FAIRiCUBE

Use Case 3

Environmental Adaptation Genomics in Drosophila

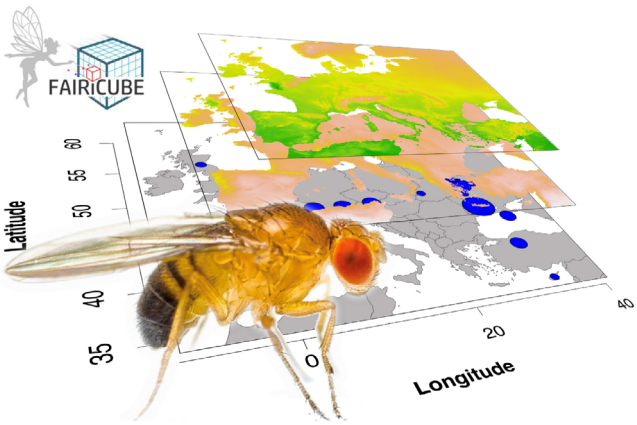
A FAIRiCUBE use case by Natural History Museum Vienna

Use case objective

The objective of Use Case 3 is to integrate genomic data of the fruit fly Drosophila melanogaster, which is one of the best-studied model organisms and a world-wide human commensal, with comprehensive environmental and climate information. This interdisciplinary approach aims to identify how environmental factors shape genetic variation and influence evolutionary processes. Taking benefit from already available and newly generated genomic datasets from European and North American populations, the study has two major goals:

I. To assess the influence of geography, environment and climate on genetic variation on natural fly populations on a continent-wide scale. By correlating population genomics with environmental data, the study aims to uncover genetic targets affected by environmental selection pressures.

II. To address the impact of urbanization on genetic variation and adaptation considering factors such as soil sealing, pollution, and habitat fragmentation. Understanding how urban environments affect species survival and adaptation is crucial amidst ongoing biodiversity loss and climate change.



Possible future applications

Overall, Use Case 3 aims to advance our understanding of the relationship between genetic variation, environmental factors, and evolutionary processes. By integrating diverse datasets and employing innovative analytical techniques, the study seeks to shed light on the mechanisms driving adaptation in
D. melanogaster populations, with broader implications for biodiversity conservation and pest management strategies in the face of global environmental changes.

The five use cases are

Urban adaptation to climate change (urban focus)

Biodiversity and agriculture nexus (regional focus)

Environmental Adaptation Genomics in Drosophila (regional focus)

Spatial and temporal assessment of neighborhood building stock (urban focus)

Validation of Phyto-sociological Methods (urban/regional focus)

Deliver the power of data cubes and machine learning (ML) to decision/policy makers and data scientists.

Why FAIRiCUBE?

There is an ever-increasing amount of earth observation data available, largely in the form of data cubes. The relevant data formats are quite mature, data is (at least partially) freely available, various data processing libraries as well as visualization and data storage tools have been developed. Additionally, compute platforms can be used, they scale well and are becoming affordable.

Despite these relevant evolvements, non-EO experts who would greatly profit by integrating these resources into their work are still struggling to make full use of the available data as well as relevant analysis and processing tools. Diverse aspects continue to confound potential users, such as:

- How to connect different data sources with storage & compute resources? What if you bring your own data?
- What computational aspects must be considered when dealing with gridded spatiotemporal data?
- How can we share tooling such as (trained) machine learning models?
- How do we visualize and share the results with the relevant stakeholders?
- How can we properly document what processing has been applied to the data? How can we include this essential provenance information?

Our vision

Within FAIRiCUBE, we demonstrate a harmonized data space, the FAIRiCUBE Hub, where we connect all the pieces required for a data science pipeline into a user-friendly framework, where everything is FAIR (Findable, Accessible, Interoperable, Reusable) and TRUSTable (Transparency, Responsibility, User focus, Sustainability, and Technology). In this manner, we illustrate how the Green Deal Data Space (GDDS) could be formed pertaining to gridded data and the analysis thereof.

Objective

The objective of the FAIRiCUBE project is to enable players from beyond classic Earth Observation (EO) domains to provide, access, process, and share gridded data and algorithms in a FAIR and TRUSTable manner.

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