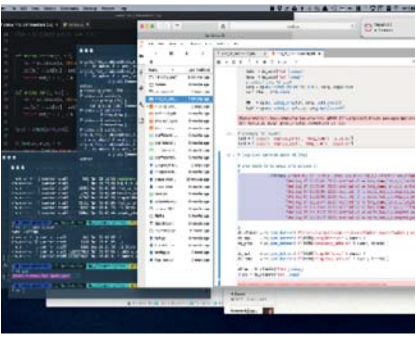
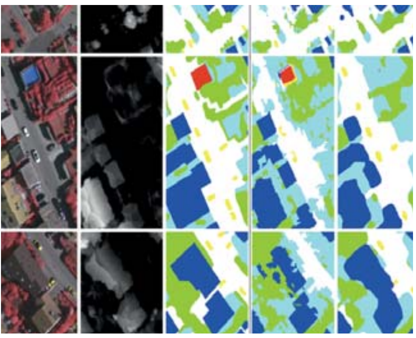
Helmholtz Research School on Mechanisms and
Interactions of Climate Change in Mountain Regions
KIT/IMK-IFU, Garmisch-Partenkirchen

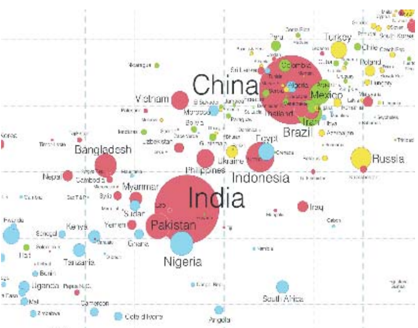
MICMoR Summer School 2019

Working with Environmental Data - From Explorative Data Analysis to Deep Learning

Institute of Meteorology and Climate Research
KIT/IMK-IFU, Garmisch-Partenkirchen, Germany
September 4-13, 2019







Data are the essence of science. They can be obtained from laboratory experiments and field site observations, large scale surveys, remote sensing or numerical simulations and are often combined with other information from colleagues or public repositories. However, data can be complex, incomplete and hard to structure. Handling of the many data formats, data exploration and analysis are thus essential skills in any scientist's toolbox. Sound and effective visualization skills and ways to cope with time series or high-dimensional data are also of great value to many disciplines. In addition, a need for reproducibility of your science, persisting results and better collaboration as well as a dedicated uncertainty quantification are now more important than ever.

In recent years a great toolbox evolved in the Python programming ecosystem and Data Science became much more accessible. Furthermore, methods such as clustering, dimensionality reduction, random forests and neural networks gained traction and enable exciting new applications in many fields. The rise of complex neural networks (Deep Learning) in the last years is the result of improved algorithms and architectures, accessible software libraries and especially increases in computational power. However, many of these tools are still not applied widely in environmental sciences but have the potential to help you explore your data further and in new and exciting ways.

In this Summer School you will learn to use the interactive programming environment Jupyter and the Python programming language with many of its state-of-the-art Data Science libraries. We will do hands-on exercises with curated environmental datasets to learn the toolbox but also look into your own data to help you gain more insights on your own research questions.

Lecturers

- Dr. Christian Werner (KIT/IMK-IFU, Garmisch-Partenkirchen, Germany) - organizing lecturer
- Dr. Marco Körner (TUM, Munich, Germany)
- Dr. Daniel Lee (EUMETSAT, Darmstadt, Germany)
- Dr. Sebastian Mutz (University of Tübingen, Tübingen, Germany)
- Prof. Alexandra Teynor, PhD (University of Applied Sciences, Augsburg, Germany)
- Dr. Katrin Fuchs (KIT/IMK-IFU, Garmisch-Partenkirchen, Germany)

Eligibility

The Summer School is open to 20 doctoral students, postdocs and Master students with a research interest in environmental science, ecosystem ecology and biogeochemistry from both measurement and modeling perspectives. Students should be familiar with a modern programming language (like Python, R, C++, or Java). Although Python

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knowledge is no strict requirement, we will only cover the basics of the language briefly on day one. Students should bring their own laptops and we will use cloud compute instances so everyone can work on the provided Jupyter notebooks regardless of their machines capabilities and operating system.

Application

Applicants must submit a motivation letter, a CV, and a letter of recommendation from their advisor or other academic familiar with their work to B. Elija Bleher (elija.bleher@kit.edu). **Application deadline is 5 June 2019.** There is a fee of 330,- € including tuition, lunches and refreshments. Participants must cover travel and accommodation costs. The Summer School will award 4 ECTS.

DRAFT COURSE OVERVIEW (as of April 24, 2019)

The course will use a mix of lectures and small group exercises. It begins on September 4 at 9am and ends on September 13 after lunch at around 2pm.

Wednesday, September 4

Introduction

Introduction to the course toolbox, data science and approaches to reproducible science Icebreaker & Postersession

Thursday, September 5

ETL, EDA and Visualization

Data formats, extract-transform-load (ETL), explorative data analysis (EDA) and effective visualization

Friday, September 6

Machine Learning

Clustering, dimensionality reduction, and other classical ML techniques

Saturday, September 7

BYO data

Bring your own (BYO) data for an optional hands-on with your research

Sunday, September 8 - free day

Monday, September 9

Time series analysis

Tuesday, September 10

Dealing with uncertainty

Frequentist and Bayesian approaches to uncertainty quantification

Wednesday, September 11

Deep Learning (1)

Introduction to neural networks and image applications

Thursday, September 12

Deep Learning (2)

Image applications, time series analysis and other use cases

Friday, September 13

Wrap-up

Course summary, project synthesis and student presentations

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