Combination of CP & CSA

D6.4- Publication on integrated analysis

Project No.262693– INTERACT

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Start date of project: 2011/01/01 Duration: 48 months
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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)	

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Publishable Executive Summary

This deliverable aims to use the data gathered on GHG and energy exchange at several INTERACT sites for cross comparisons and integrated analyses. These are valuable for understanding the spatial variability of the Arctic terrestrial landscapes and their feedbacks to a changing climate. The deliverable has multiple spatial and temporal dimensions and the publication that is included here is only the first in a series of envisioned analyses. Future analyses will include local, regional and circumpolar scales. The data from the WP6 comparison efforts are now making their impact through communications in the scientific literature and at scientific meetings.

1. Publication on Integrated Analysis – Current Status

1.1.Expansion of equipment and methodology

In addition to the ten static energy exchange towers, seven of which were equipped to also measure GHG, a mobile energy exchange tower has been deployed to sample local variability associated with different permafrost conditions.

1.2. Integrated analysis of data from the static towers

This deliverable is late due to the unforeseen and unfortunate problems with the net radiometers purchased for the energy exchange stations described in Deliverable D6.3. However, this technical problem has now been fixed. As reported in Deliverable 6.3, data has been collected and is awaiting quality-control before analysis. The expected short delay in the deliverable will have no consequences for other tasks and WP in INTERACT.

1.3.Integrated analysis of data from the mobile tower

1.3.1. Data collection

The problem with the radiometer was a particular issue for the mobile tower with the data collected in 2012. However, a new radiometer was used during 2013 to collect new data and some preliminary results are presented below and these will be developed into a full publication in the near future.

1.3.2. Overview of the first publication on integrated analysis

Below is an abstract of a presentation delivered at the AGU in December 2013 and that will also be presented at the EGU in April 2014. The publication is expected to be submitted to a scientific journal within 6 months.

Working title: *Carbon dioxide and surface energy balance of subarctic palsa mires related to permafrost degradation,* Christian Stiegler, Anders Lindroth, Torben R. Christensen, Margareta Johansson.

Extended abstract:

During the last decades, an accelerating trend in increasing active-layer thickness and rising permafrost temperatures has been observed in the Nordic area. One region where permafrost is particularly vulnerable to any further climate change is the Torneträsk area in northern subarctic

Sweden. Within the next decades a projected ongoing climate warming and increase in snow cover will most likely lead to the disappearance of lowland permafrost in this region, affecting surface vegetation cover, greenhouse gas emissions and surface energy balance.

Intensive field measurements and observations have resulted in extensive data on the effects of permafrost degradation on carbon and surface energy balance. The study area covers several mires (fen and palsa plateaus) with similar local topographic conditions along an east-west oriented transect. Due to a strong climatic gradient, with maritime climate in the west and a more continental climate in the east, active layer thickness and permafrost temperatures generally increase from east to west while permafrost thickness decreases.

For our measurements we use both mobile and stationary energy balance and eddy covariance towers. Data has been collected during the growing season in 2013 by measuring flux densities of carbon dioxide and water vapour and all components of the surface energy budget, i.e. net radiation, turbulent fluxes of sensible and latent heat as well as ground heat fluxes. In addition, we measure active layer thickness and both soil moisture and soil temperature at various depths.

In this study we aim to (A) investigate and better understand the effects of permafrost degradation on the CO_2 dynamics and energy balance in subarctic palsa mires, (B) assess variation in terrestrial CO_2, water vapour and energy flux with changes in vegetation cover and soil moisture, (C) determine possible meteorological and phenological controls on net CO_2 exchange and energy fluxes.

In general, pronounced differences in net radiation (Rn) occur between the fen and the palsa plateau sites, which might be caused by a lower albedo and increased surface temperatures at the wet fen. Diurnal turbulent fluxes of latent heat (LE) exceed the fluxes of sensible heat (H) at all investigated mires. Nevertheless, large differences between the sites have been observed. On average, 62% of the available Rn at the fen sites was partitioned into LE, while H and ground heat flux (G) consumed 28% and 10% of Rn. At the palsa plateau sites, LE consumed 56%, H and G consumed 35% and 9% respectively. Diurnal trends in CO_2 and water vapour exchange do not significantly differ between the sites.

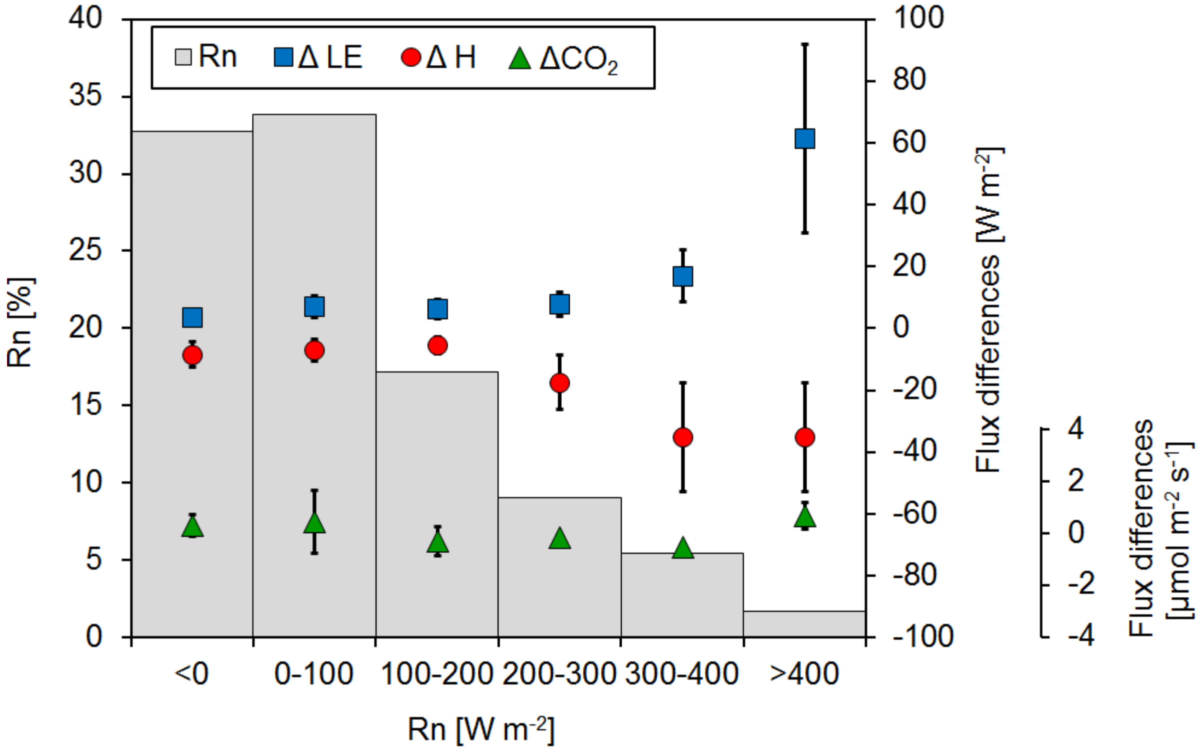

Fig. 1: Differences of latent heat fluxes (ΔLE), sensible heat fluxes (ΔH) and CO_2 fluxes (ΔCO_2) measured between the wet fen and dry palsa plateau locations in relation to the net radiation (Rn). The error bars represent the standard error. The histogram shows the distribution of net radiation (Rn) in classes of 100 W m^{-2}.

Due to pronounced variation in the availability of water and soil moisture, turbulent fluxes of H and LE at the fen sites significantly differ from those measured at the palsa plateau sites (Fig. 1). Assuming that the dependencies between Rn and the turbulent heat fluxes show similar behaviour over the entire growing season, we calculate the average differences between the locations from the distribution of Rn. The results show that the dry surfaces and the wet surfaces are distinctly different sources for sensible and latent heat fluxes. During periods of low Rn the difference is less pronounced. CO_2 fluxes do not significantly differ between the wet fen and dry palsa sites.