Maxime Bombrun, PhD

Research Leader
Chair of Forest Phenotyping - IPPN

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Experience

2019–Present **Research Leader**, *Data Analytics Team, Forest Informatics, Scion*, Rotorua, New Zealand.

I am leading the Data Analytics Team comprised of three data/computer scientists, one bio-informatician and one biometrician, working across the forestry value chain to optimise its sustainability and the transition to a bio-circular world.

Data Scientist, *Data Analytics Team, Forest Informatics, Scion*, Rotorua, New Zealand.

I implemented gradient boosting models to handle large, forest-scale dataset with complex and noisy features with mixed data types for phenotyping inferences. These inferences allow to estimate and predict the productivity of trees across the estate, and therefore to select tree stocks based on environmental conditions for superior genotyping.

- I designed a machine learning model to assess productivity across a large plantation forest.
- I improved and maintained a web platform for visualisation of large point-cloud data. I am currently Project Leader on the internal deployment of this platform.
- I supported the statistical analysis of several business-oriented projects, including client reporting.

2015–2018 **PostDoc**, *Centre for Image Analysis and SciLifeLab, Uppsala Universitet*, Uppsala, Sweden.

Principal Investigator: Prof. Carolina Wählby (Centre for Image Analysis and SciLifeLab)
Large-Scale Data Analysis for Digital Image Analysis Applications

I developed a tool for automated quantification of cell and tissue morphology in digital images. Difficulties lie in the parallel management and processing of 24 images (e.g., 48000×40000 pixels). This framework aims to support clinicians' diagnosis and to complement visual assessment when investigating disease and/or drug response.

- I developed an open-source tool which combines the analysis of gene expression with quantification of cell and tissue morphology.
- I shaped a web platform for visualisation of large slide scanner images at different resolutions.
- I developed an image processing algorithm for nucleus and lipid droplet segmentation and feature extraction in high-content/high-throughput microscopy screening.
- I co-supervised two PhD students and led a team of five PhD students for CytoChallenge 2017.

2012–2015 **PhD Student**, *Université Blaise Pascal*, Clermont-Ferrand, France.

Supervisors: Prof. Andrew Harris (Laboratoire Magmas et Volcans (LMV)) and Prof. Vincent Barra (Laboratoire Informatique, Modélisation et Optimisation des Systèmes (LIMOS))
Characterisation of Volcanic Emissions through Thermal Vision.

I studied the different components of strombolian eruptions at the full range of remote sensing spatial scales. These range from millimeters (83,000 individual particles detected through 31 eruptions recorded at 200Hz with thermal camera) to kilometers (two frames per day over two years, imaged with satellite field of view). Overall, I provided a better understanding of plume dynamics through thermal vision.

- I developed an image processing algorithm to segment and track high-speed particles recorded on thermal videos.
- I designed a novel method to segment and parameterise volcanic plumes on thermal videos.
- I implemented an algorithm to detect multiple change points in 2D radiometer data.
- I investigated new processes to detect hot spots in satellite imagery.
- I defined and supervised two projects for four MSc students.

2012 **Research Trainee**, *Lawrence Berkeley National Laboratory (LBNL)*, Berkeley, USA, 6-month internship.

Supervisors: Dr. Sylvain Costes (LBNL), Dr. Davil Hill (LIMOS)
Java applications development for Detection and Tracking of DNA repair centres

This project aimed to improve the understanding of the nuclide organisation and the spatial distribution of the DNA repair centres. I developed and optimised algorithms to segment, track and register nuclides through time in high-content screening.

Teaching

2018– (exp. 2019) **Invited Lecturer**, *Center for Molecular Medicine*, Stockholm, Sweden.
Teaching Master and PhD students: Bioimaging and Cell Analysis, CellProfiler (responsible for the content of lectures and tutorials) *4h*

2017 **Invited Speaker**, *Advanced Methods in BioMedical Image Analysis*, Brno, Czech Republic.
Summer School: Image Analysis in Biomedical Screening Application (lectures and tutorials) *4h*

2016 **Invited Speaker**, *Congress of the Internat. Society for Advancement of Cytometry*, Seattle, USA.
Scientific tutorial: Configuring accurate cell detection in images using CellProfiler *4h*

2015–2017 **Lecturer**, *Uppsala Universitet/Karolinska Institutet*, Uppsala/Stockholm, Sweden.
Teaching Master and PhD students: Bioimaging and Cell Analysis, Image Analysis & Processing, CellProfiler (responsible for the content of lectures and tutorials) *34h/year*

2013–2015 **Teaching Assistant**, *Université Blaise Pascal*, Clermont-Ferrand, France.
Teaching Master students in engineering school: Data Structure (lectures and tutorials) *56h/year*

Education & Diplomas

2012–2015 **Doctorate**, *LMV/LIMOS*, *Université Blaise Pascal*.
Characterisation of Volcanic Emissions through Thermal Vision

2011–2012 **Master's Degree**, *Université Blaise Pascal*, *Master's Degree in Image Processing*.

2009–2012 **Master's Degree**, *Institut Supérieur d'Informatique, de Modélisation et de leurs Applications (ISIMA)*, *Master's Degree in Engineering (i.e., Diplôme d'ingénieur), specialising in Computation and Scientific Modelling (Applied Mathematics)*.

Languages

French — Native speaker

English — Fluent, working language — *IELTS(2018), score 6.5/9; TOEFL(2015), score 103/120*

Swedish — Competent

Key Skills

Image Science — Geo- and Bio-Image Analysis, Infrared Imaging, Giga-pixel Images, Segmentation, Pattern Recognition & Tracking, Remote Sensing, GIS, Visualisation

Data Analysis — **Machine & Deep Learning, Regression, Classification, Clustering, Dimensionality Reduction**, Big Data, Distributed Computing, **SQL/sqlite/MongoDB**

Computer Science — C/C++/CImg, **Python**/OpenCV/Keras/TensorFlow, Java/ImageJ/Fiji, **R**, Matlab, Objective-C, JavaScript, PHP, Parallel Computing, Unix/Windows/Mac

Bioinformatics — Gene and Protein Expression, Cellular Organisation, Histopathology, High-Throughput/High-Content Screening

Operations Research — Graph theory, Linear programming, Optimization, Metaheuristic

Other — Office suite, LaTeX

References

- Prof. Vincent Barra
- Dr. Sylvain Costes
- Prof. Andrew Harris
- Prof. Carolina Wählby
- Dr. Grant Pearse

Journal Reviewer

Geology — Geochemistry, Geophysics, Geosystems
Journal of Geophysical Research

Biology — Medical Image Analysis
Transactions on Medical Imaging

Informatics — Scientific Reports - Nature
ISBI 2018

Journal Articles – Scopus h-index: 5

Bombrun, Maxime, David Jessop, Andrew Harris, and Vincent Barra. An algorithm for the detection and characterisation of volcanic plumes using thermal camera imagery. *Journal of Volcanology and Geothermal Research*, 352:26–37, 2018.

Damien Gaudin, Jacopo Taddeucci, Piergiorgio Scarlato, Andrew Harris, **Maxime Bombrun**, Elisabetta Del Bello, and Tullio Ricci. Characteristics of puffing activity revealed by ground-based, thermal infrared imaging: the example of stromboli volcano (Italy). *Bulletin of Volcanology*, 79(3):24, 2017.

Bombrun, Maxime, Hui Gao, Petter Ranefall, Niklas Mejhert, Peter Arner, and Carolina Wählby. Quantitative high-content/high-throughput microscopy analysis of lipid droplets in subject-specific adipogenesis models. *Cytometry Part A*, 91(11):1068–1077, 2017.

Bombrun, Maxime, Petter Ranefall, Joakim Lindblad, Amin Allalou, Gabriele Partel, Leslie Solorzano, Xiaoyan Qian, Mats Nilsson, and Carolina Wählby. Decoding gene expression in 2d and 3d. In Puneet Sharma and Filippo Maria Bianchi, editors, *Image Analysis*, pages 257–268, Cham, 2017. Springer International Publishing.

Maxime Bombrun, Letizia Spampinato, Andrew Harris, Vincent Barra, and Tommaso Caltabiano. On the transition from strombolian to fountaining activity: A thermal energy-based driver. *Bulletin of Volcanology*, 78(2):1–13, 2016.

Walter Georgescu, Alma Osseiran, Maria Rojec, Yueyong Liu, **Maxime Bombrun**, Jonathan Tang, and Sylvain V Costes. Characterizing the dna damage response by cell tracking algorithms and cell features classification using high-content time-lapse analysis. *PloS one*, 10(6), 2015.

Maxime Bombrun, Vincent Barra, and Andrew Harris. Analysis of thermal video for coarse to fine particle tracking in volcanic explosion plumes. In *Image Analysis*, pages 366–376. Springer, 2015.

Maxime Bombrun, Andrew Harris, Lucia Gurioli, Jean Battaglia, and Vincent Barra. Anatomy of a strombolian eruption: Inferences from particle data recorded with thermal video. *Journal of Geophysical Research: Solid Earth*, 120(4):2367–2387, 2015.

Talfan Barnie, **Maxime Bombrun**, Michael R. Burton, Andrew Harris, and Georgina Sawyer. Quantification of gas and solid emissions during strombolian explosions using simultaneous sulphur dioxide and infrared camera observations. *J. Volcanol. Geotherm. Res.*, 2014.

Maxime Bombrun, Vincent Barra, and Andrew Harris. Algorithm for particle detection and parameterization in high-frame-rate thermal video. *J. Appl. Remote Sens.*, 8(1):083549, 2014.

A. J. L. Harris, S. Valade, G. M. Sawyer, F. Donnadieu, J. Battaglia, L. Gurioli, K. Kelfoun, P. Labazuy, T. Stachowicz, **M. Bombrun**, V. Barra, D. Delle Donne, and G. Lacanna. Modern multispectral sensors help track explosive eruptions. *Eos*, 94(37):321–322, 2013.

Conference Proceedings

Maxime Bombrun, Jonathan Dash, Heidi Dungey, David Pont, and Michael Watt. Phenotyping platform: A giant laboratory in our forests. In *6th International Plant Phenotyping Symposium - Forest Phenotyping Workshop*, Nanijng, China, October 2019.

Maxime Bombrun, Jonathan Dash, Heidi Dungey, David Pont, and Michael Watt. Large-scale phenotyping inferences: From trees to forest through machine learning. In *10th eResearch NZ*, Auckland, New Zealand, February 2019.

Maxime Bombrun, Jonathan Dash, Heidi Dungey, and Michael Watt. A machine learning approach to assess productivity at forest scale. In *15th Science Coding Conference*, Rotorua, New Zealand, August 2018.

Maxime Bombrun, Hui Gao, Petter Ranefall, Niklas Mejhert, Peter Arner, and Carolina Wählby. A new hybrid algorithm for quantitative high-content/high-throughput microscopy analysis of adipogenesis models. In *NEUBIAS2020 Symposium*, Lisbon, Portugal, February 2017.

Maxime Bombrun, Petter Ranefall, and Carolina Wählby. A web application to analyse and visualize digital images at multiple resolutions. In *3rd Digital Pathology Congress*, London, UK, December 2016.

Maxime Bombrun, Petter Ranefall, and Carolina Wählby. Tissuemaps: A large multi-scale data analysis platform for digital image application built on open-source software. In *4th Nordic Symposium on Digital Pathology*, Linköping, Sweden, November 2016.

Maxime Bombrun and Anne E. Carpenter. Scientific tutorial: Configuring accurate cell detection in images using cellprofiler. In *31st Congress of the International Society for Advancement of Cytometry*, Seattle, USA, June 2016.

Maxime Bombrun, David Jessop, Andrew Harris, and Vincent Barra. Plume tracking algorithm: Parameterisation of volcanic plume dynamics. In *IUGG General Assembly*, Prague, CZK, July 2015.

Maxime Bombrun, Vincent Barra, and Andrew Harris. Analysis of thermal video for coarse to fine particle tracking in volcanic explosion plumes. In *19th Scandinavian Conference on Image Analysis*, Copenhagen, Denmark, June 2015.

D. Gaudin, J. Taddeucci, A. Harris, T. Orr, **M. Bombrun**, and P. Scarlato. When puffing meets strombolian explosions: a tale of precursors and coda. In *2014 Fall Meeting, AGU*, San Francisco, Calif., December 2014.

P. Scarlato, J. Taddeucci, E. Del Bello, Gaudin D., T. Ricci, D. Andronico, L. Lodato, F. Cannata, T. Orr, J. Sesterhenn, R. Plescher, Y. Baumgarter, A. Harris, **M. Bombrun**, T. Barnie, B. Houghton, U. Kueppers, and A. Capponi. The 2014 Broadband Acquisition and Imaging Operation (BAcIO) at Stromboli volcano (Italy). In *2014 Fall Meeting, AGU*, San Francisco, Calif., December 2014.

M. Bombrun, A.J.L. Harris, V. Barra, L. Gurioli, and J. Battaglia. Anatomy of a strombolian plume: inferences from particle data. In *AGU Fall Meeting Abstracts*, volume 1, page 07, 2014.

M. Bombrun, V. Barra, and A. Harris. Particle detection and velocity prediction for volcanic eruptions: a preliminary study. In *IAVCEI*, Kagoshima city, Japan, July 2013.

S. Valade, A. Harris, Sawyer G., F. Donnadieu, P. Labazuy, K. Kelfoun, **M. Bombrun**, V. Barra, C. Hervier, M. Ripepe, D. Delle Donne, G. Lacanna, L. Chevalier, and T. Stachowicz. Full bandwidth remote sensing for total parameterization of volcanic plumes. In *IAVCEI*, Kagoshima city, Japan, July 2013.