



Tools for the Operational Management of Inflight Icing in the 21st Century...Revisited

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First and foremost

Thank you, Marcia!



From the 1996 Paper

AIAA 96-0136

ICAO Journal, January 1997

- With two exceptions:
 - that of a microburst or other wind shear...
 - and volcanic ash,
no other meteorological phenomena are so capable of compromising aircraft performance so rapidly...
- *Beyond performance, icing is the only phenomenon capable of compromising control*



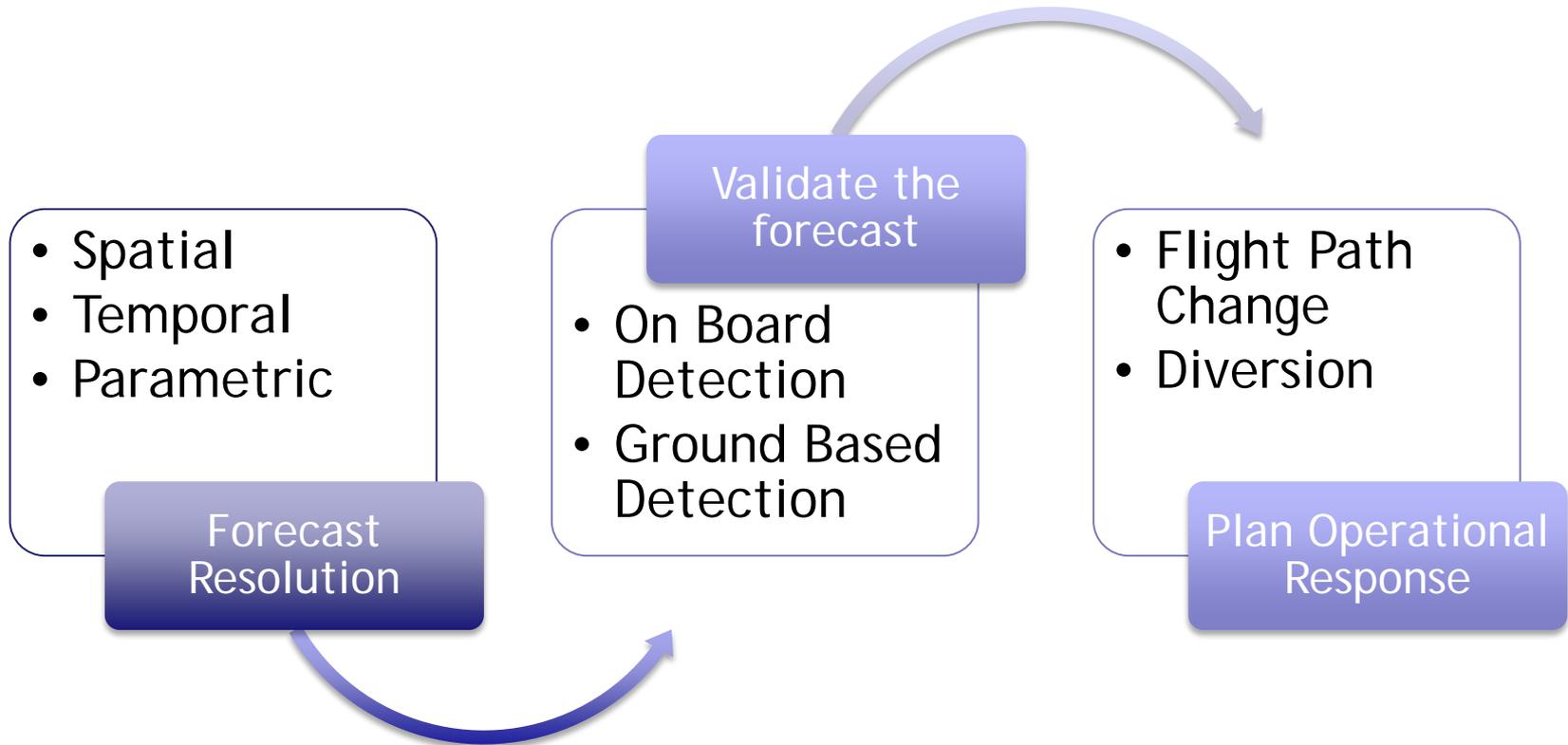
A Strategic Approach

From the 1996 Paper

- *Both enroute and terminal area forecasts of icing conditions must achieve adequate spatial, temporal and parametric resolution to allow changes in operational planning.*
- *Methods of predictive detection must be developed and implemented so that both ground-based and on-board detection can be used to validate the forecast and plan an operational response to the conditions before they are encountered.*



1996 Core Concept





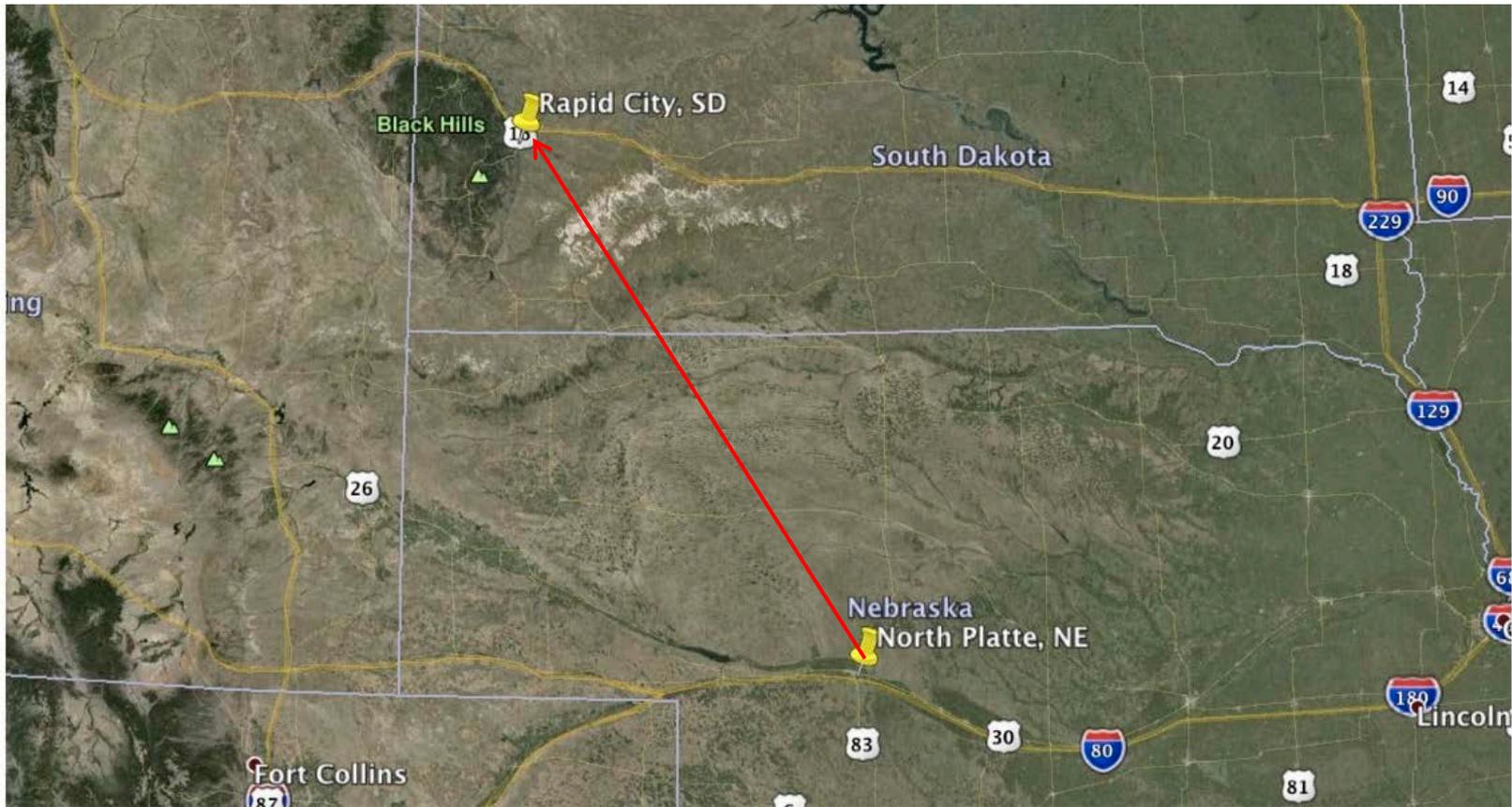
The Thunderstorm Analogy

From the 1996 Paper

- When dealing with thunderstorms, the pilot is presented with:
 - A forecast which, in past experience, has frequently been confirmed...thus giving the pilot a good degree of confidence in forecast accuracy
 - A nowcast based on real-time detection of thunderstorms
 - A weather radar system...allowing a strategic response in enroute flight planning
- When dealing with icing...
 - Inconsistent forecasts
 - Ambiguous PIREPs
 - Ambiguous experience



2013 Case Study



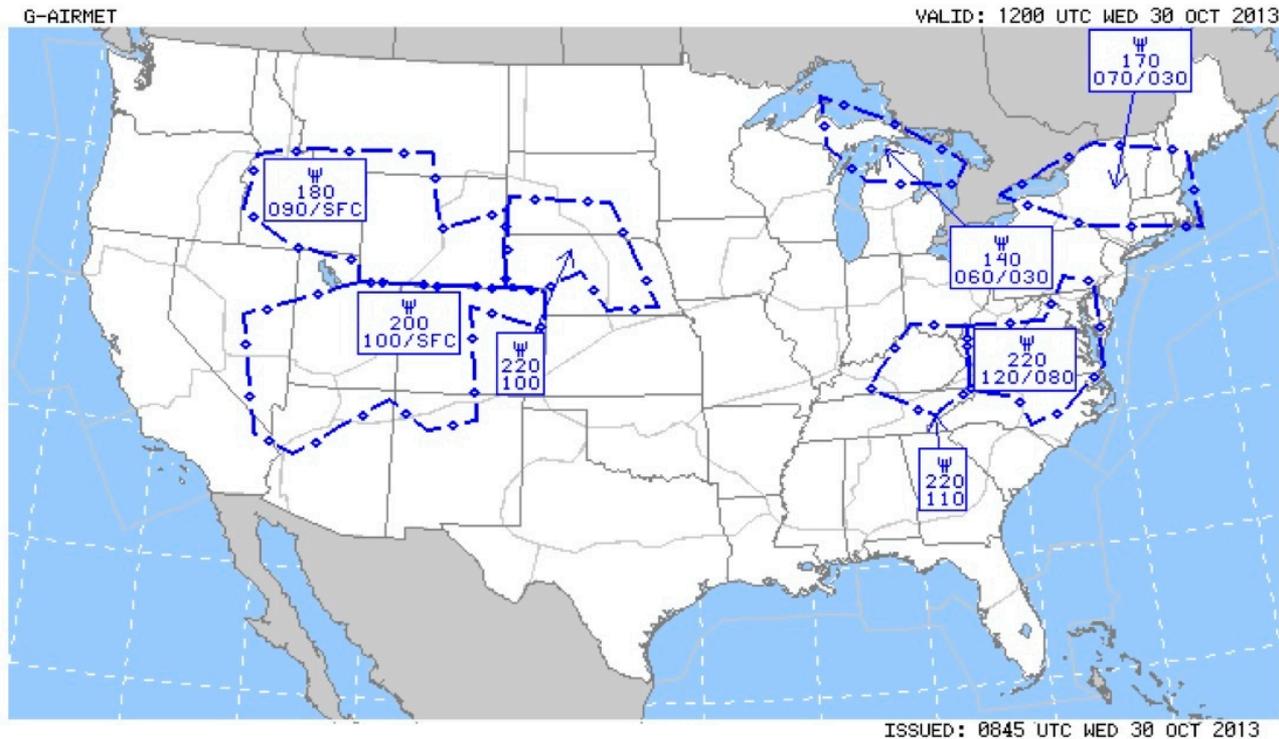


The Flight

- Typical pressurized twin turboprop with 8 to 10 seats
- Planned departure from North Platte is at 1500Z
- Planned ETA at Rapid City is approximately 1630Z
- Rapid City field elevation is 3204 feet.



1200Z G-AIRMET ZULU



0845Z: Airmet Zulu issued for moderate icing between 10,000 and 22,000 feet



NWS Hazardous Weather Outlook

. DAY ONE . . . TODAY AND TONIGHT

A SLOW MOVING LOW PRESSURE SYSTEM WILL CONTINUE TO BRING WINTRY WEATHER TO THE AREA THIS MORNING . AREAS OF FOG AND FREEZING DRIZZLE WILL CONTINUE BEFORE DISSAPATING BY MIDDAY. OCCASIONAL LIGHT RAIN . . . LIGHT FREEZING RAIN . . . AND SLEET . . . ARE POSSIBLE THIS MORNING . . . BECOMING ALL RAIN BY THIS AFTERNOON . THESE CONDITIONS MAY RESULT IN SLICK DRIVING SURFACES AND WALKWAYS .



LIGHT FREEZING RAIN

FREEZING DRIZZLE

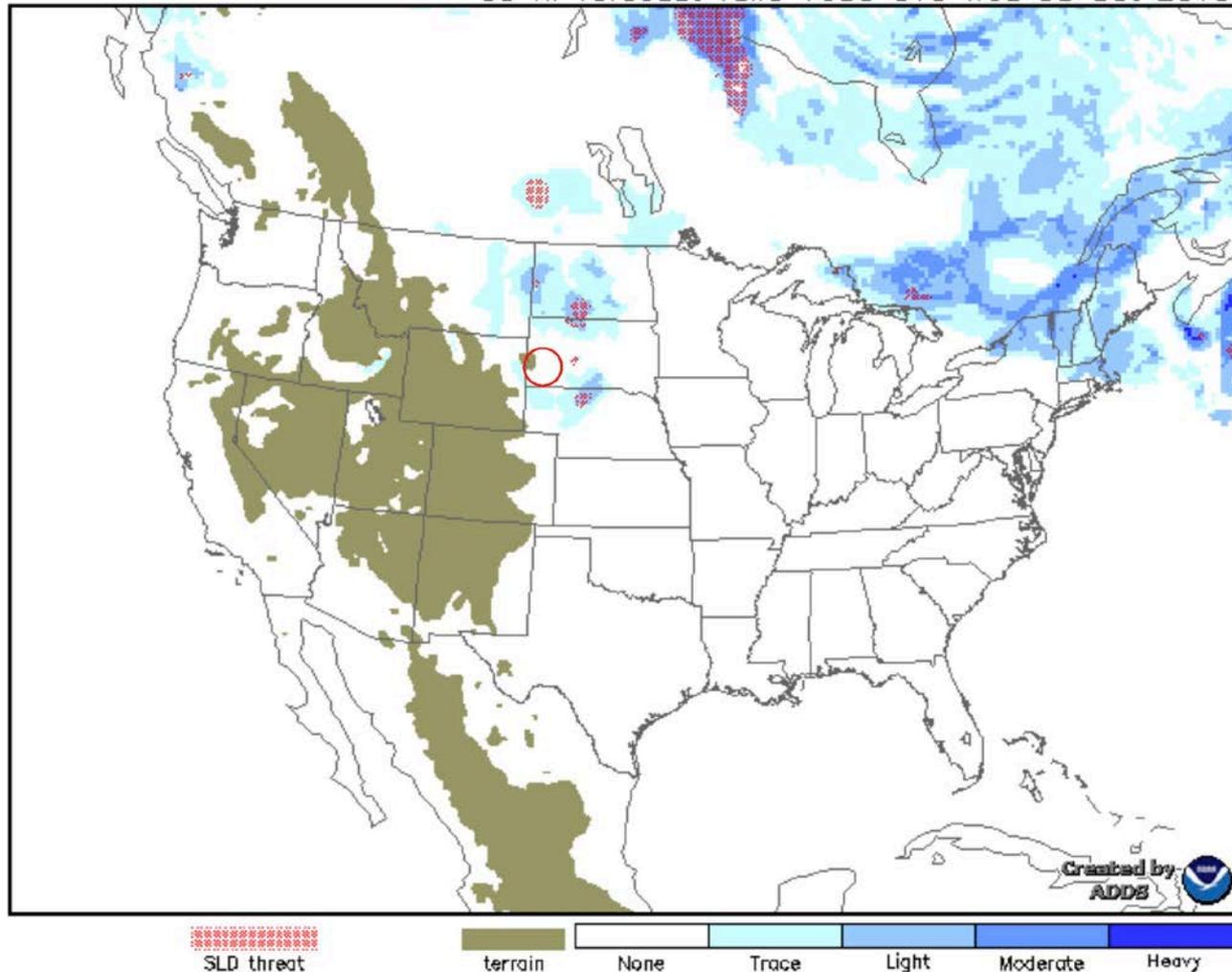


0919Z: NWS issues a Hazardous Weather Outlook



1600Z 5000 ft icing severity

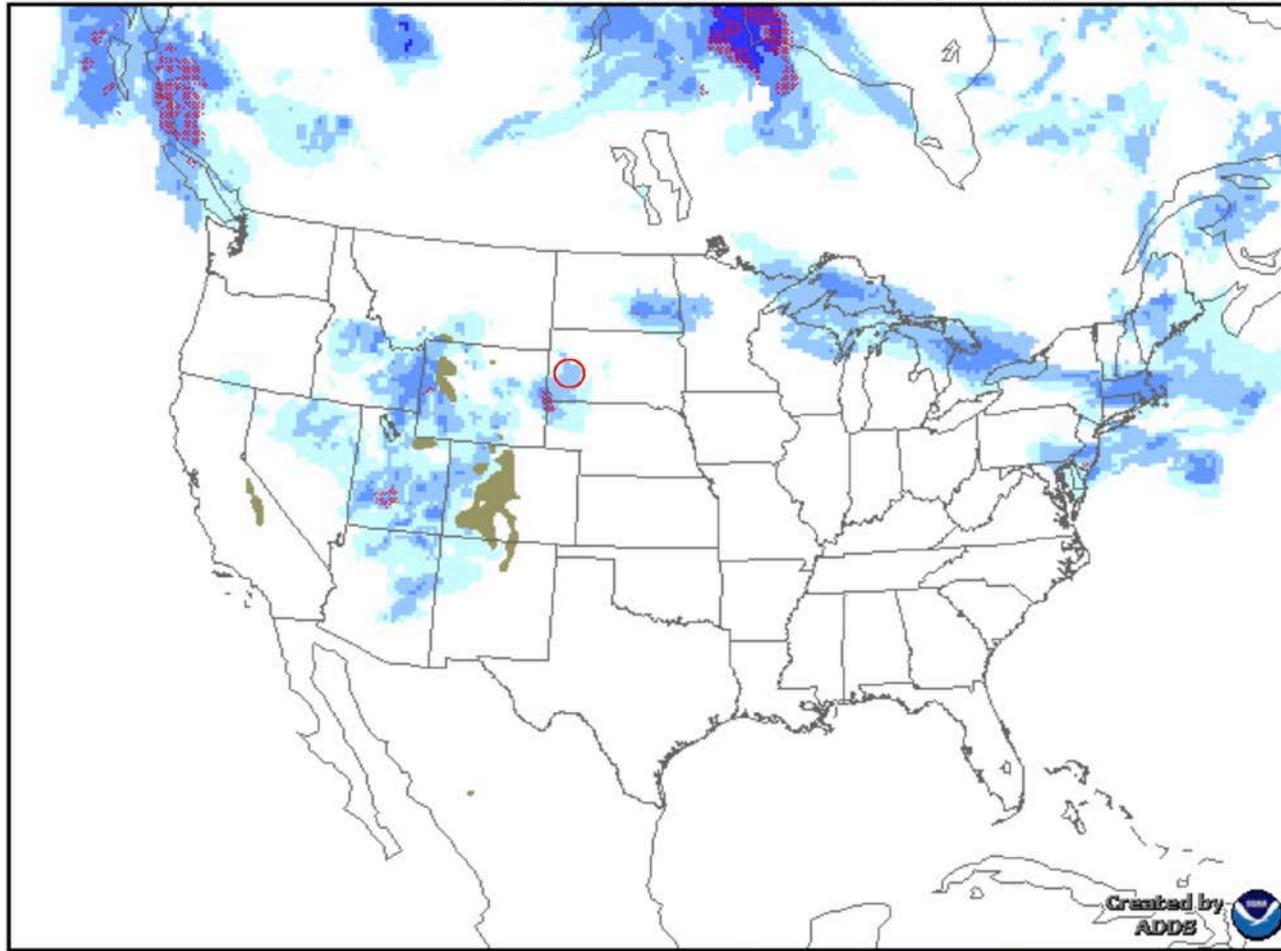
03 hr forecast valid 1600 UTC Wed 30 Oct 2013





1600 Z 9000 ft icing severity

03 hr forecast valid 1600 UTC Wed 30 Oct 2013



SLD threat

terrain

None

Trace

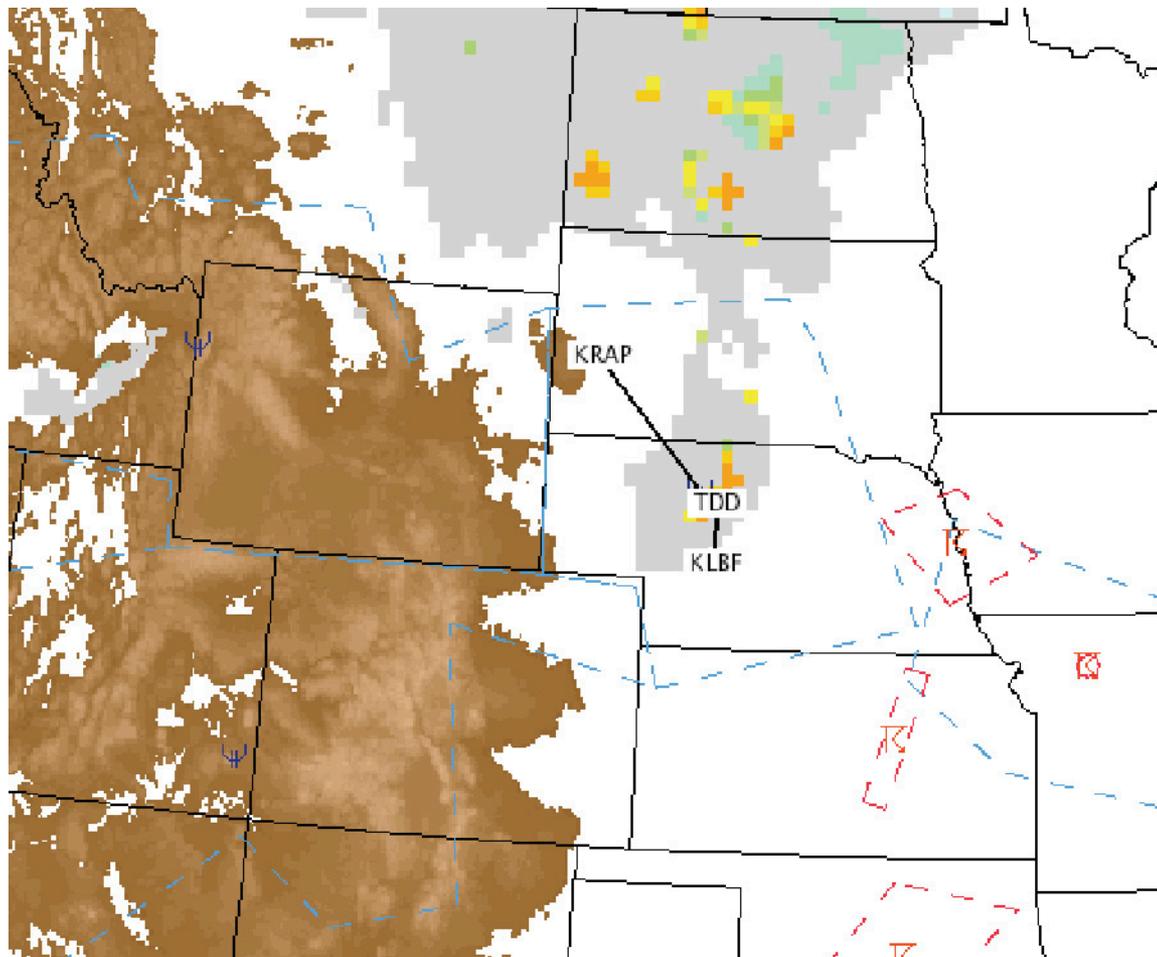
Light

Moderate

Heavy

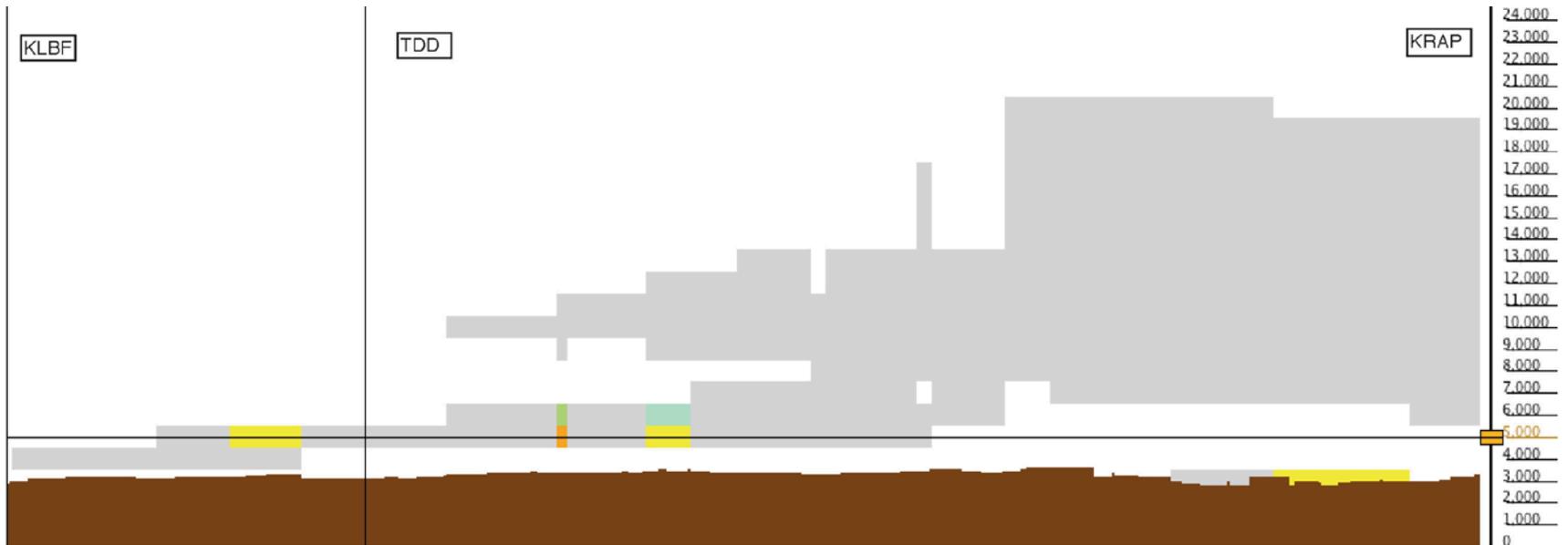


1600Z 5000 ft FPT Plan View





1600Z 5000 ft FPT Profile View





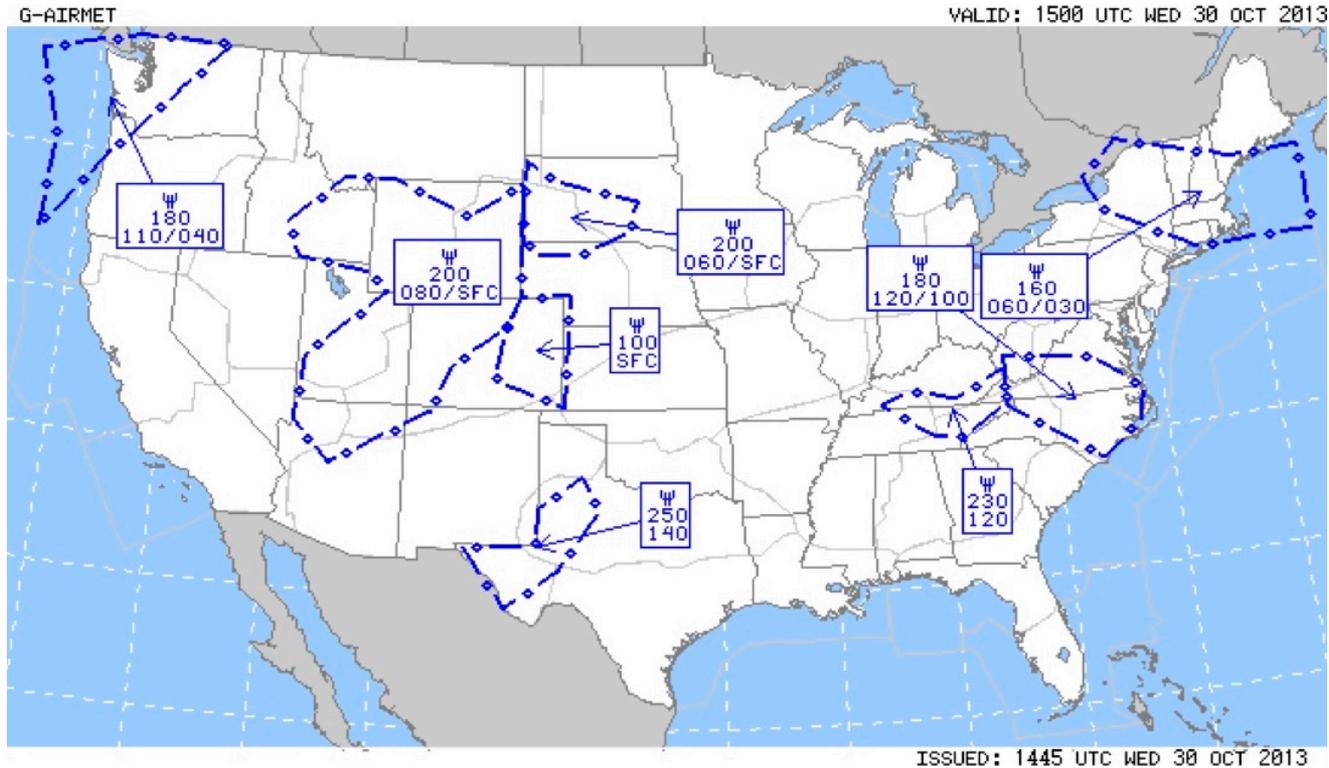
History of FZDZ in the TAFs

- At 1256Z, Ellsworth AFB issues an amended TAF with the following line:
 - BECMG 3012/3013 15005KT 3200 -FZDZ OVC002 660001 QNH2972INS
 - BECMG 3014/3015 15005KT 3200 -SN OVC002 620026 QNH2972INS
- at 1352Z, the NWS issues a TAF for Rapid City (KRAP):
 - KRAP 301401Z 3014/3112 14004KT 1 1/2SM BR OVC002
TEMPO 3014/3016 1/4SM FZFG
FM301700 VRB03KT P6SM OVC004
FM302200 VRB03KT P6SM BKN015
FM310300 34004KT P6SM BKN250

At 1410Z, the pilot picks up his weather briefing



1500Z G-AIRMET ZULU



1445Z: Airmet Zulu issued for moderate icing between surface and 20,000 feet



History of FZDZ in the TAFs, continued

- At 1450Z, Ellsworth AFB issues an amended TAF with the following conditional:
 - TEMPO 3014/3017 0800 -FZDZ OVC002
 - Note that this is the first forecast for FZDZ to bracket the flight's ETA
- At 1510Z, the NWS issues an amended TAF for Rapid City (KRAP) with the following conditional:
 - TEMPO 3015/3017 3SM -FZRA OVC004 FM301700 VRB03KT P6SM
 - This is 10 minutes past the planned departure time



Applicable PIREPS

MLS UA /OV MLS/TM 1517/FL380/TP B738/SK SKC/TA M54/WV 05533KT/TB NEG/RM AWC-WEBASA
D07 UA /OV DPR150025/TM 1613/FL240/TP BE20/TA M28/IC LGT RIME
DIK UA /OV DIK/TM 1653/FL050/TP CRJ2/IC NEG DURGD/RM BASES 038 TOPS 050
BIS UA /OV BIS /TM 1730 /FLUNKN /TP C414 /SK OVC028-TOP075 /TA 03 /IC NEG /RM DURC
MLS UA /OV MLS /TM 1951 /FL075 /TP PA34 /SK SKC
PIR UA /OV PIR/TM 2342/FL030/TP C310/SK UNKN025-TOP035/TA UNKN/IC NEG
ICR UA /OV ICR/TM 2348/FL020/TP BE20/SK UNKN038-TOPUNKN/TA UNKN/IC NEG
PIR UA /OV PIR270020/TM 0125/FL130/TP BE20/SK UNKN074-TOPUNKN/TA M06/IC LGT RIME/RM
BASES 074 +02



History of METARs

- At 1336Z, Ellsworth AFB issues the following SPECI:
 - SPECI KRCA 301336Z 12005KT M1/4SM -FZDZ FZFG VV001 M01/M02 A2987 RMK AO2A DZB1330 \$=
 - FZDZ is reported from that time through the METAR at 1608Z.
- At 1552, KRAP issues the first METAR containing a reference to light rain (-RA)
 - KRAP 301552Z 26005KT 1SM -RA FZFG OVC002 M01/M02 A2985 RMK AO2 UPB33E52RAB52 SLP139 P0000 T10061017
 - Note the temperature is reported as less than zero; this condition persists until 1758Z.
 - Freezing precipitation of any kind is never referenced.



Points to Ponder

- Why does a Hazardous Weather Advisory include freezing rain and freezing drizzle when the G-AIRMET is stuck at 10,000 feet?
- Why did it take so long for the TAFs to catch up to the Hazardous Weather Advisory?
- Why did the FIP not seem to capture the freezing precipitation possibility?
- Why did the KRAP METAR never report freezing rain, even when reporting light rain with a temp of -1°C ?
- Why did the Ellsworth TAF and METAR seem to be a little ahead of this when compared to KRAP?



Back to the 1996 paper...

- “Both enroute and terminal area forecasts of icing conditions must achieve adequate spatial, temporal and parametric resolution to allow changes in operational planning.”
 - What can we do with the tools we have today?
 - What are the obstacles?
 - Technological?
 - Bureaucratic?
 - Organizational?
- “Methods of predictive detection must be developed and implemented so that both ground-based and on-board detection can be used to validate the forecast and plan an operational response to the conditions before they are encountered.”
 - Can an enhanced CIP actually do this?
 - What else can?
 - Whatever it is, how can we uplink it to the cockpit in real-time?



A Couple of Final Thoughts

“The capable and competent pilot will never allow an airplane to crack up...”.

- Civil Aeronautics Bulletin No. 5, 1939