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Space as a Tool to Address Climate Challenges: Case Study of Hong Kong



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Abstract

Hong Kong (HK) is an international city containing small plain and hilly topography, so its' intensive urban development becomes inevitable. Explosive urbanization and human activities bring greenhouse gases (GHG) emission and climate change. Space technology, meanwhile, is proposed to combat the climatic problem. Pressure-State-Response (PSR) framework will be used in this research to examine whether the space technology can mitigate the climate challenge in HK community. Space technology can provide us accurate information like atmospheric situation and weather prediction. However, the COVID-19 pandemic gives variables to the progress of developing space technology and extent of climate change.

1 Introduction



Figure 1. View of Hong Kong with Cloudy Sky

Climate change is undoubtedly a long-term and headachy issue in the 21st century. Some youth leaders like Greta Thunberg have strongly expressed their dissatisfaction regarding the issues of climate crisis and resource exploitation. Unfortunately, developed cities like HK require the large amount of natural resource and release much GHG. Being an internationally financial centre, HK can adopt the space technology as a solution to combat the climatic challenge. This essay explores the climatic challenges and sources, discussing the space satellite technology as a tool adopted in HK.

2 Research Questions

1. What are the climatic challenges, caused by human activities, in HK?
2. How does space satellite technology mitigate this issue in HK?
3. What are the concerns of space technology implemented in HK?

3 Methodological Pressure-State-Response Framework

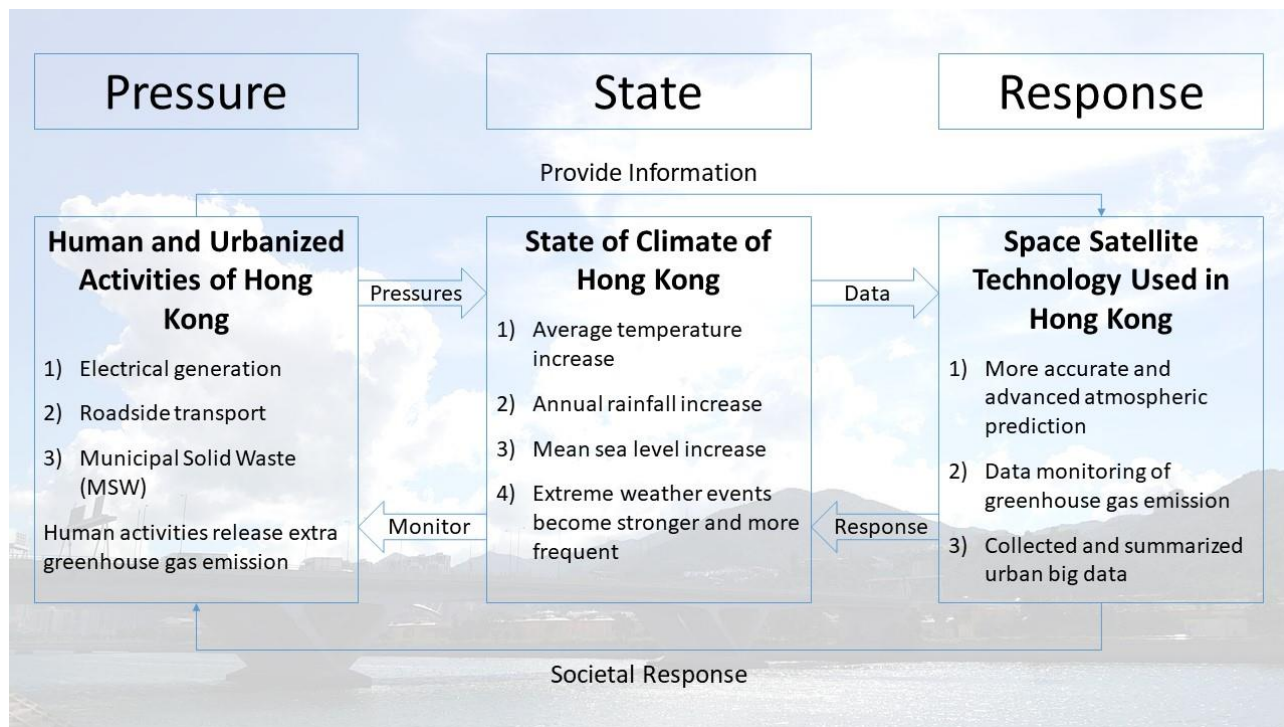


Figure 2. Pressure-State-Response (PSR) Framework applied in Hong Kong

This research uses Pressure-State-Response (PSR) framework to analyze the effectiveness of space satellite technology. It is a conceptual framework created by the Organization for Economic Co-operation and Development (OECD) in 1994 (Su, Chang, & Hsieh, 2005, p.496). Pressure comes from human activities exerted on the environment including natural resources (OECD, n.d.). State means the environmental quality and the related effects of being exploited (OECD, n.d.). Response represents the extent which society, consisting several stakeholders like public, property developers, conservationists and government, makes a response to the environment (OECD, n.d.). “There is a strong interplay between climate change, human activities and state of natural resources” (OECD, 2014, p.1), (Figure 2.).

4 Pressures and Challenges given by Climatic Factors in Hong Kong

The enormous amount of GHG is mainly released from the electrical generation, roadside transport and municipal solid waste (MSW). According to the Environment Bureau (2019), the total emission of carbon dioxide (CO₂) was 40.7 million tonnes in 2017. The electrical generation is the main source of GHG emission in HK since there are huge residential, commercial and industrial demands of

electricity. Also, there are majority of working places in Kowloon and HK Island and households in New Territories, the transport demands and capacity are large in HK (**Figure 3.**). For the municipal solid waste (MSW), the disposal amount is large in HK, especially the medical waste like wearing mask currently. The MSW dumped in landfill releases methane (CH₄) which is another type of GHG absorbing more solar energy in atmosphere. Extra GHG emission changes the climatic state of HK.



Figure 3. Hong Kong Map Indicating New Territories, Kowloon, HK Island, & Lantau Island (Panda Guide, 2015)

The average temperature, annual precipitation, mean sea level of Victoria Harbour and extreme weather events have been increasing in HK because of the anthropogenic GHG emission. The rising rate of mean temperature was 0.21°C per decade between 1990 and 2019 as the acceleration according to the Hong Kong Observatory (HKO) (2020a). Moreover, the mean sea level of South China Sea increased approximately 3 cm per decade (HKO, 2020b), that means HK necessarily faces the submerged problem in the future. The extreme weather events including heavy rain and typhoon have become more frequent, because the hourly rainfall record was broken six times since 1880s (HKO, 2020c). Therefore, the climate disasters only become stronger and more frequent in HK.

5 Space Satellite Technology is a Practical Tool for Hong Kong

Space satellite technology observes the GHG emission and environmental phenomenon, making weather prediction of the Earth. A series of space technology consists of meteorological satellites, telecommunication, navigation and earth observation satellites (OECD, 2014, p.2). It simultaneously

narrows the research gaps of human knowledge and reduces uncertainty of future projections (OECD, 2014, p.2). For the hydrological phenomenon, the collected data provides unexpected information for monitoring oceanic situation like the El Nino 1997-98 event as a feature of climate change (OECD, 2014, p.2). Also, it would be better if the space satellites monitor the GHG concentration and its human-caused increase to illustrate the relationship between the climate change and human activities. All in all, data is collected to the society to make a suitable response combating changing state (**Figure 2.**).



Figure 4. Desalination Plant in Hong Kong (Water Supplies Department, 2019)

What space satellite technology can provide to HK is a series of urban big data about GHG emission and weather situation. Besides the electrical generation, roadside transport and MSW management, satellite should also monitor the GHG emission of seawater desalination plant in HK which will be expectedly completed in 2022 (**Figure 4.**). It provides locally drinking water to HK citizens, but it also intensifies the GH effect. Satellite systems measure and monitor their GHG emission in HK (OECD, 2014, p.2), and these data are summarized through Geographic Information System (GIS) and disclosed to the public by the governmental departments and educational institutions. The social stakeholders can obtain these data and realize the emergency of climate change, taking their responses by changing their lifestyles.

6 Concerns of Using Space Technology in Hong Kong

The functions of space technology should be fully utilized if its preciseness and accuracy can overtake the **speed of climate change**, but the developing cost becomes more expensive. Term of **climate change** has gradually been replaced by **climate emergency**, because the climate change becomes urgent for human to take actions against it. It has been declared by many countries and regions, but HK government has still not declared it. However, extreme weather events have happened more frequently and stronger in HK, especially the first black rainstorm warning about 3 hours at midnight on 6th June 2020. It is observed that the atmosphere and weather are predicted with gradual difficulty due to its changing. Also, the higher performance of satellites requires human and financial resources.

The current challenges we face are the changing atmospheric situation and costly development of satellites.

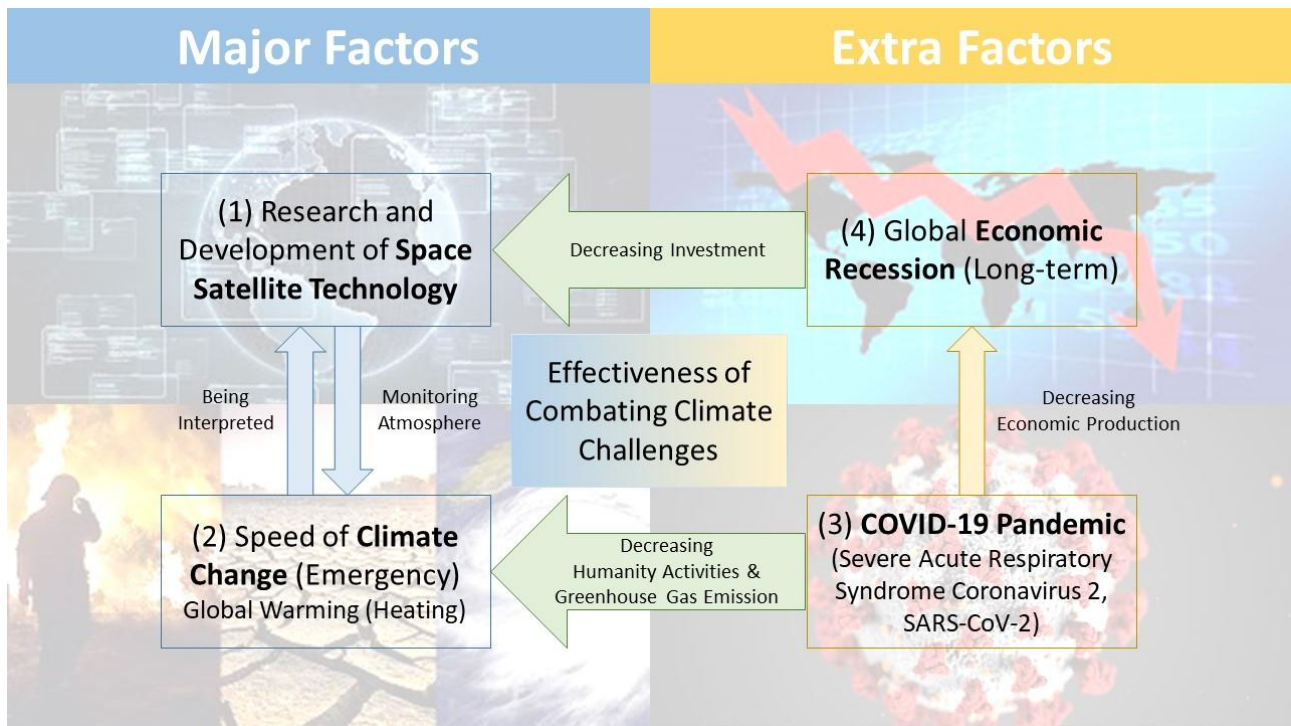


Figure 5. Contributing Factors of Effectiveness of Combating Climate Challenges

Another concern is how the changes of (1) research and development levels of space and (2) speed of climate change are affected by the COVID-19 pandemic. The COVID-19 pandemic frustrates the Sustainable Development Goals (SDGs) by bringing health crisis and economic downtown (United Nations Development Programme, n.d.). The investment activities will be reduced undoubtedly. The progress of scientific research of space technology may be obstructed. Moreover, the pandemic also reduces atmospheric GHG (carbon dioxide) emission by 1600 million tonnes this year (Australian Academy of Science, 2020), so the speed of climate change may be slower. However, we need to reflect whether the pandemic reduce the effectiveness of combating climate challenges through space technology (**Figure 5.**).

7 Conclusion

What space technology provides us is the accurate information of the Earth, so that we can take actions to face the challenges, especially the climate change. In HK, the sustainable development is promoted insufficiently. Space technology is merely a monitoring tool, but achieving SDGs still requires the international cooperation and high citizen awareness about climate emergency and environmental conservation.

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