Ensembles in the Alaska Region:

Critical Support in the land of variability and uncertainty

NOAA Testbed and Proving Grounds: Addressing Forecaster Challenges

- Testbeds (TB) accelerate the translation of R&D findings into better operations, services, and decision-making.
- A NOAA testbed is a working relationship for developmental testing, in a quasi-operational framework among researchers and operational scientists/experts
- Including partners in academia, the private sector and government agencies
- Aimed at solving operational problems or enhancing operations, in the context of user needs.

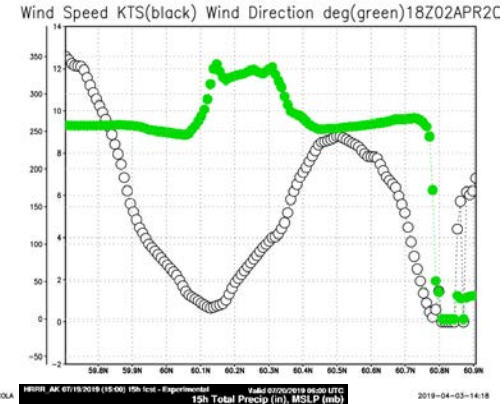
http://www.testbeds.noaa.gov/pdf/Guidelines%20051911_v7_approved.pdf

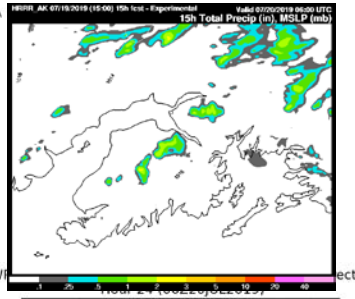
Goals of ATPG

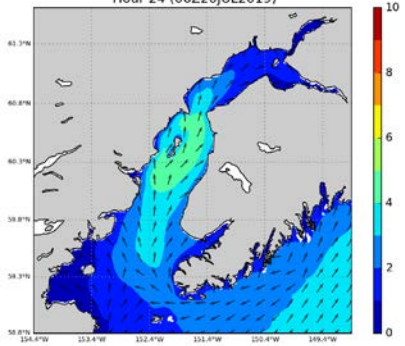
- Research and validation focused on problems that impact forecasters and customers.
- Using python and other powerful tools to format data so that it is easier for forecasters to digest and use their expertise.

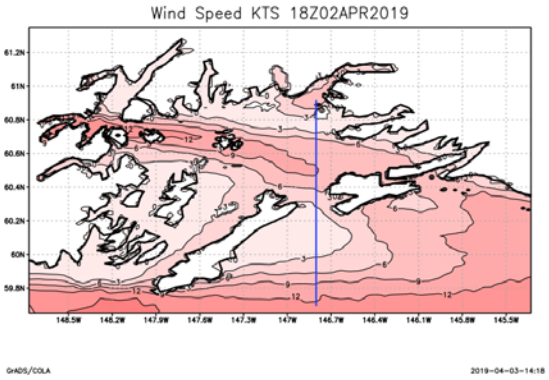
ATPG Projects

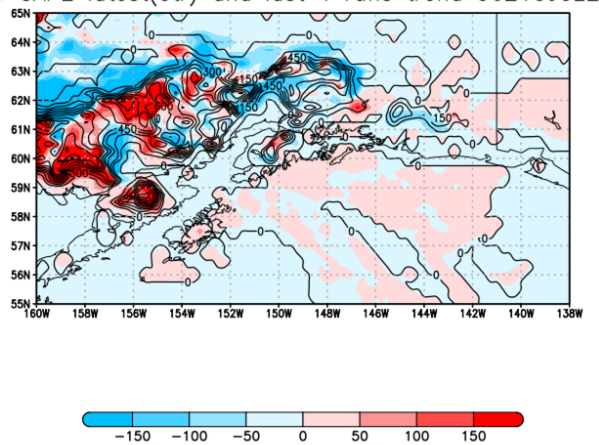
- Validation for Alaska Challenges and Value Added products
- Testing National Water Model
- Developing new fire weather tools
- Testing versions of the National Water Model
- Testing NWPS

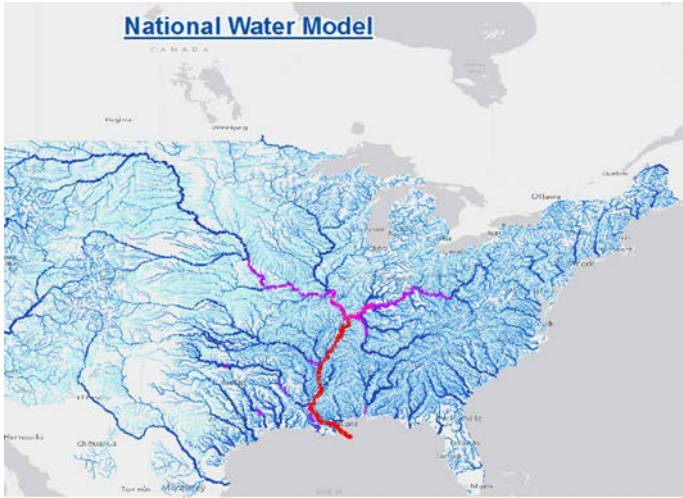






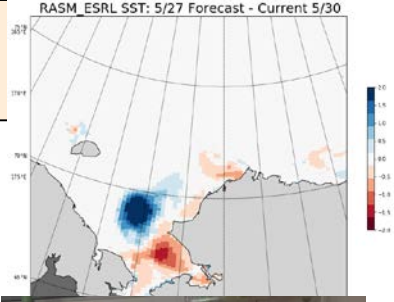


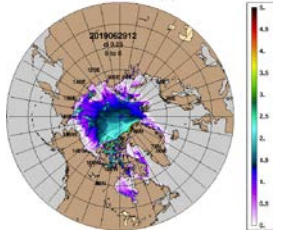




Including Forecaster

- *“The user should be the focal point for all R2O activities” **
- Closely involve forecasters such as the ASIP
- Able to apply strong local knowledge to identify model “wins” or areas for improvement
- Able to understand where models can provide best value to customers
- Able to find unusual model biases or artifacts right away and on a daily time frame
- Ultimately increases user buy-in





*” *Transitioning Research to Operations: Transforming the “Valley of Death” Into a “Valley of Opportunity”*

Alaska Challenges

Need for Early Warning

- Vulnerable coastal communities often need warnings 4-7 days in advance to evacuate due to logistics
- Significant uncertainty in cyclone tracks makes it difficult to communicate risk effectively.
- ARH is working with emergency managers and community leaders to explore effective ways to communicate risk as well as possible actions

24-60 hours (ideally 12 hours before communities)

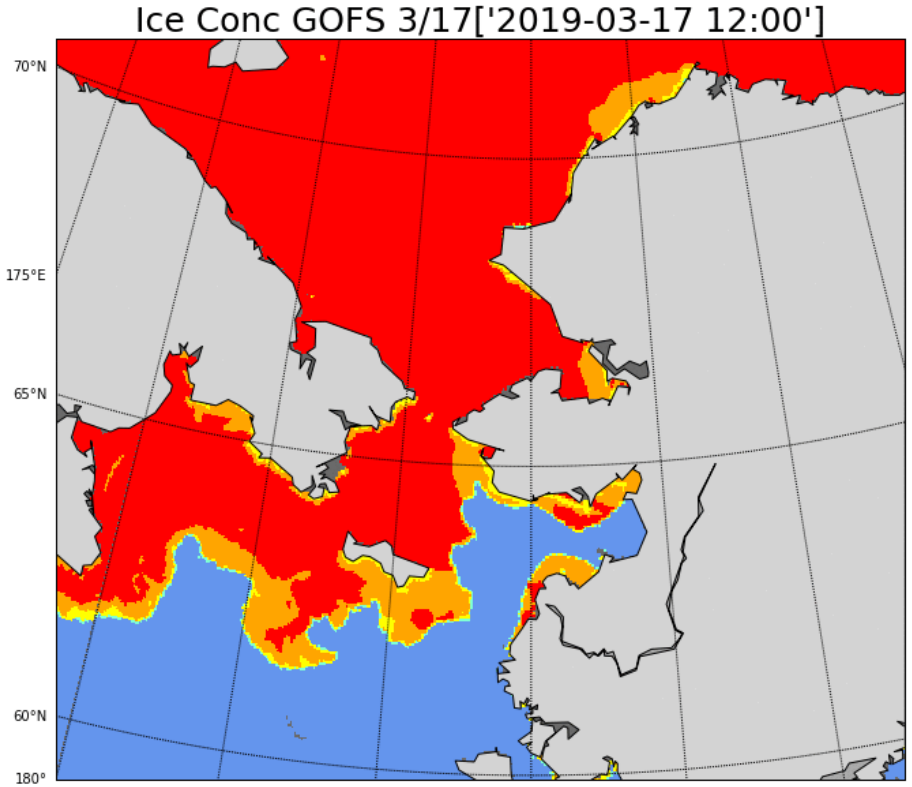
Communication Challenges

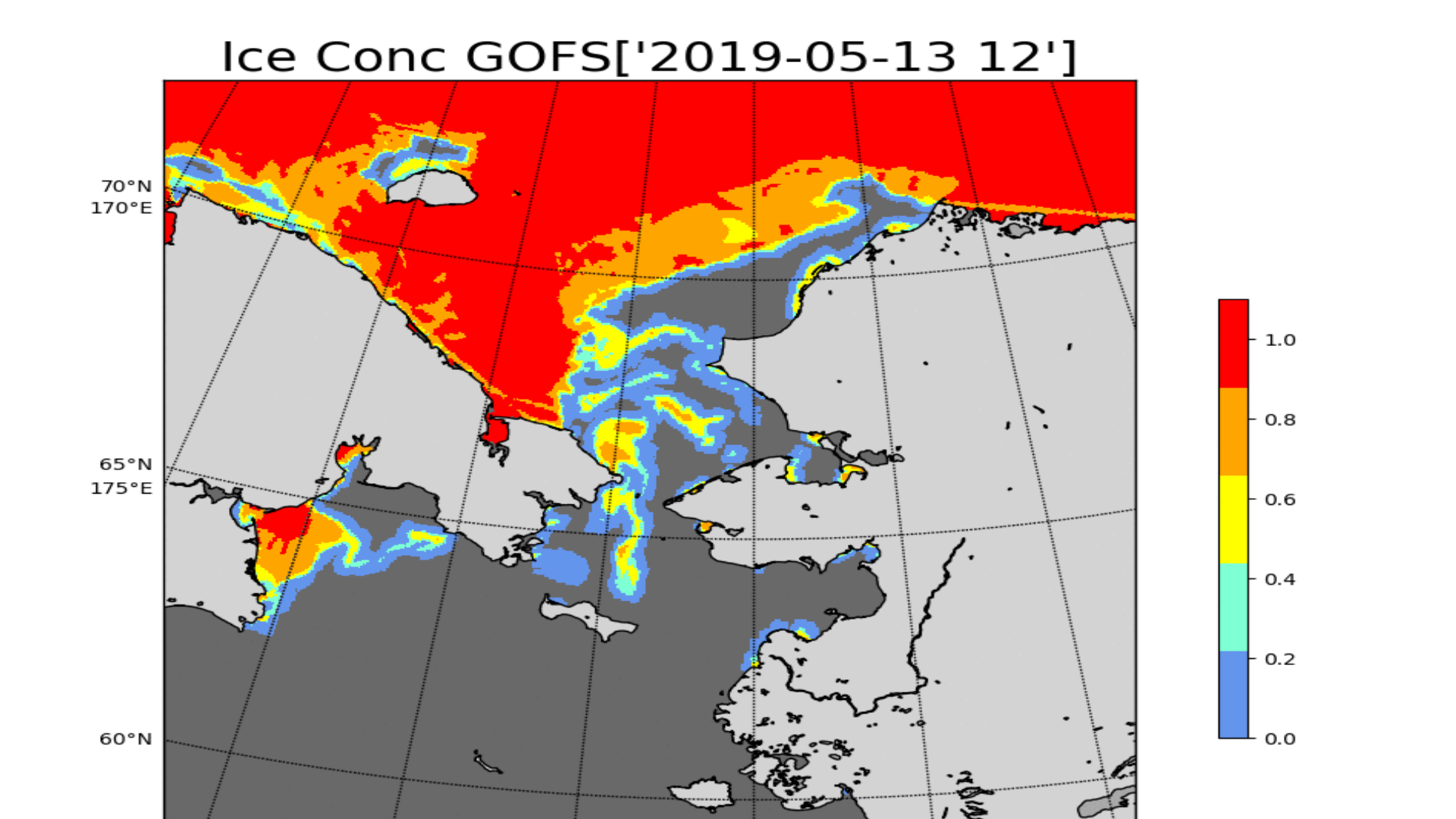
- Lack of time / resources to meet and understand all needs of diverse communities across state (off road system)
- Poor communications system – might only be reached by radio or not at all
- Poor internet connection adds challenges to social media outreach $$$ (i.e. people at fish camp or hunting are most vulnerable to weather but most difficult to reach in remote areas)

http://www.knom.org/wp/blog/2017/07/27/gci-takes-customers-worries-away-increases-data-plan-for-rural-hub-communities/

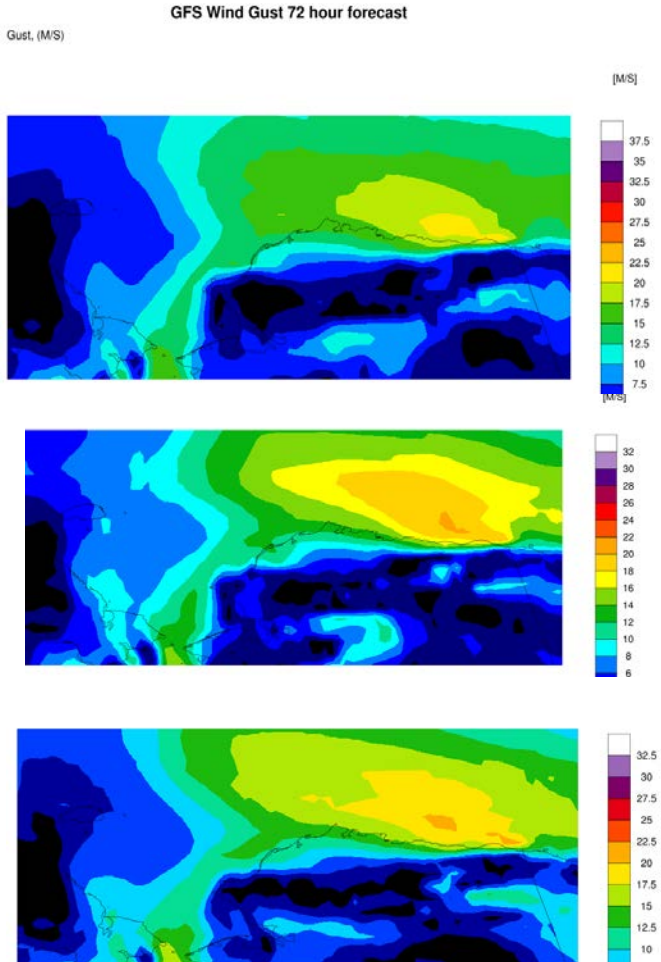
Variability

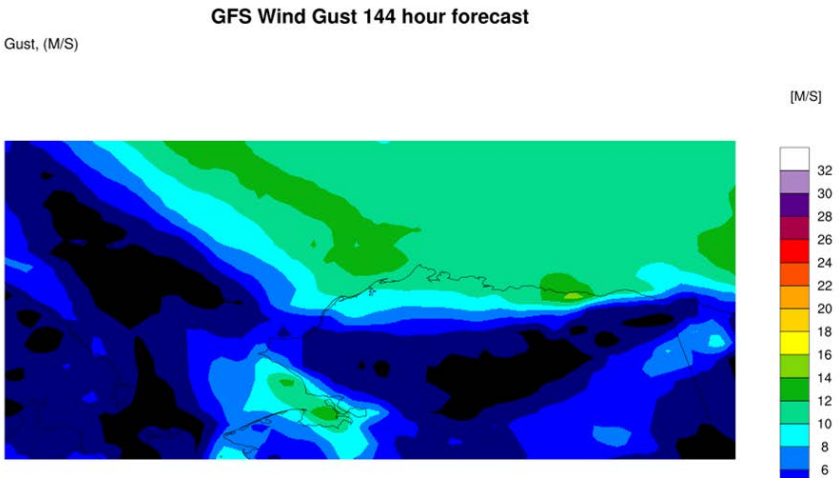
- How predictable is a day 5 vs day 10 forecast?
- Determining model errors or anomalies




Ice Conc GOFS['2019-05-13 12']
70°N
170°E
65°N
175°E
60°N
1.0
0.8
0.6
0.4
0.2
0.0

72 hour forecast for 5 15Z





Forecast for May 15 - first part of event

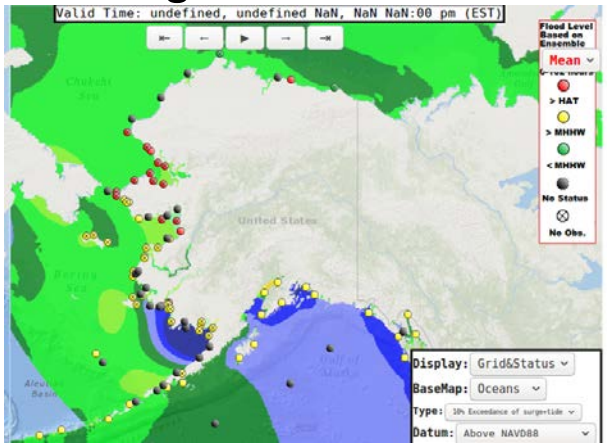
- Strong flow persisted for days- just one forecast hour shown here
- Models lock onto strong gusts 5 days in advance easily
- By forecast day 7 forecast winds become less certain
- Likely explains why 10 day forecasts underestimated ice loss for May 17
- * only GFS atmospheric model was examined
- High quality atmospheric models key to good ice forecast

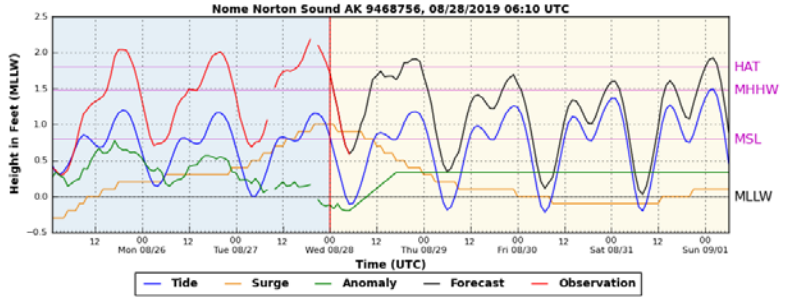
Exploring Ensemble Data next

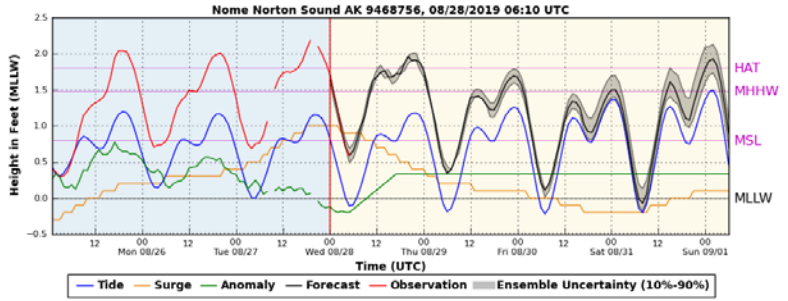
Ensembles and Coastal Surges

Surge Modeling

- ETSS uses GFS model inputs.
- Probabilistic ETSS: Surge model driven by ensemble members to provide users with an idea of uncertainty and understanding of timing and magnitude
- Increasing concern with sea ice loss



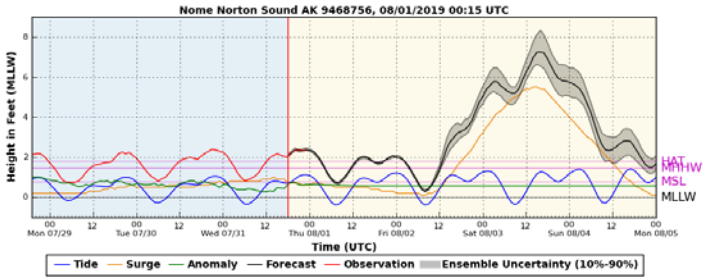




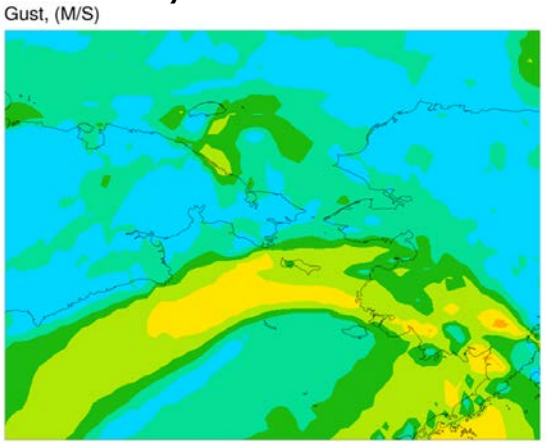
- Arthur Taylor and huiqing Liu
- ETSS - https://slosh.nws.noaa.gov/etsurge2.0/
- P-ETSS - https://slosh.nws.noaa.gov/petss/

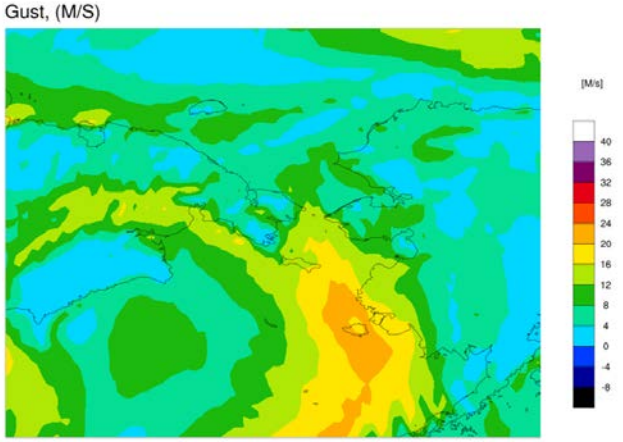
August 2-5 Forecasters add Value in uncertain situation

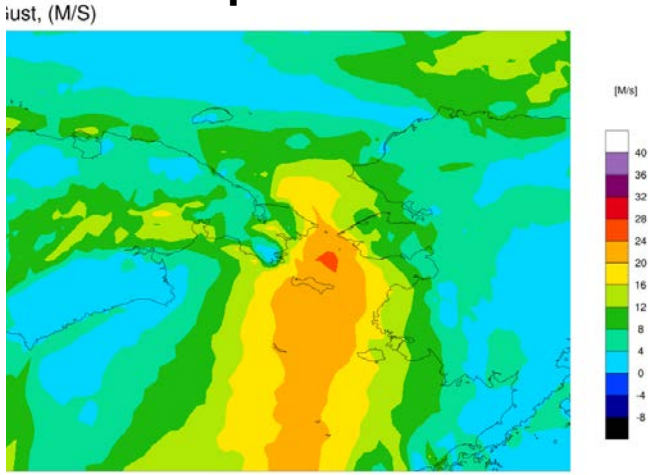
- Start anticipating event as soon as models started to indicate a threat starting August 27 18Z
- Products were issued despite early ETSS guidance not quite meeting criteria due to the fact that it was summertime and many people were expected to be out and more property than normal was expected to be out in areas that were expected to be impacted.
- FEMA Region 10 briefing early as August 29 to highlight risk for elevated surf, potential for storm surge and erosion - 5 Days ahead of event
- SPS/social media July 31st coastal flood/ high surf and notified important partners and villages ahead of time- such as the Port of Nome as well as Bering Strait Communities



168, 144 and 120 hour forecasts for wind gusts just ahead of peak of event

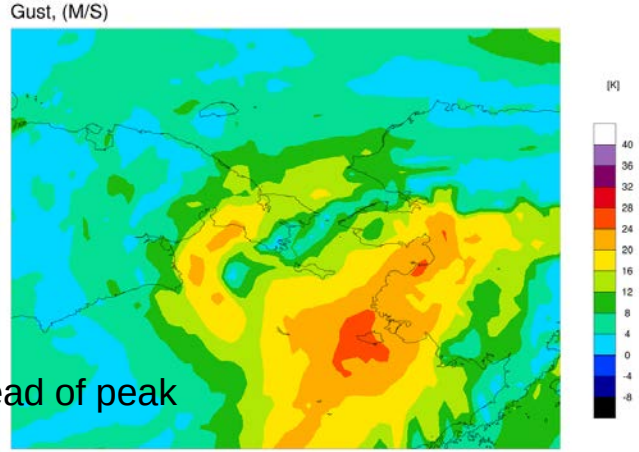






July 27- 29 00Z

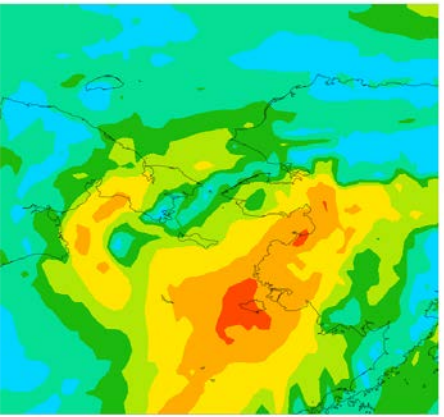
GFS Temp 2M 02 20 12Z (0 hr forecast)

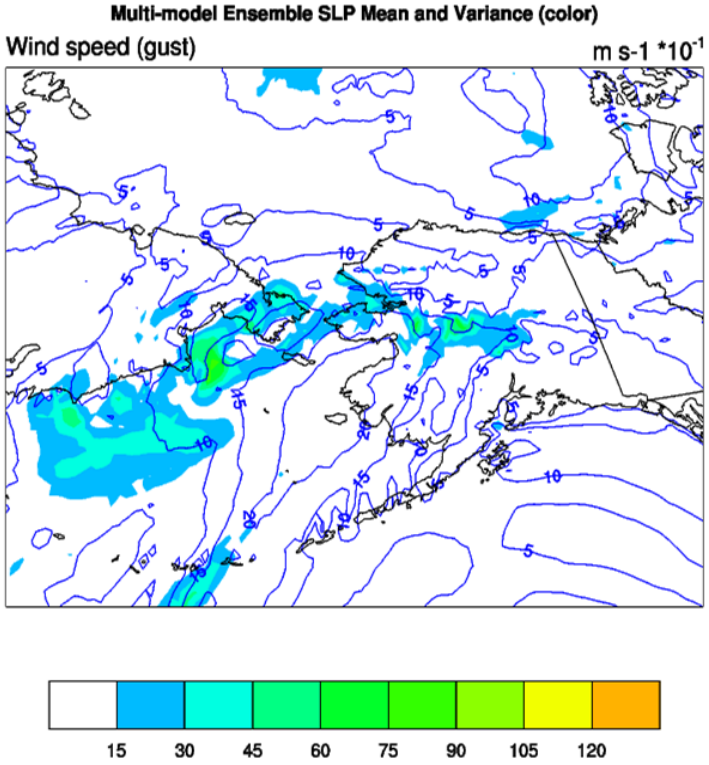


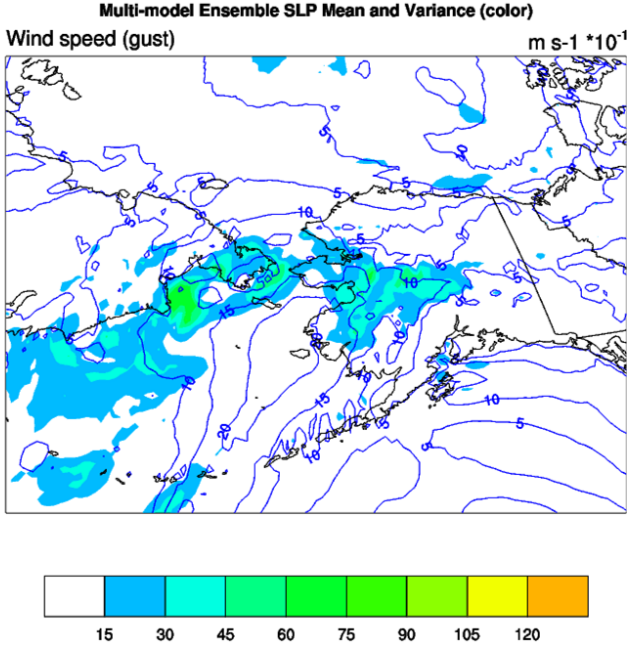
August 3 00Z - just ahead of peak

Gust Variance: 96 and 120 hour variability

GFS Gust



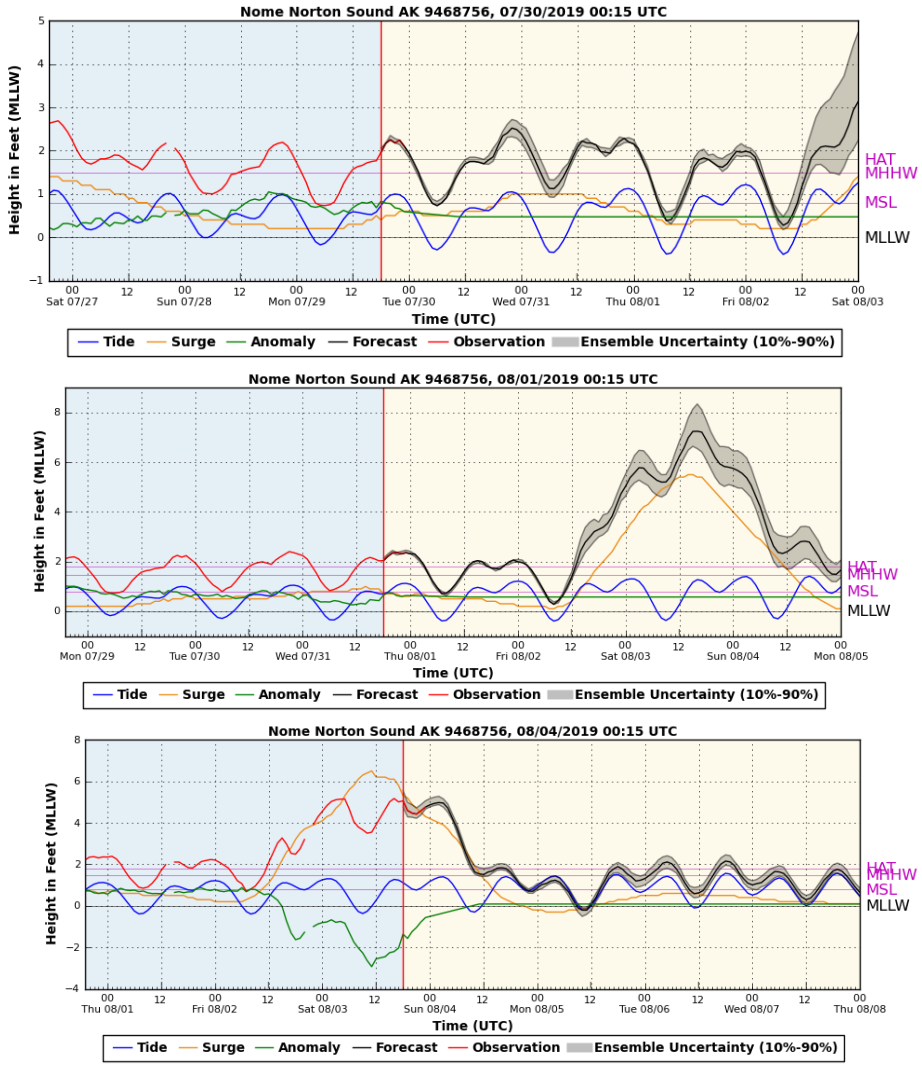




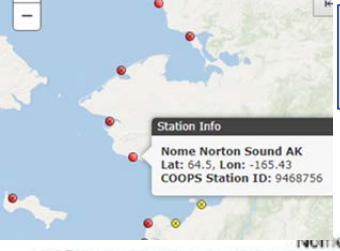
P-ETSS and Uncertainty

Direct quote from Forecasters:

- “ETSS was very consistent even multiple days out. This allowed us to get the word out early and stick to a consistent forecast message”
- Facebook generated a lot of comments during the event between locals and people checking on locals
- Fairbanks currently working within the office for an After Action Review to figure out successes and what could be better next time

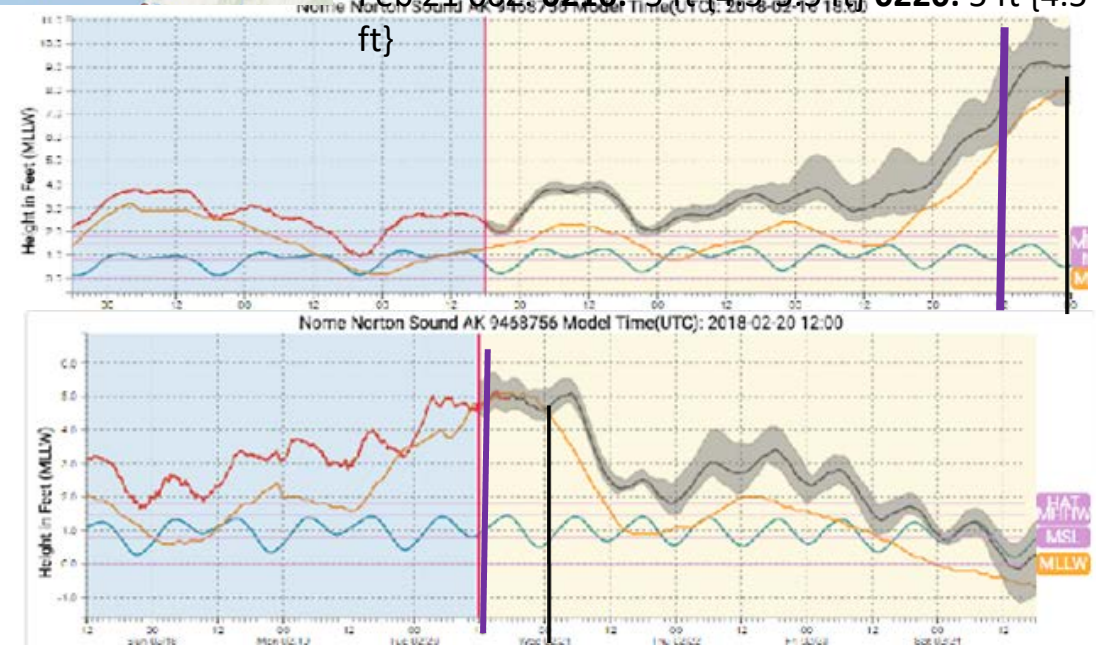


Nome Surge Forecast



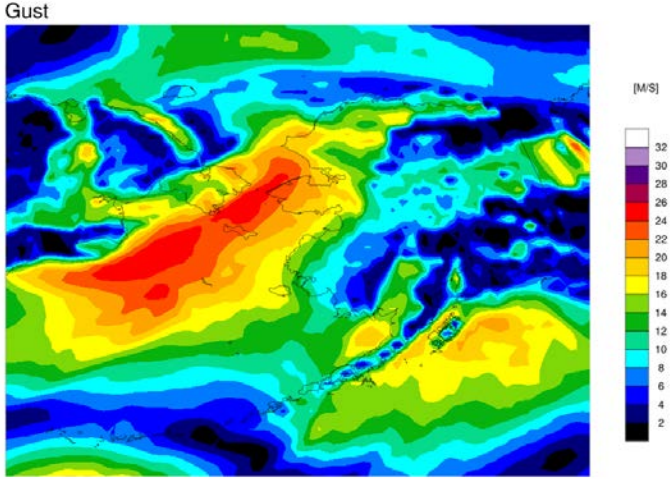
Feb 20 12Z: **0216:** 7.5 ft {6-10 ft}, **0220:** 9 ft {7-10.5 ft}

Feb 21 00Z: **0216:** 5 ft {4.5-5.5 ft} **0220:** 5 ft {4.5-5.5 ft}

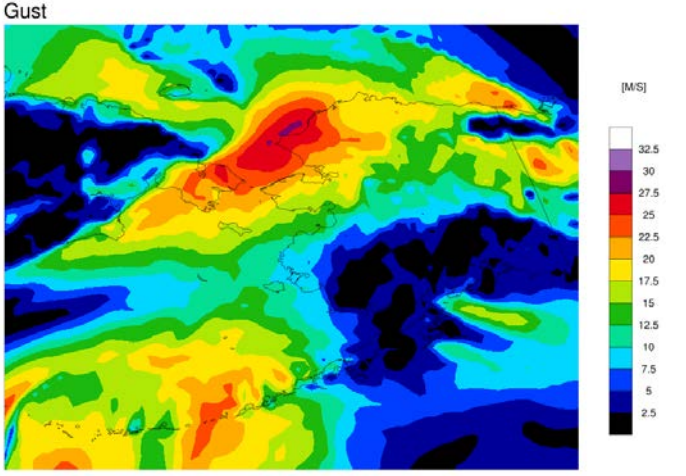


The 24 hour forecast has generally weaker winds across Nome, from 4-8 m/s weaker. In addition, the timing of gusts is earlier by the actual date, resulting in a different wave form and earlier and more prolonged surge.

GFS Gust Feb 16 00Z 120 hours



GFS Gust Feb 20 00Z 24 fcst hours



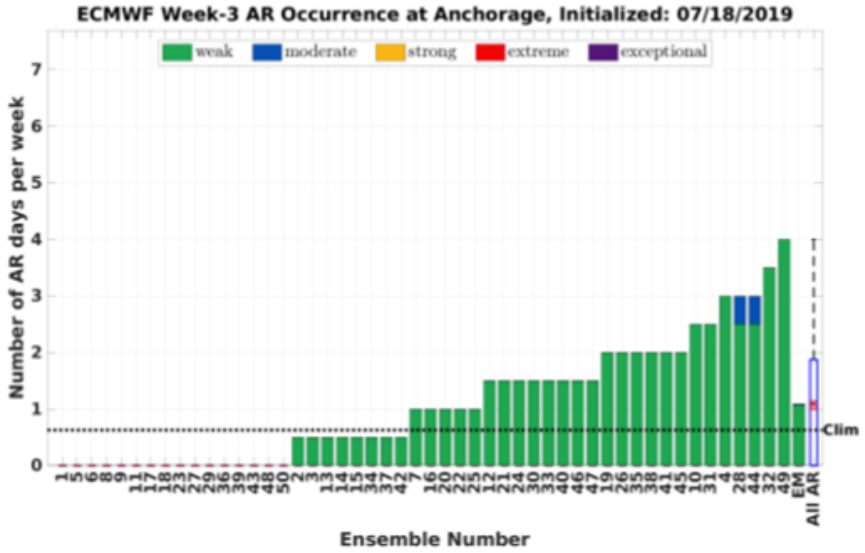
Ensembles for Atmospheric Rivers

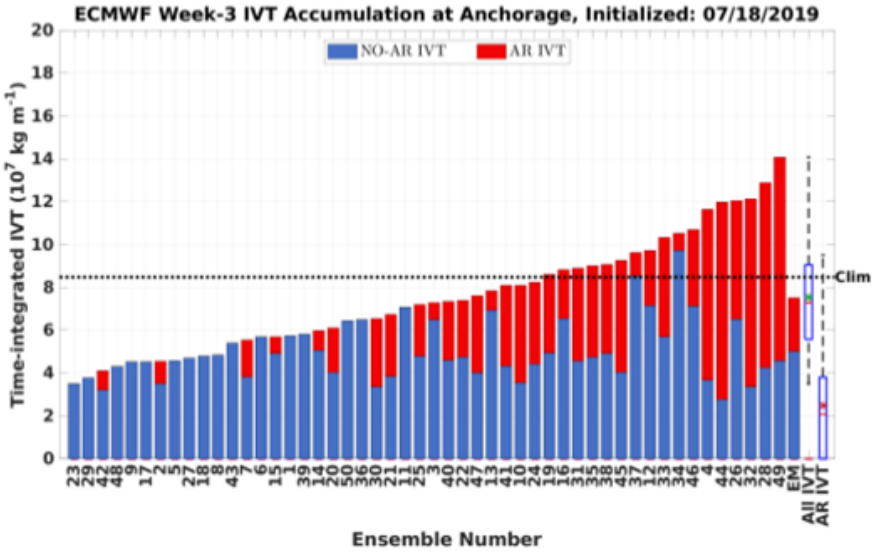
Motivation

- Forecaster awareness of upcoming significant AR events
- Support to core partners such as hydro power generation entities
- Help partners anticipate risks in changing arctic climate
- Important collaboration with Aneesh Subramania, Zhenhai Zhang, Michael DeFlorio
- NWS Lead: Aaron Jacobs Juneau Office
- Climatology the peak for time of year for highest IVT, but record breaking above that.

AR and IVT Forecasts for Week3 (08/01/2019 - 08/07/2019) from ECMWF issued at 07/18/20109

Center for Western Weather and Water Extremes
SCRIPPS INSTITUTION OF OCEANOGRAPHY AT UC SAN DIEGO





Left: *AR occurrence (number of AR days in a week) at week-3 for the 50 ECMWF ensemble members (1-50, sorted according to total AR occurrence), ensemble mean (EM), and boxplot (All AR). Different colors indicate different AR intensity categories (Ralph et al. 2019). The horizontal dashed line is the model climatology.*

Right: *Time-integrated IVT (10^7kg/m in a week) at week-3 for 50 ECMWF ensemble members (1-50, sorted according to total IVT), ensemble mean (EM), boxplot for all IVT (All IVT), and boxplot for IVT associated with AR (AR IVT). Red indicates the IVT associated with AR and the blue indicates the IVT not associated with AR. The horizontal dashed line is the model climatology of total IVT.*

Verification

- Off the charts for climatology
- August 5 saw several heavy rainfall records fall

- Nome experienced a record breaking daily rainfall of 2.47”
- Flooding on the Dalton Highway
- Anchorage did not see the right release mechanisms for that moisture

ENSEMBLE SITUATIONAL AWARENESS TABLE

NOAA / NATIONAL WEATHER SERVICE

Horizontal Tables | Archive | Help | Permalink

Model Run: Aug 1, 2019 00Z | Table Region: Alaska | Plot Region: Alaska | Output: NAEFS Return Interval | View Table

Fcst Hr: 60 Valid: Sat Aug 3 6:00 AM MDT

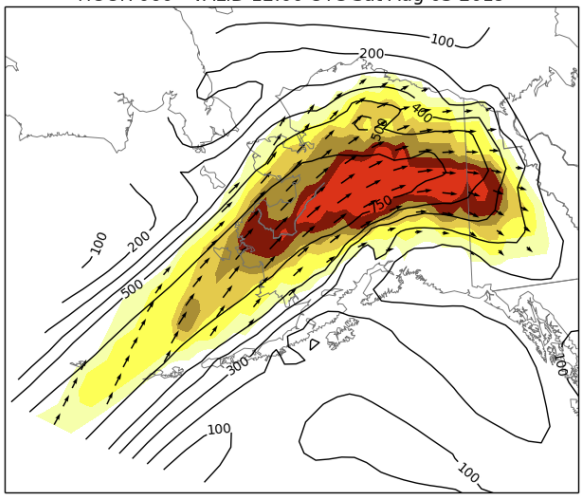
First | Back | Stop | Play | Next | Last | 2

WFO Alaska Table Aug 1, 2019 00Z Run

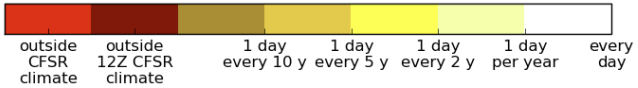
			Z	T	U	V	WSP	SLP	Q	PW	IVT
0	Thu 1st	00Z	2	5	30	10	5	5	5	10	2
6		06Z	5	5	10	30	5	5	30	10	2
12		12Z	5	30	10	30	10	5	30	5	2
18		18Z	2	30	10	30	2	2	10	5	10
24	Fri 2nd	00Z	1	30	5	30	10	1	10	30	30
30		06Z	1	30	10	30	30	1	10	30	30
36		12Z	2	30	5	10	30	1	10	10	30
42		18Z	2	10	30	30	30	2	10	10	30
48	Sat 3rd	00Z	2	10	30	30	30	2	30	10	30
54		06Z	5	10	30	30	30	5	30	10	30
60		12Z	10	10	30	30	30	5	10	10	30
66		18Z	30	30	30	30	30	5	10	5	30
72	Sun 4th	00Z	30	5	30	30	30	5	30	10	30
78		06Z	30	10	30	10	30	10	30	30	30
84		12Z	30	10	30	10	30	10	5	10	30
90		18Z	30	10	30	10	30	5	5	5	30
96	Mon 5th	00Z	30	10	30	5	10	5	10	5	10
102		06Z	30	10	5	5	10	10	5	5	2
108		12Z	30	5	5	2	2	5	5	1	1
114		18Z	30	5	5	1	1	5	5	2	0-1
120	Tue 6th	00Z	30	5	10	1	0-1	5	5	2	0-1
126		06Z	30	10	2	1	0-1	5	5	2	0-1
132		12Z	10	5	5	1	0-1	5	5	1	0-1
138		18Z	5	5	2	1	0-1	2	2	0-1	0-1
144	Wed 7th	00Z	5	5	2	0-1	0-1	2	5	0-1	0-1
150		06Z	5	10	1	0-1	0-1	2	2	0-1	0-1
156		12Z	2	10	2	0-1	0-1	1	1	0-1	0-1
162		18Z	2	5	1	0-1	0-1	1	1	0-1	0-1
168	Thu 8th	00Z	2	10	1	0-1	0-1	1	1	0-1	0-1
174		06Z	2	30	0-1	2	0-1	1	1	0-1	0-1
180		12Z	1	30	0-1	1	0-1	0-1	1	0-1	0-1
186		18Z	1	30	0-1	1	0-1	0-1	1	0-1	0-1
192	Fri 9th	00Z	0-1	10	0-1	0-1	0-1	0-1	0-1	0-1	0-1
198		06Z	0-1	10	0-1	0-1	0-1	0-1	0-1	0-1	0-1
204		12Z	0-1	30	0-1	0-1	0-1	0-1	0-1	0-1	0-1
210		18Z	0-1	10	0-1	0-1	0-1	0-1	0-1	0-1	0-1

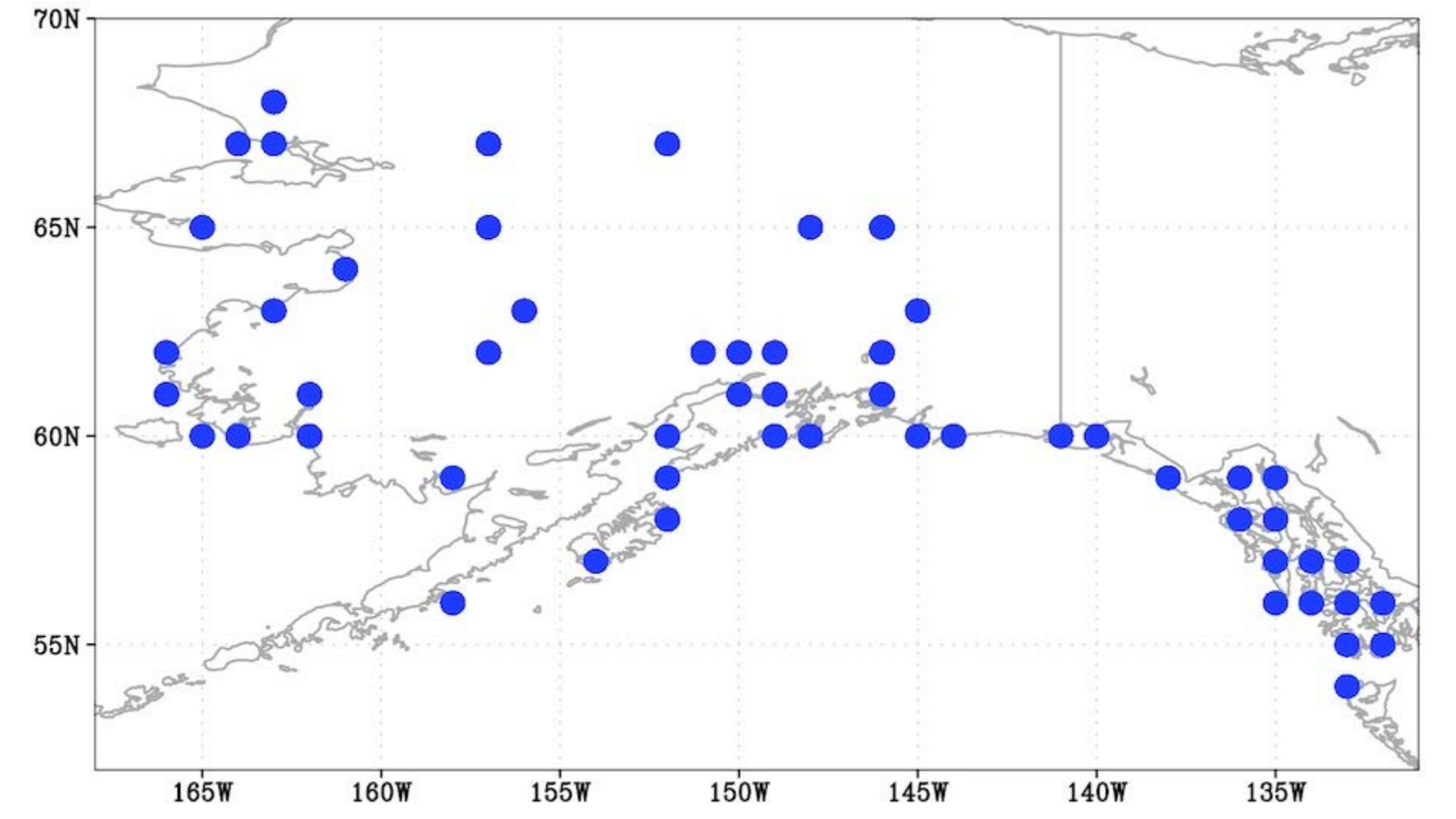
NAEFS Mean Integrated WV Transport ($kgm^{-1}s^{-1}$) and Return Interval

HOUR 060 - VALID 12:00 UTC Sat Aug 03 2019



Approximate frequncy of occurrence in the 24-Jul to 14-Aug CFSR climatology (1979-2009)




70N
65N
60N
55N
165W
160W
155W
150W
145W
140W
135W