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# Cooperation between the Swedish national networks of ICOS, ACTRIS and NordSpec

Maj-Lena Linderson (1), Janne Rinne (1), Lars Eklundh (1), Erik Swietlicki (2), Anders Lindroth (1), Jutta Holst (1), Adam Kristensson (2), Hans-Christen Hansson (3), and Radovan Krejci (3)

(1) Dept. of Physical Geography and Ecosystem Science, Lund University, Sweden (maj-lena.linderson@nateko.lu.se), (2) Dept. of Nuclear Physics, Lund University, Sweden (erik.swietlicki@nuclear.lu.se), (3) Dept of Environmental Science and Analytical Chemistry, Stockholm University, Sweden (hc@aces.su.se)

The ICOS Sweden national infrastructure is running and operational since a couple of years. During 2017, ACTRIS Sweden and Nordspec have installed their measurement programs at ICOS sites. Co-location of the three infrastructures forms integrated mulitsites that will generate new research opportunities and better process understanding, which in turns enables more accurate data and results related to future climate change. By creating a broader understanding of the environment and its changes it also becomes easier to communicate with the broader society, including planners, politicians, and the general public.

ICOS RI is a pan-European research infrastructure, which provides long-term measurements of harmonized and high precision scientific data on greenhouse gas fluxes in the atmosphere, over the ocean, and at the ecosystem level. The national infrastructure ICOS Sweden is the Swedish contribution to ICOS RI. ICOS provides data and information to constrain and validate models to assess the carbon cycle of a region. This can be done by assimilating the data, together with e.g. in-situ measurements of other parameters, remotely sensed satellite data and ground based inventories, into atmospheric transport models and terrestrial vegetation models. ICOS data also provides knowledge of key processes and feedbacks to understand the land-atmosphere and ocean-atmosphere climate interaction. One of such key processes is the climatic effect on the ecosystem carbon source strength.

ACTRIS is a distributed pan-European environmental research infrastructure for providing data and research infrastructure services of long-term quality-assured observations of short-lived climate-forcing pollutants (SLCPs) and clouds. The link between ICOS and ACTRIS is in the provision on knowledge on the exchange processes of greenhouse gases between soil, vegetation, and atmosphere. Including ACTRIS measurements at the ICOS sites improves the understanding of the carbon cycle and the exchange processes and widen the research to include the interaction between the chemical, physical, and carbon cycle processes.

NordSpec is a network of spectral measurements of vegetation dynamics. The link between ICOS' and NordSpec's measurements lies in the connection between the spectral properties of the soil and vegetation, and the carbon fluxes between soil-plant-atmosphere. Including spectral measurements at the ICOS sites would widen the research community to enhance the ecophysiological research field and improve the possibilities to carry out research involving the interaction between climate vegetation and carbon fluxes. The NordSpec measurements also provide in-situ validation and calibration data for satellite based estimates. The project will also include regular downloading of Sentinel data over the stations.

All three infrastructures provide in situ measurements, and in combination thus widen the scientific and societal use of provided information as described above. The measurements also provide a link between fluxes and remote sensing, which is needed if we are to "scale" from local fluxes (e.g. chamber or eddy covariance measurements) to regional and global understanding (e.g. satellite maps). ICOS, ACTRIS and NordSpec measurements are all involved as in-situ measurements in the Copernicus project and used to calibrate, verify and supplement the information provided by satellites, which is essential in order to deliver reliable and consistent data over time.