# Computational Facilities for Biodiversity Research

## e-Infrastructures

Wouter Los
University of Amsterdam
(institute of Biodiversity and Ecosystem Dynamics)

## Computer-assisted photo identification

Eric Pauwels
Centre of Mathematics and Informatics, Amsterdam
(Signals and images)

Richard Leakey

(Nov 2008)

"The cost of the melt-down of Wall Street is the next day in your news paper;

do we know the costs of the melt-down of our planet's nature?"

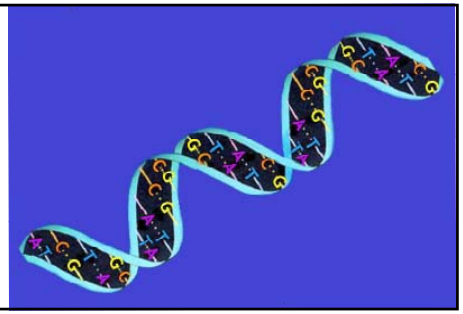
# Biodiversity

Species (organisms and their populations)

>$10^7$ species; species with $10^2$ to $10^{12}$ individuals

Genes and DNA

$10^6$ to $10^9$ nucleotides in a DNA molecule

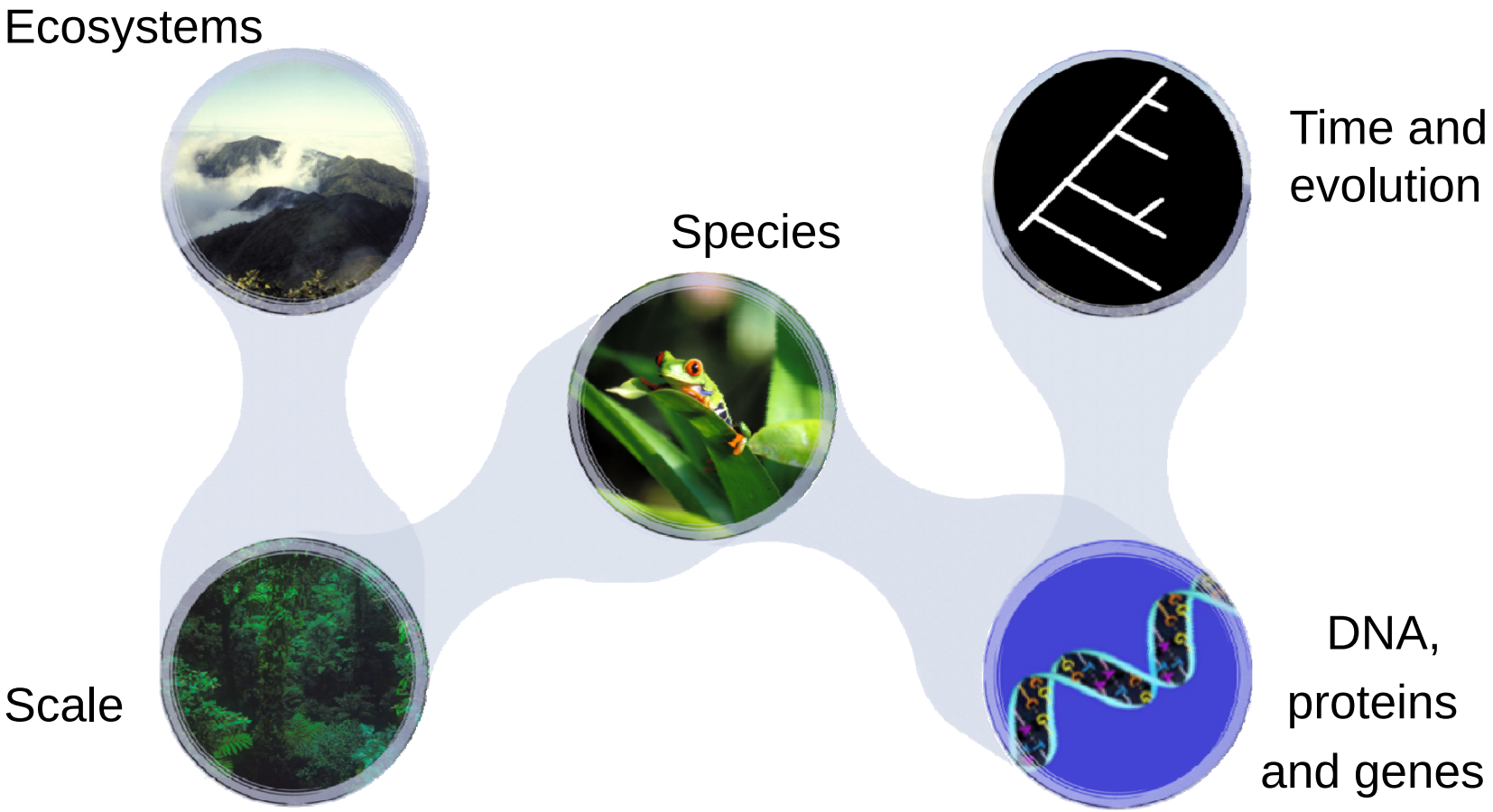


Ecosystems

habitats with $10^4$ to $10^6$ species,

and manyfold interactions

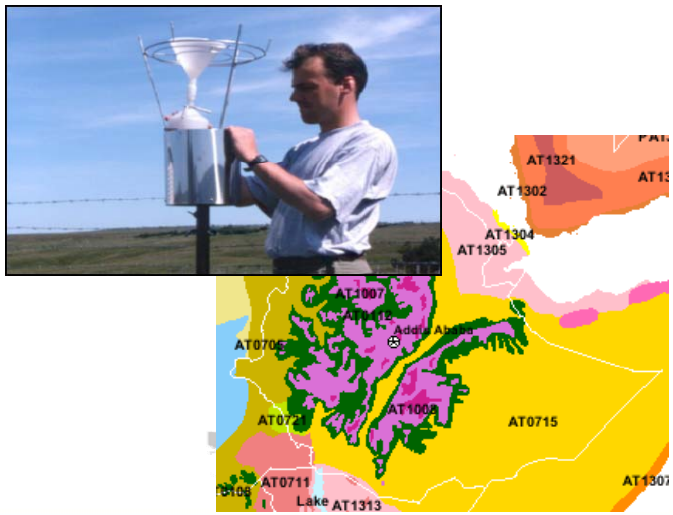
# The big questions in biodiversity research




@ Robert Guralnick & Andrew Hill (Univ Colorado)

# Even more pressing questions

Biodiversity loss, added to climate change, requires entirely new approaches and mitigation strategies.




We need forecasts and measures of future changes and their uncertainty

Understanding, predicting and managing change in biodiversity, landscapes and ecosystem services

Landscapes are highly modified by human activities

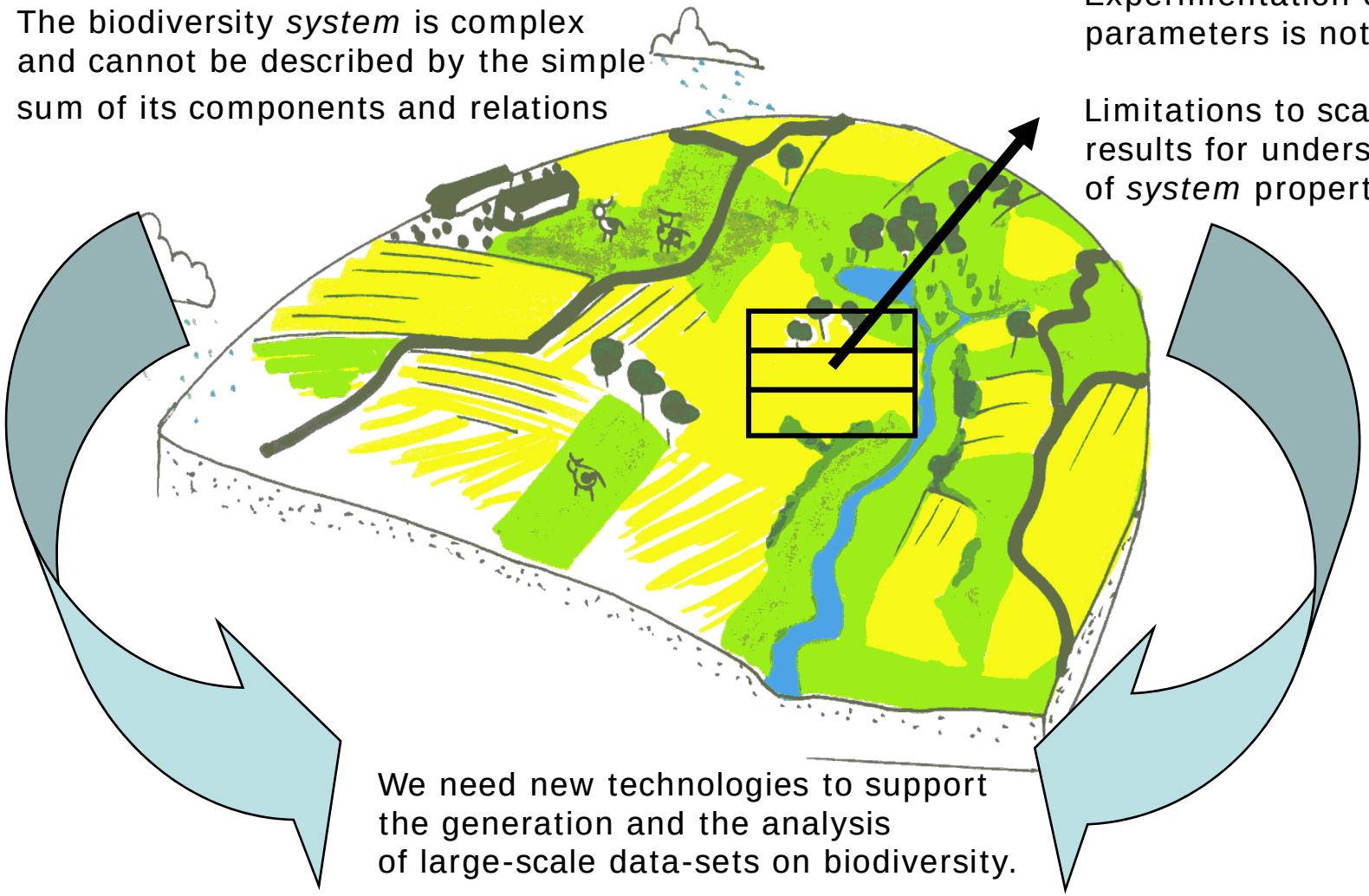
Multiple drivers and pressures affect the state of biodiversity

Research to understand, predict and manage biodiversity and its changes

The biodiversity *system* is complex and cannot be described by the simple sum of its components and relations

Experimentation on a few parameters is not enough:

Limitations to scaling up results for understanding of *system* properties



We need new technologies to support the generation and the analysis of large-scale data-sets on biodiversity.

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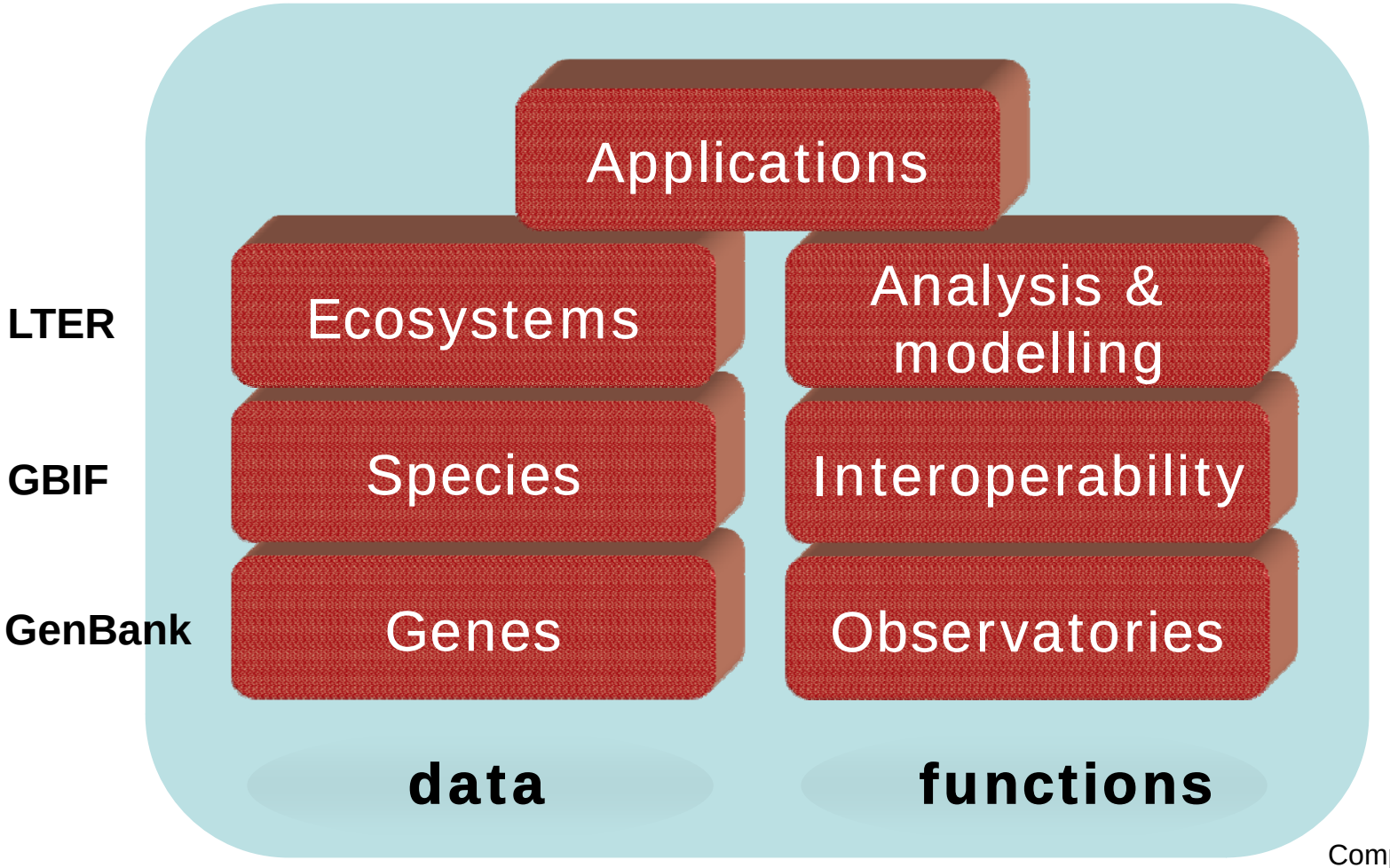
Understanding of the biodiversity system and its functions requires the analysis and modeling of large data sets to identify patterns and underlying processes.

This defines an infrastructure with
- distributed observatories/sensors,
- interoperable databases,
- computational capability,
- and computational capacity.

# Building blocks of the research infrastructure

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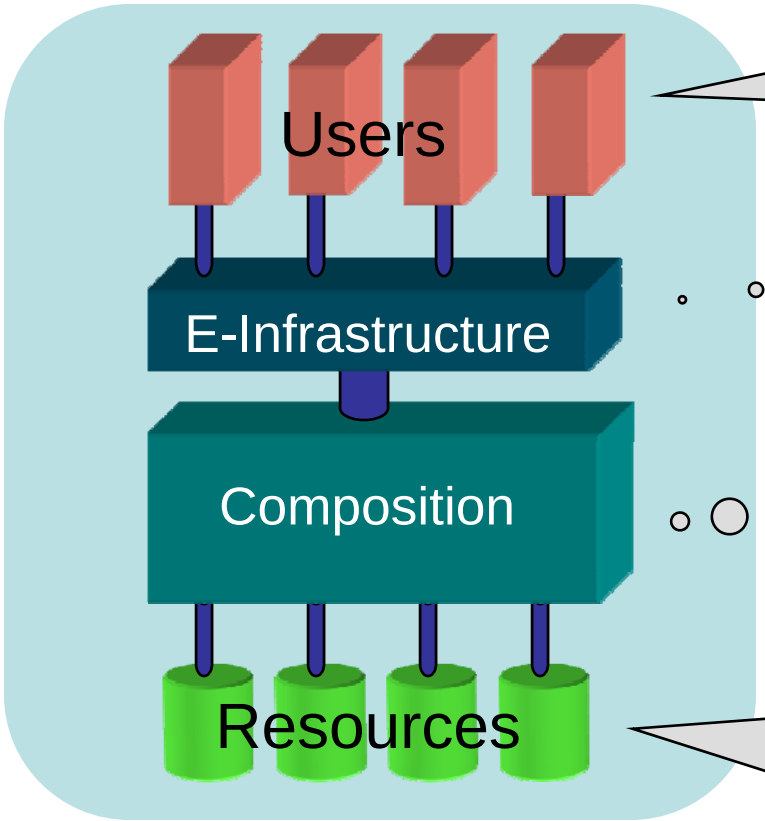
# Architecture




**Collaboration**
- Common Exploratory Environment
- Collaborative Virtual Organisations

**Semantic annotation**

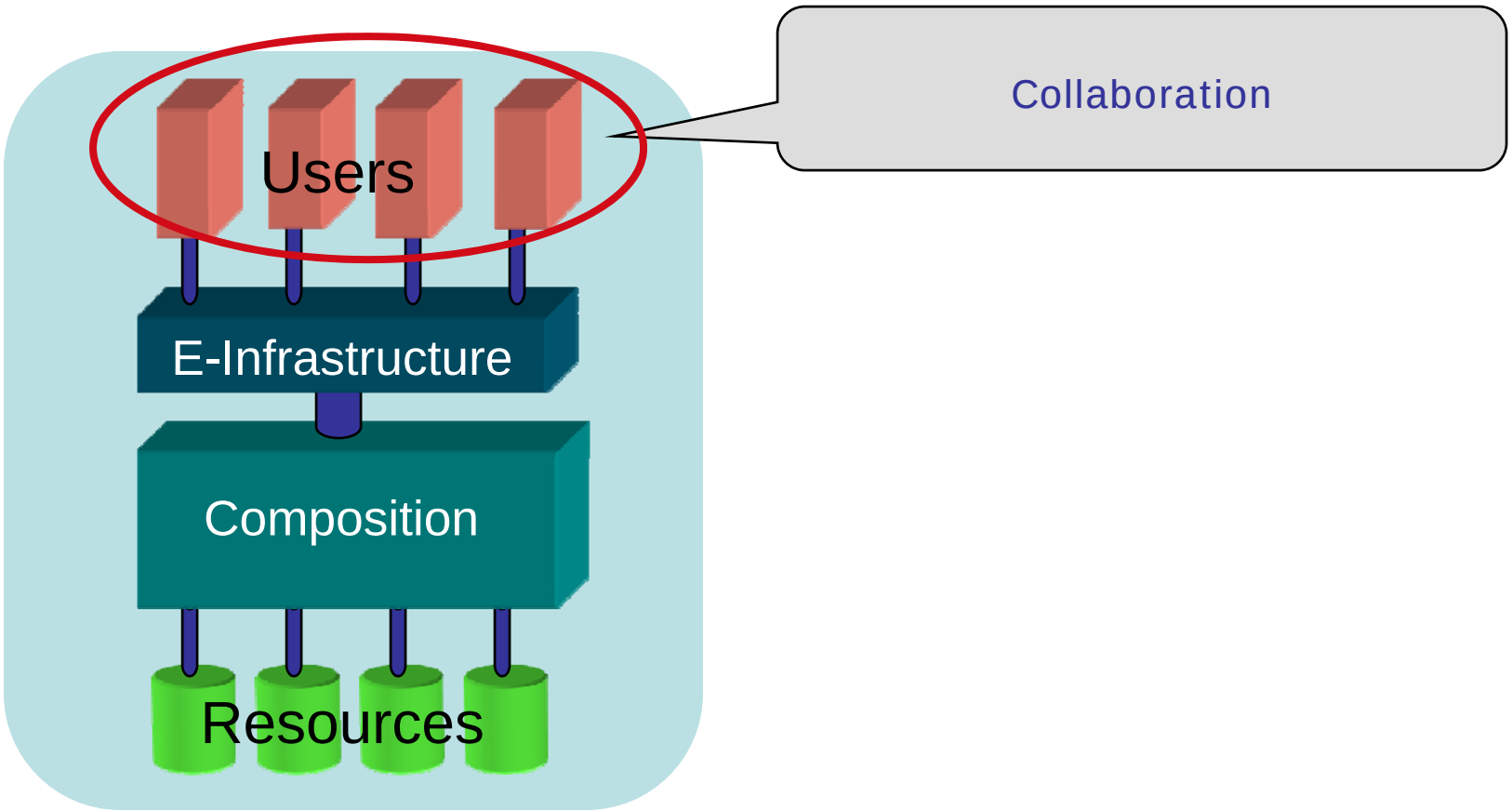
**Analysis and processing**
- Integration of resources
- Documented, shared workflows
- Grid computation

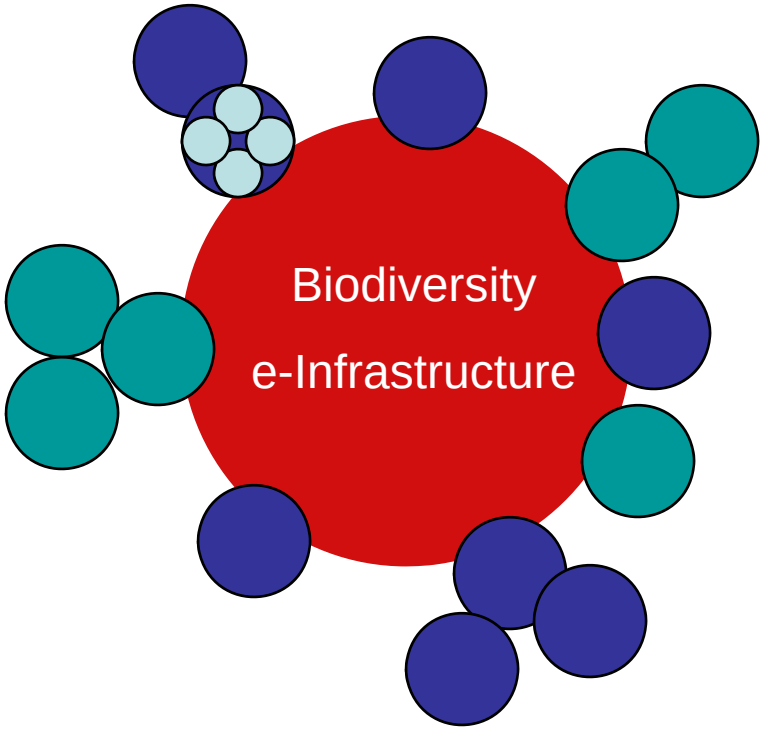
**Data**
- measurements, observations & sensors
- other infrastructures

**Statistical software**

**Distributed computing power**

# Architecture




Biodiversity
e-Infrastructure

*Year 2012*

A researcher has the innovative idea to combine distributional, genetic, ecological, phylogenetic, earth, and climatic data together in an statistical analysis to “predict” not native species invasions, with special attention to the horizontal transfer of health related parasites in the host species.

*Year 2013*

Our researcher builds her infrastructure work space and attracts dozens of collaborators inventing additional functions. Data providers also jump in.

Year 2014

The WHO starts a campaign with a funding programme to sustain the project as a main health service

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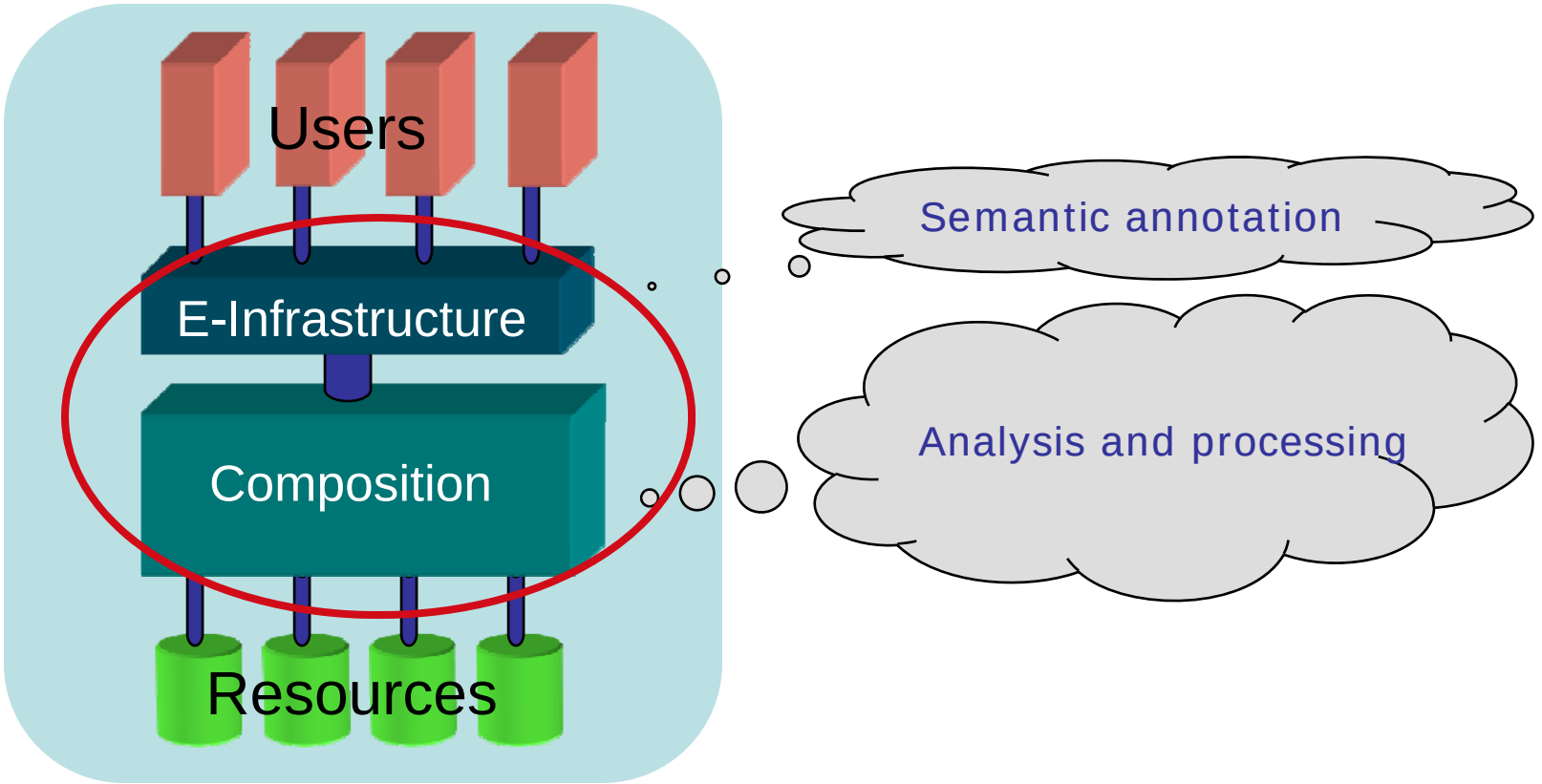
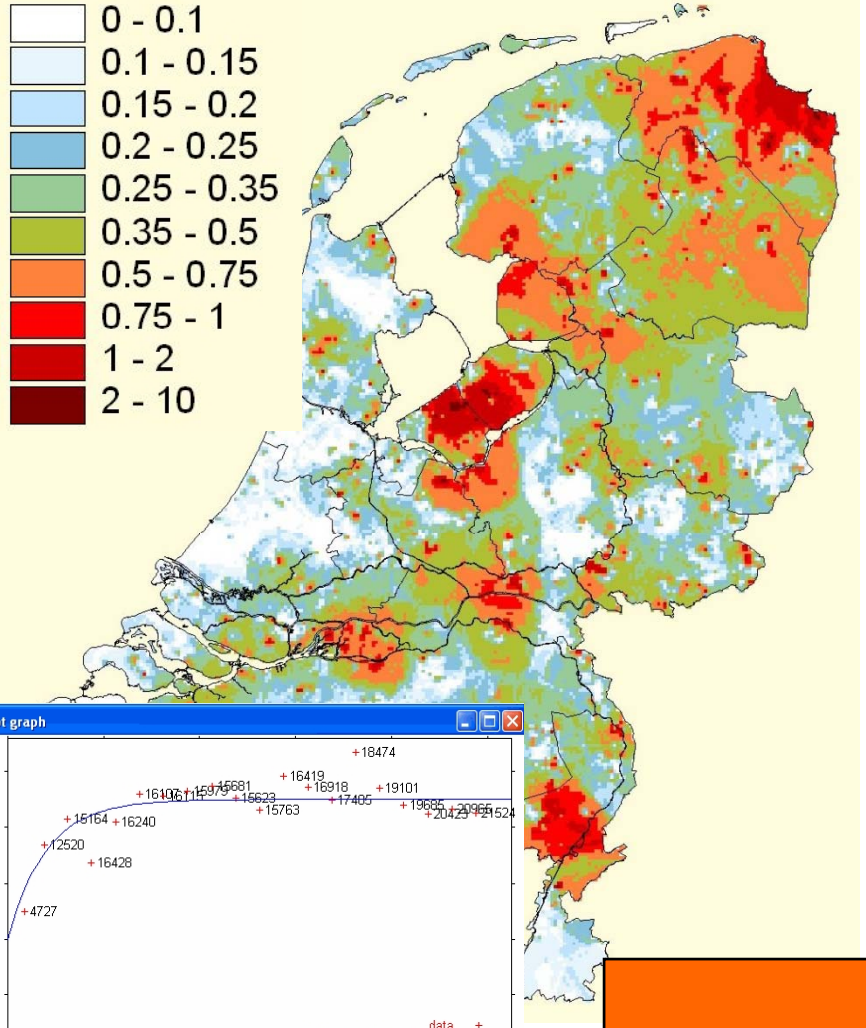
# Architecture

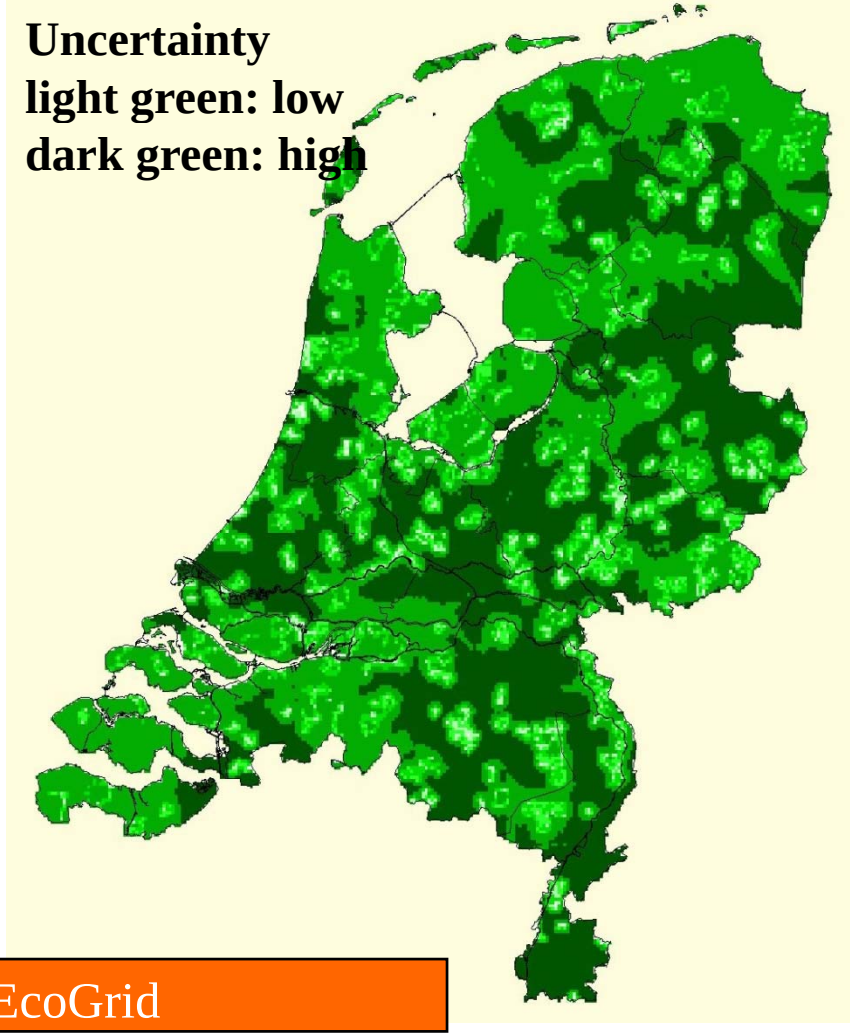


# Spatial interpolation: Kriging Uncertainty










EcoGrid

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# A prototype example

BAMBAS

THE NETHERLANDS
BIRD AVOIDANCE MODEL

home - spatial distribution - migration - spatial distribution (authorized access only) - about us

**Welcome to The Netherlands Bird Avoidance Model (NL-BAM).**

The NL-BAM is primarily designed for use by the experts of the Royal Netherlands Air Force. The main objective of the NL-BAM is to predict the density of birds in the air above the Netherlands by modelling the relationship between migration and spatial distribution of birds, and environmental conditions such as weather and landscape properties. These predictions can be used to reduce the risk of collisions between birds and aircrafts, through application for flight planning, to issue advance warnings to pilots and to inform airfield bird control units of expected bird conditions.

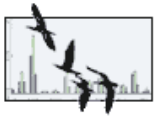
The NL-BAM consists of two modules:

1. Spatial distribution, a geographic information system (GIS) mapping the densities of birds at different times of year, day and altitudes;
2. Bird migration, predictions of bird migration up to 3 days in advance based on weather forecasts.

**Terms of use:**

Unless authorized by the project partners, this site is only for personal use. NL-BAM was developed to the best of our ability and with the best available data. Although its use can reduce the chance of a bird-aircraft collision it will not eliminate the risk. The NL-BAM developers cannot be held liable for any losses incurred as a result of bird strikes.

Spatial distribution



Migration

Spatial distribution (authorized access only)

UNIVERSITEIT VAN AMSTERDAM

vl-e virtual laboratory for e-science

Sovon

Koninklijke Luchtmacht

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LIFEWATCH

National Biological Information Infrastructure

Encyclopedia of Life

BIODIVERSIDAD MEXICANA

esa

GBIF

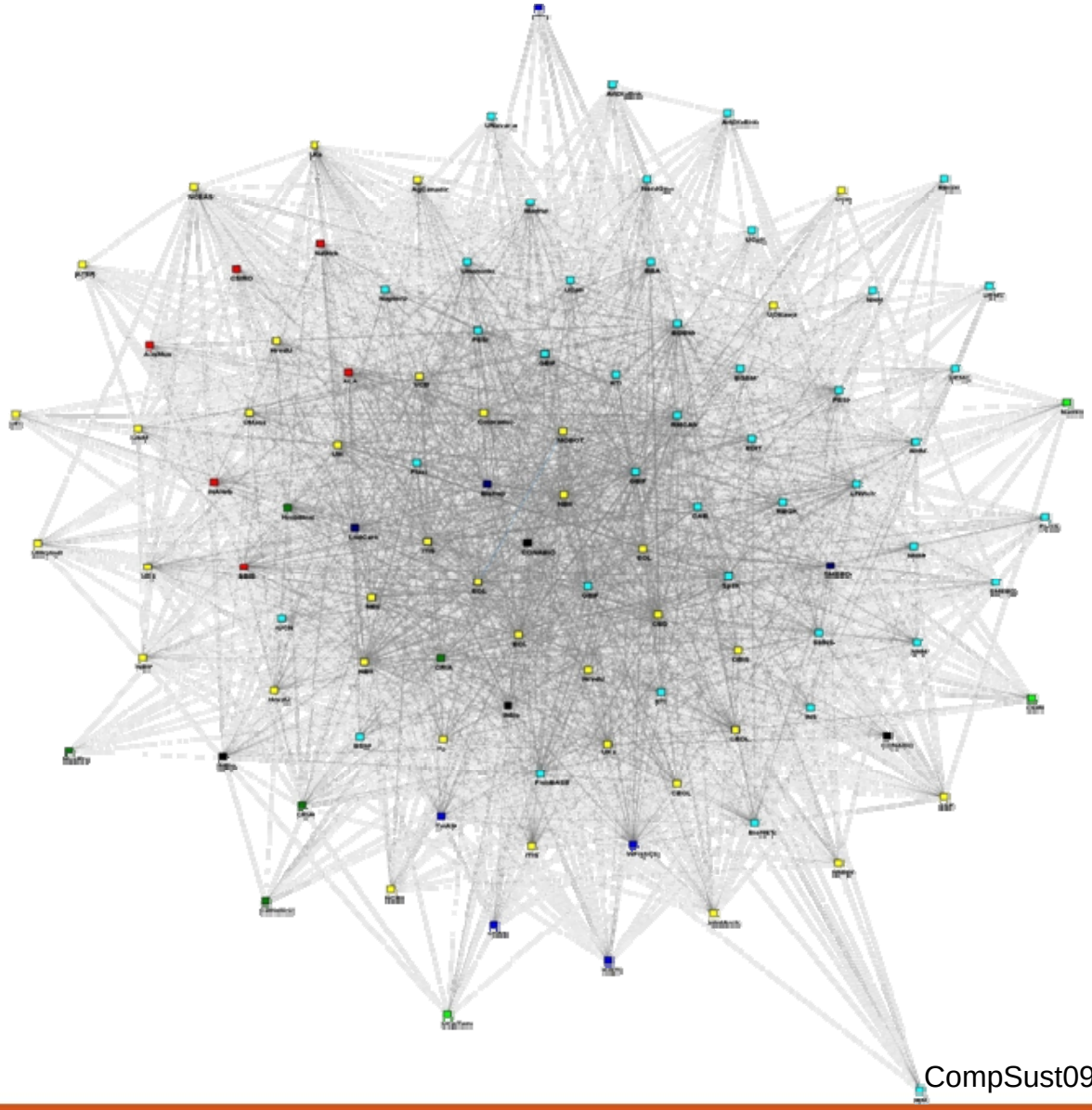
NASA

LIFEWATCH

ATLAS OF LIVING AUSTRALIA
sharing biodiversity knowledge

LIFEWATCH

- Africa
- Asia
- Central America
- Australia
- North America
- Europe
- South America
- Oceania



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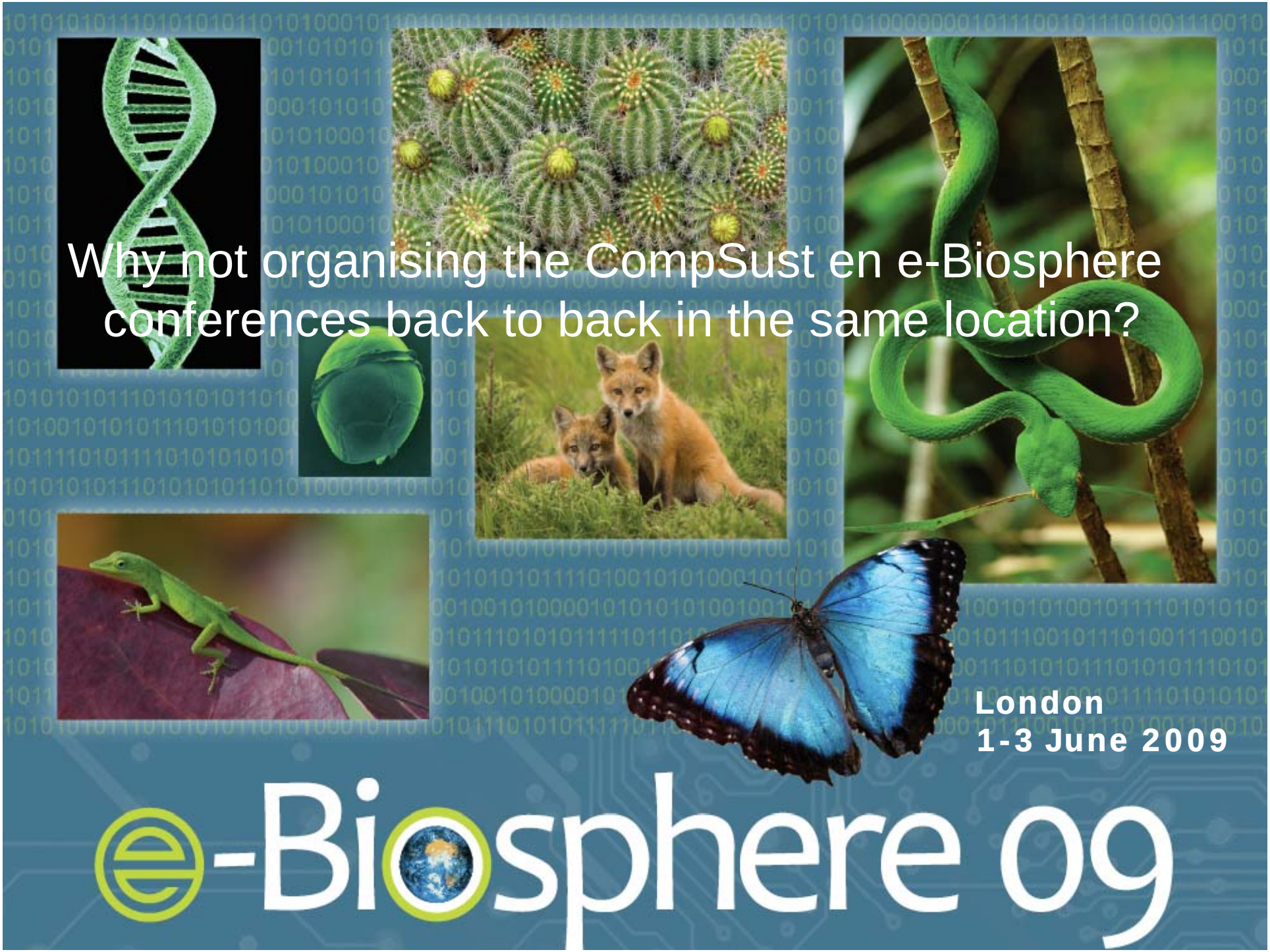
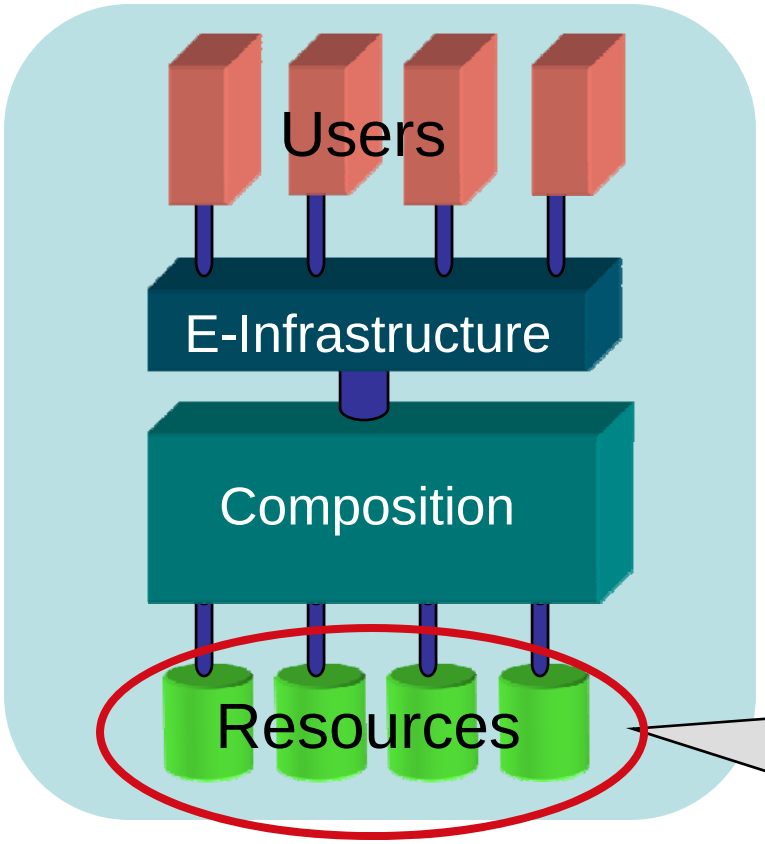

Why not organising the CompSust en e-Biosphere conferences back to back in the same location?
London
1-3 June 2009
e-Biosphere 09

# Architecture




Data -> Observations & Sensors
Statistical software
Distributed computing power

# Thank you

w.los@uva.nl