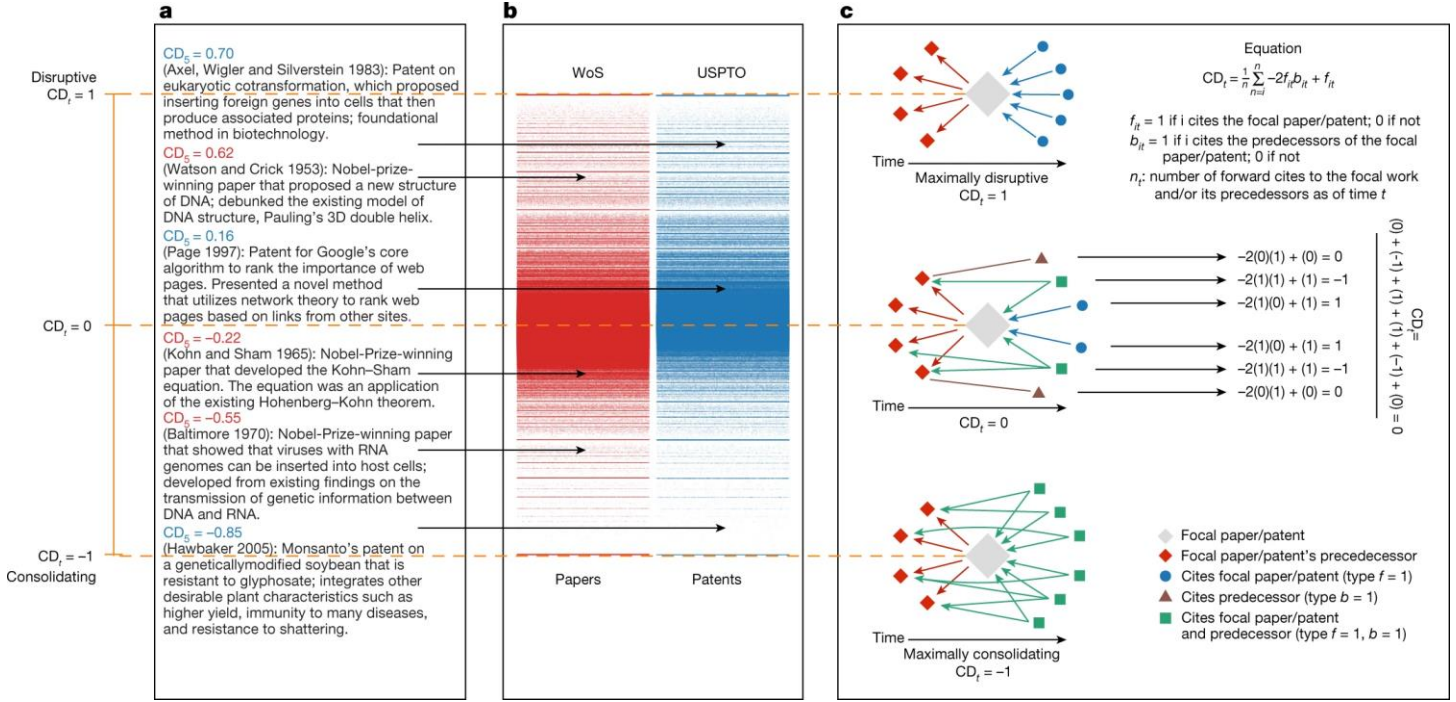
Let´s start with some

”philosophical” thoughts

“

Park, M., Leahey, E. & Funk, R. J. *Nature* **613**, 138–144 (2023).
Papers and patents are becoming less disruptive over time

‘Disruptive’ science has declined — and no one knows why



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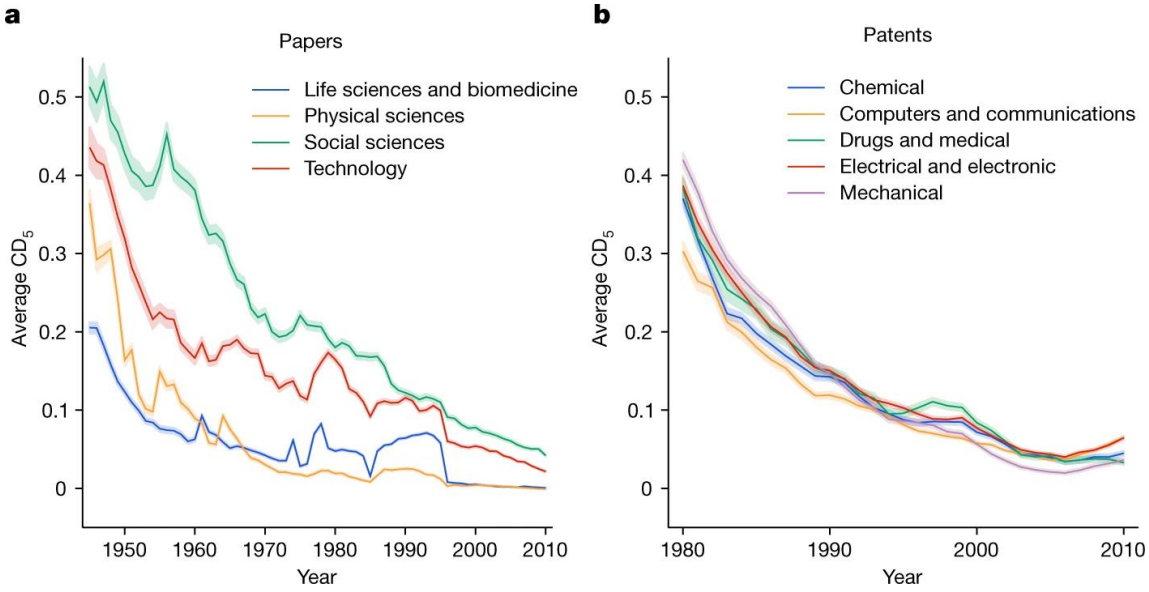
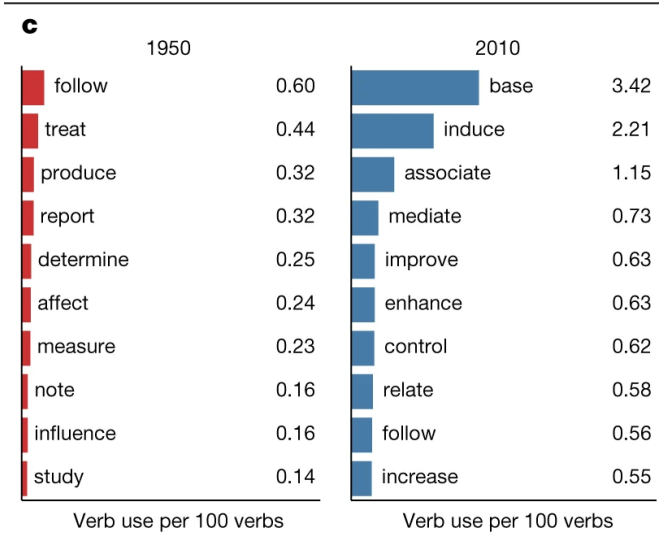


Language of papers



https://rdcu.be/dpObs

The low-hanging fruit

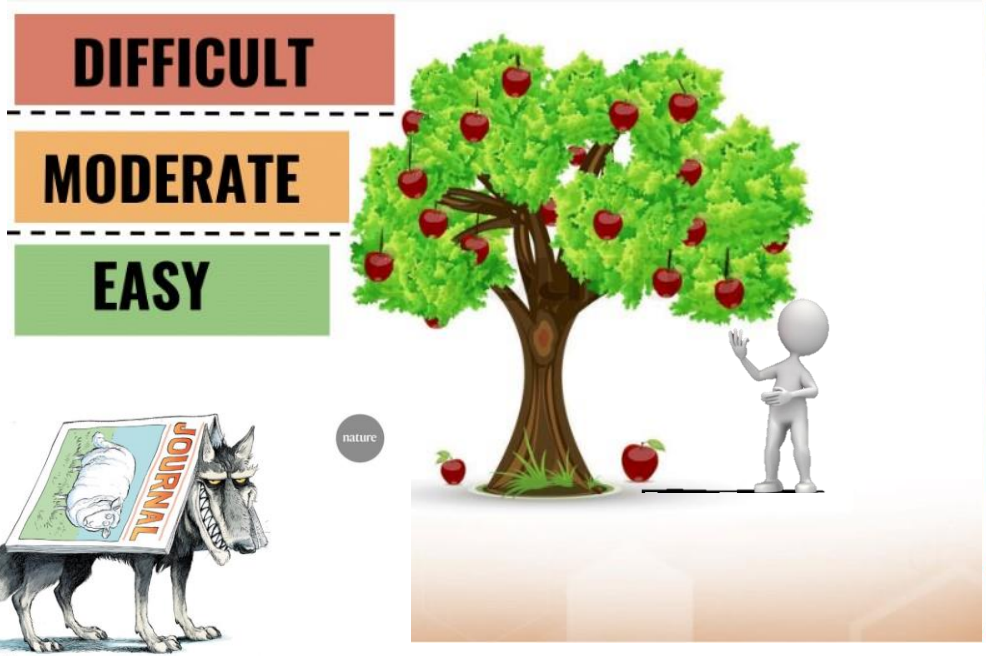


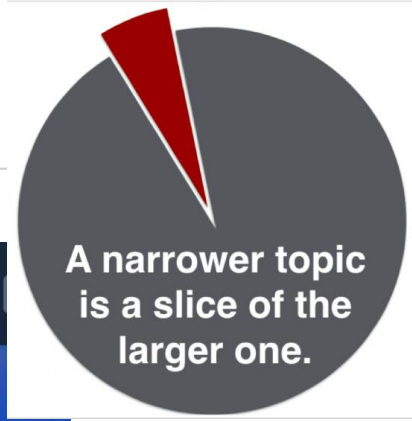
Illustration by David Parkins

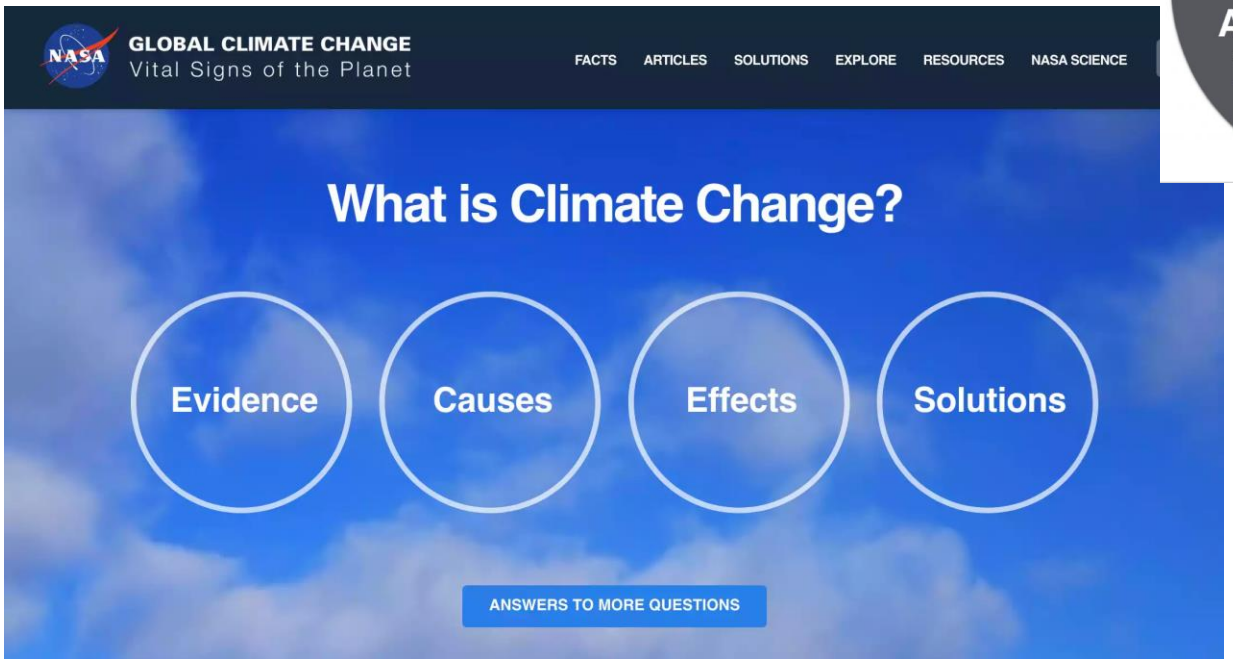
1

More complex scientific questions?

GLOBAL/CLIMATE CHANGE

1 Question of questions





https://climate.nasa.gov/

McPhee, Chris & Bliemel, Martin & van der Bijl-Brouwer, Mieke. (2018). Editorial: Transdisciplinary Innovation (August 2018). Technology Innovation Management Review.

1 Approaches

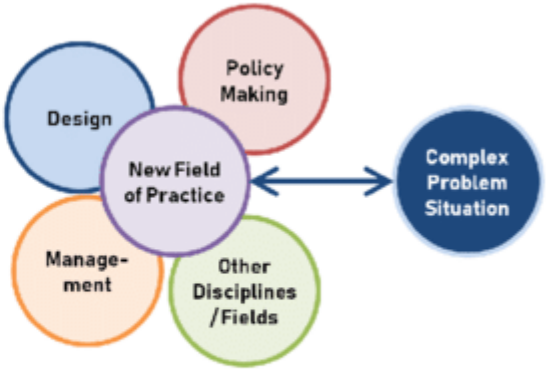
dr. Esther Slot

Multidisciplinarity

Collaboration

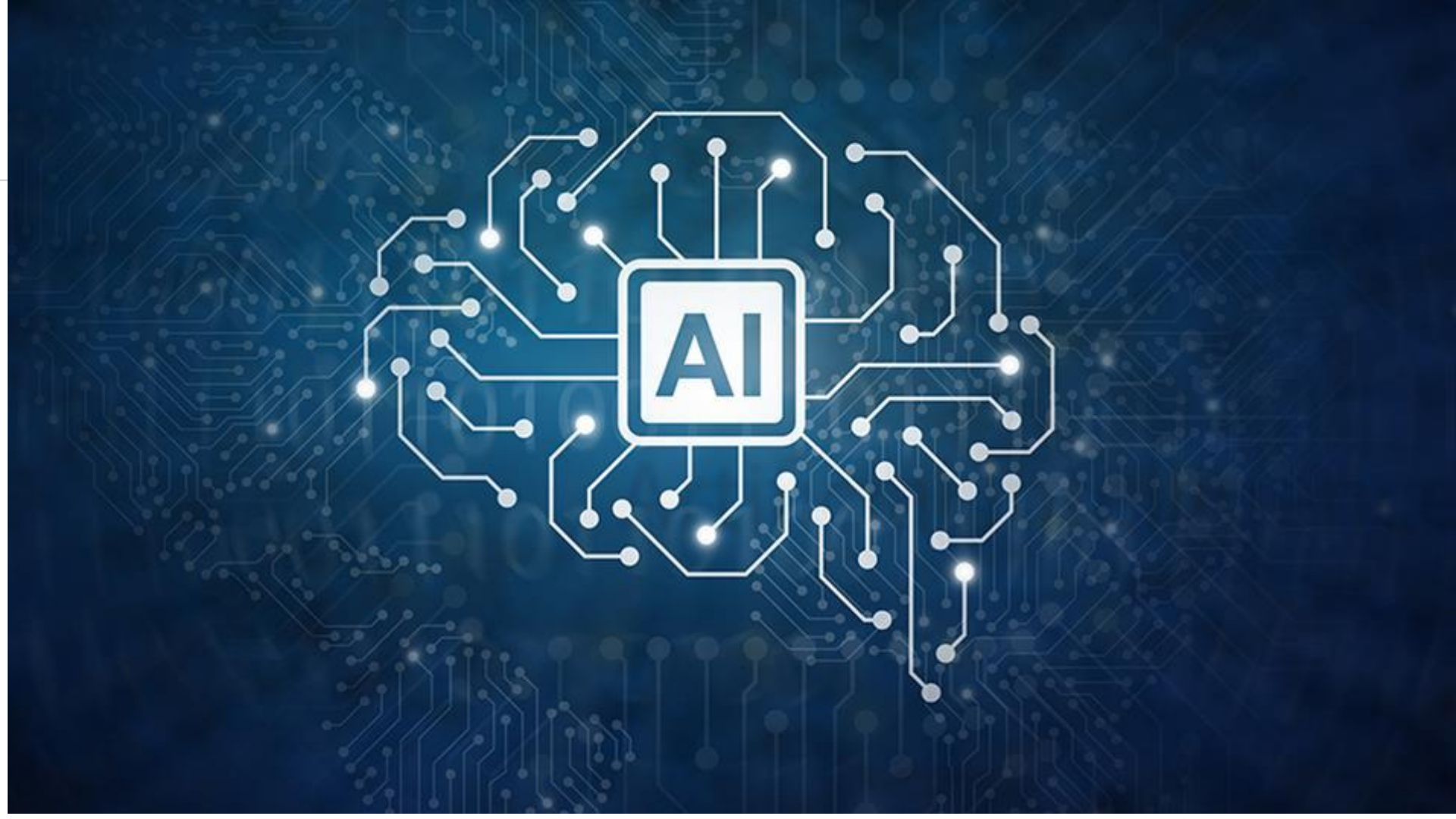
Interdisciplinarity

Integration (methods, tools….)



Transdisciplinarity

A complementary whole


AI

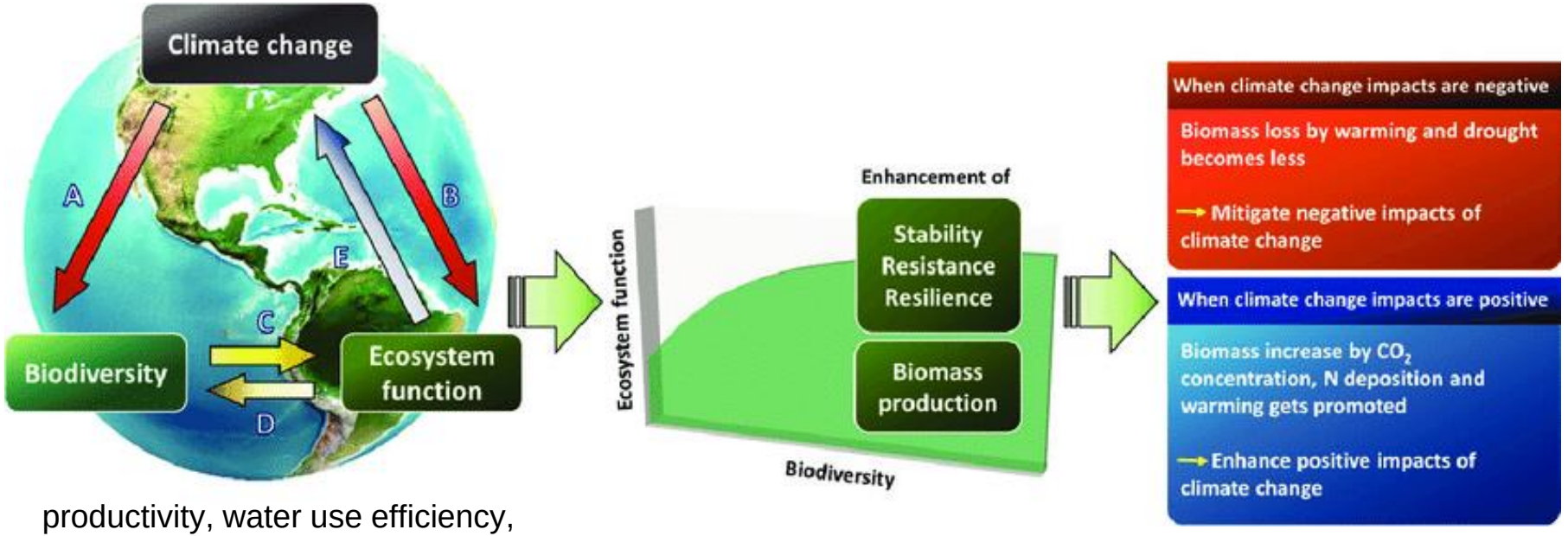
2

Study case

GLOBAL/CLIMATE CHANGE

Ecosystem function and diversity

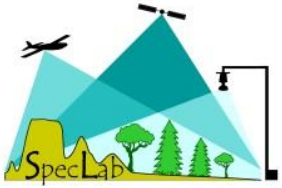
The biodiversity-mitigation concept



productivity, water use efficiency, carbon use efficiency

Hisano, Masumi & Searle, Eric. (2017). Biodiversity as a solution to mitigate climate change impacts on the functioning of forest ecosystems. Biological Reviews. 93.

¿Can Earth observation satellites provide the information needed to understand the relationships between biodiversity and functioning of thus allowing for more effective conservation and management?



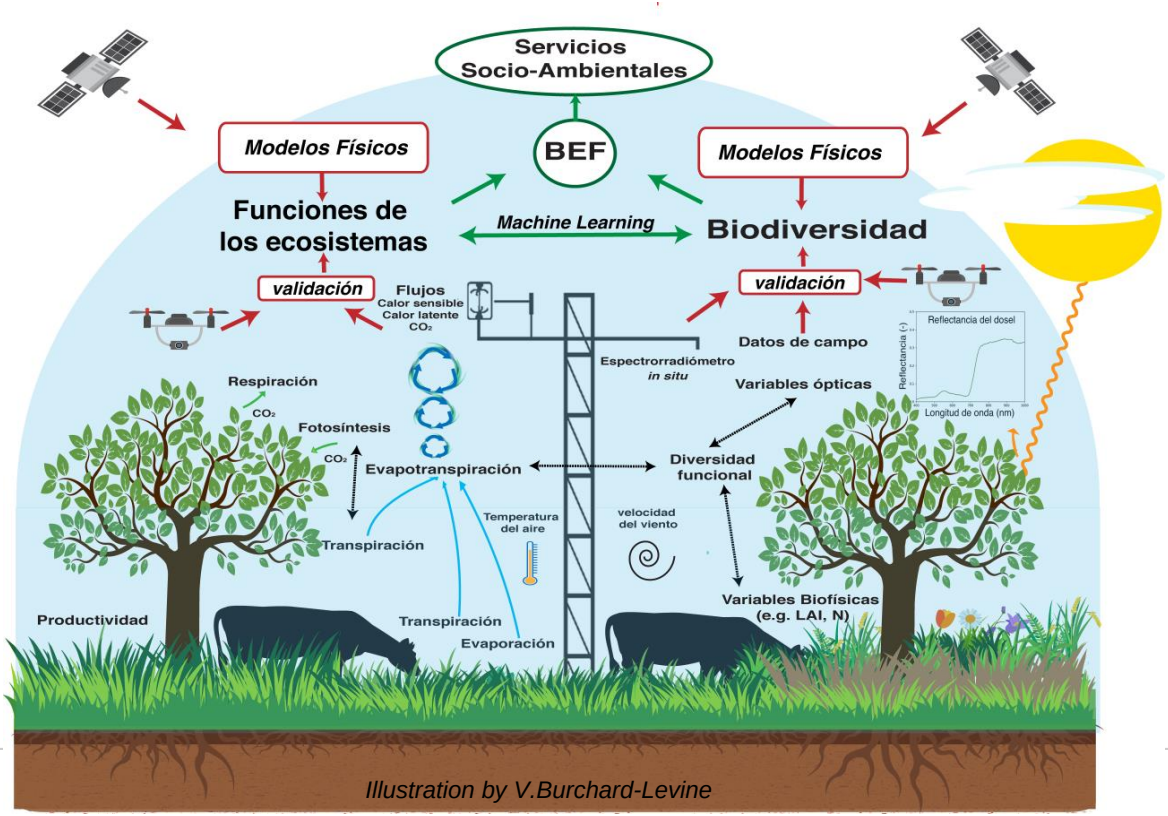
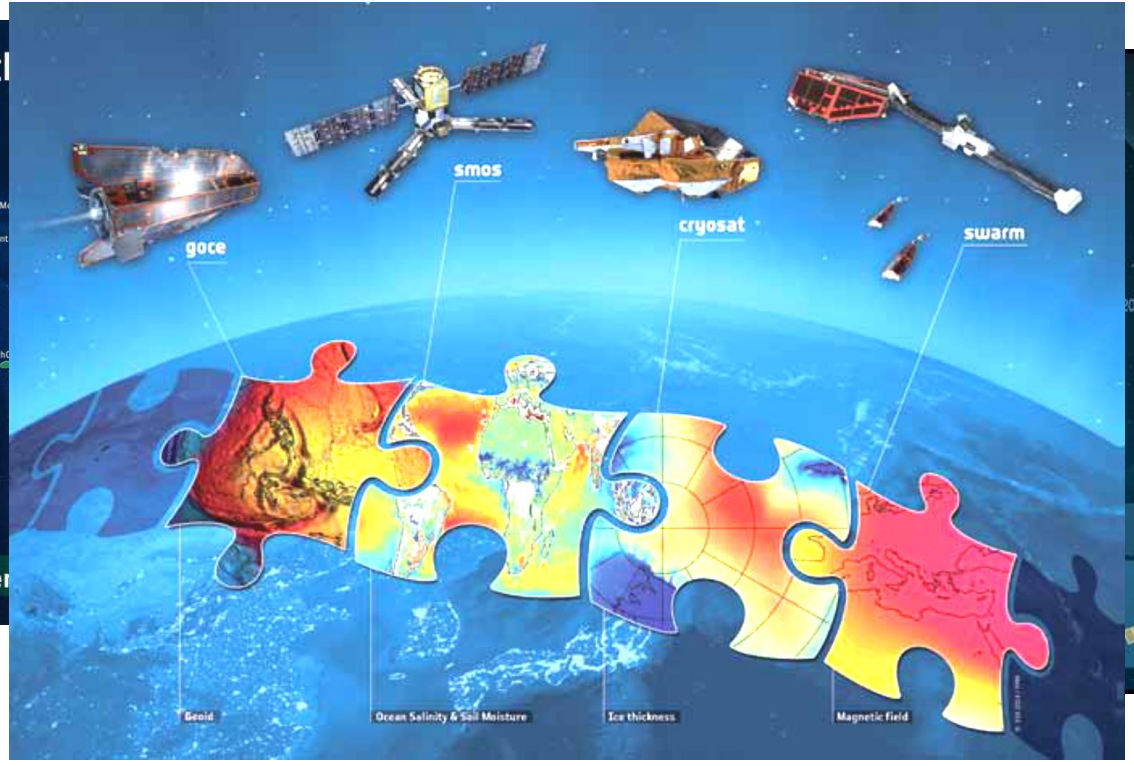


Illustration by V.Burchard-Levine

Can satellites see everything on Earth?



FUNCIONAMIENTO DE ECOSISTEMAS: FLUJOS TIERRA-ATMÓSFERA

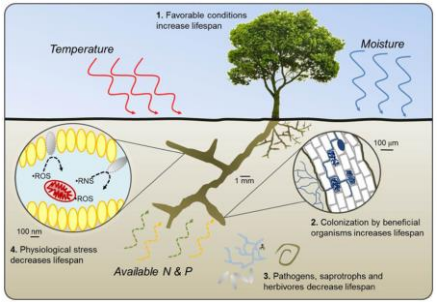
CONDICIONES AMBIENTALES

PROPIEDADES ESTRUCTURALES

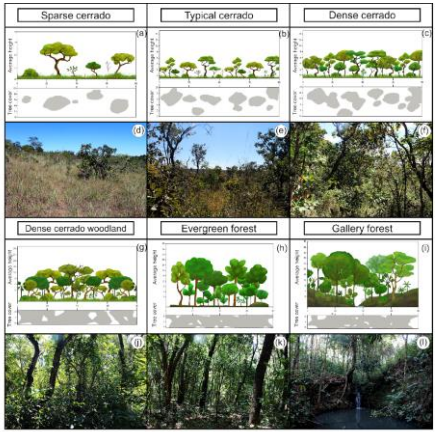
PROPIEDADES FOLIARES

DIVERSIDAD FUNCIONAL

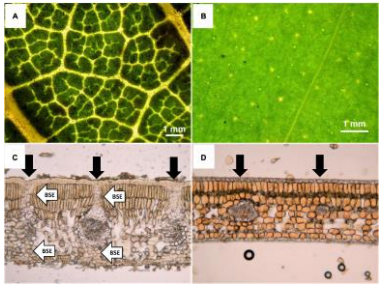
Pacheco-Labrador, j 2022



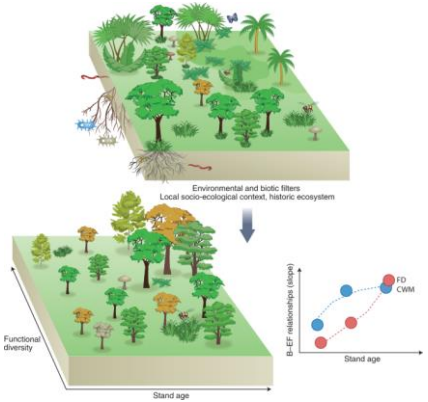
McCormack ML and Guo D (2014)
Front. Plant Sci. 5:205.



Gonçalves, Rogério Victor S. et al.
2021.Web Ecology 21:55-64.

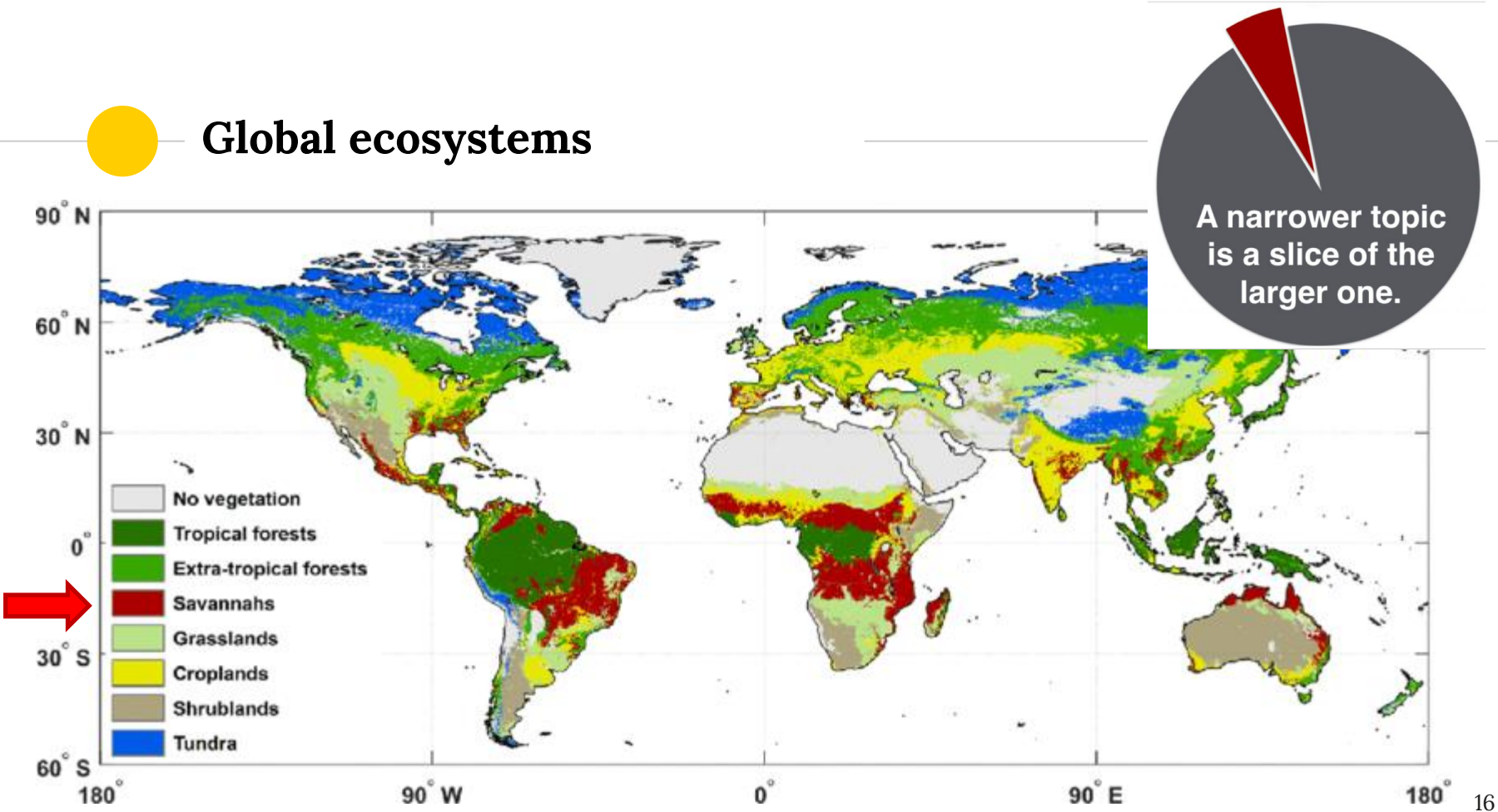


Kenzo T, Mohamad M and Ichie T (2022)
Front. For. Glob. Change 5:1002472

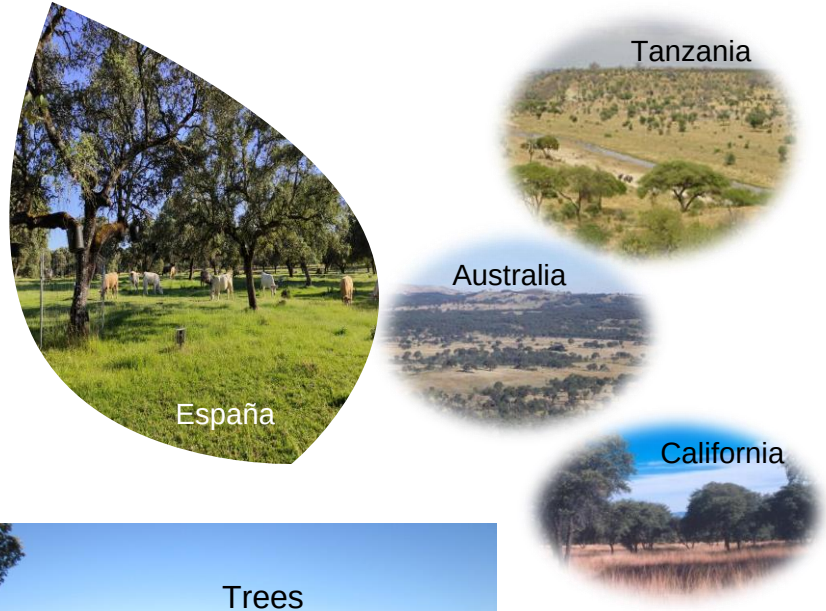


Guerrero-Ramírez, N.R. 2021. Nat Ecol Evol 5, 1572–1573

Global ecosystems

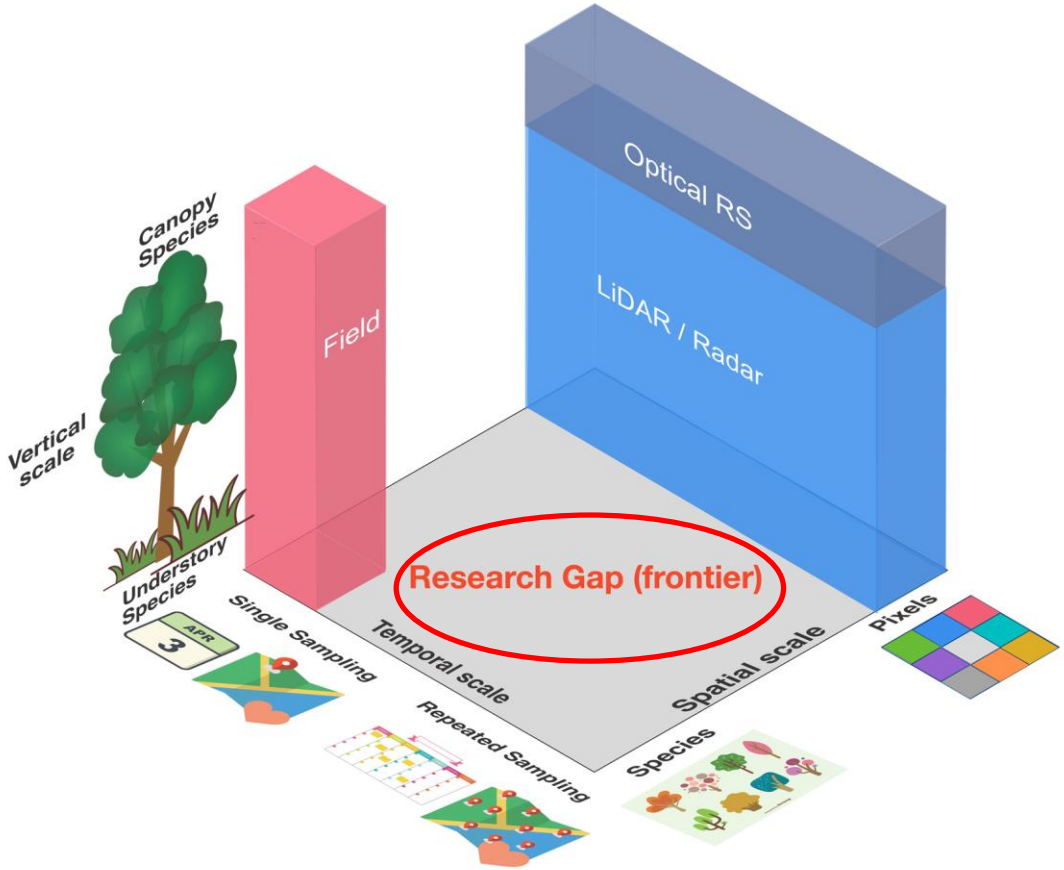


Tree-grass ecosystems



- **Biodiversity hotspot. Outstanding example of biodiversity conservation**
- Tree-grass ecosystems >15% of Earth surface
- Continental Mediterranean climate
  - Semi-arid conditions
  - Highly seasonally dynamic
  - Vulnerable to drought events and global change
    - Expected significant yield reductions
- **Remote sensing challenges:**
  - Two vegetation layers with different dynamics / properties / function
  - Highly diverse grass layer
  - Strong geometrical component
  - Optical properties badly represented by RTMs
    - NPV and flowers

Do we need more than just satellites?



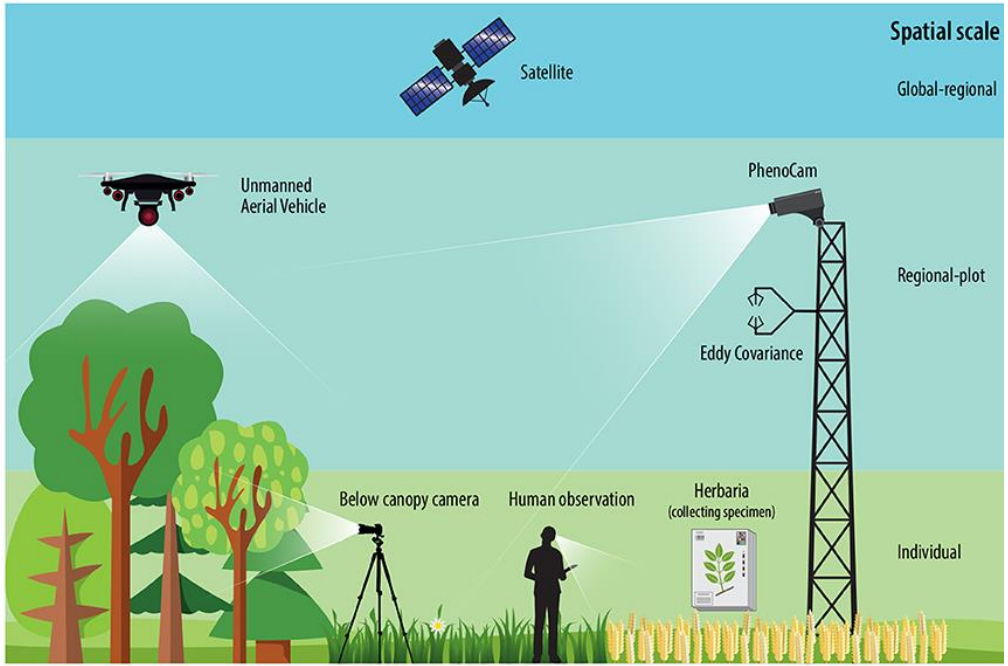
Ma, X et al 2020 *Remote Sens,12*, 1248

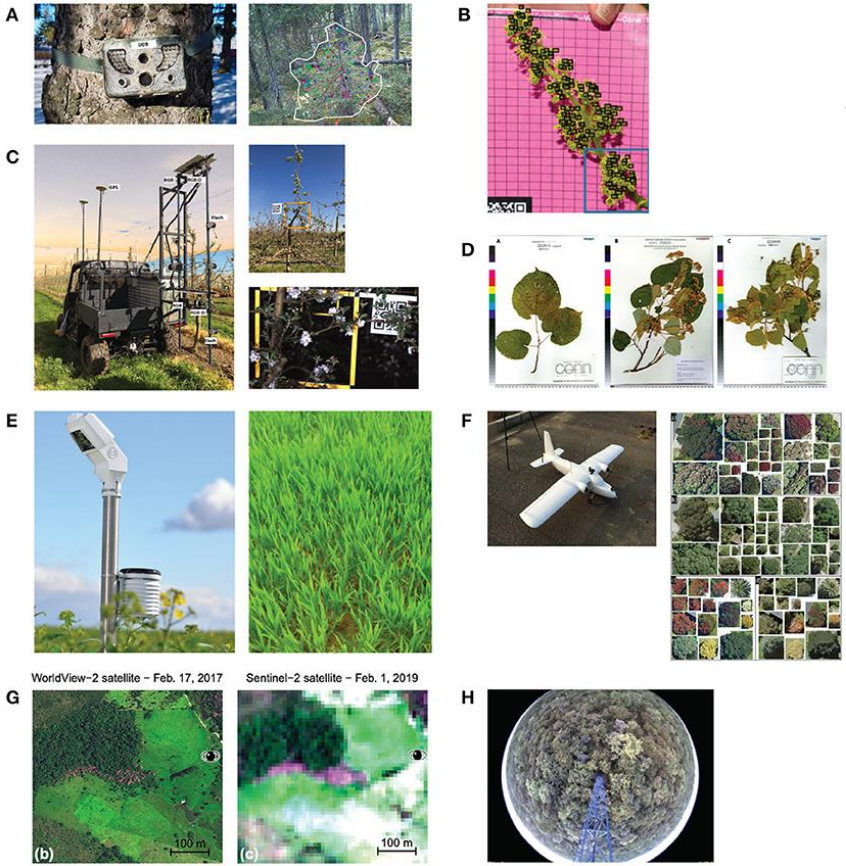
3

New paradigm

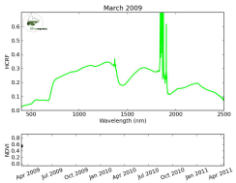
Integrated observing systems

Integrated observing systems





Katal N, Rzanny M, Mäder P and Wäldchen J (2022). Front. Plant Sci. 13:805738



Leaf spectra

Leaf traits

Plant traits

Spectral diversity

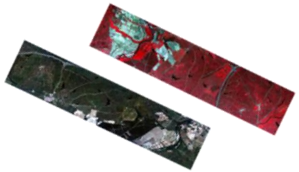
Functional diversity

Canopy spectra

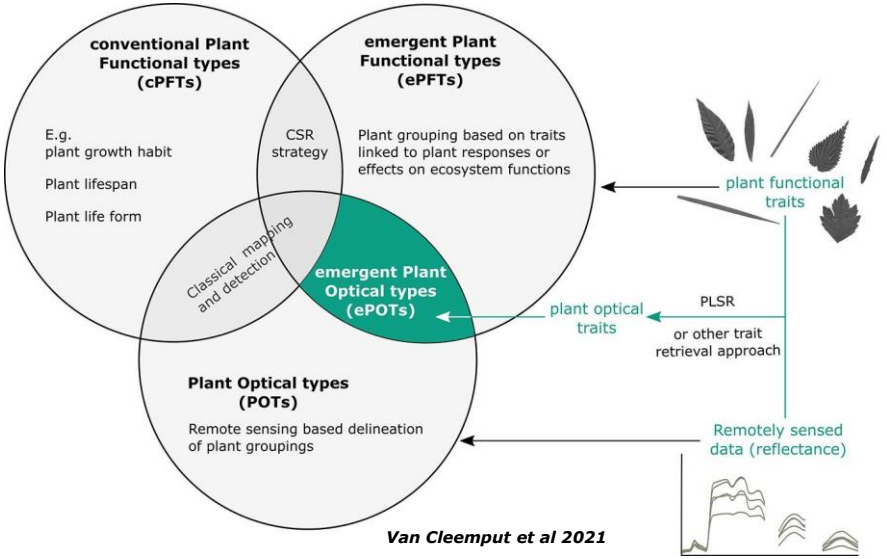
Ecosystem function

Pasture quality, productivity, biodiversity

Satellite



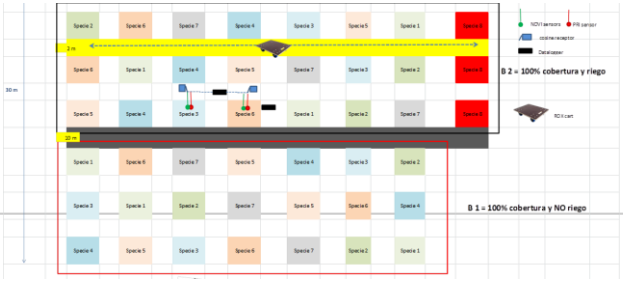
Airborne /drone



Two experiments:

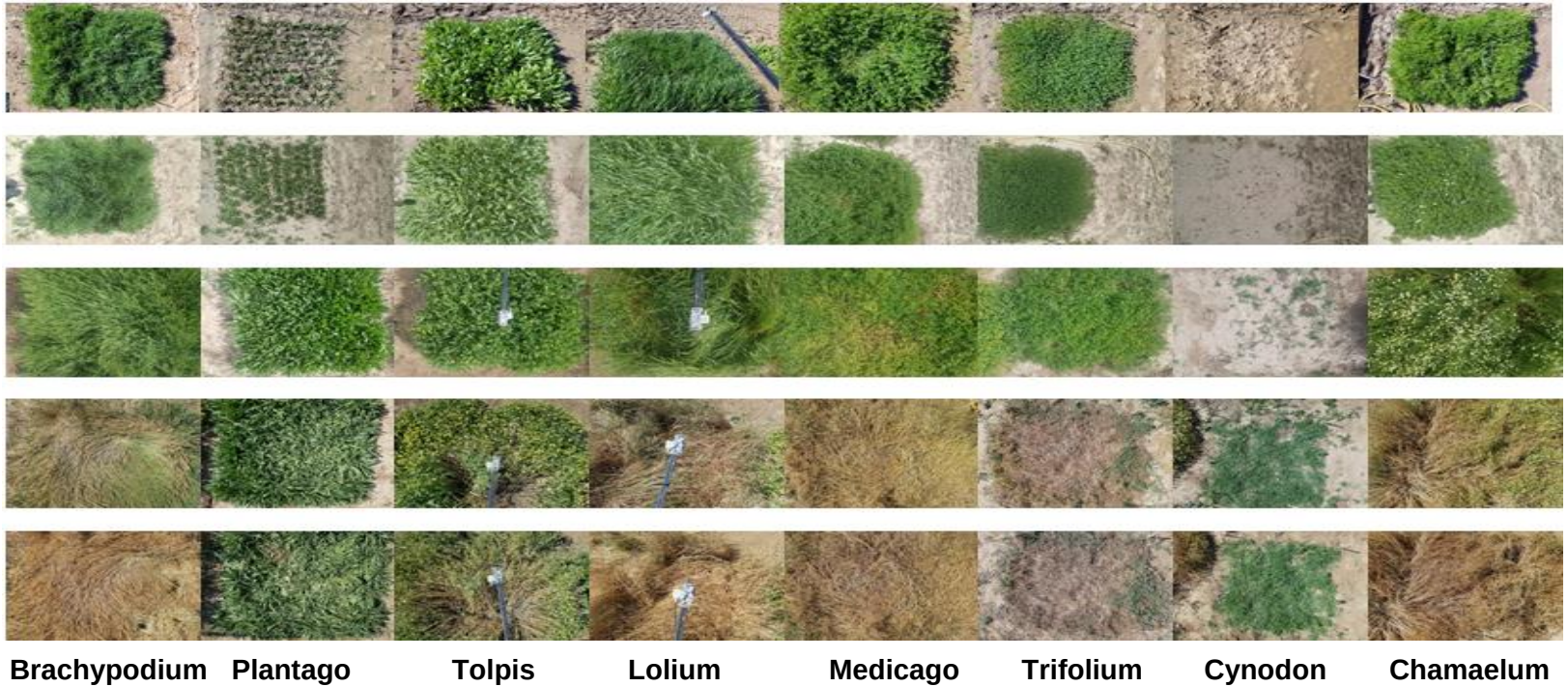
- **Monoculture of grass species**
- **Dehesa farms**

Monoculture experiment

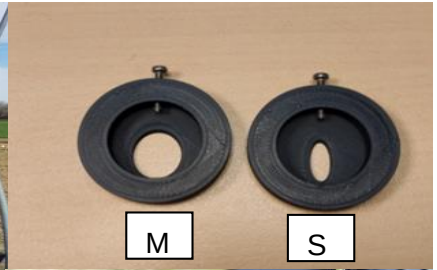


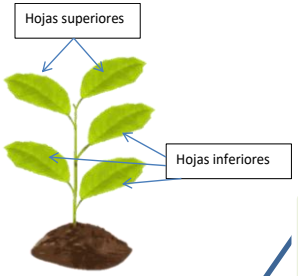
- **Leaf to canopy level analysis to characterize foliar functional traits (leaf scale) and structural effects (canopy scale) using proximal sensing**
- Analysis based in chemical, morphological and optical data
- 45 (1.5x1.5 m) plots. Selected species dominant in dehesas
  - 8 species = 4 functional types (legumes, grass forbs, grasses C3 and grasses C4)
- Water manipulation experiment (irrigations vs non irrigation)
- Optical instruments: two band sensors (NDVI /PRI), ASD, ROX, Specim IQ, Sequoia + thermal camera
- Water and carbon fluxes
- Destructive sampling and lab analysis of plant traits

Phenology


1-2/4
18-21/4
11-12/5
31-1/6
9-10/6
Brachypodium
Plantago
Tolpis
Lolium
Medicago
Trifolium
Cynodon
Chamaelum

Leaf level measurements





Leaves/campaign =168

- Block 2 Control
  - 7 species * 4 plants * 3 leaves =84
- Block 3 Water stress
  - 7 species * 4 plants * 3 leaves=84

4 plants/plot

- 2 upper leaves/plant =**8 upper leaves**
  - 5 BIO
  - 3 CHL
- 1 lower leaf/plant = **4 lower leaves**
  - 2 BIO
  - 1 CHL

Canopy level measurements

Spectral

Specim IQ Hyperspectral camera VIS-NIR

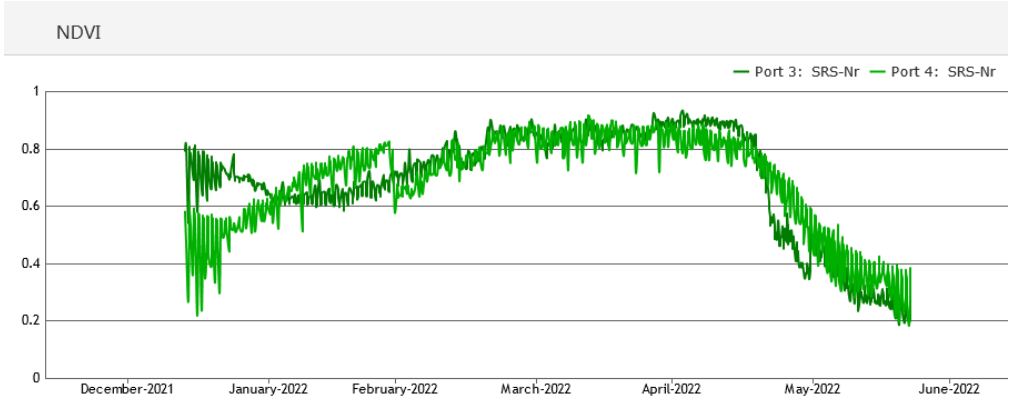
ASD Fieldspec 3 Field spectroradiometer VIS-NIR-SWIR

ROX-Mobile Field spectroradiometer VIS-NIR

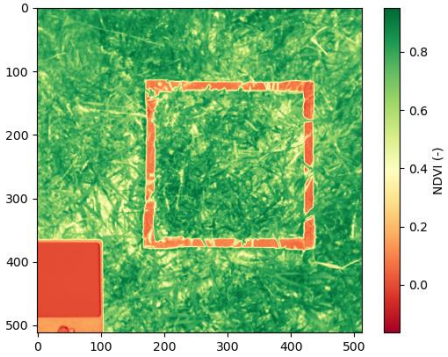
NDVI-PRI sensors Continuous Feb-Jun

Traits

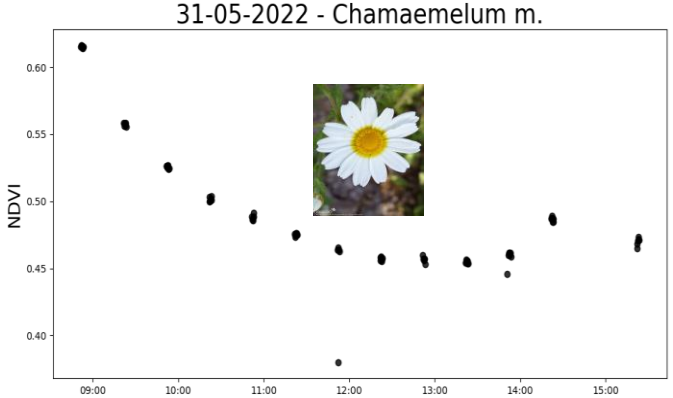
Inter-daily variation-**phenology**



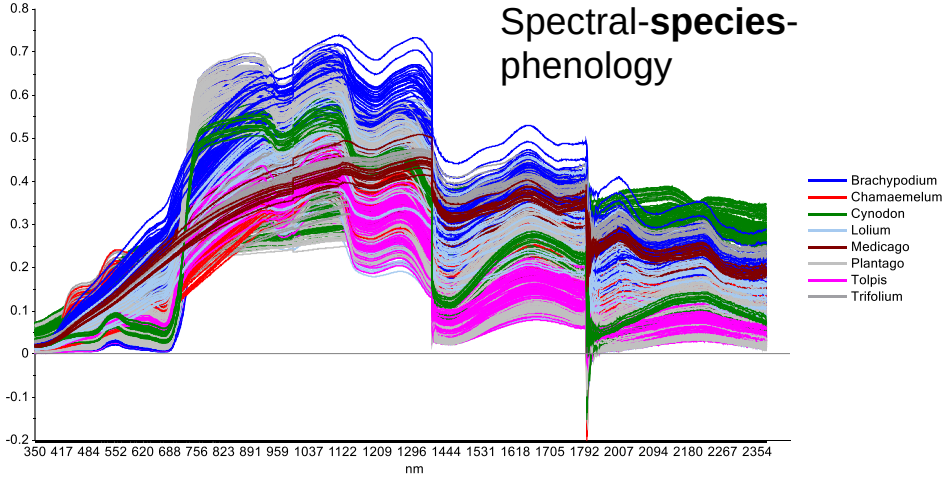
Spectral-**spatial**



Spectral- Intra-daily variation

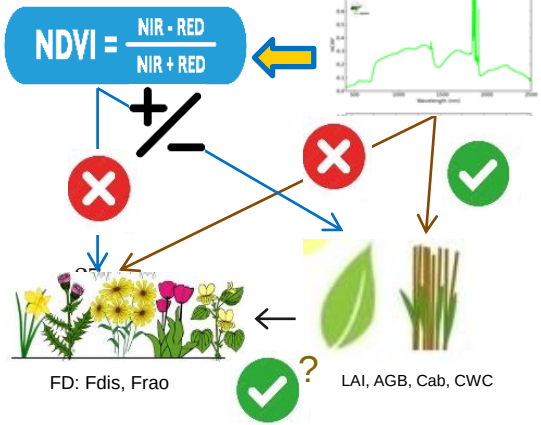


Spectral-**species**-phenology



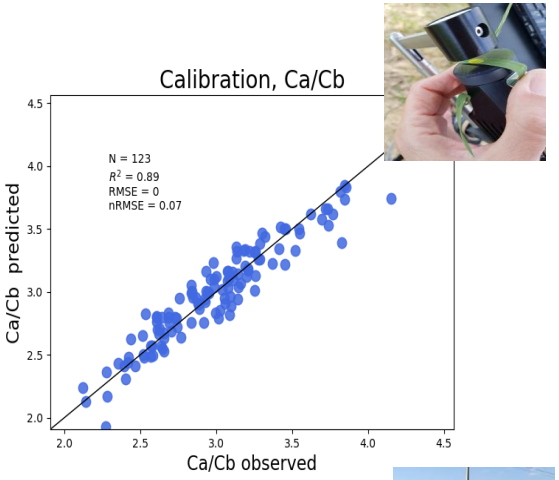
multi

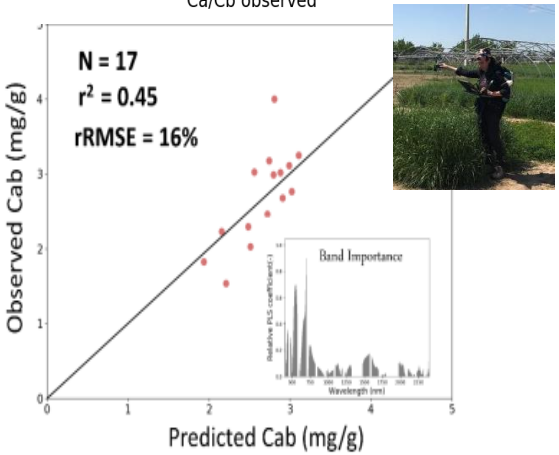
hiper

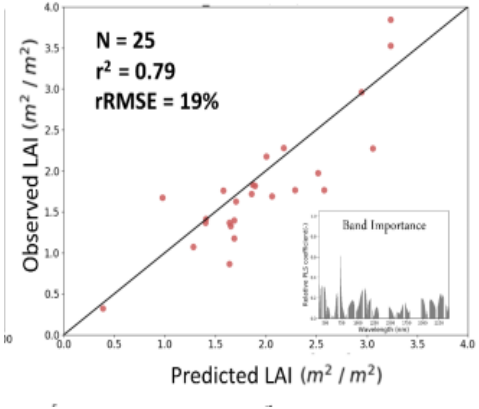


FD: Fdis, Frao

LAI, AGB, Cab, CWC

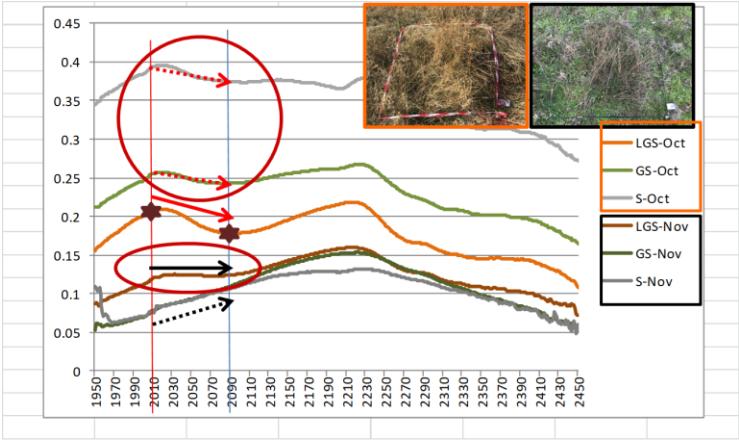


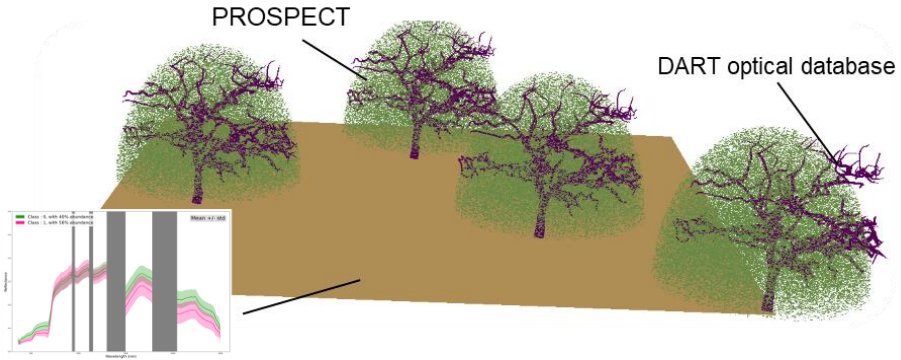




Field data used to:

- **Upscale functional diversity models from proximal sensing to space-borne data**
  - **Field spectroscopy-UAV-PRISMA (Hyperspectral) and Sentinel 2 (Multispectral)**
- Characterize and quantify non-photosynthetic vegetation using unmixing techniques (endmembers: field spectroscopy library)
  - Affects plant trait retrievals (especially in mixed phenological periods). Not well represented in RTMs
  - Important influence for heat and water fluxes
- Better characterize ‘background’ grass in 3D RTM modeling: phenology

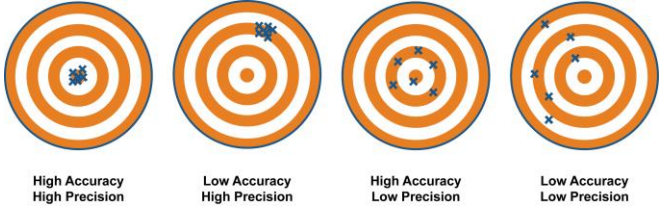




Ok, let´s say field work is “convenient” or even necessary but …

does it compensate the effort?

can in situ data yield the truth?



- Is the information we use/acquire "reliable"?
- What is the reliability of our results? Precision vs accuracy
- Field knowledge can facilitate or even determine the analysis and interpretation of the data?

LIMITATIONS: Human, technical and economic resources

Mark Reed fieldworkfail.com
My worst #fieldworkfail ended up with me running around a Ugandan forest almost naked after standing on an ant nest to measure a tree.

does it compensate the effort?
can in situ data yield the truth?

*I would say....**YES**.... but...*

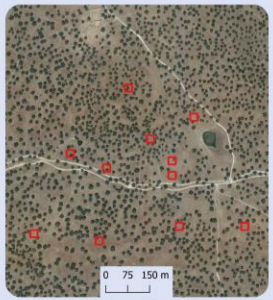
“

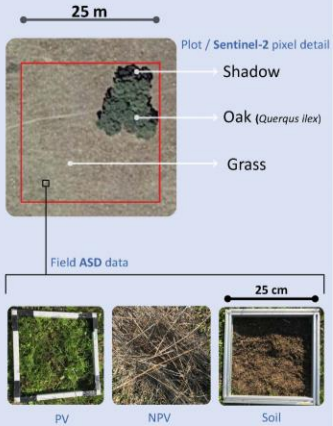
Estimating AGB NPV in semi-arid grassland using Sentinel 2 images and field spectroscopy

STUDY AREA

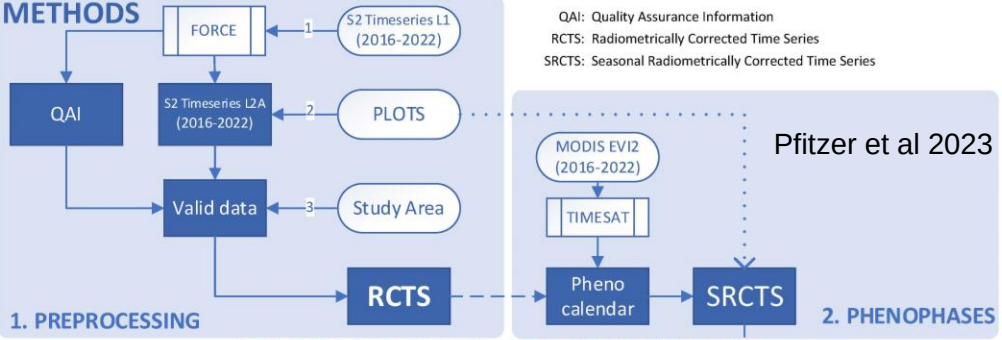
Majadas de Tiétar research station monitors various aspects of the carbon cycle, climate, vegetation, and soil in a Mediterranean tree-grass ecosystem. It is supported by Fundación CEAM, the Spanish National Research Council (CSIC), University of Extremadura, and Max Planck Institute for Biogeochemistry

More information about Majadas de Tiétar research station



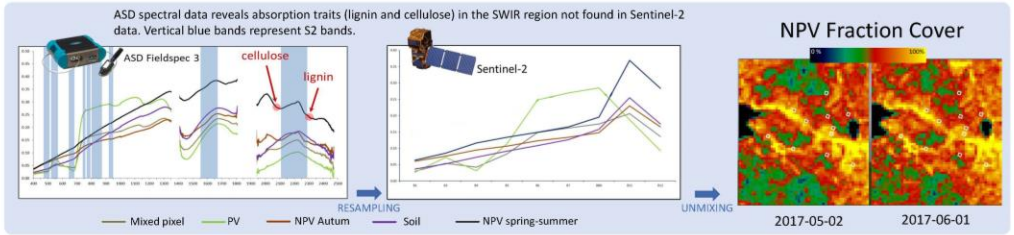


METHODS

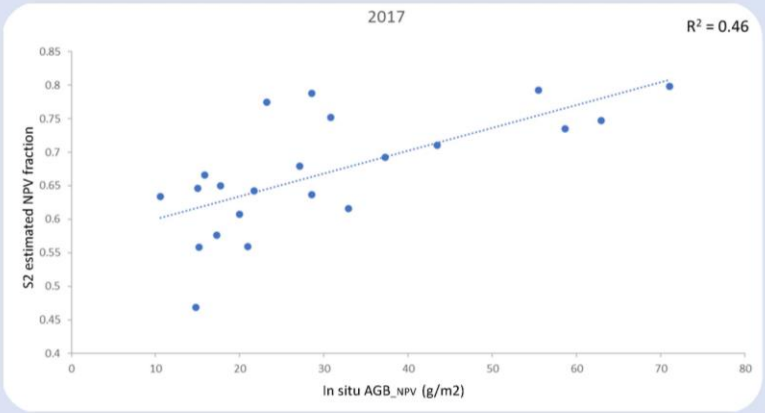


QAI: Quality Assurance Information
RCTS: Radiometrically Corrected Time Series
SRCTS: Seasonal Radiometrically Corrected Time Series

Pfitzer et al 2023



Ⓐ Grass Decay – Year 2017

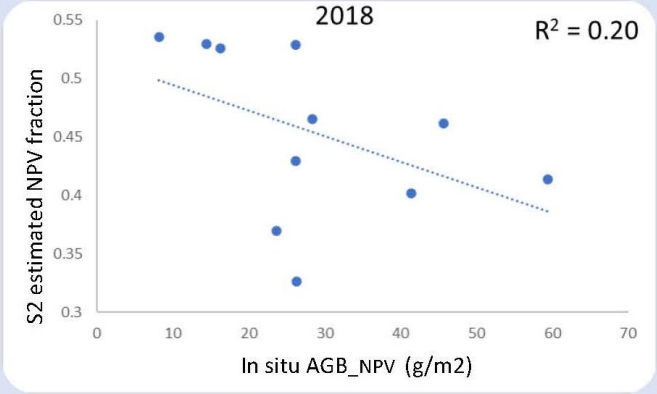


2017-05-02

2017-06-01

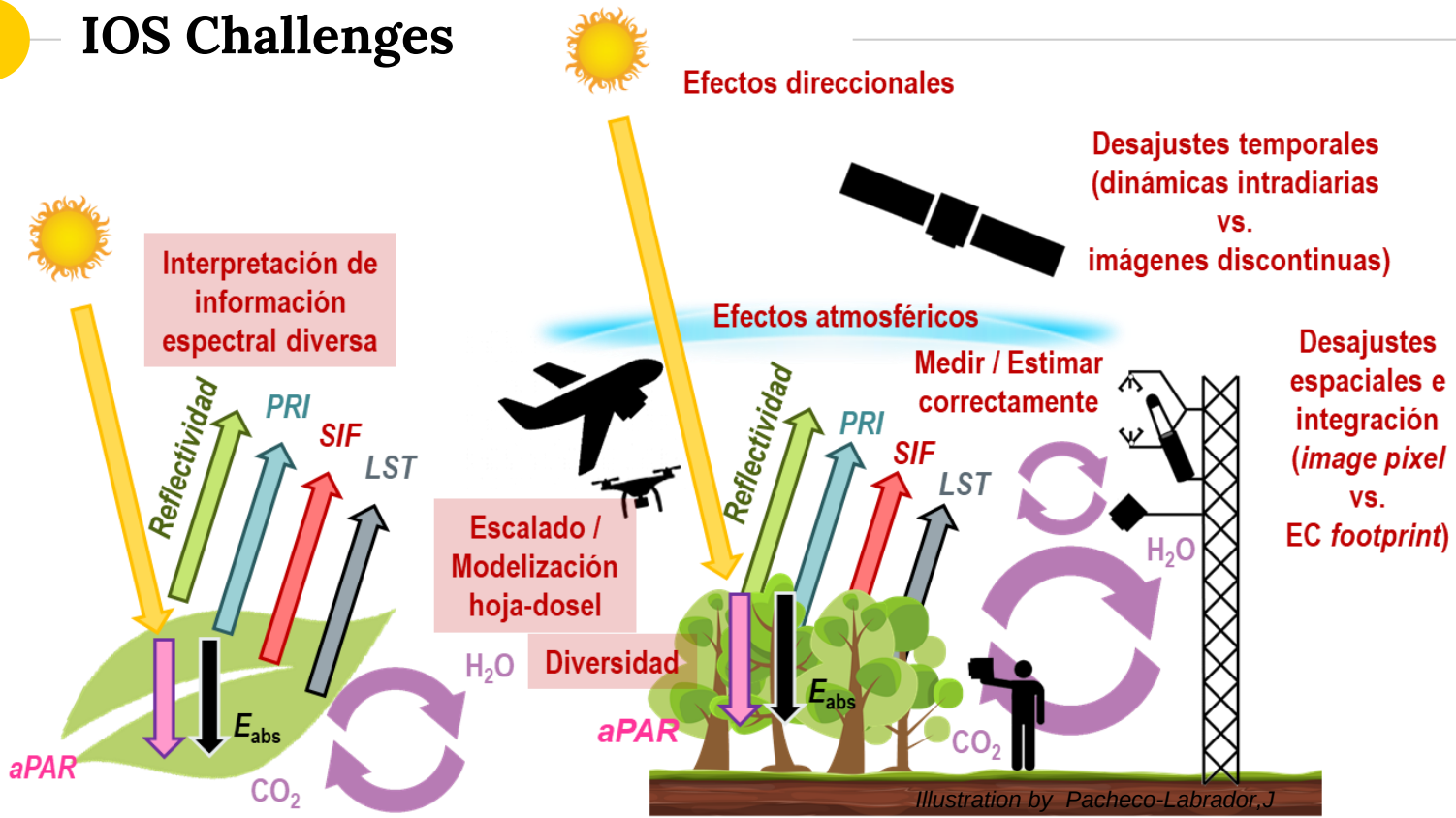
≠

Ⓑ Grass Decay – Year 2018



Pfitzer et al 2023

IOS Challenges



Take-home messages

- **Remote sensing is more than GE Engine.**
- **Field data can help to understand, validate and provide added value to your results. From just products to useful maps**
- When planning field activities
  1. Think big but start small: plan, plan and plan
  2. Develop protocols adapted to your site and objectives. Protocols are vital!... and also the field logs!
  3. Look at the past: when possible use historical data and learn from your/others data.
  4. Pre-analysis of data will help to improve long-term field campaigns ...but, be careful you can loose the homogeneity of the series!


"If I have seen further, it is by standing on the shoulders of giants."
Issac Newton

SPACE

NASA Finds 'Definitive' Liquid Water on Mars

Dark streaks that appear and vanish seasonally are made of salty water, new observations show.

BY NADIA DRAKE | PHOTOGRAPHS BY NASA, JPL CAL-TECH, UNIV. OF ARIZONA

Thank you!

ANY QUESTIONS?

You can find me at