Explanation of the NMB plots

Follows is an explanation of how the NMB plots are produced as I am not sure it is currently clear from the presentation

Datasets used

The following is what is used to produce the current NMB plots (same as Elisa)

- 1 minute resolution data must be used
- Filtered data is used
- For both the Measured and Best distribution the droplets are per cubic meter
- The dataset is filtered into different rainfall classes with the following approach:
    - Rainfall in mm/h is calculated for each time sampling period from the **measured dataset**
    - Rainfall is the same as given in the table given in the dataset and is calculated by the volumetric sum as follows:

      $$\mathrm{RR} = \sum_{\mathrm{i}}^{\mathrm{i}=22} \frac{\mathrm{V_i} \times \mathrm{n_i}}{\mathrm{A} \times \Delta\mathrm{t}}$$

      Where RR is the rainfall rate in mm/h of each sampling period, Vi is the average volume of each droplet class, ni is the number of drops recorded by the disdrometer for this droplet class, A is the capture area of the disdrometer, Δt is the time of recording of each sampling period
    - These rainfall values then are used to construct the Best distribution for each sampling period
    - Sub datasets are constructed with the calculated rainfall being used as a filter to place each sampling period into different rainfall rate categories

NMB calculation – IMPORTANT

I believe that the equation given in the slide slightly misrepresents the calculation being performed. This is the equation given in the slide:

$$NMB = \frac{\sum_{i=i_s}^{i_e} [\, (N_B)_i - (N_M)_i \,]}{\sum_{i=i_s}^{i_e} (N_M)_i}$$

Where i is defined as the index of each droplet diameter class

This, to me suggests that there is a NMB value calculated for each sampling period, summing the difference between the number calculated by Best and the number measured for every diameter class considered (e.g. for the small droplets it would consider the first 5 classes).

I assumed that the average and standard deviations were taken from these NMB for each sampling period.

This is in fact not what was performed, instead – the total number of drops for each droplet class and rainfall was calculated for Best and measured – **across all sampling periods.** These values were then used to calculate an NMB for each droplet class. The mean and standard deviation was then taken across the droplet classes. I would suggest the correct formulas would be as follows:

$$NMB_i = \sum^{t} \left(\frac{(N_b)_i - (N_m)_i}{(N_m)_i} \right)_t$$

Where t is the index for each sampling period and i is the index for each droplet diameter class. μ and σ can then be calculated across the index i.

<u>Analysis</u>

So, I believe this means we have two possible approaches, number 1 is to calculate NMB for every single sample point and then from this we can obtain an average. The standard deviation for this will show how consistent Best is vs Measurement across the whole sampling period.

OR

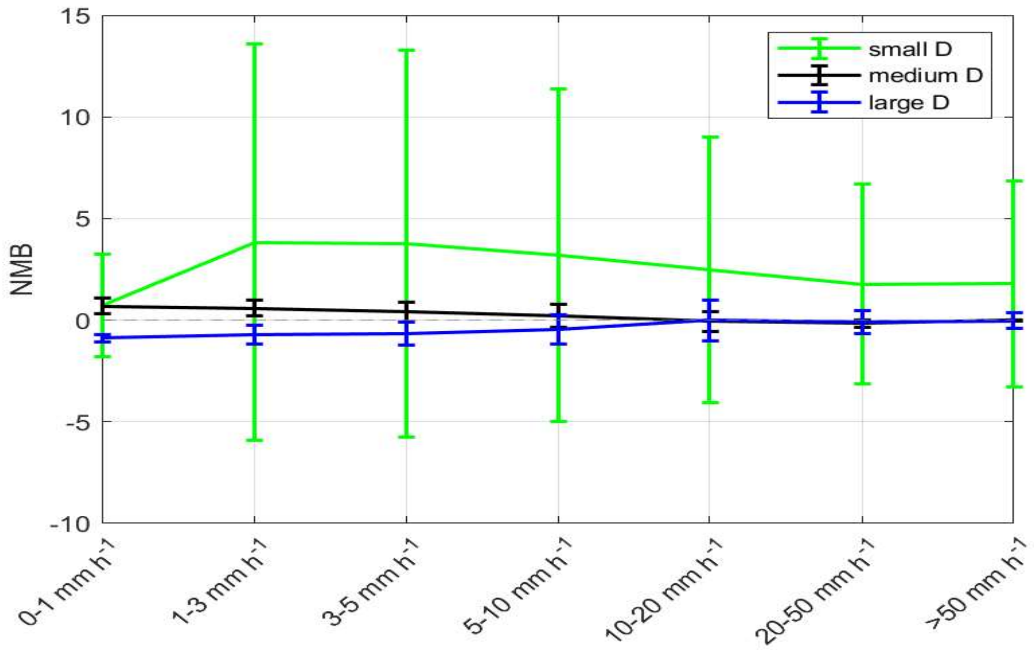
Calculate NMB for each droplet diameter. This will show a similar result that can be seen from the overall Best vs Measured plots (slide 8 in the presentation). This is because all data from individual sampling points is removed and it will be essentially the total number of drops for each rainfall rate and droplet diameter used. The standard deviation will show how consistent the NMB is across different droplet classes but not over different sampling points. **This is the current plot in the presentation**

<u>Graph Comparison</u>

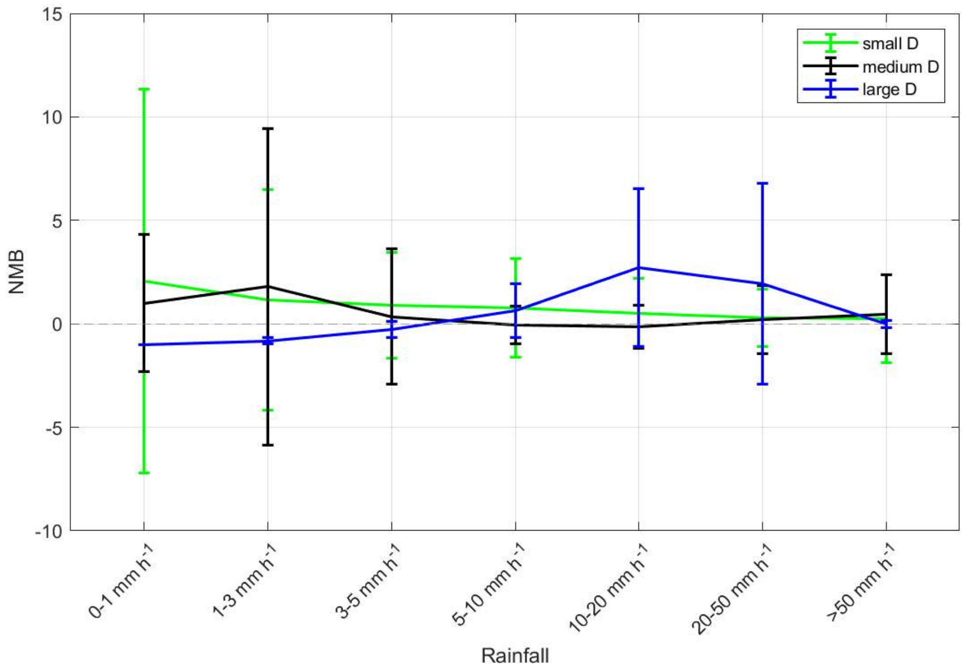
In the following I will show both plots NMB calculated at each sampling point and NMB calculated for each droplet class. Represented by NMB_time and NMB_droplet. First I will consider not excluding the first droplet class.

Lancaster

NMB_droplets (original plot)

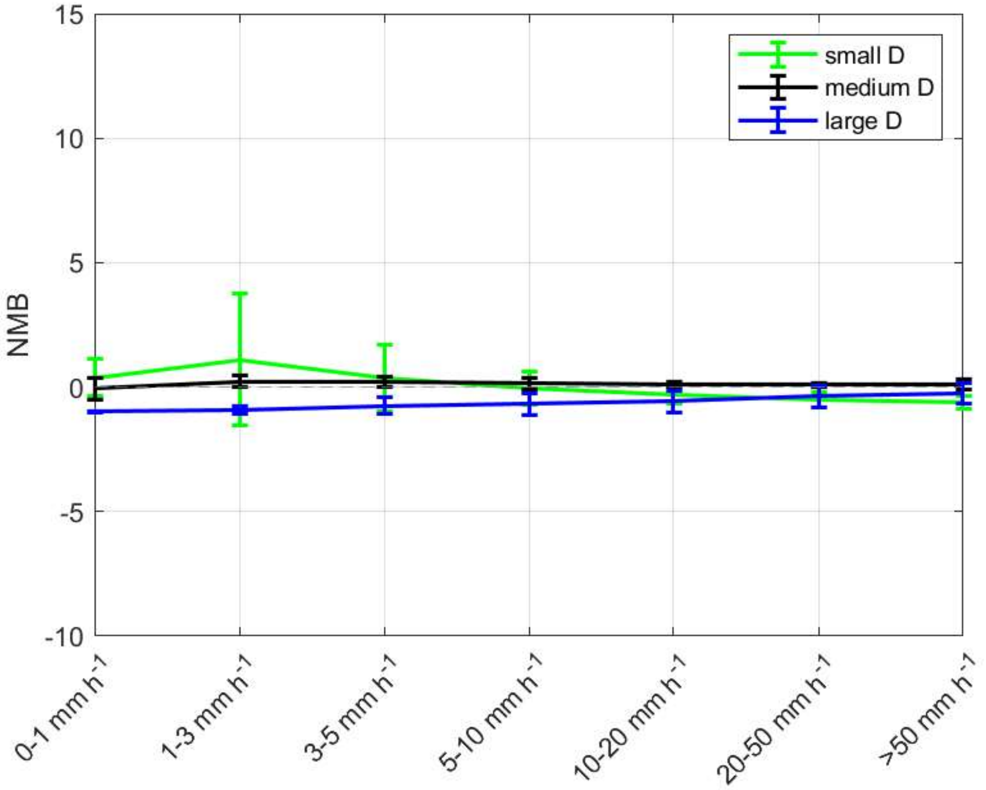


NMB_time

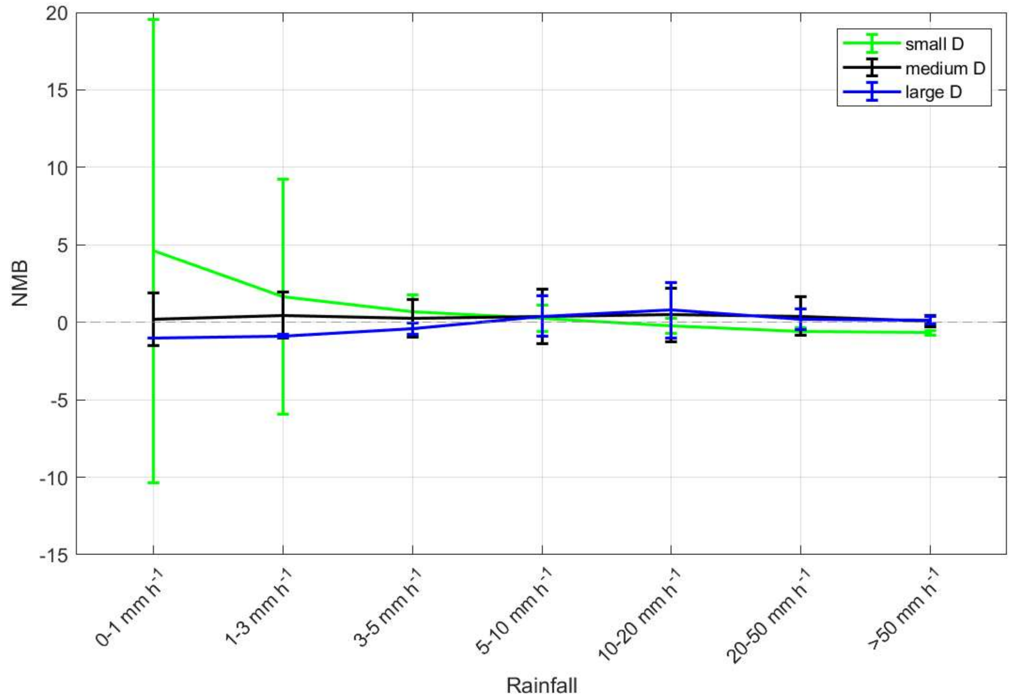


Lecce

NMB_droplets

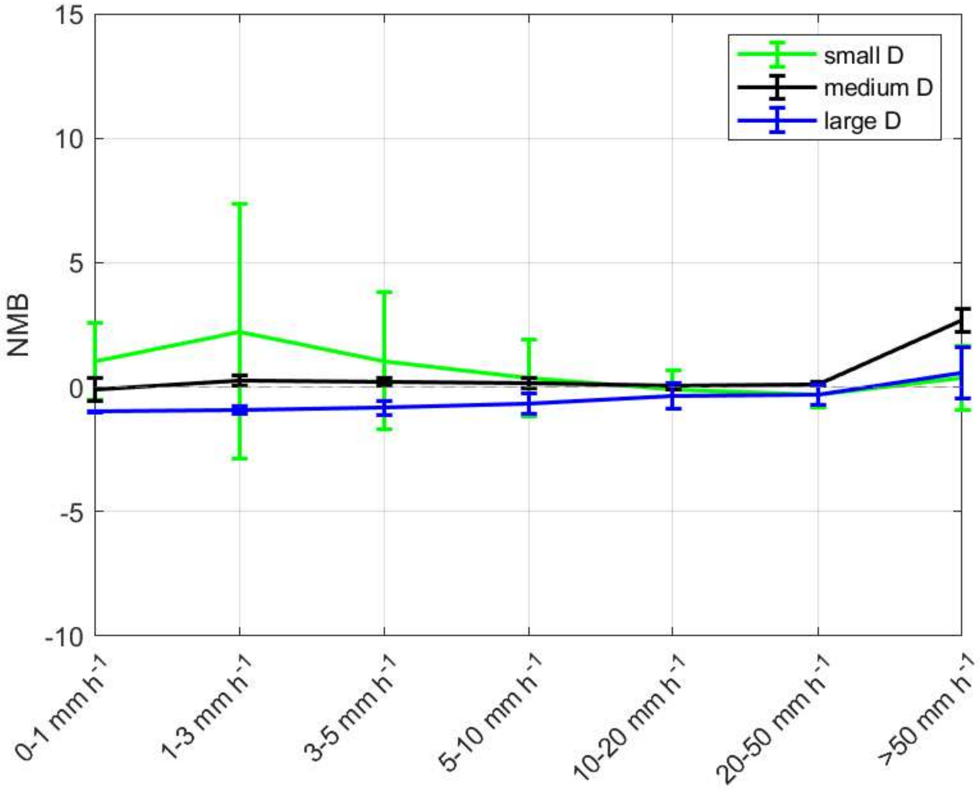


NMB_time

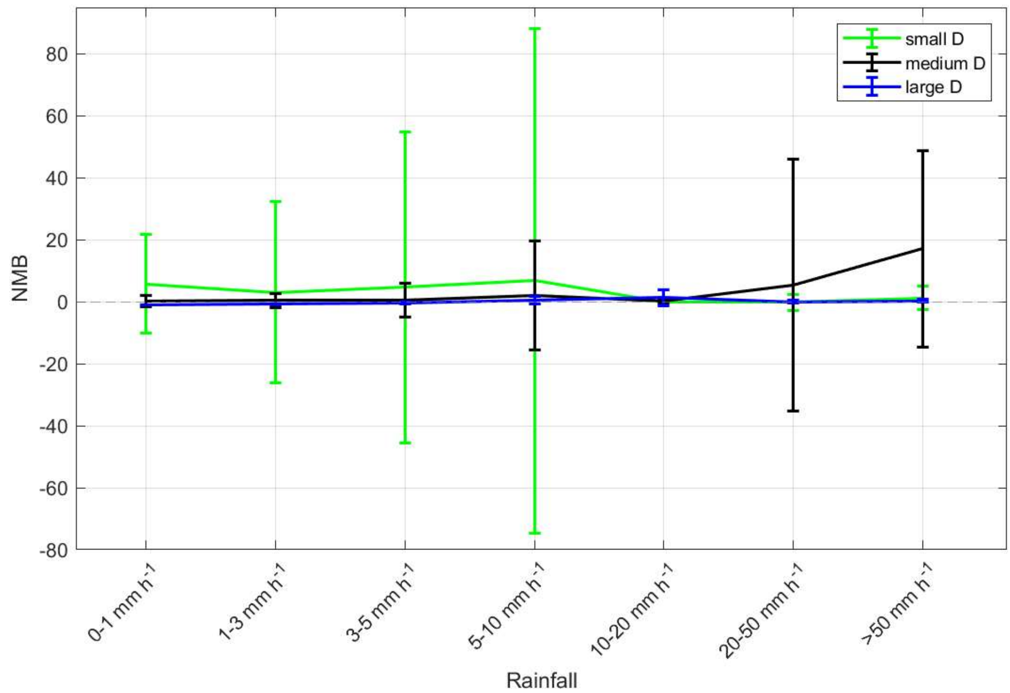


Lampedusa

NMB_droplets



NMB_time

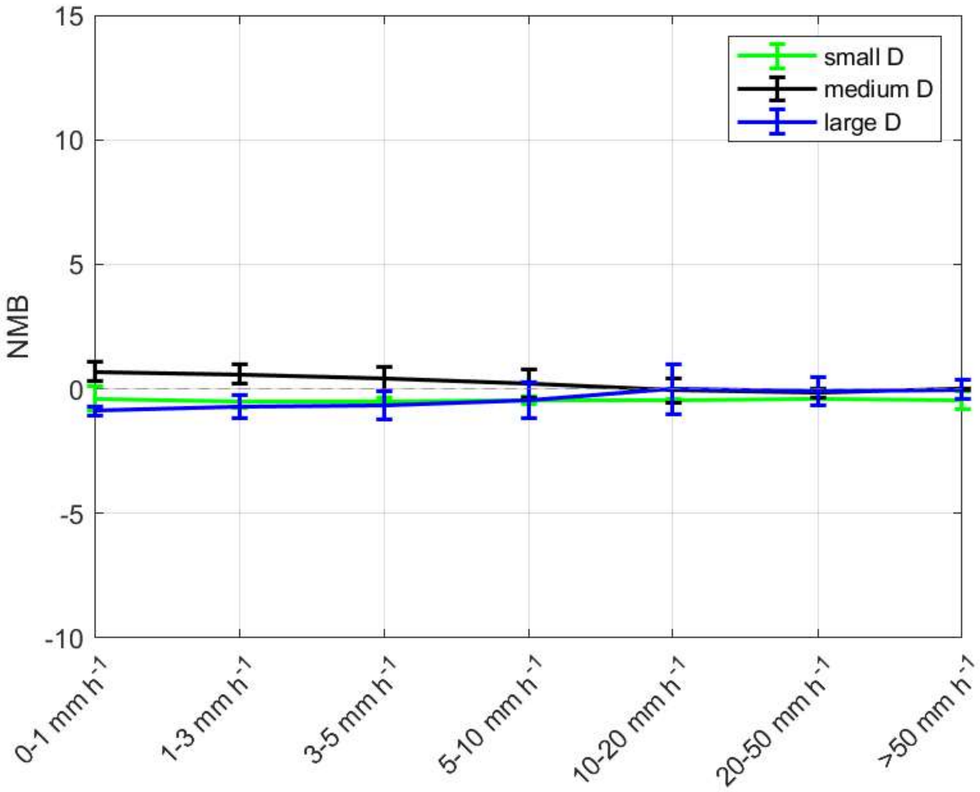


Note for the NMB_time plots the scales are changed as the values for the standard deviations get much larger.

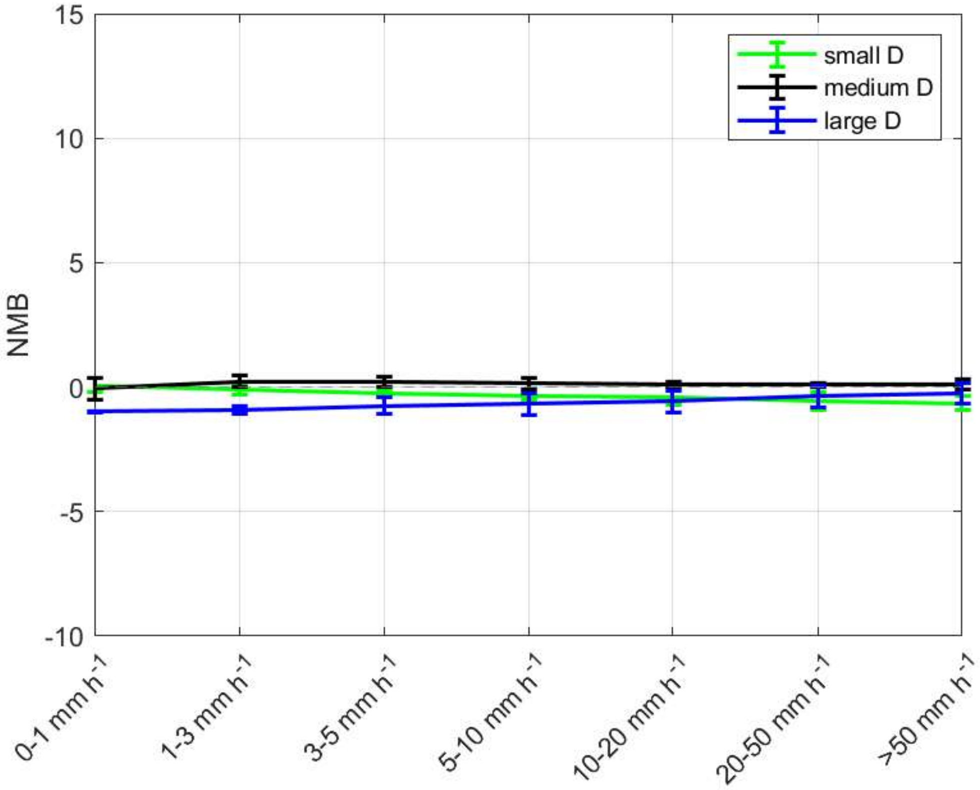
Now I will produce the NMB_droplet plots but with the first droplet bin removed to show that the main discrepancy comes from this.

NMB_droplet (Values from first bin removed)

Lancaster

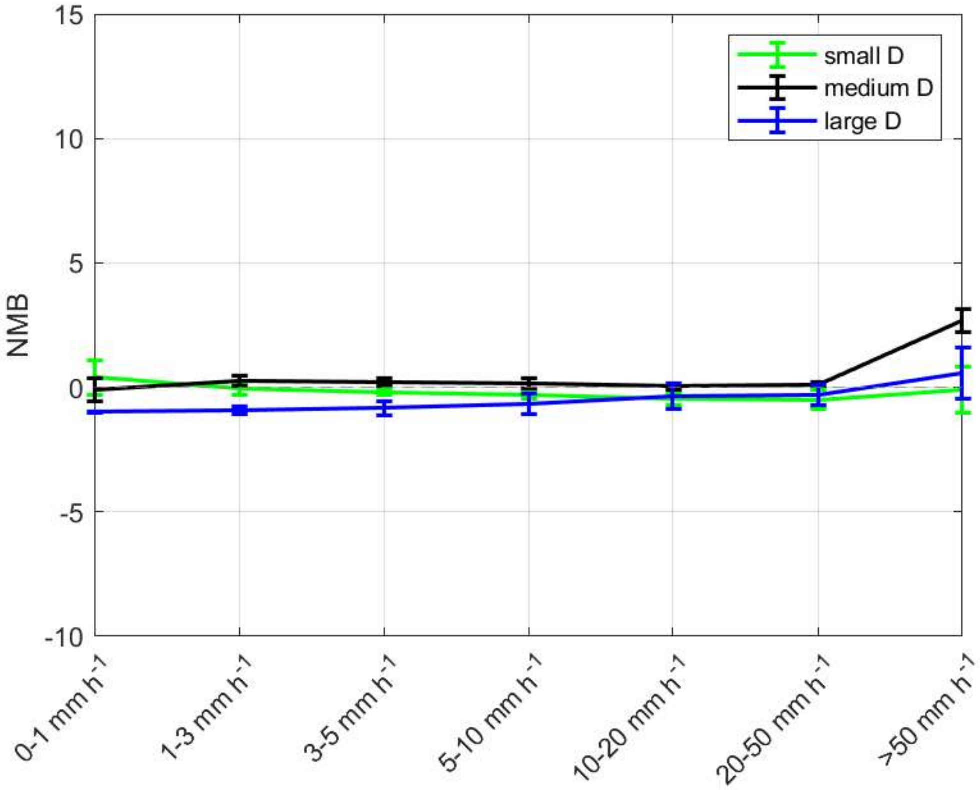


Lecce



15
10
5
0
-5
-10
NMB
small D
medium D
large D
0-1 mm h-1
1-3 mm h-1
3-5 mm h-1
5-10 mm h-1
10-20 mm h-1
20-50 mm h-1
>50 mm h-1

Lecce



15
10
5
0
-5
-10
NMB
small D
medium D
large D
0-1 mm h-1
1-3 mm h-1
3-5 mm h-1
5-10 mm h-1
10-20 mm h-1
20-50 mm h-1
>50 mm h-1