An update on Cloud Microphysical Products From TWP-ICE

ARM Cloud Properties Working Group Meeting
Ice Cloud Breakout Session

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12th Nov. 2008

OUTLINE

I. Habit Classification

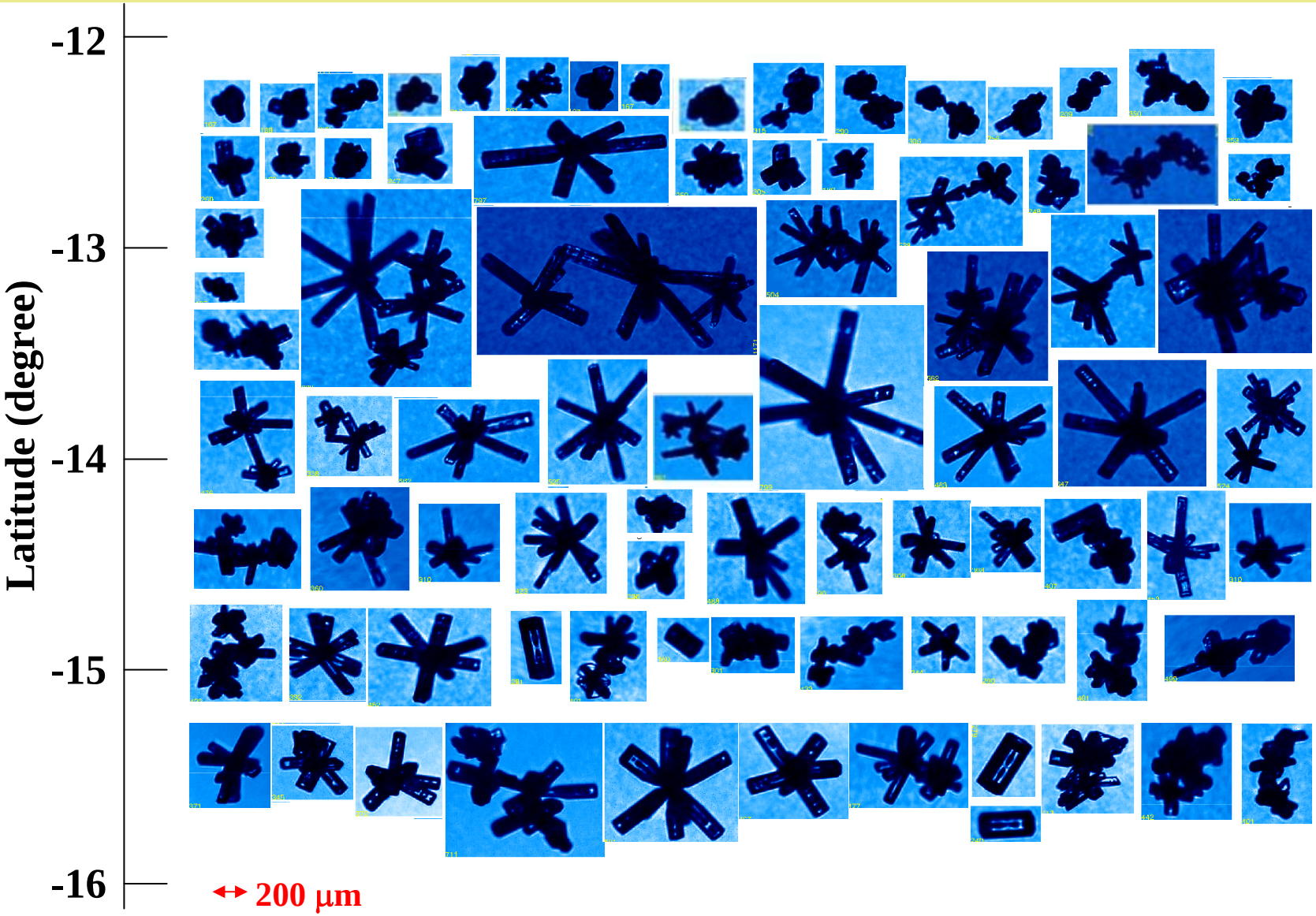
II. Aggregates of Plates

III. CIP SV Correction

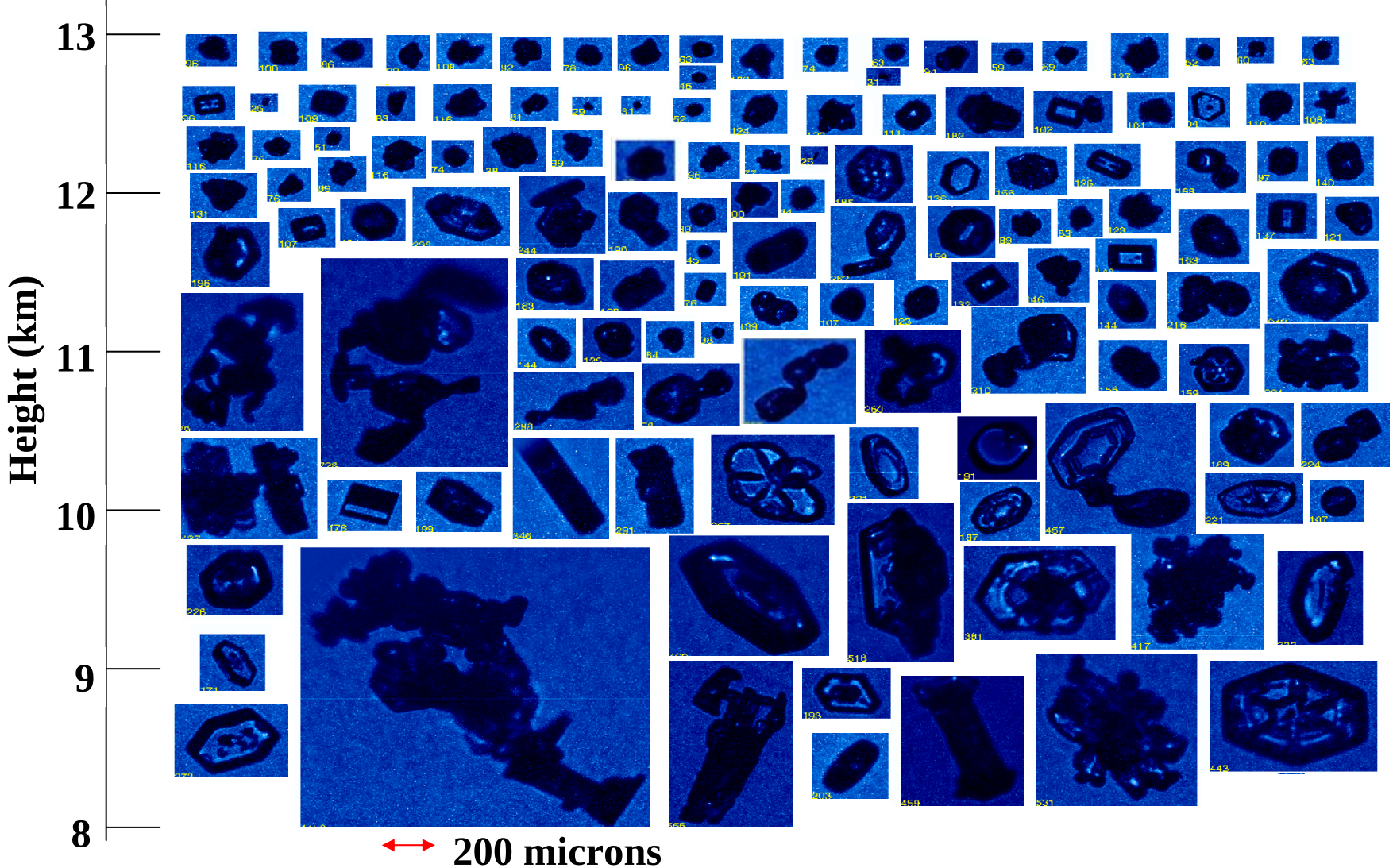
IV. CPI Size Distributions

V. Variability of Cloud Properties

I. Habit Classification



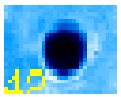
Many bullet rosettes & aggregates seen on leg at 12 km in aged cirrus



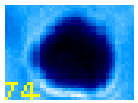
- Fresh anvil (02/02) different than aged cirrus: fewer bullet ros ettes for D > 100 μm (plates/irregulars dominate)
- Quasi-spheres/irregulars dominate overall as in aged cirrus

I. Habit Classification

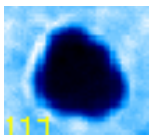
Ice Crystal Habit



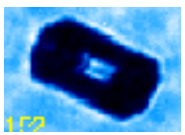
Small Quasi-Sphere



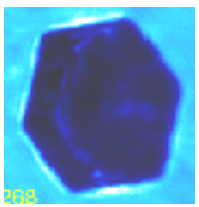
Medium Quasi-Sphere



Large Quasi-Sphere

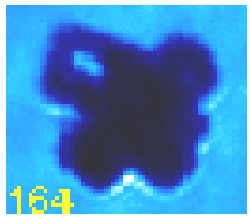


Column

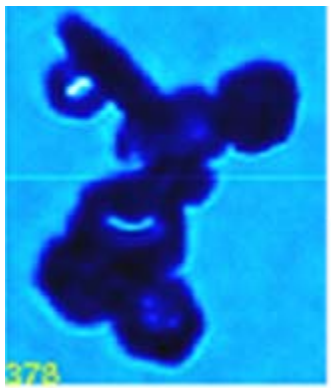


Plate

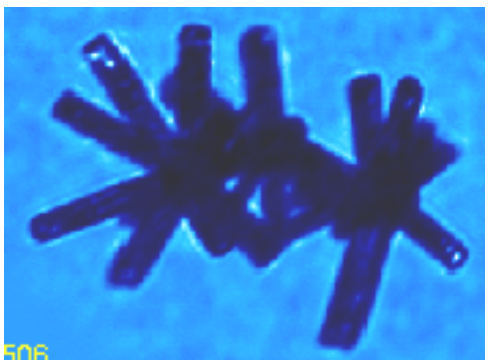
Bullet Rosette



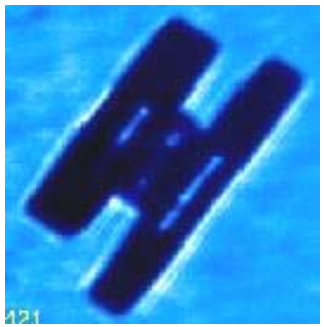
Aggregates Of Columns



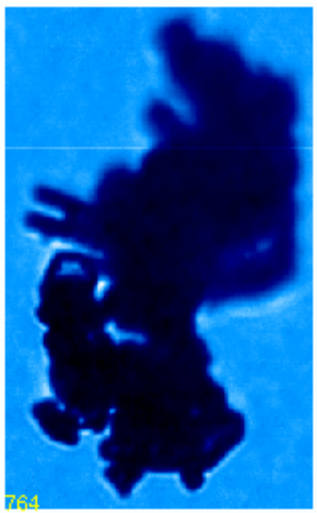
Aggregates Of Plates



Aggregates Of Bullet Rosettes



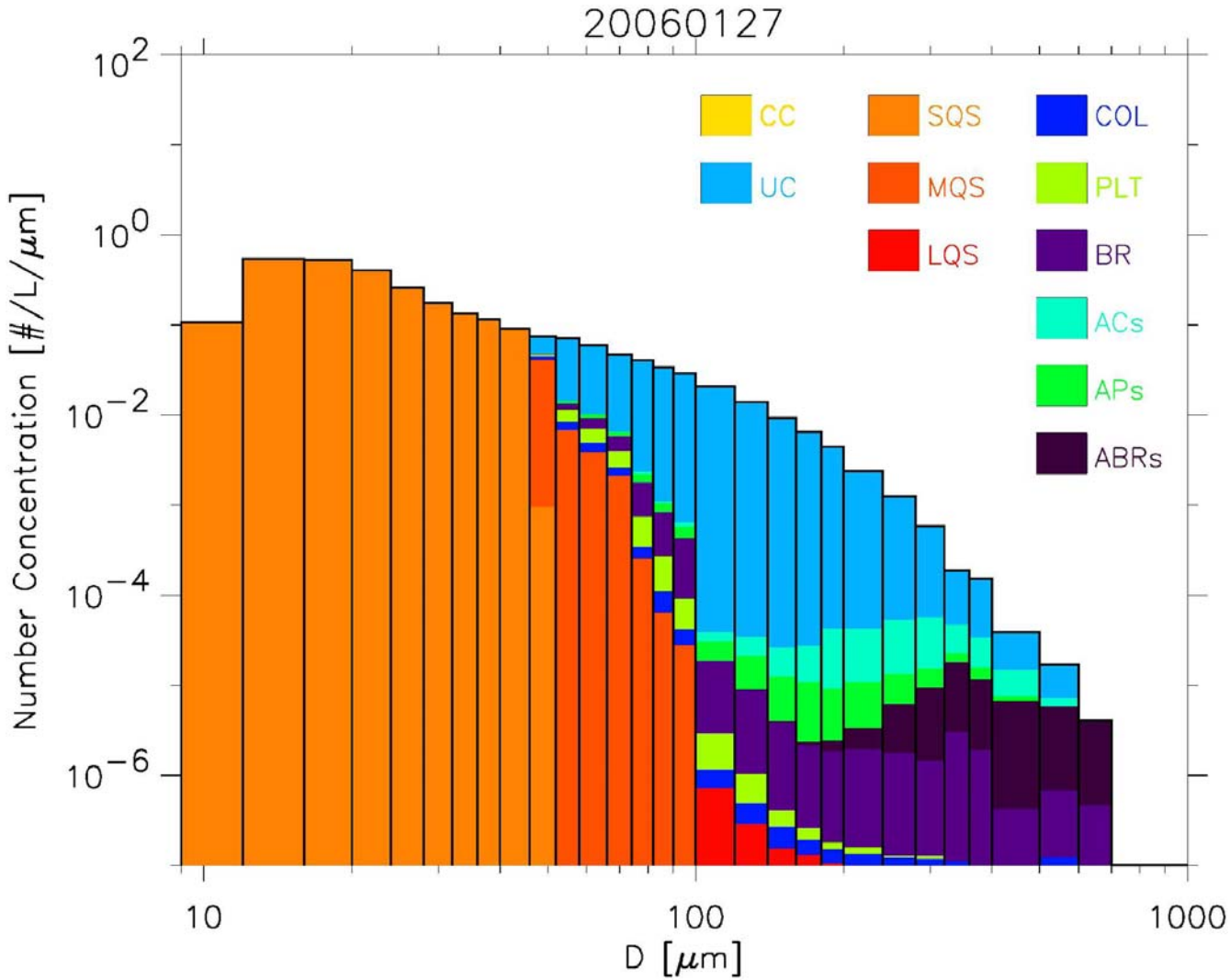
Capped Column



Unclassifiable

I. Habit Classification

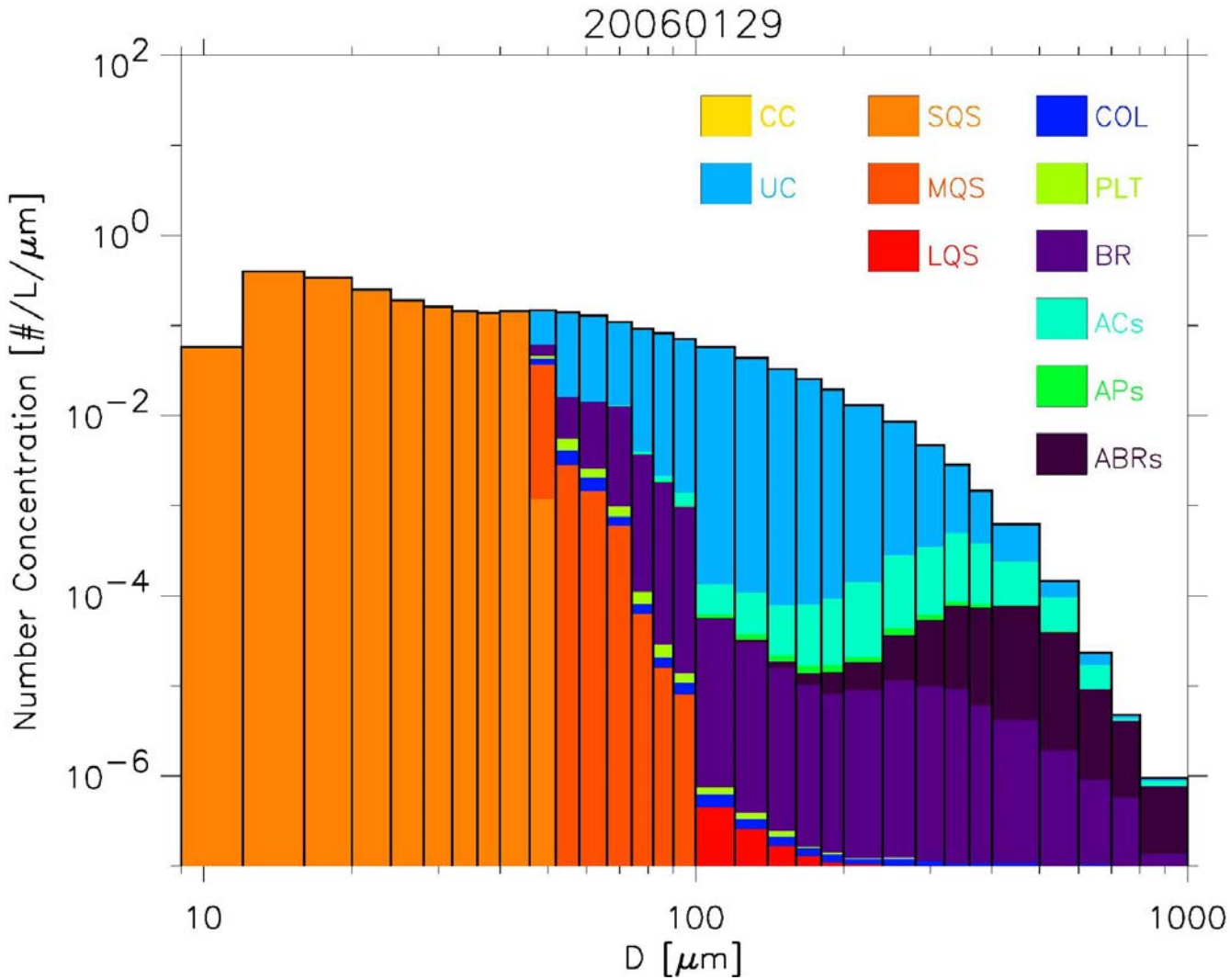
0127



✓ **High conc. of quasi-spheres, BRs and ABRs**

I. Habit Classification

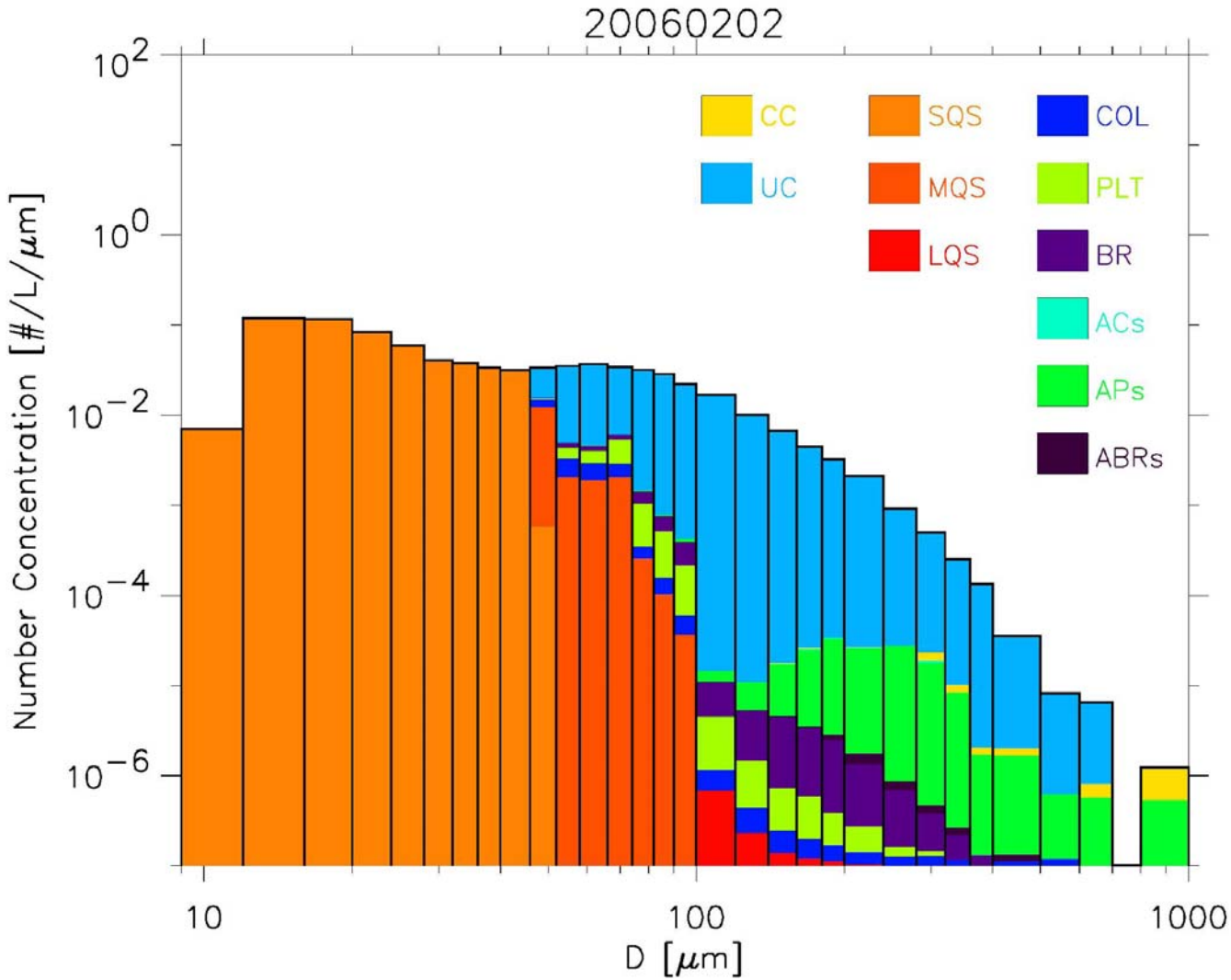
0129



✓ **BRs and ABRs**

I. Habit Classification

0202



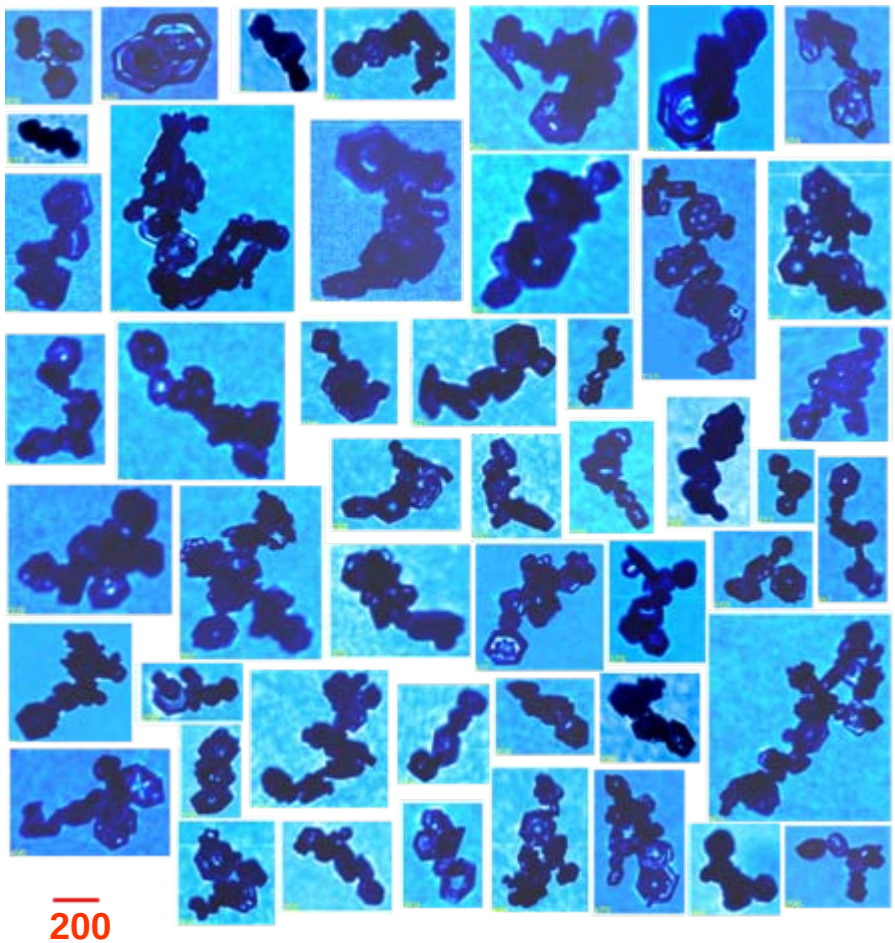
✓ **PLTs, APs, and CC**

I. Habit Classification

Contributions (%)

Ice Crystal Habit	Fraction by	27 Jan.		29 Jan.		2 Feb.	
		D > 0 μm	D > 200 μm	D > 0 μm	D > 200 μm	D > 0 μm	D > 200 μm
BR + ABRs	Number	4.5	43.3	21.3	55.69	4.3	12.1
	Area	23.3	48.0	47.7	60.0	7.1	7.0
PLT + APs	Number	2.8	9.1	1.1	1.2	11.6	46.3
	Area	8.8	8.0	1.5	1.1	33.9	51.9
CC	Number	0.0	0.0	0.0	0.0	0.1	1.3
	Area	0.0	0.0	0.0	0.0	1.0	2.3
SQS+MQS +LQS	Number	80.4	0.0	52.1	0.1	58.7	0.1
	Area	28.4	0.0	9.1	0.1	17.0	0.1

II. Aggregates of Plates

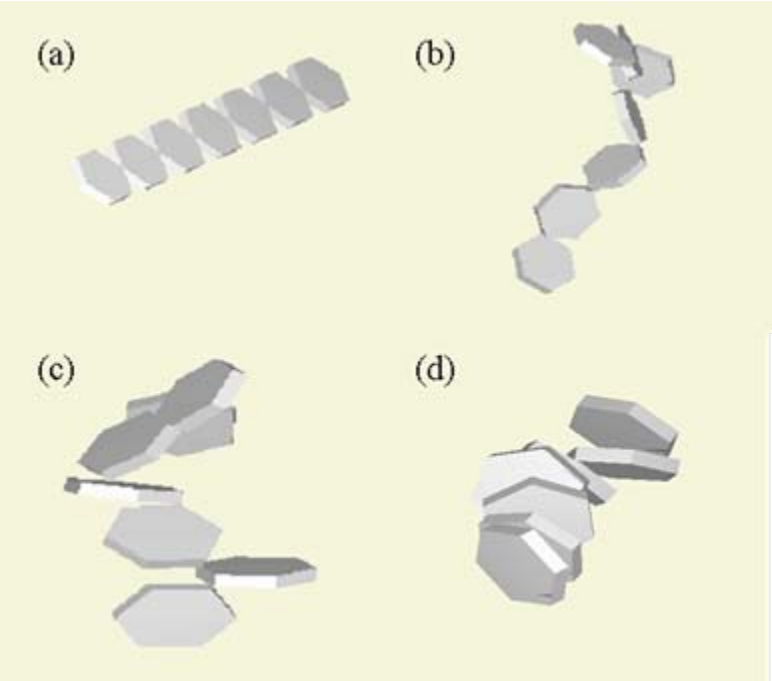


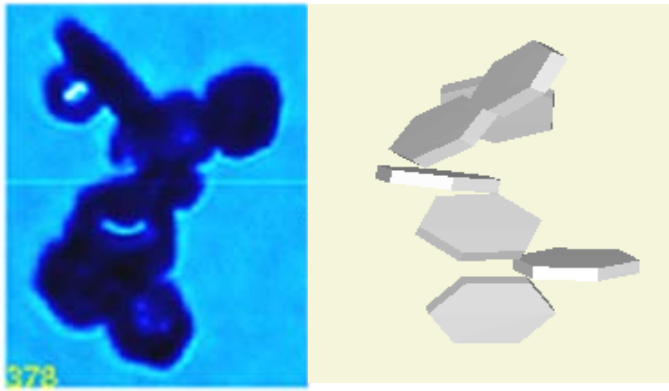
- A cluster of plates
- 1998 TEFLUN-B
  2002 CRYSTAL-FACE
  2002 EMERALD-II
  2006 TWP-ICE
- Convective origin
  - Electric field

Um and McFarquhar
(*in review*, QJRMS)

II. Aggregates of Plates

Aggregation Index (AI)

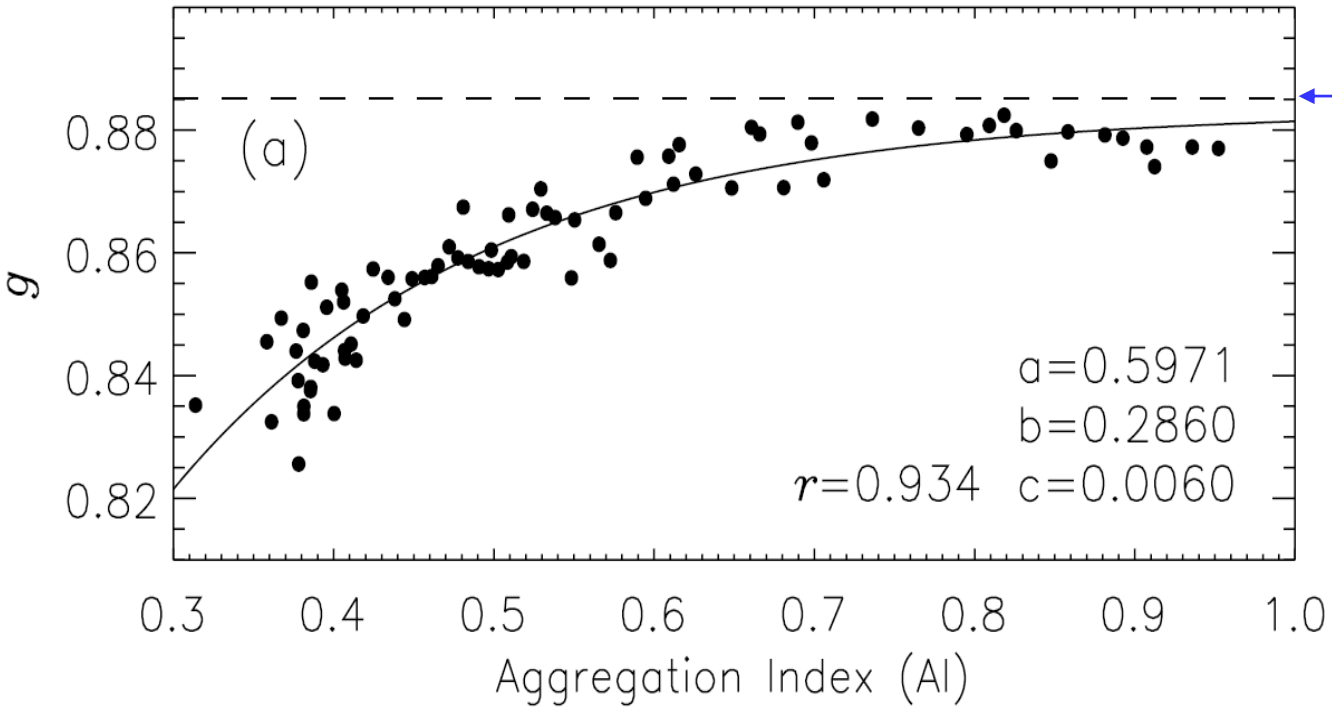




(a) AI=1.0 (b) AI=0.81 (c) AI=0.61 (d) AI=0.40

Um and McFarquhar
(*in review*, QJRMS)

II. Aggregates of Plates

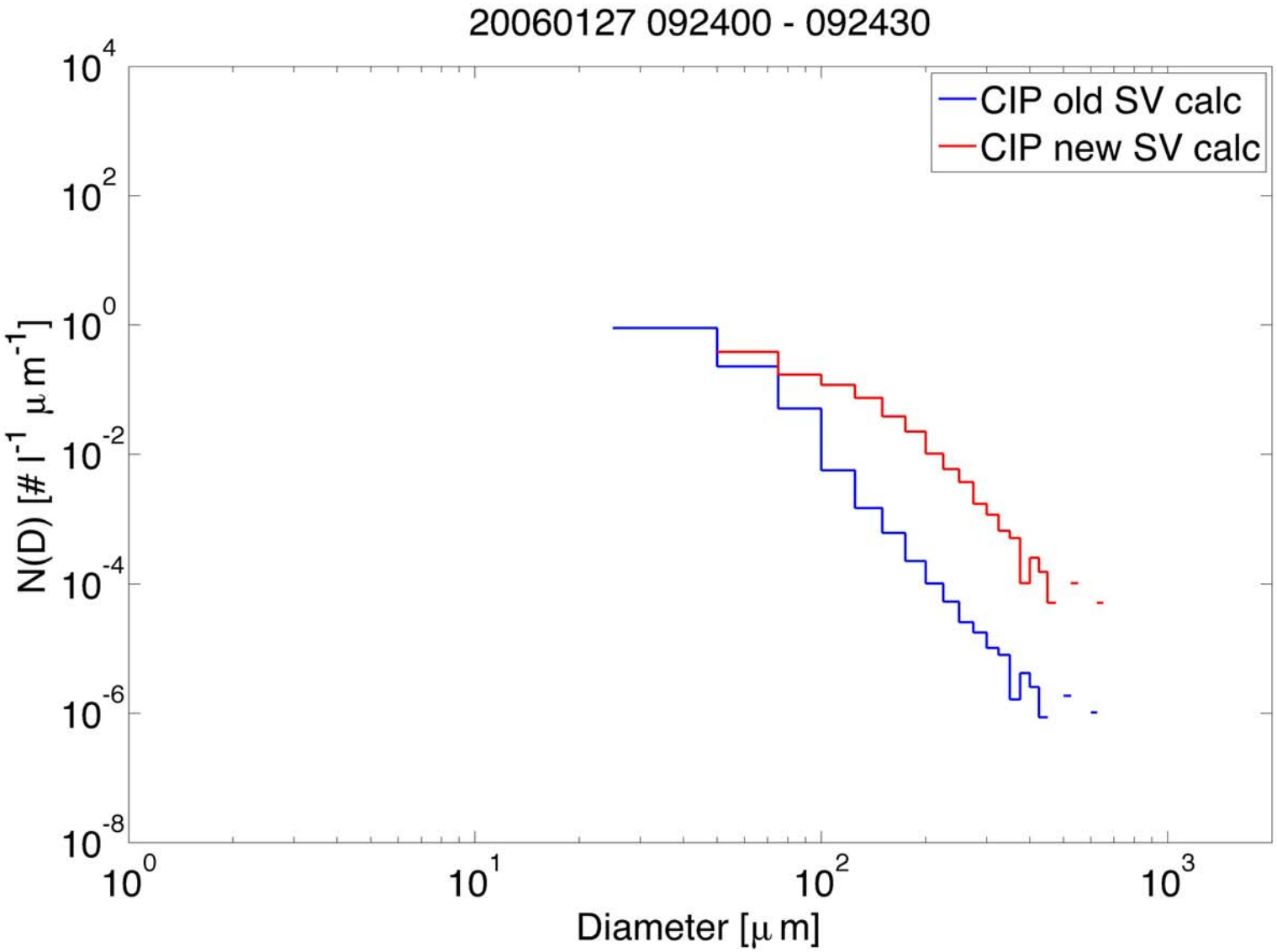


g=0.8851
Component
Plate_100

✓ **The g depends heavily on an ice crystal complexity**

Um and McFarquhar
(*in review*, QJRMS)

III. CIP SV Correction



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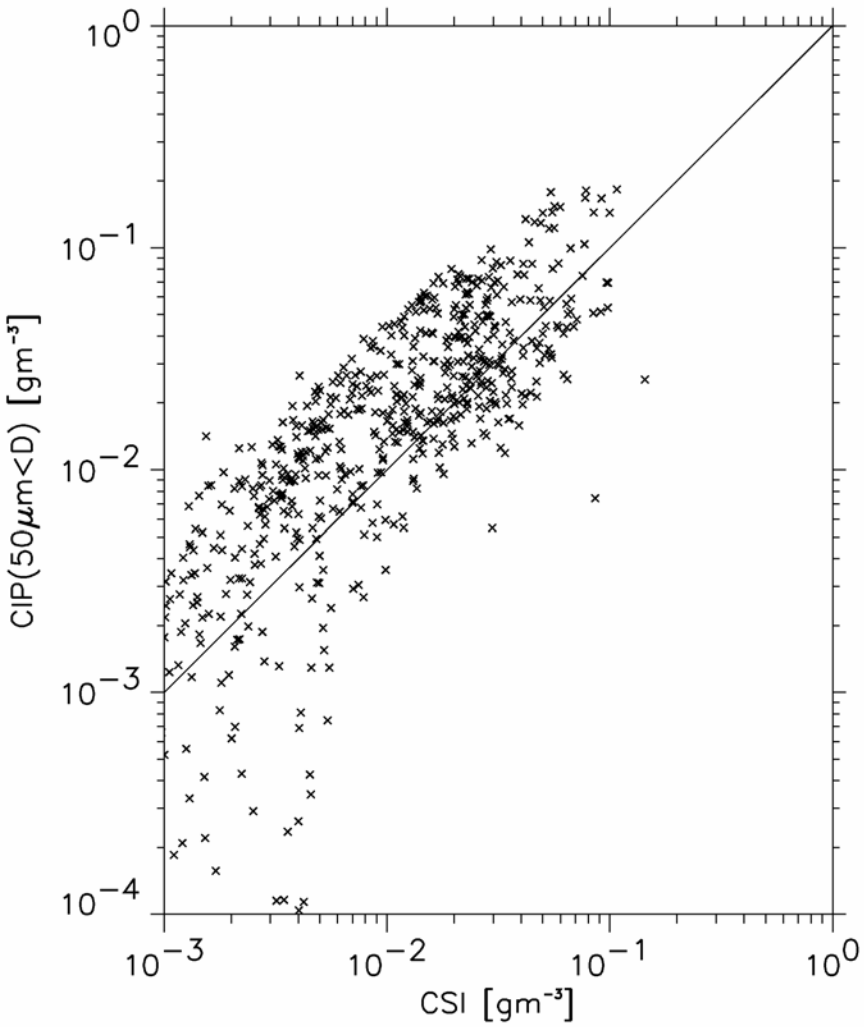
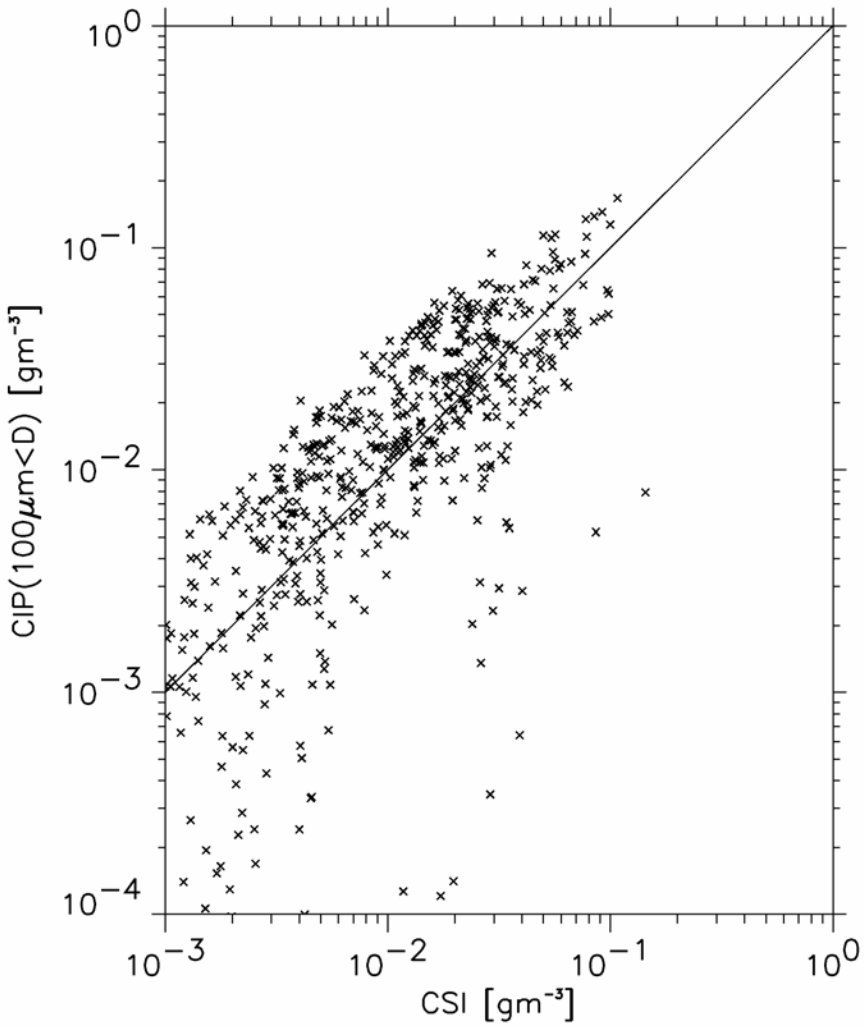
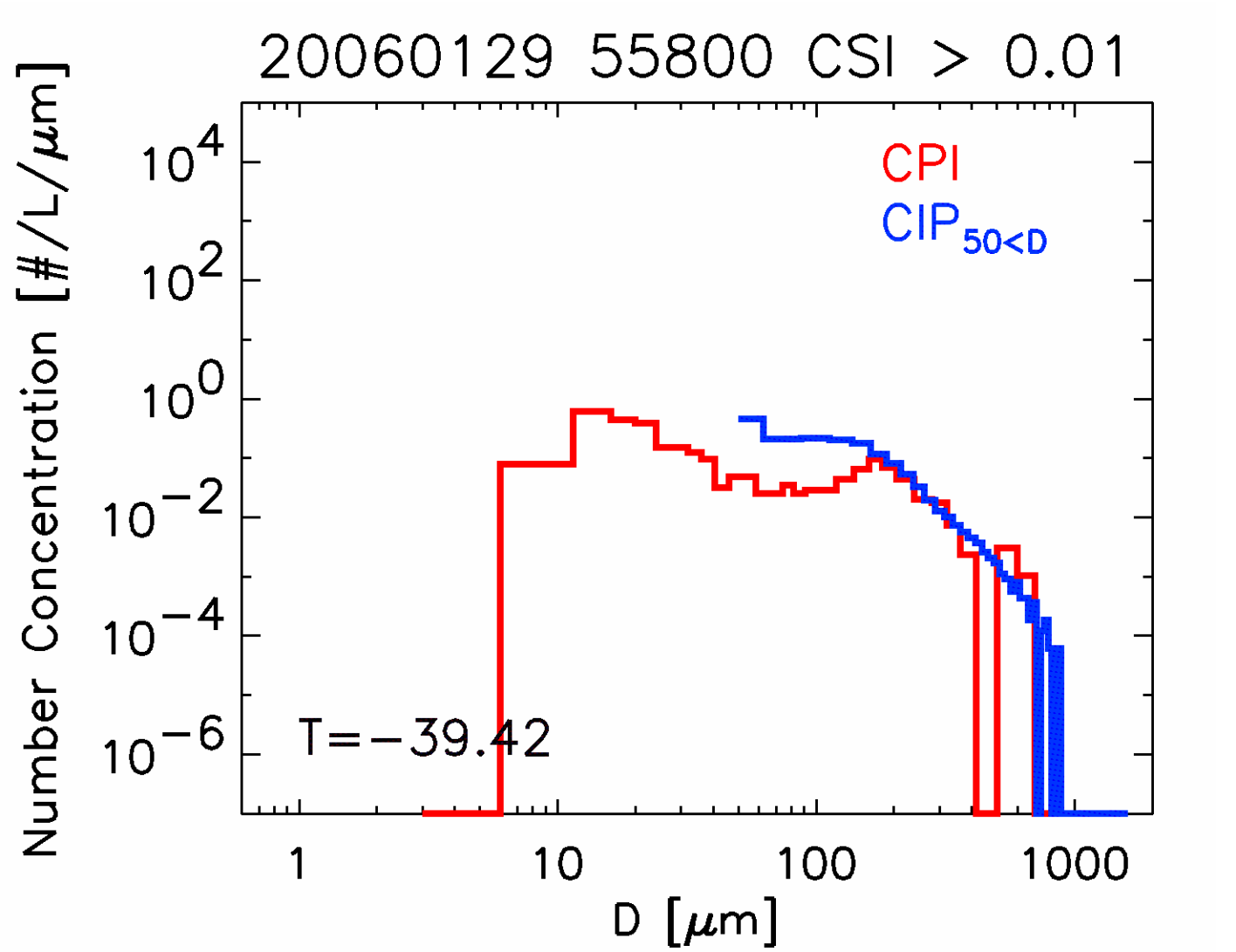




30 Sec

IV. CPI Size Distributions



30 Sec

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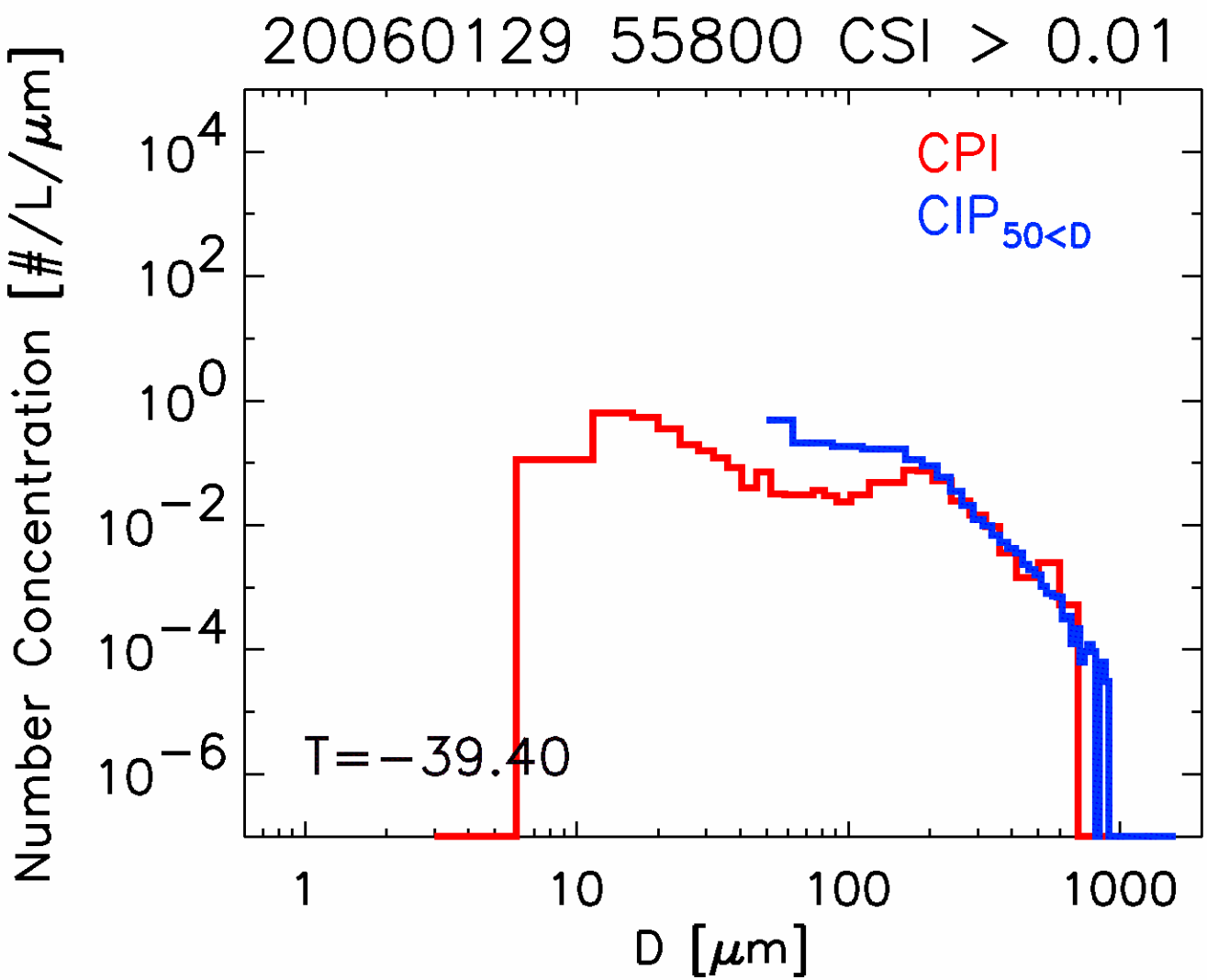
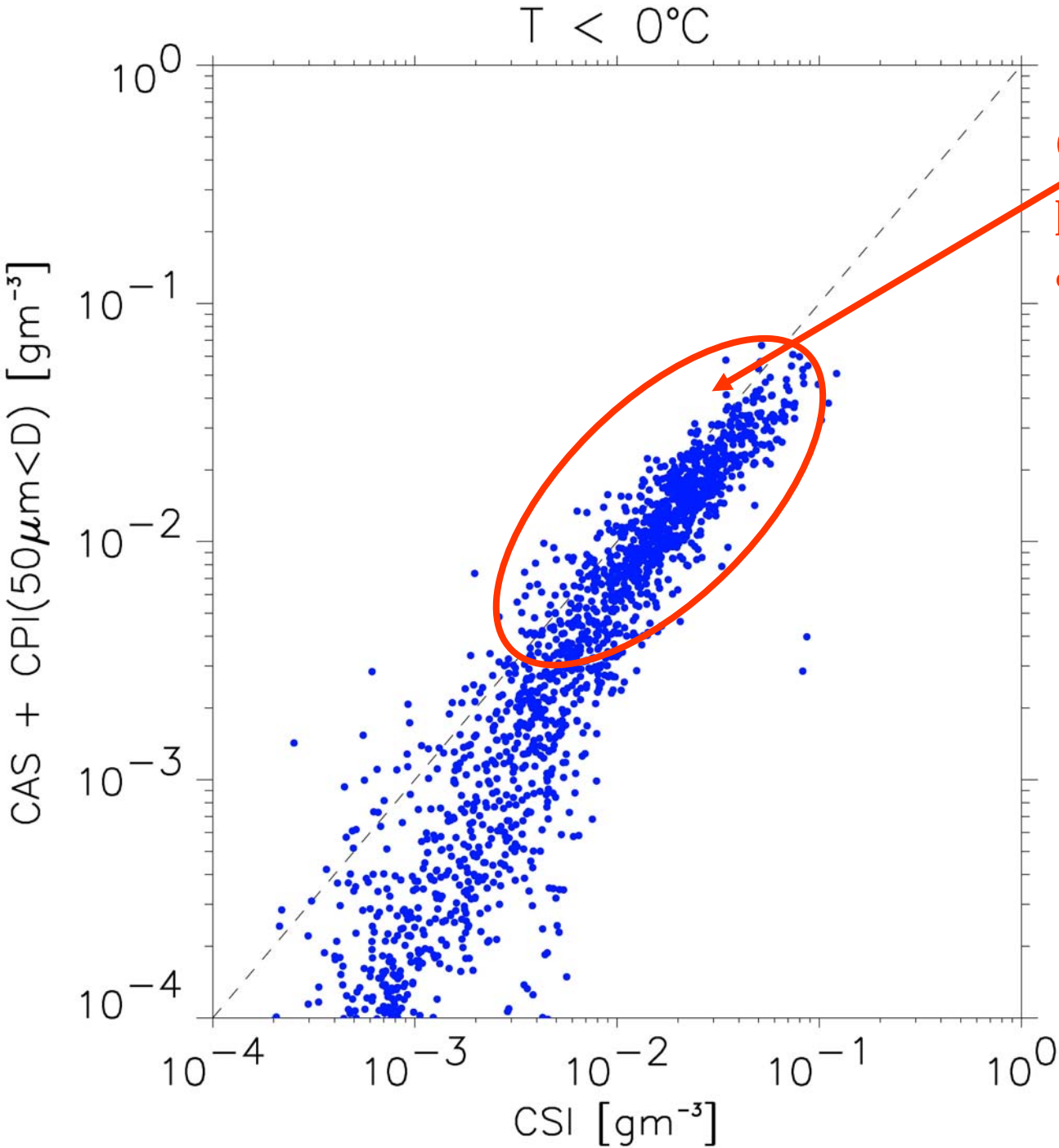


60 Sec



CPI SDs seem to provide closer agreement with CSI

Uncertainty in CPI Distributions

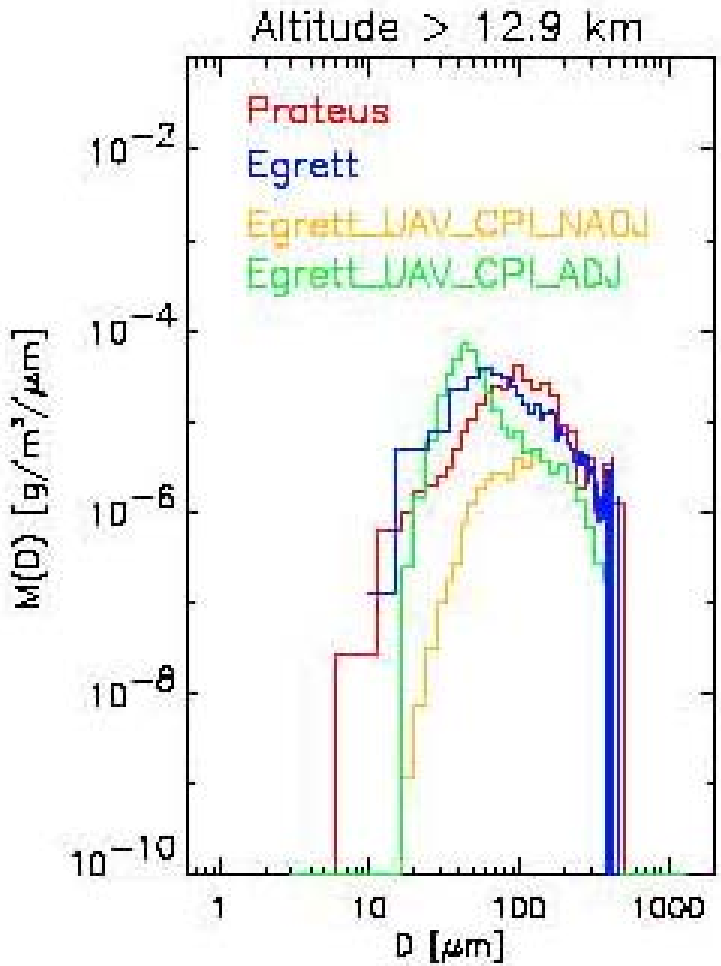


Figure 11: SDs estimated from Proteus and Egrett CPI from 6 Feb. 2006

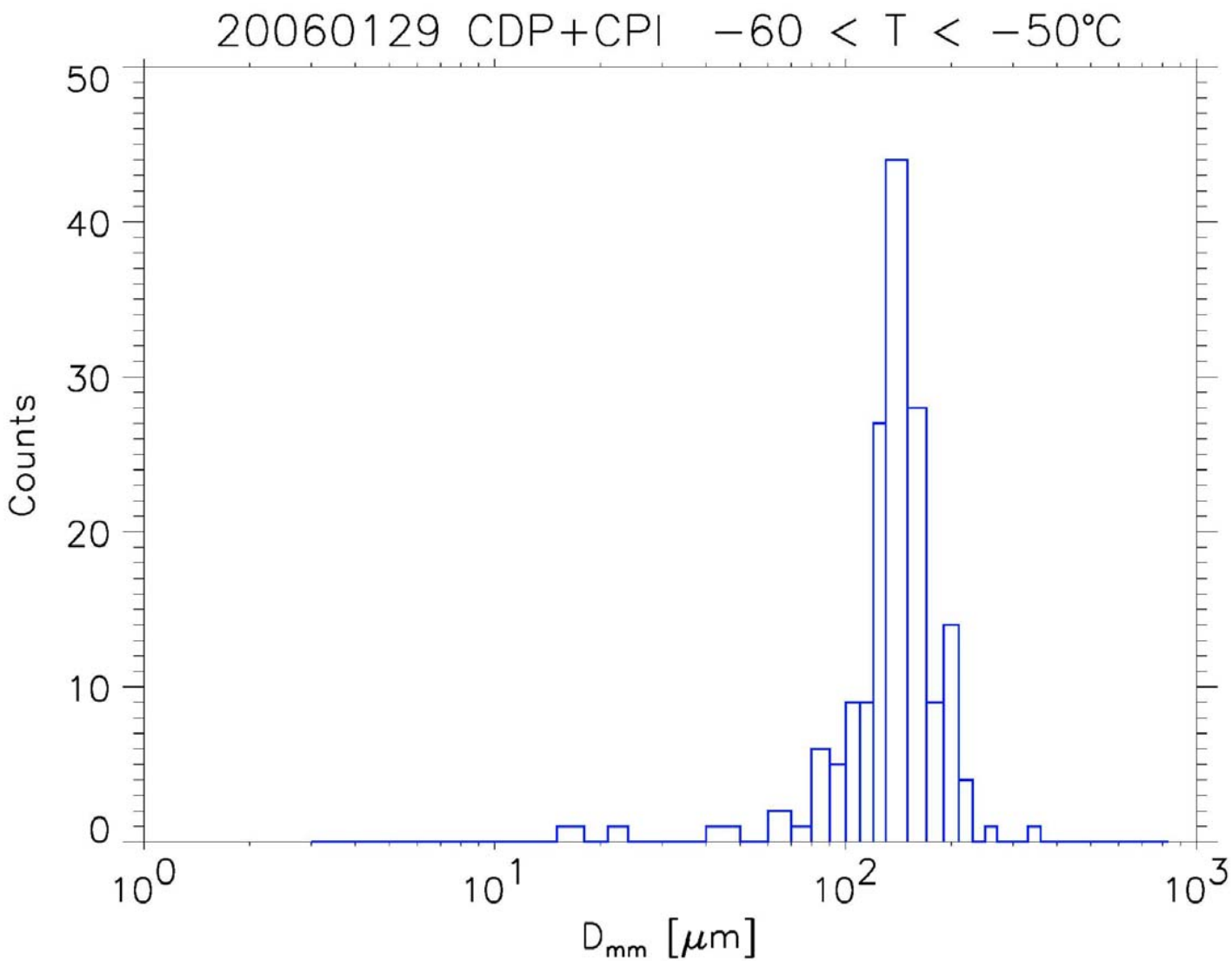
Scaling factor required to calculate CPI size distributions

Connolly et al. (2007) determined factor for Ver. 1 CPI, but we have Ver. 2

Need to determine scaling factor to get better estimate of SD for D < 100 μm

Recommend collaboration with Manchester group

V. Variability of Cloud Properties



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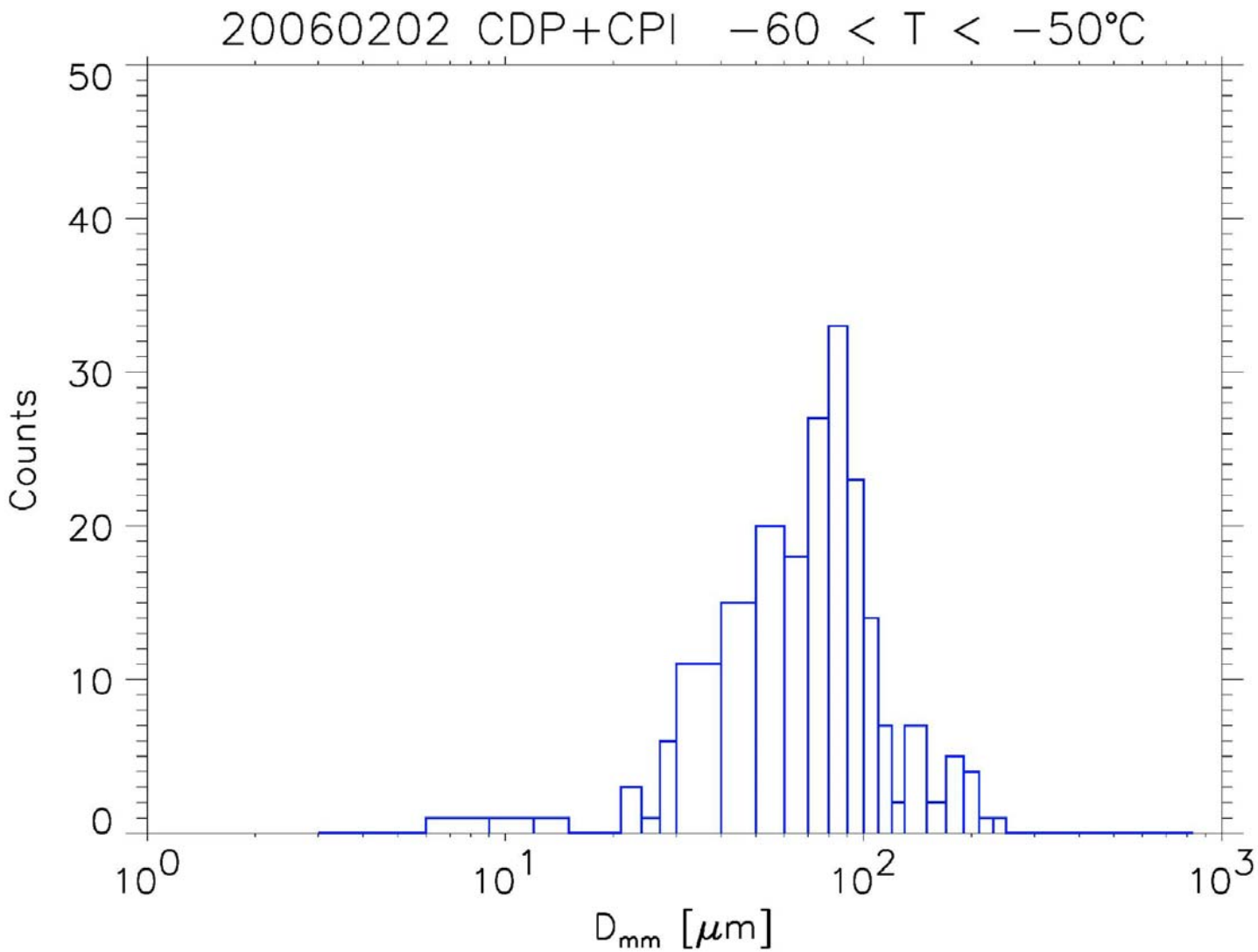

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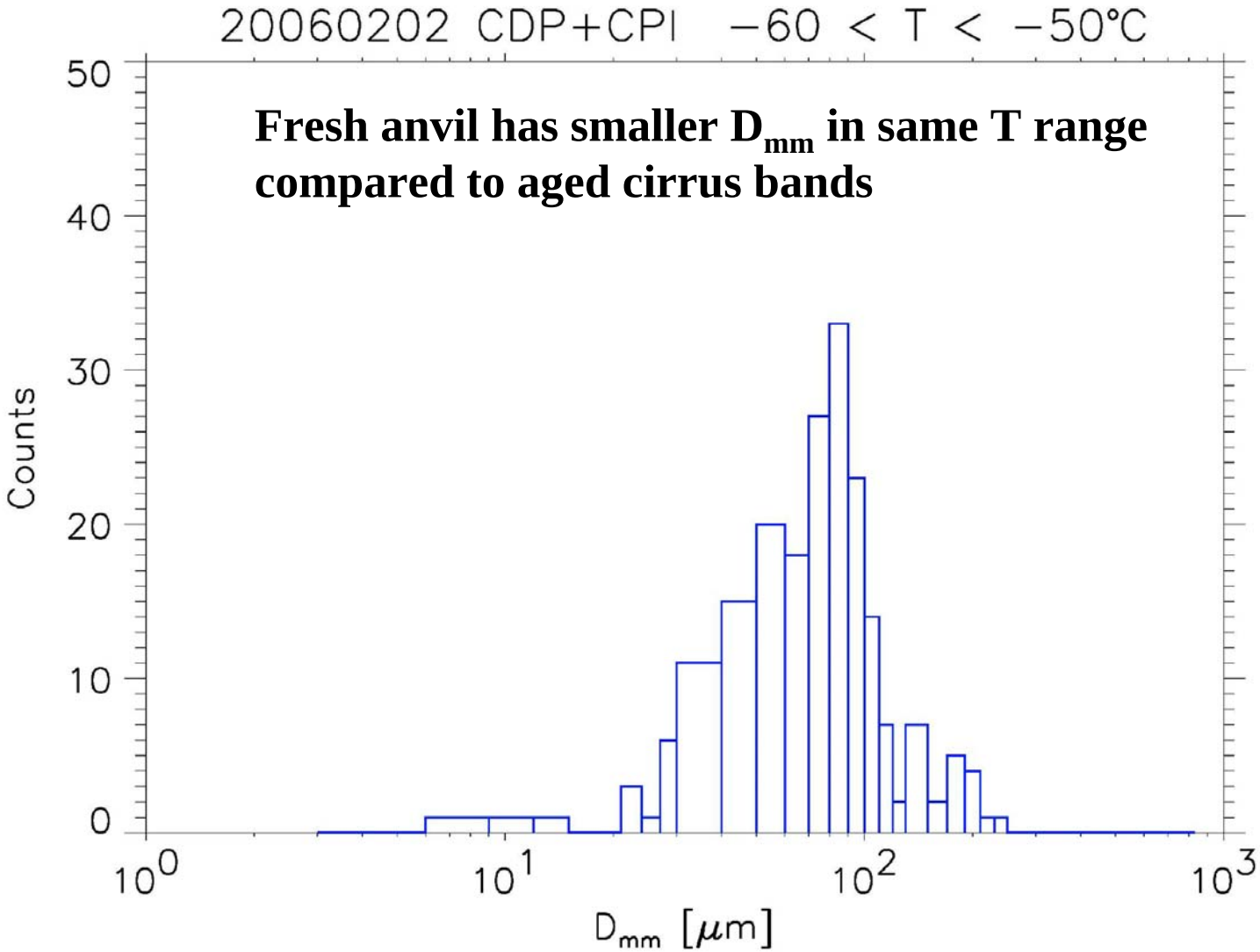
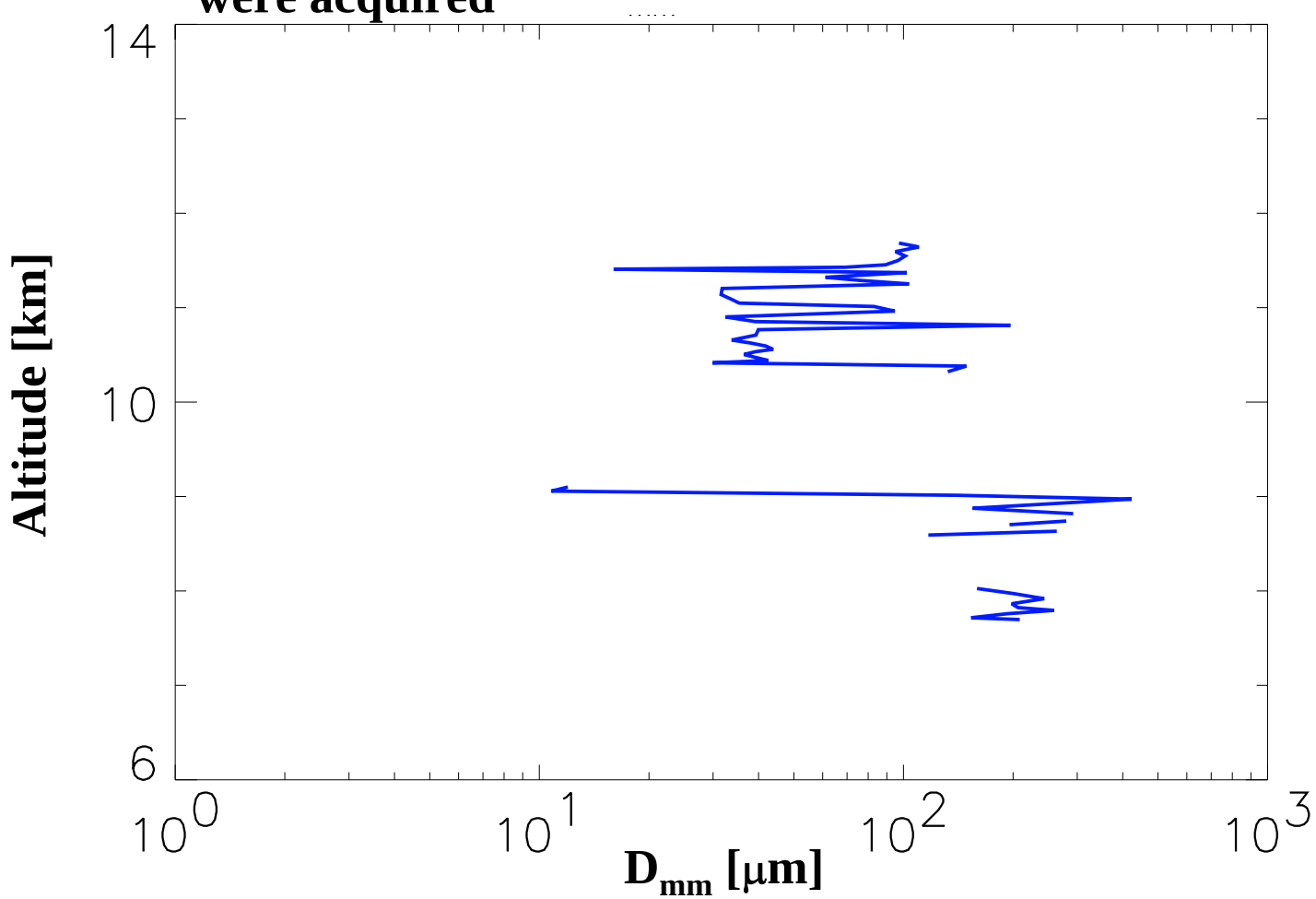


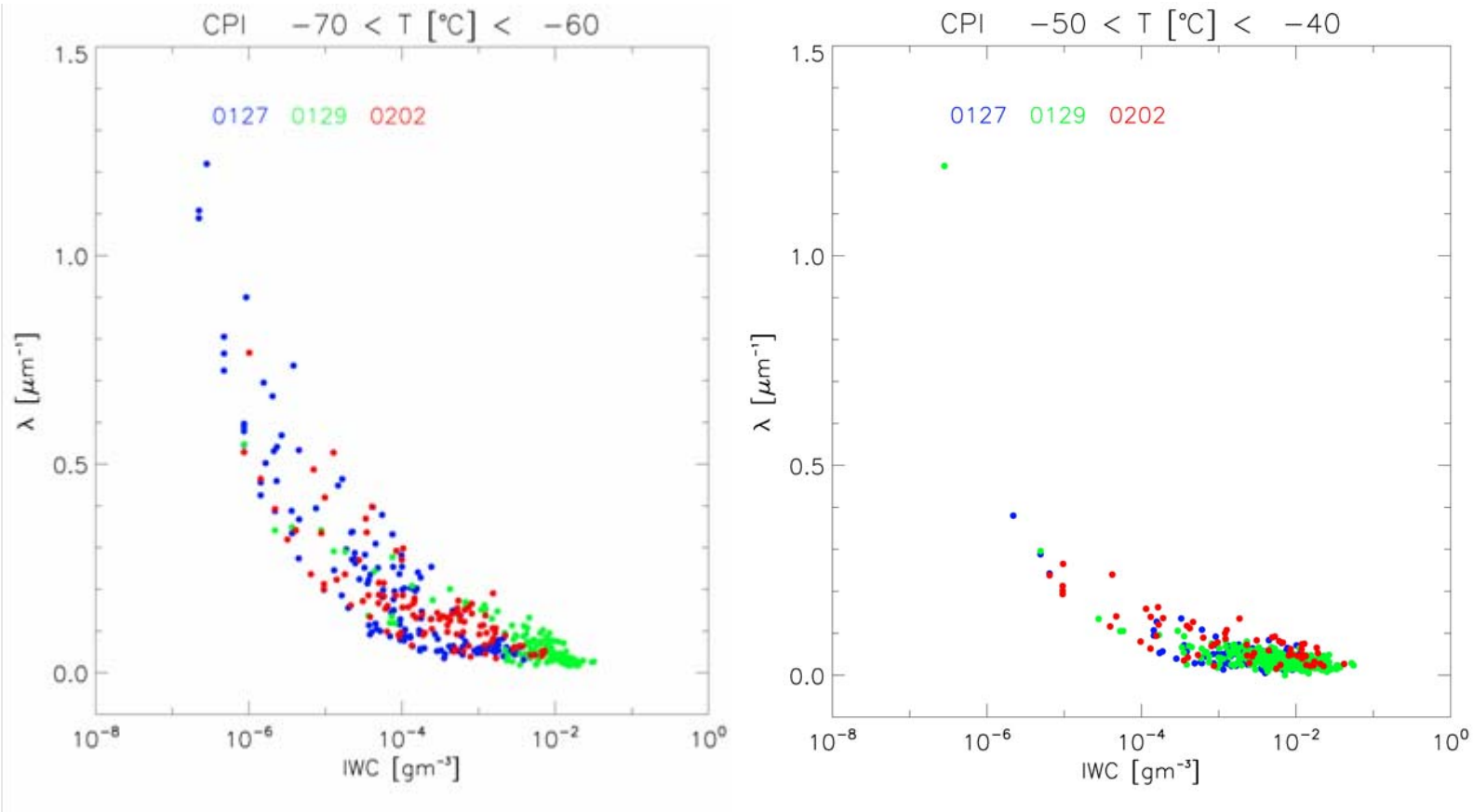
Vertical Dependence of D_{mm}

Need to consider differences in bulk properties in context of T, life stage, altitude, that observations were acquired



V. Variability of Cloud Properties

Preliminary Results



✓ **For given temp. and IWC microphysical properties (e.g., λ) indistinguishable between days**

Summary

- ✓ Corrected CIP size distributions provide better agreement with bulk mass measured by CSI
- ✓ There is good potential for using CPI to characterize ice crystals with D > 50 μm
- ✓ Scattering properties of frequently occurring aggregates of plates have been characterized
- ✓ Differences in crystal shape in fresh anvils/aged cirrus characterized & single-scattering properties computed
- ✓ Differences in bulk properties between fresh anvils/ aged cirrus being characterized

Questions?

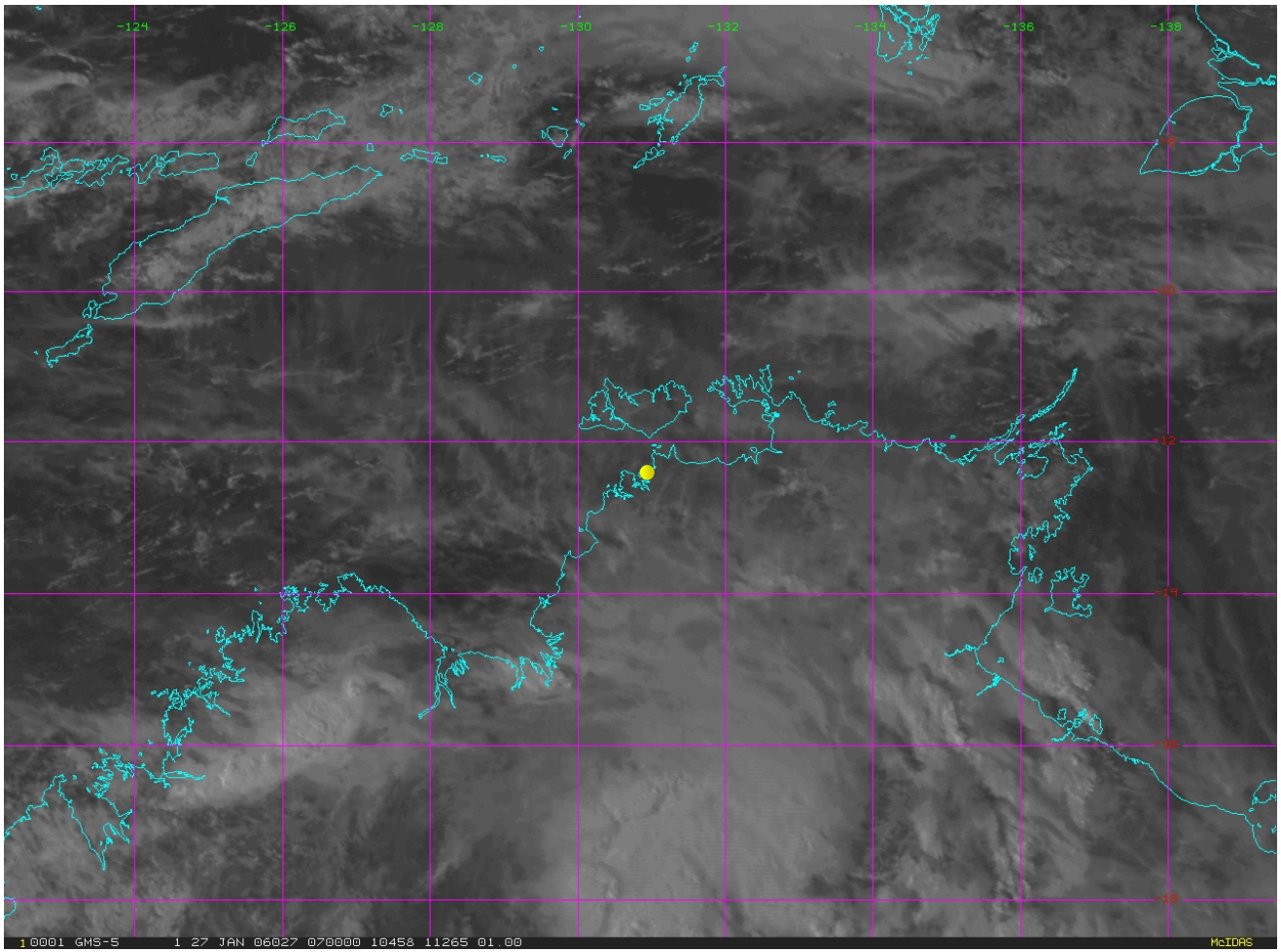
I. Introduction

27 January

- **Primary Mission**
  - **To observe aged cirrus: at least 4 or 5 hours after generation**

- **Dominated by a low pressure system south of Darwin**

- **Horizontal E-W oriented legs through cirrus band**



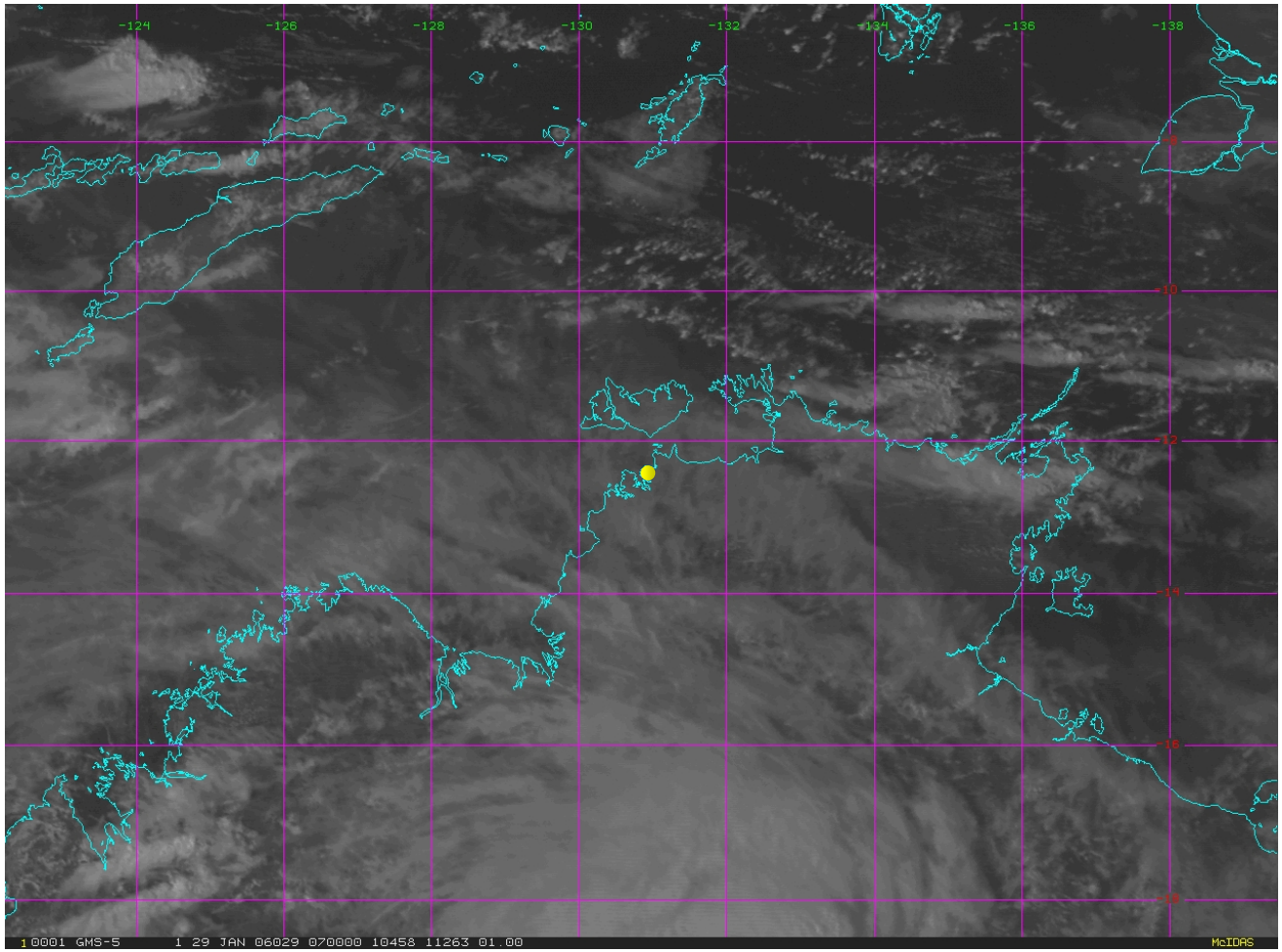
I. Introduction

29 January

- **Primary Mission**
  - Evolution or transition of cirrus from convection to generic cirrus

- **Dominated by a low pressure system south of Darwin**

- **N-S oriented legs sampled cirrus bands**

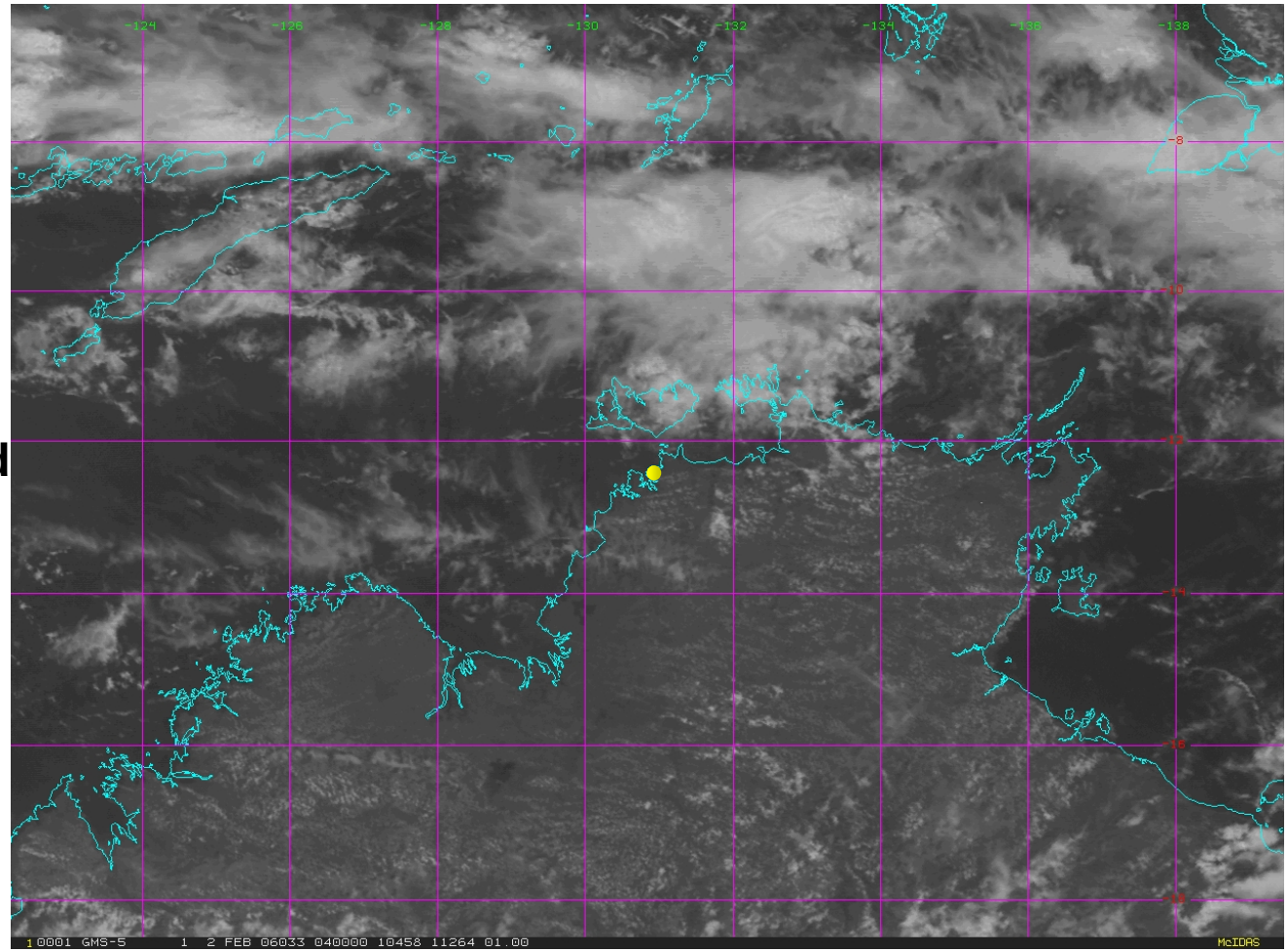


2 February

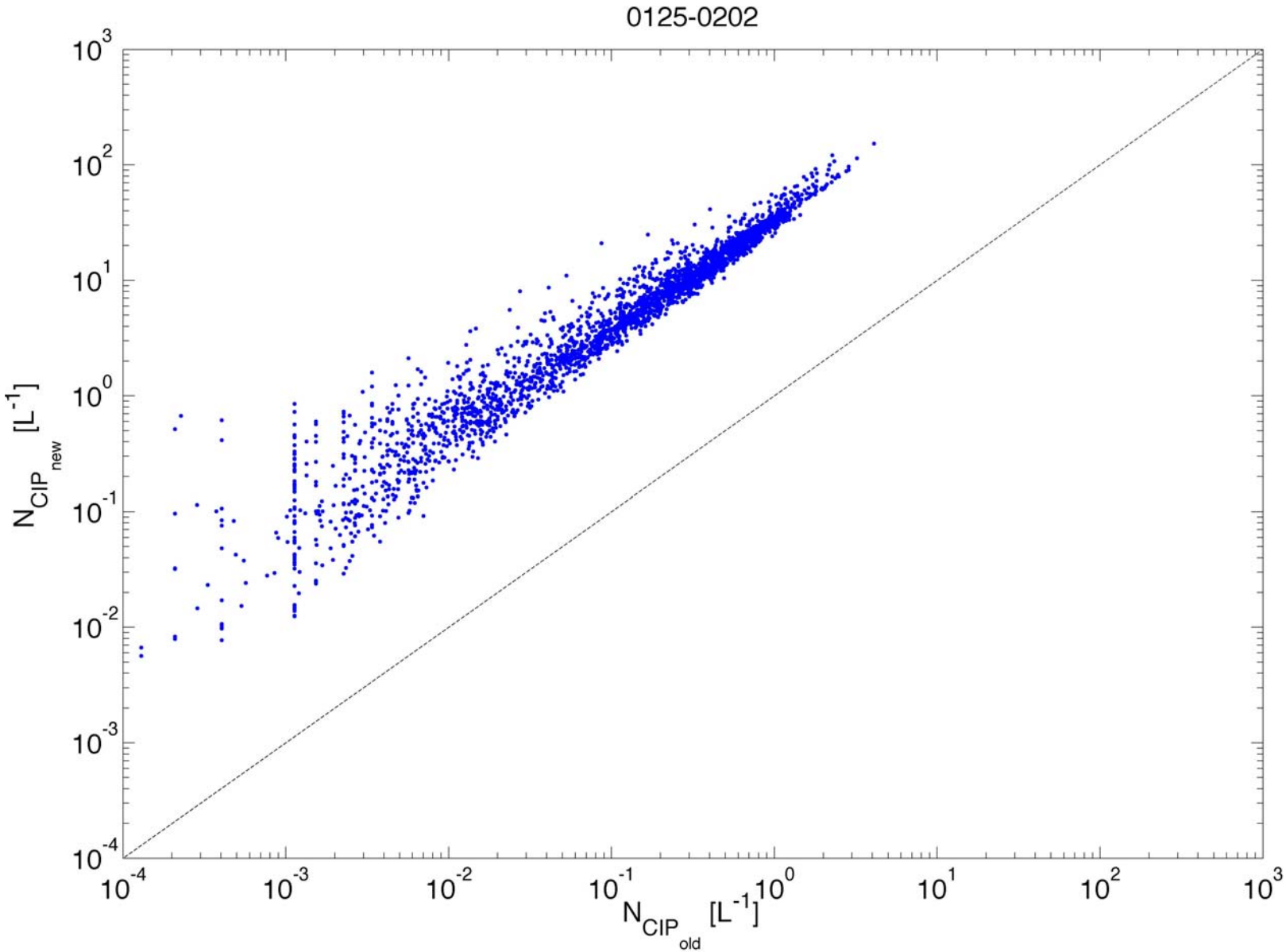
- **Primary Mission**
  - **To observe anvil and background cirrus**

- **Low pressure system weakened deep westerly flow**

- **Spiral ascent/ descents flown through dissipating fresh anvil**



IV. CIP SV Correction



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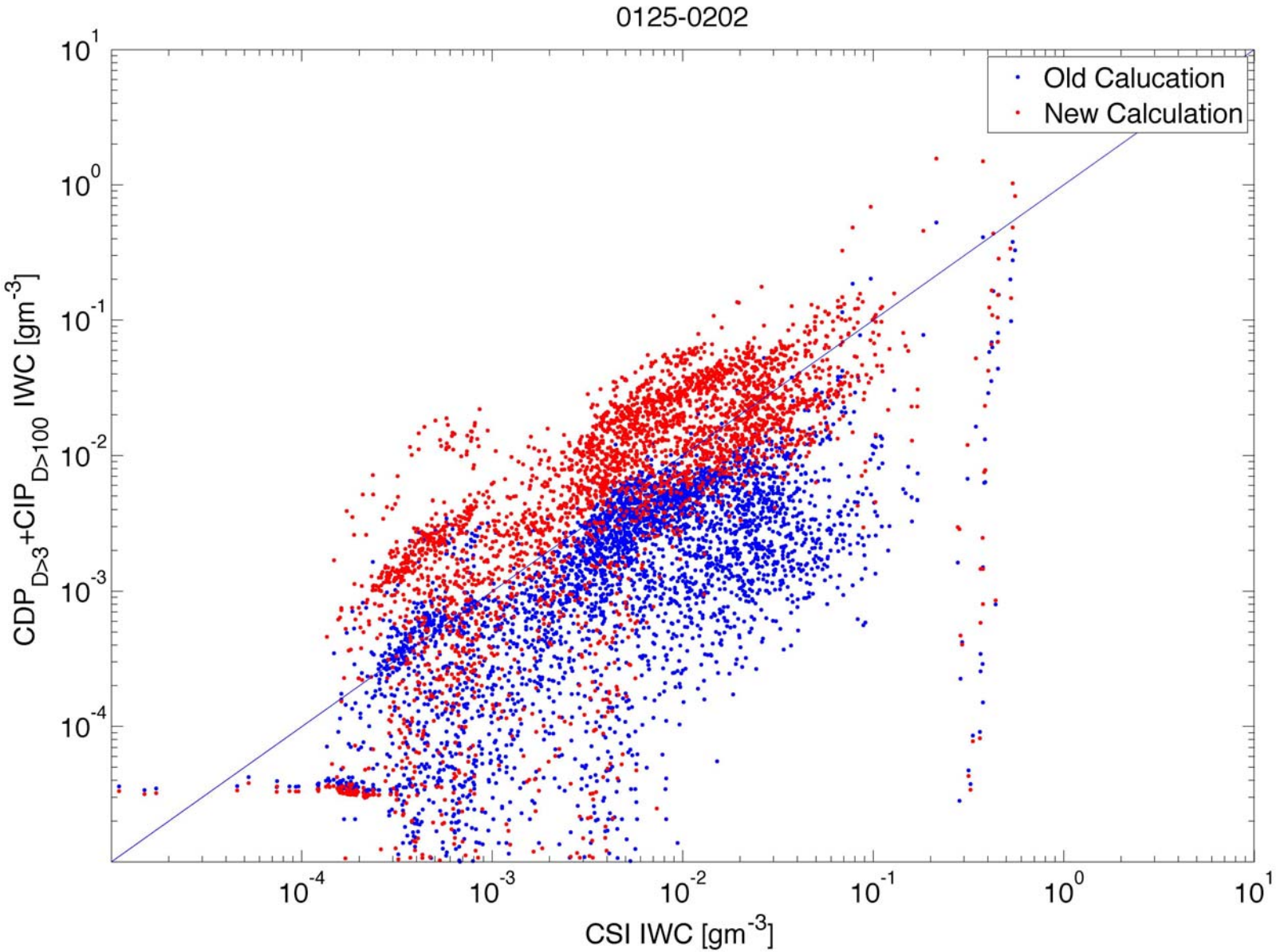

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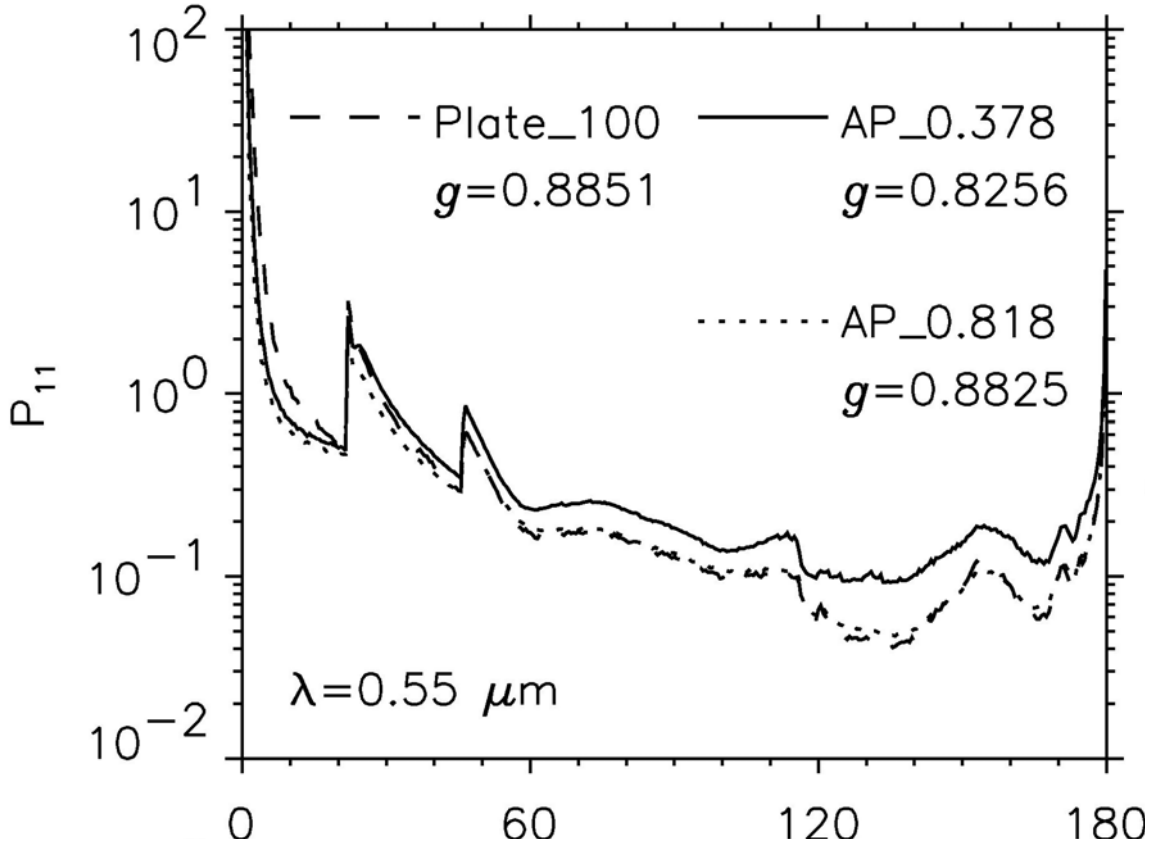

✓ **As AI decreases, multiple scattering enhanced**

Um and McFarquhar
(*in review*, QJRMS)