Characterizing Annual Land Use Conditions Using Multi-Resolution Imagery

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STAC Quarterly Meeting

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U.S. Department of the Interior
U.S. Geological Survey

Local land use and parcel data

- Low-density Residential
- Recreation
- Agriculture
- Roads

High-resolution land cover data

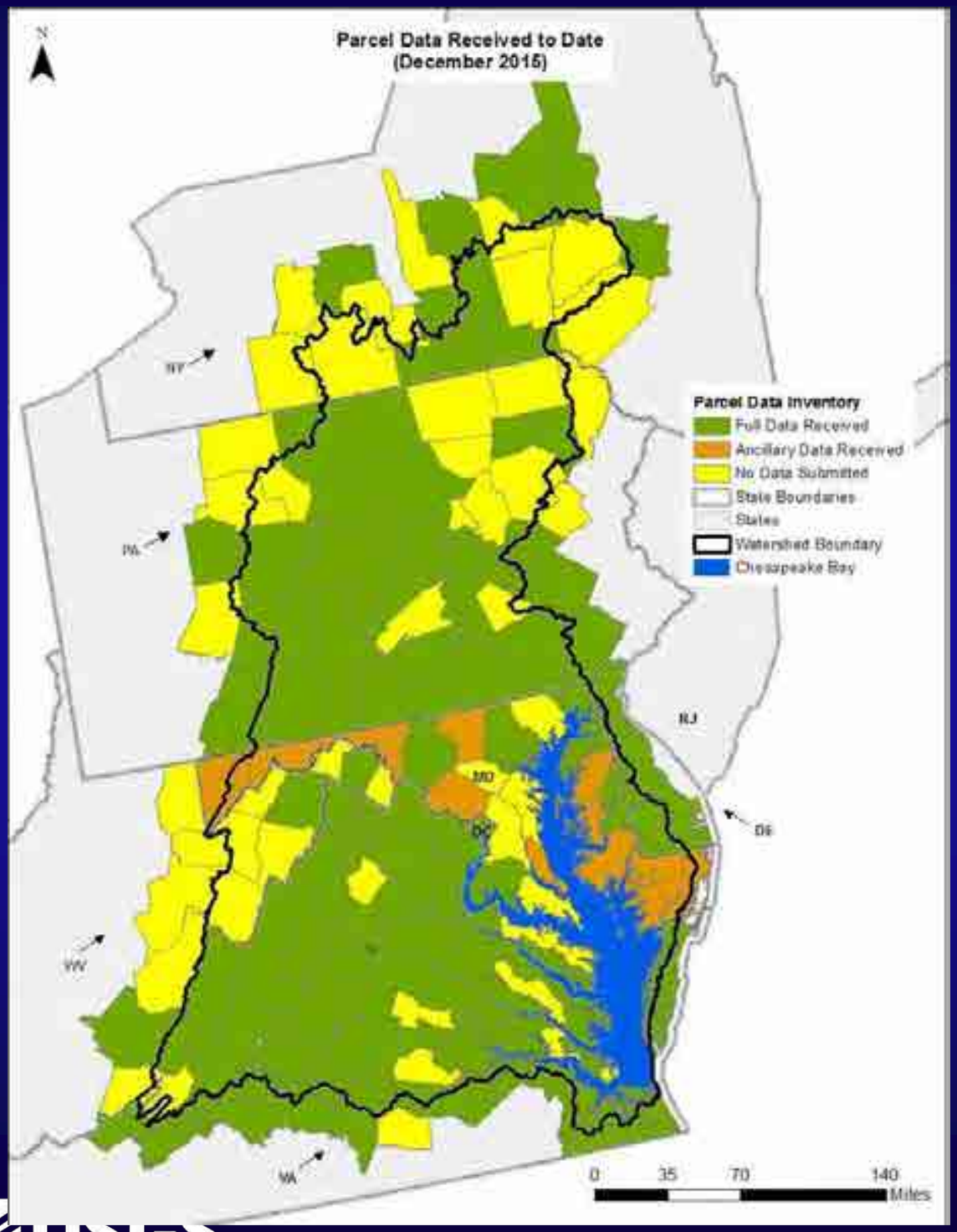
- Impervious surfaces
- Tree canopy
- Low vegetation
- Water

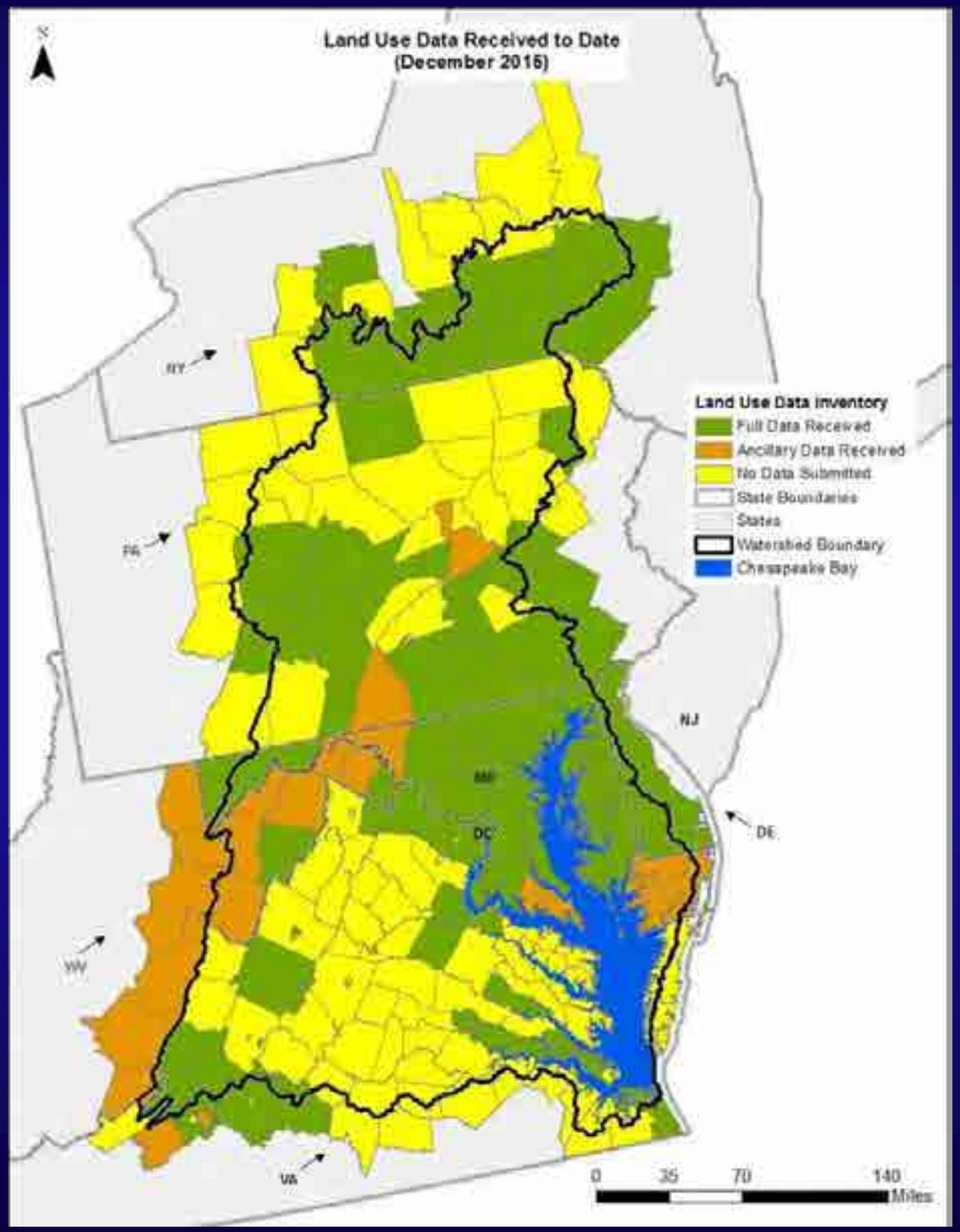
Phase 6 Land Uses

- Impervious-Roads
- Forests
- Turf Grass
- Open Space

USGS

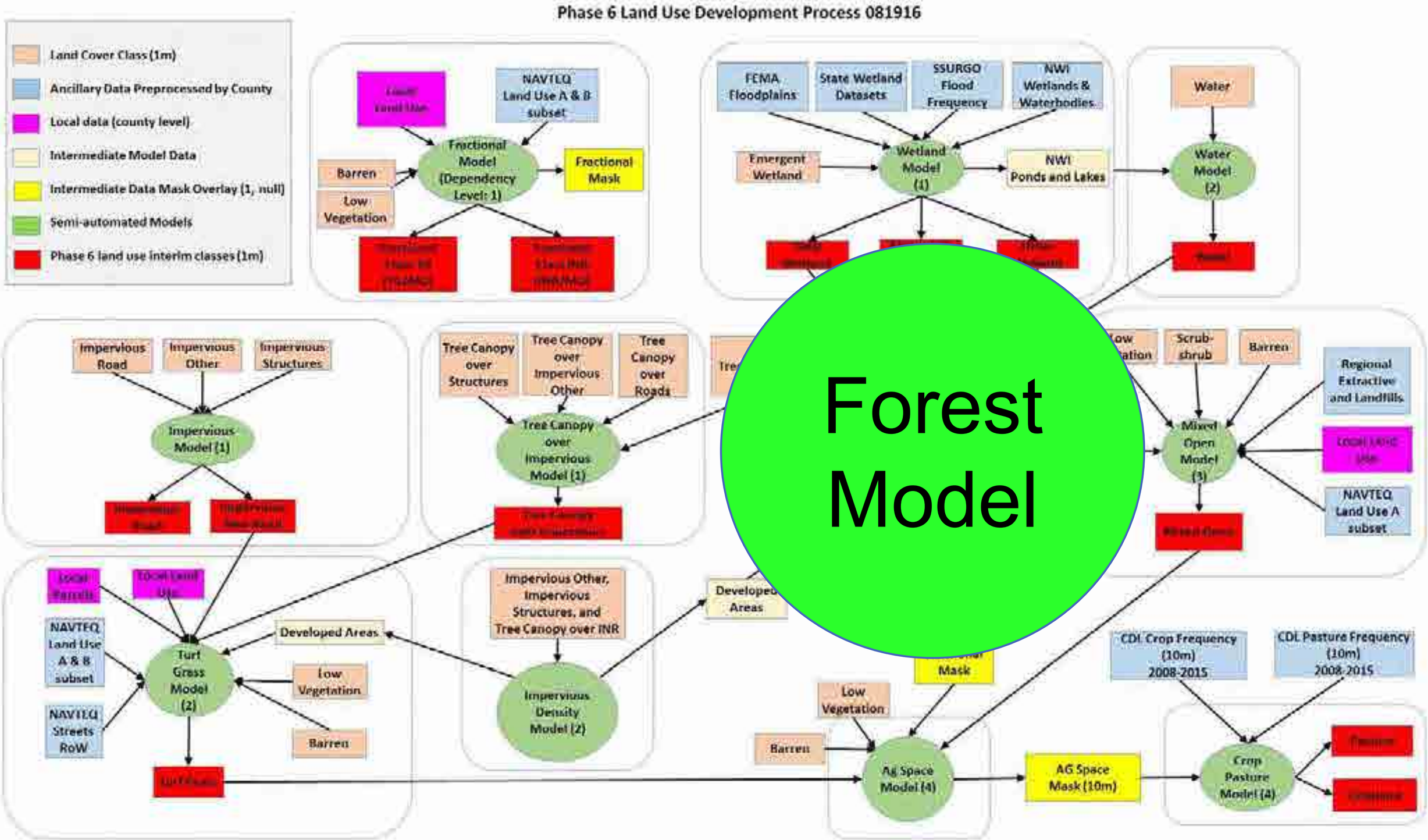
Local Parcel and Land Use Data Collected by CBP



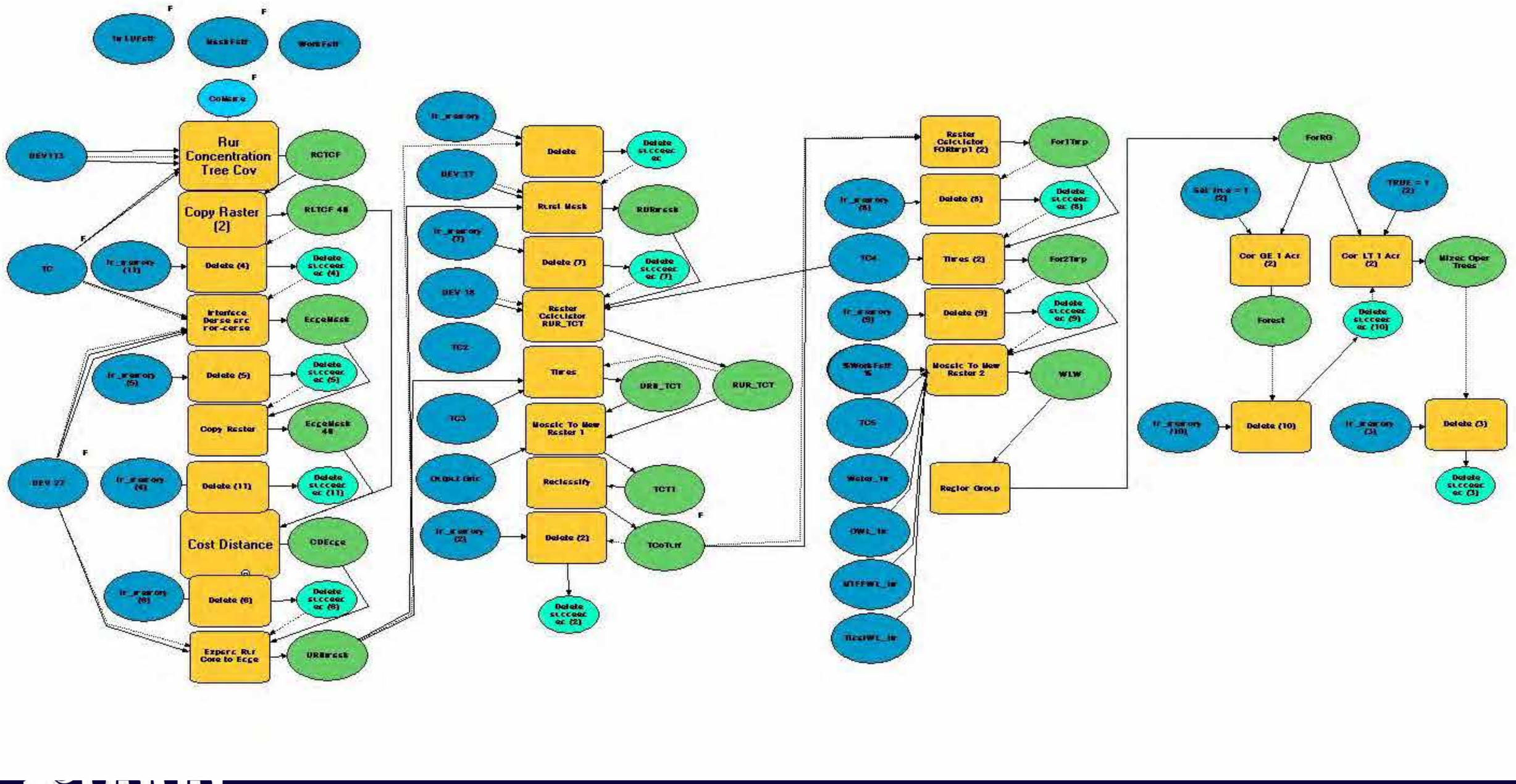


USGS

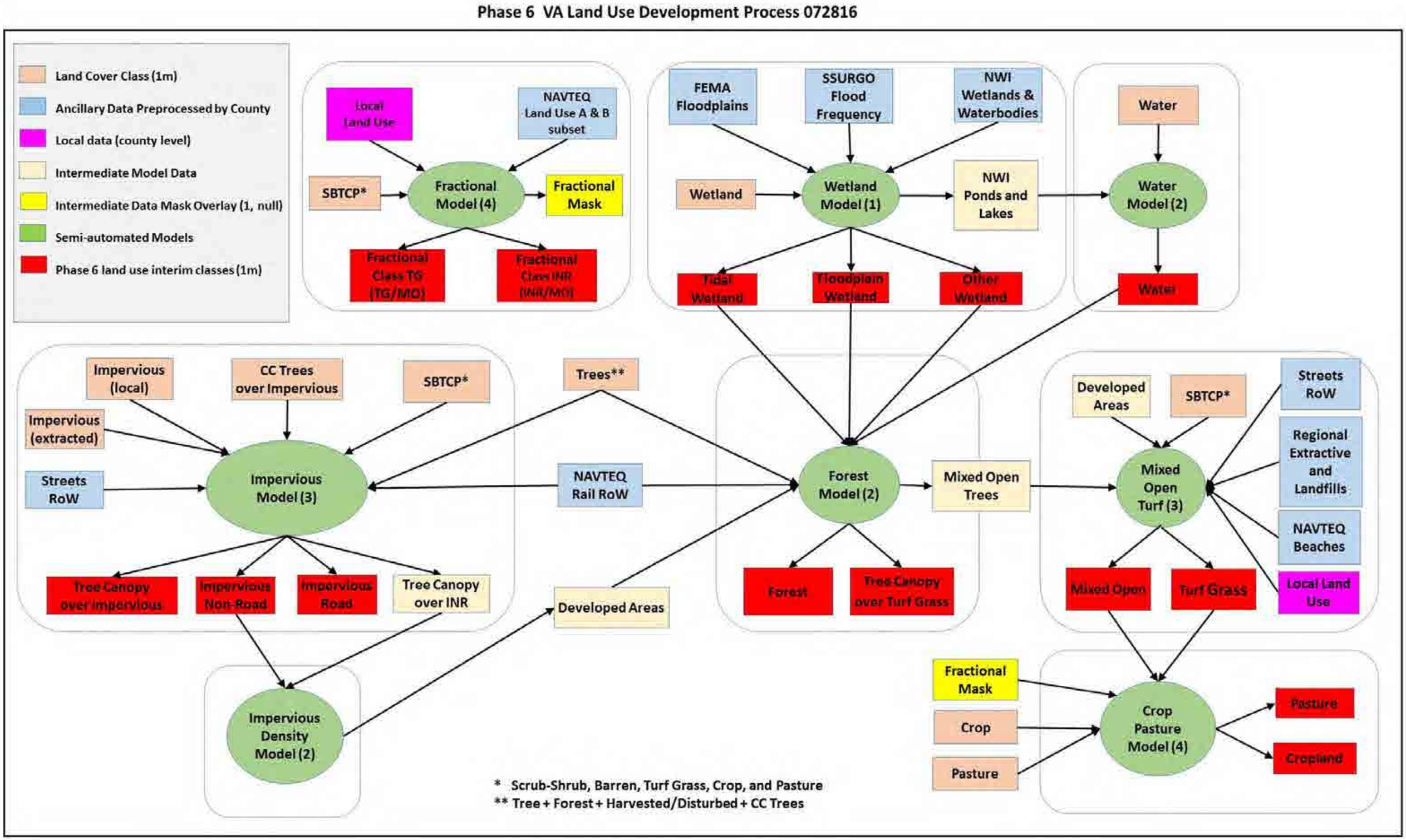
Phase 6 Land Use Development Process (all but Virginia)



Phase 6 Forest Land Use Model

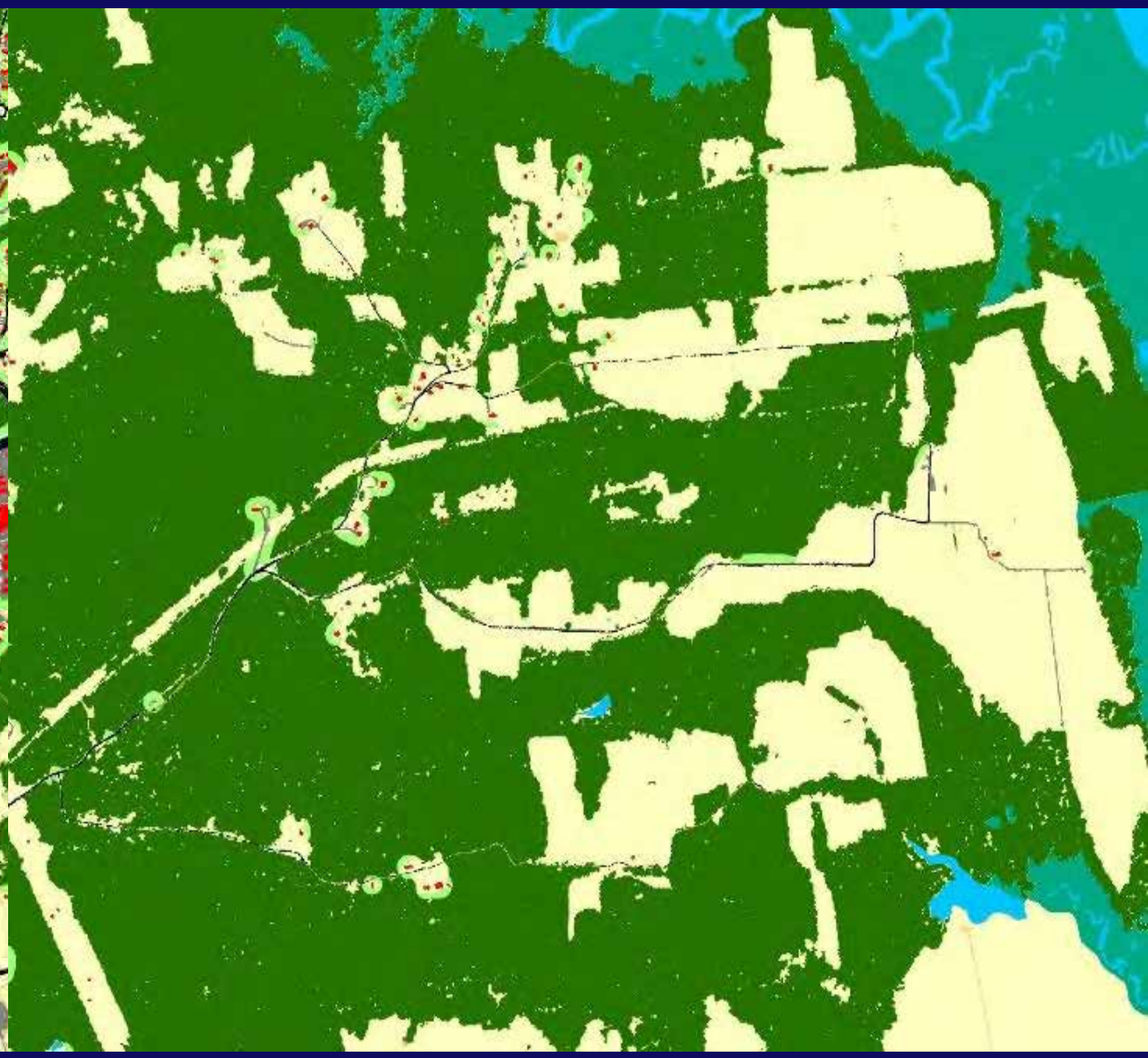


Virginia Phase 6 Land Use Development Process



Forest vs Tree Canopy over Turf

Urban Area



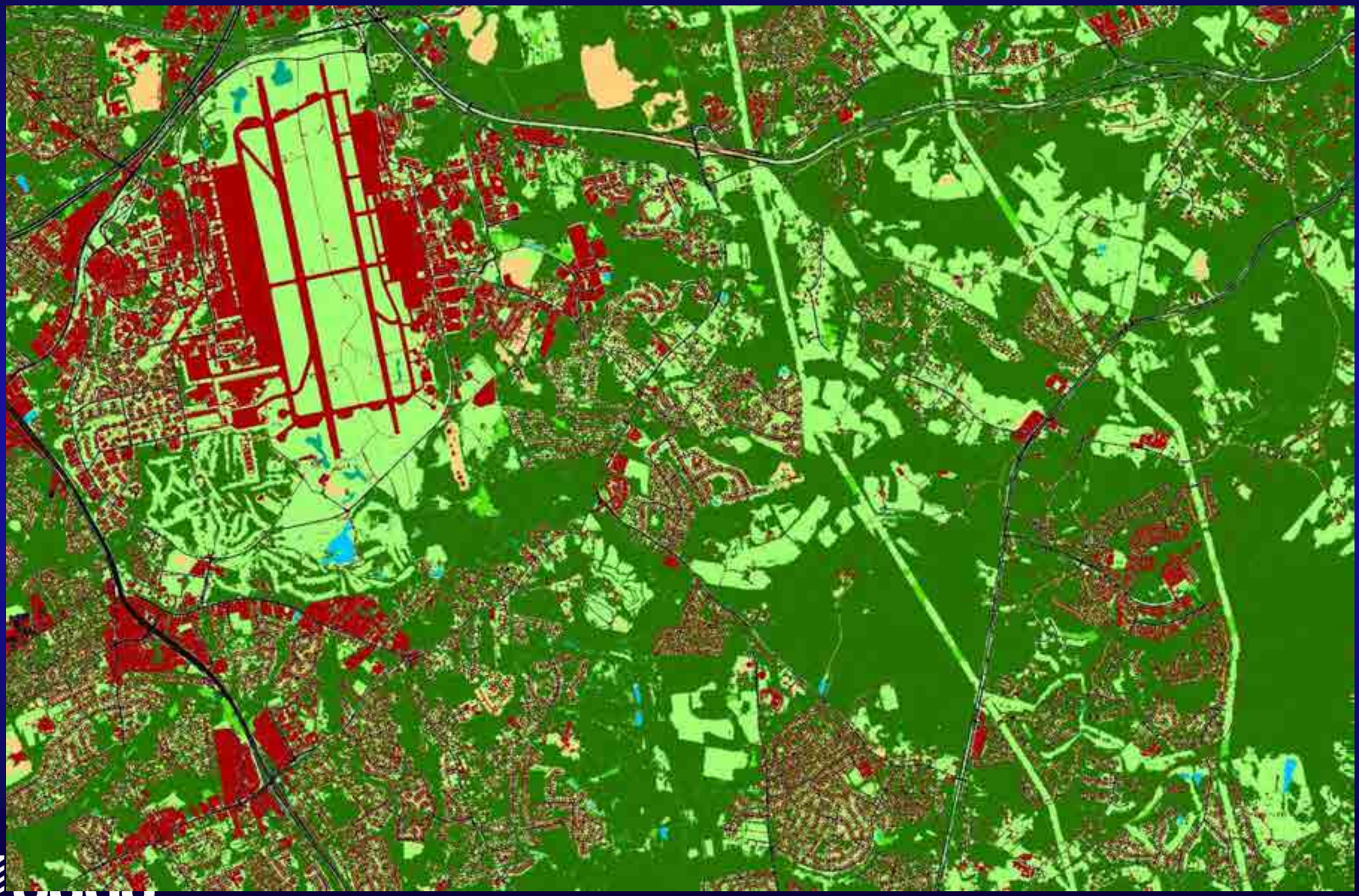
Rural Area

USGS

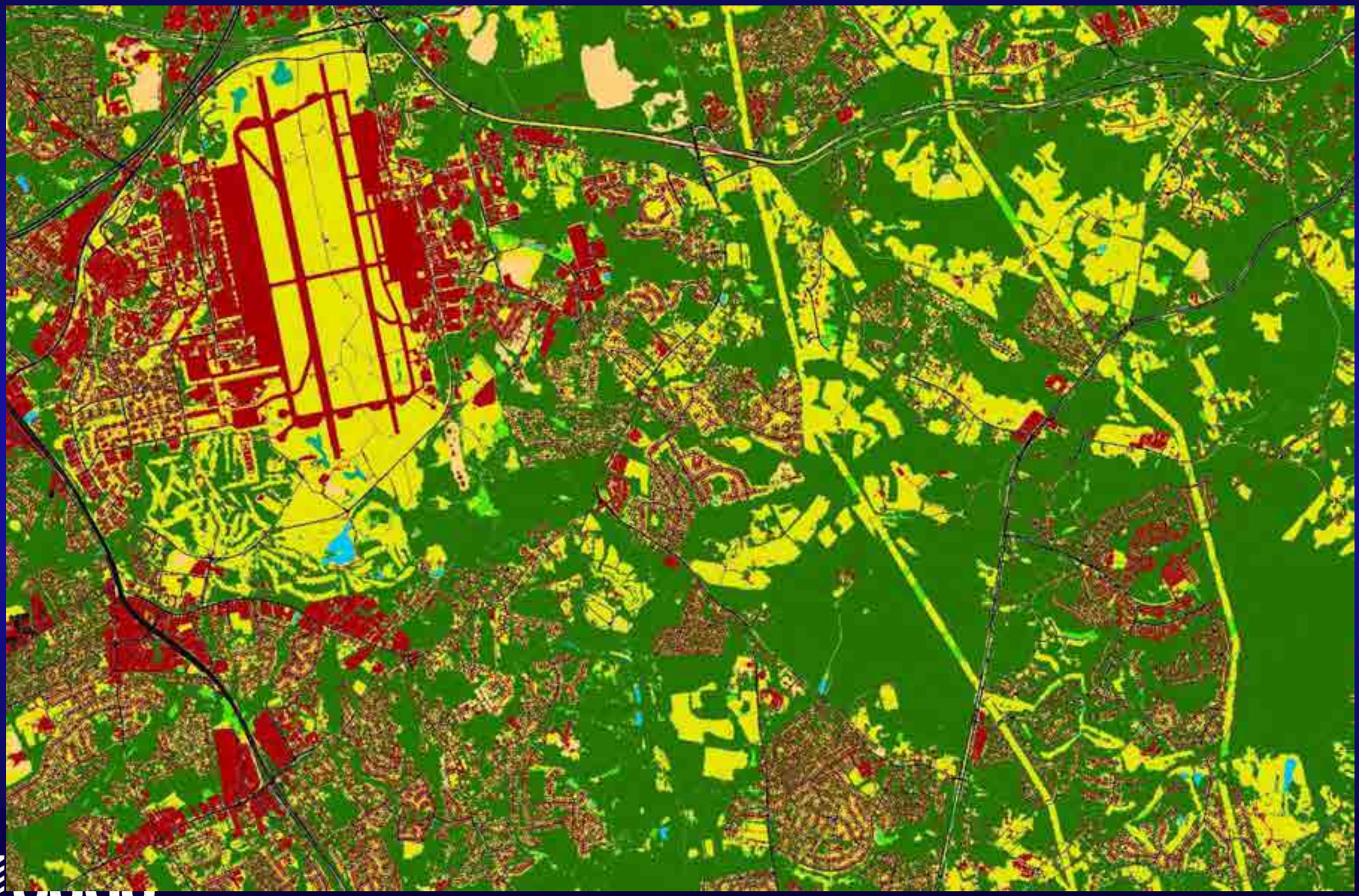
Forest

Tree Canopy over Turf

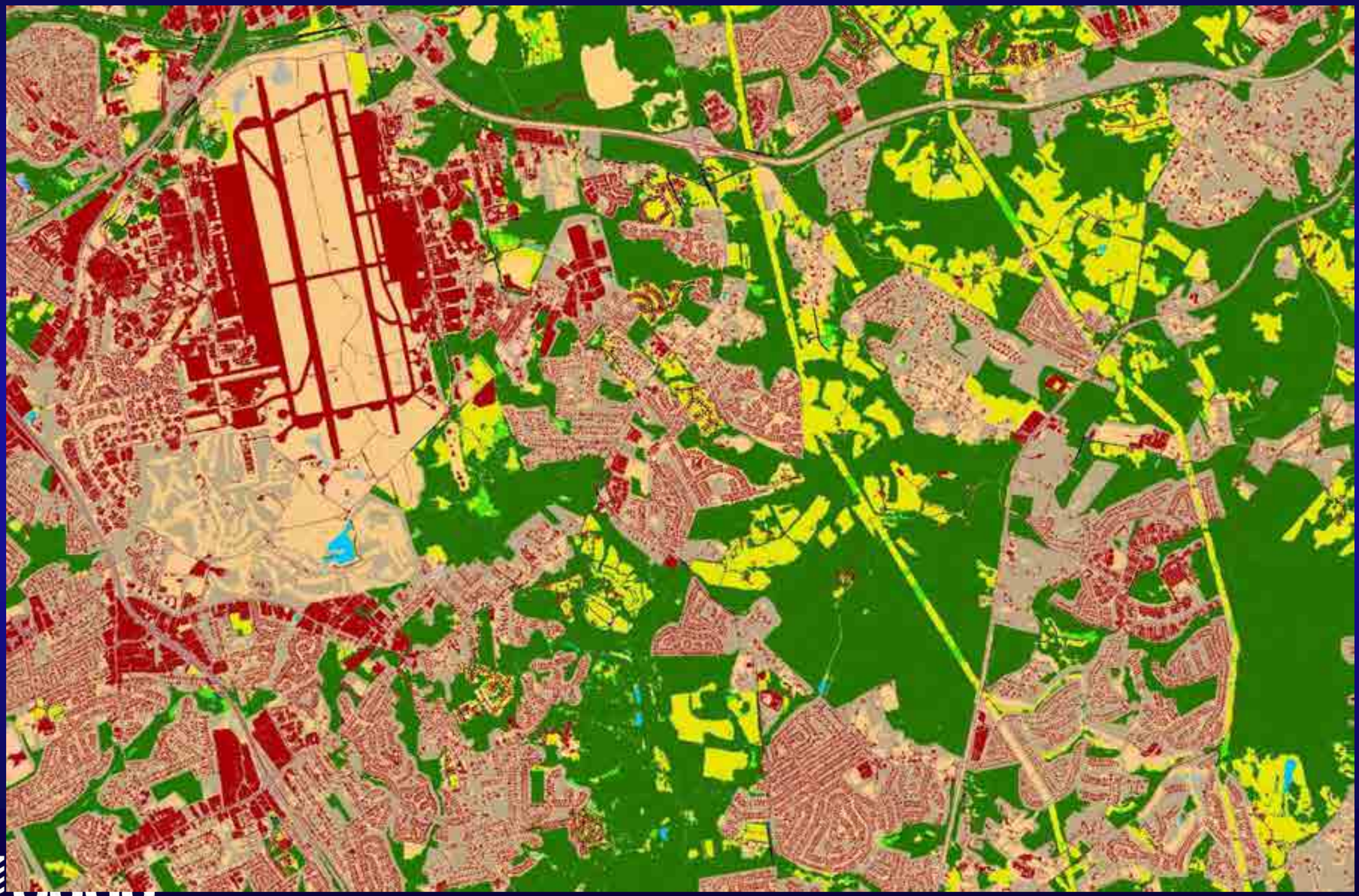
Turf Grass vs Agriculture (land cover)



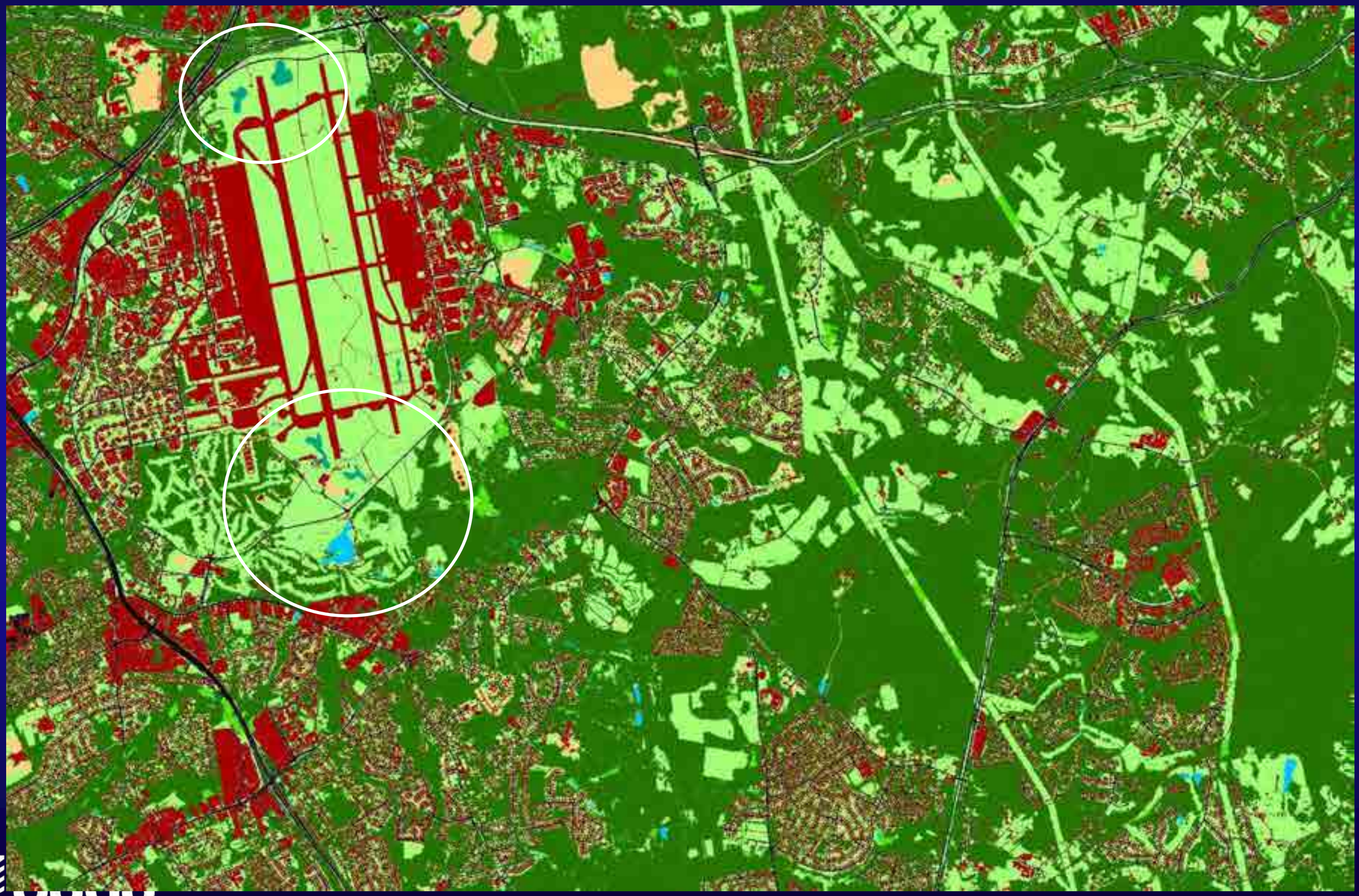
Turf Grass vs Agriculture (low vegetation)



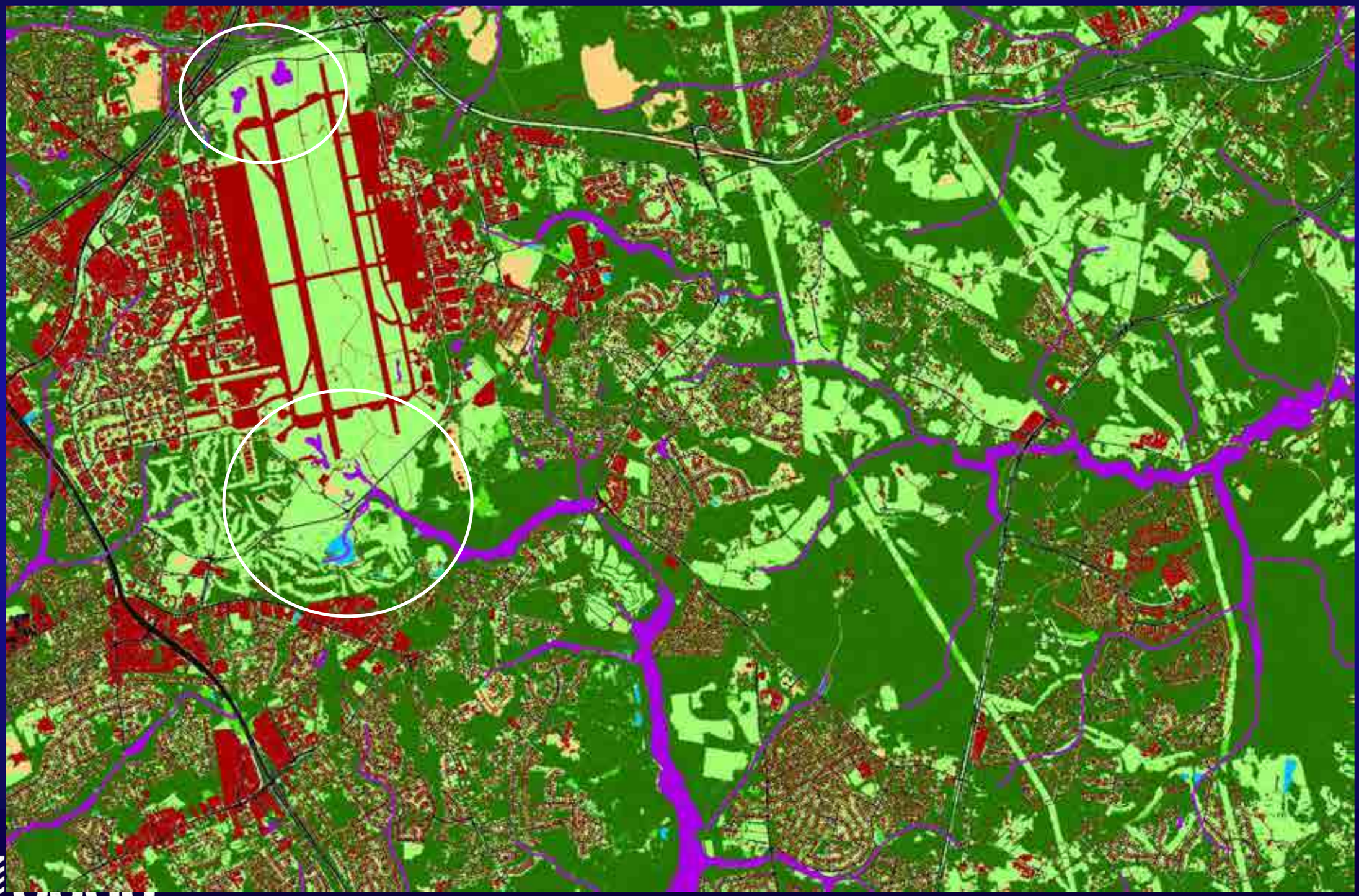
Turf Grass vs Agriculture
(developed land use overlay)



Water and Wetlands
(mapped from land cover)

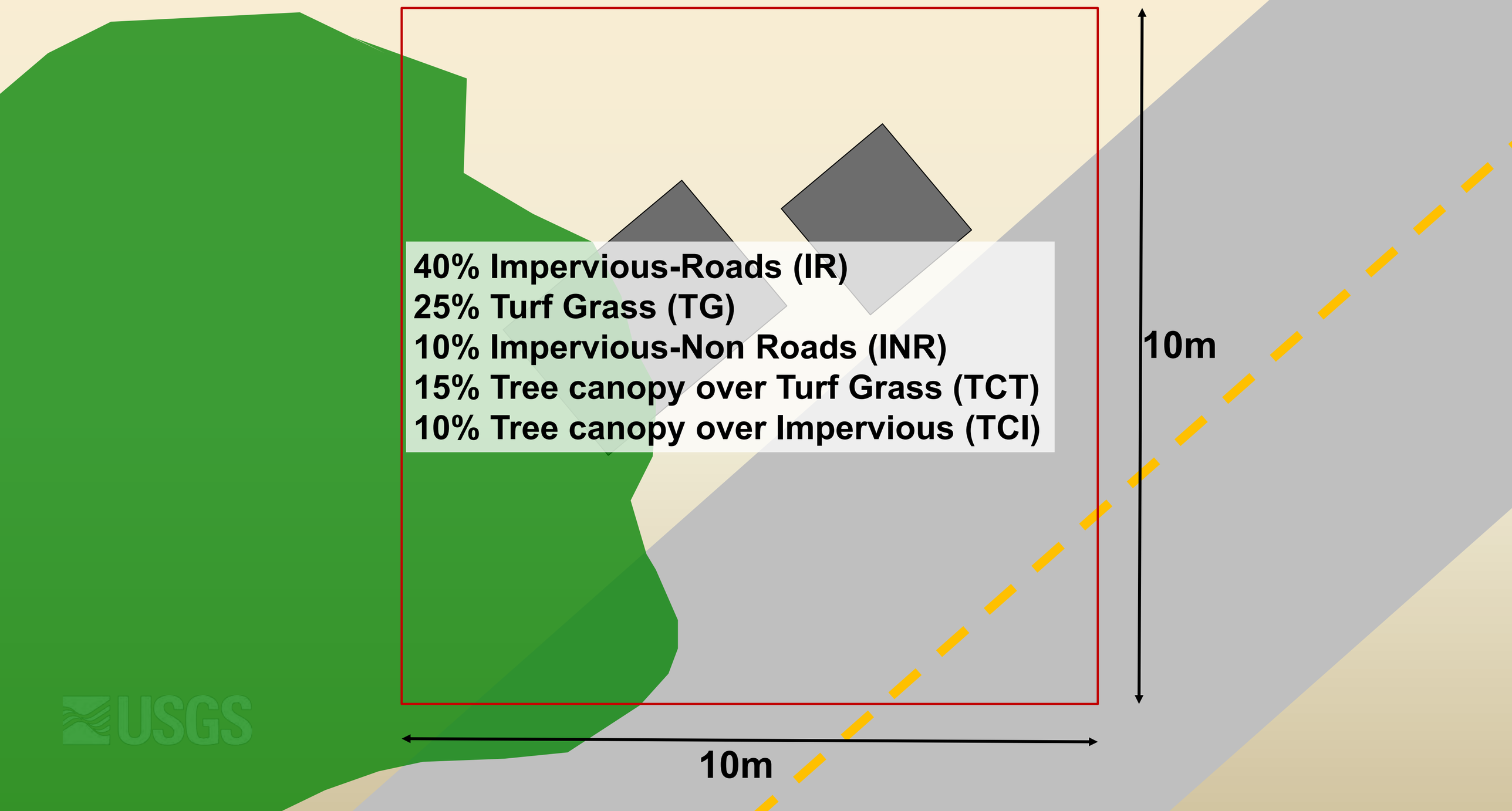


Water and Wetlands (added from NHD and NWI)

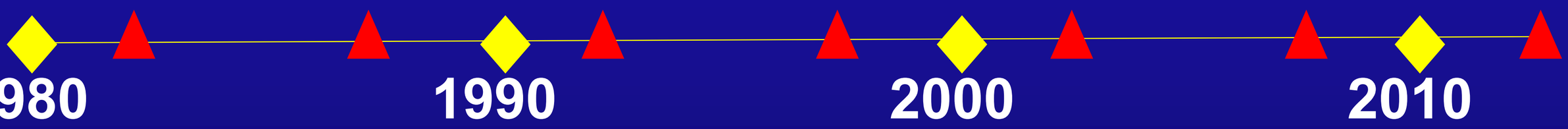


Phase 6 Land Use Database – from local & high-res data

- Thirteen different 10m resolution raster datasets
- Each cell includes the fractional composition of all land uses.



Data used Previously to Backcast Land Use for Calibrating the Chesapeake Watershed Model



Census of Population and Housing (block level)

Census of Agriculture (county level)

Irani, F. M., & Claggett, P. (2010). Chesapeake Bay Watershed Land Cover Data Series. *US Geological Survey Data Series*, *505*.

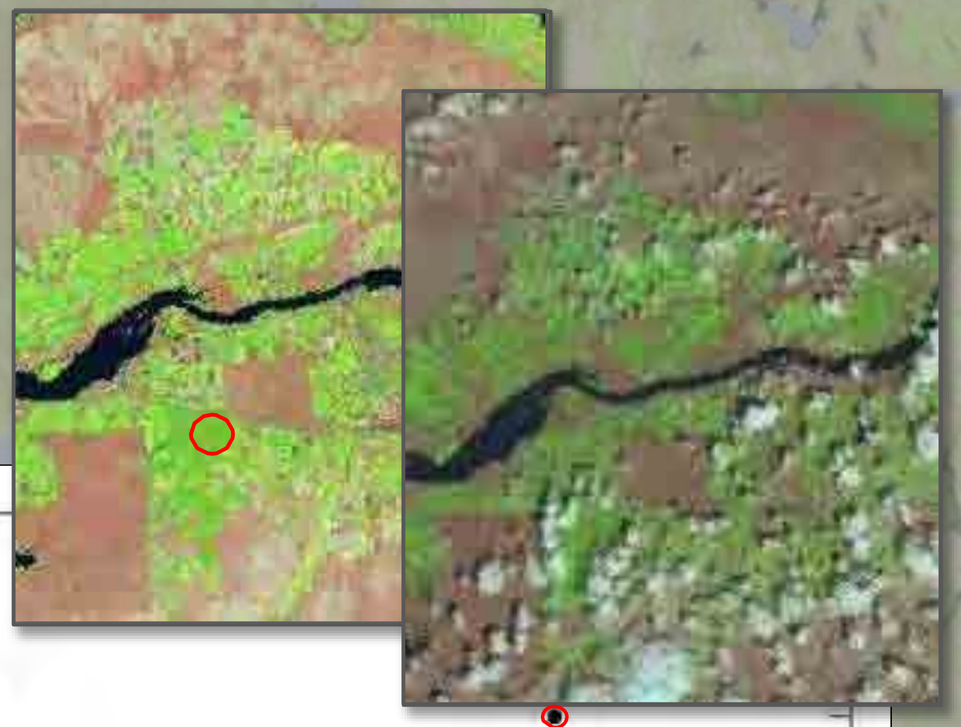
Backcasting Land Uses Annually from 2013 to 1984
New Methodology:

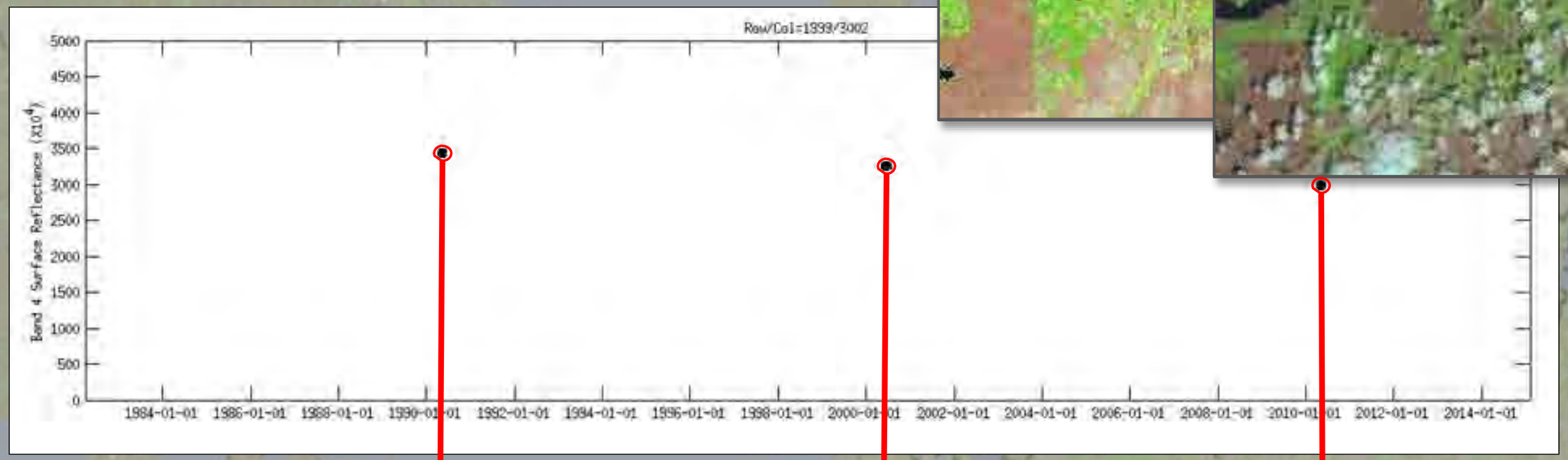
1. Use the 2013-ish Phase 6 Land Use Dataset to establish anchor for current land use conditions.

2. Use USGS' LCMAP-Continuous Change Detection and Classification (CCDC) data to identify every year of significant spectral change from 1984 through 2013 (for every 30m pixel).

3. Use CCDC to interpolate land cover/use change annually between years represented in the Chesapeake Bay Land Cover Data Series (1984, 1992, 2001, 2006) and 2013 Phase 6 Land Use Dataset.

Three decadal observations: growing seasons 1990, 2000, and 2010

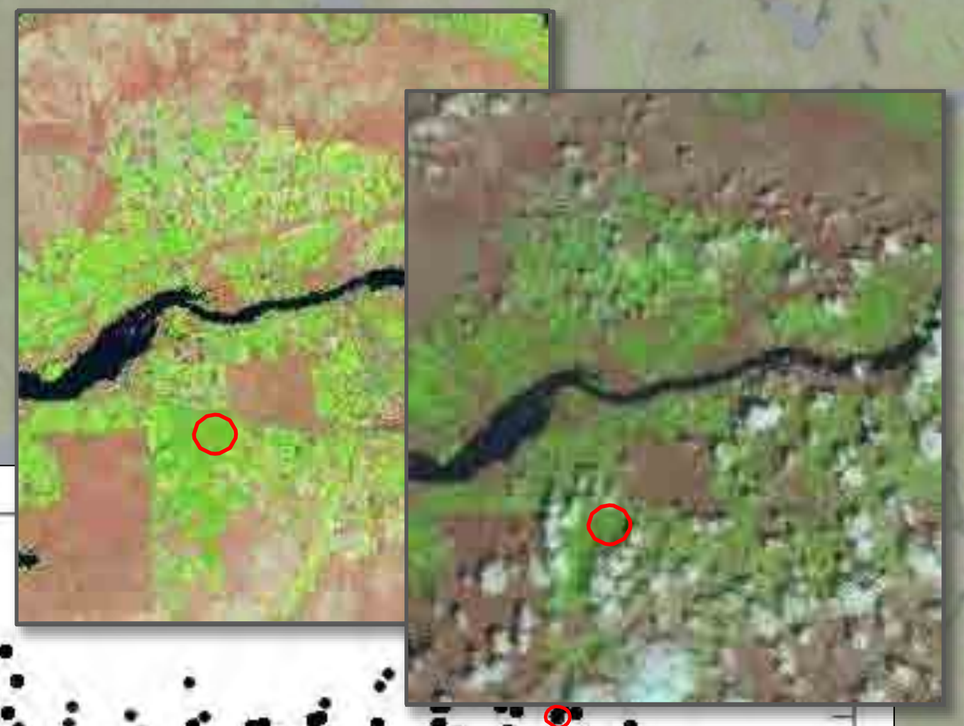


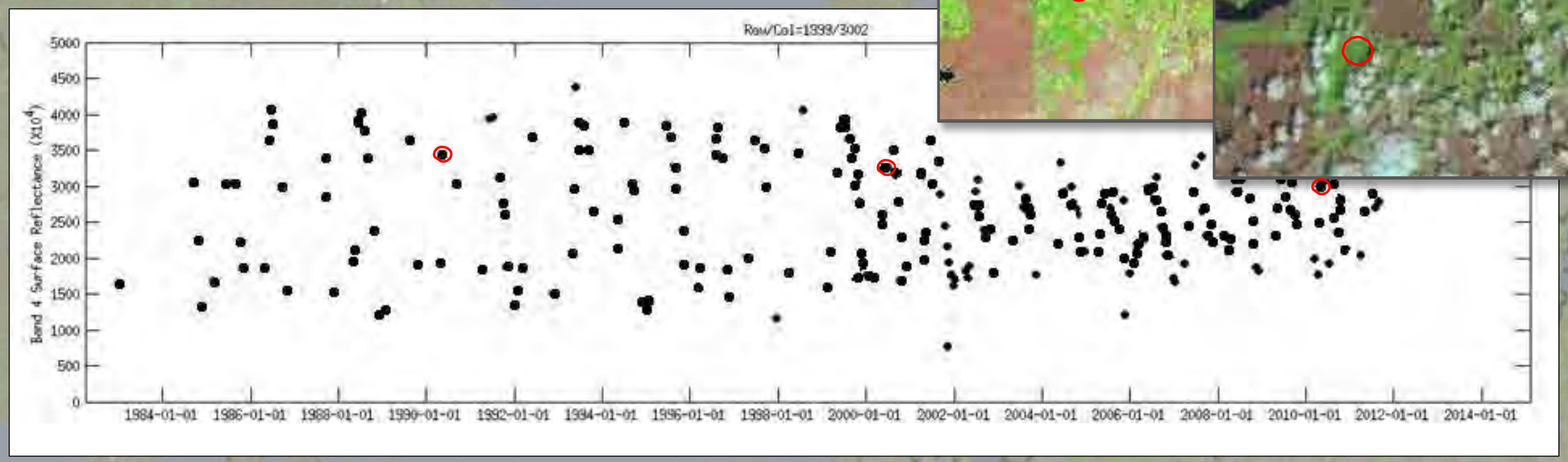


Landsat near-infrared, cloud-screened observations converted to surface reflectance using LEDAPS. Pixel row 1999, column 3002; WRS-2 path 12, row 31

USGS

All clear observations ever acquired for this location: 1984–2010





Landsat near-infrared, cloud-screened observations converted to surface reflectance using LEDAPS. Pixel row 1999, column 3002; WRS-2 path 12, row 31

USGS

Graph adapted from C. Holden, Boston University

Spectral history of a location in Fort Collins, Colorado, USA

Crop field

Hay field

In conversion

Developed

Landsat Band 5

Reflectance (scale factor 0.0001)

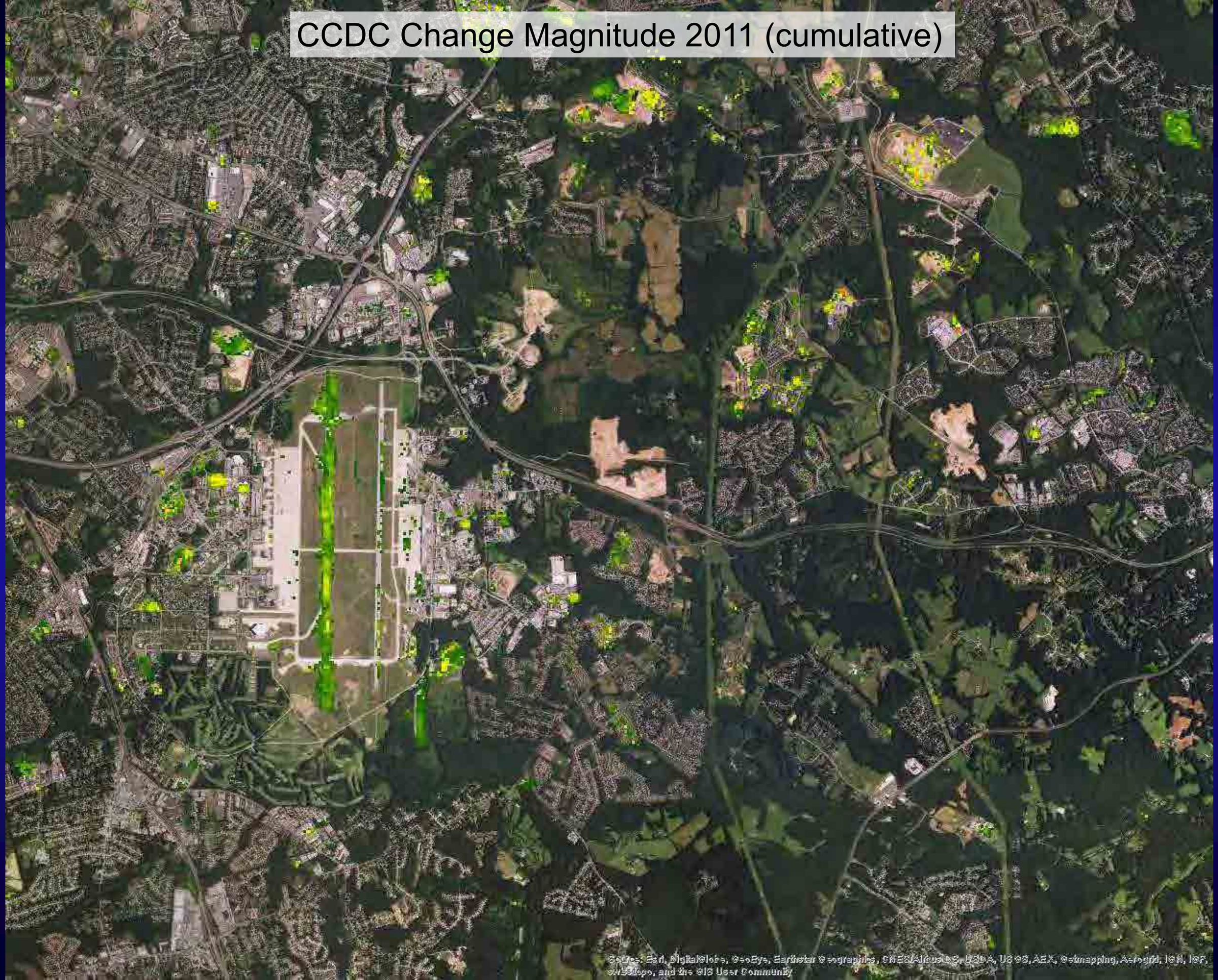
4000
3500
3000
2500
2000
1500
1000

1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012

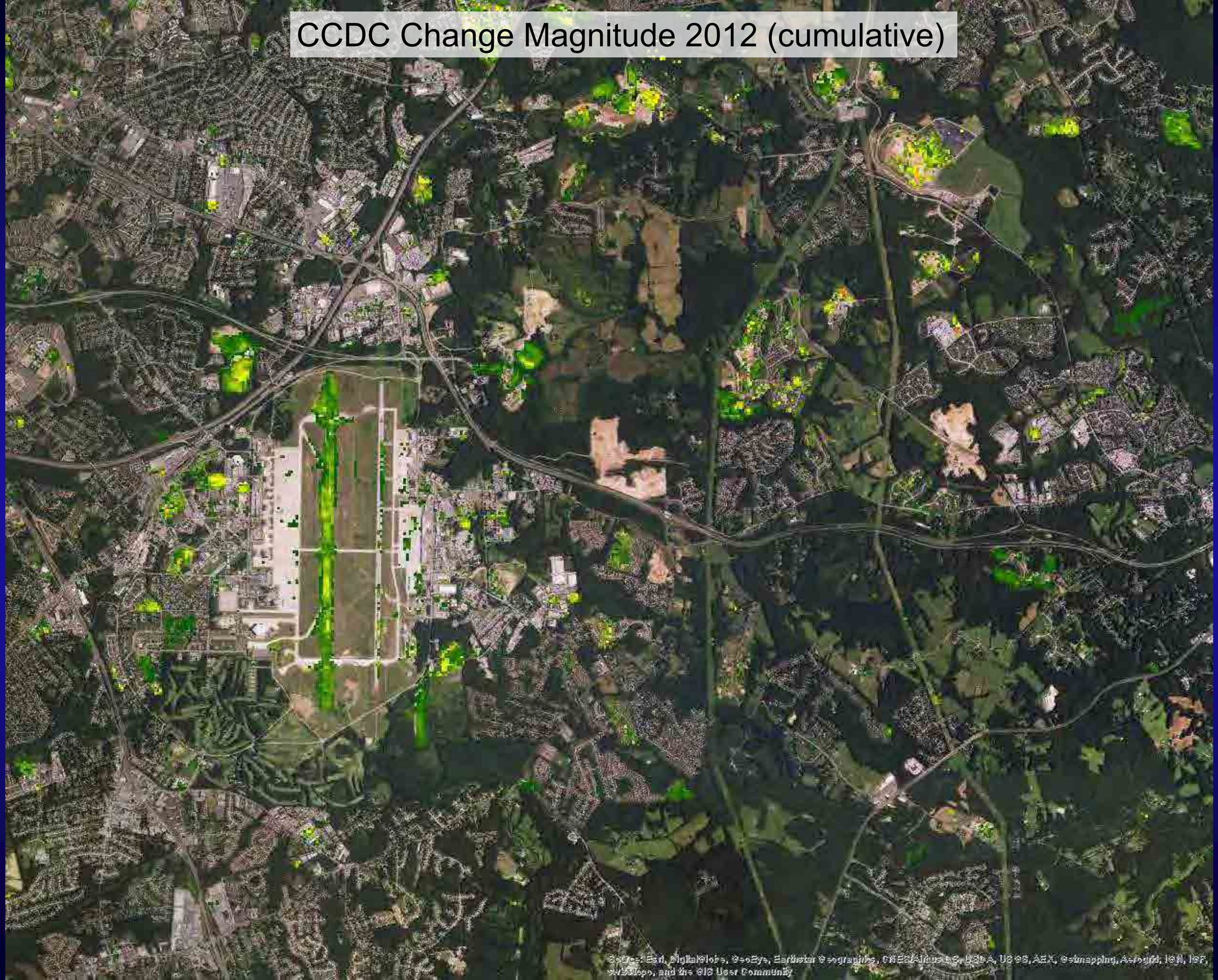
Date

CCDC Change Magnitude 2010

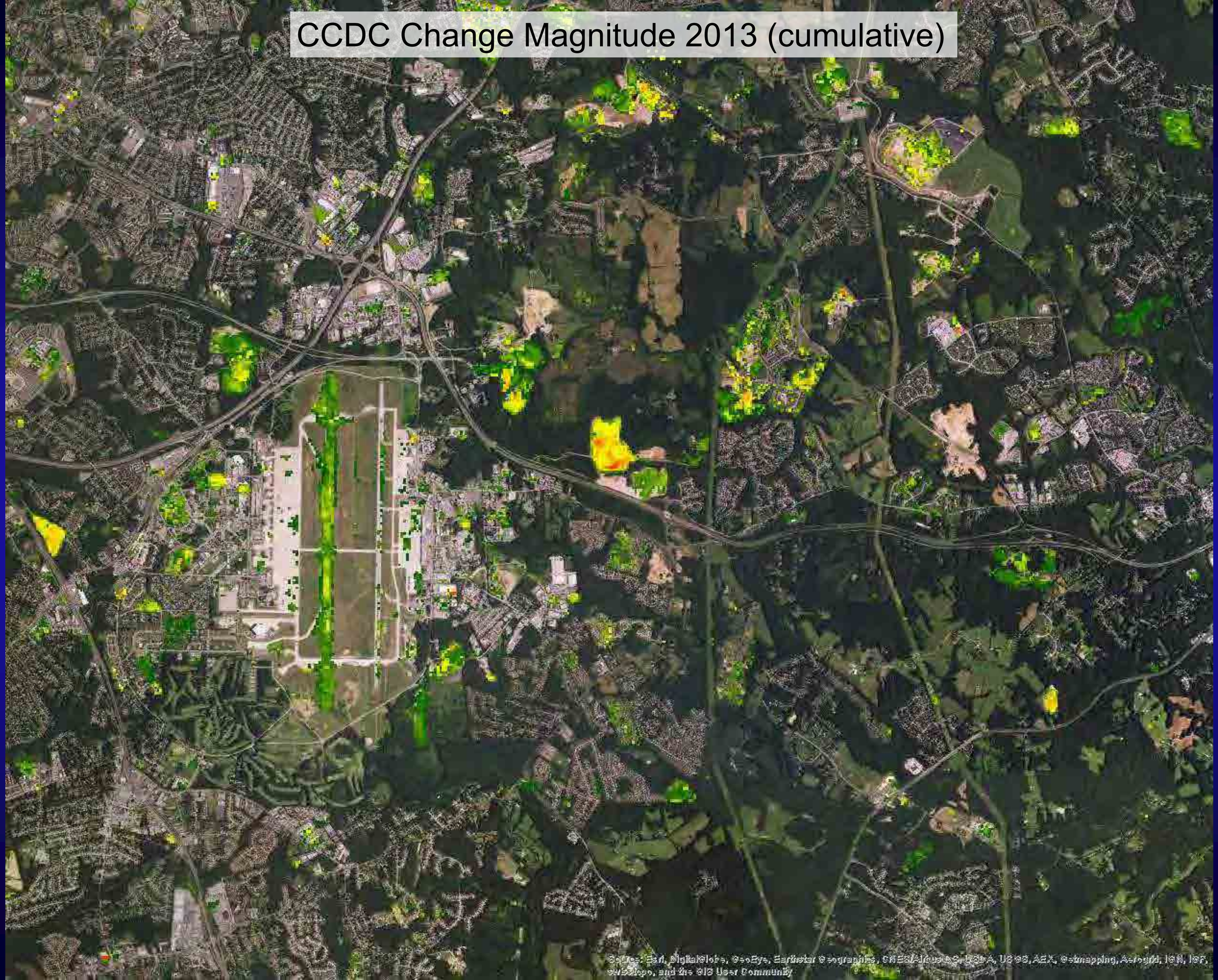
CCDC Change Magnitude 2011 (cumulative)



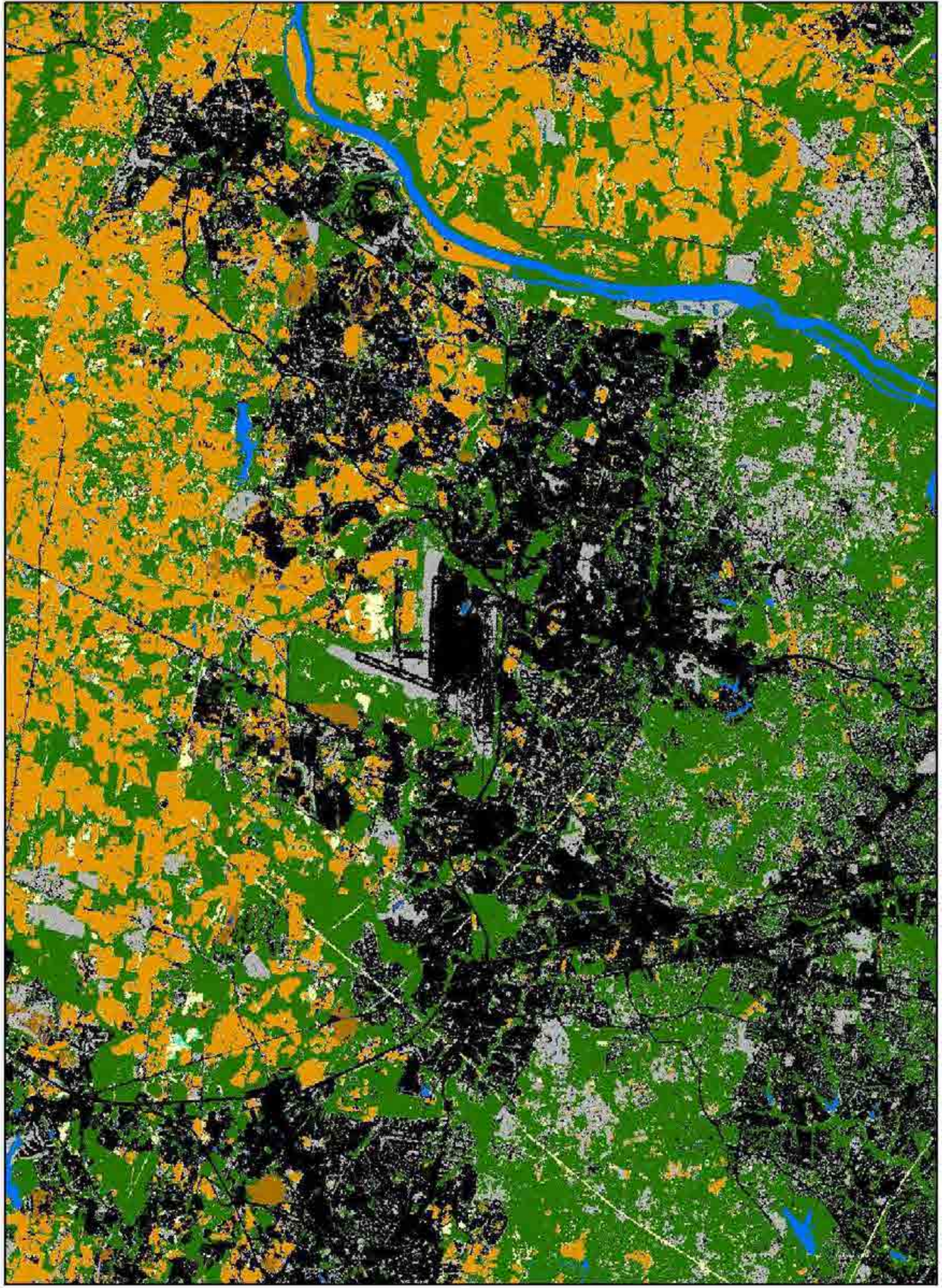
CCDC Change Magnitude 2012 (cumulative)



CCDC Change Magnitude 2013 (cumulative)



1984



2011

Incorporating Ag Census into P6 Land Uses

LRSEG	Mapped Land Use	Acres	Error Rate	Error Acres	New Acres
B	Impervious	10	5%	0.5	9.0
B	Turf	35	10%	3.5	27.9
B	Construction	5	20%	1	3.0
B	Open Space	20	5%	1	18.0
B	Forest	50	5%	2.5	44.9
B	Tree Canopy	20	5%	1	18.0
B	Crops (Ag Census)	85	3%	2.55	79.8
B	Pasture (Ag Census)	10	3%	0.3	9.4
Total Land Use Acres		235		12.4	210.0
Total LRSEG Acres		210			

STAC Review of P6 Land Use

1. Please comment on the data, methods, and stakeholder review process used to create the Phase 6 2013 land use/cover data set.

2. Please comment on the data and methods used to backcast the 2013 land use annually through the period 1984-2012.

3. Please comment on the method of incorporating Census of Agriculture data into the annual land use database.

4. For longer term CBP considerations, how can the overall approaches and procedures used in the production of the land use data set be improved and what alternative approaches and data gathering might you recommend?

5. Please comment on the documentation for the land use data set. Is it clear, well organized, concise, and complete?

USGS

Chesapeake Bay Land Change Model: Peer Review

June 2016: manuscript submitted to USGS and “Computers, Environment, and Urban Systems” for peer review.

- One USGS scientist review (complete)
- Two journal-appointed blind reviews (on going)

August 2016:

- STAC scientist Dave Newburn reviewed manuscript.
- EPA Office of Research and Development conducted independent review: three scientists specializing in land cover mapping and modeling.

Chesapeake Bay Land Use Forecasts: Production Schedule

Full-state Trend Scenario forecasts:

- **Maryland (complete)**
- **Virginia and New York (in prep)**
- **Pennsylvania, West Virginia, Delaware, District of Columbia (scheduled for August)**

Comparison of CBLCM and MDP* models

- **August & September**

Comparison of CBLCM and SLEUTH models in Delaware Watershed

- **Fall 2016**

*** https://www.farmland.org/initiatives/the-future-of-sustainable-farming-and-forestry-in-maryland**

USGS

CONservation scenario

(Frederick County, MD)

2040

- Commercial (future)
- Residential (future)
- Mixed use (future)
- Forests
- Scrub-shrub/grasland
- Agriculture
- Wetlands
- Water
- Barren/ extractive
- Developed Open Space
- Low-Intensity Developed
- Moderate-Intensity Developed
- High-Intensity Developed