The science of lightning in extrasolar planets

May 1 2014, by Gayle Cook

A thunderstorm above Unna, in Germany. Credit: smial/Wikipedia.

Scientists in Scotland are hoping to make a major 'leap' in working out whether a bolt of lightning could trigger life on planets outside the solar system.

The team, at the University of St Andrews, has been studying lightning

in extrasolar planets to better understand how atmospheres on earth become electrically charged.

In turn, the researchers, from the University's LEAP (Life Electricity Atmosphere Planets) group at the School of Physics & Astronomy hope to learn more about the role lightning played in generating the 'building blocks' for life.

Lead researcher Dr Christiane Helling will reveal one of her group's findings today at a major meeting involving 11,000 scientists working in the Earth, planetary and space sciences.

The researcher will talk about her work in a special session on lightning at the EGU (European Geosciences Union) General Assembly in Vienna.

Dr Helling said, "Atmospheric electrical discharges – or lightning – have been observed on planets other than Earth such as Jupiter, Uranus and Neptune, but it is very likely that lightning also occurs outside the Solar System too.

"We studied both exoplanets and brown dwarfs, which host clouds made of minerals or gemstones, to see how much energy is deposited into the atmosphere if a lightning strike hits.

A lightning discharge is started by a small-scale 'streamer discharge' which can evolve into a large-scale lightning bolt.

By building a discharge model related to lab works from the University of Einthoven, Dr Helling and her team were able to study the large-scale properties of lightning in extrasolar, cloud-forming atmospheres, and how much energy would be injected by such a lightning strike. They found that lightning strikes are more energetic in brown dwarfs than in giant gas planets.

"Our work combines plasma physics experiments performed in laboratories on Earth with our research into cloud formation in extrasolar atmospheres," Dr Helling explained.

"Our work tests the physical processes on Earth in non-terrestrial environments such as hydrogen-dominated atmospheres and gemstone clouds outside the solar system, in contrast to the nitrogen-dominated atmosphere and water clouds on Earth."

The St Andrews research could help in extreme situations of lightning on Earth.

"Warning systems rely on techniques tested for a well-defined set of conditions relevant for Earth. But what if the situation changed to the extreme by some unforeseen circumstances? Applying knowledge gathered on Earth to the extreme conditions in space will allow us to identify potentially weaknesses, and thereby even save lives if extreme conditions might arise," Dr Helling continued.

As to whether the scientists are any closer to working out whether lightning could have triggered life on earth, the St Andrews scientist said, "We have made the first steps. We have started to investigate how an extrasolar atmosphere changes its chemical composition due to the energy released by lightning, which in turn increases the atmospheric temperature considerably.

"There is now the possibility of working out whether large-scale lightning discharges could occur in gemstone clouds, how big they could grow, and as a result whether such events could have triggered the formation of prebiotic molecules responsible for the origin of life."

More information: Dr Helling will deliver the scientific talk on the topic 'Large-scale properties of lightning in extrasolar objects' on Friday

2 May 2014, 16.45 in room G1 at the EGU conference cite in Vienna.

The paper is available online:
adsabs.harvard.edu/abs/2014ApJ...784...43B

Provided by University of St Andrews

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