Comparison of NASA LaRC Cloud Products and NCAR Current Icing Potential (CIP) with Research Aircraft Data from AIRS-II/THORPEX

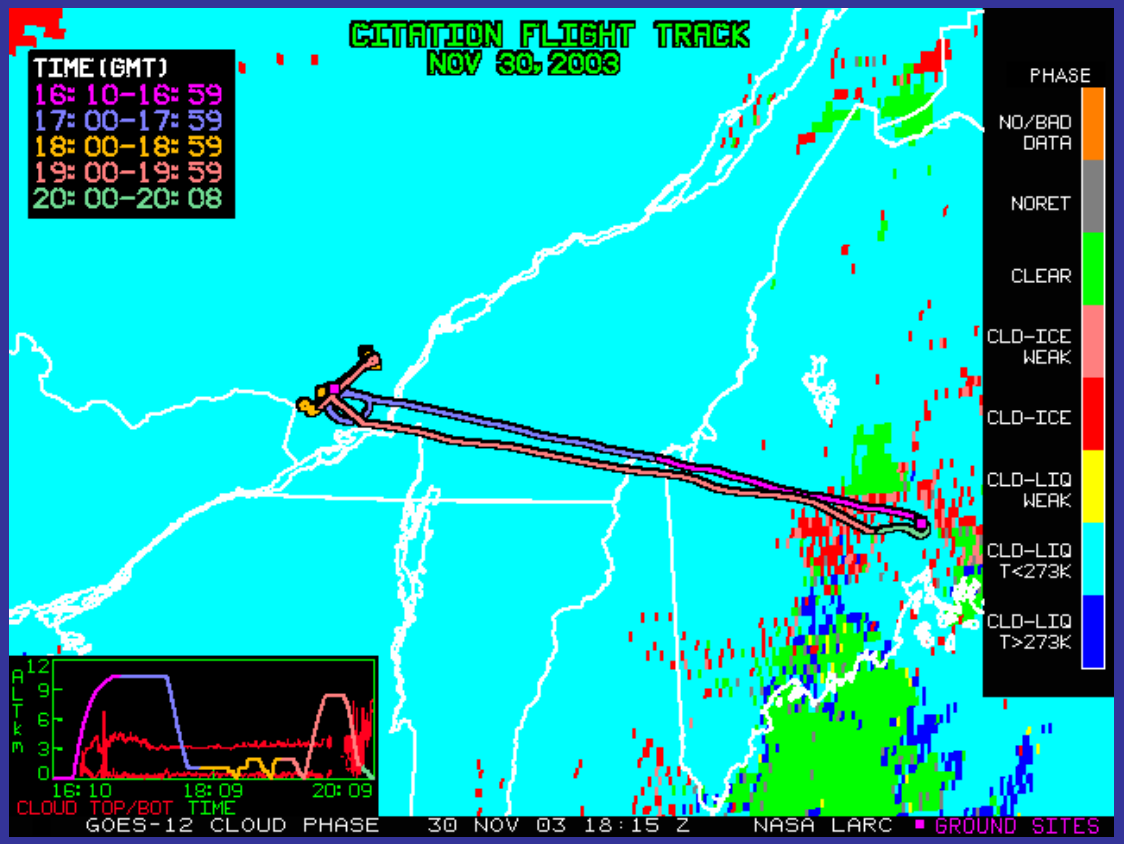
Julie Haggerty, Scott Landolt,
Cory Wolff

NCAR Research Applications Lab

Advanced Satellite Aviation-weather Products Science Meeting, April 13-14, 2005

Comparison of LaRC Cloud Products with Research Aircraft Data

- AIRS-II/THORPEX; Nov-Dec, 2003; Montreal, Bangor
- UND Citation, Canadian Convair, NASA Twin Otter
- Cloud top and base penetrations identified → 34 cases with corresponding satellite retrievals available
- Cloud height, temperature, phase, and LWP compared with VISST/SIST retrievals

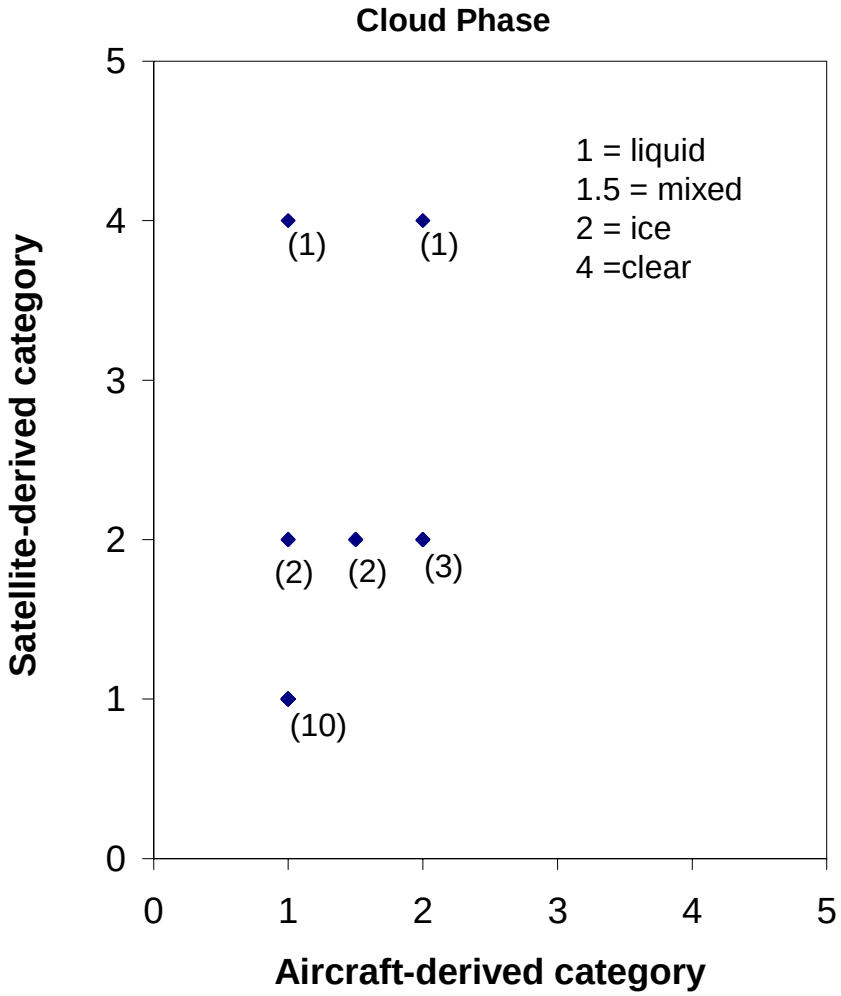


Comparison of NASA LaRC Cloud Products to Research Aircraft Data: Cloud Droplet Phase

- Numerical phase categories in LaRC Cloud Products:

  1 = liquid 2 = ice 4 = clear
- Phase retrieval represents conditions near cloud top
- Aircraft-derived phase represented with same categories plus

  1.5 = mixed phase
- All liquid is supercooled in the cases examined

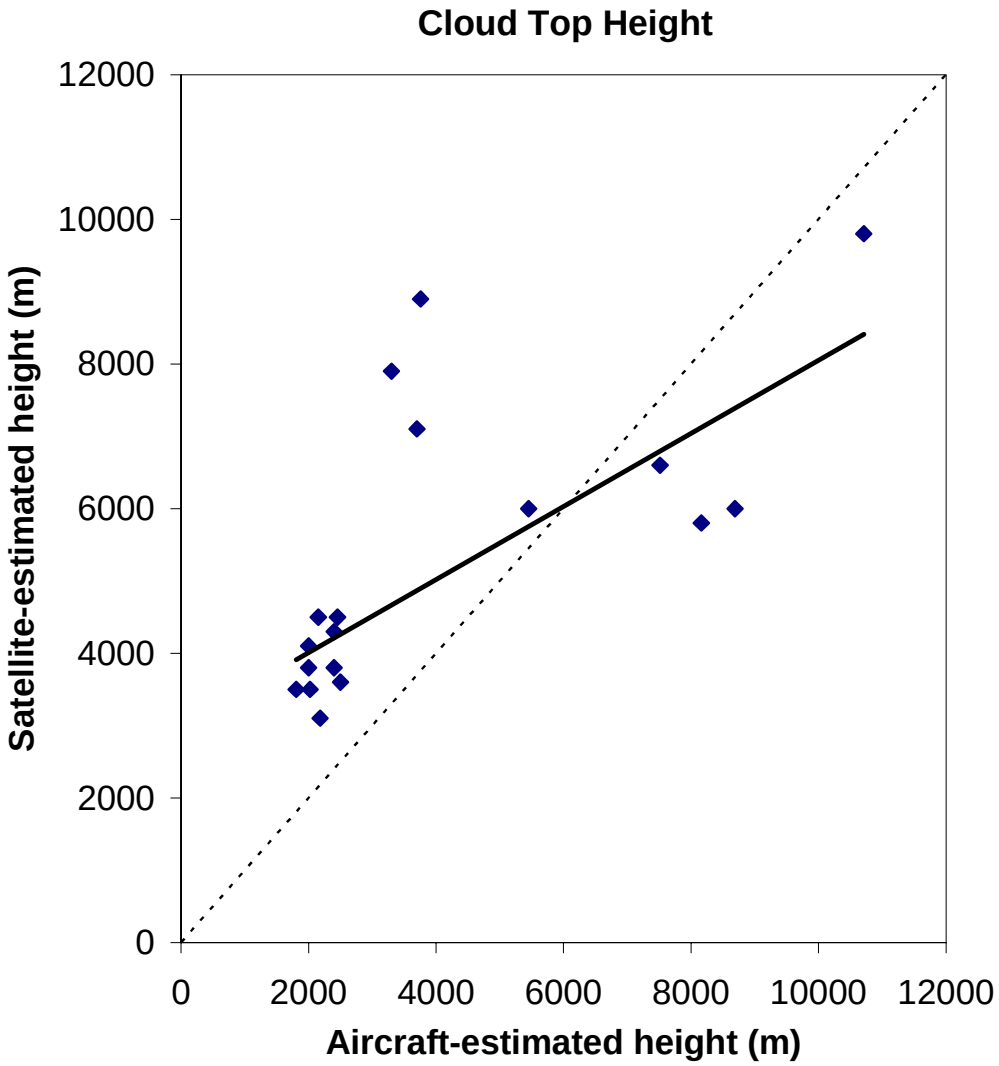


Aircraft cloud-top penetrations

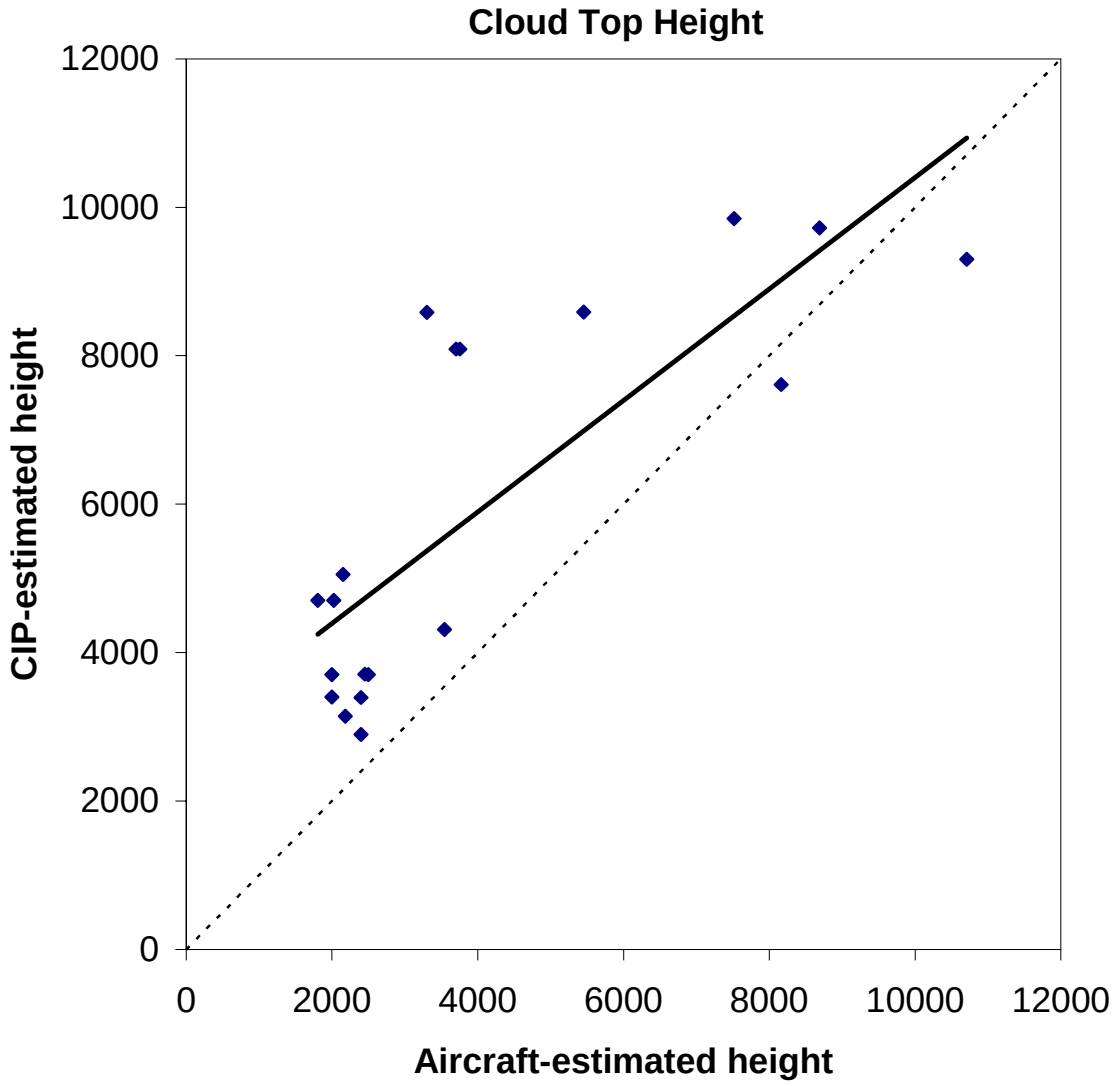
- 13 aircraft-detected liquid cases
  - −10 classified correctly by satellite
  - − 2 classified as ice (overlying cirrus?)
  - − 1 as clear (varied conditions)
- 2 aircraft-detected mixed phase cases
  - − both classified as ice by satellite
- 4 aircraft-detected ice cases
  - − 3 classified correctly by satellite
  - − 1 classified as clear

Current Icing Potential (CIP) Products vs. Research Aircraft Data: Cloud Droplet Phase

- Qualitative comparison of icing potential (0-1) and aircraft-observed cloud phase
- Icing potential at aircraft-estimated cloud top height was used
  - *Positive icing potential observed in all but one case where aircraft observed supercooled liquid*
  - *Zero icing potential in all cases where aircraft observed ice phase at cloud top*



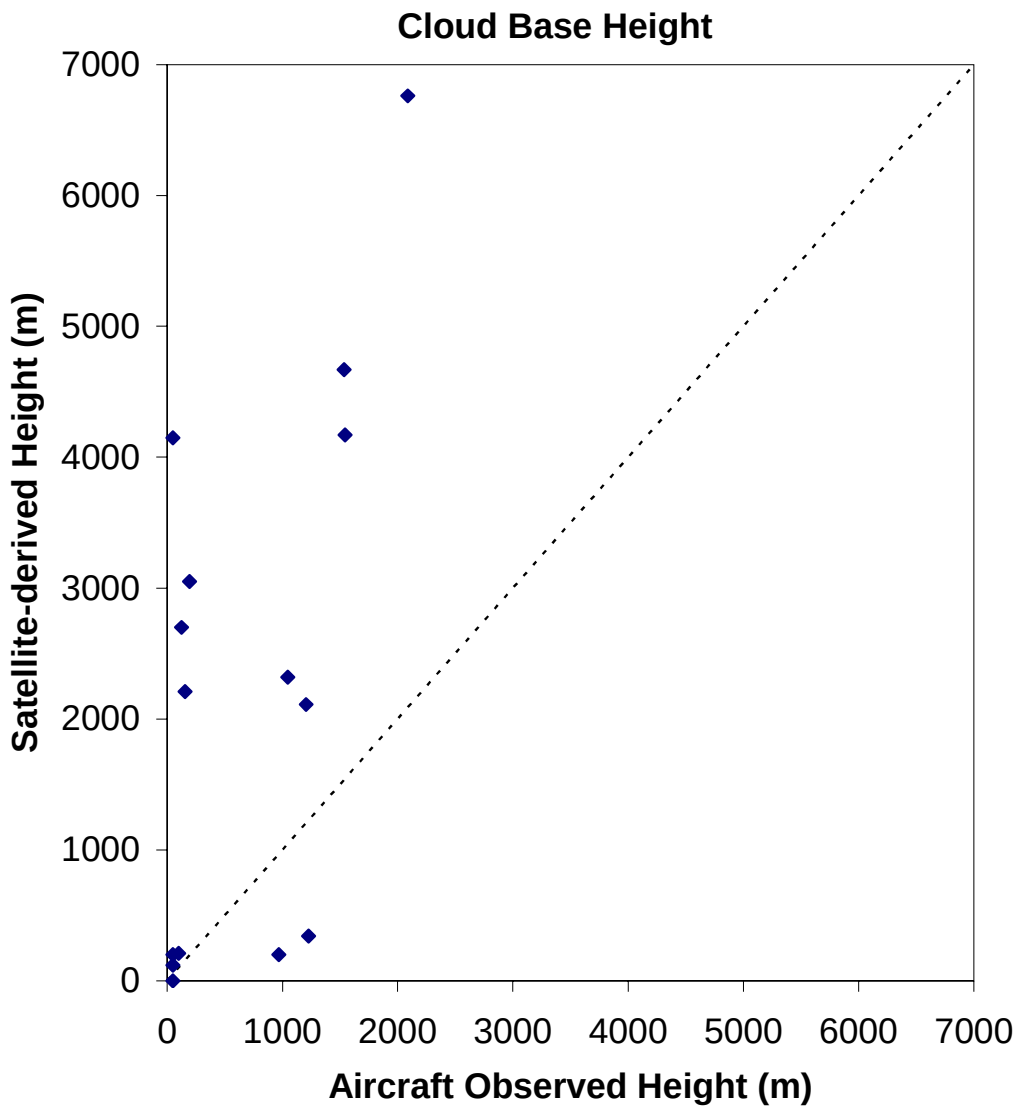
Aircraft mean = 4039 m
Satellite mean = 5377 m
Correlation coefficient = 0.67



Aircraft mean = 4039 m

CIP mean = 5923 m

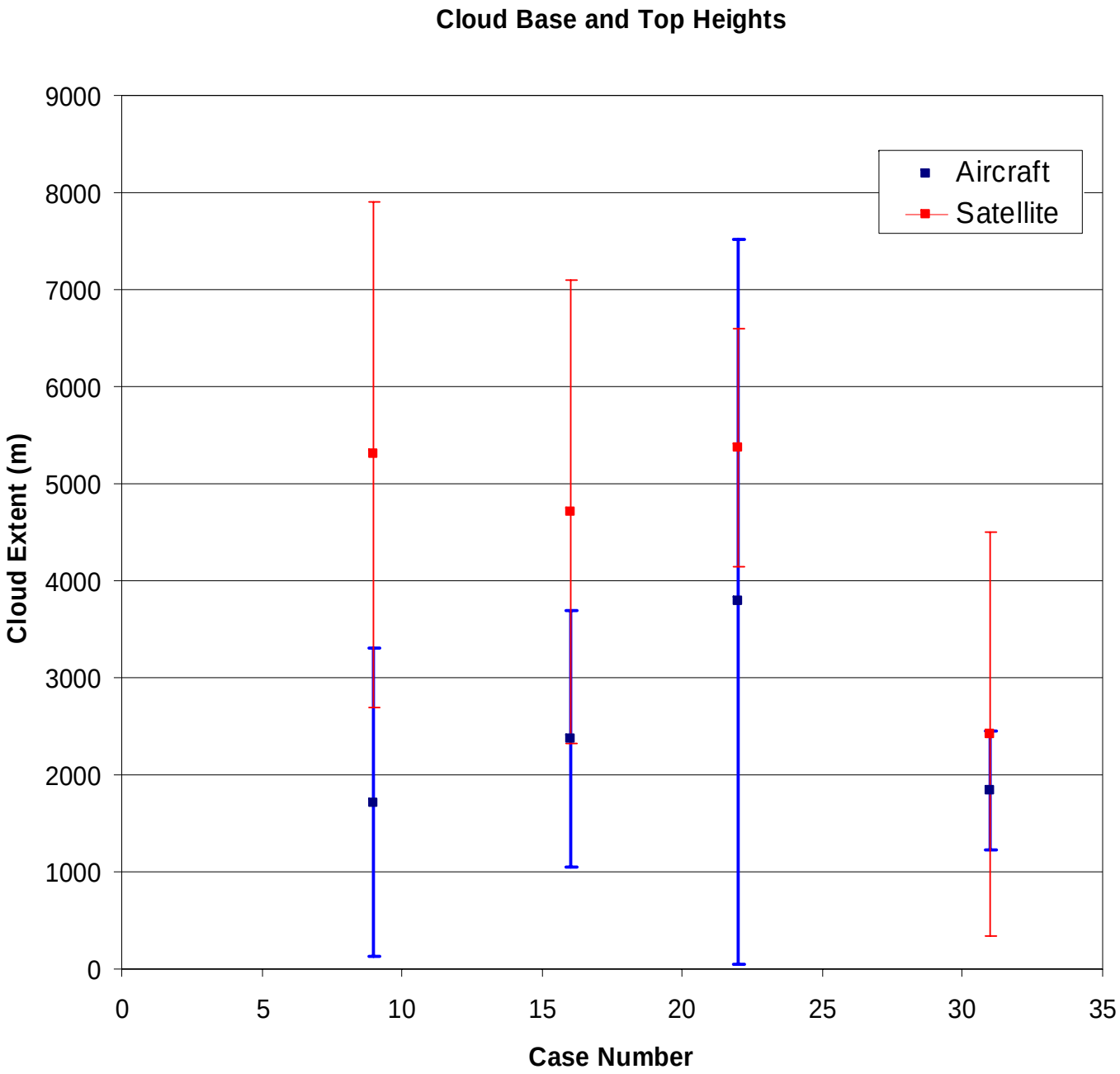
Satellite mean = 5377 m



Aircraft mean = 693 m

Satellite mean = 2213 m

Correlation coefficient = 0.58

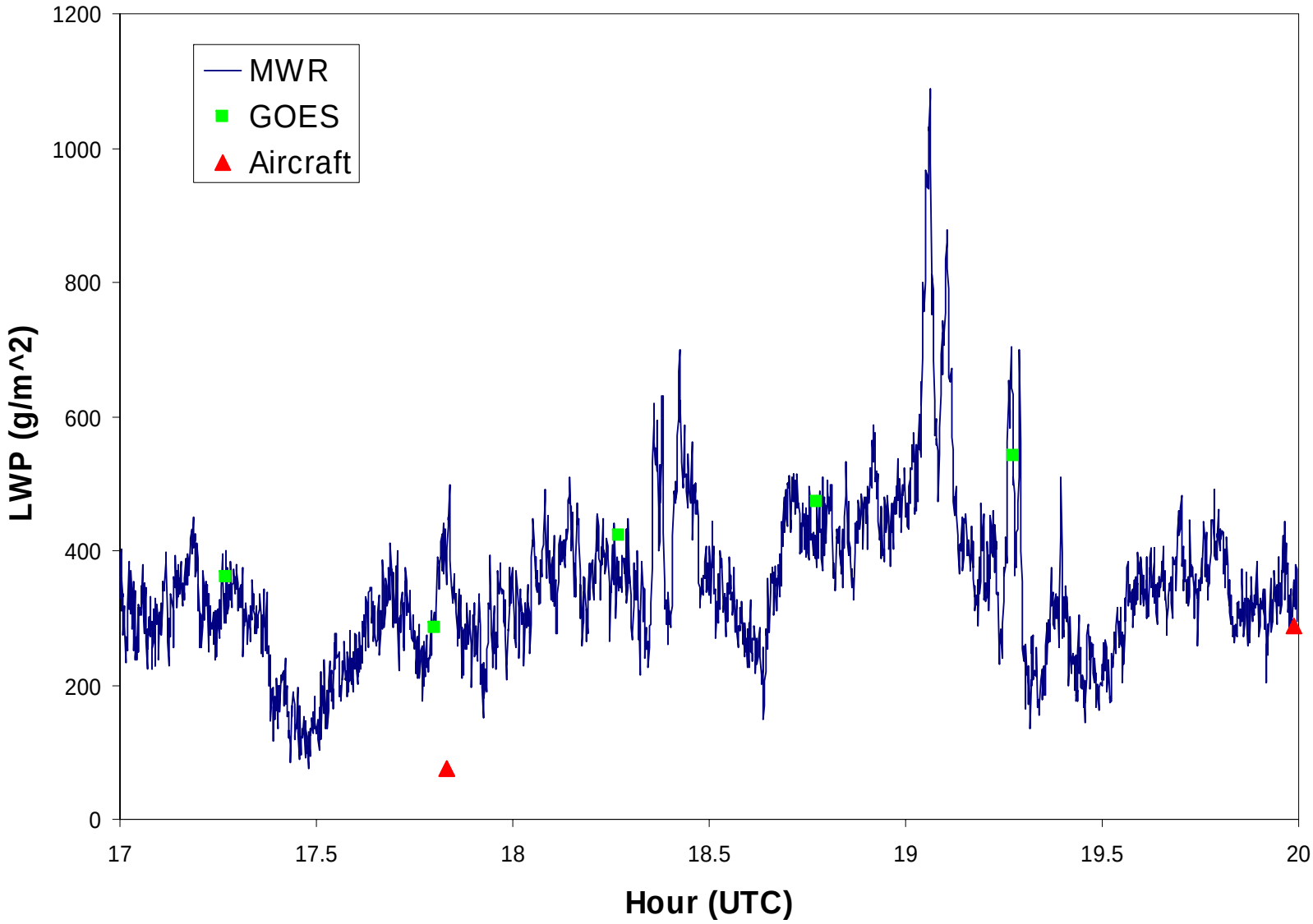

Cloud Base and Top Heights
Cloud Extent (m)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
35
Case Number
Aircraft
Satellite

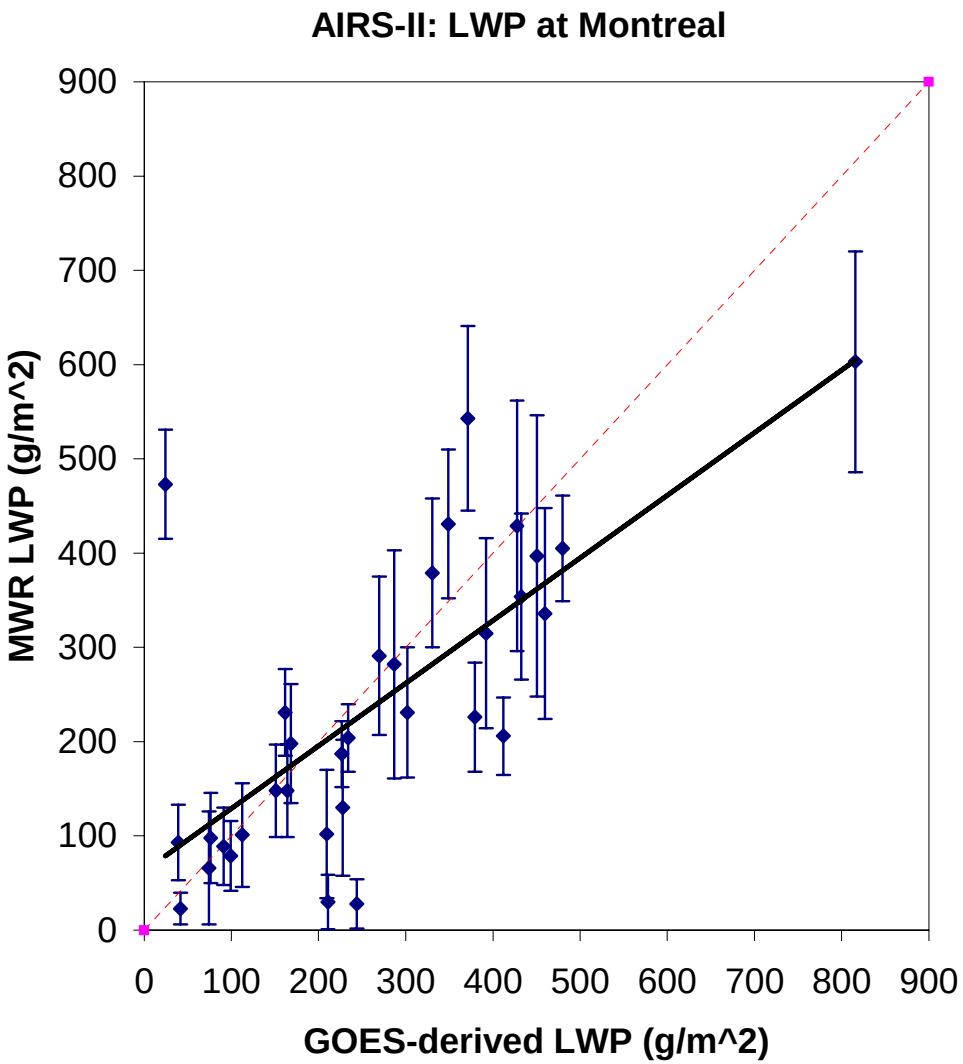
Comparison of LaRC Satellite-derived Liquid Water Path with Ground-based Microwave Radiometer Retrievals during AIRS-II

- Nov-Dec, 2003; Montreal (Mirabel) site
- VISST (daytime) algorithm applied to GOES-12 data
- NOAA MWR (2-channel); LWP retrieval method of Liljgren et al.(2001)
- Include aircraft LWP in comparisons as available
- Work in progress

LWP Comparison

- LaRC cloud products from a 10 km (30 pixels) radius around Montreal; half-hourly
- Ground-based MWR retrievals averaged over 1 hour centered at the time of the GOES products
- Aircraft liquid water content integrated vertically during ascent/descent through cloud layers near Montreal
- Selected clouds that were primarily liquid according to the satellite phase retrieval (minimal ice present in a few cases)
- No precipitation at surface


Liquid Water Path at Mirabel -- Nov 30, 2003
MWR
GOES
Aircraft
LWP (g/m^2)
0
200
400
600
800
1000
1200
17
17.5
18
18.5
19
19.5
20
Hour (UTC)



MWR Mean = 238.5

GOES Mean = 264.0

MWR Stddev = 156.6

GOES Stddev = 169.2

Correlation coefficient = 0.72

LWP Comparison: On-going Work

- Examine cases where liquid water was detected by MWR and/or aircraft but not by LaRC cloud products
- Stratify data set according to cloud type, cloud temperature and height
- Update LaRC cloud products with latest version of algorithm
- Additional aircraft points for comparison