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# Pixels to Answers

Nathan Eaton  
Director of Services



Google

IQUITOS PERU  
1984

Earth Observations





# Enormous Satellite Data Archives



Cloud Infrastructure to use it

*"Often it turns out to be more efficient to move the questions than to move the data."*

-Jim Gray (1944-2007)



The  
**F O U R T H**  
**P A R A D I G M**

DATA-INTENSIVE SCIENTIFIC DISCOVERY

EDITED BY TONY HEY, STEWART TANSLEY, AND KRISTIN TOLLE





Google

ARAL SEA  
1984

Create Knowledge from Data



An aerial photograph of a glacier, showing a large, white, textured ice mass with a dark, narrow channel or crevasse running through it. The text is overlaid on the white ice area.

Make substantive progress on  
the world's biggest  
challenges

**Address\_**





# THE NEXT GENERATION OF SATELLITE IMAGERY SERVICE

Browse. Pick. Enhance. Expose.

[EXPLORE HUB](#)[REQUEST TRIAL](#)

An aerial satellite view of a river delta and coastline. The river is a vibrant blue, winding through a lush green landscape. The coastline is sandy and curves along the edge of a deep blue ocean. The overall scene is a mix of natural beauty and geographical complexity.

# A planetary-scale platform for Earth science data & analysis

Powered by Google's cloud infrastructure

[▶ WATCH VIDEO](#)

## Meet Earth Engine

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface.

Google

MATO GROSSO BRAZIL  
1984

Earth Engine is part of “what’s next”  
from Google

Earth engine is a platform for change detection, monitoring and analysis at scale

High value for organisations that have operations, land holdings or interests that are geographically significant or diverse

# What can Earth Engine do?

## Get an image

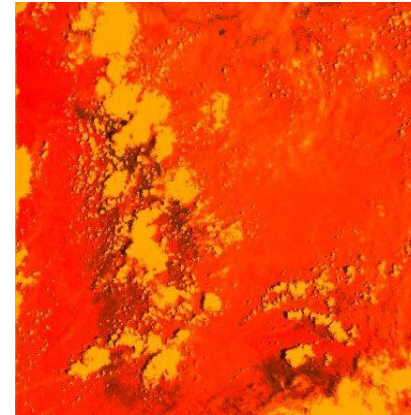
*Pick your: projection, resolution, bands, bounding-box, visualization*



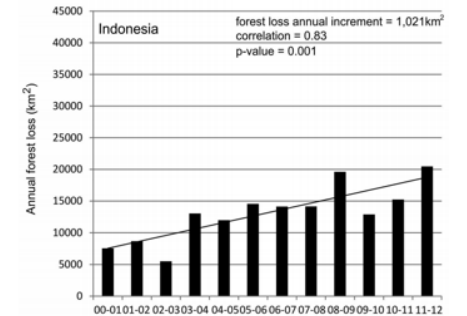


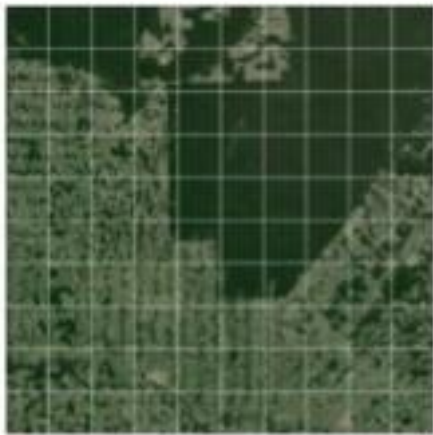
# What can Earth Engine do?

- Get an image
- Apply an algorithm to an image
- Filter a collection
- Map an algorithm over a collection
- Reduce a collection
- Compute aggregate statistics

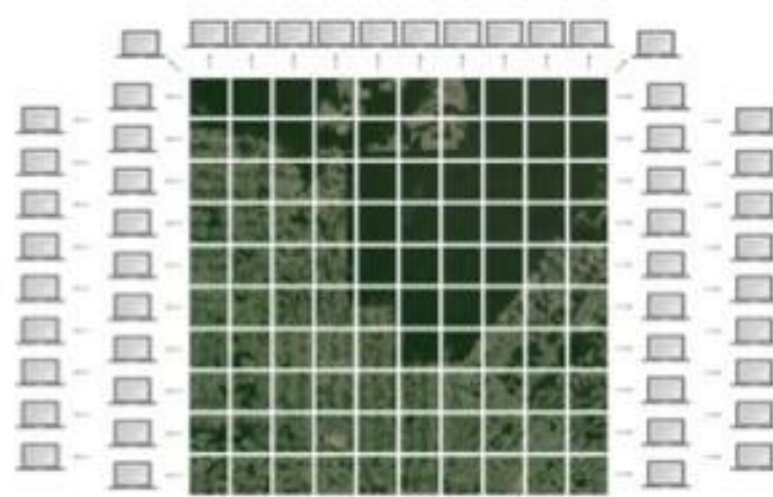


Gabon	1891	391	11898
Lithuania	1845	1226	40296
Cuba	1725	2271	68008
Mali	1694	0	1247103
Costa Rica	1653	382	11327
Czech Republic	1646	1331	46934
South Sudan	1635	38	460581
North Korea	1605	137	67695
Italy	1603	898	201331

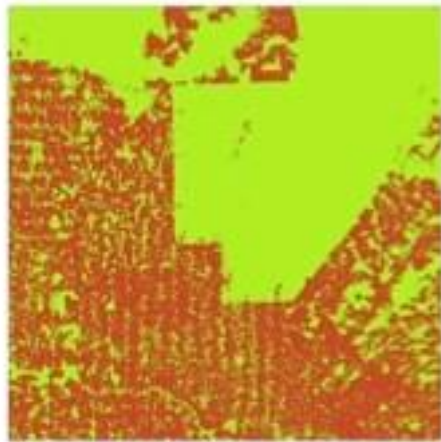




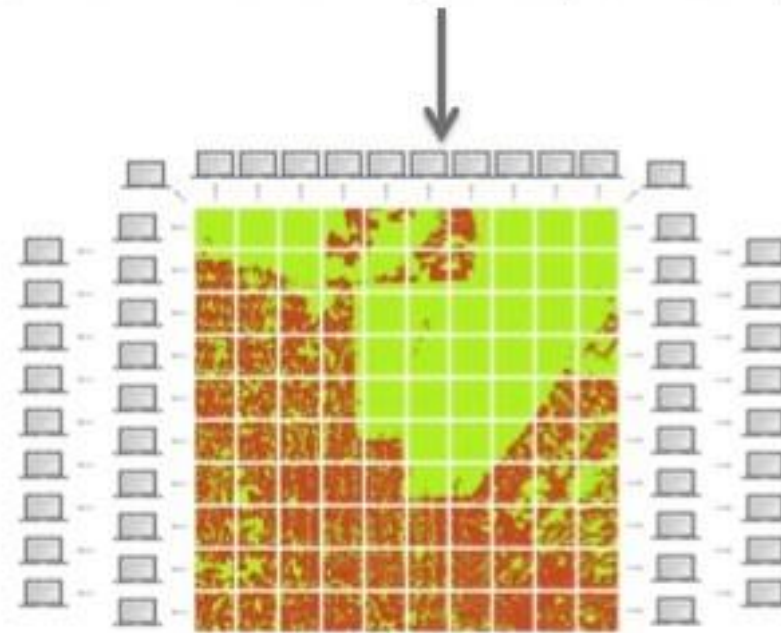
**Original Image**  
is divided into 256px sub-units.



**Sub-units are distributed**  
to separate machines where they can be processed in parallel.



**Result is reassembled**  
into a finished image.



**Thousands can be processed**  
**simultaneously.**

# Global Landsat Timelapse Animations



Columbia Glacier Retreat, 1984-2011



Saudi Arabia Irrigation, 1984-2012



Las Vegas Urban Growth, 1986-2012



Brazilian Amazon Deforestation, 1984-2012



# Coastal Risk Australia

Predicted Coastal Flooding Resulting from Climate Change

- Background
- Guide
- Useful Links

Where do you want to look? 🔍



Fremantle



Melbourne



Cairns



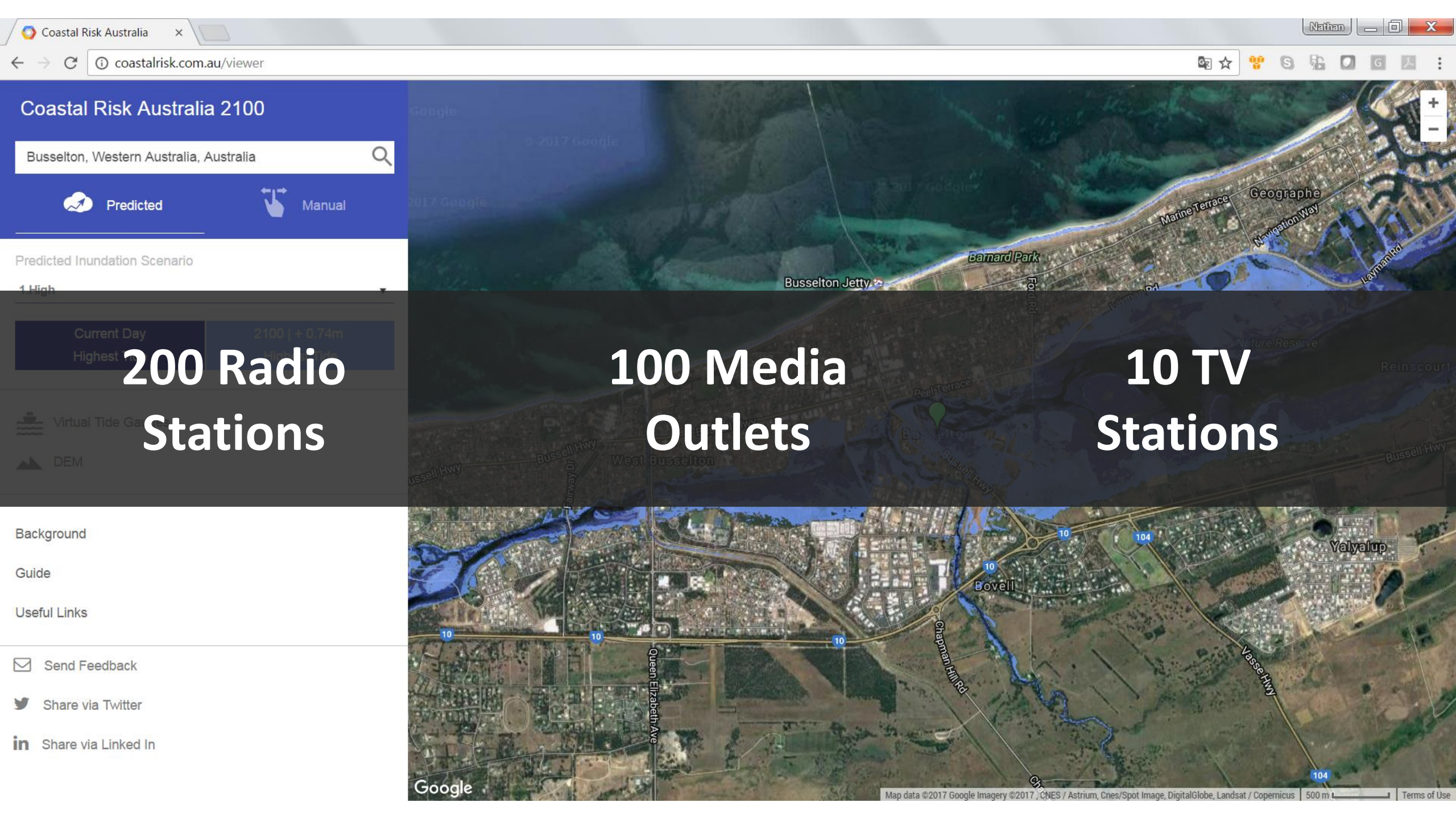
Sydney



Byron Bay



Port Douglas



# Coastal Risk Australia 2100

Busselton, Western Australia, Australia

Predicted Manual

Predicted Inundation Scenario

1 High

Current Day 2100 | + 0.74m Highest

# 200 Radio Stations

# 100 Media Outlets

# 10 TV Stations

Background

Guide

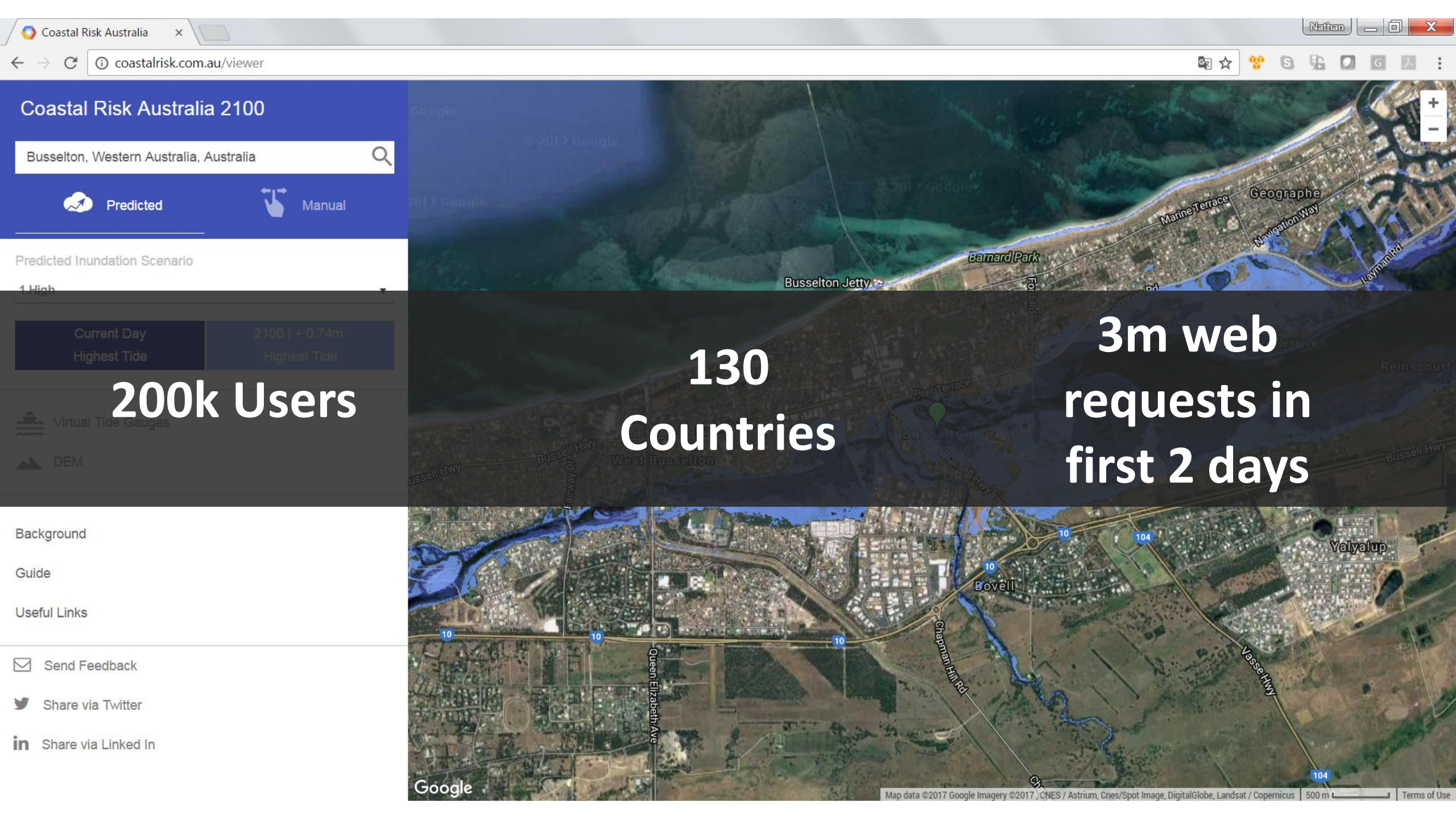
Useful Links

Send Feedback

Share via Twitter

Share via Linked In

Google



# Coastal Risk Australia 2100

Busselton, Western Australia, Australia

Predicted Manual

Predicted Inundation Scenario

1 High

Current Day Highest Tide 2100 | + 0.74m Highest Tide

# 200k Users

# 130 Countries

# 3m web requests in first 2 days

- Background
- Guide
- Useful Links
- Send Feedback
- Share via Twitter
- Share via Linked In

Google

# Coastal Risk Vanuatu 2100

Place Search



Predicted



Manual

Predicted Inundation Scenario

1.High



Current Day  
Highest Tide

2100 | + 0.74m  
Highest Tide



Aerial Photography



Cyclone Pam UAV Imagery



Cyclone Pam Crowd Sourced Photos



DEM

Background

Guide

Useful Links



Send Feedback



# Coastal Risk Vanuatu 2100

Place Search



Predicted



Manual

Predicted Inundation Scenario

1.High



Current Day

Highest Tide

2100 | + 0.74m

Highest Tide



Aerial Photography



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# Coastal Risk Vanuatu 2100

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Current Day  
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2100 | + 0.74m  
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Aerial Photography



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Cyclone Pam Crowd Sourced Photos



DEM

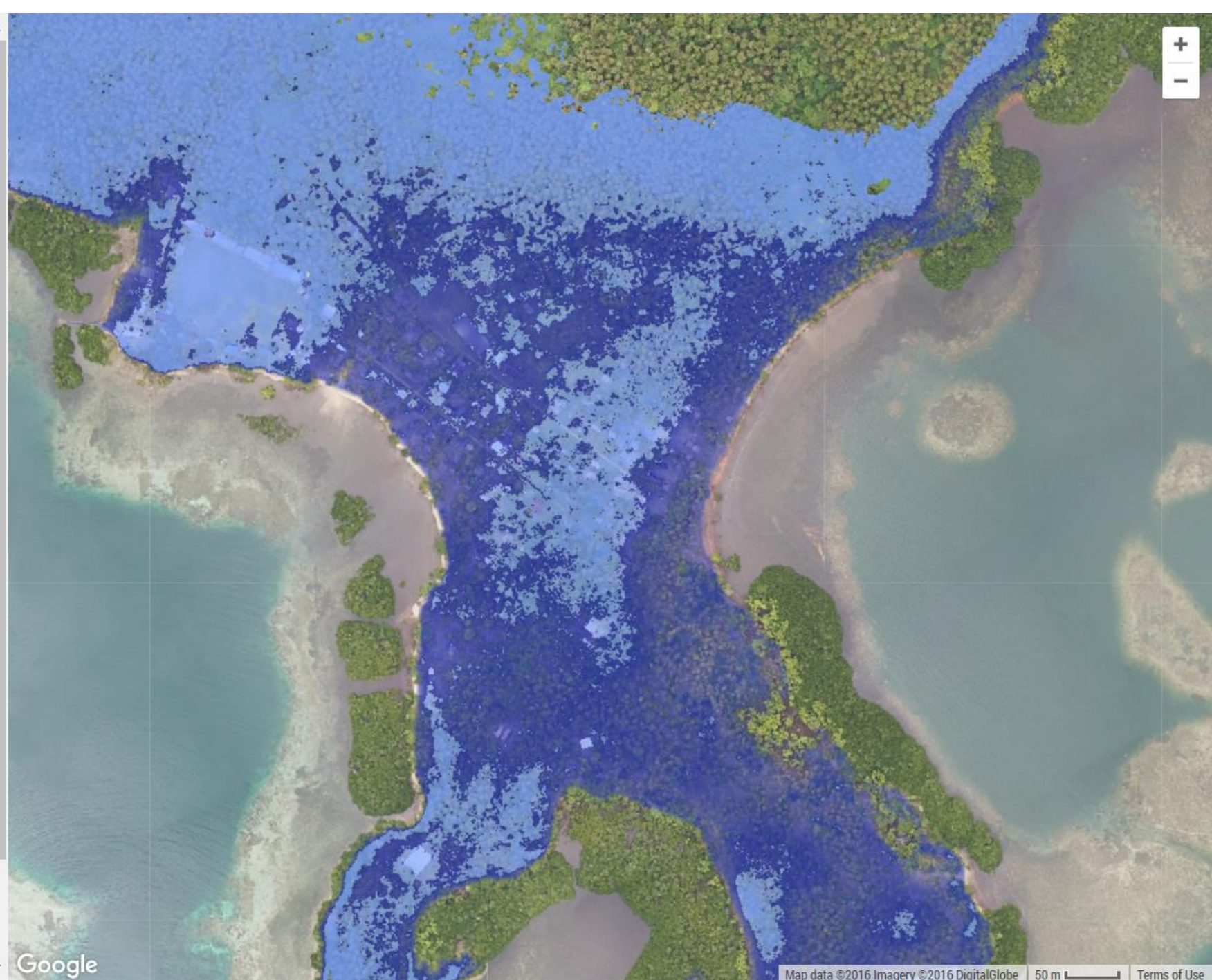
Background

Guide

Useful Links



Send Feedback



# Coastal Risk Vanuatu 2100

Place Search



Predicted



Manual

Predicted Inundation Scenario

1.High



Current Day

2100 | + 0.74m

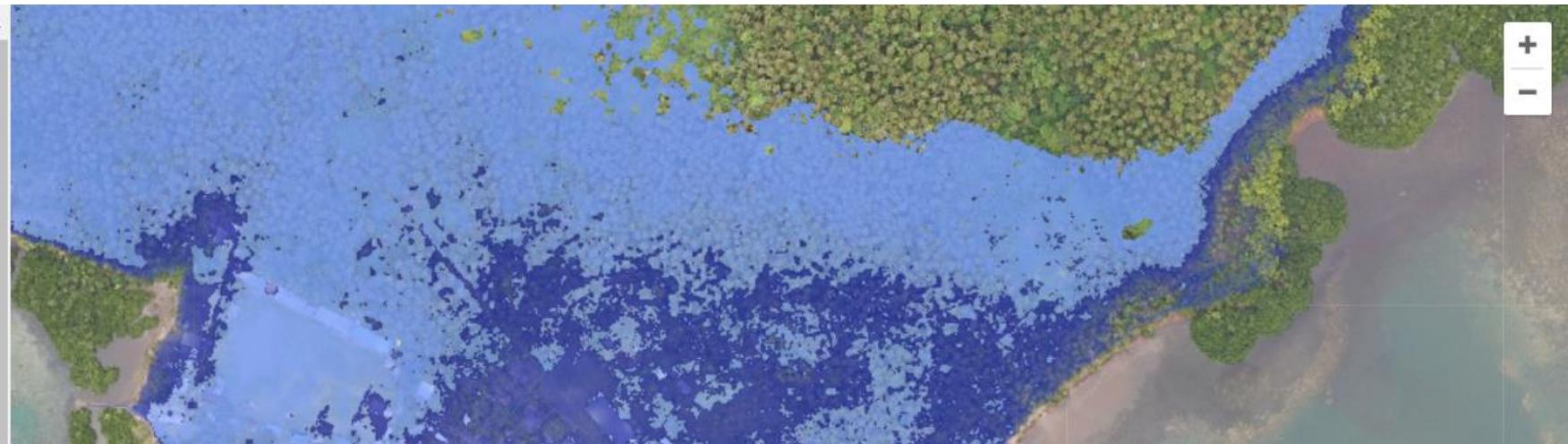
Highest Tide

Highest Tide

**680 Buildings  
in Maskelyne  
Community**

**150 Currently  
Inundated by  
High Tide**

**475 Inundated  
at High Tide by  
2100**





Find a location or farm



Map

MyData

Decipher Plus Demo

Nathan Eaton



BIOMASS



SAMPLES



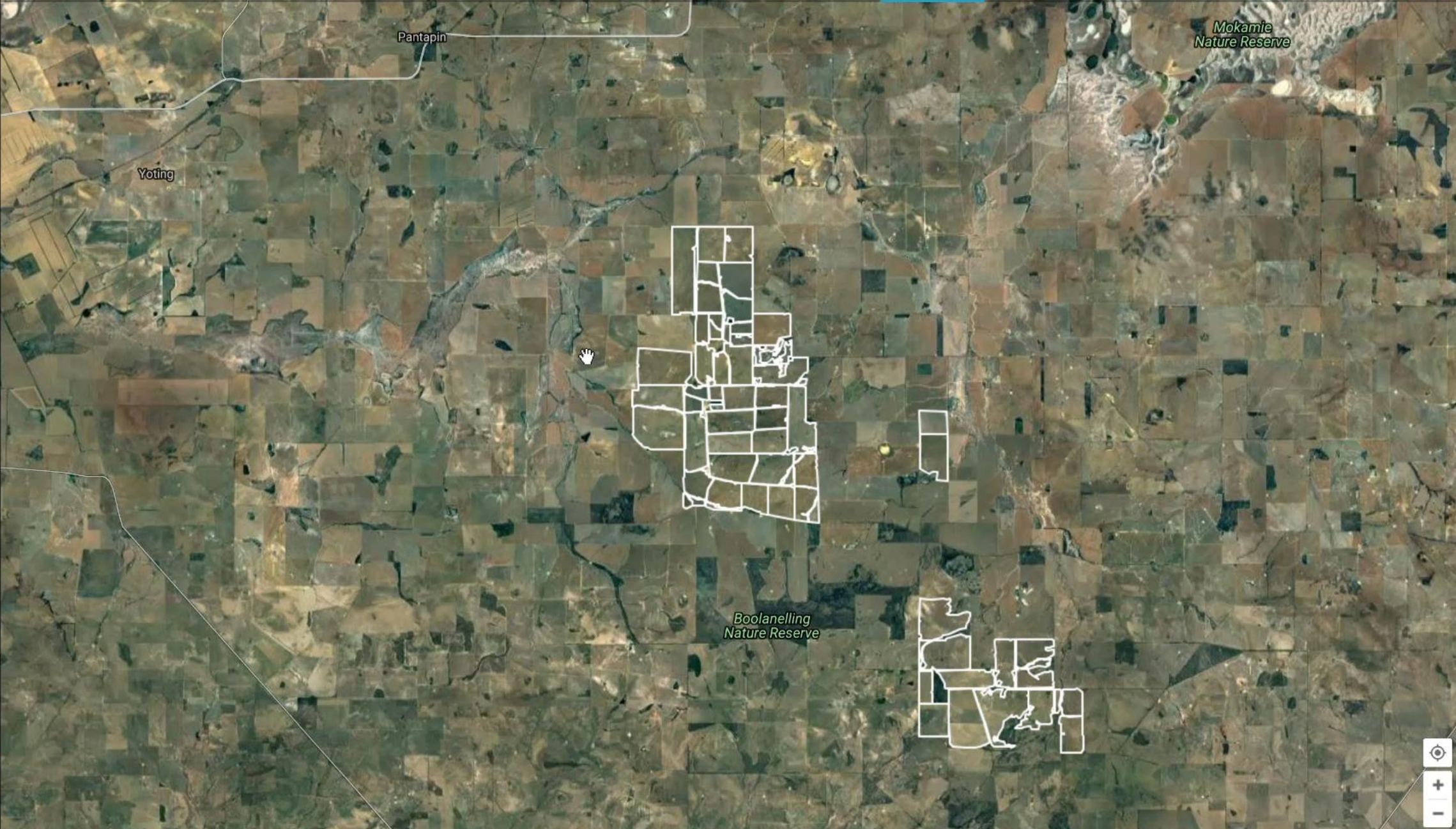
PLANS

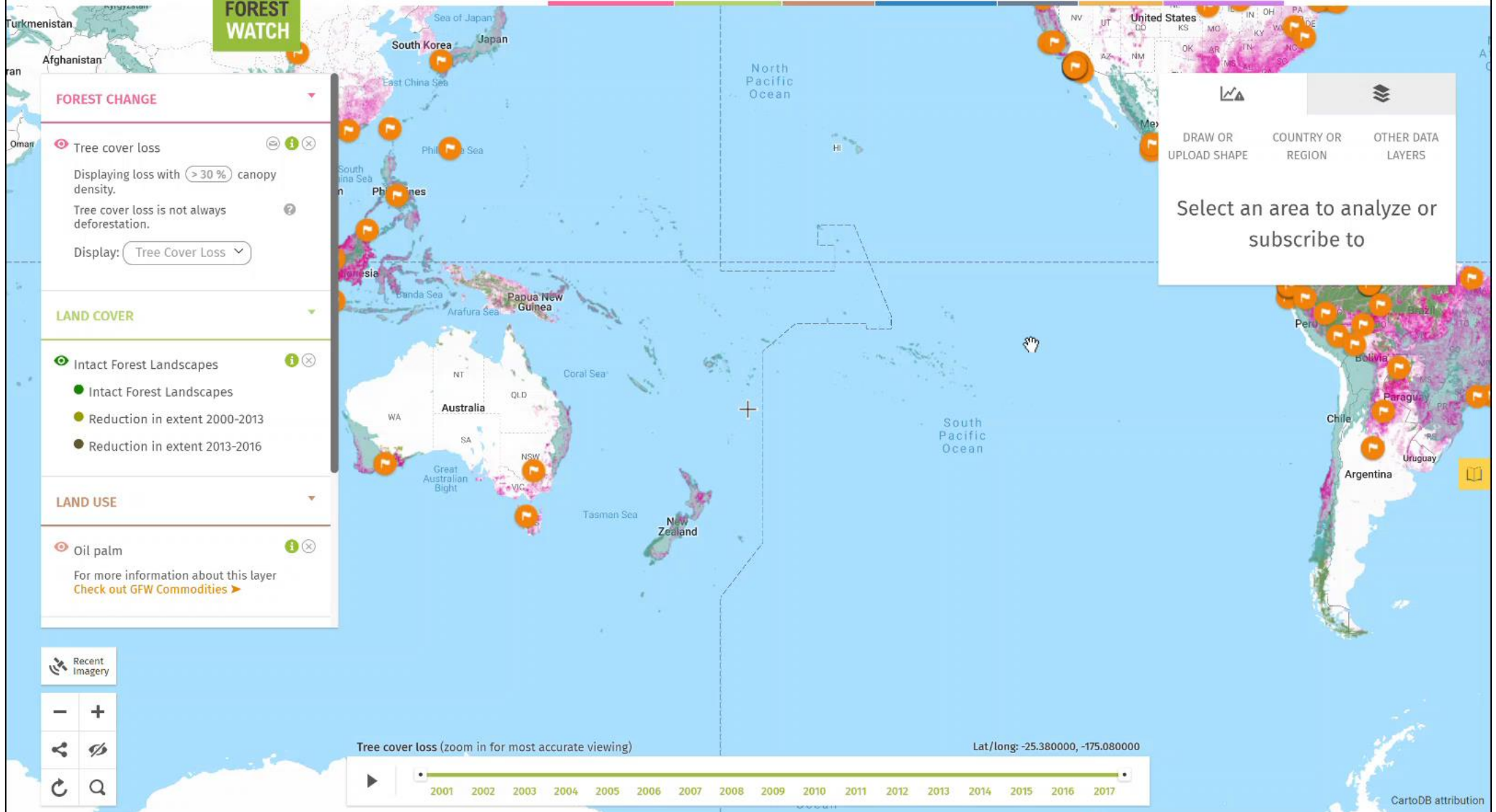


MYDATA



NOTES





**FOREST CHANGE**

Tree cover loss  
 Displaying loss with > 30 % canopy density.  
 Tree cover loss is not always deforestation.  
 Display: Tree Cover Loss

**LAND COVER**

Intact Forest Landscapes  
 Intact Forest Landscapes  
 Reduction in extent 2000-2013  
 Reduction in extent 2013-2016

**LAND USE**

Oil palm  
 For more information about this layer  
[Check out GFW Commodities](#)

DRAW OR UPLOAD SHAPE COUNTRY OR REGION OTHER DATA LAYERS

Select an area to analyze or subscribe to

Recent Imagery

Map navigation controls: zoom in (+), zoom out (-), home, full screen, refresh, search.



Search for places...

100 km  
50 mi

1984  
Slow

2016

Miami Brisbane, Australia Shirase Glacier Polarforschung San Francisco Lassen Volcanic Par Stumpy Point Las Vegas Alberta, Canada Columbia Glacier Nuflo De C

Google

## Timelapse

Share or Embed

Timelapse is a global, zoomable video that lets you see how the Earth has changed over the past 32 years. It is made from 33 cloud-free annual mosaics, one for each year from 1984 to 2016, which are made interactively explorable by [Carnegie Mellon University CREATE Lab's Time Machine library](#), a technology for creating and viewing zoomable and pannable

Make Map

Make Graph



MENU

Map

Figure/Data



Climate Engine

GET TIME SERIES

Time Series Calculation: ?

Native Time Series

One Variable Analysis

Region: ?

Point



+ Add another region

Variable 1

Variable 1 ?

Type:

Climate

Dataset: ?

CHIRPS - Pentad

Variable: ?

Precipitation

Units: millimeters

Computation Resolution (Scale): ?

4800 m (1/20-deg)

Time Period ?

Period of Record: 1981-01-01 to 2018-06-30

Colors

Layers

Masking

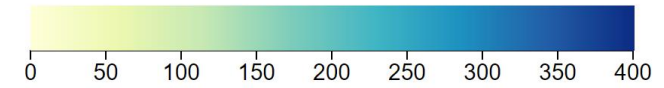
Download

Link

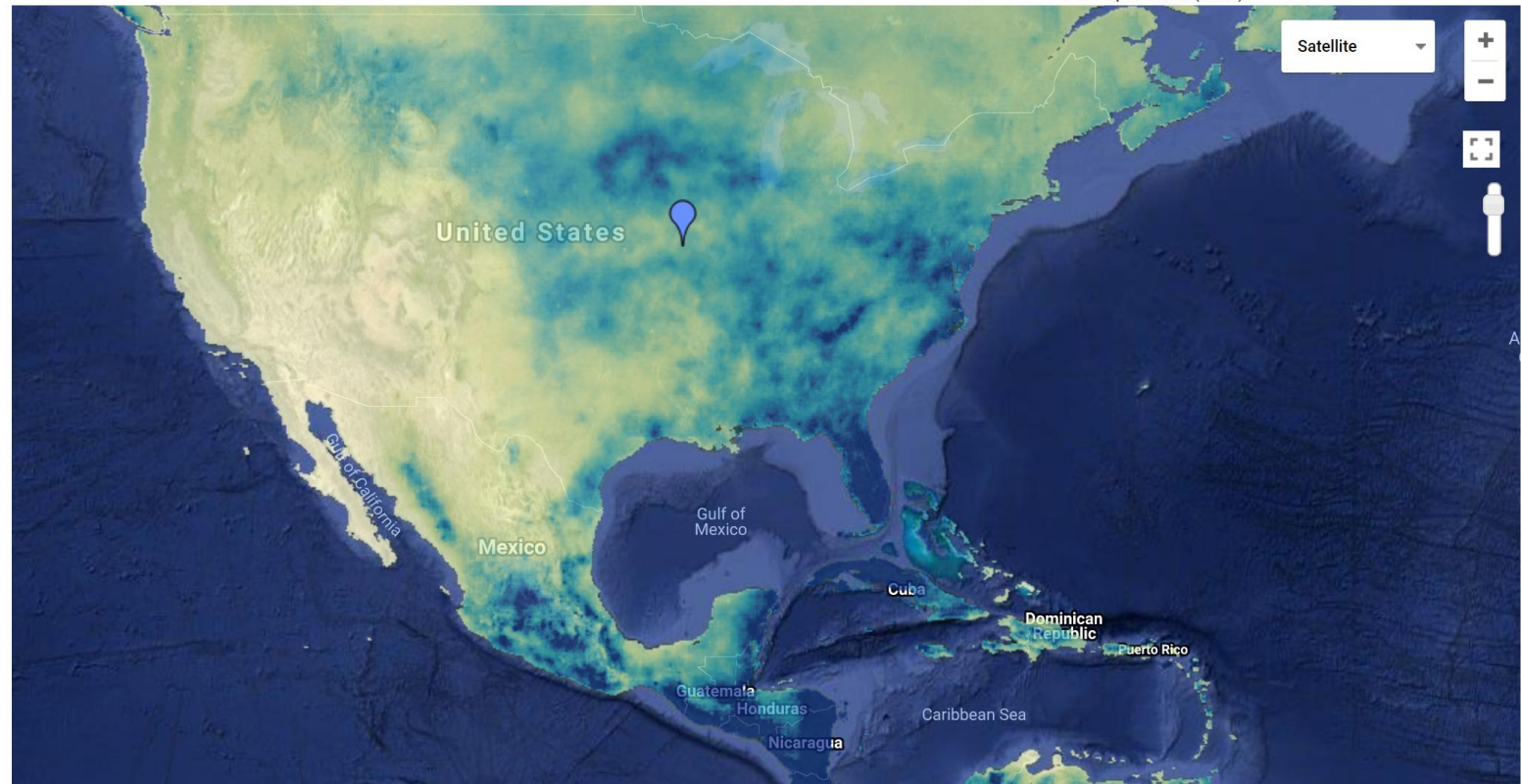
Reset

### Total Precipitation (CHIRPS)

Target Period: 2018-05-03 to 2018-06-30



Precipitation (mm)



Powered by Google Earth Engine

License by:

Get Help

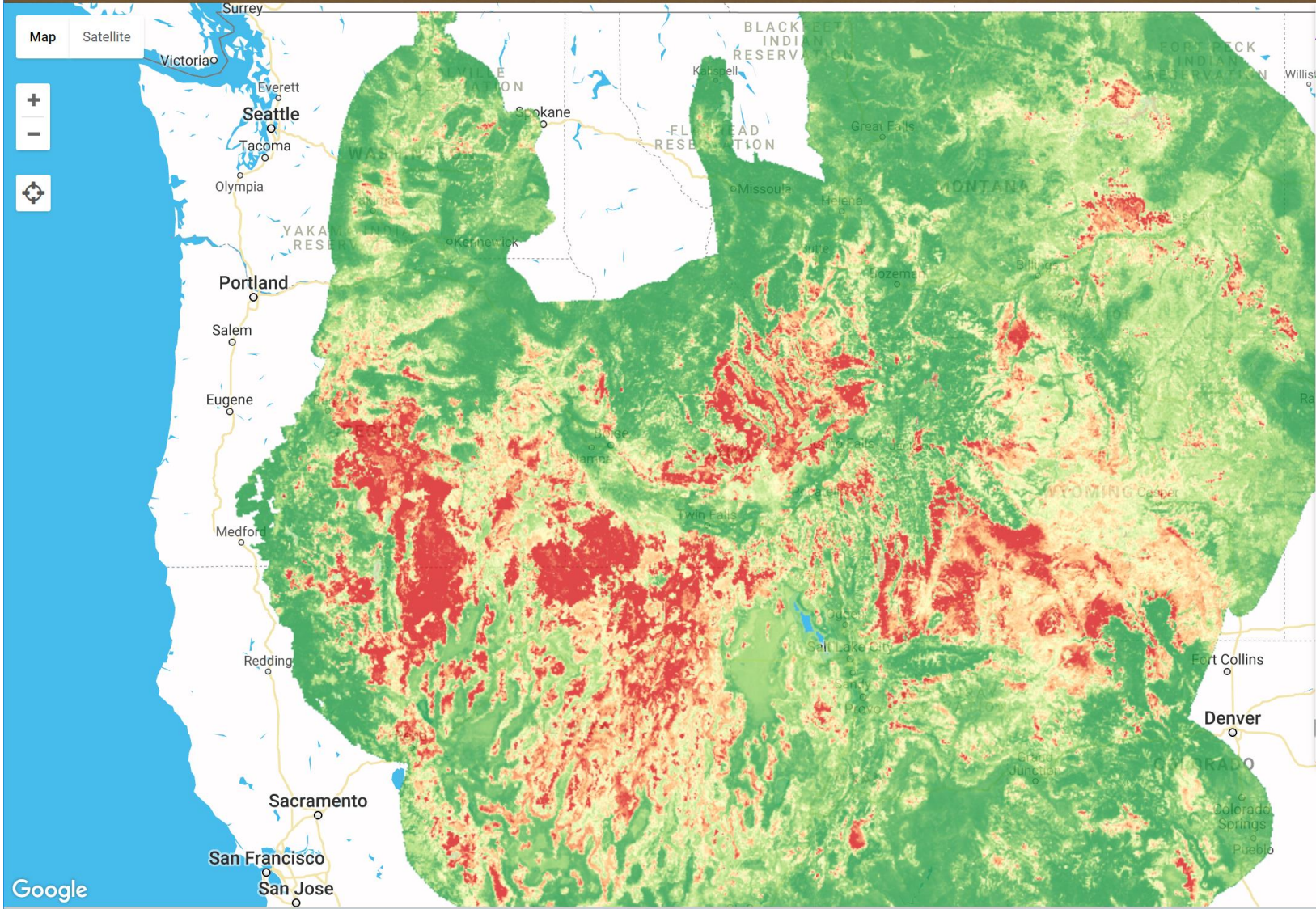
Get Info

Sponsors

Contact

Website

Home



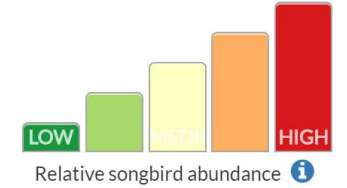
Map Satellite

+  
-  
📍

FENCE COLLISION

SONGBIRD ABUNDANCE

Predicted relative abundance maps for sagebrush and woodland-obligate species across the US sagebrush distribution.

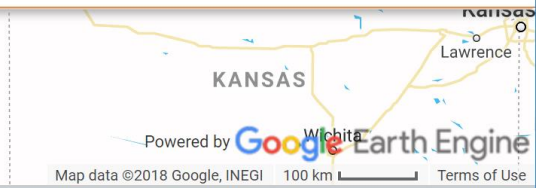


Layer Transparency:

\_\_\_\_\_●\_\_\_\_\_

- Ash-throated flycatcher
- Brewer's sparrow
- Gray flycatcher
- Gray vireo
- Green-tailed towhee
- Juniper titmouse
- Pinyon jay
- Sagebrush sparrow
- Sage thrasher

SAGE GROUSE REFERENCE LAYERS



Google

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Search Box

Surface Water x

Map Satellite

### Surface water changes (1985-2016)

Green and blue colors represent areas where surface water changes occurred during the last 30 years. Green pixels show where surface water has been turned into land (accretion, land reclamation, droughts). Blue pixels show where land has been changed into surface water (erosion, reservoir construction).

The results of the analysis are published in:

[Donchyts et.al, 2016, Nature Climate Change](#)

Powered by  
**Google Earth Engine**

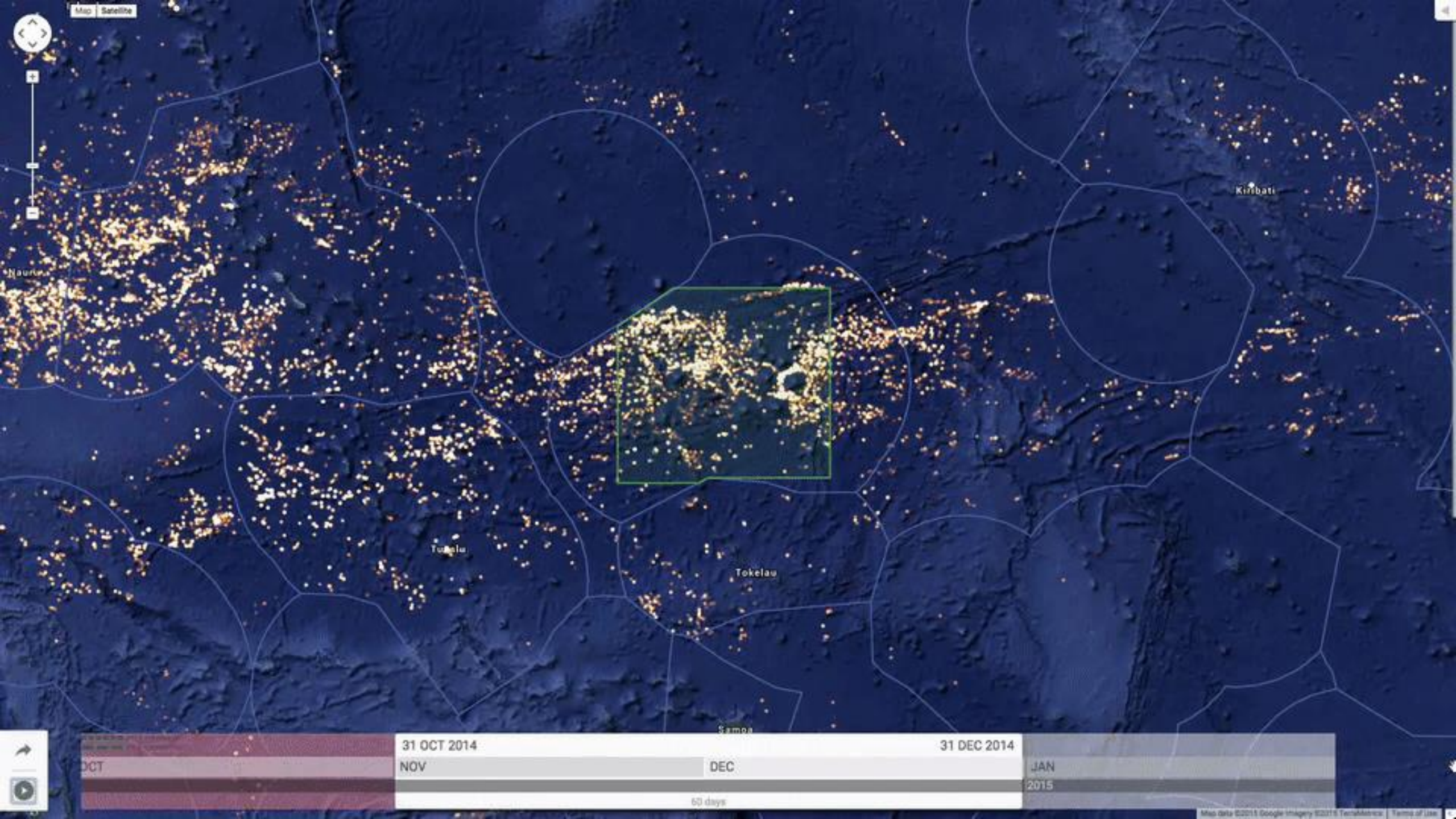


Google

Deltares

Imagery ©2018 TerraMetrics 20 km Terms of Use





Map Satellite

Nauru

Kiribati

Tokelau

Tokelau

Samoa

31 OCT 2014

31 DEC 2014

OCT

NOV

DEC

JAN

2015

60 days

Google

ARAL SEA  
1984



Make informed decisions with Geospatial



Thank you



thank you

thank you **cards**

thank you **quotes**

**thankyou water**

Press Enter to search.