Observations for PBL Validation: The Helsinki Testbed Network and SMEAR Stations

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ILMATIETEEN LAITOS Meteorologiska institutet Finnish meteorological institute







A Public–Private Partnership



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- Forecasting (public)
- Research (meteorology, air-quality)
- Commercial services (road weather, meteorology, climate)



Instrumentation (e.g., WXT, radar)Solutions (networks, applications)



Surface Weather Transmitter: Vaisala WXT510 (61)











Testbed Observations Online



Near-surface stability (°C km⁻¹)

Stability is $S = (T1 - T0) \div (z1 - z0)$,

i.e. the temperature difference between the mast top and the base divided by the difference of the corresponding altitudes.

Positive values indicate a surface inversion.

Univ of Helsinki Dual-Polarimetric Radar



Other Instrumentation

- Radiosonde (1–2)
- Road weather sensors (191)
- Weighing precipitation sensors (10)
- Ceilometers (12)
- UHF wind profiler with RASS VAISALA
- RD-69 Disdrometer
- Precipitation occurrence sensor
- Hydrometeor Size Detector 🔹







Data Availability

Google Earth



- Public Web page (testbed.fmi.fi)
 - Free real-time radar data
- Researcher's Interface on Web
- Real-time Web Service interface for customer applications (under construction)

Helsinki Testbed provides...

- Database
 - Measurements
 - NWP fields
 - Access over internet
- Infrastructure
- Measurement sites

"Open invitation to the research and operational communities...."

http://testbed.fmi.fi





SMEAR II

Station for measuring Forest Ecosystem - Atmosphere Relations University of Helsinki, Forestry Field Station, Hyytiälä



(Timo Vesala)



Continuous measurements since 1996

(Timo Vesala)

The SMEAR III Station, Kumpula Campus



- Started autumn 2004
- Surface—atmosphere interactions in an urban area
- 31-m high tower

Measurements at SMEAR III Tower

Variable	Height above ground level (m)	Instrument
Wind speed and direction	4, 8, 16 and 31	2-D ultrasonic anemometer
		(Thies CLIMA V2.1x)
Temperature	4, 8, 16 and 31	Platinum resistance thermometer
		(Pt-100)
Global radiation, PAR, and up and downward longwave radiation	31	Net radiometer and photodiode sensor (Zipp&Zonen, CNR1 + PAR Lite)
Fluxes of momentum and heat	31	3-D ultrasonic anemometer
		(Metek USA-1)
Fluxes of CO_2 and H_2O	31	Open-path and closed path CO ₂ /H ₂ O gas analyzers (LI-7500, LI-7000) + ultrasonic anemometer (Metek USA-1)
Aerosol particle flux	31	Condensation particle counter (CPC- 3781) + ultrasonic anemometer (Metek USA-1)

Measuring Turbulent Fluxes

- Turbulent fluxes are calculated with eddy-covariance (EC) technique
- The measurement set-up includes:
 - A 3-D ultrasonic anemometer (Metek USA-1) to measure vertical wind speed
 - Open-path (LI-7500) and closedpath gas analyzers (LI-7000) to measure CO₂ and H₂O concentrations
 - Condensation particle counter (CPC-3781) measures the total aerosol particle concentration



Diurnal Cycle of Fluxes



Sensible heat (black) Latent heat (red)

(Leena Järvi)





- Forecast and dispersion modeling (development and verification)
- Information systems and technology
 integration
- End-user product development and demonstration
- Data distribution: public, research
- Mesoscale weather and instrument research

LAPS: Local Analysis and Prediction System



Examples of LAPS Analyses for Testbed Area





Surface Temperature

Fractional Cloud Cover

Cloud Cover (fraction)

VT 15-Jan-2008 1800 UTC

(Erik Gregow, FMI)