



Feeding the world: getting the data right for decision-making

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Agriculture and innovation in the 20th century
We have achieved caloric *per capita*
sufficiency...



But how stable are our food systems? How much more
growth can they deliver without collapse?

9 Billion People / 1 Planet

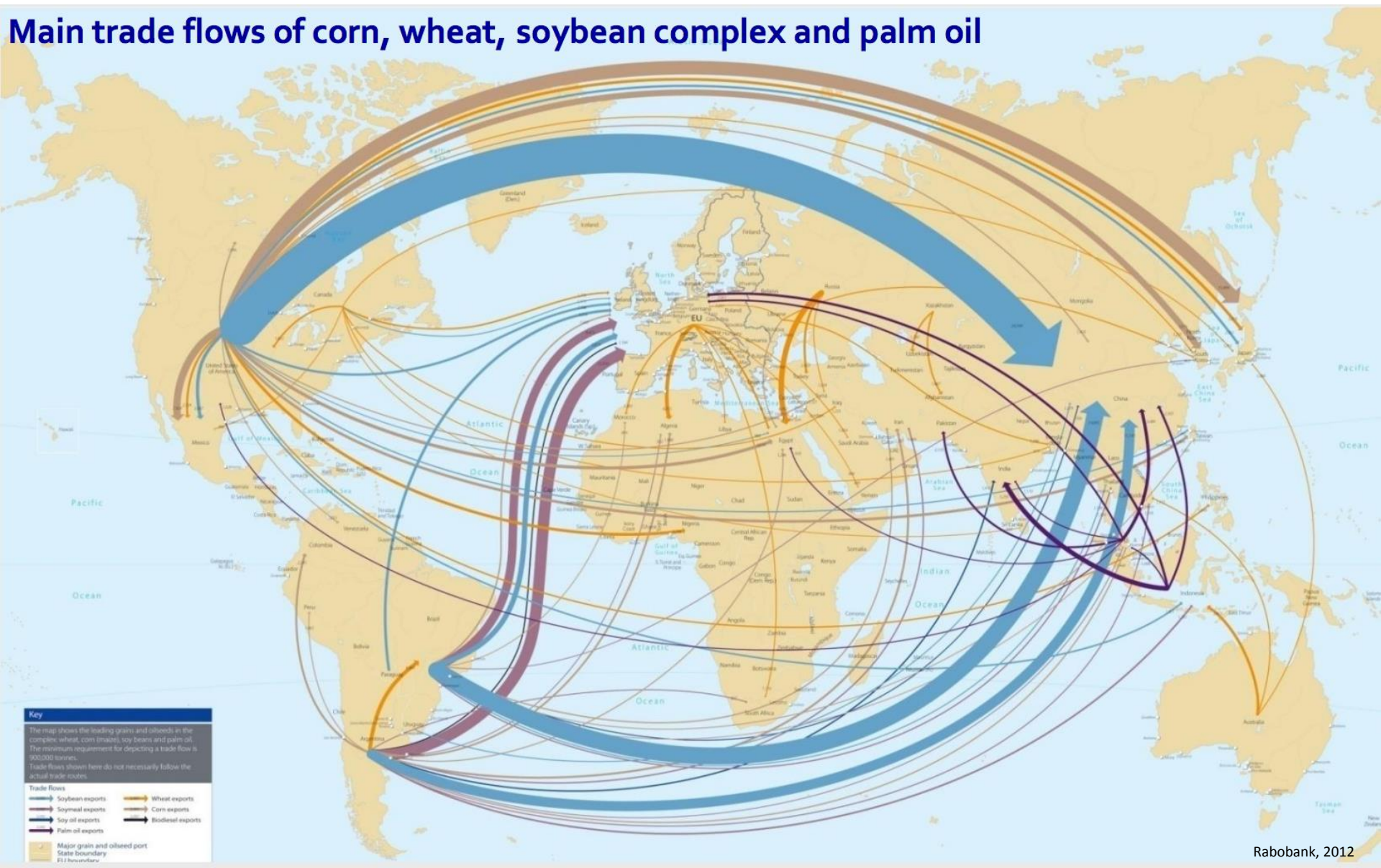


Do we have a plan?

Food, Water, Clean Air, Energy, Materials for our kind
on a habitable beautiful planet

Modern food systems are dynamic, complex and fundamentally important to security and survival

Main trade flows of corn, wheat, soybean complex and palm oil





Photos: Neil Palmer, CIAT

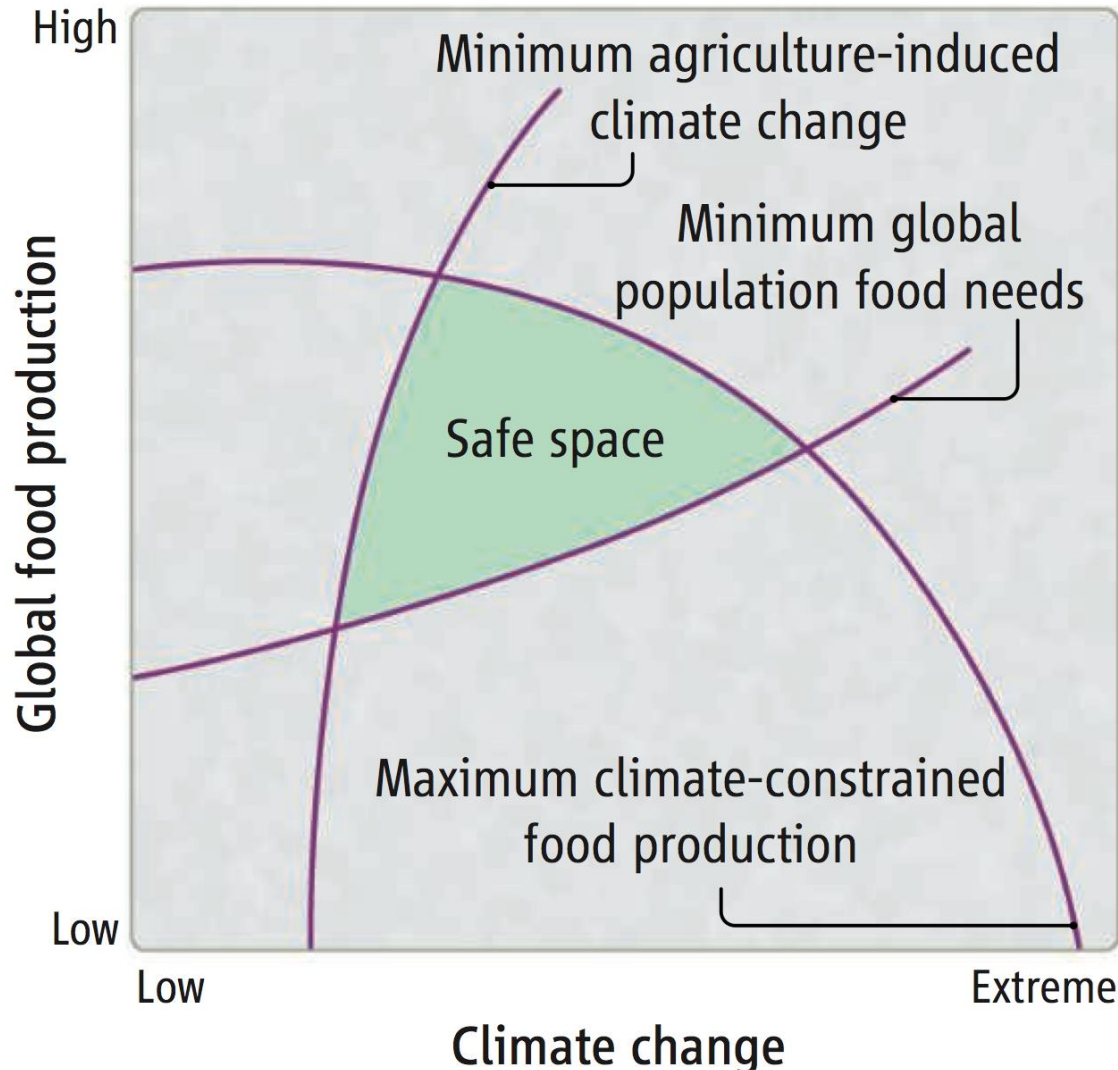
Introducing the International Commission on Sustainable Agriculture and Climate Change



CLIMATE
CHANGE
AGRICULTURE AND
FOOD SECURITY



What will we call the boundaries of Safe(r) operating spaces for the food systems?



How will we name the system components and learn to manage them better? “food security” and “food resilience” means many things to many people

Commission on Sustainable Agriculture and Climate Change

Recommendation 1: Integrate food security and sustainable agriculture into global and national policies

Recommendation 2: Significantly raise the level of global investment in sustainable agriculture and food systems in the next decade

Recommendation 3: Sustainably intensify agricultural production while reducing greenhouse gas emissions and other negative environmental impacts of agriculture

Recommendation 4: Target populations and sectors that are most vulnerable to climate change and food insecurity

Recommendation 5: Reshape food access and consumption patterns to ensure basic nutritional needs are met and to foster healthy and sustainable eating habits worldwide

Recommendation 6: Reduce loss and waste in food systems, particularly from infrastructure, farming practices, processing, distribution and household habits

***Recommendation 7:** Create comprehensive, shared, integrated information systems that encompass human and ecological dimensions

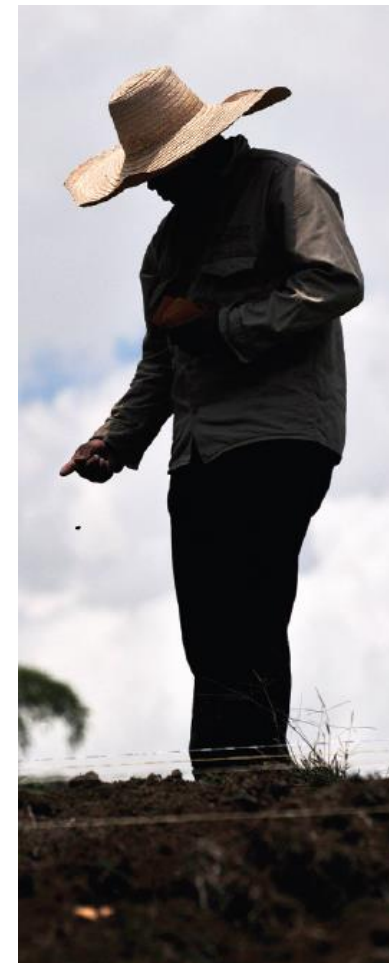
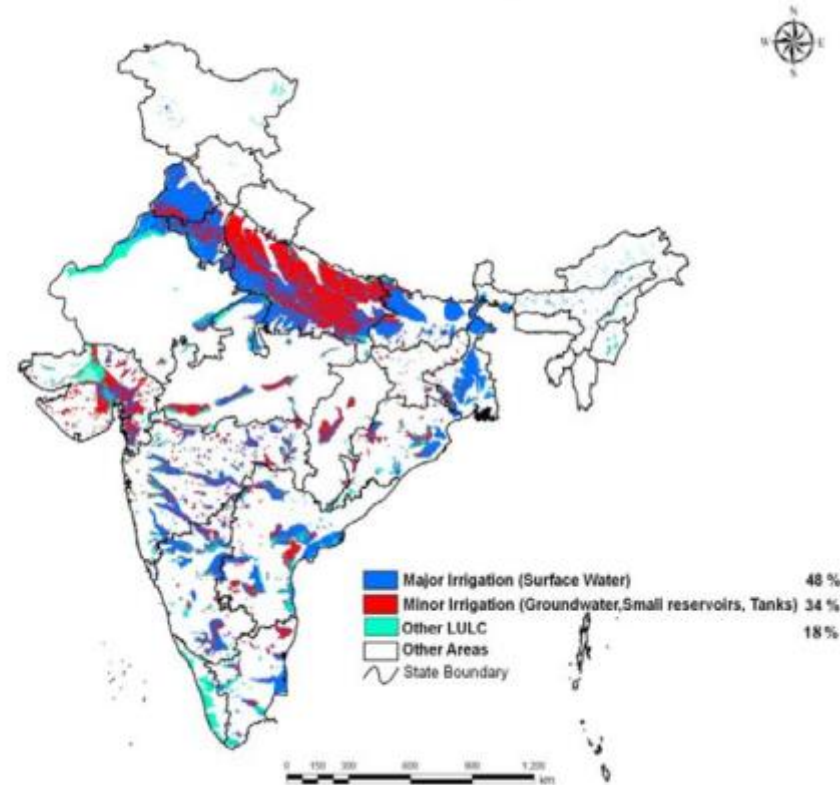
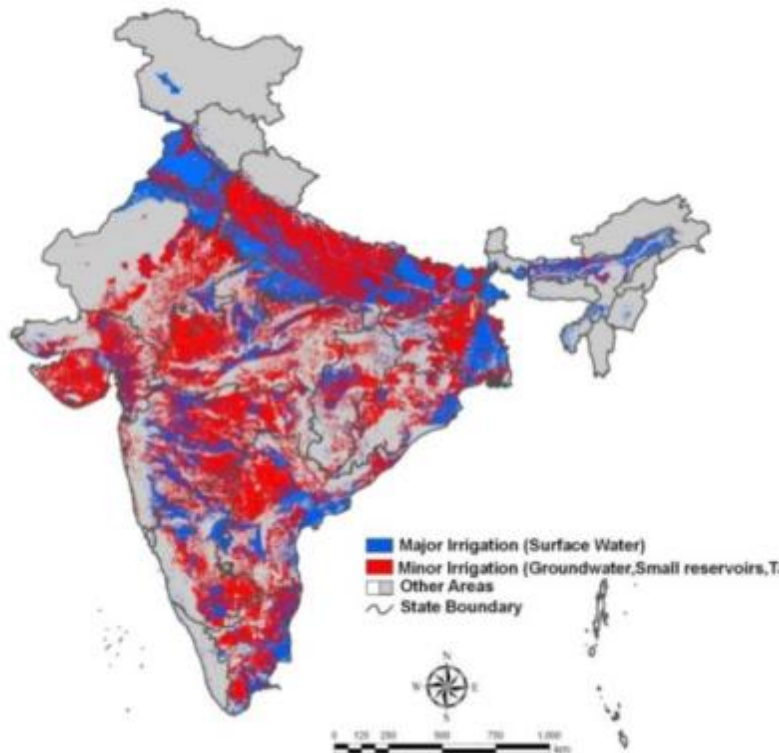


Photo: N. Palmer (CIAT)

Why is “Recommendation No. 7” so important? How much irrigated area in India?

Intl. Water Management Inst.
113 M ha (net)

Government of India
57-62 M ha



Source: Thenkabail 2009; Slide courtesy of T. Hertel and G.C. Nelson

Expect major spikes in demand from both familiar and new communities



Next, a few examples of these new sources of demand



Government can't go it alone Public-Private Partnerships

Working to create trusted information sharing environments in a pre-competitive space, across sectors, for collective benefit



A word cloud where the word 'risk' is the central focus, rendered in a bold, red, serif font. Surrounding it are numerous other words in a grey, sans-serif font, all of which are blurred and tilted at various angles, creating a sense of motion and depth. The background is white.

who
for the
risk
his new
of

Risks and opportunities in food systems are being understood in new ways with new implications

The logo for the Climate Summit 2014 features a central white circle containing the text. The background is a light yellow gradient with abstract, overlapping shapes in shades of orange, green, and yellow. The text is as follows:

**CLIMATE
SUMMIT 2014**

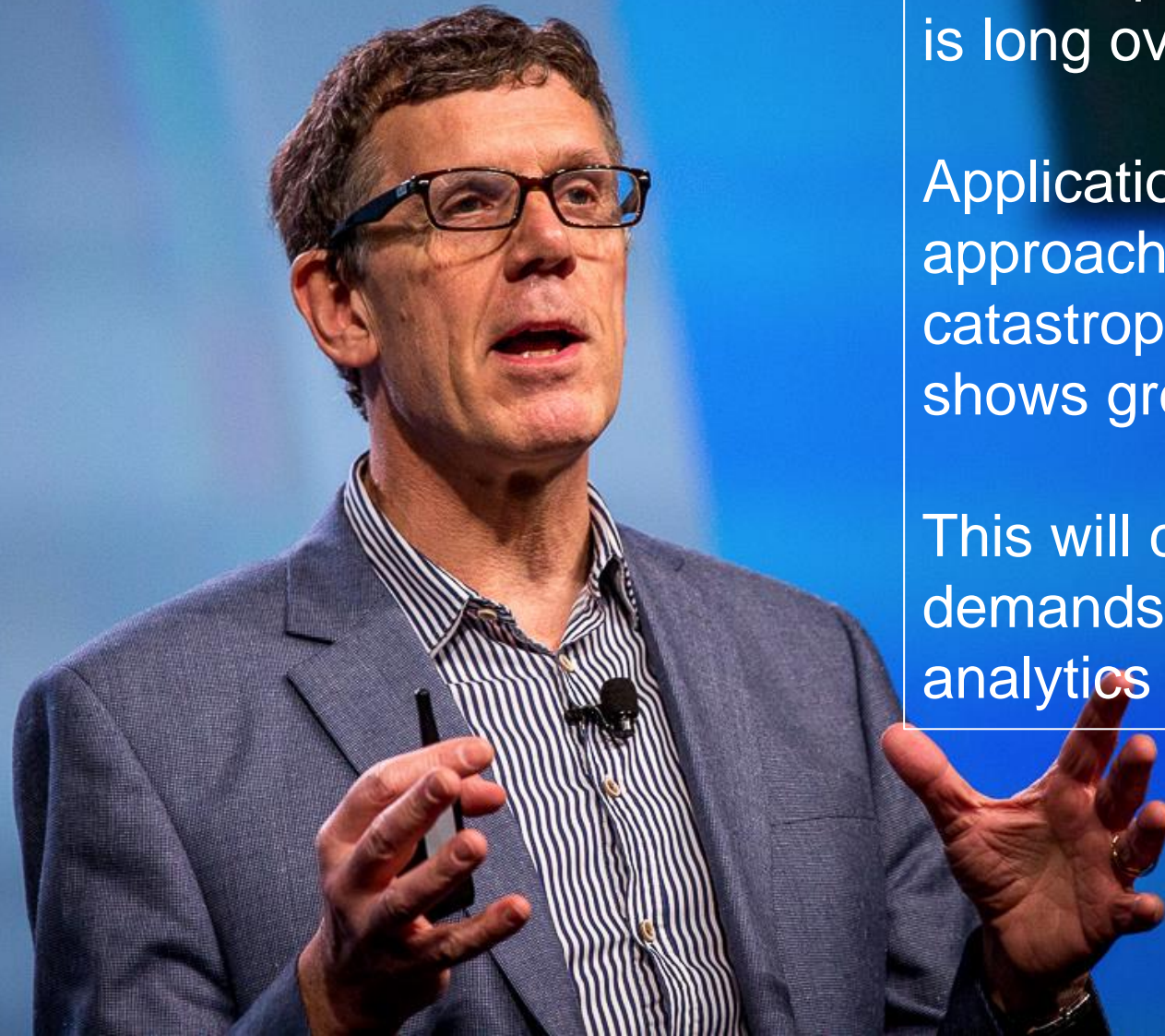
CATALYZING ACTION

Selected Highlights:

Creation of a Resilience Modeling and Mapping Forum

Commitment to coordinate \$100 million of annual investment into public science and open risk modeling platforms and facilities by 2016

Robert Muir-Wood
Chief Research Officer
Risk Management Solutions, Inc.

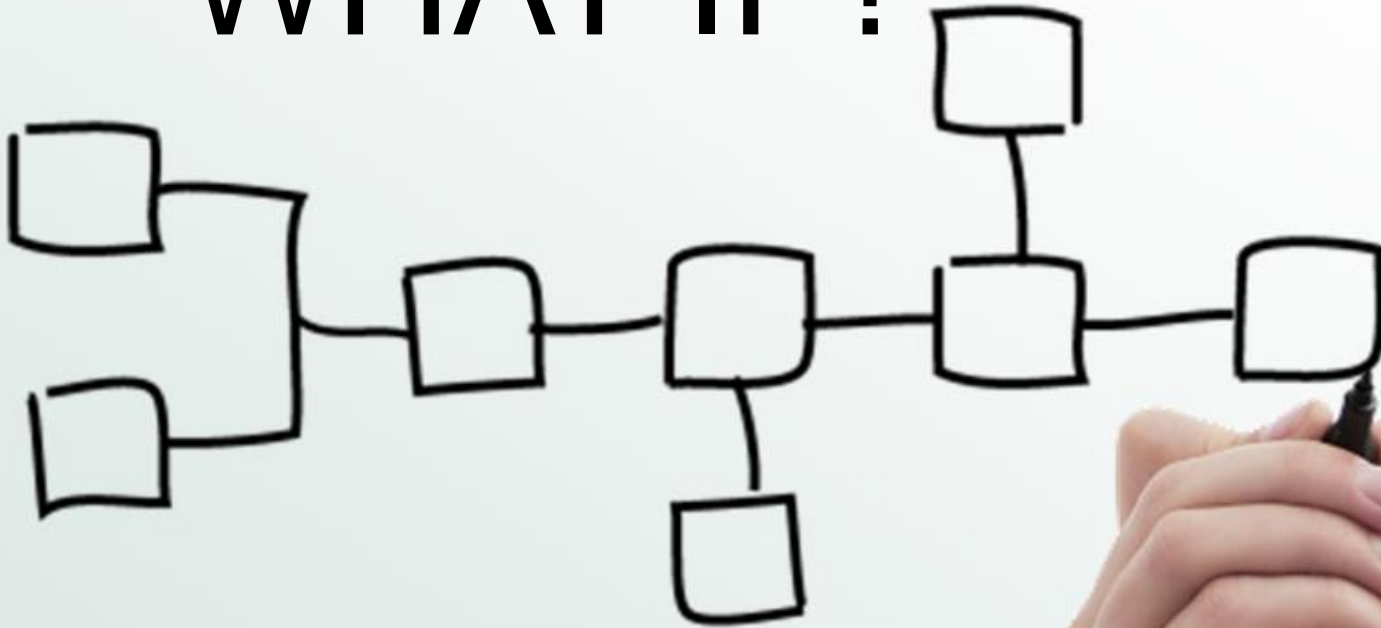


A focus on food systems in catastrophe modeling is long overdue.

Applications of hybrid approaches, like catastrophe modeling shows great promise

This will create new demands for data & analytics

WHAT IF?



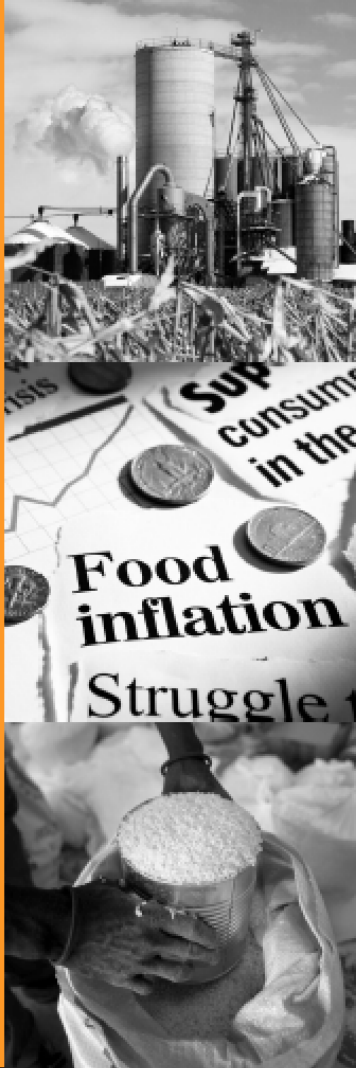
Working with the insurance industry to develop scenarios for multiple breadbasket failure. Stress testing these systems will require new data and models

Food insecurity a significant risk to “global society”

Food safety/security issues create “direct and indirect risks & opportunities for businesses”

Insurance can play a large role in risk mitigation/management as well as innovation/investment

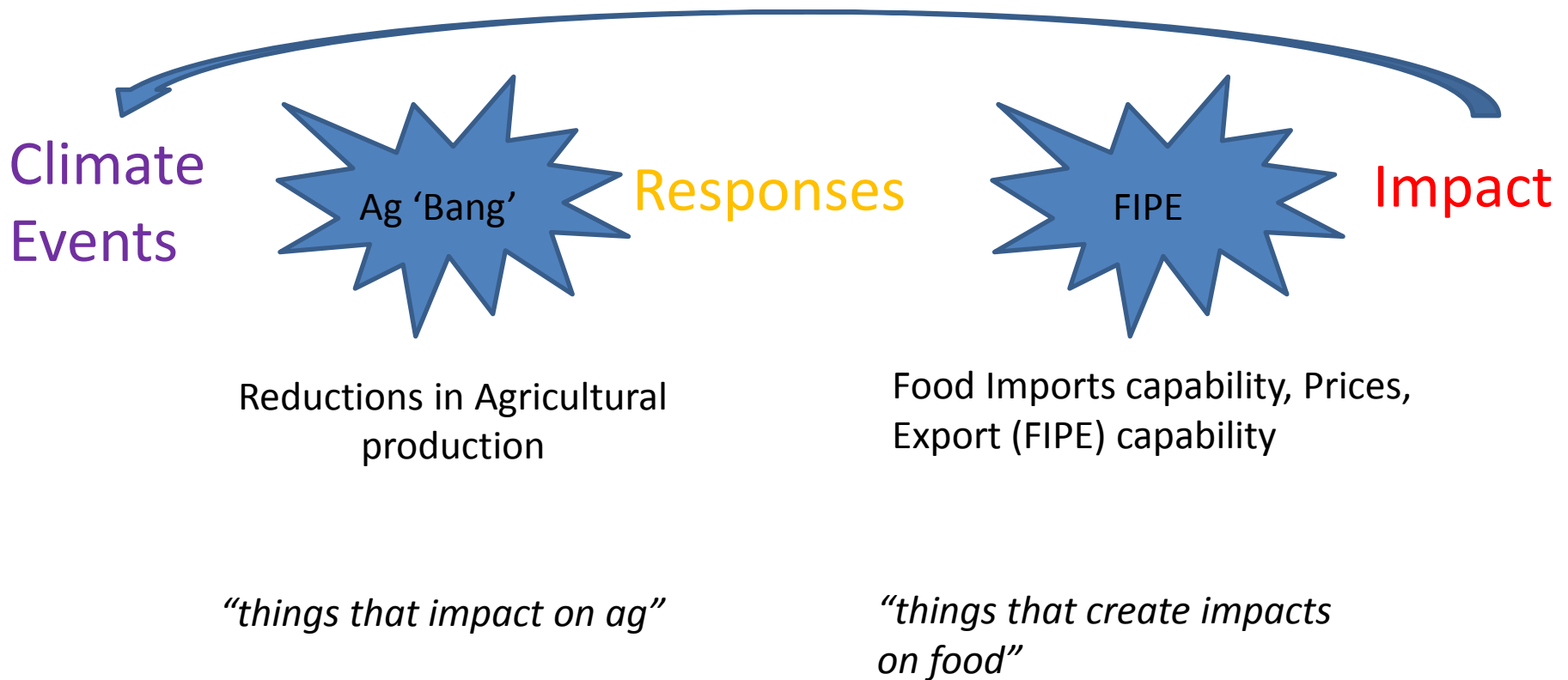
March, 2014



FEAST OR FAMINE

**BUSINESS AND INSURANCE IMPLICATIONS OF FOOD
SAFETY AND SECURITY**

UK Science & Innovation Network/ Global Food Security Programme Taskforce on Resilience of the Agri-Food System to Extreme Events



Could ESIP Ag / Climate and Disaster Clusters help?



Multiple Breadbasket Failure Initiative

Pre-Bang

Post-Bang

Quantitative scenarios

- Modeling of likelihoods of significant impacts, scope and scales of perturbations
- Enhance our ability to reflect uncertainty with sophistication and link to decision-making under uncertainty
- Assess opportunities to mitigate risks



Qualitative analyses

- Develop scenarios guided by interactions with regulators of systemic financial risks originating in food systems

* = multiple breadbasket failure

Public/Private Research Platforms Thomson Reuters Eikon

Powerful tools, news & analytics at your fingertips

The screenshot displays the Thomson Reuters Eikon desktop application interface. At the top, a navigation bar includes tabs for 'AgsBasic (*)', 'Editorial chart template (*)', 'CFTC Charts', 'Commodity Flows', 'November 2013 soybeans vs...', 'EikonChartingWhite (*)', and 'Agriculture | Overview...'. The main content area is divided into several sections:

- ASSET CLASSES:** A sidebar on the left lists categories such as Commodities, Energy, Metals, Agriculture (highlighted), Foreign Exchange, Money Markets, Fixed Income, Equities, Funds, Real Estate, and Islamic Finance.
- AGRICULTURE QUOTES:** A table showing the latest prices and changes for various agricultural commodities.

Name	Last	Net Chng
CORN JUL3	638.25	-11.25
ICE SUG11 JUL3	16.88	0.07
SOYBEANS JUL3	1,477.00	12.50
WHEAT JUL3	680.50	-4.75
SOYBEAN OIL JUL3	49.48	0.28
LEAN HOGS JUN3	92.75	0.68
SOY MEAL JUL3	438.70	3.40
WHEAT JUL3	738.50	-6.50
- AGRICULTURE NEWS:** A section featuring headlines such as 'REUTERS SUMMIT-Brazil offers better terms for infrastructure investors' and 'DJ USDA U.S. Spot Cotton Quotations: 7-Area Average'.
- THOMSON REUTERS COMMODITIES RESEARCH & FORECASTS:** A sidebar on the right providing links to 'Thomson Reuters Lanworth', 'Agriculture Weather Dashboard', and 'North America Agriculture Flows', along with a brief description of the dashboard's capabilities.
- AGRICULTURE TOP NEWS:** A featured article titled 'CORN FALLS AFTER RECORD PLANTING PACE; SOY UP AGAIN' with a sub-headline 'ANALYSIS-U.S. food labels seen heating up North America meat war'. The article text states: 'CHICAGO, May 21 (Reuters) - U.S. corn futures dropped 1.5 percent, to their lowest since early April, on Tuesday as investors unwound bull spreads following a record planting pace last week that encouraged farmers to sell some old-crop supplies to ease cash market tightness, traders said.' Below the text are links for 'ICE sugar turns up after hitting 34-month low, cocoa jumps' and 'China to raise soybean imports from May to boost stocks'.
- LOCAL MARKETS - AGRICULTURE:** A table showing local market data for various agricultural contracts.

Name	Last	Net Chng
2YC Fob USG C1	298.95	-1.30
YC FOB ARG P1	258.07	-2.86
W Mill UA FOB P1		
2HRW Fob USG C1	324.41	2.83
2SRW Fob USG C1	281.10	+0.70
Dur.Fob LaPal P1	265.00	
YSB Up River P1	640.61	+4.59
YSB Paranagua C1	531.59	
2YSB Fob USG A1	593.10	+5.80
- ECONOMIC EVENTS - KEY:** A table listing key economic events such as 'Russia-Inflation - PPI' and 'Ukraine-Money supply M3 (UAM3=ECI)'.
- KEY CHARTS:** A line chart titled 'Daily 3 Months' showing price movements for 'Wc1 680.50' and 'BL2c1 204.00' from February to April 2013.
- PRODUCT MESSAGES - COMMODITIES:** A section with links to 'Thomson Reuters Eikon - What's New for May' and 'Thomson Reuters Eikon - What's New for April'.
- MARKETING MESSAGES - AGRICULTURE:** A section at the bottom right for agricultural marketing messages.

Weather Analytics – Mapped to major crop regions

THOMSON REUTERS COMMODITIES RESEARCH & FORECASTS

Agriculture Homepage

AGRICULTURE WEATHER DASHBOARD

- North America
- USA
 - Midwest
 - Plains
 - West
 - South
 - Atlantic
 - Maps

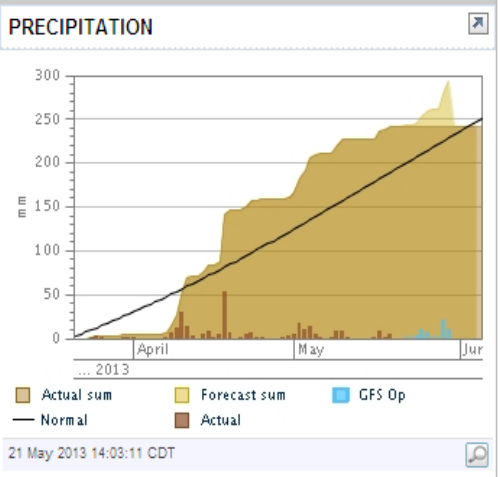
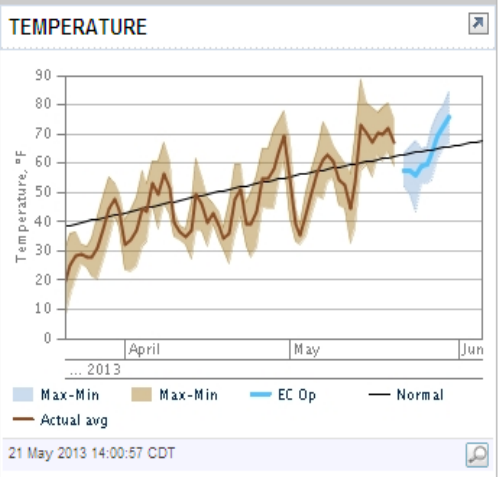
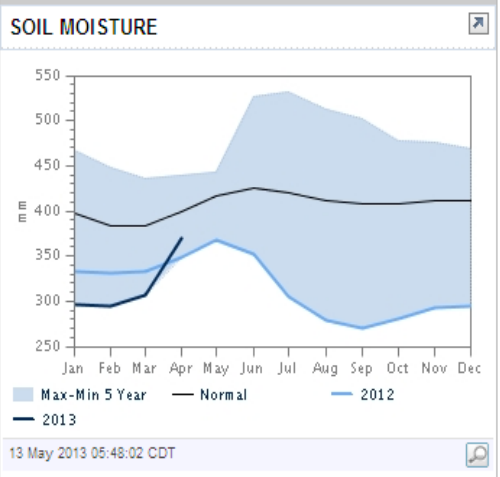
Summary | Illinois | Indiana | **Iowa** | Michigan | Minnesota | Missouri | Ohio | Wisconsin

Summary | Northwest | North Central | Northeast | West Central | Central | East Central | Southwest | South Central | Southeast

13 May 13 | 14 May 13 | 15 May 13 | 16 May 13 | 17 May 13 | 18 May 13 | 19 May 13 | 20 May 13 | Last 24 hrs

20 May GFS18 Op | 21 May GFS00 Op | EC00 Op | GFS06 Op | GFS12 Op | **EC12 Op**

Content provided by
POINT CARBON

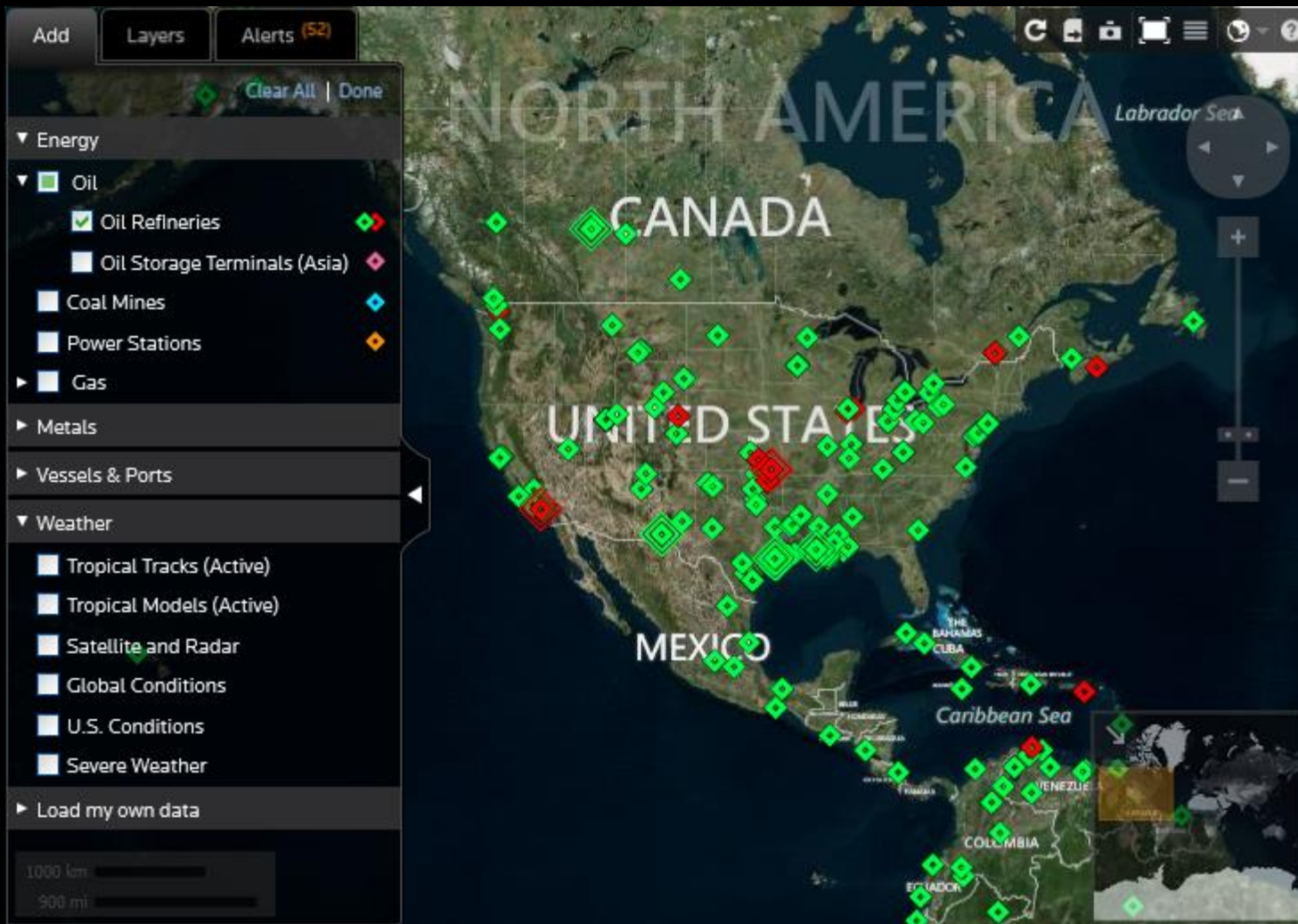


FORECAST TEMPERATURE

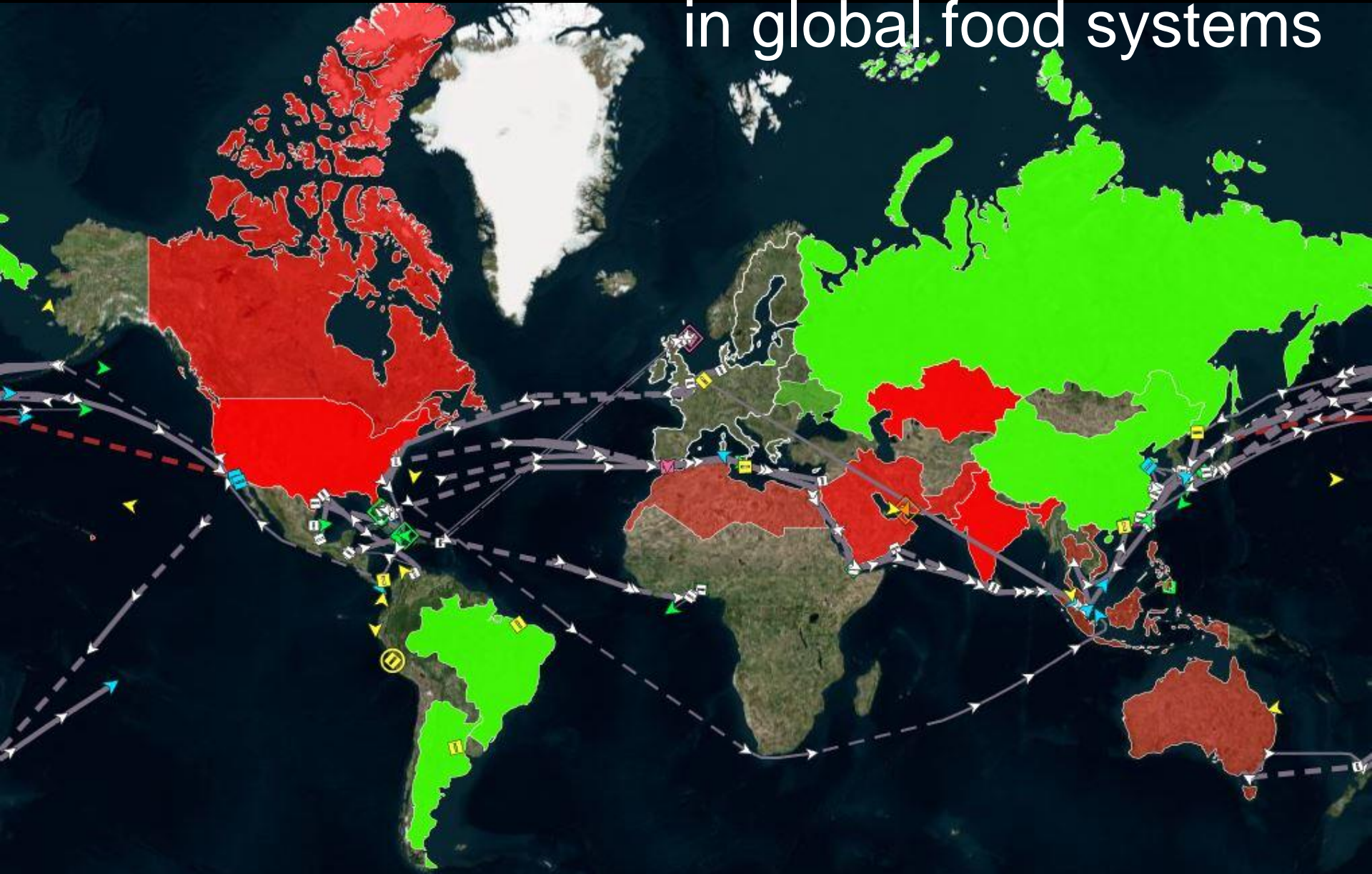
UTC	Wed 22	Thu 23	Fri 24	Sat 25	Sun 26	Mon 27	Tue 28	Wed 29	Thu 30	Total
Avg	57.6	57.6	55.8	59.2	59.4	63.1	69.1	72.5	75.6	63.3
Min	51.8	49.5	43.5	53.1	53.2	54.1	61.2	65.1	66.4	55.3
Max	63.3	65.7	67.8	65.1	65.3	72.1	77.0	79.7	84.6	71.2
Precip	1.7	0.6	2.0	9.1	5.6	0.5	1.3	20.7	10.5	52.0

21 May 2013 14:03:11 CDT

Track vessels, weather conditions in interactive map



Hurting ourselves toward global transparency in global food systems





UNISDR

The United Nations Office for Disaster Risk Reduction



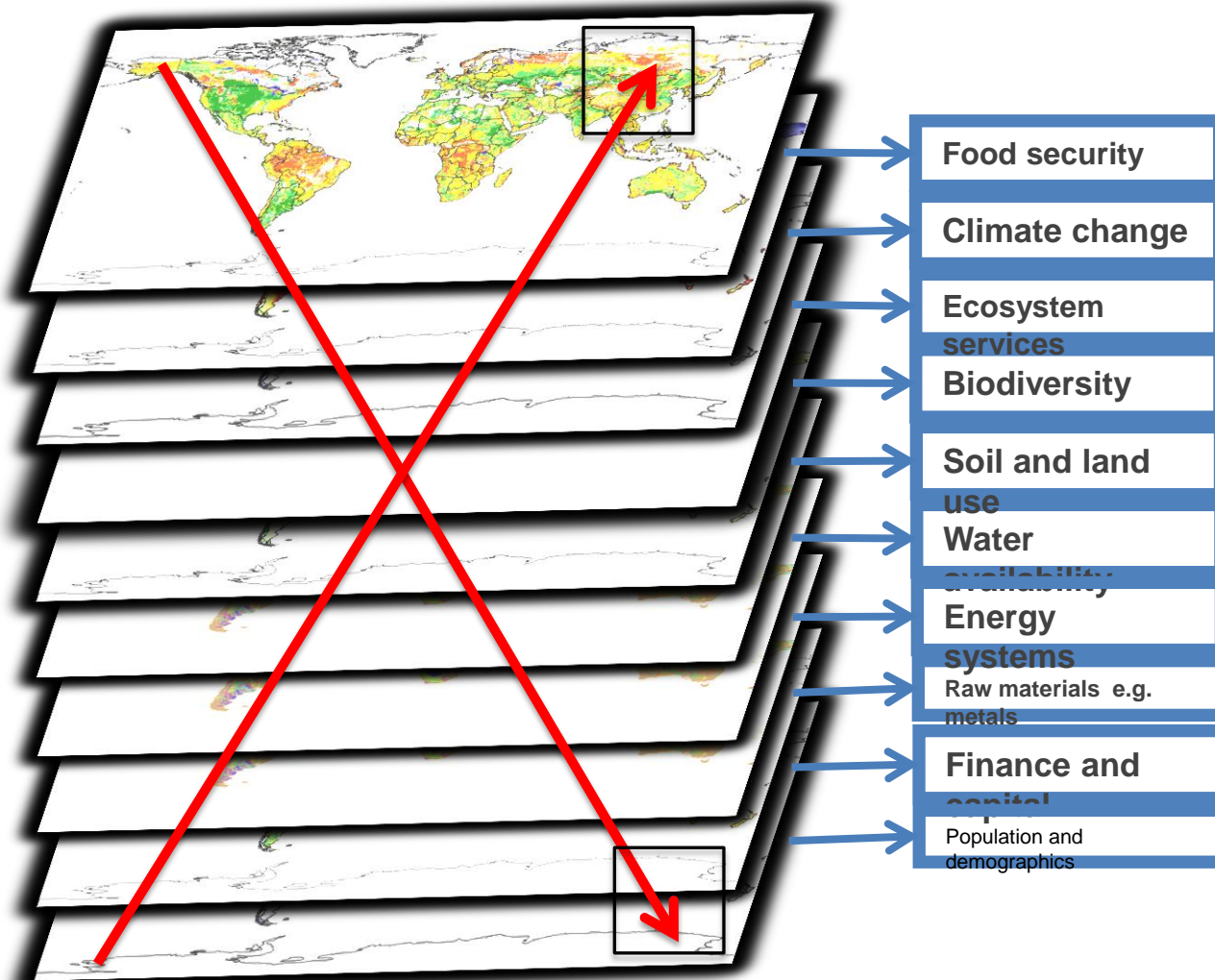
How can earth science data and analytics help make urban and rural areas more resilient to disasters?



The R!SE Initiative is focused on collaboration and tangible action to achieve risk-sensitive investment. In this way, R!SE will contribute to building the resilience of local communities and a more sustainable global economy.

The R!SE Initiative seeks to build a strong alliance that spans the globe, connects countries and allows for open exchange within and between industries and sectors. Learn more at: www.theriseinitiative.org

How do we modularize and specify models and host model modules in workflows that are interactive and interoperable?



Global Science stepping into partnership with business



GEOGLAM
Global Agricultural Monitoring



Government
Office for
Science



International Institute for
Applied Systems Analysis



The Frederick S. Pardee Center
for the Study of the Longer-Range Future



THOMSON REUTERS

Willis

A next generation modeling approach?

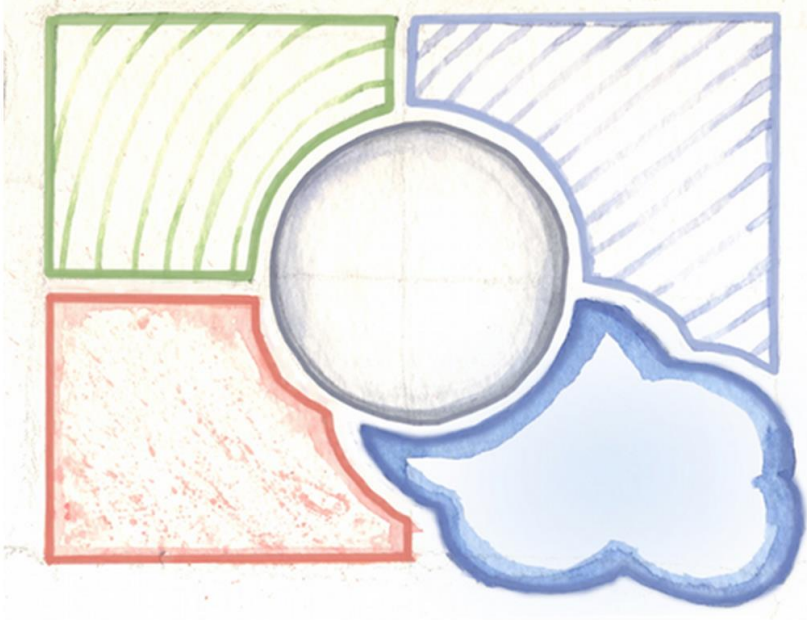
Galaxy / FACE-IT Analyze Data Workflow Shared Data Visualization Help User

Tools

Get Data
[Easy-SIM](#)
[RIA](#)

Workflows
▪ [All workflows](#)

Framework to Advance Climate, Economic, and Impact Investigations with Information Technology



FACE-IT is supported by the [NSF](#) cyberSEES program award No.1331782

The Galaxy project is supported in part by [NSF](#), [NHGRI](#), and [the Huck Institutes of the Life Sciences](#).

The Galaxy-ES (Earth System) toolshed is part of the [FACE-IT](#) project.

The FACE-IT framework is being developed out of a collaboration between the University of Chicago Computation Institute's center for Robust Decision-making in Climate and Energy Policy ([RDCEP](#)) and the University of Florida ([ABE/UFL](#)) to meet the needs of several international communities of researchers working on issues around climate change vulnerabilities, impacts, adaptations, and mitigation.

Managing complex data streams; knowledge assets

- Trends through time
- Geospatially referenced data
- Multiple scales / sources
- Reliance on cyberinfrastructure to hook assets together, repurpose existing assets
- Integration into numerical models (productivity, ecological, economic)
- Output information in relevant formats for different user groups



NIEM Empowers Meaningful Data Connections

Get Started With NIEM

1 2 3 4 5 6 7

NIEM Connects. The Dots. Data. Communities. The Nation. And Beyond.

NIEM makes it possible for organizations to share critical data; as a result, people are empowered to make informed decisions that improve efficiency and help organizations advance their missions.

[Learn more about NIEM >>](#)

NIEM News [\(more\)](#)

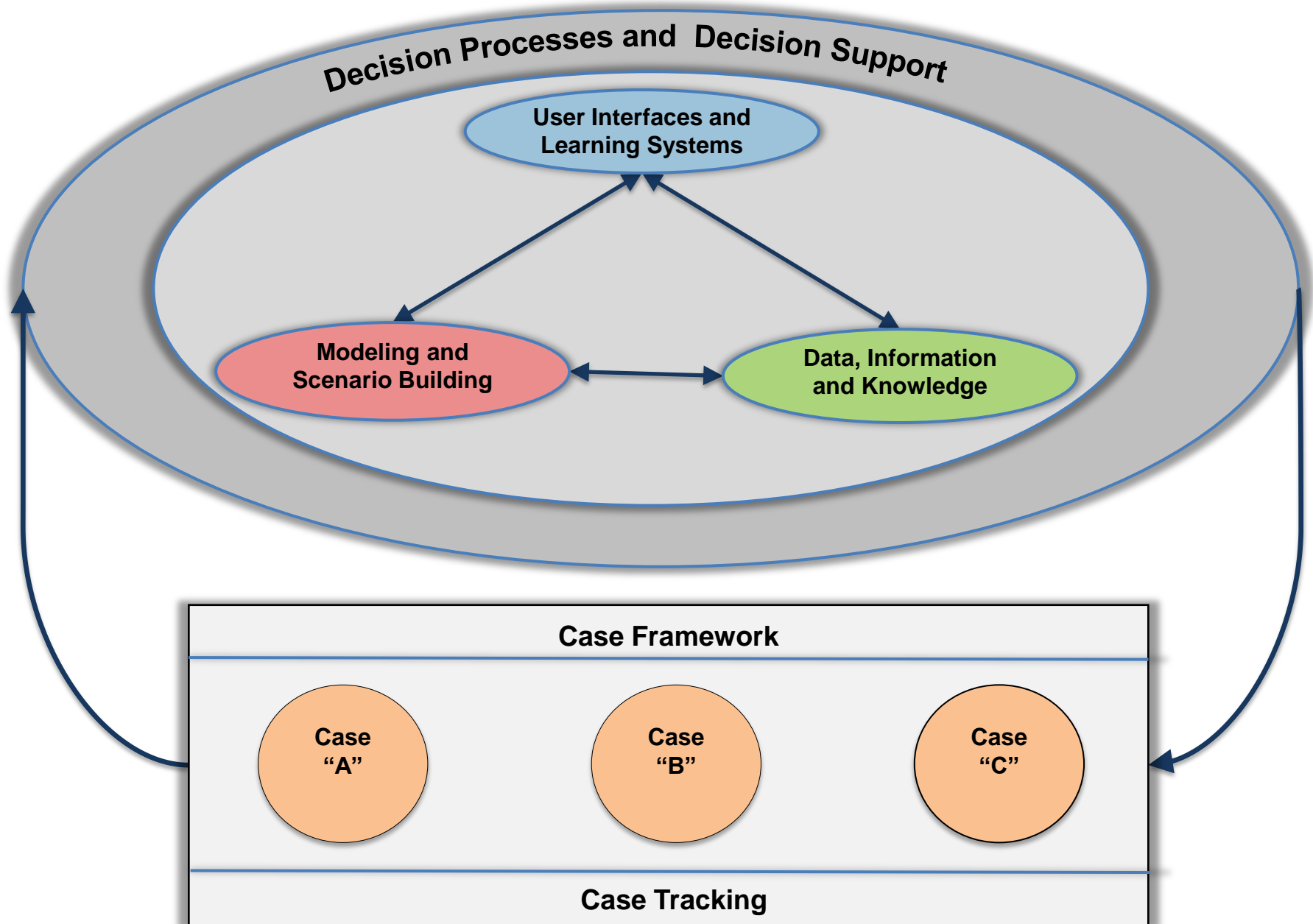
[ISE Partnership with Santa Claus Improves Information Sharing at the North Pole](#)

NIEM—the National Information Exchange Model—is a community-driven, standards-based approach to exchanging information. NIEM connects communities of people who share a common need to exchange information in order to advance their mission.

What does the next generation of integrated earth and food systems models look like?



The knowledge ecosystem for 21st century food systems





Visualization approaches force better integration of our communities:

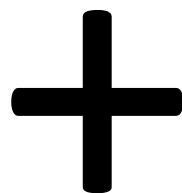
Visualizing the coupled food / water / energy systems

Beyond massive data dumps from science to governments and business our path to a more secure and stable future requires these steps:



Ag  MIP

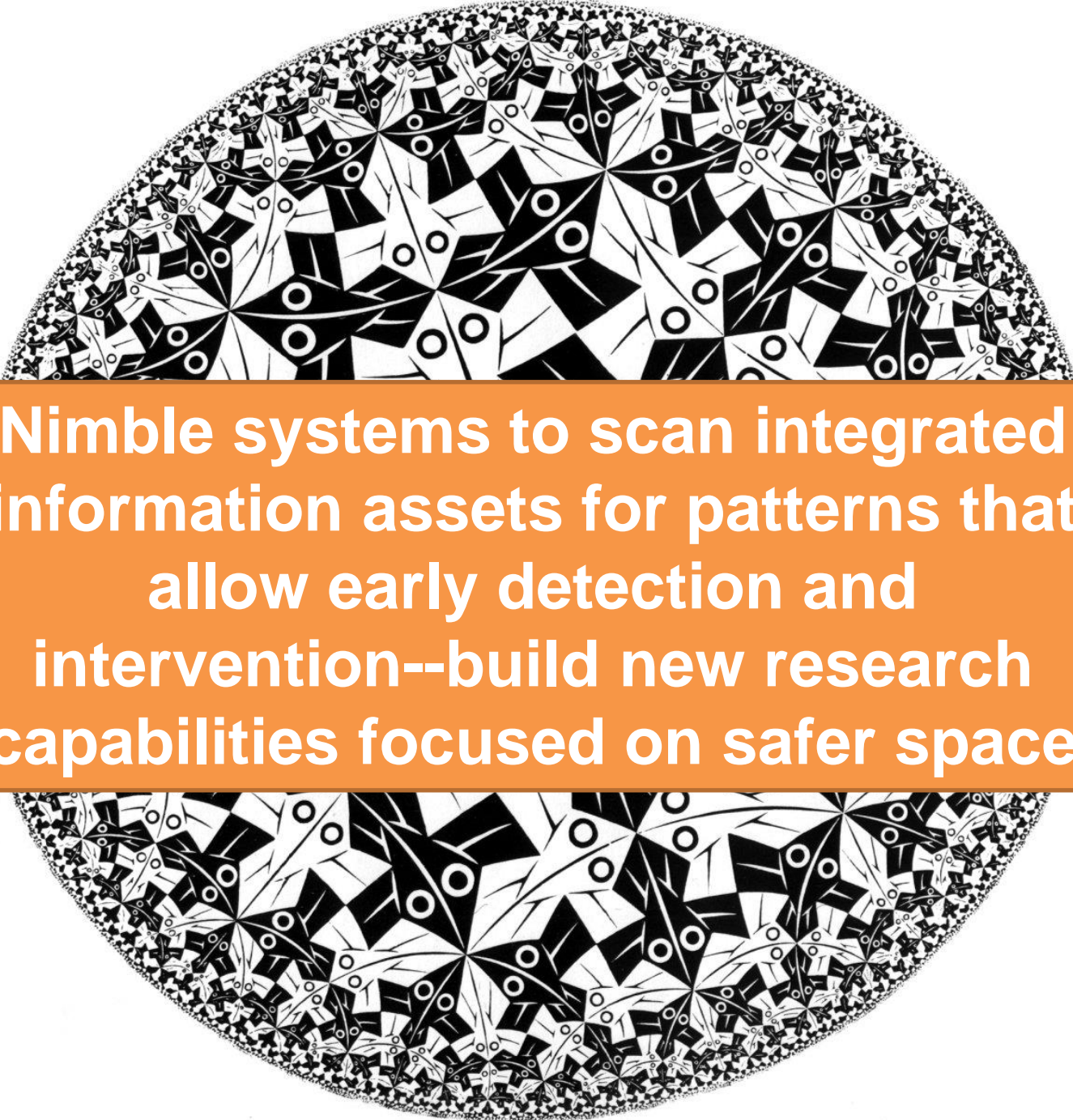
The Agricultural
Model Intercomparison
and Improvement Project



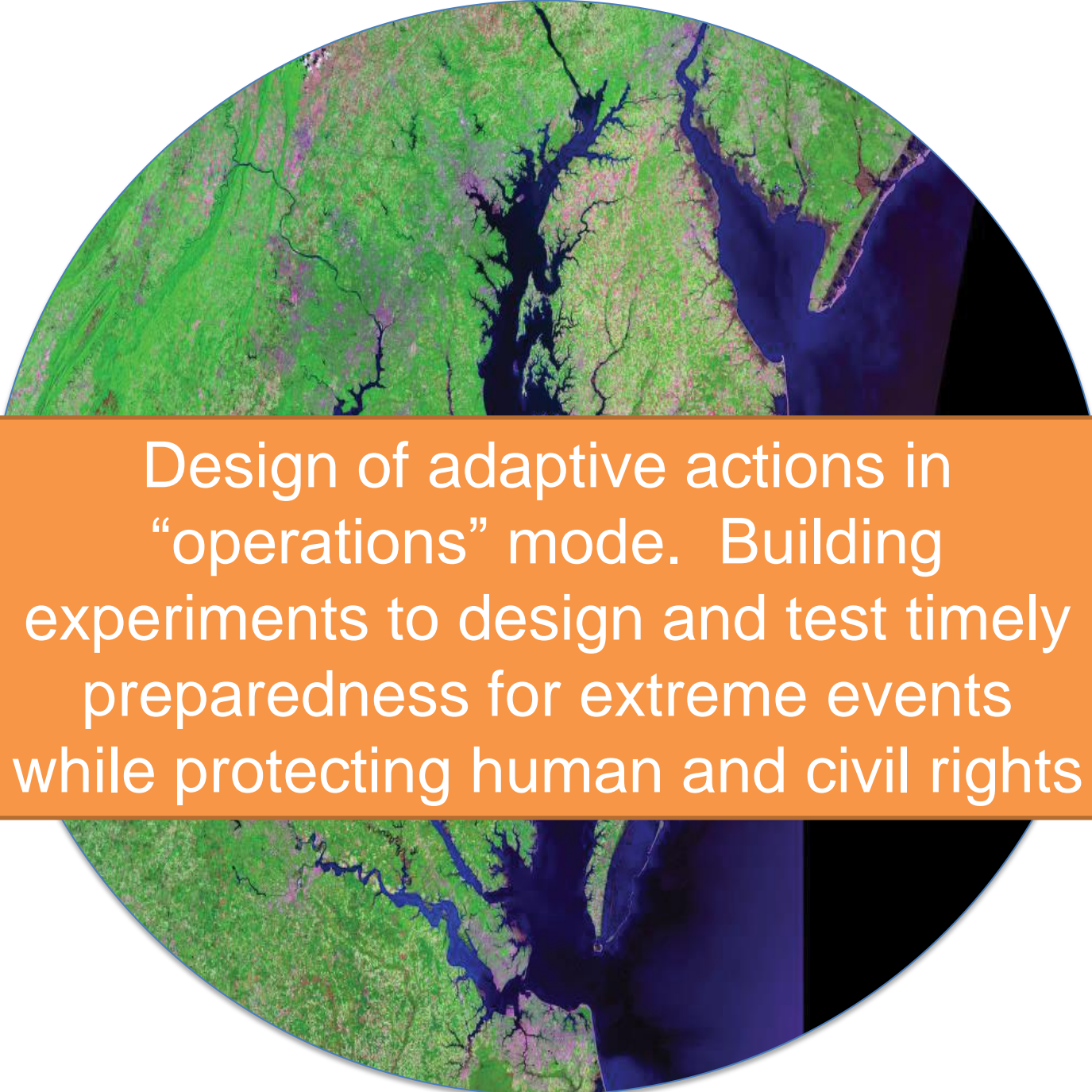
GEOGLAM
Global Agricultural Monitoring



- Public-private partnership on open data and open-source code modeling to enhance the climate-resilience of food systems
- Evaluate seven novel nutrition and sustainability metrics of global food systems, including all of the world's important staple and non-staple foods, through the year 2050



Nimble systems to scan integrated information assets for patterns that allow early detection and intervention--build new research capabilities focused on safer space

The image features a circular aerial photograph of a river delta, likely the Mississippi River Delta, showing a complex network of waterways and green land. A central orange rectangular box contains white text. The text reads: "Design of adaptive actions in 'operations' mode. Building experiments to design and test timely preparedness for extreme events while protecting human and civil rights".

Design of adaptive actions in
“operations” mode. Building
experiments to design and test timely
preparedness for extreme events
while protecting human and civil rights



Figure out how to deliver high-quality decision-relevant NRT information that recognizes food/water/energy nexus, that are relevant at the smallest scales, and that advances humanitarian commitments in all contexts

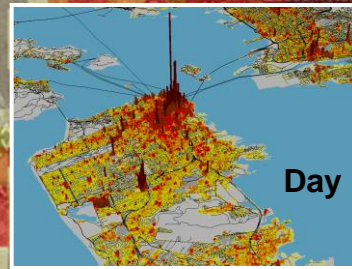
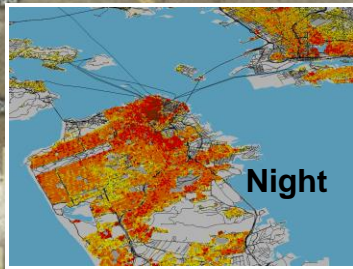
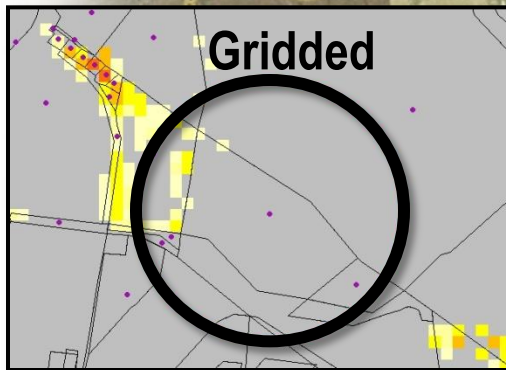
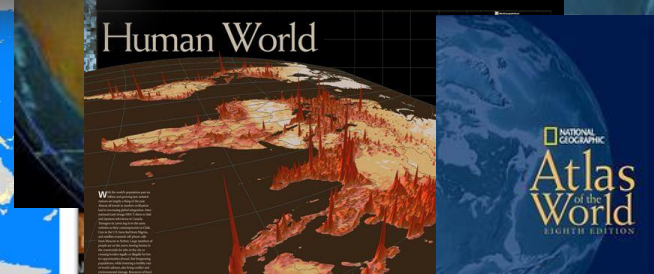
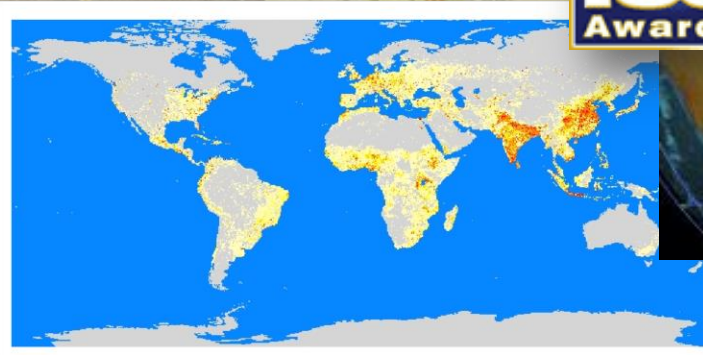
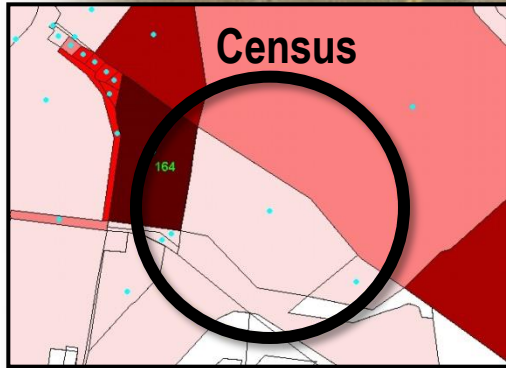
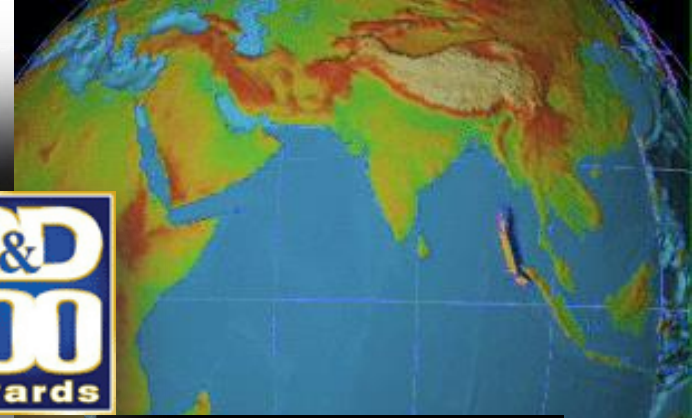


Learn how to “see” outcomes/impacts of individual and collective choices on human systems, landscapes under climate change, conflict and other stress

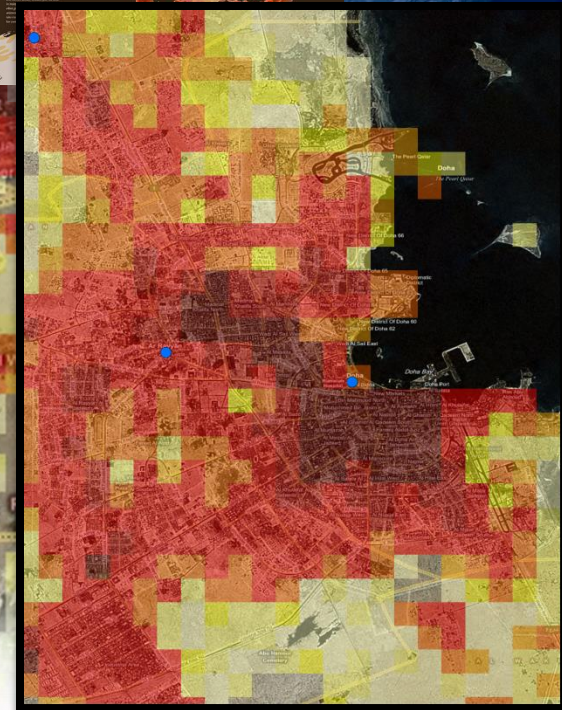


Partnerships are Key: Governments, universities and private sector have shared stake

LandScan Global

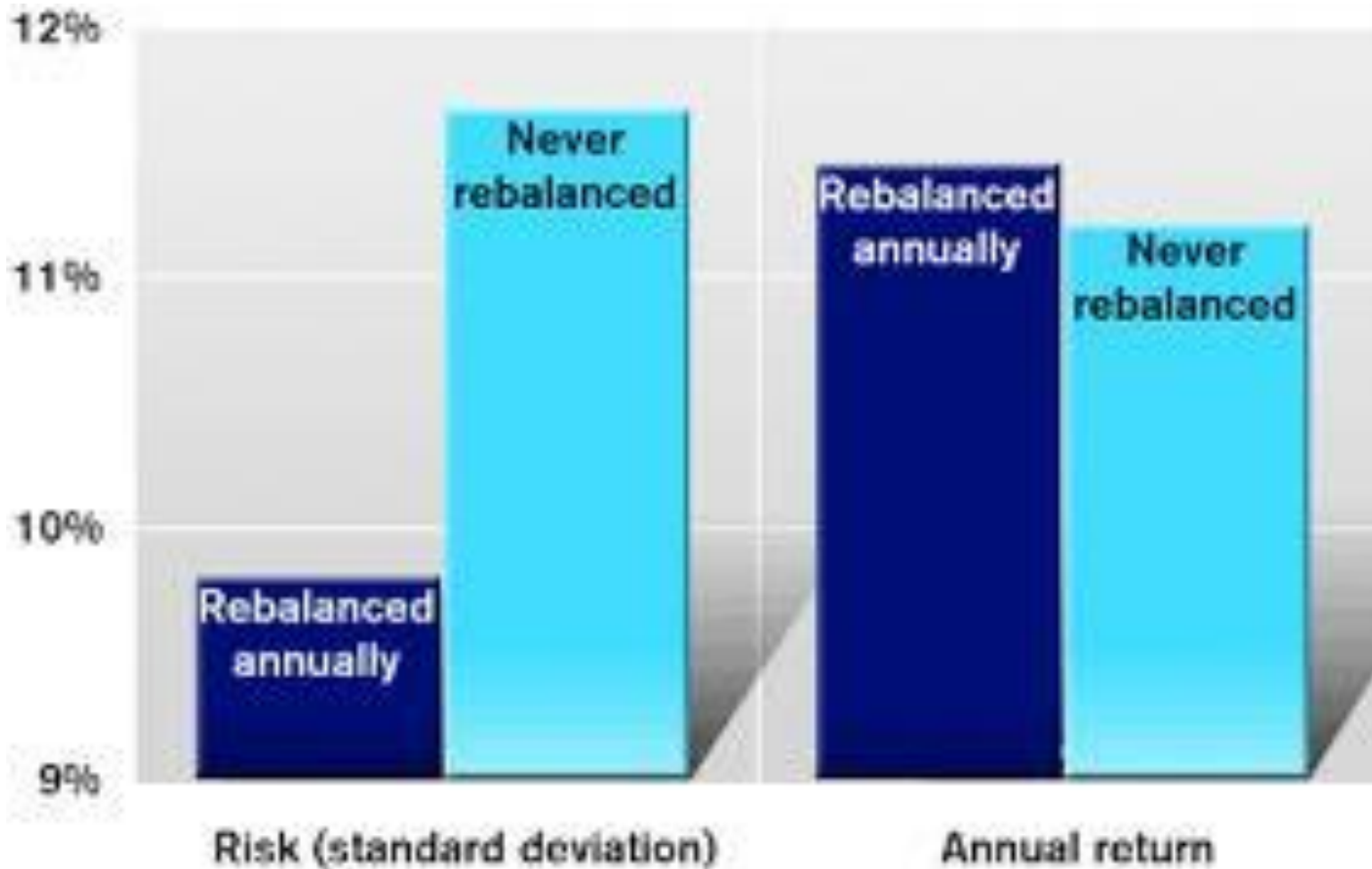


LandScan USA

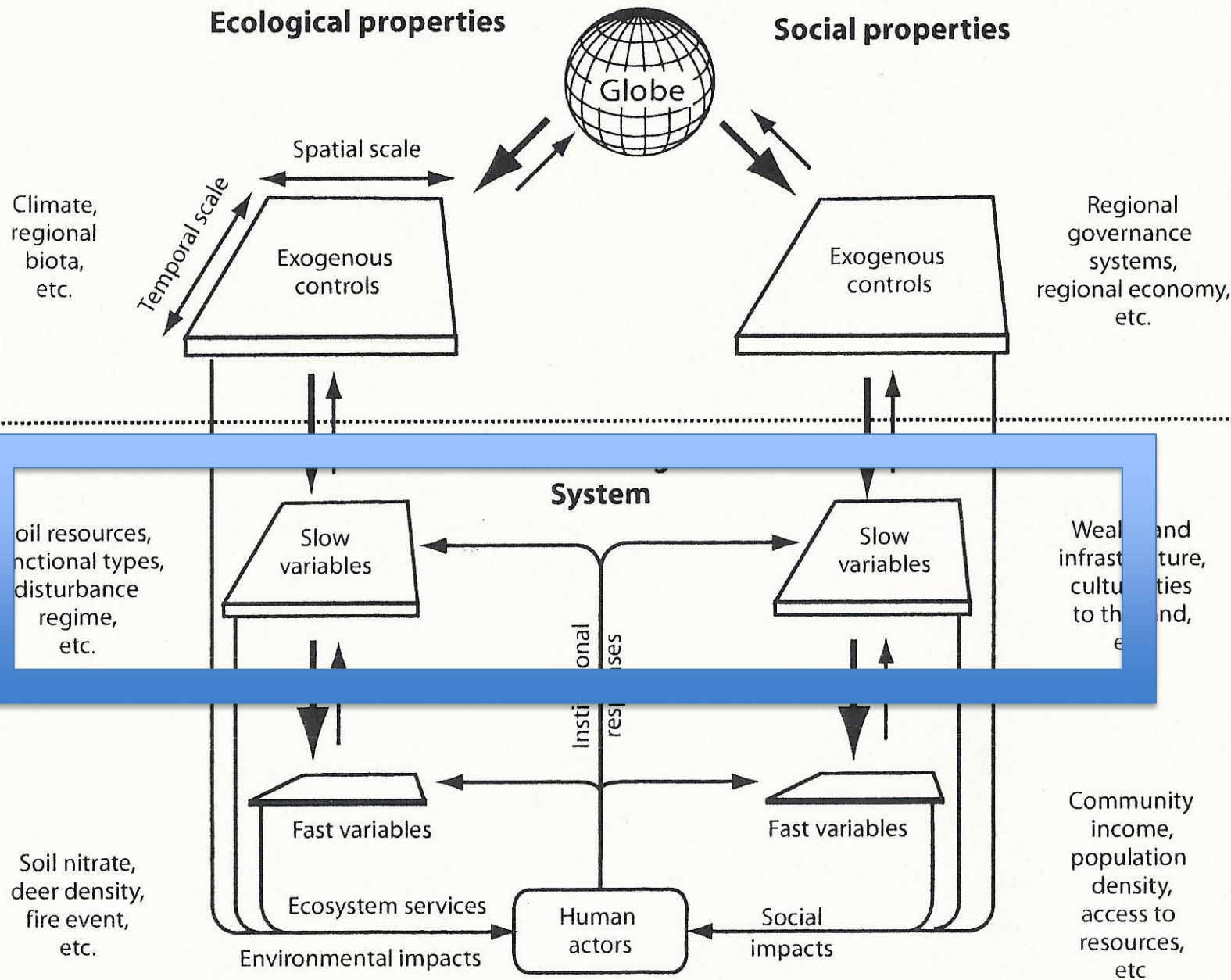


Academics leverage major investments in governments and private sector to create "shared pre-competitive space."

New combinations of skills in a post-disciplinary era:
e.g., natural scientists and actuaries looking beyond short
term returns: Balancing and rebalancing to better manage
returns and risk



Slide courtesy of Dave Ingram, WillisRe, IAA, Actuaries without borders



Thanks to Dennis Ojima

Chapin et al 2009

Intellectual trends from sustainability science with relevance to agriculture

Landscape views required, major challenge to century-old university depts, static spreadsheet archives, late 20th century corporate structures/business models; yield, productivity still important but so are limits and outcomes

Not just multi-, or trans-disciplinary, this post-disciplinary era requires new vocabulary, new taxonomies, new ontologies that describe features of systems we have historically disaggregated; implications for academic “rigor” and “excellence”

Scientific frontiers include scaling and thresholds, reflecting/managing uncertainty and risk, and linking outcomes in human and environmental dimensions to our choices in agriculture and food systems

Integrated multi-sector coalitions for research including for-profit, NGOs, universities and government, crucial roles for public sector players. Private sector finance, capital and risk will be key

Toward science, safe(r) space for food systems?

A goal for the 21st century?



**“We need to learn to live well within our means”
Chad Waukechon, Menominee Nation**