Space-adjusting Technologies
and the Social Ecologies of Place

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Reflections on Geographic Information Science
Session in Honor of Michael Goodchild

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<th>Space-adjusting technologies</th>
<th>Human Extensibility</th>
<th>Social Ecologies of Place</th>
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- Paths & networks (telegraph, land-based telephone, cable, email)
- Spatially-extensive (print media, radio, television)
- Online transaction (e-commerce, social networks)
- Mobile/smart phone
- Location-based services (LBS)
- Surveillance & tracking (digital cameras, GPS)
- Volunteered Geographic Information (VGI)

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Social Ecologies of Place
Toward an application of GIScience

• **Social Ecologies** – diversity, integration, interaction, & density of humans and their activities

• **Transitions to space-time social ecology:**
  - G Engel-Frisch, Temporal Aspects of Human Ecology 1948
  - Amos Hawley, Human Ecology 1950
  - Donald Foley, Urban Daytime Populations 1954
  - RC Schmitt, Estimating Daytime Populations 1956
  - F Stuart Chapin, Population Densities Around the Clock 1963
  - E Shevky and W Bell, Social Area Analysis 1955
  - R Murdie, Factorial Ecology of Metropolitan Toronto 1969
  - D Parkes & N Thrift, Factorial-ecology in space and time 1975
Paths to Space-time Ecological Analysis / Modeling

**1800s** Population Census

**Early 1900s** Time & activity diaries / Social ecology

**1940s – 1950s** Daytime population / Social area analysis

**1960s – 1970s** Census factorial ecology

**1960s** Time geography

**1970s** Space-time diaries / Space-time ecology

**1980s** GIS / Spatial demographics

**1990s** GPS / GIS / Time geography

**2000s** Space-time diaries / GPS / GIS

Time geography / Space-time ecologies

Web 2.0 / Volunteered geographic information (VGI)

**2010s** BIG DATA / Cyberinfrastructure
Time Geography of a Canadian City Project
(Goodchild & Janelle)

• Space-time survey, Halifax Canada 1971-72, A. Harvey
  – 2100 one-day diaries spread over the week
  – 99 activity types
  – Space-time resolution 1-min in time and 100m in space

• Link space-time social ecology with time geography
  – Trace paths through space
  – Reconstruct “census-like” data by time of day
  – Factorial ecology from activity data instead of census data
    (who is where when? What are they doing and with whom?)
  – 3-mode factor solution (activities, space, & time)
Location Quotients
Unmarried by time of day

Space-time measures by subpopulation:
• densities
• segregation

space-time paths:
• activity times, spaces, durations, sequences, fragmentation
• trip speeds
• activity dispersal, range

Janelle & Goodchild, 1983
Space-time Ecology of Human Activity

Halifax

Janelle, Klinkenberg & Goodchild, 1997
Social ecological zones by time-of-day from dominant activities & locations of 2,100 respondents

Halifax-Dartmouth NS

Janelle, Klinkenberg & Goodchild, 1997
The City of London: 11,700 permanent residents but daytime population is 390,000

City of London daytime density: 350,000 people per square mile!

Westminster: 250,000 permanent residents but daytime population nearly 1 million

Most daytime overseas visitors: Westminster (65,000)
http://undertheraedar.blogspot.com/2011_10_01_archive.html

Alasdair Rae, Lecturer, Town & Regional Planning
University of Sheffield
• ORNL’s LandScan USA integrates satellite imagery with census data in GIS
• Budhendra Bhaduri: uses a dasymetric population distribution model for simulation to 90m grid cells
This is New York City’s population by day...

Traffic rank: 16th worst (46 hr./yr.)
Average daily commute: 34 min.

...and the population at night

Issues in space-time population mapping

• Needs social grounding of human space-time behavior
• Night-time / day-time is too coarse for applications and theory testing
• Human mobility and ICT are central to understanding human social connections in space-time
• ICT have facilitated (H. Couclelis):
  – Disconnections between activities and places/times
  – Fragmentation of activities and events
  – Decreasing reliability of models for capturing the complexities of human interactions
• Discontinuities in space-time paths need elaboration
ICT-induced Discontinuities in Space-time Paths

• Individuals as *agents* can:
  – do more than one thing at a time
  – occupy more than one place at a time (virtually)
  – occupy more than one time at a place (virtually)
  – interact with others independently of their presence

• Individuals as *mobile objects* can be:
  – traced continuously in space-time
  – intercepted in-route
  – redirected along new space-time trajectories
  – archived into long-term surveillance databases

• Individuals as members of *networks* can:
  – be independent of place or dependent on place
  – coalesce into ad hoc groups to meet temporary objectives
  – be stable even though locations of members change
Big Data to the Rescue?

• **synoptic** approaches for analyzing processes of both short / long-term duration over geographical space
  – modeling & visualization to render results on demand
    • e.g., the weather map; hourly, daily, and seasonally adjusted forecasts
    • who is where, when, and what are the activities?

• **distributed ICT sensors** for continuous space-time

• **pattern-recognition** to infer activities from tracking data and known characteristics of places (e.g., land use, opening hours)

• **integrated data archives** for aggregation at any spatial scale or time period
Challenges to Dynamic Urban Social Ecology

- Demonstrating worthwhile applications
- Add theoretical understanding to process rules for modeling
- Testing hypotheses in a dynamic world
- Designing data, analysis, & display systems that recognize individual rights to shield one’s identity
- Honor rights to privacy, including locational privacy
- Avoiding intrusive and unsafe demands on respondents
- Sustainability:
  - Harvesting transportation activity surveys (decadal resolution)
  - Tweaking the American Community Survey and American Time-use Survey to capture space-time paths for annual comparisons
  - LandScan USA – from day/night to hourly simulation
  - Automating continuous space-time activity profiles from VGI
Conclusions

• Tools are at hand to integrate space-time concepts with realities of dynamic behavior
• Opportunities to portray ever-emergent social geographies and ecologies
• Dynamic social ecologies can for refined theory and modeling for applied uses
• Entering new territory that will test the ethical bounds of space-time analyses in geography, GIScience, and the social sciences

Thank you, dgj