Meeting Notes
IASOS Flux Working Group

July 8th and 28th, 2015

AGENDA (These notes combine two meetings, one that was cut short due to internet problems on July 8th and a second the resumed the conversation on July 28th).

1. Attendees: Crepinsek, Cox, Konopleva, Starkweather, Uttal, Grachev, Fairall, Lesins, Hinzman, Billesbach, Cook, Eurskirchen, Bruhwiler

2. Presentation on FMI flux observations at Tiksi (Aurela)

Mika presented the results of several site surveys conducted by FMI to establish a footprint of influence for the FMI flux observations. Their techniques included soil sampling and vegetation surveys. They did observe some signatures of influence from distinct vegetation types that makes this approach very promising for characterizing other IASOA sites.

We had to defer the discussion due to internet issues. Some off-line dialog and additional questions for FMI are found at the end of the meeting notes.

3. NOAA/CIERS presentation on Tiksi ground heat flux (Crepinsek)

Sara presented her work on the ground heat flux observations from the Tiksi site, which can be found here: http://www.esrl.noaa.gov/psd/iasoa/node/139

Some points that were raised:

- A constant thermal conductivity (lambda) and heat capacity (C) factors is an assumption that needs further exploration.
- Small scale heterogeneities in the soil was raised as an issue. The average over dry, mid and wet soils over a suitable footprint is very good but I think horizontal variations on scales of a few meters or less is another concern. One way to test this is to have several thermistor strings in the ground, some quite close to each other to test for horizontal variations (I realize this is not a practical short term solution)
- Other groups have thermal correction factors for soil moisture. I think something like this should be included at Tiksi.
- Some analyzes or solutions of a warm pulse entering the soil can help determine if the equations are performing properly.
- Can a closure study be done with the sub-surface heat fluxes and temperatures? Some inverse modelling might allow us to back-track the thermal conductivity and heat capacity factors.
- Is there an instrument that can directly measure the thermal conductivity and heat capacity, in situ in the ground?
- The role of vegetation needs to be considered when determining the conductive flux into or out of the ground at the surface. I think heat transfer mechanisms in the "canopy" is too messy but storage effects of the canopy may need to be characterized to achieve final closure of SEB.
- Work needs to be done on correcting for thermal conductivity effects of the flux plates to achieve better agreement with the thermistor string.

- Cases with rain should be identified to see if strange signals are observed. I believe liquid water passing into the soil at the surface can mess things up.
- We need to see some time series using a variety of averaging periods: from minutes to many weeks. This will eventually help to identify which time scales will have the greatest chance of success for total energy closure at the surface.

Additional notes:

- Investigate lag correlation as calculate flux into depth of soil
- Investigate how the storage and conductive magnitudes compare (ratio)

4. Combined discussion on FMI and NOAA/CIRES Tiksi flux observations (ALL)

NOTE: Some of this conversation occurred via email exchange following the internet issues.

1. What is the rough radius of influence for the methane fluxes? I realize it depends on wind speed but typically how far from the tower should one do vegetation surveys to capture most of the sources. 2. Related to the above question, do you notice an influence from the sea which appear to be about 1 km away?

The footprint varies, as you wrote, with wind speed and stability (and the measurement height). Roughly I would say that in our measurements (with 3m mast) over 80% of the flux originates within 200 m from the mast in summer day. During stable nights and wintertime the footprint is longer. Our flux system does not thus measure the sea emissions.

When estimating the area needed for vegetation survey the measurement height has a marked influence on the area. With tower of 6 m the footprint could be estimated to be twice as long as with 3m tower. These can be calculated by models more carefully if you have some real measurement site in mind. And if you already have some data from the site, the estimate will be more accurate.

3. Is there a seasonal variation in the vegetation types or is it just the total organic matter amount or leave area that varies?

About the seasonal variation we found out that (according to satellite images during different time of season) there is clear phase difference between different vegetation classes, with shrubs (on bog areas) developing faster and dominating in early July while sedges emerge later and they dominate in late July. However, for CO2 flux it is the organic matter (mainly leaf area) that controls the CO2 uptake.

4. Are all your reported fluxes just the vertical flux? Can you detect a horizontal eddy flux of methane?

The fluxes measured by the eddy covariance method is only the vertical turbulent flux. The horizontal fluxes do take place (especially during night time). They are not necessarily turbulent fluxes but can be considered to be advection, but still they can problem in interpretation our results. The eddy covariance method assumes that the measured surface is horizontally homogeneous and there are no horisontal fluxes. During day time this is usually no problem and also during night-time with windy conditions things should be ok. (The horizontal flux is very

difficult to measure and after extensive tests during CarboEurope-project it was concluded that it is not achievable with present systems.)

5. I notice on one of your graphs that the wet sedge tundra was still emitting methane even though the soil temperatures were below freezing in the autumn. Is this because the frozen soil does not create a gas barrier for the methane produced below the surface or is the methane being created right at the surface?

The graph with CH4 fluxes in early winter is still preliminary. Our CH4 analyser was not in perfect shape at that time any more and the data was rather scattered. The emissions in December was only seen at the southern sector. In other sectors the emissions ceased when the soil temperature drop clearly below zero. Now we have new data from last winter and I will be studying this specific question as soon as I get back from holidays in a couple of weeks time. Anyway, the CH4 fluxes seemed to continue surprisingly late in autumn and certainly after the snow appearance. There is a long period with soil temperatures at around 0 (mid September to late November) and during that time the soil is not necessarily totally frozen. During that time I believe that there are still actual CH4 production taking place. In laboratory test it has been found that the CH4 can be produced even in below 0 conditions. (But not very effectively I think). Partly the fluxes may be the CH4 that is produced earlier in autumn and then released while soil freezes and pushes the methane out (not sure about this process, though). But as I wrote, I'll be very happy to discuss this question more a little bit later.

Additional questions for FMI with response:

- Find out the surface temperature accuracy of the Finnish surface soil temp
  - I'll get back to you on this
- What is the distance of the temperature probes to the flux plates
  - Within 1 m. I'll check if more accurate info is needed.
- Are depth temp sensors placed directly under one another in the soil? (or scattered)
  - More or less in the same column but there is a duplicate of -5cm measurement and that is a couple of metres from the others.
- Where are the moisture sensors located? What type?
  - Sensors is DeltaT ThetaProbe (ML2x). Within 1 m of temperatures, I'll check if more accurate info is needed
- Do they see any heaving of temp sensors as permafrost freezes and thaws?
  - We have not noticed such
- How do they determine what is "dry" "mid" "wet" soil?
  - See attached photos. Dry is on rocky non-vegetated mineral soil, WET is on clearly wet vegetated are (dry fen/wet fen) and MID is in the middle of these but clearly on the vegetated side with some peat formation.