We would like to thank Referee#2 for his/her review of our paper and the important comments and suggestions provided. Please, find below our responses to the Referee's comments and the details on how we will address them in the new version of the manuscript.

Major Comments:

1. Referee comment: As the main body of PNPR v2 is very similar with PNPR v1, which is carefully described in another paper of the author in 2015, the author gave little technical description of the algorithm. But for completeness, the major technical parts of the algorithm should still be introduced with formula or figures briefly (e.g. the set of NN, the method to update weights and so on). It will facilitate readers to avoid additional literature search.

Authors' Reply:
The description in the paper of the PNPR v2 design methodology is concise as the design is similar to that already described in Sanò et al., 2015. But we agree that adding some details may facilitate the understanding of the paper. To clarify this point a short paragraph containing some technical parts of the algorithm will be added in the manuscript. The figure of the NN diagram is shown in Figure 2 of Sanò et al. (2015) and is reported below for convenience.

" **3.3 The neural network**

A detailed description of the NN is provided in Sanò et al. (2015), but some basic aspects are presented for completeness.

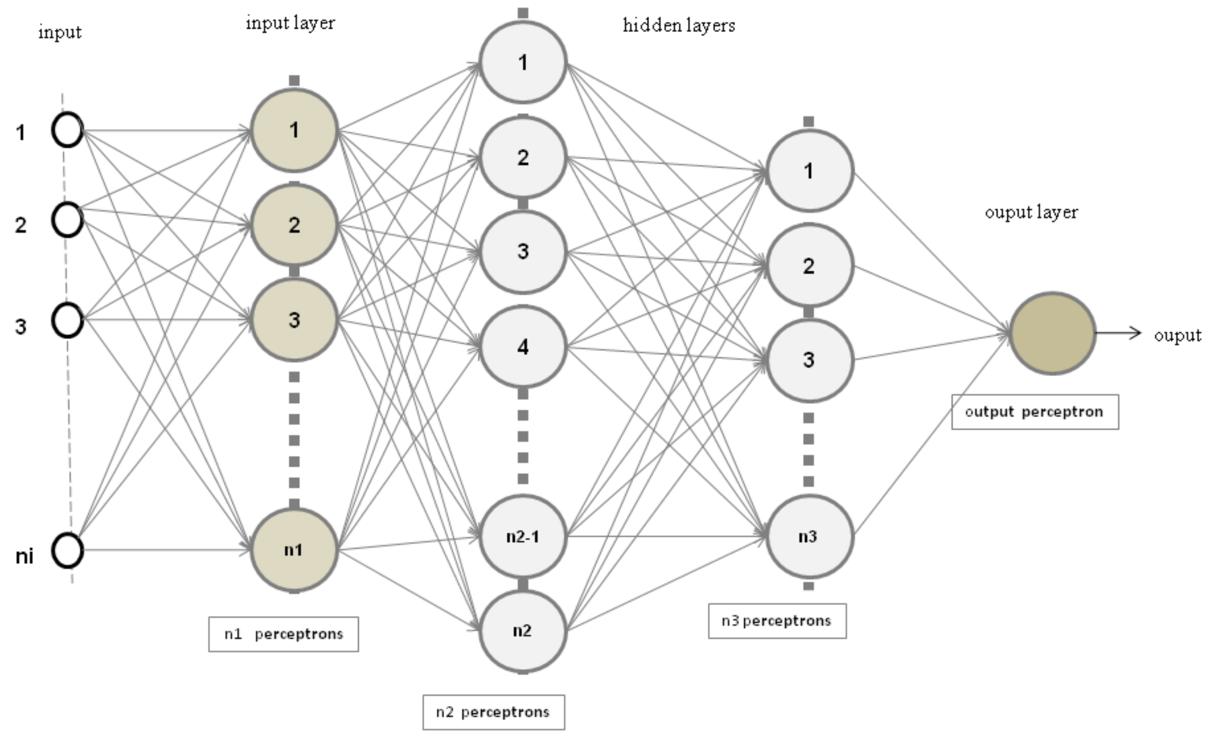
The neural network scheme, shown in Figure 2 in Sanò et al.(2015), is characterized by *ni* inputs, one input layer, two hidden layers, and a number of nodes for each layer (e.g. n1 for the first layer). Each node has its own transfer function and receives, as input, a weighted sum of the outputs of the previous layer. The output of the transfer function corresponds to the output of each node. For example, the output of a node (k-th), y_k, of the first hidden layer takes the form:

$$y_k(\omega, x) = f_2\left[\sum_{j=1}^{n1} \omega_{kj} * f_1 * \left(\sum_{t=1}^{ni} \omega_{jt} * x_t + b1\right) + b2\right] \quad (1)$$

where x_t are the input signals (*ni* values), ω_{jt} are the weights connecting the inputs to the nodes of the input layer and ω_{kj} the weights connecting the nodes of the input layer to the nodes of the first hidden layer, f_1 and f_2 are the transfer functions of the input layer and the first hidden layer, and *b1* and *b2* are the bias of nodes of the two layers. During the training phase (backpropagation network and Levenberg-Marquardt algorithm) a training database is used that provides the network with synthetic input and output data. The input signal propagates forward from the input layer of nodes to the output layer. The node in the output layer produces an output (y_i), which is compared to the i-th target output (t_i) defined in the training set. An error value is calculated as

$$E = \frac{1}{n}\sum_{i=1}^{n}(y_i - t_i)^2 \quad (2)$$

where *n* is the number of elements of the training set. The network corrects its weights to lessen the errors. The iteration continues in order to minimize the error. At the end of the training phase the performance of the NN is measured by the mean squared error and the correlation coefficient.".



Schematic diagram of a multilayer neural network (two hidden layers) (from Sanò et al., 2015).

2. Referee comment: In page 6 and line 48, the author said the phase of the precipitation (solid, liquid, mixed or unknown) is contained in output. Is there any result and analysis of that?
DPR can also differentiate solid and liquid phase.

Authors' Reply:
In the manuscript we have not provided any details about the procedure used in PNPR v2 to evaluate the phase of the precipitation as the procedure is the same used in PNPR v1, described in Sanò et al., 2015. In this study, we were focused mainly on the evaluation of the performance of the algorithm considering only liquid precipitation. We are currently carrying out a separate study on the discrimination the liquid/solid/mixed precipitation using ATMS (and GMI) measurements (and using Cloudsat and DPR as reference) in order to test and improve this procedure. The results will be presented in an upcoming paper.

3.1 Referee comment: In page 8 and line 6, the author used more than one hundred NNs to select the optimal network. What's the principle in adjusting the networks to get closer to the better one?

Authors' Reply:
The principle in adjusting the network includes two relatively distinct aspects: determining how many layers to use and determining how many nodes to include in each layer.
A detailed description of the procedure is presented in Sanò et al. 2015, section 3.2, pag 841-842:

"*the model selection has been carried out using a cross validation method (Anders and Korn, 1999; Marzban, 2009). In the cross validation strategy the comparison between two models is based on* *the mean square prediction errors (MSPE) which is obtained applying the model to different validation sets. For this purpose a test dataset is used, divided into M subsets containing n observations each. The model is repeatedly re-estimated using different dataset of n(M-1) observations, leaving out a different subset each time. The average MSPE defines the cross validation error, CV (Anders and Korn, 1999):*

$$\mathrm{CV} = \frac{1}{\mathrm{M}} \sum_{\mathrm{m}=1}^{\mathrm{M}} \mathrm{MSPE}_{\mathrm{m}}$$

In the cross validation methodology, the first step consists in determining the number of hidden layers. Starting from a simple architecture, two models are compared, one of which contains an additional hidden unit. For both the models the CV is evaluated and, if the more complex unit shows a smaller CV error, the additional hidden layer is accepted. The procedure stops when no further hidden layer is able to reduce the CV error. At this point, with a similar procedure, the number of nodes is optimized in each layer. The second step aims at determining the input connections. To find irrelevant connection, one input is removed and the resultant CV is compared with that of the complete network. In this way all the models with one input connection removed are analyzed and the model with the lowest CV error is accepted. At the end of this second step, no input connection can be removed without increasing the CV error."

Due to the complexity of the procedure we considered appropriate to include in the manuscript just a reference to that paper.

3.2 Referee comment: In page 8 and line 6. And how can you tell the present one is the most optimized with some criteria?

Authors' Reply:
The criterion for determining the most optimized NN, as reported in pag. 8, line 40-43 is:

" *"optimal" refers to the one with best performance, i.e., minimum CV over the full dynamic range of the inputs, absence of overfitting, and absence of anomalous inhomogeneities in the retrievals (Sanò et al., 2015; Staelin and Surussavadee, 2007)."*

To clarify this point, this sentence will be moved to pag. 8 lines 4-7:
" *It is worth noting that to achieve the results shown in Table 1 the training protocol described in Sanò et al. (2015) has been applied, and that for each input configuration (each row in the table) more than one hundred NNs (with different levels of perceptrons) were compared to select the optimal network configuration, where "optimal" refers to the one with best performance, i.e., minimum CV over the full dynamic range of the inputs, absence of overfitting, and absence of anomalous inhomogeneities in the retrievals (Staelin and Surussavadee, 2007)."*

Minor Comments:

1. Referee comment: In page 10 and line 37, "15 minute" should better be "15-minute".

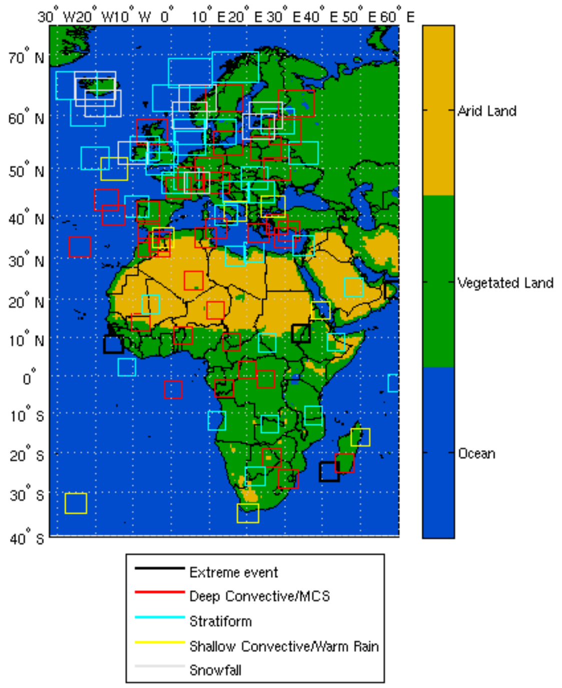
Authors' Reply: The sentences will be changed in the revised manuscript.

2. Referee comment: In page 11 and line 36, there should be a comma at the end of "and over vegetated land (for all precipitation rates)". There are some other places where a comma is missing, the author should check by yourself again.

Authors' Reply: We will review the manuscript to correct these errors.

3. Referee comment: It would be better if Figure 1 is going to be turned into color one.

Authors' Reply: The suggestion is accepted. The figures will be replaced in the revised version of the manuscript with the following:



4. Referee comment: The numbers on the diagonal of Arid land in Table 2 were not bold.

Authors' Reply: The table will be rearranged in the revised version of the manuscript.

5.1 Referee comment: In page 7 and line 20, how to define one "entry" and one "view"? What are two million entries and 45 views consist of?

Authors' Reply: The sentence is too concise, and not sufficiently clear. We apologize. As database "entry" we consider the vector composed by the simulated ATMS TBs, surface precipitation rate, and the corresponding ancillary parameters (surface type, monthly mean TPW, month, surface height, secant of zenith angle), associated to one viewing angle (and corresponding IFOV). The "views" correspond to the different ATMS viewing angles used to create each "entry" (from nadir to the edge of the scan discarding the three outmost angles).

To clarify the meaning of the terms "entry" and "view" the sentence on page 7, lines 20-21 (Section 3.2 "The training database"), will be rephrased in the revised version of the manuscript as follows:

Revised version (Section 3.2 "The training database", lines 24-28, pag. 7):
For the European/African regions, the database contains more than seventy million entries. Each entry is a vector composed by the simulated ATMS TBs, surface precipitation rate, and the corresponding ancillary parameters, associated to one cloud-resolving model microphysical

realization, and to one ATMS viewing angle (and corresponding IFOV). It is worth noting that 45 different ATMS viewing angles (discarding the three outmost pixels due to the low resolution) are considered to build the database.

5.2 Referee comment: The training database covers different seasons and different meteorological situations and precipitation regimes, is the number of each season, situation and regime equal to others?

Authors' Reply: The training database was generated using simulation of different precipitation events "in order to cover the different seasons and different meteorological situations and precipitation regimes". In detail, over the European/Mediterranean area we have considered 15 different meteorological events for each season over different geographical areas. In the simulations over the African and South Atlantic area we have considered the different climatic regions and a sufficient number of simulations in order to obtain a reliable representation of the climate variability of each region.

The following tables present some detail concerning the simulation over the African and South Atlantic area (Table 1, see Panegrossi et al., 2014) end over the European/Mediterranean area (Table 2, see Casella et al., 2013)

Table 1

#	Date	UTC time	Lat.	Lon.	NOTE
1	20/02/2007	00:00	-25,00	42,00	Tropical Cyclone Favio (madagascar)
2	21/08/2006	00:00	8,00	-15,00	tropical storm debby West Africa/Atlantic
3	23/07/2006	00:00	11,00	34,50	floods over Ethiopian highlands
4	03/06/2010	17:16	22,00	59,00	Tropical Cyclone phet (Oman)
5	17/07/2008	06:21	8,81	15,83	Storm over Nigeria-Ciad
6	18/06/2006	16:52	17,00	11,80	scattered precipitation Niger
7	02/08/2007	02:36	10,50	3,19	MCS Benin
8	20/09/2007	01:33	1,50	20,14	MCS NW Congo - fast growing
9	03/10/2007	20:49	-21,44	26,52	NE Botswana storm after front
10	07/04/2007	14:30	-22,65	45,64	Madagascar (orographic)
11	09/10/2007	03:40	-1,00	25,00	MCS line CONGO

12	26/05/2006	23:26	32,50	-3,00	Storm over Atlas
13	29/01/2006	15:22	24,50	6,00	MCS Sahara Algeria
14	10/12/2006	04:01	-26,70	31,00	Storm Swaziland
15	11/04/2006	17:30	-3,70	0,70	MCS Guinea Gulf
16	19/03/2007	23:49	-3,50	14,00	MCS WestCentral
17	15/07/2006	19:41	14,00	-8,00	MCS Sahel
18	21/04/2007	01:13	32,50	-6,00	Storm front North Morocco
19	20/01/2006	17:02	32,80	-24,00	Storm North Atlantic Ocean
20	14/10/2007	15:19	2,19	-11,63	Mixed Guinea Gulf
21	13/05/2006	01:01	8,61	25,50	Stratiform-Convective Sud Sudan
22	05/04/2006	20:04	22,94	48,33	Stratiform-Convective Saudi Arabia
23	05/02/2006	22:06	-26,11	22,19	Stratiform-Convective Botswana
24	18/03/2007	01:41	-11,90	12,17	Stratiform-Convective Angola coast
25	16/11/2007	04:20	-32,65	-25,08	Shallow-warm line South Atlantic
26	06/08/2007	23:50	-16,25	49,99	Shallow-warm Madagascar
27	29/01/2006	05:41	16,98	39,43	Shallow-warm Red Sea
28	10/05/2007	03:27	-34,90	20,35	Shallow-warm line South Africa
29	16/02/2006	23:18	18,49	-5,36	Stratiform Sahara Mauritania
30	30/03/2007	13:35	31,52	21,85	Stratiform Lybia NE
31	16/12/2006	23:07	-12,70	25,96	Stratiform round Zambia
32	29/01/2007	00:20	-10,55	37,44	Stratiform Tanzania
33	25/10/2006	22:09	8,65	43,62	Stratiform Ethiopian Highlands

34 22/09/2006 15:05 -2,10 59,49 Stratiform intense N-Indian Sea

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Table 2

	#	Initialization Date & Time [UTC]		Integration Period [hours]	Center Lat (N)	Center Lon	Type and Class of Precipitating System
SPRING	31	02/03/06	12:00	36	48.0	4.0E	1a. Weak Continental Frontal System
	32	06/03/06	00:00	36	38.0	28.0E	2c. Intense Orographic Storm System
	33	09/03/06	12:00	36	48.0	22.0E	2b. Moderate Orographic Storm System
	34	19/03/06	12:00	36	42.0	9.0W	3b. Moderate Atlantic Frontal System
	35	25/03/06	12:00	24	40.0	15.0W	3c. Intense Atlantic Frontal System
	36	26/03/06	12:00	24	50.0	10.0E	1d. Fast-moving Continental Frontal System
	37	04/04/06	06:00	24	62.0	18.0W	3d. Fast-moving Atlantic Frontal System
	38	09/04/06	06:00	36	59.0	28.0E	4a. Weak Stratiform Storm System
	39	13/04/06	12:00	36	65.0	25.0W	3a. Weak Atlantic Frontal System
	40	22/04/06	06:00	30	36.0	6.0W	5c. Intense Med-Sea Storm System
	41	03/05/06	18:00	30	54.0	7.0W	4a. Weak Stratiform Storm System
	42	08/05/06	00:00	24	30.5	17.0E	4a. Weak Stratiform Storm System
	43	12/05/06	00:00	36	63.0	0.0GM	4b. Moderate Stratiform Storm System
	44	16/05/06	12:00	24	50.0	15.0W	4c. Intense Stratiform Storm System
	45	25/05/06	00:00	24	55.0	15.0E	5b. Moderate Med-Sea Storm System
SUMMER	46	05/06/06	12:00	36	62.0	33.0E	4b. Moderate Stratiform Storm System
	47	10/06/06	12:00	30	35.0	9.0E	5a. Weak Med-Sea Storm System
	48	14/06/06	00:00	24	41.0	6.0W	5b. Moderate Med-Sea Storm System
	49	16/06/06	18:00	30	46.0	2.0E	6c. Intense Continental T-storm System
	50	23/06/06	18:00	30	57.0	5.0W	7a. Weak North-Sea Storm System
	51	02/07/06	00:00	24	42.0	27.0E	5a. Weak Med-Sea Storm System
	52	05/07/06	18:00	30	47.0	1.0E	8f. Non-convective Frontal System

	#	Initialization Date & Time [UTC]		Integration Period [hours]	Center Lat (N)	Center Lon	Type and Class of Precipitating System
	53	13/07/06	06:00	24	35.0	2.0W	9b. Moderate North-African Storm System
	54	22/07/06	12:00	36	50.0	28.0E	10b. Moderate Convective Storm System
	55	28/07/06	00:00	24	63.0	14.0E	11b. Moderate Scandinavian T-storm System
	56	02/08/06	12:00	30	60.5	22.0W	4e. Persistent Stratiform Storm System
	57	06/08/06	12:00	30	47.0	12.0E	2b. Moderate Orographic Storm System
	58	12/08/06	18:00	36	41.0	17.0E	5b. Moderate Med-Sea Storm System
	59	20/08/06	06:00	24	54.0	25.0E	12c. Intense Frontal T-storm System
	60	28/08/06	00:00	24	52.0	20.0W	8f. Non-convective Frontal System

	#	Initialization Date & Time [UTC]		Integration Period [hours]	Center Lat (N)	Center Lon	Type and Class of Precipitating System
AUTUMN	31	02/09/06	12:00	24	57.0	5.0E	4c. Intense Stratiform Storm System
	32	05/09/06	12:00	30	53.0	35.0E	4b. Moderate Stratiform Storm System
	33	07/09/06	18:00	24	57.0	30.0E	10d. Fast-moving Convective Storm System
	34	16/09/06	12:00	36	68.0	17.0E	2e. Persistent Orographic Storm System
	35	02/10/06	12:00	30	48.0	5.0E	12d. Fast-moving Frontal T-storm System
	36	06/10/06	18:00	24	47.0	7.0E	2f. Non-convective Orographic Storm System
	37	09/10/06	18:00	36	36.0	23.0E	10e. Persistent Convective Storm System
	38	17/10/06	18:00	24	55.0	5.0E	7b. Moderate North-Sea Storm System
	39	22/10/06	12:00	30	57.0	13.0E	13b. Moderate Baltic Storm System
	40	31/10/06	06:00	24	36.5	31.0E	2c. Intense Orographic Storm System
	41	05/11/06	18:00	24	60.0	25.0E	4g. Stable-cold Stratiform Storm System
	42	06/11/06	12:00	24	57.0	5.0W	4a. Weak Stratiform Storm System
	43	10/11/06	12:00	24	53.0	5.0E	12d. Fast-moving Frontal T-storm System
	44	11/11/06	18:00	24	64.0	20.0W	4d. Fast-moving Stratiform Storm System
	45	19/11/06	00:00	24	53.0	10.0W	12d. Fast-moving Frontal T-storm System

WINTER	46	02/12/06	18:00	24	53.0	2.0W	12d. Fast-moving Frontal T-storm System
	47	09/12/06	18:00	24	45.0	24.0E	6a. Weak Continental T-storm System
	48	12/12/06	00:00	24	34.0	3.0W	9e. Persistent North-African Storm System
	49	20/12/06	12:00	36	40.0	14.5E	14e. Persistent Sirocco Storm System
	50	23/12/06	12:00	36	37.0	12.0E	15c. Intense Mesoscale Convective System (MCS)
	51	01/01/07	12:00	36	63.0	7.0E	2f. Non-convective Orographic Storm System
	52	03/01/07	06:00	36	60.0	5.0E	2f. Non-convective Orographic Storm System
	53	05/01/07	18:00	24	51.0	3.0W	4d. Fast-moving Stratiform Storm System
	54	10/01/07	06:00	24	58.0	23.0E	4h. Snowing Stratiform Storm System
	55	12/01/07	18:00	30	35.0	30.0E	5b. Moderate Med-sea Storm System
	56	02/02/07	00:00	36	65.0	20.0W	4h. Snowing Stratiform Storm System
	57	05/02/07	12:00	36	33.0	35.0E	5b. Moderate Med-sea Storm System
	58	12/02/07	12:00	30	45.0	17.0E	4e. Persistent Stratiform Storm System
	59	16/02/07	12:00	36	43.5	17.0W	2e. Persistent Orographic Storm System
	60	23/02/07	12:00	30	67.0	5.0E	3b. Moderate Atlantic Frontal System

According to the Referee's suggestion, the sentence will be changed to clarify this point in section 3.2 of the revised version of the manuscript.

Revised version (Section 3.2 "The training database", lines 12-18, pag. 7):

"Simulated events were selected in order to cover the different seasons and different meteorological situations and precipitation regimes. The selection of the simulations in terms of season, typology of event and geographical location was performed in order to optimize the completeness and representativeness of the database for the area of interest (see Casella et al., 2013). In detail, over the European/Mediterranean area we have considered 15 different meteorological events for each season over different geographical areas. Simulations over African and Southern Atlantic area were chosen also on the basis of the TRMM-PR observations (in particular the Rain Type flag and the Freezing level height) and on the basis of different climatic regions in order to cover as much as possible the climatic variability in the area of interest with a limited number of simulations".

6. Referee comment: In page 10 and line 37, what does "within a 15 minute time window" means?

Authors' Reply: During the creation of the databases of coincident overpasses we have considered as coincident the observations (TRMM-PR and ATMS, GPM-KuPR and ATMS) made within a time interval of 15 minutes (time window).

In order to clarify this point the following sentence will be rephrased in the revised version of the manuscript ("Database description" pag. 10 line 37-39):

"Coincident observations in the area of interest within a 15 minute time window (maximum delay between the observations to be considered coincident) have been considered between ATMS and TRMM-PR (hereafter ATMS-PR) and between ATMS and GPM-Ku-NS (hereafter ATMS-DPR-Ku)."

7. Referee comment: In Page 11 and line 50, how to determine the intervals (0.01 - 0.25 mm/h, 0.25 – 1 mm/h, 1 - 5 mm/h and 5 - 15 mm/h)?

Authors' Reply: The precipitation intervals were chosen based on two considerations:

a) It seemed important to analyze the algorithm performance in estimating the rain rate below 1 mm/h, considering that the PMW rain rate retrieval in this range, presents many difficulties (i.e., background surface signal), and rain rate values in this range are the most frequent.

b) We have selected the two intervals above 1 mm/h to discriminate between moderate and high precipitation rate, but with the purpose of having in each interval an acceptable number of values to obtain a reliable statistical analysis.

8. Referee comment: In Figure 3 (left one) and Figure 4, why the pixels presented in Figure 4 isn't consistent with the distribution of number of coincident pixels in Figure 3?

Authors' Reply: Figure 3 (left panel) shows the number of co-located pixels from TRMM-PR and the Suomi-NPP ATMS coincident overpasses over the African area. Figure 4 shows the geographical distribution of some statistical indexes evaluated considering precipitation rate greater than 0 mm h^{-1} both from the radiometer and the radar (hits only) over a regular grid of 0.5°x0.5°. This is the reason why the number of coincident pixels is different in the two figures.