USING EARTH OBSERVATIONS FOR ECOLOGICAL RESEARCH: EXPERIENCES, CHALLENGES, AND FUTURE DIRECTIONS FOR AGRICULTURAL APPLICATIONS

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Earth observations in the form of satellite remote sensing data contribute important data for delineation of land cover, land use, and for estimates of net primary production and carbon dynamics. These contributions, among numerous others, are having substantial impacts on ecological research in the agricultural domain. These contributions can also benefit from significant improvements.

Delineation of cropland species using satellite data has historically been too aggregated for use in agricultural applications. For example, 1km-resolution data often aggregates broadleaf or row crops, which includes corn and soybean. Corn and soybean have very different growth patterns, net primary production, and associated carbon dynamics. Higher resolution satellite data is currently being used for crop delineation and is proving useful for numerous agricultural applications. Annual and national coverage for high resolution (<100m) crop species delineation is desirable.

Crop species delineation is essential for estimating the spatial extent of cropland use and management activities. For example, national inventory datasets provide information on agricultural machines, fertilizers, pesticides, irrigation, and other agricultural inputs per crop within political boundaries. These estimated inputs can be spatially distributed to respective crops following the delineation of crop species. Distribution methods for agricultural land use are particularly useful for estimating nutrient runoff, water quality, soil erosion, and carbon dynamics. Prior to such distribution methods, many ecological models could run only at watershed-scale resolution with homogeneous crop distribution and management scenarios. Enhanced earth observations that include land management are desirable for input to ecological models.

Delineation of crop species and crop management is particularly useful with regard to bioenergy issues. It is projected that dedicated bioenergy crops may be established on some agricultural lands, including grassland and pastureland. These economic projections can be distributed about the landscape only if current crop species have been delineated. Comparison of land-use practices associated with bioenergy crops and traditional crops can help estimate changes in energy use and carbon dynamics associated with a bioenergy industry. Use of existing earth observations with economic modeling to provide spatially explicit land-use projections are desirable.

Net primary production of crops is an important contribution of earth observations, yet spatial estimates of crop species production are still inadequate. Estimates of net primary production are difficult to develop using moderate resolution imagery and are often compromised due to multiple crops occurring within each pixel. Application of national inventory yield data to remotely-sensed crop delineation is one method to temporarily provide more accurate estimates of georeferenced cropland production. Other methods are available, but have not been generated or publicly provided at the national scale. Increased accuracy of cropland production will result in a significant advancement of cropland ecosystem models.

Illustrative examples of aforementioned earth observation applications to cropland ecosystem analyses will be presented. Issues surrounding computational resources, relationships between land-use data and earth observations, crop species delineation, and crop production will be discussed. Future research towards higher resolution and enhanced cropland data products will help increase the use of earth observations in agricultural applications. Computational software tools may also require improvement to handle regional- to continental-scale use of these high-resolution, multi-variable datasets.