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Shockwaves from second world war bombs rattled the edge of space

Allied bombers attack Ludwigshafen in Germany
Hulton Deutsch/Getty

By Andy Coghlan

Shockwaves from Allied bombing raids between 1943 and 1945 killed millions and devastated much of Germany. Now we know they were so powerful they disrupted the outermost layer of our atmosphere, called the ionosphere. Physicists who made the discovery say the data provides a benchmark for estimating how other natural

phenomena such as thunderstorms, volcanic eruptions, lightning and earthquakes alter the ionosphere.

The ionosphere consists mainly of molecular nitrogen, molecular oxygen, and individual oxygen atoms from which electrons get detached by solar X-rays and high-energy ultraviolet sunlight. Electrons typically rejoin oxygen ions to reform an atom within minutes, so the layer reaches a balance between atomic oxygen, ionic oxygen and free electrons. But while the impact of the sun's radiation on the ionosphere is now well established, the impact of terrestrial activity from below is less well understood.

To provide new insights, researchers turned to the dark days of the second world war. "This was an attempt to find quantifiable explosive phenomena that might have an impact on the ionosphere," says Chris Scott of the University of Reading, UK, who co-authored the study with his colleague, historian Patrick Major. "We had quantifiable data points which allowed us to conclude how much energy could cause perturbations to the layer."

Air raids

Scott relied on historical records of the density of the ionosphere logged between 1933 and 1996 by the Radio Research Centre in Slough, near London. It was possible to use the data to estimate electron densities in the ionosphere during the war. By tallying these data with records of the quantity and size of bombs dropped during 152 major air-raids on Germany and occupied France between 1943 and 1945, Scott could estimate the degree to which the bombing affected electron density.

Scott found that during the height of the bombing campaign, the shockwaves were temporarily depleting electron concentrations by as much as 3 per cent. "These effects were seen 1000 kilometres away from the bombing and 300 kilometres up," he says.

Scott worked out that the shockwaves deplete electron concentrations by dumping energy as heat in the upper reaches of the atmosphere, which causes oxygen ions and electrons to be lost by reacting with nitrogen and oxygen molecules.

"It is very interesting that human activity like this can have such a significant impact on the very upper reaches of the atmosphere at such high altitudes," says Steven Cummer at Duke University in North Carolina.

A single tonne of TNT has an explosive energy of a single cloud-to-ground lightning strike, so raids releasing 100 tonnes of TNT would have the same explosive power as 100 lightning strikes, says Scott. Some raids released more than 10,000 tonnes of TNT at a time. "They were unimaginably grim," he says.

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