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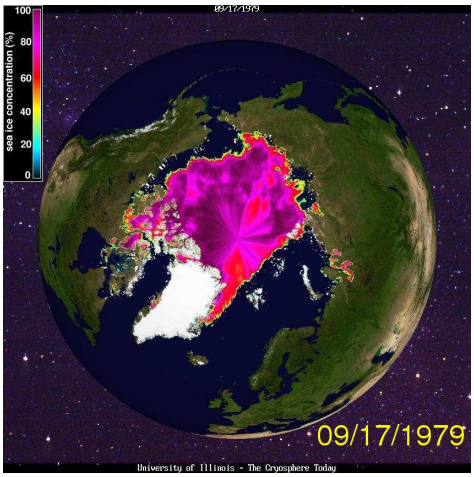
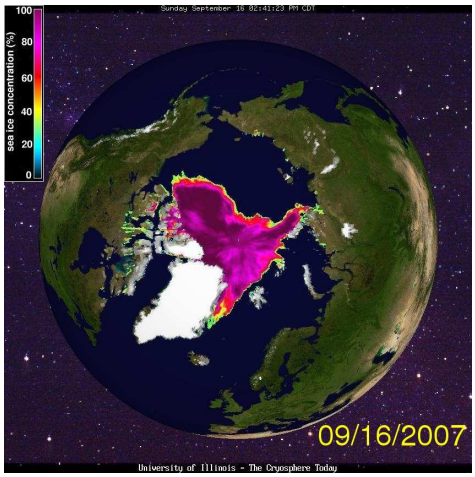
Report to Senior Arctic Officials on the Benefits of Unmanned Aircraft for Gathering Environmental Data in the Arctic
March 28, 2008

Recent environmental changes in the Arctic are substantial, some of them unprecedented in observed history, and not well understood. Arctic research suggests that these changes are likely linked to human activities leading to global climate change. Our predictions of future changes show an accelerated warming with continued ice melt. However, our predictions are limited by a lack of full understanding of mechanisms and would improve with additional observations. A group of scientists, unmanned aircraft engineers and civil aviation authorities met in Stockholm Sweden in March, 2008 to discuss the applications of Unmanned Aircraft for environmental measurements in the Arctic. This report is the summary of those discussions. More information is available at www.amap.no.

The present Arctic data gaps are large and can not be filled with current technologies. These data gaps are most prominent in understanding the cryosphere, biosphere, pollution, weather and climate. They include basic vertical measurements of temperature, humidity and wind over the Arctic Ocean; ice characteristics, and marine mammal inventories. These data gaps are critical for understanding and improving predictions for weather, climate, sea ice and environmental change in general. For many of these issues, the data gaps should be addressed with a circum-Arctic approach in order to advance our current understanding of the mechanisms responsible for change. Unmanned Aircraft Systems (UAS) offer the possibility to fill these important gaps more safely than manned aircraft or other methods of monitoring, especially in remote regions of the Arctic.

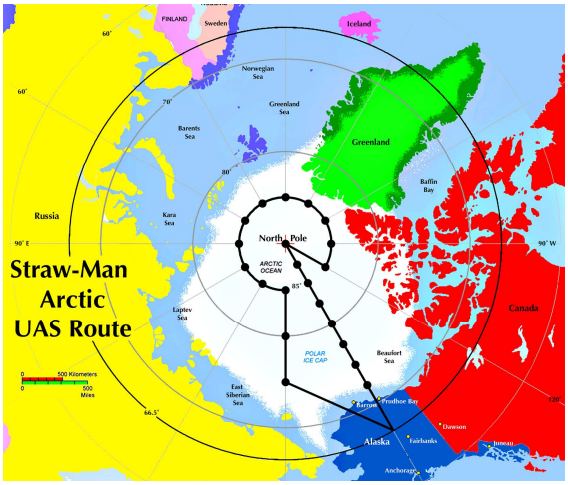




Figures presented by Erland Källén, provided by U. Illinois, show the loss of sea ice in the past decades. The loss is faster than predicted. Uncertainties about causes of ice loss are large, in part due to a lack of necessary measurements. With improved direct (in

situ) measurements, short-term predictions as well as long-term predictions could allow for better planning by the Arctic countries.

UAS would augment and expand our current monitoring capabilities in the Arctic. UAS can help in satellite calibration, especially when carried out periodically over time. Some characteristics of the Arctic can not be measured with current satellite capabilities: both campaigns and routine UAS flights will be needed to fill these gaps. Campaigns using UAS can help clarify critical mechanisms for change in the Arctic, including change in sea ice, severe storms, marine mammal populations, aforestation, permafrost distributions and glaciers. Routine UAS flights with direct vertical measurements at fixed locations around the Arctic can advance our understanding of weather, climate, the cryosphere and the biosphere over the Arctic Ocean. The incorporation of such measurements into reanalysis efforts will assist both weather and climate studies for the Northern Hemisphere.

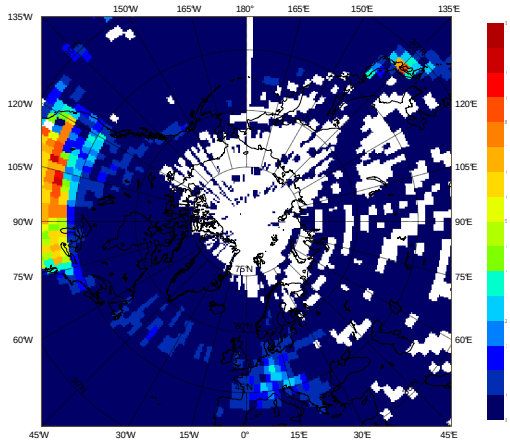


A possible flight over the Arctic Ocean could allow for a variety of environmental measurements to be gathered in a scientifically useful manner. Such a flight, could originate in any of the Arctic countries, or even outside of the Arctic, and would require coordination and cooperation from all of the civil and military aviation authorities.

Most Arctic countries are moving forward with civil applications of UAS. Operations have been safe and have resulted in valuable contributions within each project. Collaboration between all of the Arctic countries is required now to support a comprehensive understanding of changes occurring in the Arctic environment. Circum-Arctic coordination will need to include communication across the aviation authorities on the issues of UAS in the Arctic airspace. The circum-Arctic coordination is necessary to allow for an improved understanding of the current state of the Arctic. The measurements should allow for advancements in scientific understanding that will assist in both short and long-term predictions for the Arctic. These improved predictions will be valuable for decisions regarding Arctic maritime transport for shipping, development and ecosystem management.

The issues related to change in the Arctic are important enough to warrant accelerated cooperation in environmental monitoring, in which UAS can play a unique and valuable role. Sustained monitoring capabilities will allow for this important problem to be addressed in the most accurate manner. The primary need is cooperation between the science communities and aviation regulatory bodies across country borders to develop and test UAS for key Arctic environmental research. The

timing of these efforts are critically important to allow for data gathering as early as possible, while still maintaining safe operations in the Arctic.



This figure, presented by Erik Andersson of ECMWF, shows the availability of temperature and wind observations for the upper air (150-300hPa), from regular commercial aircraft during the month of July, 2006. The white areas are where no measurements were available for the entire month. Without balloon ascents, or data from airplanes, forecasting models have little direct measurements to assist in Northern Hemisphere weather prediction and climate re-analysis.

Next Steps:

To better understand the rapid changes occurring in the Arctic environment it is important to begin coordinating plans to utilize UAS technology for filling important data gaps. Increased data from UAS will assist in weather predictions, climate re-analysis and understanding the variety of changes occurring in the Arctic. Improved predictions of changes will allow for more informed decision making. In order to develop and assess the full benefit of UAS to the Arctic, we recommend to the Senior Arctic Officials that:

- The importance of the data gathering which could be achieved with UAS needs to be considered by each Arctic country with input from both the scientific communities and the aviation authorities.
- Civil Aviation Authorities should come together to understand the requirements of the airspace users and current regulations in each country with respect to UAS use in the Arctic and discuss the impending need for access to the Arctic Airspace that lies within the flight information regions of the Arctic countries.
- The Arctic Council, coordinated through AMAP should foster an effort to develop circum-Arctic UAS activities to support environmental measurements.
- Further discussions are needed to help identify key missions, platforms and measurements.
- A few initial flights should be the focus for developing circum-Arctic collaboration.
- A clear pathway for communicating needs to be established between UAS regulators, operators and users in the Arctic.
- A central location needs to be established for collecting information on all circum-Arctic UAS plans. (International Study for Arctic)
- Key points of contacts in each country need to be established and should include civilian aviation authorities.

Discussions among participants focused on principles of best practices for UAS users in the Arctic. Key recommendations were:

- Flight performance data for UAS should be gathered to support civilian aviation authority decisions with the development of UAS regulations.
- Weather relevant data need to be collected and shared in near real time in a format that is useful to the appropriate weather forecasting agencies.
- In the short term, all flights will be carried out within the scope of existing national civil aviation authority regulations; in the long-term, all flights will be carried out in accordance with any new regional and country specific operating guidelines.
- The Arctic UAS community will develop standards on data access, data formatting.
- The Arctic UAS community will share information on flight safety and guidelines as requested by the civil aviation authorities.
- The Arctic UAS community will develop protocol for communicating information on planned UAS flights well in advance of the actual flights. The protocol will be developed to foster communication among scientists and all interested parties. The protocol will also include best operating practices for data-sharing from UAS civil scientific missions in the Arctic.

We request an endorsement from the Arctic Council to support environmental data gathering with UAS in support of existing observing and data gathering efforts in the Arctic.

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