The Role of the Spatial Sciences in the Modern Research University

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Outline

- Interdisciplinary spatial science
  - Background & timeline
  - Current organizational chart
  - Interdisciplinary degree opportunities
  - GIST Online Programs
  - GIS Research Laboratory
- My own work
  - Model spatial variability of UV radiation
  - Characterize relationship between UV exposure and melanoma risk
- Final comments

Background

- Systematic development of computational tools for handling spatial data began in 1960s
- Geographic information systems & software for image processing, pattern recognition, and scientific visualization are now in widespread use throughout academy
- Functions for manipulation, analysis, and modeling of spatial data available in standard statistical and mathematical packages
  - The ArcGIS toolbox has 750 such functions

Image Courtesy of Dean Gusch

USC timeline

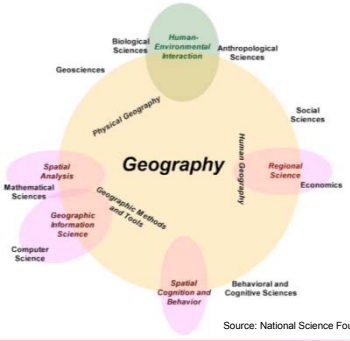
- GIS Research Laboratory established (08/97)
- GIST Online Graduate Programs launched (08/08)
- Geography Department UCAR review conducted (04/09)
- Spatial Science Faculty Advisory Committee established (08/09)
  - The College, Keck School of Medicine, School of Architecture, School of Policy, Planning and Development, School of Social Work, and Viterbi School of Engineering
- Interdisciplinary Spatial Science Proposal submitted (12/09)
- Spatial Sciences Institute established (7/10)
- AHF Building offices and labs occupied (12/10)

The opportunity (i.e. need) …

"The development of relevant theory and concepts, and the cultivating of spatial intelligence through education, has lagged far behind … and it is clear that a wide gap exists between the power and accessibility of tools on the one hand and the ability of researchers, students, and the general public to make effective use of them on the other."

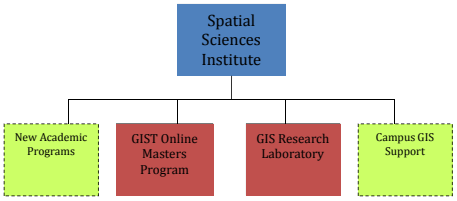
(Geography Department UCAR Committee Report, 2009)

Geography & Spatial Science



Source: National Science Foundation (2008)

Current organization chart …



Interdisciplinary Spatial Science B.A.

- Small core (22 units)
  - Fundamentals of design communication
  - Introduction to geographic information systems
  - Principles of geographic information science
  - Principles of remote sensing
  - GIS design & applications
  - Geographic information systems & planning applications
- Computing, Planning & Design, and Quantitative Analysis tracks (14 units)

Interdisciplinary Spatial Science Ph.D.

- Five core courses
  - Fundamentals of spatial thinking
  - Principles of spatial analysis
  - Geospatial information management
  - Geocomputation
  - Current topics in spatial science
- Spatial science doctoral certificate program
- New spatial science doctoral program sponsored by College & Keck School of Medicine?
- NSF IGERT Grant proposal (3/10)
- NIH Training Grant proposal (01/11)

GIST Online Programs

- M.S. & Graduate Certificate programs
- Nine semester courses
  - Concepts for spatial thinking
  - Spatial databases
  - Spatial analysis & modeling
  - Geospatial project management
  - GIS programming & customization
  - GPS/GIS field techniques
  - Remote sensing for GIS
  - Cartography & visualization
  - Web GIS
- Embanet-Compass partnership

GIS Research Laboratory

- Research enterprise with its own faculty and professional staff
- Designated ESRI Development Center
- Builds and supports geospatial web services
- Manages campus site licenses & supports a variety of geospatial software tools

Publication venues (2007 to present)

- *Geomorpholo…*
- *Earthquake Sp…*
- *Journal of Inse… Conservation*
- *GeoJournal*
- *Computers, En… Urban System…*
- *International … Geographical … Science (3)*
- *Environmental Modeling & Software*
- *Natural Hazards*
- *…al Journal of …graphics*
- *…ce & Medicine*
- *…ce Processes & …*
- *…nsing of …nt …& Remote Sensing*
- *Hydrological Processes*

Key attributes

- *Collaboration with students*
- *Diverse funding sources*
- *Interdisciplinary in character*
- *International in scope*
- *Seamlessly blends teaching, research and service*

Melanoma risk …

- Collaborative research with Myles Cockburn (Keck School of Medicine) and Zaria Tatalovich (NCI)
- One of most rapidly increasing cancers among white population in U.S.
- Studies consistently point to UV exposure as most important risk factor
- Individual sun exposure has proved difficult to quantify
- Initial research question …
  - How well can we model spatial variations in UV radiation given measurement network & interpolation techniques available (in 2005)?

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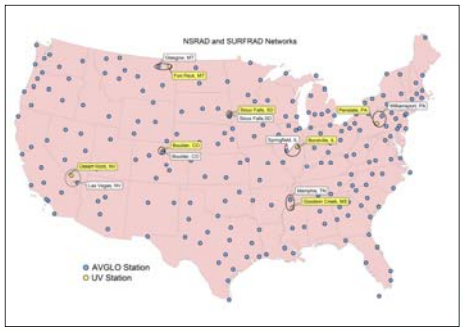
Measurement network



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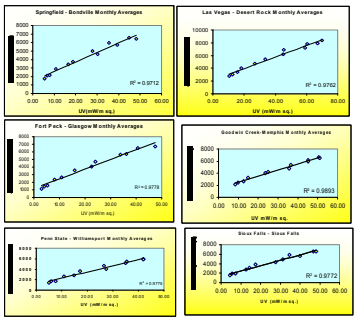
Radiation data correlations



Springfield – Bondville, IL
Las Vegas – Desert Rock, NV
Boulder – Boulder, CO
Fort Peck – Glasgow, MT
Goldwin Creek – Memphis, TN
Penn State – Williamsport, PA
Sioux Falls – Sioux Falls, SD

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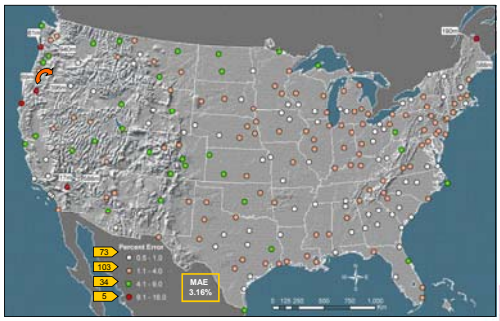
Thiessen polygon error map



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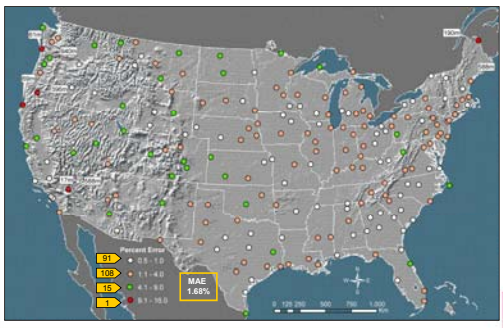
Kriging error map



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Spline error map

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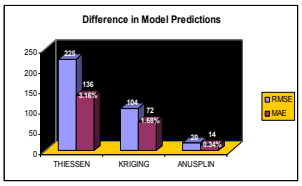
Model differences

- Spline predictions 11 & 2.2 times better than Thiessen polygon & kriging predictions
- ANUSPLIN …
  - Smallest RMSE, MAE & VE
  - Highest R (observed / predicted)
  - Smallest R (observed / error)



	RMSE	MAE	VE	Correlation OBS/PRED	Correlation OBS/ERR
THIESSEN	225	136 (3.16%)	50906	0.90	0.40
KRIGING	104	72 (1.68%)	10885	0.98	0.31
ANUSPLIN	**20**	**14 (0.34%)**	**384**	**0.99**	**0.15**

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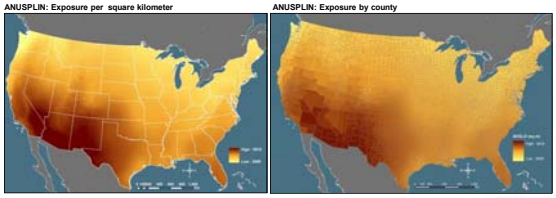
ANSPLIN UV exposure model

- Used Arc/Info GRID tools to calculate zonal means
- Generated map of UV exposures by county



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Case-control dataset

- Los Angeles County Cancer Surveillance Program
  - 820 melanoma cases among white, non-Hispanic residents < 65 years
  - Cases older than 65 yrs excluded to minimize recall bias of events occurring in young age
  - Controls included 877 individuals who lived nearby and that were matched to cases for ethnicity, age, and gender
- Structured interviews
  - Residential history from birth to time of interview recorded as county or country of residence (if outside USA)
  - Time spent at each residence reported in years
  - Time spent in outdoor activity (average number of days per year of outdoor activity during age periods 15-24, 24-44, >44 years of age)

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Statistical analysis

- Second research question …
  - How is the incidence of melanoma connected to place of residence and time spent outdoors?
- Conditional logistic regression used to estimate odds ratios for melanoma
  - Cumulative lifetime exposure categorized using four classes (<150,000, 150-200,000, 200-250,000, >250,000 Wh/m²)
  - Analysis of time spent in outdoor activity used 3 age-specific categories (15-24, 24-44, >45 yrs) because exposure at young age is thought to be important
  - Self-reported time spent in outdoor activity categorized using four classes (0-50, 51-100, 101-200, >200 days per year)
  - Examined 45+ yrs age group because younger adults have less chance for exposure and we controlled for the matching variables of age, sex and socio-economic status

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Cumulative UV exposure

Cumulative exposure (Wh/m²)	Case-control	OR
< 150,000	118/143	1
150,000-200,000	160/174	1.62
200,000-250,000	168/201	2.64
> 250,000	215/191	6.01
p-Value		< 0.0001

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Annual average UV exposure

45+ years	Case-control	OR	*p*-Value
Average annual exposure 15-24 years			
< 4,043	92/122	1	
4,043-4,840	107/124	1.23	
> 250,000	215/191	1.74	0.0209 (0.0060)
Average annual exposure 25-44 years			
< 4,736	67/122	1	
4,736-5,080	121/116	1.91	
> 5,080	153/131	2.29	0.0002 (0.0001)
Average annual exposure 44+ years			
< 5,080	31/43	1	
> 5,080	310/326	1.20	0.48

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UV adjusted time spent outdoors

45+ years	Case-control	OR	*p*-Value
UV adjusted outdoor 15-24 years			
< 558,800	90/121	1	
558,800-1,042,671	123/124	1.33	
> 1,042,671	122/122	1.55	0.0955 (0.0333)
UV adjusted outdoors 25-44 years			
< 294,330	110/120	1	
294,330-645,333	125/125	1.91	
> 645,333	105/121	0.99	0.74 (0.61)
UV adjusted outdoor 44+ years			
< 299,720	123/121	1	
299,720-609,600	99/120	0.86	
> 609,600	116/127	0.91	0.74

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New work (geocomputation) …

- Collaborative work with JC Chen in Keck School of Medicine looking at relationship between cognitive decline and light exposure
- National study tracing health of 7,500 women spread across 22 states
- Subjects undergo cognitive function testing annually (at 40 clinical centers from 1993 onwards)
- We plan to calculate mean solar light exposures for 0.5, 1, 3, 6 & 12 month intervals preceding each annual test and look for statistically significant associations

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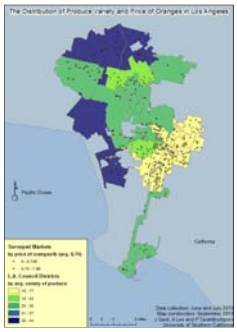
Location, location, location …



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One Final Map …

http://johomaps.com/world/worldsouth.html

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