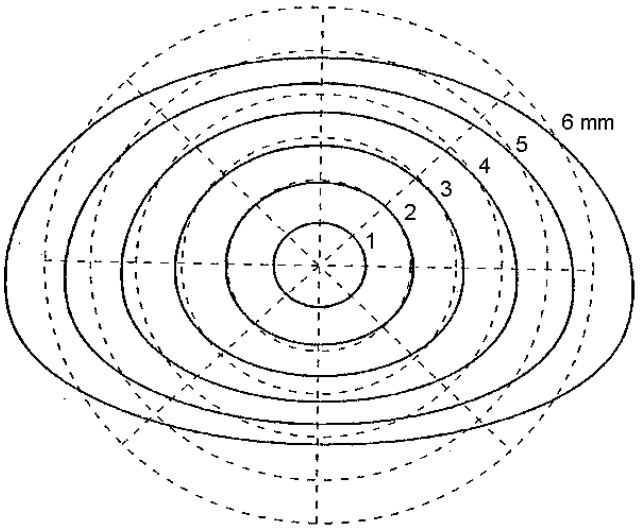
GEMATRONIK
Weather Radar Systems

Precipitation Measurement Techniques

Nordic Weather Radar Workshop
3-4 October 2002 – FMI, Helsinki

Z_{DR} – Differential Reflectivity

- Oblate Objects
- Hail detection
- Melting Layer



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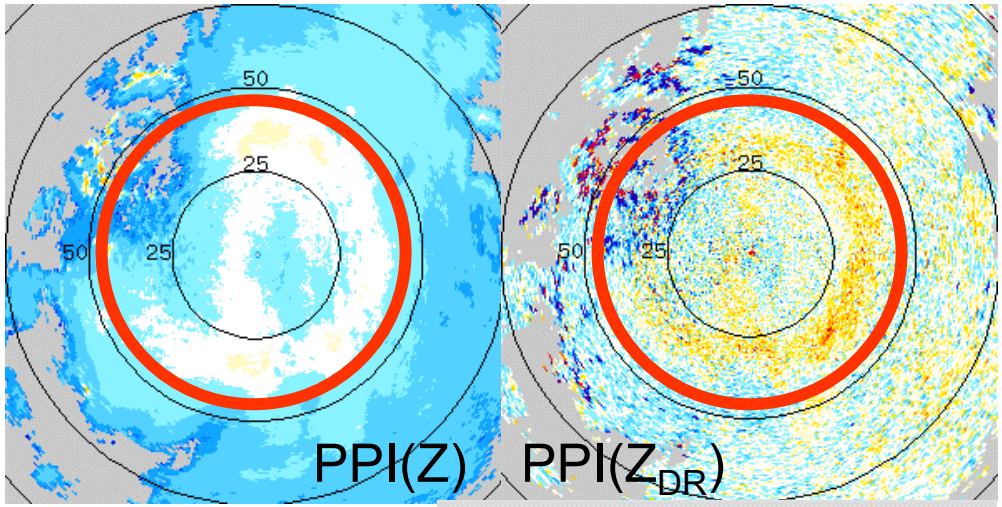

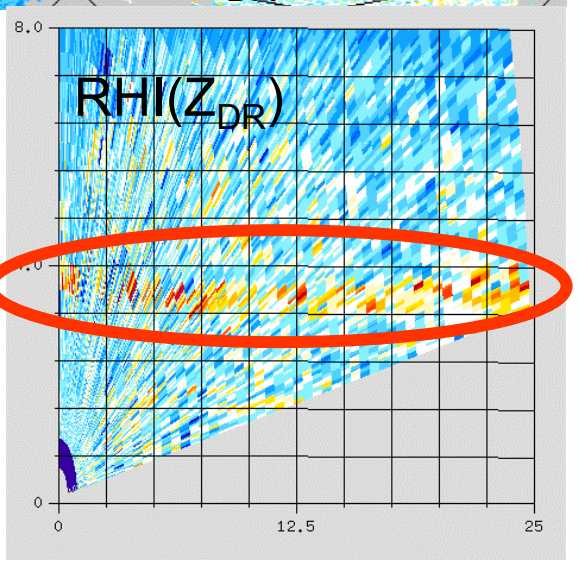

Z_{DR} – Differential Reflectivity

- Oblate Objects
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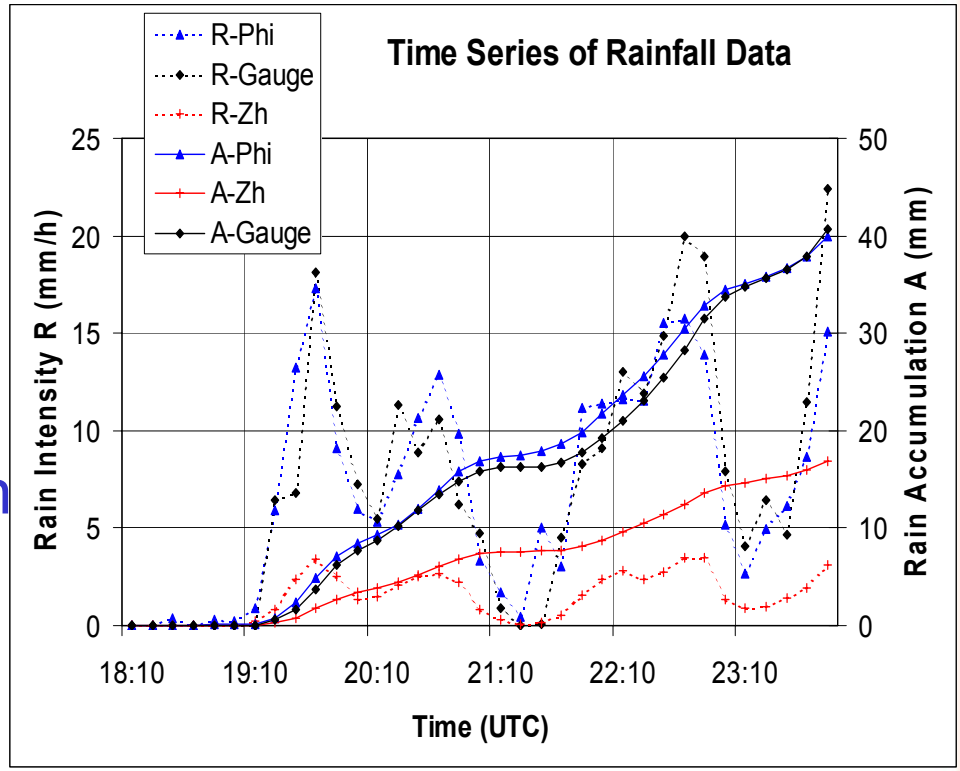
Φ_{DP} – Differential Phase Shift

- Integrated Rain Intensity
- Independent on RX calibration attenuation, beam blocking



Z_{DR} – Differential Reflectivity

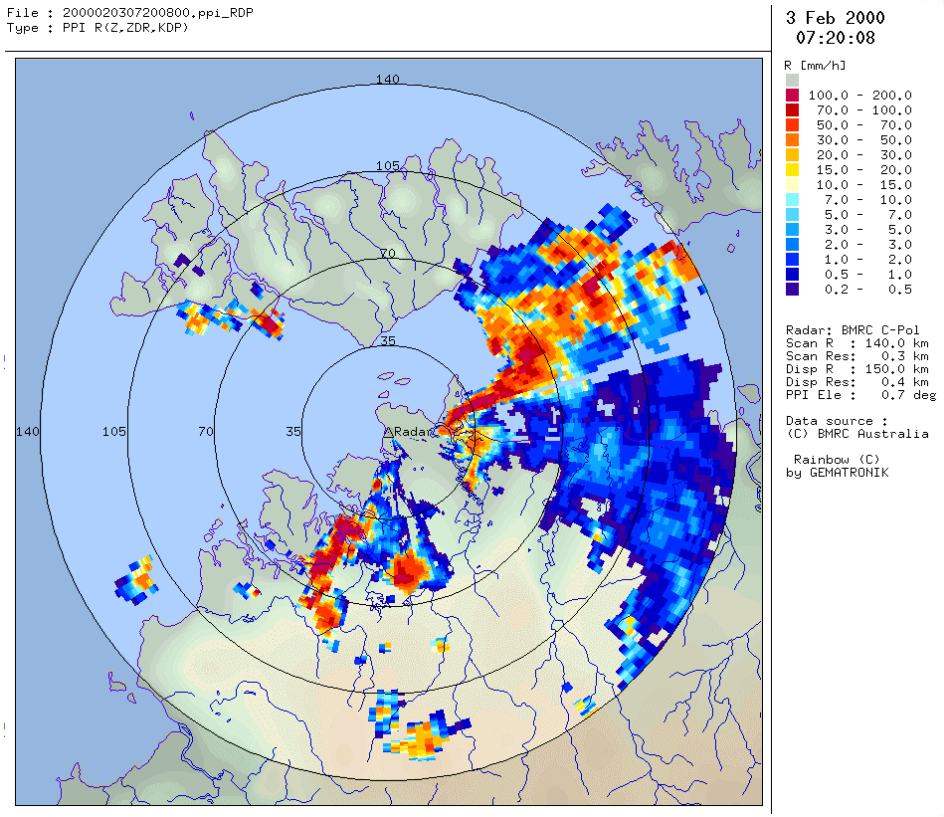
- Oblate Objects
- Hail detection
- Melting Layer

Φ_{DP} – Differential Phase Shift

- Integrated Rain Intensity
- Independent on RX calibration, attenuation, beam blocking

K_{DP} – Specific Differential Phase

- Rain Intensity
- Independent on RX calibration, attenuation, beam blocking



Polarimetric Operation: Data (2)

ρ_{HV} – Polarimetric Correlation Coefficient

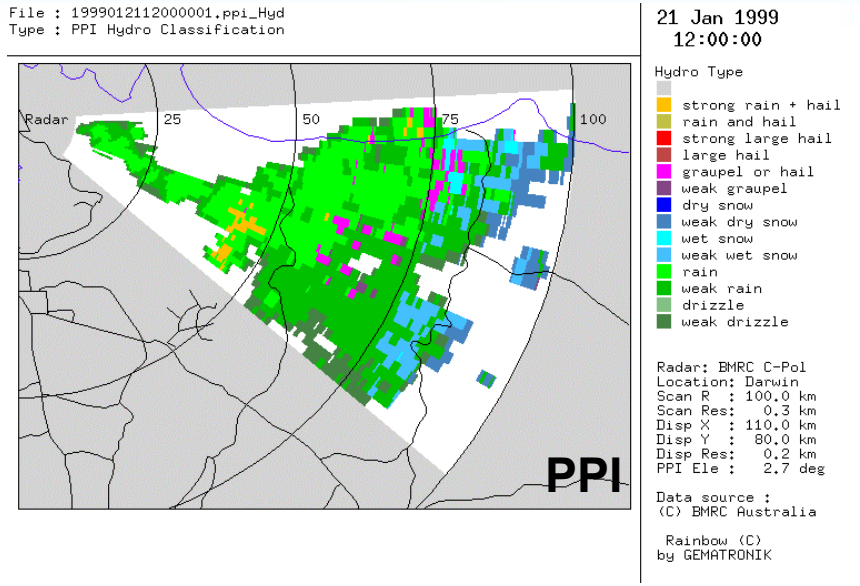
- (Ir)regularity, shape, canting angle of hydrometeors

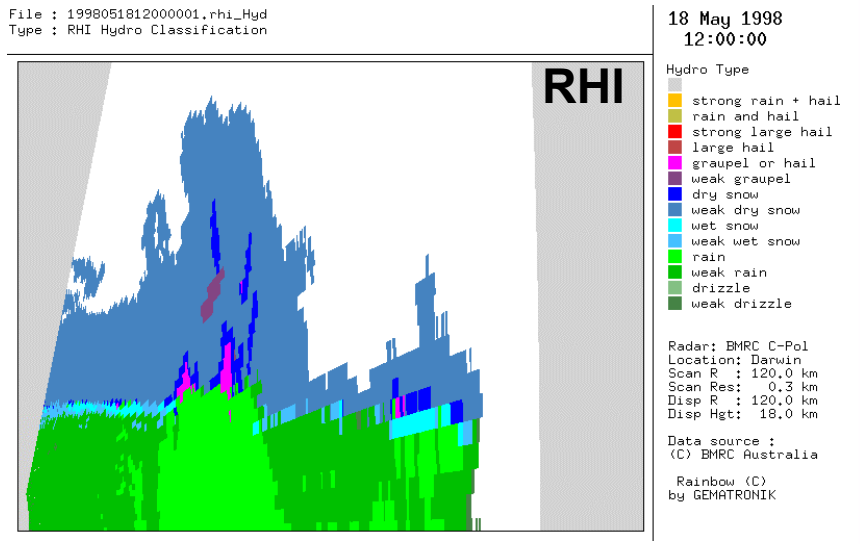
LDR – Linear Depolarisation Ratio

- (Ir)regularity, shape, canting angle of hydrometeors

Z, Z_{DR}, Φ_{DP}, K_{DP}, ρ_{HV} [, LDR]

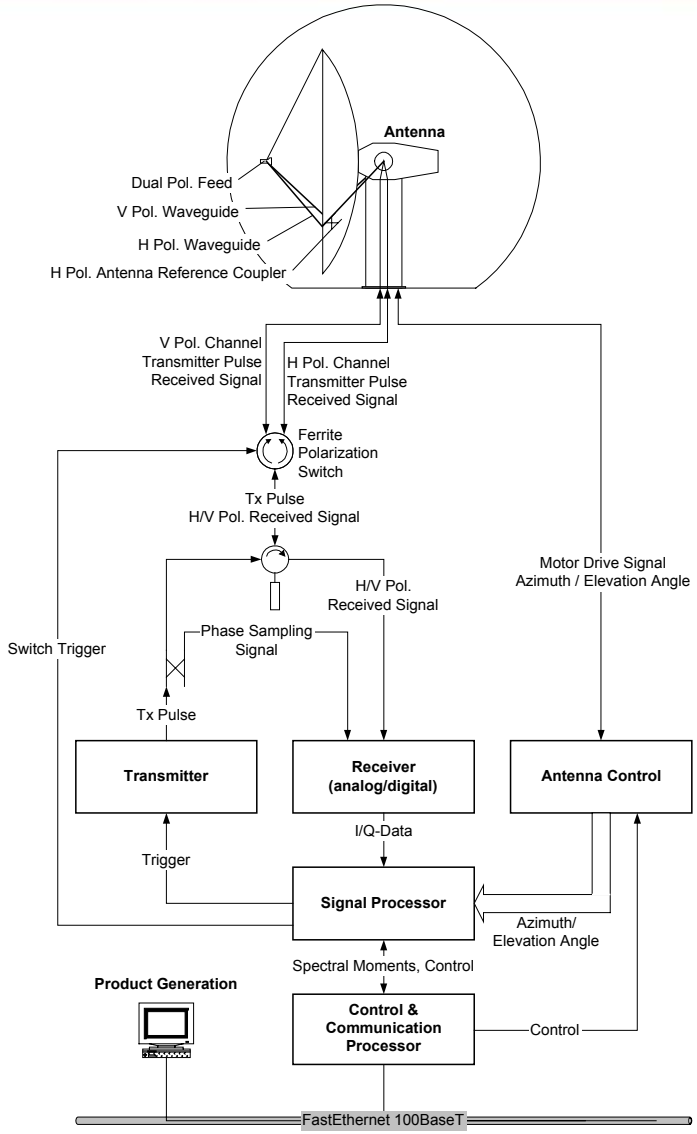
- Hydrometeor classification (Fuzzy Logic scheme)





Single Channel, Switched

- Alternating Pulses H-V-H-V
- One Receiver

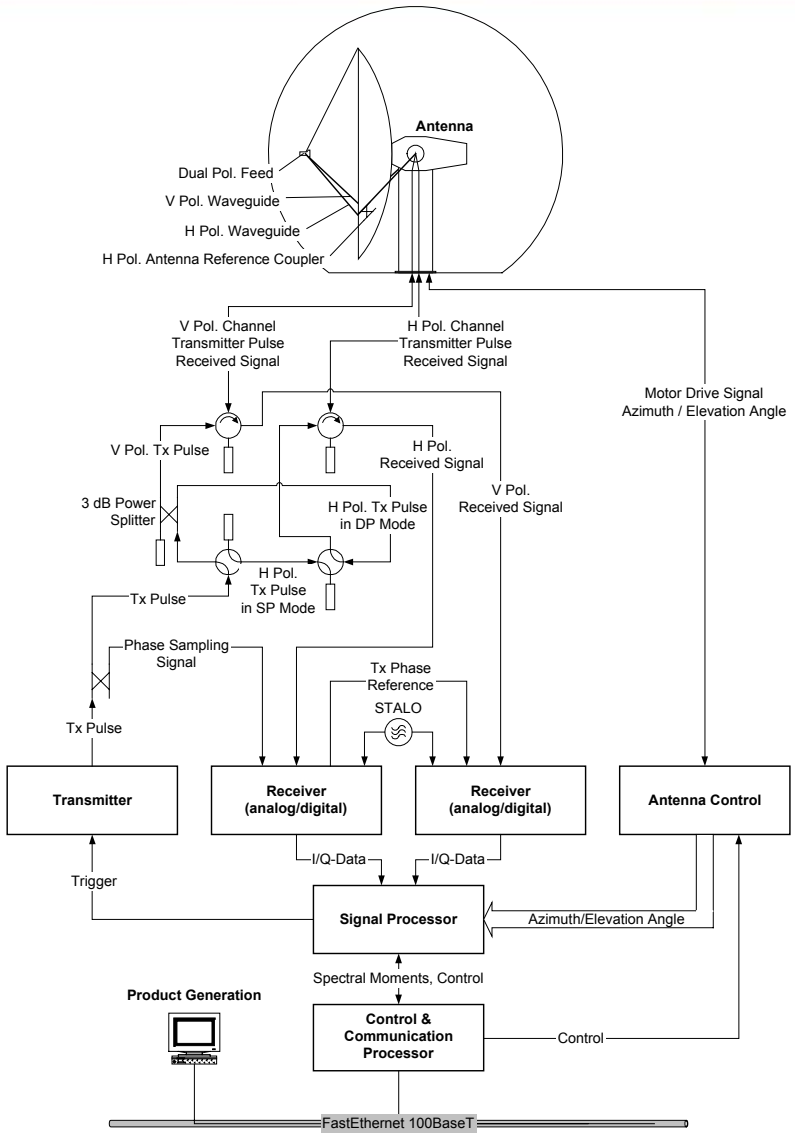


Single Channel, Switched

- Alternating Pulses H-V-H-V
- One Receiver

Dual Channel Configuration

- Transmit H and V together
- Two Receivers



Polarimetric Operation: Hardware (1)

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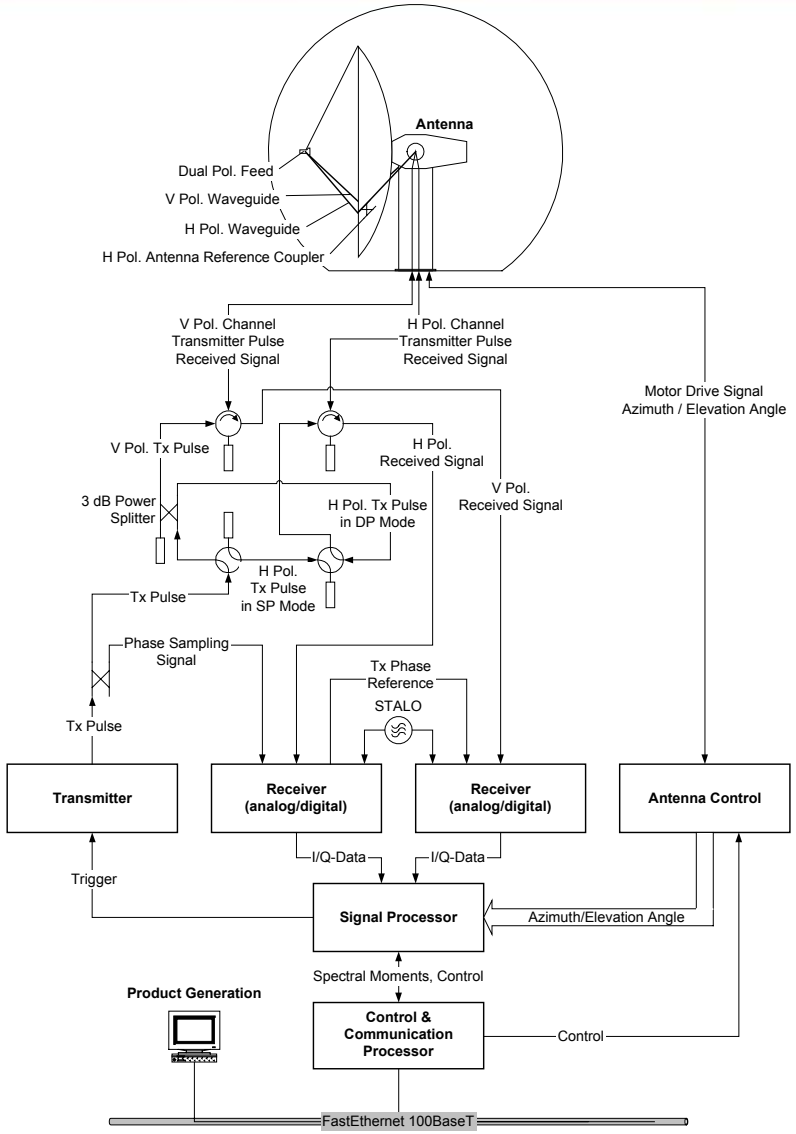
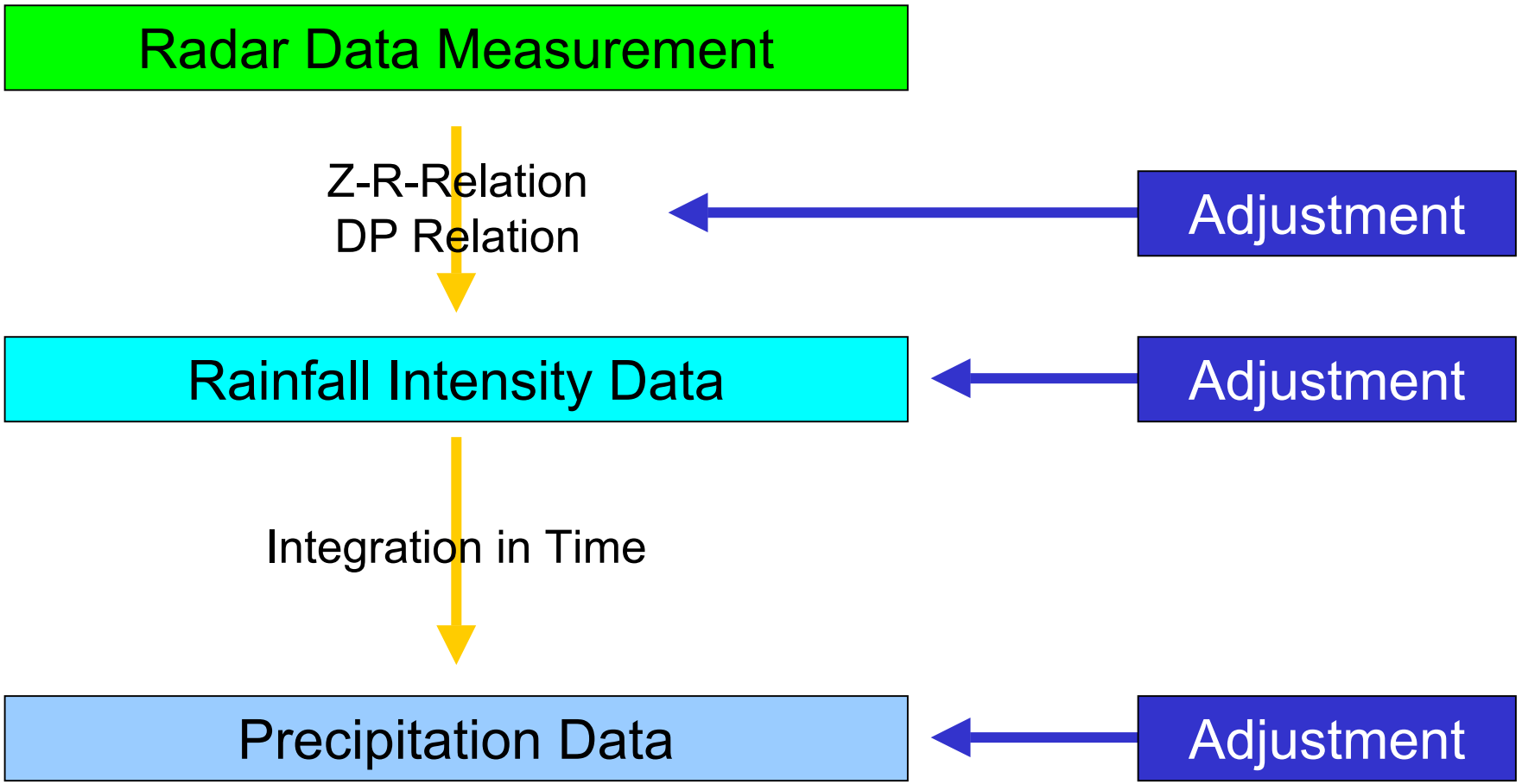


Dual Channel compared to Single Channel Switched Configuration:

- ☹ Power Separation → Sensitivity Loss 2–3 dB
- 😐 LDR: Separate Scan needed (in H-Mode)
- ☺ 2x more Processed Pulses → Better Data, Faster Scan
- ☺ Doppler Clutter Filter possible
- ☺ Unfolding by Staggering possible


Radar Data Measurement
Z-R-Relation
DP Relation
Adjustment
Rainfall Intensity Data
Adjustment
Integration in Time
Precipitation Data
Adjustment

Precipitation: Integration in Time

$$A = \sum_i R_i \cdot \Delta t_i$$

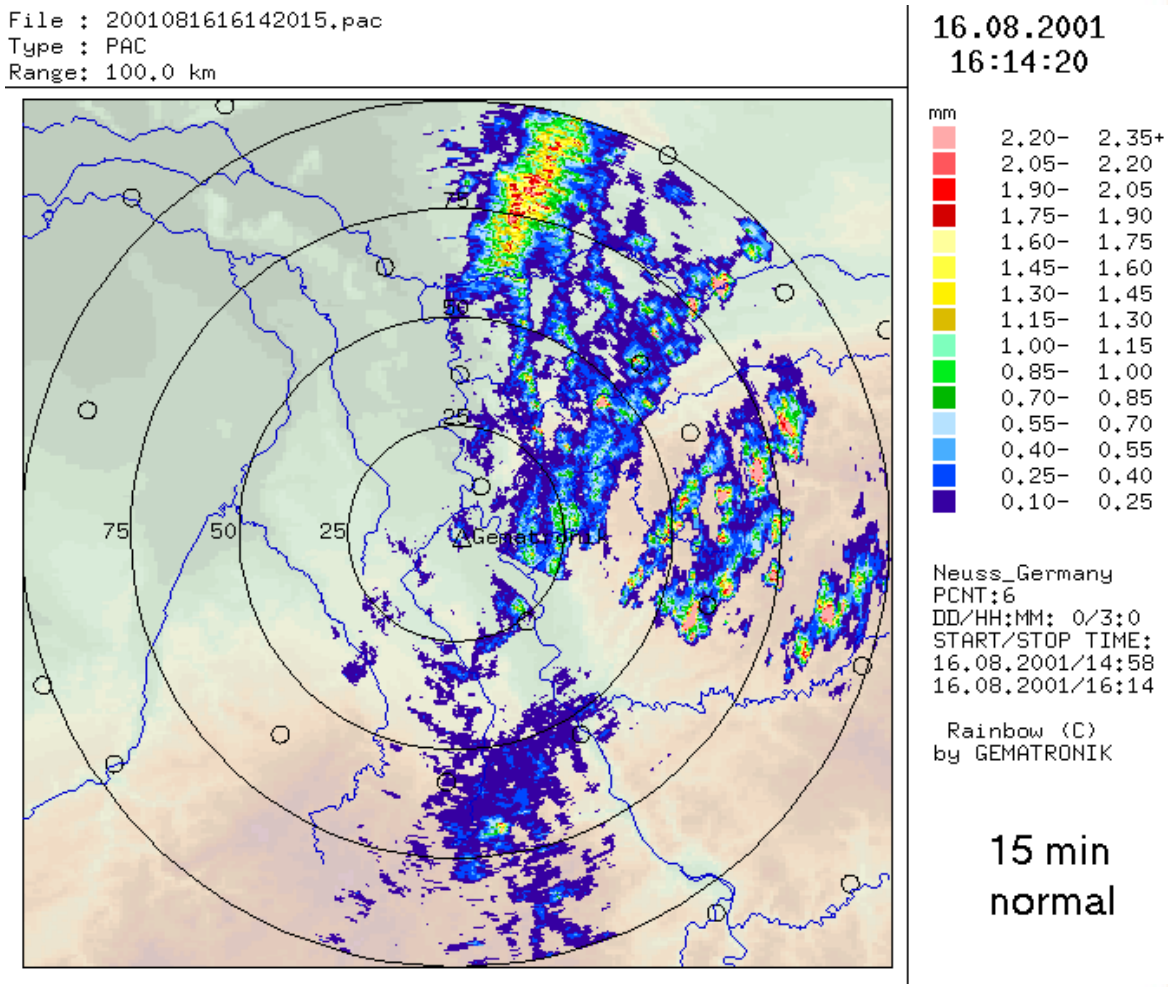
A Precipitation amount

R_i Rainfall intensity (at t_i)

Δt_i Time step

Important goal:
Minimise Δt_i

Solutions:
a) Scan Strategy



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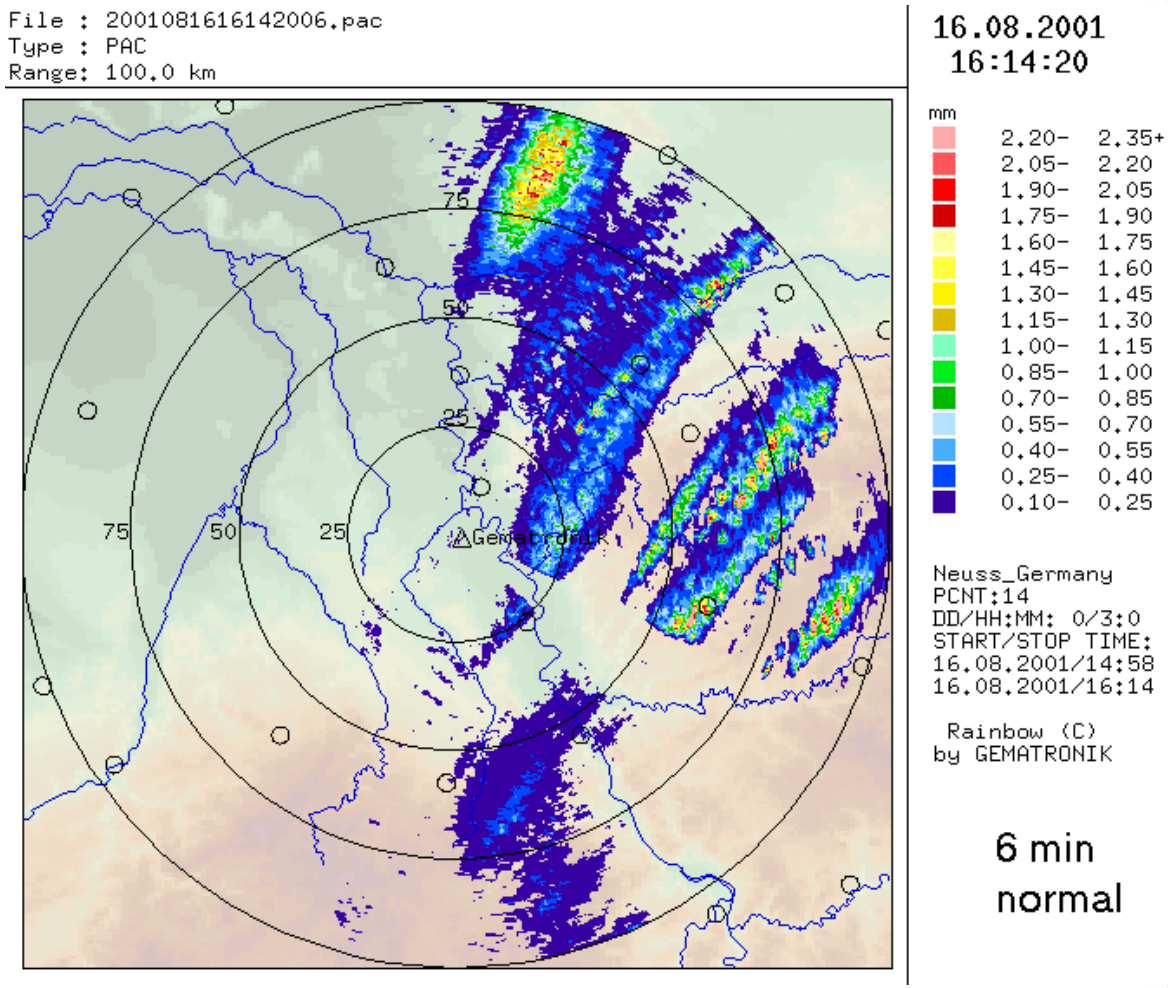

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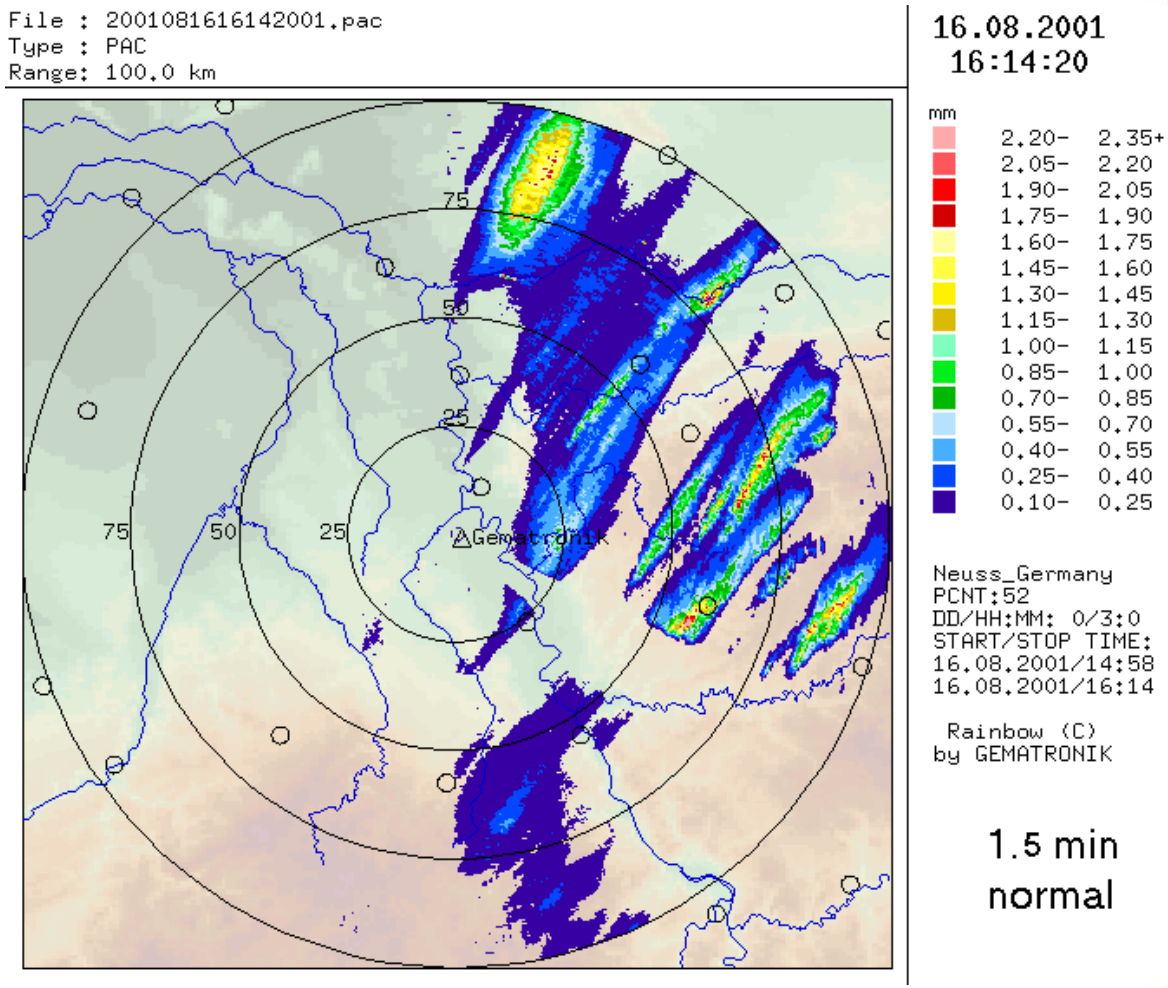

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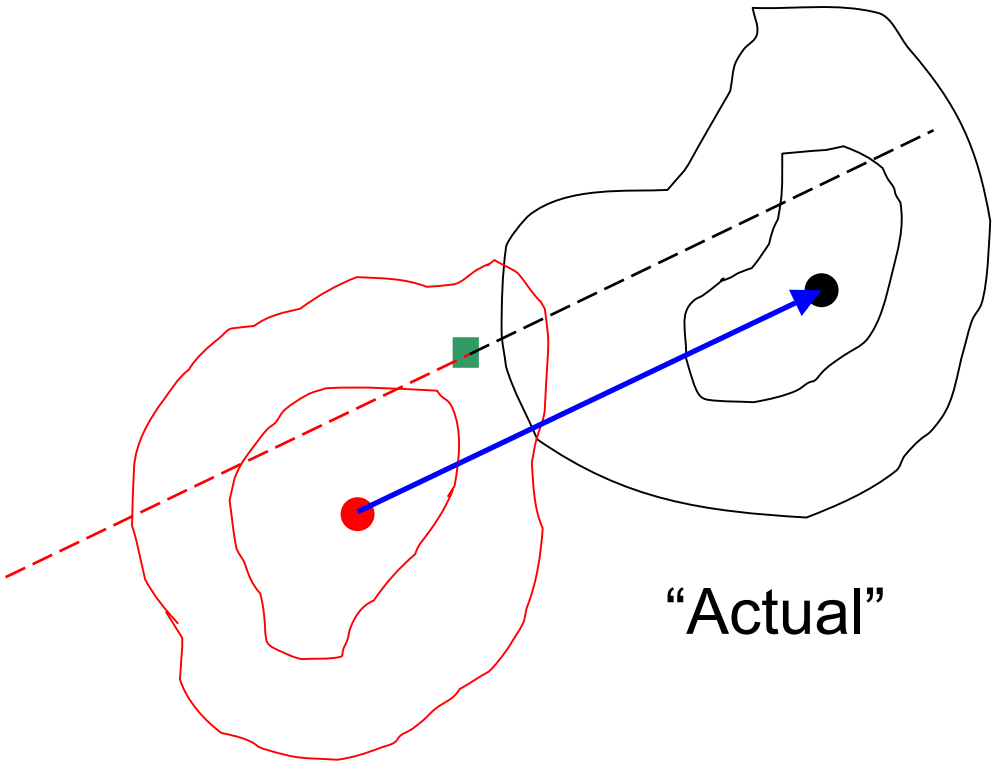

Solutions:

a) Scan Strategy

b) Tracking methods

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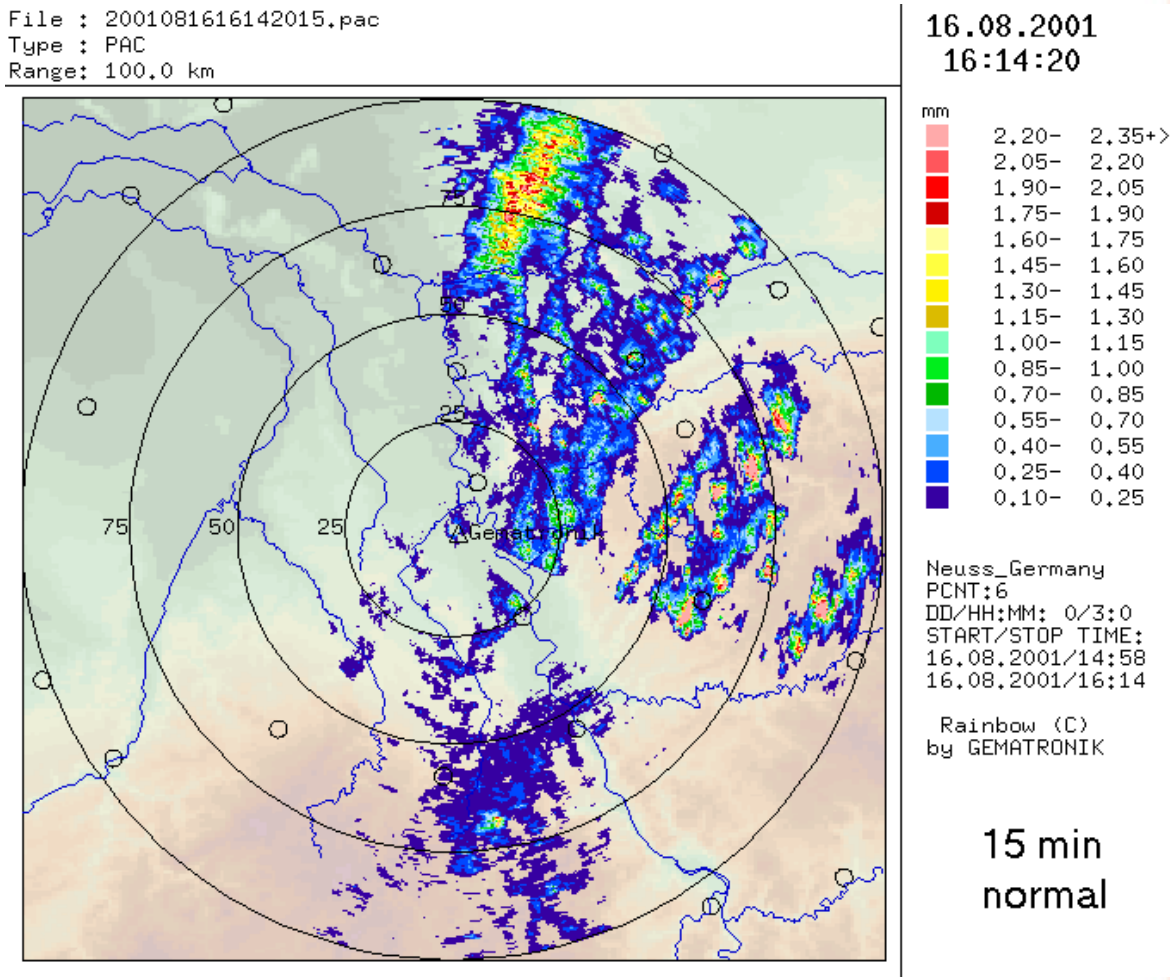

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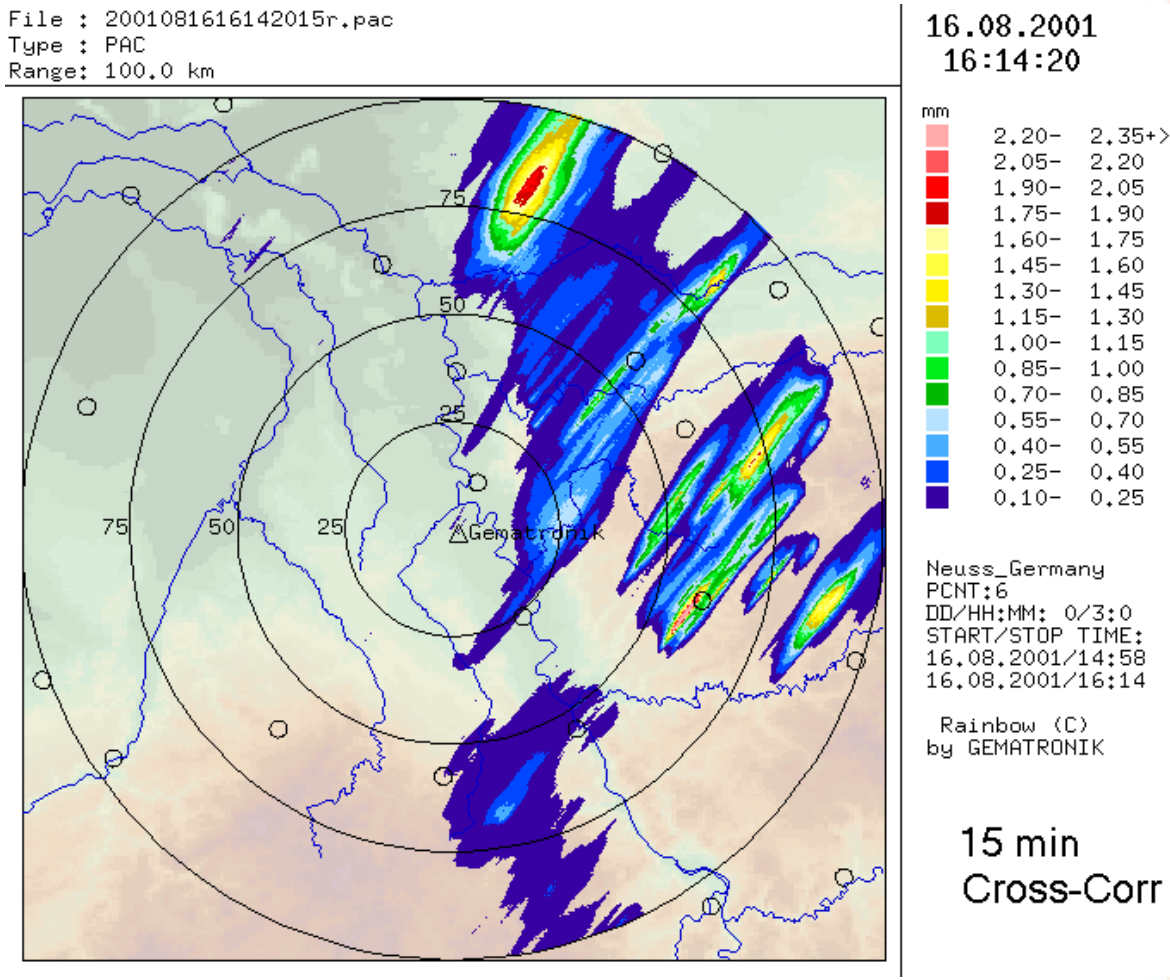

Adjustment: Steps

Adjustment step		Method
Z-R-Relation		Mechanical Disdrometer Optical Disdrometer
Rainfall Intensity		Disdrometer Rain Gauge
Rainfall Accumulation		Rain Gauge

Adjustment: Network Solutions

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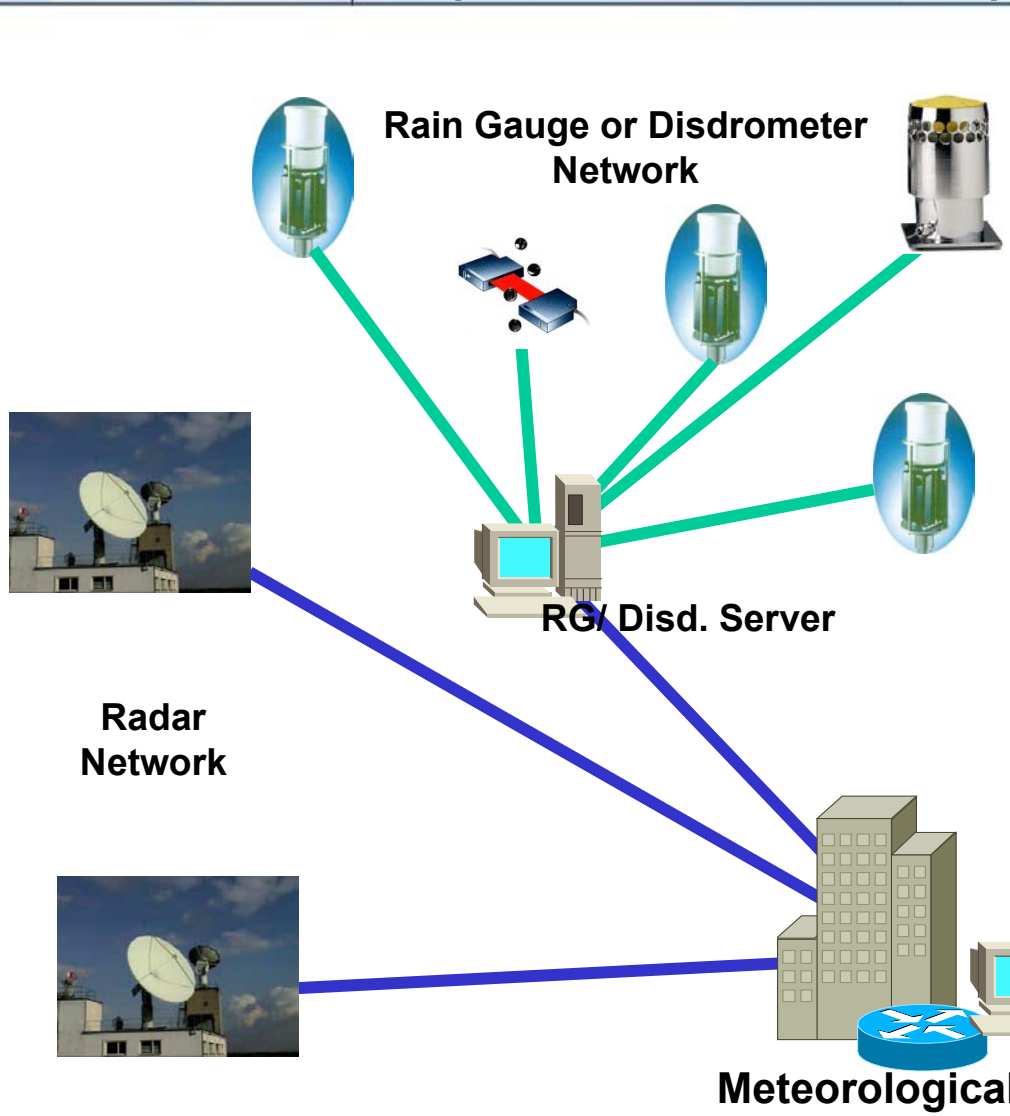

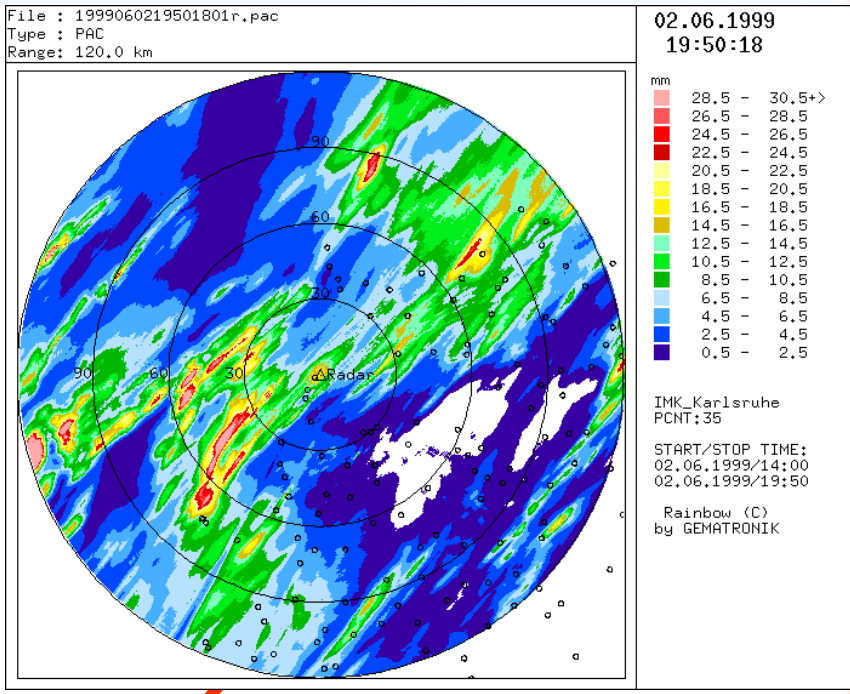

Adjusted Radar Data

Gematronik GmbH • Weather Radar Systems • P.O. Box 210351 • 41429 Neuss, Germany • E-Mail: info@gematronik.com

MUSIC – **Mu**lti **S**ensor Precipitation Measurements **I**ntegration, **C**alibration and Flood Forecasting

Objectives:
- Improvement of Precipitation Measurements
- Improvement of Flood Forecasts

Methods:
- Combine Radar, Rain Gauge and Satellite Data
- Block Kriging, Bayesian Combination
- Consider Data Errors and Uncertainties
- New Visual User Interfaces

Results:
- Multi-Sensor Precipitation Estimator
- Flood Forecasting Decision Support System

More Information: http://www.geomin.unibo.it/orgv/hydro/music/

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