Reliably predicting global warming

Dr. Krishna Kumar Singh

The 2021 Nobel Prize in Physics has been jointly awarded to three scientists for their study of role of humanity in the climate change of our planet Earth. According to the Nobel Committee for Physics, the discoveries recognized for 2021 Nobel Prize demonstrate that our knowledge about the climate rests on a solid scientific foundation, based on a rigorous analysis of observations. The first half of the Nobel Prize is shared by Prof. Syukuro Manabe of Princeton University, USA and Prof. Klaus Hasselmann of the Max Planck Institute for Meteorology in Hamburg, Germany "for the physical modelling of Earth's climate, quantifying variability and reliably predicting global warming". The other half of this Nobel Prize is rewarded to Prof. Giorgio Parisi of the Sapienza University of Rome, Italy "for the discovery of the interplay of disorder and fluctuations in physical systems from atomic to planetary scales". This is the first time the Physics Nobel Prize is shared by a climate scientist. The climate change can be described as a complex physical system which is defined by its disorder. The Earth's atmosphere is a complex and chaotic system in which the weather is highly unpredictable on the day timescale and therefore it is extremely important to explore the reliability of climate models on the timescale of months and years. The models developed by Prof. Manabe have made fundamental contributions in understanding the human caused climate change and dynamical mechanisms. Prof. Hasselmann has proposed a model to connect the short-term climate phenomena (rain and other types of weather) to the long-term climate phenomena (ocean and atmospheric currents). This work laid the foundation for studies to establish the influence of climate change on events like intense rainstorm, drought and heat wave and to detect the impacts of climate change. Ordered phenomena emerge from the disordered and chaotic systems through the subtle mechanisms and fluctuations. Prof. Parisi discovered the interplay between disorder and fluctuations in the complex physical systems ranging from a tiny collection of atoms to the atmosphere of planets. This study suggested that if a completely random system is analyzed properly, it can make a robust prediction for a collective behavior arising from the fundamentally disordered, chaotic and frustrated systems on all length scales from materials like glass to the climate.

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About the authors

Sk. Musharaf Ali, PhD, presently heading the Laboratory Services Section, ChEG. He is keenly associated with BARC News Letter. His main thrust of research is in the field of computational and experimental molecular modeling for the design, development and demonstration of existing and novel molecular system for efficient extraction and separation of radionuclide and isotopes; nanomaterials for water purification, glass formulation for nuclear waste immobilization and tritium barrier materials using the tools of ab-initio and MD simulations. He has over 265 publications to his credit in journals, symposia, conferences and book chapters. He is editorial board member of The Open Chemical Engineering Journal.

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