Solar flares may disrupt GPS systems, researcher says

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(Phys.org) —If your GPS navigation system goes on the fritz in the coming days, you might have the sun to blame. Early this week, the sun released four X-class solar flares, the strongest type of flare. Forecasters at the National Oceanic and Atmospheric Administration predict a 40-percent chance of more X-class flares in the coming days, some possibly pointed toward the Earth.

Dr. Roderick Heelis, director of the William B. Hanson Center for Space Sciences at The University of Texas at Dallas, is an expert on the interaction between the sun and planetary environments, as well as the dynamics of charged particles in the Earth's upper atmosphere. He and his colleagues measure weather in space with sophisticated instruments that fly on satellites, and they create computer models designed to predict space weather.

While the Earth's magnetic field and atmosphere protect people on the ground from direct effects of solar flares, the solar events aren't without possible consequences to modern humans.

"If a flare is particularly large, the resulting turbulence in our upper atmosphere could disrupt GPS navigation," Heelis says.

Heelis answers some basic questions about solar flares and their possible impact on human activity.

Q: Why is the sun so active now?

Heelis: The recent increase in solar activity is part of a natural 11-year cycle. We who study space weather are quite happy to see this recurring activity since the sun has been unusually quiet for the past few years.

Q: What is a solar flare?

Heelis: Solar flares occur when some of the energy in the sun, which is usually contained by the sun's magnetic field, is spontaneously released. The magnitude of a flare can vary: the X-class flares that we have seen recently are the most energetic type of flare.

The energy from a flare pointed in Earth's direction reaches us in two ways. First, very fast, high-energy particles reach our planet in just a few hours. Secondly, solar plasma – the charged particles that the sun is made of – may flow toward the Earth. This material can reach us in a few days and can have the most dramatic effects on space weather by compressing the magnetic field surrounding the Earth. It's this magnetic envelope that protects our planet from direct contact with the material.

Q: How does a solar flare affect earth?

Heelis: The resulting effects depend on many factors, including the amount of plasma released from the sun and the speed at which it arrives. These things can be predicted by computer models to some degree, but not with certainty, so the effects can be difficult to predict accurately.

Some possible effects of a large X-class flare directed at Earth include: changes in the radiation environment where communication satellites fly; changes in the atmospheric current systems that can induce voltages in

ground power lines at middle and high latitudes; and an increase in the amount of x-rays hitting high latitudes where transpolar airline routes exist.

Some of the energy from solar flares channels to the Earth's magnetic poles and produces more intense aurora, or Northern and Southern Lights.

Q: What does solar activity mean to the general public?

Heelis: First, the Earth's magnetic field protects people on the ground from high-energy particles by repelling and deflecting the particles, so they bypass the planet. Our atmosphere also filters out radiation like x-rays and gamma rays well above the surface of the Earth.

There are some mitigation practices in place for communication satellites to reduce, but not eliminate, the possibility of damage to the satellites themselves, but other effects we just have to ride out. If a flare is particularly large, the resulting turbulence in our upper atmosphere could disrupt radio signals and GPS navigation, for example. Air traffic that normally flies near the Earth's poles may also need to be rerouted to avoid navigation problems and to reduce the risk of radiation exposure to passengers and crew.

Provided by University of Texas at Dallas