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DEFINING THE FUTURE

A User-Centric System-of-Systems Approach for Delivery of Actionable Earth Environmental Data

Ground System Architectures Workshop 2009

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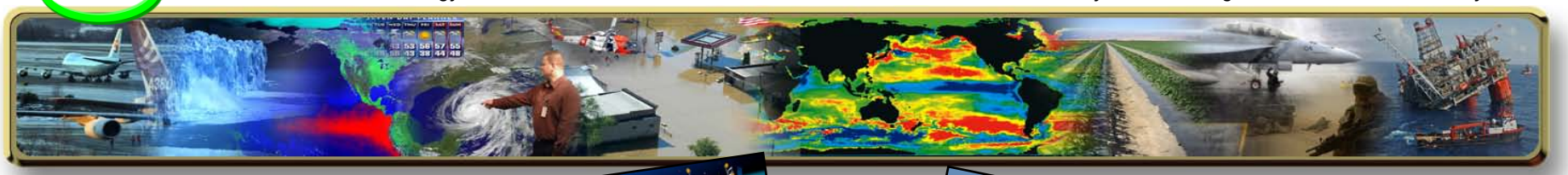
The Challenge: Connect Users to Environmental Data Providers for Disaster Response

Societal Benefit Areas

Disasters | Health | Energy | Climate | Water | Weather | Ecosystems | Agriculture | Biodiversity



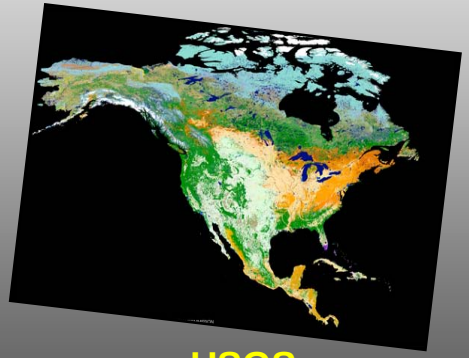
NOAA Weather & Climate
Operational weather systems
Oceanic & Atmospheric Sciences

NASA EOS
Earth Observing Satellites

State Governments
Environmental & Natural Resource

DOE
Climate Modeling

EPA
Air & Water Quality



USGS
Land & Ecosystems

Academia
Earth System Science

NSF
Earth Science Research

Global Earth Observation System-of-System (GEOSS): An Environmental Enterprise Paradigm for Benefiting Society

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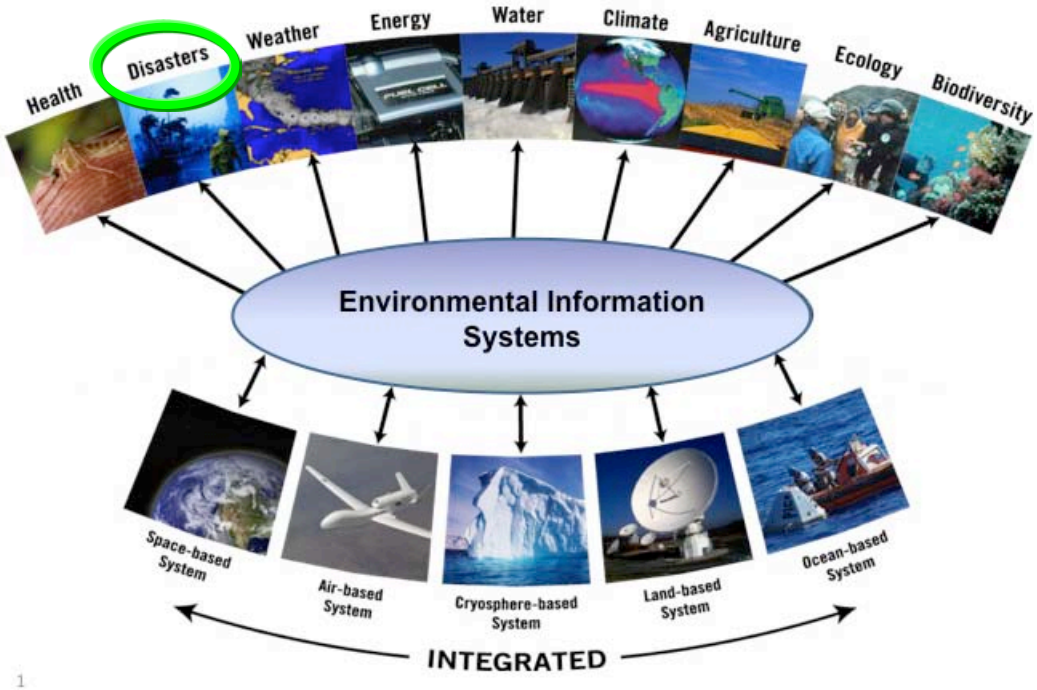

- GEOSS Implementation Plan has identified nine different user communities, called "Societal Benefit Areas" (SBA), that are responding to the challenges posed by climate and technology change.
- Each SBA has unique needs and capabilities but can share common services and approaches through a network of community portals.
- Our focus is on disaster response and management

- To be developed over ten years
- GEOSS AIP programs are coordinated by the Open Geospatial Consortium (OGC)
- 2007-08 Phase 1 demonstrated GEO Portal and Clearinghouse solutions (now IOC)
- 2008-09 Phase 2 augments IOC with "persistent" services to support SBAs and GEOSS Infrastructure
- Pilots address data and information architecture interoperability and user support
- Implemented using international standards

Figure: Group on Earth Observations, "Architecture Implementation Pilot (AIP) Phase 2: IOC Augmentation Call for Participation (CFP), Annex B – Architecture", June 2008

What are we building?
A Hurricane and Flooding Disaster Response Scenario

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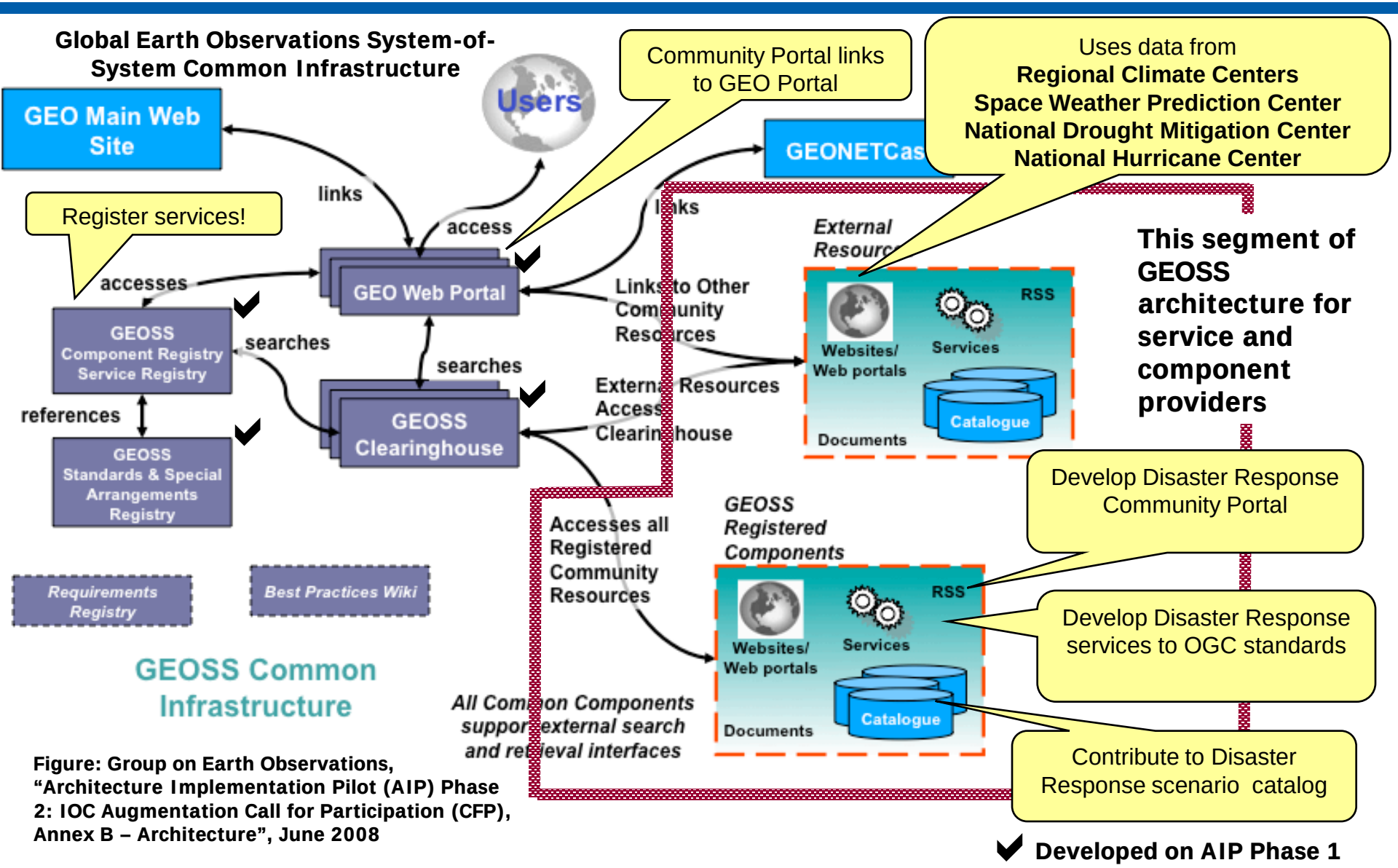
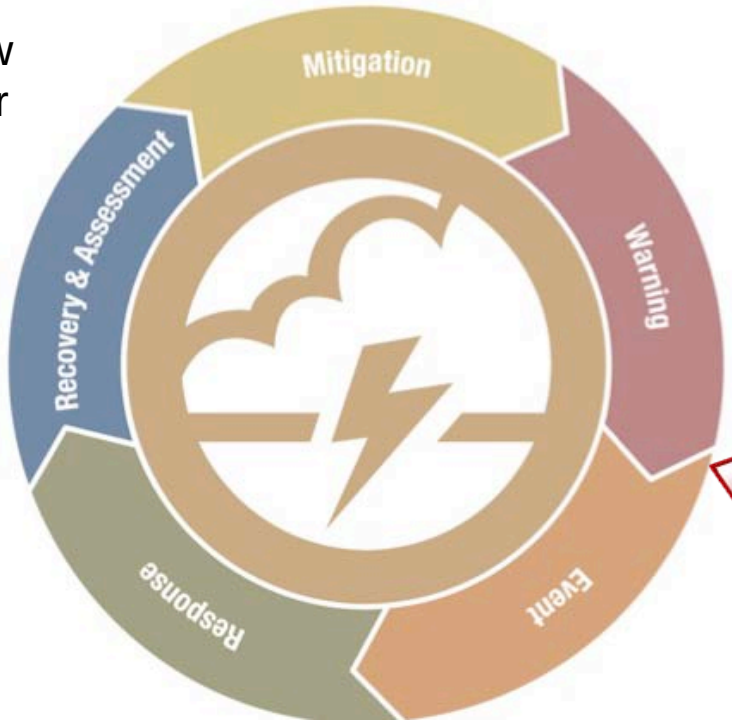


Figure: Group on Earth Observations, "Architecture Implementation Pilot (AIP) Phase 2: IOC Augmentation Call for Participation (CFP), Annex B – Architecture", June 2008

Disaster Cycle is the Workflow for Hurricane and Flooding Disaster Response

- Users exercise the workflow represented by the Disaster Cycle
- Cycle consists of seven overlapping activities
- Hurricane and flooding scenarios step through this cycle
- Uses real data taken from Katrina, Ike, etc.
- Formally bringing together community data providers to share vital environmental data with end users



Disaster Cycle

Data is organized by cycle activity & Community of Practice

Community Data Providers

Space Weather Prediction Center

USGS science for a changing world

National Drought Mitigation Center

Figure: Group on Earth Observations, "Architecture Implementation Pilot (AIP) Phase 2: IOC Augmentation Call for Participation (CFP), Annex B – Architecture", June 2008

The Disaster Response Community Portal is Central for Collaborative Disaster Response and Planning

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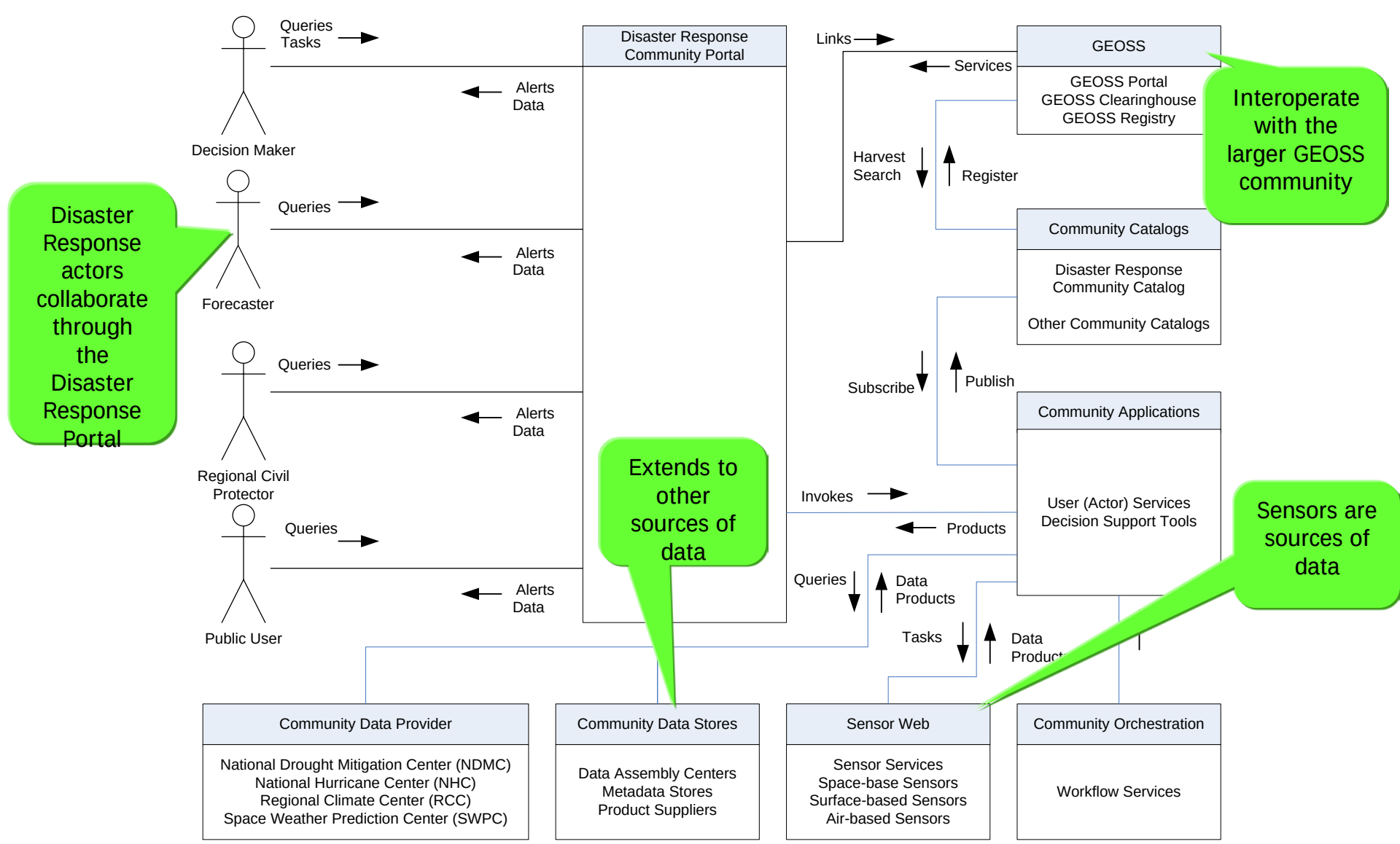

The Community Portal is the Gateway to Disaster Response Activities

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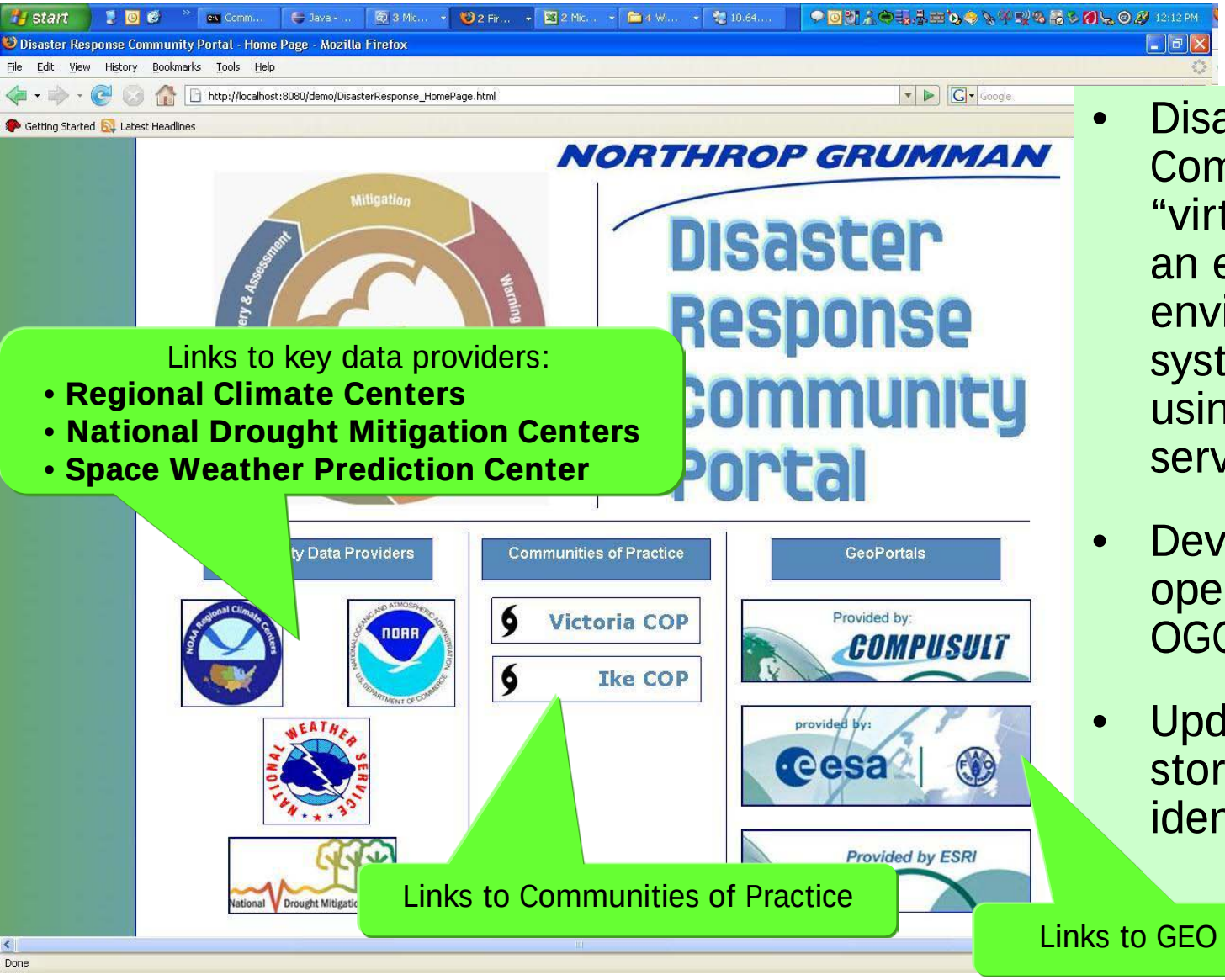


Links to key data providers:

- **Regional Climate Centers**
- **National Drought Mitigation Centers**
- **Space Weather Prediction Center**

Links to Communities of Practice

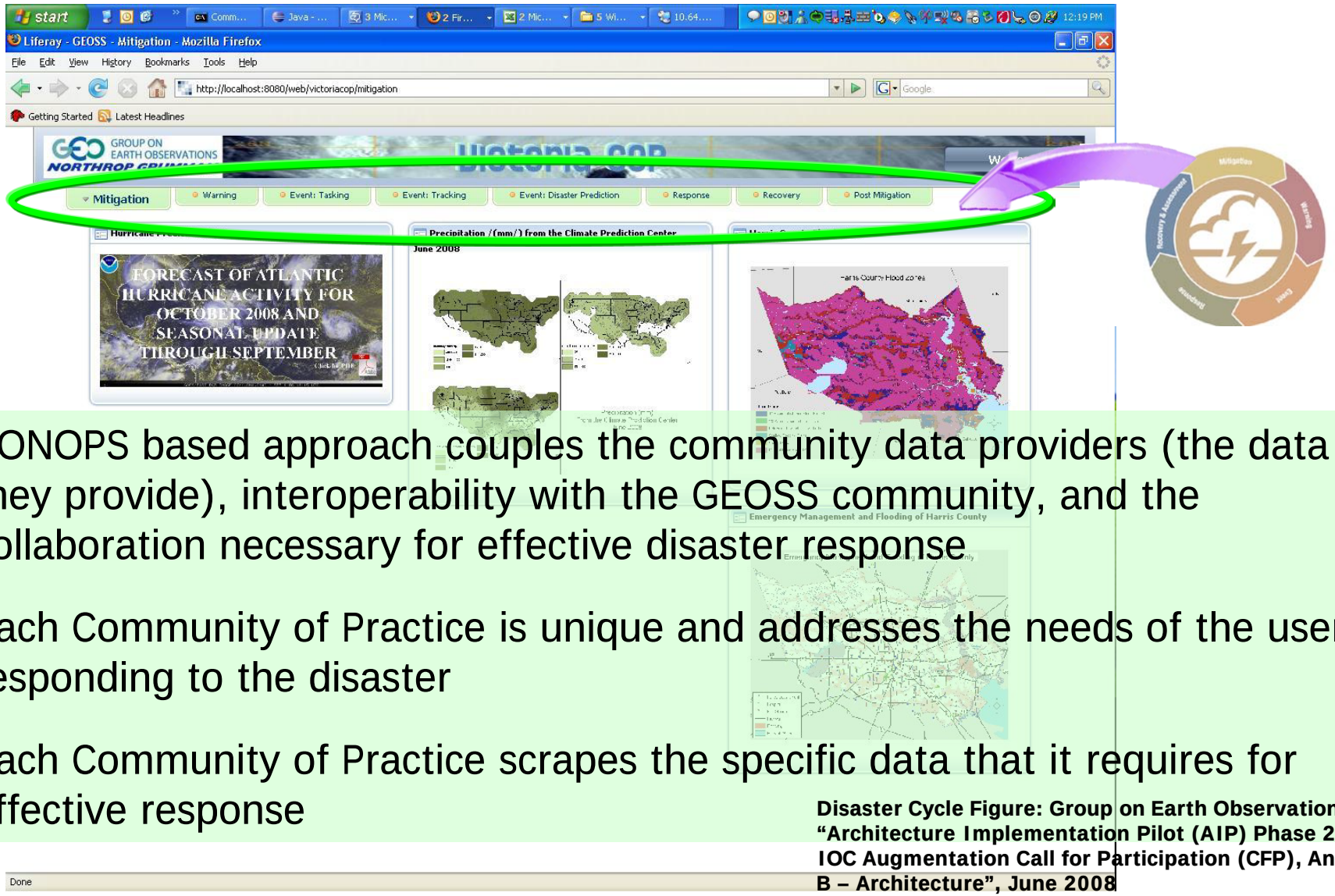
Links to GEO Web Portals

- Disaster Response Community Portal "virtually integrates" an earth environmental system-of-systems using data and services.
- Developed using open source and OGC standards
- Updated as new storms (disasters) are identified

Our Disaster Response Scenario Steps Through All Activities of the Disaster Cycle

Activity	*Scenario Step*	*User (Primary)*	*Storyline*	*Proposed Data and Source(s)*	*Proposed Service(s)*
Mitigation	Community Data Providers investigate and monitor area drought, flooding, and climate conditions	▪ Forecaster	▪ Forecasters at regional and community levels are hard at work laying down the foundation for data that needed from data providers to determine effects of hurricane activity later in the season. We provide some examples of Forecasters extracting current drought and climate information from data currently available. We are especially focused on the Louisiana (LA) and Texan Gulf Coast in this scenario	▪ NDMC – Current and forecast conditions products for the gulf coast—TX (e.g., Houston/Harris County, LA) ▪ RCC – Current climate data (precipitation totals over last 30-31 days as of the start of hurricane season –1 June; show as a percentage of normal May month) ▪ WGRFC – Current flood data ▪ LMRFC – Flood Data ▪ Harris County – Floodplain data	▪ NDMC & RCC (ACIS) – WMS ▪ WGRFC– Tabular data provided via website – WCS
Warning	Forecaster begins tracking storm and posts projected track, watches, and warnings	▪ Forecaster	▪ The Forecaster is monitoring hurricane progress. One of the data points used is IR and visible images taken by space-based sensors. In our example, we show GOES-East images in a loop of 30-minute updates. Certainly, a variety of sources are available including the NHC. Today, we can use NOAAPort but certainly, GEONETCast includes GOES-E data that will be available on GEONETCast-Americas in the future.	▪ NHC	▪ AVI
Event: Tasking	Storm gathers strength resulting in an upgrade of storm to a CAT I storm	▪ Forecaster	▪ The Forecaster upgrades the storm category to a CAT 1 hurricane and issues an alert that alerts the Response COP and the Public that Hurricane Victoria is on a path to land somewhere along the TX, LA Gulf coast.	▪ NHC – Hurricane Alert	▪ RSS
Event: Tracking & Response Preparation	Decision Maker at Regional Decision Support Center (RDSC) engages the Response Team COP including Regional Civil Protector, Forecaster	▪ Decision Maker	▪The Decision Maker is shown using the Disaster Response Community Portal to share an image of the path of the storm. He is shown using the Portal's chat capability to communicate with the Response Team.	▪ Community Portal	▪ WMS ▪ WCS ▪ CAP
Event: Disaster Prediction & Response Preparation	Decision Maker alerts COP of space weather detection of a solar flare--prediction of wide-area blackouts of HF radio communications	▪ Decision Maker	▪The Decision Maker receives a warning indicating a period of intense solar activity that may impact HF and VHF communications thereby posing a communications issue for emergency responders (245 MHz, 410 MHz). The Decision Maker issues a warning to the Response COP ▪The Decision Maker monitors TEC and frequency 1.4 GHz for potential impact to GPS navigation.	▪ SWPC	▪ WMS ▪ WFS
	Evacuation orders were mostly followed but extensive coastal damage and flooding of oil refinery areas occurred as extensive flooding occurs in area	▪ Civil Protector	▪Civil Protection takes the upper hand during this activity. In this step, the Civil Protector has access to high resolution imagery that shows extensive flooding in oil refinery and storage tank holding areas.	▪ WGRFC – Flood data	▪ WCS
Recovery & Assessment	Forecaster tracks the storm as it passes over the area slowing slightly upon landfall before it heads northward with torrential rains falling in river basins that flow toward the coast	▪ Forecaster	▪Forecaster tracks where heavy rainfall might still be falling. This greatly affects flooding patterns in the area. The Forecaster keeps monitoring the bayous in the Houston area for signs of cresting. There is a USGS sensor on the Buffalo Bayou that runs through downtown Houston. USGS sensor data is shared with the National Weather Service.	▪ RCC ▪ NHC ▪ WGRFC – Flood data	▪ WMS, WCS
Mitigation	Post-event analysis of data and products by Community Data Providers	▪ Civil Protector	▪The storm and aftermath events have passed. We are now back in the Mitigation activity of the Disaster Cycle. The Civil Protector will be reviewing the timeline of events, forecasts, types and timeliness of warnings, issuance and obeyance of evacuation orders, etc. to glean lessons learned. Here we see the Civil Protector looking at the timeline of events on the Community Portal.	▪ Community Portal	▪ Timeline ▪ AVI of storm and flooding

Disaster Cycle Workflow Embedded in Community of Practice Portal



- CONOPS based approach couples the community data providers (the data they provide), interoperability with the GEOSS community, and the collaboration necessary for effective disaster response
- Each Community of Practice is unique and addresses the needs of the users responding to the disaster
- Each Community of Practice scrapes the specific data that it requires for effective response

Disaster Cycle Figure: Group on Earth Observations, "Architecture Implementation Pilot (AIP) Phase 2: IOC Augmentation Call for Participation (CFP), Annex B – Architecture", June 2008

Summary

- The Community-of-Practice is user driven, each is as unique as the disaster response it services
- User needs are matched with environmental data providers—environmental data providers are motivated to be matched with users—a marketplace for information sharing
- Information sharing is transparent to the internal operations of the environmental or community data provider
- Workflow must be embedded into the design of the Community of Practice Portal to organize disaster response
- Open source and standards based approaches are meeting the needs of the environmental community

Thank You

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