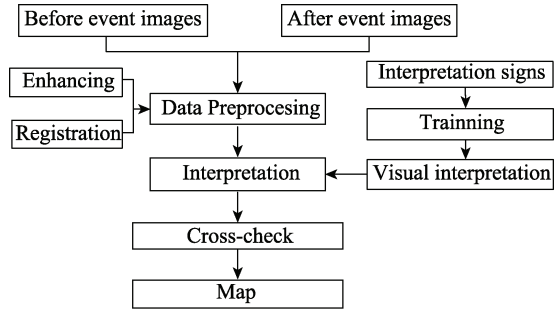


Figure 2 Procedure of the dataset development

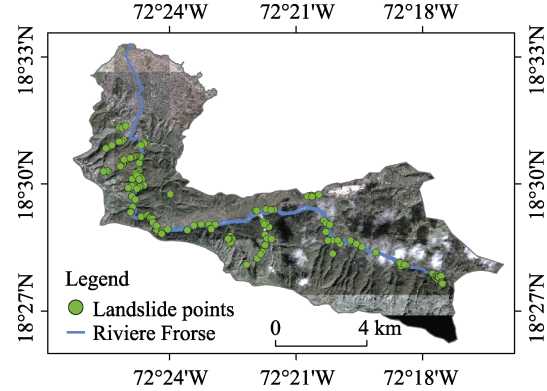


Figure 3 Spatial distribution of landslides in Riviere Frorse Basin

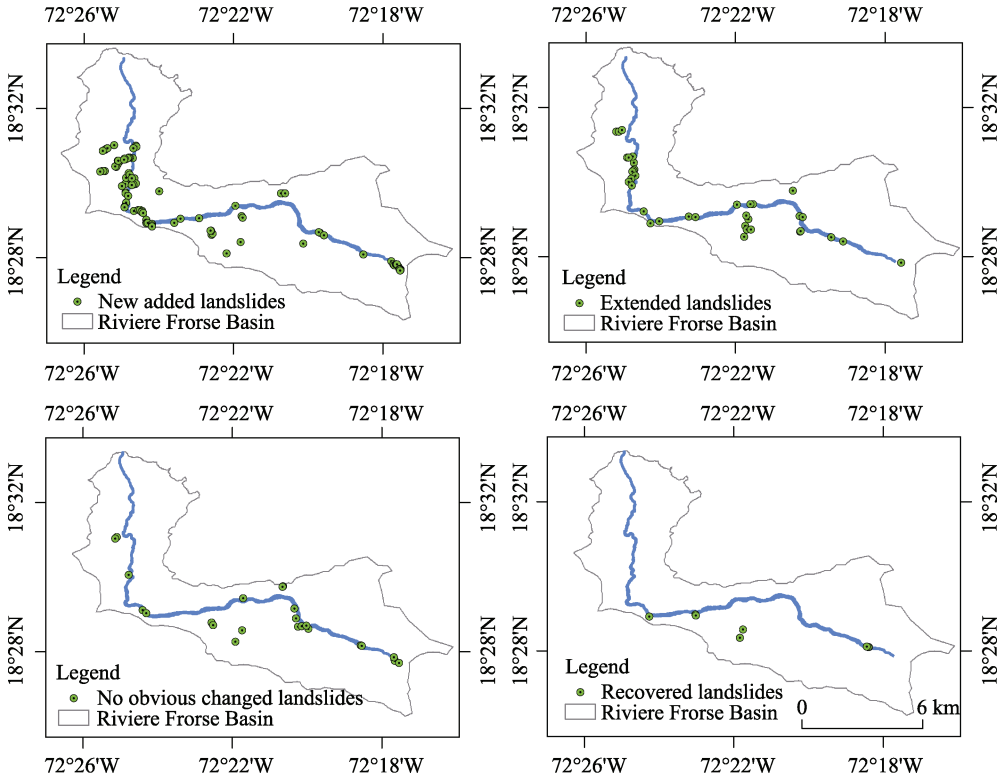


Figure 4 Spatial distribution map of landslides of four types in Riviere Frorse River Basin

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	–72.410,023	18.517,005	1,227	A-85	–72.414,524	18.511,089	1,462
A-2	–72.409,911	18.516,559	459	A-87	–72.414,700	18.502,667	2,302
A-3	–72.411,403	18.515,828	384	A-88	–72.416,270	18.499,076	256
A-9	–72.410,848	18.502,558	94	A-89	–72.417,292	18.510,066	71
A-12	–72.413,726	18.500,876	894	A-90	–72.418,292	18.508,785	152
A-13	–72.412,961	18.500,460	61	A-91	–72.418,510	18.508,511	426
A-14	–72.413,147	18.500,278	74	A-92	–72.418,864	18.507,587	117
A-15	–72.414,106	18.500,331	21	A-93	–72.419,413	18.507,676	113
A-17	–72.414,525	18.500,234	82	A-94	–72.418,287	18.510,309	191
A-18	–72.414,898	18.499,817	70	A-95	–72.417,960	18.510,391	42
A-19	–72.411,442	18.500,714	239	A-96	–72.399,644	18.496,660	5,601
A-20	–72.410,864	18.500,128	419	A-97	–72.411,566	18.511,410	83
A-21	–72.410,406	18.500,055	539	A-98	–72.413,005	18.511,654	61
A-22	–72.410,050	18.500,153	289	A-99	–72.413,289	18.511,703	104
A-23	–72.411,364	18.499,670	1,505	A-100	–72.413,797	18.511,520	43
A-24	–72.411,915	18.499,461	479	A-103	–72.415,171	18.511,227	55
A-26	–72.414,733	18.496,194	209	A-104	–72.415,425	18.510,932	47
A-27	–72.414,811	18.495,840	71	A-105	–72.425,117	18.505,668	210

(*To be continued on the next page*)

(***Continued***)

Code	Longitude	Latitude	Area（m^2）	Code	Longitude	Latitude	Area（m^2）
A-28	–72.413,499	18.494,566	1,820	A-106	–72.424,035	18.505,656	88
A-29	–72.414,576	18.491,550	93	A-107	–72.424,693	18.505,803	60
A-30	–72.415,183	18.489,767	28	A-108	–72.425,966	18.505,561	69
A-31	–72.415,326	18.489,536	64	A-111	–72.419,899	18.517,228	272
A-32	–72.411,163	18.487,830	128	A-112	–72.424,073	18.515,308	3,579
A-33	–72.408,867	18.488,362	332	A-113	–72.423,267	18.51,568	1,339
A-34	–72.408,381	18.488,465	261	A-114	–72.422,789	18.51,591	358
A-35	–72.407,310	18.487,899	412	A-115	–72.425,038	18.514,647	150
A-36	–72.407,650	18.487,549	36	A-116	–72.390,341	18.484,392	509
A-38	–72.406,816	18.486,959	223	A-120	–72.362,893	18.485,649	3,981
A-39	–72.405,553	18.483,970	426	A-121	–72.362,535	18.484,869	2,083
A-40	–72.405,431	18.482,665	96	A-129	–72.363,419	18.473,738	215
A-41	–72.405,217	18.482,574	632	A-131	–72.369,663	18.468,884	2,210
A-42	–72.405,237	18.482,239	195	A-134	–72.344,852	18.495,708	601
A-45	–72.404,720	18.482,578	203	A-135	–72.345,413	18.495,726	488
A-46	–72.402,901	18.482,051	120	A-136	–72.343,778	18.495,654	808
A-47	–72.403,029	18.481,368	28	A-138	–72.335,524	18.473,274	1,346
A-48	–72.403,038	18.481,019	82	A-148	–72.413,437	18.504,888	98
A-49	–72.392,923	18.482,494	26	A-151	–72.376,395	18.477,268	1,216
A-52	–72.381,927	18.484,673	169	A-152	–72.375,885	18.477,568	403
A-56	–72.365,625	18.490,172	1,671	A-153	–72.376,545	18.479,031	163
A-66	–72.308,770	18.468511	959	A-154	–72.376,855	18.478,965	118
A-68	–72.296,273	18.465,,213	63	A-155	–72.412,875	18.504,097	359
A-71	–72.295,276	18.463,979	848	A-156	–72.412,059	18.502,420	1,093
A-72	–72.294,840	18.463,523	513	A-163	–72.328,117	18.478,238	781
A-75	–72.292,914	18.462,871	657	A-112	–72.328,635	18.478,328	669
A-77	–72.292,023	18.461,747	108	A-164	–72.326,217	18.477,004	262
A-78	–72.291,989	18.461,484	188	A-171	–72.292,781	18.464,173	40
A-81	–72.294,250	18.463,956	34	A-172	–72.292,382	18.461,997	1,497
A-82	–72.293,820	18.464,076	76	A-173	–72.292,405	18.461,719	170
A-83	–72.293,723	18.464,032	92	A-174	–72.292,185	18.461,316	71
Total				54,132 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	–72.411,870	18.509,008	29,716	33,158	3,442
B-5	–72.411,839	18.505,923	1,252	1,321	69
B-6	–72.412,271	18.505,496	1,229	1,601	372
B-7	–72.412,581	18.504,923	1,844	2,446	602
B-8	–72.411,330	18.503,267	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	–72.413,063	18.501,734	3,288	3,846	558
B-16	–72.414,192	18.500,304	32	29	–4
B-25	–72.412,801	18.498,849	7,029	13,184	6,155
B-37	–72.407,522	18.487,241	61	401	340
B-43	–72.404,595	18.481,929	248	210	–38
B-50	–72.387,408	18.484,879	9,260	11,584	2,323
B-51	–72.384,476	18.484,730	899	1,518	618
B-55	–72.366,027	18.490,210	1,190	1,778	588
B-59	–72.338,008	18.485,133	1,939	3,748	1,808
B-60	–72.336,677	18.484,604	20,223	30,957	10,734
B-62	–72.337,896	18.478,077	1,728	1,945	217
B-86	–72.412,421	18.511,778	291	410	119
B-101	–72.414,969	18.511,205	399	320	–79
B-102	–72.414,301	18.511,263	85	86	2
B-117	–72.400,669	18.482,798	450	637	186
B-118	–72.360,785	18.483,721	13,052	13,656	604
B-119	–72.361,793	18.485,346	3,865	5,707	1,841
B-122	–72.362,305	18.480,712	21,882	22,525	643
B-123	–72.361,465	18.479,159	8,656	10,623	1,967
B-124	–72.359,610	18.479,021	10,872	11,743	872
B-125	–72.362,750	18.475,673	634	1,680	1,046
B-137	–72.341,020	18.496,429	6,517	7,171	654
B-159	–72.358,730	18.490,508	464	476	11
B-160	–72.359,841	18.490,348	214	527	314
B-161	–72.337,603	18.478,393	538	524	–14
B-165	–72.323,940	18.475,698	838	1,004	166
B-166	–72.318,504	18.473,757	75	829	755
B-176	–72.419,742	18.522,877	5,662	6,154	492
B-177	–72.418,623	18.522,813	3,208	4,528	1,320
B-178	–72.417,332	18.523,535	282	1,035	752
Total			163,819	204,134	40,315

5 Discussion and Conclusion

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	–72.404,253	18.482,336	440
N-53	–72.383,776	18.483,057	707
N-54	–72.383,440	18.482,848	1,013
N-126	–72.362,449	18.476,512	350
N-168	–72.306,310	18.468,512	491
N-169	–72.306,530	18.468,694	791
N-170	–72.307,095	18.468,773	1,677
N-175	–72.363,948	18.472,975	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.

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