# HYDRO-METEOROLOGICAL EFFECTS OF FIRE FREE LAND PREPARATION AT A WATERSHED SCALE

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## 1. INTRODUCTION

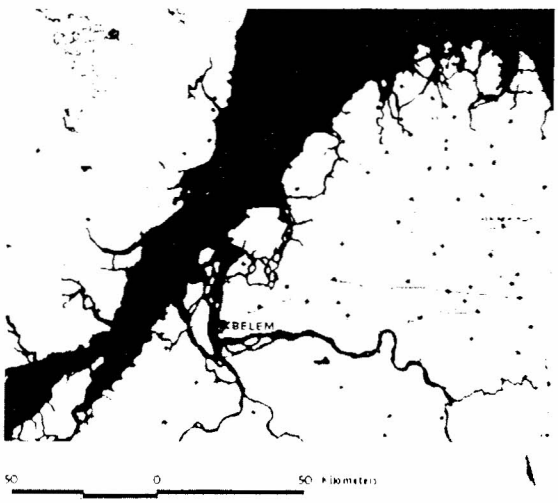
Building on the results of previous studies (Holscher, 1995, 1997a,b, Klinge, 1998, Sommer, 2000), an intensive hydro-meteorological study is being performed in a series of small agricultural headwater catchments in the Eastern Amazon region.

In order to evaluate the effects of slash-and-burn versus slash-and-mulch agriculture, hydrological and micro-meteorological measurements are made in a series of nested catchments at three spatial levels over a period of two years. In this paper the project layout and preliminary results of the study are presented.

## 2. PROJECT DESCRIPTION

The study is part of the German-Brazilian Studies of Human Impact on Floodplains in the Tropics project (SHIFT). The current study concentrates on the Cumaru watershed (1°11' S, 47°34' W), located 12 km southeast of the town Igarape Açu, and 100 km northeast of Belem, Brazil.

The study runs from January 2001 through June 2002.




Location of the study area

The region is dominated by smallholder farms that practice slash-and burn agriculture in secondary forest with rotational crops like manioc, corn, cowpea and rice with a cycle of 6 to 10 years on average. Over the last decade a shift towards perennial crops like maracuja and pepper, as well as a shortening of cropping cycles has led to stronger soil degradation and nutrient depletion. With the development of fire-free land preparation techniques (e.g. mulching) and optimization of land-use an attempt is made to grow towards a sustainable agricultural system (Denich and Kanashiro, 1998).

The introduction of mulching techniques is thought to have various micro-climatological and hydrological benefits like reduced dry season soil evaporation, decrease of nutrient losses through quickflow transport mechanisms and reduced surface erosion.

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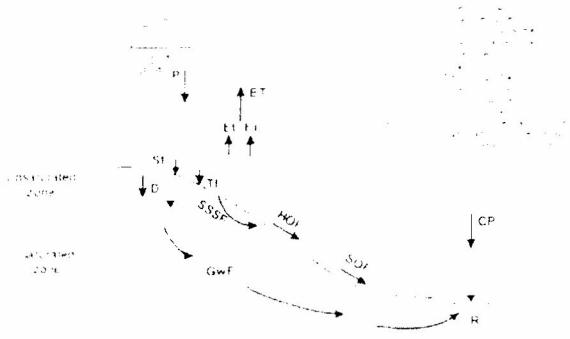
## 3. APPROACH AND INSTRUMENTATION

In order to assess the effects of land-cover change on the hydro-meteorological processes, a detailed knowledge of the hydrological balance is required. To obtain this knowledge most components of the hydrological balance are measured. The measured data serve as input for a set of hydrological and micro-meteorological models.




### 3.1 Micro-meteorological measurements

For the micro-meteorological measurements a 3m high Campbell Scientific mast was installed in a patch of approximately one hectare of 1.5 year old secondary vegetation. With this mast precipitation, wind speed and direction, relative humidity, air temperature, incoming and outgoing radiation, net radiation, soil temperature and heat flux at two depths, and surface soil moisture (0-30 cm), are measured at 5 minute intervals.

The evapotranspiration will be calculated with the modified Penman model (Shuttleworth, 1988), and with a soil water depletion model (Waterloo, 1994).

Evaporation from the secondary forest and riparian forest is estimated with a canopy water balance model. For the determination of interception two plots of 20 hand gauges is maintained.

In order to get a sense of spatial variabilty of the rainfall distribution, three tipping bucket rain gauges and 10 totalizing gauges have been distributed over the catchment area.

### 3.2 Unsaturated zone measurements

The downward flux of percolating water is estimated with 4 soil pits equipped with tensiometer and TRIME EZ TDR profiles. The soil moisture condition is currently monitored on a daily basis.

### 3.3 Groundwater

To acquire an accurate estimate of regional groundwater flow, a piezometer network with 50 piezometers distributed throughout the watersheds, is monitored. The groundwater flow will be modeled with the MicroFEM finite element model.

### 3.4 Stream flow

Stream flow is measured in three first order catchments with V-notch weirs equipped with a water level recorder. For stream water sampling and pH and EC monitoring during peak events a portable automatic water sampler is stationed at each catchment on a rotational basis.

## 4. PRELIMINARY RESULTS

Although the study is in an early stage the opportunity is taken to show some preliminary calculations.

The water balance for a catchment is:

$$Q = P - ET \pm \Delta S$$

where: Q is the discharge, P the precipitation, ET and S the storage. All parameters are expressed in mm

Over the period between the 15th of January and the 11th of March, 2001 the area received a total of 1031 mm precipitation. The total runoff of a catchment area of approximately 6ha over this period was measured to be 501 mm. The storage (saturated storage) of the catchment was estimated at 306 mm. This results in an estimated ET of 196 mm, relating to an average ET of 3,5 mm/d.

It should be stressed that these values are preliminary, and that with extended measurements a more accurate estimate of, especially, the storage component of the water balance will be obtained.

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