## E203

## Mapping the nighttime light changes in Ishikawa Prefecture after the Noto Earthquake

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The Noto Peninsula Earthquake that occurred on January 1, 2024 resulted in significant lasting impact in Ishikawa Prefecture costing direct damages costing roughly 2.6 Trillion yen. The direct impacts can be detected from space. However, information on the indirect impacts of the earthquake and their spatial distribution remain sparse. NTL data holds a great potential in mapping the economic impacts due to its relationship with economic indicators such as GDP. A recent study has shown that nighttime light (NTL) data can be used as proxy for socioeconomic variables in Japan (Otomo, 2021). Further, NTL datasets have a finer resolution than the available socioeconomic variables allowing for a more spatially granulated observation. However, most studies using NTL to determine impacts focused mostly on the immediate damages. Further, the use of NTL to determine economic impacts in Japan has been limited. Hence, this research asked the following research questions: 1) can NTL detect the impacts of the Noto Peninsula earthquake? 2) how did NTL change in Ishikawa Prefecture after the earthquake?

For this study, NTL data from the Suomi National Polar-orbiting Partnership Visible Infrared Interferometry Suite Day and Night Band was used. Monthly and annual composites were downloaded from the Earth Observation Group Payne Institute for Public Policy at the Colorado School of Mines. These were further preprocessed to eliminate the negative values, remove background noise, and replace cloud pixels. They were then aggregated to the available GDP data scale. In Japan, GDP is available at the national quarterly scale. Hence, the national quarterly GDP was compared with the NTL data aggregated to the national quarterly scale. Regression models were generated to determine whether NTL can be a suitable proxy for GDP. Then, changes in NTL brightness as an indicator of economic impacts were mapped by comparing pre- and post- earthquake datasets.

Results showed that there is a one-way relationship between GDP and NTL where GDP can explain NTL but NTL cannot explain GDP. This means that GDP can be explained by other factors. On the other hand, the increase in NTL can be largely explained by GDP. This implies that a reduction in GDP can be equivalent to a reduction in NTL. By this relationship, we can map out the most affected areas saying that the areas with reduced NTL would have an equivalent reduction in GDP.

Then, an NTL change index (NTLC) was computed by averaging the previous years' NTL and subtracting it from the post-earthquake value from January to May. The results showed significant reduction in the NTL in January 2024 and February for the Ishikawa prefecture. The NTL started increasing in the prefecture except for the most affected spots, generally the locations of damaged structures. However, the presence of clouds obscured the observations for January and February.

	Dependent variable:							Dependent variable:		
	lnNTLs (1)	lnGDP (2)	lnMFGIPI (3)	InMFGOR (4)	nMFGPC (5)	lnGVAMFG (6)		lnGVA1 (1)	1nGVA2 (2)	lnGVA3 (3)
InGDP	1.024 (0.644)						lnNTLs	-0.050 (0.162)	0.097 (0.059)	0.055
InNTLs		0.058 (0.037)	0.121 (0.078)	0.153 (0.101)	0.003 (0.008)	0.103 (0.066)	factor(qq)2	-0.043	0.059	0.029
factor(qq)2	-0.573*** (0.041)	-0.003 (0.024)	0.038 (0.050)	0.060 (0.066)	-0.002 (0.005)	0.060 (0.043)	factor(qq)3	-0.040	0.047*	0.019
factor(qq)3	-0.364*** (0.035)	0.004 (0.016)	0.036 (0.034)	0.046 (0.045)	-0.004 (0.003)	0.049* (0.029)	factor(qq)4	-0.027	0.024	0.008
factor(qq)4	-0.147*** (0.035)	0.023** (0.009)	0.034* (0.020)	0.023 (0.026)	-0.003* (0.002)	0.025 (0.017)	~~~~	(0.041)	(0.015) 0.011***	(0.011)
уууу	-0.001 (0.004)	0.004*** (0.001)	-0.009*** (0.002)	-0.013*** (0.002)	-0.005*** (0.0002)	0.014*** (0.002)		(0.004)	(0.001)	(0.001)
Constant	5.424 (7.632)	3.453* (1.746)	21.040*** (3.715)	29.035*** (4.840)	13.705*** (0.364)	-17.297*** (3.170)	Constant	(7.722)	-12.7/6*** (2.839)	(1.997)
Observations R2 Adjusted R2 Residual Std. Error (df = 40) F Statistic (df = 5; 40)	46 0.912 0.901 0.080 82.785***	46 0.649 0.605 0.019 14.765***	46 0.484 0.420 0.041 7.518***	46 0.475 0.410 0.053 7.247***	46 0.943 0.936 0.004 132.572***	46 0.677 0.636 0.035 16.751***	Observations R2 Adjusted R2 Residual Std. Error (df = 40) F Statistic (df = 5; 40)	46 0.048 -0.071 0.084 0.405	46 0.654 0.611 0.031 15.139***	46 0.266 0.175 0.022 2.904**
Note: *p<0.1; **p<0.05; ***p<0.01							Note:	*p<0.1;	**p<0.05;	***p<0.01



Although obscured by the clouds, NTL can reveal the spatial distribution of economic impacts due to the Noto Peninsula Earthquake. Further research is necessary to validate the current results. Future research could prolong the analysis period to estimate the long-term impacts.

## References:

1. Otomo, S. 2021. The correlation between Night Light and Economic and Social Indicators in Japan. Theory and Applications of GIS, Vol. 29, No. 1, 23-28.