

Perspectives on Multi-facet Impacts of Global Warming to the Hydrosphere and Cryosphere

Thian Yew Gan, Professor, University of Alberta, Edmonton, Canada
Lead Author, AR6-WGI, Intergovernmental Panel of Climate Change (IPCC)
Research Ambassador, German Academic Exchange Service (DAAD)
LEWI Fellow, Hong Kong Baptist University

Man has benefited from consuming shared resources such as air and freshwater and return their wastes back into the shared resources. However, tragedy arises when man fails to recognize that consumptive activities of some could lead to a significant impact of many - the destruction of the integrity of shared resources, such as the current global predicament of climate change impact on the hydrosphere and cryosphere. In recent decades, the world has suffered significant environmental changes such as hydrologic extremes, melting glaciers and ice caps, wetlands drying and shrinking, sea level rise, forest fires, and many natural disasters causing serious damage, massive property losses and even deaths, such as such as the 2013 Alberta flood of Canada, Congo flood of 2019-2020, European floods of 2021 in Belgium, Germany, the Netherlands, and Switzerland, and many others. A warmer climate means the atmosphere will be loaded with more water vapor which is fuel for developing intensive storms and hurricanes. Conversely, rising temperature can also give rise to prolonged moisture deficit or droughts in arid/semi-arid regions, resulting in loss of multibillion dollar revenues from agriculture, leading to famine and even humanitarian crisis, such as that of Nigeria and Somalia in 2017. Perspectives on the global energy balance, greenhouse effects and examples of observed changes to the hydrosphere will be presented. Future climate scenarios projected by general circulation models (GCMs) of the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007), the 5th Coupled Model Intercomparison Project (CMIP5) of IPCC (2013), the 6th Coupled Model Intercomparison Project (CMIP6) of IPCC (2021), and case studies based on regional climate models and land surface schemes will be discussed. The discussions will also include possible implications to the future global climate, hydrology, and water resources under the potential impacts of climate change.

Besides climate change impact to the hydrosphere, the cryosphere is also undergoing rapid changes during the 20th and the early 21st Century, such as significant retreat of glaciers worldwide; thinning of Arctic sea-ice extent and thickness by about 40% in late summer in recent decades; snow cover of the Northern Hemisphere decreased by about 10% in area since global observations by satellites began in the late 1960s; degradations of permafrost detected in some polar and sub-polar regions, and the total 20th Century global average sea level rise was about 0.17m. Possible implications to the future global cryosphere under the potential impact of climate change will be discussed.

ABOUT THE SPEAKER

Thian Yew Gan is a professor of civil & environmental engineering of the University of Alberta specializing in water resources, hydrology, cryosphere, remote sensing, and environmental impact of climate change. He is a research ambassador of DAAD (German Academic Exchange Service), a fellow of the American Society of Civil Engineers (ASCE), and a Lead author of AR6WGI and contributing author of AR6-WGII of Intergovernmental Panel of Climate Change (IPCC). He is the recipient of the ASET Technical Excellence Award of 2017, and 14 international fellowships from USA, Japan, Switzerland, France, Sweden, Singapore, New Zealand, Hong Kong, Germany, Finland and Australia. He has published over 155 refereed journal papers in various reputable international journals, e.g., Nature Publishing Group, and two books, "*Global Cryosphere, Past, Present and Future*", 1st and 2nd editions by the Cambridge University Press. He has been a visiting professor/fellow to University of Western Australia (2023), University of Tokyo (2022), University of Washington-Seattle (2022), RWTH Aachen, Germany (2022), University of Philippines-Visayas (2019), Southern U of Science & Technology (2019), Hong Kong University, Hong Kong Baptist University & Ludwig Maximilian University, Germany (2019, 2017); Chinese University of Hong Kong (2016, 2017, 2019); Isaac Manasseh Meyer Fellow of National U. of Singapore (2014), Tan Chin Duan fellow of Nanyang Technological U. of Singapore (2013); visiting professor of Aalto University, Finland (2013, 2017, 2022); visiting scholar of United Nation University (UNU-FLORES), Germany (2013); Rossby Fellow of Stockholm University, Sweden (2012); Erskine Fellow of University of Canterbury, New Zealand (2011); Visiting professor of Swiss Institute of Technology (EPFL), Lausanne, Switzerland (2010); Research Scientist of Cemagraf, France (2009); CIRES Visiting Fellow of University of Colorado-Boulder (2007); DAAD and University professor of the highest academic rank (W3) of Technical University of Munich, Germany (200607); Adjunct professor of Utah State University, USA (1998-2005); Honorary Professor of Xian University of Technology and Yangtze University of China; JSPS Fellow of Kyoto University (2000) and guest professor of Saga University (1999) of Japan, and assistant professor, Asian Inst. of Technology (1989-1990), Bangkok.