Enabling Better Decisions via The Weather Company's Probability Forecast Platform

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Today's Talk

- How can probability forecasts be used in decision-making?
- What capabilities do we offer now?
- Lessons learned

Key Points

- Probability forecasts can be used to optimize decisions
- Quantifying uncertainty increases user's confidence
- Statistical calibration is necessary to ensure forecasts are reliable and sharp

Contributors to Probabilistic Offerings

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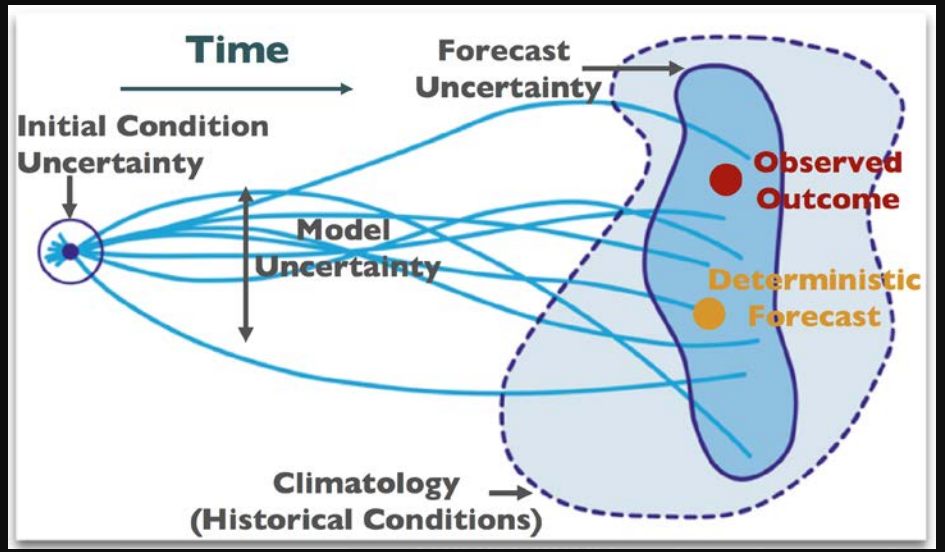
Why Probabilistic?

The atmosphere is a nonlinear chaotic fluid (bifurcations, attractors, etc.)

Chaos ⟶ The present determines the future … but the approximate present does not approximately determine the future

Deterministic forecasts represent one potential weather realization

Probabilistic forecasts represent a range of possible realizations (uncertainty)



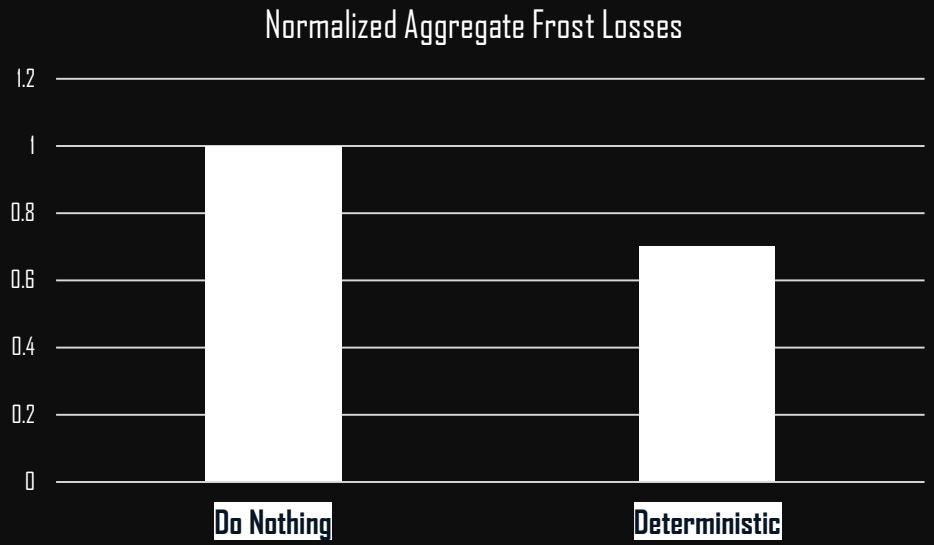
Probabilistic forecasts can be used to optimize decisions

Example: Crop Frost Loss Mitigation

Consider a farmer making a decision to protect crops in the face of a (near-)freezing forecast.

- Protection is expensive
- But not protecting could lead to significant loss.

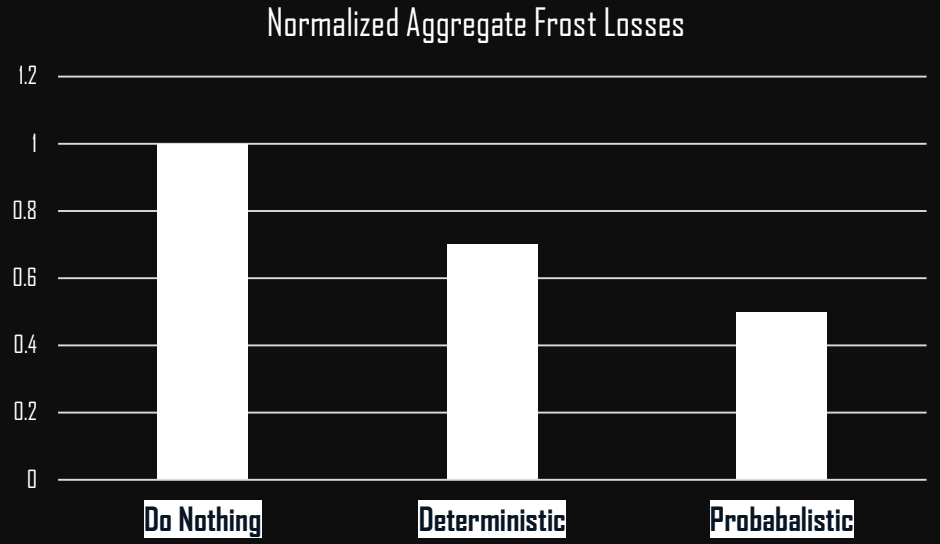
Using deterministic forecast of freezing conditions helps....



Using deterministic weather forecast to make frost protection decision mitigates losses by 30%.

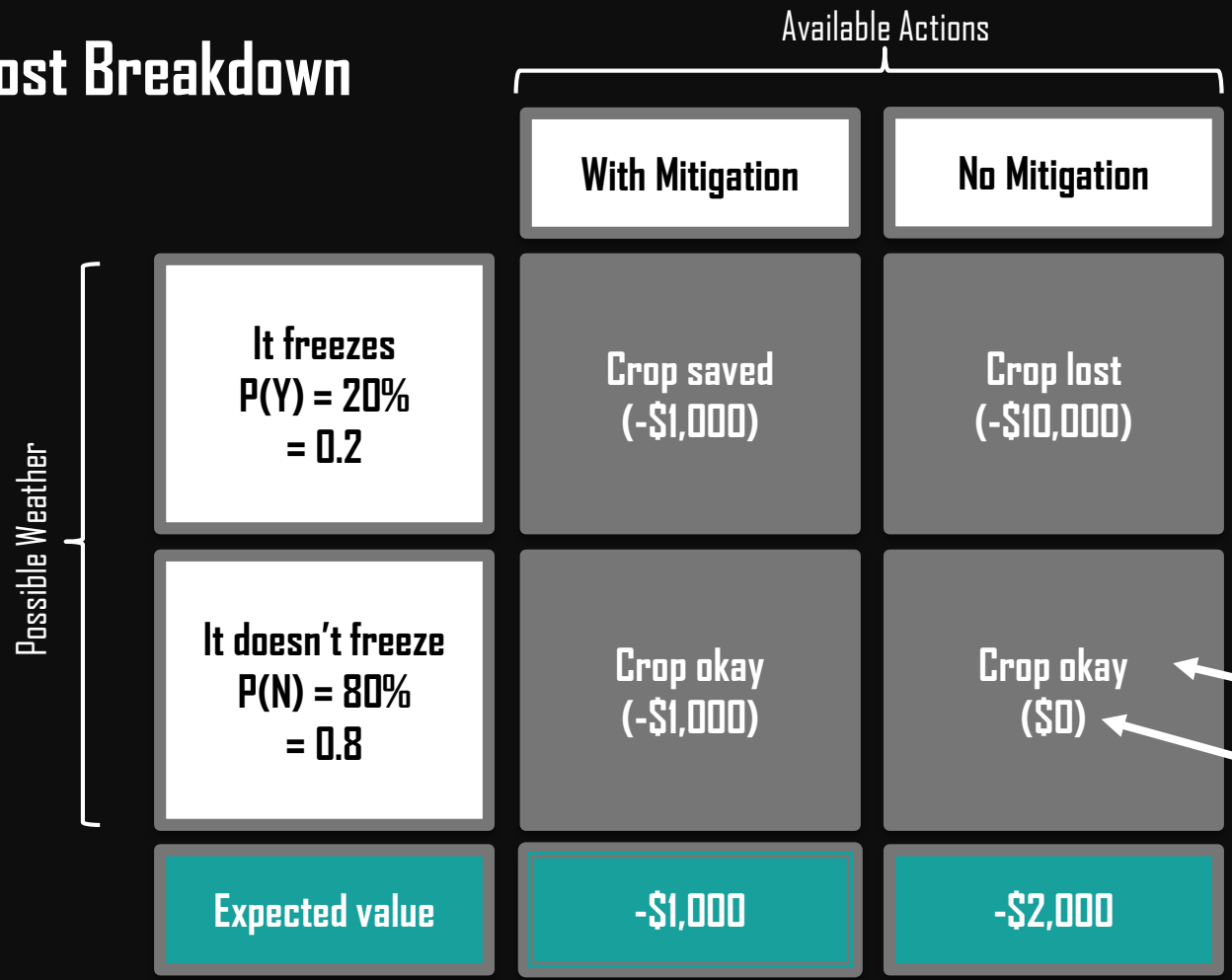
Example: Crop Frost Loss Mitigation (2)

… but using probabilistic forecasts in conjunction with cost-loss optimization further improves the net economic outcome.



Probabilistic-based protection decisions mitigate frost losses by 50%..

Cost Breakdown



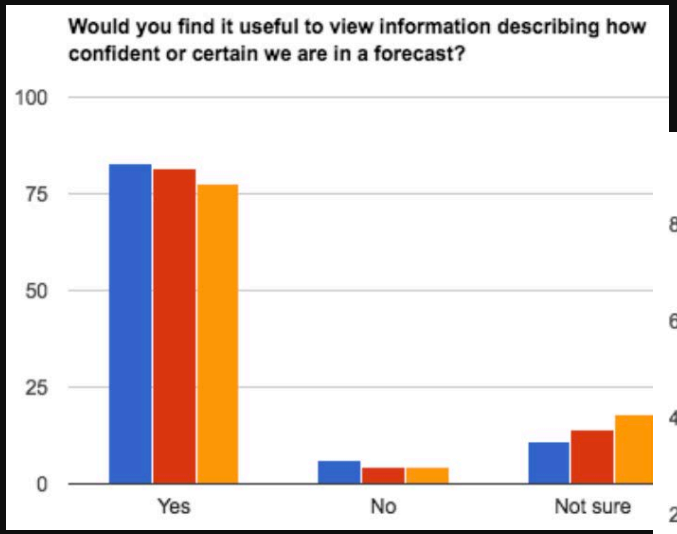
Optimal Decision: Action with highest expected value (sum of Outcome Values x Probabilities) = use mitigation!

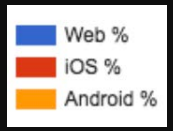
Action Impact

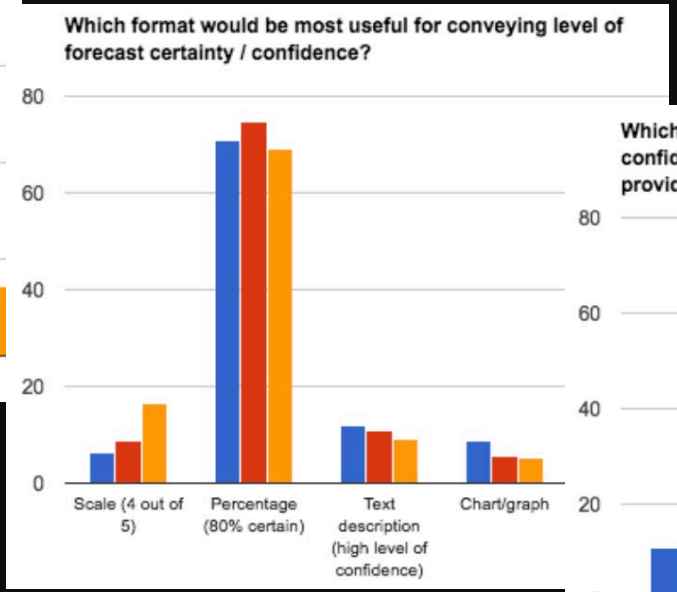
Outcome Value

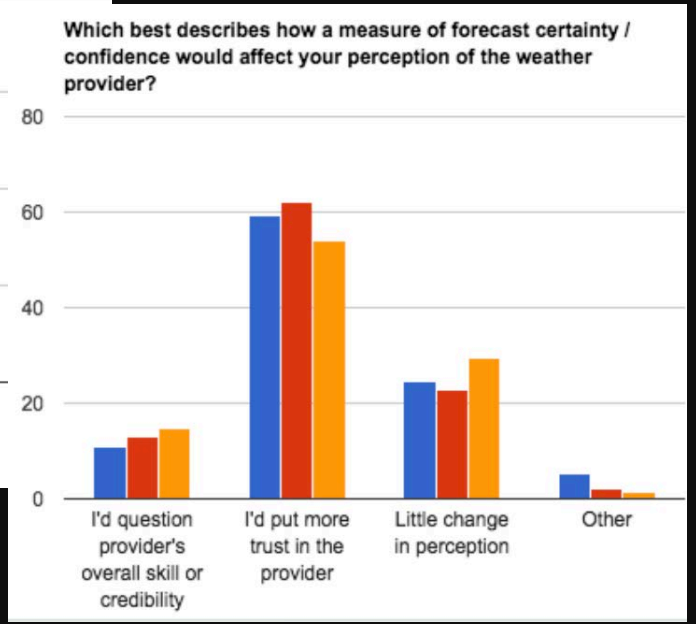
Quantifying uncertainty
increases user's confidence

Consumer Product User Survey, January 2017









Consumer Snowfall - Vison Framing

Problem Statement

Global users with snow perceive a

mismatch of forecast and observed snowfall,

eroding trust & relevance for the brand.

Opportunity

Knowing there's a high likelihood the forecast may change

is almost as important

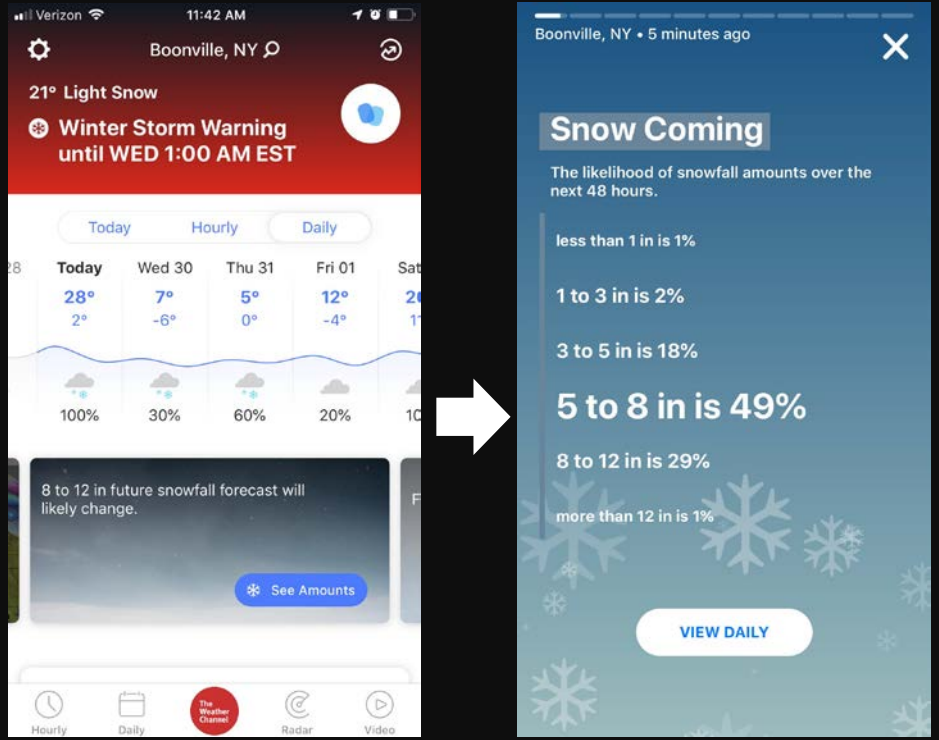
as knowing the forecast itself.

Communicate certainty & uncertainty of snowfall forecasts

to increase understanding and confident decision making during winter weather events.

Consumer Snowfall

- Snowfall forecasts derived from 154 models (EC ENS, GEFS, etc.)
- Snowfall forecasts calibrated via Logistic Regression + Bayesian Model Averaging using NOHRSC analyses
- Arbitrates machine-generated forecasts with human influenced forecast to impart some consistency
- Calculate snowfall exceedance probabilities, boom and bust amounts, confidence metric



Live in Weather Channel iOS mobile application as of February 2019

TWC's Probability Forecast Products

15-day Probabilistic (PFP)

SUN API available in PA

Time resolution

Hourly or interval max, min, or sum

Variables

Temperature	Precipitation Dewpoint
	Relative Humidity
Snowfall	Wind Speed
Wind Direction	Wind Gust
Ceiling	Visibility

Products (user specified)

Range probabilities
Probability distributions
Percentiles
Forecast prototypes

FOD 7-day Snowfall

SUN API for Consumer Product

Time resolution

Morning and overnight dayparts
Timespans: 12, 24, 36, 48, 72 h

Variables

Snowfall accumulation
Incorporates forecaster input

Products

Probability of accumulation
Interval probabilities
Percentiles (10th and 90th)
Confidence (of FOD interval)

Seasonal Probabilistic

Point publishing via email, SOW
Created on the 5th of each month

Time resolution

Daily 0 – 6 months

Variables

Daily min, mean, max temperature Daily precipitation
Temperature and precip anomalies

Products

Percentiles
Forecast prototypes

Tropical Cyclone

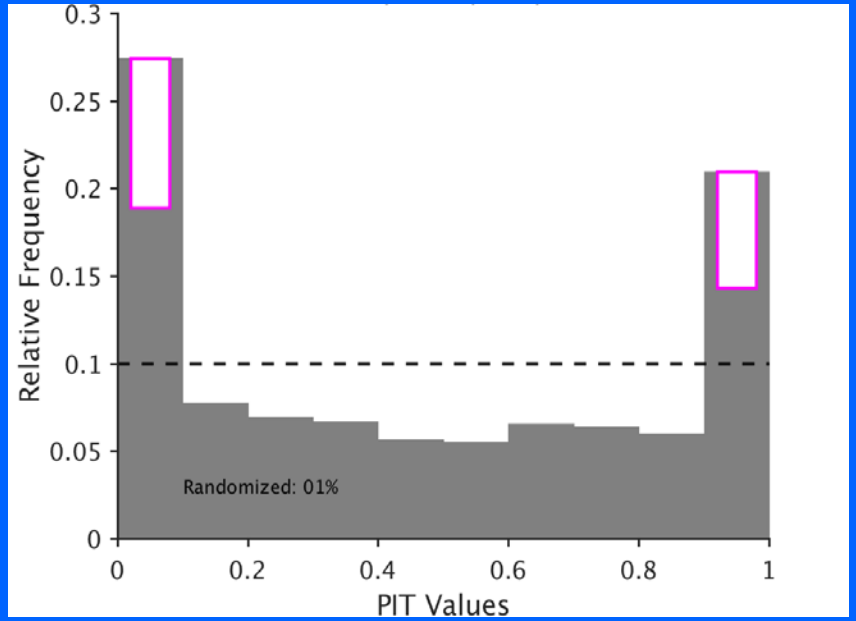
15-day intensity strike probabilities
SUN API available in Passport Advantage

Statistical calibration is
necessary to ensure forecasts
are reliable and sharp

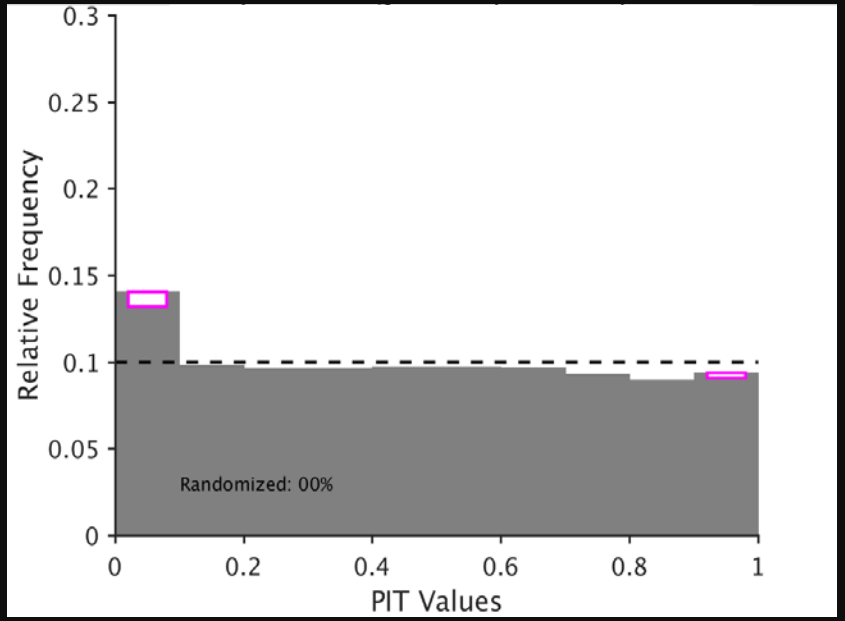
Impact of Calibration on 2m Temperature

PIT = Probability Integral Transform, a histogram of observation percentiles

Raw 2m Temperature



Calibrated 2m Temperature

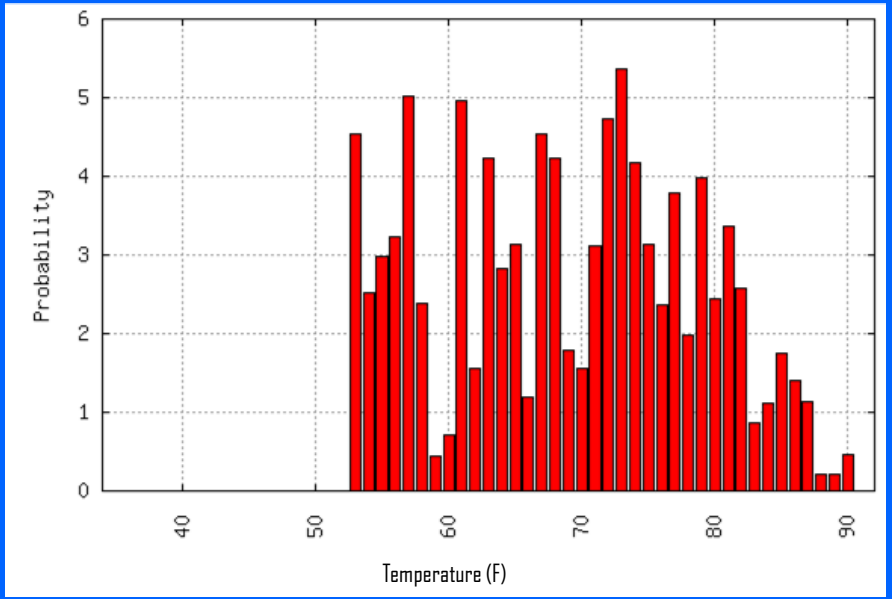


Cross-validation study 1 April 2017 – 15 September 2017

2300 CONUS METAR locations, 48 hour forecast

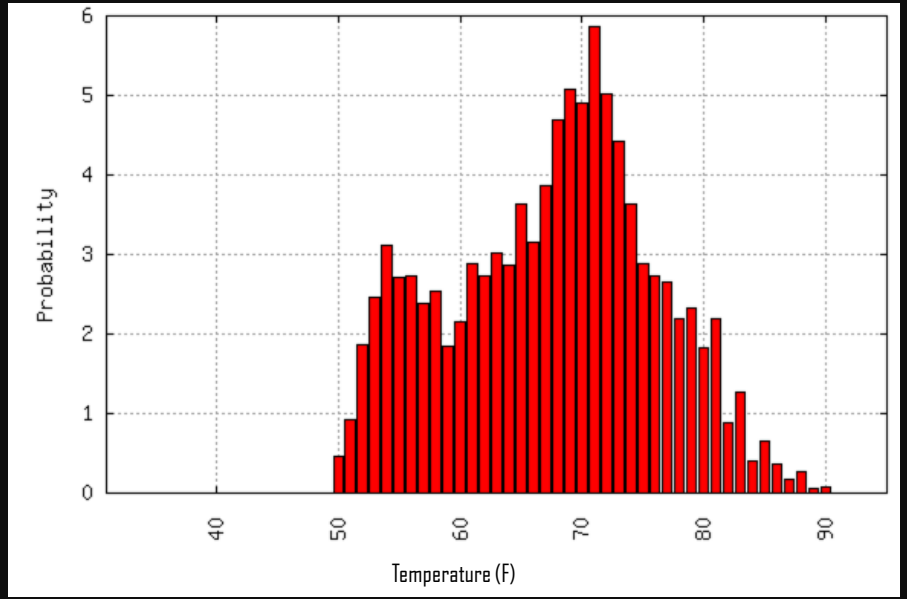
Impact of Calibration on Discrete PDF

Uncalibrated Percentiles



“noisy” and difficult to interpret the raw multi-model ensemble distribution

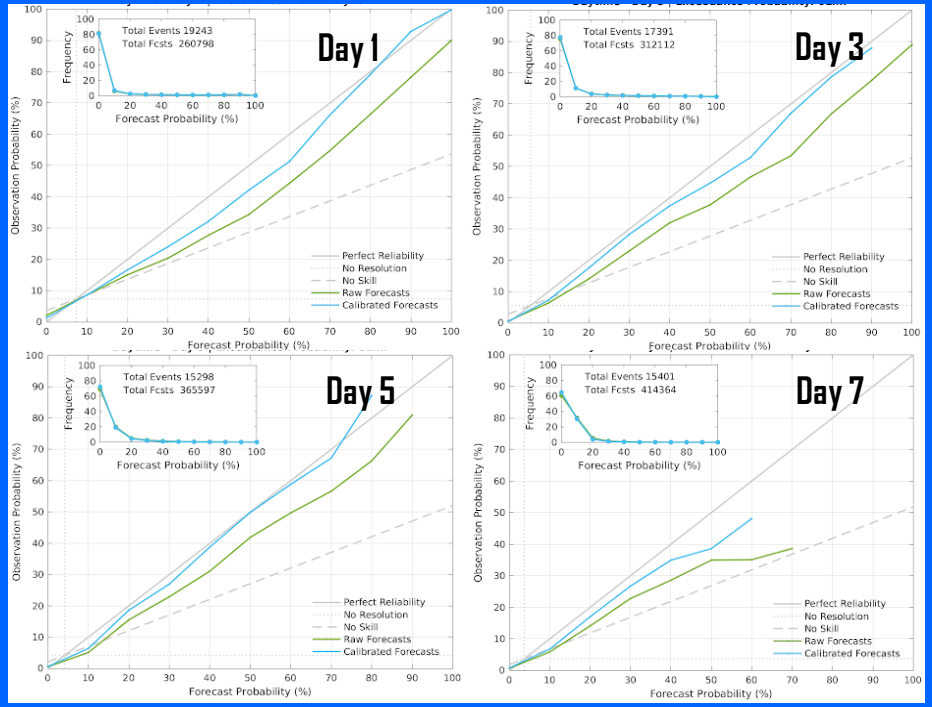
Calibrated Percentiles



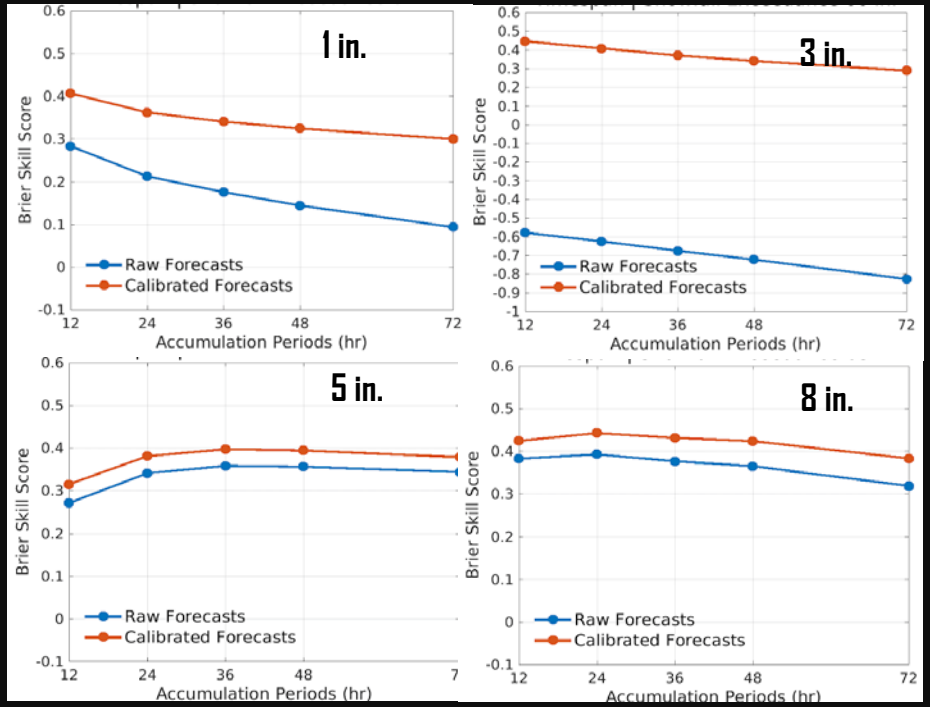
bi-modal with higher probability for warmer temperatures

Probabilistic Snowfall

Reliability



Skill



Cross-validation study 1 January – 30 April 2018
2300 CONUS METAR locations

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Thank You !

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