

26 Convención de astronomía

16 marzo 2025



Evaluación de la actividad solar desde la última Convención

Javier Alonso Santiago



Algunos resultados anuales

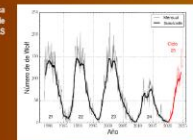
+2500
Observaciones

+1000 Fotos y dibujos
solares en luz blanca, halfa y
calcio

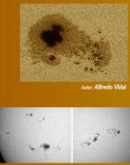
+15 Observadores
estables

+25 años de observaciones solares continuadas

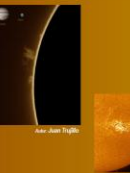
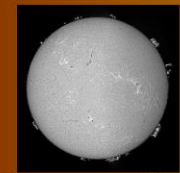
Serie histórica
del número de
Wolf de la AAS



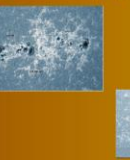
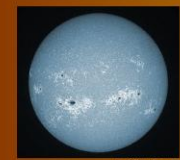
Imágenes en Luz Blanca de la fotosfera:
manchas solares



Imágenes en H α de la cromosfera:
protuberancias, filamentos y fulguraciones



Imágenes en Calcio de la baja cromosfera:
manchas y fáculas / playas



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www.astrosabadell.org



GRUPO DE HELIOFÍSICA

Observador	Telescopio	Wolf	Fotografías	Dibujos
Javier Alonso (Burgos)	R-90 / MC-102	X		
Alberto Berdejo (Zaragoza)	R-63	X		
Francesco Decorso (Milán, IT)	R-60	X		
Faustino García (Asturias)	R-70	X	X	
Àngel Graells (Barcelona)	R-80 / R40 / R80		X	
Guilherme Grassmann (Sao Paulo, BRA)	R-40 / R-40		X	
Walter Maluf (Sao Paulo, BRA)	R-102	X		
Emilio Martínez (Vizcaya)	T-100	X		X
Juan Antonio Moreno (Gran Canaria)	R-102	X		
Ángel Palazuelos (Cantabria)	BT-100	X		
Hilari Pallarès (Balears)	SC-200	X		
Xavier Parés (Barcelona)	SC-200	X		
Mariano Peñas (Tarragona)	T-200	X		
Javier Ruiz (Cantabria)	R-120	X	X	
Jordi Zamora (Barcelona)	T-150	X		

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Francesco Decorso (Milán, IT)	R-60			
Faustino García (Asturias)	R-70			
~~Àngel Graells (Barcelona)~~	~~R-80 / R40~~			
Guilherme Grassmann (Sao Paolo, BRA)	R-40 / F			
Walter Maluf (Sao Paolo, BRA)	R-10			
~~Emilio Martínez (Vizcaya)~~	~~T-10~~			
~~Juan Antonio Moreno (Gran Canaria)~~	~~R-10~~			
Ángel Palazuelos (Cantabria)	BT-10			
Hilari Pallarès (Baleares)	SC-20			
Xavier Parés (Barcelona)	SC-200	X		
Mariano Peñas (Tarragona)	T-200	X		
Javier Ruiz (Cantabria)	R-120	X	X	
~~Jordi Zamora (Barcelona)~~	~~T-150~~	~~X~~		



Q. E. P. D.

Emilio Martínez Teran



Falleció en Barakaldo-Cruces, el día 7 de noviembre de 2024, a los 74 años de edad.

Su esposa, Carmen Bretos; hija, Nora; hermano, Eugenio (†); hermanos políticos, Teri, Begoña y Carlos; sobrinos, primos, amigos y demás familia.

ACTO DE DESPEDIDA de cuerpo presente: HOY, viernes, día 8, a las SEIS de la tarde, en la capilla del tanatorio Santa Ana de Leioa (Avda. Amaia 2, frente al ambulatorio de Las Arenas).

SALA VELATORIO: HOY, viernes, de 10:00h a 13:30h y de 15:30h a 18:00h.

Funeuskadi Getxo - Tanatorio Sta. Ana. Avda. Amaia 2. Leioa Tel: 94 464 63 81.

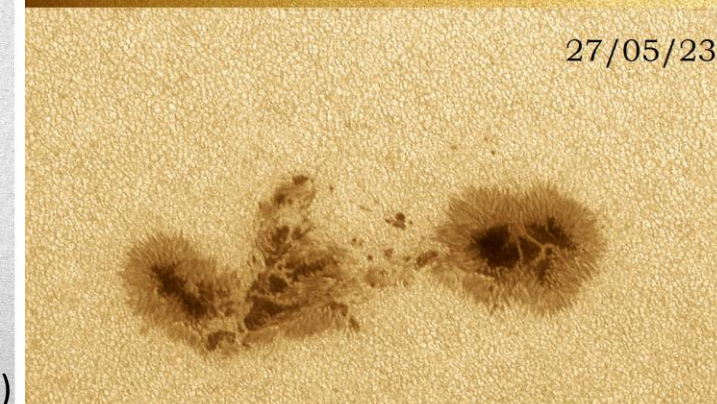
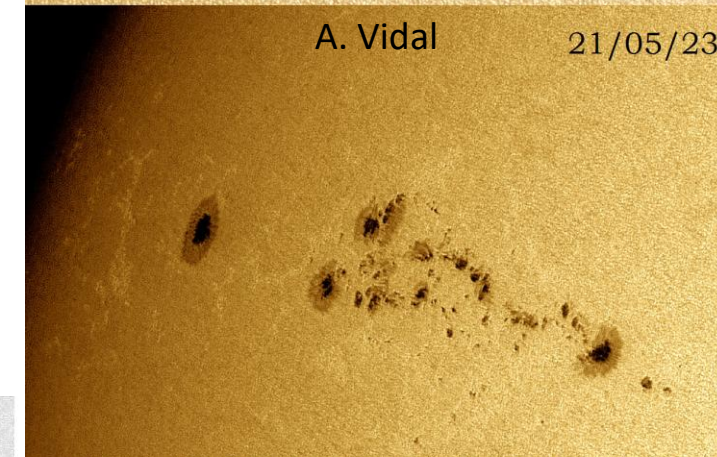
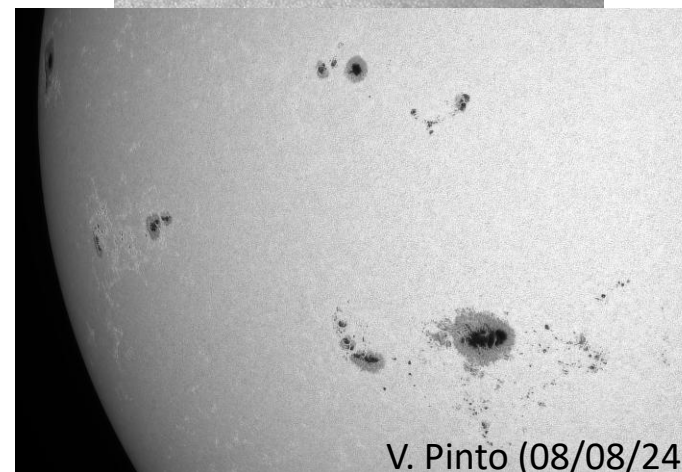
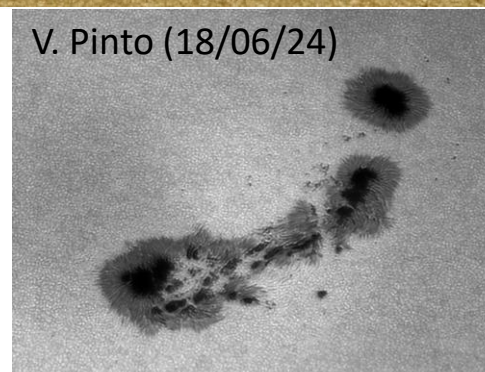
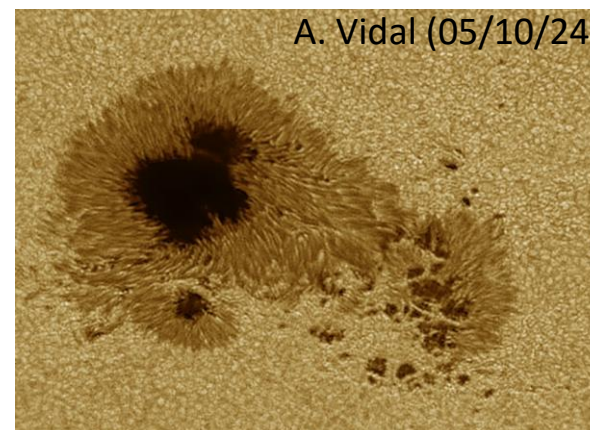
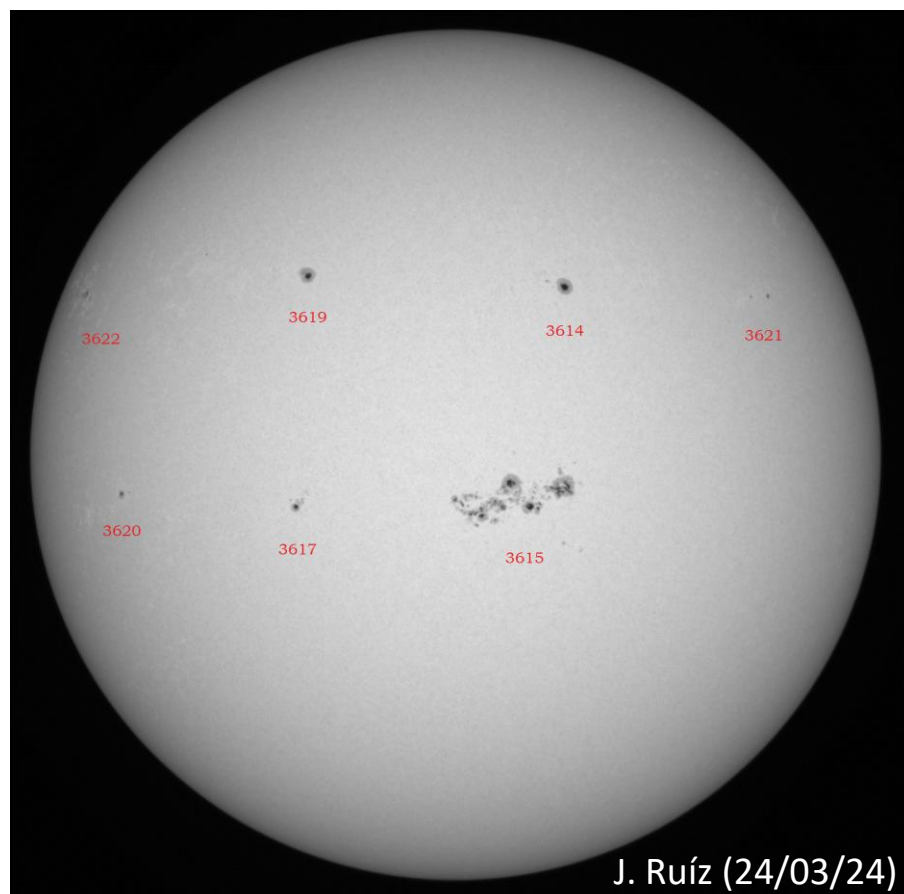
GRUPO DE HELIOFÍSICA

Observador	Telescopio	Wolf	Fotografías	Dibujos
Antonio Capapé (Barcelona)	T-150	X	X	
Ricard Casas (Barcelona)	SC-200		X	
Josep Masalles (Barcelona)	SC-200 / R-80		X	
Víctor Pinto (Barcelona)	R-140	X		
Juan M. Trujillo (Zaragoza)	R-60	X	X	
Alfredo Vidal (Barcelona)	C-11		X	

Aarón de la Casa, Jesús Conde, Carles Labordena, David López, Armand Oliva ...

¡Muchas gracias a Josep M. Oliver y Albert Morral!

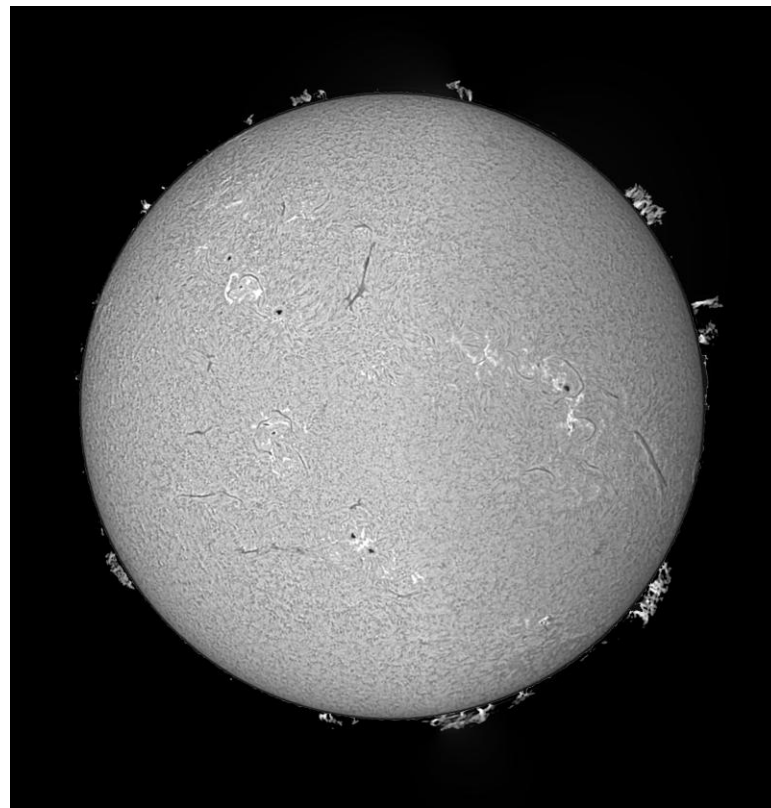
Imágenes en luz blanca: Fotosfera



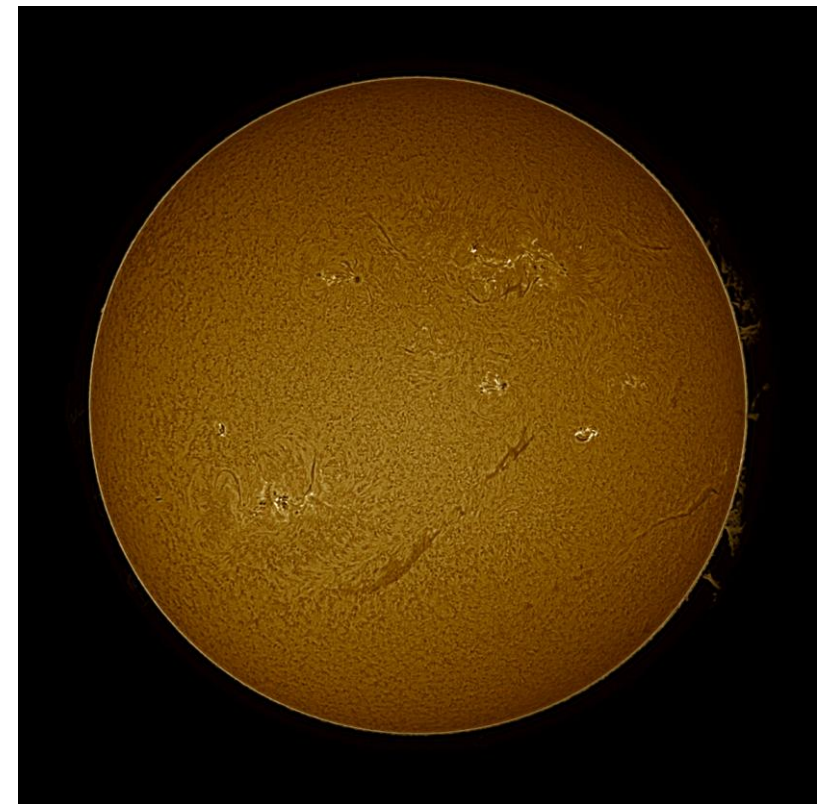
Imágenes en $H\alpha$: Cromosfera



L. Canals (20/05/23)

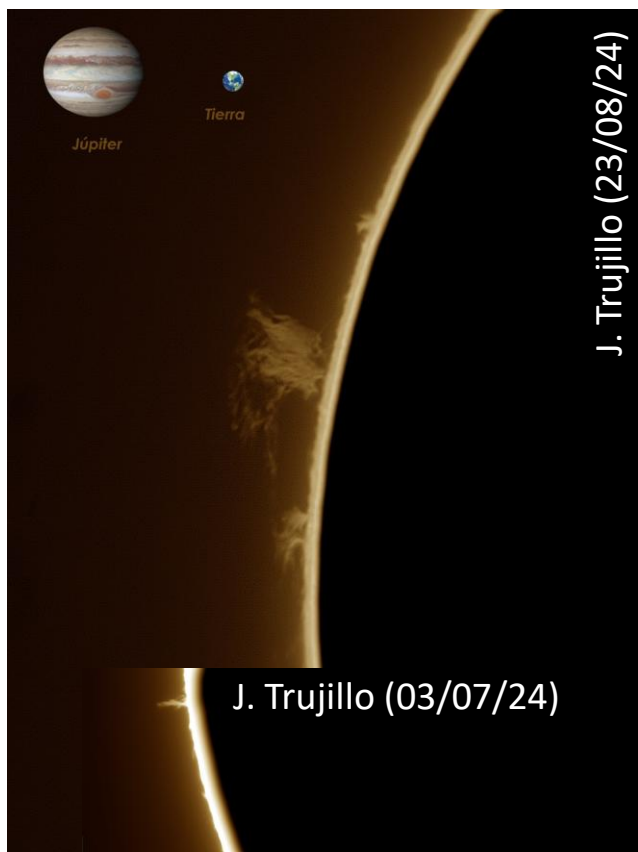


L. Ribé (18/08/23)

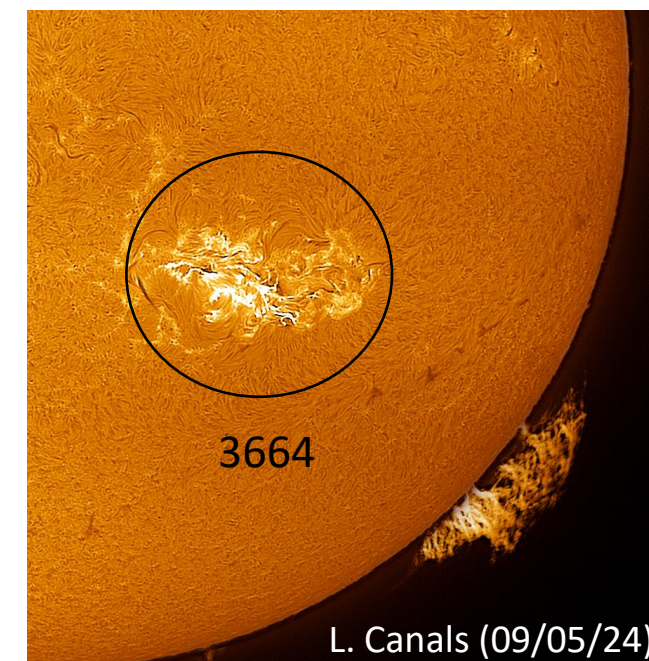
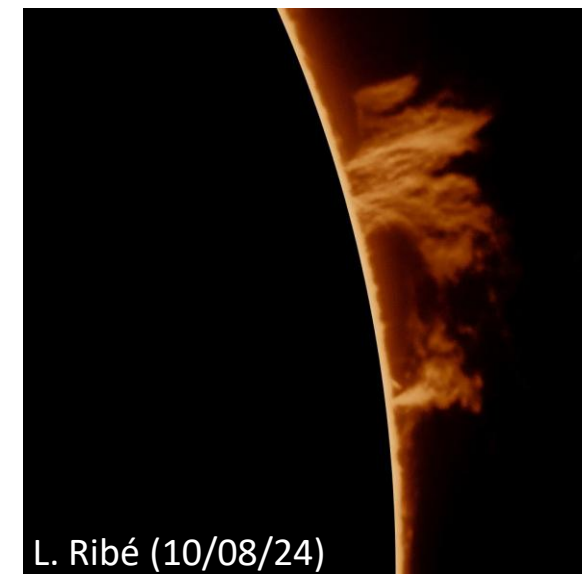
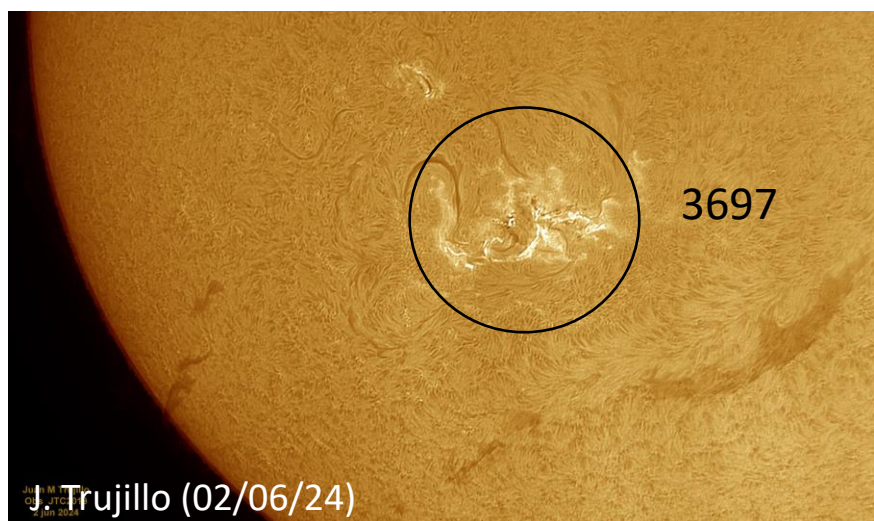
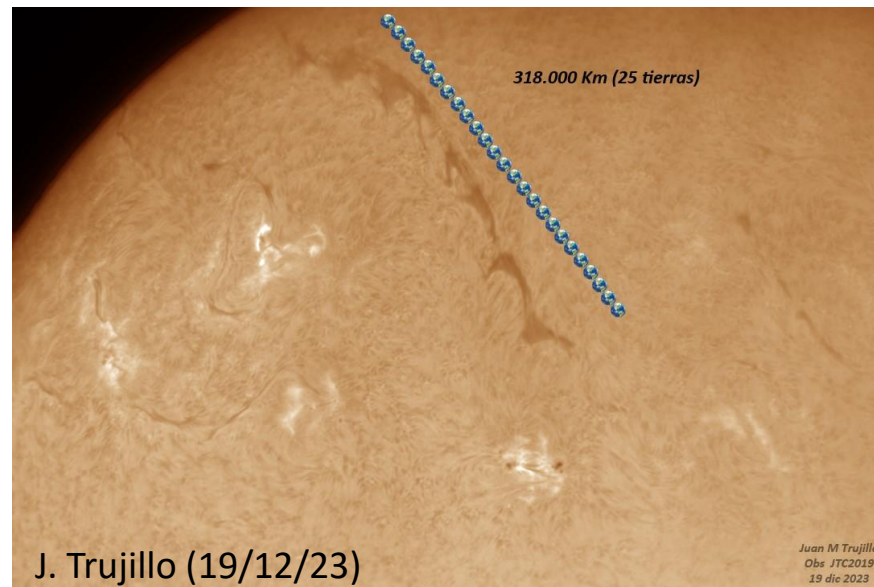


A. Capapé (01/06/24)

GRUPO DE HELIOFÍSICA



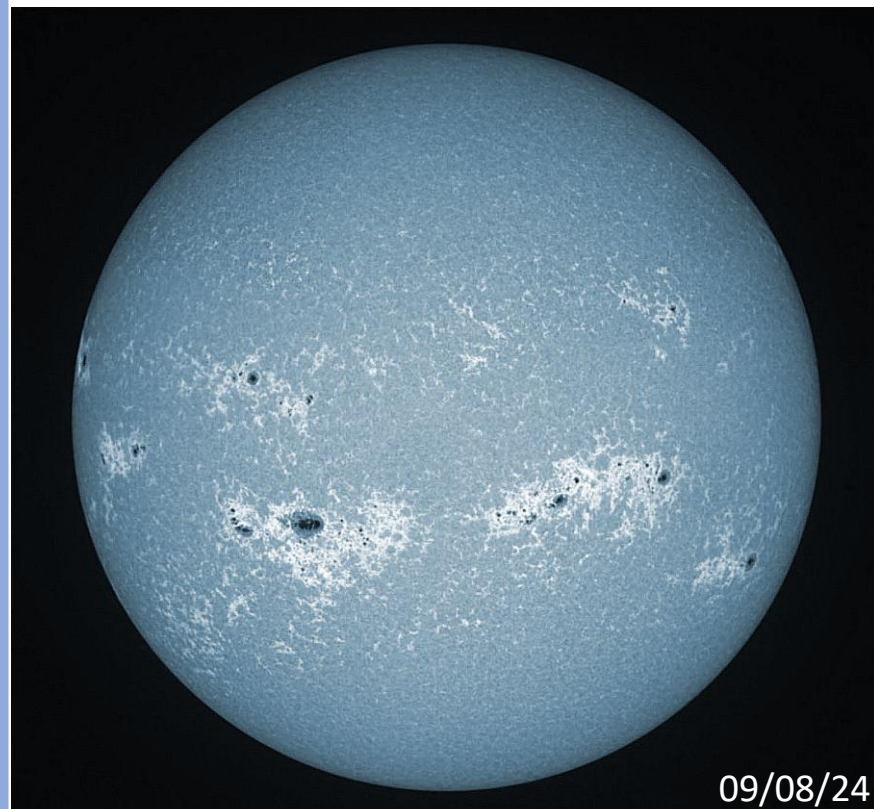
J. Trujillo (03/07/24)



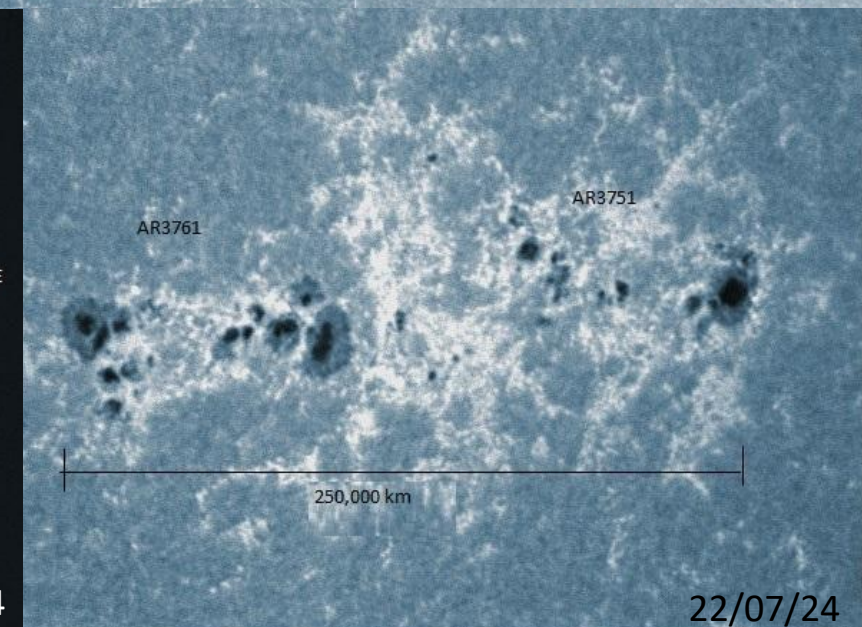
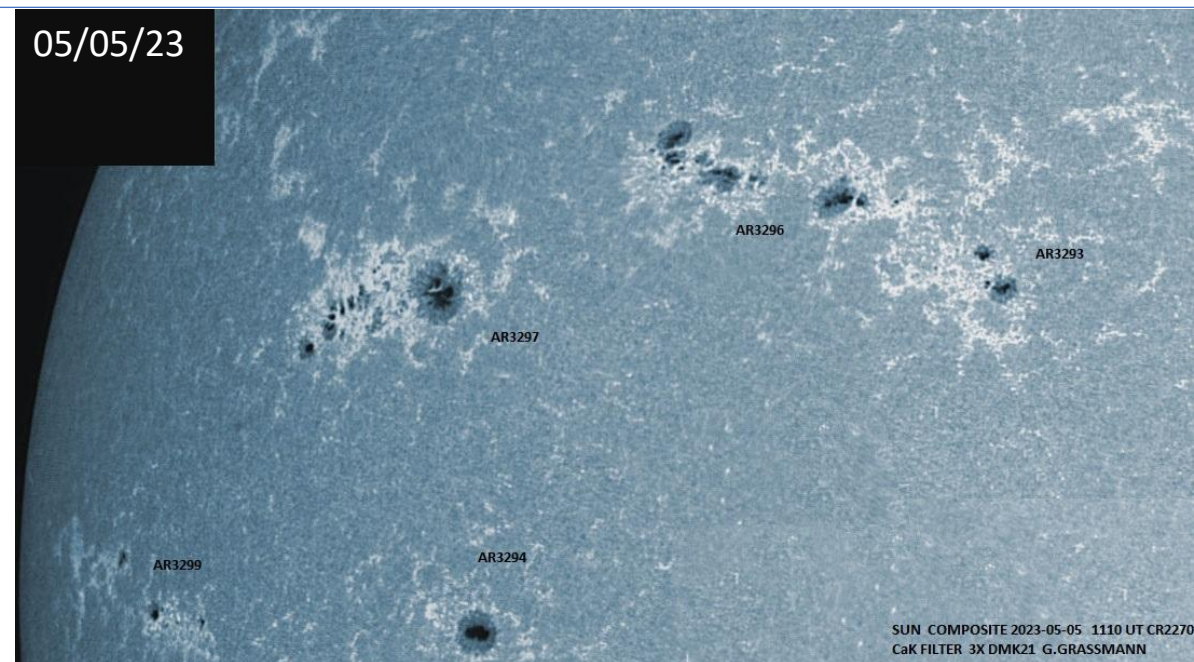
GRUPO DE HELIOFÍSICA

Imágenes en CaK: Baja cromosfera

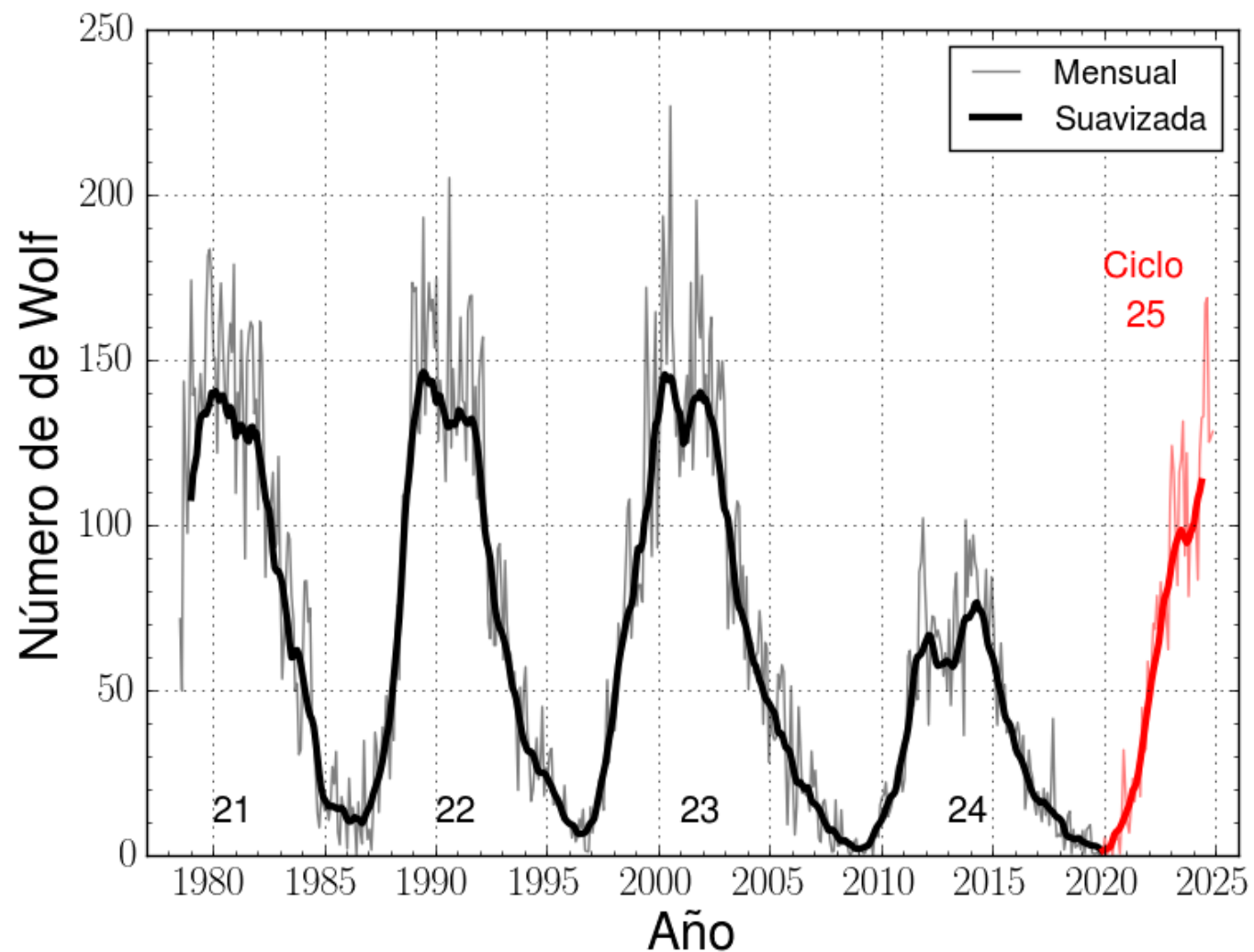
G. Grassmann



05/05/23

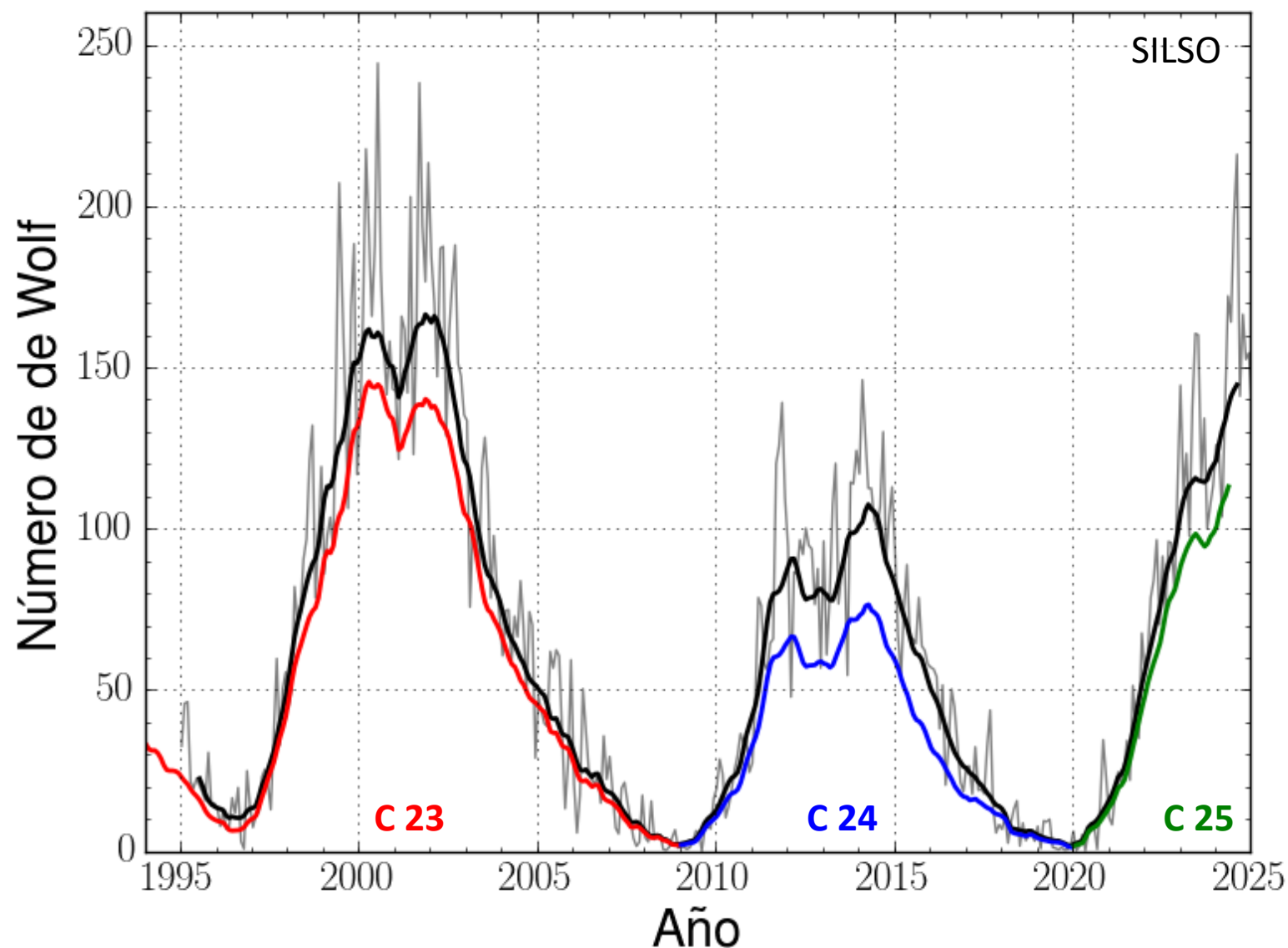


Serie histórica de la AAS (1978-2025)



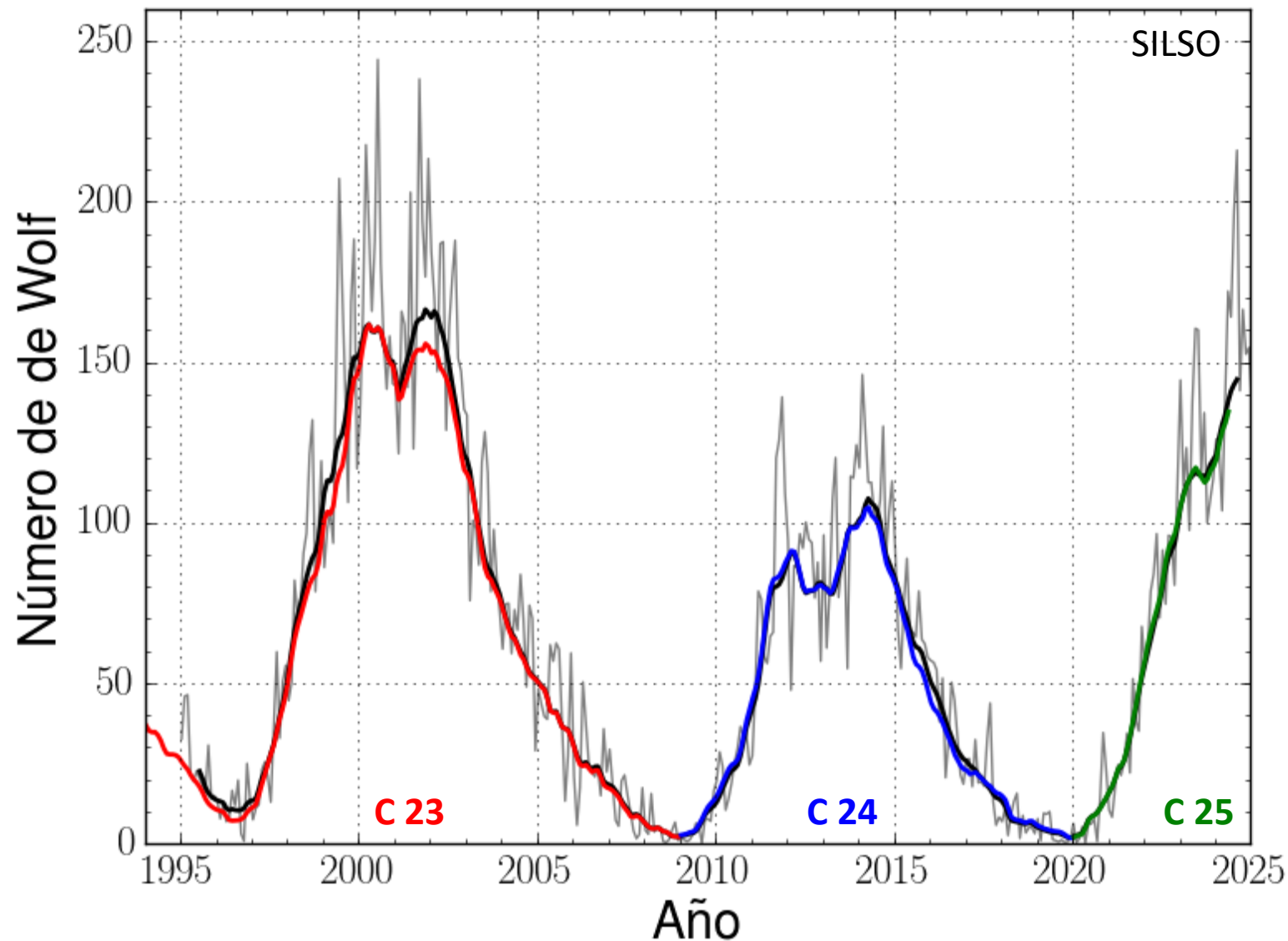
Serie histórica de la AAS (1978-2025)

Buen acuerdo
AAS - SILSO



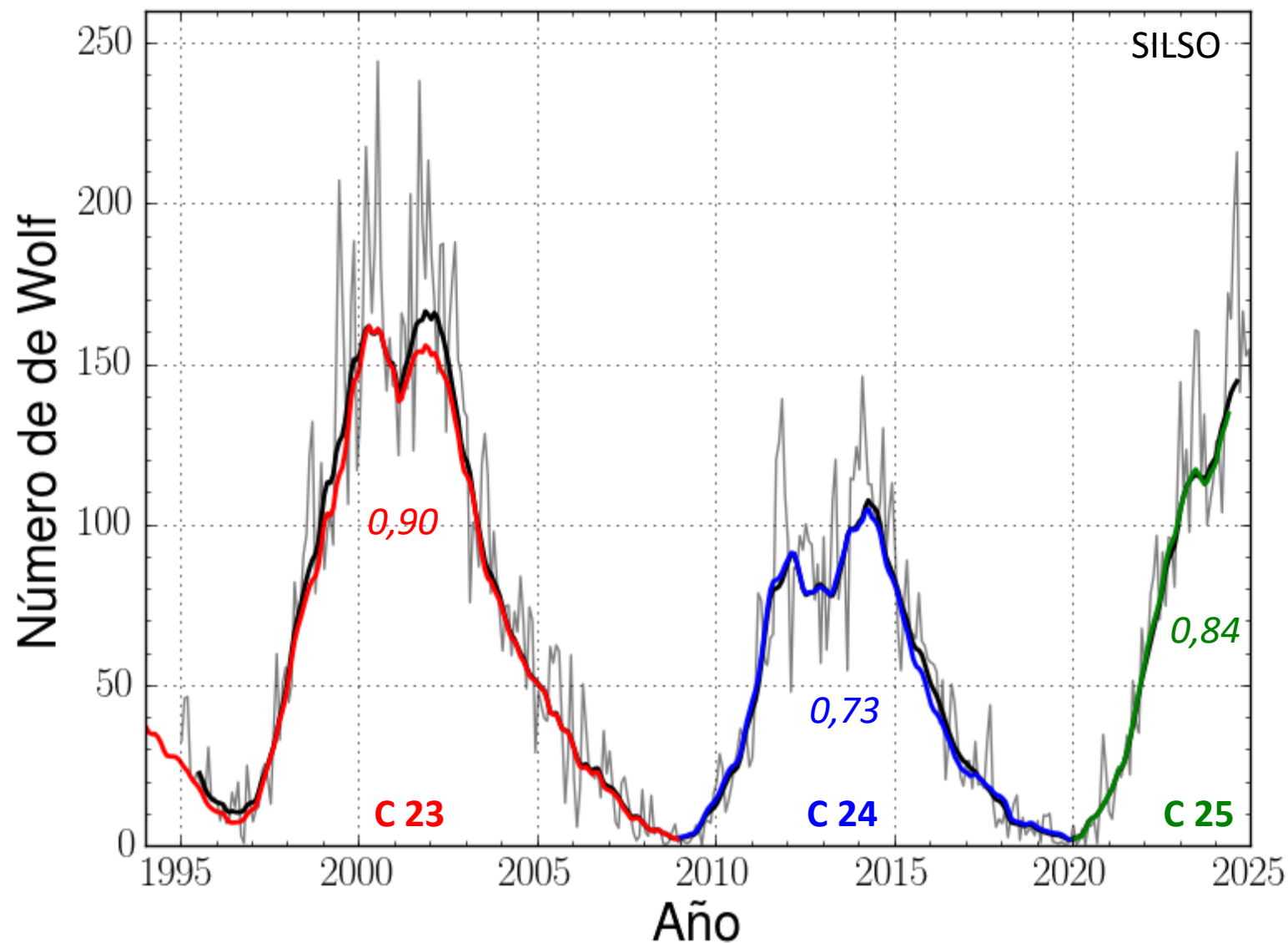
Serie histórica de la AAS (1978-2025)

Factor de escala
para cada ciclo



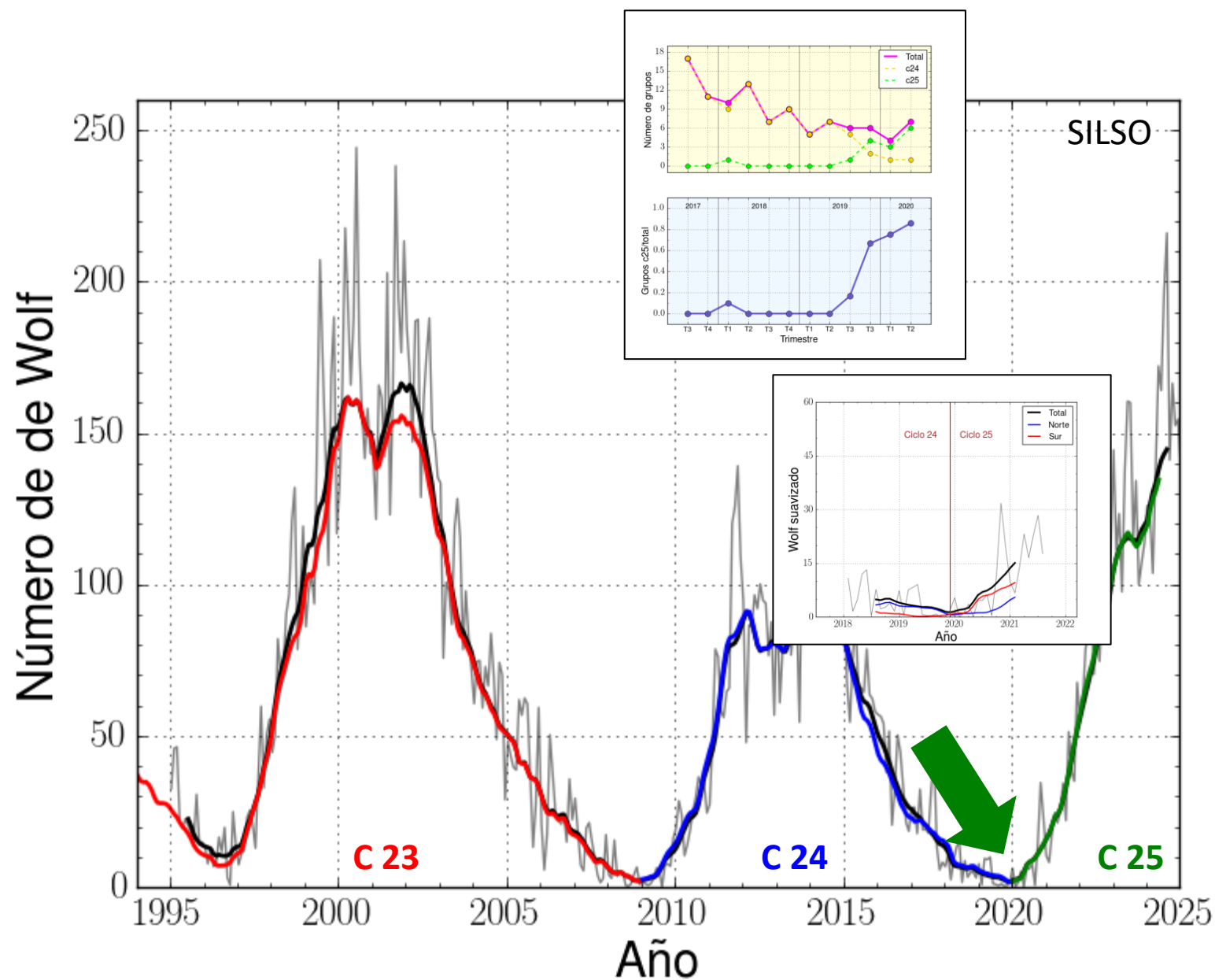
Serie histórica de la AAS (1978-2025)

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CICLO SOLAR 25

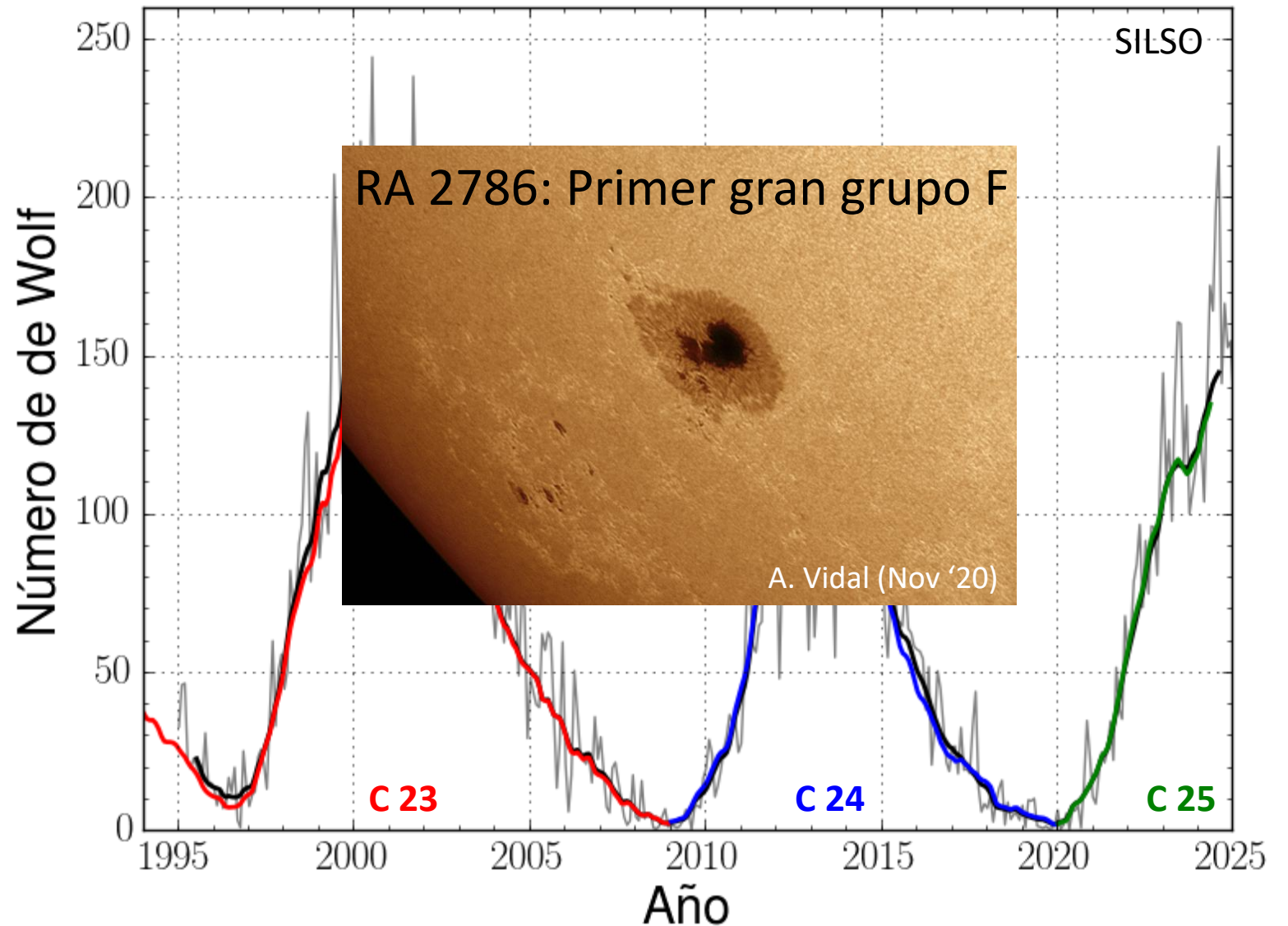
Comienzo Dic 19



CICLO SOLAR 25

Comienzo Dic 19

Rápido aumento
de la actividad

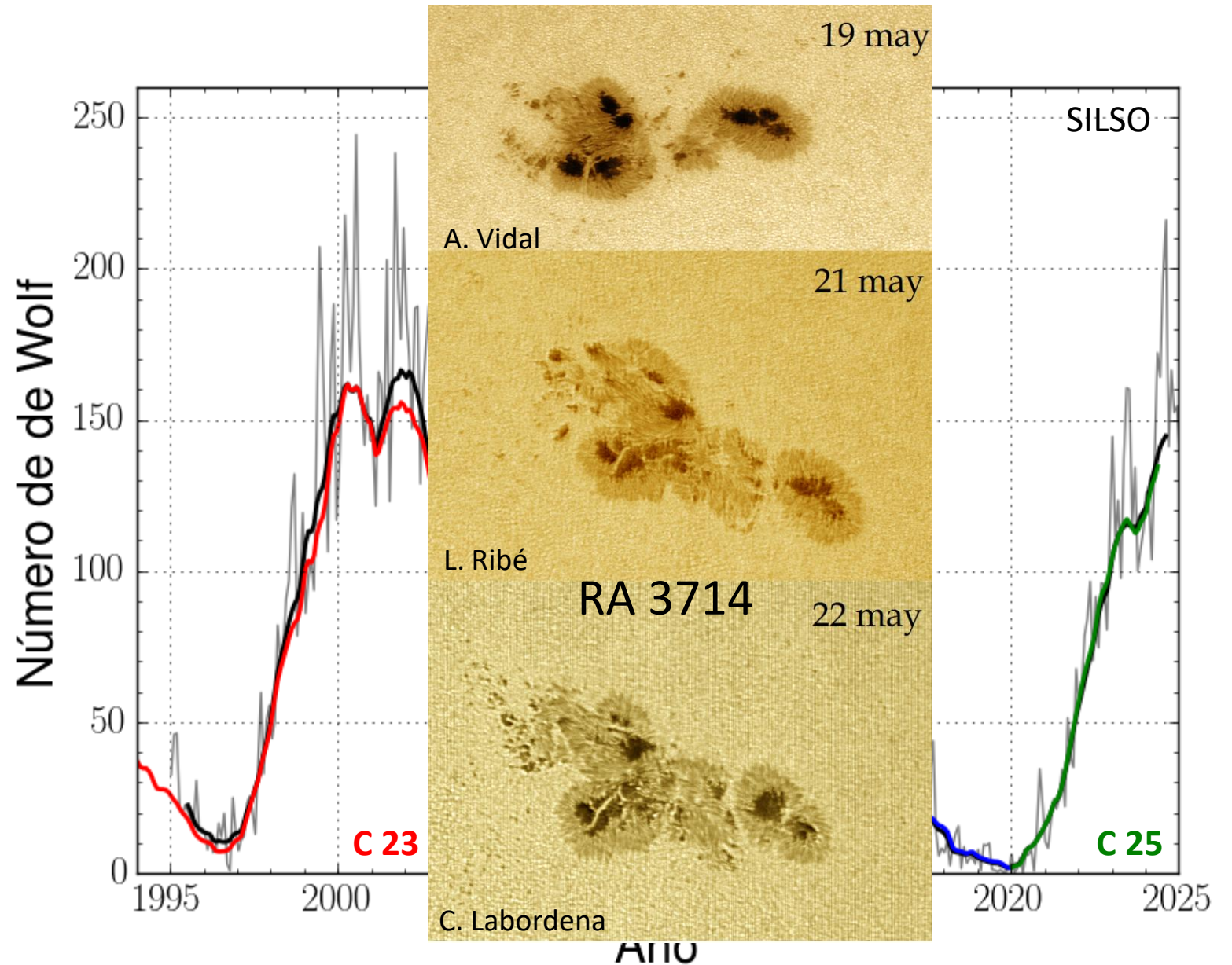


CICLO SOLAR 25

Comienzo Dic 19

Rápido aumento
de la actividad

Se alcanza $W=100$
grandes grupos
(2022)



CICLO SOLAR 25

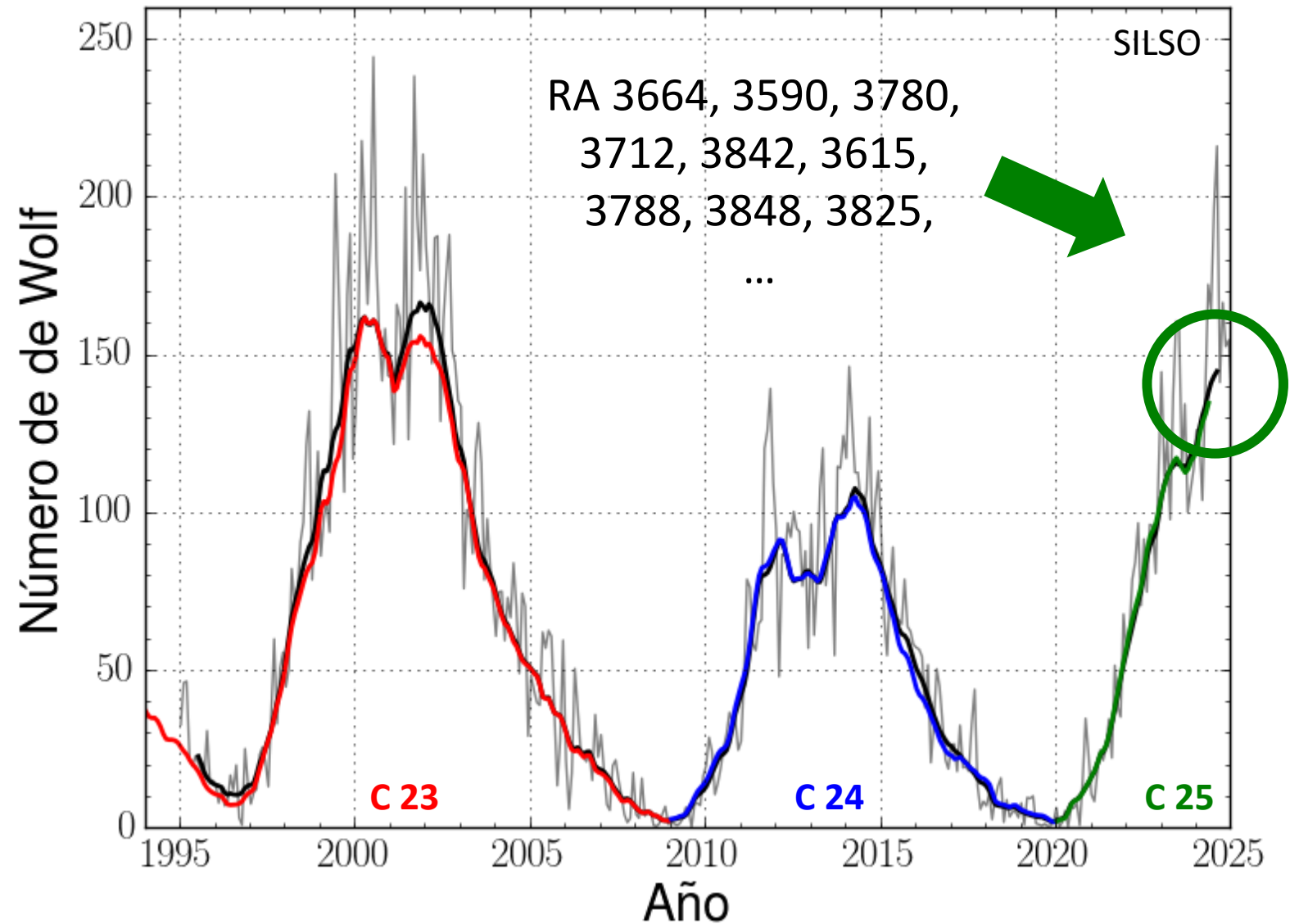
Comienzo Dic 19

Rápido aumento
de la actividad

Se alcanza $W=100$
grandes grupos
(2022)

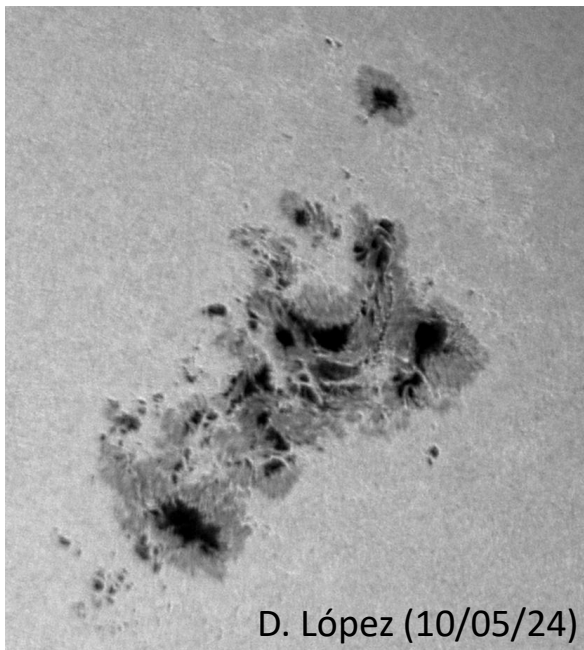
**Gran explosión de
actividad en 2024:**

Gran número de grupos E–F
Fulguraciones X



CICLO SOLAR 25

Principal grupo del ciclo



D. López (10/05/24)

RA 3664
(01/05/24-14/05/24)

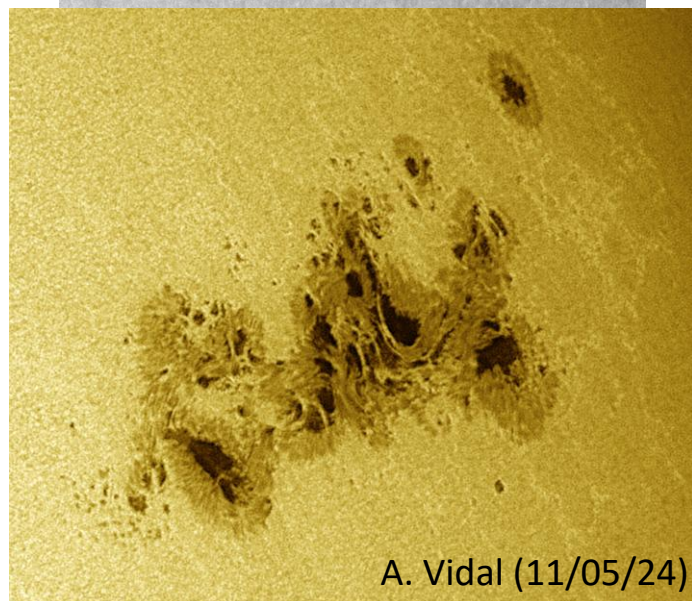
2400 mh

12 X (8,8) + 61 M

RA 3697
(28/05/24-11/06/24)

420 mh

6 X (2,9) + 27 M



A. Vidal (11/05/24)

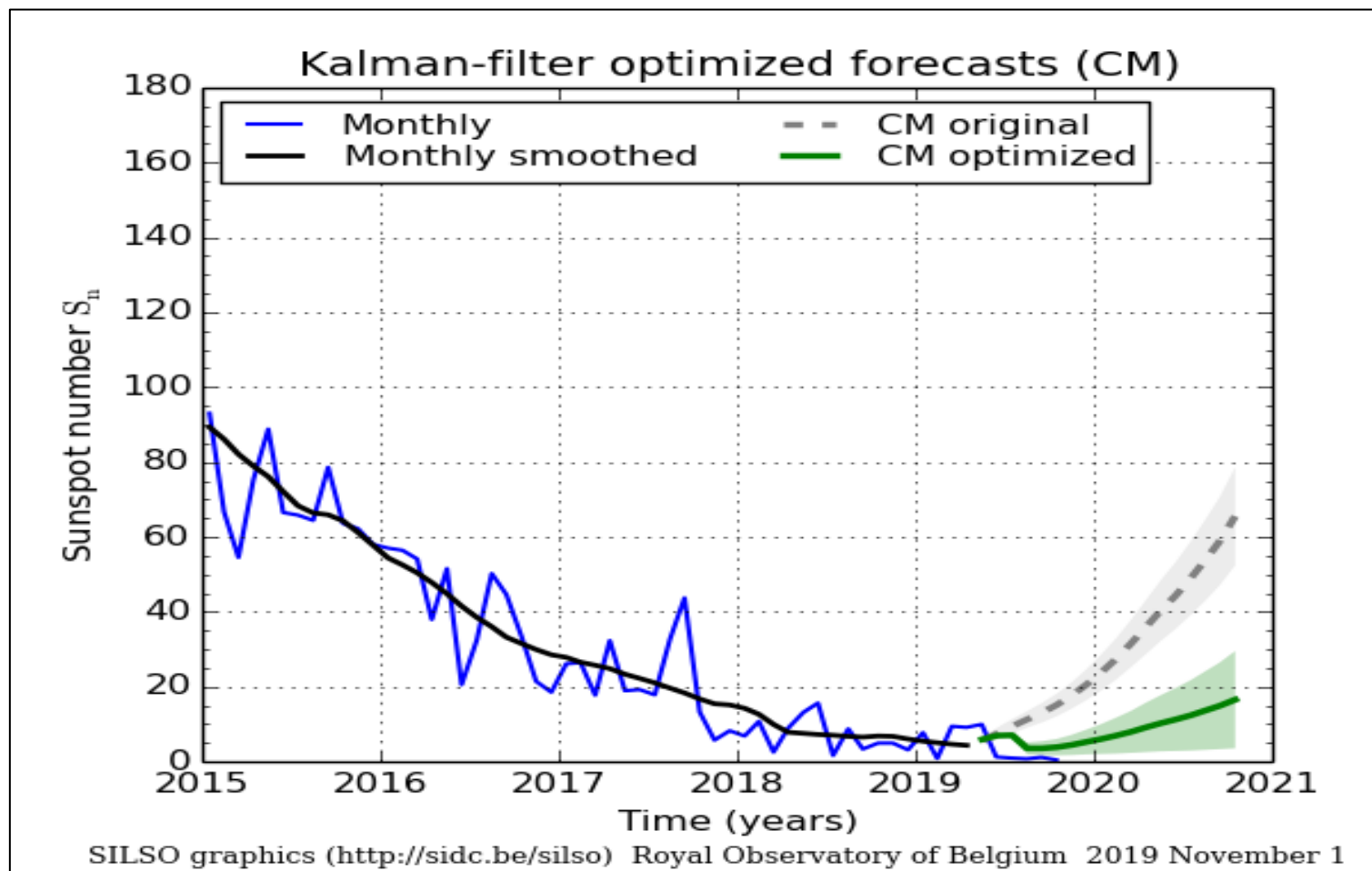
Tormenta geomagnética ¡G5!



PREDICCIONES PARA EL CICLO 25

¿Qué podemos
esperar para el
ciclo 25?

¿Cuándo, cuánto?



PREDICCIONES PARA EL CICLO 25

¿Qué pasó con el ciclo 24?

Pesnell 2008

Table 1 Predictions of Solar Cycle 24.

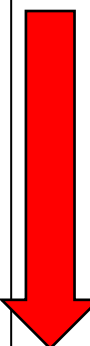
Predicted maximum		Category ¹ and summary		Author and date
R_{24}	Timing			
185	2010–2011	C	Projection of last five cycles (JSC)	Horstman (2005)
180 ± 32	–	P	Disturbed days (panel)	Thompson (1993) ²
180	2014	S	Modified global minimum analysis	Tsirulnik, Kuznetsova, and Oraevsky (1997)
152–197	–	P	Integral of sunspot number used as precursor	Podladchikova, Lefebvre, and Van der Linden (2006)
155–180	–	D	Modified flux-transport dynamo model calibrated with historical run of sunspot area	Dikpati, de Toma, and Gilman (2006)
160 ± 25	–	P	Analysis of aa index	Hathaway and Wilson (2006)
160 ± 54	2010.6	R	$R_{24} = R_{22}$ (even–odd)	Current work
148		P	aa at minimum (panel)	aa_min (2006)
145	2009.96	N	Neural network forecast	Maris and Oncica (2006)



PREDICCIONES PARA EL CICLO 25

¿Qué pasó con el ciclo 24?

Pesnell 2008



80 ± 21	2012	S	Mathematical theory of nonlinear dynamics; predicts a long cycle lasting 12 years	Baranovski (2006)
80 ± 30	2012	P	Solar polar field precursor	Schatten (2005)
80	–	D	Flux-transport dynamo model	Choudhuri, Chatterjee, and Jiang (2007)
74 ± 10	–	P	Statistics of low-latitude sunspot groups	Javaraiah (2007)
70 ± 2	–	P	Polar magnetic field strength at solar minima	Svalgaard, Cliver, and Kamide (2005) ⁶
70 ± 17.5	2012.96	S	Statistical Gaussian-based extrapolation	Kontor (2006)
<50	2010–2011	C	Statistics of the 5303 Å coronal line	Badalyan, Obridko, and Sykora (2001)
42 ± 35	–	S	Periods in R_z and radiocarbon isotopic abundances	Clilverd <i>et al.</i> (2006)
low	–	C	Observations of flare energy release during the descending phase of cycle 23 (empirical)	Mariş, Popescu, and Beşliu (2004) ⁷

PREDICCIONES PARA EL CICLO 25

¿Qué pasó con el ciclo 24?

Table 2 Summary of predictions for Solar Cycle 24.

Category	Number	Average	Range
All	54	117 ± 33	40 – 185
Climatology (C)	13	111 ± 36	40 – 185
Recent climatology (R)	2	140 ± 30	120 – 160
Dynamo models (D)	3	131 ± 45	80 – 168
Spectral (S)	12	100 ± 33	42 – 180
Neural network (N)	2	145	145 – 145
Precursor (P)	22	124 ± 30	70 – 180
Geomagnetic (mostly aa)	12	137 ± 20	111 – 180
aa	7	140 ± 14	120 – 160
Ap	5	134 ± 28	111 – 180
Solar	10	110 ± 30	70 – 175
Polar fields	3	88 ± 24	70 – 115
Other solar	7	116 ± 32	74 – 175

PREDICCIONES PARA EL CICLO 25

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		131 ± 45	80–168
		100 ± 33	42–180
		145	145–145
		124 ± 30	70–180
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- Predicción alta: 140 ± 20 2011,8

- Predicción baja: 90 ± 10 2012,6

PREDICCIONES PARA EL CICLO 25

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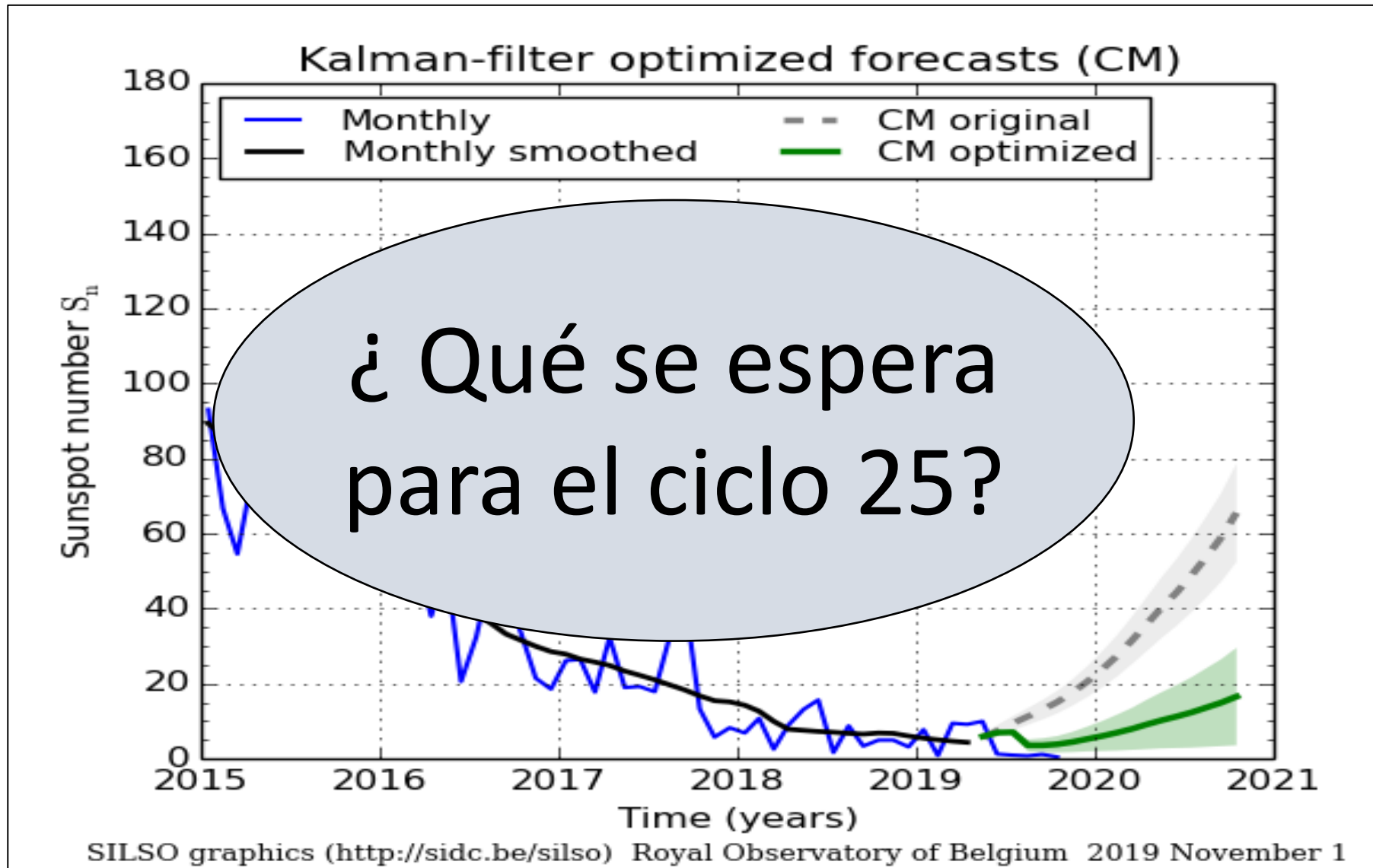
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La realidad: 116 2014,3

PREDICCIONES PARA EL CICLO 25



PREDICCIONES PARA EL CICLO 25

¿ Qué se espera
para el ciclo 25?

NOAA

95 – 130

2023 – 2026



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Solar experts predict the Sun's activity in Solar Cycle 25 to be below average, similar to Solar Cycle 24

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April 5, 2019 - Scientists charged with predicting the Sun's activity for the next 11-year solar cycle say that it's likely to be weak, much like the current one. The current solar cycle, Cycle 24, is declining and **predicted to reach solar minimum** - the period when the Sun is least active - **late in 2019 or 2020**.

Solar Cycle 25 Prediction Panel experts said Solar Cycle 25 may have a slow start, but is anticipated to peak **with solar maximum occurring between 2023 and 2026, and a sunspot range of 95 to 130**. This is well below the average number of sunspots, which typically ranges from 140 to 220 sunspots per solar cycle. **The panel has high confidence that the coming cycle should break the trend of weakening solar activity seen over the past four cycles.**

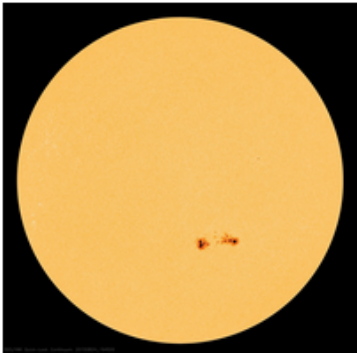
"We expect Solar Cycle 25 will be very similar to Cycle 24: another fairly weak cycle, preceded by a long, deep minimum," said panel co-chair Lisa Upton, Ph.D., solar physicist with Space Systems Research Corp. "The expectation that Cycle 25 will be comparable in size to Cycle 24 means that the steady decline in solar cycle amplitude, seen from cycles 21-24, has come to an end and that there is no indication that we are currently approaching a Maunder-type minimum in solar activity."

The solar cycle prediction gives a rough idea of the frequency of **space weather** storms of all types, from **radio blackouts** to **geomagnetic storms** and **solar radiation storms**. It is used by many industries to gauge the potential impact of space weather in the coming years. Space weather can affect power grids, critical military, airline, and shipping communications, satellites and Global Positioning System (GPS) signals, and can even threaten astronauts by exposure to harmful radiation doses.

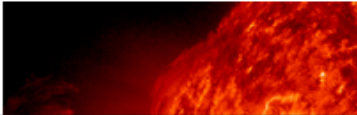
Solar Cycle 24 reached its maximum - the period when the Sun is most active - in April 2014 with a peak average of 82 sunspots. The Sun's Northern Hemisphere led the sunspot cycle, peaking over two years ahead of the Southern Hemisphere sunspot peak.

Solar cycle forecasting is a new science

While daily weather forecasts are the most widely used type of scientific information in the U.S., solar forecasting is relatively new. Given that the Sun takes 11 years to complete one solar cycle, this is only the fourth time a solar cycle prediction has been issued by U.S. scientists. The first panel convened in 1980 for Cycle 22.



Sunspots observed on the Sun August 24, 2015. NASA



PREDICCIONES PARA EL CICLO 25

¿ Qué se espera para el ciclo 25?

NOAA

95 – 130

2023 – 2026



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Solar experts predict the Sun's activity in Solar Cycle 25 to be below average similar to Solar Cycle 24

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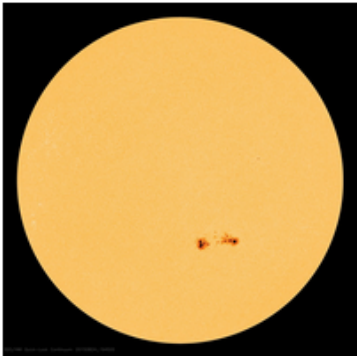
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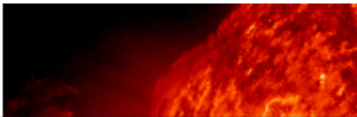
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Sunspots observed on the Sun August 24, 2015. NASA



PREDICCIONES PARA EL CICLO 25

Panel para la evaluación del ciclo 25

¿ Qué se espera
para el ciclo 25?

Petrovay 2019

Table 2 A selection of early forecasts for Cycle 25

Category	Minimum	Maximum	Peak amplitude	Reference
Internal precursors	2019.9	2023.8	175 [154–202]	Li et al (2015)
External precursor				
rush-to-the-poles	2019.4	2024.8	130	Petrovay et al (2018)
polar precursor			136 ± 48	Pesnell and Schatten (2018)
helicity			117	Hawkes and Berger (2018)
SoDA		2025.2±1.5	120 ± 39	based on Pesnell and Schatten (2018)
Model-based: SFT				
SFT			124 ± 31	Jiang et al (2018)
AFT	2020.9		95 % of Cyc. 24, i.e. 110	Upton and Hathaway (2018)
Model-based: dynamo				
2×2D	2020.5 ± 0.12	2027.2 ± 1.0	89 ⁺²⁹ ₋₁₄	Charbonneau et al. 2019, private comm.
Truncated	2019–20	2024 ± 1	90 ± 15	Kitiashvili (2016)
Spectral				
wavelet decomposition tree		2023.4	132	Rigozo et al (2011)
Attractor analysis				
simplex projection analysis		2024.0 ± 0.6	103 ± 25	Singh and Bhargawa (2017)
simplex proj./time-delay		2023.2 ± 1.1	154 ± 12	Sarp et al (2018)
Neural networks				
neuro-fuzzy		2022	90.7 ± 8	Attia et al (2013)
spatiotemporal		2022–23	57 ± 17	Covas et al (2019)
Cycle 24 [comparison]	2008.9	2014.3	116	

**Predicción
media**

116 ± 30

2024,0 ± 1,5

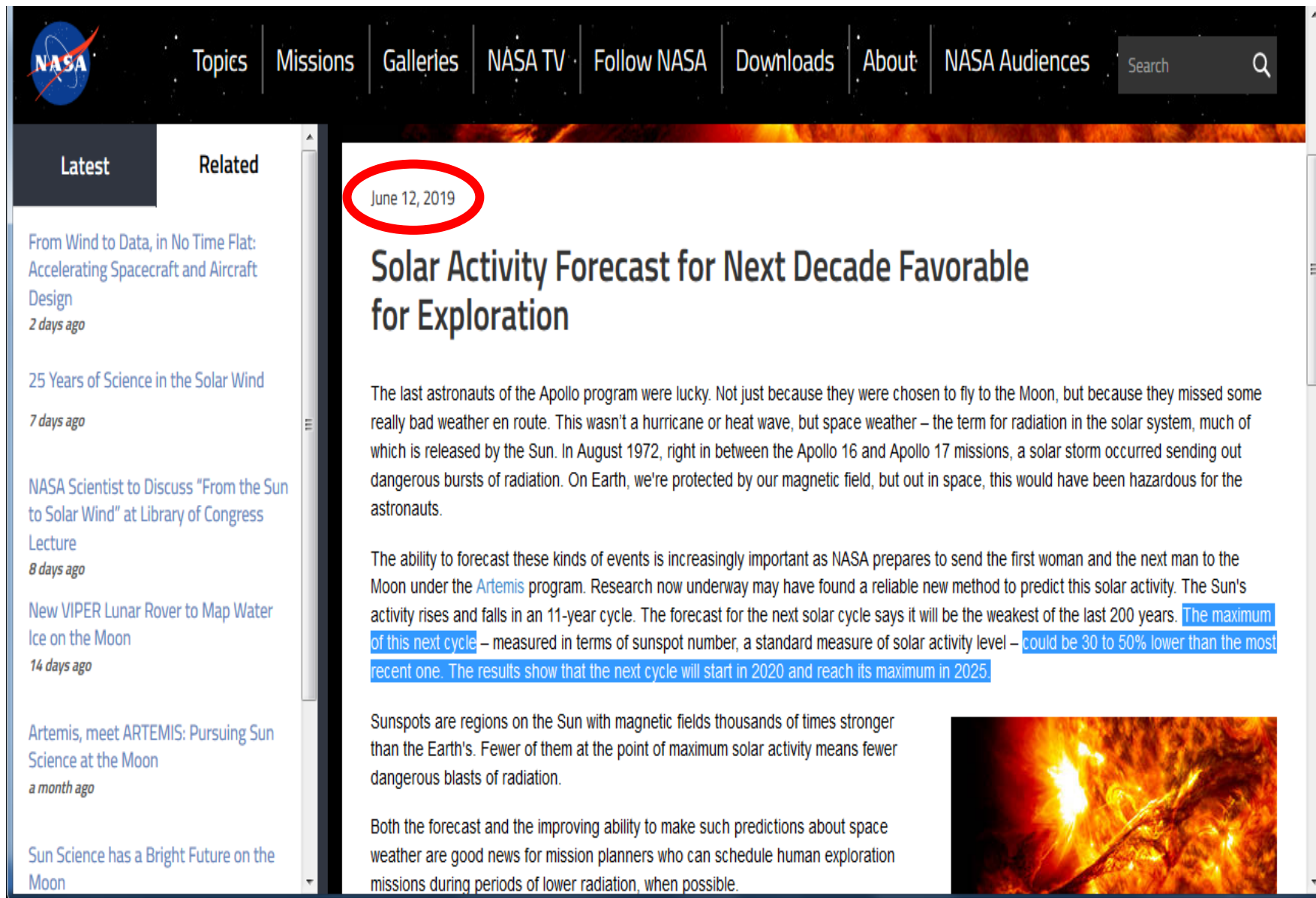
PREDICCIONES PARA EL CICLO 25

¿ Qué se espera
para el ciclo 25?

NASA

60 - 70

2024 - 2025



The screenshot shows the NASA website's navigation bar with links to Topics, Missions, Galleries, NASA TV, Follow NASA, Downloads, About, and NASA Audiences. A search bar is also present. The main content area features a news article titled "Solar Activity Forecast for Next Decade Favorable for Exploration" dated June 12, 2019. The article discusses the forecast for the next solar cycle, which is expected to be the weakest of the last 200 years, with a maximum sunspot number of 30 to 50% lower than the most recent one. The results show that the next cycle will start in 2020 and reach its maximum in 2025. The article also mentions that the forecast and the improving ability to make such predictions about space weather are good news for mission planners who can schedule human exploration missions during periods of lower radiation, when possible. A sidebar on the left lists related articles, including "From Wind to Data, in No Time Flat: Accelerating Spacecraft and Aircraft Design", "25 Years of Science in the Solar Wind", "NASA Scientist to Discuss 'From the Sun to Solar Wind' at Library of Congress Lecture", "New VIPER Lunar Rover to Map Water Ice on the Moon", "Artemis, meet ARTEMIS: Pursuing Sun Science at the Moon", and "Sun Science has a Bright Future on the Moon".

June 12, 2019

Solar Activity Forecast for Next Decade Favorable for Exploration

The last astronauts of the Apollo program were lucky. Not just because they were chosen to fly to the Moon, but because they missed some really bad weather en route. This wasn't a hurricane or heat wave, but space weather – the term for radiation in the solar system, much of which is released by the Sun. In August 1972, right in between the Apollo 16 and Apollo 17 missions, a solar storm occurred sending out dangerous bursts of radiation. On Earth, we're protected by our magnetic field, but out in space, this would have been hazardous for the astronauts.

The ability to forecast these kinds of events is increasingly important as NASA prepares to send the first woman and the next man to the Moon under the [Artemis](#) program. Research now underway may have found a reliable new method to predict this solar activity. The Sun's activity rises and falls in an 11-year cycle. The forecast for the next solar cycle says it will be the weakest of the last 200 years. [The maximum of this next cycle](#) – measured in terms of sunspot number, a standard measure of solar activity level – [could be 30 to 50% lower than the most recent one. The results show that the next cycle will start in 2020 and reach its maximum in 2025.](#)

Sunspots are regions on the Sun with magnetic fields thousands of times stronger than the Earth's. Fewer of them at the point of maximum solar activity means fewer dangerous blasts of radiation.

Both the forecast and the improving ability to make such predictions about space weather are good news for mission planners who can schedule human exploration missions during periods of lower radiation, when possible.

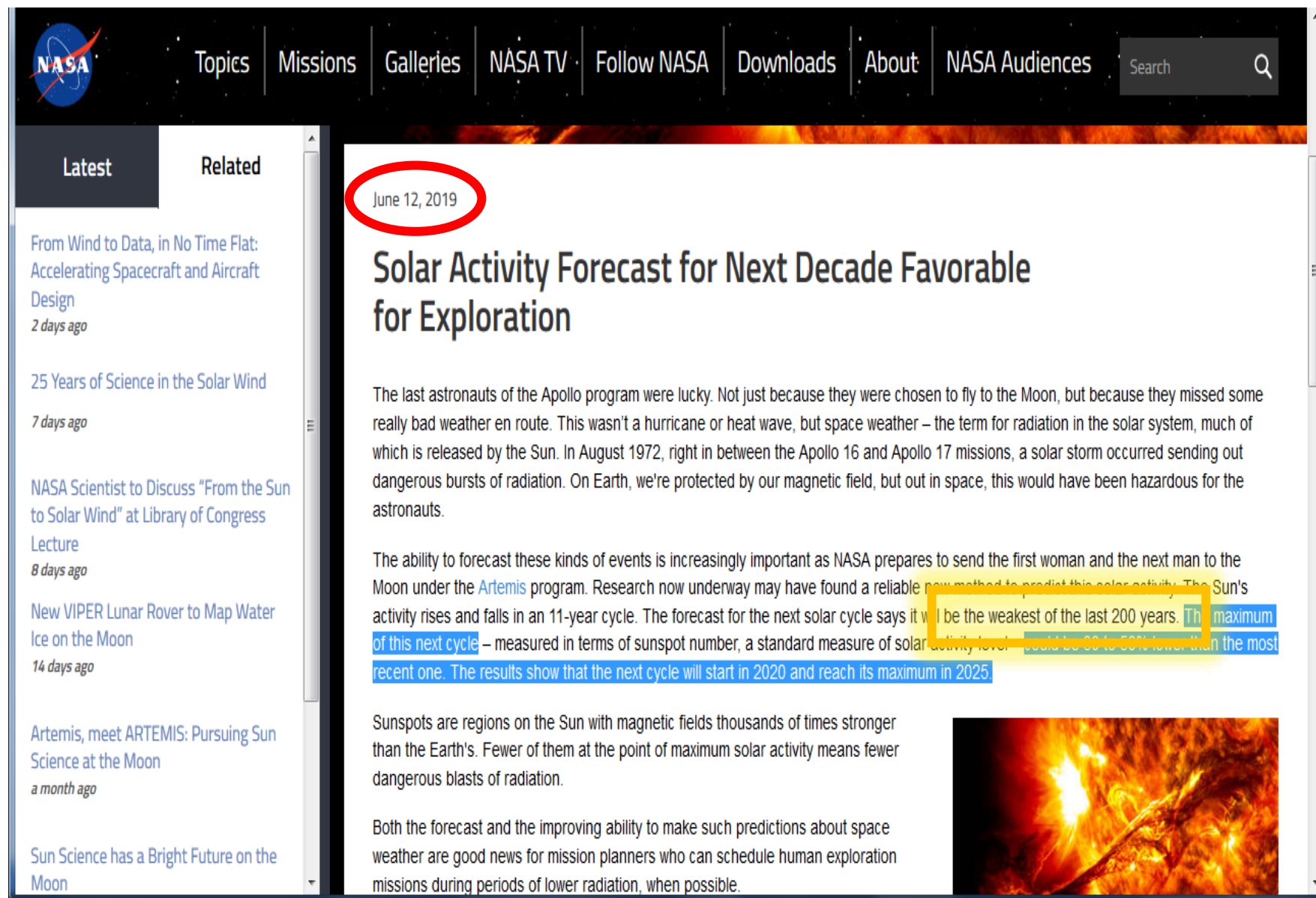
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PREDICCIONES PARA EL CICLO 25

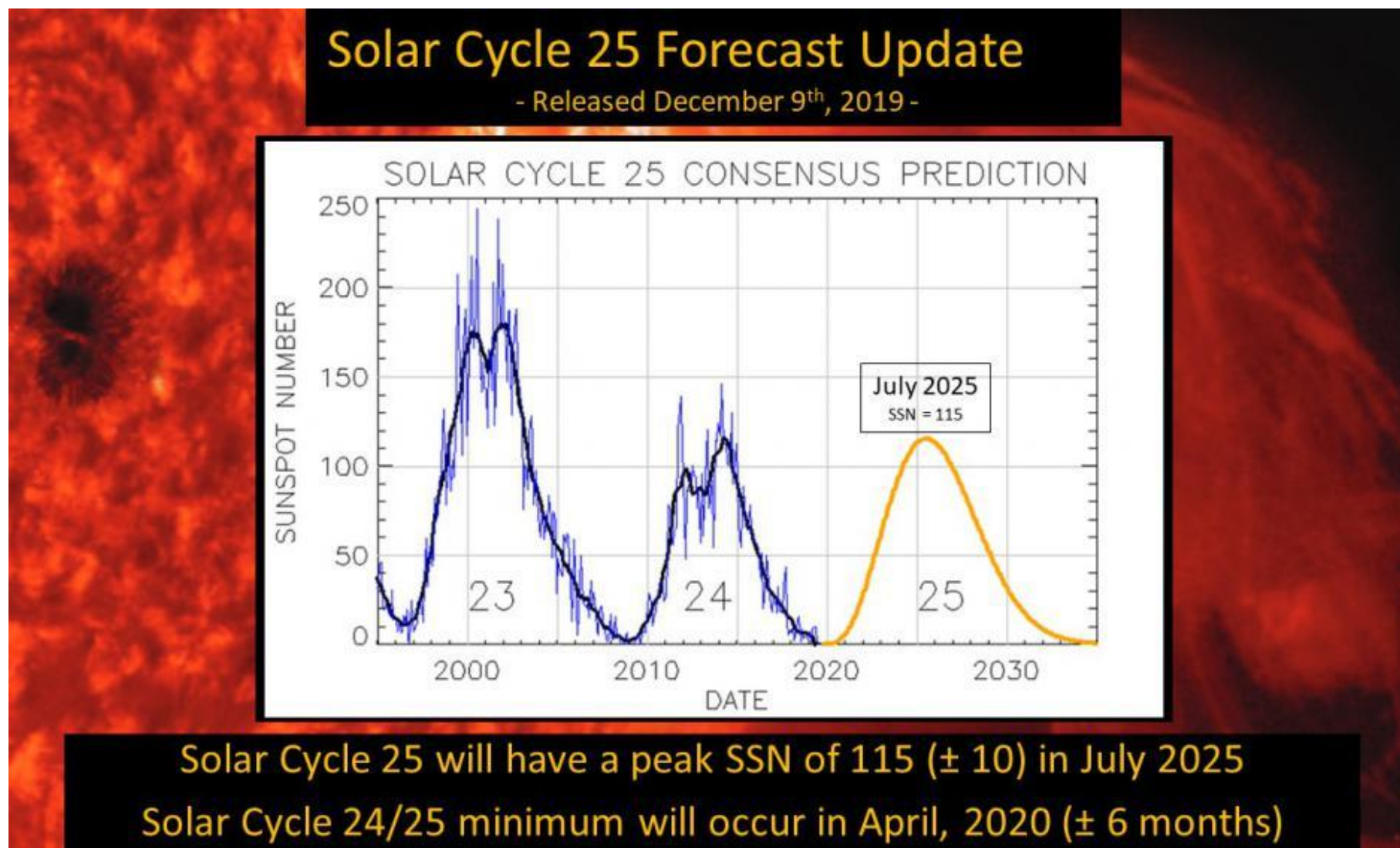
Panel para la evaluación del ciclo 25

¿ Qué se espera
para el ciclo 25?

**Predicción
media**

116 ± 30

$2024,0 \pm 1,5$

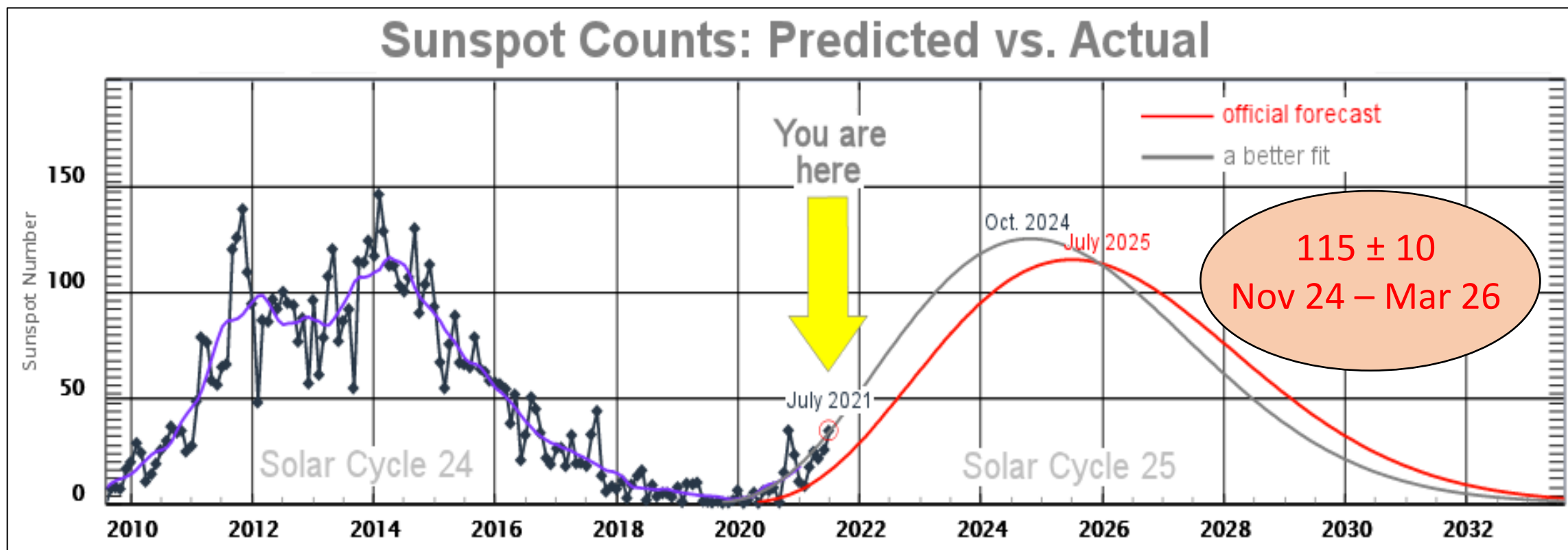


PREDICCIONES PARA EL CICLO 25

¿Qué se espera
para el ciclo 25?

Actualización de las previsiones:
Ciclo 25 **MÁS ACTIVO DE LO PREVISTO**

04/08/21



PREDICCIONES PARA EL CICLO 25

SILSO

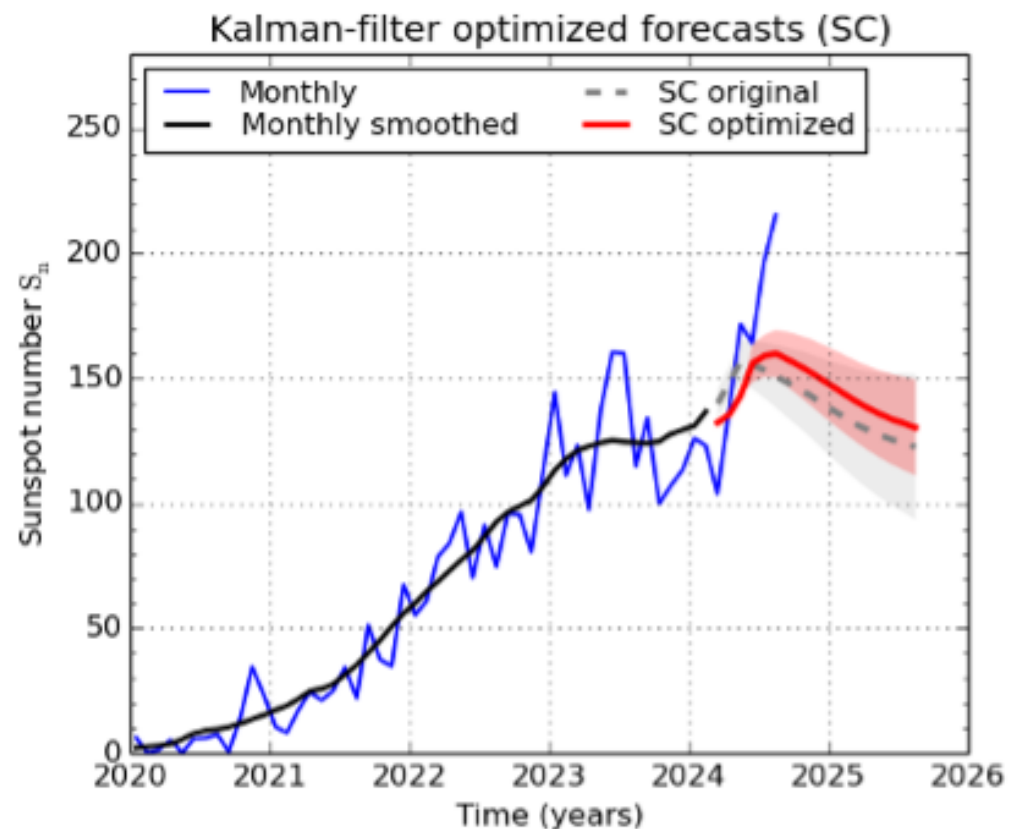
¿ Qué se espera
para el ciclo 25?

SILSO

138 - 161

May – Oct '24

“In terms of prediction accuracy, the closer we are to the actual maximum, the more the various prediction methods will converge”



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2024 September 23

PREDICCIONES PARA EL CICLO 25

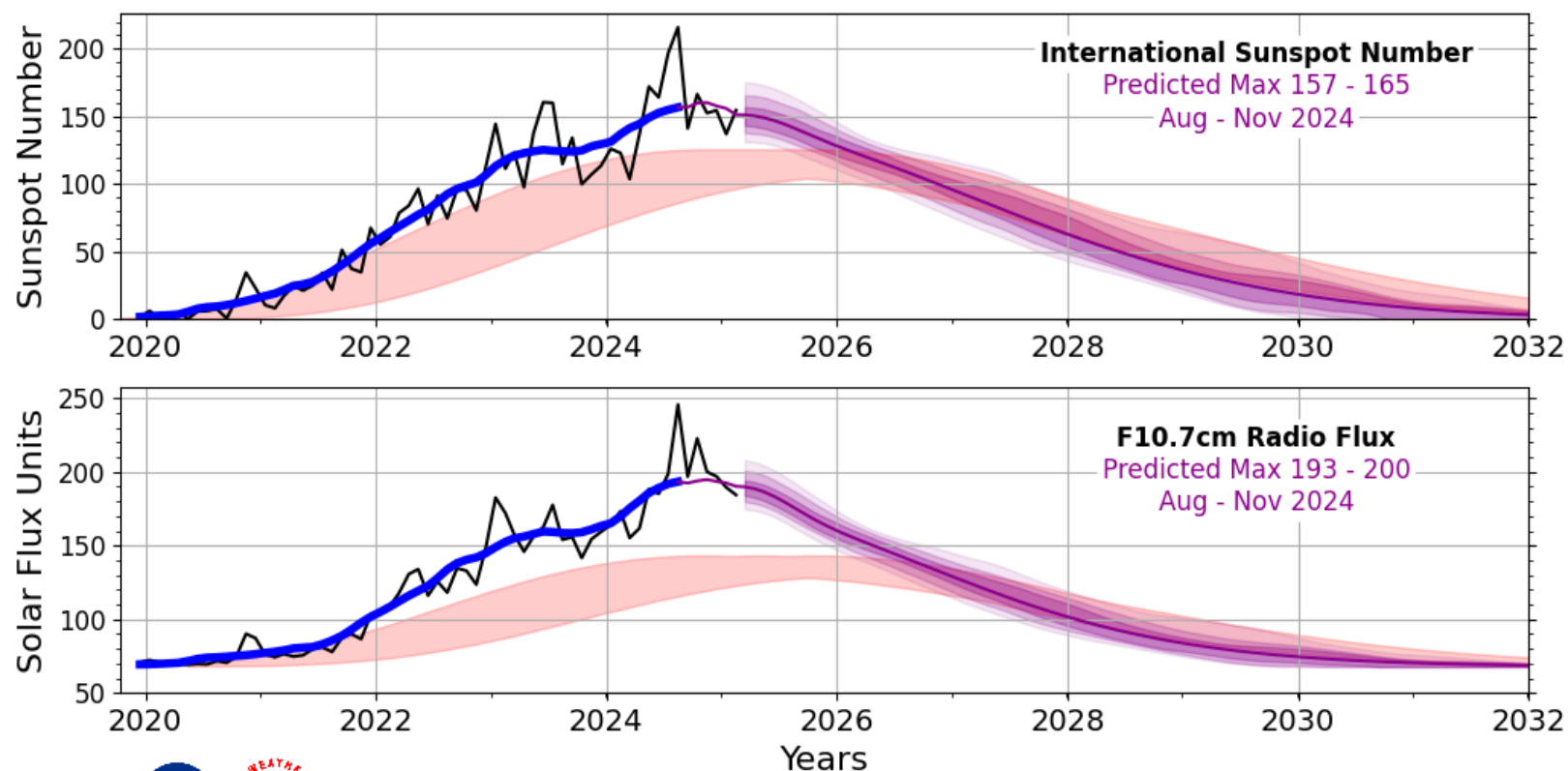
¿Qué se espera
para el ciclo 25?

NOAA

137 - 164

Feb '24 – Jan '25

Experimental Solar Cycle 25 Prediction



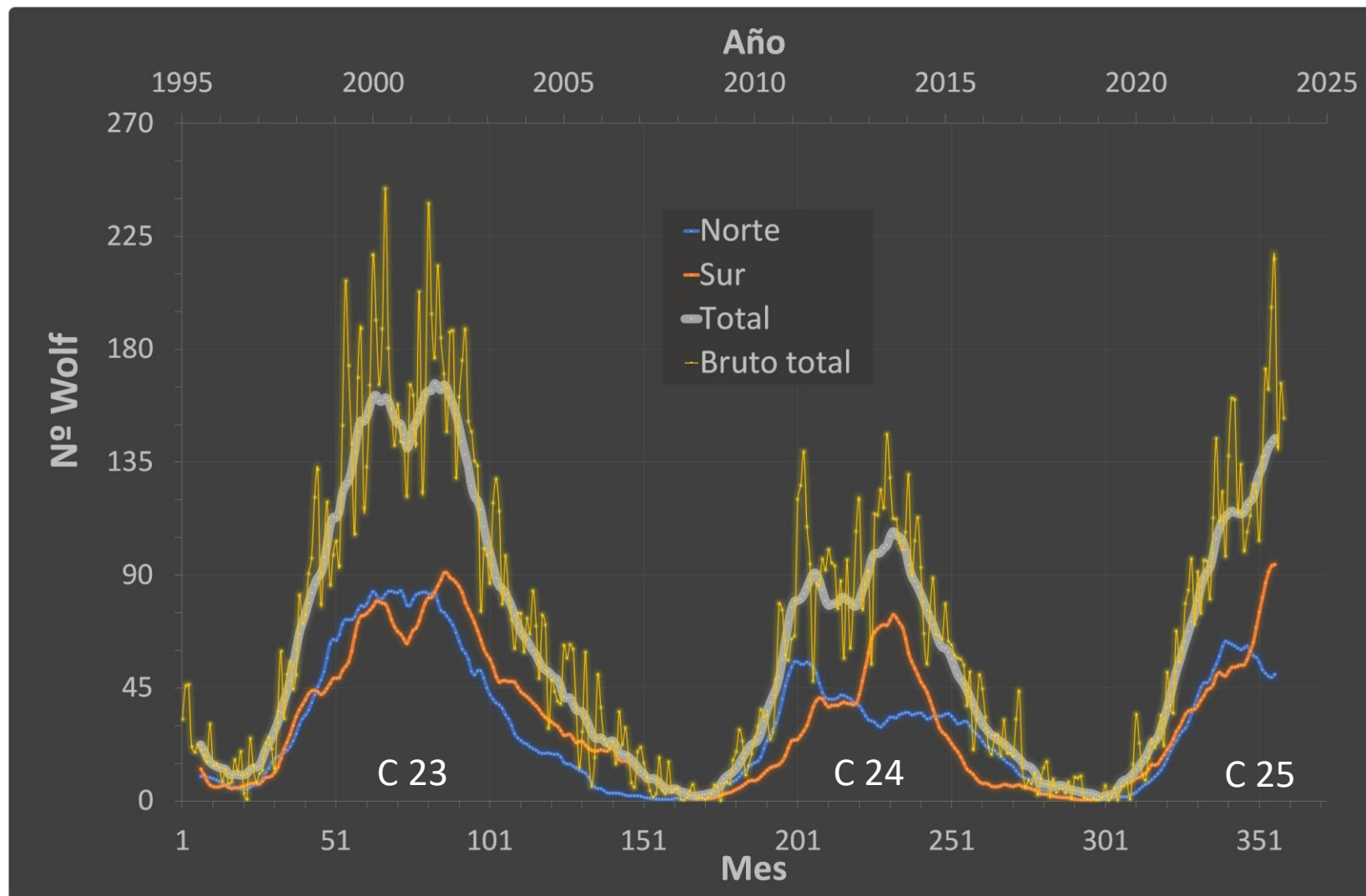
Space Weather Prediction Testbed
issued 4 Mar 2025

— Monthly observations
— Smoothed monthly observations
— 2019 NOAA/NASA/ISES Panel Prediction (range)

— Experimental Prediction
— 25% quartile
— 50% quartile
— 75% quartile

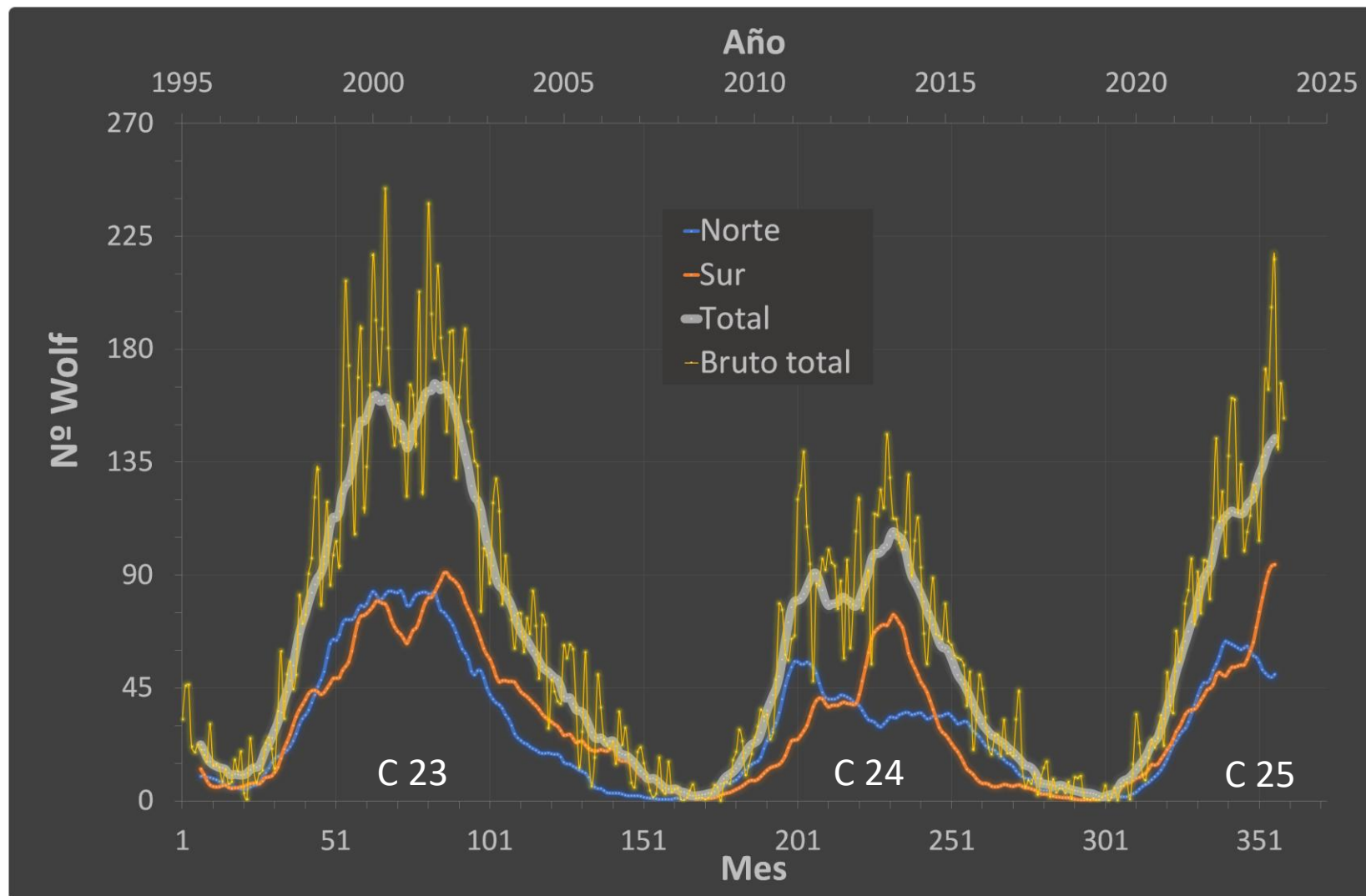
PREDICCIONES PARA EL CICLO 25

Datos reales: actividad mensual (SILSO)



PREDICCIONES PARA EL CICLO 25

Datos reales: actividad mensual (SILSO)

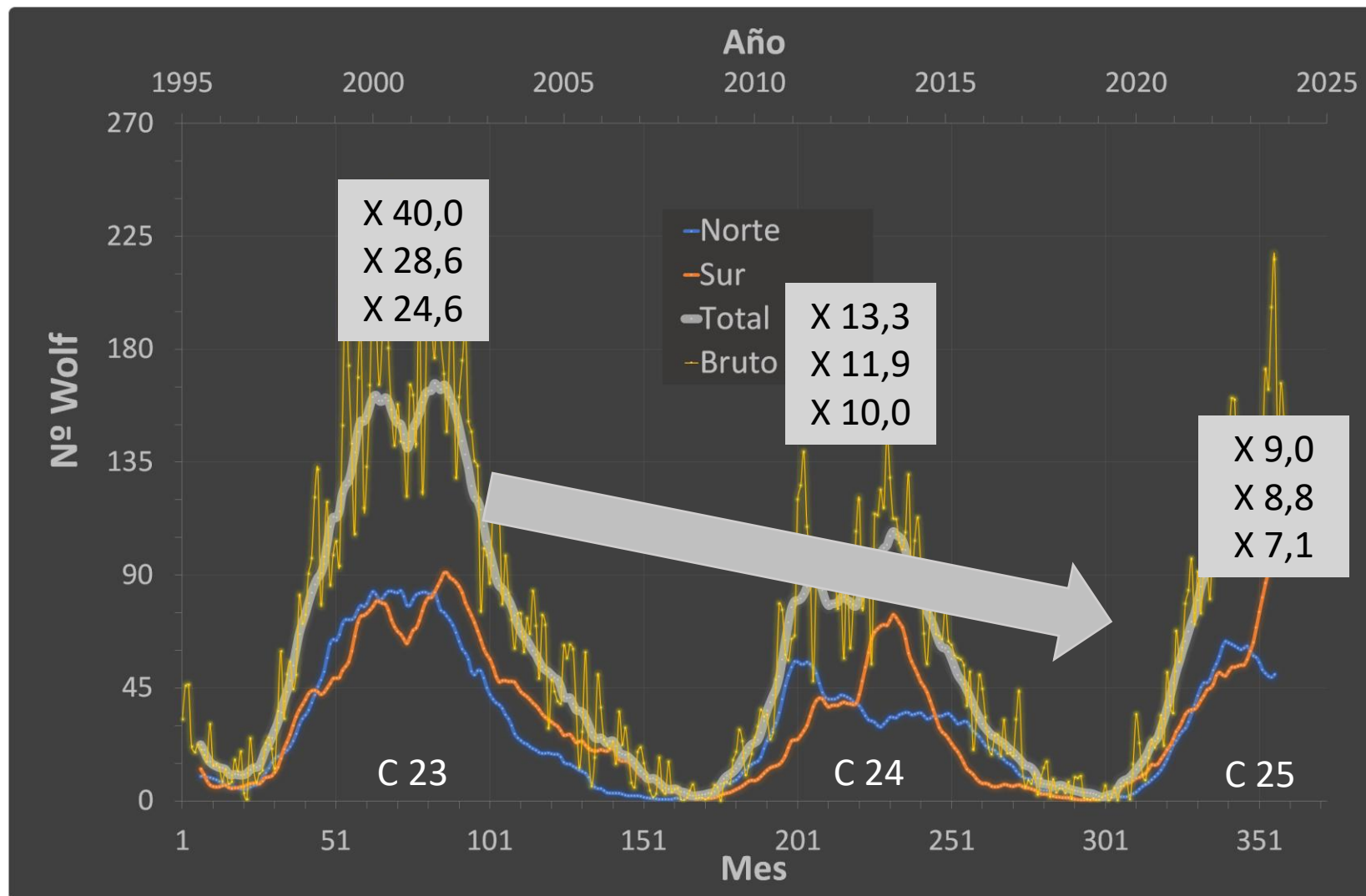


CONCLUSIONES

Claramente más activo
que el ciclo anterior

PREDICCIONES PARA EL CICLO 25

Datos reales: actividad mensual (SILSO)

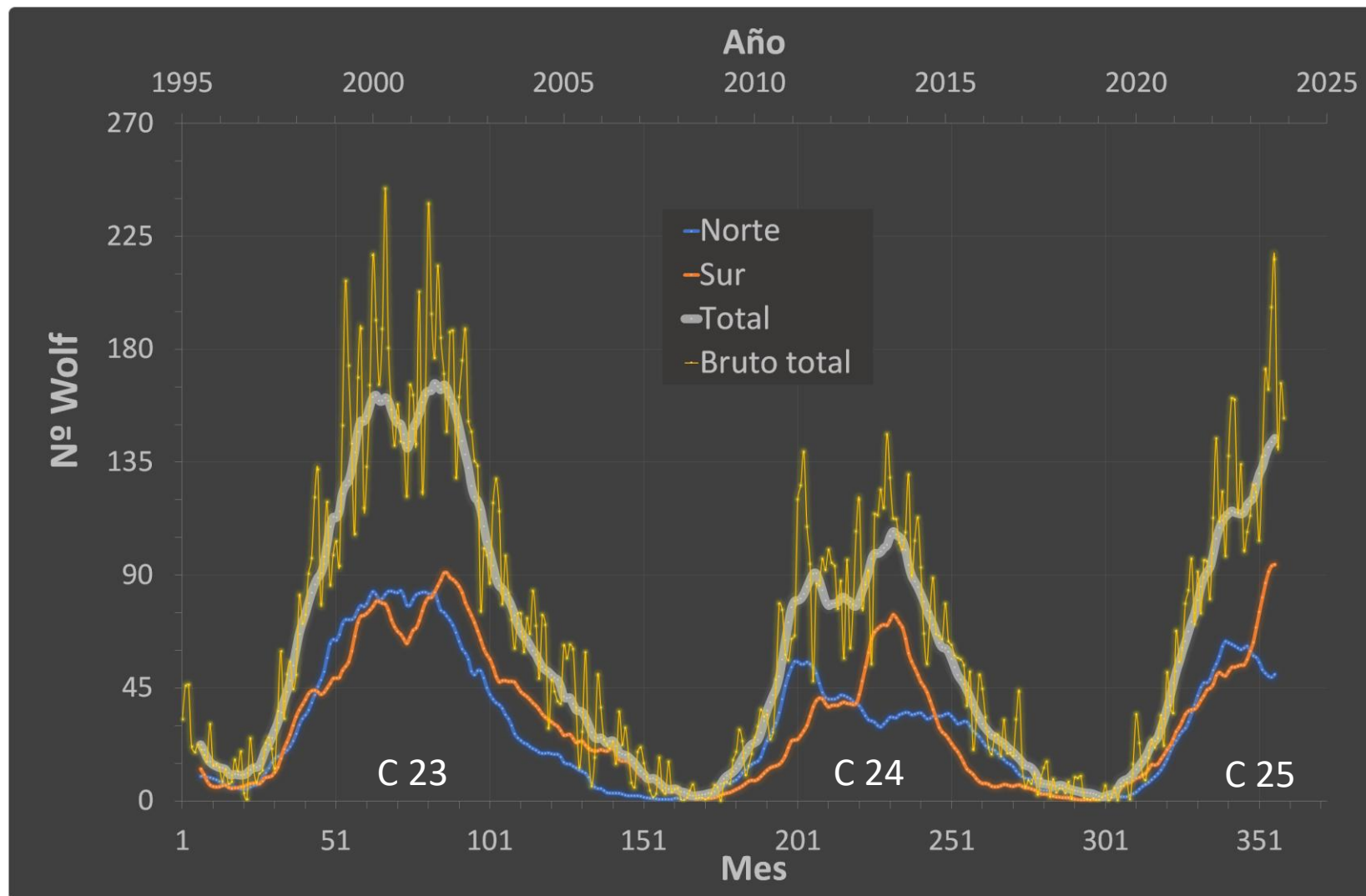


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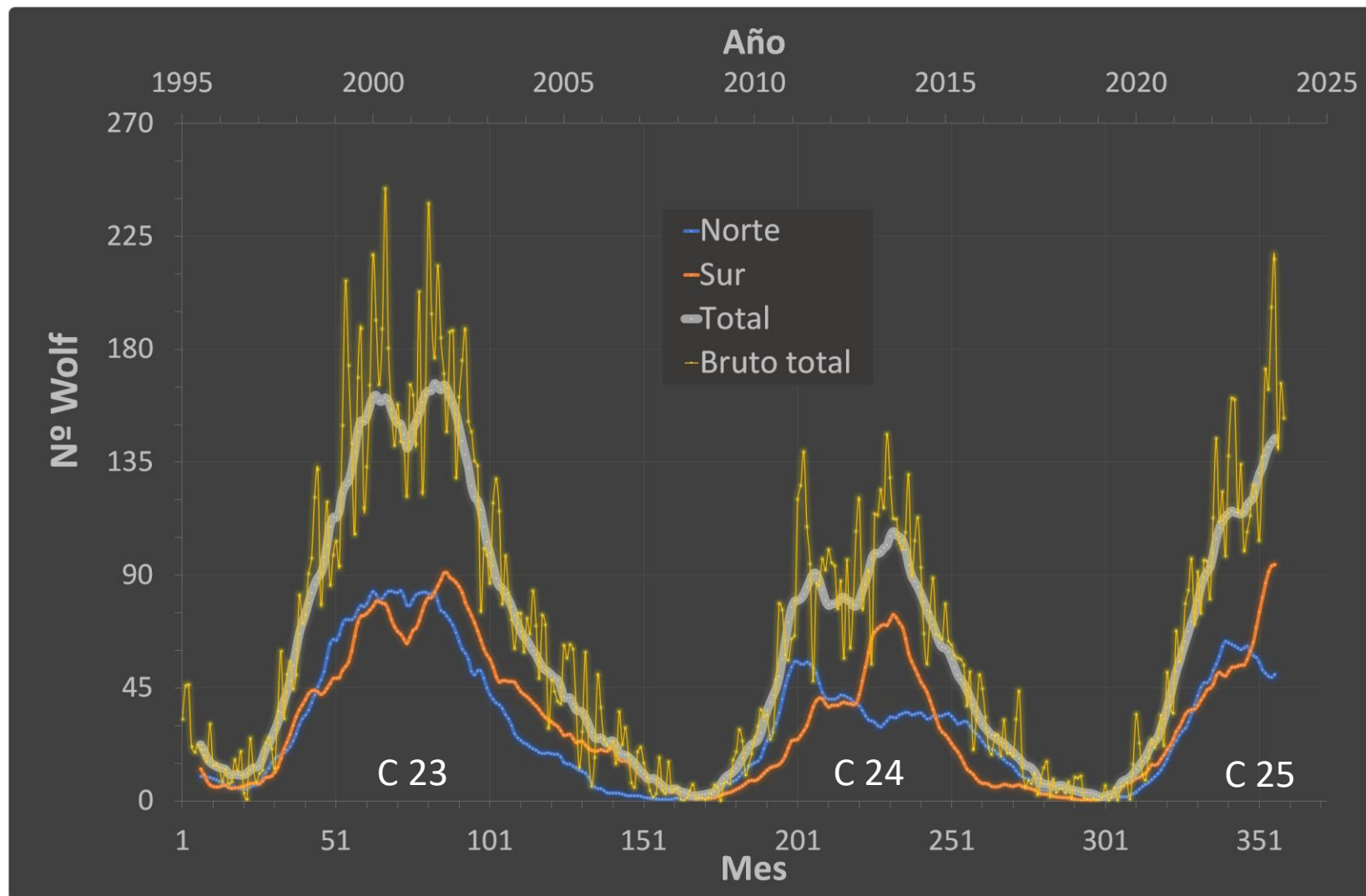
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A día de hoy (Ago '24)
actividad (suavizada)
todavía en aumento
(W=144,6)

PREDICCIONES PARA EL CICLO 25

Datos reales: actividad mensual (SILSO)



CONCLUSIONES

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actividad (suavizada)
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Llegando al
“segundo”
(y último) pico

26 Convención de astronomía

16 marzo 2025



Evaluación de la actividad solar
desde la última Convención

MOLTES GRÀCIES !!

Javier Alonso Santiago

L'ASTRONOMIA DE SABADELL

Algunos resultados anuales

- +2500 Observaciones
- +1000 Fotos y dibujos solares en luz blanca, halia y calcio
- +15 Observadores estables

+25 años de observaciones solares continuadas

GRUPO HELIOFÍSICA

Imágenes en Luz Blanca de la fotosfera: manchas solares

Imágenes en H α de la cromosfera: protuberancias, filamentos y fulguraciones

Imágenes en Calcio de la baja cromosfera: manchas y fáculas / playas

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