

Results from an Operational Demonstration of a Gridded CrIS/ATMS Product for Cold Air Aloft

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In Partnership With:





Outline

- Why CAA is Important to Aviation Operations
- Anchorage Center Weather Service Unit (ZAN CWSU) Area of Responsibility (AOR)
- Need for Gridded NUCAPS Products in Alaska Airspace
- AWIPS Gridded NUCAPS Data
- Cooperative Institute for Research in the Atmosphere (CIRA) Web Page CAA Products
- Winter 2016-2017 CAA Assessment
- Case Studies
- Winter 2016-2017 CAA Assessment Feedback Results
- Winter 2018 CAA Assessment
- Summary



Why CAA Is Important To Aviation Operations

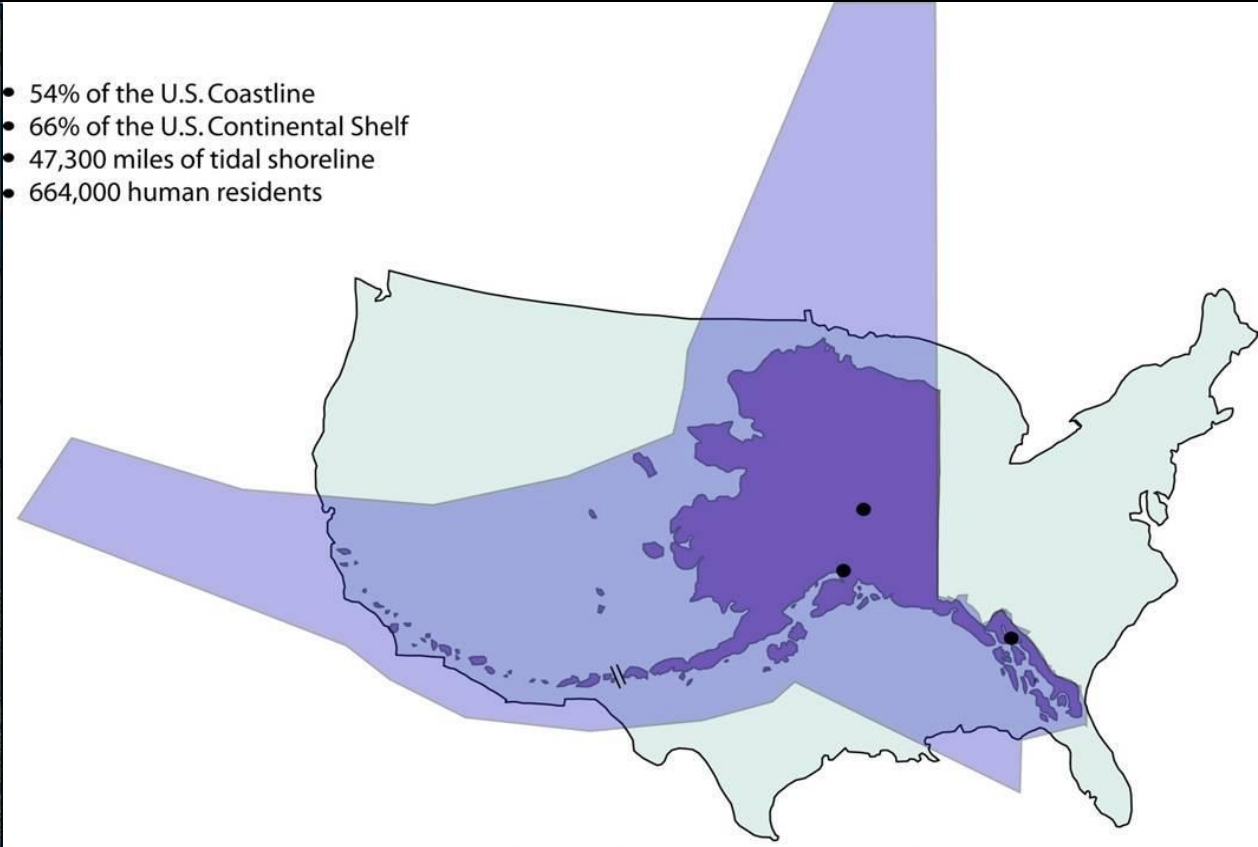
- British Airways Flight 038 Boeing 777 crash on approach at London Heathrow Airport on 17 January 2008
- Fuel freezing points vary from -40°C to -60°C , but water in fuel can freeze at higher temperatures (below -10°C); either results in a loss of engine performance due to restricted fuel flow
- CAA mitigating factors include aircraft design, fuel type, initial fuel temperature, fuel quantity, aircraft speed, and flight route
- The ZAN CWSU CAA forecast/warning threshold is an air temperature of -65°C outside the aircraft



ZAN CWSU AOR



- 54% of the U.S. Coastline
- 66% of the U.S. Continental Shelf
- 47,300 miles of tidal shoreline
- 664,000 human residents

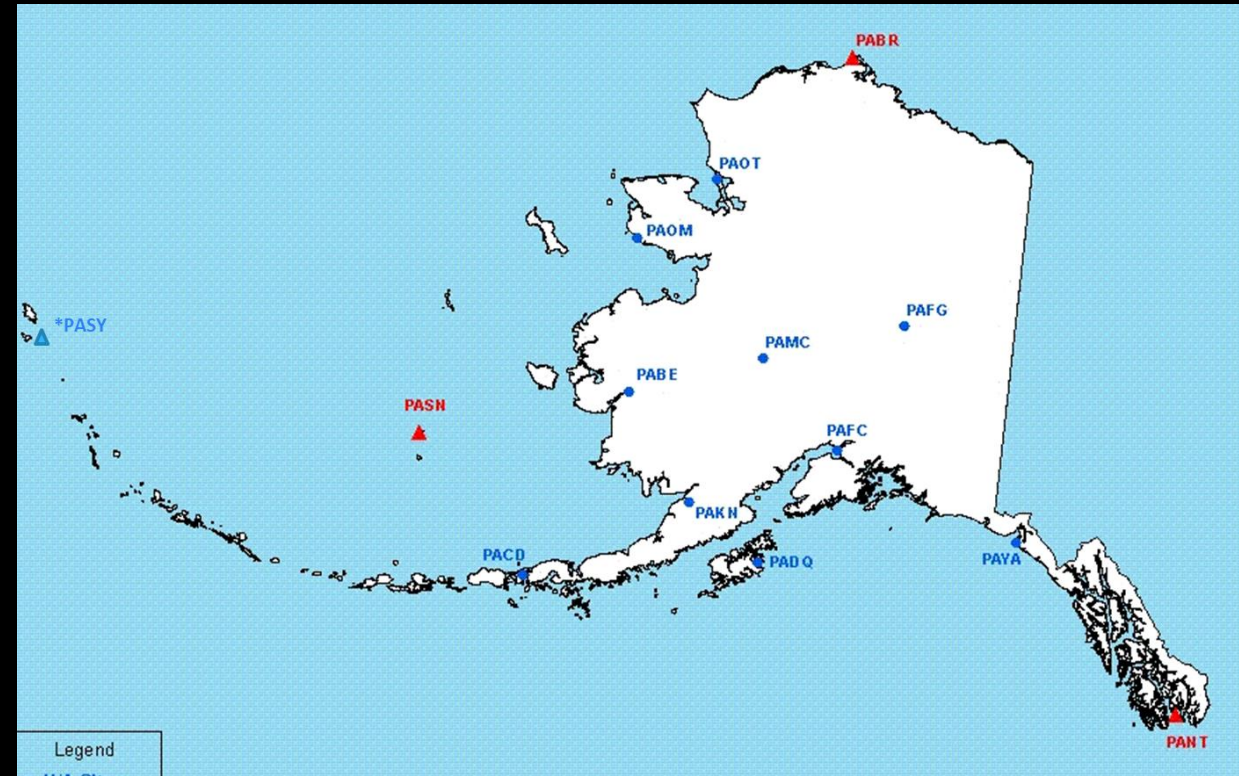


Anchorage is the only CWSU that provides a CAA Meteorological Impact Statement (MIS)



Need For Gridded NUCAPS Products In Alaska Airspace

- Only 14 upper air stations to cover 2.4 million square miles of airspace; soundings not always available twice a day due to manning issues, equipment malfunctions, computer issues, etc.
- One forecaster on shift leaves little time to look into CAA in depth with other aviation-impacting weather needing attention (LLWS, MTW, SEV TURB, SEV ICE, Volcanic Ash Clouds, etc.)
- Need something simple to use and interpret to get CAA product out quickly



Gridded NUCAPS products fill the gaps due to a lack of sounding data



AWIPS Gridded NUCAPS Data

- Easily accessible to all forecasters
- Three-dimensional spatial and temporal resolution:
 - Obtain horizontal extent of CAA
 - Obtain vertical levels of CAA
- Looping capability
- Plan view display to complement NUCAPS Soundings that are streamed over the NWS NOAAPort Satellite Broadcast Network:
 - Point and click function
 - Pop-up soundings



CIRA Web Page CAA Products

- http://rammb.cira.colostate.edu/ramsdisk/online/cold_air_aloft.asp
- Polar-orbiting satellite data and GFS model output
- Displays CAA heights in units of flight level (hundreds of feet)
- Looping capability



Winter 2016-2017 CAA Assessment

- Meeting and training in October 2016 at ZAN CWSU with NASA's Short-term Prediction Research and Transition Center (SPoRT) researchers; clearly stated what operators and researchers were trying to accomplish
- Web-based feedback implemented for ZAN CWSU forecasters
- Researchers utilized YouTube training videos to explain and demonstrate new CAA products and capabilities

Teamwork and communication are essential for R2O and O2R success



Case Study #1: 10-11 January 2017

- GFS or NAM Model Data
- Station Sounding
- Pilot Reports (PIREPs)
- Aircraft Meteorological Data Relay (AMDAR) Reports
- Gridded NUCAPS Products
- NUCAPS Sounding and Cross-Section
- CIRA CAA Products

FAAK20 KZAN 101720

ZAN MIS 31 VALID 101730-110530

...FOR ATC PLANNING PURPOSES ONLY...

FROM 400NE BRW-150SE KTN-160S PDN-300NW BRW-400NE BRW

COLD AIR ALOFT

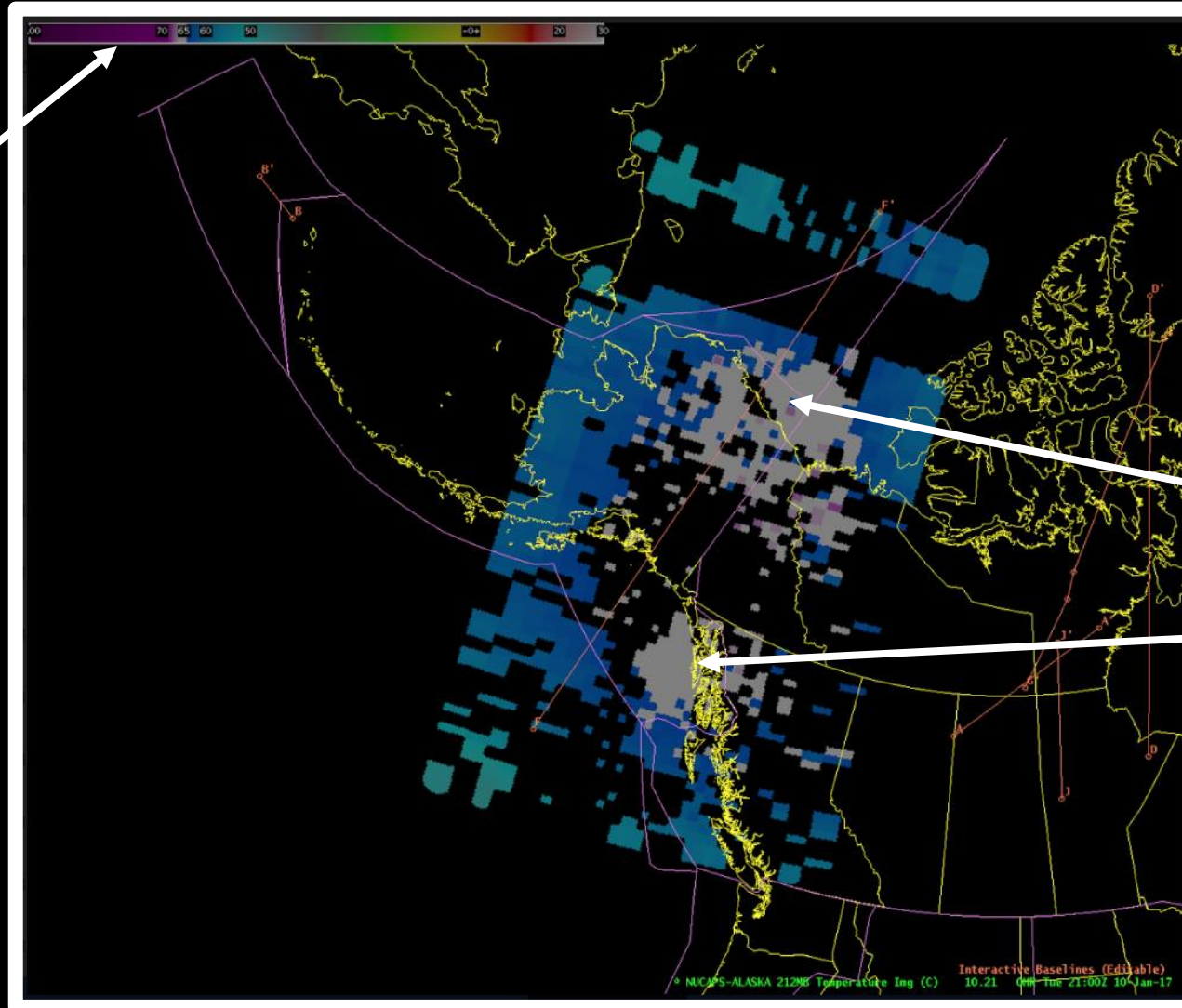
TEMPS -65C OR LESS ABV FL350. MOV E 15KT. NC.

CMW JAN 17



Case Study #1: Gridded NUCAPS Data

-65°C or colder
depicted in purple
and white colors

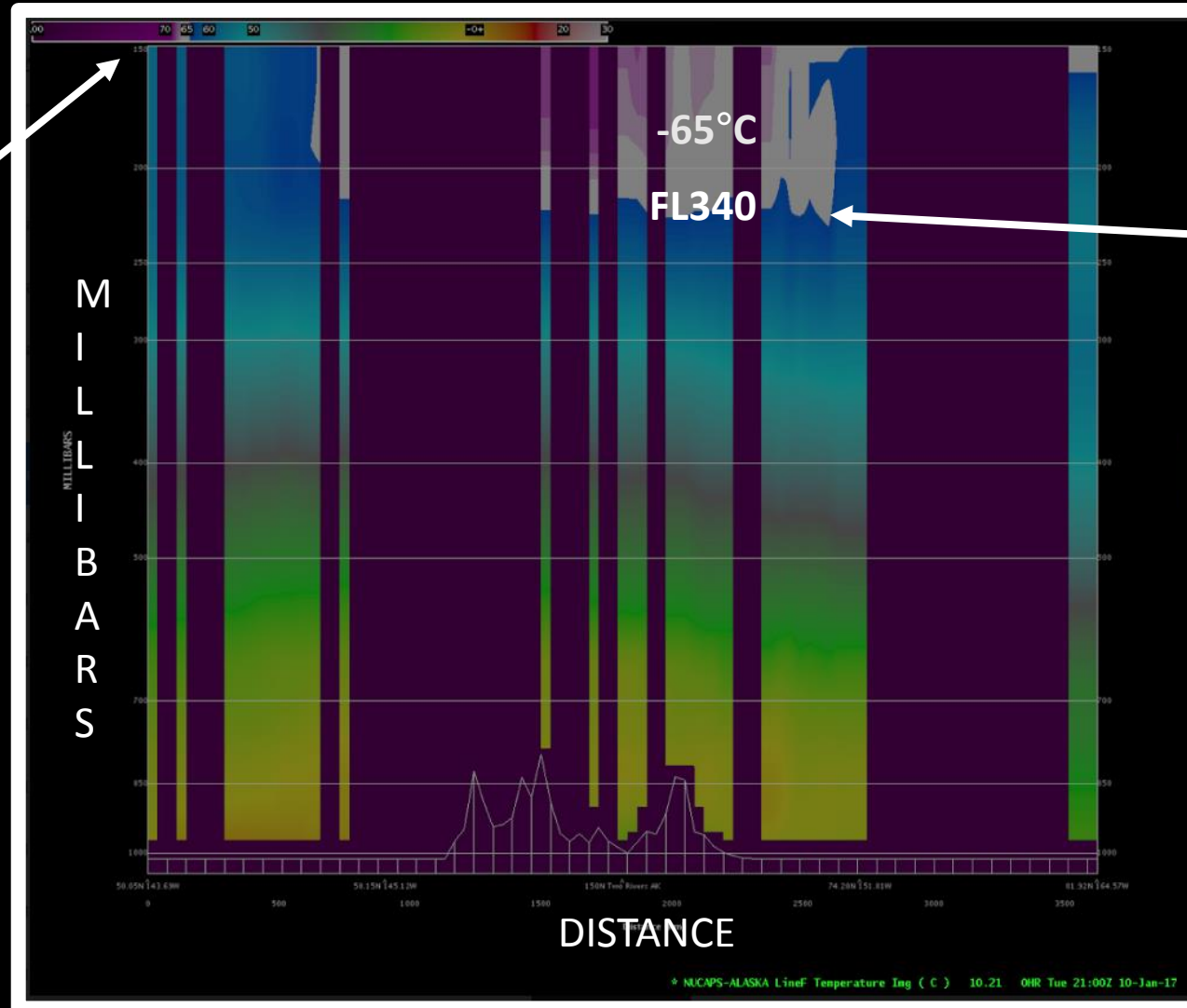


Horizontal extent
of CAA extends
from the Beaufort
Sea in northern AK
to the Panhandle in
southern AK



Case Study #1: NUCAPS Cross-Section

-65°C or colder
depicted in purple
and white colors



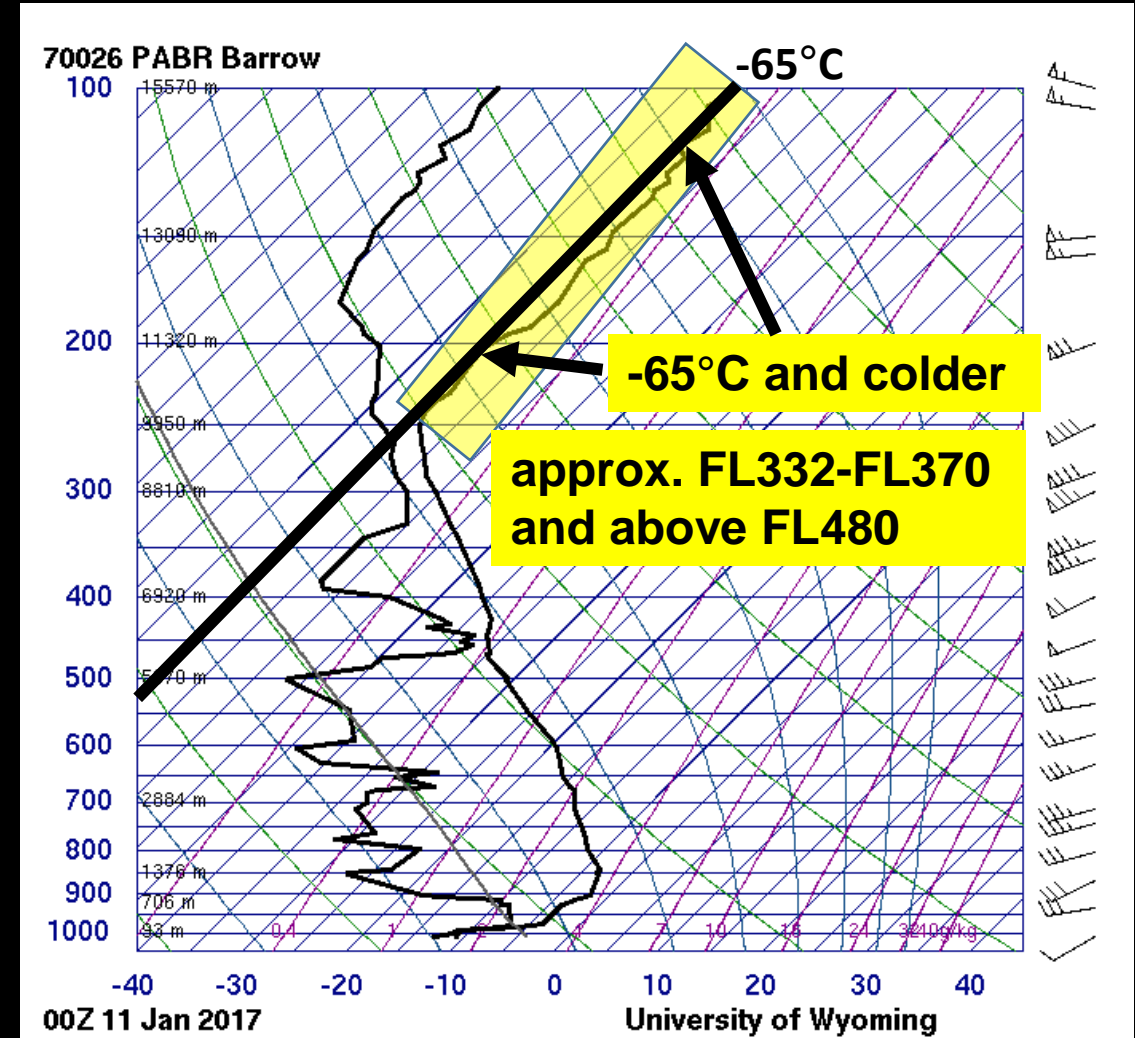
Vertical levels of
CAA extend from
approx. FL340 and
higher



Case Study #1: Barrow Sounding Data

70026 PABR Barrow Observations at 00Z 11 Jan 2017

PRES	HGHT	TEMP	DWPT	RELH	DRCT	SKNT
hPa	m	C	C	%	deg	knot
243.0	10125	-64.1	-69.1	50	245	80
235.0	10330	-64.3	-70.3	44	246	78
229.0	10489	-63.7	-70.7	38	247	77
202.0	11259	-64.9	-74.9	24	250	71
200.0	11320	-64.5	-75.5	21	250	70
126.0	14161	-63.9	-87.9	2	272	56
121.0	14409	-63.7	-86.7	3	274	56
117.0	14615	-65.3	-88.3	3	276	56
112.0	14881	-64.1	-87.1	3	277	55
105.6	15240	-66.1	-88.2	3	280	55
105.0	15274	-66.3	-88.3	3	281	55
100.0	15570	-65.3	-88.3	3	285	57
93.7	15965	-65.3	-88.3	3	287	58
77.4	17114	-69.9	-90.9	3	294	61
74.1	17374	-70.2	-90.8	4	295	62
70.0	17710	-70.7	-90.7	4	295	69
63.5	18288	-70.9	-90.9	4	295	77





Case Study #1: AMDAR Report

ANC(Up) 0143 11Jan17 (Aircraft #9082)

Ascent sounding toward 136° from Anchorage Int'L, AK (ANC) lasting 180 min, and covering 1510 nautical miles

P_alt (ft)	mb	t (°C)	w_dir/w_spd (kts)	Time (UTC)	Bng/Rng (nm)
33990	250	-57.9/	----	----	224°/024
36900	218	-65.0/	2°/009	0226	131°/296
36940	217	-65.5/	34°/050	0303	131°/611
36950	217	-65.1/	38°/038	0245	131°/457
36970	217	-65.0/	39°/035	0242	130°/432
36980	217	-65.3/	38°/047	0254	131°/533
36990	217	-64.8/	219°/027	0200	136°/091
37000	217	-65.1/	31°/048	0300	131°/580
37020	216	-64.8/	322°/009	0221	131°/259
37020	216	-66.0/	30°/053	0306	131°/637
37030	216	-65.3/	33°/047	0300	131°/585
37100	216	-66.5/	28°/052	0308	131°/653
38900	198	-66.6/	26°/052	0317	132°/727
38940	197	-69.0/	31°/049	0309	131°/663
38970	197	-62.6/	25°/030	0333	133°/878
38980	197	-67.0/	24°/050	0312	131°/690
38980	197	-64.3/	18°/043	0327	132°/824
38990	197	-66.0/	29°/050	0315	131°/716
39000	197	-64.8/	22°/043	0324	132°/796



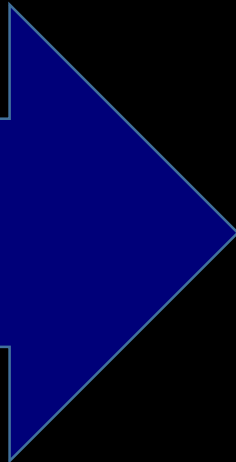
Case Study #1: Summary

- MIS CAA levels were above FL350:
 - NUCAPS Cross-Section displayed -65°C or less above FL340
 - 11/00Z Barrow Sounding Data displayed 2 levels of -65°C or less:
 - FL332-FL370 and above FL480
 - AMDAR Report verified -65°C or less above 36,900ft
- MIS CAA boundaries extended from the Arctic Ocean to the southern Panhandle to the southern Alaska Peninsula:
 - Gridded NUCAPS data product closely matched area from the Arctic Ocean to the southern Panhandle, and displayed temps close to -65°C over the southern Alaska Peninsula
- Overall, the Gridded NUCAPS data closely matched National Weather Prediction (NWP) product data, AMDAR data, and station soundings:
 - Increased forecaster confidence to issue a CAA MIS using NUCAPS data to complement NWP data



Case Study #2: 1-3 February 2017

- GFS or NAM Model Data
- Station Sounding
- PIREPs
- AMDAR Reports
- Gridded NUCAPS Products
- NUCAPS Sounding and Cross-Section
- CIRA CAA Products



FAAK20 KZAN 030256

ZAN MIS 06 VALID 030300-031500

...FOR ATC PLANNING PURPOSES ONLY...

FROM 205NNW BRW-55ESE BTI-35WNW YAK-65N

ADQ-90NNE ULL-240NNW OME-205NNW BRW

COLD AIR ALOFT

TEMPS -65C OR LESS FM FL350-FL400. STNR. NC.

NO UPDATES AFT 0600Z...REFER TO

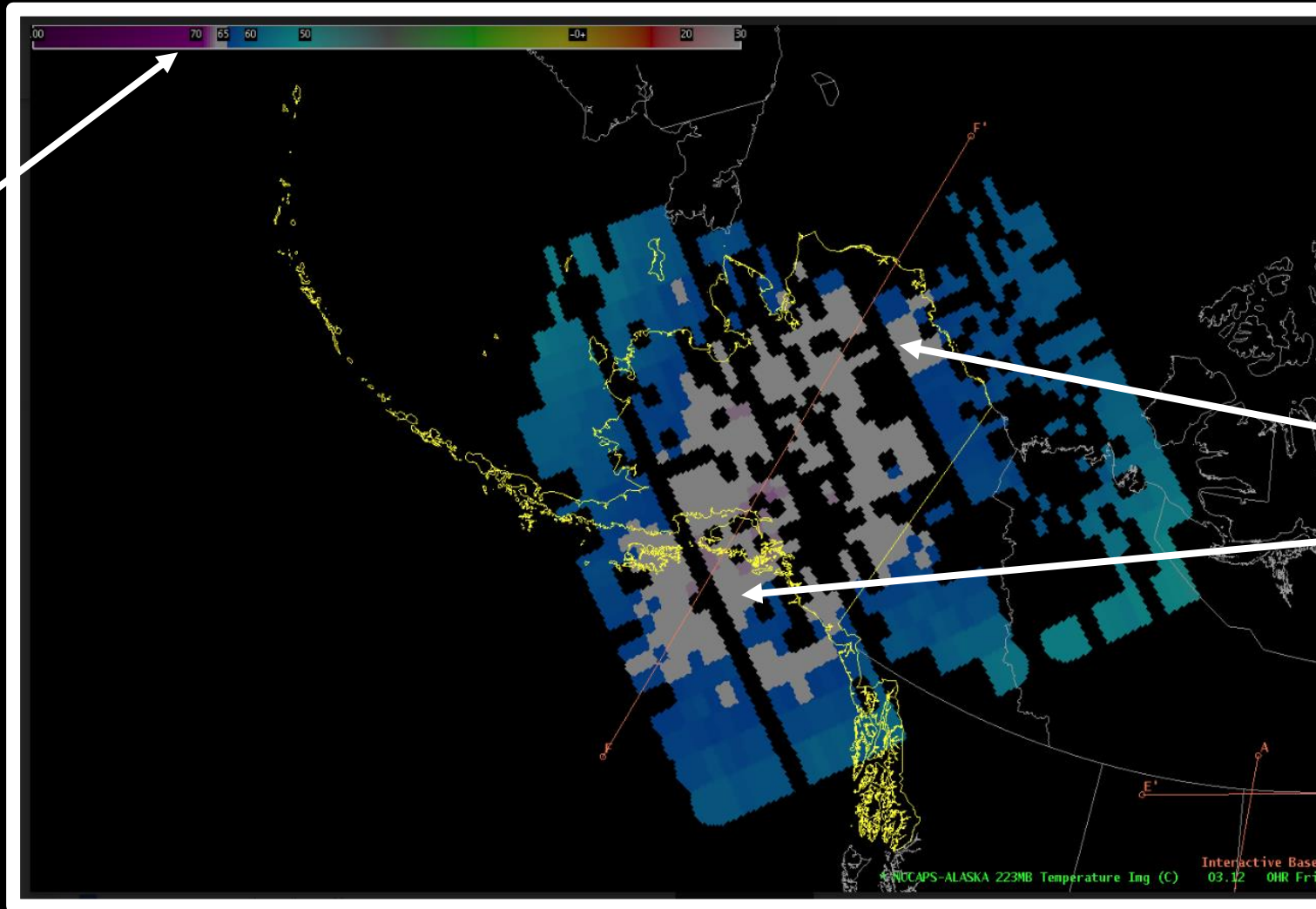
[HTTP://AAWU.ARH.NOAA.GOV](http://AAWU.ARH.NOAA.GOV)

GMW FEB 17



Case Study #2: Gridded NUCAPS Data

-65°C or colder
depicted in purple
and white colors

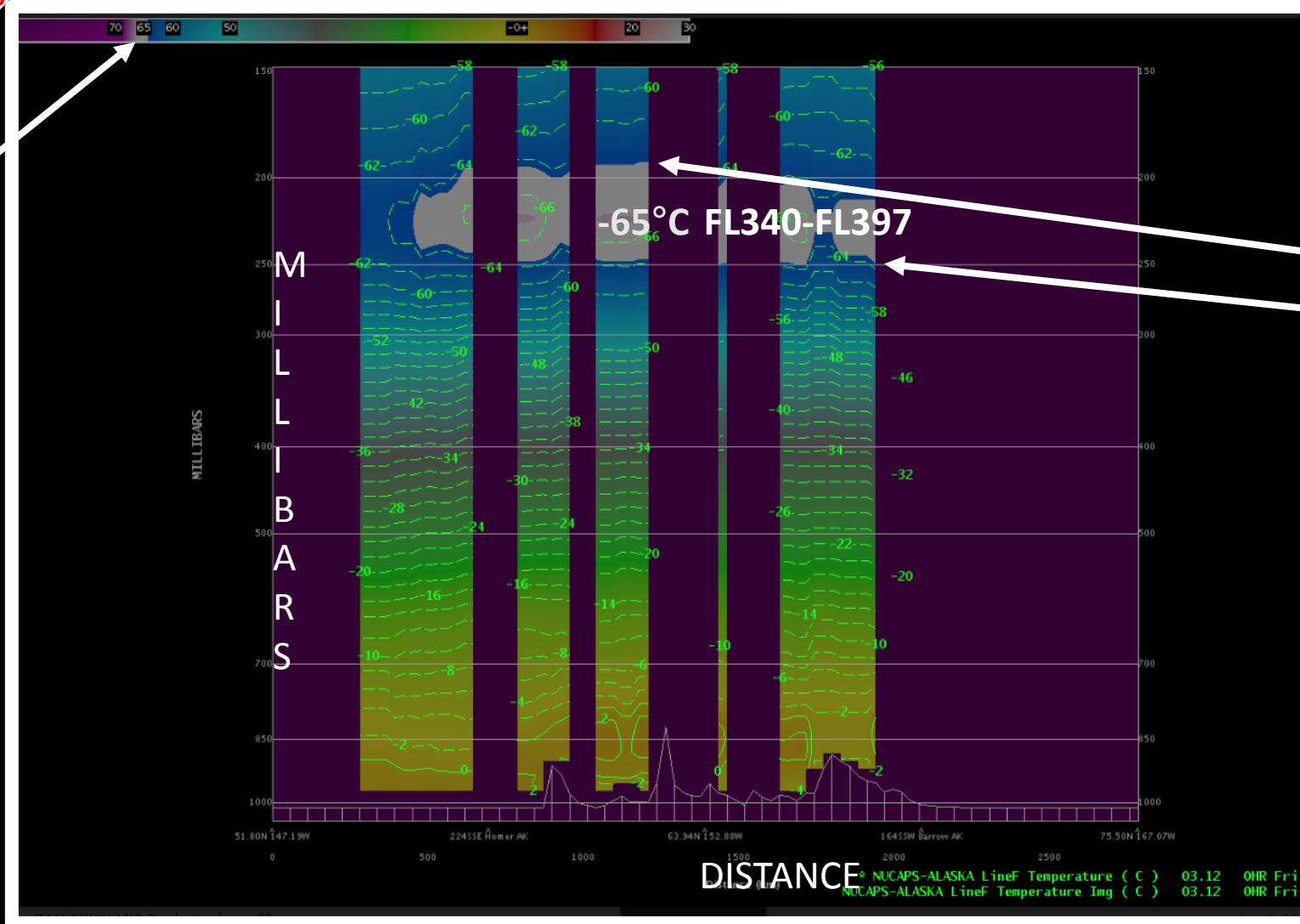


Horizontal extent
of CAA extends
from northern AK
to the Gulf of
Alaska



Case Study #2: NUCAPS Cross-Section

-65°C or colder
depicted in purple
and white colors

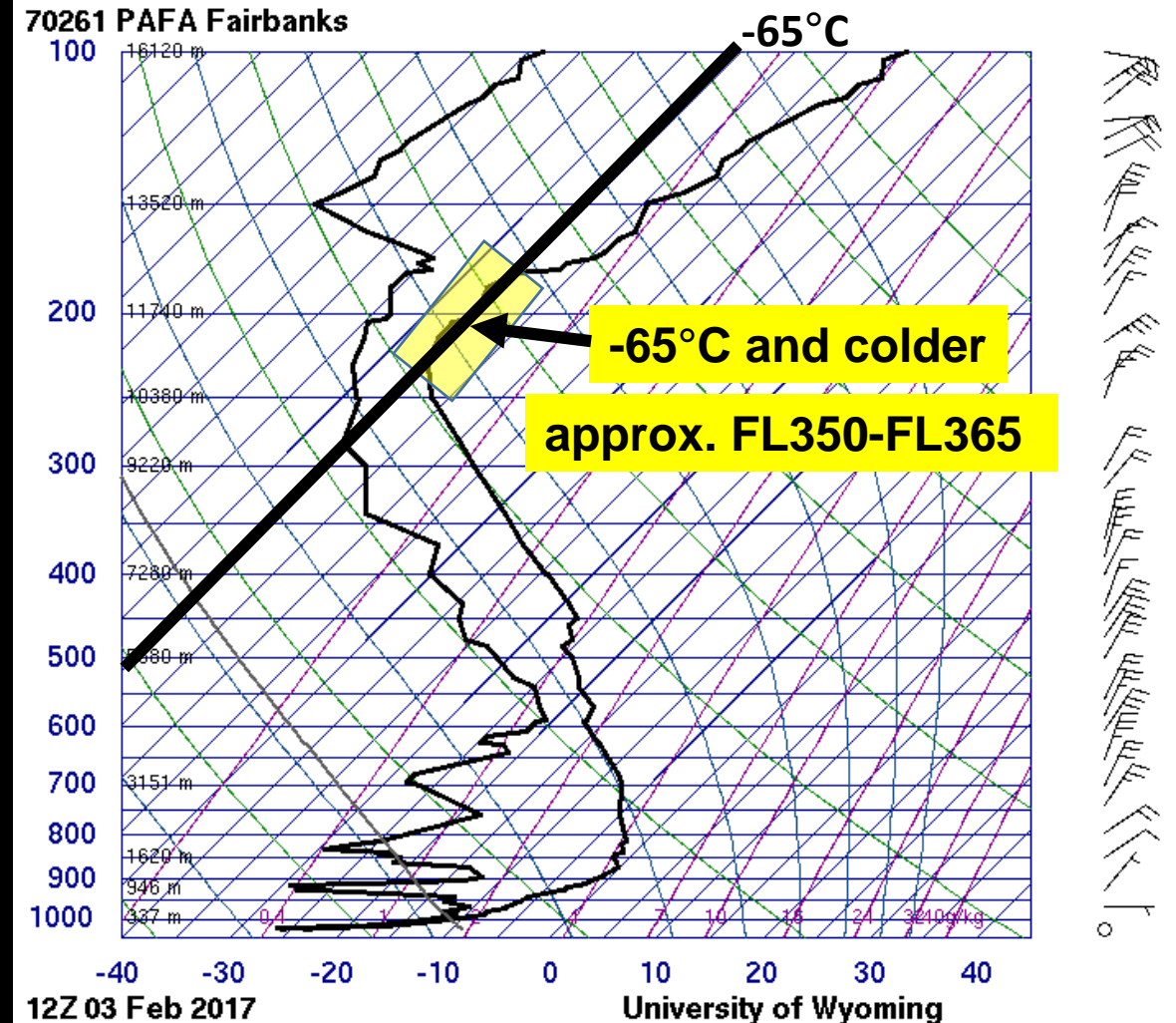




Case Study #2: Fairbanks Sounding Data

70261 PAFA Fairbanks Observations at 12Z 02 Feb 2017

PRES	HGHT	TEMP	DWPT	RELH	DRCT	SKNT
hPa	m	C	C	%	deg	knot
250.0	10240	-61.5	-69.5	34	15	77
237.0	10569	-64.3	-71.7	36	15	80
233.2	10668	-65.2	-72.3	37	15	80
231.0	10727	-65.7	-72.7	37	14	80
219.0	11051	-66.9	-73.9	37	10	77
216.0	11134	-65.9	-73.9	32	14	77
214.0	11191	-62.5	-71.5	29	16	77
212.0	11250	-61.7	-71.7	25	19	77
211.0	11278	-61.8	-71.9	25	20	77
200.9	11582	-63.4	-74.3	21	30	58
200.0	11610	-63.5	-74.5	21	30	54
199.0	11641	-63.5	-74.5	21	28	51
197.0	11703	-62.7	-74.7	18	23	44





Case Study #2: AMDAR Report

ANC(Up) 0143 11Jan17 (Aircraft #9082)

Ascent sounding toward 136° from Anchorage Int'L, AK (ANC) lasting 180 min, and covering 1510 nautical miles

P_alt (ft)	mb	t (°C)	w_dir/w_spd (kts)	Time (UTC)	Bng/Rng (nm)
34180	248	-61.0	38°/052	1718	353°/091
34630	243	-62.0	39°/054	1718	353°/092
35990	227	-64.0	0°/048	1754	2°/323
36000	227	-65.0	35°/050	1721	355°/113
36000	227	-65.0	29°/041	1727	358°/152
36000	227	-64.5	20°/038	1729	359°/165
36000	227	-64.5	15°/035	1733	359°/191
36000	227	-64.5	13°/036	1735	360°/204
36000	227	-64.1	7°/037	1737	0°/218
36000	227	-64.5	8°/035	1739	0°/231
36000	227	-64.5	8°/036	1739	0°/231
36000	227	-64.1	9°/037	1741	1°/245
36000	227	-63.6	4°/047	1747	1°/284
36000	227	-64.0	0°/047	1749	2°/297
36010	227	-64.0	2°/049	1756	2°/336



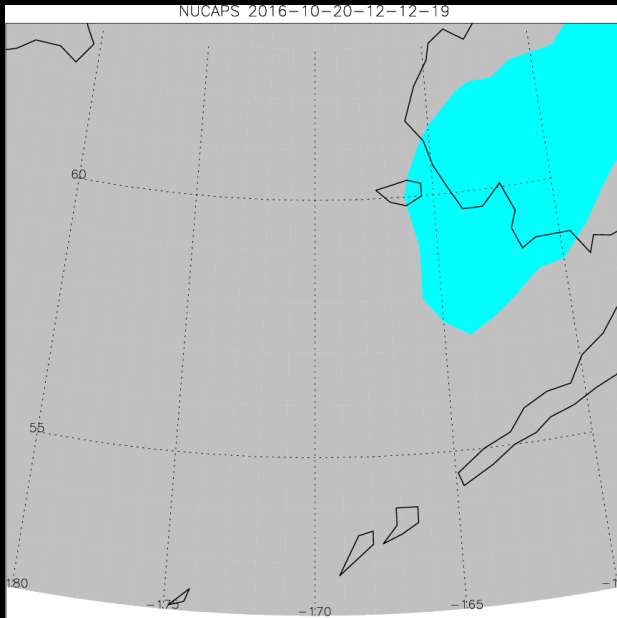
Case Study #2: Summary

- MIS CAA levels were from FL350-FL400:
 - NUCAPS Cross-Section displayed -65°C or less from FL340-FL397
 - 03/12Z Fairbanks Sounding Data displayed -65°C or less from FL350-FL365
 - AMDAR Report verified -65°C or less at 36,000ft
- MIS CAA boundaries extended from Northern Alaska to the Gulf of Alaska:
 - Gridded NUCAPS data product closely matched entire area
- Overall, the Gridded NUCAPS data closely matched NWP product data, AMDAR data, and station soundings during the third day of the CAA event:
 - Forecasters had mixed reviews for using NUCAPS data during the start of this event, but by day 3 NUCAPS data helped determine the CAA MIS area and flight levels

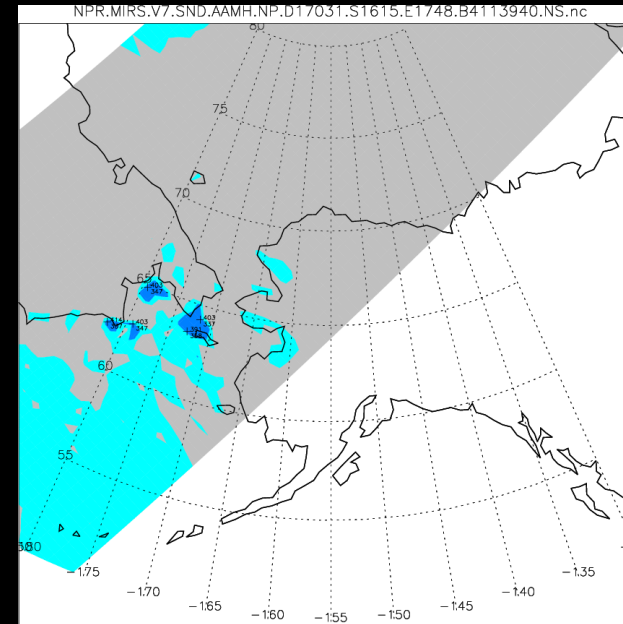


Winter 2016-2017 CAA Assessment Feedback Results

- Warm temperature bias at start of Assessment; fixed in January
- Switched CAA heights displayed on CIRA web page
- Expanded maps displayed on CIRA web page:



Bering Sea Sector before feedback



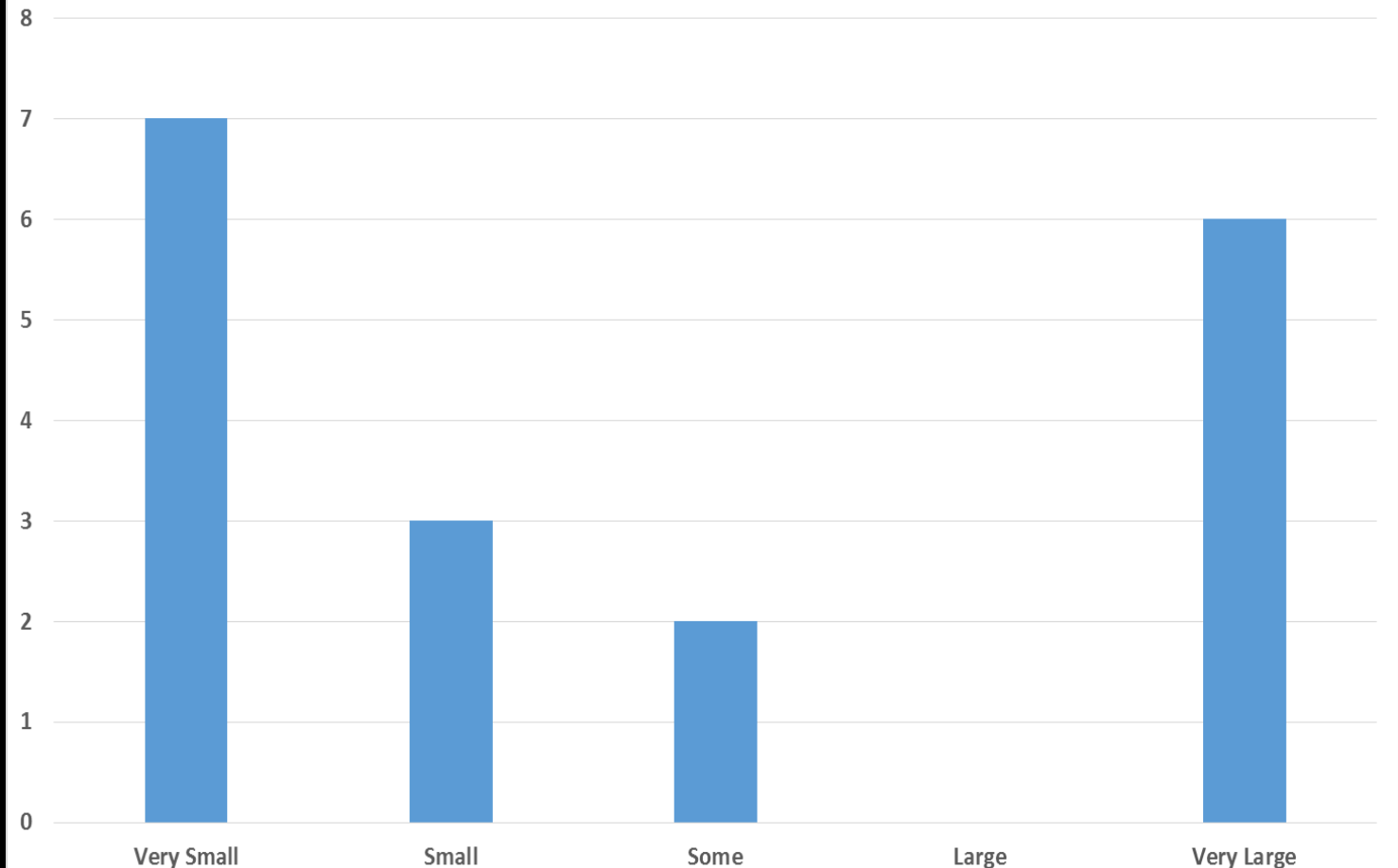
Alaska Sector after feedback



Web-based Feedback - Operational Impact

- The majority of “Very Small” and “Small” responses occurred before the Gridded NUCAPS products were fully operational in AWIPS and on the CIRA CAA Web Page, and also before the warm temperature bias was fixed
- Gridded NUCAPS data was also used to verify the non-existence of CAA

Rank the impact of the Gridded NUCAPS on decision to issue or not issue a forecast product.

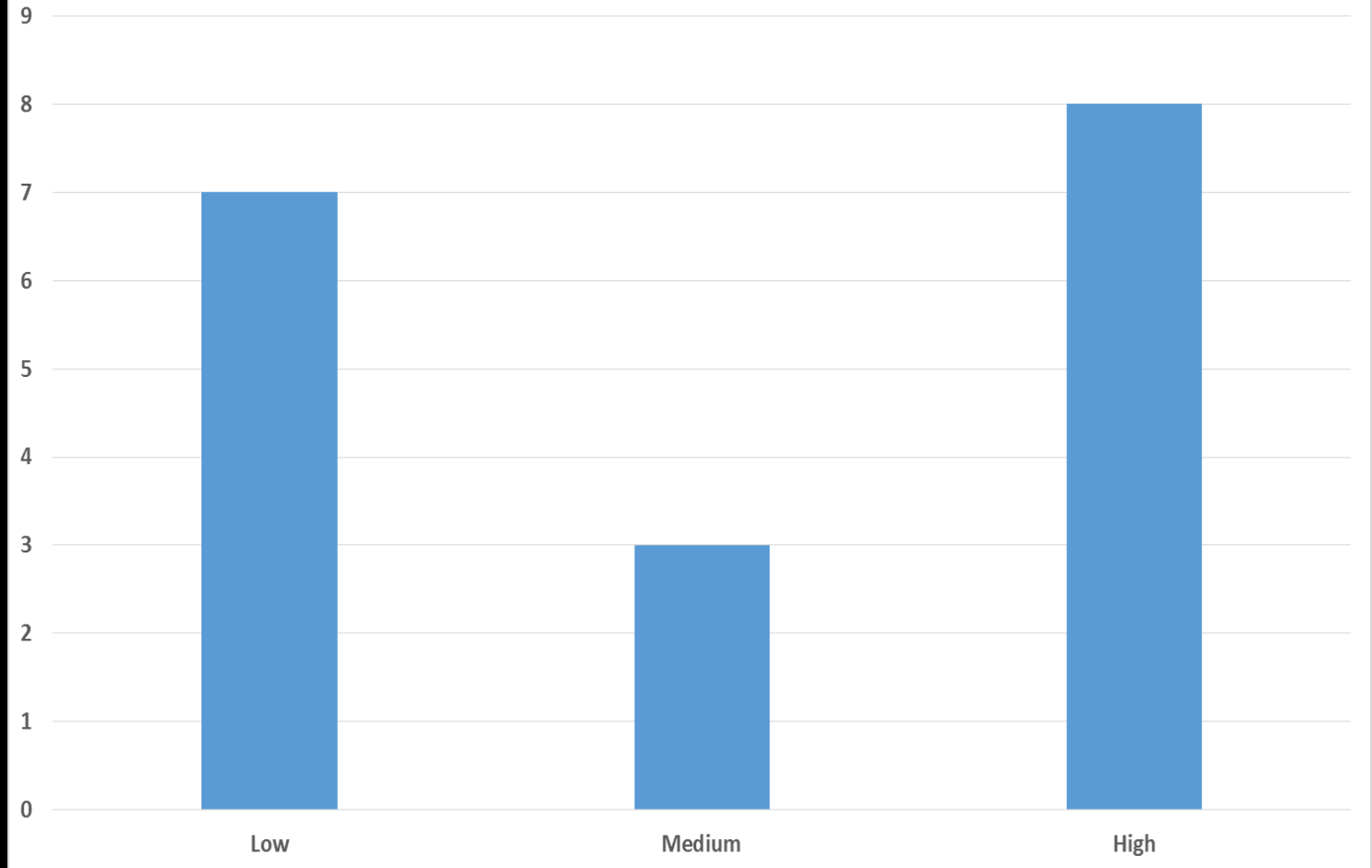




Web-based Feedback - Forecaster Confidence

- 6 out of 7 “Low” responses occurred at the beginning of the CAA Assessment when the forecasters were still becoming familiar with the new Gridded NUCAPS products
- The “Low” responses also reflect the time before the NUCAPS products were fully functional in AWIPS and on the CIRA CAA Web Page

Rate your confidence level in the Gridded NUCAPS values at upper atmosphere flight levels.

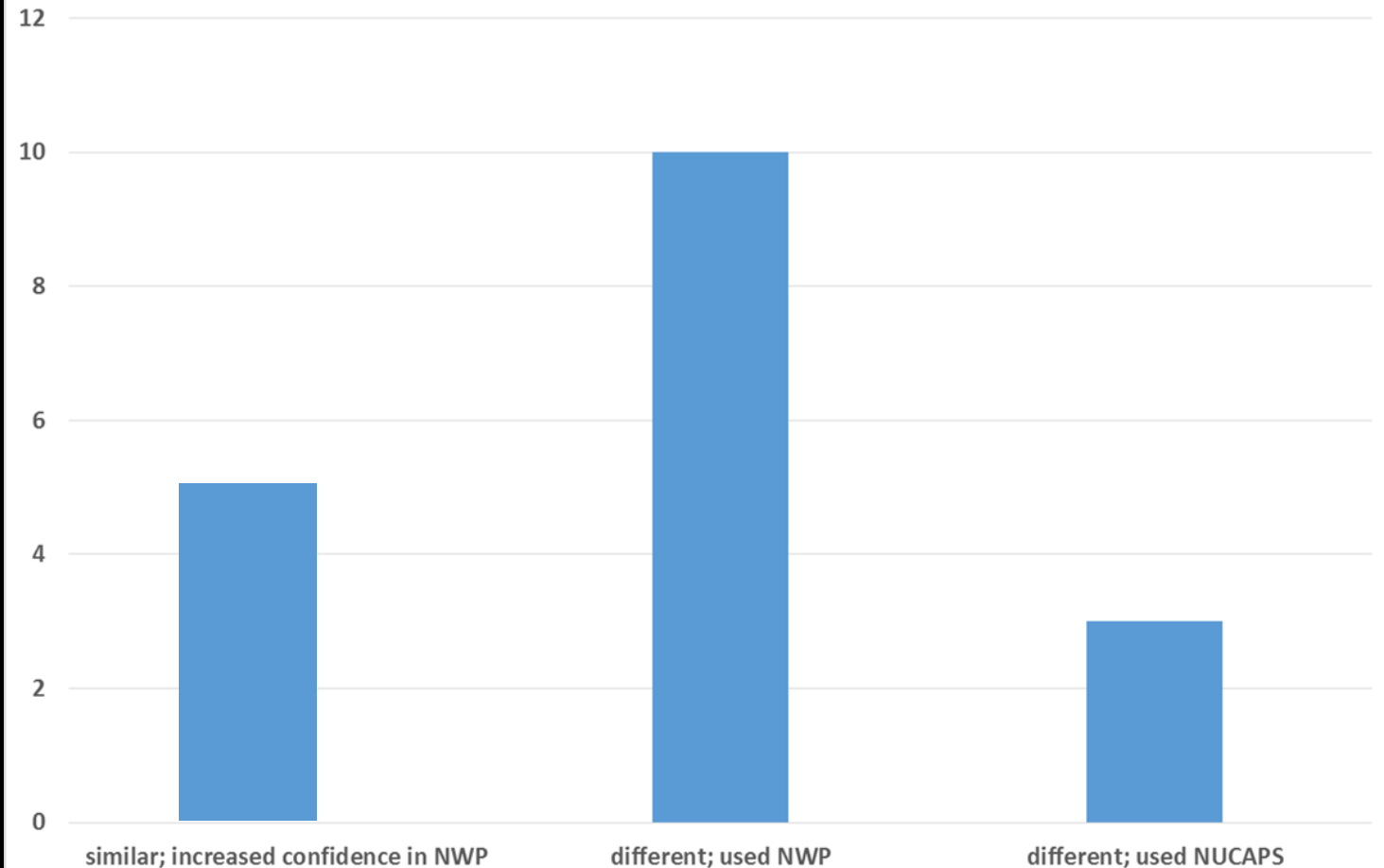




Web-based Feedback - Gridded NUCAPS VS. NWP Data

- Forecasters were most likely to use NWP data, even when the both sets of data were similar – this coincides with the lack of familiarity with Gridded NUCAPS products at the beginning of the Assessment
- The forecasters chose to use Gridded NUCAPS data over NWP data during the last month of the Assessment when the products were different – this coincides with the previous slide where forecaster confidence increased as the Assessment progressed

When compared to NWP data, the Gridded NUCAPS data were...





Winter 2018 CAA Assessment

- January 2018 through March 2018
- Continue to improve Gridded NUCAPS products on AWIPS and build on last winter's successes
- New for this year – display Gridded NUCAPS data on AWIPS in flight level vs. mb
- Excellent web-based feedback tool in place again



Summary

- The ZAN CWSU CAA MIS gives air traffic controllers, pilots, and dispatchers the tool they need to mitigate CAA effects across Alaska Airspace
- Both case studies illustrate the added value of Gridded NUCAPS products in determining the CAA MIS boundaries and flight levels
- During the Winter 2016-2017 CAA Assessment O2R feedback was quick and easy, and timely R2O improvements were made to Gridded NUCAPS products based on real-time, honest feedback and open communications

R2O and O2R success using satellite-based products in a data-sparse region