INTAROS synthesis of gap analysis of the existing Arctic observing systems

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A comprehensive assessment of a substantial subset of Arctic observing systems, data collections and satellite products across scientific disciplines was carried out in INTAROS, also including data repositories and a brief scientific gap analysis. The assessments cover a multitude of aspects such as sustainability, technical maturity and data handling for the entire chain from observation to users, including metadata procedures and availability to data. Community based environment monitoring programs were surveyed and assessed separately; they do not form part of the present assessment.

The assessed observing systems were first ranked according to general sustainability and other aspects, were analyzed subsequently. While the range of sustainability is large, it was found that high scores on all other aspects, such as for data handling and technical maturity, are more likely for systems with high sustainability. Moreover, many systems with high sustainability, as well as advanced systems for data handling and availability in place, resulted from national commitments to international monitoring or infrastructure programs, several of which are not necessarily particular to the Arctic.
Traditionally, terrestrial and atmospheric observation network assessments build on the network concept with a “comprehensive” level including all observations, a “baseline” level of an agreed subset of sustained observations, and a “reference” level, with observations adhering to specific calibrations and traceability criteria. Examples from atmospheric observations are the “comprehensive” global GCOS radiosounding network, the “baseline” GUAN (GCOS Upper Air Network) and “reference” GRUAN (GCOS Reference Upper Air Network) networks. With the lack of in-situ observations especially from the Arctic Ocean and the logistical difficulties to deploy new stations, it was concluded that this concept does not work well in the Arctic.

In summary, we recommend that:

- advancement in Arctic observing should be done in international global or regional programs with well-established routines and procedures, rather than to invest in new Arctic-specific programs
- investments in new instruments and techniques be done at already established sites, to benefit interdisciplinary studies and optimize infrastructure costs
- more observations be based on ships of opportunity and that a subset of ocean, sea-ice and atmosphere observations always be made on all research expeditions, regardless of their scientific aim
- the funding structures for science expeditions is reviewed to maintain, and preferably increase, the number of expeditions and to safeguard funding for appropriate data handling and storage
- observing-network concept for the atmosphere over the Arctic Ocean is revised, so that coupled reanalyses represent the “comprehensive level”, satellite observations complemented with available in-situ data is the “baseline level”, while scientific expeditions is the “reference level”. This requires substantial improvements in reanalysis, better numerical models and data assimilation, better satellite observations and improved data handling and accessibility for scientific expeditions.