Environmental Data Services for Delaware:

Serving Emergency Responders, Planners, and Researchers

Network Delaware Day

November 6, 2013

Overview

- Operational Data Services
  - More than just research
  - DEOS and DEMAC
- Constituents and End-users
  - Local, State, and Federal Agencies
  - Academia, too
- Highly dependent on reliable, stable technology
  - Connectivity
  - Band-width

What is DEOS?

DEOS is a real-time environmental data service provider for Delaware and the surrounding region.

DEOS provides expertise in:

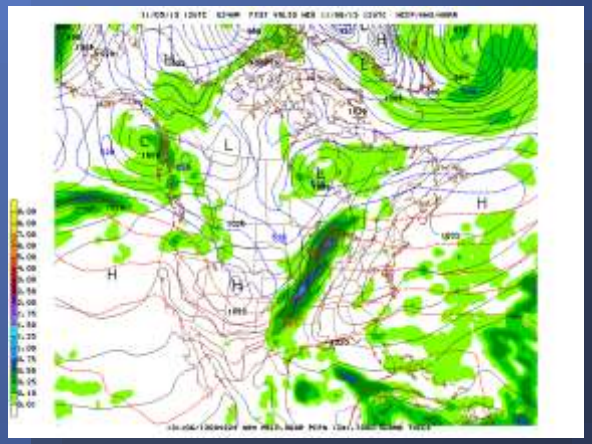
- the monitoring of environmental conditions
- the integration of environmental data for real-time use
- the development of data products for environmental applications

Who uses DEOS?

Emergency Management

Transportation

Agriculture



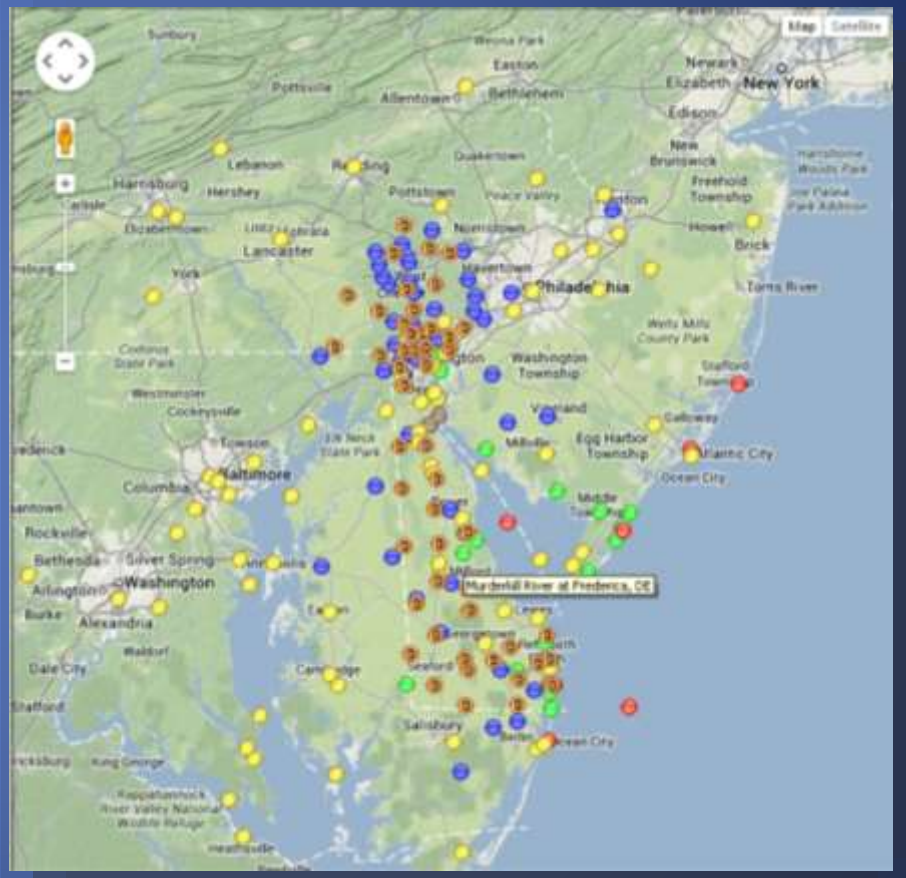
Scientific Community

DEOS Monitoring Network

- Began in 2003
- DEOS manages end-to-end monitoring of approximately 50 sites across Delaware and southeast Pennsylvania.
- Sites monitor mostly meteorological conditions with multiple sensors per site
- Sites are self-contained (solar, cell service)
- Data are 5-minute resolution

DEOS Data Integration

- Data integrated from about 350 additional monitoring platforms throughout region
  - Sources: Mainly NOAA, USGS, and EPA, but also state groups like DelDOT, DNREC, and DSWA
  - About 200 are used real-time
- Data cover vast environmental spectrum
  - Meteorological
  - Physical Hydrology (e.g. flow, height, etc.)
  - Water Quality
  - Wave/Marine



DEOS Website

- URL: www.deos.udel.edu
- Primary User: General Public, State/Local Governments
- Stats:
  - Typically sees 200-250 site visits (1500 page views) per day
  - Peaks with significant weather events
    - 10/28/12 – 10/30/12 (Hurricane Sandy) – 8,000 visitors
  - State of Delaware use typically 8% of visitors
    - Much higher during significant weather events
  - Mobile = 25% of users
- Provides basic access to data products, visualize real-time data, and access historic data.

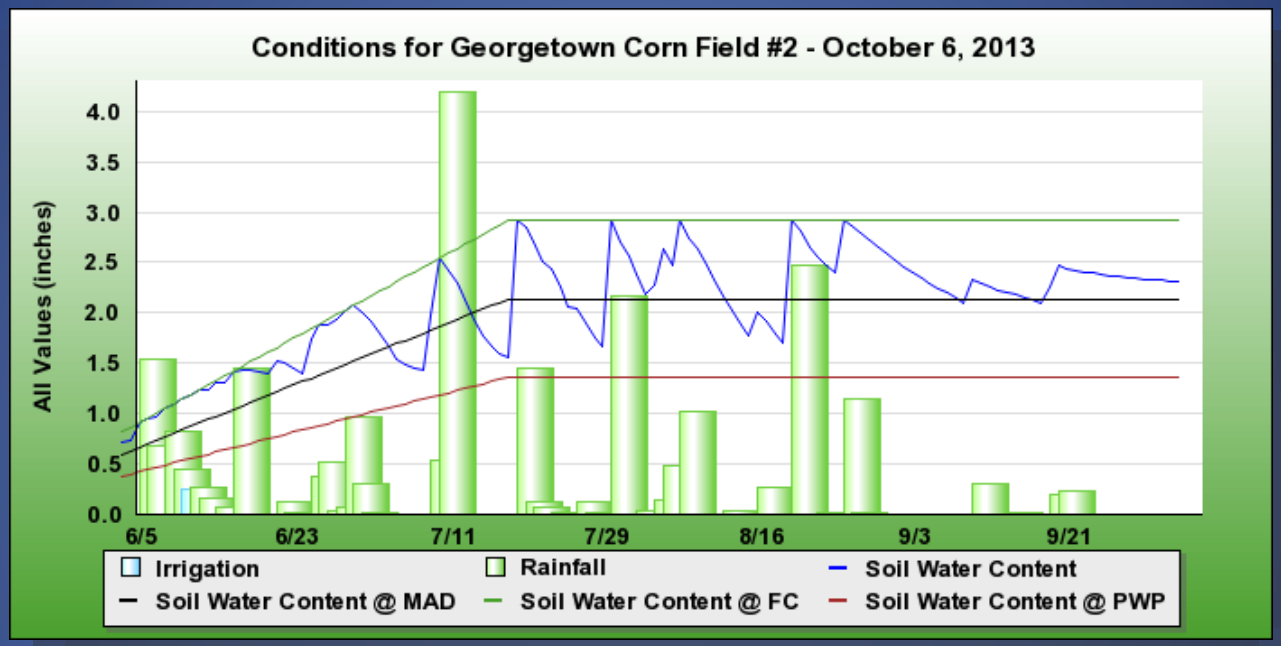
DEOS Alerts System

- Notifies users in real-time about critical environmental conditions
  - Parameter-specific (e.g. Rainfall, Air Temperature)
  - Text Message and/or E-mail delivery
  - User-defined thresholds
- Target audience: Emergency Management/Government
- High uptime/availability is **critical**
- Some alerts require external data resources

Coastal Flood Monitoring System

- www.coastal-flood.udel.edu
- Provides predicted water levels, inundation maps and road profiles for communities along a portion of Delaware coastline
- Supported by alerts system to notify emergency management community
- High uptime/availability is **critical**
- Utilizes external (NOAA) data resources

Delaware Irrigation Management System



- Provides farm field-specific modeled daily crop water requirements for growers using soils dataset, DEOS network data, and user input.
- Benefits (Economic):
  - Maximizes crop yield; minimizes water usage
  - Reduces nutrient runoff/leaching
- Users: Agriculture community (growers and crop consultants)
- Uptime is important on day-to-day basis

Snow Monitoring Network

- Provides real-time measurements of snow accumulation for 18 sites in Delaware and 8 sites in Chester County, PA.
- Used by DelDOT to reimburse civic associations for snow removal costs during significant snow storms
- Also used operationally by DelDOT for plowing
- High uptime/availability is **critical**

DEOS Snow Monitoring Network

"A real-time resource for snow conditions across Delaware"

Sponsored By:

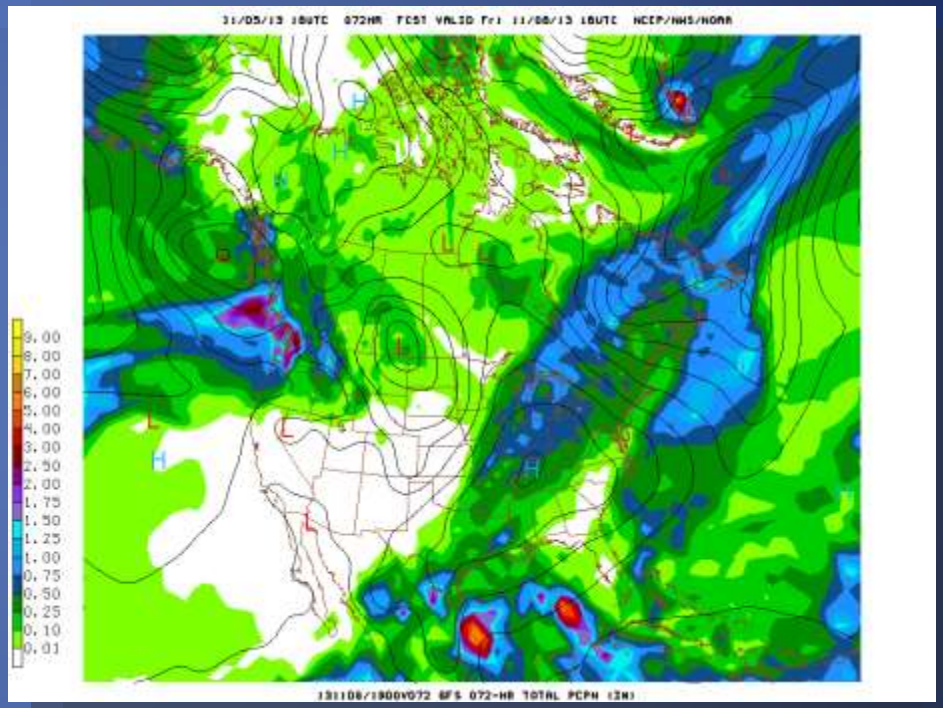
Current | Archived Events | About

Snow Totals For: March 25, 2013

DelDOT Maintenance Area	Location	Last Update (minutes ago)	Snow Storm Total (in)
12	Talley	7	1.5
12	Greenville	7	3.1
12	Claymont	7	1.1
11	Hockessin	7	1.5
11	White Clay Creek	7	1.9
11	Prices Corner	7	1.1
10	Glasgow	7	1.3
10	New Castle	7	1.4
10	Newark	7	0.9
9	Blackbird	7	2.2
8	Dover	7	2.3
7	Viola	2	2.8
6	Harrington	7	2.1
5	Selbyville	2	0.0
4	Stockley	2	Trace
3	Ellendale	2	1.3
2	Bridgeville	7	1.5
1	Laurel	7	0.4

DEOS (Data) Web Services

- DEOS provides RESTful XML web service interface for recurring data and metadata needs
- Used operationally by 5 organizations
  - Most notably National Weather Service (NWS)
    - Used for initialization of numerical weather prediction models
    - Used by local NWS Forecast Office (Mt. Holly, NJ) to issue advisories and warnings during severe weather
- Typically daily usage is about 600,000 data values
  - NWS usage is around 500,000 per day
- High uptime/availability is **critical**



Summary: DEOS Network

- DEOS data and products are used by others to make decisions that protect life and property and minimize financial risk
- Major IT Needs:
  - High uptime/availability of system (and network)
  - Continuous access to external data sources
  - Oracle database support
    - UD Oracle Users Group???

Delaware Environmental Monitoring & Analysis Center

EXTENDING THE DATA

Continuous Monitoring Efforts in the Delaware Region

Meteorological variables

- Temperature
- Precipitation
- Wind speed/direction
- Atmospheric pressure,
- Humidity,
- Solar radiation,
- soil temperature
- soil moisture

Continuous Monitoring Efforts in the Delaware Region

Streamflow

- gage height
- discharge

USGS science for a changing world

Tidal Data

- tide levels

USGS science for a changing world

NOAA

Ocean Buoy Data

- wave height
- wave period
- water temp

NOAA

Delaware Department of Natural Resources and Environmental Control

Continuous Monitoring Efforts in the Delaware Region

Water Quality Sampling

- Salinity
- Dissolved Oxygen
- pH

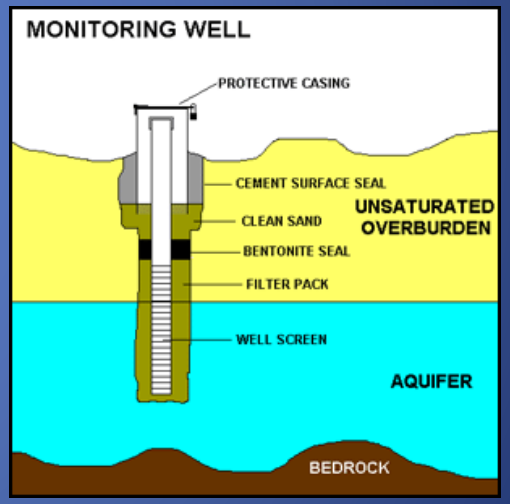
DELAWARE CENTER FOR THE INLAND BAYS
Rehoboth Indian River Little Assawoman

USGS science for a changing world

UNIVERSITY OF DELAWARE
Citizen Monitoring Program

Groundwater Levels

- depth to aquifer



DELAWARE GEOLOGICAL SURVEY

DEMAC Delaware Environmental Monitoring & Analysis Center

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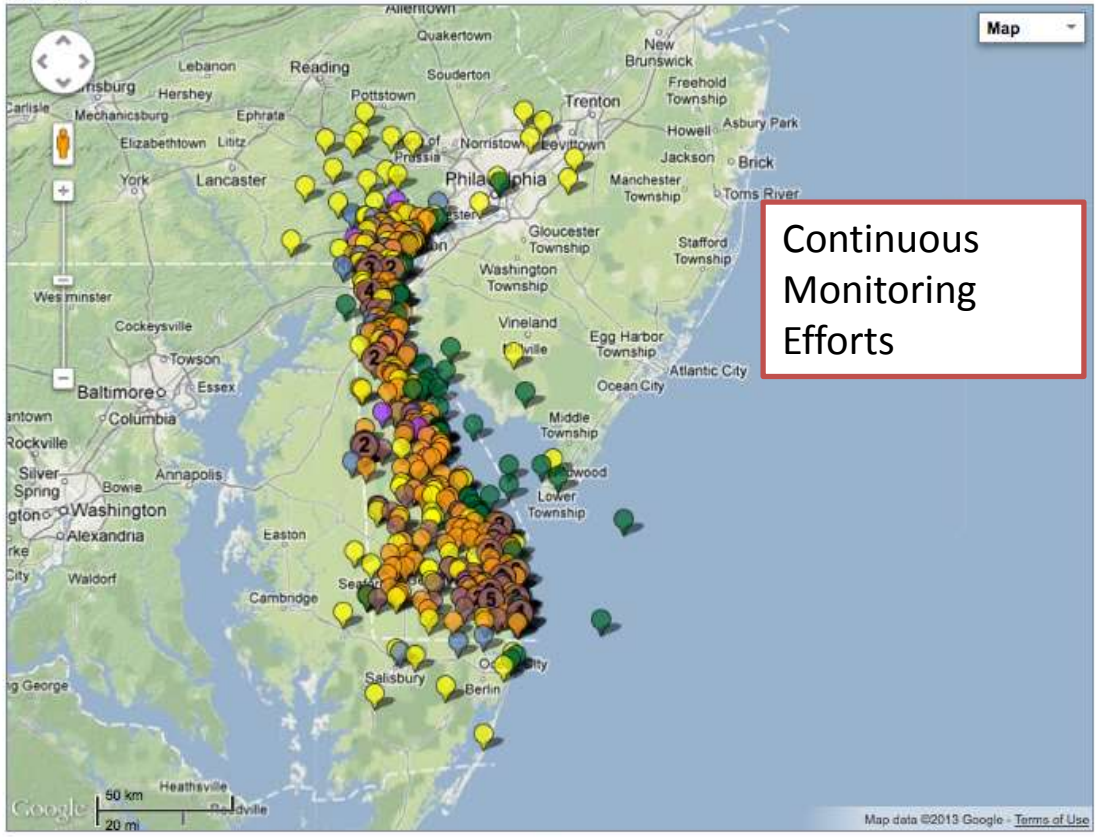
Delaware Environmental Monitoring Sites

MAP • TABLE • LIST VIEW

469 Items



Continuous Monitoring Efforts

Type

- 137 Groundwater
- 96 Meteorological
- 27 Streamflow
- 66 Tidal
- 159 Water Quality

Source

- 24 COOP/NWS
- 9 DELDOT
- 58 DEOS
- 137 DGS
- 169 DNREC
- 12 FAA/NWS
- 14 NOAA
- 2 USACE
- 44 USGS

Project

- 4 Bombay Hook
- 6 CFMS
- 24 COOP/NWS
- 2 DCMP
- 9 DELDOT
- 50 DEOS

Text Search

Delaware Watersheds

Active?

- 71 N
- 398 Y

Realtime?

- 335 N
- 134 Y

Variables

- 108 air temperature
- 138 bacteria
- 1 cdom
- 1 ceiling height
- 1 chlorophyll
- 1 conductivity
- 1 current direction
- 1 current speed
- 74 dewpoint temperature
- 27 discharge
- 156 do
- 15 do %sat
- 4 dominant wave period
- 138 hardness
- 1 nitrate
- 146 nutrients

Groundwater | Meteorological | Streamflow | Tidal | Water Quality | Multiple

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Delaware Environmental Monitoring Sites

MAP • TABLE • LIST VIEW

134 Items filtered from 469 originally (Reset All Filters)

Type

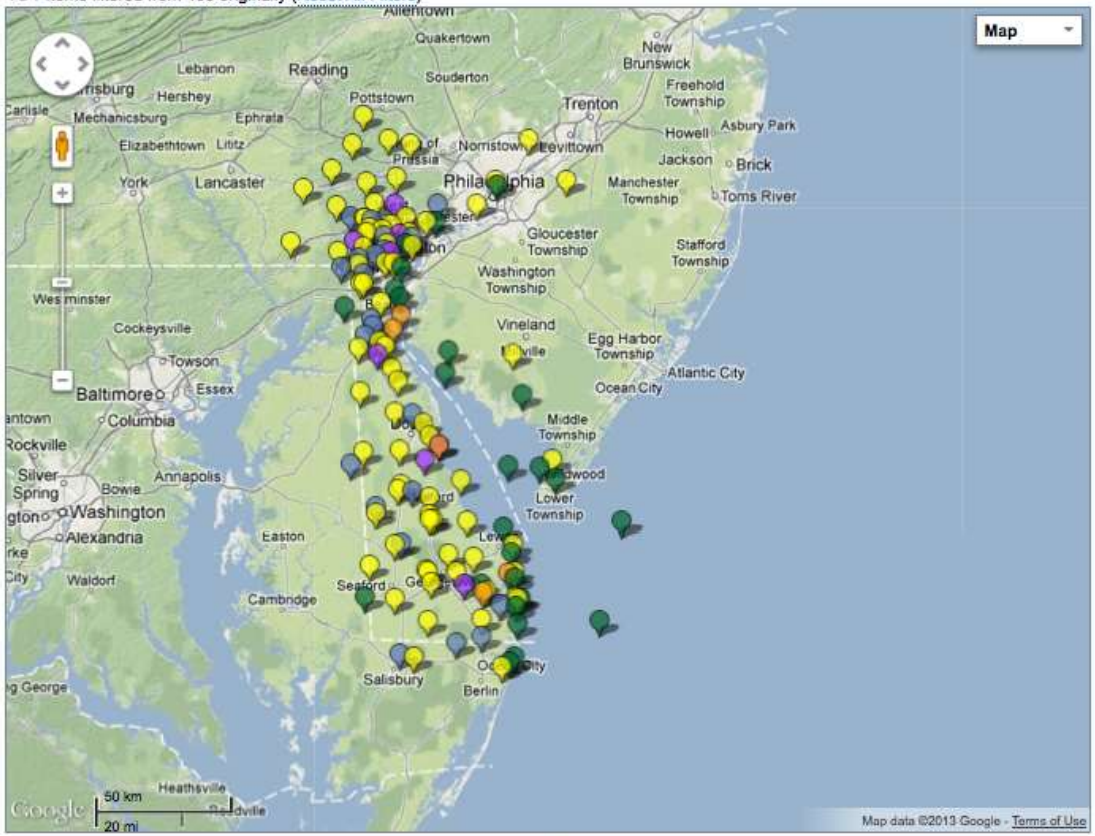
- 74 Meteorological
- 27 Streamflow
- 28 Tidal
- 13 Water Quality

Source

- 2 COOP/NWS
- 9 DELDOT
- 52 DEOS
- 1 DNREC
- 12 FAA/NWS
- 12 NOAA
- 2 USACE
- 44 USGS

Project

- 2 COOP/NWS
- 9 DELDOT
- 50 DEOS
- 1 DEOS, Inland Bays
- 12 FAA/NWS
- 1 Inland Bays



Meteorological | Streamflow | Tidal | Water Quality | Multiple

Text Search

Delaware Watersheds

Active?

- 2 N
- 132 Y

Realtime? 1

- 335 N
- 134 Y

Variables

- 85 air temperature
- 1 cdom
- 1 ceiling height
- 1 chlorophyll
- 1 conductivity
- 74 dewpoint temperature
- 27 discharge
- 12 do
- 9 do %sat
- 2 dominant wave period
- 1 nitrate
- 1 nutrients
- 1 o2
- 1 o2sat
- 13 ph
- 74 precipitation

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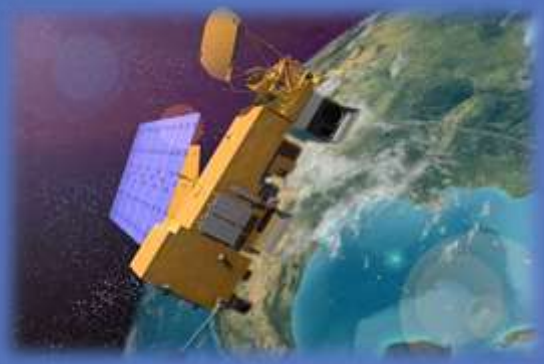
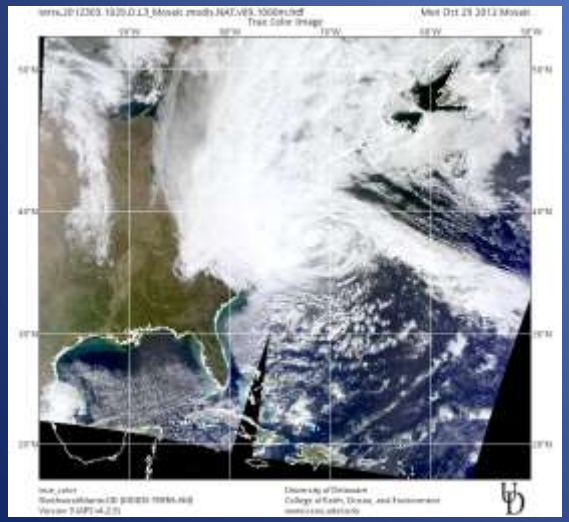
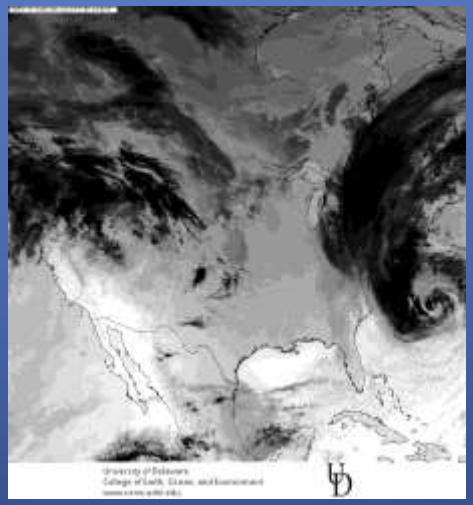
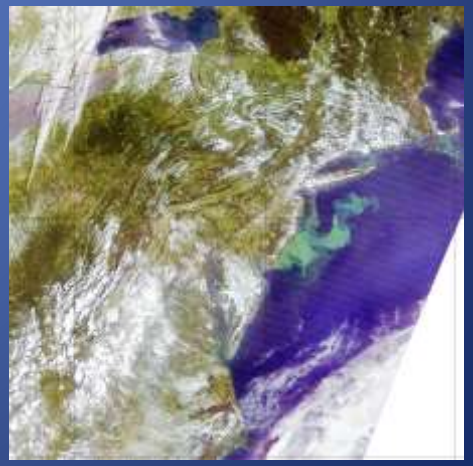
Continuous Monitoring Efforts in the Delaware Region

UD Satellite Receiving Station (UDSRS)









Numerous additional environmental sensing instruments such as AUVs, ADCPs, Ocean Gliders, CODAR, and the RV Sharp are also monitoring the coastal and ocean environment.

DEMAC works with all of these groups to help them share and visualize their data.

What is DEMAC?

Delaware Environmental Monitoring & Analysis Center

- NSF EPSCoR funded

Goals:

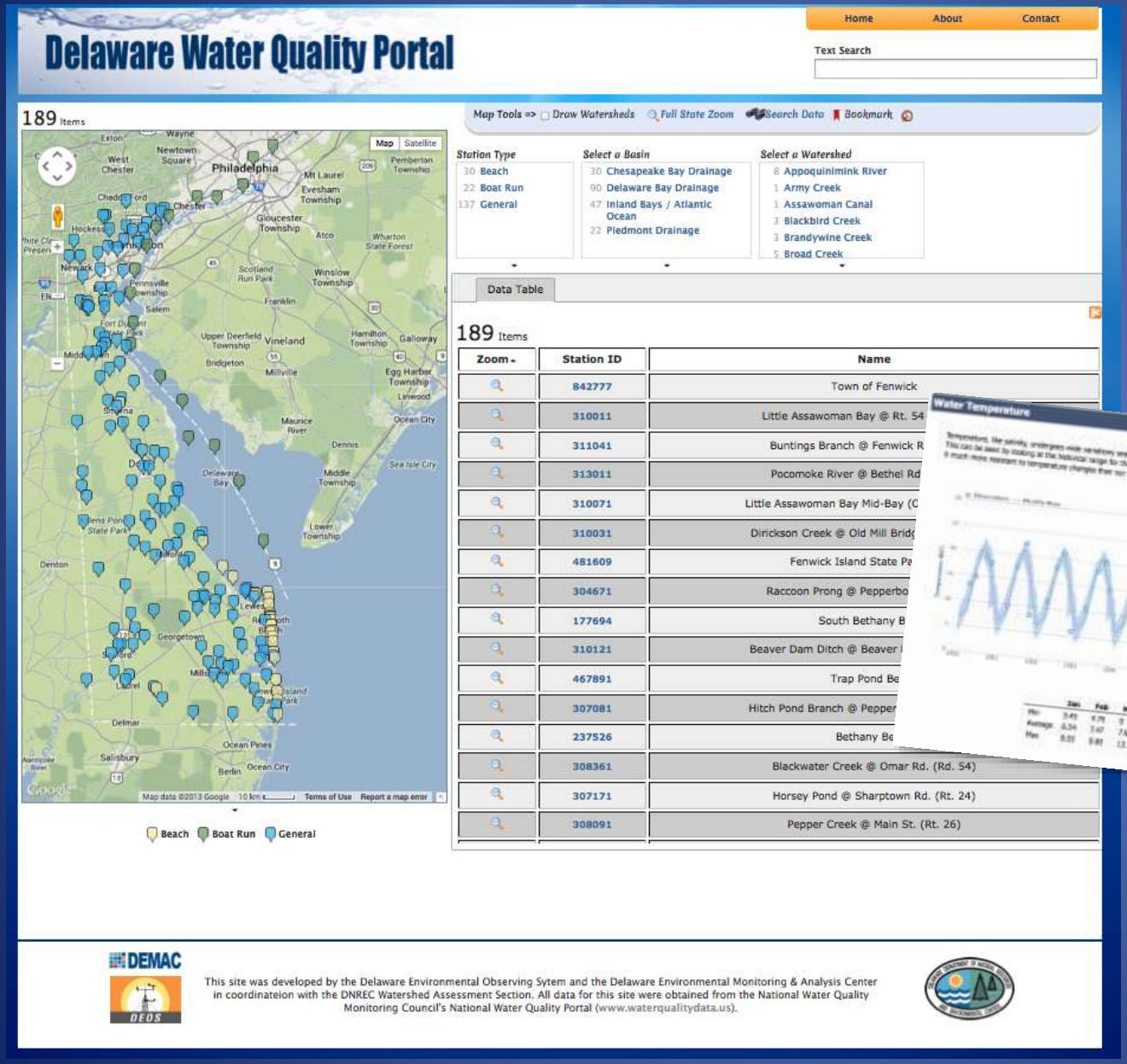
- to coordinate and collaborate on environmental monitoring efforts throughout the State of Delaware and its surrounding areas
- to provide effective analysis and visualization tools for cross-discipline research
- assist researchers in sharing their findings with K-12, decision-makers, and the general public

About DEMAC…

- Started in Fall 2011

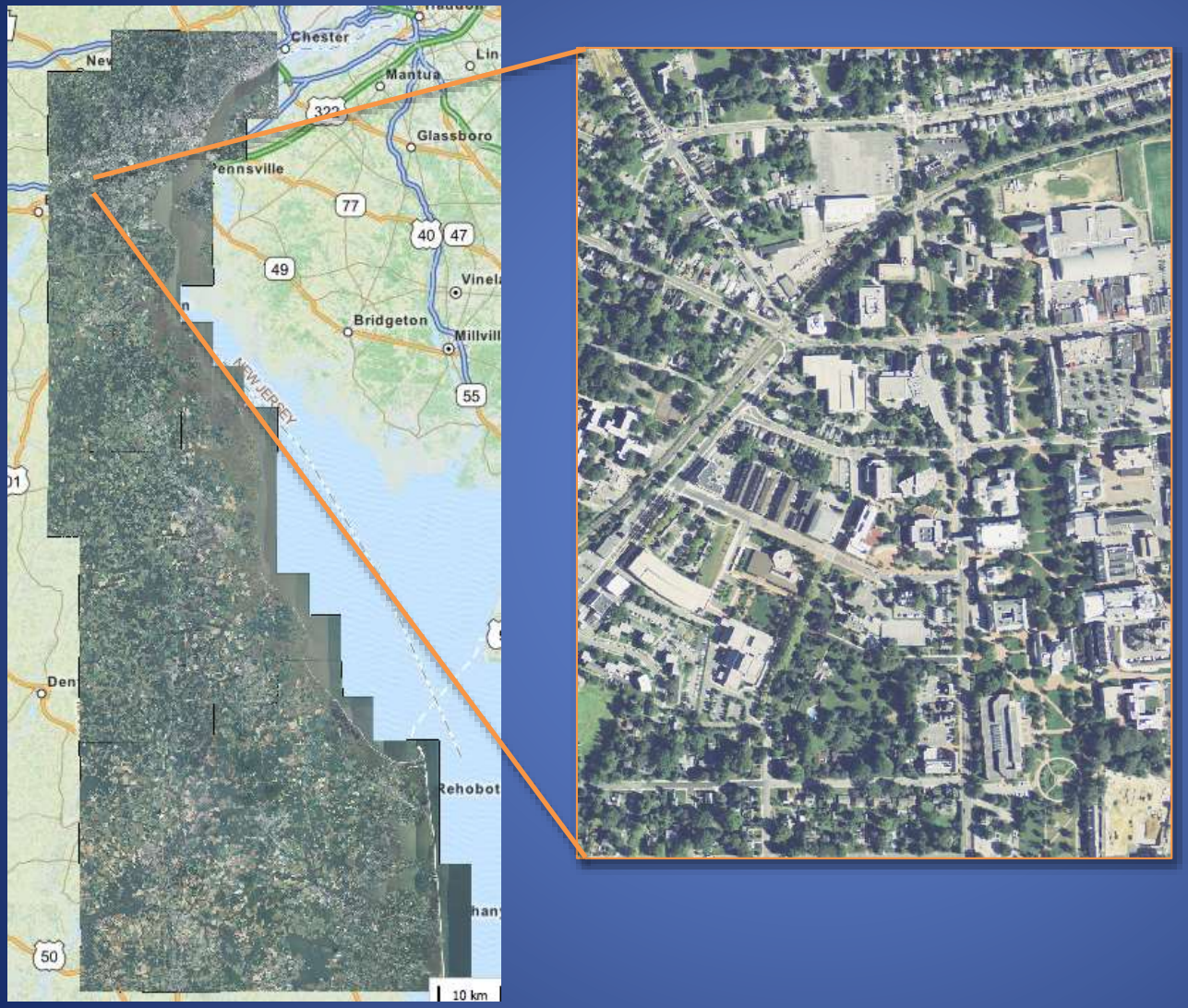
- Located at the University of Delaware in the College of Earth, Ocean & Environment (CEOE)
- Work closely the Delaware State Climatologist and the Delaware Environmental Observing System (DEOS)
- Specialties in spatial data mapping & data visualization, web application development, geospatial analysis

Integrated, Value-added Applications



Purpose:
Overview of all water quality monitoring efforts for policy and planning

User: Delaware DNREC Watershed Assessment



Purpose:
Full statewide aerial imagery used in landuse planning and emergency management

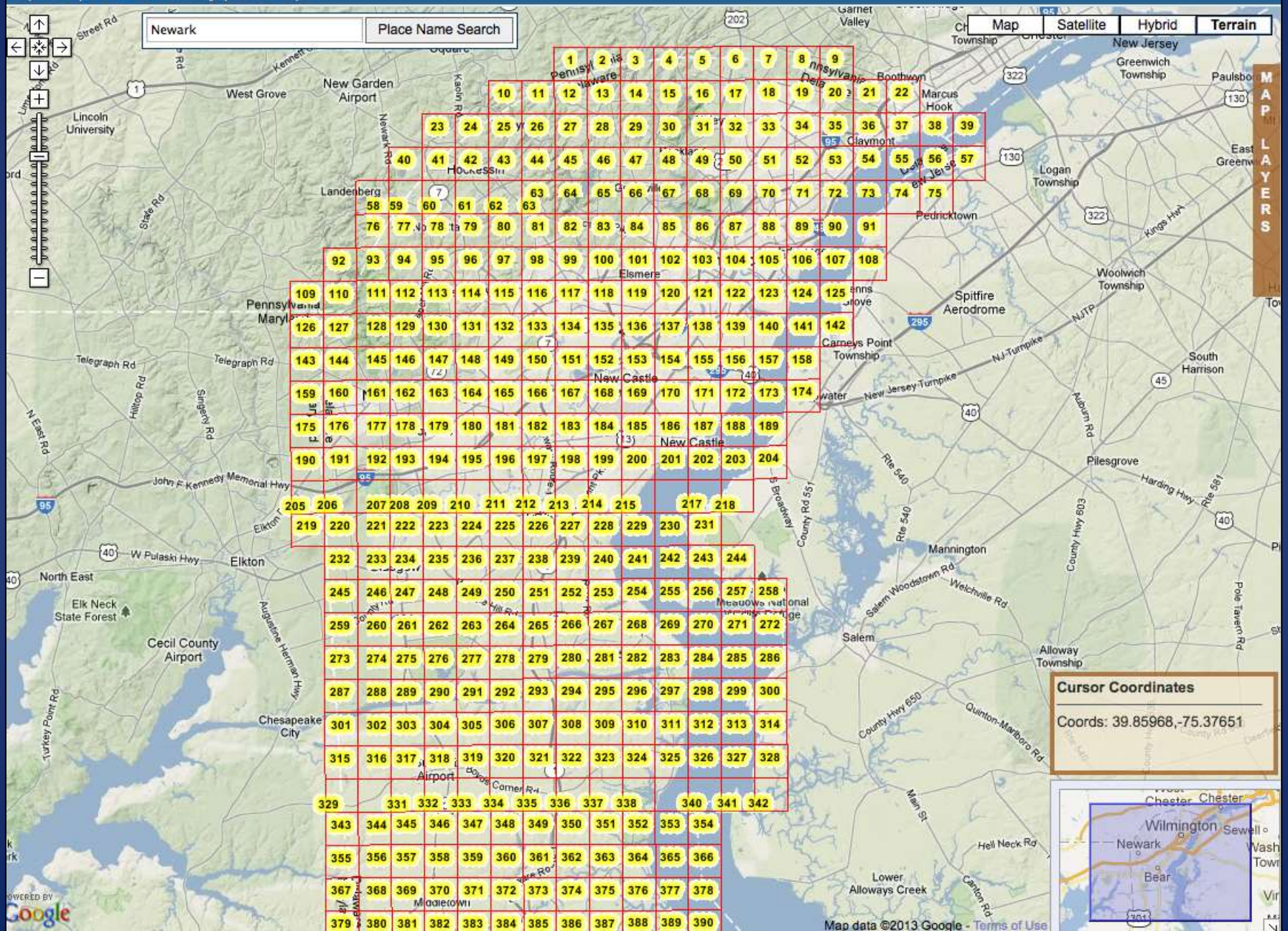
Imagery from 1937 - present

User: State of Delaware Agencies, K-20 Academia

DEMAC Aerial Data Distribution

What is 7-Zip?

Map Tiles | DE Ortho Inventory | Need Help?



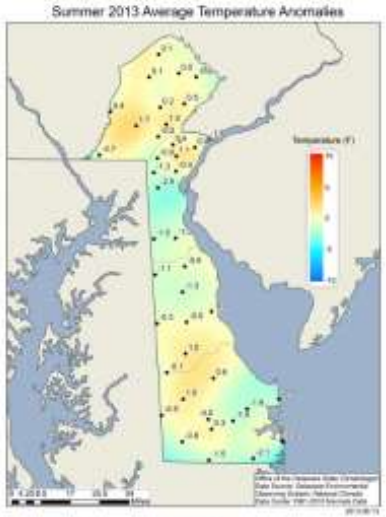


Figure 3. Summer 2013 average temperature departures from the 1981-2010 mean based upon DEOS station data.

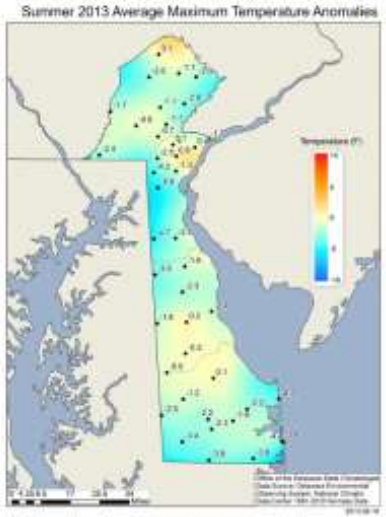


Figure 4. Summer 2013 maximum temperature departures from the 1981-2010 mean based upon DEOS station data

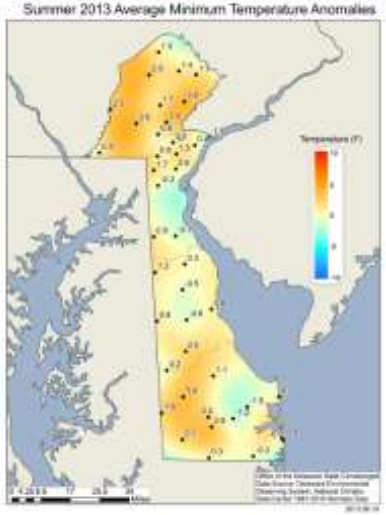


Figure 5. Summer 2013 minimum temperature departures from the 1981-2010 mean based upon DEOS station data

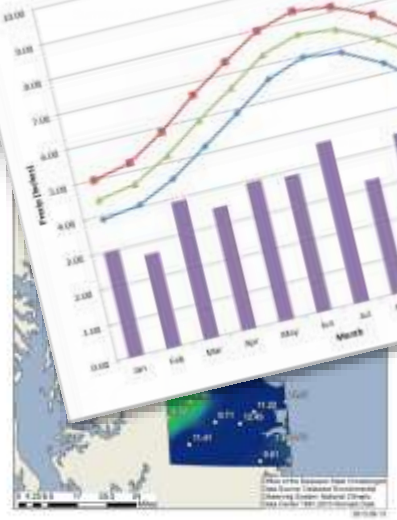
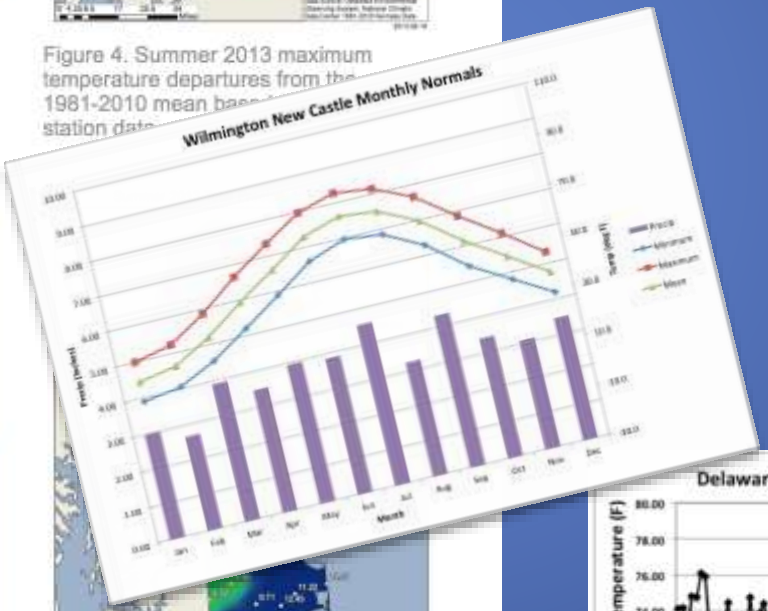
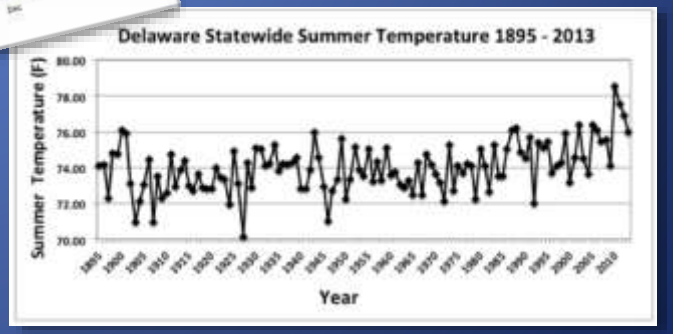


Figure 6. Summer 2013 precipitation departures from the 1981-2010 mean based upon DEOS station data

Purpose:
Statewide anomalies (differences from the climate normal)

User: State Climate Office State of Delaware Agencies, K-20 Academia





College of Earth, Ocean, and Environment

UD SATELLITE RECEIVING STATION

polar orbiter receiving dish
(Willard Hall, UD Main Campus)

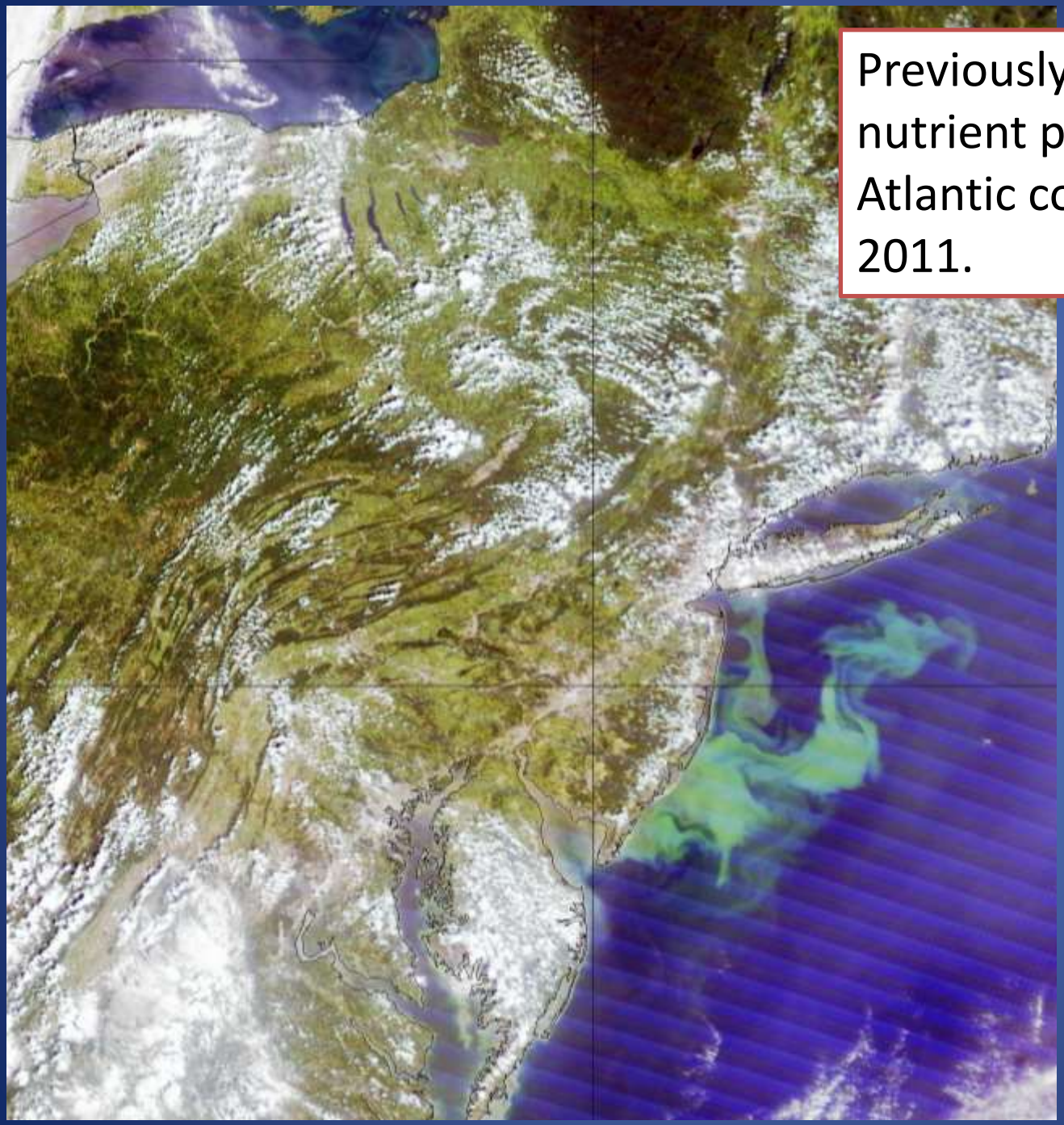
Products vary in…
- Resolution: 250m – 4km
- Frequency: 15 min – 4x daily
- Holdings: past week - 2010

Satellites:
- GOES - East
- MODIS Terra & Aqua
- NPP/JPSS
- NOAA – 16, 18, 19
- MetOP

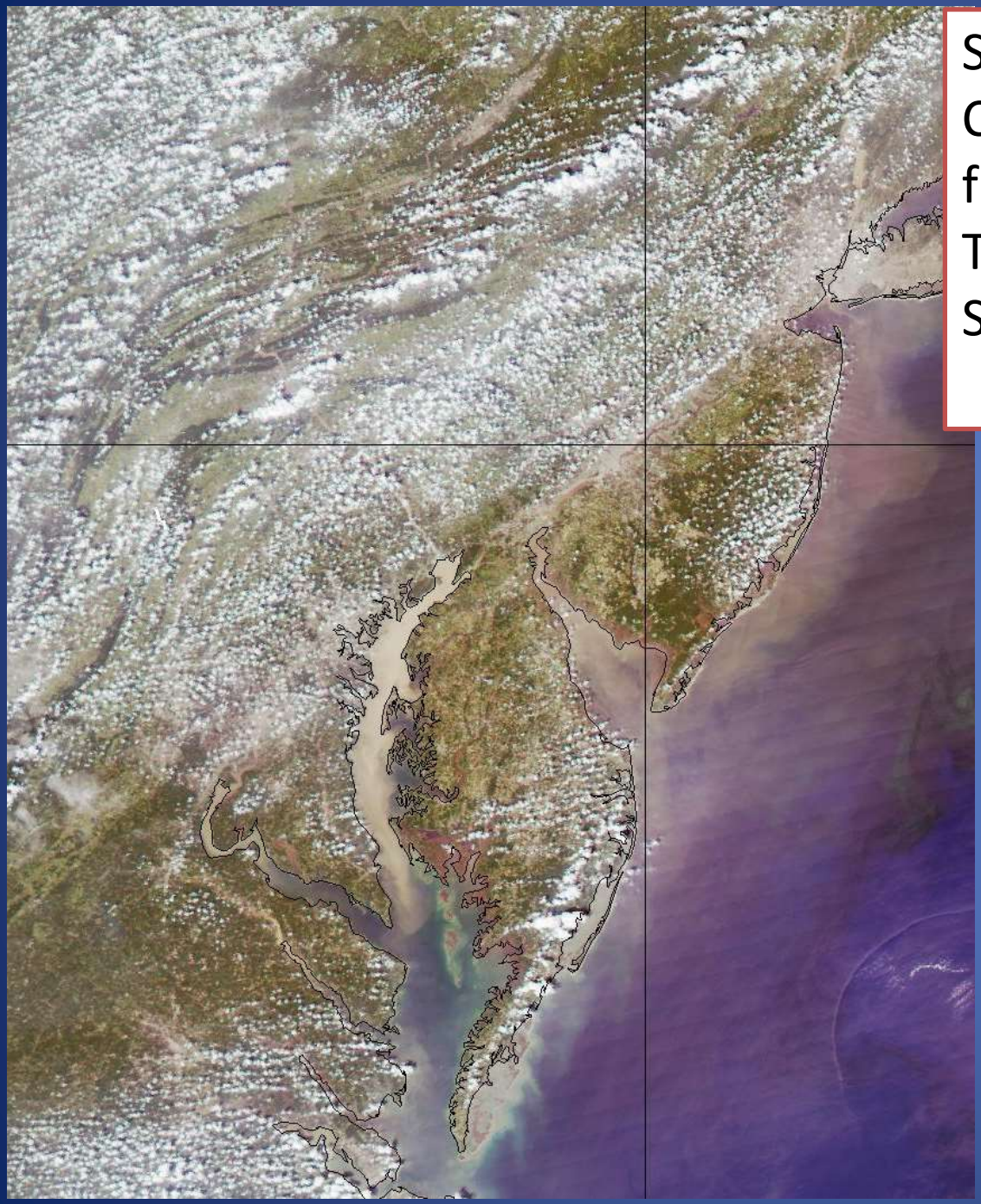
Products:
- Channel data
- SST/LST
- NDVI
- Chlorophyll
- CO2
- Cloud Pressure
- Cloudtop Temp
- Water Vapor Pressure/Heights

geosynchronous receiving dish
(Willard Hall, UD Main Campus)

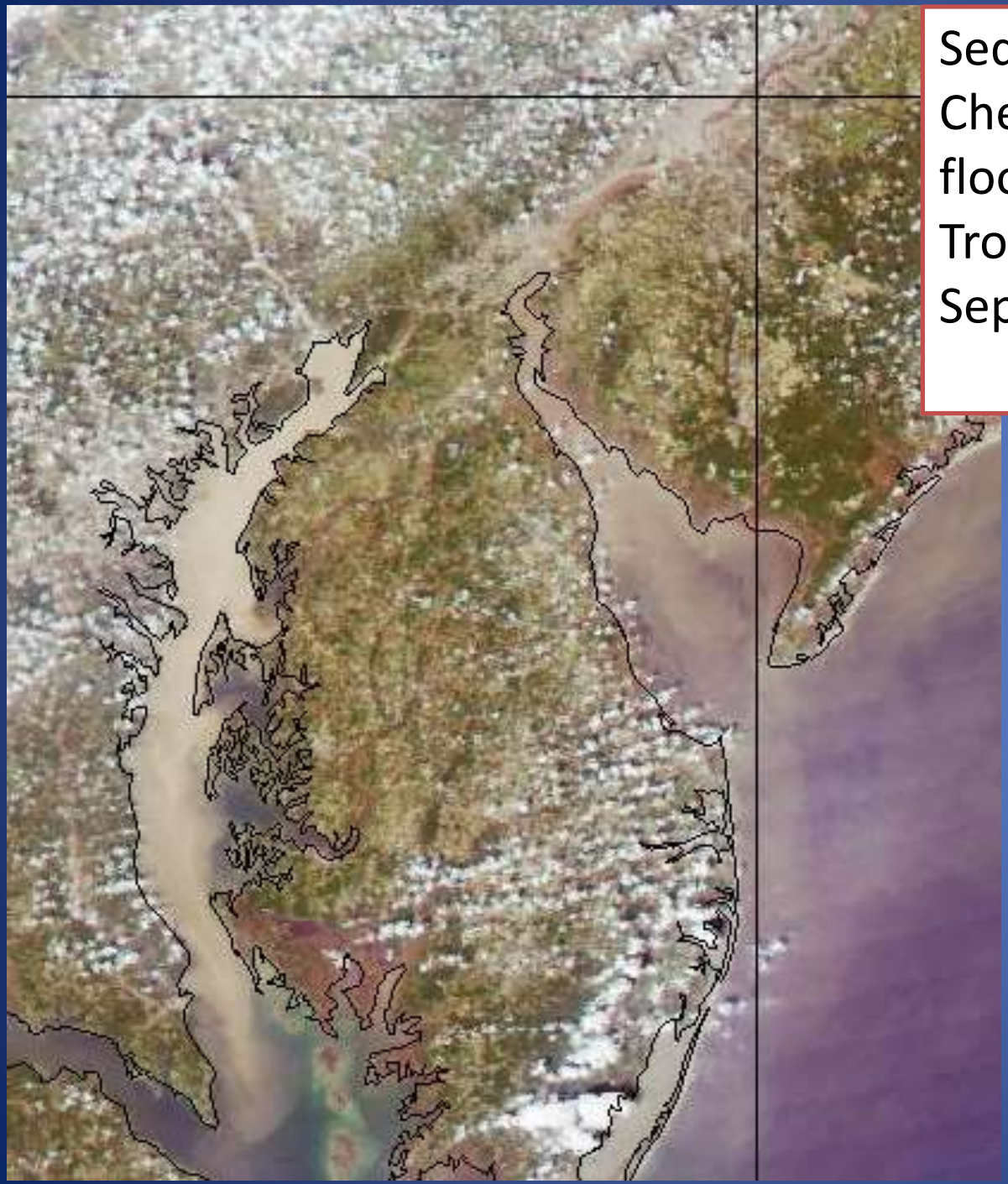
http://udsrs.udel.edu



Previously unobserved nutrient plume along mid-Atlantic coast August 2011.

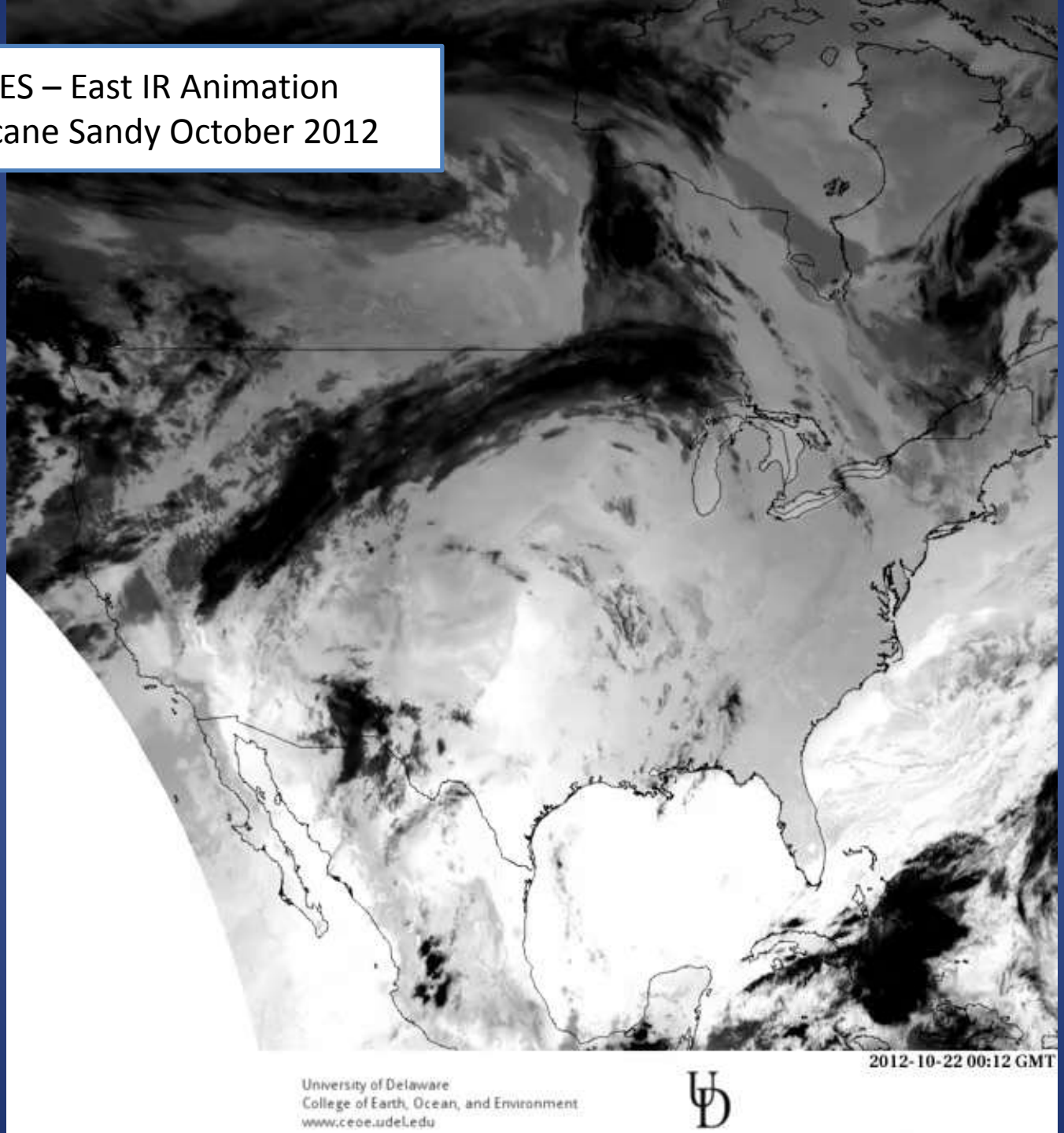


Sediment in Delaware and Chesapeake Bays after flooding from remnants of Tropical Storm Lee, September 13, 2011.



Sediment in Delaware and Chesapeake Bays after flooding from remnants of Tropical Storm Lee, September 13, 2011.

GOES – East IR Animation
Hurricane Sandy October 2012



Operational Uses:

- emergency management
- agriculture (drought, irrigation scheduling, poultry mortality, etc.)
- natural resource monitoring (nutrient fluxes, water supply, air quality, etc.)
- transportation

Basic and Applied Science Questions:

- detailed watershed analysis (water balance, nutrient fluxes, etc.)
- meteorological studies (observational and modeling)
- agricultural studies
- ecosystem health (Inland Bays, Delaware Bay, watersheds)
- critical zone science
- climate variation and change
- data integration methodologies

Concerns:

- Data/service availability
- Operational systems exist within research environments
- Ways to express concern over issues (Lingo!!!)

Environmental Data Services for Delaware:

Serving Emergency Responders, Planners, and Researchers

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UNIVERSITY OF DELAWARE