# Daily Report - 7th September 2013 (Vardo Lund, Miriam Tschaffon, Madlen Prang)

## 8:30 – 10:00: Experimental climate change (Dr. Ilja Reiter)

The day started at 8:30 am and first presentation was about Experimental climate change.
That is Global Change and climate change: Global Change encompasses population, climate, economy, land use, urbanization, carbon cycle and more however climate change is distribution of weather patterns over periods ranging from decades to thousands years.
Definition about climate change: steady state (stable), dynamic equilibrium and Pseudo-steady-state.
In climate change models you can predict what is coming up in future. Models show that temperature increase should range from the 0.3-6.0°C. A warming of 0.3-6.0°C increases significantly the rate of soil respiration, the net N mineralization and the aboveground plant productivity. In future there should be more research, especially long term experiments, whole ecosystem warming and gradient studies for the southern hemisphere.
Global carbon dioxide in atmosphere is reached over 400 ppm (parts per million), carbon dioxide has a big impact to climate change. At the beginning of industrialisation the concentration of $CO_2$ was just 280 ppm.
A good research on climate change is hard to do because there are many factors. You need to know components to understand how it affects the climate.
**Climate change is multifactorial.**

## 10:30 – 12:00: Soils and Ecosystem Dynamics I (Dr. Tomáš Picek)

This presentation was about the biogeochemistry of wetlands.

**Wetlands used by people**

- rice (25% of the world's population is fed by rice)
- fishing
- wastewater treatment (constructed wetlands)
- hunting
- water for drinking, irrigation

**Importance of wetlands**

Wetlands protect from global warming because of the carbon sink.

**Tropical raised mire (Indonesia)**

- forest, river
- water from precipitation
- organic matter: peat
- mixed silt and clays
- production of coal

$CO_2$

**Oxygen transport to soil**

- agar-dissolution in water (by heating)
- bubbling with $N_2$ – anoxic conditions
- adding of $FeSO_4$
- after cooling: put plants into the agar
- paraffin on the surface of the medium (inhibition of diffusion of oxygen)

→ observation of redox reactions:

$FeSO_4$: Fe(II) (reduced form, blue)
Fe + $O_2$ → Fe(III) (oxidized form, red)

**Results after several days of incubation:**

red colour around the roots of the wetland plant
→ it was able to oxidise the iron by $O_2$ from the air transported to the roots

- also $Na_2S$: black colour

→ after 1 day, the agar was becoming transparent around the roots of the rice plant
→ after 4 days, the transparent medium became larger, a reddish colour appeared around the roots (from oxidized Fe)

**Redox pairs**

- redox pairs have different redox potentials:

high: oxidized, negative: reduced

- most reduced compound: $CH_2O$

→ microorganisms gain much energy by oxidizing it with $O_2$

**Oxidation-Reduction-Reaction:**

An Oxidation-Reduction-Reaction is a reaction in which one substance loses electrons (is oxidized) and another substance gains electrons (is reduced).

**General formula for Oxidation-Reduction-Reactions:**

aOx + bB + ne → cRed + dD

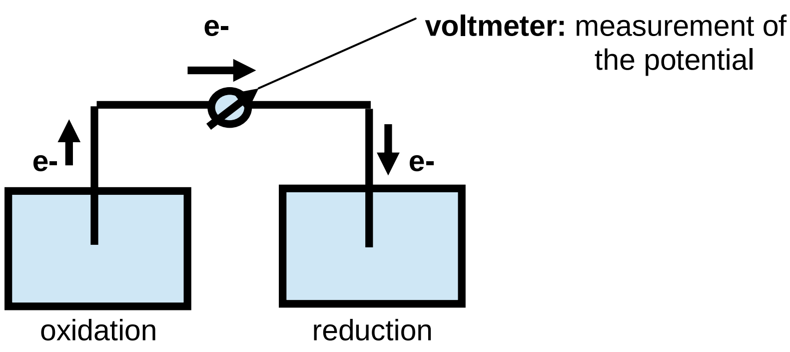
Ox: oxidizing agent (electron acceptor)
Red: reducing agent (electron donator)
ne: number of electrons
B, D: general substances taking part in the reaction

**Redox Potential E°:**

The Redox Potential is the tendency of a substance undergoing oxidation to give up electrons and of a substance undergoing reduction to gain electrons.

- calculated by Nernst equation
- units: V or mV, sometimes log E (pE) is used

**Electrochemical Cell**




**When can water / soil be anoxic?**

→ when soil is flooded (waterlogged) and there is consumption of oxygen
e. g. when algae are on the top and organisms in the water consume the oxygen by respiration

**Experiment with *Scripus validus***

- measurement of redox potential close to the root

→ around the root you can find oxygen, after 1 mm there is almost no oxygen

- redox potential is decreasing away from the root

- light → photosynthesis → stomata are opened → oxygen diffuses to the roots

→ positive redox potential at day, negative potential at night

→ **oxygen microenvironments**

## 13:00 – 13:45: Soils and Ecosystem Dynamics II (Dr. Tomáš Picek)

In his second presentation Dr. Picek told something about constructed wetlands.

- substrate: can be mineral (sand...)
  but also organic (humus)

example: Wayland, Australia

- can also be directed to buildings in a city
- some are constructed for farming

**What are Constructed Wetlands?**

- systems constructed by men
- biotechnology
- used for (waste) water treatment

**What are they used for?**

→ treatment of polluted water

- landfill leachate
- mine leachate
- farmyard runoff
- highway runoff
- industrial waste water
- municipal waste water

**History**

- natural wetlands used for waste water treatment in middle ages
- first experiments with constructed wetlands in 20th century
- now there are many constructed wetlands in Europe

**Types of Constructed Wetlands:**

**surface flow:**

- emergent plants
- submerged plants
- free floating area
- floating-leaved plants

**sub-surface flow:**

- most of the newest wetlands
- filled with sand, water goes through substrate

**Important parameters:**

- Person Equivalent (PE)

- Removal Efficiency

→ percentage of pollutant removed in constructed wetlands

- Total Suspended Solids (TSS)
- COD = Chemical Oxygen Demand
- BOD = Biological Oxygen Demand

**Hydrology**

- Hydraulic Residence Time (HRT)

→ average time that water remains in the wetland

- Hydraulic Loading Rate (HLR)

A simple water balance equation for constructed wetlands:

$$S = Q + R + I - O - ET$$

S: net change in storage
R: contribution rate
I: net infiltration
O: surface outflow
ET: loss due to evapotranspiration

**Substrate**

- gravel
- crushed rock
- sand in size of 0.5 cm to several centimetres

**Treatment processes**

1) settling of suspended particulate matter
2) filtration and chemical precipitation through
3) contact of the water with the substrate and litter
4) chemical transformation … etc.

Inflow → screens → Imhoff septic tank → inflow into the beds → bed 1 / 2 → outflow

**Pretreatment:**

- screens
- sand trap
- septic tank

**Treatment bed**

Constructed wetland with horizontal subsurface flow

→ mostly goes out as gasses like $CO_2$

→ nitrogen is also removed as gas

- tubes: plastic tubes with holes

**Plant species used for constructed wetlands:**

Plants like Typha, Phragmites, Phalaris, Iris and Glyceria.

**Advantages of these systems:**

- the best for discontinuous waste water inflow and for waste waters with low concentrations of pollutants
- low maintenance costs
- no need of electricity (or very low)
- no need of professional staff
- natural system – part of the landscape

→ can be biotope for frogs, birds, mosquitoes

- cooling system for landscape
- can survive floods usually without any problems

**Disadvantages:**

- need large space
- variable efficiency for N and P removal
- cost can be little bit higher than for traditional plants

In the end, Dr. Picek presented some examples of different wetlands, e. g. Anne Valley, Ireland, Klosterenga, Oslo, or Heglig in Sudan.

## 14:15 – 16:45: Taxonomy and ecology of wetland organisms (Dr. Hermann Muhle)

Dr. Muhle's presentation was the last one today. He began with general information to wetlands, especially bogs and afterwards he started with the wetlands in Germany and continued with the ones in Estonia. He also described the plants which are growing on theses wetlands.
In Estonia the most common form of vegetation are boreal spruce- and pine forests. In the centre of wetlands, were the wetlands are actively growing, the pines were smaller than at the edge of the wetlands. In the German “Pfrunger-Burgweiler Ried” the pine (*Pinus montana*- group) is also the dominating species. The peat past has to be restored in the “Pfrunger-Burgweiler Ried”, therefore the drainage has to stop and the water has to be re-injected, so that *Sphagnum magellanicum* has the possibility to grow again and produce biomass. To reach this goal the farmers have to be convinced and involved, because naturally they are the biggest obstacle. Because in the wetlands the soil can't be easily tilled, there has to be another possibility to use these wetlands. One of

these possibilities are the permission of grazing animals like the heck cattle (*Bos taurus*). It's important to rewater the drained bogs in Germany, because only than the typical bog species like Sph*agnum russowii* can grow again. In Germany there are many bogs, which were drained but now there are reconstruction measures like in the "Murnauer Moos", the "Großes Moor (Vechta-Diepholz)" or the "Kendlmühlfilze", so that nowadays cottongras species (*Eriophorum)* can grow again.

The effects of agriculture on wetlands are various, so the human drain used the litter-meadow and changed the structure of the bogs; they also take the peat out, so of several species, there are only 1-2 species left. After decades there are only forest left, caused to drainage the birches and other species can grow on the dried land. To restore bogs, which were used to peat- production for horticulture, there are only problems in re-watering if the water level is not still high, when the water is gone, there are problems in re-watering, and the process lasts longer. When the water is out of the bogs, it also goes out of the dead cells, *Sphagnum* species bleach out and they get pale.

*Pedicularis sceptrum-carolinum* also called Moor-king Lousewort is a member of the family of Orobanchaceae, which is distributed in the area of foothills of the Alps.

*Sphagnum magellanicum* is a big red member of mosses species, which make up the highest amount of new peat. Whereas *Sphagnum papillosum*, with a brown colour only appears in western areas, like western Europe and northern America, *Sphagnum rubellum*, with a red colour can also be found in the bog we visited yesterday. *Sphagnum balticum* offers in Germany a very rare sight, whereas in Estonia it's commonly seen, also *Sphagnum pulchrum* and *Helodium blandowii* are nearly gone in Germany.

For the *Sphagnum* species and other bog plants the re-watering of the peatlands is very important and in some bogs in Germany the processes of reconstruction have already started.