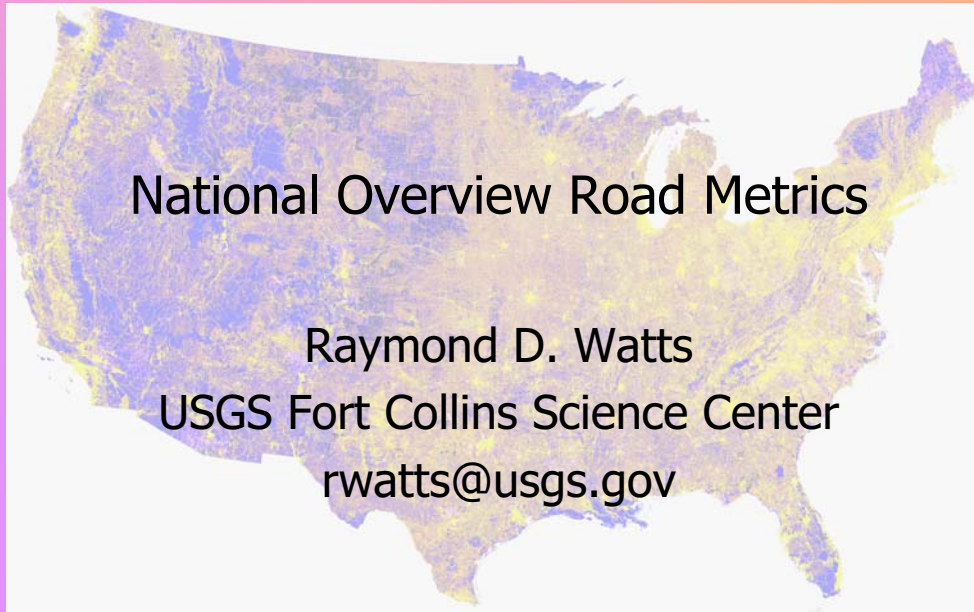

USGS NATIONAL OVERVIEW ROAD METRICS

Raymond D. Watts

United States Geological Survey
USGS Fort Collins Science Center

The road network of North America has over 6.5 million km of roads, is the largest construction on Earth, and provides easy means for access to nearly every part of the American landscape. Humans using roads bring invasive species with them, so there is much to learn about road-induced exposure risk. One approach to these studies is development and application of *indicators*, which summarize the relative status of roads and of the intervening open space, providing a basis for comparison between places and times. It is helpful to design indicator datasets so they can be used easily with other datasets; a first indicator, the *National Overview Road Metrics Euclidean Distance* (NORM ED) dataset has been designed for ready use with the National Land Cover Dataset (NLCD). NORM ED gives distance to the nearest road at 30 meter intervals across the nation in an Albers Equal Area projection. USGS is working on more complex indicators at lower resolution (1 km), and has discovered that there is a strong correlation between road-derived indicators and ecoregions. USGS would like to work with other agencies to apply metrics as they are developed and to develop new metrics, particularly for application to management of resources on public lands.

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National Overview Road Metrics

Raymond D. Watts

USGS Fort Collins Science Center

rwatts@usgs.gov

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The Most Invasive Species

- Humans occupy every terrestrial environment
- Humans are vectors for most exotic species
 - Intentionally...followed by spread:
 - Tamarisk
 - Africanized bees
 - Unintentionally...followed by spread:
 - Smallpox
 - Dutch elm disease





Can we ignore human process?

- Humans move organisms around the world in hours
- On continents, roads are the least monitored of transportation systems
- Organisms cross continents in days



North America's Road Network

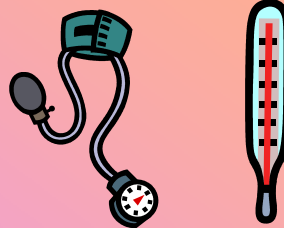
- World's largest construction
- 6.5 million km of documented, publicly accessible roads
- Unknown private roads and tracks, such as OHV routes





National Overview Road Metrics

- Indicators summarize condition and changes
- Parallels:
 - Medicine:
 - Temperature
 - Blood pressure
 - Economy:
 - Gross Domestic Product
 - Cost of Living Index
 - S&P 500 Index

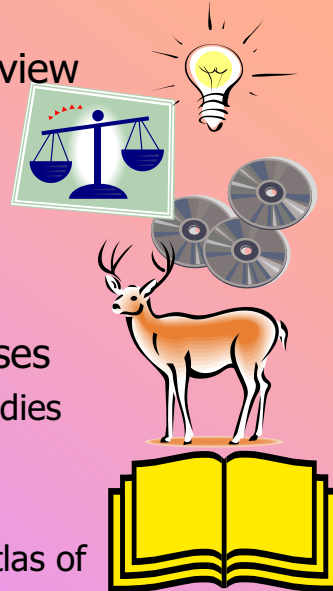


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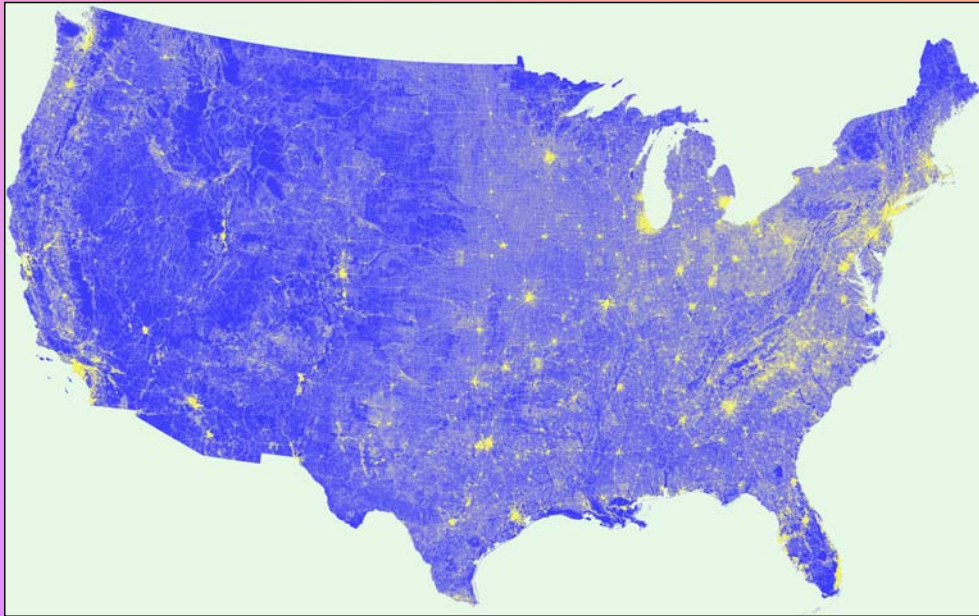
The Road Indicator Project

- Invent indicators (National Overview Road Metrics = NORM)
- Assess the value of indicators
- Develop datasets
- Apply datasets in analyses
- Couple NORM metrics to processes
 - Road/traffic/wildlife interaction studies in Yellowstone and Colorado
- Publish visual products
 - Geographic Face of the Nation: Atlas of Open Space of the United States





The classic: Road Density

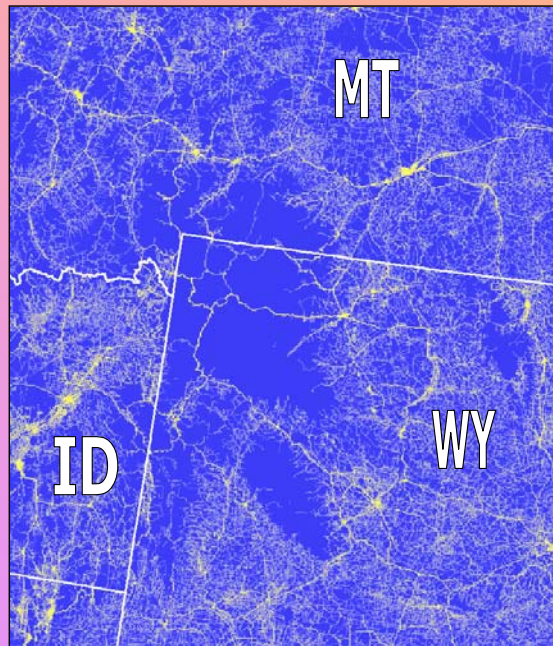


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Road Density

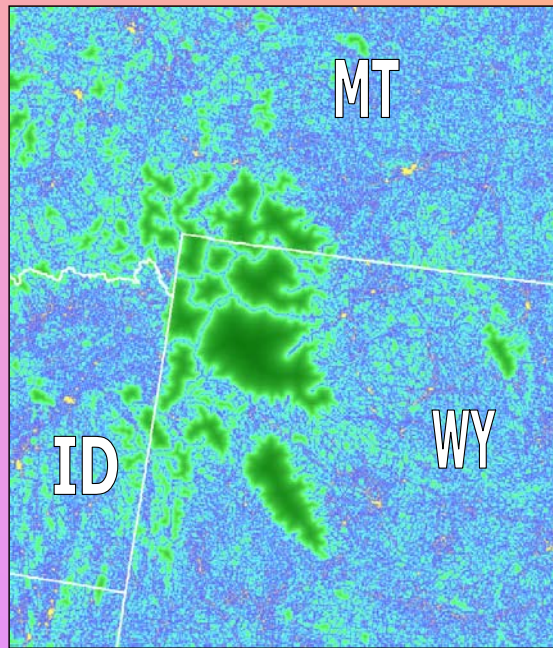
- Yellowstone Area
- Note insensitivity to remoteness
- This is a problem with Road Density as an environmental indicator





Distance to Nearest Road (ED)

- Yellowstone Area
- ED = Euclidean Distance (to nearest road)
- Units = m or km
- Note sensitivity to remoteness
- This is a more robust environmental indicator than road density



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ED Measures Open Space

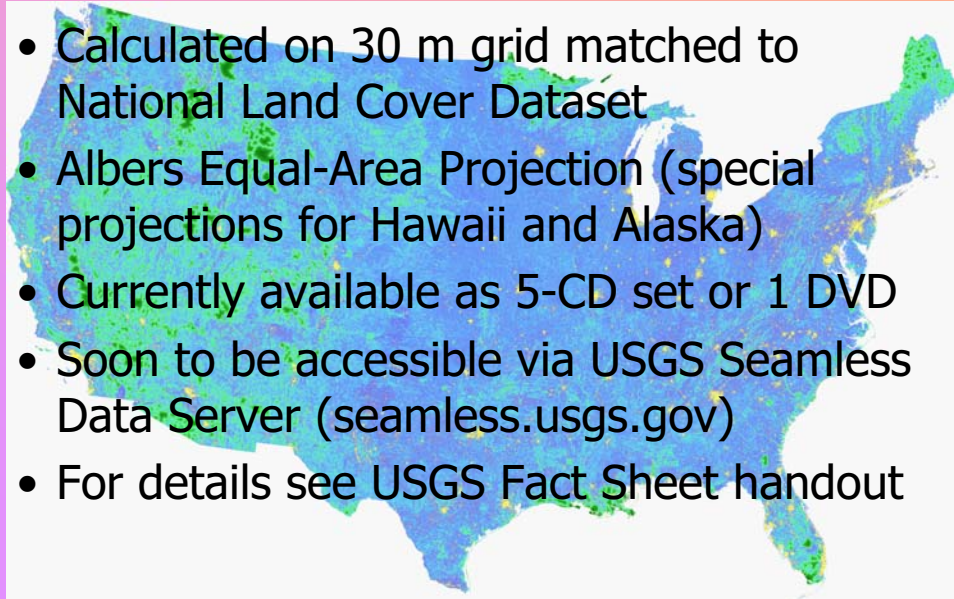
- ED rendered as topography
- The volume of the topography is "roadless volume"
- $\text{Roadless volume} \div \text{base area} = \text{mean distance to road}$
- This video has actual road pattern 1937, 57, 77, 97
- Change is random between these dates





NORM ED dataset

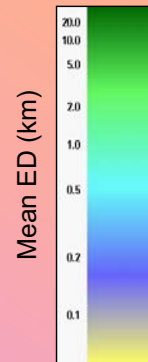
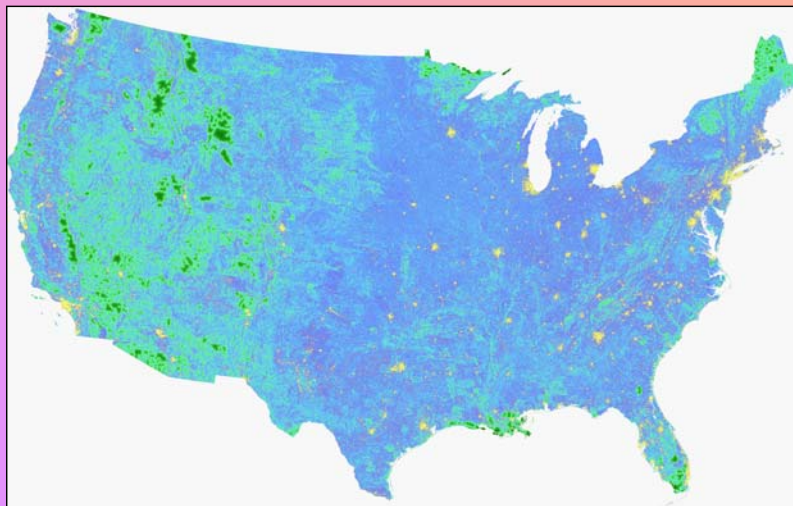
- Calculated on 30 m grid matched to National Land Cover Dataset
- Albers Equal-Area Projection (special projections for Hawaii and Alaska)
- Currently available as 5-CD set or 1 DVD
- Soon to be accessible via USGS Seamless Data Server (seamless.usgs.gov)
- For details see USGS Fact Sheet handout



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Euclidean Distance (ED)

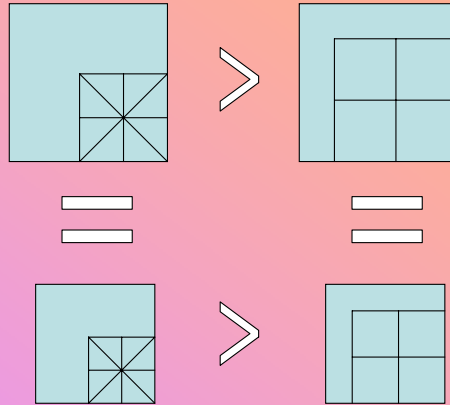


ED averaged over 1 km squares
Maximum ED = 30 km (20 mi)



Composite Indicators

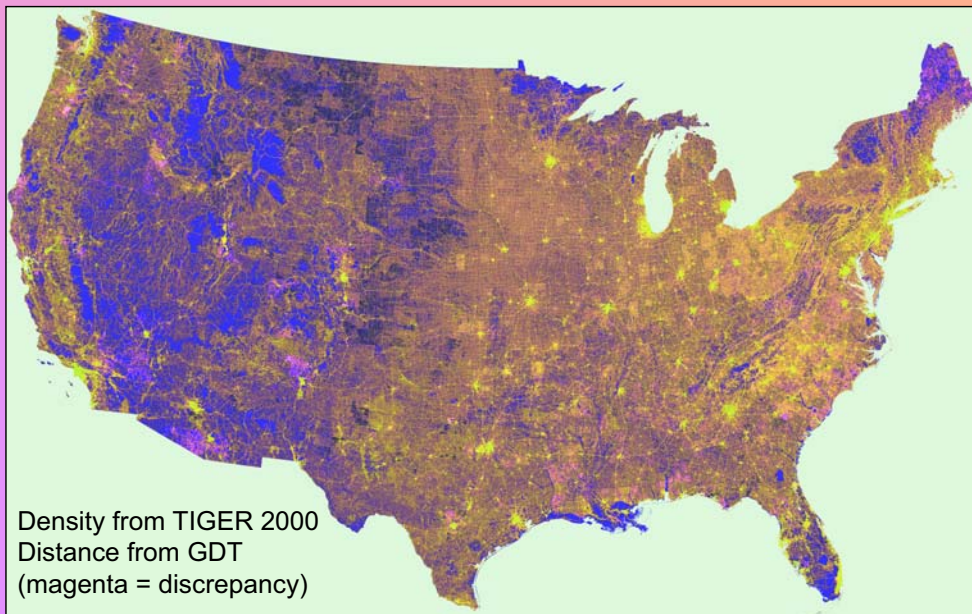
- Heterogeneous Distribution Index (HEDI)
- Product of road density * ED
- Dimensionless
- HEDI increases when roads are isolated



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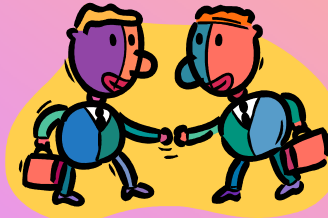
HEDI – Density - ED



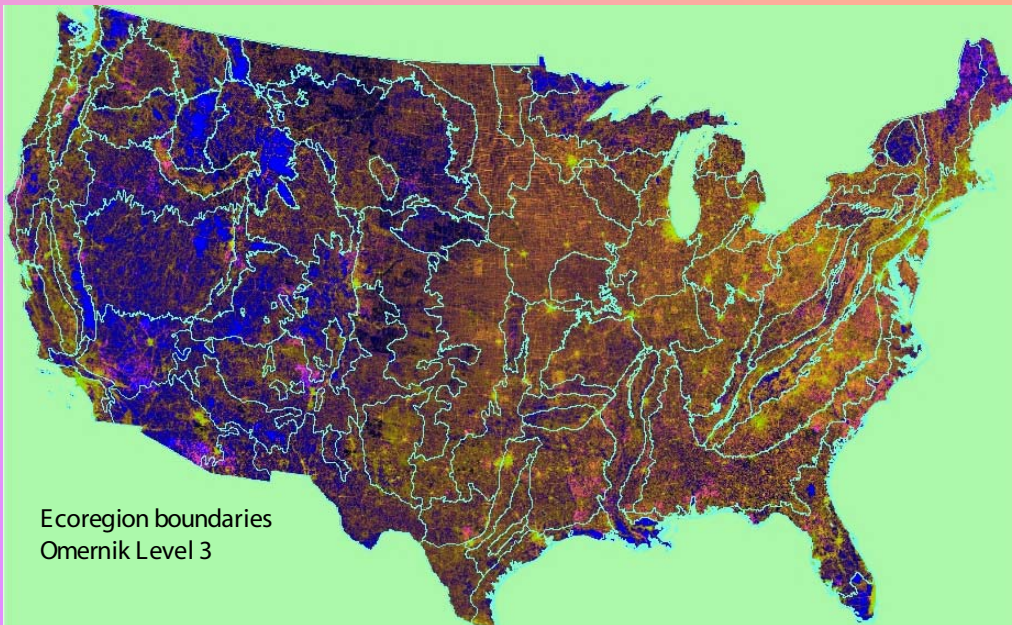


Difficulties

- There is no authoritative national road dataset
- Scientists and managers think of people as separate from ecosystems, so don't "think roads"
- So many interesting problems, so little time (and personnel)
- Scant funding; cooperative research is welcome!



Roads Reflect Ecoregions



Ecoregion boundaries
Omerik Level 3

