VAISALA / APPLICATION NOTE

Vaisala AWS310 Weather Station Assists Geodynamics Research

A 10 m mast with meteorological sensors at Metsähovi research station.

The Finnish Geospatial Research Institute (FGI) of the National Land Survey leads Finland's national geodetic and geodynamics research. A Vaisala AWS310 weather station was installed at Metsähovi Fundamental Geodetic Research Station as part of their infrastructure development project. Meteorological data from the weather station is collected to improve the accuracy of gravity measurements and satellite laser ranging.

A changing Earth

Earth's orientation in space and its temporal variation are continuously changing. The continents are drifting, certain land surfaces are rising, and some ocean floors are falling relative to the center of the Earth. These changes affect climate, sea levels, and glaciers, and also present a continual need to adjust our geoinformation systems. Measuring and understanding the phenomena affecting our lives requires a full set of modern observation techniques.

Meteorological data and satellite laser ranging

Satellite laser ranging (SLR) measures the distance from Earth to a satellite by timing the round-trip flight of a laser beam from Earth to the satellite. The results give us highly precise information about satellite orbits, mass redistribution of the solid Earth, and motion of the station network with respect to the Earth's geocenter. SLR measurement is an optical measurement affected by the atmospheric conditions.

Meteorological data, such as air temperature, relative humidity, and air pressure are measured to know the actual surface weather conditions during laser measurement are known. When this data is known, laser measurements can be corrected for atmospheric delay to improve the measurement accuracy. According to senior research scientist Dr. Jyri Näränen, the correction magnitude may be up to a few meters whereas the ranging precision is a few millimeters. Thus, accurate weather data is crucial for successful ranging.

Rain detection as part of observatory dome control

At the FGI research station, satellite laser measurement equipment is located in a dedicated observatory building with a domed roof that is only opened when measurements are being taken. Sensitive optical electronics must be protected from precipitation and measurements are only taken when the weather is dry and there is no thick cloud cover disturbing the view to space. One important safety system to prevent equipment damage is an automatic control system that closes the dome as soon as rain begins. Dome operation is controlled using a separate precipitation sensor and Vaisala DRD11A precipitation detector. This is an important feature since the operation is semi-automatic and the SLR operator may not be constantly watching the weather.

Satellite laser building with domed roof.

The force of gravity is not constant

Post-glacial land uplift is still ongoing in Fennoscandia and this affects the gravitational field in Finland. At the FGI research station, very small gravity changes are monitored with sensitive gravimeters. One important local factor influencing gravity is the hydrological water flow in the vicinity of the gravity laboratory. This is why precipitation, snow height, and ground water levels need to be measured and monitored. Wind and global radiation values are also taken into account when determining the changes in local water storage.

Metsähovi Fundamental Geodetic Research Station is located in southern Finland and is part of the global network for high-precision geodetic measurements.

Find out more about FGI at: http://www.fgi.fi

The weather station installation team after a successful day: Heikki Virtanen, Jyri Näränen, Kim Goh, and Arttu Raja-Halli.

References

1. http://www.fgi.fi/fgi/
2. http://en.wikipedia.org/wiki/Satellite_laser_ranging

"The fact that we live at the bottom of a deep gravity well, on the surface of a gas covered planet going around a nuclear fireball 90 million miles away and think this to be normal is obviously some indication of how skewed our perspective tends to be." Douglas Adams, The Salmon of Doubt: Hitchhiking the Galaxy One Last Time.