FedGeoDay 2016

Interactive Visualization of Satellite (and Other) Data Online Using Cesium

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About My Job

- Precipitation Processing System Group at NASA Goddard

- Ingest and process data from the Global Precipitation Measurement (GPM) Mission Core satellite.

- STORM Data Portal - Production data from GPM Core satellite and 11 partner satellites; Archival data from the Tropical Rainfall Measurement Mission (TRMM) satellite.

- Visualizations of both Near Real Time and Production Data
Cesium – What is it?
- A Javascript library for visualizing...almost anything...on a 3D globe.

Source: The East Japan Earthquake Archive
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Source: ICGC
Cesium – What is it?
- A Javascript library for visualizing...almost anything...on a 3D globe.
Cesium – What Makes it Awesome?

- Extensive tutorials in their Cesium Sandcastle
  cesiumjs.org/Cesium/Apps/Sandcastle/

- Dozens of demos showcasing the best work from Cesium users around the world.
  cesiumjs.org/demos.html
Cesium – What Makes it Awesome?

- A commitment to working with the user community, both through the Github Issues page, and the Cesium Google Group.

- Cesium Markup Language (CZML). Simple, intuitive ways of changing position, color, size, and other properties with time.

- Cesium gives you essential tools for telling a story in four dimensions, no matter what your data source might be.
How I Use Cesium – About Satellite Data

- GPM Core satellite orbits the Earth between \( \sim 65^\circ N \) and \( \sim 65^\circ S \) latitude about every 90 minutes.

- Two primary instruments: the GPM Microwave Imager (GMI) and the Dual-frequency Precipitation Radar (DPR). Combined, the two give detailed information on precipitation type, precipitation rate, cloud structure, and many other variables.

- Satellite data are stored in HDF5 files, which are designed for high-density, multi-dimensional, gridded datasets.

- Post-processed files contain data in both orbit-based and latitude/longitude gridded formats.
How I Use Cesium – The Development Process

- When I started working with the data provided, I was making 2D images similar to this one.

- My officemate generates two of these each day showing 24 hours of GPM GMI ascending and descending scans.
How I Use Cesium – The Development Process

- One day, I saw this demo in the Cesium showcase. It presents 3D atmospheric model output. Each pixel is selectable, and sliders control ranges visible as well as time.

I thought that if Cesium could handle weather model data like that, then I could use the same principles to display precipitation satellite information.
How I Use Cesium – GPM Near Real Time Viewer

- The first product I developed was a way of visualizing the most recent data available from the GPM satellite. I generate CZML files every five minutes displaying the satellite scans as it flies over the Earth and observes many different variables (storm.pps.eosdis.nasa.gov/storm/cesium/GPMNRTView.html)
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How I Use Cesium – GPM Near Real Time Viewer

Precipitation over the Bay of Bengal on 11 October 2016
How I Use Cesium – STORM Virtual Globe

- After getting the NRT Viewer operational, I took the lessons learned from that product and transitioned to developing a tool for helping scientists using the production data order interface to view the files in 3D before downloading them.

- To streamline the process, a user makes a request that is passed to server-side Java, which grabs the relevant data from the raw HDF5 files. The values and positions are stored in a simple JSON object, which is passed to the client and parsed by Javascript, which creates the points in Cesium.

- The data order interface can be found at storm.pps.eosdis.nasa.gov/storm/Service.jsp?serviceName=RestrictedOrder
How I Use Cesium – STORM Virtual Globe

- Before STORM VG, when users were selecting a dataset, they could look at a static image of the overflight on a 2D map.
Now, they can zoom in on the orbit data on a 3D globe with the ability to mouseover individual data points.
How I Use Cesium – STORM Virtual Globe

STORM Virtual Globe

GPM-GMI GPROF
2016-09-19 0015-0148 UTC
Minute Range: 0-15
0 93
Hide DPR Hide GPROF
Show Lat/Lon Grid

Scale
All values in mm/hr
Color
Rainfall
-<4.0
21.0-34.0
13.0-21.0
8.0-13.0
5.0-8.0
3.0-5.0
2.0-3.0
1.0-2.0

About This Page
STORM Virtual Globe places raw precipitation data at your fingertips, displaying each data point from the selected product on a three-dimensional globe viewer. If not using IMERG or MGDPID, you can drag the slider to change the currently visible interval to any place in the granule, with an orange box providing a visual aide to show where the interval will appear. Once the data is displayed, mouse over the data points to see the raw values in the space above the scale.

Radar data adds the ability to see data not just on a globe, but above it. When the DPR or GPM product is chosen, precipitation rate values appear above the globe’s surface. This allows three-dimensional representations of storms. Mousing over these points displays not only the precipitation rate in mm/hr, but also the altitude.

Want to see other products in STORM Virtual Globe? Have questions about the technology behind it? Contact us.

Curator: Matt Lammers
NASA Official: Birch Stacker

STORM Home

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How I Use Cesium – Event Viewer

- The Event Viewer came out of a need to display high impact events as soon as the data were available in 3D.

- Focused on combining the simultaneous DPR and GMI scans.

- Display both precipitation rate and storm height from DPR, which involved efficiently changing the colors of over 100,000 points – but Cesium can do it.

- This product is currently in development, but will likely be released soon.
How I Use Cesium – Event Viewer
Super Typhoon Megi, September 2016, Off the Coast of Taiwan
How I Use Cesium – Event Viewer

Super Typhoon Megi, September 2016, Off the Coast of Taiwan
How I Use Cesium – Other Demos

Using Hurricane Weather Research & Forecasting (HWRF) model output ([storm.pps.eosdis.nasa.gov/storm/cesium/HWRF.html](storm.pps.eosdis.nasa.gov/storm/cesium/HWRF.html))
How I Use Cesium – Other Demos

Precipitation Measurement Mission Global Precipitation Viewer (pmm.nasa.gov/data-access/global-viewer, currently in Beta)
Wrapping Up

- Cesium has expanded our ability to visualize precipitation satellite overflight data, enabling the creation of web-based interactive tools that rival in visual quality the pre-rendered animations typically generated for high-impact weather events.

- While some of these products are over a year in the making, the extensive examples and vocal user community make the initial development process far less painful.

- If you have a geospatial story to tell, give Cesium a chance, you might be surprised by what you can create.

- Thanks to Patrick Cozzi, Owen Kelley, Erich Stocker, ESRI, and the entire Cesium development team!
https://storm.pps.eosdis.nasa.gov

Questions?