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

(NASA 80NSSC21K1183)

Jasper A Slingsby[1,2], Brian Maitner[3], Glenn R Moncrieff[4,2,5], Yingjie Hu[3], **Adam M Wilson**[3]

[1] Biological Sciences and SEEC, University of Cape Town
[2] South African Environmental Observation Network, Fynbos Node
[3] University at Buffalo, NY
[4] The Nature Conservancy
[5] SEEC, Statistical Sciences, University of Cape Town

University of Cape Town · iYunivesithi yaseKapa · Universiteit van Kaapstad · SPES BONA

SEEC – Statistics in Ecology, Environment and Conservation

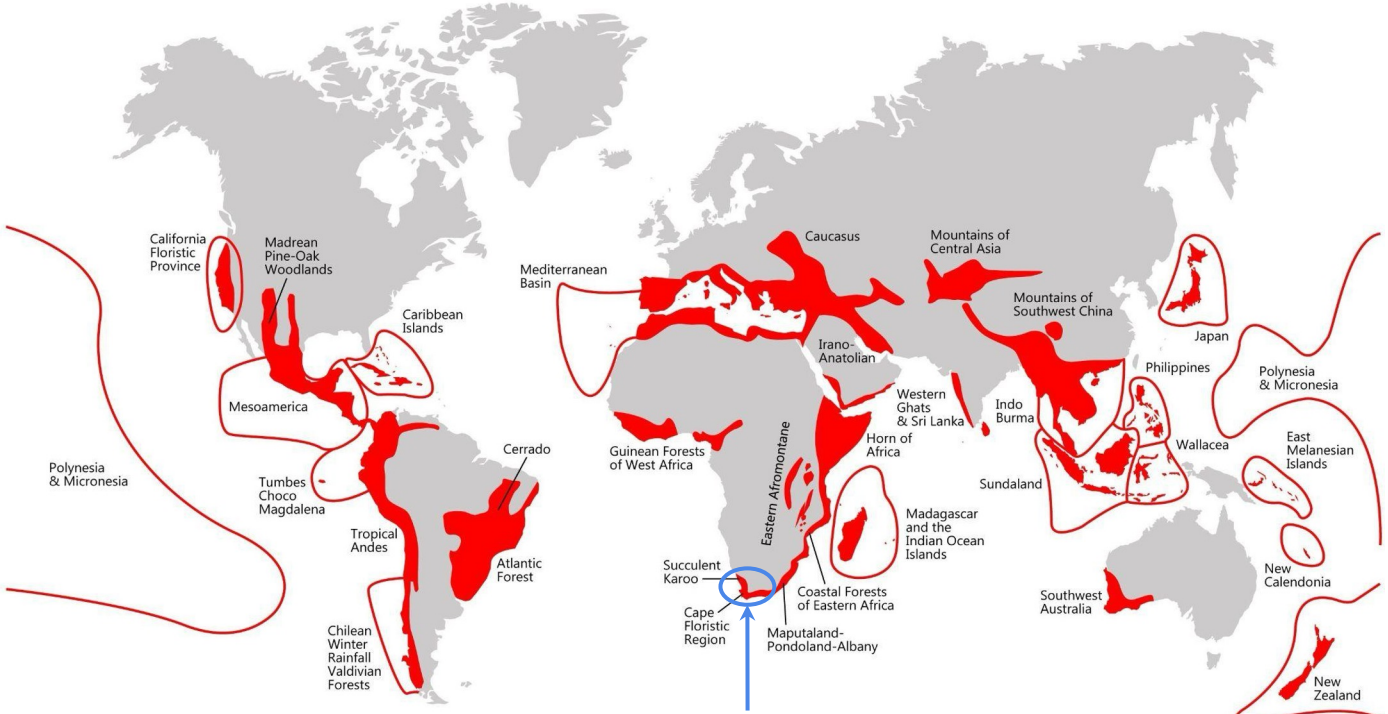
University at Buffalo
The State University of New York

The Nature Conservancy

NRF National Research Foundation | SAEON South African Environmental Observation Network

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

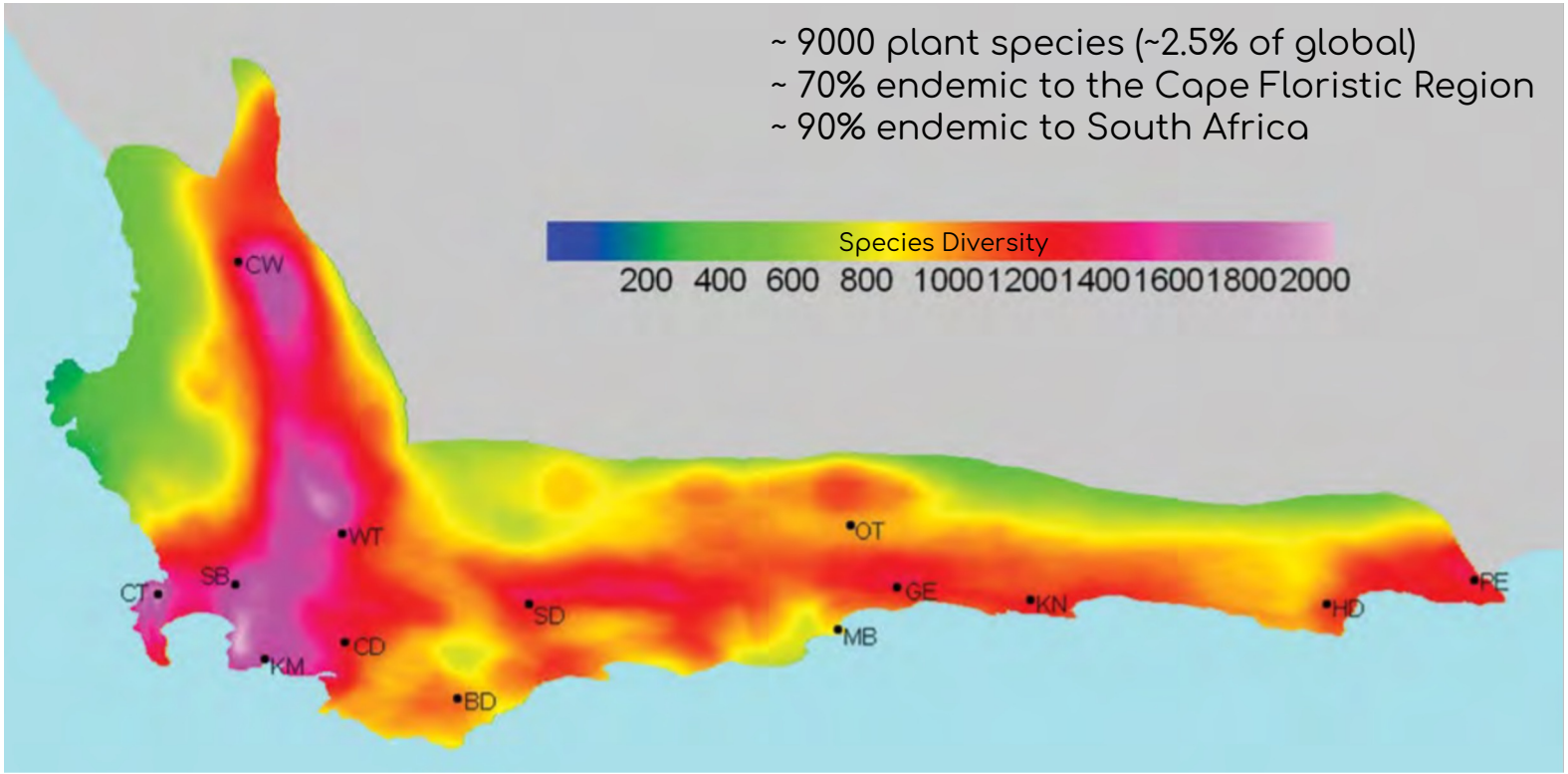
Global Biodiversity Hotspot!



HERE!!!

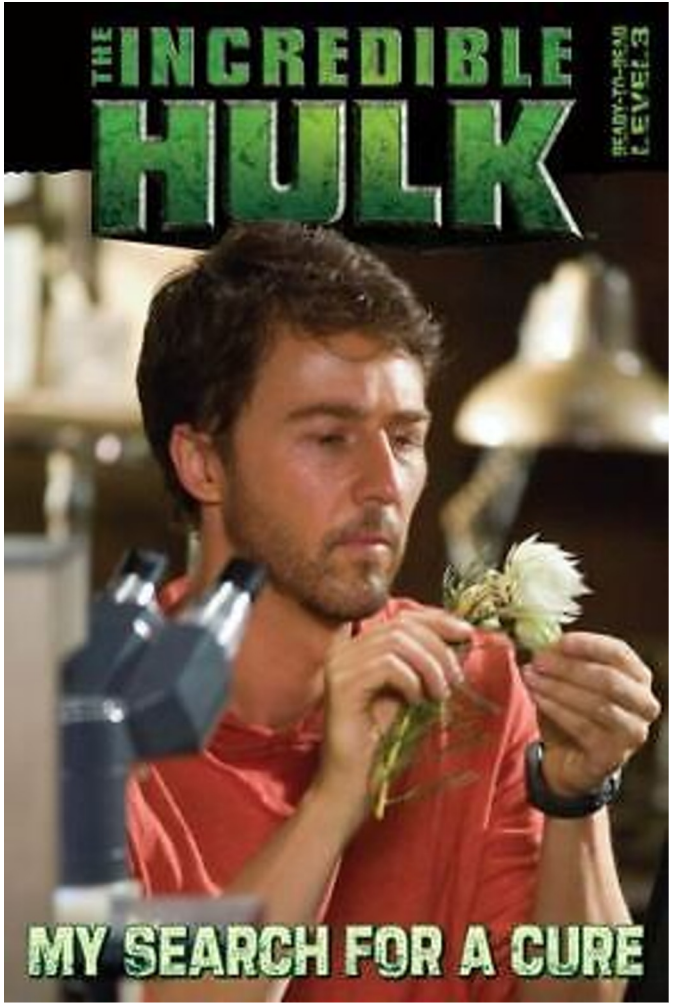
Myers et al. 2000. Nature. http://dx.doi.org/10.1038/35002501

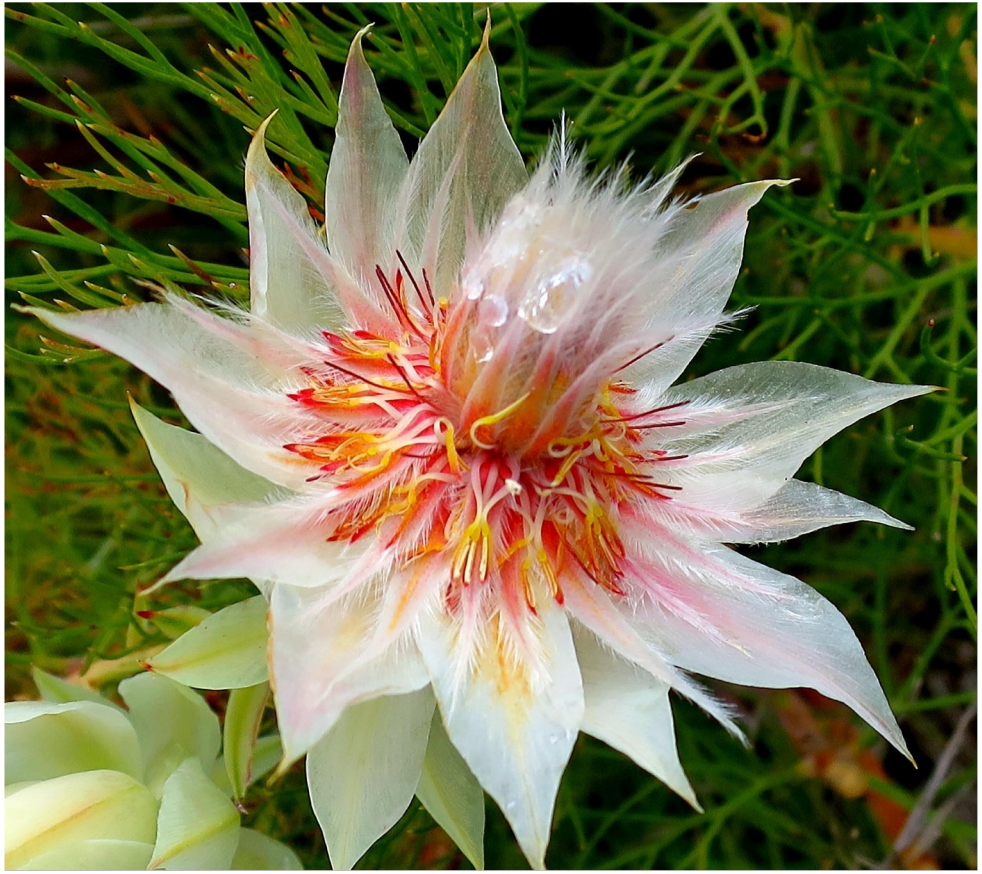
Global Biodiversity Hotspot!



Freiberg and Manning 2013

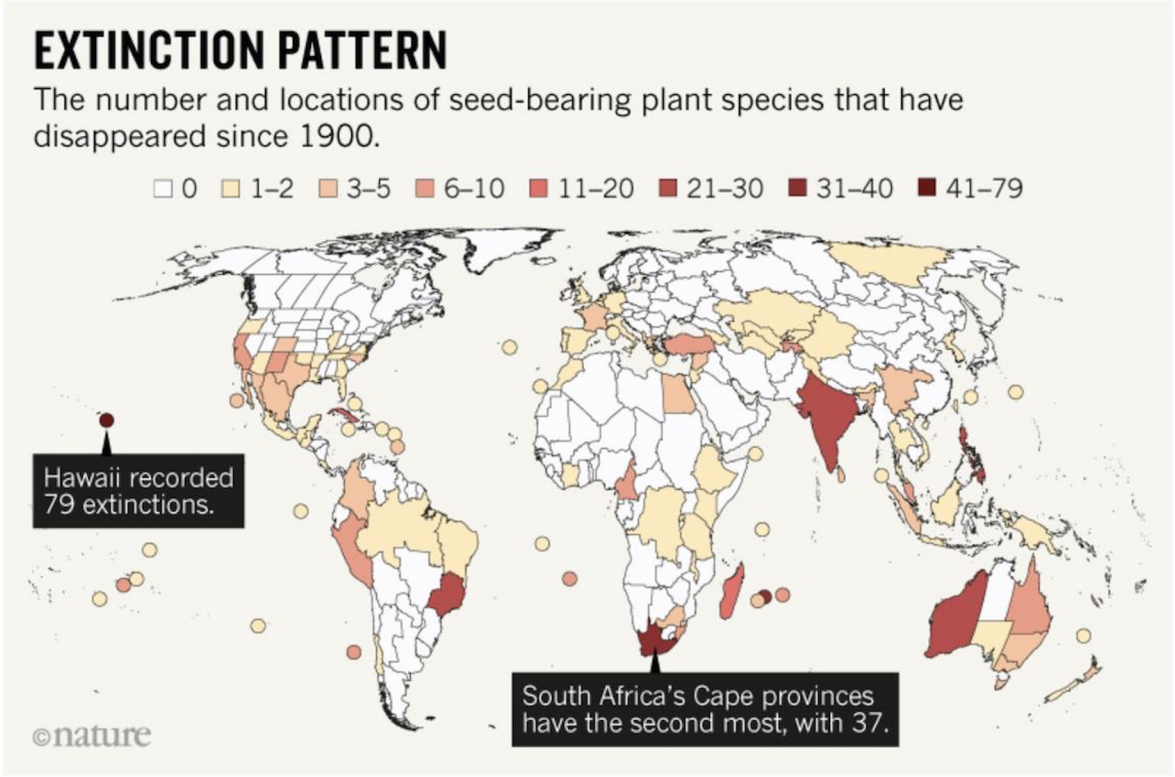
Source: iNaturalist.org





The Blushing Bride, *Serruria florida*, Proteaceae

Global Extinction Hotspot!



Humphreys et al. 2019


1

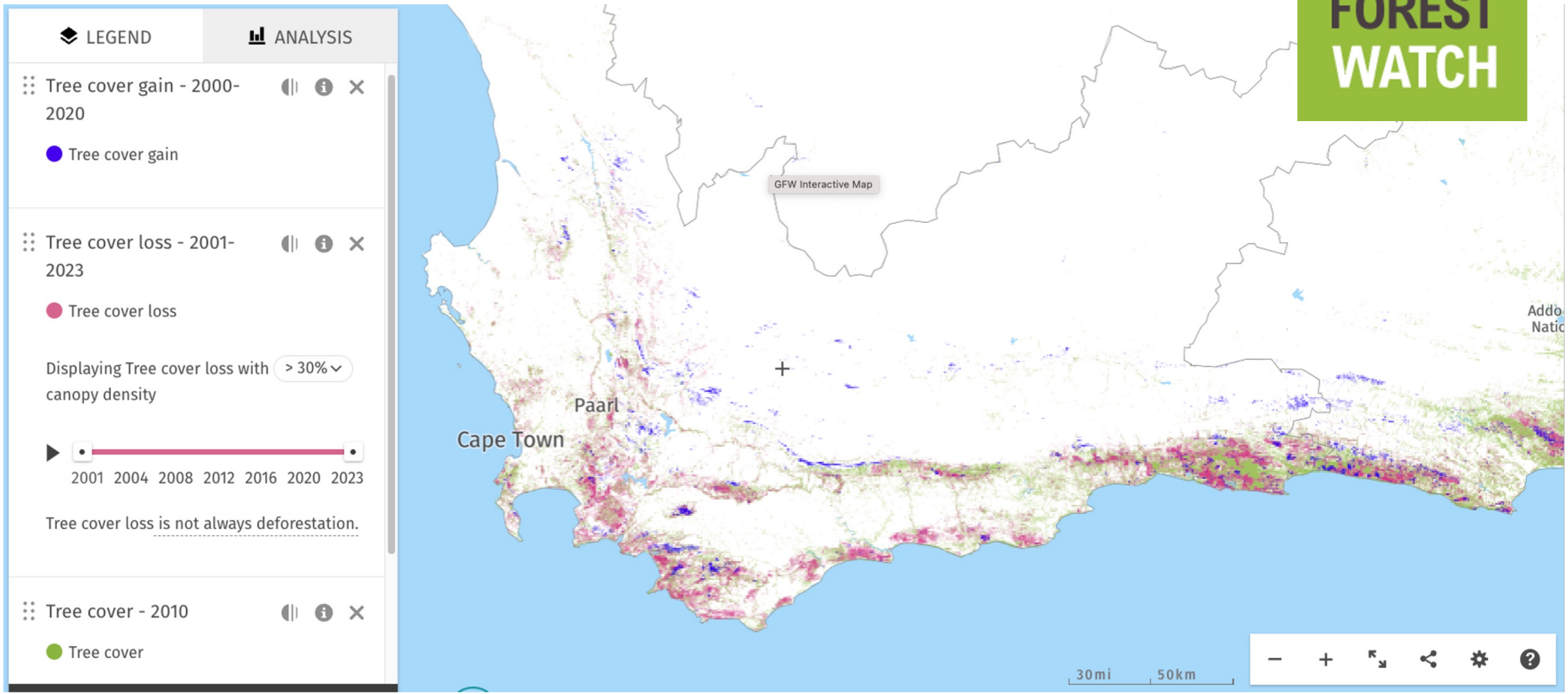
User needs?

How to allocate limited resources for:

- Policing unlawful land transformation?
- Alien tree clearing?
- Fire management?
- Monitoring climate change?

Among others...

Existing tools don't work here...

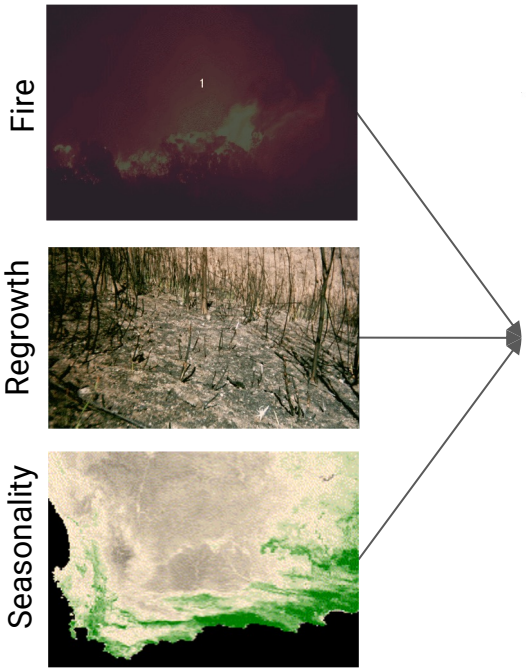


Modeling Fynbos Dynamics

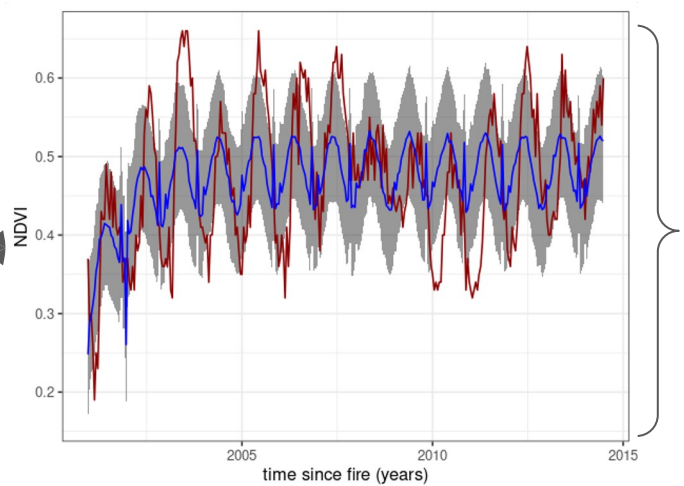
ECOSYSTEM MONITORING MANAGEMENT APPLICATION

Dynamism makes detecting change very difficult!!!

Healthy Fynbos can have almost any NDVI at any time!



Postfire recovery trajectory (satellite NDVI)



Grey is model forecast, red is observed vegetation activity

Modeling Fynbos Dynamics

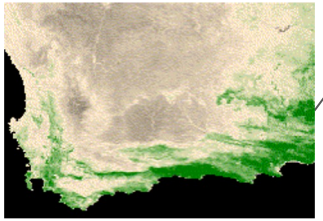
ECOSYSTEM MONITORING MANAGEMENT APPLICATION

Detect deviations from the model forecast!

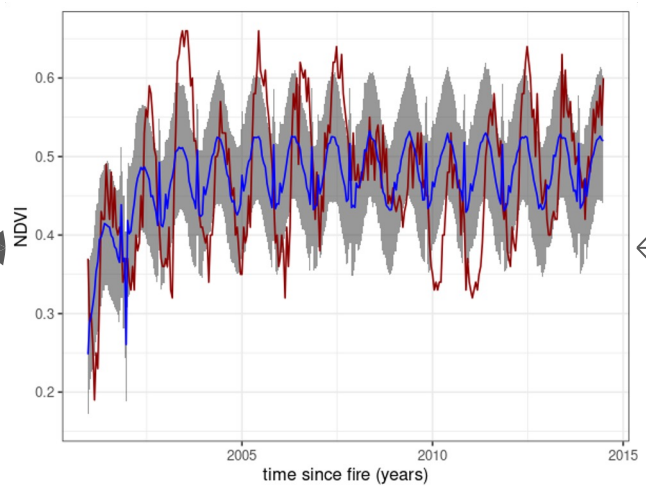
Fire

Regrowth

Seasonality



Postfire recovery trajectory
(satellite NDVI)



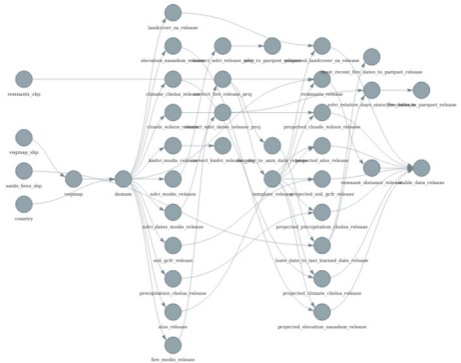
Habitat loss

Invasives

Climate

Informatics pipeline from data ingest to reporting interface

Github/Targets reproducible workflow

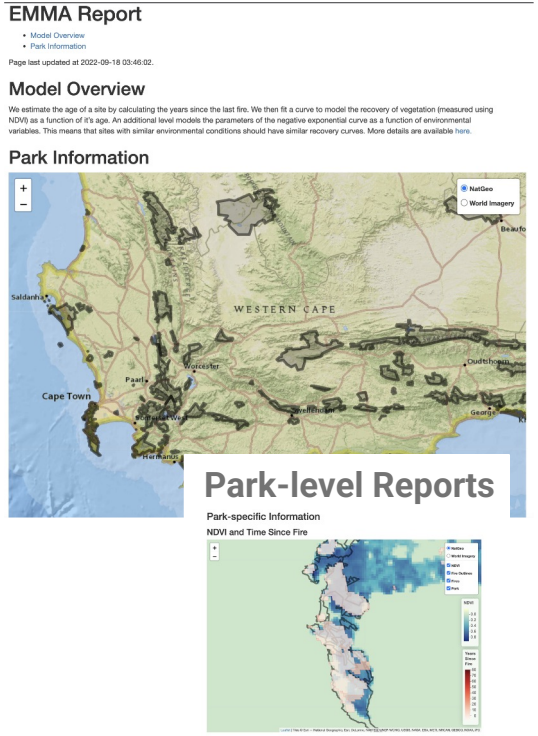


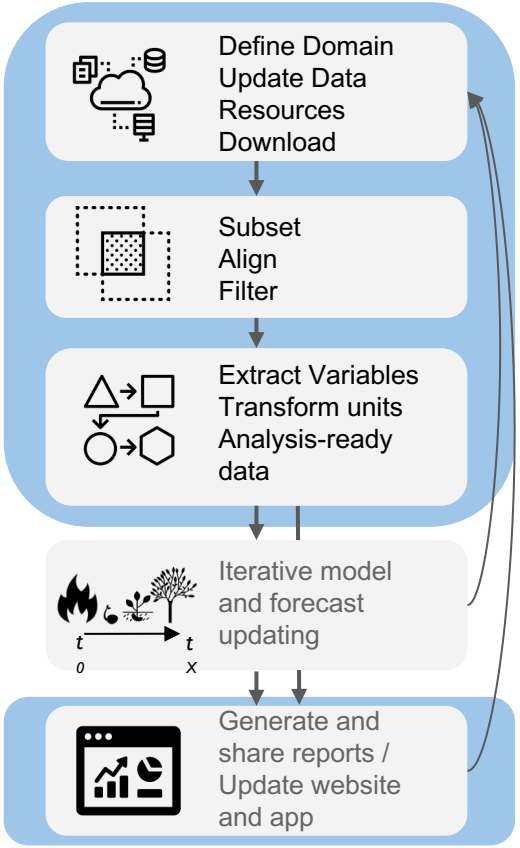
docker

targets

www.emma.eco

Regional summaries

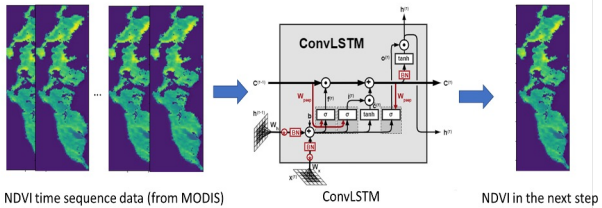




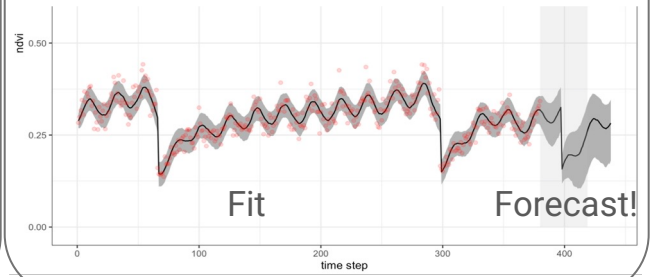
Model Development

- Less computationally intensive
- AI approaches (esp to diagnose deviations)
- Other satellite products

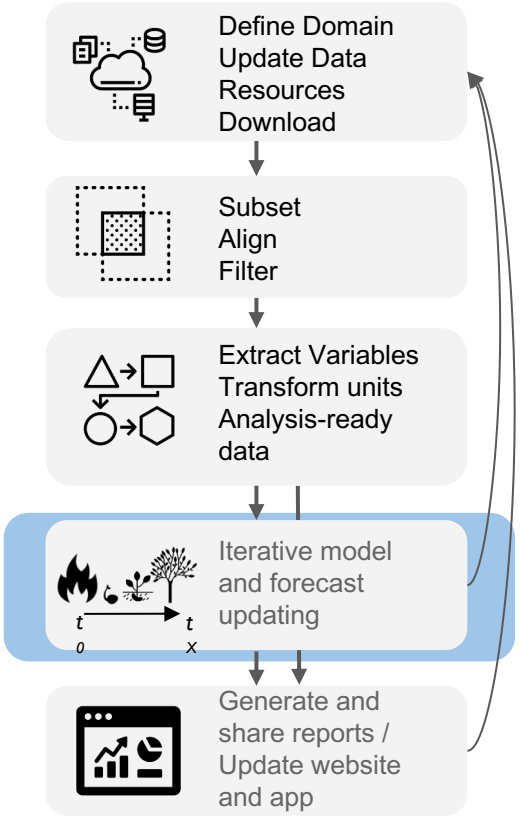
Using a Convolutional Long Short-Term Memory (ConvLSTM) model for prediction



Hierarchical state-space model



www.emma.eco



We want this working well before we go online!!!

Near-real-time Alerts

End Users

Near-real-time Alerts

Regular summaries

End Users

Management

South African National Parks

The Nature Conservancy

CapeNature

Policy

SANBI Biodiversity for Life
South African National Biodiversity Institute

Western Cape Government
FOR YOU

forestry, fisheries & the environment
Department: Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

ECOSYSTEM MONITORING MANAGEMENT APPLICATION

Near-real-time Alerts

Regular summaries

Global change Observations

End Users

Management

South African National Parks

The Nature Conservancy

CapeNature

Researchers

NRF National Research Foundation | SAEON South African Environmental Observation Network

University of Cape Town · Universiteit van Kaapstad · iYunivesithi yaseKapa

Etc...

Policy

SANBI Biodiversity for Life
South African National Biodiversity Institute

Western Cape Government FOR YOU

forestry, fisheries & the environment
Department: Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Near-real-time Alerts

Regular summaries

Verify Alerts

Global change Observations

End Users

Management

South African National Parks

The Nature Conservancy

CapeNature

Researchers

NRF National Research Foundation | SAEON South African Environmental Observation Network

University of Cape Town • Universiteit van Kaapstad • iYunivesithi yaseKapa • Yunivesithi

Etc...

Citizen scientists

C·R·E·W Custodians of Rare & Endangered Wildflowers

iNaturalist

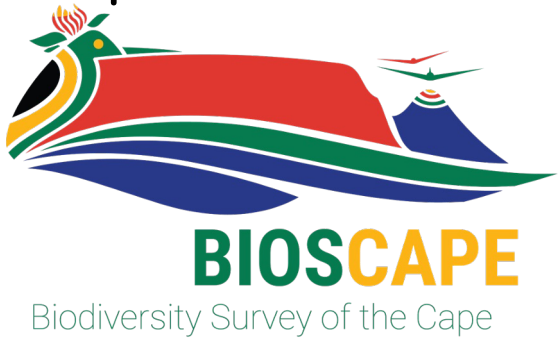
Policy

SANBI Biodiversity for Life
South African National Biodiversity Institute

Western Cape Government FOR YOU

forestry, fisheries & the environment
Department: Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

EMMA vs BioSCape?



Earlier work started in 2012

Very applied focus. Lots of stakeholder engagement

Platform for disseminating some of BioSCape's applied products?

Potential to learn from BioSCape to develop new approaches

Earlier work started in 2015

Initial focus on new technologies and opportunities

Increasing interest in potential for applications


Thanks!!!