Linking regionally downscaled seascapes to biological variability in a high-latitude sea

AMBON - the Arctic Marine Biodiversity Observing Network

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> Seascapes are ocean ecosystem classifications based on remotely-sensed features
> AMBON's goal is to relate seascapes to biological communities and processes

FROM MICROBES TO WHALES

What is AMBON?

- Measuring marine biodiversity (species richness and distribution) on the Chukchi Sea shelf
- Monitor arctic marine biodiversity from microbes to whales
- Relate diversity patterns to physical environment
- Build network through collaboration & data sharing
  - MBON; National & International Arctic networks
- Contribute to long-term biological observing to improve scientific understanding, management and other stakeholder needs
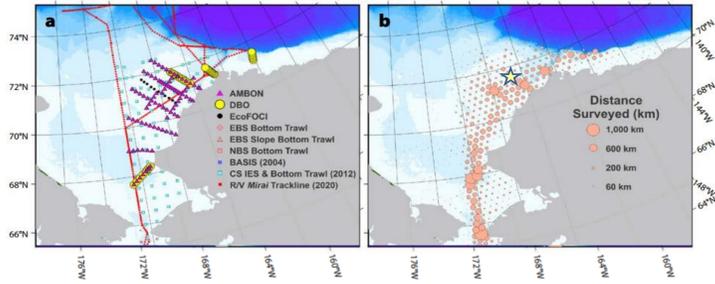

Fig. 1: Vessel-based sampling in the Chukchi Sea , including AMBON (a) and transect-based seabird sampling effort (b). From Danielson et al. (2022). Yellow star in right panel denotes CEO mooring (see Fig. 2)
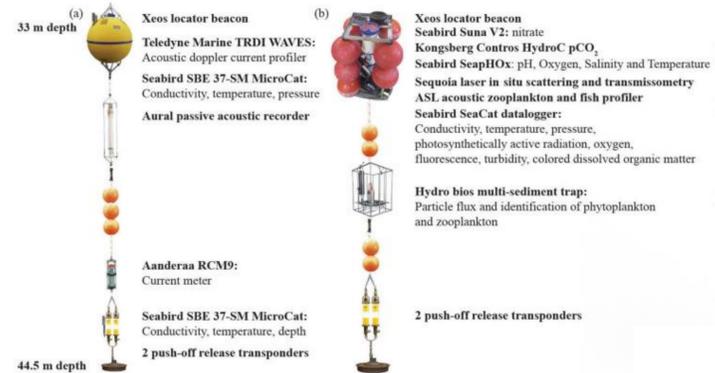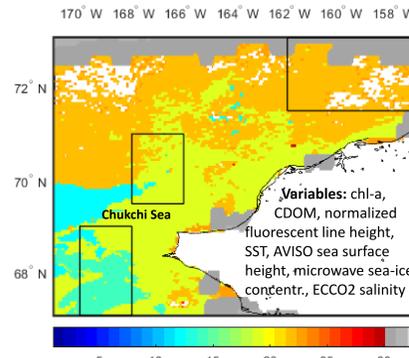

Fig. 2: Chukchi Ecosystem Observatory physical (a) and bigeochemical (b) moorings. Not shown: water sampler (eDNA), passive acoustics (mammals), benthic camera.
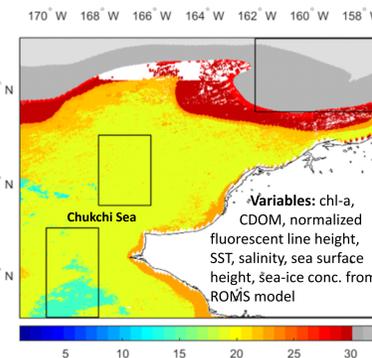
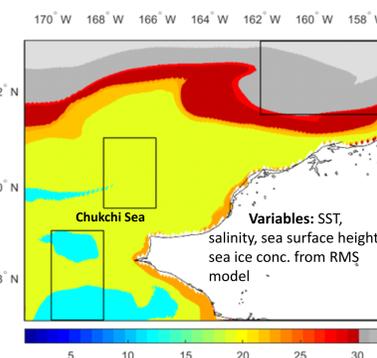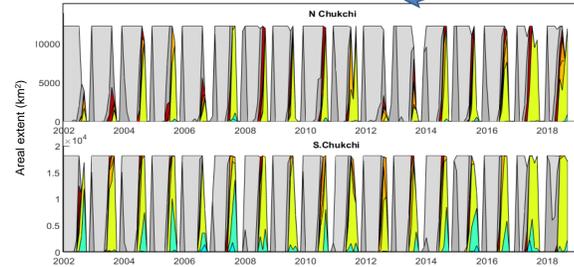### Global satellite data   Regional model   Physics only model

Fig. 3: Dynamic seascape classifications for July 2017 from: The Global model (**left**), the Regional model (**middle**), and the Physics only model (**right**). Rectangles denote regions where seascape output or model fields were extracted. Seascape classifications as in Fig. 4
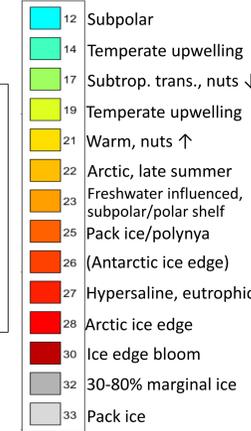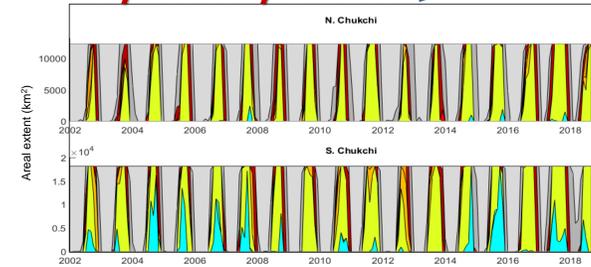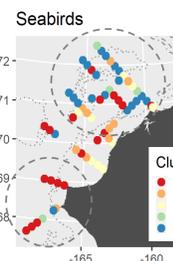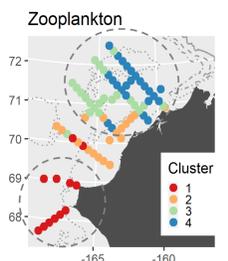
Regional model   Physics only model

Fig. 4: Changes in seascape areal extent through time (2002-2018) for: Northern Chukchi Sea (**top**) and Southern Chukchi Sea (**bottom**) from the regional model (**left**) and the physics only model (**right**).

12	Subpolar
14	Temperate upwelling
17	Subtrop. trans., nuts ↓
19	Temperate upwelling
21	Warm, nuts ↑
22	Arctic, late summer
23	Freshwater influenced, subpolar/polar shelf
25	Pack ice/polynya
26	(Antarctic ice edge)
27	Hypersaline, eutrophic
28	Arctic ice edge
30	Ice edge bloom
32	30-80% marginal ice
33	Pack ice

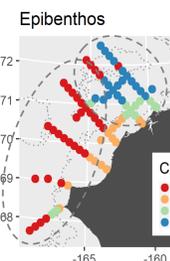### Seabirds   Zooplankton   Fish   Infauna   Epifauna   Projection
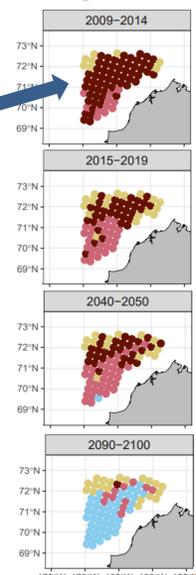

Fig. 5: Examples of biological communities showing that community structure in the Southern and Northern Chukchi Sea is distinctly different, supporting the use of regional Seascape models (**top**). Colors denote a distinct community for each of the community types separately with a gradient from more Pacific (red) to more Arctic (blue) communities. Using regional community assessments, combined with climate projections, support future projections of community structure (example shows projections for _epibenthic functional groups_, based on high temperature scenario) (**right**).

> Moderate coherence between regional and global model
> Validation ongoing
> Regional model can fill data gaps
> Physics only model maintains regional seascape structure
> Physics only model allows classifications in shoulder seasons

> Time series provide regional differences in seascape composition and their seasonal evolution
> Summer seascapes reflect gradient from Pacific to Arctic waters
> Biological variables are important to characterizing interannual variability in seascapes

> Biological community structures differ strongly between southern and northern Chukchi Sea
> Differences reflect gradient from Pacific to Arctic community
> Linking seascapes with communities through regional model outputs is ongoing
> Regional models may support future projections of Seascapes and biological responses

Funding