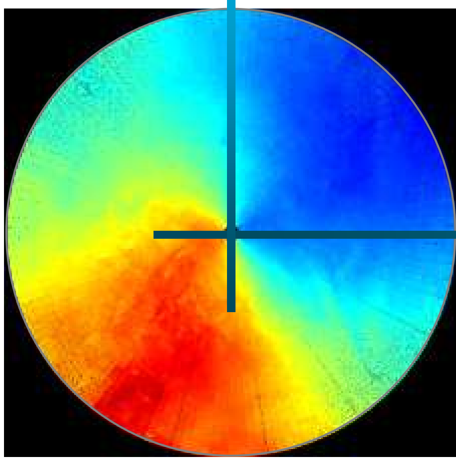
ATMOS



Rainfall rate retrieval with IDRA

Tobias Otto
Herman Russchenberg

A T M O S

IDRA – TU Delft IRCTR Drizzle radar

CESAR – Cabauw Experimental Site for Atmospheric Research

IDRA is mounted on top of the 213 m high meteorological tower.

Specifications

- 9.475 GHz central frequency
- FMCW with sawtooth modulation
- transmitting alternately horizontal and vertical polarisation, receiving simultaneously the co- and the cross-polarised component
- 20 W transmission power
- 102.4 μs – 3276.8 μs sweep time
- 2.5 MHz – 50 MHz Tx bandwidth
- 60 m – 3 m range resolution
- 1.8° antenna half-power beamwidth

Reference

J. Figueras i Ventura: "Design of a High Resolution X-band Doppler Polarimetric Weather Radar", *PhD Thesis*, TU Delft, 2009. (online available at http://repository.tudelft.nl)

Near real-time display:
http://ftp.tudelft.nl/TUDelft/irctr-rse/idra

Processed and raw data available at:
http://data.3tu.nl/repository/collection:cabauw

IDRA data processing

Standard measurement specifications:

- polarimetric measurements at linear horizontal / vertical polarisation basis
- sweep time: 409.6 μs
- range resolution: 30 m (512 range bins, i.e. 15 km maximum range)

Data processing and rainfall rate estimation

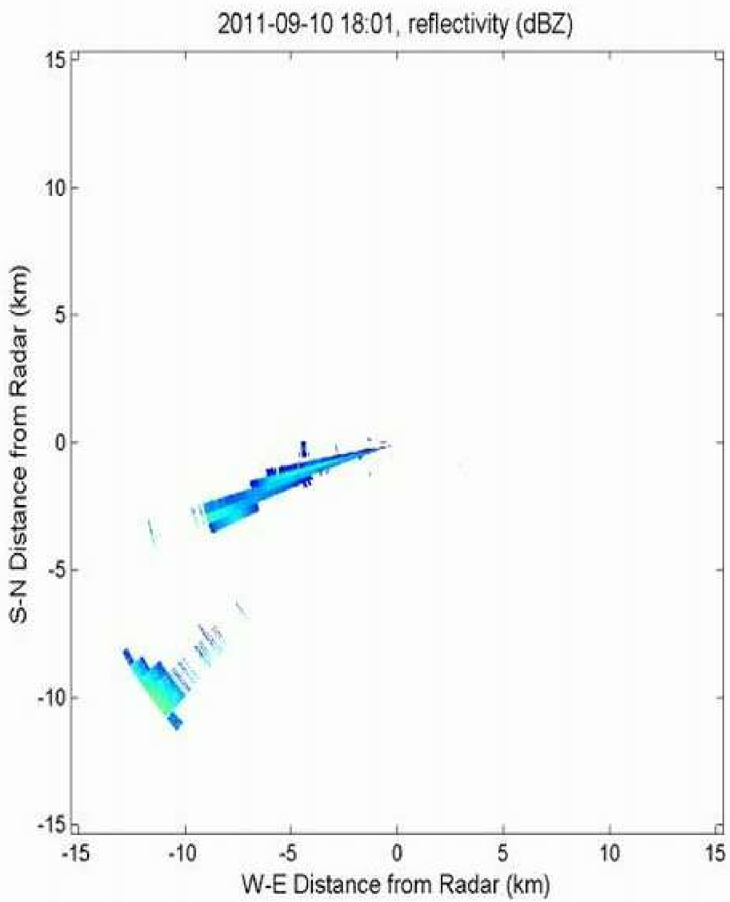
- powerful spectral clutter suppression [1]
- estimation of the specific differential phase K_{dp} [2]
  (reflectivity-weighted to overcome the coarse range-resolution of conventional K_{dp} estimators, the estimated *K_{dp} is unaffected by signal attenuation and independent of the radar calibration*)
- estimation of the one-way specific attenuation by $\alpha_{hh} = 0.34 \cdot K_{dp}$ with α_{hh} (dB km^{-1}) and K_{dp} (deg km^{-1}) and attenuation correction of the reflectivity
- the parametrisations for the rainfall rate estimation are based on 41530 raindrop-size distributions measured by a 2D-video disdrometer data at Cabauw in 2009:
  - $R = 243 \cdot z_{hh}^{1.24}$ with the rainfall rate R (mm h^{-1}) and the reflectivity at horizontal polarisation z_{hh} ($mm^6\ m^{-3}$)
  - $R = 13 \cdot K_{dp}^{0.75}$ with the rainfall rate R (mm h^{-1}) and the one-way specific differential phase K_{dp} (deg km^{-1})
- for the final rainfall rate product, $R(K_{dp})$ is chosen if the reflectivity is above 30 dBZ, and the standard deviation of K_{dp} is below 2 deg km^{-1}, else $R(z_{hh})$ is used

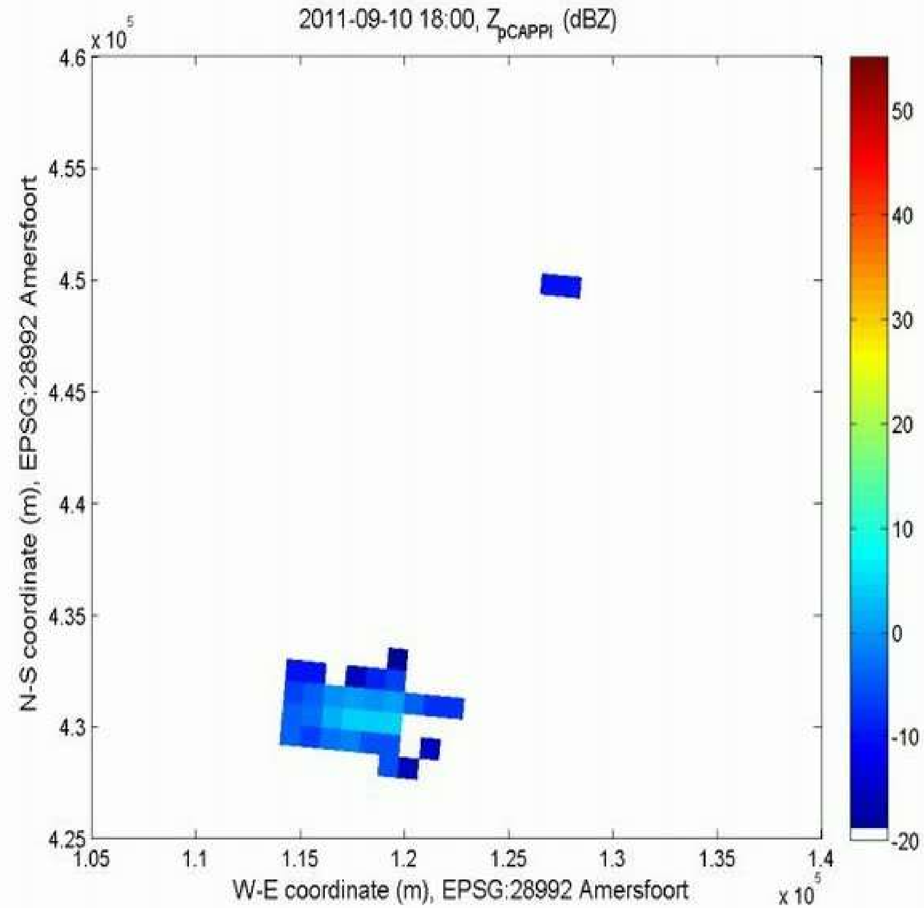
[1] C. Unal, 2009: Spectral Polarimetric Radar Clutter Suppression to Enhance Atmospheric Echoes, *J. Atmos. Oceanic Technol.*, **26**, 1781–1797.

[2] T. Otto and H.W.J. Russchenberg, 2011: Estimation of Specific Differential Phase and Differential Backscatter Phase from Polarimetric Weather Radar Measurements of Rain, *IEEE Geosci. Remote Sens. Lett.*, **8**, 988-992.

A T M O S

ZX-band vs ZC-band; hi-res vs lo-res





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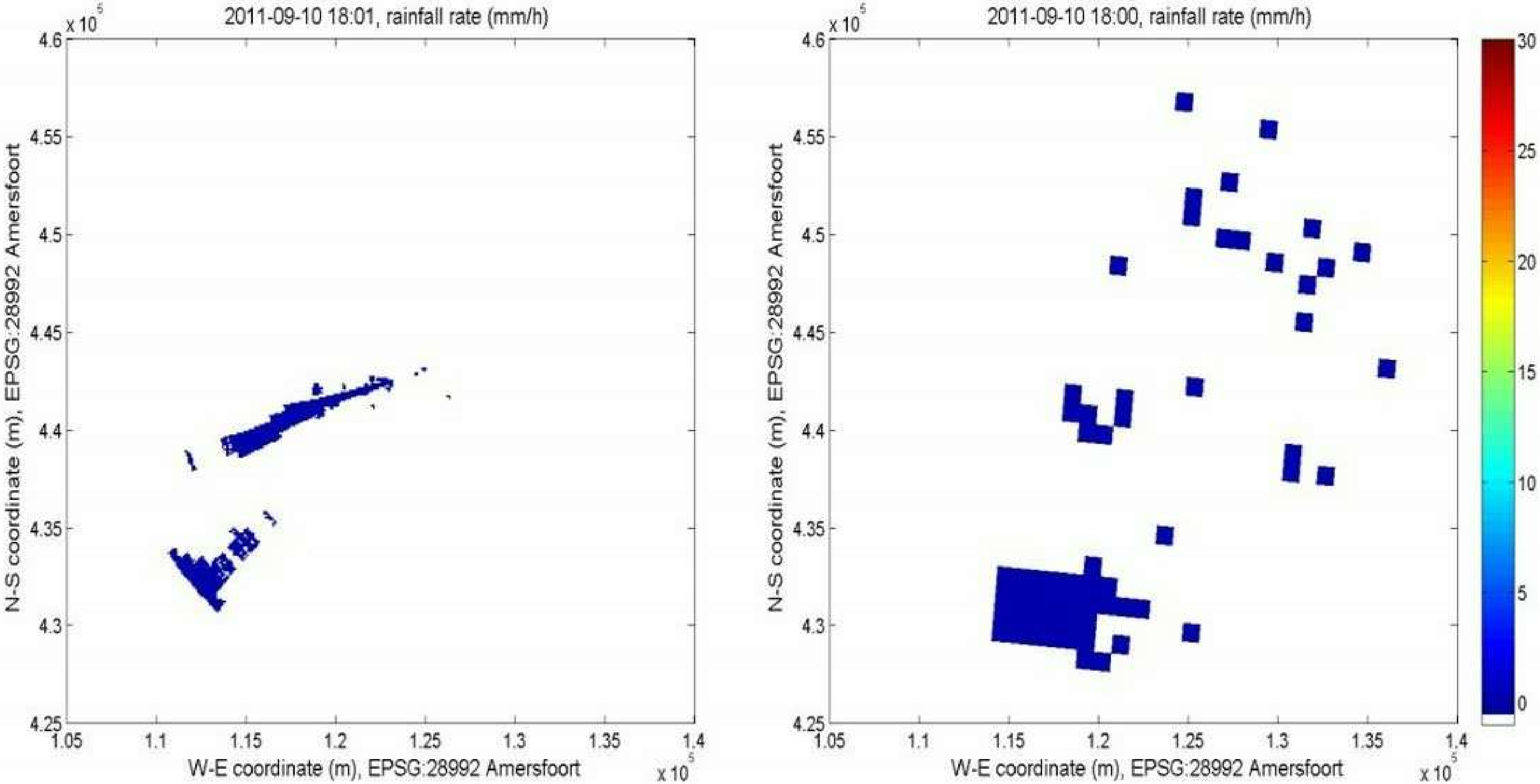
RX-band vs RC-band; hi-res vs lo-res



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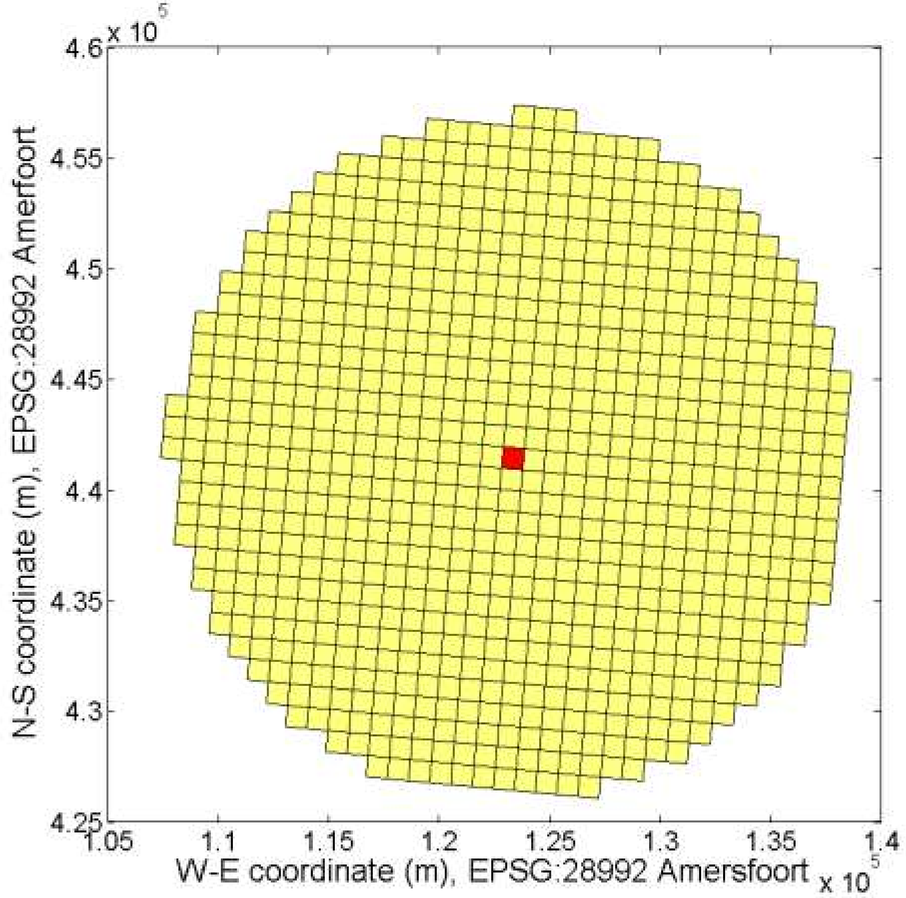
Cell selection



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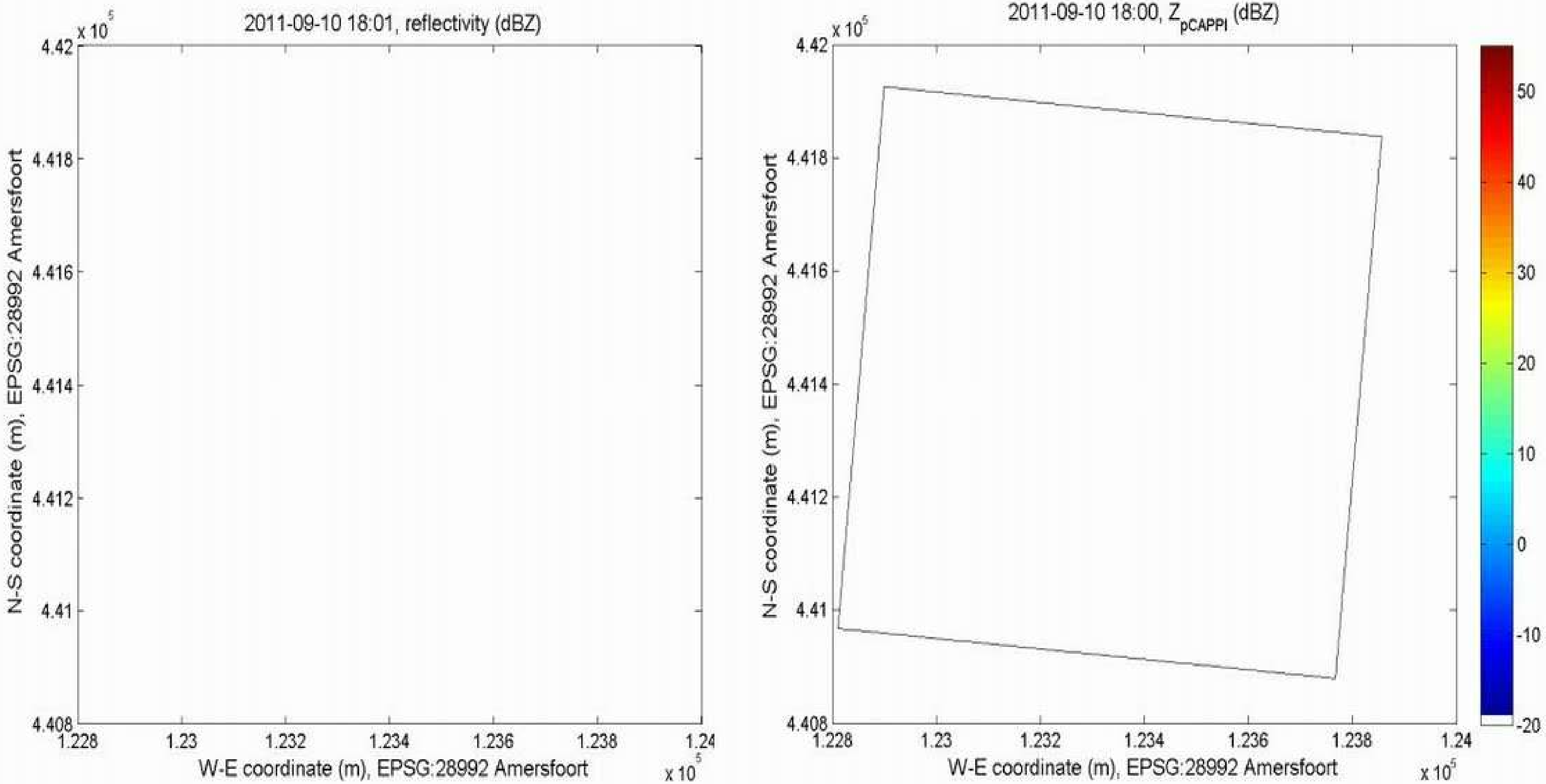
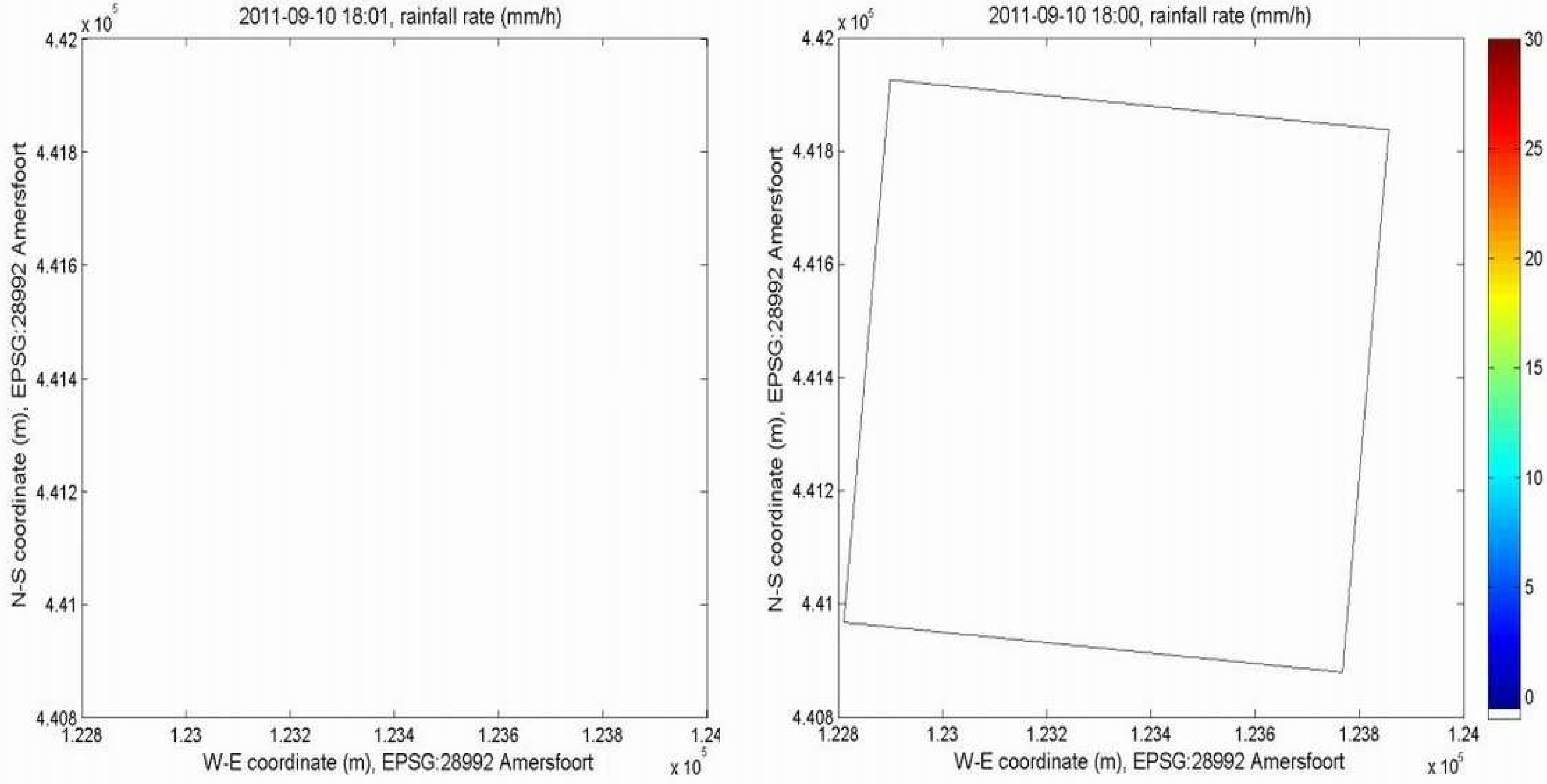
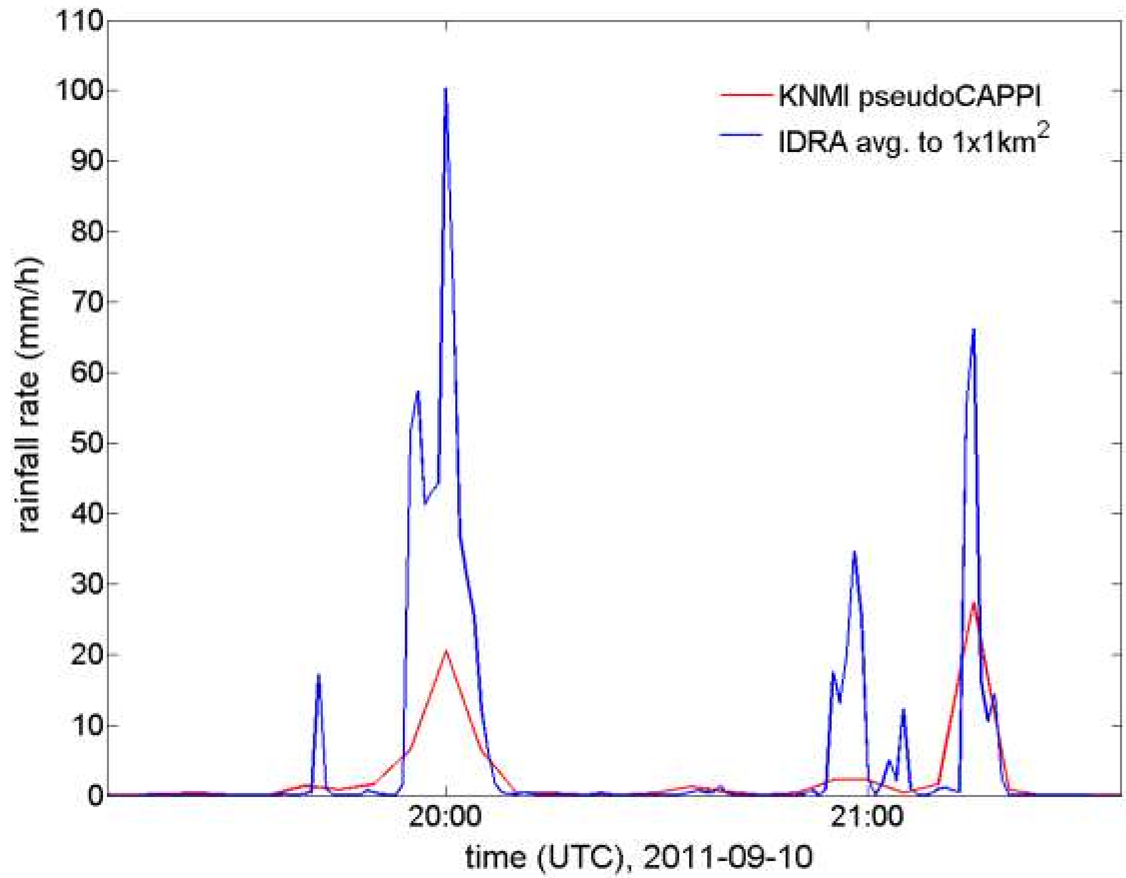
Zx vs Zc; variability in lo-res



Rx vs Rc; variability in lo-res



Rx vs Rc in one lo-res cell; time lapse



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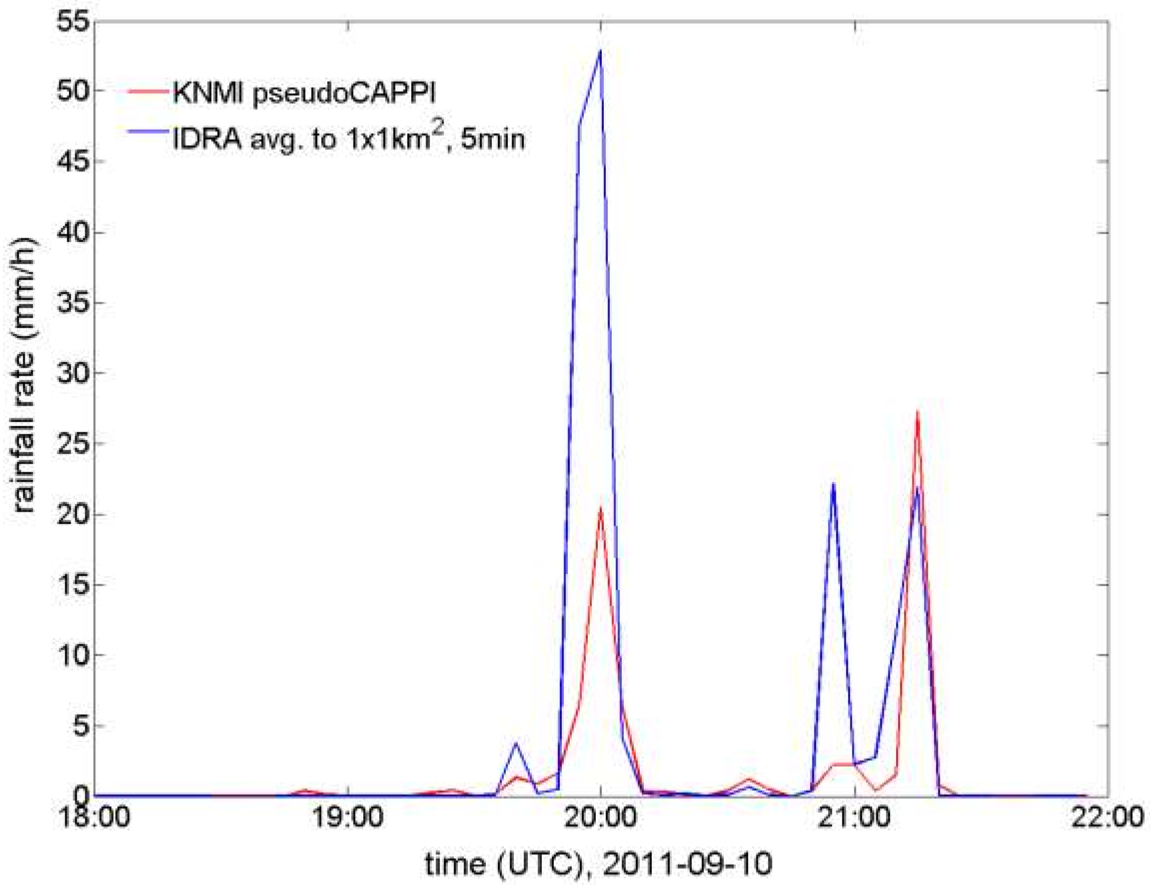
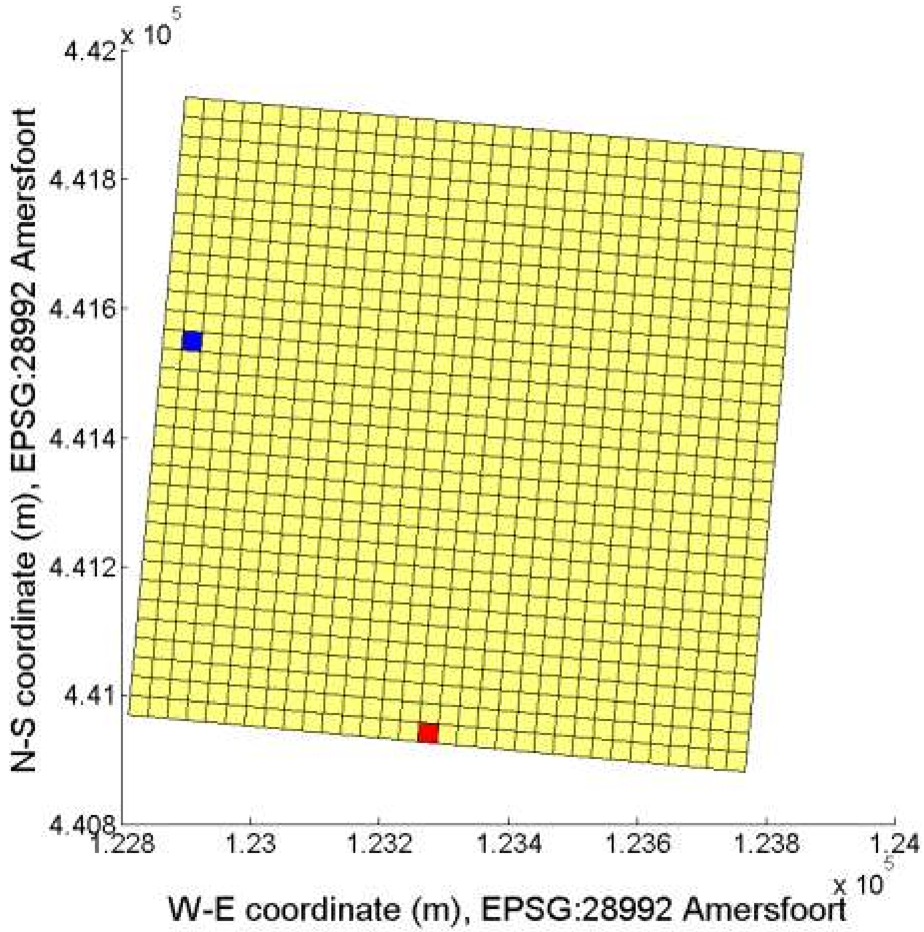
Rx vs Rc in one lo-res cell; time lapse



Cell selection in lo-res cell



Rx vs Rc; variability within lo-res cell