Tourist arrivals and climate risk indices: Impact of the ruggedness of climate risk conditions on tourism industry across the globe

Ryan O. Tayco[1]
Rosemarie Cruz-Español[2]
Grissil P. Babon[2]
Tourism and Hospitality Management Department[1]
Negros Oriental State University
College of Business Administration[2]
University of the Visayas
Tycs_ryn15@yahoo.com

Date submitted: January 23, 2014 Date accepted: June 30, 2014

ABSTRACT

The study demonstrates the use of methods associated with fractal statistics in the analysis of data roughness of the climate risk condition measured by a Global Climate Risk Index among countries in the world as this induces a subsequent ruggedness in the number of international tourist arrivals in the different countries. Results reveal that there are considerable amount of unevenness in the climate risk conditions of the countries studied and that such irregularities occur more apparently in the less stable and more risky nations. This finding implies that the weather patterns situation of a country, specifically climate risk condition, has considerable effects on international tourist arrival. Current findings lend support that changing climate and weather patterns at tourist destinations and tourist generating countries can significantly affect the tourists travel decisions. Theoretical implications of the study are discussed later in the study.

Keywords: *fractal statistics, global climate risk index, international tourist arrival*

I. INTRODUCTION

Tourism contribution is estimated at some 5 % of the GDP's of countries across the globe particularly in Asia-Pacific region. In the Philippines, tourism contributes 5.9 % to the GDP in 2011. Philippines is an archipelago comprised of 7, 107 islands. It offers a rich biodiversity with its tropical rainforests, mountains, beaches, coral reefs, islands, and diverse range of flora and fauna, making it as one of the mega diverse countries in the world. Tourism is reliant on an intact ecosystem and on influential structures that can respond to the needs of local and international visitors. Hence, governments strive to attract tourists through various strategies aimed at establishing an image of a desirable tourist destination for the country. It is said that an abundance of tourist sites and efficient services alone are not sufficient to guarantee a strong tourism industry. In another study, Tayco (2013) demonstrated that on top of a typical tourist's destination criteria is peace and safety of the destination. This study looks into how the roughness (variability) of the climate risk indices in various countries influence the corresponding variability or roughness of international tourist arrivals. The United Nations Development Program (UNDP, 2008) defines disaster as a serious destruction of nature causing extensive human, materials, environmental and trade industry fatalities which surpass the capability of the affected community or society to cope using its own resources. It is a must that every locality is prepared before the calamity occurs.

Disaster risk reduction involves elements to be contemplated hoping to lessen vulnerabilities and disaster risks to prevent and mitigate unfavorable effects (UNDP, 2008). According to Birkmann and Bogardi (2004), disaster risk consists of four elements: hazard, exposure, vulnerability, and capacity or measures. This present tudy focuses on fluctuation in the climate risk conditions in various countries in the international tourist arrivals across the globe.

According by UNWTO (2012), an ever expanding tourism destinations have started and invested in development, directing contemporary tourism into a prime operator of socio-economic development through revenues from export industry, establishment of employment and enterprises, and improvement of infrastructure. As a global marketed service, inbound tourism has become a major global trade industry. Inbound tourism generated US$ 1.2 Trillion (2011) or an average 3.4 Billion a day income from export taking in passenger transport. It accounts 30 % of the global trades of commercial services, while the overall export of goods and services is 6 %. Globally, it ranks fourth after fuels, chemicals and food. For a number of developing countries, it becomes one of the prime initiators of income from foreign exchange. As a top export industry, it generated much needed job opportunities necessary for development. For rich economies, it impacts the GDP ranging from 2 to 10 %. For developing countries, the leverage can be even stupendous in some tourist destinations that accounts for up to 25 %.

Harmeling and Eckstein (2012) warned that the world needs to accept the variability of climate and its effects to the tourism industry. More than 530,000 expired as an answering upshot of nearly 15,000 drastic weather conditions. In 1992-2011, Global losses of more than USD 2.5 trillion (in PPP) arose. The World Bank underlines the existential threats to the world and in particular the defenseless populace in developing countries would expect the 4 °C. The international community needs to avoid temperature increase that may affect the tourism industry across the globe. Harmeling and Eckstein (2012) explained that the Climate Risk Index assess the disaster risk. It points out an amount of risk and vulnerability to impactful conditions which nations should use in counteracting the crises. The most recent available data from 2011 and even for the period from 1992- 2011 were considered. But in the study, the researchers only use the data set for the year 2011 because of the unpredictable climate that happens every year across the globe. In 2011, 302 accounts of climate related disaster were recorded, where in more than 200 million were affected and roughly cost USD 366 billion economic damage (UNISDR, 2012). Most affected countries in the year 2011 were Thailand, Cambodia, Pakistan, El Salvador, the Philippines and Brazil. The investigation reaffirms that less developed nations are predominantly more affected compared to industrialized nations.

As said by UNWTO and UNEP (2008), the rapid variation in climate increased global awareness emphasizing the potential hazardous impact it may bring to the natural, human and economic resources. The tourism industry recognized that this is not a distant event but an existing circumstance that impacts the tourist destinations. Furthermore tourism industry also contributes in greenhouse gas emission (GHG), particularly the transportation system they are using as they travel from one destination to other.

The study looks into how the fluctuation in the climate risk conditions in various countries influence the corresponding variability of the international tourist arrivals across the globe.

II. Research Design and Methods

One hundred sixteen (116) countries across the globe were used in this study (these are the countries with complete data sets). Secondary data sets were also utilized. The Climate Risk Index (CRI) was collected from the Global Climate Risk Index Report by Harmeling and Eckstein (2012). Information on International Tourist Arrivals was obtained from the World Tourism Organization (UNWTO, 2013). The fractal dimensions of this data were determined.

The fractal dimensions of the two (2) variables, the international tourist arrival (y) and global climate risk index (x) were obtained by transforming the data sets into graphs. The one-dimensional representation of the variables in question tells how a straight line segment is fragmentized by the random variable in question. The degree of fragmentation or roughness is summarized in an index called the fractal dimension (λ). The fractal dimension is calculated through the box-counting method which is automated through the freeware *frak.out*.

The result of two-dimensional configuration (x,y) will reveal a fractal figure. The fractal dimension of this two-dimensional configuration is likewise obtained by the box-counting algorithm using the *frak.out* software.

In this paper, it investigates how the fractal dimension of the two (2) variables correlates each other. The results will look into how the roughness (variability) of the climate risk condition in various countries influence the corresponding variability or roughness of international tourist arrivals. The formula is as follows:

$$R^{\lambda} = 1 - (\lambda - 1)^{\sqrt{\lambda_x \lambda_y}}$$

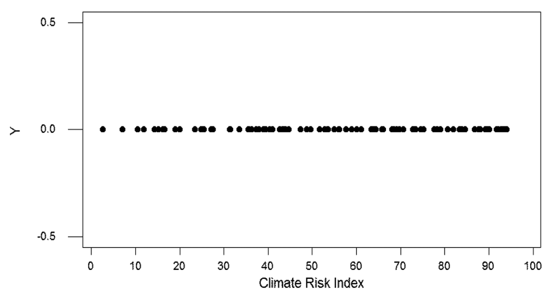
Where:
λ = fractal dimension of (x,y) plot
λx = fractal dimension of X
λy = fractal dimension of Y
$R\lambda$= roughness correlation

The analyses have the following steps. First, the data sets are converted into pictorial forms by creating graphs. For the independent variable (Global Climate Risk Index), the researchers used values of 0 as the dependent variable and values of CRI as the independent variable. They did a similar move for the dependent variable (International Tourist Arrival). This time, they used the value of 0 as the independent variable and the international tourist arrival as the dependent variable. Next, they plotted the relationship between the two variables on a graph. Then the fractal dimensions were obtained using the freeware *frak.out*. Lastly, they entered the result of fractal dimensions in the roughness correlation formula explicated above.

III. RESULTS

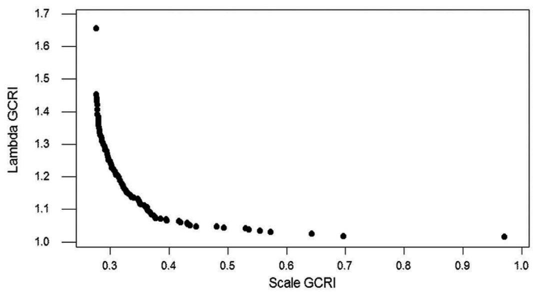
The results present the findings of the study conducted on the impact of climate risk on the international tourist arrivals across the globe. Figure 1 illustrates the fragmentation induced by the global climate risk index on the ruggedness of the climate risk condition across the globe.

Figure 1. Fragmentation or fractality induced by GCRI on nations across the globe



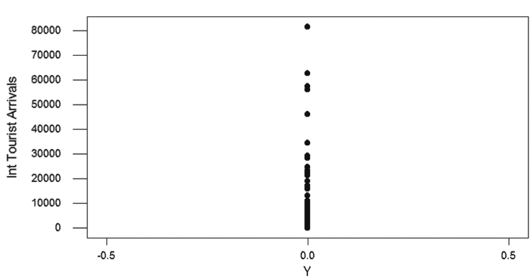
The computed fractal dimension is λ = 1.6204 which indicates that climate risk condition across the different countries in the world is quite rough and irregular. Fragmentations of the climate risk indices are revealed on both ends. These mean that variations of climate risk indices are found among countries with the lowest and highest variation, (increase or decrease). The fractal spectrum is displayed below for a deeper analysis of the situation.

Figure 2. Fractal Spectrum of the Global Climate Risk Index



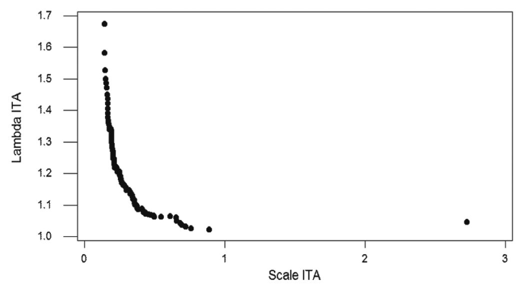
For countries belonging to the smaller scales, high fractal dimensions are noted while for countries belonging to the larger scales, low fractal dimensions are observed. In other words, they observe greater variability in the climate risk indices for countries with smaller GCRI scores like Thailand, Cambodia, Pakistan, El Salvador, the Philippines, Brazil, the United States of America, Guatemala, Sri Lanka and Honduras which are generally risky and are more irregular in terms of the GCRI. While countries that have higher GCRI scores are Swaziland, Suriname, Sierra Leone, Seychelles, Qatar, Senegal, Mongolia, Moldova, Macedonia, Luxembourg, Lesotho, Brunei Darussalam, Cape Verde, Cyprus, Egypt, Hong Kong, Iceland, Israel, Jordan, Latvia and United Arab Emirates, as the least risky countries and are relatively more homogeneous in terms of this index since their fractal dimensions are lower. Figure 3 shows the fragmentation of the countries induced by tourist arrivals.

Figure 3. Fragmentation or fractality induced by tourist's arrival on nations across the globe.



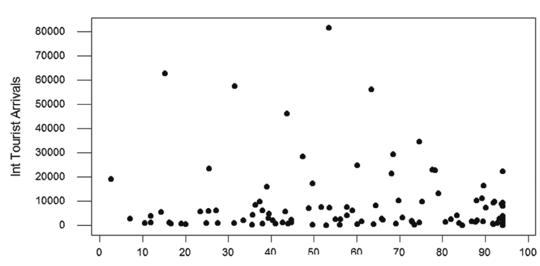
The computed fractal dimension is λ = 1.7590 which indicates that the international tourist arrivals across the different countries in the world are more rough and irregular compared to climate risk indices. The fractal spectrum is displayed for a deeper analysis of the situation:

Figure 4. Fractal Spectrum of the travel and tourism competitiveness



Countries belonging to the smaller scales have low fractal dimensions while countries belonging to the larger scale have high fractal dimensions. To be exact, they observe greater inconsistency for countries with larger tourist arrival because their fractal dimensions are higher. These countries include France, the United States of America, China, Spain, Italy, Turkey, United Kingdom, Germany and Malaysia. Countries that belong to lower scale and have the lowest international tourist arrivals are Sierra Leone, Moldova, Mali, Seychelles, Benin, Suriname, Madagascar and Burkina Faso.

Figure 5: Plot of international tourist arrival versus global climate index, Λxy = 1.29



As seen on the two variables, the Climate Risk Indices data set is more fragmented than the data on International Tourist Arrival. The fragmentations of CRI almost happen at all of its levels. On the other hand, fragmentations of International Tourist Arrival data only occur at the start to the middle. The calculated fractal dimension of the Global Climate Risk Index of countries across the globe amounts to 1.6204. The implication is that there is a wide range of variability in the climate risk condition of the country across the globe considered in the study with greater uniformity for the least risky country and higher variability across countries that are most risky. In other words, the researchers observe greater variability in the climate risk indices for countries with smaller CRI scores i.e. Thailand, Cambodia, Pakistan, El Salvador, the Philippines, Brazil, the United States of America, Guatemala, Sri Lanka and Honduras. Generally, countries that are risky are more variant in terms of the Global Climate Risk Index. In contrast, more risky countries are relatively fluctuating in terms of this index since their fractal dimensions are higher. The same can be said in the roughness and irregularity of the tourist arrivals with a computed fractal dimension of 1.7590. To be exact, they observe greater inconsistency for countries with more tourist arrivals. These countries include France, the United States of America, China, Spain, Italy, Turkey, the United Kingdom, Germany and Malaysia.

When the two variables were simultaneously analyzed for roughness, it resulted in a fractal dimension of 1.2903. The roughness correlation measure is therefore $R\lambda = 0.8792$. That is, around 87.92 % of the variability in the tourist arrivals in the countries is accounted for by their global climate risk ratings. It appears that score ratings of GCRI correspondingly induce a reduction in the roughness of international tourist arrival. Specifically, the countries that are not risky have higher international tourist arrival than the countries which are generally risky.

The link between climate change and international tourist arrival is evident. Climate is a fundamental resource for tourism considering that tourist patronizes the beach, nature and winter sport tourism events. Variations in the climate and weather patterns can notably disturb the comfort and travel decisions among tourists. This alters the demand and tourist flows which will eventually trouble the tourism industry. Climate change issue has emerged as one of increasing importance to the tourism and hospitality industries in terms of both the potential contribution of tourism to climate change and its effects to each other (UNWTO & UNEP, 2008).

Cavallo and Noy (2010) investigated on the economics of natural disaster by summarizing the state of the economic literature and examining the aggregate impact of disasters. Further, this reviews the main disaster source available, discusses the determinants of the direct effects, and distinguishes between short and long- run indirect effects. Then, relevant policies were identified; make projections about future disasters, and gaps in literature. The study is related to the present study in terms of the investigation of disaster and its effects but this present one looks into how the fluctuations in the climate risk conditions have made significant effects to the international tourist arrival of countries.

It should be noted that tourism business partakes a primal part in facing the challenges of climate change. The impressive increase of arrivals offers both challenges and opportunities. The patrons and service providers both acted to this over the years and noticeably threaded up its response. There is currently an explicit understanding of the industry's role solving issue (UNEP, 2008). This evidence develop awareness among government administrations, policy makers and tourism stakeholders to heedfully examine the effects of tourism policies for climate change mitigation.

IV. DISCUSSION

The consequence of these observations is extensive. Important considerations, such as the climate risk condition of the locality topped in the foreigner's list of preferred vacation places. The climate risk condition in various countries influence the corresponding international tourist arrivals. When the country is relatively not risky, more tourists are expected to visit on those countries.

The top countries for International Tourist Arrivals are mostly from developed nations especially the European countries. Together with Asia and the Pacific, Europe surpassed expectations in 2011 with a growth of 6 % for international tourist arrivals. In spite of unrelenting economic doubt, international arrivals in the year 2011 to Europe reached 504 million, accounting for 29 million of the 43 million additional international arrivals recorded across the globe. But for the Climate Risk Indices, that mostly on the highest ranking, are countries that are mostly affected on severe weather events in 2011 and these countries are always prone to typhoon and flood i.e. Thailand, Cambodia, Pakistan, El Salvador, the Philippines, Brazil, the United States of America, Guatemala, Sri Lanka and Honduras which are generally risky and are more irregular in terms of the GCRI scores. The lowest ranking and seldom to have catastrophic event are countries that belong to the Sub-Saharan and Middle East Countries.

The relationship between global climate risk index and international tourist arrival is obvious. For example, in most developed countries, tourist arrivals have been increasing every year and most of the countries with higher CRI scores are countries like France, the United States, China, Italy, Turkey, the United Kingdom, Germany and Malaysia.

For example, the incident in Central Philippines due to Typhoon Yolanda caused catastrophic destruction in the Visayas, particularly on Samar Island, Leyte, Northern Cebu and Panay Island causing undesirable impact on the country's image as a preferred tourist destination. Travel advisories issued by other countries to their citizens against Philippines as tourist destination do not help bolster the tourism prospects for the entire country because even if the advisories are specific to Visayas, these translate to the country as a whole by mere association.

In general, global climate risk condition of the locality is the utmost reason in choosing countries of preferred vacation places. This study looks into the roughness of the climate risk condition as basis of tourist arrival across the globe. In their decisions and actions for travel and destination, tourists are advised to take account the climate risk conditions as part of their considerations. Foreign tourists are advised to read the GCRI as their precautionary measure. Frequent events or rare, but extraordinary catastrophes may happen when they visit certain tourist's destination. Hence, the importance of having an effective and concrete disaster risk reduction program in all locales is undisputable.

V. CONCLUSION

In this paper, the researchers offer evidence on the effects of climate risk condition of countries on tourism. They found out that variations or roughness in climate risk condition induces the roughness in the level of international tourist arrival across the globe. The current evidence lends proof that the weather patterns of a country, specifically climate risk condition, has considerable effects on international tourist arrival. Climate change and unpredictable weather affect tourist decisions and arrivals in tourist destinations. International travellers naturally choose to go to reliable and safe places even if the tourist sites in these countries are not as attractive as those in the Asia-Pacific regions.

Originality Index:	95 %
Similarity Index:	5 %
Paper ID:	464259009
Grammarly:	Checked

REFERENCES

Blanke, J., & Chiesa, T. (2013). The Travel & Tourism Competitiveness Report 2013. *In The World Economic Forum*. Cologny/Geneva Switzerland.

Bogardi, J., & Birkmann, J. (2004). Vulnerability assessment: the first step towards sustainable risk reduction. *Disaster and Society–From Hazard Assessment to Risk Reduction. Logos Verlag Berlin, Berlin*, 75-82.

Cavallo, E., & Noy, I. (2010). The economics of natural disasters. *IDB Working Paper Series,* IDB-WP-124. Inter-American Development Bank. Department of Research and Chief Economist.

Highlights, U.T. (2012). *UN World Tourism Organization Tourism Highlights* (2012 ed.). Retrieved from http://mkt.unwto.org/en/publication/unwto-tourism-highlights-2012-edition.

Highlights, U. T. (2013). *UN World Tourism Organization Tourism Highlights* (2013 ed.). Retrieved from http://mkt.unwto.org/en/publication/unwto-tourism-highlights-2013-edition.

Laukkonen, J., Blanco, P. K., Lenhart, J., Keiner, M., Cavric, B., & Kinuthia-Njenga, C. (2009). Combining climate change adaptation and mitigation measures at the local level. *Habitat International*, 33(3), 287-292.

Most, W.S., & Weather, E. (2012). *Global Climate Risk Index 2013*.

Padua, R., et al. (2013). *Statistical fractal inference*. Unpublished manuscript.

Simpson, M.C., Gössling, S., Scott, D., Hall, C.M., & Gladin, E. (2008). *Climate change adaptation and mitigation in the tourism sector: Frameworks, tools and practices*. UNEP, University of Oxford, UNWTO, WMO: Paris, France.

So, P. (2008). *Philippine Tourist Destinations*. Binondo, Manila: Action Holidays Tour Corporation.

Tayco, R. (2013). Tourist arrivals and peace indices: Ascertaining the impact of the irregularities and ruggedness of peace situation on tourism across the globe. *NORSU, Prism*, 18(1).

UNEP (2007). Disaster risk reduction in tourism destinations. *Disaster reduction through awareness, preparedness and prevention mechanisms in coastal settlements in Asia-demonstration in tourism destinations*. Milan, Paris, France: UNEP.

UNEP (2008). Disaster risk management for coastal tourism destination responding to climate change. *A practical guide for decision-makers*. Paris, France: UNEP.

UNEP (2008). Disaster risk reduction. *A toolkit for tourism destinations: Practical examples from coastal settlements in Asia.* Paris, France: UNEP.

UNEP & FU (2008). UN collaborative programme on reducing emissions from deforestation and forest degradation in developing countries (UN-REDD). *Framework document.*

UNICEF & UNDP (2008). Improving local service delivery for the millennium development goals. *Restoring the image of Blue Mongolia: Rural water supply & sanitation, Ulaanbaatar*.

United Nation International Strategy for Disaster Reduction (2013). *Business resilience top agenda for future disaster risk reduction.* Retrieved from http://www.thejakartapost.com/news/2013/05/28/business-resilience-top-agenda-future-disaster-risk-reduction.html

UNWTO & WMO (2007, 2008). Climate change and tourism: Responding to global challenges. *Advanced Summary*, October.

UNWTO (2013). UNWTO Tourism highlights. Retrieved 3rd October 2013 from http://mkt.unwto.org/en/ publication/unwto-tourism-highlights-2013-edition.pdf

World Bank Group (2012). *World development indicators 2012*. World Bank Publications.

APPENDIX

Country	Climate Risk Index	Int'l Tourist Arrivals	Country	Climate Risk Index	Int'l Tourist Arrivals
1. Albania	93.33	2865	33. Estonia	82	2665
2. Algeria	44.67	2395	34. Ethiopia	92	523
3. Argentina	43.33	5705	35. Finland	57.67	4192
4. Armenia	91.83	758	36. France	53.5	81552
5. Australia	23.5 5	875	37. Georgia	44.67	1319
6. Austria	77.67	23012	38. Germany	47.33	28352
7. Azerbaijan	87.83	1562	39. Greece	89.67	16427
8. Barbados	94.17	568	40. Guatemala	16.17	1225
9. Belgium	51.67	7494	41. Honduras	19	871
10. Benin	84.67	209	42. Hong Kong SAR, China	94.17	22316
11. Bolivia	31.33	946	43. Hungary	69.83	10250
12. Bosnia and Herzegovina	49.67	392	44. Iceland	94.17	566
13. Brazil	14.33	5433	45. India	27.17	6309
14. Brunei	94.17	242	46. Indonesia	57.67	7650
15. Bulgaria	59	6328	47. Iran	70.67	3354
16. Burkina Faso	56	238	48. Ireland	48.83	7134
17. Cambodia	7	2882	49. Israel	94.17	2820
18. Cameroon	60.17	604	50. Italy	43.67	46119
19. Canada	39	16016	51. Jamaica	72.83	1952
20. Cape Verde	94.17	428	52. Japan	38	6219
21. Chile	39.33	3137	53. Jordan	94.17	3900
22. China	31.5	57581	54. Kazakhstan	83.5	4093
23. Colombia	33.5	2045	55. Kenya	61.17	1750
24. Costa Rica	40.33	2192	56. Korea, Republic	37.33	9795
25. Croatia	92.17	9927	57. Kuwait	73.5	269
26. Cyprus	94.17	2392	58. Latvia	94.17	1493
27. Czech Republic	93.83	9019	59. Lebanon	86.83	1655
28. Denmark	53.67	7363	60. Lesotho	94.17	398
29. Dominican Republic	35.67	4306	61. Lithuania	89.5	1775
30. Ecuador	74.67	1141	62. Luxembourg	94.17	863
31. Egypt	94.17	9400	63. Macedonia	94.17	327
32. El Salvador	11.83	1184	64. Madagascar	35.5	225

Country	Climate Risk Index	Int'l Tourist Arrivals
65. Malawi	69.17	767
66. Malaysia	60.17	24714
67. Mali	52.83	160
68. Mauritius	92.83	965
69. Mexico	25.5	23403
70. Moldova	94.17	75
71. Mongolia	94.17	460
72. Morocco	92	9342
73. Namibia	27.5	1027
74. Nepal	38	736
75. Netherlands	89.33	11300
76. New Zealand	55	2601
77. Nicaragua	24.83	1060
78. Nigeria	38	715
79. Norway	39.5	4963
80. Pakistan	10.5	1000
81. Panama	80.83	1473
82. Paraguay	20	524
83. Peru	56.17	2598
84. Philippines	11.83	3917
85. Poland	79.17	13350
86. Portugal	90.17	7412
87. Qatar	94.17	2500
88. Romania	73	1515
89. Russia	78.33	22686
90. Saudi Arabia	49.67	17400
91. Senegal	94.17	1001
92. Serbia	41	764
93. Seychelles	94.17	194
94. Sierra Leone	94.17	52
95. Singapore	88	10390
96. Slovenia	88.17	2037
97. South Africa	64.5	8339
98. Spain	63.5	56177
99. Sri Lanka	16.5	856
100. Suriname	94.17	220
101. Swaziland	94.17	879
102. Sweden	75.33	9959
103. Switzerland	36.33	8534
104. Tanzania	44	843
105. Thailand	2.5	19230
106. Turkey	74.67	34654
107. Uganda	42.67	1151
108. Ukraine	68.17	21415
109. United Arab Emirates	94.17	8100
110. United Kingdom	68.5	29306
111. United States	15.17	62711
112. Uruguay	65.83	2857
113. Venezuela	64	595
114. Vietnam	25.33	6014
115. Zambia	84	906
116. Zimbabwe	66.17	2423

Source: *Global Climate Risk Index 2013* (Harmeling and Eckstein, 2012) and the *World Tourism Organization* (UNWTO, 2013)