

ESRI UC
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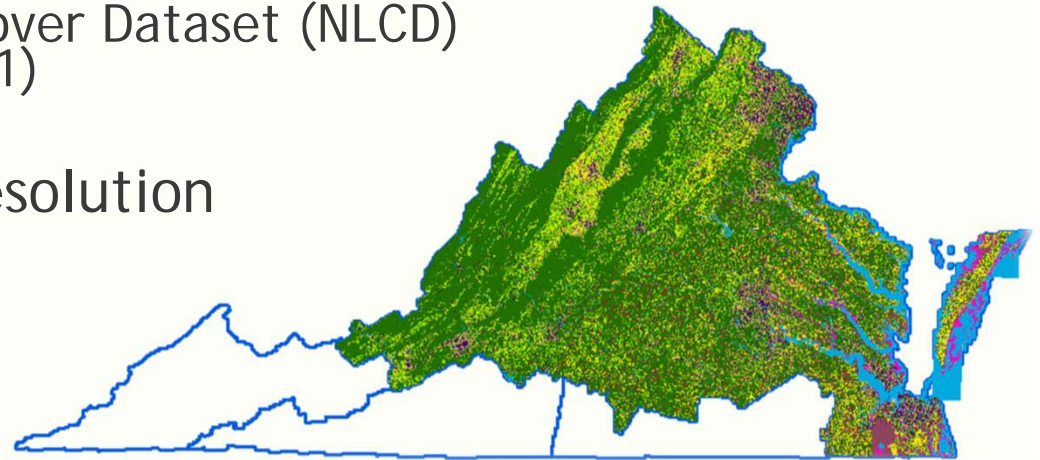
Utilizing Raster & Vector Data to Develop Statewide Land Cover Dataset

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Project Background

- Virginia Geographic Information Network (VGIN) received a grant to develop statewide land cover
 - Chesapeake Bay Program funding to update watershed models
- Will supplement existing Land Use/Land Cover data in nutrient load models
 - Currently using National Land Cover Dataset (NLCD) (30 meter resolution - 2006/2011)
- State LULC will have 1 meter resolution and be freely available



Project Background

Chesapeake Bay Program (CBP) regularly refines and updates environmental modeling across multiple states

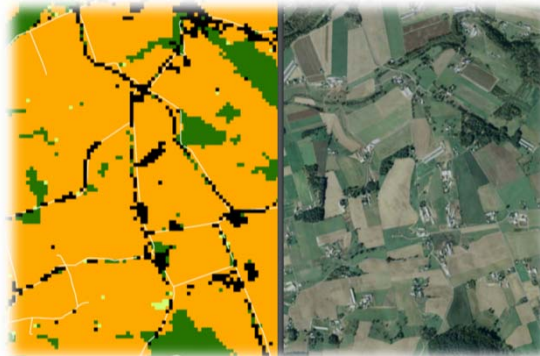
- Data outputs model pollution loads and flow
- Include Estuary, Airshed, Land Change and Watershed models

Watershed Model inputs include information on land use, fertilizer applications, wastewater plant discharges, septic systems, air deposition, farm animal populations, weather and other variables



Project Background

- Land cover and land use are two of the principal datasets used by the watershed modeling suite to estimate nutrients and sediments transported from land to the Bay
- Land cover data & imagery improvements continue
- 2015 - CBP partnership awarded contracts to develop new 1m resolution land cover raster data for all 64,000 square-miles
 - Phase 6 Watershed Model in the works



NLCD 30-meter land cover dataset

- Underestimates impervious cover in rural areas
- Underestimates vegetation in dense urban areas
- Overestimates agricultural areas

Virginia Land Cover Dataset

Statewide 1-Meter Resolution Vector & Raster Products



12 Classes Targeted for 85-95% Accuracy

1. Turf / Grass
2. Impervious Extracted
3. Impervious Collected
4. Forest
5. Tree
6. Harvested Forest
7. Scrub / Shrub
8. Cropland
9. Pastureland
10. NWI / Other Wetland
11. Water
12. Barren



Project Considerations

- Raster or vector?
External datasets were in vector, so started there
- What size processing areas?
Sought manageable areas that could fit into schedule

USGS has quads



Virginia Base Mapping Program
flow in its own grid



Selecting Extraction Software

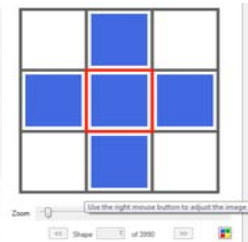
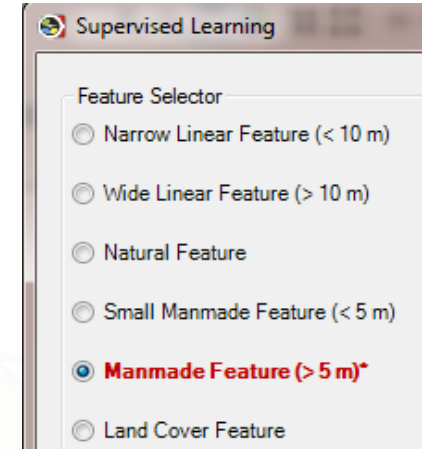
- Previous Esri **Spatial Analyst** extension experience for smaller (e.g., county) projects
 - Better fit for just a few technicians skilled with Maximum Likelihood Classification workflows
- **ENVI** worked great when looking at a few classes in a defined area
 - Involved more complexity and configuration than project called for
- Textron's **Feature Analyst** extension chosen for integration with Esri ArcGIS for Desktop Suite
 - Builds models that can integrate with Esri ModelBuilder and geoprocessing tools; Simplified workflow for repetition and changing parameters (ex: search kernel patterns) - had to change many times!

Image Extraction Settings

- Used supervised classification
(though unsupervised is a great way to discover how to divide results)
Have to “train” the software on what to look for



- Iterated to find the best spatial pattern
 - Some worked better for certain classes
 - FA has a great shortcut to pattern choices that can be further modified



Developing Each Tiled Image

- Tile Size: ~3.5 GB tiff
- Software does not recommend processing imagery > 1 GB
- Vector outputs initially failed, as some contained > 600,000 features!
- Feature Analyst extracts **shapefiles**
 - Must be smaller than 2 GB
 - Must contain fewer than 70 million pts/vertices

WARNING



- Workaround: Extract as **raster**, then converting to file geodatabase feature class to combine with external data
 - FGDB **feature classes** support up to 2,147,483,647 features!

- Some machines still couldn't handle processing (i.e., would error out, fail, or crash), so we beefed up our RAM

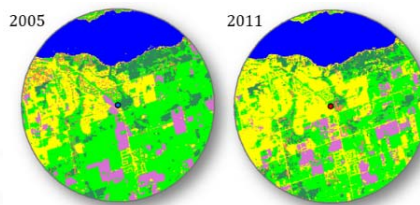
Getting Results

- Multi-class Image extraction doesn't get everything right
 - Ended up having to run single-class outputs for Harvested, Crop, etc then integrated
 - Overlaying multiple datasets means sliver features (cleanup scripts + data QC)
- Found patterns of confusion
 - Small pieces of turf appear between external wetland datasets and forest extraction (can automate reclassification)
- Not just automated processing...
Land Cover/Land Use means MORE than image extraction
 - Crop & Pasture utilized NASS data, imagery, pasture lot ID points, etc
 - Some grasses such as airports & paintball courses came back as Pasture, had to be reclassified as Turf



Key Characteristics

- Goal: 85% - 95% accuracy standards
 - Exceeds current NLCD product
 - Internal accuracy check + outside vendor results
 - Random point sampling, photo interpretation
 - Enhanced automated cleanup AND additional hand QC measures
- One-time deal
 - No current plans or funding for product updates
 - However, VBMP imagery cycle could align (4 yr)
 - Change detection useful for multi-year comparisons



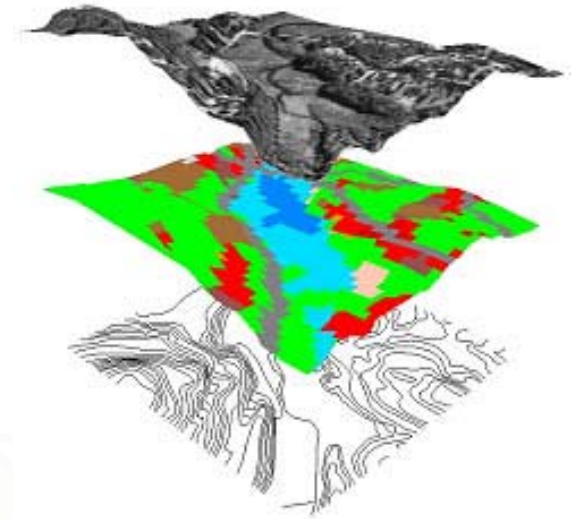
Accuracy Threats

- Are external datasets on a **maintenance schedule**?
 - Do they align with the year of imagery?
- Are datasets stored in the same **coordinate system**?
 - Geoprocessing and combining / converting data can result in shifts
- Can your **product compare** to another?
 - Different classifications may not be derived in both datasets
- Can **change / repetition** occur?
 - Different number of bands in imagery
 - Other imagery changes (e.g., Landsat scan line reflector failure post 2003)



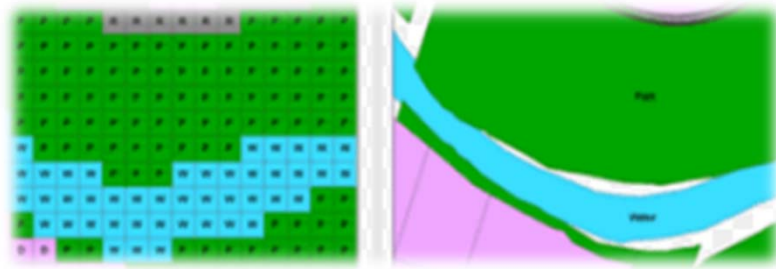
Land Cover Dataset End-Users

- Immediate Chesapeake Bay Program Phase 6 modeling needs
- Other **state** modeling initiatives
 - VA Development Vulnerability Model (ConservationVision) to detect urbanization risks
 - DCR VA Natural Landscape Assessment (VaNLA) core area identification
- **Regional** use cases
 - Various Planning District Commissions
 - Regularly developing land use datasets, impervious surface reports, green infrastructure planning models, etc.
- **County** planning
 - Stormwater management programs
 - Long-range transportation plans
 - Total Maximum Daily Load (TMDL) requirements
 - Sustainability initiatives



Final Considerations

- Providing combination of raster AND vector output
Not all users have the resources to convert raster to vector to derive coverage estimates



- Compressing your data
Raster compression can be TIFF, JPEG, LZW, and lossy OR lossless... while lossy saves on size, it compromises your resolution permanently! Not all compressions are user friendly to a non-ESRI user

Should you create land cover?

NLCD available for all states

Advantages

- Nationwide coverage
- Many useful Land Use types
- Standardized classifications for comparison over time

Drawbacks

- Not always current enough (2001, 2006, 2011)
- May not be detailed enough (30 meter)
- Will not have taken advantage of all local datasets available

