NISP

NSO Integrated Synoptic Program

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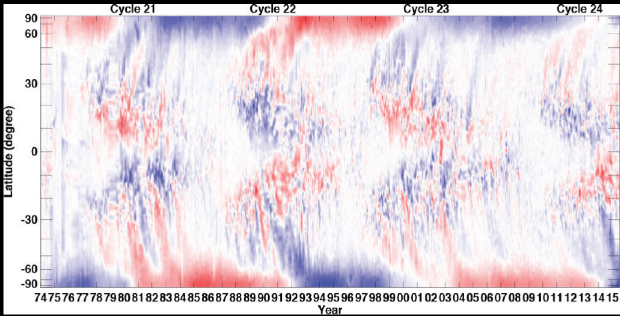
National Solar Observatory

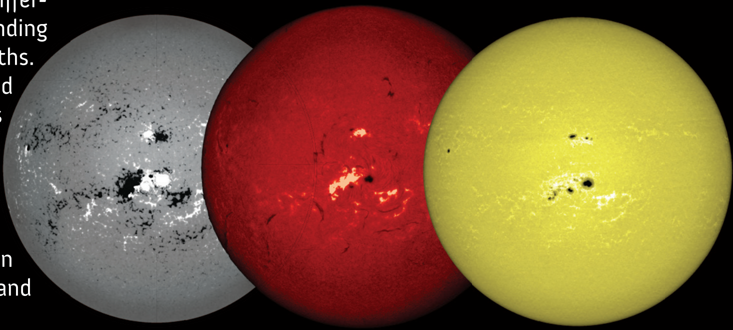
Probing the Sun for 50 years

NSO's Integrated Synoptic Program, NISP, provides an archive of daily solar observations extending back to 1974 and continuing to expand today. Two suites of instruments - the "Synoptic Optical Long-term Investigations of the Sun" (or SOLIS) and the "Global Oscillation Network Group" (or GONG) are currently in operation.



This valuable dataset allows scientists to study the long-term variability of the Sun and its magnetic fields. Using it, scientists have increased our understanding of the regular 11-year cycle of waxing and waning solar activity; shed new light on the solar dynamo that drives the Sun's magnetic behavior, solar flares, and coronal mass ejections; and probed the interior of the Sun using a technique called helioseismology (literally meaning the study of sunquakes). All of these areas build a picture of the underlying causes of solar activity and its effects.

The NISP program provides daily observations of the Sun at different wavelengths corresponding to different atmospheric depths. For example, the middle and right images are of the Sun's chromosphere (the lower layer of the outer atmosphere) and photosphere (essentially the Sun's "surface"), respectively, as seen in spectral lines of infrared and visible light.



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NISP instruments operate at six worldwide locations. This distributed network means that the Sun is almost always shining on it somewhere (or, about 90% of the time anyway). The sites comprising the network are: High Altitude Observatory at Mauna Loa in Hawaii; Learmonth Solar Observatory in Western Australia; Udaipur Solar Observatory in India, Observatorio del Teide in the Canary Islands, Spain; Cerro Tololo Interamerican Observatory in Chile; and Big Bear Solar Observatory in California. The Big Bear site is home to both a GONG site and NISP's sole SOLIS instrument suite.

The NISP program contains a library of more than 135 million images of the Sun taken since 1995.

Hawai'i Mauna Loa Observatory

California Big Bear Solar Observatory

Chile Cerro Tololo Interamerican Observatory

Tenerife Observatorio del Teide

India Udaipur Solar Observatory

Australia Learmonth Solar Observatory

NISP provides not only images of the Sun's layers but also data products derived from these images. For example, images of the far-side of the Sun (that we cannot see with traditional methods) can be generated using sound waves to identify the location of sunspots. Using the polarization of light, calculations of the Sun's surface magnetic fields can be made. This results in daily magnetograms, or magnetic maps. These maps are critical for identifying large sunspots (see grey image to the left) which can be the origin of large solar eruptions.

Since the Sun is the closest star to us, scientists test theories and apply their findings to other stars in the Universe. The NISP program provides spectroscopic observations of the Sun as if it were a distant star, enabling researchers to characterize other stars that may house extrasolar planets and extraterrestrial life.

Space Weather

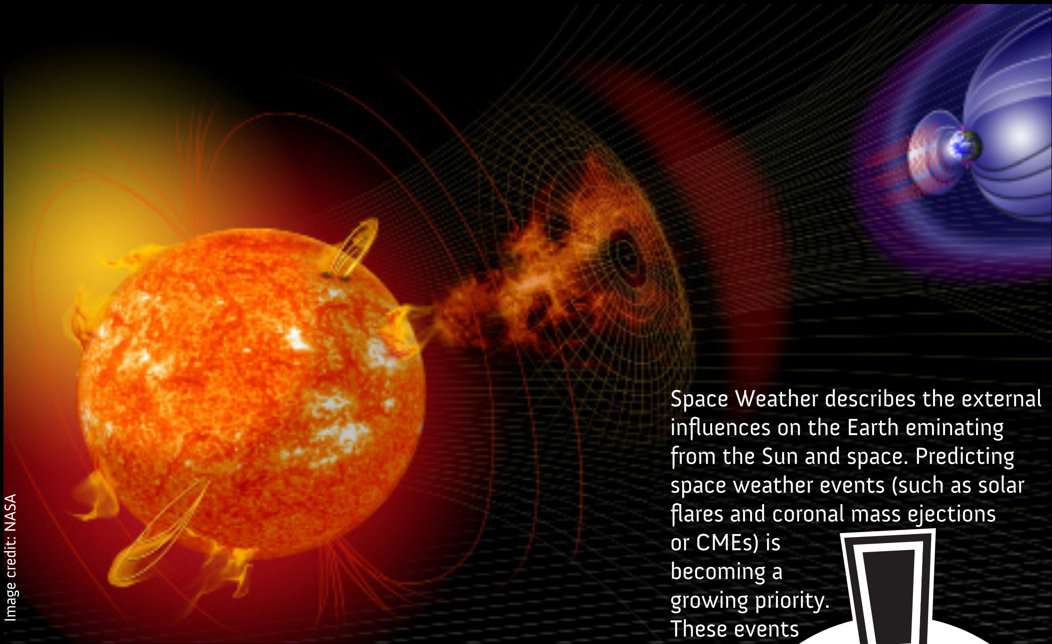


Image credit: NASA

Space Weather describes the external influences on the Earth eminating from the Sun and space. Predicting space weather events (such as solar flares and coronal mass ejections or CMEs) is becoming a growing priority. These events can significantly impact our techology-driven lifestyles, from disrupting GPS navigation signals — used by the military and communication, agriculture, and airline industries — to the looming threat of overloading the national electrical grid.

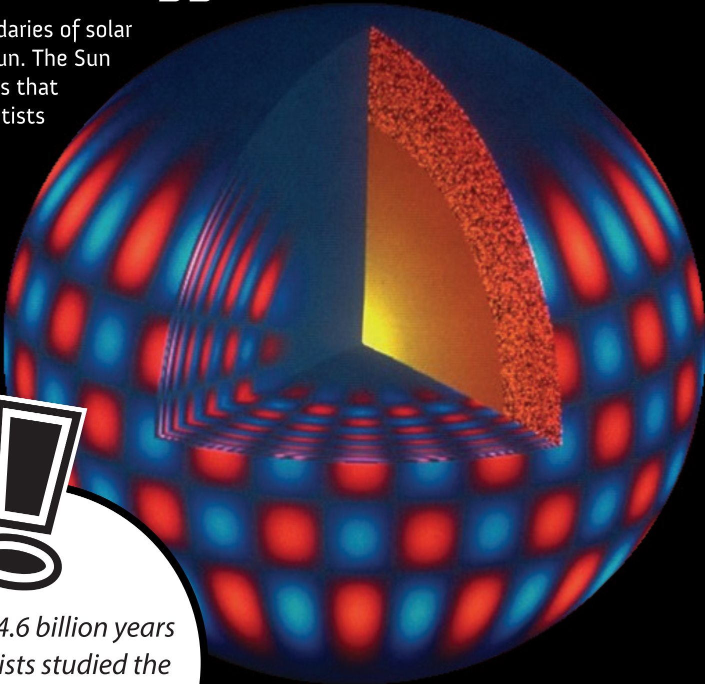
As part of a national security-driven initiative, data from NISP are being integrated into the NOAA Space Weather Prediction Center's pipeline. This will mean that NOAA, as part of the National Weather Service, will be able to have a 24/7 view of the Sun's magnetic field conditions thanks to the NISP magnetograms. This information is used for identifying the space weather threat on a daily basis.

Light takes 8 minutes to travel from the Sun to the Earth. So when we observe a solar eruption, it actually happened 8 minutes in the past.

The Song of the Sun

Solar Helioseismology

The NISP program pushes the boundaries of solar observations by “listening” to the Sun. The Sun is filled with millions of sound waves that reverberate within its interior. Scientists can actually observe and measure the acoustic waves as they distort the surface of the Sun, much like the vibrating head of a drum. The patterns observed in these sound waves tell us about the internal structure of the Sun. Changes in the patterns indicate irregularities, such as large bundles of magnetic field called sunspots. Since we are using sound waves and do not need to observe the sunspots directly, this technique allows us to predict the location of large sunspots on the far-side of the Sun.



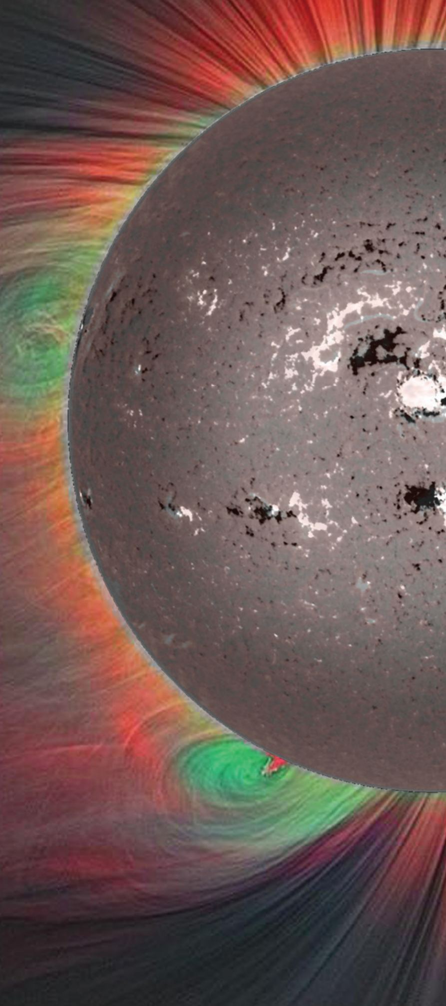
The Sun is 4.6 billion years old. Scientists studied the frequency of the Sun’s internal sound waves to determine its age.

The Magnetic Sun

Changes in the solar magnetic field drive the Sun's activity cycle. By observing the Sun's surface magnetic field over many solar cycles using NISP instrumentation, scientists can seek the origin and nature of the Sun's internal magnetic dynamo.

The state of the Sun's magentic field at the solar surface, or photosphere, also provides critical information about space weather activity at Earth.

Studying the Sun's global magnetic field gives us a long-term and large-scale overview of what our nearest star is doing. This is important because magnetic fields permeate the Universe, from our own planet to the distant stars. The Sun is an ideal laboratory to understand these extragalactic magnetic fields because we can closely study how they interact with an average star.



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