
Greening Energy Market and Finance

First GrEnFin Summer School

Team Works Presentation:
Section 7 - The most significant effects of climate change (Vulnerability matrix)

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Vulnerability

- **According to the IPCC*:**
 - *"[Vulnerability is] the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt."*
 - **Vulnerability = Risk (predicted adverse climate impacts) – Adaptation****
- *"Vulnerability assessment is more than measuring potential harm using information about climate impacts. It includes an assessment of the region's or sector's ability to adapt."***
 - **Risk** → Analysis of the solar installation's exposure to a given climate change effect and its sensitivity to this effect → **Vulnerability matrix**
 - **Adaptation measures**
- Vulnerability matrices for two different locations:
 - Bologna, Italy
 - Manila, Philippines
- Climate change effects that we analyse ➡ ➡ ➡

* IPCC Report Glossary. ** Downing, T.E. & Patwardhan, A. (2005). *** The European Climate Adaptation Platform Climate-ADAPT.

Sensitivity matrix

Object	Area	Area							
		Air temperature increase	Rainfall change	Average wind speed change	Sea level rise	Storms	Flooding	Wild fire	Air quality
Solar installation	Mechanical damage to installations	Yellow	Green	Green	Green	Red	Red	Red	Yellow
	Energy production from installations	Yellow	Yellow	Green	Green	Red	Red	Red	Red
	Access to the installation	Green	Green	Green	Green	Red	Red	Red	Yellow



Climate change effects that we analyse:

- Air temperature increase
- Storms
- Flooding
- Wild fire
- Air quality



Vulnerability matrix for Bologna, Italy

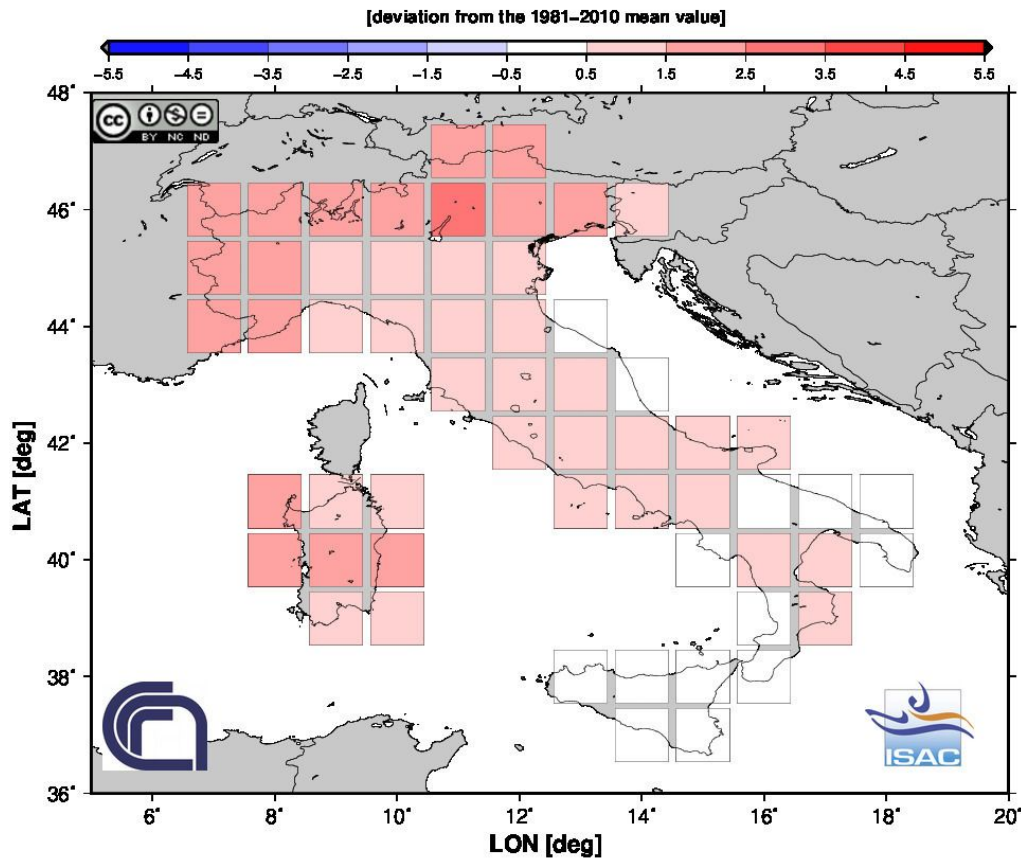
		<i>Exposure</i>		
		<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>Sensitivity</i>	<i>Low</i>			
	<i>Medium</i>	Air temperature increase Air quality		
	<i>High</i>	Flooding	<i>Wild fire</i>	<i>Storms</i>



The mean temperature - from 1981 to 2010

Analysis implemented by SAC CNR Bologna

http://www.isac.cnr.it/~climstor/climate/latest_month_TMM.html



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LINZ CREWUM 2011

AIR QUALITY:

Number of days in 2017 in which the daily average exceeds $50\mu\text{g}/\text{m}^3$ (Emilia Romagna, Italy)

<https://apps.arpae.it/qualita-aria/bollettino-qa-provinciale/bo>



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The other effects in our vulnerability matrix:

- Storms: Two are the main catastrophic effects
 - 1) Damage to the system ➡ stop production
 - 2) Storms dropped near the solar farm: installation of surge protector and lightning-rod
- Wild fire: we referred mostly to arsons
- Flooding: very unlikely in Bologna



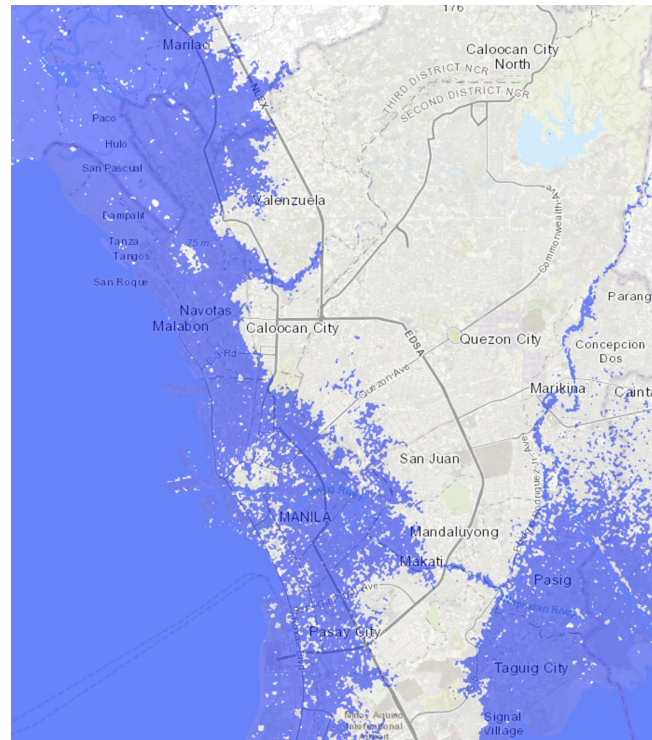
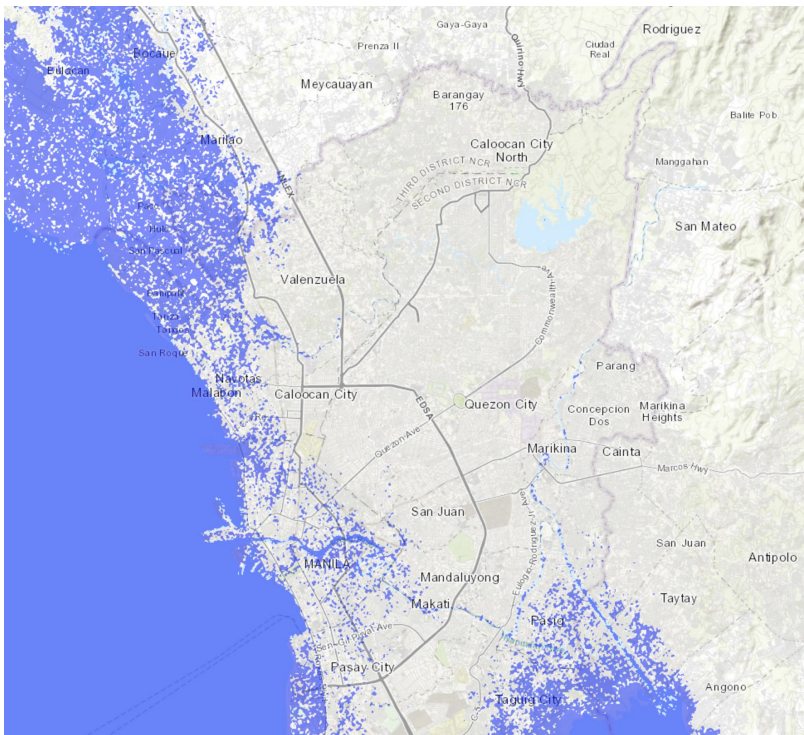
Vulnerability matrix for Manila, Philippines

		<i>Exposure</i>		
		<i>Low</i>	<i>Medium</i>	<i>High</i>
<i>Sensitivity</i>	<i>Low</i>		Average speed wind change	Rain change
	<i>Medium</i>		Air quality Wild fire Air temperature increase	
	<i>High</i>			Storms Flooding Sea level rise



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Flood simulation - 5m (left) and 10m (right)



Source: floodmap

Co-funded by the Erasmus+ programme of the European Union

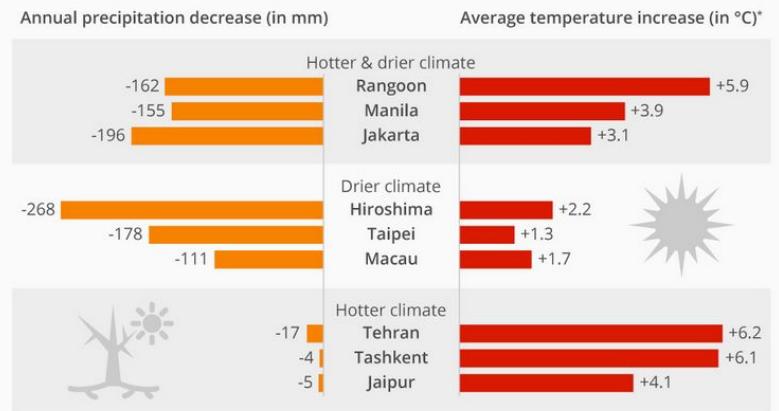
LINK CREATION TOOL



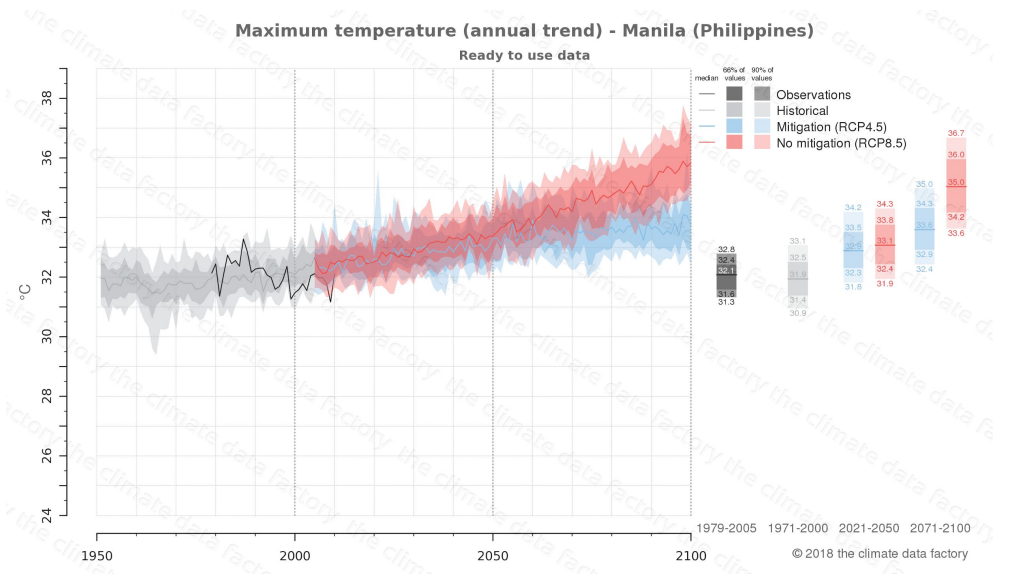
Air temperature increase scenarios - medium level

Asian Cities to Experience Climates Extremes

Projected average temperature increase/precipitation decrease in selected cities until 2050



* in warmest month of the year
Source: Jean-Francois Bastin et al: Understanding climate change from a global analysis of city analogues, Plos One Journals



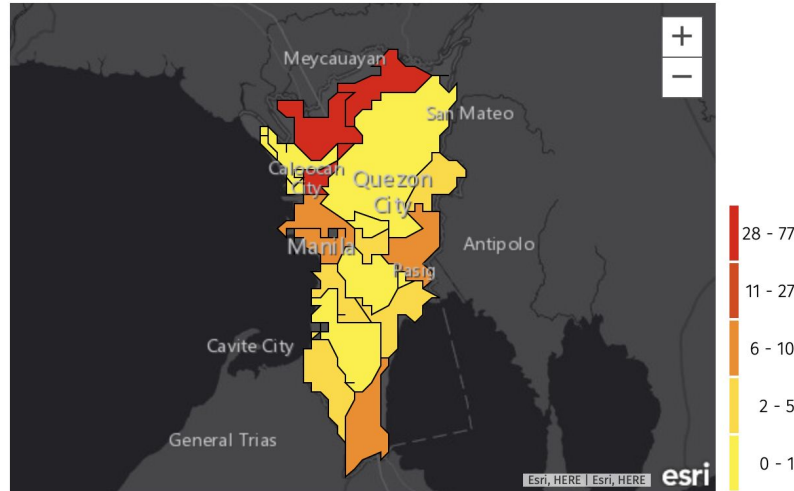


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Wildfire alerts over the past year - medium level

GREATEST NUMBER OF FIRE ALERTS BY CITY 10 JUN 2019 - 9 JUN 2020

Subregion	Province	#
Kalookan City	Metropolitan Manila	77 ●
Valenzuela	Metropolitan Manila	27 ●
Muntinlupa	Metropolitan Manila	10 ●
Manila	Metropolitan Manila	7 ●
Pasig City	Metropolitan Manila	7 ●
Las Piñas	Metropolitan Manila	5 ●
Marikina	Metropolitan Manila	3 ●
Pasay City	Metropolitan Manila	2 ●
Mandaluyong	Metropolitan Manila	1 ●
Taguig	Metropolitan Manila	1 ●



The air quality index PM 2.5 for Manila

Air
Pollution
Level

Good

Moderate

Unhealthy
for
Sensitive
Groups

Unhealthy

Very
Unhealthy

Hazardous



Manila Center, Philippines past 12 months daily average AQI

[Download the CSV data for Manila Center, Philippines](#)

Data Sources

Department of Environmental Management Bureau (EMB) - Air Quality Management Section

Daily Data

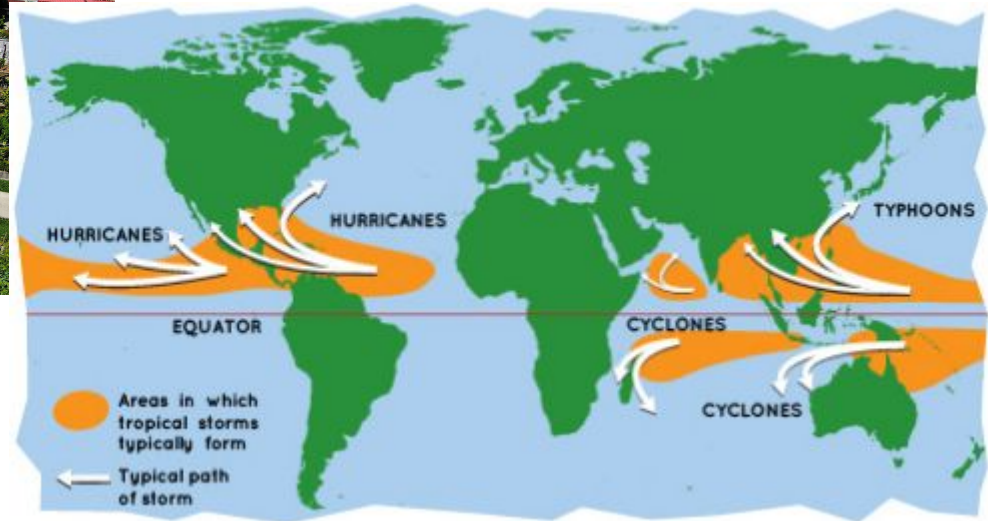
PM_{2.5} NO₂

Summary		Days of the month																																																	
2018																																																			
Aug	3 4	28	23	22	20	26	39	33																																											
Jul	16	23	21	28	21	19	23	26	47	36	19	24	18	19	26												20	24	50				32	22	20	26	23	24	23												
Jun	6	15	67	41	33	28	54	53	61	31	33	10	14	19	20	27	33	28	23	21	24	31	34	49	45	47	68	41	60	58	41	21																			
May	3	10	4	14	18	61	31	73	38	50	53	35	70	82	54	51	58	56	53	29	31	39	54	71	70	45	79	85	70	41	44	46																			
Apr	5	10	3	39			6	27	42	46	37	47	58	53	2												37	38	33	38	62	1	1	1																	
Mar	10	4	10	19	6	3	4	2	19	24	22	15	20	42	42	53	78	58	71	75	58	49	51	76	75	67	48	54	72	77	74	78	69	89																	
Feb	11	15	2	61	72	58	56	68	55	57	73	61	78	78	67	43	51	63	84	38	29	31	34	62	39	36	48	57	34	43	31																				
Jan	5	10	8	49	55	49	51	43	72	28	62	53	55	55	45	108	122	114	106	136	96	117	73	89	75	98	104	89	86	79	82	54	112	68																	
2017																																																			
Dec	10	8	9	129	119	130	127	107	118	113	105	117	80	97	78	102	85	96	122	52	99	108	91	59	58	69	64	52	62	76	58	65	50																		
Nov	2	9	8	1												78	110	81	64	75	54	99	95	59	41	58	76	77	61	75	64	49	56	61	57																
Oct	1	8	12	87			54	85	71	62	49	76	61	80	63	28	28	31	42							70	71	24	40	47	51	63	44	52	64	51															
Sep	2	2	1																																										45	30	61	97	91	51	131

Note: the daily AQI is based on the 24 hours average of hourly readings.



Rising sea level, Tropical Storms



Source: The New York Times, NASA

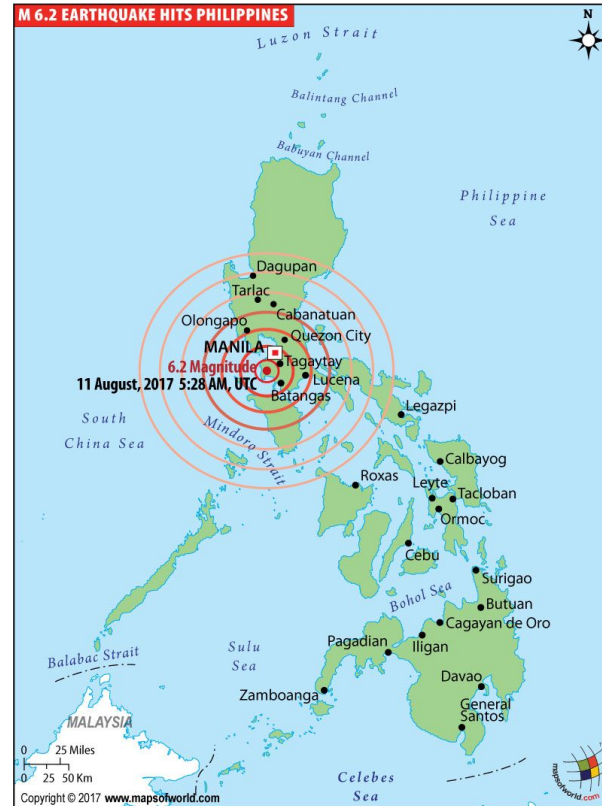
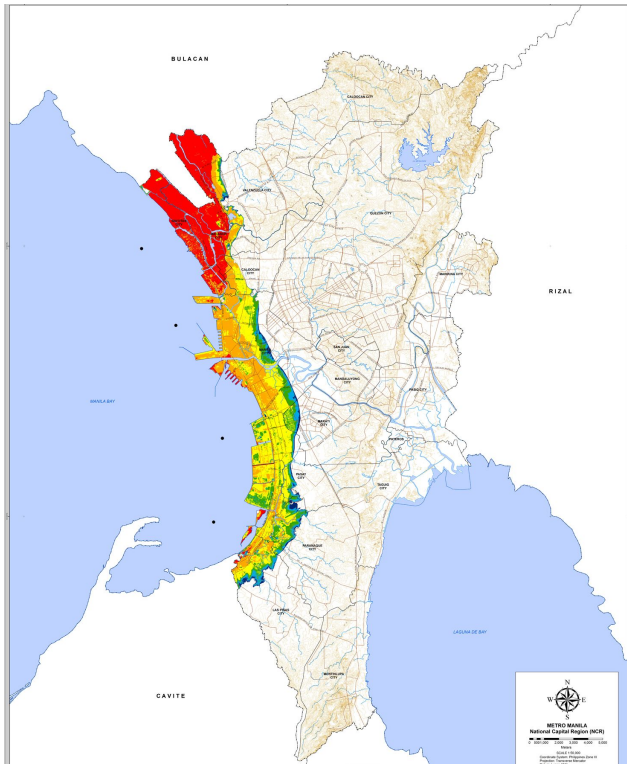


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Tsunamis, earthquakes



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