STATION DE RECHERCHE EXPERIMENTALE FORESTIERE DE PARACOU

RAPPORT SCIENTIFIQUE ANNUEL 2019

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT

Unité Mixte de Recherche
ECOlogie des FOrêts de Guyane

Présentation de la station de Paracou

La station forestière expérimentale de Paracou en Guyane Française est un dispositif scientifique de renommée internationale contribuant à la production de connaissance sur le fonctionnement des forêts tropicales. Ce dispositif est géré par le Cirad (UMR EcoFoG) et consiste en un ensemble de placettes forestières permanentes (environ 120ha) suivant la dynamique de croissance d'environ 70000 arbres à une fréquence annuelle ou bisannuelle. A sa création au début des années 1980, le dispositif avait principalement un objectif de recherche appliquée pour la définition de pratiques durables de gestion sylvicole pour le secteur forestier guyanais. A cet objectif qui a perduré jusqu'à aujourd'hui ce sont ajoutées de nombreuses autres thématiques de recherche sur la dynamique et le fonctionnement de l'écosystème, et en particulier sur le rôle des forêts dans la séquestration de carbone, l'étude de la biodiversité, la résilience des forêts face aux perturbations anthropiques et aux changements climatiques, ainsi que du développement méthodologique, pour le calibrage des missions satellitaires d'observation de la terre par exemple. Ces nouvelles thématiques se sont accompagnées de l'installation de nouveaux dispositifs tels que la tour à flux Guyaflux (INRA) et les parcelles de fertilisation (Projet ERC Imbalance-P). Le dispositif de Paracou fait partie de plusieurs réseaux de parcelles permanentes, à l'échelle de la Guyane (Guyafor) ou internationale (RainFor-ForestPlot, TmFO…), ce qui permet les changements d'échelles dans la compréhension des phénomènes étudiés. La richesse des données acquises et les facilités d'accueil confère à la station de Paracou une attractivité internationale.

L'équipe

- Responsible scientifique: Géraldine Derroire
- Responsible technique: Aurélie Dourdain
- Botaniste: Pascal Pétronelli
- Techniciens forestiers: Michel Baisie, Martinus Koese, Frits Kwasie, Petrus Naisso, Onoefé Ngwete, Richard Sante, Lindon Yansen,
- Apprentis (CAPA Matiti) : Isaac Devon, Eric Emile, Jean-Martin Odan

Fréquentation en 2019

- 23 projets de recherche accueillis sur la station (119 personnes dont 39 internationaux)
- Projets et visite d'étudiants: 5 cursus accueillis (92 personnes dont 21 internationaux)
- 3 autres visites (ex : formation professionnelle, média) (51 personnes)

Publications scientifiques

Cette liste présente les **41 publications scientifiques publiées en 2019** qui résultent d'une activité de recherche conduit à Paracou et/ou utilisant les données d'inventaires menés à Paracou.

1. Aguilos M, Stahl C, Burban B, et al. Interannual and Seasonal Variations in Ecosystem Transpiration and Water Use Efficiency in a Tropical Rainforest. *Forests*. 2019;10(1):14. doi:10.3390/f10010014

2. Aubry-Kientz M, Dutrieux R, Ferraz A, et al. A Comparative Assessment of the Performance of Individual Tree Crowns Delineation Algorithms from ALS Data in Tropical Forests. *Remote Sens*. 2019;11(9):1086. doi:10.3390/rs11091086
3. Aubry-Kientz M, Rossi V, Cornu G, Wagner F, Hérault B. Temperature rising would slow down tropical forest dynamic in the Guiana Shield. *Sci Rep*. 2019;9(1):10235. doi:10.1038/s41598-019-46597-8
4. Bréchet L, Courtois EA, Saint-Germain T, et al. Disentangling Drought and Nutrient Effects on Soil Carbon Dioxide and Methane Fluxes in a Tropical Forest. *Front Environ Sci*. 2019;7. doi:10.3389/fenvs.2019.00180
5. Courtois EA, Stahl C, Burban B, et al. Automatic high-frequency measurements of full soil greenhouse gas fluxes in a tropical forest. *Biogeosciences Discuss*. August 2019:1-21. doi:10.5194/bg-2018-341
6. di Porcia e Brugnera M, Meunier F, Longo M, et al. Modelling the impact of liana infestation on the demography and carbon cycle of tropical forests. *Glob Chang Biol*. July 2019:gcb.14769. doi:10.1111/gcb.14769
7. El Idrissi Essebtey S, Villard L, Borderies P, et al. Temporal Decorrelation of Tropical Dense Forest at C-Band: First Insights From the TropiScat-2 Experiment. *IEEE Geosci Remote Sens Lett*. 2019:1-5. doi:10.1109/lgrs.2019.2937382
8. Esquivel-Muelbert A, Baker TR, Dexter KG, et al. Compositional response of Amazon forests to climate change. *Glob Chang Biol*. 2019;25:39-56. doi:10.1111/gcb.14413
9. Fortunel C, Stahl C, Heuret P, Nicolini E, Baraloto C. Disentangling the effects of environment and ontogeny on tree functional dimensions for congeneric species in tropical forests. *New Phytol*. December 2019:nph.16393. doi:10.1111/nph.16393
10. Fu T, Houël E, Amusant N, et al. Biosynthetic investigation of γ-lactones in Sextonia rubra wood using in situ TOF-SIMS MS/MS imaging to localize and characterize biosynthetic intermediates. *Sci Rep*. 2019;9(1):1928. doi:10.1038/s41598-018-37577-5
11. Ghislain B, Alméras T, Prunier J, Clair B. Contributions of bark and tension wood and role of the G-layer lignification in the gravitropic movements of 21 tropical tree species. *Ann For Sci*. 2019;76(4). doi:10.1007/s13595-019-0899-7
12. Ghislain B, Engel J, Clair B. Diversity of anatomical structure of tension wood among 242 tropical tree species. Donaldson L, Baas P, eds. *IAWA J*. 2019;1(aop):1-20. doi:10.1163/22941932-40190257
13. Graciolli G, Guerrero R, Catzeflis F. Streblid bat flies (Diptera) and other ectoparasites on bats (Mammalia: Chiroptera) from French Guiana. *Biota Neotrop*. 2019;19(4).
14. Grossiord C, Christoffersen B, Alonso-Rodríguez AM, et al. Precipitation mediates sap flux sensitivity to evaporative demand in the neotropics. *Oecologia*. 2019;191(3):519-530. doi:10.1007/s00442-019-04513-x
15. Hartke J, Sprenger PP, Sahm J, et al. Cuticular hydrocarbons as potential mediators of cryptic species divergence in a mutualistic ant association. *Ecol Evol*. July 2019. doi:10.1002/ece3.5464
16. Honorio Coronado EN, Blanc-Jolivet C, Mader M, et al. Development of nuclear and plastid SNP markers for genetic studies of Dipteryx tree species in Amazonia. *Conserv Genet Resour*. January 2019:1-4. doi:10.1007/s12686-019-01081-3
17. Jaouen G, Sagne A, Buyck B, et al. Fungi of French Guiana gathered in a taxonomic, environmental and molecular dataset. *Sci Data*. 2019;6(1):206. doi:10.1038/s41597-019-0218-z
18. Kattge J, Bönisch G, Díaz S, et al. TRY plant trait database – enhanced coverage and open access. *Glob Chang Biol*. 2019; doi:10.1111/gcb.14904
19. Laybros A, Schläpfer D, Féret J-B, et al. Across Date Species Detection Using Airborne Imaging Spectroscopy. *Remote Sens*. 2019;11(7):789. doi:10.3390/rs11070789

20. Lehnebach R, Bossu J, Amusant N. Wood Density Variations of Legume Trees in French Guiana along the Shade Tolerance Continuum : Heartwood Effects on Radial Patterns and Gradients. 2019:1-22. doi:10.3390/f10020080
21. Lehnebach R, Doumerc L, Clair B, Alméras T. Mechanical stress in inner bark of 15 tropical tree species and relation with anatomical structure. *Botany*. 2019:cjb-2018-0224. doi:10.1139/cjb-2018-0224
22. Liao Z, He B, Quan X, van Dijk AIJM, Qiu S, Yin C. Biomass estimation in dense tropical forest using multiple information from single-baseline P-band PolInSAR data. *Remote Sens Environ*. 2019;221:489-507. doi:10.1016/J.RSE.2018.11.027
23. Longo M, Knox RG, Medvigy DM, et al. The biophysics, ecology, and biogeochemistry of functionally diverse, vertically and horizontally heterogeneous ecosystems: the Ecosystem Demography model, version 2.2 – Part 1: Model description. *Geosci Model Dev*. 2019;12(10):4309-4346. doi:10.5194/gmd-12-4309-2019
24. Peguero G, Sardans J, Asensio D, et al. Nutrient scarcity strengthens soil fauna control over leaf litter decomposition in tropical rainforests. *Proc R Soc B Biol Sci*. 2019;286(1910):20191300. doi:10.1098/rspb.2019.1300
25. Picard N. Asymmetric Competition Can Shape the Size Distribution of Trees in a Natural Tropical Forest. *For Sci*. 2019. doi:10.1093/forsci/fxz018
26. Piponiot C, Rödig E, Putz FE, et al. Can timber provision from Amazonian production forests be sustainable? *Environ Res Lett*. 2019;14(6):064014. doi:10.1088/1748-9326/ab195e
27. Quegan S, Le Toan T, Chave J, et al. The European Space Agency BIOMASS mission: Measuring forest above-ground biomass from space. *Remote Sens Environ*. 2019;227:44-60. doi:10.1016/J.RSE.2019.03.032
28. Réjou-Méchain M, Barbier N, Couteron P, et al. Upscaling Forest Biomass from Field to Satellite Measurements: Sources of Errors and Ways to Reduce Them. *Surv Geophys*. 2019:1-31. doi:10.1007/s10712-019-09532-0
29. Santos VM, Silva Cáceres ME, Lücking R. Diversity of foliicolous lichens in isolated montane rainforests (Brejos) of northeastern Brazil and their biogeography in a neotropical context. *Ecol Res*. 2019:1440-1703.12071. doi:10.1111/1440-1703.12071
30. Schlund M, Erasmi S, Scipal K. Comparison of Aboveground Biomass Estimation From InSAR and LiDAR Canopy Height Models in Tropical Forests. *IEEE Geosci Remote Sens Lett*. 2019;PP:1-5. doi:10.1109/LGRS.2019.2925901
31. Sebbenn AM, Blanc-Jolivet C, Mader M, et al. Nuclear and plastidial SNP and INDEL markers for genetic tracking studies of Jacaranda copaia. *Conserv Genet Resour*. 2019:1-3. doi:10.1007/s12686-019-01097-9
32. Sprenger PP, Hartke J, Feldmeyer B, Orivel J, Schmitt T, Menzel F. Influence of Mutualistic Lifestyle, Mutualistic Partner, and Climate on Cuticular Hydrocarbon Profiles in Parabiotic Ants. *J Chem Ecol*. 2019:1-14. doi:10.1007/s10886-019-01099-9
33. Steidinger B, Crowther T, Liang J, et al. Climatic controls of decomposition drive the global biogeography of forest tree symbioses. *Nature*. 2019;in press. doi:10.1038/s41586-019-1128-0
34. Tebaldini S, Ho Tong Minh D, Mariotti d'Alessandro M, Villard L, Le Toan T, Chave J. The Status of Technologies to Measure Forest Biomass and Structural Properties: State of the Art in SAR Tomography of Tropical Forests. *Surv Geophys*. 2019:1-23. doi:10.1007/s10712-019-09539-7
35. ter Steege H, Henkel TW, Helal N, et al. Rarity of monodominance in hyperdiverse Amazonian forests. *Sci Rep*. 2019;9(1):13822. doi:10.1038/s41598-019-50323-9
36. Tysklind N, Blanc-Jolivet C, Mader M, et al. Development of nuclear and plastid SNP and INDEL markers for population genetic studies and timber traceability of Carapa species. *Conserv Genet Resour*. 2019:1-3. doi:10.1007/s12686-019-01090-2

37. Van Langenhove L, Depaepe T, Vicca S, et al. Regulation of nitrogen fixation from free-living organisms in soil and leaf litter of two tropical forests of the Guiana shield. *Plant Soil*. 2019:1-18. doi:10.1007/s11104-019-04012-1

38. Van Langenhove L, Janssens IA, Verryckt L, et al. Rapid root assimilation of added phosphorus in a lowland tropical rainforest of French Guiana. *Soil Biol Biochem*. 2019:107646. doi:10.1016/J.SOILBIO.2019.107646

39. Vargas OM, Heuertz M, Smith SA, Dick CW. Target sequence capture in the Brazil nut family (Lecythidaceae): Marker selection and in silico capture from genome skimming data. *Mol Phylogenet Evol*. 2019;135:98-104. doi:10.1016/j.ympev.2019.02.020

40. Yguel B, Piponiot C, Mirabel A, et al. Beyond species richness and biomass: Impact of selective logging and silvicultural treatments on the functional composition of a neotropical forest. *For Ecol Manage*. 2019;433:528-534. doi:10.1016/J.FORECO.2018.11.022

41. Ziegler C, Coste S, Stahl C, et al. Large hydraulic safety margins protect Neotropical canopy rainforest tree species against hydraulic failure during drought. *Ann For Sci*. 2019;76(4). doi:10.1007/s13595-019-0905-0

Conférences scientifiques et séminaires invités

Cette liste, potentiellement non-exhaustive, présente les **24 communications scientifiques** écrites et orales de 2019 qui résultent d'une activité de recherche conduit à Paracou et/ou utilisant les données d'inventaires menés à Paracou.

1. Allio R, Tilak M-K, Magdeleine A, Avenant NL, Nabholz B, Delsuc F. MinION roadkill: High quality mammalian genomes combining MinION long reads and Illumina short reads. *Annual Meeting of the Center for the Study of Biodiversity in Amazonia - Cayenne, French Guiana*. 2019.

2. Bréchet L, Courtois E, Stahl C, et al. Full year of CO2, CH4, and N2O gas exchanges from the soil and above-canopy of a tropical rainforest, in French Guiana : magnitudes, patterns and hypothesis. *5th IMBALANCE-P Annual Meeting, Sitges, Spain, February 11-15.* 2019.

3. Brechet L, Courtois E, Stahl C, et al. Soil GHG, i.e. CO2, CH4, and N2O, flux responses to nutrient fertilization experiments in a tropical rainforest, French Guiana. *BES/Gto Symposium, Edinburgh, UK.* 2019.

4. D'Alessandro MM, Tebaldini S. The Impact of Orbital Control on the Quality of Biomass Estimates through P-Band SAR Tomography - IEEE Conference Publication. 2019.

5. Daniel W, Brechet L, Stahl C, Burban B, Janssens I. Soil-tree-atmosphere gas exchanges CO2, CH4, and N2O in a tropical rainforest, in French Guiana. *EGU, Annual Meeting. Vienna, Austria.* ; 2019.

6. di Porcia e Brugnera M, et. al. Lianas in silico: The impact of forest structure on the abundance of woody vines. *ATBC, Antananarivo, Madagascar, 30 July – 3 August*. 2019.

7. El Idrissi Essebtey S, Villard L, Borderies P, et. al. TropiScat-2: A multifrequency tower-based scatterometer experiment at P,L,C bands for a comprehensive characterization of temporal variations impacting the backscatter of tropical dense forests. In: *Living Planet Symposium ESA, May 2019*. 2019.

8. Heuertz M, Jehanne Q, Schmitt S, et al. Species delimitation and evolutionary history of closely related abundant vs. rare rainforest trees (Eschweilera, Parvifolia clade, Lecythidaceae) in French Guiana. *IBS Humboldt Meeting, Quito, August 2019*. ; 2019.

9. Laurans M, Vincent G, Geniez C, et al. Towards the prediction of wood resource in tropical forests from TLS and ALS. *Conference: Terrestrial Laser Scanning in Forest Ecology - May 2019 - Ghent Belgium*. ; 2019.

10. Levionnois S, Calvet E, Ziegler C, et al. Hydraulic and vulnerability segmentations at the leaf-stem interface : Do they exist and are they coordinated through Neotropical trees ? *XIM4, Padua, Italia.* ; 2019.

11. Levionnois S, Salmon C, Clair B, et al. Allometric scaling of hydraulics and mechanics drive the leaf-stem size spectrum for 42 Neotropical tree species. *XIM4, Padua, Italia*. ; 2019.

12. Longo M, Saatchi S, Ferraz A, et al. Linking tropical forest structure from regional-scale airborne lidar data to terrestrial ecosystem models. *IUFRO, Brazil*. ; 2019.

13. Schirinzi HA; AB; GF; VP; G. On the Separation of Ground and Canopy Scatterings Using Single Polarimetric Multi-Baseline SAR Tomography - IEEE Conference Publication. 2019

14. Sist P, Mazzei L, Piponiot C, et al. The main challenges of sustainable forest management in the Amazon: why sustainable forest management in the Amazon should be reinforced? *IUFRO World Congress 2019 "Forest Research and Cooperation for Sustainable Development". 25, 2019-09-29/2019-10-05, Curitiba (Brésil)*. 2019.

15. Stahl C, Bonal D. Functional diversity and response to drought in tropical forests. Report of the strategic project 2016-2019. *Labex CEBA Annual Meeting, Cayenne, France*. ; 2019.

16. Stahl C, Courtois E, Saint-Germain T, et al. Disentangling the drought and nutrient effects on the soil CO2 and CH4 fluxes in a tropical forest. *5th IMBALANCE-P Annual Meeting, Sitges, Spain, February 11-15.* 2019.

17. Stahl C, Manzi O, Bellifa M, Ziegler C, Coste S. Amplitude and velocity of response to drought are not directely linked to recovery capacities for tropical tree seedlings. *XIM4, Padua, Italia.* 2019.

18. Tysklind N. Genomic resource development for timber traceability and adaptation genomics in Neotropical Trees. *Biogeco Scientific Seminar Series. Bordeaux 12 Mai 2019*. 2019.

19. Tysklind N, Blanc-Jolivet C, Mader M, et al. Population genetic structure and individual assignment to population of origin : A South American example with Carapa. *Largescale Final Conference. Ahrensburg, 4 December 2019.* 2019.

20. Tysklind N, Etienne MP, Scotti-Saintagne C, et al. Adaptive variance and speciation in Symphonia. *INRA Genetics Group Meeting. Montpellier 17 Mai 2019*. 2019.

21. Van Langenhove L, Verryckt LT, Stahl C, Janssens I. Rapid post-fertilisation plant phosphorus uptake indicates phosphorus limitation in French Guiana. 2019. *BES/Gtö Symposium, Edinburgh, UK.* 2019.

22. Vasile G. on Ica Based Ictd Classification of Polsar Data. *IEEE International Geoscience and Remote Sensing Symposium, 2019, Yokohama, Japan*. 2019.

23. Verryckt LT, Stahl C, Coste S, et al. Spatial variation of photosynthesis in a lowland tropical forest in French Guiana : saplings vs. adults. *BES/Gtö Symposium, Edinburgh, UK.* ; 2019.

24. Ziegler C, Coste S, Stahl C, et al. How resistant are Neotropical canopy rainforest tree species to branch embolism and are they at risk of hydraulic failure during the dry season ? *XIM4, Padua, Italia.* ; 2019.

Principaux projets de recherche

Cette liste regroupe les principaux projets de recherche conduits à Paracou en 2019.

- *CartDivDendroLidar project Terrestrial Laser Scanning of targeted tree species to build improved allometries*, Grégoire Vincent, IRD
- *Characterisation of moth communities along a gradient of forest disturbance*, Carlos Lopez Vaamonde, INRA
- *Drought recovery mechanisms in a tropical forest*, Megan Bartlett, University of California Davis
- *Earthworm community ecology in the littoral area of French Guyana*, Thibaud Decaëns, CNRS
- *Entomological survey of Coleoptera (Cicindeliadae and Scarabaeoidea)*, Philippe Le Gall, IRD
- *Étude de marqueurs de fonctionnement hydrique de sols répartis en toposéquences*, Eric Lucot, UMR Chrono-Environnement, Université de Franche-Comté/CNRS
- *ForestScan project New technology for characterising forest structure and biomass at 'Super Sites' for EO cal/val across the tropics*, Mathias Disney, University College London
- *GFclim: Adapting forest management to climate change in the Guiana Shield,* Bruno Hérault, Cirad
- *Imbalance-P project Responses of litter, fine roots and soil nutrient cycling to nitrogen and phosphorus additions after three years of fertilizer additions*, Philippe Ciais, Ivan Janssens, Michel Obersteiner, Josep Peñuelas, ERC projet
- *ManagForRes: Effect of forest management on guyanese forest ecosytem response to climate change,* Géraldine Derroire, Cirad
- *Multiscale determinants of arbuscular mycorrhizal fungal communities*, Francis Q. Brearley, Manchester Metropolitan University
- *Non-structural carbohydrates and tree functional groups in the context of forest succession*, Alexia Stokes, CIRAD
- *Rain Forest GreenHouse Gases*, Laetitia Bréchet, UMR EcoFoG
- *RéfHab project Réponses fonctionnelles des arbres aux contraintes hydriques saisonnières des habitats de forêts tropicales*, Clément Stahl, UMR EcoFoG
- *Testing field portable Nanopore sequencing in the Guianan rainforest using the MiniON device*, Frédéric Delsuc,, Institut des Sciences de l'Evolution CNRS, IRD, EPHE
- *The diversity of plant secretory structures and their exudates: an analysis of their functional roles and ecological significance in forests of French Guiana*, Nick Rowe, CNRS
- *Tropiscat-2 project Terrestrial Laser Scanning of forest in the Tropiscat 2 footprint*, Ludovic Villard, Thierry Koleck, CESBIO CNES

Thèses de doctorat défendues

- De Deurwaerder H. 2019. "Below ground water competition between lianas and trees". Faculty of Bioscience Engineering, Ghent, Belgium
- Demétrius LM. 2019. "Disentangling tropical forest stand characteristics in terms of cation availability and functional traits". Imperial College London

- Legeay J. 2019. “Ecologie des Oomycètes et champignons phytopathogènes dans les sols de forêt de Guyane Française : éclairages sur les relations entre communautés de Phytophthora et d’arbres dans les forêts tropicales”. Université de Lorraine
- Levionnois, S. 2019. “Plasticité Du Fonctionnement et de l’architecture Hydraulique Des Arbres Vis-à-Vis de La Sécheresse : Étude de Cas En Forêt Tropicale Humide Guyanaise.” Université de Guyane.

Mémoires de master

- Beauseroy, Doriane. 2019. “Meilleure Valorisation de La Diversité Forestière de Guyane. Quelles Marches Pour Les Arbres de Petits Diamètres et Les Essences Secondaires ?” Ecole Superieur du Bois.
- Dalban-Pilon, Coralie. 2019. “Effets à long terme des perturbations passées sur les trajectoires de biodiversité lors de la succession secondaire en forêt tropicale Guyanaise”. Université des Antilles
- Folituu, Thomas. 2019. “Étude de La Diploïdisation et de La Délimitation Des Espèces Dans Le Complexe d’arbres Tropicaux Du Genre Eschweilera Clade Parvifolia, Lecythidaceae.” Univ. Bordeaux.
- Girard-Rercieux, Camille. 2019. “Étude de l’effet de La Variabilité Intraspécifique Sur La Coexistence Des Espèces d’arbres Dans La Forêt Tropicale.” Université Paul Sabatier Toulouse III.
- Klay, Léna. 2019. “Modélisation de La Forêt Guyanaise Par Les Processus Ponctuels Grâce Aux méthodes INLA-SPDE.” Université Paris Sud.
- Philippe, Eva. 2019. “Modélisation de la survie de jeunes arbres en forêt tropicale humide”- Ecole Normale Supérieure.
- Prud’homme, A. 2019. “Génomique historique: Analyse rétrospective des mécanismes évolutifs en lien avec l’occupation précolombienne et l’adaptation climatique sur les populations contemporaines de palmiers d’Amazonie”. Université de Montpellier.