The Algorithm for the Prediction of HIWC Areas (ALPHA):

Performance Assessment Using Darwin and Cayenne Isokinetic Probe Measurements

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HAIC-HIWC Science Team Meeting
16-19 May 2016 Toronto, ON

ALPHA development is sponsored by the U.S. Federal Aviation Administration
NCAR is sponsored by the U.S. National Science Foundation

NCAR Icing Products
Use of Artificial Intelligence Methods

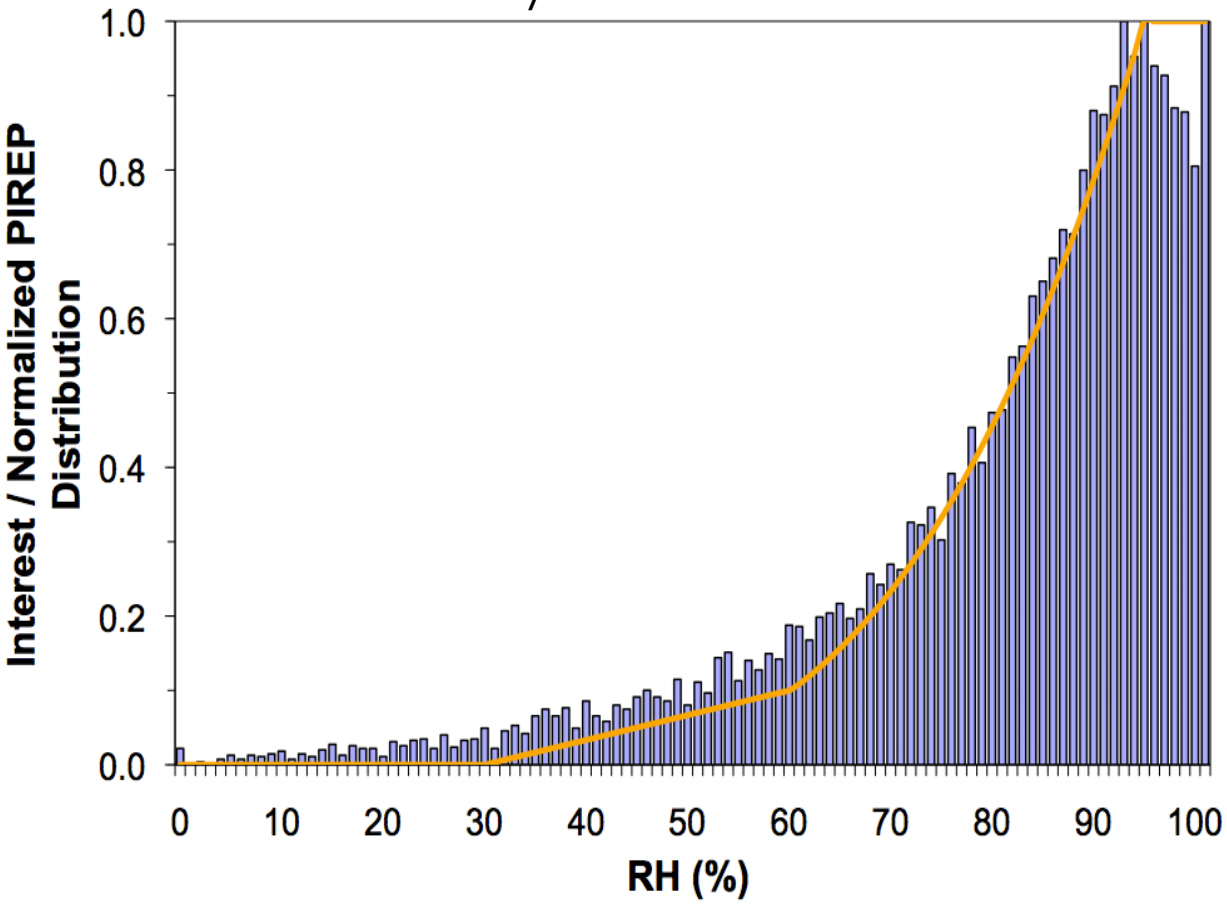
- *Fuzzy-logic **membership functions** are applied to related fields to create **interest maps,** which are situationally combined to estimate the **potential for HIWC conditions***

- *Rather than applying hard thresholds, this approach allows for uncertainties evident in the datasets and mimics the gradual transition from HIWC to non-HIWC environments associated with each field*

Membership Function Development

Example: Relative Humidity vs. Icing PIREPs

Normalized Distribution of Icing Pilot Reports vs. Relative Humidity



Membership functions are also derived from field observations, cloud physics principles, and human forecasting techniques

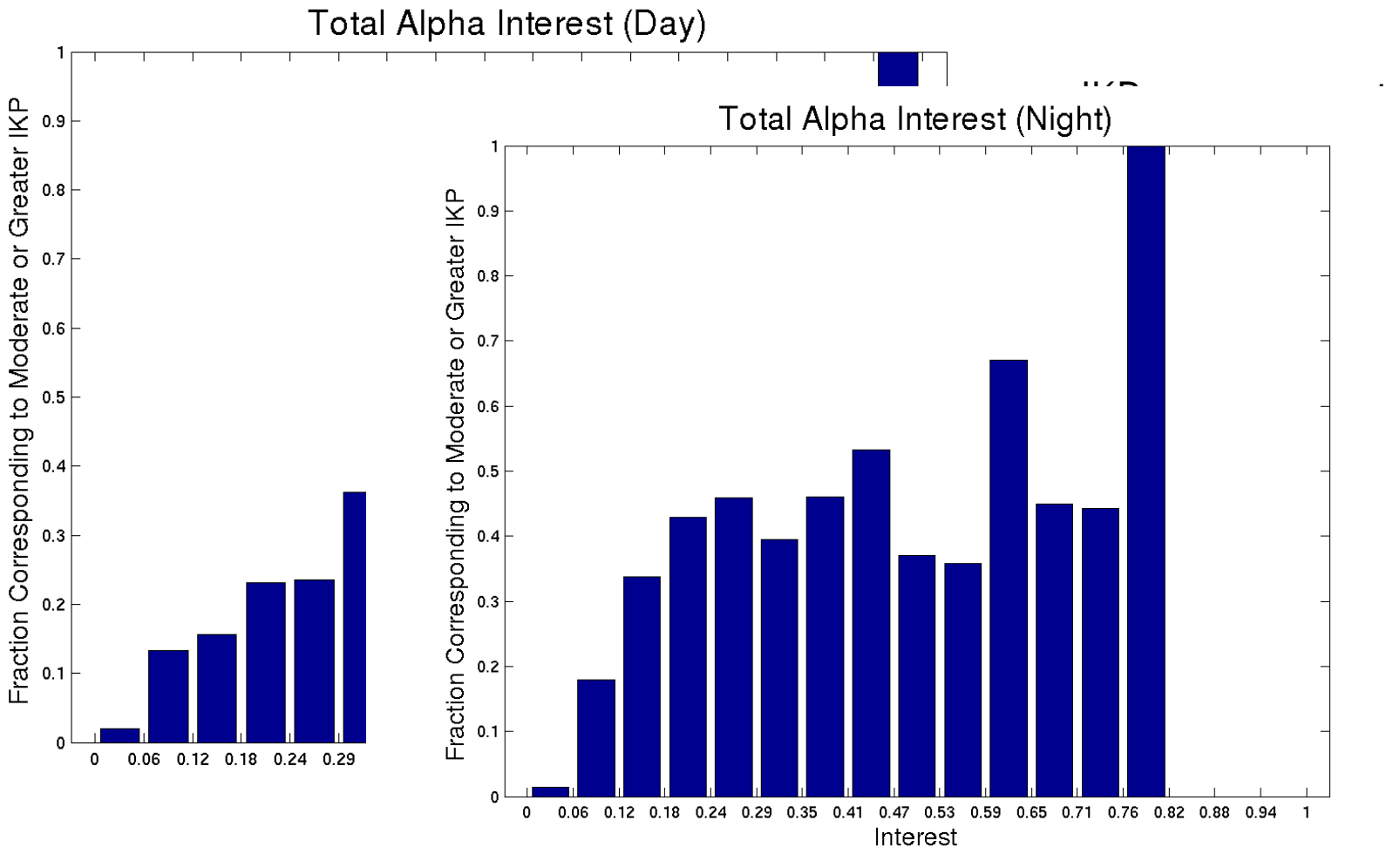
Algorithm for the Prediction of HIWC Areas

- ALPHA v1.0
  - Set of original membership functions relate each variable to the possibility of HIWC conditions; interest estimates from each variable are blended with adjustable weighting factors
  - Membership functions and weighting factors were based on limited data and intuition
  - Output is a 3-dimensional, uncalibrated estimate of HIWC likelihood
- ALPHA v2.0
  - Data from field campaigns allows us to objectively define membership functions using measurements of IWC

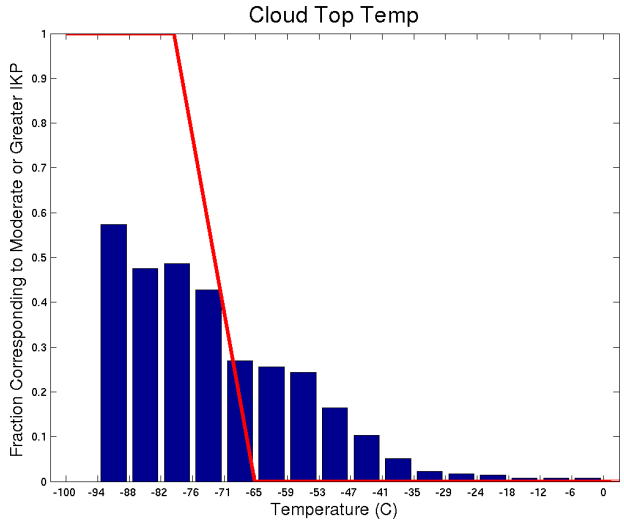
ALPHA Assessment Procedures

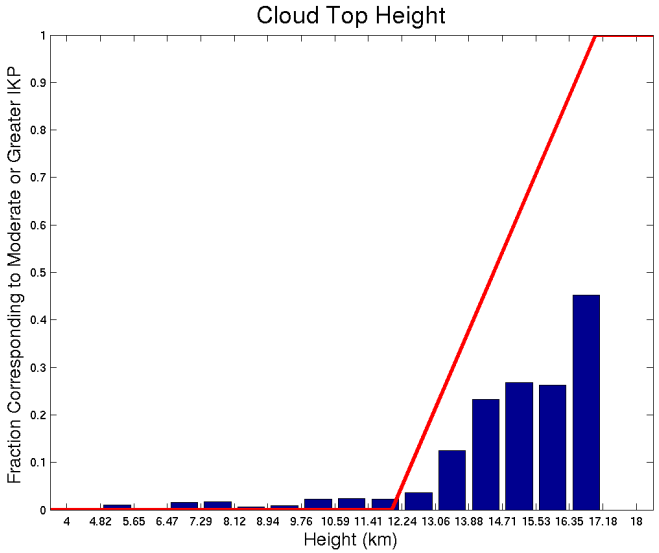
- Ice water content (IWC) from airborne Isokinetic Probe (Darwin and Cayenne flights)
- Extract ALPHA HIWC interest parameters along flight track; compare relative trends in IWC and ALPHA products
- Compile probability of detection statistics
- Correlate IWC observations with individual input fields to evaluate and refine membership functions

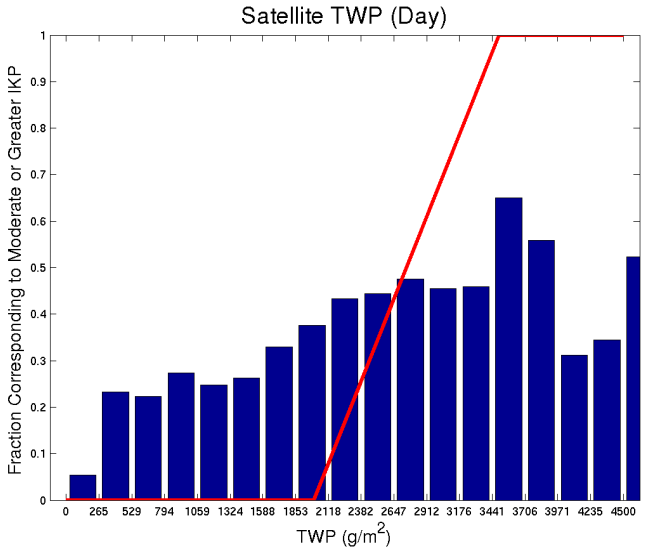
Distribution of HIWC Likelihood Parameter vs. Fraction of Moderate or Greater (MOG) IWC

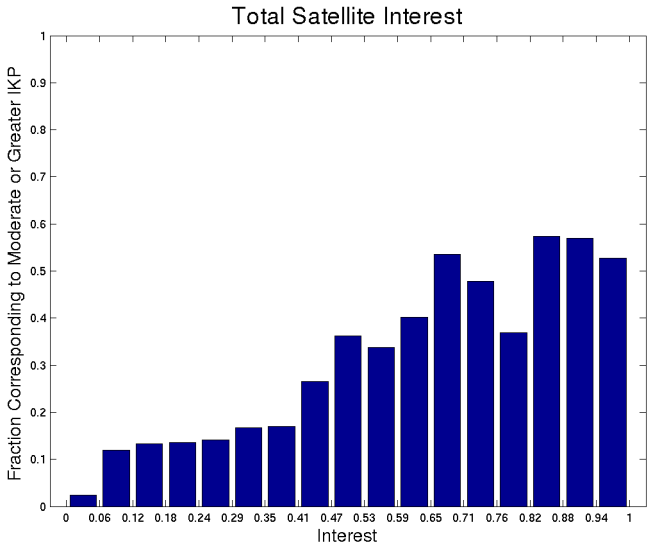


Fraction of MOG IWC vs. Satellite data currently used in ALPHA (NASA LaRC products)

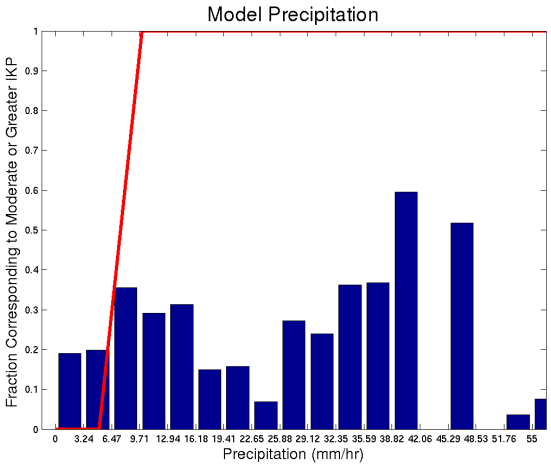


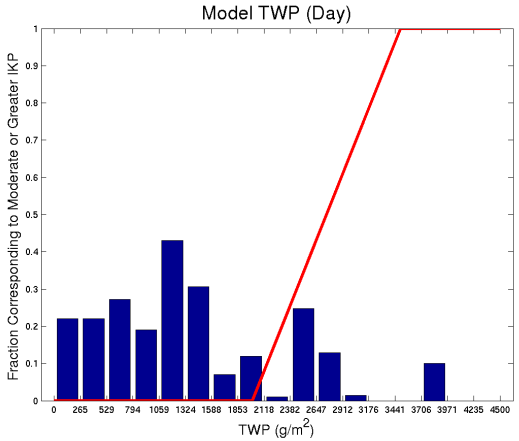


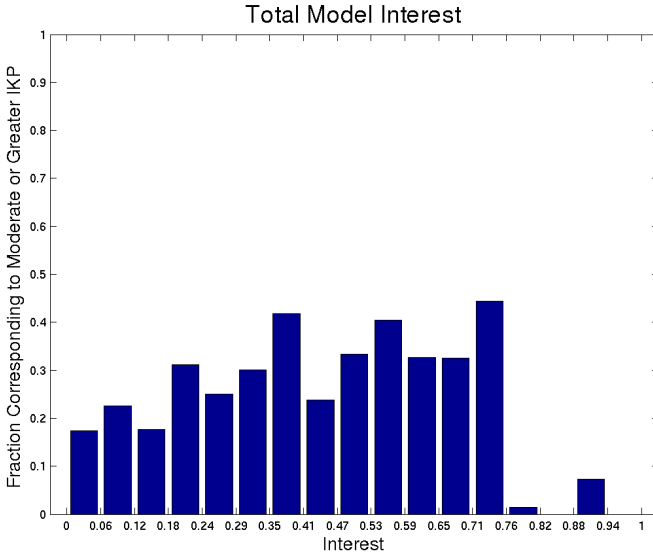


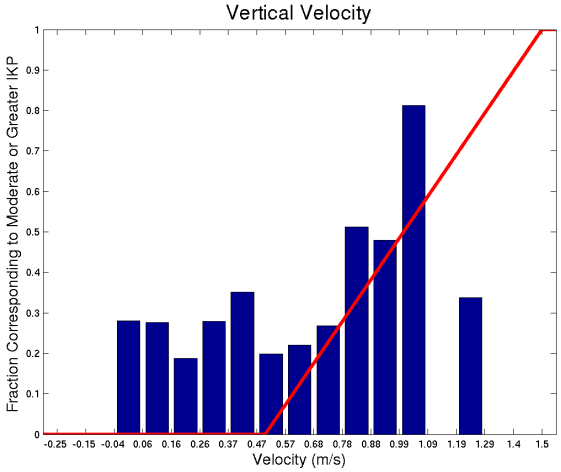


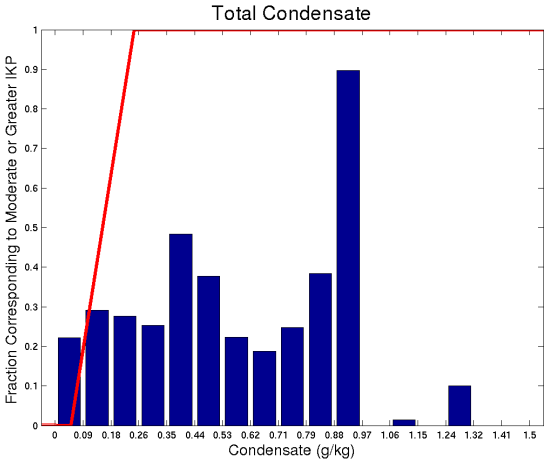
Fraction of MOG IWC vs. Model products currently used in ALPHA (ACCESS and WRF)



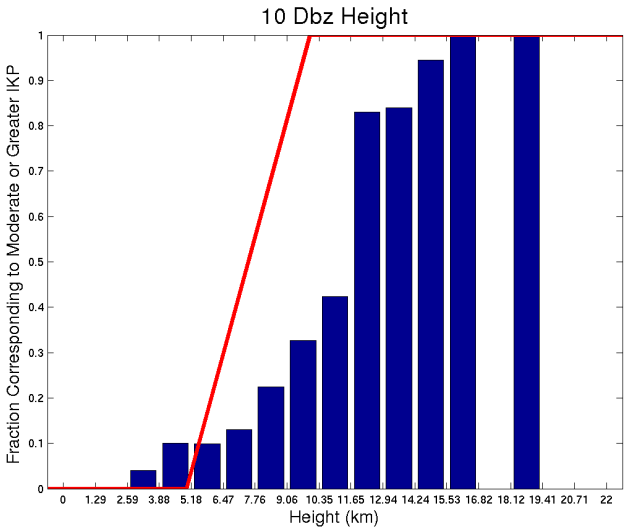


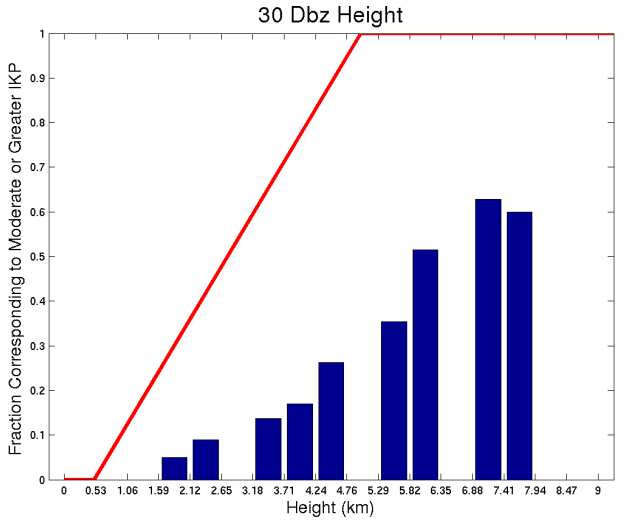


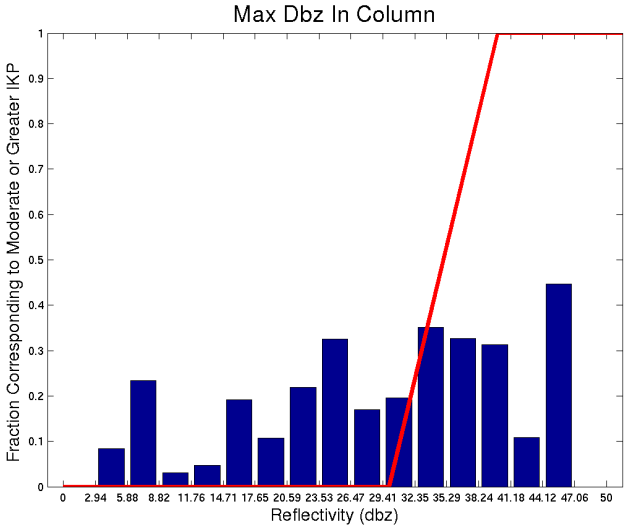


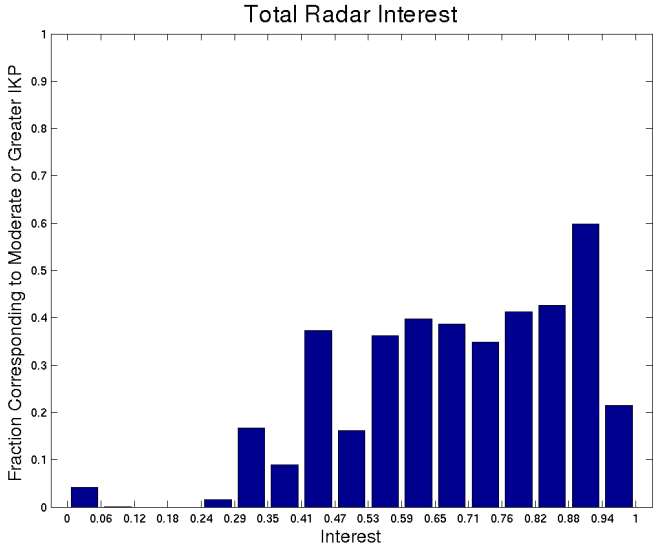


Fraction of MOG IWC vs. Radar products currently used in ALPHA (BOM groundbased radar – Darwin)

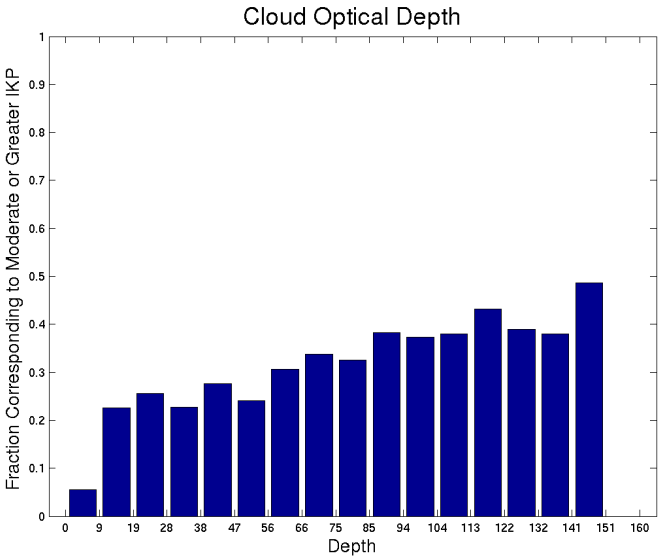


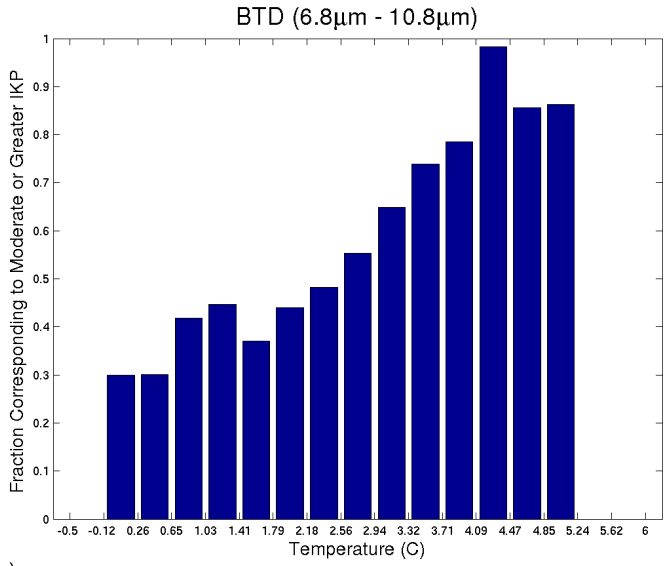


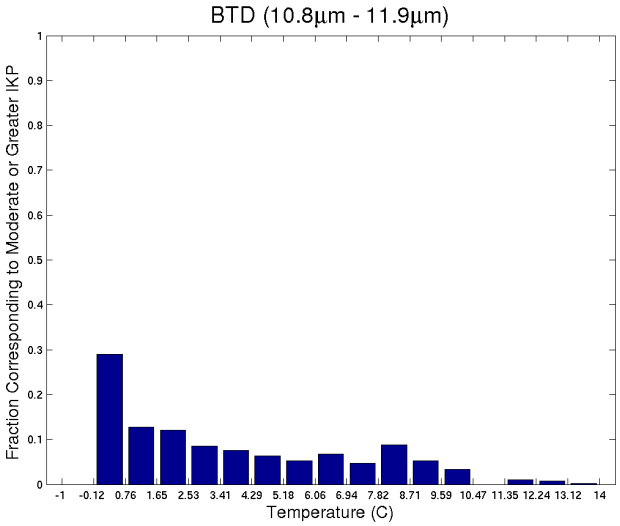




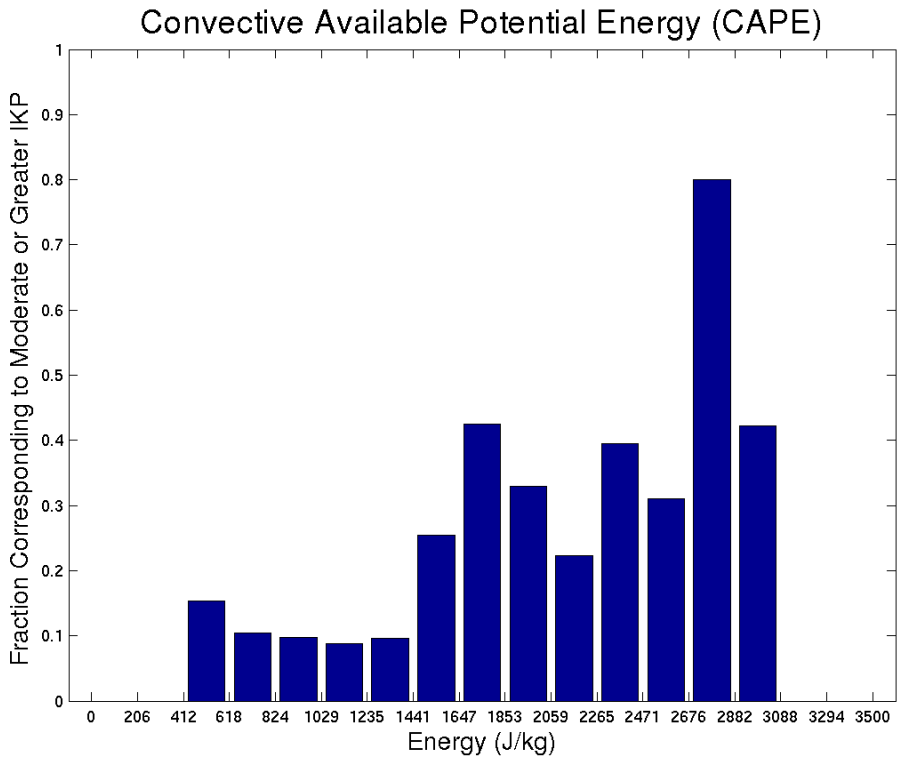
Additional Satellite Products under Consideration for ALPHA 2.0



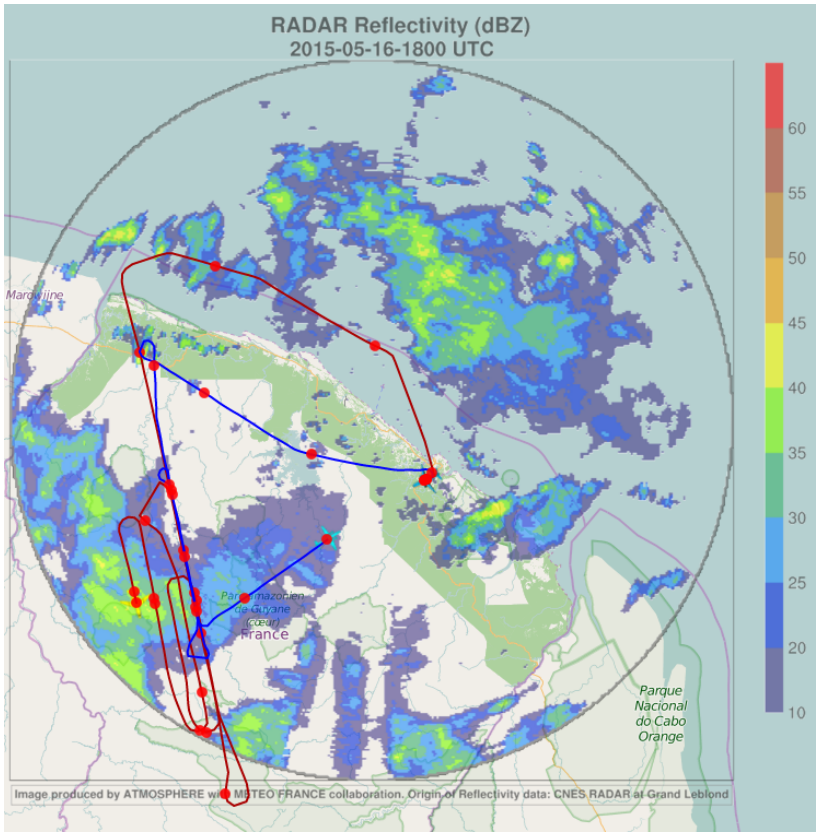




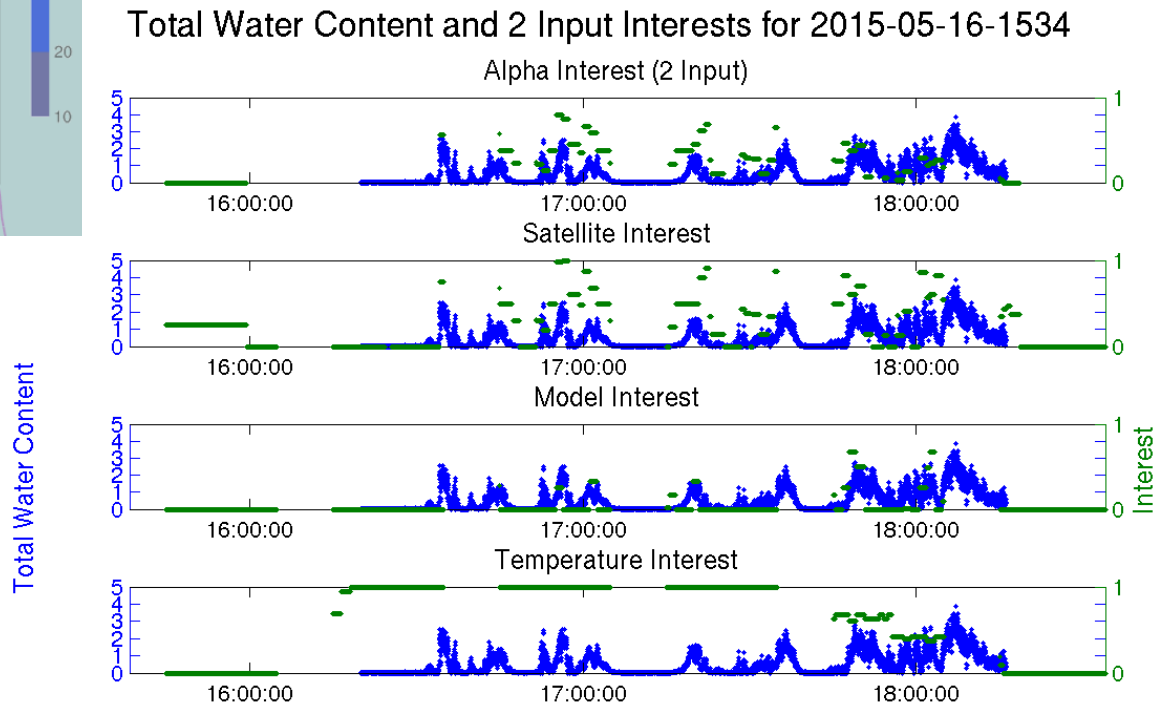
Additional Fields under Consideration for ALPHA 2.0



- Derived model fields (e.g., convergence)
- Radar reflectivity profiles
- Lightning
- Overshooting tops



Cayenne Case Study
16 May 2015



Next Steps

- ALPHA v2.0: include revised and new membership functions, experiment with weighting factors to optimize simulation of Darwin and Cayenne observations.
- Apply ALPHA v2.0 to HIWC Radar (Florida) data set for independent verification
- Use RASTA IWC retrievals to assess ALPHA vertical variation
- Compare and collaborate with other nowcasting teams