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Modeling Gross Primary Production of Deciduous Forest Using Remotely Sensed Radiation and Ecosystem Variables

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We explored the potential application of two remotely sensed (RS) variables, the Global Vegetation Moisture Index (GVMI) and the near-infrared albedo (AlbedoNIR), in modeling the gross primary production (GPP) of three deciduous forests. For the Harvard forest (deciduous) of Massachusetts, USA, it was found that GPP is strongly correlated with GVMI (R2 =0.60) during the growing season, and with AlbedoNIR (R2 =0.82) throughout the year. Subsequently a statistical model called the Remotely Sensed GPP (R-GPP) model was developed to estimate GPP using remotely sensed radiation (land surface temperature (LST), AlbedoNIR) and ecosystem variables (enhanced vegetation index (EVI) and GVMI). The R-GPP model, calibrated and validated against the GPP estimates derived from the eddy covariance flux tower of the Harvard forest, could explain 95% and 92% of the observed GPP variability for the study site during the calibration (2000 – 2003) and the validation (2004 – 2005) periods, respectively. It outperformed the primary RS based GPP algorithm of the Moderate Resolution Imaging Spectroradiometer (MODIS) which explained 80% and 77% of the GPP variability during those same periods, respectively. The calibrated R-GPP model also explained 93% and 94% of the observed GPP variation for two other independent validation sites (the Morgan Monroe State Forest and the University of Michigan Biological Station), respectively, which demonstrate its transferability to other deciduous ecoregions of north-eastern USA.