BRICS Network for Constant Monitoring of the Sun (NCMS)

Observe the Sun 24/7 and be aware of any events

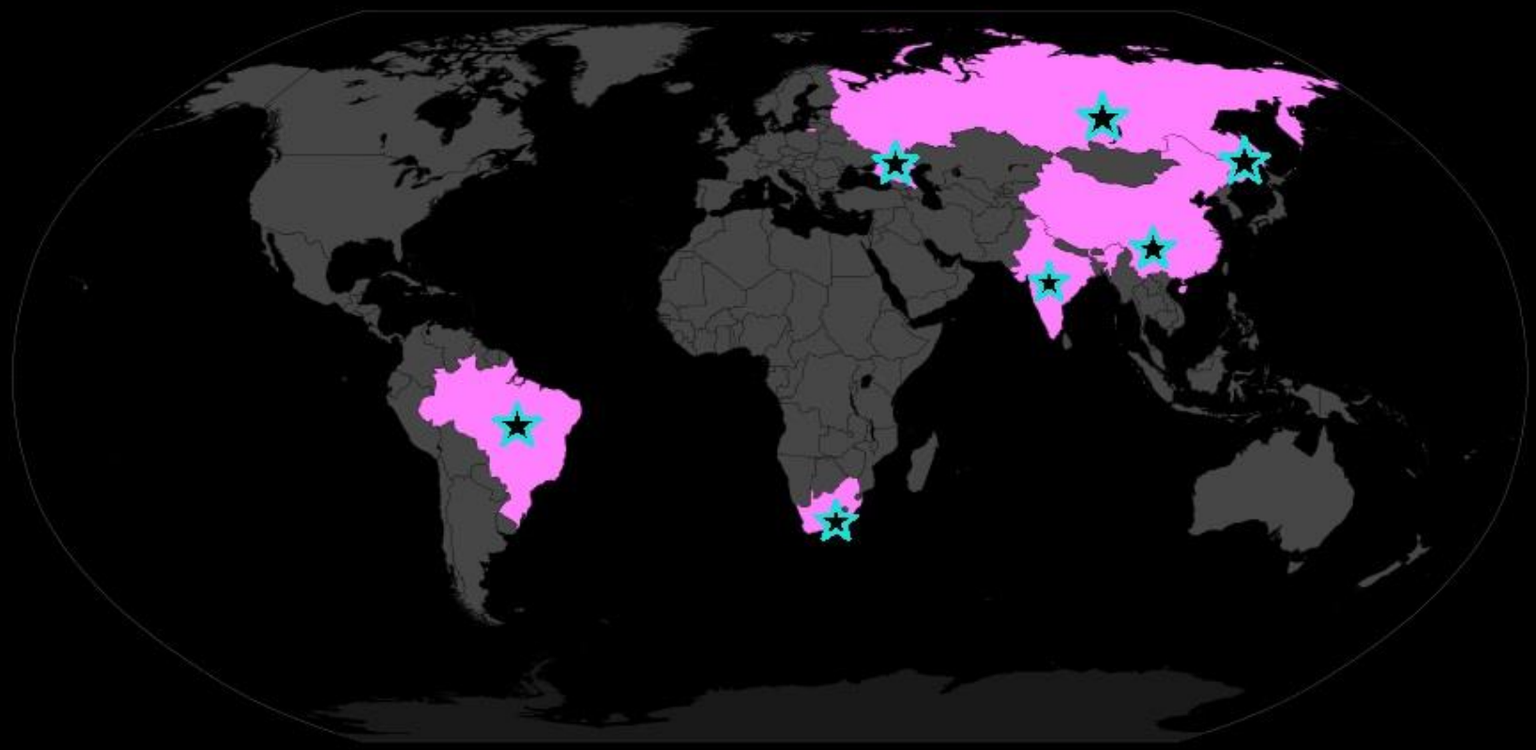
Collaboration: Pulkovo (Kislovodsk), Ussuriysk, Irkutsk & Crimea Observatories, **Russia,**

Huairou Solar Observatory, **China**

National Institute for Space Research, **Brazil**

Global challenge for BRICS

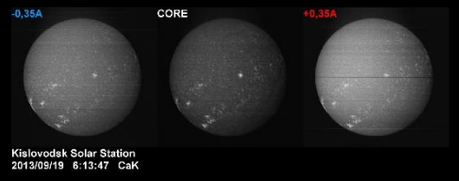
Real-time space weather forecast requires 24/7 monitoring of the Sun. National observatories can provide only a **partial** monitoring.



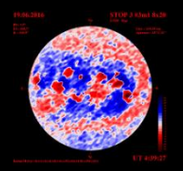
Integration of BRICS countries into a network enables **continuous** tracking of solar activity and real-time forecasting of space weather events.

NCMS model

24/7 patrol telescope network observes the Sun in several spectral lines



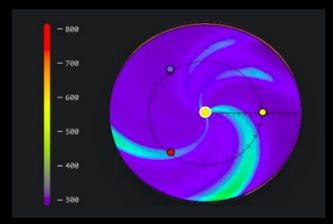
Solar observatories measure large-scale magnetic fields



Data mining centers process data flows and detect new events (solar flares, coronal mass ejections, etc)

Updating a database of solar observations

Updating a solar wind model



Production of space weather forecast and alerts

NCMS in focus

7 automated solar patrol telescopes. 3 in Russia and at least 1 in each of BICS

24/7 continuous observation of the Sun and real-time forecasting

5 solar magnetographs incl. 1 solar vector magnetograph

15 Gb daily from each of automated telescopes

7 day forecast of solar wind and tracing of CMEs up to 3 days

NCMS road map

Select locations and start construction of telescopes

Build a data center and elaborate API

Mount and calibrate telescope network

Adjust a solar wind model

Launch an online space weather monitoring and forecasting service

Run 24/7 data production

Project costs

Construction of 1 telescope – 70K (x7)

Telescope infrastructure – 20K (x6)

Telescope operational costs – 10K / year (x7)

Data center equipment – 200K

Data center operational costs – 30K / year

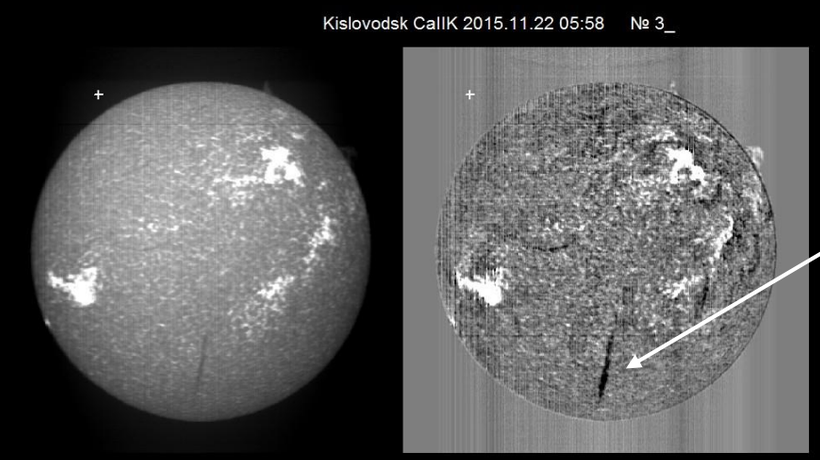
Data center personnel – 100K / year

Total – 810K and 200K / year

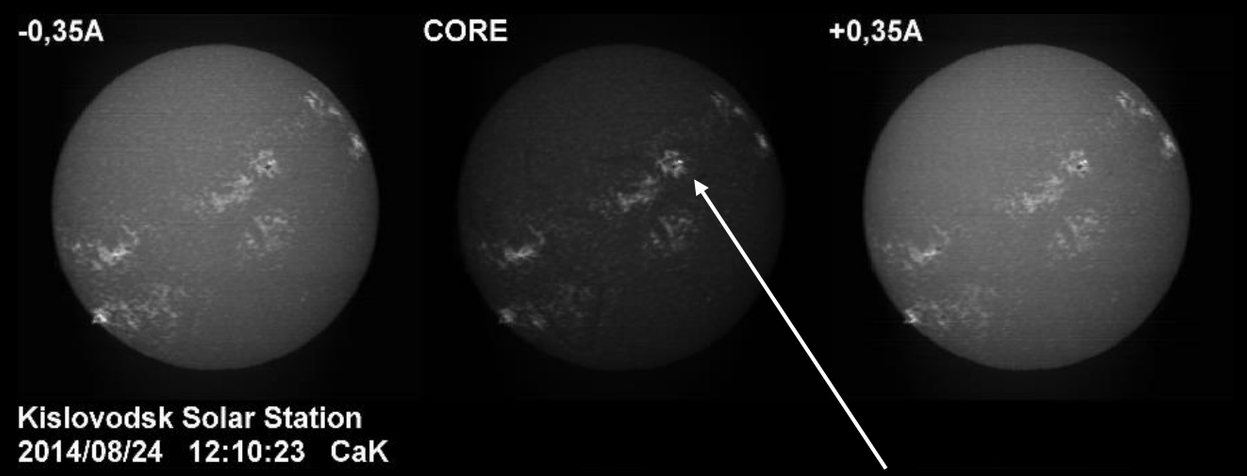
Patrol telescope for solar monitoring

Fully automated solar patrol telescopes observe the Sun in CaII-K, Hα and white light every 1 minute. It allows detection of solar flares and coronal mass ejections over the whole disk. Two telescopes operate daily in Russia and can be **easily combined with the new ones from BRICS into a global network**.

Solar patrol telescope at the Kislovodsk Mountain Astronomical Station

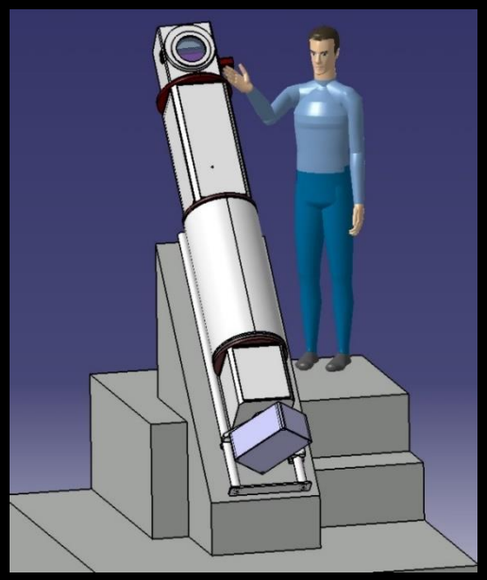


This dark line is a coronal mass ejection



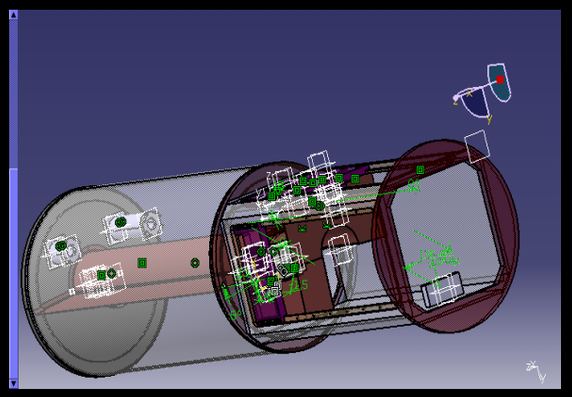
This bright spot is a solar flare

Under the hood of the patrol telescope

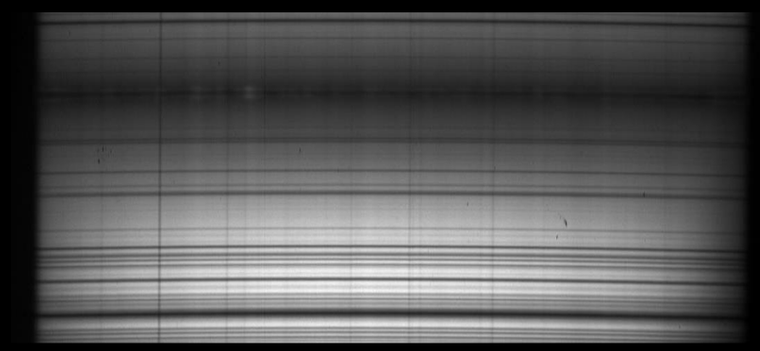


Focal distance of the main mirror: 2000 mm
Main mirror diameter: 100 mm
Detector type: CCD matrix
Matrix resolution: 4000 × 2672 pixels
Solar optical resolution: ~2 arcsec
Spectral resolution (R): 40K
Effective spectral resolution at CaII-K: 0.1 Å/pix
Effective spectral resolution at Hα: 0.16 Å/pix

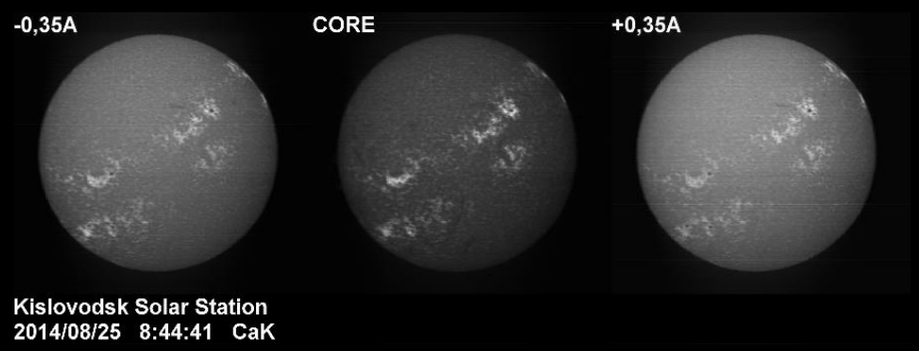
How it works



Spectrograph scheme



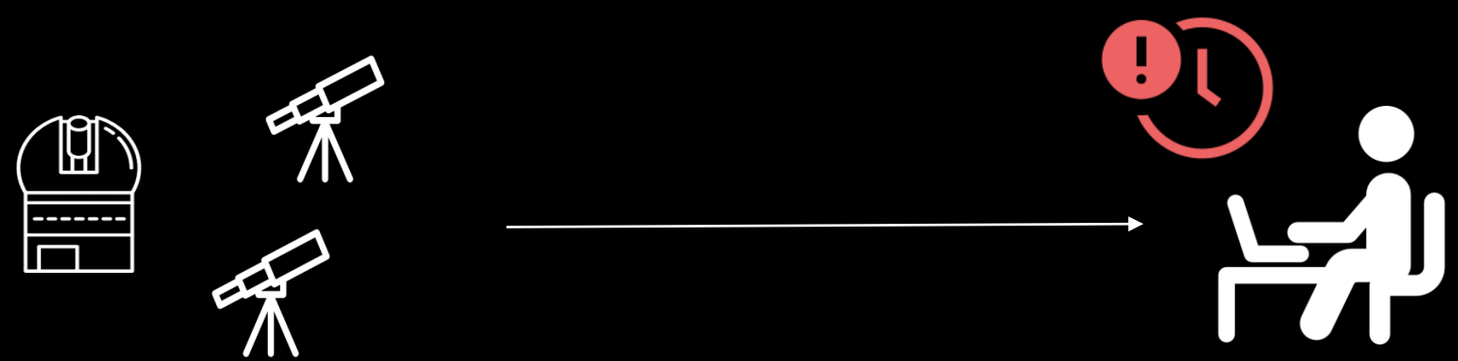
Scanned solar disk along a spectrograph entrance slit



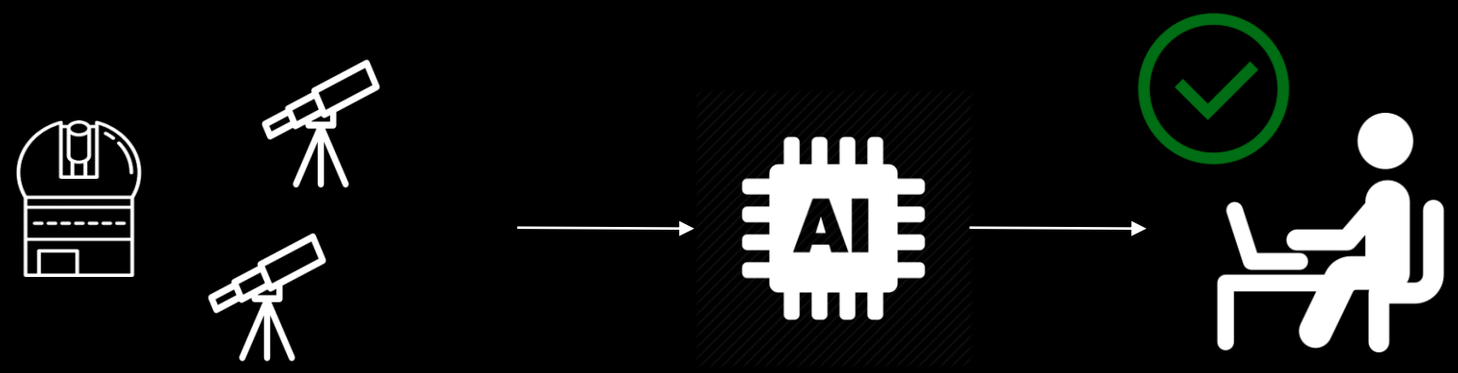
Solar disk images at the core and wings of spectral line

Data processing challenge

Global observational network will produce a large flow of raw data, while the number of experts to process data in real-time is very limited. This will cause **delays** in a forecast production.



Machine learning algorithms were demonstrated to provide an expert-level solar data processing. They are able to **speed up** routine workflows.

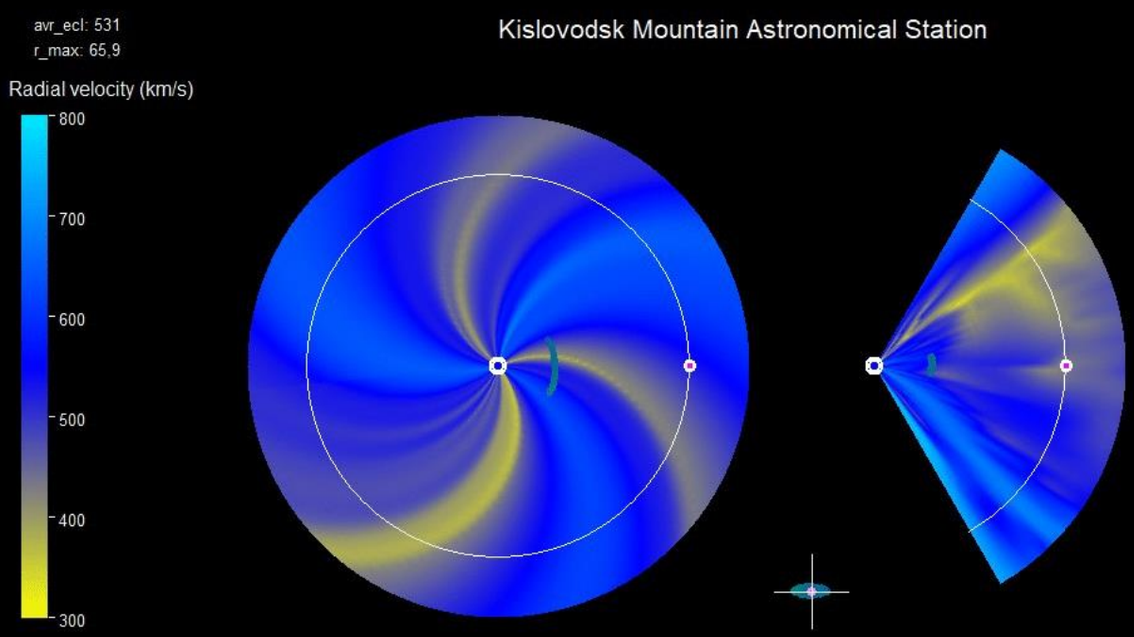


NCMS real-time outcome

Solar wind forecast up to 7 days and tracing of CMEs up to 3 days

Detection of solar flares and estimation of X-ray flow

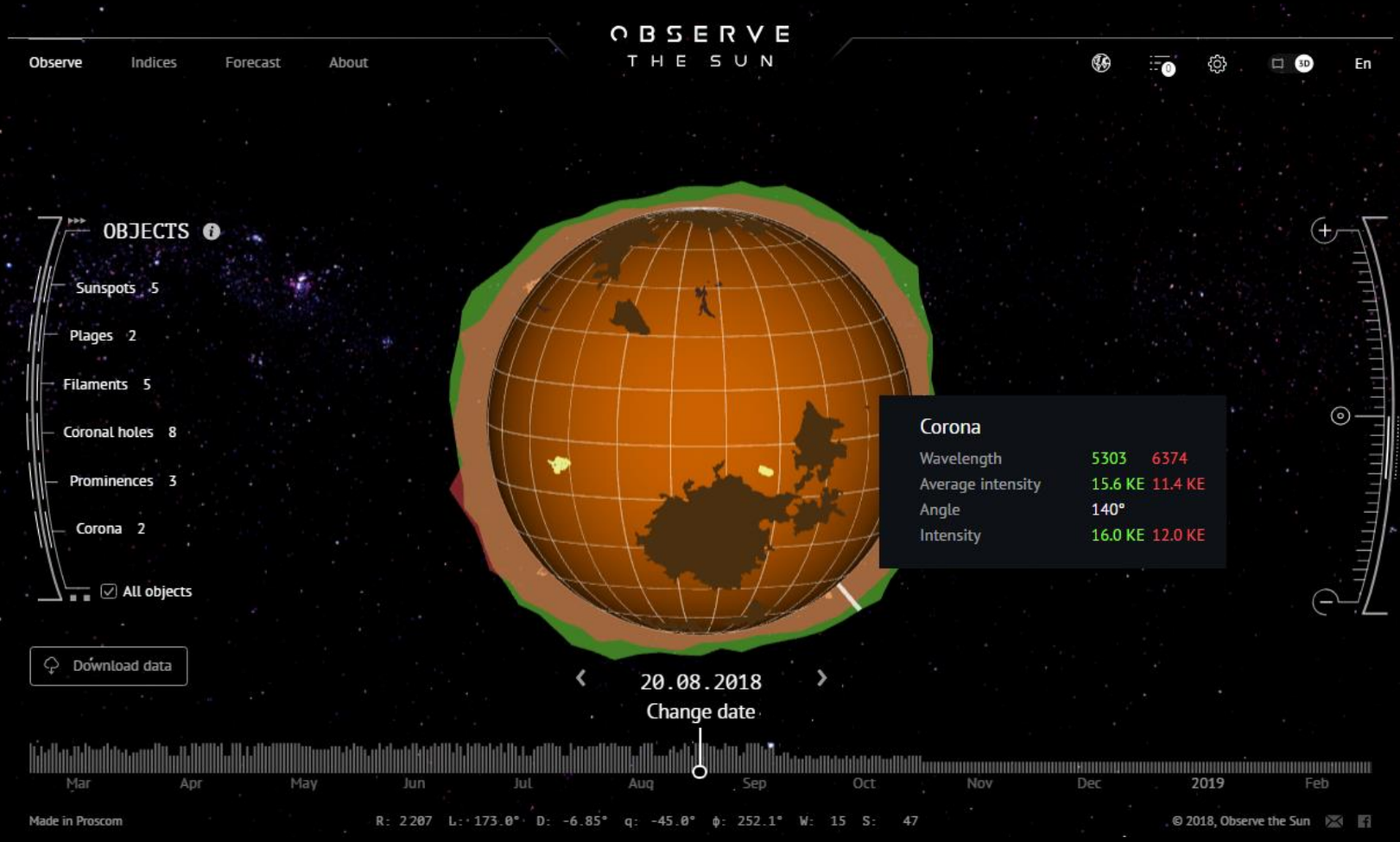
Space weather indices and alerts



Solar wind and CME prediction model

NCMS and long-term observations

NCMS extends and complements catalogues of solar observations.
More accurate models can be elaborated and validated on this basis.



Daily updated catalogue of solar active regions.
Learn more at http://observethesun.com

Conclusion

BRICS solar monitoring network

enables 24/7 real-time space weather forecasting

extends current catalogues of solar observations

provides a common database