Workshop report:

A New Synoptic Solar Observing Network

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Since all space weather originates in and on the Sun, forecasters need continuous, long-term, consistent, and reliable solar data as a foundation for useful predictions. An effective strategy to obtain nearly continuous solar data is the use of a ground-based network of identical observing instruments geographically distributed so that gaps from night time, weather and instrumental problems are reduced. For example, NASA established the Solar Particle Alert Network (SPAN) in 1965 and the US Air Force set up the Solar Optical Observing Network (SOON, http://www.afweather.af.mil/library/factsheets/factsheet.asp?id=16522) and the Radio Solar Telescope Network (RSTN) in 1976. Networks also have a long history in the field of helioseismology, including the UK BiSON (Birmingham Solar Oscillations Network) and US GONG (Global Oscillation Network Group, http://gong.nso.edu/) networks. GONG is also a major supplier of space weather data to the US Air Force Weather Agency (AFWA) and NOAA's Space Weather Prediction Center (SWPC). While space platforms can provide nearly continual solar observations that are also free of terrestrial atmospheric limitations, ground-based networks have several distinct advantages, including costs, repair and upgrade, and less stringent telemetry restrictions.

The SOON and GONG networks currently used to supply data to space weather providers are aging and facing challenges to their operational funding. In addition a number of new scientific research directions in solar physics motivate the desire for a new ground-based network. For example, there is a growing need for multi-wavelength measurements to provide observations of wave propagation and the vector magnetic field as a function of height in the solar atmosphere. For magnetic field measurements, it is essential to know the direction and strength of the field above the photosphere for accurate coronal field extrapolations, and to reliably remove the azimuthal ambiguity. Understanding of the generation, transport and evolution of solar magnetic fields would make significant progress with the availability of continual long-term multi-wavelength observations

Given these motivations, a workshop was held in April 2013 at the High Altitude Observatory to discuss and gather community input on science requirements, capabilities and instrumentation for a next-generation synoptic network of solar observing instruments. 36 scientists and engineers attended the meeting, representing space weather agencies, solar physics research institutes, observatories, government agencies, and international organizations. A broad range of topics in addition to, but related to, space weather was covered, including radio observations, coronal science, helioseismology, vector magnetic field studies, irradiance, and solar cycle behavior. Several instrumental concepts were presented as well. Most of the presentations, together with the participant list, can be found at https://www2.hao.ucar.edu/docs/2013-synoptic-network.

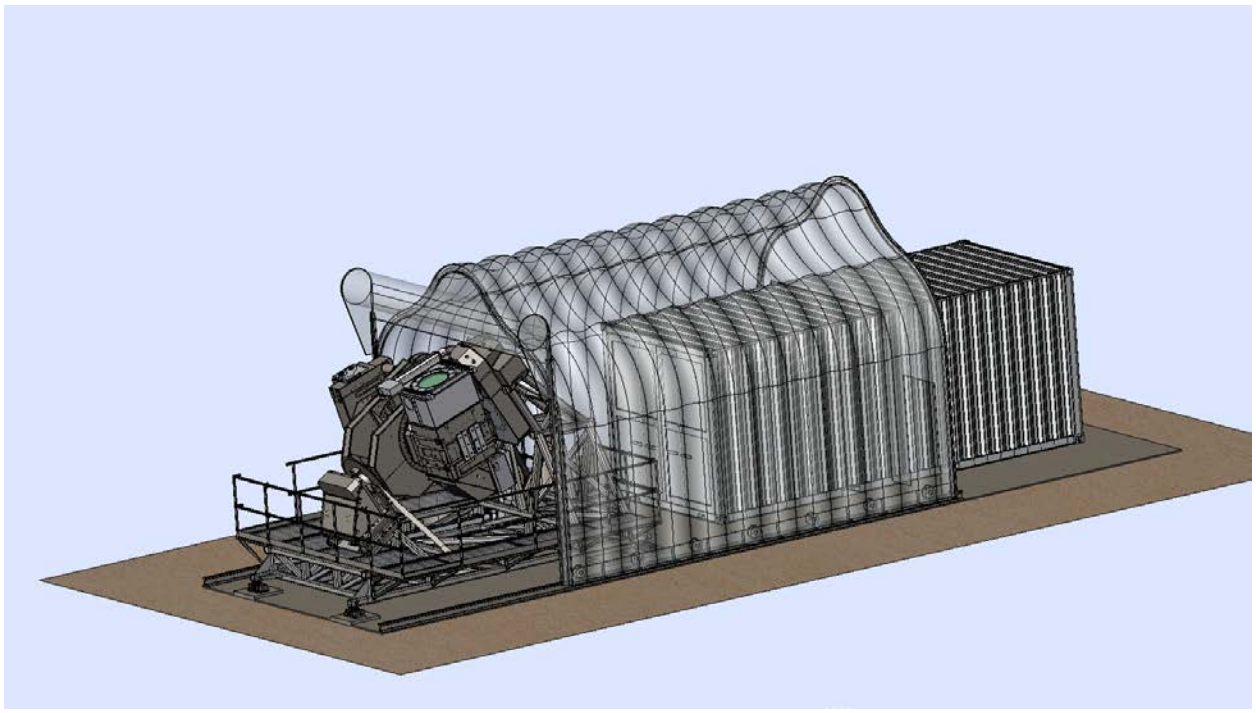
There were two major outcomes of the workshop. The first was the realization that each network location should not house a single device to provide all observations, but should comprise individual specialized instruments on a common pointing platform. An example of a multi-instrument platform concept is shown in the figure. This approach has several advantages:

- Fewer compromises for scientific requirements within a single instrument
- More flexibility in funding and schedules
- Ability to have different instrument suites at different sites to exploit specific observing conditions (e.g. coronal, radio observations)
- Relaxation of stringent scientific requirements for space weather forecast data
- Lower initial costs – need pointing platform, infrastructure and one instrument.

The other major outcome was an expressed desire for a new international organization to foster synoptic solar observations. Some entities are already in existence that touch upon the topic, such as

NASA's International Living With A Star (ILWS) program, the World Meteorological Organization, and the IAU working group on Coordination of Synoptic Observations of the Sun. However, there was some opinion that a more visible effort was required. There is considerable interest in a new synoptic network in Europe, as demonstrated by the SPRING (Solar Physics Research Integrated Network Group) work package in the recently funded SOLARNET program (http://www.solarnet-east.eu/) and led by the Kiepenheuer-Institut für Sonnenphysik.

Workshop participants recognized that it will be a challenge to locate the resources to develop and construct a new ground-based solar observing network. It will be an even larger challenge to identify and arrange the long-term operational funding that is required to fully utilize a new investment such as this. Workshop participants expressed the view that a multi-agency organization would be desirable to ensure that the needed data be acquired for forecasters and researchers. The recent Decadal Survey on Solar and Space Physics supports the network concept, and a mid-scale funding line that would accommodate a new network is anticipated to be established by the NSF.



A possible configuration of a new synoptic solar observing network site providing a multi-instrument platform for space weather operations, magnetic field research, and helioseismology.