# Processes of streamflow generation in a headwater catchment in central Amazonia

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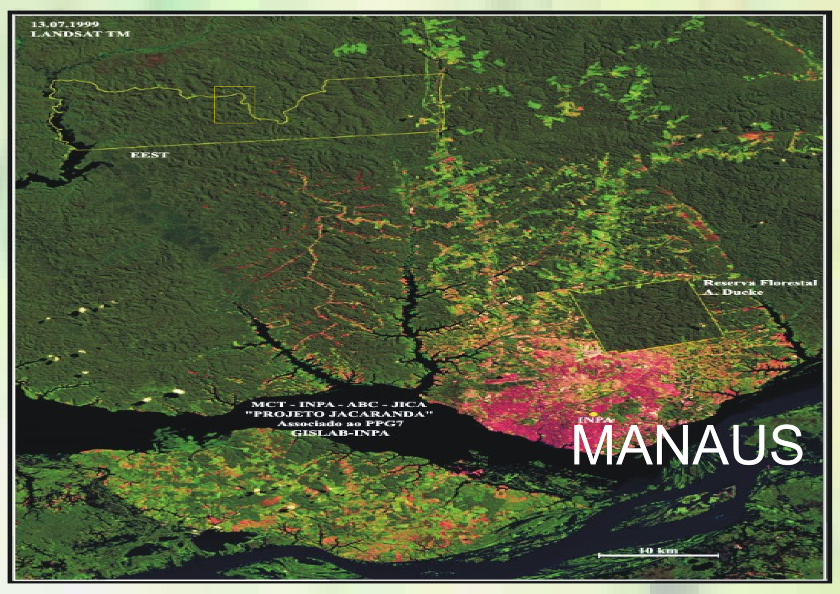


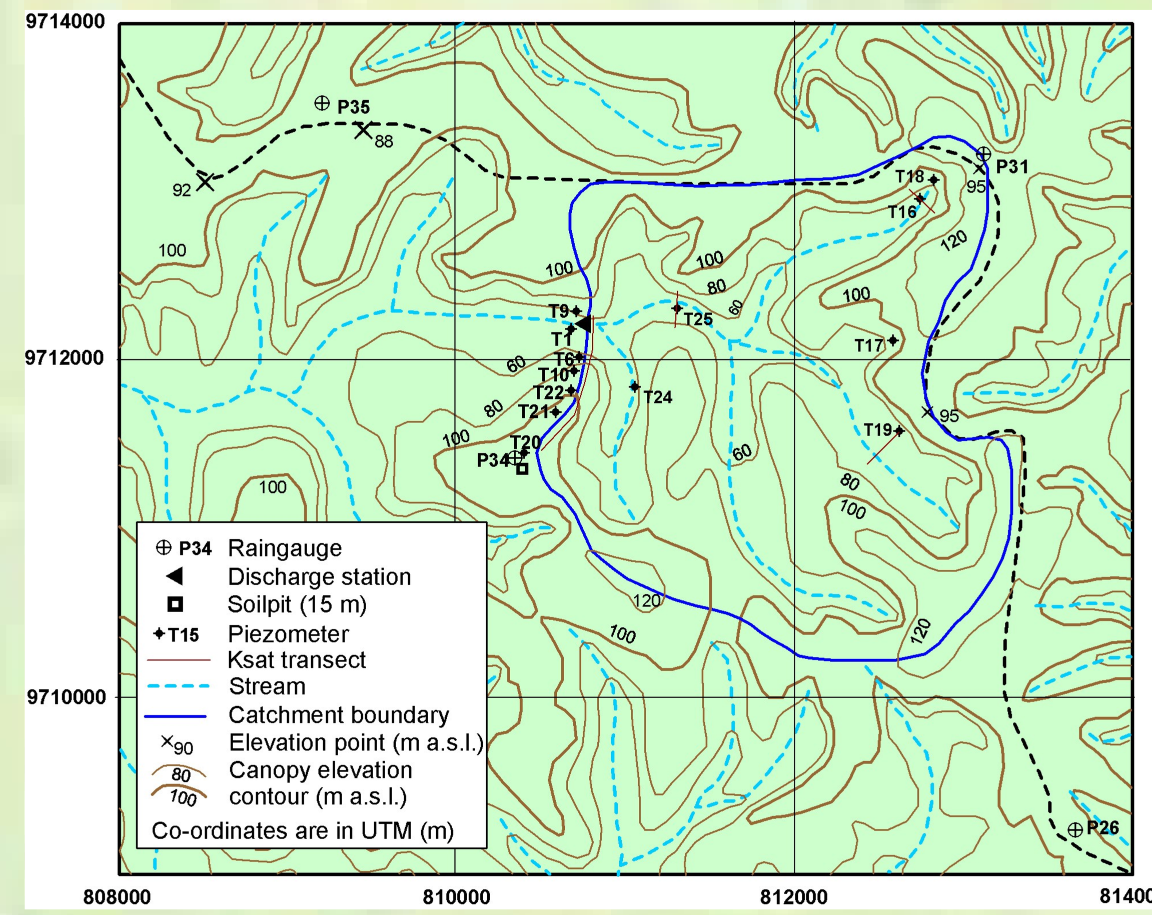

Landsat image showing location of the Cueiras micro-catchment


## Background

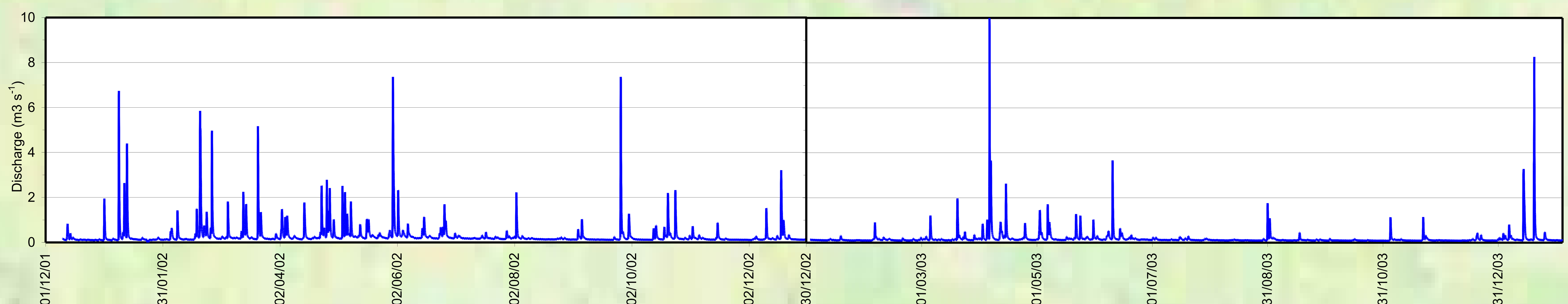
The 6.8 km² Cuieiras micro-catchment is located in the INPA EEST Reserve, north-west of Manaus, in Central Amazonia, and has been instrumented to measure the interdependent carbon, water and nutrient balances.

Mean annual rainfall is about 2400 mm. Maximum relief variation is about 50 m. There is a catenary sequence of soils from deep clayey oxisols on the plateau through sandy clay ultisols on the slopes to sandy spodosols on the valley floor. Typical water table depths range from 36 m below ground level (bgl) on the plateau to 0.1m bgl on the valley floor.

The hydrological instrumentation was installed in November – December 2001 and observations have continued since then. Data up to January 2004 are presented here.



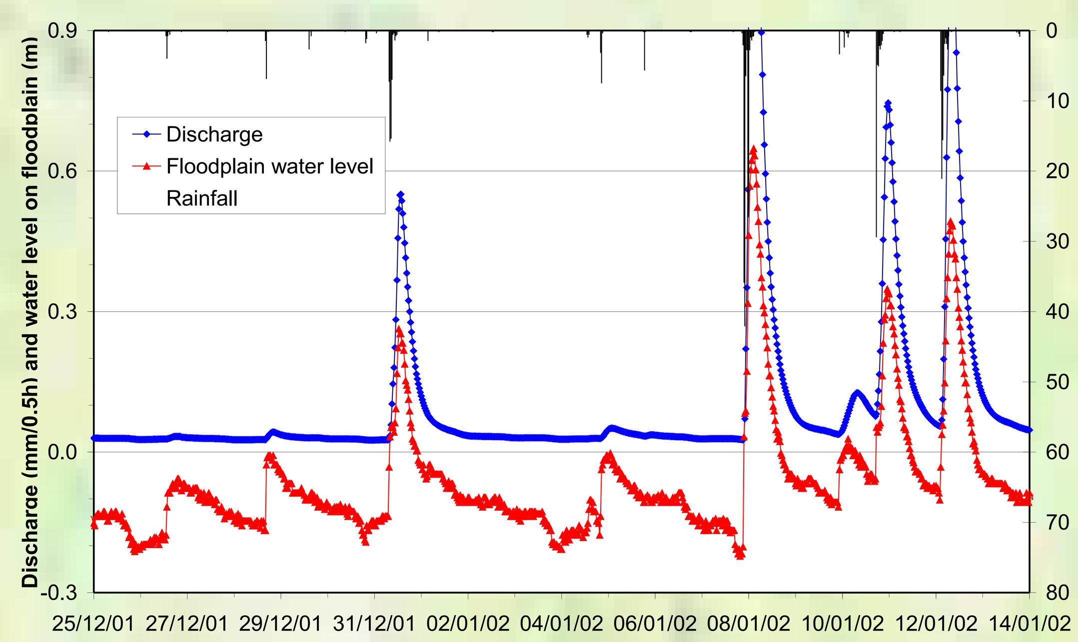

## Discharge December 2001 – January 2004




### Runoff summary

| Year (calendar) | 2002 | 2003 |
|---|---|---|
| Catchment Rainfall (mm) | 2975 | 2054 |
| Total Runoff (mm) | 1362 | 781 |
| % of Rainfall | 46 | 38 |
| Storm Runoff (mm) | 618 | 241 |
| % of Total | 45 | 31 |
| Baseflow (mm) | 744 | 540 |
| % of Total | 55 | 69 |

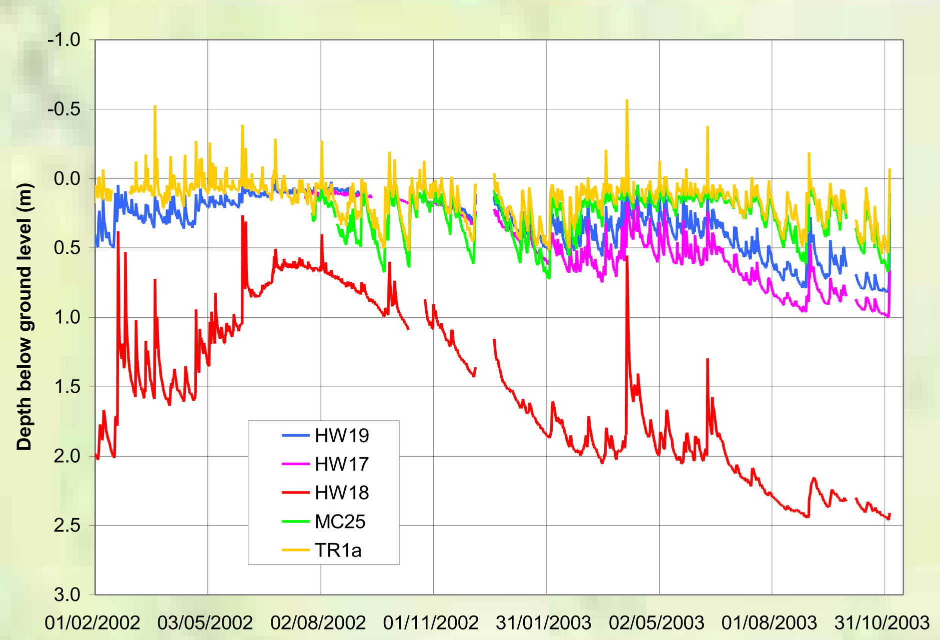
Discharge and water level, 7m from stream bank




- Rapid response of water table even to very small rainfall events
- Small increase in runoff when water table does not reach the soil surface
- Greater runoff if water table reaches soil surface – subsequent rainfall runs off
- Good illustration of capillary fringe effect, described by Gillham (1985)
- Event runoff depends on depth of water table below the valley floor

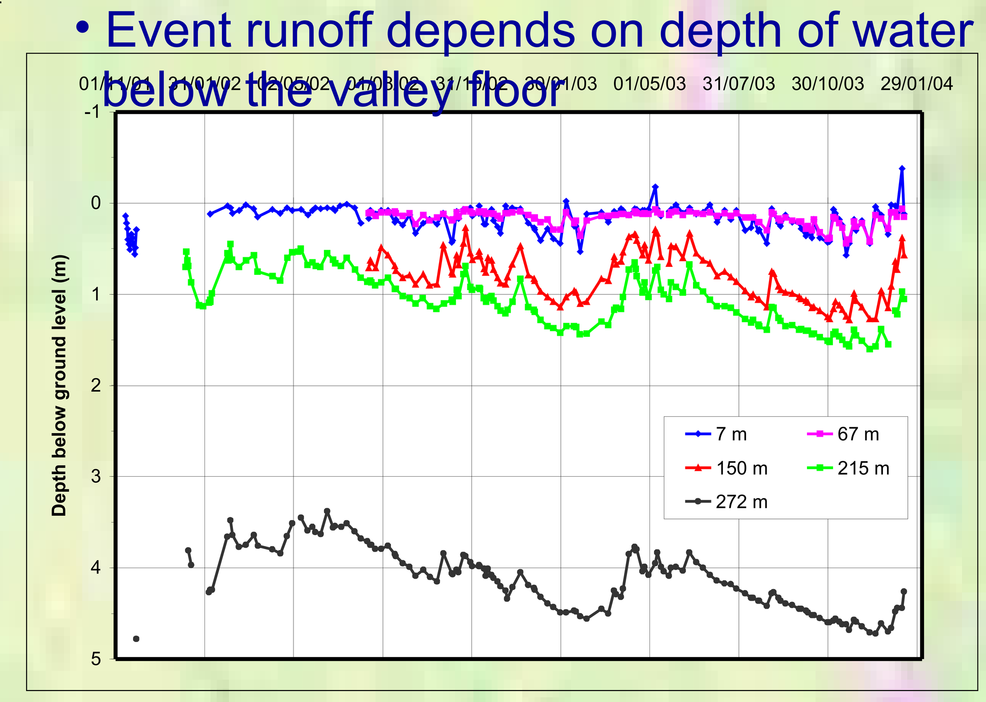
## Groundwater level below surface

Seasonal variation of depth to water table at various locations on the valley floor. TR1a is at the gauging site, MC25 is in the centre and HW17 – 19 are in the headwaters of the catchment



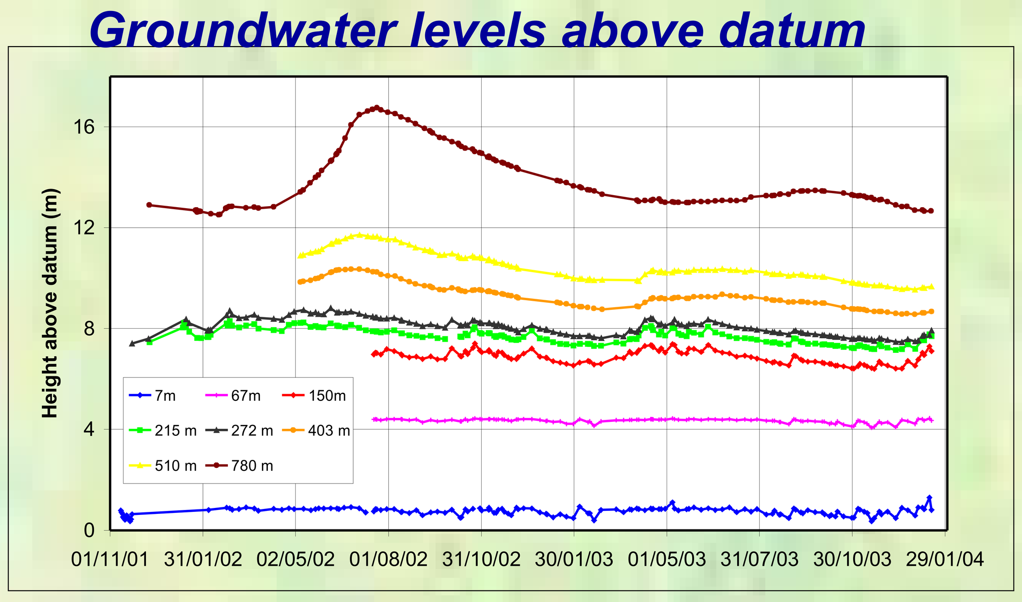

- In wet season, water level near surface at almost all sites
- Greater seasonal variation in water level in mid catchment and at head water sites
- HW18 is on the valley floor, close to a small gully. Large peaks in water level correspond with large and intense rainfall events
- This is evidence of a contribution to discharge from the slopes

Seasonal variation of depth to water table at different distances from stream (weekly observations)




- Water level rarely falls below 0.3m, up to 70 m from the stream – little seasonal variation
- Water table progressively deeper further from stream but
- Water level may reach the soil surface during large events, increasing contributing area

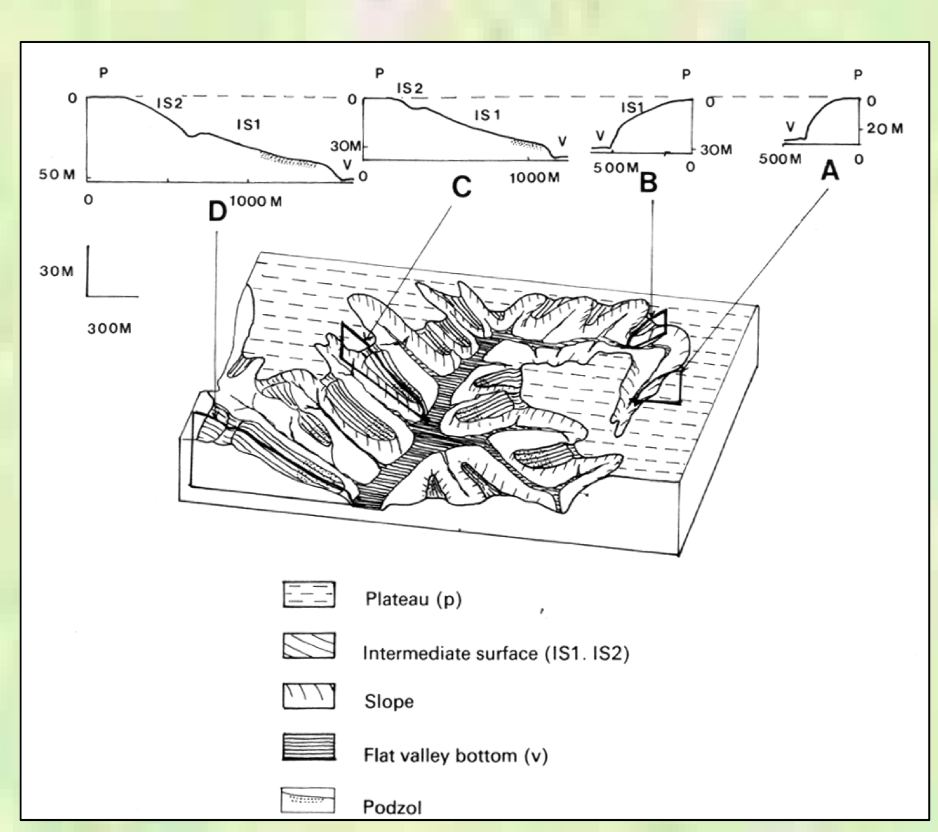
## Groundwater levels above datum




The dipwells furthest from the stream (>400m) are below the plateau. The water table depth at 780 m is 36 m bgl. There is a long delay for recharge to arrive at this depth (eg peak in July 2002). There was little recharge in 2003. Groundwater discharge from beneath the plateau and slope maintains the water levels in the valley floor areas. Note lack of variation at 7 m and 67 m from the stream

## Comparisons with previous data

| Catchment | Area (km$^2$) | Years | Rainfall | Stormflow (% of total) | Source |
|---|---|---|---|---|---|
| Calado | 0.024 | 1984-85 | 2870 | 5 | Lesack (1993) |
| Barro Branco | 1.3 | 1981 | 2312 | 9 | Leopoldo et al. (1995) |
| | | 1982 | 2365 | 9 | |
| | | 1983 | 1949 | 9 | |
| Asu | 6.8 | 2002 | 2975 | 45 | Hodnett et al. (2004) |
| | | 2003 | 2054 | 31 | |




Block diagram (from Chauvel et al., 1987) showing valley X-sections in an area about 15km to the E of the Asu catchment.

This clearly shows the change in valley shape from V-shaped to flat bottomed as catchment size increases, and the increase in proportion of valley floor area. The valley floors are wider in the Asu area.

The proportion of storm runoff is partly dependent on catchment size, because of the change in proportion of valley floor area

## Conclusions

Understanding the processes of streamflow generation and determining the quantities of water generated by the different processes is very important to determining the fate of nutrients and carbon in this forest ecosystem. The valley floor is clearly the source of the rapid runoff; but the role of interflow is less clear. Stormflow is a major contributor to total outflow, and is much larger in this catchment than in the smaller catchments previously studied. This is due to the greater area of valley floor in the Asu catchment. The proportion of valley floor increases with catchment size. This must be taken into account in scaling up the results from small basins.

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