Standards and practices for developing and using Bayesian Belief Network models to incorporate local knowledge and improve natural resource management practice in Greenland

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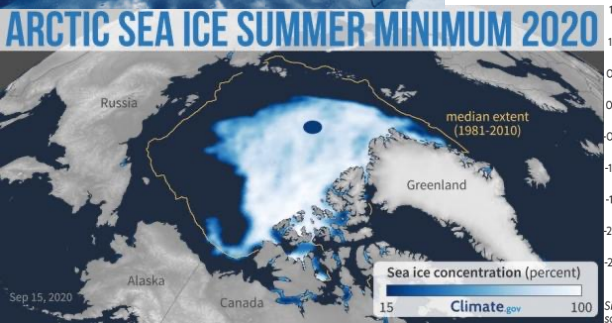
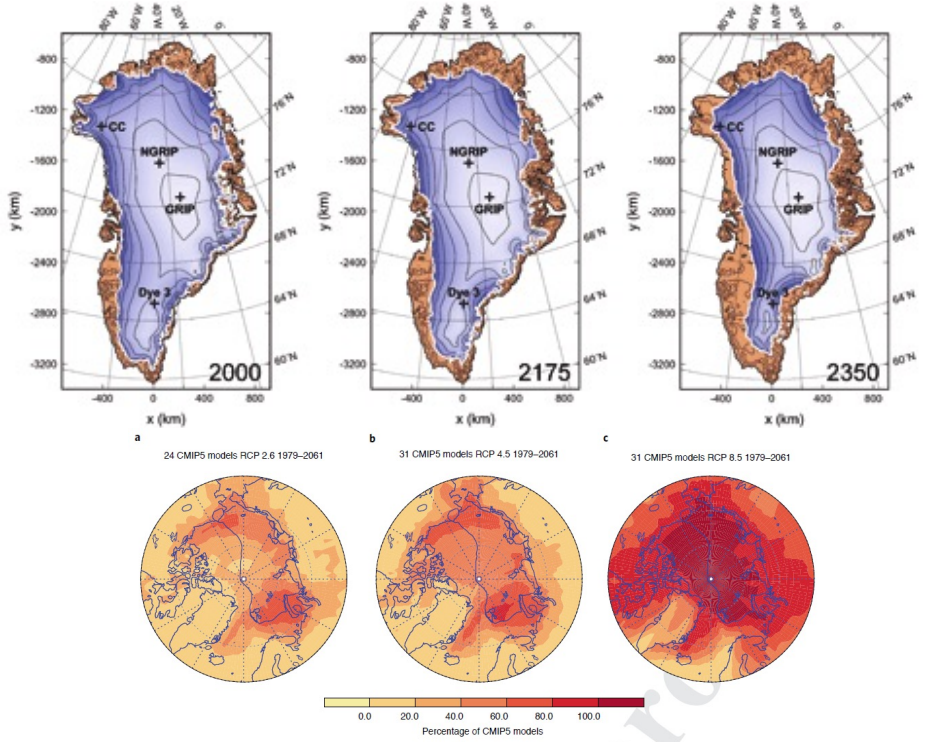
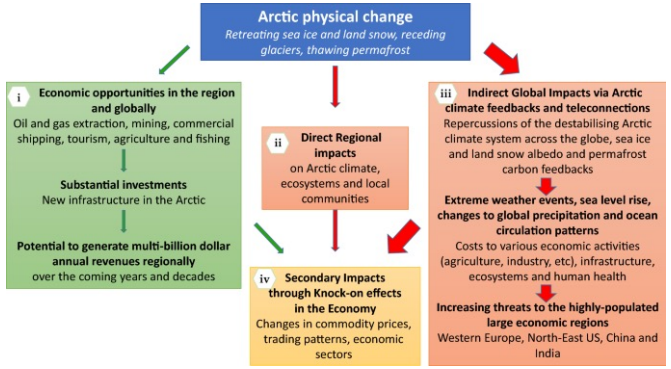
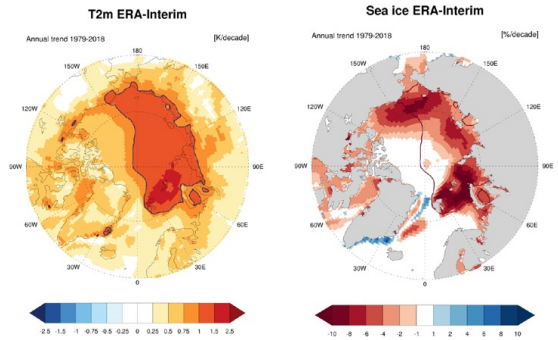
Capardus

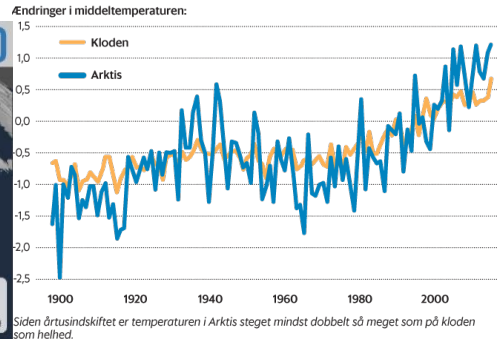
Challenges of natural resource management in Greenland

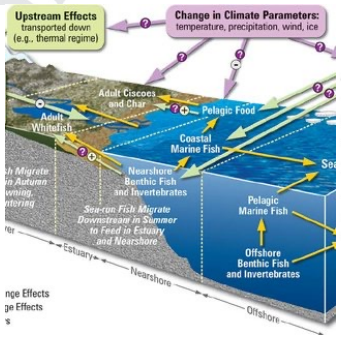


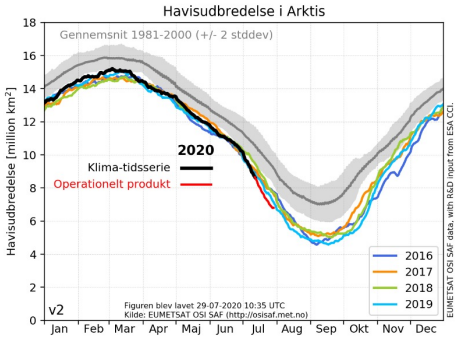












Challenges of natural resource management in the Arctic

- Rapid large-scale climate change combined with far-ranging economic, cultural and political change
  - Disappearance or dramatic modification of habitats, ecosystems and populations, shifts in species geographic range and the timing of ecological events and outbreaks of pests and disease
  - Adverse consequences for resource dependent communities through increasingly unpredictable conditions and changes undermining established production patterns
- Both physical and economic forecasts and scenario assessments needed to inform decisions
  - Constraints on availability of scientific data describing these systems
  - An ecosystem based approach - considering nature and biodiversity conservation, sustainable use and just and equitable benefit sharing combined
- Indigenous Peoples and Local Communities (IPLC) observations and ecological knowledge
  - Inhabiting and traversing the often remote areas using the resources and making observations
  - Practice-based systems of knowledge accumulated through experience and transmitted among members of a community
  - Inclusion of local knowledge important where natural resource management is highly politicised
- How can IPLC knowledge be combined with scientific knowledge and integrated in management?

Bayesian Belief Network Models

- An integrated modelling framework to structure specific scientific problems and explore scenarios - increasingly relevant to incorporate uncertainty arising from climate change
  - Making predictions about the outcome of management interventions and how sensitive these are
- Enables exploring complex socio-ecological systems with limited data by incorporating multiple forms of knowledge
  - Scientific data and models, literature review, expert opinion and local knowledge (beliefs)
- Describes systems graphically as a network of interactions between nodes from primary cause to outcome with all cause-effect assumptions made explicit
  - Promoting co-development, interpretation and acceptance of resulting management strategies by local stakeholders
- Spatial relationships can be incorporated directly into the model structure and the outcome in different scenarios visualized in maps
- Results can be made available to stakeholders at all levels through online applications

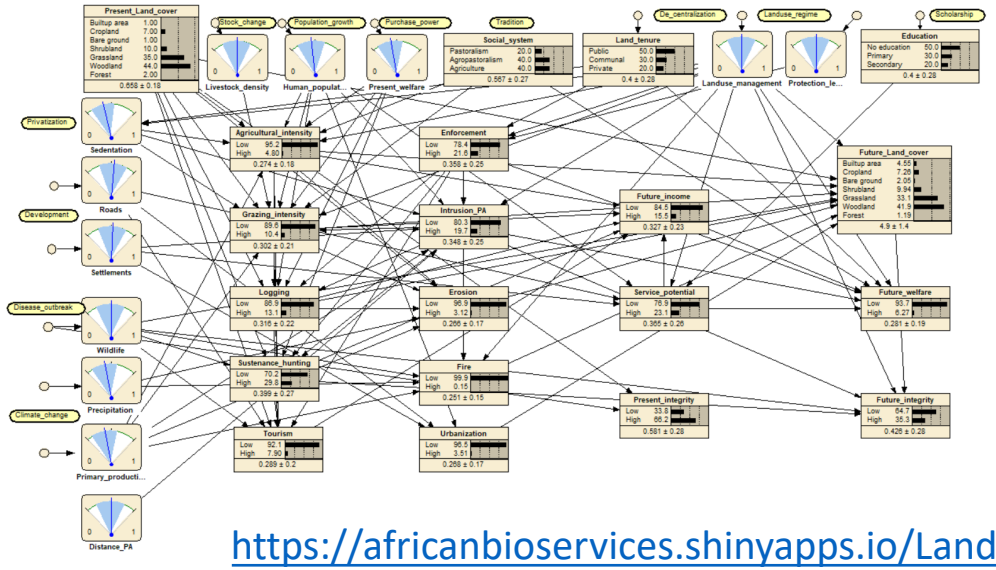
LandScapes in the Greater Serengeti-Mara Ecosystem

Downward Spiral
In this scenario, lack of governance structures leads to eroded agricultural and pastoral production and lack of tourism income, in turn causing reduced welfare of communities and pressure on the environment through increased illegal activities.

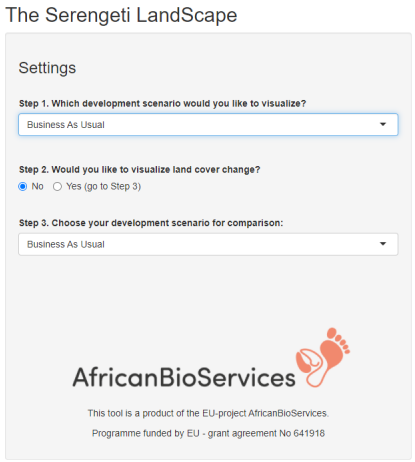
Globalization
In this scenario, national governance structure provides good infrastructure and service provision for communities, who through intensification of land-use have good access to markets and trade at the cost of natural and cultural heritage.

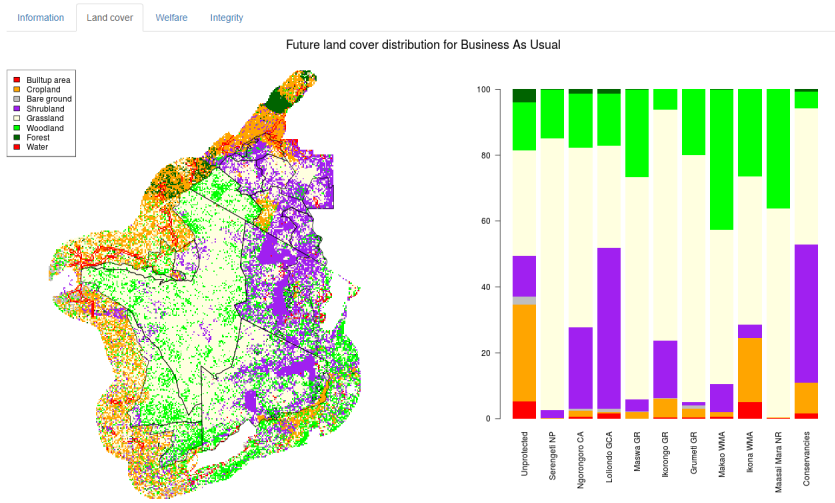
Green Haven
In this scenario, top-down conservation-driven governance ensures the services and livelihood of few communities obtaining revenues from ecotourism, and strict preservation of wildlife and their habitats.

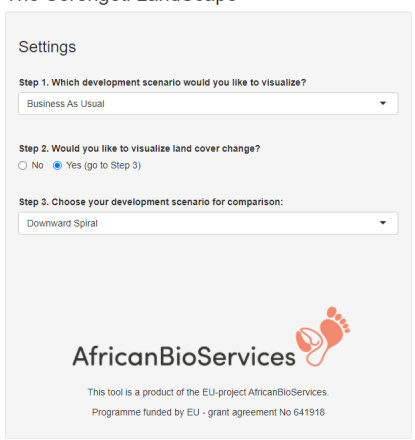
Local communities
In this scenario, local governance of communities enables stable and self-sustainable livelihoods through agropastoral sustenance opportunities from natural resource use, while conserving natural and cultural heritage.

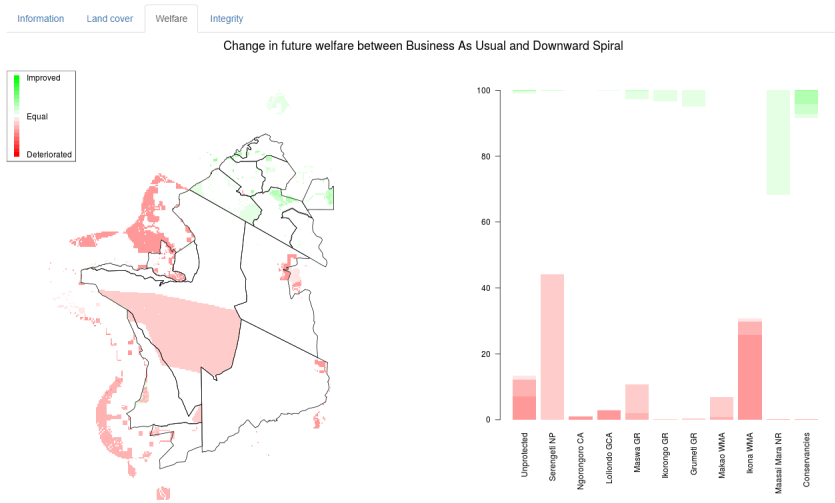


https://africanbioservices.shinyapps.io/LandScape/



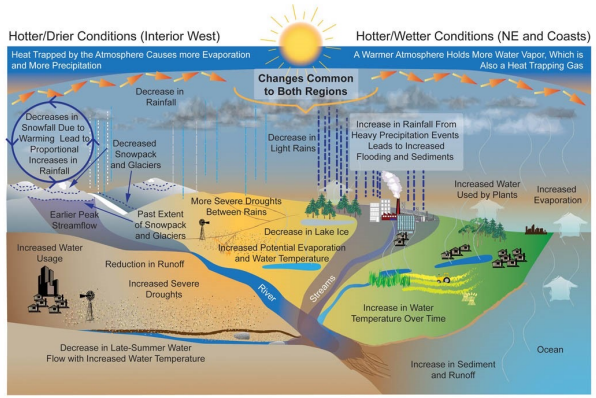


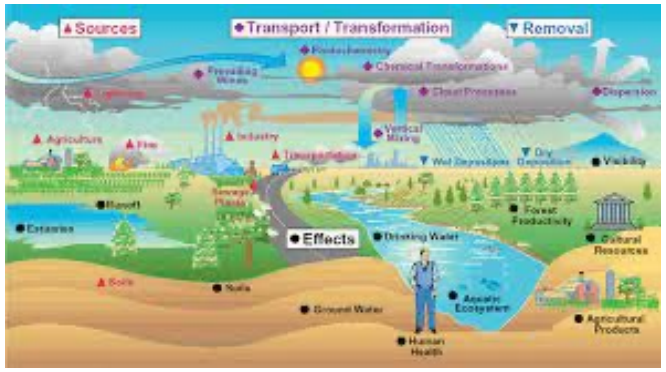


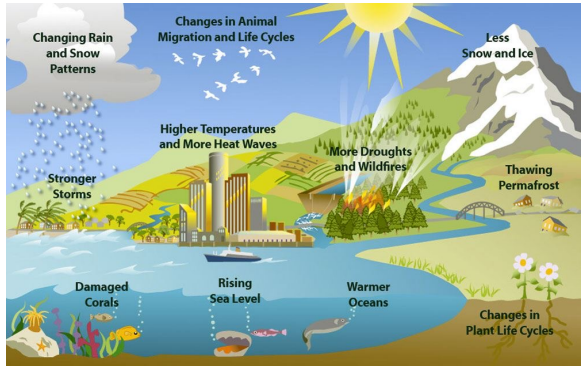


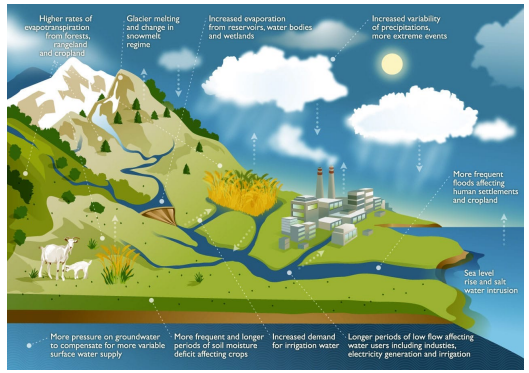
Standards and practices for using BBN models in Greenland

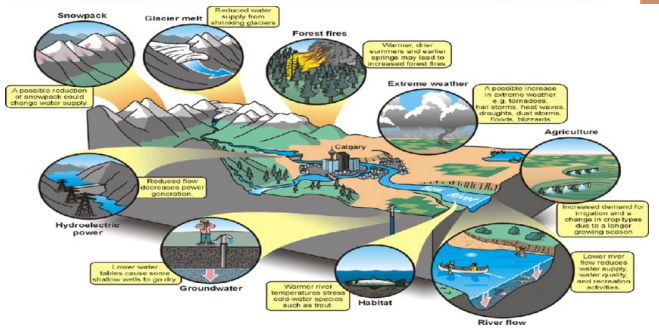
- What are the appropriate standards and practices?
- What are the ethical concerns and requirements?
- How can the use of BBN models be promoted as a way to incorporate IPLC knowledge into natural resource management in Greenland?

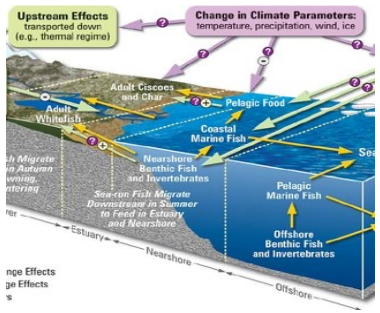


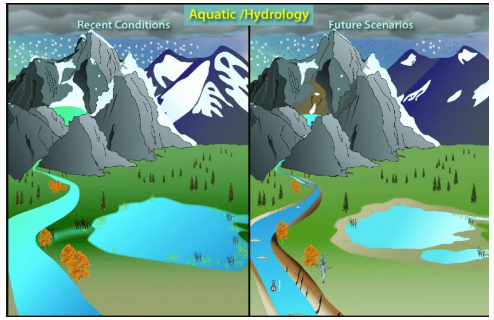


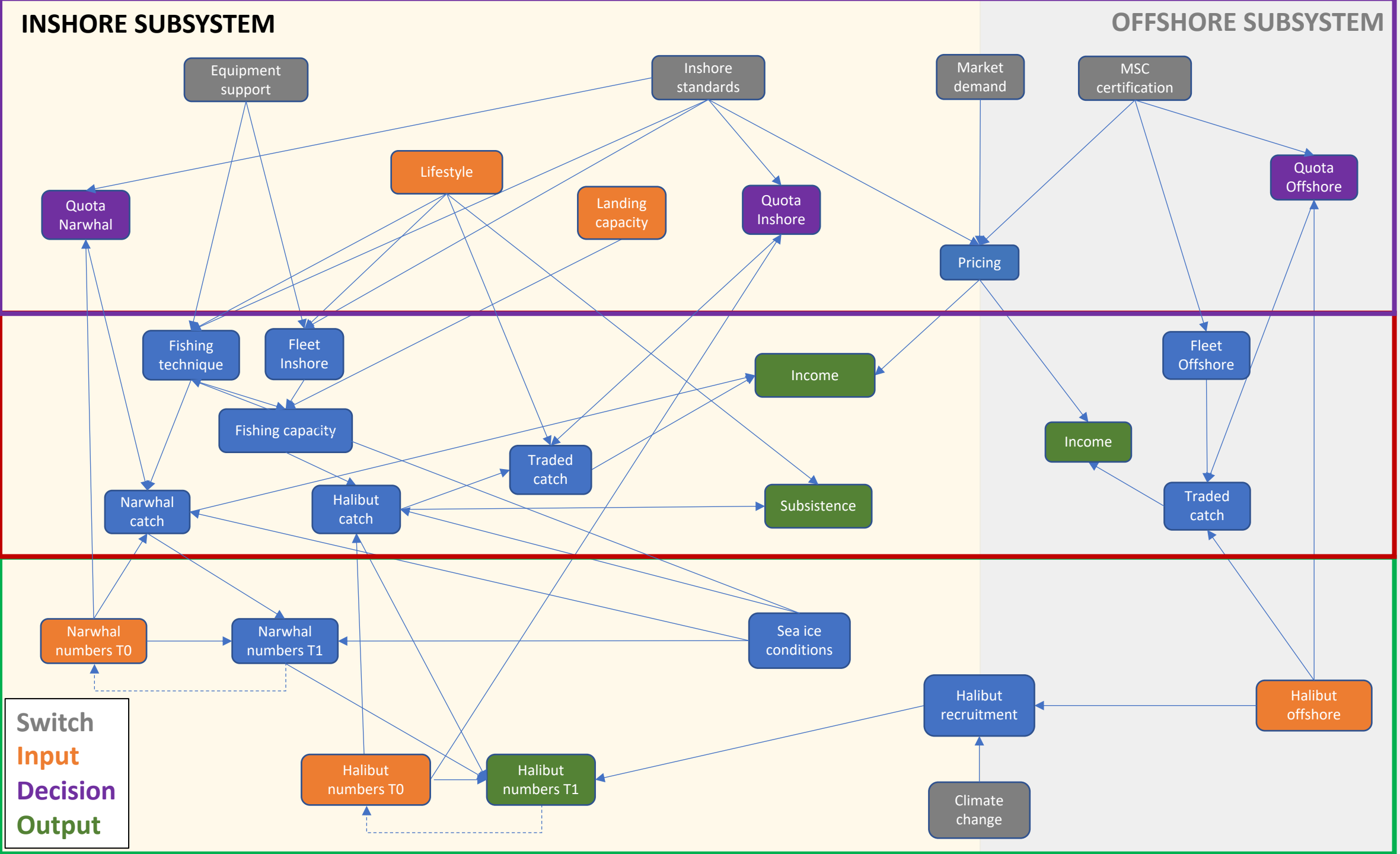




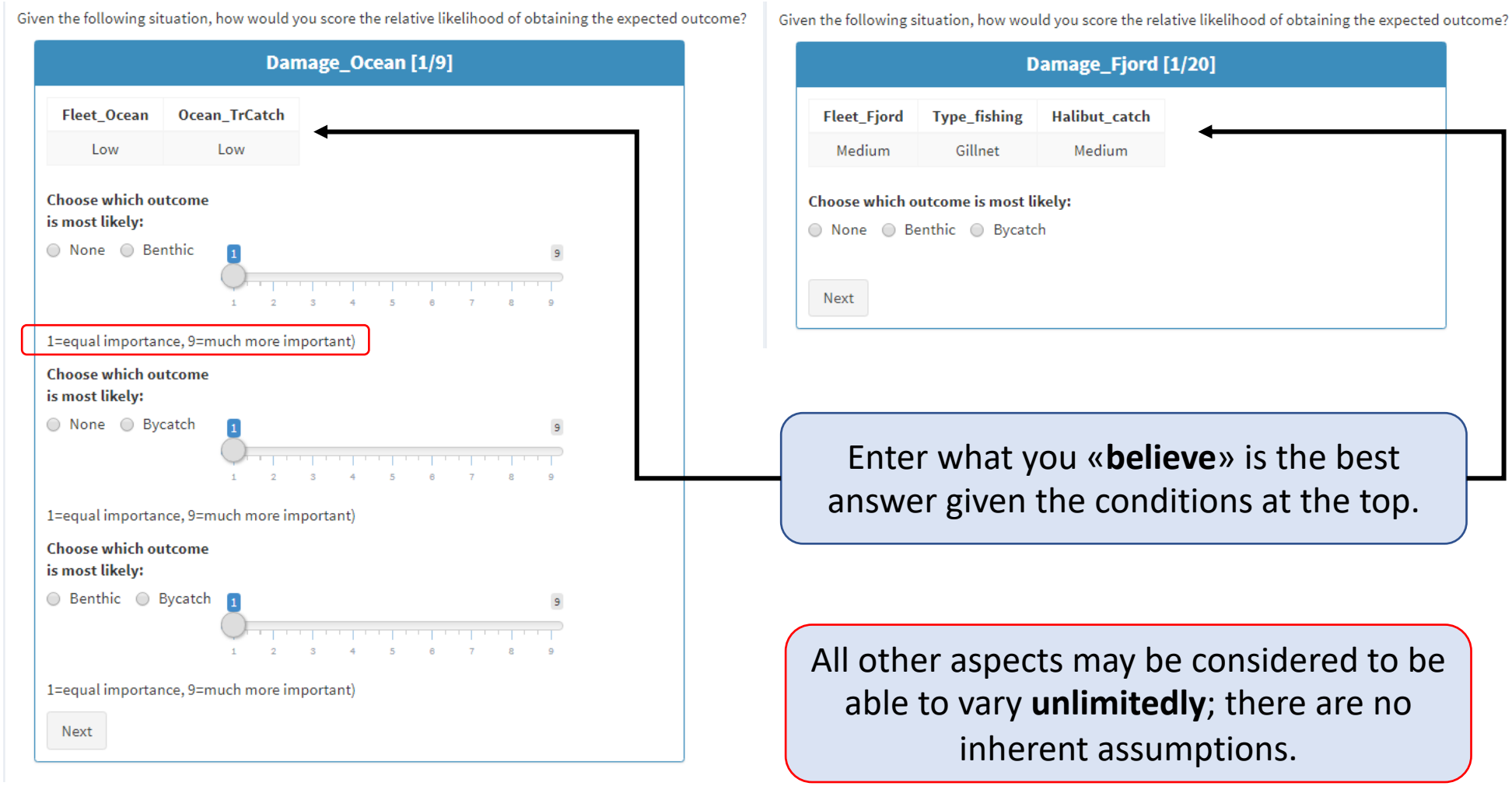







INSHORE SUBSYSTEM
OFFSHORE SUBSYSTEM
Equipment support
Inshore standards
Market demand
MSC certification
Lifestyle
Quota Offshore
Quota Narwhal
Landing capacity
Quota Inshore
Pricing
Fishing technique
Fleet Inshore
Fleet Offshore
Income
Fishing capacity
Income
Traded catch
Narwhal catch
Halibut catch
Subsistence
Traded catch
Narwhal numbers T0
Narwhal numbers T1
Sea ice conditions
Halibut recruitment
Halibut offshore
Halibut numbers T0
Halibut numbers T1
Climate change
Switch
Input
Decision
Output
Governance
Socioeconomics
Environment

Capturing stakeholder knowledge and beliefs through online surveys



Enter what you «**believe**» is the best answer given the conditions at the top.

All other aspects may be considered to be able to vary **unlimitedly**; there are no inherent assumptions.

~/Werk/Projects/CAPARDUS/BBN - Shiny

http://127.0.0.1:6367 | Open in Browser | Publish

surBayes

Dashboard

- Home
- Instructions
- Construct network
- Define nodes
- Enter data
- Inference

Network input

- Create new model
- Load exising model

Choose a file

Halibut

Password:

Load!

Network correctly loaded...

Save!

Construct model structure

View/Edit

Show groups

Nodes in the network:

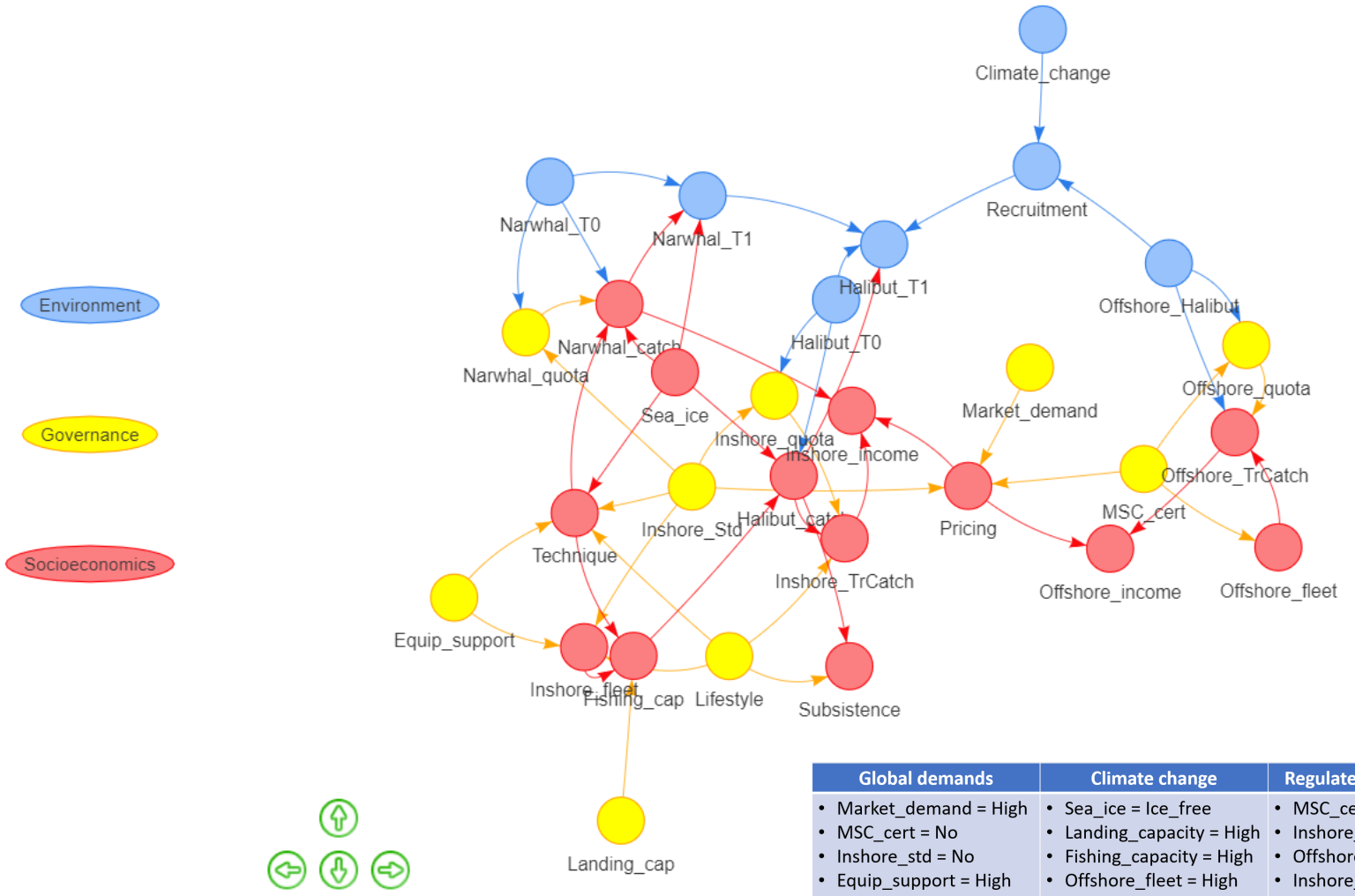
Climate_change

Edges in the network:

Equip_support --> Technique

Save edits

Finalize!



Global demands	Climate change	Regulated communities
• Market_demand = High • MSC_cert = No • Inshore_std = No • Equip_support = High • Landing_cap = High • Offshore_quota = High • Inshore_quota = High	• Sea_ice = Ice_free • Landing_capacity = High • Fishing_capacity = High • Offshore_fleet = High • Inshore_fleet = High • Technique = Cutter	• MSC_cert = Yes • Inshore_std = Yes • Offshore_quota = Low • Inshore_quota = Low • Narwhal_quota = Low • Equip_support = Low

surBayes

Dashboard

- Home
- Instructions
- Construct network
- Define nodes
- Enter data
- Inference

Network input

- Create new model
- Load exising model

Choose a file

Halibut

Password:

Load!

Network correctly loaded...

Save!

Inference of the model

Display network

Display nodes

Choose node(s) of interest

Choose focal node

Include influencer

Display probability

Display influencers

Add evidence

Choose temporal nodes

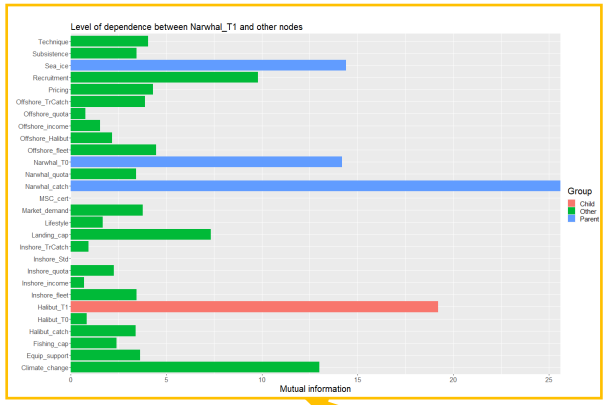
Choose input node

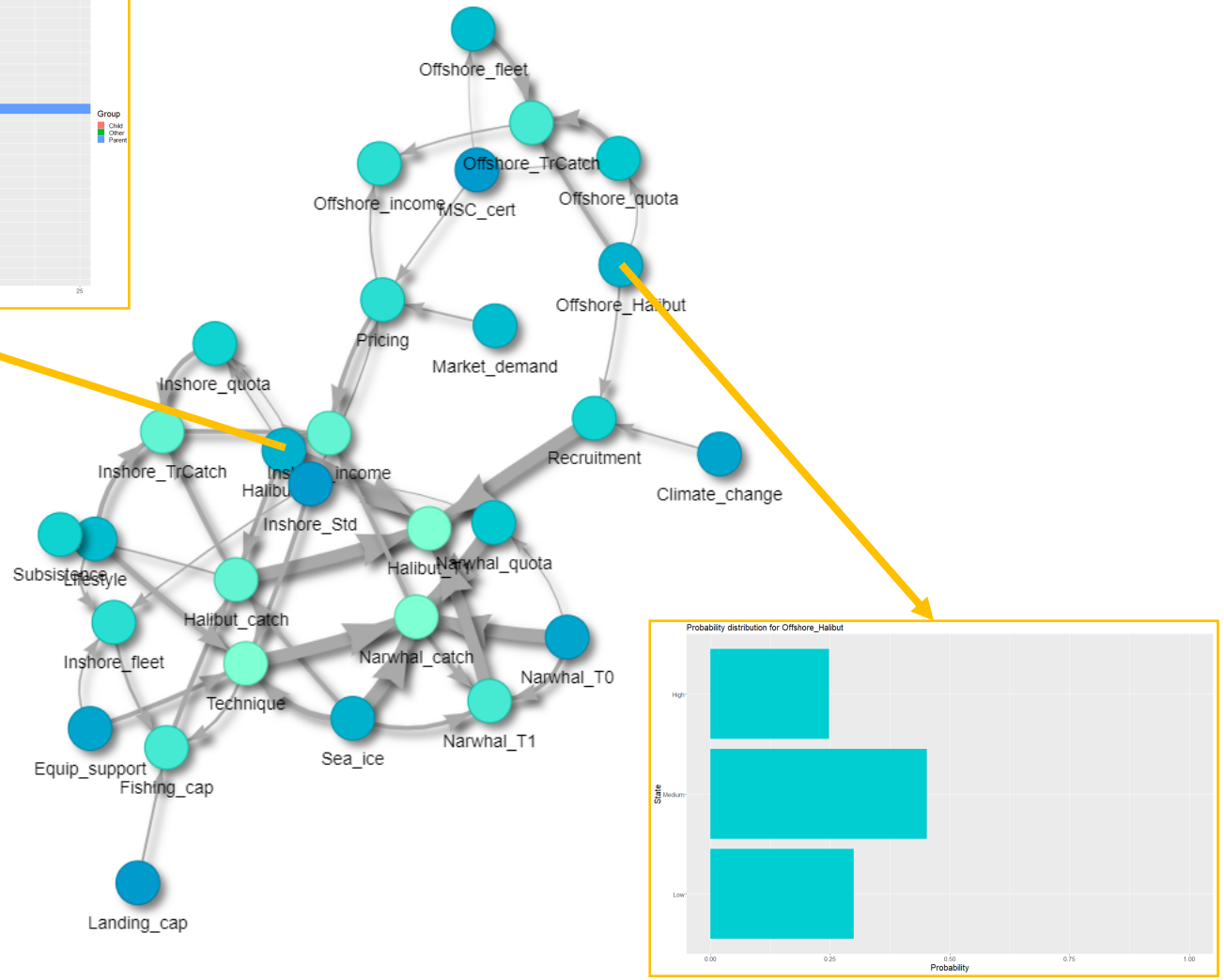
Choose output node

Choose node of interest

Time steps: 5

Display temporal





Standards for promoting inclusion of LIK in BBN models

- Carefully consider the identification and selection of key knowledge holders, taking into consideration differences in knowledge holding, and determine the level of their representation using purposeful sampling and thematic saturation to define the sample and its size
- Create a respectful collaboration process between scientists and knowledge holders to facilitate mutual learning and empowerment and where LIK holders retain ownership of the data and information and control over the knowledge, the validation process, and the application of the knowledge

Standards for promoting inclusion of LIK in BBN model

- Facilitate mobilization of LIK. This could also involve using triangulation or other approaches to validate LIK quality (but not in comparison to scientific or other knowledge) – i.e. conducting multiple group discussions or consultations and individual interviews to ensure the reliability of both quantitative and qualitative input to the BBN model construction (this involves aspects of negotiation)
- Be transparent and inclusive in framing the scope and objective of the BBN model and use concepts important to local perceptions and understanding (i.e. involves aspects of translating), focusing on problems and solutions of relevance to local communities. Ideally, the information provided by the model output should be interpreted unambiguously by both the analyst and the communities

Standards for promoting inclusion of LIK in BBN models

- Involve knowledge holders in the overall model design and the analyses and interpretations of the findings by presenting to and discussing each step along the way (i.e. negotiation and synthesis) with study participants to avoid misinterpretation
- Produce tools operationalizing technical models accessible to communities (i.e. apply) and be very clear about the risks of misconception if the tool is not used appropriately
- Explore options for making the underlying LIK in the BBN model explicit and viewable to the user acknowledging LIK intellectual property rights

Required ethical considerations for the use of BBN models with LIK

- Consult with all relevant regional, local, and/or indigenous institutions about the proposed research, inquire about previous and ongoing community research and priorities, and collaborate appropriately. This includes initiating community contact as early as possible, identifying community representatives and striving to build meaningful relationships based on good faith and partnership.
- Adhere to local and Indigenous traditions, customs, and locally adopted research guidelines, permitting requirements, or specific protocols. This includes learning about the region's history, cultures, languages, community perceptions of past and current research conducted in the region, and organizational structures, practices, values, and institutions.

Required ethical considerations for the use of BBN models with LIK

- Seek approval from various entities and informed consent from participants. This requires a description of the research in a plain and local language that discloses methods, sponsors, purposes, and objectives.
- Ideally, the research project should be co-developed by determining the objective and boundaries of the BBN model in collaboration with the community, but as a minimum, ensure that it addresses problems significant to the communities and participants.
- Developing and presenting the research plan, make sure to address community concerns and expectations for the project. Provide structures for shared decision-making. Be aware and respectful of indigenous peoples' practices and protocols for accountability.

Required ethical considerations for the use of BBN models with LIK

- Determine and enable the appropriate level of community involvement (to both the community and the project) in all stages of developing and implementing the BBN model – including design, analysis, and interpretation. Make all efforts to provide communities and participants information to make informed choices regarding their involvement and contribution to the research. Keep communities and participants informed about research progress and results throughout the research. Include community involvement in all phases of the research effort.

Required ethical considerations for the use of BBN models with LIK

- Determine and describe clearly and in advance who collects, owns, manages, evaluates, and disseminates the data and the privacy rights in relation to beliefs entering into the creation of the BBN model. A clear understanding of data ownership and how data will be treated, including with regard to the anonymity of respondents, allow projects to proceed with a shared understanding of data governance and ownership. Guarantee and uphold anonymity if desired by respondents. Identify potentially sensitive data and observations with individuals and/or the community and establish measures to reduce the likelihood of any harm to individuals or the community.

Required ethical considerations for the use of BBN models with LIK

- Time research activities to avoid disturbing participating community members and knowledge holders during peak hunting, fishing, harvesting, gathering or other seasonal activity periods.
- Present research outputs to local communities in plain and, if possible, the local language using appropriate and effective means of communication. Research participants should have the right to review all products to ensure they have been represented correctly before publicly disseminating them. Researchers should inform how they are used and share all products with participants. Indigenous concepts or words should be written, and orthography used in publications with explanations in other languages.

Required ethical considerations for the use of BBN models with LIK

- Include an assessment of the feasibility of implementation and the long-term sustainability of research recommendations within the community. Provide assistance in affecting policy implementation of research recommendations.
- Disseminate research findings while respecting confidentiality and design dissemination strategies involving community partners for both academic and community-level distribution (newsletters, videos, lay publications, TV, and radio). The research participants should be accredited in publications, lectures etc.

Promoting the use of BBN models in natural resource management

- Make visible the data and knowledge gaps where CBM, LIK and BBN models could promote enhanced natural resource management, including reducing cost or effectively supplementing and supporting other monitoring investments and management decisions or providing other tangible benefits
- Show and highlight how CBM and LIK already contribute to and inform management decisions and promote BBN models as a way to increase the transparency
- Highlight BBN model's ability to incorporate and combine scientifically verifiable data with other forms of knowledge, including based on CBM observations and LIK

Promoting the use of BBN models in natural resource management

- Promote setting aside time and funds for government staff (incl. advisory scientists) to learn about LIK and engage in the development of BBN models
- Involve the government administration as well as communities and advisory scientists in determining the objectives of BBN models and in developing the underlying conceptual model
- Make BBN models as simple and easy to parametrize and operate as possible without scarifying relevance and accuracy to make them accessible to community members and government managers.

Promoting the use of BBN models in natural resource management

- Enable use of locally generated data and incorporate options for addressing uncertainty in parameter inputs in the BBN model to enable assessment of risk, including through scenario analysis
- Conduct workshops and one-on-one meetings with relevant administrative level stakeholders to explain, parameterize, and run the BBN model
- Develop and describe the model in detail in Greenlandic, Danish and English