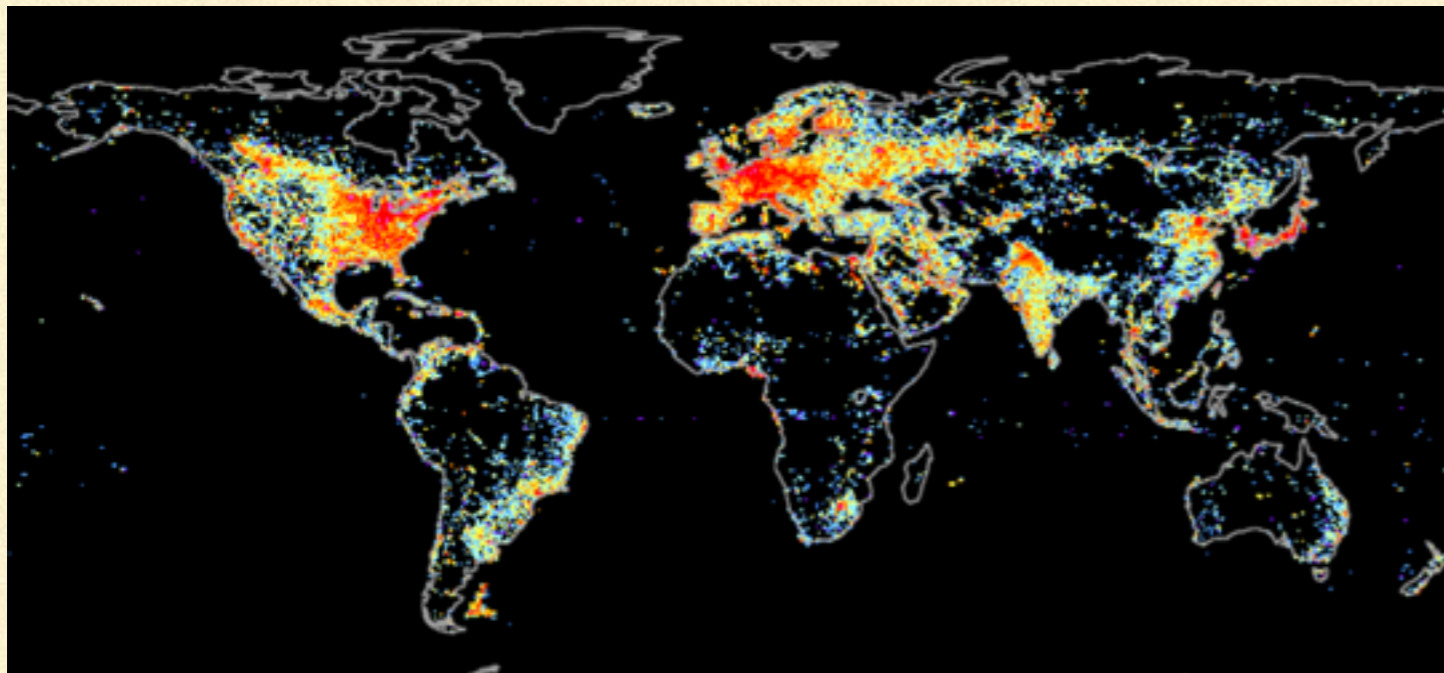


NEXT GENERATION MODELS FOR PLANETARY MANAGERS



Michael Barton - May 2016

A HUMANIZED PLANET



- > 50% of land in crops or pasture

A HUMANIZED PLANET



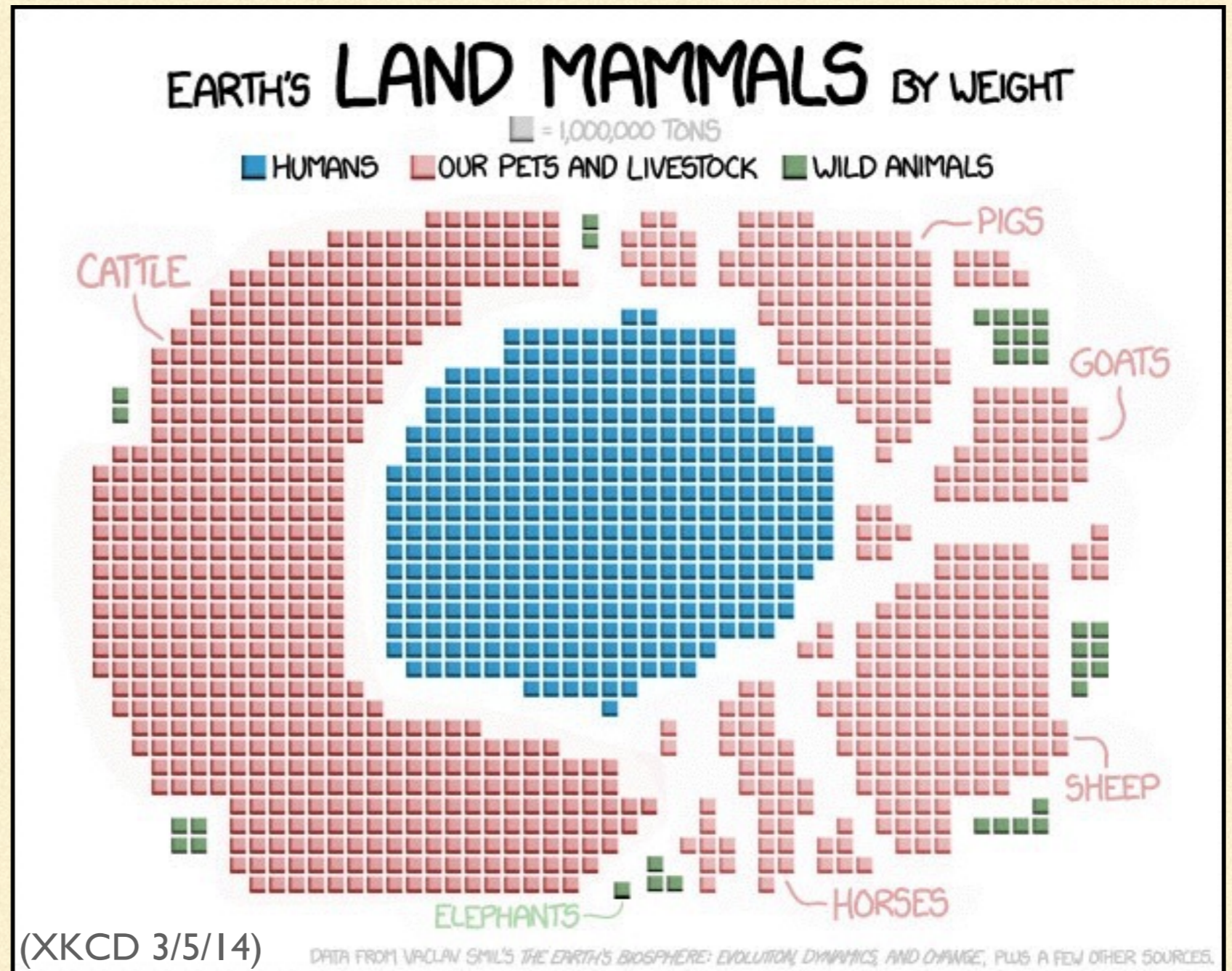
- > 50% of land in crops or pasture

- > 50% of forests cleared; more reforested



A HUMANIZED PLANET

- Humans plus agro-biomass >3 billion tons
- More than all other vertebrates combined (land and sea)



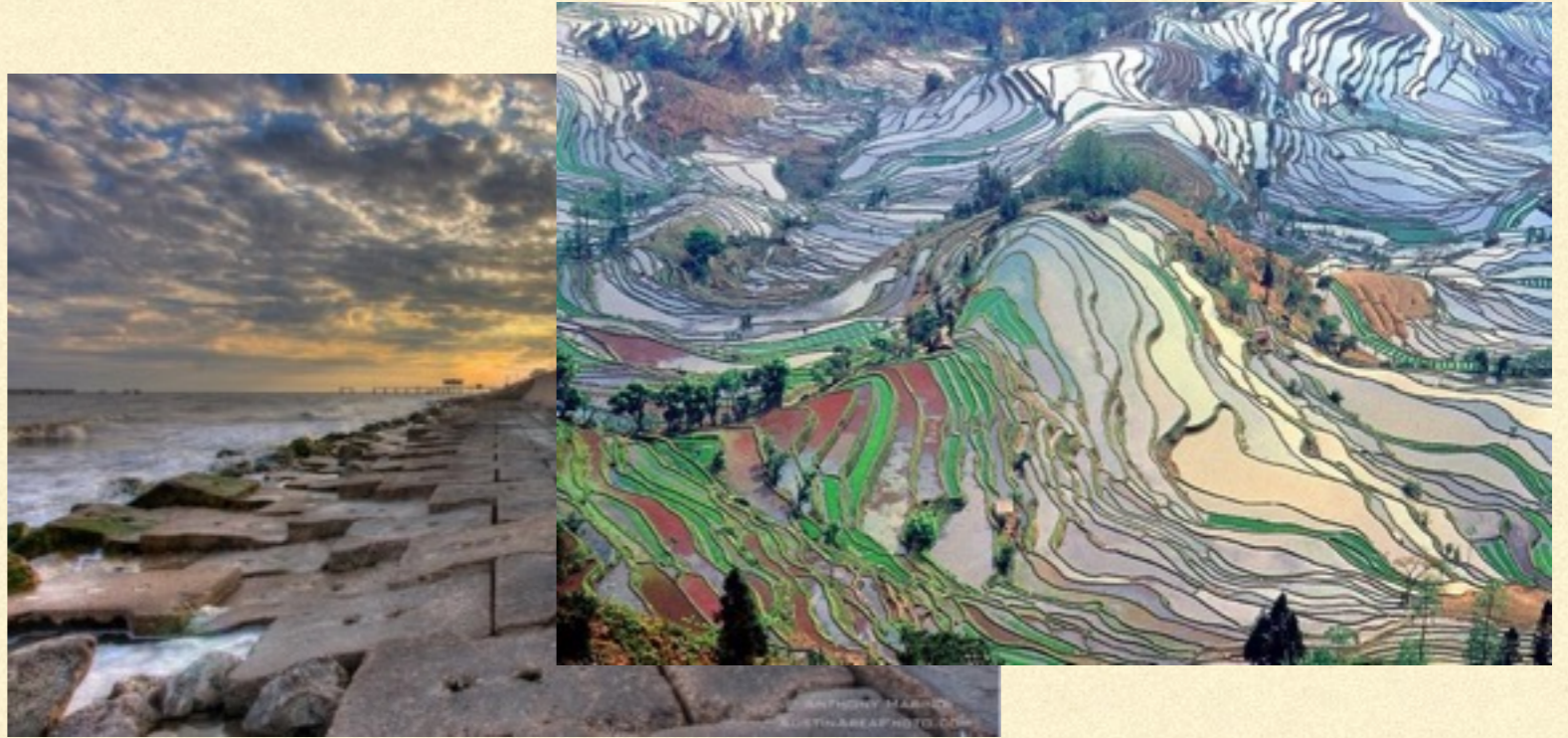
A HUMANIZED PLANET

- Coastlines engineered



A HUMANIZED PLANET

- Coastlines engineered
- > 50% of fresh water used and 6x more water stored



A HUMANIZED PLANET

- Coastlines engineered
- > 50% of fresh water used and 6x more water stored
- More N cycled

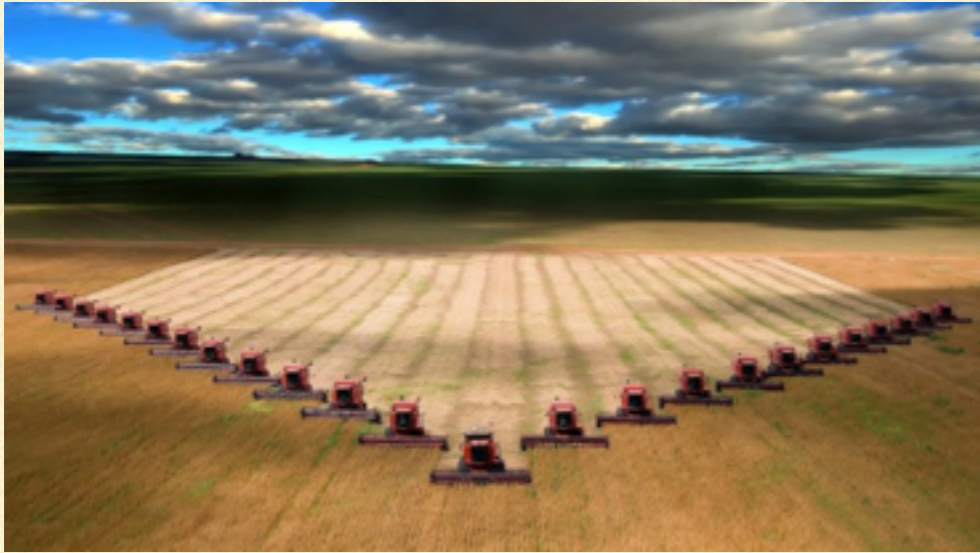


A HUMANIZED PLANET

- Coastlines engineered
- > 50% of fresh water used and 6x more water stored
- More N cycled
- More sediment transported



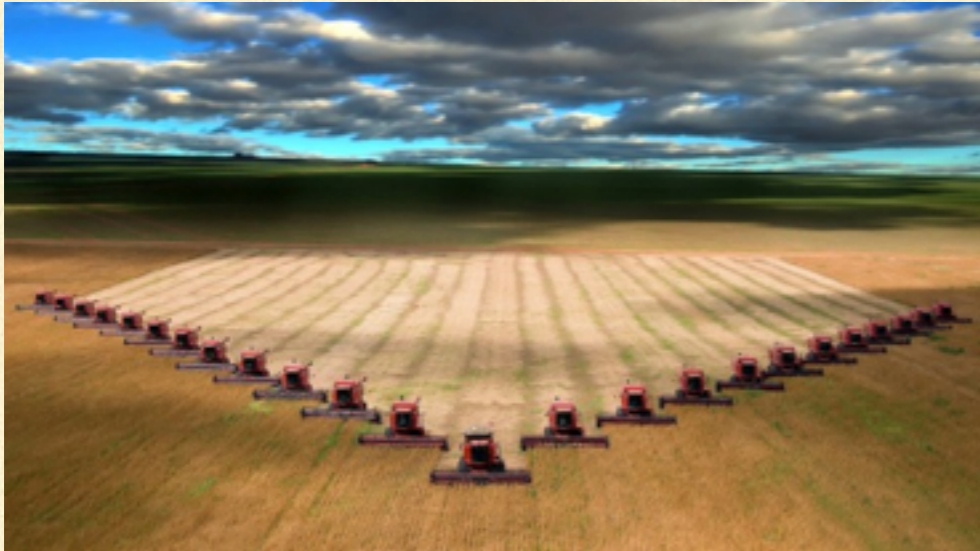
A HUMANIZED PLANET



Ruddiman et al 2016

- Humanity is more than a global keystone species
-

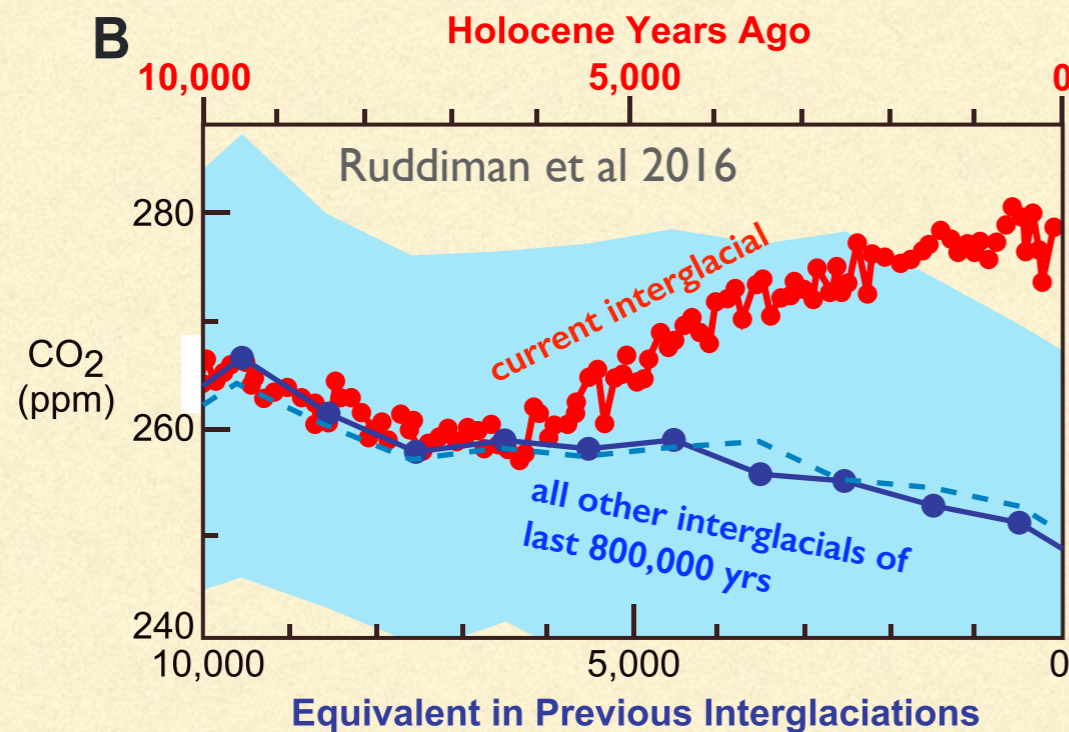
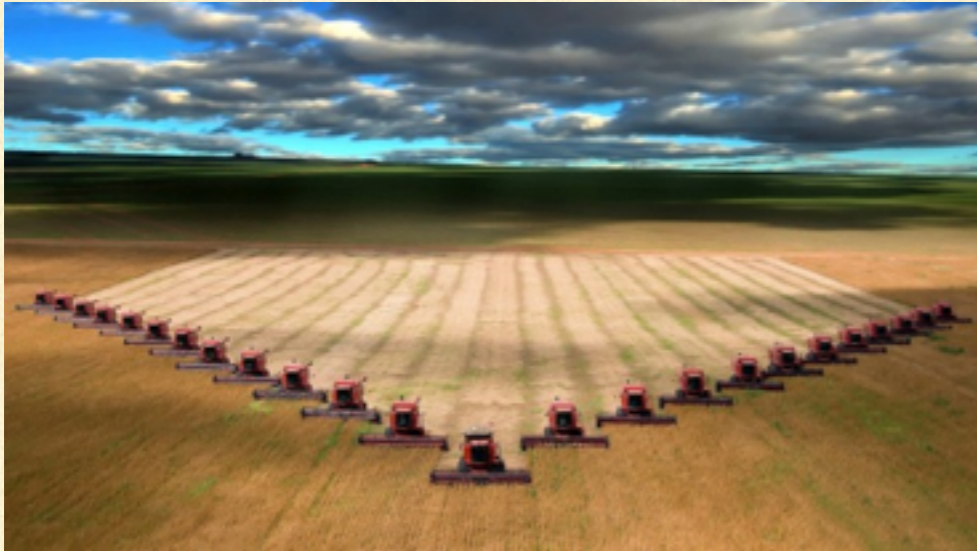
A HUMANIZED PLANET



Ruddiman et al 2016

- Humanity is more than a global keystone species
 - Our planetary environment shaped by human decisions, technology, and nature
-

A HUMANIZED PLANET



- Humanity is more than a global keystone species
- Our planetary environment shaped by human decisions, technology, and nature
- Human impacts can exceed non-human forces

A HUMANIZED PLANET

- The human species has transitioned from individuals harvesting wild resources



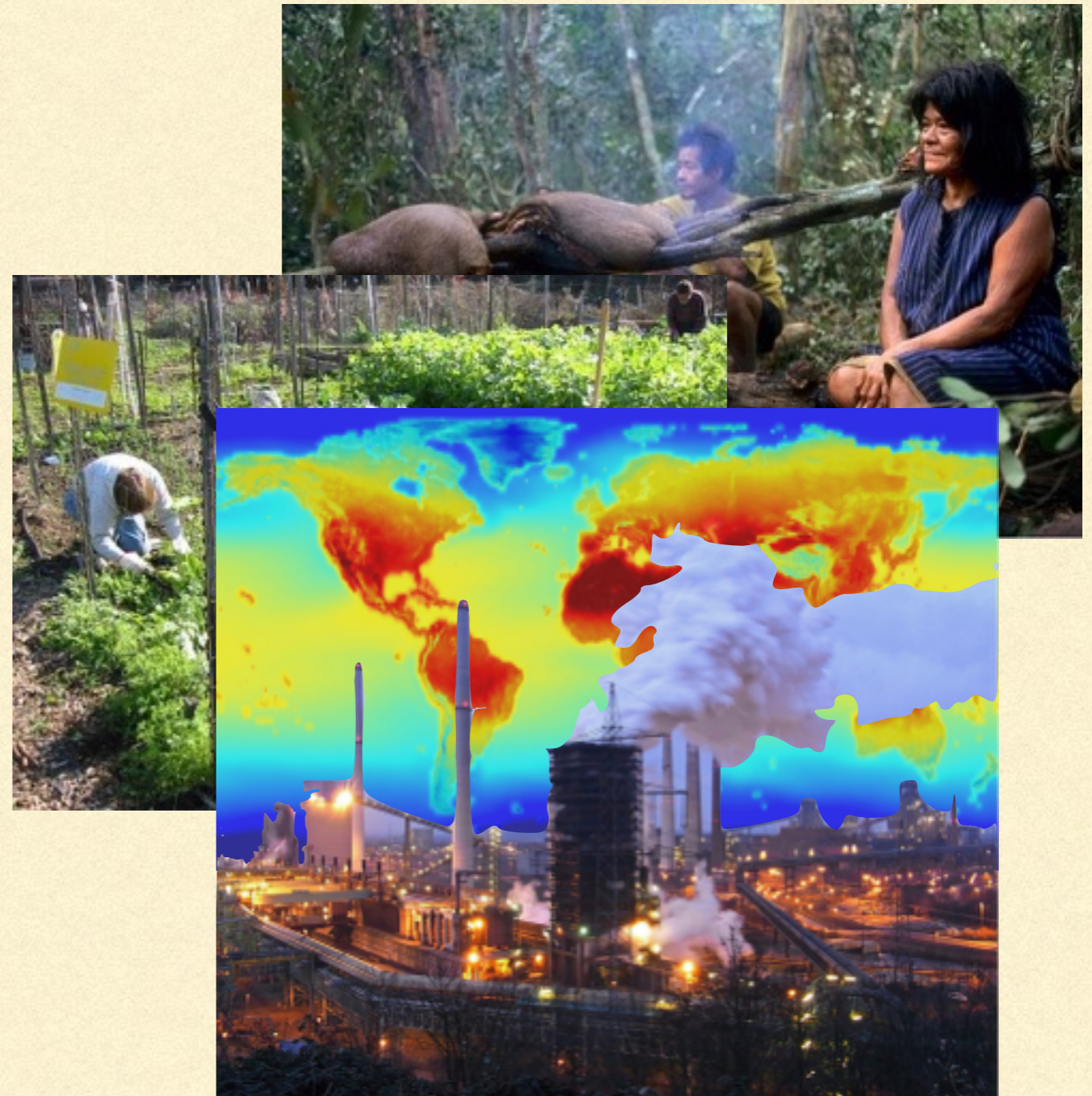
A HUMANIZED PLANET

- The human species has transitioned from individuals harvesting wild resources
- To communities managing local ecosystems



A HUMANIZED PLANET

- The human species has transitioned from individuals harvesting wild resources
- To communities managing local ecosystems
- And now are confronted with the need to manage our planetary systems



A NEW SOCIAL REALITY

- Our social life has also become global
- Humankind has transformed from a normal terrestrial animal to a unique global phenomenon
- Nearly 8 billion people
- Over half live in urban hives of millions of individuals



A NEW SOCIAL REALITY



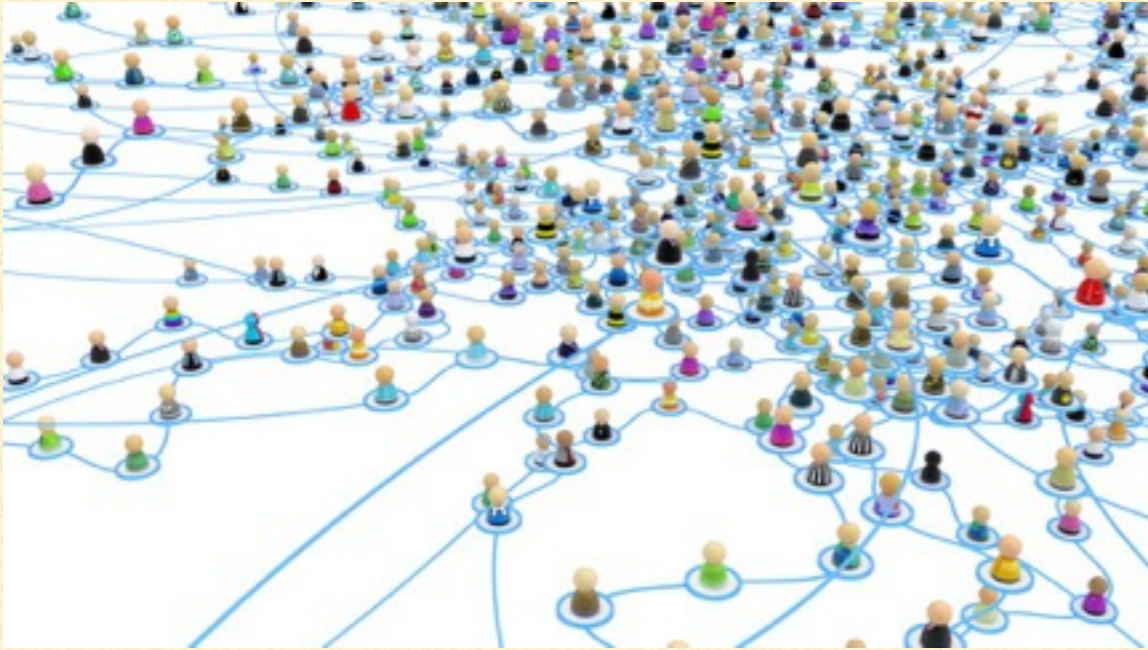
- Digital media and rapid transportation now connect humanity economically, socially, and culturally in a global network of multiple, cross-cutting ties
- This has created *complex social-ecological-technological systems* (CSETS) at planetary scale

A NEW SOCIAL REALITY

- A few millennia ago, all people lived in small communities
- An individual could observe social and natural phenomena and extrapolate the consequences of their actions on fellow humans and the natural world
- This is no longer the case



PLANETARY CSETS



- Scale and complexity of our global CSETS *unprecedented for any organism in earth's history*

PLANETARY CSETS



- Scale and complexity of our global CSETS *unprecedented for any organism in earth's history*
- CSETS multi-dimensional, multi-scale causality and non-linear dynamics *exceed our innate abilities* to anticipate the consequences of decision-making

PLANETARY CSETS



- Scale and complexity of our global CSETS *unprecedented for any organism in earth's history*
- CSETS multi-dimensional, multi-scale causality and non-linear dynamics *exceed our innate abilities* to anticipate the consequences of decision-making
- And human system dynamics are *major drivers of Earth's biophysical environment*

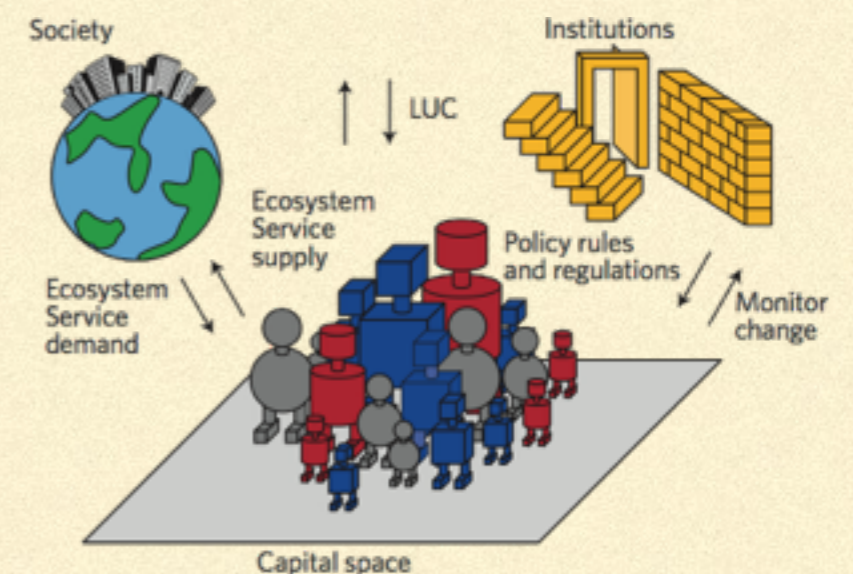
NEXT GENERATION SCIENCE FOR PLANETARY SOCIOECOLOGICAL SYSTEMS



- In an Earth dominated by rapidly changing, telecoupled human and biophysical processes...
 - we need next generation data-driven science and modeling to enable us to sustainably manage dynamics of a planetary socio-ecological system
-

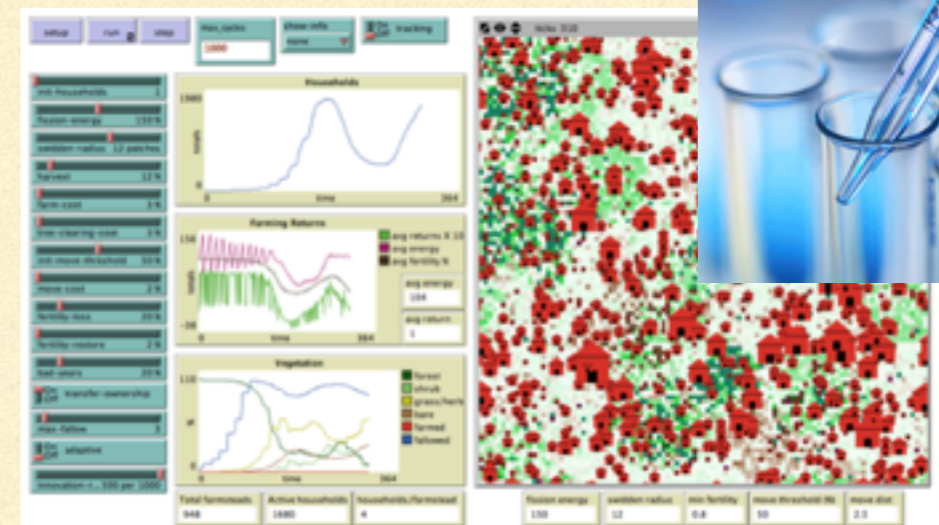
NEXT GENERATION SCIENCE FOR PLANETARY SOCIOECOLOGICAL SYSTEMS

- Building new capacity in data science and modeling of human systems at planetary scales poses significant challenges
- Require coordinated, community-wide efforts
- Need to build on existing research and also be willing to explore new directions
- Briefly outline some of the relevant issues and challenges

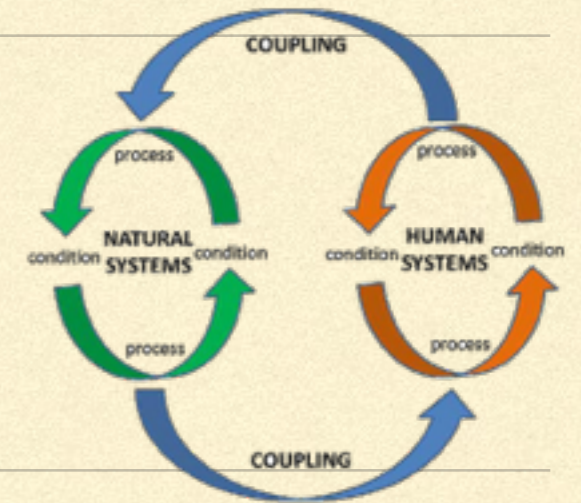


MODELING GOALS

- All models are wrong but some are useful (G. Box)
- What kind of models are most useful - produce the most value - for scientific understanding and for planetary management?
- Generative/process models vs. descriptive/empirical models
- Models as experiment & scenario creation vs. replicating the planet *in silico*
 - Which behaviors or phenomena are controlled or boundary conditions?
 - Which are simulated?
 - Which can be ignored?

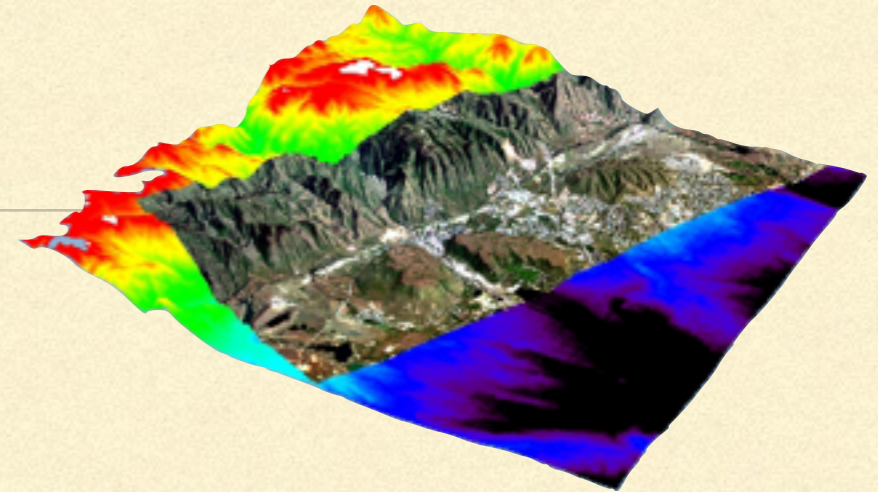


FEEDBACKS ARE CRUCIAL



- We know from abstract models and small-scale realistic simulations that...
 - Insignificant differences can have enormous consequences in complex systems due to cascades of interaction effects and feedbacks
 - Powerful forces can have negligible consequences for the same reasons
 - Feedbacks in CSETS should be equally important at global scales.
 - How can we create modeling environments that simulate feedbacks between human and biophysical processes?
-

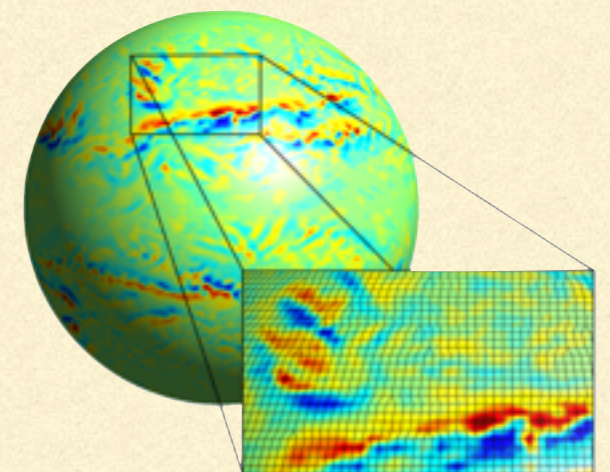
SPACE MATTERS...EXCEPT WHEN IT DOESN'T



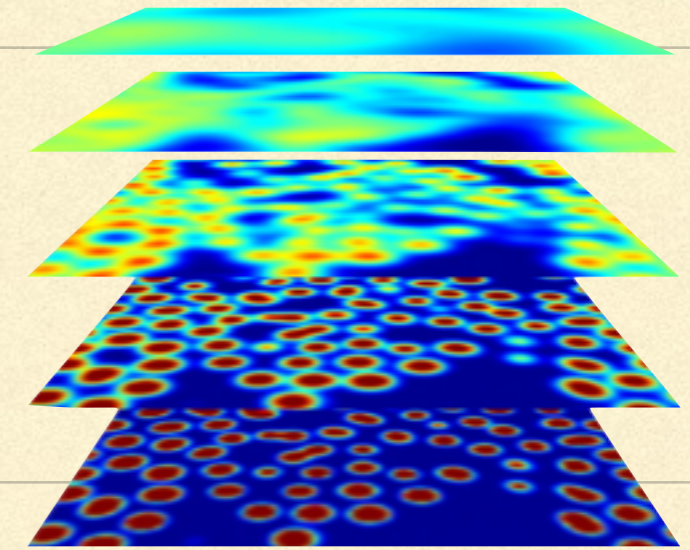
- Much current social science is aspatial
 - e.g.: individual cases studies, social networks, national surveys, economic indicators
 - Human action and impacts on biophysical systems are local and vary across space
 - But interaction effects change across scales
 - And electronic media have created global interaction networks where distance is irrelevant—though consequences may still be local.
 - How can we represent interactions of spatially-explicit social actors and distance-irrelevant information networks?
-

DYNAMICS CROSS MULTIPLE SCALES

- Climate is global, weather is local. Policies and institutions are top down, human action is bottom up.
 - Combined effects of many individual actions are changing climate
 - Climate imposes boundary conditions on weather which affects human actions
- Interaction effects and feedbacks cause CSETS dynamics operate across multiple scales.
- How do we model cross-scale processes and consequences



WHERE & HOW TO COARSE-GRAIN



- In all CAS, higher level emergent properties are not easily explained or predicted from properties of individual lower level components
 - All biophysical and human components of CSETS composed of subatomic particles
 - Earth's thermal balance can be represented in a single equation
 - Neither scale of analytical units or processes helpful for understanding and managing most relevant dynamics of global CSETS
 - Between the scales of modeling 8 billion individual agents, and aggregating all people into a single variable, what provides the most value and is most tractable?
 - How to downscale and coarse-grain up human systems processes and interactions at chosen scales?
-

BIG DATA ARE SMALL DATA

- Much current social science focuses on ...
 - Few, information rich cases
 - Indices aggregated across a few regions

BIG DATA ARE SMALL DATA

- Much current social science focuses on ...
 - Few, information rich cases
 - Indices aggregated across a few regions
- Need to make much better use of ...
 - Many cases with a little information in each
 - High-dimensional data
 - Integrating ontologically diverse and multi-scale data sets



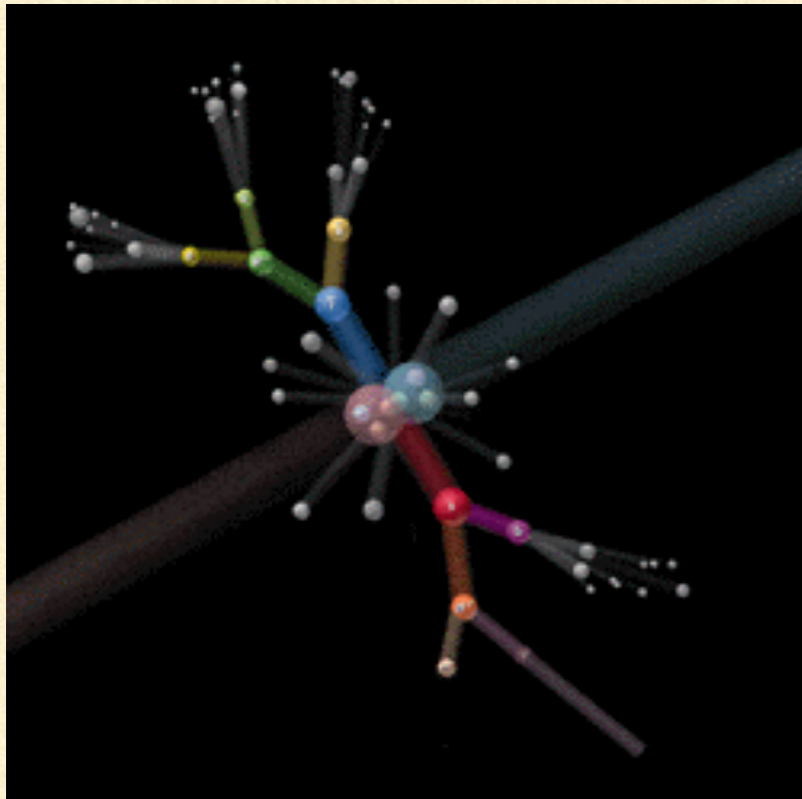
PRAGMATICS

```
def are_connected(self, user1, user2):  
    """  
    Returns a queryset of connections for user.  
    """  
    set1 = self.filter(from_user=user1).select_related(depth=1)  
    set2 = self.filter(to_user=user2).select_related(depth=1)  
    return set1 | set2  
  
def are_connected(self, user1, user2):  
    if self.filter(from_user=user1, to_user=user2).count() > 0:  
        return True  
    if self.filter(from_user=user2, to_user=user1).count() > 0:  
        return True  
    return False  
  
def remove(self, user1, user2):  
    """  
    Deletes proper object regardless of the order of users in arguments.  
    """  
    connection = self.filter(from_user=user1, to_user=user2)  
    if not connection:  
        connection = self.filter(from_user=user2, to_user=user1)  
    connection.delete()  
models.py  
Top 11
```

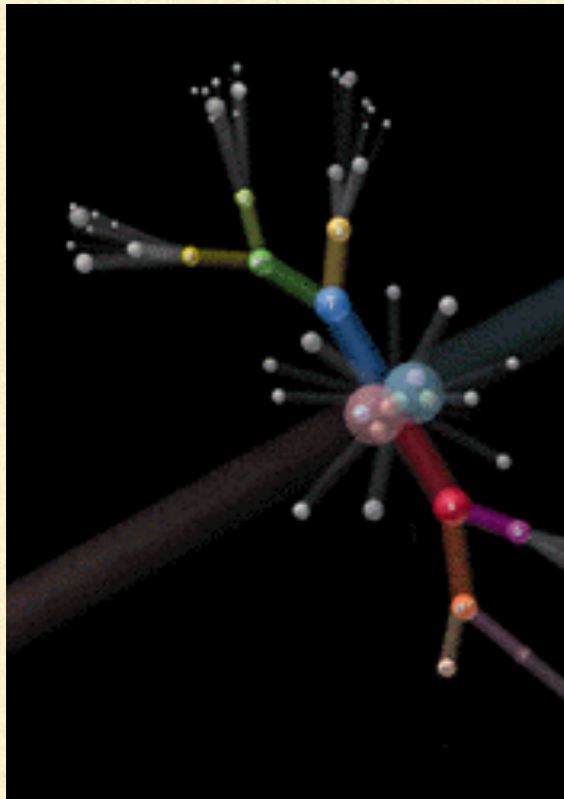


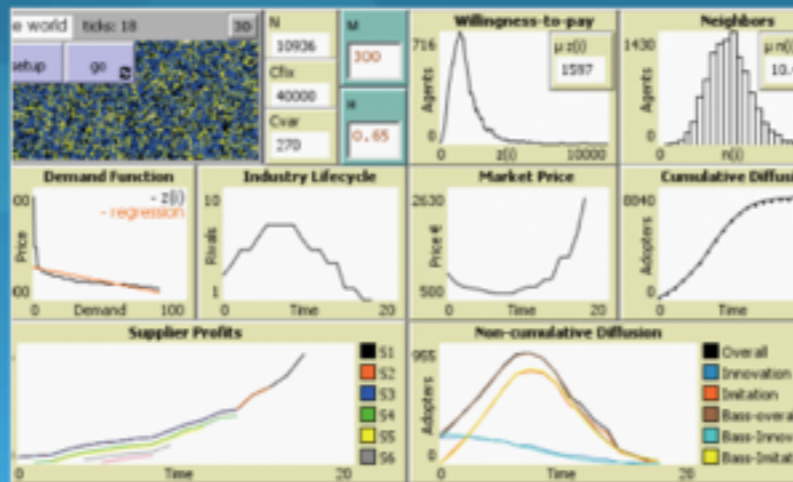
- How do we intellectually maintain and manage a global scientific agenda for modeling human systems?
- Who writes the code? In what language?
- How does modeling environment evolve?
- How do we maintain standards for API or I/O and integrate them with existing ESMs?
- Where can the code be run?
- How do we decide which modeling experiments to run?
- How do we evaluate results? (HSMIPS?)

A FIRST STEP FOR NEXT GENERATION HUMAN-EARTH SYSTEMS SCIENCE



A FIRST STEP FOR NEXT GENERATION HUMAN-EARTH SYSTEMS SCIENCE





Featured Content

9 Maturity levels in Empirical Validation - An innovation diffusion example

The model integrates both demand and supply in a single model. The underlying demand function links both sides. It is determined by consumer's learning status, the awareness

[View Model](#)

Welcome to CoMSES Net

The Network for Computational Modeling for SocioEcological Science (CoMSES Net) and OpenABM provide a growing collection of resources for model-based science, including: tutorials and FAQ's on agent-based modeling, a model library intended to provide a locus for authors and modelers, a forum for discussions

The Computational Model Library is a library of downloadable agent-based models

[Find models](#)

[When to use agent-based models?](#)

[Submit a model to the library](#)

COMSES NET

Network for Computational Modeling in Social & Ecological Sciences

Partner with CSDMS for organizing workshop

COMSES NET

open abm ... a node in the CoMSES Network

Home about faq contact

Home
Model Library
Education
Resources
Bibliographic Library
Events Calendar
Forums
Jobs & Appointments
CoMSES Membership

Welcome to OpenABM & CoMSES

OpenABM is a node in the CoMSES Network, providing a growing collection of tutorials and FAQs on agent-based modeling, a model library intended to provide a locus for authors and modelers to share their models, and forums for modeling-related discussions and job postings.

The Network for Computational Modeling for SocioEcological Science (CoMSES Net) is a scientific research coordination network to support and expand the development and use of computational modeling in the social and life sciences.

[Read more](#)

Featured Model

Replication of the well known Artificial Anasazi model that simulates the population dynamics between 800 and 1350 in the Long House Valley in Arizona.

[more ... Artificial Anasazi](#)

ABM News

CIP: special issue of Sociometrics on "Simulating the Social Processes of Science"

Oct 15: There will be a special issue of Sociometrics on "Simulating the Social Processes of Science" Basically asking for agent-based simulations of science. Deadline 30th April 2015 Full details at: <http://simsocsci.blogspot.co.uk/2014/10/cip-special-issue-of-sociometrics-on.html>

[Read More](#)

CoMSES By-Laws Approved

Oct 03: The CoMSES By-Laws were approved by the membership.

[Read More](#)

A Computational Model Library for publishing model documentation and code

Jul 27: New article describing CoMSES and its goals published in Environmental Modeling & Software.

[Read More](#)

Agent Based Models and RNetLogo

Jul 27: If I had to pick just one application to be the "killer app" for the digital computer I would probably choose Agent Based Modeling (ABM).

[Read More](#)

Call For Papers Deadlines

Oct 25, 2014 - Modelling Routines

Oct 29, 2014 - Computational Social Science Winter Symposium

Oct 31, 2014 - Policy Modeling in Practice Workshop

Nov 15, 2014 - International Conference on Computational Social Science

Jan 01, 2015 - Summer School Complex Networks: Theory, Methods, and Applications

[Read More](#)

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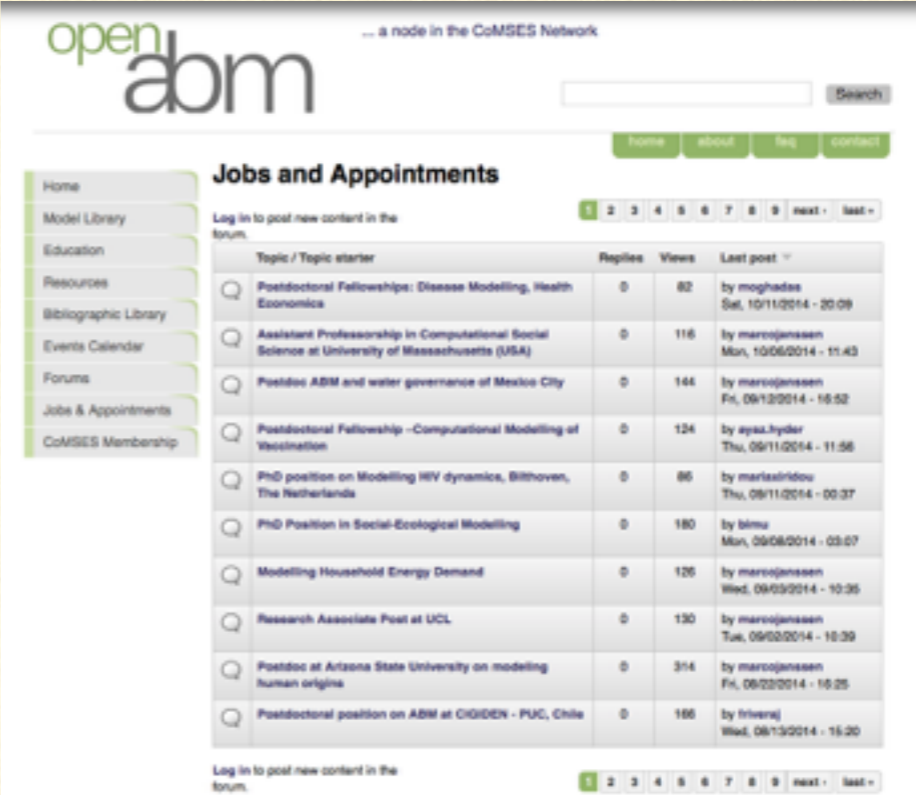
© 2012 OpenABM Consortium

List

- NSF sponsored Research Coordination Network
- A community of practice for scientists using advanced modeling to study human and natural systems

COMSES NET

- Framework for interaction and professional development

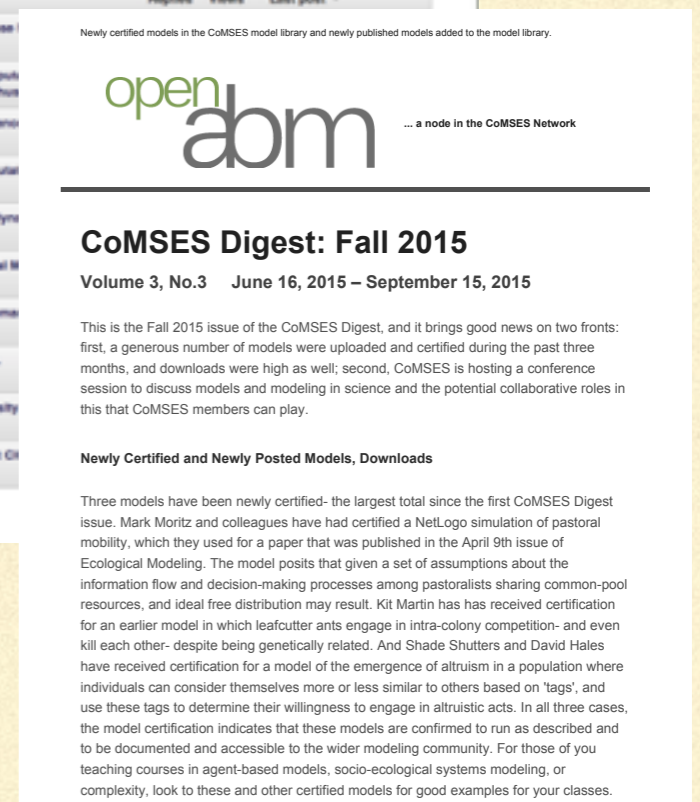
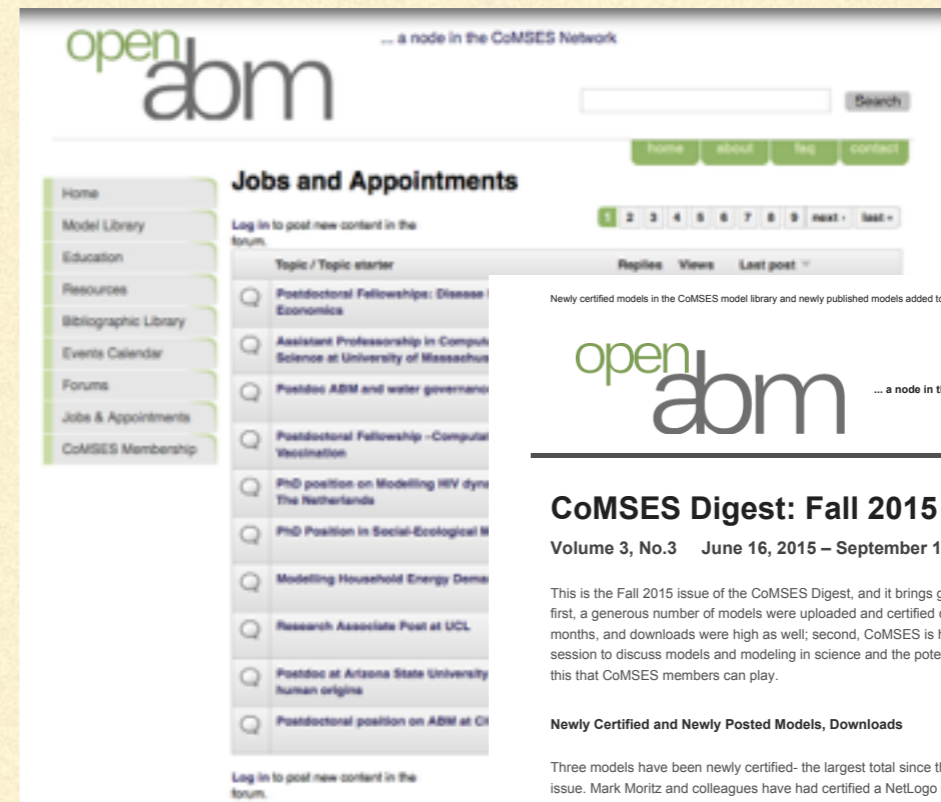


The screenshot shows the 'openabm' website, which is a node in the CoMSES Network. The page is titled 'Jobs and Appointments' and features a forum listing. The forum has a search bar and navigation links for 'home', 'about', 'log', and 'contact'. The forum listing includes a table with columns for 'Topic / Topic starter', 'Replies', 'Views', and 'Last post'. The table contains several entries, including 'Postdoctoral Fellowships: Disease Modelling, Health Economics', 'Assistant Professorship in Computational Social Science at University of Massachusetts (USA)', 'Postdoc ABM and water governance of Mexico City', 'Postdoctoral Fellowship - Computational Modelling of Vaccination', 'PhD position on Modelling HIV dynamics, Bilthoven, The Netherlands', 'PhD Position in Social-Ecological Modelling', 'Modelling Household Energy Demand', 'Research Associate Post at UCL', 'Postdoc at Arizona State University on modeling human origins', and 'Postdoctoral position on ABM at CIGIDEN - PUC, Chile'. The page also includes a 'Log in to post new content in the forum.' link and a pagination bar.

Topic / Topic starter	Replies	Views	Last post
Postdoctoral Fellowships: Disease Modelling, Health Economics	0	82	by moghadam Sat, 10/11/2014 - 20:09
Assistant Professorship in Computational Social Science at University of Massachusetts (USA)	0	116	by marcojanssen Mon, 10/06/2014 - 11:43
Postdoc ABM and water governance of Mexico City	0	144	by marcojanssen Fri, 09/12/2014 - 16:52
Postdoctoral Fellowship - Computational Modelling of Vaccination	0	124	by ayaz.hyder Thu, 09/11/2014 - 11:56
PhD position on Modelling HIV dynamics, Bilthoven, The Netherlands	0	96	by marialridou Thu, 09/11/2014 - 00:37
PhD Position in Social-Ecological Modelling	0	180	by bima Mon, 09/08/2014 - 03:07
Modelling Household Energy Demand	0	126	by marcojanssen Wed, 09/03/2014 - 10:35
Research Associate Post at UCL	0	130	by marcojanssen Tue, 09/02/2014 - 18:39
Postdoc at Arizona State University on modeling human origins	0	314	by marcojanssen Fri, 08/22/2014 - 16:25
Postdoctoral position on ABM at CIGIDEN - PUC, Chile	0	166	by frivers Wed, 08/13/2014 - 15:20

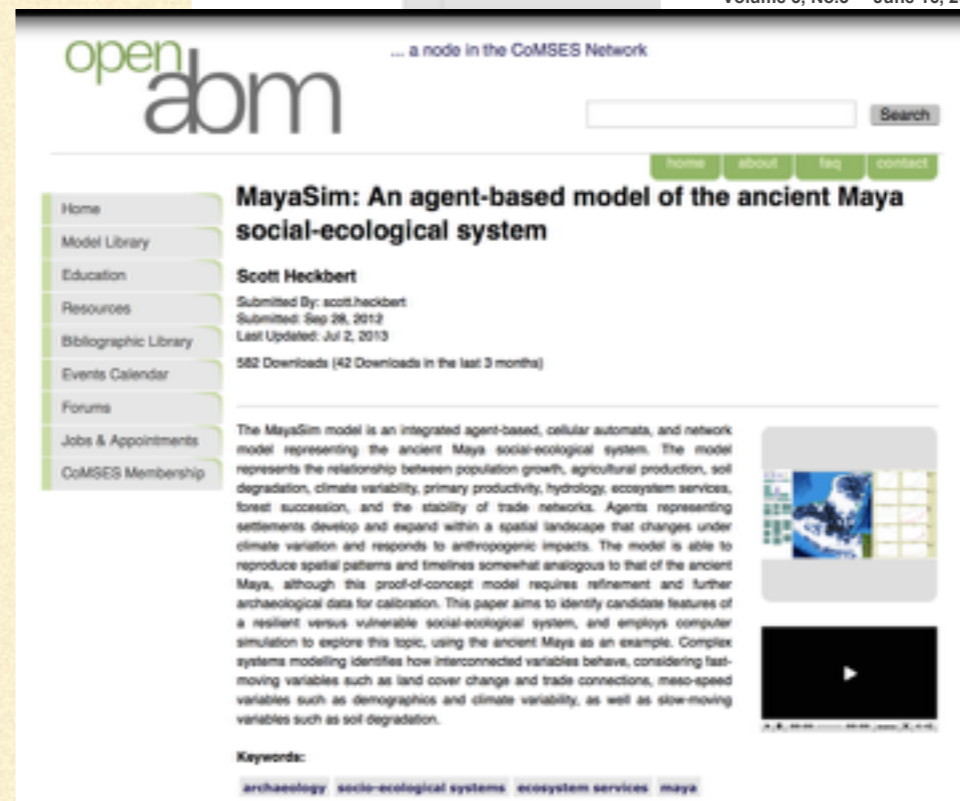
COMSES NET

- Framework for interaction and professional development
- Overcoming challenges to knowledge dissemination and sharing



COMSES NET

- Framework for interaction and professional development
- Overcoming challenges to knowledge dissemination and sharing
- Publishing model code to catalyze innovation in computational modeling



COMSES NET

- >1600 members
- 348 published models
- >53,000 site visitors in 2015
- >16,000 model downloads in 2015

