Assessment Report
2018 Gridded NUCAPS Cold Air Aloft Evaluation

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Introduction

The Cold Air Aloft (CAA) forecast challenge is unique to the Center Weather Service Unit (CWSU) in Anchorage (ZAN), Alaska. When temperatures are -65° C or less jet fuel "waxing" or water crystallization in the fuel may occur. These hazardous conditions can result in a loss of engine performance due to restricted fuel flow. Fuel freezing points can vary from -40° to -60° C, but water in fuel can freeze at higher temperatures. The ZAN CWSU uses the -65° C threshold for CAA forecasting and warning and is the only CWSU that issues a CAA Meteorological Impact Statement (MIS). Climatologically CAA events occur most frequently in January, February, and March. In 2017, March was the busiest month for CAA events as evidenced by the number of MIS issued ***(Fig.1)***. Forecasters have a unique challenge of anticipating areas of CAA over a data sparse 2.4 million square mile area of responsibility. There are only 14 upper air stations and routine soundings are not always available twice a day due to staffing, equipment, and computer issues. With only one forecaster on shift at the CWSU, there is little time to assess the environment for CAA given additional forecasting responsibilities related to low-level wind shear, mountain waves, turbulence, and icing. Given the nature of limited data over a vast domain, satellite observations can fill the gaps between routine observations and model runs. The Joint Polar Satellite System (JPSS) NOAA Unique Combined Atmospheric Processing System (NUCAPS) Initiative developed the capability to provide plan-view displays of Suomi-National Polar Orbiting Partnership (S-NPP) Cross-track Infrared Sounder/Advanced Technology Microwave Sounder (CrIS/ATMS) temperature observations (i.e Gridded NUCAPS) in the Advanced Weather Interactive Processing System (AWIPS). The product is referred to Gridded NUCAPS since the CrIS/ATMS observations are processed through the operational NUCAPS algorithm (Gambacorta et al. 2013).

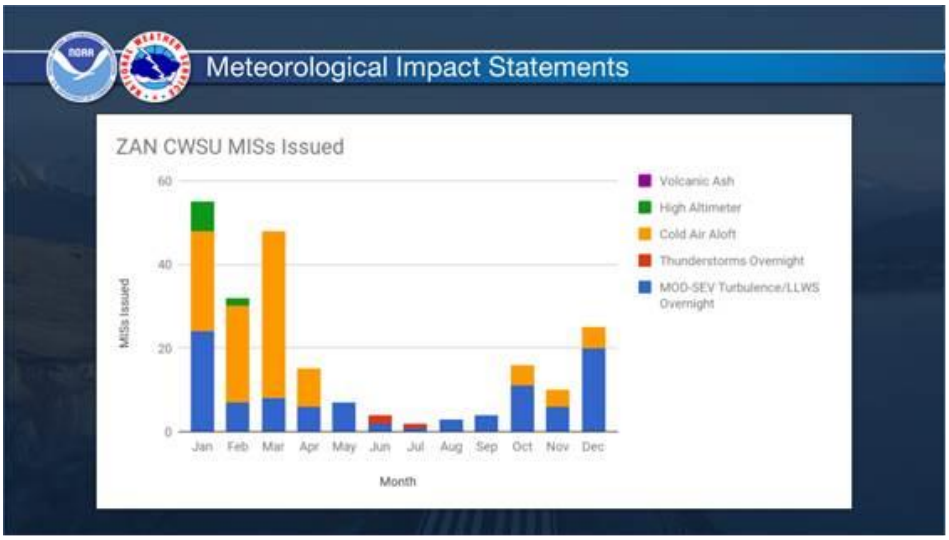


Figure 1. Summary of Anchorage CWSU Meteorological Impact Statements issued in 2017 ***(courtesy of Carrie Haisley, ZAN CWSU)***

User Feedback

a. Summary of online responses

There were a total of 13 online responses from 2 February to 30 March 2018. Gridded NUCAPS was rated with a "Very Large" impact on the forecast process for 8 events, "Large" impact for 2 events, and "Very Small" Impact for 3 events ***(Fig. 2)***. On 20 February the Gridded NUCAPS had a "Very Small" impact on the forecast process because the data was too latent and unavailable. The Gridded NUCAPS was rated with a "Very Small" impact on 22 and 30 March because the forecaster had confidence in another analysis/model or real-time observation and the Gridded NUCAPS missed the location or magnitude of the feature compared to other observations. Overall 77% of the feedback indicated Gridded NUCAPS had a "Large" to "Very Large" impact on the forecast process, specifically the decision to issue or not issue a forecast product ***(Fig. 2)***. The feedback results indicate the forecasters were able to assimilate the Gridded NUCAPS and Soundings into their forecast process. ***Figures 3 and 4*** below show that 82% of the time NUCAPS was similar to NWP and increased confidence in NWP and 67% of the time NUCAPS was similar to observations and increased confidence in the event. There were no instances where NUCAPS was different than NWP or observations and the forecaster chose to use or have more confidence in NUCAPS ***(Figs. 3 and 4)***. NUCAPS was use to confirm NWP or observations or fill in the gap when no observations were available. Another question was asked to "Rate your confidence in the Gridded NUCAPS when viewing data on flight levels." Unfortunately, due to the limits of the operational environment, the configurations to view the data on flight levels in AWIPS was not configured until the close of the evaluation period. Forecasters were able to effectively use the data in AWIPS on pressure levels paired with the flight level information on the CIRA CAA web page to determine the flight level of the CAA. Post-evaluation statements from the forecasters regarding their use and confidence in Gridded NUCAPS on flight levels in AWIPS are summarized in the conclusions and recommendations section.

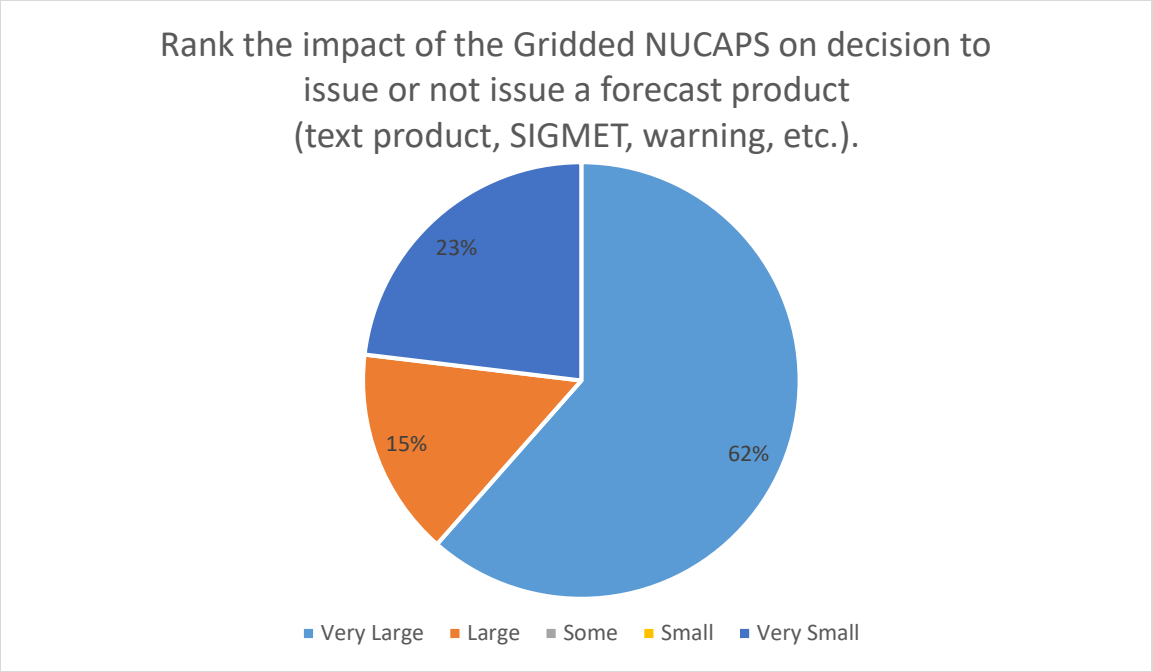


Figure 2

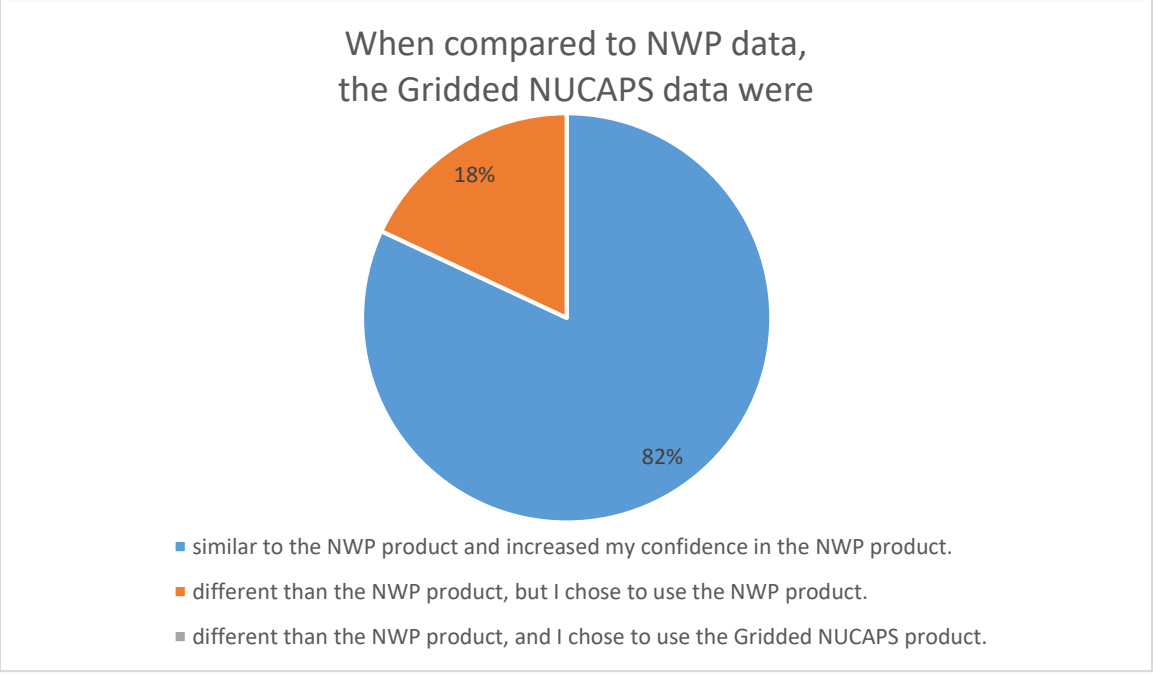


Figure 3

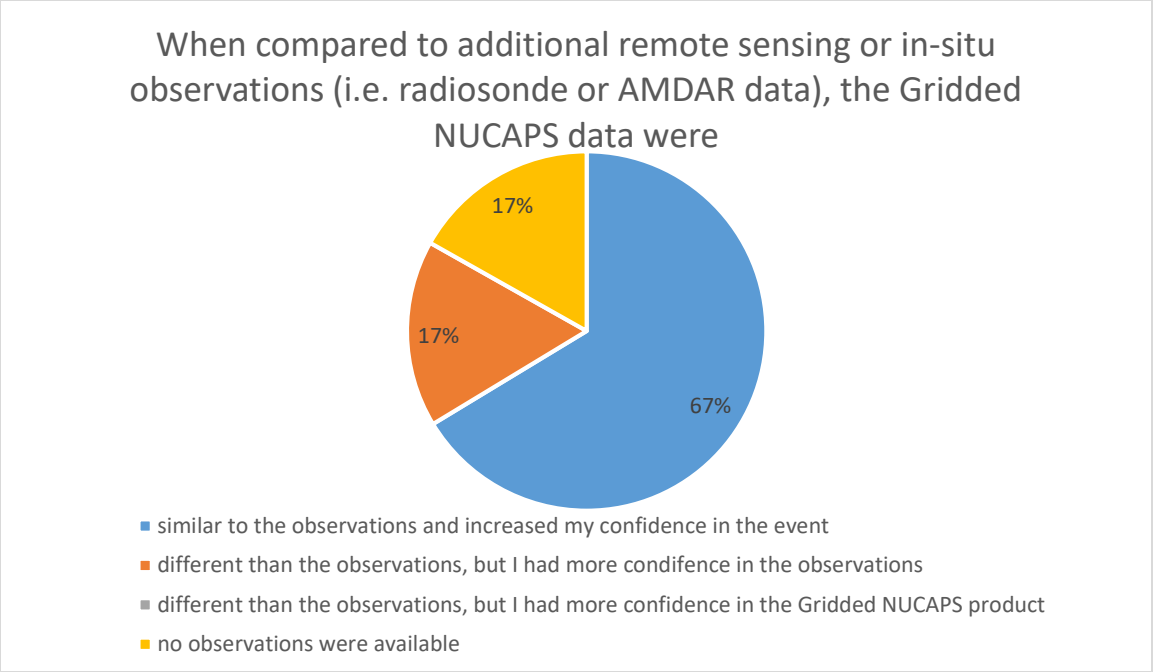


Figure 4

Product Impact and Limitations

a. Summary of Results

The 2018 CAA Winter Assessment was conducted from 5 January thru 31 March. During that time, a CAA MIS was in effect 47 out of 85 days. The most popular month was February, when a CAA MIS was in effect 23 out of 28 days. Overall, Gridded NUCAPS data, when available, increased forecaster's confidence in the CAA event. There were a few instances when Gridded NUCAPS data was not available on AWIPS, or the Gridded NUCAPS data was available, but did not line up with the CAA area due to the satellite path coverage. There were also times when the Gridded NUCAPS data did not closely match the RAOB and NWP data. Finally, forecasters also highlighted Gridded NUCAPS latency issues, which were especially evident during the initiation of CAA events. Gail Weaver's online feedback from 20 February stated: "Latest NUCAPS Soundings availability on AWIPS was 20/1321Z. This data was way too latent to use for the 21/0500Z CAA MIS."

b. Case Example (Positive – Large Impact)

On 14 February a FedEx MD-11 asked the ZAN air traffic controller for permission to descend from FL360 to FL300 due to a cold fuel temperature indicator on their instrument panel. The aircraft was flying from Memphis to Anchorage at a planned flight level of 34,000ft (FL340). On that day there was a large CAA area of temperatures less than -65° C extending from the north-central United States all the way through Canada and into eastern Alaska. CAA MIS 05 was in effect at the time for temperatures less than -65° C above FL340 across a large portion of northern, central, and eastern Alaska Airspace ***(Fig. 5)***. As the FedEx MD-11 travelled through Edmonton Airspace the Canadian air traffic controllers directed them to ascend to FL360, directly into the CAA area. Once they crossed over into Alaska Airspace they immediately requested permission to descend to warmer air below FL340. Based on feedback from forecasters, Gridded NUCAPS data that day were similar to the observations and increased their

confidence in the event. Chris Waterhouse's online feedback stated: "Gridded NUCAPs data and soundings were in excellent agreement this morning with CAA over much of the state." The Gridded NUCAPS data helped forecasters pinpoint the CAA area and flight levels, and gave air traffic controllers the necessary information to approve the pilot's request to descend safely to a lower altitude. As noted by Gail, "This was one of the rare times the forecasters received feedback on aircraft in ZAN airspace changing altitude due to CAA". This event and an extended duration late February event was pivotal in increasing communication between the CWSU and Anchorage Air Traffic Control Center and raising awareness of the CWSU's CAA MIS beyond the intended customer.

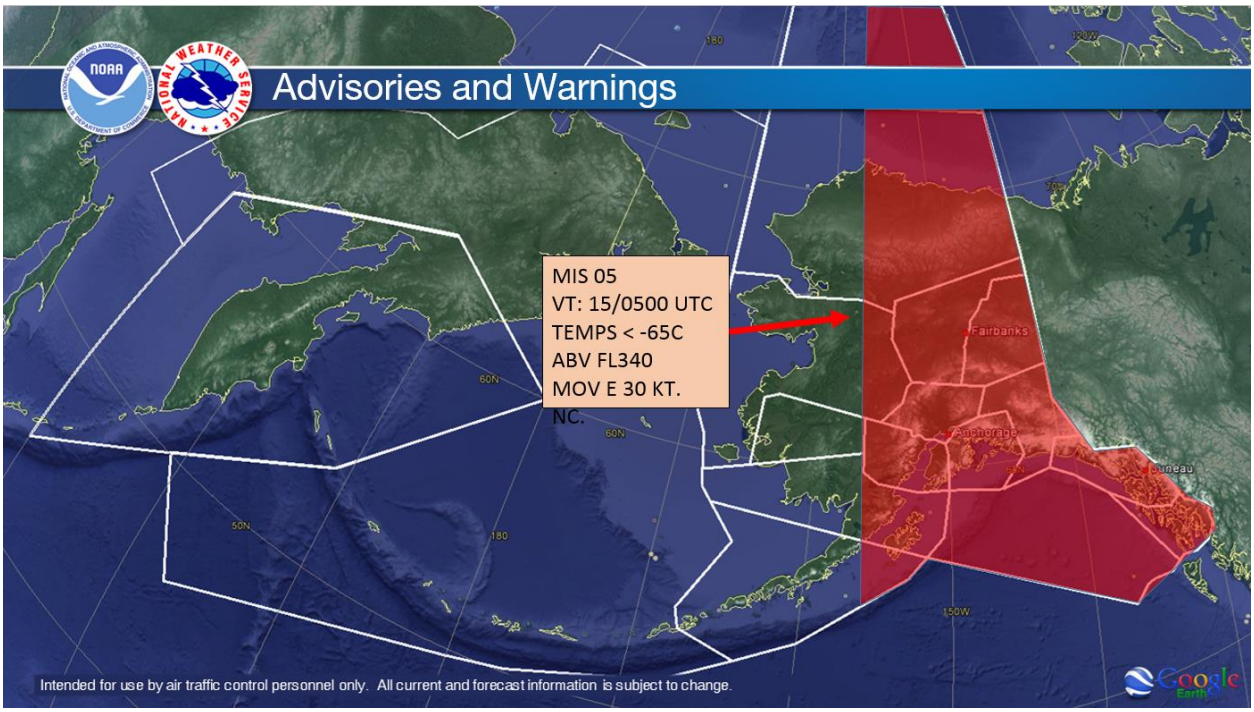


Figure 5

c. Case Example (Negative – Limitations/small impact)

On 22 March Chris Waterhouse's online feedback stated: "12Z NAM showed CAA over the western third of AK this morning. RAOBs confirmed this with -65° C heights between FL350-FL410. Gridded NUCAPS and NUCAPS soundings were much too warm today...only showing a small area of -65 °C mainly over the NW corner of the state and the Seward Peninsula. Compared to area RAOBs (BRW and OTZ missing)... the observed minimum temps were -69° C...NUCAPS gridded data was 4° - 6° C too warm in most locations. Also...heights of the Gridded CAA ranged between 260mb-212mb which equates to FL320-FL370. So even where it picked up the CAA it was 3-4K feet too low." In this case, the gridded NUCAPS temperatures and CAA height differences from RAOB data decreased the CWSU forecaster's confidence in the Gridded NUCAPS products that day. NWP and RAOB data were used to issue the CAA MIS ***(Fig. 6)***.

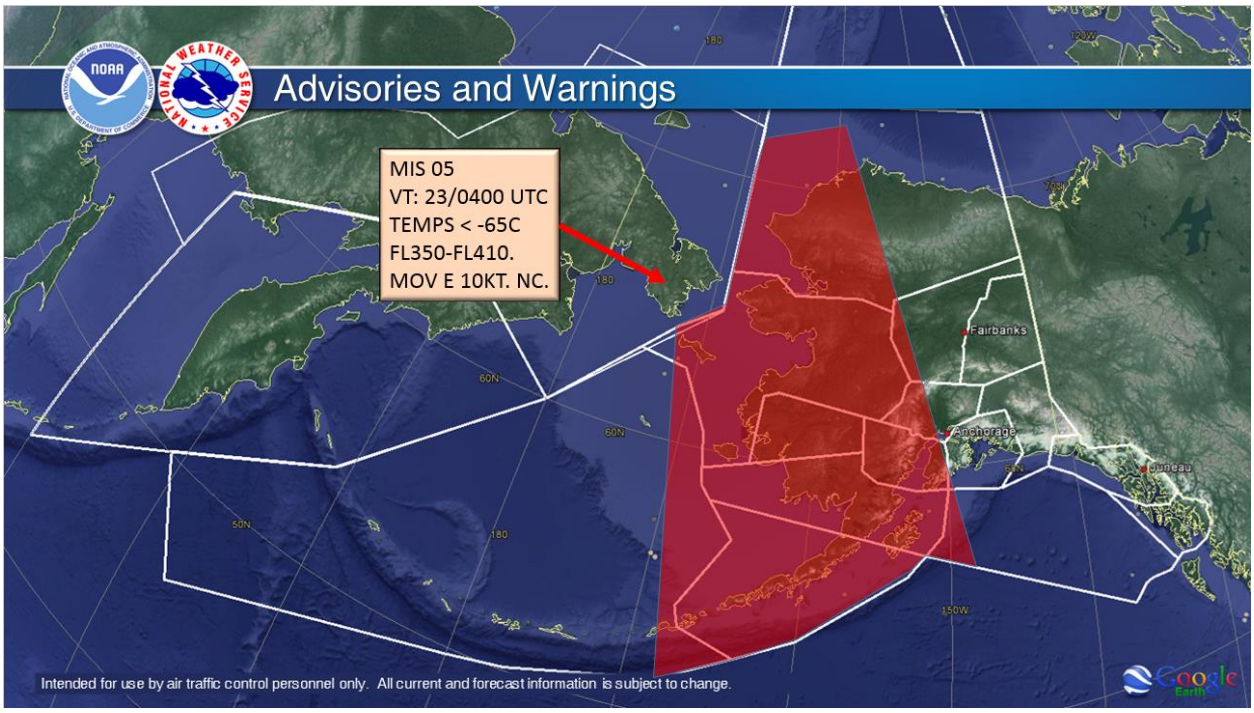
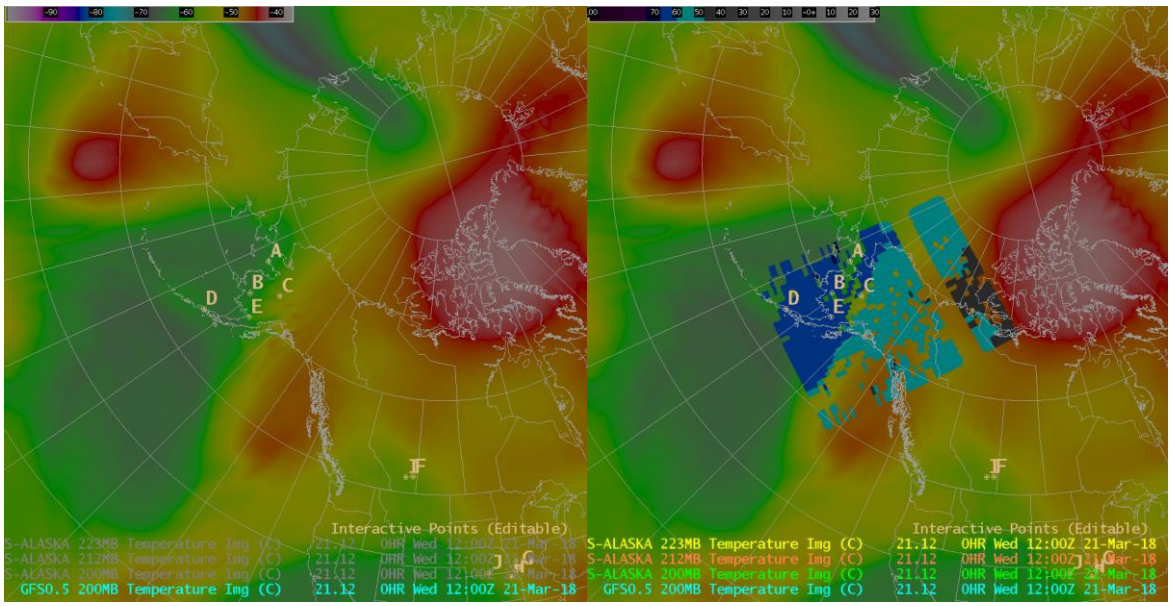
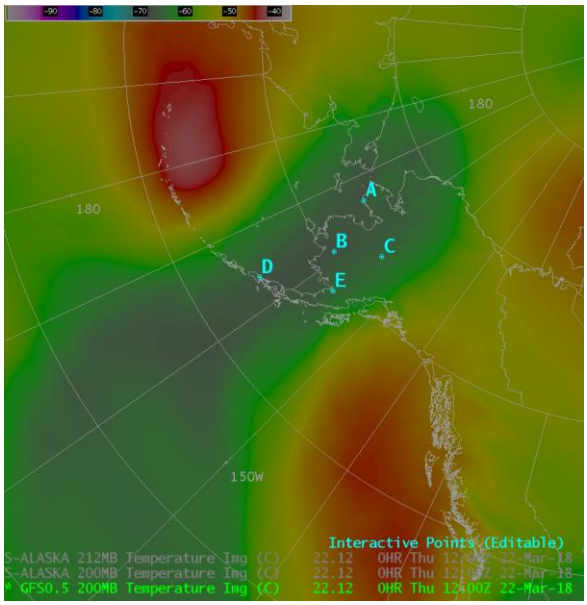

Advisories and Warnings
MIS 05
VT: 23/0400 UTC
TEMPS < -65C
FL350-FL410.
MOV E 10KT. NC.
Fairbanks
Anchorage
Juneau
Intended for use by air traffic control personnel only. All current and forecast information is subject to change.

Figure 6


A
B
C
D
E
F
Interactive Points (Editable)
S-ALASKA 223MB Temperature Img (C) 21.12 0HR Wed 12:00Z 21-Mar-18
S-ALASKA 212MB Temperature Img (C) 21.12 0HR Wed 12:00Z 21-Mar-18
S-ALASKA 200MB Temperature Img (C) 21.12 0HR Wed 12:00Z 21-Mar-18
GFS0.5 200MB Temperature Img (C) 21.12 0HR Wed 12:00Z 21-Mar-18



Confidence in which model to trust…observations

Conclusions and Recommendations

- ***Establish benefit of data on flight levels***

Gridded NUCAPS data displayed as flight levels on AWIPS saves forecaster time in preparing and disseminating CAA products. Instead of taking extra time to convert the data from millibars to flight levels, the forecasters are able to see at a glance what the flight levels are for the entire area of CAA by creating a cross-section on AWIPS. The 3-D cross-section visualization is also valuable for determining the CAA boundaries.

- ***Explore the use of Microwave-only Soundings***
- ***Recommend CIRA web processing/web display be made operational at the Office of Satellite and Product Operations (OSPO) as part of the Soundings webpage***

The CIRA website is invaluable to CWSU forecasters since it serves as a backup in case the AWIPS is inoperable, and it provides a looping capability and visualization of CAA labeled in thousands of feet. The web display also provides a platform to directly compare NUCAPS data with GFS data. Including the CIRA CAA visualization on the OSPO website would allow for increased accessibility and use of NUCAPS observations for CAA events by a broader national and international community or non-AWIPS users.

- ***Expansion to international agencies***

It would be beneficial for aircraft safety and efficiency to coordinate CAA products with Canada, Russia, and Oakland since the CAA areas extend into their airspace. On 7 February 2018, the ZAN CWSU hosted a Canadian meteorologist from the Canadian Meteorological Aviation Centre and showed him the MIS CAA product. He was very interested in the product and its' relevance to aircraft safety, but he works for a private aviation weather company and we have not received any other feedback from them on implementing a CAA product in Canadian Airspace. No attempts have been made to coordinate a CAA

product with the Russians or ZOA CWSU (Oakland). Recommend reaching out the ZOA CWSU to determine their interest in Gridded NUCAPS for CAA events and coordination with the ZAN CWSU. In addition, recommend reaching out to the Canadian Meteorological Aviation Centre to determine interest in the CIRA web display and coordination of CAA MIS's or similar products to alert customers of the aviation hazard.

- ***FAA Feedback***

The ZAN CWSU focused on obtaining more CAA MIS feedback from the FAA ZAN managers and air traffic controllers during this winter's CAA Assessment. For the first time, CWSU forecasters heard directly from air traffic controllers when pilots requested permission to change their flight level to avoid CAA. CWSU forecasters emphasized the importance of obtaining temperature data from pilots, and solicited PIREPs directly from air traffic controllers when aircraft were flying through or close to CAA areas. This real-time feedback helped verify CAA areas and flight levels, and validated Gridded NUCAPS data. Also, long-lived CAA events with flight level temperatures as cold as -74° C across Canada and Alaska brought more attention to the impacts of low fuel temperatures this past winter. During such an event in in February, Alaska Airlines and Ravn Alaska regional airline dispatchers were directed to the ZAN CWSU website where MIS's are displayed in order to obtain the latest CAA information.