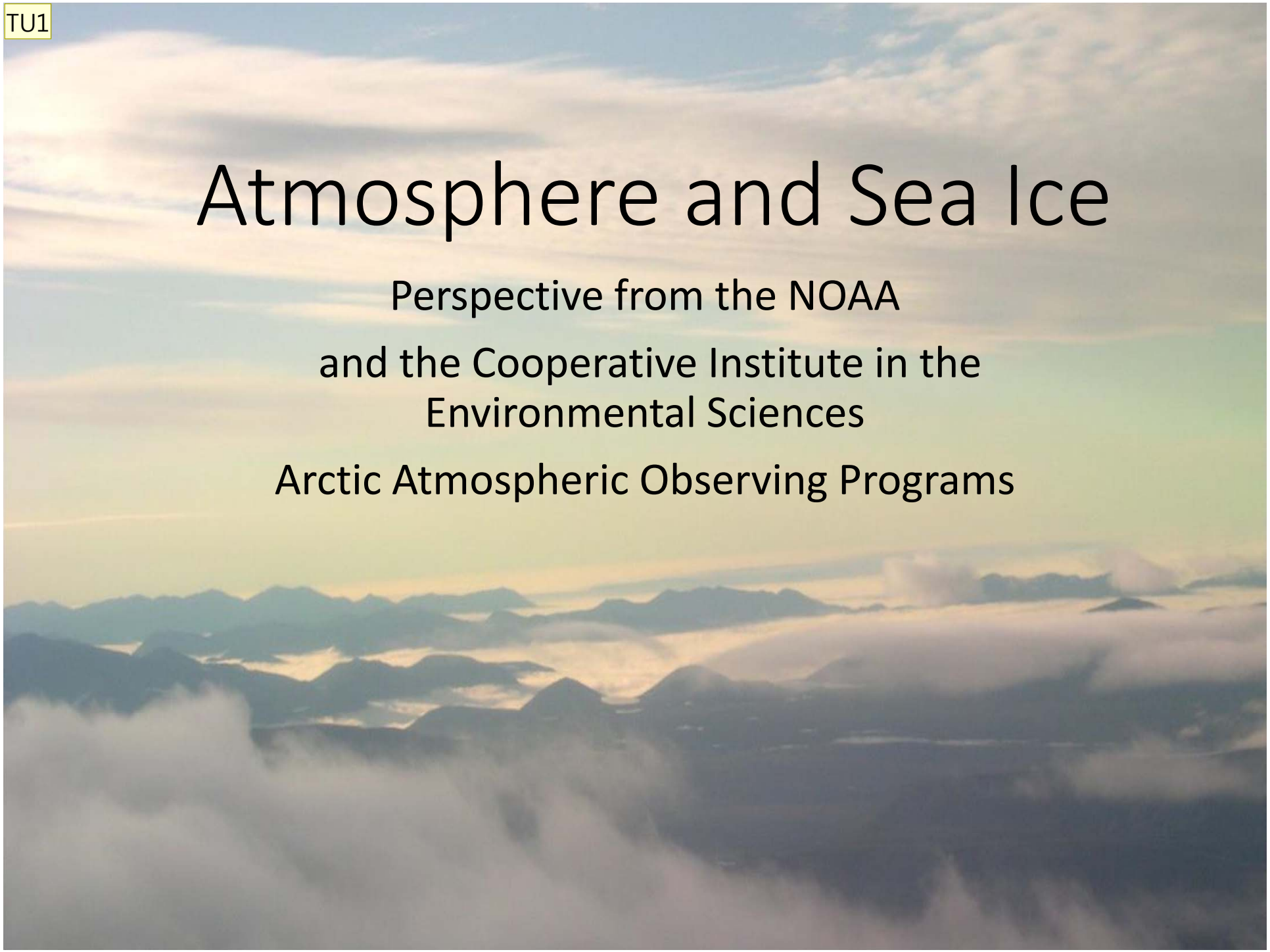
TU1



Atmosphere and Sea Ice

Perspective from the NOAA

and the Cooperative Institute in the Environmental Sciences

Arctic Atmospheric Observing Programs

슬라이드 1

TU1 Taneil Uttal, 2015-04-16

A decade of environmental change in the Pacific Arctic region

Kevin R. Wood , Nicholas A. Bond, Seth L. Danielson , James E. Overland , Sigrid A. Salo , Phyllis Stabeno , Jonathan Whitefield

Submitted to Progress in Oceanography

"Oceanic heat in the surface mixed layer is a principal driver of the seasonal cycle of sea-ice melt and freeze in the Arctic (e.g. Carmack et al., 2015), but mapping the relative contribution of local solar radiation (on the scale of tens of kilometers and less) versus advection from more distant locations (hundreds of kilometers and more) is incomplete."

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Preconditioning of Arctic Sea Ice and Snow by the Atmosphere

- Kapsch, M.-L., Graversen, R.G., and Tjernstrim, M. 2013: Springtime atmospheric energy transport and the control of Arctic summer sea-ice retreat. Nature Climate Change, 3, 744-748, dpi: 10.1038/NCLIMATE1884.
- Kapsch, M.-L., R.G. Graversen, T. Economou, and M. Tjernstrom. 2014: The importance of spring atmospheric conditions for predictions of the Arctic summer sea ice extent. GRL, 5288-5296, doi: 10.1002/2014GL060826.
- Francis and Hunter 2006: New insight into the disappearing arctic sea ice. EOS 87, 509-511.
- Maksimovich and Vihma 2012: The effect of heat fluxes on inter annual variability in the spring onset of snow melt in the central arctic ocean, JGR 117, C07012.
- Dong, X., Zib, B. J., Xi, B., Stanfield, R., Deng, Y., Zhang, X., ... & Long, C. N. (2014). Critical mechanisms for the formation of extreme arctic sea-ice extent in the summers of 2007 and 1996. Climate Dynamics, 43(1-2), 53-70.
- Choi, Y.-S., B.-M. Kim, S.-K. Hur, S.-J. Kim, J.-H. Kim, and C.-H. Ho (2014), Connecting early summer cloud-controlled sunlight and late summer sea ice in the Arctic, J. Geophys. Res. Atmos., 119, 11,087–11,099, doi:10.1002/2014JD022013.
- Schroder, D., Daniel Feltham, Daniela Flocco and Michel Tsanmados, 2014:, September Arctic sea-ice minimum predicted by spring melt-pond fraction, nature Climate Change 4, 252-257, doi:10.1038/nclimate2203

MUST ALSO CONSIDER:

$$SW\downarrow(1-\alpha) + LW\downarrow - LW\uparrow + H_s + H_l$$

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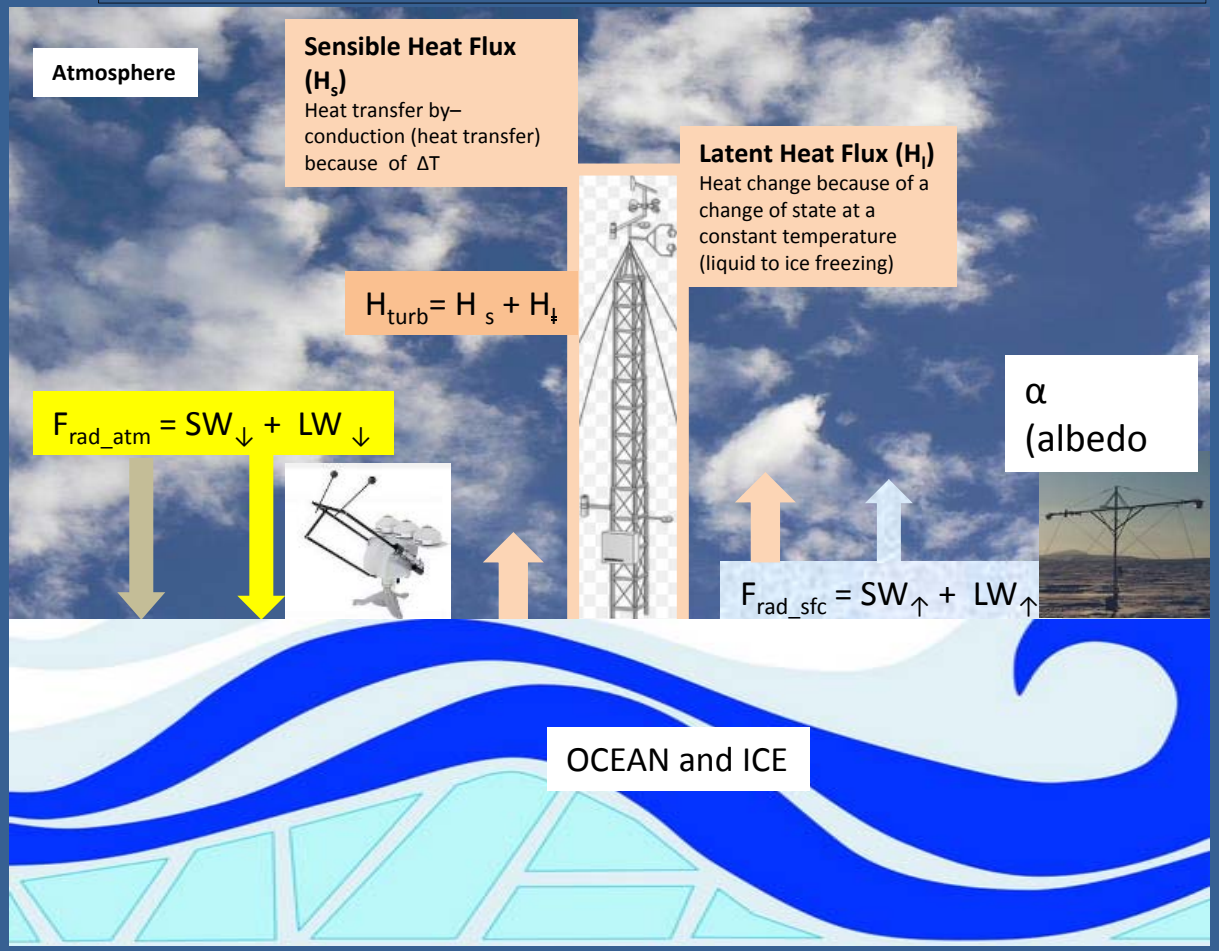

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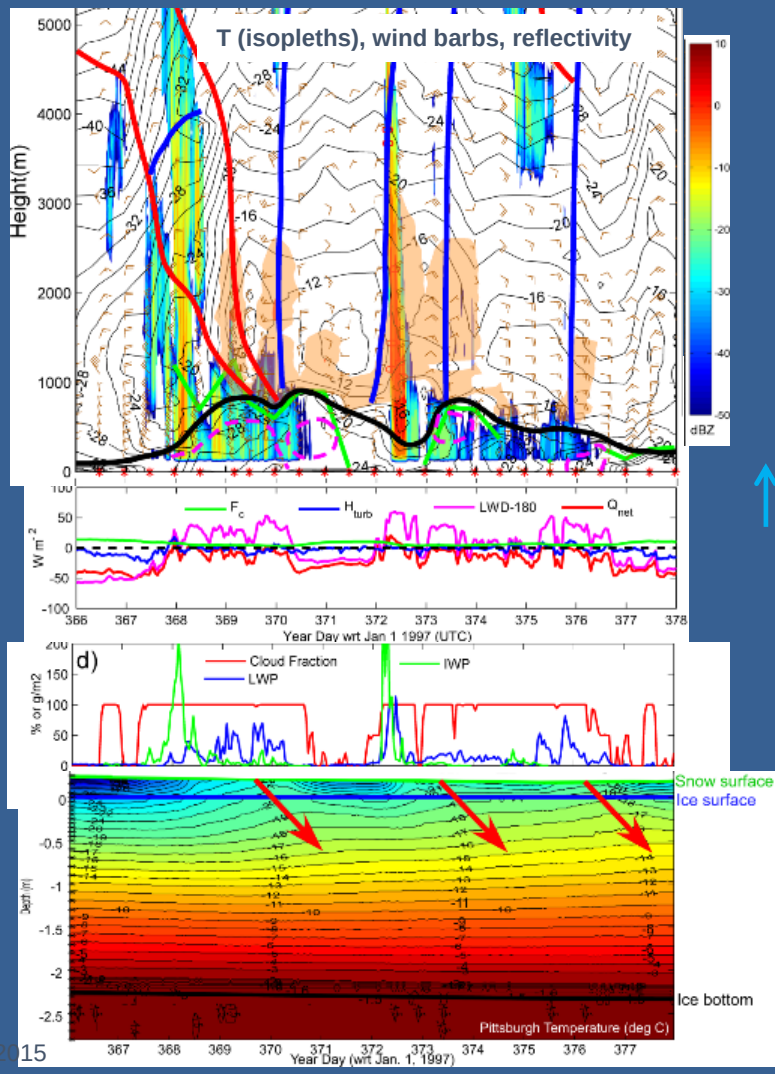
Ola Persson

1) Long-distance free tropospheric advection of heat and moisture significant

2) Associated clouds (esp. with liquid) have strong impact on LW_d, F_{net}, and T_s

3) Thermal structure in snow and ice respond strongly to synoptic/mesoscale atmospheric events and presence of liquid water in clouds

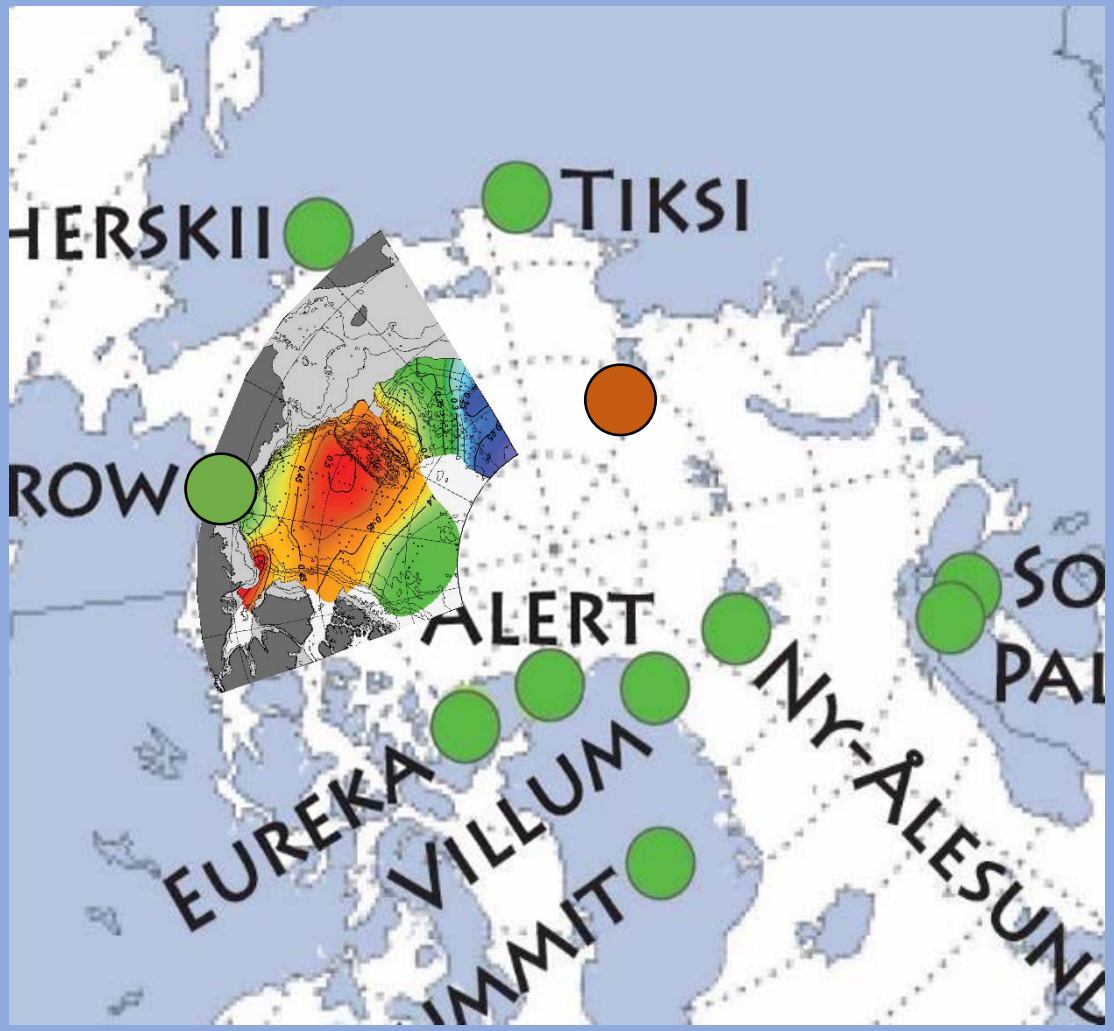


Persson et al 2015

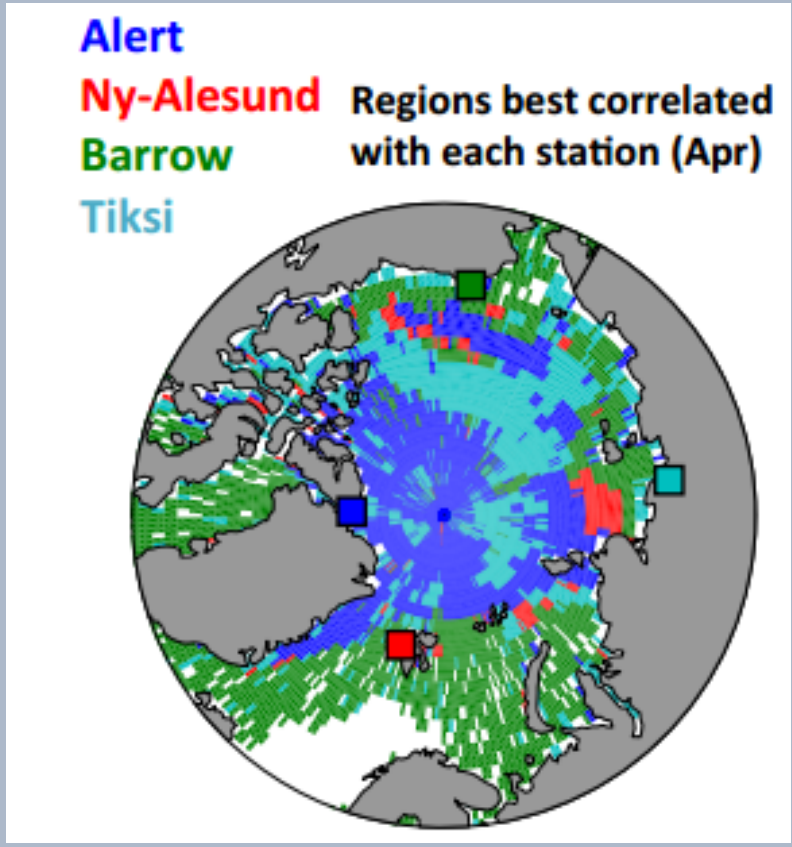
Atmospheric Observing Activities that can support PAG

- The IASOA Atmospheric Observatories
- A number of ship-based campaigns
  - ASCOS (Arctic Summer Cloud Ocean Study) Swedish Arctic Research Secretariat
  - ARCROSE (Arctic Research Collaboration for Radiosonde Observing System Experiment) NIPR
  - SEASTATE ONR
  - MOSAIC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) Interagency and International Planning
- Observational Technology Development
- Data Stewardship
- Upscaling

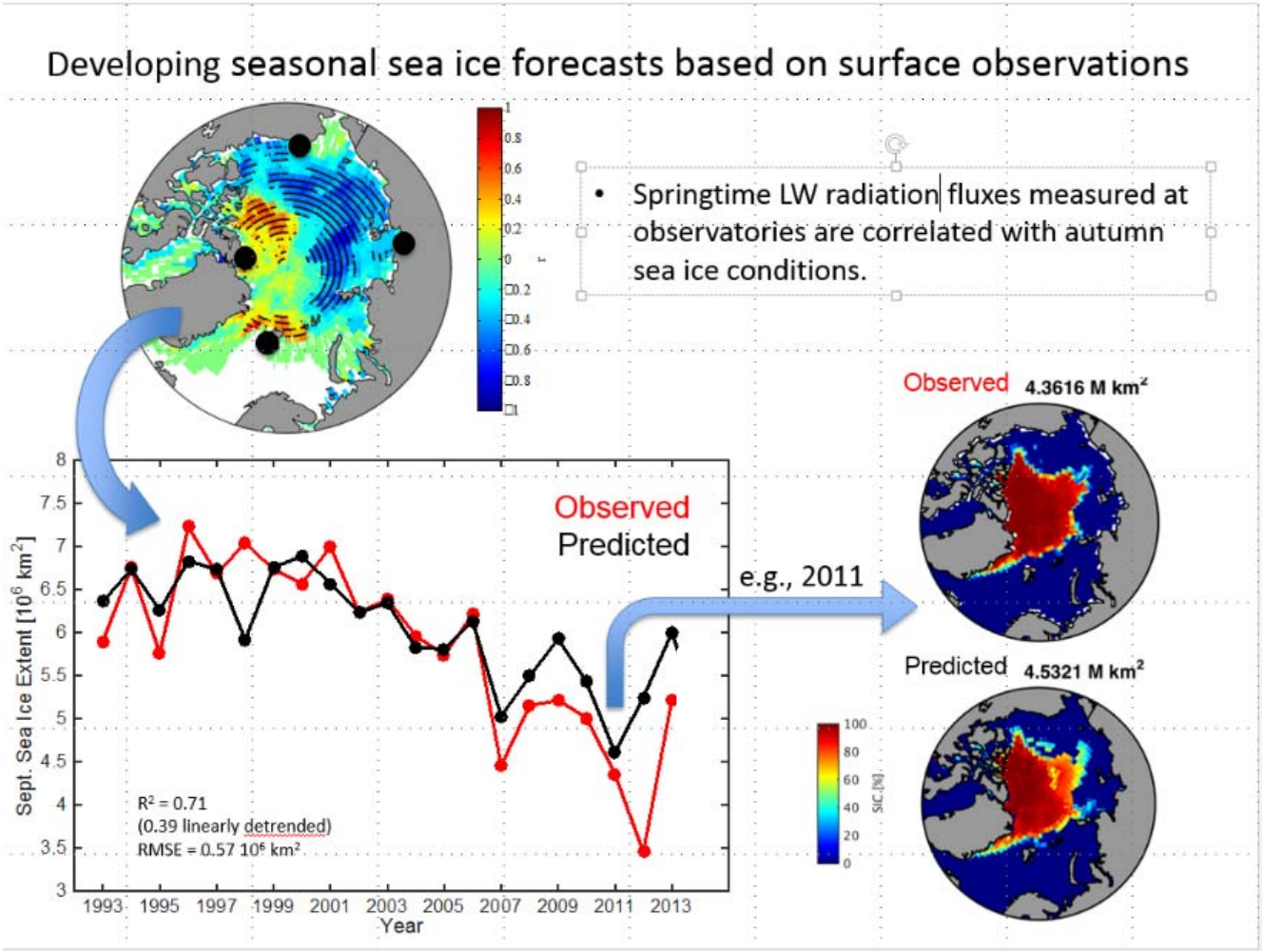
www.iasoa.org


TIKSI
ALERT
EUREKA
VILLUM
NY-ÅLESUND

Downwelling flux anomaly (SW+LW) measured at land stations in April/May correlated with September sea ice concentrations

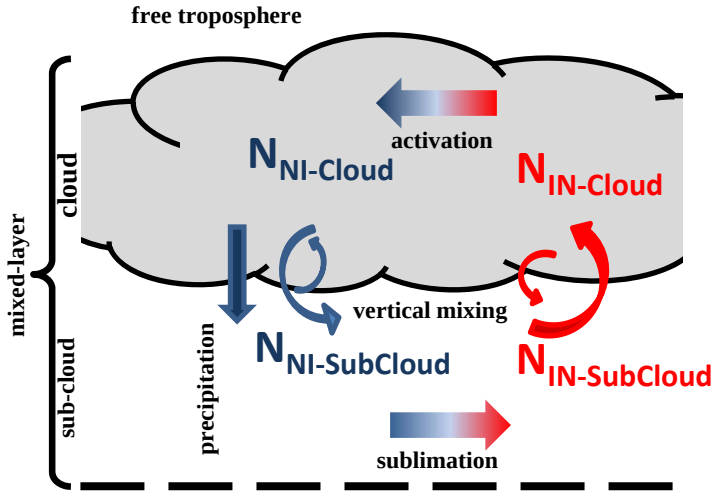


Cox

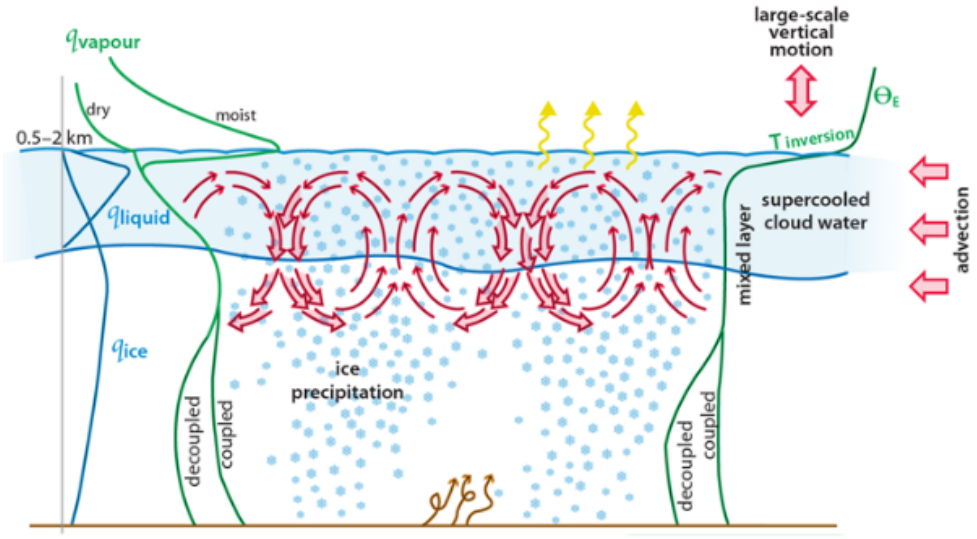

Developing seasonal sea ice forecasts based on surface observations
• Springtime LW radiation fluxes measured at observatories are correlated with autumn sea ice conditions.
Observed
Predicted
Sept. Sea Ice Extent [10^6 km^2]
Year
R² = 0.71
(0.39 linearly detrended)
RMSE = 0.57 10⁶ km²
e.g., 2011
Observed 4.3616 M km²
Predicted 4.5321 M km²
SIC [%]

Cox

Combinations of radiometers, lidars, radars on land and ships can provide information on cloud microphysics

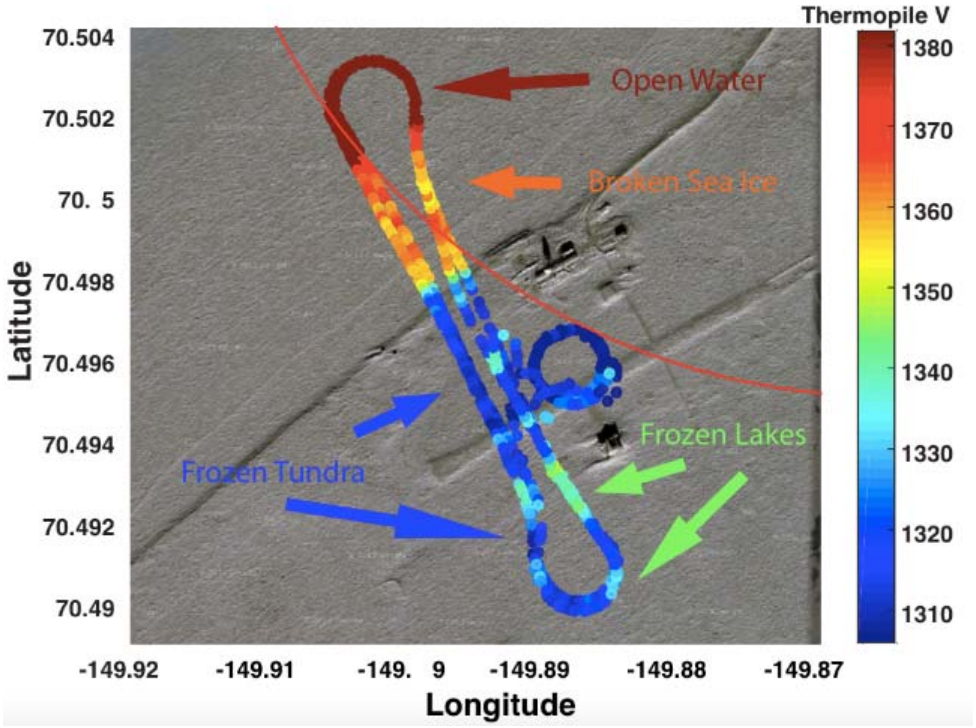


Solomon



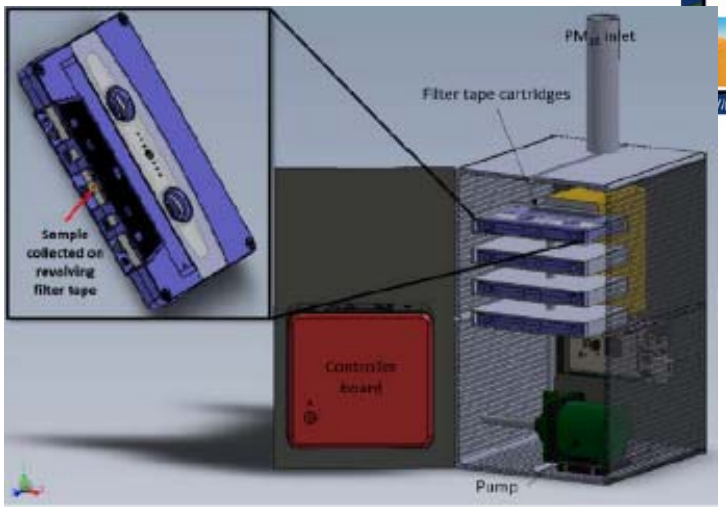
Morrison, Shupe

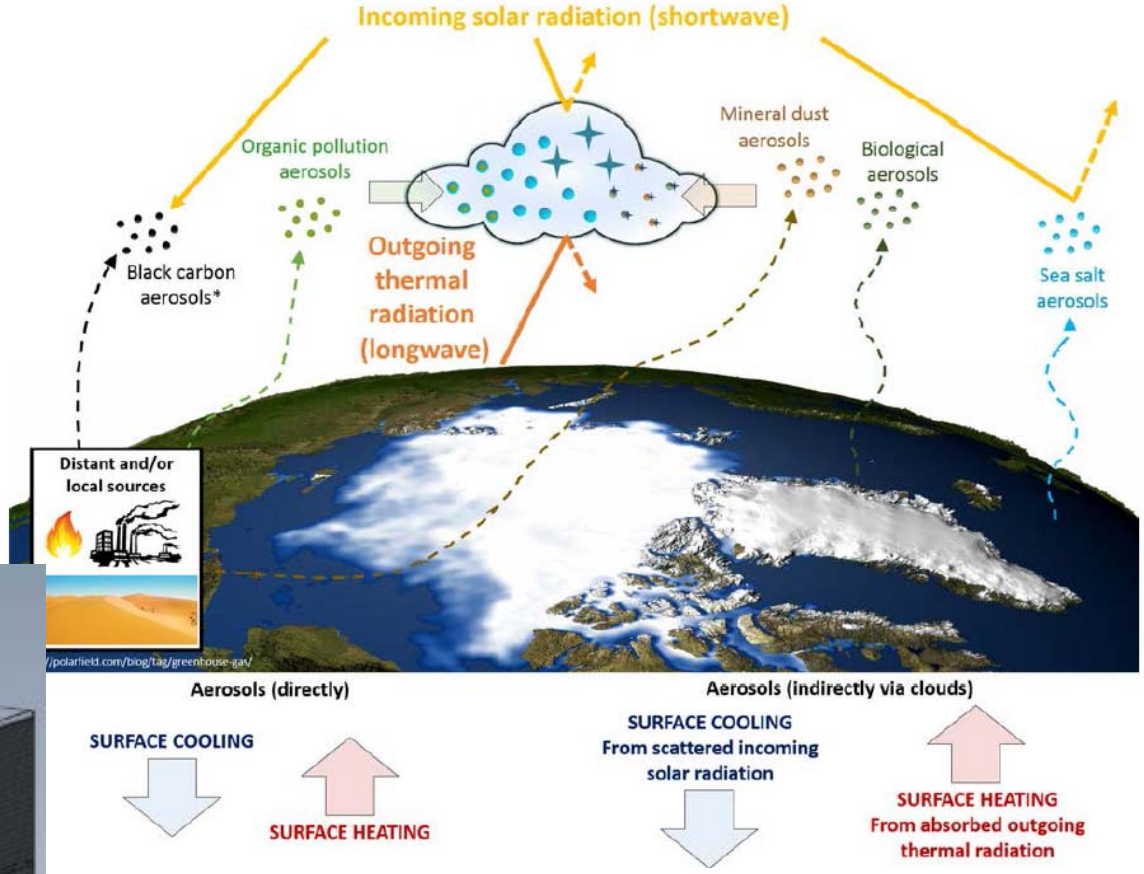
New Technologies - UAS



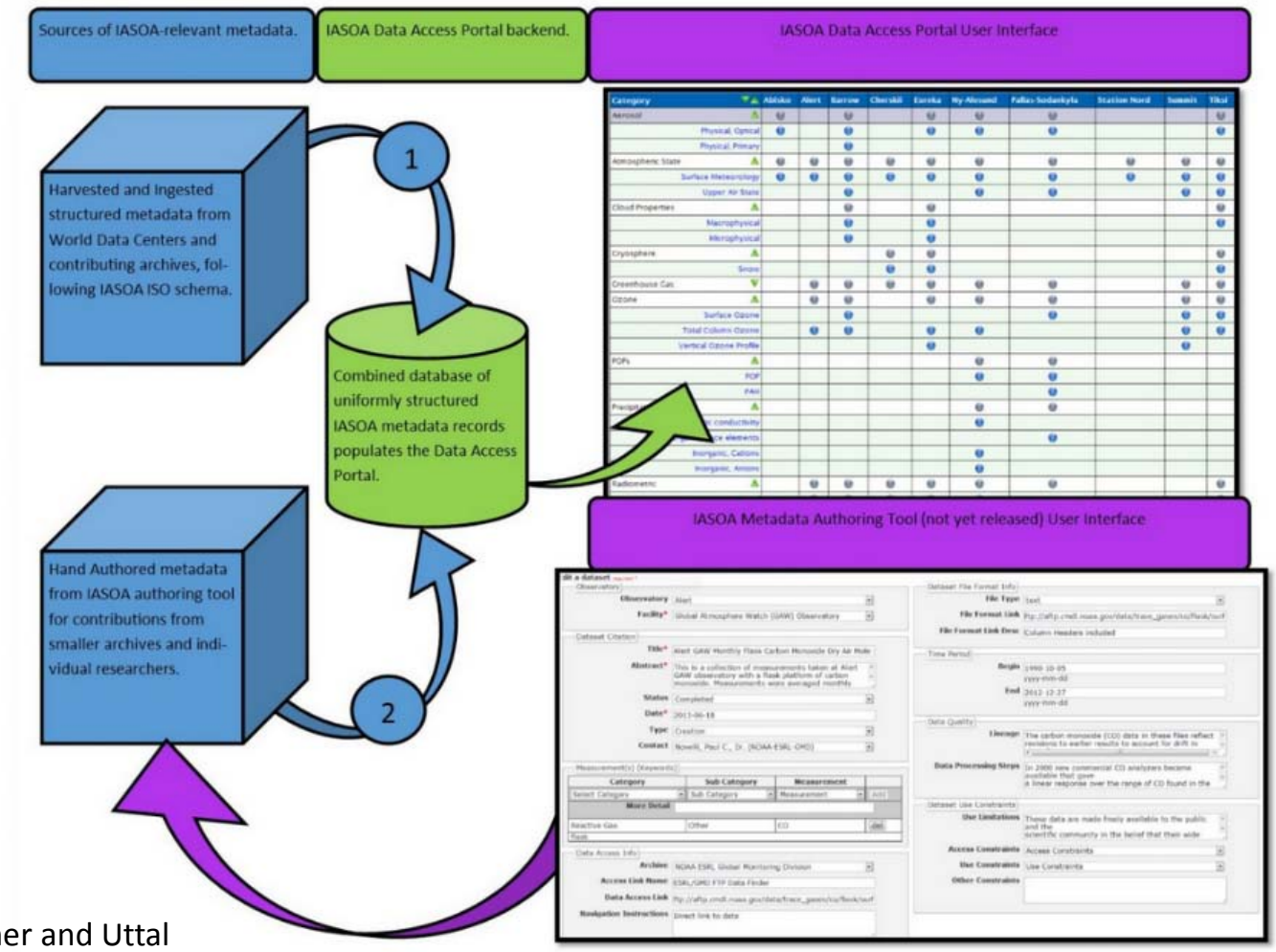
De Boer

New Technologies – Aerosol Chemistry Filter Samplers



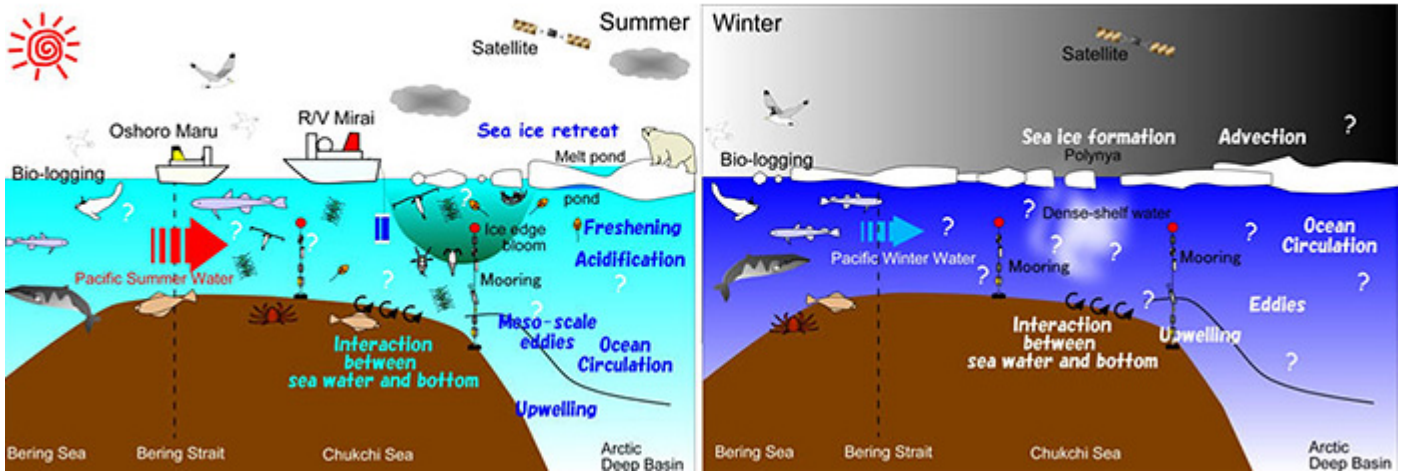


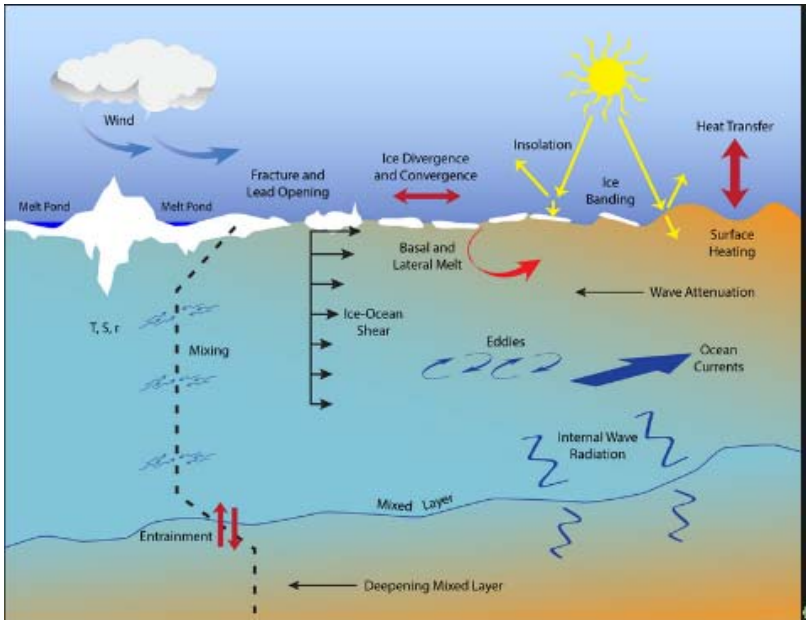
Creamean



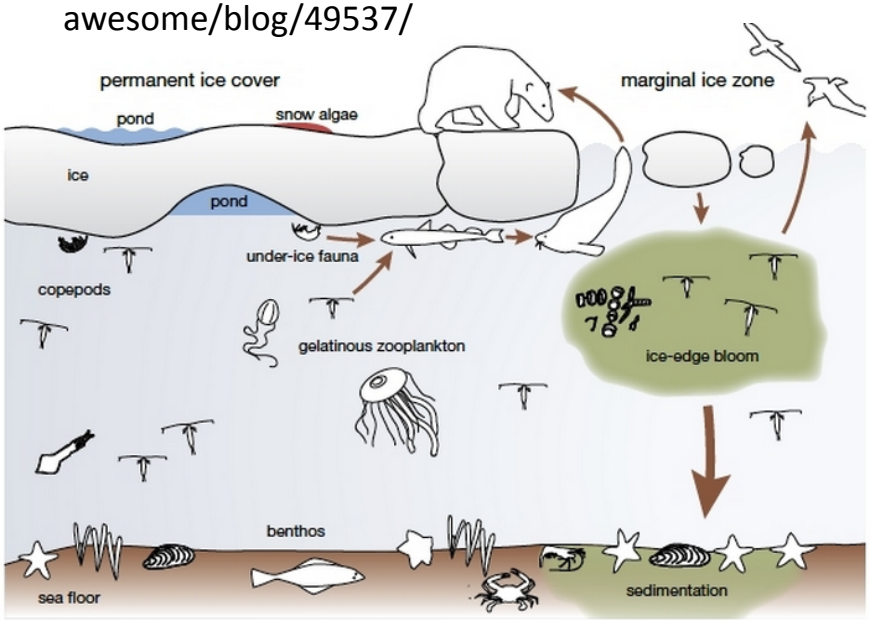
Starkweather and Uttal

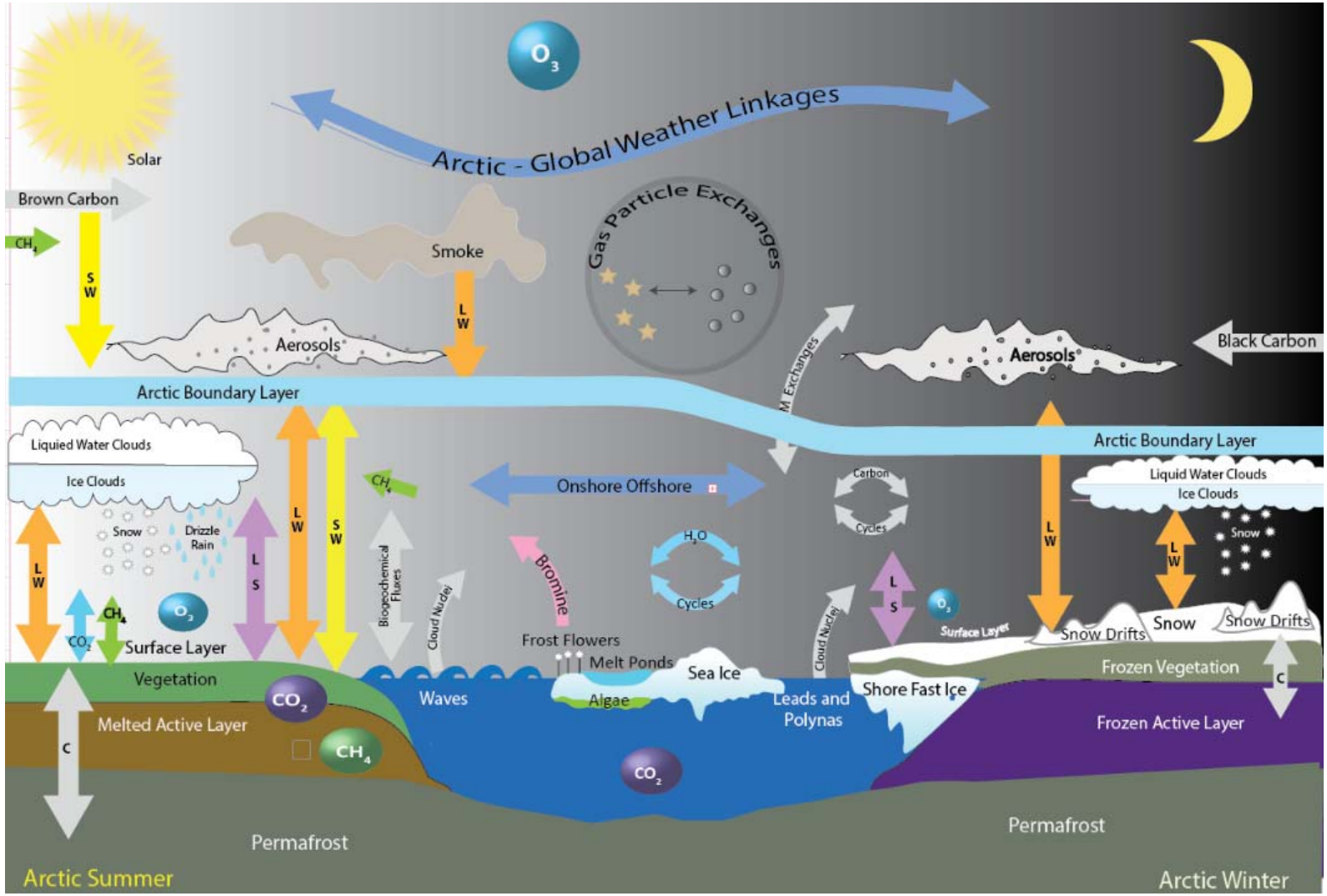
http://www.nipr.ac.jp/grene/e/subject-id06.html





http://www.greenpeace.org/international/en/news/Blogs/makingwaves/arctic-is-awesome/blog/49537/




Arctic - Global Weather Linkages
Solar
Brown Carbon
Smoke
Gas Particle Exchanges
Aerosols
Black Carbon
Arctic Boundary Layer
Liquied Water Clouds
Ice Clouds
Snow
Drizzle
Rain
Onshore Offshore
Carbon
Cycles
Bromine
Frost Flowers
Melt Ponds
Sea Ice
Algae
Waves
Leads and Polynas
Shore Fast Ice
Surface Layer
Snow Drifts
Frozen Vegetation
Vegetation
Melted Active Layer
Frozen Active Layer
Permafrost
Arctic Summer
Arctic Winter

PAG Objectives

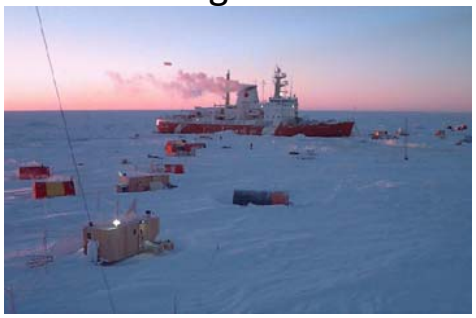
(1) To identify gaps in knowledge and priority research needs across the Pacific Arctic Region and seek means to implement programmes and activities that address them.

(2) To facilitate and coordinate science operations among PAG member countries.

(3) To promote and facilitate data accessibility and integrated data bases for the region.

(4)To serve as a forum for information exchange on Pacific Arctic Region (PAR) science programmes.

(5)To establish and maintain a direct link between PAG and other relevant science organizations.




The mission of IASOA is to advance coordinated and collaborative research objectives from independent pan-Arctic atmospheric observatories through (1) strategically developing comprehensive observational capacity, (2) facilitating data access and usability through a single gateway, and (3) mobilizing contributions to synergistic science and socially-relevant services derived from IASOA assets and expertise.


PAG
PACIFIC ARCTIC
GROUP


International Arctic Systems for Observing the Atmosphere
IASOA