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Mapping surface disturbance from wind farms

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Wind energy is one of the fastest growing segments of the electricity market and this trend will likely continue as countries strive to reduce CO_2 production while meeting growing energy demands. One impact of wind facilities is surface disturbance, including roads, that lead to habitat loss and fragmentation. Numerous studies of wind power utilize estimates of surface disturbance for GIS-based modeling or basic calculations of the land area required to generate energy using wind. However published estimates of the land use required for a MW of electricity from wind facilities vary by more than 10 times (0.83 to 250 MW/Km^2). We report results from a geospatial analysis of 39 wind facilities in the United States that we fully digitized using high resolution photo-imagery. The selected sites and analyses were designed to elucidate the effects of turbine size, topography, and land use on the area requirements of wind facilities. The results indicate point estimates of average surface disturbance/MW have wide levels of variation, explained primarily by Landcover and Topography. Wind facilities in agricultural landscapes had smaller surface disturbance/ha than facilities in forests and shrublands, and facilities in relatively flat topography had smaller surface disturbance/ha than facilities on hills, ridges, or mesas. Land use, topography, and turbine size all influenced turbine spacing. The statistical models suggest we can predict geographic locations where new wind facilities could be placed with minimized surface disturbance.