



## Norunda boreal forest site

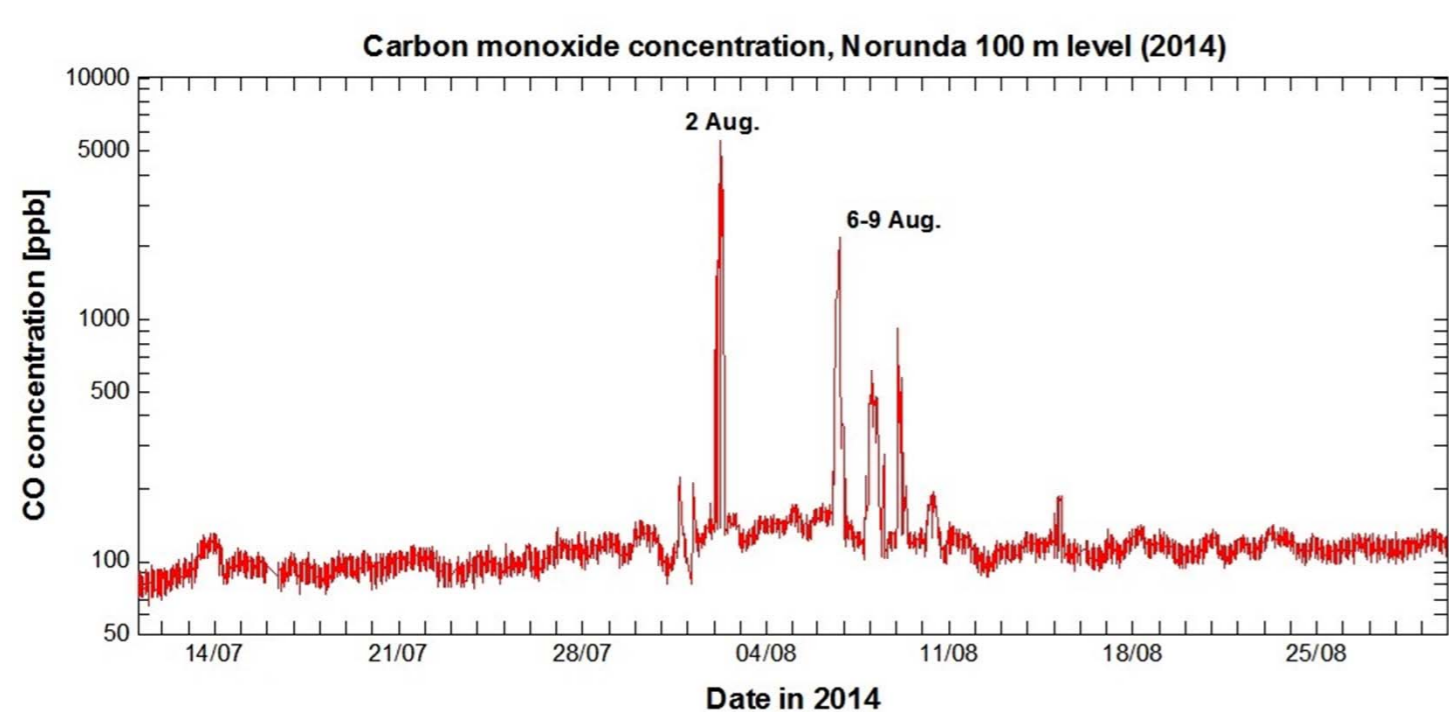
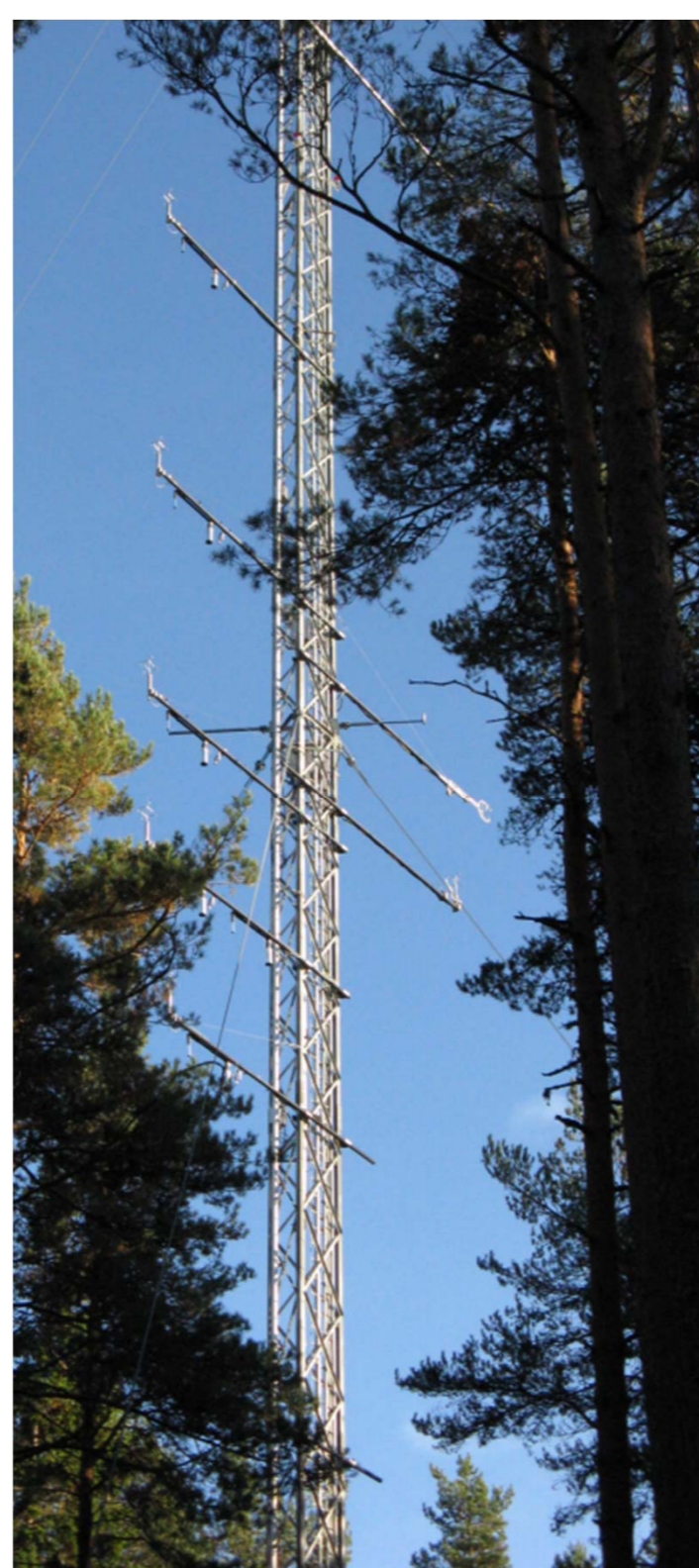
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The Norunda field station (60° 05' N, 17° 29' E) was established in 1994 when the 102 m tall tower was constructed. Since 2012, the site is hosting a combined ecosystem and atmospheric ICOS station, operated by Lund University.

Norunda is located in a mature boreal forest, situated in a quite fragmented landscape with lakes, agriculture and wetlands. The area around the tower is dominated by mature 80-130 years old Norway spruce and Scots pine of about 26 m height. The soils are sandy-loamy tills with a high content of stones and blocks, topped by a thin organic layer. Ditching around 1900 lowered the water table and increased productivity, but also accelerated decomposition of soil organic matter.

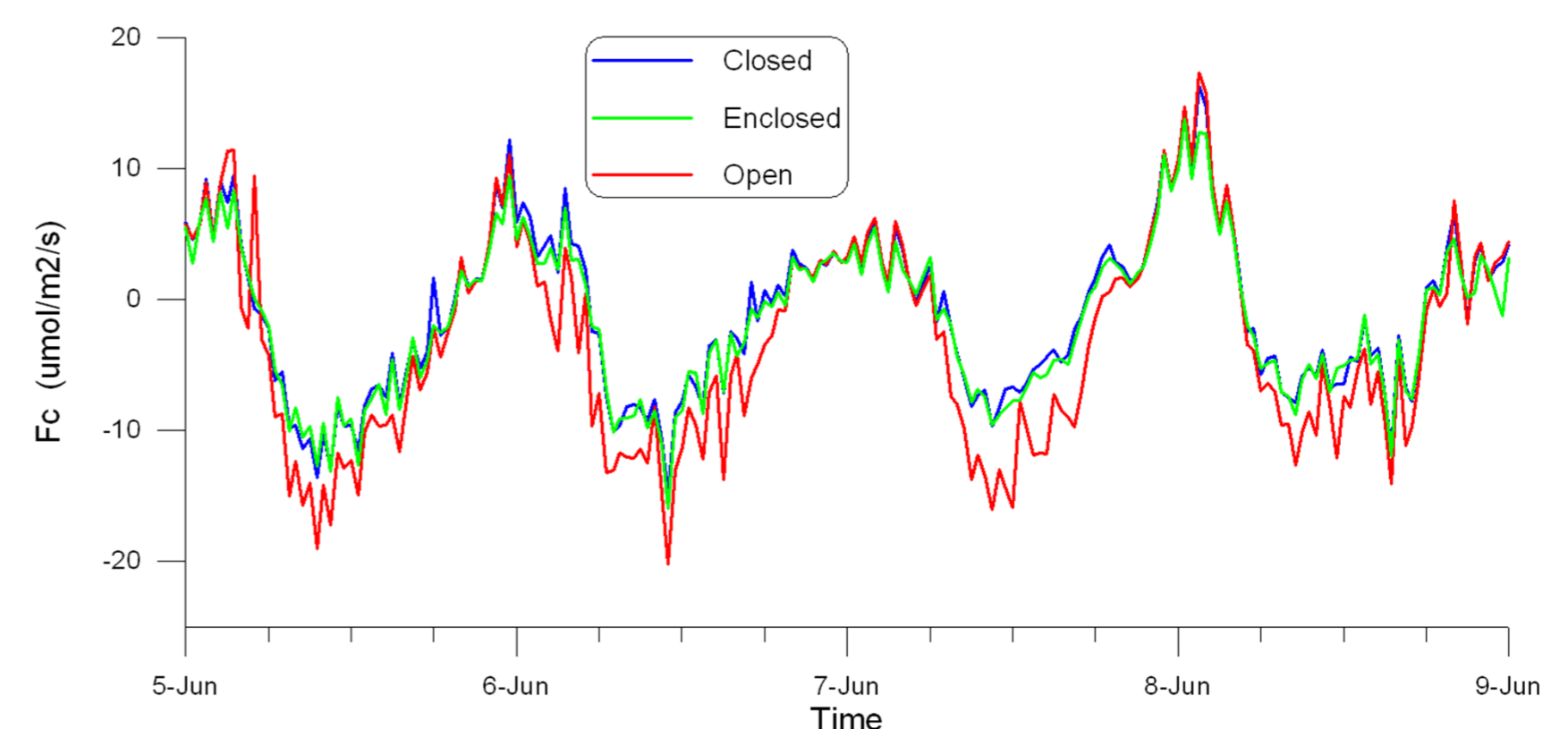
The ICOS atmospheric station, started up in July 2014, is still in the initial testing phase. Air from three inlets in the tower (32, 57, 100 m) is passed to a Picarro G2401 analyser that measures concentrations of CO<sub>2</sub>, CO, CH<sub>4</sub> and H<sub>2</sub>O.

An interesting observation was made in early August 2014, when air masses originating from an area in central Sweden (80-120 km away) affected by severe forest fires passed by Norunda. As shown below, during these events the carbon monoxide concentration increased dramatically.



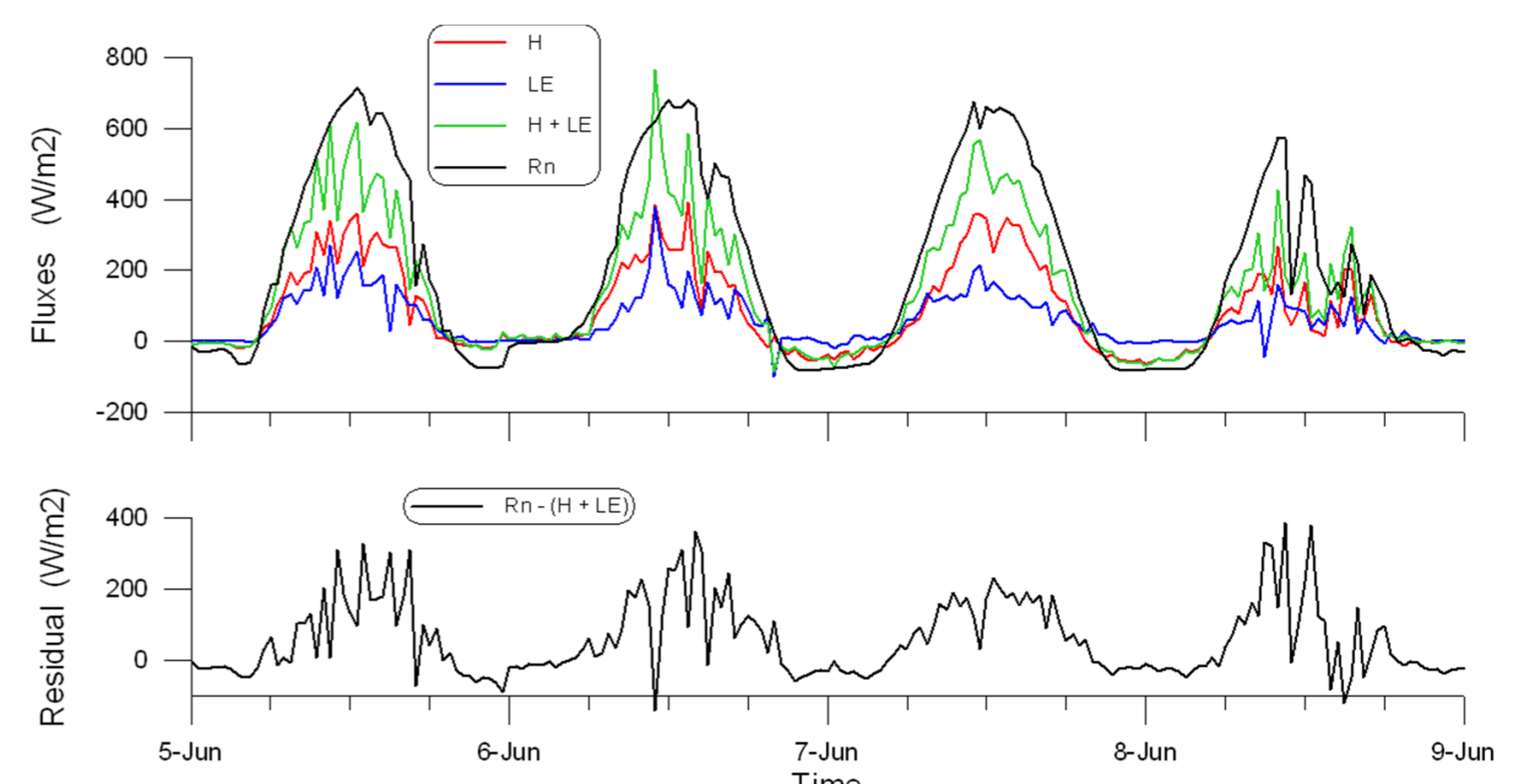
A record of carbon dioxide measurements from the highest, 100 m, atmospheric station level between July 11 and August 30, 2014. The large spikes are caused by forest fires.

The Norunda ICOS ecosystem station has been operating since late 2012. In order to test the performance of the flux system, which is based on an enclosed-path gas analyser (LI-7200; pictured), it is being run in parallel with the old system, consisting of both a closed-path (LI-7000) and an open-path analyser (LI-7500). While the results of the enclosed- and closed-path analysers are in good agreement, the test clearly shows that the open-path analyser consistently measures a too large uptake during daytime – see the figure below.



Comparison of open- and closed-path gas analyzers.

Another important test of the ICOS instrumentation regards the ability to correctly measure all the components of the Norunda forest energy balance. This is done by comparing the sum of the turbulent latent and sensible heat fluxes with the net radiation. The residual should be fully explained by storage in soil, biomass and air. Data indicate that circa 100 W/m<sup>2</sup> remains unexplained, giving an energy balance closure of about 85% - a typical value.



Above: Turbulent fluxes and their sum together with net radiation. Below: Residual term of the energy balance.