

Weakened magnetic field, cosmic rays and Zika virus outbreak

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The Zika virus outbreak in 2015 posed a serious public health threat because of its association with congenital abnormalities. Research on the environmental factors underlying this outbreak epidemiology may provide useful insights into its occurrence. This study suggests that the localized lowering of the earth's magnetic field intensity and a sudden increase of cosmic rays recorded in Mexico in 2015 were causally associated with the resurgence of the Zika virus outbreak in the Americas. Potential mechanisms by which a weakened magnetic field and enhanced cosmic ray activity may influence this outbreak in humans are discussed here. Current and future surveillance efforts should be supported to construct a comprehensive early warning system involving monitoring of the earth's magnetic field, solar activity and cosmic ray intensity for predicting or detecting future Zika virus outbreaks as early as possible.

The unexpected emergence of Zika virus (ZIKV) in Latin America and its association with congenital abnormalities such as microcephaly and Guillain-Barré syndrome led the World Health Organization to declare an international public health emergency on 1 February 2016. The epidemic is known to have been the largest and deadliest since the disease was first recognized in 1947. Although the outbreak has now tapered off, we remain ignorant as to why it occurred in such a serious form. Therefore, in our view, it is necessary to find the real cause of the outbreak if possible.

It is generally known that the earth is protected from solar particles and cosmic

rays by a magnetic field. In June 2014, after just six months of collecting relevant data, the European Space Agency's (ESA's) Swarm satellite confirmed the general trend of weakening of the geomagnetic field intensity, with the most dramatic declines witnessed over the Western Hemisphere. However, in other areas such as the southern Indian Ocean, the magnetic field had strengthened since January.

New data released by ESA reveal that the geomagnetic field is systematically weakening by around 5% every ten years, which is nearly ten times faster than previous estimates¹. Furthermore, it is weakening faster in some places than

in others. For example, the South Atlantic Anomaly (SAA) is a large depression of the earth's magnetic field strength characterized by values of geomagnetic field intensity around 30% lower than that expected for those latitudes, and covers a large area in the South Atlantic Ocean and South America.

The geomagnetic map shown in Figure 1 was obtained in June 2014 just before the emergence of ZIKV in the Americas. According to Swarm satellite monitoring results, SAA has moved steadily westward and weakened further by about 2%. Previous studies have suggested that the mosquito is sensitive to magnetic field, and weakening of the magnetic field can increase its reproductive rate and density². ZIKV is mostly transmitted to humans by bites from infected *Aedes* mosquitoes, especially *Aedes aegypti*, a highly competent and anthropophilic vector species. The rapid weakening of the earth's magnetic field in SAA probably caused a rapid increase of mosquitoes, thus promoting rapid spread of the virus.

A sharp change of the magnetic field in this region allows cosmic rays and other charged particles to reach lower into the atmosphere. The sharp increase in ground-level cosmic rays was actually recorded in Mexico in 2015, and lowering of the magnetic field strength could possibly have led to a mutation/recombination event in the circulating ZIKV (Figure 2). Recent genetic data reveal that ZIKV outbreak in 2015 is probably a recombinant/mutation virus infection, consistent with the point of view of other researchers^{3,4}.

It is significant that at present, solar activity is in its most inactive stage in the past 100 years. The sunspot cycle (no.

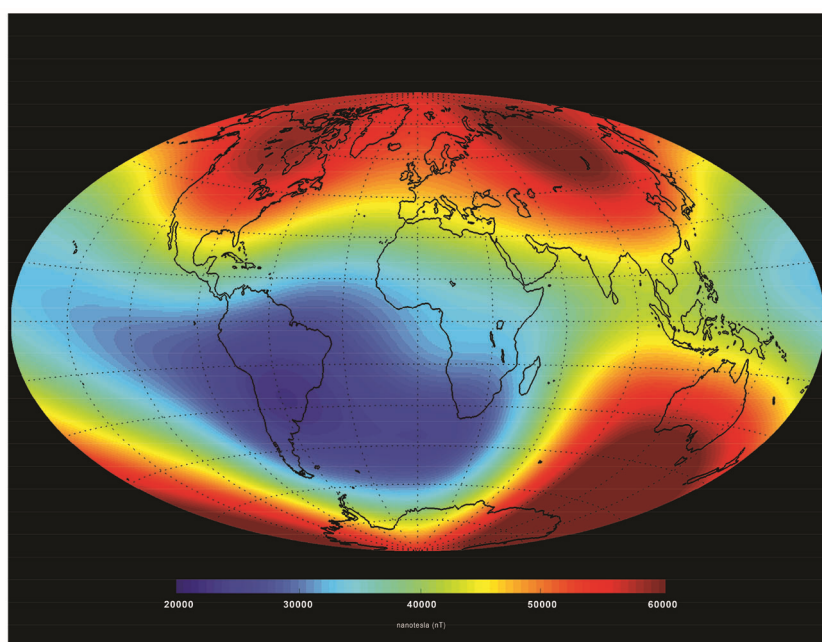


Figure 1. 'Snapshot' of the main magnetic field at the earth's surface as of June 2014 based on Swarm data. Red colour represents areas where the magnetic field is stronger, while blue colour shows areas where it is weaker.

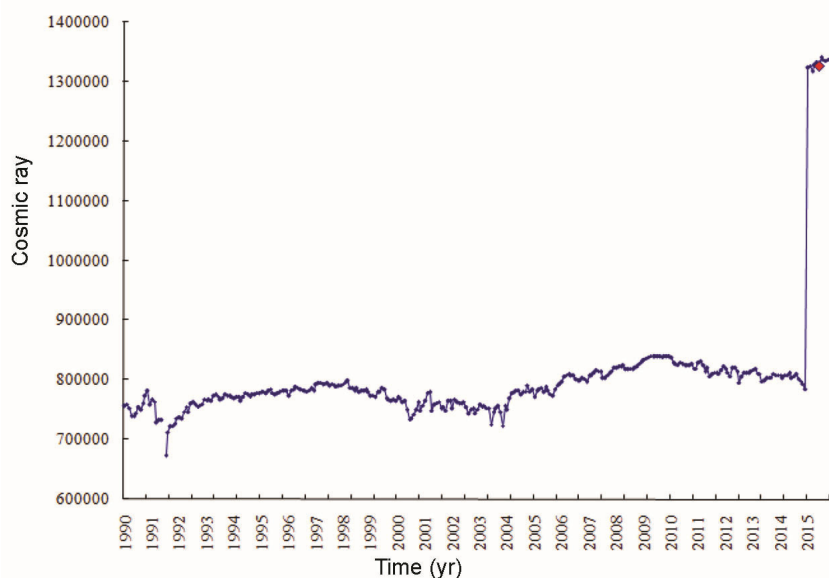


Figure 2. Association between cosmic ray and 2015 Zika virus outbreak. Red square represents onset of the 2015 Zika virus outbreak.

24) that peaked in 2014 showed the lowest sunspot number recorded since 1906, with many consecutive days of very low sunspot numbers in 2014/15 (ref. 5). Cosmic rays, particularly galactic cosmic rays, can reach a maximum intensity when the earth's magnetic field is weakening dramatically and the sun is least active. A new study revealed that solar radiation and cosmic rays are physical mutagens of natural genetic mutation/recombination, and can lead to the emergence of some modified viruses such as those responsible for pandemic influenza⁶.

Thus the ZIKV outbreak in 2015 may have been linked to a systematic increase in the flux of cosmic rays and a general decline of sunspot activity with an accompanying weakening of the magnetic field around the earth⁷. Hence we propose that a surveillance of magnetic field, sunspot numbers and cosmic ray activity may serve as a potential warning of future pandemics. Together with other epidemiological data, such information might prove to be a useful factor for strategic disease control planning of ZIKV, as well as other pandemic-causing viruses.

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CRISPR-Cas: the molecular scissors for genetic disease surgeries?

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CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) is an emerging biomedical tool, which allows researchers to manipulate DNA sequence(s) for desired gene(s) function. Genetic disorders, namely sickle-cell anaemia and β -thalassemia, had corrected in the stem cells using CRISPR. Therefore, researchers are much optimistic that CRISPR can prevent and cure human diseases in the coming future. However, it is a debatable question that whether this tool is safe and effective for use in human.

The news of CRISPR-Cas (clustered regularly interspaced short palindromic repeats and its associated protein nuclease) mediated gene editing in human embryos is a hot and exciting topic of discussion

in the scientific fraternity, which prognosticates that many genetic diseases can be cured using CRISPR technology. CRISPR is a molecular tool (see a knowledge box) that can potentially allow the

precise changes in the genome by adding, removing or altering the nucleotides in organisms, from a tiny *Drosophila* to a gigantic elephant. In 2013, for the first time, scientists used CRISPR to edit