R Computing services as SaaS in the Cloud

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CSIC

Introduction

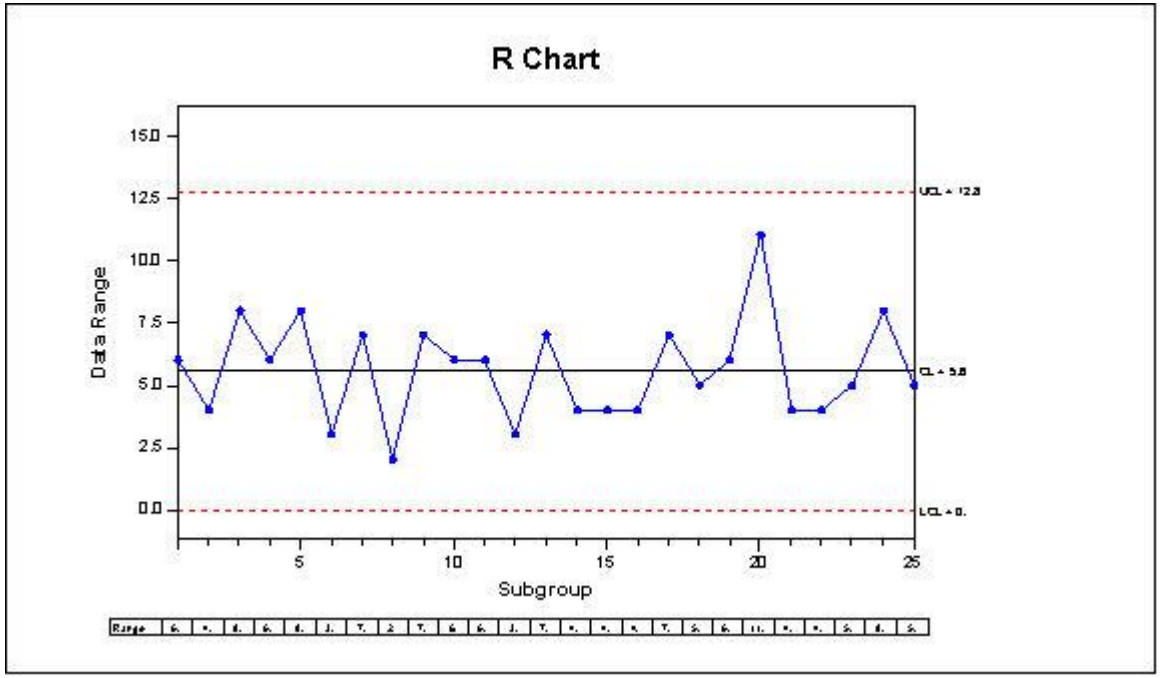
- **R** is a programming language and software environment for statistical computing and graphics, widely used among statisticians and data miners for developing statistical software and data analysis.
- R is a very useful language for those researchers that need to analyse data and are not IT experts.
- R community is pretty wide, so there are a number of plugins and modules to enrich the use.
- R is open.

Introduction – Why R?

- Easy for beginners. Powerful for experts (integration with others, data sources, etc.)
- Thousands of packages.
- Explicit parallelism is straightforward in R.
- Growing community of users.

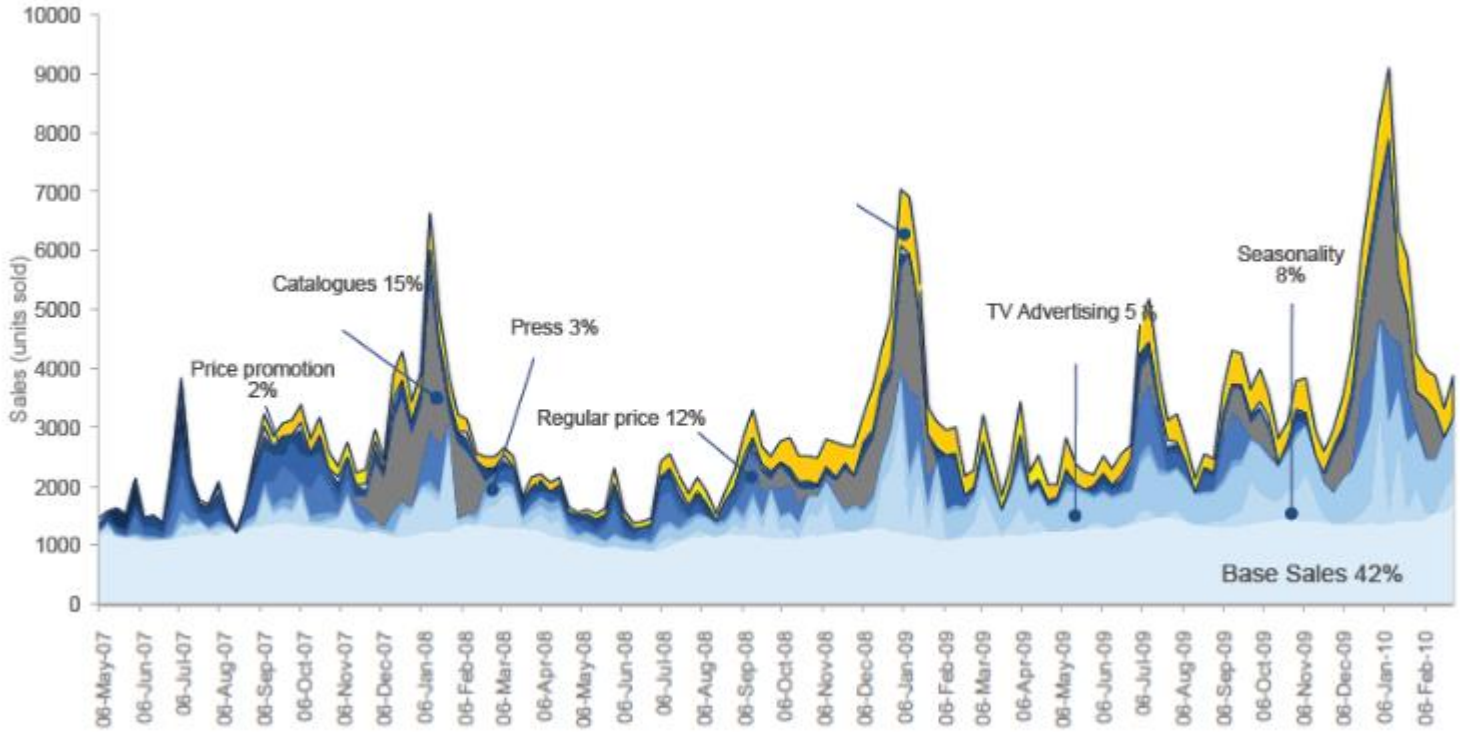
Introduction – Use of R

- Fields: data explotation, data analysis, data mining, etc.
- From basic to complex:



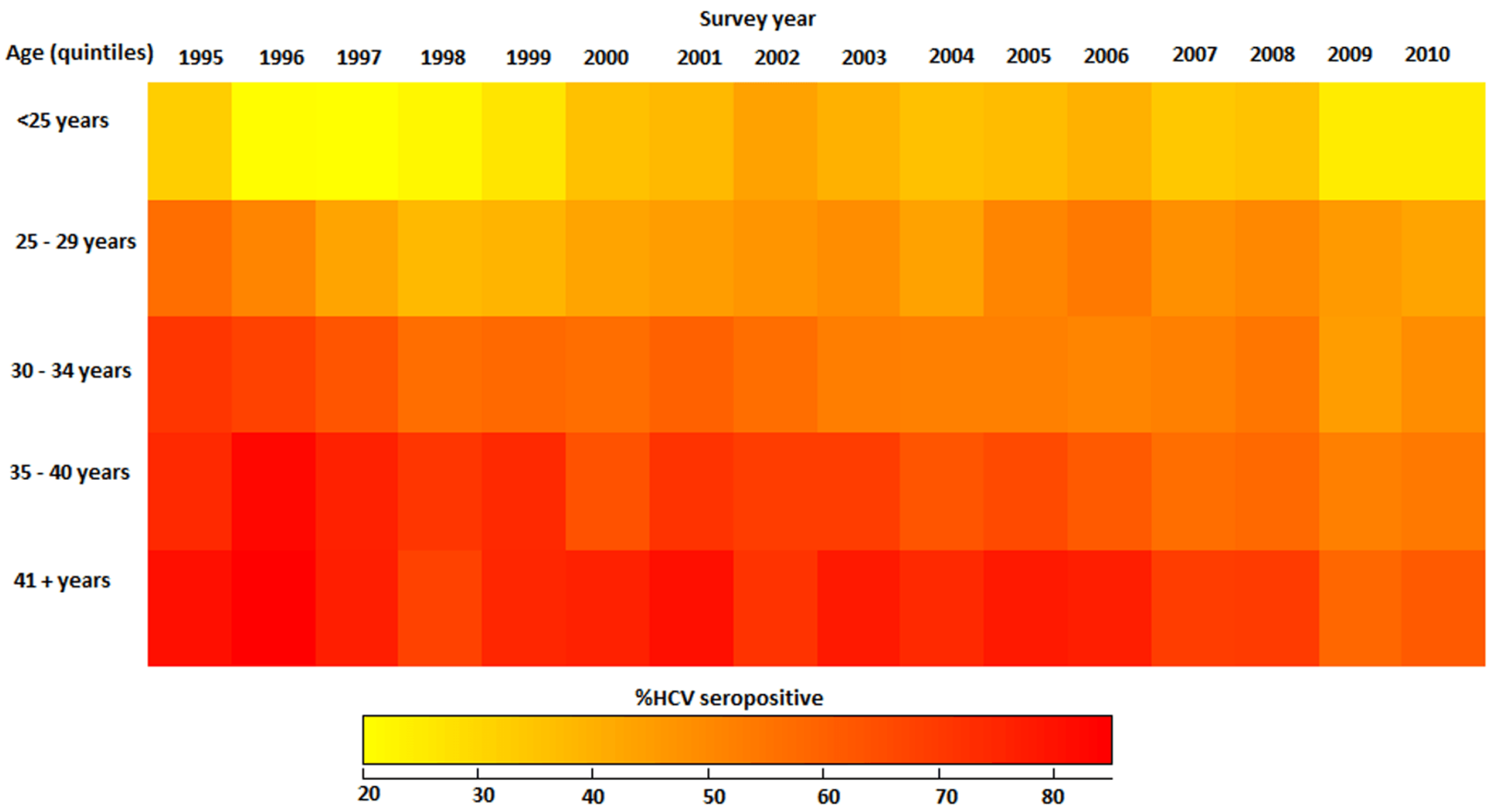
Introduction – Use of R

- Different sources, formats (DB, csv, etc.).



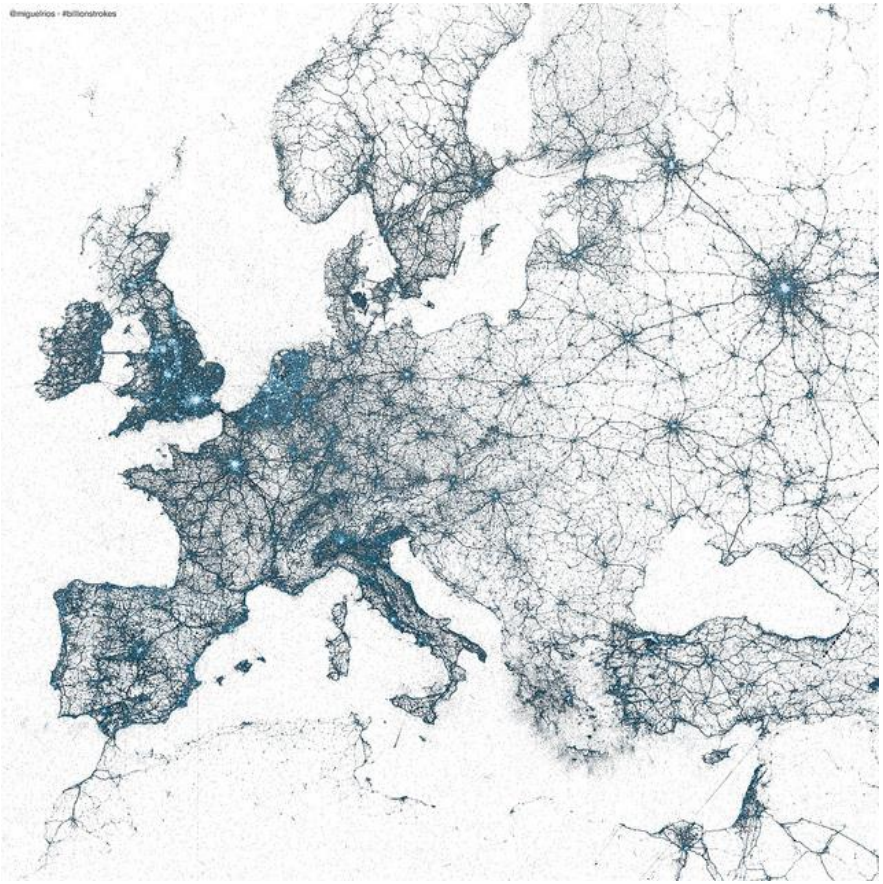
Introduction - Use of R

- More complex charts, more than one-two params.



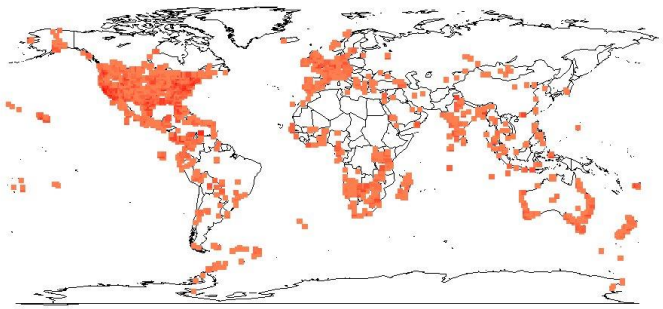
Introduction – Use of R

- Geo Packages: maps, google, GIS connection.



Introduction –R in Biodiversity

- Species distribution (geo formats)
- Data analysis
- Data filtering
- Satellite data
- Image analysis



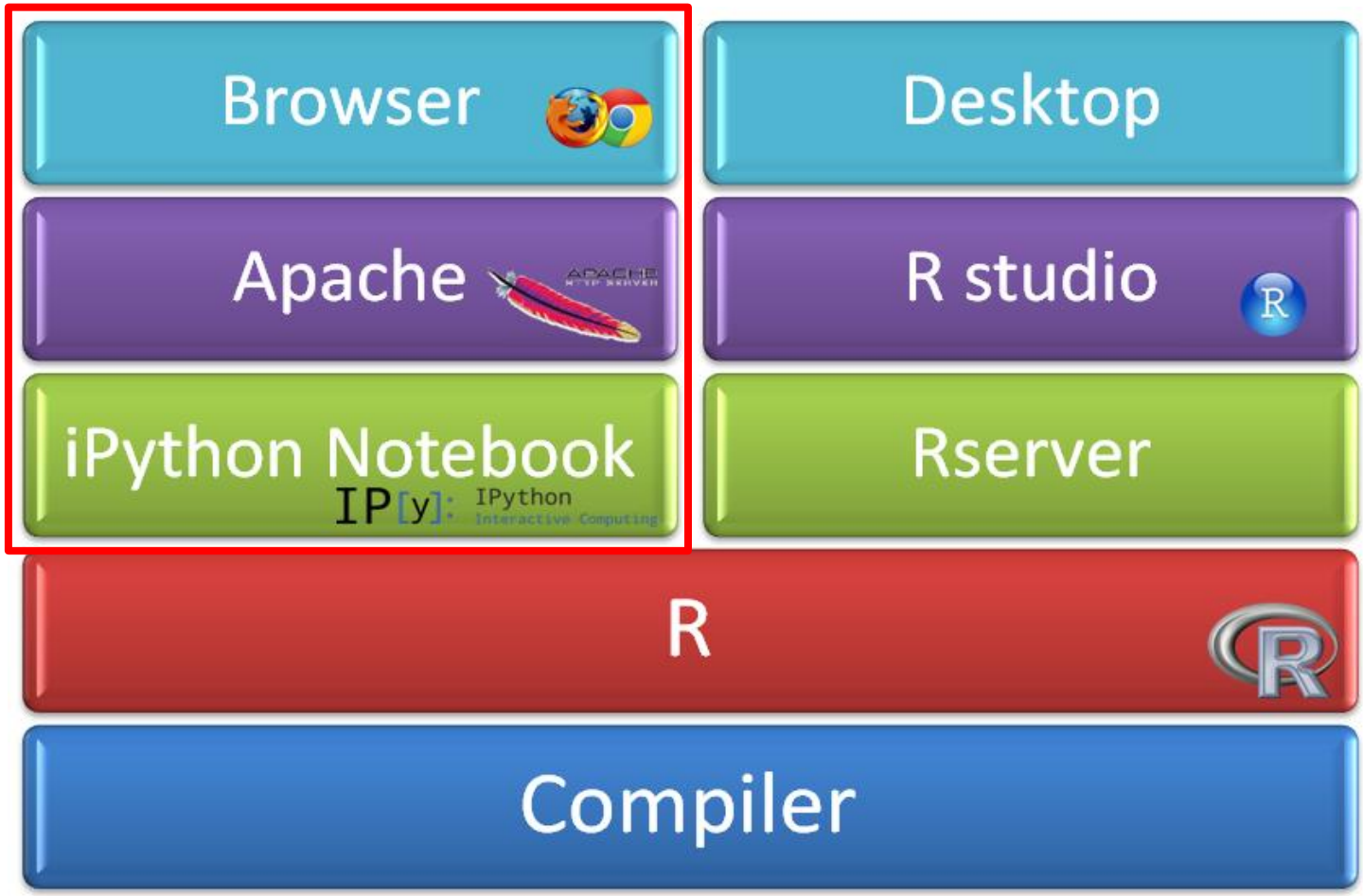
Lifewatch

- LifeWatch is the European e-Science infrastructure for biodiversity and ecosystem research. ESFRI
- Aims to provide advanced capabilities for research on the complex biodiversity system.
- e-Science infrastructures capitalize existing resources and data from physical infrastructures, distributed centers and single research groups.
- The capabilities offered by LifeWatch, as a e-Science infrastructure, allow users to tackle the big basic questions in biodiversity, as well to address the urgent societal challenges concerning biodiversity, ecosystems and other crosscutting issues.

EGI-Lifewatch Competence Centre

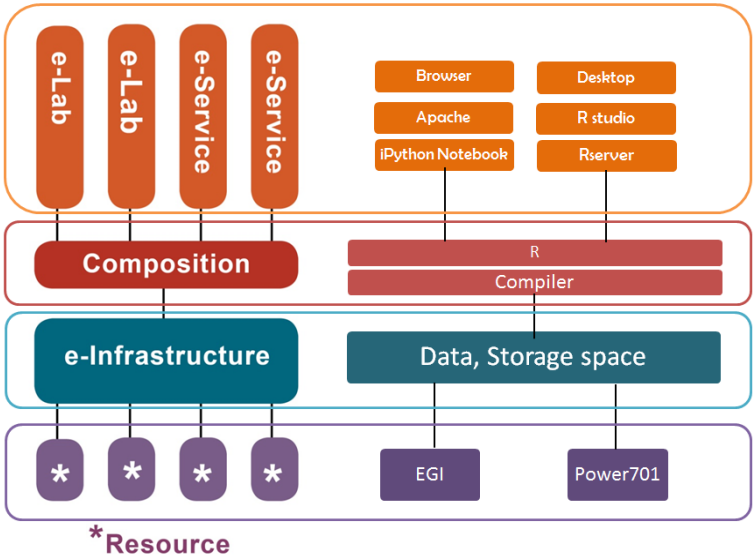
- Support the requirements of the community in Biodiversity and Ecosystems research.
- Establishing a direct collaboration between EGI.eu and the ESFRI LifeWatch to address specific needs.
- Four Mini-Projects:
  - Exploitation of the EGI infrastructure by the LifeWatch user community.
  - Tools required to support data management, data processing and modeling.
  - Integrate in EGI FedCloud framework, workflows, Vlabs.
  - Citizen Science in EGI e-infrastructure.
- Working Groups: R

Architecture



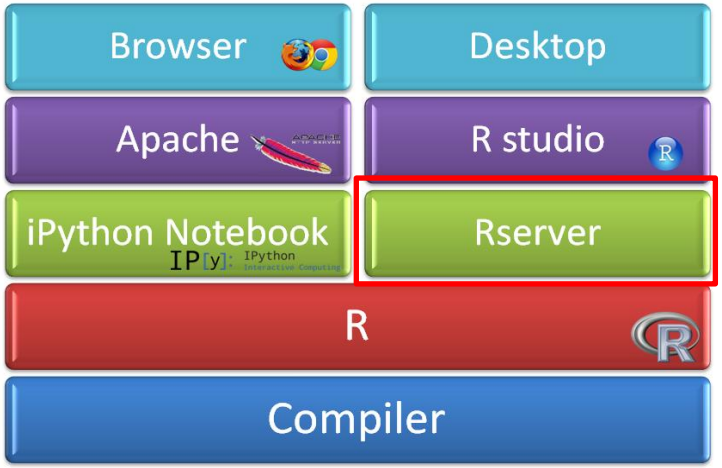
Architecture - Bottom Layer

- R instances, compiler, computing layer.
- Different choices:
  - HPC: Power701, improve performing.
  - Cloud: Load balance, different R version (package dependant), container.



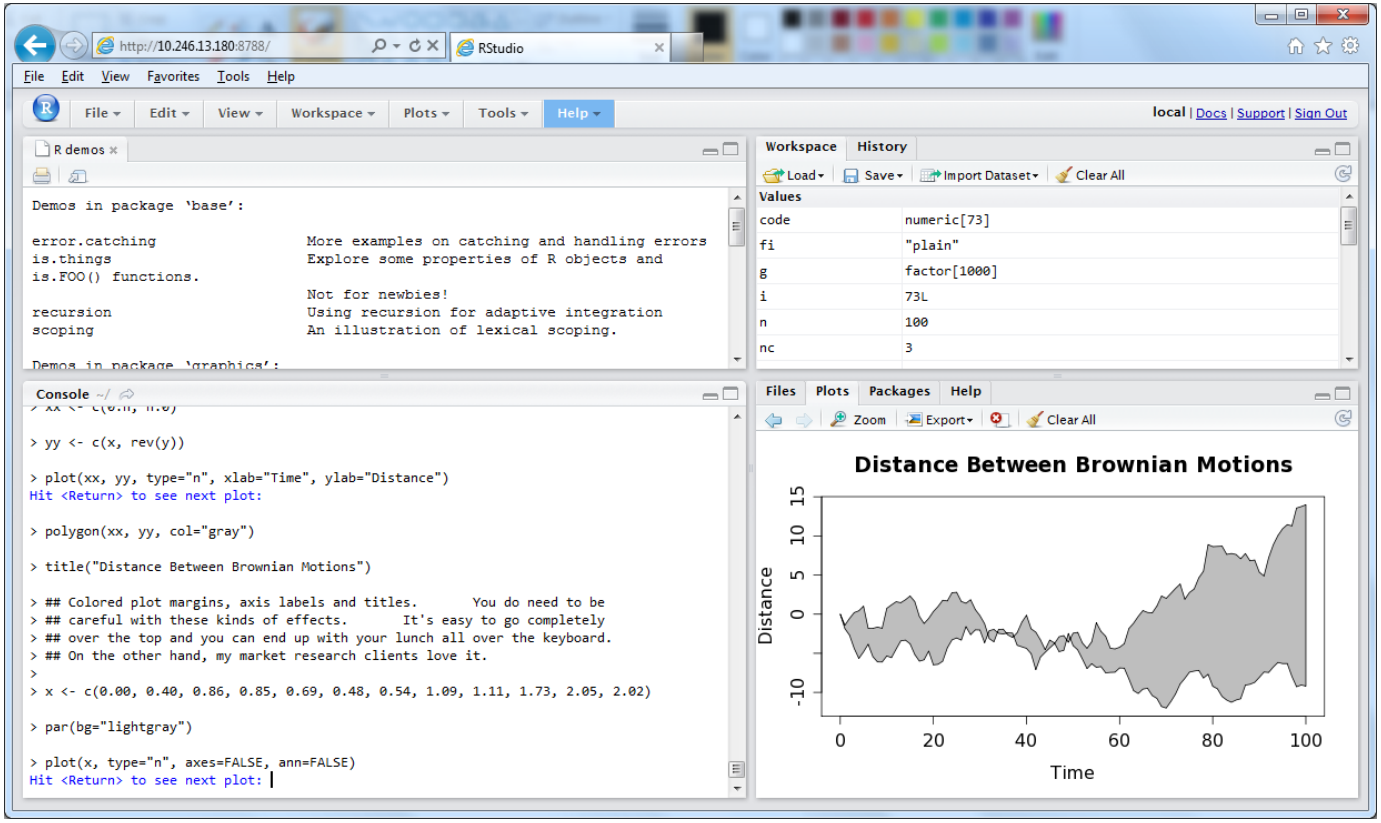
Architecture - Medium Layer

- R server – Interface between Computing and GUI.
- Not always needed.
- Client contact with server, that is an R package that connects both.
- Needs a desktop client.



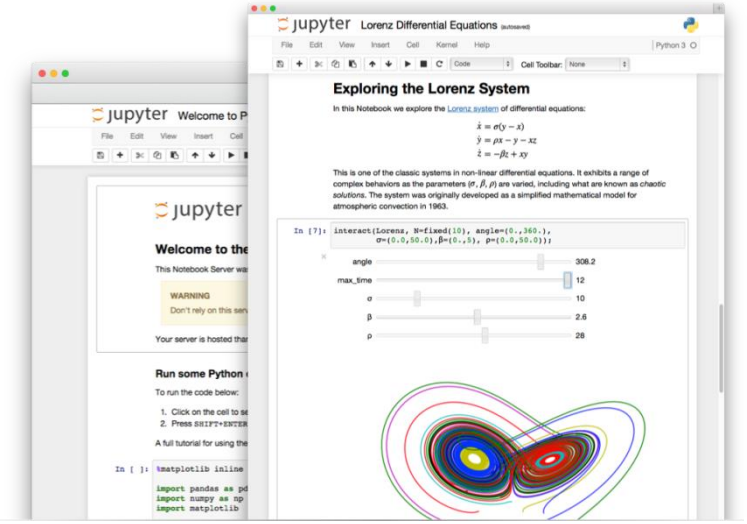
Architecture - SaaS

- Rstudio Server



Architecture - SaaS

- The **Jupyter Notebook** is a web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and much more.
- Over 40 languages.
- Sharable notebooks.
- Jupyter hub.



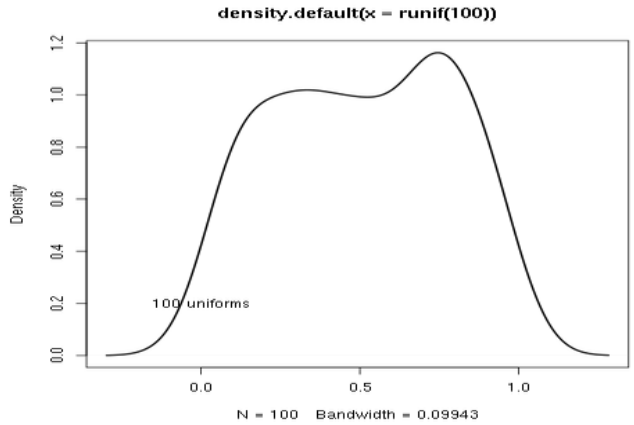
Architecture - SaaS

jupyter Untitled0 Last Checkpoint: 05/26/2015 (autosaved)

File Edit View Insert Cell Kernel Help Python 2

Code Cell Toolbar: None

```
In [1]: %load_ext rpy2.ipython

In [5]: %R getwd()

Out[5]: array(['/home/ipynb/notebooks'],
              dtype='|S21')

In [4]: %R library(parallel); detectCores(); system("grep MemFree /proc/meminfo", intern = TRUE)

Out[4]: array(['MemFree:        28163456 kB'],
              dtype='|S27')

In [10]: # Let me take some pains on the 1st
         %R plot(density(runif(100)), lwd=2); text(x=0, y=0.2, "100 uniforms")        # Showing you how to place text at will
         %R x=seq(0.01,1,0.01);par(col="blue")                                        # default colour to blue.
         %R plot(x, sin(x), type="l"); lines(x, cos(x), type="l", col="red")
```



Architecture – SaaS - Explotation

- Workflows: R, python scripts, OpenShift.
- User space.
- Lifewatch Data Portal: dataset usage, experiment reanalysis, reproducibility.
- Not only R, but other languages.

R virtual laboratory (Rvlab) basics

- Ecological/biological interest
- Offer statistical and visualization tools for LifeWatch Project, using R statistical language.

Main Objective:

- Optimize certain VEGAN package functions (Community Ecology Package), which supports, ordination methods, diversity analysis and other functions for community and vegetation ecologists.

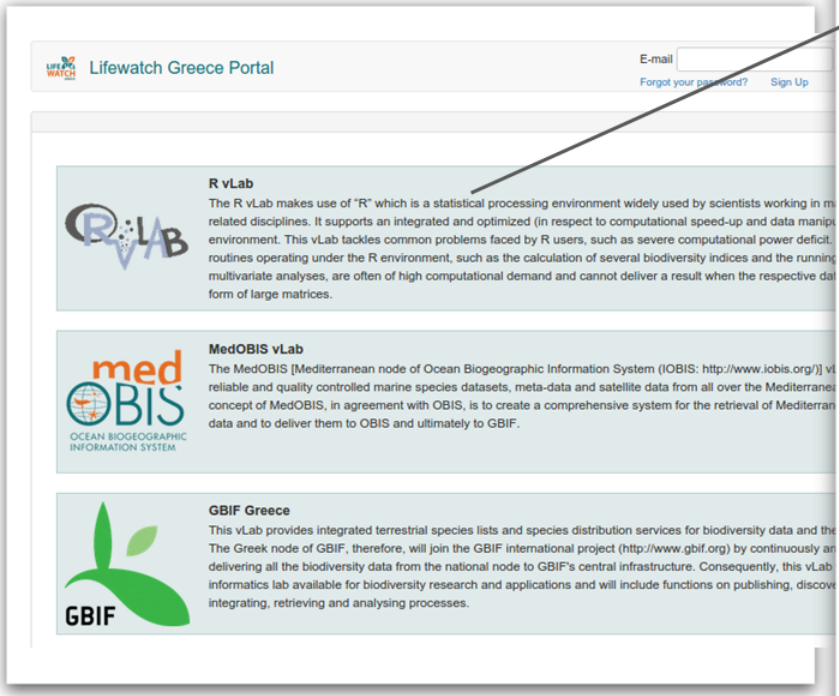
More specific issues addressed are:

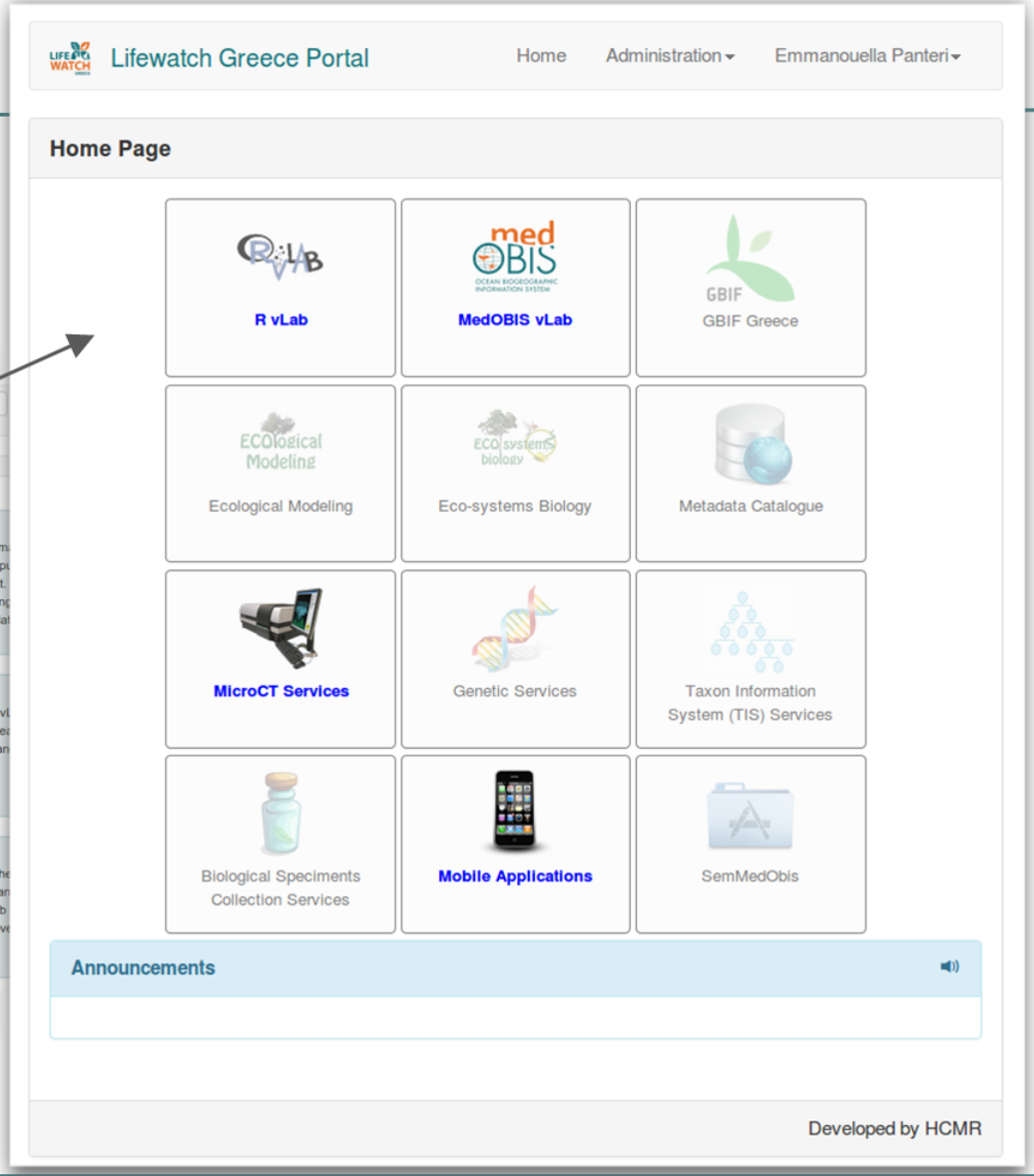
1. Big data manipulation (overcome memory barriers)
2. Computational time speed-up (task segmentation multi-cores, cluster computing environment at HCMR – recently upgraded from Llifewatch)

- Develop an efficient and friendly user interface for analysis of ecological community data.

Accessed by the LifeWatchGreece Portal

portal.lifewatchgreece.eu





RvLab Main Page

R vLab

Workspace File Management

Available input files:

- softlagoonabundance.csv
- softLagoonAbundance.csv
- softlagoonaggregation.csv
- softLagoonAggregation.csv
- softlagoonenv.csv
- softLagoonEnv.csv
- softlagoonfactors.csv
- softLagoonFactors.csv

Upload new input files:

Select file(s)... Add Files

User's Storage Utilization: (396.00 KB)

0.0%

Recent Jobs:

Job ID	Function	Status	Submitted At	
Job312	taxa2dist	Completed	2015-08-22 21:04:25	✖
Job339	taxondive	Failed	2015-08-31 14:21:39	✖
Job340	vegdist	Completed	2015-08-31 14:21:55	✖
Job341	taxa2dist	Completed	2015-08-31 14:22:13	✖
Job342	anova	Failed	2015-08-31 14:22:39	✖
Job344	taxondive	Failed	2015-08-31 14:52:47	✖

Help

Submit a new Job

Statistical Function taxa2dist

Input files

Select classification table with a row for each species or other basic taxon, and columns for identifiers of its classification at higher levels from loaded files

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Parameters

varstep FALSE

check TRUE

Run Function

Developed by HCMR

RvLab Main Page

R vLab

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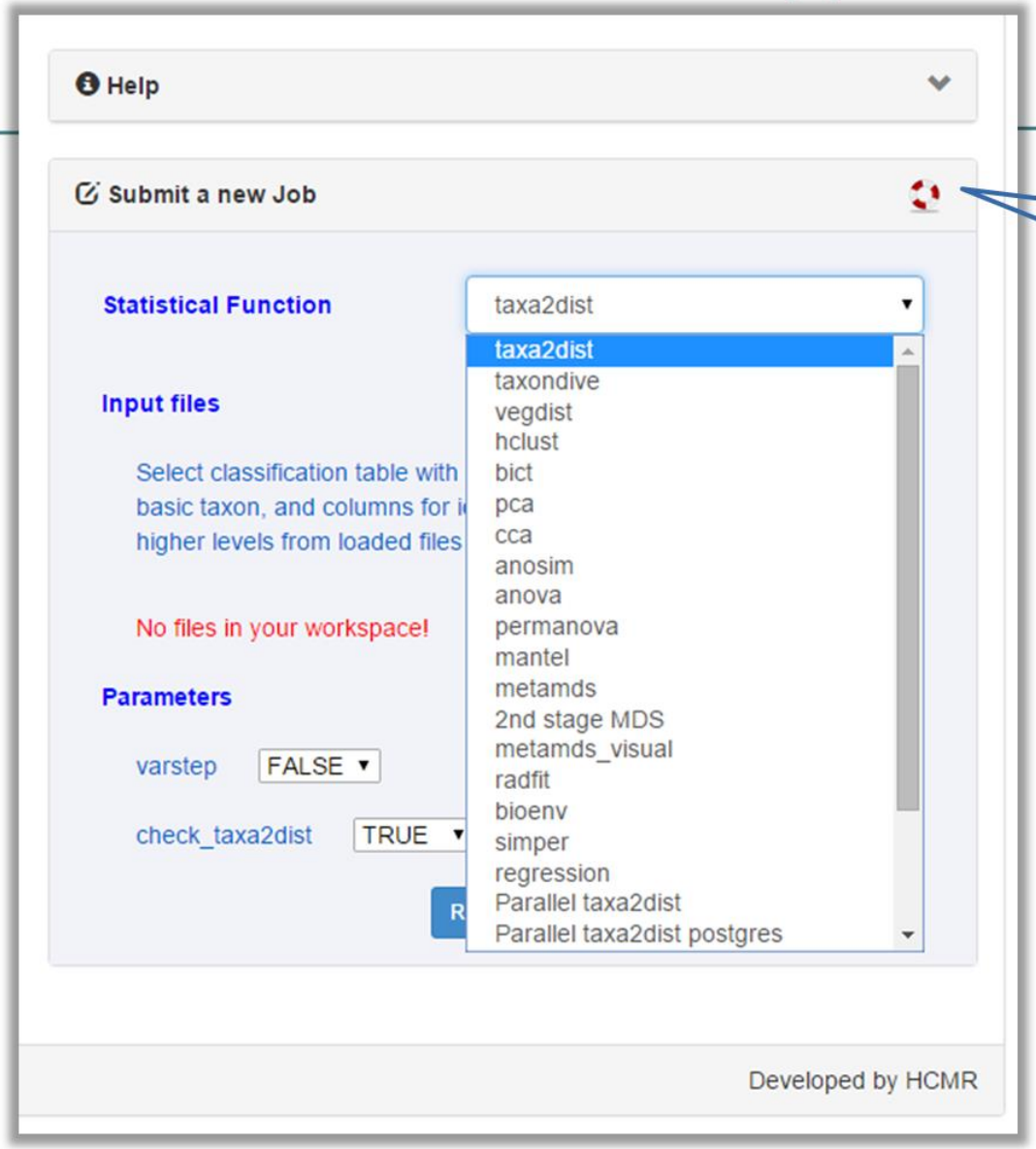
check TRUE

Run Function

Developed by HCMR

Functions supported by Rvlab



Function documentation

Conclusions

- R is one of the best language for data analysis, managing, etc. For experts and non-experts.
- SaaS is the best approach for non IT researchers. Biodiversity.
- SaaS solutions that can explote FedCloud resources:
  - R oriented – RStudioServer
  - Jupyter – More open, more functionalities
  - LFW Greece VLab
- Lifewatch Open Science Framework integrates preservation of the whole data lifecycle with jupyter to provide user a complete environment for data managing.

Thanks for your attention

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