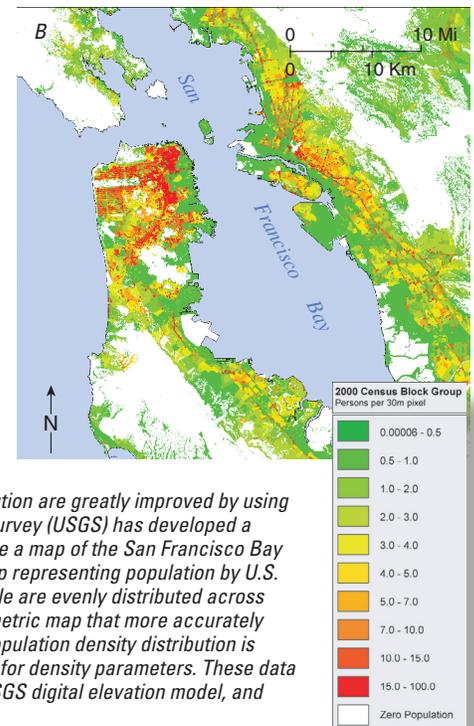
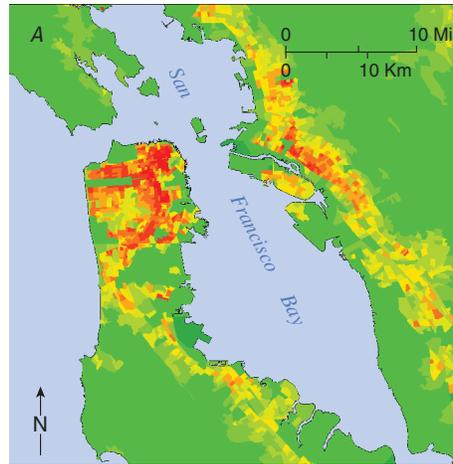


A New Method for Mapping Population Distribution

Human population counts are collected and commonly displayed uniformly across areas, such as U.S. Census Bureau block-groups and tracts. The limitation inherent in this type of representation is the assumption that people are evenly distributed across each areal unit, when in actuality many areas such as parks, open spaces, and industrial zones are uninhabited. The U.S. Geological Survey (USGS) has developed a geospatial tool that uses a “dasymetric” mapping method to redistribute census population values to homogenous, inhabited, zones, enhancing visualization and accuracy.

The U.S. Census Bureau collects demographic information at the household level, which is then aggregated to larger areal units such as census tract, block-group, and block. A census tract can contain many land uses such as residential, recreational, industrial/commercial, and agricultural, but will show population evenly distributed throughout the census tract, even though the inhabitants usually live only within the residential part. In addition, as a result of job requirements, school attendance, and other daytime activities, population distribution during the day is far different than population distribution at night. These differences can be very important in preparing for emergency response or traffic planning. Thus, standard methods of depicting population by census units suffer from two problems—(1) people are not evenly distributed across an area and (2) people



Visualization and spatial accuracy of population distribution are greatly improved by using a “dasymetric” mapping method. The U.S. Geological Survey (USGS) has developed a new dasymetric-mapping tool, which was used to create a map of the San Francisco Bay region. The left map (A) is a traditional “choropleth” map representing population by U.S. Census Bureau block-group, where the number of people are evenly distributed across each block-group, whereas the right map (B) is a dasymetric map that more accurately represents population by census block-group, where population density distribution is determined by ancillary data sets, providing the criteria for density parameters. These data sets include, a USGS National Land Cover Dataset, a USGS digital elevation model, and land-ownership and transportation data.

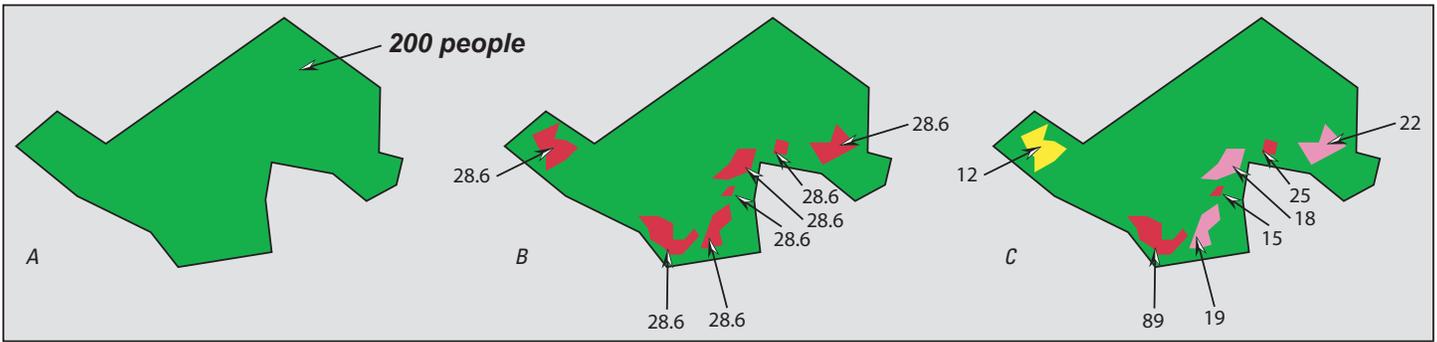
are often in other locations during the day.

U.S. Geological Survey (USGS) researchers have refined and extended automated ways of improving spatial accuracy and visualization in mapping population distributions using “dasymetric” mapping. This technique aims to refine the spatial accuracy of aggregated data by using ancillary information to partition space into zones that better reflect the statistical variation of population. Scientists at the USGS Western Geographic Science Center have developed a dasymetric-mapping tool that generates improved population distribution maps from census, land-use/land-cover, employment, schools, and business data.

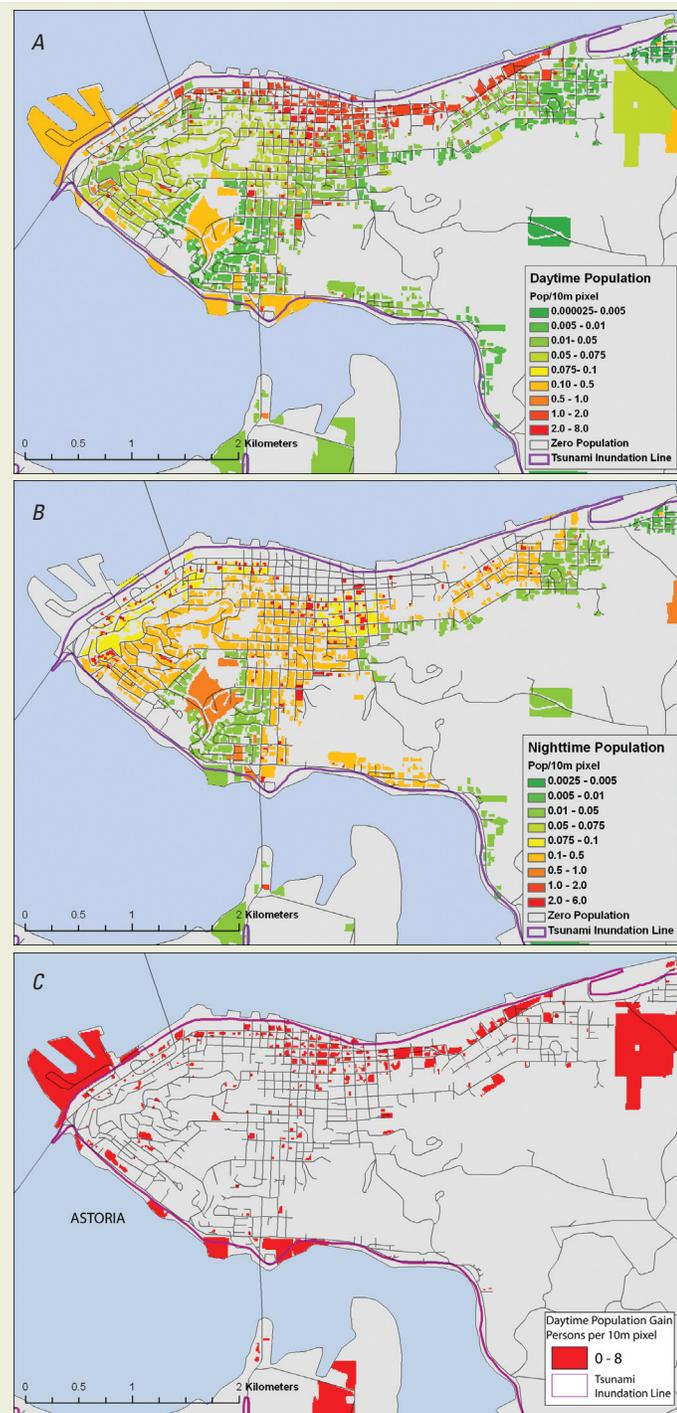
Spatial analysis of the nine-county San Francisco Bay region is necessary to conceptualize urban growth patterns essential for land-use planning and urban-growth modeling. A dasymetric mapping technique was developed and modified from previous efforts and applied in mapping population density for the region. USGS National Land Cover Data for 1992 and 2001 provided homogenous zones of high-intensity residential, low-intensity residen-

tial, and non-urban land cover. Slope, land-ownership, and transportation data were used to identify and exclude uninhabited areas. Population data, collected by census block-groups, were then reallocated to a 30-meter surface grid based on the relative difference in population densities among the urbanization classes and the percentage of total area of each census-block-group occupied by the three inhabited zones. This new and improved dataset of the nine-county bay region is available online for download at <http://geography.wr.usgs.gov/science/dasymetric/data.htm>.

A more complex example of using dasymetric mapping methods to map population densities by night and day was developed by the USGS for Oregon coastal communities vulnerable to tsunamis. Hazard preparedness has become a critical issue for local populations who are potentially vulnerable to natural disasters. Essential to preparedness planning is determining where people are likely to be located, a factor which varies from day to night. Scientific analysis and technological advances have led to the growth of geographic analy-



This diagram represents a dasymetric method for showing population distribution—(A) total number of people aggregated by census delineated unit, (B) inhabited (red) versus uninhabited (green) areas with populations evenly distributed within the inhabited land use, and (C) an “urban 3-class method,” where populations are distributed in high (red), medium (pink), and low (yellow) population class based on land-use class code and areal weighting.



U.S. Geological Survey scientists used dasymetric mapping to show temporal differences in population distribution for Astoria, Oregon—(A) daytime population distribution with the major concentrations in the business district, (B) nighttime population distribution with a shift in distribution to residential areas, and (C) areas with the highest change in population during the daytime. The purple line signifies the tsunami inundation line. Populations within the line are most vulnerable. The importance of distinguishing the difference between daytime and nighttime populations contributes to emergency-management planning and preparedness strategies that seek to minimize the loss of life and property in a natural disaster.

sis tools that have the capacity to aid local jurisdictions in emergency planning. Using a dasymetric mapping technique, daytime populations are estimated by interpolating the census-block values to 10-meter pixels based on parcel-level land use, business data, and census information on education and age. Nighttime population estimates were derived solely from parcel-level land use, reflecting residential, inhabited zones, and distributed to a 10-meter grid.

The use of geographic information systems allows users to visually and statistically characterize populations at risk within hazard zones. The results from the USGS dasymetric-mapping tool are an indicator of which populations are most vulnerable, making hazard-mitigation planning more effective. Such planning helps minimize the loss of life and property from natural hazards, which is an important part of the USGS mission.

The USGS dasymetric-mapping tool has been developed for use within the commercially available ArcGIS software package. The tool is available for download at <http://geography.wr.usgs.gov/science/dasymetric/data.htm>.

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