

AgriGIS Workshop and Think Tank

Regional Centre for Mapping of Resources for Development (RCMRD), Near Kasarani Police Station, Kasarani - Mwiki Road, Nairobi, Kenya

GRASP, eGRASP, GRASP2gfs

Didier Leibovici, Suchith Anand,
Nottingham Geospatial Institute

Sean Mayes,

Plant & Crop sciences

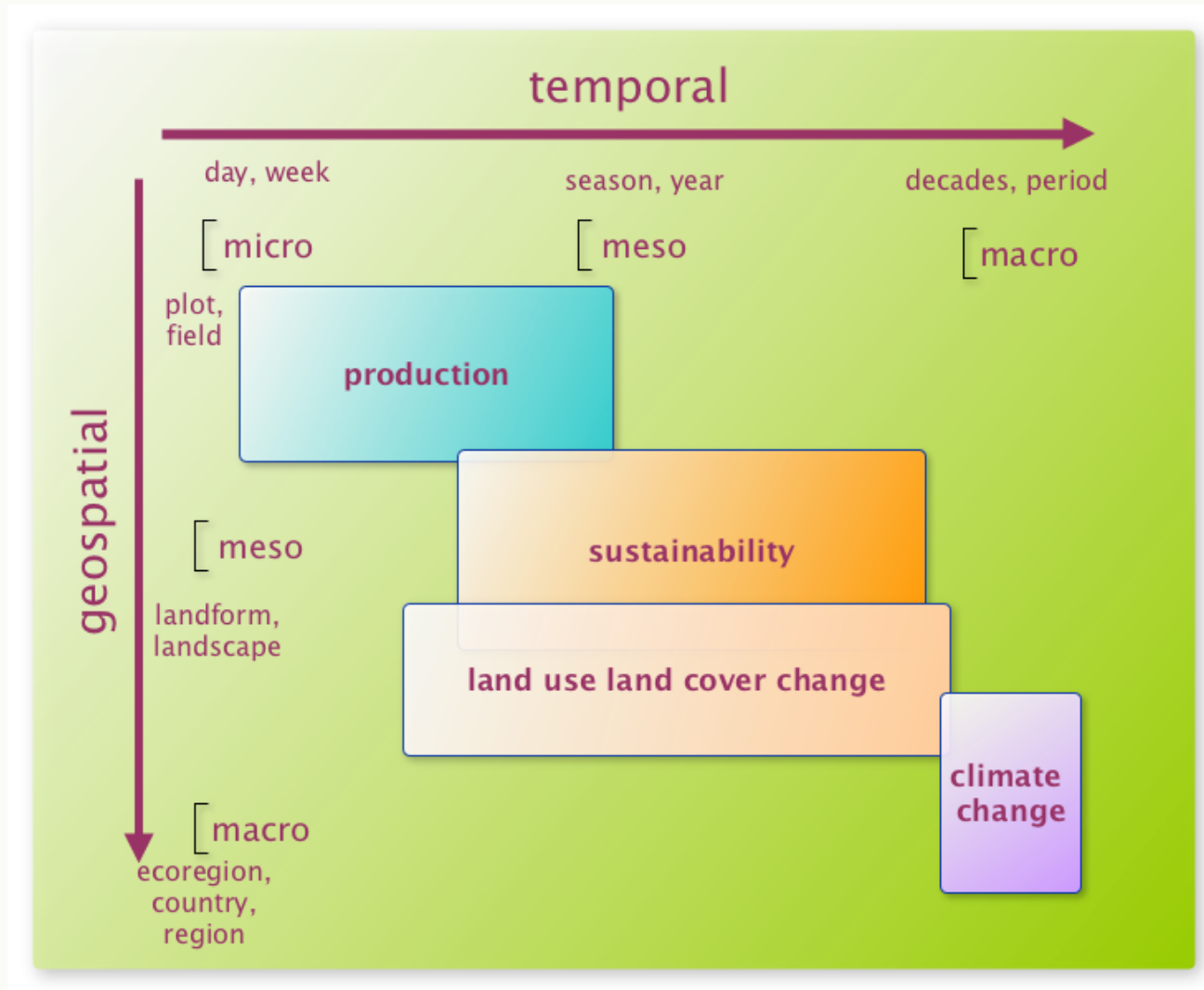
University of Nottingham, UK

GRASP

Geospatial Resource for Agricultural Species and Pests

Facilitating modelling from sharing data and processing

Spatio-temporal Agricultural modelling



The University of
Nottingham

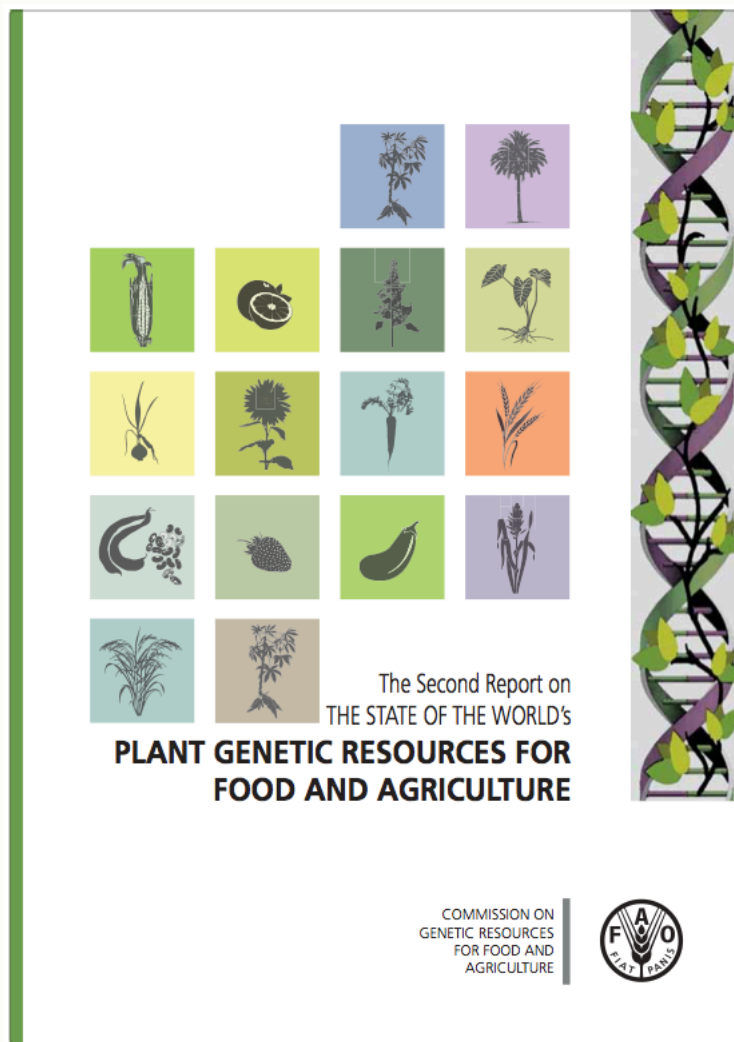
UNITED KINGDOM • CHINA • MALAYSIA

<http://aims.fao.org/activity/blog/agrigis-workshop-and-think-tank>



Regional Centre for
Mapping of Resources
for Development

The State of the World's Plant Genetic Resources for Food and Agriculture



1.2.3.2 Geographic Information Systems

New geographic methods are also proving to be of significant value in the management of plant genetic resources. Global Positioning Systems (GPS) are highly effective at pinpointing the exact location where a plant was collected in the field. Such data is invaluable, especially when combined with other georeferenced data, e.g. on topography, climate or soils, and analysed using GIS software. This information can greatly facilitate decisions on what to collect and where, and can help elucidate relationships between crop production, genetic diversity and various agro-ecological parameters. Such techniques can also be used to draw up agro-ecological models that can predict, for example, the impact of climate change on different crops and in different locations. These methods have demonstrated through the Focused Identification of Germplasm Strategy (FIGS) that they have a significant impact on the effectiveness and efficiency in 'mining' germplasm for specific adaptive traits for crop improvement.²⁵

No country report indicates the extent to which geographic information tools are available and used within the country concerned and most of the reports

a multidisciplinary project between

Crop sciences / Plant Sciences /Agronomy
& Geospatial Sciences

- genetic & phenotypic & trait information
- agricultural & environmental information
- geospatial architecture & data & models management

“Geospatial Resource for Agricultural Species and Pests with integrated workflow modelling to support Global Food Security (GRASP-GFS): a prototype”

BBSRC TRDF call 2 Support for Development of Bioinformatic Tools and Computational Approaches to the Biosciences 2013

“Geospatial Resource for Agricultural Species and Pests with integrated workflow modelling to support Global Food Security (GRASP-GFS)”



Interoperability from data integration to
geocomputational forecasts

Dr. Didier G Leibovici, Dr. Sam Meek, Dr. Suchith Anand,
Pr. Mike Jackson

University of Nottingham, Nottingham Geospatial Science

Dr. Rumiana Ray, Dr. Sean Mayes, Pr. Charlie Hodgman,
Pr. Sayed Azam-Ali

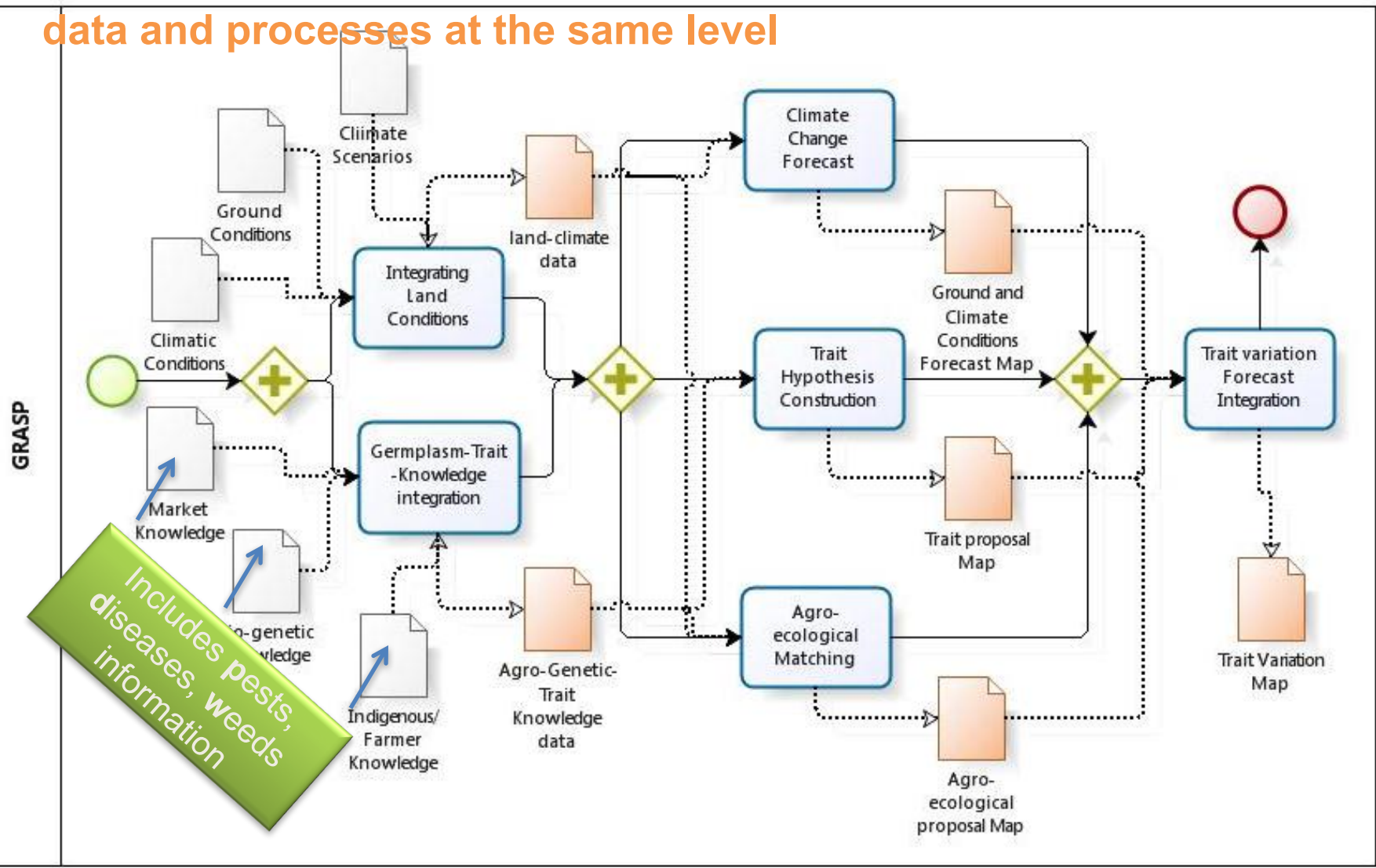
University of Nottingham, Crop Science / CPIB,
CFFRC (Malaysia)

and other partners UK, Australia,...

Generic workflow of the GRASP project

use and reuse of available information

data and processes at the same level



eGRASP = Spatial Data Infrastructure

- A Database (GeogermplasmDB) → genotypic variations

CropStoreDB + OpenGIS (using PostGIS)

- a workflow composition tool (wAT) → used for crop modelling

e.g. coupling a disease model with APSIM

- a simulation approach for quality & error propagation → metadata & decision

-classical error propagation

(multiple-run of the workflow)

-meta-propagation of uncertainty

(running the workflow on quality informatio)

major crops (wheat) and underutilised crop (Bambara groundnut)

geogermplasmDB



OGC
Making location count.

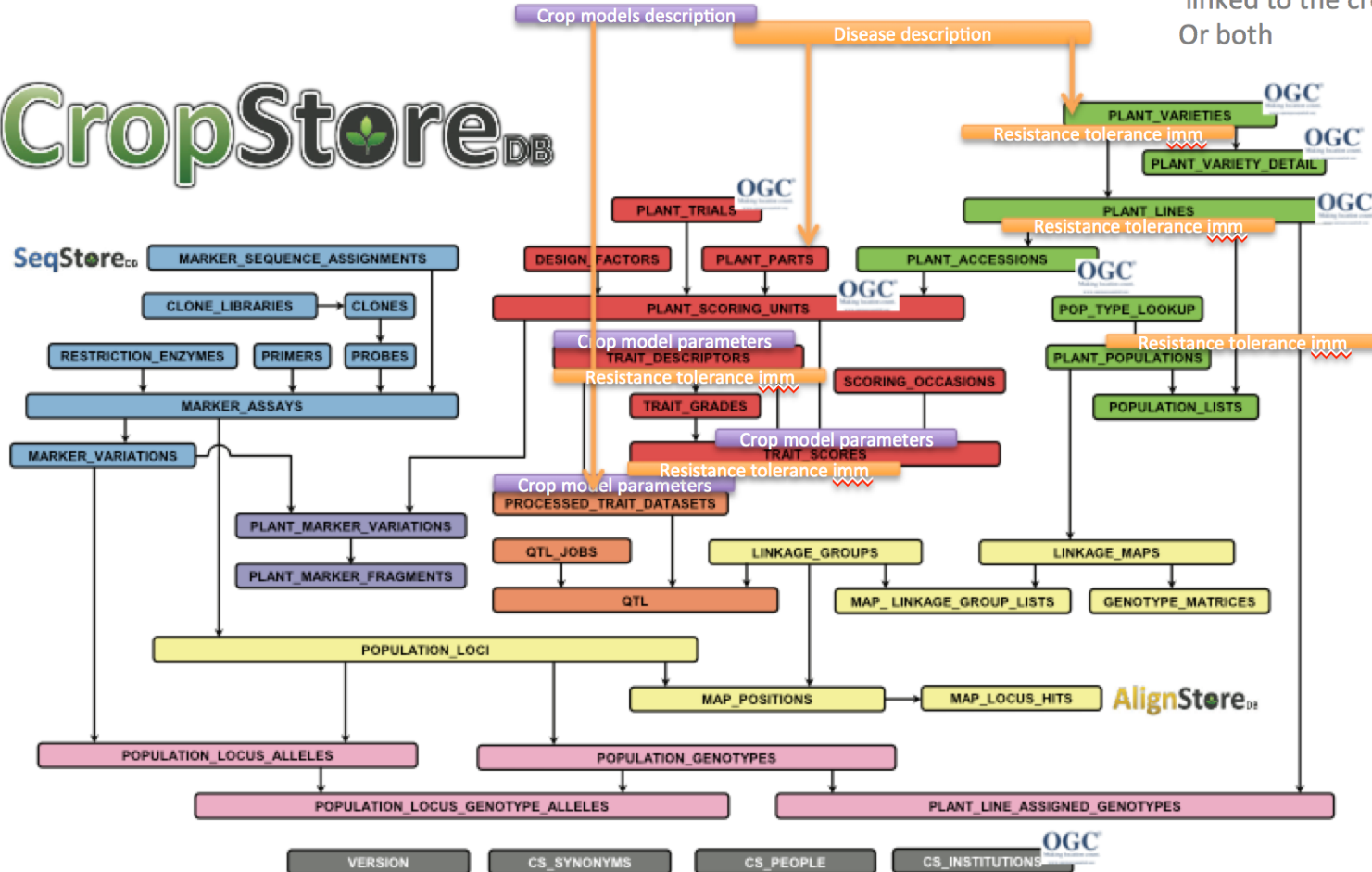
geometry field (as in PostGIS DBMS)
spatial inclusion /scale
e.g. geom in plant scoring unit
included the geom from plant trials
(but not compulsory)
see also mixed geometry

Disease
description

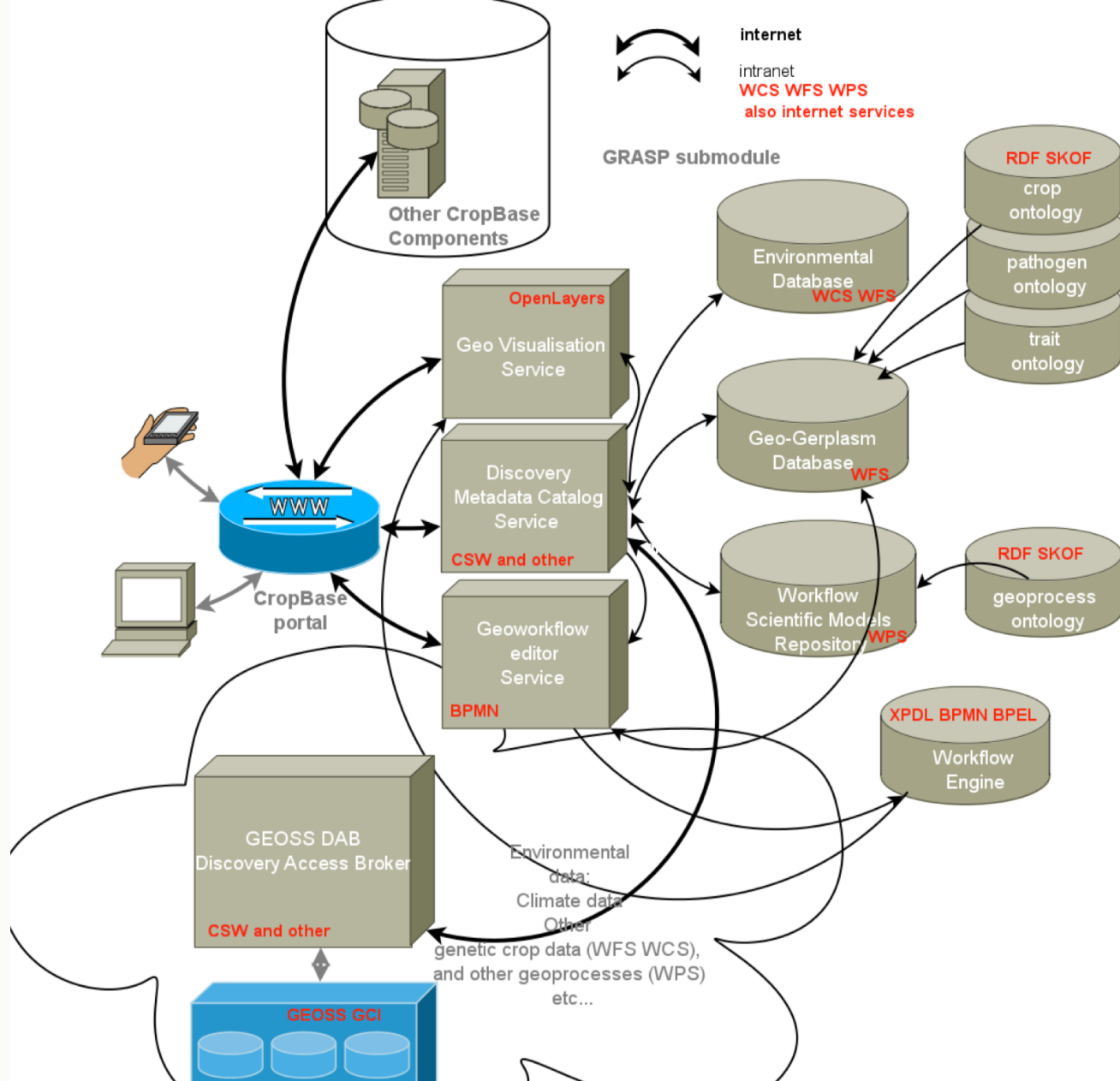
Crop model
description
(parameters for
aguacrop, APSIM)

As fields in trait descriptors
(with scoring method being
linked to the crop model)
Or processed trait datasets
(with stats analysis description
linked to the crop model)
Or both

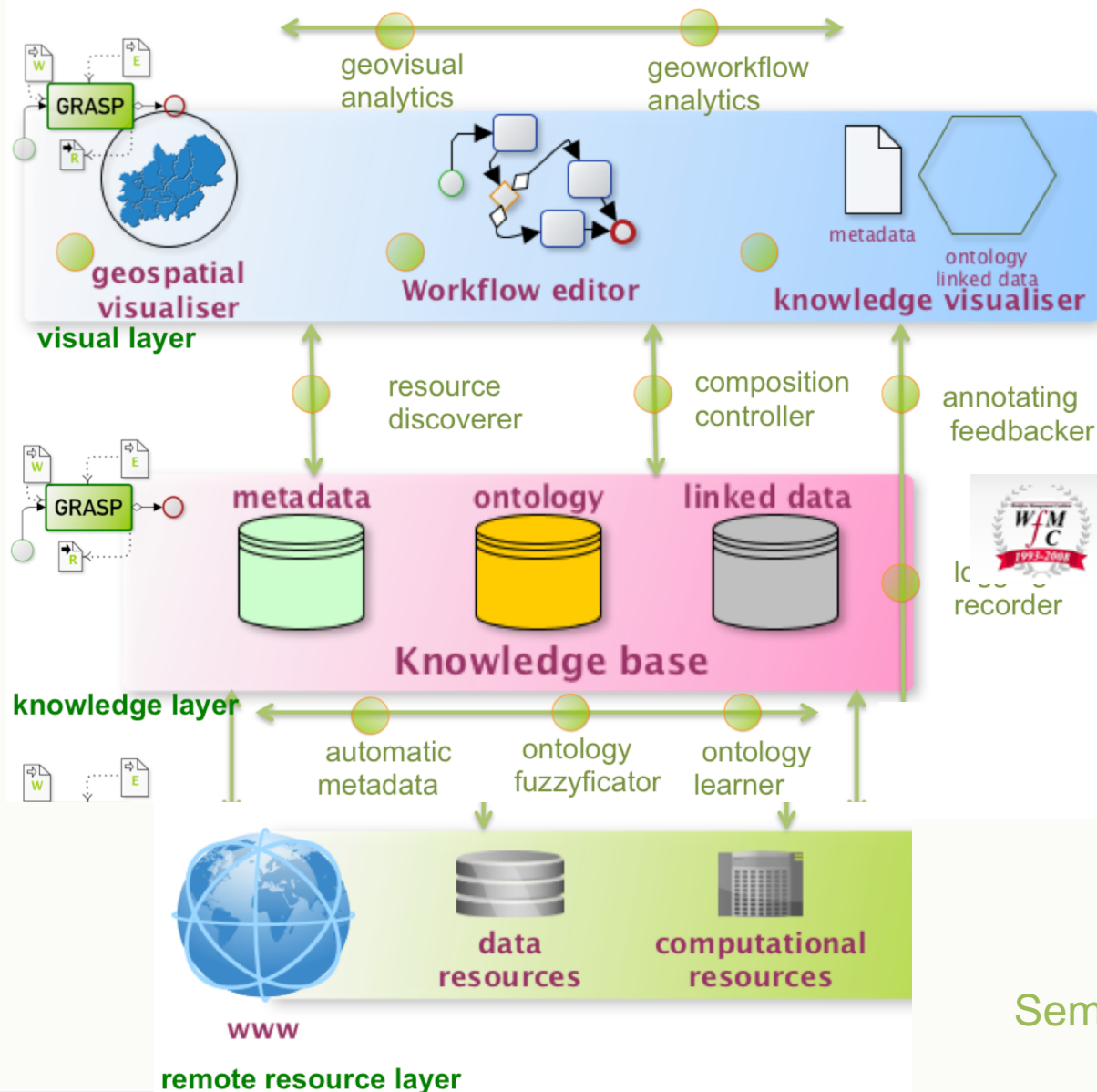
CropStore_{DB}



eGRASP platform architecture



Workflow composition of Data & Processes



OGC[®]
Open Geospatial Consortium, Inc.

ISO ISO/TC 211
Geographic information/Geomatics

WPS, WFS, WCS
CSW ...



WORKFLOW



COALITION

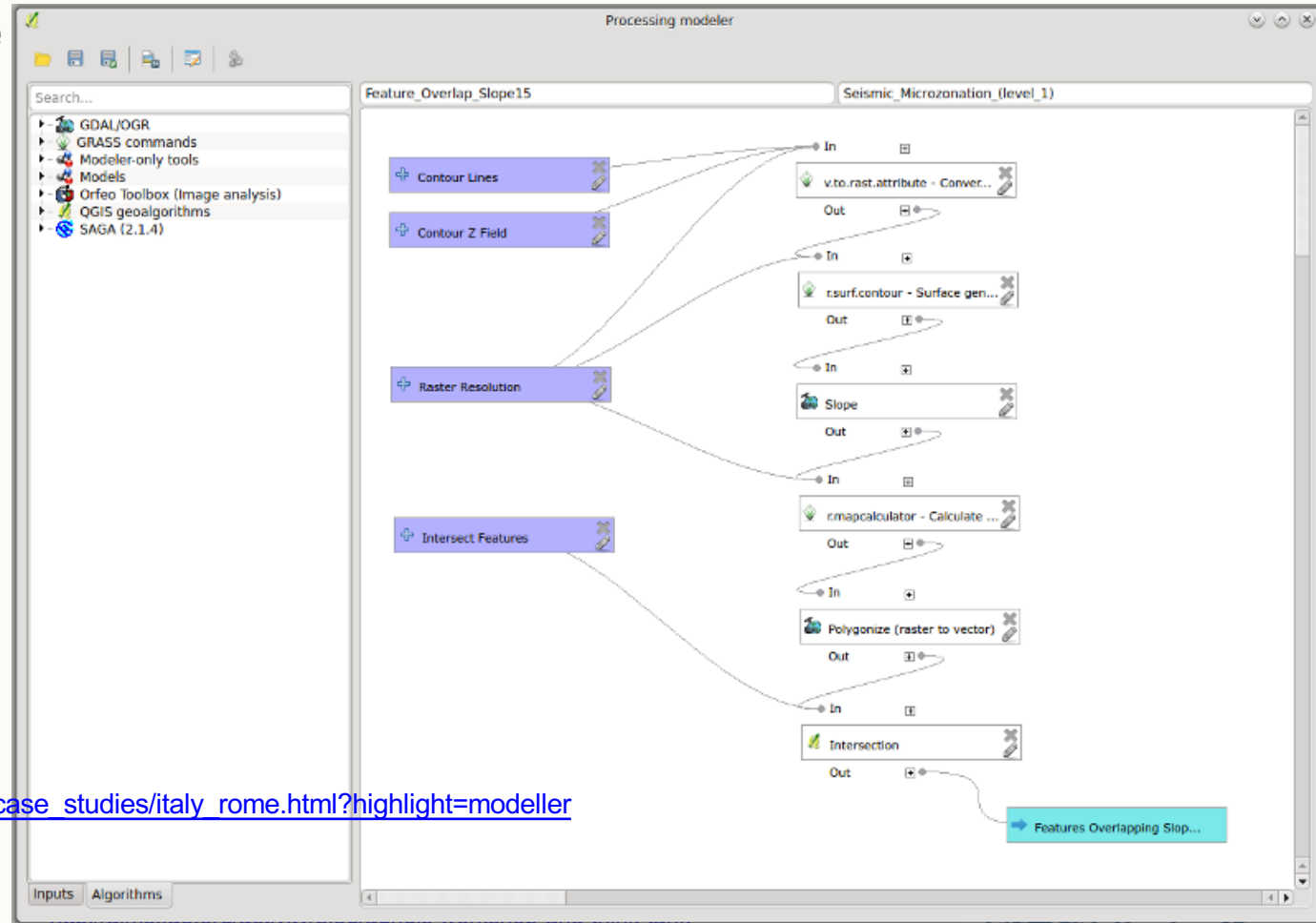
BPMN 2.0



Semantic Framework...RDF

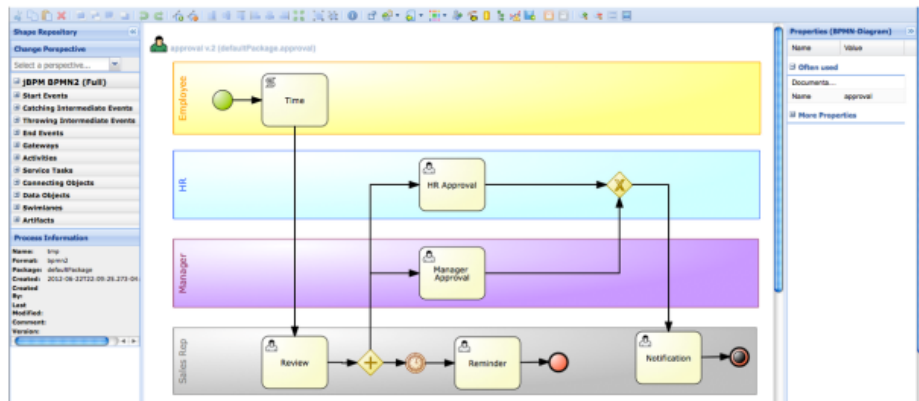
QGIS Graphical modeler

- Useful for chaining and workflow of GIS operations/transformations
- Less for Scientific modelling such as crop modelling unless you register WPSs
- Doesn't use the



http://www.qgis.org/en/site/about/case_studies/italy_rome.html?highlight=modeler

Workflow editor & Workflow engine



Web-based process editing is possible using the jBPM5 Designer. The designer is fully integrated into Drools repository where you can store all your BPM assets such as of course your BPMN2 processes as well as rule configurations and process forms. The Designer can be used to create, view or update BPMN2 processes.

BPMN 2.0



WORKFLOW MANAGEMENT COALITION



- **wAT**
workflow Authoring Tool
for OGC services
(WPS)
- **WPS**
flexibility for geoprocessing
registration in wAT



wAT web editor for WPS services

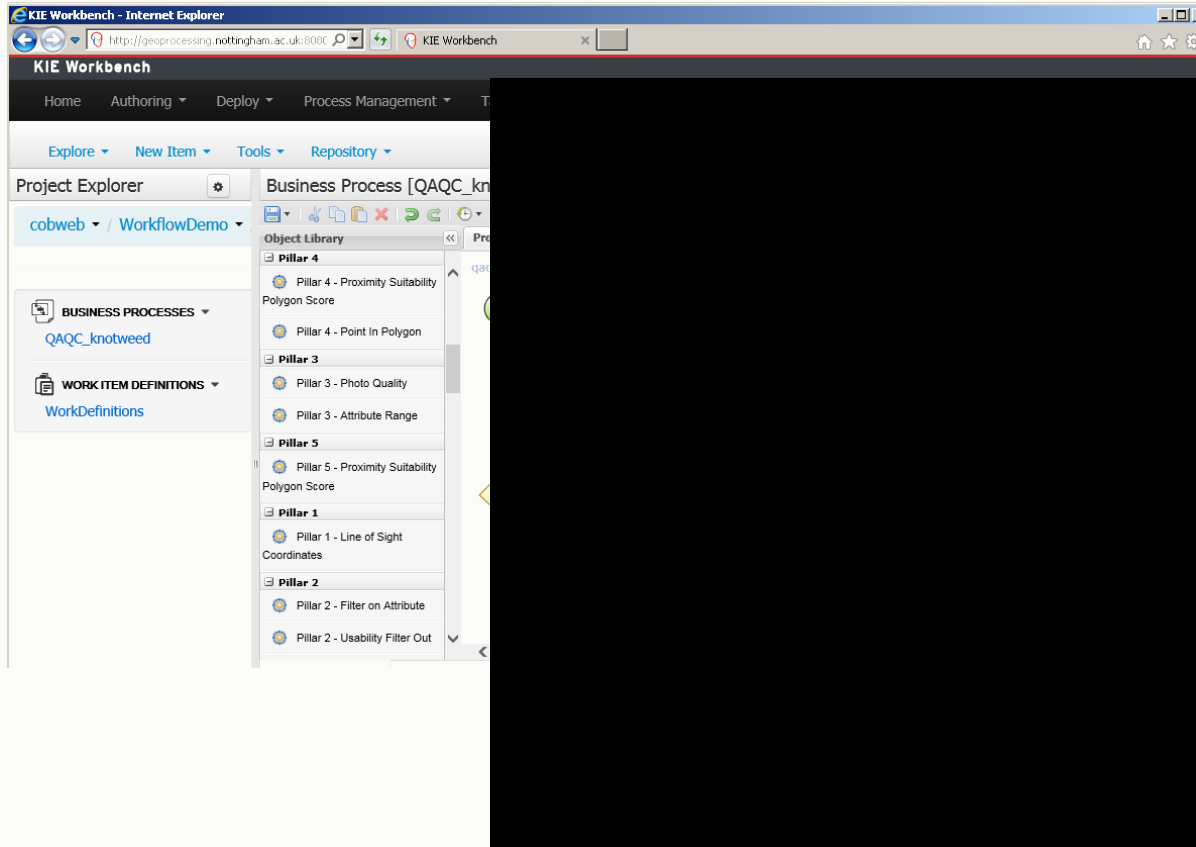
drag & drop

Instantiate

run

Examples of a workflows for Quality Assurance of crowdsourced data and ... Weight of Evidence flooding extent estimation

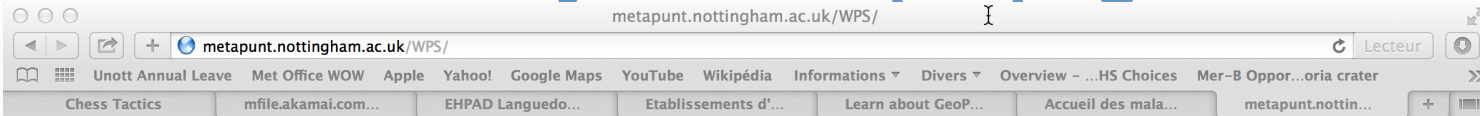
wAT web editor for WPS services



- drag & drop
- Instantiate
- run

Examples of a workflows for Quality Assurance of crowdsourced data
Weight of Evidence flooding extent estimation

Quality & error propagation



MetaPunt

An Open Source tool for Meta-Propagation of uncertainties in Geospatial Processing

A Contribution to the [FP7 EuroGEOSS](#) European project from the [\(Centre for Geospatial Science\) Nottingham Geospatial Institute](#)

Dr Didier G. Leibovici & Dr Amir Pourabdollah

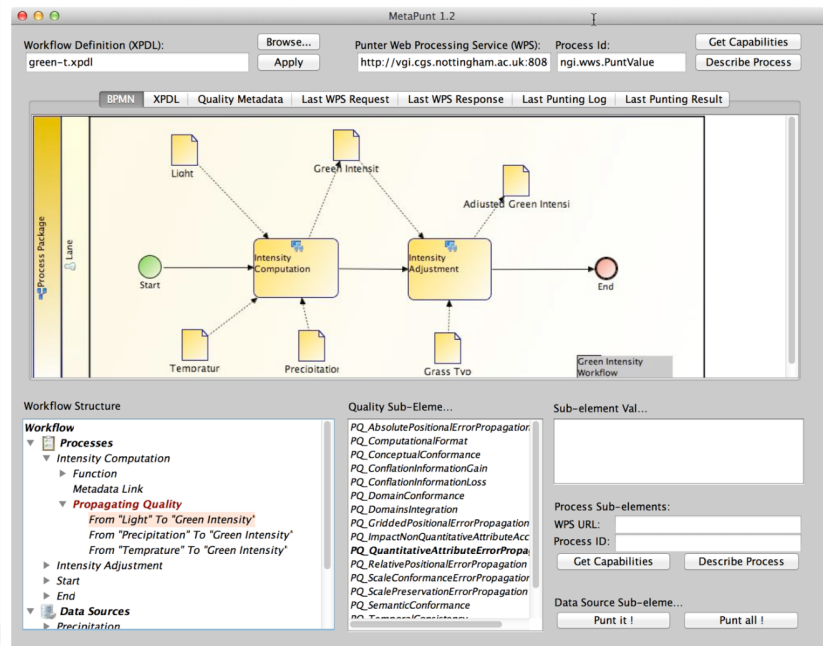
[Download MetaPunt 1.2 Desktop Application](#)

[Download System Documents](#)

[OGC's WPS \(Web Processing Service\): Get Capabilities](#)

[DescribeProcess PuntValue\(single\)](#)

[Source Code \(Eclipse project\)](#)



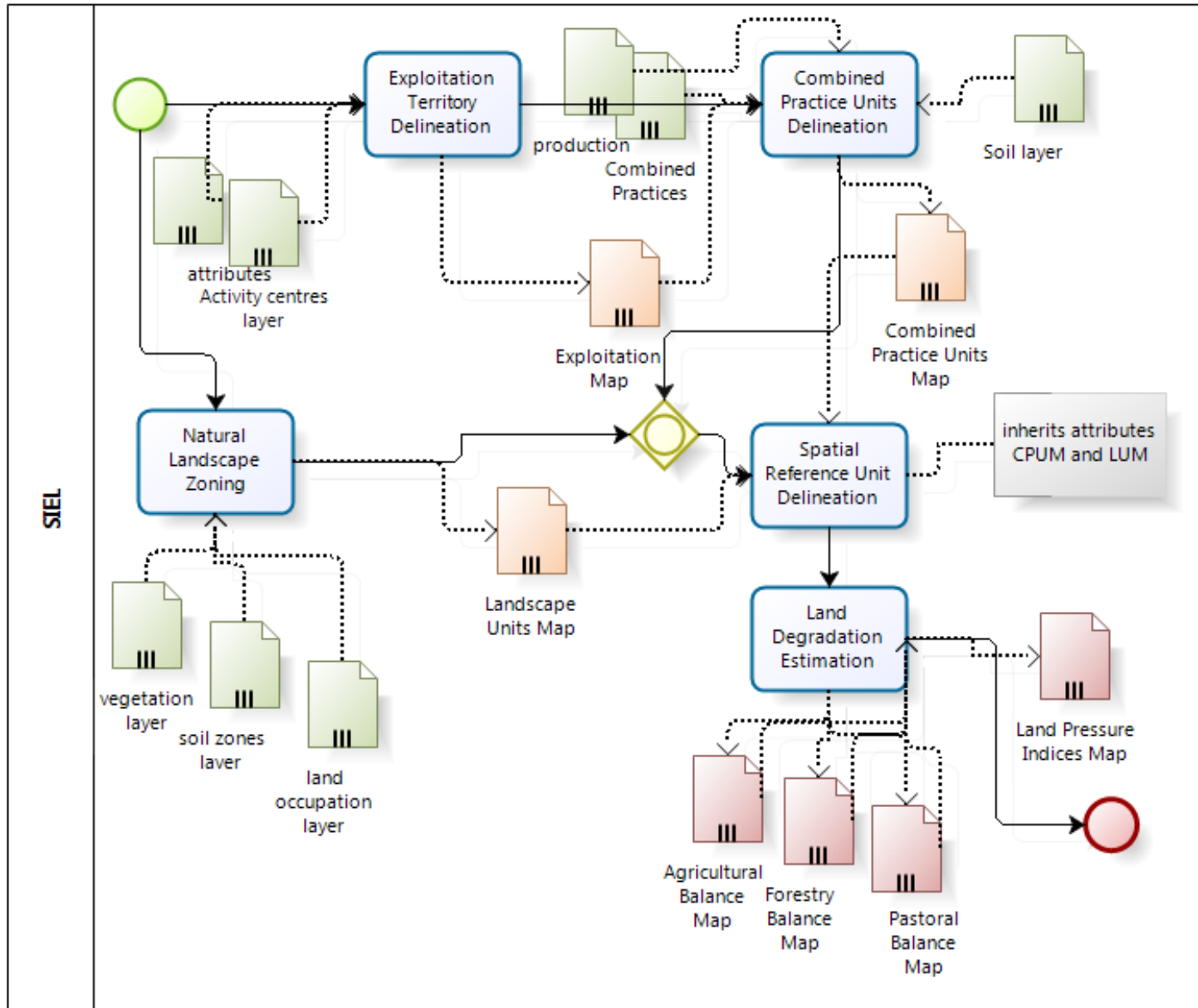
Where really
Datasets & GeoProcessing
are on equal footing!

*Leibovici et al. 2011 EGU, 2013
Journal of Spatial Science*

last updated 5th of July 2012



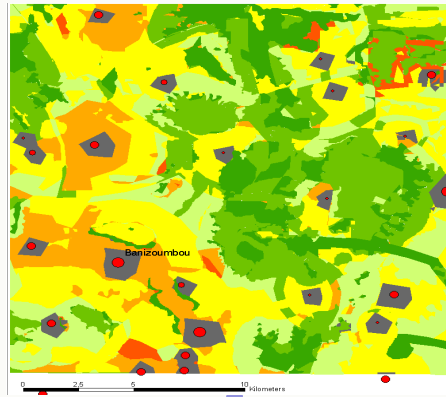
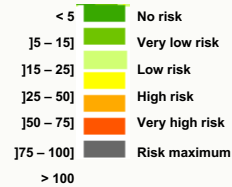
Land Degradation / Sustainable Agriculture



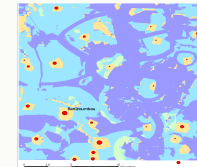
SIEL LEIS

Banizoumbou (NER)

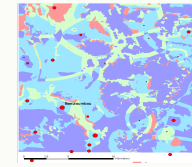
Representative of an
extensive agro-
pastoral system in
sahelian zone



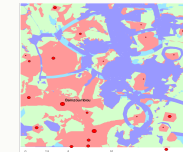
Vegetation Balances by usage



agricole Usage

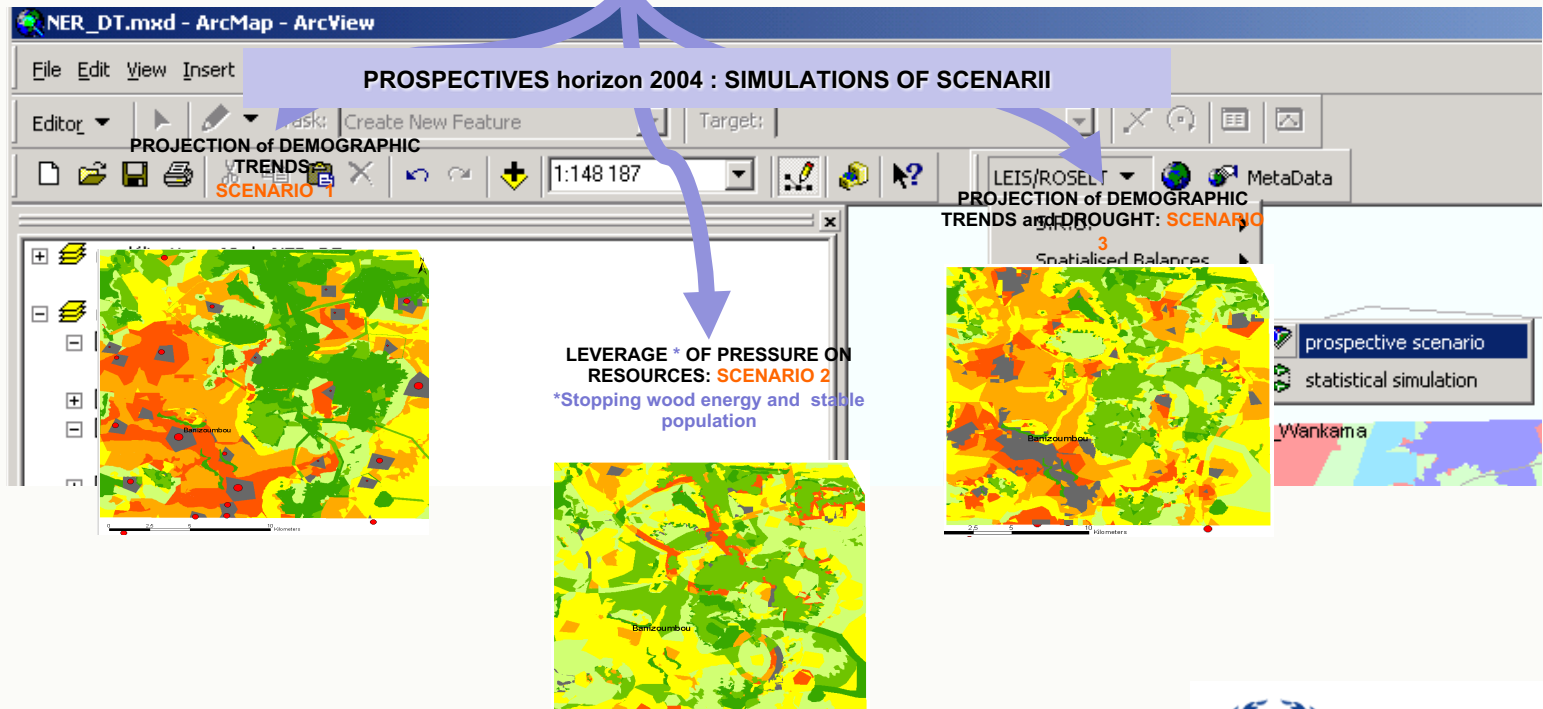
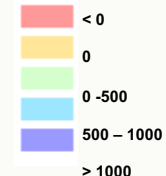


pastoral Usage



wood Usage

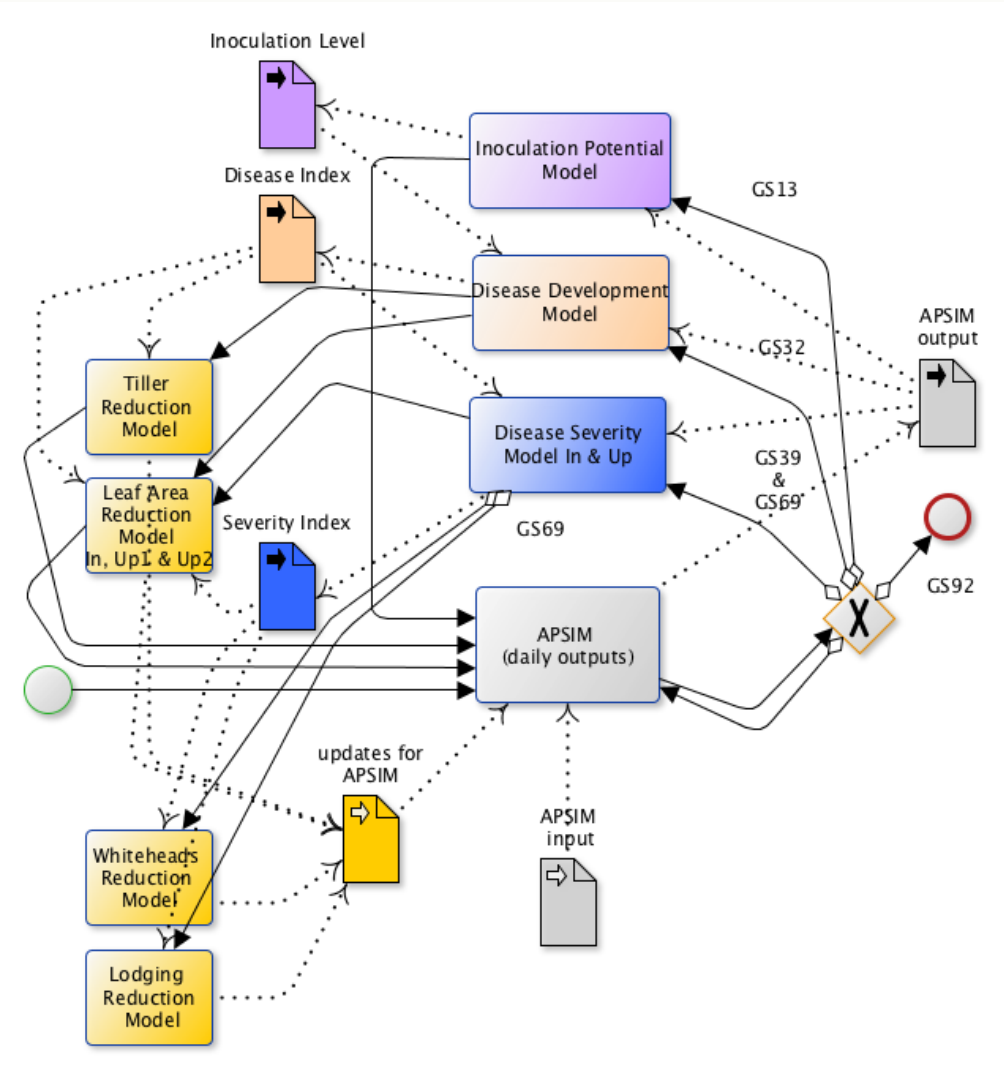
(Disponibility – Extraction in kg DM /ha)



eGRASP platform current and projects

- PhDs
 - Roberto Santos *Genetic and Environmental information (see next)*
 - Masoud Al –Azri *Disease modelling & crop growth integration*
 - Dai Huynh *Crowdsourcing under-utilised crops*
- **GRASP2gfs** GCRF-BBR proposal (Nov 2016):
Geospatial Resource for Agriculture Species and Pests with workflow e-infrastructure to support Global Food Security modelling simulations (GRASP2gfs)
- AgriGIS workshop & think tank (Nairobi 27-28 Oct 2016)
<http://opensourcegeospatial.icaci.org/2016/10/agrigis-workshop-and-think-tank-meetings-in-nairobi/>

Eyespot disease (wheat)



<http://www.fao.org/docrep/013/i1500e/i1500e.pdf>
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geogermplasmDB



OGC
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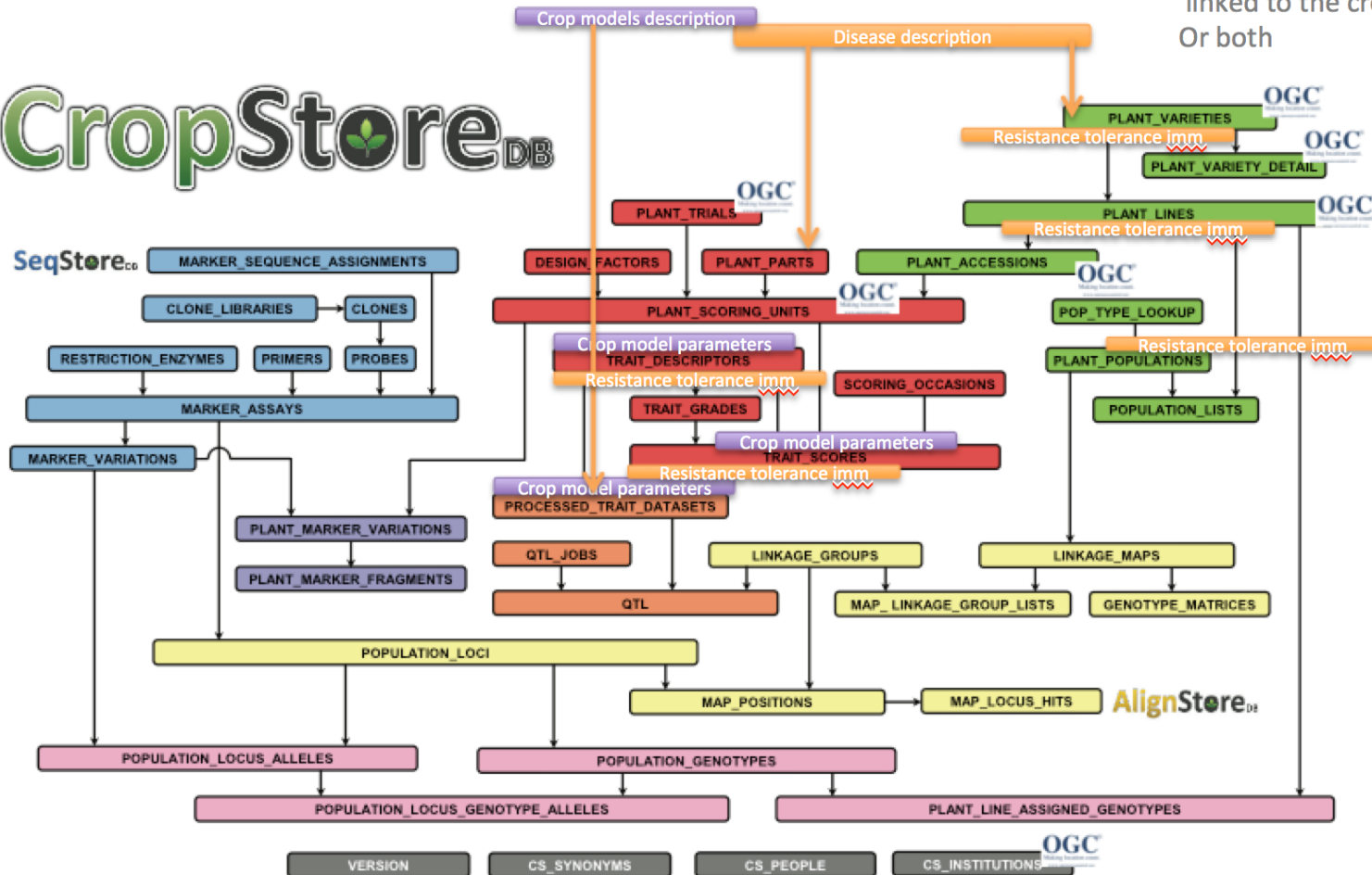
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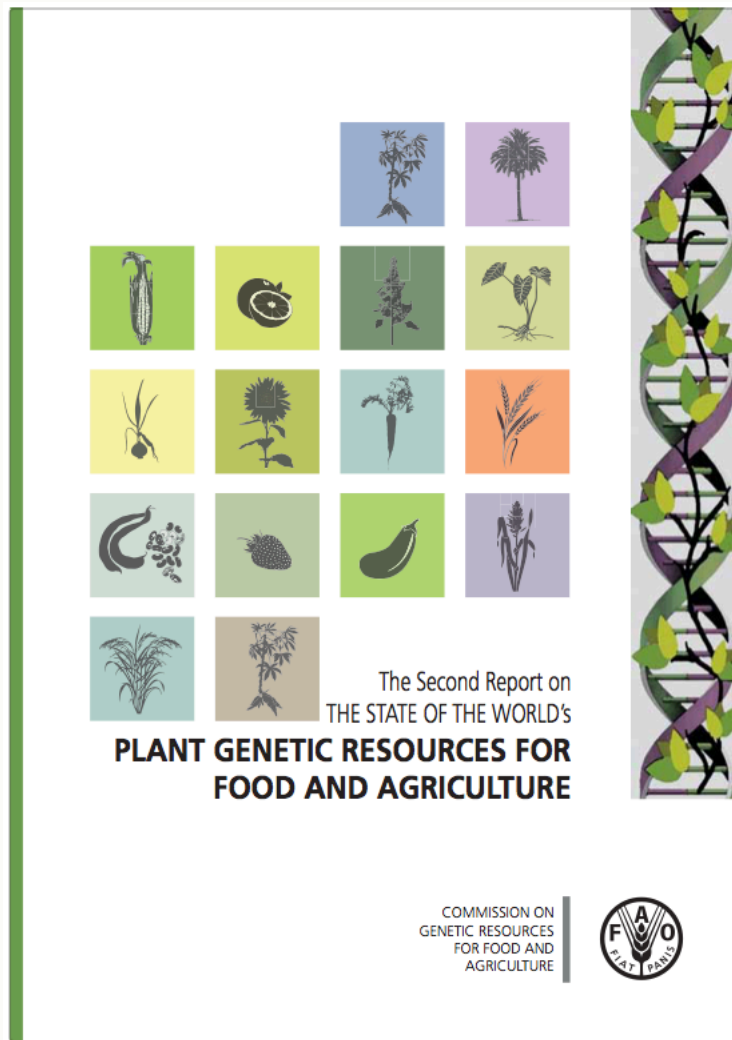
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Spatial Patterns in the genetic variation of Bambara groundnut



How environmental and anthropocentric factors affected the genetic variation of Bambara groundnut?

Approach: molecular markers, environmental data and linguistic data;

Spatial Patterns in the genetic variation of Bambara groundnut

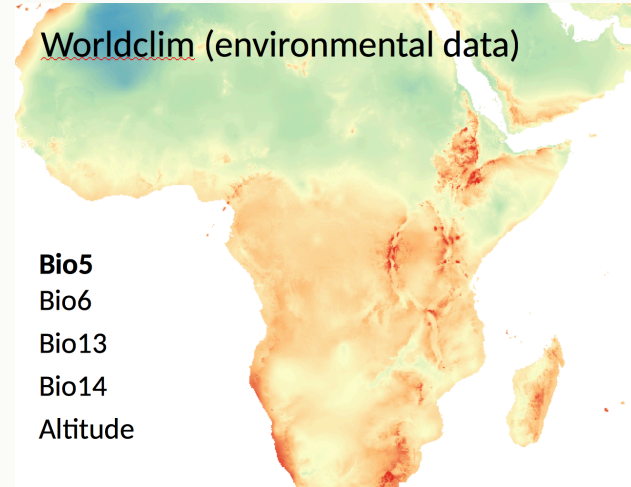
Single Sequence Repeats Markers or
Microsatellites

Plant A ... C A G T A G T T **A T G** A C ... (1 repetition)
 Plant B ... C A G T A **A T G A T G** A C ... (2 repetitions)
 Plant C ... C A **A T G A T G A T G** A C ... (3 repetitions)

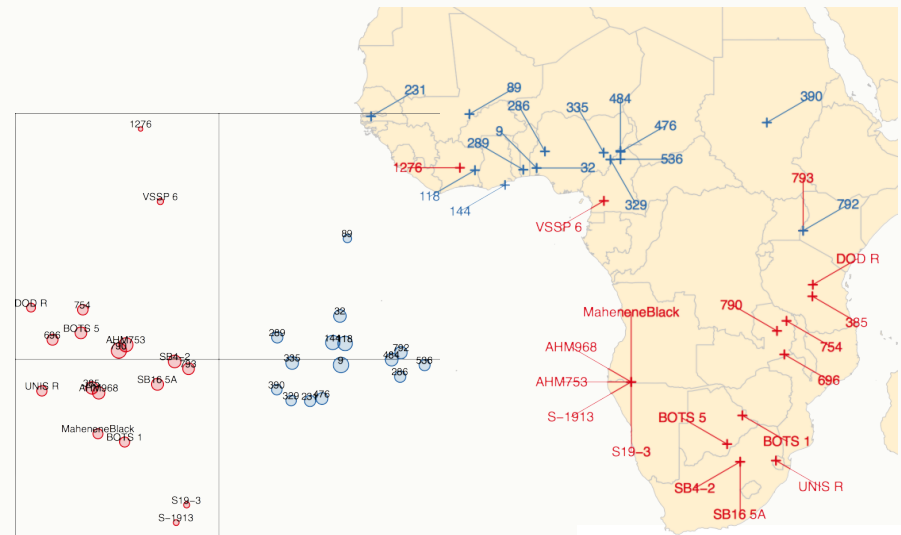
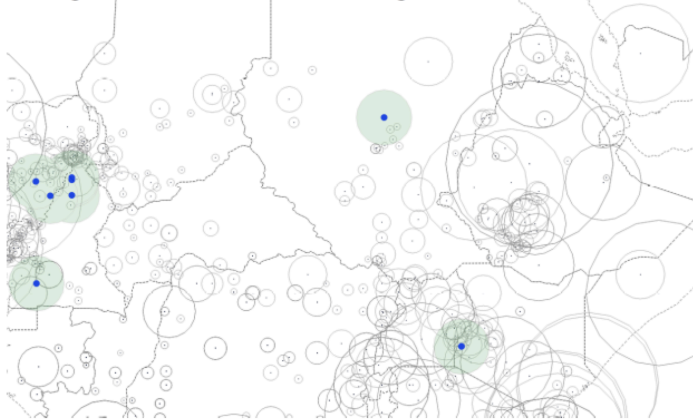
SSRs are most found between genes and
usually do not alter proteins / functions

Worldclim (environmental data)

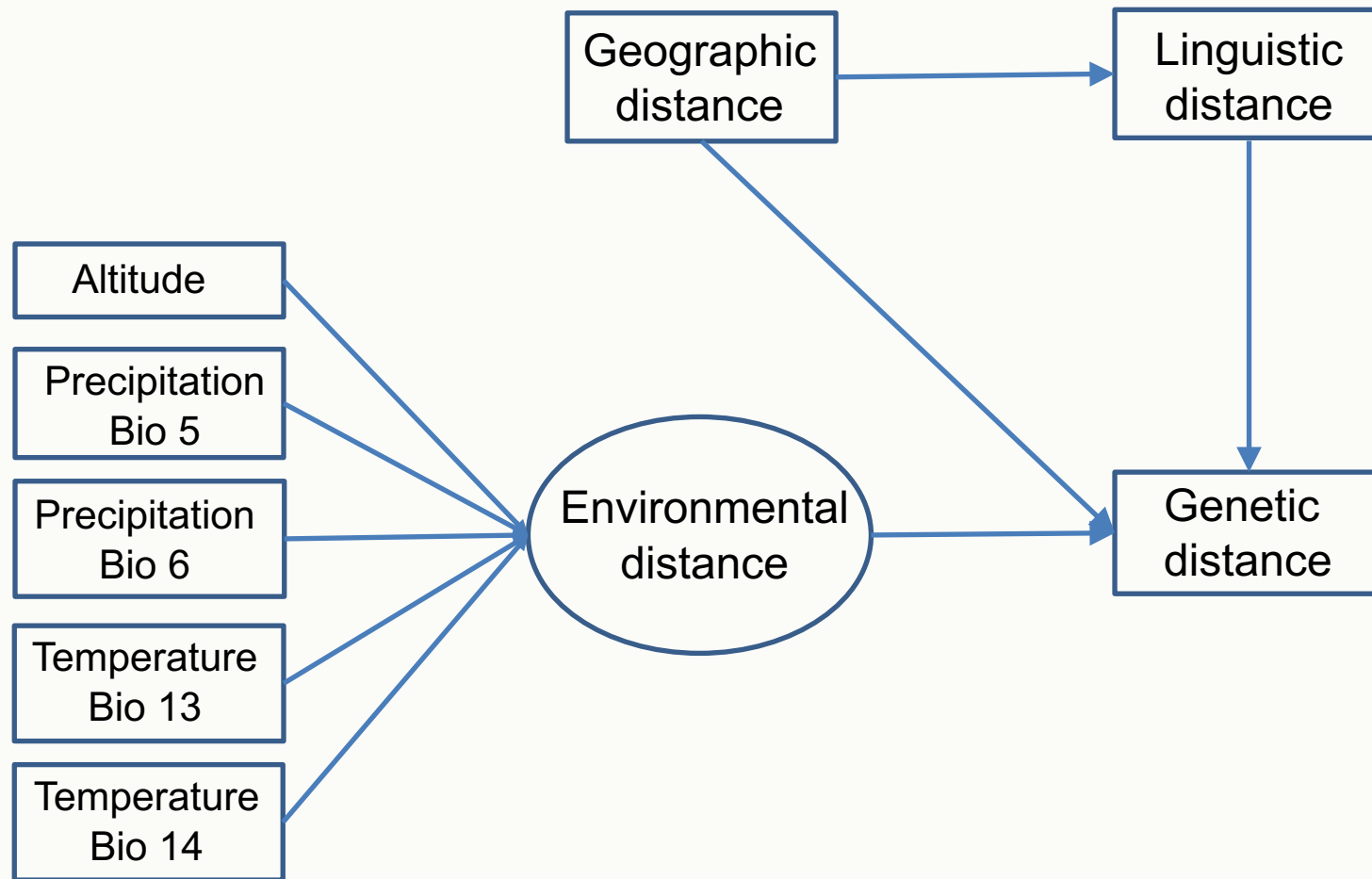
Bio5
 Bio6
 Bio13
 Bio14
 Altitude



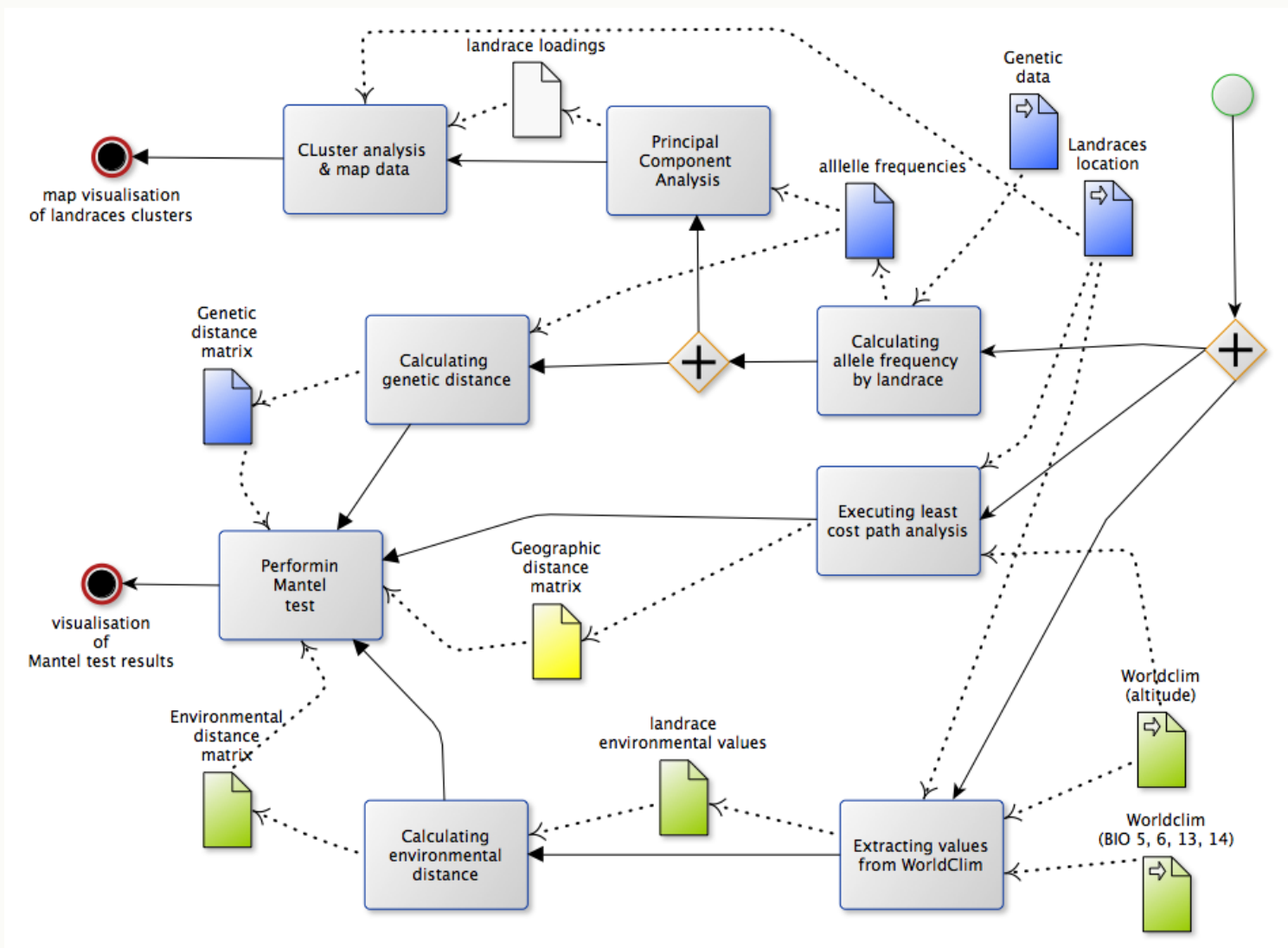
Automated Similarity Judgment
Program database (linguistic data)

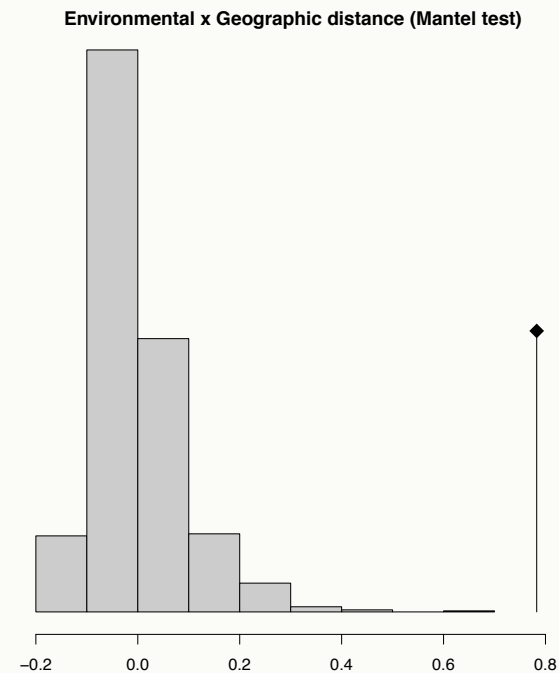
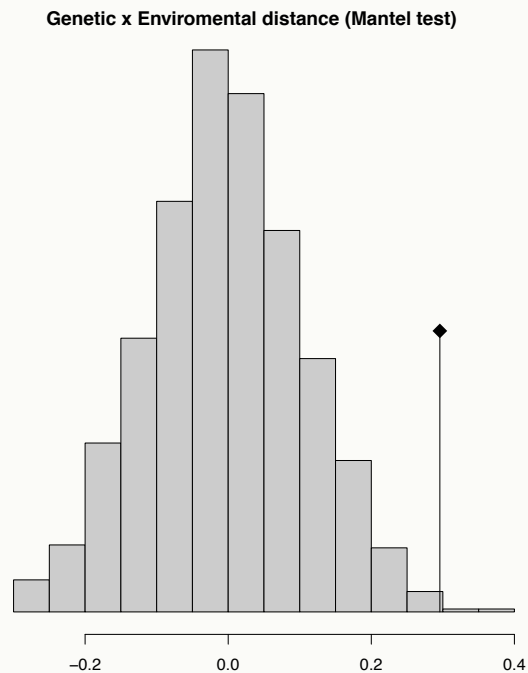
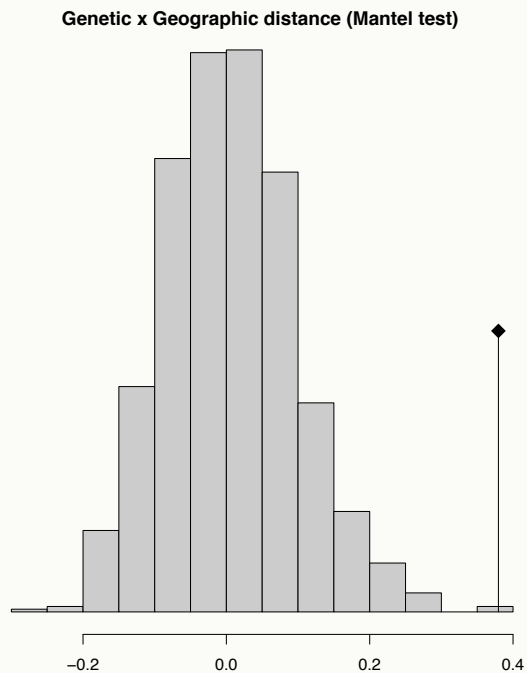


Spatial Patterns in the genetic variation of Bambara groundnut



Same seen as a BPMN workflow





Function mantel, package ade4 (R)

PhD Dai Huynh: Crowdsourcing under-utilised crops
example of Moringa crop

- The greatest body of **knowledge** often lies with the farmers who have grown the crops.
- **Crowdsourcing** is a potential method to collect such knowledge (data).
- How can the **quality** of crowdsourced data be assessed in situations where there is **no or limited ground-truth**?
- Proposed approach: assessing thematic quality (knowledge) of contributor as a **proxy** for quality of data.

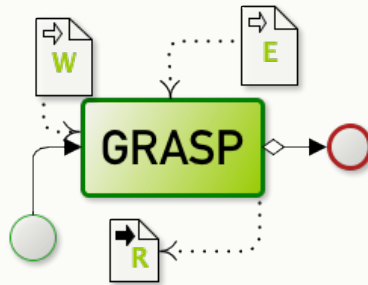
GRASP2gfs project proposal

- *Geospatial Resource for Agriculture Species and Pests with workflow e-infrastructure to support Global Food Security modelling simulations (GRASP2gfs)*

- (i) . The **GRASP2gfs GeoGermplasmDB** initiated will be consolidated and expanded with new data assembled from existing and funded experiments. Links with the GODAN² initiative will foster the rest of the community towards sharing this type of data via the GRASP2gfs platform within a open paradigm.
- (ii) . The **GRASP2gfs metadata catalog** facilitating discovery of the geogermplasmDB data will be enhanced with searching and selection on multiple criteria including spatial origin, genotype, trait and variety. Information on crop disease and model parameters will be enabled and searchable. This will allow the community to register their available resources, data, processes and models that follows interoperability standards³, enabling any member of the community to use this sharing environment for modelling and simulations.
- (iii) . The **GRASP2gfs workflow capacity** already designed⁴ will be deployed to allow simulations using the GeoGermplasmDB within registered processes or models with complementary data harvested from the dynamic catalog.

eGRASP platform status

- Still lots of *stiches* to do and better interfacing
- The design and principles are there
- Would allow scenario / simulations etc...



Workflow Research Environment