Presented by

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LaMP SEA Robust Probe analysis

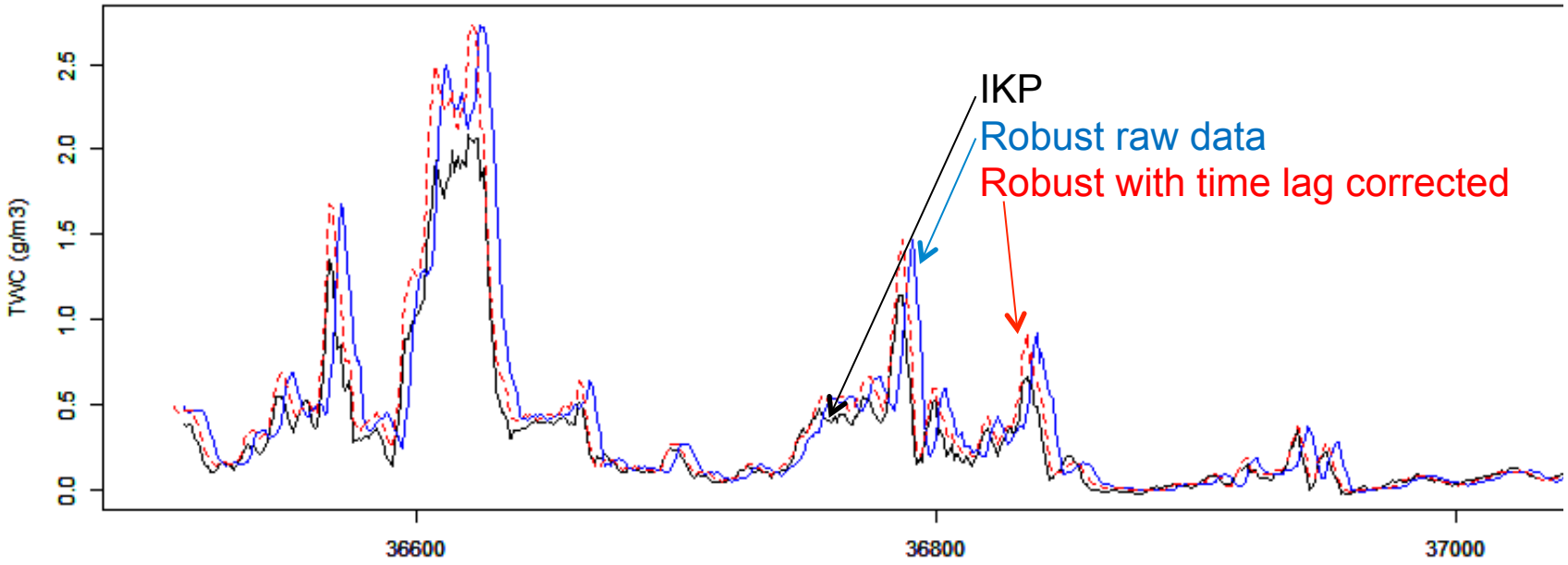
High Altitude Ice Crystals
Contents

- Robust dataset
- Quality of the first guess TWC: $\varepsilon=0.4$
- Parameterisation as a function of TWC: $\varepsilon=f(TWC)$
- Adding temperature considerations: $\varepsilon=f(TWC, T)$

Robust dataset

Dataset :

- Darwin and Cayenne measurements
- Removal of liquid phase based on the CDP data analysis
- IKP v5 ➔ 5s running average
- Robust 1Hz data but 5s running average applied
- time lag between Robust and IKP corrected for each flight individually

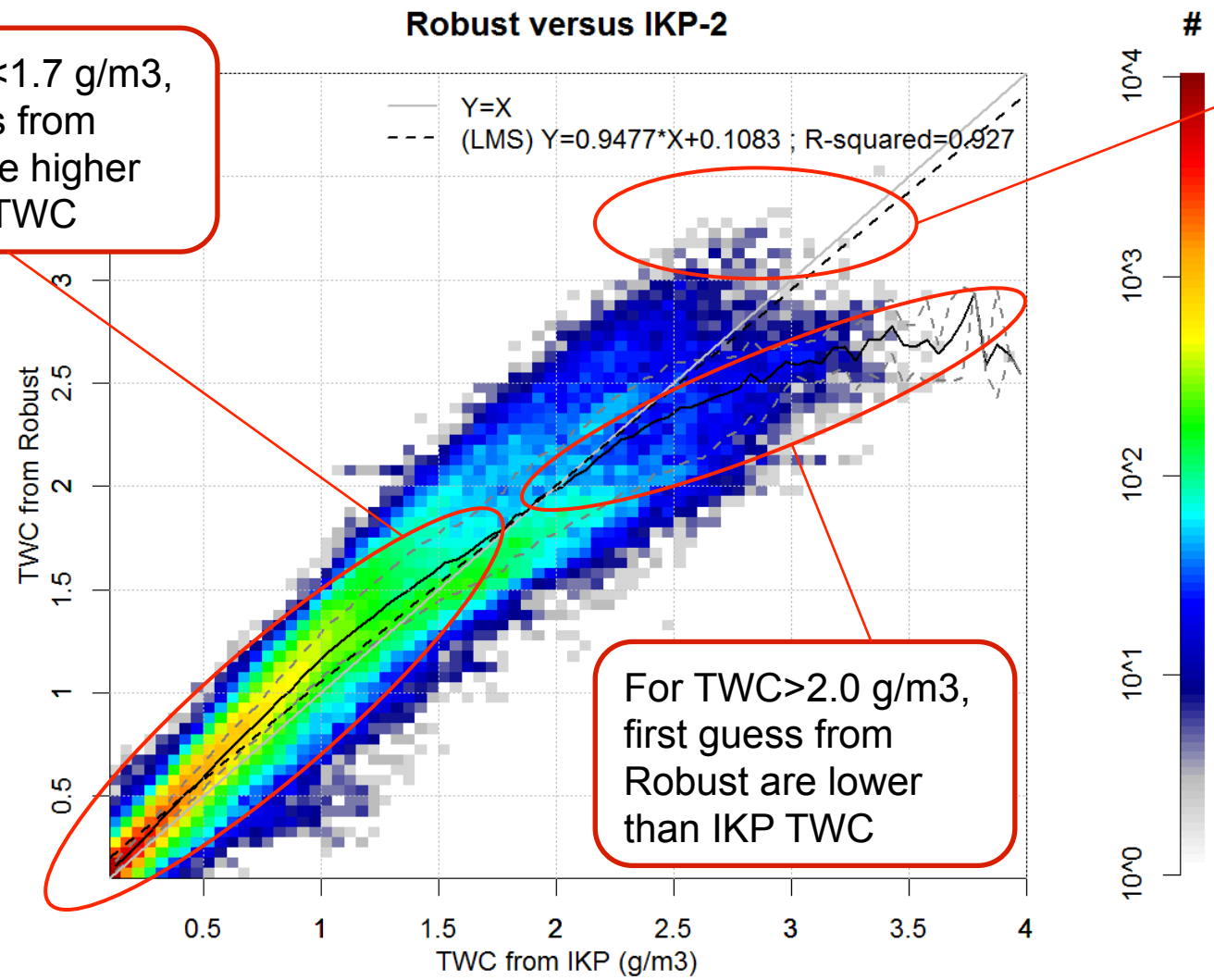


First guess TWC

First guess with efficiency = 0.4 : $TWC\downarrow 1st = TWC\downarrow raw / 0.4$

For TWC<1.7 g/m3, first guess from Robust are higher than IKP TWC

ε=0.4 « first guess »

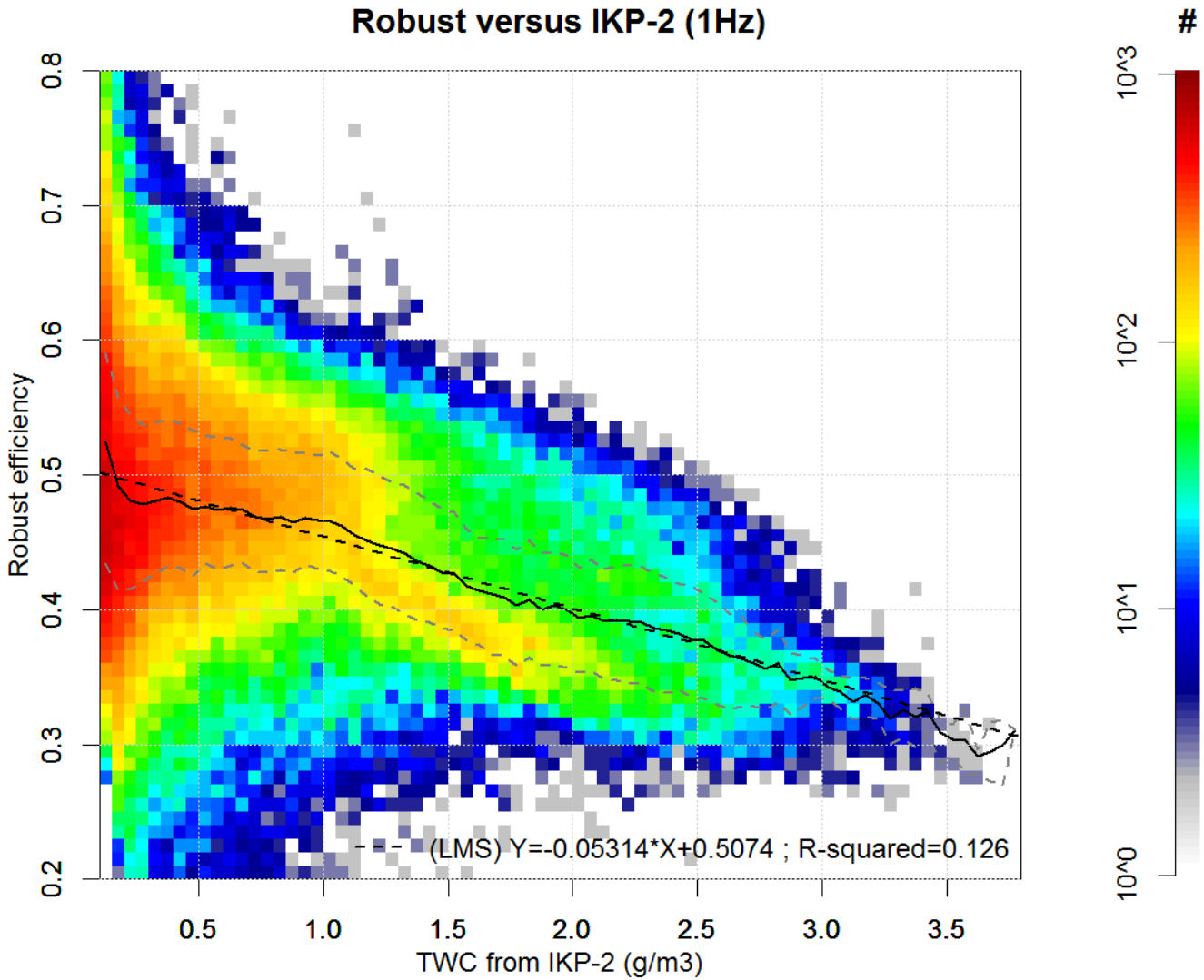


1st guess TWC rarely exceeds 3 g/m3

For TWC>2.0 g/m3, first guess from Robust are lower than IKP TWC

First guess TWC

Robust efficiency versus IKP TWC

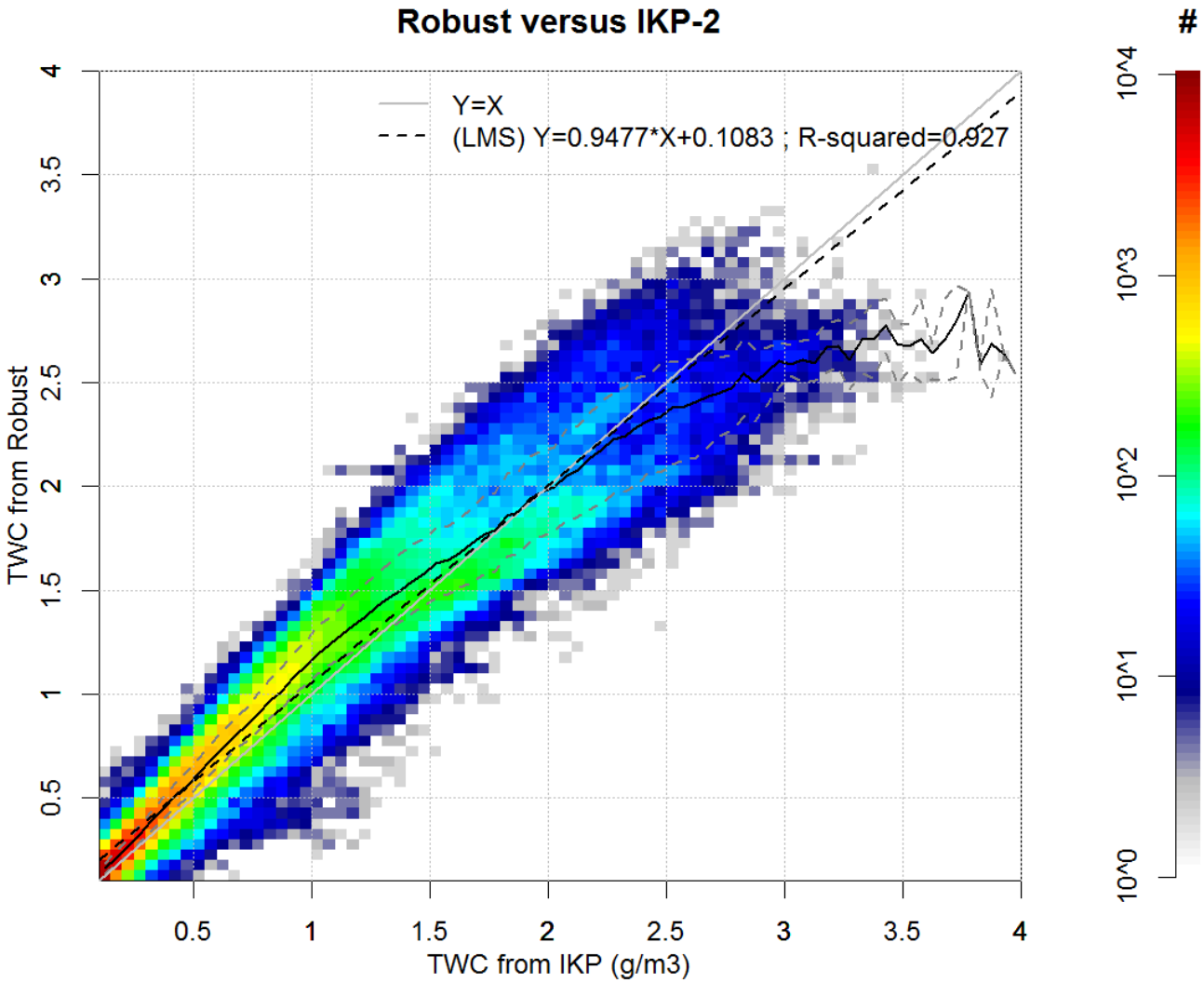


Efficiency decrease with increasing contents

Changes starting between 1 and 1.5g/m3

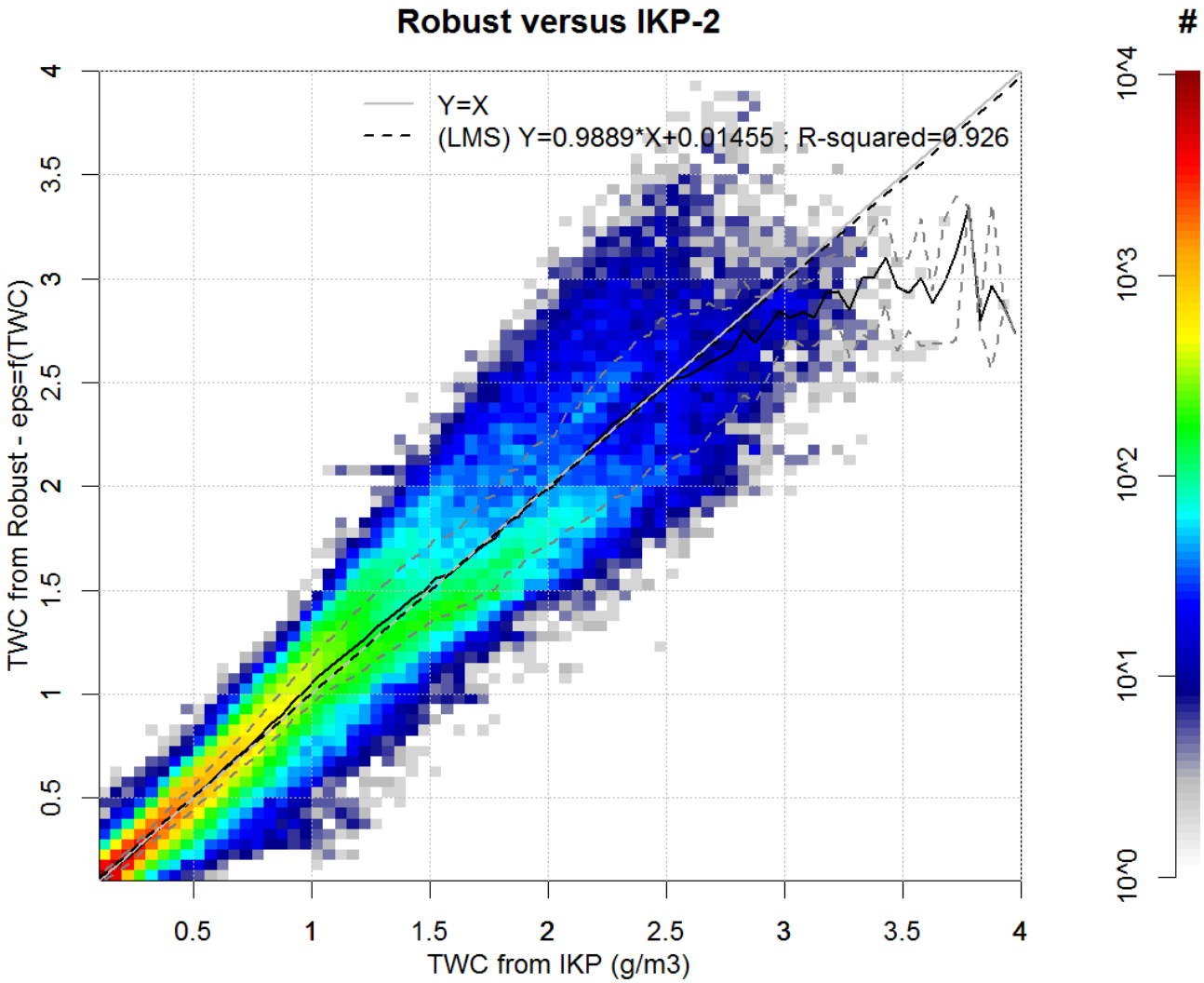
First guess TWC

First guess with efficiency = 0.4 : $TWC\downarrow 1st = TWC\downarrow raw / 0.4$

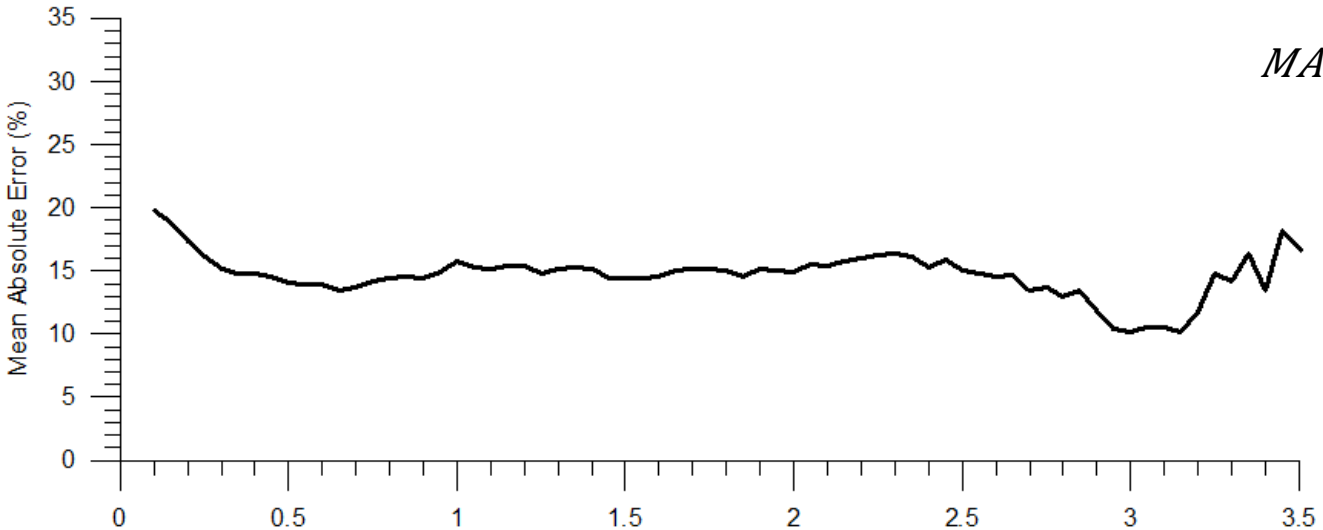


Efficiency = f(TWC)

$\varepsilon = -0.05314 * TWC\downarrow 1st + 0.5074$ ou $\varepsilon = -0.05314 * TWC\downarrow raw / 0.4 + 0.5074$

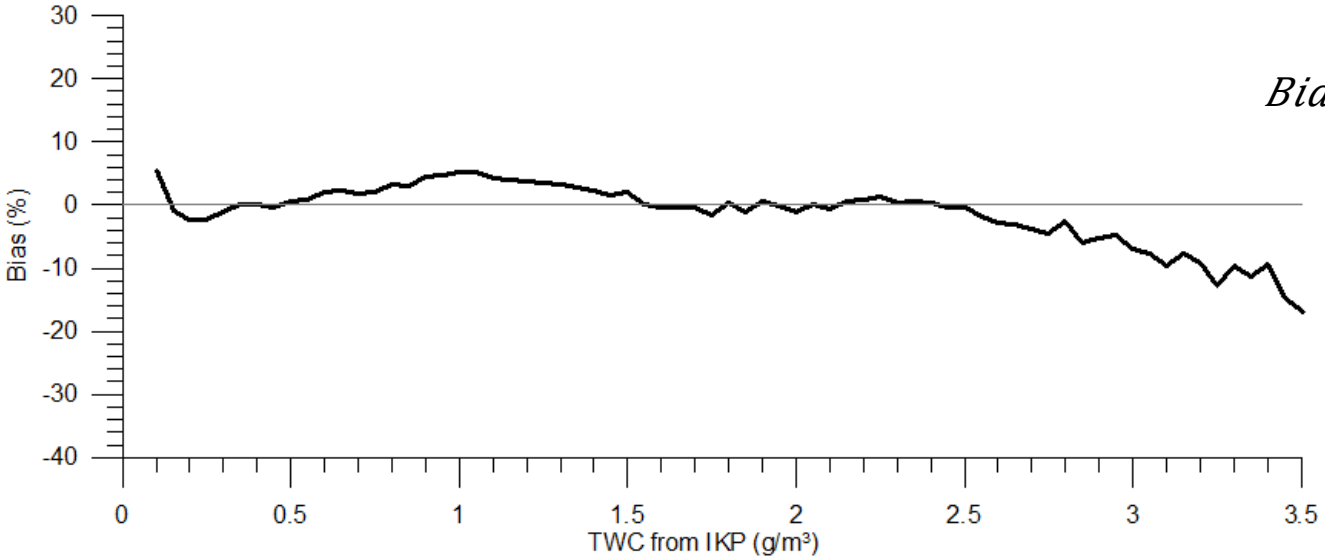


Efficiency = f(TWC)



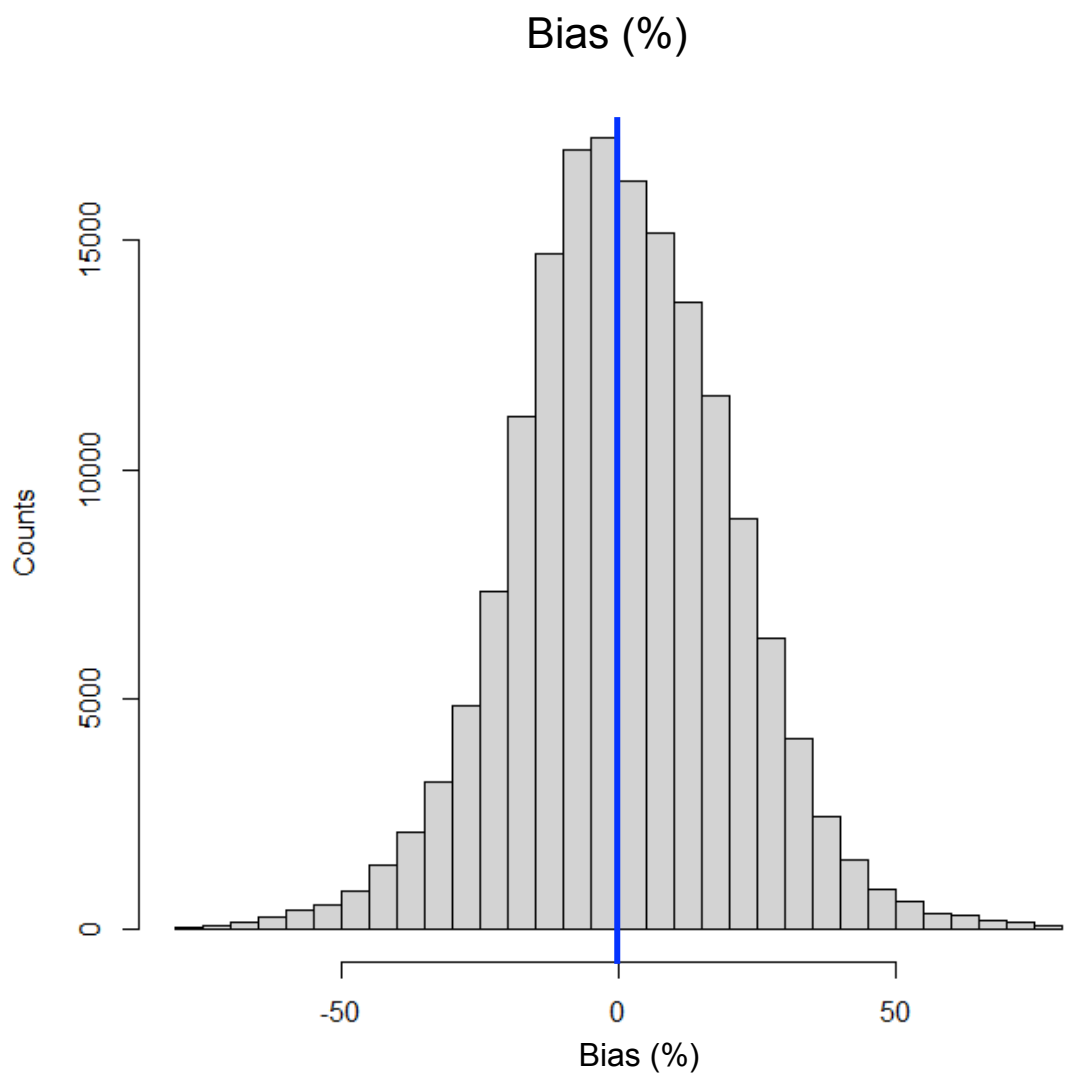
$$MAE = |TWC\downarrow Rbt - TWC\downarrow IKP| /$$

MAE ~ 15 %
Bias ~ 0



$$Bias = TWC\downarrow Rbt - TWC\downarrow IKP / TW$$

Efficiency = f(TWC)



MAE ~ 15 %
Bias ~ 0

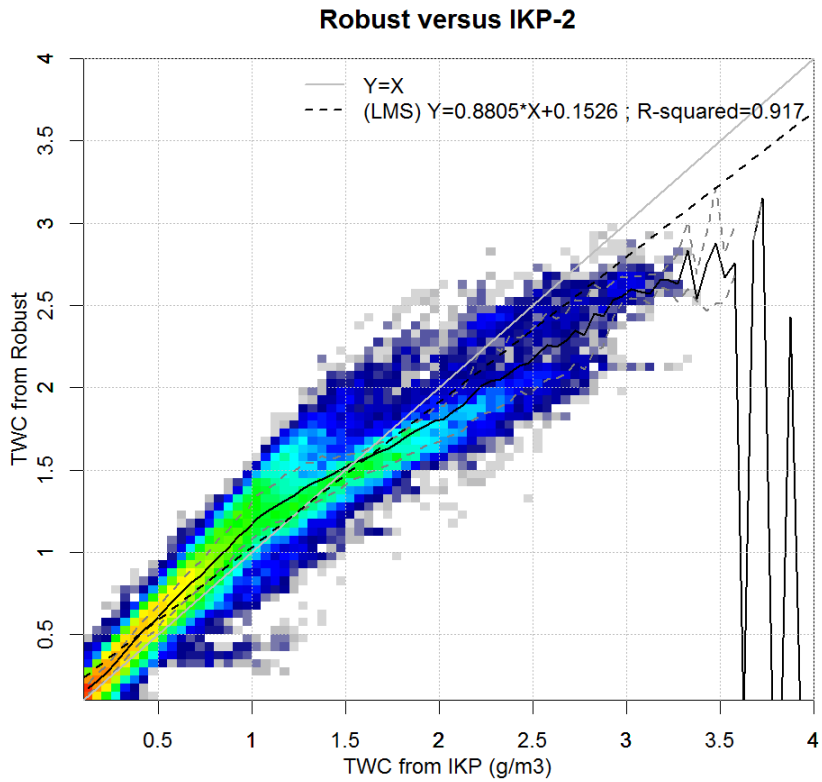
But the bias distribution is quite widespread…

➔ Good mean values (MAE & bias) but strong differences possibles

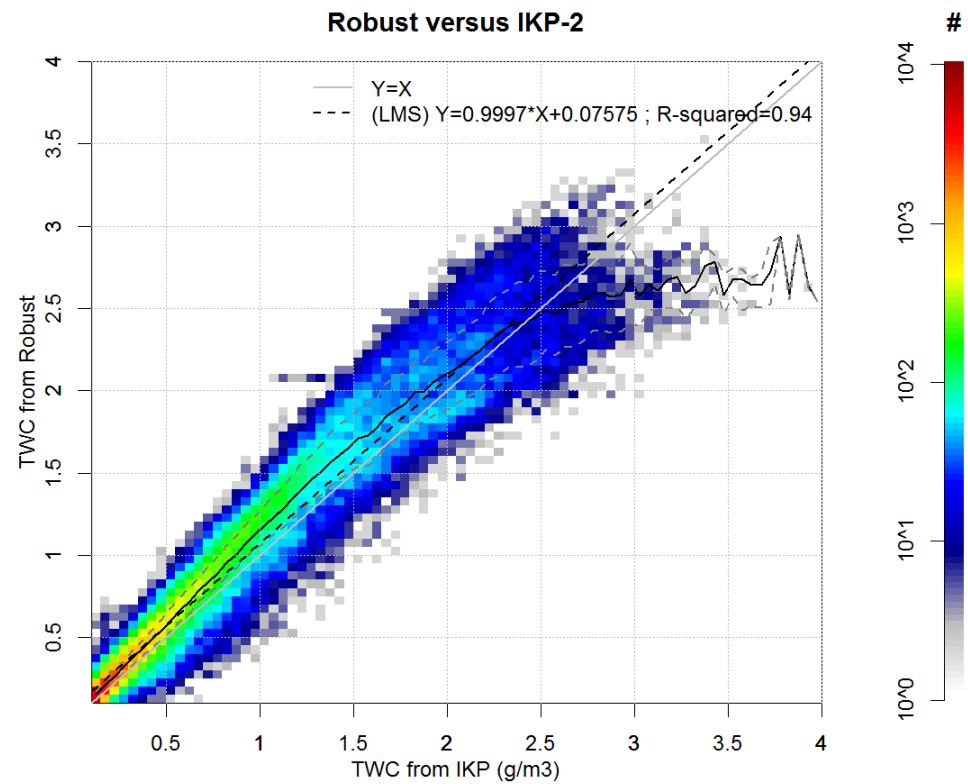
Improving the parameterisation ?

First guess with efficiency = 0.4

Darwin



Cayenne

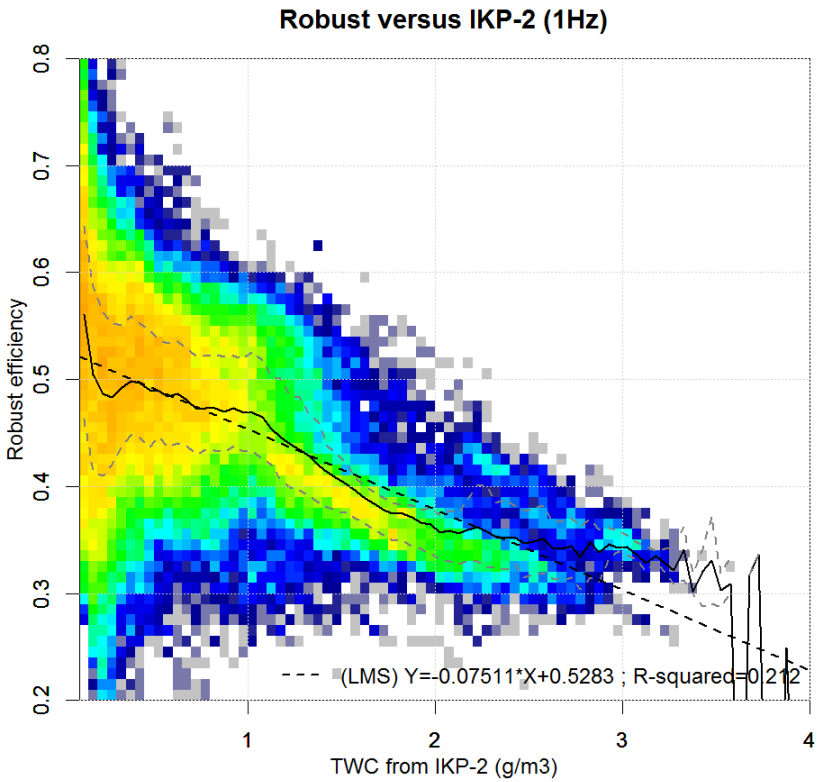


➔ Different behaviour for the two campaigns for TWC larger than 1gm-3

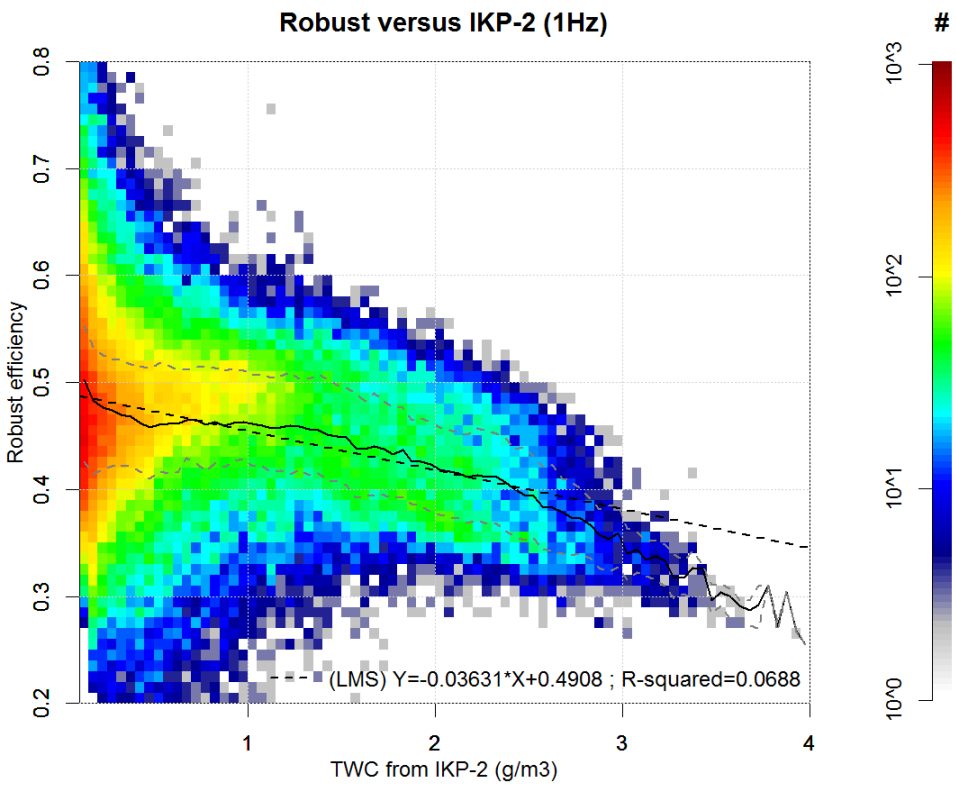
First guess TWC

First guess with efficiency = 0.4

Darwin

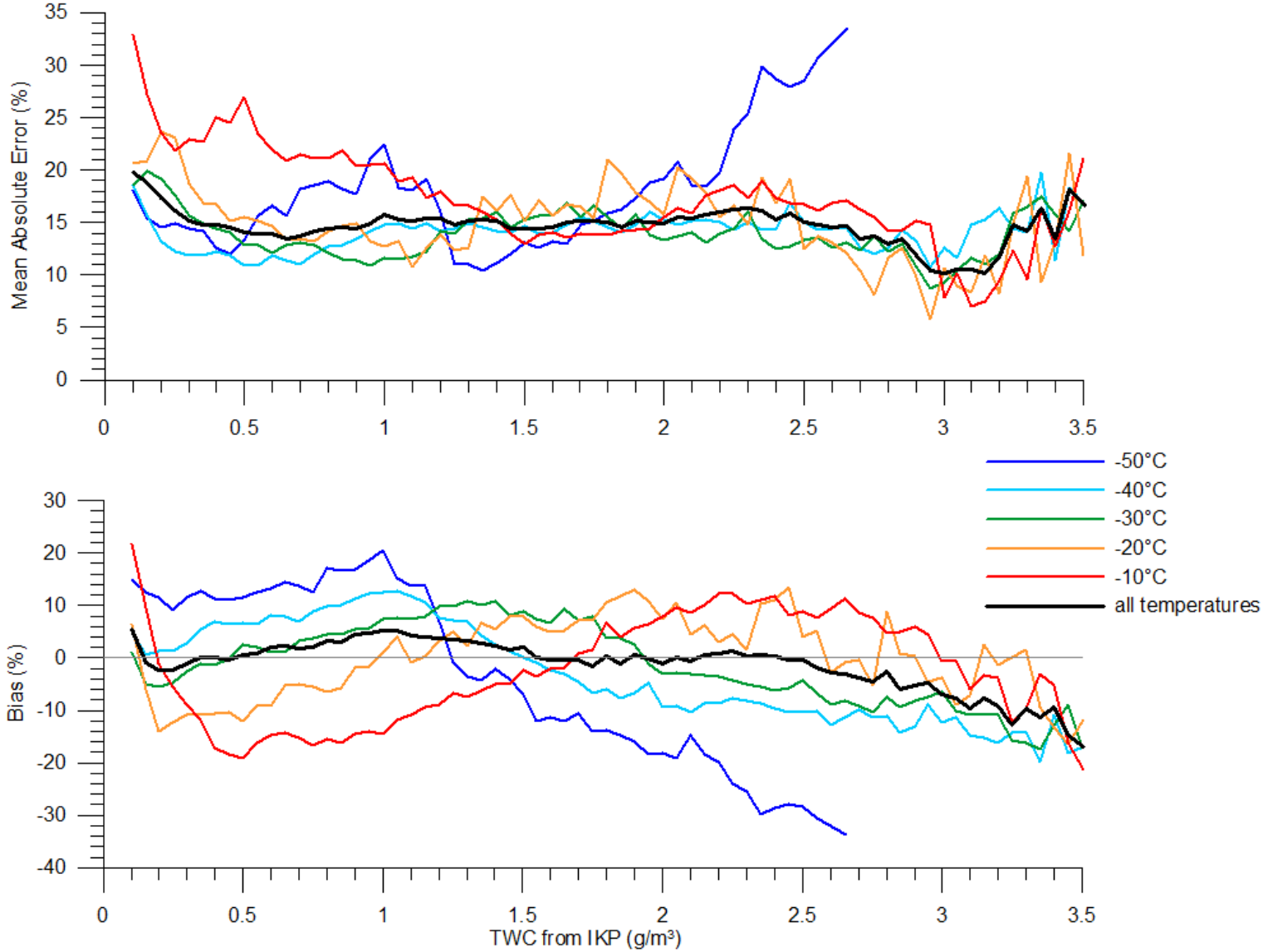


Cayenne



Improving the parameterisation ?

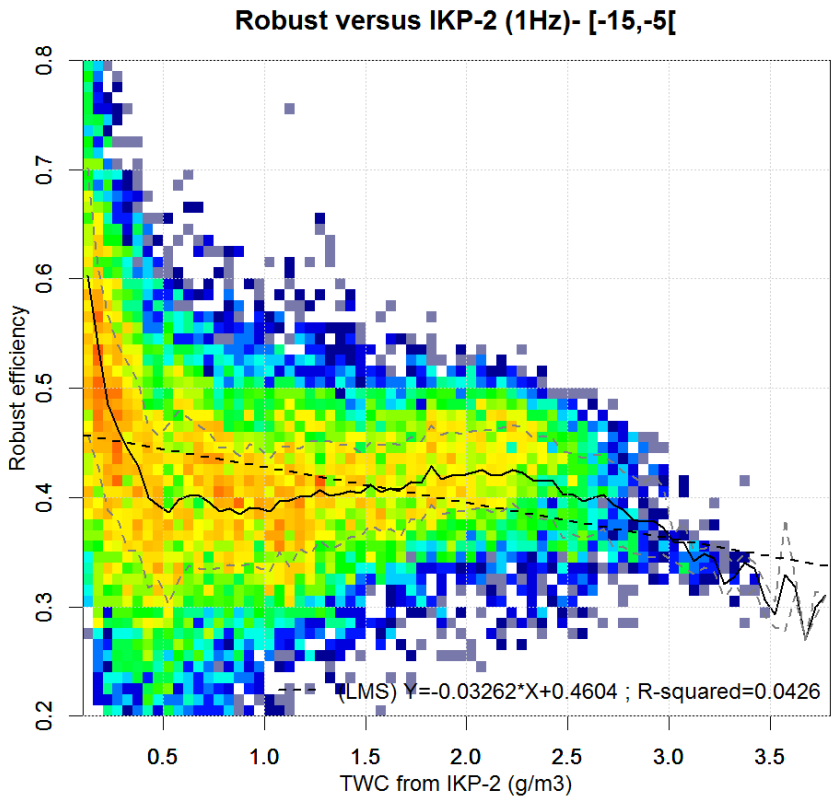
Scores as a function of temperature

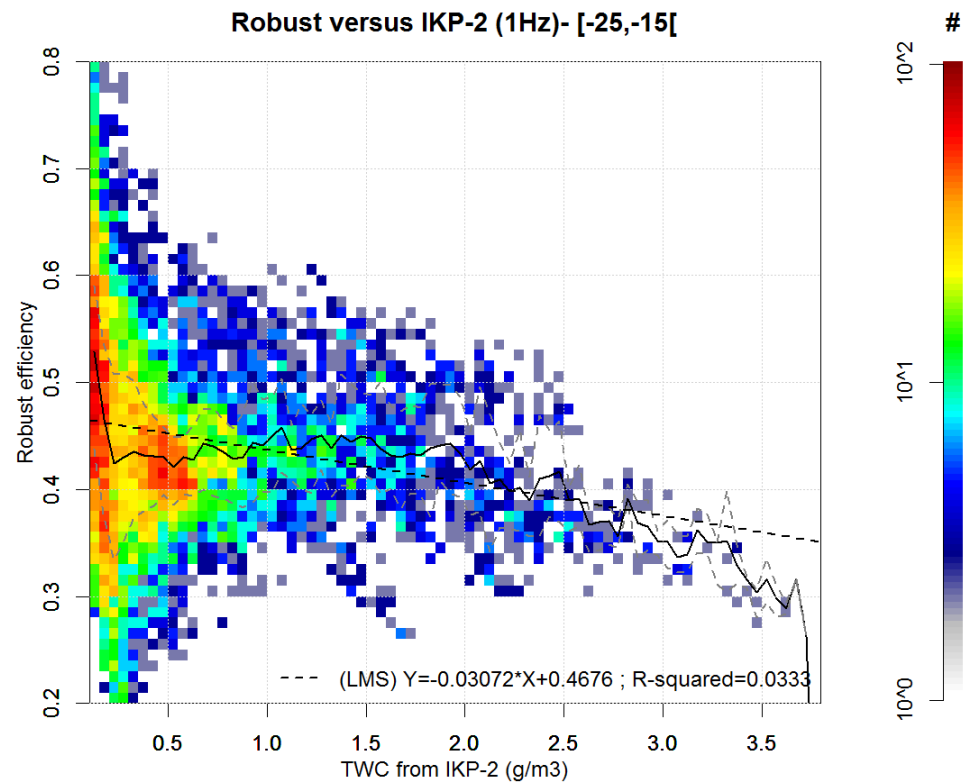


MAE ~ 15 %
Bias ~ 0

Effect of temperature

Robust efficiency versus IKP TWC – pattern with temperature



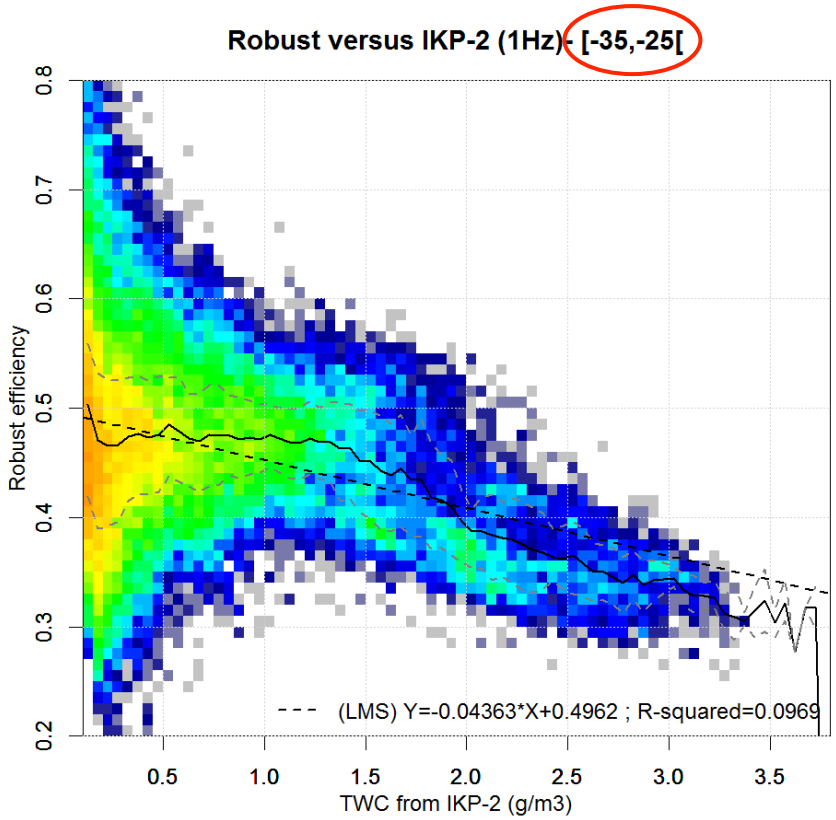


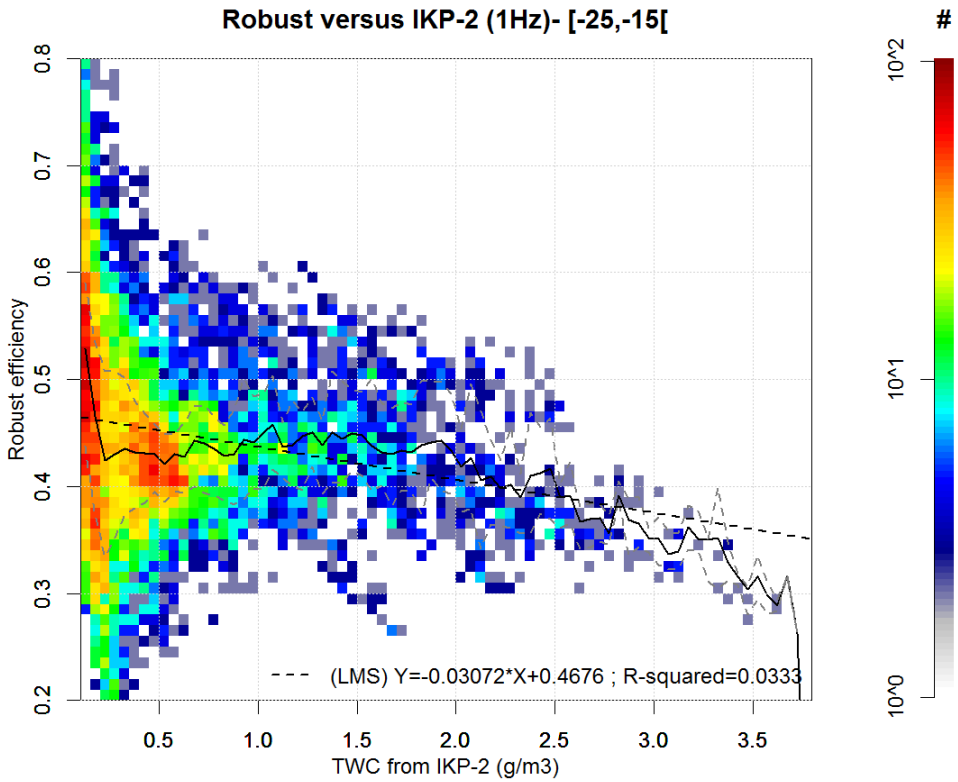
Close to -10°C :
mean ε very close to 0.4 up to 2 g/m3

Close to -20°C :
Again, mean ε quite constant up to 2 g/m3 but now slightly higher than 0.4

Effect of temperature

Robust efficiency versus IKP TWC – pattern with temperature



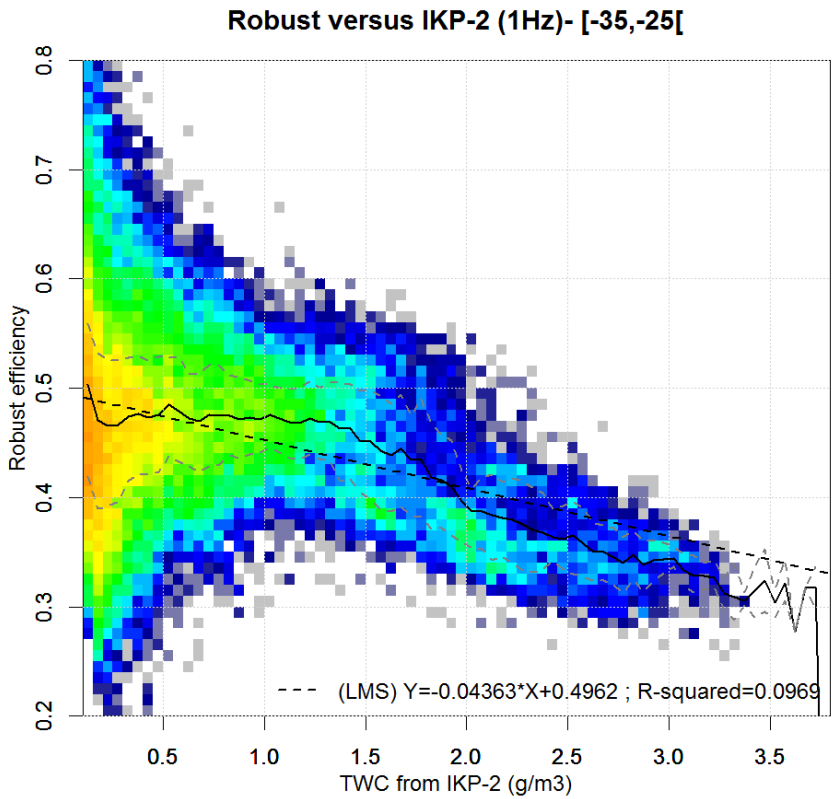


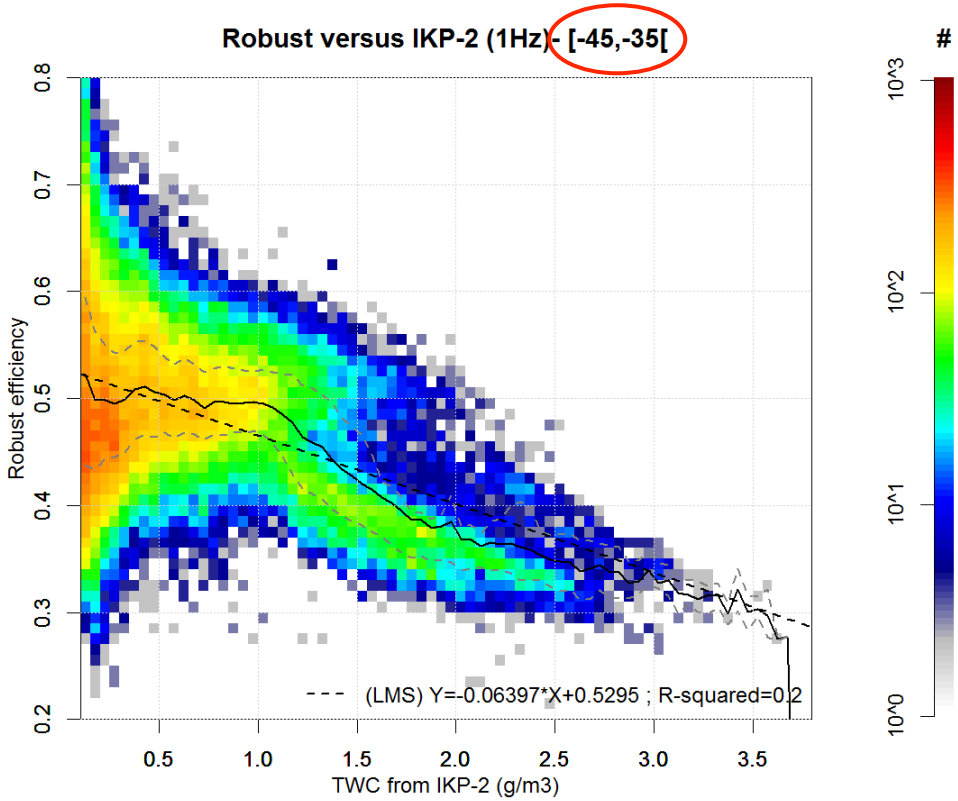
Close to -30°C :
Still, mean ε quite constant up to 1.5g/m3 (with values larger than 0.45) and then decreasing

Close to -20°C :
Again, mean ε quite constant up to 2 g/m3 but now slightly higher than 0.4

Effect of temperature

Robust efficiency versus IKP TWC – pattern with temperature



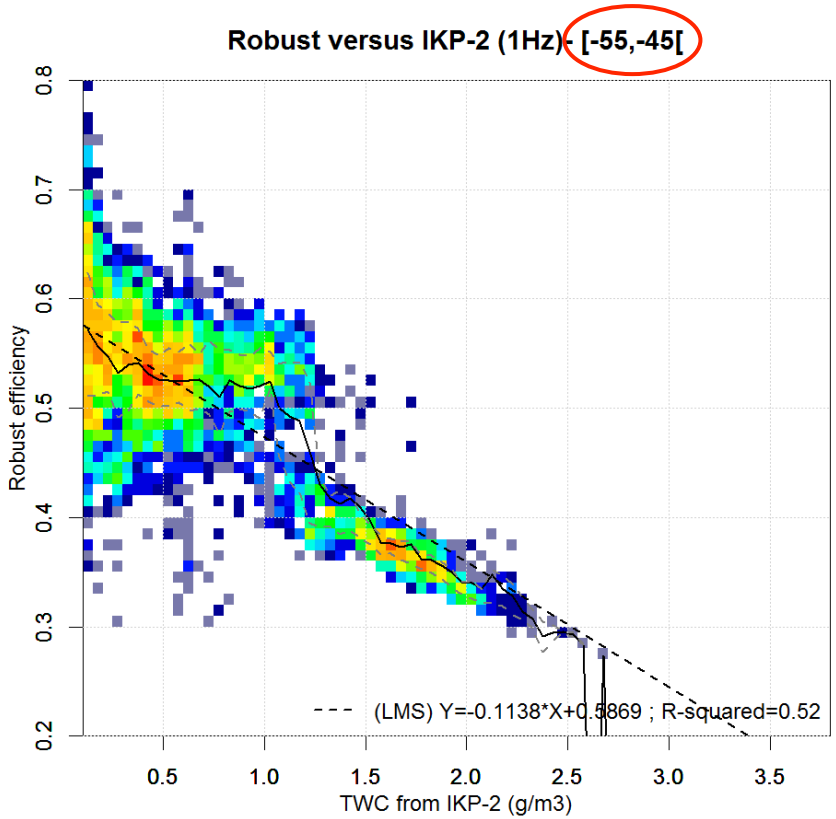


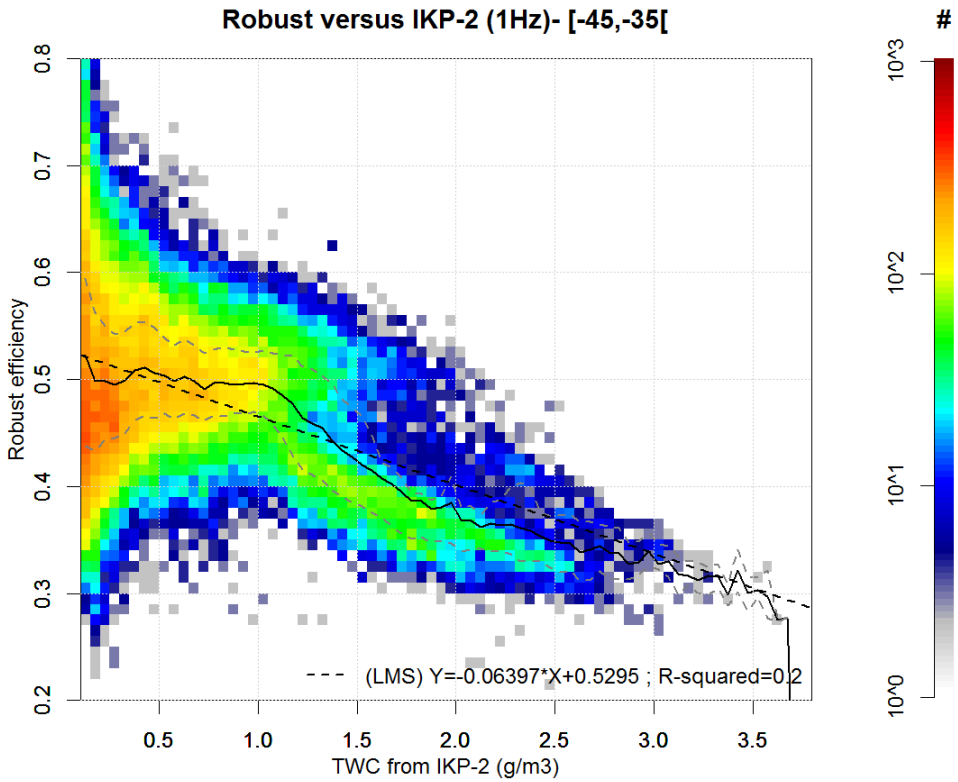
Close to -30°C :
Still, mean ε quite constant up to 1.5g/m3 (with values larger than 0.45) and then decreasing

Close to -40°C :
mean ε quite constant up to 1 g/m3 (close to 0.5) and then decreasing

Effect of temperature

Robust efficiency versus IKP TWC – pattern with temperature



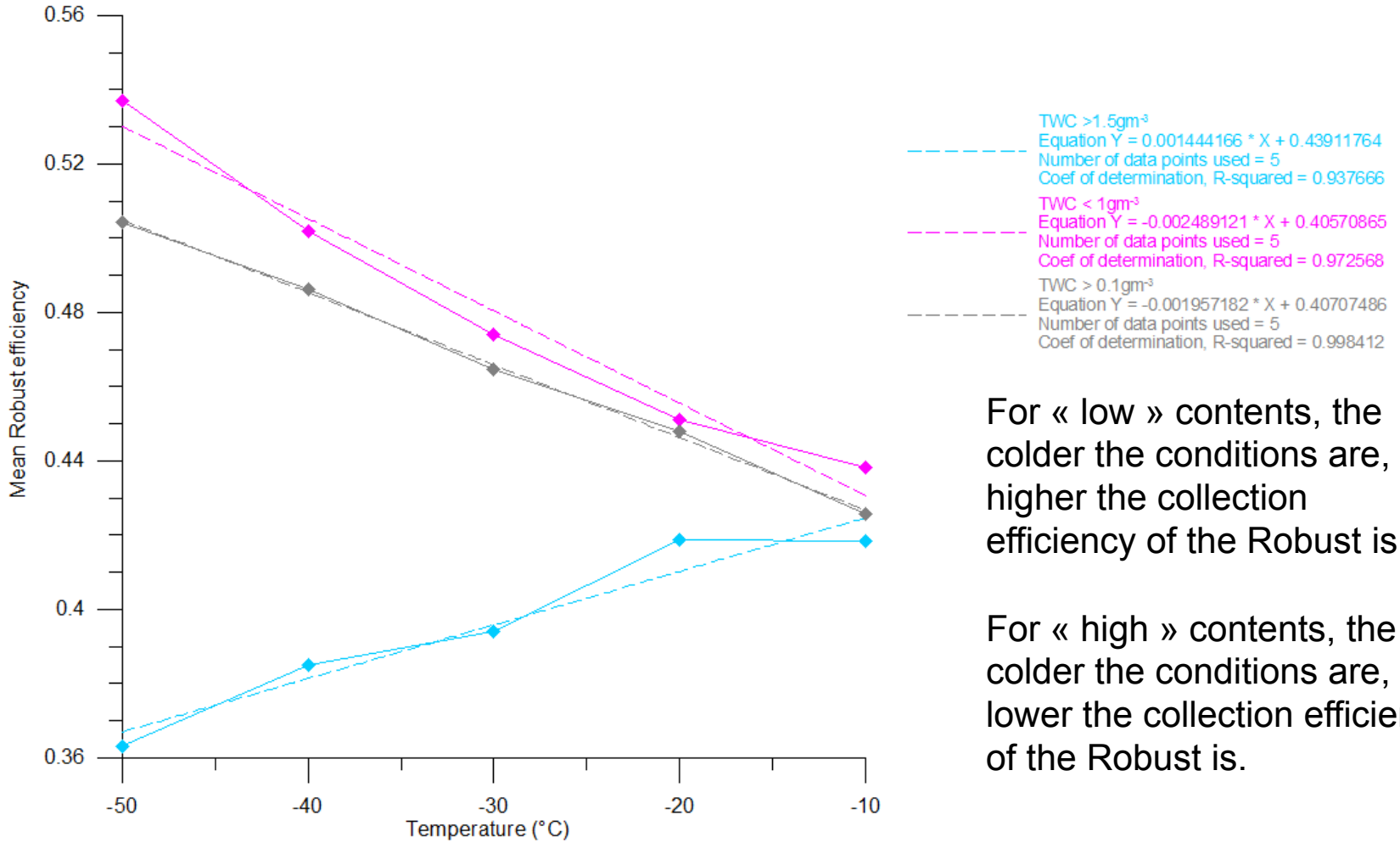


Close to -50°C :
mean ε almost constant up to 1.0g/m3 (with values larger than 0.5) and then decreasing

Close to -40°C :
mean ε quite constant up to 1 g/m3 (close to 0.5) and then decreasing

Effect of temperature

Robust efficiency versus IKP TWC – pattern with temperature



For « low » contents, the colder the conditions are, the higher the collection efficiency of the Robust is.

For « high » contents, the colder the conditions are, the lower the collection efficiency of the Robust is.

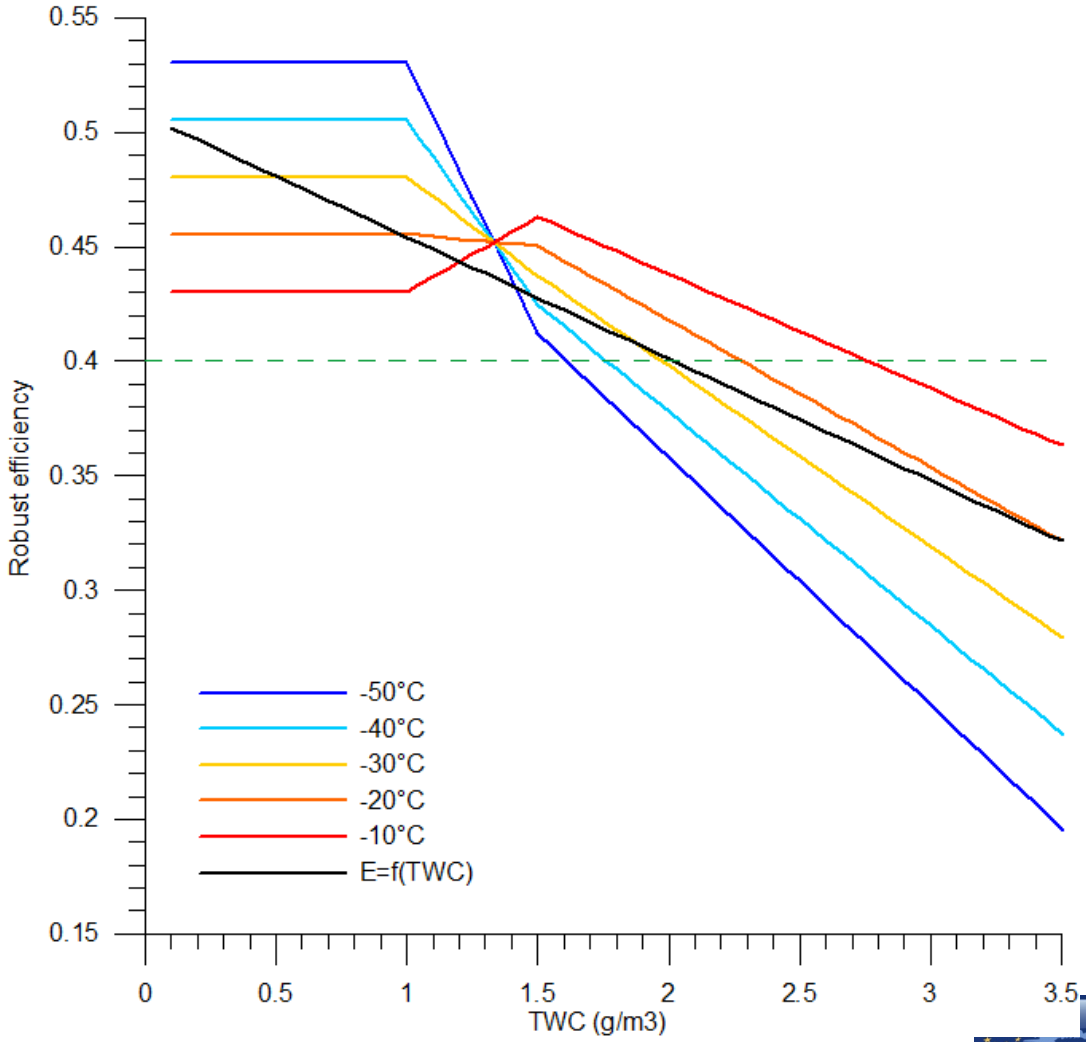
Efficiency=f(TWC,T)

Robust efficiency versus IKP TWC – pattern with temperature

Below 1g/m3 :
ε quite constant and increase with decreasing temperatures
➔ Choose a parameterisation of the mean efficiency as a function of temperature only

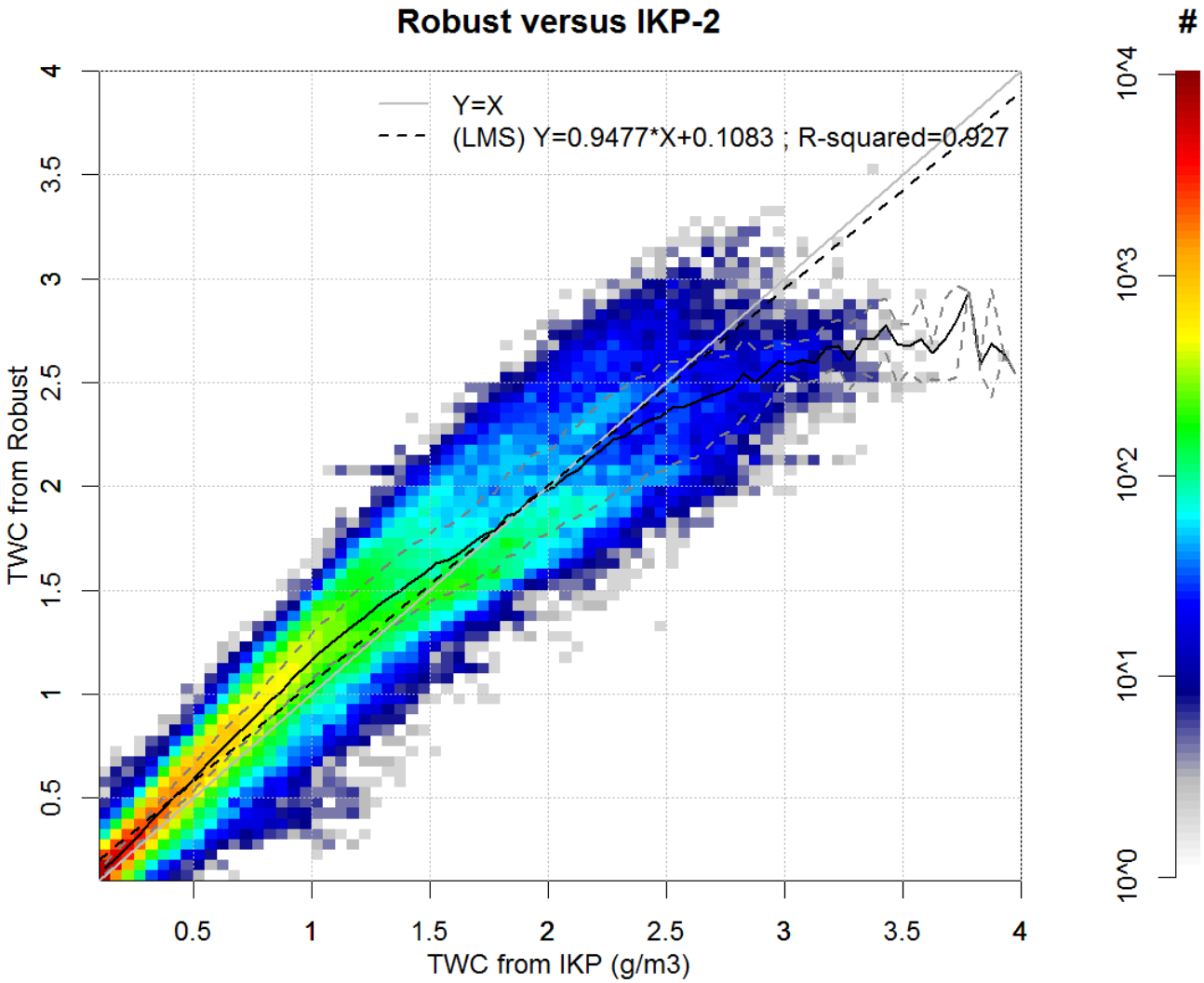
Above 1.5g/m3 :
ε decrease with decreasing temperatures and TWC
➔ Use a linear fit for the TWC dependancy with coefficients that are a function of temperature

Between 1 and 1.5 g/m3:
➔ Join the two parameterisations with a linear equation



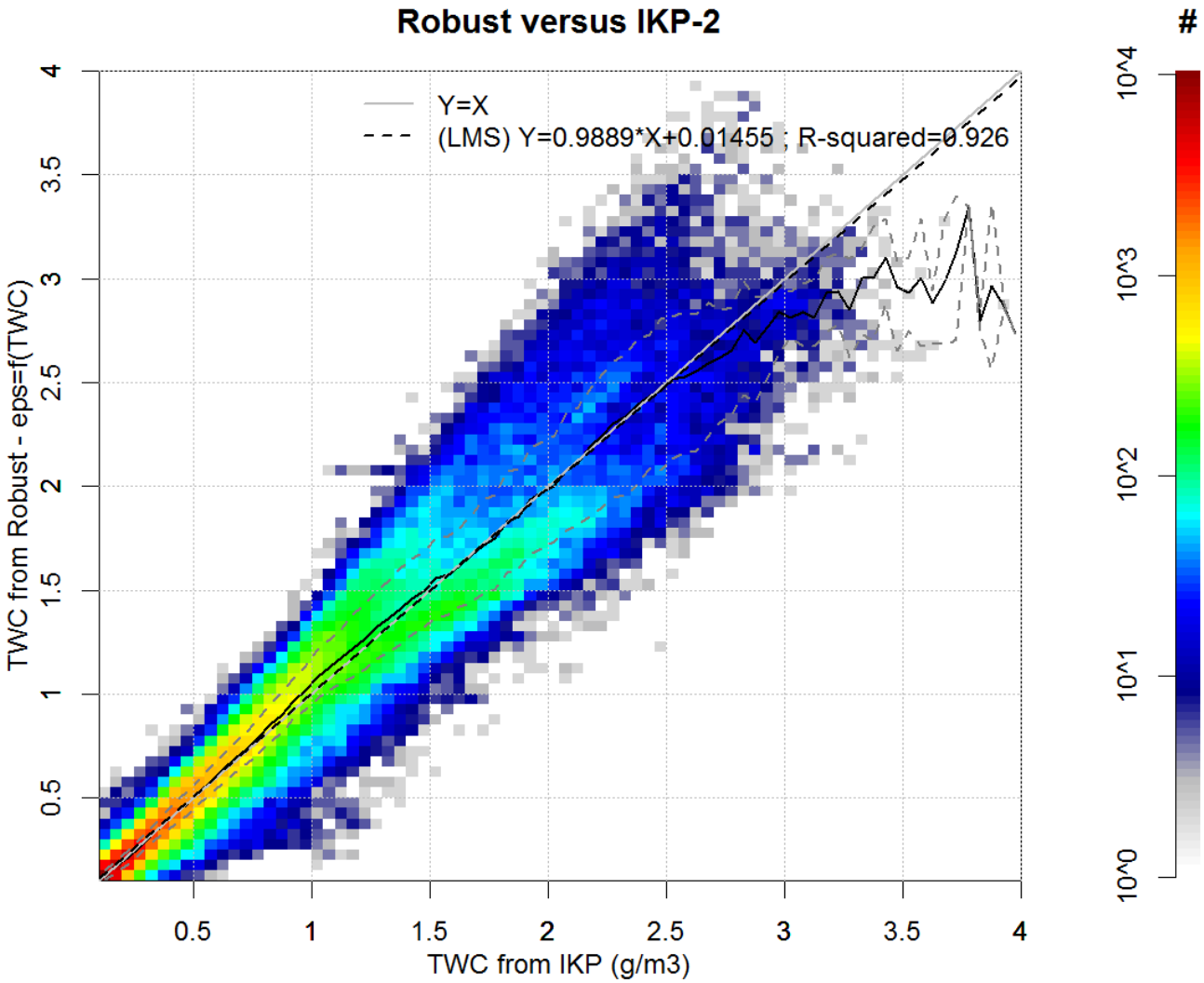
First guess TWC

First guess with efficiency = 0.4 : $TWC\downarrow 1st = TWC\downarrow raw / 0.4$



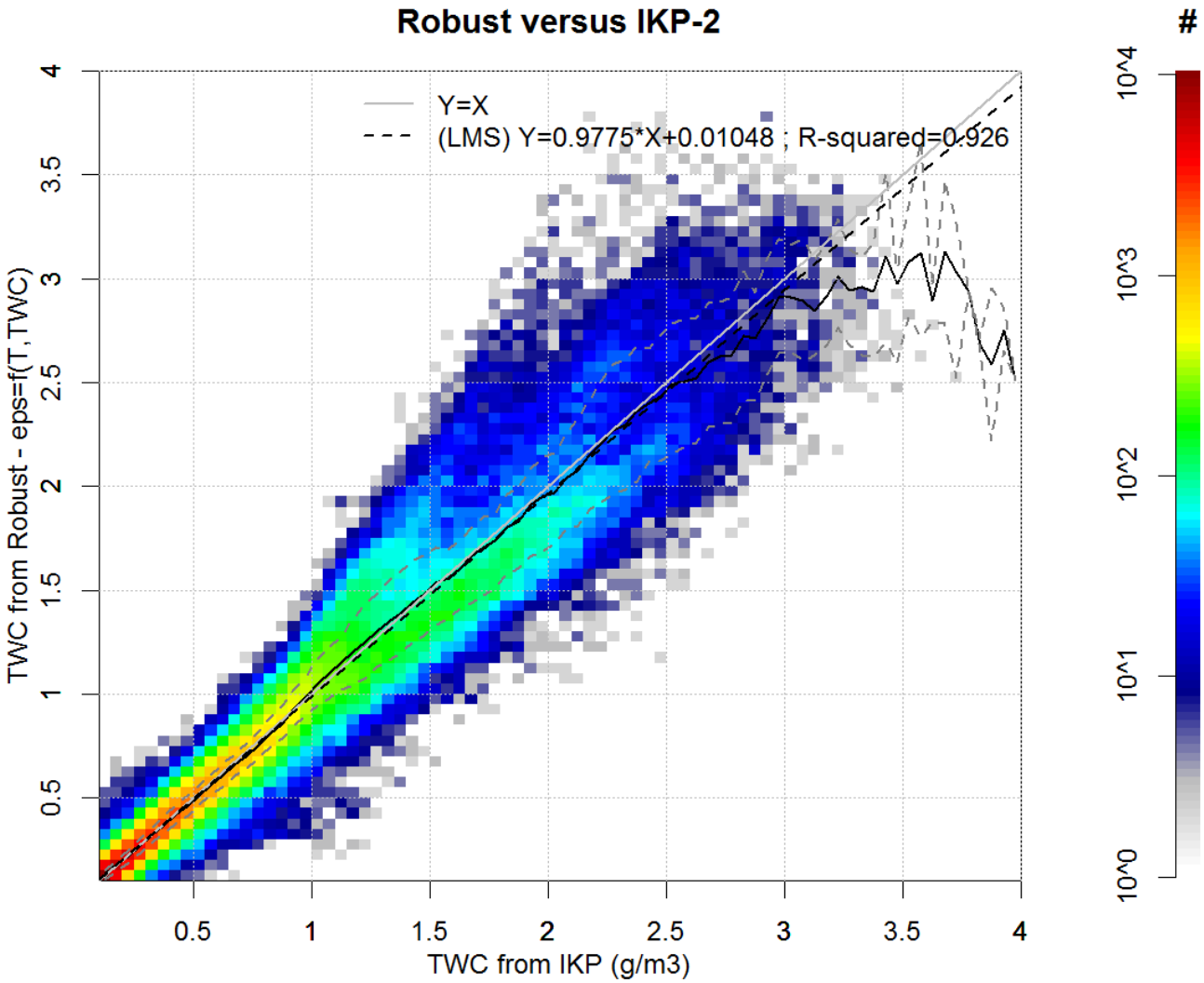
Efficiency=f(TWC)

Parameterisation as a function of TWC

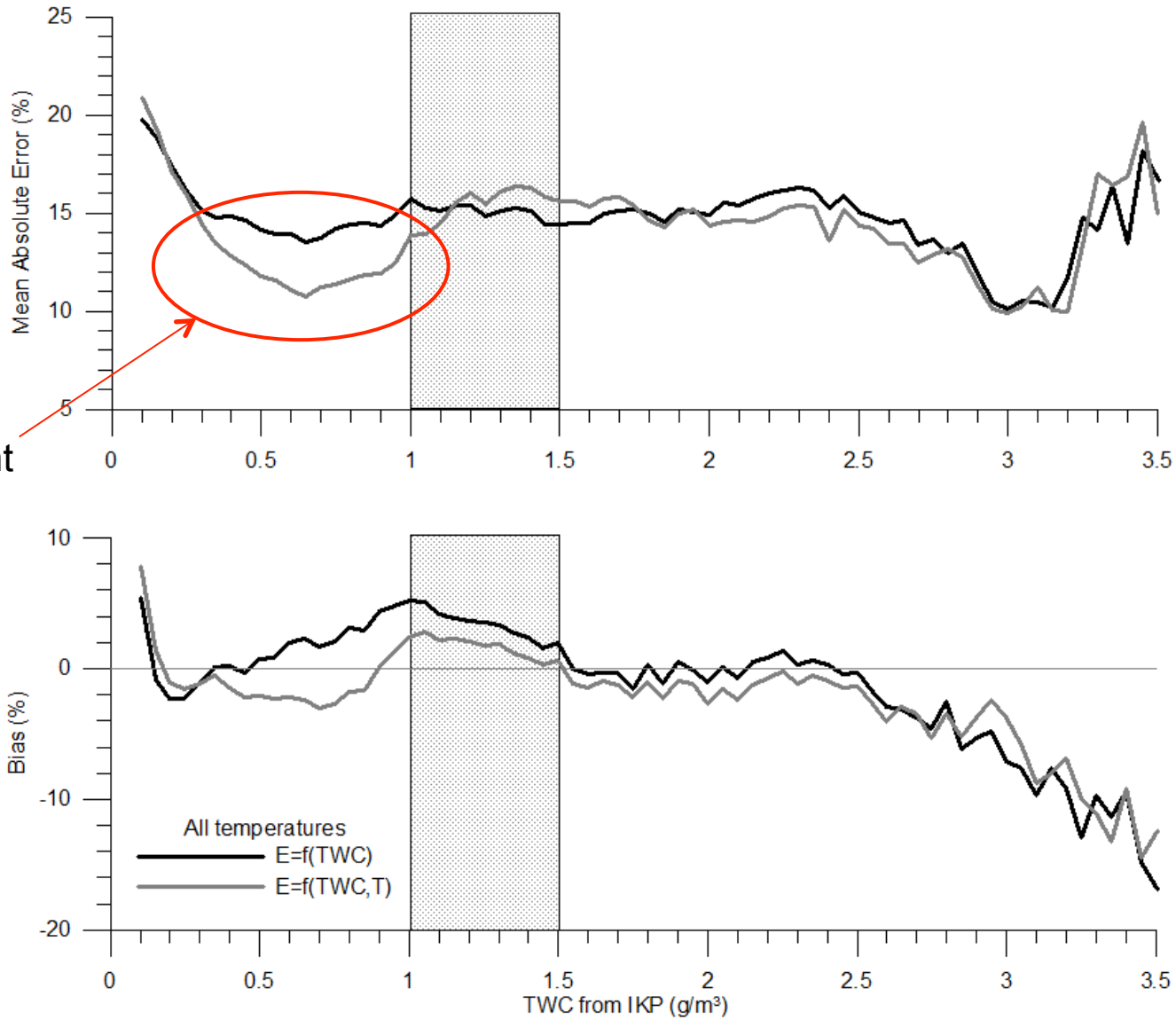


Efficiency=f(TWC,T)

Parameterisation including temperature



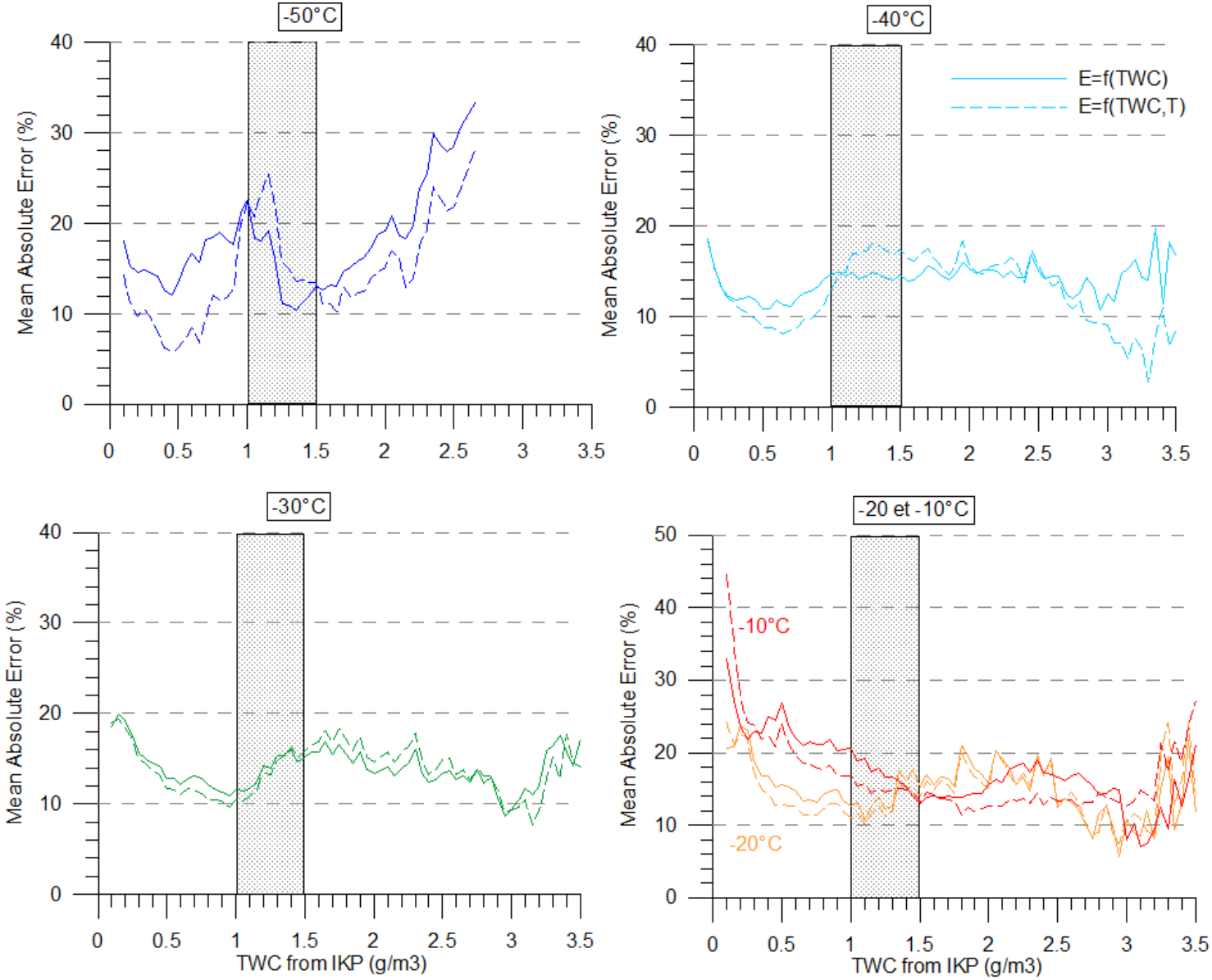
Efficiency=f(TWC,T)



Noticeable improvement for low contents

Only light changes for TWC larger than 1.5 g/m3

Efficiency=f(TWC,T)



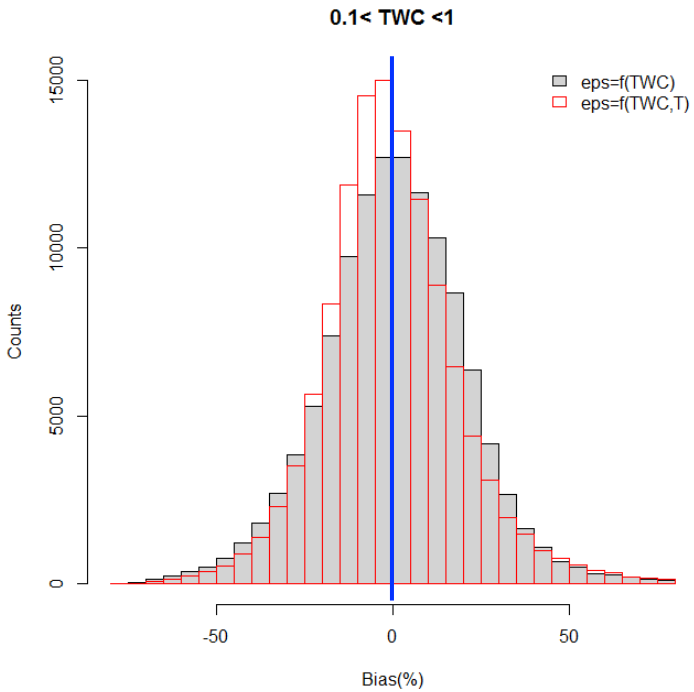
Improvement for low contents for all temperatures

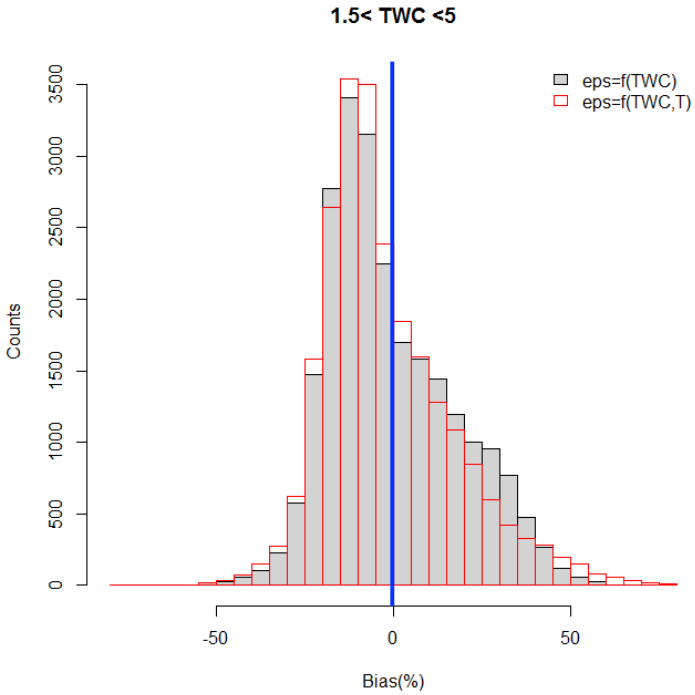
Reduced MAE for large contents (>1.5g/m3) at -50°C and -10°C temperature levels

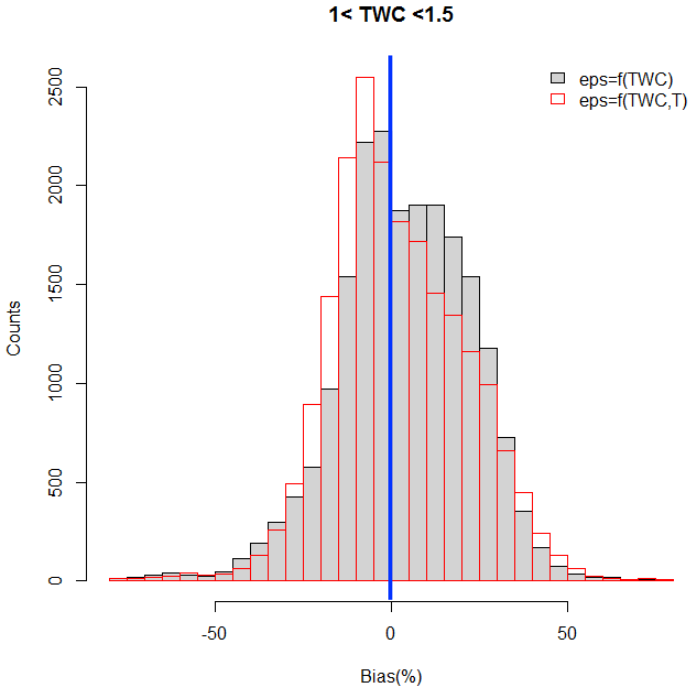
Except at -50°C, MAE stay below 20%

Efficiency=f(TWC,T)

Bias distribution for different TWC threshold



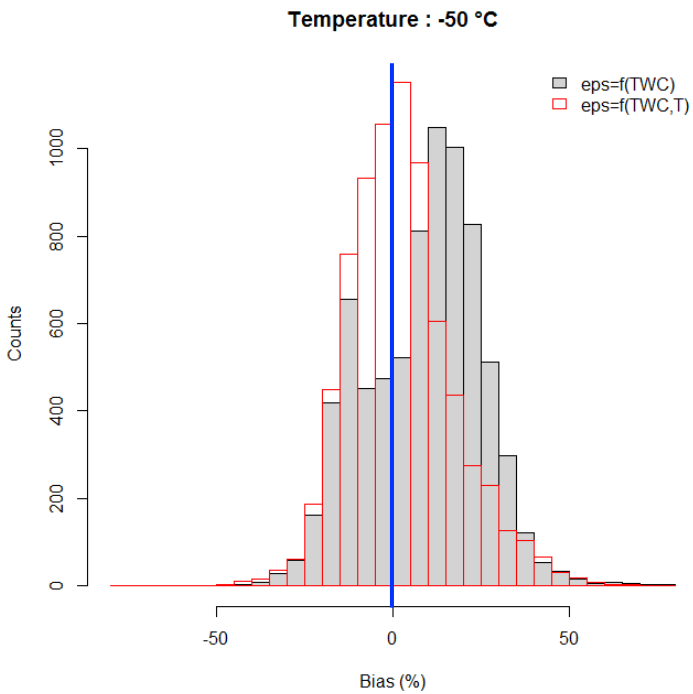


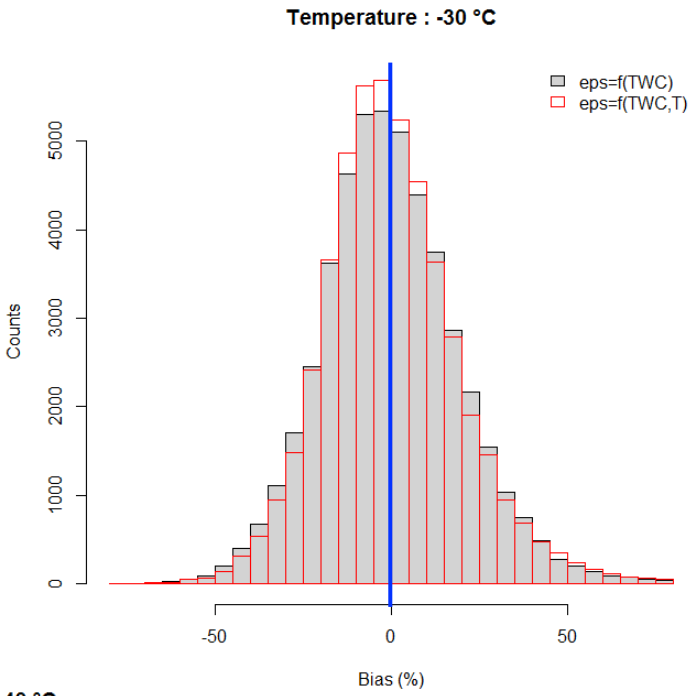


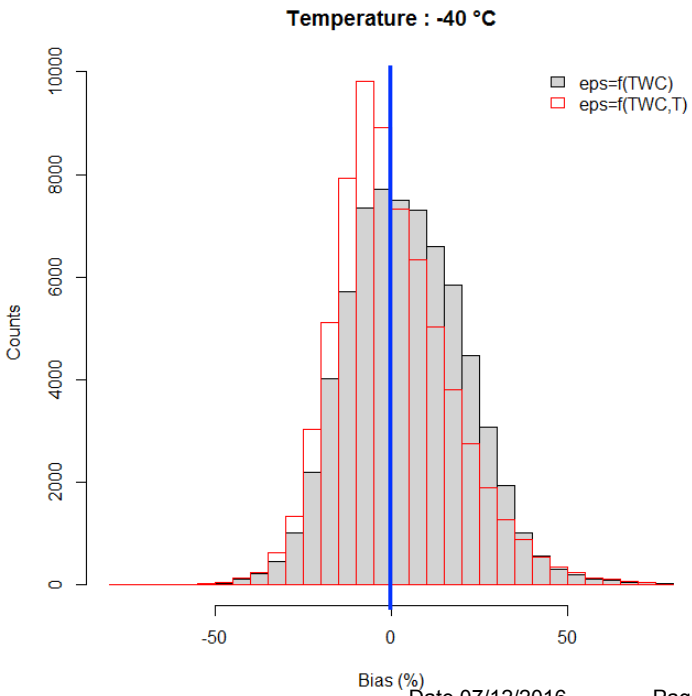
E=f(TWC,T) (in red) seems to produce slightly narrower histograms for the bias compared to E=f(TWC) (in grey)

Efficiency=f(TWC,T)

Bias distribution for different temperatures



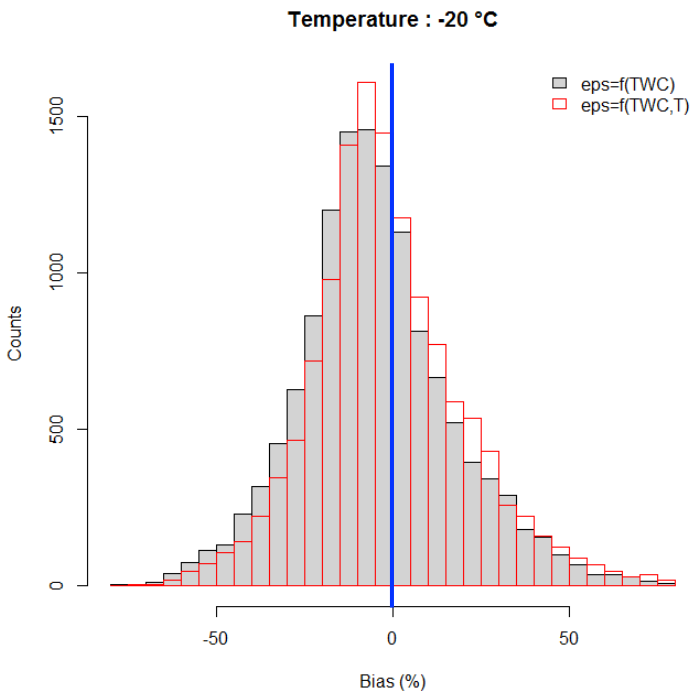


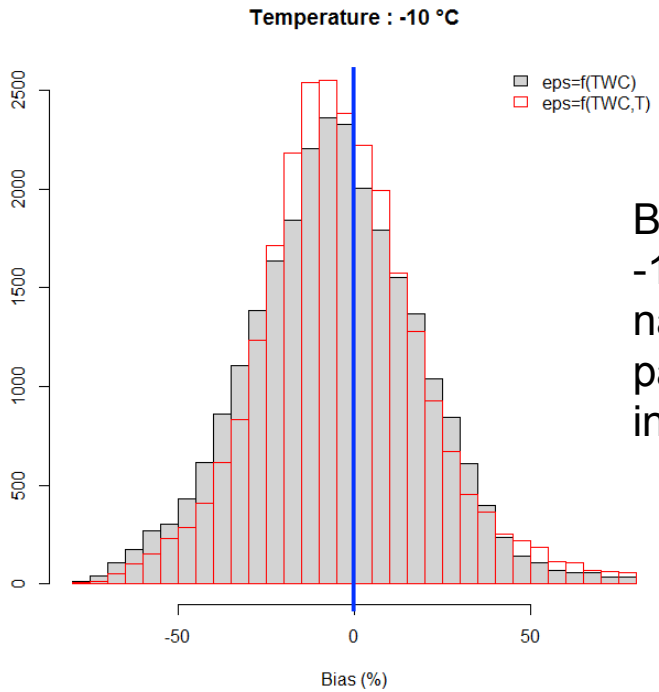


Bias are now almost symetrical for the -50°C level

Efficiency=f(TWC,T)

Bias distribution for different temperatures





Bias distribution at -10°C is slightly narrower for the parameterisation that includes temperature

Summary:

➔ Using a constant efficiency value for TWC < 1g/m3 improves the results

➔ Including temperature in the parameterisation improves the results mostly at -10°C and -50°C. Changes are light for the other temperature levels

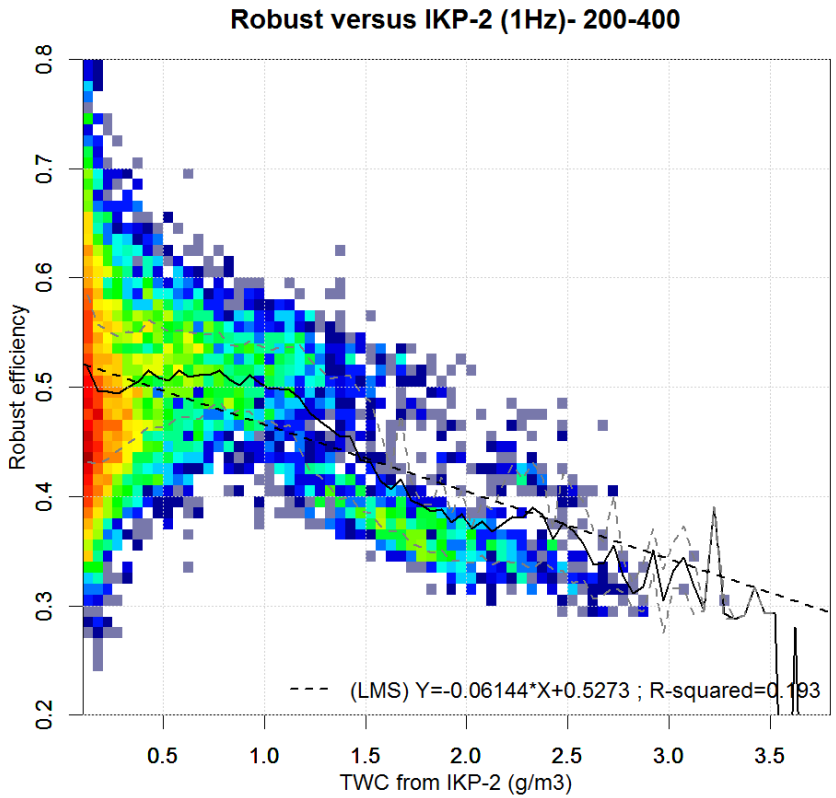
High Altitude Ice Crystals (HAIC, 314314)

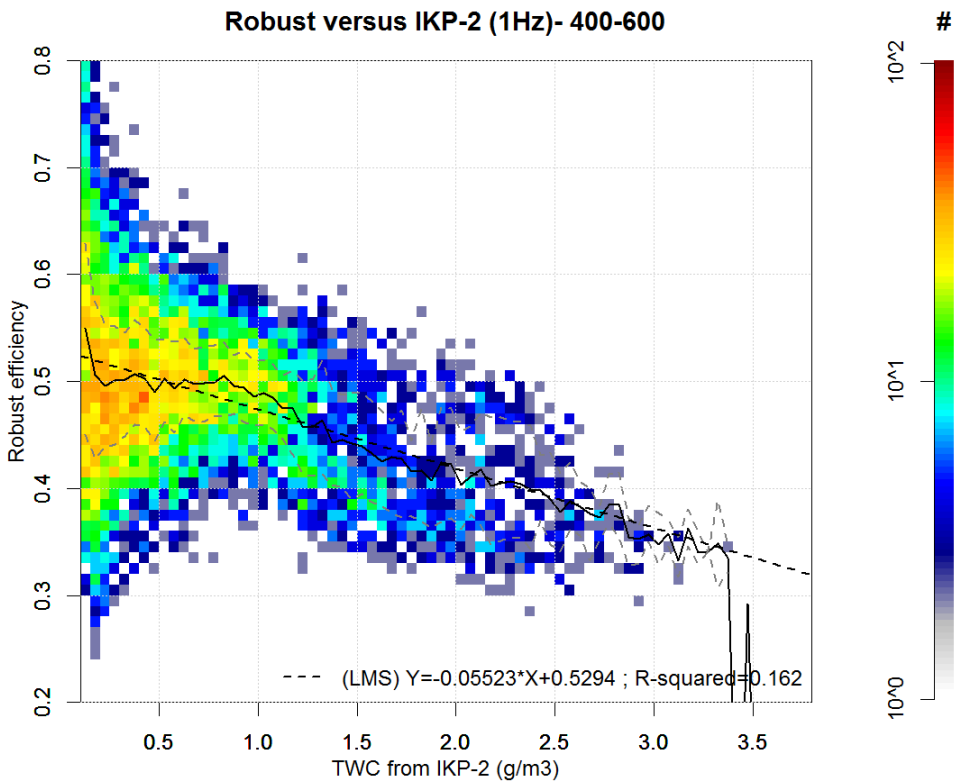
Project co-funded by the European Commission within the Seventh Framework Programme (2012-2016)

EUROPEAN COMMISSION
European Research Area

Sensitivity to MMD

Robust efficiency versus IKP TWC – pattern with MMD



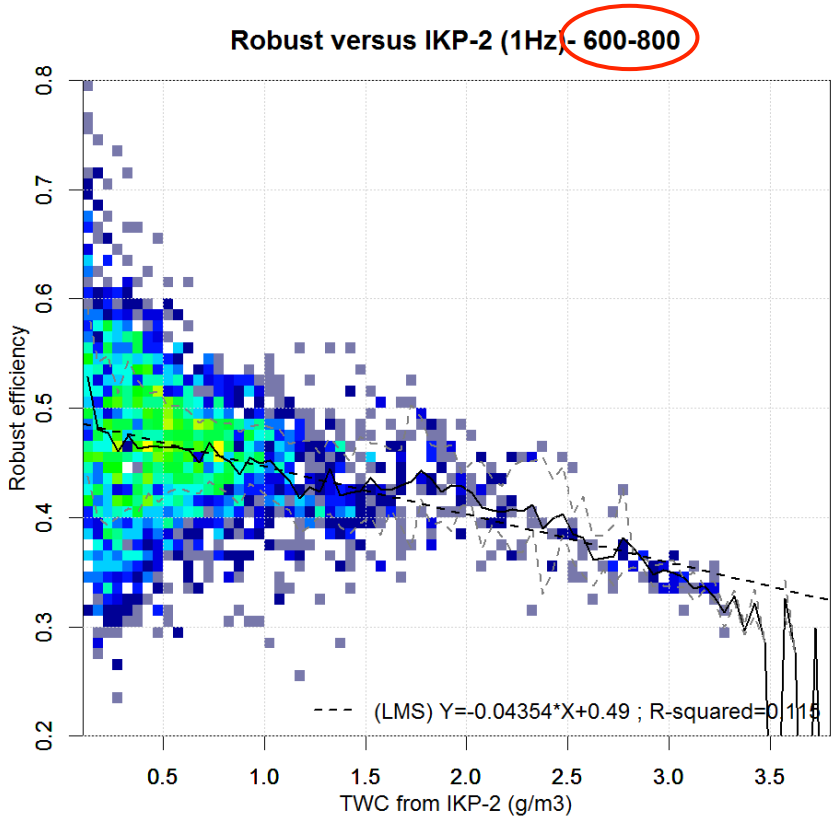


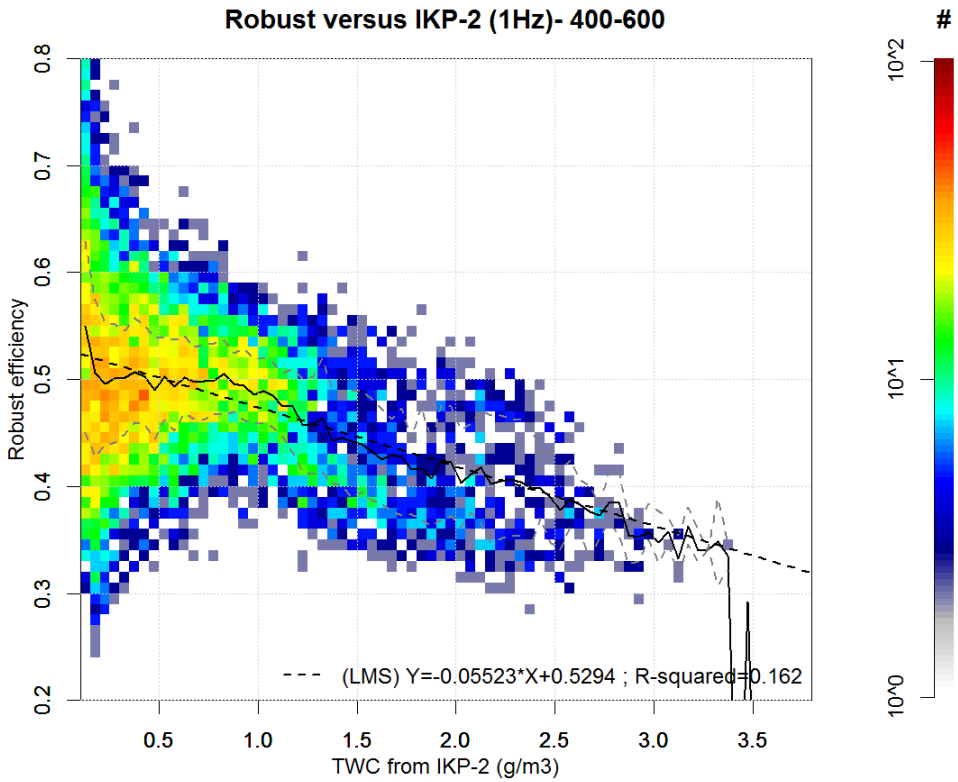
MMD between 200 and 400 µm :

MMD between 400 and 600 µm:

Sensitivity to MMD

Robust efficiency versus IKP TWC – pattern with MMD



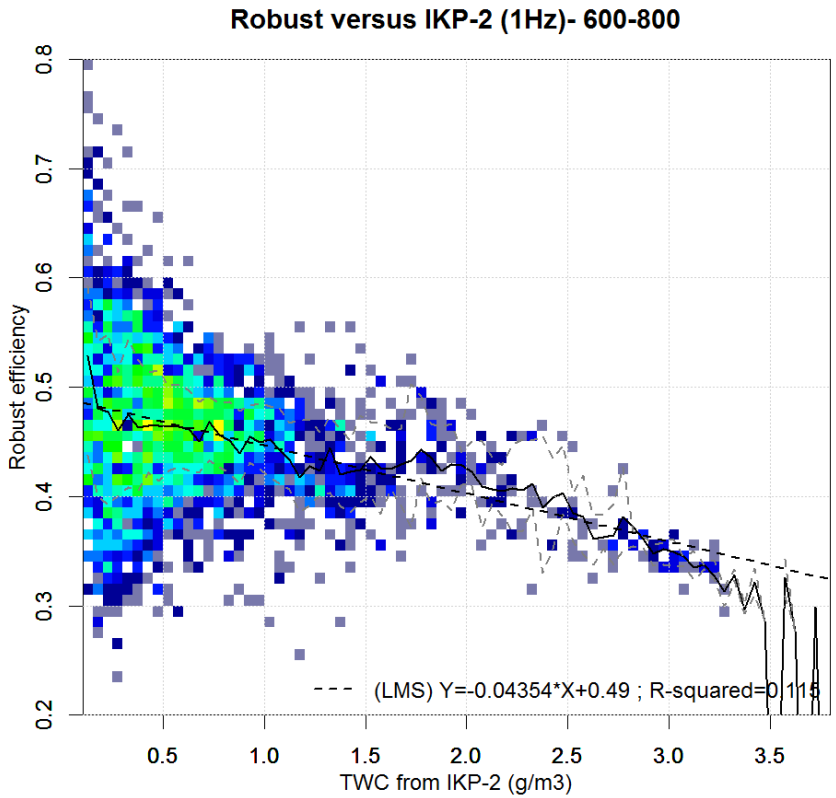


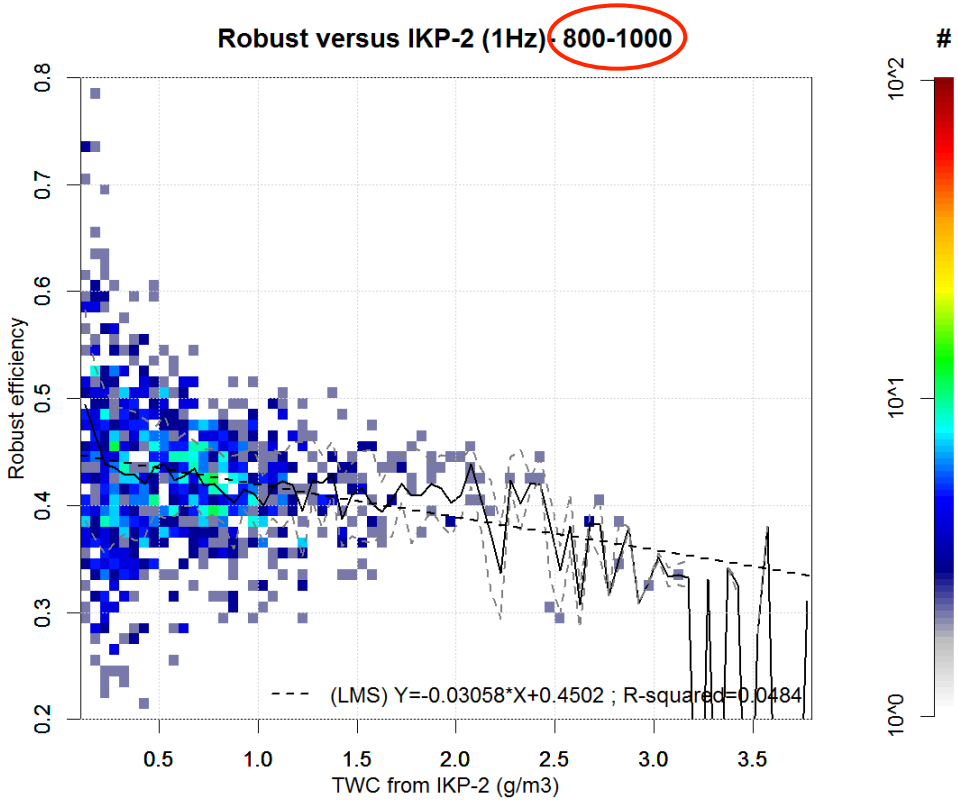
MMD between 600 and 800 µm :

MMD between 400 and 600 µm:

Sensitivity to MMD

Robust efficiency versus IKP TWC – pattern with MMD





MMD between 600 and 800 µm :

MMD between 800 and 1000 µm: