

Global Food Security

Sustainable, healthy food for all

Research Infrastructure for Food (and nutrition) Security

Tim Benton

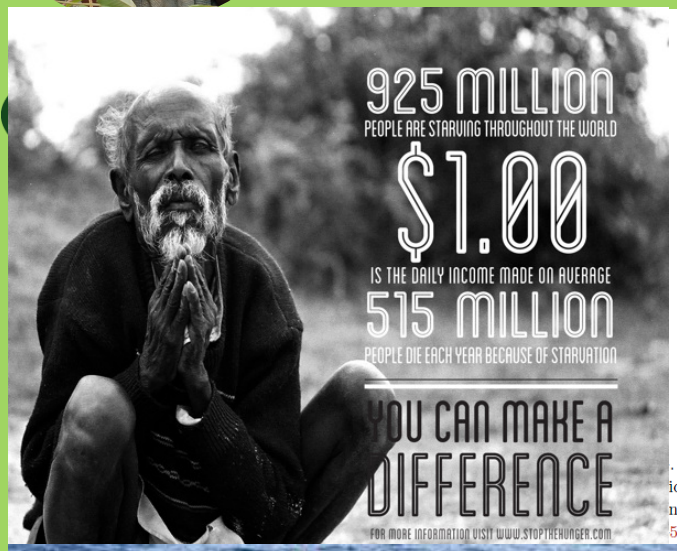
UK Champion for Global Food Security & Professor of Ecology, University of Leeds

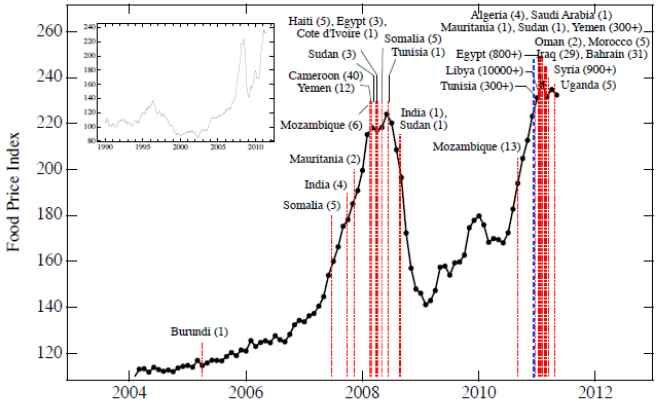
tim.benton@foodsecurity.ac.uk

@timgbenton



Food security is important





. 1: Time dependence of FAO Food Price Index from January 2004 to May 2011. Red dashed
ical lines correspond to beginning dates of "food riots" and protests associated with the major
nt unrest in North Africa and the Middle East. The overall death toll is reported in parentheses
55]. Blue vertical line indicates the date, December 13, 2010, on which we submitted a report to









…and the food system is the world biggest land user, employer and, arguably, polluter



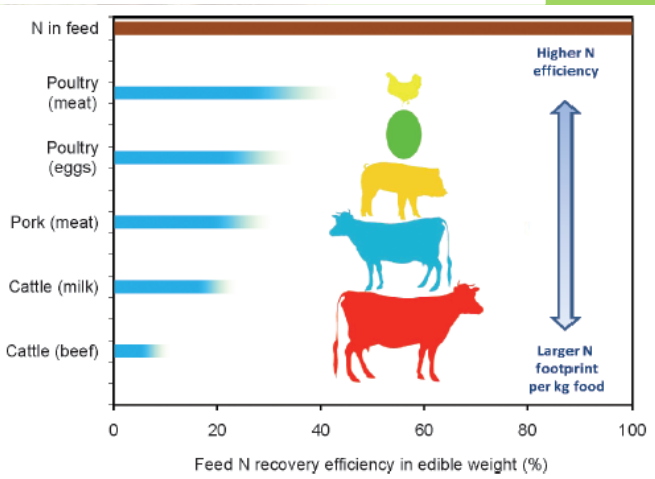
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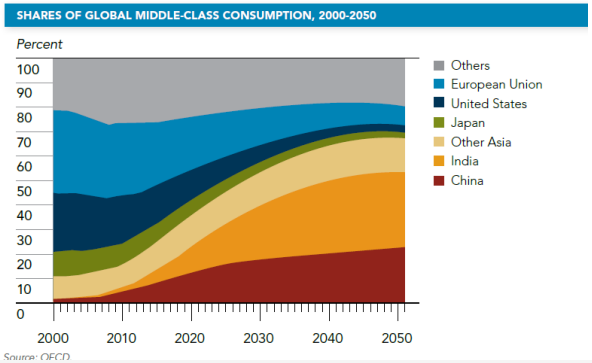
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DRIVERS OF CHANGE

DRIVER 1: DEMAND IS GROWING

Animal protein expensive in resources to produce (ENA)





2000: 60% middle class "western" vs 20% "eastern"
2050: 12% vs 68%

Growth in global food demand



- 35% more mouths by 2050
  - Mainly in Asia, Africa and S. Am
- Richer people eat more and differently:
  - Global middle class will increase 3bn by 2050
- 70% urbanised
  - Understanding of food systems

- All add up to projected increased global food demand (FAO estimate 60% more)



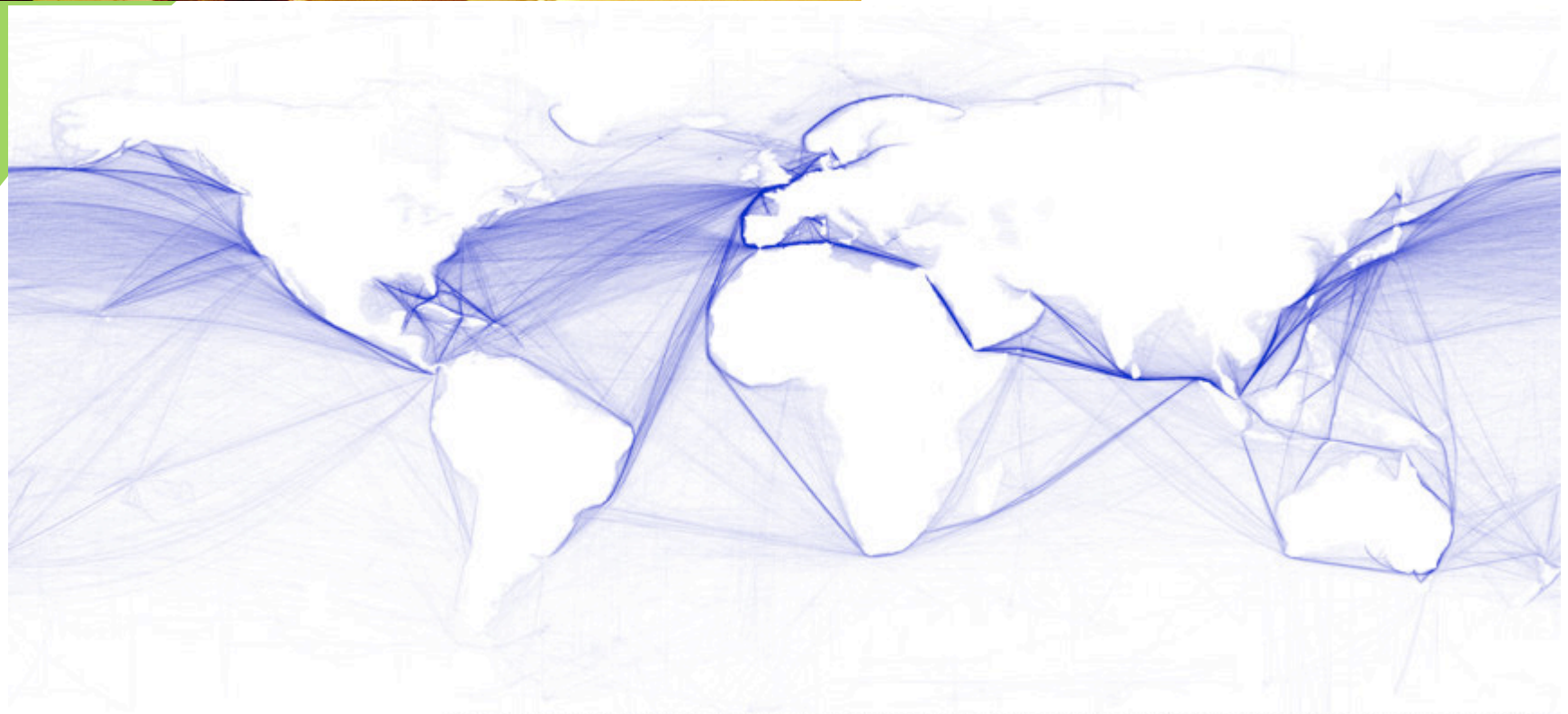
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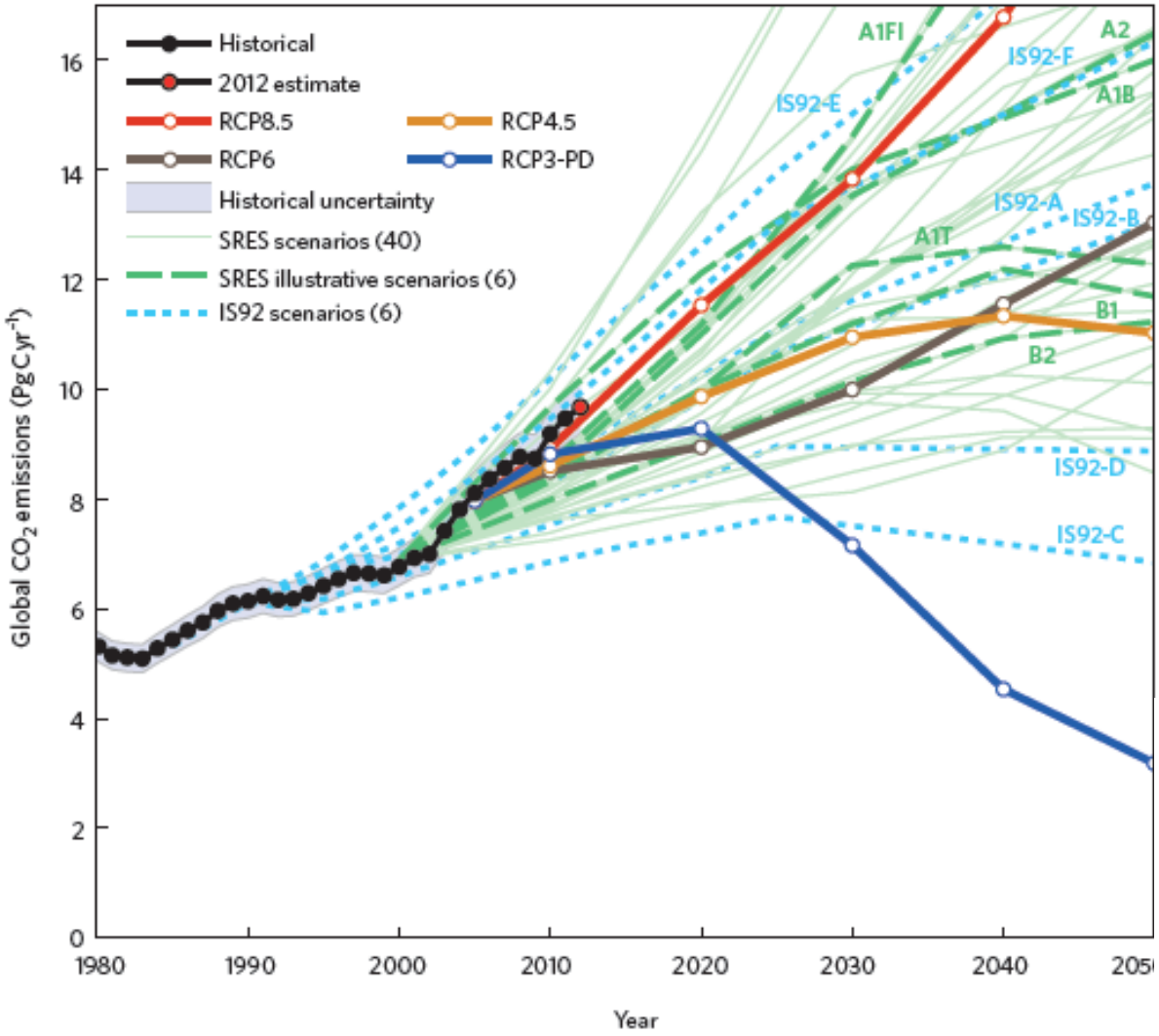
DRIVER 2: THE WORLD IS GLOBAL AND CHANGING

Supply chain logistics





courtesy of http://rsif.royalsocietypublishing.org/content/early/2010/01/19/rsif.2009.0495.full



The challenge to keep global warming below 2 °C

Glen P. Peters, Robbie M. Andrew, Tom Boden, Josep G. Canadell,
Philippe Ciais, Corinne Le Quéré, Gregg Marland, Michael R. Raupach and Charlie Wilson

We're on course for a 4 degree world



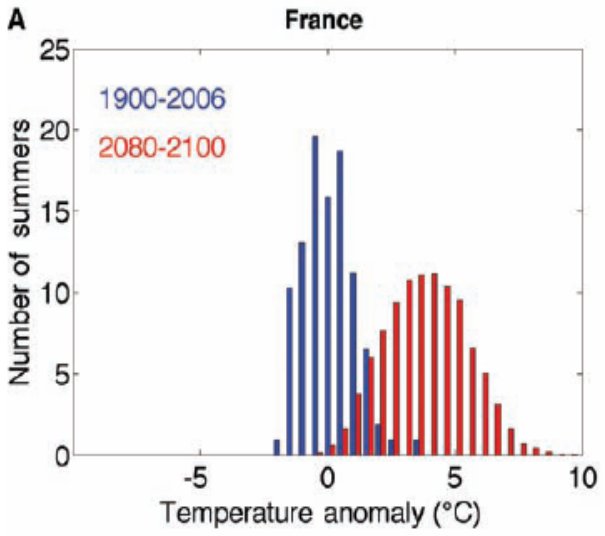
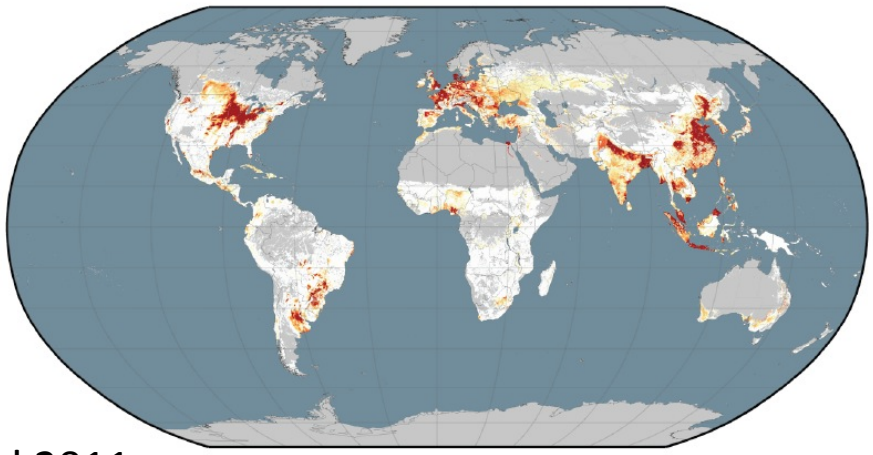
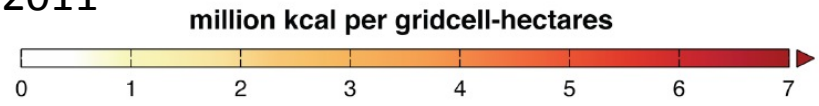
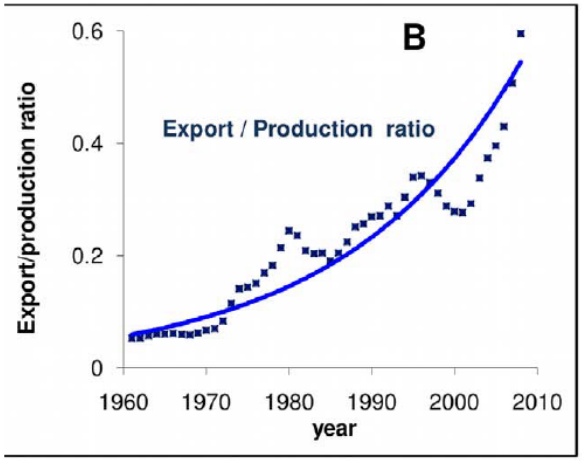


Fig 37a



Foley et al 2011

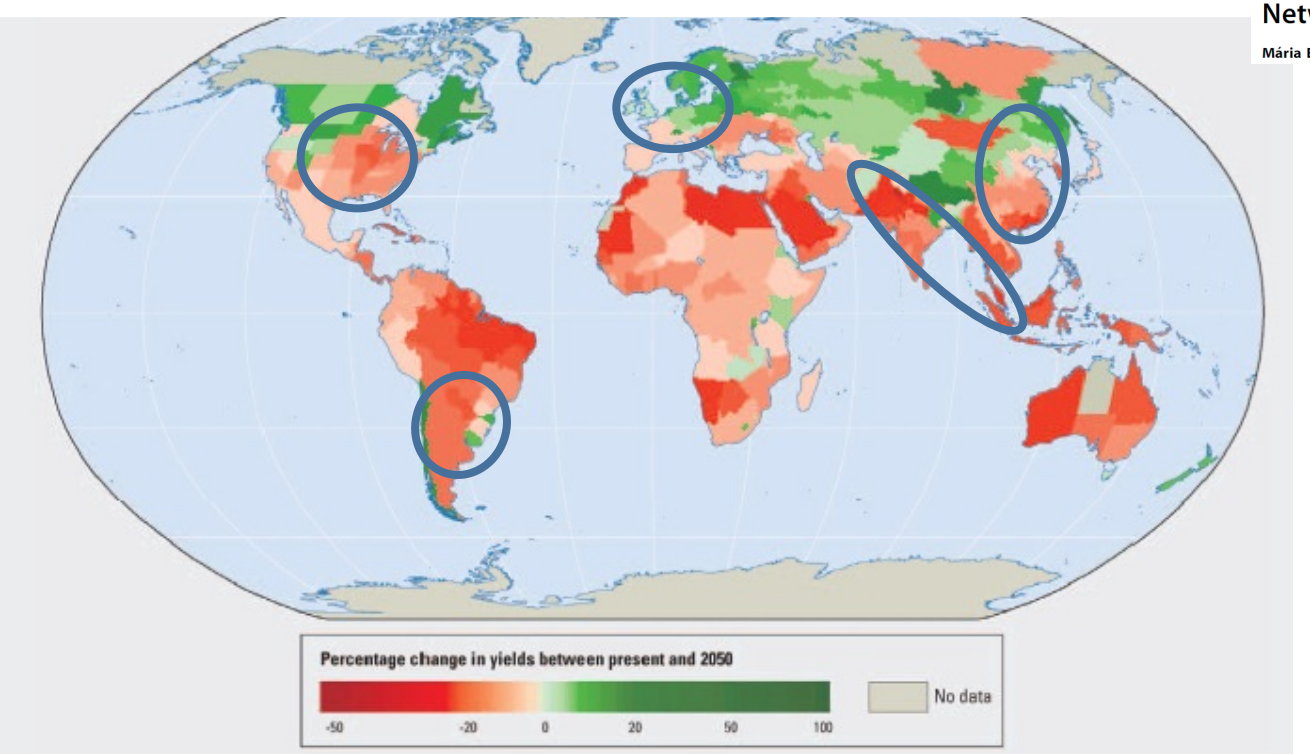




ction. (**A**) (Log-linear scale). The world's food production (thin red line), nt of food transported on the IFTN (linearly fitted small squares, blue) s flow at an increasing rate from countries to countries, as shown by the rom the above data (small squares fitted by an exponential curve). Note JN databases [6,23].

Complexity of the International Agro-Food Trade Network and Its Impact on Food Safety

Mária Ercsey-Ravasz[1,2], Zoltán Toroczkai[1], Zoltán Lakner[3], József Baranyi[4]*



From Wheeler & Von Braun (2013) after World Bank (2010)



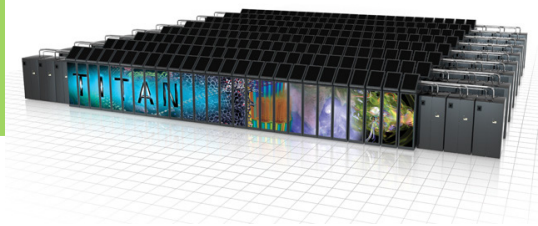
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INFRASTRUCTURE NEEDS

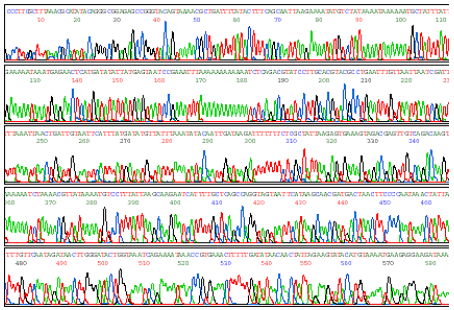
1. Genes to phenotypes

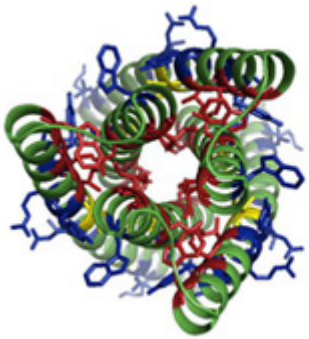


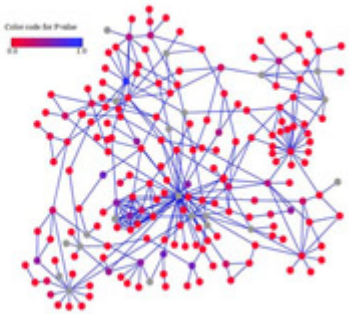


- Traits to understand:
  - Yield
  - Nutritional quality
  - Resource use efficiency
  - Resistance to biotic and abiotic stresses
  - Growth rate and phenology

- Infrastructure needs
  - Genomics
  - Proteomics
  - Metabolomics
  - Bioinformatics
  - phenotyping
  - Open and big data
  - Multilevel models









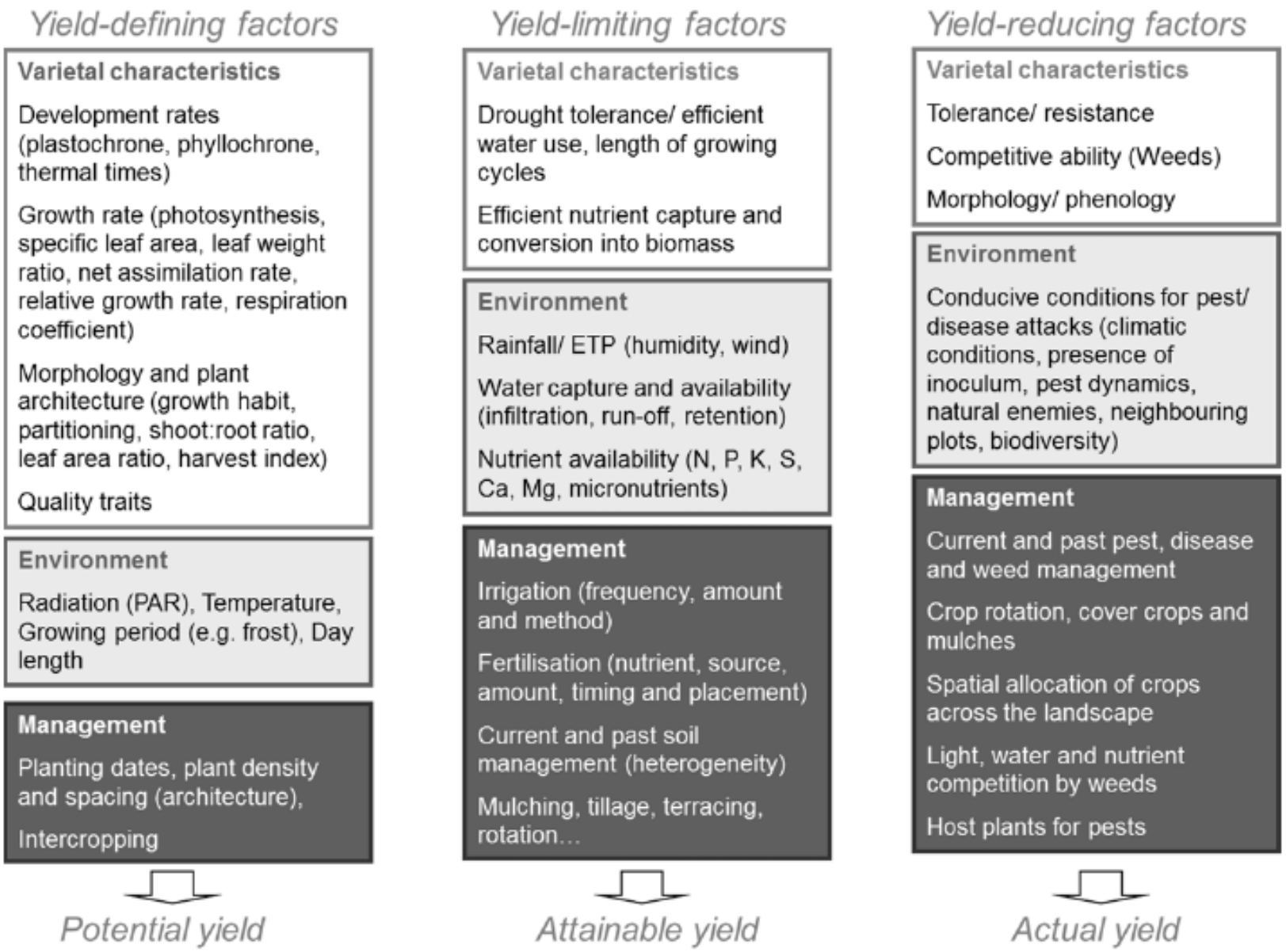


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INFRASTRUCTURE NEEDS

2. Genes to phenotypes in the field

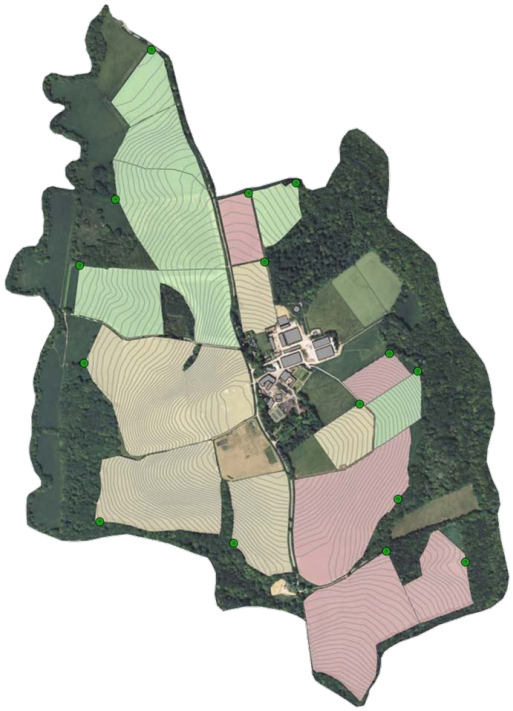


- Exploiting GxExM



Understanding GxExM

The North Wyke Farm Platform



Farming for food security and ecosystem services



- Farm-scale instrumented platforms
  - Sensors
  - Networks
  - Big data
- Distributed across many replicates to sample many Envts
- Functioning networks of existing platforms?

BBSRC bioscience for the future

NORTH WYKE RESEARCH



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INFRASTRUCTURE NEEDS

3. Managing landscapes

What does land do?





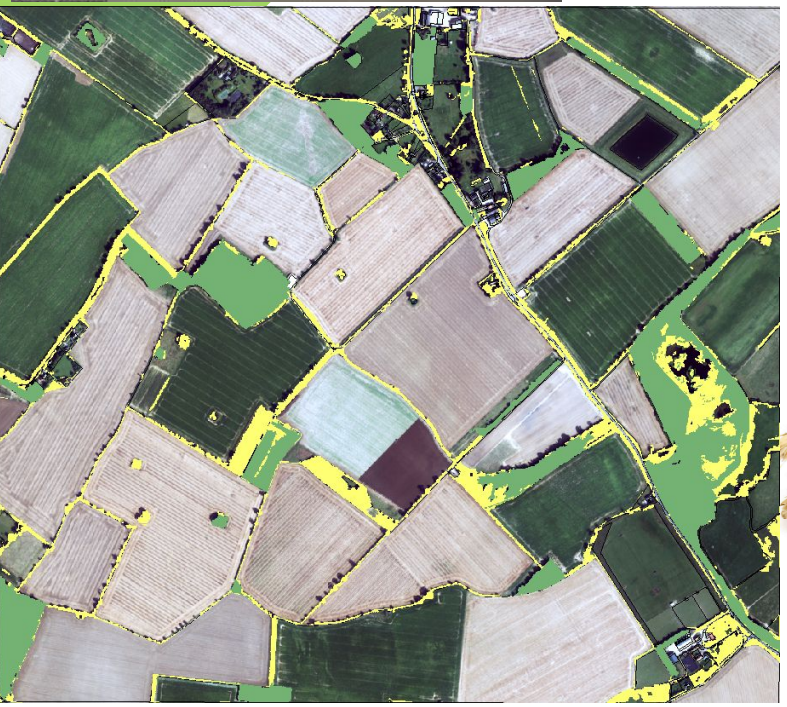










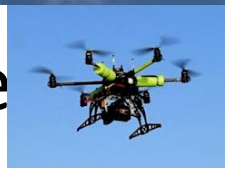




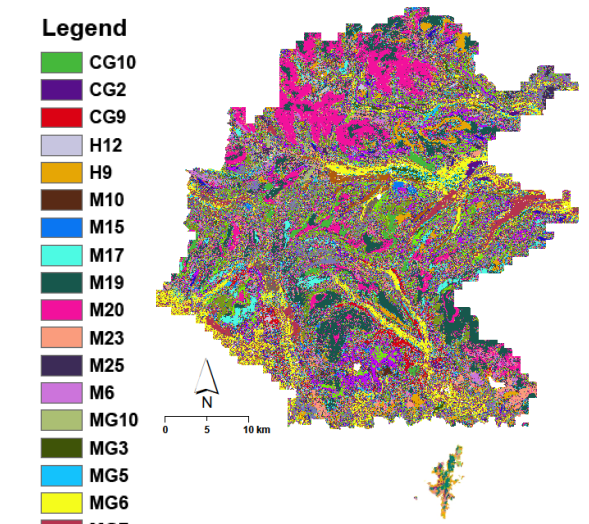


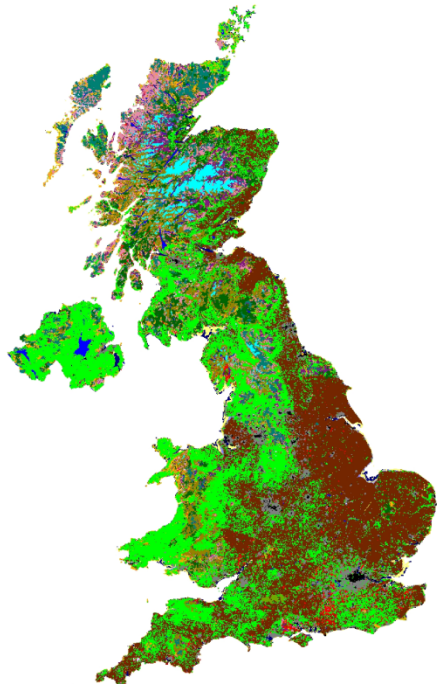
Creating smart landscapes

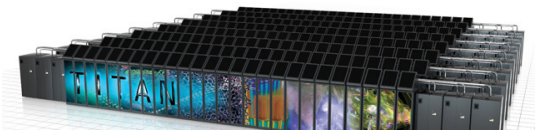


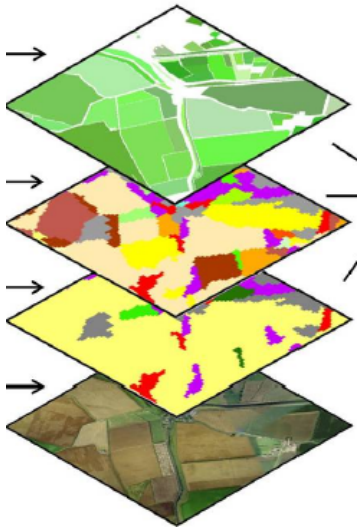


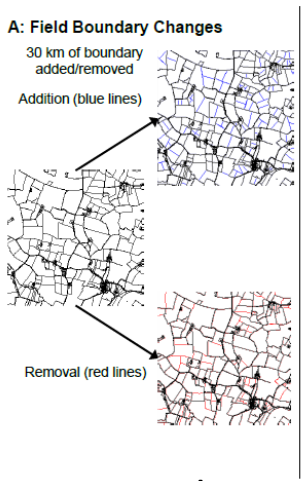
- New algorithms for remote sensing
- Detailed ecosystem service mapping
- Big data and scalable models











Richard German thesis 2012



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INFRASTRUCTURE NEEDS

4. Resilience and risk-management



Resilience and risks

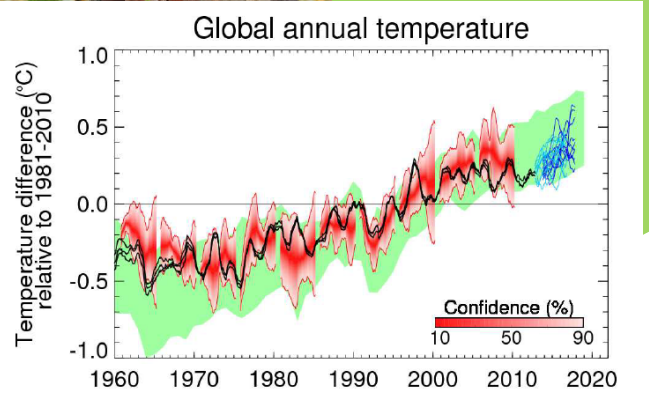
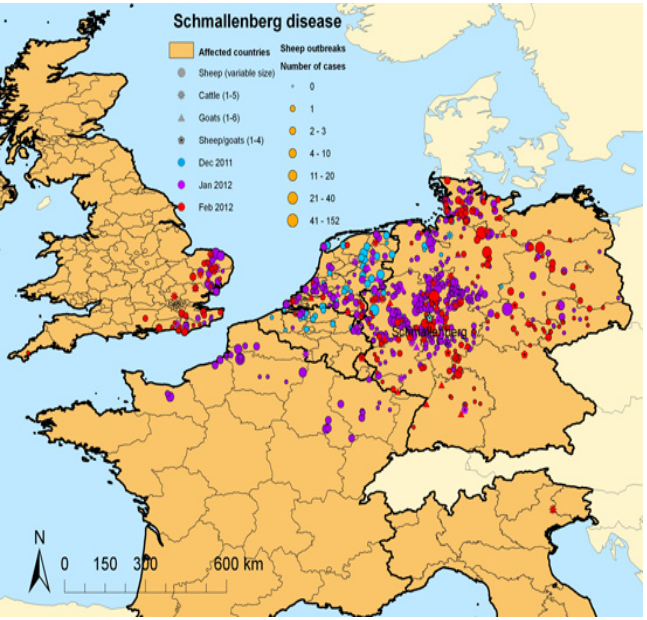


Figure 1: Global annual temperature record since 1960 and the latest ensemble of forecasts from the Met Office decadal prediction system produced in January 2014. The dark blue lines show the evolution of the 10 individual forecasts from this year's forecast starting from November 2013 and the pale blue lines the equivalent for last year's



- Weather
  - High resolution forecasts
  - Seasonal-to-decadal
- Trade/production/impact models
  - How does a shock in one place influence food security in another?
- Pests and diseases
  - Surveillance, monitoring and forecasting
- Crop diversity
  - Developing new crops to reduce reliance on rice, wheat, maize

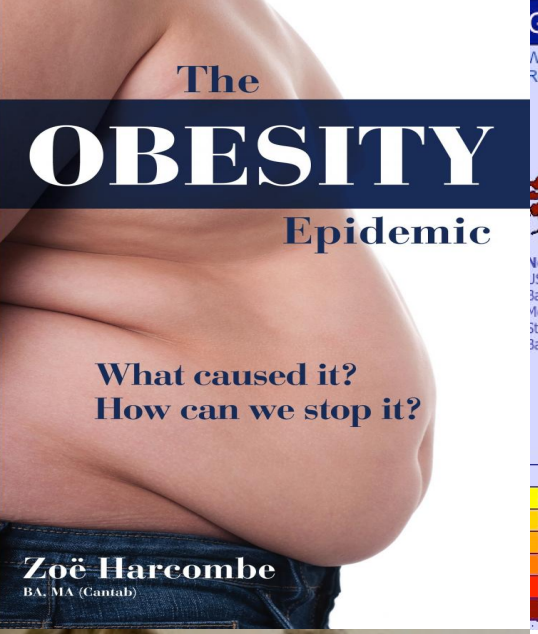


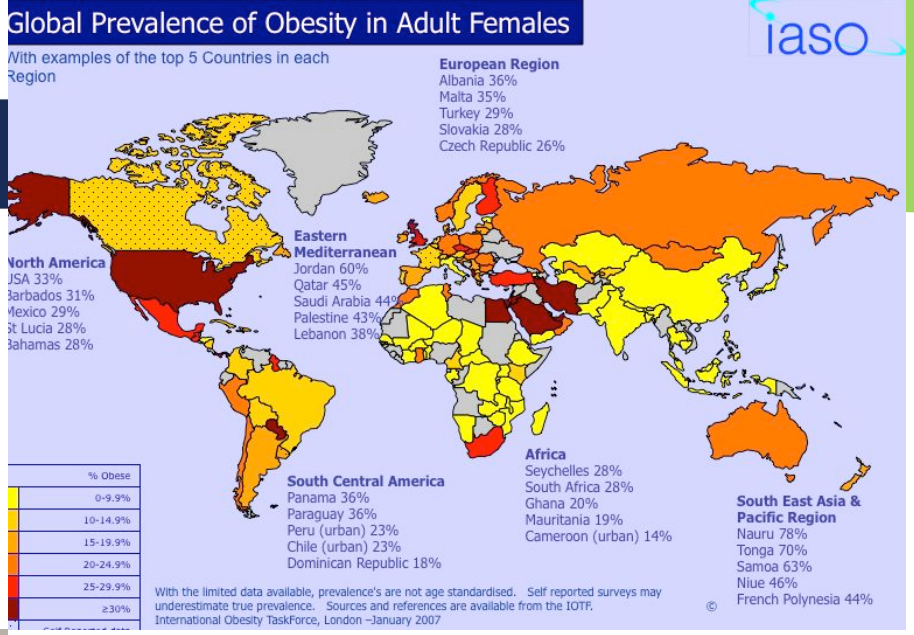
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INFRASTRUCTURE NEEDS

5. Food into health









Diet and health:

- Diabetes UK cost ~£30bn
- >50% of adult Chinese are pre-diabetic *JAMA*. 2013;310(9):948-958. doi:10.1001/jar 2013.168118
- over-consumption associated with >20% of deaths globally;
- Malnutrition & micronutrients



Need for greater understanding of

- Attitudes to food choice and consumption
- Impacts of food
  - At population and demographically structured levels (e.g. elderly)

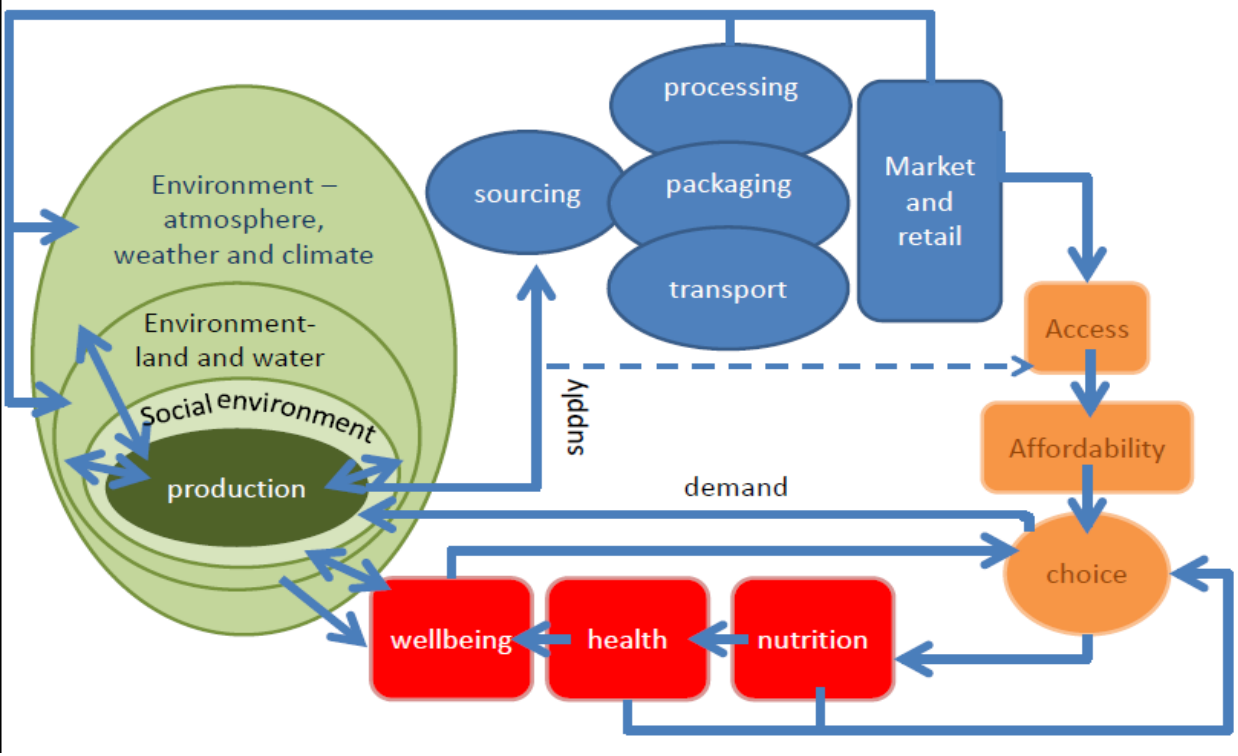
- Infrastructural needs
  - Cohort & population studies
    - Link to European Social Survey (ERIC)?
  - Basic biology underpinning health
    - Personalised nutrition
    - Holistic nutrition
  - Big and open data
    - Health data?



"Let's see...number of cheeseburgers eaten in a typical month? three...no, I'll put down four."



Systems approaches



Needs:

- Systems' view
- trans-disciplinarity
- Prioritisation of "key questions"
  - Is complex & needs stakeholder input

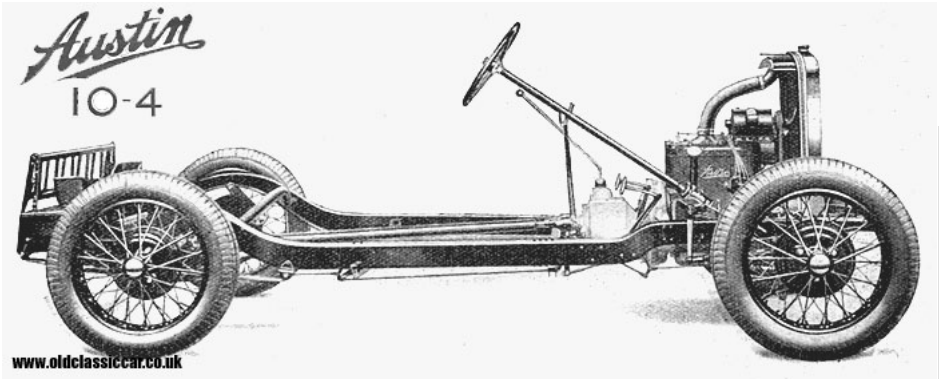


Final thoughts

Global Food Security
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- Much existing infrastructure already exists
  - Perhaps less need for “big kit” than other sectors/disciplines
- The key is to connect it rather than re-invent the wheel
  - As with JPIs
- Need integrated knowledge systems and networks

Connected infrastructure already exists:
e.g. global observatories (e.g. NEON) or LTER sites



Don’t reinvent the wheel multiple times: connect them with a chassis



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Thank you!

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