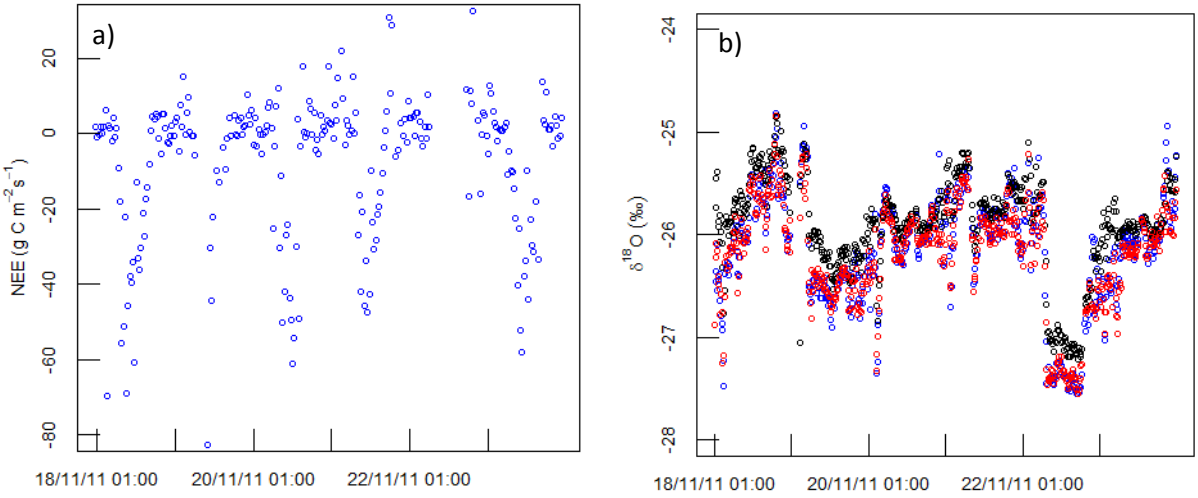
Vulnerability of the carbon and water cycles in primary rainforest and agroforestry ecosystems in Indonesia to Climate Change.

This project is funded by the Deutsche Forschungsgemeinschaft (German Research Foundation, DFG).

Current and future climatic changes are affecting the functioning of tropical rainforest ecosystems in Indonesia by altering the energy balance and fluxes of water and greenhouse gases and consequently the productivity of the ecosystems. There is particular concern that climate change could make these ecosystems more vulnerable to drought. This project aims to determine the origin and recycling of atmospheric water vapour using stable water isotopes (^{18}O and ^{2}H), and its influence on fluxes of CO_2 and H_2O from a tropical montane rainforest in Bariri, Indonesia. In this project, we are combining eddy covariance (EC) measurements of sensible heat, water vapour, and CO_2 fluxes with novel online measurements of ^{18}O and ^{2}H in water vapor using laser spectroscopy. The Bariri site is the only known EC site in a pristine high-elevation tropical rainforest, which in combination with the strong influence of the Asian monsoon and El-Nino Southern Oscillation (ENSO) in this region makes it a unique and valuable study site.

Bariri 70 m carbon flux tower and stable water vapour analyzer with calibration system.

Initial measurements from Bariri showed a high C uptake. However, the expected increasing frequency of ENSO-caused drought in this region could lead to dramatic changes in C and water cycling in these stands. The isotopic composition of water vapour is expected to provide detailed information on the sources of atmospheric water vapour and subsequent mixing, and thus enable us to assess the vulnerability of these stands to climate change.



a) Eddy covariance measurements of net ecosystem exchange (NEE) measured at 48-m in Bariri. Negative values indicate carbon uptake, positive carbon release.
b) 5-minute averages of $\delta^{18}O$ measurements made at 70- (black), 48- (blue) and 36-m (red) in Bariri.