Rising carbon dioxide levels increase risks to satellites

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Climate change is widely attributed to the build-up of greenhouse gases, such as carbon dioxide, in the Earth's atmosphere. However, scientists from the School of Engineering Sciences at the University of Southampton have shown that the impact of carbon dioxide is being felt in space too.

Dr Hugh Lewis from the School will present a paper to the Fourth European Conference on Space Debris at the European Space Operations Centre (ESOC) in Germany this week indicating that increasing levels of CO2 are causing the amount of space debris orbiting the Earth to increase faster than previously thought.

Whilst CO2 is causing a global rise in temperature at the Earth's surface, it has the opposite effect in the upper part of the atmosphere known as the thermosphere. Here, in a region of space that contains the International Space Station and many other satellites, the temperature and the atmospheric density are falling rapidly.

Evidence from the Naval Research Laboratory in the USA suggests that the atmospheric density at these heights could be halved in the next 100 years. At first glance, this is good news for satellite operators: it will take longer for their satellites to re-enter the atmosphere. However, the research conducted at the University of Southampton in collaboration with QinetiQ shows that in the later half of this century satellites would be at greater risk from collisions with orbiting debris.

Collisions between objects orbiting the Earth can release as much energy as ten sticks of dynamite because of the enormous speeds involved, around ten kilometres per second. These events can subsequently produce hundreds of thousands of objects larger than 1 cm – each one a collision risk to satellites and used rocket stages.

According to the research team's initial predictions a process known as 'collision cascading' – where the number of collisions in orbit increases exponentially – could occur much more quickly in the region of space between 200 km and 2,000 km above the Earth in response to rising CO2 levels. Simulations of a 'business as usual' scenario, where satellites are launched and destroyed at the rate they are now, show a 17 per cent increase in the number of collisions and a 30 per cent increase in the number of objects larger than 1 cm by the end of the 21st century.

Dr Lewis stresses that steps are already being taken to diminish the threat posed by orbiting debris. The Inter-Agency Space Debris Coordination Committee (IADC), an international governmental forum that coordinates activities related to the issues of debris in space, has produced a set of guidelines that identify mitigation options. Whilst Dr Lewis' research has implications for these guidelines, he believes that they will remain effective measures: 'We are only now beginning to understand the impact that polluting the atmosphere is having on space, but our knowledge of the problems posed by space debris is reliable,' he commented.

The research was undertaken by Dr Lewis, with Dr Graham Swinerd and Charlotte Ellis of the School of Engineering Sciences, and Dr Clare Martin of QinetiQ.

Source: University of Southampton