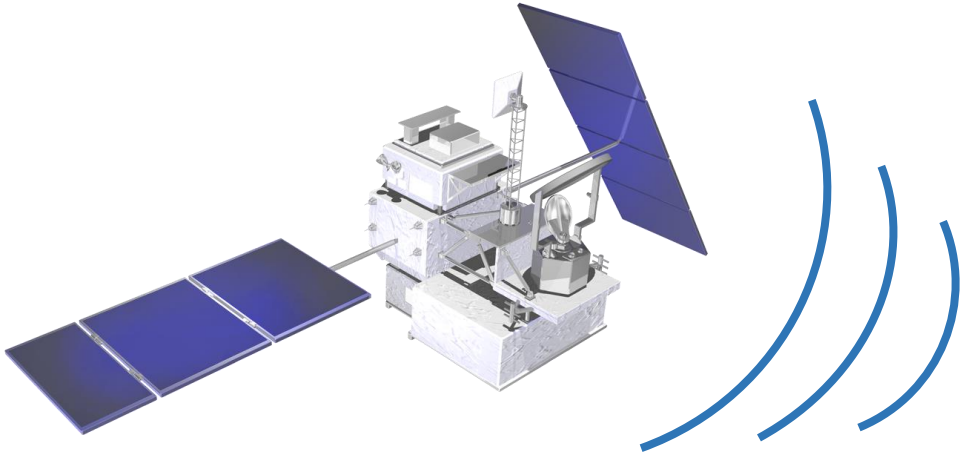
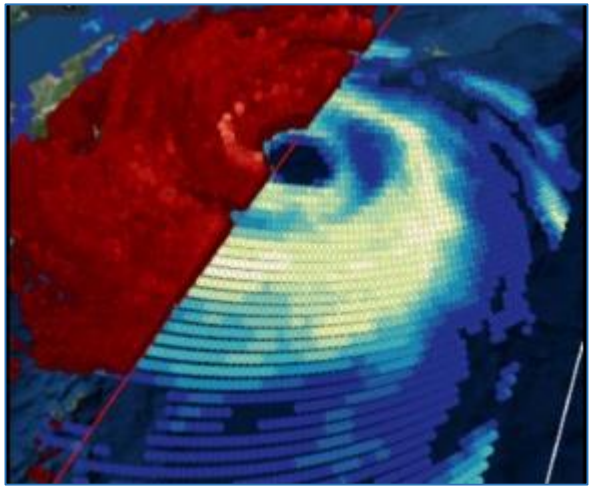
Weather from 250 Miles Up: Visualizing Precipitation Satellite Data (and Other Weather Applications) using CesiumJS





August 16, 2017

Matt Lammers (matthew.r.lammers@nasa.gov)
Senior Science Data Visualization Analyst/Software Engineer

Who Am I?

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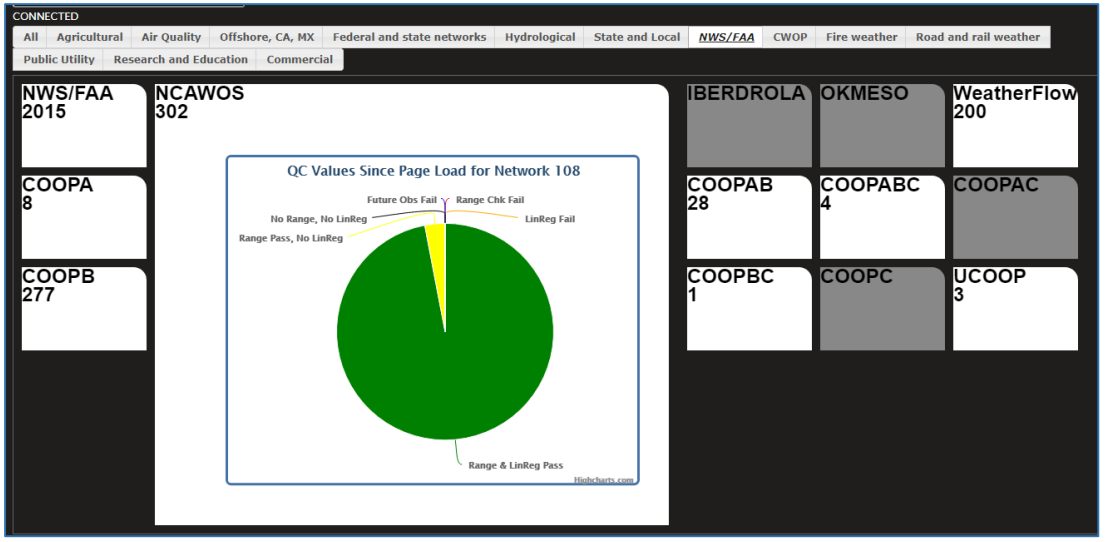

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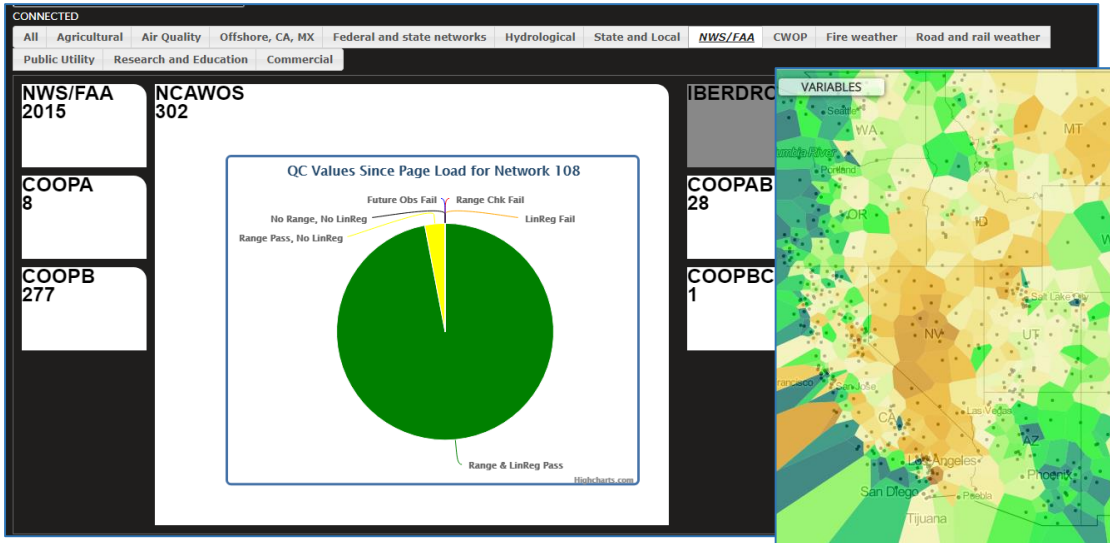

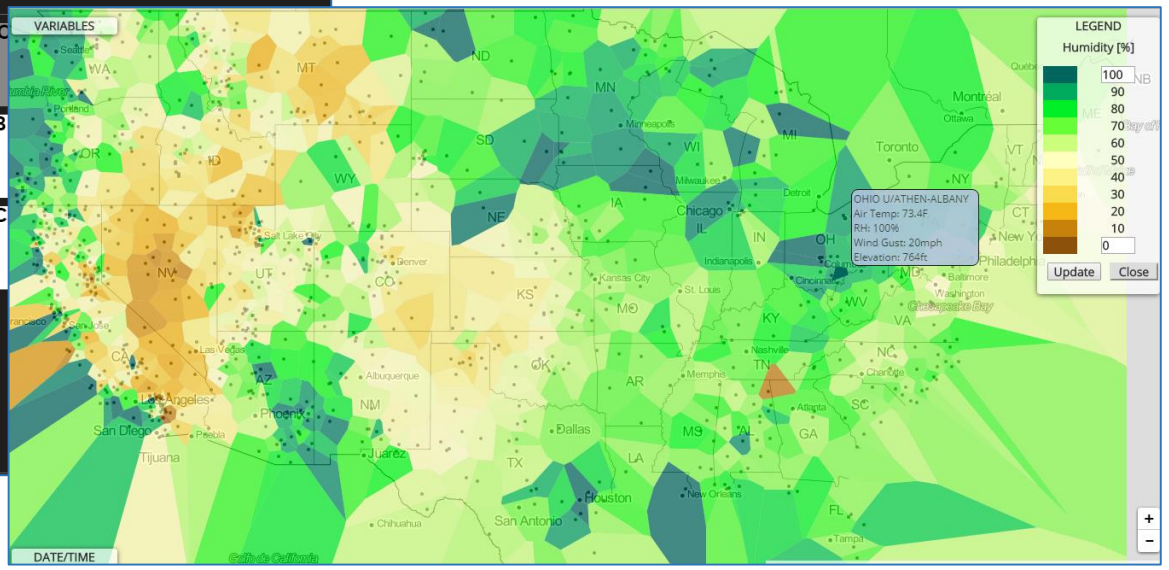

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HDF5 files from low-Earth orbit microwave imager/sounders and radars

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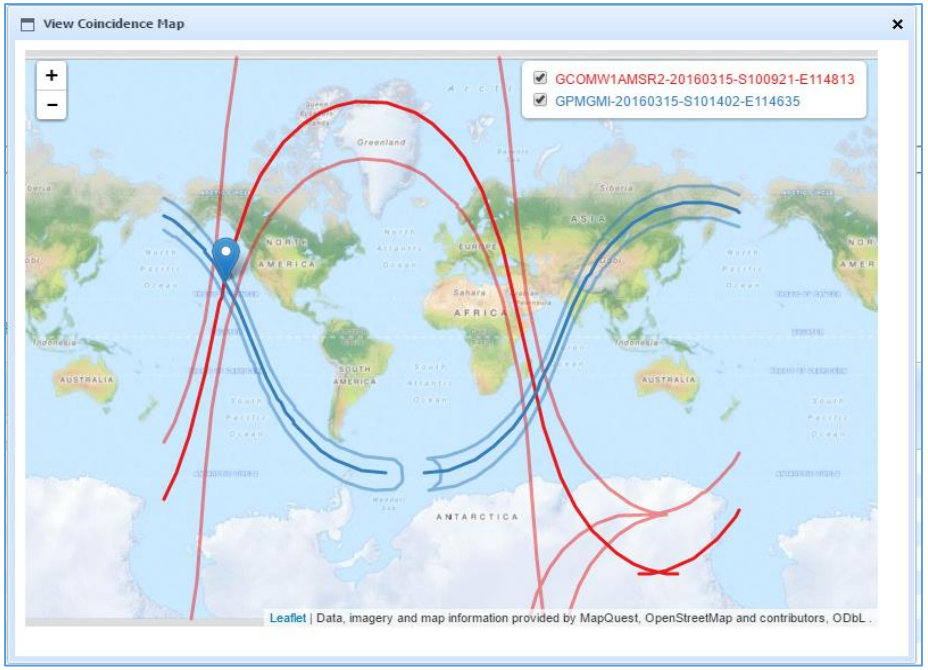

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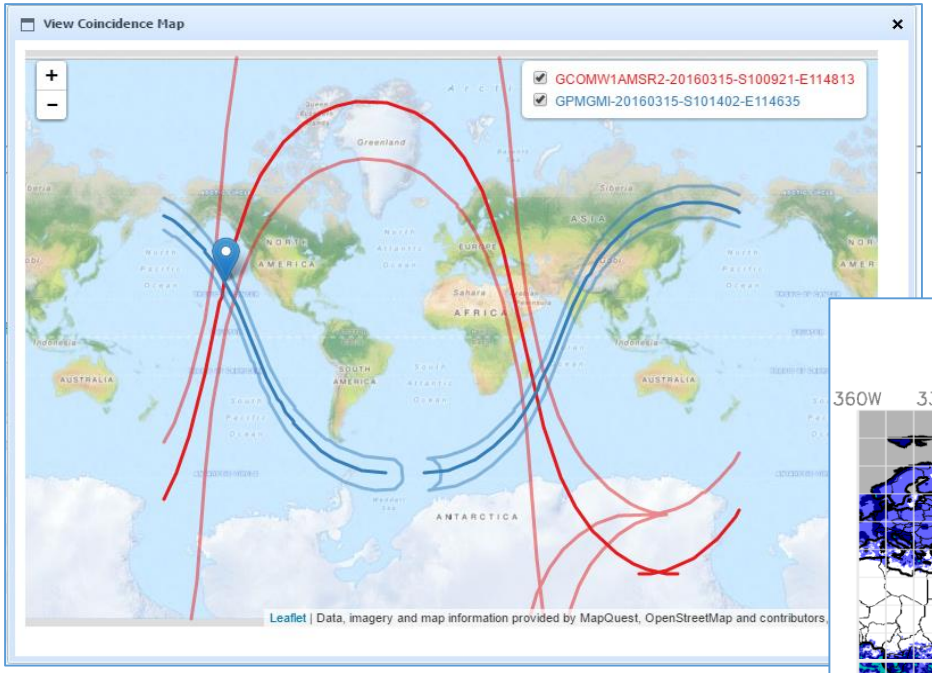

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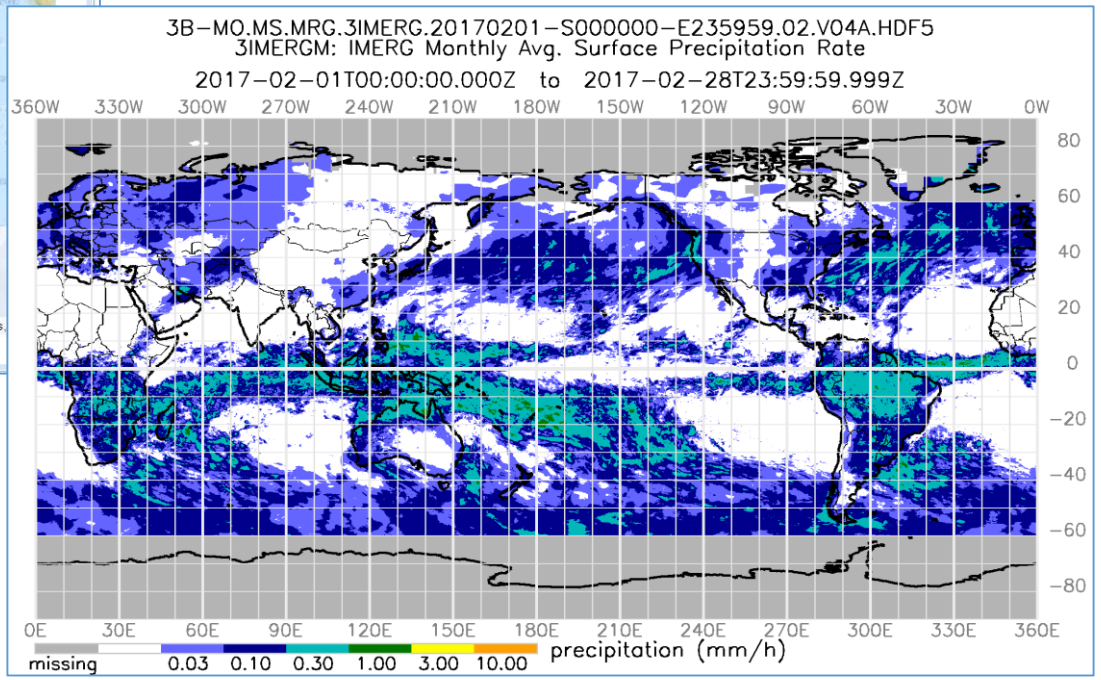
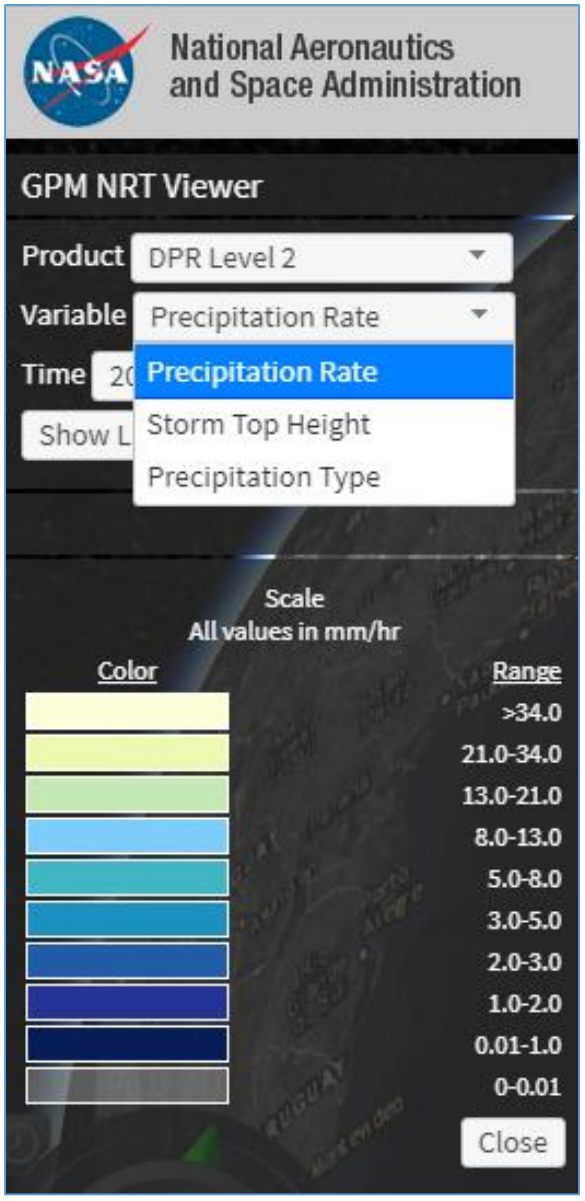


Sometimes it's on a latitude-longitude grid

What Data Do I Use?



Variables include brightness temperature, reflectivity, precipitation phase, and precipitation rate.

Some demos I will be showing also include model output of wind speed and reflectivity, as well as modeled tracers of air quality.

What Tool Do I Use?

CesiumJS!

Source: The East Japan Earthquake Archive

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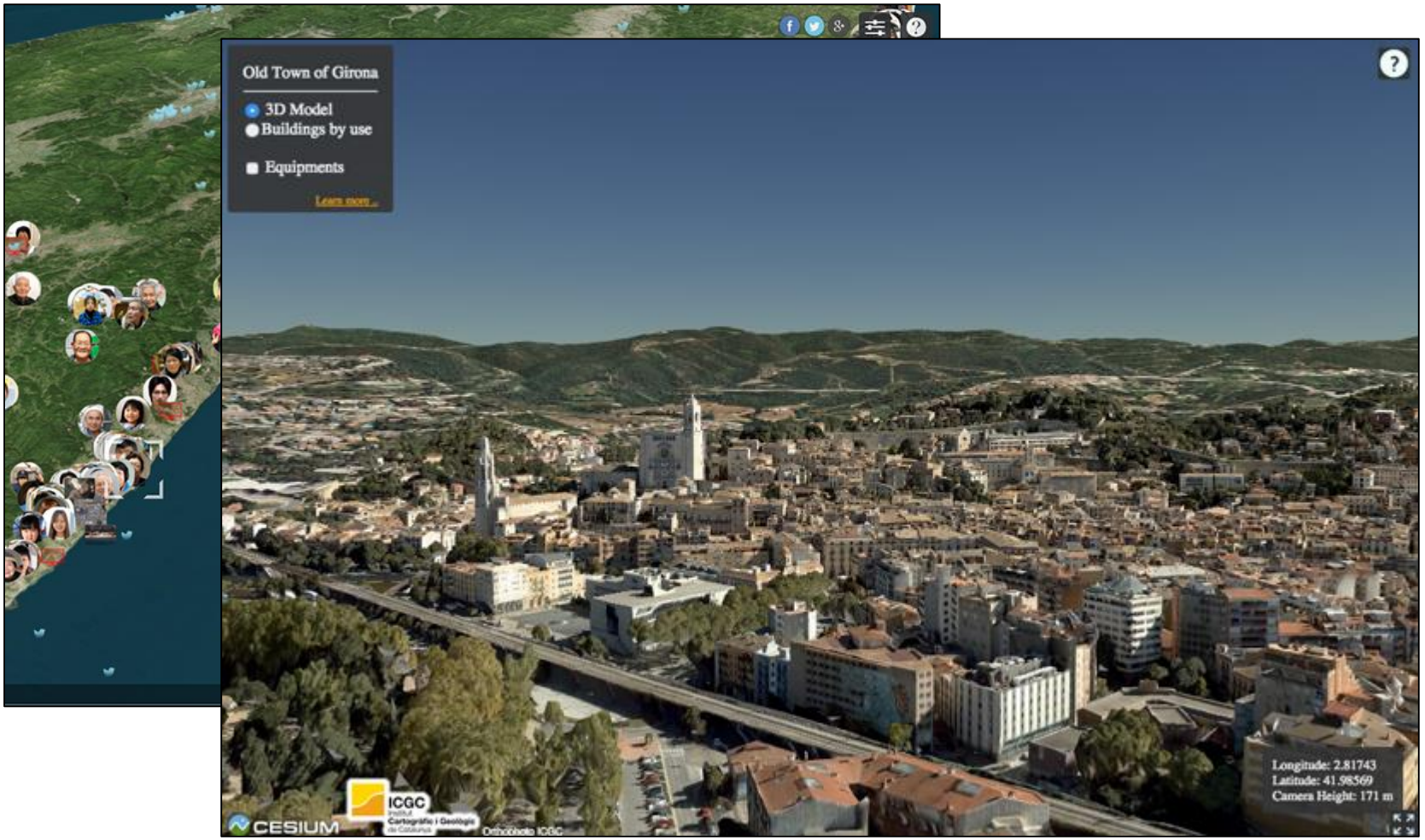

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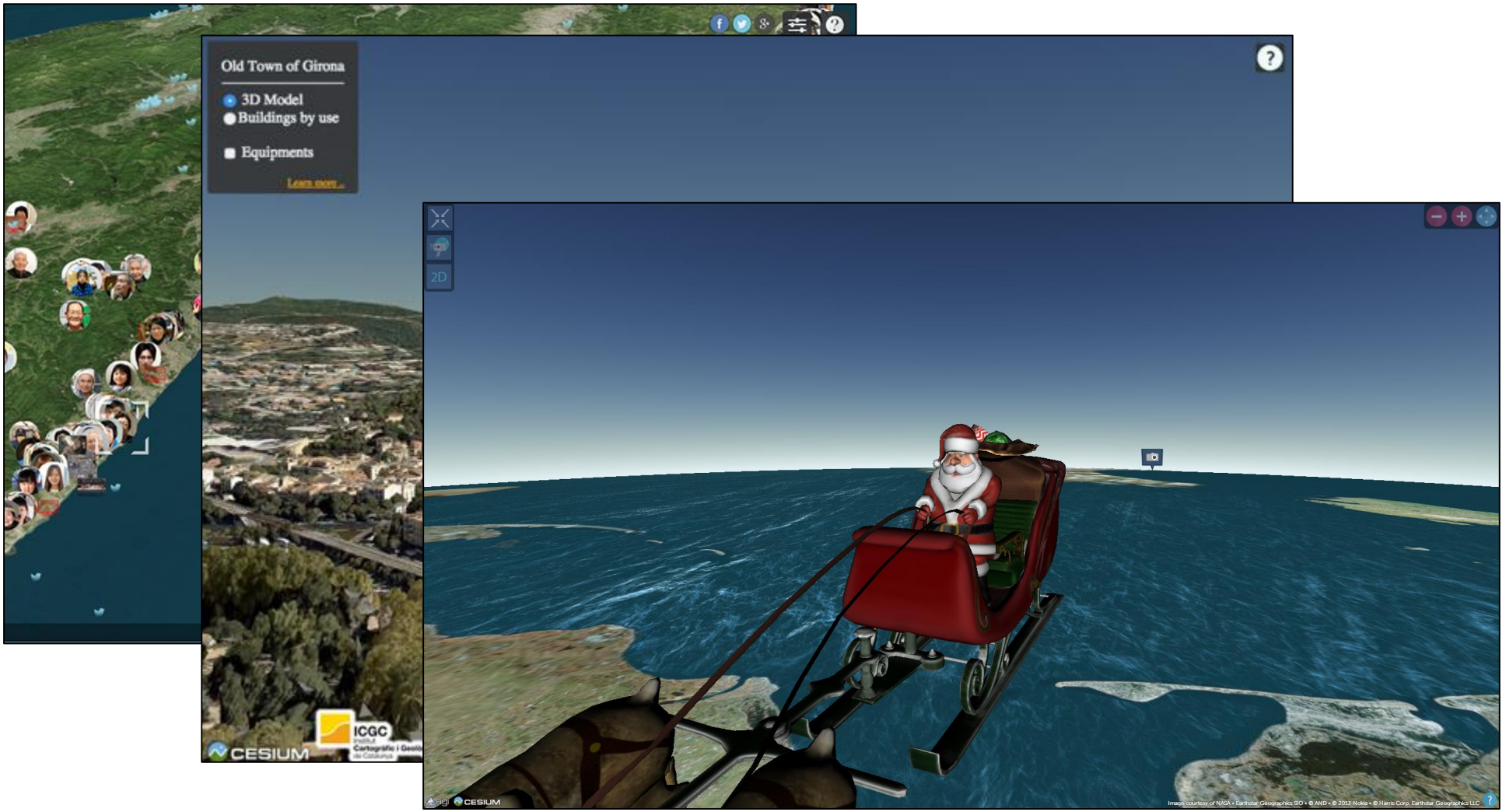
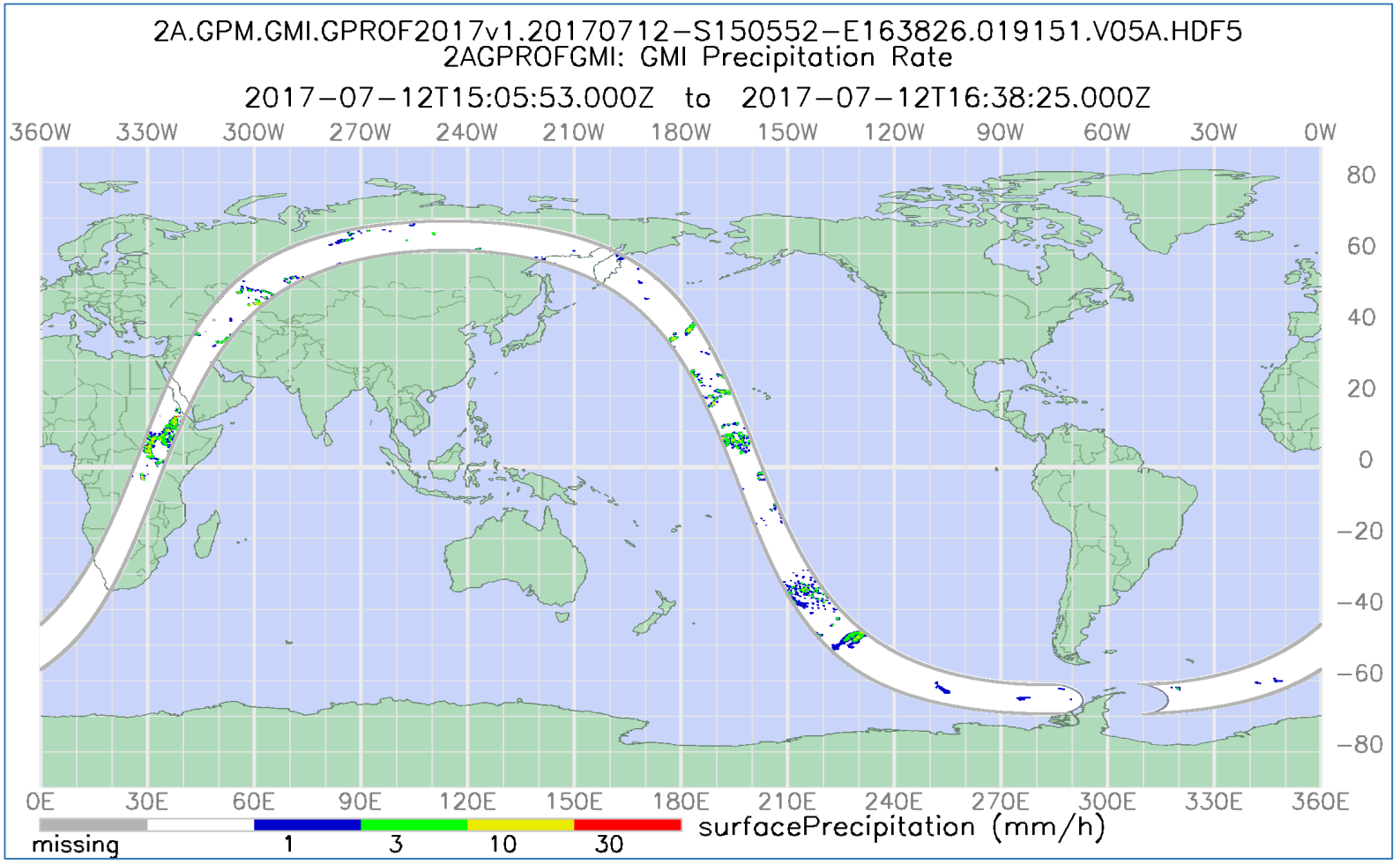


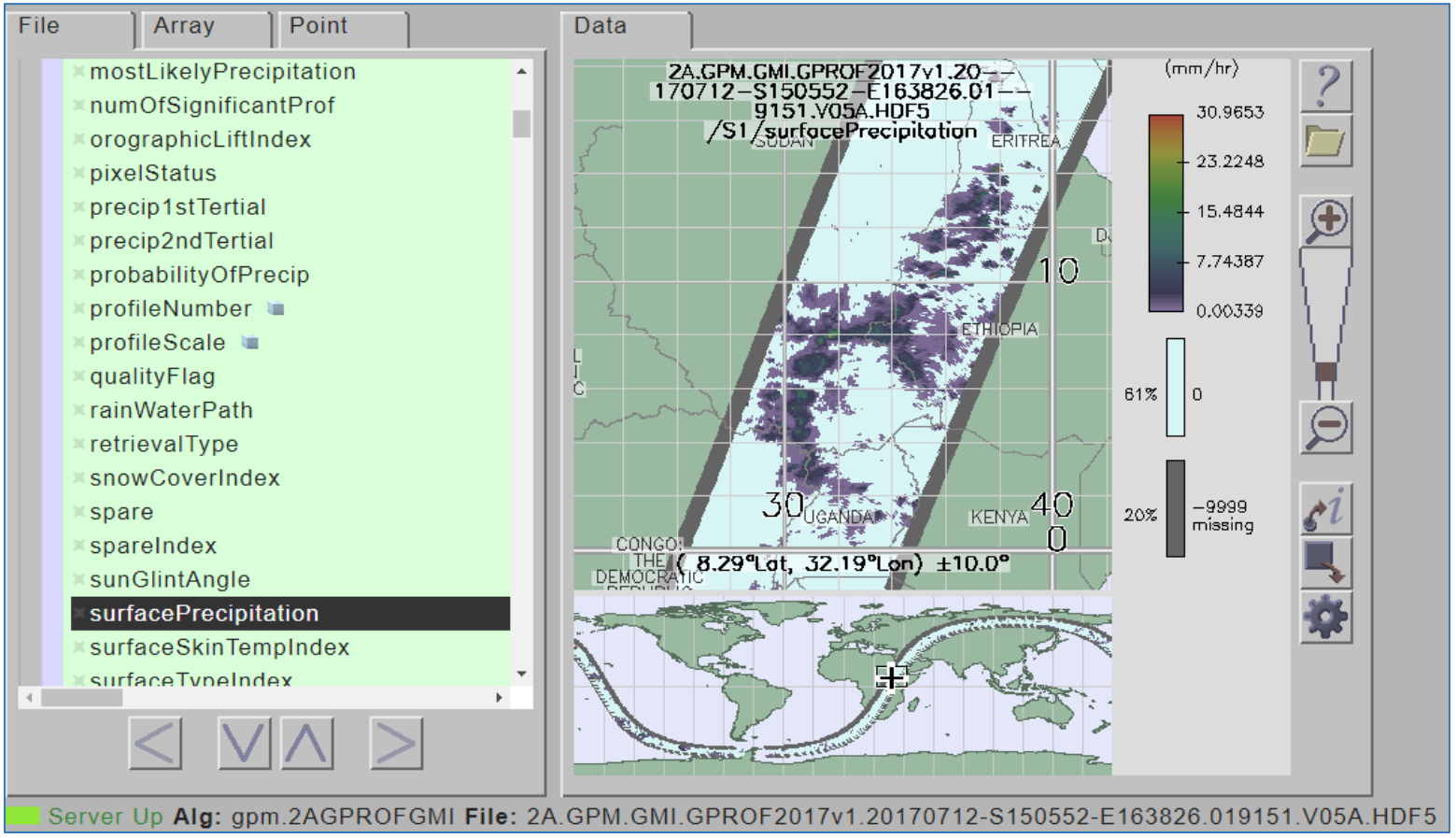
What Motivates This Work?

When I came to NASA, project scientists were making decisions about data acquisition based on static images.



What Motivates This Work?

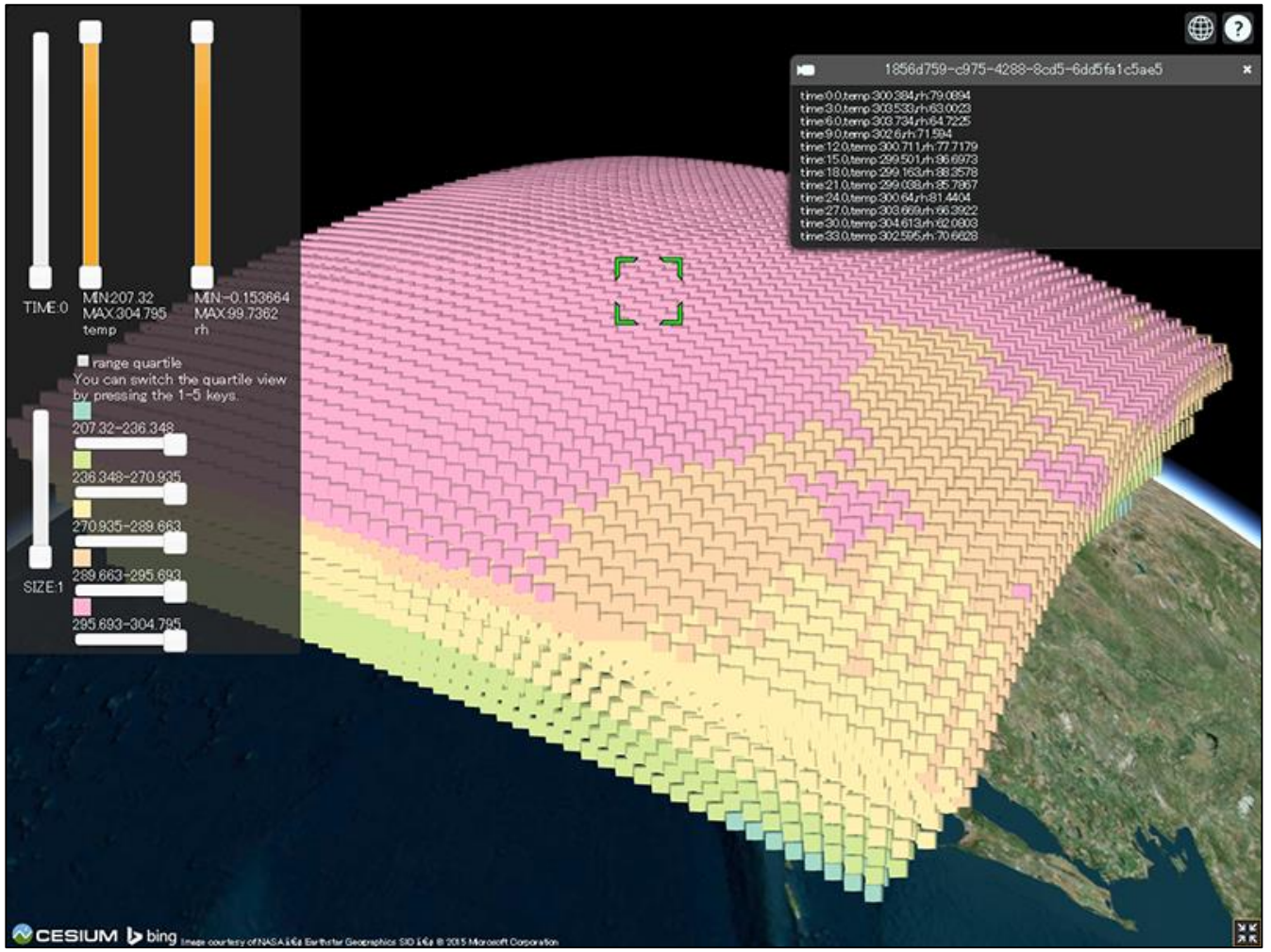
Files could be ingested into THOR data viewer tool, but visualization was limited to two dimensions.



With Near Real Time data, they had no ability to preview files.

What Motivates This Work?

One day, I saw this demo in the Cesium showcase…

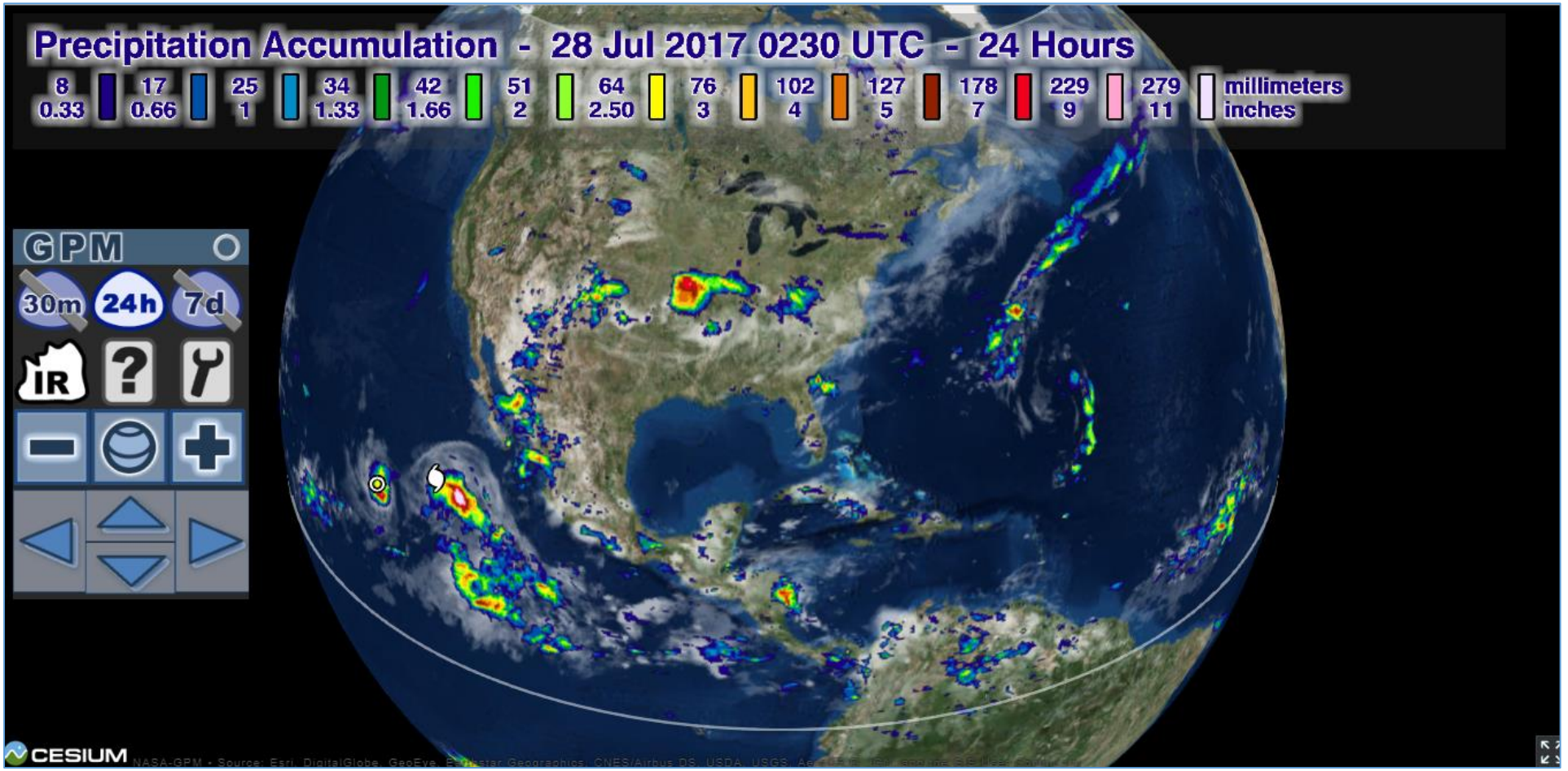


What Motivates This Work?

If Cesium could handle weather model data like that, I could use the same principles to display precipitation satellite information.

What Motivates This Work?

One approach is to use image tiles, which remains 2D, but can still be placed on a 3D globe.

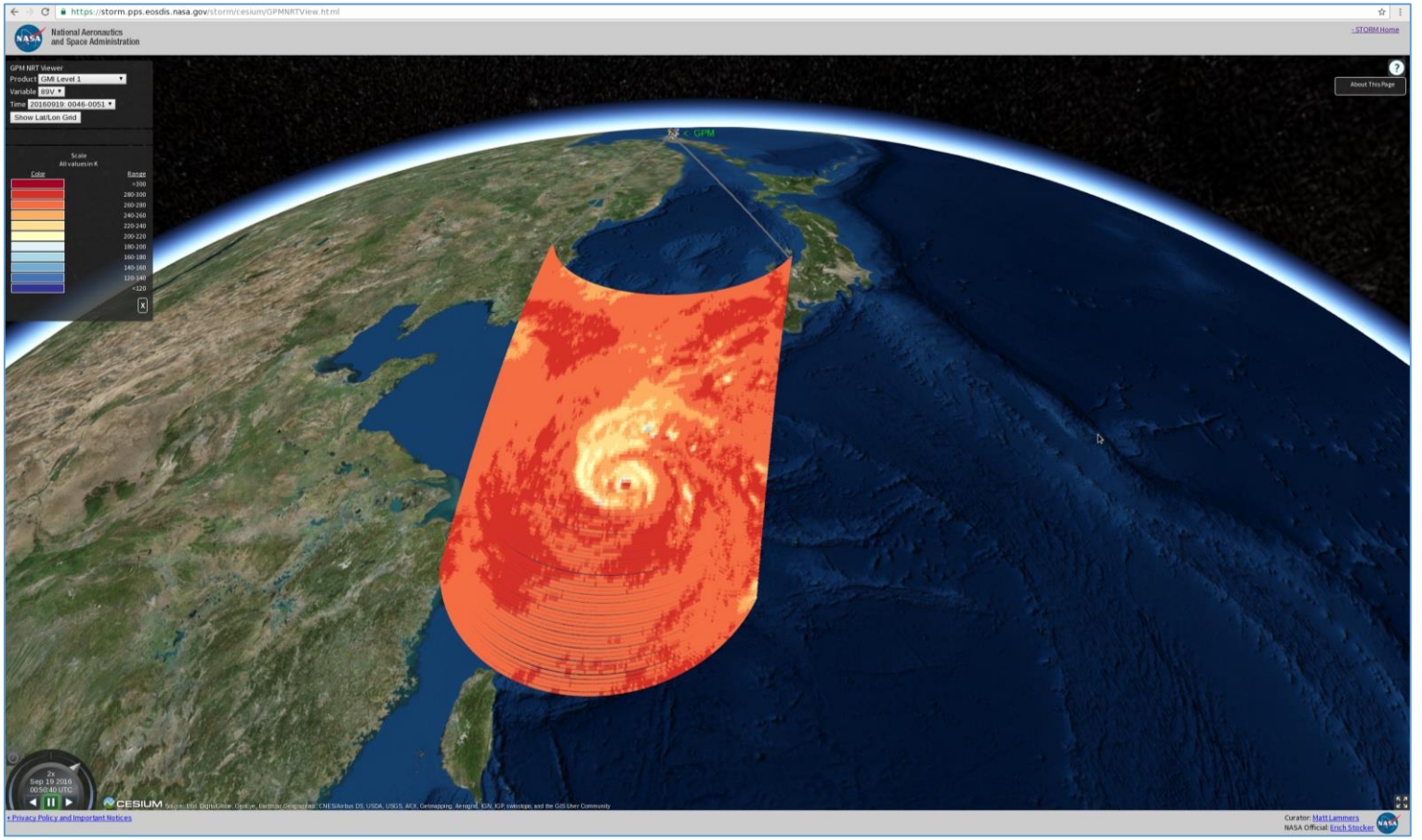


GPM Near Real Time Viewer

So where did I start? Near Real Time Data…

https://storm.pps.eosdis.nasa.gov/storm/cesium/GPMNRTView.html

GPM Near Real Time Viewer



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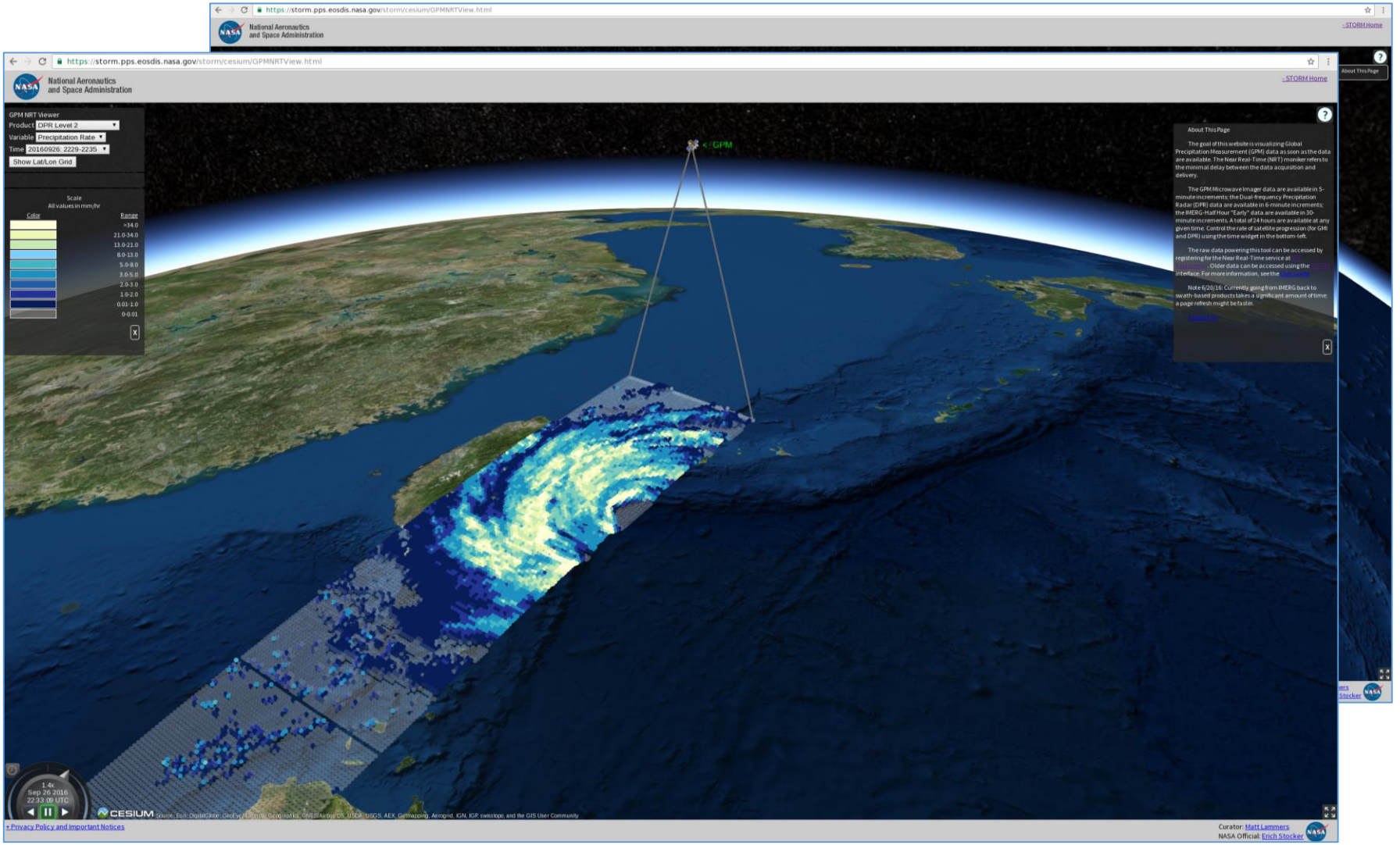

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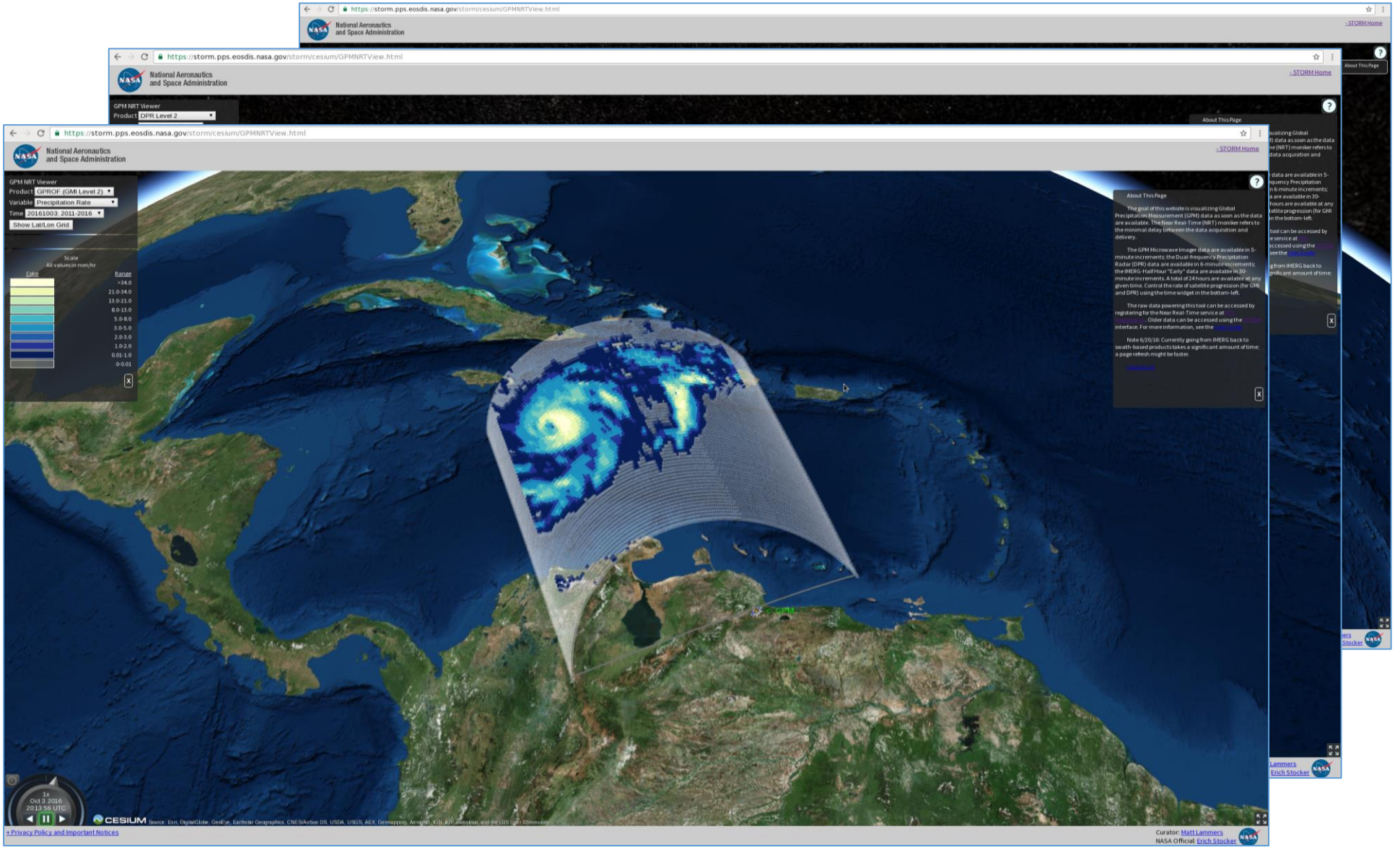

GPM Near Real Time Viewer

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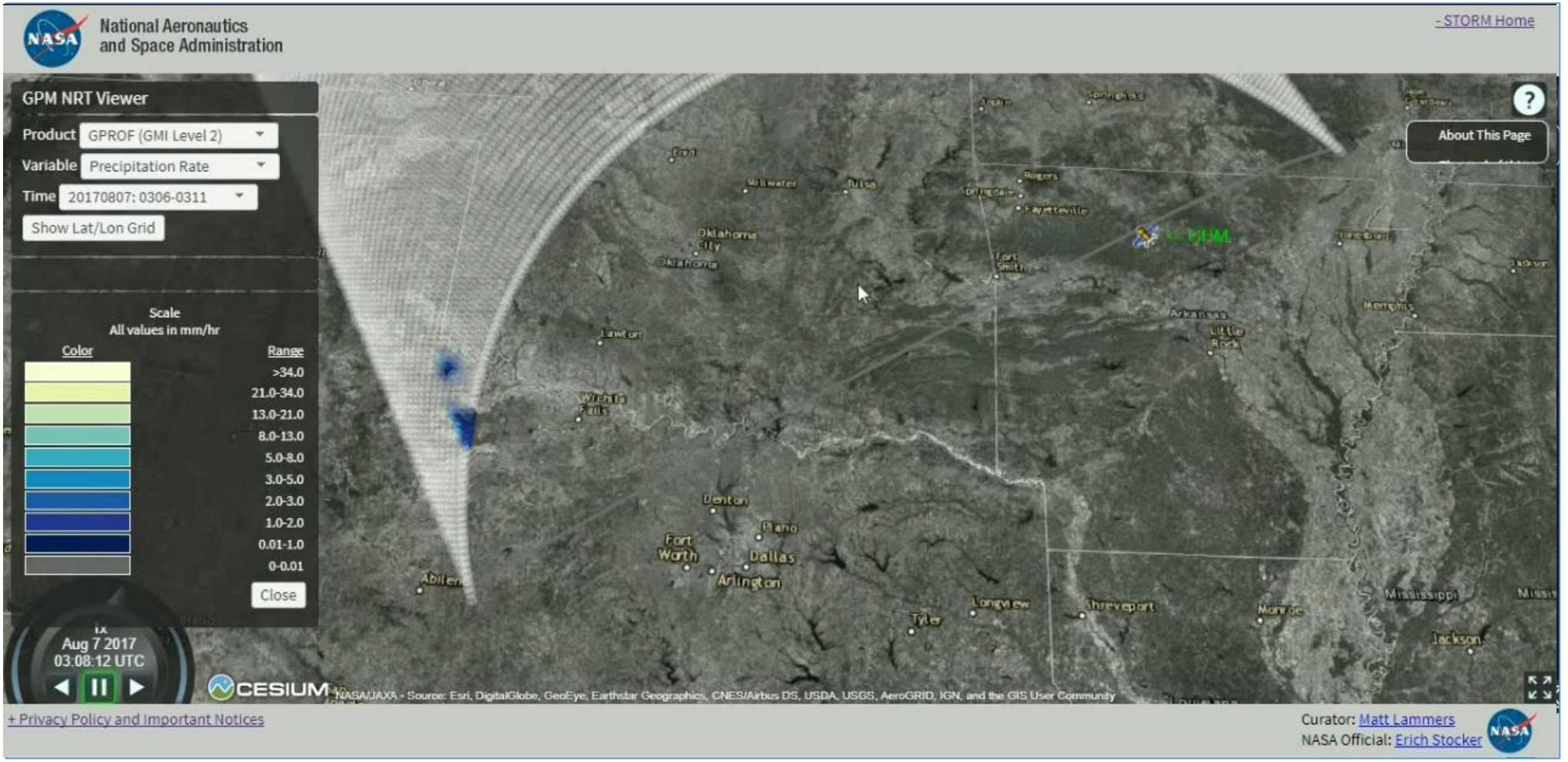
- Each scan time, the point positions/colors are dumped out and stored as the satellite and time dynamic points move forward. These dumped points are erased after 15 minutes of scan.

GPM Near Real Time Viewer

A close-up to illustrate how this process works…



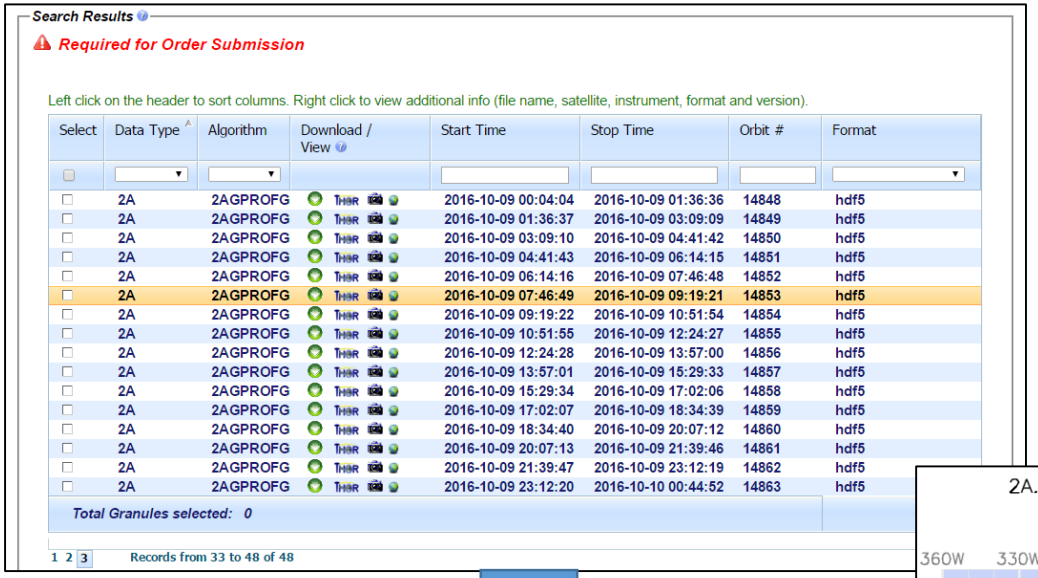
STORM Virtual Globe

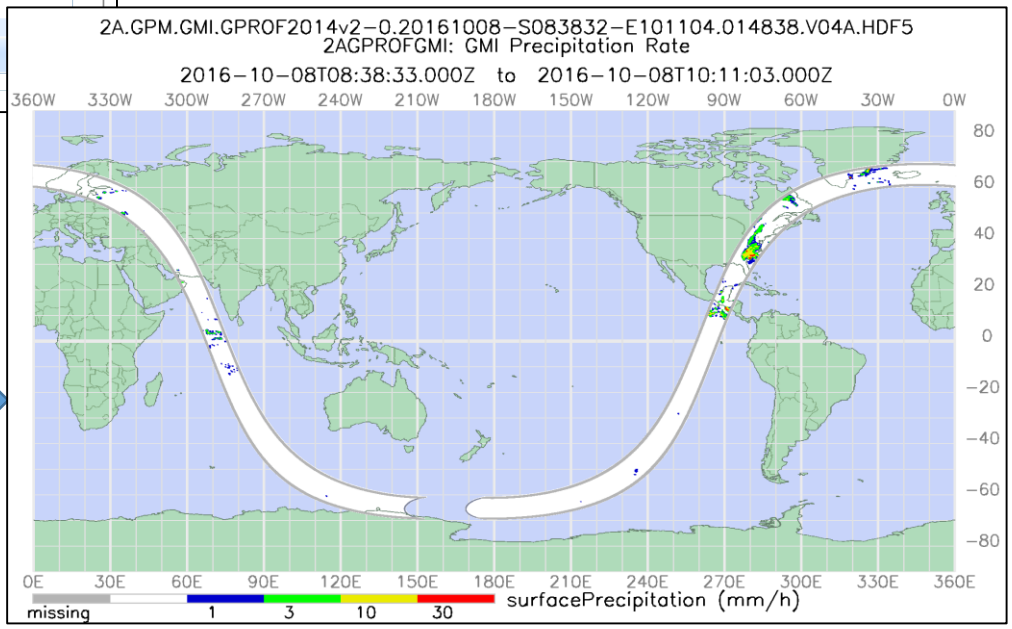
Moving on to “production” data, and STORM Virtual Globe

https://storm.pps.eosdis.nasa.gov/storm/data/Service.jsp?serviceName=Order

STORM Virtual Globe

BEFORE:





STORM Virtual Globe

AFTER:

Search Results

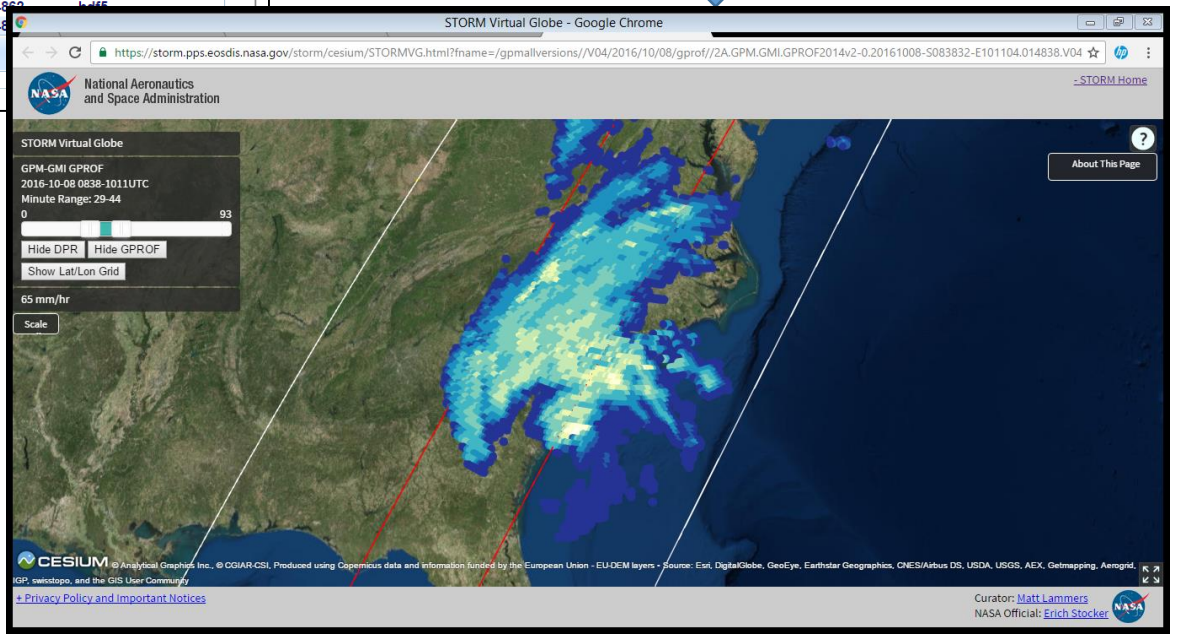
Required for Order Submission

Left click on the header to sort columns. Right click to view additional info (file name, satellite, instrument, format and version).

Select	Data Type	Algorithm	Download / View	Start Time	Stop Time	Orbit #	Format
	2A	2AGPROFG	THSR	2016-10-09 00:04:04	2016-10-09 01:36:36	14848	hdf5
	2A	2AGPROFG	THSR	2016-10-09 01:36:37	2016-10-09 03:09:09	14849	hdf5
	2A	2AGPROFG	THSR	2016-10-09 03:09:10	2016-10-09 04:41:42	14850	hdf5
	2A	2AGPROFG	THSR	2016-10-09 04:41:43	2016-10-09 06:14:15	14851	hdf5
	2A	2AGPROFG	THSR	2016-10-09 06:14:16	2016-10-09 07:46:48	14852	hdf5
	2A	2AGPROFG	THSR	2016-10-09 07:46:49	2016-10-09 09:19:21	14853	hdf5
	2A	2AGPROFG	THSR	2016-10-09 09:19:22	2016-10-09 10:51:54	14854	hdf5
	2A	2AGPROFG	THSR	2016-10-09 10:51:55	2016-10-09 12:24:27	14855	hdf5
	2A	2AGPROFG	THSR	2016-10-09 12:24:28	2016-10-09 13:57:00	14856	hdf5
	2A	2AGPROFG	THSR	2016-10-09 13:57:01	2016-10-09 15:29:33	14857	hdf5
	2A	2AGPROFG	THSR	2016-10-09 15:29:34	2016-10-09 17:02:06	14858	hdf5
	2A	2AGPROFG	THSR	2016-10-09 17:02:07	2016-10-09 18:34:39	14859	hdf5
	2A	2AGPROFG	THSR	2016-10-09 18:34:40	2016-10-09 20:07:12	14860	hdf5
	2A	2AGPROFG	THSR	2016-10-09 20:07:13	2016-10-09 21:39:46	14861	hdf5
	2A	2AGPROFG	THSR	2016-10-09 21:39:47	2016-10-09 23:12:19	14862	hdf5
	2A	2AGPROFG	THSR	2016-10-09 23:12:20	2016-10-10 00:44:52	14863	hdf5

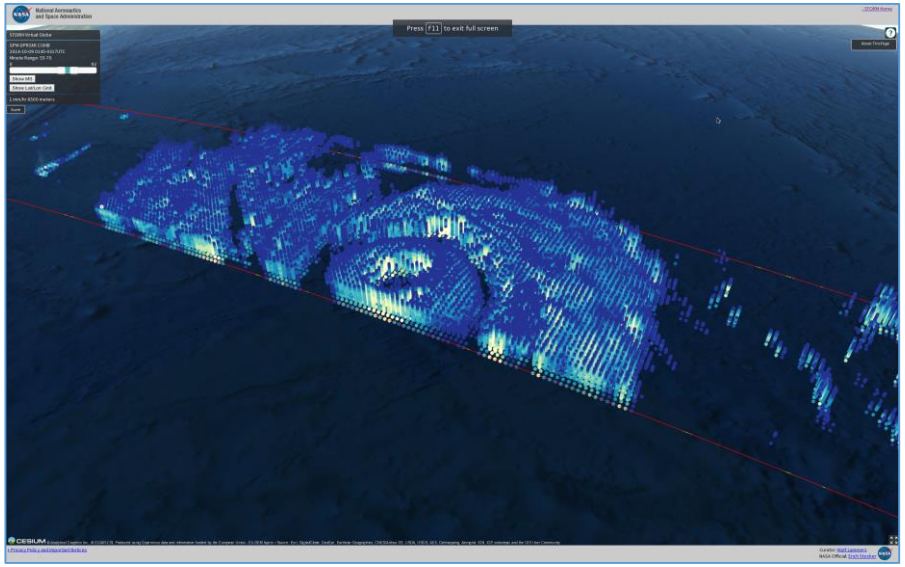
Total Granules selected: 0

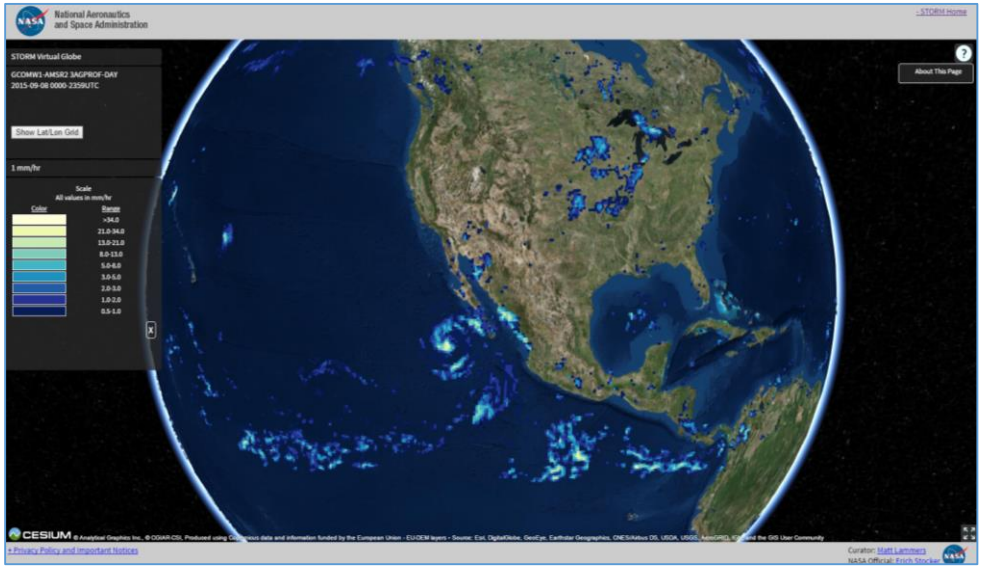
1 2 3 Records from 33 to 48 of 48

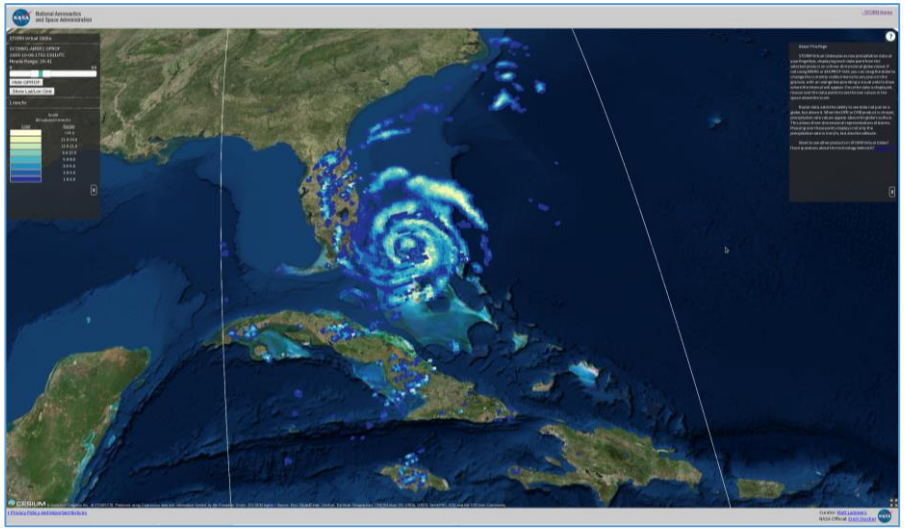


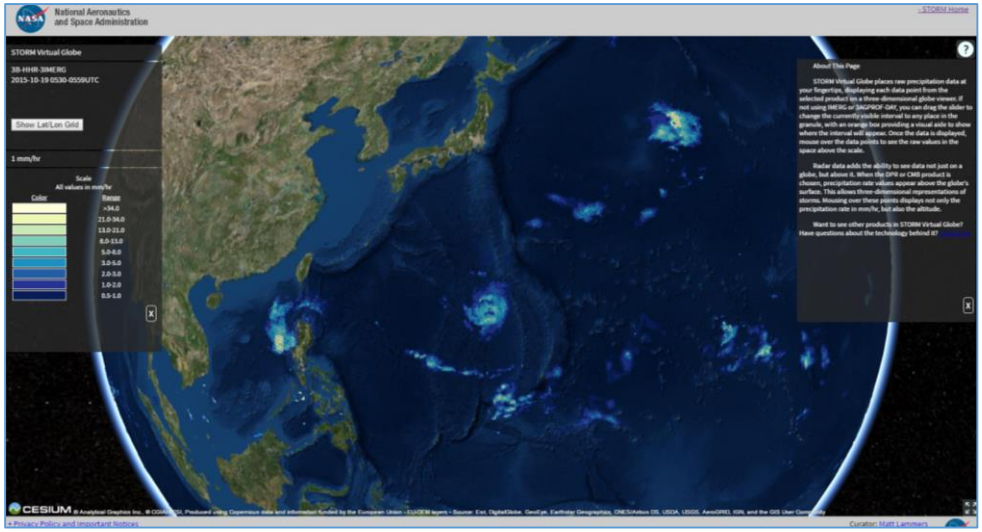
STORM Virtual Globe

29 Products Available









STORM Virtual Globe

- AJAX Request sent to Java Apache Tomcat server, which pulls in the HDF5 file

- Java code converts the relevant data to JSON

- JavaScript parses the JSON and loops through it, generating CesiumJS PointPrimitives

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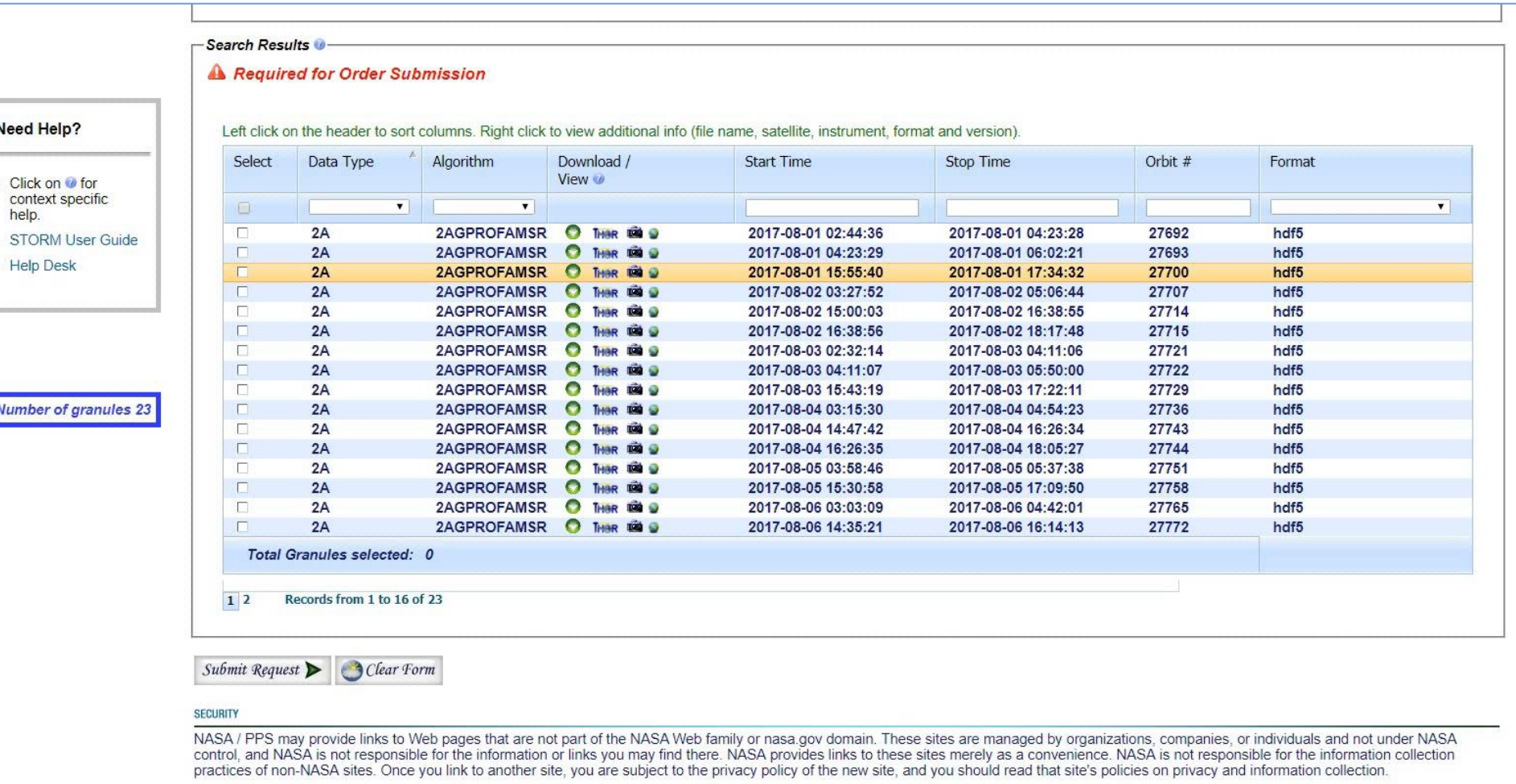
- Only 15 minutes of swath data allowed at a time to avoid overloading Cesium

STORM Virtual Globe



Search Results

Required for Order Submission

Need Help?

- Click on for context specific help.
- STORM User Guide
- Help Desk

Left click on the header to sort columns. Right click to view additional info (file name, satellite, instrument, format and version).

Select	Data Type	Algorithm	Download / View	Start Time	Stop Time	Orbit #	Format
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	2A	2AGPROFAMSR	THOR	2017-08-01 04:23:29	2017-08-01 06:02:21	27693	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-01 15:55:40	2017-08-01 17:34:32	27700	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-02 03:27:52	2017-08-02 05:06:44	27707	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-02 15:00:03	2017-08-02 16:38:55	27714	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-02 16:38:56	2017-08-02 18:17:48	27715	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-03 02:32:14	2017-08-03 04:11:06	27721	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-03 04:11:07	2017-08-03 05:50:00	27722	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-03 15:43:19	2017-08-03 17:22:11	27729	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-04 03:15:30	2017-08-04 04:54:23	27736	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-04 14:47:42	2017-08-04 16:26:34	27743	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-04 16:26:35	2017-08-04 18:05:27	27744	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-05 03:58:46	2017-08-05 05:37:38	27751	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-05 15:30:58	2017-08-05 17:09:50	27758	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-06 03:03:09	2017-08-06 04:42:01	27765	hdf5
	2A	2AGPROFAMSR	THOR	2017-08-06 14:35:21	2017-08-06 16:14:13	27772	hdf5

Number of granules 23

Total Granules selected: 0

1 2 Records from 1 to 16 of 23

Submit Request Clear Form

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+ Privacy Policy and Important Notices

Curator: Matthew Lammers
NASA Official: Erich Stocker, Code 610.2, NASA/GSFC
Last Updated: 8/18/2015

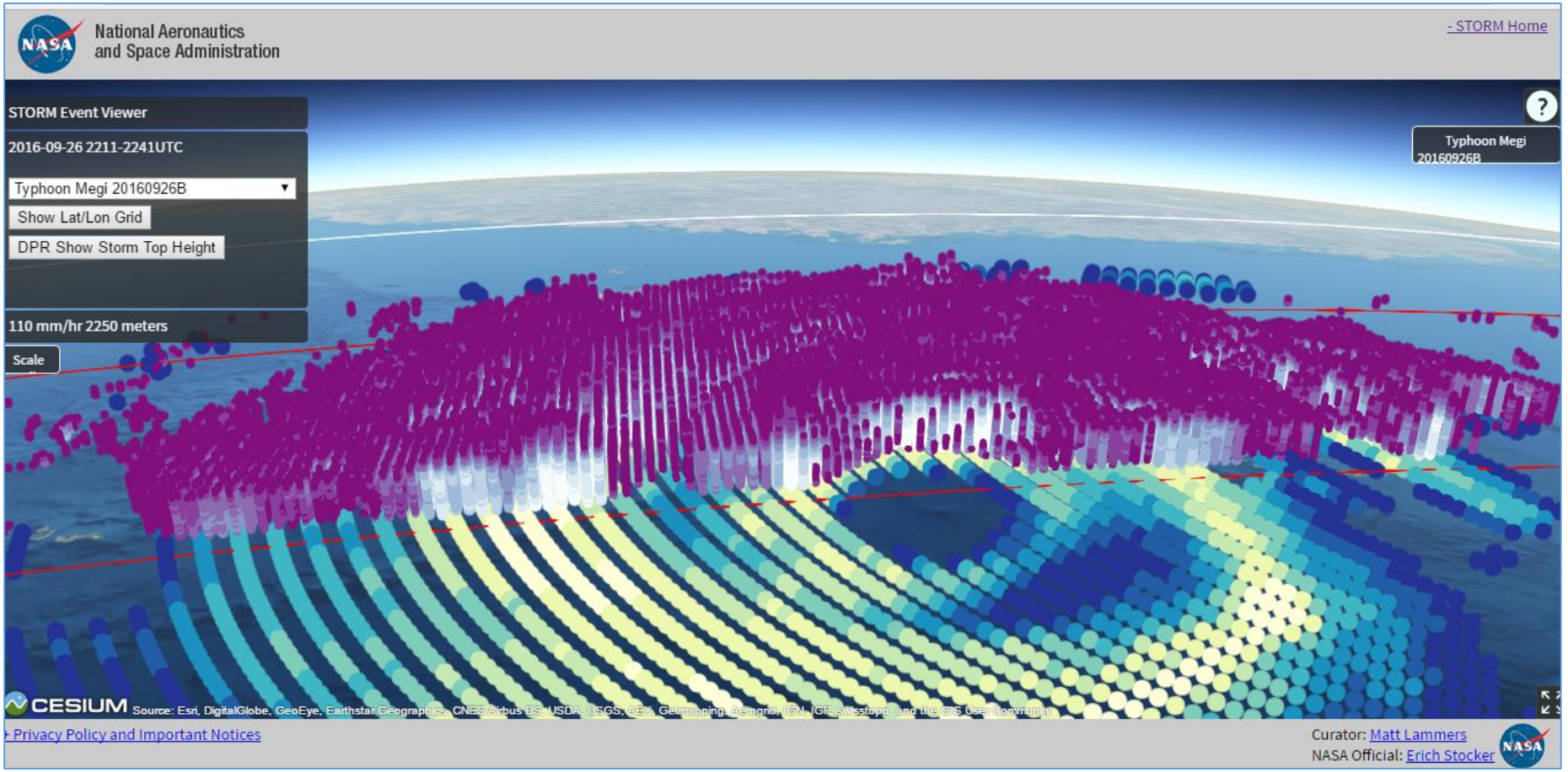
STORM Event Viewer

What about really important, high impact events?

https://storm.pps.eosdis.nasa.gov/storm/cesium/EventViewer.html

STORM Event Viewer

With tens of thousands of GPM orbits, isolating the ones that contain high-impact events is a priority.



STORM Event Viewer

Three ways “Events” get selected:

STORM Event Viewer

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- I performed a massive survey collocating GPM overflights with tropical cyclones

STORM Event Viewer

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- I see events occurring in the NRT Viewer and isolate them for preservation in the Event Viewer

STORM Event Viewer

Three ways “Events” get selected:

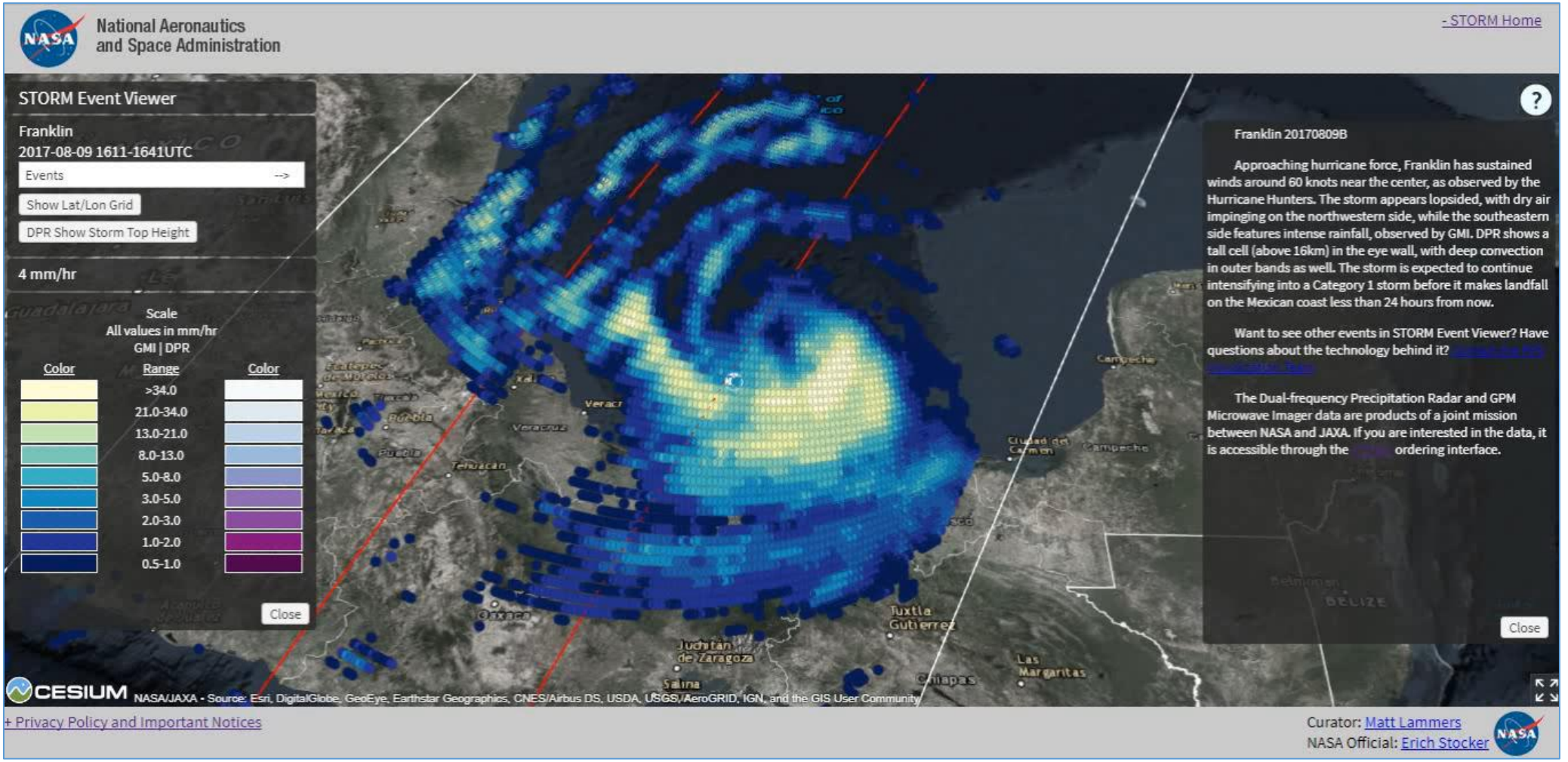
- I performed a massive survey collocating GPM overflights with tropical cyclones

- I see events occurring in the NRT Viewer and isolate them for preservation in the Event Viewer

- A researcher or project member requests a specific case get highlighted for a press release or to feature in a presentation

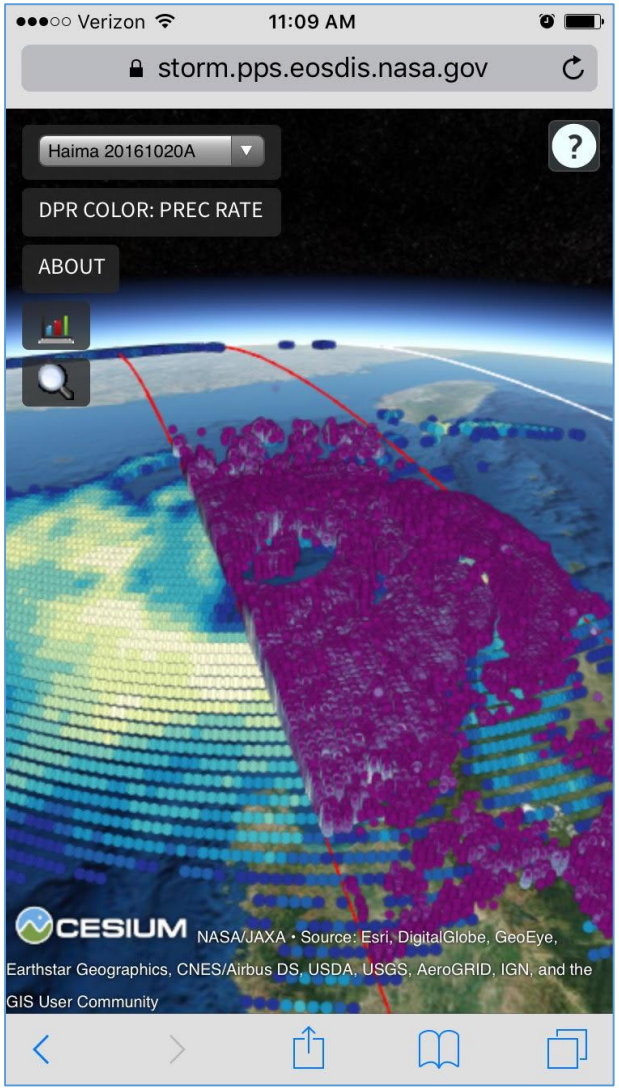
STORM Event Viewer

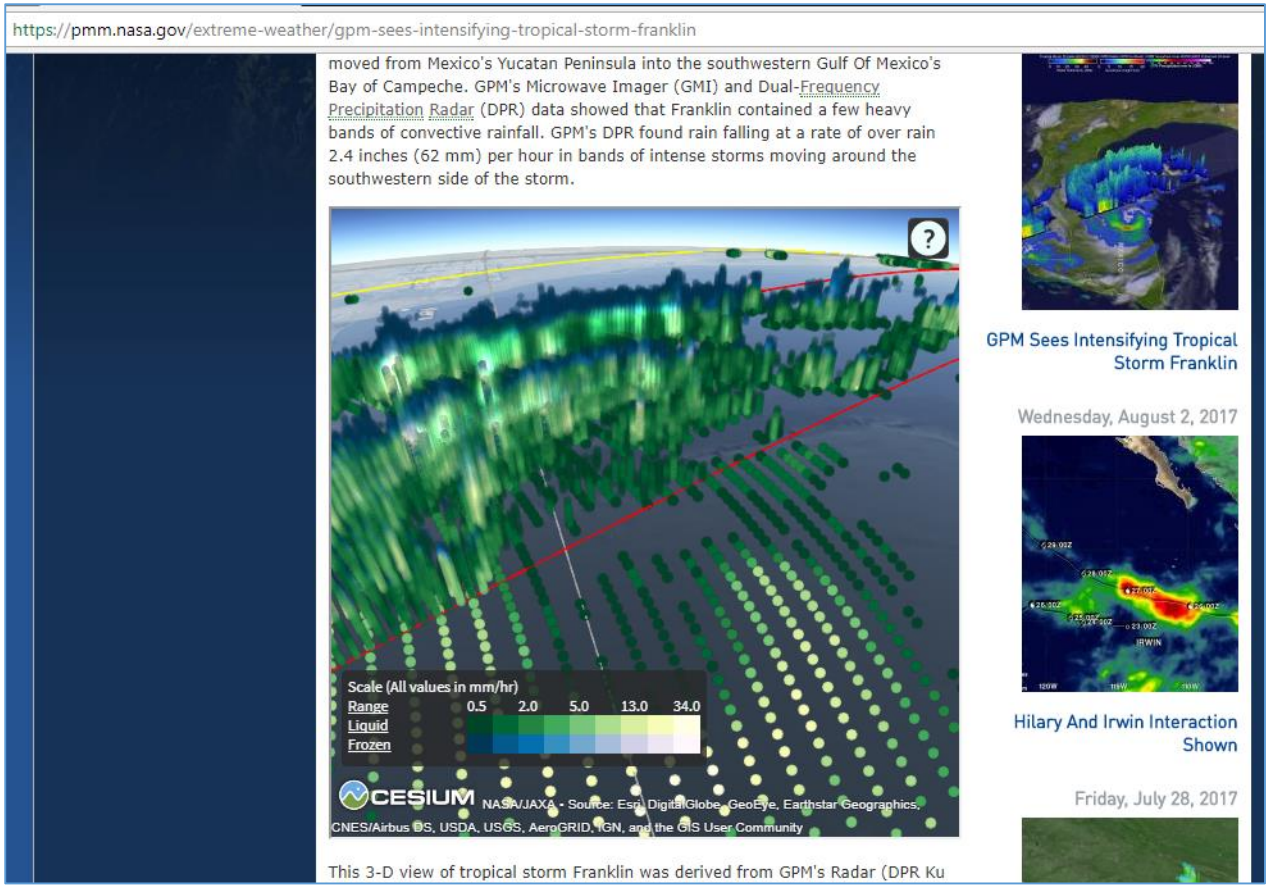
Latest Event: Hurricane Franklin 8/9/17



STORM Event Viewer

Mobile Version (EVMini) and Embeddable Version (EVMicro)





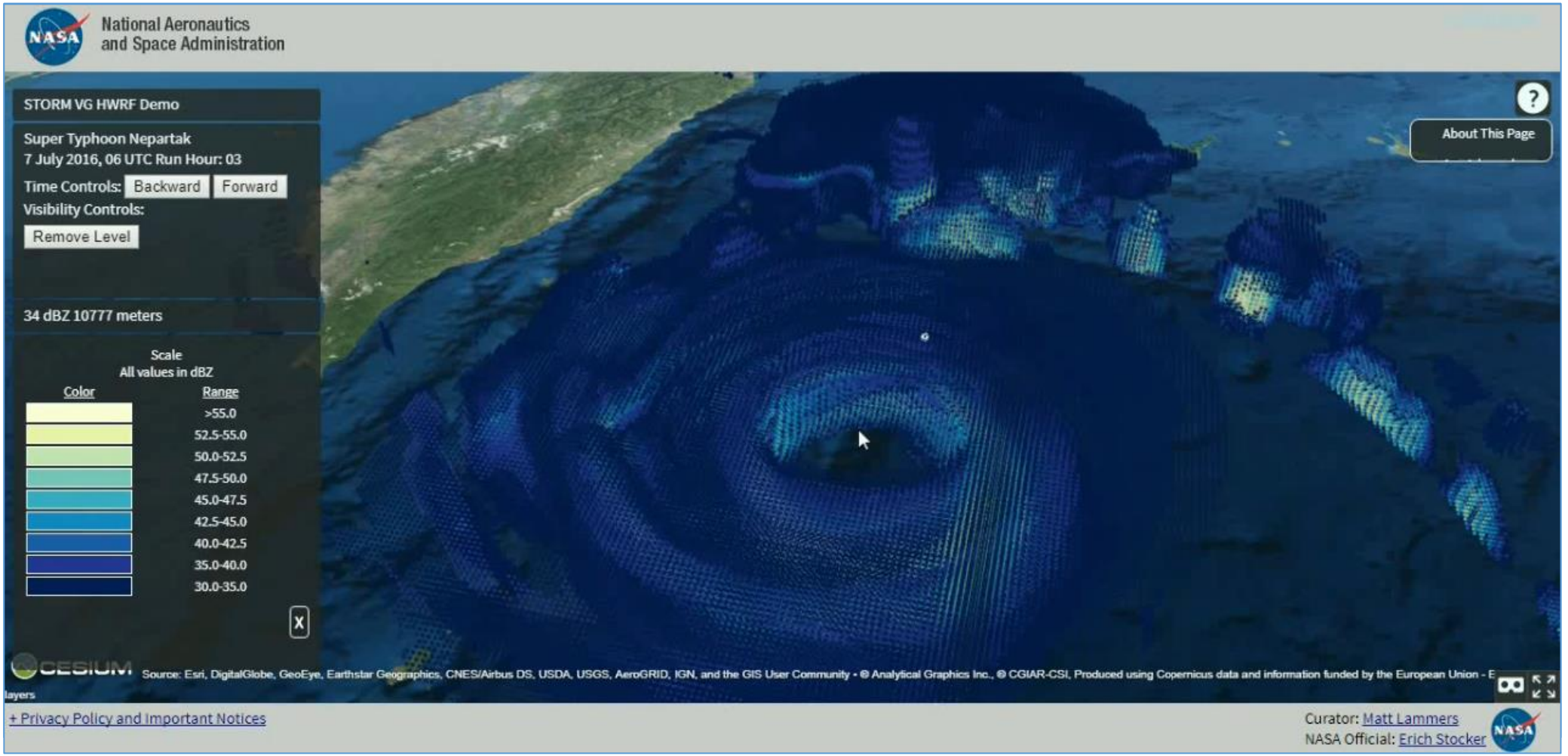
Other Demos

Where else has this CesiumJS journey taken me?

Other Demos

High-Resolution Weather Model Output

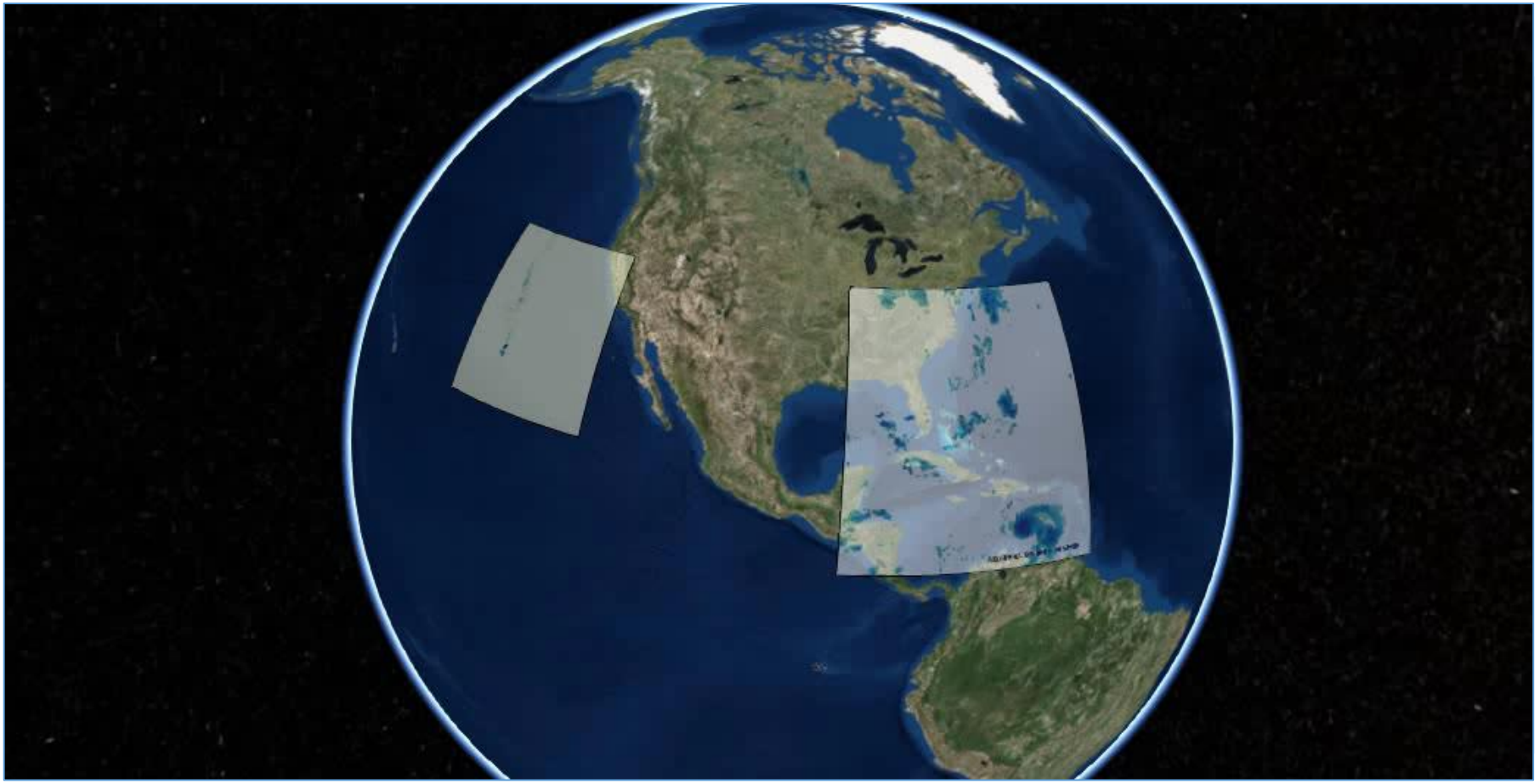
https://storm.pps.eosdis.nasa.gov/storm/cesium/HWRF.html



Other Demos

Generating Videos from Gridded Data and Previewing Them on the Globe

https://storm.pps.eosdis.nasa.gov/storm/cesium/VidTest.html



Other Demos

Animating Modeled Particle Transport

Final Remark

This is just scraping the surface of what can be done with remote sensing and other atmospheric data in CesiumJS. It is on this generation (and future generations) of researchers to leverage innovative tools to make scientific investigation easier to perform and results easier to share online with colleagues and the public.

...THANK YOU!

matthew.r.lammers@nasa.gov

Oh Yeah!

Demos and Discussions Tomorrow (Thursday) at Noon at the CesiumJS Booth

...THANK YOU!

matthew.r.lammers@nasa.gov

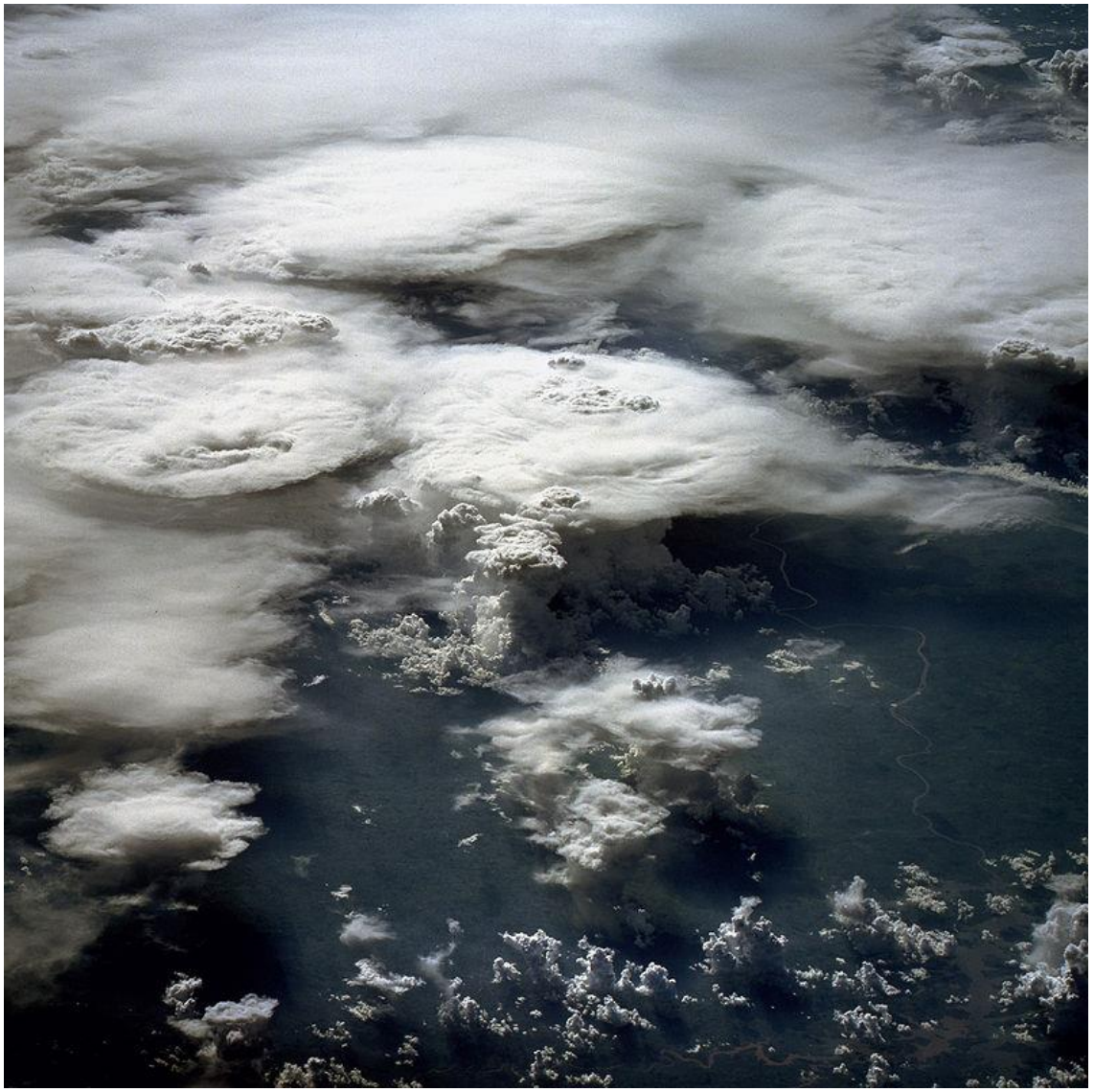
Extra Slides…

Who Am I?

Then, I saw weather from the ground

By Taken byfir0002 | flagstaffotos.com.auCanon 20D + Canon 17-40mm f/4 L - Own work, GFDL 1.2, https://commons.wikimedia.org/w/index.php?curid=893031

Who Am I?



By NASA - http://eol.jsc.nasa.gov/sseop/EFS/photoinfo.pl?PHOTO=STS41B-41-2347, Public Domain, https://commons.wikimedia.org/w/index.php?curid=1975689

Now,
I see it from space

Other Demos

High-Resolution Weather Model Output

https://storm.pps.eosdis.nasa.gov/storm/cesium/HWRF_v2.html