**VISAGE Framework for Interactive Exploration of Diverse Precipitation Data**
(Visualization for Integrated Satellite, Airborne and Ground-based data Exploration)

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**VISAGE ARCHITECTURE**

**High Level Architecture**

- **Application Programming Interface**
- **Visualization**
- **Components**
  - **Database**
  - **Analytics Services**
  - **Data**
- **Front End Interface**

**Components**

- **Database**
- **Analytics Services**
- **Data**

**VISAGE Components**

- **GRIB**
- **GPM**
- **Chimera**
- **Carto**
- **RadarSim**
- **NetCDF**
- **JSON**

**Technical Challenges / Research Areas**

- **Serverless cloud-native technologies**
- **AWS Web Service (AWS) Athena stateless query service for searching data stored in S3 buckets**
- **AWS Step Functions and Lambda to orchestrate and run data processing and rendering code without provisioning or managing servers, automatically scaling resources as needed**
- **Analysis optimized data store**
- **Scalable, efficient data access to support on-the-fly rendering and analytics**
- **Data framework with ingest and access APIs to Parquet files via the Athena query interface**
- **3D data visualization and exploration of large data volumes on a web-based platform**
  - **Oceans and Potere visualization engines**
  - **Evaluation of different 3D data rendering approaches (visual appeal, memory usage, etc.)**
  - **3D data interrogation via map user interface**
- **Basic analytics across different data sources (e.g., statistics, histograms)**
- **Temporal alignment of diverse data sets**
- **Time-dynamic visualization specifications (CZML or 3D Tiles)**
- **Metadata to define window around user interface time that the data should be displayed (real-time and lag time)**

**EXAMPE SCIENCE QUESTION:**

**What are the characteristics of convective precipitation that result in non-uniform beam filling effects on GPM satellite sensors?**

**EXAMPLE SCIENCE QUESTION:**

**Integrated Precipitation and Hydrology Experiment**

Warm season orographic precipitation regimes and hydrologic processes in regions of complex terrain.

-Earth Focus: Warm-season convective storms with severe hail observations from ground-based radars, ER-2, Citation, and GPM Core overpasses with very good GMI and DPR coverage

-Location: W. North Carolina & S. Appalachia
-Operation: April – June 2016
-Use Cases: 524 May 2016, 250-0200 UTC
-Regions: 39N, 78W, 38N, 38W

**DATA AVAILABLE FOR THIS USE CASE:**

- Ground radars including NPOD
- ER-2 and Citation aircraft
- DPR and ground hail match-ups

**EXAMPLE SCIENCE QUESTION:**

**Olympic Mountains Ground Validation Experiment**

Evaluating space-based observations of rain and snow in extreme coastal and topographic gradients.

-Earth Focus: Complex orographic system with orographic enhancements, excellent sampling coordination with simultaneous satellite, airborne, and ground-based observations
-Location: Olympic Mountains of Washington State
-Use Case: 3 Dec 2015, 1400-1700 UTC
-Regions: 46N, 127W, 43N, 124W

**DATA AVAILABLE FOR THIS USE CASE:**

- Most ground instruments, including:
  - Radiosonde
  - Rader, NPOD, IDF, DPR, DWR
  - Disdrometers, gauges, profi, ground probes, rain
  - ER-2, DC-8 and Citation aircraft

- **GPM**
  - **ER-2**
  - **DWR**
  - **GPM**

- **GPM**
  - **ER-2**
  - **DWP**

- **GPM**
  - **ER-2**
  - **DWR**

**DATA AVAILABLE FOR THIS USE CASE:**


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- **VISAGE Visualization Data**
  - **Data layers**
    - **Elevation**
    - **Temperature**
    - **Humidity**
    - **Wind Speed**
    - **Wind Direction**
  - **Rendering Tools**
    - **Contouring**
    - **Shading**
    - **Texturing**
  - **Science Tools**
    - **Statistics**
    - **Histogram generation**

- **Effective use of visualization and data management to support analysis**
  - **Max min, mean, std deviation, histogram**
  - **This will serve as the basis for comparison across different data fields**