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SOLAR TSUNAMI CAN TRIGGER THE SUNSPOT CYCLE

Relevant for: Geography | Topic: The Earth and the Solar System

It is believed that the “solar dynamo” — a naturally occurring generator which produces electric and magnetic fields in the sun — is linked to the production of sunspots. What kick-starts the 11-year sunspot cycle is not known. Now, a group of solar physicists suggests that a “solar tsunami” is at work that triggers the new sunspot cycle, after the old one ends.

The extreme temperature and pressure conditions that prevail some 20,000 km below the sun’s surface cause its material to form a plasma consisting primarily of hydrogen and helium in a highly ionised state. The plasma is confined with huge magnetic fields inside the sun. Explains Dr. Dipankar Banerjee from the Indian Institute of Astrophysics, Bengaluru, and one of the authors of the paper published in *Scientific Reports*, “The [sun’s] toroidal magnetic field, from which sunspots get generated, wraps around the sun in the east-west direction.”

These magnetic fields behave like rubber bands on a polished sphere. They tend to slip towards the poles. Holding these fields in their place requires that there is extra mass (plasma mass) pushing at the bands from higher latitudes. Thus, a magnetic dam is formed which is storing a big mass of plasma. At the end of a solar cycle, this magnetic dam can break, releasing huge amounts of plasma cascading like a tsunami towards the poles.

These tsunami waves travel at high speeds of about 1,000 km per hour carrying excess plasma to the mid-latitudes. There they give rise to magnetic flux eruptions. These are seen as the bright patches that signal the start of the next cycle of sunspots. The tsunami waves can traverse the required distance in a few weeks, unlike in earlier models.

To arrive at this simulation, the group used data from the Kodaikanal observatory of sunspots recorded over 100 years and the Cheyenne supercomputer belonging to National Center for Atmospheric Research (NCAR), Boulder, U.S. Mausumi Dikpati of NCAR and first author of the paper said in an email to *The Hindu*, “Cheyenne has 1,45,000 processors, and is a 4.5 petaflop machine. Each of these processors can perform 184 million arithmetic operations per second,” says Mausumi Dikpati of NCAR, the first author of the paper.”

She adds “We used about 100,000 processor cores of the supercomputer to perform about 100 simulations to conclude our results. This means in each of these hundred simulations, we performed about 66,000 trillion arithmetic operations per hour.”

Adds Dr. Banerjee, “The solar cycle and sunspot activity are intimately connected with space weather. The model provides a sound physical mechanism supporting why we should expect the next sunspot cycle 25 to begin in the year 2020, followed by a strong increase in space weather shortly after the trigger of a series of new sunspots in that year.”

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