National Aeronautics and Space Administration

Postdoc Research

# High-resolution aboveground carbon dynamics in the Amazon forest

**Author: Ovidiu Csillik, Postdoctoral Fellow (329G)**
**Michael Keller (329G), Marcos Longo (Berkeley Lab)**

## KNOWLEDGE GAP

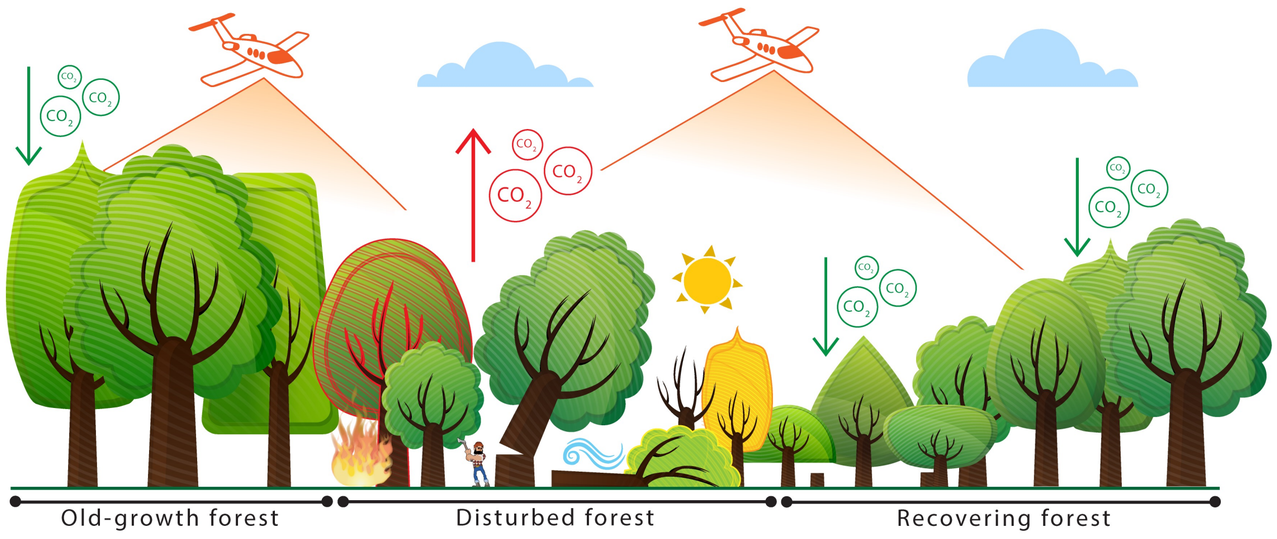


**Figure 1.** Quantifying carbon loss from human-induced degradation and natural disturbances, as well as carbon gain from forest recovery, varies widely and is challenging at a large scale.

## OBJECTIVE

- Provide a detailed partitioning of aboveground carbon losses and gains in the Amazon forest using high-resolution repeated airborne laser scanning.

## IMPORTANCE

- Forest degradation (logging and fires) directly impacted 3.5% of the surveyed area surpassing the area of forest cleared (0.7%).
- The Brazilian Arc of Deforestation experienced a net annual carbon loss of -90.5 ± 20.8 Tg C $y^{-1}$ between 2016 and 2018.
- This research directly contributes to one of the six prioritized objectives of NASA Decadal Survey: Ecosystem Change.

## FUTURE WORK

- Combine airborne and spaceborne lidar for pantropical analysis of aboveground carbon dynamics.

## METHODS and DATA

**99 airborne lidar**
repeated transects

**2 campaigns**
2016 and 2017-2018

**48,280 ha**
lidar coverage

**random sampling**
in the Brazilian Arc of Deforestation

**7 classes**
clearing, fire, logging, windthrow, other disturbances, no change, growth

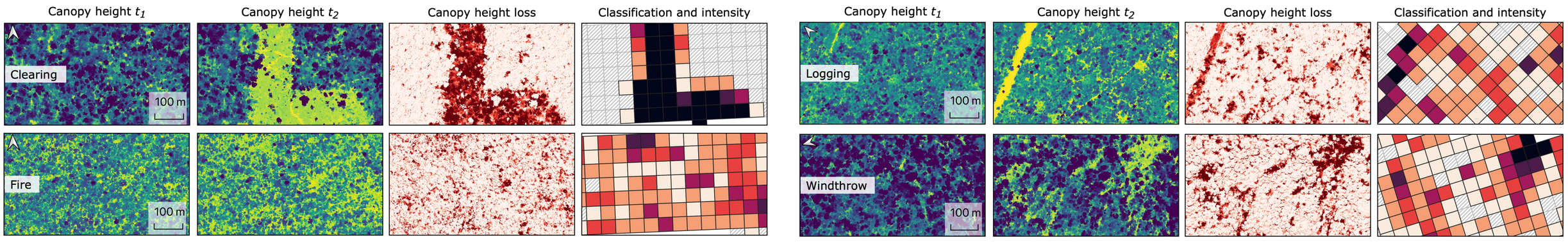


**Figure 2.** Canopy height loss from lidar time-series and the classification and intensity of relative height loss for clearing, fire, logging, and windthrow based on 50×50 m cells.

## RESULTS

Spatial distribution and transect-wise statistics of aboveground carbon dynamics

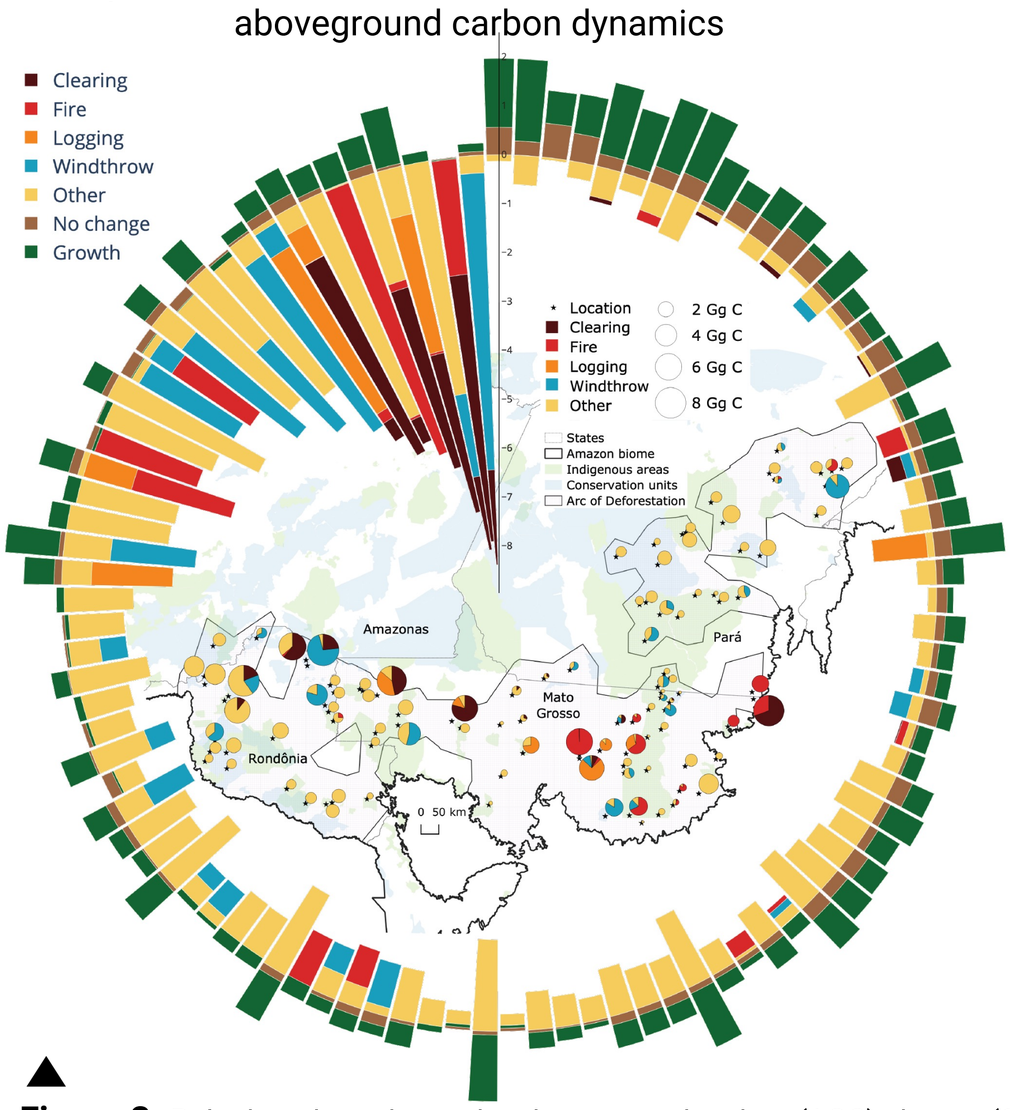


**Figure 3.** Polar bar chart shows the aboveground carbon (AGC) change (Gg C) for each of the seven classes analyzed and for each of the 99 transects, ordered by the net AGC change between the two lidar campaigns. The inset map shows the random locations of repeated lidar transects in the Brazilian Amazon biome.

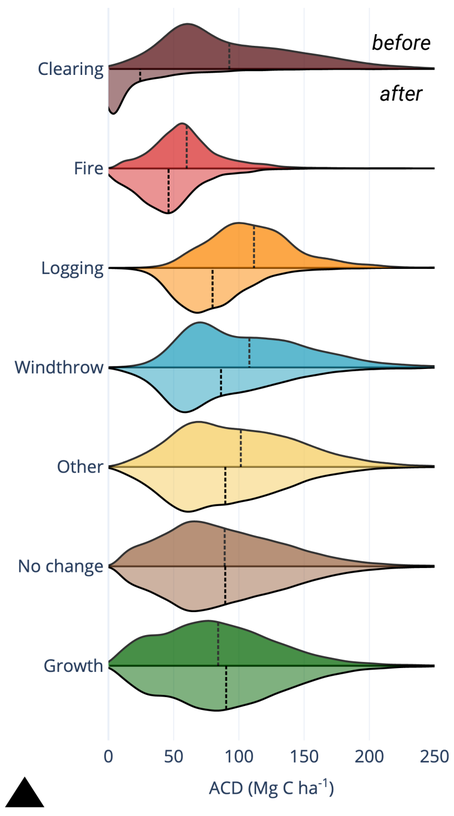


**Figure 4.** Variation in the overall distribution of aboveground carbon density (ACD, Mg C $ha^{-1}$) between the two lidar campaigns (*before* and *after*). The black dotted vertical lines represent the mean ACD.

Extrapolation statistics for the Brazilian Arc of Deforestation (544,300 km$^2$)

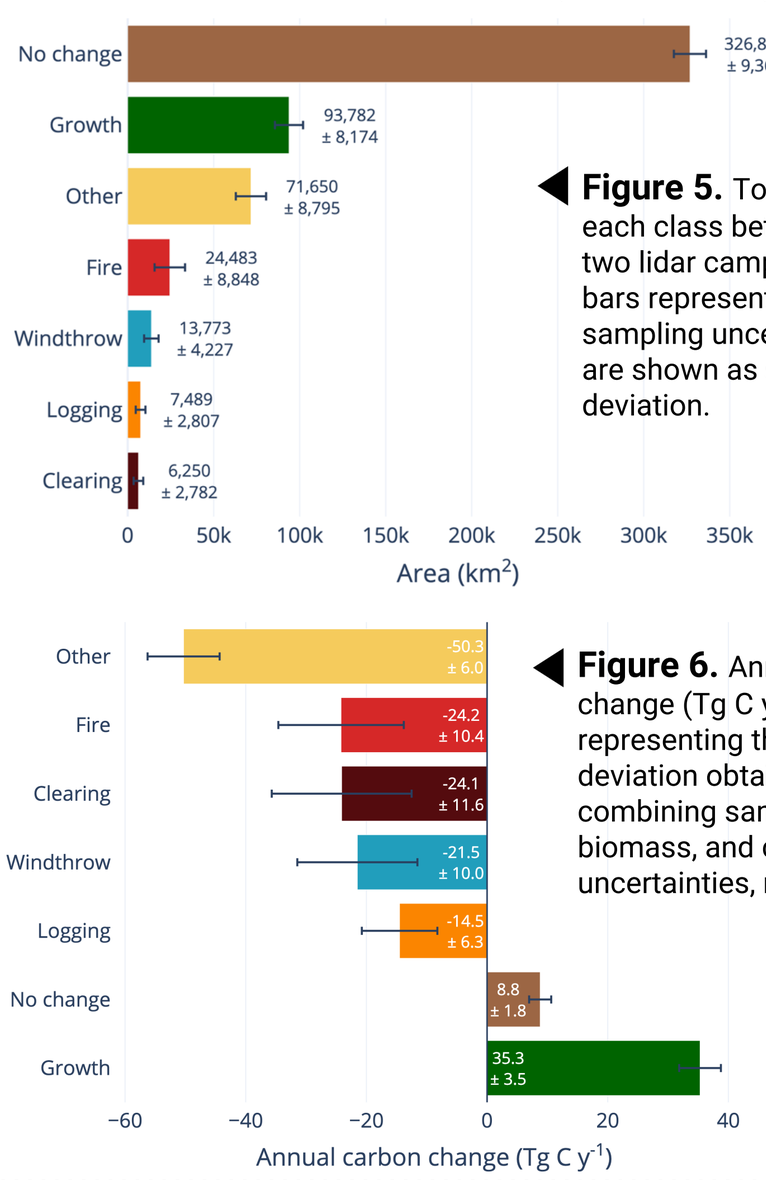


**Figure 5.** Total area for each class between the two lidar campaigns. Error bars represent the sampling uncertainty and are shown as standard deviation.

**Figure 6.** Annual AGC change (Tg C $y^{-1}$), with bars representing the standard deviation obtained by combining sampling, biomass, and classification uncertainties, respectively.

**National Aeronautics and Space Administration**

**Jet Propulsion Laboratory**
California Institute of Technology
Pasadena, California
**www.nasa.gov**

Clearance Number: CL#00-0000

Poster Number: PRD-E-009



**Publications and Acknowledgements:**
Csillik, O., Keller, M., Longo, M., Ferraz, A., Pinagé, E.R., Görgens, E.B., Silgueiro, V., Ometto, J.P., Saatchi, S., *(in review)*, A large net carbon loss attributed to anthropogenic and natural disturbances in the Amazon Arc of Deforestation

**Author Contact Information:**
*213-465-6732* *ovidiu.csillik@jpl.nasa.gov*