Verification of NASA LaRC Cloud Products and CIP using PIREPs

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Purpose

- Enhancement of CIP severity algorithm

- Forecasters of in-flight icing find NASA LaRC products extremely useful

- Examination of verification methods for products that incorporate high resolution satellite products

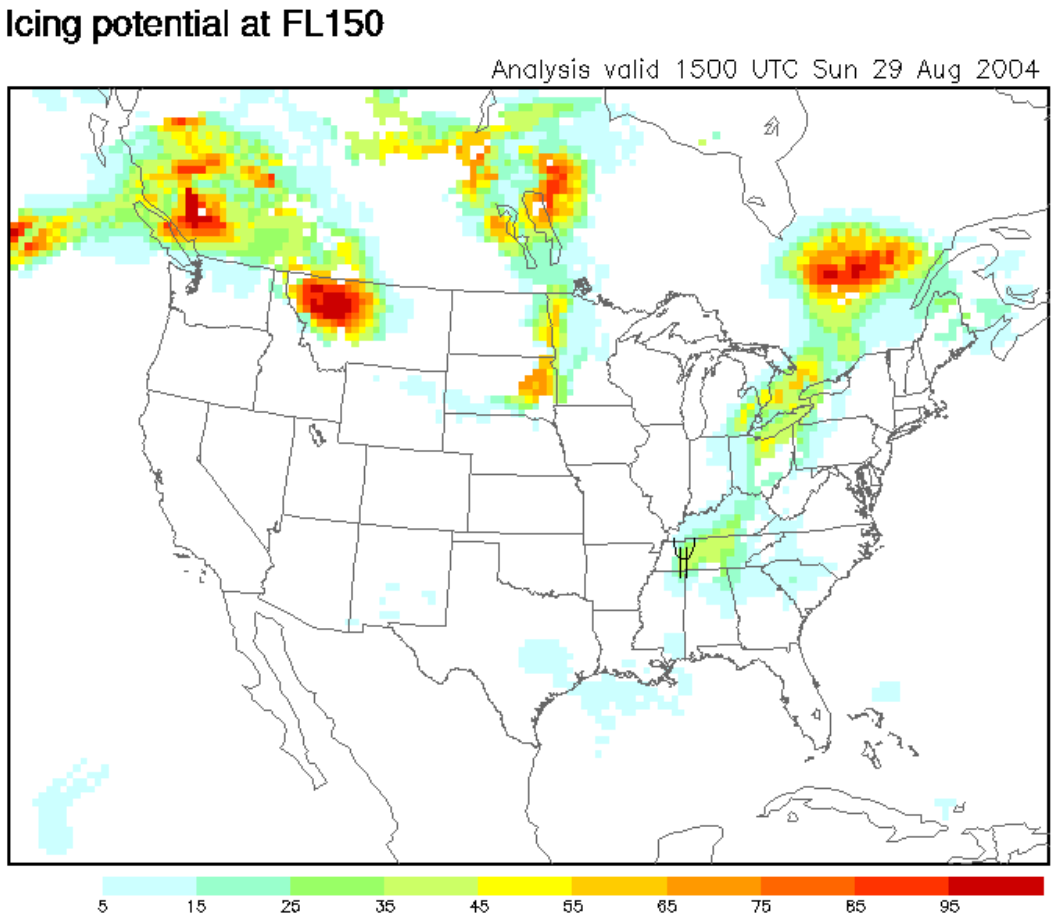
Introduction

Current Icing Potential (CIP)

Icing diagnoses based on …

- RUC 3-h Temperature
- RUC 3-h Relative Humidity
- Satellite
- Radar
- Surface
- PIREPs
- Lightning reports

CIP



http://adds.aviationweather.noaa.gov

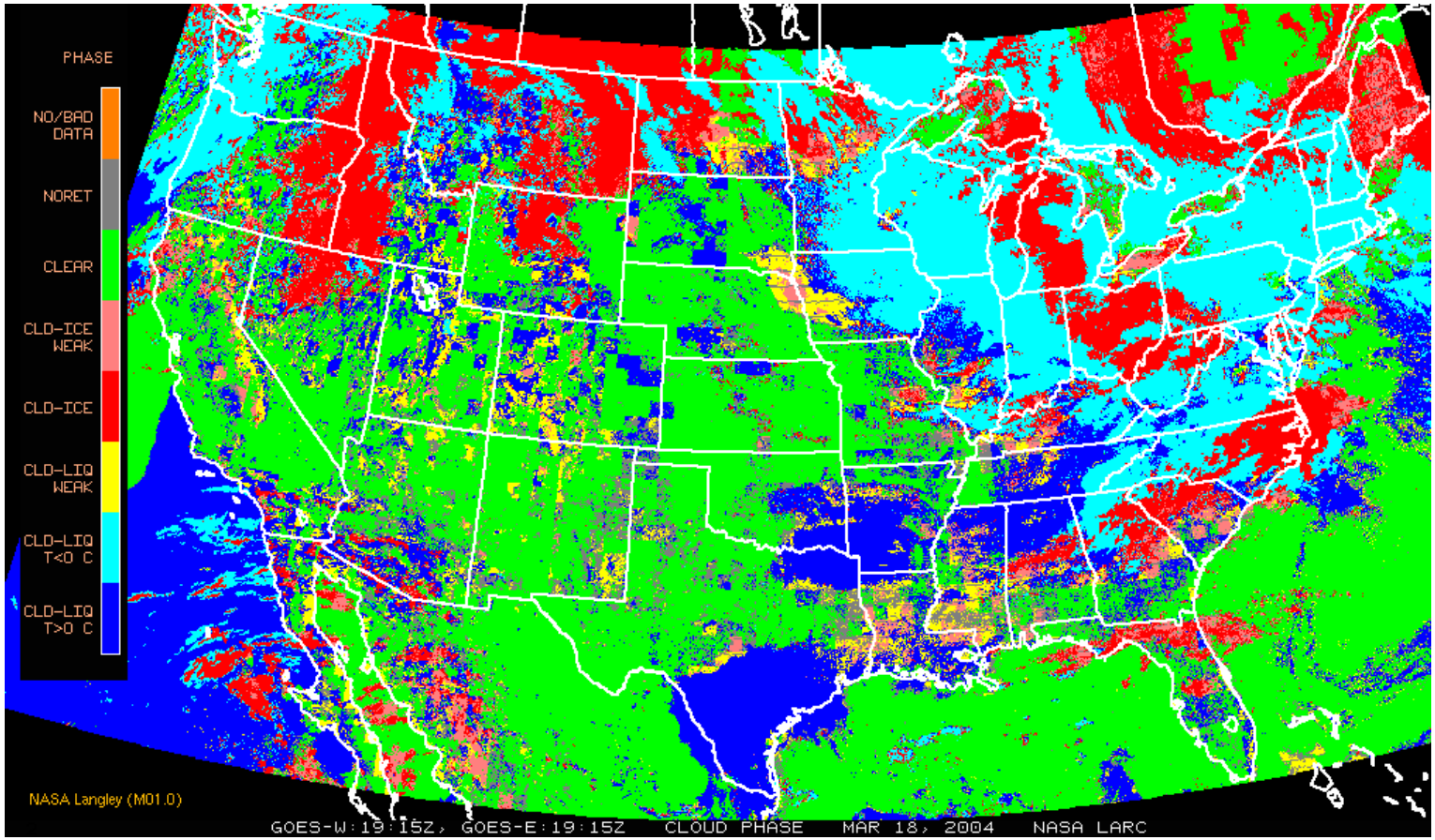
Introduction (cont.)

NASA LaRC Satellite-based Cloud Products

- **Uses half-hourly GOES (West and East)**
- **Each pixel classified as clear or cloudy**
- **Cloudy pixels analyzed to determine…**

Cloud Phase	**Liquid Water Path**
Ice Path	**Optical Depth**
Effective Temp.	**Effective Particle Size**
Effective Height	

NASA LaRC Cloud Phase

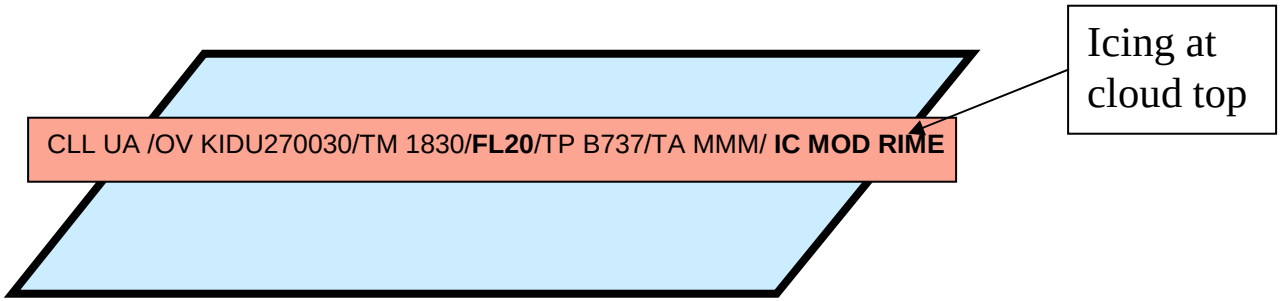


Data Sets

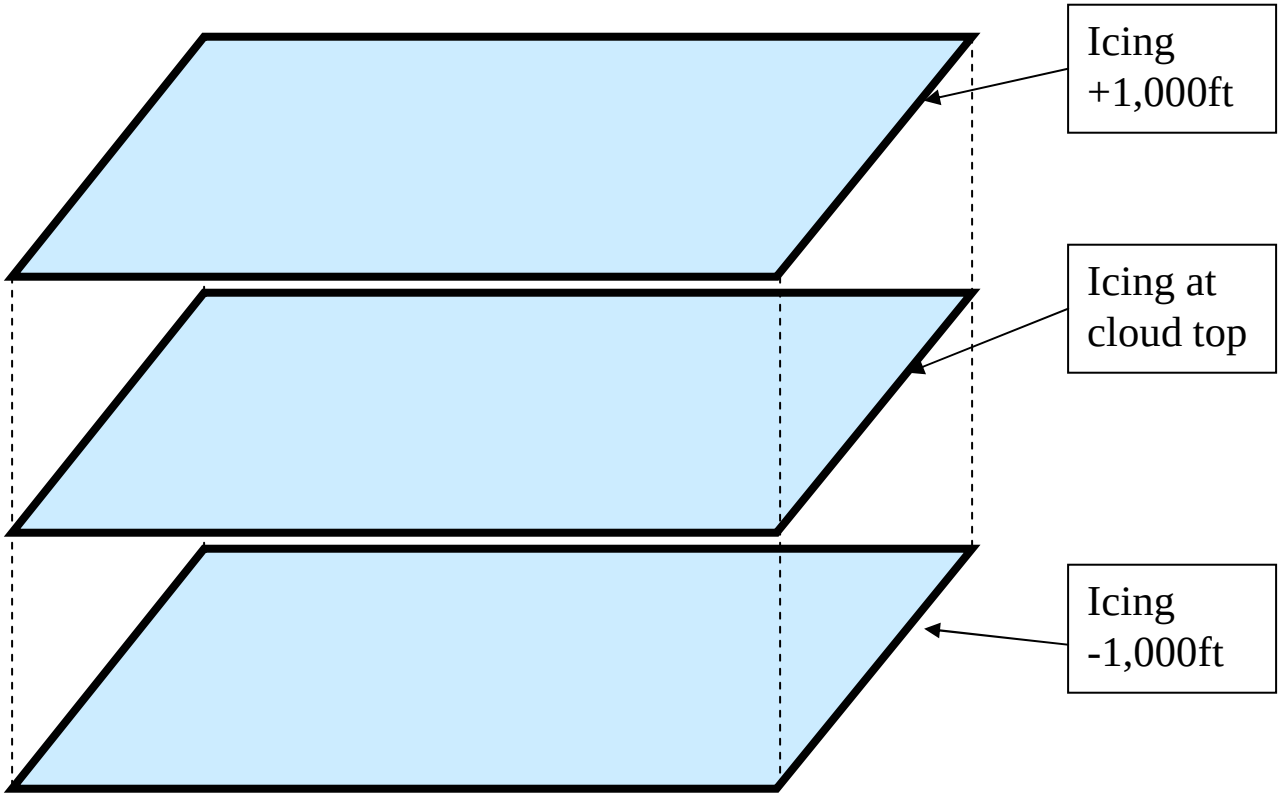
01 October 2003 – 31 March 2004

- **1500 and 2100 UTC 20km CIP Icing Potential**
  - **341 files available**
- **1445 and 2045 UTC NASA LaRC 5km Cloud phase product (PHAS)**
  - **319 files available**
- **Pilot Reports (PIREPs) of in-flight icing**

Verification Method (CIP)

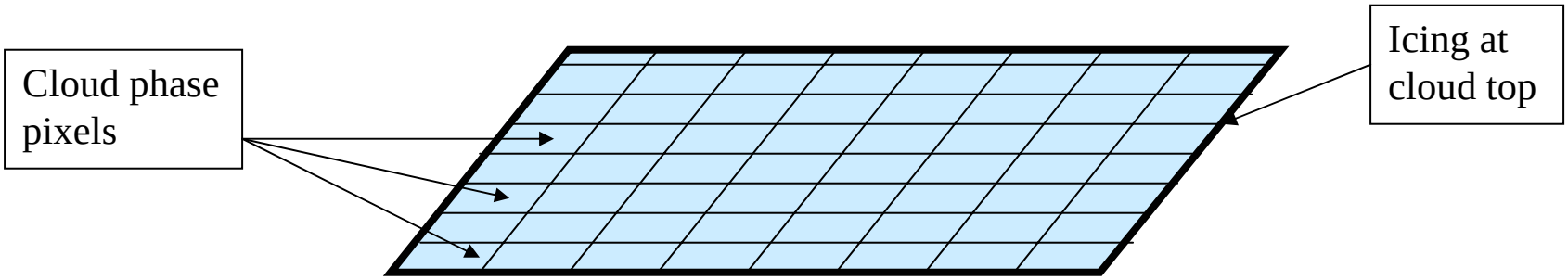


Verification Method (CIP)



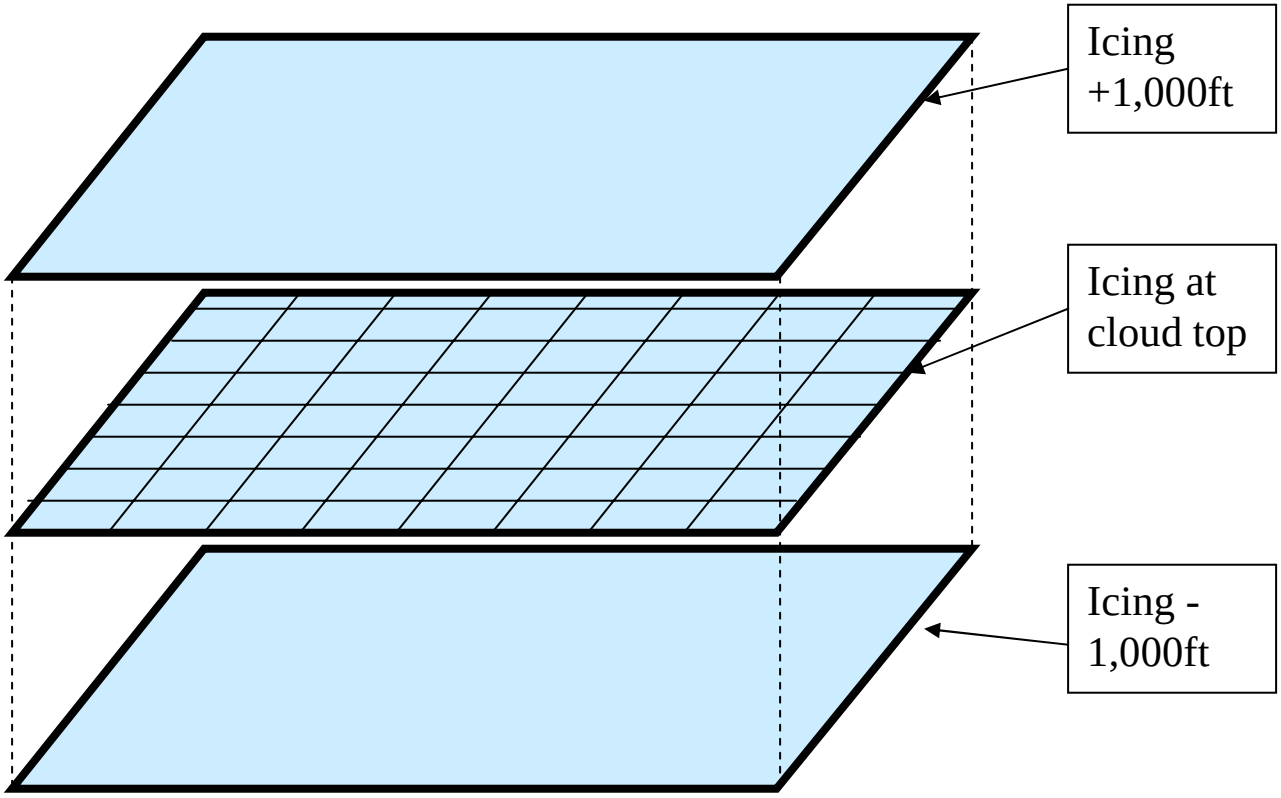
***Use the maximum CIP icing potential from the 12 gridpoints**

Verification Method (PHAS)



* Assume icing conditions exist if cloud top temperature <0°C and cloud phase is liquid

Verification Method (PHAS)



* Minimum, maximum or median CTH measurements between all 64 pixels were used to determine CTH for comparison to PIREP

Statistical Measures

Forecast	*Observation*		*Total*
	YES	***NO***	
YES	YY	YN	YY+YN
NO	NY	NN	NY+NN
Total	YY+NY	YN+NN	YY+YN+ NN+NY

****Each cell in this table contains a count of the number of times a particular forecast/observation pair was observed.**

Statistical Measures

Statistic	*Definition*	*Description*
PODy	YY/(YY+NY)	Probability of detection of YES observations
PODn	NN/(NN+YN)	Probability of detection of NO observations

* Thresholds for CIP ranged from 0.0 – 1.0 in increments of 0.05 icing potential

* Thresholds for PHAS ranged from 0 – 64 in increments of 8 icing pixels

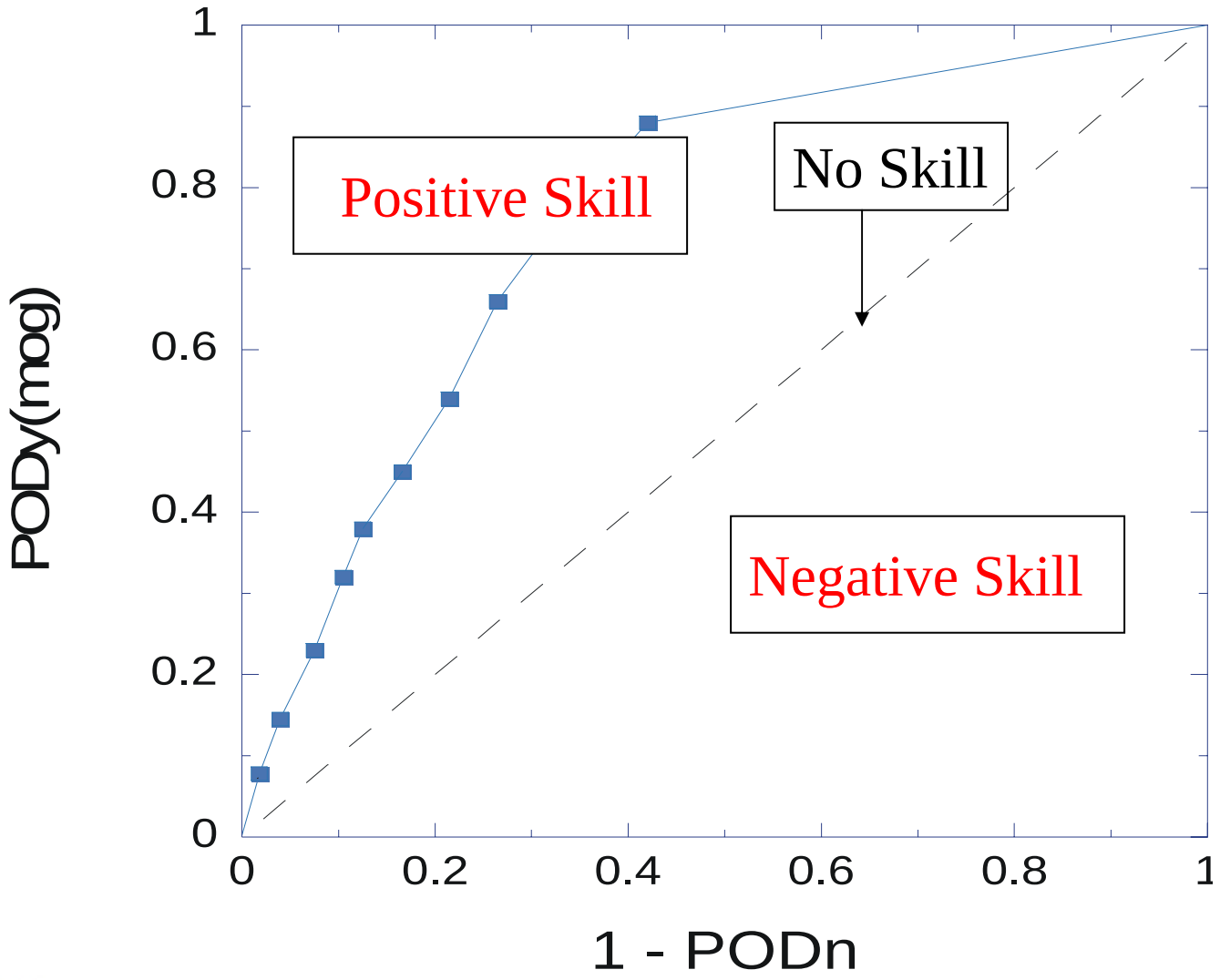
Observation Counts

FLAG	All PIREPs within …	*YES MOG*	*NO*
1	+/- 1,000 ft of median CTH (All Cloudy pixels)	134	1620
2	+/- 3,000 ft of median CTH (All Cloudy pixels)	349	3936
3	+/- 1,000 ft of median CTH (All SLW pixels)	130	1059
4	+/- 3,000 ft of median CTH (All SLW pixels)	328	2790
5	+/- 1,000 ft of min/max CTH (All Cloudy pixels)	643	6244
6	+/- 3,000 ft of min/max CTH (All Cloudy pixels)	828	8229
7	+/- 1,000 ft of min/max CTH (All SLW pixels)	393	3300
8	+/- 3,000 ft of min/max CTH (All SLW pixels)	552	4827

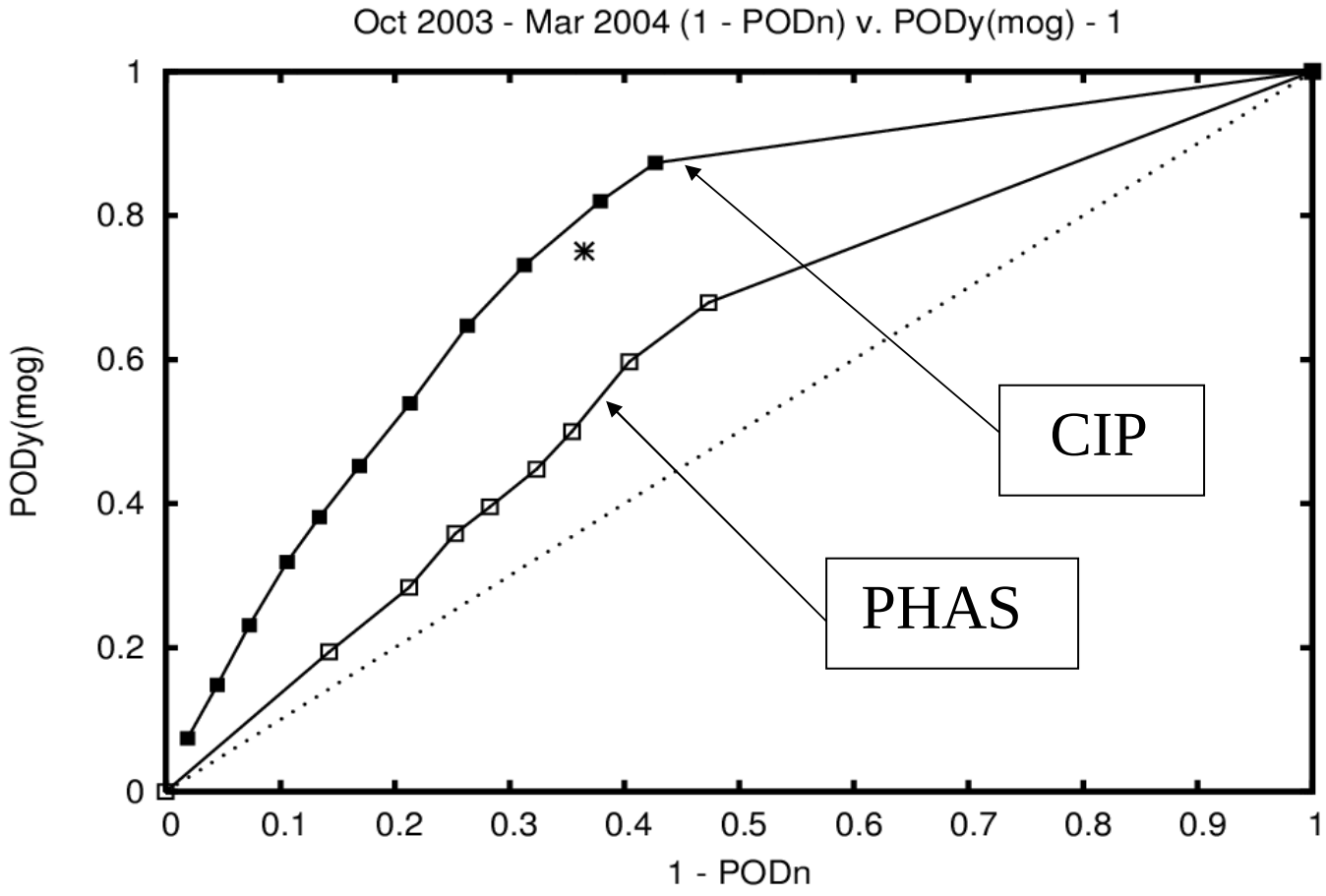
Statistical Measures

Product	*PODy(MOG)*	*PODno*	*TSS*
CIP (.05)	0.828	0.604	0.432
CIP (.15)	0.744	0.671	0.415
AIRMET	0.751	0.635	0.386
GDCP-1	0.679	0.527	0.206
GDCP-2	0.642	0.536	0.178
GDCP-3	0.708	0.294	0.002
GDCP-4	0.741	0.306	0.047
GDCP-5	0.579	0.481	0.060
GDCP-6	0.578	0.499	0.077
GDCP-7	0.822	0.195	0.017
GDCP-8	0.790	0.241	0.031

ROC curve

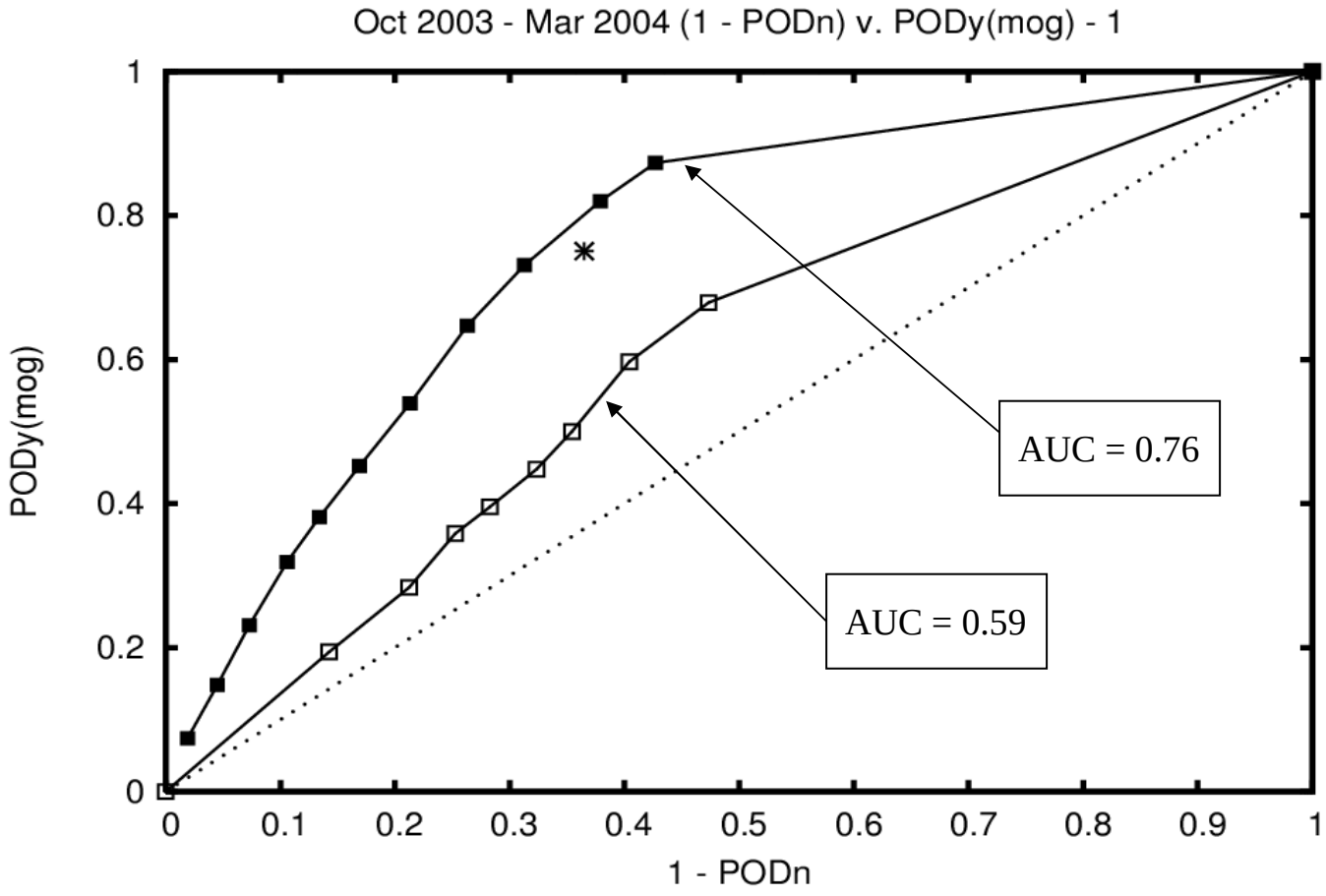

Positive Skill
No Skill
Negative Skill
PODy(mog)
1 - PODn
0
0.2
0.4
0.6
0.8
1

Results



* PIREPs located +/-1,000ft of PHAS median CTH value for all cloudy pixels were used as observations

Results



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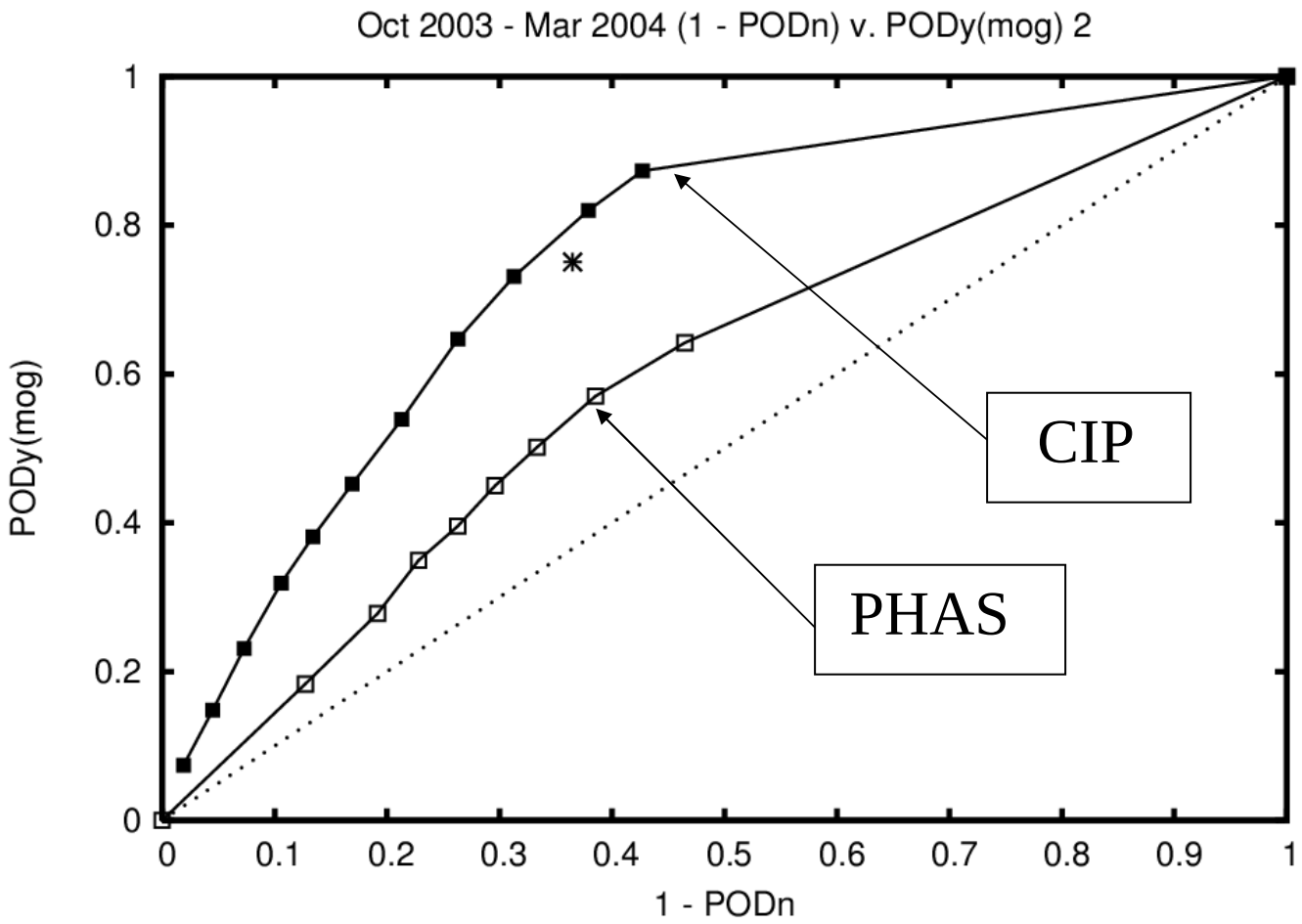
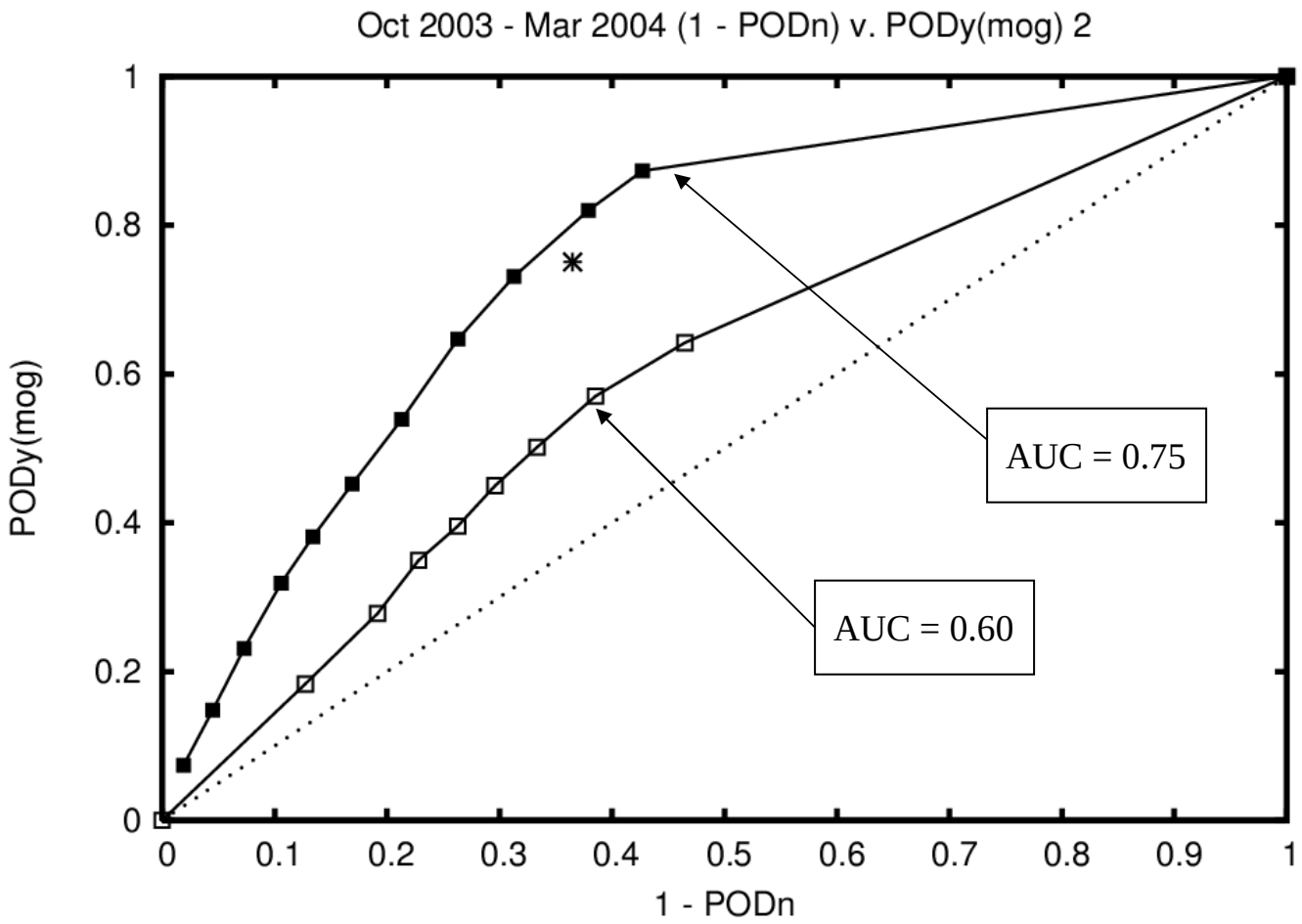
Results



* PIREPs located +/-3,000ft of PHAS median CTH value for all cloudy pixels were used as observations

Results



* PIREPs located +/-3,000ft of PHAS median CTH value for all cloudy pixels were used as observations

Conclusions

- **CIP results were similar to past studies (Brown et al. 1999; Bernstein et al. 2000)**
- **NASA LaRC PHAS product showed decent positive skill in capturing “YES” observations**
- **Results were confined to NASA LaRC CTH calculation which possibly penalized PHAS product**

Future Work

- **Compare CTH from CIP and PHAS**

- **Statistical evaluation of NASA LaRC products using research aircraft data from AIRSII**

- **Compare AIRSII results with CIP, FIP, SIGMA, GEM, and MM5**

If you are interested in more…

Politovich, M.K., P. Minnis, D.B. Johnson, C.A. Wolff, M. Chapman, P.W. Heck, and J.A. Haggerty, 2004: Benchmarking In-flight Icing Detection Products for Future Upgrades. *Proceedings, 11th Conf. on Aviation, Range, and Aerospace Meteorology,* Hyannis, MA, 4-8 October 2004.

Thanks!!!!