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HAIC/HIWC Science Team Meeting

9/03/2015

PSD microphysics

HAIC – High Altitude Ice Crystals

Content

- MMD sensitivity studies (flight 23)
 - ▶ Size definition
 - ▶ Smallest sizes
- MMDs in High IWC areas (all flights)
- Conclusions

HAIC – High Altitude Ice Crystals

MMD sensitivity study

MMD computation from OAP images 1/2

1) Size retrieval

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0
0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
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0	0	0	0	1	1	0	0	0	1	1	1	1	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

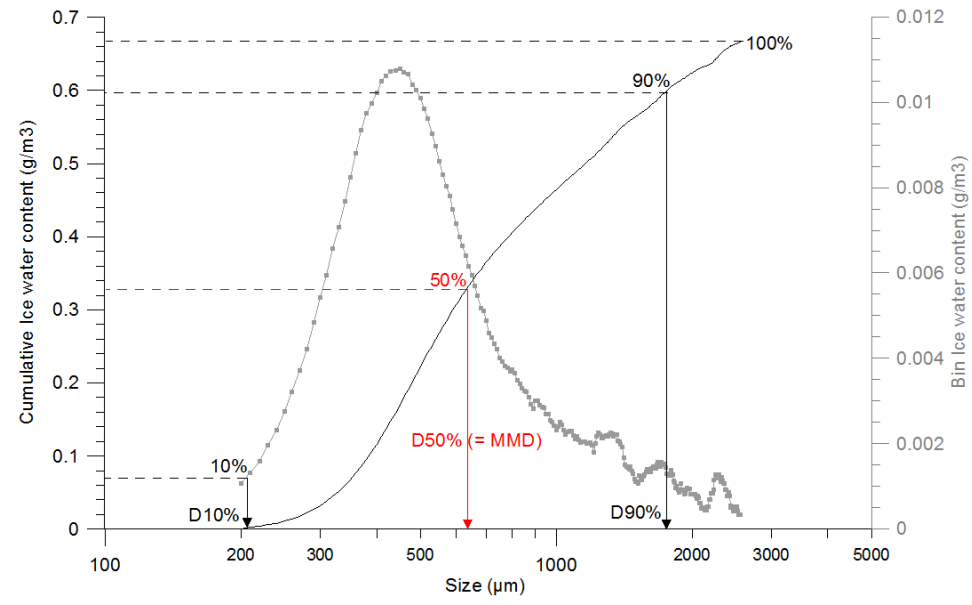
→ Size D

2) Particle Size Distribution

$$m = \alpha D^\beta$$

3) Mass distribution

Median mass diameter (MMD)
+ 10% and 90% mass diameters



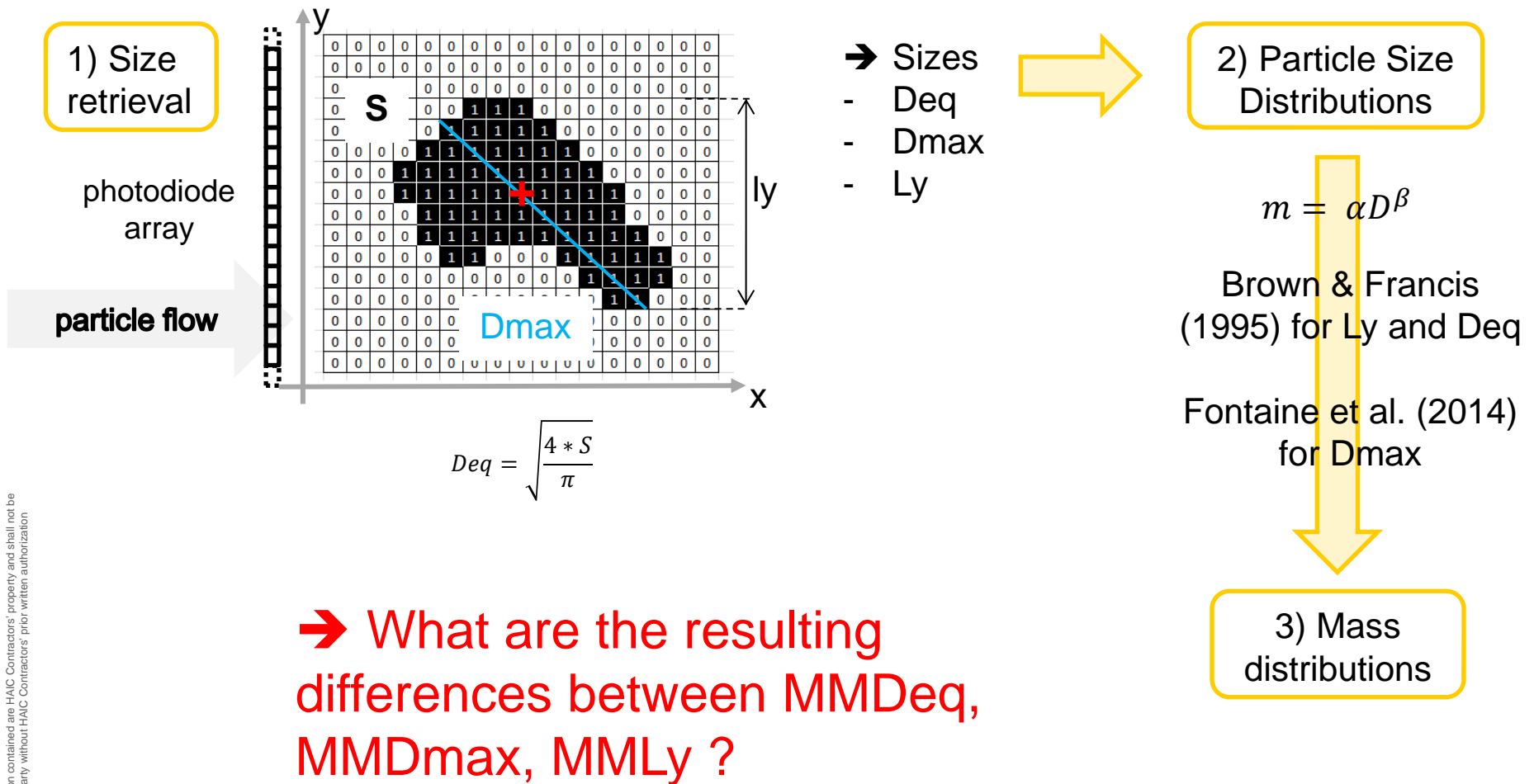
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MMD sensitivity study

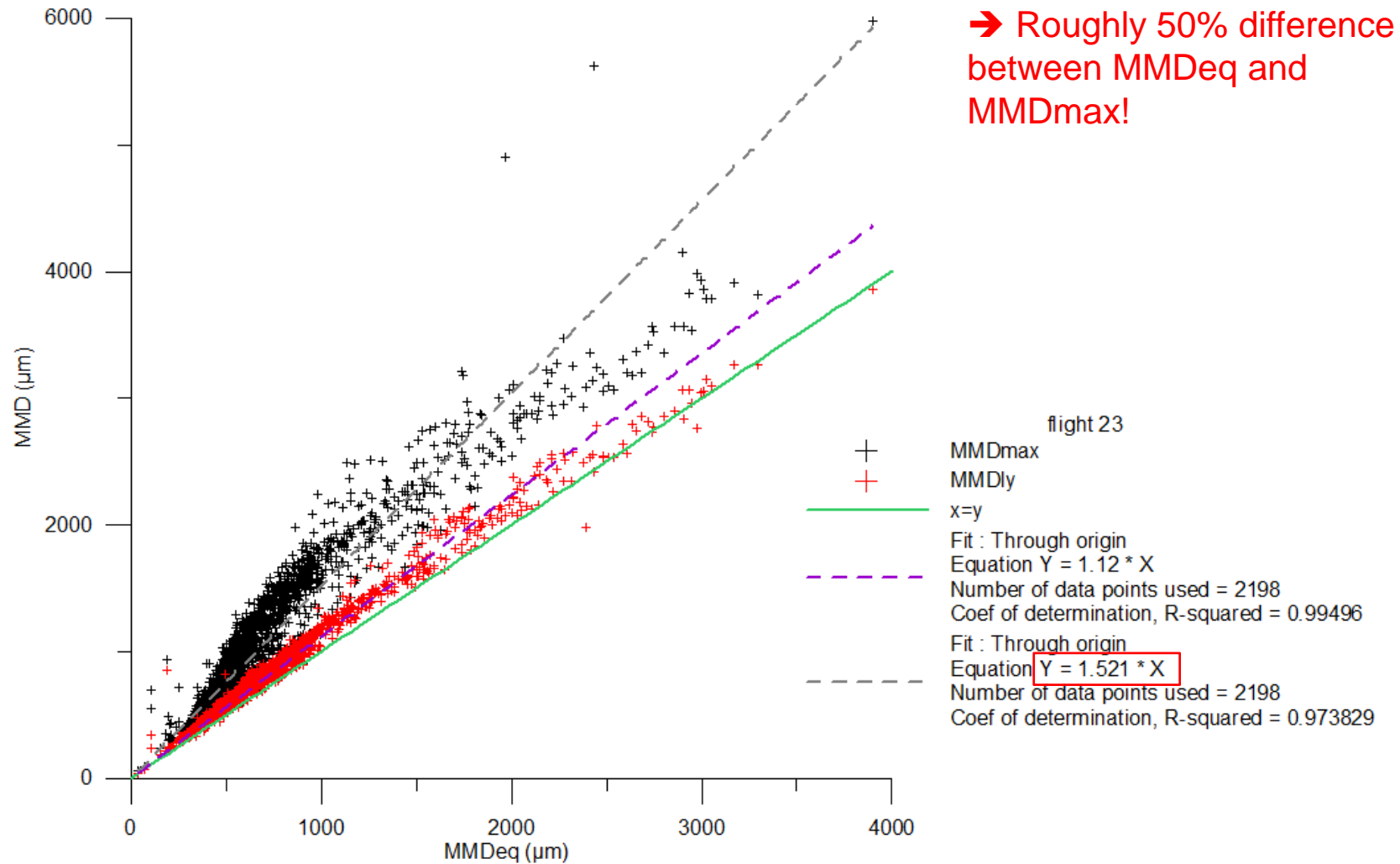
MMD computation from OAP images 2/2



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MMD sensitivity study

Sensitivity to size definition



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MMD sensitivity study

Sensitivity to the smallest sizes

Case A – start of composite PSD = 15 μm

Case B – start of composite PSD = 55 μm

$$\text{absolute error} = |\text{data B} - \text{data A}|$$

$$\text{relative absolute error}(\%) = 100 \frac{|\text{data B} - \text{data A}|}{\text{data A}}$$

MMDLy	Relative error (%)	Absolute error (μm)
Min	0	0
25th percentile	0.058	0.327
Median	0.093	0.58
Mean	0.719	2.46
75th percentile	0.147	1.02

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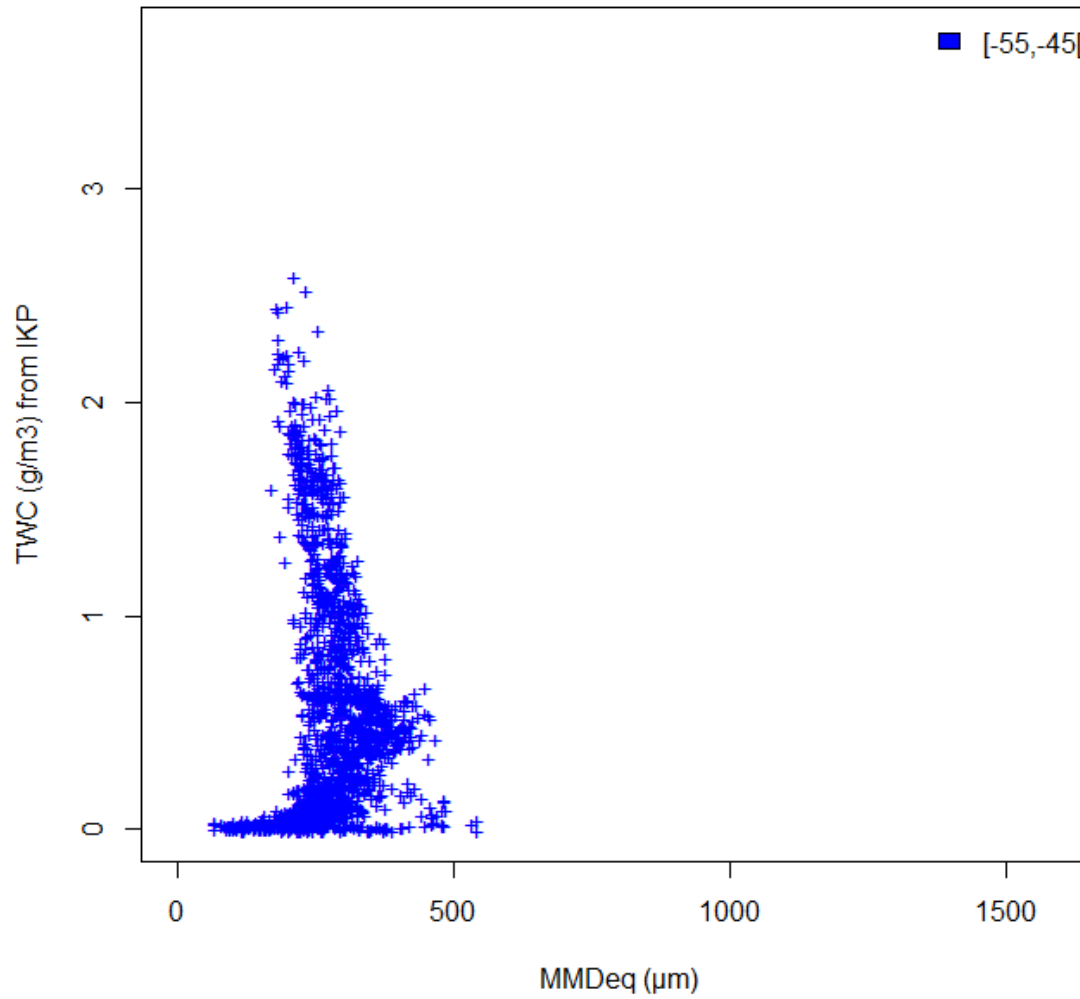
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MMD and temperature

« Almost » all flights, 5s average data

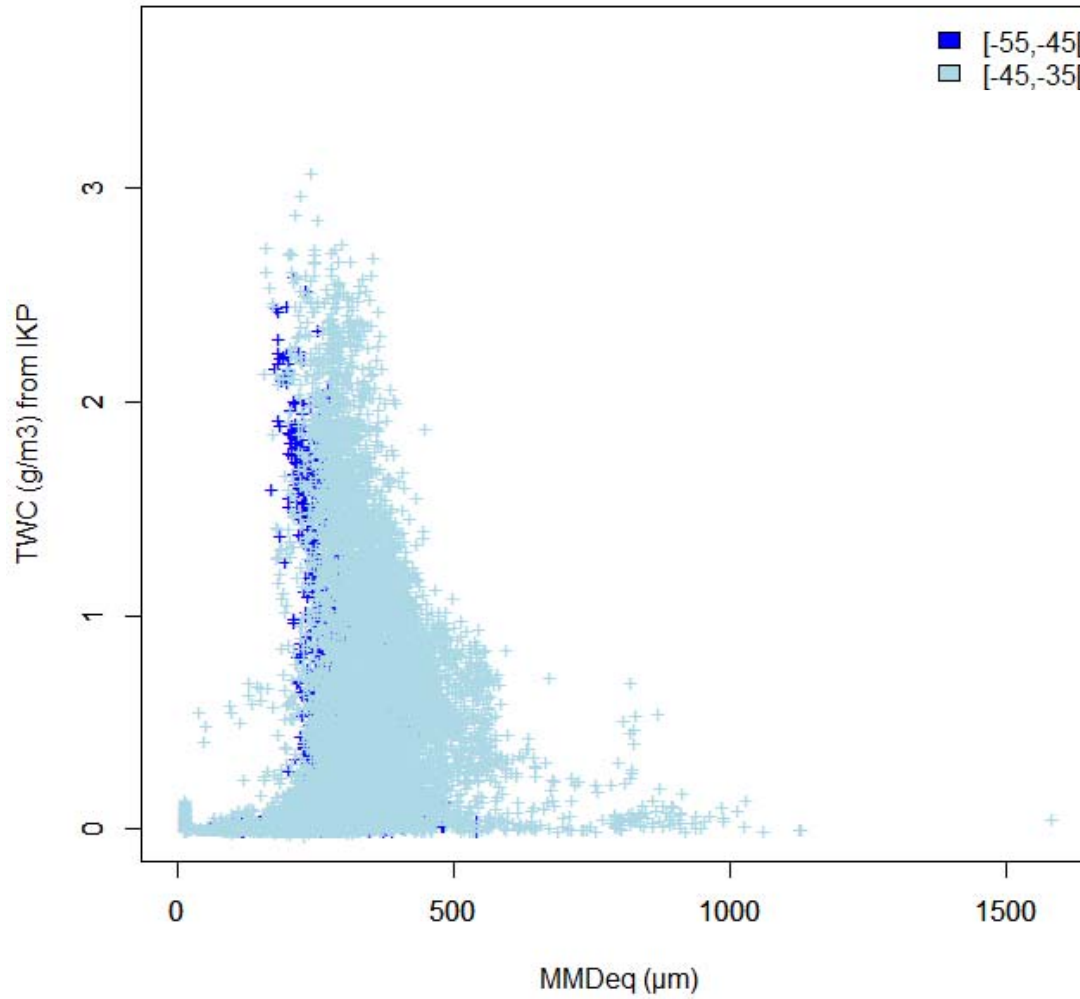


For [-55°C - 45°C]:
MMDs seem to
decrease with
increasing TWC

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MMD and temperature

« Almost » all flights, 5s average datas

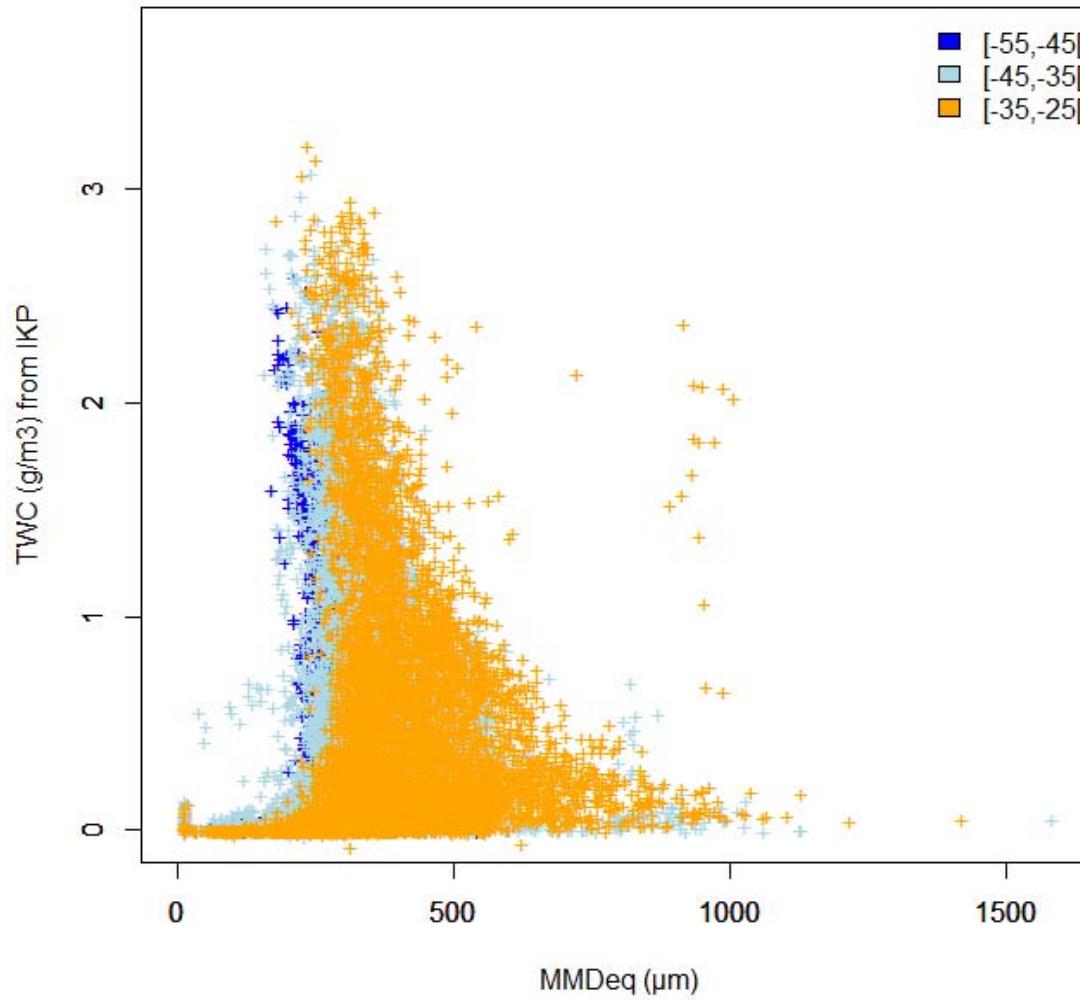


Also for [-45°C - 35°C]:
MMDs seem to
decrease with
increasing TWC

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MMD and temperature

« Almost » all flights, 5s average datas

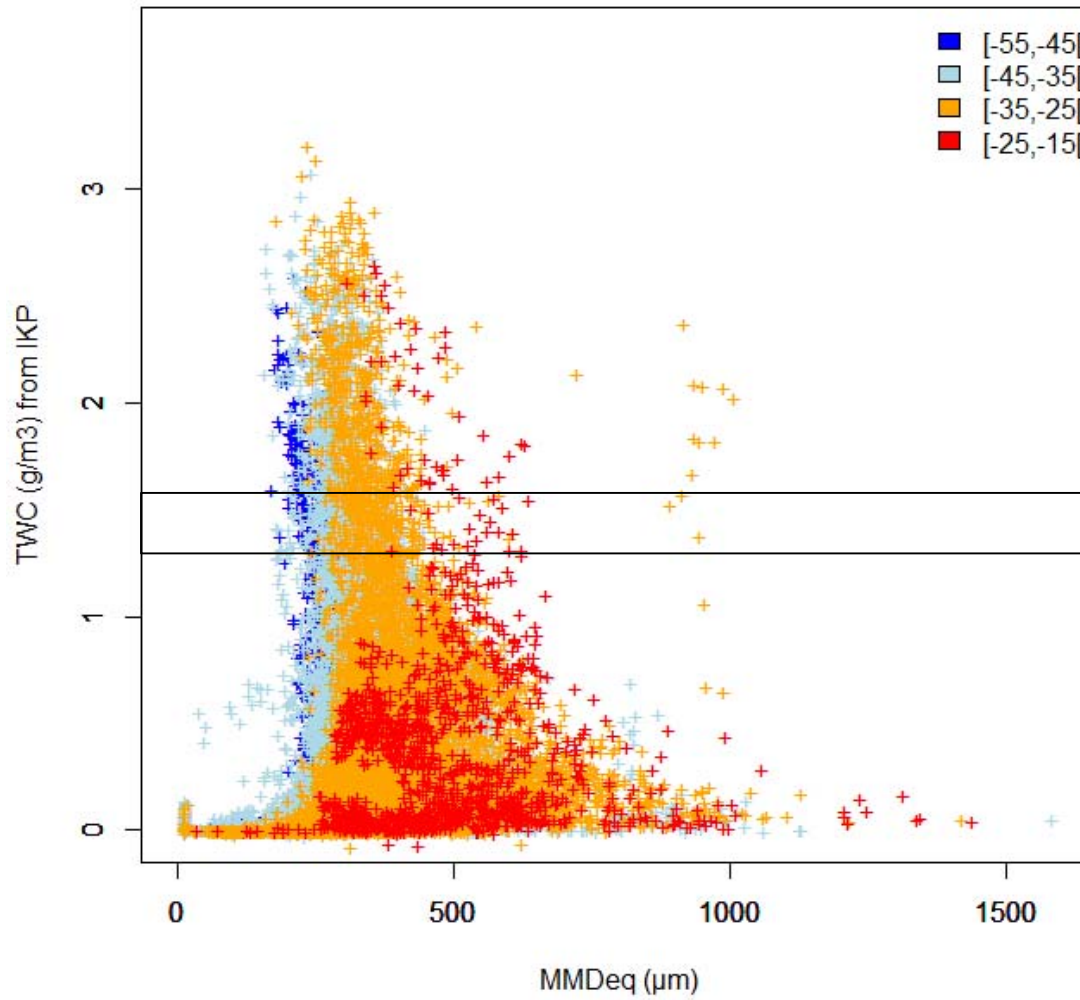


Also for [-35°C - 25°C]:
MMDs seem to
decrease with
increasing TWC

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MMD and temperature

« Almost » all flights, 5s average datas



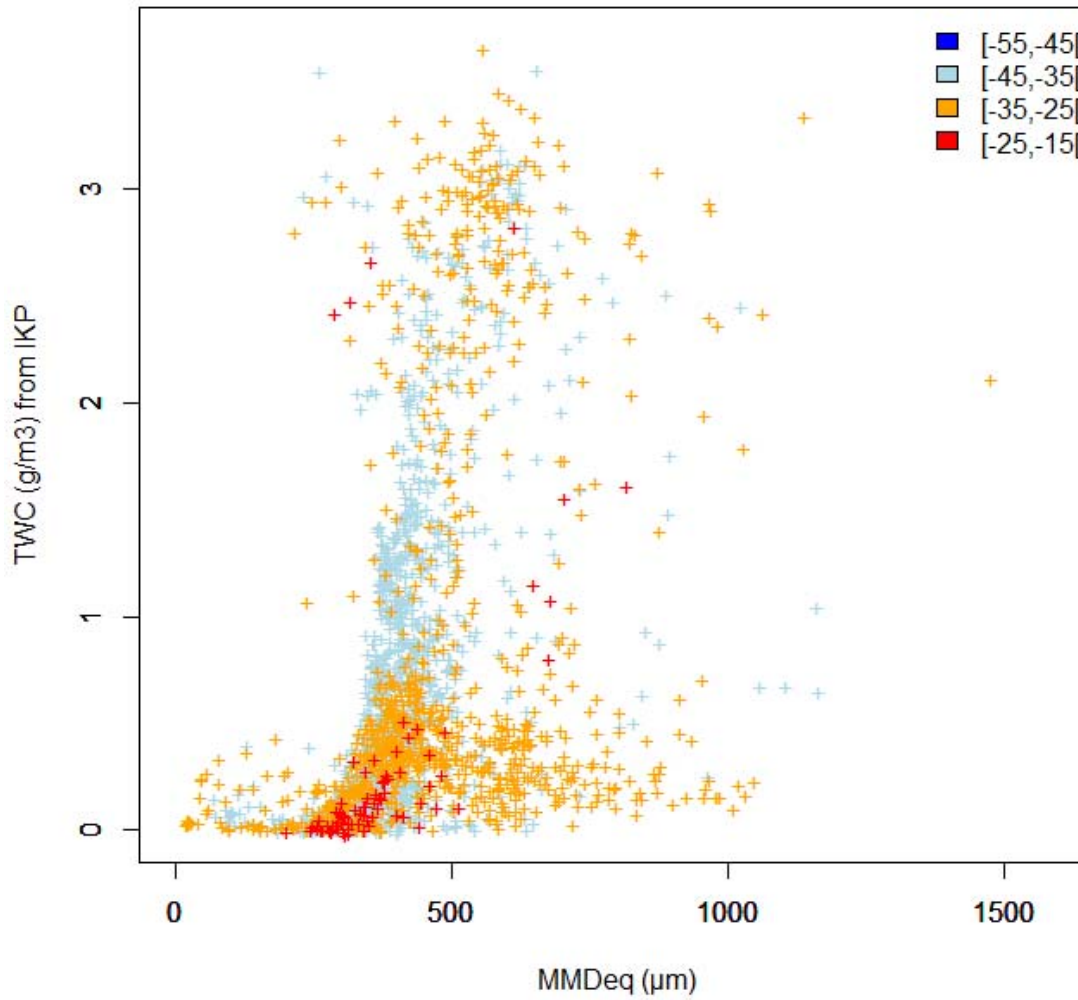
Also for [-15°C - 25°C]:
MMDs seem to decrease with increasing TWC

For a given range of TWC, MMDs increase with increasing temperatures

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MMD and temperature

Only flights 12 and 13 don't follow above findings



In contrast to above:
Here MMDs seem to
increase when
increasing TWC

Dependency of MMDs
with temperature is not
obvious

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Conclusions

In general:

- MMD values are not very sensitive to small sizes (below 55 μm)
- MMD values highly depend on the size definition extracted from the binary images
→ Any suggestion on what is needed/preferred is welcome

Results from the first HAIC/HIWC campaign (with MMD=MMDeq)

Except for flights 12 and 13 :

- From TWC larger than 1g/m^3 , MMDs range from **200 μm** to **700 μm** .
- MMDs decrease with decreasing temperatures.
- MMDs decrease with increasing TWCs.

For flights 12 and 13 :

- From TWC larger than 1g/m^3 , MMDs range from **300 μm** to **1.2 mm**.
- MMDs increase with increasing TWCs.

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Dissemination

	Contribution	Status
EGU	HAIC/HIWC field campaign – investigating ice microphysics in high ice water content regions of mesoscale convective systems	Accepted Oral in session AS3.5
	Variability of mass-size relationships in tropical Mesoscale Convective Systems	Accepted Poster in session AS3.5
SAE	HAIC/HIWC field campaign – specific findings on PSD microphysics in high IWC regions from in-situ measurements: median mass diameters, particle size distribution characteristics and ice crystal shapes	Abstract & manuscript accepted.
La Meteo- rologie	Projet HAIC (High Altitude Ice Crystals): Utilisation du Falcon 20 dans le cadre d'un projet international dédié à la sécurité aéronautique	
GRL	Size of ice crystals in high ice water content regions: results from the first HAIC/HIWC campaign	Waiting for co-authors' feedback

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Dissemination

- Used datasets :
 - IKP dataset version 4
 - SAFIRE dataset (temperature and TAS)
 - PSD dataset

- Useful references :
 - IKP : tunnel experiments and validation ? Probe efficiency and data treatment (background humidity removal)

High Altitude Ice Crystals (HAIC, 314314)

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