Assessing Upland Tree Methane Emissions Using an Automated System

Andrew R. Sample

Crop, Soil & Environmental Sciences

UNIVERSITY OF ARKANSAS

UNIVERSITY OF ARKANSAS

THE PROBLEM

Previous assessments of global atmospheric methane concentrations do not account for methane emissions from upland forested ecosystems, a recently observed and potentially significant source of atmospheric methane.

Fig 1. Setting up the tubing to our main board that cycles the air sample from the tree chamber through the gas analyzer and back. All chambers were programmed to open and close using open source hardware called Arduino Mega.

THE PROJECT

During my summer internship at the Smithsonian Environmental Research Center (SERC) in Edgewater, MD, I worked in the Biogeochemistry lab on a project to help develop an automated sampling system to improve the accuracy of tree methane emission measurements. We programmed our system to sample one chamber at a time in a continuous cycle for eight minute intervals with the gas analyzer taking a concentration measurement every five seconds. This gave us clear results and helped us answer the questions of when trees emit methane.

Fig 2. A view of the portable gas analyzer (yellow). It uses Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) to monitor in real time the concentrations of methane, carbon dioxide, and water vapor of the gas pumped through its sampling chamber.

Tulip Poplar

- 1) 75 cm
- 2) 165 cm
- 3) 245 cm

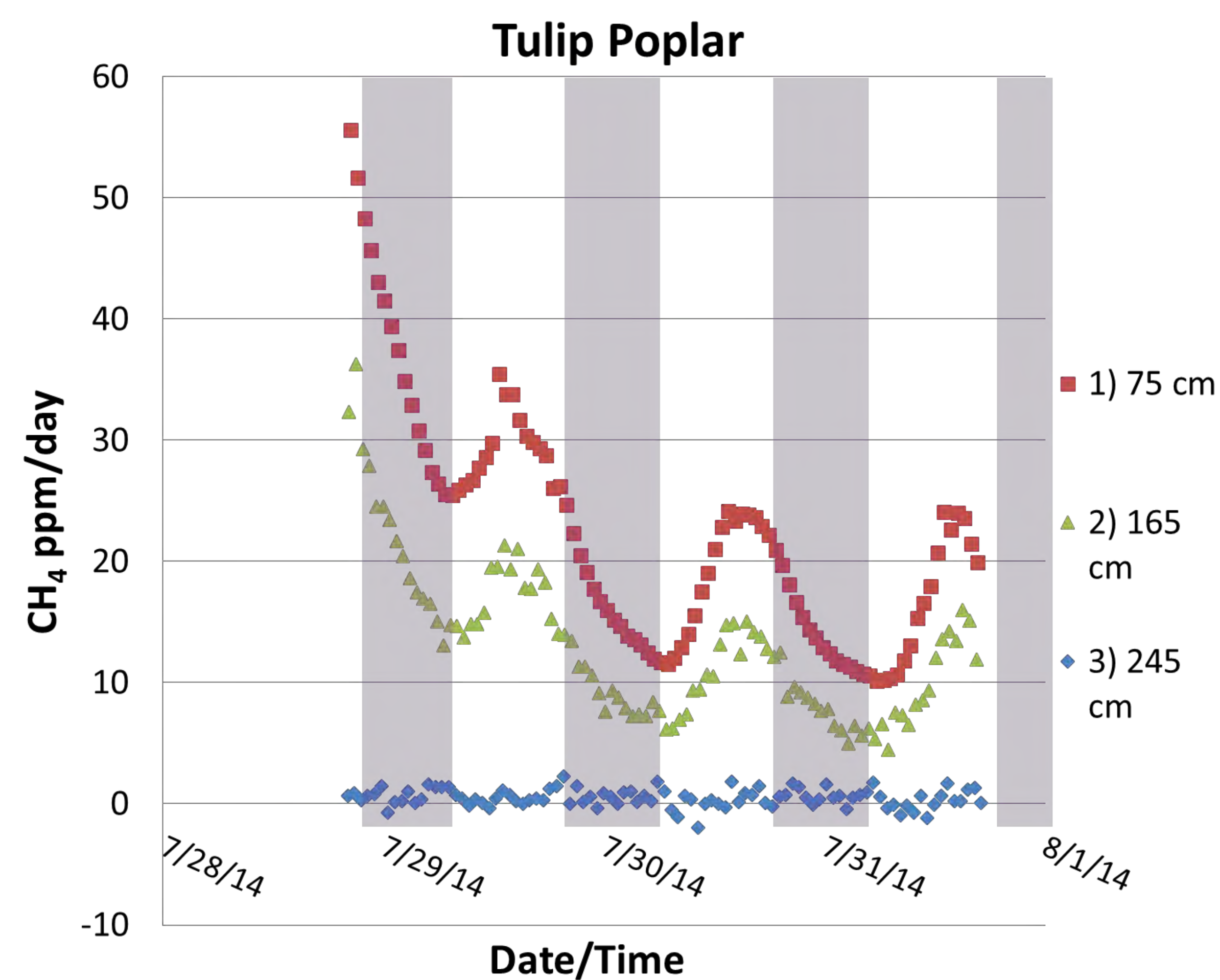Y-axis: CH_4 ppm/day; X-axis: Date/Time (7/28/14, 7/29/14, 7/30/14, 7/31/14, 8/1/14)

Fig 4. Methane emission flux rate in parts per million per day over 3 days on a Tulip Poplar tree taken at three heights up the tree. Y-axis shows CH_4 flux rate in ppm/day, x-axis shows date. We observed a cyclic flux over the days with high peaks around 2:00 PM and low peaks around 6:00 AM. Methane emissions decreased up the tree
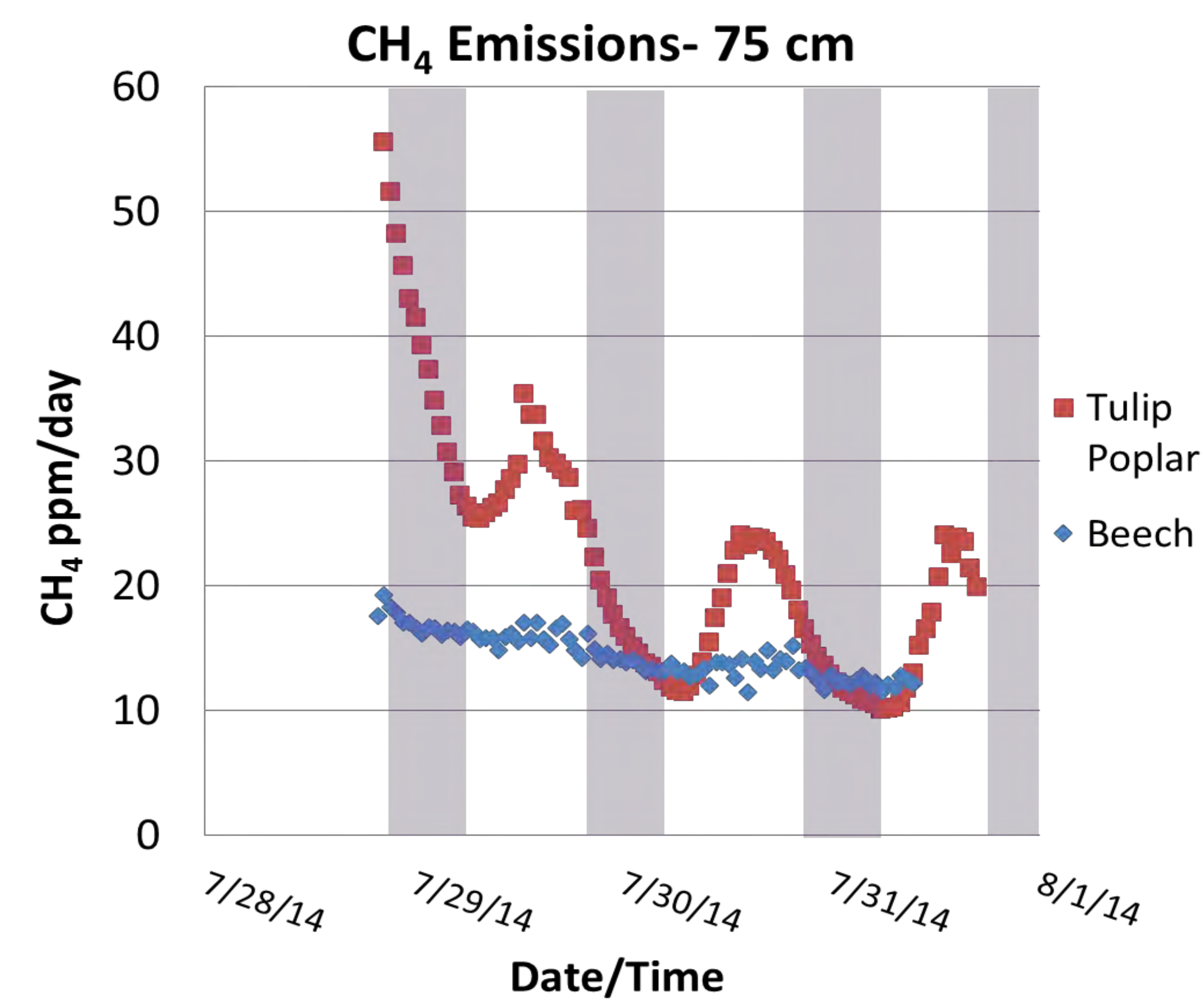

Fig 3. Installing the monitoring chambers on one of the Tulip Poplar trees. Chambers were custom designed, cut and sealed on the trees.

CH_4 Emissions- 75 cm

- Tulip Poplar
- Beech

Y-axis: CH_4 ppm/day; X-axis: Date/Time (7/28/14, 7/29/14, 7/30/14, 7/31/14, 8/1/14)

Fig 5. Methane emission flux rate in parts per million per day over three days at 75cm on two different tree species . Y-axis shows CH_4 flux rate in ppm/day, x-axis shows date. We observed major differences in emissions between the tulip poplar tree and Beech tree. The trees had different diameters, heights and wood densities.

SUSTAINABILITY

My internship experience at SERC allowed me to contribute to research that will ultimately affect how we assess a sustainable greenhouse gas budget of Earth's atmosphere. This research will continue at SERC and address the questions of how, why, how much, and what effects methane tree emissions.

This experience was incredible and I benefitted greatly from it. I was able to apply the things I have learned at the UofA to work to try to answer questions about natural system sustainability, and have been able to apply my experience gained from my internship here at Arkansas.

Fig 6. View of the automatic chambers during a sampling run on a Tulip Poplar tree at heights of 75 cm, 165 cm and 245 cm. The middle chamber at 165 cm is closed and cycling air through the gas sampler.