What will the next solar cycle bring?

Orbiting mission will probe the Sun's activity, including flares that can disrupt electricity grids.

The Sun is rousing from an unusually heavy slumber. On 19 January, the otherwise calm and quiet Sun erupted in a violent blast of light and energy — an M-class solar flare, the largest observed in nearly two years. Over the next 24 hours, four more M-class flares erupted from the same sunspot, each more powerful than the one before.

It was a welcome bit of excitement for solar physicists, who have been languishing during the quietest period of solar activity in nearly a century. Sunspots, flares and the plasma-spewing eruptions known as coronal mass ejections typically wax and wane on an 11-year cycle, but the most recent solar cycle has lasted for 12.5 years. "A number of my colleagues were wondering if there would even be a new cycle," says solar physicist David Hathaway of NASA's Marshall Space Flight Center in Huntsville, Alabama.

On 9 February, NASA plans to launch its Solar Dynamics Observatory (SDO), just in time to watch the Sun's activity. Using a suite of imaging instruments, the SDO will probe the inner workings of the Sun, including how material flowing within it helps to generate its magnetic field and how that energy is released. The findings could help researchers to improve their understanding of the fluctuations in solar activity that can, at their peak, scramble electricity grids and throw Global-Positioning-System devices off by dozens of metres.

"The Sun is getting much more interesting to look at," says Frank Eparvier, a solar physicist at the University of Colorado at Boulder. "We really want to get the SDO up there to watch the rise to the next maximum."

Solar activity is on the rise.

NASA/MSAL

Eparvier is one of 13 scientists charged with combing through dozens of predictions and issuing the official prediction of the timing and strength of the upcoming solar cycle, cycle 24. In April 2009, the group reached a consensus that the solar maximum would arrive relatively late, in May 2013, and be less intense than average, with only 90 sunspots per day at its peak (see graphic). But there was a notable dissenter: Mausumi Dikpati at the National Center for Atmospheric Research in Boulder thinks that cycle 24 will have at least 150 sunspots at its maximum. The last solar cycle peaked at around 120 sunspots.

Strength to strength

The difference for cycle 24 boils down to the different methods used to predict solar activity. Historically, the most reliable prediction methods have been 'precursor' techniques that rely on the strength of the magnetic field during the previous minimum. A number of precursor models all suggest that the peak for solar cycle 24 will be small.

But Dikpati uses a different method, a solar-dynamo model that incorporates theories of how material within the Sun travels from its poles toward the equator. She argues that the material can take decades, not a few years, to

make this journey — meaning that the last maximum doesn't say much, if anything, about what the next one will be like.

Dikpati says that her model has retrospectively predicted the past eight cycles with 96% accuracy. Those earlier cycles, however, were also used to calibrate the model, and the model has not been used yet to predict future activity. "The true test we want to see is to make a prediction before [the cycle] has actually happened," says Doug Biesecker of the National Oceanic and Atmospheric Administration's Space Environment Center in Boulder, Colorado. The predictions of other solar-dynamo models have differed from Dikpati's.

The SDO may help to clear up the confusion by giving the deepest look yet at the flow fields inside the Sun. It will also measure the magnetic field at the surface, take high-resolution images of the corona and measure the Sun's extreme ultraviolet output.

From an orbit offset from Earth's equator, the observatory will take images every 10 seconds for 5 years, giving astronomers their first near-continuous look at the Sun's activity. Currently astronomers only take one to two images a day, and they can only see the part of the Sun that faces Earth.

Lizzie Buchen

SOLAR CYCLE 24

A consensus prediction suggests that 2013 will see a maximum of 90 sunspots a day — although some researchers think that the number could go to 150 or even higher.