Using Rainforest Research

Where earth meets sky: cloud forests of the Wet Tropics

April 2002

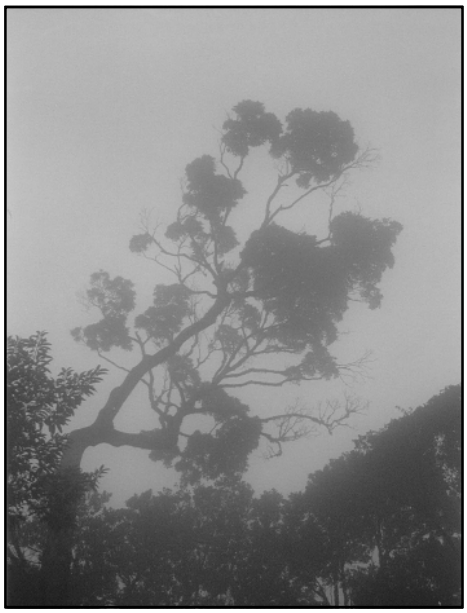
It has long been suspected that high altitude forests which are immersed in cloud for a large proportion of the time may in fact 'strip' considerable amounts of moisture from passing clouds. This has now been confirmed by Rainforest CRC researchers from CSIRO Atherton who have measured water input in rainforest on mountain tops in the Wet Tropics. Their findings suggest that, in some months of the year, up to forty per cent more water could be harvested out of the clouds than is measured as rainfall in a standard rain gauge.

The team of researchers has been first to accurately measure both the transpiration of rainforest at different altitudes, and the amount of water collected by leaves and branches as clouds pass through the canopy of the high altitude cloud forests.

Their research highlights the ability of cloud forests to contribute much higher volumes of water to catchments than rainforest at lower altitudes. This is because of their comparatively low rates of water use combined with their ability to 'harvest' significant volumes of water from passing clouds.

Measuring the harvest

Measuring cloud harvesting requires that all sources of water input to the forest be measured. In a cloud forest environment rain falls on the canopy and then either falls through to the ground as *throughfall* or runs down the tree trunks as *stemflow*. In addition, the trees also harvest water as clouds blow through the canopy wetting the leaves, stems, trunks and epiphytes, water which also becomes throughfall or stemflow.



Above: Typical cloud forest environment
Left/right: Equipment for measuring stemflow and throughfall being set up in the forest

To estimate the water input to the forest from rainfall and cloud harvesting, collars are fixed onto trees to collect stemflow and troughs are placed beneath the canopy to collect throughfall. The amount of water collected is then compared to the amount of water collected in a standard raingauge over the same time period. The excess is equivalent to water collected by cloud harvesting. Cloud forests are often difficult and costly to access and the establishment of throughfall troughs and stemflow collars at a large number of sites is time consuming, therefore researchers from the Rainforest CRC are also refining a simple method for measuring cloud harvesting.

Providing science for the conservation and management of Australia's World Heritage tropical rainforests.

COOPERATIVE RESEARCH CENTRE FOR TROPICAL RAINFOREST ECOLOGY AND MANAGEMENT

The Rainforest CRC is a research partnership involving the Commonwealth and Queensland State governments, the Wet Tropics Management Authority, the tourism industry, Aboriginal groups, CSIRO, James Cook University, Griffith University and The University of Queensland

The 'cloud stripper'

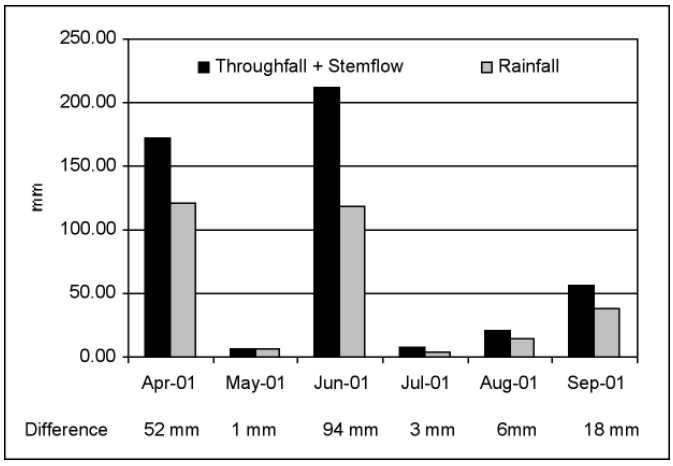
The instrument used is known as a 'cloud stripper' and is basically a modified raingauge with a cylinder of wire mesh fixed above it and a roof over the top to keep rainfall out. When cloud blows through the mesh it collects on the mesh and runs into the raingauge where it is measured. However, the mesh of the cloud stripper is not representative of the rainforest canopy so readings need to be adjusted to make them 'real'. This is achieved by analysing the relationship between cloud stripper measurements and throughfall and stemflow for the same period. Once suitable calibration of cloud strippers is achieved, these instruments can be distributed through the cloud forest of the Wet Tropics to improve spatial estimates of the contribution of cloud stripping to the hydrology of the region. Initial measurements in cloud forest show that cloud stripping could add billions of litres of extra flow to tropical river systems, boosting the already considerable amount of water these forests receive from rainfall.

Conserving as well as capturing

Although these high altitude Wet Tropics forests receive huge volumes of water from rainfall and cloud harvesting, Centre researchers are also finding that these forests use very little water. Measurements of tree water use are showing that the trees of the cloud forests use much less water than forests at lower altitudes. This is because the leaves of trees are nearly always wet and the clouds block incoming energy from the sun that would otherwise drive transpiration (tree water usage).

Significance and threats

Cloud forests cover only a small area of the Wet Tropics but contribute a disproportionally large amount of water. Behaving like giant sponges, they capture large volumes of water, but then release this water slowly throughout the year. For this reason, cloud forests are believed to be of great importance both in feeding stream systems and to the maintenance of stream flows through out the dry season.



While this research highlights the importance of cloud forest areas for water supply, it also raises important issues regarding long term water security and water resource management because of potential threats to cloud forest areas.

These threats include conversion of cloud forest to agriculture and predicted rises in temperature and cloud base altitude as a result of global warming.

Although Australian cloud forests are largely protected from clearing and change of land use, the same is not the case in many other nations like PNG, Indonesia and Malaysia where upland rainforests are under threat from development and agriculture. In some areas, the loss of cloud-harvesting ability has already lead to water shortages in the dry season.

Another threat to cloud forests is global warming. Predicted increases of 1 to 2 degrees in temperature over 50 years would cause the cloud base to rise in altitude. In the Wet Tropics this would result in a predicted loss of about three-quarters of Queensland's cloud forests (70,000 hectares). In the light of current research findings, such losses would clearly have a major impact on stream flows, and as a result current water allocations are unlikely to remain sustainable.

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