

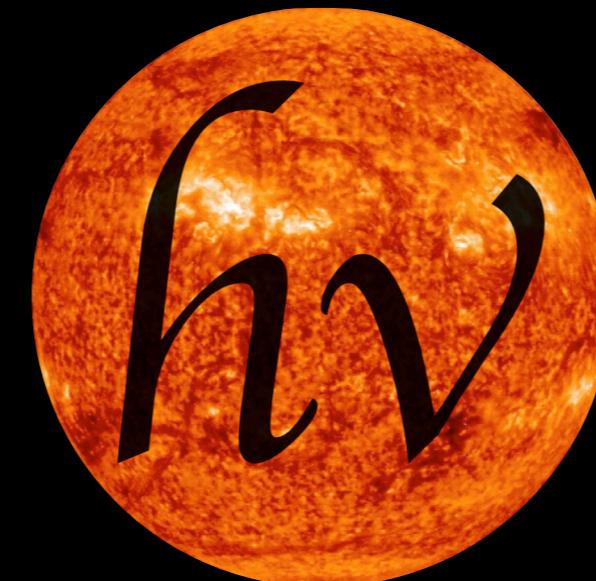
JHelioviewer

A Novel Approach to Discovery and Image Access
in the Petabyte Age

Daniel Müller

for the Helioviewer Team

European Space Agency c/o NASA GSFC



JHelioviewer

A Novel Approach to Discovery and Image Access in the Petabyte Age

Daniel Müller

Ludwig Schmidt

V. Keith Hughitt

Markus Langenberg

George Dimitoglou

Jack Ireland

Stephan Pagel

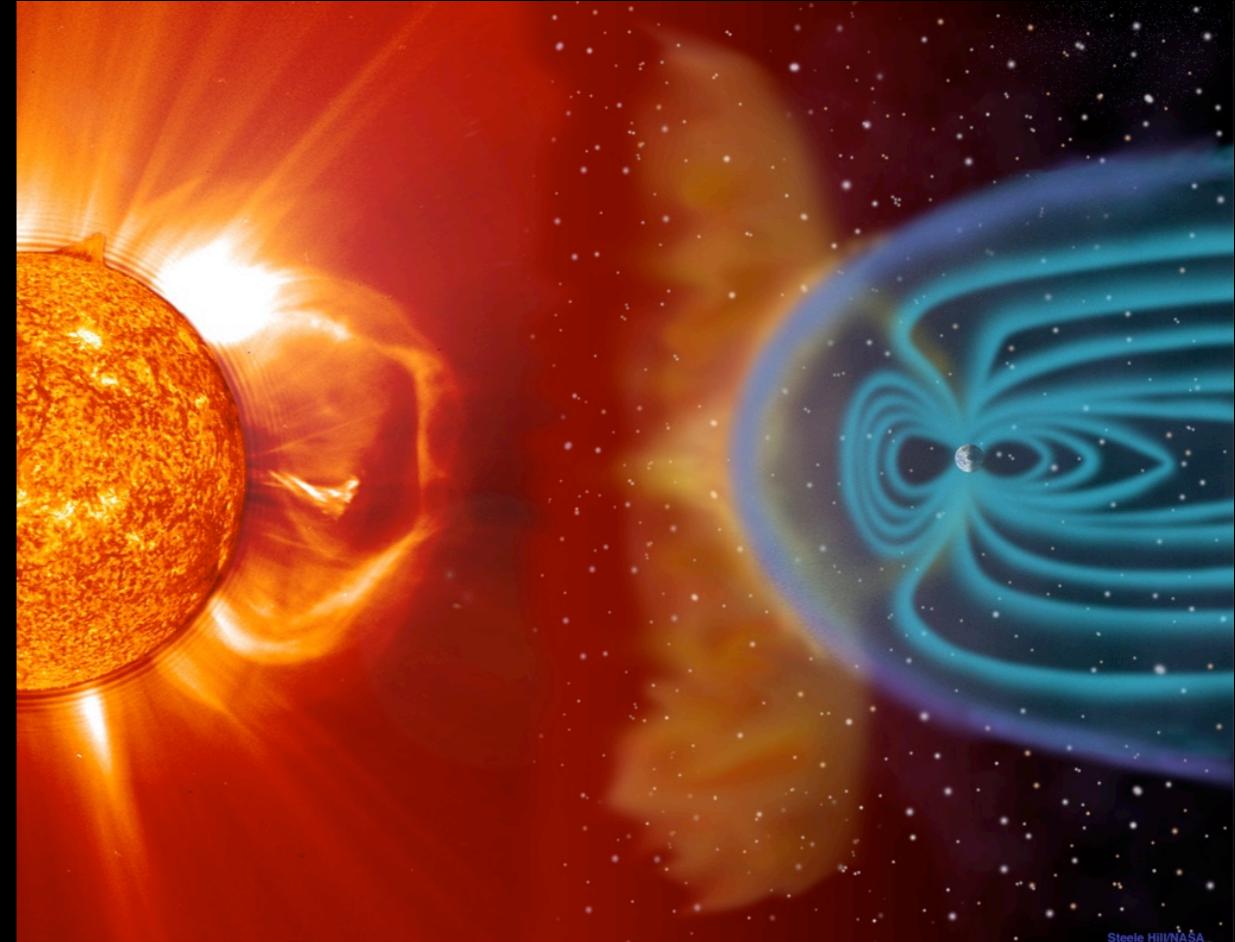
Juan Pablo García Ortiz

Bernhard Fleck

The Helioviewer Project

Motivation

- Space missions generate huge amount of data:
 - SOHO: ~0.2 Gbyte/day
 - SDO: ~1.4 Tbyte/day
- Large range of physical length-scales
- Many different data products available

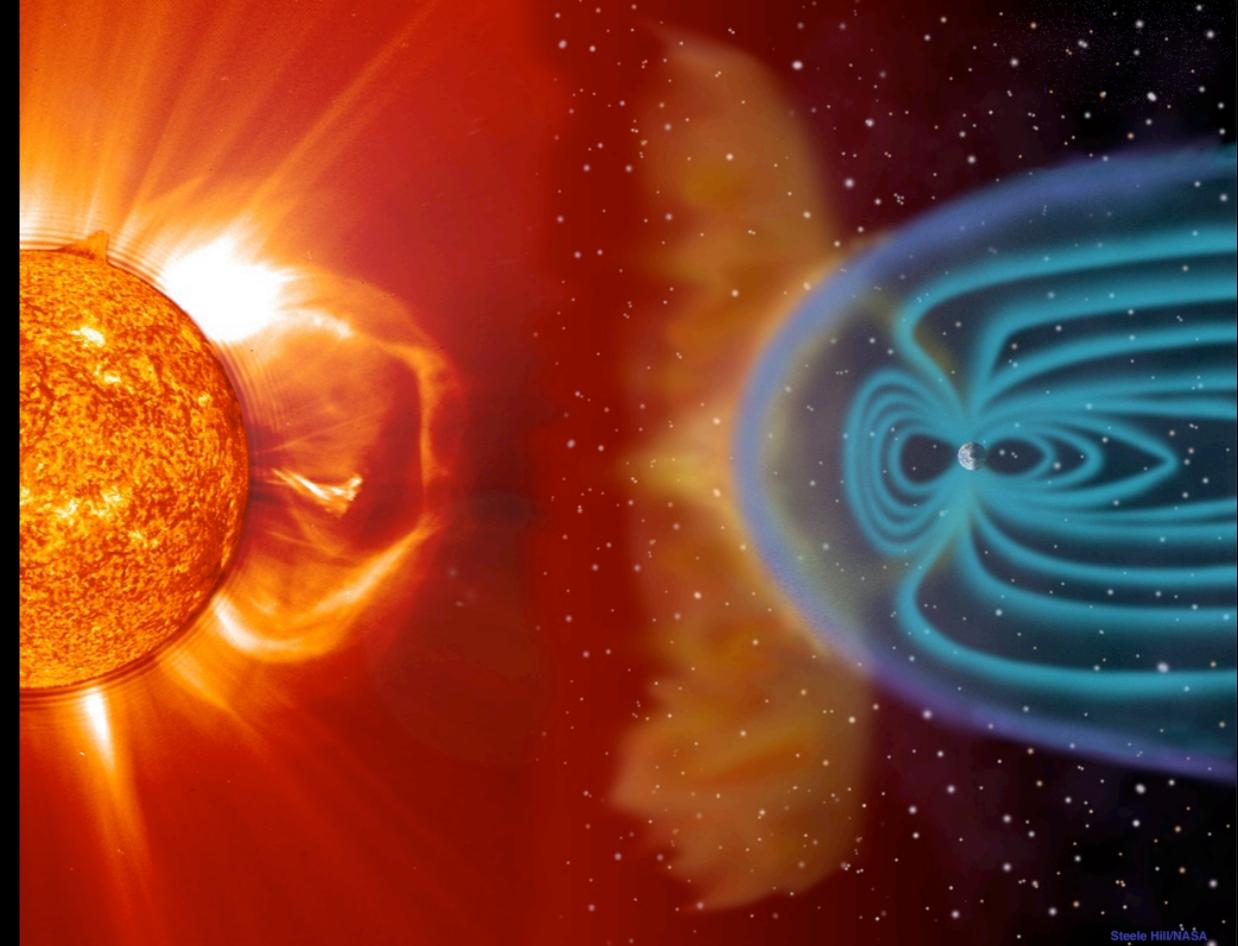


Steele Hill/NASA

The Helioviewer Project

Motivation

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Goals

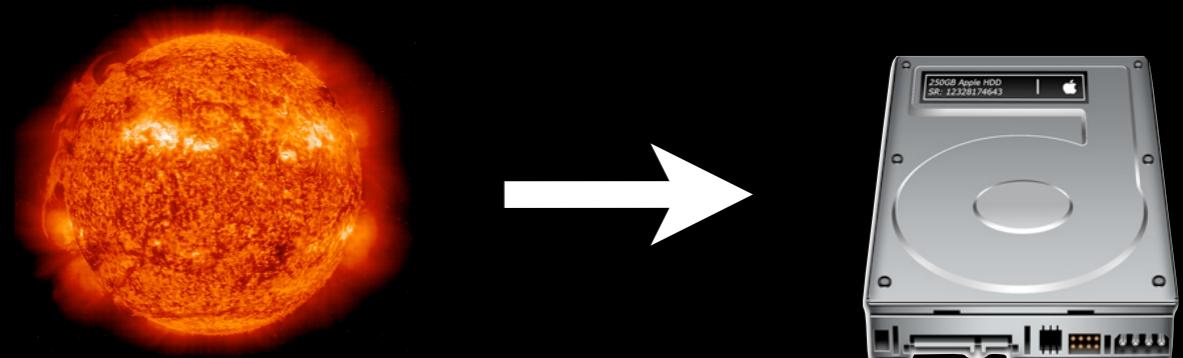
- Create discovery infrastructure by
 - Enabling efficient data browsing and visualization
 - Linking data to knowledge bases and automated feature recognition algorithms

Solar Dynamics Observatory

SDO will take 16MP images in 10 channels, every 10 sec, 24/7

Challenges:

- Data access & distribution
- Search
- Visualization



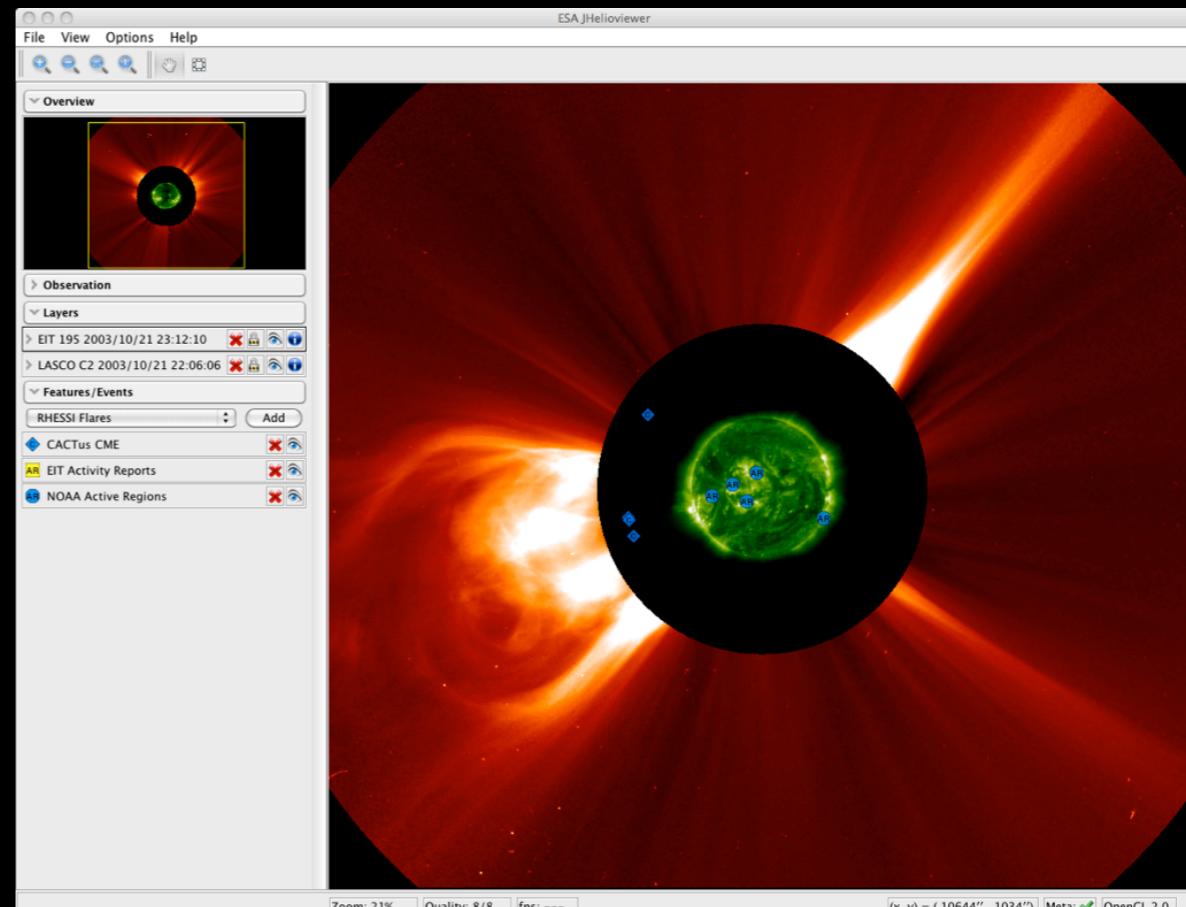
Solution:

- With JPEG 2000: Can compress 4k × 4k image to 1 MB
- 10 channels at 30 sec cadence → 29 GB/day = 10.6 TB/year
- Can keep comprehensive data set of browse data online for entire mission (science data: only few months)

JHelioviewer

What is JHelioviewer?

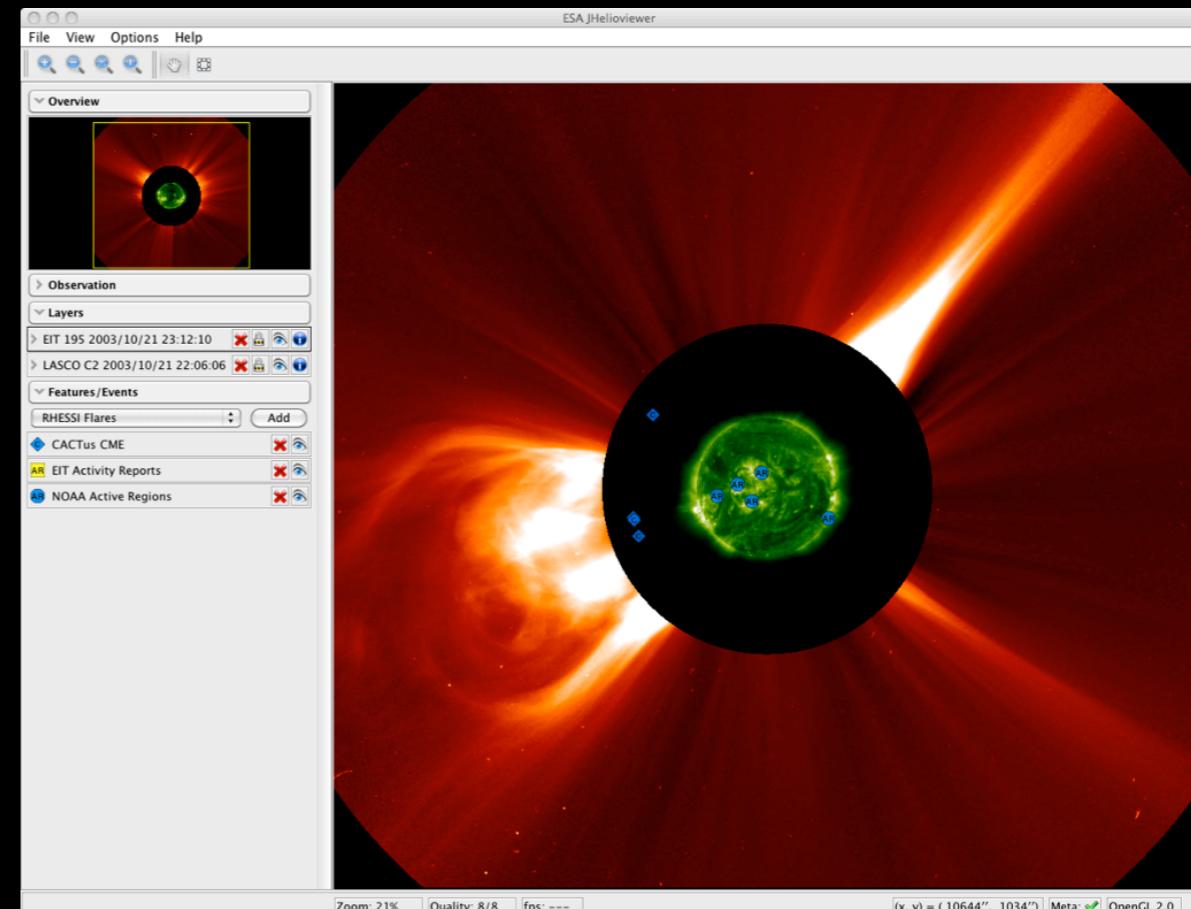
- Client-server solution for browsing large data volumes, using
 - JPEG 2000 compression
 - JPIP for interactive streaming
 - OpenGL for fast rendering



JHelioviewer

What is JHelioviewer?

- Client-server solution for browsing large data volumes, using
 - JPEG 2000 compression
 - JPIP for interactive streaming
 - OpenGL for fast rendering



What can JHelioviewer do for you?

- Interactively generate, play and overlay high-res movies with arbitrary cadence
- Perform image processing on-the-fly
- Connect to event databases, request science data

What is JPEG 2000?

JPEG 2000 = new wavelet-based compression standard

Advantages:

- **Multiple resolutions**

[Images at different resolutions are automatically created during wavelet compression process]

- **Random image access**

[Selected parts + quality layers can be accessed remotely]

- **Flexible file format** [can add metadata]

- **Well-suited for archives**

[offers lossless mode, “Compress once, decompress many ways”]

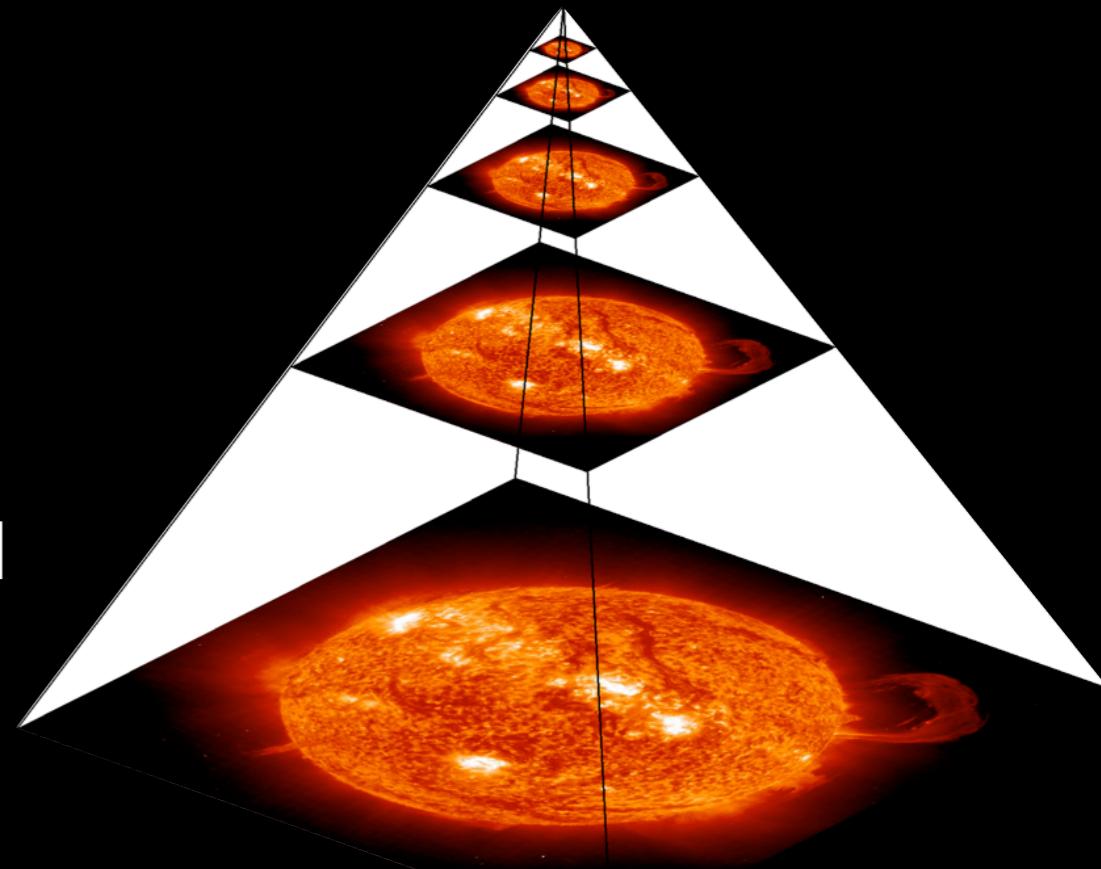
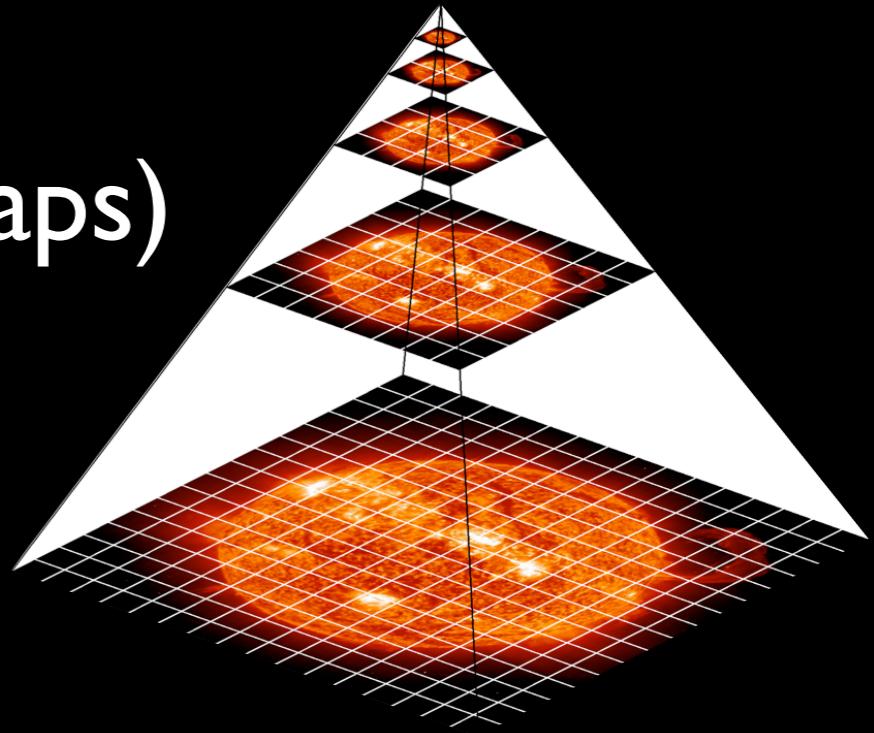


Image Tiling vs. Wavelet Compression

- **Tile-based approach (e.g. Google Maps)**

- + easy to render in web browser
- need to transfer redundant data when zooming
- overhead of data volume and number of files
- metadata must be stored separately



- **Wavelet approach (JPEG 2000)**

- + no data overhead
- + added functionality (movies, remote access, metadata)
- not yet supported by all web browsers

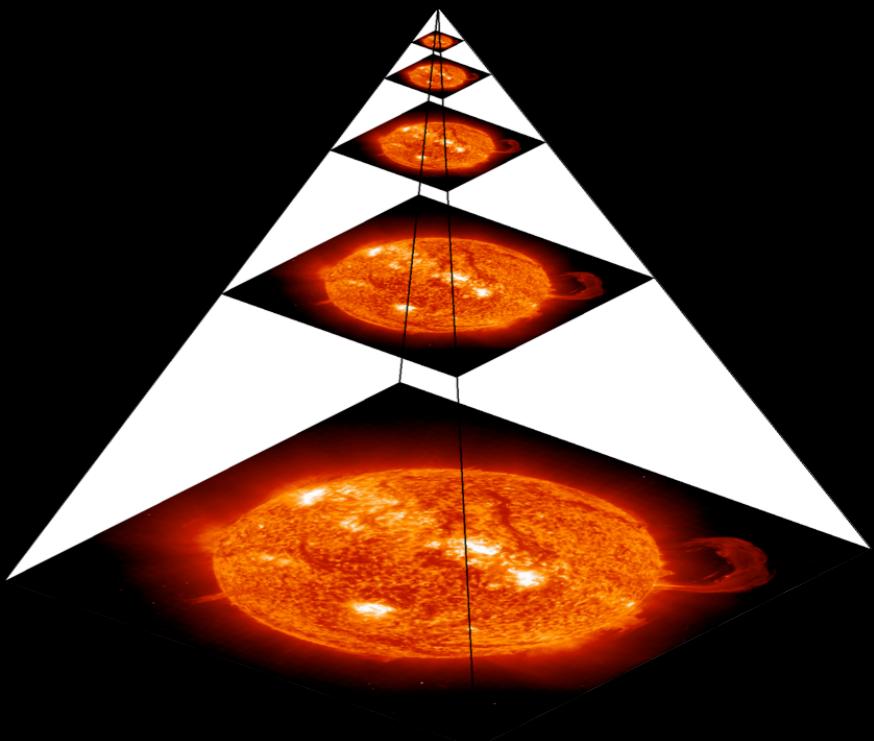


Image Tiling vs. Wavelet Compression - Example

4096^2 px image
 256^2 px tiles

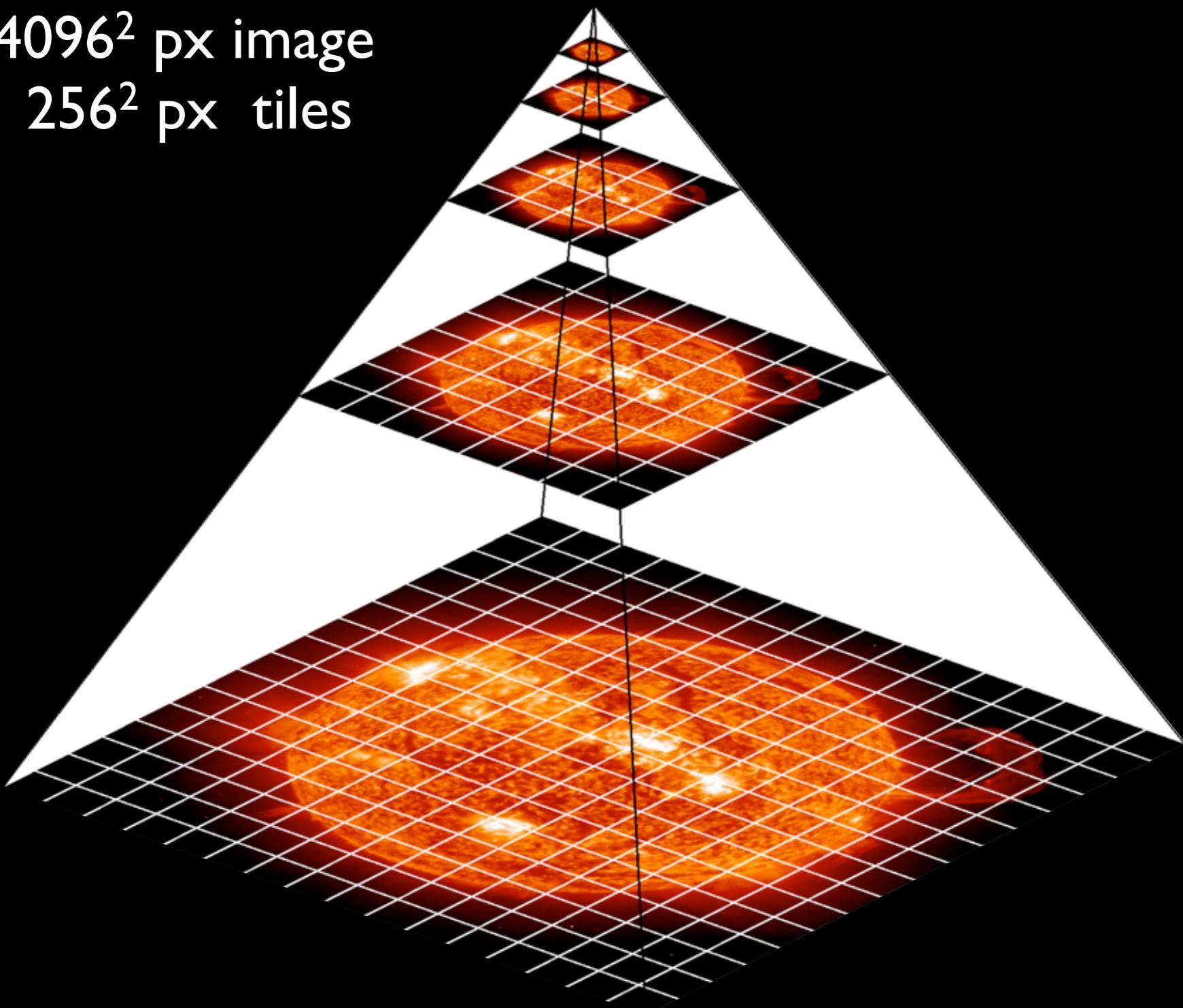


Image Tiling vs. Wavelet Compression - Example

4096^2 px image
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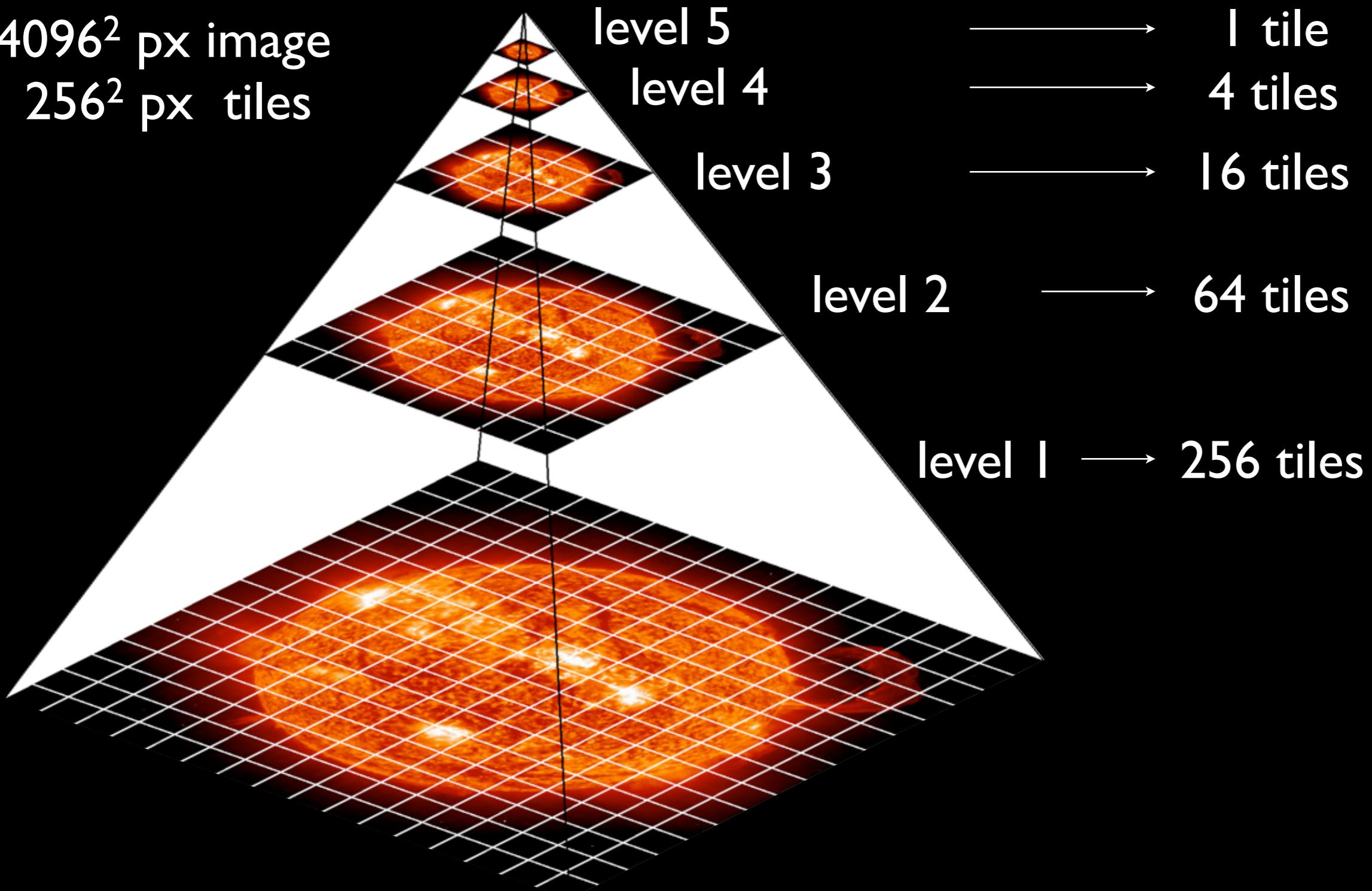
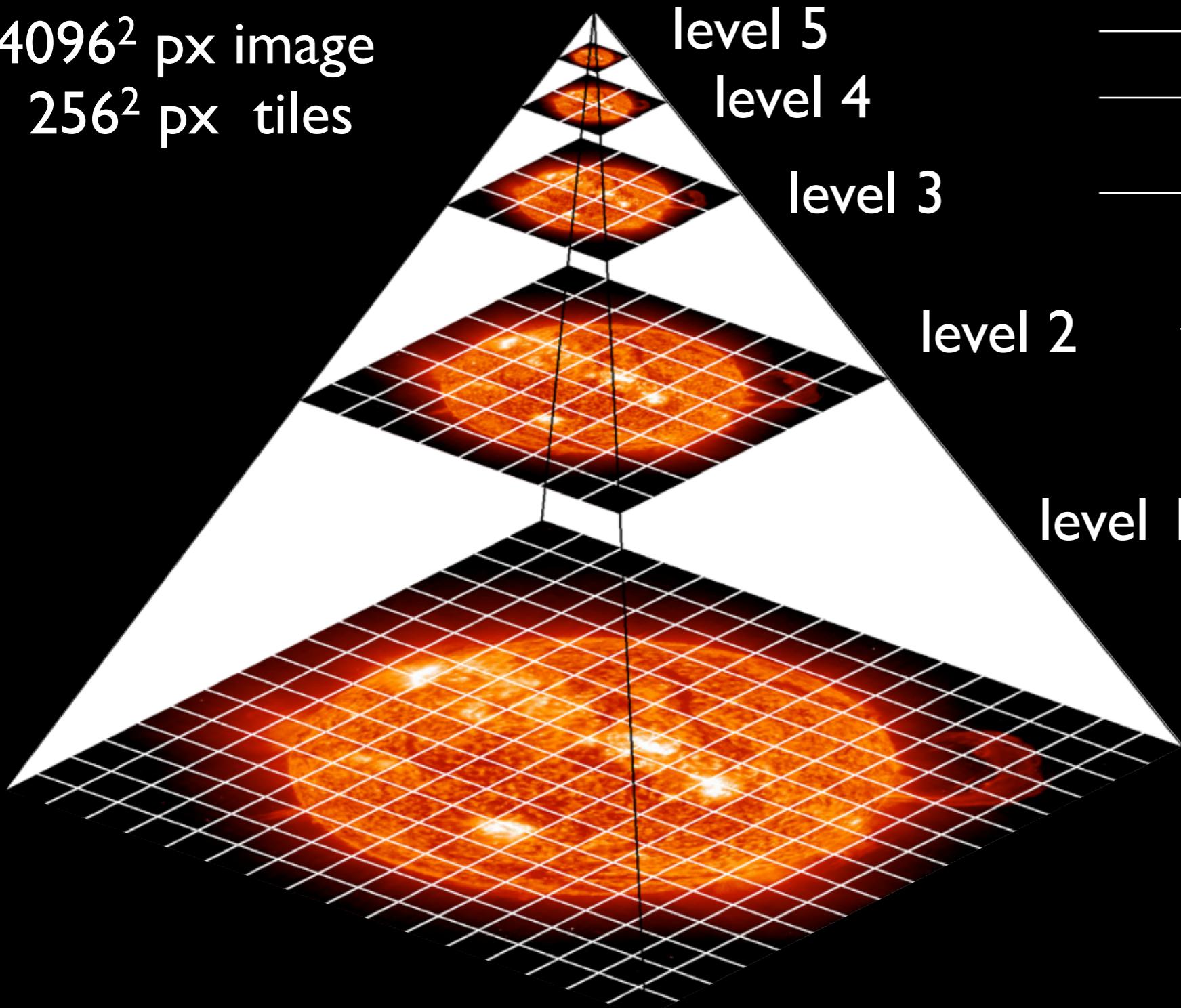


Image Tiling vs. Wavelet Compression - Example

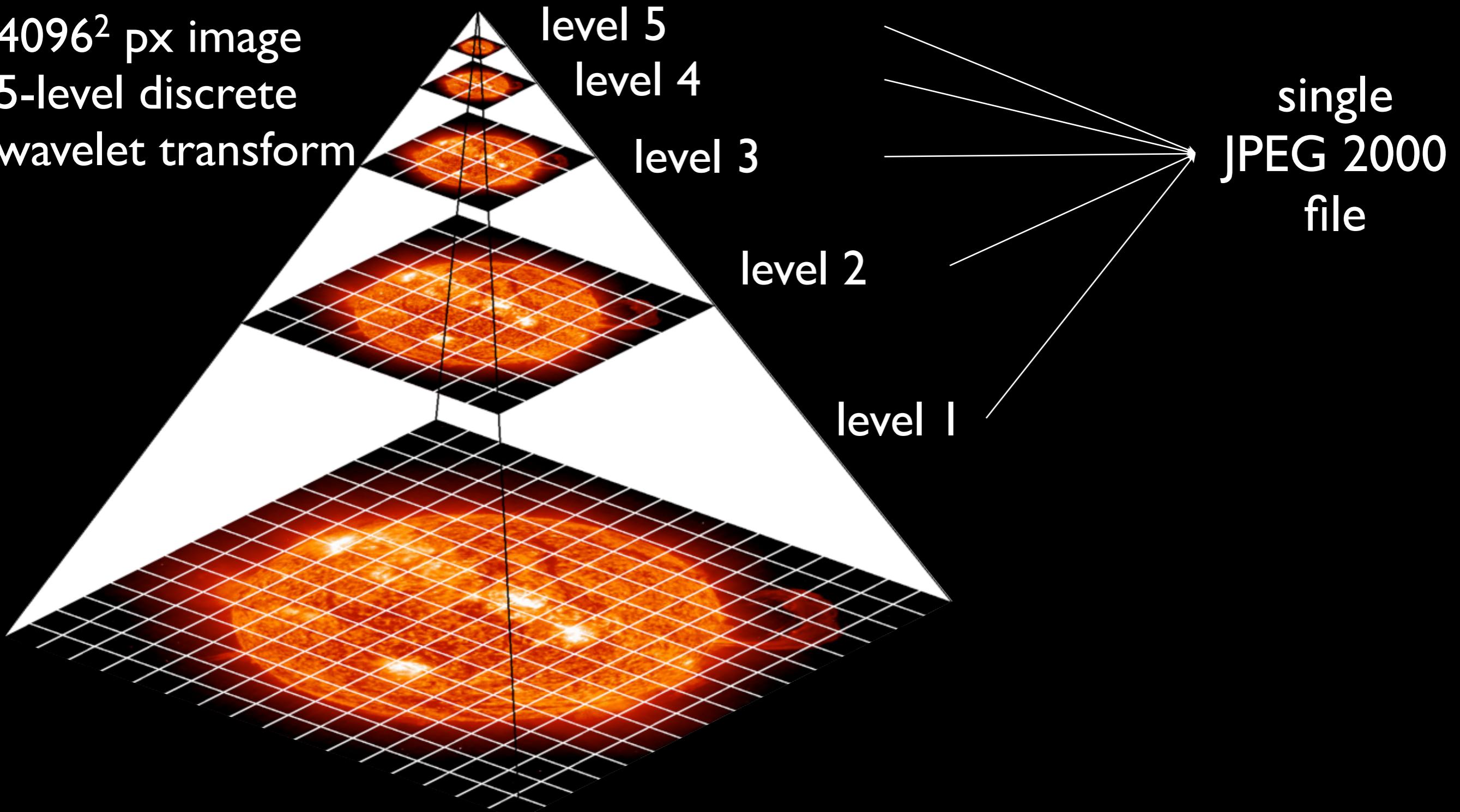
4096^2 px image
 256^2 px tiles



level 5	→ 1 tile
level 4	→ 4 tiles
level 3	→ 16 tiles
level 2	→ 64 tiles
level 1 →	256 tiles
<hr/>	
total: 341 tiles	
increase in total file size: $\approx 2-10$ (depends on compression)	

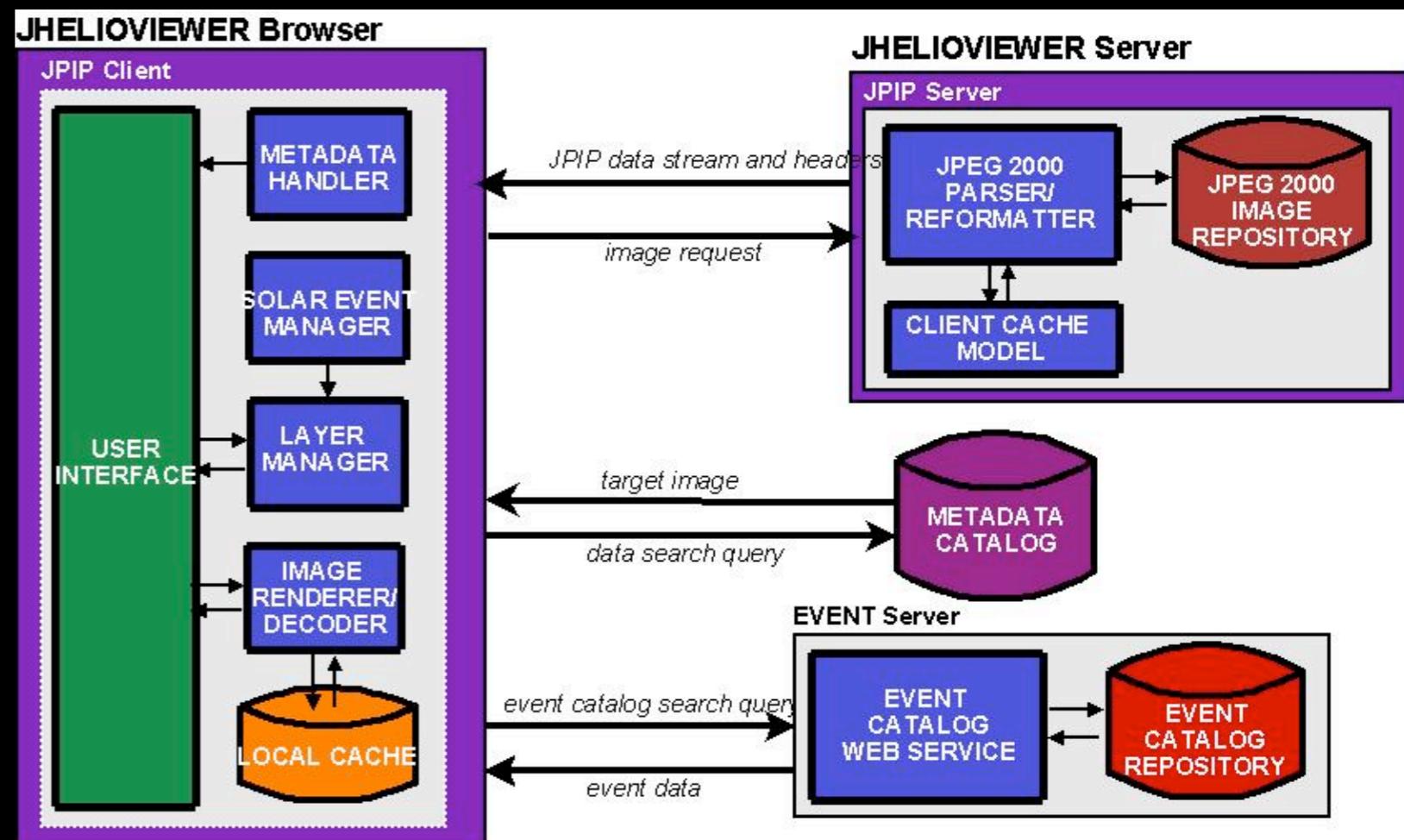
Image Tiling vs. Wavelet Compression - Example

4096^2 px image
5-level discrete
wavelet transform

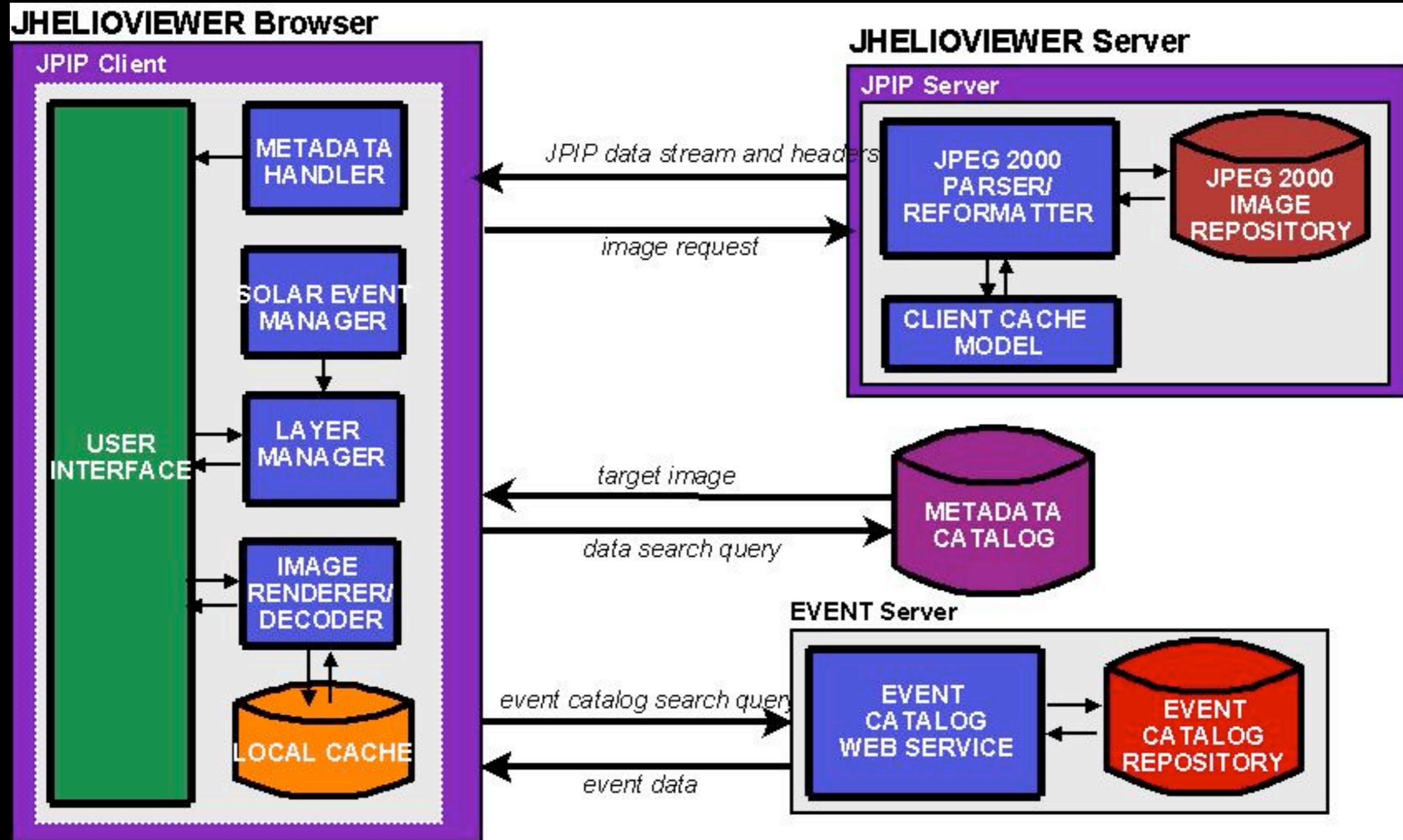


Remote Access to Image Data

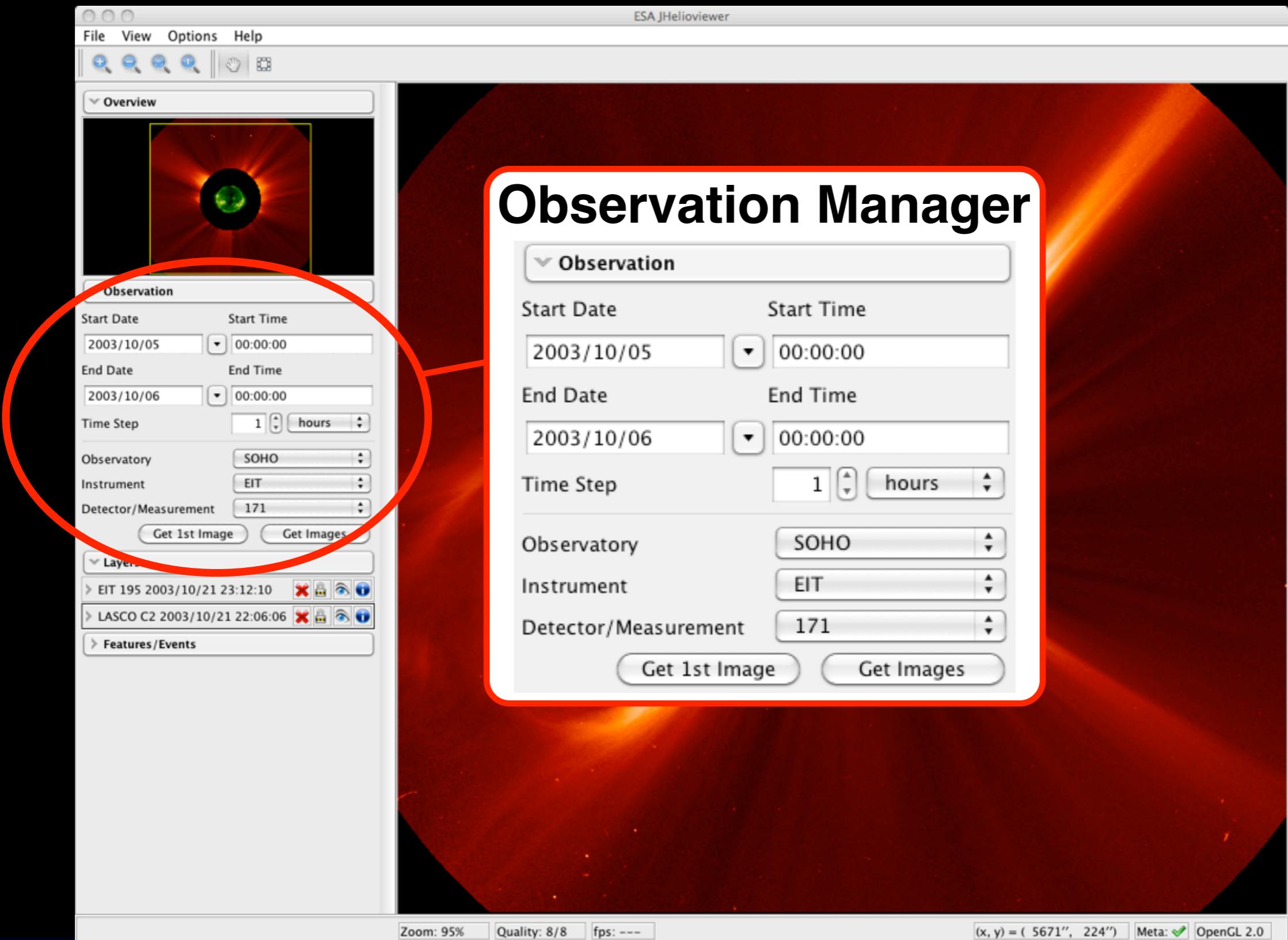
- JPIP = JPEG 2000 Interactive Protocol
- JPIP provides a client–server architecture for transmitting JPEG 2000 imagery over networks
- Can query arbitrary parts and quality levels of images and movies



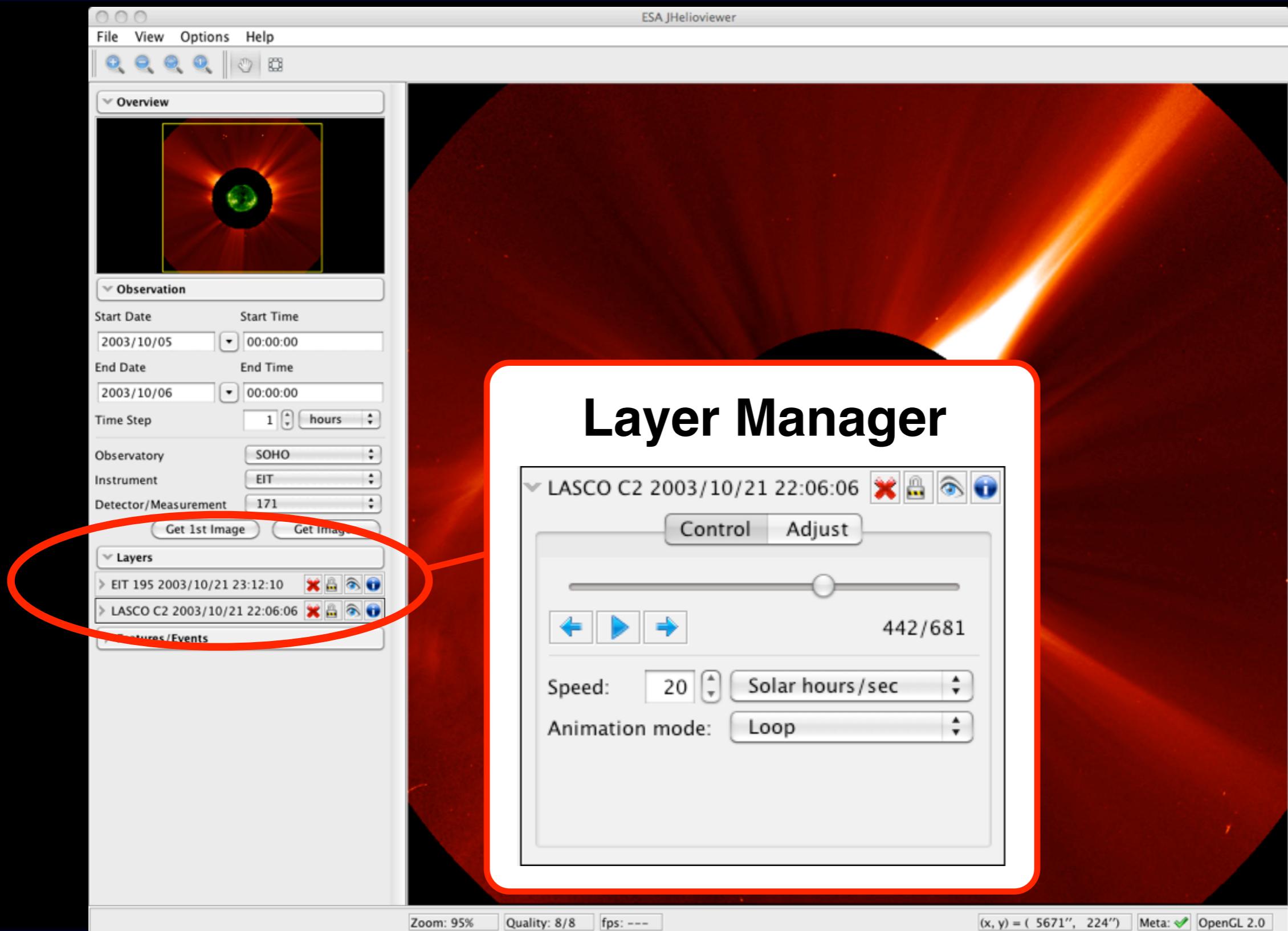
JHelioviewer Architecture



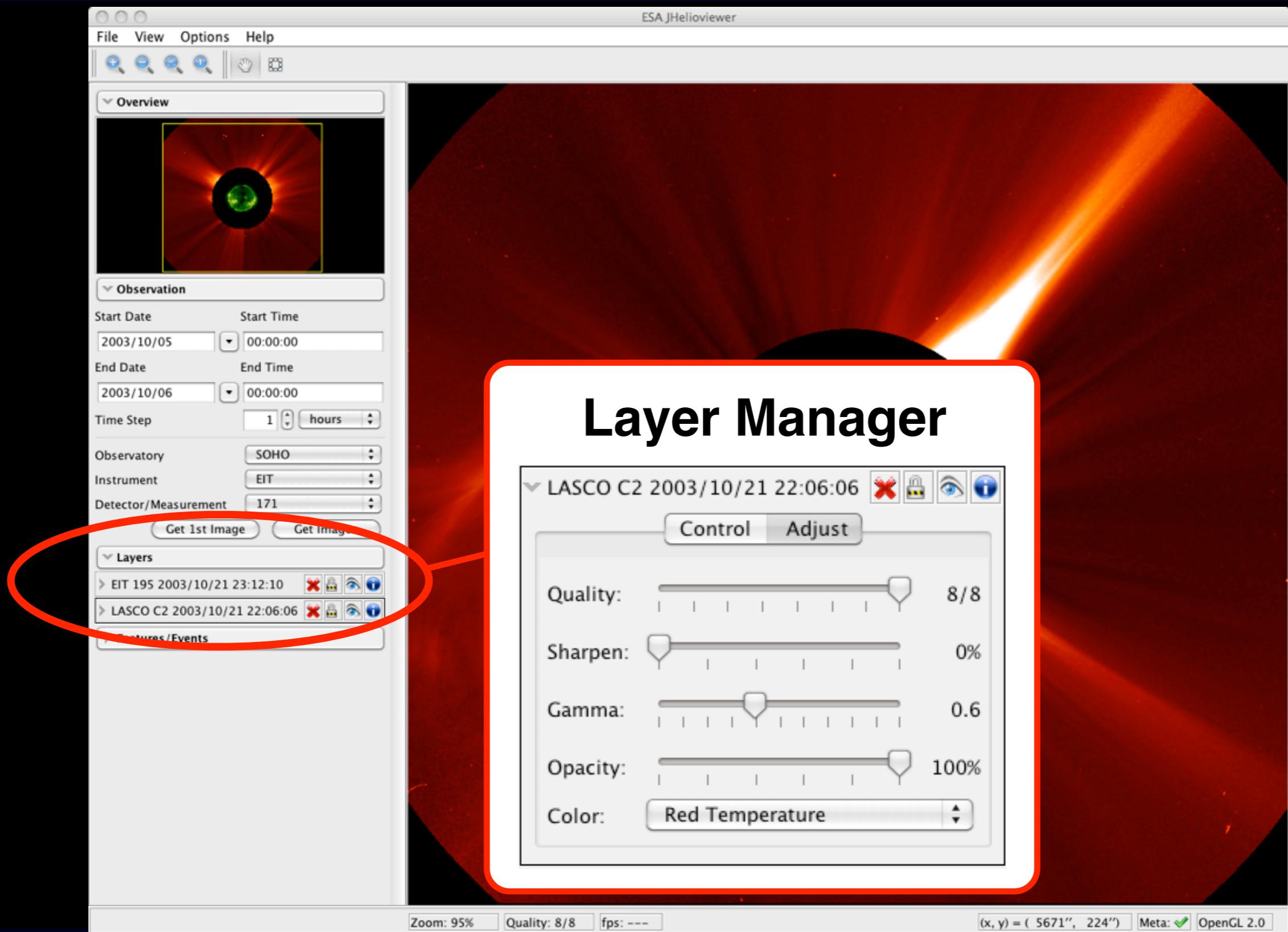
JHelioviewer User Interface



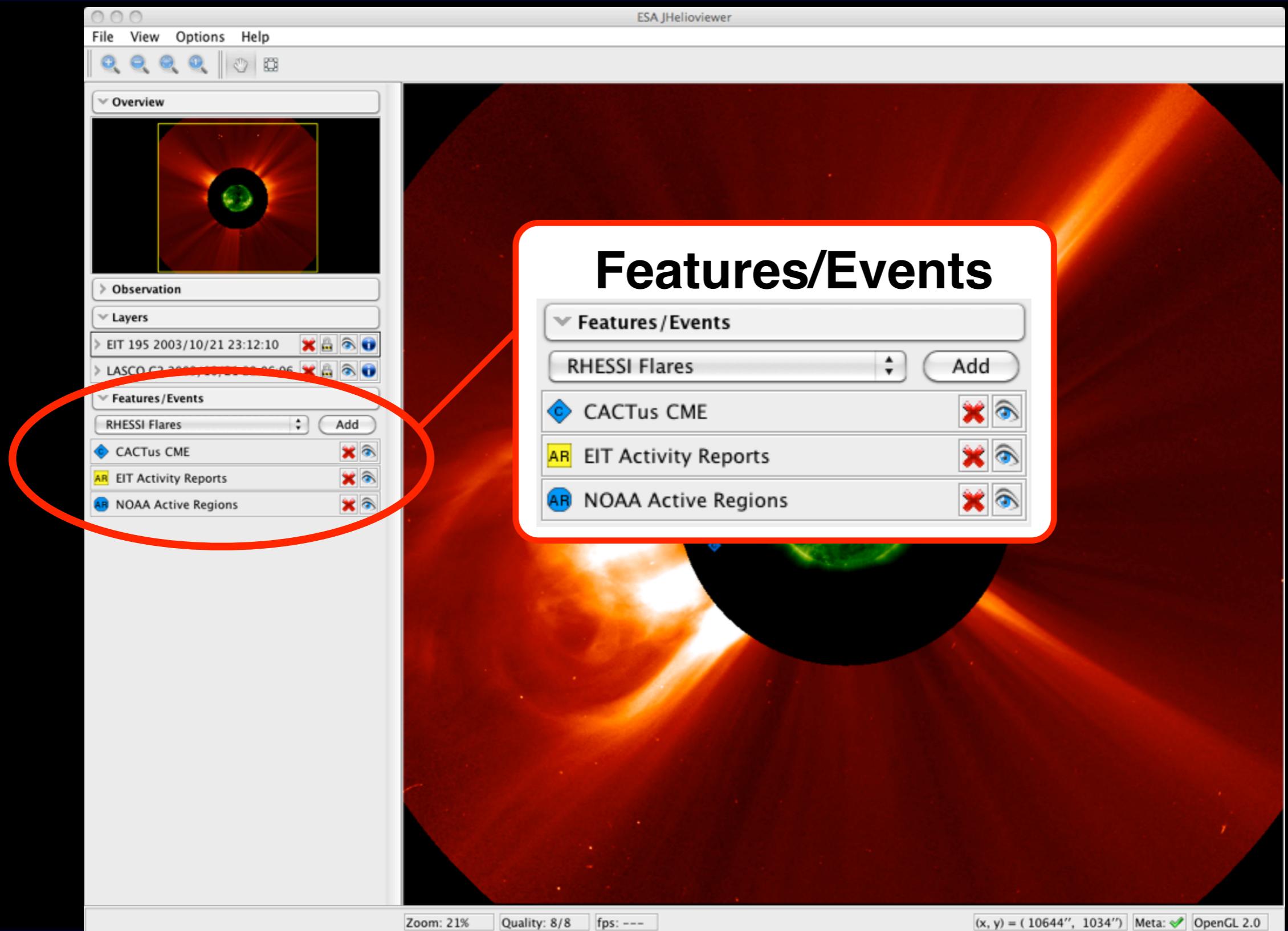
JHelioviewer User Interface



JHelioviewer User Interface

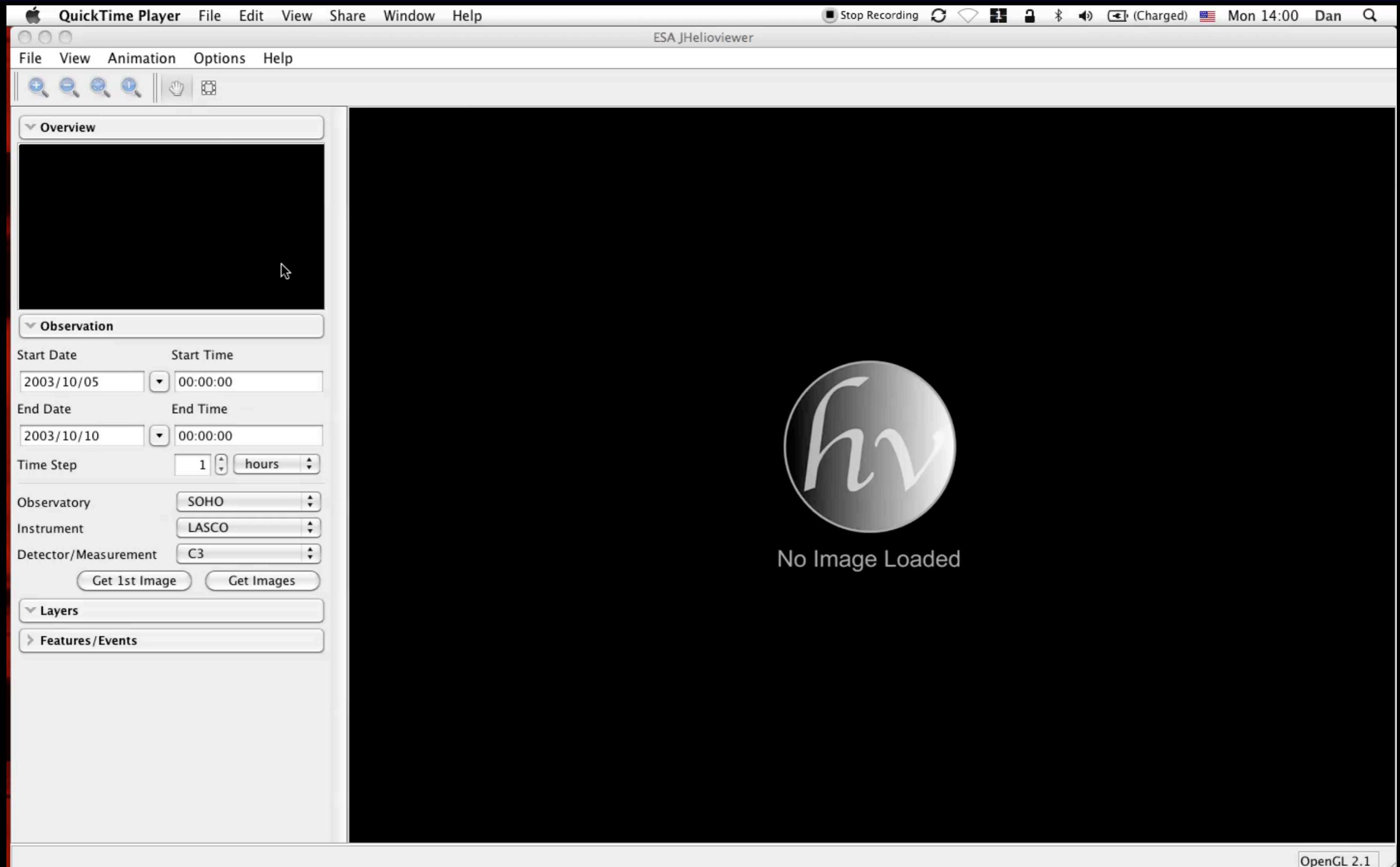


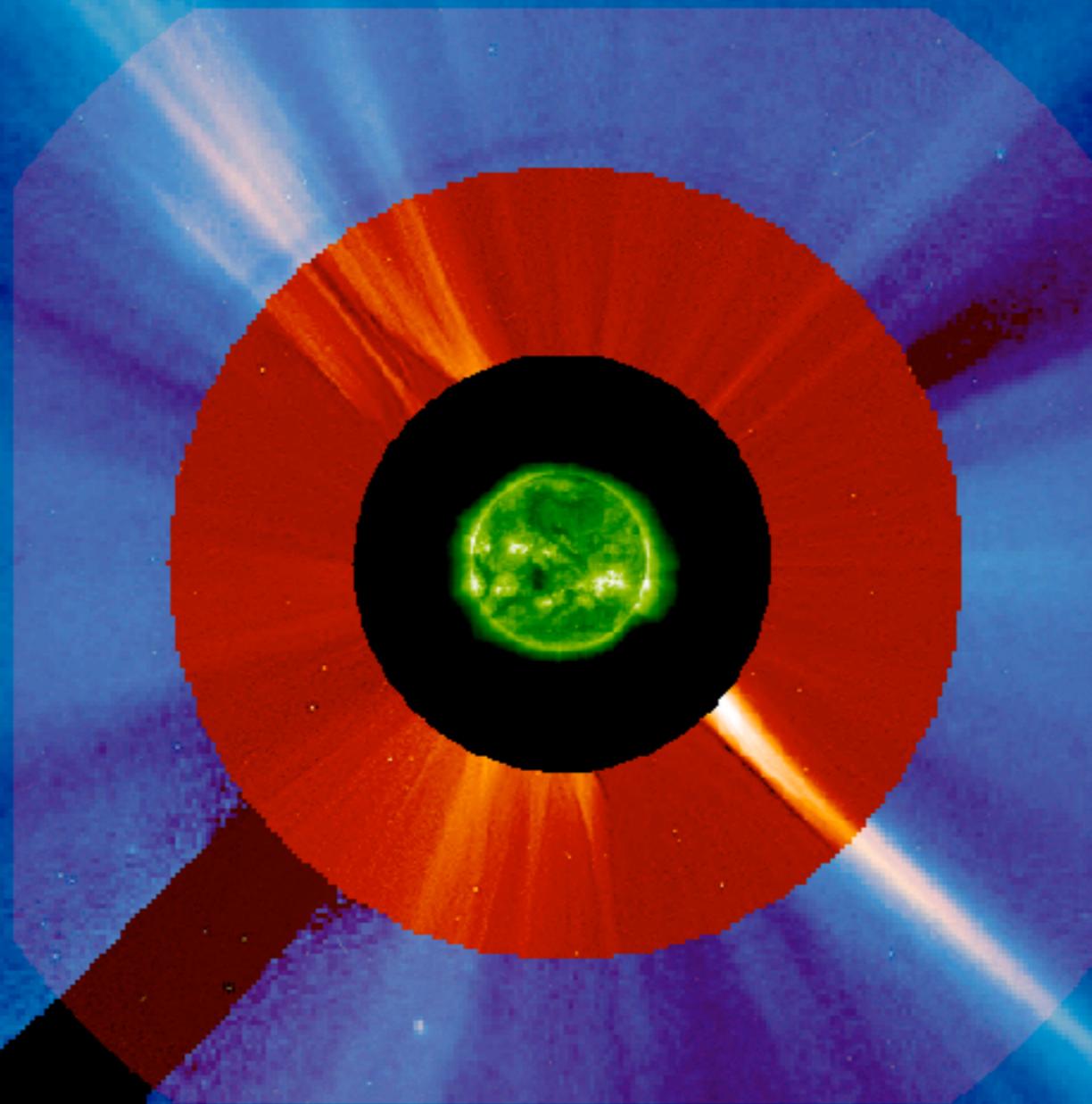
JHelioviewer User Interface



JHelioviewer Demo

JHelioviewer Demo





www.jhelioviewer.org

The screenshot shows a web browser window displaying the JHelioviewer website. The title bar reads "JHelioviewer". The address bar shows the URL "http://www.jhelioviewer.org/". The page content includes the JHelioviewer logo, a navigation menu with links to "home", "data", "JPEG 2000", "wiki", "links", and "contact", and three sample solar images (red, green, blue). A "WELCOME" section encourages users to try the tool and download versions 1.0 or 2.0 beta. A "GETTING STARTED" section provides an overview of the software's features.

JHelioviewer

http://www.jhelioviewer.org/

JHelioviewer

jhv

home data JPEG 2000 wiki links contact

jhelioviewer

WELCOME

JHelioviewer is a visualization tool for solar data. Give it a try and let us know what you think!

Download JHelioviewer 1.0

Download JHelioviewer 2.0 beta

GETTING STARTED

JHelioviewer makes it easy to explore the Sun! When you launch JHelioviewer, a sample image is loaded right away. Simply select a time range and instrument in the observation panel to access more images or to generate a movie. You can also download some of our test images and animations. If you find a bug, please report it here.

www.helioviewer.org

Helioviewer – Solar and heliospheric image visualization tool

http://helioviewer.org/ Google ABP

Helioviewer – Solar and heliospheric image visualization tool

Observation

Date: 2003/07/08 12
Time: 19:00:00
Time-step: 1 Day + -

Overlays [Add]

- MDI Int 2003/07/11 02:29:32 | C X
- EIT 304 2003/07/08 15:40:27 | F X
- LASCO C2 WL 2003/07/07 11:25:45 | AR X

Features/Events [Add]

- LASCO CME List C | X
- GOES X-Ray F | X
- NOAA Active Regions AR | X

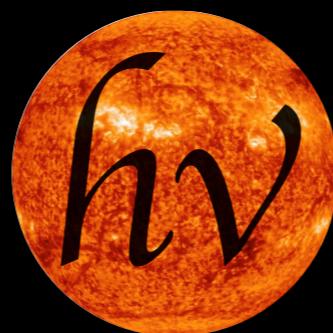
center

+ -

About Usage Tips JHelioviewer Wiki API Contact Report Bug

Conclusions

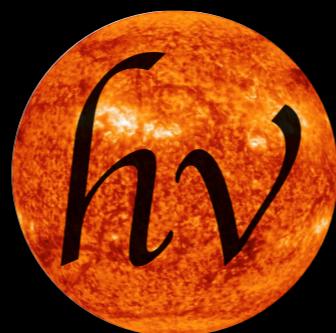
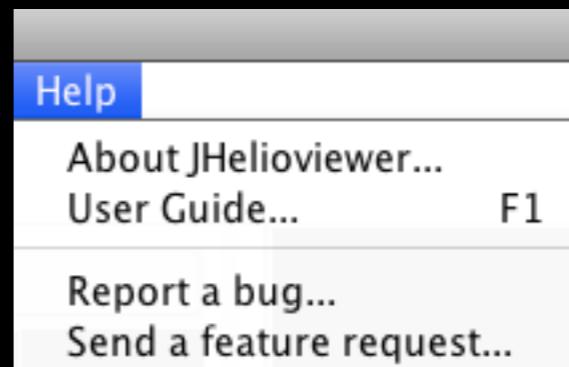
- JPEG 2000 + JPIP offer exciting new functionality that enables users to explore petabyte-scale image archives
- With JHelioviewer, you can
 - Interactively generate, play and overlay high-res movies
 - Perform image processing on-the-fly
 - Connect to knowledge bases



<http://www.jhelioviewer.org>

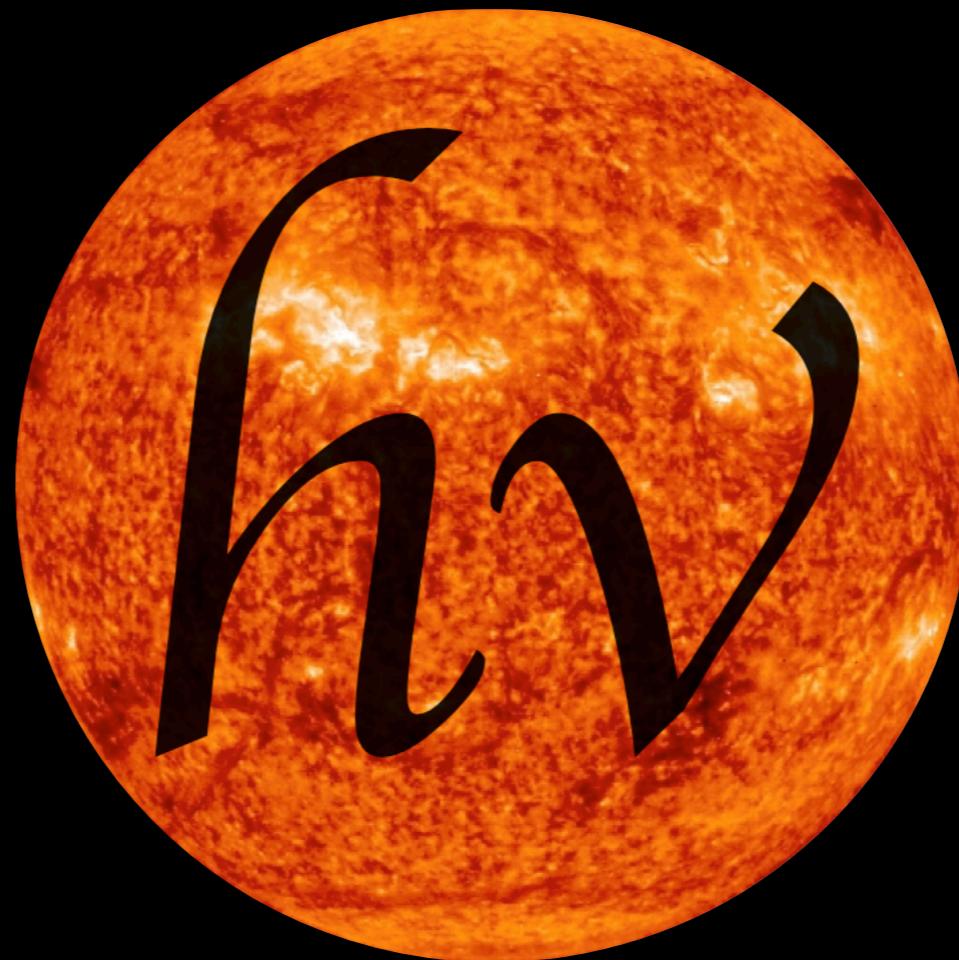
This Software is For You - Get Involved!

- Download it, test it, report bugs
- Submit feature requests
- Get the source code



<http://www.jhelioviewer.org>

Thank you



<http://www.jhelioviewer.org>