DYNAMO

Funded by the National Science Foundation Grant #1826997

SCinet Tech Challenge: Dynamic Network-centric Multi-cloud Platform (DyNamo) for Real-Time Weather Forecasting Workflows

Eric Lyons, George Papadimitriou, Cong Wang, Komal Thareja, Paul Ruth,
J. J. Villalobos, Ivan Rodero, Ewa Deelman, Michael Zink, Anirban Mandal

renci
USC Viterbi School of Engineering Information Sciences Institute
UMass Amherst
Rutgers

DYNAMO

Extreme Weather Events Cause Severe Property Damage and Life Loss

WEATHER

Tornado causes damage in Dallas; more severe thunderstorms, hail move into DFW

BY KALEY JOHNSON

OCTOBER 20, 2019 11:44 AM

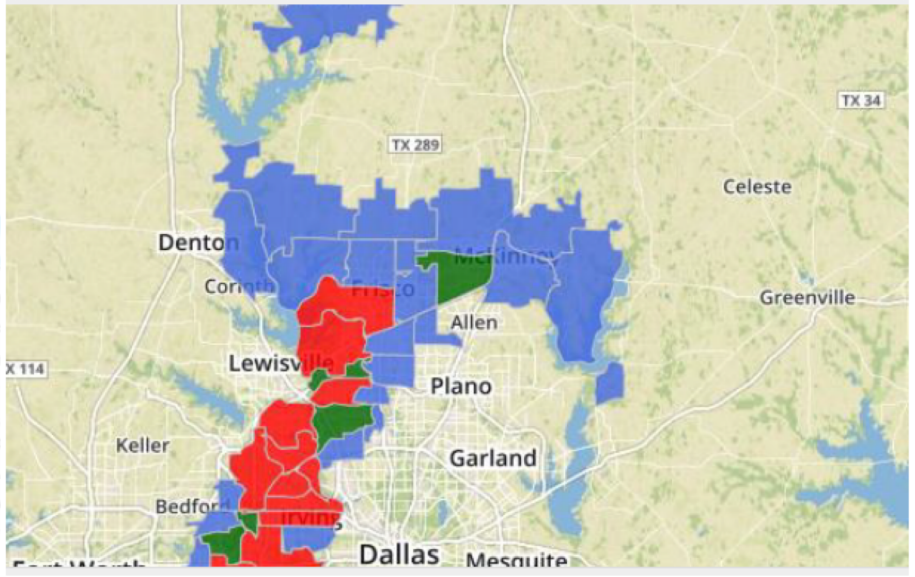
Tornadoes leave behind heavy damage, power outages after moving through Dallas

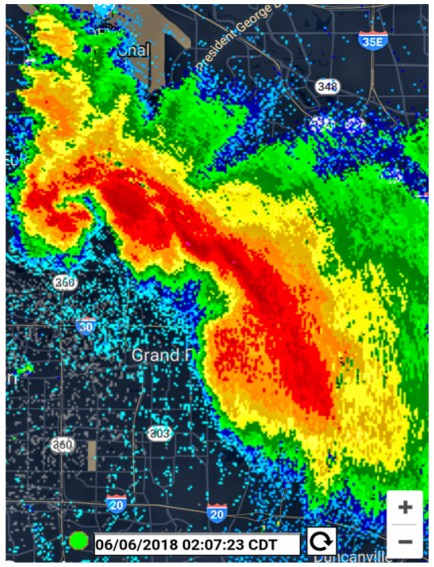
Weather Service suspects more than one funnel cloud hit the area, but no deaths reported.

Ken Foster (center) wipes his brow while helping a friend clear some belongings from her damaged home on Pemberton Drive in Dallas, Monday, October 21, 2019. A tornado tore through the neighborhood knocking down trees and ripping roofs from homes. (Tom Fox / Staff Photographer)

Damage from June 6 Texas Hailstorm Estimated at $1B

June 12, 2018





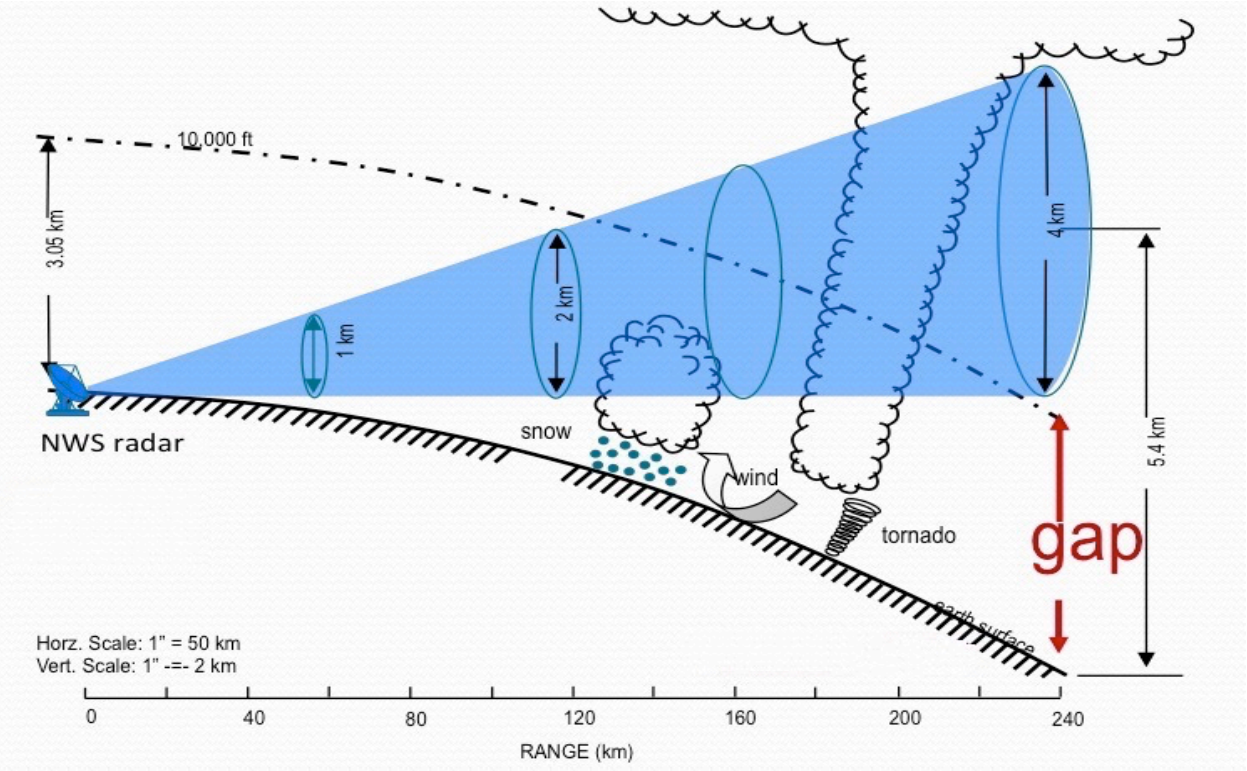
renci

USC Viterbi School of Engineering *Information Sciences Institute*

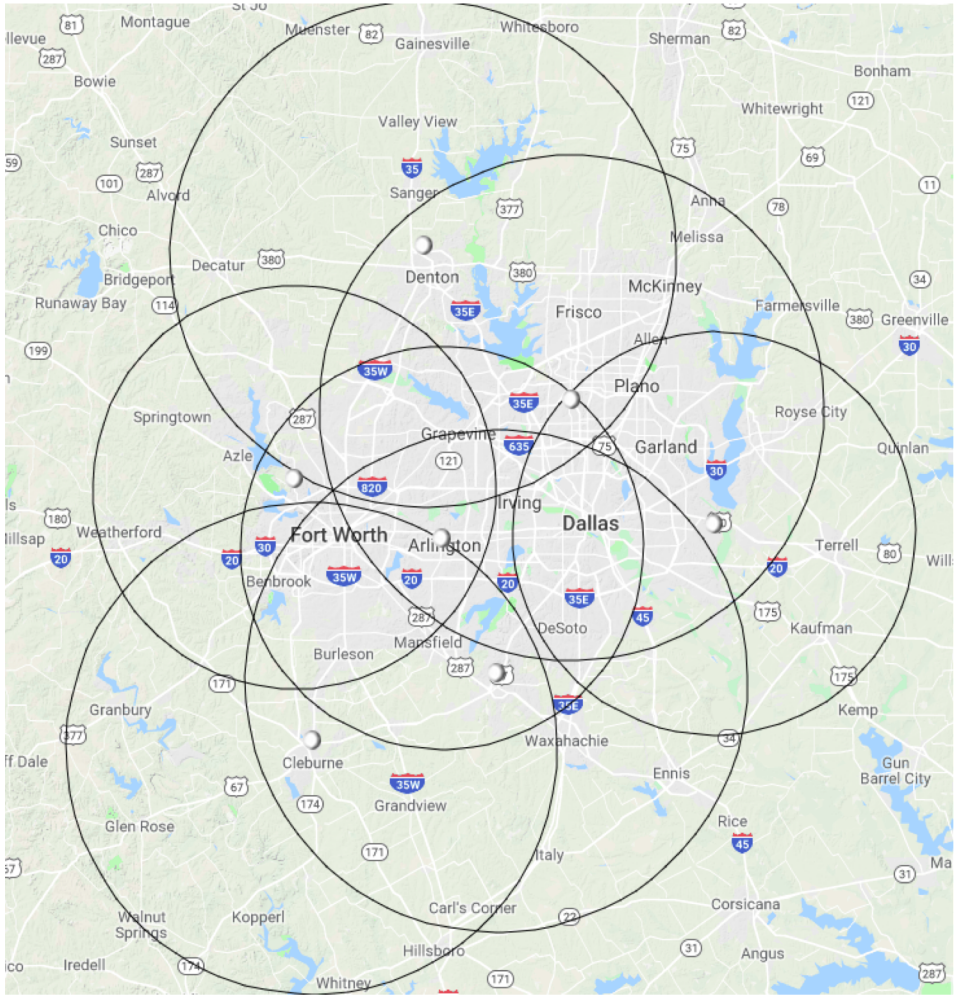
UMass Amherst

RUTGERS

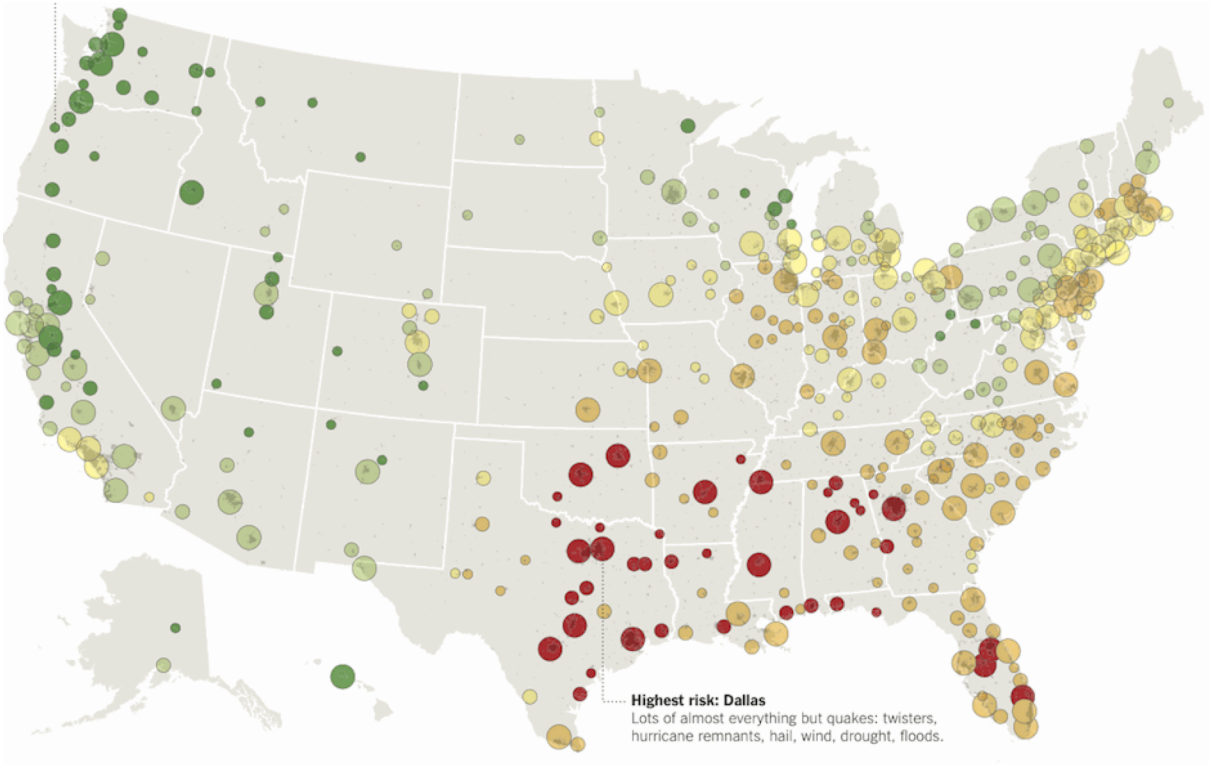
CASA: Collaborative Adaptive Sensing of the Atmosphere



- Traditional Next Generation Weather Radars (NEXRAD)
  - High power, long range
  - Limited ability to observe the lower part of the atmosphere because of the Earth's curvature
- CASA
  - Network of short range Doppler radars
  - Adjustable sensing modes in response to quick weather changes
  - Suitable for near-ground weather events: tornado, hail, high winds



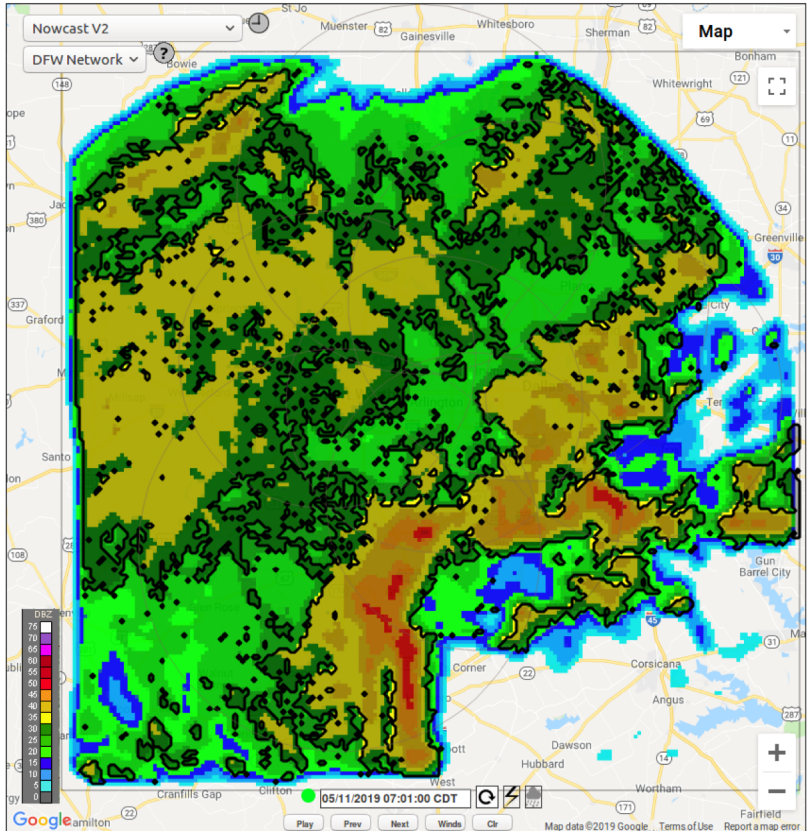
- > 7M people, >100K businesses, >1500 Corporate HQs



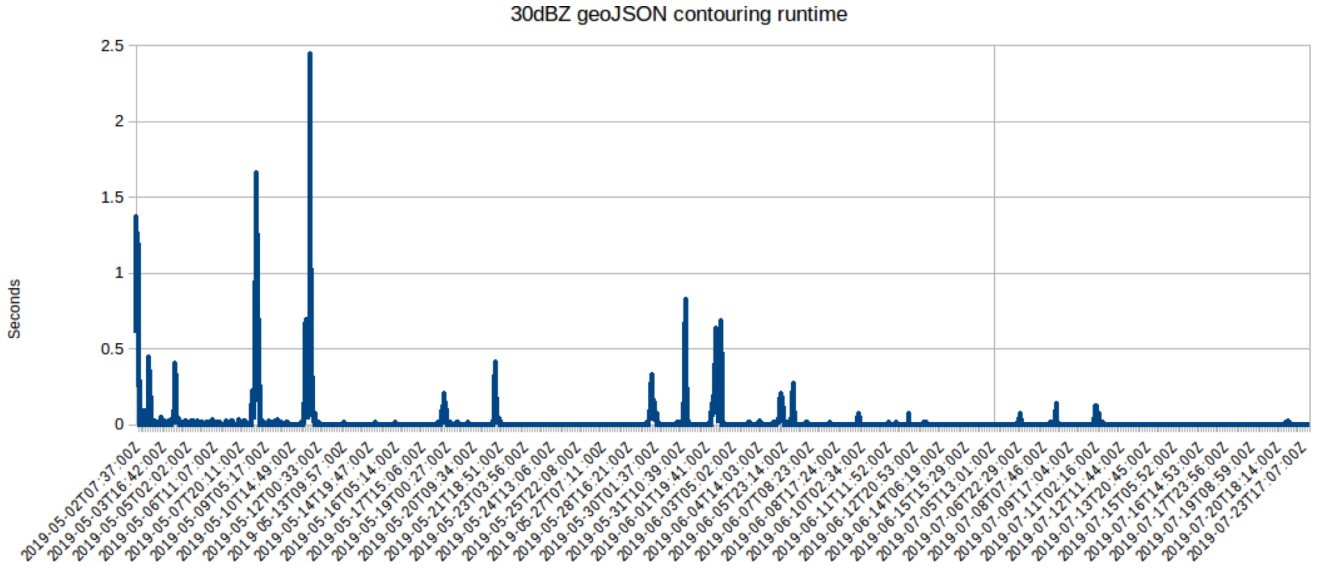
DYNAMO

CASA DFW Network

CPU load and network utilization highly correlated to **coverage and intensity**



Notable weather events are **infrequent**



Expensive to maintain dedicated resources for the worst case

Needs from scientist: high performance, on-demand, scalable compute and networking infrastructure

renci

USC Viterbi School of Engineering Information Sciences Institute

UMass Amherst

Rutgers

DYNAMO

DyNamo: Multi-Cloud Platform for Scientific Workflows

- Develop novel mechanisms to offer adaptive and secure data-flows across multiple cyberinfrastructures.
- Provide solutions as a network-centric platform to integrate data-intensive science workflows with state-of-the-art network architectures and services.
- Implement network-aware workflow scheduling, predictions and ensemble mechanisms using Pegasus Workflow Management System (WMS)
- Improve performance and efficiency of science workflows
  - **Collaborative and Adaptive Sensing of Atmosphere (CASA)**
  - Ocean Observatory Initiative (OOI) and Virtual Data Collaboratory (VDC)

renci

USC Viterbi School of Engineering Information Sciences Institute

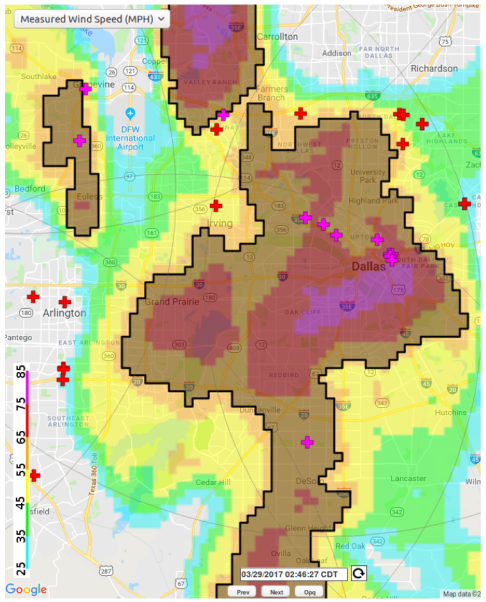
UMass Amherst

RUTGERS

CASA Data Transfers

- ~100 Mbps per radar raw data, processed locally
- ~10 Mbps per radar "moment" data, needs to be transferred across network
- ~1 Mbps gridded product data
- Transferred to DFW Radar Operations Center at NOAA Southern Region Headquarters (SRH)
- Transferred to Univ. Of North Texas for DYNAMO data collection

CASA Wind Contouring Data Processing Workflow

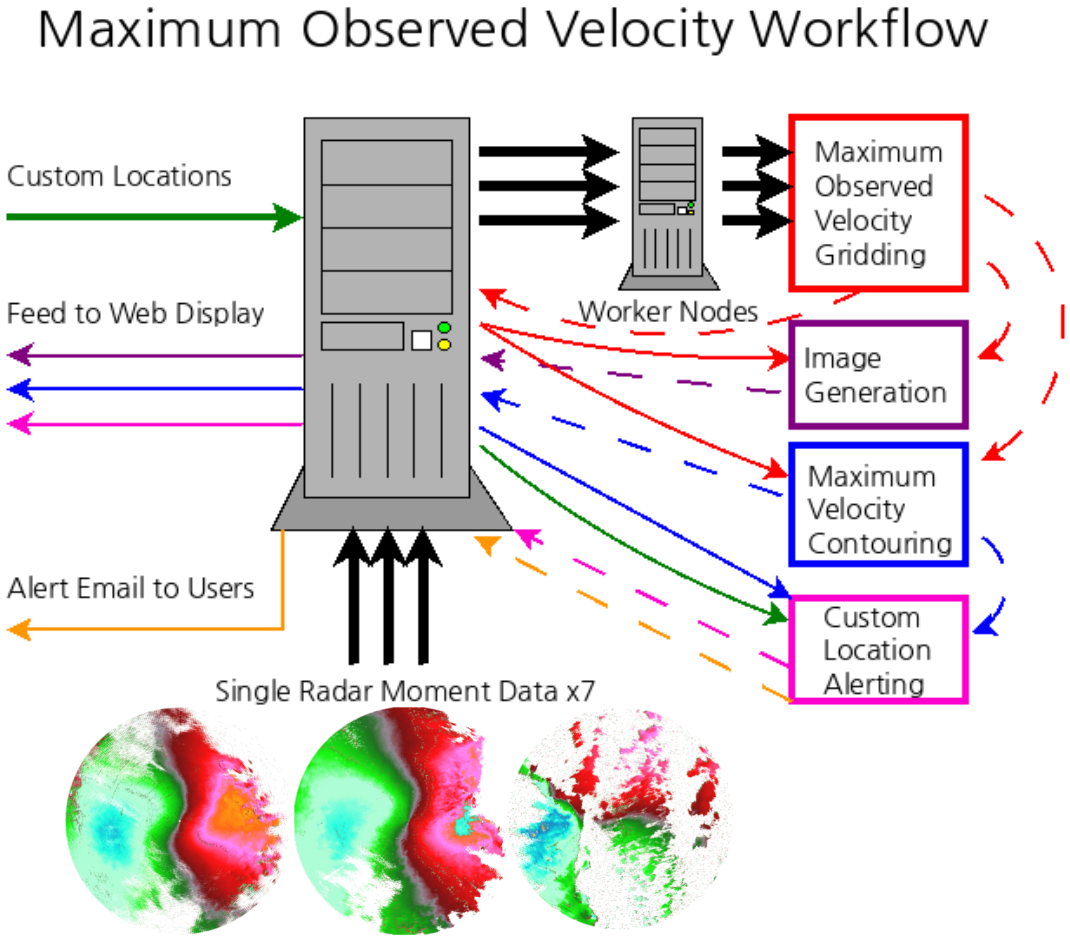


CASA automated notification for BAYLOR UNIVERSITY MEDICAL CENTER

noreply@papajim.eu

siteLocation: BAYLOR UNIVERSITY MEDICAL CENTER
alert type: WINDS_CASA mag: 58MG
timestamp: 2017-03-29T07:55:00Z

To be removed from this mailing list, please send email to elyons@engin.umass.edu.



- Ingests compressed data from 7 radars
- Combine into grid of maximum observed wind speed
- Generate combined radar image
- Compute wind contours with velocity thresholds
- Send alerts based on user locations

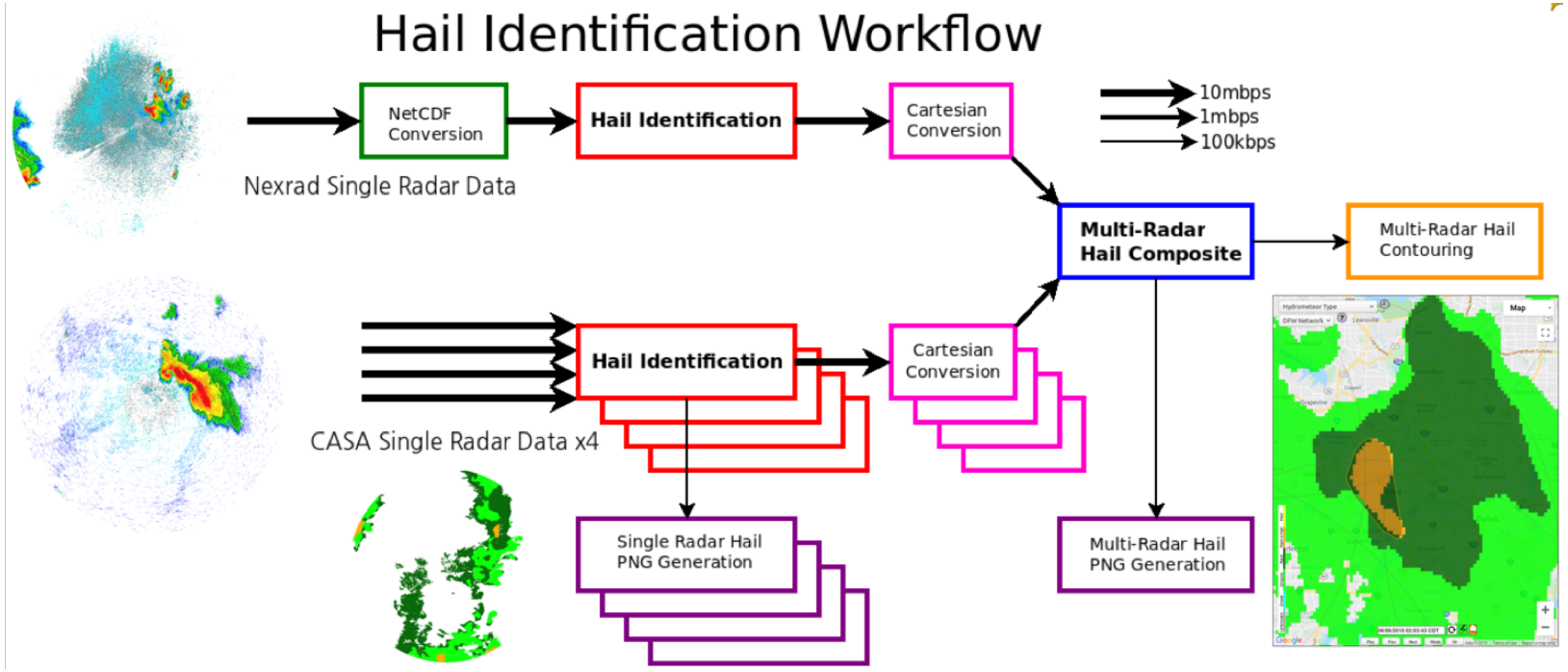
renci

USC Viterbi School of Engineering Information Sciences Institute

UMass Amherst

Rutgers

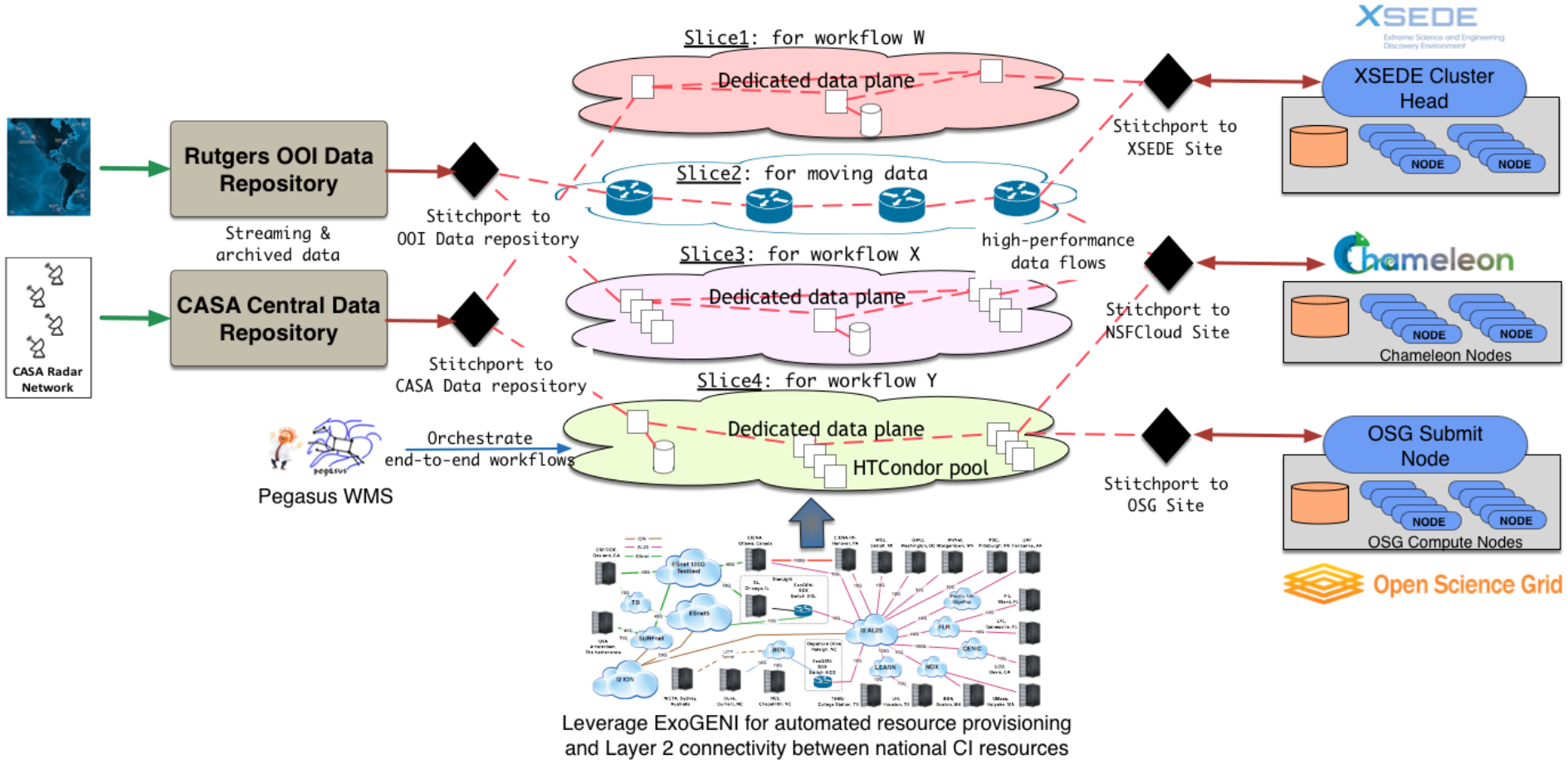
CASA Hail Data Processing Workflow



- Ingest compressed data from 4 CASA radars
- Collect Nexrad single radar data
- Hail event identification
- Combine hail data from multiple radars
- Compute hail contouring
- Generate combined radar image

DYNAMO

DyNamo Platform Overview



Leverage ExoGENI for automated resource provisioning and Layer 2 connectivity between national CI resources

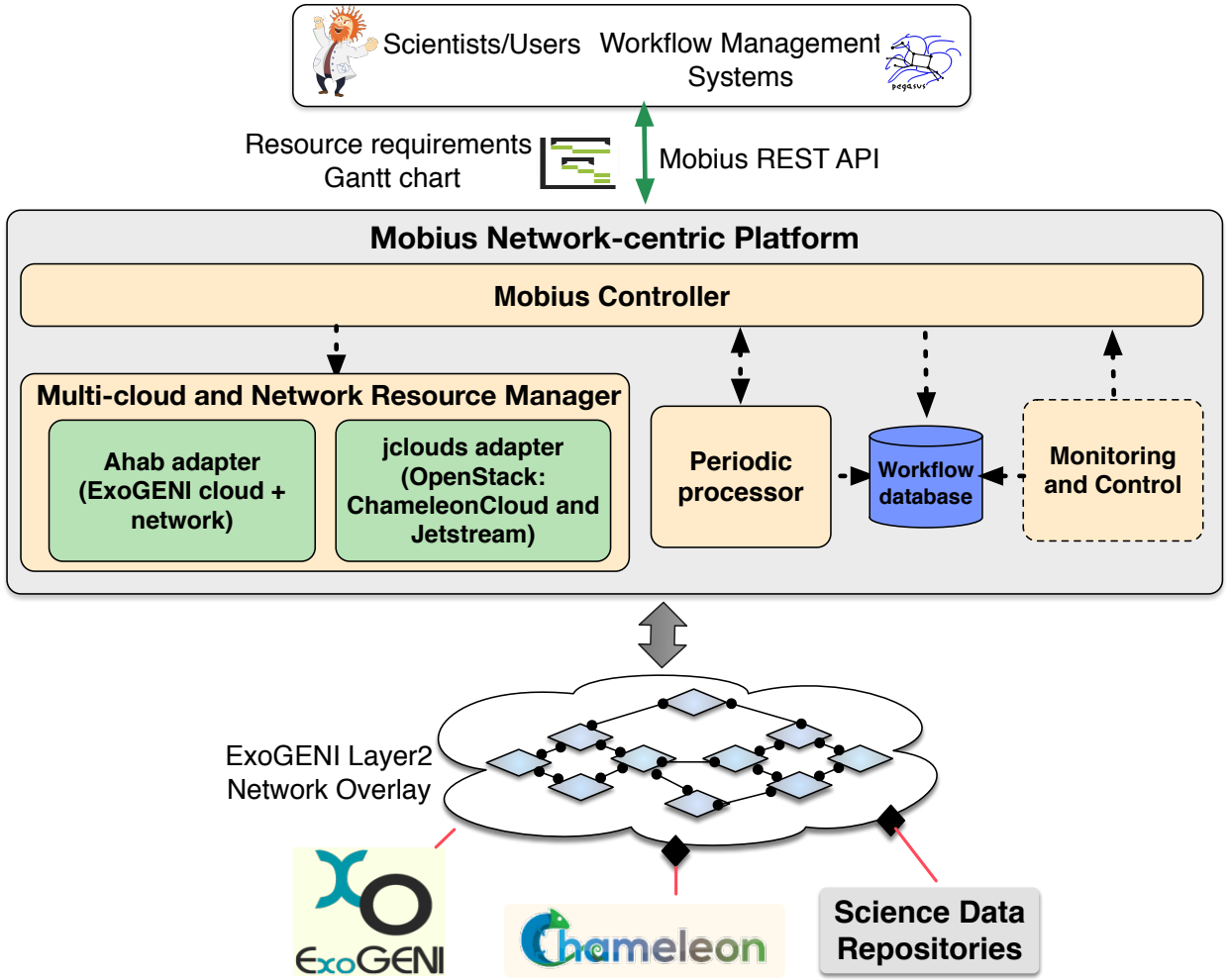
renci

USC Viterbi School of Engineering Information Sciences Institute

UMass Amherst

RUTGERS

Workflow Provisioning and Orchestration with DyNamo

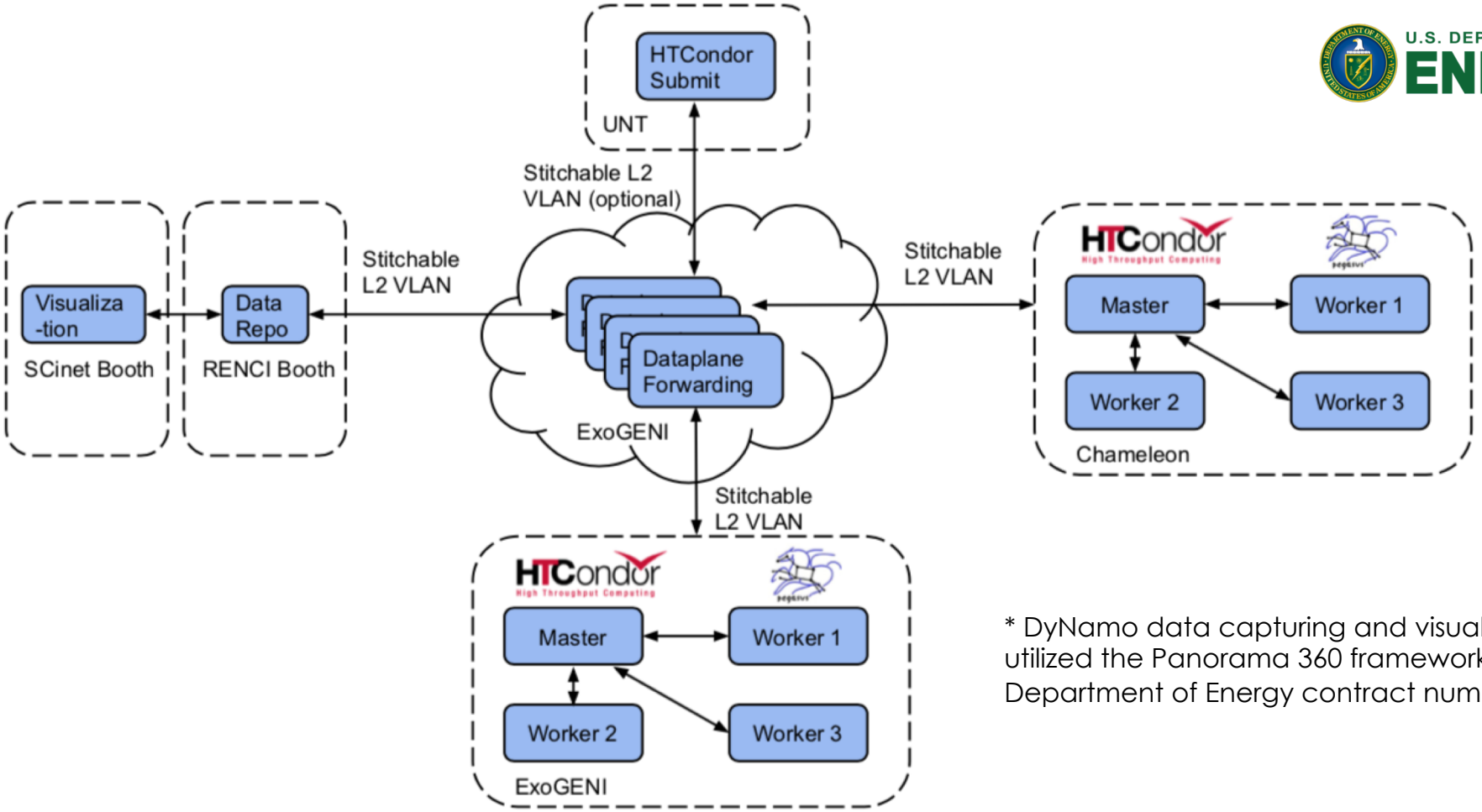


- Mobius adaptive resource provisioning service
  - Multi-cloud provision compute and network resources
  - Periodic processor
    - Make periodic reservations
  - Resource monitoring
    - CPU, RAM and Disk usage

Demo: CASA Operational Workflows on Chameleon and ExoGENI

- We will demonstrate:
  - HTCondor compute cluster on both ExoGENI and Chameleon
  - CASA workflow with wind and hail applications
  - High performance layer 2 connections among geographically distributed compute resources
  - High performance data transfer via SCinet

Demo: CASA Operational Workflows on Chameleon and ExoGENI



* DyNamo data capturing and visualization processes utilized the Panorama 360 framework, funded by Department of Energy contract number #DE-SC0012636M

Funded by the National
Science Foundation
Grant #1826997

DyNamo
Demo