BREAKOUT GROUP: MODES OF VARIABILITY IN THE ARCTIC SYSTEM

Group Leaders: Louis Codispoti, Larry Hamilton, Jim Overland
Rapporteur: Dick Moritz

What are the key uncertainties?

1. **THE COMMON CAUSES AND REMARKABILITY OF RECENT CHANGES IN THE ARCTIC SYSTEM**

2. **THE NATURE AND IMPORTANCE OF THRESHOLD EVENTS, EXTREME EVENTS, AND ABRUPT CHANGES**

3. **DEFINING THE EXTREME STATES OF THE ARCTIC SYSTEM**

4. **HOW TO PRODUCE USEFUL SCENARIOS OF THE FUTURE**

5. **SORTING OUT THE INTERACTIONS BETWEEN GLOBAL AND ARCTIC MODES OF VARIABILITY**

What are the key uncertainties?

1. THE COMMON CAUSES AND REMARKABILITY OF RECENT CHANGES IN THE ARCTIC SYSTEM

- how do we track these changes
- what are the appropriate conceptual models
- how to link observations of change to their causes
- natural vs. anthropogenic
- how do we integrate across systems physics _ HARC
- where and what to measure
- sensitivity and key variables
- mis-match between info we need and what models can predict

What is the impact of this uncertainty on our understanding of the AS?

- high (we see changes but not sure of which model to apply)

What is our level of confidence in the above assessment?

- high

What is our level of readiness to deal with this uncertainty?

- high in some areas and regions (Barents), but… don't have a theoretical understanding of the atmosphere-ocean circulation; insufficient long-term ecosystem time-series (Toolik Lake only ~25 yrs)

Should this focus area be addressed by a new or existing initiative, by one or a combination of existing ARCSS components, or by some other means?

- yes – existing: SEARCH, LTOs/LTERs

What are the key uncertainties?

2. THE NATURE AND IMPORTANCE OF THRESHOLD EVENTS, EXTREME EVENTS, AND ABRUPT CHANGES

- how do we model these things (non-linear)
- impacts on society
- how do these things re-organize or synchronize ecosystems & society
- what are the ecosystem buffers
- rates and reversibility of change
- the frequency of extreme events
- what is an extreme event
- are we looking hard enough for extreme events
- limits of predictability
- relative importance

What is the impact of this uncertainty on our understanding of the AS?

- high

What is our level of confidence in the above assessment?

- high for paleo record; high for some co-varying data such as Larry's fishery collapse report; high for some ecosystem models depending on scale; low for dynamic models; medium for societal models

What is our level of readiness to deal with this uncertainty?

- high for re-analysis of already existing co-varying data; medium for new cross-disciplinary efforts (mathematicians are ready)

Should this focus area be addressed by a new or existing initiative, by one or a combination of existing ARCSS components, or by some other means?

- good avenue for cross-directorate Announcement of Opportunities (mathematics, LTER, OPP, SBE, GEO)

What are the key uncertainties?

3. DEFINING THE EXTREME STATES OF THE ARCTIC SYSTEM

- how far can it go
- bumpers on separate quasi-steady states (ice-covered vs ice-free)
- how do you recognize an extreme state (vs extreme event: persistence time-scale)
- how likely –frequency
- multiple quasi-steady states
- what can we learn from combining the paleo record and the models – what else happens with ice-free arctic
- other 10-100 yrs examples: deep convection; ecosystem collapse (ecosystem shifts to lower trophic levels– return to Cambrian ocean); phase lock of natural oscillation (AO); depopulation; species extinction; new CO_2 levels; oil impacts; permafrost degradation

What is the impact of this uncertainty on our understanding of the AS?

- moderate to high with high relevance (40% ice loss or 10% + hiding)

What is our level of confidence in the above assessment?

- low

What is our level of readiness to deal with this uncertainty?

- high

Should this focus area be addressed by a new or existing initiative, by one or a combination of existing ARCSS components, or by some other means?

- PARCS, SEARCH

What are the key uncertainties?

4. HOW TO PRODUCE USEFUL SCENARIOS OF THE FUTURE

- sort out non-linear thresholds from organized change
- scenario choices – multiple possibilities
- pathways of change
- can include probabilities
- start with communities; what is the question; who is end user
- model assessment, what is necessary for GCM and regional models
- user-defined scenario generation; type of model depends on users
- confidence depends on having clear assumptions
- needs and information base

What is the impact of this uncertainty on our understanding of the AS?

- NA: wrong question – scenario is application of information

What is our level of confidence in the above assessment?

- NA: wrong question

What is our level of readiness to deal with this uncertainty?

- NA

Should this focus area be addressed by a new or existing initiative, by one or a combination of existing ARCSS components, or by some other means?

- HARC is already doing some of this
- *We are dumb scientists, society, tell us what you need!*

What are the key uncertainties?

5. SORTING OUT THE INTERACTIONS BETWEEN GLOBAL AND ARCTIC MODES OF VARIABILITY

- harmonize Arctic with global program – ASOF, CLIVAR
- polynyas – international programs
- relative importance of internal vs external modes of variability; interactions and relationships between the ENSO, PDO, AO, other
- ecological impacts: river basins southern limits, contaminants, animal migrations, circulation changes
- impact changes in the deep convection, salinity anomalies
- changes in private and government policies; new technology
- understanding the stratosphere – ozone hole
- CO_2, radiative trace gases

What is the impact of this uncertainty on our understanding of the AS?

- very high – how open is the system

What is our level of confidence in the above assessment?

- very high – need to tie in with larger communities

What is our level of readiness to deal with this uncertainty?

- different states of readiness:
  positive readiness: contaminant transport
  negative readiness but improving: global climate modeling

Should this focus area be addressed by a new or existing initiative, by one or a combination of existing ARCSS components, or by some other means?

- Evil Axis of SEARCH, CLIVAR & ASOF