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Methodology

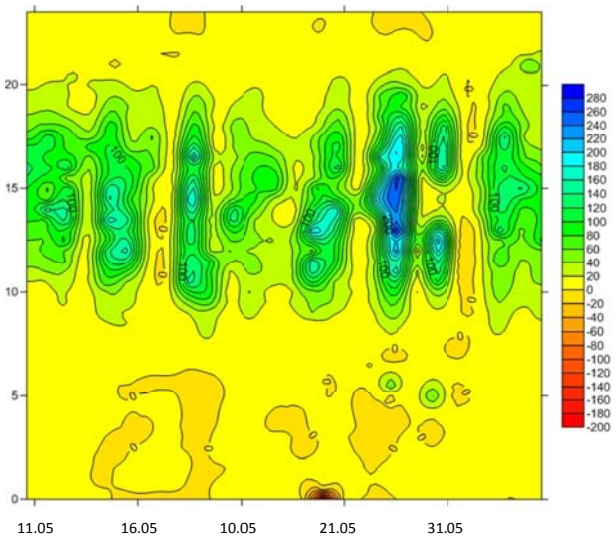
Remote sensing: This field embraces, inter alia, the analysis of land use changes, correlation of NDVI with the Standard Precipitation Index (SPI) in order to evaluate drought events, and snow cover analysis based on MODIS data. Ground truthing includes own field investigations in combination with observations from official services.

Hydro-climatic stations: Currently two stations are operated on an agricultural research site in the central Rhine Valley. Here all components of the water balance as well as the radiation budget have been measuring. The determination of actual transpiration from standing crops is at the core of our investigations. Two methods have been implemented: The Bowen-Ratio-Method and an Eddy Covariance system as the most direct method for transpiration measurement.

Modelling: All surveyed data will serve as input for the hydrological model TRAIN which is aimed to simulate current and future water fluxes on the plot and the landscape scales.

Figure 3: Eddy Covariance station (Schifferstadt, 2013)

Figure 4: Diurnal variations of the latent heat flux [W m^{-2}] from spring wheat (10. May - 4. June 2013)



Cooperation partners

- Regional Authority for Environment, Waterways and Trade Control (LUWG)
- Regional Authority for Geology, Rhineland-Palatinate
- Dienstleistungszentrum Ländlicher Raum (DLR)
- Rhineland-Palatinate Centre of Excellence for Climate Change Impacts
- Heidelberg Centre for the Environment (HCE)
- Institute of Environmental Physics, University of Heidelberg

Institute of Geography

Professorship in Hydrology and Climatology

RHINE-TRANSECT

An interdisciplinary, long-term research project across the Upper Rhine Valley

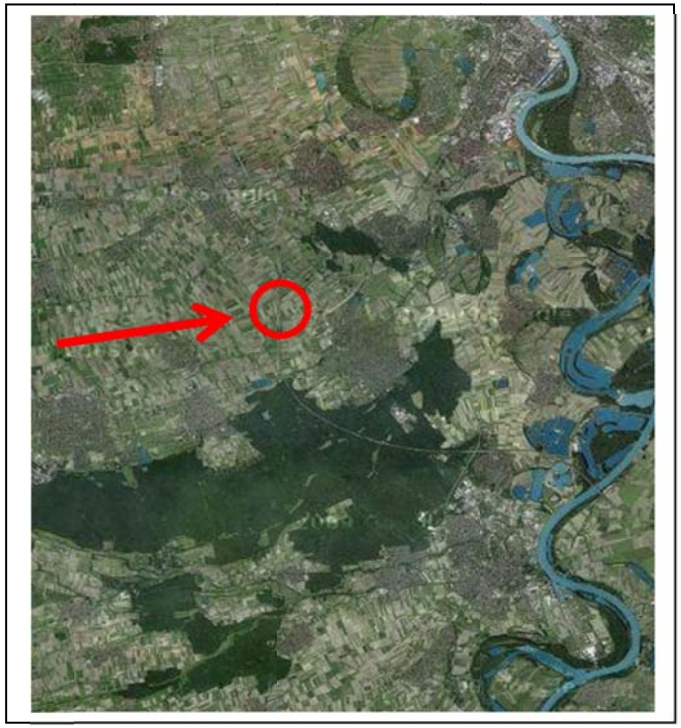


Figure 1: Location of the research site “Queckbrunner Hof“ near Speyer, SW-Germany. Source: Google Earth

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Introduction

Land use has significantly changed in the Rhine valley since World War II due to the intensification of agricultural production, urbanisation processes and forestry management practices.

This possibly leads to changes in the water balance as well as in the heat budget of the study region, which has been documented by several observations. For instance, an indicator is the enhanced water consumption in agriculture due to a shift from grain to vegetable- and fruit-based production systems, which results in an intensification of irrigation and changing dynamics of evapotranspiration and ground water recharge.

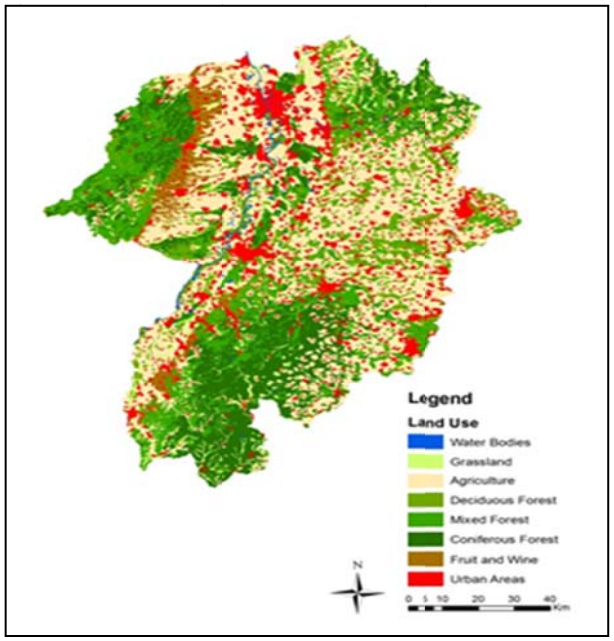
This is emphasized by climate variabilities and climate change. It is expected that temperature and precipitation rates will experience shifts towards dryer and hotter spring and summer months on the one hand and more humid and mild autumns and winters on the other hand.

This triggers agricultural drought and modifies the water balance, e.g. through changing snow cover conditions.

Objectives

- Quantification and analysis of environmental and meteorological parameters indicating changing water balances and heat budgets
- Estimation of future shifts of these parameters facing climate change effects
- Investigation of hydro-climatic effects from land-use changes and evaluation of adaptation measures from land-use change to changing climatic conditions

Figure 2: The land use map of the Upper Rhine valley and its surroundings illustrates the variety of landscapes



Study region

The Upper Rhine valley and its surroundings has been chosen as study region since it embraces a large variety of landscapes with very specific regional climatic conditions, topography and land cover.

In the western and the eastern edges of the study region two mountain ranges stretch, the Palatinate- and the Black-Forest. Predominant vegetation here is coniferous and mixed forest, but also some grassland which has been used for pastoral purposes since centuries. Both areas exhibit high amounts of precipitation and relative low mean annual temperatures during the year, e.g. +3.3°C and 1900mm/a (Feldberg/Black Forest).

Main land use in the Rhine valley itself consists of agriculture. Flat terrain, fertile soils, a warm to moderate climate and sufficient amounts of precipitation makes the project region most productive for agriculture.

In spite of these favourable conditions, water is also a limiting factor since precipitation rates decrease from east to west because of rain shadow effects of the Palatinate Forest. Thus, the gradient varies from 804 mm/a (Heidelberg) into 550 mm/a (Schifferstadt) long term annual mean. Low precipitation rates in the western part of the study region resulted in the construction of irrigation systems, like the biggest one in the region, managed by the water and soil association Oberpfalz.