Another Easter Island? Climate change, human insecurity and politics in Haiti and the Dominican Republic

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Abstract

Two neighbouring countries, Haiti and the Dominican Republic, occupy the same island and are exposed to a similar level of increasing intensity of annual geohazards (for example tropical storms, landslides, floods, and earthquakes). But compared to the Dominican Republic, Haiti is far more vulnerable to geohazards. An assessment of political factors may explain this difference. This paper argues that nations with greater political stability, such as the Dominican Republic, are more resilient to cope with natural disasters and have greater capacity to adapt to future climate change impacts than nations with greater political instability, such as Haiti.

Keywords: Haiti, Dominican Republic, Climate Change, Natural Hazards, Earthquakes, Tropical Cyclone, Political Instability, Regime Change

Introduction and Research Objective

The objective of this research is to study the historical spatio-temporal relationships between natural hazards, economic development, and political stability in Haiti and the Dominican Republic between 1850 and 2007. A major goal of this study is to identify patterns and significant relationships between both, natural systems and human interactions on the Island of Hispaniola in space and time. In this paper, the focus is on the relationship between natural hazards and political factors. As a working hypothesis, we propose that Haiti's social, political, and economic trajectory is rooted in multiple factors, such as geographic location, annual meteorological and seismic hazards, demographic development, and cultural factors.

Both countries, Haiti and the Dominican Republic, share the Island of Hispaniola (Hispaniola thereafter). The two countries have experienced similar intensity levels of meteorological and seismic hazards, within the period from 1850 to 2007. Compared to the Dominican Republic, Haiti seems historically more vulnerable to geohazards resulting in more socio-economic damage and casualties. One major factor, discussed in the following is political stability (measured by the "Polity Score" index), shaping vulnerabilities in both Haiti and the Dominican Republic. Other factors of relevant importance are population densities and incomes.

Hispaniola's Historical Trajectory (1850 to 2010)

Domestic politics and the colonial era also played a major role in shaping the

development trajectories of Haiti and the Dominican Republic. Both countries had a series of regime changes within the last two centuries. The developmental paths of the two countries diverted already in the eighteenth century when Hispaniola was divided into a French and Spanish colony. The French colony, which was later to become Haiti, had a much larger population and a greater percentage of slaves (80% compared to 10%). In 1804, France gave up its claims to its colony and in the same year, Haiti gained independence being the first country in the "New World" in 1804. The years following independence were characterized by political coups and instability in both countries. All but one 22 Haitian presidents from 1843 to 1915 were either assassinated or driven out of office (Diamond 2006). Although, Slavery was abolished, large-scale plantations were destroyed and the land divided into small-holder farms. Moreover, Haitians spoke Creole making it more difficult for European traders to do business. Consequently, agricultural productivity declined and exports dwindled.

The Eastern part of the island, on the other hand, remained more open towards the "Old World". Relations with Europe continued in the Spanish-speaking part of Hispaniola following independence in 1821 from Spain. Thus, economically important immigrant groups preferred to settle in the Dominican Republic, which continued to have a lower population density putting less pressure on environmental resources. It can be speculated whether higher population pressures and colonial exploitation in Haiti had been largely responsible for stripping of its forests by the mid-nineteenth century .

Since its independence from Haiti in 1844, politics was equally tumultuous in the

Dominican Republic, which had 50 regime changes between 1844 and 1930. Outside occupations followed, largely by the United States to prevent European powers from taking a permanent presence in the region. The United States invaded Haiti in 1915 and stayed until 1934, and in the Dominican Republic from 1916 to 1924. Political instability was then replaced with military dictatorships that lasted for many years.

Starting from 1930, Trujillo autocratically ruled the Dominican Republic until 1961 when he was assassinated. Although the country suffered under his dictatorship, it was the beginning of modernization and industrialization. This was also the beginning of environmental protection, when Trujillo began to protect forests to generate hydro-electric power and to protect his personal interest in logging. Balaguer who shaped Dominican politics for the next three decades continued with this path of development and environmental protection until 1996.

While the Dominican Republic was on track to economic growth and prosperity, Haiti continued to experience political instability. In 1957, Haiti came under the control of François “Papa Doc”, an equally ruthless politician as Trujillo but with no interest in developing and modernizing the country. When he died in 1971, Jean-Claude “Baby Doc” Duvalier who ruled until 1986 succeeded him. The years that followed were characterized by political instability and economic decline. Since 2006, politics during president Preval's second term increased Haiti's economic development slightly. The country's growth rate remained positive around 2.2% from 2006 to 2009 (CIA 2010).

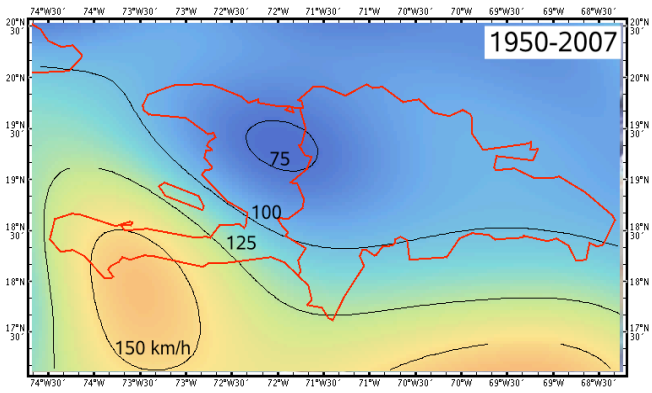
Frequency and Intensity of Meteorological and Seismic Hazards on Hispaniola

One way to answer the question whether social, political, and economic development is shaped by geographic location, annual meteorological and seismic hazards, is to determine overall geohazard levels since 1850 and spatially and temporally compare them with socio-political data. First, the multi-dimension data set was explored and sort trough by computer aided expert systems based on machine intelligence (Klose 2006, 2009; Klose and Webersik 2010 submitted). The purpose to utilize such a system is to see how tropical storms and earthquakes relate to socio-political data.

Almost every year, natural disasters, both earthquakes and tropical cyclones, make thousands of people on Hispaniola homeless as well as they claim lives. Several major earthquakes occurred in Haiti in 1751, 1770, 1842, 1860, 1887, 1897, and most recently in 2010. These seismic events destroyed the city of Port Au Prince in Haiti's South or Cap-Haïtien in its North several times. The M7 earthquake of January 12, 2010 resulted in more than 220,000 fatalities and destroyed most governmental buildings in Port-au-Prince. A major earthquake of May 7, 1842 caused severe loss of life and destroyed the city of Cap-Haïtien. This severe earthquake coincided with a political revolt that lead into the independence of the Dominican Republic in 1844. In the Dominican Republic in 1946, an earthquake and subsequent tsunami killed 2550 people.

Tropical storms also have a major impact on Hispaniola, which was directly hit by 69 storm events since 1850. Haiti and the Dominican Republic were hit by 33 storms between 1850 and 1929 and by 36 storms between 1930 and spring 2010. When comparing the storm hazard patters of these two periods, the intensities of extreme storm events increased by 30% in the Dominican Republic and by 50% in Haiti (See figure 2). The frequency of storms increased by 25% in the Dominican Republic and remained unchanged in Haiti.

Figure 1: Velocity field (in kmh^{-1}) of tropical storms and hurricanes (category 1-5) between 1950 and 2007 in the surrounding area of Hispaniola Island

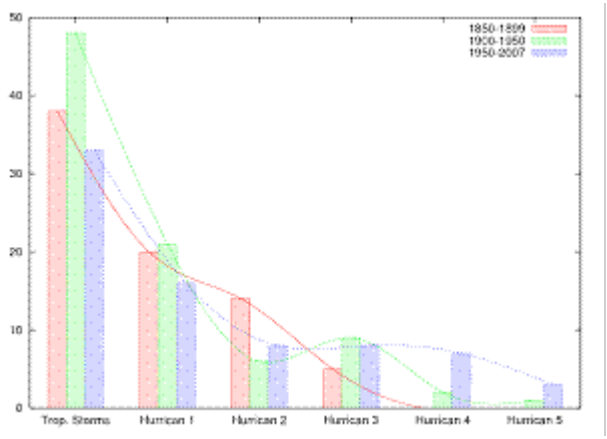


These storms caused human casualties and great economic damage, in particular in Haiti. In 1935, a severe tropical storm killed more than 2000 people. Hurricane George destroyed more than 75% of all the crops in the country in 1998. Finally, tropical storm Gustav and Fay directly affected more than 800,000 people (10% of the total population) in Haiti in August and September 2008, respectively (United Nations Development Programme 2009a).

Although it is disputed whether the number of tropical storms have increased (Webster et al. 2005a; Webster et al. 2005b), the intensity and, thus, severity of

category 4 and 5 hurricanes, however, has been increasing in the Gulf of Mexico since the nineteenth century (Giorgi et al. 2001; Landsea et al. 2006).

Figure 2: Number of tropical storms and hurricanes (category 1-5) between 1850 and 2007 in the surrounding area of Hispaniola island (Longitude: 68'-77'; Latitude:16'-22')



Spatial and temporal data of all major storms and earthquakes that occurred on Hispaniola between 1850 and 2010 are summarized in Table 1. The data are divided into *departements* for Haiti and regions for the Dominican Republic (not shown in Table 1 for the sake of clarity). Table 1 shows that Haiti and the Dominican Republic experienced similar severe storms since 1850, although 30% more tropical storms hit the Dominican Republic with a maximum observed hurricane category 4 on the Saffir–Simpson Hurricane Scale. Moreover, the Dominican Republic experienced a higher earthquake hazard during the last 100 years. Hurricanes and earthquakes, however, differently affect both countries.

Table 1: Geographic data of Hispaniola in space and time

	Haiti	**Dominican Republic**
Area \ km^{-2}	27750	48667
Population (1850) \ 1000 inhabitants	543	137
Population (2009) \ 1000 inhabitants	9036	10118
Population growth rate annual	0,02	0,03
Population growth rate (1850 - 2009)	16	73
Population density (2009) \ inhabitant per km^{-2}	326	208
Infant mortality rate \ per 1000 inhabitants	766	359
GDP per Capita (2009) \ $US	770	4525
Number of observed storms that hit Hispaniola (1850-2009)	16	21
Storm hit rate \ %	23	30
Max. storm intensity \ km h^{-1}	130	150
Observed storm hazard \ km h^{-1}	30	45
Observed earthquake hazard (1970-2009) \ peak ground acceleration	1,52	2,72

Political instability

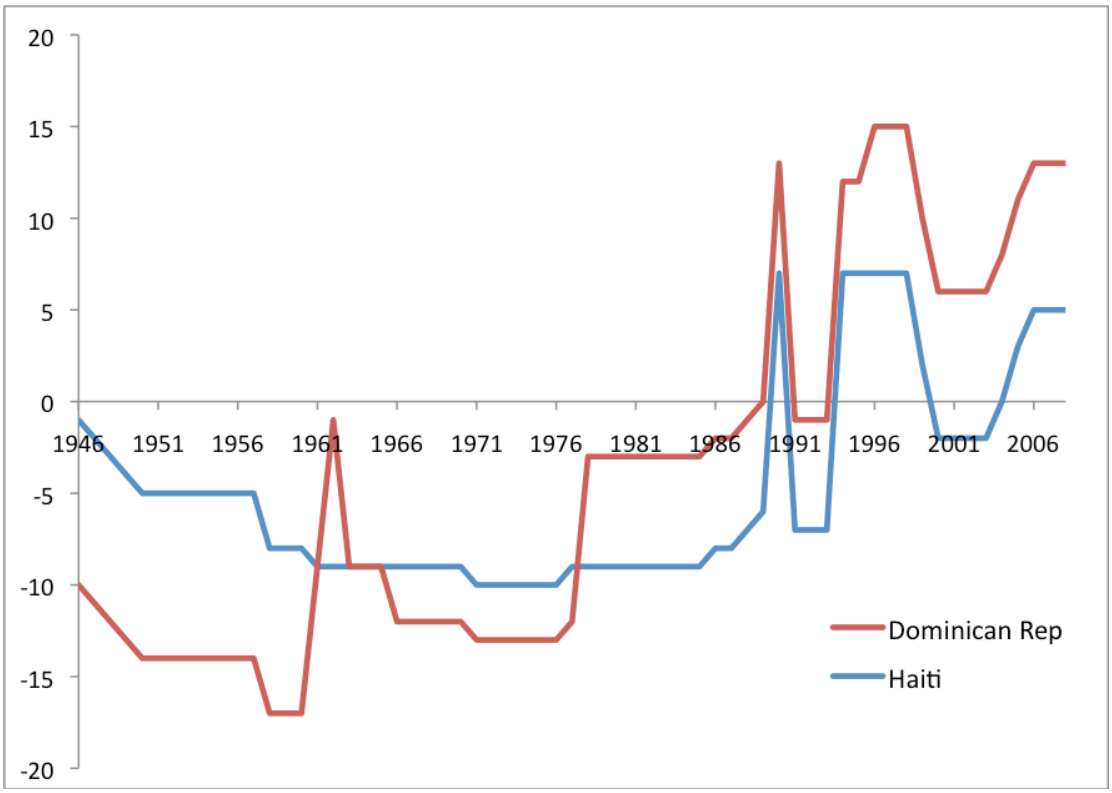
Since 1850, Hispaniola experienced in total 69 storms and 5 severely damaging earthquakes that directly hit the island (see Table 2). In the Dominican Republic, from the observed 69 storms, only three storms coincided with a change of political stability in the same or the following year in the Dominican Republic – one in 1930 and two larger storms in 1963 (see Table 2). In Haiti, in total five storms coincided with a decline in political stability in the same or the following year. All these events occurred after the 1950s. Political change is measured by employing the Polity Score scale from -10 (autocracy) to +10 (democracy).

Table 2: Major earthquakes and hurricanes in Haiti (H) and the Dominican Republic (DR) since the 18th century and their political context and socio-economic consequences

date DD.MM.YYYY	**hazard type**	**location**	**Socio-economic damage/ political insecurity**
18.10.1751	major earthquake	Southern Haiti	**H:** destruction of ¾ of masonry houses in Port-au-Prince
21.11.1751	major earthquake	Southern Haiti	**H:** destroyed Port-au-Prince
03.06.1770	M7.5 earthquake	Southern Haiti	**H:** killed 250 people; destroyed Port-au-Prince
07.06.1842	major earthquake	Northern Haiti	**H:** major damages in Cap-Haïtien; 10,000 fatalities; revolts that lead to the foundation of the Dominican Republic two years later
08.04.1860	major earthquake	Southern Haiti	**H:** destruction of Port-au-Prince
23.09.1887	earthquake	Northern Haiti	**H:** major damage in Moles St Nicholas
29.09.1897	earthquake	Northern Haiti	No data available
04.08.1946	M8.0 earthquake, tsunami	Northern DR	**DR:** killed 2550 people; year of political transition period in **H**: 1946-50 from rather democratic (-1) to autocratic (-5)
12.01.2010	M7.0 earthquake	Southwest Haiti	**H:** killed 230,000 people, 300,000 injured, 1,000,000 homeless; destroyed Port-au-Prince, Léogâne and Petit-Goâve
03.09.1930	Not named tropical storm	Hispaniola	**DR:** Political transition period 1930-33, from autocratic (-5) to autocratic (-9)
01.09.1958	Cat 2 hurricane Ella	Southwest Haiti	**H:** 28.06.1958 (before Ella) attempted invasion of USA to arrest Duvalier, from 1957 to 58 from -5 to -8
03.10.1961	Tropical storm Frances	Eastern DR	**H:** U.S. administration suspended aid, from 1960-61 from -8 to -9 **DR:** year of political transition from autocratic (-9) to democratic (+8) from 1960-62
27.09.1963	Cat 1 hurricane Edit	Northeast DR	**DR:** killed 7190 people; interregnum period (1963-1965) with complete collapse of central political authority from democratic (+8 in 1962) to autocratic (-3 in 1966)
03/04.10.1963	Cat 4 hurricane Flora	Southwest Haiti	killed 7190 in **H** and **DR**
07.10.1985	Tropical storm Isabel	DR	**H:** 07.02.1986 president Duvalier flees after disorder; political transition period 1985-86, from autocratic (-9) to autocratic (-8)
22.09.1998	Cat2/3 hurricane Gorges	Hispaniola	**H:** political transition in 1999, from democratic (7 in 1998) to autocratic (-2 in 2000)
10.10.2003 05.12.2003	Tropical storm Mindy Tropical storm Odette	DR DR	**H:** The 2004 coup d'état and Aristide's ousting; political transition period 2004-05, from autocratic (-2 in 2003) to democratic (+5 in 2006)

It is rather speculative to draw a link between these political changes and the occurrence of natural disasters, largely tropical cyclones that are relevant for climate change research. What is possible is an effect on the capacity of the government to contain upheaval. But this assumption desires further investigation. For example, there is no causal relation between the flood of May 2004 and Hurricane Jeanne in September 2004 and the subsequent political violence, connected to the ousting of former President Aristide in 2004. Fact is, that compared to the Dominican Republic, Haiti had a recent history of political instability and social turmoil. However, plotting the regime type over years from 1946-2008, Haiti and the Dominican Republic had a fairly similar political trajectory (See figure 3).

Figure 3: Political regime characteristics, 1946-2008 (from authoritarian (-) to democratic (+), 2008 Polity Score IV data series)



Socio-economic factors

Apart from political instability, the biggest challenge to cope with an anticipated increase in intensity of meteorological disasters is population growth that exposes more people to stronger storms (Klose and Webersik 2010 submitted).

Therefore, it matters how many and where people live. Haiti's population has grown steadily from 431,140 inhabitants in 1804—the year of independence—to roughly 10 million in 2009, it has now reached a population density of 359 people per square kilometer compared to 208 in the Dominican Republic (See table 1). The Southeast of the Dominican Republic with the city of Santo Domingo, the highest populated city of the country, experienced only 60% of the number of storms in comparison to Port-au-Prince. Since the 1930s the Dominican's Southeast developed outstandingly in comparison to the rest of all other provinces in the Dominican Republic, although a not-named hurricane in 1930 and hurricane David in 1979 hit this province and killed an overall 2078 people.

By contrast, The Quest province with the city of Port-au-Prince and the Northern province with the city of Cap-Haïtien are characterized by a drastically accelerating urbanization since the second half of the twentieth century, which, in turn, exposed even more people to storm hazards. Governmental policies, however, are lacking in Haiti to increase the countries resilience against hurricanes and earthquakes.

Storm hazards also seems to shape people's preferences of where to settle in the past: When comparing the demographic development trajectories of both countries it becomes obvious that Haiti's South and Hispaniola's northern parts were in average less populated and exposed to higher storm hazards. This has changed in recent years with rapid population growth, especially in Haiti where people started to settle in areas that are hazard prone. Whereas the Dominican Republic's Southeast being on average more densely populated has been exposed by fewer storms. Perhaps as a consequence, and as a result of greater political stability compared to the Haitian capital, Port-au-Prince, this province shows the highest GDP per capita in 2007.

Another factor shaping vulnerability is income. In Haiti, more than half of its population lives on less than a dollar per day (United Nations Development Programme 2009a). With the lack of skilled labor and few employment opportunities, Haiti has an unemployment rate of about 70%. Cumulative figures of annual GDP show that Haiti’s economy, especially since the 1980s, neither grew nor managed to bounce back following major natural disasters. In 2009, Haiti's human development index ranks it at 149 of 182 at the bottom of the list among countries like Sudan, Tanzania and Ghana in sub-Saharan Africa (United Nations Development Programme 2009b). The levels of infant mortality rate, a robust indicator for development, has dropped to 72 per 1,000 newborn babies in 2008 but still remains high, compared to 33 in the Dominican Republic (The World Bank 2010).

Conclusion

Despite the slightly higher natural hazard risk (both in meteorological and seismic) in the Dominican Republic, each year, more people lose their lives due to flooding and earthquakes in Haiti. Over the years, the country's economy appears to be less resilient to natural disasters.

Haiti's history of frequent regime changes, political violence, weak governance, coupled with high population densities and low incomes has weakened the country's ability to prepare, cope with, resist, and recover from impacts of a tropical cyclones and earthquakes. This explains the high number of affected people, the displaced, injured and fatalities, in particular, during extreme and devastating events, such as the 2010 M7 earthquake near Port-au-Prince, which killed more than 220,000 people.

There is very little evidence that political change in either Haiti or the Dominican Republic was triggered through natural disasters apart from anecdotal evidence. Rather, both countries had practiced different natural hazard response strategies, in particular, in the second half of the 20th century. Not only was the Dominican Republic able to respond more effectively to natural disasters than Haiti due to its political and economic climate but also due to its environmental policies and practices. Little attention was given in Haiti to disaster preparedness and mitigation due to volatile security and political disorder. As result, the Dominican Republic with higher per capita income and political stability tend to be more resilient to cope with natural disasters than Haiti with a lower per capita income and political instability. Again, they might have been

amplified, in particular, by human-influenced factors compounding the severity of geohazards, such as massive deforestation. Environmental degradation (e.g., forest) and exploitation of natural resources (e.g., forest, water) have been accelerated since 1920's by increasing population growth and rural poverty (Dolisca et al. 2006).

Thus new approaches are needed that respond to local needs by nature protection policies, including educational measures of the public, legal to ensure environmental protection and sustainable forest management.

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