Evaluation of Satellite Precipitation Estimates using Israel Ground Reference Data

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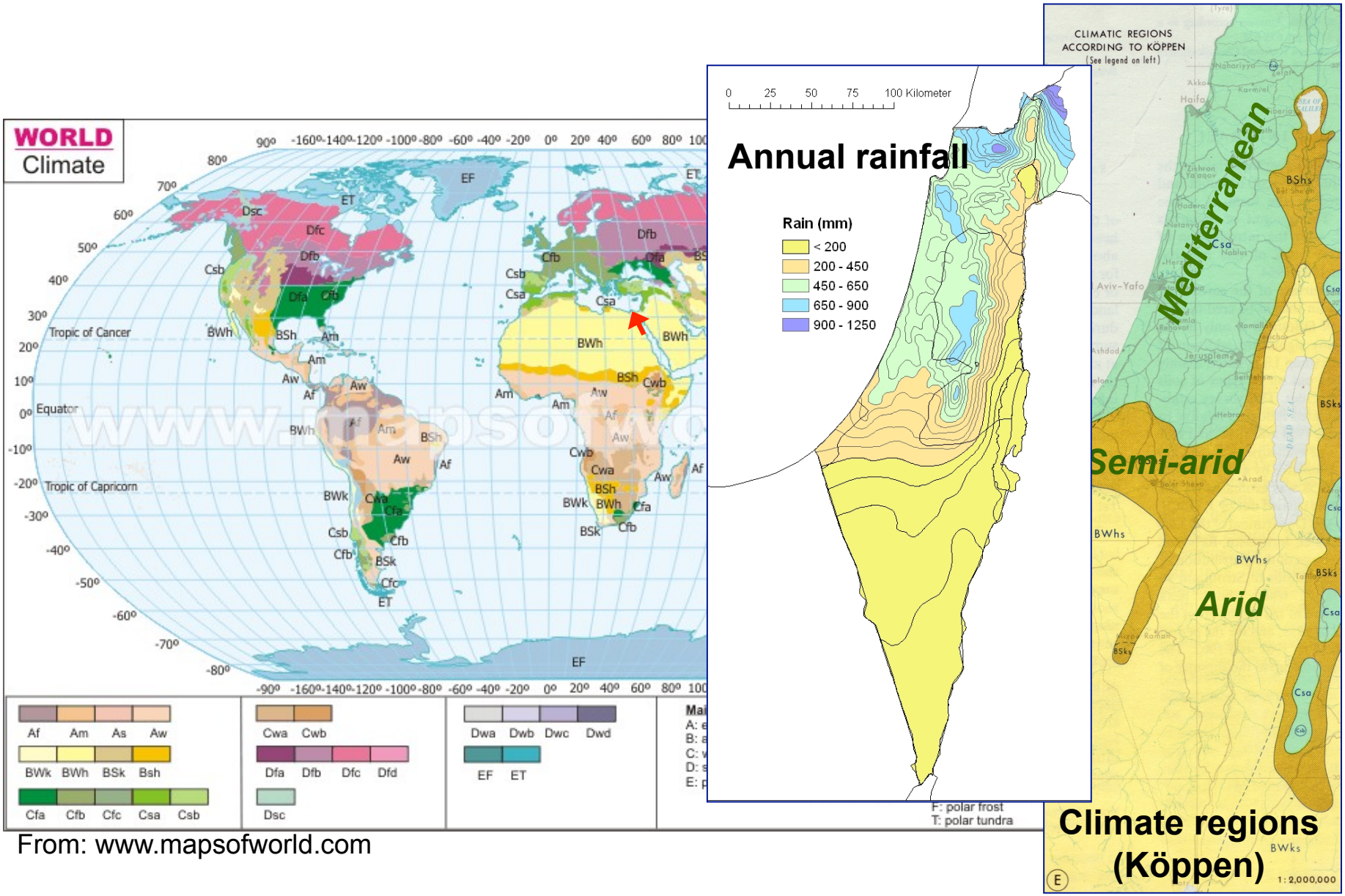
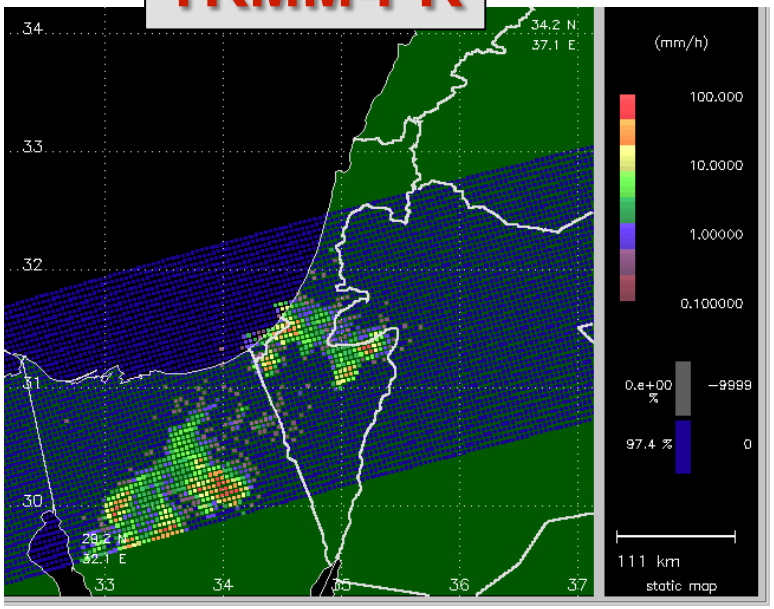
Background



From: www.mapsofworld.com

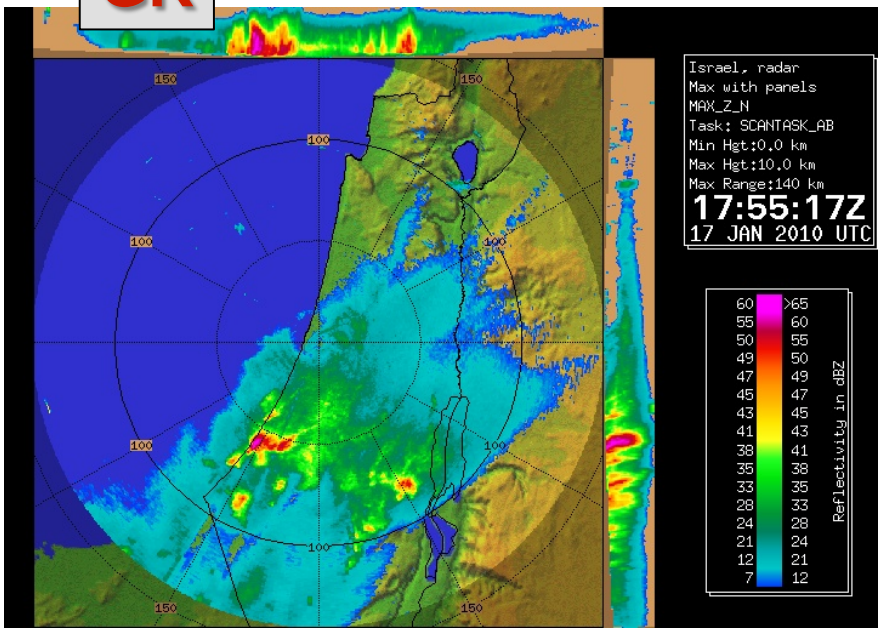
Data and Processing

TRMM-PR



- 2A25-V7 (PR near-surface *R*)

GR



- IMS C-band ground Doppler radar, single polarization, 5/10-min, 1^{o}x125 m resolution, 0.3^{o} elevation.
- Rain rate estimation ($Z=AR^{1.5}$)
- Gauge adjustment (49 tipping bucket gauges), different schemes: daily/yearly/overall

Data and Processing

	Scan	System type
	2008/09	
1	28/10/2008 07:45 (07:40)	EC
2	23/12/2008 23:15 (23:10)	EC
3	24/12/2008 02:31 (02:30)	MC
4	10/02/2009 02:21 (02:20)	EC
5	20/02/2009 21:03 (21:00)	MC
6	21/02/2009 16:52 (16:50)	EC
7	27/02/2009 14:34 (14:30)	EC
8	27/02/2009 17:50 (17:50)	EC
9	28/02/2009 13:39 (13:40)	MC
10	28/02/2009 16:54 (16:50)	EC
	2009/10	
11	30/10/2009 10:37 (10:40)	EC
12	31/10/2009 09:41 (09:40)	MC
13	17/12/2009 10:24 (10:25)	MC
14	17/01/2010 17:49 (17:50)	DC
15	17/01/2010 21:04 (21:05)	BB
16	20/01/2010 16:40 (16:40)	DC
17	20/01/2010 21:55 (21:55)	SC
18	24/01/2010 14:35 (14:35)	MC
19	24/01/2010 17:50 (17:50)	MC
20	04/02/2010 09:15 (09:15)	MC
21	26/02/2010 21:46 (21:45)	MC
22	27/02/2010 01:01 (01:00)	MC
	2010/11	
23	06/12/2010 02:06 (02:05)	MC
24	12/12/2010 19:37 (19:35)	EC
25	08/01/2011 09:18 (09:20)	SC
26	29/01/2011 22:40 (22:40)	MC
27	30/01/2011 21:44 (21:45)	SC
28	07/02/2011 17:35 (17:35)	SC
29	10/02/2011 13:11 (13:10	MC
30	26/02/2011 08:09 (08:10)	SC
31	28/02/2011 04:39 (04:40)	MC
32	08/03/2011 03:46 (03:45)	MC
33	09/03/2011 02:51 (02:50)	MC
34	20/03/2011 17:22 (17:20)	BB
35	24/03/2011 15:18 (15:20)	MC
36	28/04/2011 22:15 (22:15)	DC
37	29/04/2011 01:30 (01:30)	DC

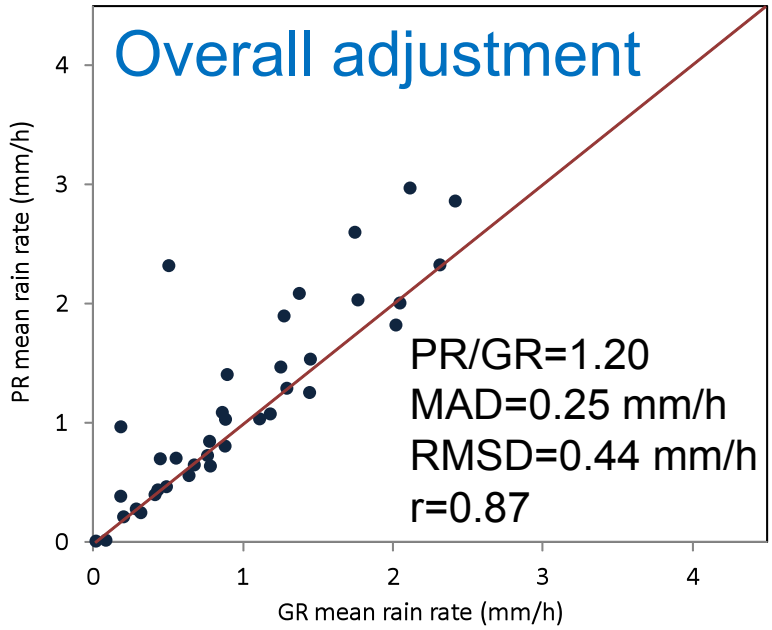
37 rainy overpasses over Israel from three seasons: 2008/09 (10 cases), 2009/10 (12 cases), and 2010/11 (15 cases)

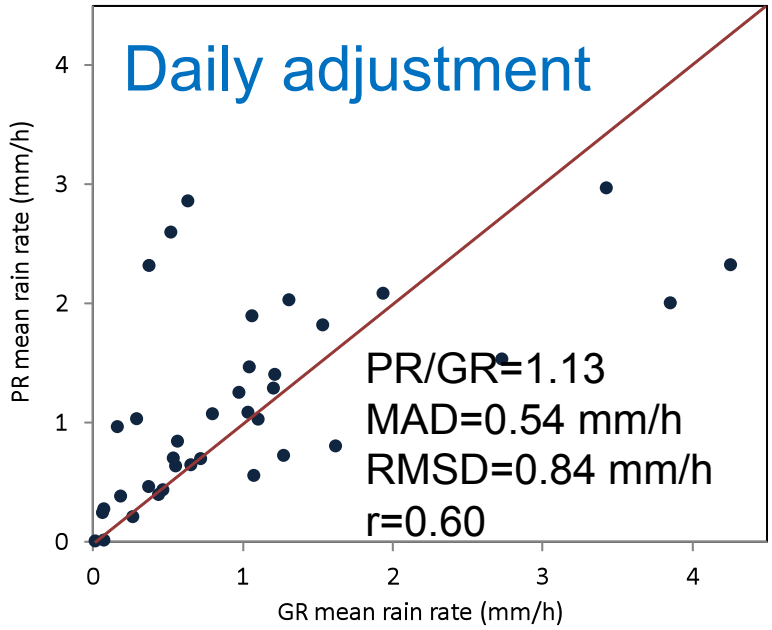
Subjective classification into system type according to radar, synoptic and sounding data.

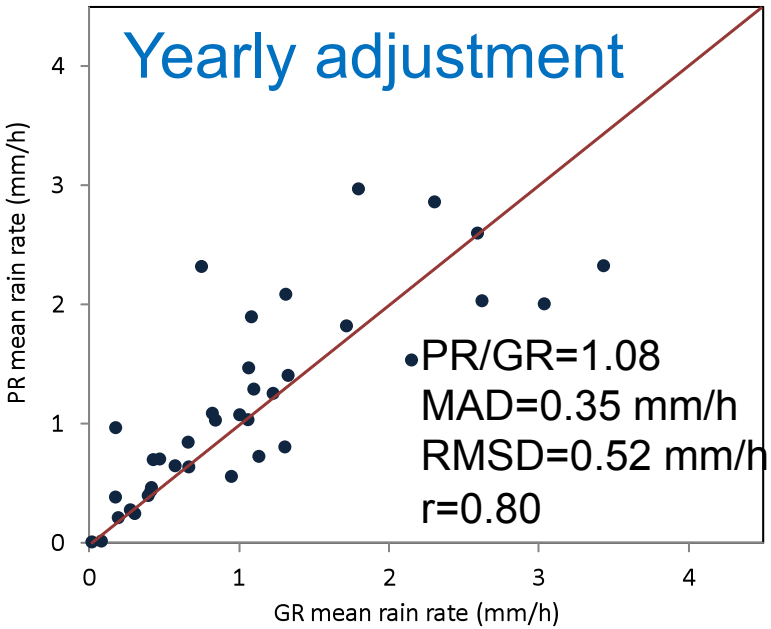
- Deep Convection
- Medium Convection
- Embedded Convection
- Bright Band
- Shallow Convection

Area-Averaged Rain Rate Comparison

GR – PR fit for different temporal gauge adjustment schemes



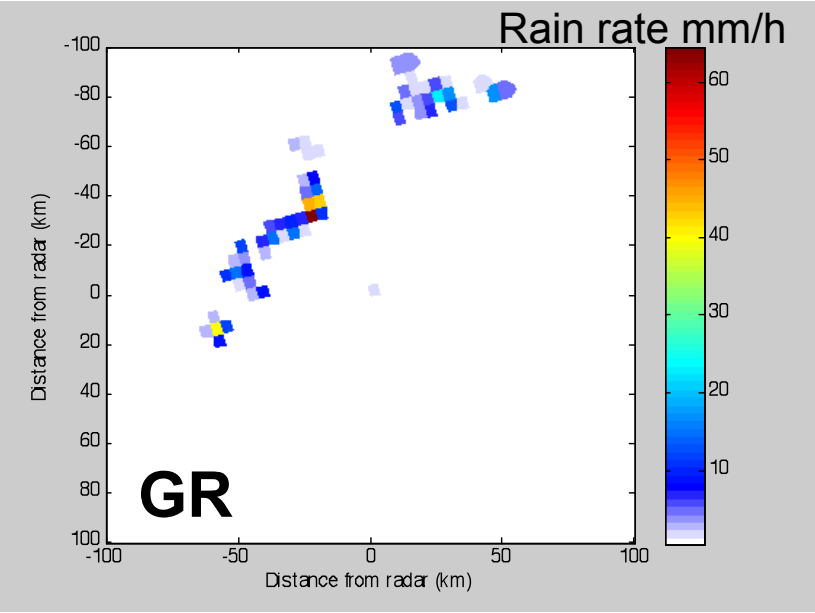


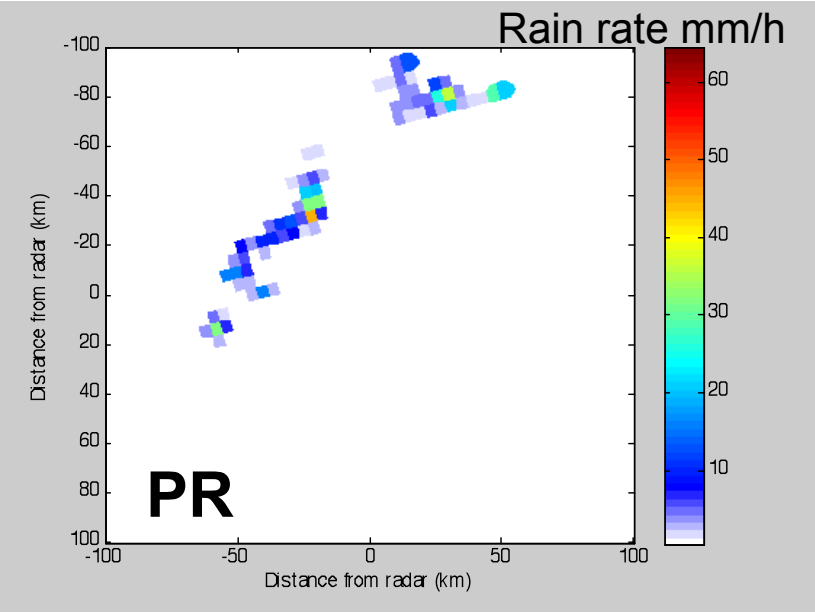


Considering TRMM-PR data stability, the above results suggest that the *overall* gauge adjustment provides better rain rate estimates

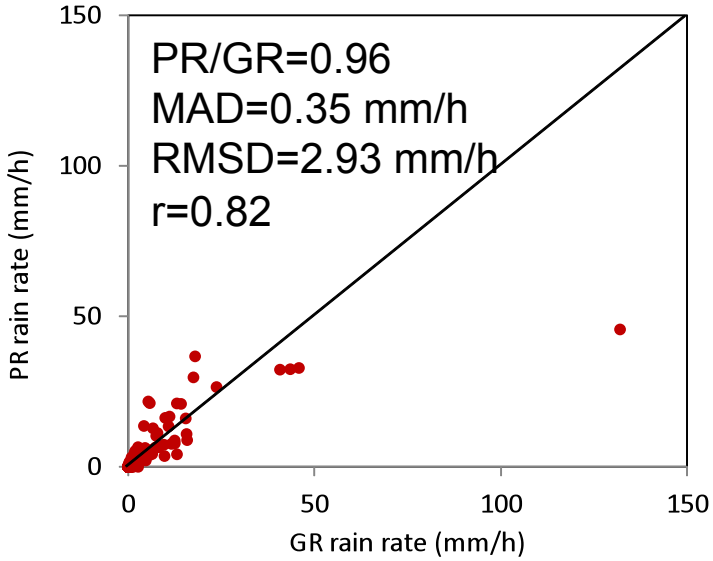
Pixel-Based Rain Rate Comparison

20/1/2010 16:40 GMT (Deep Convection)



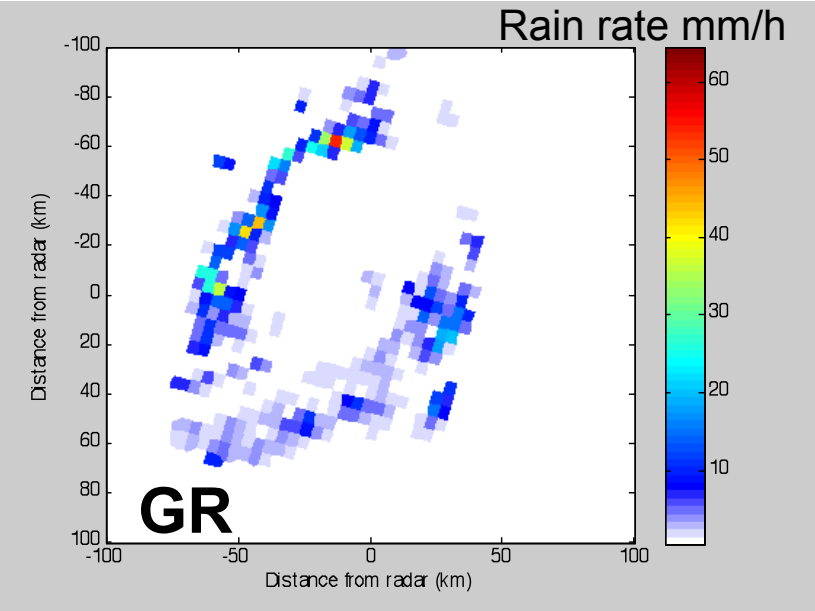


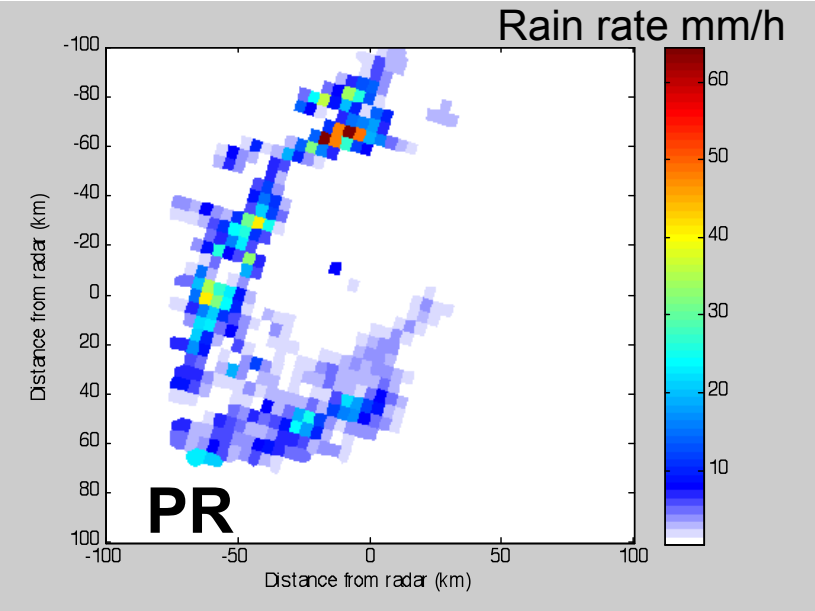
Spatial patterns are quite similar but estimated the rain rates, especially at high rain rates, may differ substantially.

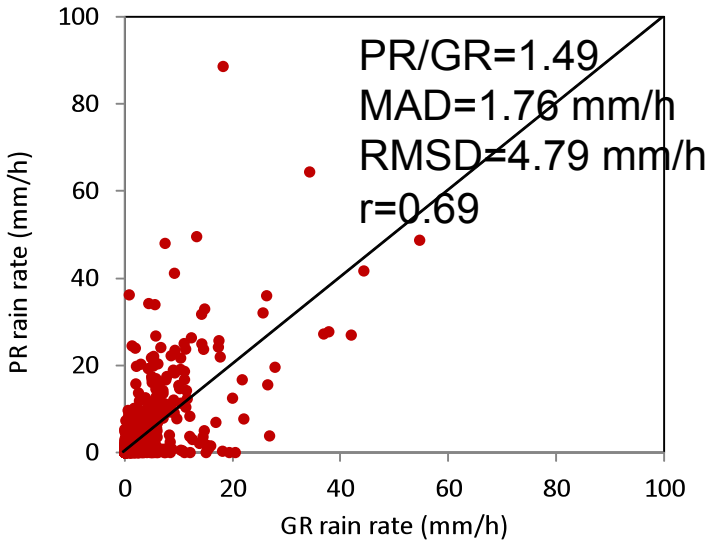


Pixel-Based Rain Rate Comparison

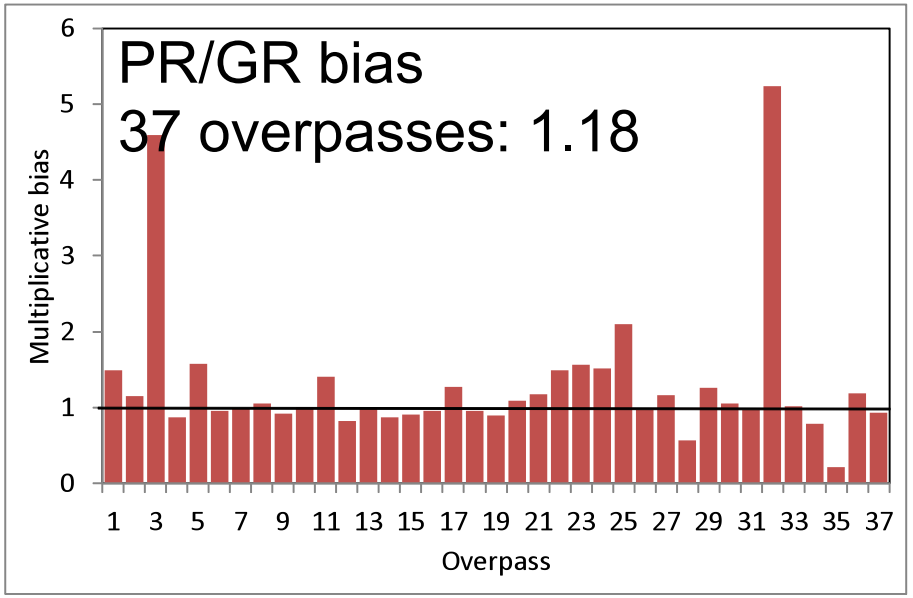
28/10/2008 7:45 GMT (Embedded Convection)

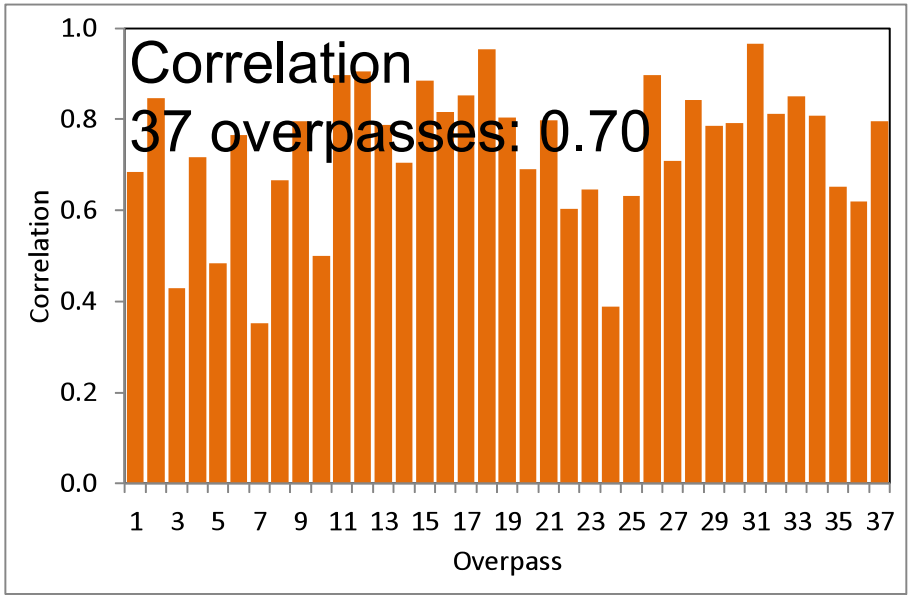


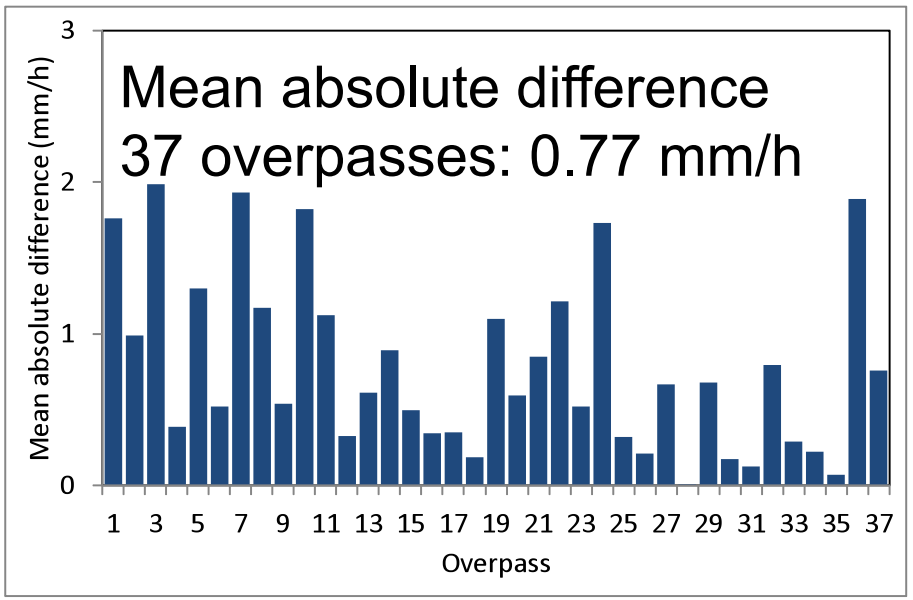


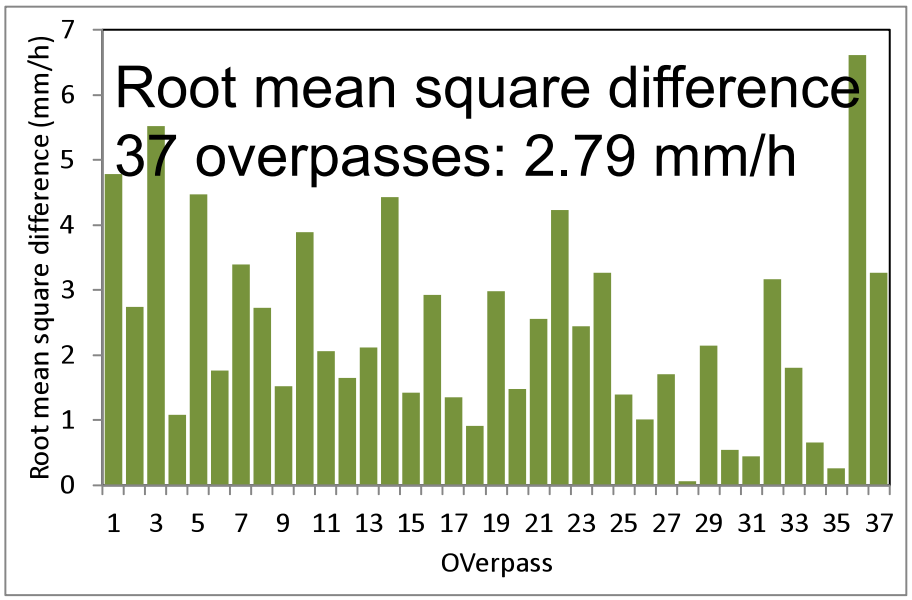


Pixel-Based Rain Rate Comparison

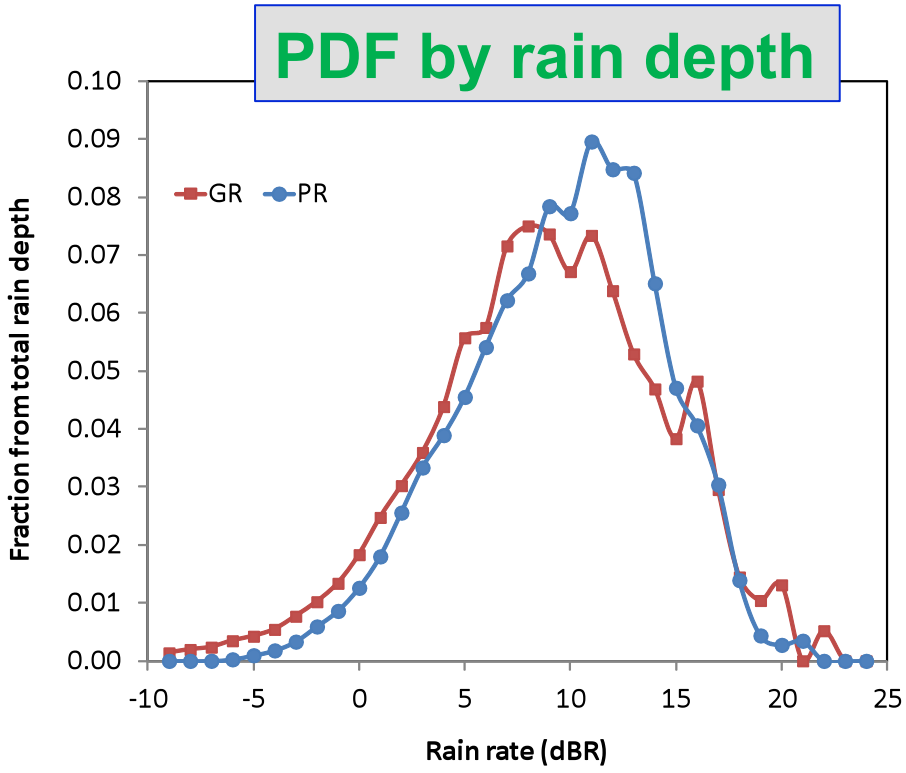


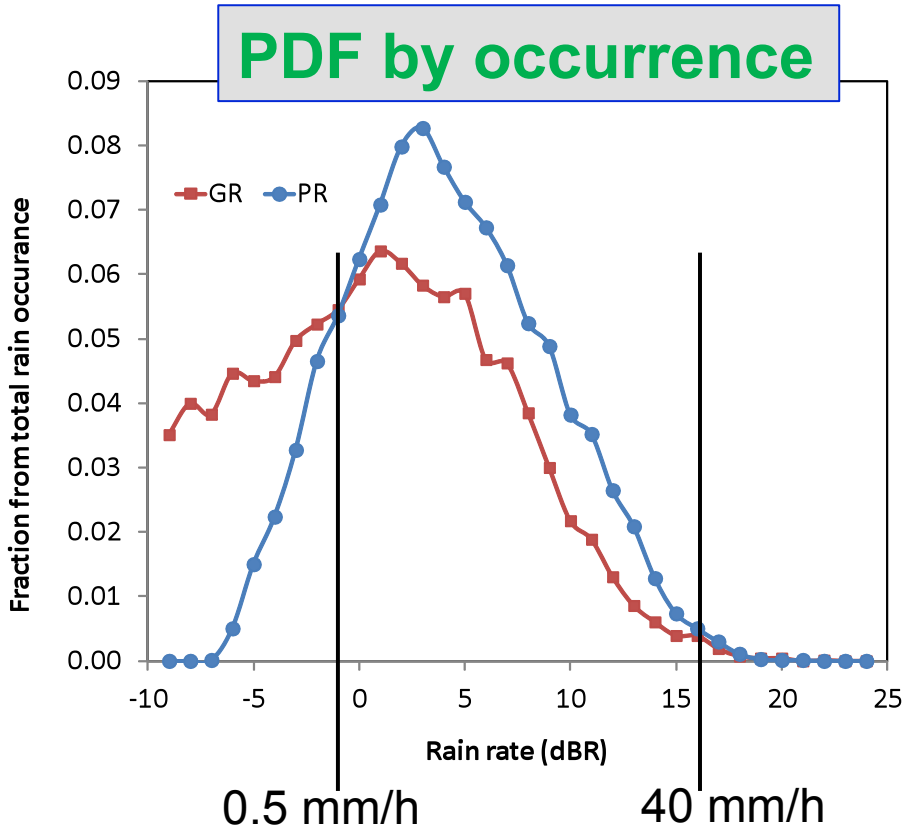






Rain Rate PDFs Comparison



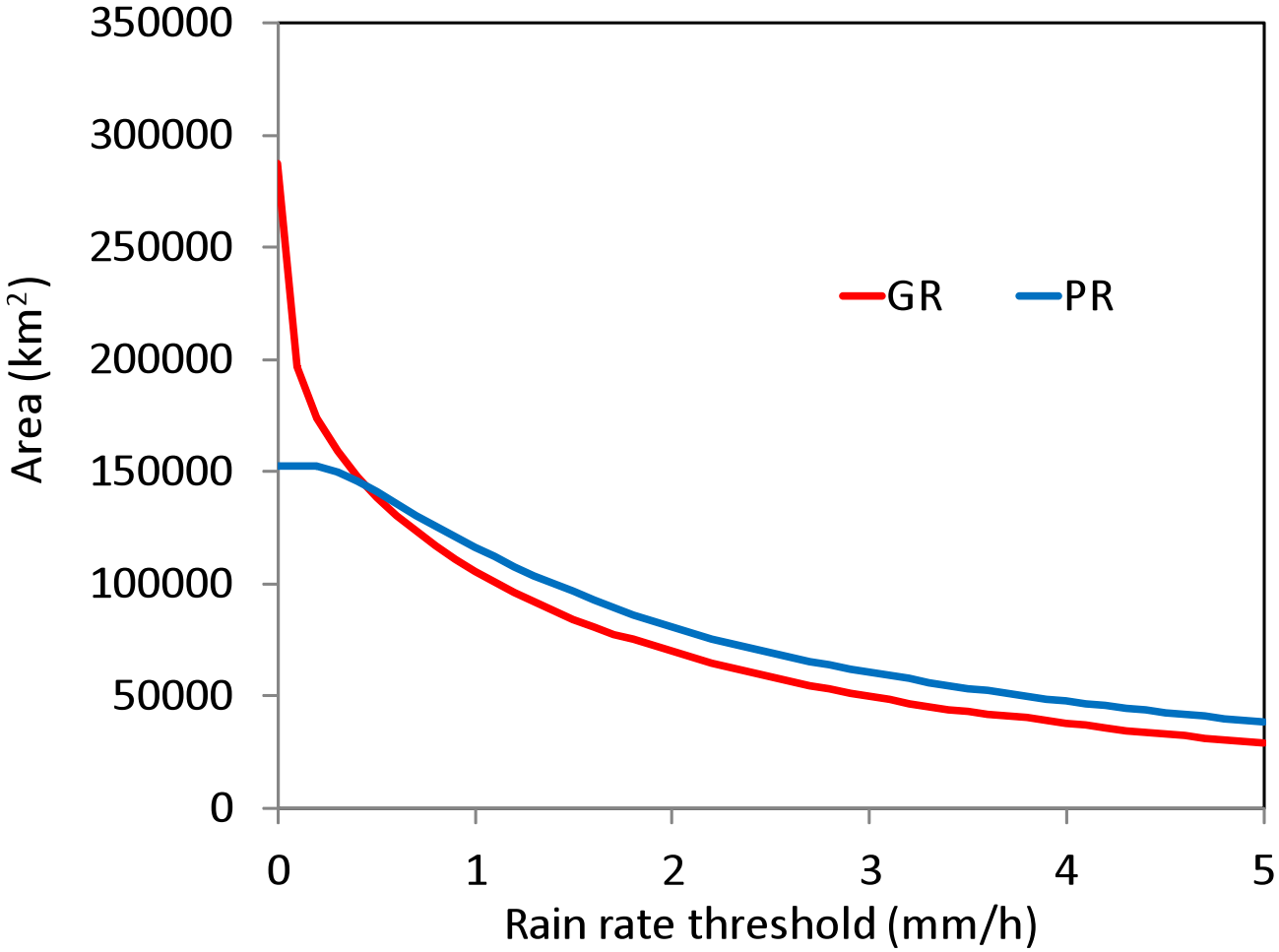


Generally, a good fit between GR and PR rain rate (*R*) distributions

R<0.5 mm/h: Lower occurrence and volume of PR relative to GR
0.5<*R*<40 mm/h: Higher occurrence and volume of PR relative to GR
R>40 mm/h: Slightly lower occurrence and volume of PR relative to GR

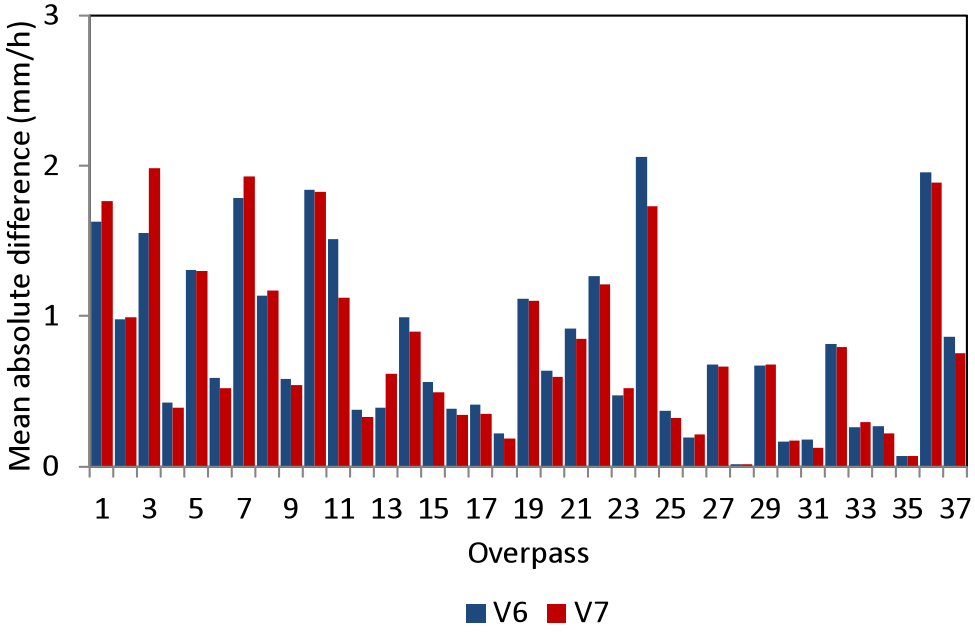
Rain Coverage Area Comparison

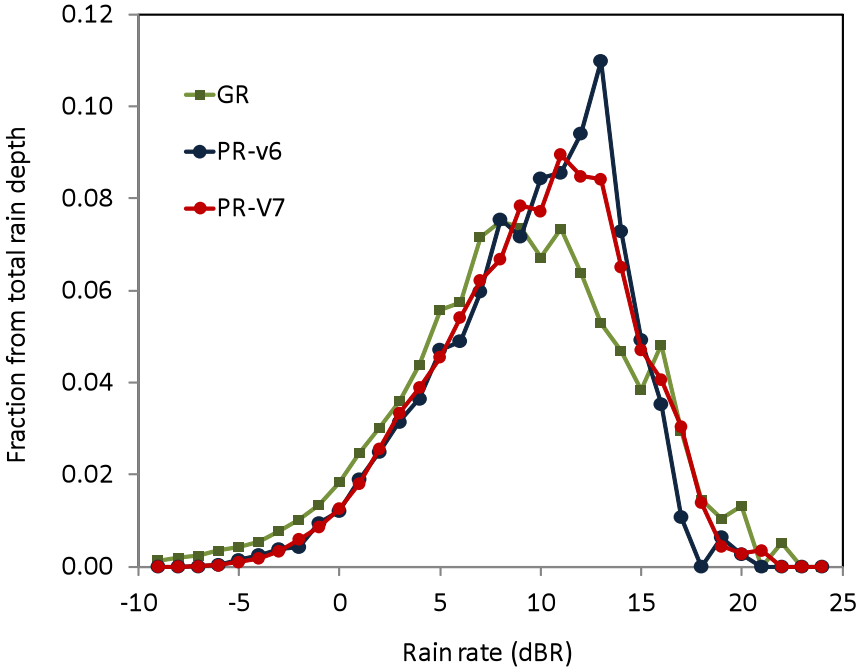
Rainy area above a threshold rain rate for all 37 overpasses



At low rain rates PR observes smaller rainy areas while at high thresholds it observes larger rainy areas relative to GR.

PR V6 – V7 Comparison





	V6	V7
Multiplicative bias	1.21	1.18
Mean absolute difference	0.79	0.77
Root mean square difference	2.84	2.79
Correlation	0.68	0.70

General improvement in rain rate fit to GR from V6 to V7

Conclusions and Plans

Conclusions:

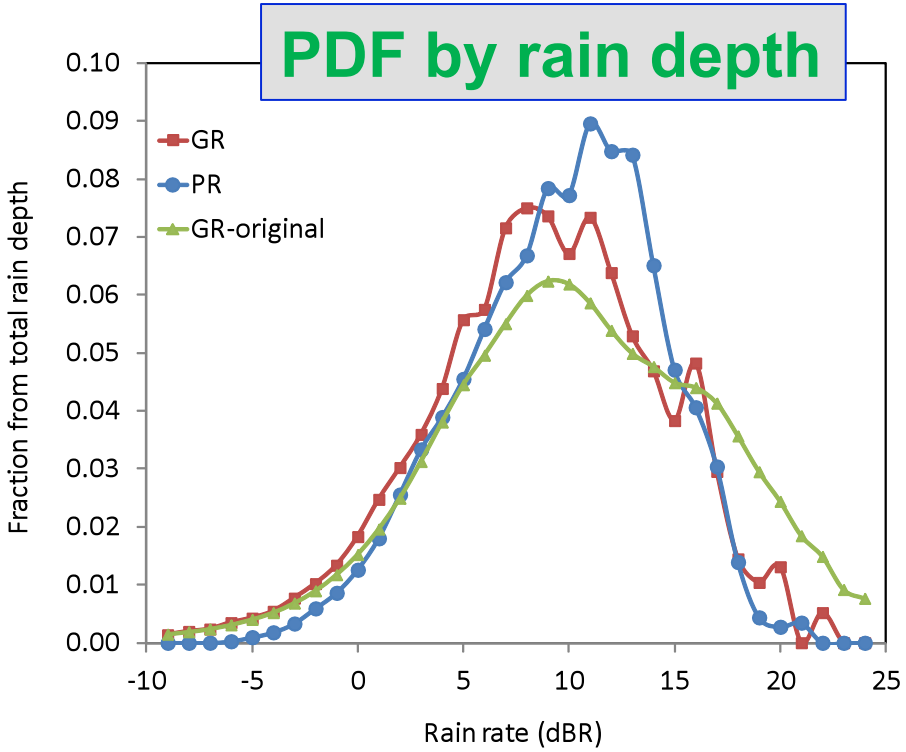
- General good fit between PR and GR *R*s in terms of: area-averaged value, spatial patterns and PDFs
- At locations with high *R*s the difference may be quite large
- In general, PR overestimates relative to GR (PR/GR=1.18)

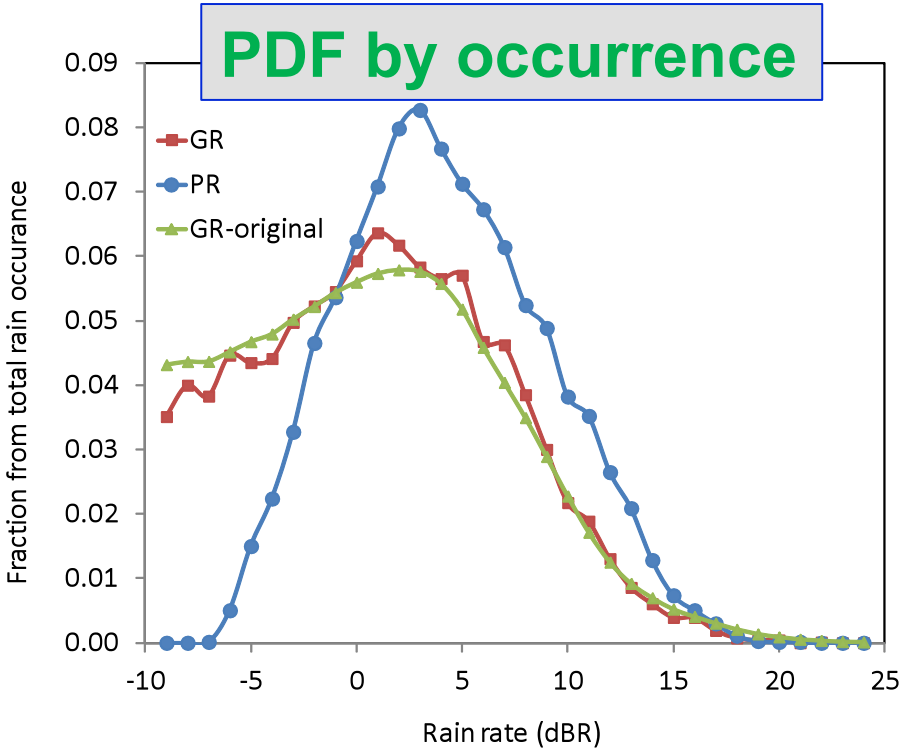
Near Future Plans:

- Study impacts of sub-pixel variability on TRMM/GPM *R* estimations using dense rain gauge network (27 gauges within a 2x2 km^2) and X-band radar data
- Continue examine causes for PR-GR differences: storm characteristics, sensors, algorithms, “random” errors
- Examine hydrological implications of recognized differences

Thank you for your attention

Rain Rate PDFs Comparison

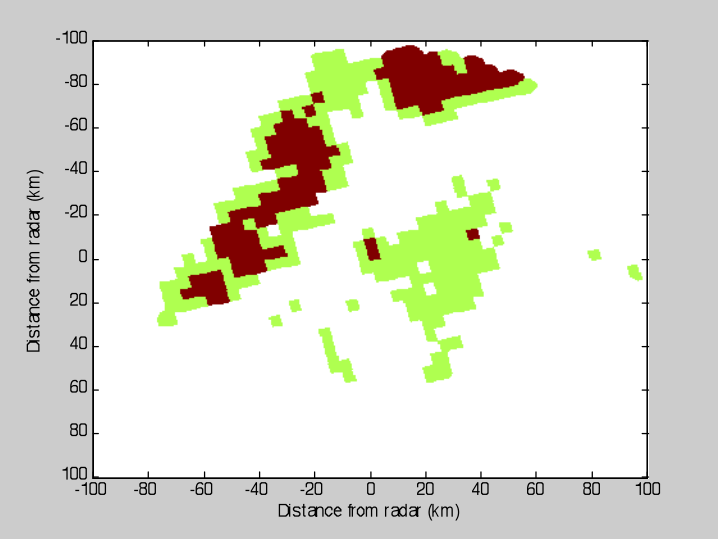




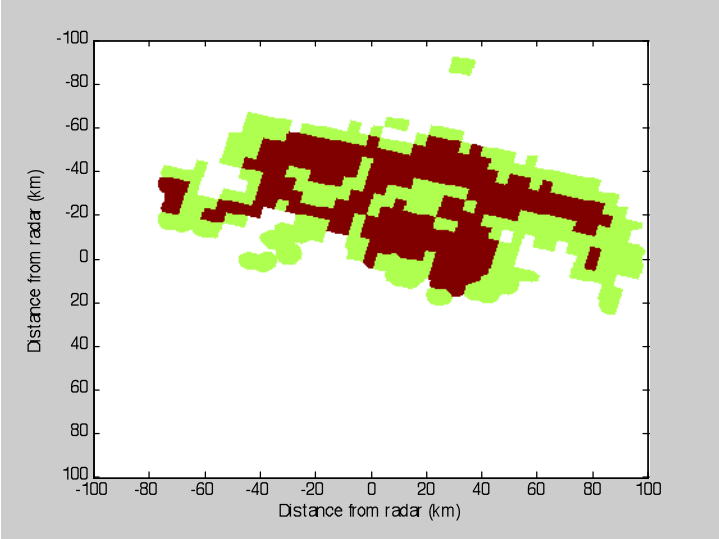
Rain rate differences are **not** related to the averaging process of GR data

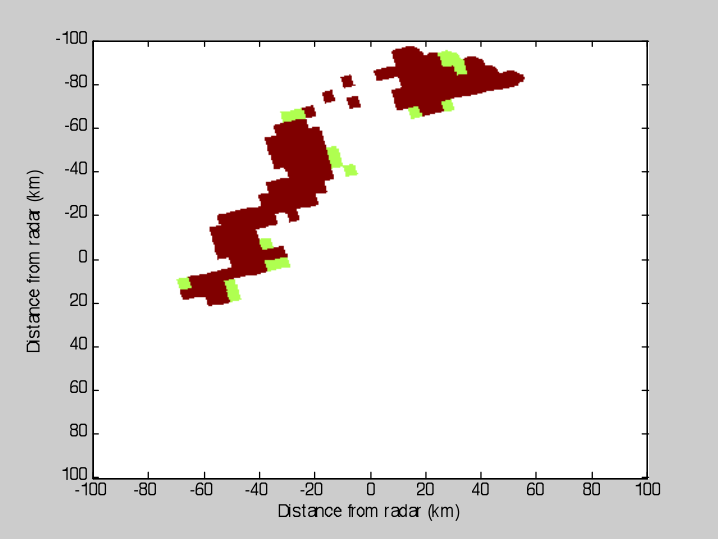
Rain Coverage Area Comparison

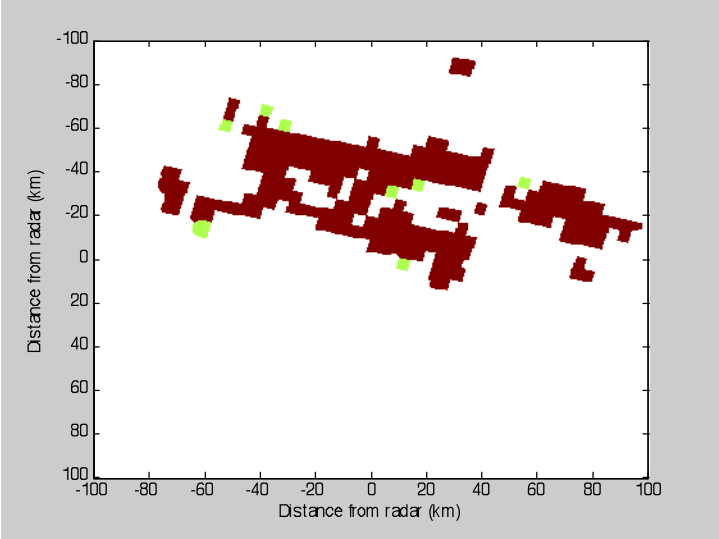
20/1/2010 16:40 GMT



30/1/2011 21:44 GMT







R<=0.5 mm/h

R>0.5 mm/h

R< 0.5 mm/h are almost absent from the PR estimations