

Geospatial Science and Technology for Bioenergy

Modeling the Sustainability of the National Bioenergy Infrastructure

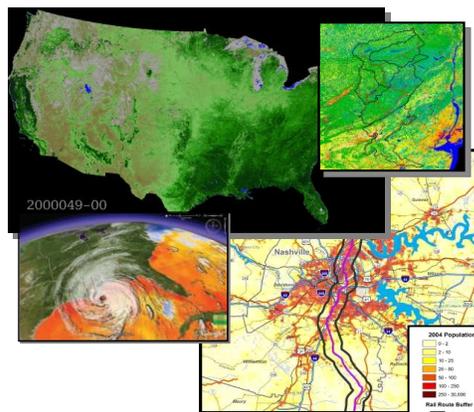
The Challenge

Developing an optimized large-scale supply chain infrastructure to meet U.S. demands for bioenergy and bio-products is a major challenge for the coming decades. The bioenergy supply chain, from crop to customer, is a spatiotemporal process, and geospatial science provides key technology for advancing the state of the art in bioenergy infrastructure analysis and modeling. This includes geospatially integrated modeling to assess feedstock production, feedstock transportation and biorefinery location, distribution of ethanol, and micro-spatial modeling of end-user demand.

Geospatial Science and Technology based Modeling

As a world leader in geospatial science and technology for scientific and technological missions, ORNL has strong research programs in geographic information science, development and applications of Geospatial Information Systems, image analysis and applications of remote sensing, and geospatial data services. With High Performance Computing (HPC), global geospatial data assets, and advanced visualization, ORNL addresses bioenergy research and development issues including:

- Feasibility of sustainably producing biofuels
- Reliability of biofuel production and distribution
- Security of managing a spatially distributed energy source (i.e., biocrops), including threats from climate change and extreme climate events
- Agility of bioenergy infrastructure to adapt to changing demand and production
- Interdependencies of bioenergy with other energy (electric, oil, and gas) and critical infrastructures (such as agriculture, transportation, water, and commerce)



Relevant Capabilities and Ongoing Activities

Biomass Production: Remote sensing data analysis and geospatial integration and modeling of multidimensional, multi-resolution, and multidisciplinary experimental (Sun Grant Initiatives), observation (space and airborne imagery), and simulation data for biomass health and distribution and feedstock production feasibility assessments.

Bioenergy Environmental Sustainability: ORNL is developing parallel geocomputing and visualization approaches to advance assessment using hydrologic models (Soil Water Assessment Tool) from local to regional scales and to design optimal landscapes for biofuel production.

Biomass and Bioenergy Delivery: With unique expertise in the development of high resolution population (LandScan and LandScan USA) and transportation network data (particularly rail, responsible for ~75% of biofuel transport), and routing models (Transportation Routing Analysis GIS), ORNL employs multimodal commodity transportation analysis to develop comprehensive and robust algorithms for geographically scalable, space-time optimization for the bioenergy supply chain.

Bioenergy Security: ORNL is developing novel data mining and pattern recognition approaches for fusion and exploitation of large geospatial-temporal databases to enhance understanding of biomass response to short- and long-term climatic trends and disturbances including droughts, floods, plant diseases, and pest infestations.

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