Max Planck Institute
for Biogeochemistry

Isoprene emission from measurements to model estimates - ATTO site

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EGU 2020

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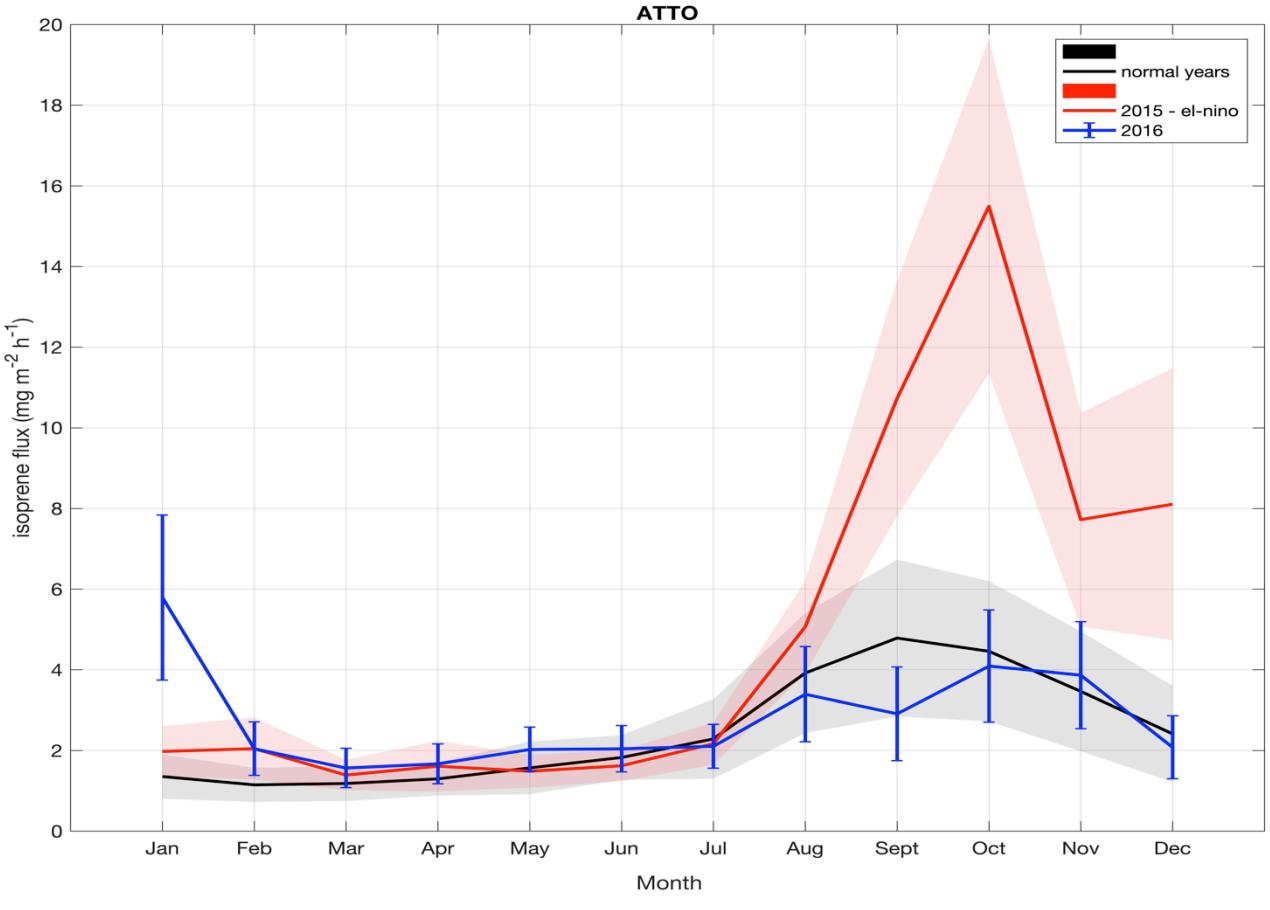
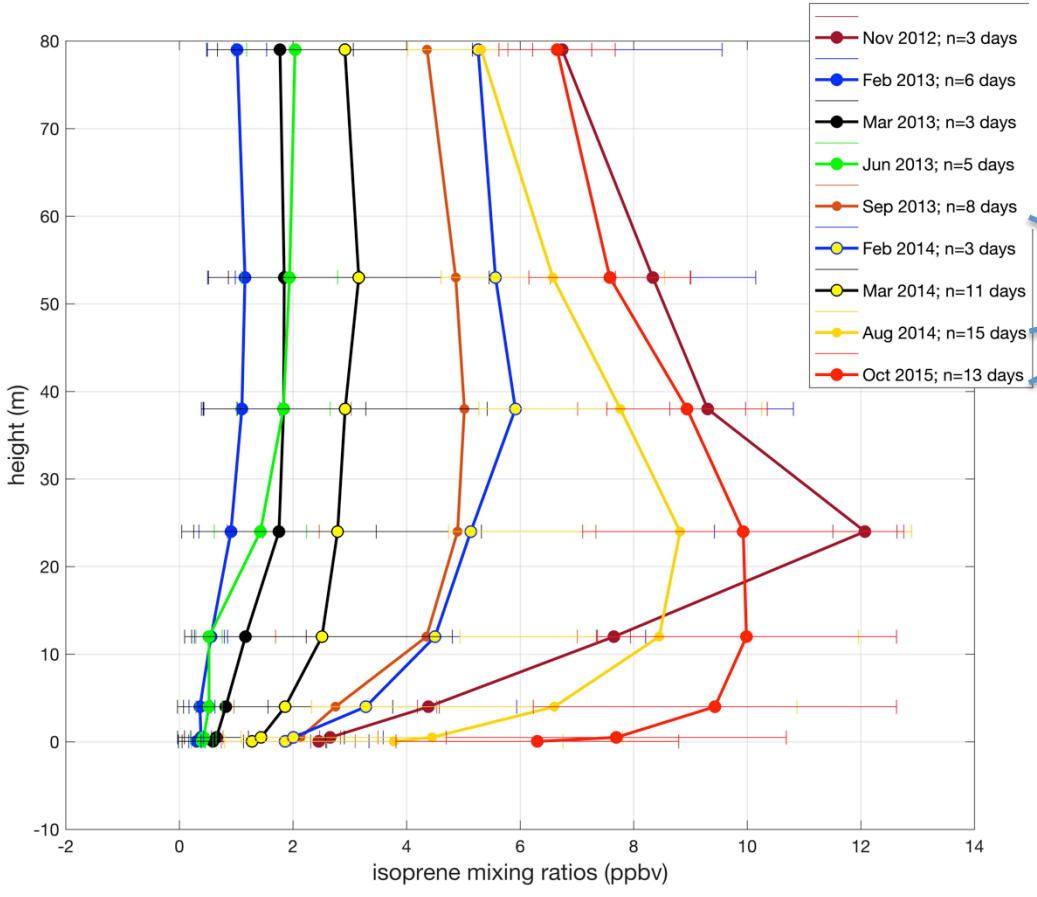
AMAZON TALL TOWER OBSERVATORY

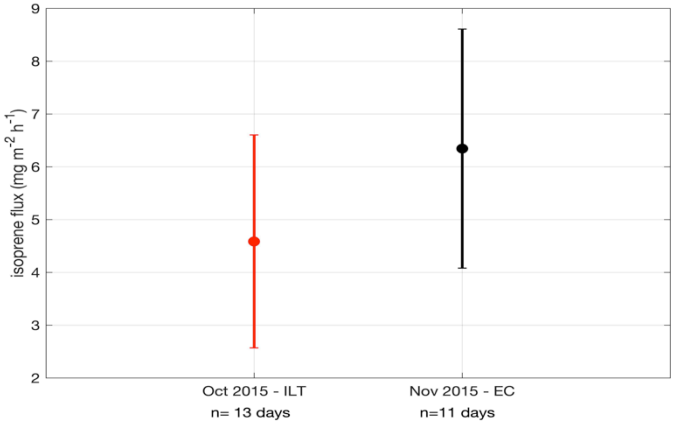
Satellite derived isoprene emission from 2013-2017



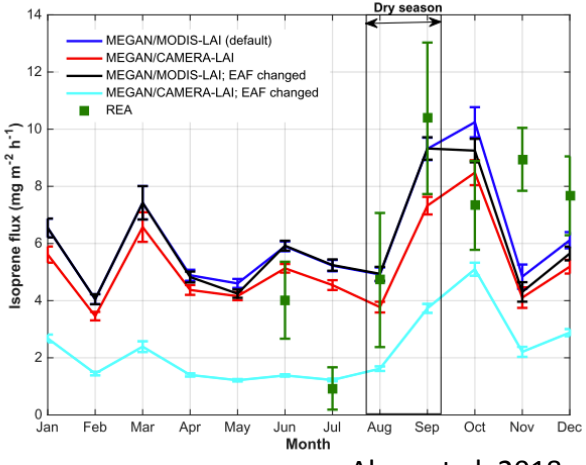
There is seasonal variation in isoprene emission, as already indicated by satellite retrievals…

Mixing ratios and fluxes of isoprene from 2012 to 2015





Dry season



Alves et al. 2018

WHAT IS TRIGGERING THE SEASONALITY OF ISOPRENE EMISSIONS?

Environmental factors (Seasonality)

Ecosystem isoprene emission (Seasonality)

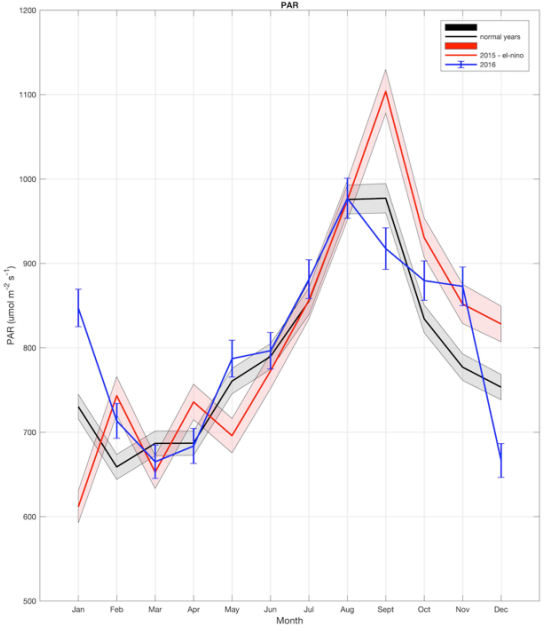
Solar radiation

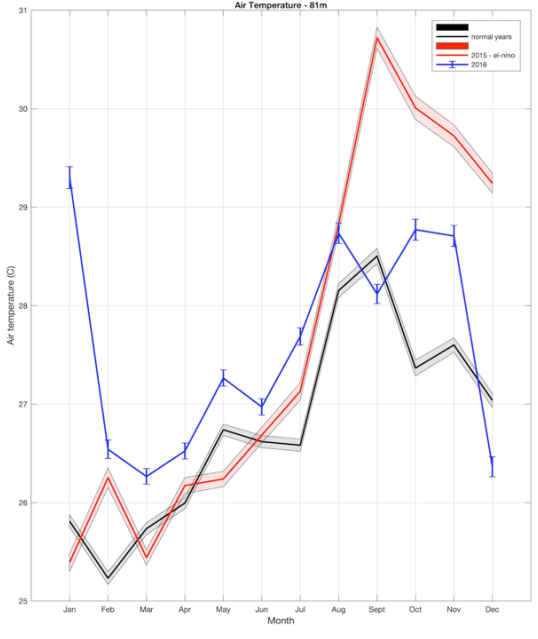
temperature

Forest functioning: isoprene

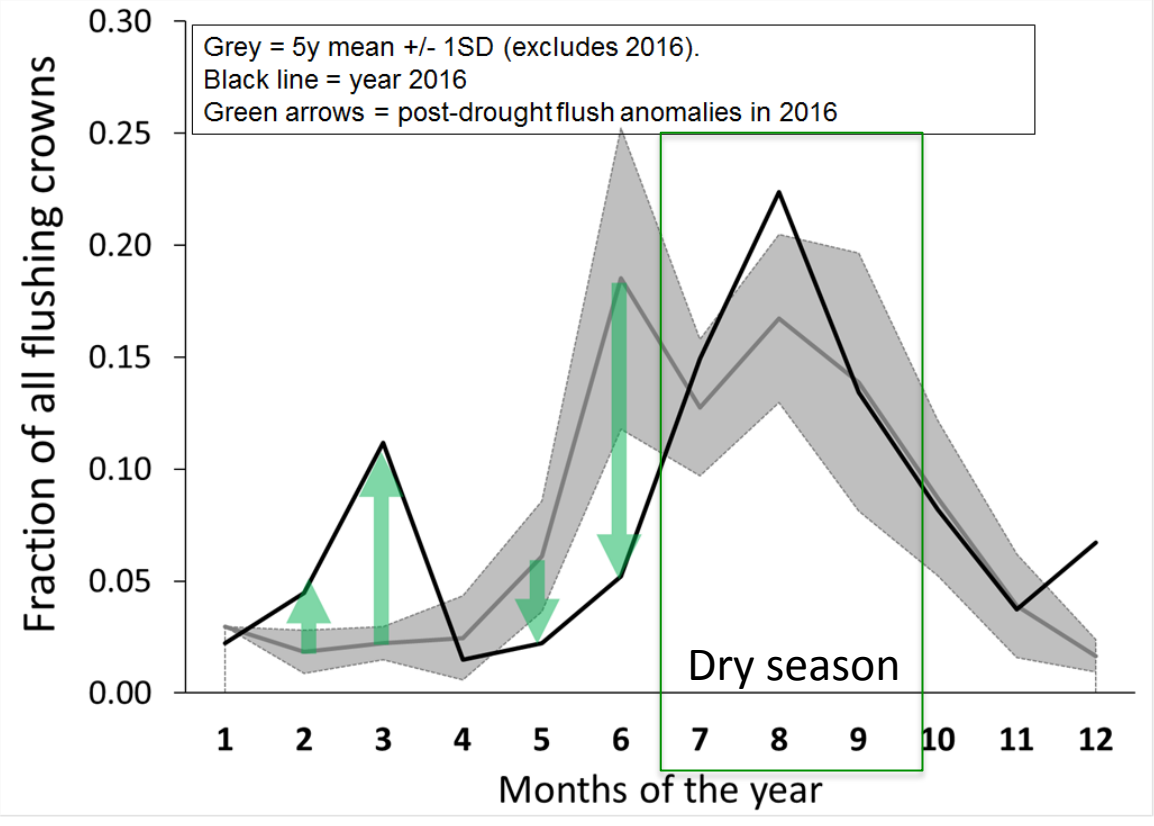
more isoprene emission with more solar radiation

more isoprene emission with temperature increasing





… recently, seasonality of leaf demography and phenology has been shown for the ATTO site..



~ 70% of 194 trees

Gonçalves et al. 2019

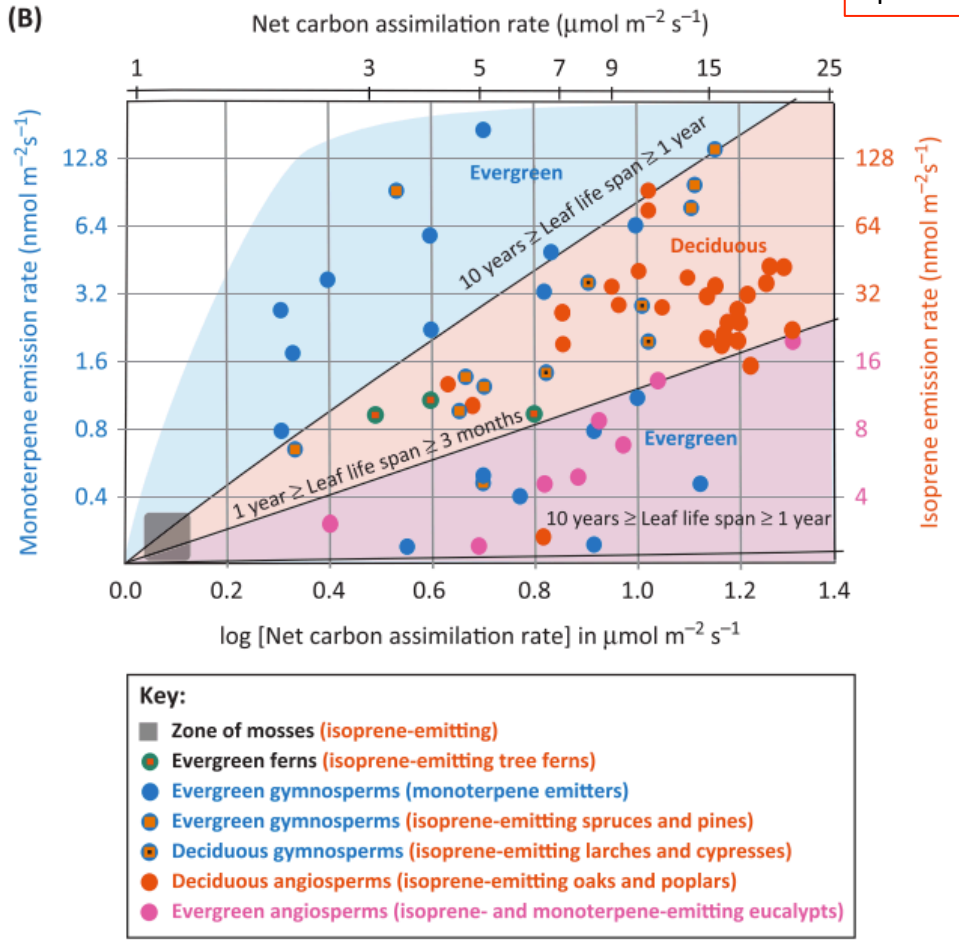
Isoprene emission capacity changes with leaf age

…isoprene emission trait is more abundant among deciduous species

Distribution of emitters at the ATTO site

emission trait	trees ind.	%
emitters	68	35.05
non-emitters	85	43.8
NA	41	21.13
Total (ind)	194	

Study with data compilation of species from different biomes

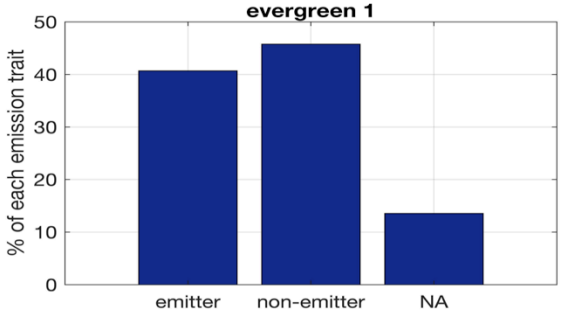


Dani et al. 2014

Are the isoprene emitters more abundant among species that have young mature leaves during the dry season?

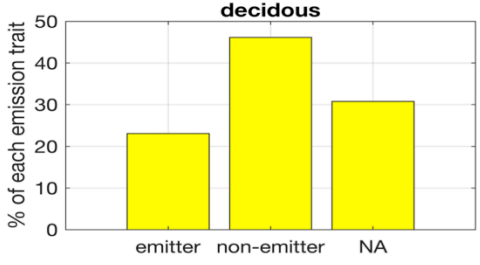
evergreen

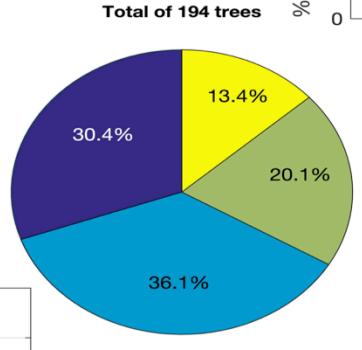
flushing=0 and leaf fall=0



deciduous

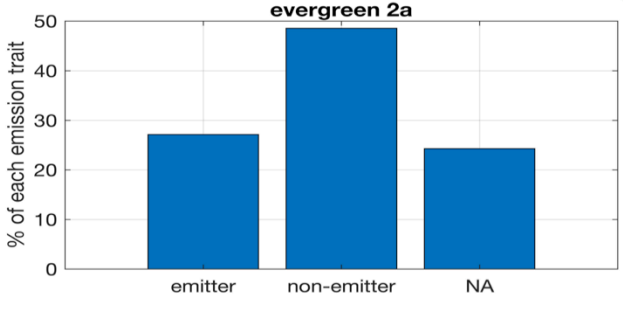
flushing >=5 and leaf fall >=5





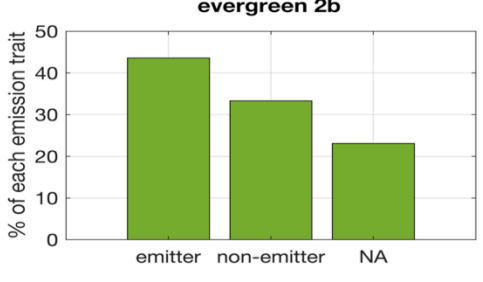
semi-evergreen (2a)

flushing >=5 and leaf fall <=4



semi-evergreen (2b)

flushing 1-4 and leaf fall <=4

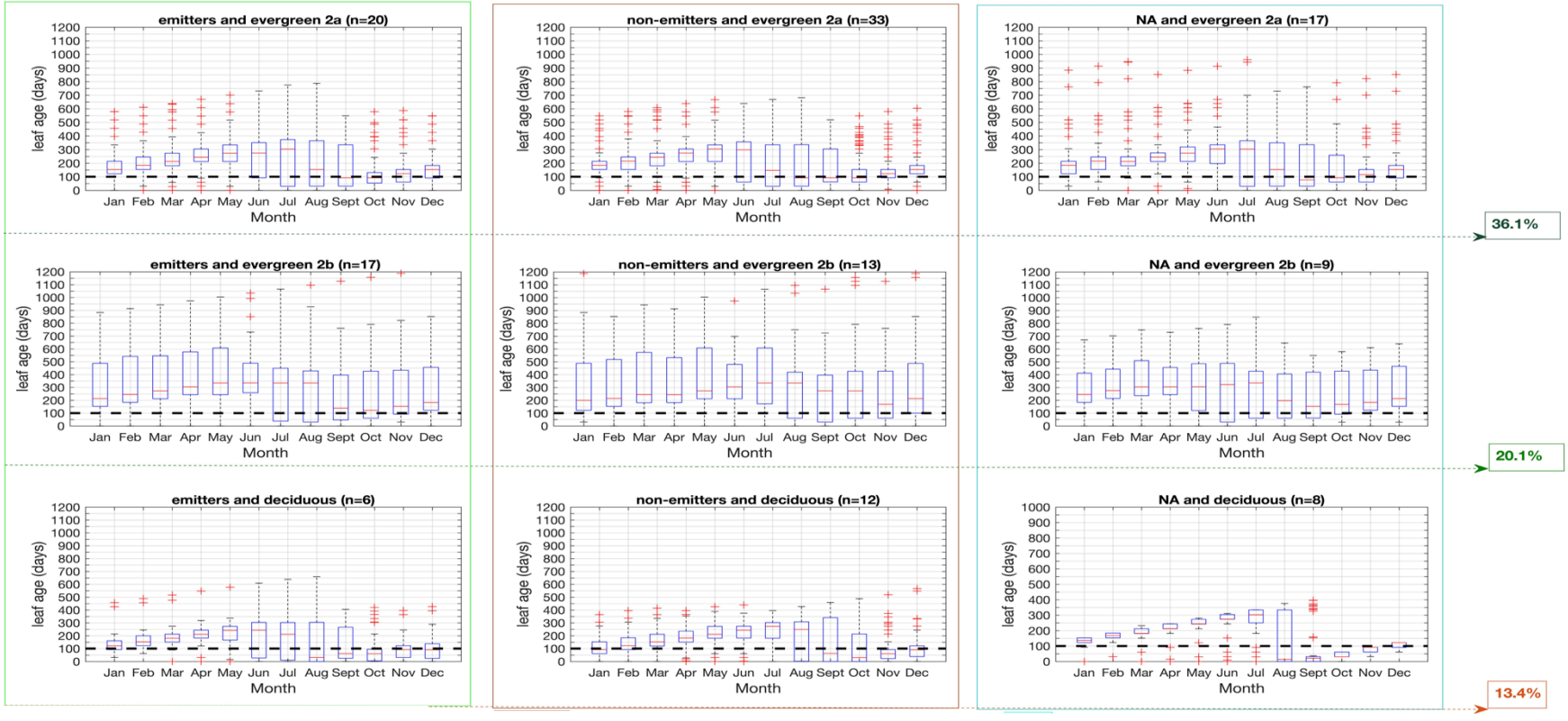


Results of 194 tree species monitored with a PhenoCam from 2013 to 2018

The amount of emitters among phenotypes does not change significantly and the pattern of leaf phenology is consistent among species that are emitter or non-emitter

…but, Isoprene emission capacity changes with leaf ageing

69.6% of the trees have massive flushing



2a: flushing every year; leaf fall not every year

2b: flushing not every year; leaf fall not every year

Deciduous: flushing every year; leaf fall every year

Leaf level monitoring

LEAF DEMOGRAPHY

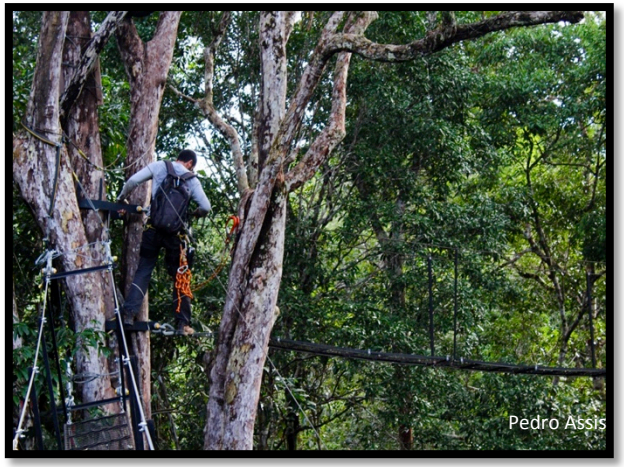
(branch and tree levels)

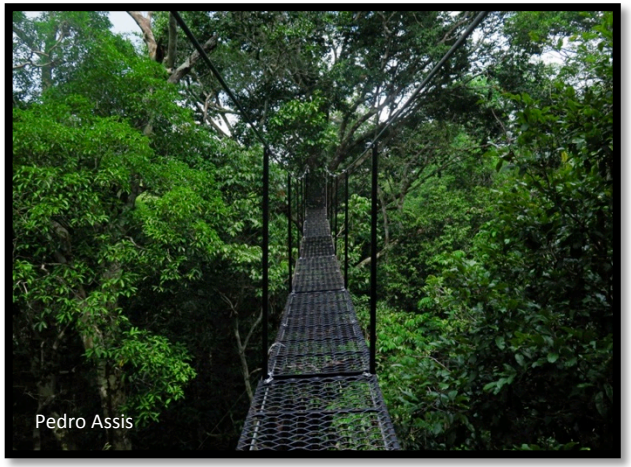
-Monthly monitoring (Mar/2016);

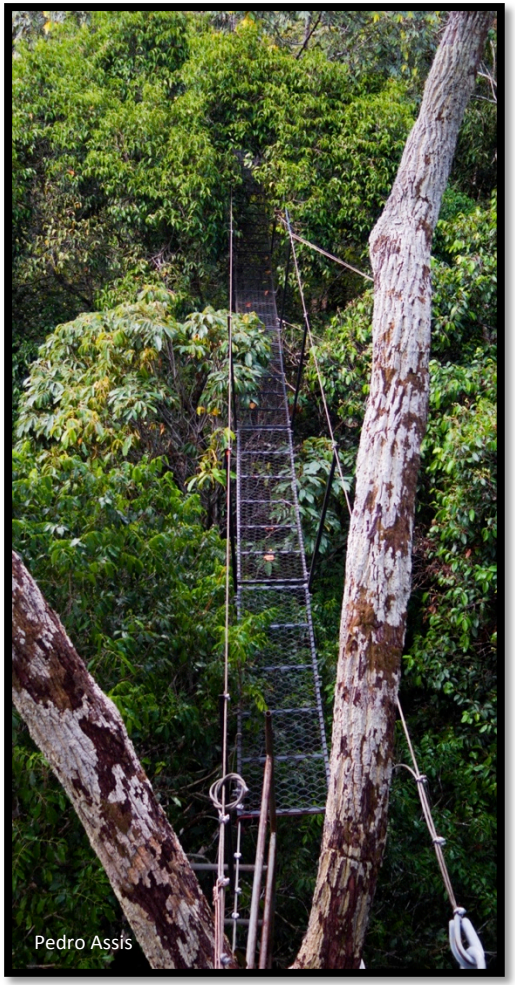
- 36 canopy trees;

- 10 branches/tree

Walkways at the upper canopy - ~ 25 m





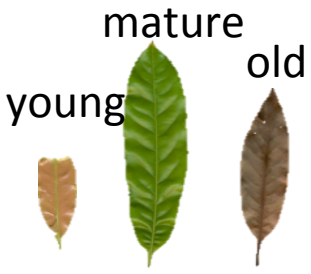


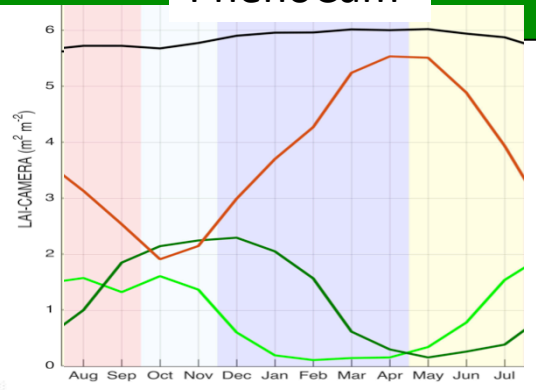
Phenocam and leaf level – leaf demography and phenology

PhenoCam

LEAF DEMOGRAPHY

(branch and tree levels)

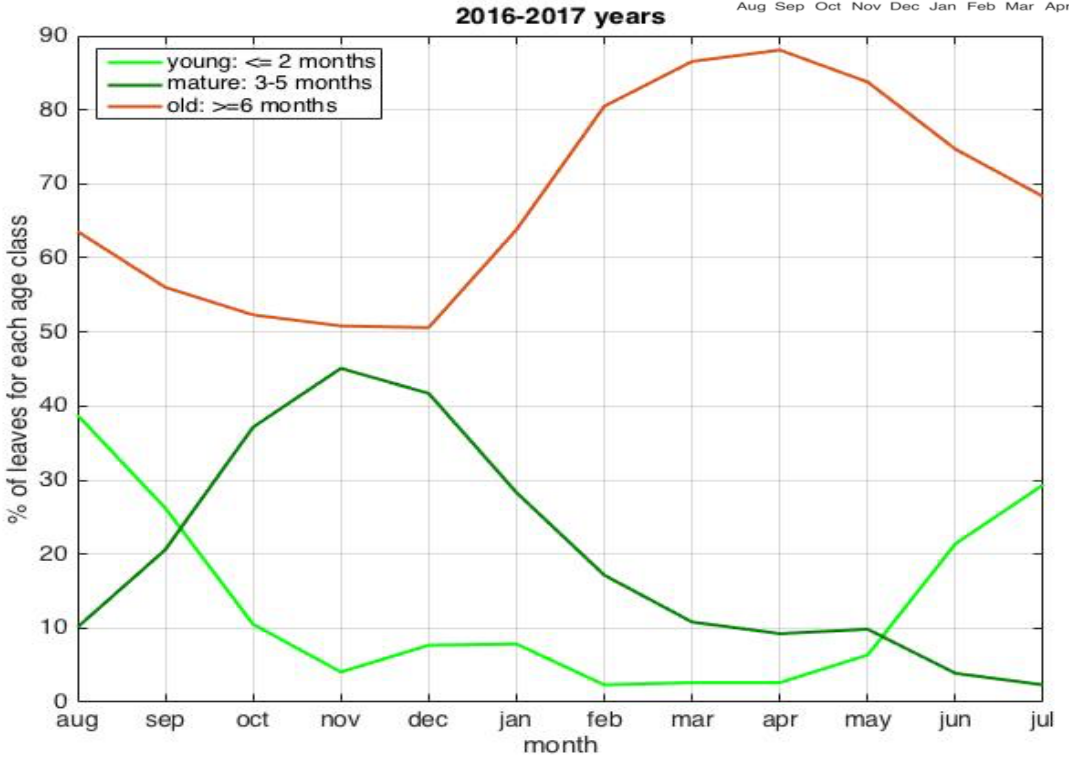




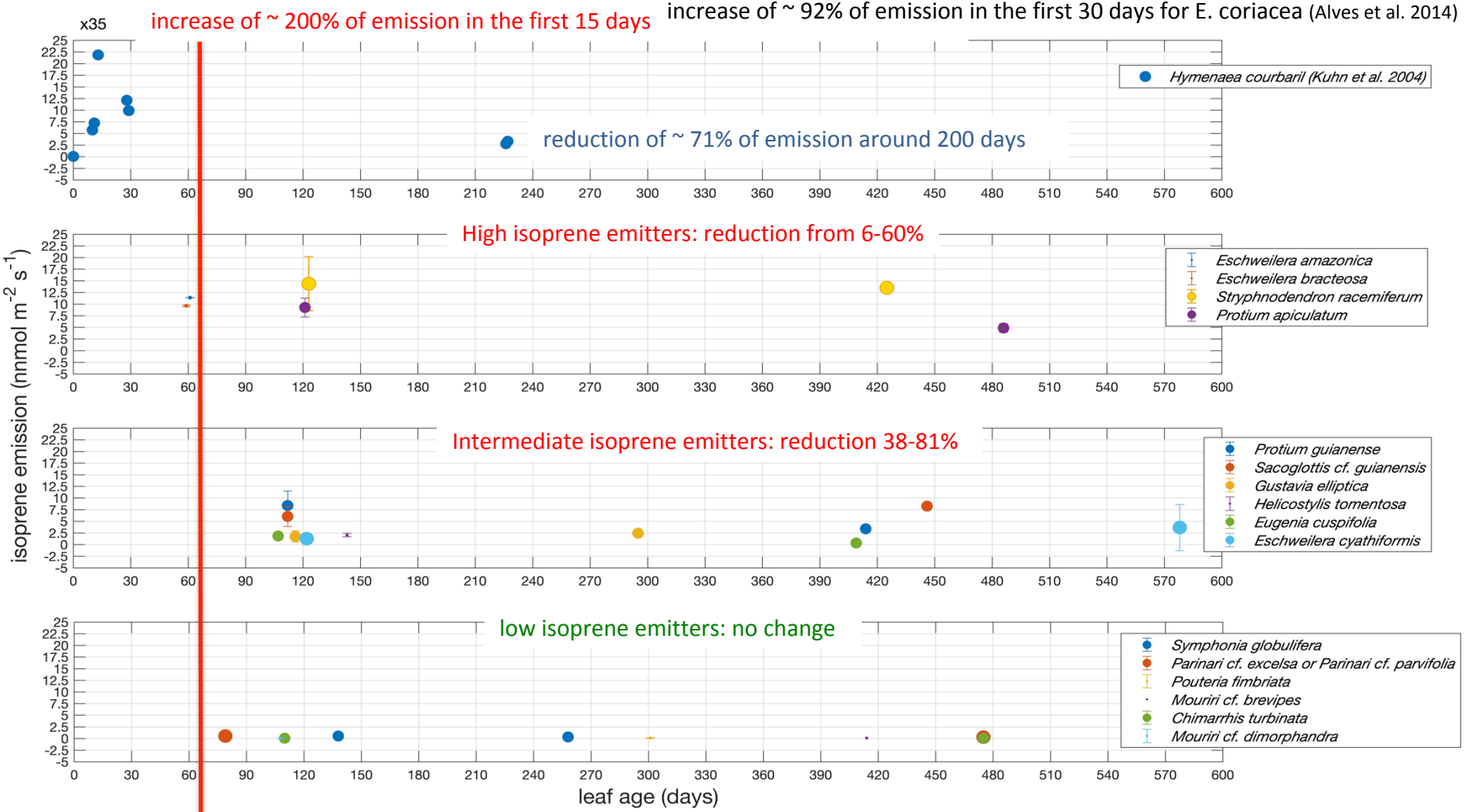
-Monthly monitoring (Mar/2016)

- 36 canopy trees;

- 10 branches/tree



... the isoprene emission capacity (magnitude) might vary among leaf ages and this is probably more pronounced in species that have a consistent seasonal pattern of leaf phenology, with leaves ageing from 0–2 months during the dry season



Next steps…

- To evaluate other plant traits that might explain the variation of isoprene emission capacity (e.g. leaf nutrient content);

- To optimize the leaf age algorithm of MEGAN to account for the seasonality of leaf dynamics and isoprene emission capacity;
    - e.g. seasonal isoprene estimates were improved in ~ 50% (Alves et al., 2018);

- To verify how anomalies in leaf phenology during El-niño and post El-niño might effect seasonal isoprene emissions

Acknowledgments

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MAX PLANCK INSTITUTE FOR CHEMISTRY

To everyone from our fieldwork and lab team!!

Thank you!!!

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MAX-PLANCK-GESELLSCHAFT