

# EXECUTIVE SUMMARY

## **1. SPACE WEATHER DESCRIBES EVENTS THAT HAPPEN IN SPACE, WHICH CAN DISRUPT MODERN TECHNOLOGIES**

Like weather on the Earth, Space weather comes in different forms and different strengths. However, space weather is governed by an 11-year solar cycle that allows us to predict, at some level, when effects are likely to be most severe. This period is called 'solar maximum' and is next likely to occur between 2012 and 2015.

## **2. THE GROWTH OF TECHNOLOGIES HAS LEFT SOCIETY MORE AT RISK FROM SPACE WEATHER**

Previous periods of solar maximum have varied in their severity. However, as we become more reliant on modern technologies (and as systems become more interconnected) a major space weather event in the next 3 years could disrupt unprepared businesses.

Although we have evidence of space weather existing for centuries, it poses a much greater threat today because of the emergence of vulnerable technologies. The first example of the impact of space weather on technology was the electric telegraph, arguably the Victorian equivalent of the internet. This was followed by the telephone at the end of the 19th century and radio communications in the early part of the 20th century. Since the 1950s there has been a steady growth in the use of advanced technologies by business and government.

## **3. SPACE WEATHER COULD POTENTIALLY CREATE HUGE DISTURBANCES IN THE TRANSPORT, AVIATION AND POWER SECTORS**

Electrical power, in particular, is vulnerable to space weather and is of course of critical importance to modern economies and societies. A number of space weather incidents have already disrupted electrical transformers and grids in Canada and South Africa and, following these, the sector has introduced mitigation practises. However, more could be done: particularly to understand the risk from both extreme events (for example, a major magnetic storm) and low-level risk (often a cumulative build up of minor damage from smaller storms).

## **4. ALL GPS SIGNALS ARE VULNERABLE TO SPACE WEATHER, WHICH IMPACTS ON, FOR EXAMPLE AVIATION NAVIGATION SYSTEMS**

Space weather also has a major impact on aviation, primarily because it interferes with navigation; indeed all GPS systems are vulnerable to space weather. This is a particular problem in polar regions. Airlines are developing good responses to this, especially on transpolar flights. Space weather can also increase radiation levels on board planes; particularly long-haul flights because they fly at higher altitudes. This could affect both flight crew and very frequent flyers and needs continued close surveillance by airlines.

## **5. SPACE WEATHER CAN ALSO DISRUPT PIPELINES AND RAILWAY SIGNALS**

It can cause problems such as corrosion on pipelines and incorrect signal settings on railways. Again, there are means to mitigate these effects, but they usually require keeping back-up systems, which adds to operational costs.

## **6. A VERY SEVERE OUTBREAK OF SPACE WEATHER COULD CREATE A SYSTEMIC RISK TO SOCIETY**

Because space weather affects major global systems, such as power and transport, a very severe outbreak presents a systemic risk. For example, a loss of power could lead to a cascade of operational failures that could leave society and the global economy severely disabled. Governments own only 5% to 10% of critical infrastructure, so businesses have a responsibility to ensure their systems are adequately protected.

## **7. BUSINESSES AT RISK FROM SPACE WEATHER NEED ACCESS TO RELEVANT EXPERTISE**

This may be done by expanding in-house engineering expertise or by employing specialist service providers. Whichever route is followed, it is critical to have access to measurements and forecasts that allow businesses to adapt to and mitigate the effects of space weather. This will also require better understanding of the science of space weather and its representation of that science in computer models.

## **8. FINDING DEFENCES AGAINST SPACE WEATHER MAY ALSO PROVIDE BUSINESS OPPORTUNITIES**

Specialist businesses can provide information and services to help other businesses at risk from space weather. But there is also an opportunity for those businesses at risk to use their understanding of space weather impacts to gain a competitive advantage by improving the resilience and the performance of their business systems.