

Helsinki Testbed - A four-season mesoscale research and development platform

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Introduction

The Finnish Meteorological Institute (FMI) and the Vaisala meteorological measurements company have established a new mesoscale observational network in Southern Finland. The Helsinki Testbed is expected to provide new information on observing systems and strategies, mesoscale weather phenomena and applications in a coastal high-latitude environment. The goal of this project is to provide input and experience for mesoscale weather research, forecast and dispersion model development and verification, information systems integration, end-user product development and data distribution for the public and the research community.

During the first phase of the project the most intense activities have concentrated on specific, usually month-long measurement campaigns. After August 2006 FMI and Vaisala have agreed to keep the infrastructure running and continue the operation of Helsinki Testbed as a continuous, dynamic mesoscale weather research and innovation environment.

According to Dabberdt et al. (2005), a testbed can be defined as a working relationship in a quasi-operational framework among measurement specialists, forecasters, researchers, the private sector, and government agencies aimed at solving operational and practical regional problems with a strong connection to end-users. Outcomes from testbeds are more effective observing systems, better use of data in forecasts, improved services, products, and economic/public safety benefits. Testbeds accelerate the translation of R&D findings into better operations, services, and decision-making. A successful testbed requires physical assets as well as long-term commitments and partnerships.

The Helsinki Testbed core project has funding from Technology Agency of Finland (TEKES) and partners from many sides of the society: e.g. Finnish Road Enterprise and Road Administration, Radiation and Nuclear Safety

Authority, Helsinki Metropolitan Area Council (Air Quality Authority) and some partners from industry. Additional research projects are welcome to use the data.

Network and instrumentation

status 1.8.2006

Surface station network, total 355 stations

Surface weather stations

- 46 FMI weather stations
- 34 FMI precipitation stations
- 5 Weighing precipitation gauges
- 13 Off-line temperature loggers
- 22 Vaisala Weather Transmitter stations
- 191 Road weather stations

Instrumented towers

- 44 Cell phone base station masts with Vaisala Weather Transmitters at 2 or 3 levels each

Remote sensing instruments

- 5 Optical backscatter profilers (ceilometers)
- 4 Doppler radars
- 1 Dual-polarization Doppler radar
- 1 Wind Profiler with RASS

RAOB sounding stations

- 4 stations with 3-4 daily soundings during the campaigns

Weather transmitter installation on top of the Olympic Stadium, Helsinki, Finland.

UPPER WEATHER TRANSMITTER
h = 40 ... 100 m

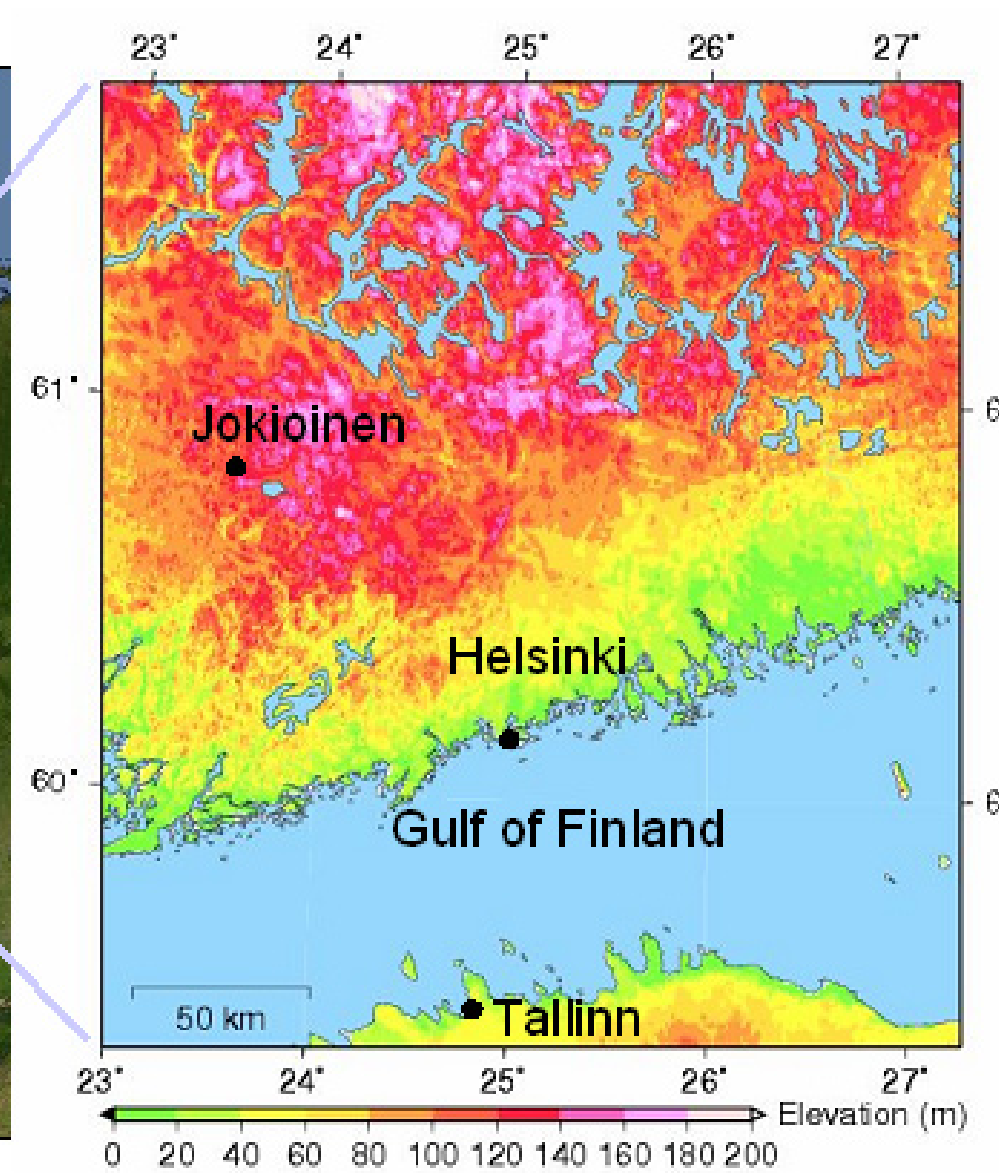
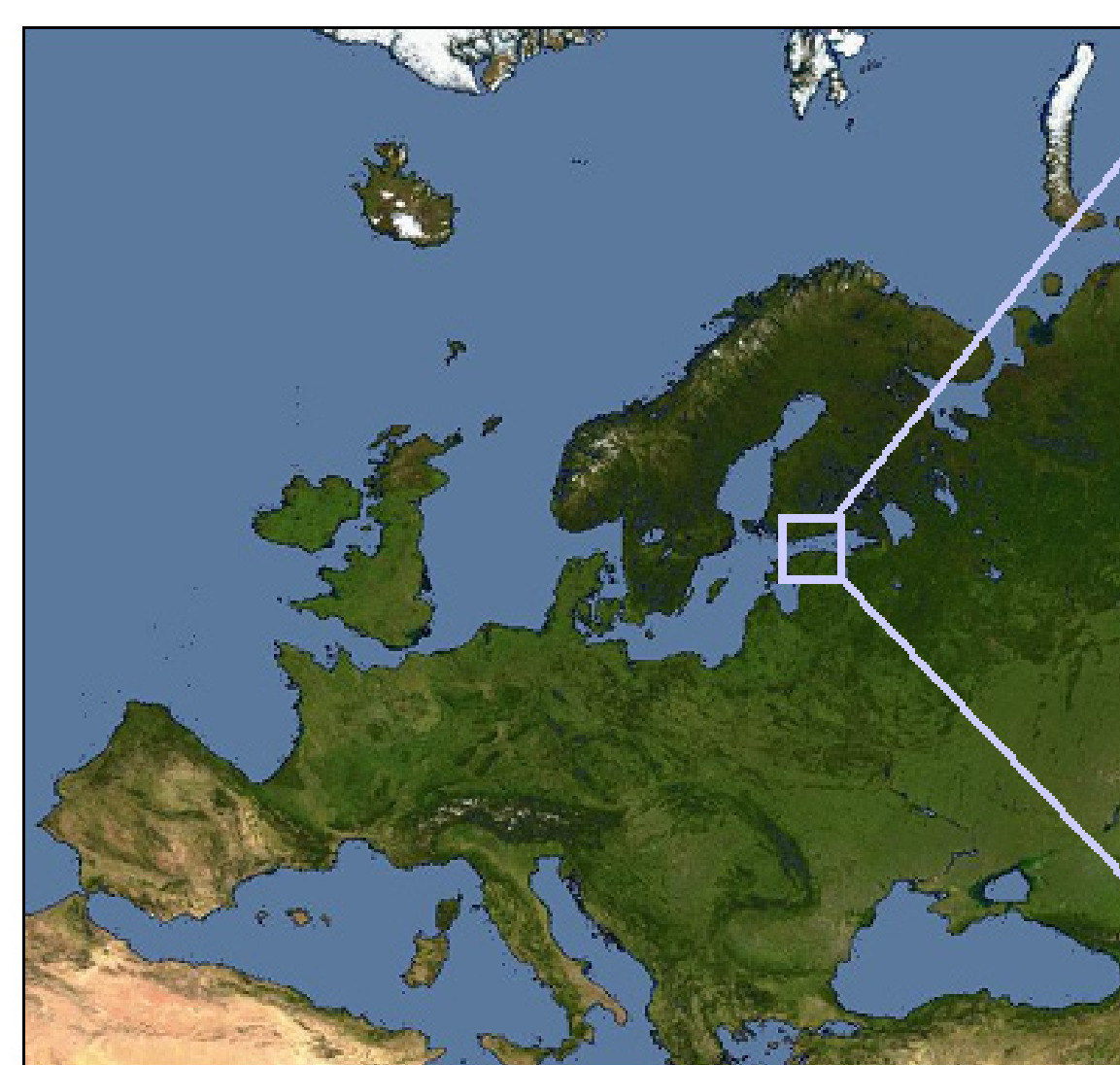
MIDDLE LEVEL WEATHER TRANSMITTERS (OPTIONAL)
h = 20 ... 30 m

LOWER WEATHER TRANSMITTER
h = 2 m



COMMUNICATIONS UNIT

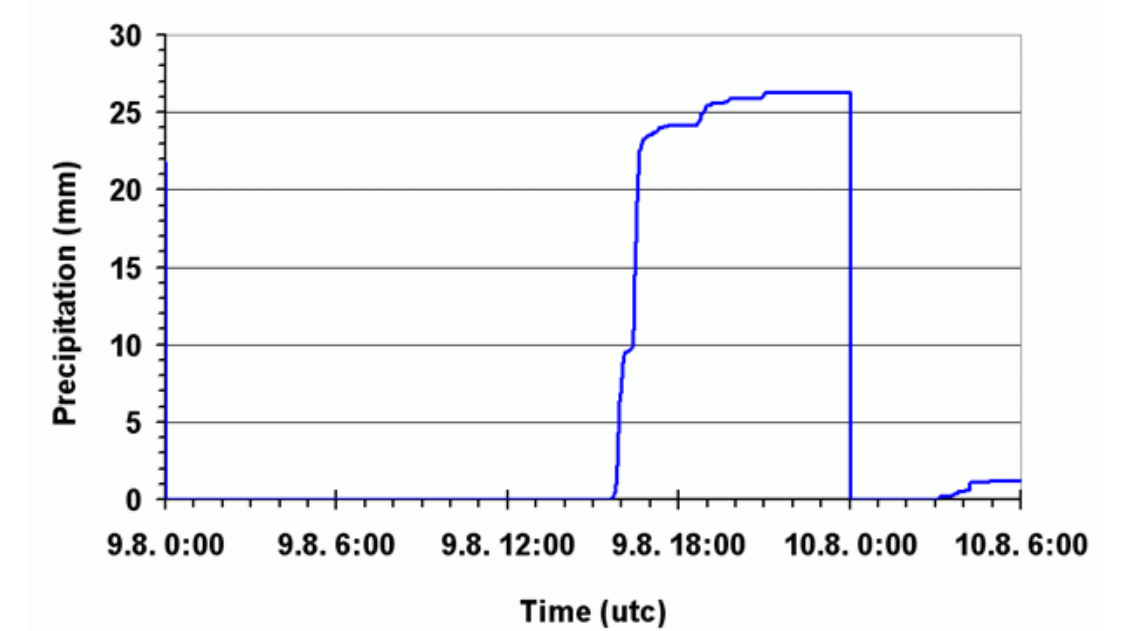
Schematic drawing of a mast site.



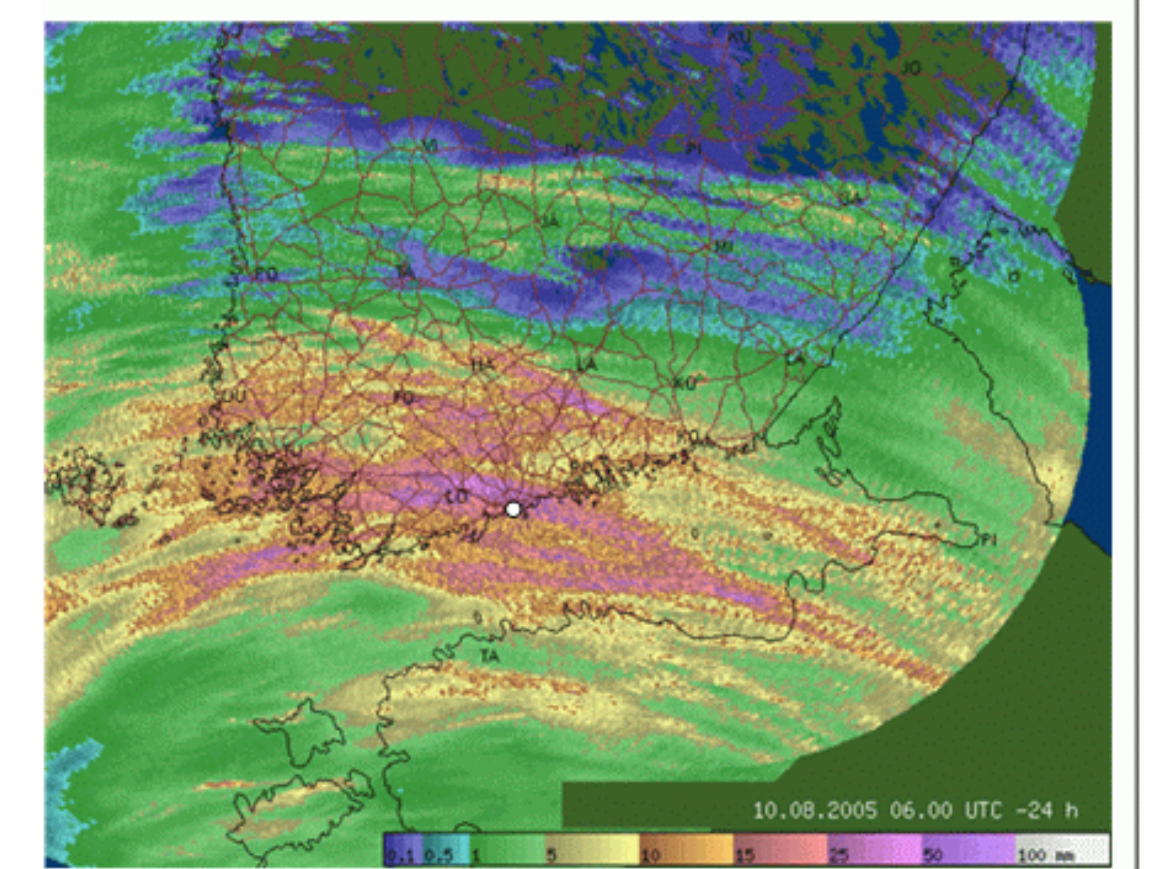
Campaigns

For convenience, each of the campaigns has been named with a typical mesoscale phenomena or activity of that season.

- August 2005: Nowcasting campaign
- November 2005: Precipitation type campaign
- January-February 2006: Stable boundary layer campaign
- May 2006: Sea breeze campaign
- August 2006: Convection campaign



Measurements on 9-10 August 2005 with Vaisala Weather Transmitter WXT510 at Olympic Stadium, Helsinki.



Accumulated 24 h rainfall on 9-10 August 2005 with 5.4 GHz weather radar. Helsinki city center is marked with a white dot.

IT design, web access to data

The Helsinki Testbed central data warehouse (CDW) uses modular interfaces for heterogeneous data producers with the help of XML definitions, named FMML (Finnish Meteorological Markup Language). Data from AWS stations are collected and quality-checked in a separate front-end database and inserted to the CDW through the XML interface. All data feeding and retrieval from the CDW are based on web services utilizing publicly available FMML schema.

Primary data are available online in real time through a website (<http://testbed.fmi.fi>), data needing manual interference (such as synoptical maps with hand-made frontal analysis) as well as data from prototype, non-COTS (commercial, off-the-shelf) instruments are uploaded afterwards. Data can be retrieved in XML, csv (comma-separated values suitable for Matlab and Excel) and as simple graphs. Some datasets are presented as browsable images. For database

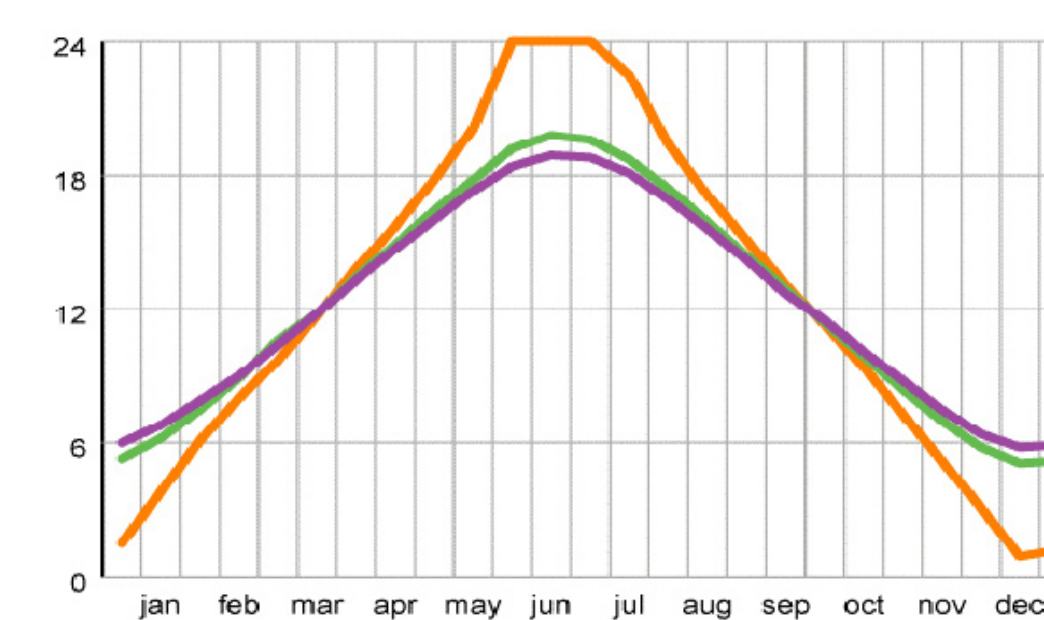
use, a registration is needed. By July 2006, 241 users had registered. Out of named affiliations, majority was connected to research, but there were also people in IT industry, educational bodies and those who used the data for a hobby, varying from gliding, sailing and sea scouts to a marching brass band.

The website with realtime observations and animations has become very popular, eg. nine thousand separate users visited the page on week 25, the page was loaded 210 000 times. More than 400 people answered the user survey; 74.7% would be extremely interested in using the service in the future, and 21.2% would be interested in using the service in the future.

The Helsinki Testbed is open to researchers around the world to test measurement and modeling systems. For further information, contact Jarmo Koistinen (jarmo.koistinen@fmi.fi) at the Finnish Meteorological institute or Walter Dabberdt (walter.dabberdt@vaisala.com) in the Vaisala office in Boulder, Colorado.

Helsinki climate summary

- Four seasons, northern environment.
- Weather is dominated by transient eddies connected to the polar front, arriving to Finland from south-west usually in a rather late phase of the occlusion process.
- Snow cover lasts around 100 days.
- The Gulf of Finland freezes on average on 1 February, and 2-4 weeks earlier (Leppäranta et 1988) along the coasts.



The annual variation of duration of possible daylight in hours: Helsinki (purple), Jyväskylä (green) and Sodankylä (orange). Source: FMI

| MONTH | T MEAN AVE | T MAX AVE | T MIN AVE | T MAX ABS | T MIN ABS |
|----------|------------|-----------|-----------|-----------|-----------|
| January | -4.2 | -1.7 | -6.9 | 8.5 | -34.3 |
| February | -4.9 | -2.2 | -7.7 | 10.3 | -26.0 |
| May | 9.9 | 14.0 | 6.0 | 26.3 | -3.1 |
| August | 15.8 | 19.3 | 12.6 | 31.2 | 3.4 |
| November | 1.4 | 3.6 | -0.8 | 11.6 | -18.6 |

Climatological statistics of temperature in Kaisaniemi, Helsinki for the months of the Helsinki Testbed Campaigns (Drebs et al., 2002)

| MONTH | DAYS T>25 | DAYS T<0 | RR AVE (mm) | RR MAX |
|----------|-----------|----------|-------------|--------|
| January | | 26 | 47 | 85 |
| February | | 24 | 36 | 101 |
| May | 2 | 1 | 32 | 68 |
| August | | | 78 | 174 |
| November | | 15 | 68 | 160 |

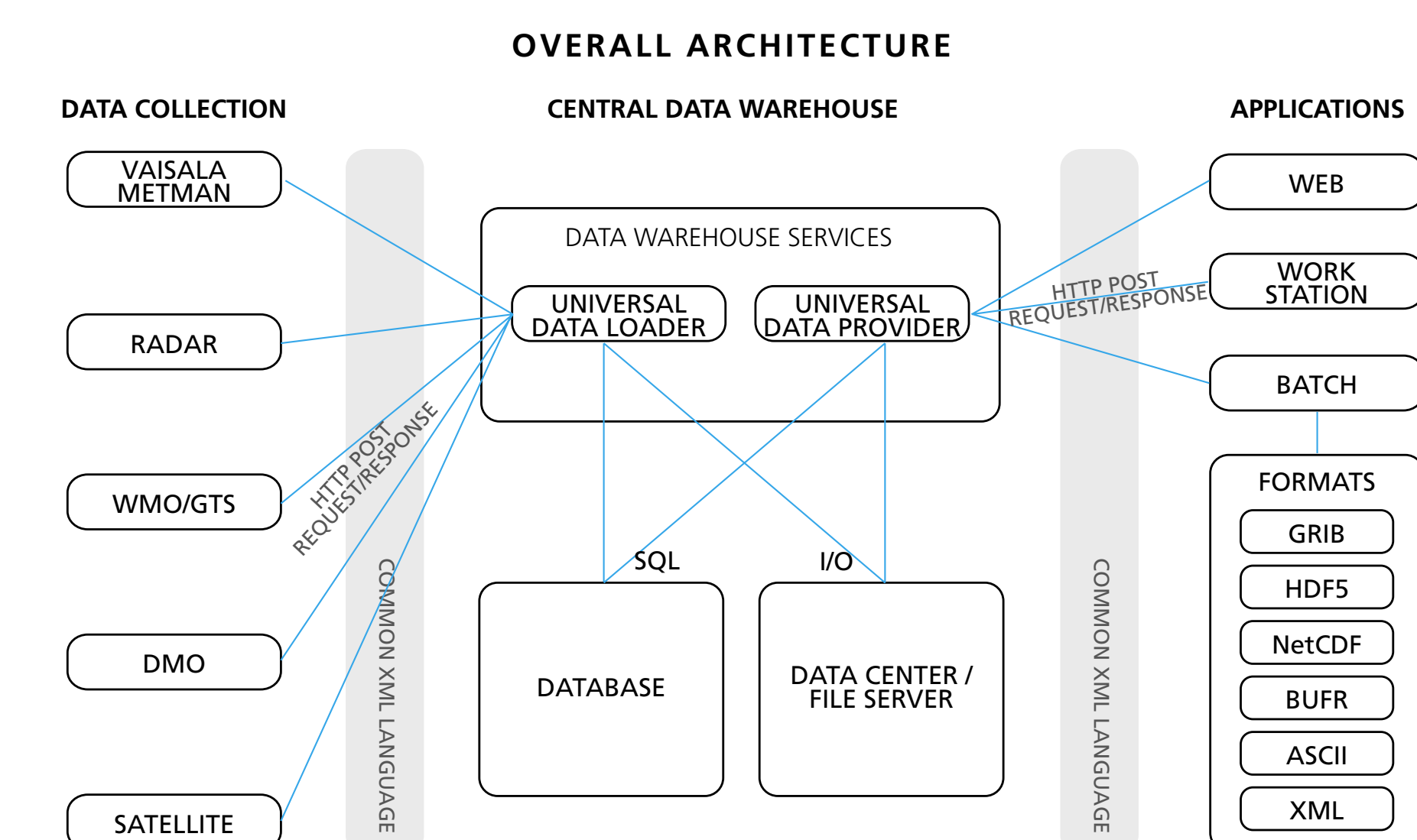
Climatological statistics of some weather parameters in Kaisaniemi, Helsinki for the months of the Helsinki Testbed Campaigns (Drebs et al., 2002)

References

Dabberdt, W. F., T. W. Schlatter and F. H. Carr with E. W. J. Friday, D. Jorgensen, S. Koch, M. Pirone, M. Ralph, J. Sun, P. Welsh, J. Wilson and X. Zou, 2005: Design and Development of Multifunctional Mesoscale Observing Networks in Support of Integrated Forecasting Systems, accepted for publication in Bull. Amer. Meteor. Soc., 86 (7), 2005.

Drebs, A., A. Nordlund, P. Karlsson, J. Helminen and P. Rissanen, 2002: Climatological statistics of Finland 1971-2000. Finnish Meteorological Institute, Helsinki, Finland.

Leppäranta M., E. Palosuo, H. Grönvall, S. Kalliosaari, A. Seinä ja J. Peltola 1988: Phases of the ice season in the Baltic Sea (North of latitude 57° N), Finnish Institute of Marine Research, No 254.



Overview of the project architecture



A screen shot from the project web site. Data are also available through mobile phone services during the measurement campaigns.



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