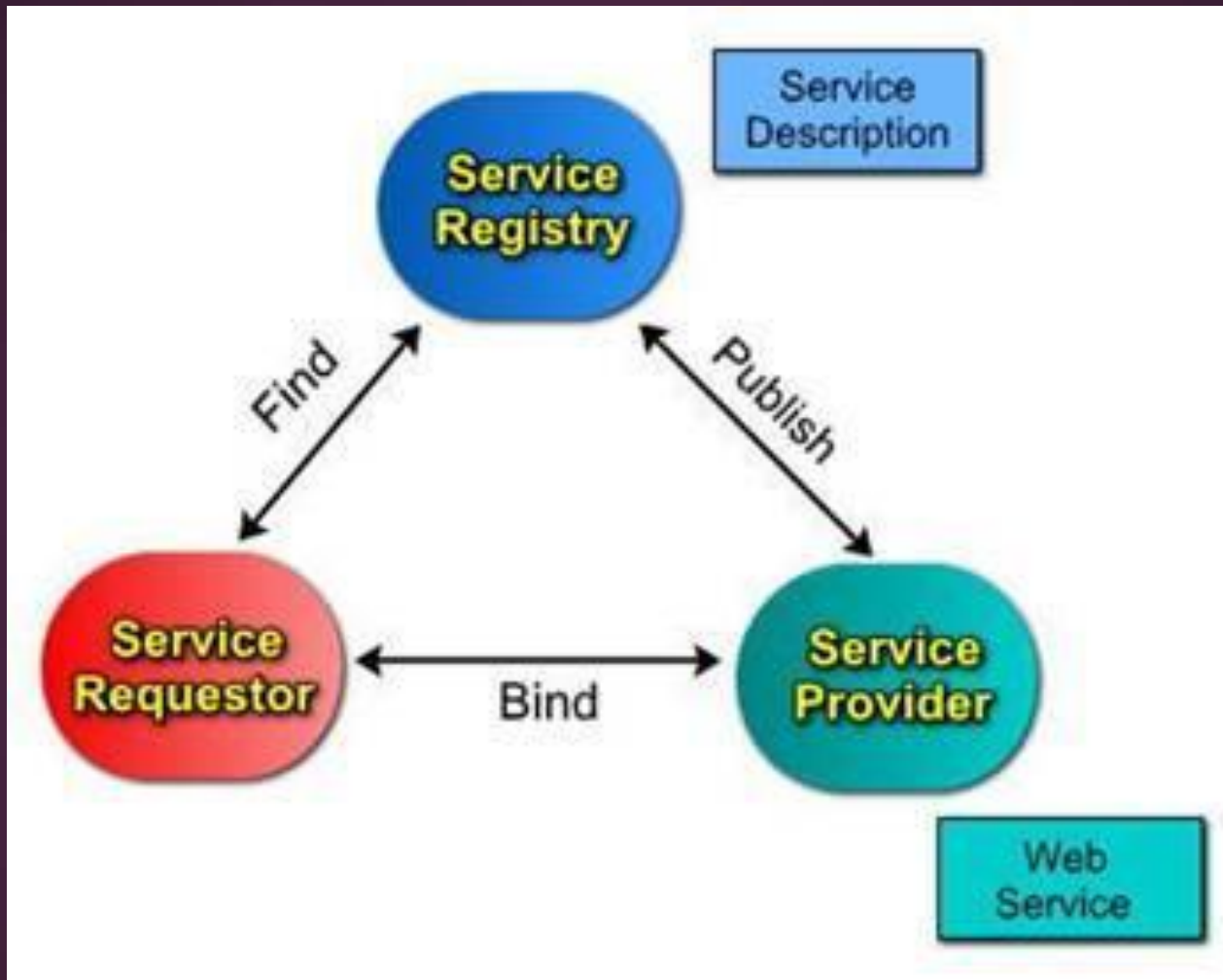# Web Services for the Next Generation Air Transportation System
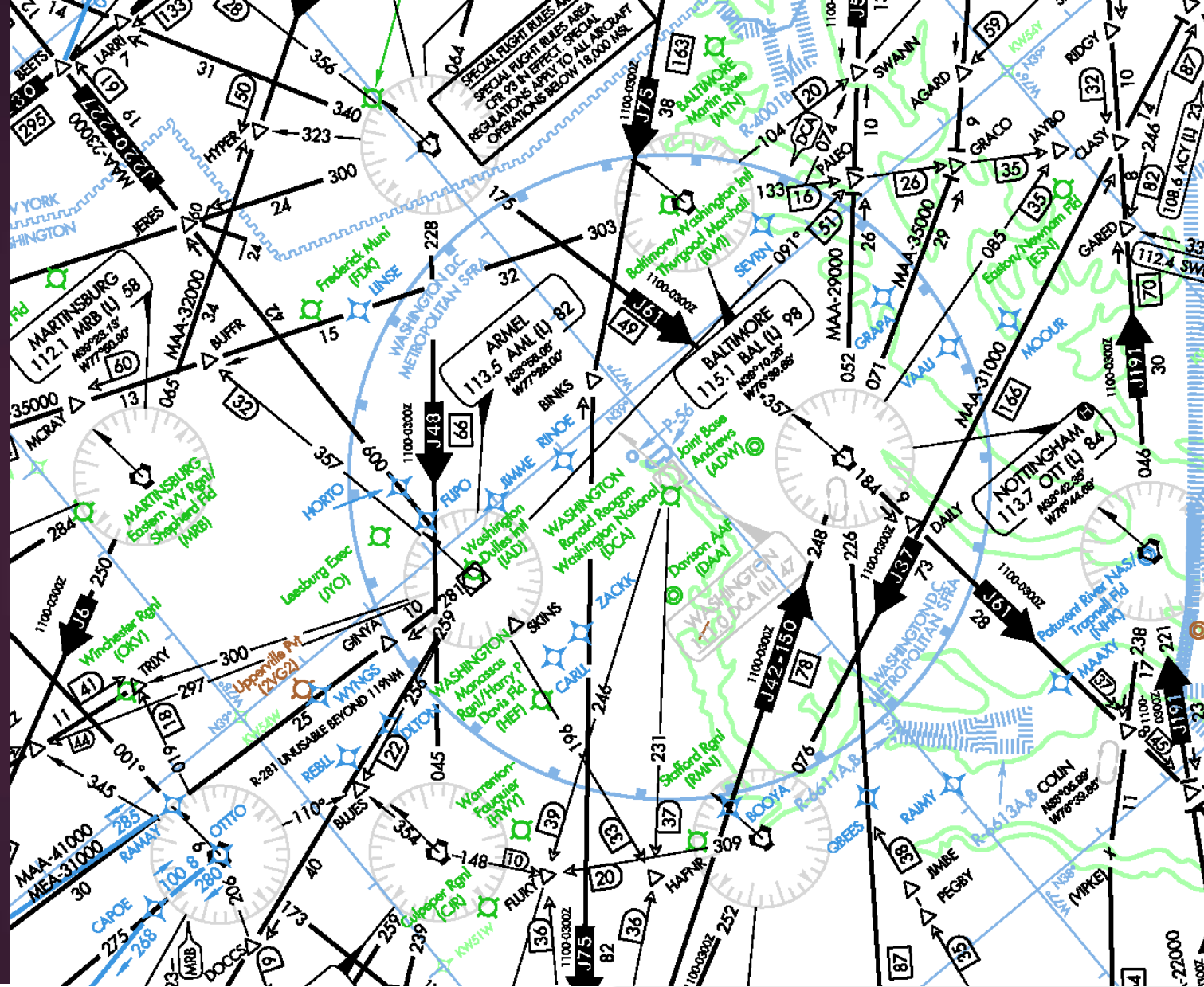
Matt Peroutka
Meteorological Development Lab
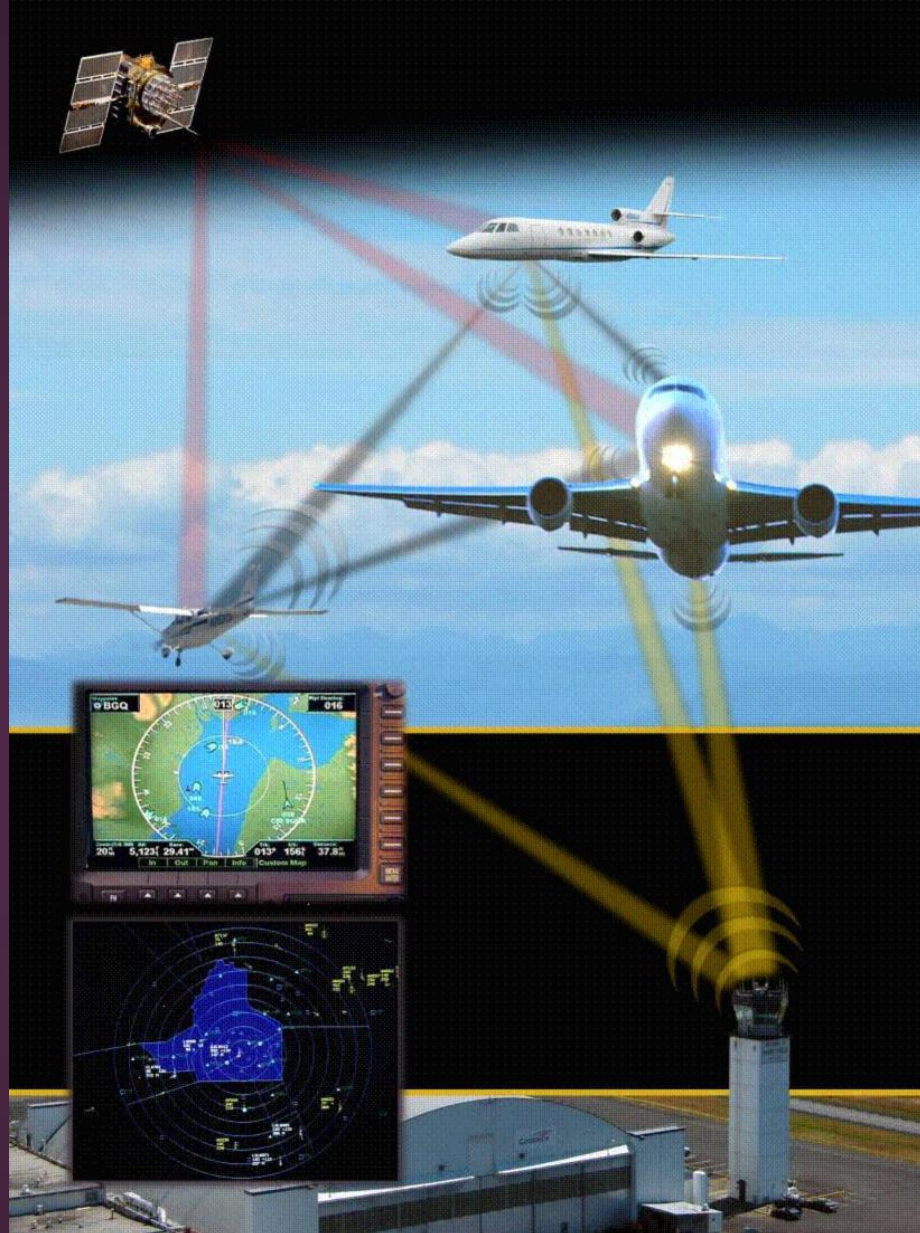*September 2013*

Background: Web Services for NextGen

- 4+ years of collaboration between NWS and FAA to make NextGen a reality

- Many partners, including NCAR, MIT/LL, NOAA/ESRL, MDL, AWC, AFWA, and FAA Hughes Tech. Ctr.

- Current effort has a clear path to operations between NWS and FAA
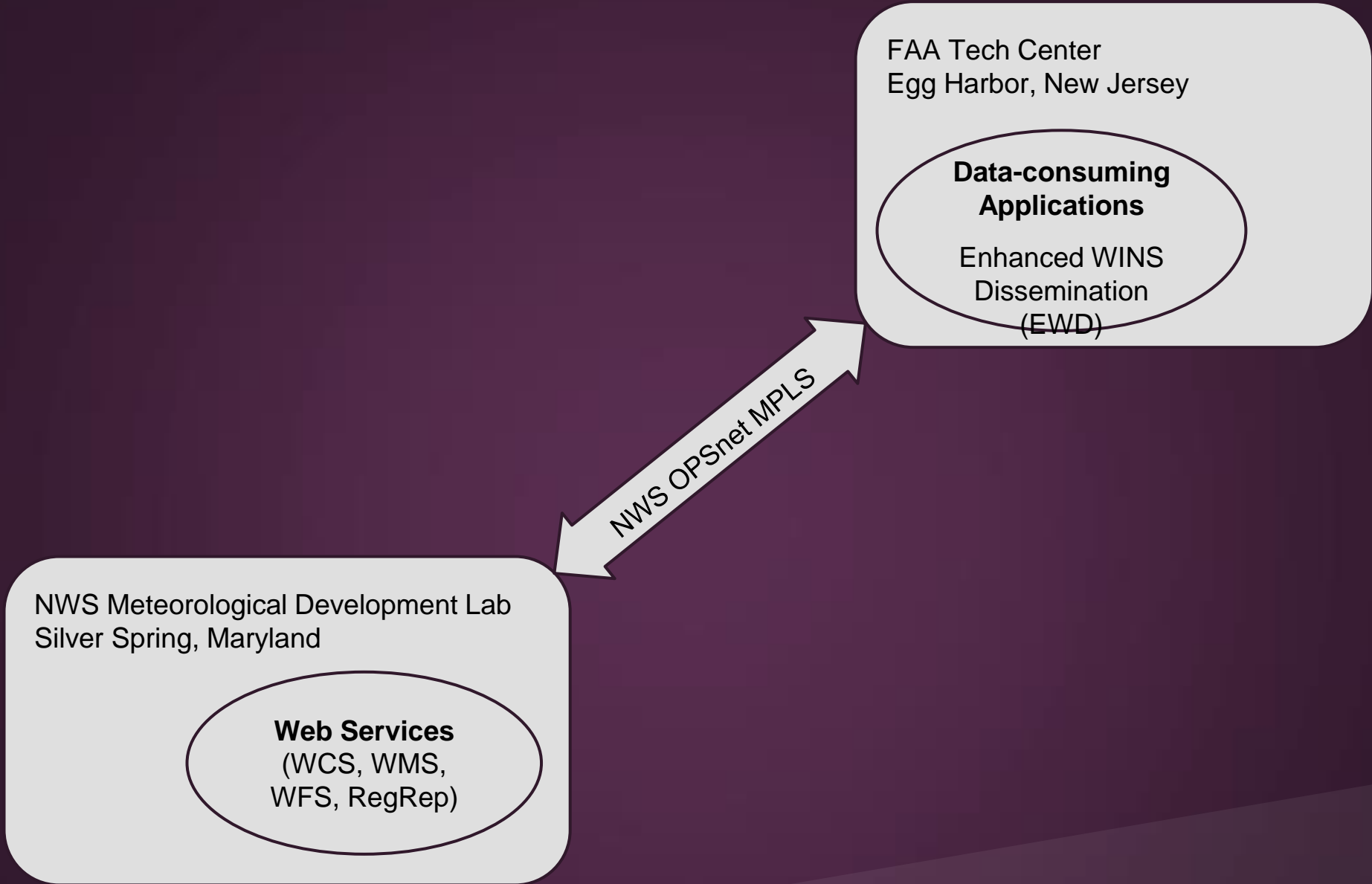
Web Services

Next Generation Air Transportation System (NextGen)

Next Generation Air Transportation System (NextGen)

FAA Tech Center
Egg Harbor, New Jersey

Data-consuming Applications

Enhanced WINS Dissemination (EWD)

NWS OPSnet MPLS

NWS Meteorological Development Lab
Silver Spring, Maryland

Web Services
(WCS, WMS, WFS, RegRep)

Stage One: Prototypes

FAA National Testbed
ARTCCs ZTL and ZLC

Data-consuming Applications (pub/sub)

FAA Tech Center
Egg Harbor, New Jersey

Data-consuming Applications

Enhanced WINS Dissemination (EWD)

NWS Meteorological Development Lab
Silver Spring, Maryland

Web Services (WCS, WMS, WFS, RegRep

NWS OPSnet MPLS

National Climate and Weather Prediction Center
College Park, Maryland

Web Services (WCS, WMS, WFS, RegRep)

Stage Two: Migration towards operations

FAA Operational Networks

**Data-consuming
Applications
(pub/sub)**

NWS OPSnet MPLS

National Climate and Weather
Prediction Center
College Park, Maryland

Web Services
(WCS, WMS,
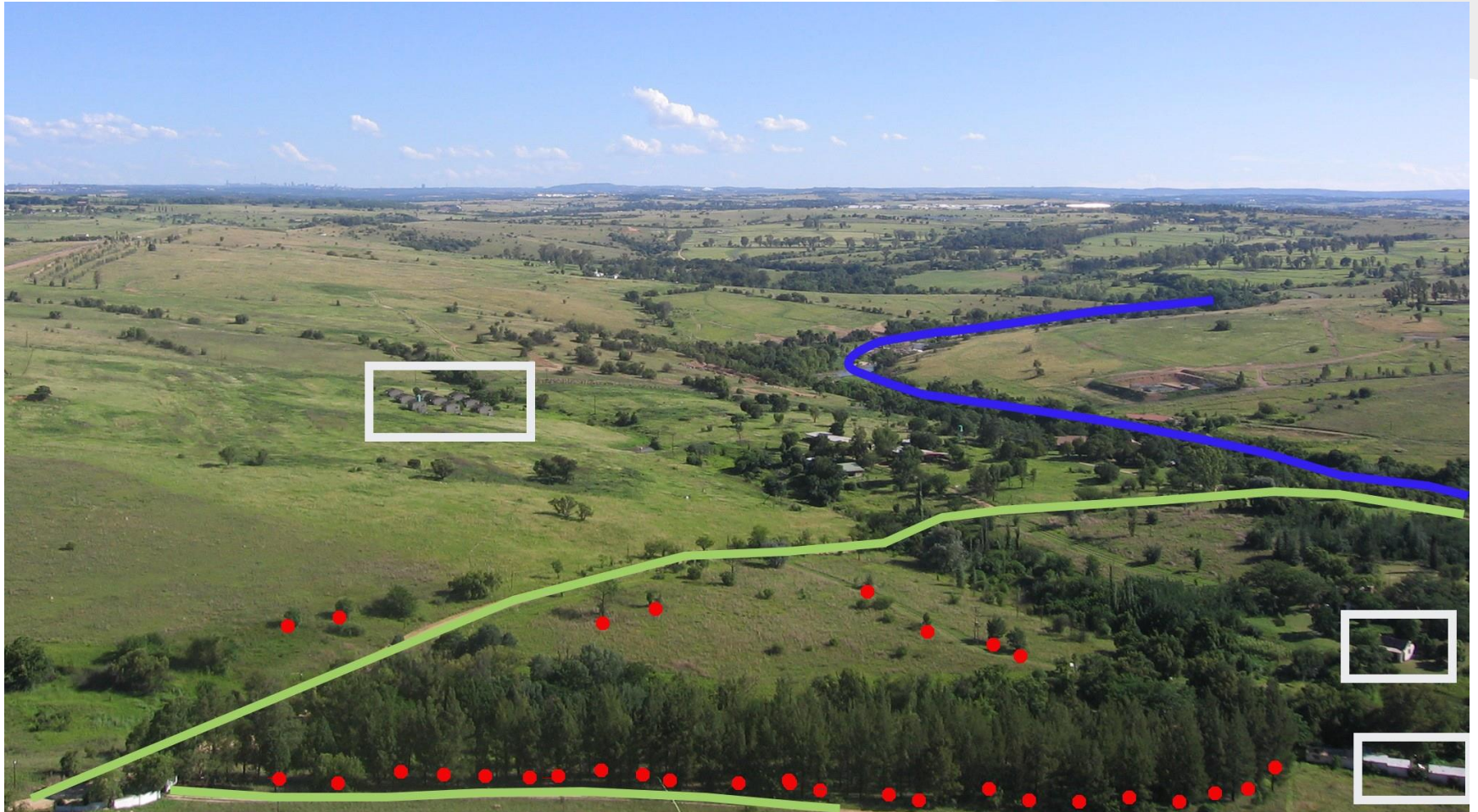WFS, RegRep)
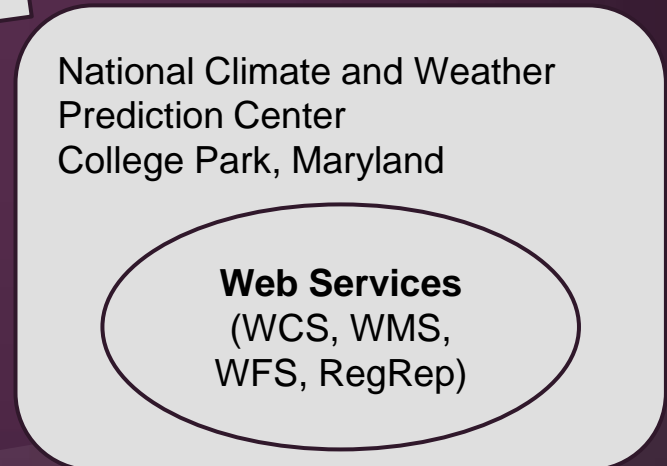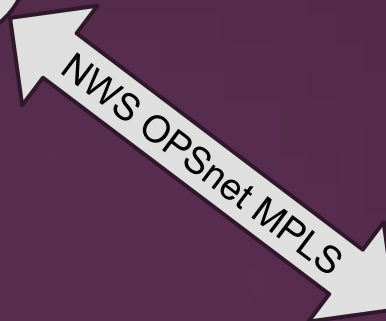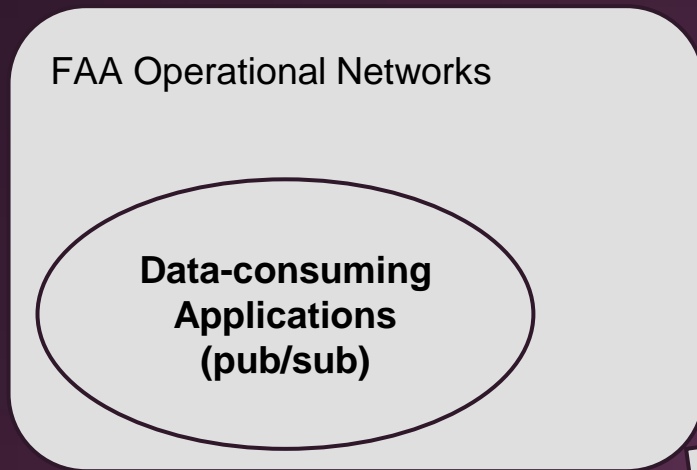
Stage Three: Operations

Feature? Coverage? Map?

- Reg/Rep, WFS, WCS, WMS

- *Feature*, *coverage*, and *map* are all concepts from Geospatial Information Systems...

- ...with useful applications in meteorology

What's a feature?

# What's a feature?

Features in GIS

- Generally, anything you can see

- E.g., stop signs, roads, houses

- Often represented as points, polylines, and polygons

Features in meteorology

- Point observations or forecasts (e.g., METAR, TAF, PIREP)

- Geographic region where a weather forecast or warning is valid (e.g., Forecast Zone, County Warning Area, valid area of a Tornado Watch)

- Airspace volume where a weather forecast or warning is valid (e.g., SIGMET)

What's a coverage?

© QGIS 2009

© QGIS 2009
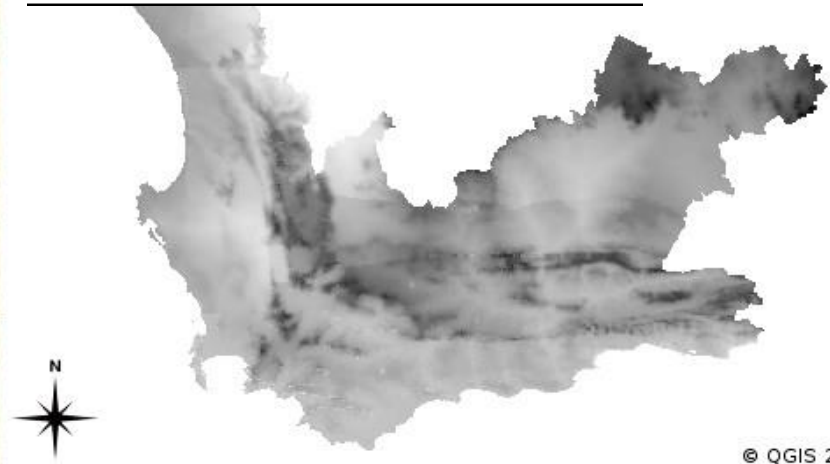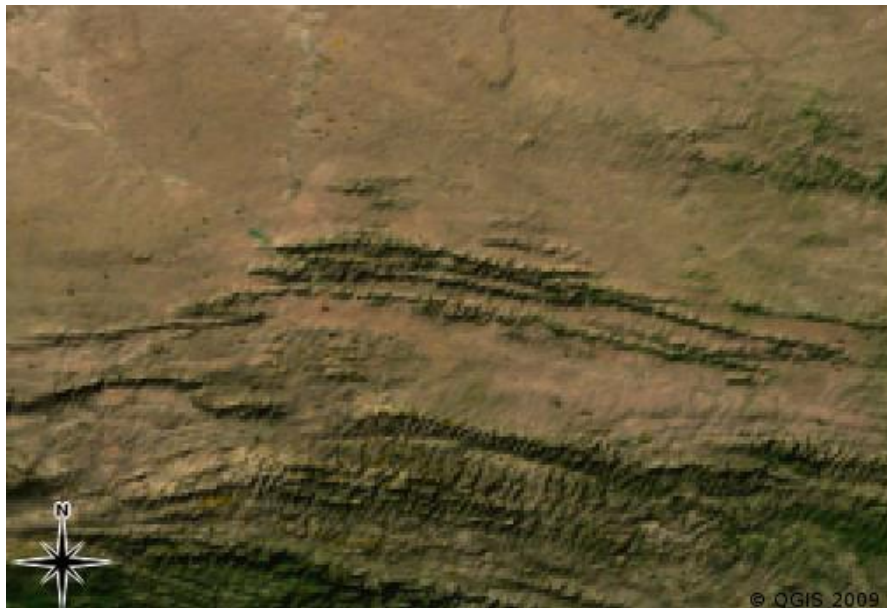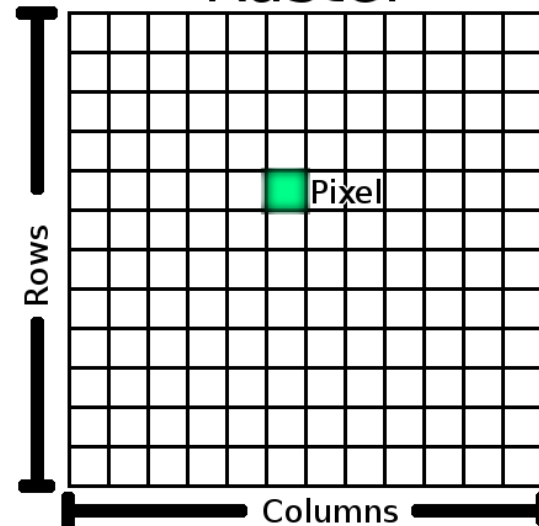
Coverage in GIS

- Geographic feature that conveys different values at different locations

- Note: Regular spacing not required

Coverage in meteorology

- Grids!

- Gridded analyses, Numerical Weather Prediction (NWP) output

- National Digital Forecast Database (NDFD)

- Radar data

- Satellite data

Others...

- Maps: Images that convey interpretations of data.

- Metadata: Information about the data. (E.g., Coordinate Reference System, location, beginning/end of record)

- Methods for data discovery, including Registry/Repository (Reg/Rep)

Web Feature Service (WFS)

- Client sends a query

- Server accesses database

- Server encodes response (often multiple data points) in XML

- Server sends response to client

- Subscription also supported
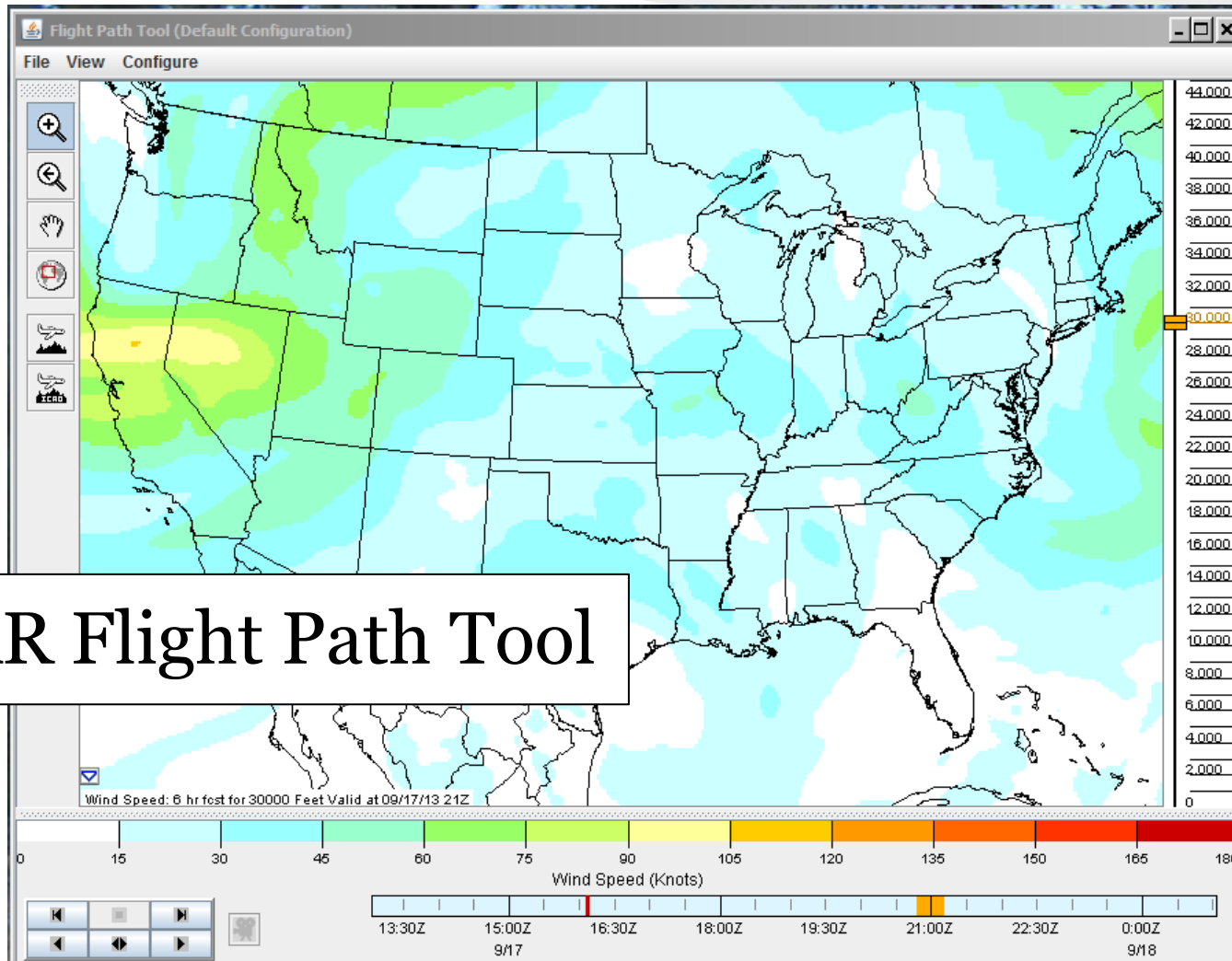
Example WFS in action

- CustomWeather's MyForecast

- Background map is served by Web Mapping Service (WMS)

- Station data are served by WFS
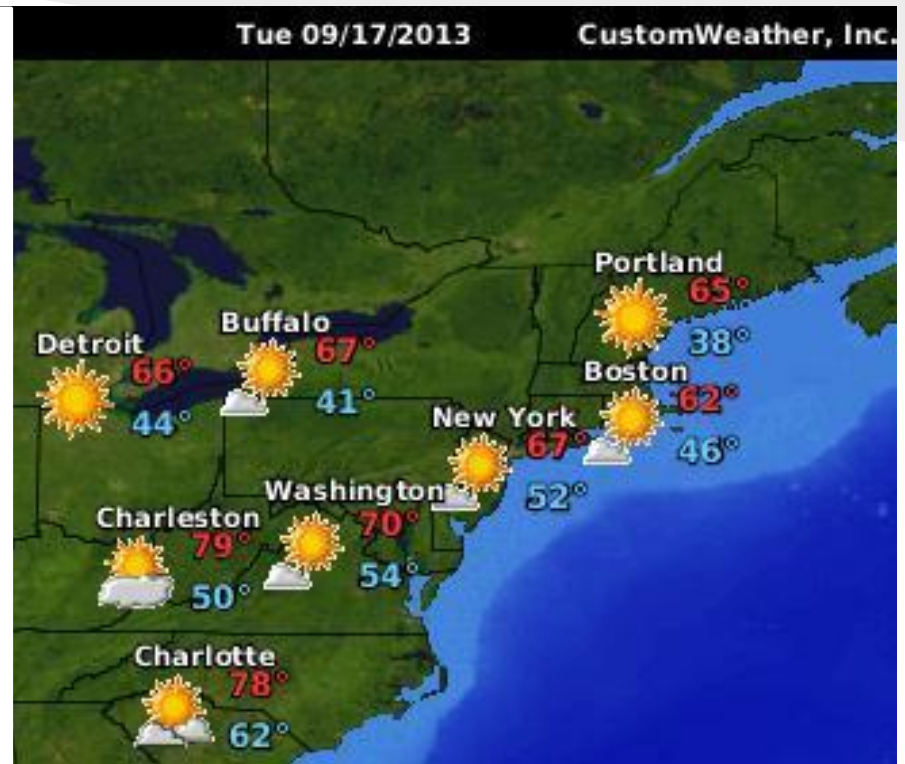
Web Coverage Service (WCS)

- Client sends a query

- Server accesses data store

- Server encodes response. GRIB2 and NetCDF are common response formats.

- Server sends response to client

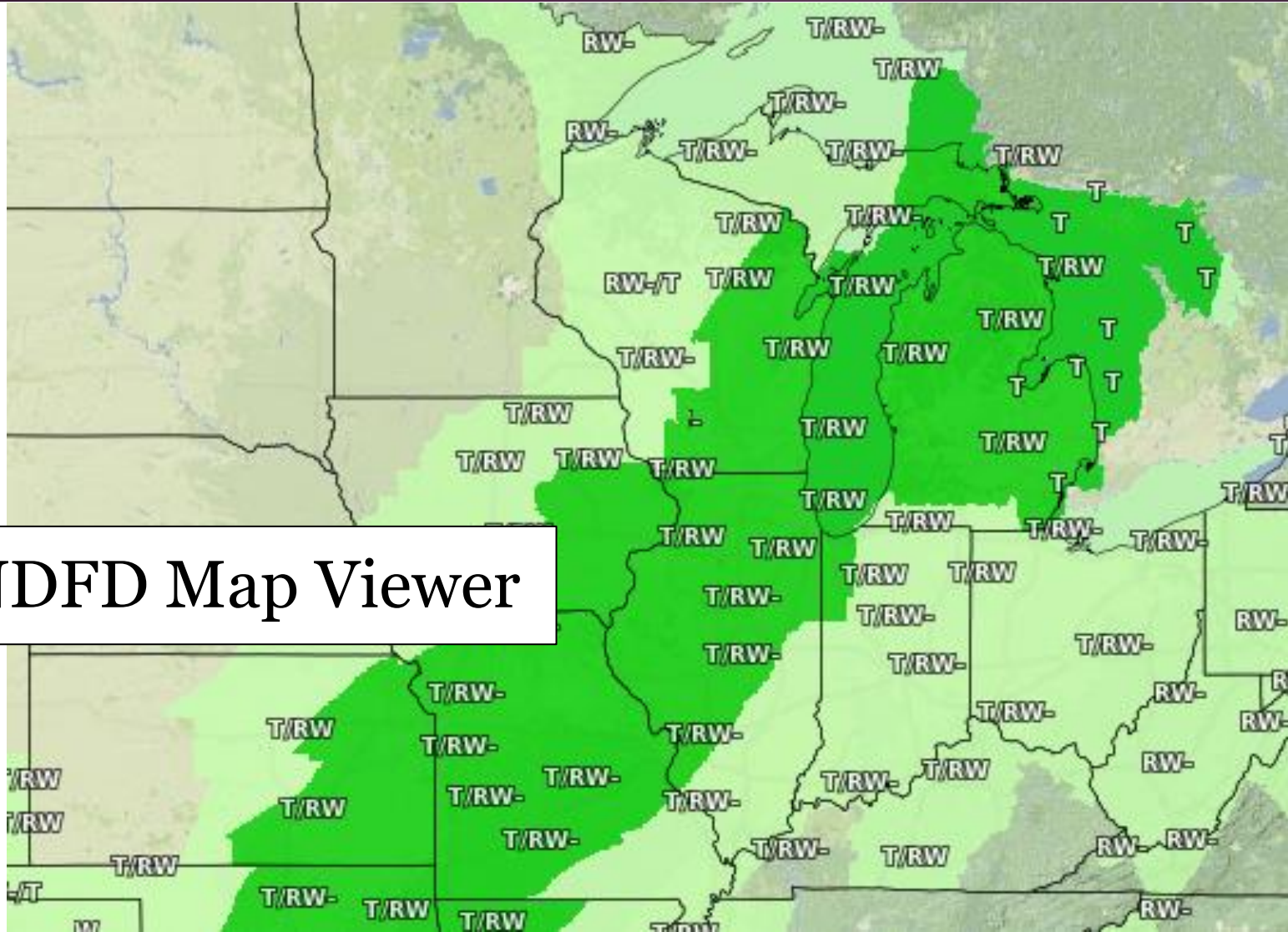- Subscription also supported

Example WCS in action

NCAR Flight Path Tool

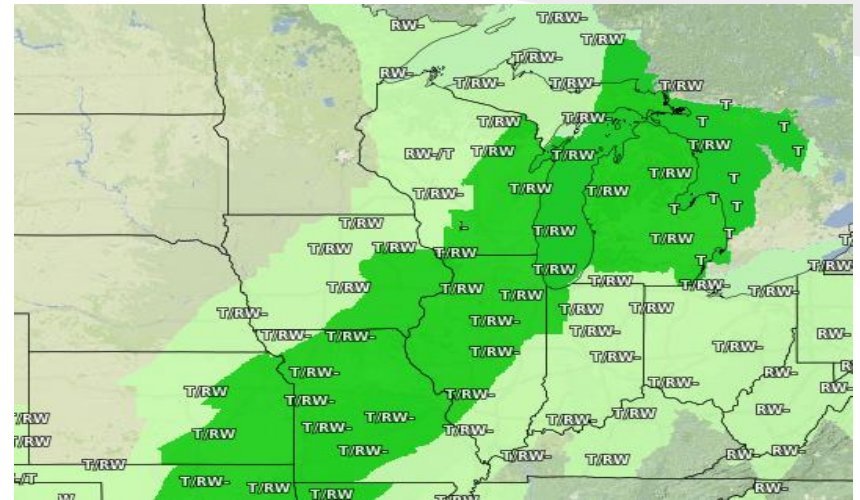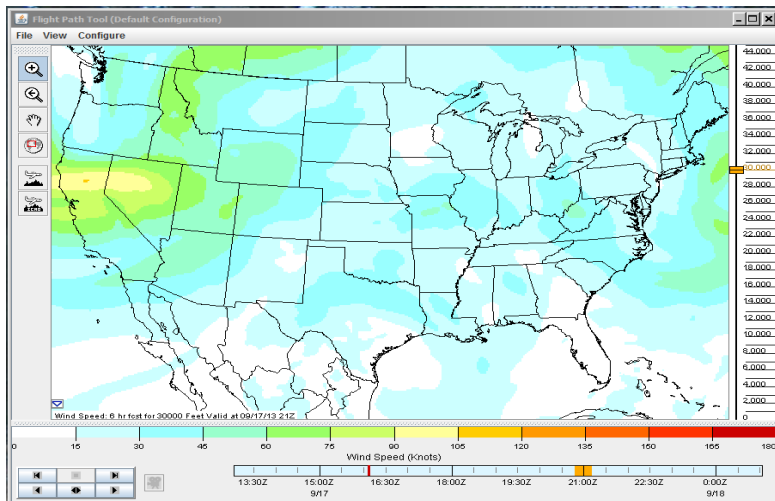# Web Mapping Service (WMS)

- Client sends a query

- Server accesses data store

- Server encodes response as a bitmapped graphic

Example WMS in action

NDFD Map Viewer

WCS vs. WMS

- Important point the images don't show:

- WCS: Server sends data to client

- WMS: Server sends image to client

Web Services, Old and New

- WCS, WMS Reference Implementation by NCAR
  - Implemented at FAA Tech Center, NCAR, LL/MIT, NOAA/ESRL, AWC and MDL
- WFS Reference Implementation by MIT/LL
  - Implemented at FAA Tech Center, NCAR, LL/MIT, NOAA/ESRL, AWC and MDL
- EbXML Registry/Repository by Wellfleet
  - Implemented at FAA Tech Center, LL/MIT, GSD, and MDL
- WCS, WMS, WFS prototype by ITT/Excellis
  - Implemented and being evaluated at MDL
  - Installing at NCWCP

Migrating Legacy Products

Input for FAA's Common Support Services--Weather (CSS-Wx)

- ~1000 grids (model, satellite)
- ~130 images (various aviation charts)
- METAR, SPECI, TAF, SIGMET
- Other Traditional Alphanumeric Codes (TAC). A small number, but many headaches
  - Requires considerable xml schema extension and development

Data transport vs. contents

- WFS
  - XML documents
- WCS
  - Generally, grids encoded in NetCDF, HDF5, or GRIB2
- WFS
  - Bitmap images (JPEG, PNG, GIF)
- Reg/Rep
  - Metadata encoded in XML

Legacy Aviation Products

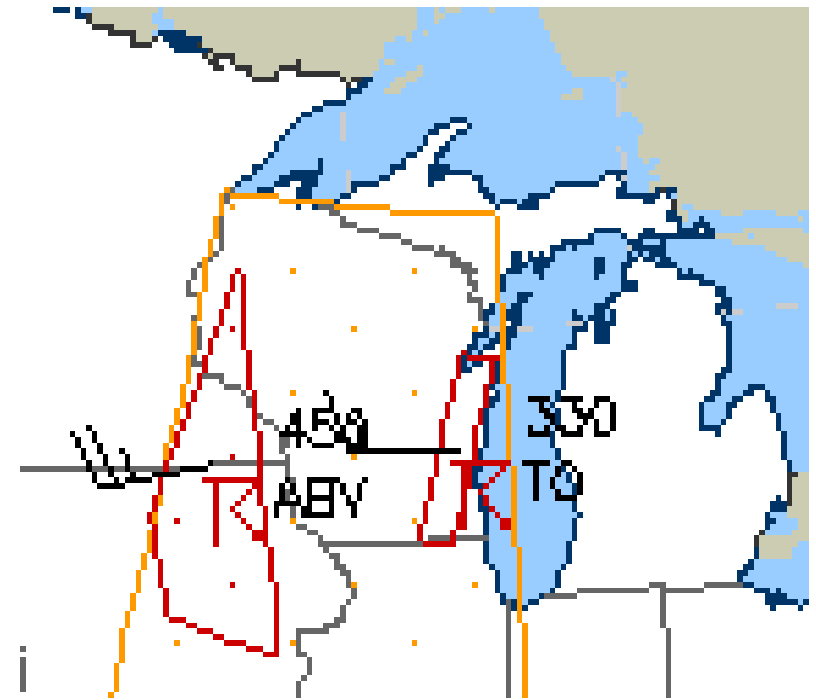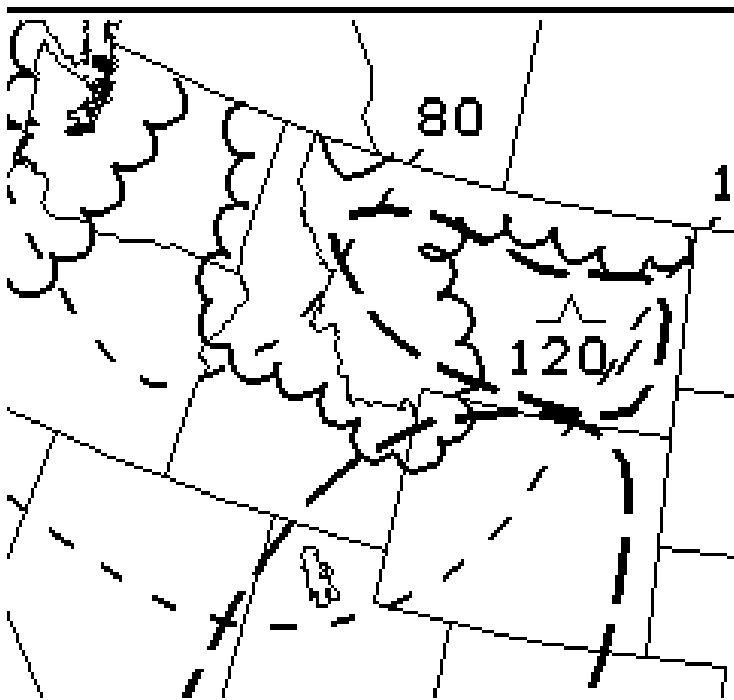METAR and SPECI: Weather observation at an aerodrome

Legacy Aviation Products

TAF: Weather forecast at an aerodrome

Legacy Aviation Products

SIGMET: Weather hazards for pilots en route

Traditional Alphanumeric Codes (TAC)

METAR/ SPECI	METAR KBWI 181254Z 00000KT 10SM FEW250 14/09 A3034 RMK AO2 SLP272 T01390089

TAF	KGTF 181140Z 1812/1912 23012KT P6SM BKN100
	    FM181800 25015G22KT P6SM VCSH SCT050 BKN080
	    FM190100 30010KT P6SM VCSH BKN060
	    FM190800 26007KT P6SM BKN120

SIGMET	CONVECTIVE SIGMET 19E VALID UNTIL 1455Z FL GA AND FL CSTL WTRS FROM 30NW CRG-60E OMN LINE TS 25 NM WIDE MOV LTL. TOPS TO FL430.

From TAC to XML

- Traditional Alphanumeric Codes for aviation are regulated internationally
  - International Civil Aviation Organization (ICAO)
  - World Meteorological Organization (WMO)
  - Strict 3-year update cycle
- WMO Task Team for Aviation XML (TT_AvXML) developing data models and XML schemas
- Will enable "states in a position to do so" to exchange XML data.

New Data Models

- WMO: *Modèle pour l'Échange des informations sur le Temps, le Climat et l'Eau* (METCE)
  - In English, it may also be known as the 'METeorological Community Exchange' model
- ICAO: ICAO Meteorological Information Exchange Model (IWXXM)
  - Possible point of confusion: NCAR and EUROCONTROL have developed another model named WXXM