Mapping Invasive Species in the Pacific: An Investigation
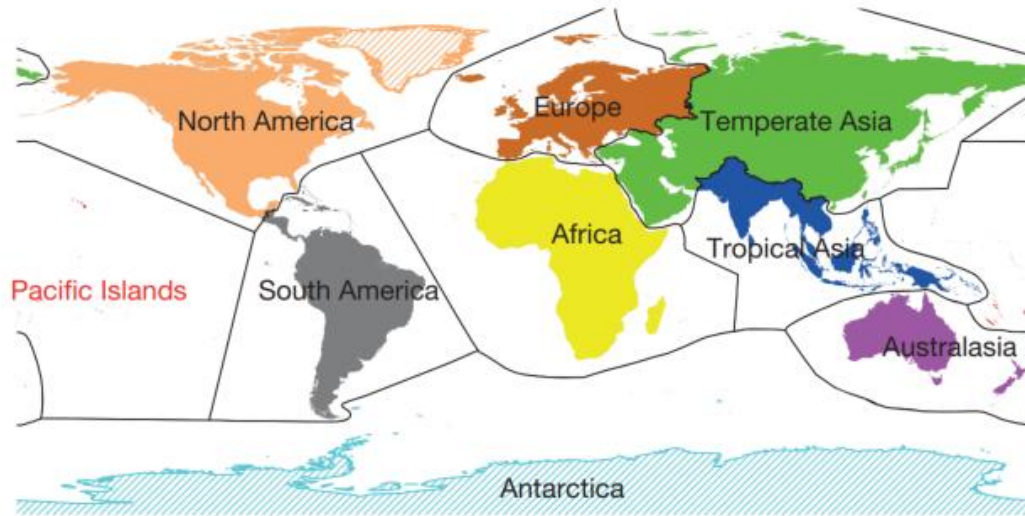
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The University of Newcastle

SPREP

Introduced Species and the Pacific?

Naturalised species-accumulation curves for major biogeographical areas
Figure 1: Map of the 9 Taxonomic Database Working Group continents
Figure 2: Naturalised alien species-accumulation curves

Published Database: https://glonaf.org/
Source: Van Kleunen *et al* 2015
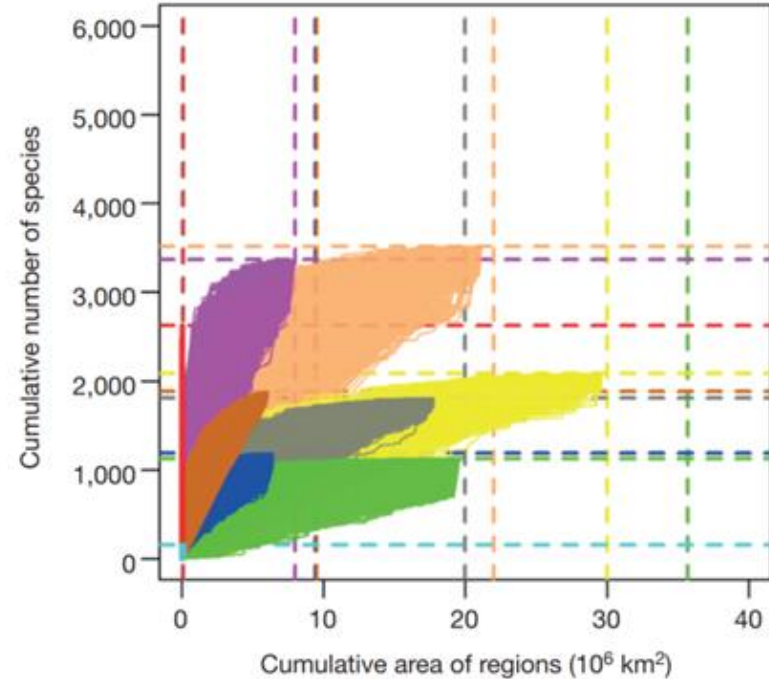
Invasive species

Invasive species: The impacts…

What kind of impacts?

- Second most leading driver of global change

- Economic impacts

- Environmental harm: biodiversity, including decline or elimination of native species

- Human health

More importantly

- Only a small portion of invasive species have been studied

- Climate change including cyclones threatens exacerbation

40%

Cumulative records of alien species have increased by **40%** since 1980

The rate of introduction of new invasive alien species is **higher than ever before** and shows no signs of slowing

70%

Across a set of 21 countries with detailed records, the no of IAS per country have risen by ~**70%** since 1970

Invasive Alien Species can have devastating impacts on biodiversity

for the native species

for assemblages on islands

for mainland assemblages

for assemblages in other settings with high proportions of endemic species

Can we better manage invasive species in the Pacific using geospatial tools and technology?

The candidates

African tulip

Devils ivy

Merremia

Where do we focus?

- Comprises of 10 islands, two main islands Savai'i and Upolu
- Majority of flora are of Malaysian origin
- Experiences high degree of economic and social shock during disaster years
- Is heavily impacted by the Merremia vine across agricultural fields and disturbed sites
- African Tulip and Taro vine are also common and have proliferated into urban areas

The African Tulip Tree

(Spathodea campanulata)

- 100 worst invasives by IUCN

- Limited literature

- Ornamental introduction, 1936 in Fiji

- Moist soils, sheltered tropical areas, elevations up to 1200m [1]

- Wind-blown seed and vegetative propagation

- Logistical growth curve (carrying capacity of 4000 trees per HA/40 yrs) [1]

[1] Brown and Daigneault (2014)

CHARACTERISTICS

- Flowering (April - August; all year round in some places)

- Moist soils

- Sheltered tropical areas (shade tolerant)

- Elevations up to 1200m

- Wind-blown seed and vegetative propagation

We know a bit, but not a lot….

IAS characteristics are known to differ outside of their native range. Will climate change impact their distribution? How can we gain some insight into their behaviour in the Pacific region?

SPECIES DISTRIBUTION MODELLING

Expansion outside of native range ---- > **BEHAVIOUR**

Current and future habitat suitability of African Tulip using available open data within the region -------> **RISK IDENTIFICATION**

Early Detection Tool

Rainfall zones suitability
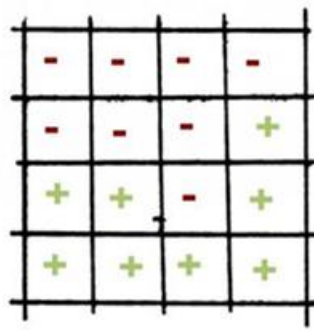
Altitude zones suitability
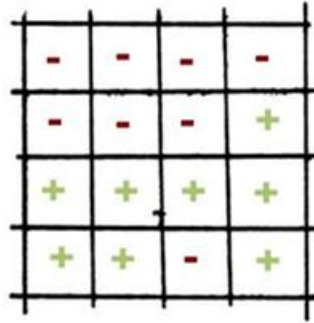
Current observations
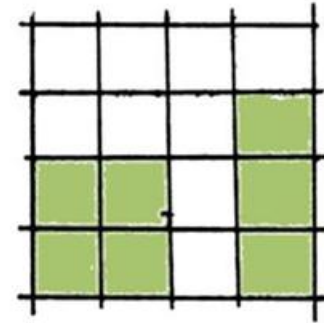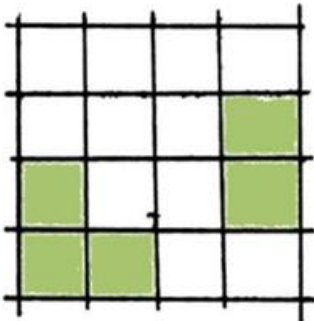
Habitat model based on suitable rainfall and altitude zones in combination with current observations
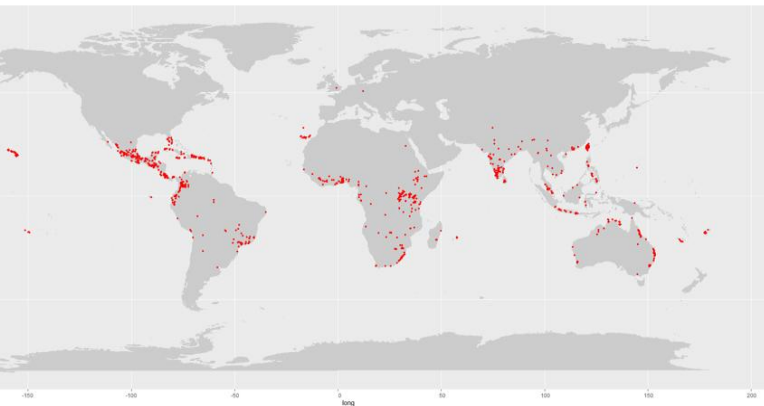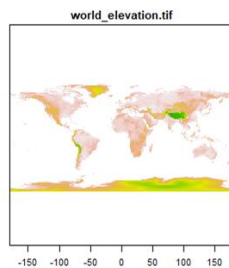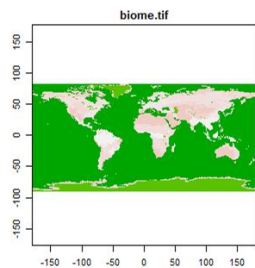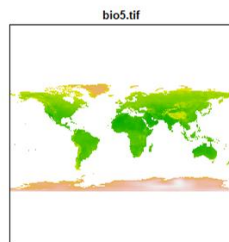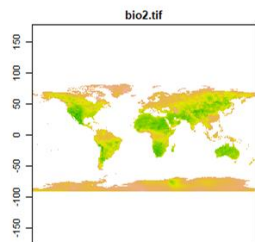
GBIF, iNATURALIST, field collected

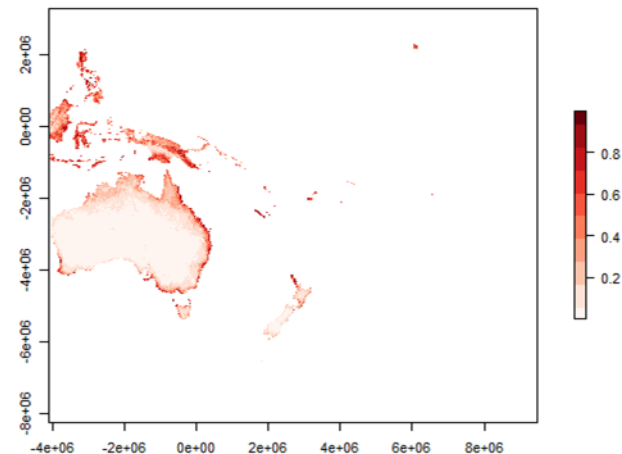## SPECIES OCCURRENCE

PREDICTED SUITABILITY

ENVIRONMENTAL PREDICTORS

WorldClim (2.5m, 30sec)
Bio1:19 variables
Elevation, Slope, Hillshade
Biomes

Predictor selection based on p-values
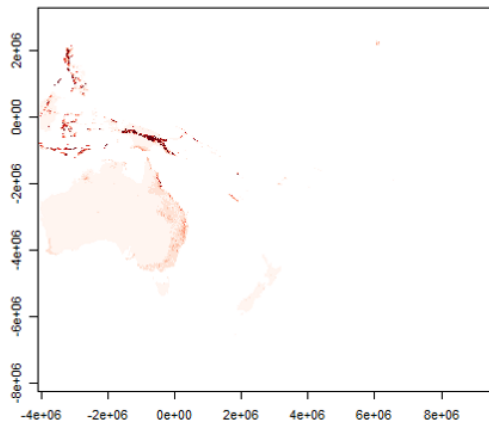
Removal of predictors based on >0.8 correlation

AFRICAN TULIP

Maxent

GBIF occurrence

WorldClim Bio Variables

Global Biomes

Elevation, Slope, Hillshade

Variable Selection

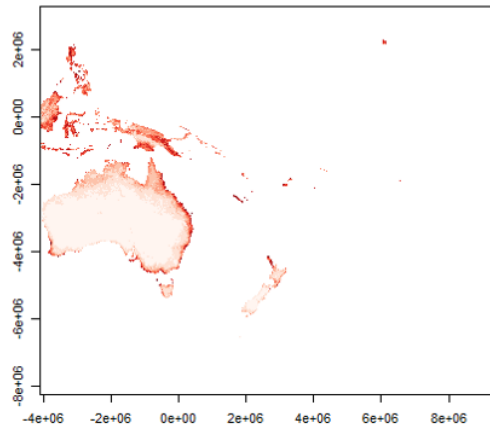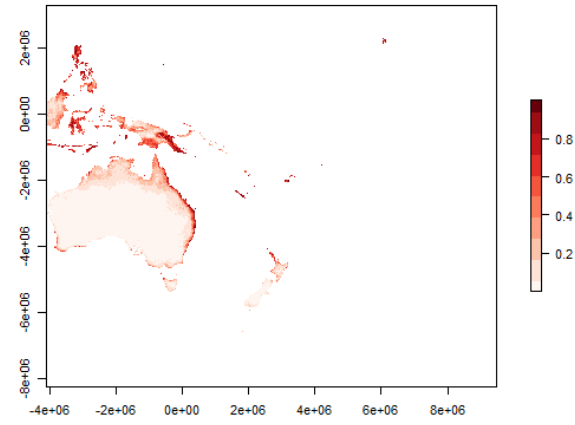Pearsons correlation

Literature

Pres Only NRP - 30s African Tulip Suitability for Pacific Region

Pres Only - 30s African Tulip Global Suitability for Pacific Region

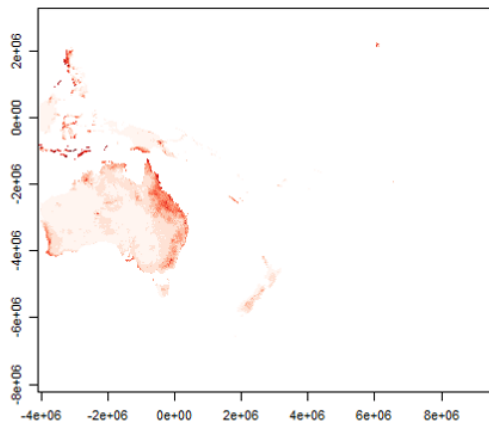Pres Only - African Tulip Global Future Suitability for Pacific Region
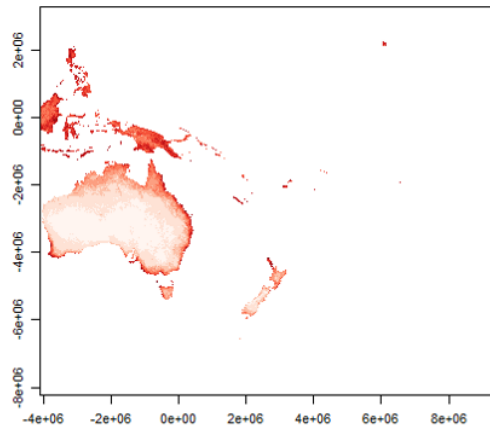
Native Range Geographic Restriction

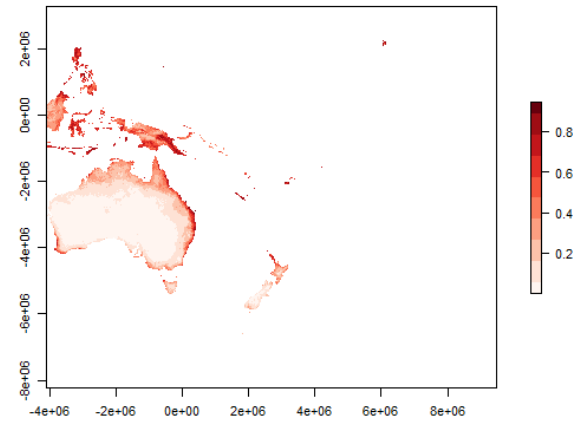**No Geographic Restriction**

Future Prediction (CIMP6)

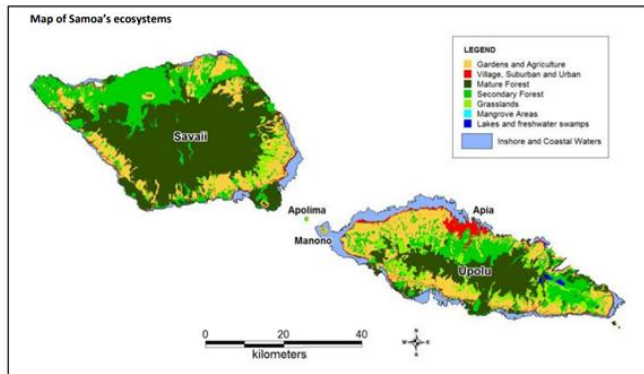Pres/Abs NRP - 30s African Tulip Probability for Pacific Region

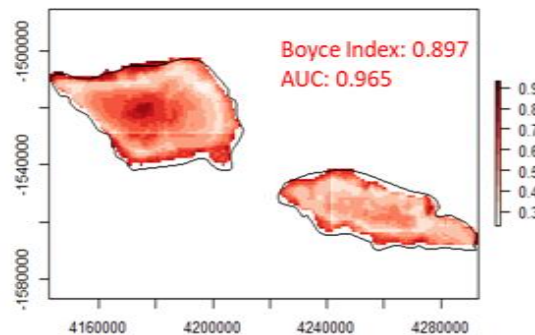Pres/Abs - 30s African Tulip Global Probabilty for Pacific Region

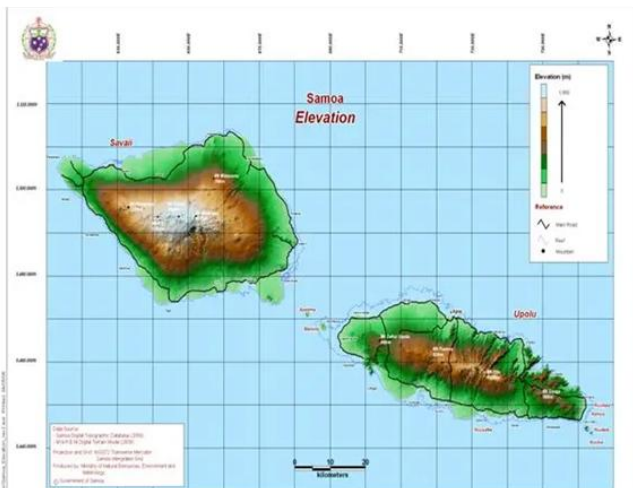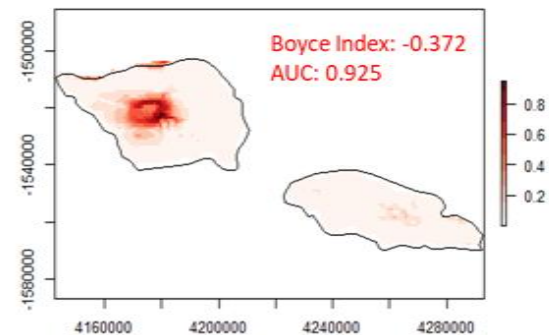Pres/Abs - African Tulip Global Future Probabilty for Pacific Region

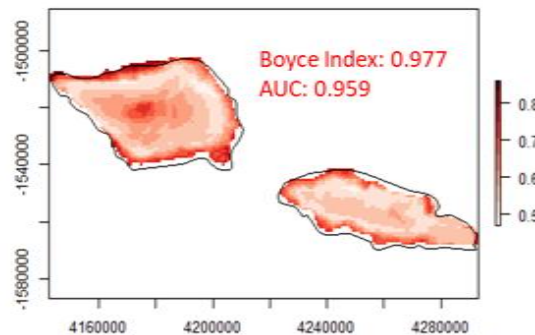Map of Samoa's ecosystems

LEGEND
- Gardens and Agriculture
- Village, Suburban and Urban
- Mature Forest
- Secondary Forest
- Grasslands
- Mangrove Areas
- Lakes and freshwater swamps
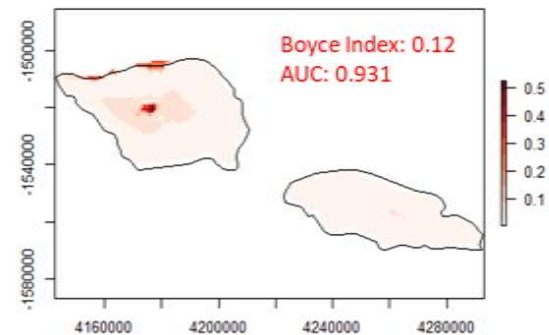- Inshore and Coastal Waters

Pres Only - African Tulip Global Suitabilty for Samoa

Boyce Index: 0.897
AUC: 0.965

Pres Only NRP Probabilty for Samoa

Boyce Index: -0.372
AUC: 0.925

Samoa Elevation

Pres/Abs - African Tulip Global Probabilty for Samoa

Boyce Index: 0.977
AUC: 0.959

Pres/Abs NRP - African Tulip Probability for Samoa
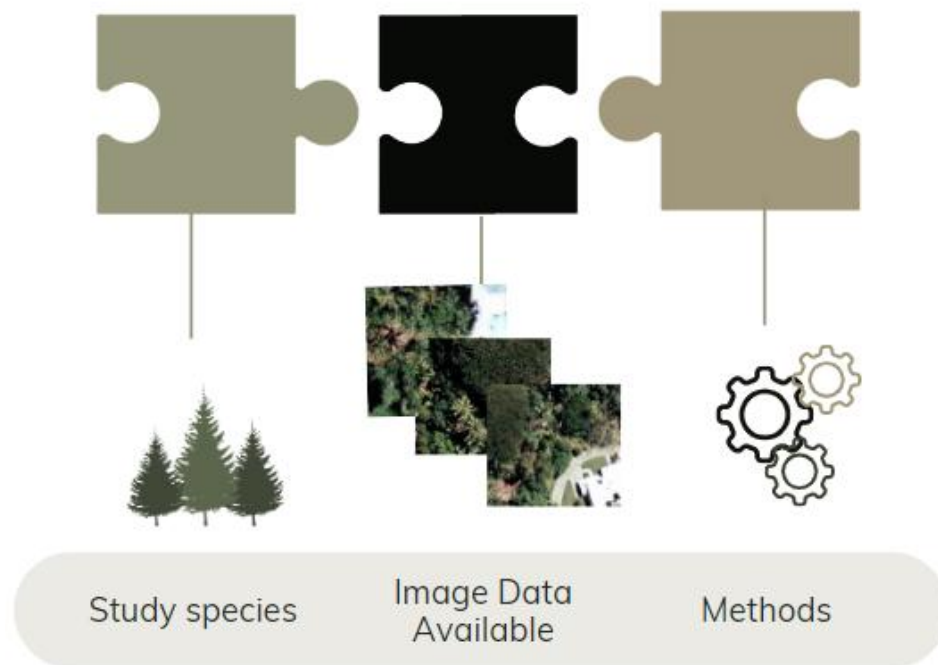
Boyce Index: 0.12
AUC: 0.931

Predicted vs Actual Distribution: Applying EO

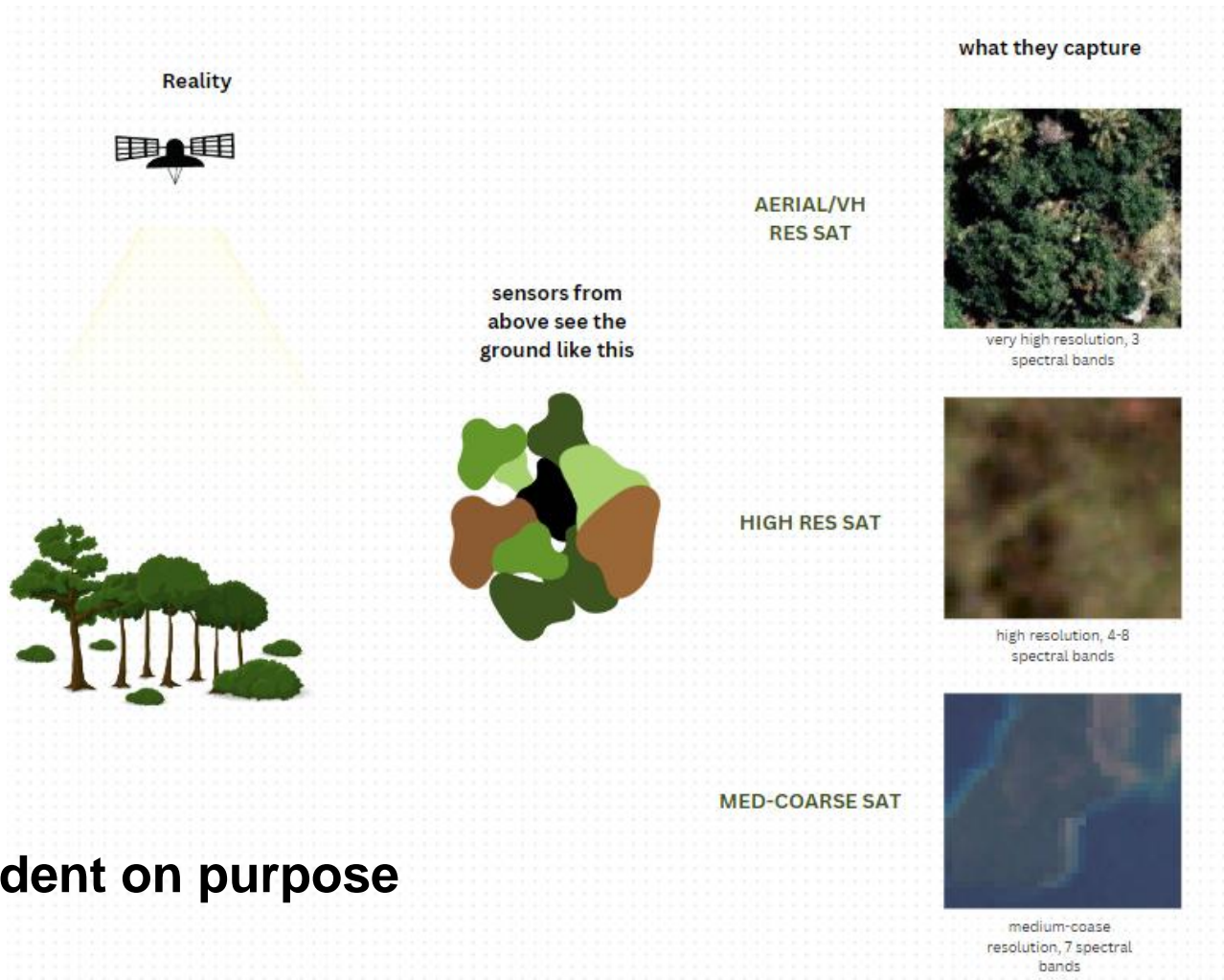Actual distribution benefits:

1. Quantitative result

2. Higher confidence interval

3. More requirements

Classification of invasive species (species level) distribution using Earth Observation

Biocontrol monitoring

Study species   Image Data Available   Methods

DEPENDENT ON SCALE OF MAPPING - > PURPOSE

Reality

what they capture

sensors from above see the ground like this

AERIAL/VH RES SAT

$$$$$ $$$$$

very high resolution, 3 spectral bands

HIGH RES SAT

$$$$$ $$$$$

high resolution, 4-8 spectral bands

MED-COARSE SAT

Publicly available, historical catalogue

medium-coase resolution, 7 spectral bands

Scale dependent on purpose

What image data is available

DATA AVAILABILE

FREE, PUBLICLY AVAILABLE

Landsat 7,8,9
Sentinel-1, 2, 3
Hyperion
AVHRR
MODIS

ORG OWNED, REQUEST

IKONOS
WV 1, 2, 3
Quickbird
GeoEye
Aerial Images (Procured)

LIDAR Series

PURCHASE

IKONOS
WV 1, 2, 3
Airbus
Planet
Quickbird
GeoEye
Aerial Images (Procured)

LIDAR Series

SHOULD I FOLLOW THE DATA

OR MY INSTINCTS?

memegenerator.net

Investigating African Tulip Phenology - Case Study

Hyperspectral recordings of datasets available
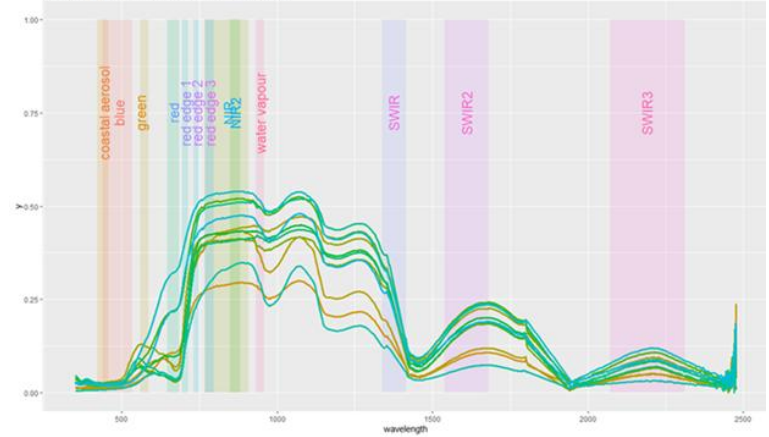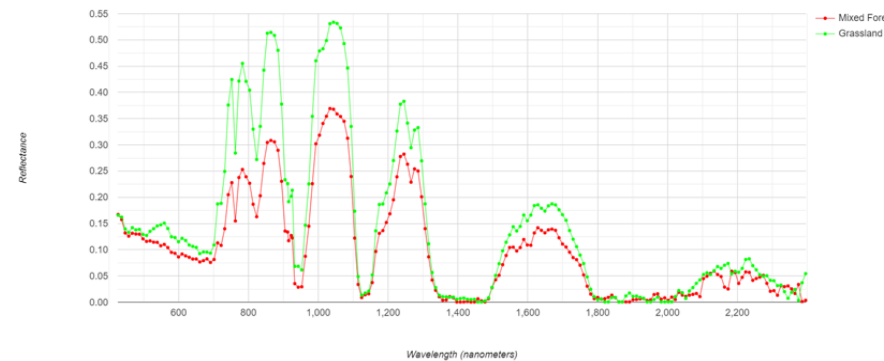
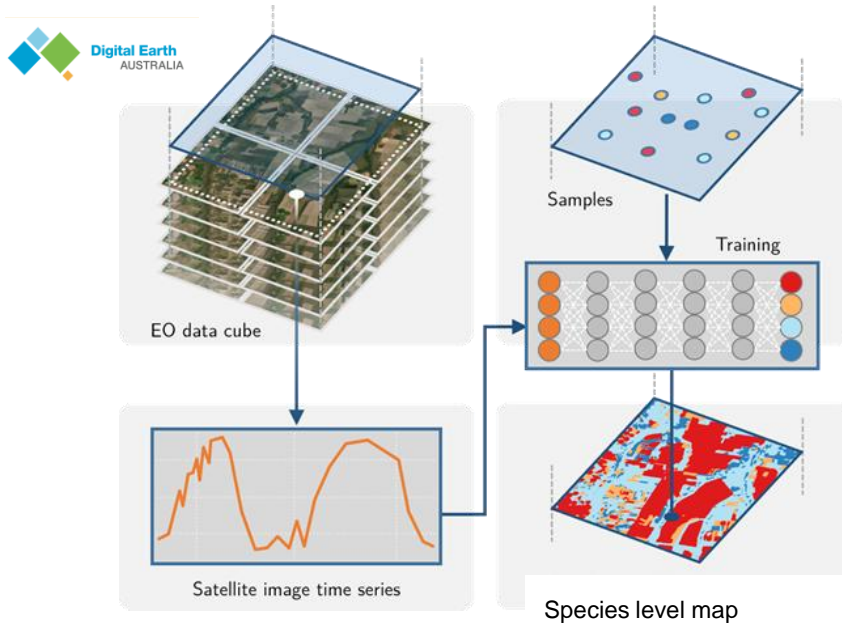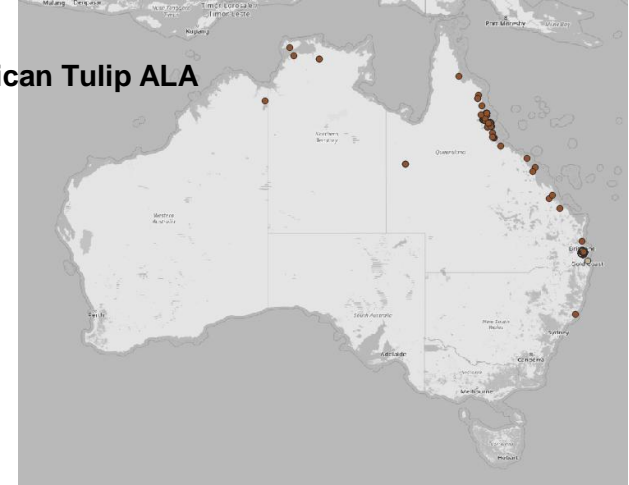**Species level mapping requires '*fancier data, technology and people*'.... And dedicated funding**

Investigating African Tulip Phenology - Case Study

Digital Earth AUSTRALIA

EO data cube

Satellite image time series

Samples

Training

Species level map

African Tulip ALA
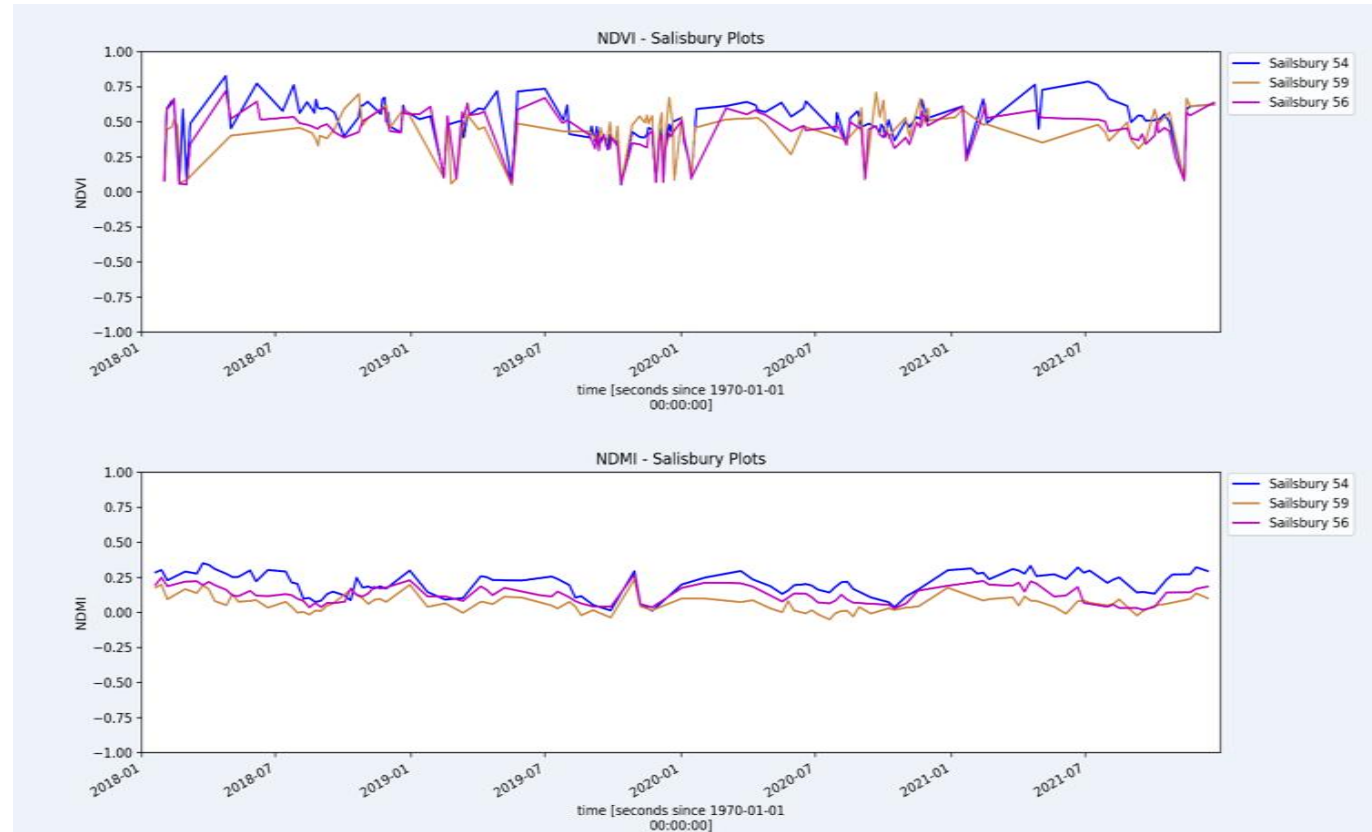
Global Climate Zones

Access tools for reproducibility >> PACIFIC APPLICATION
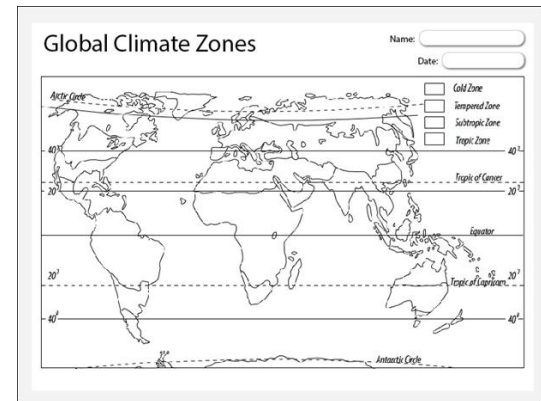
Deriving Insight using temporal sequences

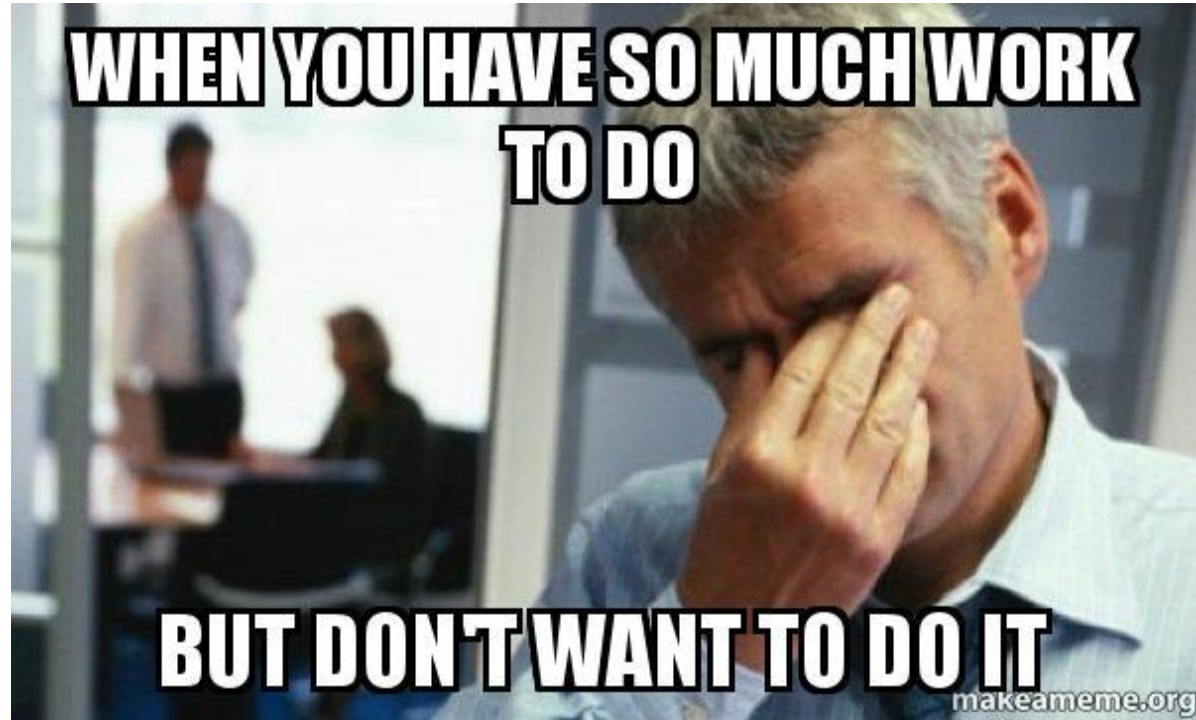Track distinct plant
behaviour overtime -
phenology based

Behavior varies in
different ecosystem,
changes

MORE WORK IS NEEDED…..

- Integration of SDM results
- LiDAR Data - structural characteristics of African Tulip
- Field validation
- More weeds to survey

QUESTIONS?

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