TiP (DFG SPP 1372) Atmosphere - Ecology - Glaciology - Cluster

Energy fluxes above Nam Co lake and the surrounding grassland – The NamCo 2009 experiment

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Motivation

Spatial heterogeneity poses a major challenge for modelling and upscaling of energy and matter exchange between the atmosphere and the underlying surface. For this task high quality flux measurements from different surface types are a prerequisite, but these are scarce on the Tibetan Plateau.

Experiment and site description

- Eddy Covariance and energy balance measurements at a small lake near Nam Co lake, period: June 27th to August 8th, 2009
- As the EC complex was situated directly at the shoreline (Figure 1), turbulent fluxes correspond to land or lake surface, according to wind direction
- The footprint climatology (Figure 2) underpins the existence of a local land – sea circulation system
- In contrast to the very dry alpine steppe around the permanent station of the ITP, CAS nearby, the measurements cover a more humid grassland
- Providing the first EC data over lake on the TP as far as we know

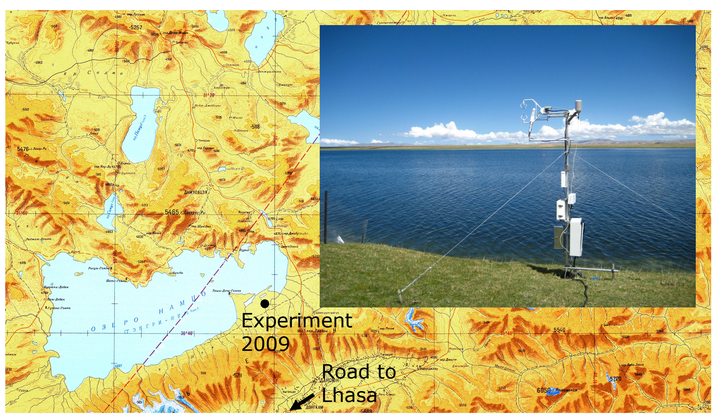

Figure 1: Location of the NamCo-2009 experiment and setup of the EC station.

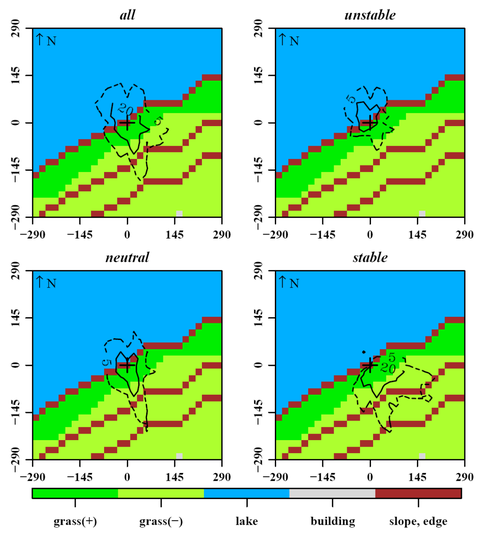

Figure 2: Footprint climatology for the measuring period June 27th to August 8th.

Data processing

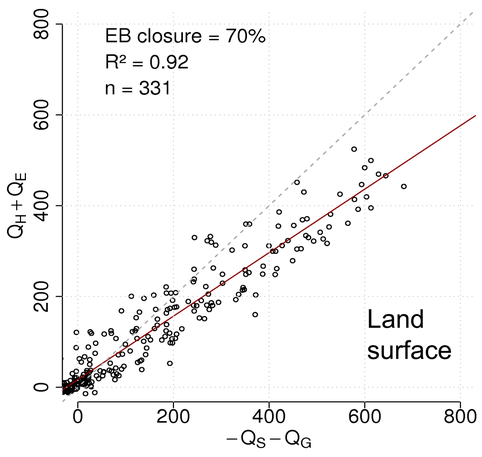

Figure 3: Available energy versus turbulent fluxes for the shoreline grassland surface

- state of the art flux corrections
- quality filtering
- footprint analysis
- energy balance closure (EBC) for the land surface (Figure 3)
- separation into land and lake fluxes
- EBC correction of land surface fluxes with the Bowen ratio (Twine et al, 2000)
- modelling of land and lake surfaces

Surface modelling

Lake

- Hydrodynamic multilayer (HM) model by Foken (1986).
- Supplemented with a shallow water correction term by Panin et al. (2006)
  → increased turbulent fluxes

Land

- Surface Energy and Water Balance (SEWAB) by Mengelkamp et al. (1999).
- Parameter estimation by in situ measurements, laboratory investigation of soil characteristics and literature values

Both models were forced with standard meteorological in situ measurements.

Results

- Land surface model performs well for the few observations left (Figure 4)
- Lack of detailed water temperature (only 1 Pt100 in 20 cm depth) and lake depth data → EBC estimation difficult
- Lake model reasonable coherence to the observations, slight bias for the latent heat flux Q_E
- Best fit with lake depth 2m reasonable within the footprint of the observations
- Sharp differences in diurnal cycles (Figure 5) well represented
  → simulations suitable for gapfilling
- Low Bowen ratio over shore grassland differs to the dry conditions at ITP station

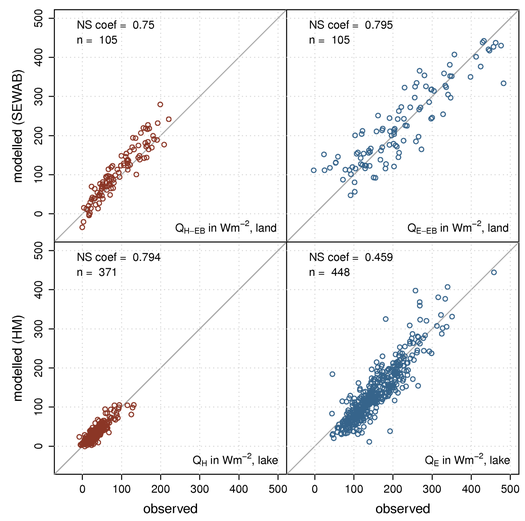

Figure 4: Scatterplots of modelled and observed turbulent fluxes. *Upper panel*: energy balance corrected (EB) fluxes over grass vs. SEWAB model simulations. *Lower panel*: Turbulent fluxes over lake vs. HM model runs. Model performance is indicated with the Nash-Sutcliffe coefficient.

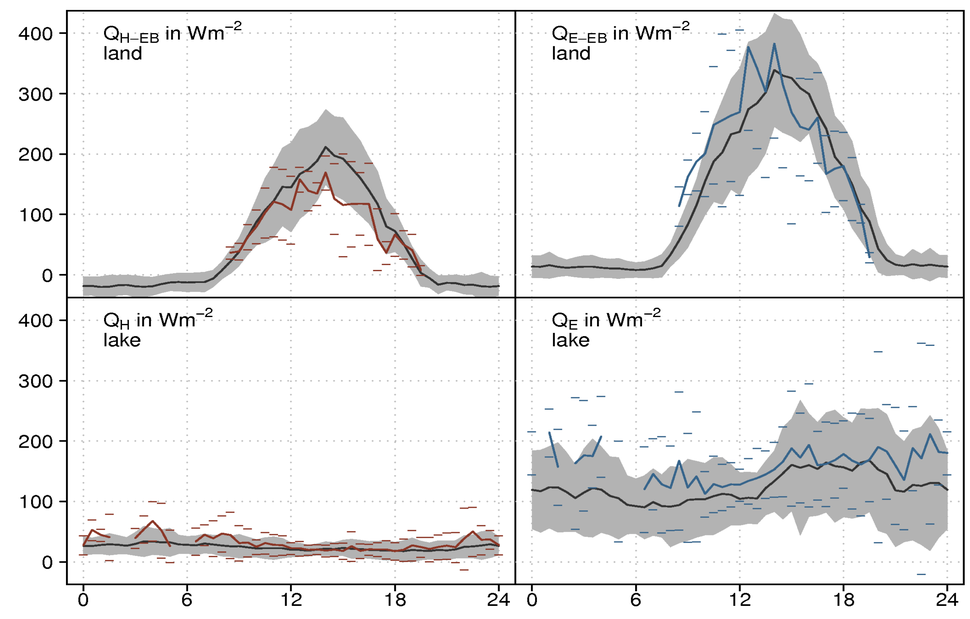

Figure 5: Mean daily cycles for the whole measurement period. Time axis in CST, approx. 2h ahead compared to LT. Observed fluxes are denoted by coloured solid lines, the horizontal bars indicate the respective standard deviation; Black lines show the modelled fluxes with standard deviations given by the grey shaded area.

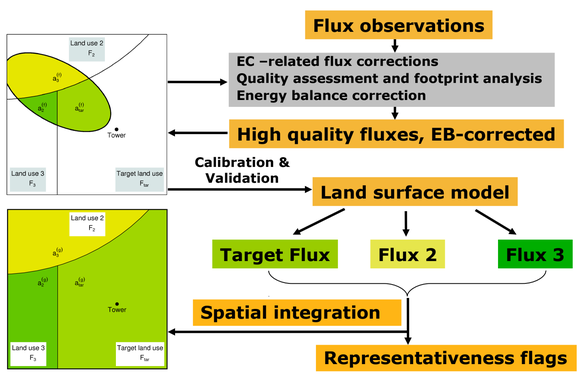

Figure 6: Sketch of an upscaling scheme from target land use measurements to a heterogeneous grid cell utilizing footprint and land surface modelling.

Outlook

- Gapfilled turbulent fluxes for lake and wet alpine steppe available for the monsoon season at Nam Co lake.
- Physically based upscaling approach possible for validation of remote sensing and mesoscale modelling (see Figure 6)
- Further efforts needed in determination of the energy balance closure of EC data above the lake surface

Benefit for the community

The surface separated and gapfilled turbulent fluxes provide additional information for modelling within TiP priority program of the DFG and for upscaling within the CEOP-AEGIS project. Especially the subprojects called Modules 1,2,3 and 9 within the Atmosphere-Ecology-Glaciology cluster (see also Figure 7, DFG subproject titles are given on the respective cluster poster) gain from that investigation.

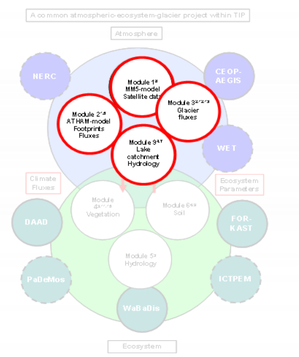

Figure 7: Interaction within the TiP-AEG cluster.

7th Sino-German Workshop on Tibetan Plateau Research
Hamburg, Germany, March 3th – 6th 2011

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funded by
Deutsche Forschungsgemeinschaft
DFG