J11.6 Energy and water vapour fluxes over a heterogeneous land surface: The EVA-GRIPS project

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1. Introduction

The determination of the area-averaged evaporation and sensible heat flux over a heterogeneous land surface is fundamental for the simulation of the regional energy and water budget. This is also the major issue of EVA_GRIPS. EVA-GRIPS is funded under cluster 3 “Regional Process Studies in the Baltic Sea Area (BALTEX)” of the Climate Research Programme (DEKLIM) of the German Federal Ministry of Education and Research. Through a combination of near-surface and boundary layer observations, the analysis of satellite data and numerical simulations EVA-GRIPS aims at testing and implementing concepts for the description of area-averaged turbulent fluxes in land surface schemes. The spatial scale considered in EVA-GRIPS corresponds to the grid scale of a regional atmospheric NWP or climate model (here in particular the "Lokal-Modell", LM, of the Deutscher Wetterdienst, DWD, and the model REMO of the BALTIMOS group), but also to the pixel scale of currently available satellite images.

Experiment and modelling activities focus on an area of roughly 20 x 20 km2 around the Meteorological Observatory Lindenberg (MOL) of DWD. The continuous measurement program of the MOL as a CEOP reference site formed the basis for a major field experiment in May and June, 2003.

Eddy correlation instruments were placed at 13 sites over different land use types and vertical profiles in the boundary layer were sampled by lidar and radar. A set of scintillometers, a helicopter borne turbulence probe HELIPOD (Bange et al., 1999) and an infrared camera for surface photography on board a Tornado aircraft as well as satellite images completed the set of instruments. The spatial sampling and footprint scales of this suite of measurement systems covered five orders of magnitude (10-1 .. 104 m for the sampling scale) and three orders of magnitude (101 .. 104 m for the footprint scale), respectively.

2. Some Results

Pronounced differences in surface characteristics (e.g. surface temperature) can be found over the different types of land use in the LITFASS area.

These differences in land use and surface characteristics result in significant evaporation differences both in numerical models and estimates from satellite data (Figure 2). The intercomparison of LM results and NOAA images reveals differences in magnitude of the evaporation and its spatial patterns due to surface heterogeneity.

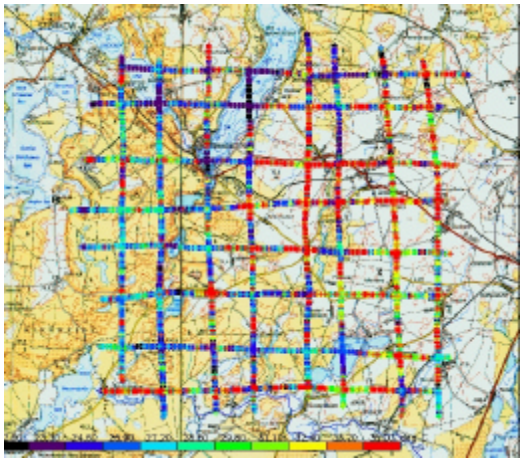


Fig. 1: Regional distribution of surface temperature in the LITFASS area measured by the Helipod during a grid flight pattern on June 17, 2003 (picture by J. Bange, TU Braunschweig)

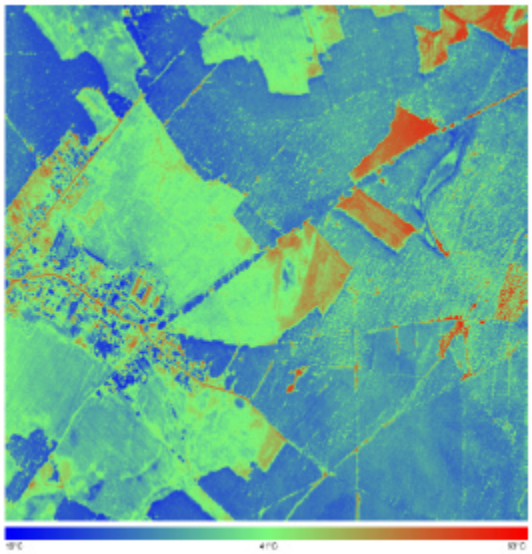


Fig. 2: Calibrated infrared surface temperature. Photo taken from the Tornado aircraft over a small part of the LITFASS area on June 17, 2003 (picture by J. Bange, TU Braunschweig)

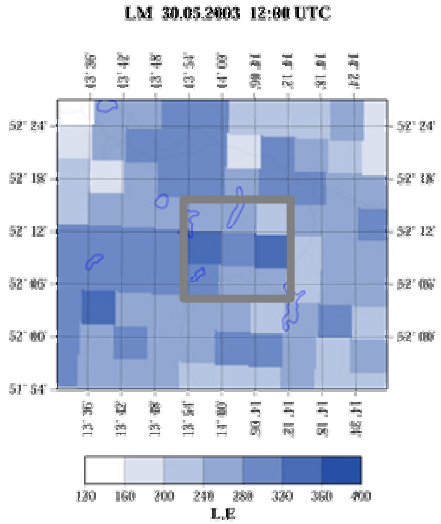
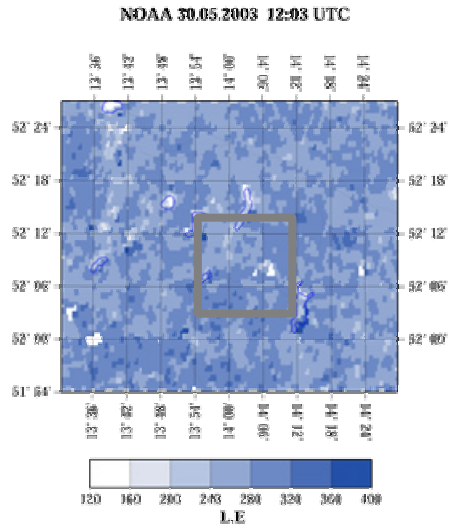


Fig. 3: Evaporation over the LITFASS area on May 30, 2003, around noon, LM simulation –above- and derived from NOAA data – below - (figure by C. Heret and F. Berger, TU Dresden)



Locally measured water vapour fluxes over different types of land use were found to show significant differences. Area averages of grid-size representative fluxes will be derived from the surface observations over various land use types by a suitable averaging strategy and will be compared to the fluxes determined from area-averaging measurement systems (Helipod, scintillometers, lidar-radar combination).

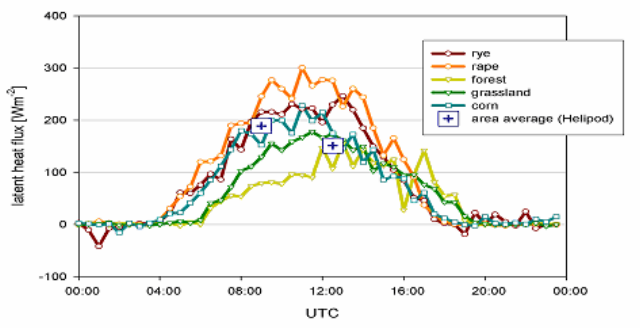


Fig. 4: Diurnal cycle of latent heat flux over various land use types for June 7, 2003 (figure by M. Mauder, University of Bayreuth, including data by GKSS, DWD and TU Braunschweig)

EVA-GRIPS will combine model and satellite data with the in-situ measurements to finally analyse the representativeness and validity of the evaporation parameterisation in atmospheric models.

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