Physics Nobel: deciphering climate disorder to better predict it

October 5 2021, by Juliette Collen, Pierre Celerier

US-Japanese scientist Syukuro Manabe who has been awarded the 2021 Nobel Prize in physics.

The Nobel Prize in Physics has gone to three scientists who sought to predict the long-term evolution of a complex system such as the climate

by modelling variables—weather, human actions—that create disorder within those systems.

What is the link between the modelling of global warming, which earned Syukuro Manabe and Klaus Hasselmann half the prize, and the work of the third winner, Giorgio Parisi, who focused on the underlying disorder of matter?

All three study complex systems: large-scale climate or the behaviour of certain materials at an infinitely small scale. From the erratic fluctuations within these systems, the three physicists succeeded in teasing out simpler behaviours and reliable predictions.

"We recognised that emerging phenomena sometimes require us to look at all the individual complicated physical mechanisms and knit them together to make a prediction," said Nobel Physics Committee member John Wettlaufer, on hand when the awards were announced in Stockholm on Tuesday.

Climate "is THE complex system par excellence," said Freddy Bouchet, a physicist at France's National Centre for Scientific Research.

A large number of variables, in other words, interact—atmosphere, oceans, soils, vegetation—rendering any reliable forecast beyond a few weeks elusive.

But alongside and within this observable chaos there are also clear trends that can be linked to well-identified causes, such as long-term global warming attributable to human activity.

Co-winner of the 2021 Nobel Prize in Physics, Klaus Hasselmann of Germany.

Hidden rules

"In climate science, the random and the systematic overlap," said Bouchet. "The mathematical tools developed by Klaus Hasselmann have made it possible to separate the two in order to better understand the evolution of climate."

Being able to tease out patterns in what is random—the signal in the noise—is fundamental to understanding the evolution of extreme weather such as heat waves, storms and hurricanes.

The models developed by the Japanese-American Syukuro Manabe have succeeded in cracking the signature code of climate subsystems.

"These are the first models which made it possible to calculate the effect of the increase in carbon dioxide of anthropogenic origin on global warming at the core of contemporary climate models", Bouchet said.

Giorgio Parisi, for his part, made a major contribution to the theory of these complex systems by revealing the hidden rules that govern them.

"I started to lay the foundations of this science—which did not exist at the beginning of the 1980s—by studying nature through mathematics", the Italian researcher told Corriere della Sera newspaper earlier this year.

It is a science that allows us, for example, to explain the changing form of a cloud of starlings in flight.

Parisi provided the mathematical tools to understand how random processes can play a decisive role in the development of large structures, such as those governing climate.

Today, they are applied in biology, neuroscience and artificial intelligence.

Citation: Physics Nobel: deciphering climate disorder to better predict it (2021, October 5) retrieved 4 May 2024 from https://phys.org/news/2021-10-physics-nobel-deciphering-climate-disorder.html