PROFESSOR P. R. PISHAROTY
Distinguished Lecture

IMPROVED ESTIMATES OF 20TH AND EARLY 21ST CENTURY GLOBAL SEA-LEVEL RISE

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Meghdoot-Auditorium,
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Dr. Homi Bhabha Road, Pashan, Pune-411008, India.

by

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Indian Meteorological Society, Pune Chapter
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Professor Pisharoth Rama Pisharoty - the father of the Indian Remote Sensing Programme, a distinguished meteorologist and a space scientist of international repute was born on 10th February 1909 at Kollengode, Palghat District, Kerala. Starting with his early education in Kerala, Prof. Pisharoty had a brilliant academic career in Trichinopoly and Chennai (Madras State), Bangalore and Los Angeles, and worked with the Nobel Laureate Sir C.V. Raman, at the Indian Institute of Science, Bangalore. He began his professional career as a Lecturer in Loyola College, Chennai in 1935 and later joined as a Senior Officer in the India Meteorological Services in 1942, where he conducted research on thunderstorms, western disturbances, monsoon depressions, orographic rain etc. Prof. Pisharoty then joined the University of California where he came in close contact with world renowned meteorologists like Professors Jacob Bjerkenes, Holmboe, Jule Charney, Neilburger, Yale Mintz and Wurtele. During this time, he was engaged in investigations of atmospheric general circulation and published two reports entitled "*Some aspects of geostrophic poleward flux of sensible heat"* and "*The kinetic energy of the atmosphere"*. After obtaining his MS and PhD degrees in 1954, he returned to India.

Prof. Pisharoty was the Director of the Colaba Observatory, Mumbai (Bombay) during 1959-1962 and also directed the International Indian Ocean Expedition (IIOE) programme (1961-62). He became the Founder Director of the Institute of Tropical Meteorology, Pune (now known as the Indian Institute of Tropical Meteorology, IITM) in 1962 and was instrumental in nurturing the Institute in its initial formative years. Following his retirement from IITM in February 1967, Prof. Pisharoty was invited by Prof. K.R. Ramanathan and Dr. Vikram Sarabhai as a senior professor of Aeronomy at the Physical Research Laboratory (PRL), Ahmedabad. At this point, he was instrumental in introducing remote sensing technology to India. His pioneering experiment of detection of coconut wilt-root disease using Soviet aircraft and US equipment was considered to be the first success in remote sensing in India.

Prof. Pisharoty served as the Director, Remote Sensing and Satellite Meteorology, at the ISRO Space Applications Centre, Ahmedabad during 1972-75. He was a Member of the Scientific Advisory Board of World Meteorological Organization from 1963 to 1968 and later its Chairman. He also served as the Vice-President of the International Association of Meteorology and Atmospheric Sciences, and as a Executive Member of the Joint Organising Committee for Global Atmospheric Research Programme from 1969 to 1977. He worked at the PRL until the early nineties when he retired for health reasons. Prof. Pisharoty contributed to a good number of research papers in national and international journals and wrote a number of books on the Indian Monsoon and related topics.

Prof. Pisharoty was elected a Fellow of the Indian Academy of Sciences in 1957 and a Fellow of the Indian National Science Academy in 1978. In recognition of his contributions, he was awarded the prestigious Padma Shri national civilian award of the Indian government in 1970. He was the first recipient of the Raman Centenary Medal in 1988. He was awarded the IMO Prize by the WMO in 1989. He was also conferred the K. R. Ramanathan Medal established by the Indian National Science Academy in 1990. He died on the morning of September 24, 2002 at Pune, at the age of 93. Prof. Pisharoty continues to remain as a major inspiration for many young meteorologists and will be fondly remembered for his inimitable style of inaugurating scientific meetings, seminars and symposia with invocation of Sanskrit verses and explaining their meaning very carefully.

DR. C.K. SHUM is a Professor and Distinguished University Scholar, Division of Geodetic Science, School of Earth Sciences, at The Ohio State University. He is a Fellow of the American Association for the Advancement of Science, and a Fellow of the International Association of Geodesy. He received numerous awards including the 2012 Vening Meinesz Medal from the European Geosciences Union. He was a Lead Author in 2007 Intergovernmental Panel for Climate Change (IPCC) Working Group 1 (The Physical Science Basis), Fourth Assessment Report (AR4), which contributed to the 2007 Nobel Peace Prize awarded to IPCC and Al Gore, Jr. He and his group focus on scientific research relates to the quantification of 20th Century and present-day global sea-level rise due to various geophysical sources, including anthropogenic climate-change. He specializes in satellite geodesy, precision satellite orbit determination, temporal gravity field and tide modeling, and their cross-disciplinary science and applications to oceanography, hydrology, geodynamics, ice mass balance, GNSS meteorology and space physics. He has published over 241 refereed journal articles and book chapters. His work was covered by New York Times, Physics Today, Sky & Telescope Radio Show, Discoveries and Breakthroughs Inside Science TV, Science News, Science Daily, Scientific American, Soundings magazine, Deccan Chronicle, La Figaro, MSNBC.com, Tomorrow Focus Portal GmbH, Axel Springer AG, Televisión Española, Neue Zürcher Zeitung, Zurich, Columbus Dispatch, and other news organizations.

He has several international awards/medals at his credit in the field of Geoscience and related area of research. He has edited more than seven international journals and also edited one book on Geoscience.

He has 260 research papers published in referred journals, 4 chapter books, more than 150 proceeding papers, more than 10 reports and more than 600 presentations at his credit. For details of research by Prof Shum, please see: Google Scholar: Citation number: 9079, H-index: 42, i-10 Index: 134, [§]Accessed January, 2016 https://go.osu.edu/CKShumPublication.

ABSTRACT

IMPROVED ESTIMATES OF 20TH AND EARLY 21ST CENTURY GLOBAL SEA-LEVEL RISE

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The potential for accelerated sea-level rise under anthropogenic warming is a significant societal problem, in particular in world's coastal deltaic regions where about half of the world's population or ~3 billion people reside. Improved estimates of sea-level rise and quantifying the contributing geophysical process remain a complex and challenging interdisciplinary research problem. These geophysical processes include ice-sheet/glacier ablations, steric sea-level, solid Earth uplift or subsidence due to global isostatic adjustment (GIA), tectonics, sediment loading or anthropogenic causes, hydrologic imbalance, and human processes including water retention in reservoirs and aquifer extraction. The 2013 IPCC AR5 concluded that the observed and explained geophysical causes of global geocentric sea-level rise, 1993–2010, are closer towards closure. However, the discrepancy reveals that circa 12.5→ 37.5% of the observed sea-level rise remains *unexplained*. This relatively large discrepancy is primarily attributable to the wide range of estimates of respective contributions of Greenland and Antarctic ice-sheets and mountain/peripheral glaciers to sea-level rise. Estimates of the last century and early 21st century sea-level rise depend primarily on the fidelity of long-term tide gauges. Most studies or the IPCC studies assume that GIA is the only process governing solid Earth (land, islands and sea-floor) uplift or subsidence arguably may cause the estimated sea level trend to be biased. Understanding and quantifying the natural (GIA, tectonic), and anthropogenic (sediment compaction/load and groundwater extraction) processes governing solid Earth uplift/subsidence at the regional and local scales are critical towards addressing coastal vulnerability due to *relative* sea-level rise hazards, including world's deltaic regions. Here we provide new estimates of geocentric sea-level rise while separating vertical land motion at global tide gauge datum, via a joint adjustment of vertical motion and reconstruction of sea-level trends over the last six decades, 1950–2012. The resulting vertical motion is validated using global GPS tide gauge data sets, and the reconstructed sea-level is compared with independent tide gauge records, indicating good agreement. Finally, an updated tabulation of the sea-level budget, or the reconciliation of observed and explained contributing sources of global sea-level rise, is presented.

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