



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





August 16, 2017

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I maintain the STORM data portal for Global Precipitation Measurement (GPM) Mission satellite data at NASA Goddard







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







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View Coincidence Hap

Sometimes it's on a latitude-longitude grid

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FOSS4G 2017

August 14-19, 2017







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.

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CesiumJS!







CesiumJS!



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CesiumJS!



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







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.





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



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





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





So where did I start? Near Real Time Data... https://storm.pps.eosdis.nasa.gov/storm/ cesium/GPMNRTView.html



GPM Near Real Time Viewer







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.



A close-up to illustrate how this process works...







Moving on to "production" data, and STORM Virtual Globe

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



STORM Virtual Globe

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### **STORM Virtual Globe**

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#### **29 Products Available**









- 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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- Gridded, swath, and 3D data are all treated the same

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



#### **STORM Virtual Globe**



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#### What about really important, high impact events?

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





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











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





- 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





- 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**

National Aeronautics and Space Administration	- STORM Home
STORM Event Viewer Franklin 2017-08-09 1611-1641UTC Events -> Show Lat/Lon Grid	Franklin 20170809B Approaching hurricane force, Franklin has sustained winds around 60 knots near the center, as observed by the Hurricane Hunters. The storm appears lopsided, with dry air implinging on the porthwestern side while the southeastern
DPR Show Storm Top Height 4 mm/hr Scale All values in mm/hr GMI   DPR Color Range Color	side features intense rainfall, observed by GML DPR shows a tall cell (above 16km) in the eye wall, with deep convection in outer bands as well. The storm is expected to continue intensifying into a Category 1 storm before it makes landfall on the Mexican coast less than 24 hours from now. Want to see other events in STORM Event Viewer? Have questions about the technology behind it?
>34.0         >21.0-34.0         >13.0-21.0         >13.0-21.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0         >10.0-10.0 </td <td>Curat det Common Curat det Curat det</td>	Curat det Common Curat det Curat det
	Tuxtla Gutierrer Close
+ Privacy Policy and Important Notices	Curator: Matt Lammers



Haima 20161020A

ABOUT

DPR COLOR: PREC RATE

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### **STORM Event Viewer**



#### Mobile Version (EVMini) and Embeddable Version (EVMicro)

https://pmm.nasa.gov/extreme-weather/gpm-sees-intensifying-tropical-storm-franklin



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GIS User Community

Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the





#### 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



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### Generating Videos from Gridded Data and Previewing Them on the Globe

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









#### Animating Modeled Particle Transport







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...





#### Then, I saw weather from the ground



By Taken by fir 0002 | flagstaffotos.com.auCanon 20D + Canon 17-40mm f/4 L - Own work, GFDL 1.2, https://commons.wikimedia.org/w/index.php?curid=893031







### Now, I see it from space

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### **Other Demos**



## High-Resolution Weather Model Output

https://storm.pps.eosdis.nasa.gov/storm/cesium/HWRF v2.html

