# Near-Real-Time Forecasting and Change Detection for a Fire-Prone Shrubland Ecosystem

(NASA 80NSSC21K1183)

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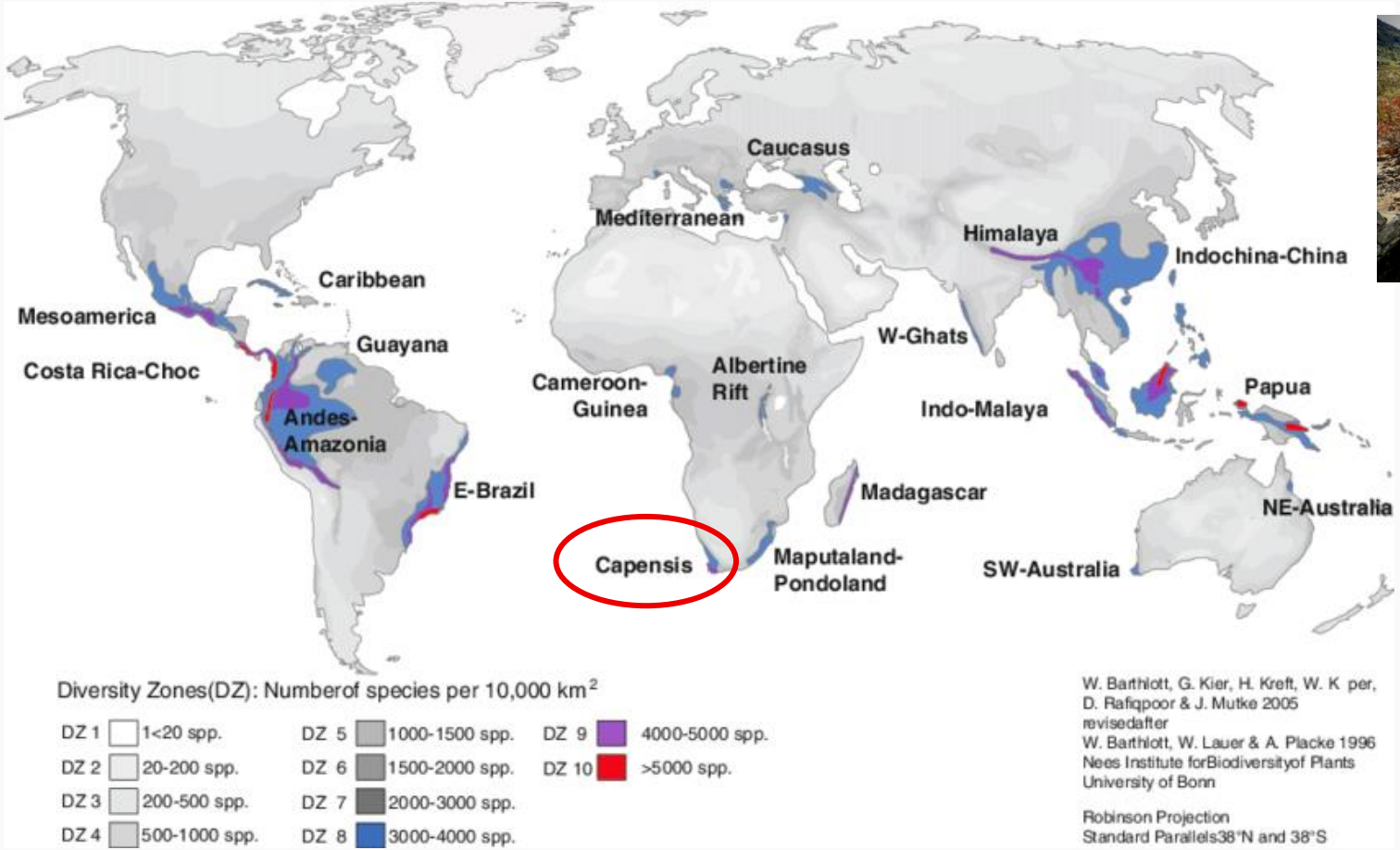
# Global Biodiversity Hotspots

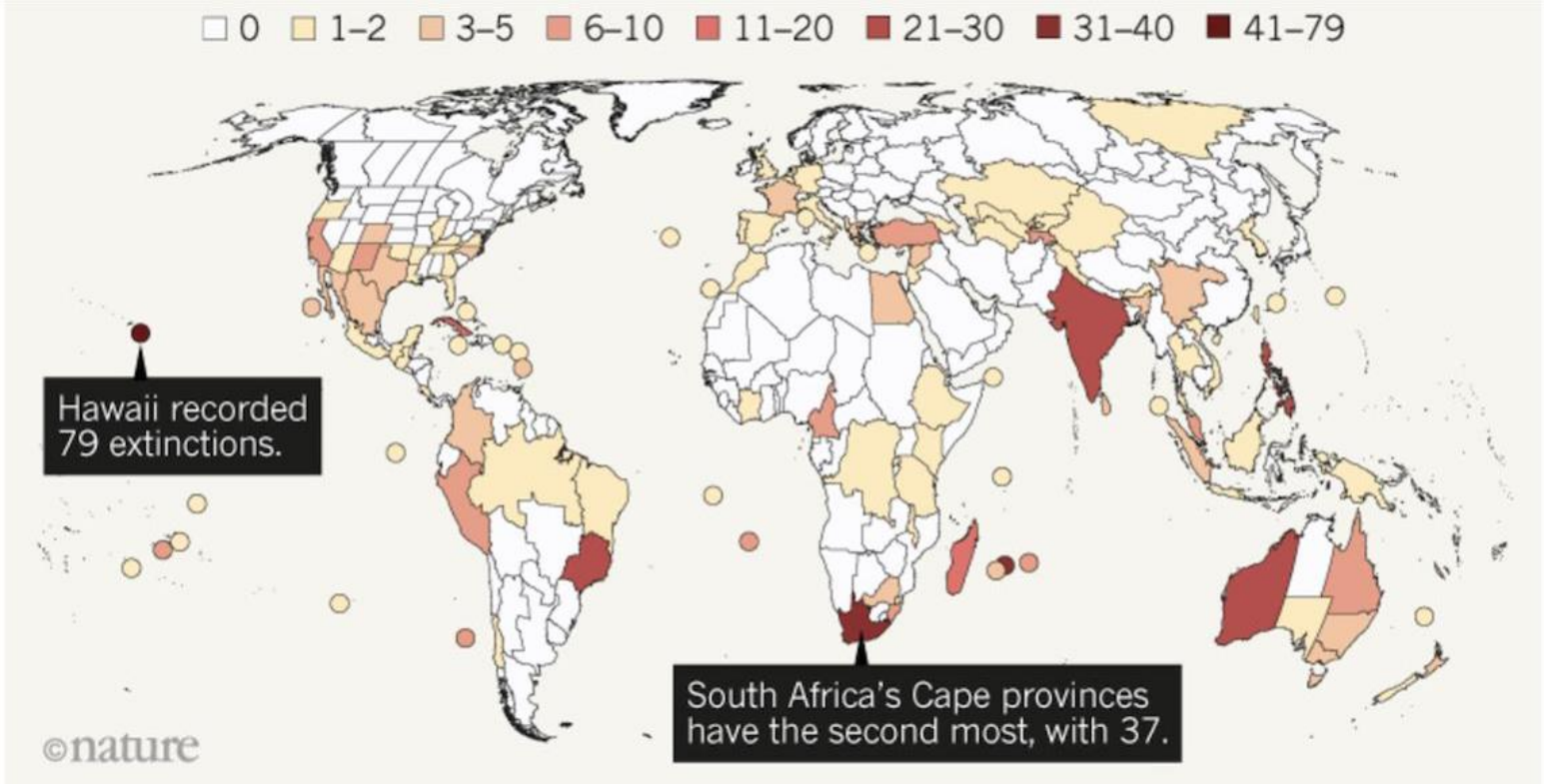



**Semi-arid shrubland**

Global map of species richness of vascular plants highlighting the 20 centres of highest species richness. Vascular Plant Diversity in a Changing World: Global Centres and Biome-Specific Patterns (2011) DOI:10.1007/978-3-642-20992-5_5

# Global Extinction Hotspot!

**Seed-bearing plant species lost since 1900**

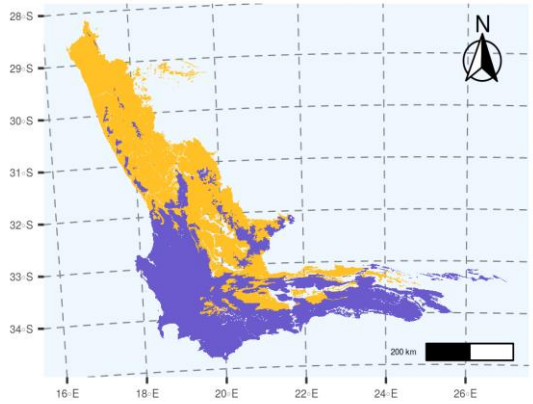



Humphreys et al. 2019

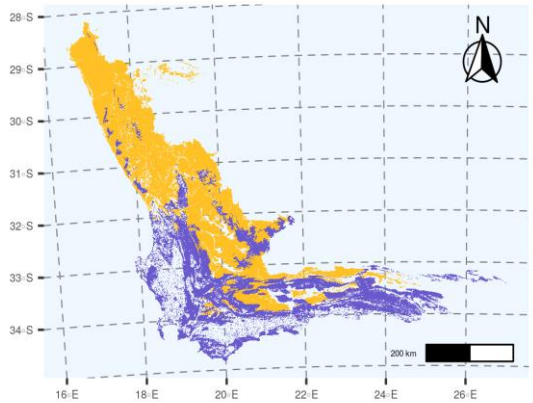
# Major Threats

## Habitat loss and fragmentation…

Skowno et al. 2021. SAJS https://doi.org/10.17159/sajs.2021/8182
Ntshanga et al. 2021. Aus Ecol http://dx.doi.org/10.1111/aec.13037




Historical Biome Distribution



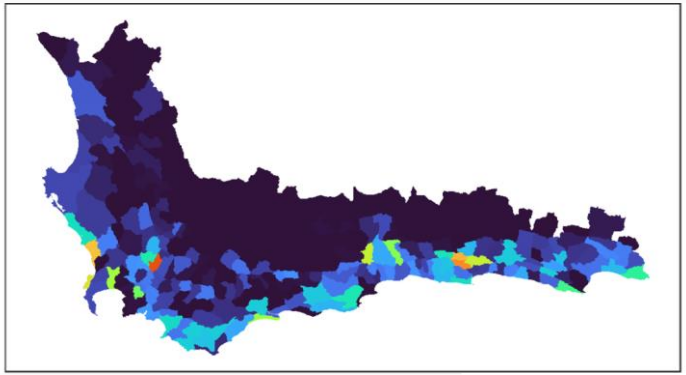

Current Biome Distribution

# Major Threats

## Invasive alien plants (trees in particular)

- outcompete local flora
- alter fire regimes
- reduce runoff

## Reduction of freshwater supply due to alien plants

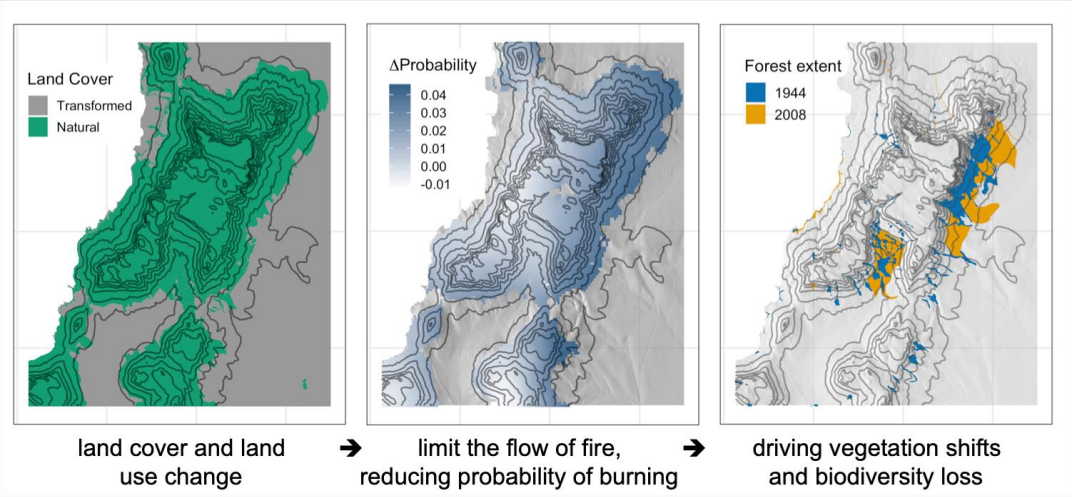



Moncrieff et al. Hydr Proc 2021
http://dx.doi.org/10.1002/hyp.14161
Slingsby et al. 2017 PNAS
http://dx.doi.org/10.1073/pnas.1619014114

# Major Threats

## Altered fire regimes

- population die-offs
- vegetation state shifts




Slingsby et al. 2020. Global Change Biology.
http://dx.doi.org/10.1111/gcb.14861

# Major Threats

Climate change…

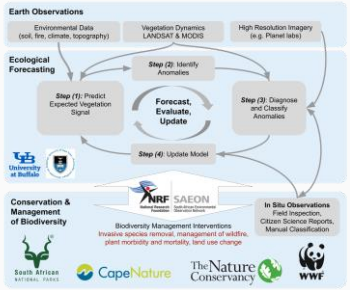
- population die-offs
- reduced postfire regeneration
- diversity loss
- shifts in functional composition

Slingsby et al. 2017 PNAS
http://dx.doi.org/10.1073/pnas.1619014114
Slingsby et al. 2020 ISPRS
https://doi.org/10.1016/j.isprsjprs.2020.05.017


How do we manage such a complex and dynamic system?
South African
NATIONAL PARKS
CapeNature
Photo: Jasper Slingsby

# 2021 Fynbos Forum: *Satellite monitoring of the Fynbos biome: identifying user needs*


~80 Participants from a variety of organizations across South Africa




**Breakout Rooms**

1. Fire management
2. Monitoring species and ecosystems
3. Invasive Species
4. Hydrology
5. Illegal vegetation clearing

**User Requests:**

- Records of past changes
- Current ecosystem status *in context*
- Spatial resolutions < 1 km
- Regular updates

SANBI Biodiversity for Life
South African National Biodiversity Institute

NELSON MANDELA UNIVERSITY

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

CSIR Touching lives through innovation

The Nature Conservancy

South African NATIONAL PARKS

BOTANICAL SOCIETY OF SOUTH AFRICA

CapeNature

SEEC - Statistics in Ecology, Environment and Conservation

NRF National Research Foundation

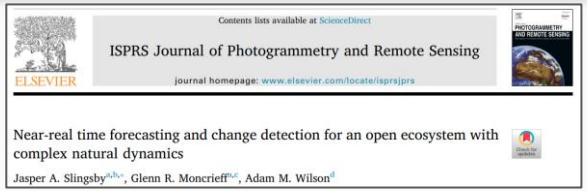
SAEON South African Environmental Observation Network

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Stellenbosch

# Near-real-time monitoring and forecasts of ecosystem state

ECOSYSTEM MONITORING MANAGEMENT APPLICATION

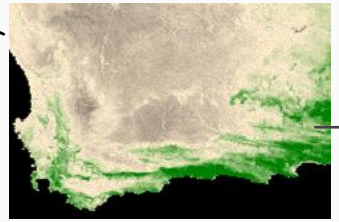
Use satellite time-series to identify fire, recovery, invasion, and change




https://doi.org/10.1016/j.isprsjprs.2020.05.017

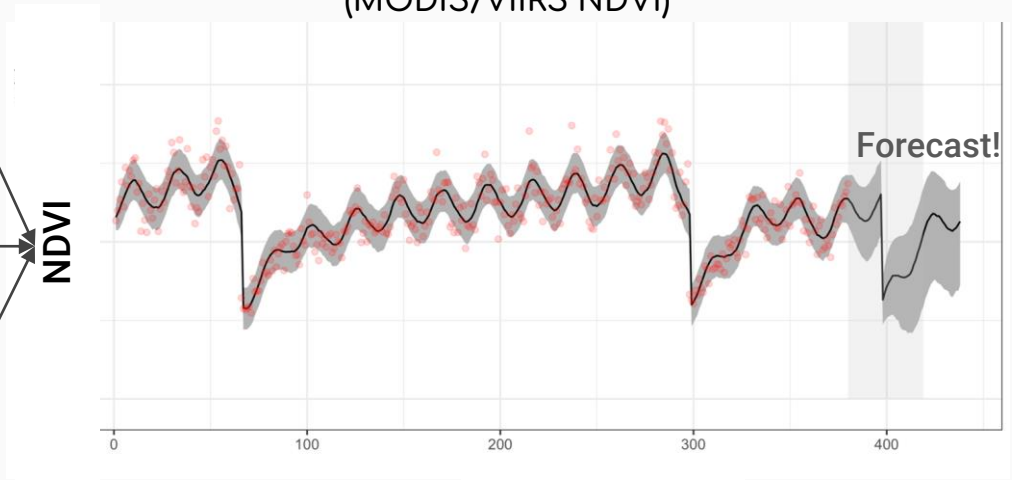
Fire

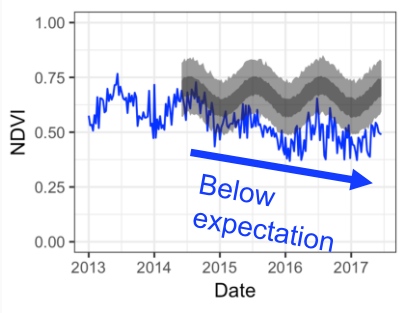
Seasonality



Regrowth

Postfire recovery trajectory (MODIS/VIIRS NDVI)



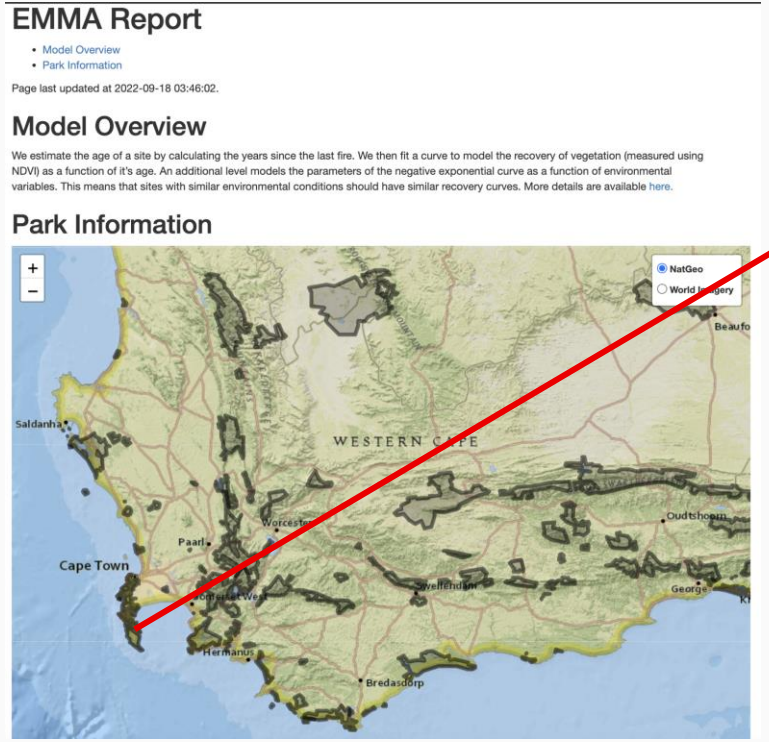




Shrub Mortality due to drought

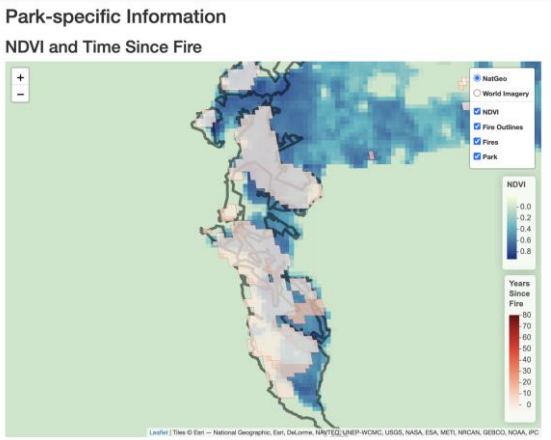
Comparing bayesian, state-space, & AI methods

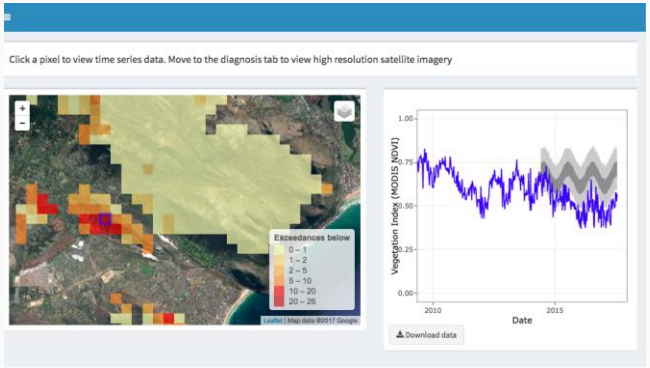
# Near-real-time change detection for Cape Floristic Region

## Regional summaries




## Park-level Reports




ECOSYSTEM MONITORING MANAGEMENT APPLICATION

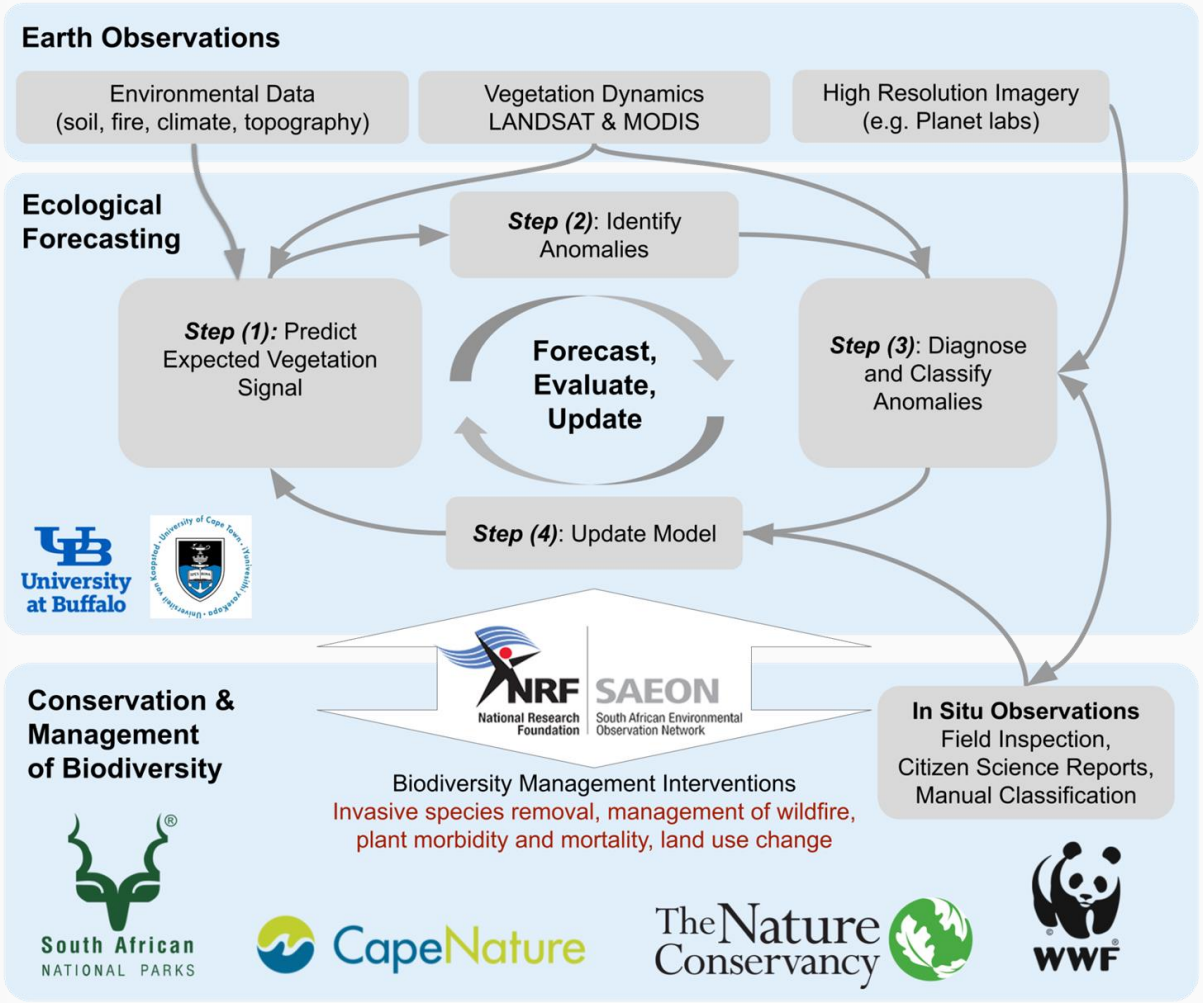
South African NATIONAL PARKS

CapeNature

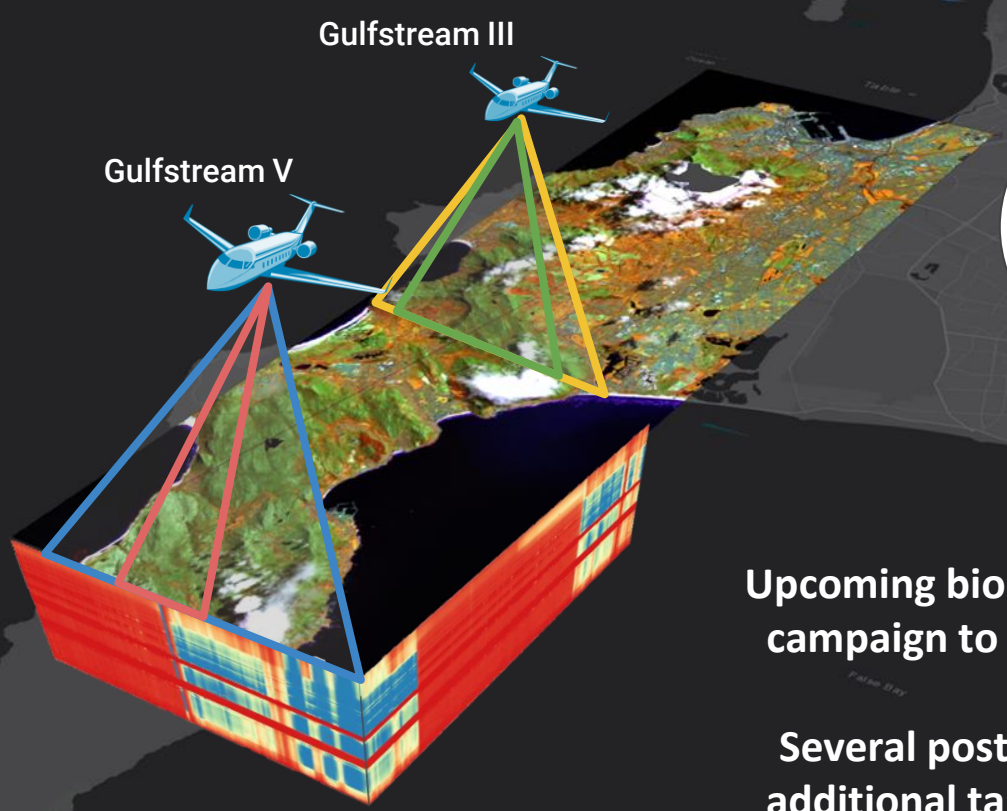
Use satellite time-series to identify fire, recovery, invasion, and change

ECOSYSTEM MONITORING MANAGEMENT APPLICATION

Partnering with regional stakeholders to develop an operational monitoring system in a dynamic ecosystem



# Applied component of the Biodiversity Survey of the Cape (BioSCape)




BIOSCAPE
Biodiversity Survey of the Cape

**Upcoming biodiversity field campaign to South Africa**

**Several posters today & additional talk tomorrow**

ECOSYSTEM MONITORING MANAGEMENT APPLICATION

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# Thank you!

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