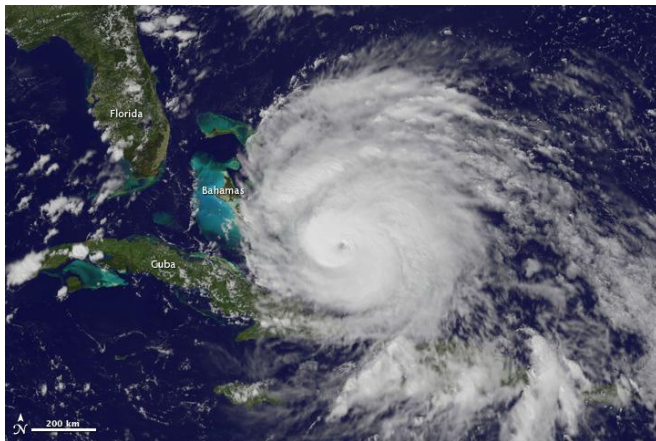


Remote Sensing and Geospatial Data Sources for Disasters: Hurricane Sandy

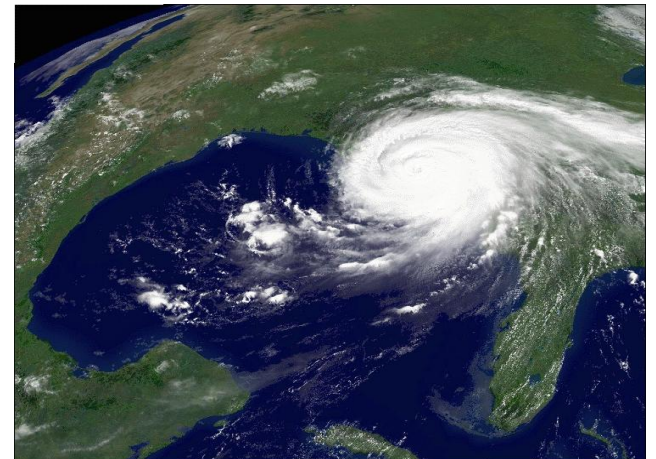
Glenn Bethel

USDA Remote Sensing Advisor

glenn.bethel@usda.gov



June 6, 2013



Outline

- **Disaster Data Sources**
 - Geospatial Information and Remotely Sensed Imagery Products
- Hurricane Sandy
 - Pre-Event Imagery
 - Event Imagery and GIS products
 - Licensing
- The Scope USDA Involvement In Disasters

Data Sources Documents

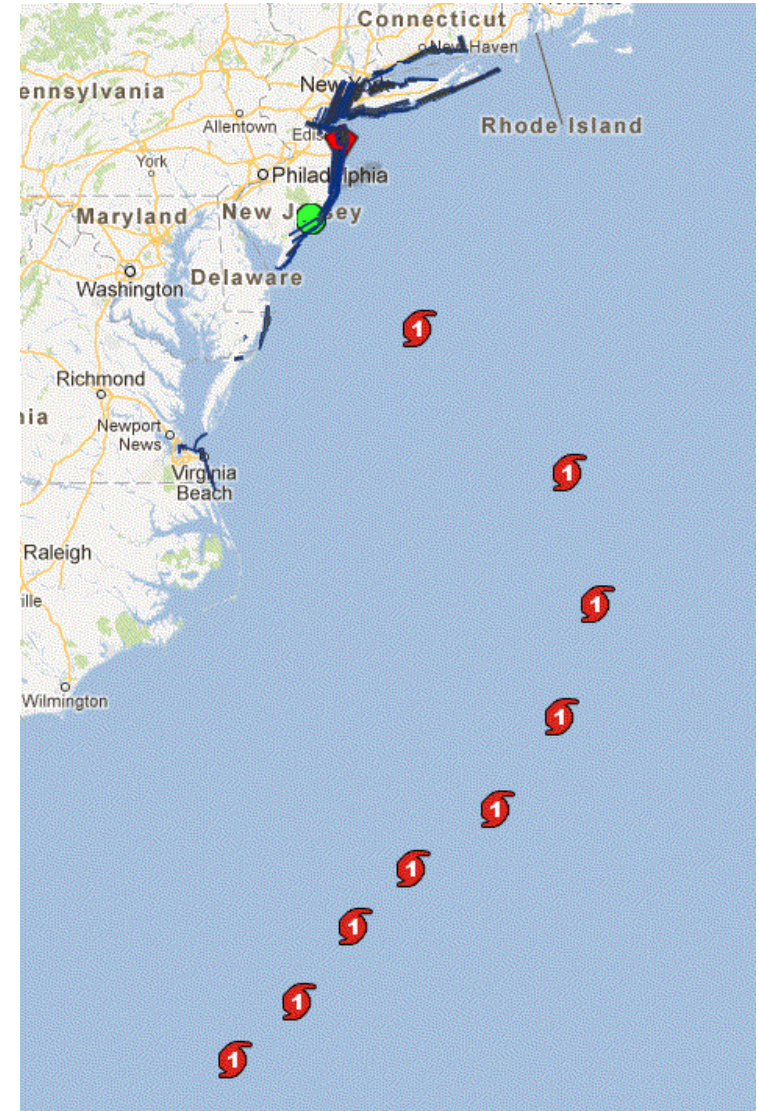
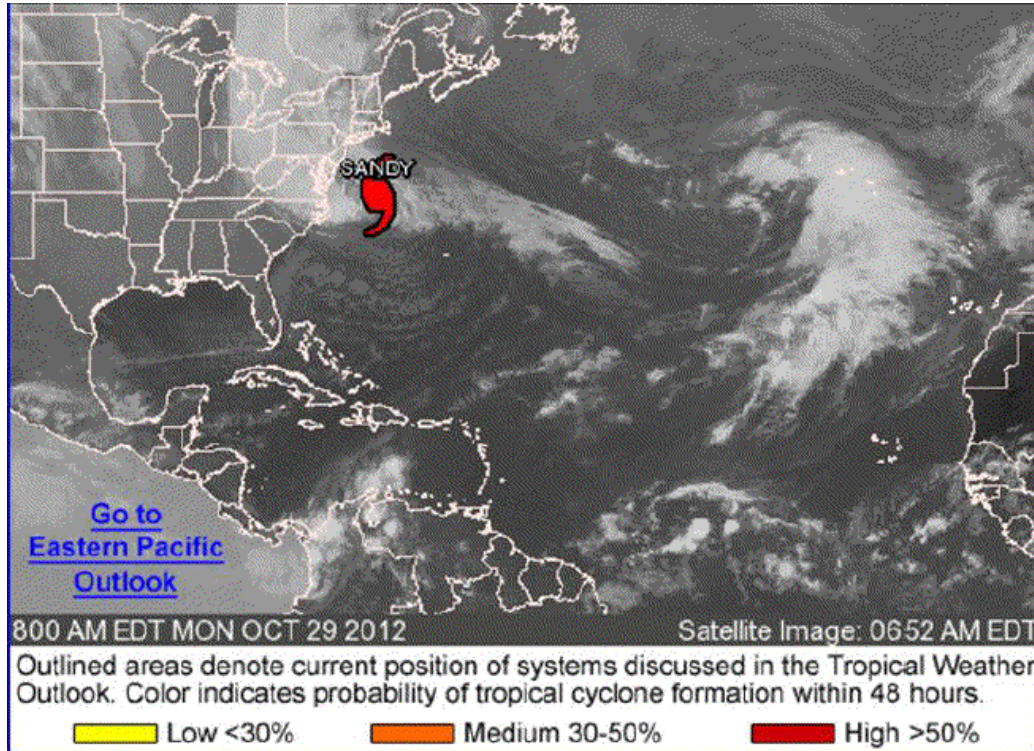
- Updated as needed
 - Starts as once or twice a day, 7 days a week
 - Response needs fast turn around.
 - As situation stabilizes and new sources slow, updated as needed
 - Emailed to over 300 people (Federal, State, Local, Universities, Private Sector)
- Inputs
 - Emails from the community
 - USGS
 - Close coordination with Brenda Jones and Rynn Lamb
 - FEMA
 - EPA
 - ESRI
 - NOAA
 - DoD
 - NGA
 - Red Cross
 - HiFld
 - Daily teleconferences
 - Mining sites (HDDS)
 - Interactions with SMEs
- Started During Hurricane Katrina (2005) to service needs of USDA.



Data Sources Documents

- Goal:
 - Create consolidated source of remote sensing and GIS data sources.
 - Document locations of US Government Authoritative data that can be Mashed Up to create additional information.
 - US Government agencies should use one source of GIS layers (Actual vs. Modeled).
 - Surge
 - Wind Fields
 - Flooding
 - Imagery investments: acquire once, use many times.
 - Quick Reference for local and national level response and recovery
- Provide best available information to the Disaster Community
 - USDA has over 65,000 ArcGIS users that can create products.
 - Remote Sensing and GIS are great resources during disasters!

Hurricane Sandy: Large and Slow Moving

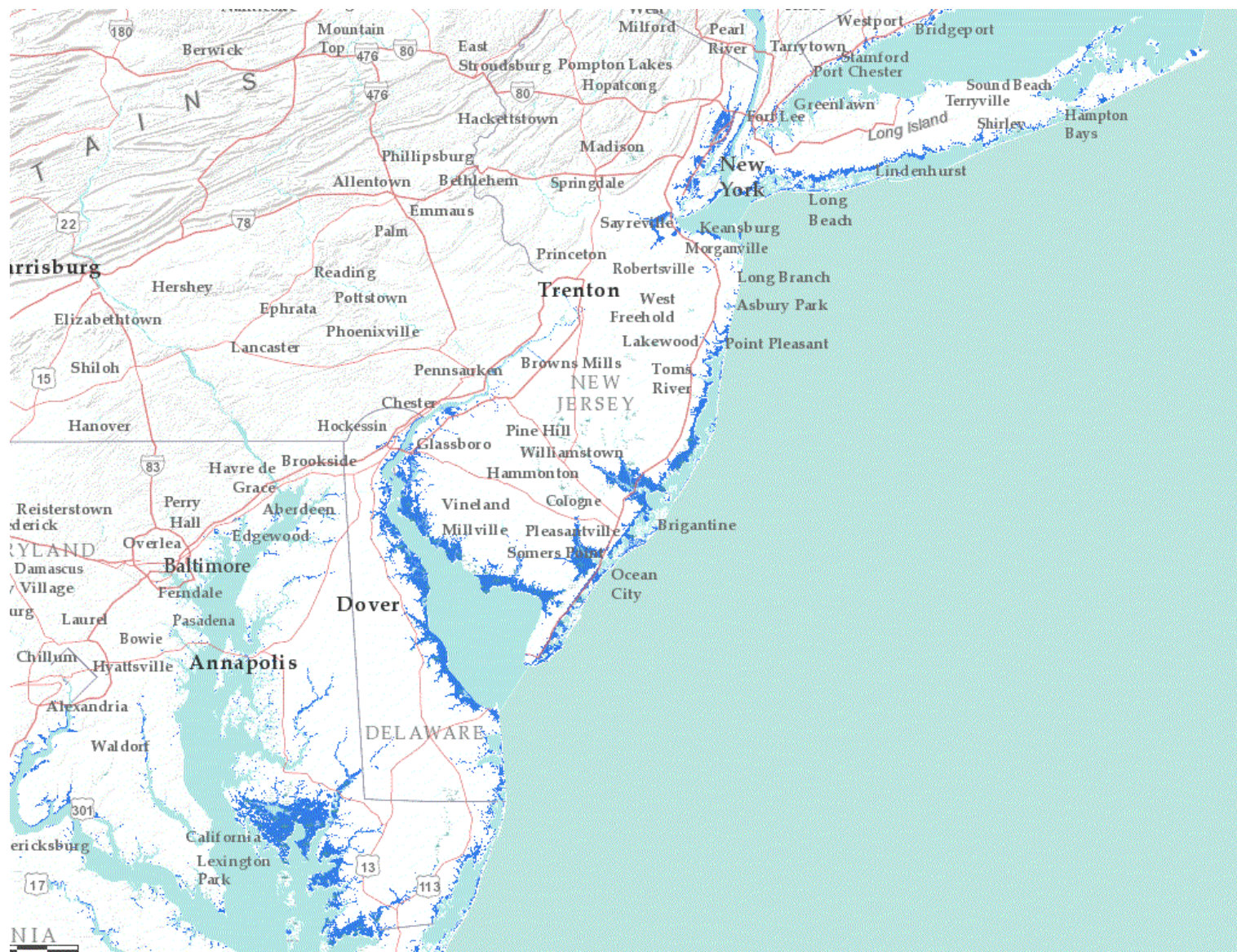


Winds spanning 1,100 miles

On October 29, moved ashore near Brigantine,
New Jersey



Blue areas = Extent of Surge





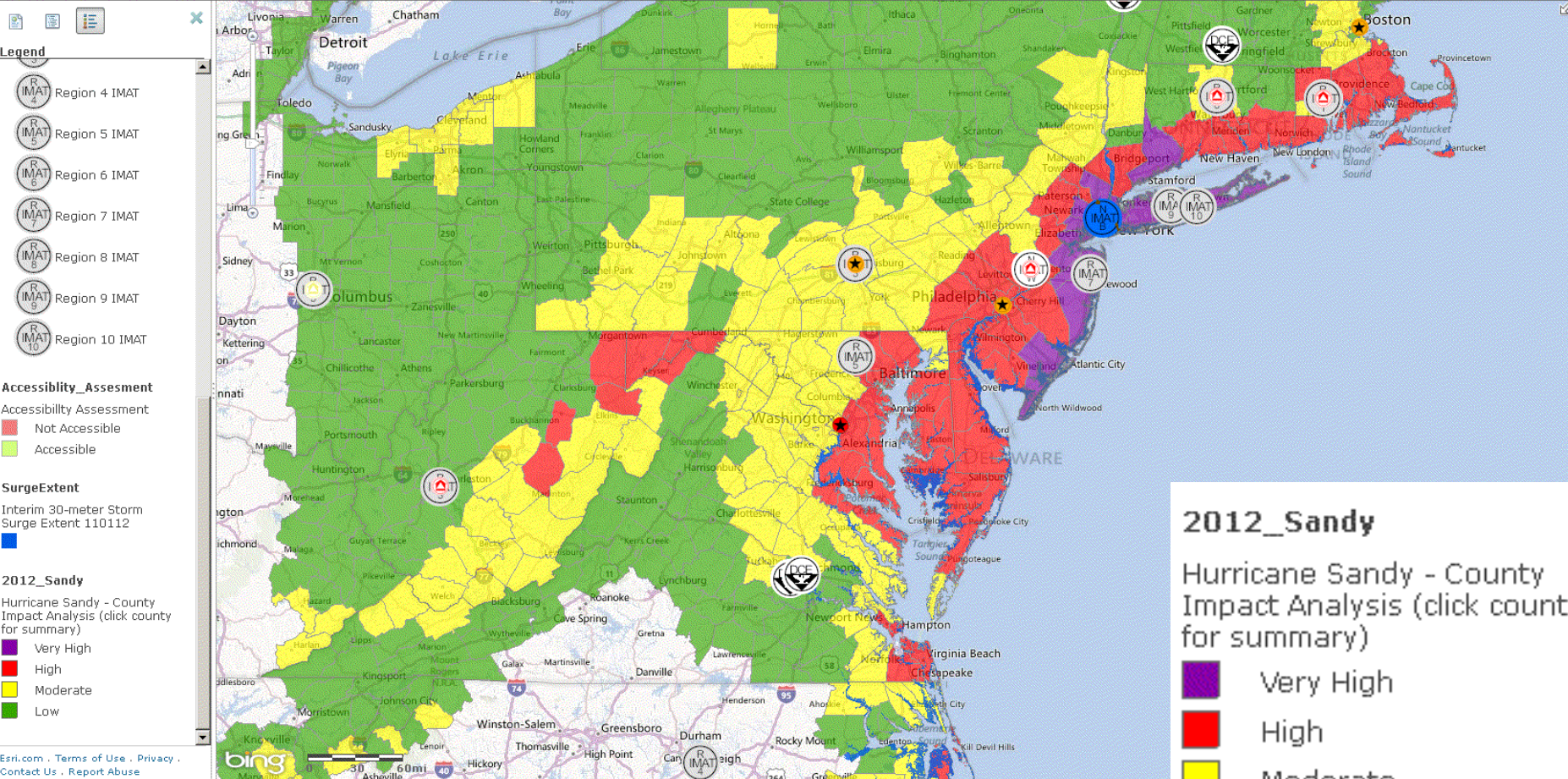
Impacted Area

HOME

Hurricane Sandy

New Map My Content Help Sign In

Details Add Basemap Save Share Print Measure Bookmarks Find address or place



Legend

- Region 4 IMAT
- Region 5 IMAT
- Region 6 IMAT
- Region 7 IMAT
- Region 8 IMAT
- Region 9 IMAT
- Region 10 IMAT

Accessibility_Assesment

- Not Accessible
- Accessible

SurgeExtent

Interim 30-meter Storm Surge Extent 110112

2012_Sandy

- Hurricane Sandy - County Impact Analysis (click county for summary)
- Very High
- High
- Moderate
- Low

2012_Sandy

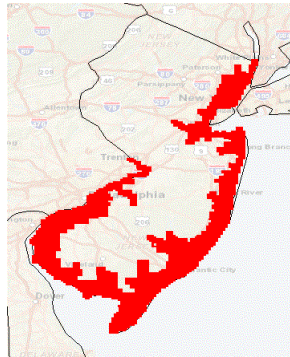
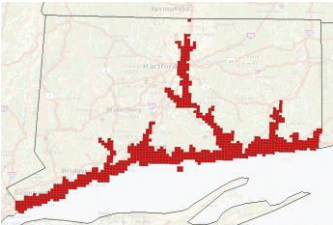
Hurricane Sandy - County Impact Analysis (click county for summary)

- Very High
- High
- Moderate
- Low

Best Available Pre-Event Imagery

Available On HDDS:

- 1-foot 2012 Connecticut
- 1-foot 2012 for New Jersey



USDA National Agriculture Imagery Program (NAIP) One Meter Imagery:

- Connecticut 2012
- Delaware 2012
- Illinois 2012
- Maine, 2011
- Maryland 2011
- Massachusetts 2012
- Michigan 2012
- New Hampshire 2012
- New Jersey 2010
- New York 2011
- Ohio 2011
- Pennsylvania 2010
- Rhode Island 2012
- Vermont 2012
- Virginia 2012
- West Virginia 2011
- Wisconsin 2010

Rest Services:

<http://gis.apfo.usda.gov/ArcGIS/rest/services/>

Or to download by county:

<http://datagateway.nrcs.usda.gov/>

Must know date of pre-event imagery for optimal change detection.

Best Available Pre-Event Imagery

- Issues:
 - The US Government does not cost share on all state high resolution aerial programs.
 - Sometimes if we do not cost share, we do not get a copy of the imagery.
 - The State often has the best high resolution programs = Best available Pre-Event.
 - The US Government does not have the funds to host all of the pre-event imagery. (State offers to give copy to gov, but we do not accept)
 - The US Government does not have the funds to create REST Services for all image layers.
 - USDA public facing NAIP imagery service only serves most recent year and is not robust.
- So:
 - You have to search for the best available sources for each event.
 - You may need to download imagery tiles rather than tap into a REST Service.
 - Community settles for service from ESRI, BING or Google Earth that do not have image meta data.

Imagery Acquired Post-Landfall for Damage Assessments **Loaded to HDDS**

Public Domain

- ★ **NOAA Aerial Imagery**
 - 3,731 Images
- ★ **Civil Air Patrol**
 - 158,012 Images
- ★ **NC DOT Aerial Imagery**
 - 194 Images
- **EO 1 + Hyperion**
 - 18 Images
- **International Space Station**
 - 78 Images
- **Landsat 7**
 - 4 images

Licensed

- **WorldView 1 & 2**
 - 1,028 images
- **SPOT**
 - 66 images
- **Radarsat-2**
 - 18 images
- ★ **COSMO**
 - 8 images
- **TerraSar-X**
 - 4 images
- **DMC**
 - 3 images
- **RapidEye**
 - 3 images
- **QuickBird**
 - 2 images

Who Pays for the Imagery?

- NGA acquires Commercial High Resolution
 - Contract with Digital Globe and GeoEye.
 - Imagery found in HDDS and Earth Explorer
- U.S. Air Force Eagle Vision
 - Spot (In HDDS)
 - RapidEye (In HDDS)
- USGS – USDA Funded N. American Data Buy
 - Spot 4 and 5 Imagery in Earth Explorer
- FEMA and/or states
 - Civil Air Patrol
- NOAA Aerial
 - NOAA



FEMA





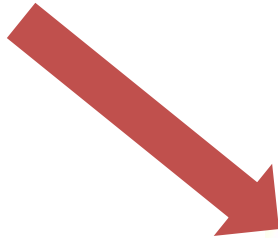
Public Domain Imagery



Hazards Data Distribution System (HDDS)

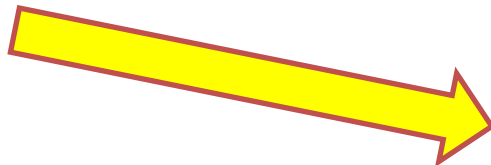
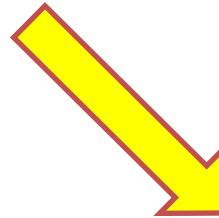
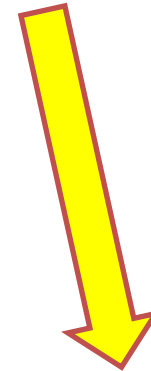
<http://hdds.usgs.gov/hdds2/>

Rest Services
Imagery Downloads



Google.org Crisis Response

<http://google.org/crisismap/2012-sandy>



Viewer

<http://ngs.woc.noaa.gov/storms/sandy/>

Plus: WMTS, TMS



Public
Governments
Responders

Use Constraints: We request that you credit the National Oceanic and Atmospheric Administration (NOAA) when you use these photos in a report, publication, or presentation.

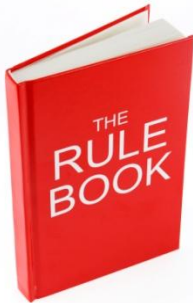


Licensed Imagery

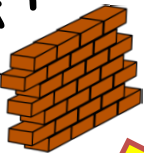


Hazards Data Distribution System (HDDS)
<http://hdds.usgs.gov/hdds2/>

Imagery Downloads / Password Protected ★
No Rest Services



Limit Access



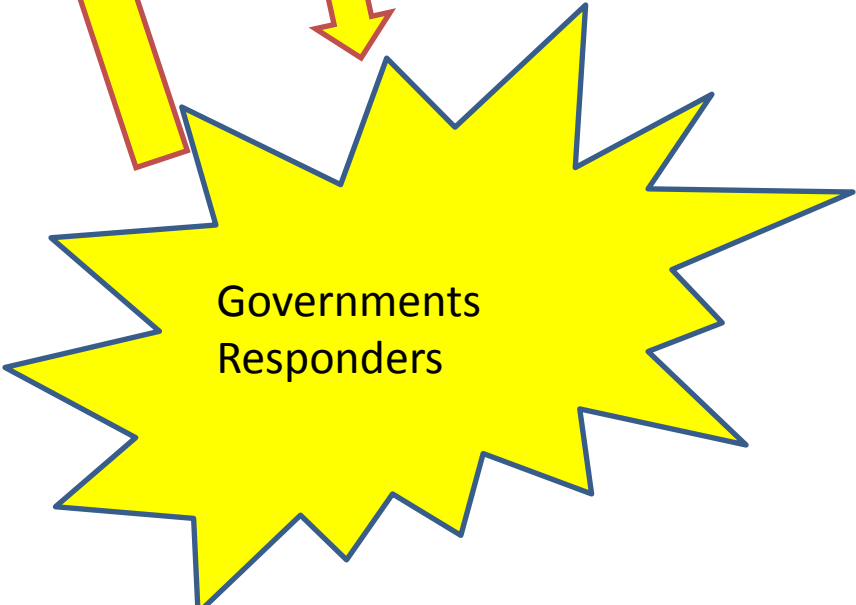
No Access



Request Access



Public



Governments
Responders

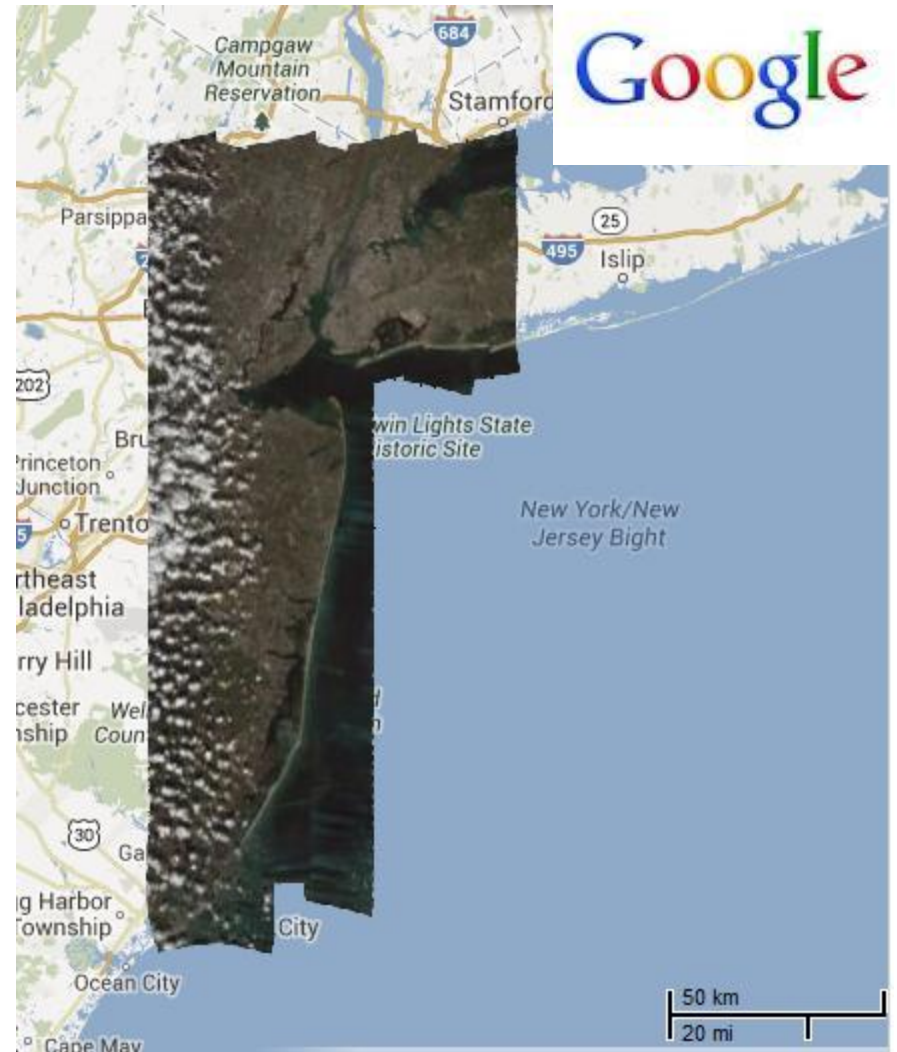
Product Generation

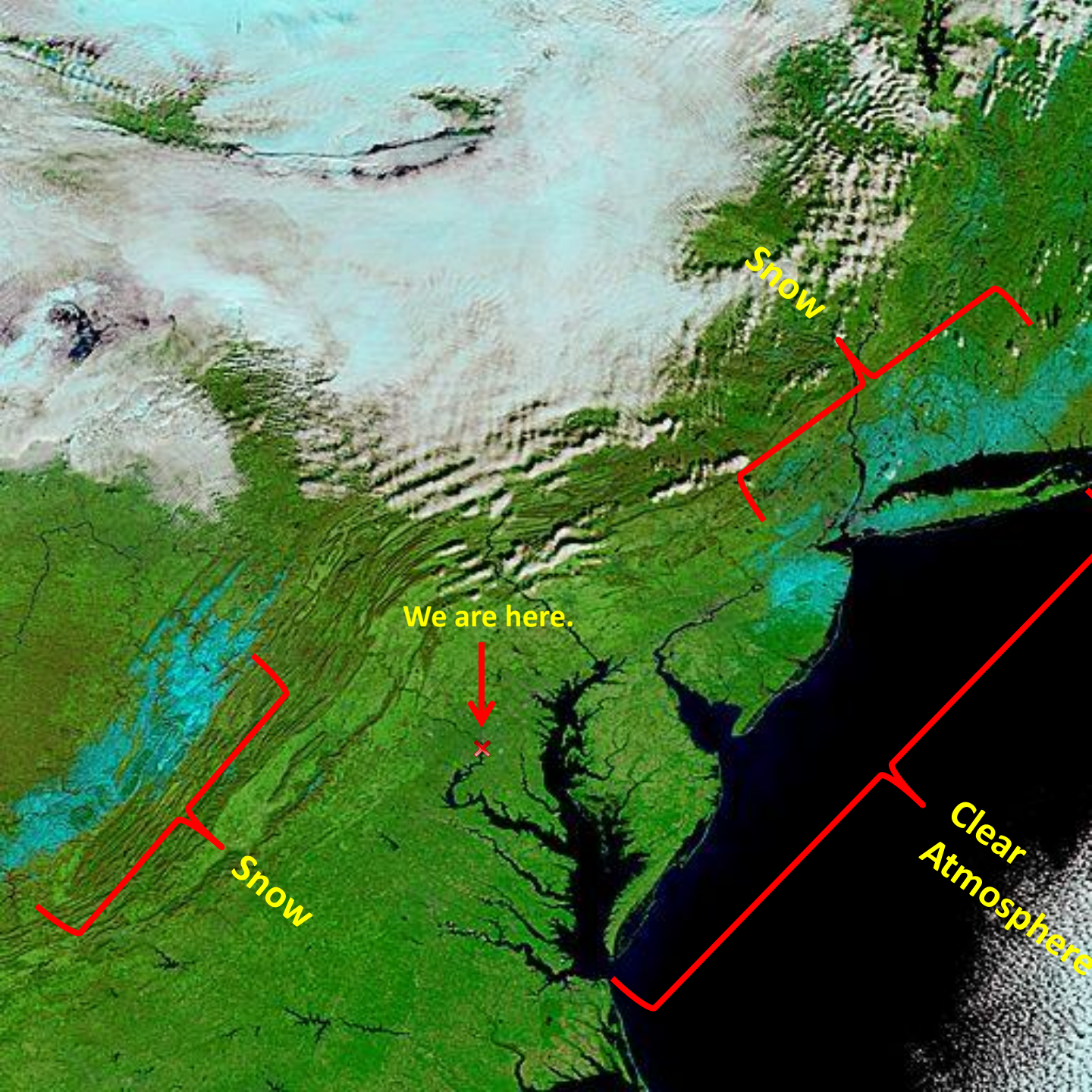


Private Sector Aerial

Google Flights

- Google sometimes acquires post-event imagery .
- Other Disasters imagery acquired by:
 - Microsoft
 - Surdex
 - Bearing Tree Land Surveying (Moore, Oklahoma)
- These images may or may not be available in HDDS





US Sandy Landfall:
October 29, 2012

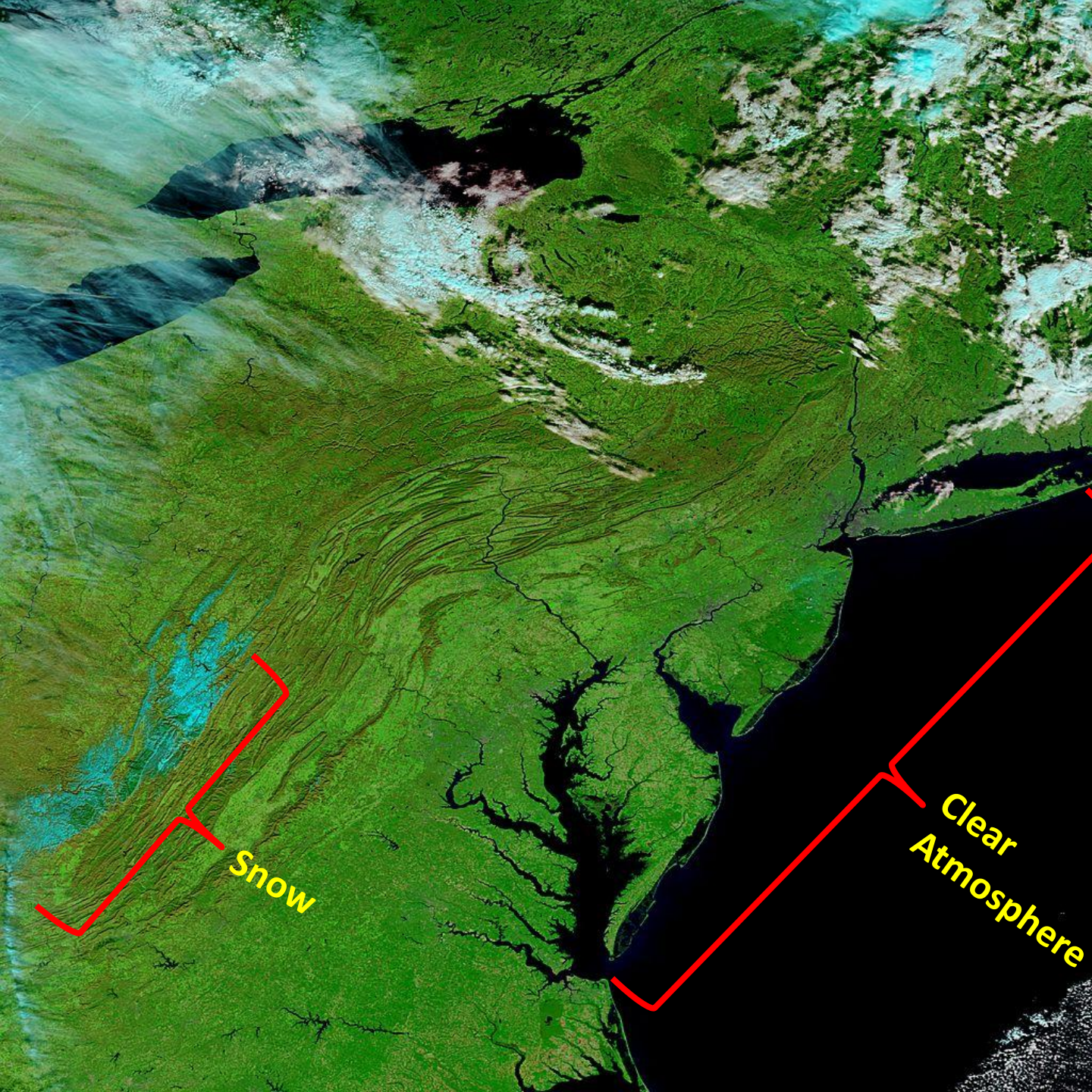
November 9, 2012
MODIS Terra 721

**11/9 was first mostly
clear day.**

Allows view from
Space

10 days after Landfall

http://www.pecad.fas.usda.gov/cropexplorer/modis_summary/



**US Sandy Landfall:
October 29, 2012**

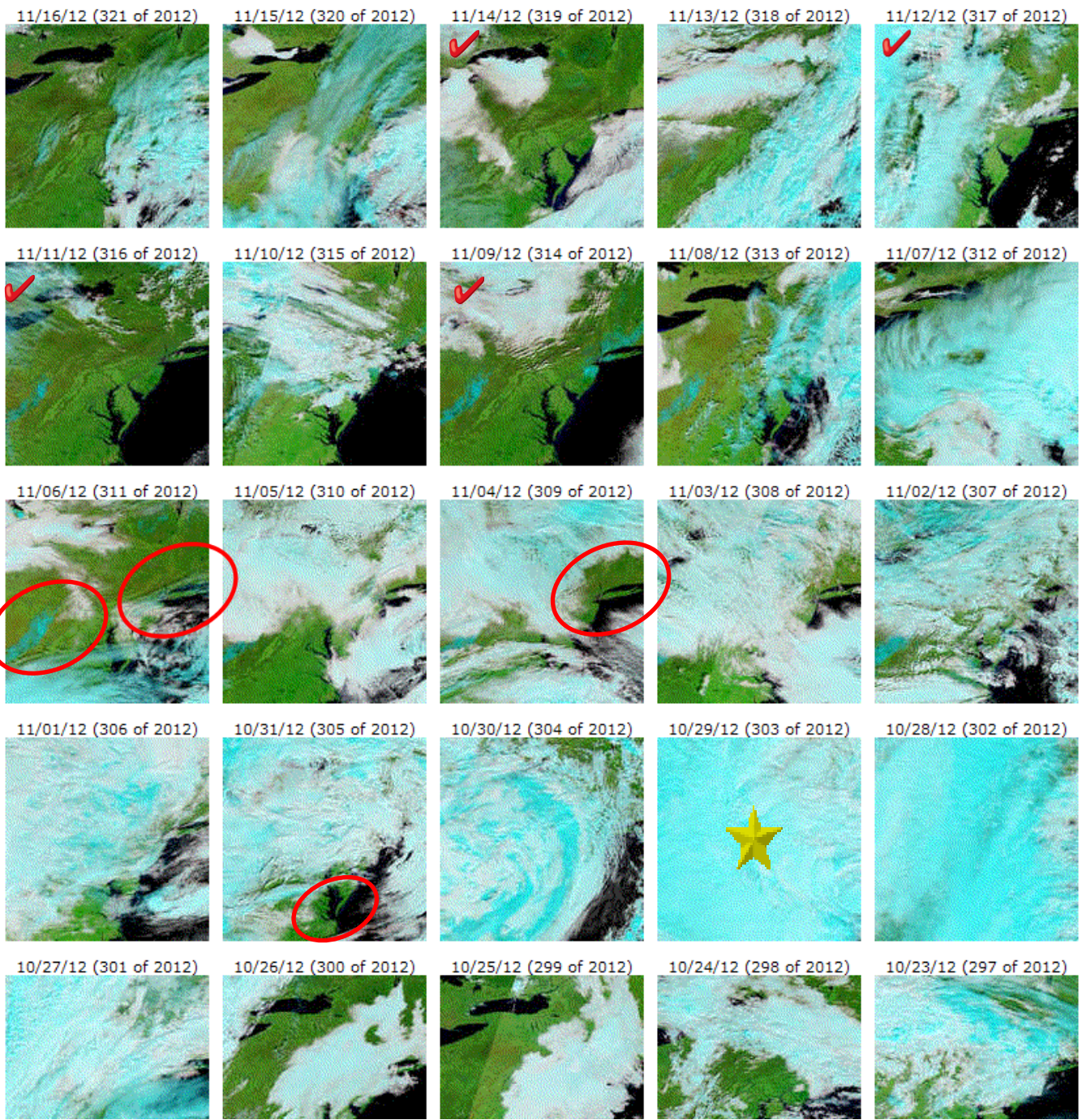
**November 11, 2012
MODIS Terra 721**

**11/12 was second
mostly clear day.**

Allows view from
Space

13 days after Landfall

http://www.pecad.fas.usda.gov/cropexplorer/modis_summary/

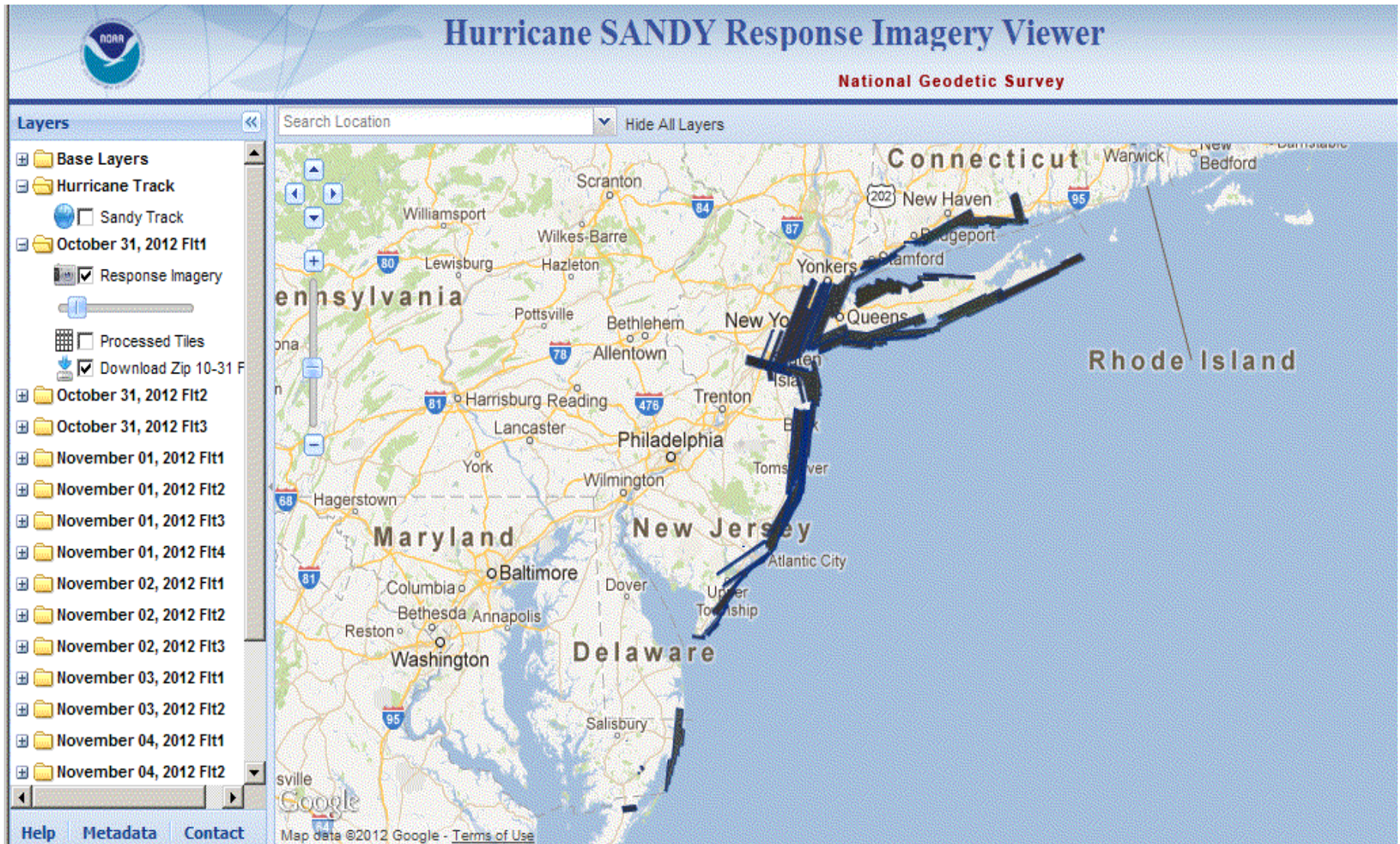


October 29, Sandy made landfall in New Jersey

MODIS Terra Time Series showing clouds resulting in problems with disaster acquisitions.

http://www.pecad.fas.usda.gov/cropexplorer/modis_summary/modis_page.cfm?regionid=us&modis_tile=r14c11

Aircraft Flies Low Below Clouds Starting Oct 31.

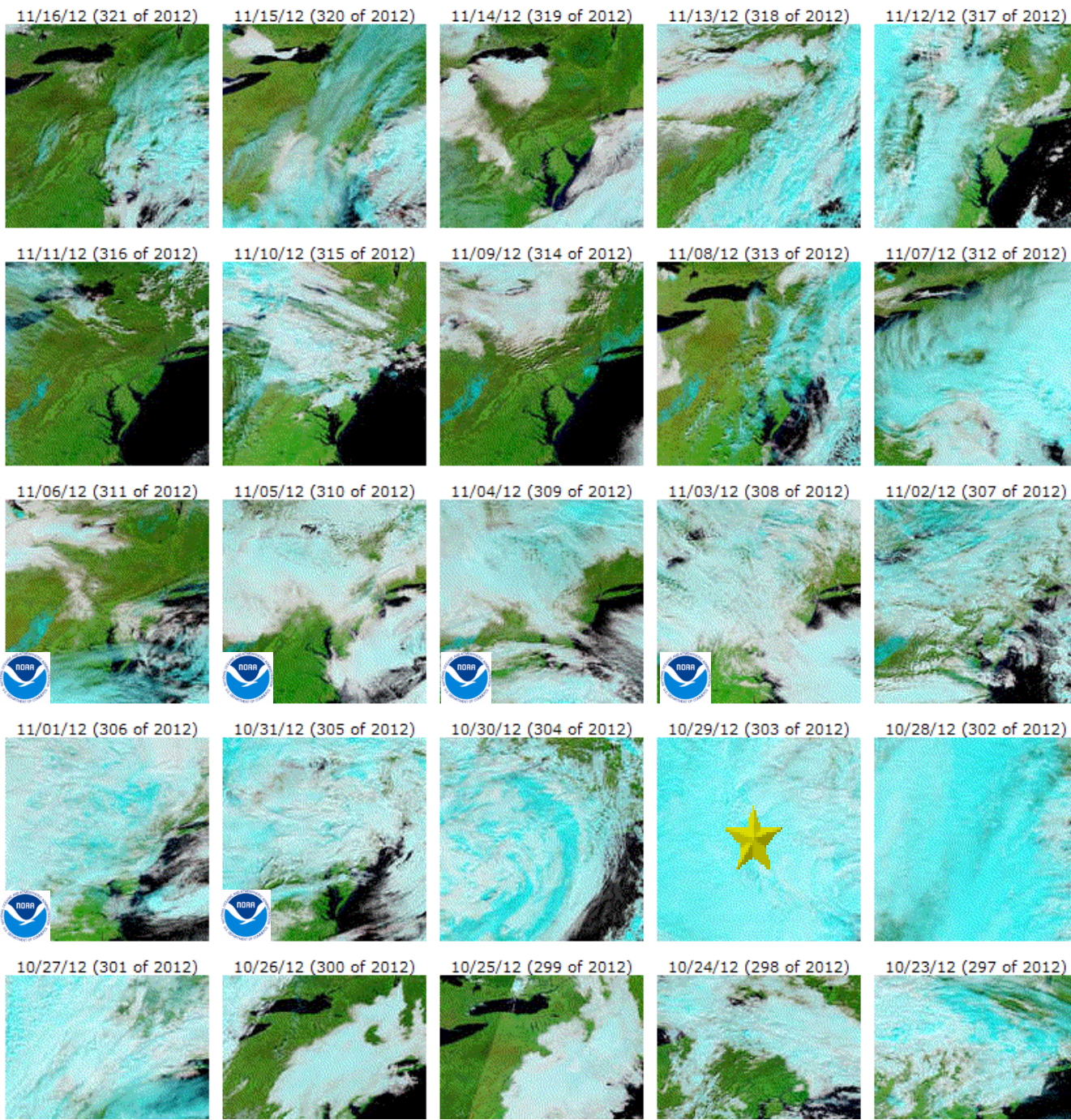


Select Satellite

Satellite: terra.721 Region: r14c11 Year: 2012

October 29, Sandy made landfall in New Jersey

NOAA Completes flights on November 6. Some areas flow more than once.



= NOAA Flights

http://www.pecad.fas.usda.gov/cropexplorer/modis_summary/modis_page.cfm?regionid=us&modis_tile=r14c11



October 31, 2012 Flight 2
Mantoloking, NJ





November 1, 2012 Flight 1
Mantoloking, NJ



LIBRARY

MAP VIEW

ALERTS



20 m
100 ft
Zoom Level: 18
lon: -74.049, lat: 40.041

MAP DATA (C) OPENSTREETMAP CONTRIBUTORS, CC BY-SA

Navigation controls including a timeline of satellite images with dates: 05/01/2011, 09/01/2011, 10/31/2012, 10/31/2012, 11/04/2012. The 11/04/2012 image is highlighted with a green border. There are also play/pause, back, forward, and help icons.

© DigitalGlobe, Inc. All Rights Reserved™

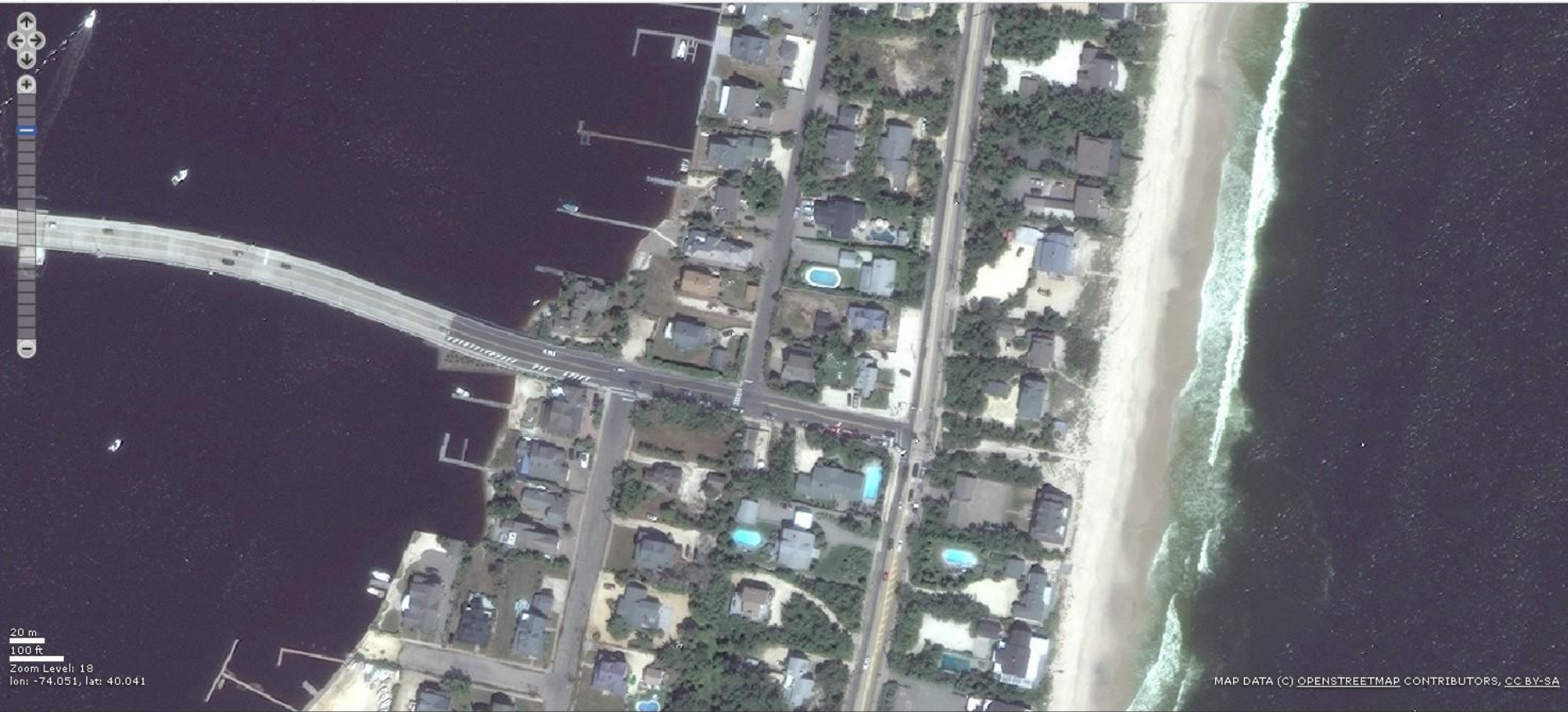
Mantoloking, NJ

November 4, 2012

LIBRARY

MAP VIEW

ALERTS



20 m
100 ft
Zoom Level: 18
lon: -74.051, lat: 40.041

MAP DATA (C) OPENSTREETMAP CONTRIBUTORS, CC BY-SA

Navigation and history controls including back, forward, and search icons, and a timeline of map history:

- 05/01/2011
- 09/01/2011** (highlighted)
- 10/31/2012
- 10/31/2012
- 11/04/2012
- 11/04/2012

© DigitalGlobe, Inc. All Rights Reserved™

<https://rdog.digitalglobe.com/myDigitalGlobe/#LOGIN>

September 1, 2011

Mantoloking, NJ

Access Funded by NGA



EPA Aspect Imagery
November 4, 2012





New Jersey Aerial Flown in 2012





Civil Air Patrol Flown During 1st 5 Days



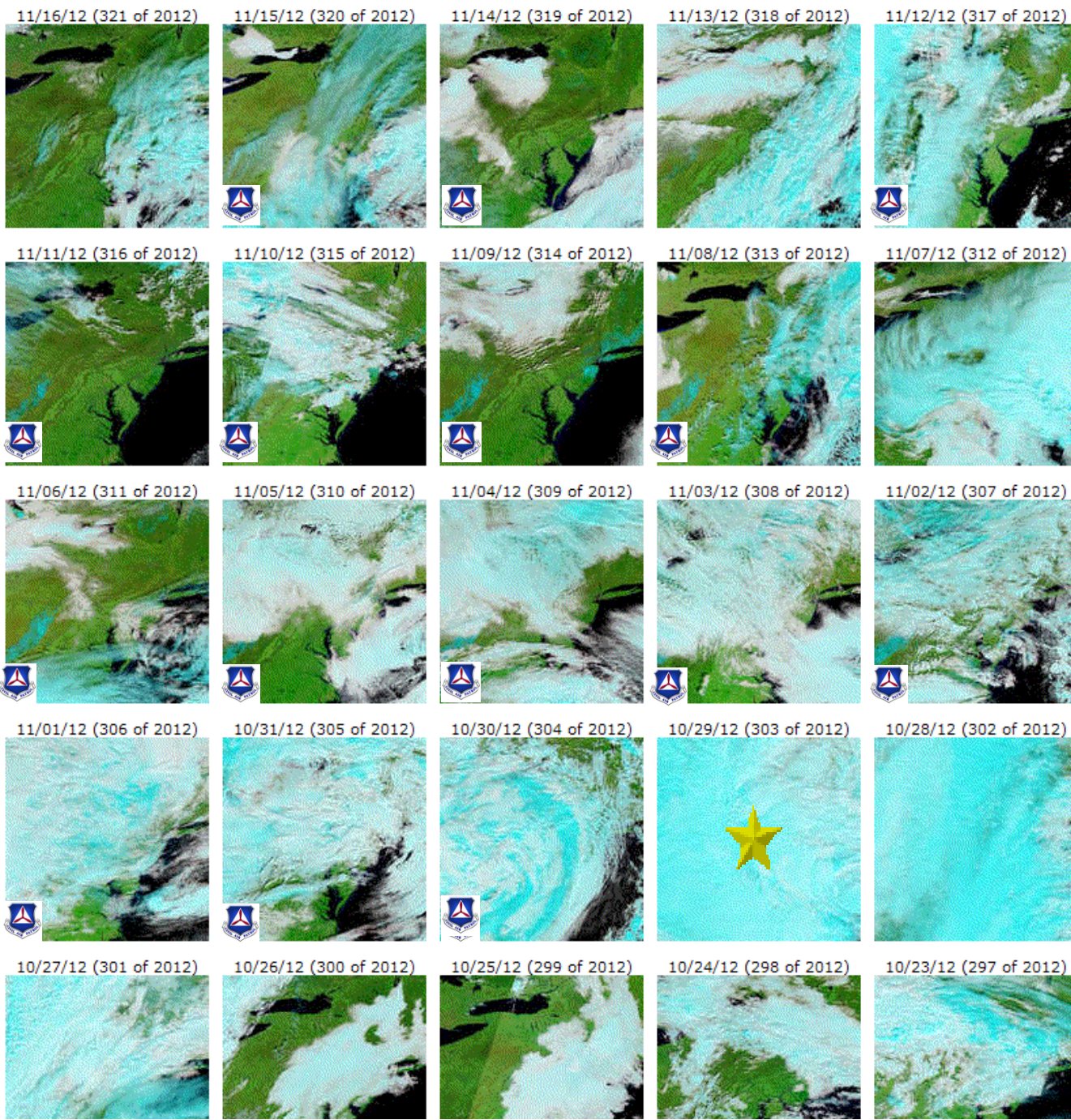
- ★ 2012-10-30
- ★ 2012-10-31
- ★ 2012-11-01
- ★ 2012-11-02
- ★ 2012-11-03

Select Satellite

Satellite: terra.721 Region: r14c11 Year: 2012

October 29, Sandy made landfall in New Jersey

Civil Air Patrol



= Cap Flights loaded to HDDS

Available on HDDS and FEMA Portal

CAP November 11, 2012





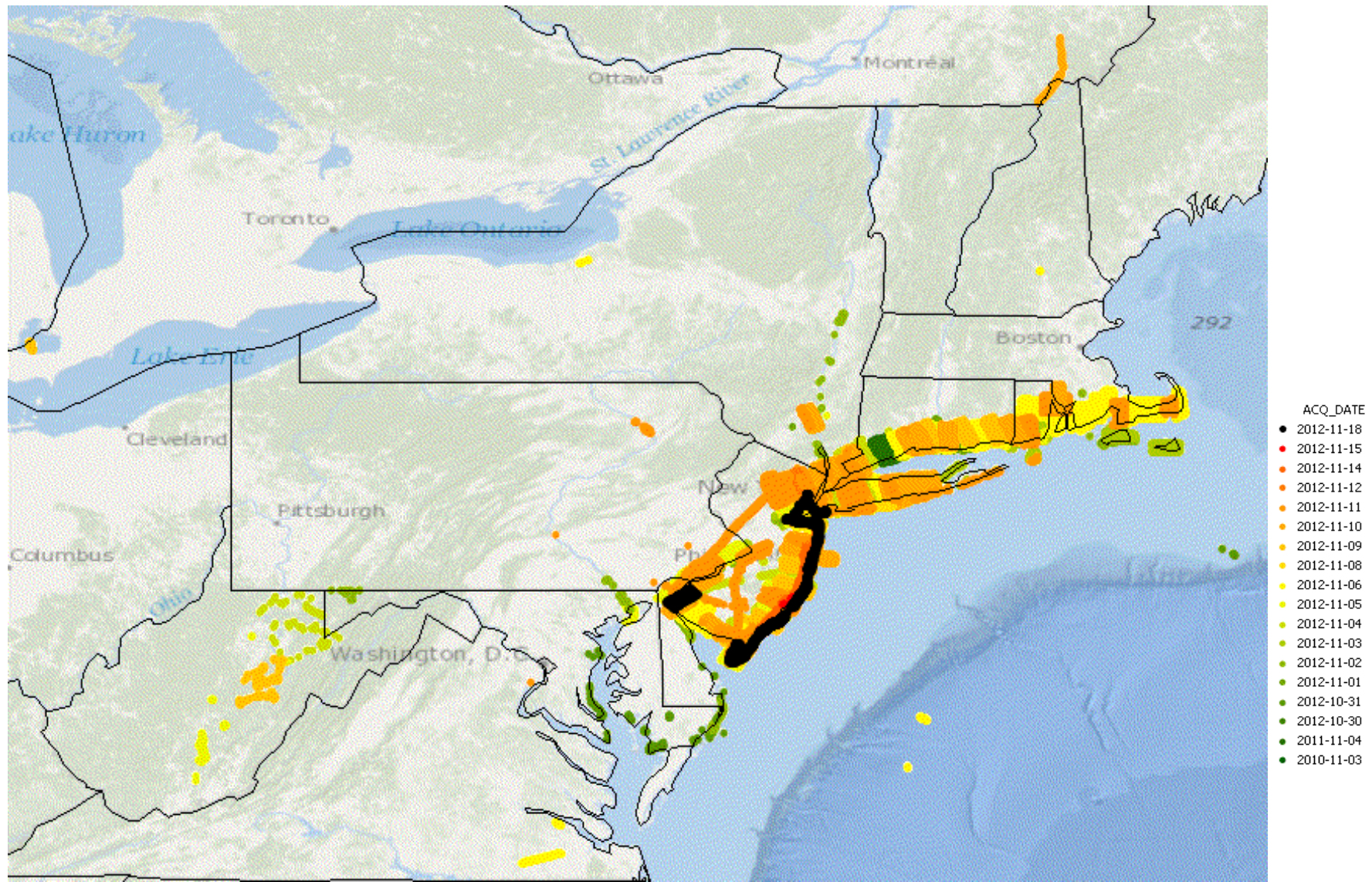
CAP November 18, 2012





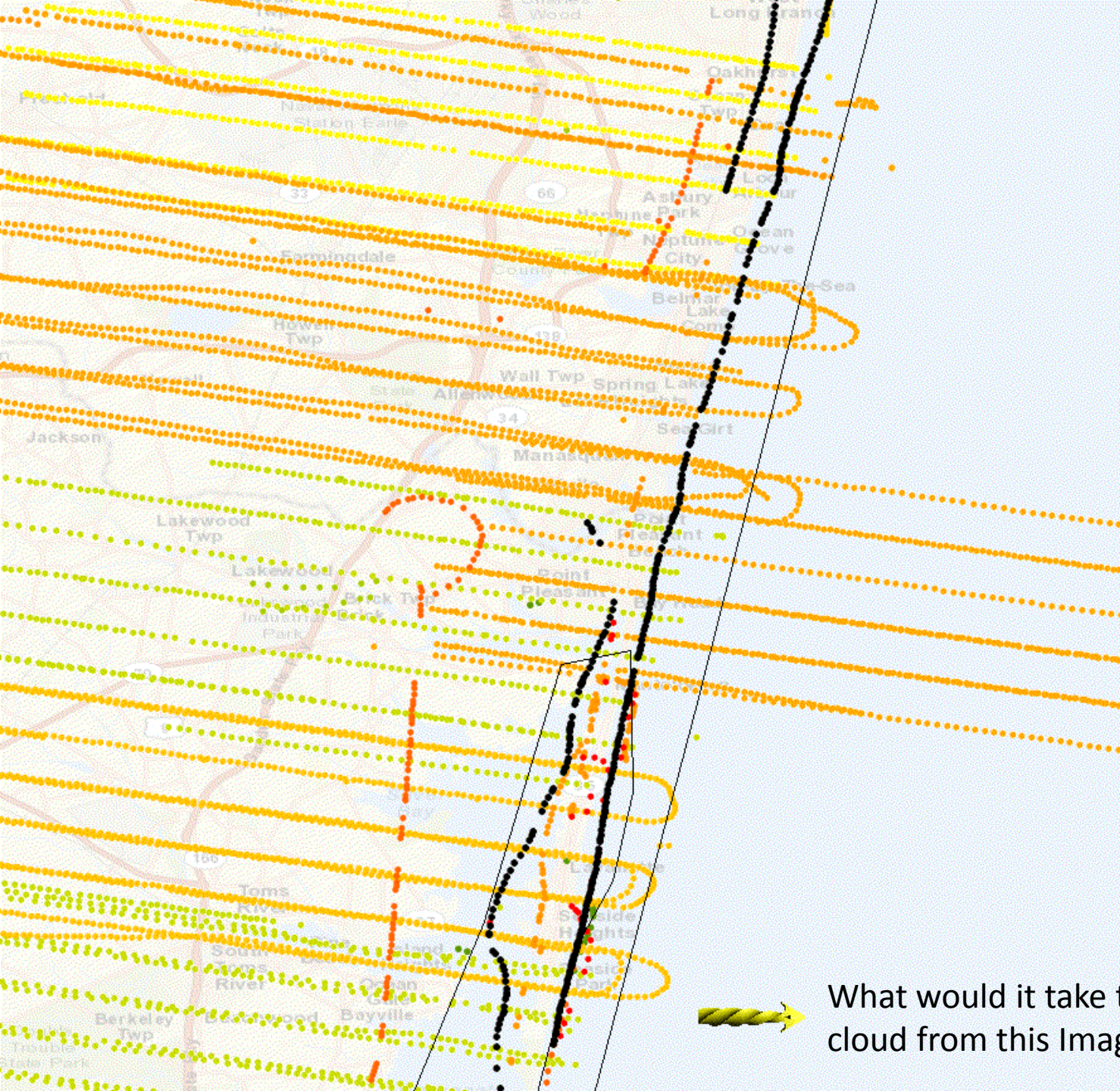
CAP November 18, 2012

Civil Air Patrol 158,012 Images



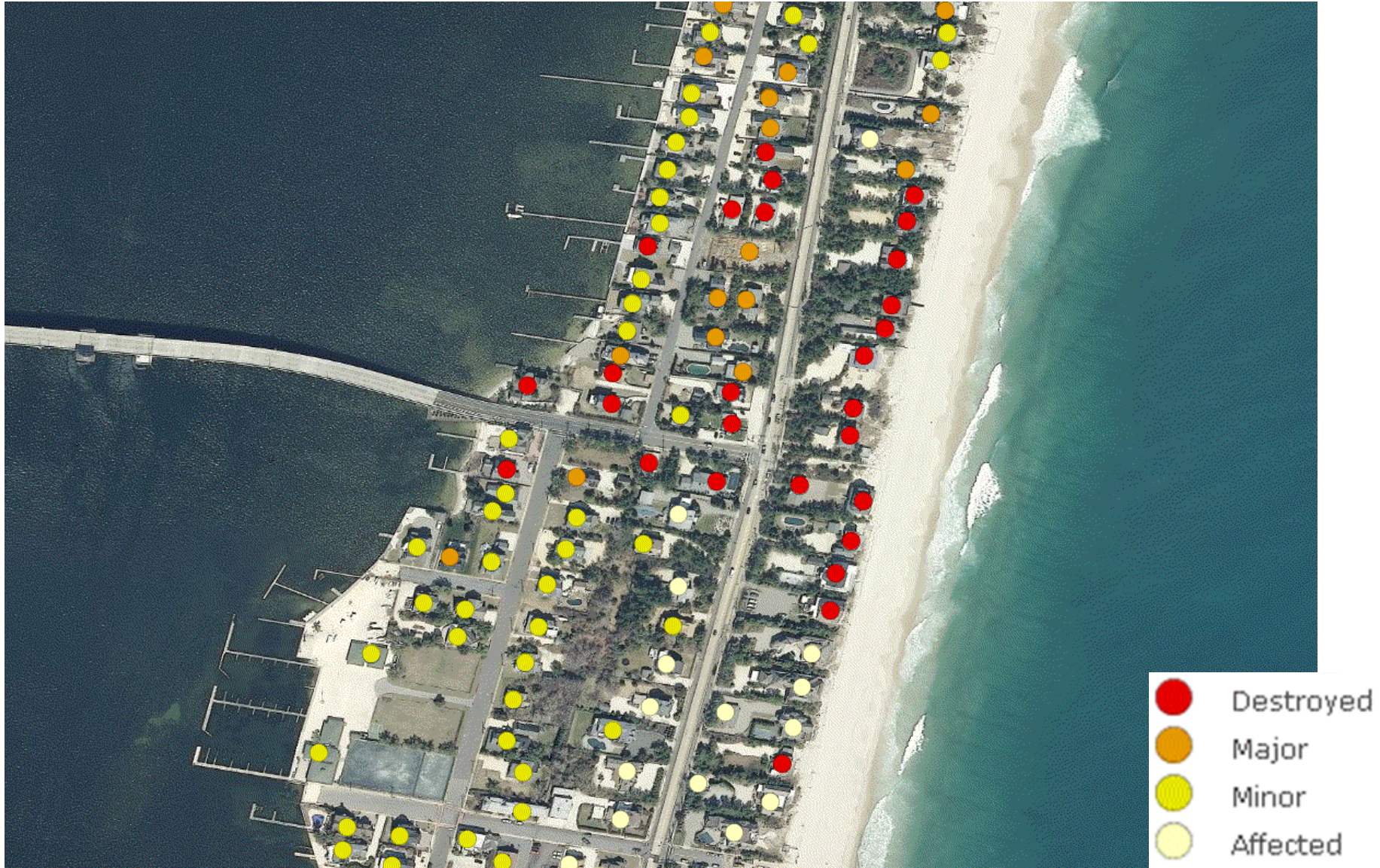


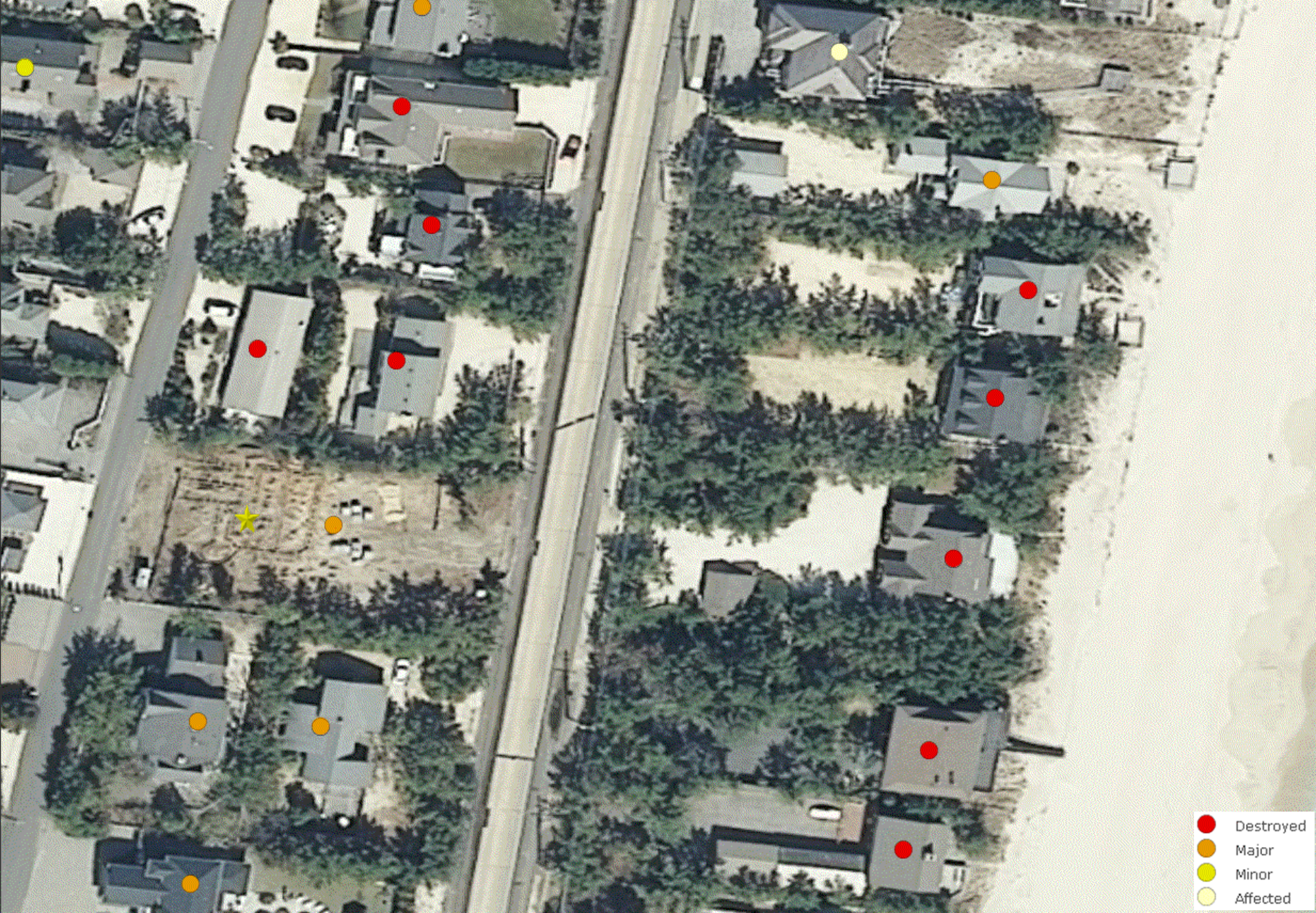
- ACQ_DATE
- 2012-11-18
 - 2012-11-15
 - 2012-11-14
 - 2012-11-12
 - 2012-11-11
 - 2012-11-10
 - 2012-11-09
 - 2012-11-08
 - 2012-11-06
 - 2012-11-05
 - 2012-11-04
 - 2012-11-03
 - 2012-11-02
 - 2012-11-01
 - 2012-10-31
 - 2012-10-30
 - 2011-11-04
 - 2010-11-03



What would it take to create a 3D point cloud from this Imagery?

FEMA Contractors used NOAA, CAP and other Imagery to make Initial Damage Assessments





Animation: NJ 2012 Pre-Event, NOAA Oct 31 and Nov 1, 2012

Digital Globe WV2 Animation



Pre-Event 09/01/2011 Post Event 11/04/2012



CAP



NOAA



Seaside NJ After Sandy Imagery from NOAA



Open and Secure FEMA Portal

Resource Center Show: Web Content Only Help Sign In

HOME

GALLERY

MAP

GROUPS

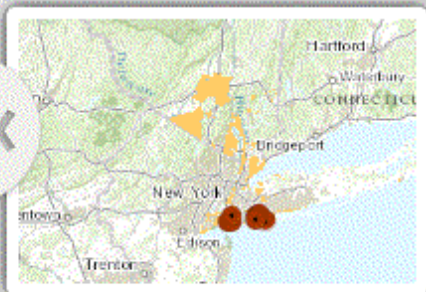
MY CONTENT

Find maps, applications and more...



FEMA

GeoPortal Online



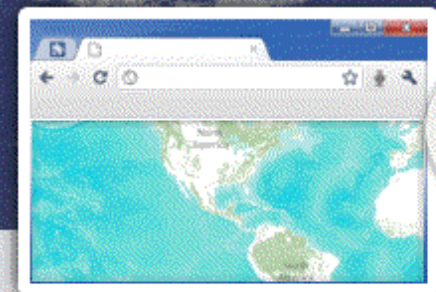
CR Completed Surveys



FEMA MOTF-Hurricane
Sandy Impact Analysis



Hurricane Sandy Housing
Task Force



Best Available Flood Data:
Tiled and Feature

Add Additional Layers

<http://fema.maps.arcgis.com/home/>
ImageCat Damage Assessment, Surge Extent, CAP

HOME | Hurricane Sandy-Damage Assessments

Details | **Add** | Basemap

Save | Share | Print | Measure | Bookmarks | Mantoloking NJ

Contents

- Cong. Dist. & Counties
- Humanitarian OpenStreetMap Team
- CAP Images
- ImageCat NLT damage analysis
- SurgeExtent
- Imagery

Aerial Images:
NJ_141036_DSC_0795.JPG

Name	NJ_141036_DSC_0795.JPG
Date	2012/11/18 21:19:07
Image	
Taken	

CAP Image

Zoom to

Esri.com | Terms of Use | Privacy | Contact Us | Report Abuse

POWERED BY **esri**

Creation of Services allow Easy Mashups

Description

Analysis associated with imagery products reflect an ongoing work product and do not represent a final determination of eligibility or damage classification.

Access and Use Constraints

Analysis associated with imagery products reflect an ongoing work product and do not represent a final determination of eligibility or damage classification.

Map Contents

Cong. Dist. & Counties:

<http://fema-services2.esri.com/arcgis/rest/services/Boundaries/MapServer>

Humanitarian OpenStreetMap Team:

http://fema-services2.esri.com/arcgis/rest/services/2012_Sandy/HOT/MapServer

CAP Images:

http://fema-services2.esri.com/arcgis/rest/services/CAP_Sandy/MapServer

ImageCat_NLT_damage_analysis:

http://fema-services.esri.com/arcgis/rest/services/2012_Sandy/ImageCat_NLT_damage_analysis/MapServer

SurgeExtent:

http://fema-services2.esri.com/arcgis/rest/services/2012_Sandy/SurgeExtent/MapServer

Light Gray Canvas:

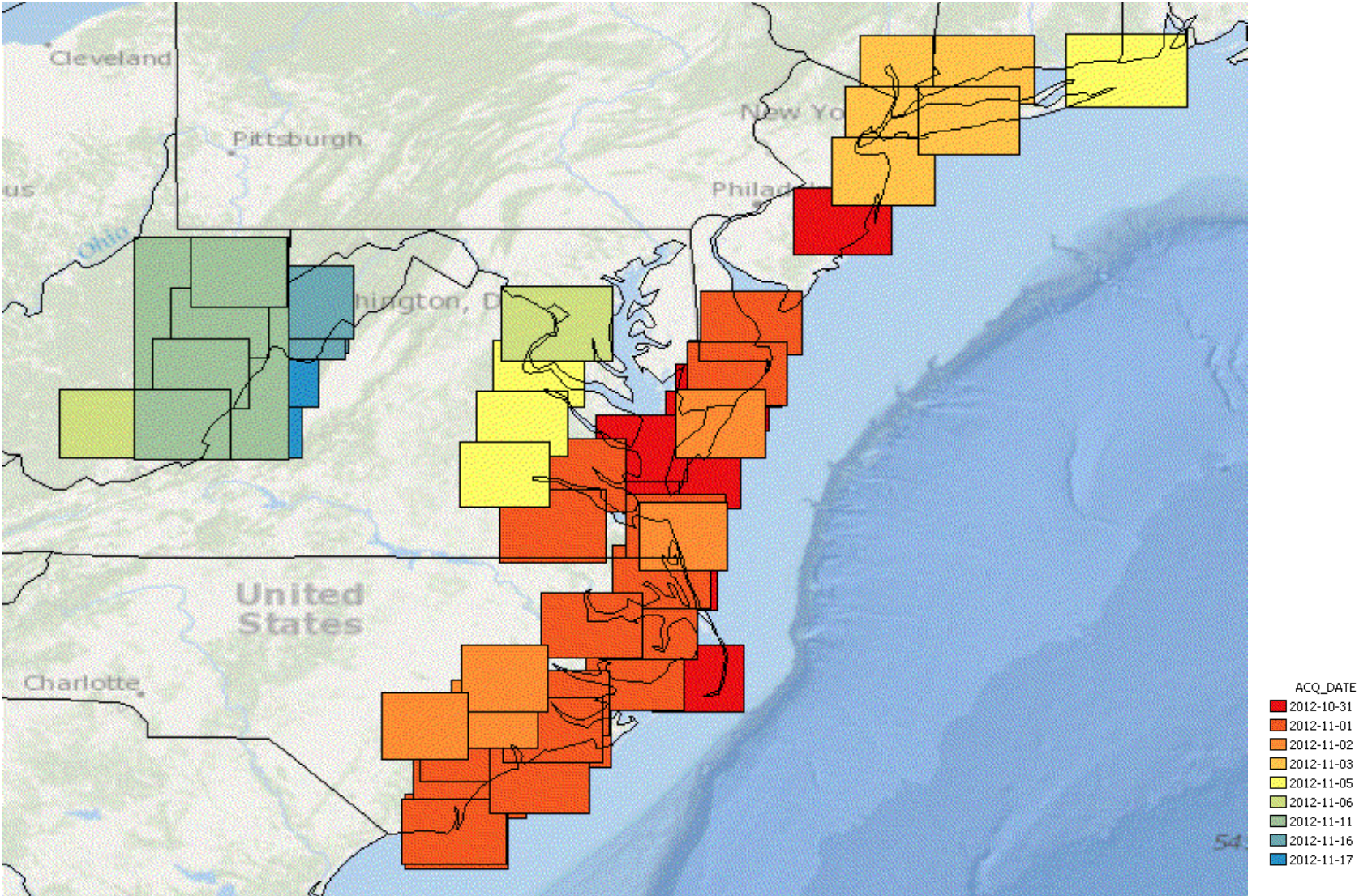
http://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Light_Gray_Base/MapServer

Eagle Vision Disaster Imagery

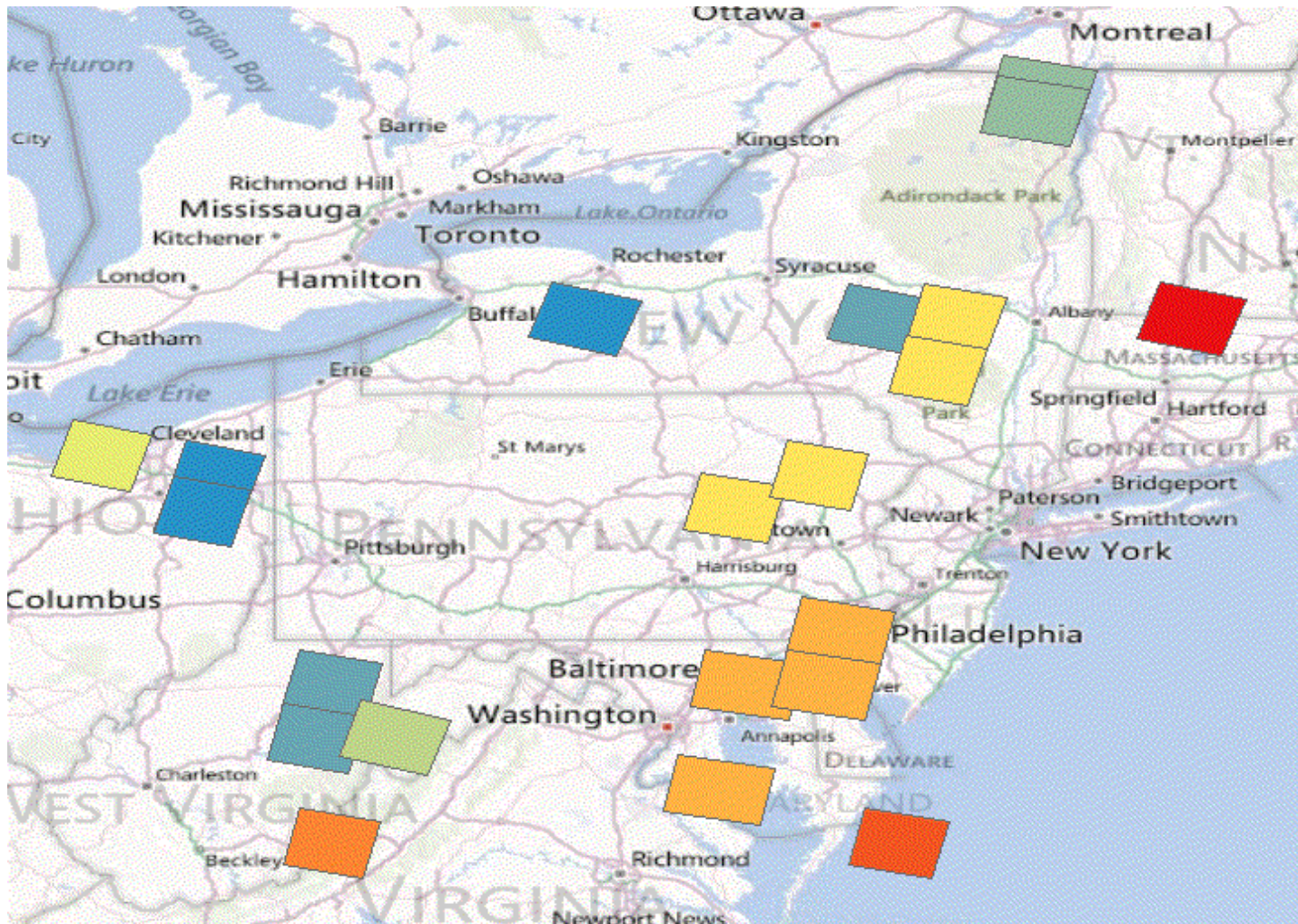
- Eagle Vision is uploading data to their organic EVR2EST servers as well as pushing it to HDDS.
- Imagery Access:
<http://evr2est.us>
<http://evr2est.us/data/layers.kmz>
- Web interface:
<http://evr2est.us/sandy.html>
- User/pass is not required for disaster relief imagery.
- Training materials, account request, support and RFI forms are available through the <http://evr2est.us> website.
- Commercial imagery from SPOT 4 and 5, RapidEye ...



Eagle Vision Imagery > Spot Data Buy



Spot 5 Data Buy Coverage



ACQ_DATE
12-NOV-12
11-NOV-12
08-NOV-12

<http://earthexplorer.usgs.gov/>

Loaded to EarthExplorer

FEMA Services and Data Download

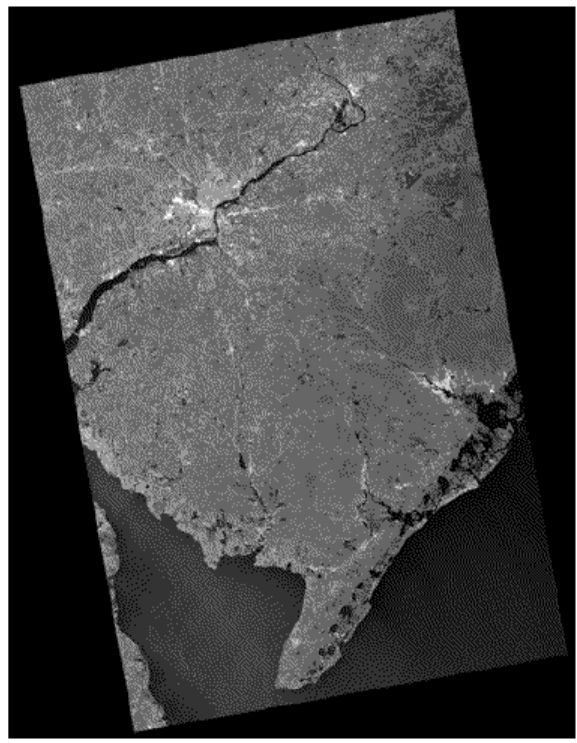
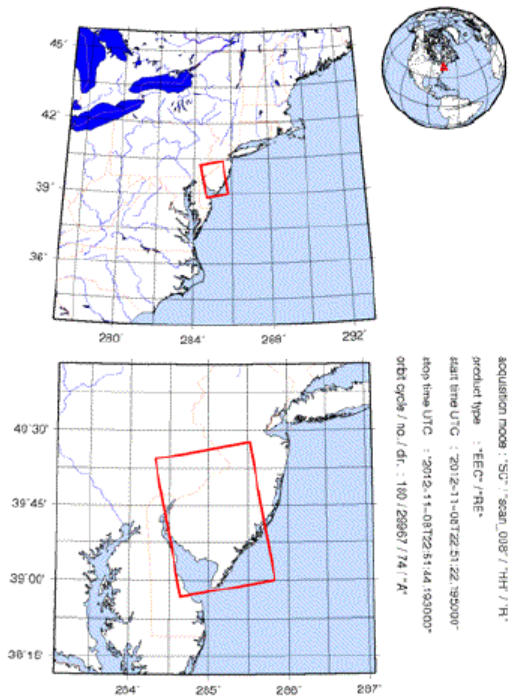
- FEMA NSS GIS rest endpoint: http://gis.fema.gov/REST/services/NSS/FEMA_NSS/MapServer
- **Power Outage Mapping:** <http://gis.fema.gov/REST/services/FEMA/PowerOutages/MapServer>
- **Sandy_Surge_Extent:**
- http://fema-services.esri.com/arcgis/rest/services/2012_Sandy/Sandy_Surge_Extent/MapServer
- **sandy_storm_surge - storm_tide**
- http://54.243.149.253:8080/ArcGIS/rest/services/sandy_storm_surge/MapServer/1
- **sandy_storm_surge - rapid_deployment_streamgage**
- http://54.243.149.253:8080/ArcGIS/rest/services/sandy_storm_surge/MapServer/2
- **sandy_nwis_sites - sandy_nwis**
- http://54.243.149.253:8080/ArcGIS/rest/services/sandy_nwis_sites/MapServer/0
- **Hurricane Sandy Impact Analysis:**
 - http://fema-services.esri.com/arcgis/rest/services/2012_Sandy/2012_Sandy/MapServer
 - [2012_Sandy/2012_Sandy](#) (MapServer)
 - [2012_Sandy/Accessibility Assesment](#) (MapServer)
 - [2012_Sandy/AHC Fuel Status](#) (MapServer)
 - [2012_Sandy/Airport status](#) (MapServer)
 - [2012_Sandy/DR4086 IncidentMap](#) (MapServer)
 - [2012_Sandy/Force Laydown GeoPortal](#) (MapServer)
 - [2012_Sandy/HurricaneSandy ResponseStabilization](#) (MapServer)
 - [2012_Sandy/IADData Sandy EC2](#) (MapServer)
 - [2012_Sandy/ImageCat NLT damage analysis](#) (MapServer)
 - Legend: http://fema-services.esri.com/arcgis/rest/services/2012_Sandy/ImageCat_NLT_damage_analysis/MapServer/legend
- **FEMA Data Download**
 - <http://184.72.33.183/GISData/>

The International Charter Space and Major Disasters

- **International Charter Activation for Hurricane Sandy Situation Report for United States**
http://www.floridadisaster.org/eoc/Sandy2012/Sandy_International_Charter_SitRep.pdf
 - Activated by FEMA
 - DMC, RapidEye, KARI KOMPSAT2 (optical, 1m)
 - Requested: IRS-P5, TerraSar-X, Cartosat-2, CBERS
- **The International Charter Space and Major Disasters for Haiti**
 - Activated by UNITAR/UNOSAT on behalf of UNOCHA for Hurricane Sandy in Haiti.
- To gain access to these image collections may require signing non-disclosure agreements and have strict dissemination restrictions.



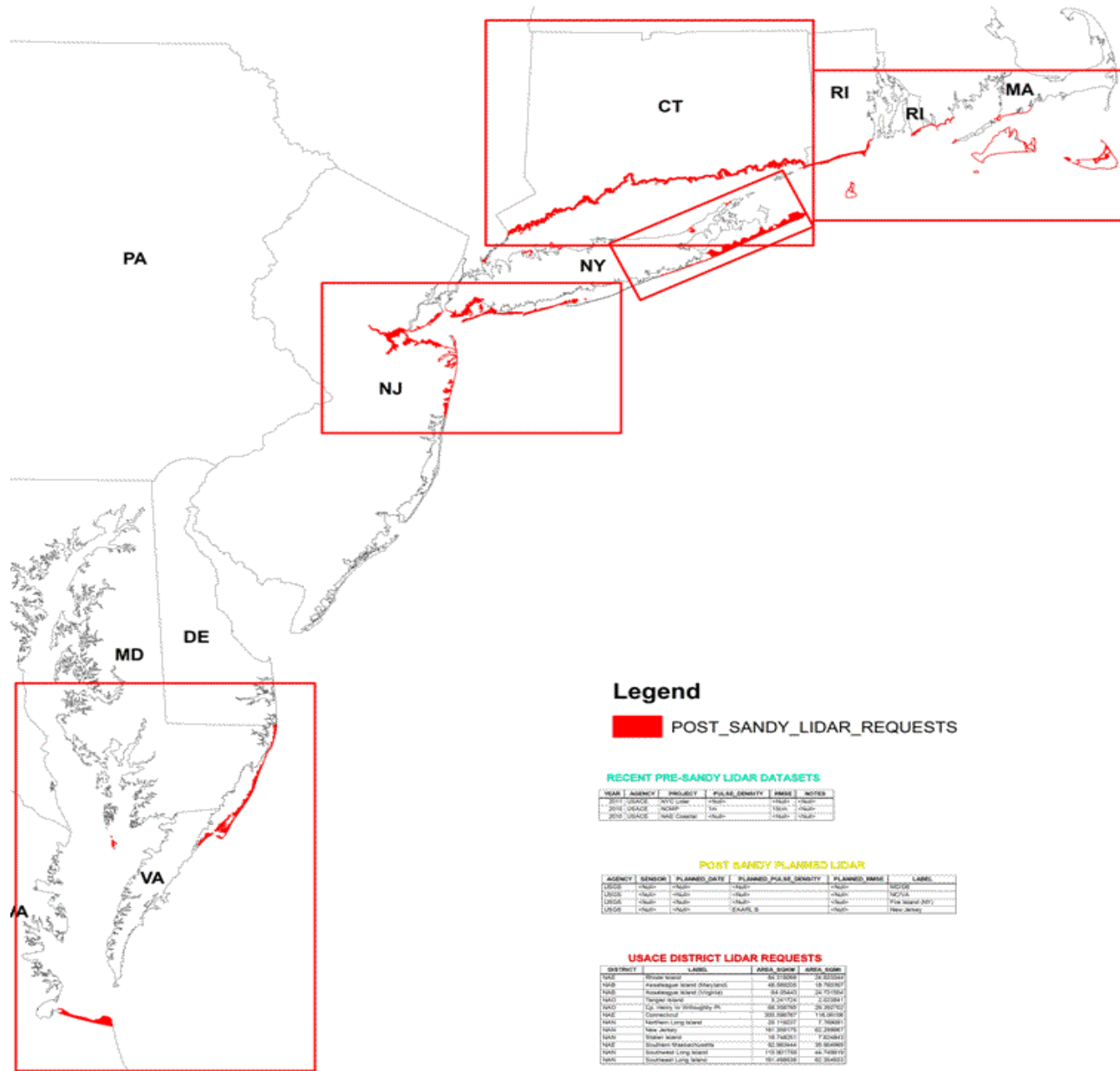
DLR Stripmap (radar, 3m) – new acquisition collected 11/01/12 (contact [Richard Butgereit](#) to obtain non-disclosure agreement and FTP site credentials)



GeoEye for Haiti



Planned Coastal Lidar Collections



Legend

■ POST_SANDY_LIDAR_REQUESTS

RECENT PRE-SANDY LIDAR DATASETS

YEAR	AGENCY	PROJECT	PULSE_DENSITY	NAME	NOTES
2017	USACE	NYC Lide	-Null-	-Null-	-Null-
2017	USACE	NOAA	Yes	-Null-	-Null-
2017	USACE	NAE Coastal	-Null-	-Null-	-Null-

POST SANDY PLANNED LIDAR

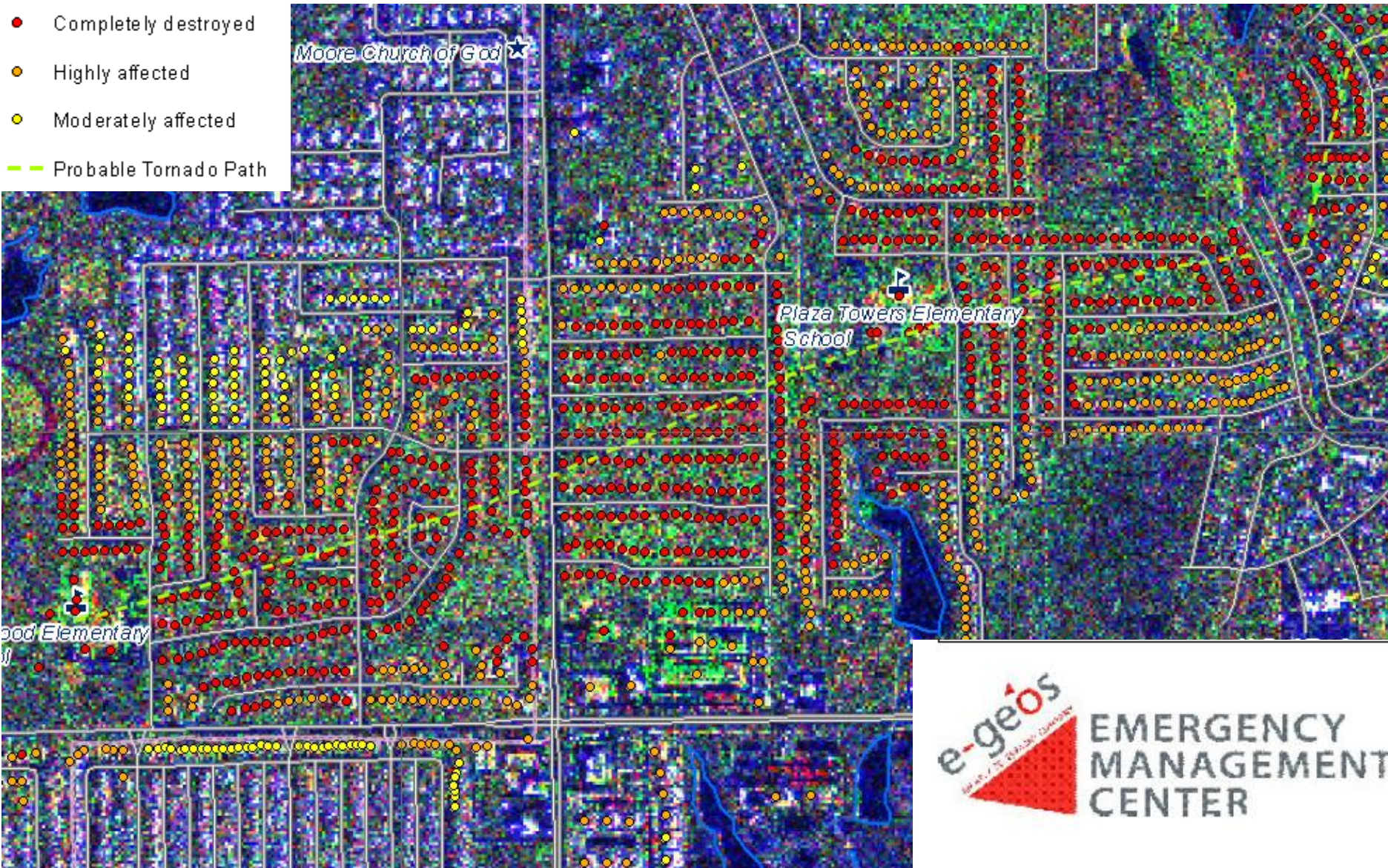
AGENCY	SENSOR	PLANNED DATE	PLANNED PULSE_DENSITY	PLANNED NAME	LABEL
USACE	-Null-	-Null-	-Null-	-Null-	EDGE
USACE	-Null-	-Null-	-Null-	-Null-	NOVA
USACE	-Null-	-Null-	-Null-	-Null-	Five Island 2017
USACE	-Null-	-Null-	3,000,000	-Null-	New Jersey

USACE DISTRICT LIDAR REQUESTS

DISTRICT	LABEL	AREA_SQKM	AREA_SQMI
USACE	Atlantic Ocean	44,713,664	17,263,024
USACE	Atlantic Ocean (Maryland)	44,566,025	17,160,937
USACE	Atlantic Ocean (Virginia)	44,284,411	17,077,824
USACE	Chesapeake Bay	3,247,424	1,254,141
USACE	Co. Study to Wilmington, DE	88,338,769	34,112,702
USACE	Connecticut	393,398,917	151,891,941
USACE	Northern Long Island	38,118,037	14,716,667
USACE	New Jersey	191,368,174	74,084,841
USACE	Shaker Island	18,748,000	7,238,441
USACE	Southern Massachusetts	62,963,844	24,348,641
USACE	Southeast Long Island	113,367,738	43,768,912
USACE	Southeast Long Island	82,288,038	31,764,000

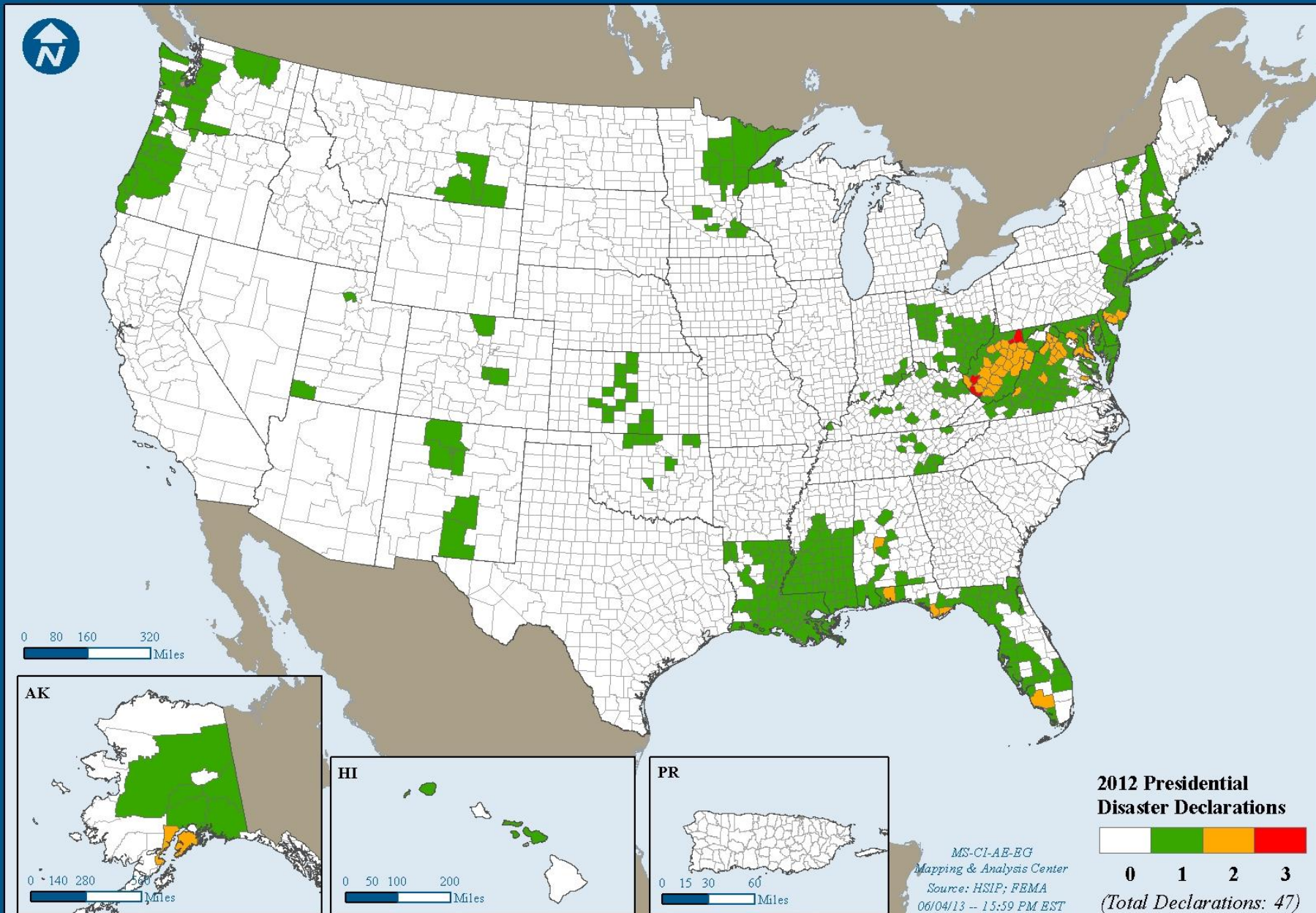
Multi-temporal Coherence from Cosmo SkyMed: Damage Assessment for Moore Oklahoma Tornado.

The Lack of US Space Architecture that Supports Disasters results in US being without the capability to see through clouds and make operation products like these.

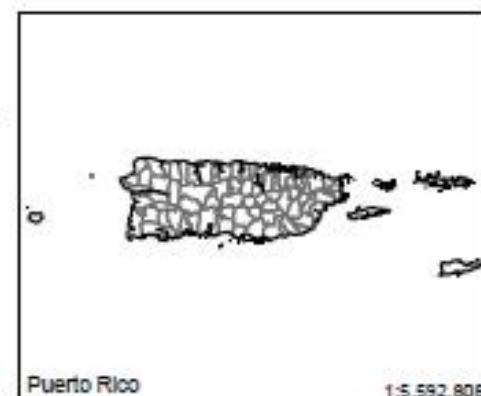
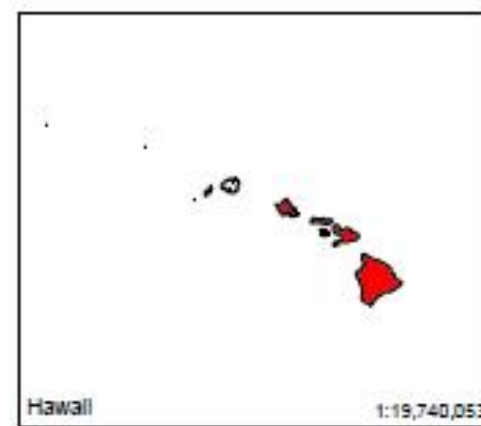
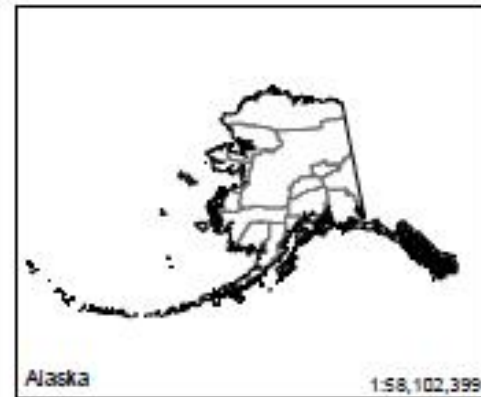
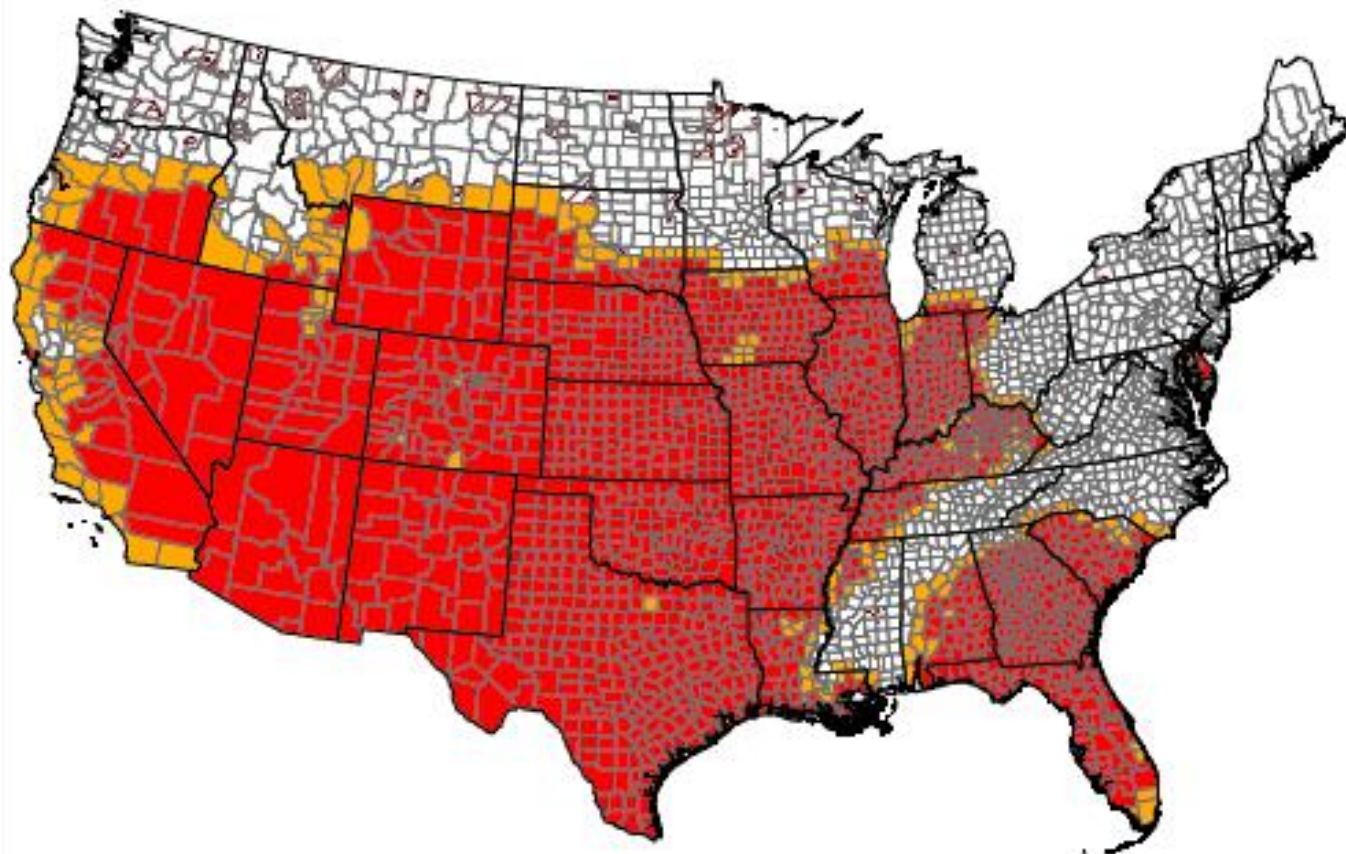


The Scope USDA Involvement In Disasters

USDA agencies have many programs that are activated during disasters.



2012 Secretarial Drought Designations - All Drought



All Drought Disaster Incidents as of 8/22/2012

- State Boundary
- County Boundary
- Tribal Lands
- Primary Counties: 1,692
- Contiguous Counties: 276



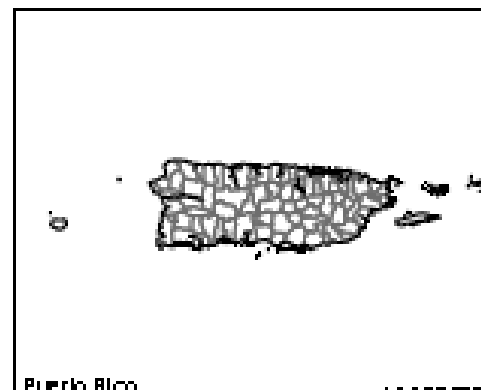
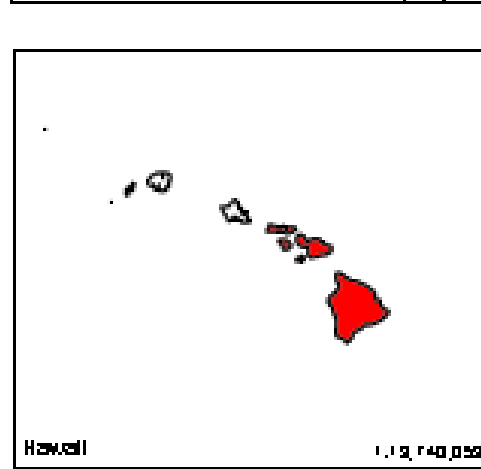
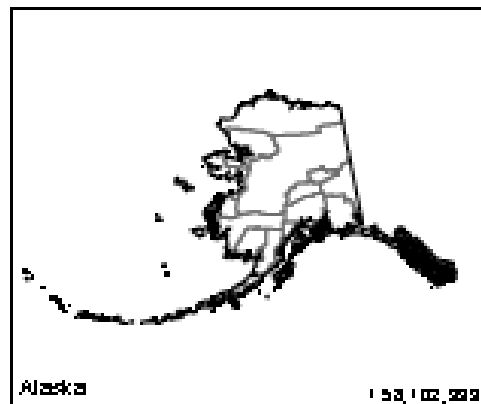
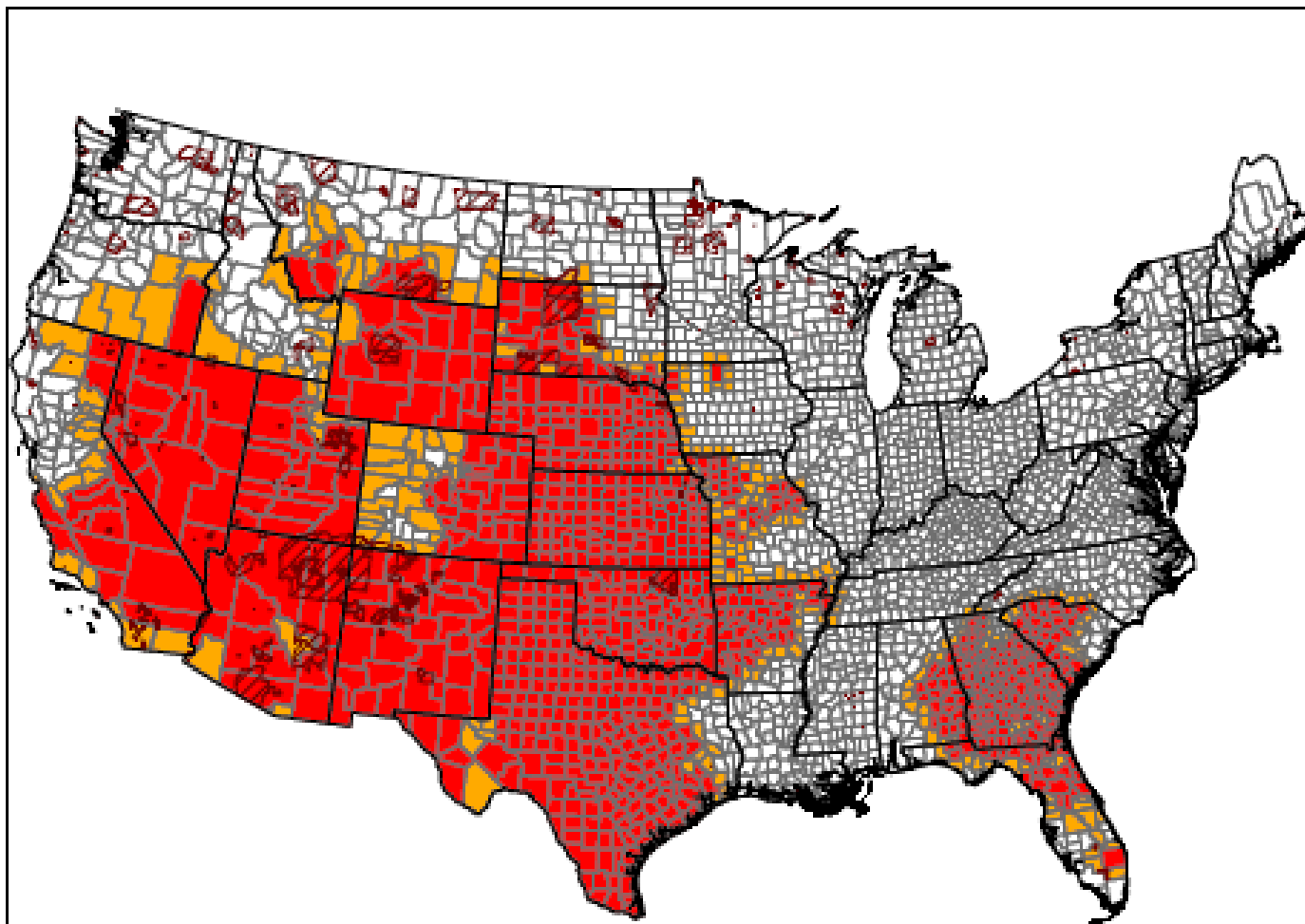
USDA Farm Service Agency
Production, Emergencies and Compliance Division
Washington, D.C.
August 22, 2012

1:23,520,203

1:5,592,808






Secretarial Disaster Designations - CY 2013

Primary and Contiguous Counties Designated for 2013 Crop Disaster Losses



All Secretarial Designations as of May 29, 2013

Total All Crop Approved Designations

-  State Boundary
-  County Boundary
-  Tribal Lands
May 29, 2013
-  Primary Counties: 570
-  Contiguous Counties: 258



USDA Farm Service Agency
Production, Emergencies and Compliance Division
Washington, D.C.

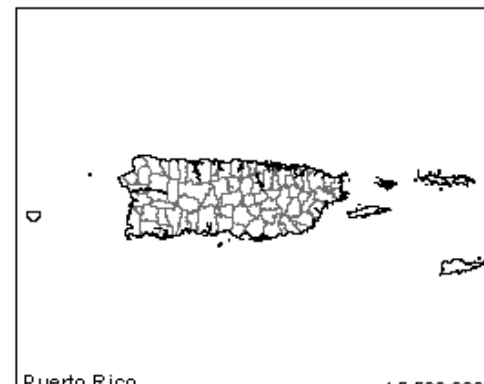
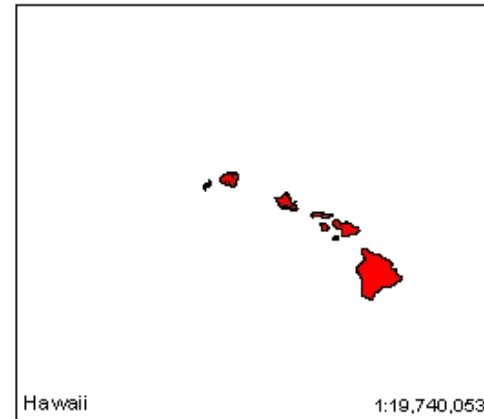
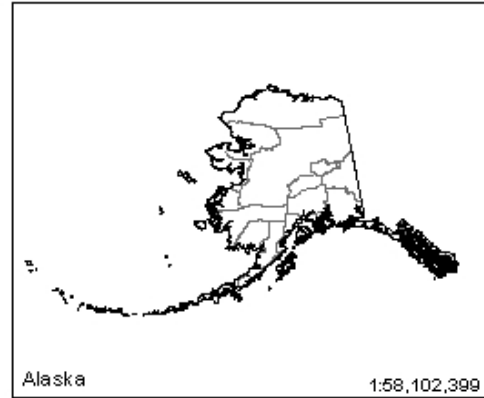
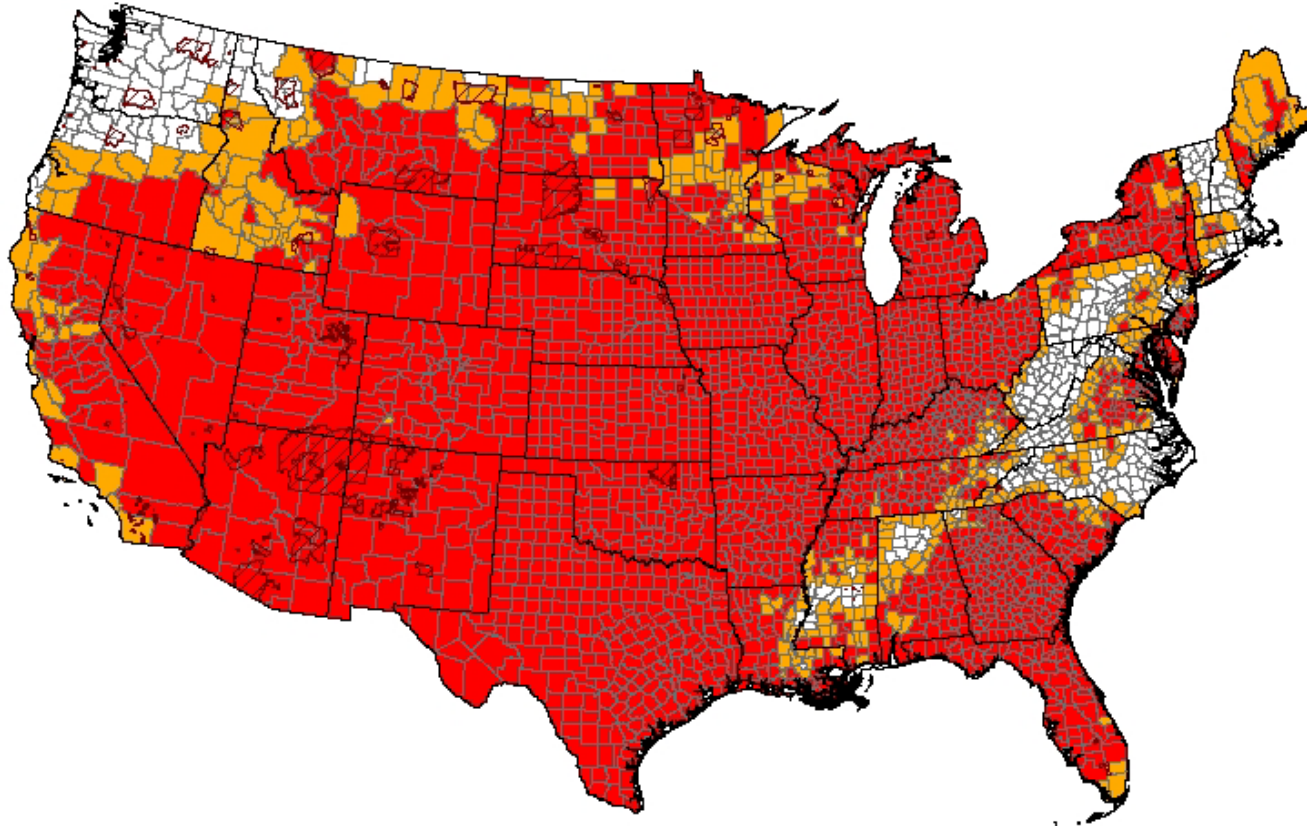
May 29, 2013

1:25,000,000

Puerto Rico

Secretarial Disaster Designations - CY 2012

Primary and Contiguous Counties Designated for 2012 Crop Disaster Losses



All Crop Disaster Incidents as of 2/13/2013

- State Boundary
- County Boundary
- Tribal Lands

Total All Crop Approved Designations
February 13, 2013

- Primary Counties: 2,333
- Contiguous Counties: 423

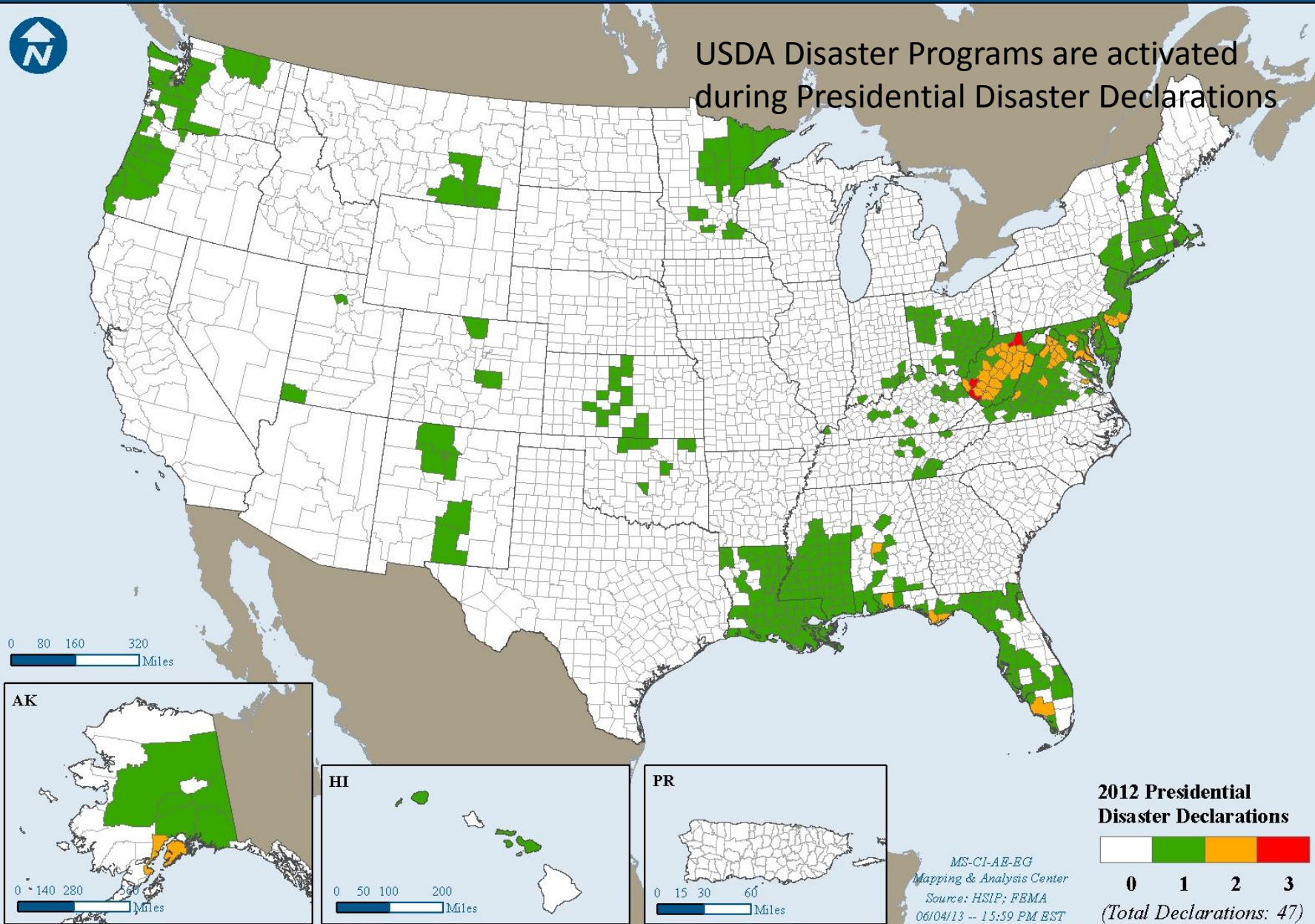


USDA Farm Service Agency
Production, Emergencies and Compliance Division
Washington, D.C.
February 13, 2013

1:23,520,203



USDA Disaster Programs are activated during Presidential Disaster Declarations



USDA Disaster Assistance Programs for Landowners, Farmers, Ranchers and Producers

- Emergency Conservation Program
- Emergency Watershed Protection Program
- Emergency Forest Restoration Program
- Noninsured Crop Disaster Assistance Program
- Tree Assistance Program
- Supplemental Revenue Assistance Payments Program
- Emergency Assistance for Livestock, Honeybees, and Farm Raised Fish
- Livestock Forage Disaster Program
- Livestock Indemnity Program
- Emergency Loan Program



The Food and Nutrition Service (FNS) coordinates with State, local and voluntary organizations to:

- Issue Disaster Supplemental Nutrition Assistance Program (D-SNAP) benefits.
- As part of the **National Response Framework**, FNS provides nutrition assistance to those most affected by a disaster or emergency.
 - FNS supplies food to disaster relief organizations such as the Red Cross and the Salvation Army for mass feeding or household distribution.