

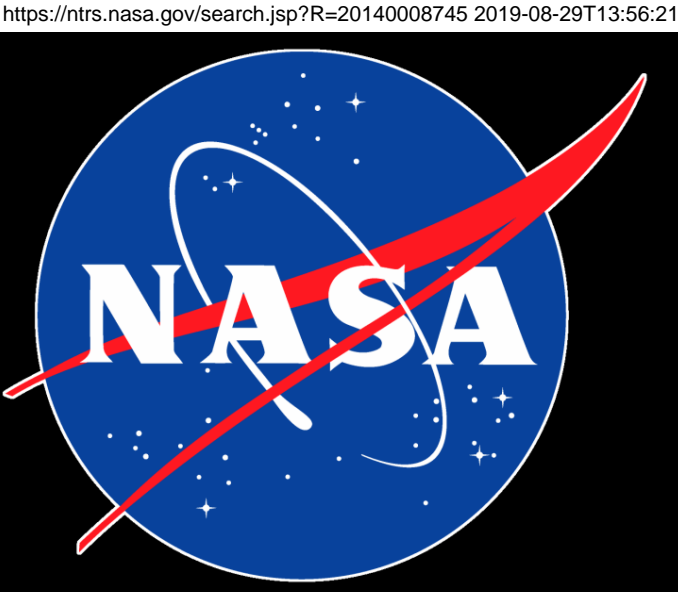
# Constructing Data Albums for Significant Severe Weather Events

Ethan Greene<sup>1</sup>, Bradley Zavodsky<sup>2</sup>, Rahul Ramachandran<sup>2</sup>, Ajinkya Kulkarni<sup>3</sup>, Xiang Li<sup>3</sup>, Rohan Bakare<sup>3</sup>, Sabin Basyal<sup>3</sup>, & Helen Conover<sup>3</sup>

<sup>1</sup>Mitchell College; New London, CT

<sup>2</sup>NASA/Marshall Space Flight Center; Huntsville, AL

<sup>3</sup>Information Technology and Systems Center/University of Alabama in Huntsville; Huntsville, AL



## Why Do We Need Data Albums?

- Important for generating case studies to enable researchers to improve prediction of convective thunderstorms that may result in damaging wind, hail, lightning, flooding and tornadoes.
- “One-stop shop” for information and data related to a specific science topic or event, such as severe weather events
- Links relevant data files from different instruments, online searches, news reports, official storm summaries, pictures, background information, damages, deaths, and injuries
- Aggregated data are organized in ways that can aid in the discovery of new trends through exploration
- Existing hurricane Data Album (Figs. 1 & 2) modified for severe weather

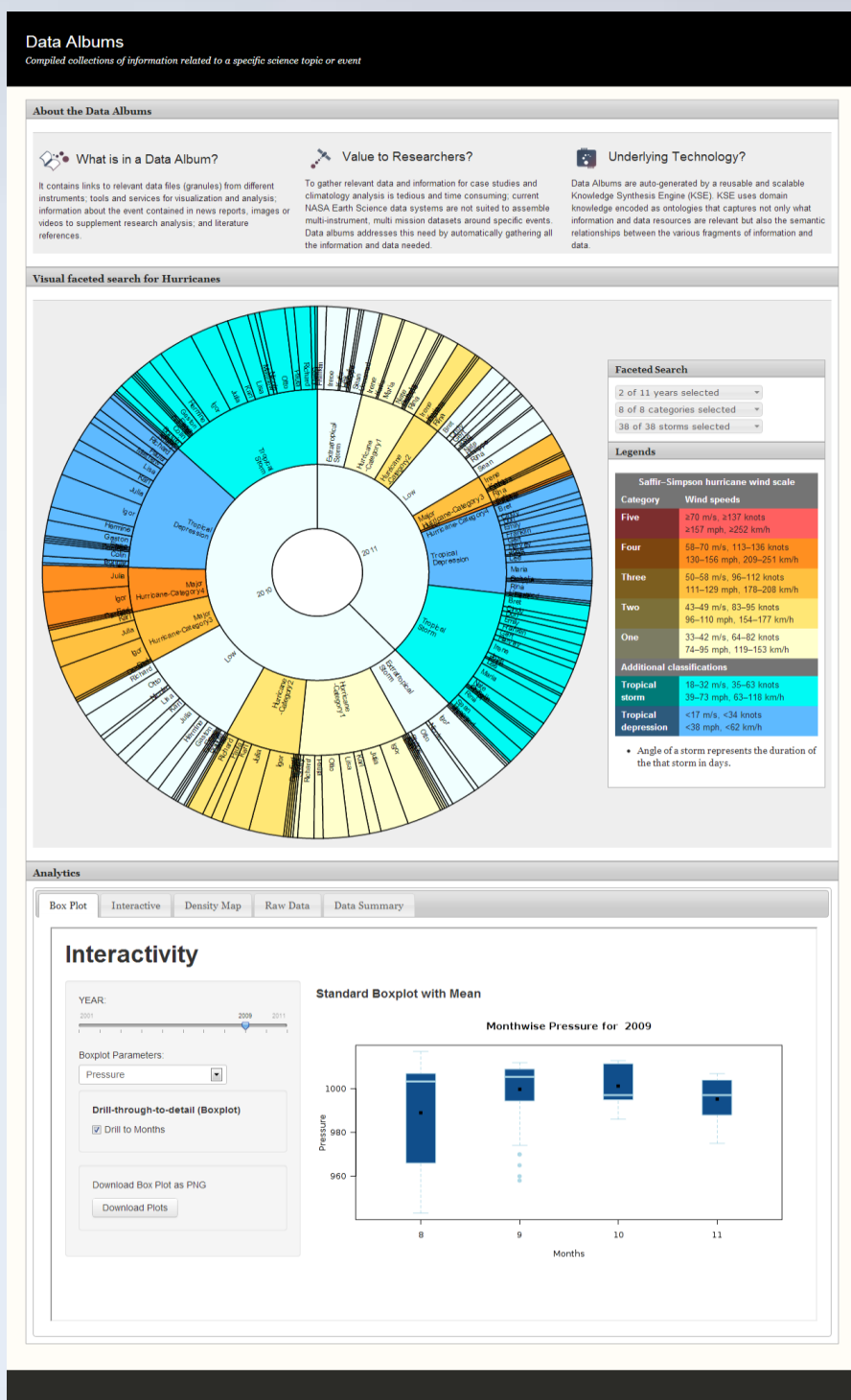


Figure 1: Navigation system and charting capabilities of an ontology driven data album for hurricane case studies.

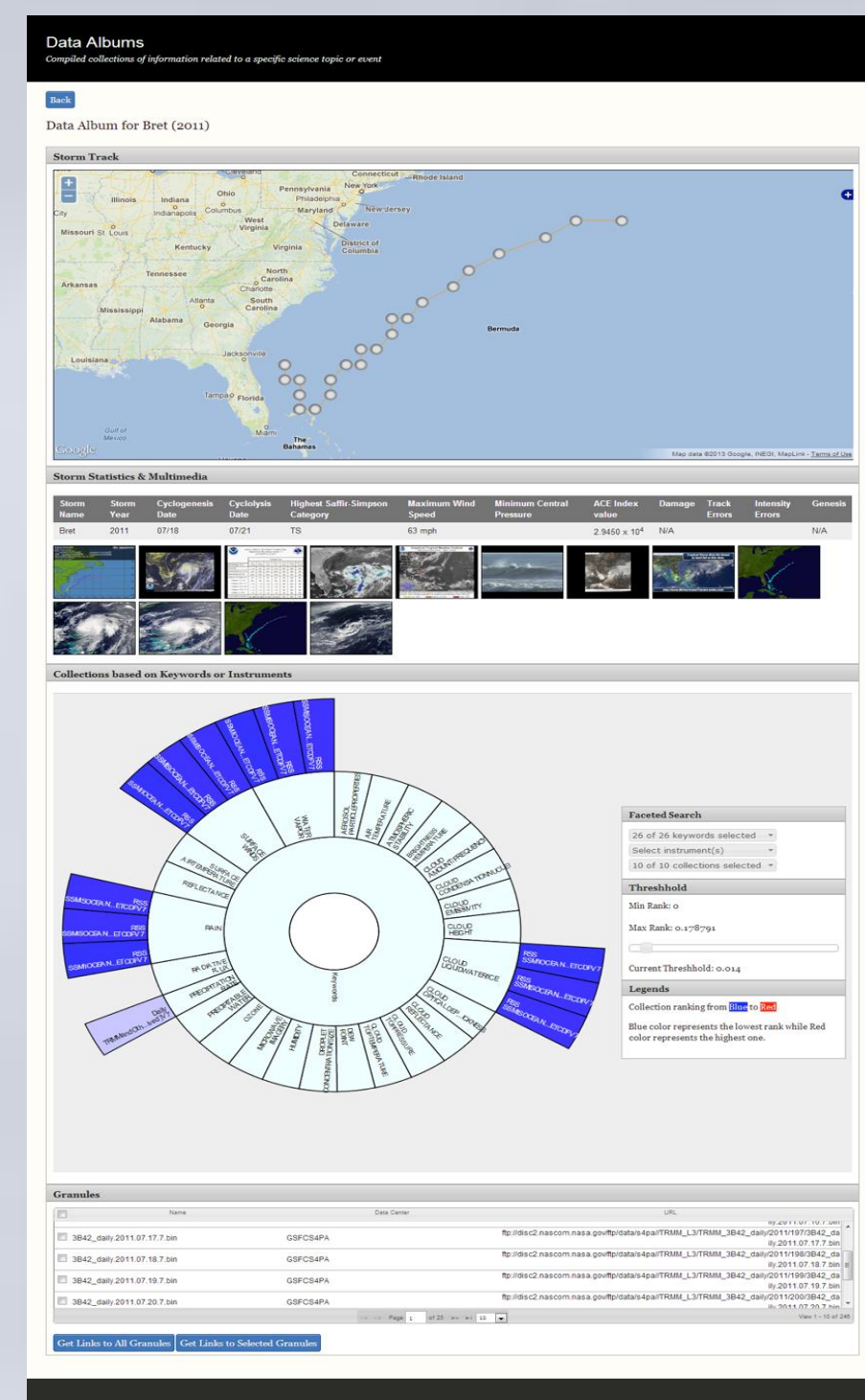


Figure 2: Full screen capture of the data album for Tropical Storm Brett showing the relevant NASA datasets in a pinwheel

## Noesis 2.0

- Open source, reusable aggregation software, which incorporates a variety of current web aggregation concepts to pull together data from:
  - Relevant NASA datasets are introduced through the Earth Observing System (EOS) Clearinghouse (ECHO; “2” in Fig. 3)
  - Web-based information from various online data formats, such as PDF and HTML (“3” in Fig. 3)
  - Social media information such as Twitter, Flickr, YouTube, etc. (“4” in Fig. 3)

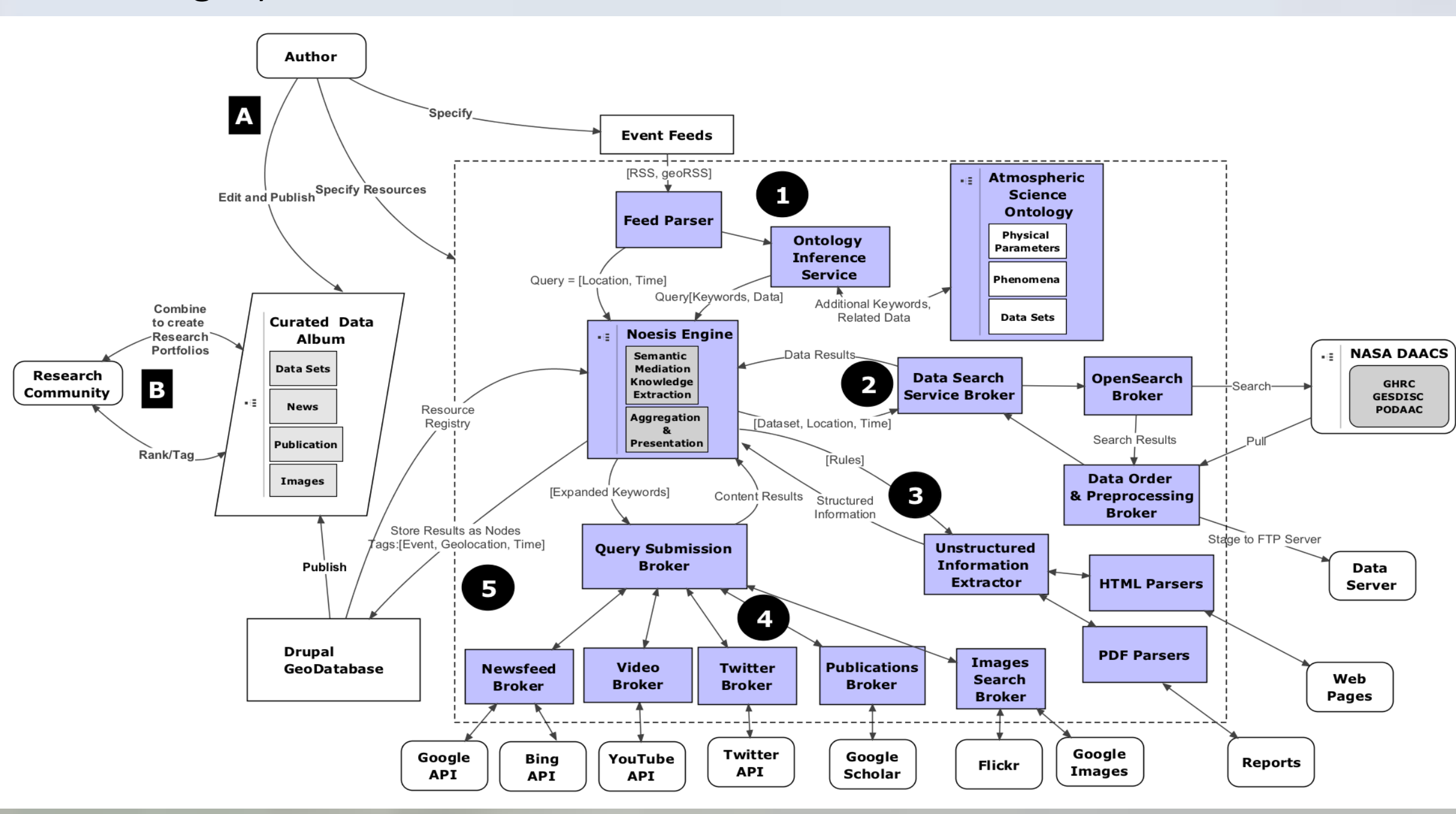


Figure 3. Schematic of Noesis System used to create data albums

## Ontology Development

- An ontology is a structured model of a specific topic showing key concepts and the relationships between them (Fig. 4)
- Can be thought of as similar to organizing the animal kingdom by phylum, species, etc.; however, instead using severe weather event keywords organized in the hierarchy

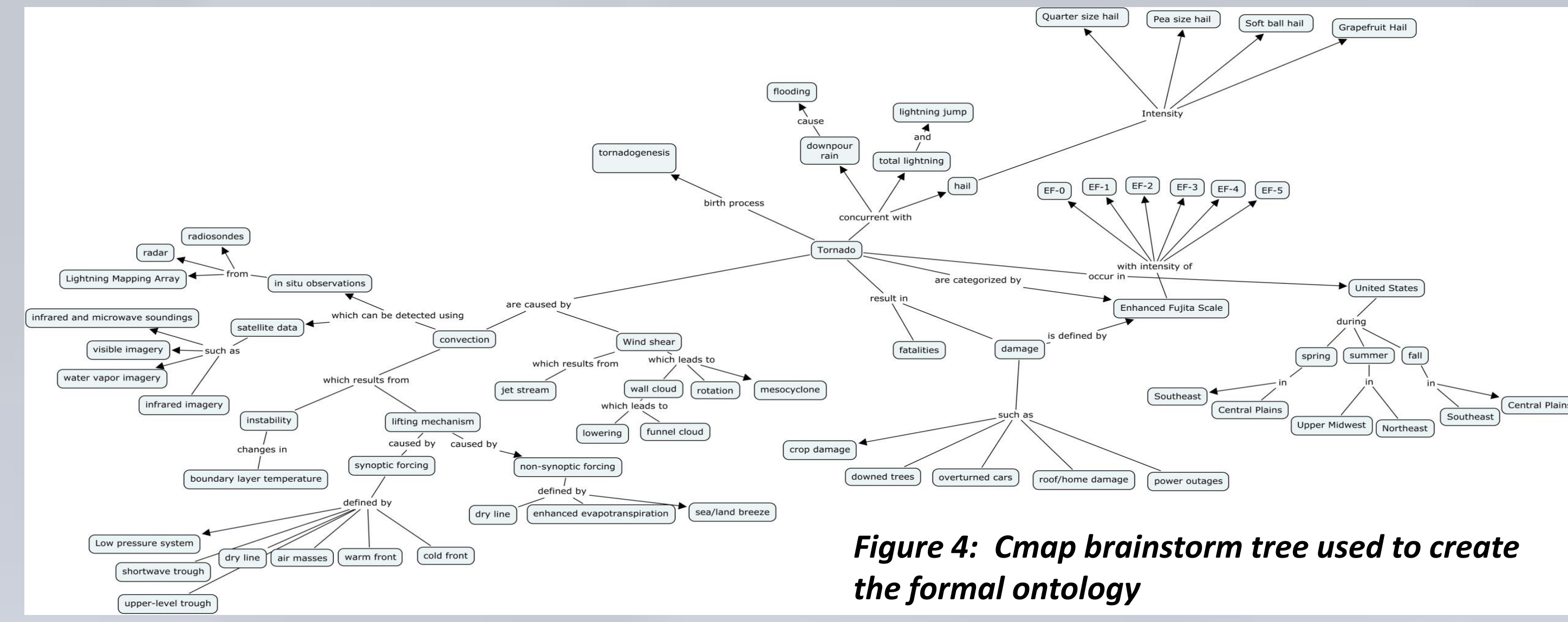


Figure 4: Cmap brainstorm tree used to create the formal ontology

## Meteorological Datasets

- Meteorological products are used to refine search areas for NASA datasets and to determine the quality of pre-event forecasts
- Products brought in include Public Severe Weather Outlook (PWO), Convective Outlooks, Convective Weather Watches, Mesoscale Discussions, and Storm Reports disseminated by the Storm Prediction Center (see Fig. 5)

## Social Media Archive

- Massive source of online data through news outlets and social media for investigating severe weather events
- YouTube Videos, Facebook, national and local news feeds online and recorded news broadcasts, Twitter, Flickr

## NASA Datasets

- NASA collects many different Earth Science observations both from satellite and field campaigns for ground validation, which are stored in a clearinghouse called ECHO
- Only a small percentage of the datasets are relevant to meteorology and the measurement of severe weather phenomena
- Appropriate NASA datasets were selected based on their relevance to the severe weather phenomena for inclusion in a severe weather Data Album (Tables 1 & 2)
- Using the ontology and geolocation information in the SPC products; only the relevant NASA data are included in the Data Album

Table 1: Recent NASA field campaigns relevant to severe weather

Campaign	Location	Date	Relevance
Light Precipitation Validation Experiment (LPVEx)	Finland	Sept.-Dec. 2010	High latitude precipitation
Mid-latitude Continental Convective Clouds Experiment (MC3E)	Oklahoma	April-May 2011	Convective precipitation
Iowa Flood Study (IFloodS)	Iowa	May-Jun. 2013	Heavy precipitation

Table 2: NASA satellite data relevant to severe weather

Instrument	Relevant Measurement
AMSU-A	T, RH profiles
AIRS	T, RH profiles
AMSRE	Precipitation, WV
TRMM	Rain Rate
LIS	Total Lightning
MLS Aura	T, RH, cloud ice
OLS	Moonlit clouds
VIIRS	Clouds
CrIS	T, RH profiles

## Severe Weather Data Album

- Home page (Fig. 5 left):
  - Statistical overview of weather events binned by date
  - By clicking on the year, month, and day, users can “dig down” to investigate severe weather events from a particular date
- Event page (Fig. 5 right):
  - Aids in answering the question: “Was this a good forecast?” by providing forecast products and NASA datasets
  - Interactive map with storm reports overlaying convective outlooks detailing the forecast process leading up to an event
  - Videos, pictures, and social media information during and after the event
  - Based on date and location of convective outlook, all NASA data relevant to severe storms is linked into the page

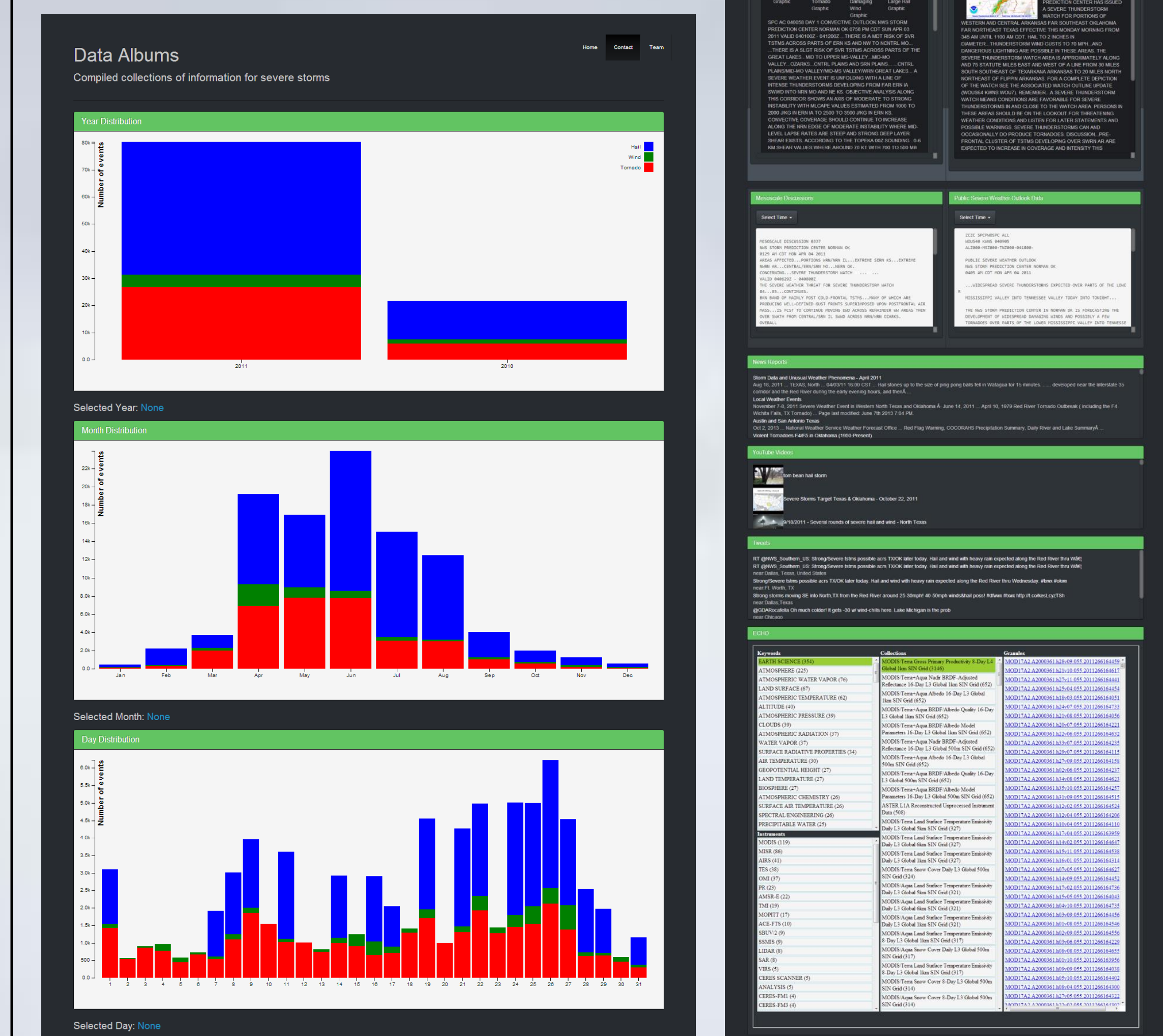


Figure 5: Home page (left) and event page (right) for a widespread severe weather event on 3-4 April 2011.

## Summary

- Data Albums provide a one-stop-shop combining datasets from NASA, NWS, online new sources, and social media
- Data Albums will help meteorologists better understand severe weather events to improve predictive models
- Developed a new ontology for severe weather based off current hurricane Data Album
- Selected relevant NASA datasets for inclusion in Data Album

## Acknowledgements

This work was funded by Steven Berrick at NASA HQ, through a NASA ROSES ACCESS proposal, and the American Association for the Advancement of Science, which funded the lead author's NASA internship.