



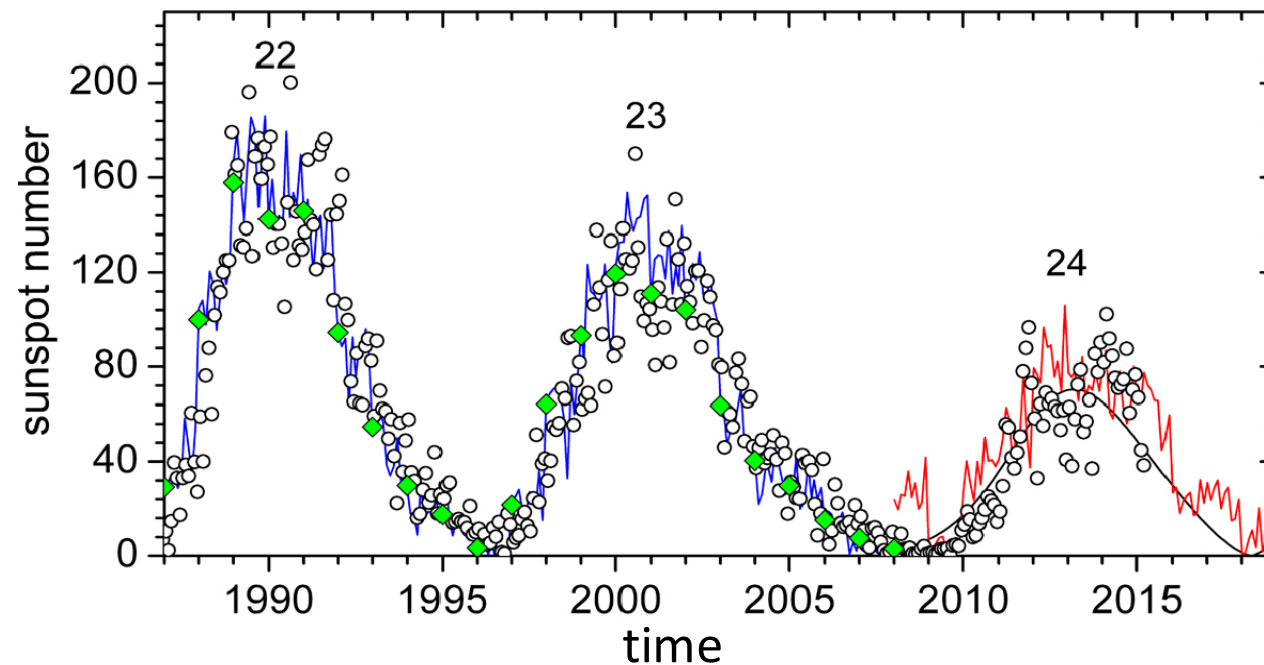
Global Solar Activity Data Portal for Long-Term Forecasting

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Solar Cycle Prediction: Sunspot number as model input



◆ Annual sunspot data, used for assimilation ○ Monthly sunspot data

Dynamo model

$$\begin{aligned}\frac{\partial A}{\partial t} &= \alpha B + \eta \nabla^2 A \\ \frac{\partial B}{\partial t} &= G \frac{\partial A}{\partial z} + \eta \nabla^2 B\end{aligned}$$

(Parker, 1955)

$$\frac{\partial \alpha_m}{\partial t} = \frac{\mu}{4\pi\rho} \left(\mathbf{B} \cdot (\nabla \times \mathbf{B}) - \frac{\alpha \mathbf{B}^2}{\eta} \right) - \frac{\alpha_m}{T_\alpha}$$

(Kleeorin & Ruzmaikin, 1982;

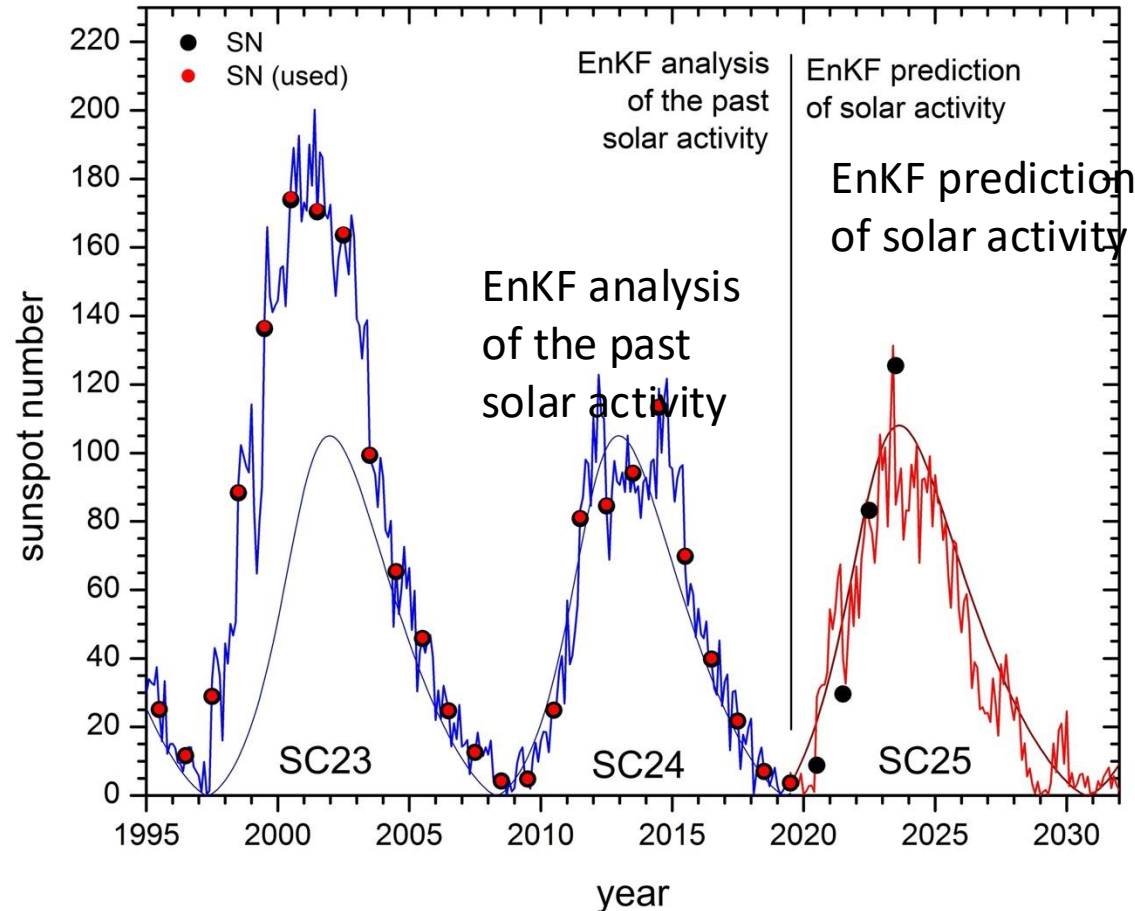
Kleeorin, Rogachevskii, Ruzmaikin, 1995)

$$\mathbf{W} \sim \mathbf{B}_t^{3/2}$$

Bracewell, 1953; 1988

Kitiashvili & Kosovichev 2008, 2009

Solar Cycle Prediction: Sunspot number as model input



Dynamo model

$$\frac{\partial A}{\partial t} = \alpha B + \eta \nabla^2 A$$

$$\frac{\partial B}{\partial t} = G \frac{\partial A}{\partial z} + \eta \nabla^2 B$$

(Parker, 1955)

$$\frac{\partial \alpha_m}{\partial t} = \frac{\mu}{4\pi\rho} \left(\mathbf{B} \cdot (\nabla \times \mathbf{B}) - \frac{\alpha \mathbf{B}^2}{\eta} \right) - \frac{\alpha_m}{T_\alpha}$$

(Kleeorin & Ruzmaikin, 1982;

Kleeorin, Rogachevskii, Ruzmaikin, 1995)

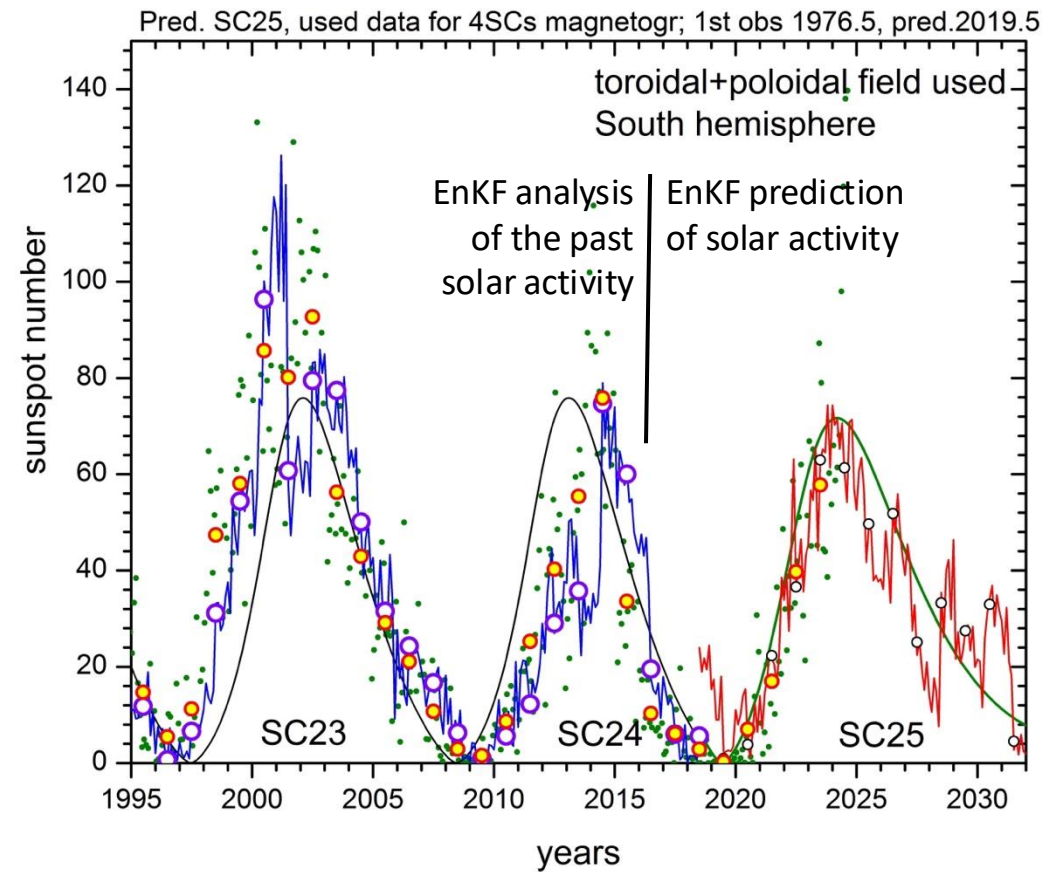
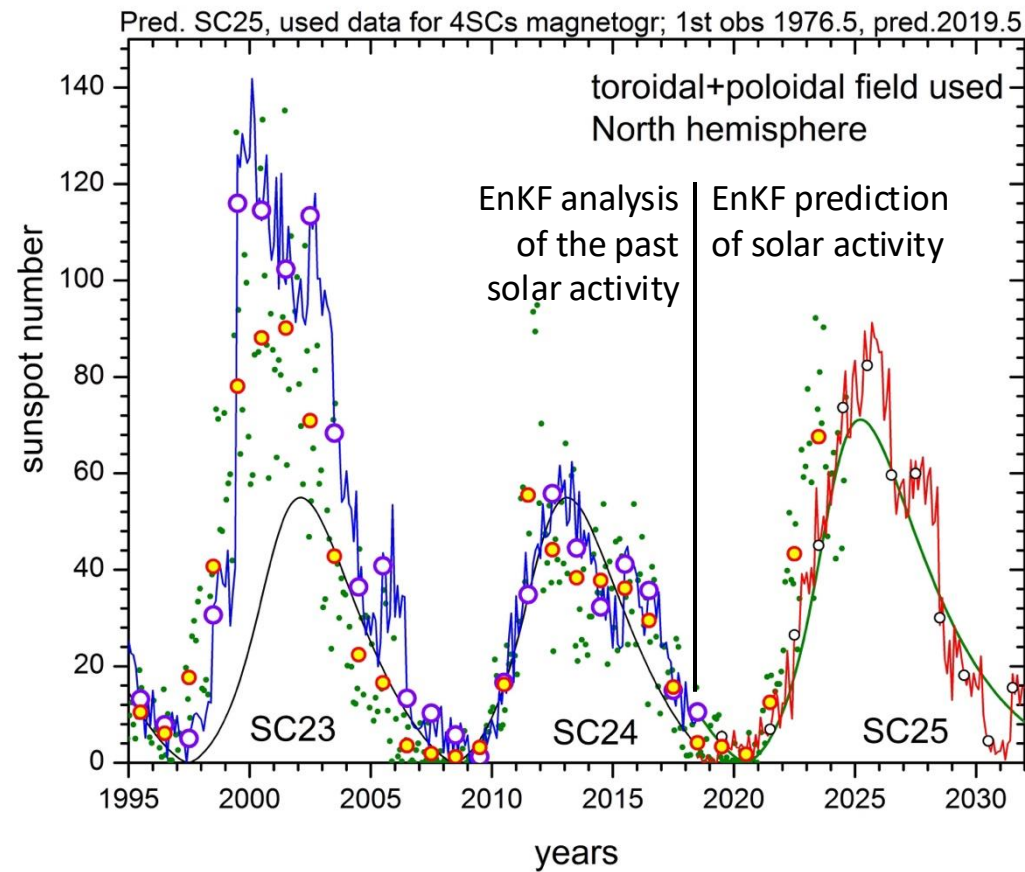
$$W \sim B_t^{3/2}$$

Bracewell, 1953; 1988

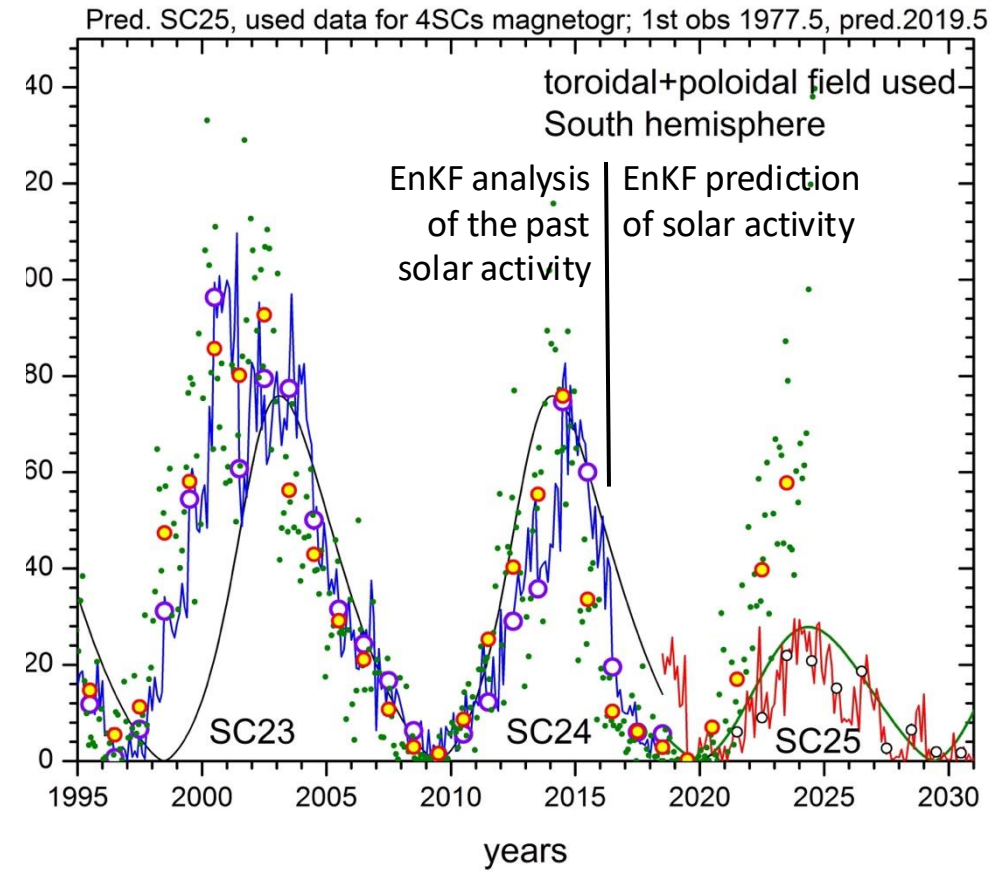
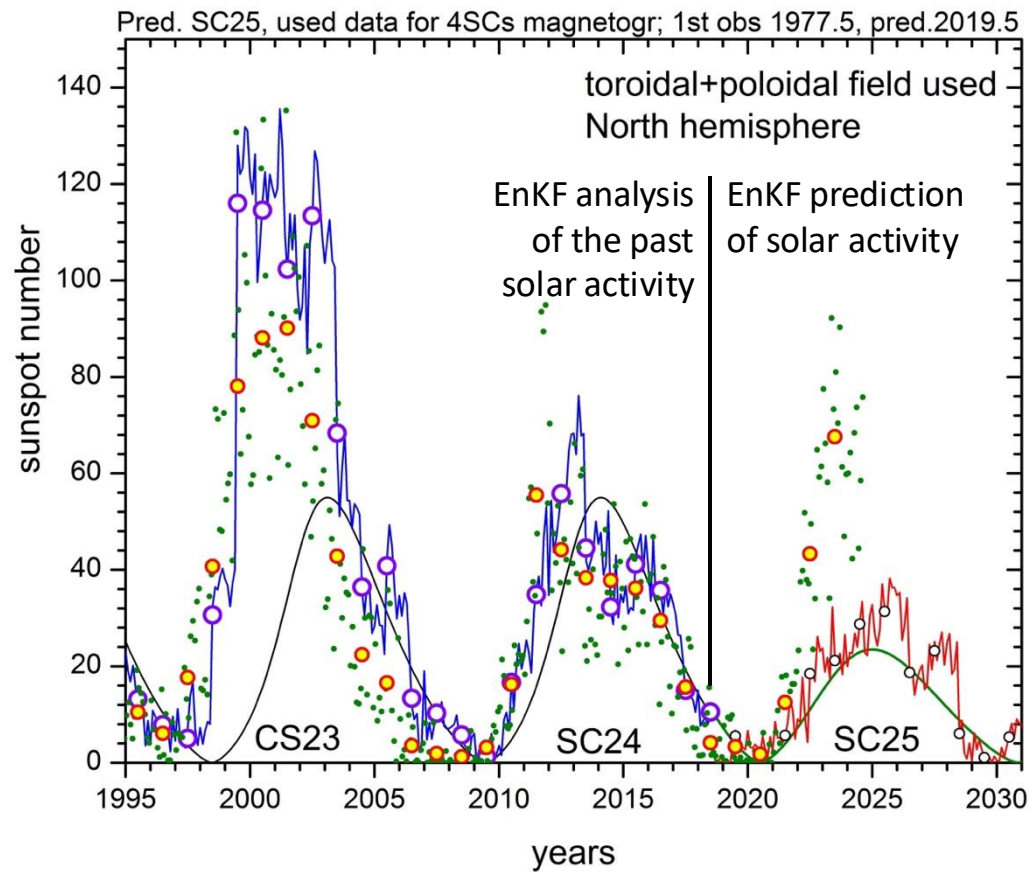
Kitiashvili & Kosovichev 2008, 2009

Kitiashvili 2016, 2021, 2020

Solar Cycle Prediction: Synoptic magnetograms as model input



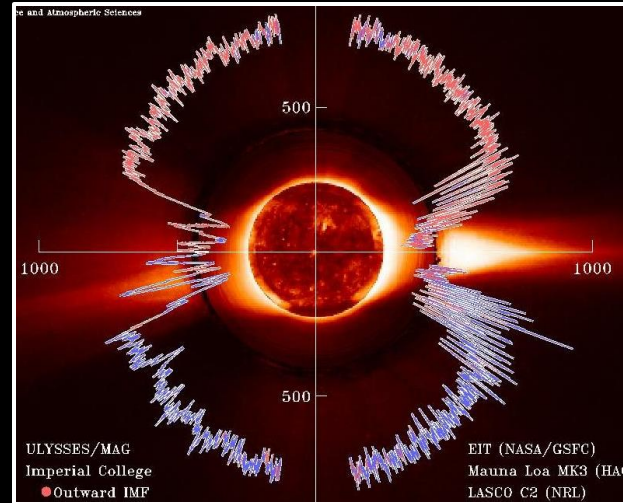
Solar Cycle Prediction: Synoptic magnetograms as model input



Observations of Solar Activity

1D observations

- ❖ Sunspot number
- ❖ Total Solar Irradiance
- ❖ Solar wind
- ❖ Polar faculae
- ❖ Surface magnetic fields
- ❖ Solar corona
- ❖ Differential rotation
- ❖ Meridional circulation



ULYSSES/SWOOPS

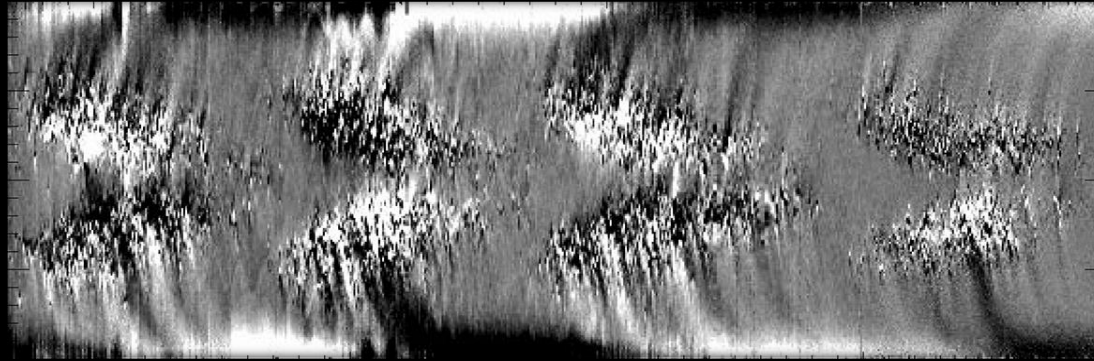
SDO/AIA

Observations of Solar Activity

2D observations

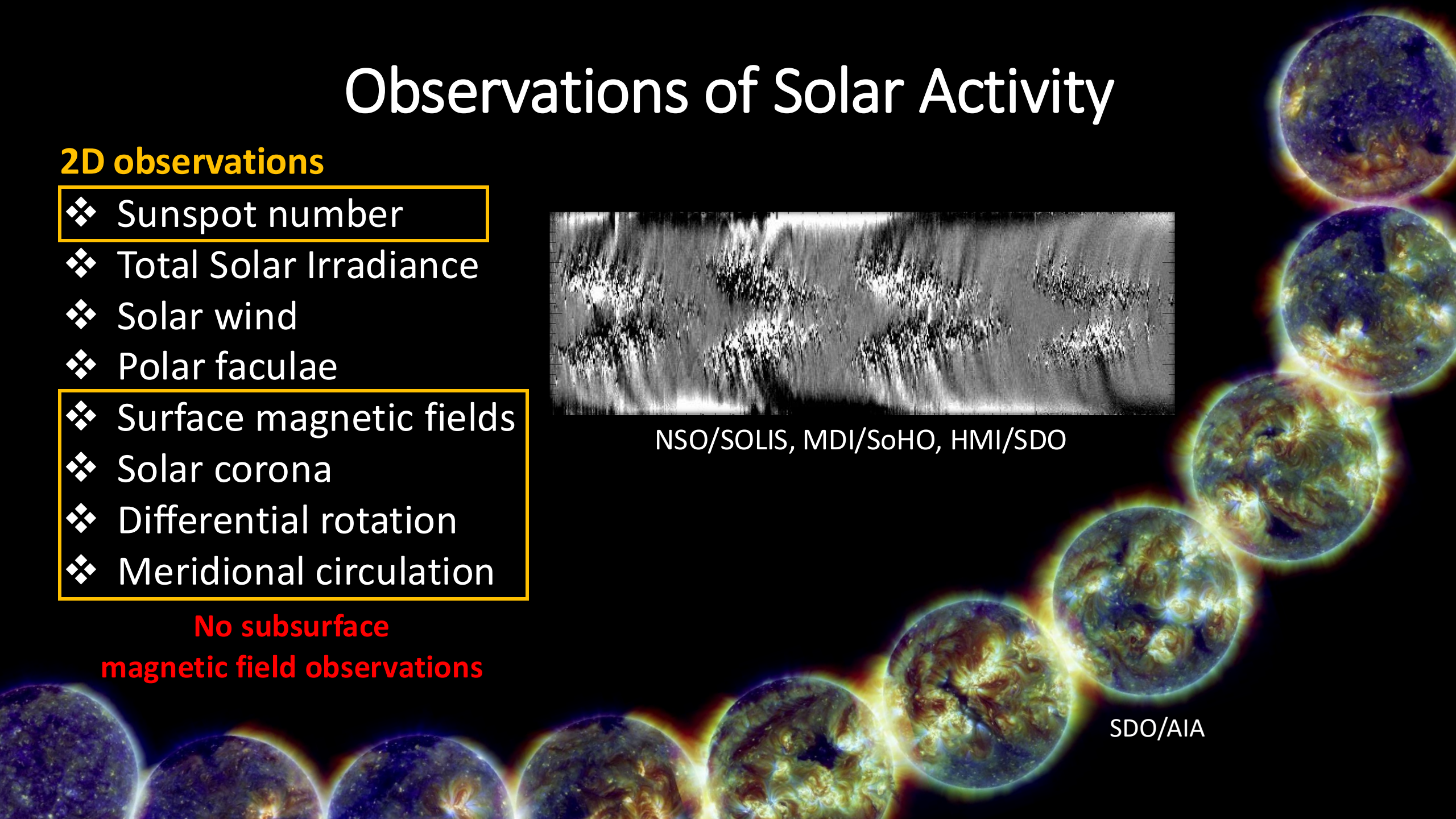
- ❖ Sunspot number
- ❖ Total Solar Irradiance
- ❖ Solar wind
- ❖ Polar faculae
- ❖ Surface magnetic fields
- ❖ Solar corona
- ❖ Differential rotation
- ❖ Meridional circulation

**No subsurface
magnetic field observations**



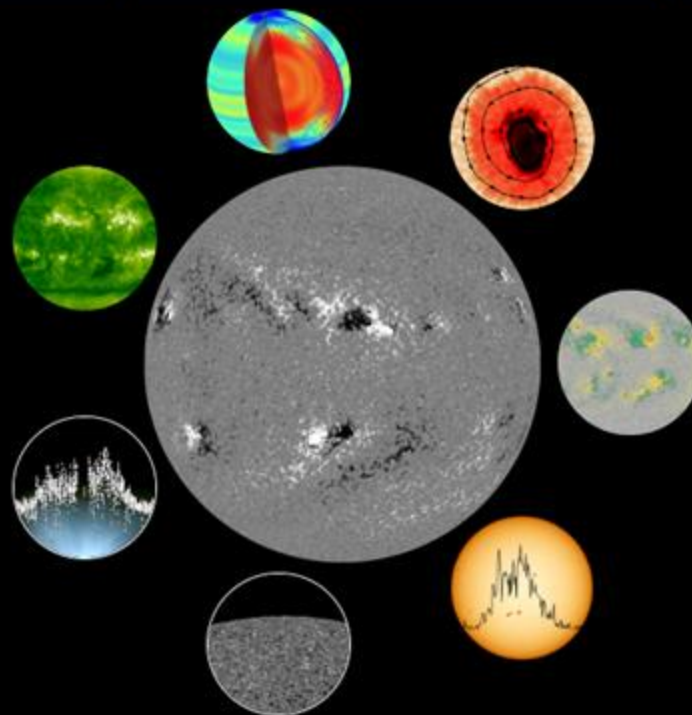
NSO/SOLIS, MDI/SoHO, HMI/SDO

SDO/AIA



Global Solar Activity Data Portal

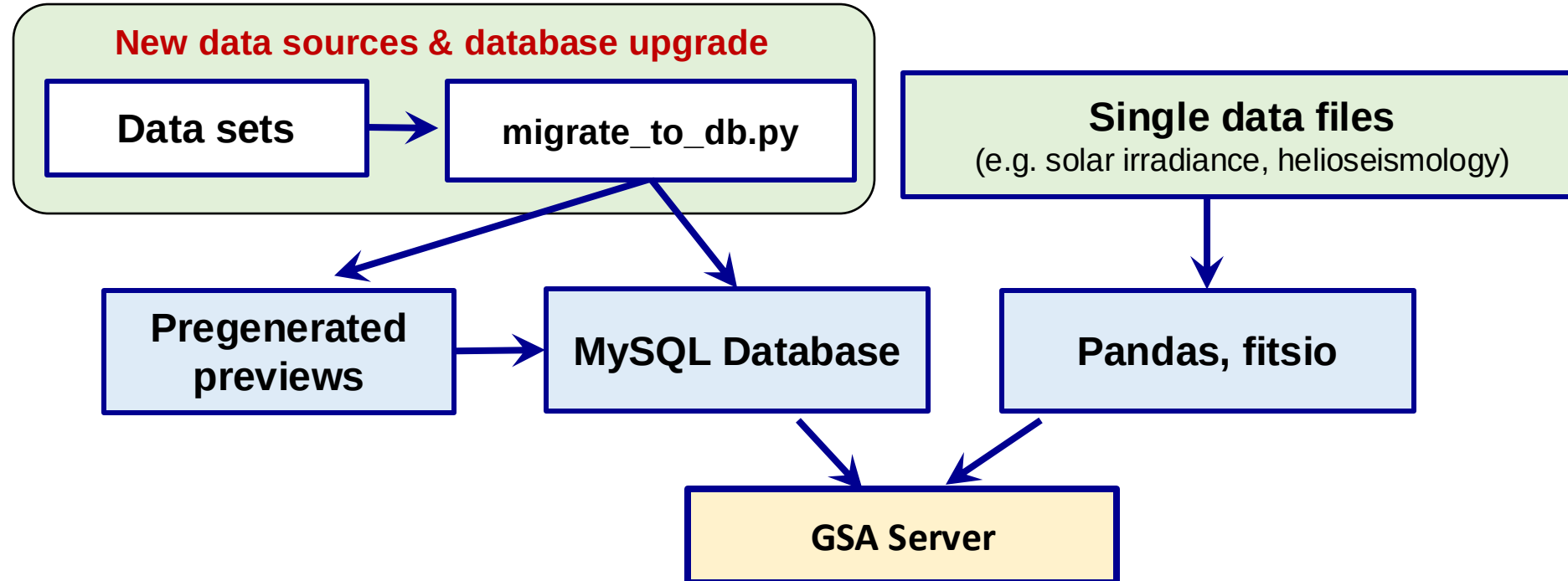
Data collection to picture global solar activity of the Sun.

[View Data](#)

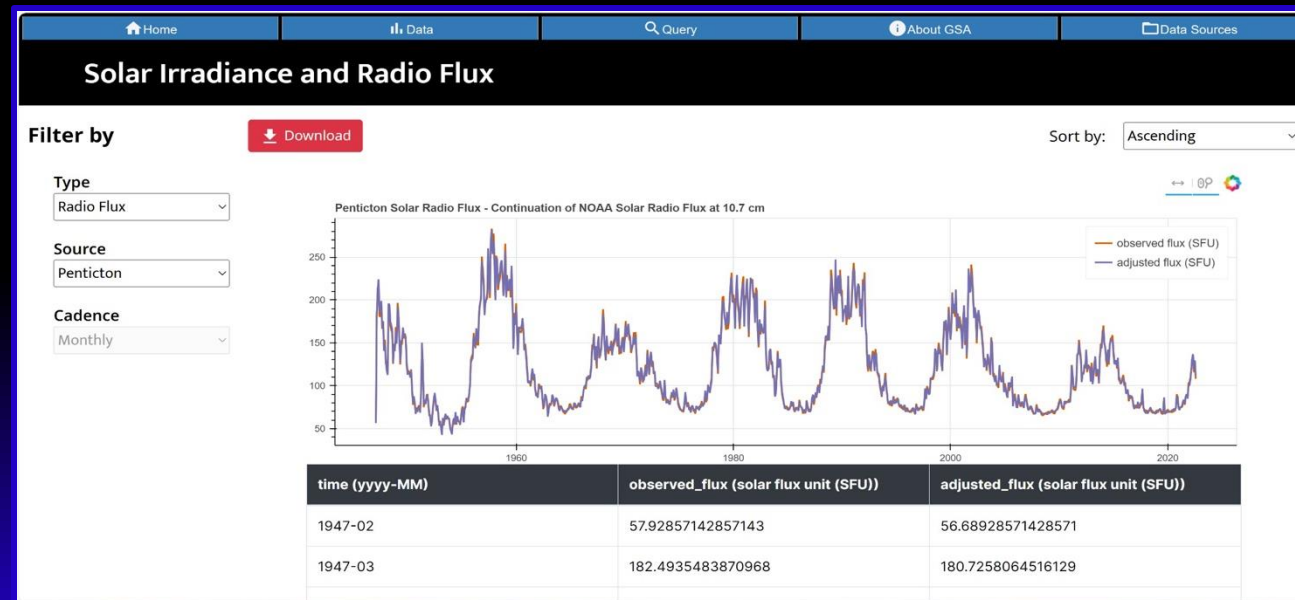
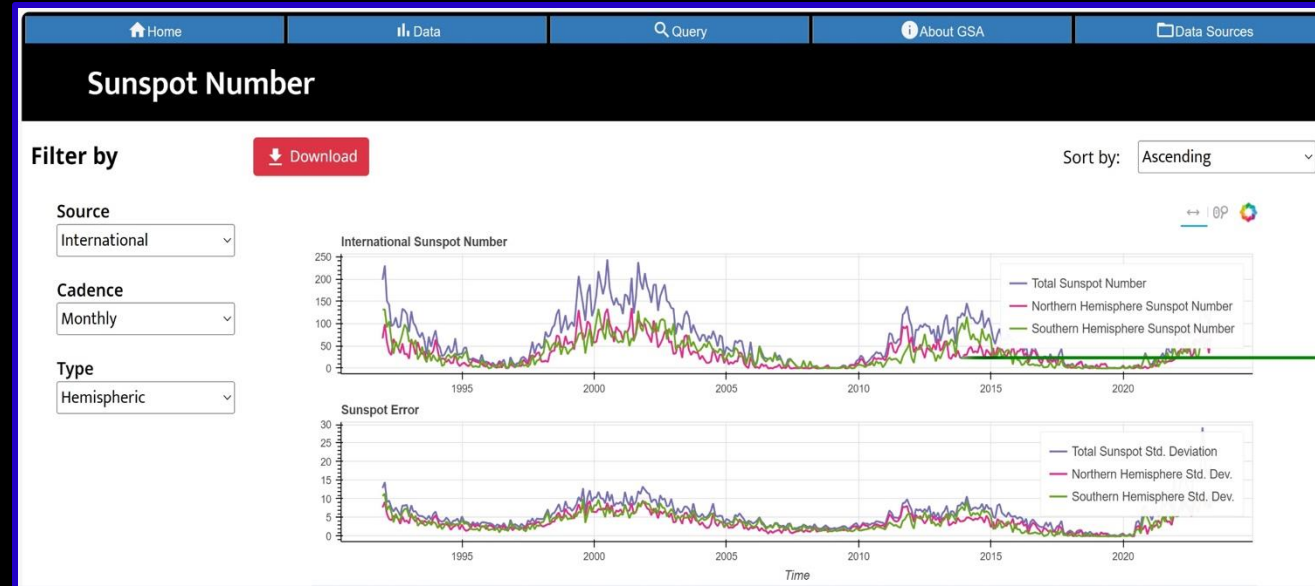
Categories

[Magnetograms](#)[Subsurface flows](#)[Sunspot Number](#)[Polar Magnetic Fields](#)[Magnetic Helicity](#)[Solar Irradiance](#)[Synoptic Maps of Solar Corona](#)

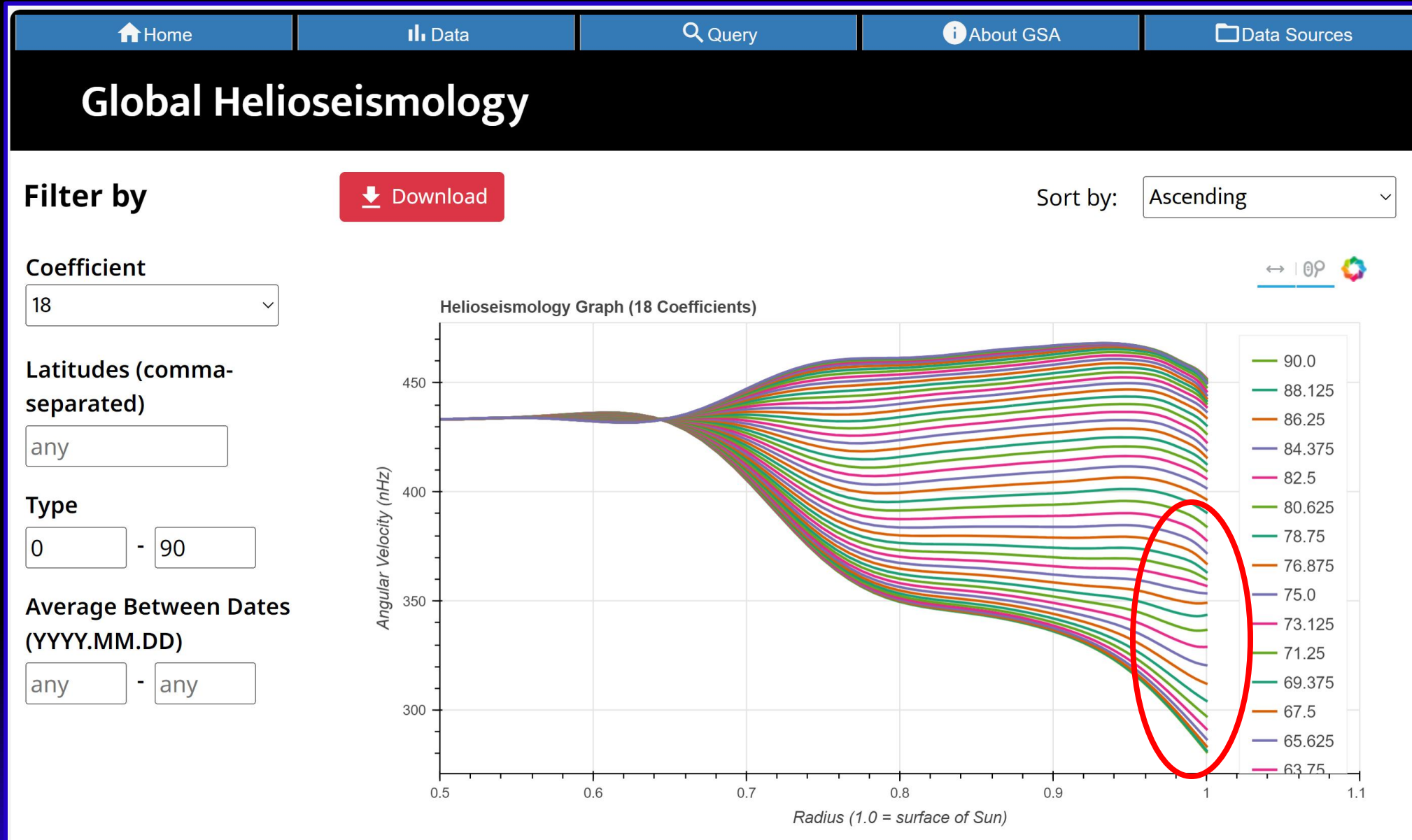
GSA Portal: Data Flow



Data Processing and Visualization: 1D



Data Processing and Visualization: 1D



Data Processing and Visualization: 2D

[Home](#)[Data](#)[About GSA](#)[Data Sources](#)

Magnetograms

Filter by

[Download](#)Sort by: Ascending

Source

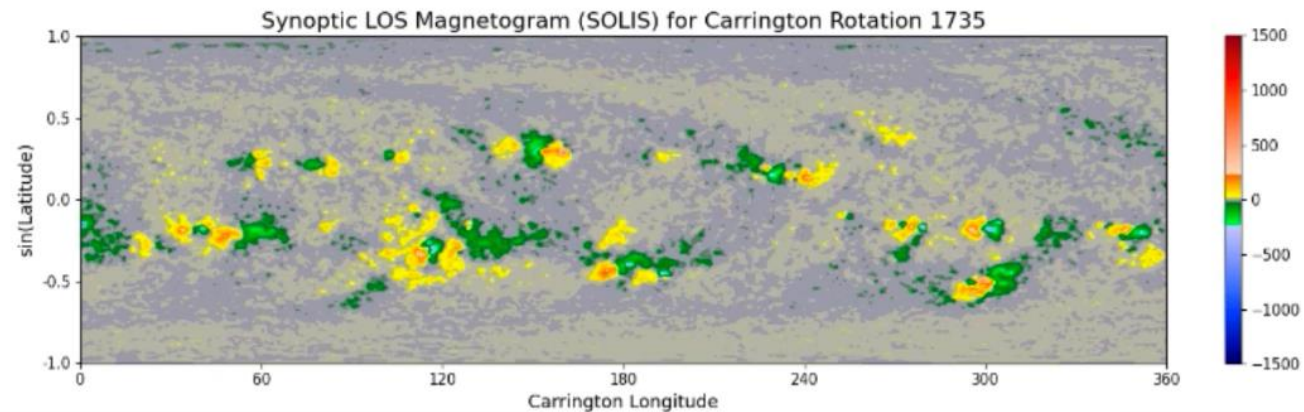
☒ SDO/HMI☒ MDI☒ SOLIS

Type

☒ Radial☒ Interpolated polar☒ LOS

Start (Carrington)

Carrington number to preview: 1735



Source	Type	Carrington Rotation i	File
SOLIS	LOS	1735	m1735f.fits

Data search and retrieval

[Home](#)[Data](#)[Query](#)[About GSA](#)[Data Sources](#)

Query and Download Data

From To

☒ All

☒ Magnetograms

Sources

☒ SDO/HMI

☒ SOHO/MDI

☒ SOLIS

Types

☒ LOS

☒ Interpolated Polar

☒ Radial

☐ Sunspot Number

Sources

☐ International

☐ American

☐ Greenwich

☐ Subsurface Flows

Time Format

☐ Date

☒ Carrington Rotation

Type

☐ Differential Rotation

☐ Meridional Flow

Dimension

☐ 1D

☒ 2D

☐ Solar Irradiance/Radio Flux

Sources

☐ EMPIRE

☐ TSIS

☐ Historical-TSI

☐ NN-SIM

☐ NRLTSI2

☐ Composite Solar Lyman-alpha

☐ NOAA (10.7cm flux)

☐ Penticton (10.7cm flux)

☐ Polar Magnetic Field

Sources

☒ SOLIS VSM 6302A Polar Radial Field

☒ WSO Mean Magnetic Field (1976-2022)

☐ Solar Corona

Sources

☒ SOHO/EIT

Wavelengths

☒ 171A

☐ 195A

☐ 284A

☐ 304A

☐ Magnetic Helicity

☐ Helioseismology

Coefficient

☒ 6

☐ 18

☐ 36

Results

Download Script

Conclusions

- For analyzing and forecasting solar activity, we are developing the Global Solar Activity data portal, which collects observations from multiple sources, including data from space missions, ground observations, and historical data.
- The data portal will be publicly available as a part of the NASA Helio Portal in 2025.