

# Far Flung Forest Landscapes in the Anthropocene

Far Flung Forest Landscapes in the Anthropocene  
Structural analysis of China's embodied forest network

Matthew Kekoa Lau (Ph.D.)

Chinese Academy of Sciences and Harvard University

1. Forests ~ 80% terrestrial biodiversity (WWF)
2. Soil stabilization
3. Forests carry out important processes: clean air and water
4. Forests store carbon

# Far Flung Forest Landscapes in the Anthropocene

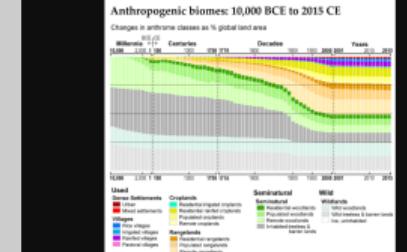
## └ Context



1. Anthropocene = proposed geological epoch distinguished by human impacts

# Far Flung Forest Landscapes in the Anthropocene

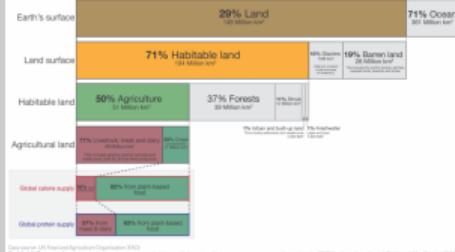
## └ Context



1. Land-use changes = conversion
2. One proposal is it started about 1950 with acceleration
3. Biodiversity changes = species introductions and extinctions

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



1. 90% biomass on Earth is humans and livestock

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



1. 90% biomass on Earth is humans and livestock

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



1. Atmospheric changes = climate change, fire

## Far Flung Forest Landscapes in the Anthropocene

### └ Context



1. Climate change is causing hurricanes that make landfall to take more time to weaken, reports a study published 11th November 2020 in the journal Nature.

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



1. Tornado damaged Southbridge, MA forest in 2011

# Far Flung Forest Landscapes in the Anthropocene

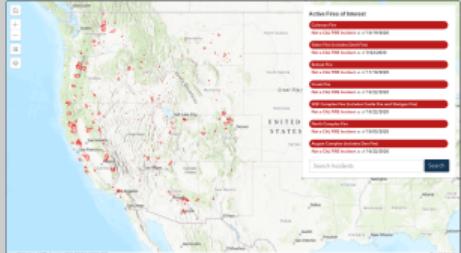
## └ Context



### 1. Droughts

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



### 1. CAL FIRE MAP Tue 17 Nov 2020 12:10:52 PM EST

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



### 1. CA Cranston Riverside 2018

# Far Flung Forest Landscapes in the Anthropocene

## └ Context



### 1. Fires in Australia 2020

# Far Flung Forest Landscapes in the Anthropocene

## └ Context

### └ Today's Talk

- ① Environmental Extended Economic Models
- ② Global Trade Networks of Forest Landscapes
- ③ China's Forest Networks
- ④ Conclusions
- ⑤ Future Work

- 1.** Intro/Context
- 2.** Global forest loss and gain and change
- 3.** Global greening = India(Agriculture) + China(Forests)
- 4.** Economics\*Ecology = Landscape Extended Models
- 5.** Network Analysis of China's Greening
- 6.** Global Scale
- 7.** Local Scale
- 8.** Landscape = Tian 2019, Chen 2019
- 9.** Resilience Analysis of China's Forest LE-MRIO
- 10.** Conclusions and Future Work
- 11.** Acknowledgements

# Far Flung Forest Landscapes in the Anthropocene

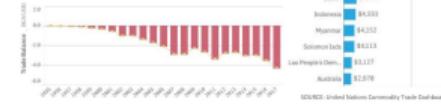
## └ Environmental Extended Economic Models

Final consumption	$x_j^0$
Sector 1	$x_j^1$
...	$x_j^n$
Primary inputs	$y_j^0$
Exogenous environmental inputs	$y_j^e$

1. This is why they're called input-output tables
2. Each region has a set of sectors/industries
3. They can receive inputs from within a region
4. They can also receive input from another region (aka. imports)
5. Final use = Consumption not used to produce another product

# Far Flung Forest Landscapes in the Anthropocene

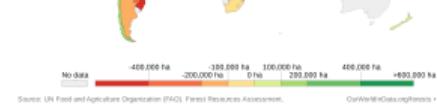
## └ Global Trade Networks of Forest Landscapes



1. China's imports have been increasing over time
2. Mostly from Russia and USA, lesser Canada and New Zealand
3. Cumulatively, southeast Asian countries rival Russia (43,621)

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



1. Global forest loss and gain and change
2. Global greening = India(Agriculture) + China(Forests)

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks

$$H = - \sum_i \frac{T_{ij}}{T_-} \ln \frac{T_{ij}}{T_-}$$

Where,  $T_{ij}$  represents the effect that element  $i$  has on element  $j$  and the symbol  $\sum$  indicates summation over that index.

From the above formulas it is evident that a higher value of  $H$  indicates higher diversity in a system. There is also a hierarchical aspect of diversity as expressed in the three types of ecological diversity. One considers genetic, species, and ecosystem diversity as necessary features for continuing ecological functioning. In the micro-macro and perhaps meso scales addressed before, this includes the diversity of agents and network configurations - often expressed in terms of autocatalytic cycles (Gatti et al., 2014; Ulanowicz et al., 2014).

Information theory connects diversity and redundancy through a variable representing the efficiency of pathways within a network.

### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

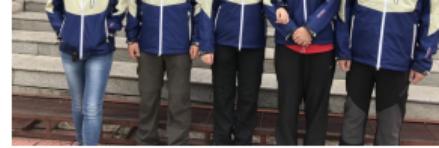
## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ China's Forest Networks



### 1. China's Forests are Diverse

# Far Flung Forest Landscapes in the Anthropocene

## └ Future Work



1. Questions, comments?