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A contemporary decennial global Landsat sample of changing agricultural field sizes

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Agriculture has caused significant human induced Land Cover Land Use (LCLU) change, with dramatic cropland expansion in the last century and significant increases in productivity over the past few decades. Satellite data have been used for agricultural applications including cropland distribution mapping, crop condition monitoring, crop production assessment and yield prediction. Satellite based agricultural applications are less reliable when the sensor spatial resolution is small relative to the field size. However, to date, studies of agricultural field size distributions and their change have been limited, even though this information is needed to inform the design of agricultural satellite monitoring systems. Moreover, the size of agricultural fields is a fundamental description of rural landscapes and provides an insight into the drivers of rural LCLU change. In many parts of the world field sizes may have increased. Increasing field sizes cause a subsequent decrease in the number of fields and therefore decreased landscape spatial complexity with impacts on biodiversity, habitat, soil erosion, plant-pollinator interactions, and impacts on the diffusion of herbicides, pesticides, disease pathogens, and pests.

The Landsat series of satellites provide the longest record of global land observations, with 30m observations available since 1982. Landsat data are used to examine contemporary field size changes in a period (1980 to 2010) when significant global agricultural changes have occurred. A multi-scale sampling approach is used to locate global hotspots of field size change by examination of a recent global agricultural yield map and literature review. Nine hotspots are selected where significant field size change is apparent and where change has been driven by technological advancements (Argentina and U.S.), abrupt societal changes (Albania and Zimbabwe), government land use and agricultural policy changes (China, Malaysia, Brazil), and/or constrained by historic patterns of LCLU (Albania, France and India). Landsat images sensed in two time periods, up to 25 years apart, are used to extract field object classifications at each hotspot using a multispectral image segmentation approach. The field size distributions for the two periods are compared statistically and quantify examples of significant increasing field size associated primarily with agricultural technological innovation (Argentina and U.S.) and decreasing field size associated with rapid societal changes (Albania and Zimbabwe). The implications of this research, and the potential of higher spatial resolution data from planned global coverage satellites, to provide improved agricultural monitoring are discussed.