

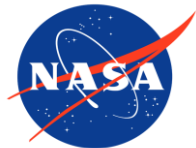


# BIOSCAPE

Biodiversity Survey of the Cape

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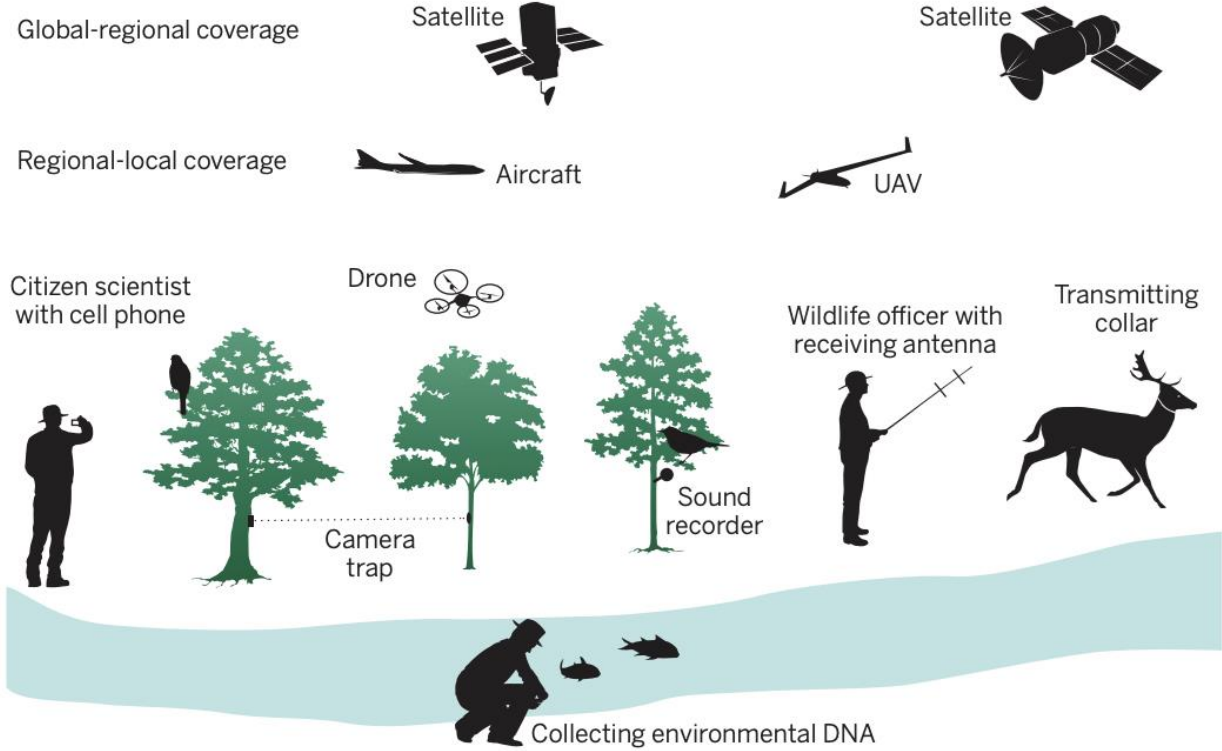
**UNIVERSITY OF CAPE TOWN**  
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

# Integrating field and remotely sensed observations

“Inclusive integration of remote sensing with field-based ecology and evolution is needed to fully understand and preserve Earth’s biodiversity.”

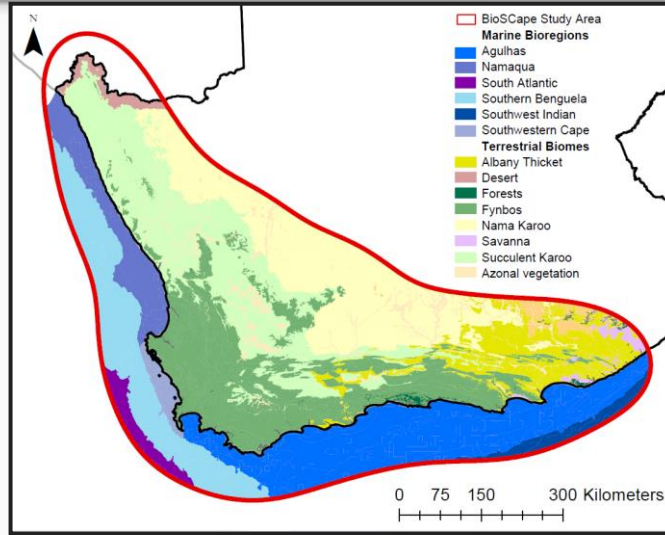
*Cavender-Bares et al., 2022, Nat Ecol Evol*

Seeing the unseeable  
~ Keith Gaddis



Turner, 2014, *Science*

# South Africa's Greater Cape Floristic Region - Testing our abilities



Biodiversity Hotspot:

- 7 Terrestrial Biomes
- 4 Marine Bioregions
- Important Freshwater Systems

≈90,000km<sup>2</sup> (~1% Africa's area)

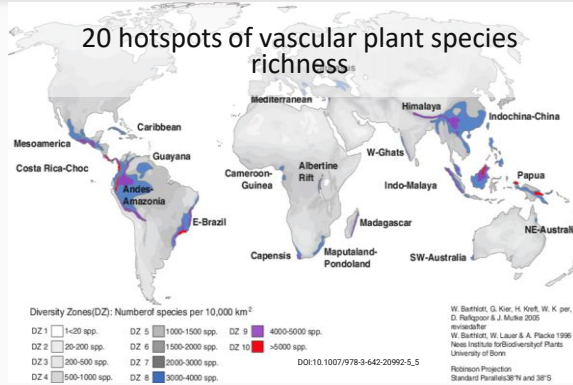
≈9,000 vascular plants (~20% Africa's Plants)  
- 65% endemic

3<sup>rd</sup> highest marine endemism in the world



# South Africa as a Microcosm of Global Challenges

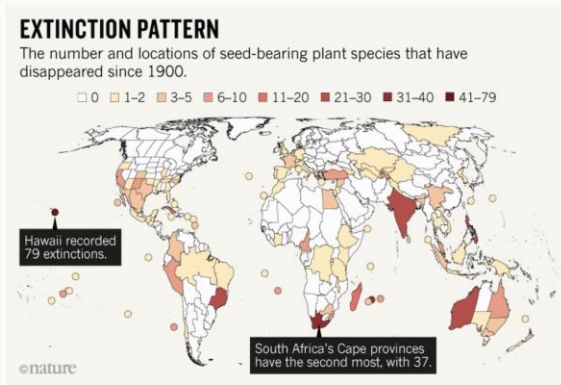
Global Biodiversity Hotspot



Complex history and ongoing social challenges



Global Extinction Hotspot



Source: Humphreys et al.

Humphreys et al. 2019

**Development + Environmental Change + Biodiversity**

Remote sensing is a tool to measure, map, monitor, and understand biodiversity and its role in this complex socio-economic environment.

# BioScape Timeline

2015-  
2020

- NASA Scoping Proposals
- Stakeholder Meetings
- Co-design of Scoping Proposal with SAEON (Slingsby and Moncrieff)

2021

- NASA ROSES call
- NRF NEOFrontiers Call
- Networking and Stakeholder Needs Workshop (May)
- Fynbos Forum Stakeholder Needs Workshop (Sept)
- Parachute Science Workshop (Dec)

2022

- NASA Science team selected now
- Co-design implementation plan, flight paths, and field logistics.

2023

- Planning
- **Field Campaign (late-2023)**

2024+

- Data Sharing
- Analysis
- Publication
- EFTEON Landscape
- Ongoing partnerships



Flight line planning



Capacity building and networking



Methods testing & field logistics planning



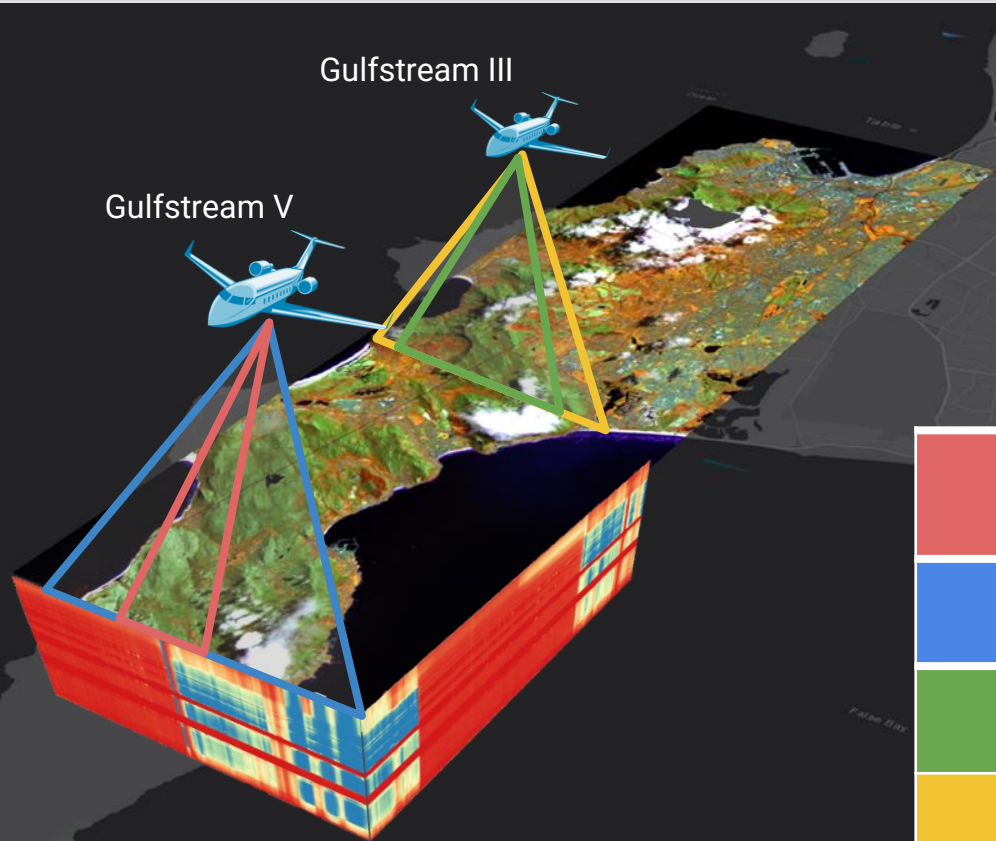
# BioSCape's Major Research Themes

1. The distribution and abundance of biodiversity,
1. The role of biodiversity in ecosystem functions, and
1. The feedbacks between global change, biodiversity change, and ecosystem services.

***Where is biodiversity,  
what is it doing,  
and why does it matter?***



# Two Aircraft and Four Instruments



*Flights in Oct/Nov 2023!*

LVIS	Land, Vegetation, and Ice Sensor (Laser altimeter)
HyTES	Hyperspectral Thermal Emission Spectrometer
PRISM	Portable Remote Imaging Spectrometer
AVIRIS-NG	Airborne Visible-Infrared Imaging Spectrometer (NextGen)



# BioScape Overview

## Satellite Data:

MODIS, Landsat, Sentinel, EMIT, ECOSTRESS

## Hyperspectral Airborne Data:

AVIRIS-NG & PRISM

## Thermal Emission and Laser

Altimeter Data: HyTES & LVIS

## Remote Sensing Data





# BioScape Overview

## Satellite Data:

MODIS, Landsat, Sentinel, EMIT, ECOSTRESS

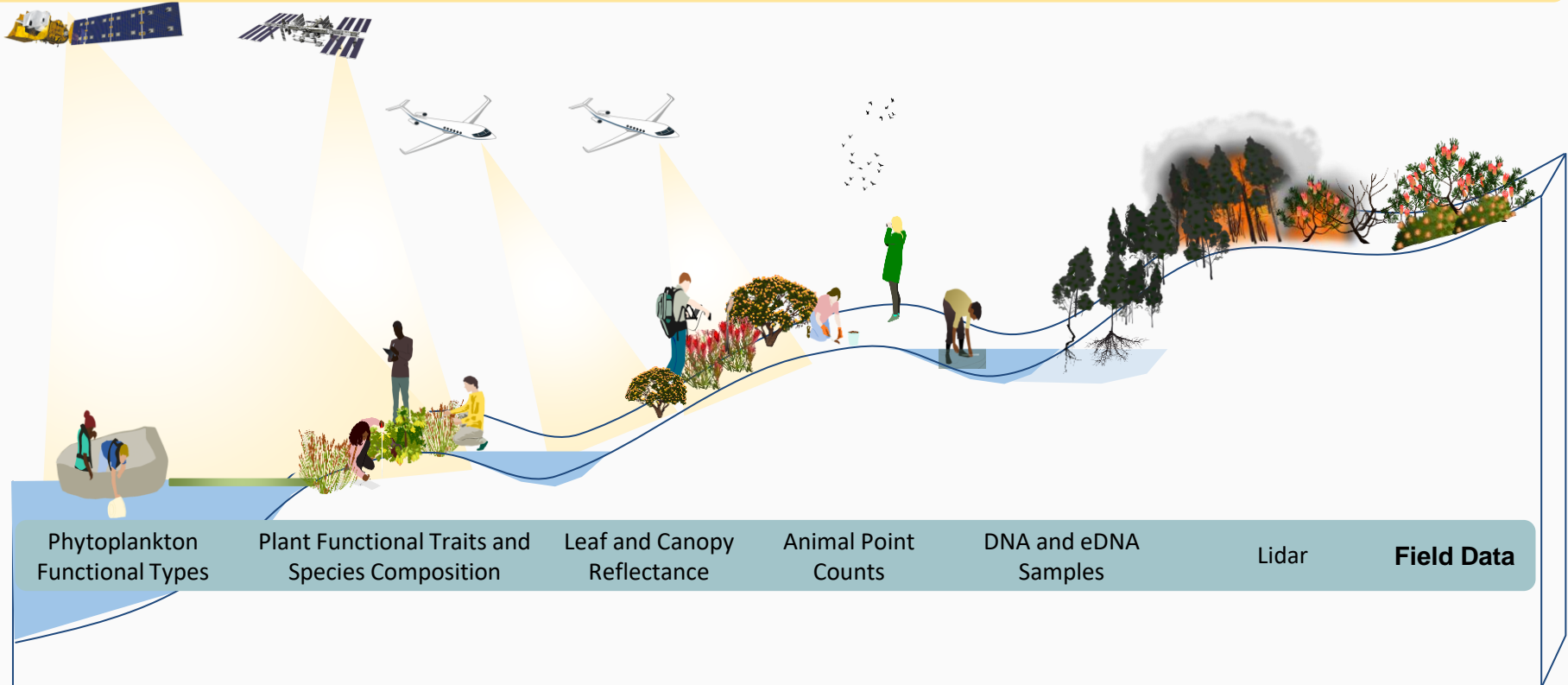
## Hyperspectral Airborne Data:

AVIRIS-NG & PRISM

## Thermal Emission and Laser

Altimeter Data: HyTES & LVIS

## Remote Sensing Data



Phytoplankton  
Functional Types

Plant Functional Traits and  
Species Composition

Leaf and Canopy  
Reflectance

Animal Point  
Counts

DNA and eDNA  
Samples

Lidar

Field Data

# BioSCape Overview

## Satellite Data:

MODIS, Landsat, Sentinel, EMIT, ECOSTRESS

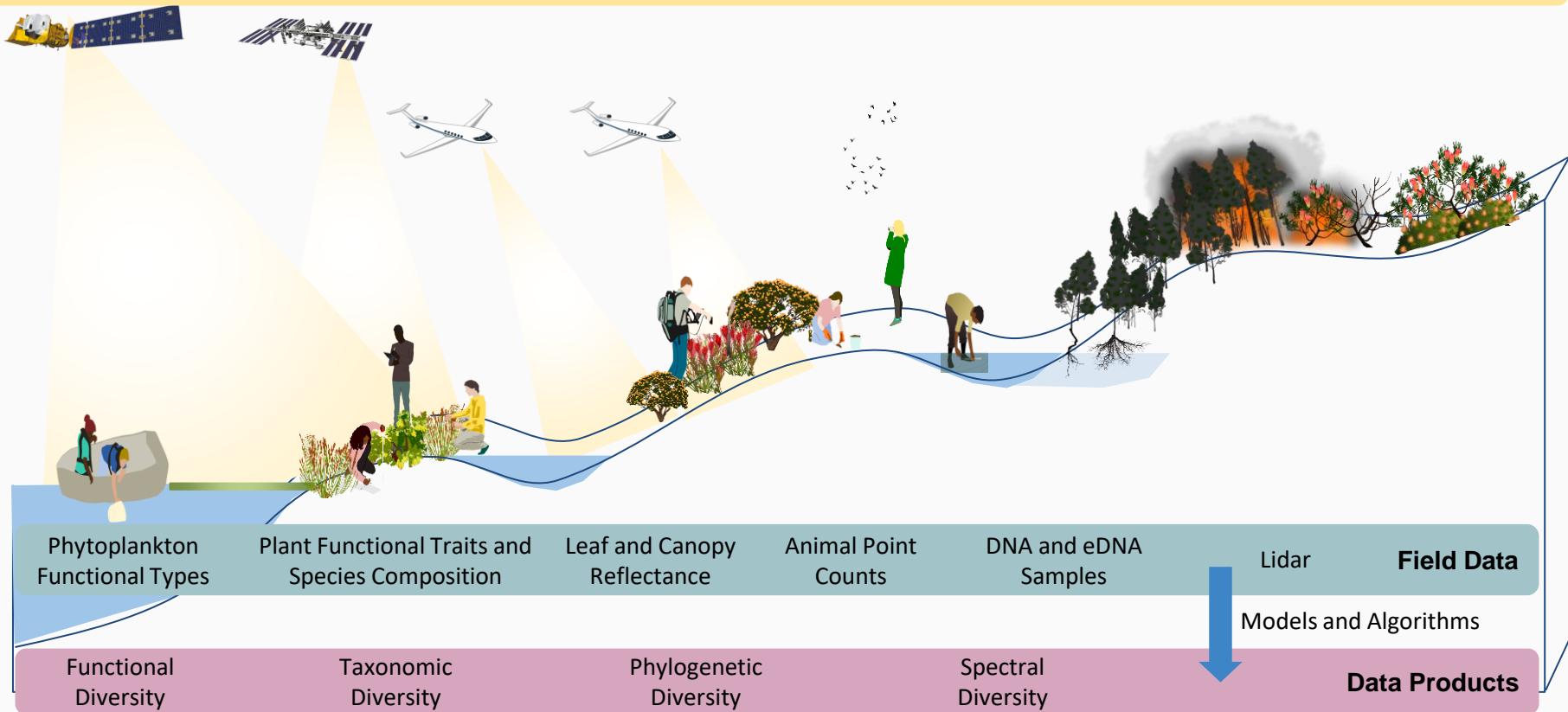
## Hyperspectral Airborne Data:

AVIRIS-NG & PRISM

## Thermal Emission and Laser

Altimeter Data: HyTES & LVIS

## Remote Sensing Data



# BioSCape Overview

## Satellite Data:

MODIS, Landsat, Sentinel, EMIT, ECOSTRESS

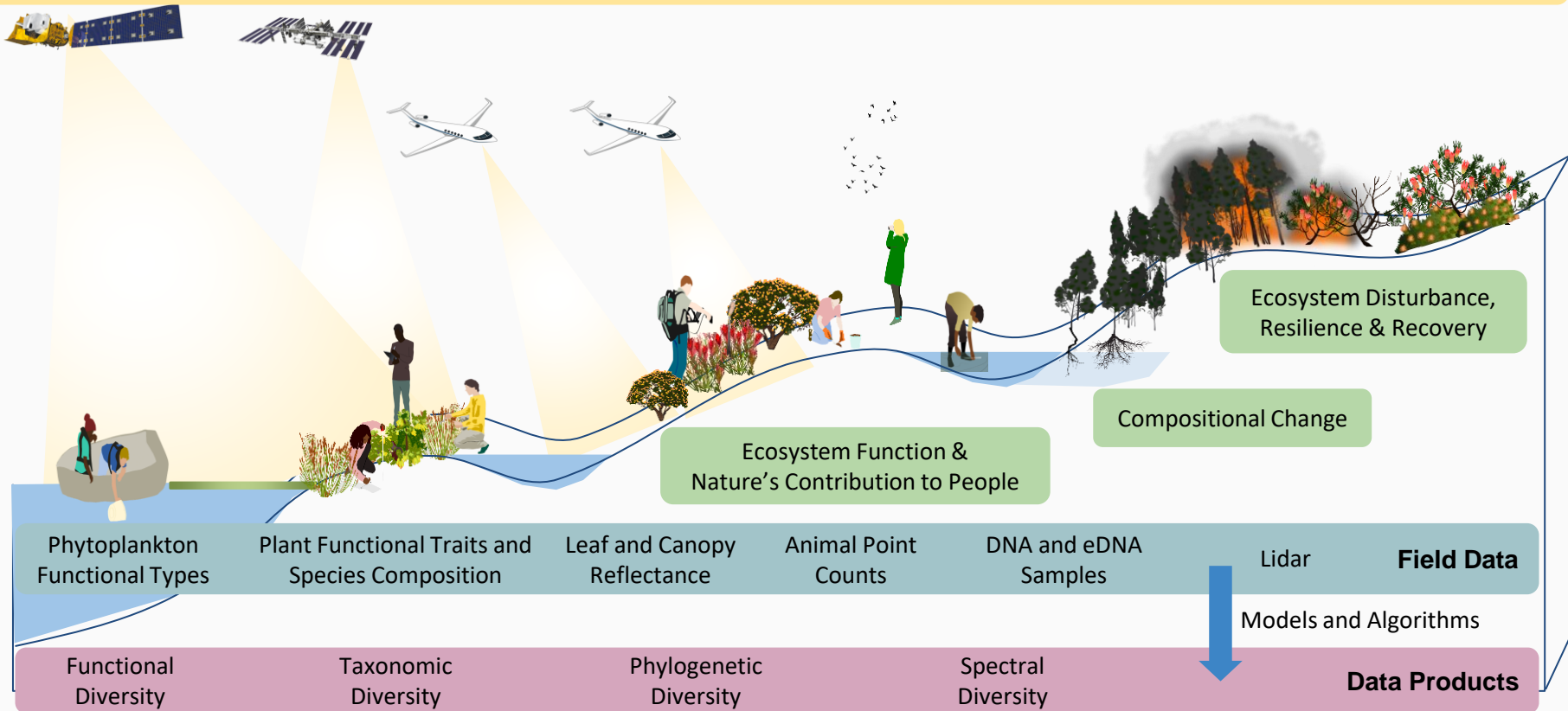
## Hyperspectral Airborne Data:

AVIRIS-NG & PRISM

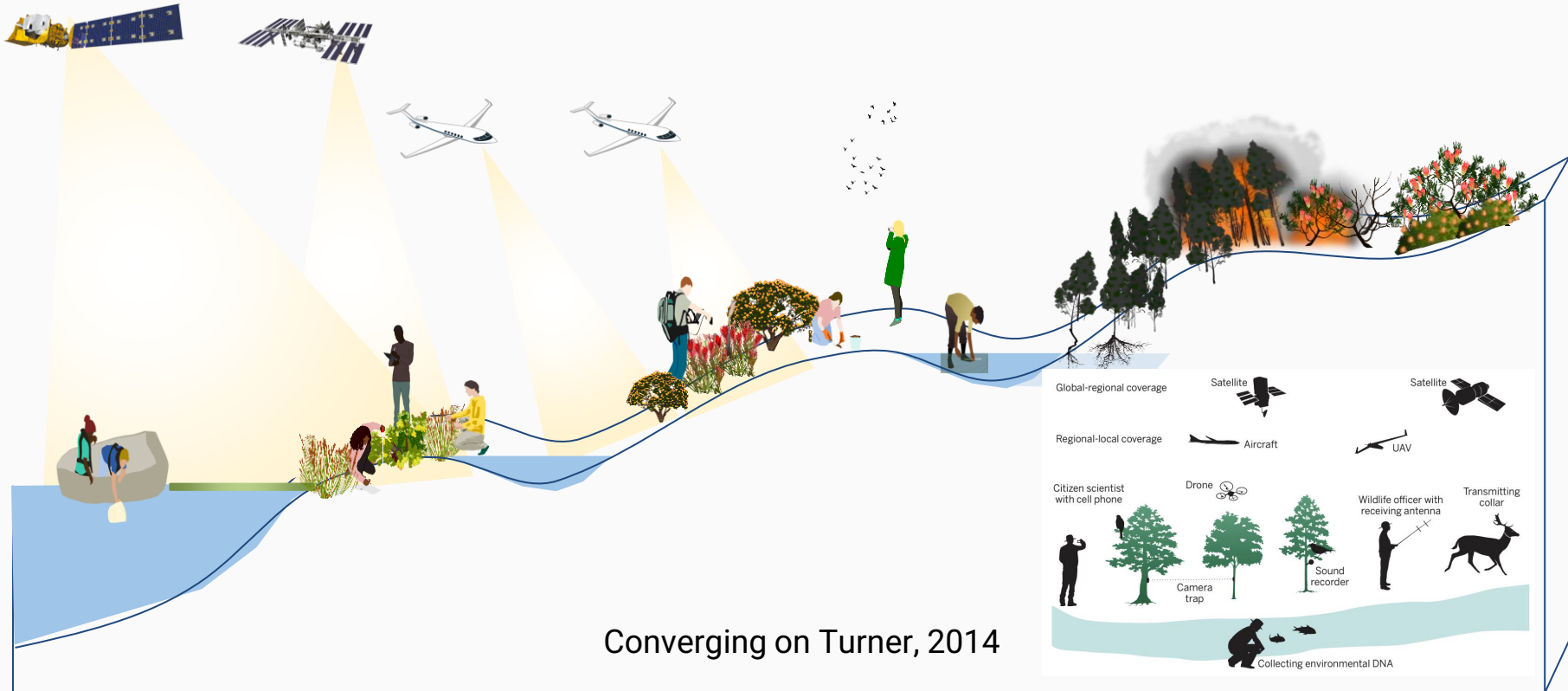
## Thermal Emission and Laser

Altimeter Data: HyTES & LVIS

## Remote Sensing Data



# BioSCape Overview





## Support

16 Funded Projects



14 Projects



science & innovation

Department:  
Science and Innovation  
REPUBLIC OF SOUTH AFRICA



NEOFrontiers

2 affiliated projects



Earth Science Project Office  
Logistics & Planning

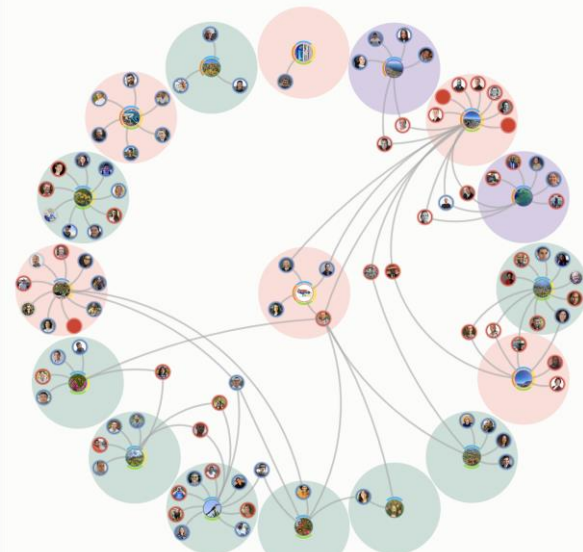
## Institutions



## People

157 people

~50:50% US:SA members



### Legend

- Terrestrial Projects
- Aquatic/Marine Projects
- Aquatic/Marine & Terrestrial Projects
- South African Participants
- USA Participants
- Other Country Participants

# Developing Aquatic Algorithms & Models

- Developing a hyperspectral radiometric method to map the spatial distribution of phytoplankton functional types across environmental gradients in coastal waters.
  - Jinghui Wu et al., Columbia
- Application of next-generation algorithms to determine the phytoplankton biodiversity, including potentially toxic cyanobacteria, and monitor floating aquatic vegetation in freshwater bodies.
  - Liane Guild et al., NASA AMES





# Developing Terrestrial Algorithms & Models

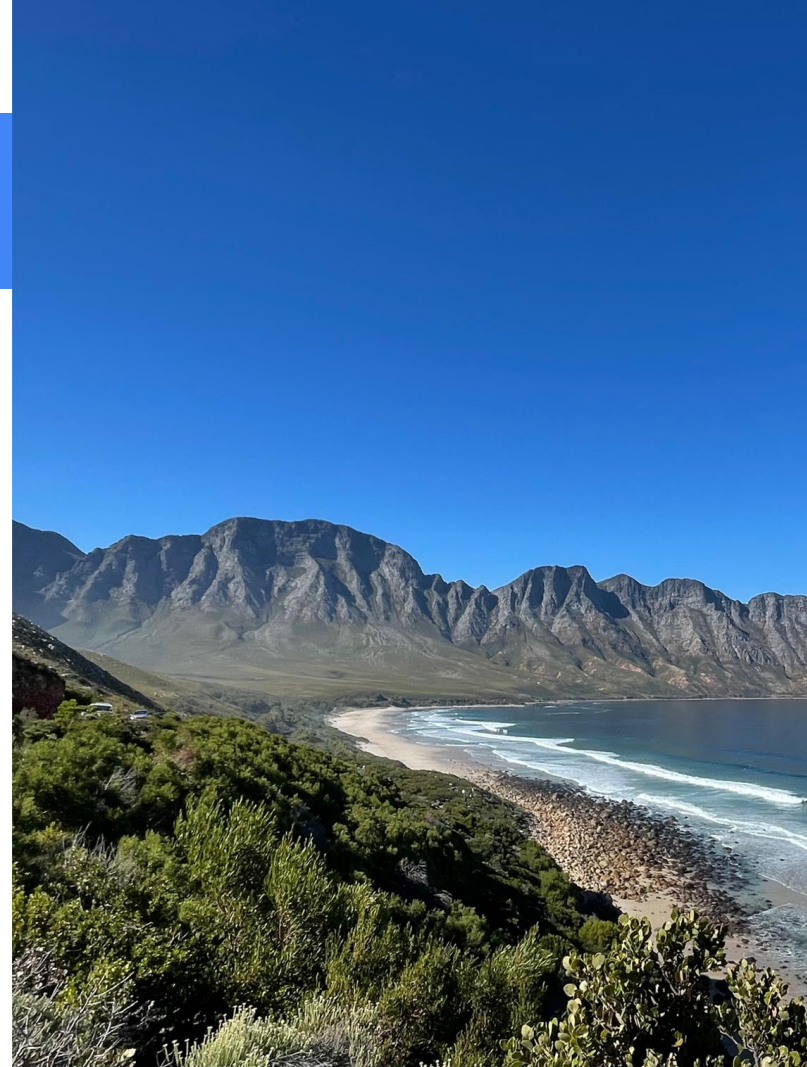
- Using the Intrinsic Dimensionality approach to estimate functional alpha, beta, and gamma diversity.
  - Kerry Cawse-Nicholson et al., NASA JPL
- Applying Generalised Dissimilarity Modelling and Gradient Forest approaches to assess the capability of remote sensing to detect different dimensions of community-level biodiversity.
  - Matthew Fitzpatrick et al., U. Maryland
- Investigating the scaling relationships between leaf and canopy level spectral measurements.
  - John Silander et al., U. Connecticut





# Radiative Transfer Modelling

- Using a Radiative Transfer Model to simulate the observed reflectance spectra for scenarios with varying taxonomic, functional, and phylogenetic diversity and composition.
  - Jan van Aardt et al., Rochester Institute of Tech.
- Producing a synthetic dataset of surface reflectances to top of atmosphere radiances over the natural vegetation, agricultural lands, aquatic realms, and the atmosphere.
  - Adriaan Van Niekerk et al., Stellenbosch U.
- Building a synthetic database based on parameterisation of 1D and 3D radiative transfer models, and exploring model algorithms to predict biochemical and biophysical parameters for the various ecosystems.
  - Moses Azong Cho, CSIR







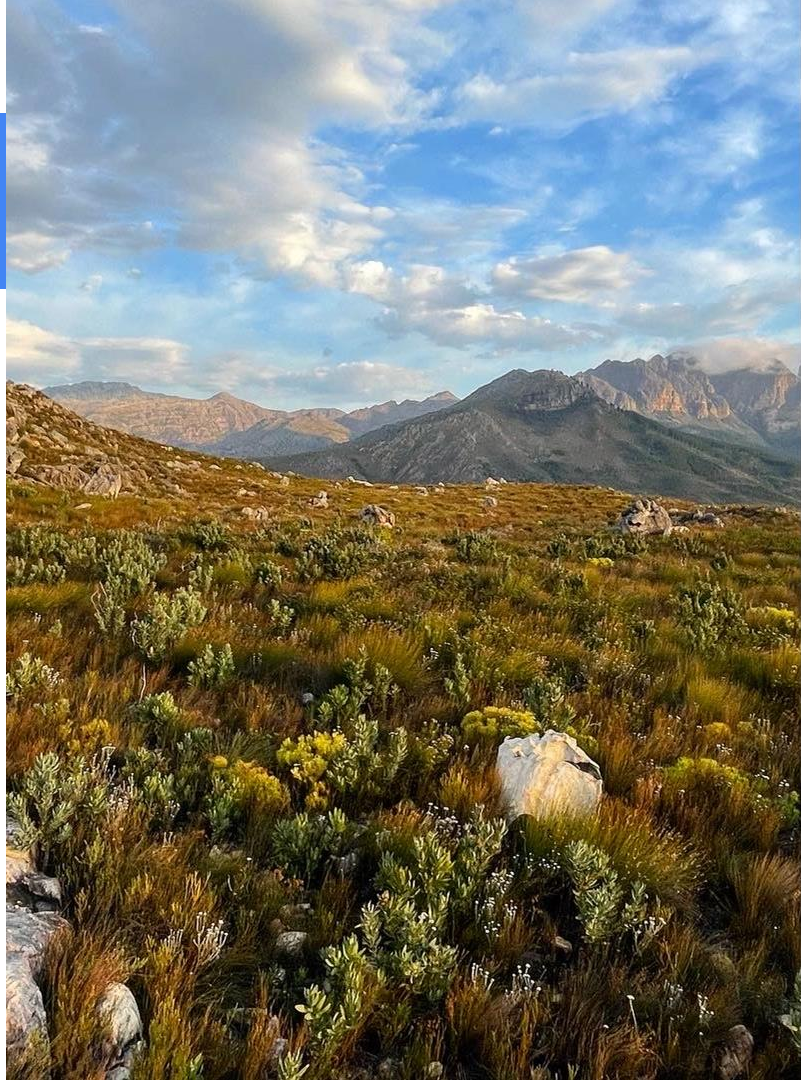
# Testing Novel Methods

- Using eDNA to observe phylogenetic, taxonomic, and functional biodiversity along freshwater to marine watersheds and assess the temporal (seasonal) signal of this diversity.
  - Natasha Stavros et al., U. Colorado
- Testing whether automated analysis of an ecosystem's sounds (i.e., soundscape) allows assessment of biodiversity distribution and habitat condition, and how these factors change spatially (e.g. distance from water or road).
  - Matthew Clark et al., Sonoma State U.



# Investigating Evolutionary Processes

- Quantifying functional trait composition and diversity and modelling the environmental drivers and macroevolutionary processes that underlie them.
  - Phil Townsend et al., U. Wisconsin
- Testing whether traits and spectra in major lineages show similar responses to contrasting environmental conditions.
  - Jeannine Cavender-Bares et al., U. Minnesota







# Answering Ecological Questions

- Mapping alien tree invasions and potentially affected ecosystem functions, including primary production and its temporal stability, water-use efficiency, and fuel loading for fire.
  - Peter Adler et al., Utah State U.
- Investigating microrefugia- specifically when and where are fynbos communities likely to be resilient to change, the extent that microrefugia may act as a buffer against climate change, and how much immigration is likely to offset local extinctions.
  - Cory Merow et al., U. Connecticut
- Evaluating the drivers of estuarine biodiversity and whether greater functional diversity increases climate resilience.
  - Atticus Stovall et al., U. Maryland

# Metrics of Success:

- Equitable Science
- Applications
- Capacity Building
- Outreach
- Education

## Avoiding Parachute Science

Encouraging US-SA collaboration through international teams, workshops, and joint-funding

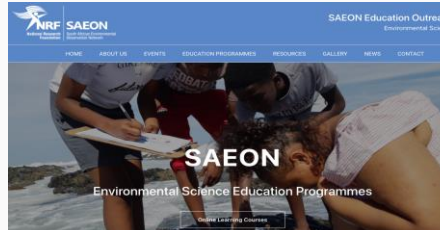


## Applied Courses for Practitioners

NASA Applied Remote Sensing Training (ARSET) Program to develop new BioSCape-related trainings and a potential in person workshop in 2023-2024.

## Reaching 'Broader' Audiences

Two South African (PhD) filmmakers to document BioSCape including time in the field with most teams and interviews following the campaign. [fishwaterfilms.com](http://fishwaterfilms.com)



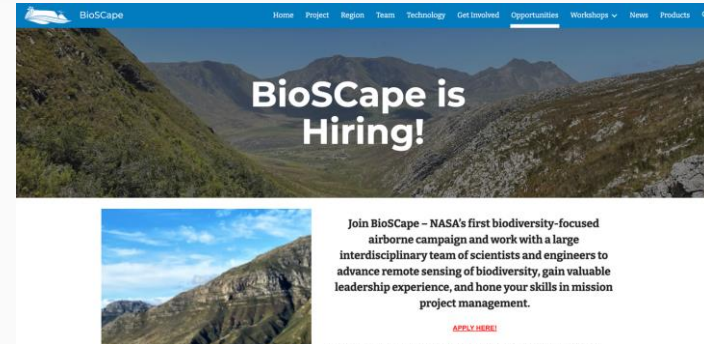
## Science Education

BioSCape 'open house' for kids to meet scientists, possibly visit the planes, and see field work (under development).



# Open Applications Coordinator Position!

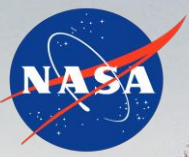
- Creating, building, and maintaining relationships with South African institutions.
- Pinpointing ways BioSCape data can support decision making processes and biodiversity applications.
- Teaching data end-users how to access and use the BioSCape data and other relevant remote sensing data products.
- Find and execute synergies between BioSCape research and South Africa's application needs.
- Document the ways in which BioSCape research is being applied by South African end users.
- PhD (or MSc) Graduate, based in Cape Town (some international travel expected).



Apply @

[bioscape.io/opportunities](https://bioscape.io/opportunities)





**BIOSCAPE**

Biodiversity Survey of the Cape

# Thank you!

# BioSCape.io

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# Metrics of Success:

- No Parachute Science
- Equity & Inclusion

“Parachute science occurs when scientists and/or NGOs from the Global North venture to the Global South to conduct research or deploy programs and **fail to invest in, fully partner with, or recognize local governance, capacity, expertise, and social structures.**”

*de Vos & Schwartz, 2022, Con. Bio.*

## Which of the following are most relevant to the issue of parachute science?

