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Editorial: Interactions between land surface and climate

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Editorial on the Research Topic
Interactions between land surface and climate

The rate of climate change intensification will increase with growing emissions of greenhouse gases in the future. Regional terrestrial temperature increases differ in magnitude from global warming due to feedback processes. This has far-reaching consequences to our society especially for our ecosystems, agricultural food production, water availability, living habitat and electric power generation.

Anthropogenic changes in land use/cover can influence the lower atmosphere by modifying land surface properties that control the exchange of energy, water, and momentum, and thus affect the regional or local climate. Teleconnections are possible depending on the magnitude of land surface transformations. The strength of the land-atmosphere coupling is linked to the morphological characteristics of the land surface including vegetation and urban areas. Here, the species composition and distribution play a crucial role with their transpiration and photosynthesis, reflection ability of radiation, and roughness. The scale and nature of land surface modifications affect those processes, but the quantification of these interactions is not resolved, and the strength of the impact is still debated. This fact limits decision-makers to modulate land management strategies at different scales in light of climate change mitigation and adaptation. Thanks to the development of monitoring, satellite remote sensing and climate modelling, this Research Topic brings together novel observational and numerical modelling studies regarding the interaction between land surface and climate change at global and regional or local scales, from bed-rock to the upper atmosphere, in the past, present, and future. Eight papers contribute to this Research Topic.

Recent climate change significantly impacts on the phenology of vegetation. The growing season average NDVI of grassland vegetation significantly increase around 0.023/10a over the Mongolian Plateau Li et al.. Land use/cover management is a key sector to meet climate change mitigation and adaptation strategies. Land cover management will change the surface vegetation structure, and then affect land surface processes. For example, forest canopy closure determines the local snow depth and snowfall intensity, higher forest canopy closure leads to a lower snow depth (Gao et al.). Land cover changes also impact on the large general circulation (Zhang et al.) and surface solar radiation (Jin et al.).

Climate model is an important tool to investigate the interaction between land surface and climate. Vegetation structure and physiology in the model determines the model

performance in capturing land surface processes. Jones et al. found that implementing the Newton-Raphson stomatal optimisation method in the model can better predict gross primary productivity, stomatal transpiration and leaf water potential, with a much higher computational efficiency. Using a regional climate model (i.e., RegCM), Li et al. investigated the effect of forest change on convective rainfall, and Li et al. studied the temperature extremes response to present-day irrigation over China. Reforestation in southern China significantly enhanced local convective afternoon rainfall during the post-flood season (Li et al.). Present-day irrigation led to significant reductions (slightly changes) in the extreme indices associated with the warm (cold) tails of the maximum and minimum temperatures distributions, e.g., hot days, tropical nights (cold nights, frost days), particularly in the regions with intense irrigation (e.g., the North China Plain) (Li et al.).

Dirmeyer et al. employed multi-model simulations to explore the evolution of land surface feedbacks on extreme heat. The climatological land-heat coupling mirrors other metrics of land–atmosphere interaction, peaking in transition regions between arid and humid climates. Changes from preindustrial to recent historical conditions are dominated by decreased land surface controls on extreme heat, mainly over the broad areas that have experienced expanded or intensified agriculture over the last 150 years. Future projections for increased atmospheric CO_2 concentrations show a waning of areas of weakened land-heat feedbacks, while areas of increasing feedbacks expand over monsoon regions and much of the midlatitudes.

This Research Topic of papers provides valuable insights into how changes in land surface affect regional climate. However, there is still large uncertainty about how land cover changes affect regional extreme climate and its transition of teleconnection effect. To better understand the impacts of land cover management strategies on climate change mitigation and adaptation, more studies are needed to consider both the regional and global biogeophysical and biogeochemical effects.

Author contributions

BH, YL, and MT devised the concept for the editorial. BH drafted the manuscript. YL and MT provided editorial comments and revisions. BH finalized the manuscript and submitted.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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