New Mission Need or Requirement Request

Addressing Alaska Observation Gaps by Optimizing and Enhancing Ground-based Observation Networks

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CONTACT INFORMATION

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1 Statement of Mission Need or Requirement

1.1 Mission Need or Requirement

An enhanced and integrated set of environmental observations is required to evolve forecast and warning services in Alaska and to provide IDSS at the level expected not only of our partners, but also for the agency.

Rapid integration, interpretation, and dissemination of this information in near-real time are required. A robust observational network is a core foundation for the science, services, and stewardship that are central to the NOAA and NWS missions. For example:

- A robust data network is necessary to improve reliability and/or expansion of efforts such as NBM, HRRR, MRMS, RTMA/URMA and FACETs into NWS Alaska field operations.
- Robust gridded analysis driven by observation networks are required to improve the calibration of post-processed gridded guidance such as the NBM, FACETs, and other future Warn on Forecast Activities.
- Coastal and river water level information and forecasts are necessary for coastal and riverine community protection of life and property and hazard resilience.
- Observations of ocean currents and sub-surface temperatures are crucial for understanding and anticipating sea-ice development and the timing of “freeze-up” – a critical forecast parameter for marine transportation, offshore oil and gas operations, and Arctic coastal communities.
- Lightning detection information is critical for pilots, mariners, the general public, and fire-weather forecasts supporting land managers and fire crews.
- Profiles of wind speed and direction are key to understanding the vertical structure of the atmosphere, important for precipitation, wind, and turbulence forecasts along with predicting where ash will be transported after a volcanic eruption.
- Precipitation accumulation and snow depth observations are critical to a multitude of decision support applications including: flood forecasts and warnings, assisting partners managing water resources such as reservoir and hydroelectric dams, drought monitoring, seasonal outlooks for wildland fire, avalanche mitigation for recreators and across rail and road transportation and utility corridors, and pilots seeking safe landings.

1.2 Time Sensitivity

At the present time, NWS Alaska Region has many observational gaps that limit our capability to evolve forecast and warning services in Alaska and to provide IDSS at the level expected not only of our partners, but also of our agency.

This requirement and capability should be developed and implemented as soon as possible given the current impacts to the public and commerce with respect to Alaska Region aviation, fire weather, marine, severe weather, climate, water resources, public, tsunami, and winter weather hazards.

1.3 Existing Operational Gaps

Cross program:

For the NWS Alaska Region, there are unique challenges and many data gaps. Across the entire state, the NWS owns and operations 44 Automated Surface Observing System (ASOS) units, 13 upper air sounding locations and 3 wind profilers. There is a very sparse network of precipitation and river gauges and coastal water level monitors. While this network is supplemented by other partners, their quality and reliability metrics do not always support the NWS's 24/7 mission. For example, the 7 weather radars in Alaska area are owned and operated by the FAA. While coordination of maintenance generally accounts for weather, there have been times, even during the fire season, where a key radar was taken down despite concerns for active convection with public, marine, aviation and fire teams impacted.

To overcome the sparsity of ground-based observations, NWS Alaska depends heavily on satellite data. The northern latitude provides both opportunity and shortfalls in the satellite data realm. While forecasters and partners in Alaska benefit from relatively good coverage from polar-orbits, they will not benefit from some tools available with the new GOES including Global Lightning Mapper, which will not provide data north of 55 degrees longitude.

Current Alaska observation gaps inhibit performance and/or expansion of service improvements such as NBM, HRRR, RTMA/URMA, MRMS and FACETs. Situational Awareness is limited to datasets available, which poses daily operational challenges and can lead to critical shortfalls for decision support. Forecasts for high-impact weather events such as heavy rain, snow, severe weather, dangerous waves and other threats, can be missed and misdiagnosed.

Coastal Flooding:

Alaska has more than 6,600 miles of coastline yet has a network of only 35 water-level stations. Of those, only three are located in Arctic waters where Alaskan villages are most susceptible to coastal flooding and the effects of coastal erosion. In 2003, the U.S. Government Accountability Office (GAO) found flooding and erosion affects 184 out of 213, or 86%, of Alaska Native villages to some extent. Alaska's west coast is particularly vulnerable to periodic, yet severe, erosion and flooding due to several factors, including decreasing Arctic sea ice extent as it exposes many of the communities to storm surge caused by extratropical storms.

Aviation Forecasts:

According to a 2014 article by the Aircraft Owners and Pilots Association (AOPA), Alaska pilots do not have a sufficient amount of weather data available to adequately make critical go/no-go flight decisions. Our aviation forecasters face tough challenges to meet aviation requirements. This includes the MDC validation to deliver Alaska Aviation Guidance (AAG) products for 157 sites, of which 64 locations do not provide ceiling and visibility information. The FAA is also requesting an *additional* 27 full TAFs be provided by three forecast offices.

Alaska has six times as many pilots per capita and 16 times as many aircraft per capita as the rest of the United States. In addition to the large number of private pilots, many commercial air services carry passengers, mail and essential supplies to communities off the road system, where people who also are in need of emergency medical care must be flown to a larger city on a medevac flight.

Marine Forecasts:

There is an enormous gap in buoy observations. This is partially, though not solely due to seasonal sea ice coverage. Consequently, the lack of available data from operational ocean buoys in addition to the frequent buoy outages greatly compromises the NWS' ability to provide accurate and reliable forecasts in this region.

One area where there is a gap is the Bering Strait where the NWS Alaska Region expects to see increasing marine traffic (cruise ships, resource extraction activities, transportation of goods and services and the potential for search-and-rescue activities by DoD and DHS/USCG).

Another critical gap area is in Southeast Alaska, particularly in the Inside Passage. These highly trafficked waters are nuanced with locally wind driven waves and strong currents, yet they are completely void of wave buoys.

Winter Weather:

Snowfall and snow depth information is extremely sparse in Alaska and is generally concentrated along the road system. With Partners, including the state of Alaska and the WMO's Global Cryosphere Watch have repeatedly requested additional snow-related observations. This data sparsity inhibits accurate detection of snow depth and SWE for the majority of the state. Automated snow data is point data subject to sensor snow data provides valuable information in remote locations, but values should only be used as an index of conditions in the area.

Alaska's complex topography is further reason a denser snow observation network is needed for accurate storm validation and seasonal forecasts for other service areas. One recent example is the 2017 fire season outlook. Alaska Fire Service Predictive Services Meteorologists did not feel they had adequate information regarding snowpack in interior Western Alaska, and thus its impacts on the spring fire season outlook, as there is only one western Interior SNOTEL site.

River and Water Resource Forecasts:

River flooding accounts for more than one-third of all Presidential Disaster Declarations in Alaska. Yet, Alaska's ability to monitor waterways is significantly hampered by data sparsity. The state of Maryland has 220 active water level and stream gauges. By comparison the state of Alaska, which is more than 53 times larger than Maryland, has only 105.

While river flood prediction is at the heart of the NWS hydrologic mission, it is not the only information core partners seek from NWS Alaska Region hydrologists.

Gaps in the Alaska river gauge network inhibit detailed water level and stream flow forecasts on major waterways critical to Alaska's infrastructure and economy. Lack of information defining and forecasting elements of the water cycle also affects the ability to provide informed decision support. Partners who utilize that information include communities depending on reservoirs for water supply and hydropower, agencies who manage fisheries, agencies making water allocation decisions, barge operations that transport heavy machinery to interior mines and many others. Whether as an ice road or a boating waterway, Alaska's rivers are a major transportation corridor, source of subsistence food and drinking water, and electrical power in vast areas of roadless Alaska.

Northern provinces of Canada face many of the same issues that Alaska faces and because a number of major rivers including the Yukon flow from British Columbia and the Yukon Territory into Alaska, information about precipitation, air temperature and water level and discharge for those areas in Canada is vital to accurate forecasting downstream in US waters. Developing a closer connection and collaboration with the Canadian agencies responsible for data collection can only improve model performance for those transboundary rivers

Radar and QPE:

Alaska has only 7 Dual Polarization radars, owned and operated by the FAA, to cover an area more than twice the size of Texas. And unlike the Lower 48, there are no supplemental radars like the Terminal Doppler Weather Radar. Radar placement is designed to capture volcanic ash as a priority over weather elements such as precipitation and wind. As such, placement does not always provide optimal weather or national security coverage even for Alaska's most populated areas. For example, the state capital of Juneau, which resides in a temperate rainforest, does not have radar coverage. The radar closest to Anchorage is approximately 60 miles from the city center and can overshoot low-level convection along the most heavily traveled transportation corridor, including visibility-restricting snowsqualls.

Radar coverage gaps, which are exacerbated by complex terrain, inhibit MRMS implementation and generation of quantitative precipitation estimate (QPE) products. QPE is already inhibited by the region's sparse precipitation gage network. Expansion of these components is essential to forecast floods, winter precipitation, critical fire weather events, and provide optimal aviation forecast services.

Lightning:

The Alaska Region has a critical need for a dependable lighting detection system which is compatible and comparable to that used in CONUS and Canada. With large gaps in Alaska's radar coverage, lightning detection can be a key situation awareness and severe weather diagnostic tool, and a vital role in convective forecast and warning services, and aviation weather support. NCEP EMC also uses lightning data to initialize critical parameters for HRRR and NSSL integrates lightning into MRMS.

The present lightning detection capabilities in Alaska consist of a BLM owned and operated time of arrival (TOA) system focused primarily in the Interior, with considerably degraded performance (by design) outside of this traditional core wildland fire region. Both the BLM and NWS have noted several inconsistencies and errors with his system even within the Interior, further degrading user reliability. NWS also has access to GLD360 network, but the vendor estimates approximately 60% detection rate for this region. Neither of these systems are compatible with the LDN deployed in CONUS or Canada. A compatible system would enable data sharing across the AlCan border and/or easier integration into probabilistic forecast algorithms, HRRR and MRMS.

Strategic Drivers and Mandates

Table 2.1: Justification	
Does the requirement address a mandate by NOAA, DOC, OMB, Executive Order, or Law?	**Y**
Is the requirement needed to satisfy a specific external organization's needs?	**Y**
Does the requirement address a specific DOC, NOAA, or NWS strategic initiative?	**Y**

Explanation of justification:

15 USC 313 - Organic Act

The Secretary of Commerce ... shall have charge of the forecasting of the weather, the issuance of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce, and navigation, the gauging and reporting of rivers.

33 U.S.C. § 706 - Flood Control/River Forecasting Authority

Authorizes agency expenditures in support of… the establishment, operations, and maintenance by the NWS of the Hydroclimatic Network (information service on precipitation, flood forecasts and flood warnings.)

15 USC 313c: Authorized activities of the National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration, through the United States Weather Research Program, shall…1) improve the capability to accurately forecast inland flooding (including inland flooding influenced by coastal and ocean storms) through research and modeling.

Strategic Initiatives

This request with the documented requirements meets all aspects of NWS Strategic Plan. It builds on the NWS capability to save lives and property, looks onward to future challenges of water and the key goals that will enable NWS to achieve the vision of a Weather-Ready Nation which are:

- Improve weather decision services;
- Deliver improved weather forecasting services to support management of the Nation's water supply;
- Support enhanced climate services;
- Improve sector-relevant information in support of economic productivity;
- Integrate environmental forecasting services to support healthy communities and ecosystems; and
- Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission.

December 2003, U.S. General Accounting Office Report to Congressional Committees
http://www.gao.gov/new.items/d04142.pdf

February 2011, NOAA Arctic Vision & Strategy
http://www.arctic.noaa.gov/docs/NOAAArctic_V_S_2011.pdf

April 2014, NOAA Arctic Action Plan
http://www.arctic.noaa.gov/NOAAarcticactionplan2014.pdf

January 21, 2015, White House released Executive Order (EO) to "Enhance Coordination of National Efforts in the Arctic"
https://obamawhitehouse.archives.gov/the-press-office/2015/01/21/executive-order-enhancing-coordination-national-efforts-arctic

The National Strategy for the Arctic Region (NSAR)
https://obamawhitehouse.archives.gov/sites/default/files/docs/nat_arctic_strategy.pdf

The Department of Defense Arctic Strategy (in the process of being updated)
https://www.defense.gov/Portals/1/Documents/pubs/2013_Arctic_Strategy.pdf

The U.S. Coast Guard Arctic Strategy (in the process of being updated)
https://www.uscg.mil/Portals/0/Strategy/cg_arctic_strategy.pdf

The U.S. Navy Arctic Roadmap, 2014 - 2030 (updated version expected in summer 2018)
http://www.navy.mil/docs/USN_arctic_roadmap.pdf

Weather Research and Forecasting Innovation Act of 2017
https://www.congress.gov/bill/115th-congress/house-bill/353

US Department of Commerce 2018-2022 Strategic Plan
https://www.commerce.gov/file/us-department-commerce-2018-2022-strategic-plan

Draft NWS Strategic Plan

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2.1 Benefits

Table 2.2: Benefit to the NWS
Describe how the request will benefit NWS' mission to protect life and property.
Describe how the request will help the NWS better serve our partners and the public.
Describe how the request will improve how NWS operates.
Describe how the request will help NWS be a better steward of government resources (e.g., time or money).
Explanation of benefits to NWS: With an expanded observation network, forecasters will have better situational awareness, can better visualize high-impact weather threats and in turn provide more accurate forecasts, improve lead time, and advance IDSS in Alaska. The Arctic, including Alaska, is being transformed into an increasingly accessible place for economic opportunity. However, warmer air and ocean temperatures, thawing permafrost, loss of sea ice, and shifts in ecosystems are straining community resilience and presenting significant challenges to transportation and public-sector decision-makers and planners. Critical environmental, economic, and national security issues are emerging, many of which have significant impacts for human lives, livelihoods, and coastal communities. Impacts are also being studied outside the Arctic, as NOAA scientists and colleagues work to better understand the Arctic's influence on global weather and climate patterns, as "what happens in the Arctic doesn't stay in the Arctic." An expanded observation network is critical to assist NOAA and its partners to better understand these changes and meet expanding IDSS needs. This request enables deliverables such as NBM, HRRR, RTMA/UMA, MRMS and FACETs services to improve or expand into Alaska. Such improvements will improve national consistency, plus aid quality control and streamline forecast operations, such as gridded forecasts. This will not only translate to better routine services for our partners and the public, but the later will also unlock operational hours to improve and expand IDSS and deep core partnerships.

3 National Service Program

Table 3.1: Identification of lead National Service Program					
Program Name	**X**	**Program Name**	**X**	**Program Name**	**X**
Aviation		Tropical		Public	
Fire Weather		Winter Weather		Space Weather	
Marine		Climate		Tsunami	
Severe Weather		Water Resources		Overarching (broad cross-cutting)	x

4 Estimated Resource Needs

Required resources will be determined and/or refined as part of solution space activities after validation of this request. If validated by the MDC, the Alaska Region will present user requirements to the PIC for their evaluation. Guidance from the MDC and PIC will be considered by Alaska Region to inform a team to implement a solution based on MDC/PIC guidance.

Solution space activities have thus far identified:

- Four primary gap regions in the state where surface-based ceiling, visibility and precipitation sensors would prove highly beneficial to Alaska's aviation forecast services. The gap regions are: 1) The North Slope; 2) Southwest Alaska; 3) Eastern Interior; and 4) Southeast Alaska.
- Three broad areas representing the largest gaps in Alaska's river gauge network include: 1) The delta, lower and middle regions of the Yukon and Kuskokwim Rivers and the Nushagak River of Western Alaska; 2) the Arctic; 3) the Eastern Interior and Prince William Sound, and 4) Southeast Alaska.
- Two regions of marine forecast areas have been identified as most data-gap critical
- Nine communities as a priority for water-level instrumentation due to either very high flood risk or socioeconomic importance as "hub communities," however, given the findings from the 2003 GAO report, ideally, NWS AR would like to be able to provide enhanced forecasts and warnings for many of the other communities at risk.

Several required resources and cost savings could be gained by partnering with other agencies seeking multi-beneficial observation platforms or expanding on current NWS contracts. One such example could include expansion of the lightning networks over Alaska for improved land and marine coverage. We could work with foreign partners, such as the Environment Canada, to integrate additional infrastructure with their existing lightning detection, marine buoy and or hydrographic and snow observation networks. Expansion of the SENSR program to address radar gaps and stewardship of the Transportable Array network in Alaska in conjunction with the NSF (or a subset of stations deemed high priority) are examples of partnership opportunities. There are also many relatively low-cost instruments that could be installed to dramatically improve NOAA's storm surge and water level predictions, as has been demonstrated through partnership with the Alaska Ocean Observing System.