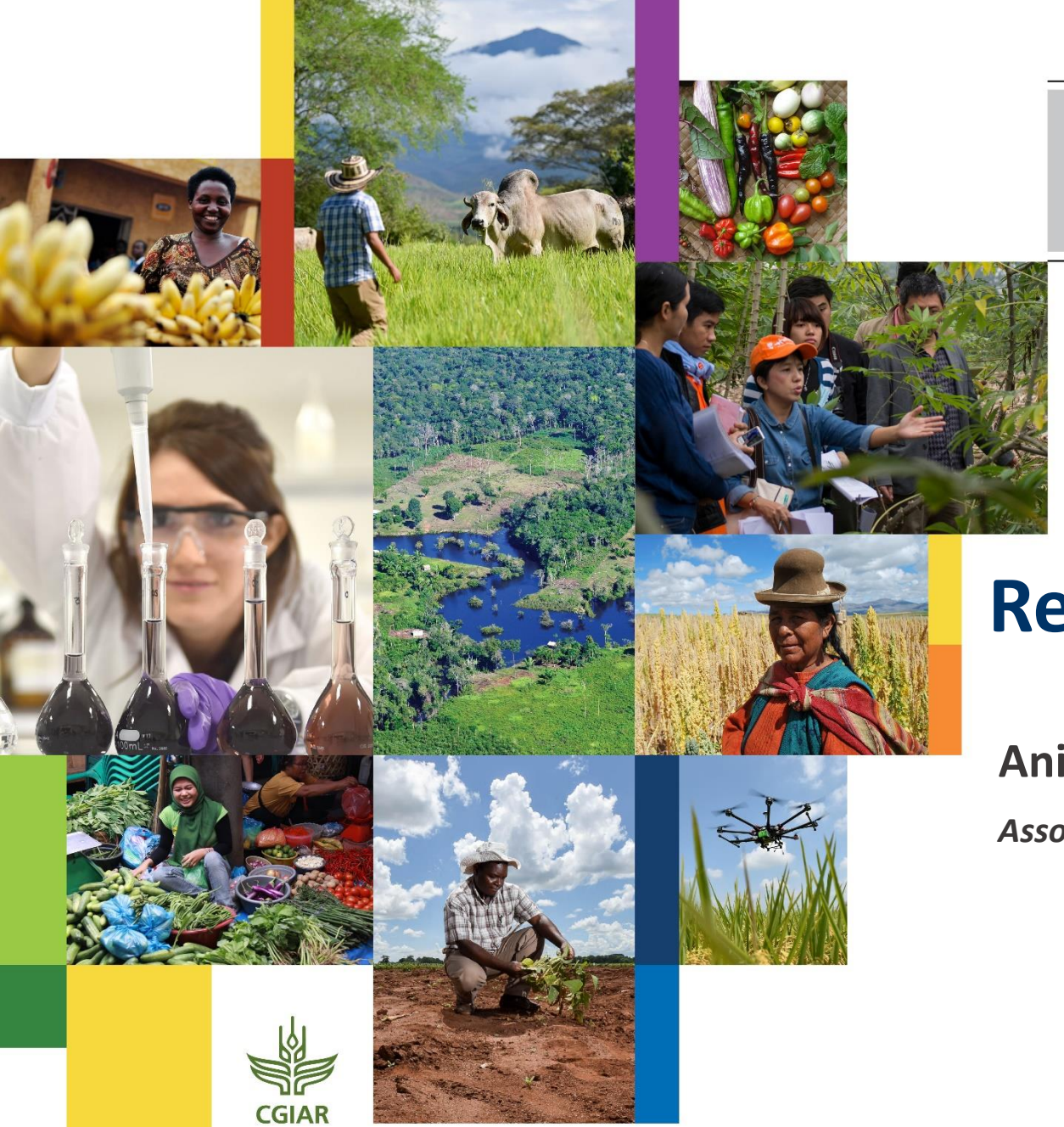


Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Remote Sensing with terra

Ani Ghosh

Associate Scientist

CGIAR

Bioversity International and the International Center for Tropical Agriculture (CIAT) are CGIAR Research Centers.
CGIAR is a global research partnership for a food-secure future.

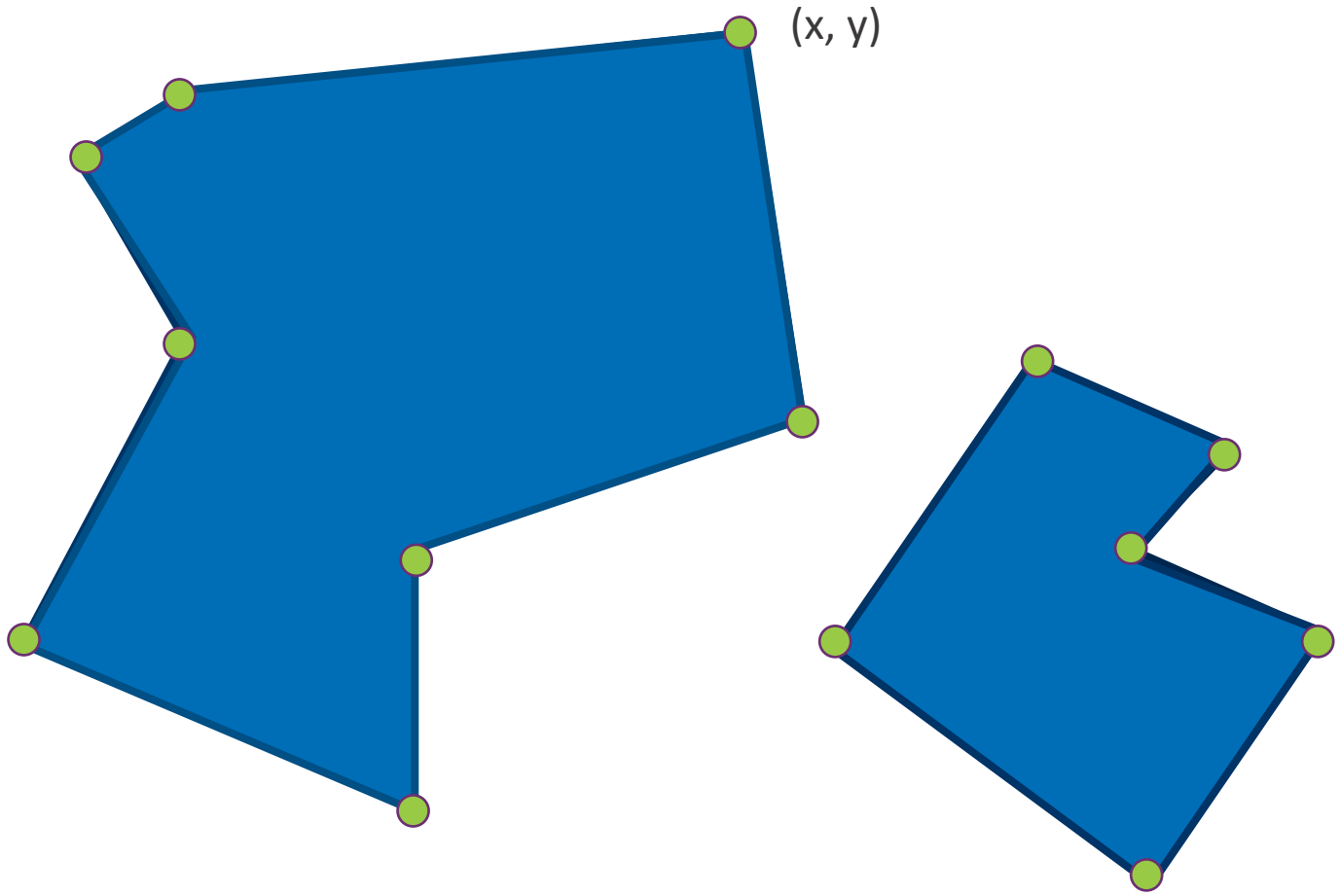
New to spatial data?

Objects

Discrete entities, defined by coordinates

points, lines, areas

typically represented as *vector*



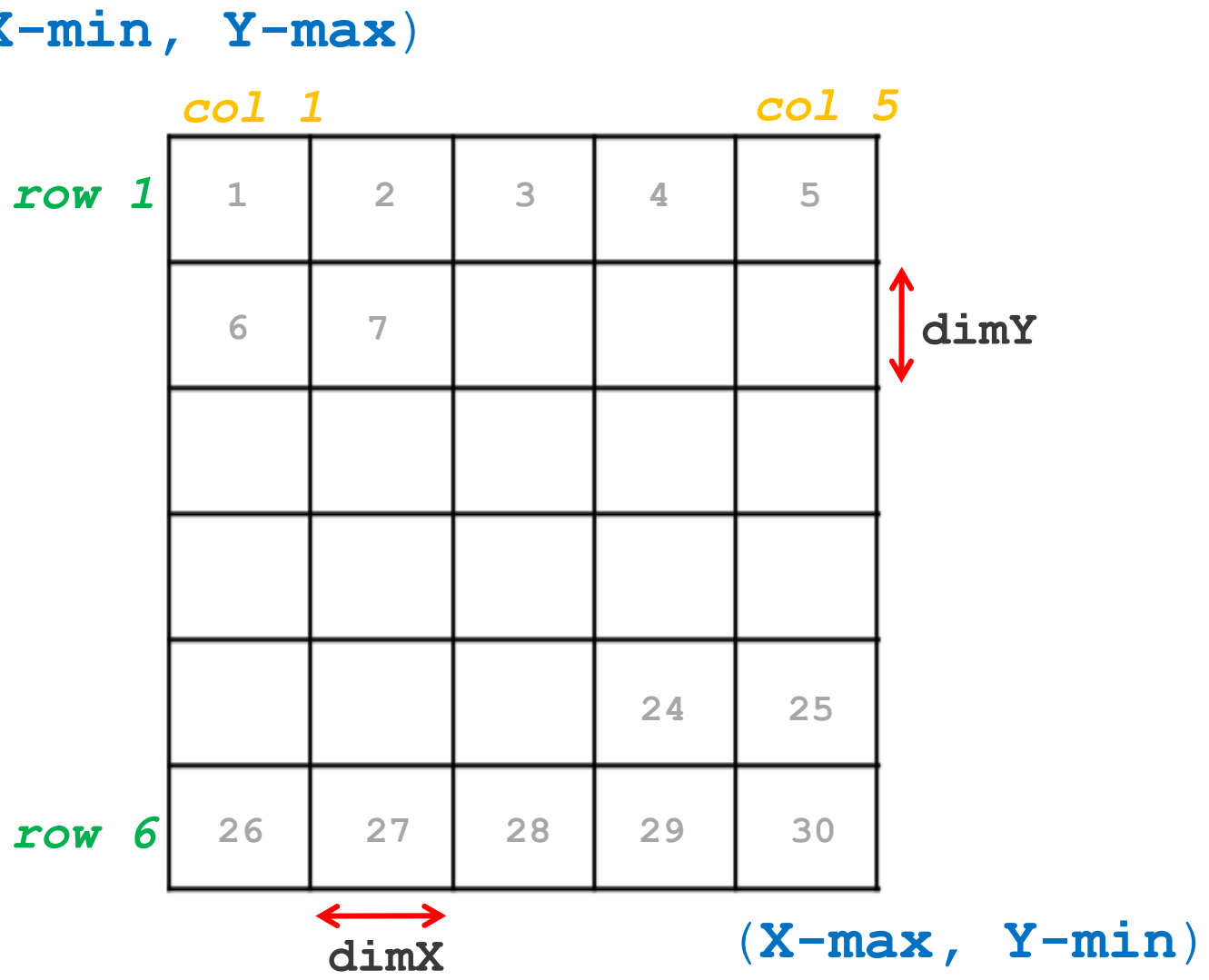
Slide credit Robert Hijmans

New to spatial data?

Fields

Continuously varying properties

typically represented as *raster*



Slide credit Robert Hijmans

Spatial data packages in R

```
library(rgdal)
library(sp)
library(raster)
```

```
library(rgdal)
library(sf)
library(terra)
```

Slide credit Robert Hijmans

raster package

The good

- No file size restrictions
- 200 functions to manipulate raster and vector data
- Simple to use
- Easy integration with machine learning
- Mature and large user community

Slide credit Robert Hijmans

raster package

The bad

- 200 functions to manipulate raster and vector data
- Unnecessarily complex `(RasterLayer, RasterStack, RasterBrick)`
- Cannot repurpose code (R only)

Slide credit Robert Hijmans

raster package

The ugly

- Too slow *(it's complicated to know why it is slow!)*
- Cannot read HDF5 files (*have you processed MODIS data with raster?*)

Slide credit Robert Hijmans

terra

Like raster, but

- faster
- simpler
- more capable
- read HDF5, read COG *(what's that)*

`terra: Spatial Data Analysis`

Methods for spatial data analysis, especially raster data. Methods allow for low-level data manipulation as well as high-level global, local, zonal, and fc regression type (interpolation, machine learning) models for spatial prediction. Processing of very large files is supported. See the manual and tutorials package; but 'terra' is simpler, better, and faster.

Version:	1.0-10
Depends:	R (≥ 3.5.0)
Imports:	methods, Rcpp, raster (≥ 3.3-7)
LinkingTo:	Rcpp
Suggests:	parallel, tinytest, ncdf4
Published:	2021-01-22
Author:	Robert J. Hijmans [cre, aut], Roger Bivand [ctb], Karl Forner [ctb], Jeroen Ooms [ctb], Edzer Pebesma [ctb]
Maintainer:	Robert J. Hijmans <r.hijmans at gmail.com>
BugReports:	https://github.com/rspatial/terra/issues/
License:	GPL (≥ 3)
URL:	https://rspatial.org/terra
NeedsCompilation:	yes
SystemRequirements:	C++11, GDAL (>= 3.0.4), GEOS (>= 3.8.0), PROJ (>= 6.3.1)
Materials:	NEWS
In views:	Spatial
CRAN checks:	terra results

terra

New data classes

- SpatRaster → Replaces layer/stack/brick
- SpatVector → Spatial vector
- SpatExtent → Replaces extent
- SpatRasterDataset
- SpatRasterCollection/ SpatVectorCollection

} New classes

terra

New data classes

- SpatRaster → Replaces layer/stack/brick
- SpatVector → Spatial vector
- SpatExtent → Replaces extent
- SpatRasterDataset
- SpatRasterCollection/ SpatVectorCollection

} New classes

terra

New functions/names

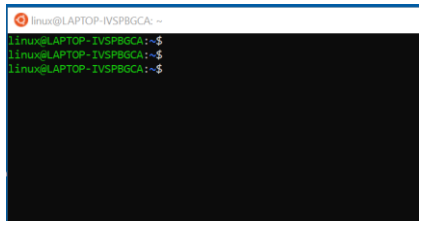
? terra

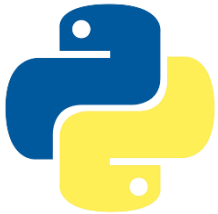
raster package	terra package
raster, brick, stack	rast
rasterFromXYZ	rast(, type="xyz")
stack, addLayer (combining Raster* objects or files)	c
addLayer	add<-
extent	ext
calc	app and arith
overlay	lapp
stackApply	tapp
extend	expand
nlayers	nlyr
NAvalue	NAflag
stackSelect	selectRange
reclassify, subs, cut	classify
cellStats	global
projectRaster	project
dropLayer	subset
isLonLat, isGlobalLonLat, couldBeLonLat	is.lonlat
shapefile	vect

Can’t find what you need?

Report https://github.com/rspatial/terra/wiki

terra





Rcpp module

Boost module

C / C++

spat

gdal

geos

ncdf

Slide credit Robert Hijmans

Remote Sensing Image Analysis Workflow

Search and Download Image

e.g. https://earthexplorer.usgs.gov/

→

Visualization and Pre-processing

Mask cloud, atmospheric correction, align

↓

Image Enhancement

Compute Indices, transformation

←

Spatial prediction

Classification & Regression

Infrastructure for today

CG-Labs: https://workshop.cgiar.scio.systems/

Login via Globus, use CG-credential if you have one, otherwise use Gmail, ORCID, Institutional account,…

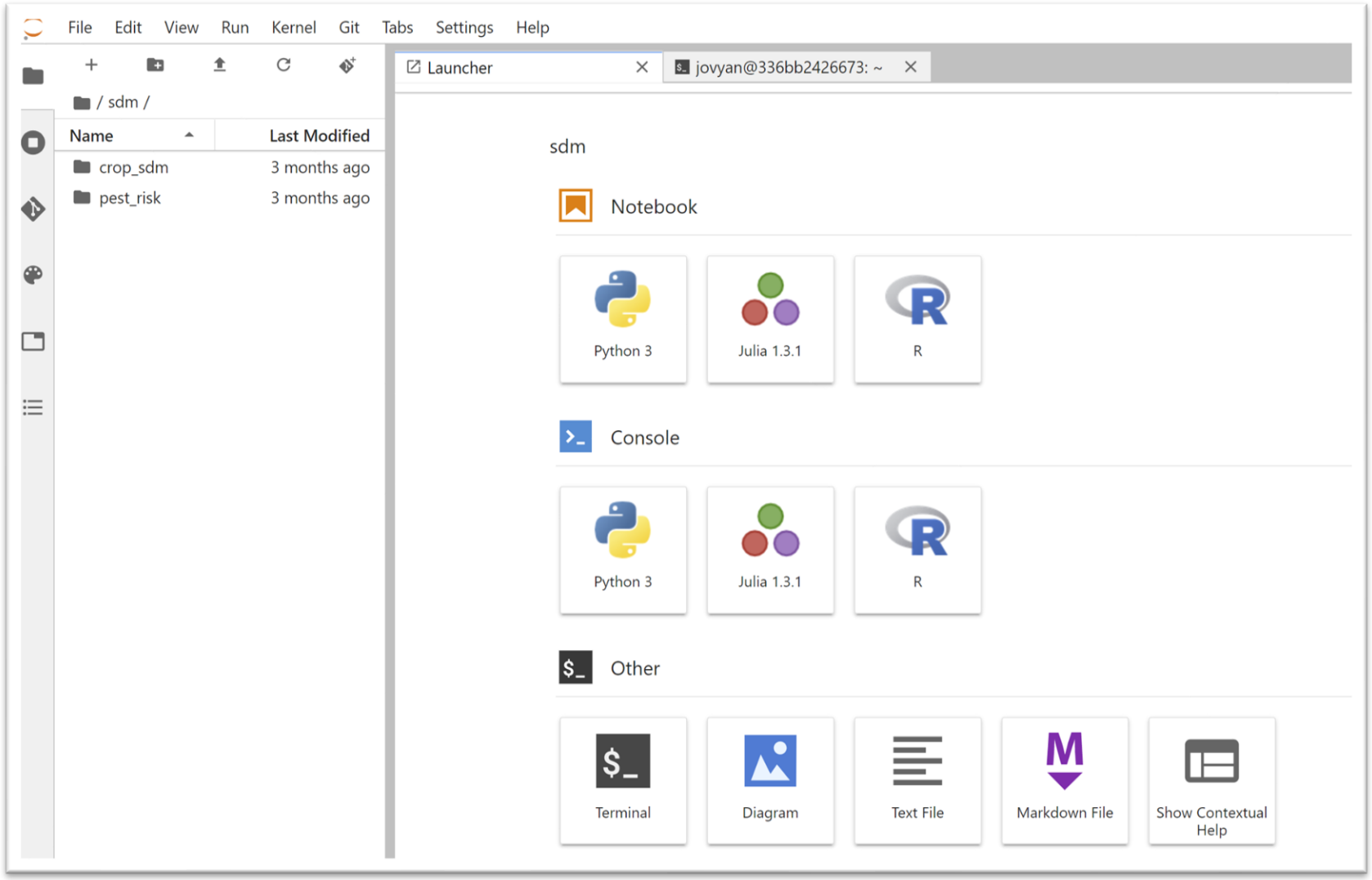
What is CGLabs?

For users

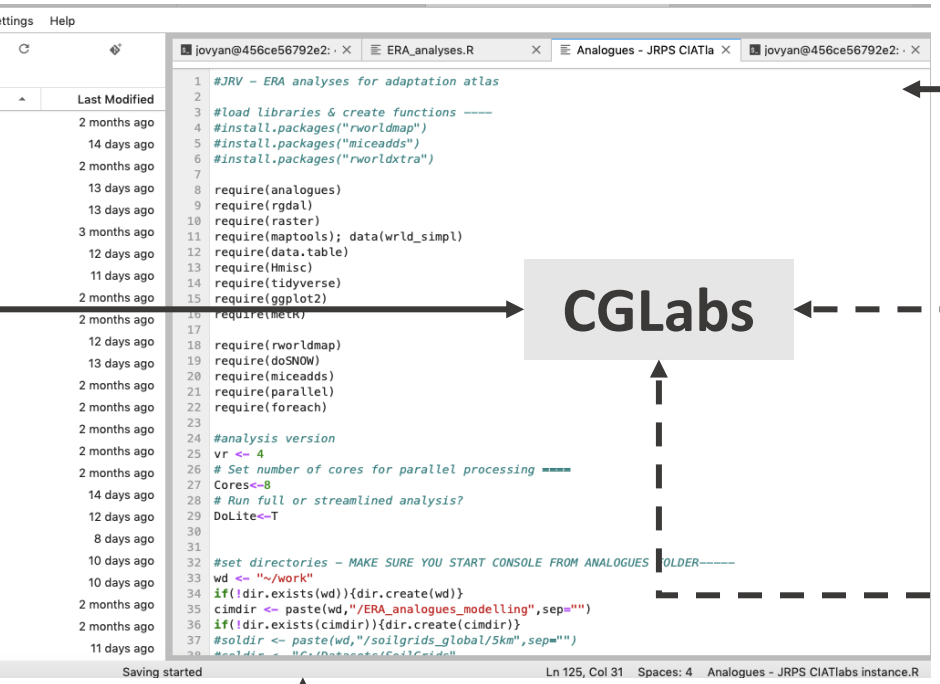
- A portable workstation
- Access to terminals or notebooks with git integrations

For system admins

Complete Jupyterhub experience without the complicated setup



Code sharing GitHub



CGLabs

Computing resource

Cloud resource (AWS, GCP, Azure)

Local Cluster at my center

Slide credit Julian Ramirez

Data

Link

CGIAR data mapped into GARDIAN

BVI-CIAT DV

IFPRI's DV

...

1. CCAFS-Climate
2. MapSPAM
3. HC27…

Download

Other datasets available in the internet

1. CHIRPS
2. SoilGrids
3. …

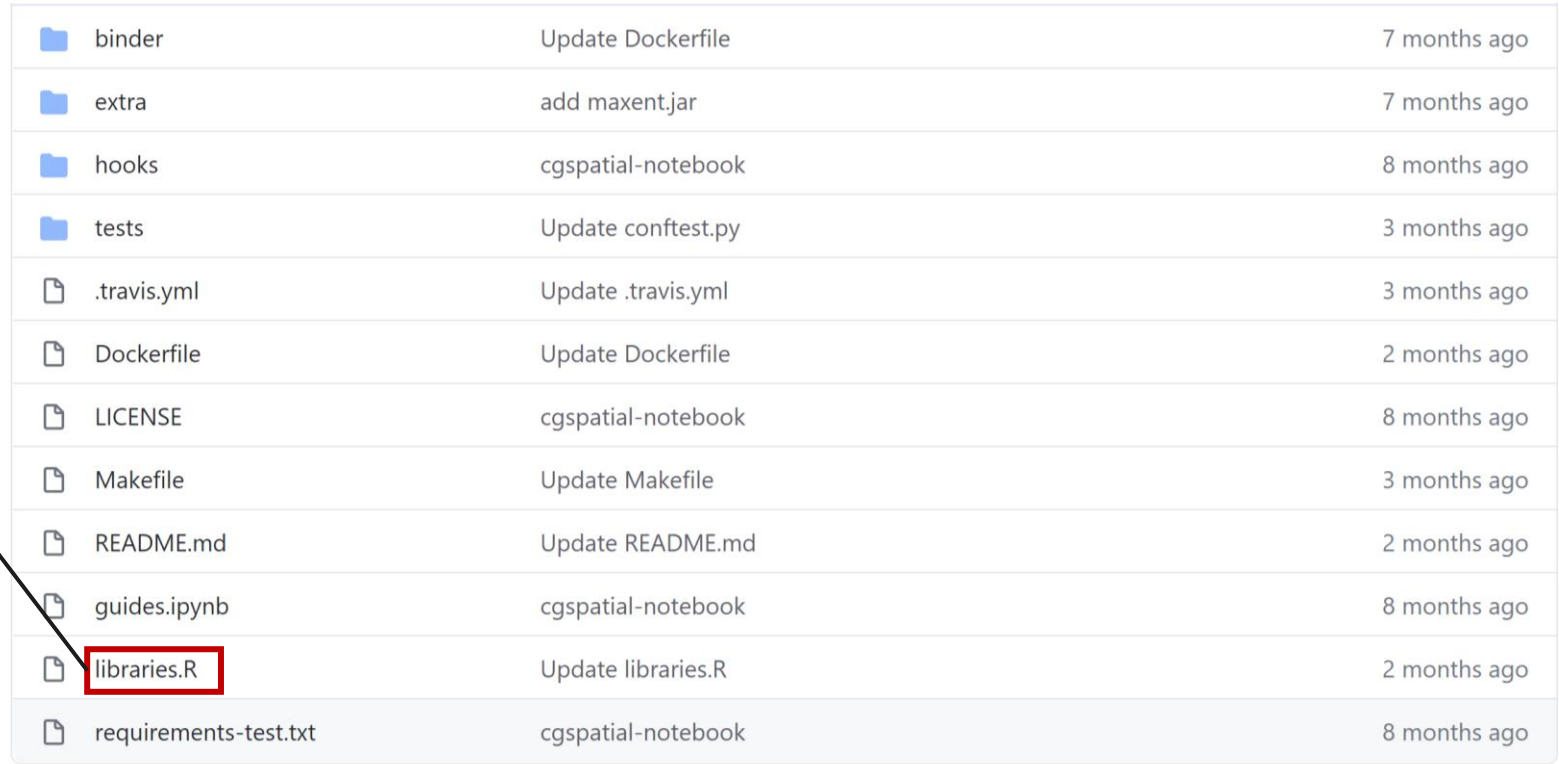
SFTP transfer/Filezilla

My own or my Center's local data

Is it customizable?

- Yes! Check out https://github.com/SCiO-systems/cgspatial-notebook
- Need to add more R or Python packages?

Add your r-install command here
`install.packages("terra")`



Let’s find some data

- *terra + luna +cog*

Codes available in https://github.com/ani-ghosh/workshop/blob/main/cgiar_csi_jan_2021_remote_sensing_with_R/workshop_terra.ipynb

Package ecosystem around terra

Crop modeling

`Rwofost, Rquefts, Recocrop, ...`

Data

`geodata, luna`

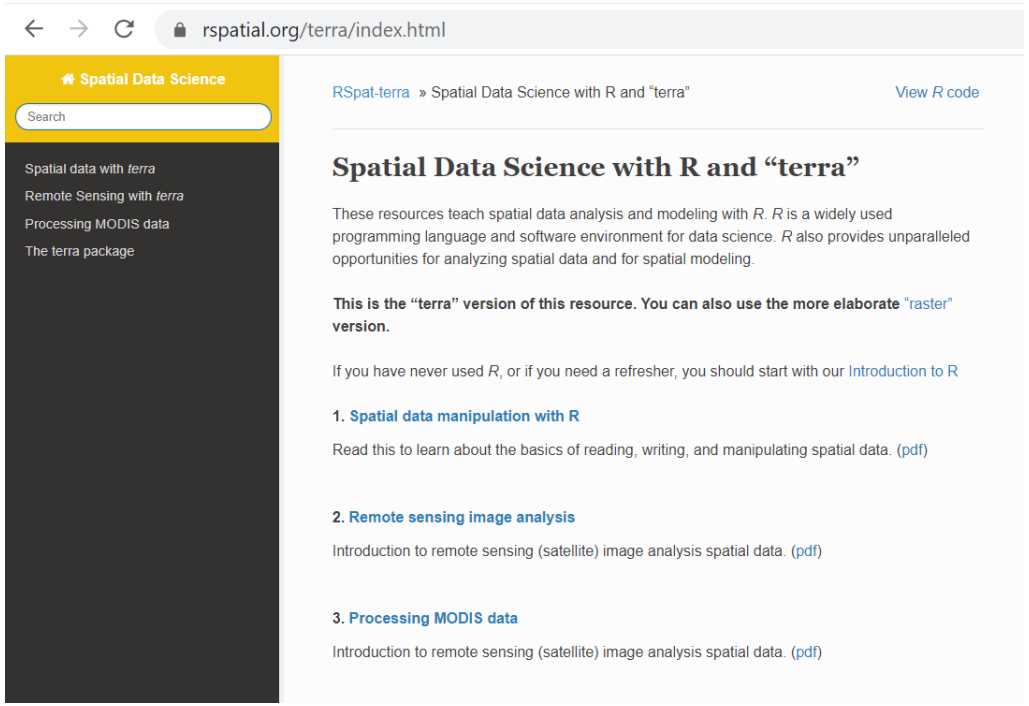
Analysis

`luna, predicts`

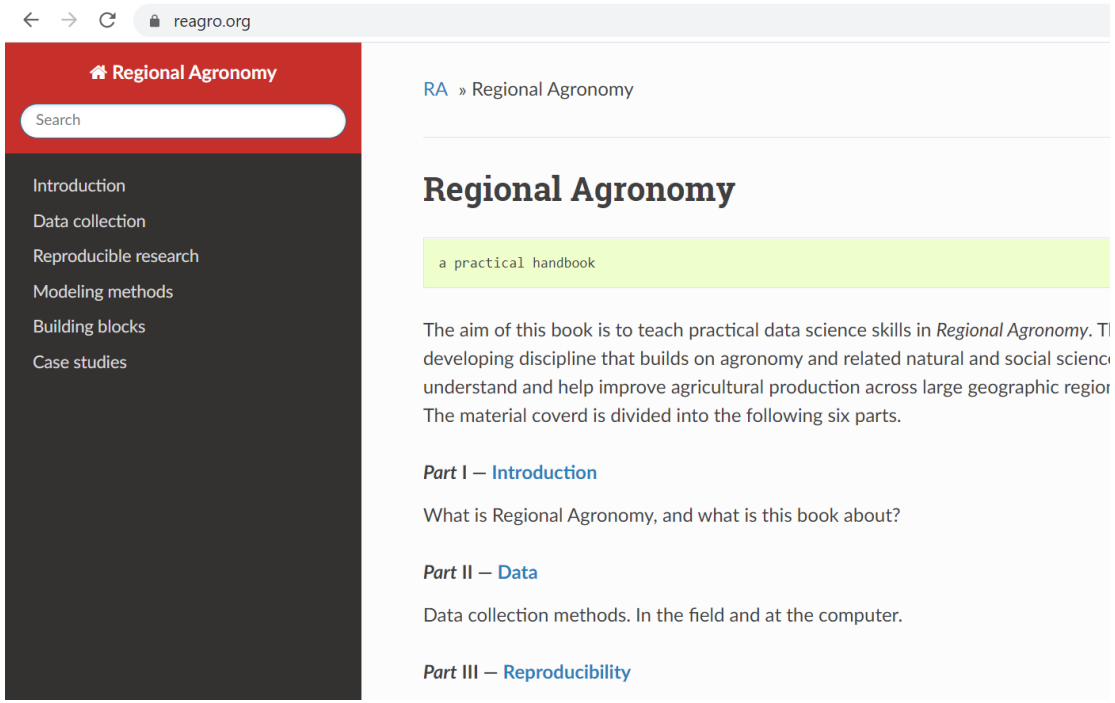
Slide credit Robert Hijmans

Resources

rspatial.org/terra



Agronomy "at scale"



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Thank you!

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