

SPACE WEATHER JHELIOVIEWER

HIGH PERFORMANCE DISTRIBUTED SOLAR IMAGING AND PROCESSING PROTOTYPE

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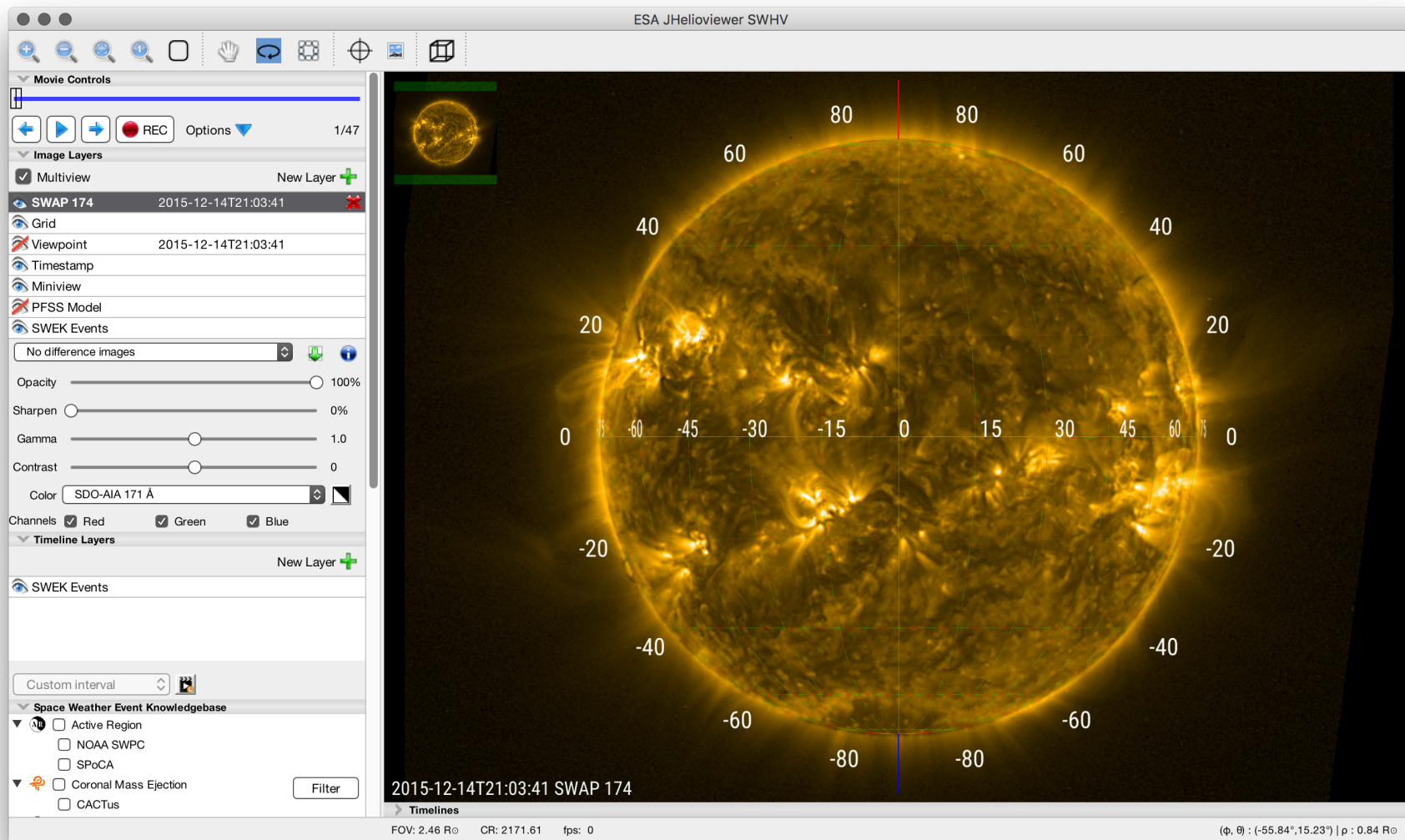
¹Royal Observatory of Belgium; ²ESTEC

Full online version: <http://swhv.oma.be/SEE2015-presentation/>

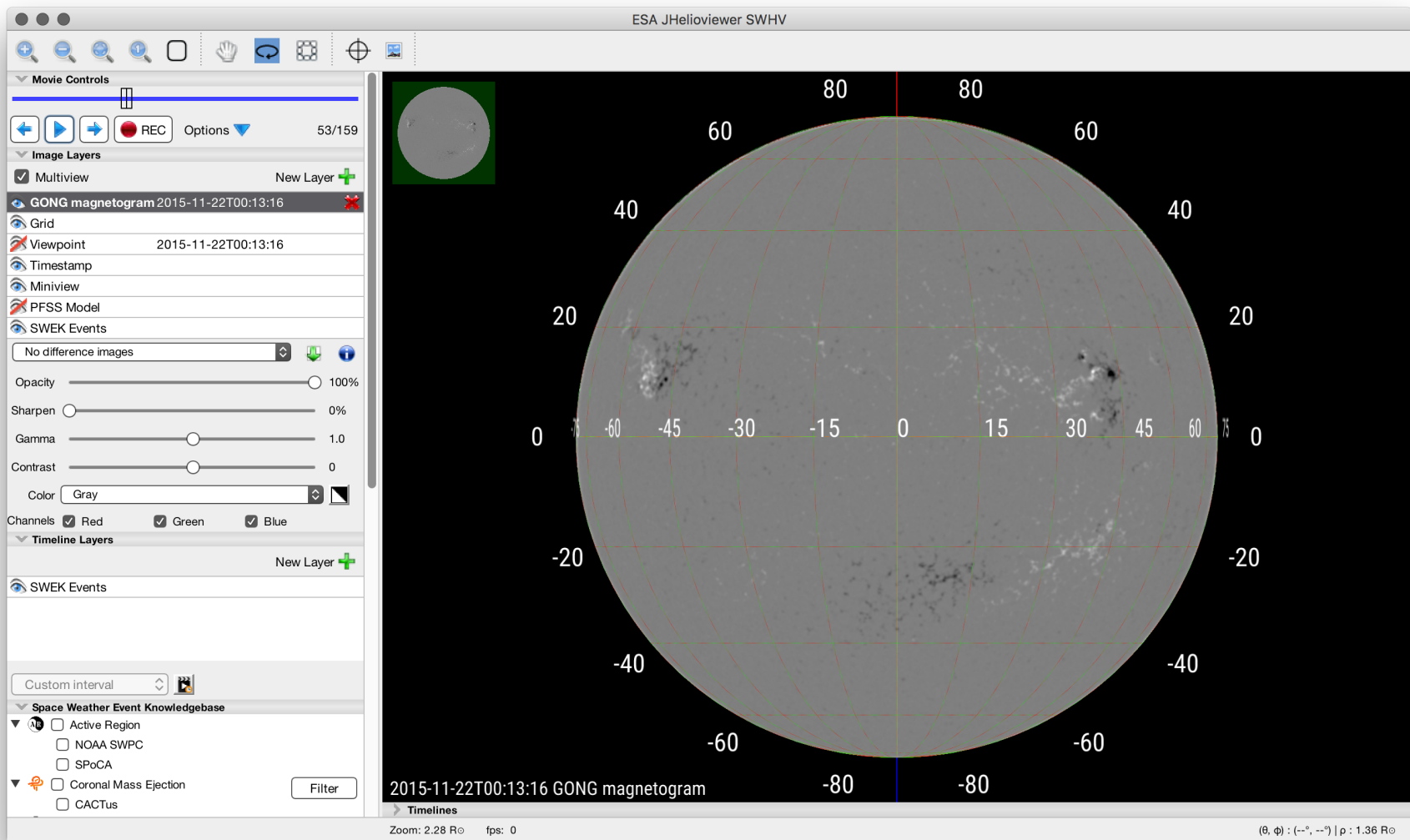
- High performance visualisation of quicklook, context and model solar data.
- Builds upon and extends the Helioviewer services.
- Display of 1D (timelines), 2D (solar images and spectrograms), and 3D data (multi-spacecraft imaging, magnetic field lines modelling).
- Integrate solar event detections (HEK), and space weather alerts (COMESSEP).

- Client - server system with JSON APIs.
- Helioviewer server augmented with services built on ESA ODI, AFFECTS STAFF and others.
- JPEG2000 images streamed by ESA JPIP server.
- The Java client is the main focus of the project.

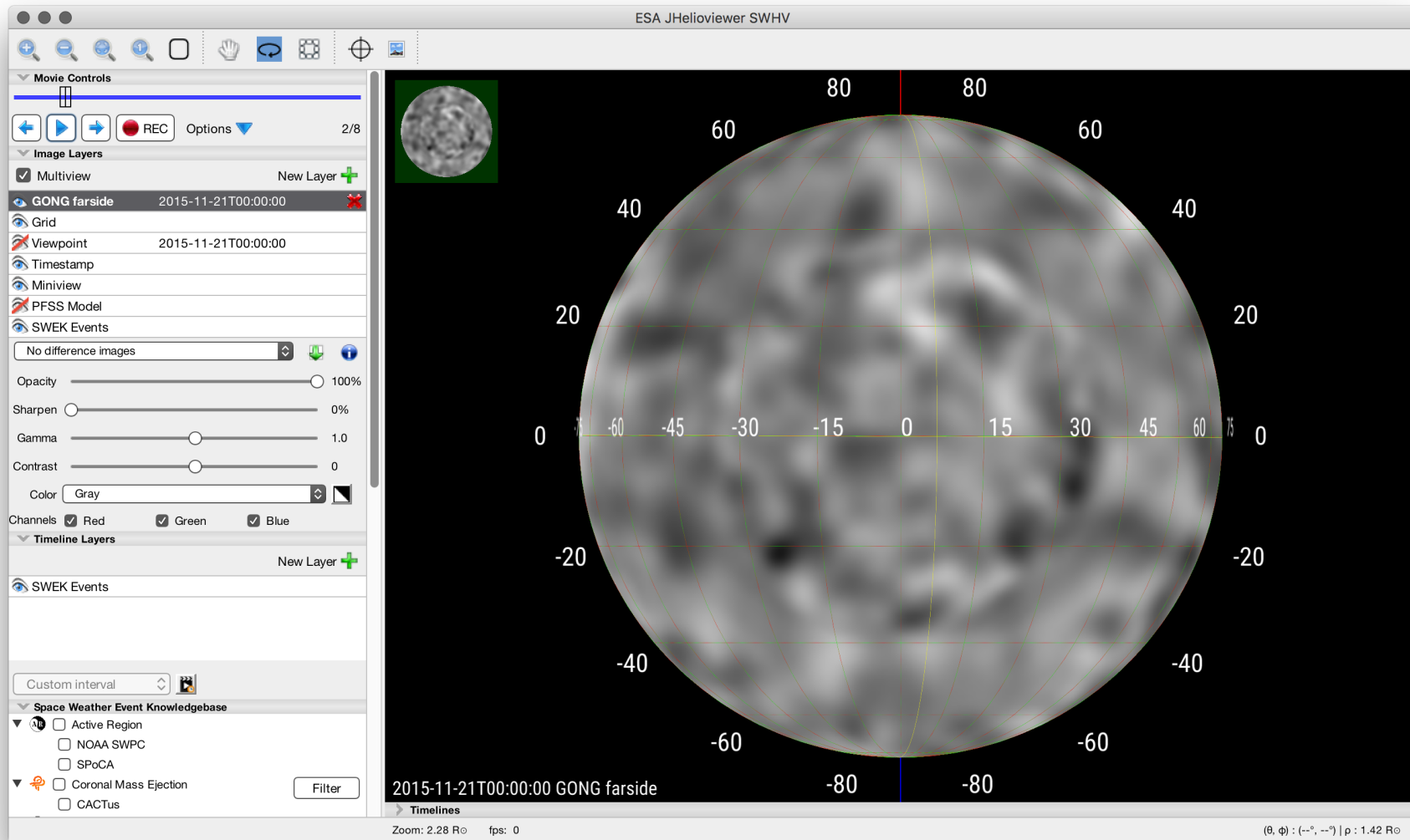
EXTRA DATASETS: PROBA2/SWAP



EXTRA DATASETS: GONG MAGNETOGRAM



EXTRA DATASETS: GONG FARSIDE IMAGES



EXTRA DATASETS: GONG H-ALPHA

The screenshot displays the ESA JHelioviewer SWHV interface. The main window shows a solar image in H-alpha light, overlaid with a coordinate grid. The grid labels include 80, 60, 40, 20, 0, -20, -40, -60, and -80. The interface includes a control panel on the left with sections for Movie Controls, Image Layers, Timeline Layers, and Space Weather Event Knowledgebase. The Space Weather Event Knowledgebase section is expanded, showing options for Active Region, NOAA SWPC, SPoCA, Coronal Mass Ejection, and CACTus. The bottom status bar indicates the zoom level (2.28 R_o), frame rate (fps: 0), and coordinates (0, φ) : (---, ---) | p : 2.18 R_o.

ESA JHelioviewer SWHV

Movie Controls

Image Layers

- Multiview
- GONG 6562 2015-11-25T04:56:34
- Grid
- Viewpoint 2015-11-25T04:56:34
- Timestamp
- Miniview
- PFSS Model
- SWEK Events

No difference images

Opacity 100%

Sharpen 0%

Gamma 1.0

Contrast 0

Color Gray

Channels Red Green Blue

Timeline Layers

- SWEK Events

Custom interval

Space Weather Event Knowledgebase

- Active Region
- NOAA SWPC
- SPoCA
- Coronal Mass Ejection
- CACTus

Filter

2015-11-25T04:56:34 GONG 6562

Timelines

Zoom: 2.28 R_o fps: 0 (0, φ) : (---, ---) | p : 2.18 R_o

EXTRA DATASETS: SOLIS 1083

The screenshot displays the ESA JHelioviewer SWHV interface. The main window shows a solar image of NSO-SOLIS 1083, dated 2015-04-22T16:53:02. The image is overlaid with a coordinate grid showing latitude and longitude values. The interface includes several control panels:

- Movie Controls:** Features a play button, a red REC button, and a progress bar at 20/22.
- Image Layers:** Lists layers such as Grid, Viewpoint, Timestamp, Miniview, PFSS Model, and SWEK Events. It includes a 'No difference images' dropdown, an 'Opacity' slider at 100%, a 'Sharpen' slider at 0%, a 'Gamma' slider at 1.0, and a 'Contrast' slider at 0. The color is set to 'Gray'.
- Timeline Layers:** Includes a 'SWEK Events' section.
- Space Weather Event Knowledgebase:** Contains checkboxes for 'Active Region', 'NOAA SWPC', 'SPoCA', 'Coronal Mass Ejection', and 'CACTus', with a 'Filter' button.

The main image area shows a solar disk with a coordinate grid. The grid labels include 80, 60, 40, 20, 0, -20, -40, -60, and -80 for both longitude and latitude. A small thumbnail of the solar image is visible in the top-left corner of the main view area.

At the bottom of the interface, the text '2015-04-22T16:53:02 NSO-SOLIS 1083' is displayed, along with 'Zoom: 2.43 R_o' and 'fps: 0'. The status bar at the bottom right shows '(θ, φ) : (---, ---) | p : 1.67 R_o'.

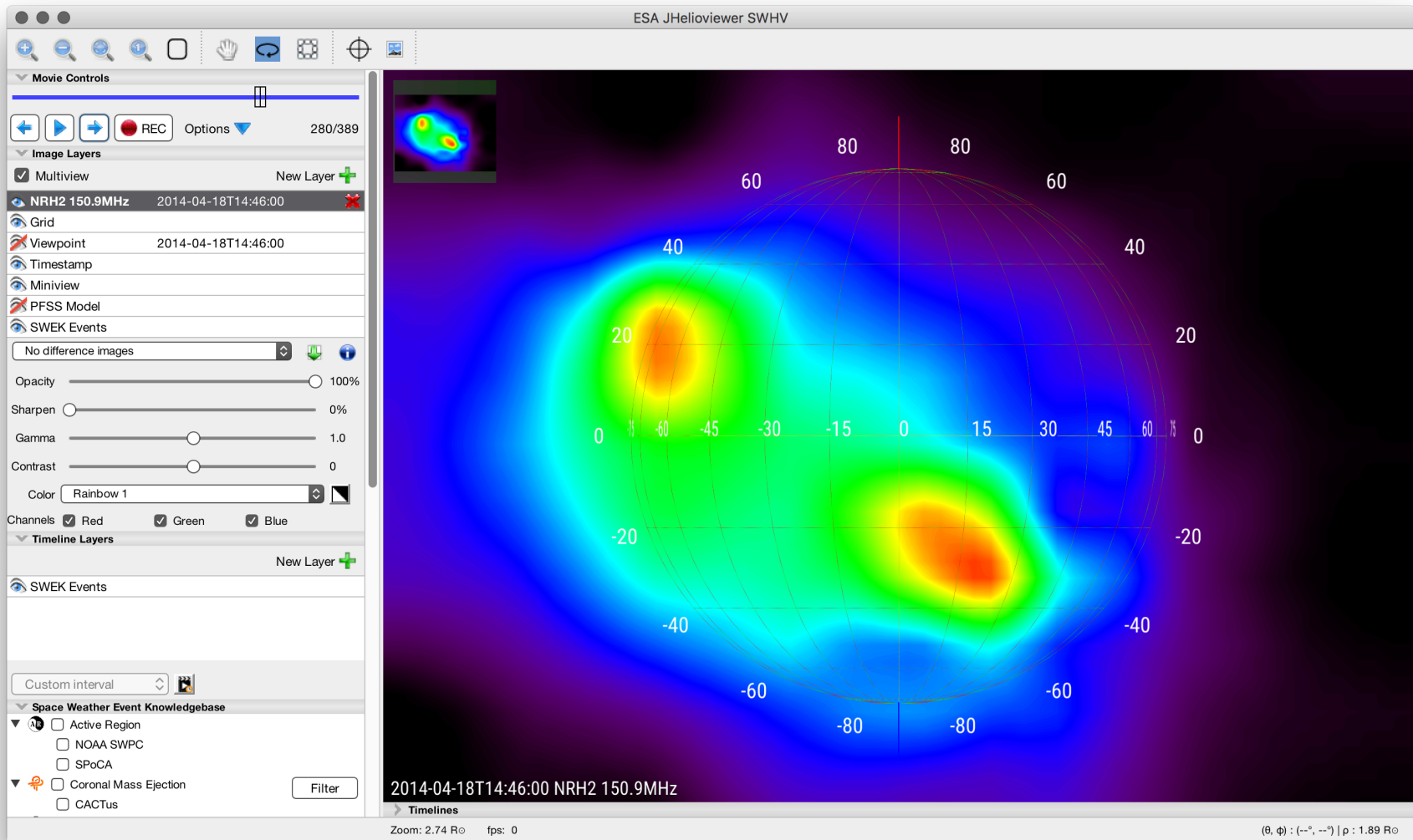
EXTRA DATASETS: SOLIS 6302

The screenshot displays the ESA JHelioviewer SWHV interface. The main window shows a solar image of NSO-SOLIS 6302, dated 2015-04-17T16:45:14. The image is overlaid with a coordinate grid, with longitude values ranging from -80 to 80 and latitude values from -40 to 40. The interface includes several control panels:

- Movie Controls:** Features playback buttons (back, play, forward), a REC button, and a progress bar at 15/22.
- Image Layers:** Lists various layers including Grid, Viewpoint, Timestamp, Miniview, PFSS Model, and SWEK Events. The main image layer is NSO-SOLIS 6302.
- Image Processing:** Includes sliders for Opacity (100%), Sharpen (0%), Gamma (1.0), and Contrast (0). A Color dropdown is set to Gray.
- Channels:** Checkboxes for Red, Green, and Blue are all checked.
- Timeline Layers:** Includes a SWEK Events layer.
- Space Weather Event Knowledgebase:** A list of event types with checkboxes: Active Region, NOAA SWPC, SPoCA, Coronal Mass Ejection, and CACTus. A Filter button is present.

At the bottom of the interface, the text "2015-04-17T16:45:14 NSO-SOLIS 6302" is displayed, along with "Timelines" and "Zoom: 2.42 R_o fps: 0". The status bar at the bottom right shows "(θ, φ) : (---, ---) | p : 1.55 R_o".

EXTRA DATASETS: NANÇAY RADIOHELIOGRAPH



EXTRA DATASETS: ROB USET H-ALPHA

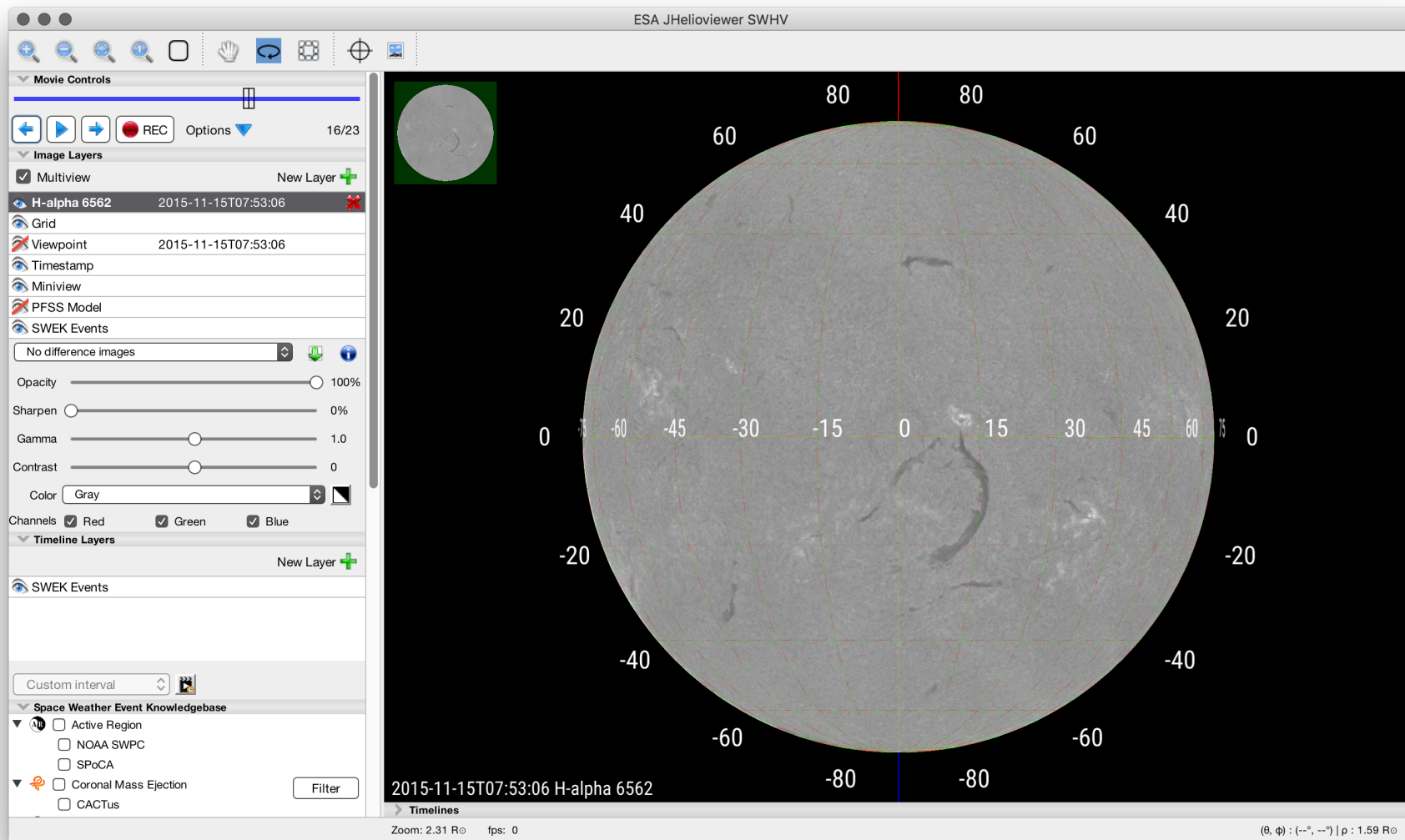
The screenshot displays the ESA JHelioviewer SWHV interface. The main window shows a grayscale H-alpha image of the Sun with a grid overlay. The grid lines are labeled with longitude values (80, 60, 40, 20, 0, -20, -40, -60, -80) and latitude values (40, 20, 0, -20, -40). The image is titled "2015-11-03T10:24:38 H-alpha 6562".

The interface includes several control panels on the left side:

- Movie Controls:** Features navigation buttons (back, play, forward), a "REC" button, "Options" dropdown, and a progress indicator at "11/34".
- Image Layers:** Lists various layers including "H-alpha 6562" (selected), "Grid", "Viewpoint", "Timestamp", "Miniview", "PFSS Model", and "SWEK Events". It also includes a "No difference images" dropdown, "Opacity" (100%), "Sharpen" (0%), "Gamma" (1.0), "Contrast" (0), and "Color" (Gray) settings.
- Timeline Layers:** Includes a "SWEK Events" layer.
- Space Weather Event Knowledgebase:** Lists various event types with checkboxes: "Active Region", "NOAA SWPC", "SPoCA", "Coronal Mass Ejection", and "CACTus". A "Filter" button is present.

The bottom status bar shows "Zoom: 2.32 R \odot fps: 0" and coordinates "(θ , ϕ): (---, ---) | p: 1.78 R \odot ".

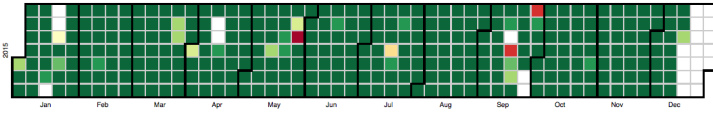
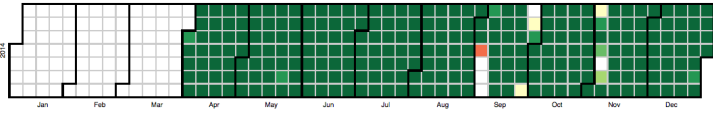
EXTRA DATASETS: KANZELHÖHE H-ALPHA



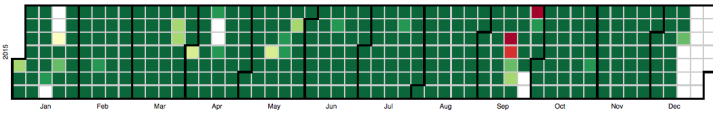
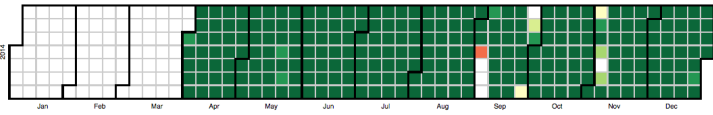
DATA AVAILABILITY

Similar for timelines and PFSS.

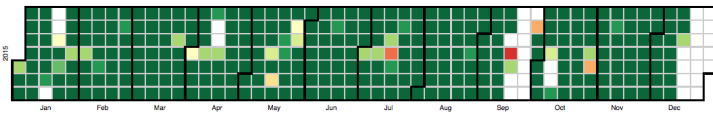
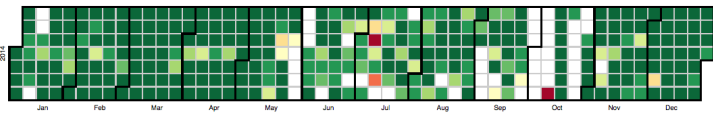
SDO AIA 171



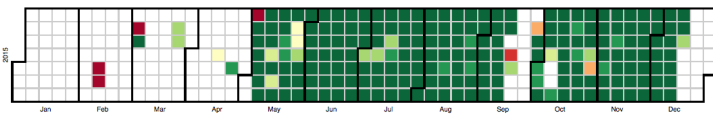
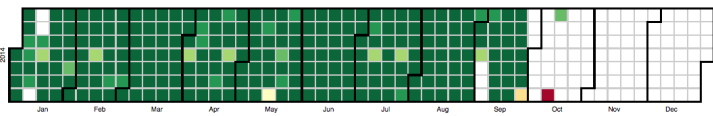
SDO AIA 304



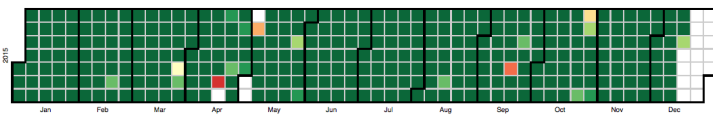
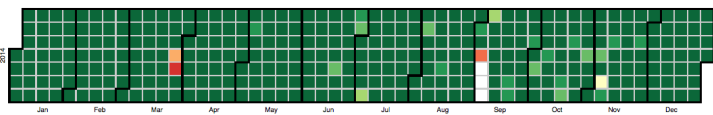
SDO HMI Int



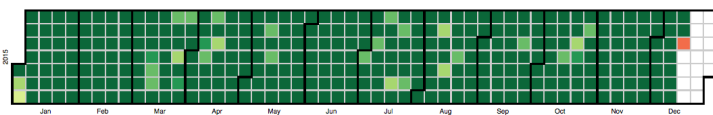
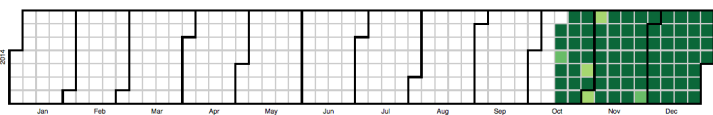
SDO HMI Mag



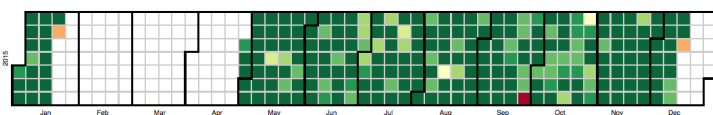
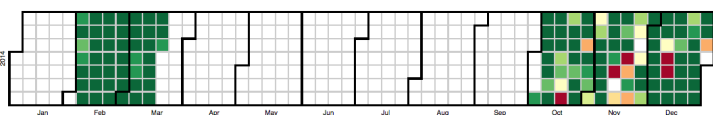
PROBA-2 SWAP 174



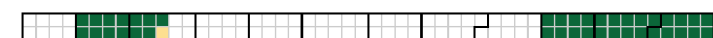
H-alpha images from the GONG/NSO network



Magnetograms from the GONG/NSO network

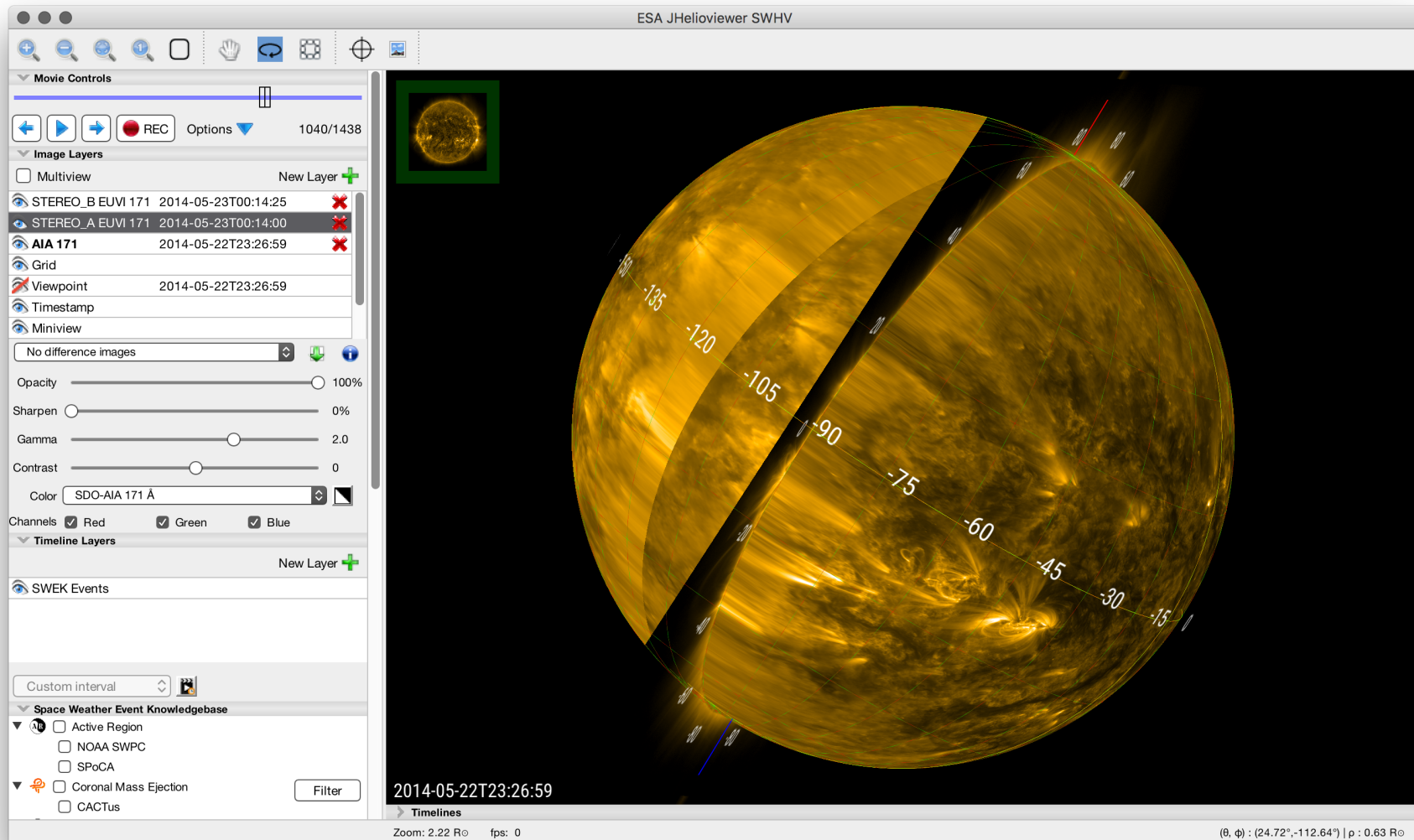


Farside images from the GONG/NSO network



COMBINED VIEW FROM DIFFERENT VANTAGE POINTS

For instance combining SDO AIA171 with EUVI171 of STEREO Ahead & Behind.



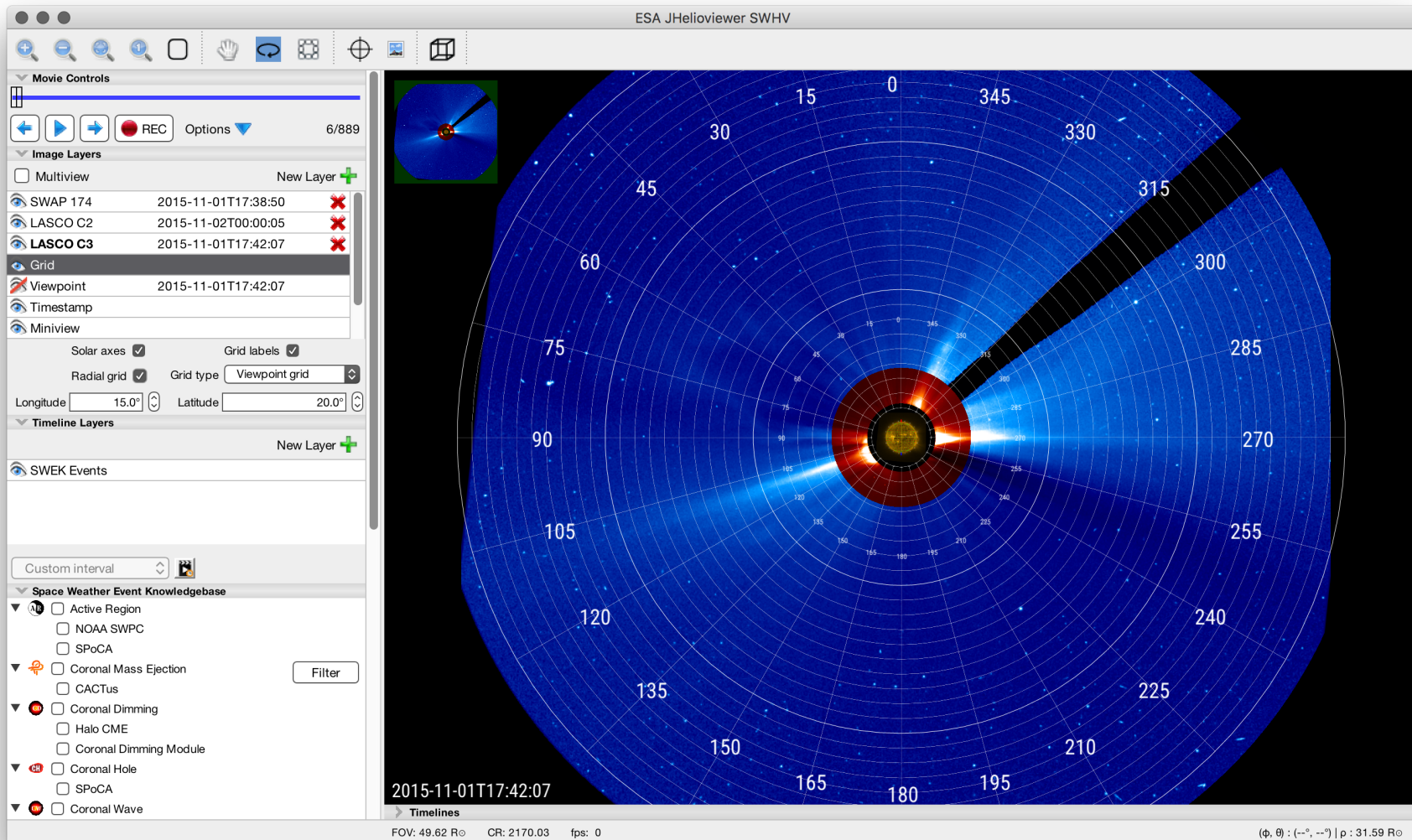
GRIDS

Viewpoint, Stonyhurst, Carrington, HCl.

The screenshot displays the ESA JHelioviewer SWHV interface. The main window shows a solar image in blue, overlaid with a grid. The grid lines are labeled with values: 40, 20, 0, -20, -40 on the vertical axis and 0, 15, 30, 45, 60, 75, 0, 15, 30, 45, 60, 75, 0 on the horizontal axis. The interface includes a toolbar at the top with various navigation and viewing tools. On the left, there are several control panels: 'Movie Controls' with a play button and 'REC' button; 'Image Layers' with a 'New Layer +' button and a list of layers including 'STEREO_A EUVI 171 2015-11-18T08:14:00', 'Grid', 'Viewpoint', 'Timestamp', 'Miniview', 'PFSS Model', and 'SWEK Events'; and 'Timeline Layers' with a 'New Layer +' button and 'SWEK Events'. At the bottom left, there is a 'Space Weather Event Knowledgebase' section with checkboxes for 'Active Region', 'NOAA SWPC', 'SPoCA', 'Coronal Mass Ejection', and 'CACTus', along with a 'Filter' button. The bottom status bar shows 'FOV: 1.80 R_o CR: 2170.64 fps: 0' and '(φ, θ) : (---, ---) | p : 1.27 R_o'.

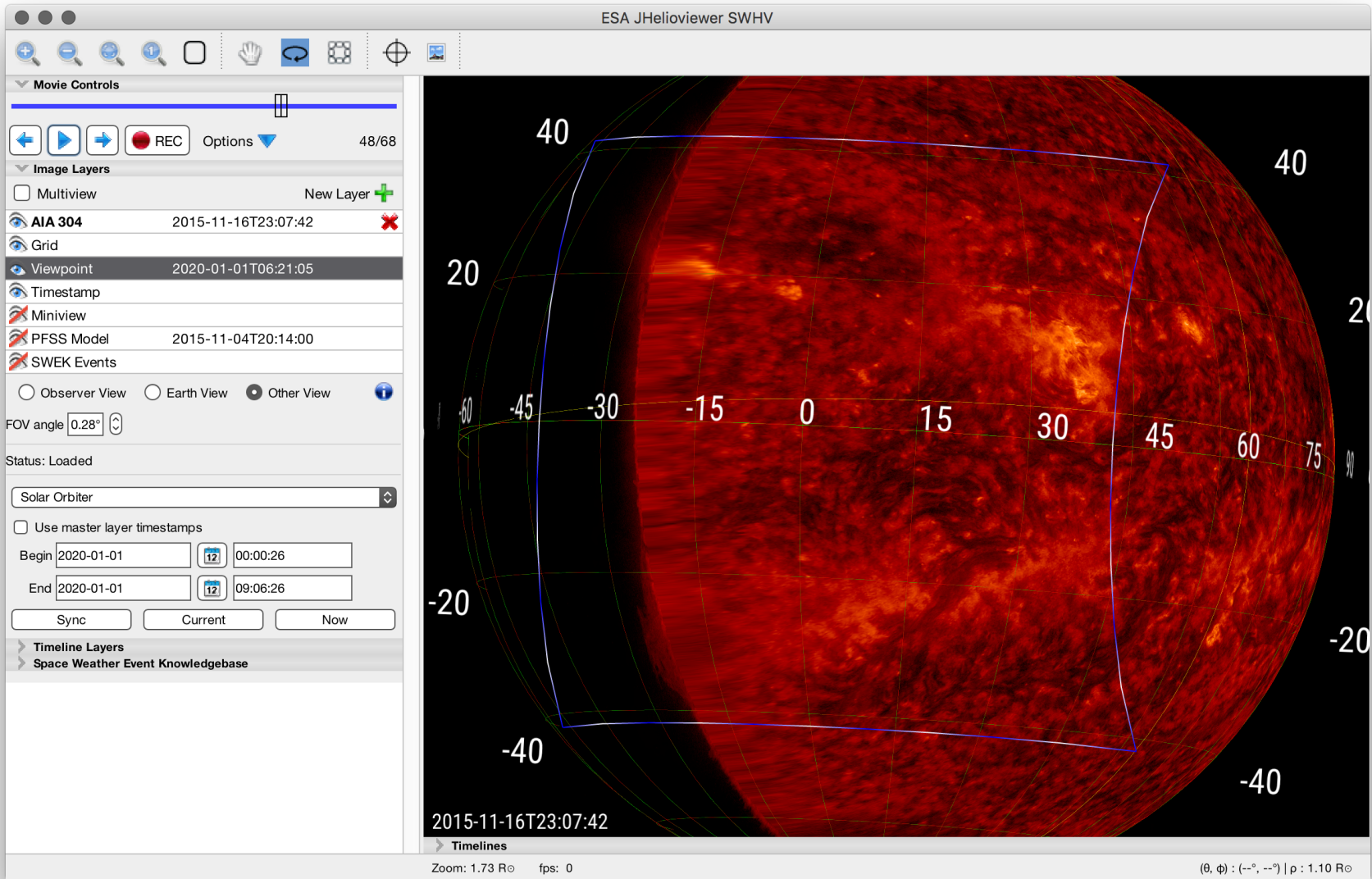
CORONAGRAPH IMAGES

With optional radial grid.



DIFFERENT VIEWPOINTS WITH ACCURATE POSITIONING

Example view as from Solar Orbiter EUV/HRI using data from current instruments.



RUNNING AND BASE DIFFERENCES

ESA JHelioviewer SWHV

Movie Controls
3/1219

Image Layers

- Multiview New Layer +
- AIA 171 2015-11-01T00:10:22
- Grid
- Viewpoint 2015-11-01T00:40:58
- Timestamp
- Miniview
- PFSS Model 2015-11-04T20:14:00
- SWEK Events

Running difference

Rotation correction Contrast boost 80%

Opacity 100%

Sharpen 0%

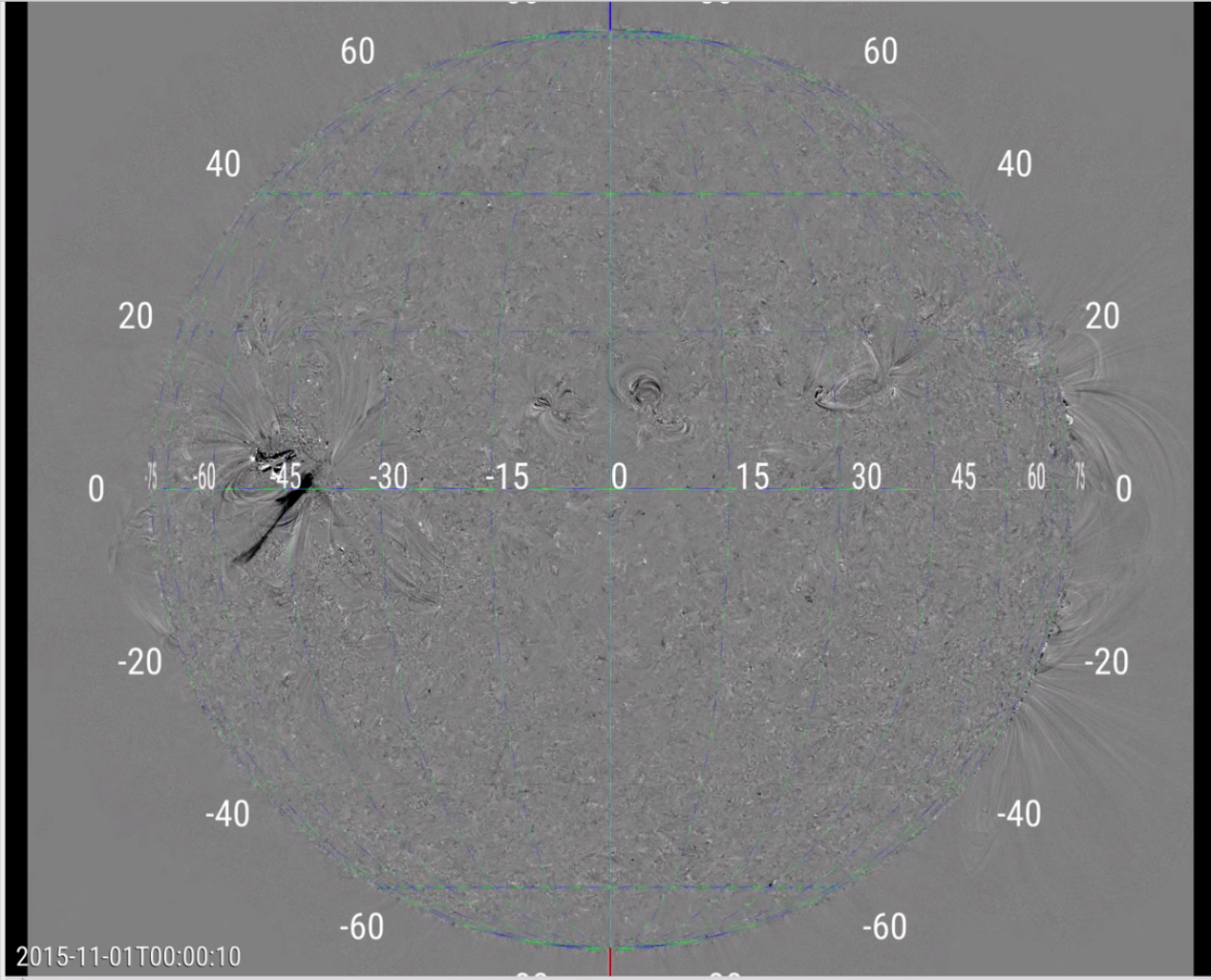
Gamma 1.0

Contrast 0

Color SDO-AIA 171 Å

Channels Red Green Blue

Timeline Layers
Space Weather Event Knowledgebase



2015-11-01T00:00:10

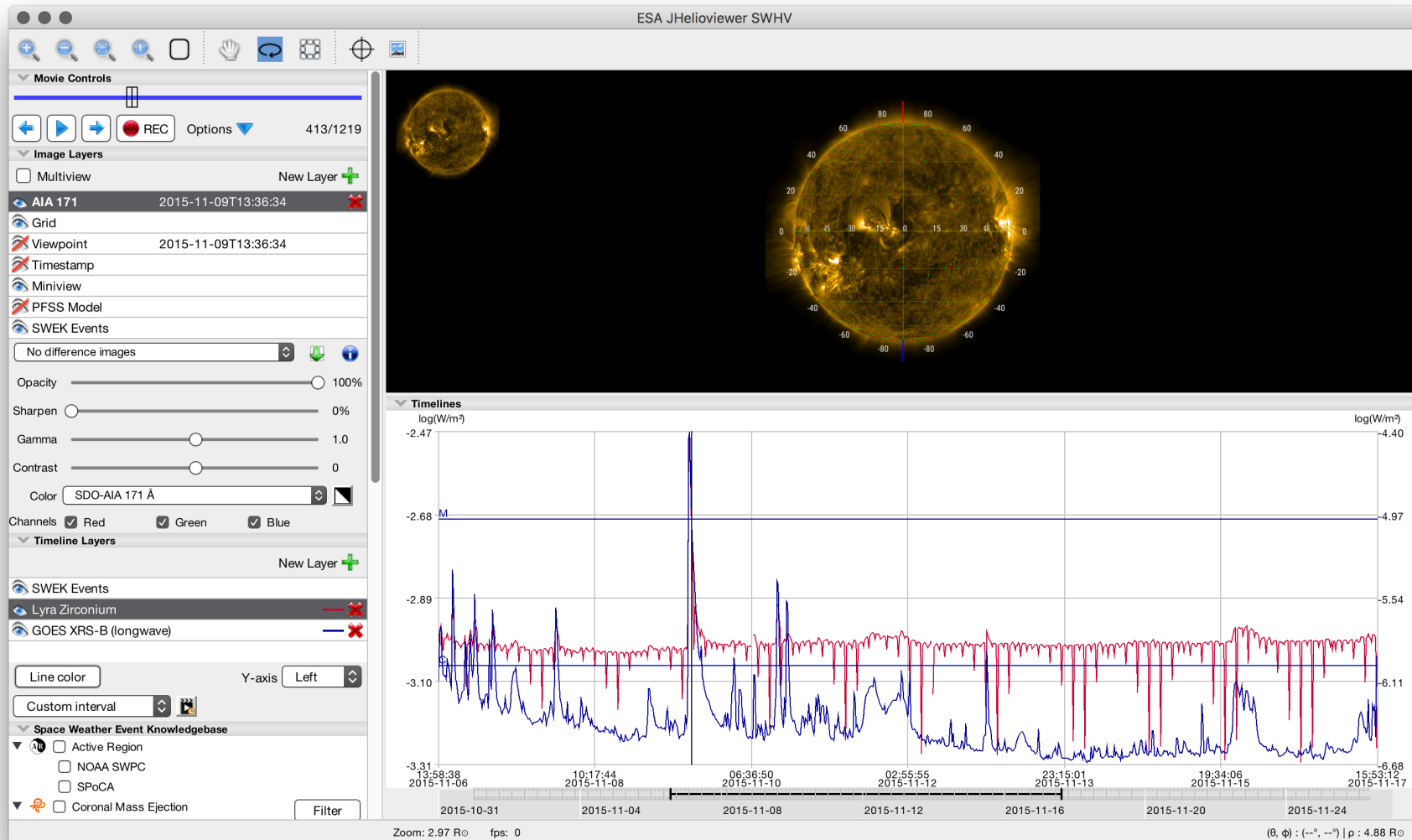
Timelines

Zoom: 2.12 R_o fps: 0

(θ , ϕ) : (---, ---) | ρ : 1.11 R_o

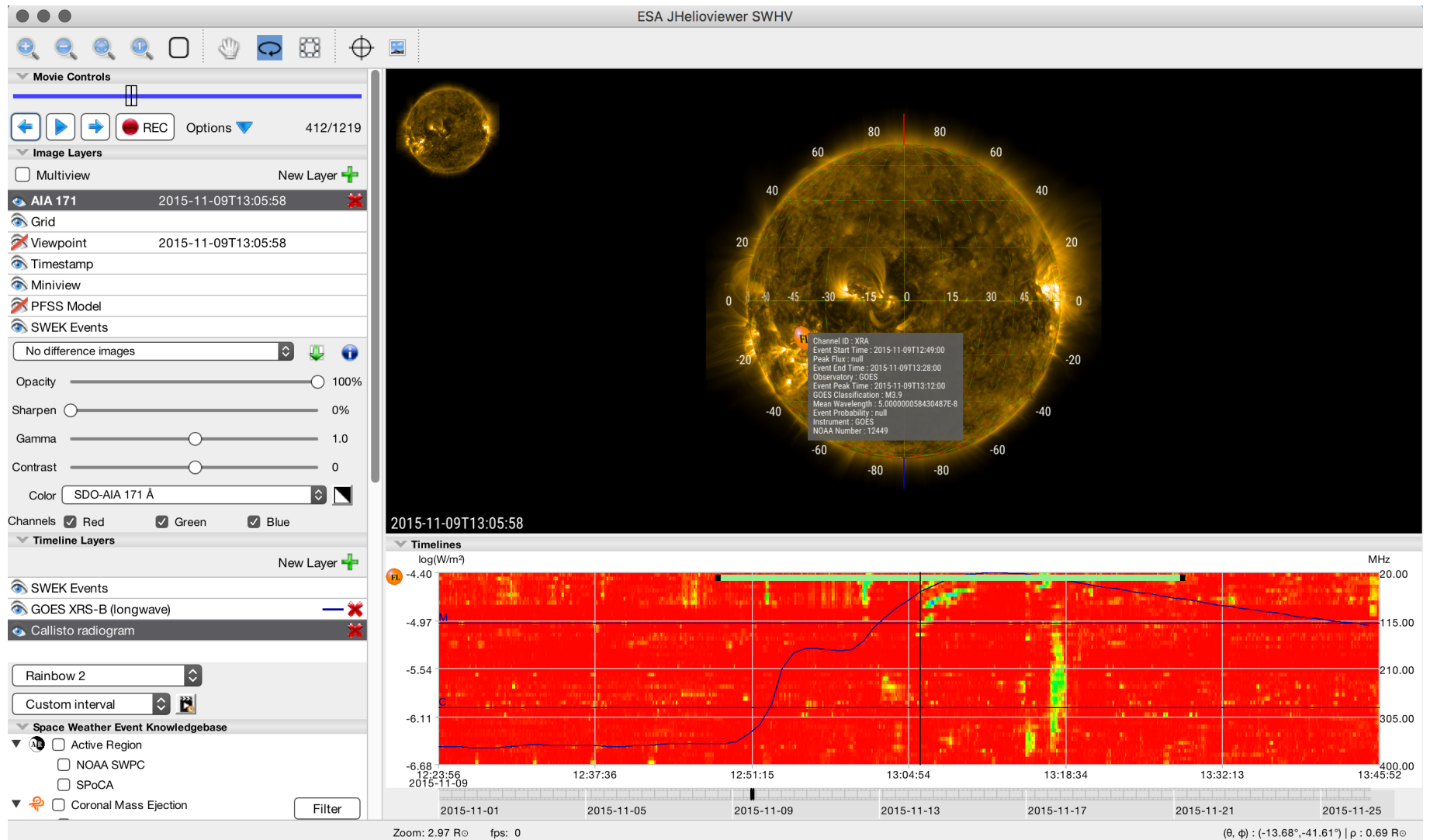
TIMELINES

Display of various timelines, with indicator of the time of the current image.



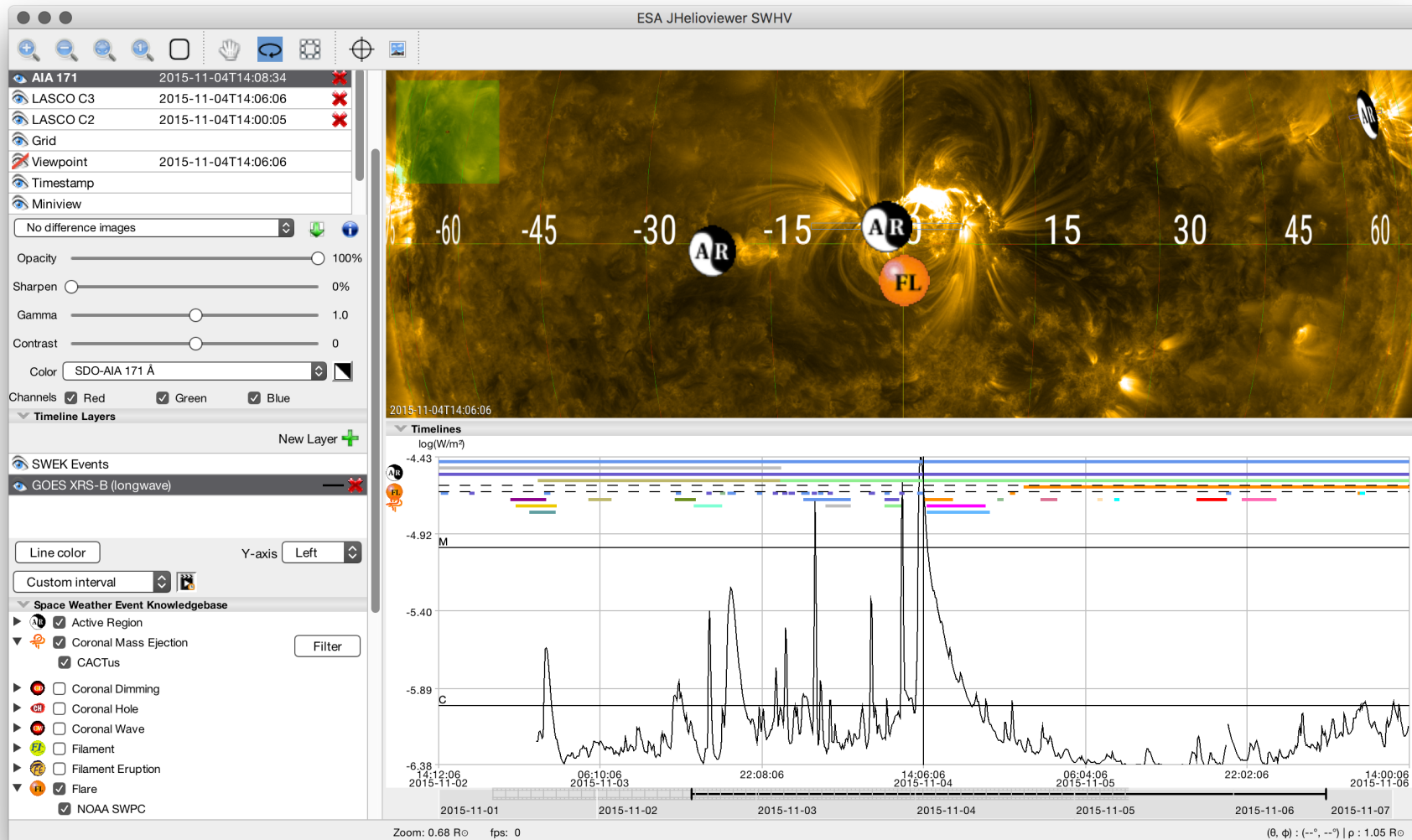
TIMELINES

Callisto radiograms



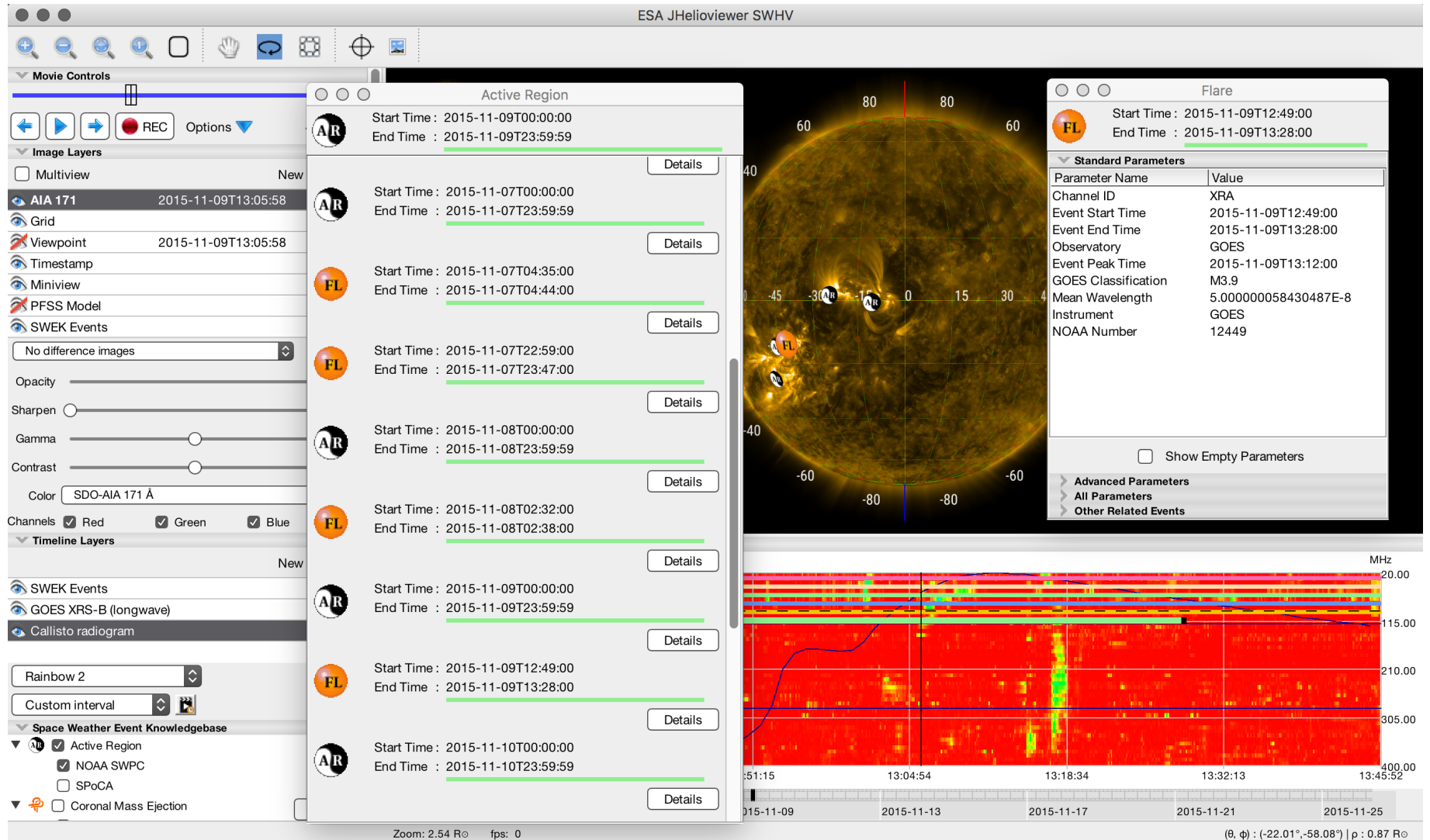
EVENTS

Curated HEK and COMESEP events



EVENTS

Details of event parameters; relationships between events



EVENTS

Off-disk events

ESA JHelioviewer SWHV

15/17

Image Layers

- Multiview New Layer +
- AIA 171 2015-11-04T20:08:58
- LASCO C3** 2015-11-04T20:06:06
- LASCO C2** 2015-11-04T20:00:05
- Grid
- Viewpoint 2015-11-04T20:06:06
- Timestamp
- Miniview

No difference images

Opacity 100%

Sharpen 0%

Gamma 1.0

Contrast 0

Color Red Temperature

Channels Red Green Blue

Timeline Layers

SWEK Events

Custom interval

Space Weather Event Knowledgebase

- Active Region
- NOAA SWPC
- SPoCA
- Coronal Mass Ejection
- CACTus
- Coronal Dimming
- Halo CME

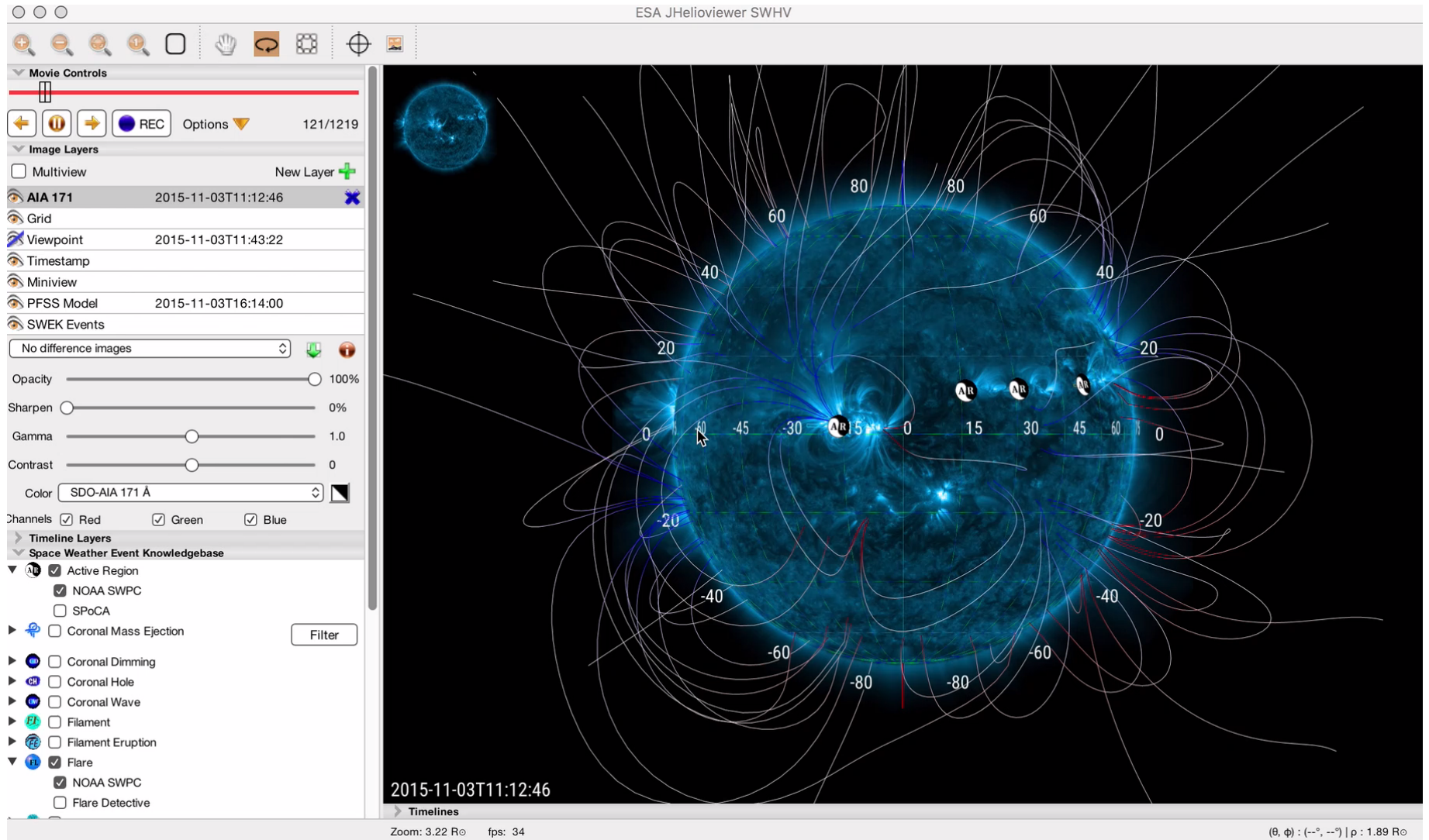
2015-11-04T

Zoom: 12.82 R \odot fps: 0

(θ, ϕ) : (---, ---) | p : 7.79 R \odot

Observatory : LASCO
Acceleration Uncertainty : null
Radial Linear Velocity Standard Deviation : 81
Acceleration : null
Event Probability : null
Instrument : c2 c3
NOAA Number : null
Maximum Radial Linear Velocity : 381
Radial Linear Velocity Uncertainty : 18.299999237060547
Channel ID : C2 orange filter, C3 clear filter
Event Start Time : 2015-11-04T14:24:05
Event End Time : 2015-11-04T20:36:05
Minimum Radial Linear Velocity : 101
Mass : null
Mean Wavelength : 5.999999848427251E-5
Radial Linear Velocity : 183

MAGNETIC FIELD LINES EXTRAPOLATIONS



CO-ROTATING ANNOTATIONS

ESA JHelioviewer SWHV

Movie Controls
← → REC Options 1/1219

Image Layers
Multiview New Layer +
AIA 171 2015-11-01T00:00:10
Grid
Viewpoint 2015-11-01T00:00:10
Timestamp
Miniview
PFSS Model 2015-11-04T20:14:00
SWEK Events

No difference images
Opacity 100%
Sharpen 0%
Gamma 1.0
Contrast 0
Color SDO-AIA 171 Å

Channels Red Green Blue

Timeline Layers
Space Weather Event Knowledgebase
Active Region
NOAA SWPC
SPoCA
Coronal Mass Ejection
Coronal Dimming
Coronal Hole
Coronal Wave
Filament
Filament Eruption
Flare

2015-11-01T00:00:10

Zoom: 2.54 R_☉ fps: 0

(θ, φ) : (°, °) | p : 1.52 R_☉

MULTIVIEW MODE

ESA JHelioviewer SWHV

Movie Controls
1/68

Image Layers

- Multiview New Layer +
- AIA 171 2015-11-16T00:00:22
- AIA 304 2015-11-16T00:00:18
- HMI continuum 2015-11-16T00:00:26
- HMI magnetogram** 2015-11-16T00:00:26
- Grid
- Viewpoint 2015-11-16T00:00:26
- Timestamp

No difference images

Opacity 100%

Sharpen 0%

Gamma 1.0

Contrast 0

Color Gray

Channels Red Green Blue

Timeline Layers

- Space Weather Event Knowledgebase

2015-11-16T00:00:22 AIA 171

2015-11-16T00:00:18 AIA 304

2015-11-16T00:00:26 HMI continuum

2015-11-16T00:00:26 HMI magnetogram

Timelines

Zoom: 0.51 R_☉ fps: 0

(θ, ϕ) : (27.91°, -47.93°) | ρ : 0.49 R_☉

PROJECTIONS: LATITUDINAL

ESA JHelioviewer SWHV

Movie Controls

← → REC Options 1/1000

Image Layers

- Multiview New Layer +
- SWAP 174** 2015-11-01T14:00:37 X
- Grid
- Viewpoint 2015-11-01T14:00:37
- Timestamp
- Miniview
- PFSS Model
- SWEK Events

No difference images

Opacity 100%

Sharpen 0%

Gamma 1.0

Contrast 0

Color SDO-AIA 171 Å

Channels Red Green Blue

Timeline Layers

New Layer +

SWEK Events

Custom interval

Space Weather Event Knowledgebase

- Active Region
 - NOAA SWPC
 - SPoCA
- Coronal Mass Ejection
 - CACTus

Filter

Timelines

FOV: 1.00 R CR: 2170.03 fps: 0 (φ, θ): (11.38°, 101.75°)

PROJECTIONS: POLAR

ESA JHelioviewer SWHV

Movie Controls
1/1000

Image Layers
+ New Layer

<input checked="" type="checkbox"/>	SWAP 174	2015-11-01T14:00:37	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	LASCO C2	2015-11-02T00:00:05	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	LASCO C3	2015-11-01T14:06:05	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Grid		
<input checked="" type="checkbox"/>	Viewpoint	2015-11-01T14:00:37	
<input checked="" type="checkbox"/>	Timestamp		
<input checked="" type="checkbox"/>	Miniview		

No difference images

Opacity 100%
Sharpen 0%
Gamma 1.0
Contrast 0

Color: SDO-AIA 171 Å

Channels Red Green Blue

Timeline Layers
+ New Layer

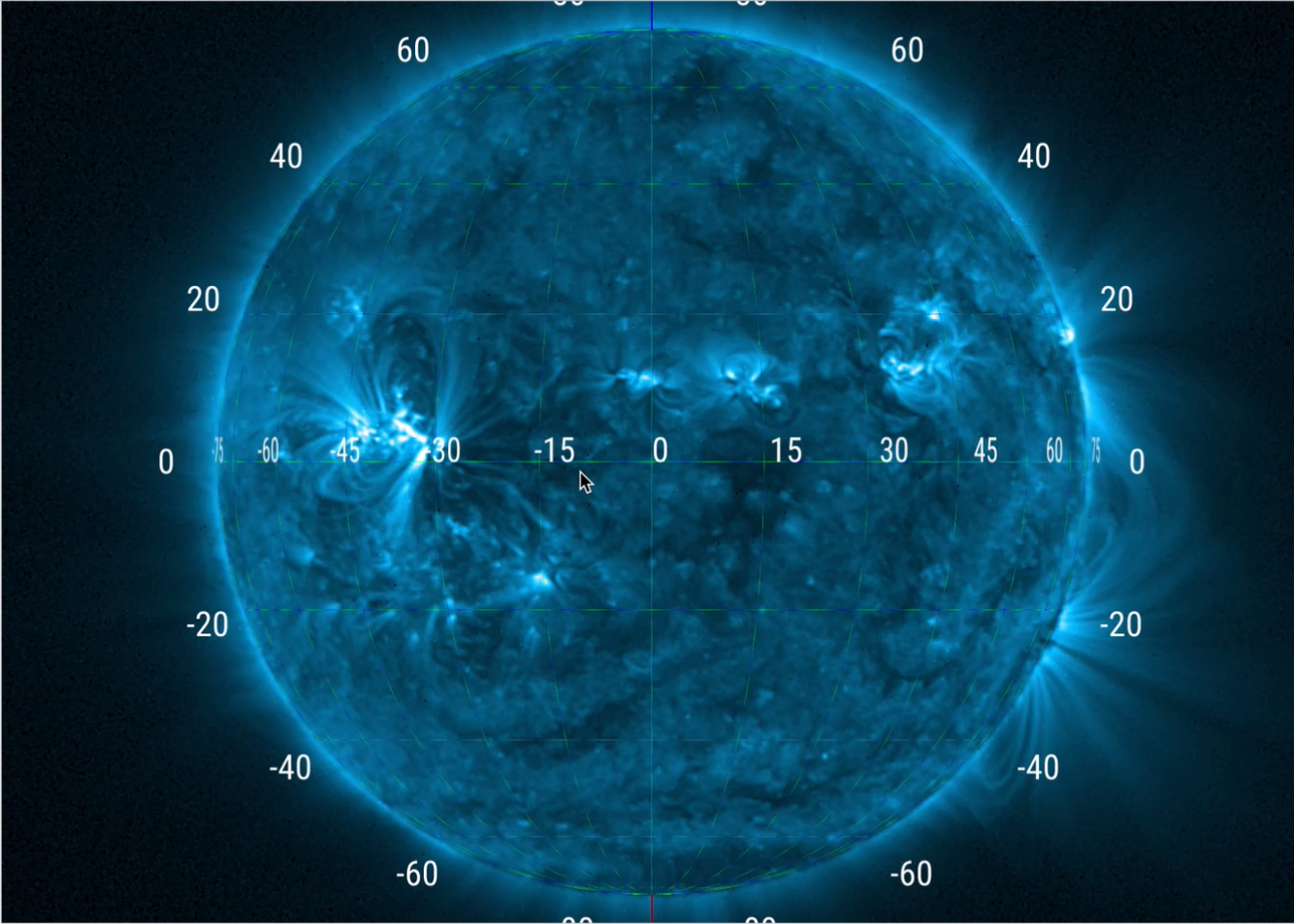
SWEK Events

Custom interval

Space Weather Event Knowledgebase

- Active Region
 - NOAA SWPC
 - SPoCA
- Coronal Mass Ejection
 - CACTus

Filter



Timelines
FOV: 2.13 R_☉ CR: 2170.03 fps: 0 (φ, θ) : (-8.39°, -1.46°) | p : 0.15 R_☉

STATUS

- All project requirements have been implemented and many more in addition.
- CCN till May 2016 to implement extra features and deliverables.
- Transitioning to advertisement and dissemination to all interested public.
- Download: http://swhv.oma.be/swhv_releasev2.9/
- Manual: http://swhv.oma.be/user_manual/