ICEWISE

A game to test the effects of sea ice forecast reliability on voyage planners' confidence

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SALIENSEAS
CO-PRODUCING MARINE CLIMATE SERVICES

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UMEÅ UNIVERSITY

UNIVERSITY OF TROMSØ

Danmarks Meteorologiske Institut

Norwegian Meteorological Institute

The SALIENSEAS Project

2017-2020

An ERA4CS project

Consortium:
- Norwegian and Danish Meteorological Institutes
- University of Tromso
- Wageningen University and Research
- University of Umea

Collaborating Partners:
- Greenland Pilot Service
- Hurtigruten
- Oceanwide Expeditions
- AECO
- Arctia
- KNAPK (Association of Fishers and Hunters in Greenland)
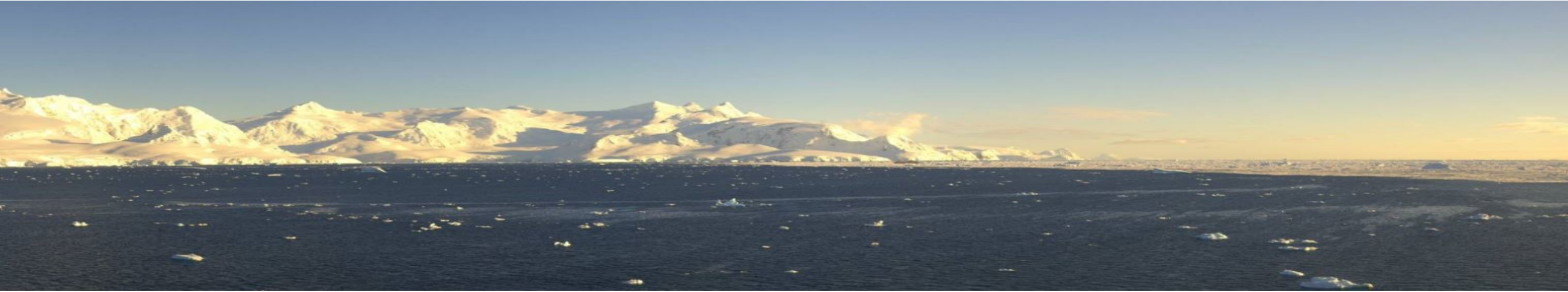- HARNVIG-Arctic and Maritime

ERA4CS is an initiative of

JPI Climate

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SALIENSEAS Summary

User needs

Arctic communities and maritime sectors that depend on either the presence or the predictable absence of sea ice, **are seeking decision support** for an ever-uncertain operating environment.

Expert roles

This puts **experts** who provide information services, such as the meteorological institutes that provide ice charts and forecast products, **on the front lines of managing rapid change** by the design and innovation of user-centric services.

SALIENSEAS

In the **SALIENSEAS** project, downstream services are developed in a collaboration of meteorological institutes, social scientists and end-users. A **focus is on** marine **Arctic monitoring and forecasting** on weather and seasonal time-scales and **weather and sea ice services** and dissemination systems dedicated to Arctic marine end-users that are **tailored to** their key social, environmental and economic **needs**.

# Testing MET.no's new seasonal sea ice forecast
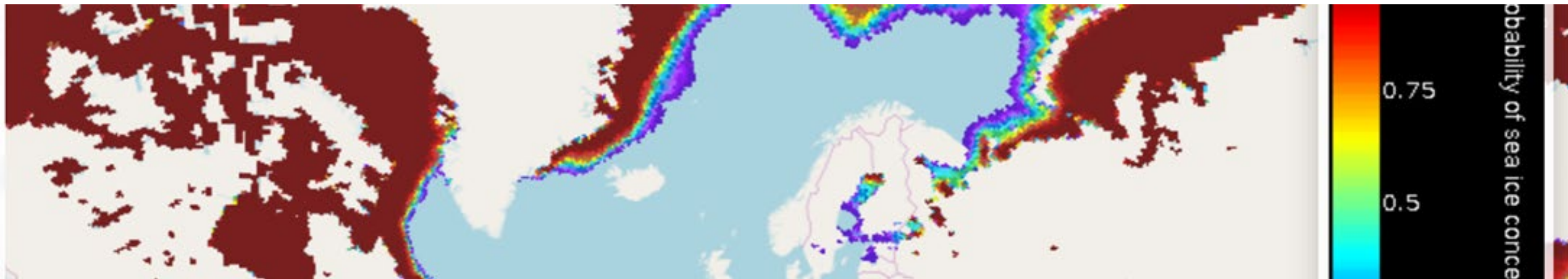
MET.no has developed a seasonal sea ice forecast.

- Project partners at the Norwegian Meteorological Institute (MET.no) have developed a seasonal forecast of sea-ice probabilities in the Arctic based on ECMWF's (European Centre for Medium-Range Weather Forecasts) seasonal prediction system.
- The sea ice map shows probabilities for concentrations greater than 15% for the following 6 months.
- The reliability of the forecast is provided for users, and depends on its range -how far out it is viewed- and the season.
- We use participatory modeling to understand the dynamics of sea ice services as a decision support tool.

A question we are investigating is: how does the sea ice forecast's reliability impact the user's confidence in the decisions they take informed by the forecast?

A Simulation Gaming Approach

- Direct questioning about perceived risks and uncertainties during operations do not always lend themselves well to traditional inquiries such as self-report surveys.

- ICEWISE is a simulation gaming environment that integrates a newly developed sea ice forecast product, voyage planning and game mechanics such as reward collection, story-based narrative and roll the dice elements based on realistic chance events. The game simulates current conditions, as well as a plausible 2035 scenario.
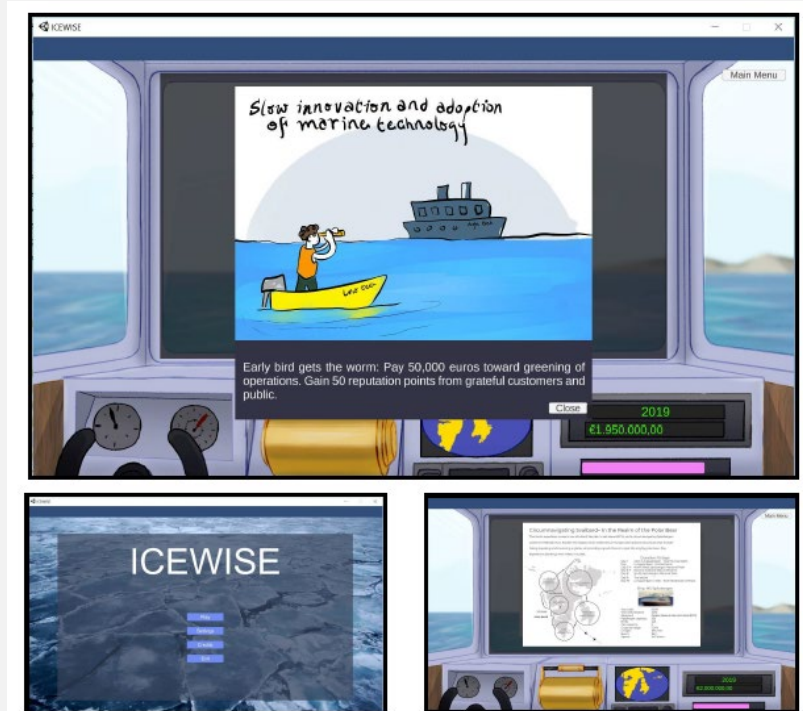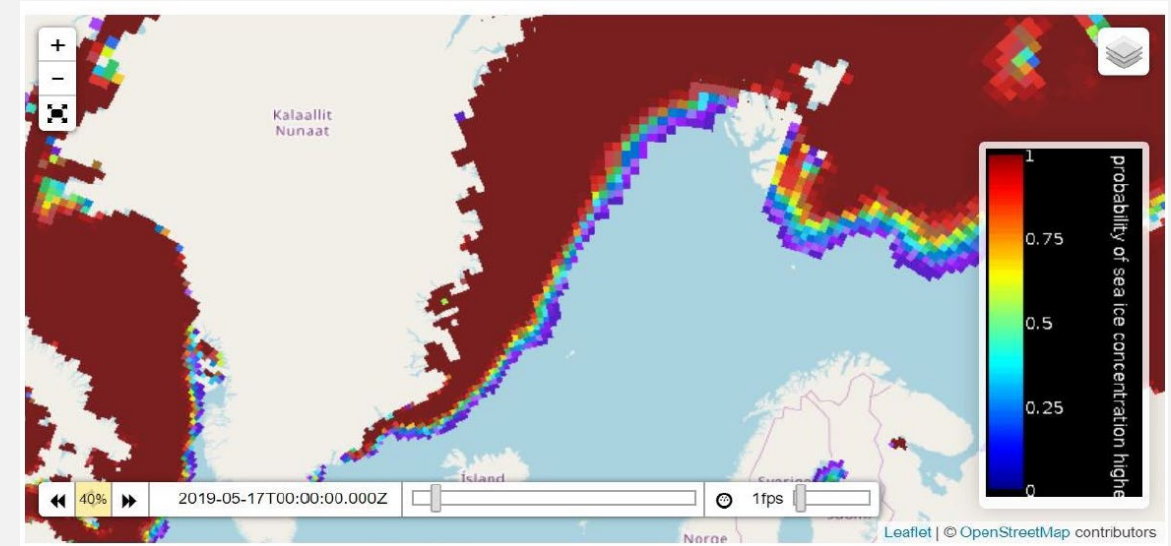
Why use a gaming approach: The 4 Paradoxes in sea ice services

Blair, B., Lee, O.A. and Lamers, M., 2020. Four Paradoxes of the User–Provider Interface: A Responsible Innovation Framework for Sea Ice Services. *Sustainability*, 12(2), p.448.

Tensions from contradictory or opposing requirements or solutions to problems:
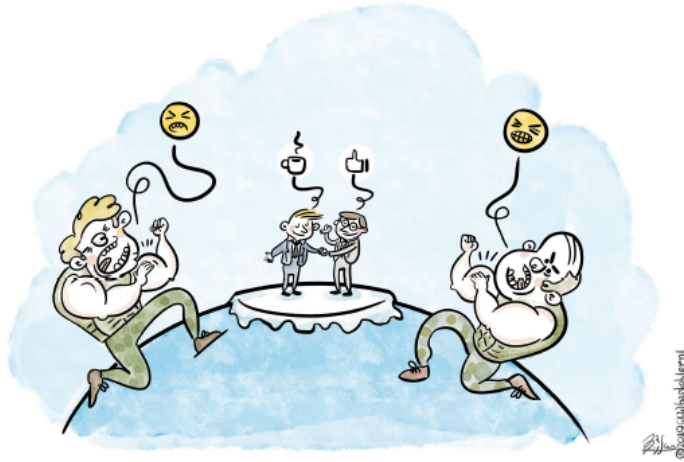
1. Paradoxes of performing

2. Paradox of conflicting values accrued to users from the use of sea ice

3. Paradox of desired futures

4. Paradox of responsible innovation

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Why a gaming approach (cont.)

- Sea ice services have **socio-economic potential** as a decision support tool
- **Operational context** of users determines observation, monitoring and forecasting needs
- Diverse needs necessitate **long-view targeted strategies** for service provision
- Scientific activities driven not only by research needs, but also by specific **mandates** of research institutes and domestic interests of a nation state
- Anticipatory methods such as socio-economic scenarios support **Responsible Innovation**
- **Simulation/gaming approach can help to explore these complex relationships**

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2018 Workshop with stakeholders: most robust 2035 scenario (sample illustration)

full report: http://salienseas.com/?p=1317

Blair, B., Lee, O.A. and Lamers, M., 2020. Four Paradoxes of the User–Provider Interface: A Responsible Innovation Framework for Sea Ice Services. *Sustainability*, 12(2), p.448.

Previous slide: explanation

- To examine the broader social, political, and environmental processes that frame not only current demands, but also the need for future developments in climate and sea ice services provision, we organized a participatory scenarios workshop (Nov.2018 Danish Meteorological Institute). This was phase 1 of game development. We engaged experts in Arctic maritime planning, policy and sea ice services in a participatory scenario workshop. The deliberations focused on factors that impact information needs for safe, sustainable Arctic maritime operations now and through 2035.

- The workshop produced 12 key factors, with 2-4 future projections with narrative description for each. Robustness analysis of all future projections produced a 2035 scenario bundle. The status quo conditions for each key factor were also described in short narratives for a 2019 scenario.

- **The game's story-based narrative was developed and illustrated based on these narrative scenarios, to offer 2019 and 2035 playing modes.**

Video: introduction to the game

video online: **http://salienseas.com/?p=2169**

Players were instructed that:

- They are to assume the role of Director of Itinerary Development of a fictional cruise company

- They decide on the earliest and latest voyage dates for given itineraries (in some rounds it is earliest, in some rounds it is latest)

- In each round they are asked to select a voyage date two times:

  1. First they choose a date based on past experience and intuitions when viewing the assigned itinerary

  2. Then they view the sea ice forecast for the area and revise the dates if you wish

- The lead time of the forecast they view will be different in each round, and therefore the reliability will also be different

Players were instructed that:

- They will invest money in each round. They start with 2 million euros. The amount they invest is entirely up to them. The money doesn't have to be realistic (no need to add up itemized costs you would incur in real life).

- The earlier/later they sail in the shoulder seasons, the higher the rate of return on case of a successful voyage, but greater the chance of adverse events due to unfavourable conditions.

- The money serves as a measurement of their confidence in the dates they picked in each round. It is a gain/loss mechanism. They were free to invest as they wished.

Players were instructed that:

- They will come across news events that will impact their business environment (things happening in politics, economy, regulations). These events have been workshopped with advisors to be realistic.

- Some of these events pop up when they 'roll the dice'.

- The game is played in two modes: in 2019 and 2035.

- In real life, sea ice is only one of several important parameters, in the game they were asked to consider sea ice only

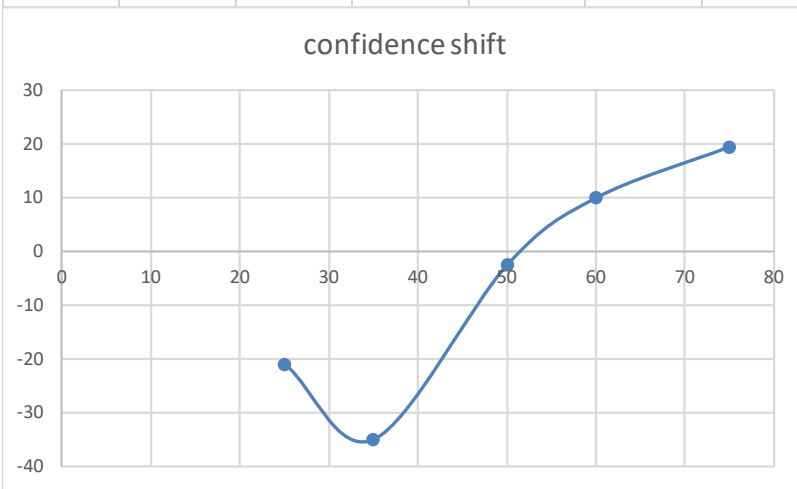6 captains from the cruise sector, and 3 metservice personnel played the game.
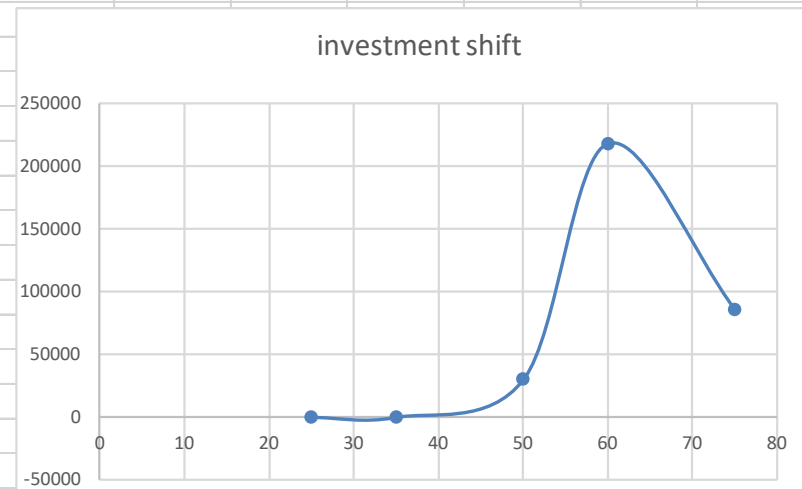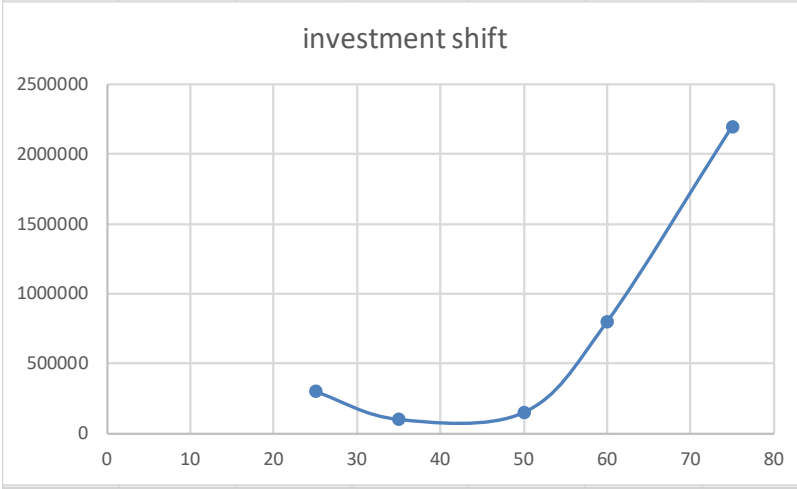
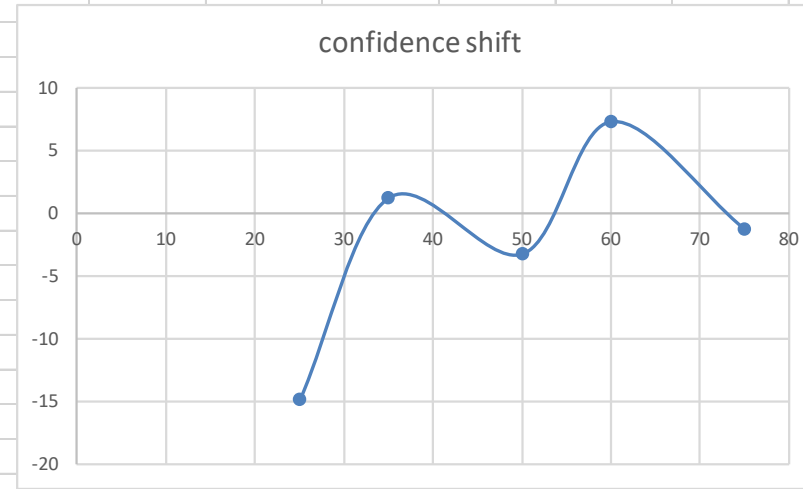A structured, 2 hour debriefing session followed.

Results: discussing decisions based on data

MET.no

Captains/navigators

confidence shift

confidence shift

investment shift

investment shift

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Previous slide: explanation

- The "hard" data from the gaming session will not yield significant results due to the low number of players. We still spent a few minutes in the debriefing sessions discussing patterns of decision making visible from data, as a jumping off point to get some insights about player uncertainties.

- The figures titled "confidence shift" shows the forecasts' reliability estimates (X axis), and the difference in how players evaluated their confidence in their chosen sail dates before and after seeing the forecast and the reliability of the forecasts. The investment shifts show how players changed their investments before and after observing the forecasts (again, with the forecast they also were given the reliability estimates). Metservice personnel followed a fairly consistent pattern in terms of higher reliability = higher confidence and investment. The captains were not swayed by reliability estimates to the same extent.

Debriefing results: some highlights

- Some good feedback on the game itself (for now we are not planning to develop it further)

- In real life, forecast does not have a homogenous reliability over all areas, in some places more or less reliable → players commented this makes reliability estimates less useful

- "When I am in doubt, my own knowledge and experience wins every time in terms of decisions I make"

- "During game, I relied 60% on experience, maybe 40% on forecast"

- "When I was not familiar with an area, I used 50% my own experience /intuitions/educated guess, and 50% the forecast "

Debriefing results: some highlights (cont.)

- Trust in a service is very important and develops over time
- "With a service we trust we will rely 90% on forecast and 10% own experience or intuition in decision making"
- **This relationship to forecasts is true now (2019) but will change in the coming years with a shifting sea ice regime. Greater reliance on forecasts expected.**
- 3-4 weeks forecast could be useful for the NWP between Nuuk and Cambridge Bay
- For Greenland and NE Svalbard, glacial ice is more relevant than sea ice
- Sector is not interested in pushing itineraries into fall season, spring is of more interest esp. with shifting climate patterns

Debriefing is more important than game itself

- Simulation gaming exercise is an opportunity to immerse participants in the experience

- Debriefing session is where most data is collected

- Debriefing session must be well-considered and planned in advance to provide a structured environment

- Players give individual feedback as well as collective ideas via small group discussions

Next steps

- SALIENSEAS in its final stages will distil findings into an exploratory agent-based model

- Model will incorporate the main factors that influence user uptake of forecast information in the Arctic marine sectors

- Model will investigate the relationships between these factors and user uncertainties in decision making over time

Thank you

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