

PINT OF SCIENCE · CAMBRIDGE · 2026

# Teaching a computer to spot a bush *(from space)*.

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TODAY'S STORY FEATURES

# Shane and Anil.



SHANE



ANIL



*... and Gabriel.*

CAMBRIDGE · BOAT RACE 2025



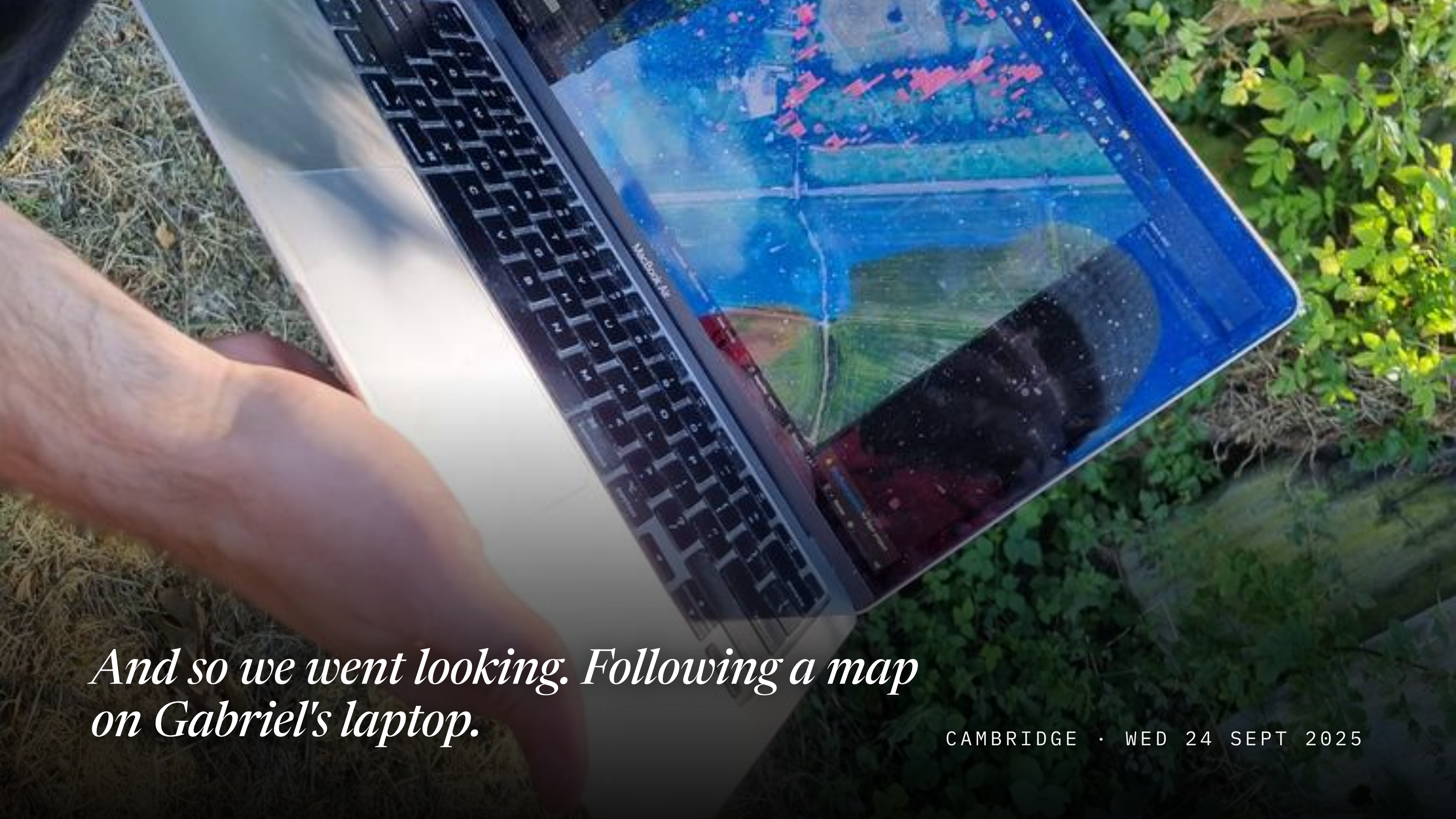
*Our story starts with hedgehogs.*

GABRIEL'S SUMMER · 2025



*Can we find brambles? From space?*

FIRST EXERCISE



*And so we went looking. Following a map  
on Gabriel's laptop.*

CAMBRIDGE · WED 24 SEPT 2025

A SMALL CLIFFHANGER

Did it work?

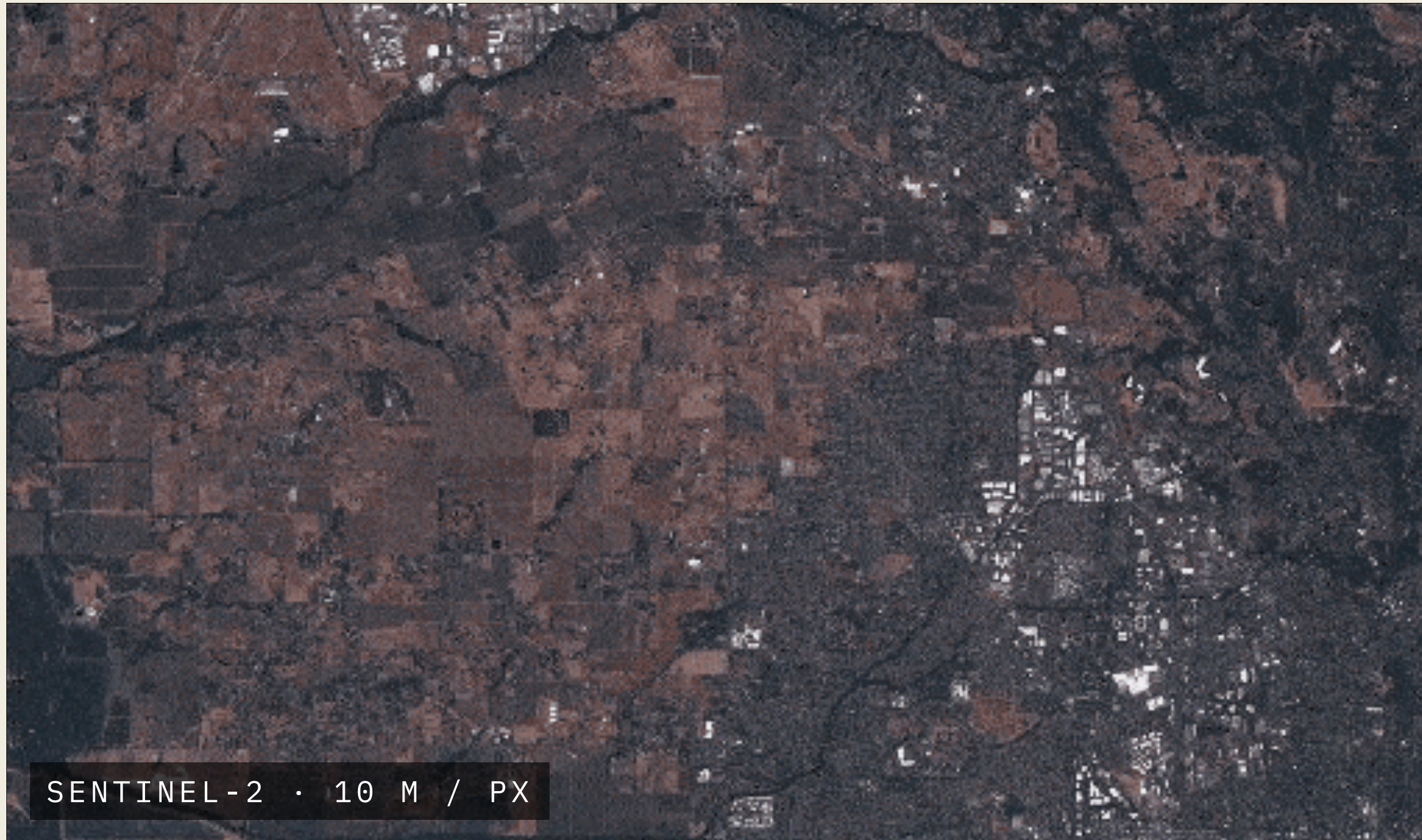
*We'll get there.*

*But first: what does a satellite actually see from 800 km up?*

QUESTION 01

What can a  
satellite  
*actually* see?

ROUGHLY WHAT THEY SEE, LOOKING DOWN.



PIXEL SIZE

**10 m**

≈ the width of this  
room.

REVISIT

**5 d**

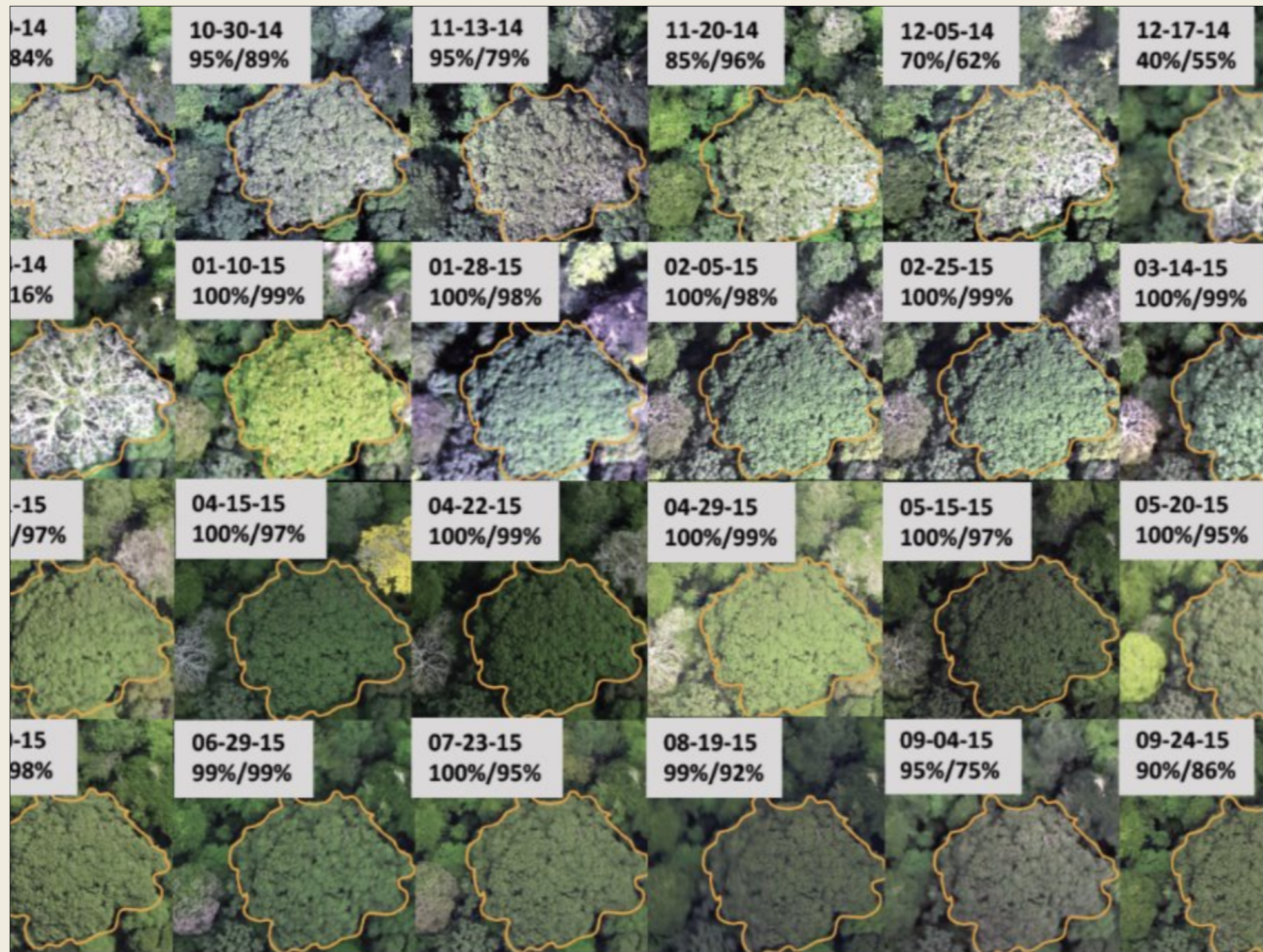
A new picture,  
every five days.



*Average a year of pictures. Throw away  
the year.*

EUROPE · CLOUD-FREE COMPOSITE

## PHENOLOGY



How colour  
changes *across*  
*the year* is  
itself a feature.

WHAT WE DO INSTEAD

# Fingerprint.



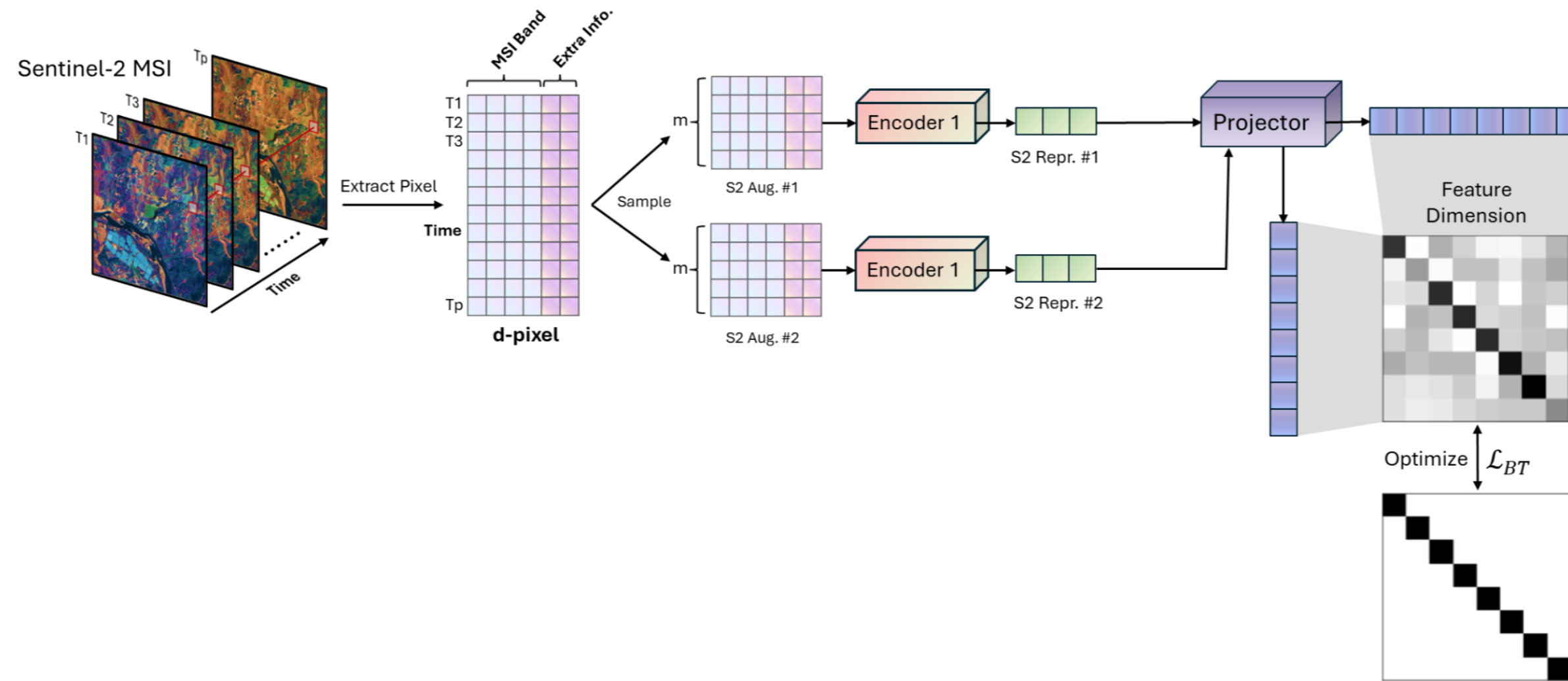
A YEAR OF PATCHES



A FINGERPRINT

# Two views of the same patch.

*Give me back the same fingerprint for both.*



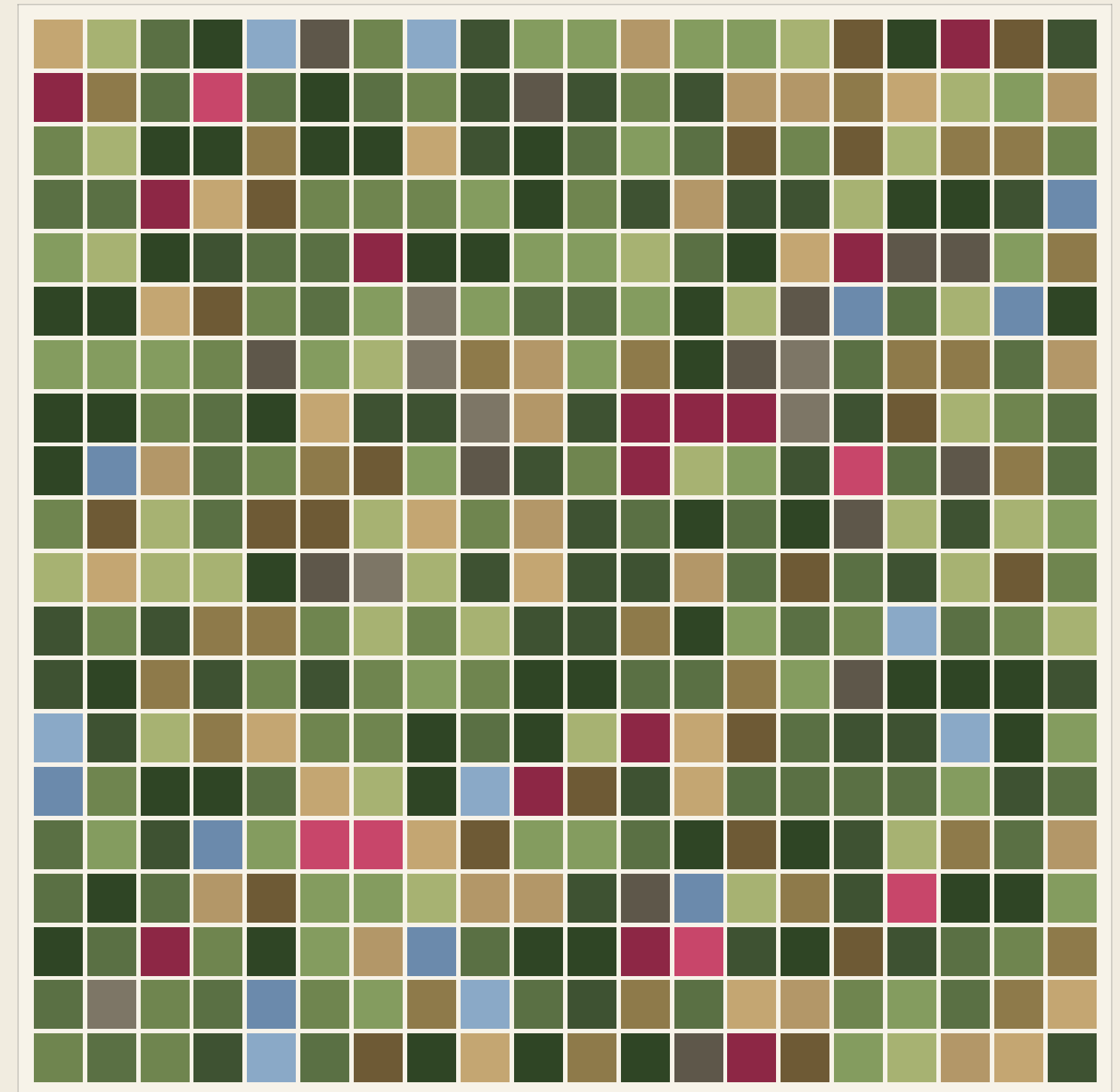
HOW MUCH WE SHOWED IT

# 800MM

10-metre patches of Earth.  
*No labels. Just patches.*

PULLED FROM every continent, every biome  
PER PATCH a year of Sentinel-1 & Sentinel-2  
LABELS USED zero

800,000,000 OF THESE



EACH SQUARE HERE  $\approx$  2 MILLION PATCHES.

A close-up photograph of two men in a server room. Both are wearing large, professional-grade headsets with microphones. The man on the left is smiling slightly and looking towards the right. The man on the right is smiling broadly, showing his teeth, and looking directly at the camera. In the background, there are server racks with various cables and components. The lighting is somewhat dim, typical of a server room.

*Where we trained it. Dawn in  
Cambridge, plus AMD compute, and  
other places.*

SADIQ & FRANK

THE OUTPUT

128 numbers per patch.  
Every 10 m. Whole world.  
Every year since 2017.



ONE 10 M PATCH

```
+0.412      +0.218      +0.602      +0.951
-0.087      -0.776      +0.279      -0.366
+1.203      +0.945      -0.041      +0.227
+0.554      +0.131      +0.815      +0.578
-0.913      -0.388      -0.220      -0.612
+0.034      +0.396      +1.046      +0.142
+0.728      +0.012      +0.354      +0.806
```

... + 100 more numbers

EARTH · LAND SURFACE · 10 M PIXELS

1,500,000,000,000

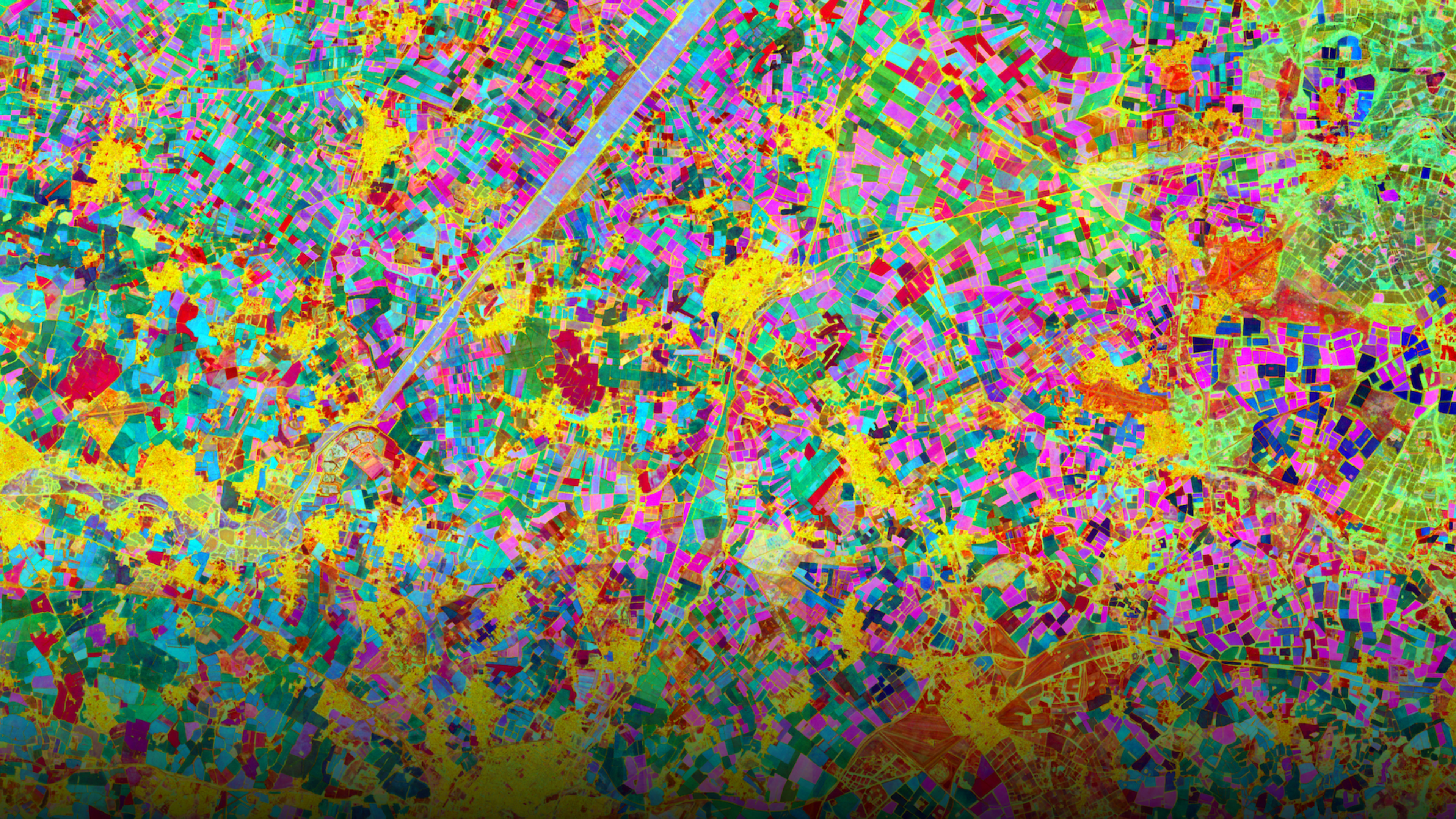
*10-metre patches on Earth's land surface.*

BACKGROUND: A SLICE OF THE ACTUAL FINGERPRINTS, RENDERED AS COLOUR.



*Anyone recognise this place?*

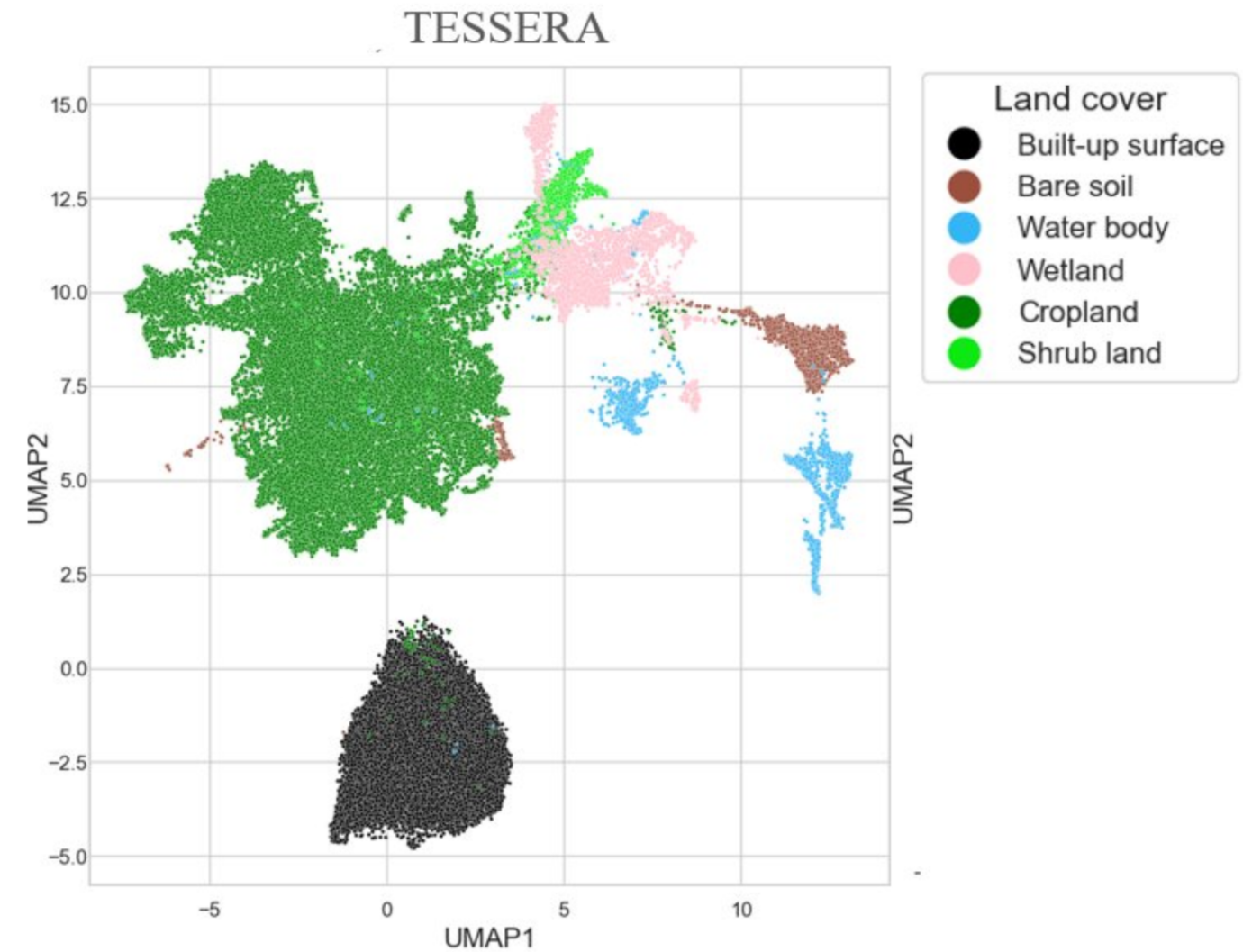
FINGERPRINTS · 128 → 3 → RGB



PLOT THE FINGERPRINTS. SEE WHERE THEY FALL.

Nobody  
told it those  
categories  
*exist.*

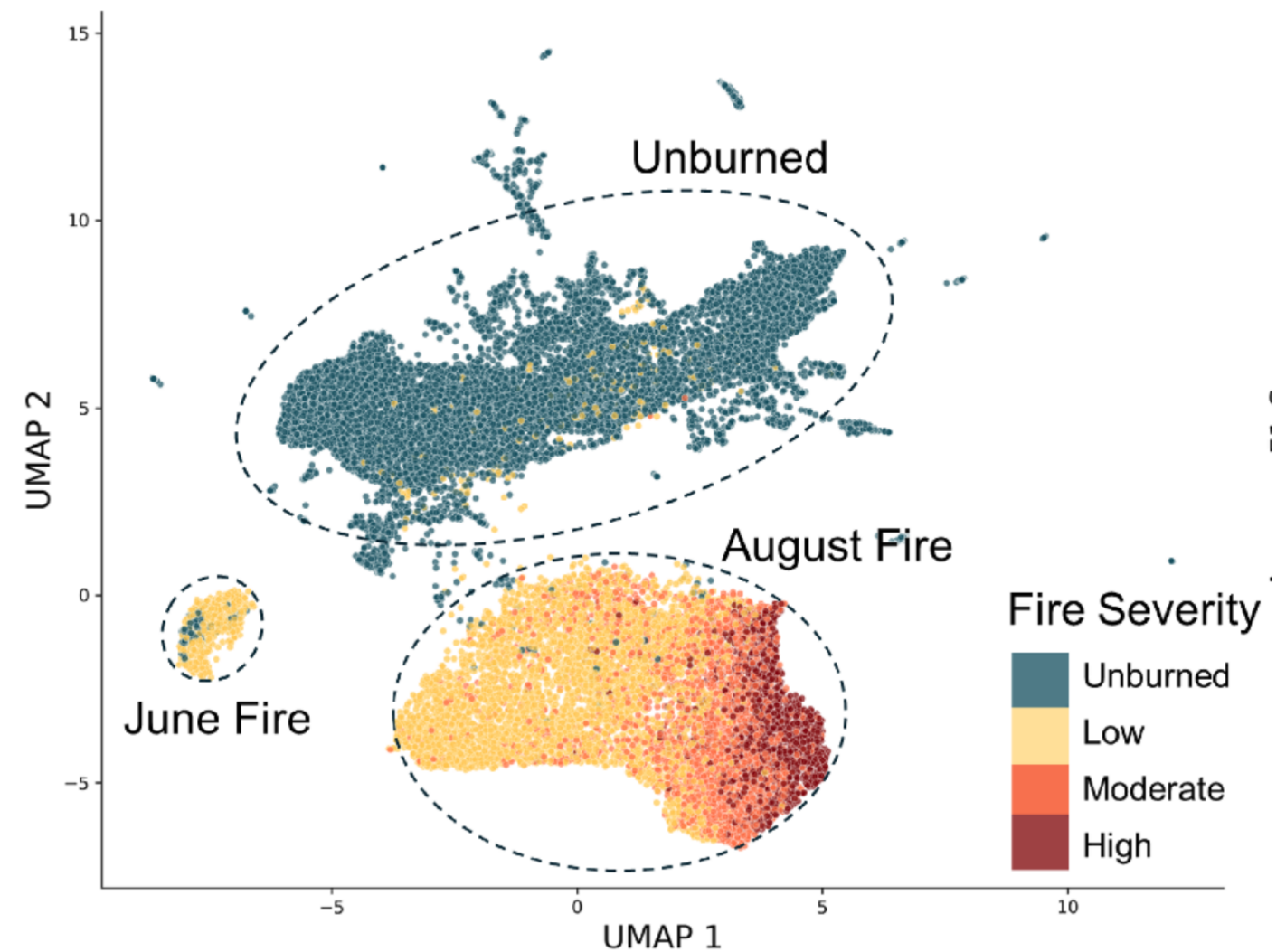
UMAP · SENEGAL · LAND COVER



SAME TRICK · DIFFERENT QUESTION

It also  
pulls apart  
*burn severity.*

UMAP · CALIFORNIA · FIRE SEVERITY



- 01 Satellites see a lot. It's pretty noisy.
- 02 What matters is the time series. Not any single picture.
- 03 An AI can learn abstract features straight from that.

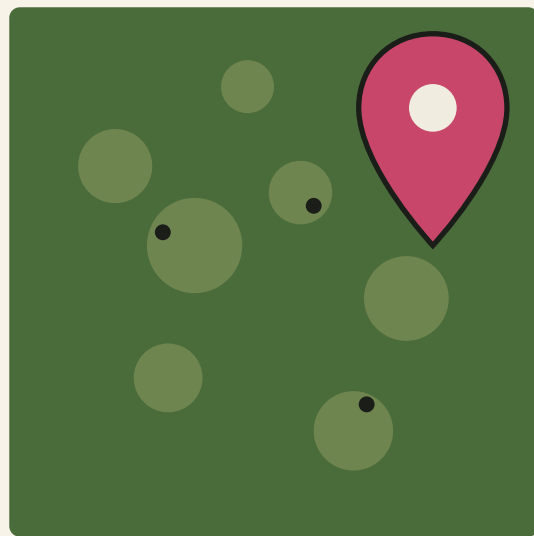
FROM FINGERPRINTS TO FIELDWORK

Right. Back  
to *that walk.*

THE WHOLE THING · TOOK AN AFTERNOON

01

Bramble photos with  
GPS pins.



INATURALIST ·  
~500 EXAMPLES



02

Look up the fingerprint  
at each pin.

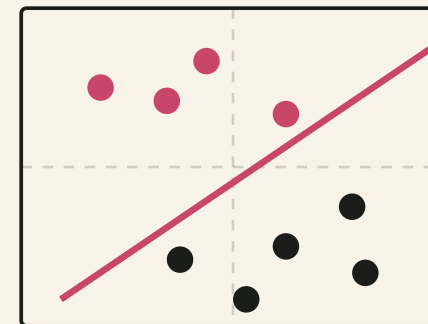


128 NUMBERS ·  
ALREADY MADE



03

Train the simplest  
classifier you can  
imagine.



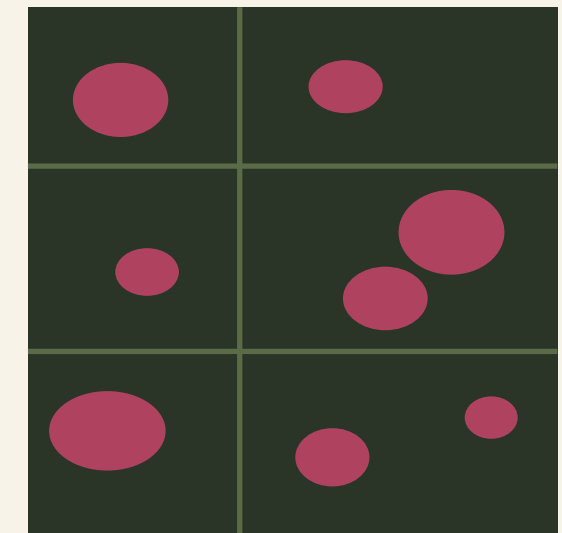
bramble vs. not

LOGISTIC  
REGRESSION



04

Ask it about everywhere  
else.



A BRAMBLE MAP

WHY THIS WORKS WITH SO LITTLE DATA

30×

*fewer labels than starting from scratch.*

A photograph showing two men standing on a gravel path in a wooded area. The man on the left is wearing a red hoodie and a grey beanie, with his back to the camera. The man on the right is wearing a black t-shirt and is looking at a laptop held by the first man. The laptop screen displays a map with several pink markers. The background consists of dense green foliage and trees.

*We picked the pinkest spots. Went for a walk.*

WED 24 SEPT · 09:24



*Twenty seconds in.*

FIND 01 · 10:04



*Then this.*

FIND 02 · 11:16



*In an empty plot in a housing estate. We'd never have thought to look here.*

FIND 03 · 14:17



*And finally, this.*

FIND 04 · 14:02

The Local Nature Reserves (LNRs) in Cambridge are for both people and wildlife. Designated under the Wildlife and Countryside Act 1981, these reserves help to protect some of the best wildlife habitats and geographical features across the City, whilst making an important contribution to the UK's biodiversity. The reserves provide an opportunity for people to enjoy, learn about and enjoy nature of their own city.

Cambridge City Council works in partnership with the local community to manage the reserve. If you would like to assist in the management of this reserve or any of the other reserves across the city, we would love to hear from you.

For more information about volunteering or any issue regarding Local Nature Reserves in Cambridge please contact:

Cambridge LNRs  
Cambridge City Council  
Environment & Planning Department  
The Courtyard  
Cambridge  
CB2 3QJ

01223 437000  
Email: [lnr@cambridge.gov.uk](mailto:lnr@cambridge.gov.uk)  
Or visit: <http://lnr.cambridge.gov.uk>



## Welcome to Bramblefields LNR

At the turn of the 20th Century this region was ten and farmland. More recently it was used as allotments but these were abandoned after poor yields. Today Bramblefields provides a quiet haven for wildlife and people in the midst of a residential area. Local Nature Reserve status has helped safeguard the site from future development and with it a commitment to protecting its wildlife and community value.



The dominance of **Bramble** and **Hawthorn** provide important nectar sources in early spring for a variety of insects. This in turn provides a good supply of food for breeding birds including Blackcaps, Chiffchaffs and Blackbirds. In autumn the abundance of berries attracts Redwings and Fieldfares. Bramblefields is an important refuge for breeding birds with many that breed here, whose numbers have declined by more than 50% over the last 20 years, including House Sparrows, Starlings, Song Thrushes and Bullfinches.



Though many mammals use the reserve there is little evidence of their activity with the exception of the distinctive rusty smell of Foxes and badger setts in the reserve to hunt.

The flat meadows in the level of water to the small pond provide ideal conditions for breeding amphibians and insects such as the Broad-bodied Chaser Dragonfly. The pond is



carefully managed to benefit these species by maintaining areas of open water.

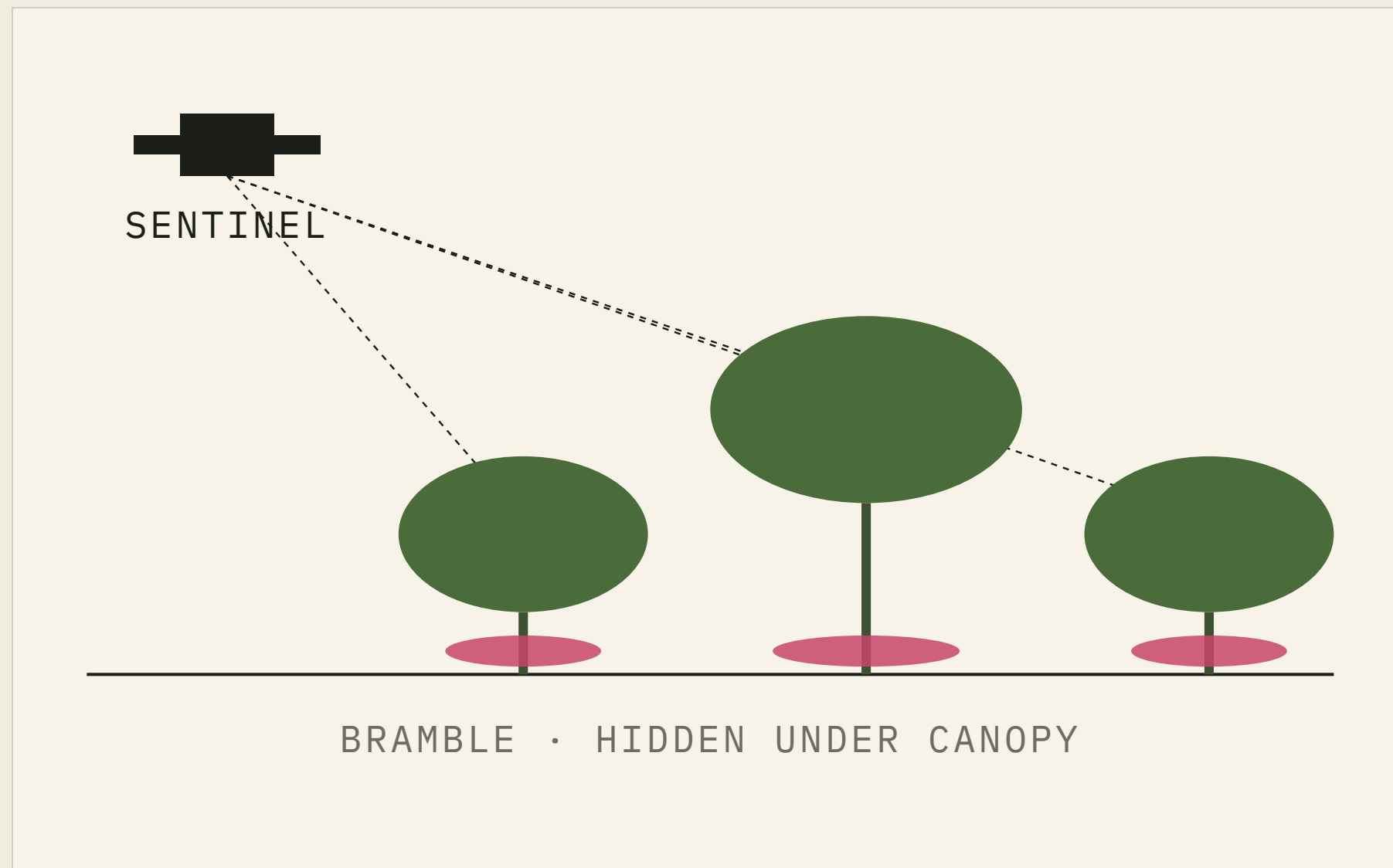
A meadow of heath is managed through the regular cutting of grass and leaving areas of grass to grow tall to form a sward. To attract the range of new invertebrates areas of heath are also regularly mown.



*Ended up somewhere with lots of brambles...*

## LIMITATIONS

# We only see reflected photons. Block them, and we're blind.

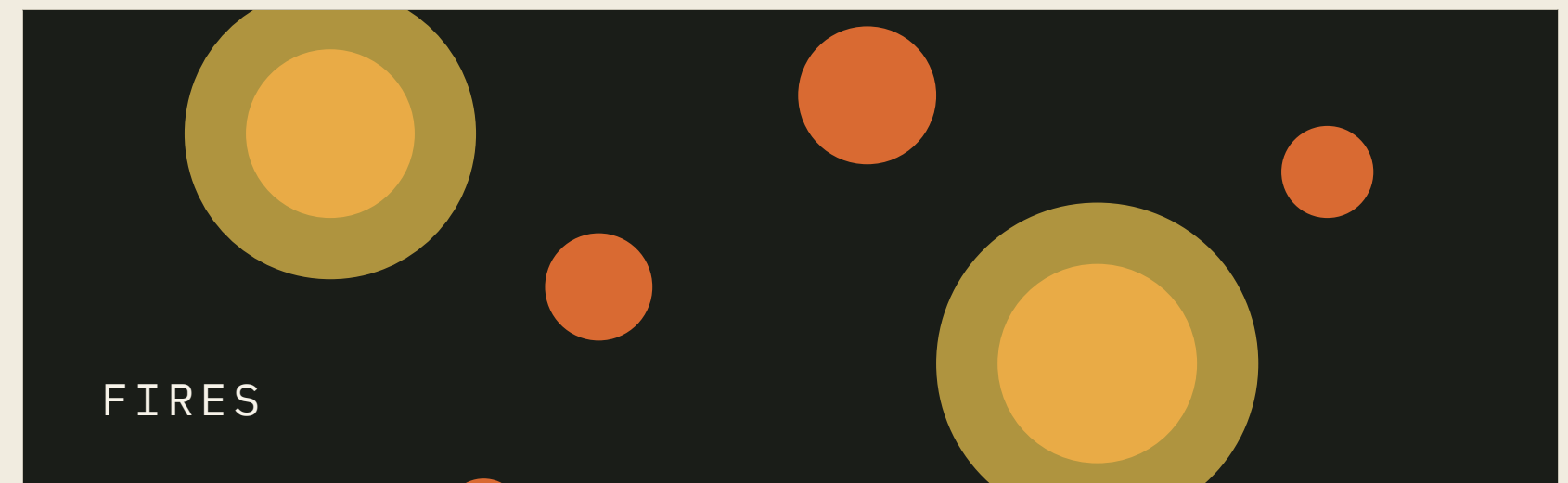
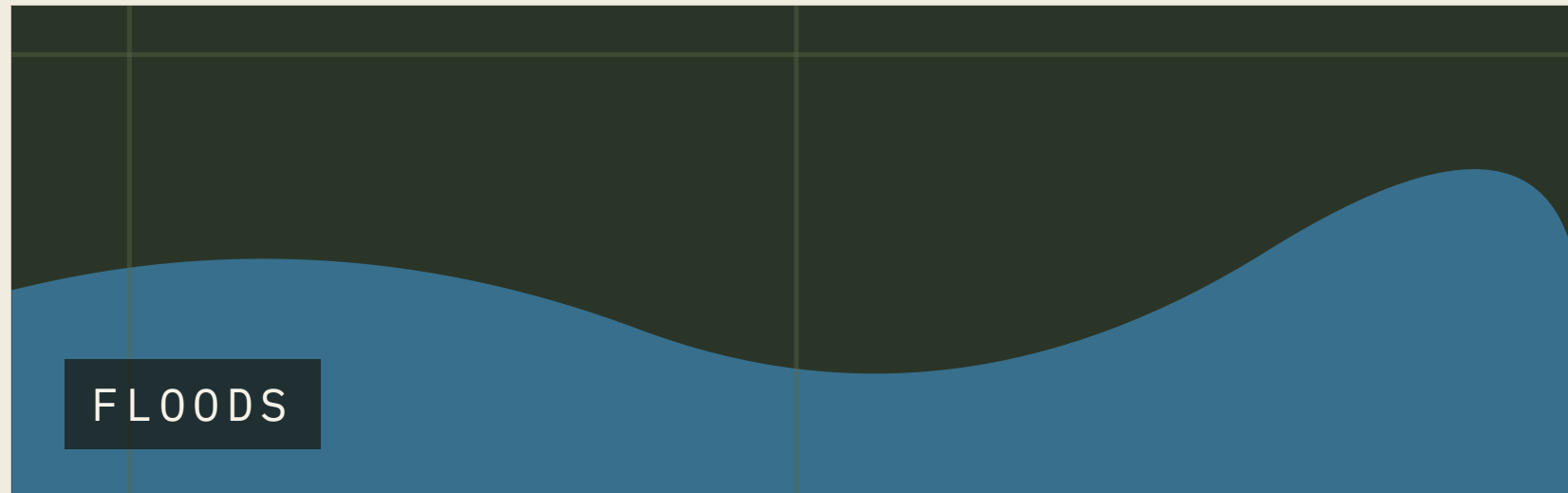


Anything between us and the ground blocks the signal. Clouds, smoke, a tree canopy.

*Knowing what we can't see is itself useful.*

THE FINGERPRINTS ARE MADE ONCE • THEN THEY'RE FREE

# Other researchers are asking other questions.



- 01 Take a year of satellite photos of Earth.
- 02 Squeeze them into a sequence per 10 m square.
- 03 Train a model to learn a *fingerprint* for each.
- 04 Match a little ground-truth to those fingerprints.

THANKS & LINKS

# Thank you.

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PAPERS, ARTICLES & GUIDES

[geotessera.org](http://geotessera.org)

HOMEPAGE

[toao.com](http://toao.com)

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