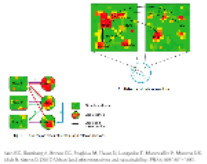
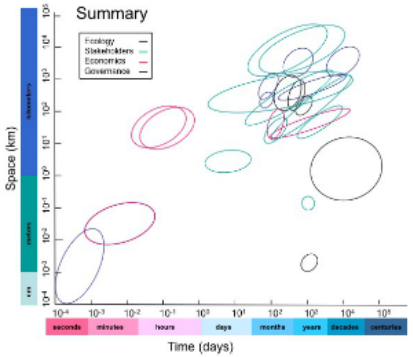








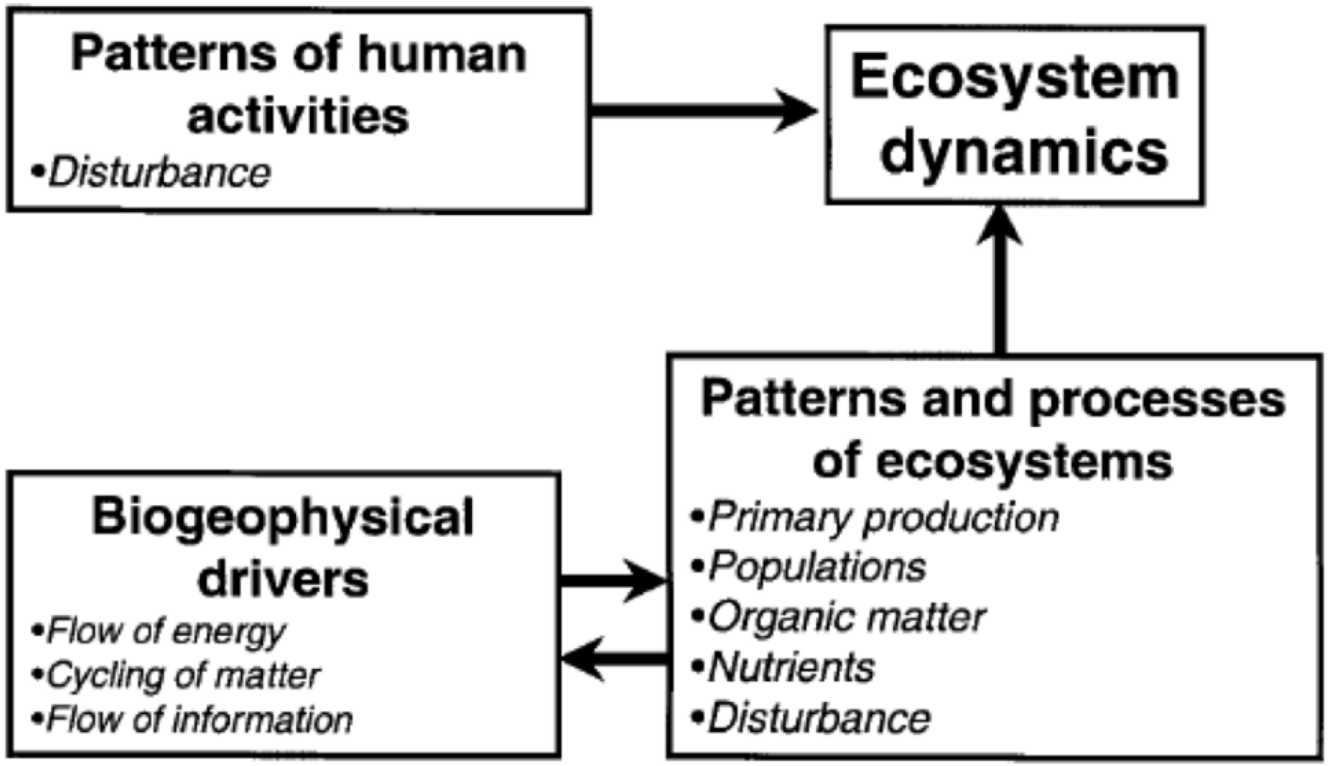
From: http://portal.nceas.ucsb.edu/Members/broitman/ebm-scales-reading-group/summary.jpg/view


Opportunities and Challenges for Incorporating Humans in to Ecological Understanding

Libby Larson

AAAS Science Policy Fellow

Image source: http://jackandcokehead.blogspot.com/2010/10/north-slope-in-pictures.html



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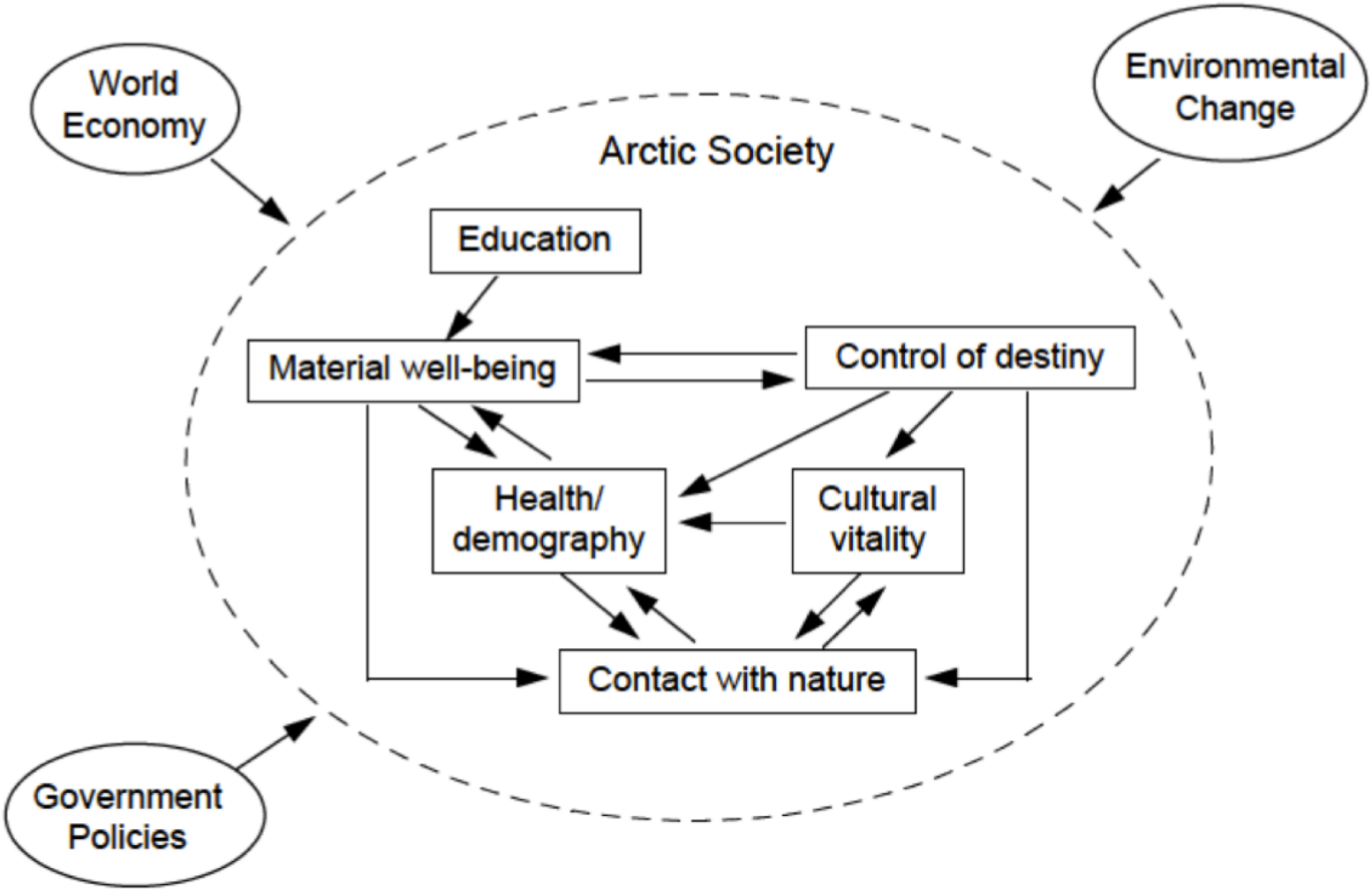

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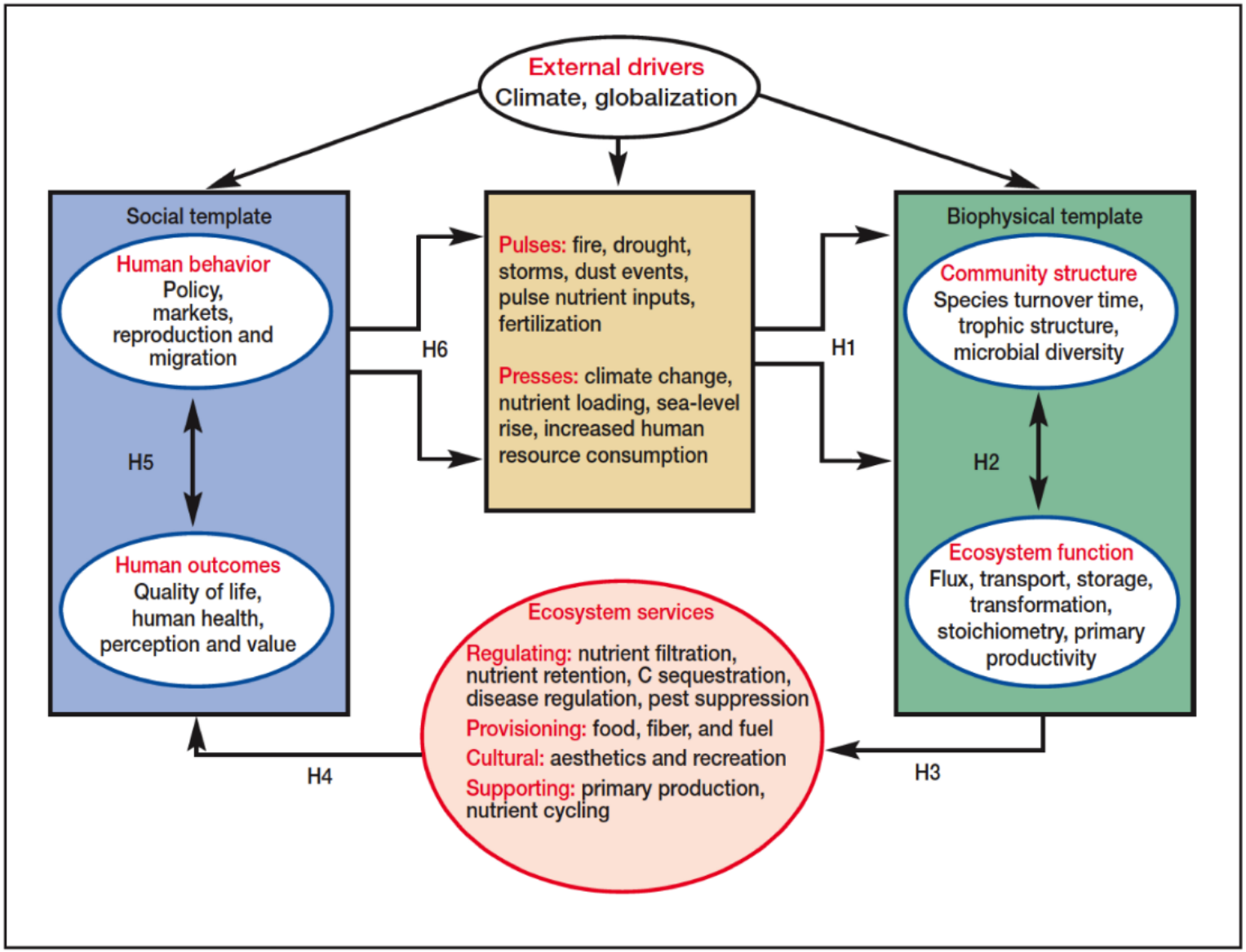

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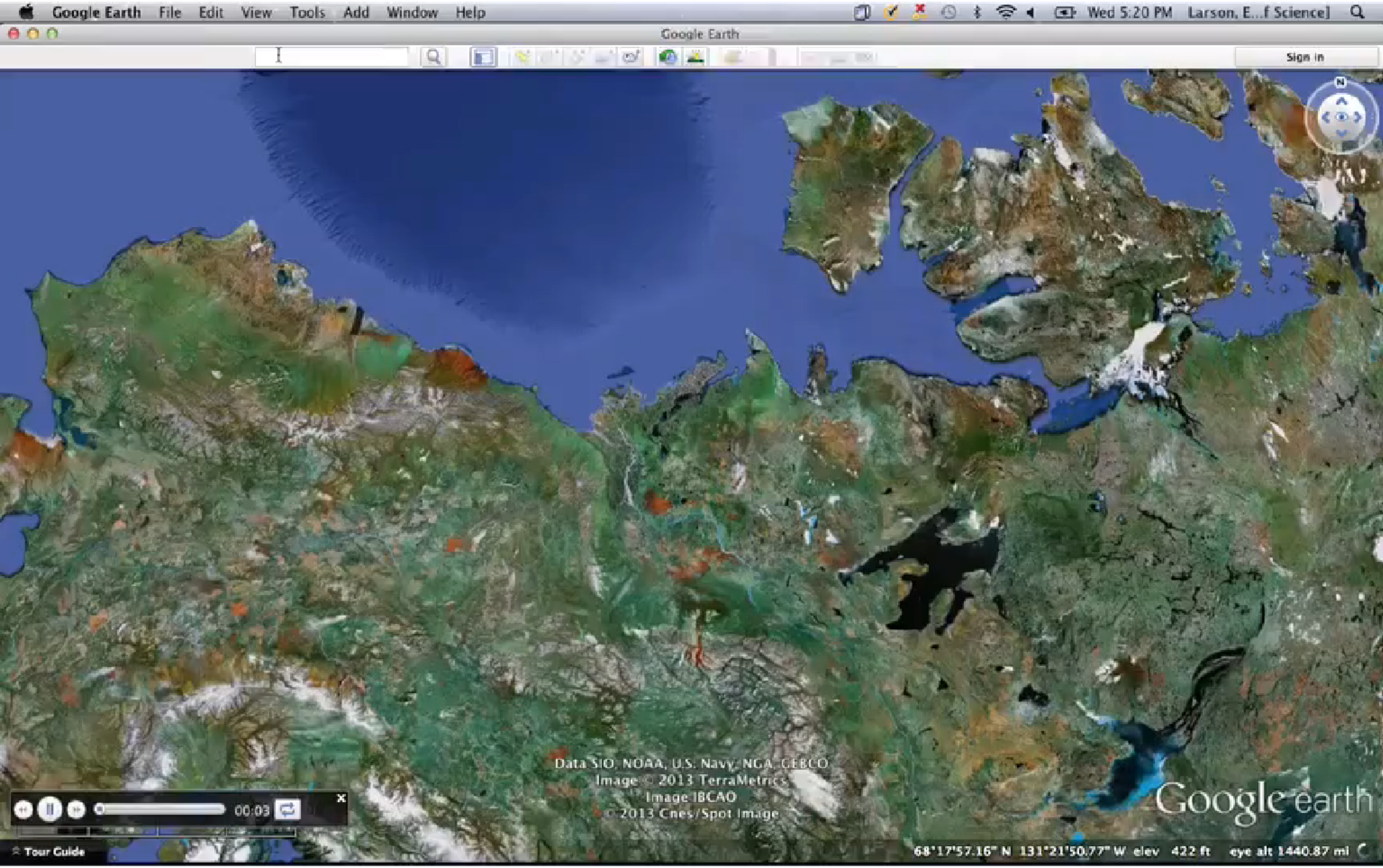
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Examples of Economic Impacts from Climate Change

Sector	Impacts
Hydroelectric Power	Increase in winter runoff, due to decrease of snow storage, resulting in decreased reservoir capacity, threats from downstream ice-jamming
Oil and Gas	Subsurface movement of drilling wastes due to permafrost thaw; threats to processing facility and pipeline infrastructure due to permafrost thaw, river ice break-up, ice-jam flooding, coastal erosion, SLR
Mining	Potential increase in summer exploration activities, but decrease in winter resupply due to reduced availability of ice roads; lack of containment of tailings and wastes due to permafrost thaw
Infrastructure	Damage from slope instability and subsidence
Transportation	Potential reduction in summer-time flow of important river transportation corridors; shortening of winter ice-road season, increased danger in use of ice-roads
Fisheries	Variability in sea-ice formation affecting access and safety; changes in species production
Wildlife + Biodiversity	Changes in species range and abundance throughout the food web; altered access to important subsistence hunting species; increase in toxic contaminants
Tourism	Increase in visitation due to improved access and longer summer season

TABLE 10: Examples of the impacts of climate change on the northern forest sector (modified from Lemmen and Warren, 2004). From *From Impacts to Adaptation: Canada in a Changing Climate 2007*. NRCAN

Biophysical Impact	Socioeconomic Impact
Changes in forest productivity	Changes in timber supply and rent value
Increased atmospheric greenhouse gases	Introduction of carbon credit-permit mitigation policies that create a carbon sequestration market
Increased disturbances	Loss of forest stock and non-market goods
Northward shift of ecozones	Change in land values and land-use options
Change in climate and ecosystems	Economic restructuring leading to social and individual stresses
Ecosystem and specialist species changes	Changes in non-market values
Ecosystem changes	Dislocation of parks and natural areas, increased land-use conflicts

TABLE 15: Summary of potential, direct, climate related health impacts in northern regions (*adapted from* Furgal et al., 2002).

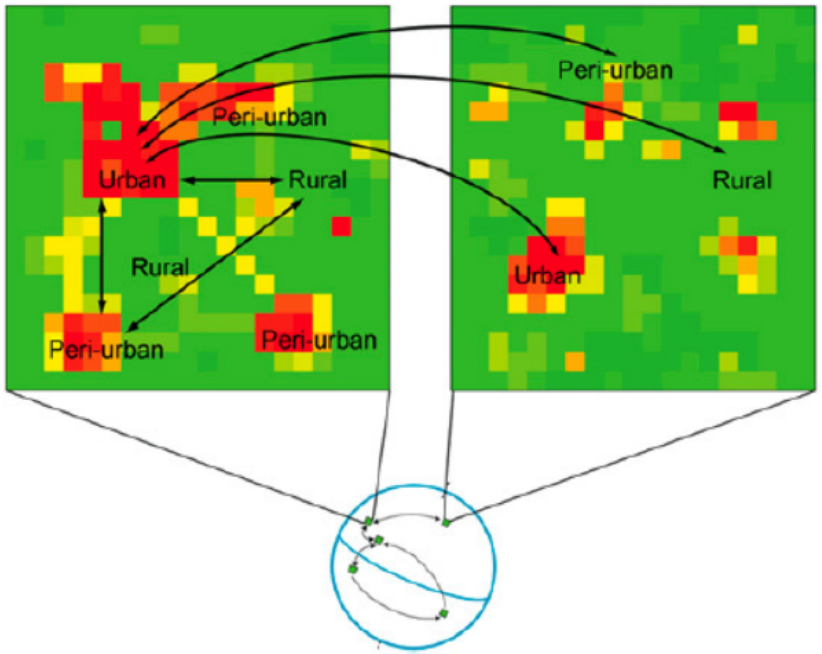
Identified climate-related change	Potential direct health impacts
Increase in temperature extremes (magnitude and frequency)	Increased heat- and cold-related morbidity and mortality
Increase in frequency and intensity of extreme weather events (e.g. storms, etc.) Increase in uncharacteristic weather patterns	Increased frequency and severity of accidents while hunting and travelling, resulting in injuries, death and psychosocial stress
Increase in ultraviolet-B exposure	Increased risk of skin cancers, burns, infectious diseases, eye damage (cataracts), immunosuppression

TABLE 16: Summary of potential indirect climate-related health impacts in northern regions (adapted from Furgal et al., 2002).

Identified climate related change	Potential indirect health impacts
Increase in temperature extremes (magnitude and frequency)	Increased incidence and transmission of infectious disease, psychosocial disruption
Decrease in ice distribution, stability and duration of coverage	Increased frequency and severity of accidents while hunting and traveling, resulting in injuries, death and psychosocial stress Decreased access to country food items, decreased food security, erosion of social and cultural values associated with country foods preparation, sharing and consumption
Change in snow composition (decrease in quality of snow for igloo construction with increased humidity)	Challenges to building shelters (igloo) for safety while on the land
Increase in range and activity of existing and new infective agents (e.g. biting flies)	Increased exposure to existing and new vector-borne diseases
Change in local ecology of water and food-borne infective agents (introduction of new parasites and perceived decrease in quality of natural sources)	Increased incidence of diarrheal and other infectious diseases Emergence of new diseases
Increase in permafrost melting, decrease in land surface stability	Negative impacts on stability of public health, housing and transportation infrastructure Psychosocial disruption associated with community relocation (partial or complete)
Sea-level rise	Psychosocial disruption associated with infrastructure damage and community relocation (partial or complete)
Changes in air pollution (contaminants, pollens and spores)	Increased incidence of respiratory and cardiovascular diseases, increased exposure to environmental contaminants and subsequent impacts

TABLE 19: Sources of social and economic resilience and vulnerability that characterize many Arctic systems (*from* Chapin et al., 2006).

Arctic characteristics	Sources of resilience	Sources of vulnerability	Opportunities for adaptation
Social and institutional properties	Sharing of resources and risks across kinship networks Multiple jobs and job skills held by an individual ('jack of all trades')	Inadequate educational infrastructure to plan for future change Relatively unskilled labour force	Learning and innovation fostered by high cultural diversity
Land tenure and use rights are regionally variable; where strong there is flexibility for adaptation			
Economic properties	Flexibility to adjust to change in mixed wage-subsistence economy	Decoupling of incentives driving climatic change from economic consequences Non-diverse extractive economy: boom-bust cycles Infrastructure and political barriers to relocation in response to climate change	Substitution of local resources for expensive imports (food, fuel) National wealth sufficient to invest in adaptation
Retention of rents from development are regionally variable; where present, they can build infrastructure and social capital that allow adaptation and diversification			



2. Urban land teleconnections.

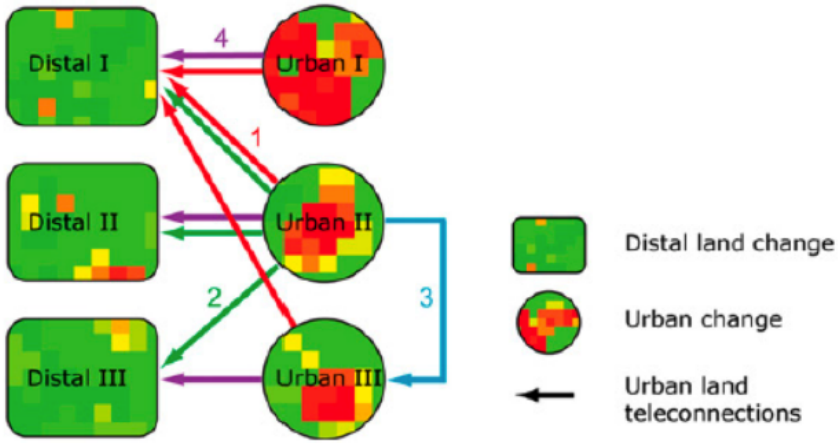
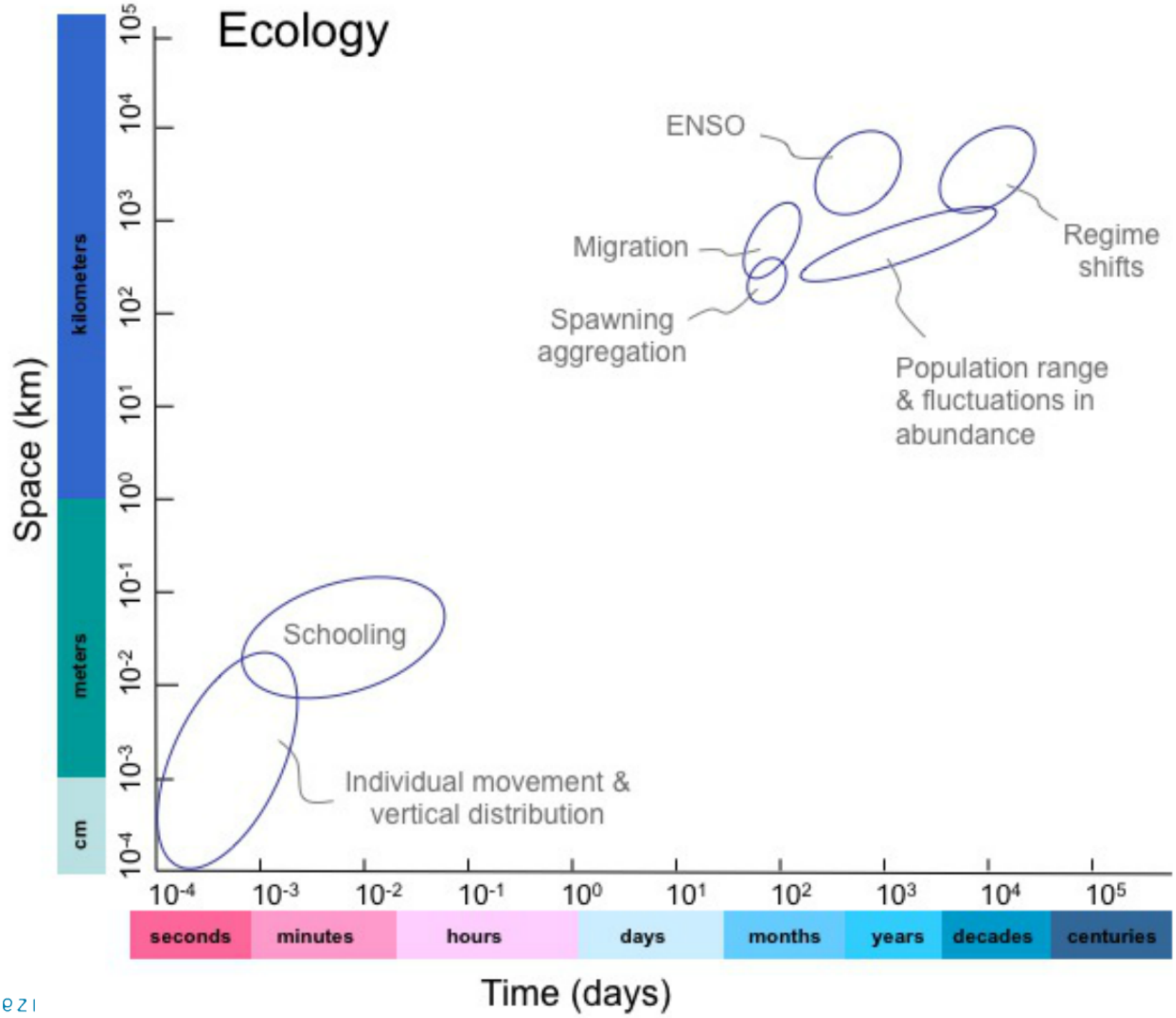
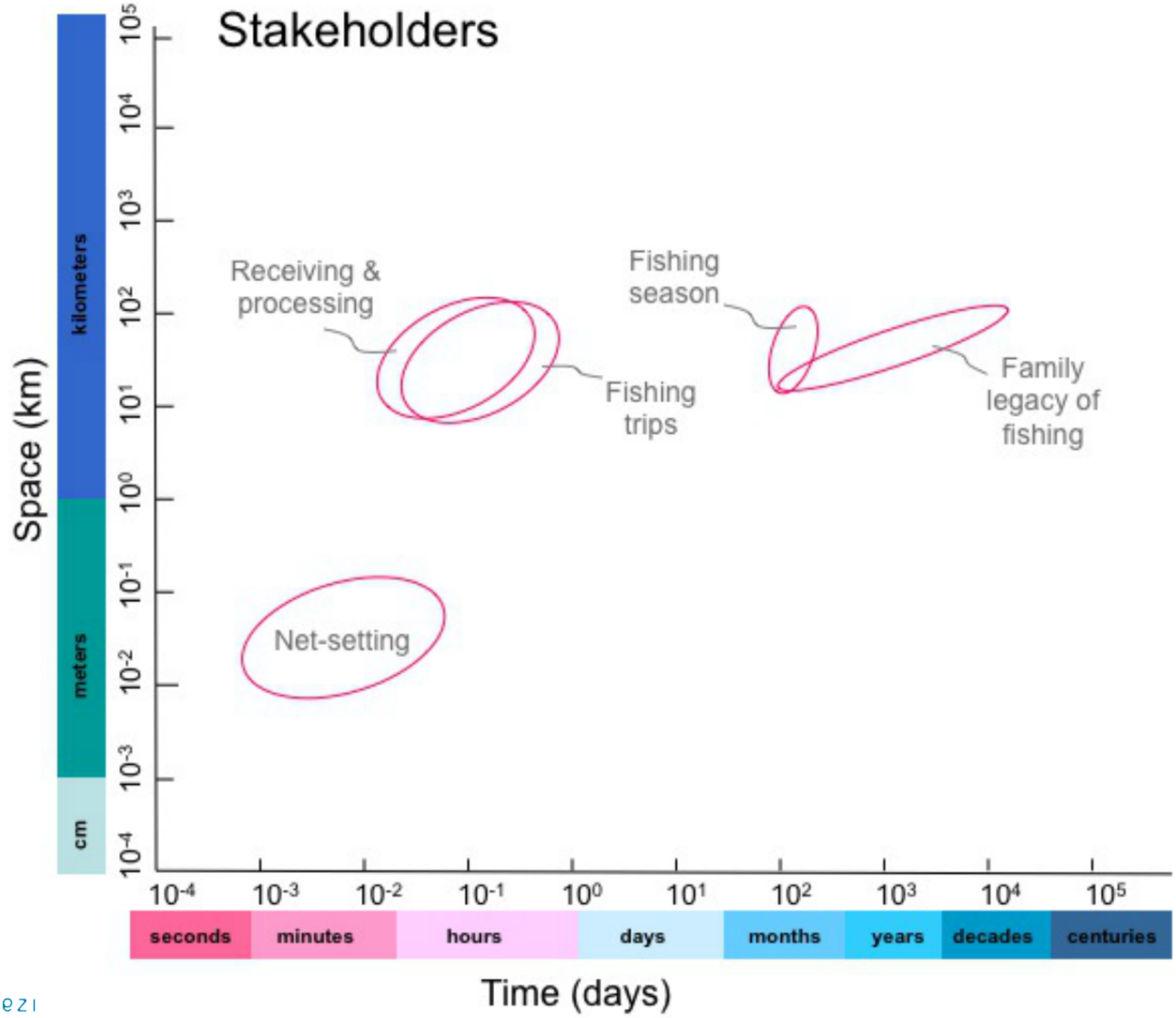
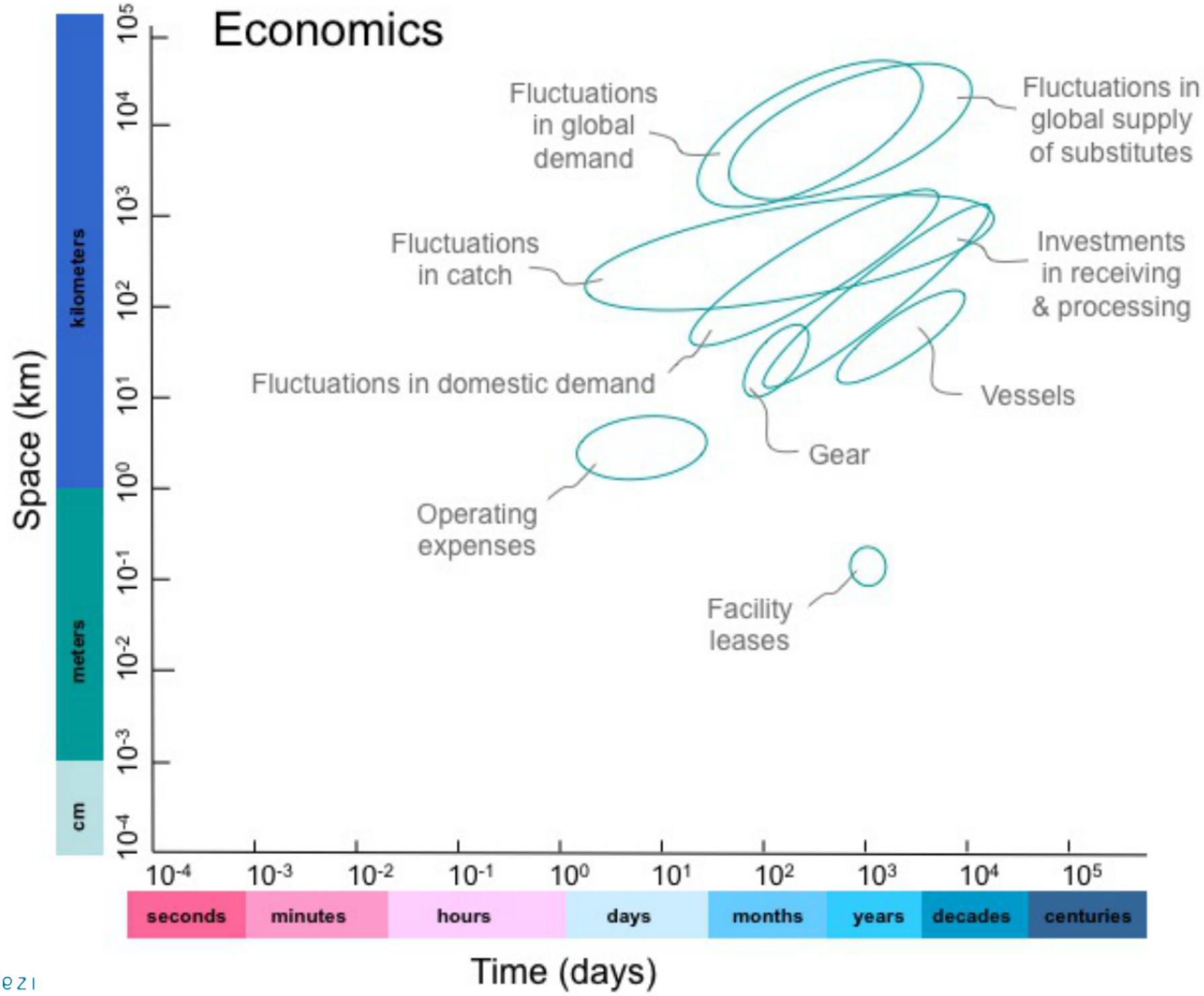


Fig. 3. Four major types of urban land teleconnections.

Seto KC, Reenberg A, Boone CG, Fragkias M, Haase D, Langanke T, Marcotullio P, Munroe DK, Olah B, Simon D (2012) Urban land teleconnections and sustainability. PNAS 109:7687–7692.


Ecology
ENSO
Migration
Regime shifts
Spawning aggregation
Population range & fluctuations in abundance
Schooling
Individual movement & vertical distribution
Space (km)
kilometers
meters
cm
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
seconds
minutes
hours
days
months
years
decades
centuries
Time (days)


Stakeholders
Space (km)
kilometers
meters
cm
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
Receiving & processing
Fishing trips
Fishing season
Family legacy of fishing
Net-setting
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
seconds
minutes
hours
days
months
years
decades
centuries
Time (days)


Economics
Fluctuations in global demand
Fluctuations in global supply of substitutes
Fluctuations in catch
Investments in receiving & processing
Fluctuations in domestic demand
Vessels
Gear
Operating expenses
Facility leases
Space (km)
kilometers
meters
cm
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
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10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
seconds
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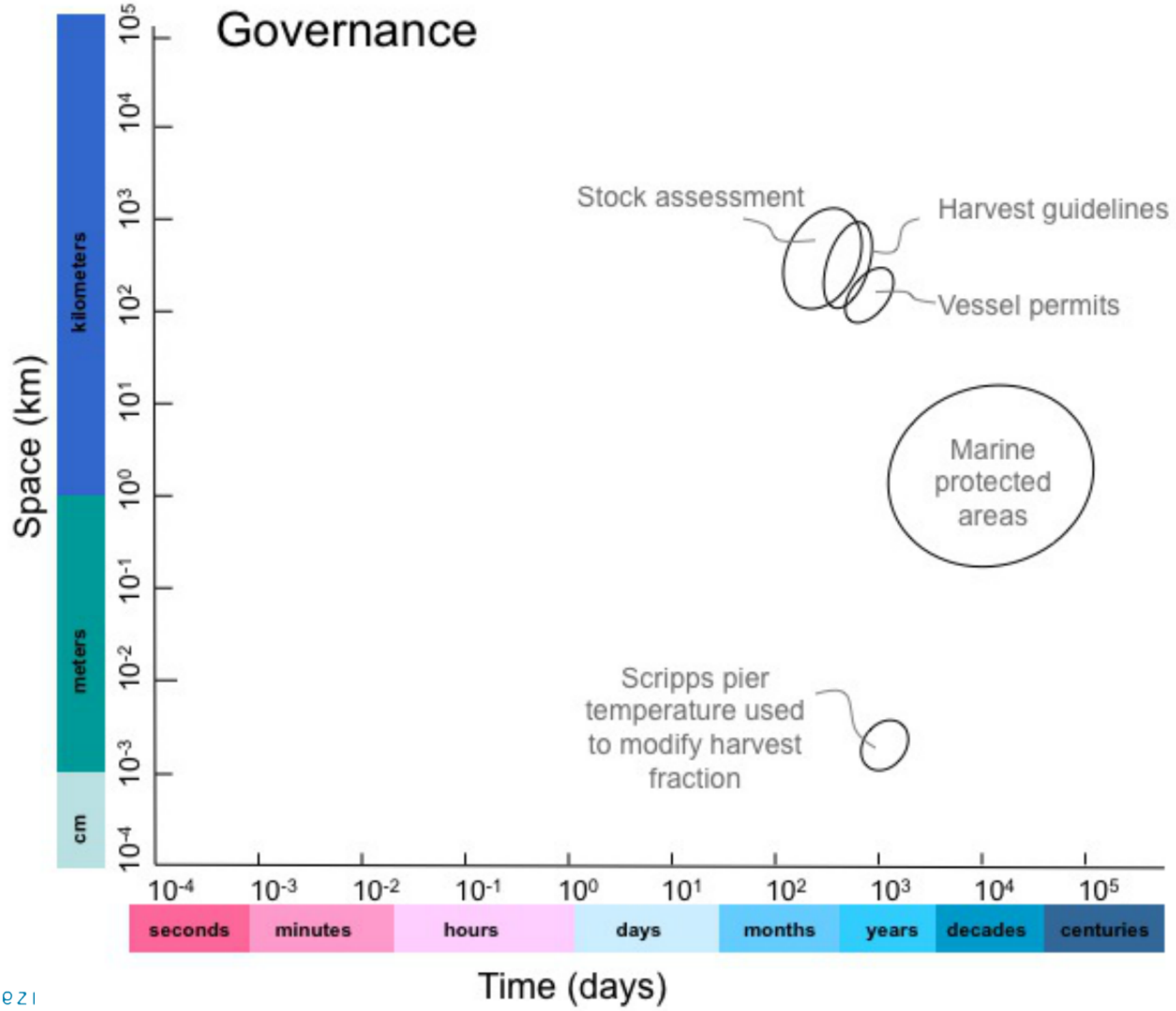
centuries
Time (days)


Governance
Space (km)
kilometers
meters
cm
10^{5}
10^{4}
10^{3}
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10^{-3}
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Stock assessment
Harvest guidelines
Vessel permits
Marine protected areas
Scripps pier temperature used to modify harvest fraction
10^{-4} 10^{-3} 10^{-2} 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
seconds
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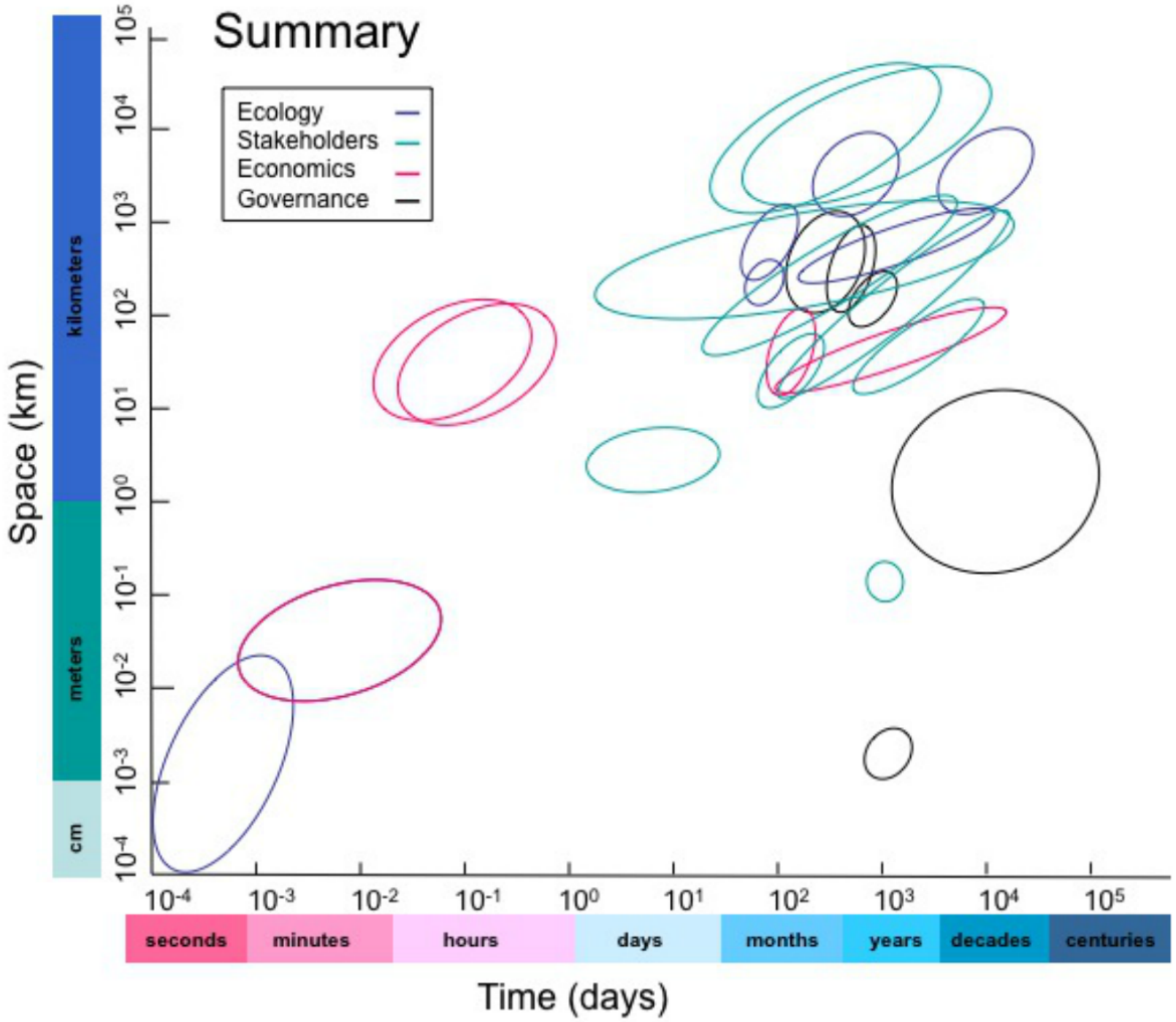
centuries
Time (days)



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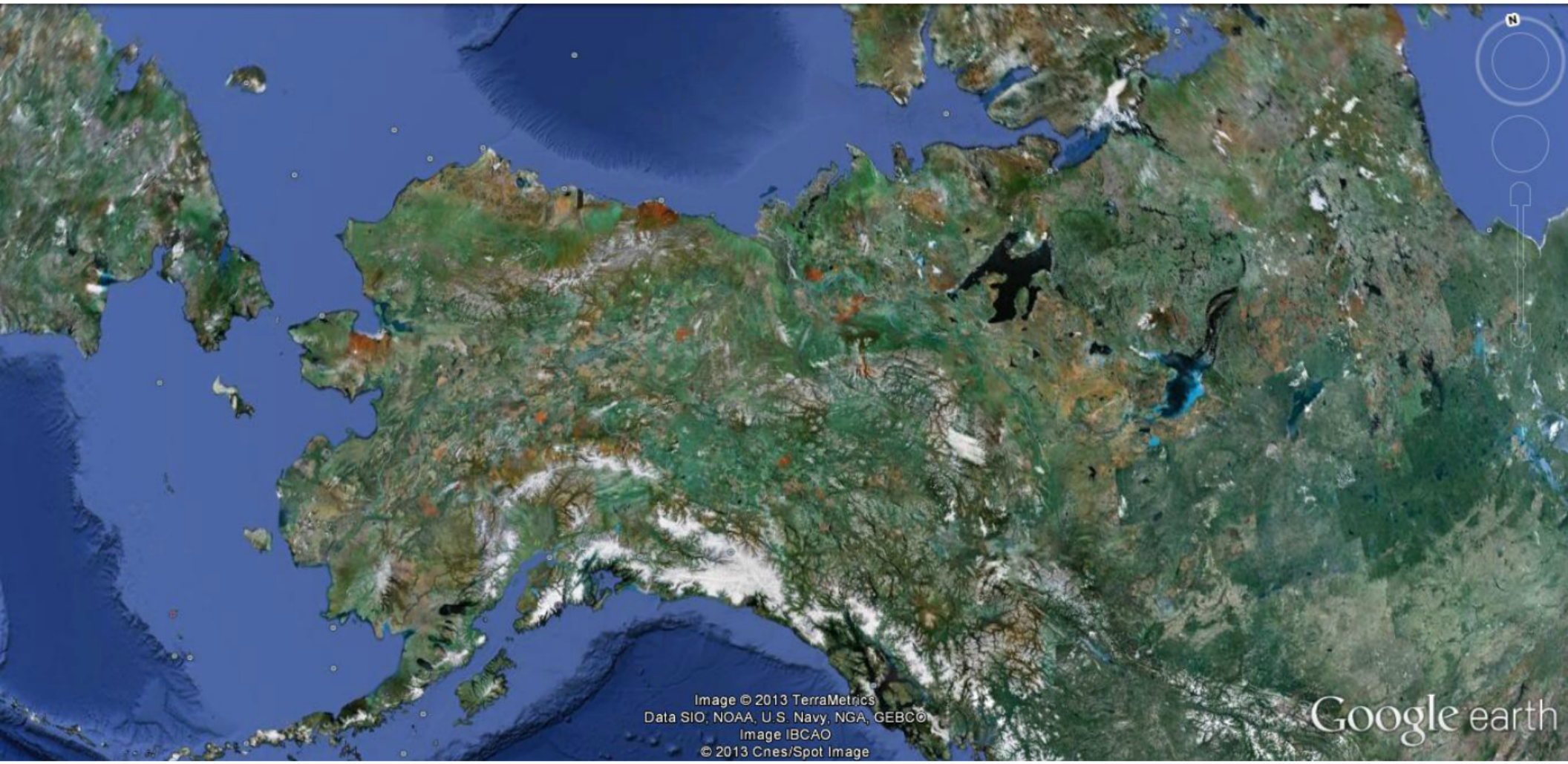
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