



GEOLAT



SatCafé

Satellite Remote Sensing for Improved and Sustainable Coffee Production

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International Coffee Council Projects Committee

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International Maritime Organization (IMO), London, UK

Agri-Tech Catalyst Colombia project co-funded by



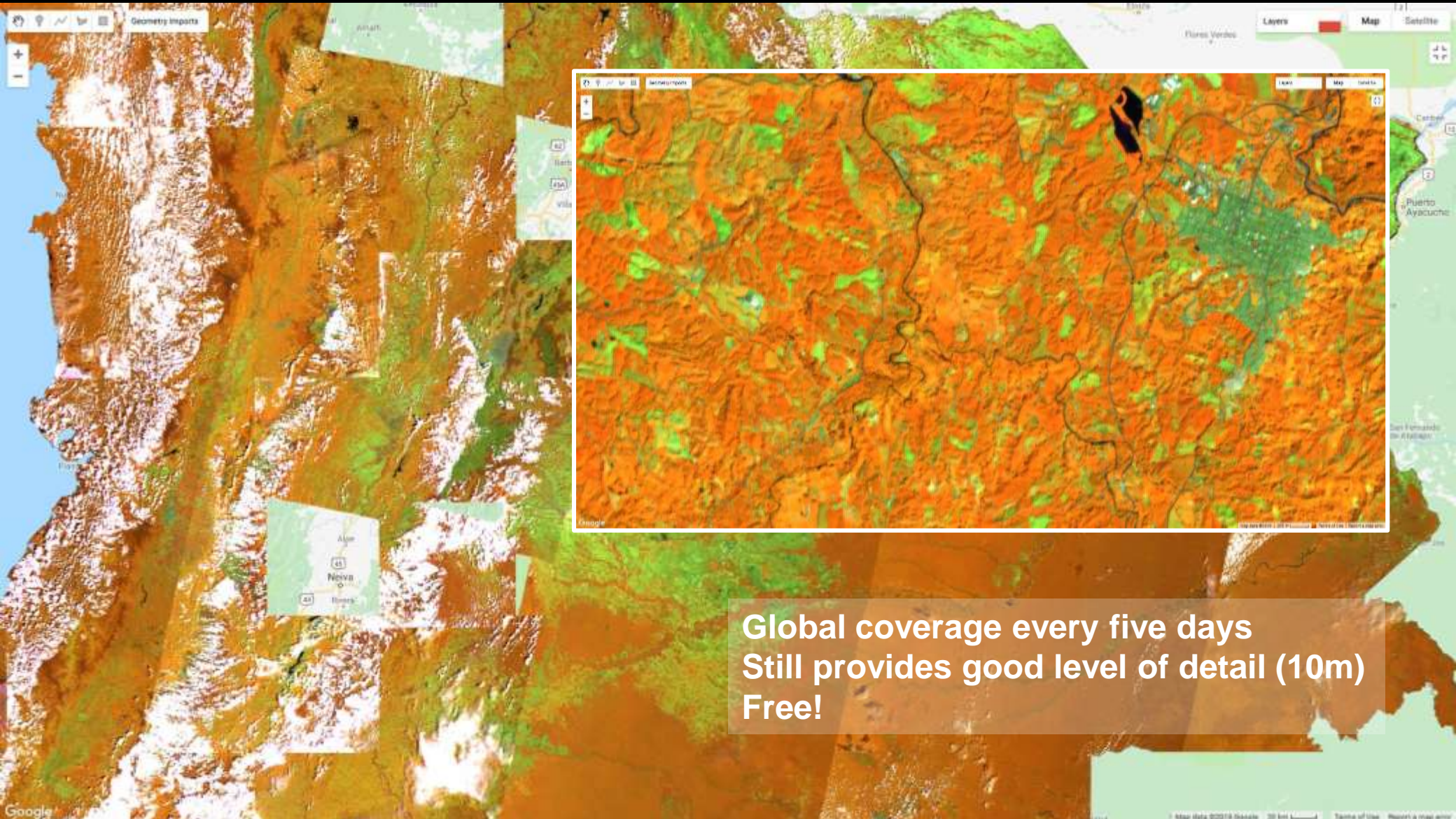
Innovate UK
Technology Strategy Board



VERY-HIGH RESOLUTION SATELITE IMAGERY

**Field-scale detail over
limited areas
Very irregular infrequent
coverage, expensive**

COPERNICUS SENTINEL-2 IMAGERY



**Global coverage every five days
Still provides good level of detail (10m)
Free!**

- **Aims to develop useful applications of satellite data for mapping and monitoring changes in coffee plantations, including deterioration due to climate change, as well as monitoring the condition of crops**
- **Feasibility study part-funded through Agri-Tech Catalyst Colombia, an ‘Innovate UK’ programme to support the uptake of new technologies and innovations in the Colombian Agriculture sector, particularly by female smallholder farmers in post-conflict areas; financed by the Colombian Prosperity Fund managed by the British Embassy, Bogotá**
- **Selected as one of only 7 projects starting in 2019, from more than 150 proposals**
- **Partners are RSAC, GEOLAT, Fedecafé, ICO**
- **Planned effort by RSAC and GEOLAT is 3 man-years over 18 months**
- **Project kicked off 1 February 2019**

SATCAFÉ PARTNERS



Remote Sensing Applications Consultants Ltd (RSAC)

- Based in Hampshire, UK; created in 1986
- Small consultancy specialised in land use mapping derived from Earth Observation data, with expertise in forestry and agriculture
- Strong relationship with the European Space Agency
- South American crop monitoring experience in Paraguay, Peru and Colombia (Magdalena Valley)



GEOLAT SAS

- SME based in Bogotá
- Focused on developing remote sensing land applications using different types of satellite optical, radar (SAR), lidar and UAV data
- Extensive experience in research and operational projects on agricultural and environmental topics

Fedecafé (FNC)

- Colombian Coffee Growers' Federation
- Represents ~540,000 families growing coffee in Colombia, providing technical assistance and carrying out programmes to address environmental and pest and disease problems

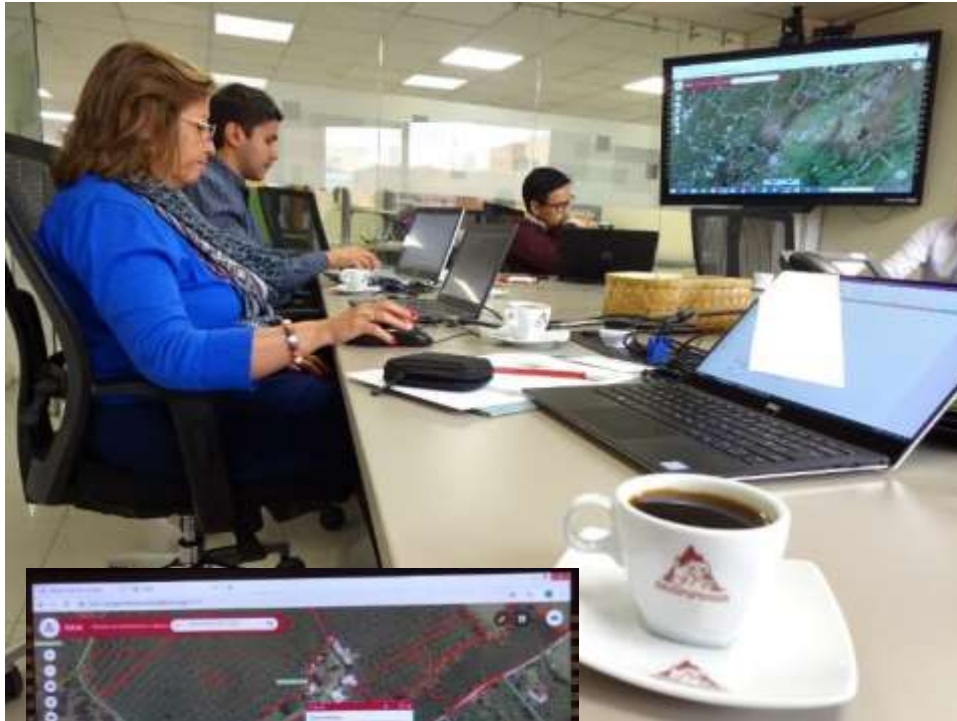


ICO



- **Working with Fedecafé to**
 - improve accuracy and currency of information on coffee farms, enabling more effective and efficient operations (e.g. Extension Service visits)
 - integrate results within national systems, providing a contribution to decision making processes enabling both government and growers to take timely action in response to potential threats
- **Working directly with smallholder farmers to provide information on the condition of crops**
- **RSAC and GEOLAT part-funding their involvement in the project; project objectives include exploring opportunities for future commercial developments providing products and services to Fedecafé and coffee organisations in other countries**

REQUIREMENTS REVIEW

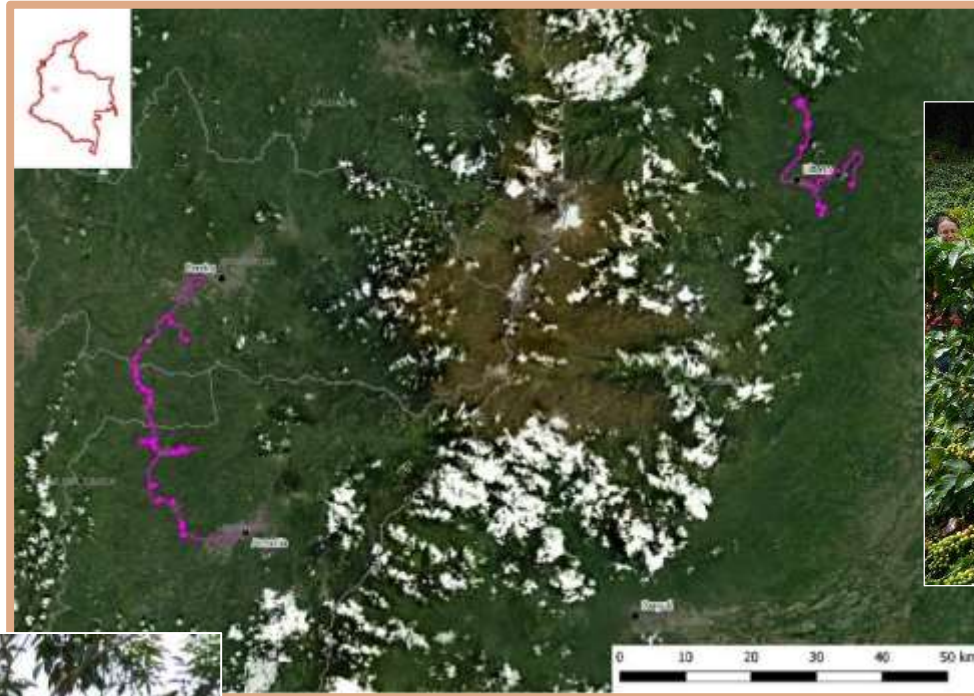


Working sessions at Fedecafé



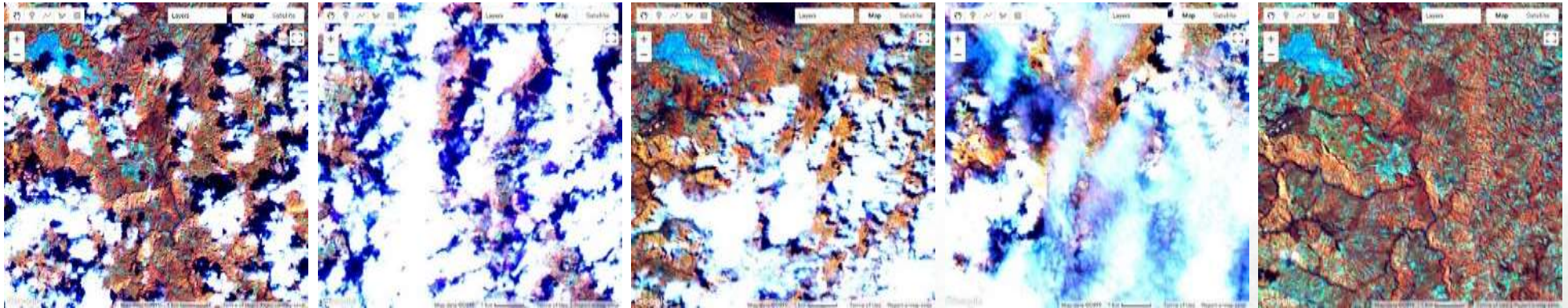
Discussions with women coffee growers' associations

COFFEE FARM VISITS



Fincas visited in Tolima, Quindío and Risaralda

AVAILABLE SENTINEL-2 COVERAGE



20/12/2018

13/02/2019

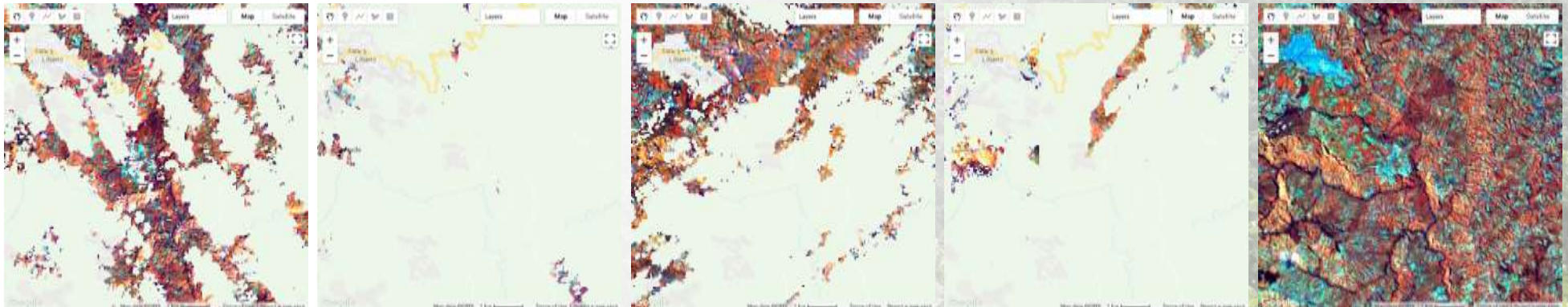
24/05/2019

18/06/2019

07/08/2019

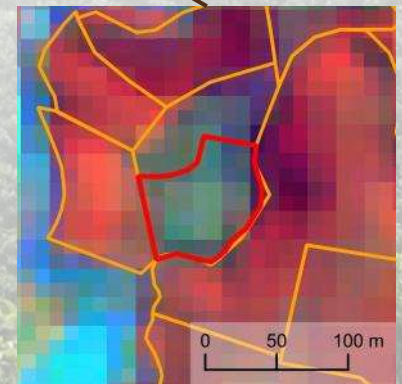
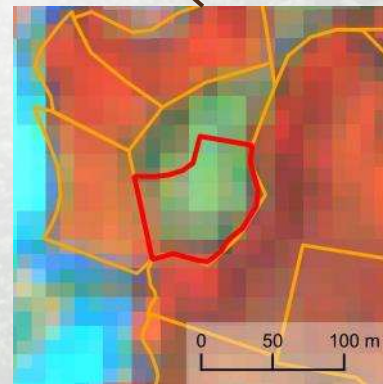
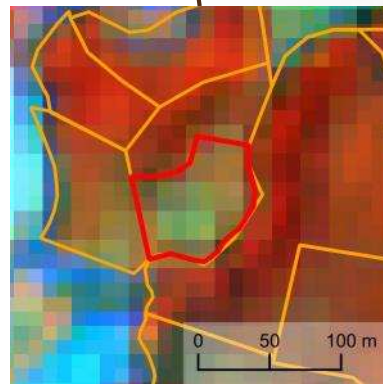
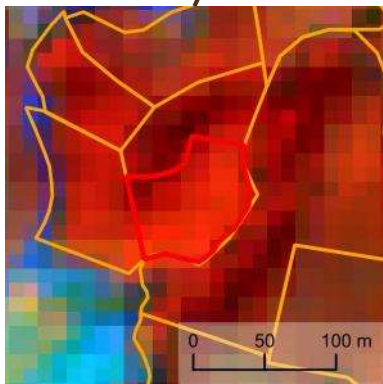
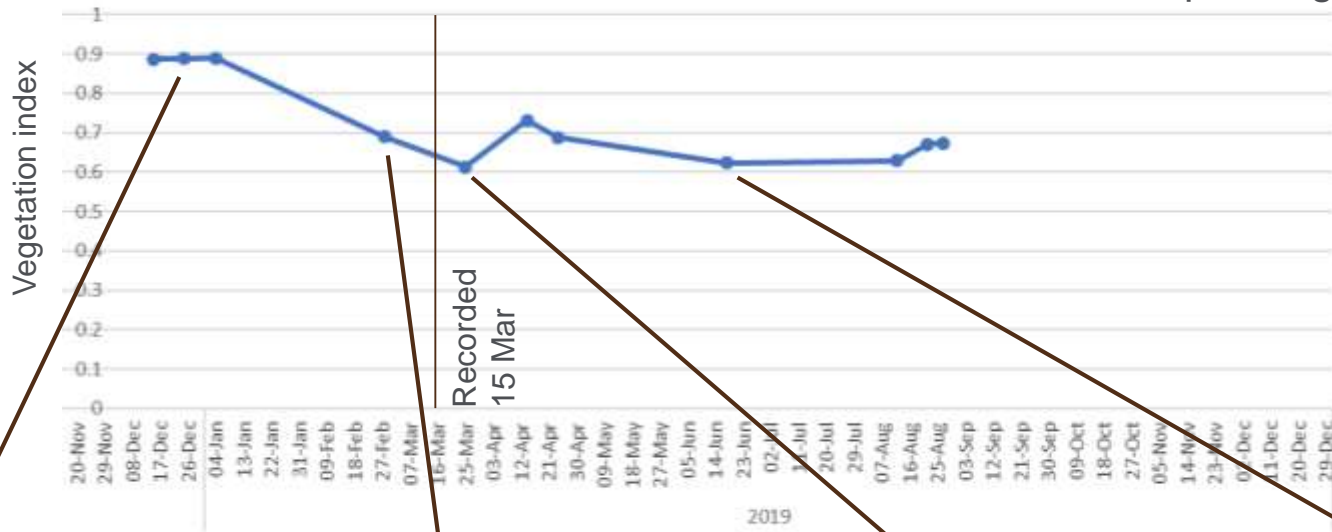
Only one completely cloud-free image in last two years

Automated cloud masking

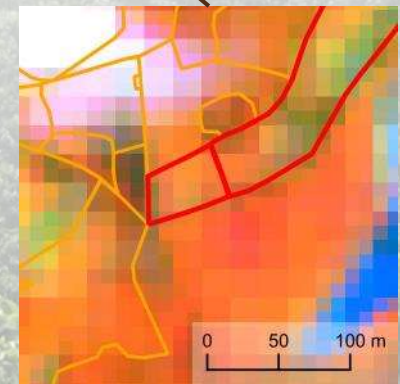
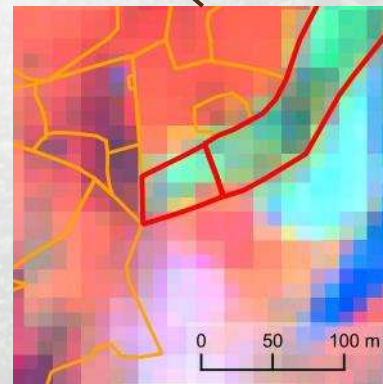
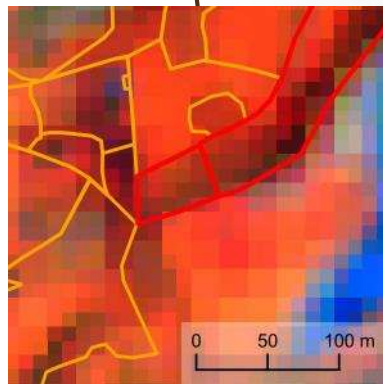
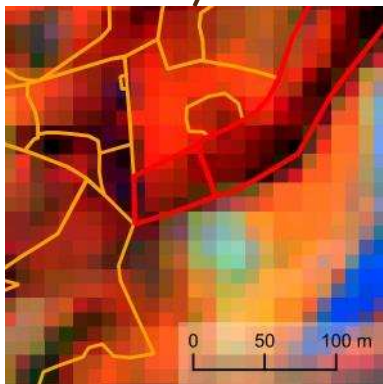
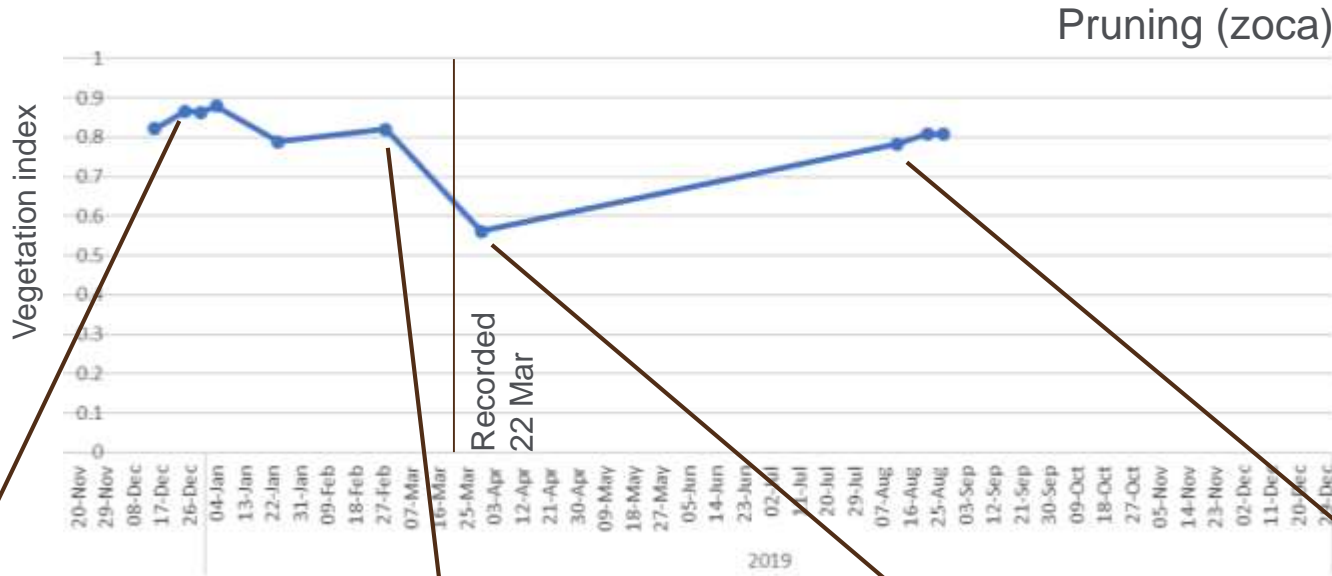


DETECTION OF 'RENOVATION' EVENTS

Replanting



DETECTION OF 'RENOVATION' EVENTS



DETECTION OF 'RENOVATION' EVENTS



Parcel.No	Labour	Date Recorded	Date Sentinel-2
1	RENOVACION ZOCA	07/07/2018	02/08/2018
3	RENOVACION ZOCA	01/07/2018	28/07/2018
4	RENOVACION SIEMBRA	11/12/2012	25/03/2018
5	RENOVACION SIEMBRA	05/05/2018	03/06/2018
7	RENOVACION SIEMBRA	01/06/2016	15/11/2016
10	RENOVACION SIEMBRA	01/02/2011	24/01/2018
14	RENOVACION SIEMBRA	06/11/2015	12/08/2019
18	RENOVACION SIEMBRA	28/11/2015	03/06/2018
22	RENOVACION ZOCA	01/02/2015	08/06/2019
26	RENOVACION ZOCA	01/02/2014	24/01/2019
29	RENOVACION SIEMBRA	28/02/2019	24/05/2019
30	RENOVACION ZOCA	03/07/2016	07/08/2016
36	RENOVACION ZOCA	10/11/2016	07/08/2016
40	RENOVACION ZOCA	01/07/2016	07/08/2016
41	RENOVACION SIEMBRA	27/08/2017	17/08/2017
43	RENOVACION SIEMBRA	11/12/2012	07/08/2016
50	RENOVACION SIEMBRA	10/04/2017	21/09/2017
52	RENOVACION SIEMBRA	22/05/2013	18/07/2017
53	RENOVACION SIEMBRA	01/04/2011	28/02/2019
55	RENOVACION ZOCA	01/06/2016	07/08/2016

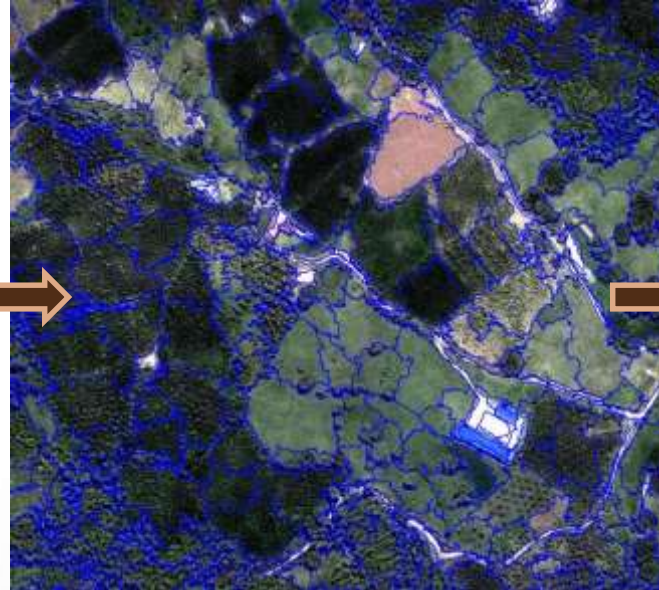
Sentinel-2 automated dating of replanting and pruning (zoca) events, compared with date recorded

AUTOMATIC MAPPING OF COFFEE PARCEL BOUNDARIES

Very-High Resolution Image



Segmentation



Coffee Parcel Map



UAV SURVEY

- Field surveys using UAVs will be used for detailed investigations of the spectral properties of coffee crop conditions, working directly with smallholders



Healthy coffee



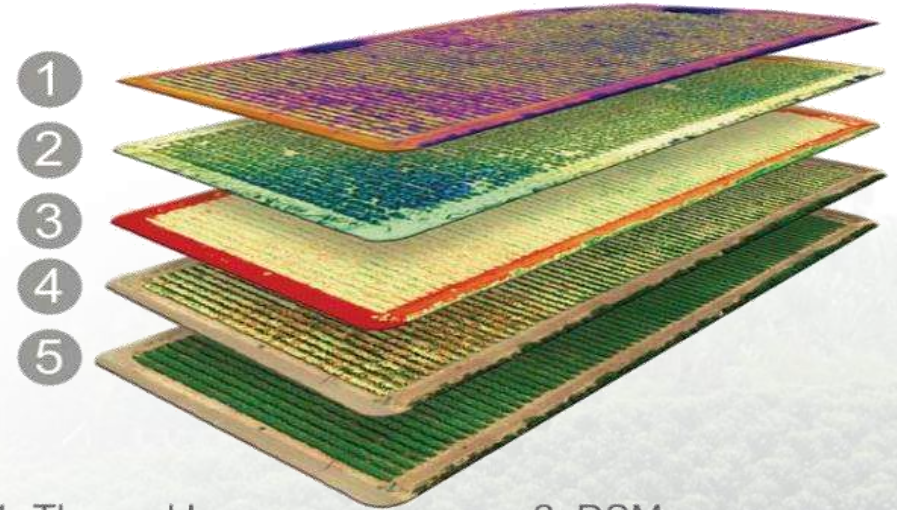
Coffee rust



THERMAL INFRARED UAV SENSOR



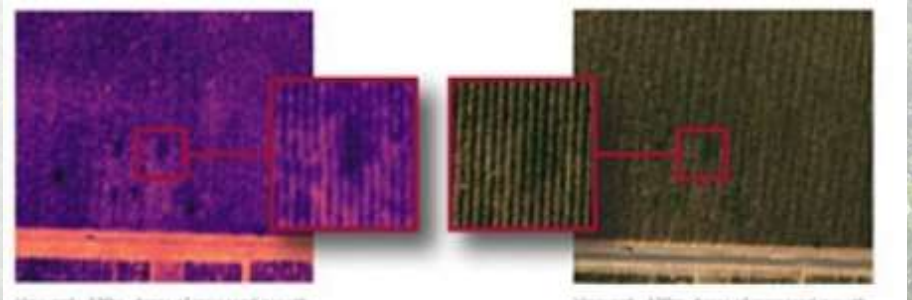
MicaSense



- MicaSense Altum produces aligned thermal, multispectral, and high-resolution imagery in one flight for advanced analytics
- Potential Coverage area: $2\text{km} \times 2\text{km} = 200\text{Ha}$
- GSD: 5.2 cm per pixel @ 120m (~400 feet)
- Applications: Coffee crop health mapping, water stress analysis, fertiliser management, zone mapping, etc...

1. Thermal Layer
3. NDVI
5. High-Res RGB

2. DSM
4. Chlorophyll Map



NEXT STEPS



- **Large Area Monitoring (parcel crop and growth conditions)**
 - use free Sentinel-2 satellite data
 - concentrate initially on selected study areas (total 900km²)
 - develop strategy for maximising use of cloud-free pixels
 - prepare maps showing mature coffee, renovation, young coffee, other crops, also maps showing changes over longer periods
 - develop automated techniques to prepare regional and national maps
- **Detailed Coffee Mapping (using VHR satellite and UAV data)**
 - use of data at highest available resolution (e.g. 50cm or better)
 - investigate potential for identifying coffee areas/coffee plants using pattern and feature recognition techniques
 - investigate potential for automated delineation of coffee-growing parcels
 - investigate use of thermal spectrum (UAV-mounted sensor) to detect condition of coffee crops



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