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### Background

- Global urban population will reach 70% in 2050 from 50% in 2010;
- Urban sprawl, driven by urban population growth, is reshaping our urban environment;
- The change in urban environment has important impacts on nature systems and human activities in the urban domain;
- Satellite remote sensing observations and the planetary-scale platform provide the opportunities to monitor urban environmental change and its implications in the coupled human-nature system over large areas.

### Research framework

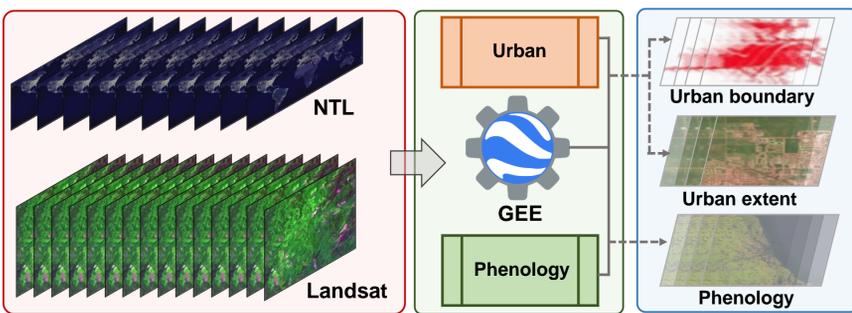


Fig. 1. The framework of mapping urban extents and vegetation phenology in the urban domain.

### Global urban dynamics 1992-2013 (1-km)

- Urban land (%) increased from 0.2% in 1992 to 0.5% in 2013
- The product provides spatially explicit boundaries of urban extents

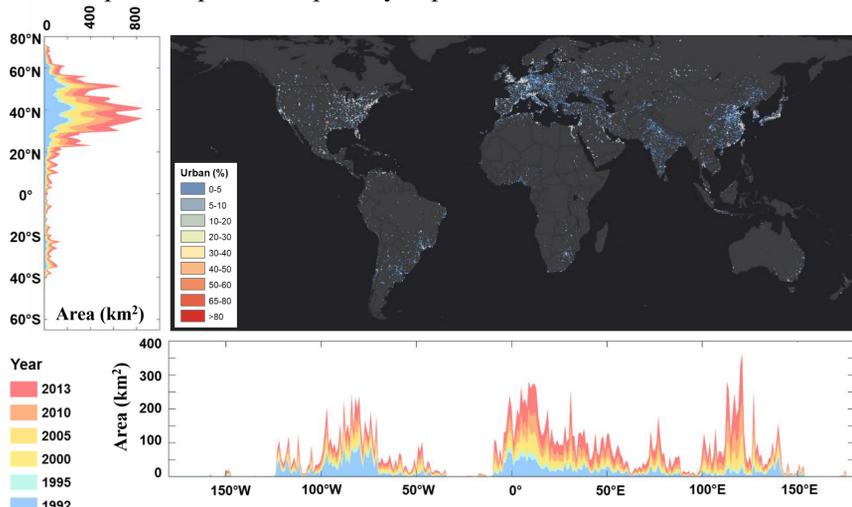


Fig. 2. Global urban extent dynamics from 1992 to 2013.

### Urban dynamics 1985-2015 in the US (30-meter)

- US urban area increased by about 20% over past three decades
- Urban spatial sprawl varied greatly across time and space

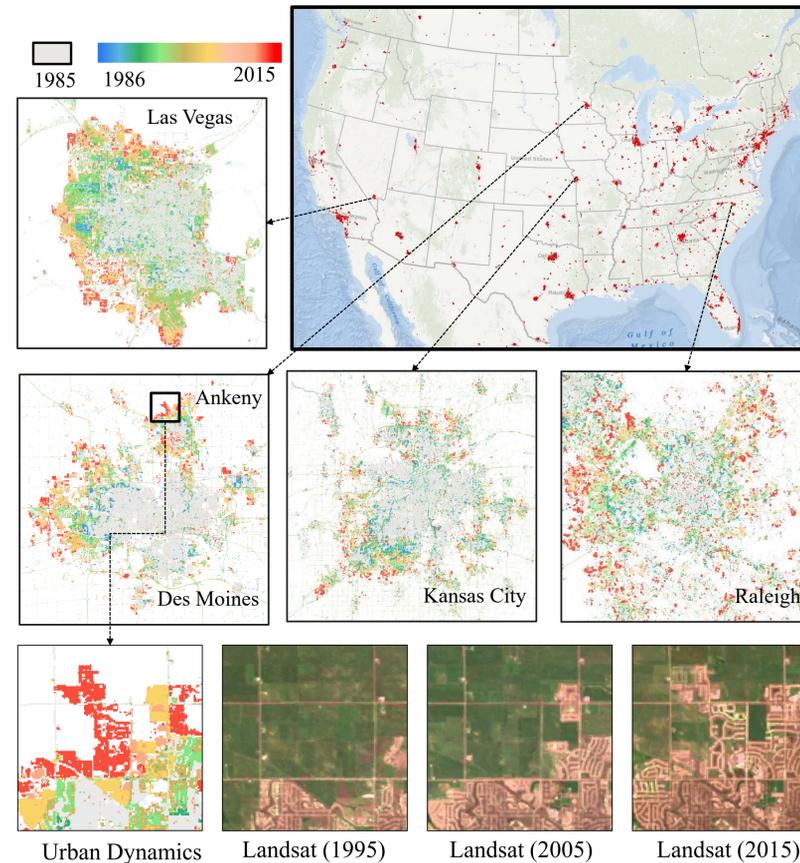


Fig. 3. Urban dynamics in US example cities at different spatial scales.

### References

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- Li, X., Zhou, Y., Zhu, Z., Liang, L., Yu, B., & Cao, W. (2018). Mapping annual urban dynamics (1985-2015) using time series of Landsat data. *Remote sensing of Environment*, 216, 674-683.
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### Phenology dynamics and response to urbanization

- A new product of vegetation phenology (30-meter) in the US was developed
- More details of vegetation phenology can be revealed in the urban domain
- A unique phenology pattern was found along urban-rural gradient
- Urbanization showed a significant impact on vegetation phenology

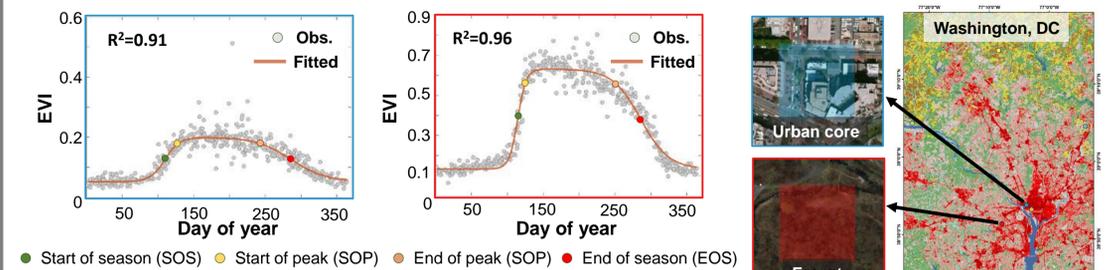


Fig. 4. Illustration of vegetation phenology pattern in the urban core and forest.

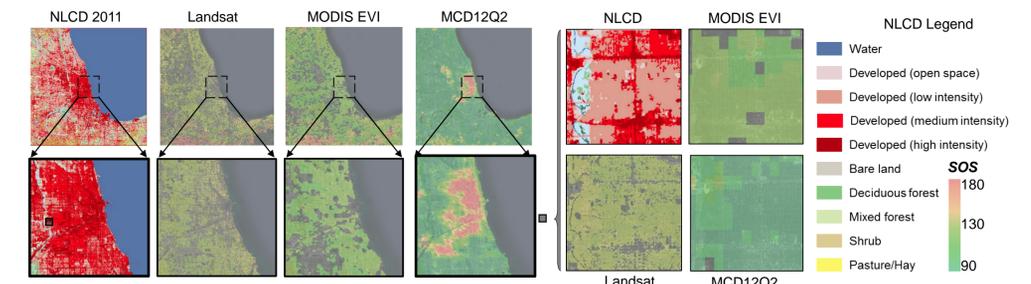


Fig. 5. An example of vegetation phenology in Chicago metropolitan area.

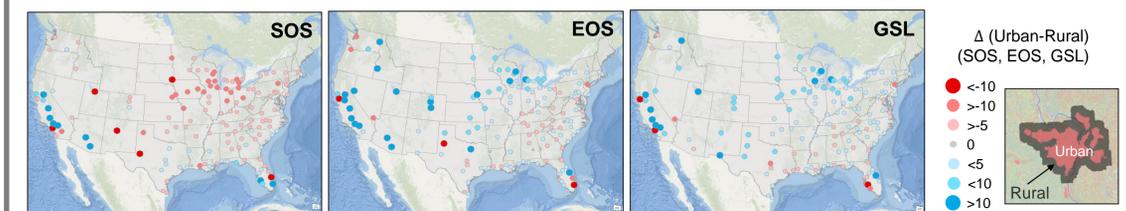


Fig. 6. Difference of vegetation phenology indicators between urban and rural areas in the US cities

### Summary

- We developed the products of annual urban extents and phenology indicators at a 30-meter spatial resolution in the conterminous US from 1985 to 2015;
- These products provide the possibility to monitor urban environmental changes in high spatial resolution;
- Our analyses indicate that the human-induced land use and land cover change (i.e., urbanization) changed the nature system and has important implications such as respiratory allergies in urban domains.