

## **Sustaining Geospatial Science and Technology at Cornell University\***

Geospatial data and information are essential to advancing the sciences, and their importance is only anticipated to increase in the coming years. Broadly defined, geospatial data are quantitative and qualitative values that represent facts and measured observations of the environment, referenced to the Earth's surface and are therefore amenable to spatially-explicit inquiry, mapping, and modeling. When these data are combined with co-variates, we can pursue essentially a limitless extent of spatial analyses within the context of geographic information systems (GIS), image processing, and statistical computing environments. Geospatial information science and technology (GIS&T) represents the field of study that advances knowledge about the acquisition, processing, and analysis of geospatial data to meet the information needs of scientists, resource managers, and policy analysts.

Students graduating from Cornell are already expected to have some knowledge and skills in geospatial science and their related technologies, including GIS, and this demand will only increase. Currently, some majors require a subset of courses in GIS&T, and others are likely to make such knowledge and skills a foundational component in the future. Graduate student research in agricultural, environmental, and social sciences increasingly includes GIS and image processing as an important data analytical approach. We expect this trend to continue and anticipate that the demand for GIS research support will escalate, particularly among graduate students but within undergraduate cohorts as well.

Given the relatively limited resources in place on campus, even a moderate increase in demand in GIS&T by a broader range of graduate fields and concentrations may exceed the existing available capacity for courses, faculty resources, and research support. The widely distributed nature of GIS at Cornell reflects the teaching, research, and extension activities consistent with the fulfillment of our land grant mission. Expertise in and usage of GIS&T is dispersed across campus in several academic departments, and five colleges, including but not limited to: Applied Economics and Management (AEM), Animal Science (ANSCI), Biological and Environmental Engineering (BEE), City and Regional Planning (CRP), Civil and Environmental Engineering (CEE), Classics (CLASS), Crop and Soil Sciences (CSS), Development Sociology (DSOC), Earth and Atmospheric Sciences (EAS), Ecology and Evolutionary Biology (BIOEE), Economics (ECON), Entomology (ENTOM), Food Science (FDSC), Government (GOVT), Industrial and Labor Relations (ILR), Landscape Architecture (LA), Natural Resources (NTRES), Policy Analysis and Management (PAM), Astronomy (ASTRO), and Nutritional Sciences (DNS). Given developments in the availability of spatially-referenced data from a variety of sources, including crowd sourcing and Internet-based accession and processing, other departments with an interest in and the capability to process such data may also move to having GIS play a more prominent role in their instruction, research, and extension programs, such as Biological Statistics and Computational Biology (BSCB) and Communication (COMM).

Although Cornell lacks a geography department, where instruction and research are often concentrated at peer institutions, our broad pattern of GIS&T usage is consistent with an institution of our size and areas of expertise. However, many similar institutions, whether they

have a geography department or not, have made efforts to coordinate and sometimes consolidate leadership and institutional support for GIS instruction, research, and extension. Harvard's Center for Geographical Analysis (<http://gis.harvard.edu/>), University of Minnesota's USpatial Center (<https://uspatial.umn.edu/>), the GIS Center at Tufts (<http://sites.tufts.edu/gis/>), and the Geospatial Centroid at Colorado State (<http://gis.colostate.edu/>) are examples of successful approaches at centralizing campus research and instructional support. Other institutions, such as Duke (<http://library.duke.edu/data/>), Yale (<http://guides.library.yale.edu/gis>), and Stanford (<http://lib.stanford.edu/gis/>) have established their libraries as the central venue for research and instructional support.

To date, Cornell has also pursued a library-based effort for institutional geospatial support. Mann Library serves as a centralized source of GIS&T information and support for Cornell faculty, students, and staff, primarily through the Cornell University Geospatial Information Repository (CUGIR), staff with geospatial expertise, and computer classrooms with required software resources for both undergraduate and graduate level courses (<http://mannlib.cornell.edu/research-help/gis>). In addition, the Maps & Geospatial Information Collection and Services in Olin Library offers instruction, consultation, and geospatial data access services. However, related and additional activities continue to operate across various other units, including the Institute for Resource Information Sciences (IRIS), the Cornell Institute for Social and Economic Research (CISER), and the Cornell Statistical Consulting Unit (CSCU). Our lack of institution-wide coordination and collaboration in areas of research, teaching, extension, and other campus-oriented activities, is a limiting factor in our efforts to promote and support existing and future geospatial demands. This manifests itself in inefficiencies, misinformation, and missed opportunities as we seek to address potential shortcomings and/or redundancies of local expertise, as well hardware and software resources to meet the steady but growing demand by instructors and students.

For example, given the diversity and dispersion of GIS expertise, interdepartmental coordination in faculty and staff hiring would help ensure that existing and foreseeable curricular needs are met and that expertise for research and extension support is available. CALS currently has faculty searches in BEE and DSOC in areas that will likely integrate GIS&T. In addition, future search requests in CSS and NTRES may require substantial geospatial expertise and responsibility. Based on the growing demand for computing classrooms, both centralized (e.g., Mann Library) and smaller satellite classroom and recurring software licenses for graduate level instruction and research are needed (e.g., 108 Bradfield Hall).

Improved inter-departmental coordination of course content and breadth, and support infrastructure that links GIS experts and provides support for teaching, research, and extension, will benefit the entire Cornell community. Such coordination and infrastructure support will play a critical role in bringing together faculty members who will continue to be distributed across departments. We believe this collaboration will enable faculty members to be more productive, improve efficient use of resources, and increase the visibility of GIS expertise outside of the university.

The table below is an initial summary of existing and anticipated GIS&T faculty, staff, and infrastructure needs. This information serves as background for the development of a coherent approach to meet geospatially focused instruction, research, and extension support needs for the foreseeable future. The table indicates academic units that provide expertise in important areas related to geospatial science and technology as well as potential subject areas in which these areas can provide inputs in the future.

**Table 1. Cornell Geospatial Science and Technology Faculty, Staff, and Infrastructure Needs**

Geospatial Topic	R/T/E	College/Division																
		AAP	AS	AS	CALS	CALS	CALS	CALS	CALS	CALS	CALS	CALS	CALS	CALS	CALS	CHE	ENG	NS
		CRP	GOVT	ASTRO	AEM	ANSCI	BEE	BSCB	COMM	CSS	DSOC	EAS	ENTOM	NTRES	LA	PAM	CEE	
Crowd Sourcing		F	F	N	N	N	N	F	F	N	F	N	N	N	F	F	F	F
Spatial Demographics		F	F	N	N	N	N	N	F	N	C	N	N	N	F	C	N	N
Geographic Information Systems		C	C	F	N	N	N	N	C	C	F	F	F	F	F	F	F	F
Global Positioning Systems		C	N	N	N	N	N	N	C	N	F	N	F	N	N	N	N	F
Internet Sourcing & Web Mapping		C	F	N	N	N	N	F	C	F	C	F	F	N	F	C	F	
LIDAR		N	N	N	N	N	N	N	F	N	N	N	N	N	N	C	N	
Inventory & Mapping		C	N	F	N	N	N	N	C	N	N	N	F	N	N	N	N	
Precision Agriculture		N	N	N	N	F	N	N	C	N	N	N	N	N	N	N	N	
Remote Sensing		N	N	F	N	N	N	N	C	N	C	N	N	N	N	C	F	
Spatial Modeling		C	C	N	F	N	C	F	N	C	C	F	C	N	C	N	F	
Spatial Statistics		N	N	N	F	N	F	F	N	C	C	C	F	C	N	C	C	
Big Data		N	N	F	F	N	F	F	N	F	F	F	F	F	N	F	F	
Unmanned Aerial Systems (UAS)		N	N	N	N	N	N	N	N	F	N	F	C	N	N	N	F	

Table codes:

- C = current course offerings
- F = possible future course offerings
- N = future course offerings not probable
- R = research
- T = teaching
- E = extension/outreach

As one step to begin to bring together the GIS&T community at Cornell, we propose to hold a one-day geospatial forum on campus on Tuesday, October 14, 2014. At this event we will hear from individuals involved with campus GIS activities, discuss potential models to consider for future GIS&T support, and share highlights of the current and innovative GIS&T-support projects underway. We believe that through such events held annually we can clarify the needs of this community, encourage further coordination and collaboration, and marshal sustained institutional support as we share our geospatial knowledge and information with the Cornell and global community.

\* Original briefing paper prepared September 2013 by D. Brown (Development Sociology), D. Decker (Natural Resources), S. DeGloria (Crop and Soil Sciences), and T. Setter (Crop and Soil Sciences) at the request of Senior Associate Dean Max Pfeffer for Dean Katherine Boor, College of Agriculture and Life Sciences, Cornell University. Current version edited by S. DeGloria, J. Finkelstein (Division of Nutritional Sciences), Keith Jenkins (Mann Library) and D. Sinton (Crop and Soil Sciences), 26 August 2014.