

Raphaëlle Momal

APPLIED MATHEMATICS · PHD CANDIDATE

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Current Position

PhD student in Mathematics applied to Biology and Ecology

16 rue Claude Bernard, Paris (75)

MIA-PARIS (APPLIED MATHEMATICS AND IT), AGROPARIS TECH

Nov 2017 - Present

- **Supervisors:** Stéphane Robin (INRA, MIA-Paris), Christophe Ambroise (LaMME, Évry)
- **Aim:** Infer species interaction networks from abundance data, in presence of unobserved major actors.
- **Keywords:** Variational Expectation-Maximization algorithm, Graphical models, Spanning trees dependency structures, Matrix Tree Theorem, Poisson log-Normal distribution

Education

Research M.S. in Mathematics applied to Statistics

Rue du Thabor, Rennes (35), France

RENNES 2 UNIVERSITY

2016 - 2017

M.S. Biostatistical Engineer

Rue Blaise Pascal, Bruz (35), France

ENSAI (NATIONAL SCHOOL FOR STATISTICS AND DATA ANALYSIS)

2014 - 2017

CPGE MPSI/MP

44 Bd Saint-Michel, Paris (75), France

LYCÉE SAINT-LOUIS

2012 - 2014

Skills

Programming R (expert), Latex (good), C++ (basic), Python (basic)

Desktop tools R Markdown, github, Linux

Languages French (mother tongue), English (C1, almost native), German (B2, intermediate)

Experience

PELAGIS Observatory - UMS 3462

5 Allée de l'Océan, La Rochelle (17)

SCIENTIFIC STAY

Jun. 2019

- Worked together with Matthieu Authier to extend our inference method of species interaction networks to macro-ecology.
- Data analysis of 2016 marine mega-fauna survey from New Caledonia

INRA - GABI - PSGen

Allée de Vilvert, Jouy-en-Josas (78)

INTERNSHIP - BIOSTATISTICS RESEARCH ENGINEER

Apr. 2017 - Oct. 2017

- Worked under the supervision of Dr. Andrea Rau on statistical integration of OMICS data (RNA-seq, ATAC-seq and HiC data), part of the FR-AgENCODÉ project (functional annotation of livestock genomes).
- Used the mixed-model paradigm to assess the importance of taking both into account the DNA 3D structure and the chromatin accessibility when explaining the genome-wide expression.

Soladis

94 Rue Saint-Lazare, Paris

INTERNSHIP - STATISTICAL ENGINEER

Jun. 2016- Sept. 2016

- Work in supervised autonomy on several biotech problems
- Used SAS software to implement logistic regression models, ANOVAs, Bayesian estimation MCMC procedures.

Teaching Experience

Statistical data analysis with R - IT Sessions

Paris-Saclay University (LMO)

L3 LEVEL

Jan. 2020 - present

- Introduce R programming to HEC students and Paris-Saclay students in IT and mathematics (3rd year).
- Teach both the programming language, and peculiar statistical functions dedicated to statistical data analysis.

Mathematical Modelling - Exercises Sessions

Paris-Saclay University (bat. 336)

L1 LEVEL

Oct. 2019 - Jan 2020

- First year students in biology (BCPST)
- Function analysis (one and several variables), Probabilities computation, random variables (discrete and continuous), Laws approximation.

MISS (House for Science Initiation and Awareness) - scientific mediation

Paris-Saclay University (bat. 224)

SCHOOL PUPILS OF 8 TO 15 YEARS OLD

Oct. 2017 - Oct 2019

- History of numbers: how did they count in Mesopotamia without our current numerary system?
- Mathematics and Botany: to the discovery of fractals in nature.
- Bubbles and foam: how can a foam be solid and liquid both at the same time.

The aim of MISS is to bring the lab into the classroom. Teachers would come with their class at MISS and experiment on a specific subject during an entire day. These scientific workshops are animated by junior scientists (often PhD students), which facilitate exchanges with students.

Scientific production

Articles

Tree-based Inference of Species Interaction Networks from Abundance Data

under minor revision at Methods in

R. Momal, S. Robin, C. Ambroise

Ecology and Evolution

PREPRINT (<https://arxiv.org/abs/1905.02452>) -

2019

- Explains the inference method developed in the PhD project, compares it to existing methods and illustrates its application with examples using field data.
- This article is written towards the community of ecology, by bringing together concepts from the fields of mathematics, statistics and ecology.

Multi-species annotation of transcriptome and chromatin structure in domesticated animals.

BMC Biology vol.17(1), Art. n°108.

doi:10.1186/s12915-019-0726-5.

Sylvain Foissac and 35 others

2019

IT materials:

EMtree (<https://github.com/Rmomal/EMtree>)

R PACKAGE

- EMtree is an R package implementing the inference method developed in my PhD project.
- EMtree was developed as a tool for experts in biology and ecology who wishes to infer a direct dependency network from abundance data they collected.
- The method is appreciated as it efficiently handles environmental covariates, and experimental offsets.

Fancy plotting with ggraph, gganimate (<https://stateofther.github.io/post/fancy-plotting/GG.html>)

STATEOFTHER WORKSHOP

- Introduction to ggplot framework and gganimate, examples and exercises
- Networks with ggraph and tidygraph, examples and exercises
- Edge selection on a simulated ecological dataset

Scientific groups

StateOfTheR (<https://stateofther.github.io/>)

SELF-STUDY GROUP

- A group of researchers and engineers who meet to deepen their know-how, improve the dissemination of their statistical methods and exchange views on the latest innovations in the field of statistics.
- Participate to monthly workshops and annual bootcamps
- Co-designed and led a workshop with *Marie Perrot-Dockes* on how to use ggplot and R's newest packages to draw fancy graphs, and networks in particular

EcoStat (<https://sites.google.com/site/gdrecostat/>)

RESEARCH GROUP

- Development and application of statistical methods and tools for ecology and evolutionary biology
- Benefited from a grant from the group for a stay in an ecology laboratory (PELAGIS Observatory, La Rochelle, France).

EcoNet (https://cmatias.perso.math.cnrs.fr/ANR_EcoNet.html)

ANR RESEARCH PROJECT

- Advanced statistical modelling of ecological networks

Conferences

With talk:

Sep. 2019 **WiMLDS**, Women in Machine Learning and Data Science

Paris, France

Jan. 2019 **SMPGD**, Statistical Methods for Post Genomic Data

Barcelona, Spain

Dec. 2018 **NETBIO**, Networks inference in Biology

Montpellier, France

Jul. 2018 **JOBIM**, Open Days of Biology, IT and Mathematics

Marseilles, France

Attended:

Oct. 2019 **NETBIO**, Networks inference in Biology

Saclay, France

Sep. 2019 **networks2019**, 4th Symposium on Ecological Networks

Paris, France

Jul. 2019 **MMEE**, Mathematical Models in Ecology and Evolution conference

Lyon, France

May 2019 **JDS**, Statistical Days

Nancy, France

Feb. 2019 **SatRday**, International conference on R

Paris, France

Oct. 2018 **EcoStat GdR**, Conference of the EcoStat Research Group

Nancy, France

May 2018 **JDS**, Statistical Days

Saclay, France

Research Schools

With talk:

Aug. 2019 **FINIST'R 19**, R and GitHub summer bootcamp organised by StateOfTheR.

Roscoff, France

Feb. 2019 **COSTNET**, European early career training - Networks. Course by **Tom A.B. Snijders** (University of Groningen, University of Oxford) and **Tiago de Paula Peixoto** (University of Bath).

Munich, Germany

Aug. 2018 **FINIST'R 18**, R and GitHub summer bootcamp organised by StateOfTheR.

Beg Meil, France

May 2018 **Chaire MMB**, Spring Research School - Mathematical Modeling and Biodiversity. Course by **S. Robin** and **J. Josse**.

Aussois, France

Mar. 2018 **Rochebrune Seminar**, Winter Research School - Statistical Seminar. Course by **Julyan Arbel**.

Rochebrune, France

Attended:

Sep. 2019 **StatMathAppli'19**, Summer Research School. Course by **P. Bühlmann** and **M. Lerasles**

Fréjus, France