Sprawl

Sprawl Highlights

README for data files included on this CD-ROM

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These are image files of the various data layers, compressed with
gzip. The image files are binary raster files, with ENVI headers.
If a different header is needed for different software,
the image parameters are:

Number of Lines: 2910
Number of Samples: 4626
Number of Bands: 1
Upper left corner of Upper Left Pixel: -2362000, 3178000
Pixel size 1000 m

Projection information:

Albers Conical Equal Area Projection
Datum NAD 83
Spheroid GRS1980
Units Meters

1st Standard Parallel	29	30	0.00
2nd Standard Parallel	45	30	0.00
Central meridian	-96	0	0.00
Latitude of projection's origin:	23	0	0.00

****

develop_percent.dat	Image of estimates of percent development for each pixel.
us_radiance.dat	The Radiance Calibrated Lights product for the coterminous United States. DN values can be converted to radiance with the equation Radiance = DN * 10^(-9) watts/cm^2/sr/um.
us_roads.dat	Image of lenth of roads per 1 km-square pixel, derived from streets and roads layers of Census Bureau TIGER 98 files. Pixel values are sum lengths of streets and major roads (including interstate highways) in units of meters.
us_roads_litmskd.dat	Image of length of roads, masked to include roads only in pixels coincident with detected lights. Pixel values are sum lengths of streets and major roads (including interstate highways) in units of meters.
nlcd_class#.dat	Image of land cover classification produced by the USGS National Land Cover Characterization Project, acquired from Landsat TM for years near 1992. A more complete description can be obtained at (http://landcover.usgs.gov/natlandcover.html). The classification key (21 classes) can be obtained at (http://landcover.usgs.gov/classes.html). Pixel values range from 0 to 10,000. The percent area estimate was multiplied by 100 to keep data precision (e.g. 9876 means 98.76%).

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us_pop2000.dat          Population density image derived from Landscan
                        2000 Global Population Database, developed by
                        Oak Ridge National Laboratory. Pixel values are
                        population density per square kilometer.
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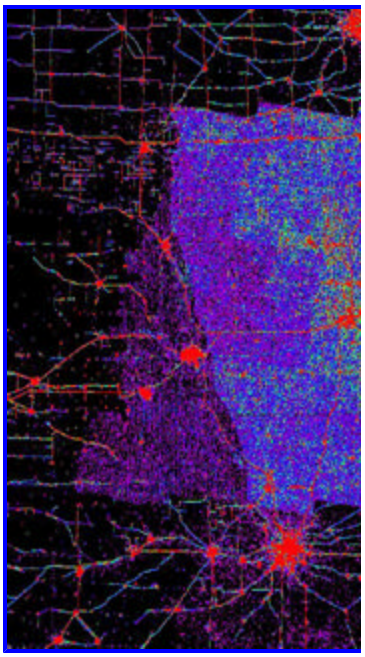
Problems, issues, potential solutions (continued)

We discovered that there are variations in the percent cover of MRLC Class 23 (commercial/industrial/transportation).



These variations propagate as errors in % development. Our solution has been to exclude the MRLC land cover classes from the model used to estimate percent development.

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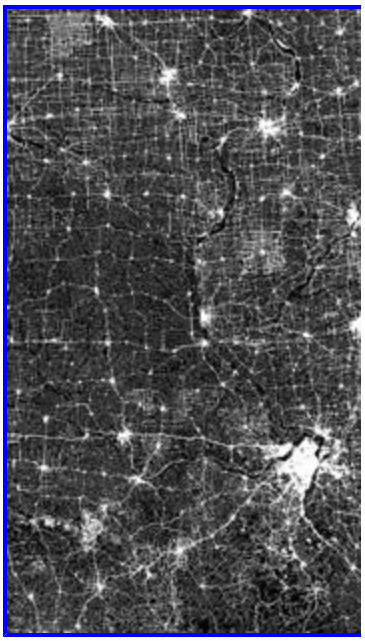
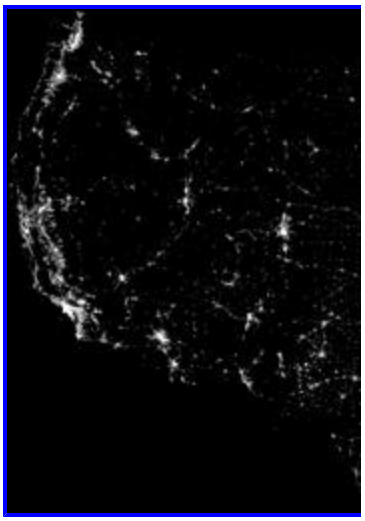
Problems, issues, potential solutions (continued)



We discovered that there are county-to-county variations in street density in the TIGER data.



These variations propagate as errors in % development. Our solution has been to only use streets in areas with lights detected.

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Problems, issues, potential solutions (continued)

The provisional radiance calibrated nighttime lights product has been produced using DMSP-OLS data acquired at three gain settings during the winter months of 1999-2000 under low lunar illumination. NGDC has used the thermal band to identify clouds so that cloud-free composites can be generated. We noticed areas with anomalously bright and extensive lighting in the initial product. Upon investigation we determined that when the gain setting is high, the OLS lights from the outer quarter panels are slightly brighter and more extensive than the lights from the inner half of each swath. This is due to automatic switching of the gain in the outer quarter panels built into the OLS for the purpose of "constant contrast" cloud imaging. Another factor which appears to result in brighter and more extensive lights is the presence of snow cover.

Our solution was to reprocess the lights without use of the outer quarter panels at high gain setting and screening out data that may be impacted by snow cover based on daily 1 degree snow cover grids produced by the NOAA National Center for Environmental Prediction (NCEP). An updated nighttime lights product will be produced using DMSP-OLS data being acquired during September, October, and November, 2001.

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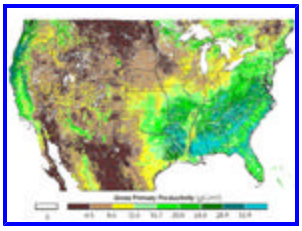
Future Steps - Schedule, Deliverables (continued)

4. During year 3, we propose to improve the estimates of the impacts of Development on carbon sequestration in three different ways:

1). We will use MODIS NPP and LAI products to analyze the effects of development on carbon budgets


Gross primary production computed from MODIS data over the conterminous U.S.

2). We will also use estimates of development derived from regressions developed by NGDC in BGC model runs. Our current estimates reflect gross impacts of development on the carbon budgets using the USGS MRLC classification scheme. Specifically, we would like to simulate NPP of lawns, parks etc. and add these amounts to the total NPP. Our current estimates do not reflect this amount.

3) Finally, we will run our simulation model on a distribution of land covers in each eco-region instead of dominant land cover as was done in year 2.

5. During year three USGS and NGDC will collaborate on the development of methods for estimating the percent cover of impervious man made surfaces from Landsat 7 data. USGS will use the air photo point count estimates of the percent development to evaluate the accuracy of the estimates made from Landsat 7 data.

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Future Steps - Schedule, Deliverables

1. Land Cover Calibration: In the calibration we have used two transects of eleven air photos each from Atlanta and Chicago, representing the south and northern USA. During the next three months we will add in results from 25 more air photos covering Las Vegas (intermountain west), Houston (south), Portland, OR (northwest), and Sacramento (west). During March-May, 2002 we will add in another set of photos, in areas to be selected.

2. Update Nighttime Lights: 27 additional nights of lowgain OLS data are being collected during the dark part of lunar cycles during September, October, and November of 2001. These data will be more reliably free of snow and will be processed to make an updated radiance calibrated nighttime lights product for the project. Completion date is scheduled for January 2002.

3. Development of 1 km Land Cover Products: NGDC has completed a prototype 1 km map indicating the percent cover of development. Percent lawn and percent tree cover products are yet to be developed These products will be reprocessed as new air photo calibration data becomes available.

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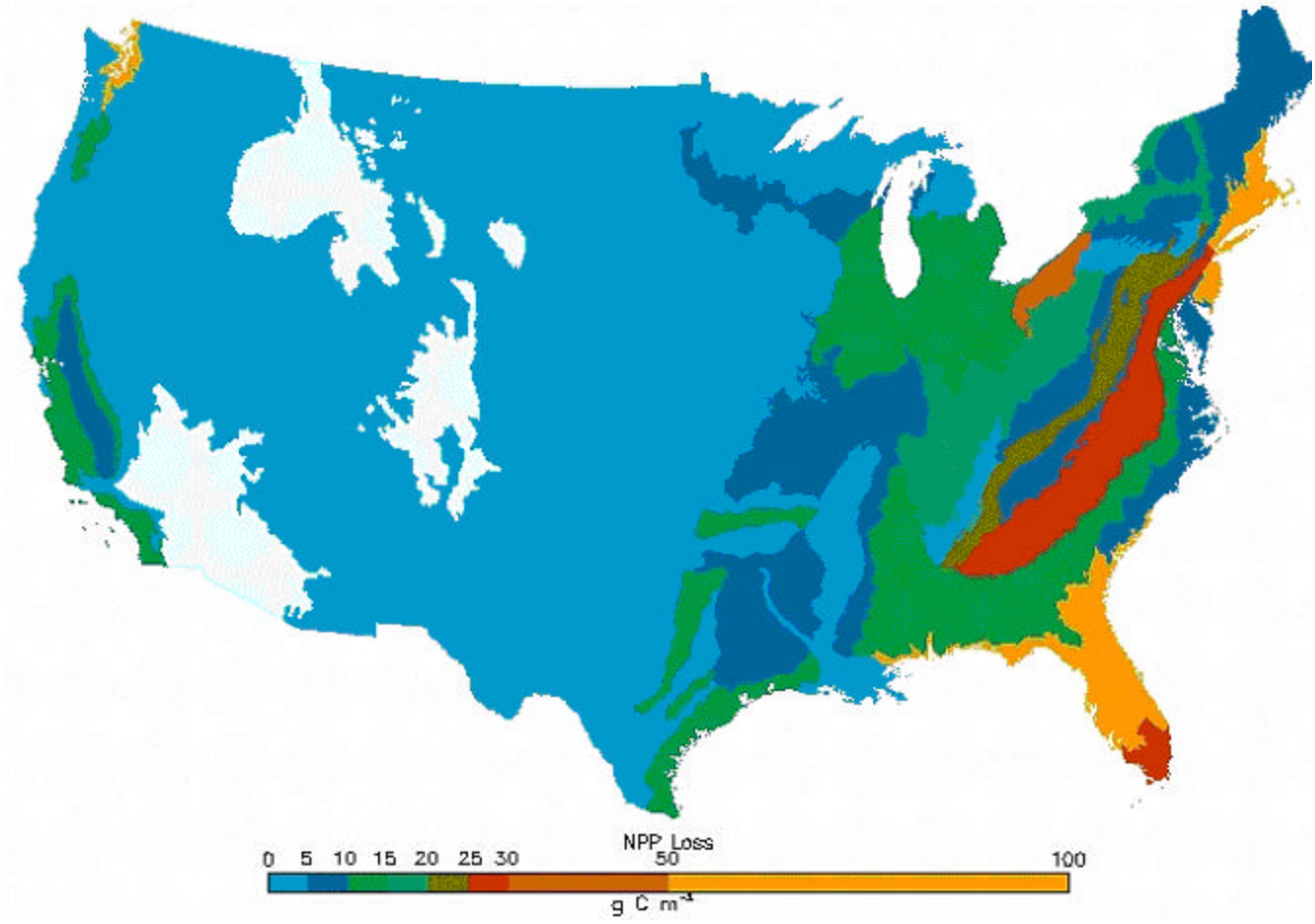
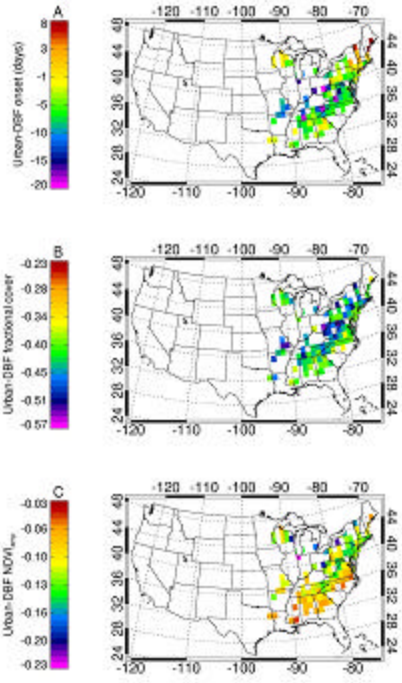
Results (preliminary)

The total NPP for the U.S is estimated to be 2.6 Gt/yr which is similar to earlier estimates for the U.S. Then, for each ecoregion, we estimated the fraction of landscape that is under “development”. This was done by aggregating land cover classes (from MRLC): residential, commerical and mines etc. This area came to be about 1.75% of the continental U.S. For each eco-region, we adjusted the NPP based on the fraction of area that is under development. The total NPP lost due to development is estimated to be 0.058 Gt/yr or 2.2%.



Results (preliminary)

We found the onset of greenness is earlier in urban areas by 2-7 days. The reason for such an advancement is found to be enhanced temperatures as a result of urbanization. The fraction of vegetation cover is a significant factor in controlling the phenological differences. Areas with low fractional cover (high development) showed the earliest onset of greenness in urban areas.



Phenological and vegetation differences between urban and Deciduous Broadleaf Forest (DBF) land covers. Panels show, for all 1° latitude by 1° longitude blocks with statistically different growing season length between urban and DBF regions, the within block difference of: (A) onset of greenness, (B) fractional cover, and (C) normalized difference vegetation index amplitude.

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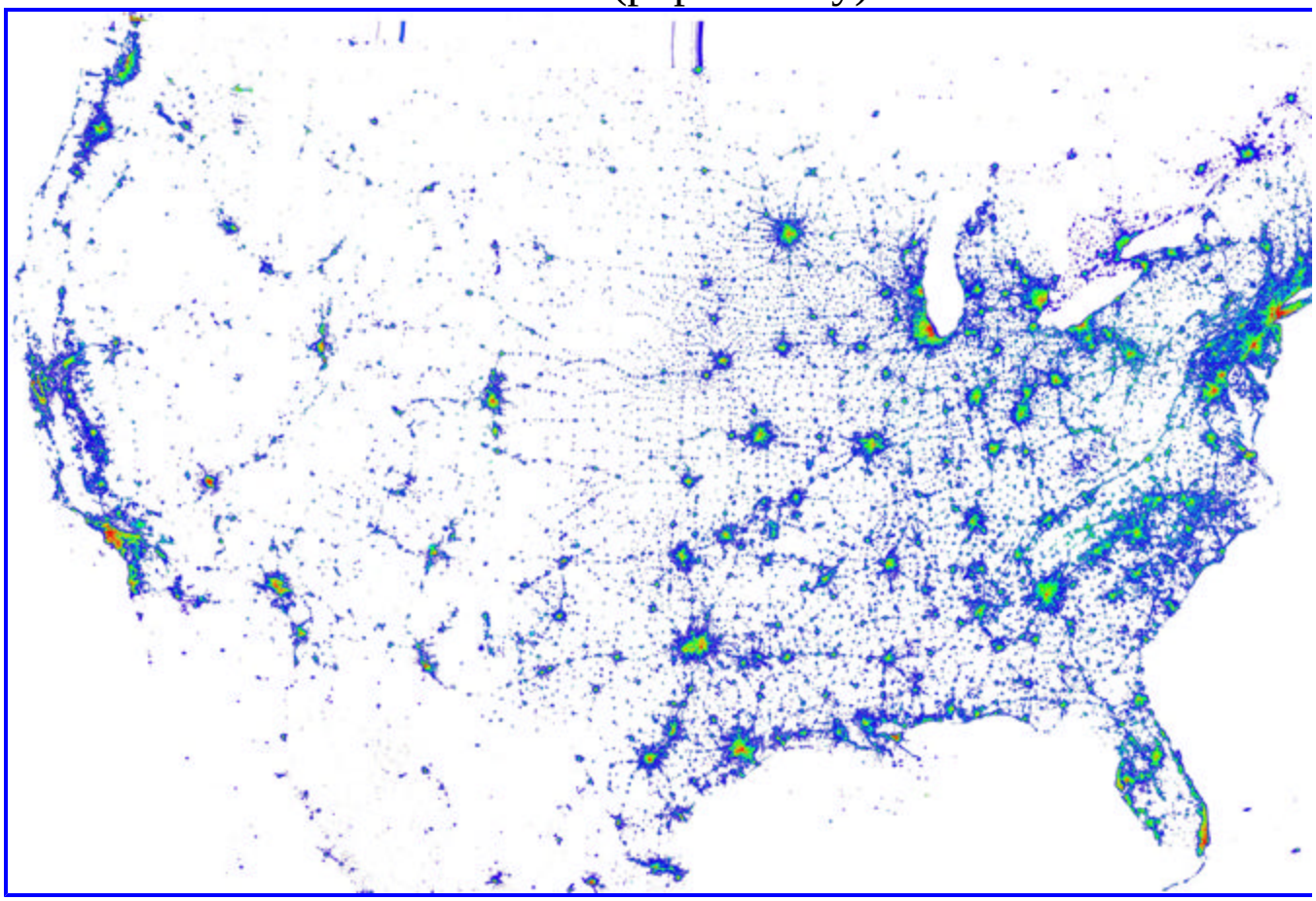
Results (preliminary)

Preliminary calibration developed to estimate the percent cover of development:

Development % = 0.3366 + 0.1757(radiance) + 0.0015(road density) + 0.0049(pop. density)



0% **Percent Development** >60%

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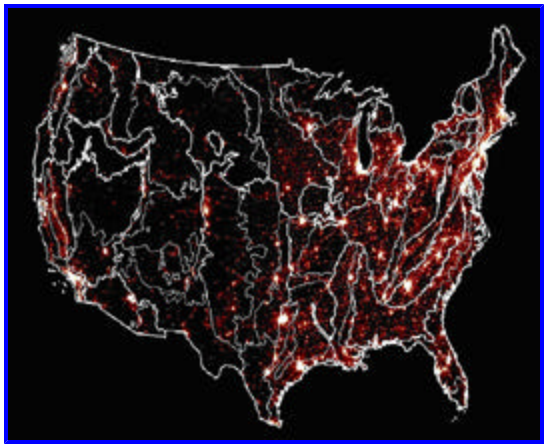
Research Approach / Methods (continued)

We are using the BIOME-BGC and RHESSys ecosystem model, and AVHRR NDVI time series to analyze the carbon dynamics of the US with and without the current level of development.
While satellite derived measures such as NDVI cannot quantify the carbon fluxes, they are useful to study the changes in land surface dynamics as a result of development. To study such changes, we used AVHRR NDVI over the east coast of the U.S. with predominantly broadleaf forest canopies. For each 1x1 degree area, we calculated the onset of greenness for urban and rural areas. The onset of greenness is strongly related to carbon sequestration potential.

We ran the ecosystem model, BGC, using the eco-regions of the continental U.S as a template. The conterminous U.S is divided into 84 eco-regions. These eco-regions represent similar conditions of climate, vegetation, topography and soil conditions. For each ecoregion, we developed a set of daily climate data covering 18 years (1980-1997), dominant land cover from MRLC, dominant soil properties and topography. For each eco-region, we ran the BGC model to compute net primary production.



Distribution of eco-regions around the continental U.S super-imposed on night lights data showing the level of urbanization.

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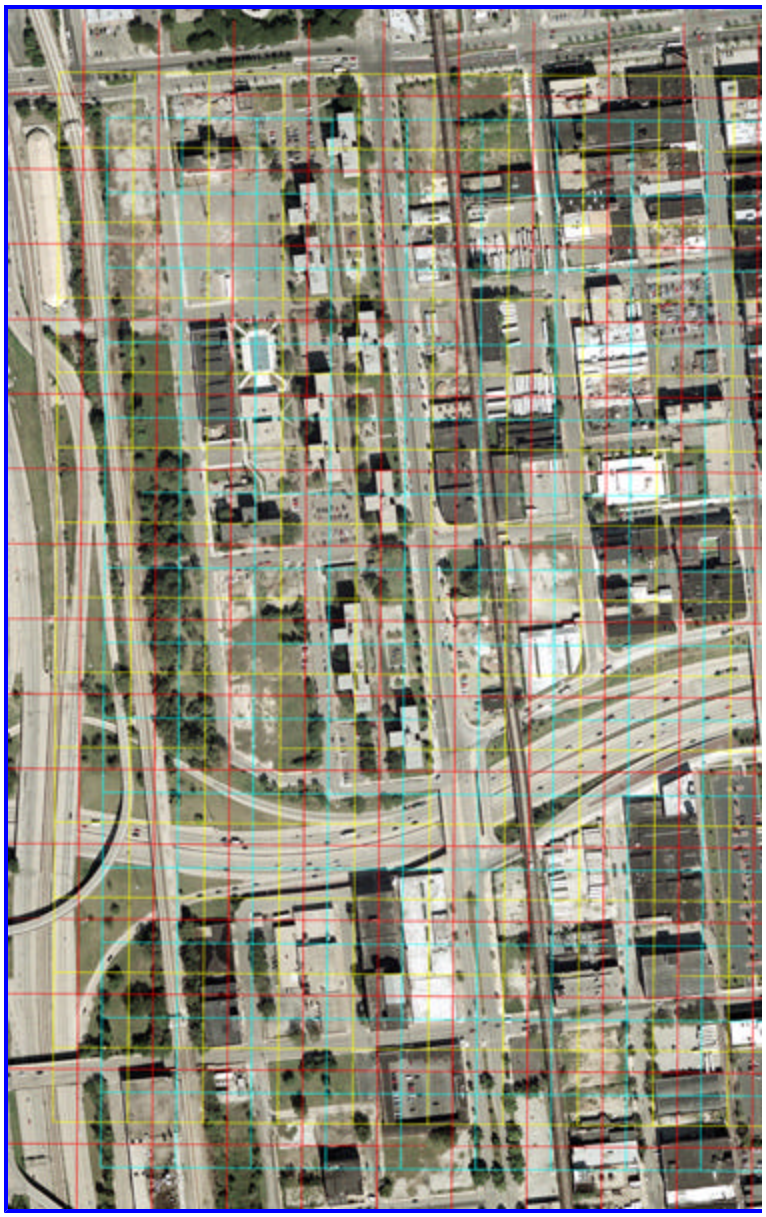
Research Approach / Methods (continued)

For calibration, development, lawn and tree cover are being measured directly in a subsample of the area using aerial photography (1998-00) acquired along transects crossing major metropolitan areas in each region of the country. Each photo tile covers a 1Km Albers Equal Area grid cell.



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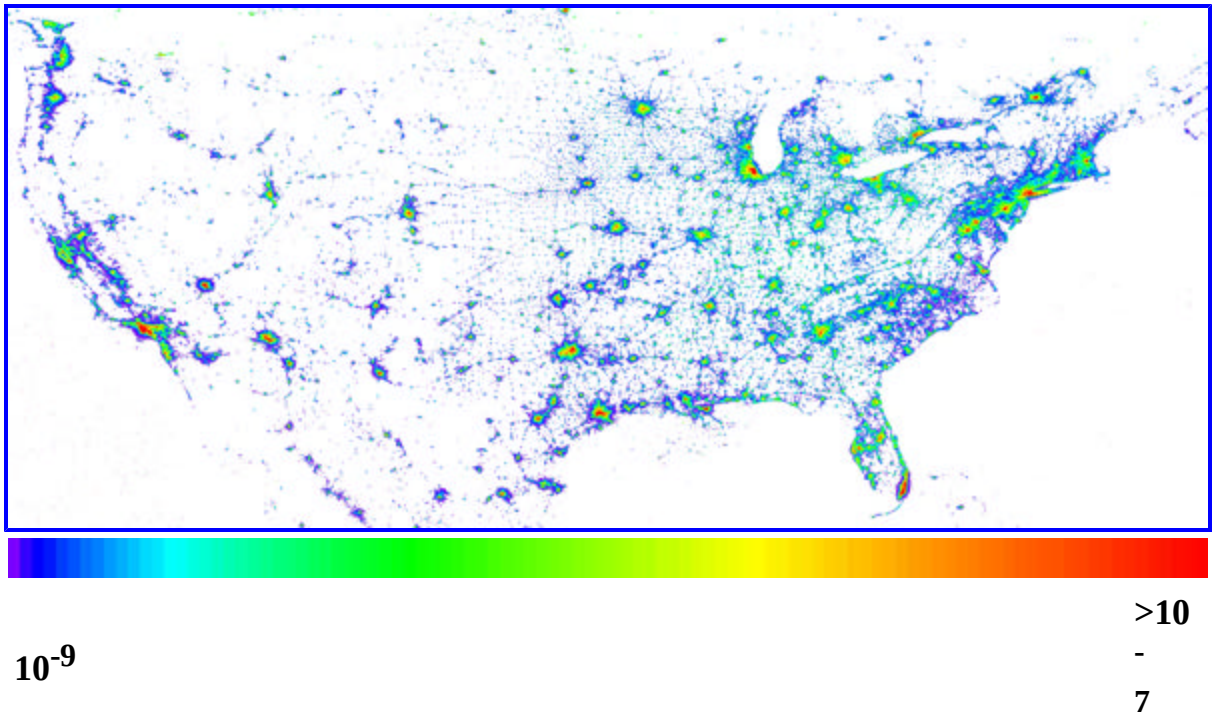
Research Approach / Methods (continued)

Radiance Calibrated Nighttime Lights (1999-2000)



Radiance (watts/cm^2/sr/um)

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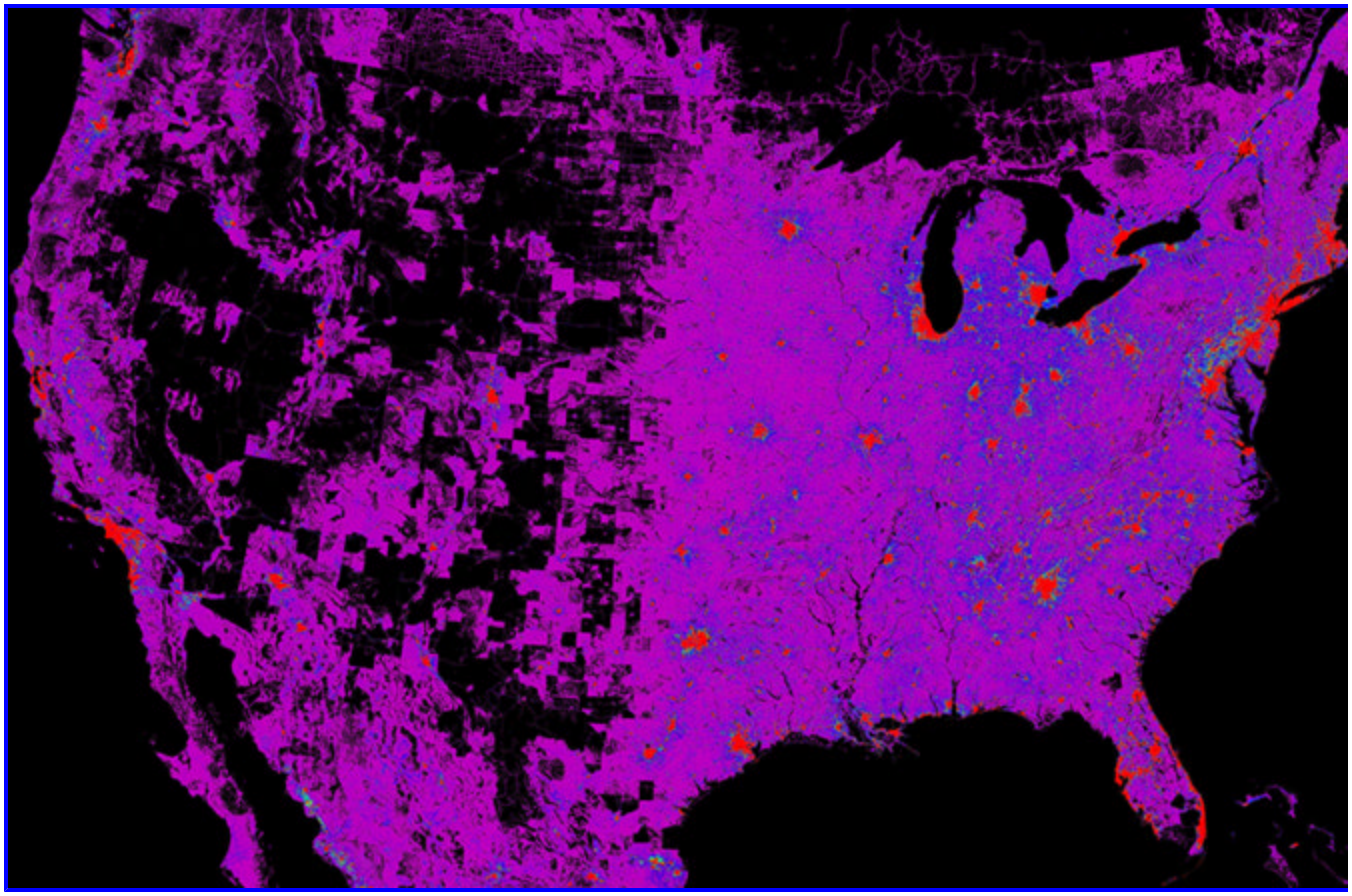
Research Approach / Methods (continued)

DOE Landscan Population Density



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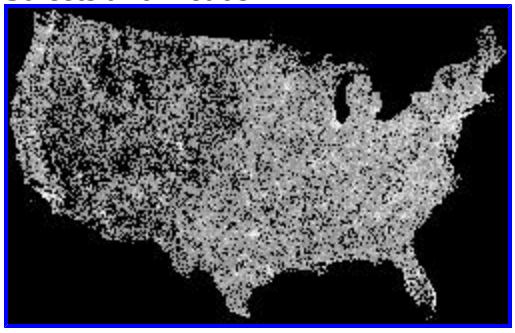
Research Approach / Methods (continued)

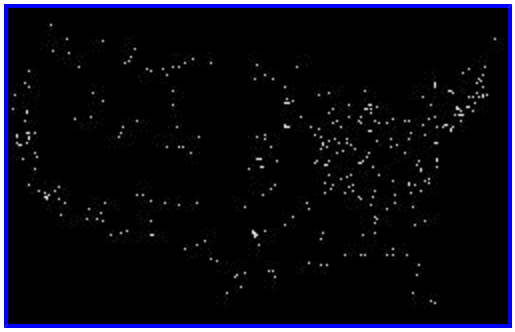
Road density of the USA

Streets and Roads

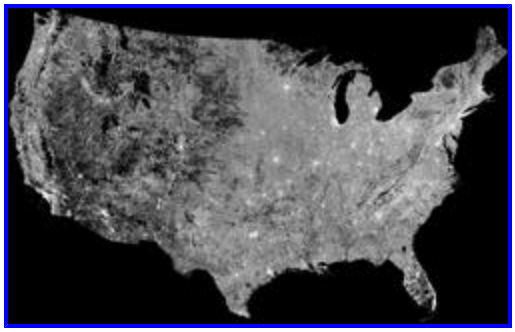


Major Roads

Interstates



Total



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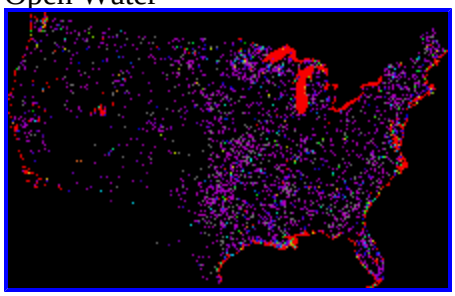
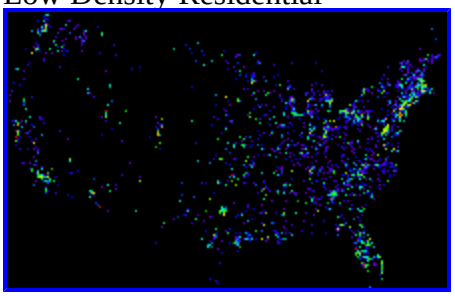
Research Approach / Methods (continued)

MRLC Land Cover from Landsat TM - all 21 classes

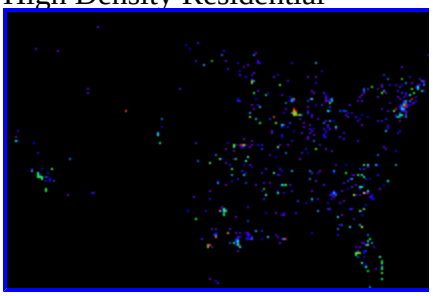
Class 11 - Open Water



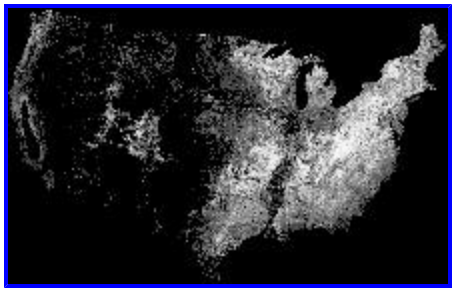
Class 21 - Low Density Residential



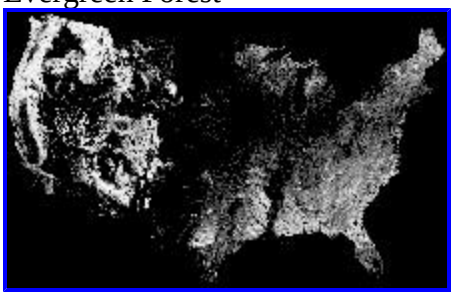
Class 22 - High Density Residential



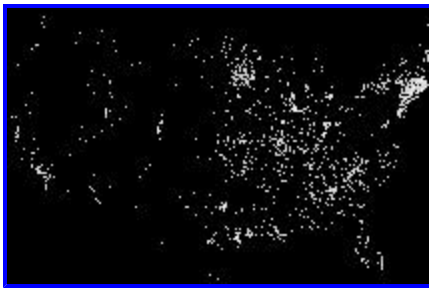
Class 41 - Deciduous Forest



Class 42 - Evergreen Forest



Class 85 - Urban/Recreational Grasses



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Research Approach / Methods

We are using multiple sources of data to generate a one km land cover grid of the USA with specific estimates of the percent cover of constructed materials, lawn and trees/shrubs within developed areas. The national 1 km Albers Equal Area data sets we have used include:

1) regridded 30 meter land cover from Landsat TM (MRLC),
2) radiance calibrated nighttime lights from the DMSP-OLS,
3) road density derived from the U.S. Census Bureau TIGER data, and
4) DOE Landscan population density data.

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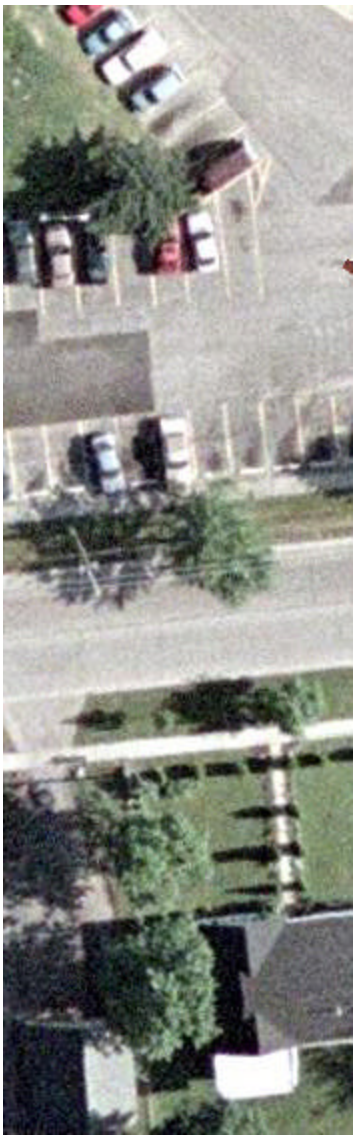
Objectives

To analyze the impacts of development on the terrestrial carbon dynamics of the 48 states.

The impact will analyzed by comparing ecosystem model runs made using land cover data with and without the current level of development. Surfaces covered by constructed materials (roads, buildings, etc.) are withdrawn from photosynthesis and respiration. This loss is counterbalanced to some extent by managed vegetation (lawns, trees, etc.), which may be irrigated and fertilized. Unlike other types of disturbances, development typically does not have a recovery phase. Other disturbances such as deforestation have a demonstrable effect on terrestrial carbon dynamics. We will evaluate the impact development has on terrestrial carbon dynamics, and how this effect varies spatially. This information should be useful for improving our understanding, modeling and prediction of the global carbon cycle and the build up of carbon dioxide in the atmosphere.



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Development Sprawl Impacts on the Terrestrial Carbon Dynamics of the United States

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