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

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In Partnership With:

Outline

- Why Cold Air Aloft (CAA) is Important to Aviation Operations
- CAA Mitigating Factors
- Anchorage Center Weather Service Unit (ZAN CWSU) Area of Responsibility (AOR)
- Need for Gridded NUCAPS CAA Products in Alaska Airspace
- AWIPS Gridded NUCAPS Data
- CIRA Web Page CAA Products
- Winter 2016-2017 CAA Assessment
- Case Studies
- Winter 2016-2017 CAA Assessment Feedback Results
- Gridded NUCAPS Limitations
- Winter 2018 CAA Assessment

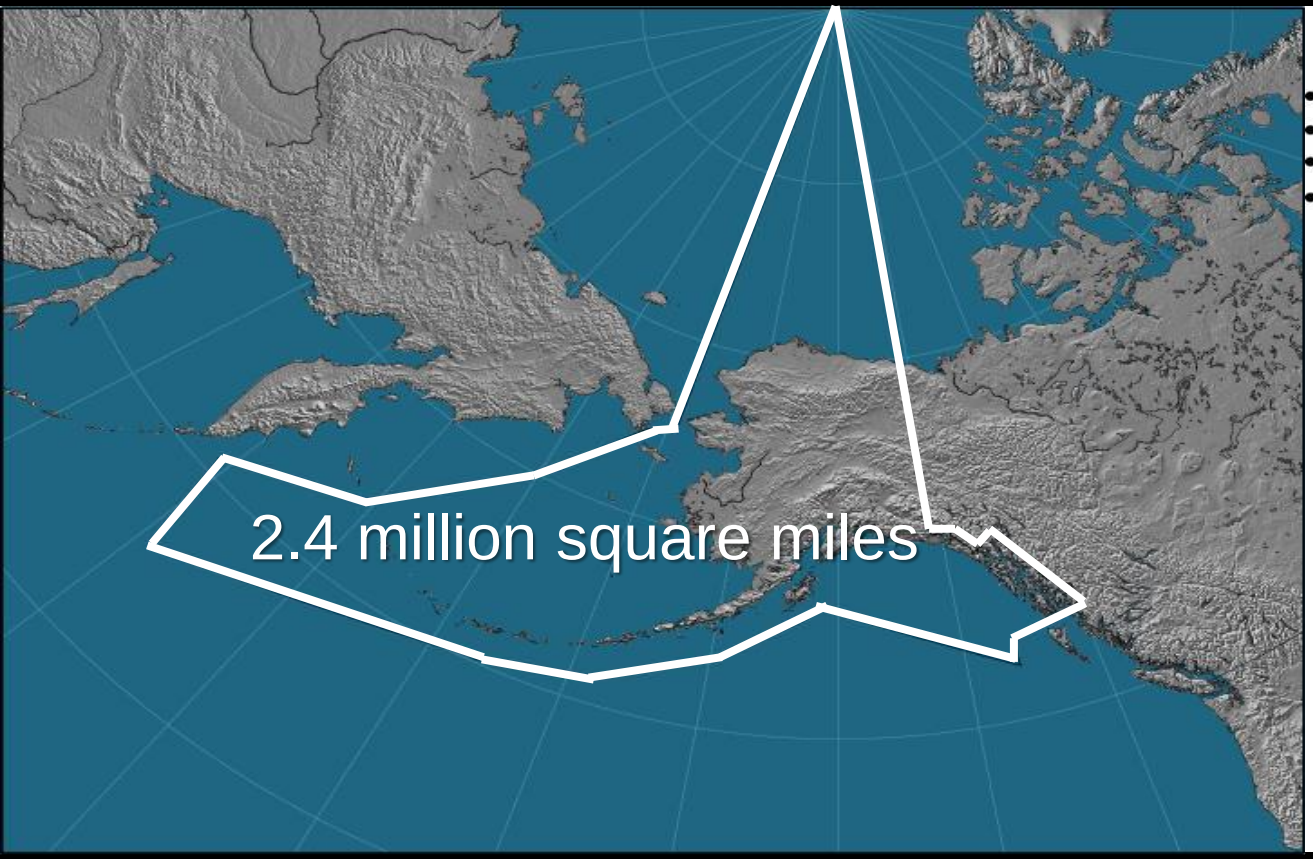
Why CAA Is Important To Aviation Operations

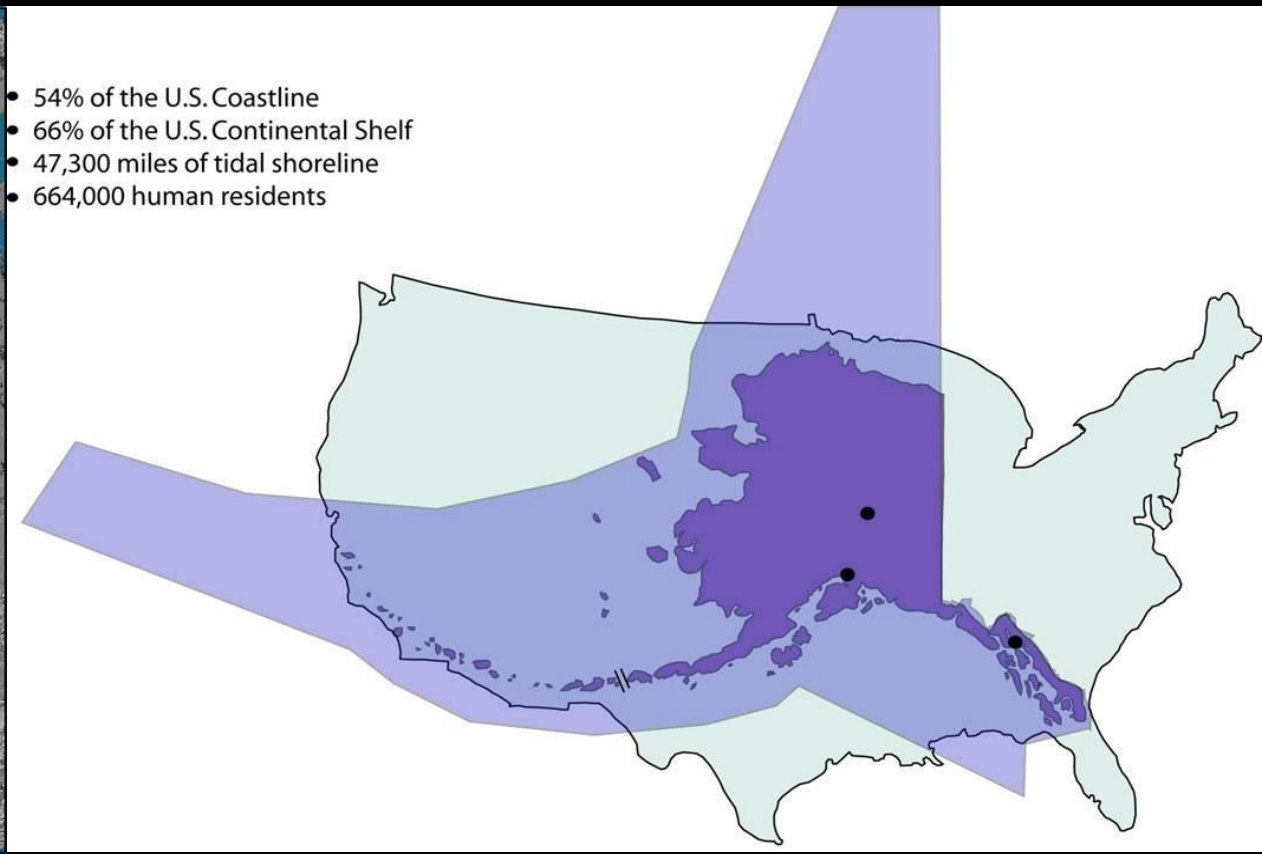
- British Airways Flight 038 Boeing 777 crash on approach at London Heathrow Airport on 17 January 2008
- Temperatures -65C or colder may lead to jet fuel “waxing” or water crystallization in fuel, which results in a loss of engine performance due to restricted fuel flow
- Fuel freezing points vary from -40C to -60C, but water in fuel can freeze at higher temperatures (below -10C)
- -65C is the CAA forecast/warning threshold at ZAN CWSU

CAA Mitigating Factors

- Initial fuel temperature; warmer fuel is slower to freeze
- Outside air temperature; colder air freezes fuel faster
- Aircraft speed; faster speeds generates more friction and heat
- Quantity of fuel; the greater amount of fuel in the tank, the slower it freezes
- Aircraft design; constant pumping of fuel to mix it, transfer fuel between fuel tanks, run hydraulic lines close to fuel tanks for heat source, heated fuel screens, etc.
- Use a fuel with a lower freezing point
- Choose a route with warmer temperatures; avoid areas of CAA

ZAN CWSU AOR





Anchorage is the only CWSU that provides a CAA Mission Impact Statement product

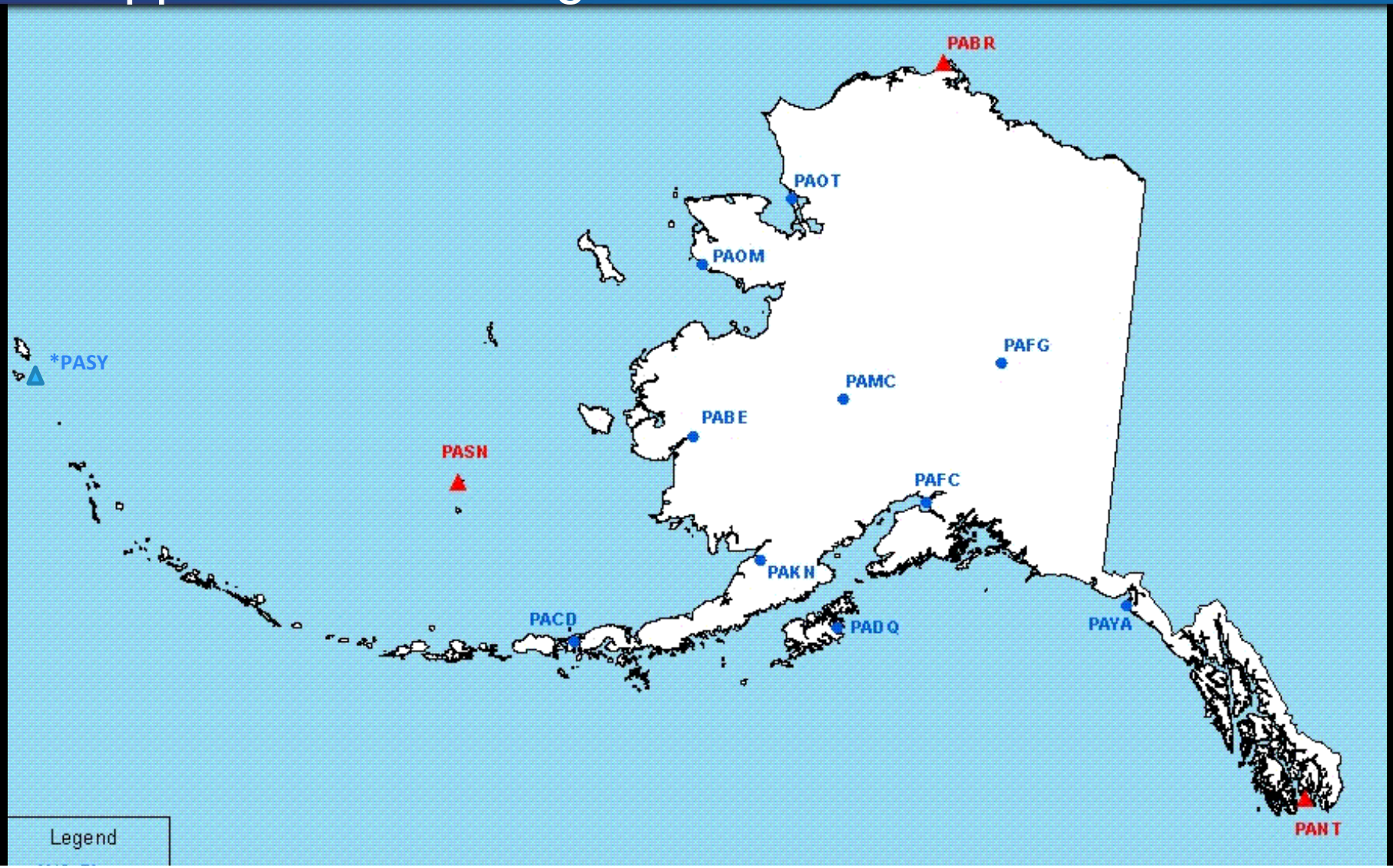
Need For Gridded NUCAPS Products In Alaska Airspace

- 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.
- Satellite data can fill the void in data-sparse AK, but this also has limitations
- One forecaster on shift leaves little time to look into CAA in-depth with other mission-impacting weather needing attention (LLWS, MTW, SEV TURB, SEV ICE, 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 upper air data

14 Upper-Air Sounding Locations in Alaska

Anchorage
Annette Island
Barrow
Bethel
Cold Bay
Fairbanks
King Salmon
Kodiak
Kotzebue
McGrath
Nome
Saint Paul
Yakutat
*Shemya (military)



AWIPS Gridded NUCAPS Data

- Easily accessible to all forecasters on AWIPS
- Three-dimensional spatial and temporal resolution:
  - Obtain horizontal extent of CAA
  - Obtain vertical levels of CAA
- Looping capability
- Point and click function
- Pop-up soundings

CIRA Web Page CAA Products

- Cooperative Institute for Research in the Atmosphere Web Page: http://rammb.cira.colostate.edu/ramsdis/online/cold_air_aloft.asp
- Utilizes SNPP-MIRS and AMSU-MIRS data
- Displays CAA heights in thousands of feet
- Looping capability
- Displays GFS model data

Winter 2016-2017 CAA Assessment

- Meeting and training in October 2016 at Anchorage CWSU with NASA SPoRT researchers; clearly stated what operators and researchers were trying to accomplish
- Web-based feedback implemented for CWSU forecasters
- Gridded NUCAPS products improved throughout assessment based on real-time, honest feedback and open communications
- Researchers utilized You Tube training videos to explain and demonstrate new CAA products and capabilities

Teamwork and communication is essential for R2O success

Case Study #1: 10-11 January 2017

GFS or NAM Model Data

PIREPs

AMDAR Data

Gridded NUCAPS Products

Gridded NUCAPS Sounding

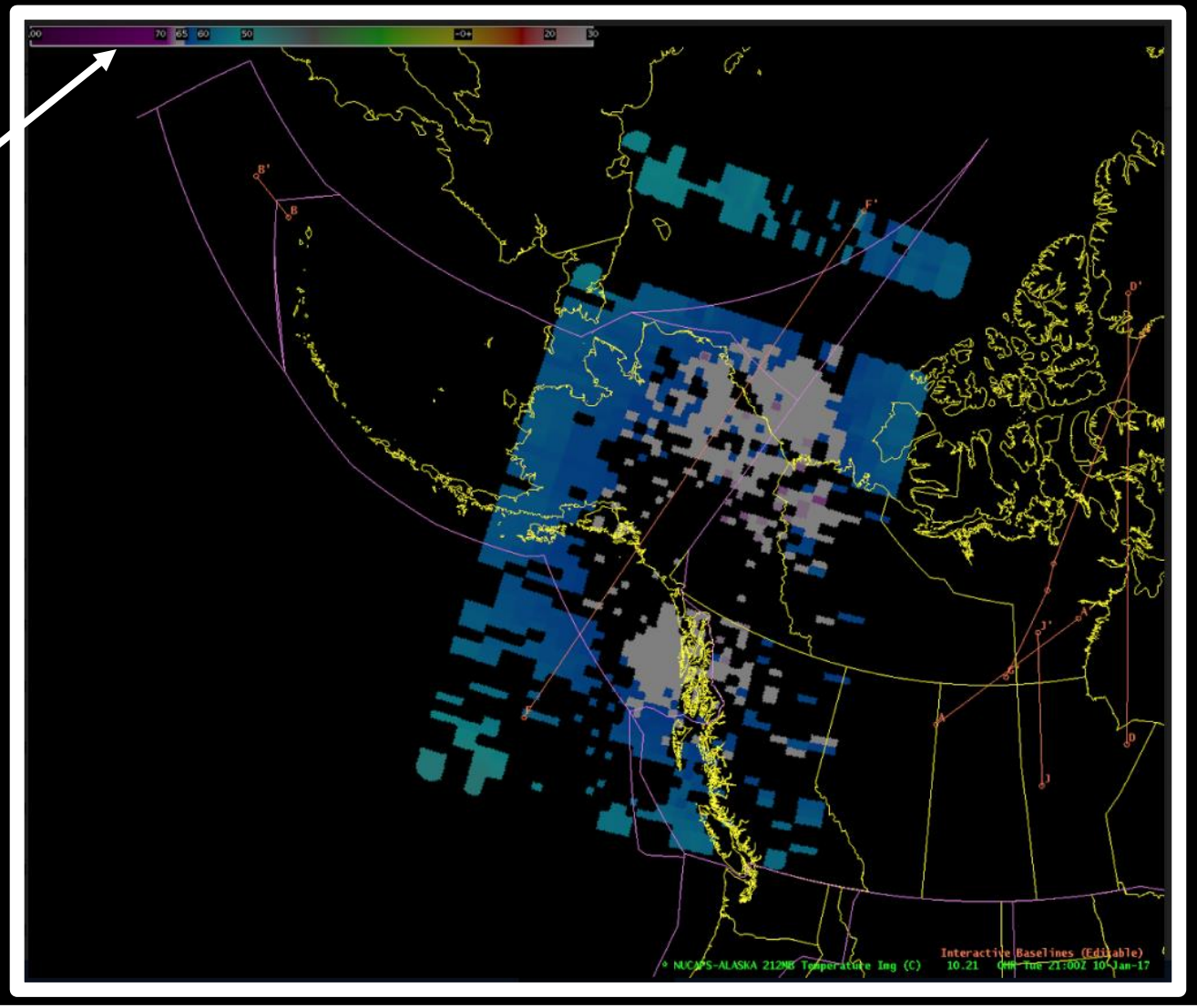
Station Sounding

CIRA CAA Products

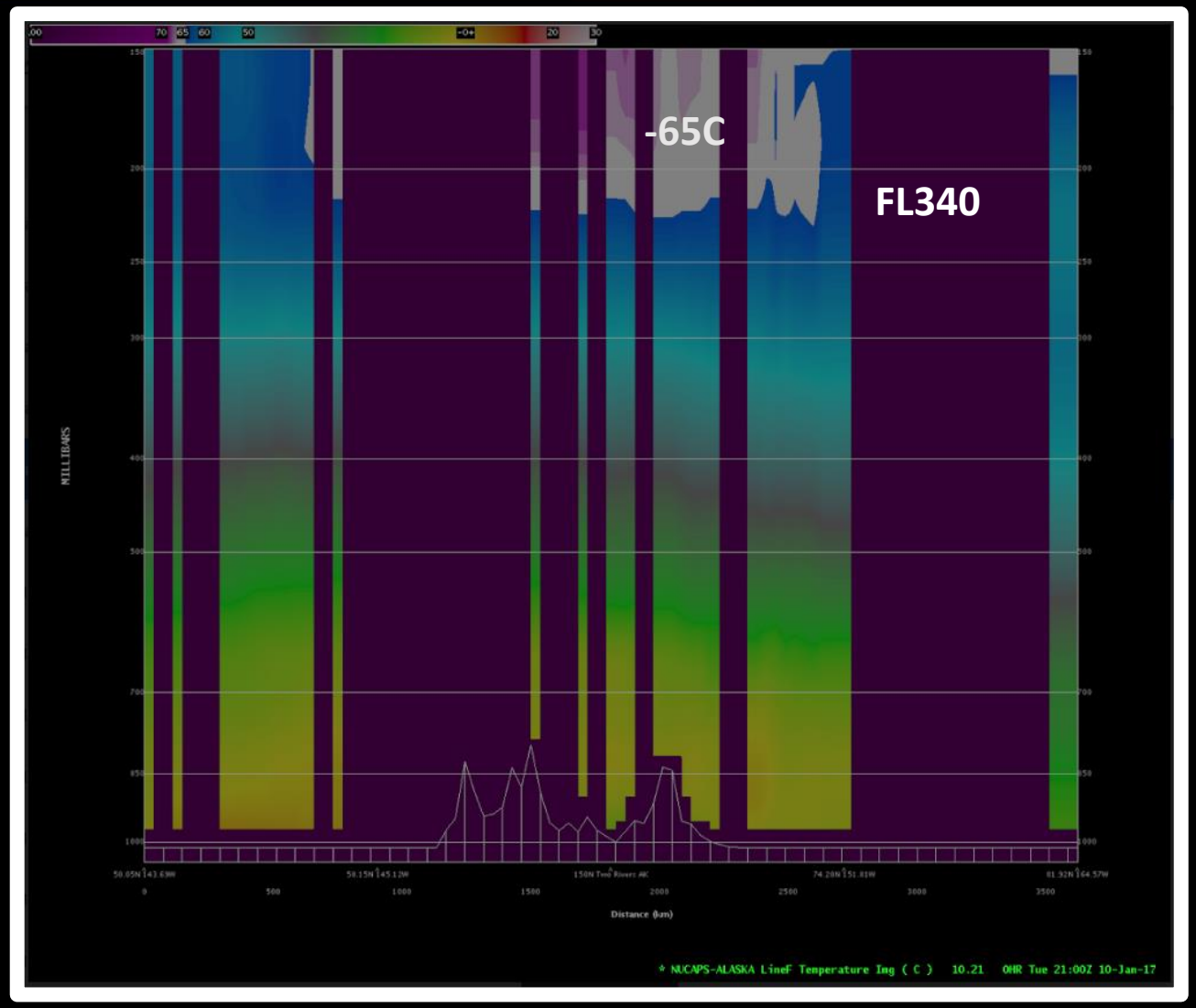
FAAK20 KZAN 101720
ZAN MIS 31 VALID 101730-110530
...FOR ATC PLANNING PURPOSES ONLY...
FROM 400NE BRW-150SE KTN-160S PDN-300NW
BRW-400NE BRW
COLD AIR ALOFT
TEMPS -65C OR LESS ABV FL350. MOV E 15KT. NC.
CMW JAN 17

Case Study #1: Gridded NUCAPS Data

-65C or colder depicted in purple and white colors



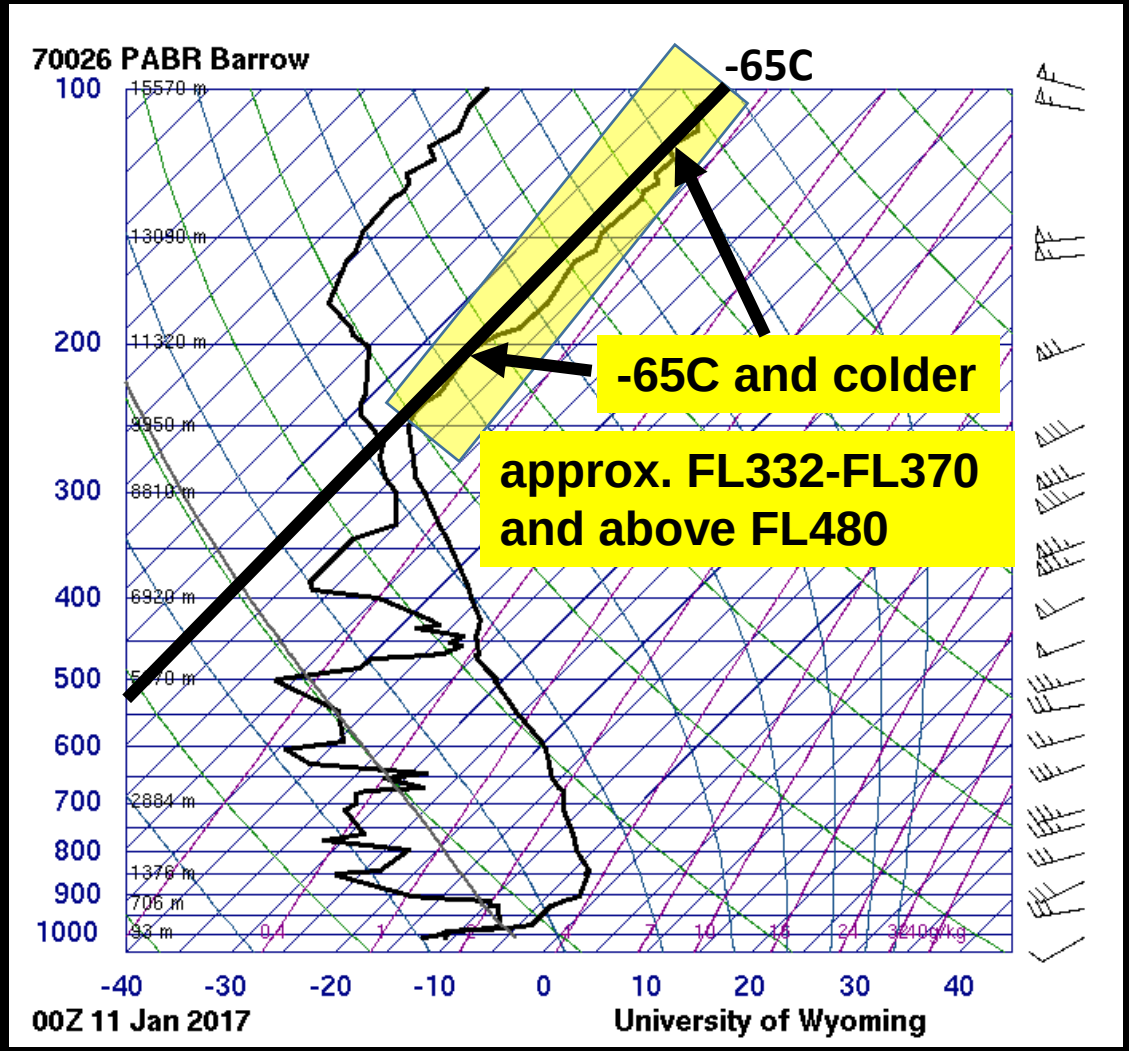
Case Study #1: NUCAPS Cross-Section



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 Data

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 #2: 1-3 February 2017

GFS or NAM Model Data

PIREPs

AMDAR Data

Gridded NUCAPS Products

Gridded NUCAPS Sounding

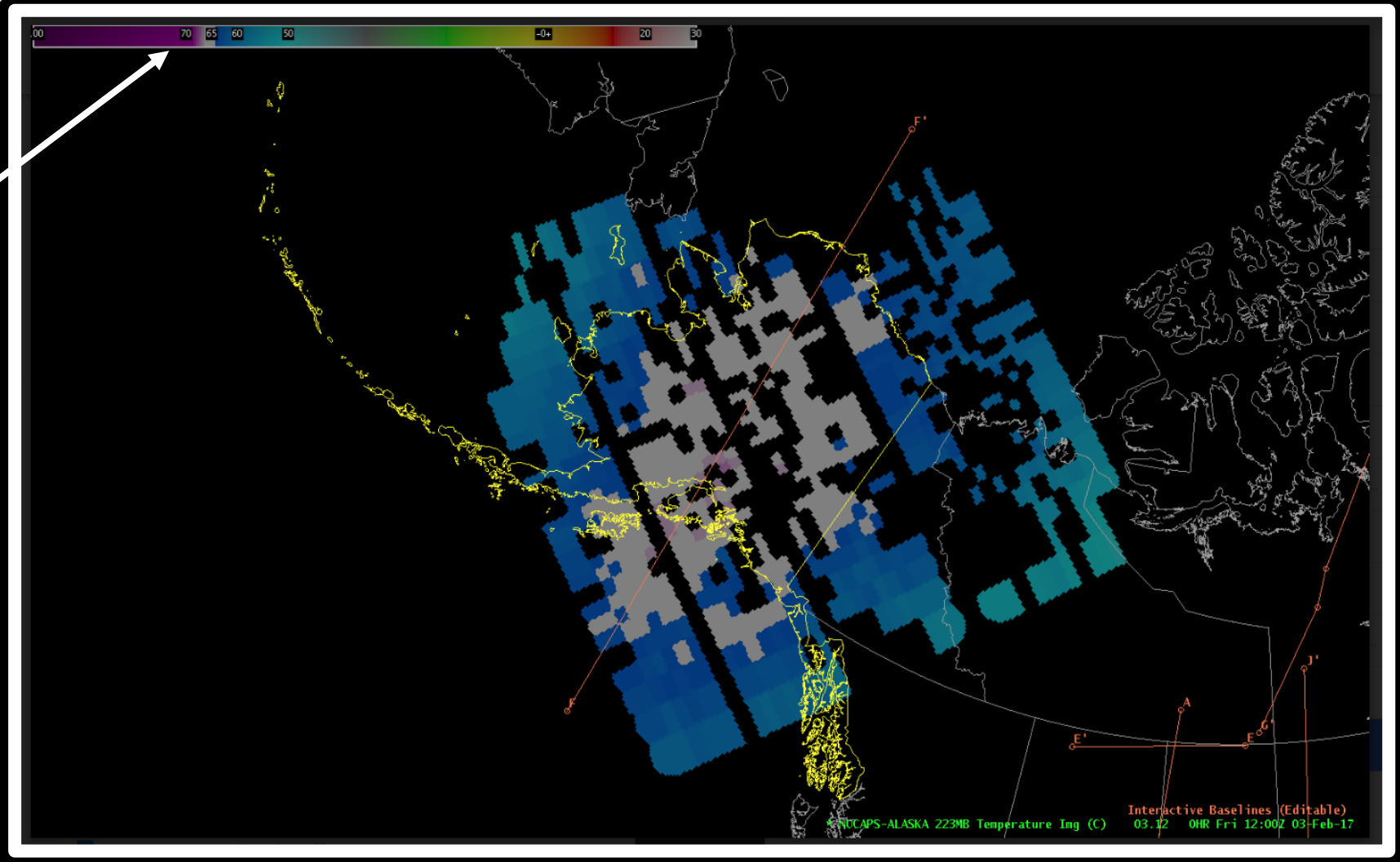
Station Sounding

CIRA CAA Products

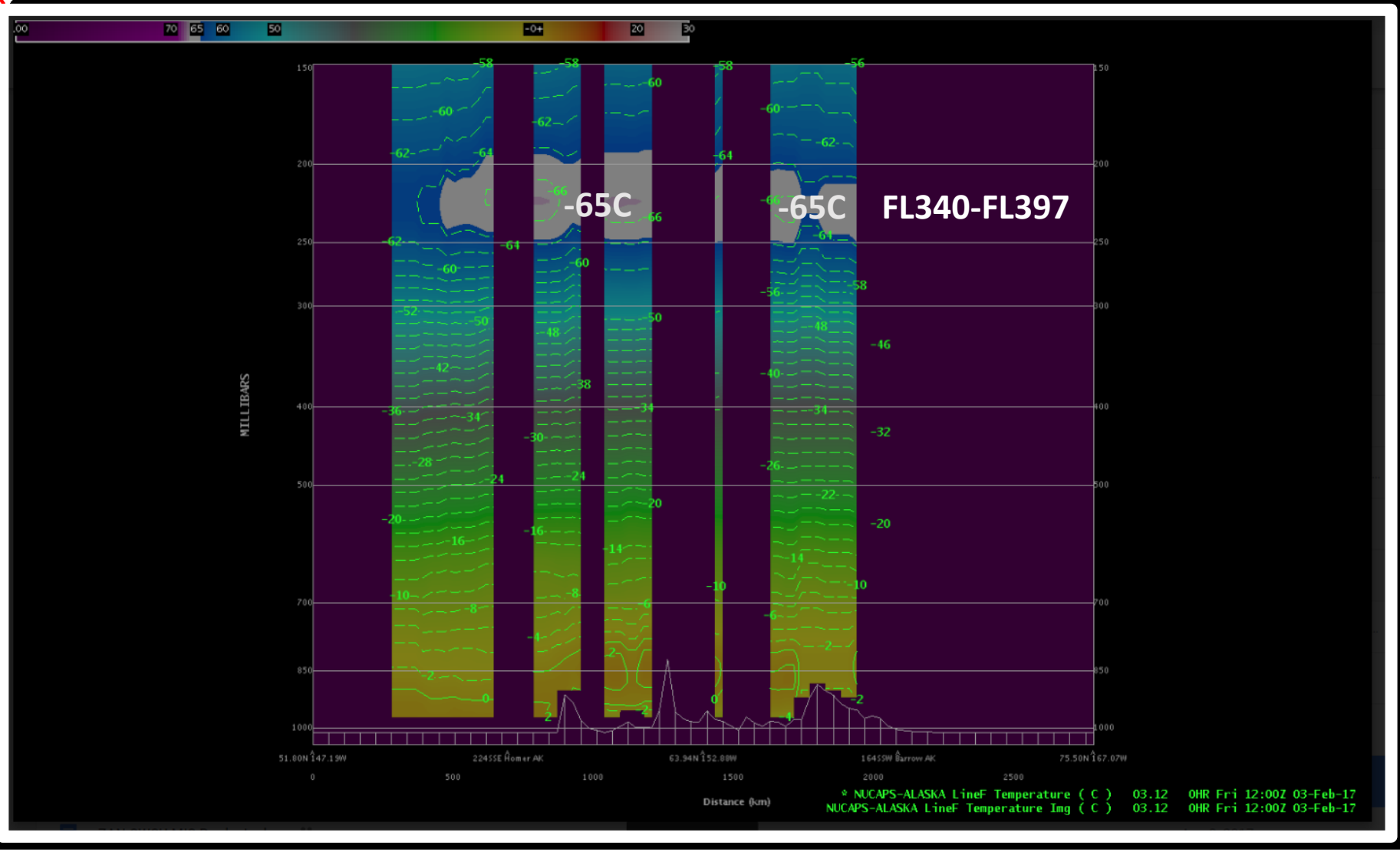
FAAK20 KZAN 030256
ZAN MIS 06 VALID 030300-031500
...FOR ATC PLANNING PURPOSES ONLY...
FROM 205NNW BRW-55ESE BTI-35WNW YAK-65N
ADQ-90NNE ULL-240NNW OME-205NNW BRW
TEMPS -65C OR LESS FM FL350-FL400. STNR. NC.
NO UPDATES AFT 0600Z...REFER TO
HTTP://AAWU.ARH.NOAA.GOV
GMW FEB 17

Case Study #2: Gridded NUCAPS Data

-65C or colder depicted in purple and white colors



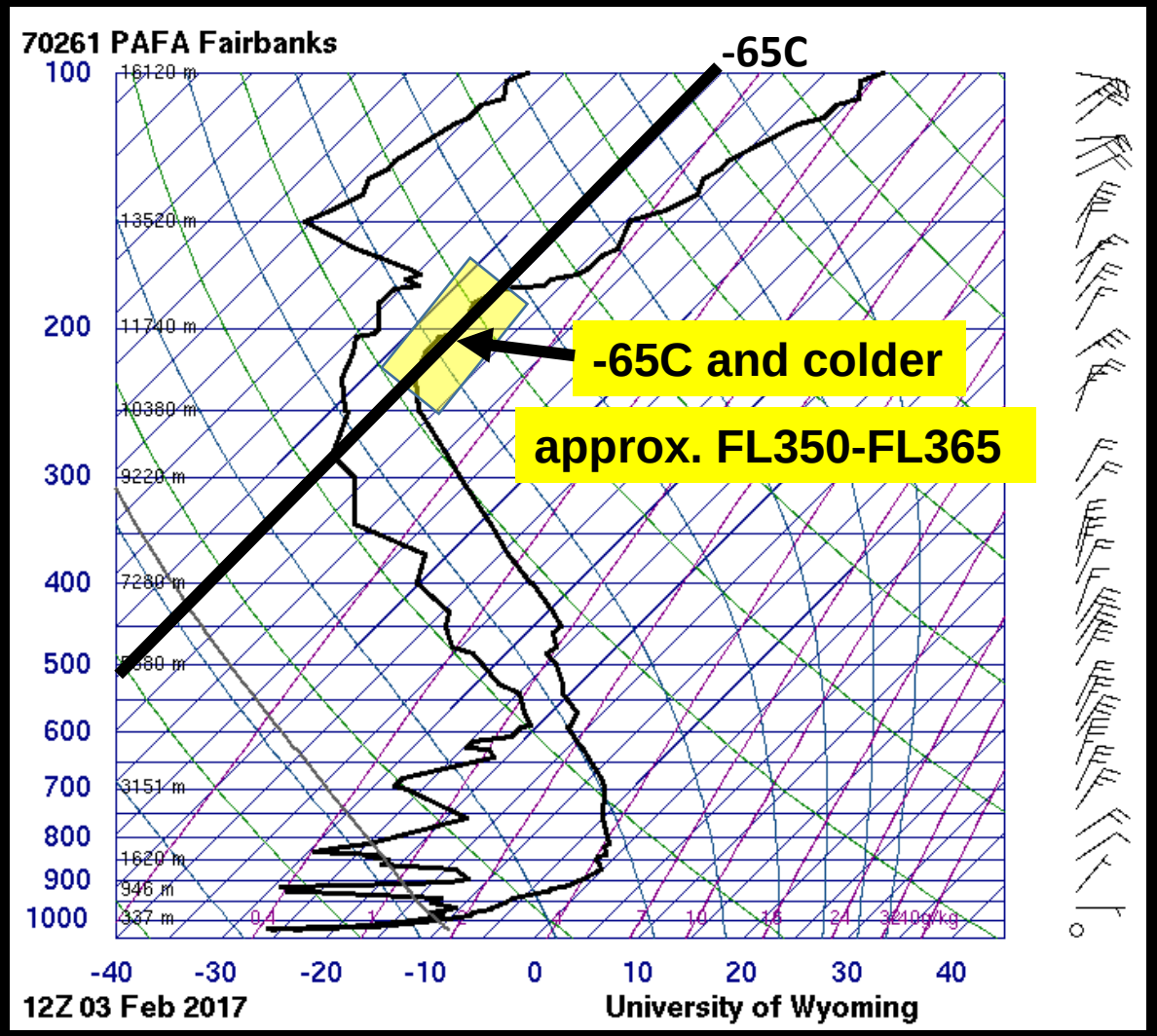
Case Study #2: NUCAPS Cross-Section



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



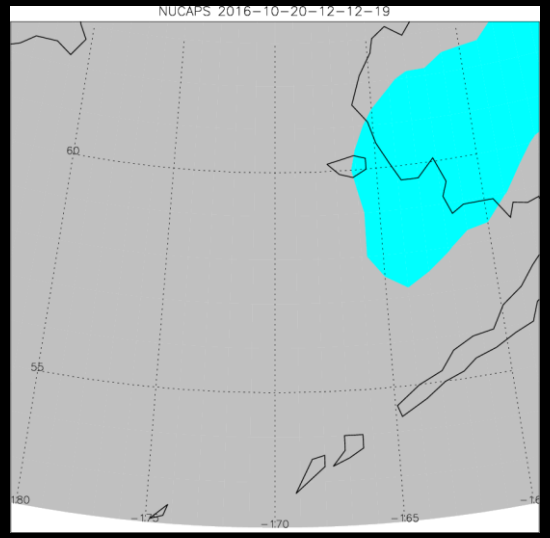
Case Study #2: AMDAR Data

ANC(Up) 0143 11Jan17 (Aircraft #9082)
Ascent sounding toward 136° from Anchorage Int'L, AK (ANC) lasting 180 min, and covering 1510 nautical miles

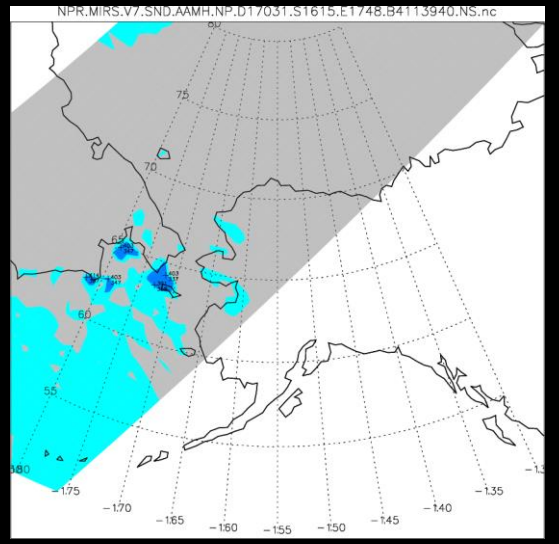
P_alt (ft)	mb	t (°C)	w_dir/w_spd (kts)	Time (UTC)	Bng/Rng (nm)
34180	248	-61.0	38°/052	1718	353°/091
34630	243	-62.0	39°/054	1718	353°/092
35990	227	-64.0	0°/048	1754	2°/323
36000	227	-65.0	35°/050	1721	355°/113
36000	227	-65.0	29°/041	1727	358°/152
36000	227	-64.5	20°/038	1729	359°/165
36000	227	-64.5	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

Winter 2016-2017 CAA Assessment Feedback Results

- Warm bias at start of assessment; fixed by beginning of Jan 2017
- Switched CAA heights displayed on CIRA web page (lower height on bottom)
- Expanded maps displayed on CIRA web page:

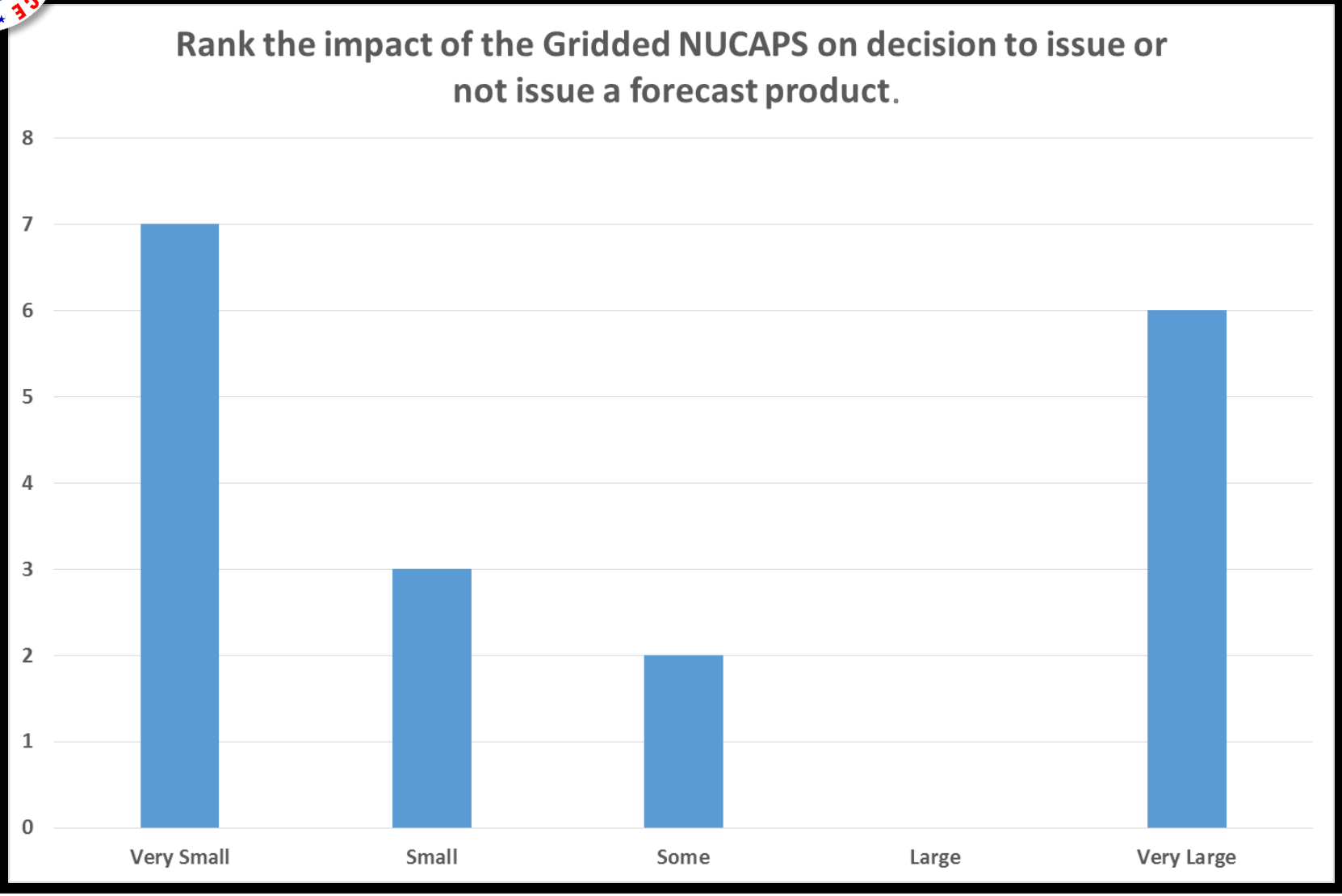


Bering Sea Sector before feedback

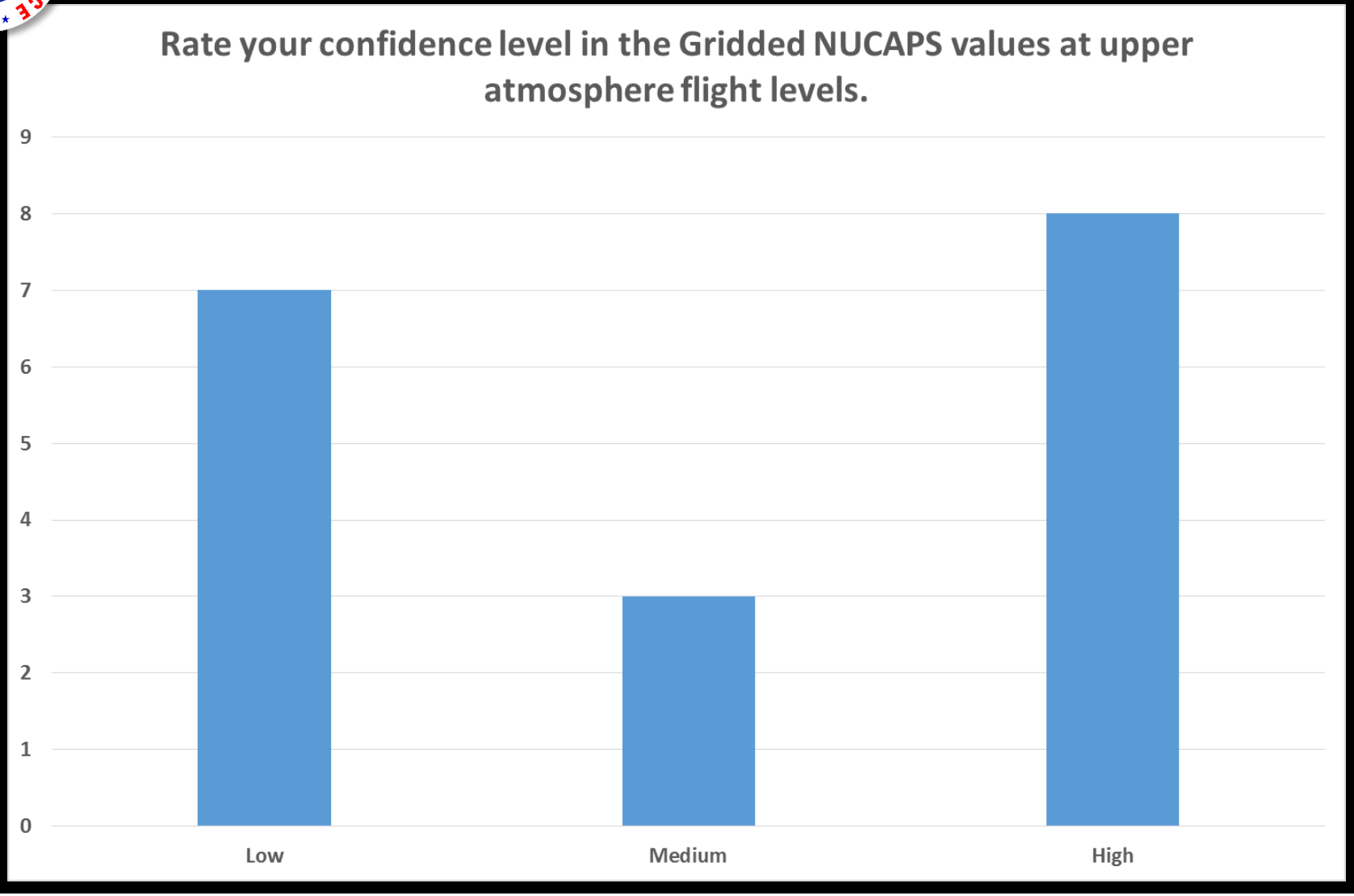


Alaska Sector after feedback

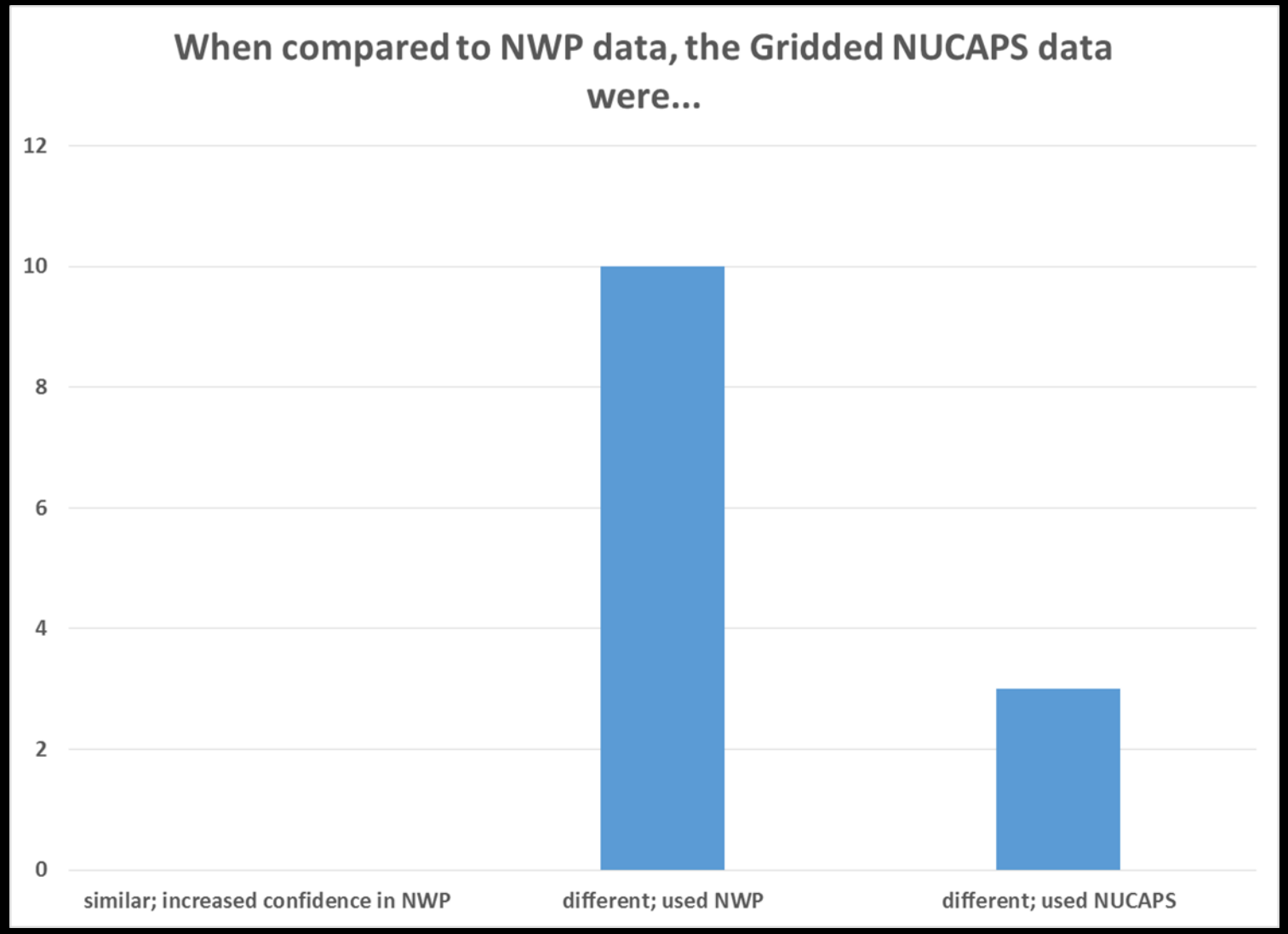
Operational Impact



Forecaster Confidence In Gridded NUCAPS Products



Gridded NUCAPS VS. NWP Data



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

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