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Sea level Rise impact on Singapore, Solomon Island, Saint Vincent and Grenadines, Trinidad and Tobago, Tuvalu

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Abstract

Coastal areas of smaller islands are vulnerable to global sealevel rise due to climate change. But the impact in the current scenario is threatening because of the human preference for living in Coastal areas. The impact will be very devastating sometimes like total submergence. In this study, the sealevel of 1m, 2m, 3m, 4m, 5m rise and its influence on Singapore, Solomon Island, Saint Vincent and Grenadines, Trinidad and Tobago, Tuvalu has been studied and its submergence area has been calculated using the screen shots for various sea level rise of 1, 2, 3, 4 and 5 meters obtained from the website http://flood.firetree.net/ and it is then digitized using ArcGIS to calculate the submergence area.

Keywords: Sea level rise, flood, Island, Singapore, Solomon Island, Saint Vincent, Grenadines, Trinidad, Tobago, Tuvalu, Flood tree

Introduction

The climate *can* clearly explains that the system is in equilibrium, where the incoming radiation is balanced by outgoing radiation. The change in equilibrium leads to climate change. Climate change will have impact over global mean climate/temperature which in turn increases drought condition, reduction in agriculture, coastal erosion and sea level rise etc. But it will have more contrasting regional implications. In some areas temperatures may not rise for several years, but rainfall occurrence may change, and tropical cyclone activity may also get altered. Climate change: The figure-1 explain the global mean temperature obtained from various climate models for over a period of 160 years. The global mean temperature starts to increase after the 20th century. From IPCC report the changes are related to global warming due to increase in green house gases which trap the outgoing radiation[1].

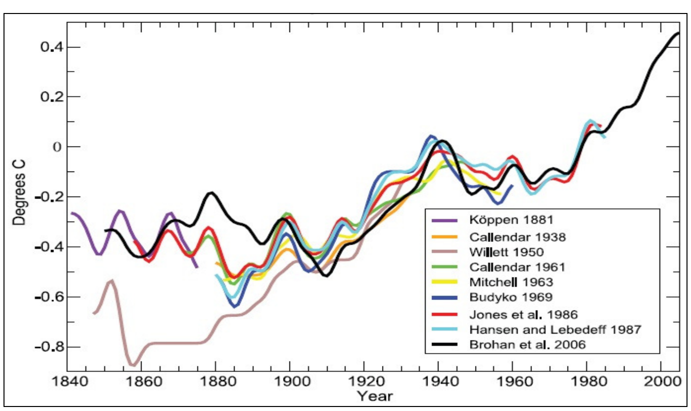

Figure-1
Published Global Mean Surface Temperature over large region[1]

From IPCC 2007 the change in sea level is obvious and it affects major part of the land scape. Figure-2 shows, Increase in sea level between 1992 and 2007. This is computed from satellite altimetry data. The dots represent ten days estimates and the dark blue line represents 60 days smoothing. Figure-3 explains the variation over past 5 decades in rate of increase sea level rise. The curves are the observed readings from various tide gauge stations. Some tide gauge station experienced larger rates of coastal sea level rise than open ocean rates.

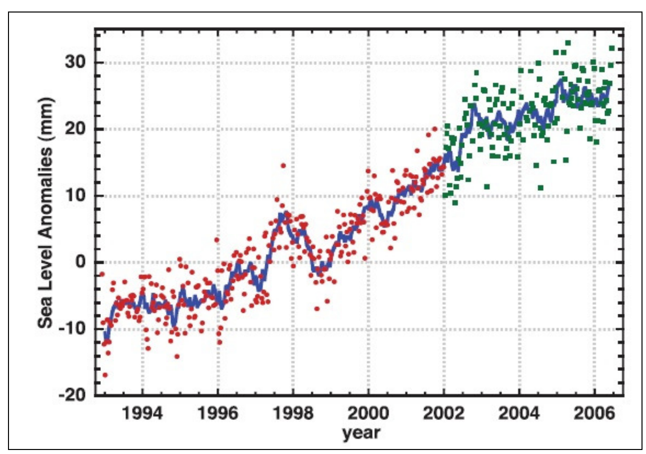

Figure-2
Variations of Global mean sea level[1]

The reduction in Greenland ice sheet is projected to be continued, since the negative mass balance is sustained over 100 years which completely melts Greenland ice sheet in future. Hence the sea level rise after 2100 is estimated to be 7m due to increase in temperature of about 1.9°C to 4.6°C which results in rapid increase of precipitation levels[1].

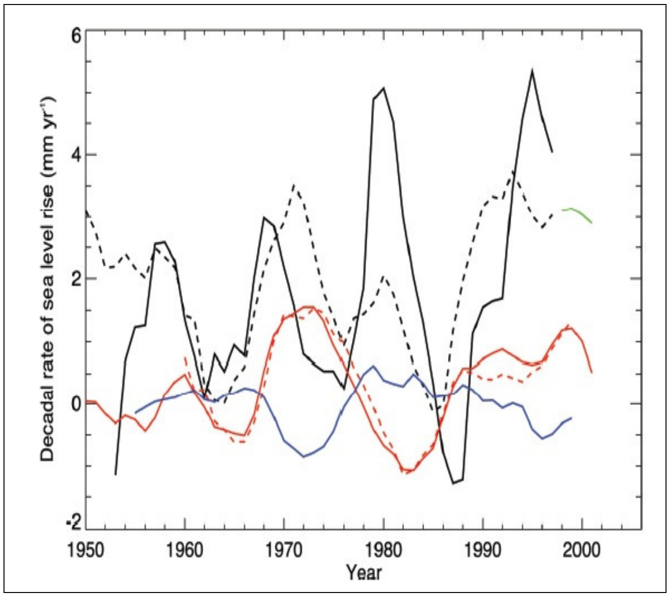

Figure-3
Overlapping 10 year global sea level rise rates in mm.yr^{-1} obtained from tide gauge data set[1]

Methodology

Based on the report of David Anthoff, et al., the sea level rise scenario is obtained from Global DEM and LOICS data, a similar consideration is made for this analysis[2]. The various islands that are found to be vulnerable are analysed for sea level rise of 5m and the total area of impact is determined for each 1.0m rise of sea level. The study by John A. Church, et al., has evaluated the consistency of the sea level rise with geological data and found that some detailed studies are required to predict much accurate sea level rise, and hence for the analysis[3], the screen shots for various sea level rise of 1, 2, 3, 4 and 5 meters is obtained from the website http://flood.firetree.net/ (Data provided by NASA), which provides the vulnerable area that is likely to be damaged[4]. Then the images are digitized using ARCGIS to determine the exact area of impact.

Study Area: i. Singapore: Total area: 696 Sq.Km, 100 Sq.Km of coral, low lying, population: 4,740,737, ii. Solomon Island: Total area: 5450 Sq.Km, 20% is covered by coral, mostly rugged mountains, population: 571,890, iii. Saint Vincent and Grenadines: Total area: 369 Sq.Km, 140 Sq.Km of coral, volcanic mountains, population: 103,869, iv. Trinidad and Tobago: Total area: 5170 Sq.Km, 40 Sq.Km of coral, plain and low mountains, population: 1,227,505, v. Tuvalu: Total area: 18.6 Sq.Km, 25% of worlds coral reef, low lying and narrow, population: 10,544.

Results and Discussion

Based on the following GIS output results shown in figure-4 to figure-33 the inundation area is calculated and tabulated in table-1

Figure-4
Singapore with Sealevel at 0m

Figure-5
Singapore with Sealevel at 1m

Figure-6
Singapore with Sealevel at 2m

Figure-7
Singapore with Sealevel at 3m

Figure-8
Singapore with Sealevel at 4m

Figure-9
Singapore with Sealevel at 5m

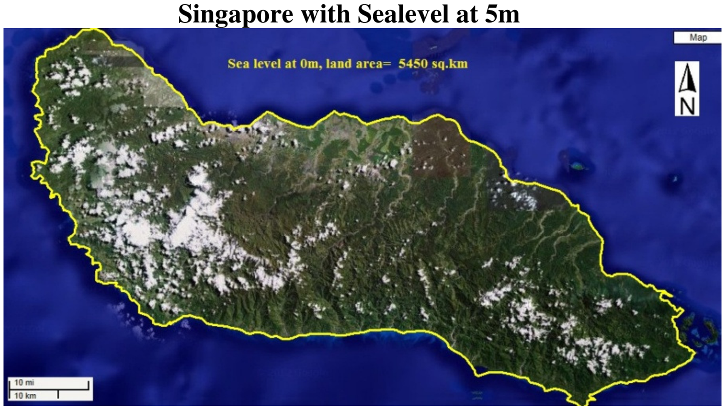

Figure-10
Solomon Island with Sealevel at 0m

Figure-11
Solomon Island with Sealevel at 1m

Figure-12
Solomon Island with Sealevel at 2m

Figure-13
Solomon Island with Sealevel at 3m

Figure-14
Solomon Island with Sealevel at 4m

Figure-15
Solomon Island with Sealevel at 5m

Figure-17
Saint Vincent and the Grenadines with Sealevel at 1m

Figure-16
Saint Vincent and the Grenadines with Sealevel at 0m

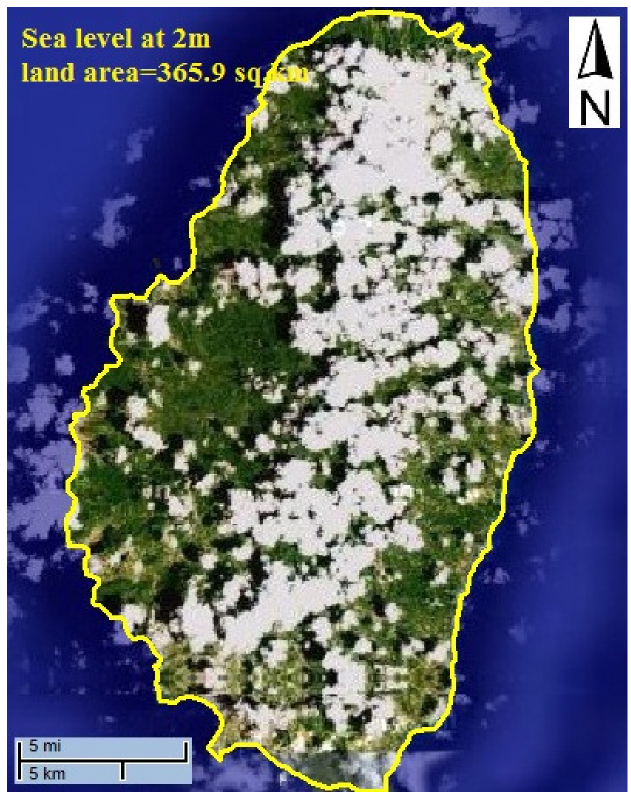

Figure-18
Saint Vincent and the Grenadines with Sealevel at 2m

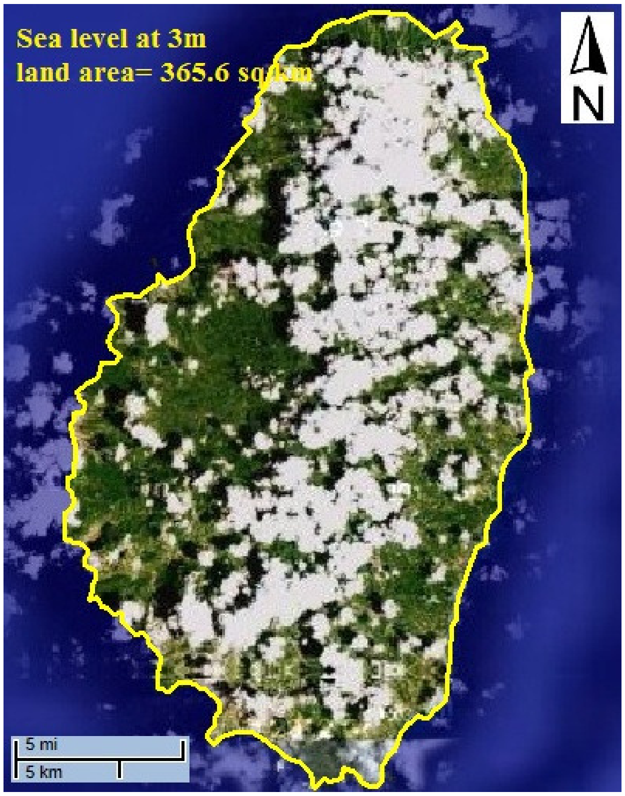

Figure-19
Saint Vincent and the Grenadines with Sealevel at 3m

Figure-20
Saint Vincent and the Grenadines with Sealevel at 4m

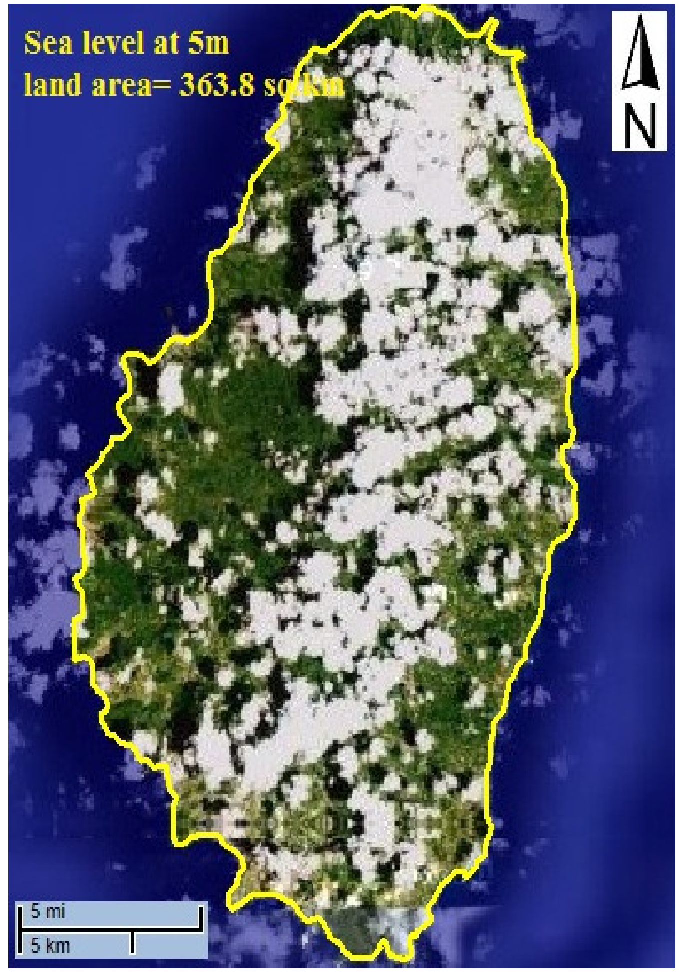

Figure-21
Saint Vincent and the Grenadines with Sealevel at 5m

Figure-22
Trinidad and Tobago with Sealevel at 0m

Figure-23
Trinidad and Tobago with Sealevel at 1m

Figure-24
Trinidad and Tobago with Sealevel at 2m

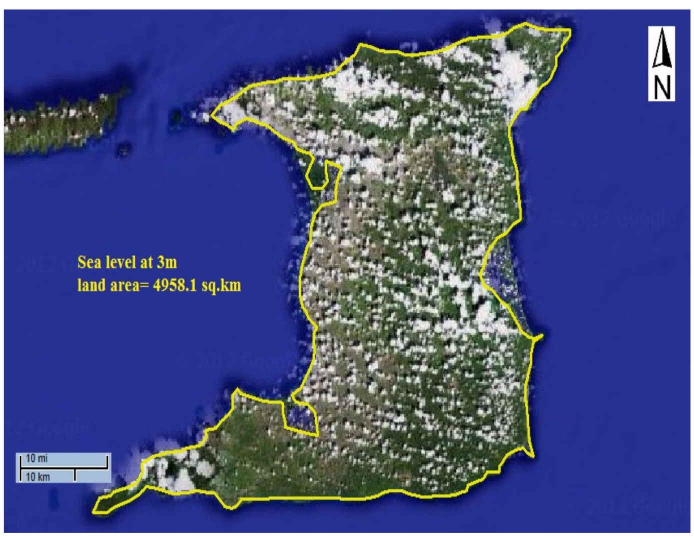

Figure-25
Trinidad and Tobago with Sealevel at 3m

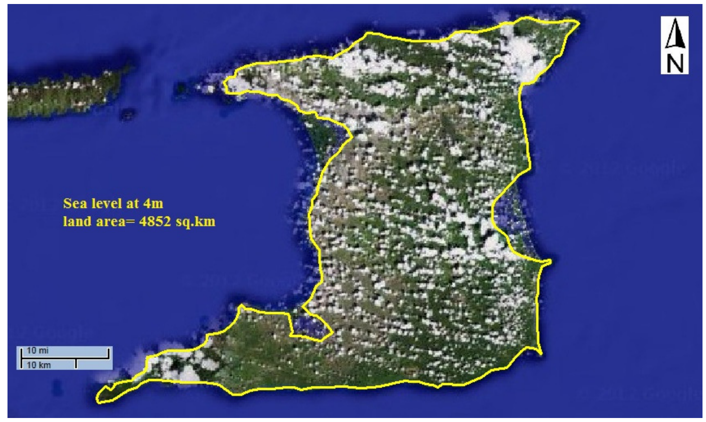

Figure-26
Trinidad and Tobago with Sealevel at 4m

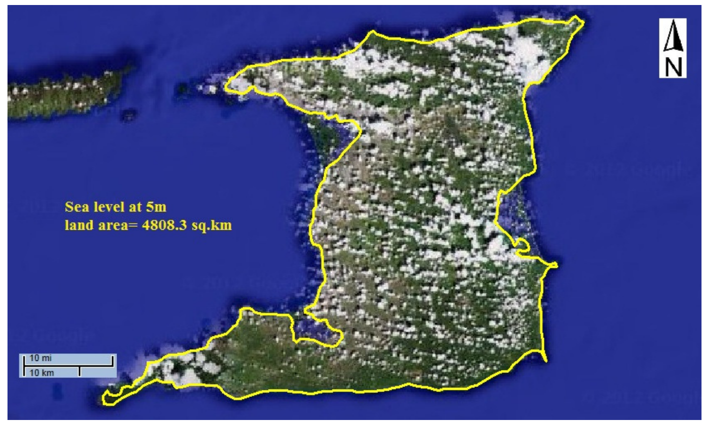

Figure-27
Trinidad and Tobago with Sealevel at 5m

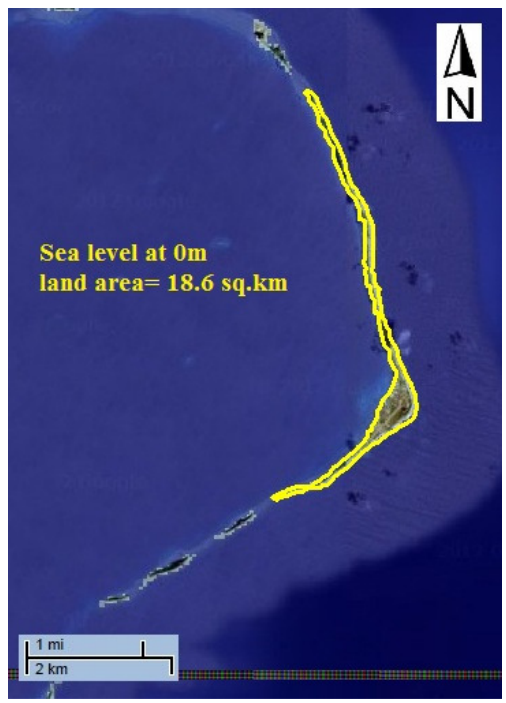

Figure-28
Tuvalu with Sealevel at 0m

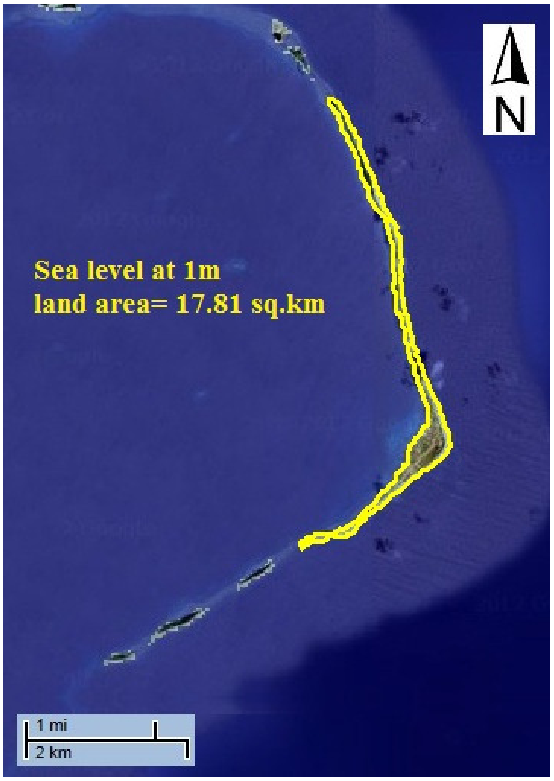

Figure-29
Tuvalu with Sealevel at 1m

Figure-31
Tuvalu with Sealevel at 3m

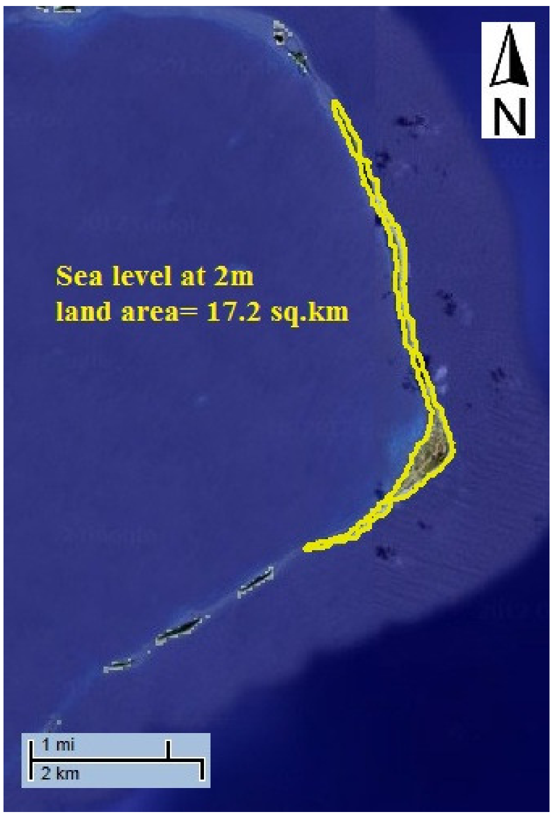

Figure-30
Tuvalu with Sealevel at 2m

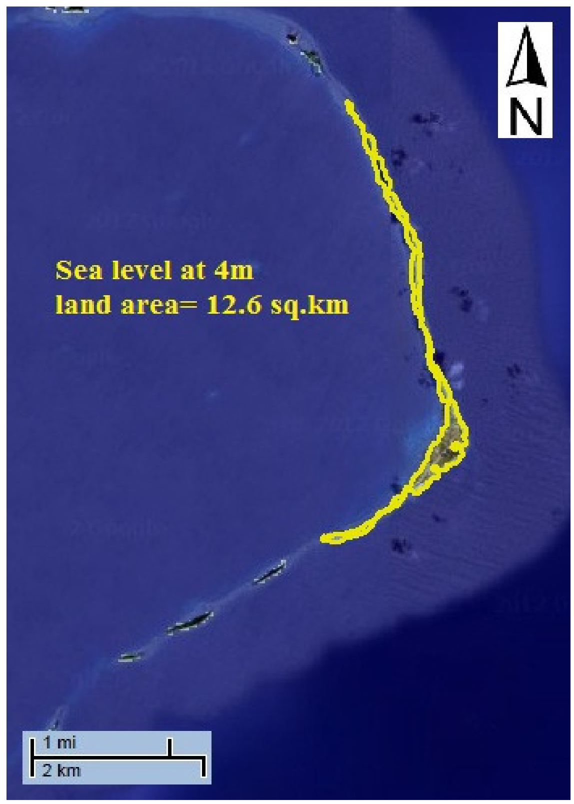

Figure-32
Tuvalu with Sealevel at 4m

Table-1
Inundation Area

S.No	Island	Total Area Measured in Sq.Km	Affected area by sea level rise				
			of 1m in Sq.Km	of 2m in Sq.Km	of 3m in Sq.Km	of 4m in Sq.Km	of 5m in Sq.Km
1.	Singapore	696	9.9	13.3	21.2	28.2	55
2.	Solomon Island	5450	39.4	78.1	99.6	122.1	187.7
3.	St Vincent and the Grenadines	369	1.2	3.1	3.4	3.9	5.2
4.	Trinidad and Tobago	5170	59.3	141	211.9	318	361.7
5.	Tuvalu	18.6	0.79	1.4	3.4	6.0	9.38

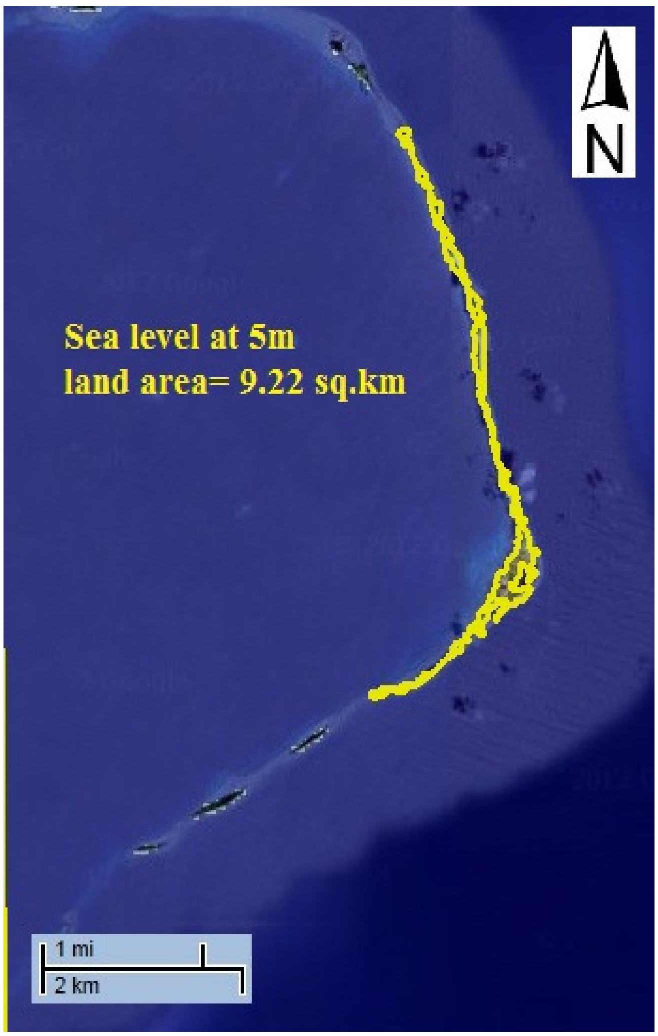

Figure-33
Tuvalu with Sealevel at 5m

Conclusion

The total affected areas for various islands are analysed for different sea level rise scenarios. These predictions can be used for future planning of infrastructure and for tourism development. A detailed study can be conducted based on the uncertainties and risk as mentioned in the report by Hay.J.E, etal., 2001 which clearly highlights about the possible impacts to Small Island States[5].

References

1. Solomon S., Qin D., Manning M., Chen Z., Marquis M., Averyt K.B., Tignor M. and Miller H.L. (eds.)., Climate Change 2007: The Physical Science Basis, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, United Kingdom and New York, NY, USA, **(2007)**

2. Anthoff D., Nicholls R.J., Tol R.S.J. and Vafeidis A.T., Global and regional exposure to large rises in sea-level: A sensitivity analysis, Working Paper 96, Tyndall Center for Climate Change Research, Norwich, UK **(2006)**

3. Church J.A. and White N.J., A 20th century acceleration in global sea-level rise, Geophysical Research Letters, 33:L01602 **(2006)**

4. *http://flood.firetree.net/* **(2013)**

5. Hay J.E., Suarez A.G., Poh Poh Wong, Briguglio L., Ragoonaden S., Small Island States, Chapter-17, Climate Change 2001 Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change Cambridge, United Kingdom 2001, 845-870 **(2001)**