Internship in Helsinki, Finland

January - February 2006

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Overview of the visit

- Presentation with FMI people
  - Dr. Pauli Rissanen, Antti Taskinen about wind error correction,
  - Johanna Ramo about comparison study of manual & automatic gauge
  - Anu Petaja about WXT 510 weather station (6 params)
  - Jarmo Koistinen about integrating radar with ground measurements by RG (underestimation of precip. from radar, bias grows with distance).
- Visit to 2 meteostations, one good (Roykka) & one bad place (Maasoja).
- New Vaisala radar visit, University of Helsinki.
- Office work:
  - description of 42 meteostations around Helsinki, position, surrounding
  - web page prototype.
  - wind error calculation for different cases (Excel)

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General description

- Dense network of meteostations around Helsinki, distance < 10 km from e.a.
- 42 masts with 94 WXT510 on 2/3 levels. Not optimal for precipitation measurements.
- 5 min time resolution, communication through cell network
- Each WXT510 gives 6 params: temperature, humidity, pressure, wind speed & direction, liquid precipitation (acoustic disdrometer)

Fig. 1 Testbed network around Helsinki

Vaisala Weather Transmitter WXT510

- **Wind speed**
  Measurement range 0 ... 60 m/s
  Accuracy ±0.3 m/s or ±3%, whichever is greater (0 ... 35 m/s)
- **Wind direction**
  Accuracy ±3°
- **Liquid precipitation**
  Accuracy 5%*
  Rain duration - counting each ten second increment when droplet detected
  Rain intensity - one minute running average in ten second steps
- **Barometric pressure**
  Measurement range 600 ... 1100 hPa
  Accuracy ±0.5 hPa at 0 ... 30 °C (+32 ... +86 °F)
- **Air temperature**
  Measurement range -52 ... +60 °C (-60 ... +140 °F)
  Accuracy at +20 °C (+68 °F) ±0.3 °C (±0.5 °F)
- **Relative humidity**
  Measurement range 0 ... 100 %RH
  Accuracy ±3 %RH within 0 ... 90 %RH

All Weather Precipitation Gauge VRG101

- Weighting gauge
- anti-freeze, temperature compensated load cell
- Tretyakov wind shield used in Finland
- time resolution 1 min (max).
- 5 units were used in the testbed.

Fig. 2 VRG101 and one of testbed experimental stations (Roykka)

Visit to meteostations (Roykka, Maasoja)

Fig.3 Roykka meteostation

Well isolated from the wind place, in the forest opening. Reliable measurements.

Visit to meteostations (Roykka, Maasoja) Cont.

Fig.4 Maasoja meteostation.

Open place, field , high wind errors, up to 50 %.

Wind induced error

The amount of measured precipitation is giving an underestimation, that could be as large as 50% of ”real” precipitation.

- The main source of error for the measurements in Nordic countries is aerodynamical error.
- Correction model used here is based on the windspeed on the level of gauge orifice, because for VRG (weighting gauge)
  - evaporation loss = 0 and
  - wetting loss = 0,

  so wind induced error is the most important loss.

Correction Model

General equation:

$P_{real}=k*P_{measured}$,

where *k* is a function of Temperature
(different coefficient for liquid precipitation and different kinds of snowflakes) and wind speed at gauge level.

“Angle of exposure” alpha (0-26 °)

shows, how much place is protected from the wind, helps to estimate wind at gauge level. Here, we simply measure wind at gauge level.

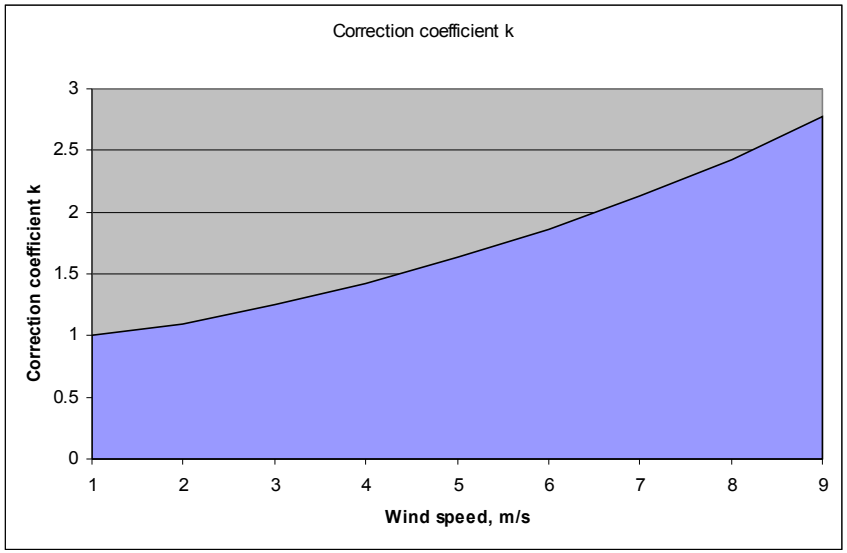
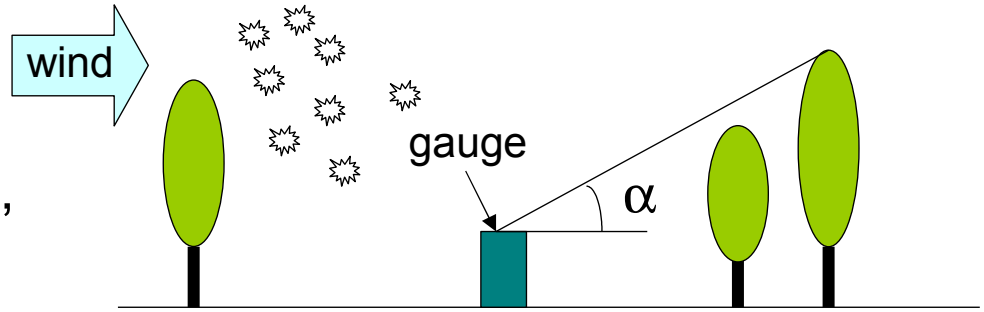


Fig. 5 Correction coeff. for T>0



Summary of some studied cases

- ”Drizzle case” 5-7 November 2005
  - Röykkä total PI_{corr}=4.96 mm, delta=0.17, or 3.4 %
  - Loukku total PI_{corr}=12.47 mm, delta=1.86, or 15 %
  - Malmi total PI_{corr}=11.73 mm, delta=3.26, or 28 %
- ”End of December ” 15-31 December 2005
  - Malmi, total PI_{corr} = 48.6 mm, delta= 19.5, or 40.2 %
- Radar case 28 -30 November 2005
  - Malmi, total PI_{corr} = 41.5 mm, delta= 17.8, or 42.80% !!

Radar visit

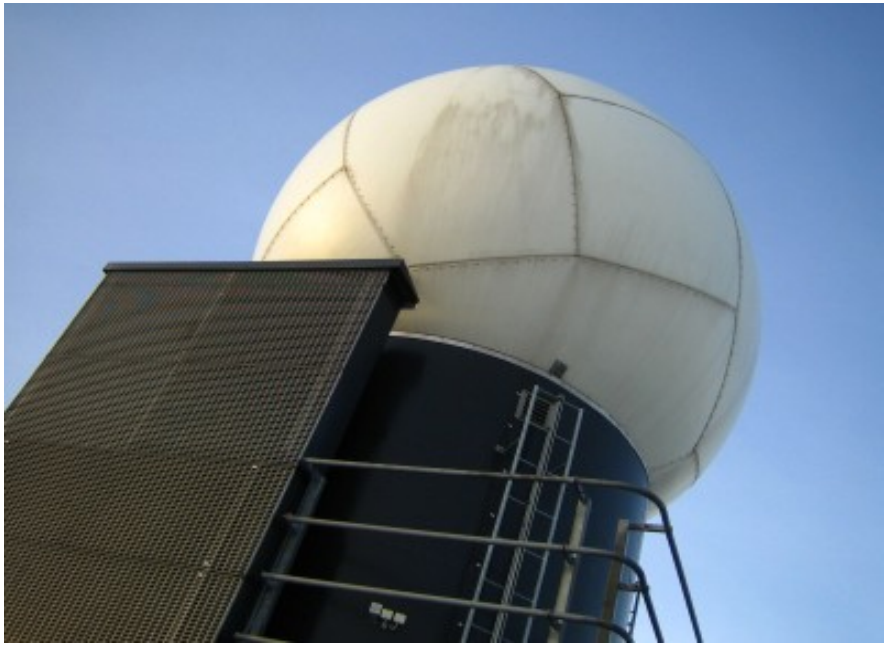


Fig. 6 Vaisala' new prototype radar, roof of University of Helsinki, Kumpula.

Dual-pol (simultaneous H+V) C-band experimental radar:

1 deg beam, 50 m max horizontal resolution.

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integration of radar data & ground observation, for 4 gauges

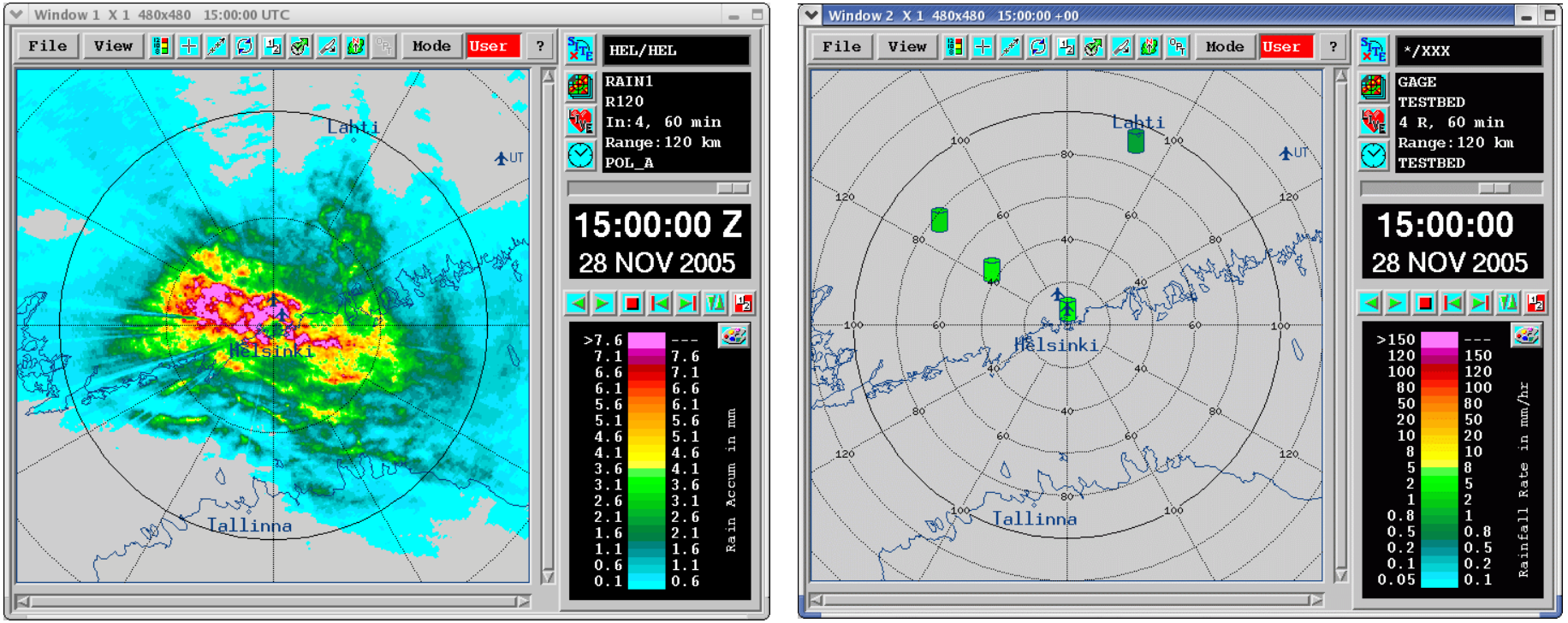

Fig. 7 Radar data, and gauges data, 1hr average, 28 November 05

Radar data shown here is not corrected.

Work done

- Created description of 42 meteostations around Helsinki, which includes meta-data important for meteorologists, such as position, altitude ASL, type of surrounding, distance from the see, etc.
- Created web page prototype, with description of the degree of wind protection and surrounding for each of 8 directions (N, S, W, E, etc). This should be placed on Vaisala web-page soon, for every station.
- Wind error was calculated for different cases (T><0, wind speed 0-8 m/s), using Excel. This is a test of real algorithm that should be applied to collected data from the testbed.
- As a result of the research, the strategy of adding new sensors to the testbed was changed.
- Ideas about integration of radar data and ground observation, data from the gauges.

Question?

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