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Proposal for Polar Year activities related to carbon stocks and fluxes in the High-Arctic.

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Out of the handful of locations in the Arctic where measurements of CO₂ fluxes are carried out year round only few are located in the High-Arctic region and all are placed in Alaska [1-3]. As the winter season is prolonged

with increasing latitude, the lack of year round measurements makes the annual estimates of Carbon fluxes (mainly CO₂ and CH₄) from these areas highly uncertain [4-6].

This uncertainty is added to the general precariousness with which the functioning of high latitude ecosystems should be treated, when the interaction

with climate and atmospheric greenhouse gas concentration is in question.

Measurements and models from Zackenberg in NE Greenland suggests that this High-Arctic valley is a small sink (20 g) of atmospheric CO₂ [7-9] but these yearly estimates are based on summer season measurements only and should for that reason be taken with caution. The wetter parts of the valley has been shown to be a substantial source of another powerful greenhouse gas, methane (Friborg et al, 2000), and the importance of this gas in the full year greenhouse gas budget is unknown.

Wintertime in most of the high Arctic comprises 75 % of the year and model simulation [10] support that more than 25 % of the annual turnover

(CO₂ release) takes place in that period, so there is a need for further work in this area [11-12]. Further, little information is available on the inter-annual variation which may be critical to simulate and predict inter-annual greenhouse gas variations.

Due to the record of both meteorological and carbon flux data the Zackenberg

research station is well suited for expanding the existing monitoring program with wintertime measurements. We here propose to do so by undertaking full year measurements of CO₂ fluxes for a minimum of two dominating ecosystem types and campaign wise measurements of CH₄ during all parts of the year. Such a program would considerably enhance the knowledge on high arctic ecosystem functioning during off-season periods

and minimize the uncertainty of the yearly estimates on CO₂, CH₄ and total carbon balances in an undisturbed part of the high arctic region.

[1] Jones et al. 1999. Hydrological Processes 13:2977-2989

[2] Oechel et al. 2000. Nature 406:978-981

- [3] Vourlitis et al. 2000a. *Ecological Applications* 10:60-72
- [4] Vourlitis et al. 2000b. *Functional Ecology* 14 :203-214
- [5] Vourlitis et al. 2003. *Global Change Biology* 9:930-941
- [6] van Wijk et al. 2003]. *Global Change Biology* 9:743-758
- [7] Friborg et al. 2000. *Global Biogeochemical Cycles* 14(3) :715-723
- [8] Soegaard et al. 2000. *Global Biogeochemical Cycles* 14(3) :725-744
- [9] Nordstrøm et al. 2001. *Theor. Appl. Climatol.* 70(1-4):149-166
- [10] Hinkler et al.2002: *Int. J. of Rems. Sens.* 23(21):4669-4682
- [11] Elberling 2003]. *Journal of Hydrologi* 276 :159-175
- 12] Christiansen et al. 2002. *Journal of Quaternary Science* 17(2): 145-16