X- and C-band radars: experiences in the Netherlands

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RainGain meeting, Leuven | April 16, 2012

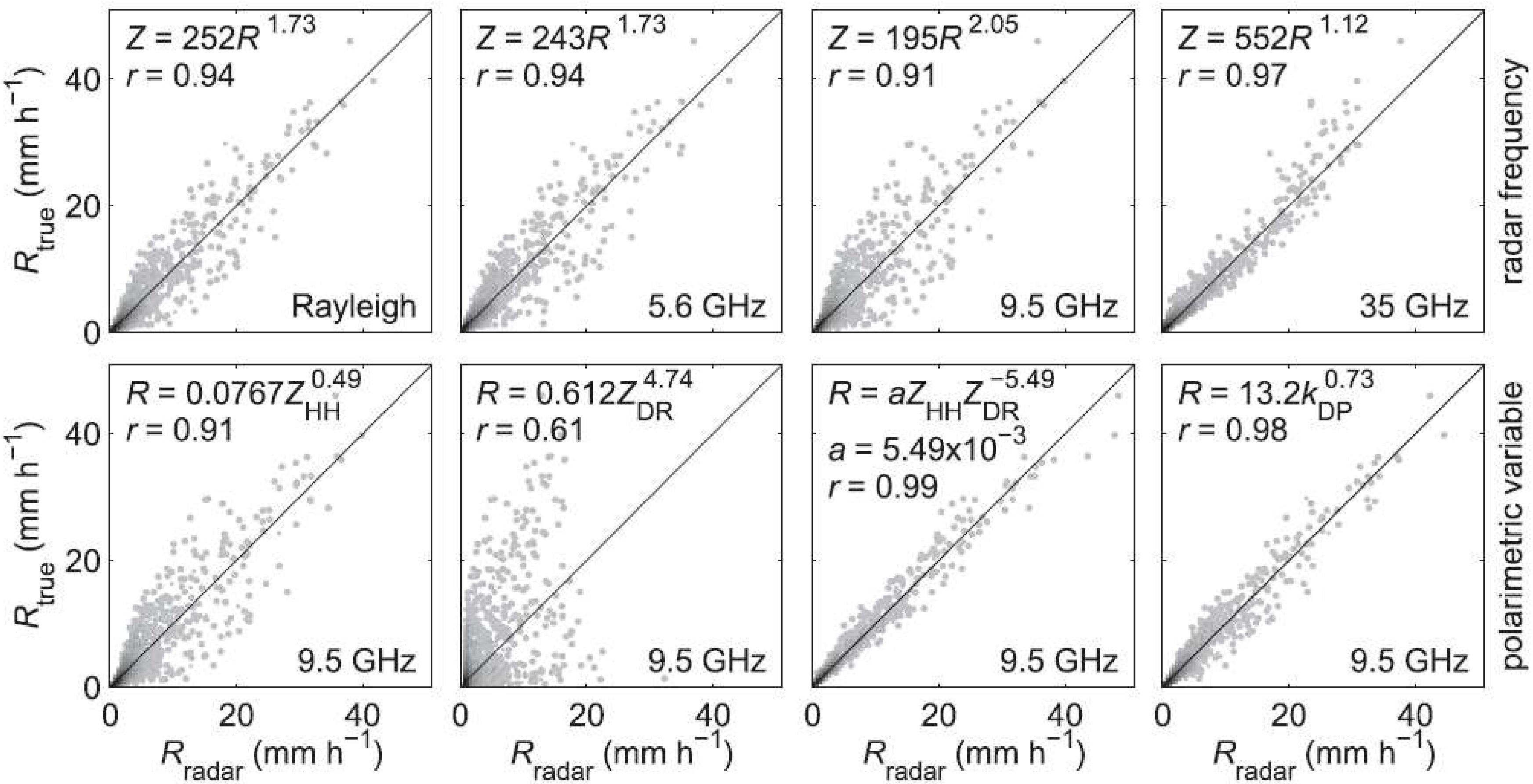
X- and C-band: important differences

	X-band	C-band
Price	+	-
Ease of installation	+	-
Clutter	+	-
Attenuation	-	+
Usable range	-	+

Note that the resolution of X-band radars is not higher by definition!

- C-band radars are often used for country-wide rainfall information
  - 1500-m pseudoCAPPI composite is the standard product
  - Volume data could also be used

X- and C-band: important differences



Topic 1: calibration

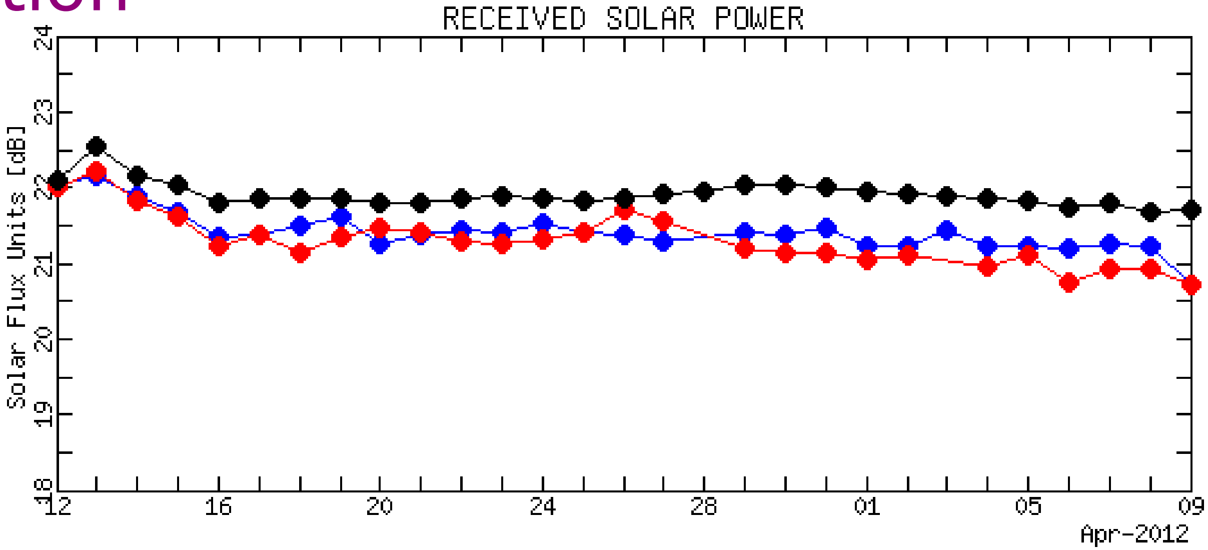
There are several possibilities for monitoring calibration of radars (this goes for X- and C-band radars alike):

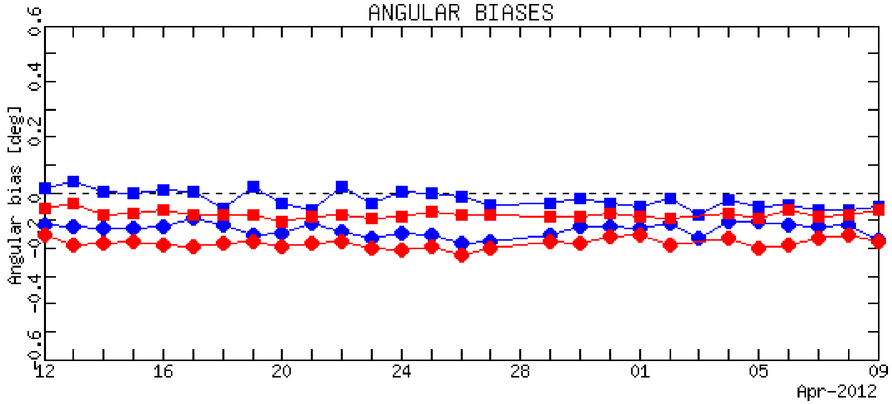
- Measuring solar power
- Analyzing returns from stable clutter targets
- Measuring transmitted power in wave guide
- Comparison of reflectivity in a given volume from different radars (statistics of differences)
- For dual-pol radars: consistency of polarimetric moments

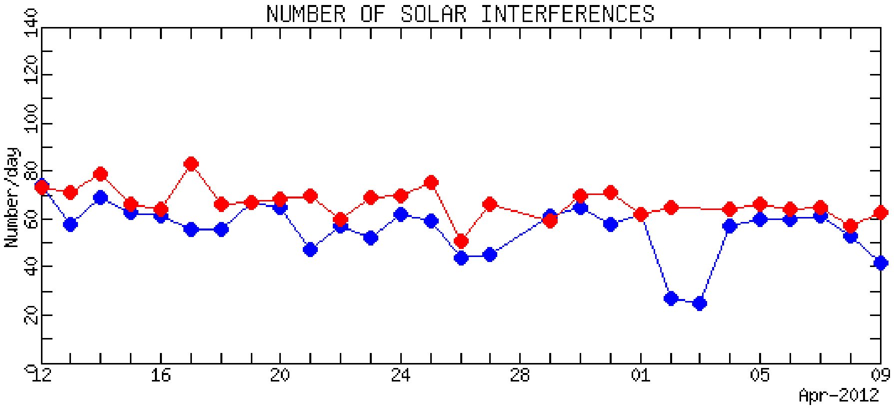
Topic 1: calibration

Example of solar monitoring (C-band)

- Power
- Antenna pointing
- Number of 'hits'

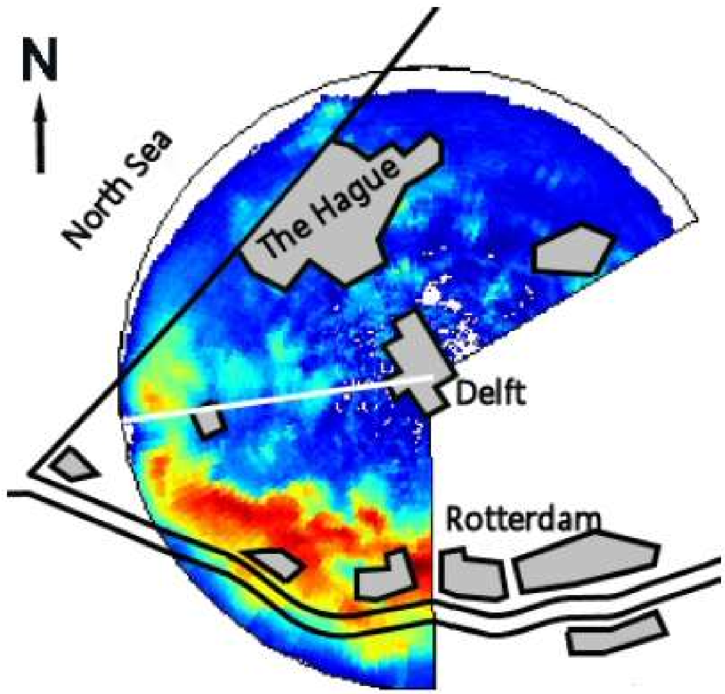


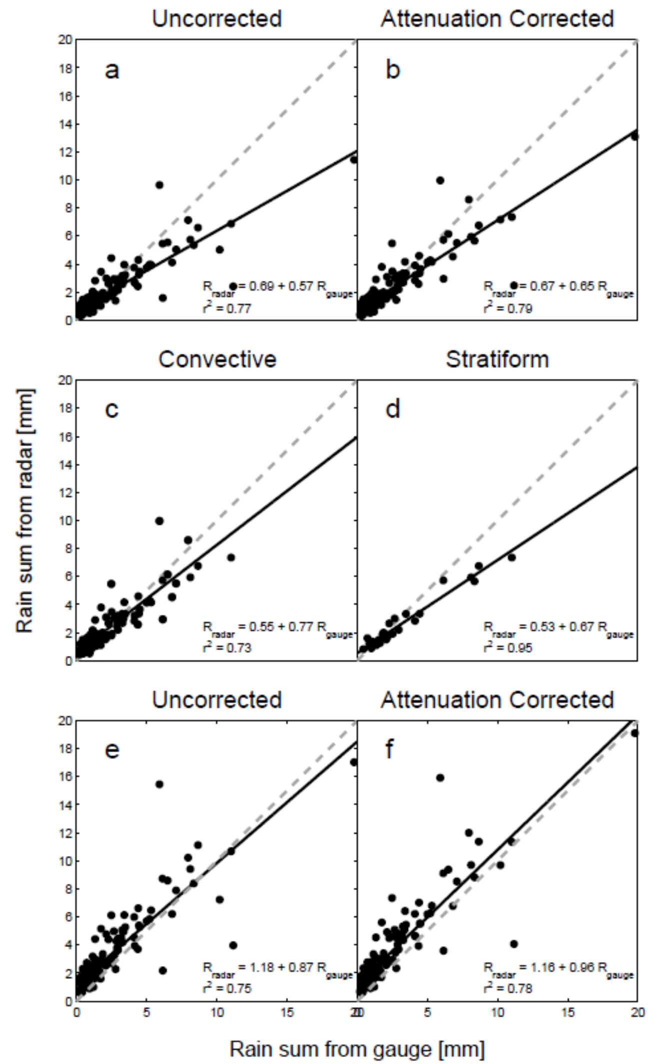




Topic 2: performance

Data from the SOLIDAR X-band radar (predecessor of IDRA) from 1993-1994 (195 events), with a 30-m and 16-s resolution



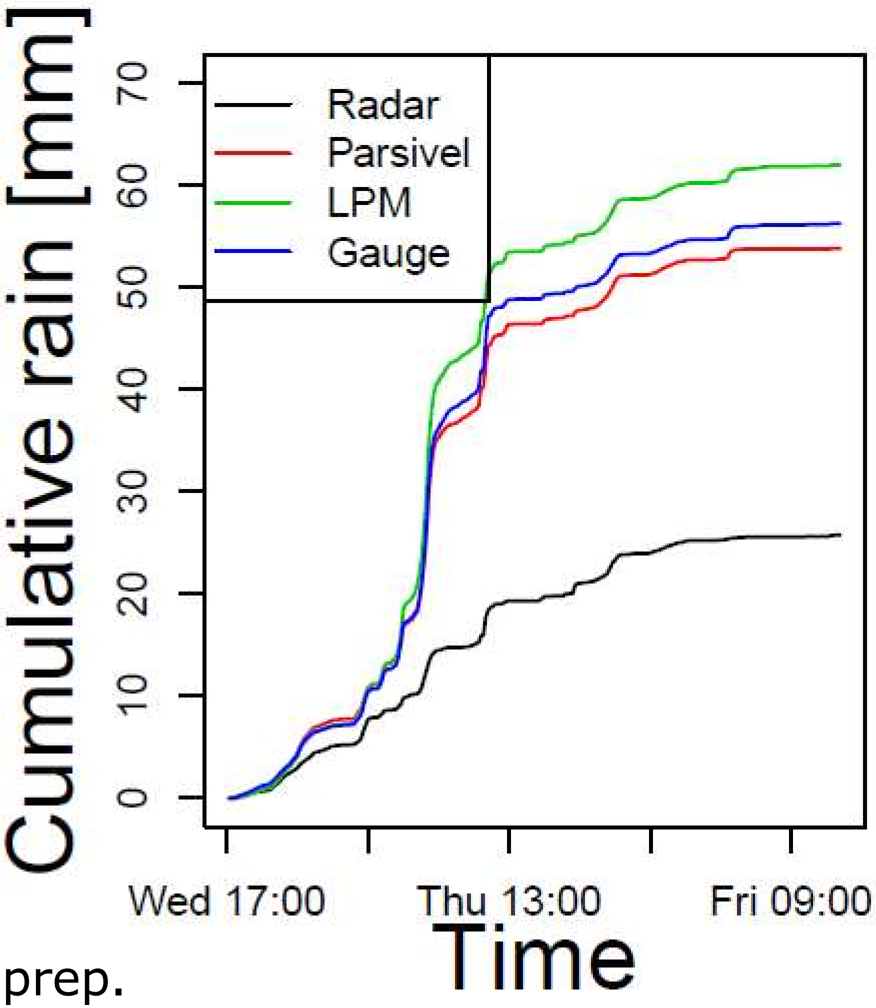


van de Beek et al., HESS, 2010

Topic 2: performance

Data from operational C-band radar in De Bilt

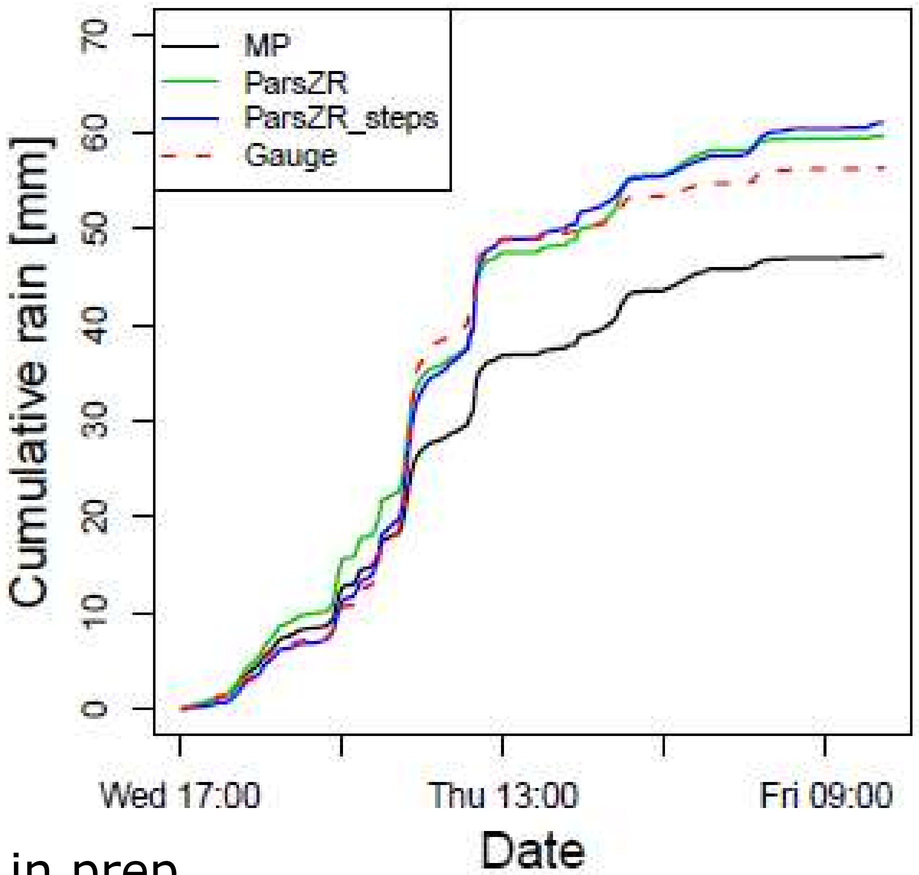
- Data very close to the radar
- Used radar elevation scan 3 (0.8 deg., 1.0 km range res.) second range bin.
- Used standard Z-R relation ($Z=200R^{1.6}$).
- Severe underestimation by radar



van de Beek et al., QJRMS, 2012, in prep.

Topic 2: performance

- Corrections applied for:
  - Calibration
  - Clutter
  - Wet radome attenuation
  - Non-standard Z-R relation
- Corrections can be seen to work well

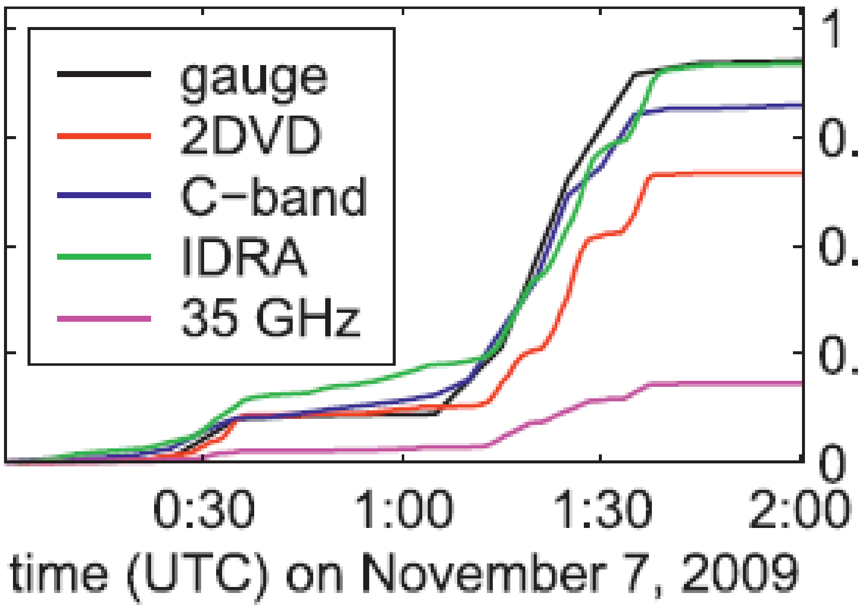


van de Beek et al., QJRMS, 2012, in prep.

Topic 2: performance

Comparison of radar QPE for three radars and two in-situ instruments at the Cabauw Experimental Site for Atmospheric Research (CESAR)

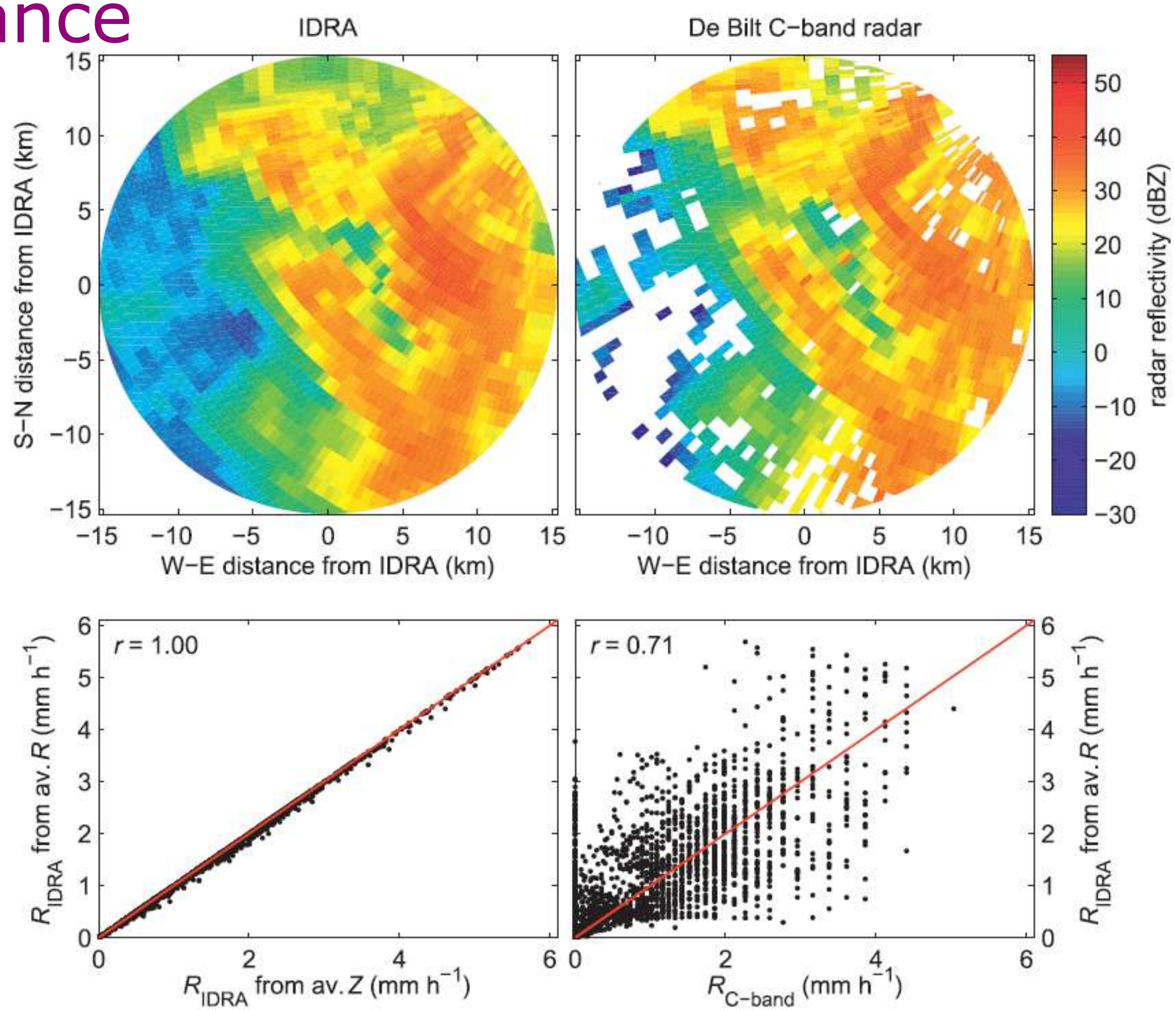
- Operational C-band radar
- X-band radar IDRA
- Vertically-pointing 35-GHz cloud radar
- Rain gauge
- 2-dimensional video disdrometer (2DVD)



Topic 2: performance

Comparison of X- and C-band radars

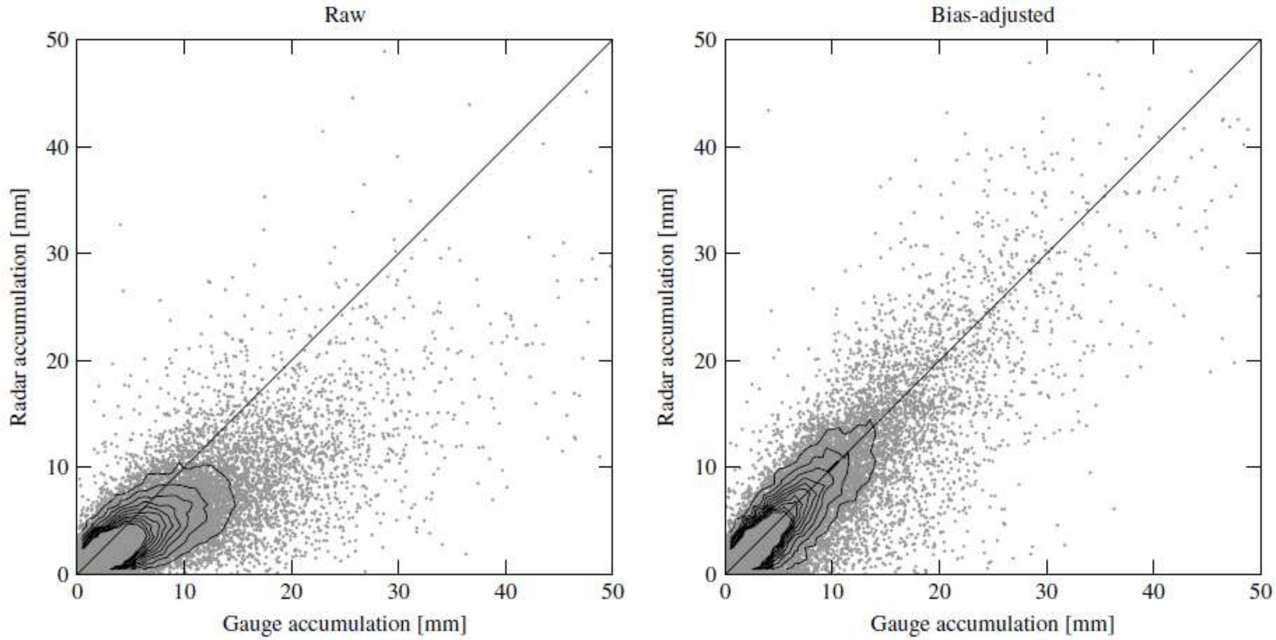
- Simulated C-band radar signal from X-band radar data
- Compare results using Z-R relation before or after averaging
- Compare results with true C-band radar data



Topic 3: integration of data sources

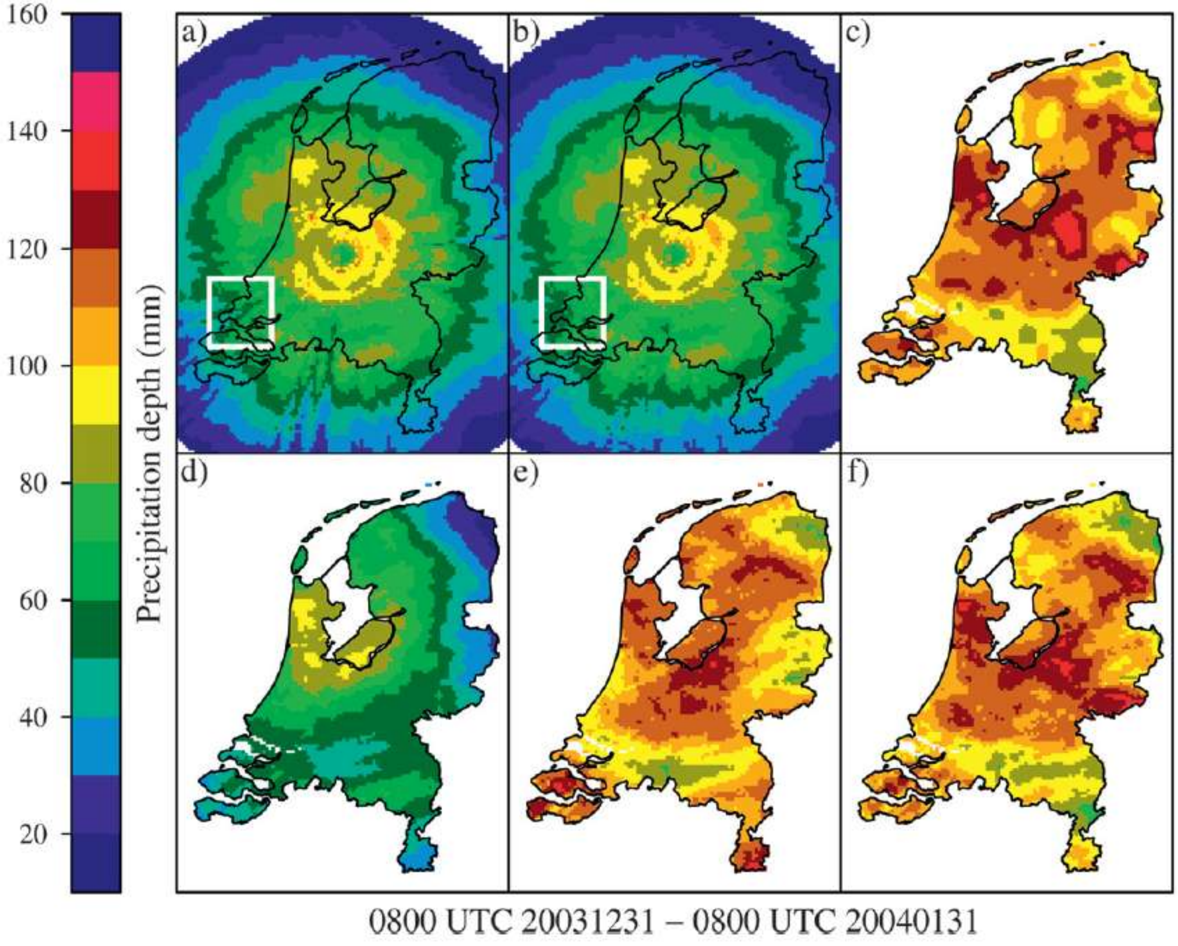
In the Netherlands: only experience with integration of radar and rain gauge data

- Mean field bias (hourly rain gauge data from 32 gauges)
- Spatial correction field (daily rain gauge data from 325 gauges)



Holleman, MA, 2007

Topic 3: integration of data sources

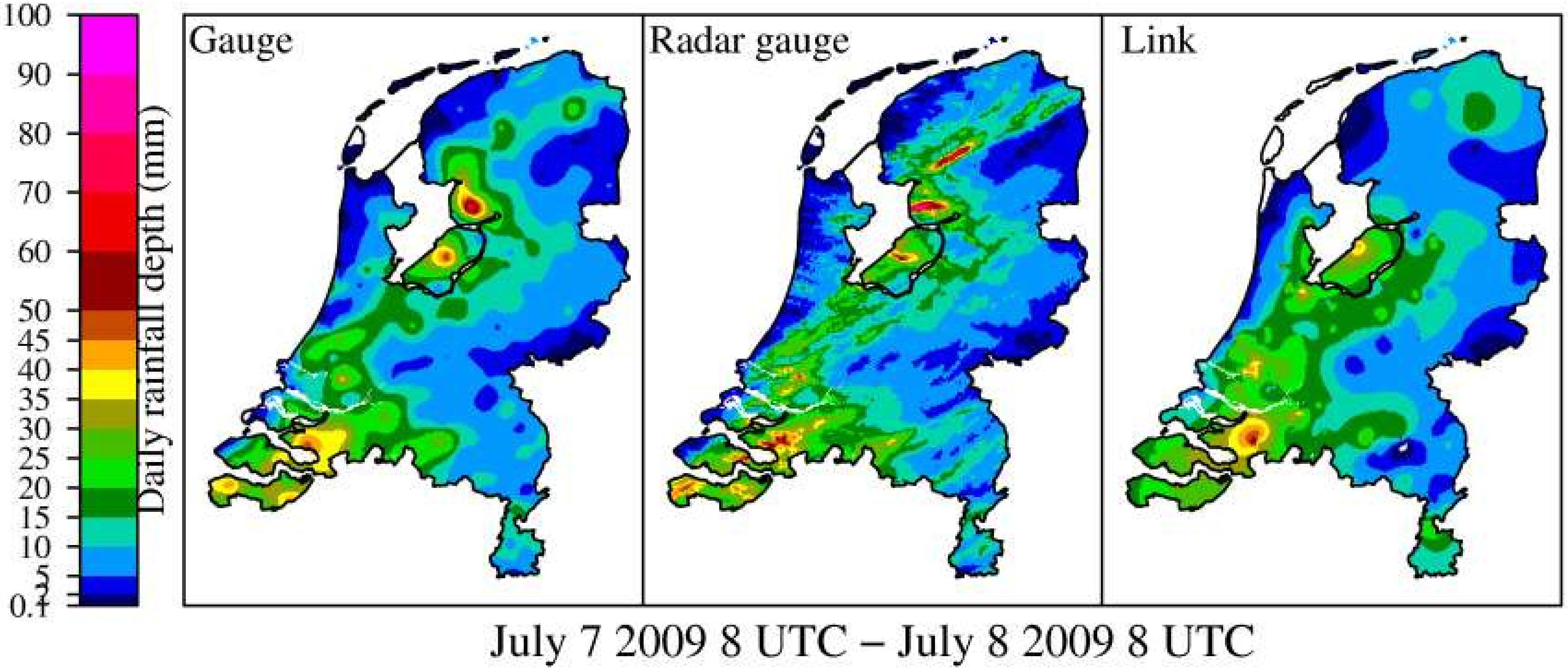


a) De Bilt pCAPPI
b) Occultation-corrected pCAPPI
c) Rain gauges
d) Raw composite
e) Bias-corrected composite
f) Spatially-corrected composite

Overeem et al., JAMC, 2009

Topic 3: integration of data sources

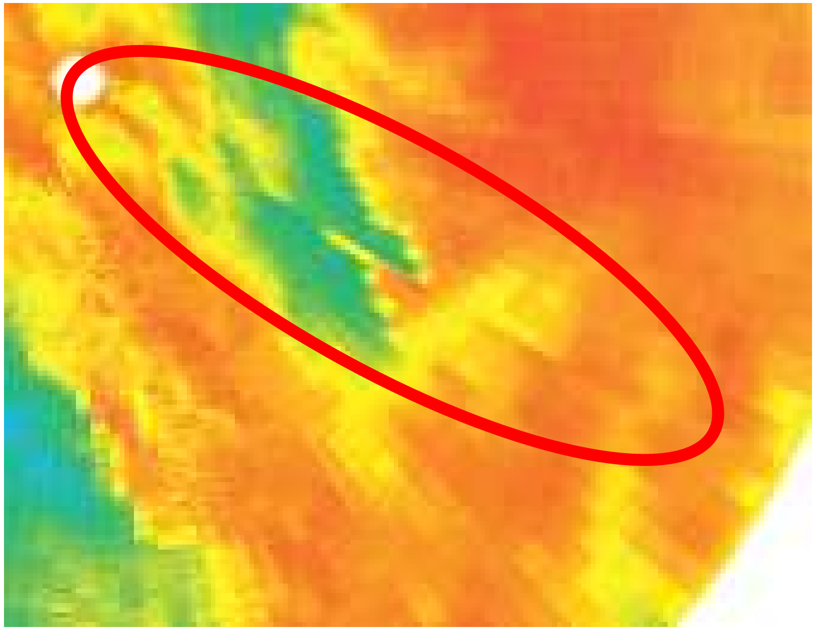
Other data source: microwave links from commercial cellular communication networks

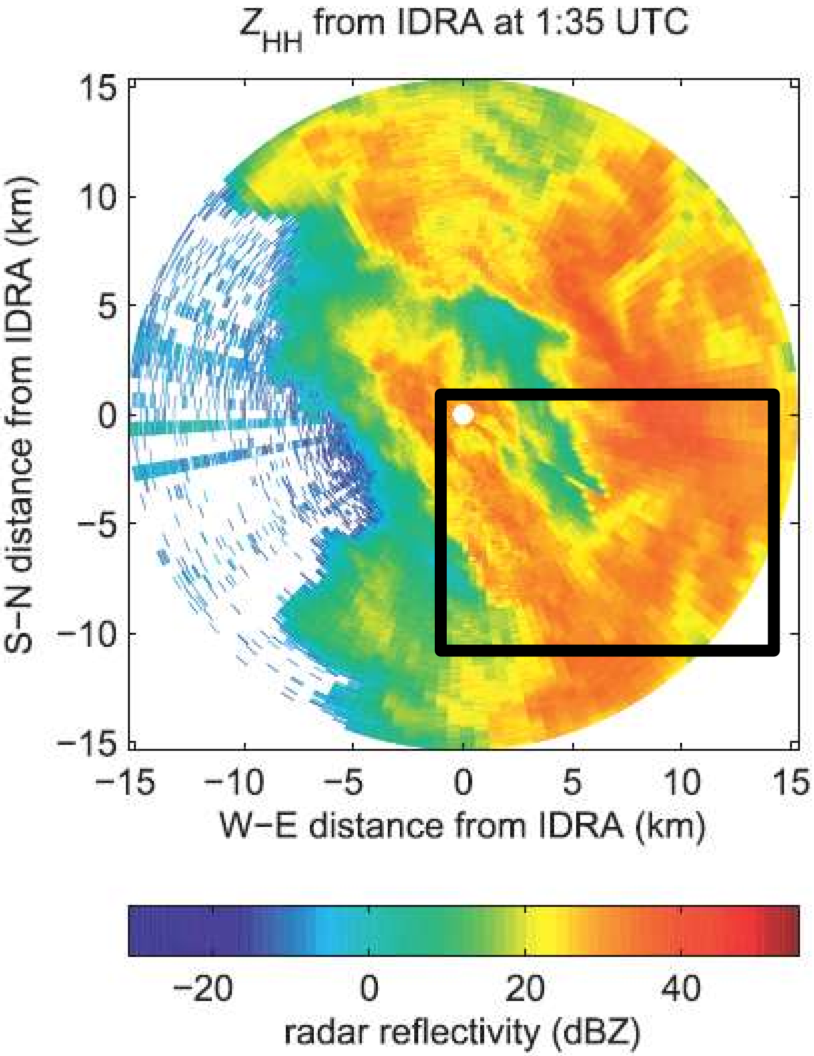


Overeem et al., BAMS, 2012, in prep.

Topic 4: fine-scale

Consistency of spatial and temporal resolution





Topic 4: fine-scale

- Question: what resolution is really needed?
  - Space
  - Time
- Question: given a certain resolution (in space and time), what is the desired accuracy?