The LSO/KSO H alpha prominence catalogue – status report

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status report - 31/08/2012

Kanzelhöhe Observatory Colloquium 2013, 8-10/10/2013

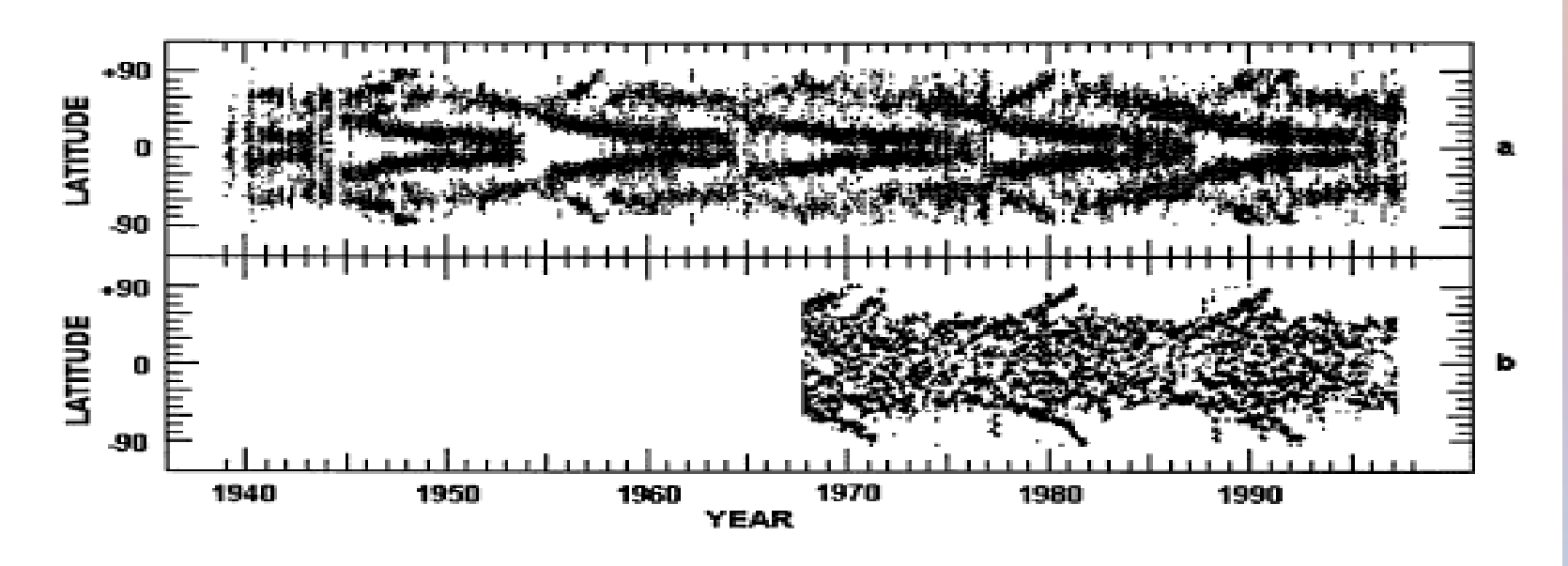
Project and its aims

- Long-term catalogue of positions, areas, brightness of the H alpha prominences derived from the coronagraphic observations: coronagraph ZEISS 200/3000, interference filter - ~0.6 nm, film,...
- Papers:

  "Catalogue of solar prominences (1967 – 1986)", Rušin, V.; Rybanský, M.; Dermendjiev, V.; Stavrev, K. Ya., CAOSP, Vol. 17, p. 63 – 292, 1988

  "Catalogue of solar prominences 1987 – 1993", Rusin, V.; Rybansky, M.; Dermendjiev, V.; Stavrev, K. Ya., CAOSP Supplement, vol. 24, p. 135-136, 1994

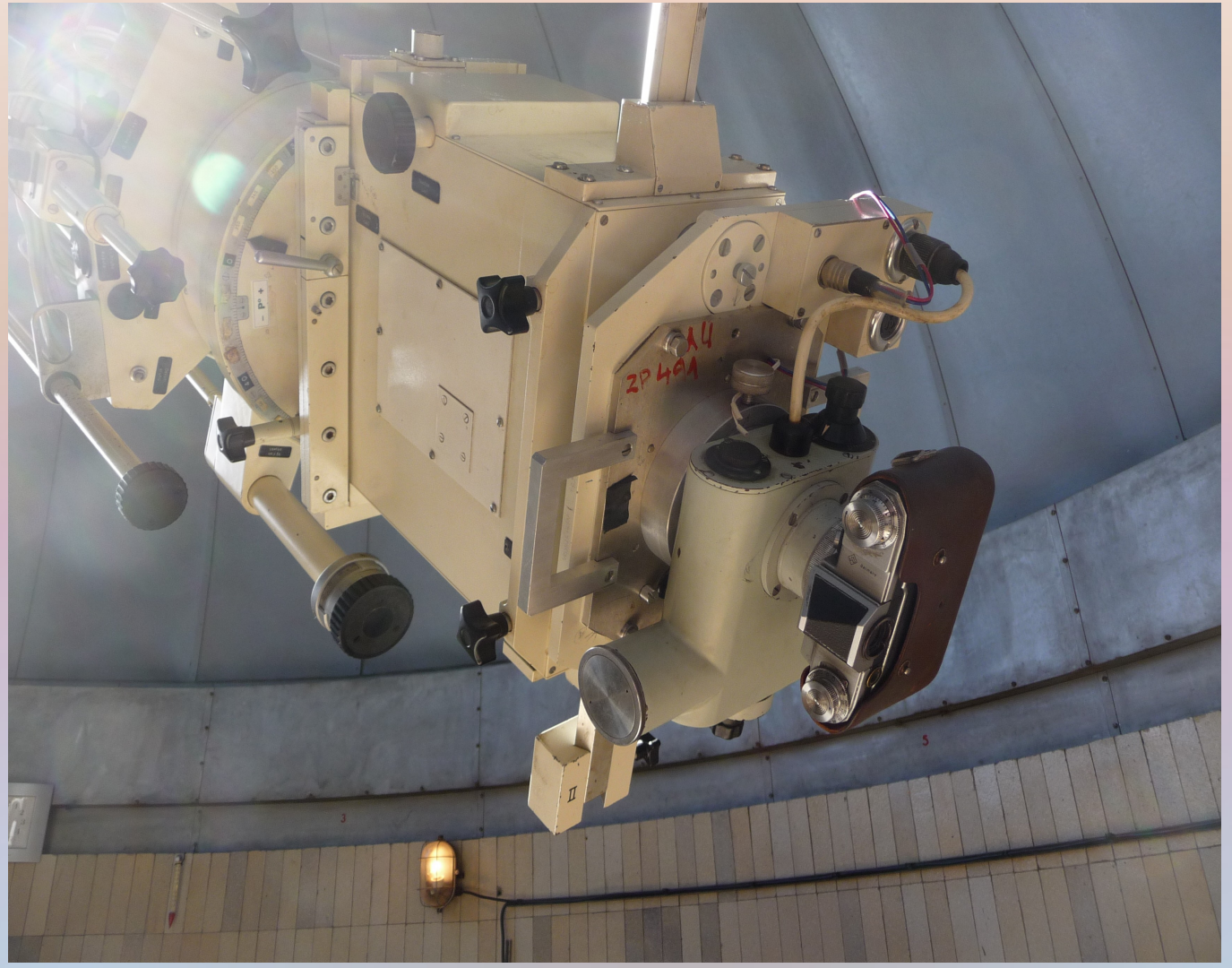
- Time-latitude distribution of prominences and solar cycle



Minarovjech, Rybansky, Rusin, 1998, ASP Conf. Ser. 150, 484

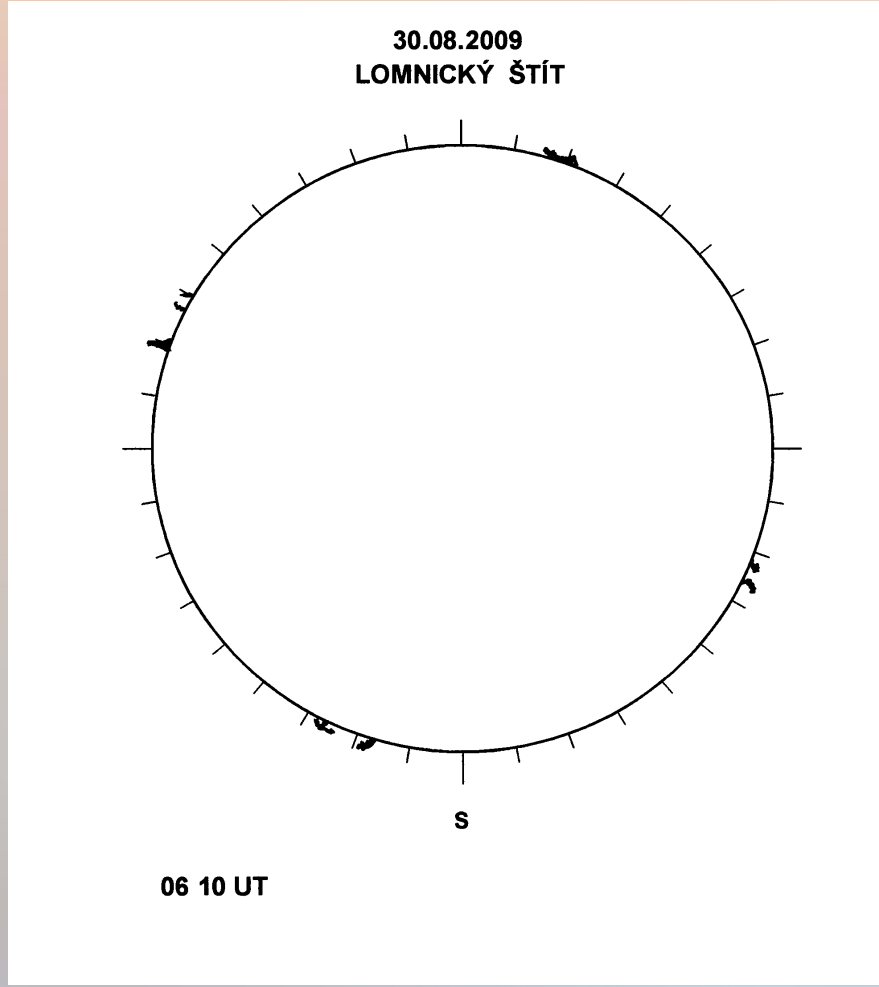
LSO observations in the past

- Long-term catalogue of positions, areas, brightness of the H alpha prominences derived from the coronagraphic observations: coronagraph ZEISS 200/3000, interference filter - ~0.6 nm, film,...



LSO observations in the past

- LSO: photographic film, 36x24mm, several exposures along the limb
- Development with a hight contrast, projection for a large image
- drawing of shapes of prominences, measurement of the parameters: position angle, limb, latitude, longitude, area, height, subjective brightness (1-2-3)

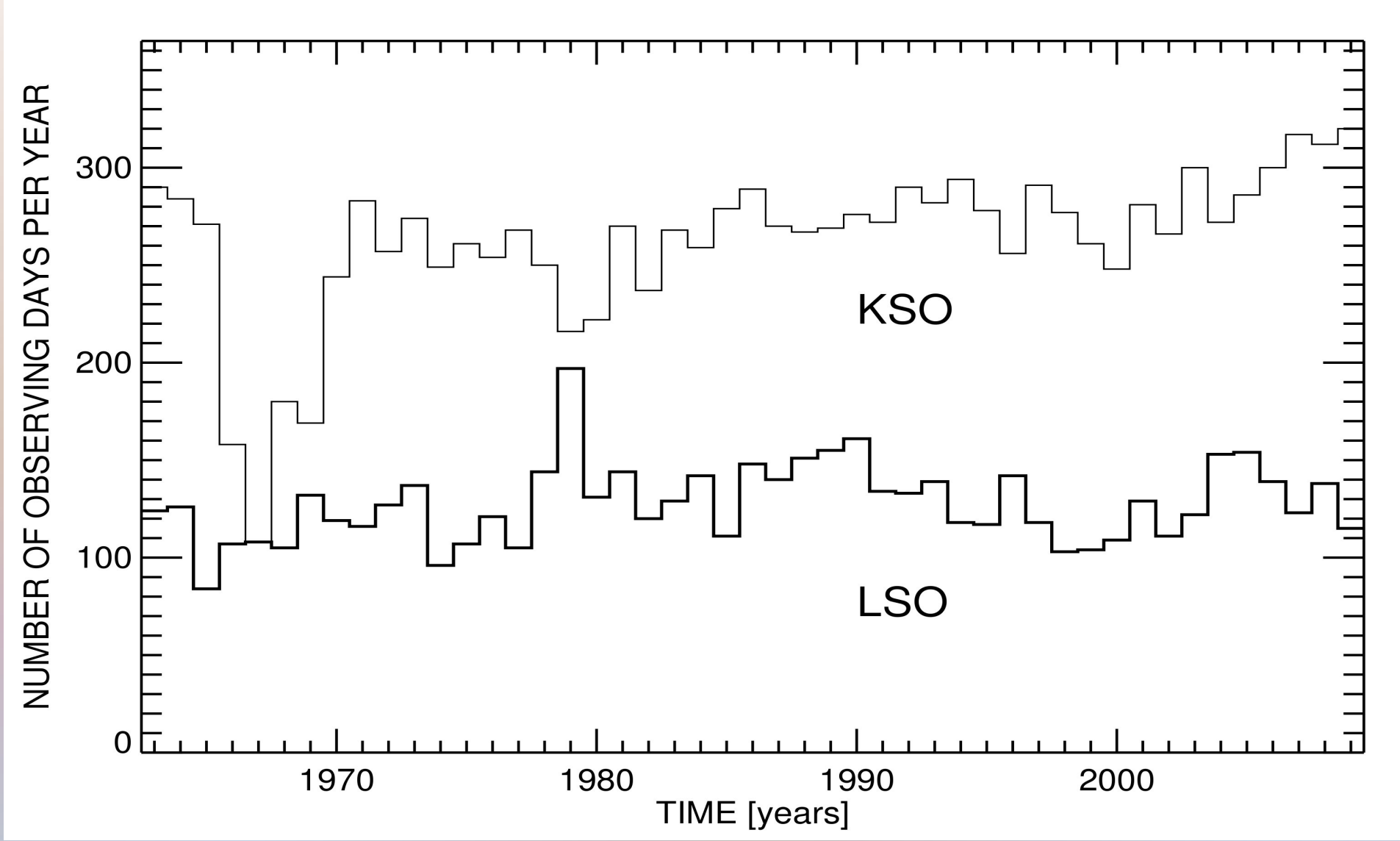


Example: 30/08/2009 – LSO

Future of the project

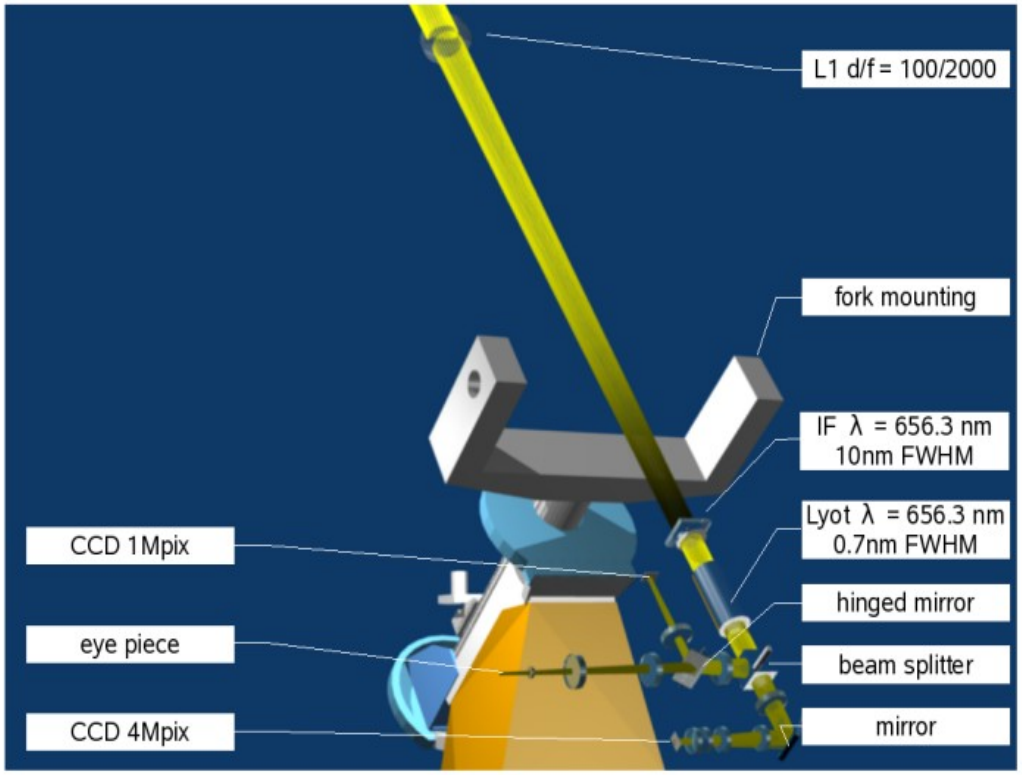
- Free post-focal space needed for new instruments – CoMP-S, SECIS,...
- End of the coronagraphic photographic observations at the LSO – 20/09/2009
- Request for introduction of the full-disk H alpha observations with an extended exposure time for prominences at the KSO – 8/2009
- Attempts to acquire a new coronagraphic instruments for CCD full-disk measurements at the LSO for auxiliary data to the CoMP-S instrument and for continuation of the prominence catalogue – work still in progress (telescope selected, H alpha filter, CMOS camera, computer available, more mechanical work needed to finish installation)

Data coverage KSO ~ LSO: statistical expectations...



Kanzelhöhe data

- Kaznelhőhe observatory for solar and environmental research (Austria, 1526 m n.m.)
- Refractor d/f = 100/2000
- Lyot filter Zeiss H alpha 656.3 nm, FWHM 0.07 nm
- camera Pulnix TM-4200GE, 12bit, 2kx2k
- 2082″x2082″, 1.01676″/px -> minimum in radial distance 80″
- daily, e.g. 2009: ~320 days in total in the year 2009



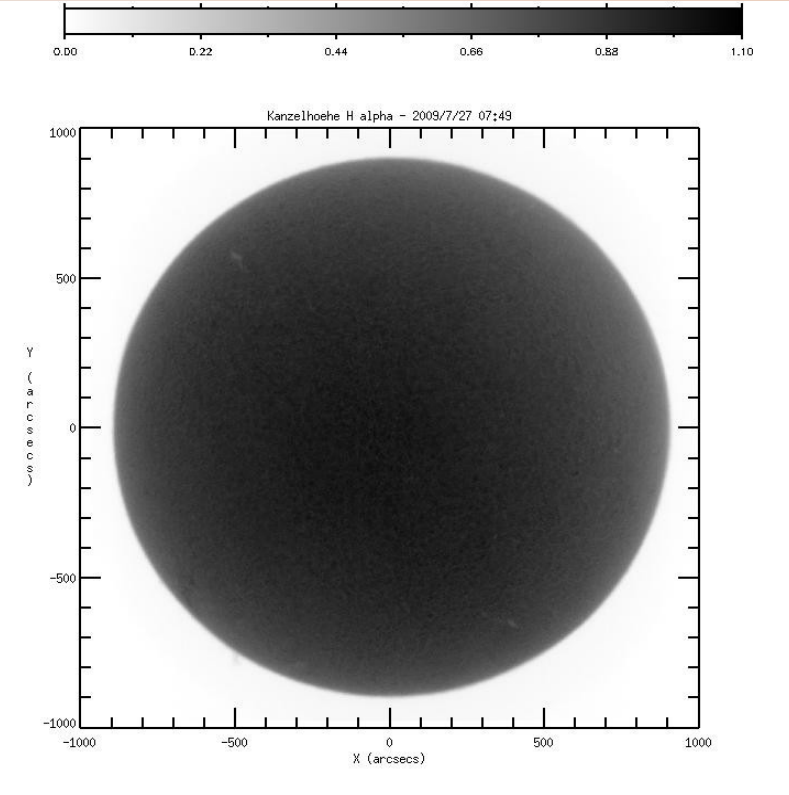
Kanzelhöhe data

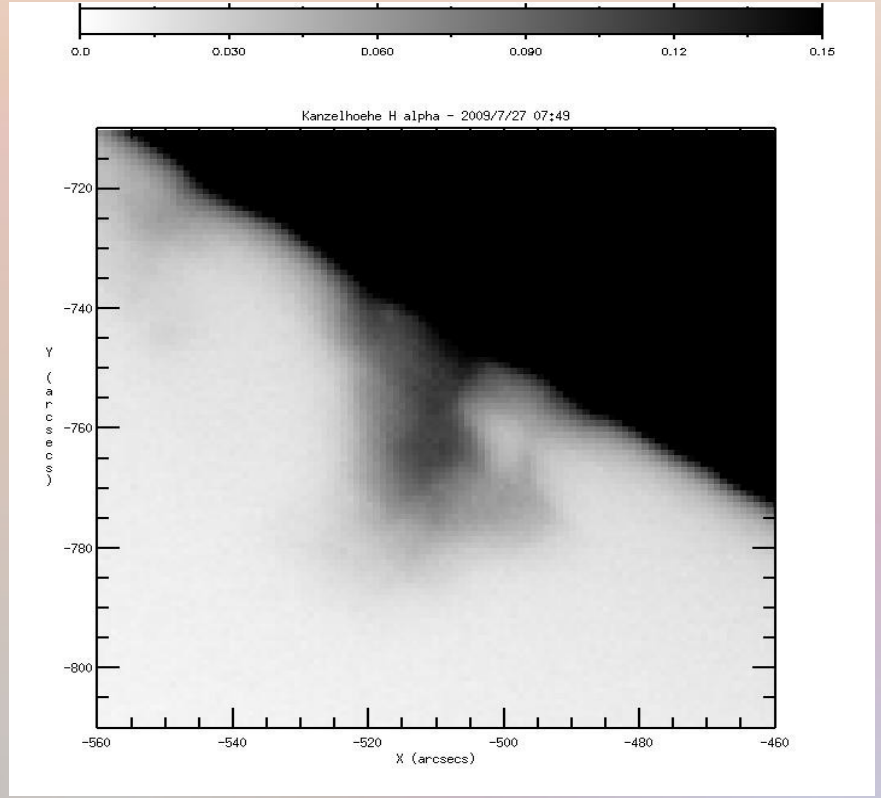
- 3 exposures in a series: 5, 20, 50 ms
- N up, E left + basic parameters in the FITS file header

Example: 30/08/2009 – 5ms, 20ms, 50ms

Kanzelhöhe data - reduction

- DC but no FF and scattered light
- scattered light correction: edges of the CCD chips unilluminated -> subtracted
- Intensity calibration to the mean disk centre intensity taking into account the exposure time ratio

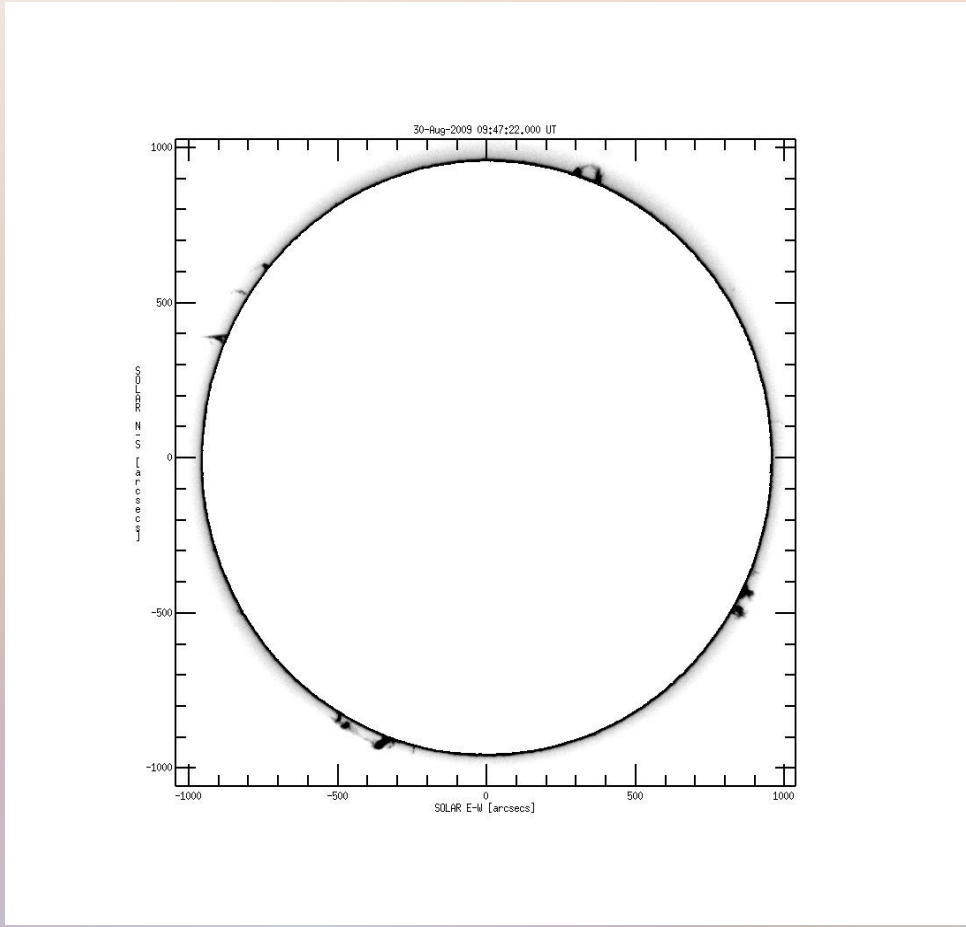


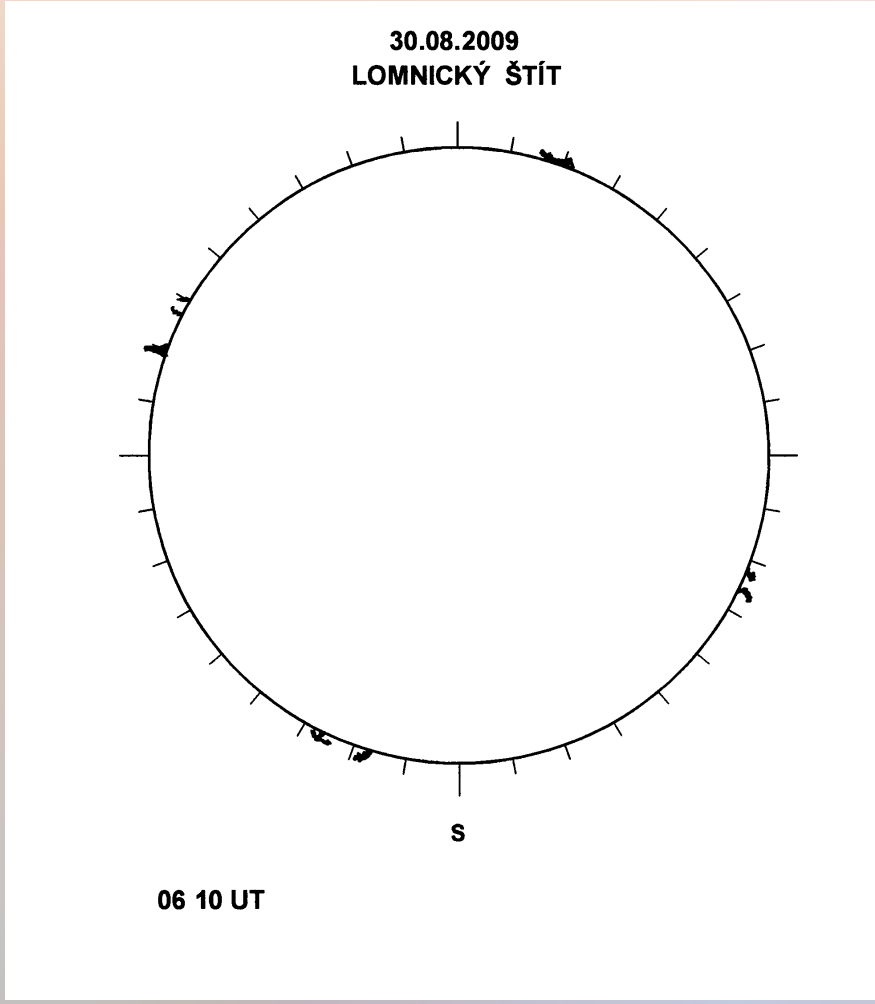


Example: 27/07/2009 – KSO

KSO data ~ LSO data

- Similar in general distribution of prominences but different prominence details as well...





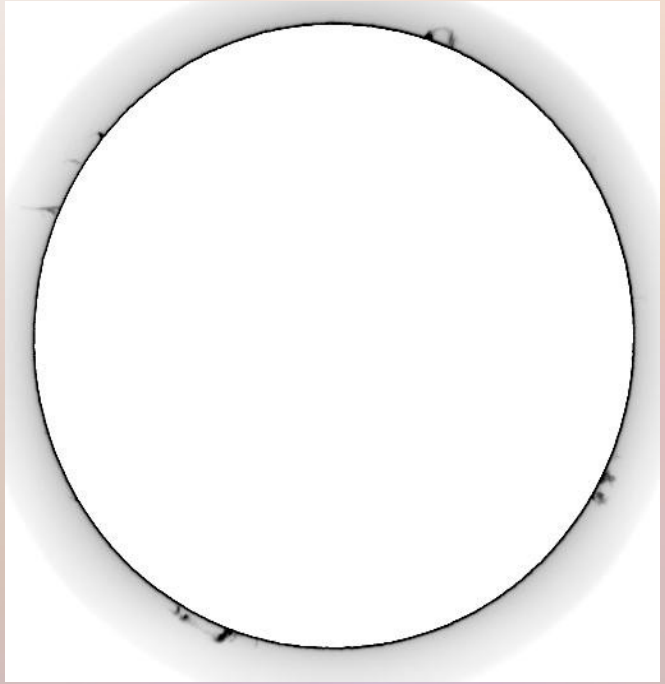
Example: 30/08/2009 – KSO, LSO

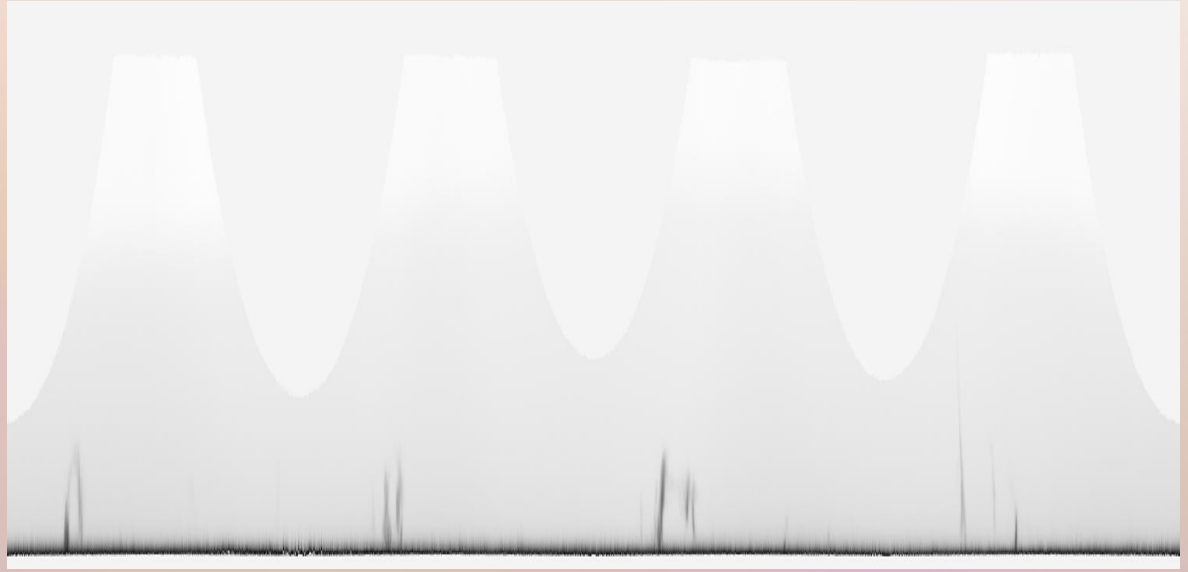
Kanzelhöhe data -> LSO catalogue

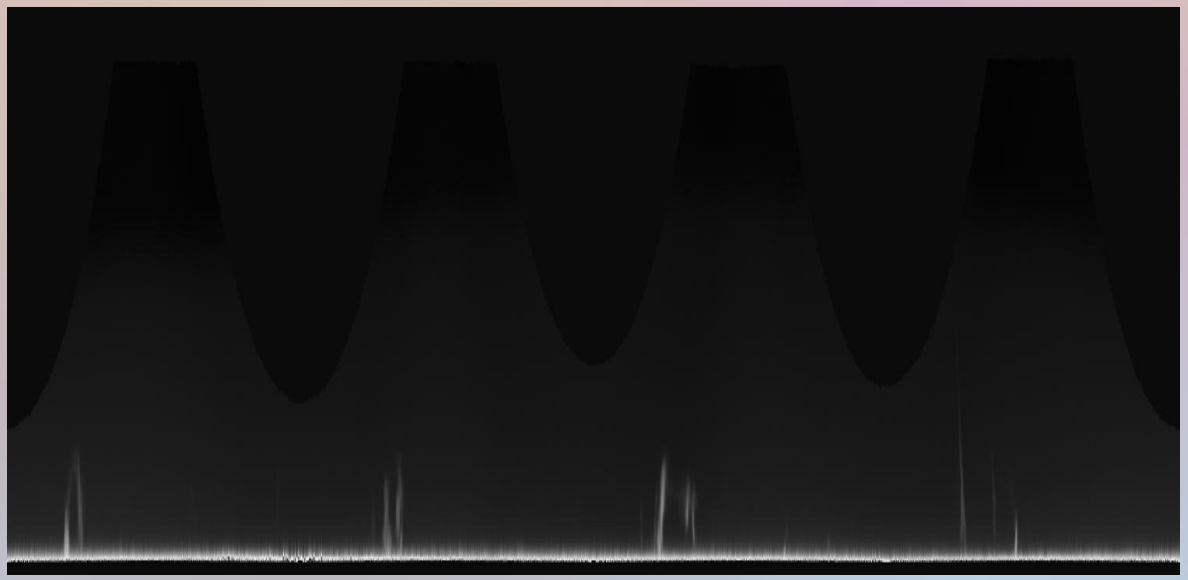
- 1/ download from the CEASAR archive: once per month to our server “penumbra”
- 2/ IDL code – written by JR, used by RM - assistant at the LSO
  - Corrections, zoom, selection, control
  - Calibrated image in the cartesian coordinates
  - Radial cut in the polar coordinates
  - Interactive selection of a prominence: 2x cursor
  - Subtracting of the scattered light in the radial direction
    - Interactive selection for calculation of the prominence parameters:
      - width:: 2x cursor
      - height: 1x cursor
  - Calculation of the prominence parameters:
    - area, maximum, mean, total brightness
    - Position angle, width -> heliographic latitude and longitude
    - height, area
    - Subjective estimate of the prominence brightness:: 1-2-3
    - output: ASCII file of the catalogue

Reduction procedure – IDL code

- Preparation and tests: 30/08/2009 KSO



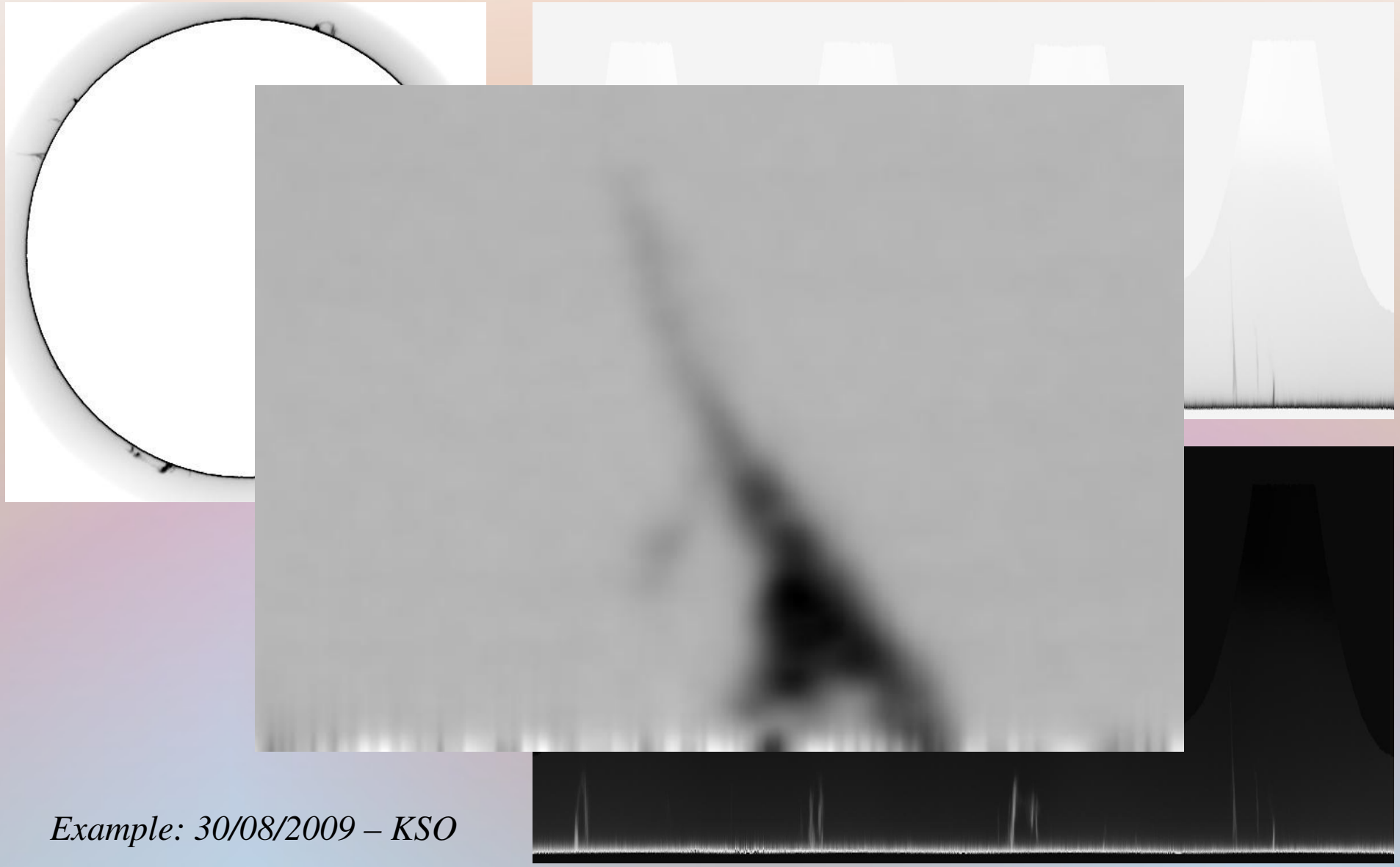




Example: 30/08/2009 – KSO

Reduction procedure – IDL code

- Preparation and tests: 30/08/2009 KSO – prominence example P = 19 degrees



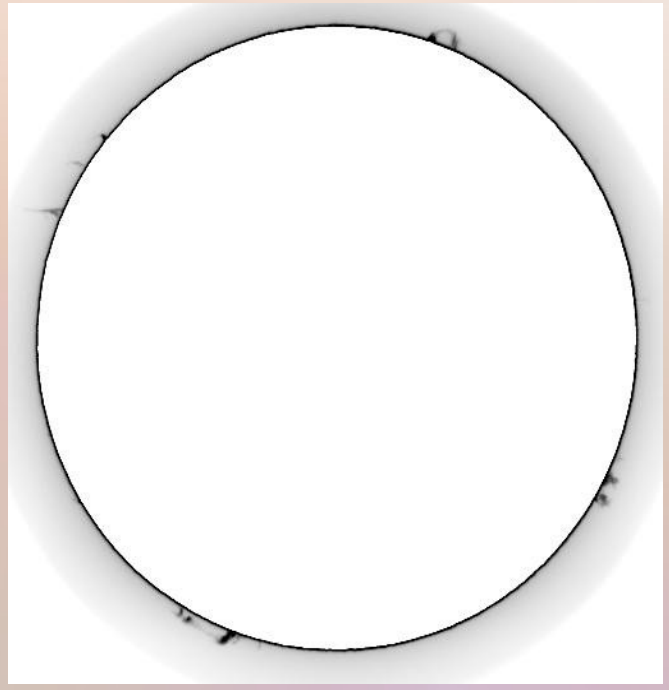
Example: 30/08/2009 – KSO

Reduction procedure – IDL code

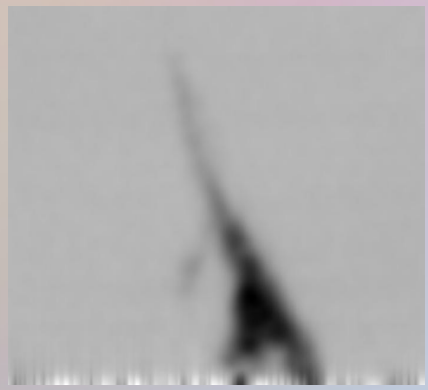
- Preparation and tests: 30/08/2009 KSO – prominence example PA = 71 degrees

- LSO catalogue - 30/08/2009:

41471 2009 8 30.26 2087 136 +29 E 1 30 1 30
41472 2009 8 30.26 2087 136 +27 E 1 30 1 30
41473 2009 8 30.26 2087 136 +19 E 2 60 1 90
41474 2009 8 30.26 2087 136 -63 E 1 30 1 60
41475 2009 8 30.26 2087 136 -72 E 1 40 2 50
41476 2009 8 30.26 2087 316 -27 W 1 50 2 50
41477 2009 8 30.26 2087 316 -23 W 1 40 2 40
41478 2009 8 30.26 2087 316 +73 W 5 30 2 90



- KSO image – 30/08/2009:
  Position angle: 67.7 degrees
  Heliographic latitude 22.3 degrees,
  Width of the prominence base 2.4 degrees
  Height of the prominence 171”
  max. intensity 0.054 I_center
  area 94.5 degrees x arcsecs



Example: 30/08/2009 – KSO

Calibration data

- Common observing days: 6 days

  2009/08:

  LSO: 2,3,16, 25 ,30,31

  KSO: 21,24,25,26,27,28,30,31

  2009/09"

  LSO : 1, 2, 5, 8, 9, ,29

  KSO : 1, 3, 6,7, 9,10,12,13,17,19,21,22,23,24,25,26,28,29,30

- Selected observing days:: 4 days

  1/ 25, 28, 31/08, 1/09

  2/ prominences: LSO – 25, KSO - 31

  3/ “common” prominences: 20

  4/ KSO but not LSO: 11, LSO but not KSO: 5

  5/ KSO as 2 and LSO as 1: 2

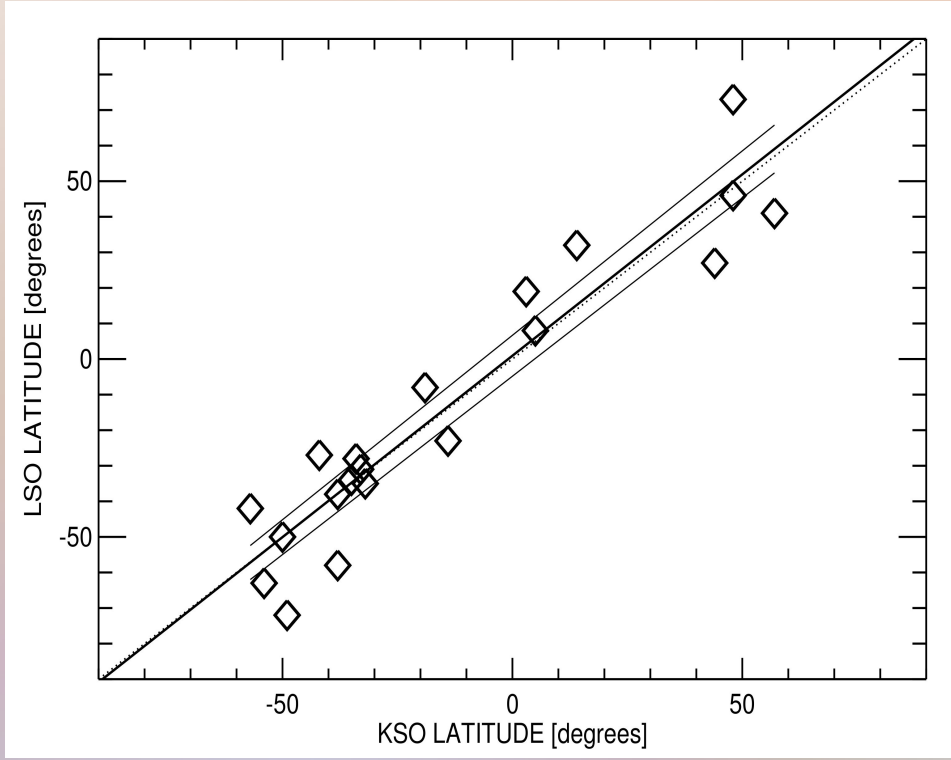
LSO and KSO data of the catalogue

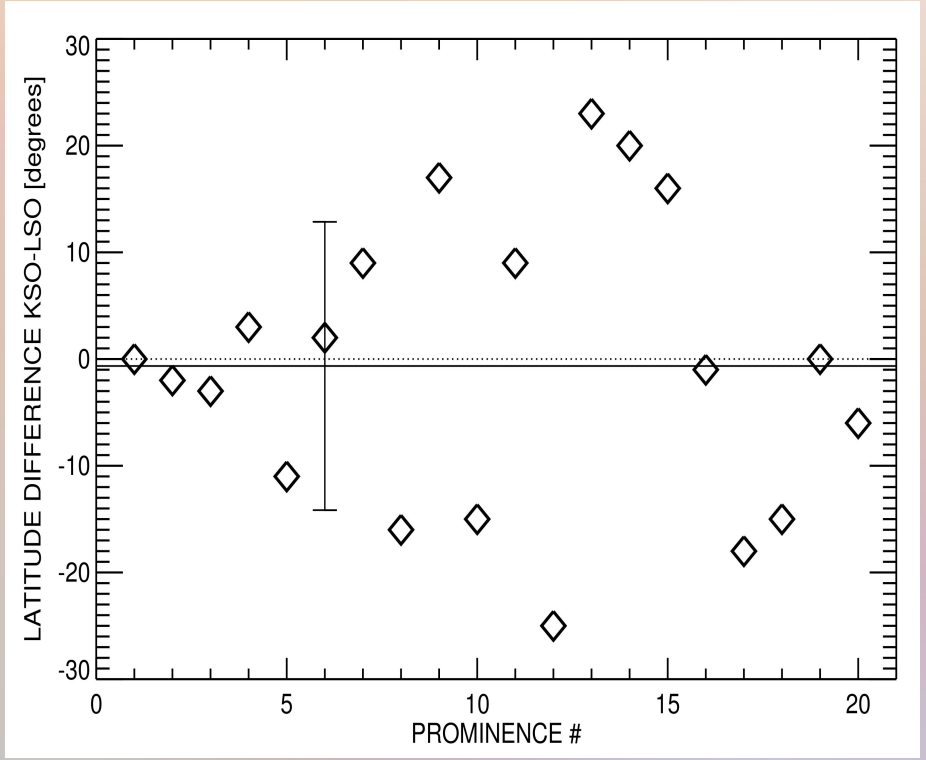
;	YYYY	MM	DD.DD	CARR	lon	lat	l	w	h	I	area	PARAMETERS
;					deg	deg		deg	arc		deg x arcsec	UNITS
	41452	2009	8	25.22	2087	202	+8	1	2	30	1 40	
	41453	2009	8	25.22	2087	202	-31	1	1	40	1 30	
	41454	2009	8	25.22	2087	202	-50	1	2	60	1 80	
	41455	2009	8	25.22	2086	22	-35	2	1	50	2 40	
	41456	2009	8	25.22	2086	22	-8	2	1	20	1 10	
	41457	2009	8	25.22	2086	22	+46	2	1	30	2 30	
	41471	2009	8	30.26	2087	136	+29	1	1	30	1 30	
	41472	2009	8	30.26	2087	136	+27	1	1	30	1 30	

;	YYYY	MM	DD.DD	CARR	lon	lat	l	w	h	I	area	PARAMETERS
;					deg	deg		deg	arc		deg x arcsec	UNITS
	1	2009	8	25.47	2086	10	+48	2	2	37	2 47	
	2	2009	8	25.47	2086	15	-19	2	1	33	1 1	
	3	2009	8	25.47	2086	13	-32	2	2	76	1 24	
	4	2009	8	25.47	2087	354	-72	2	1	24	2 19	
	5	2009	8	25.47	2087	207	-50	1	2	69	2 91	
	6	2009	8	25.47	2087	203	-33	1	4	109	1 366	
	7	2009	8	25.47	2087	200	-16	1	2	15	2 27	
	8	2009	8	25.47	2087	198	+05	1	1	35	1 23	
	9	2009	8	30.41	2087	305	+48	2	7	65	2 158	
	10	2009	8	30.41	2087	311	+12	2	2	40	1 38	

Cross-calibration: heliographic latitude

- statistics:: shift -0.65 degrees, scatter +/-13.5 degrees
- Reasons of the large scatter: 1 or 2 prominences, false identification of a common prominence, filter passband width



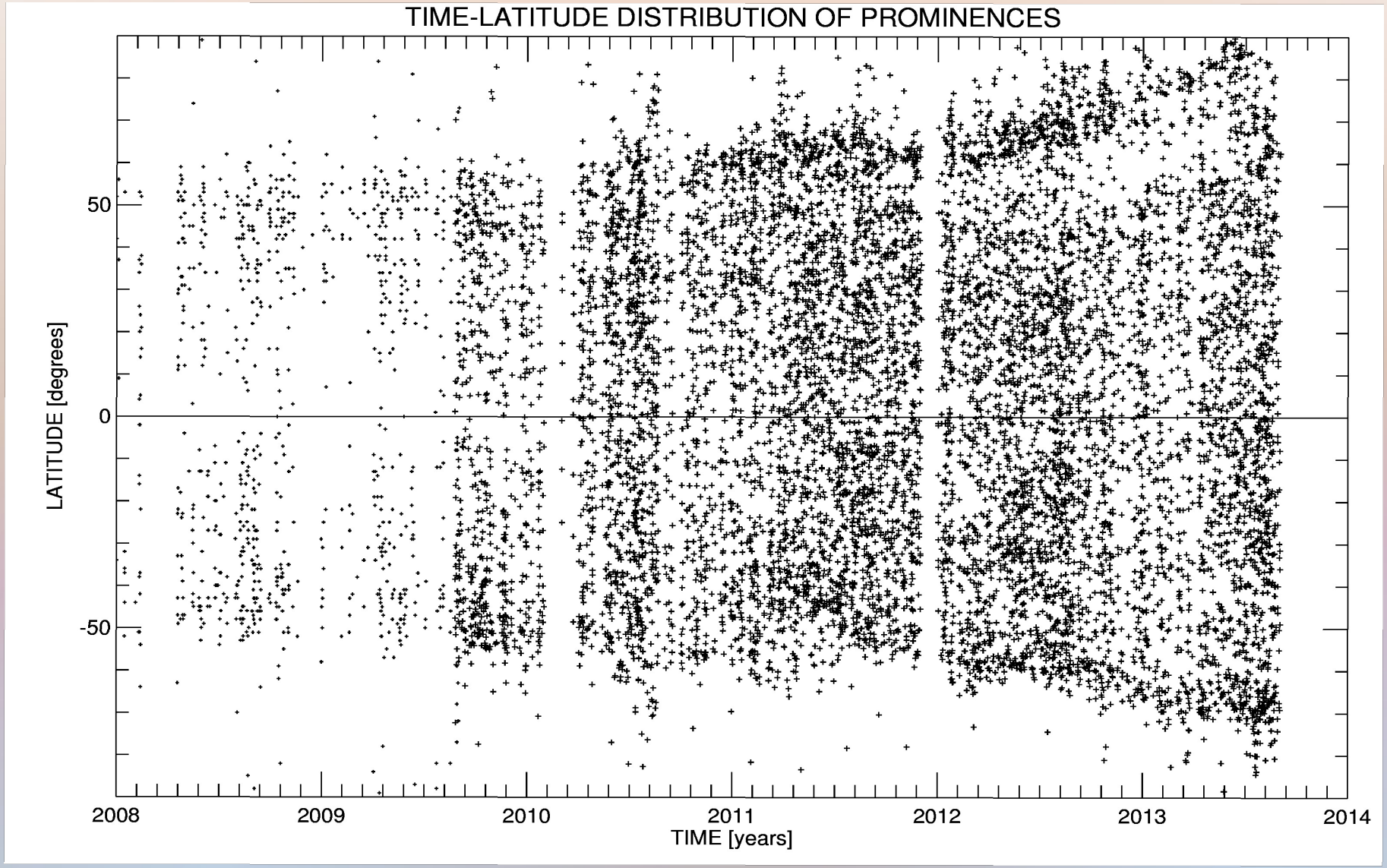


Current status of the catalogue

- The LSO catalogue becomes the LSO/KSO catalogue
- Pros:
    - Better data coverage
    - Better dynamic range
    - Greater number of prominences
    - More precise calculation of the heliographic latitude and longitude
    - Right coronagraph at the LSO is free to host other instruments
- Cons:
    - Different filter passbands
- Current status:
    - LSO: 05/1967 - 08/2009: 41482 data records (in 42 years)
    - KSO: 09/2009 - 08/2013: 10319 data records (in 4 years)

Current status of the catalogue

- When more is much better...



Current status of the catalogue

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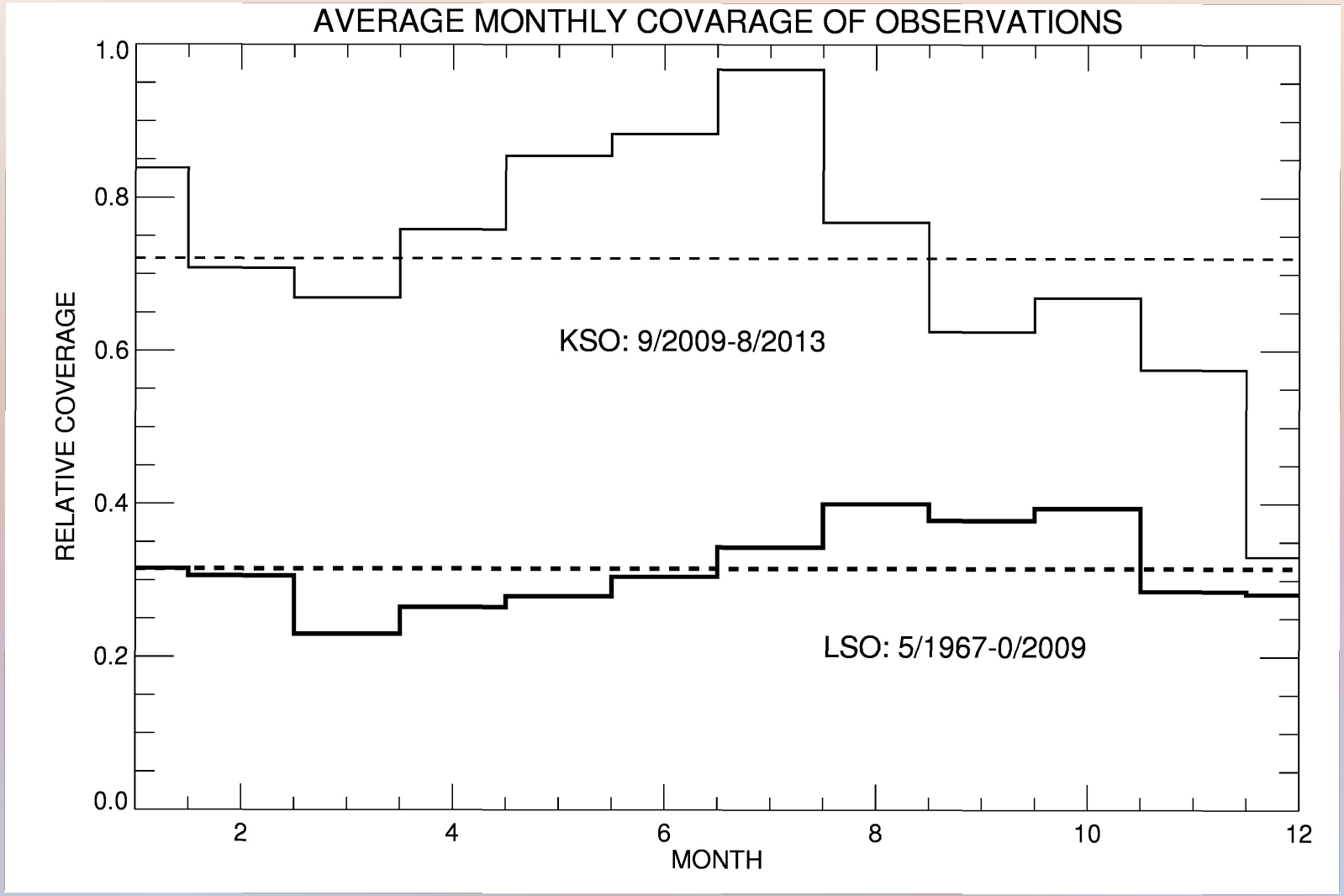
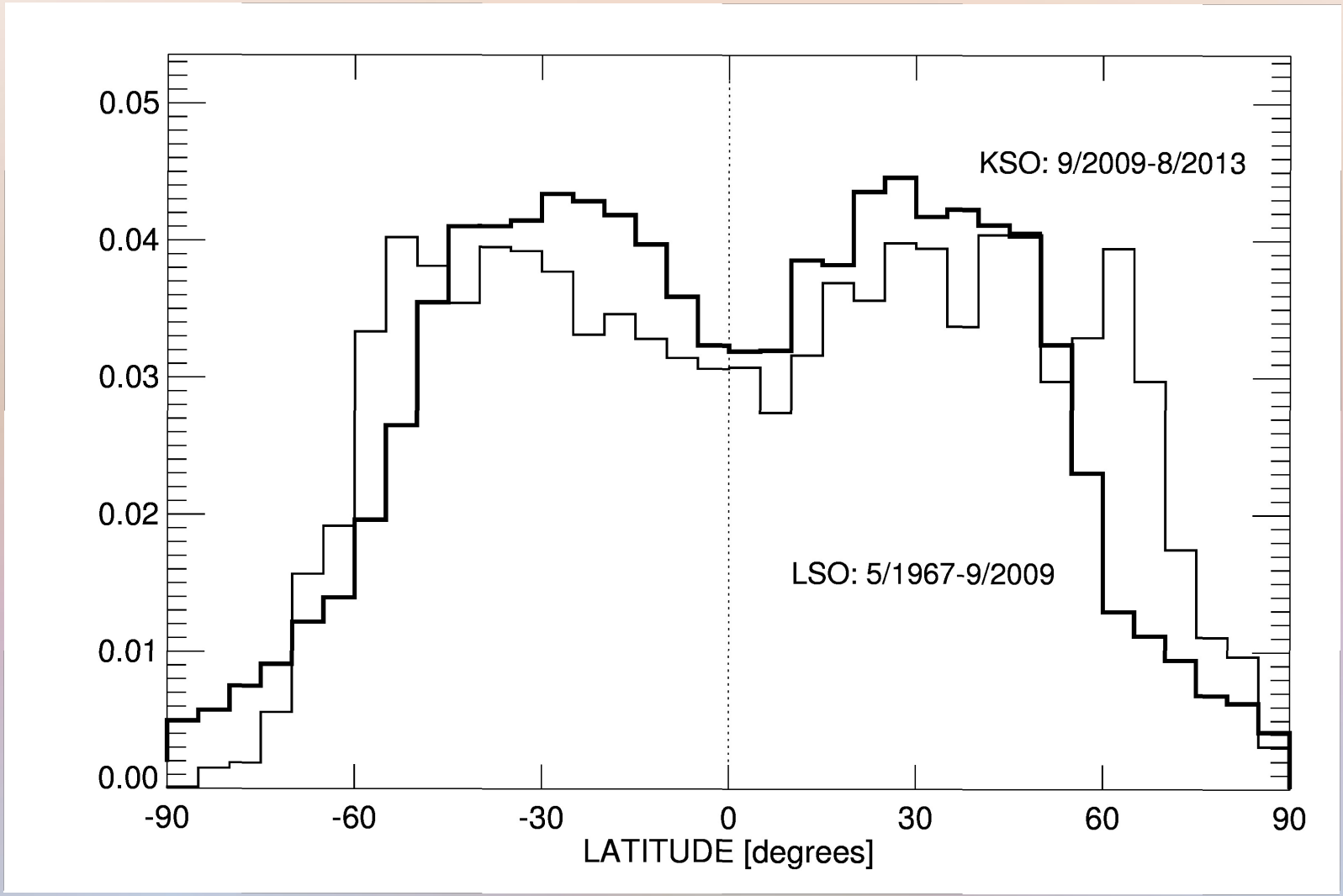


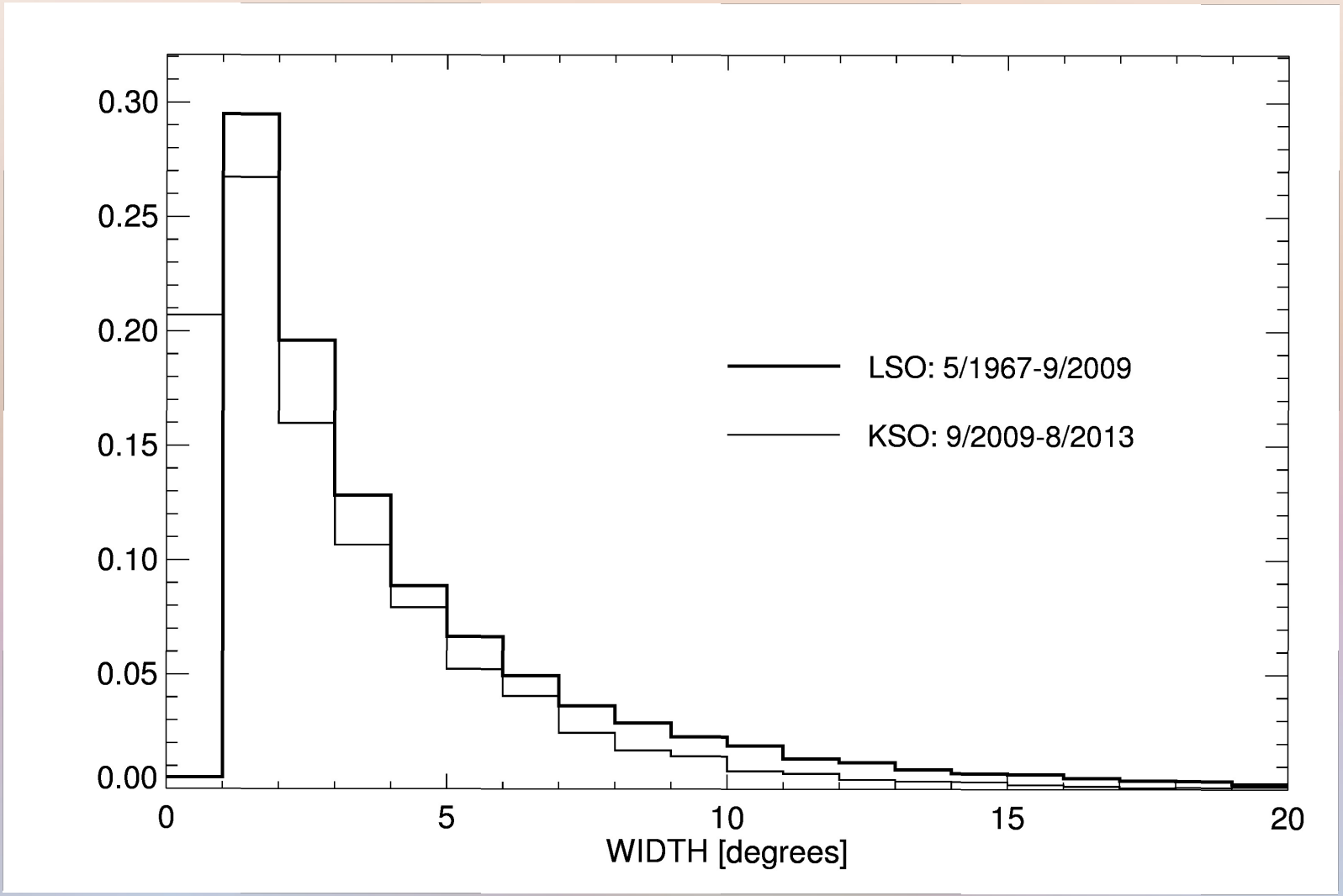
Current status of the catalogue

- Latitudinal distribution of the prominences: probable still some solar cycle effects



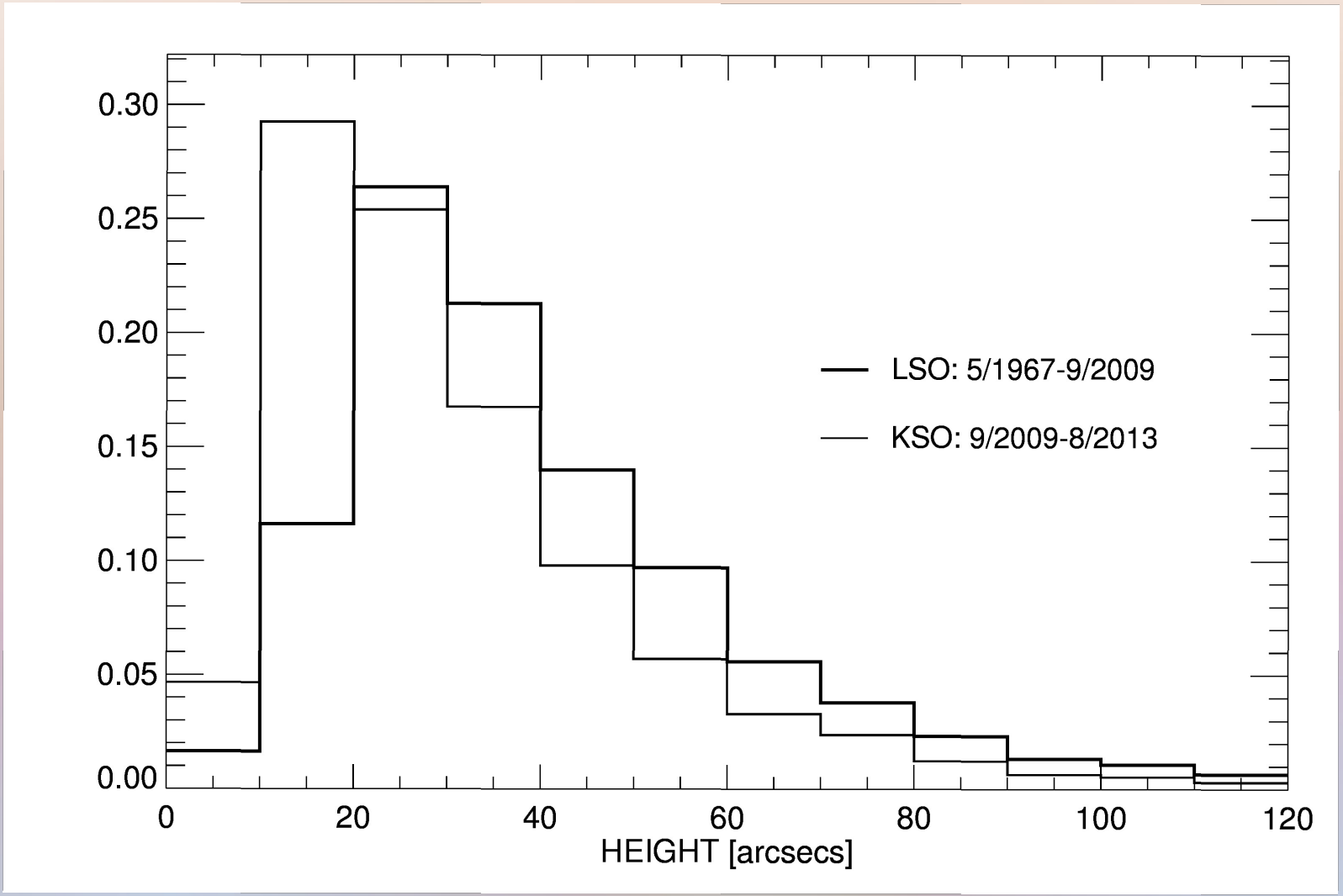
Current status of the catalogue

- Distribution of the prominence width: systematic shift due to the changed data acquisition



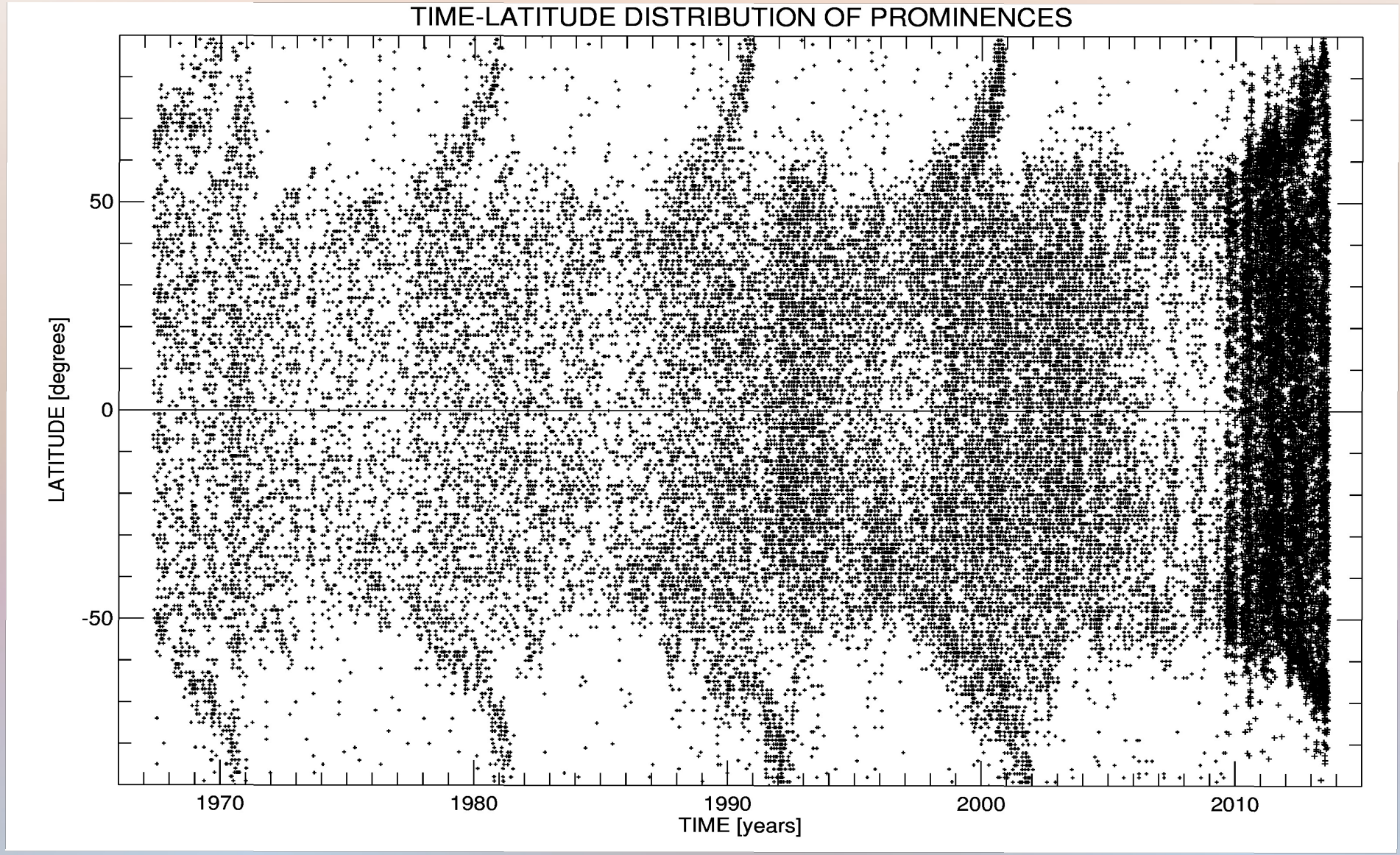
Current status of the catalogue

- Distribution of the prominence height: systematic shift due to the changed data acquisition



Project and its aims

- Long-term catalogue of the H alpha prominences – time-latitude distribution of prominences

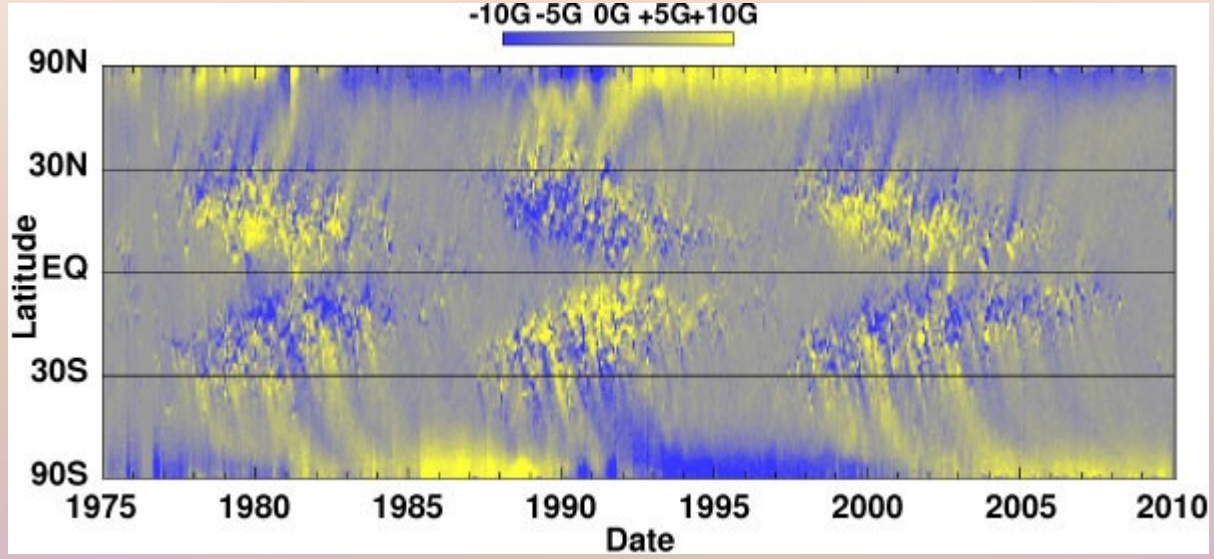


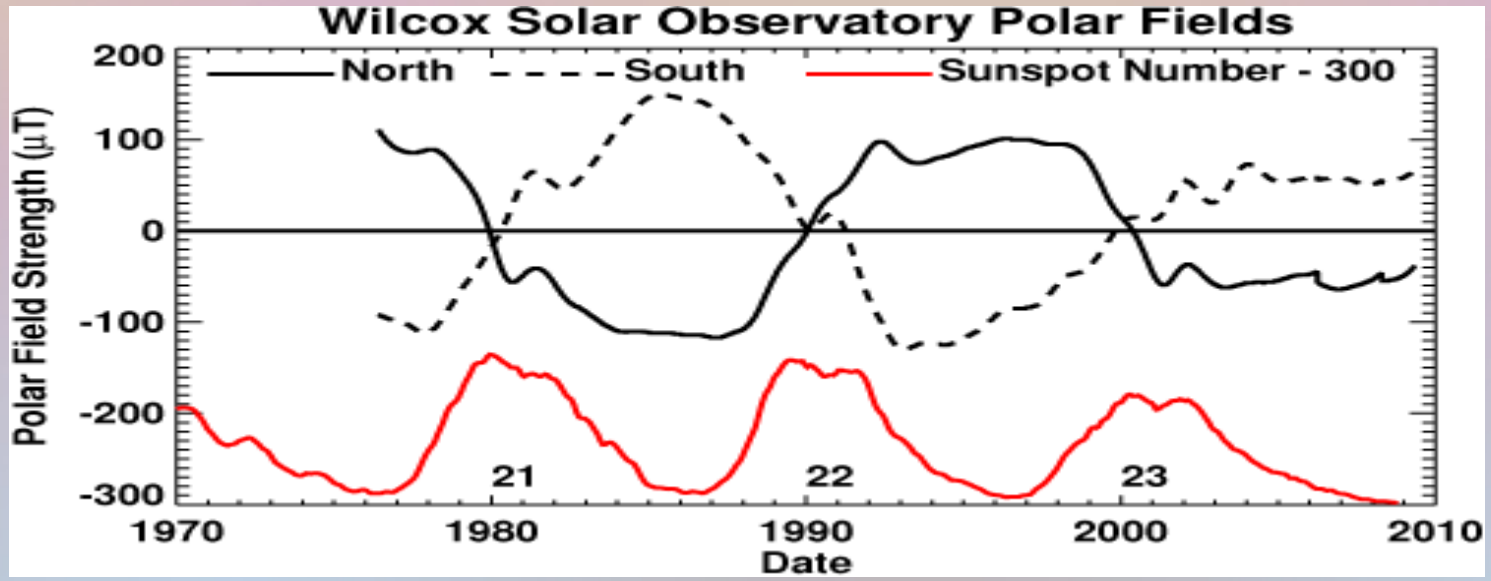
Future of the project

- Solar cycle 24: hemispheric differences, polar reversal finished only on the N pole so far
- Continuation of the data acquisition, reduction and prolongation of the catalogue
- A paper when both polar branches will be over in the current solar cycle: hemispheric differences and possible consequences for the solar activity cycles
- An analysis comparing the catalogue with the photospheric magnetic field measurements in the polar regions for a polar reversal (from 1976)
- An extension of the prominence catalogue backward when possible (filaments ~ prominences)
- A search for broader relations – HCS, cosmic rays (Izmiran group) – but taking into account the hemispheric differences and shifts

Future of the project

- An analysis comparing the catalogue with the photospheric magnetic field measurements





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