

Presented by

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Robust probe data set

High Altitude Ice Crystals

Contents

- Data processing
- Efficiency sensitivity study
- Correction method
- Changes in efficiency from flight to flight ?

Data processing

Processing done by Marc Weber (Airbus) for both campaigns.

- 1Hz resolution
- Filtering applied only for Darwin data to remove power oscillations
- Fixture correction
- Calibration curve: computed for each flight using CDP measurements to select out of clouds flight parts
- Change in airspeed with time to account for fuel consumption → no more offset
- Efficiency = 0.4

→ Data available on CNRS/LaMP website

Efficiency study

Definition :

$$\text{efficiency} = \varepsilon = TWC_{Robust} / TWC_{IKP}$$

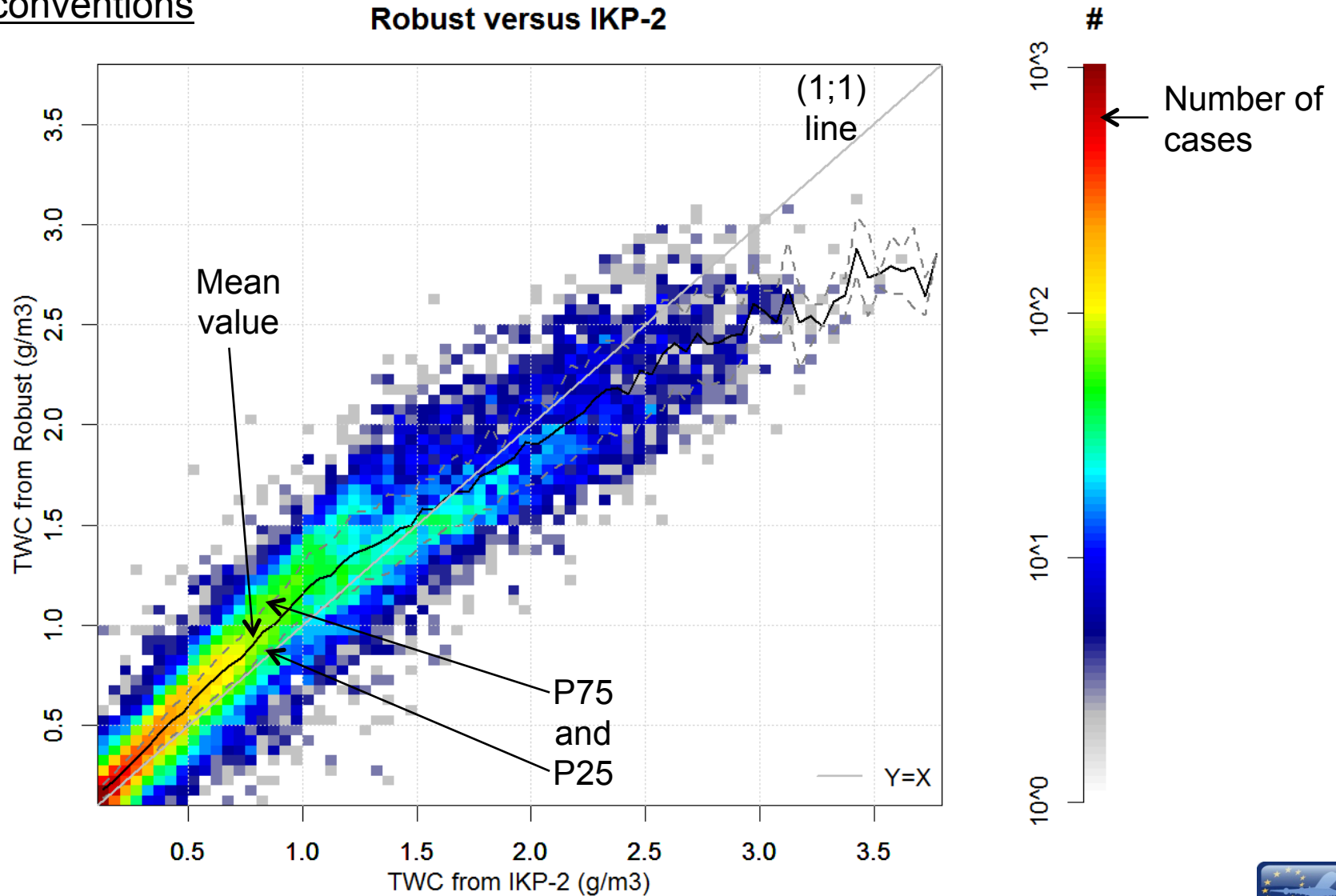
Data selection :

- Time resolution : 5 s
- Darwin & Cayenne campaigns
- Data collected on constant flight levels only (no climb or descent)
- Liquid phase cases removed (cayenne dataset mostly)

- TWC from IKP > 0.1 g/m³
- TWC from Robust (1st guess with 0.4 efficiency) > 0.1 g/m³

Efficiency study

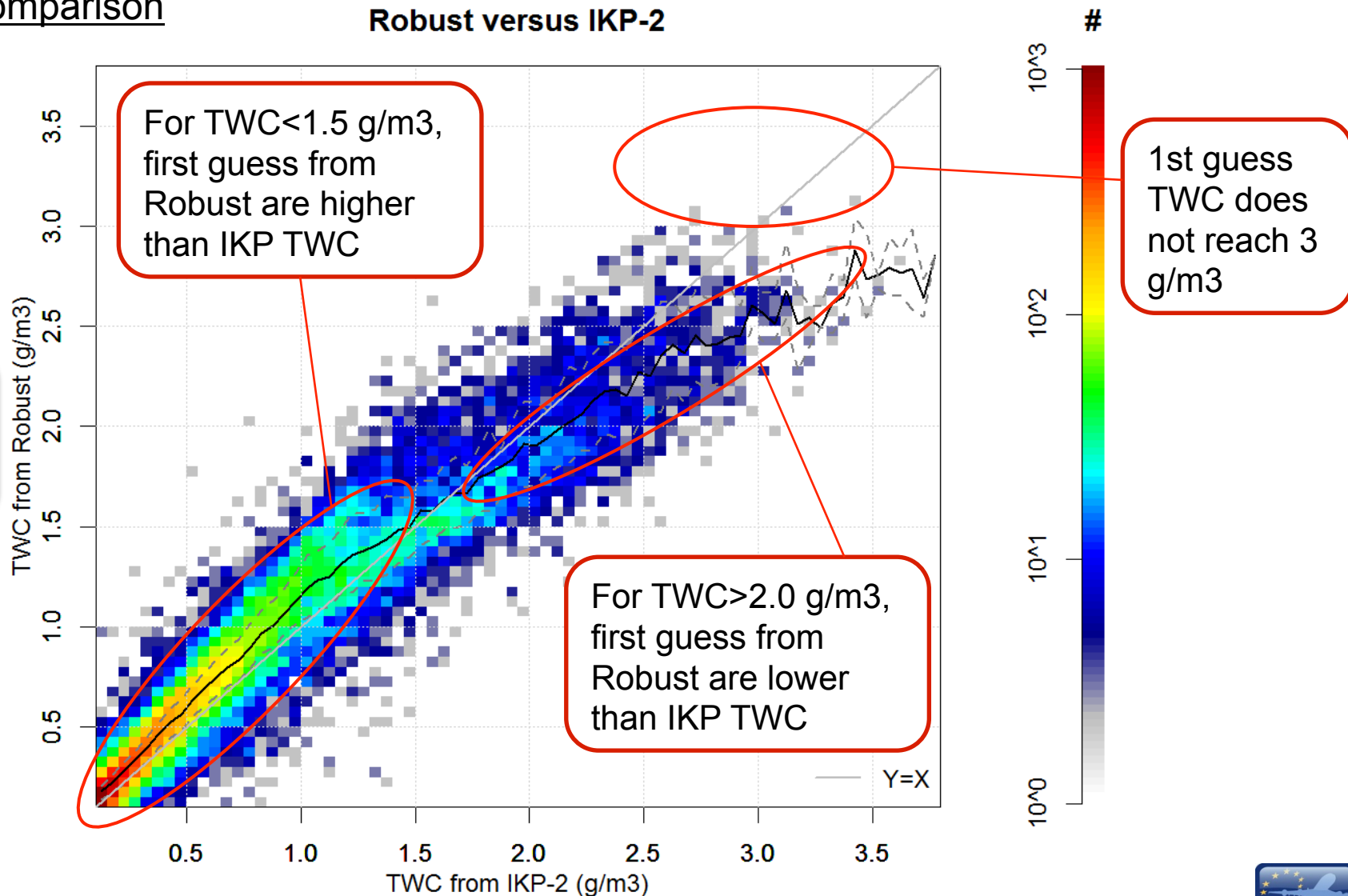
Figure conventions



Efficiency study

TWC comparison

Robust versus IKP-2



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Efficiency study

General statements to keep in mind

$$\text{efficiency} = \varepsilon = TWC_{\text{Robust}} / TWC_{\text{IKP}}$$

TWC below 1.5 g/m³:

The TWC first guess (with $\varepsilon=0.4$) overestimates the « true » TWC

- real $\varepsilon > 0.4$
- a higher value for ε is needed to decrease the TWC from Robust

TWC larger than 2.0 g/m³:

The TWC first guess with $\varepsilon=0.4$ underestimates the « true » TWC

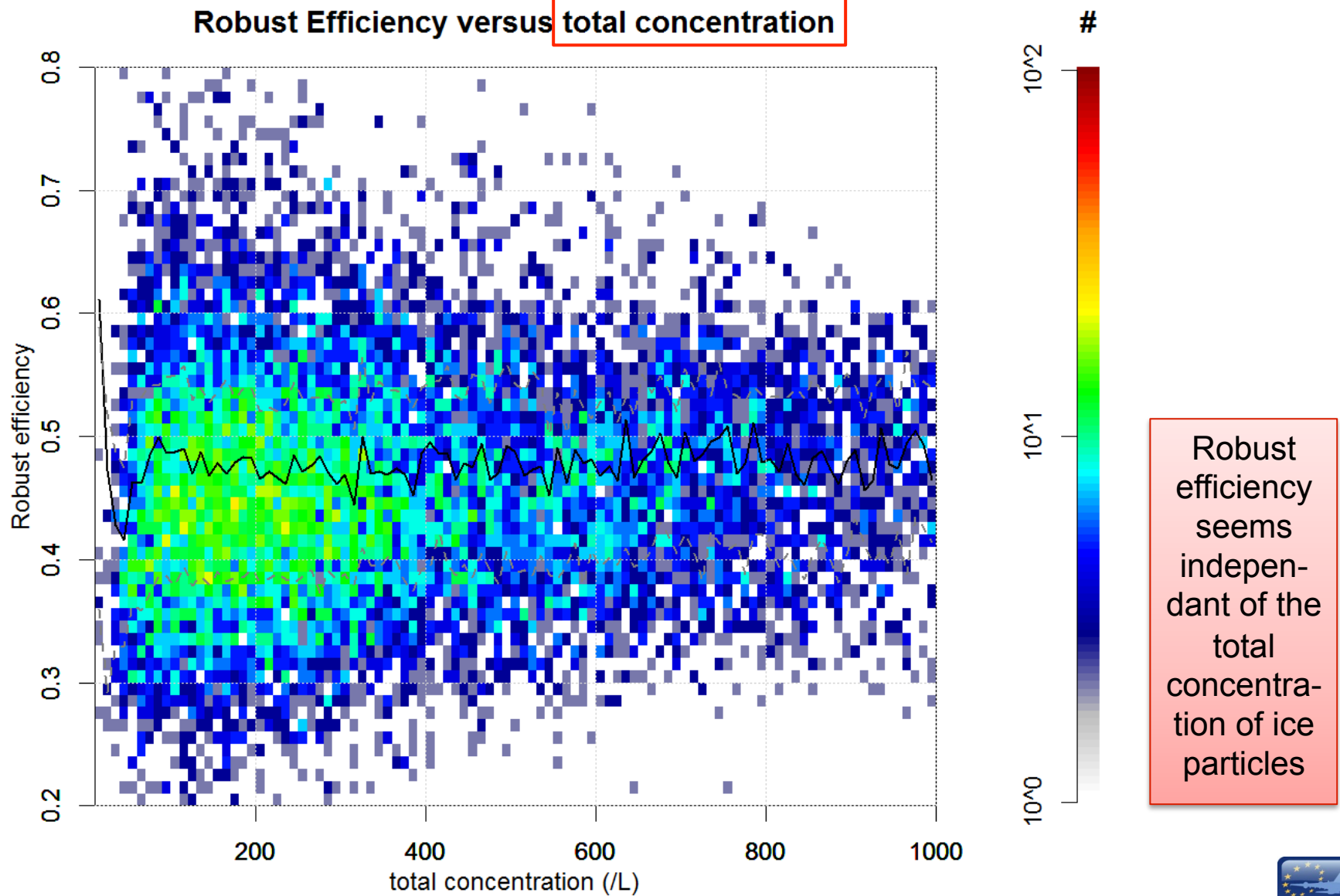
- real $\varepsilon < 0.4$
- a lower value of ε is needed to increase the TWC from Robust

How can we parameterize the efficiency ?

- sensitivity study with respect to :
 - total concentration,
 - temperature,
 - MMD,
 - flight parameters,
 - etc.

Efficiency study

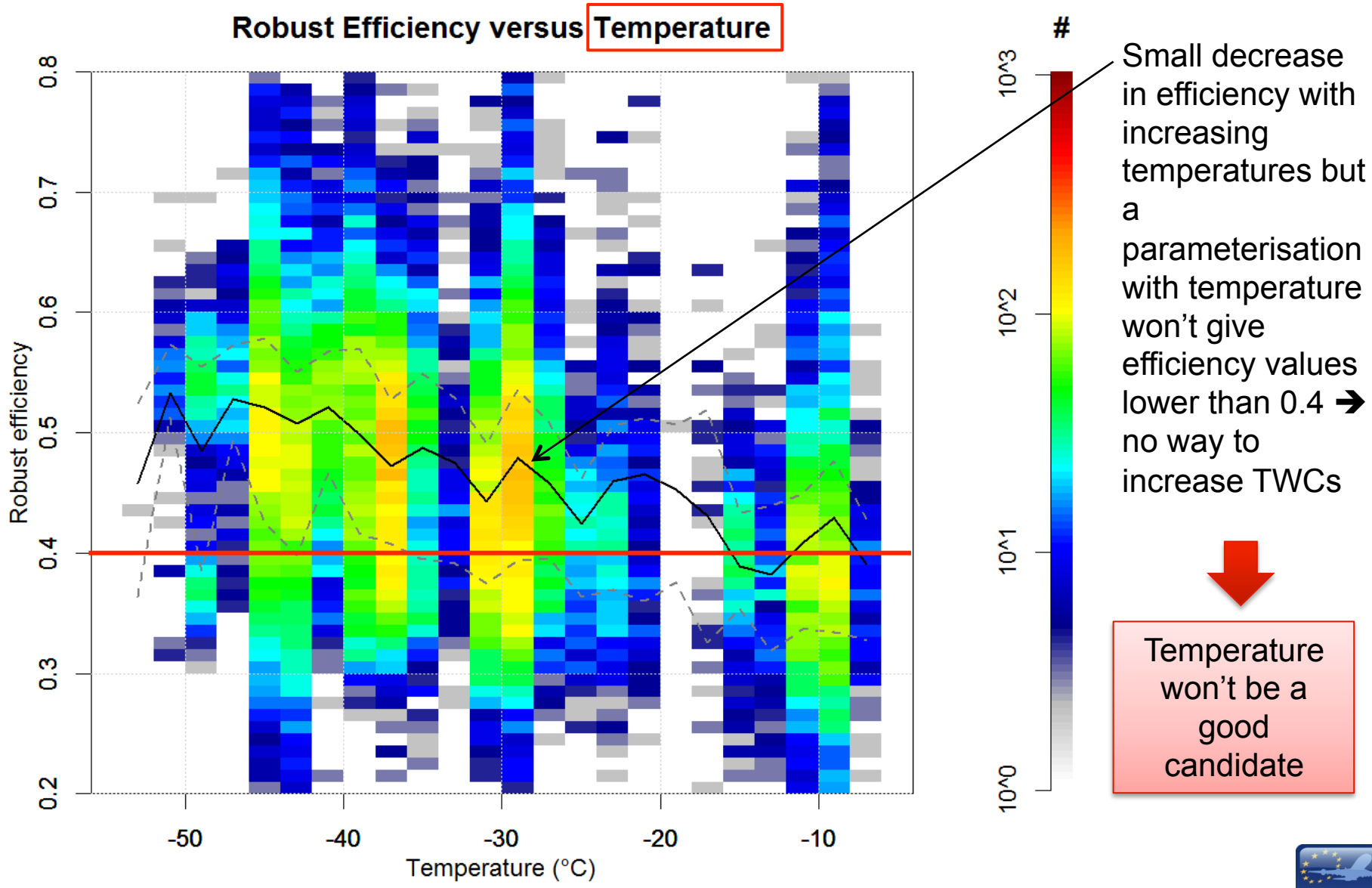
$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$



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Efficiency study

$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$

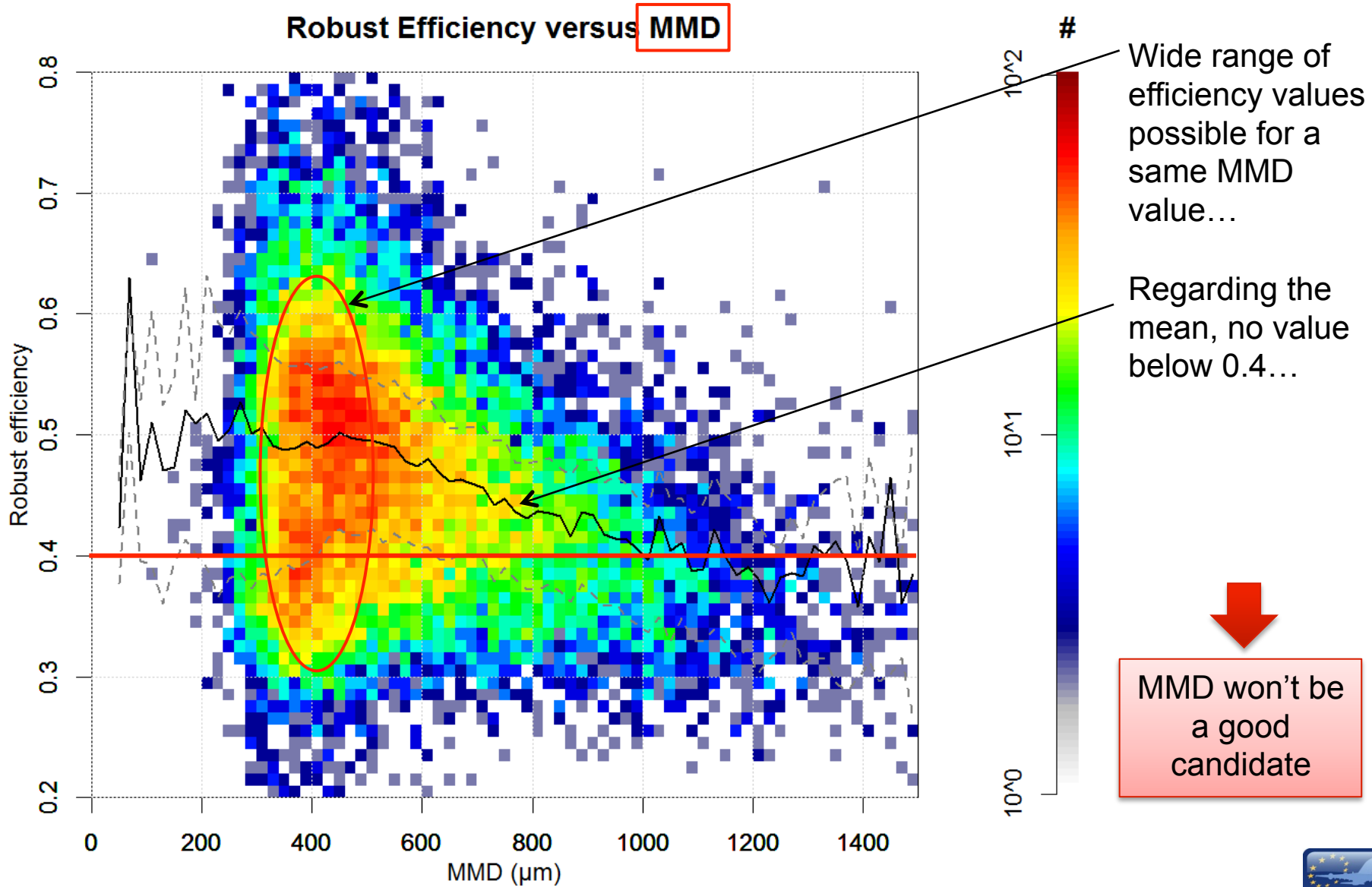


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Efficiency study

$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$

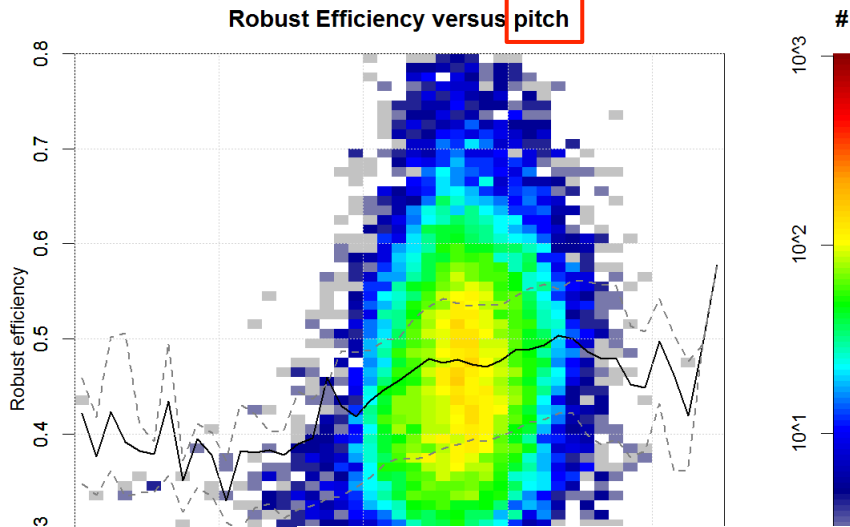


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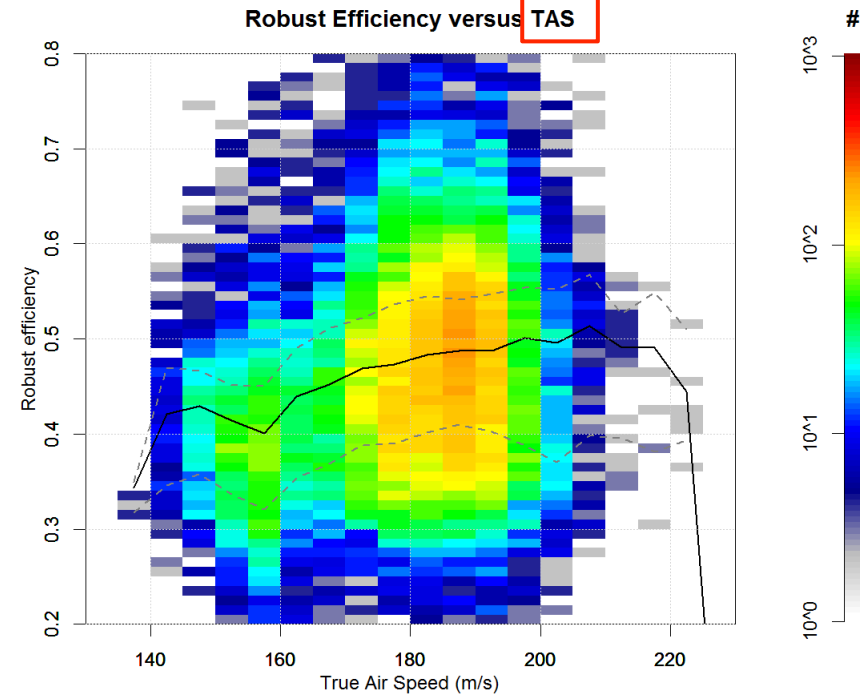
Efficiency study

$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$

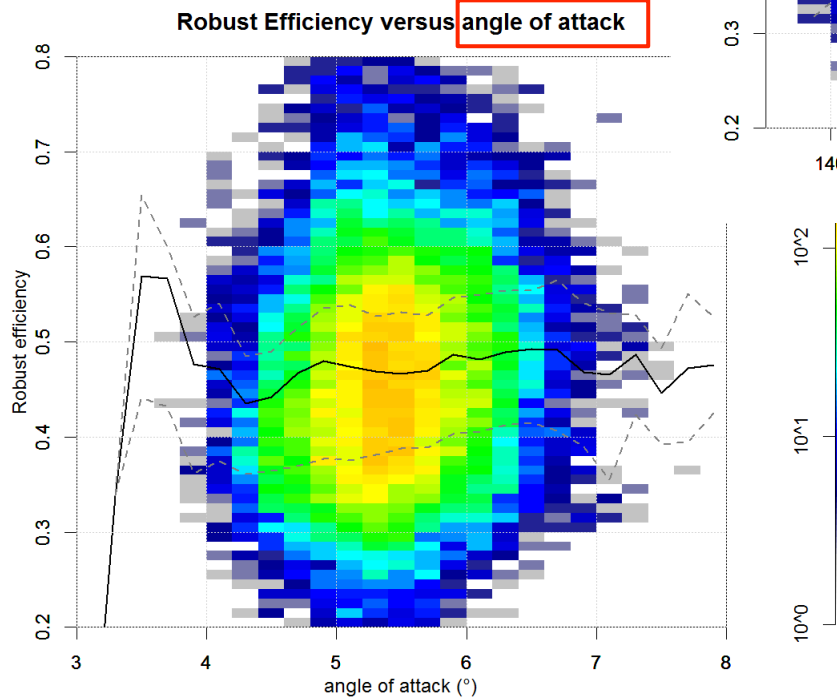
Robust Efficiency versus **pitch**



Robust Efficiency versus **TAS**



Robust Efficiency versus **angle of attack**

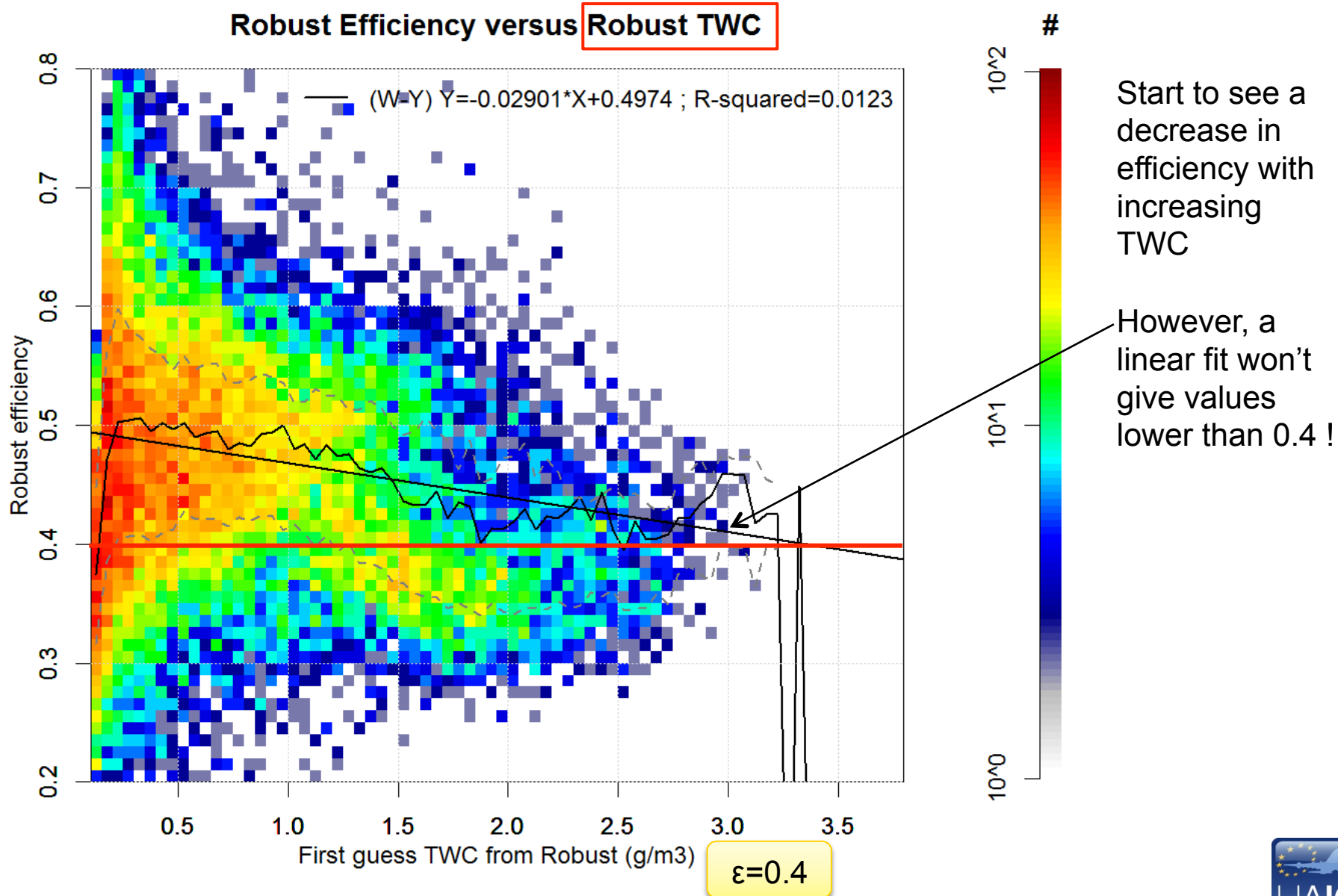


Still no interesting candidate...

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Efficiency study

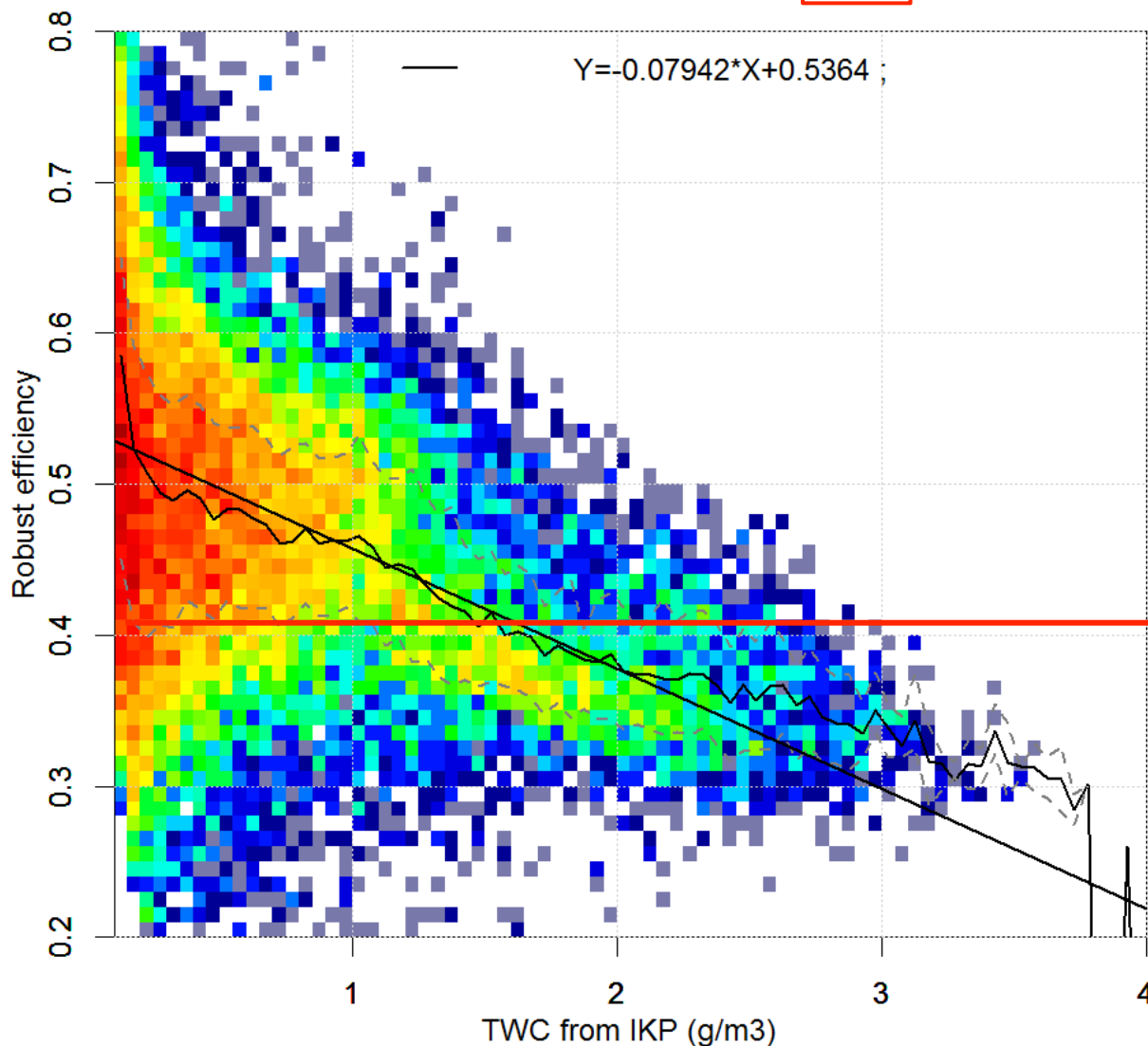
$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$



Efficiency study

$$efficiency = \varepsilon = TWC_{Robust} / TWC_I$$

Robust Efficiency versus IKP-2



Changes in efficiency seems only related to changes in TWC...

The more content there is, the lower the probe's efficiency

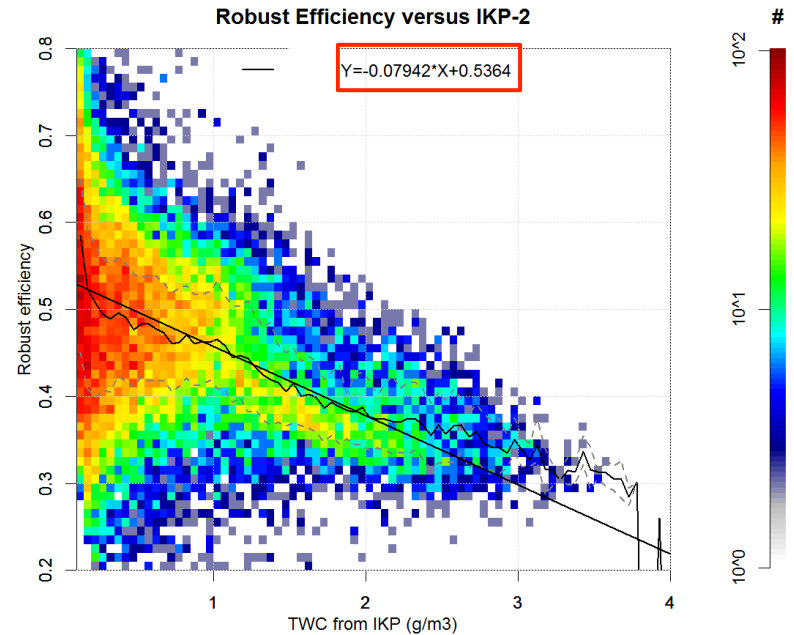
Correction method

➔ Use the linear fit obtained for the TWC from IKP but replace TWC IKP by the Robust first guess

$$\varepsilon = -0.07942 * \text{Raw Robust TWC} / 0.4 + 0.5364$$

$$\text{TWC Robust} = \text{Raw Robust TWC} / \varepsilon$$

$$\text{TWC Robust} = \text{Raw Robust TWC} / (-0.07942 * \text{Raw Robust TWC} / 0.4 + 0.5364)$$



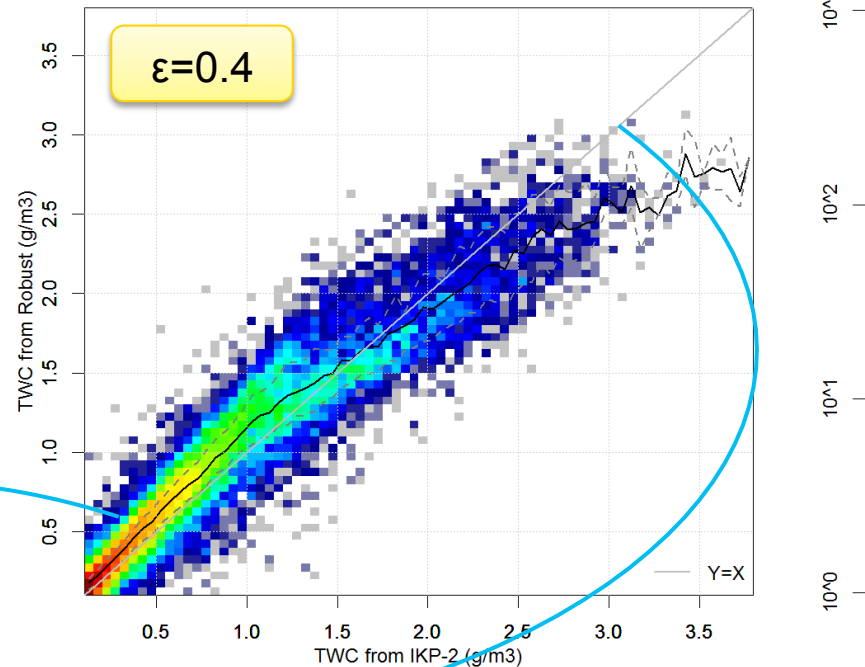
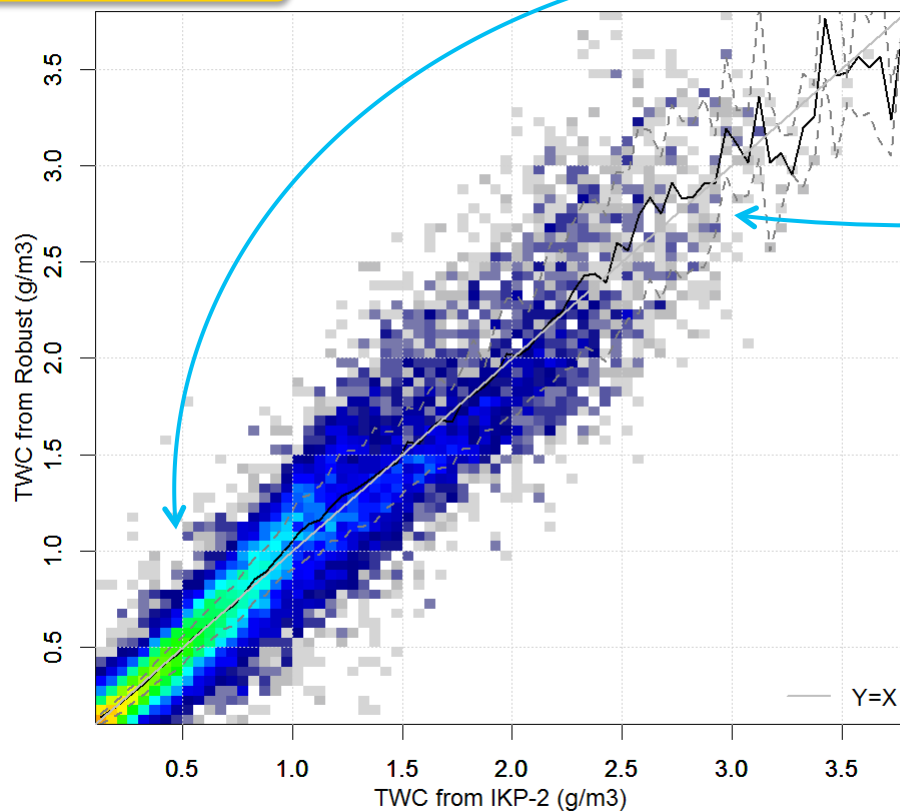
Correction method

TWC comparison

$\epsilon = f(\text{1st guess})$

No more overestimation of the small contents

Robust versus IKP-2

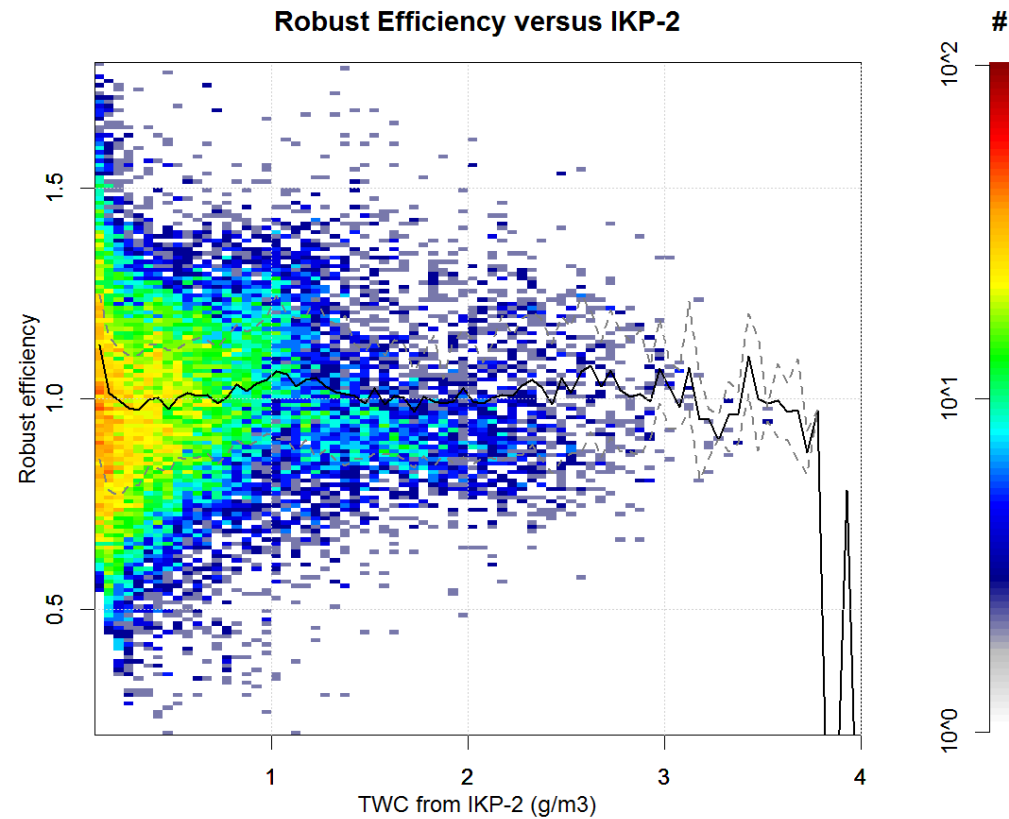
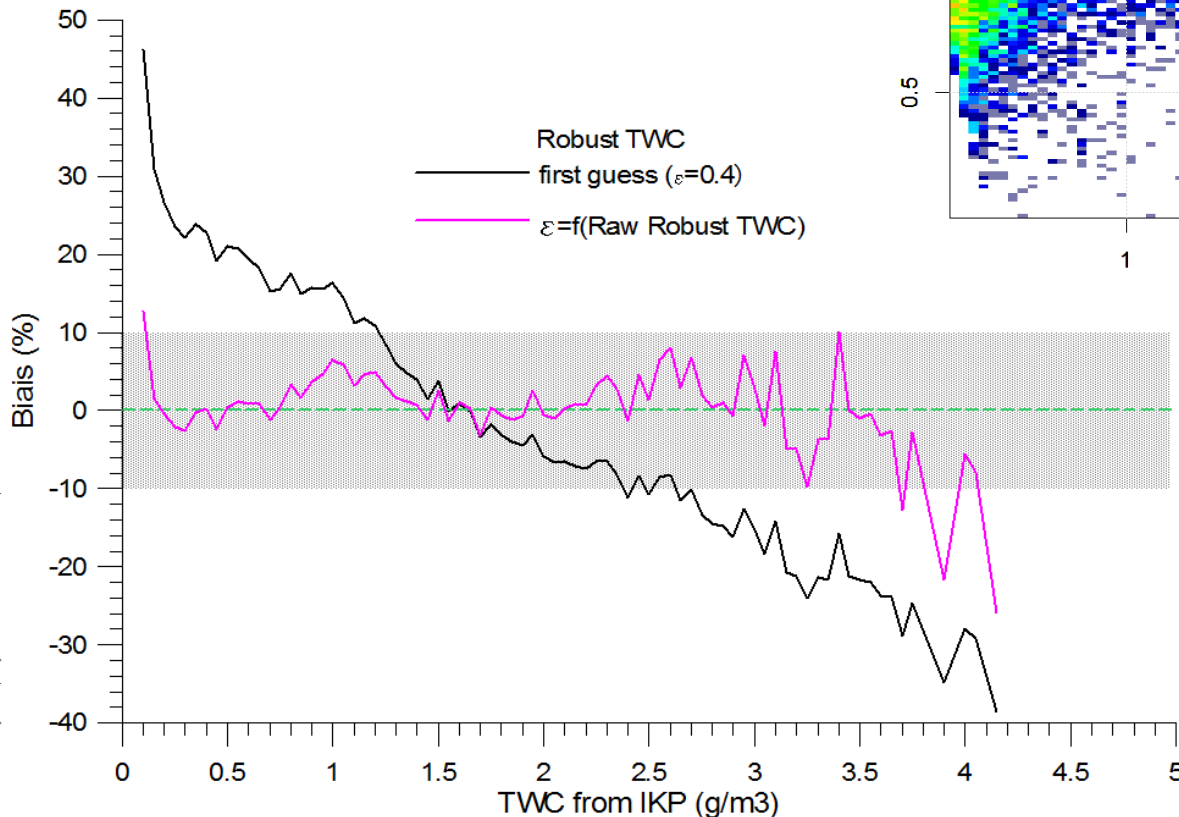


Robust is now able to give high TWC values

Correction method

TWC comparison

$$\text{Bias (\%)} = 100 \frac{\text{Robust} - \text{IKP}}{\text{IKP}}$$

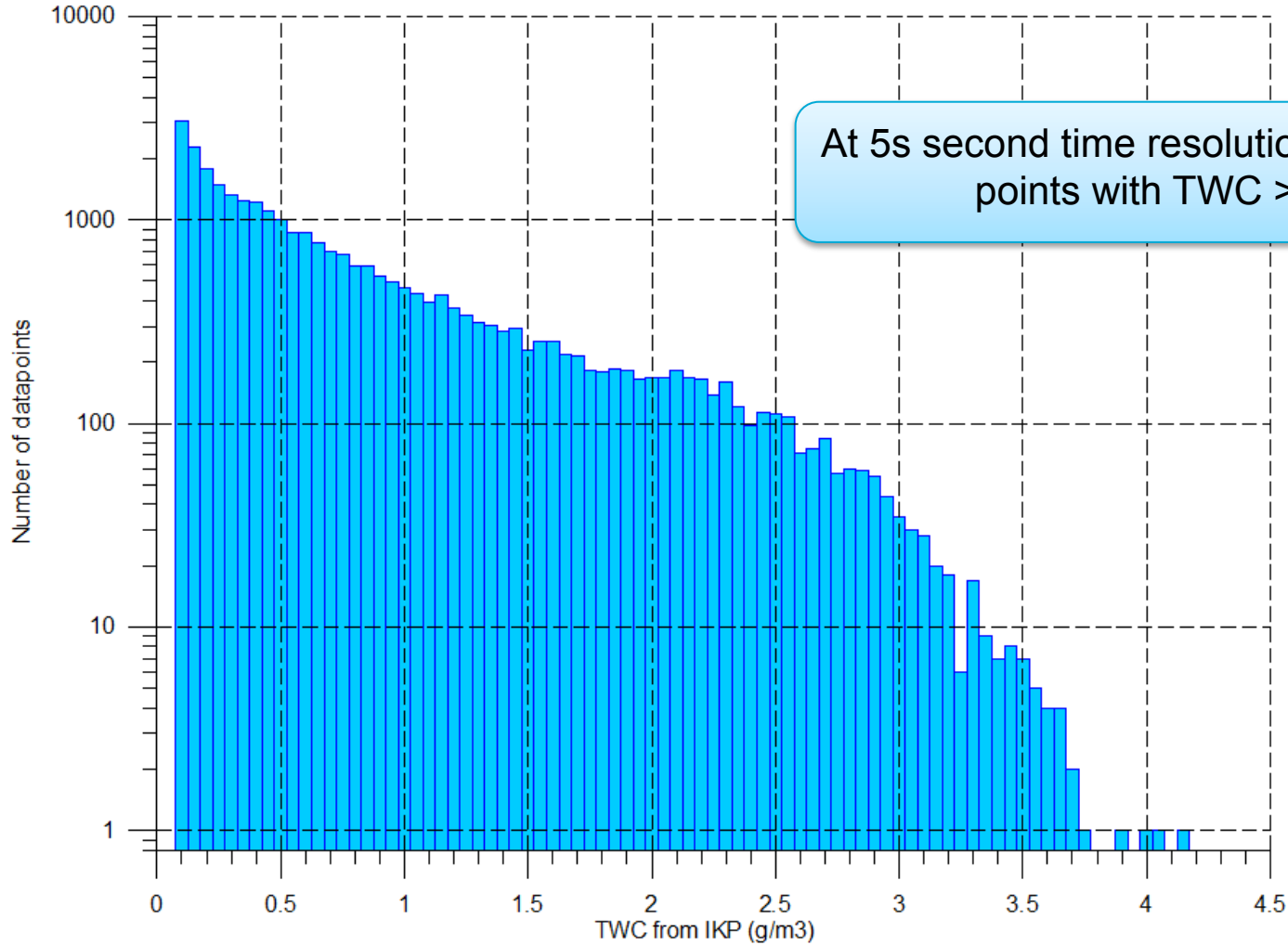


Efficiencies are now close to 1 no matter the TWC & Bias are below 10%

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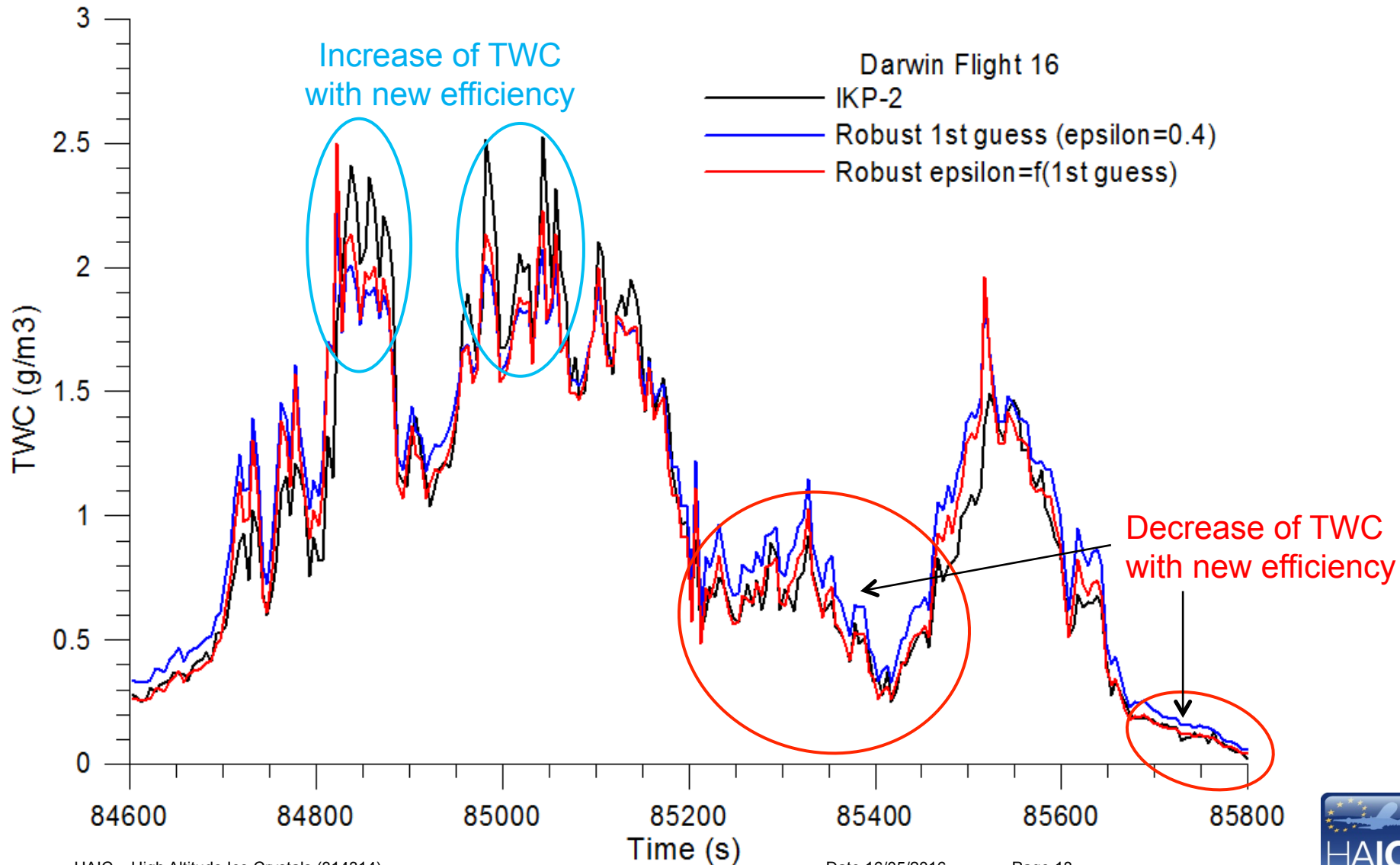
Correction method

TWC comparison



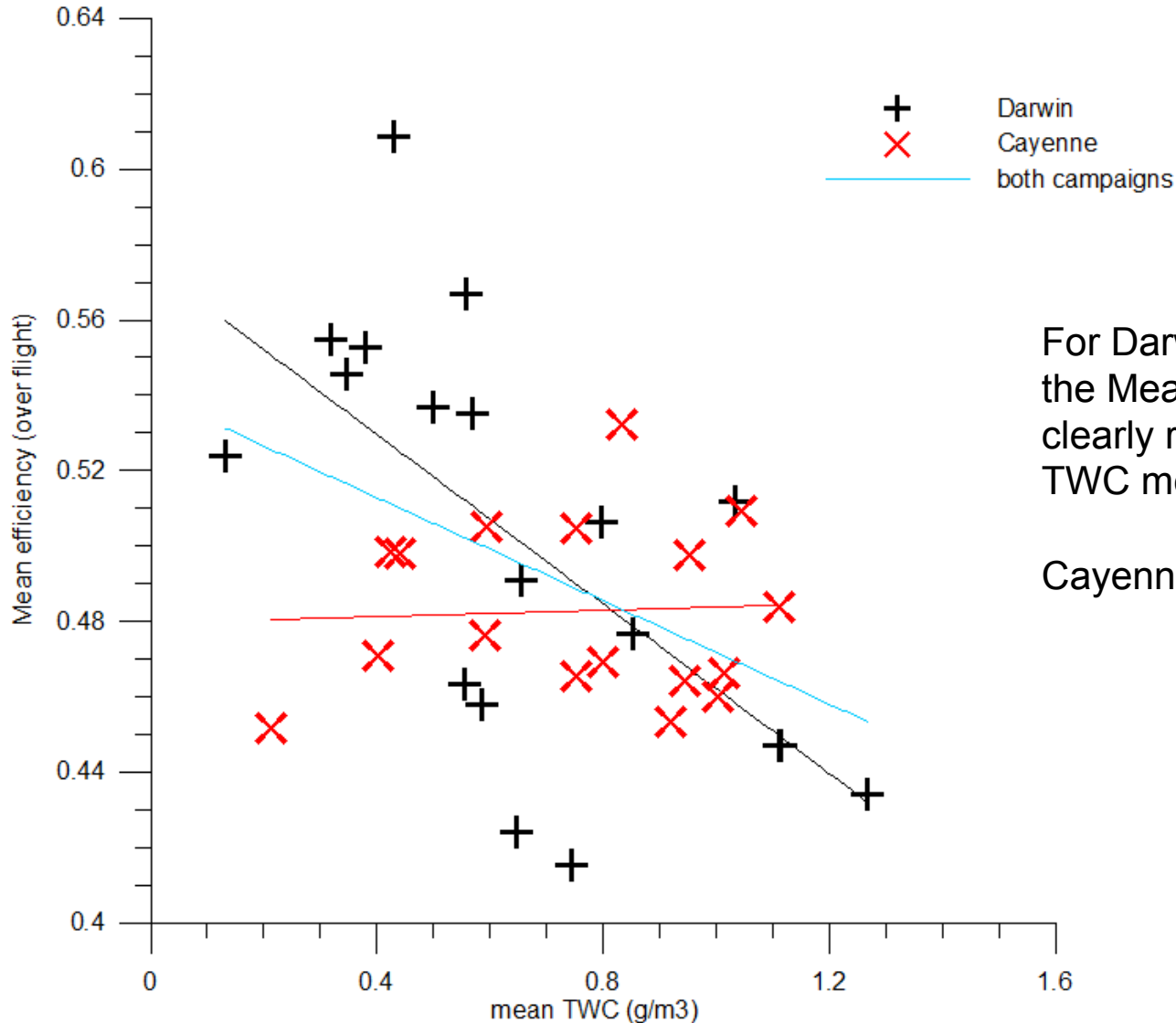
Correction method

TWC comparison



Changes from flight to flight ?

TWC comparison



For Darwin, the changes in the Mean efficiency seems clearly related to the mean TWC measured during flight.

Cayenne ?

High Altitude Ice Crystals (HAIC, 314314)

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