



STUDY OF ENVIRONMENTAL ARCTIC CHANGE



Study of Environmental Arctic Change (SEARCH) *Kick-off Tactics Meeting* **Knowledge to Action for Arctic Science**

*The SEARCH Science Steering Committee
with help from
Helen Wiggins, ARCUS
Olivia Lee, UAF*



Goals & background for this meeting

(1) Kick-off

- 5-year SEARCH strategy can get underway with support from NSF
- SSC, Action Team Leads, and OCP leads meet as a group, with participation by NSF, other agencies, and ACADIS to reaffirm and fine-tune vision for SEARCH's 5-year plan implementation

(2) Tactics

- Specific, coordinated plans for Action Teams, SSC and OCP (Y1&2 focus)
- Review/refine criteria, metrics & approaches to evaluation of success
- SEARCH and Arctic long-term observations (OCP's future, AON, interagency coordination; SEARCH & ACADIS)
- SEARCH & agency linkages
- SEARCH governance and Terms of Reference
- Position description & recruitment for Executive Director (& Obs. System Coordinator)
- Action Team, OCP and SEARCH SSC membership

(3) Knowledge to Action

- Explore specifics of SEARCH 5-year program plan elements that focus on actionable science, knowledge synthesis and responses to rapid Arctic change
- Review/discuss relevant Arctic system science context



Key meeting products & outcomes

- Action plans for Action Teams (focus on Years 1-2); identify cross-links & potential for synthesis
- Explore & refine key SEARCH 5-year plan elements relevant for Knowledge to Action (K2A)
- Synergies between Arctic change, Arctic systems & K2A science

- SEARCH, AON and Arctic Observing System(s)
- ACADIS & SEARCH links & partnerships

- Review & define formal linkage(s) between federal agencies and SEARCH
- Review & define SEARCH Terms of Reference
- Position descriptions for SEARCH Executive Director & Arctic Observing System Coordinator

- Review & refine communication strategies
- Review international engagement & collaboration: ISAC, EU, Canadian & other projects; Belmont Forum; Arctic Observing Summit 2016



SEARCH Objectives

The overall objective of SEARCH is to

Understand the nature, extent and future development of the system-scale change presently seen in the Arctic.

SEARCH is built around three basic elements:

- **Observing Change** - Arctic Observing Network
- **Understanding Change** - Modeling & synthesis
- **Responding to Change** - Linking Arctic system science & stakeholder information needs

www.arcus.org/search-program/



What is SEARCH?

- Collaborative scientific program with roots in the Arctic research community going back to 1997
- Works with academic and government agency scientists to prioritize, plan, conduct, and synthesize research focused on Arctic environmental change
- Guided by Science Steering Committee and several panels and working groups with broad representation of the research community
- ***Response of the research community to Arctic change***

Science

Science Plan

Strategy

Implementation Strategy Plan

Implementation

Implementation Workshop Report

Understanding Arctic Change Task Force Report

ADI Task Force Report

State of AON Workshop

ARCUS Ways Forward Memo

Arctic Observing Summit

Arctic Obs. Integration Workshop

Interagency AON Working Group Mtg

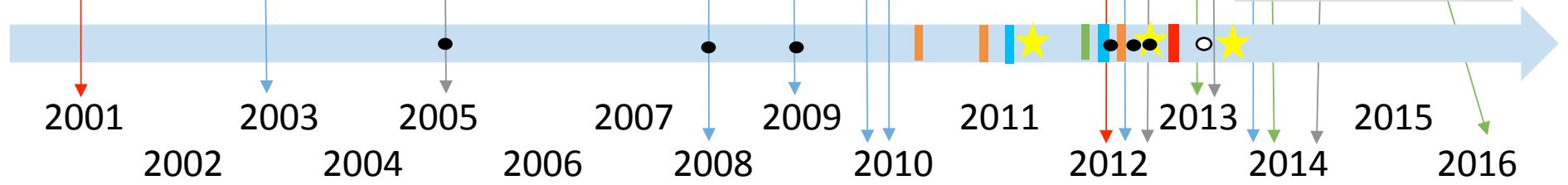
Interagency/OSTP Arctic Observations Mtg

US AON Coordination Workshop

Framework & 5yr plan

Kickoff Meeting

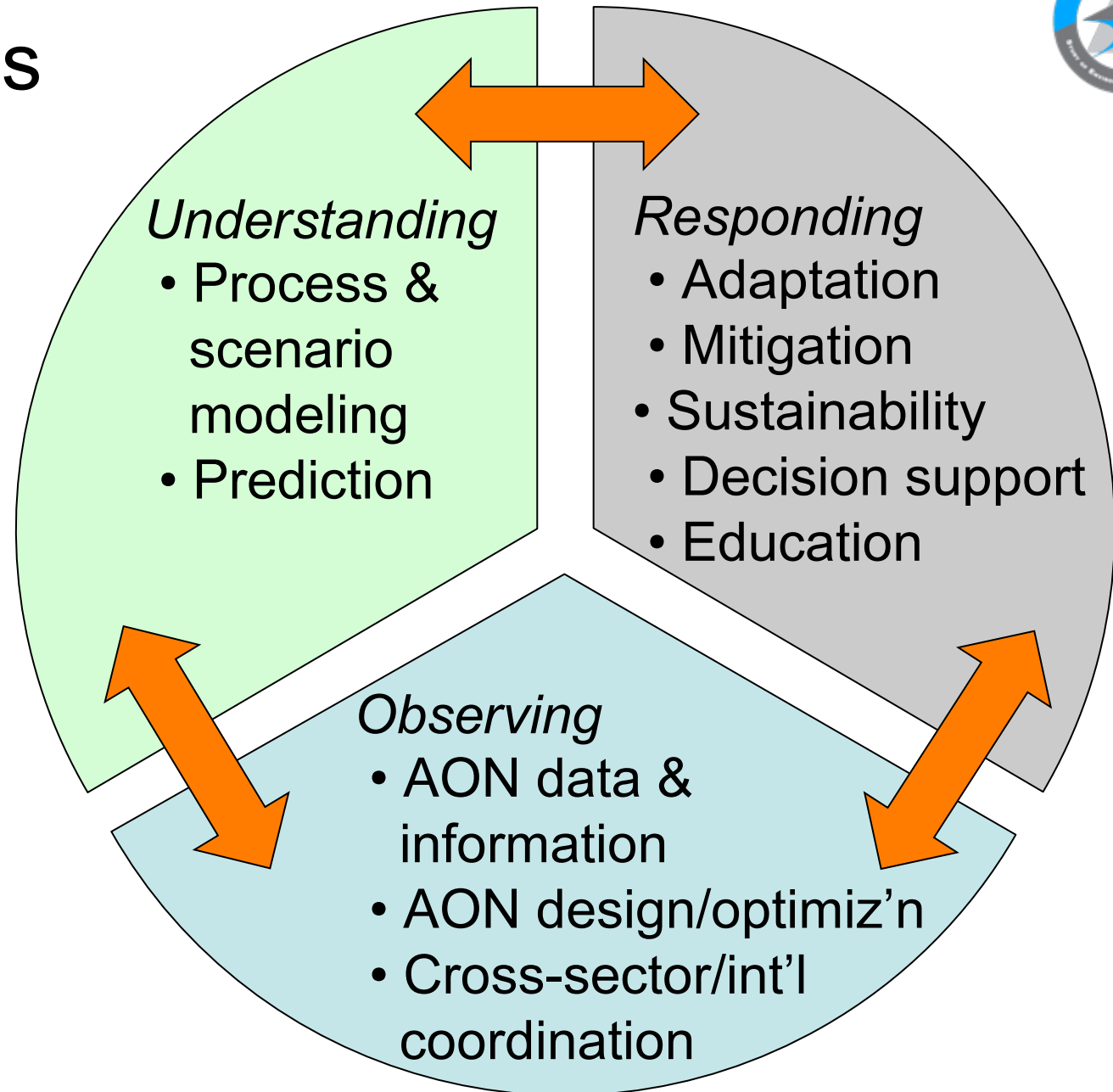
★ Town Hall
■ SEARCH/ Agency Mtg
■ SSC Mtg
■ Priorities & Goals draft
■ Final Goals, objectives and proposal
● Reports ○ White paper

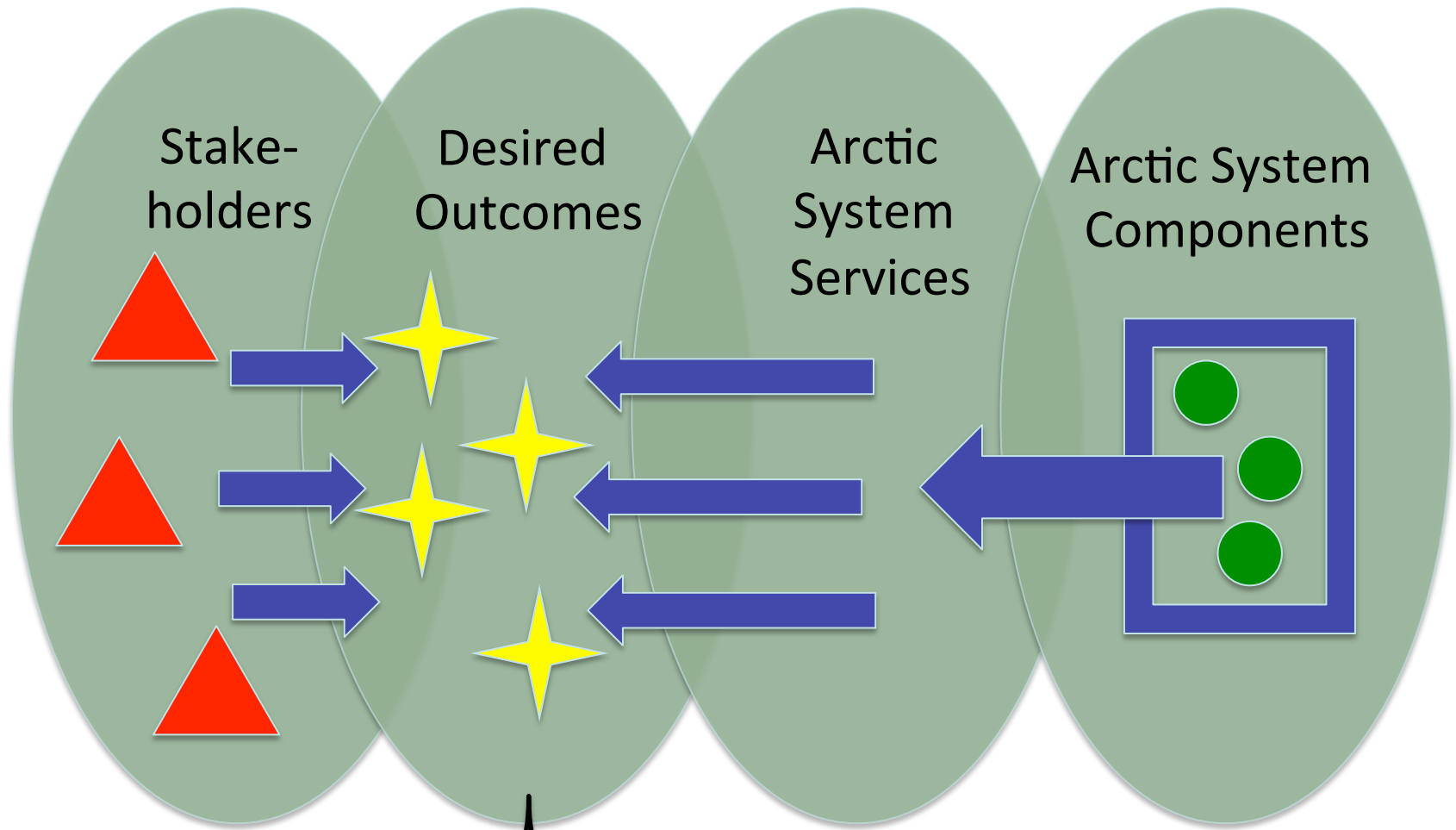


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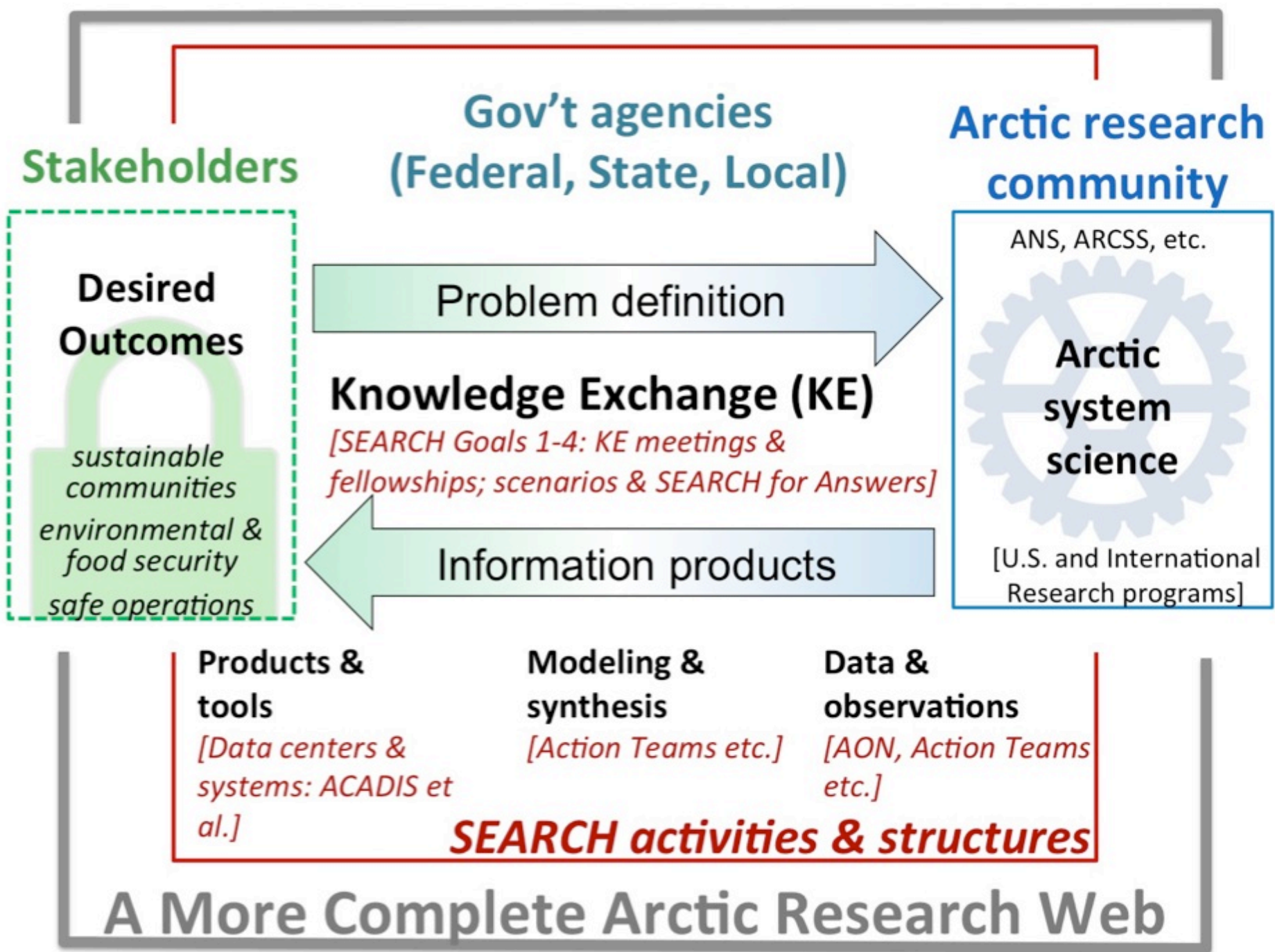


SEARCH's Tripartite Approach to Arctic Change





Intersection of agency, stakeholder & scientific community interests





SEARCH 5-Year Goals & Action Teams

(1) Document and Understand How Degradation of Near-Surface Permafrost Will Affect Arctic and Global Systems

Action Team Lead: E. Schuur

- *Precursor: Permafrost Carbon Research Coordination Network*
- *Partnership with DOE Next Generation Ecosystem Experiment (NGEE)*

(2) Improve Understanding, Advance Prediction, and Explore Consequences of Changing Arctic Sea Ice

Action Team Leads: J. Francis & H. Huntington

- *Sea Ice Prediction Network (incl. Sea Ice Outlook & Sea Ice for Walrus Outlook)*

(3) Improve Predictions of Future Land-ice Loss and Impacts on Sea Level

Action Team Leads: F. Straneo & T. Scambos

- *Partnership with CLIVAR Working Group*

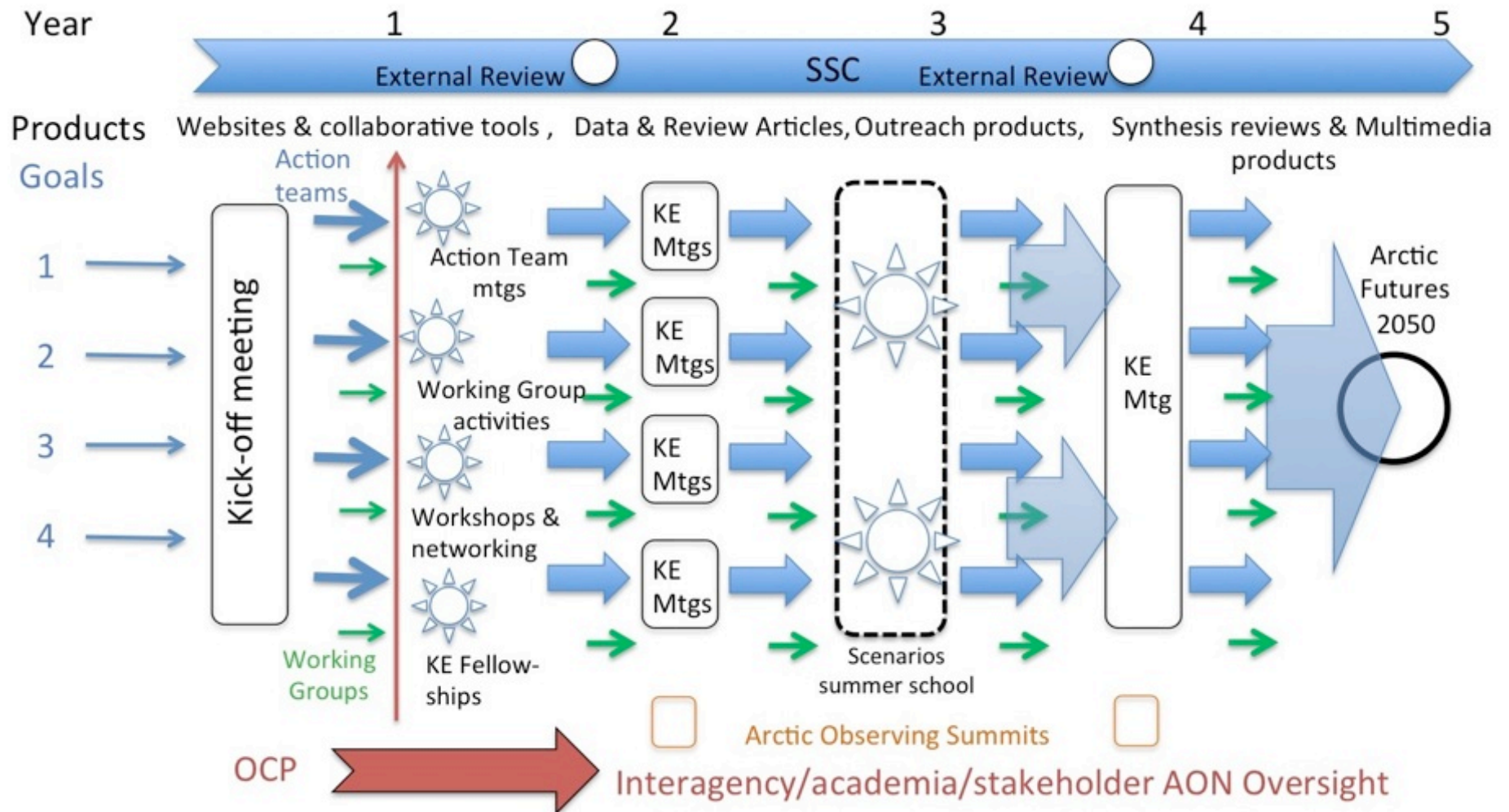
(4) Analyze Societal and Policy Implications of Arctic Environmental Change

- *Activities integrated into three Action Teams*



Potential synergies with planned SEARCH Activities

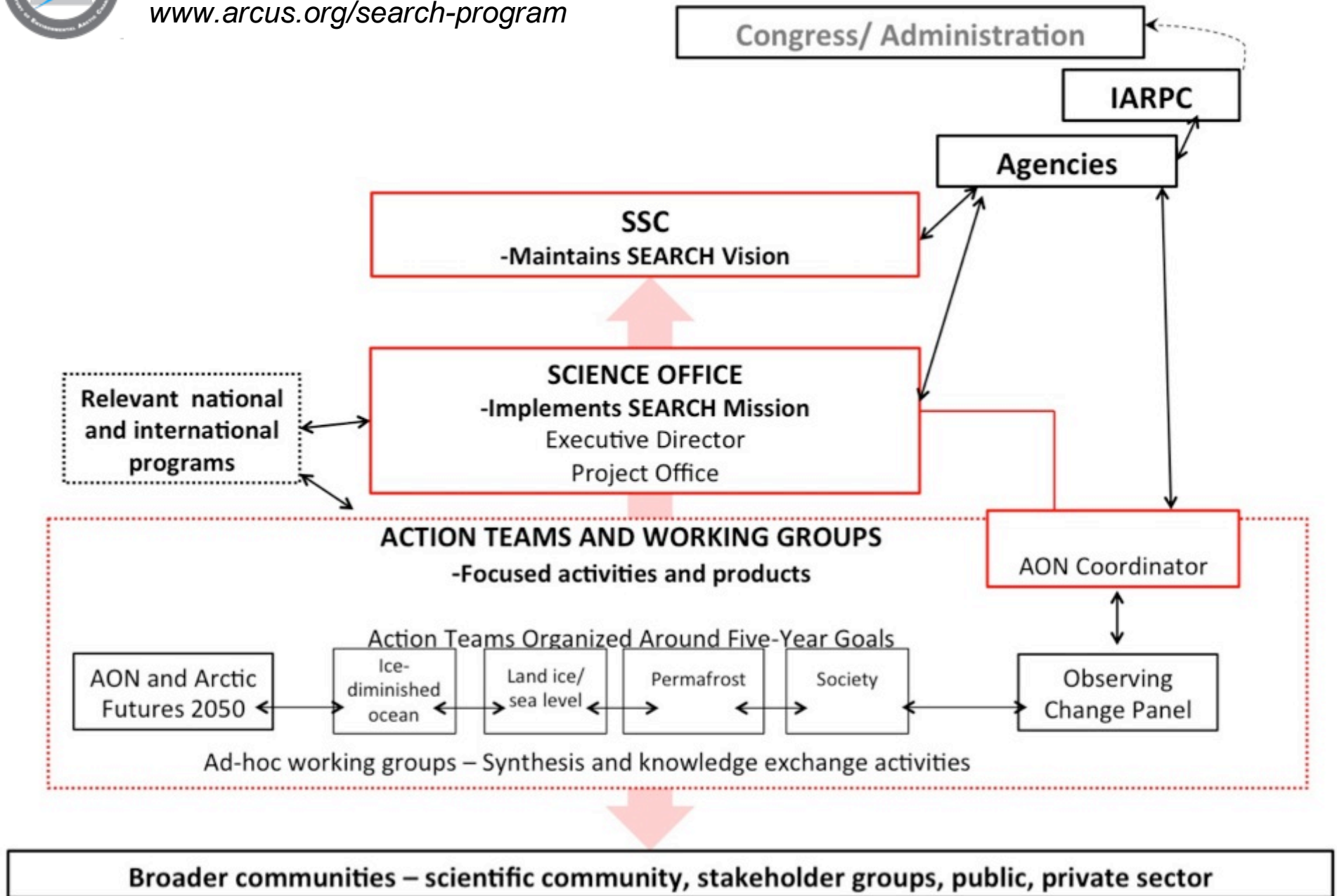
Action teams; synthesis/knowledge exchange efforts; working groups/networks (e.g., Sea Ice Prediction Network - SIPN)





SEARCH Structure & Activities

www.arcus.org/search-program



	Permafrost	Land Ice Loss	Arctic Sea Ice	Societal & Policy	AON	Arctic 2050	New goals
<p>Scientific Syntheses (for science) <i>assess, describe, budget, integrate, assimilate, predict</i></p>	<ul style="list-style-type: none"> observing & predicting nature & timing of thaw carbon budget community report on landscape response to thaw 	<ul style="list-style-type: none"> design targeted instrument network integrating modeling tools (energy, melt, geodesy, sea level) 	<ul style="list-style-type: none"> determine sea ice predictability seasonal – decadal guide observ. network design seasonal outlook support CliC in sea ice prediction find low summer ice analog 	<ul style="list-style-type: none"> develop databases of: (i) social science/ interdisciplinary research in Arctic communities on climate change; (ii) qualitative & quantitative approaches proven to work efficiently develop best-practices recommendations for integrating across disciplines & stakeholders integration into each goal 	<ul style="list-style-type: none"> ACADIS integration pilot project with ACADIS data network design Arctic-systems reanalyses serve activities Barrow flagship site + new ones 	<ul style="list-style-type: none"> Environmental & human scenarios across all SEARCH goals feedback systems in 2050 Interdisciplinary workspaces 	<ul style="list-style-type: none"> ...
<p>SEARCH Coordination for New Research Needs and Opportunities:</p> <ul style="list-style-type: none"> SEARCH works with agencies, industry & communities to identify data & research needs, then coordinates development of new funding opportunities. Each Action Team will rely on team websites & collaborative tools to facilitate synthesis & collaborative research 							
<p>Applied Syntheses (for stakeholders) <i>deliver timely information, predict, warn, link broad range of interests</i></p>	<ul style="list-style-type: none"> prediction of social-ecological system responses 2050-scenarios 	<ul style="list-style-type: none"> projected regional sea level estimates Stakeholder-driven products 2050-scenarios coastal risk tool 	<ul style="list-style-type: none"> Sea ice prediction network with outlooks Sea Ice for Walrus Outlook sea ice area, property & thickness products 2050-scenarios 	<ul style="list-style-type: none"> perception of Arctic change in & outside of Arctic ecosystem & people response to changes Life in 2050-Arctic 	<ul style="list-style-type: none"> Internat. Arctic Observing Summit open data archives real time data develop funding opportunities to fulfill agency needs 	<ul style="list-style-type: none"> 2050-scenarios scenario tools multi-media products novel tele/meet framework to link scientists & stakeholders 	<ul style="list-style-type: none"> ...
<p>Knowledge Exchange Interns/Fellows: Junior scientists & managers bridging between science, government, business & local communities to educate about tools and scientific knowledge, ensure data quality, learn from needs & develop response options</p> <p>SEARCH Coordination for New Tools: SEARCH works with agencies, industry & communities to identify monitoring, management & prediction tools for stakeholder needs & adaptation planning</p>							
<p>Education, Public Outreach & Strategic Communication <i>exchange knowledge & capability, translate</i></p>	<p>SEARCH Knowledge Exchange Workshops: Every 2 or 3 years, Open Science meeting with Knowledge Exchange activities provides cross-links between science & stakeholder groups & activities and sets research plans & products with agencies</p> <p>SEARCH for Answers:</p> <ul style="list-style-type: none"> Communication and Educational Outreach by SEARCH Program Office building on its community resources Organize regular open Webinars and distribute Newsletters, Multimedia products and videos, and other products for scientists and stakeholders Expand knowledge about Arctic change across Arctic communities and beyond the Arctic <p>SEARCH Publication Series:</p> <ul style="list-style-type: none"> Arctic Now and Arctic Futures 2050 book, White papers, Special issues, Review articles, Team and Topic Monographs for State of Science or Management Challenges 						



Milestones & criteria for success

- Meeting key milestones within set deadlines. Milestones and tasks, such as topical workshops, development of documents and products, and program management tasks will be tracked and communicated on a new SEARCH website.
- Publications in the peer reviewed literature.
- White papers.
- Datasets or data products.
- Increasing diversity of participation in SEARCH, including by key defined stakeholder groups – measured through participation in discrete SEARCH activities, diversity of representation on SEARCH action teams or other ad hoc working groups, and measures of impact/use of SEARCH resources (e.g., tracked through the website, etc).
- Involvement of SEARCH member agencies, through direct funding, in-kind support, or other participation in SEARCH activities.
- Each action team and the SSC will produce a high-level review paper in a journal that helps guide the direction of the science and synthesis as we approach the second part of the 5-year project.



Milestones & criteria for success

TASK/MILESTONE	TIMEFRAME	NOTES
Development of recommendations for scientific activities that cut across Action Teams based on an analysis of SEARCH Panel white papers (including tracking of science commonalities between different activities mapped by the program) (D)	Years 1-2	
One or two conceptual studies and manuscripts to identify paths of effective knowledge exchange on Arctic change and a framework to anticipate and respond to Arctic change (E)	Year 2	Guided by SSC; developed by Action Teams
SEARCH AON white paper translated into specific guidance to AON PIs, NSF and other agencies on observing system implementation, including a mapping of ongoing activities onto priorities. (E, G)	Year 2	Will require collaboration of NSF and other agencies.
Activities implemented to lead up to Arctic Observing Summit 2016 (B, G, J)	Years 1-2	Will involve international partners and stakeholders
Assess engagement of research community and support of agencies and use these measures to guide future SEARCH strategy (I)	Year 2	
Track/map SEARCH-related research by developing/adapting measures of interdisciplinary synthesis and knowledge integration (Porter and Rafols 2009; Hicks et al. 2010) (E, H)	Years 2-4	This activity will also foster synthesis
External review of SEARCH program (K)	Year 2	
Work with other agencies and private sector to develop broader model of funding support of SEARCH activities and science office (C)	Years 2-3	
Identified specific data set collections and information products developed jointly with ACADIS and other data centers that allow synthetic evaluation of Arctic change and enhance understanding of key processes (H)	Year 2	Initial focus on permafrost
Action Teams and Observing Change Panel (or similar committee) evaluate status of AON (G)	Years 2-5	
Secured funding in support of Knowledge Exchange fellowships and meetings as a measure of broader agency and private sector support (I)	Year 2	

- Details provided in the SEARCH Management Plan accessible on meeting website



Sea Ice Prediction Network (SIPN)

Goals

- Coordinate & evaluate sea ice predictions
- Integrate, assess & guide observations
- Synthesize predictions & observations
- Disseminate predictions & engage key stakeholders

Network Leadership Team



Julienne Stroeve, NSIDC (Project P/NSF PI)



Cecilia Bitz, U. Washington (ONR PI)



Edward Blanchard-Wrigglesworth, U. Washington



Walt Meier, NASA (Co-PI)



Jim Overland, NOAA/University of Washington



Myrin Wang, NOAA/University of Washington



Hejo Eicken, UAF (Co-PI)



Jenny Hutchings, Oregon State University



Larry Hamilton, U. New Hampshire (Co-PI)



Helen Wiggins, ARCUS (ARCUS PI)



Adrienne Thy, National Research Council of Canada



Philip Jones, Los Alamos National Laboratory (DOE PI)



Elizabeth Hunke, Los Alamos National Laboratory

Funding



National Science Foundation Arctic Sciences Section



Office of Naval Research, Office of Naval Research-Global



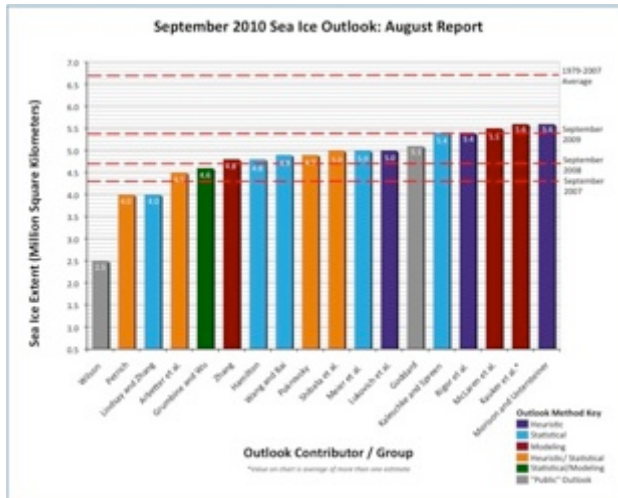
National Oceanic and Atmospheric Administration (NOAA)



National Aeronautics and Space Administration (NASA)



Department of Energy (DOE)



Activities

- Sea Ice Outlook & Sea Ice for Walrus Outlook
- Data integration & staging
- Workshops & online collaboration
- Guided observations
- Evaluation of stakeholder information needs



Key meeting products & outcomes

- Action plans for Action Teams (focus on Years 1-2); identify cross-links & potential for synthesis
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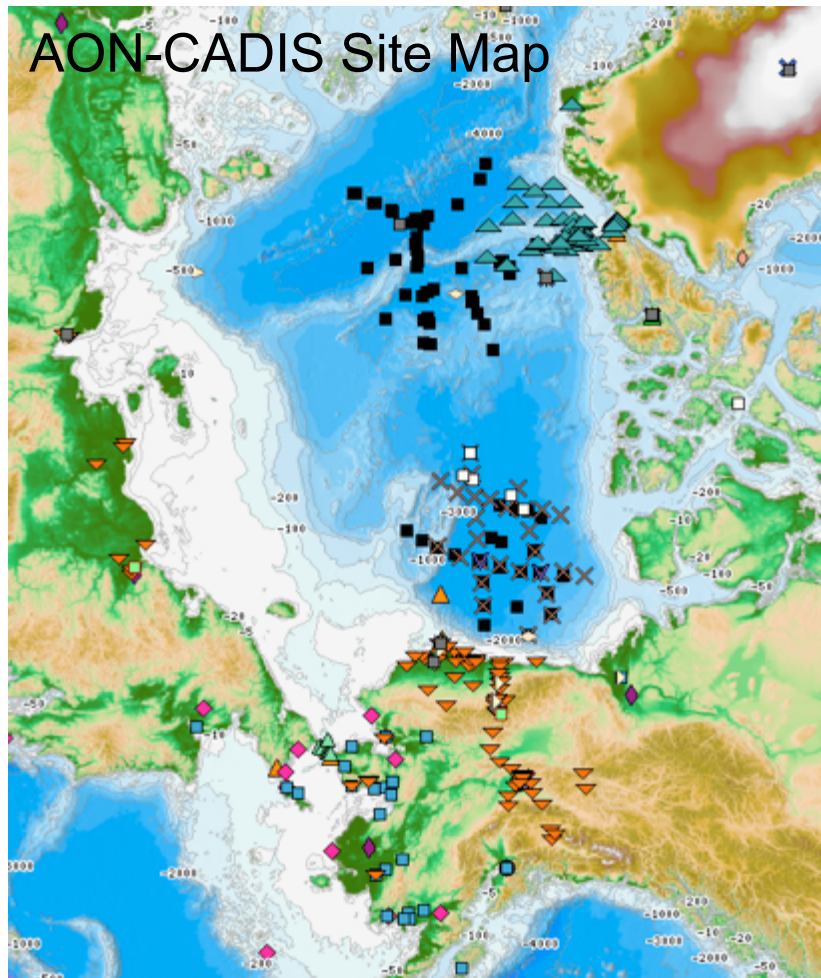
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- Review & refine communication strategies
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Arctic Observing Network (AON)



- ~50 NSF-supported AON projects
- State of AON:
 - Disjunct observing activities by scientific community, federal/state/local agencies and stakeholders
 - Vision for integrated observing system/network emerging
 - How to catalyze cross-sector, cross-disciplinary network?
- Arctic Observing Coordination Meeting 2012: IARPC agencies & scientific community
- Arctic Observing Summit 2013 & 2014: ISAC, IASC & SAON



Sea Ice Prediction Network (SIPN)

SIPN builds on the Sea Ice Outlook to develop a collaborative network of scientists and stakeholders to advance research on sea ice prediction and communicate sea ice knowledge and tools.

Project Goals

- Coordinate and evaluate activities to predict sea ice
- Integrate, assess, and guide observations
- Synthesize predictions and observations
- Disseminate predictions and engage key stakeholders

Network Leadership Team

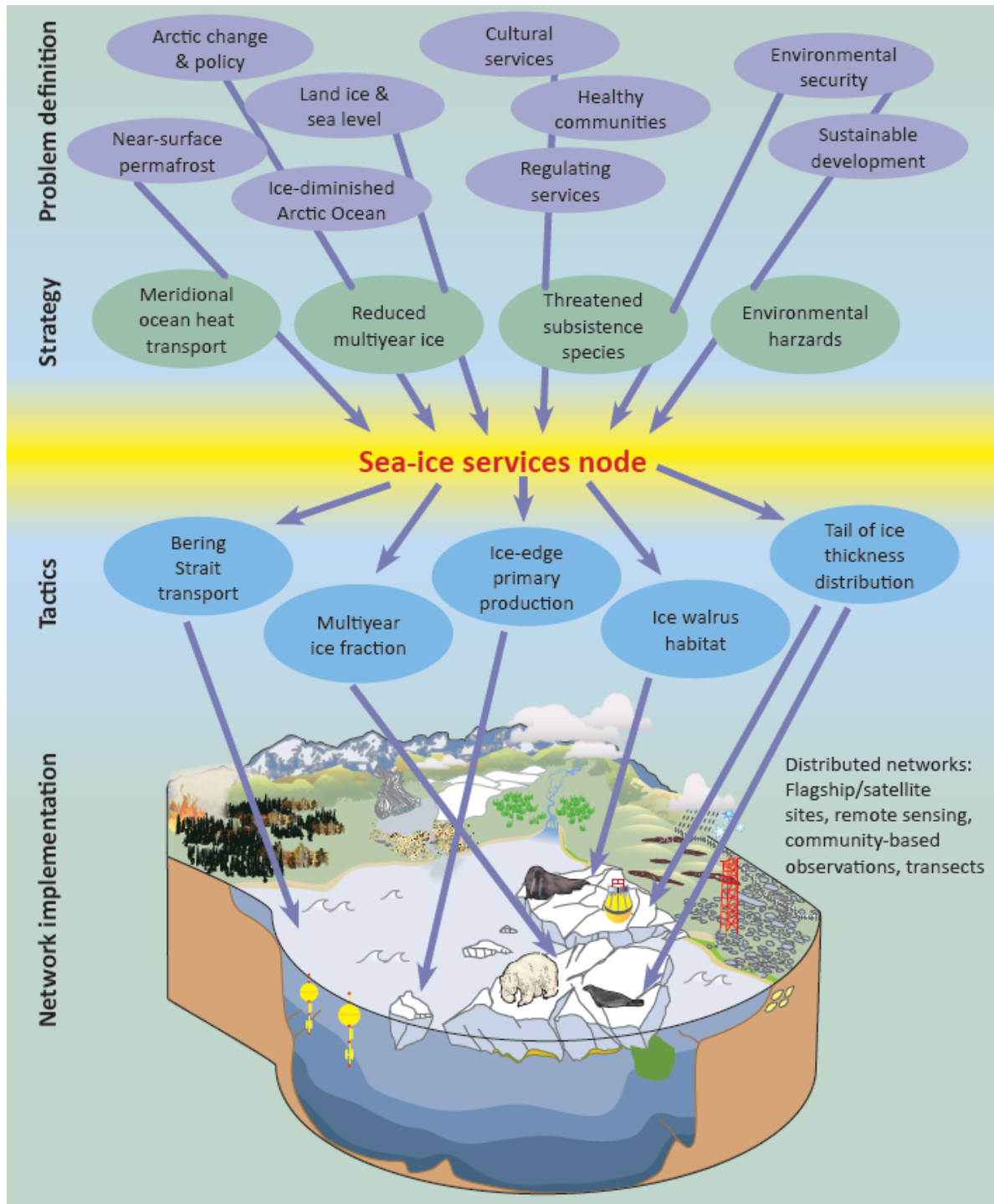
- Julienne Stove, NSIDC (Project PI)
- Cecilia Bitz, U. Washington (ONR PI)
- Edward Blanchard-Wrigglesworth, UW
- Walt Meier, NASA (Co-PI)
- Jim Overland, NOAA/U. Washington
- Muyin Wang, NOAA/U. Washington
- Hajo Eicken, U. AK Fairbanks (Co-PI)
- Jenny Hutchings, Oregon State U.
- Larry Hamilton, U. New Hampshire (Co-PI)
- Helen Wiggins, ARCUS (ARCUS PI)
- Adrienne Tivy, Nat'l Research Council of Canada
- Philip Jones, Los Alamos Nat'l Lab. (DOE PI)
- Elizabeth Hunke, Los Alamos Nat'l Lab

SIPN Town Hall Meeting

Wednesday, 11 Dec. 6:30-7:30 p.m.
Marriott Marquis, 4th Floor, Pacific J



www.arcus.org/sipn

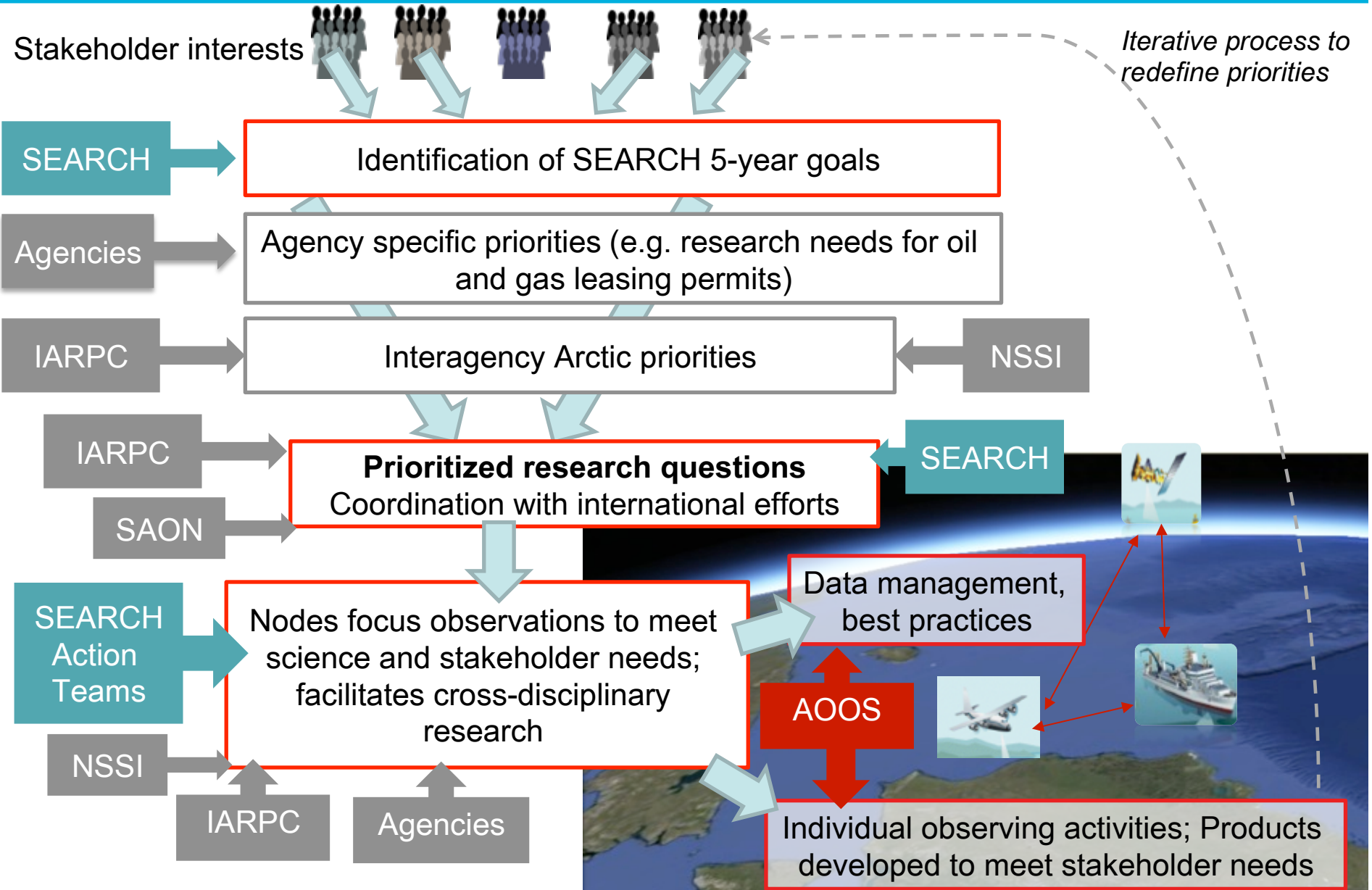


Gaps & Monitoring needs:

- Implementation of a sea services node for integrated, dual-use long-term observations
- Potential for joint effort between SEARCH & AOOS?



Coordination needs & potential SEARCH/ AOOS collaboration





Key Points

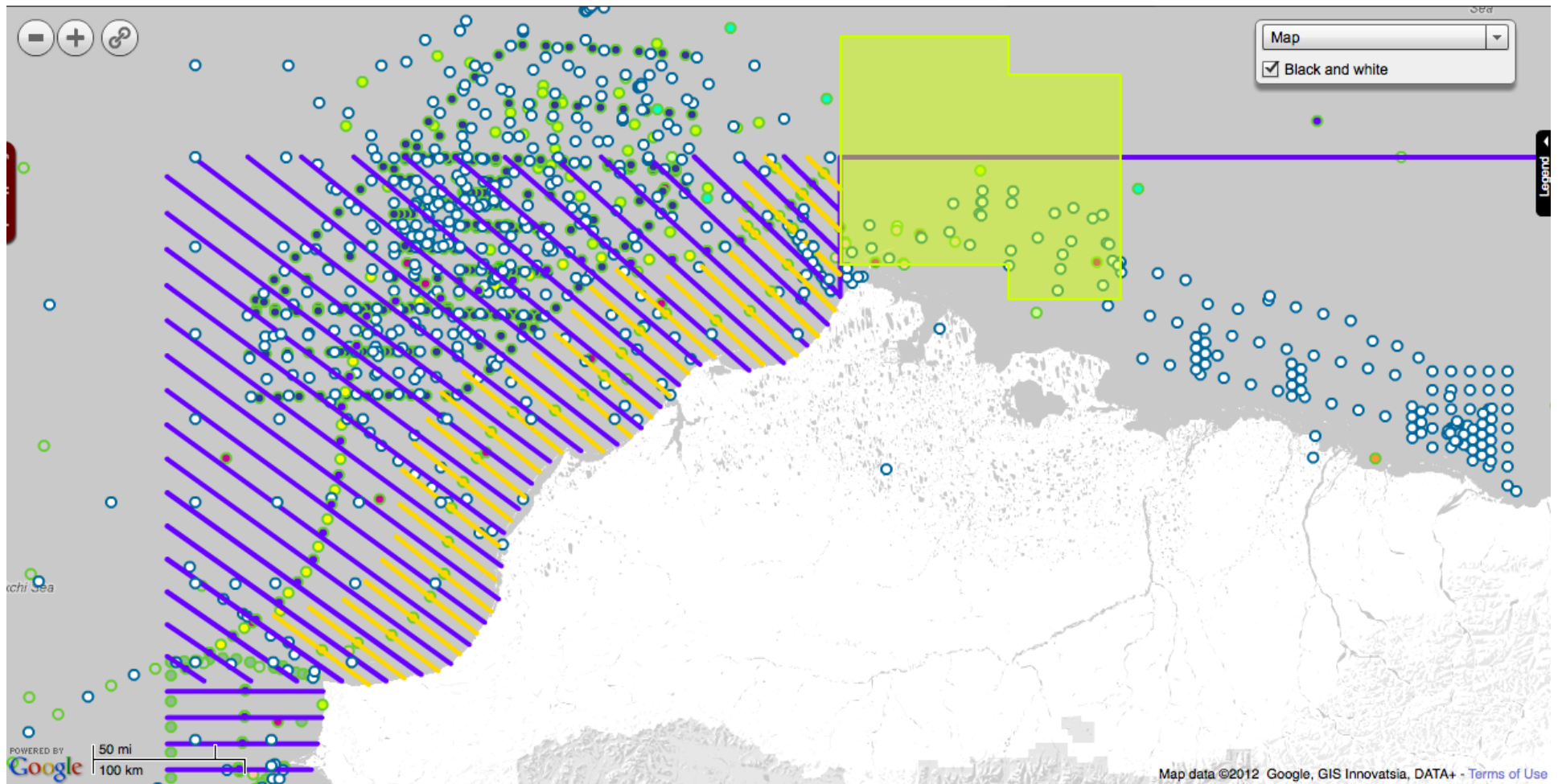
- (1) SEARCH as potential link to science of large-scale Arctic change (research priorities, gaps, new approaches etc.)
- (2) SEARCH Action Teams as potential catalysts and interfaces for integration between stakeholder- and research-driven observations
- (3) AOOS as integrator and interface to different agencies and stakeholders
- (4) SEARCH science support structure and planned activities may help AOOS address priority observations for coming years

NOAA's Arctic Vision & Strategy Goals

1. Forecast Sea Ice
2. Strengthen Foundational Science to Understand and Detect Arctic Climate and Ecosystem Changes
3. Improve Weather and Water Forecasts and Warnings
4. Enhance International and National Partnerships
5. Improve Stewardship and Management of Ocean and Coastal Resources in the Arctic
6. Advance Resilient and Healthy Arctic Communities and Economies

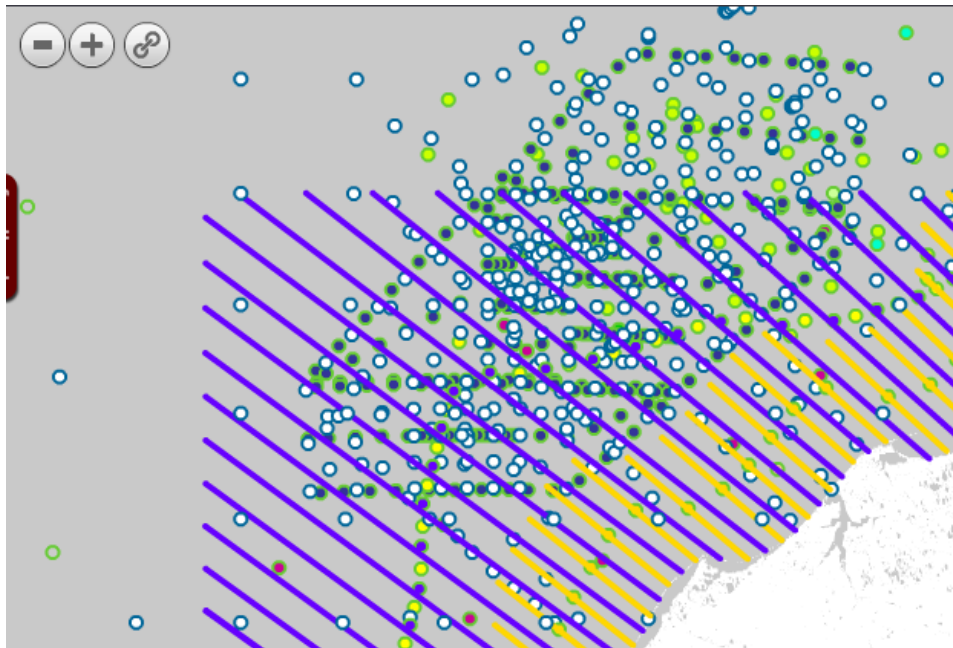


Impacts of changes in marine environment in Chukchi/Beaufort oil & gas lease areas

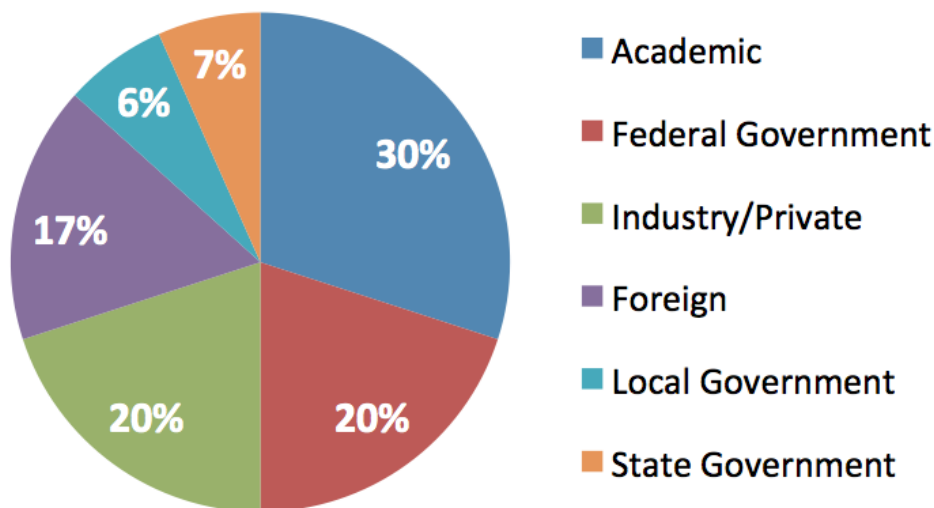


- US Arctic observing system assets deployed 2011/12;
aoots.org

Impacts of changes in marine environment in Chukchi/Beaufort oil & gas lease areas



- 30 different entities support or run long-term observations
- 46 programs generate between 1 and >20 datasets each (compare with 12 datasets total at NODC)
- Data availability varies: AON data most accessible; data from 22 out of 46 programs currently not available
- Little to no compliance with UNCLOS MSR requirements
- Limited coordination in data acquisition & program design





Sea Ice Prediction Network (SIPN)

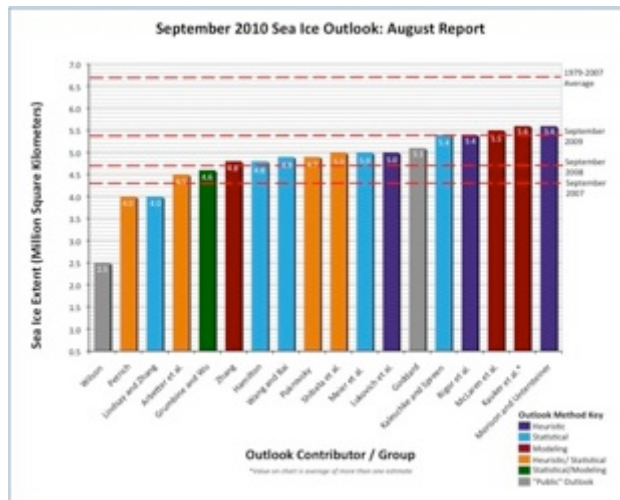
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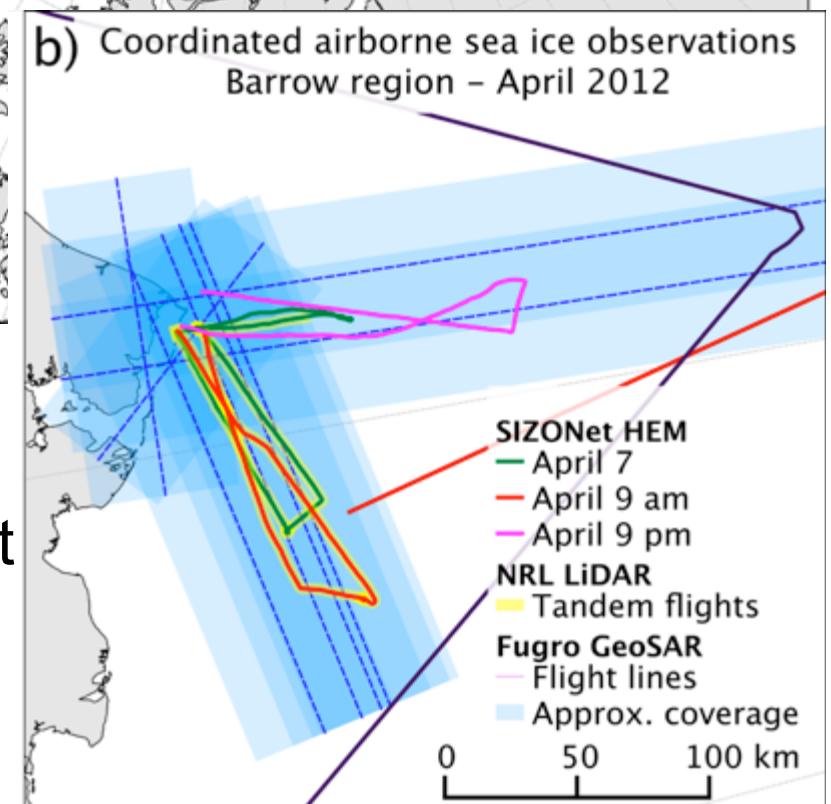
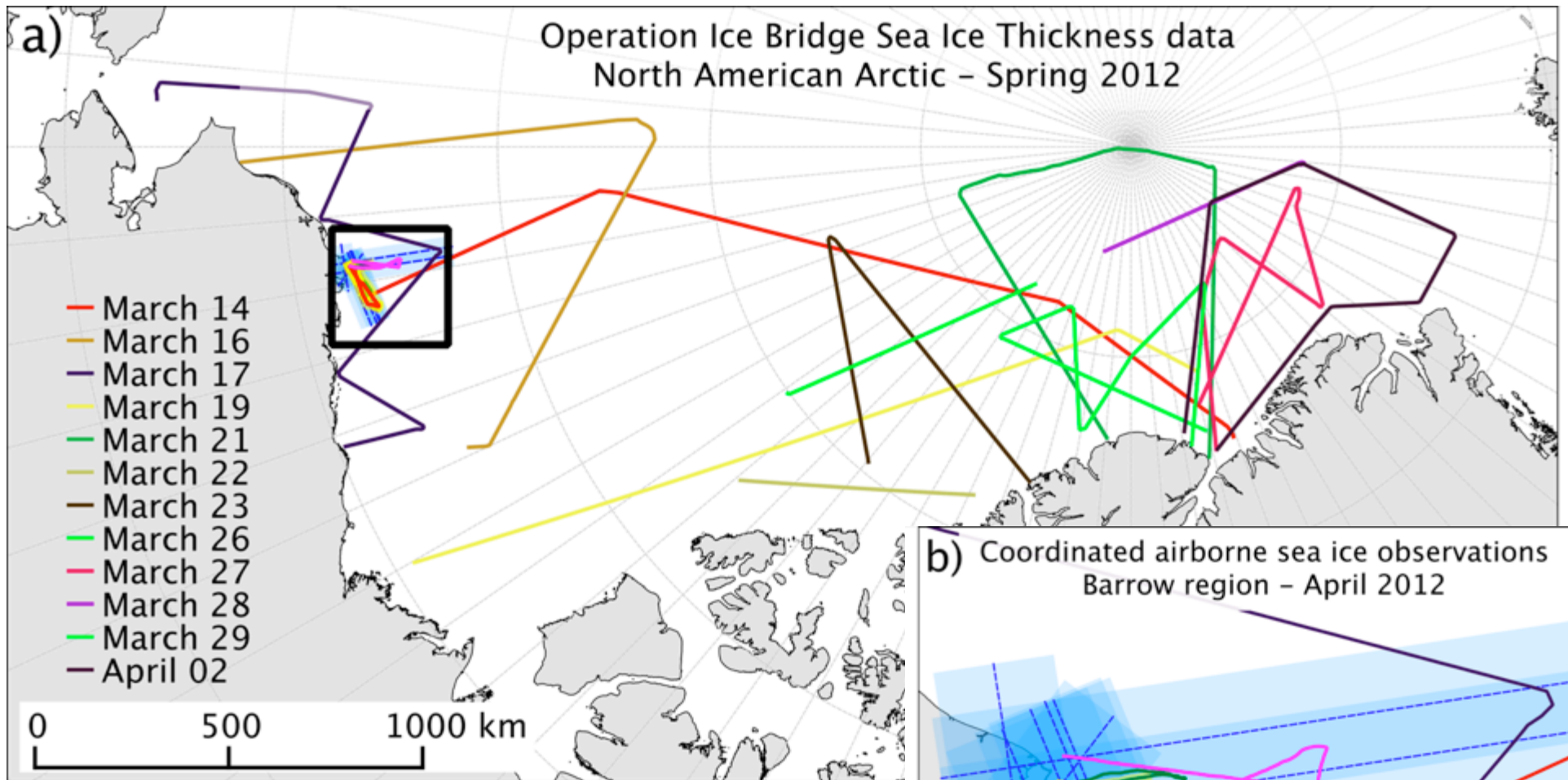


Funding



Activities

- Sea Ice Outlook & Sea Ice for Walrus Outlook
- Data integration & staging
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- Guided observations
- Evaluation of stakeholder information needs



Criteria and metrics for observing system design and optimization:

- Prediction of summer sea ice extent
- Coordinated research & industry flights



ADI Task Force Conclusions and Recommendations

Key Science Questions:

- Must be laid out in an actionable form
 - (i) The question translates an overarching science question or SEARCH or IARPC 5-year science goal
 - (ii) Data and information derived from addressing this actionable question allows stakeholders or governing bodies to develop policies or inform specific decisions and actions in response to Arctic change



ADI Task Force Conclusions and Recommendations

Space and time scales:

- Pan-Arctic space scale and seasonal to decadal time scales
- ***AON should take advantage of regional measurements that are mandated or taken by other national and international organizations***
- Questions of societal relevance will often require AON observing activities at the local or regional scales



ADI Task Force Conclusions and Recommendations

Prioritization:

- AON should strive for a balance between the physical, biological and human components of the Arctic system
- ***Higher priority assigned to those approaches that can help address multiple science questions***
- More rigorous evaluations should be carried out using (e.g. OSSE's, data denial experiments) for well-established sampling strategies
- Pilot studies should be implemented to explore effective approaches for system design where the background science has not yet developed sophisticated design algorithms



ADI Task Force Conclusions and Recommendations

Design and optimization approaches:

- Methodologies and implementation strategies for network design vary widely between disciplines, both in approach and maturity
- Observing system design and optimization need to be considered in a hierarchy of approaches
- ***An important aspect of its design is the ability of the network to remain agile and able to adapt to a rapidly changing Arctic***



ADI Task Force Conclusions and Recommendations

Metrics:

- Network design to address specific science questions requires quantitative metrics (targets) of allowable uncertainty in the quantities being measured
- ***Metrics should be relevant to the present and possible future states of the Arctic as opposed to the Arctic of the past***
- Allowable uncertainties will depend on the science question asked
- Consensus within the scientific community is needed to determine the allowable uncertainty



ADI Task Force Conclusions and Recommendations

Management structure:

- AON Scientific Steering Group (AON-SSG) is recommended to provide a management structure
 - responds to input from the SEARCH SSC, the scientific community, AON stakeholders, and federal or state agencies
- SSG composition would reflect this diversity
 - Able to advise NSF and other agencies supporting the AON on network goals
 - provide input on how individual projects address these goals and how different observations may be prioritized
 - May require the formation of ad-hoc working groups that focus on specific issues

IPY-4: From Knowledge to action (K2A)

- *Bodies of knowledge*
 - Scientific
 - Practical
 - Local
 - Indigenous
- *Holders of knowledge*
 - Communities & practitioners
 - Repositories & archives
 - Institutions & frameworks
- *Action: Response to Arctic change*
 - Passive system response
 - Active response through adaptation, mitigation, negation, etc.
- *Scales of action*
 - Local
 - Regional
 - National
 - Global

K2A: Where are we post-IPY-4?

- *Trickle down*: Indirect exchange, academic papers
- *Translation – Specialists*: Traditional science communication & popularization
- *Participation – Facilitators*: Direct consultation
- *Integration – Funders*: Scientists & practitioners joined through funding support & shared accountability
- *Negotiation – Lobby groups*: Scientists & practitioners pursue action agenda
- *Learning – Facilitators*: Iterative engagement, K2A

Following van Kerkhoff and Lebel (2006), Annu. Rev. Environ. Resour.



Responding to Arctic Change

- Studying & anticipating responses of the Arctic system to social-environmental change
- Linking Arctic system science & stakeholder information needs

The Arctic of 2050

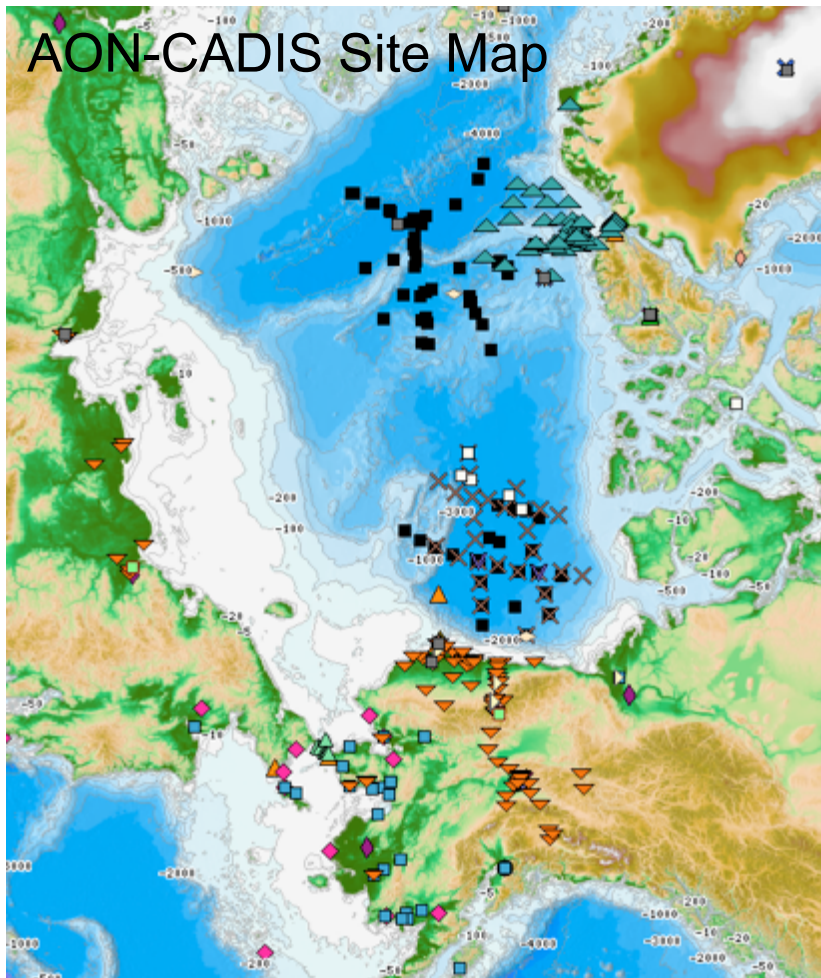


Moving SEARCH forward

- Building partnerships across agencies: IARPC, linking with USFWS Landscape Conservation Cooperatives, NPS Vital Signs program & others
- Multi-agency proposal for Arctic Sea Ice Prediction Network (Leads: J. Stroeve, C. Bitz)
- Proposal for stakeholder/agency/research linkages to NPRB for Sea Ice for Walrus Outlook
- Marine resource governance & observing systems: Joint ACCESS/SEARCH Proposal to ArcSEES (K. Pletnikoff, P. Berkman, O. Young & others)
- International linkages: WCRP, CliC, PPP, etc.
- Engagement of private sector



Arctic Observing Network (AON)



- Roughly 50 NSF-supported AON projects
- Data dissemination and archival at Coop Arctic Data & Information Service <http://aoncadis.org>
- State of AON:
 - Scientific community, federal/state/local agencies, stakeholders and general public all with a vision for an Arctic observing system
 - Action toward improved networking & coordination underway





Elements of AON Design and Optimization Hierarchy

AON design elements	Activity	Implementation
<i>Problem definition</i>	Development of science goals & definition of actionable science questions	SEARCH program, agencies, stakeholders, AON Science Steering Group
<i>Strategy</i>	Feedback & uncertainty analysis, metrics, model-based assessments, process studies	Working groups, funded projects, ad-hoc meetings (researchers, agencies, stakeholders)
<i>Tactics</i>	Target quantity definition and measurement options, model-based assessments	Synthesis forums (e.g., Sea Ice Outlook, flagship site teams), funded projects & ad-hoc meetings
<i>Deployment scale</i>	Sampling array design	AON projects, OSSE/OSE teams



Lessons from other efforts

For example:

- Tropical Atmosphere Ocean Array (TAO) – science to operational (relevant for ocean and sea ice prediction; low-latitude linkages – ENSO prediction as key driver)
- Long-Term Ecological Research (LTER) – bottom-up effort that resulted in network with core set of quantities measured
- National Ecological Observing Network (NEON) – top-down effort with stringent design guidelines

Arctic Observing Coordination Workshop

Anchorage 20-22 March 2012

- Showcase projects:
E.g. - From Observations to Management: Providing Scientific Information to Inform Decisions Regarding Offshore Oil and Gas Activities in the Chukchi Sea
- Local vs. pan-Arctic perspective
- Fundamental vs. applied science
- Showcase projects
- Next steps: SEARCH & DAMOCLES – ArcSEES proposal



U.S. Arctic Observing Coordination Workshop

Major Recommendations

“Showcase” projects – demonstrate effective approaches towards interagency collaboration

1. From Observations to Management: Providing Scientific Information to Inform Decisions for Offshore Oil & Gas Activities in the Chukchi Sea
2. Distributed Environmental Observatory for Terrestrial Change Detection
3. What are the Causes and Consequences of the Greening of the Arctic?
4. A Marine Distributed Biological Observatory
5. Multidisciplinary Drifting Observatory for the Study of Arctic Climate
6. Community-based Observation Network for Adaptation and Security
7. Ocean Observations to Improve Sea Ice Forecasting
8. Long-Term Sea Level Measurements along the Alaskan Chukchi and Beaufort Coasts
9. Arctic Ocean Freshwater and Heat Observing System
10. Utilizing the State of the Existing Knowledge to Guide Infrastructure Development
11. Building a Community-Based Observation Network

U.S. Arctic Observing Coordination Workshop

Major Recommendations

- Need more interaction between academic scientists and agency managers
- AON needs to be more responsive to stakeholder information needs and agency management goals – synthesized, interpreted data and information products from multiple sources – not just ‘raw observational data’
- Joint agency sponsorship of core monitoring activities (models such as the National Ocean Partnership Program)
- An arctic observations data policy
- Moving recommendations forward: SEARCH SSC will discuss with relevant groups (OCP, IPMC, IARPC, USARC)
- The biggest challenge: a productive balance between the fundamental research questions driving much of the NSF-supported AON and the data, products, and information needs of agency managers and other stakeholders

ADI Task Force Report



ADI Task Force Members & Key Contributors:

- S. Andelman, H. Eicken (Chair), L. Hamilton, M. Holland, C. Lee, B. Owens, M. Ramamurthy, P. Schlosser, H. Seim, M. Serreze, J. Vande Castle, C. Vörösmarty, and J. Walsh
- J. Francis, D. Nechaev, and ADI workshop participants
- Support by Olivia Lee, Helen Wiggins & Reija Shnoro, SEARCH Project Office/ARCUS
- Financial support by the National Science Foundation
- Workshops, community survey (n = 119) & proof-of-concept studies, final report in fall 2012:

<http://www.arcus.org/search/aon/adi>

ADI Task Force Report

- Assess the present state and near-term implementation plans of the AON and related efforts
- Synthesize lessons learned from other observing systems
- Identify and assess promising approaches and tools for design and optimization
- Offer and discuss specific design options and approaches
- Provide a summary of ADI Task Force findings and recommendations – Report released in fall 2012, :
<http://www.arcus.org/search/aon/adi>

