Combination of CP & CSA

D6.5- Multi-year dataset on GHG and energy exchange

Project No.262693– INTERACT

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Lead partner for deliverable: ULUND
Author: Torben R. Christensen

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the Consortium (including the Commission Services)	
CO	Confidential, only for members of the Consortium (including the Commission Services)	

Publishable Executive Summary

The INTERACT WP6 delivery of multi-year datasets at a range of spatially distributed sites within the INTERACT network of stations has been completed. These data will be analysed and communicated in the scientific literature as well as shared in open databases. The data will be highly useful for the validation of climate and process model output.

Multi-year dataset on GHG and energy exchange - status

All INTERACT stations that hosted the GHG and energy exchange equipment now hold multi-year datasets on energy exchange and several of them also include greenhouse gas measurements. Since the direct INTERACT efforts are focused on the energy exchange measurements we provide below some examples of these data from chosen sites. The collected datasets are currently being analyzed as described in D6.6.

Example data from INTERACT energy balance installations

Figures 1-4 illustrate the range of variables measured by the INTERACT energy balance systems at the two sites in Greenland. Systems were installed in 2011 at all the test sites, and as of 2012 most systems and sensors were fully operational. Due to the remote locations providing sufficient power supply for the systems is challenging, especially during winter time. However, investments in additional power sources, primarily by wind and solar power, together with more energy-efficient measurement schemes, have resulted in near-complete time series since 2013.

Example data from the fen in Kobbefjord, situated close to the Greenlandic capitol Nuuk within the low Arctic climate zone, includes net radiation (R_n), albedo and soil temperature (SoilT; figure 1). The albedo time series reflects whether the surface is snow-covered or not; and for periods without snow, more energy is absorbed by the surface resulting in more available energy and hence higher R_n. Parts of this energy are used to heat the ground, resulting in increased SoilT.

The Nuuk heath system (figure 2) is located within the same Kobbefjord valley as the fen. Example data illustrates time series of air temperature (AirT) and relative humidity (RH), two of the most important meteorological drivers for various ecosystem processes such as energy, water vapor and greenhouse gas exchange. Furthermore, normalized difference vegetation index (NDVI) provides information on vegetation greenness and thus the potential for productivity and transpiration.

Similar to the measurement systems close to Nuuk, there are two energy balance systems in high Arctic Zackenberg, both a fen (figure 3) and a heath ecosystem (figure 4). For the fen site (figure 4), all four components of the net radiation are shown, namely the incoming and outgoing shortwave (SW_{in}, SW_{out}) and longwave radiation (LW_{in}, LW_{out}). Valuable

information with regards to energy balance can be derived from these measurements, including albedo and surface temperature.

For the heath site in Zackenberg (figure 4) time series of snow depth (SD), soil temperature (SoilT) and soil heat flux (G) are shown. The SD is arguably the most important driver of inter-annual variation in Arctic ecosystems, as it regulates variations in albedo as well as provides the boundary conditions for ground vegetation growth. Soil heat flux is a core component of the energy balance, especially for ecosystems underlain by permafrost, as a relatively large fraction of the available energy is used to thaw the soil each summer. For the Zackenberg heath, the maximum active layer depth is fairly shallow, illustrated by the SoilT at 60 cm depth that were just slightly above 0 °C during end of summer for the study period. This can be compared with the SoilT time series at Nuuk fen (figure 1), where there is no permafrost close to the surface.

It should be noted that most of these variables are available for all test sites. Within the Greenland Ecosystem Monitoring (GEM) programme, much effort has been put into making data freely and easily available for the international research community as well as for students. A new, open database has been launched at www.g-e-m.dk which holds the data from the Greenland sites and the data from Svalbard and Abisko is freely available from our INTERACT server in Lund.

A Nordic Center of Excellence funded PhD program (Christian Stiegler) has been focusing on analyzing and making cross-comparisons of data from the INTERACT towers and this will be defended in February 2016.

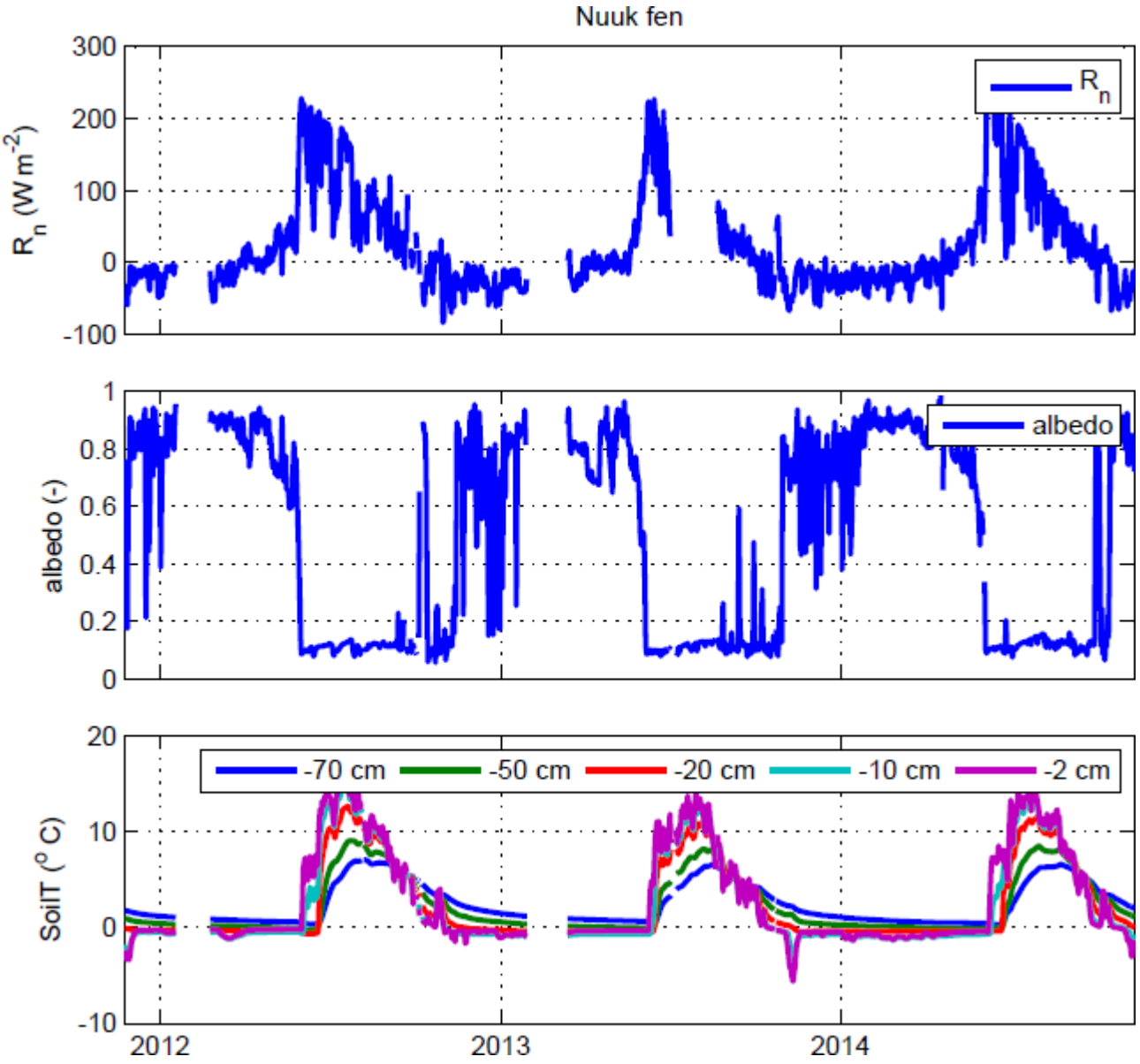

Figure 1. Daily means of net radiation (R_n), albedo and soil temperature (SoilT) at various depths from Nuuk fen. Albedo data are mid-day (11:00-16:00 local time) means.

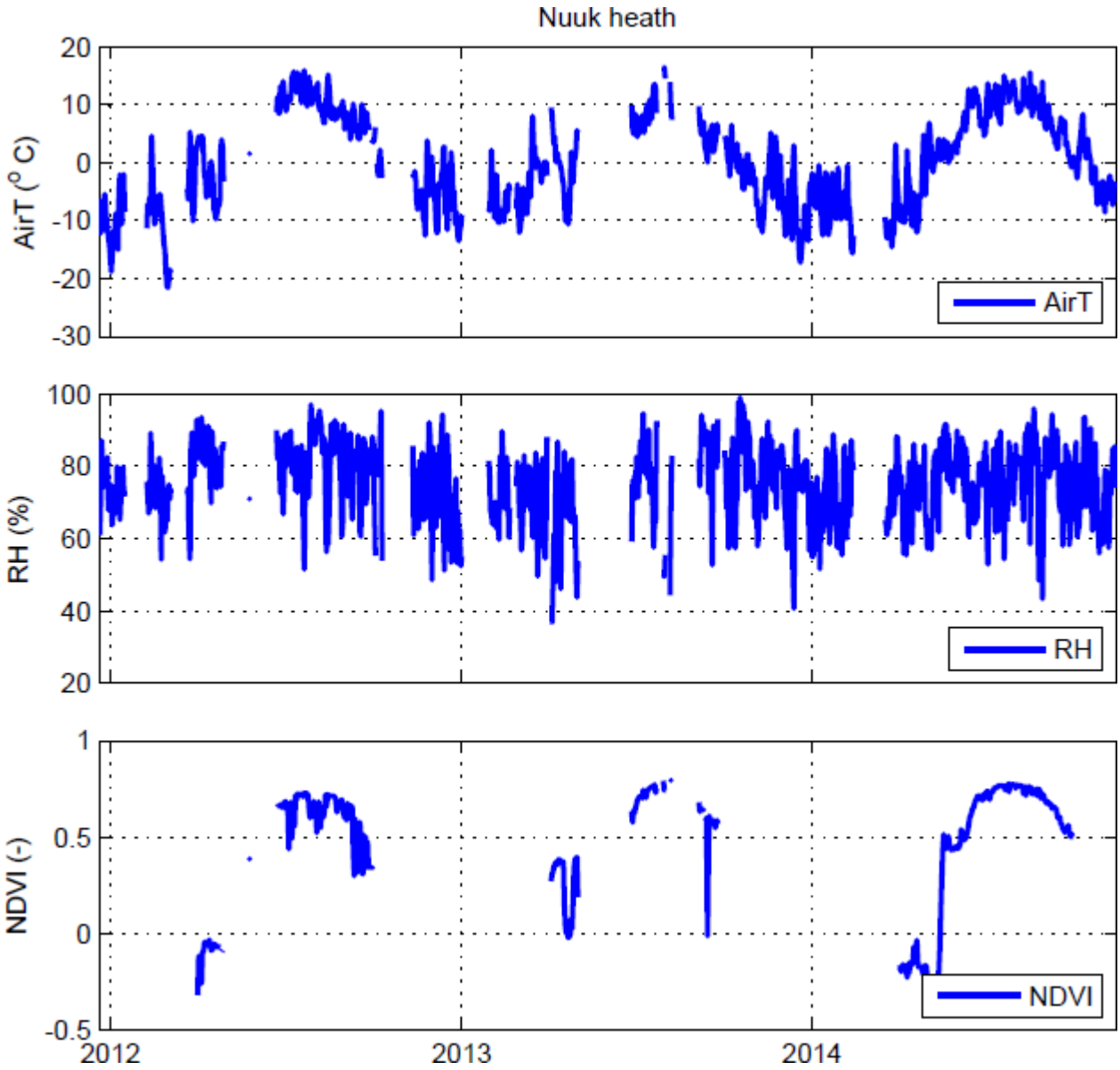

Figure 2. Daily means of air temperature (AirT), relative humidity (RH) and normalized difference vegetation index (NDVI) from Nuuk heath. NDVI data are mid-day (11:00-16:00 local time) means between 1 April and 30 September. The gaps are due to sensor failures as well as power problems.

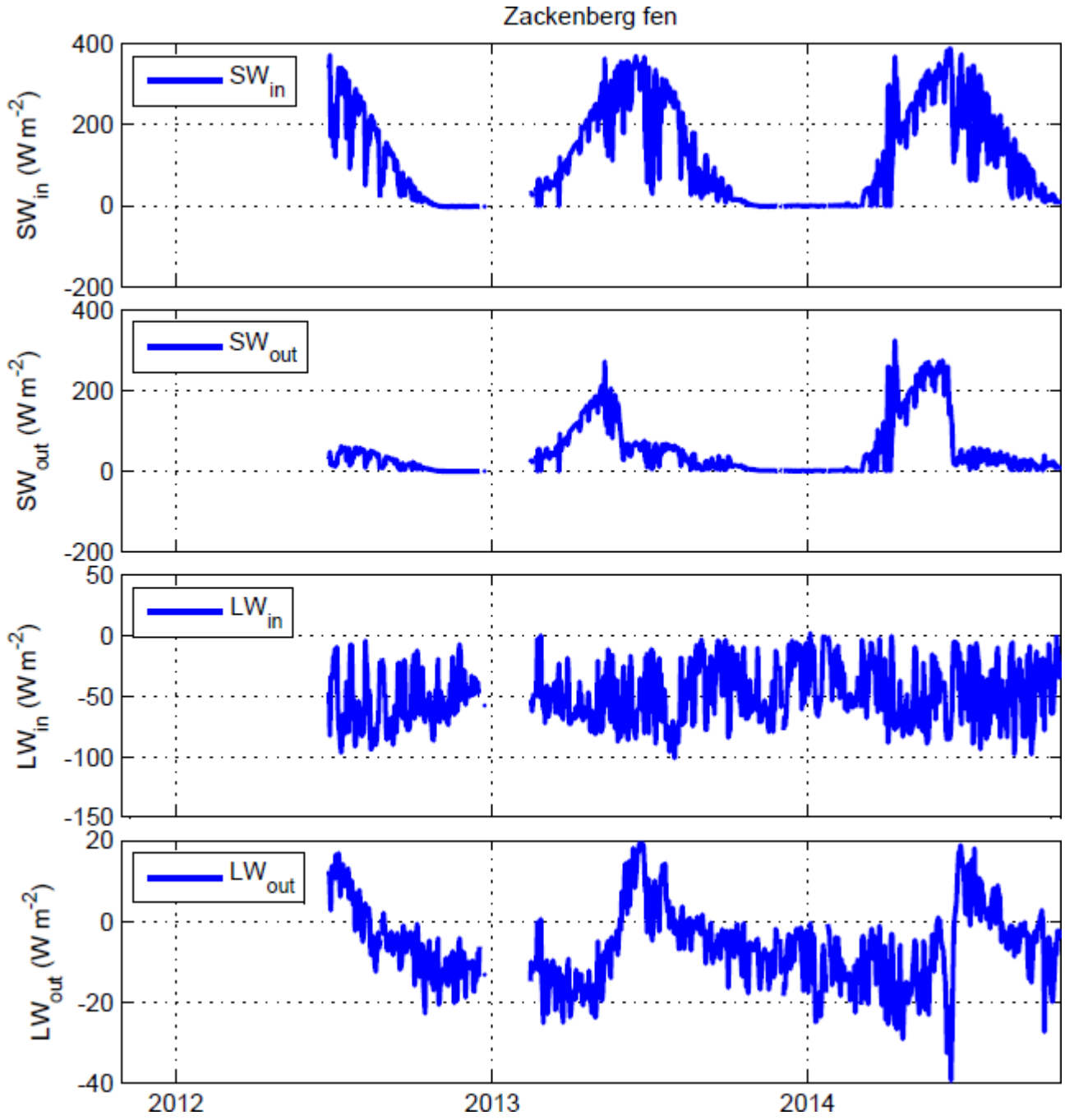

Figure 3. Daily means of shortwave incoming radiation (SW_{in}), shortwave outgoing radiation (SW_{out}), longwave incoming radiation (LW_{in}) and longwave outgoing radiation (LW_{out}) from Zackenberg fen.

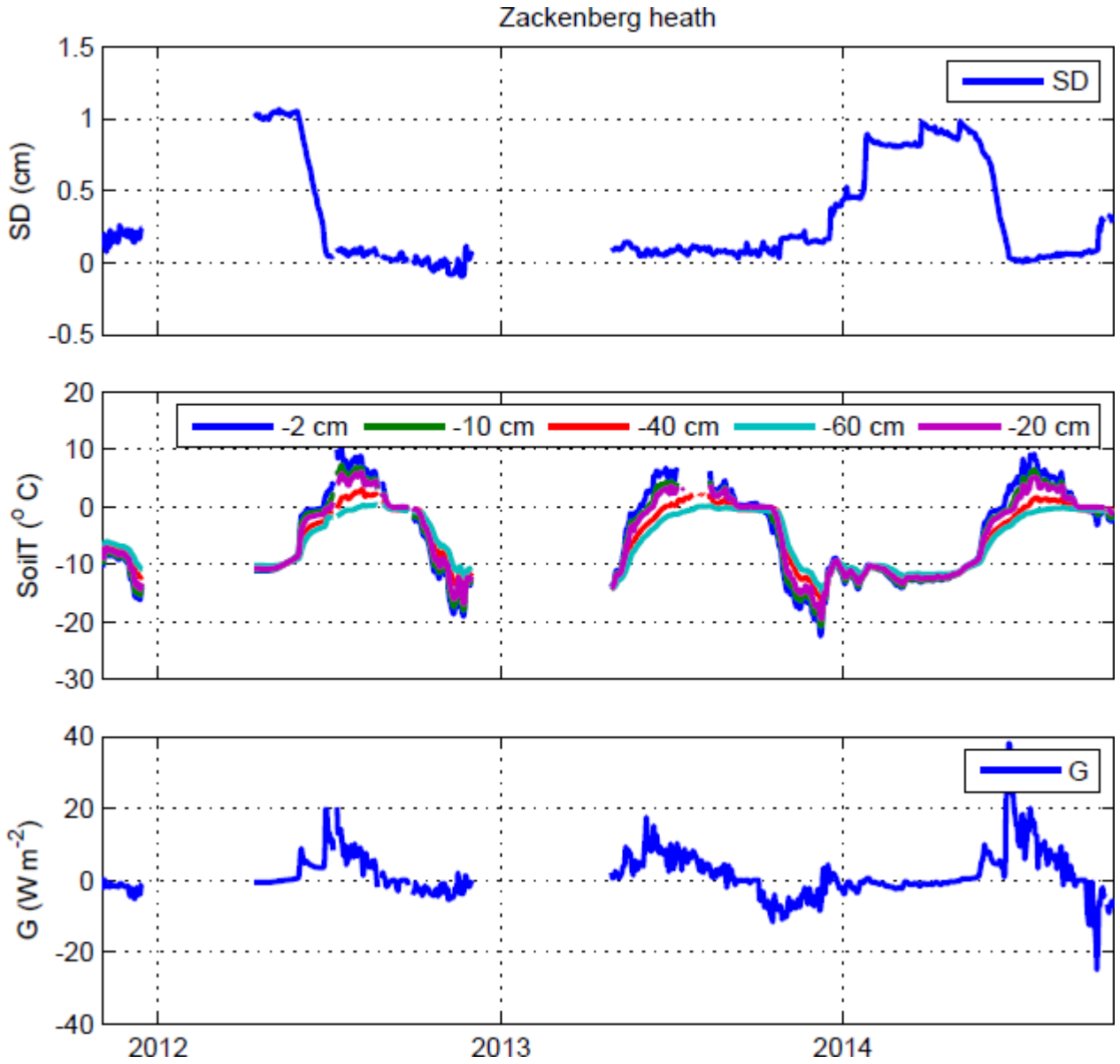

Figure 4. Daily means of snow depth (SD), soil temperature (SoilT) at various depths and soil heat flux (G) from Zackenberg heath.