

Geo 873 – 001: Seminar in Human-Environment Geography

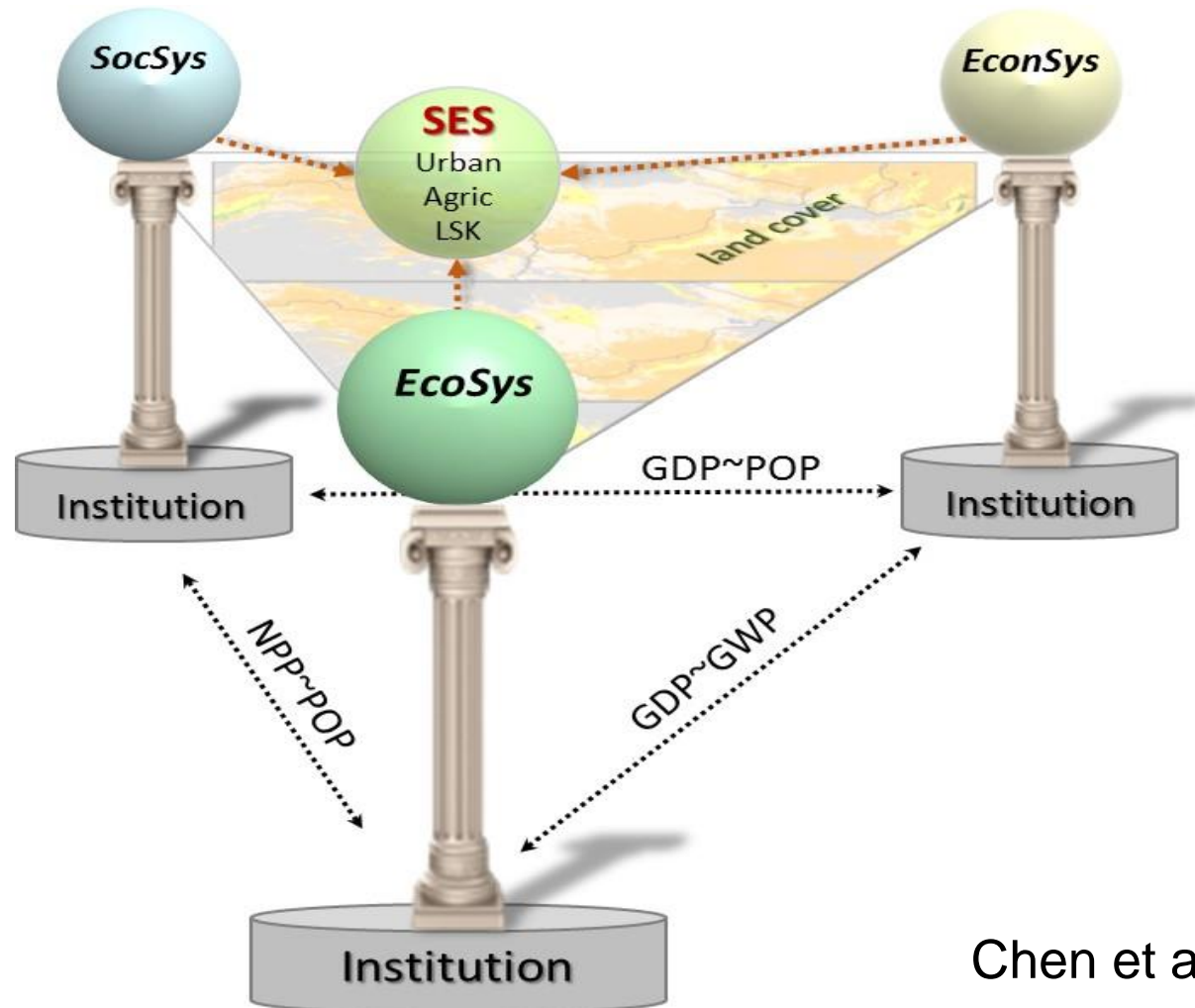
Feb. 1, 2023

12:40 am – 3:30 pm; Geo 120

Office Hours: 12:00 am – 2:00 pm; Friday, Geo213

- 1) Social-Environmental systems on the Mongolian Plateau
- 2) Art of Scientific Writing
- 3) Group discussion on study objectives and timetable

Conceptual framework illustrating the research approaches for SES. The entangled elements of *EcoSys*, *SocSys* and *EconSys* are driven by changes in global climate, market, technology, informational technology, *etc.* for modeling the SES dynamics. Institutional structure and shift are proposed as the foundation for understanding the complex interactions among the nodes of the three pillars, with LCC mediating the interactions and feedback among three pillars.



Each management option is accompanied with some expectations and many surprises

1) Jafar tricked by Aladdin: the power fighting for the lamp between evil and people continues throughout;

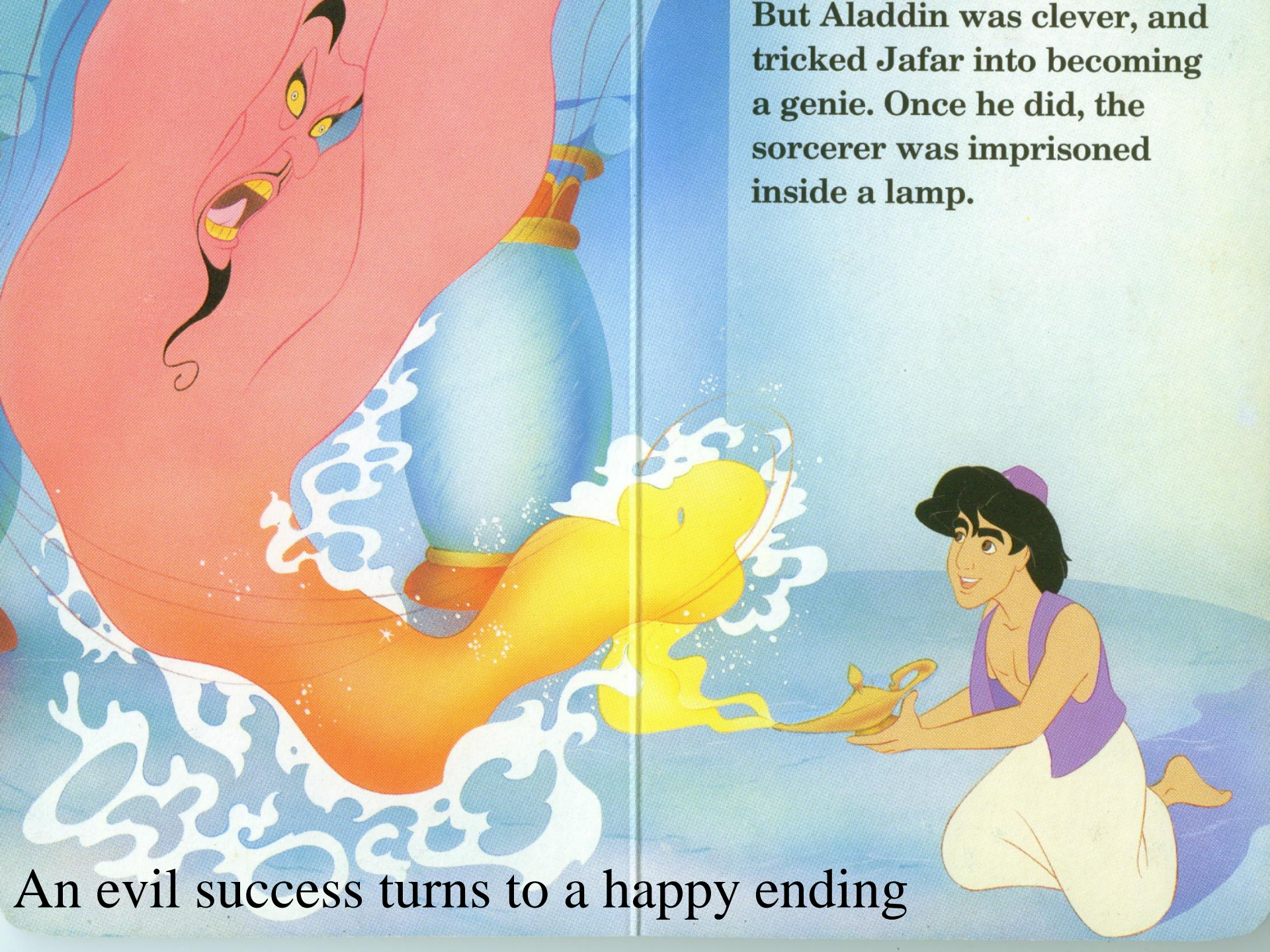
The image is a screenshot of the Disney Online website for the Aladdin Special Edition DVD. The page features a dark blue background with a night sky theme. At the top, there is a navigation bar with "Disney Online" and "Entertainment > Disney Video + DVD > Aladdin Special Edition". A search bar and a "powered by hp" logo are also visible. Below the navigation, there are promotional banners for "Choose From 5 Magical Designs" and "Earn Disney Rewards™ On Everyday Purchases". The main content area includes the "Aladdin 2-DISC SPECIAL EDITION" logo, the text "Wish Granted. Now Available On DVD!", and a central image of the DVD cover. To the right, there is a box highlighting the song "A Whole New World" performed by Nick Lachey and Jessica Simpson. A "Platinum Edition" award seal is also present. On the left, a menu lists options like "Home", "2-Disc DVD", "Trailer & Clips", "Fun & Games", "Downloads", "Sweepstakes", "Aladdin Links", "Trading Cards", and "Order Now". The bottom of the page features a small image of the magic lamp and Jafar, and a "Wish Granted" logo.

Meanwhile, Jafar and his parrot, Iago, plotted to steal the lamp.



With the genie's magic, the evil sorcerer would be all-powerful!

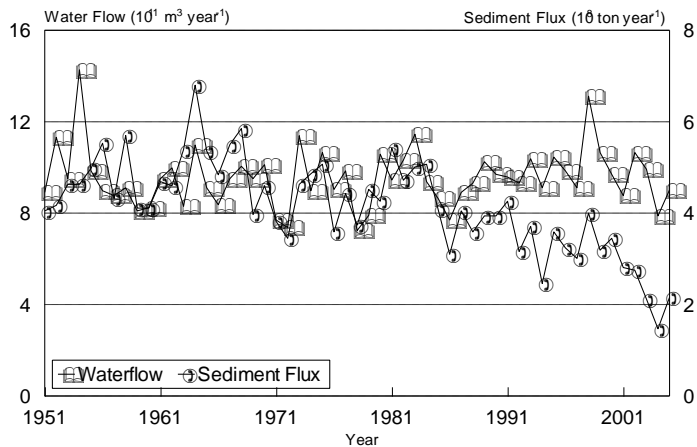




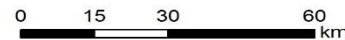
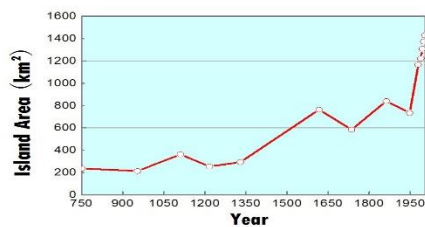
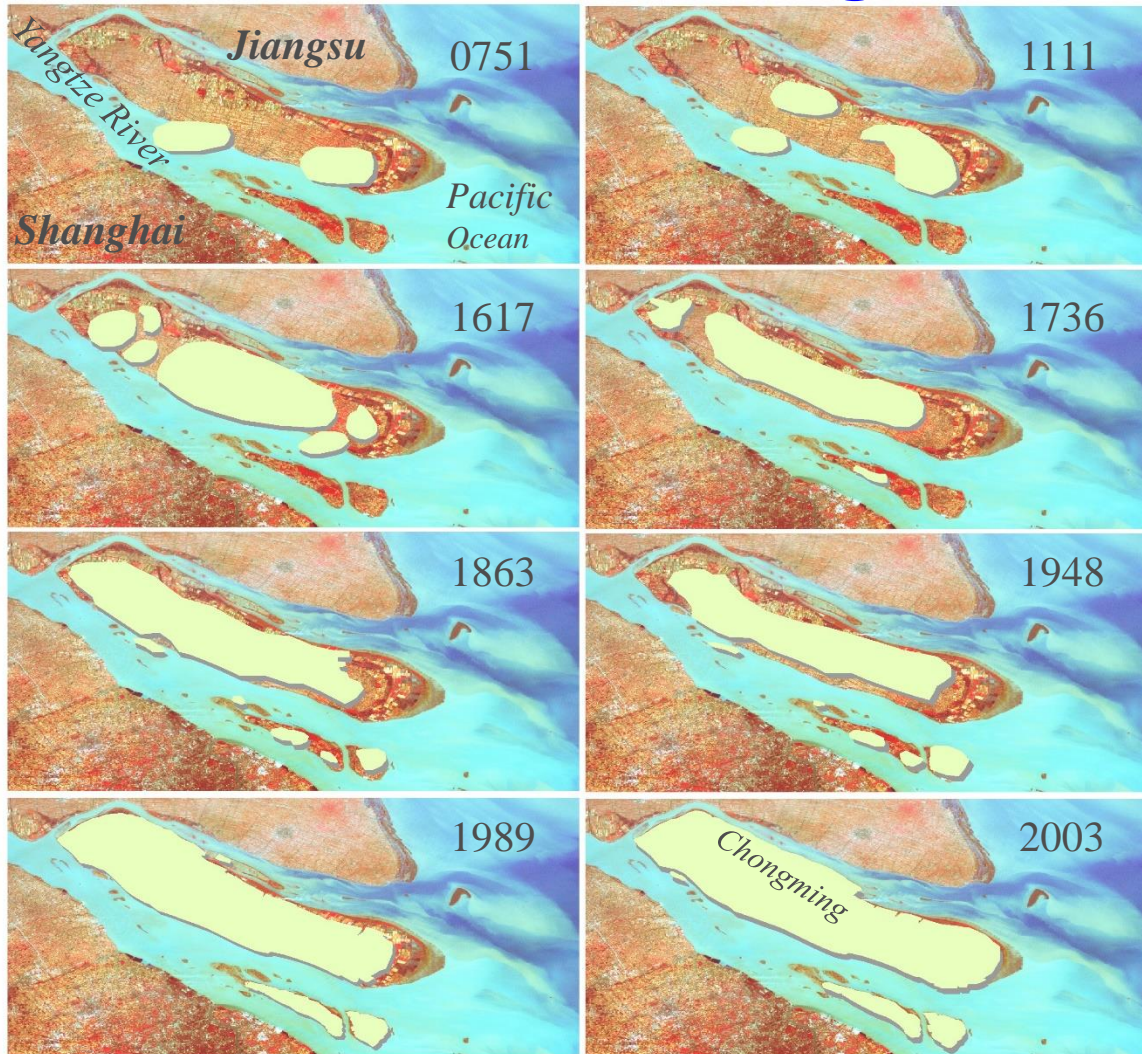
But Aladdin was clever, and tricked Jafar into becoming a genie. Once he did, the sorcerer was imprisoned inside a lamp.

An evil success turns to a happy ending

Growing islands (120/year) were measured because of large amount of sediments carried down from >2000 km polluted Yangtze River.



The island has been growing



Invasive *Spartina* on coastal islands of eastern China.

It provides a powerful filtering function clean water from heavily polluted Yangtze River and higher carbon sequestration;

But native species lose their habitat



Syn.thesis: the combination of ideas to form a theory or system

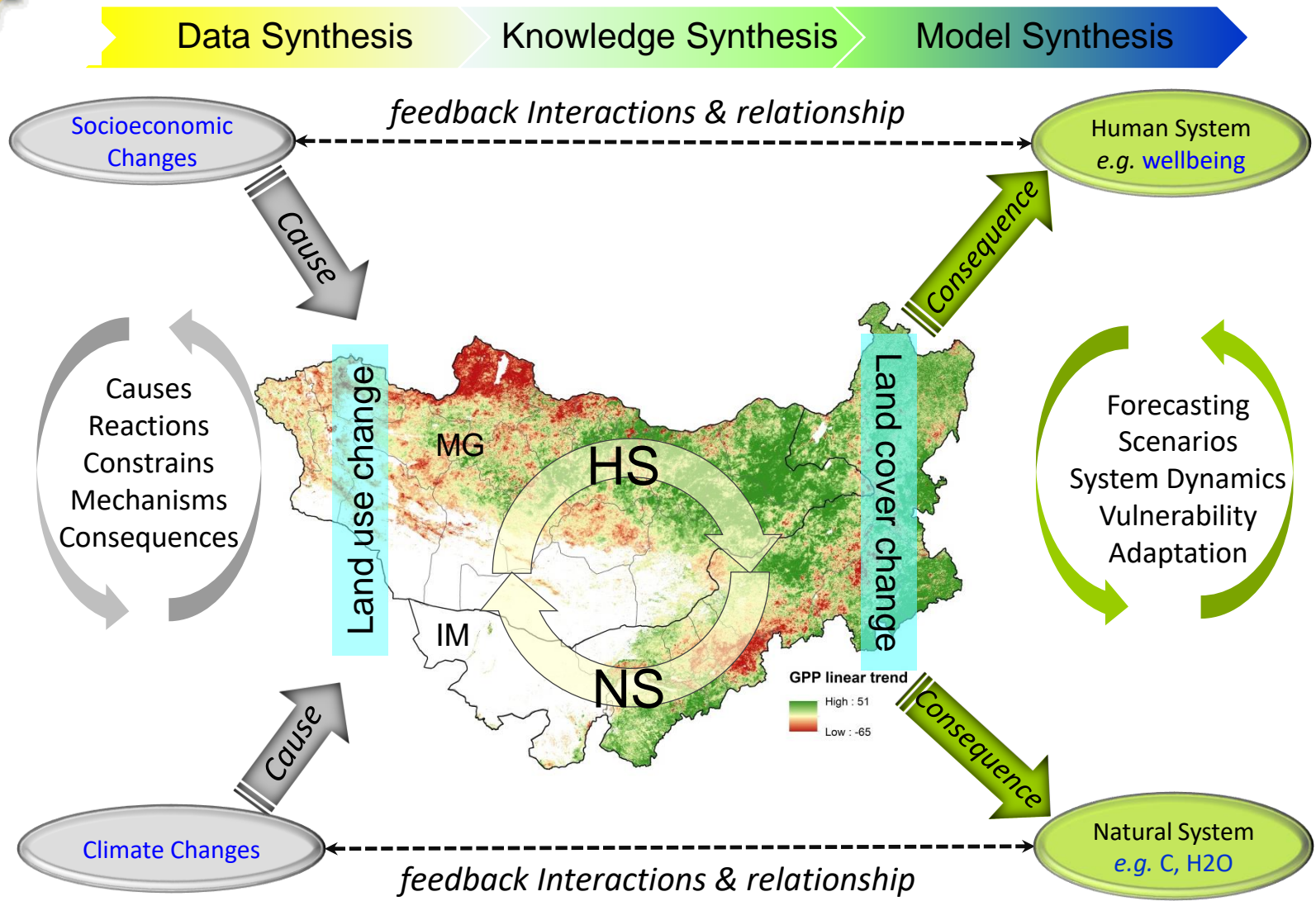
Etymology

Greek, from *syntithenai* to put together, from *syn-* + *tithenai* to put, place — more at [DO](#)

Summary: a brief statement or account of the main points of something

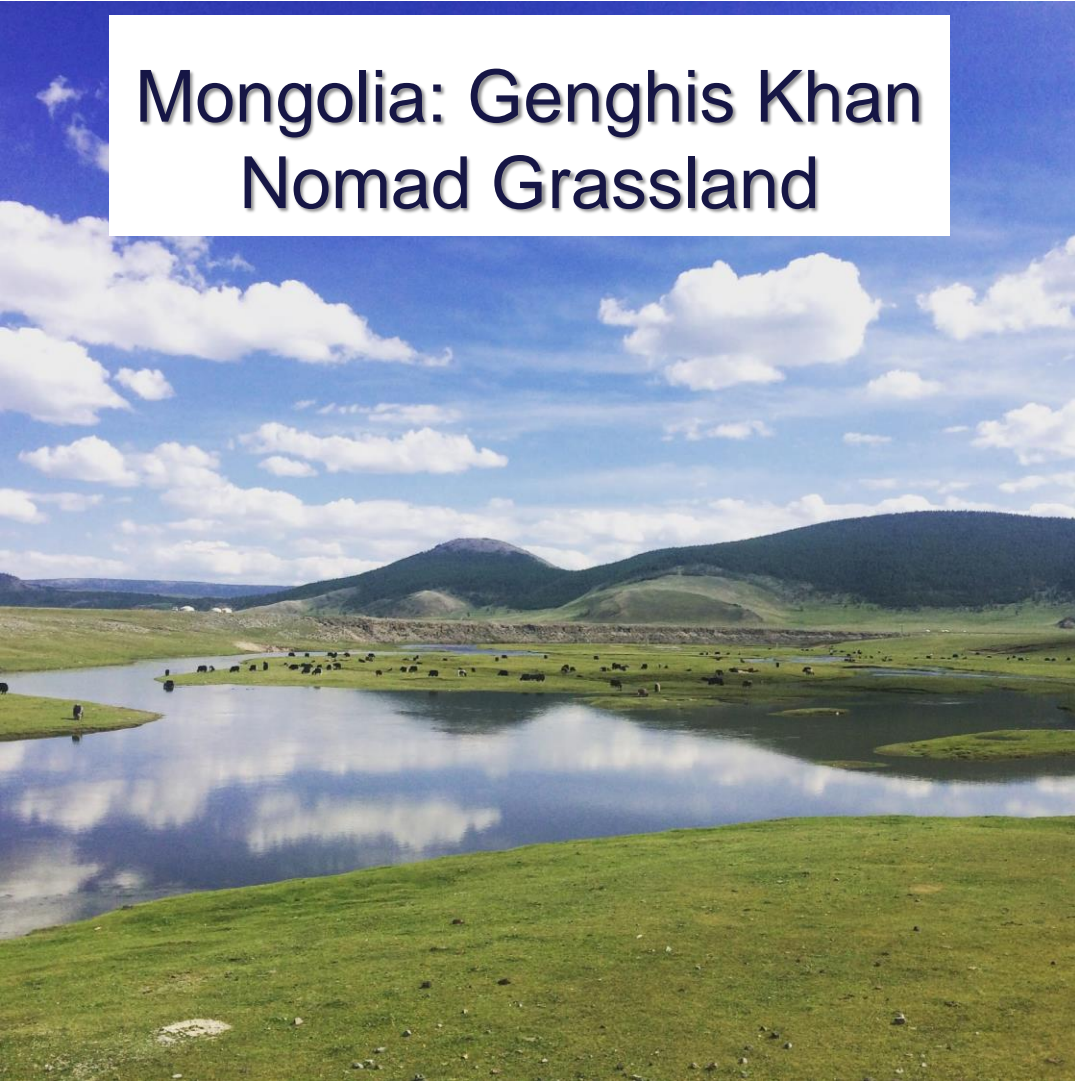


Drivers and Functions of MG Plateau: a synthesis

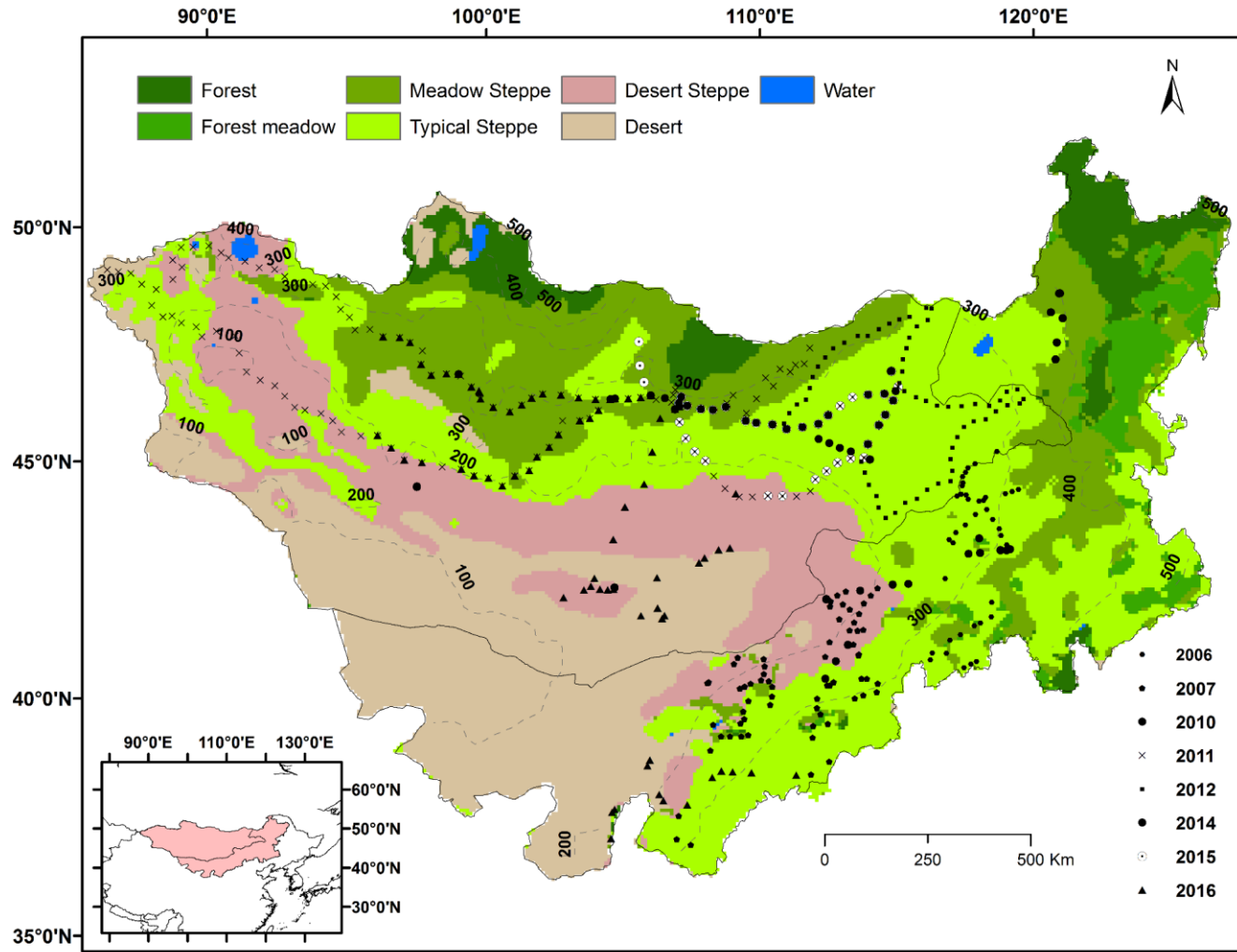


Lessons from the Mongolian Plateau

Mongolia: Genghis Khan
Nomad Grassland

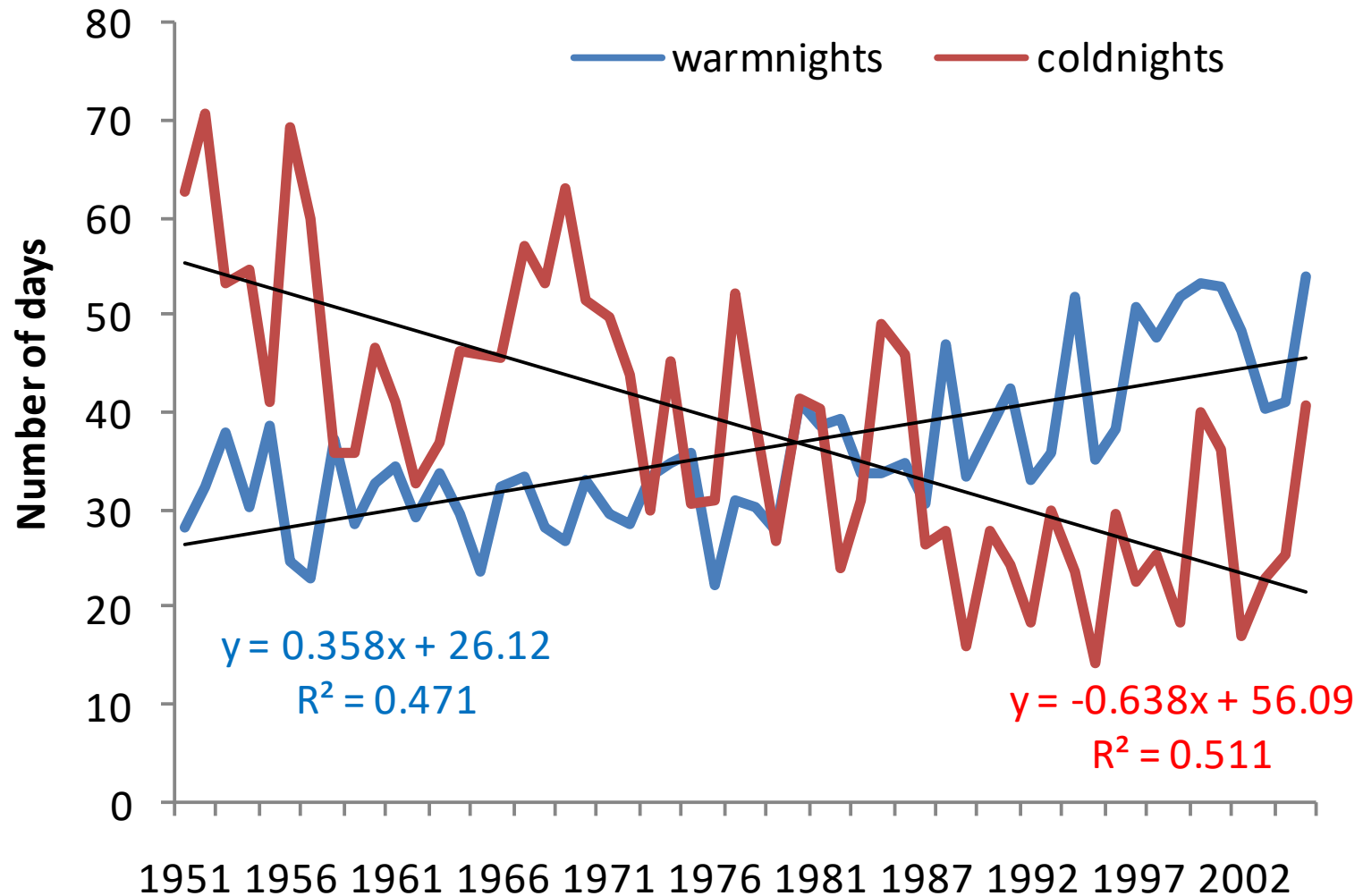


Vegetation type map of the Mongolian plateau overlaid with isohyets (dashed lines) derived from CRU TS323 mean annual precipitation (1981-2014)

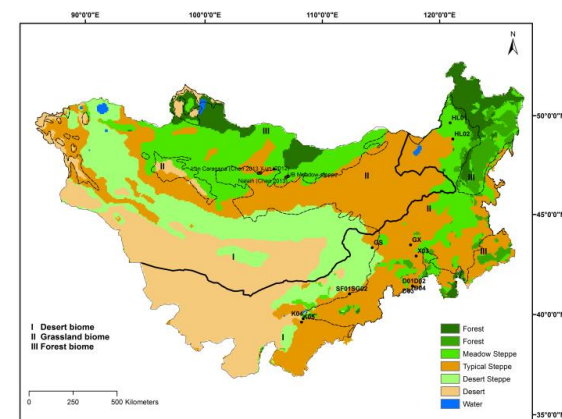
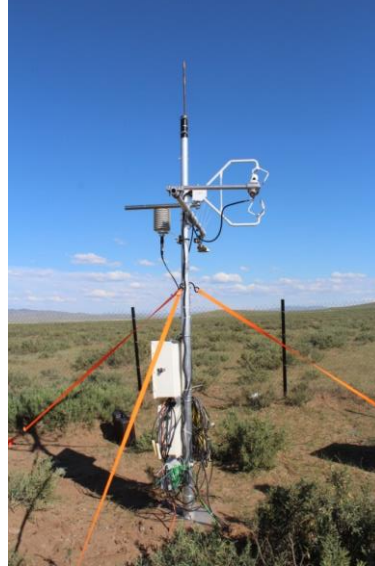


Regional trend of warm nights and cold nights

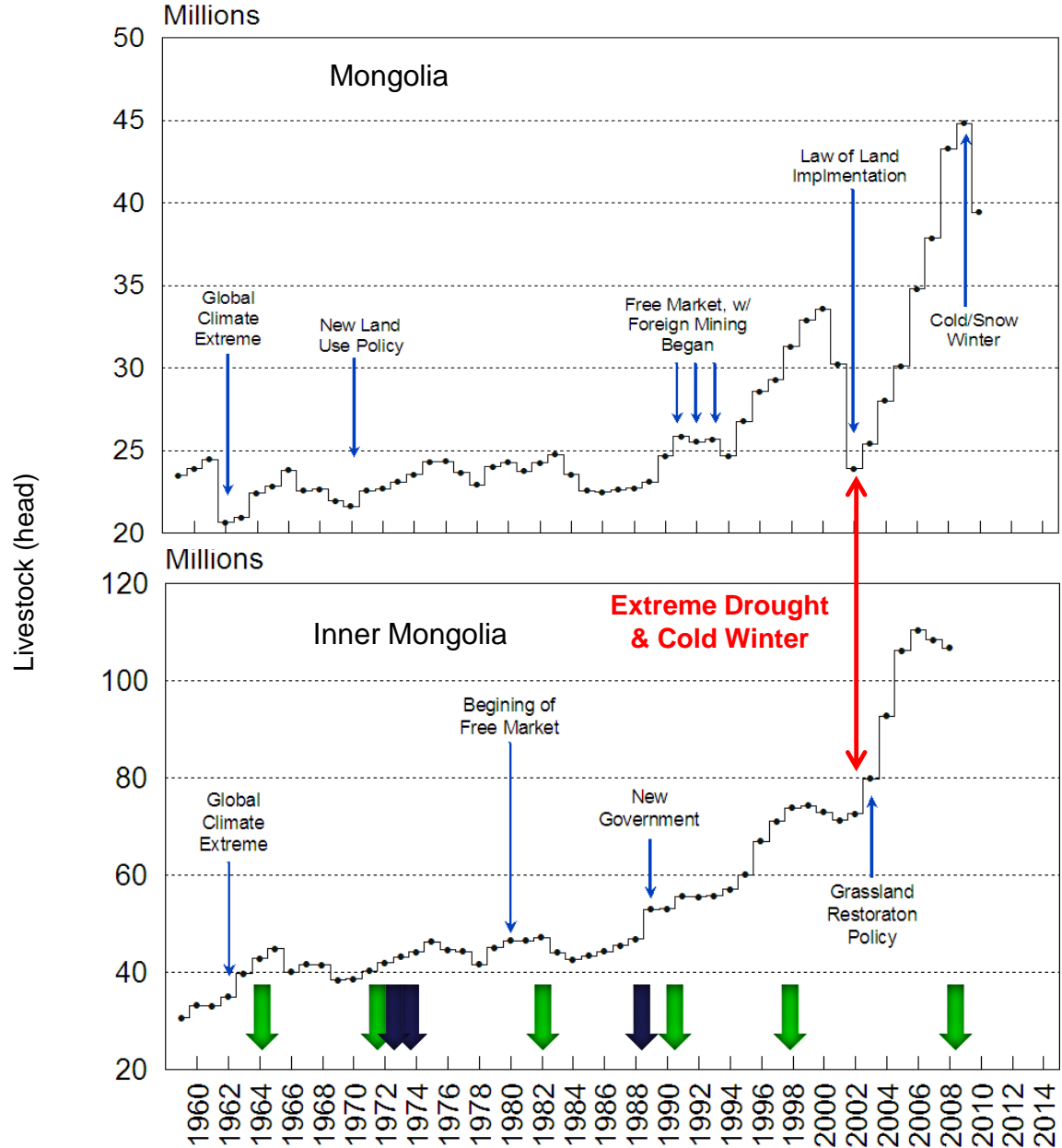
• [10.1016/j.ecolind.2021.108353](https://doi.org/10.1016/j.ecolind.2021.108353)



Direct measurements of CO₂ and H₂O through eddy-covariance towers on the Mongolian Plateau



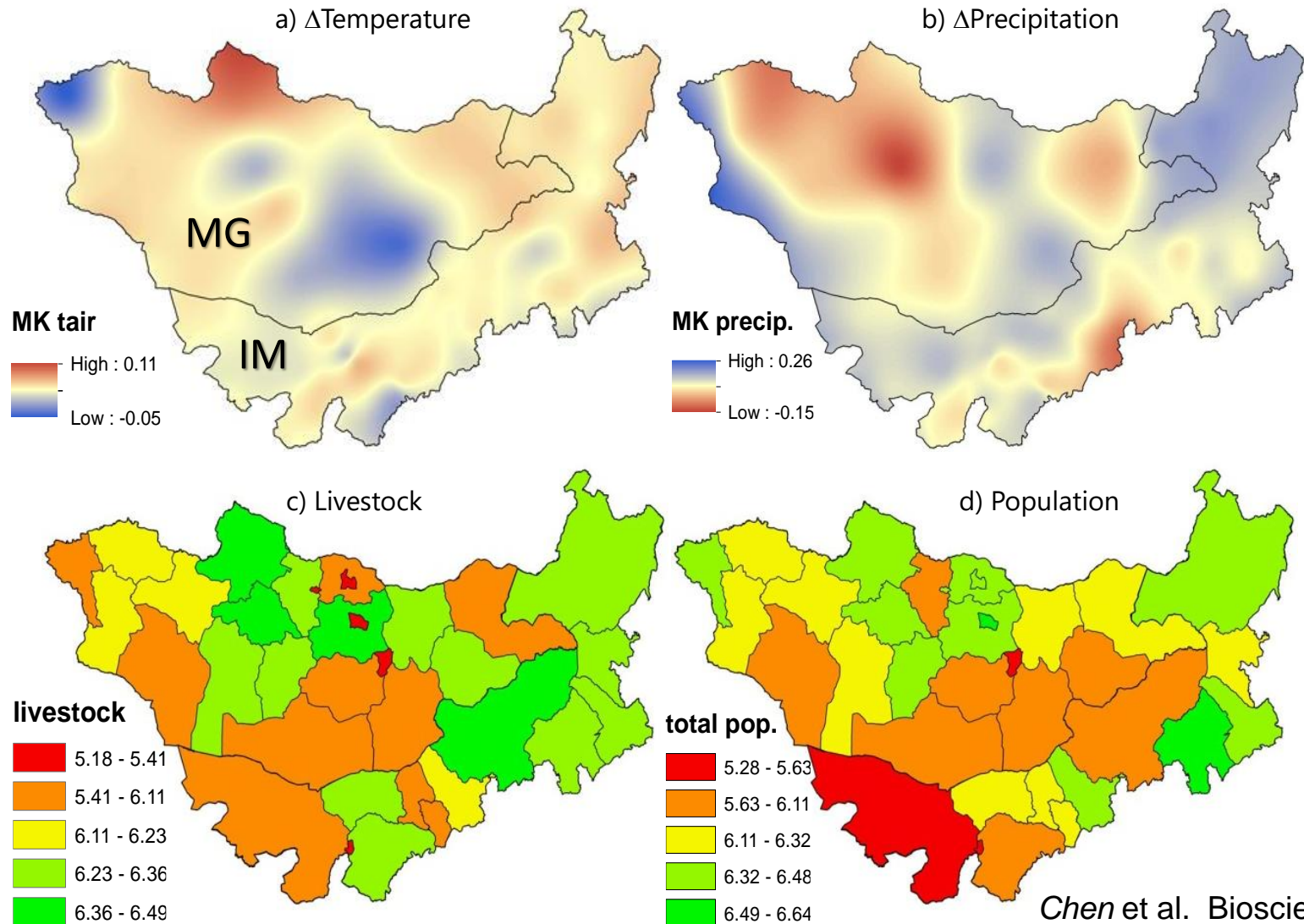
Changes in livestock, policy, and climate in IM & MG



Challenges

- 1) Central to the concept of the coupled natural and human (CNH) system, humans and nature are organized into interacting sub-systems of a cohesive whole at multiple spatial and temporal scales.
- 2) Quantitative linkages between the elements between the human and natural systems are rare!

The contrasting distributions of four demonstrative variables on the Mongolia Plateau showing the mismatches in space and time



Policy-Driven Migration in Mongolia



Abandoned village in Inner Mongolia, China



Modeling the Dynamics of SES

Admirably, many metrics have been developed in each discipline

SOC_{sys}

- Population size
- Life expectancy Index
- Education Index
- Health Index
- Years of Schooling
- Prisoner Population
- Crime Rate
- Unemployment Rate
- Poverty Index
- Urban Population
- Literacy rate
- Labor Force
- Net Immigration Rate
- Family Size
- Sex Ratio
- Age structure
- Birth/Death Rate
- ...

ECO_{sys}

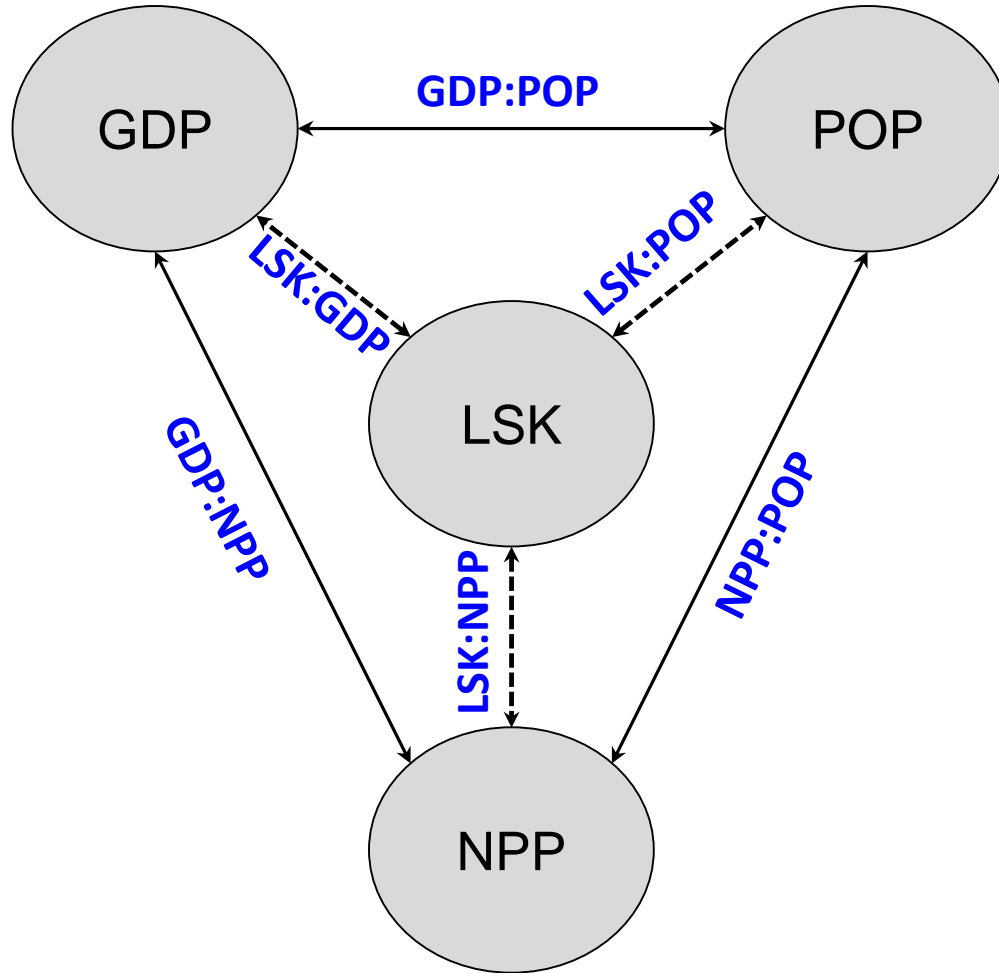
- Gross Primary Production (GPP)
- Net Ecosystem production
- Evapotranspiration (ET)
- Carbon Sequestration strength
- Ecosystem Respiration
- Global Warming Potentials
- Biomass
- Livestock
- Grain production
- Time Volume
- Canopy height/cover
- Stand Density
- Number of Species
- Leaf Area Index
- Diversity Indices
- Soil Water, N, P,
- Water Retention
- ...

ECON_{sys}

- Gross domestic production
- 2nd and 3rd Industrial Production
- Gross Capital Formation
- Health Expenditure
- Steel Production
- Consumer Index
- Energy Consumption
- Ag. Livestock, Forestry Production
- Income Index
- Import/Export
- Remittance
- CO₂ Emission
- Foreign direct investment
- Inflation
- Military Expenditure
- External Debt Stocks
- Domestic Credit
- ...



Connecting the dots representing social, economic, ecosystem functions, and land use



POP: population

GDP: gross domestic production

NPP: net primary production

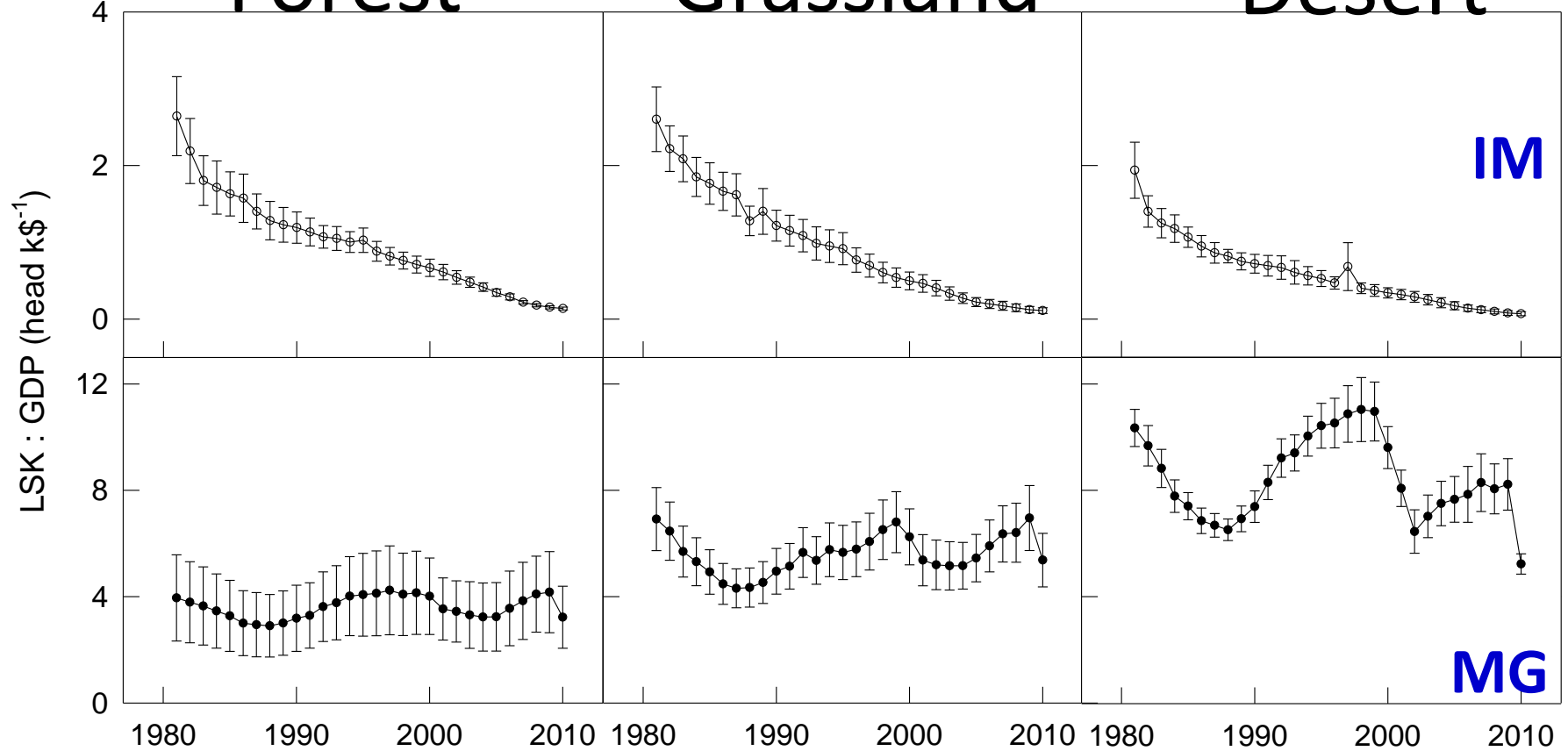
LSK: livestock

Changes in mean (STD) of LSK:GDP by biome

Forest

Grassland

Desert



IMoSES: a single metric for integrating SES function, such as

$$IMoSES = \left[\frac{\sqrt{GDP \cdot (A \cdot NPP)}}{POP} \right] \cdot \frac{1}{ET^{\kappa/2}}$$

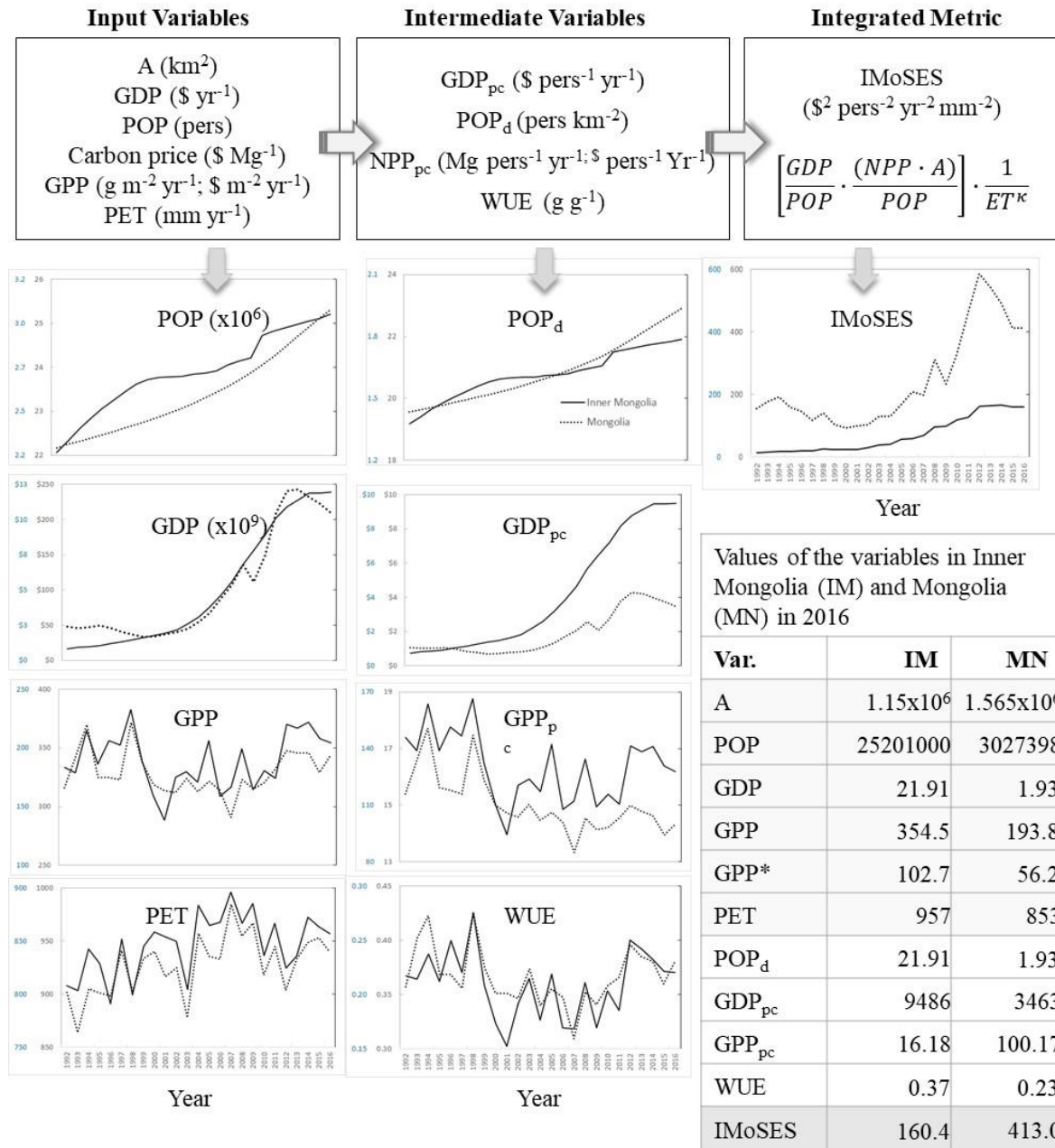
Where

- 1) GDP: Gross Domestic production (\$)
- 2) NPP: Net Primary Production (Mg C.ha⁻¹yr⁻¹)
- 3) POP: Population Size (person)
- 4) WUE: Ecosystem Water Use Efficiency (NPP:ET)
- 5) A: Land Area of the SES (km²)
- 6) A·NPP: Total NPP of the SES (Mg C. year⁻¹)

- 1) The unit of NPP can be converted to \$ yr⁻¹ based on monetary valuations of ecosystem services, resulting in SES_{m1} with a unit of \$ yr⁻¹ pers⁻¹ mm⁻¹.
- 2) Thus, IMoSES can be interpreted as water use efficiency of SES performance. When energy consumption replaces ET, SES_{m1} becomes a measure of energy use efficiency.

Modeling the Dynamics of SES

Calculations of the intermediate variables and IMoSES from six input variables using the algorithms of Equations (3)–(5). Historical data during 1992–2016 from Inner Mongolia (IM) and Mongolia (MN) are used to illustrate the changes of input variables, intermediate variables and IMoSES. Because of the large differences between the two jurisdictions, independent vertical axes are used for MN (leftmost labels, blue) and IM (rightmost labels, grey). The vertical axes are scaled for easy visualization of the changes over time.



Major Policy Shifts

Inner Mongolia

WTO 2001: China became a member of the World Trade Organization

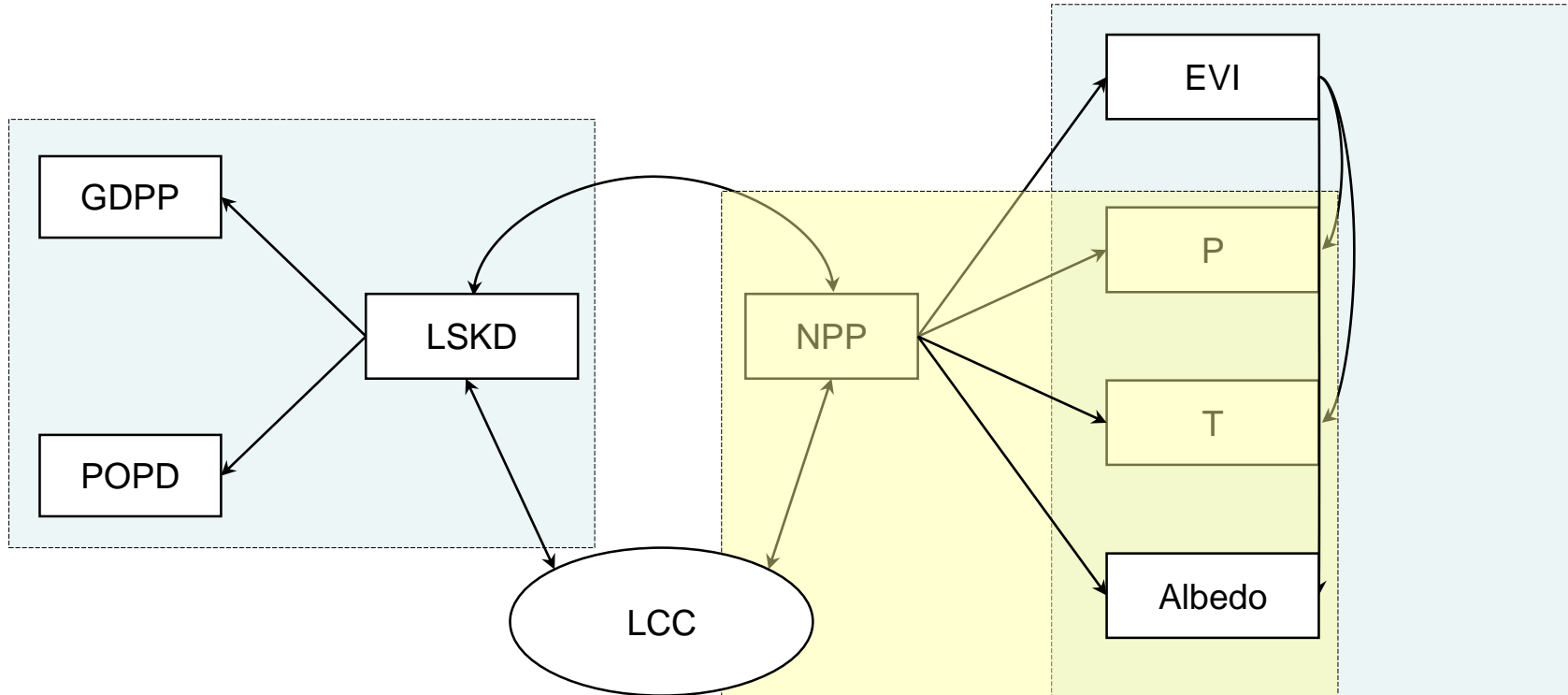
GFG 2001: Grain for Green

Mongolia

CSU 1991: Collapses of the Soviet Union

Atar 1995: 2001

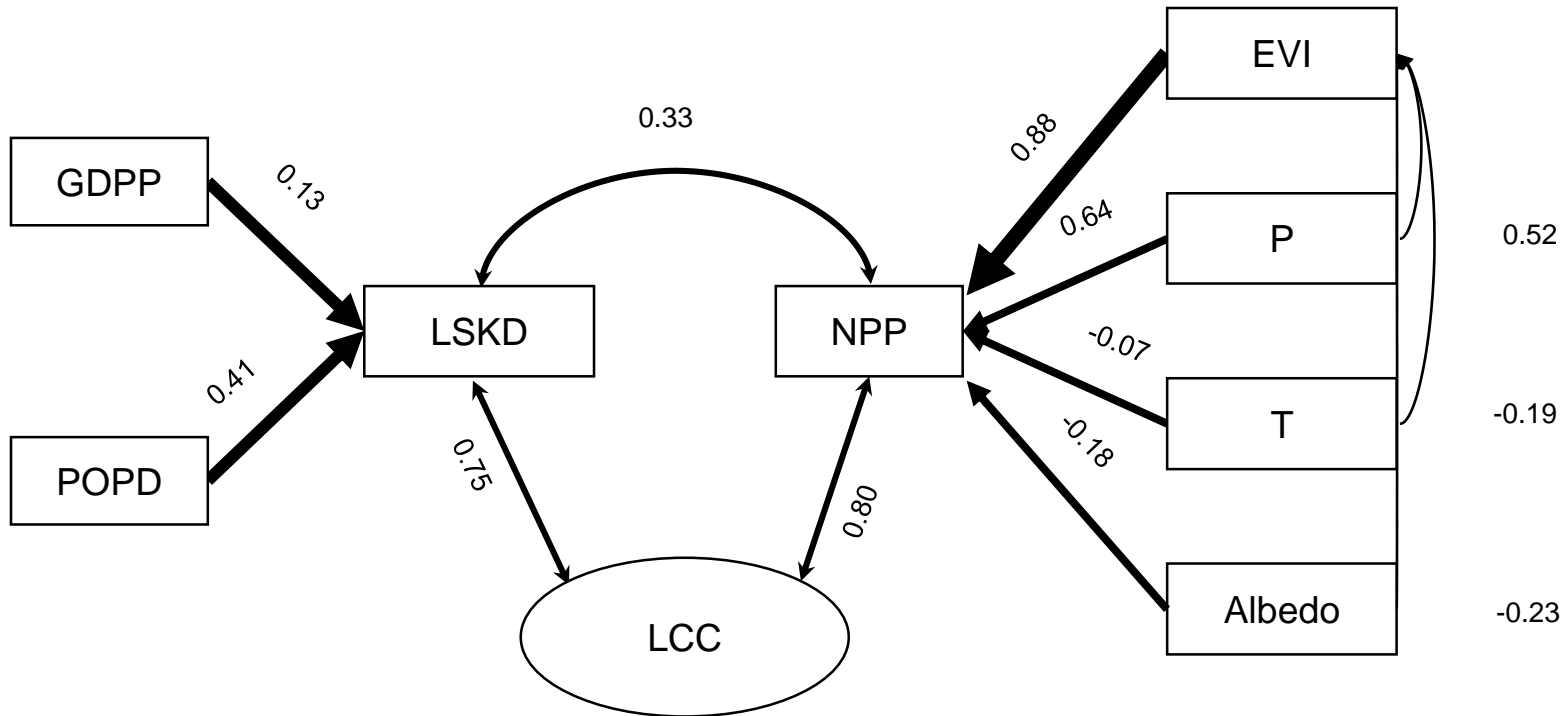
Hypothesis: Structural Equation Modeling (SEM)





Mongolia Plateau

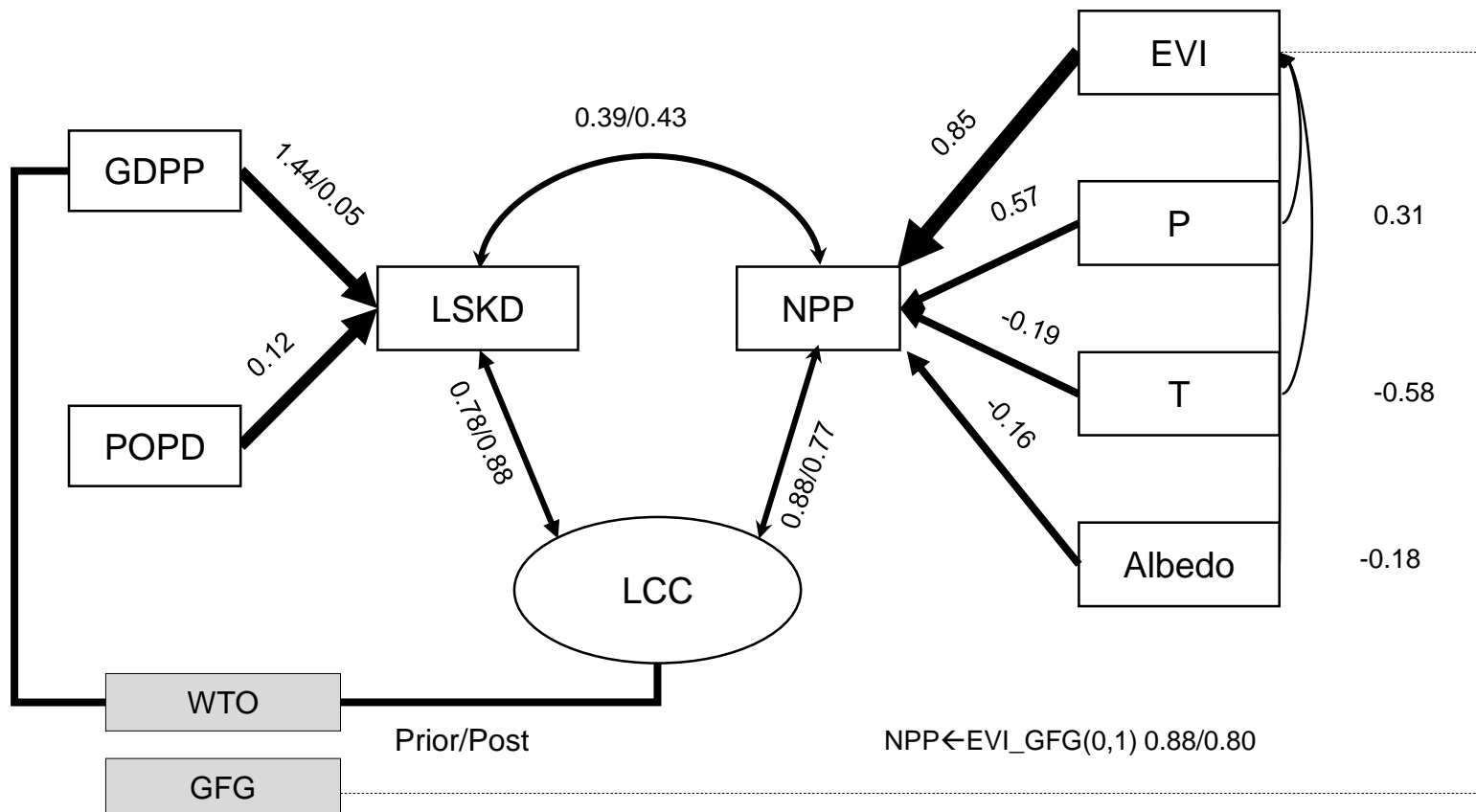
The Structural Equation Modeling of the CNH system





Mongolia Plateau

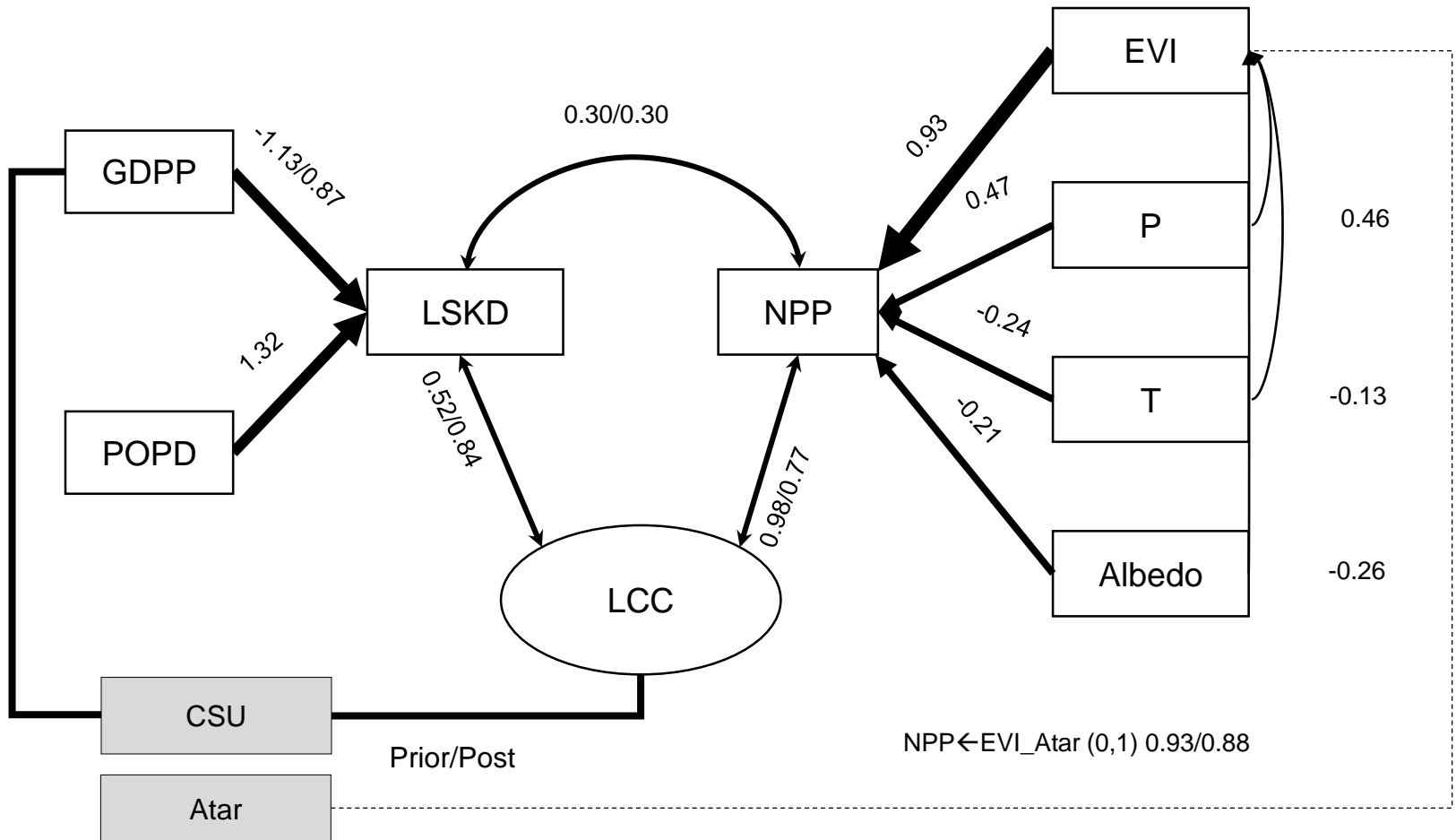
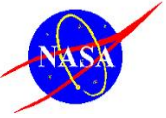
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Mongolia Plateau

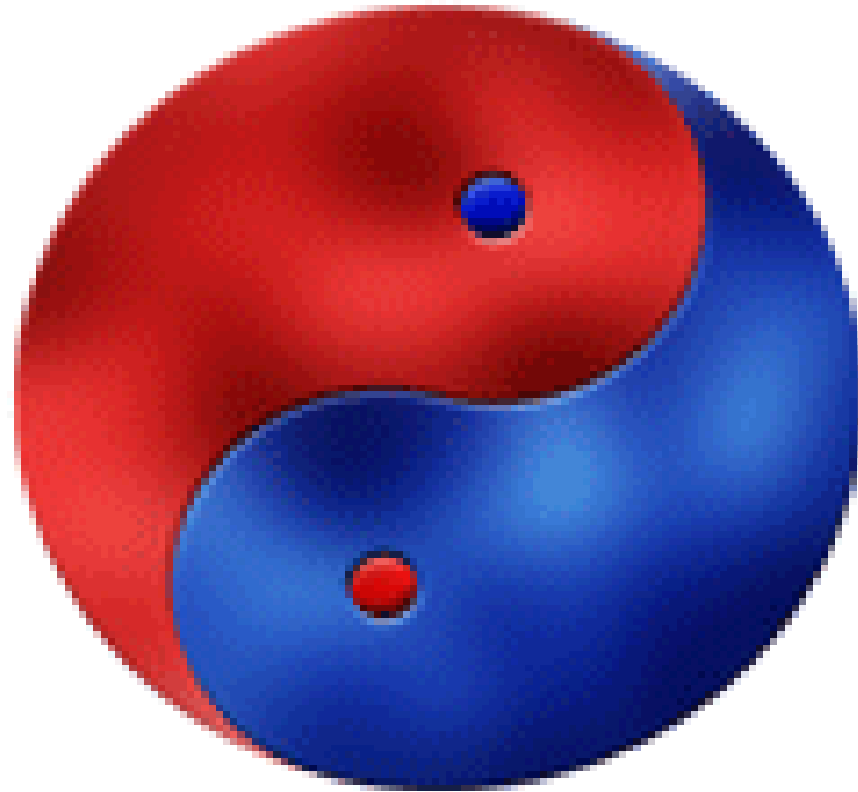
The Structural Equation Modeling of the CNH system



Thank You for Listening!

Webpage: <http://lees.geo.msu.edu/>

Email: jqchen@msu.edu



Discussion