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Local land surface temperature response to the widespread Earth greening

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Vegetation greenness has been increasing over the global land for the past few decades. Such trends are consistent with observed changes in seasonal CO_2 amplitude, enhanced primary productivity, and increased carbon storage especially in the woody biomass. The change of vegetation greenness is attributed to intensified agriculture activities, woody vegetation encroachment, and forest gain and loss as a combined result of natural forcings (e.g, CO_2 fertilization and climate change) and human land management. While the large-scale response of vegetation to the abovementioned factors is well recognized now, the vegetation biophysical feedback at local to regional scales remains under debate.

In this study, we quantify how much of the land surface temperature change over the past two decades is attributed to leaf area index change. We introduce a new attribution method called the Two Resistance Mechanism (TRM) method based on the surface energy budget equation, which can quantify the contributions of different biophysical parameters (e.g., albedo, aerodynamic resistance, and surface resistance) to LST changes. The TRM method addresses two challenges that previous studies have faced. It ensures independence among different biophysical drivers and separates the surface biophysical feedback signal from the signal that originates from atmospheric changes. We apply the TRM method to a combination of offline land model simulations (CLM5), as well as remote sensing data, to evaluate the relative importance of changes in the dynamic variables (e.g., aerodynamic and surface resistances) and changes in the thermodynamic variables (e.g., albedo) stemmed from LAI changes in terms of affecting the local land surface temperature.

Our preliminary results indicate different roles of these biophysical parameters and distinct patterns of contributions from each biophysical parameter across climatic zones (according to the temperature and precipitation) and biome types (e.g., forests, croplands, etc) on local LST changes.