ABSTRACT

Pesticide exposure estimation in epidemiologic studies can be constrained to analysis scales commonly available for cancer data—census tracts and ZIP codes. Research goals included (1) demonstrating the feasibility of modifying an existing geographic information system (GIS) pesticide exposure method using California Pesticide Use Reports (PURs) and land use surveys to incorporate Landsat remote sensing and to accommodate aggregated analysis scales, and (2) assessing the accuracy of two rurality metrics (quality of geographic area being rural), Rural-Urban Commuting Area (RUCA) codes and the U.S. Census Bureau urban-rural system, as surrogates for pesticide exposure when compared to the GIS gold standard. Segments, derived from 1985 Landsat NDVI images, were classified using a crop signature library (CSL) created from 1990 Landsat NDVI images via a sum of squared differences (SSD) measure. Organochlorine, organophosphate, and carbamate Kern County PUR applications (1974-1990) were matched to crop fields using a modified three-tier approach. Annual pesticide application rates (lb/ac), and sensitivity and specificity of each rurality metric were calculated. The CSL (75 land use classes) classified 19,752 segments [median SSD 0.06 NDVI]. A total of 148,671 PUR records were included in the analysis. Landsat contributed 689 additional tier matches. ZIP Code Tabulation Area (ZCTA) rates ranged between 0 and 1.36 lb/ac and census tract rates between 0 and 1.57 lb/ac. Rurality was a mediocre pesticide exposure surrogate—higher rates were observed among urban areal units. ZCTA-level RUCA codes offered greater specificity (39.1-60%) and sensitivity (25-42.9%). The U.S. Census Bureau metric offered greater specificity (92.9-97.5%) at the census tract level; sensitivity was low (≤6%). The feasibility of incorporating Landsat into a modified three-tier GIS approach was demonstrated. Rurality accuracy is affected by rurality metric, areal aggregation, pesticide chemical class, and pesticide exposure cutoff. Future research should explore integrating Landsat for higher spatial resolution pesticide exposure ascertainment.