Tutorial on Drone Usage and IoT: Technology of the CENIC-Connected Drones and LoRaWAN Sensors at the Iron Horse Vineyards Testbed

7NRP Tuesday May 5, 1pm -2am

Presenter: John Graham

DJI Mavic 3 Multispectral - Drone

DJI Mavic 3 Multispectral

$6,132.00

Shipping calculated at checkout.

B-DJI-M3M-CB

- Ideal for Agriculture & Surveying: Designed for precision farming and land analysis.
- 20MP RGB + 4 x 5MP Multispectral Cameras: Captures detailed RGB and multispectral data.
- Green, Red, Red Edge & Near Infrared Bands: Enables advanced crop health monitoring.
- RTK Positioning: Centimeter-level precision for accurate mapping.
- Omnidirectional Obstacle Avoidance: Ensures safe and reliable flights.
- Wide-FOV Sensors: Adapts to sloped terrain for consistent data collection.
- Integrated Sunlight Sensor: Ensures accurate multispectral data in varying light conditions.
- 43-Minute Flight Time: Extended cruise time for efficient operations.
- O3 Transmission: Stable video feed up to 9.3 miles (15 km).
- DJI Care Enterprise: Includes comprehensive protection and support.

DJI Mavic 3 Multispectral Drone: Data and Displays

UgCS - Drone Flight Path Mission Planning

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https://www.sphengineering.com/flight-planning/ugcs

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UgCS - Photogrammetry

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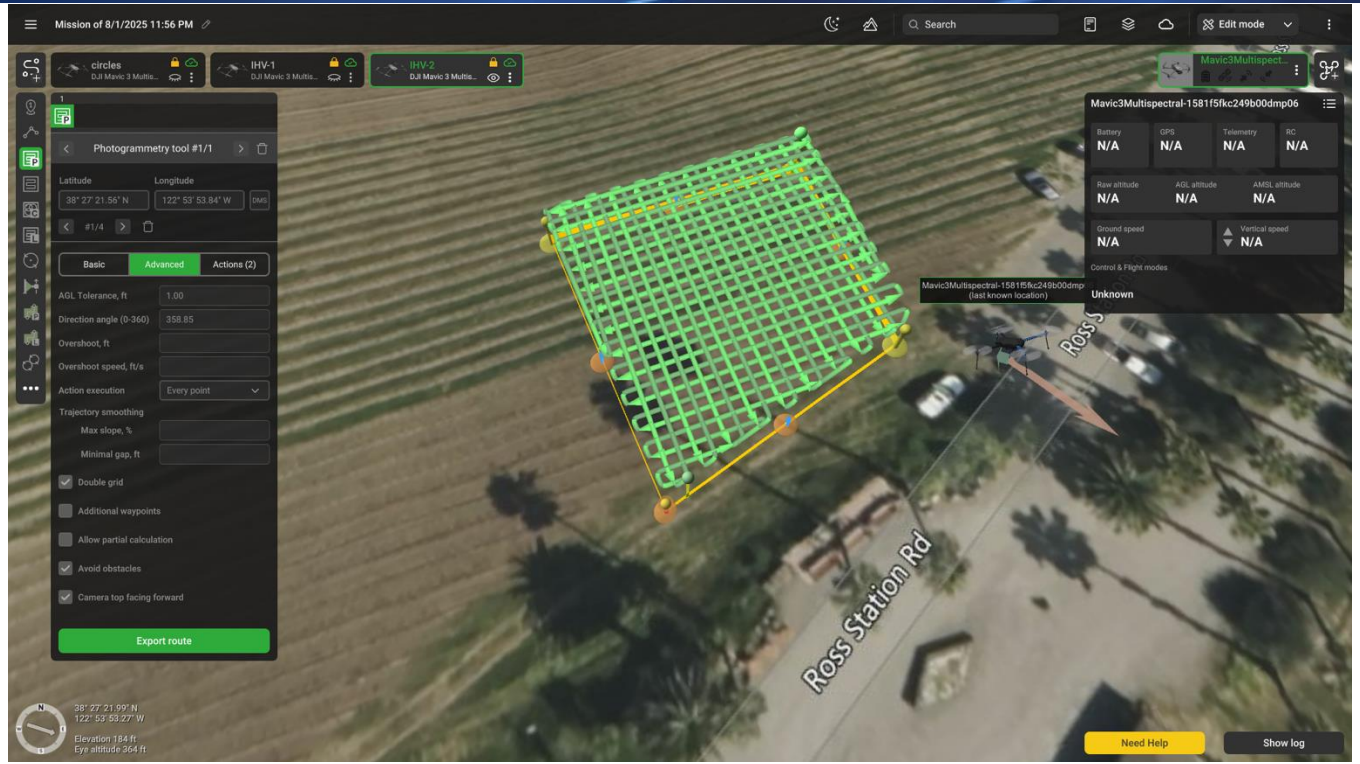
UgCS - Circlegrammetry

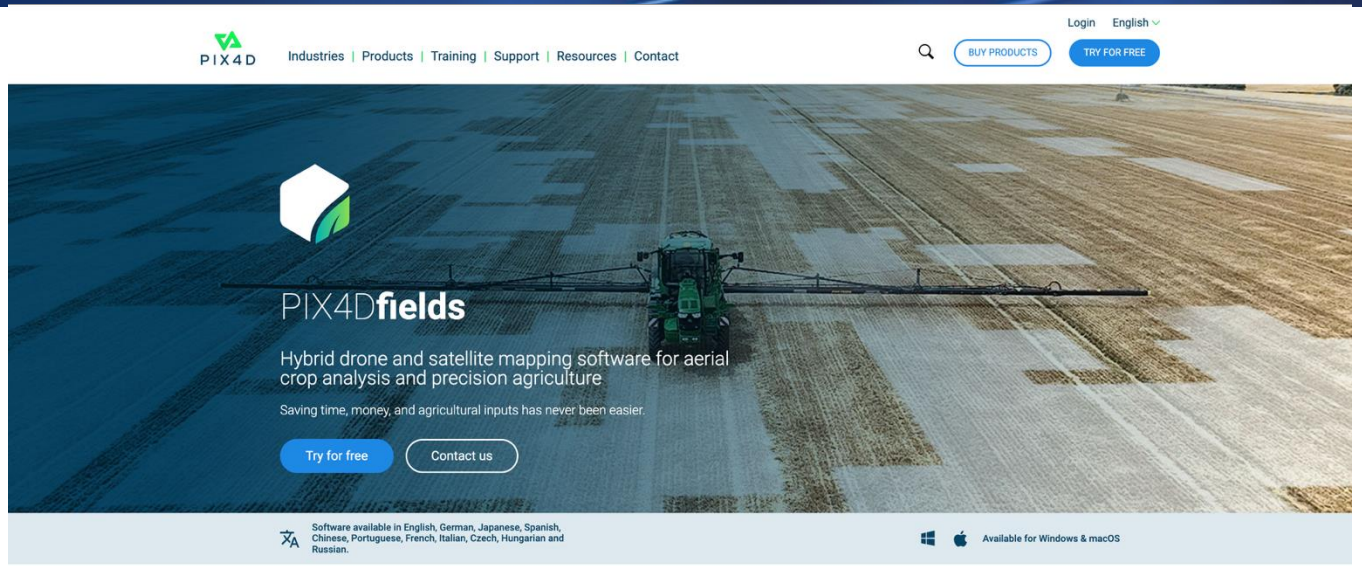
https://www.sphengineering.com/flight-planning/ugcs

UgCS – Photogrammetry Low Altitude Terrian Following



https://www.sphengineering.com/flight-planning/ugcs

PIX4D**fields** – crop analysis software



Compatible with industry leaders

Ready-to-use & customizable variable rate and spot spraying maps for spray drones, tractors, and field sprayers.

ISOXML for standard ISOBUS machine terminals

Compatible with

https://www.pix4d.com/product/pix4dfields

Vegetation Indices, Particularly NDVI:

Vegetation indices (VIs) are mathematical formulas applied to remote sensing data to provide insights into vegetation health, density, and water content, with the most common being the Normalized Difference Vegetation Index (NDVI).

They work by comparing the reflectance of different light bands, particularly near-infrared (NIR) and red, as healthy vegetation reflects NIR light and absorbs red light.

VIs are used in precision agriculture, forestry, and environmental monitoring to assess factors like crop vigor, drought conditions, and biomass.

Light Reflection: Different surface types reflect and absorb light differently across the electromagnetic spectrum.

Spectral Bands: Data from specific spectral bands, like red and near-infrared (NIR) highlight characteristics of vegetation.

Formula Application: A formula combines the reflectance values from these bands to produce a single index value that indicates a vegetation property.

Interpretation: Higher VI values generally correspond to healthier, more vigorous vegetation, while lower values can indicate stress, drought, or sparse cover.

Normalized Difference Vegetation Index (NDVI): The most popular VI, NDVI assesses vegetation health by calculating the difference between NIR and red reflectance. Use: Monitors plant vigor, biomass, and growth over a season.

Vegetation Indices Processed from Drones

VEGETATION INDEX	CHARACTERISTICS AND USES
Green Normalized Difference Vegetation Index (GNDVI)	Uses visible green light (instead of visible red and near infrared) to measure rates of photosynthesis and monitor plant stress.
Leaf Chlorophyll Index (LCI)	Assesses chlorophyll content in areas of complete leaf coverage.
Modified Chlorophyll Absorption in Reflective Index (MCARI)	Used to measure chlorophyll concentrations and variations in the Leaf Area Index.
Normalized Difference Red Edge (NDRE)	Sensitive to chlorophyll content in leaves against soil background effects (Can only be formulated when the red edge band is available).
Normalized Difference Vegetation Index (NDVI)	Used to measure biomass in precision agriculture (used in forestry to quantify forest supply and leaf area index).
Visible Atmospherically Resistant Index (VARI)	RGB index for leaf coverage. Used to estimate the fraction of vegetation in an image with low sensitivity to atmospheric effects.
Blue Normalized Difference Vegetation Index (BNDVI)	An index without red channel availability that uses the visible blue, for areas sensitive to chlorophyll content.
Triangular Greenness Index (TGI)	RGB index for chlorophyll sensitivity. Relies on reflectance values at visible wavelengths. A good proxy for chlorophyll content in areas of high leaf cover.
Structure Intensive Pigment Index 2 (SIPI2)	Used in areas with high variability in canopy structure (e.g. forestry).

PIX4D**fields** – PDF report generation

IHV-8-27-2025

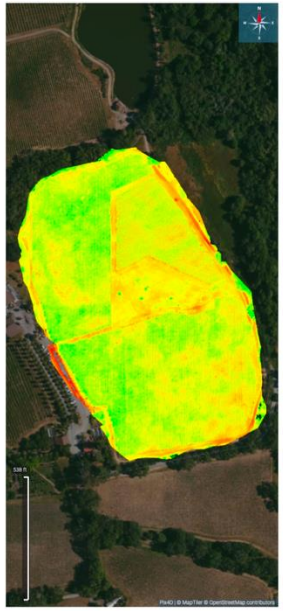
IRON HORSE VINEYARDS

MS 100' mission

Layer name	Acquisition time	Center	Area	Page
GNDVI	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	2
LCI	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	3
MCARI	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	4
NDRE	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	5
NDVI	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	6
Orthomosaic	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.269 ac	7
SIPI2	8/27/25 3:48:53 PM PDT Duration: 00:38:54	38.4560440, -122.8967575 (WGS84)	22.248 ac	8
Surface model	Information not available	38.4560440, -122.8967575 (WGS84)	22.289 ac	9

PIX4D**fields** – PDF report generation

GNDVI
Index



Layer details

Acquisition time	8/27/25 3:48:53 PM PDT Duration: 00:38:54
Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

-0.645 -0.250 0.145 0.540 0.936

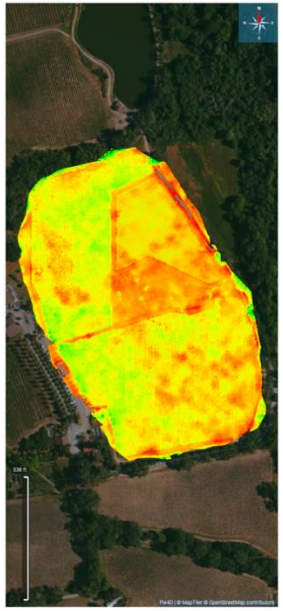
Visualization settings

Histogram equalization: Off
Selected minimum value: 0.178
Selected maximum value: 0.810
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.55034
Index SD: 0.13609
Mean index (visible): 0.54854
Index SD (visible): 0.13166

LCI
Index



Layer details

Acquisition time	8/27/25 3:48:53 PM PDT Duration: 00:38:54
Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

-0.315 -0.034 0.246 0.527 0.808

Visualization settings

Histogram equalization: Off
Selected minimum value: 0.039
Selected maximum value: 0.555
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.25227
Index SD: 0.12172
Mean index (visible): 0.25453
Index SD (visible): 0.11699

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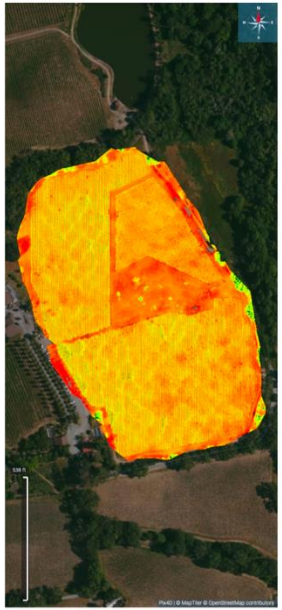
MCARI

Index



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Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

-2.403 -1.390 -0.376 0.638 1.651

Visualization settings

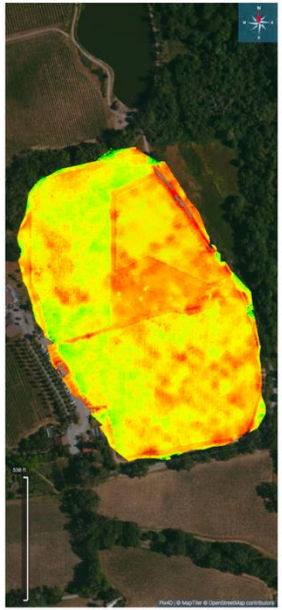
Histogram equalization: Off
Selected minimum value: 0.014
Selected maximum value: 0.822
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.21827
Index SD: 0.18329
Mean index (visible): 0.21133
Index SD (visible): 0.16407

NDRE

Index



Layer details

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Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

-0.293 -0.040 0.213 0.466 0.718

Visualization settings

Histogram equalization: Off
Selected minimum value: 0.034
Selected maximum value: 0.444
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.20168
Index SD: 0.09072
Mean index (visible): 0.20363
Index SD (visible): 0.08665

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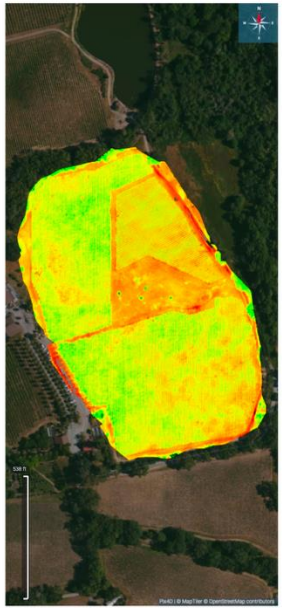
NDVI

Index



Layer details

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Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

Visualization settings

Histogram equalization: Off
Selected minimum value: 0.122
Selected maximum value: 0.864
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.48347
Index SD: 0.20063
Mean index (visible): 0.48106
Index SD (visible): 0.19498

Orthomosaic

Orthomosaic

Layer details

Acquisition time	8/27/25 3:48:53 PM PDT Duration: 00:38:54
Center	38.4560440, -122.8967575 (WGS84)
Area	~22.269 ac
GSD	0.566 in/px
Bands	5 (Green, Red, Red edge, NIR, Alpha)

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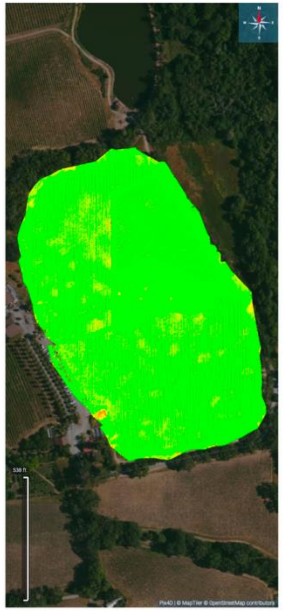
SIPI2

Index



Layer details

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Center	38.4560440, -122.8967575 (WGS84)
Area	~22.248 ac
GSD	0.566 in/px
Bands	1 (Index)

Histogram and Legend

-1.000 -0.500 0.000 0.500 1.000

Visualization settings

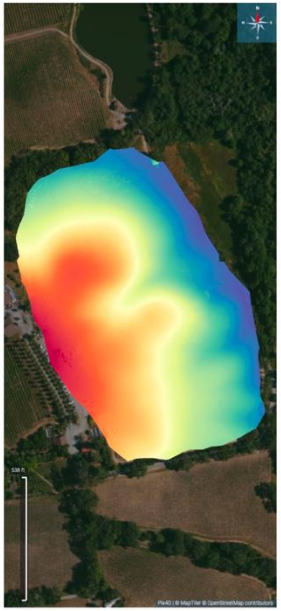
Histogram equalization: Off
Selected minimum value: 0.891
Selected maximum value: 1.000
Values out of range: Transparent

Statistics

Layer area: 22.248 ac
Mean index: 0.98898
Index SD: 0.03178
Mean index (visible): 0.99009
Index SD (visible): 0.02104

Surface model

Surface model



Layer details

Acquisition time	Information not available
Center	38.4560440, -122.8967575 (WGS84)
Area	~22.289 ac
GSD	0.566 in/px
Bands	1 (DSM)

Elevation

-19.256 ft 10.598 ft 40.451 ft 70.305 ft 100.159 ft

Visualization settings

Selected minimum value: -5.869
Selected maximum value: 30.528
Values out of range: Transparent

Statistics

Layer area: 22.289 ac
Mean height: 33.64944 ft
Height SD: 30.13212 ft
Mean height (visible): 33.64944 ft
Height SD (visible): 30.13212 ft

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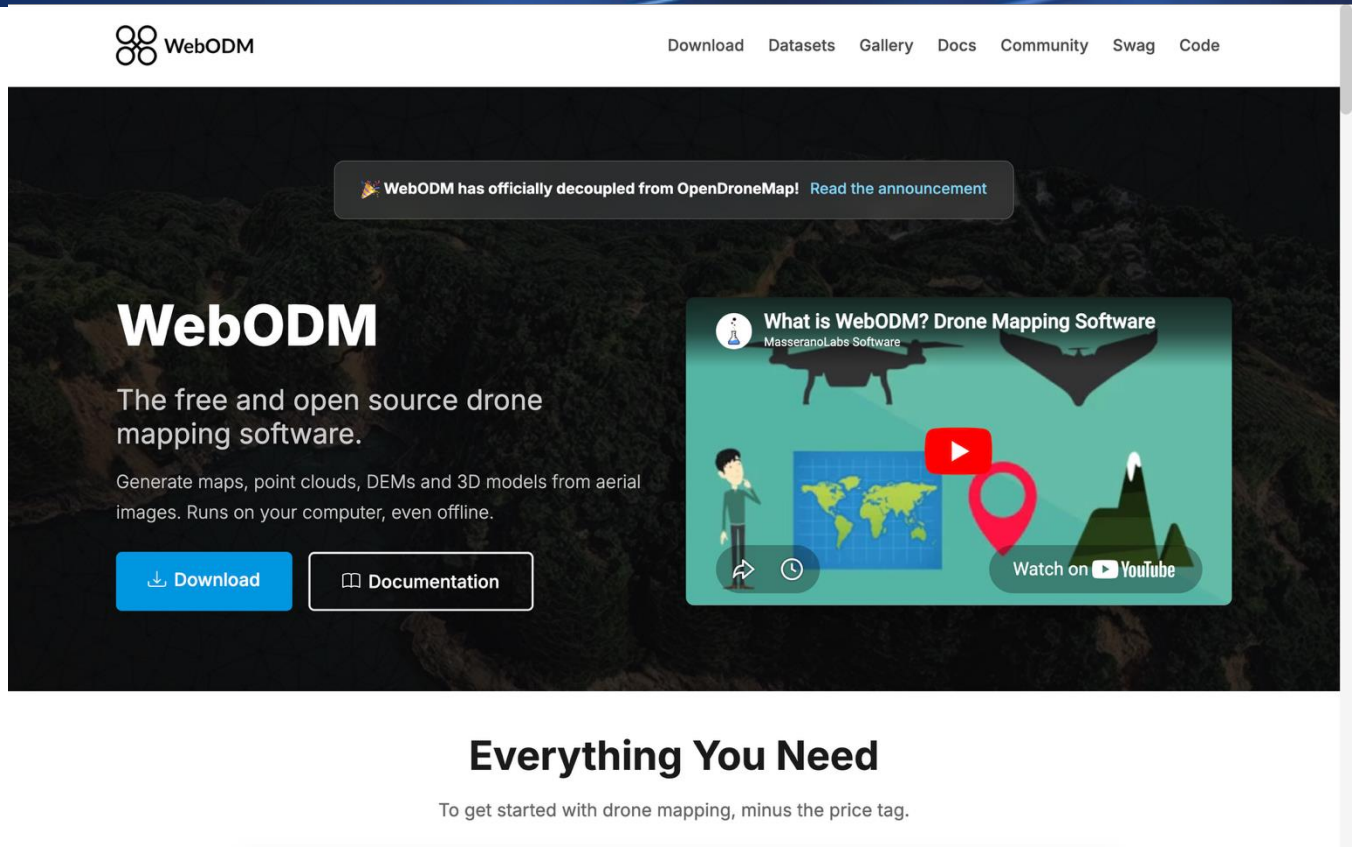
Software

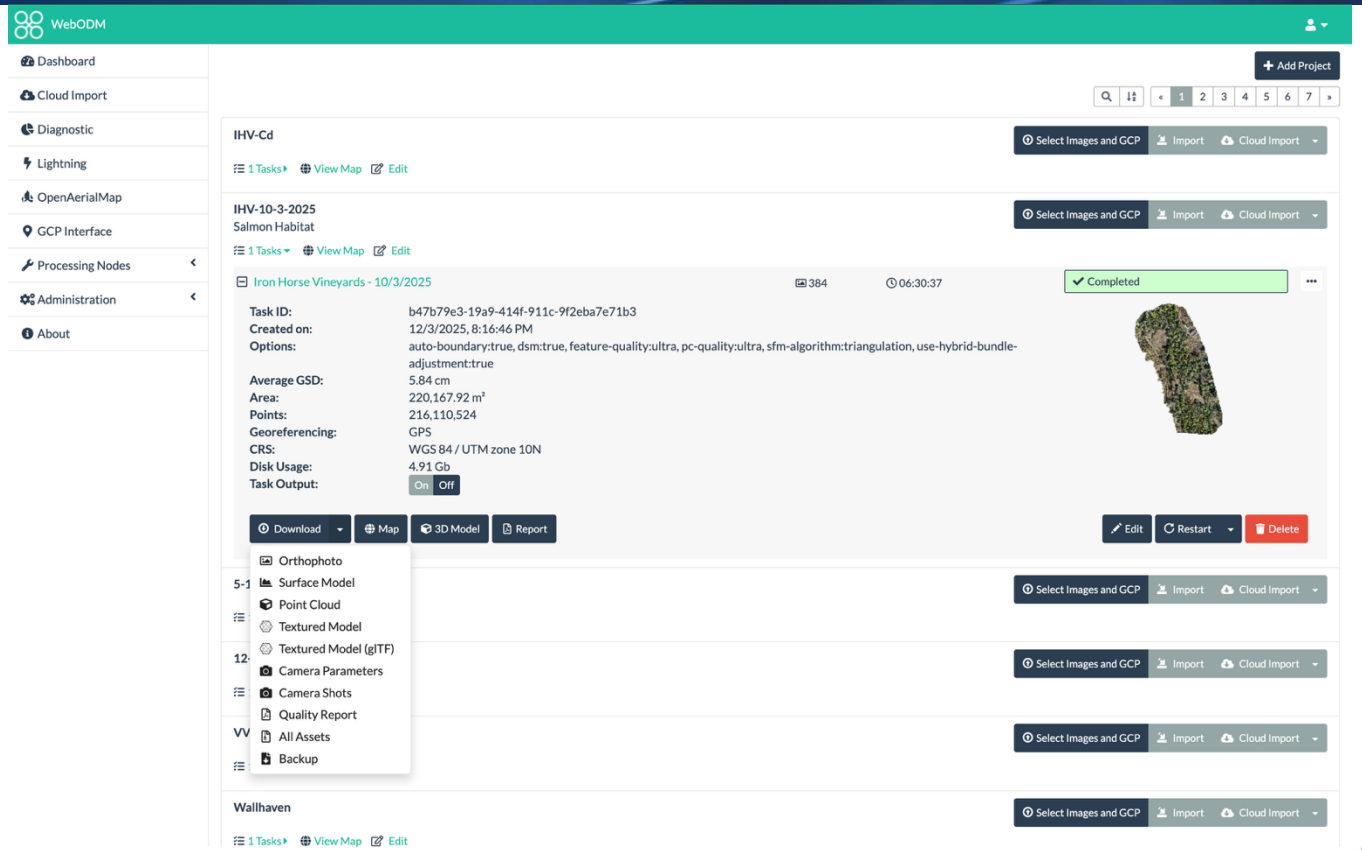
PIX4Dfields Classroom - educational - floating license (use up to 25 devices at a time)	$2,000.00
https://www.pix4d.com/pricing/pix4dfields-educational/	
UgCS Educational Partners Program	$1,558.00
https://www.sphengineering.com/partners/educational-program?country=united-states	

WebODM



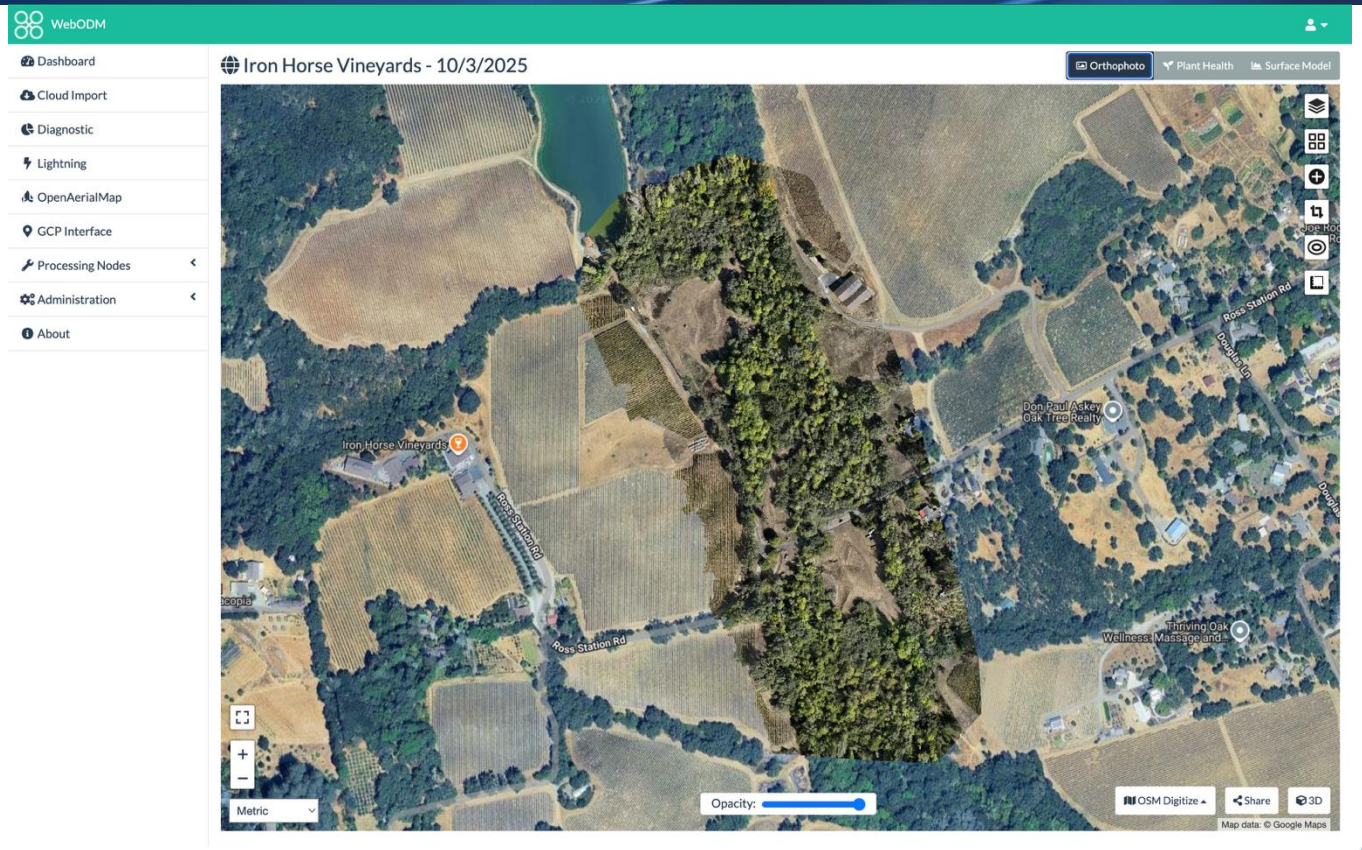
https://webodm.org/

NRP WebODM Service



https://webodm.nrp-nautilus.io/

NRP WebODM Orthophoto



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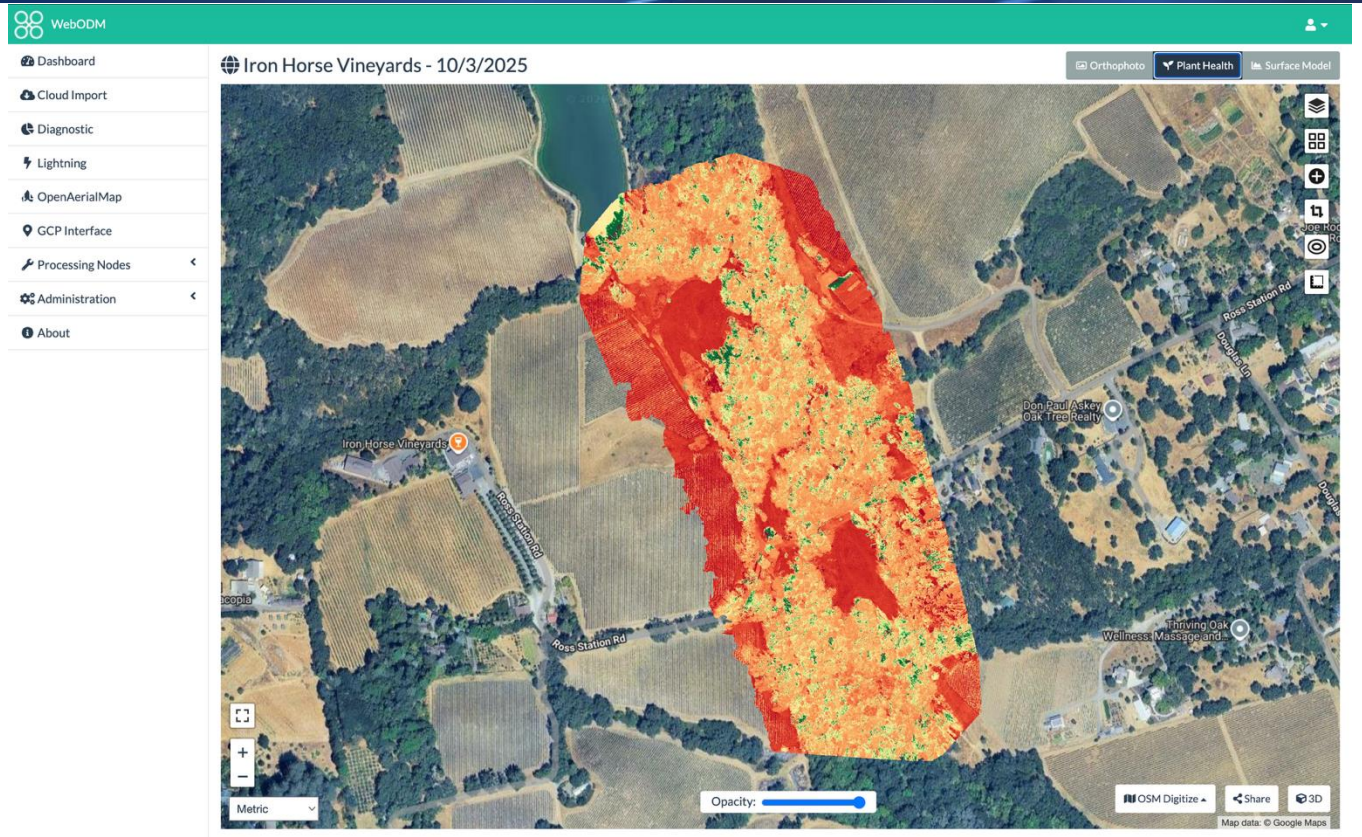
NRP WebODM NDVI



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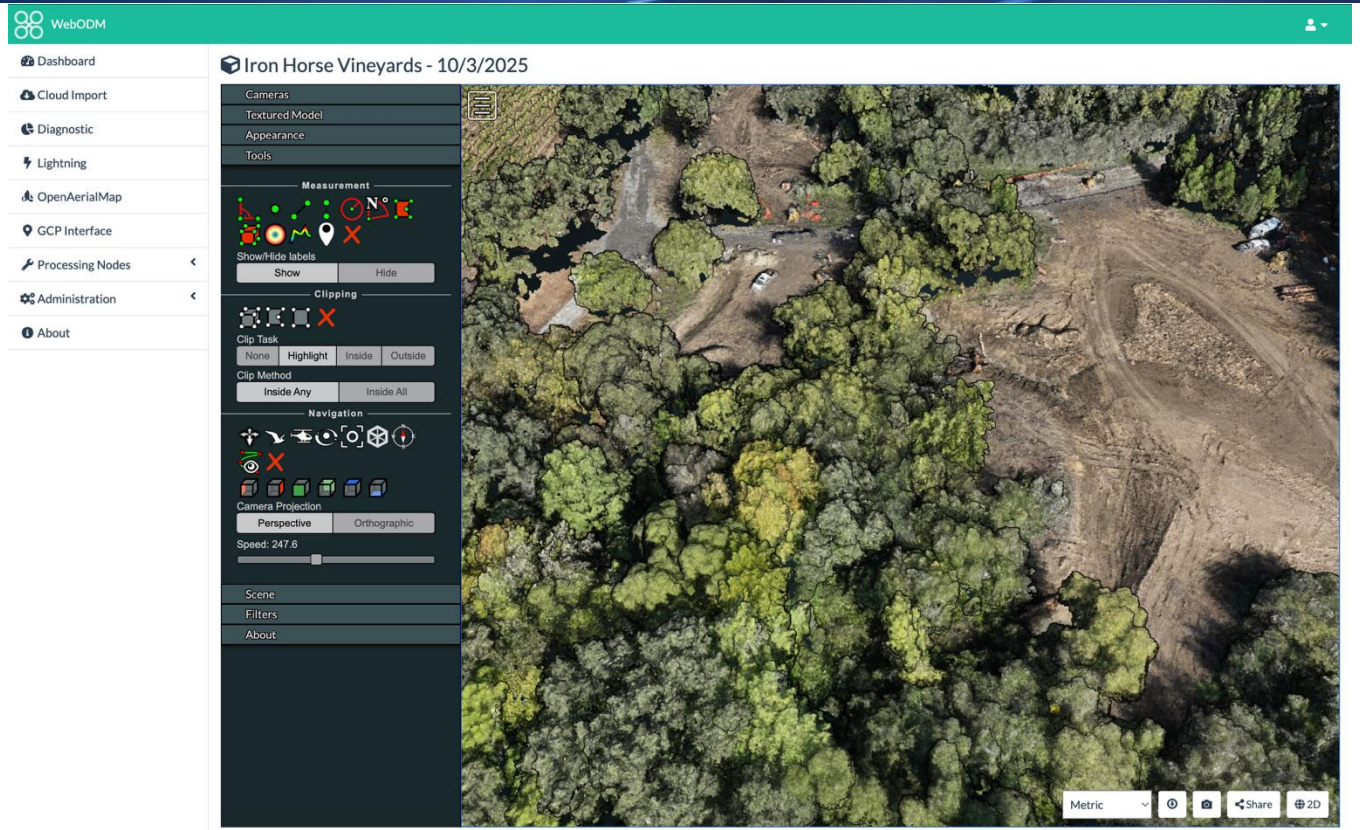
NRP WebODM 3D Point Cloud



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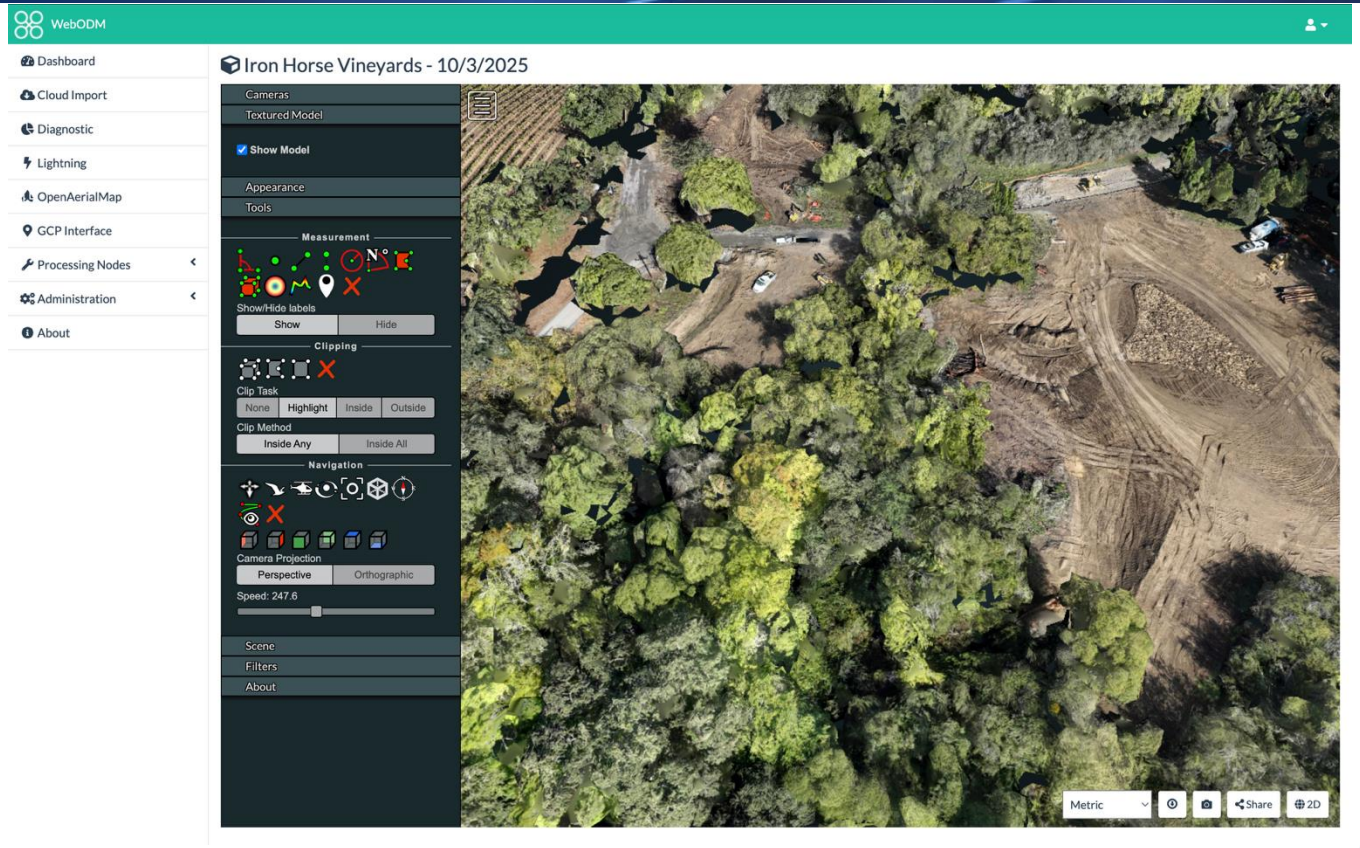
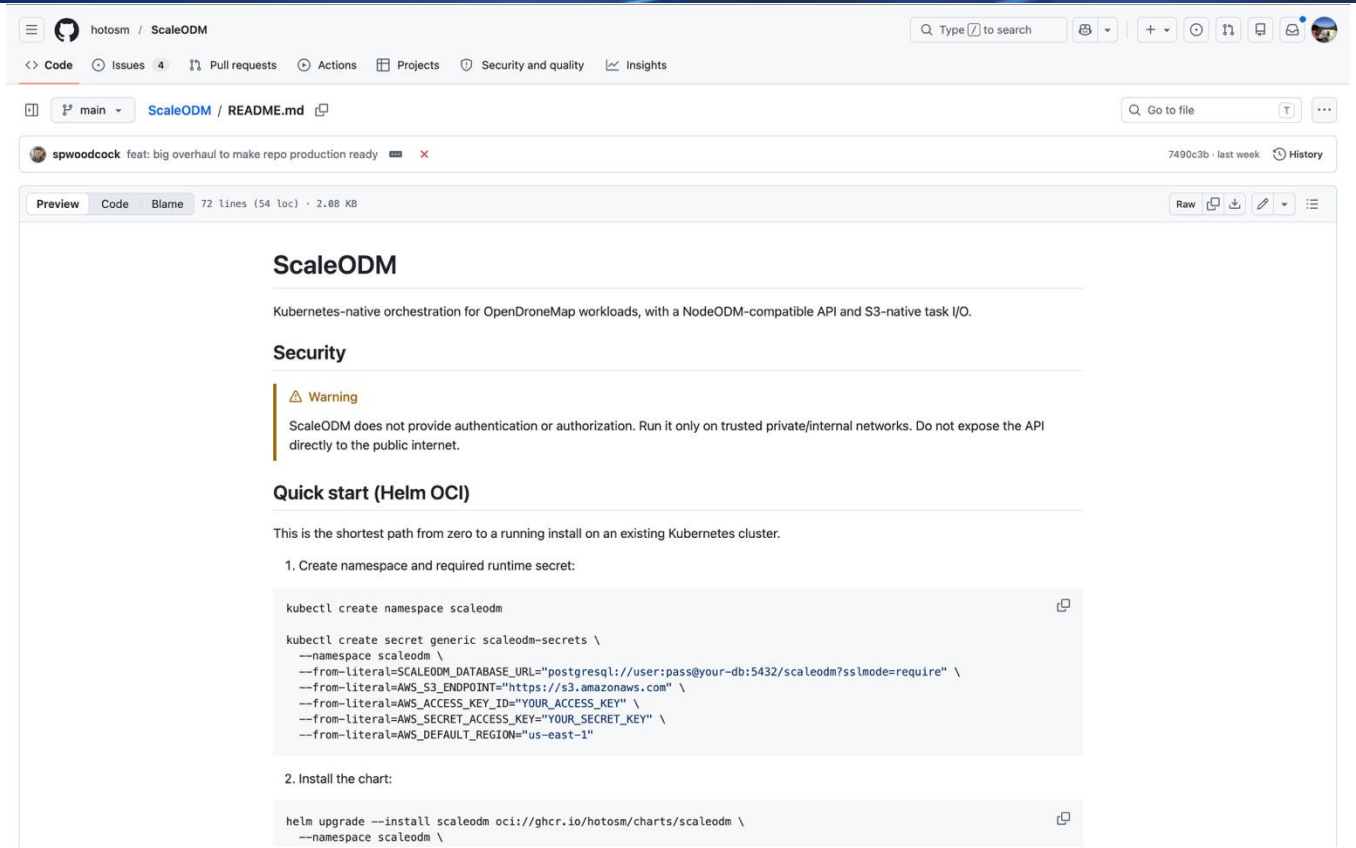
NRP WebODM 3D OBJ Textured Model



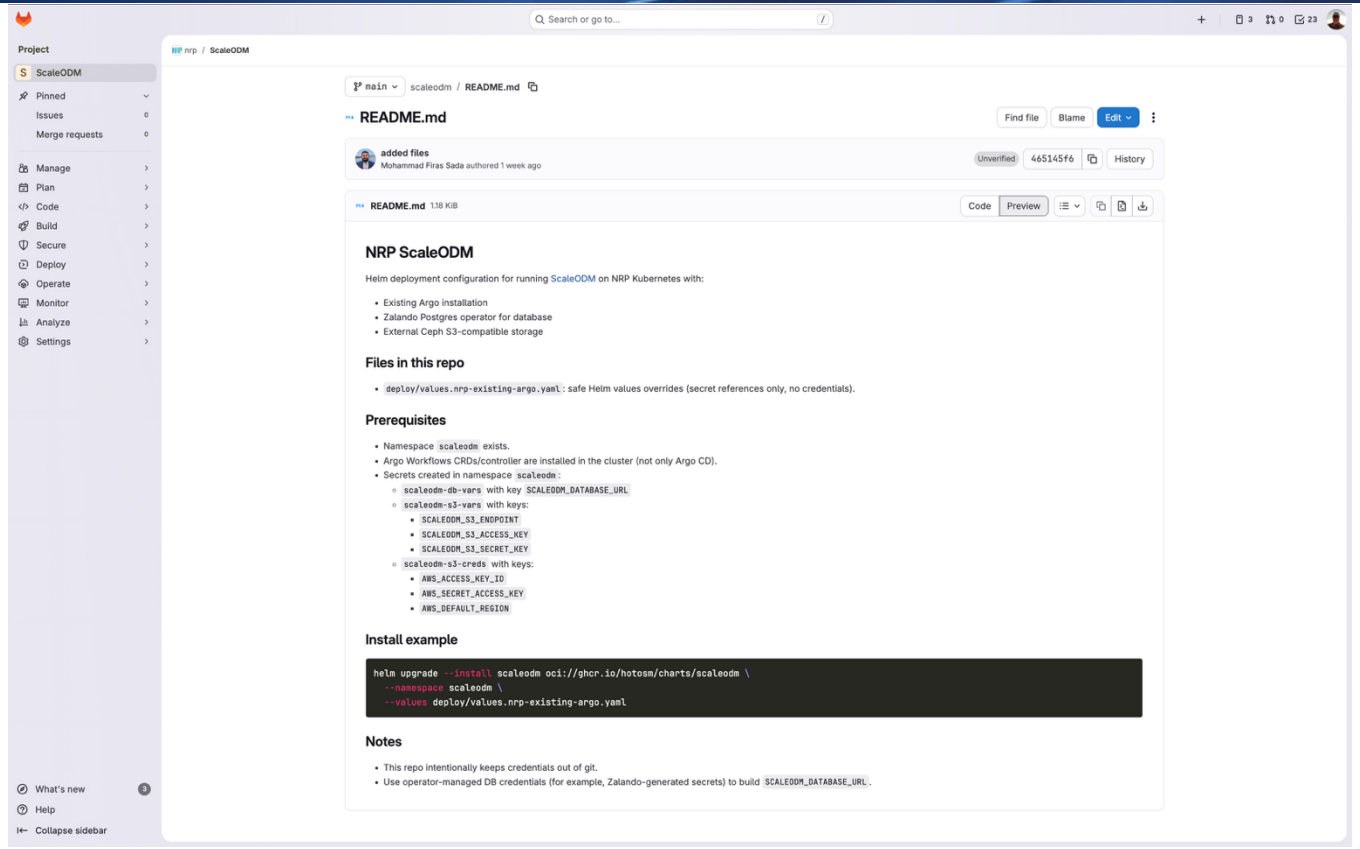
https://webodm.nrp-nautilus.io/

ScaleODM Helm Chart



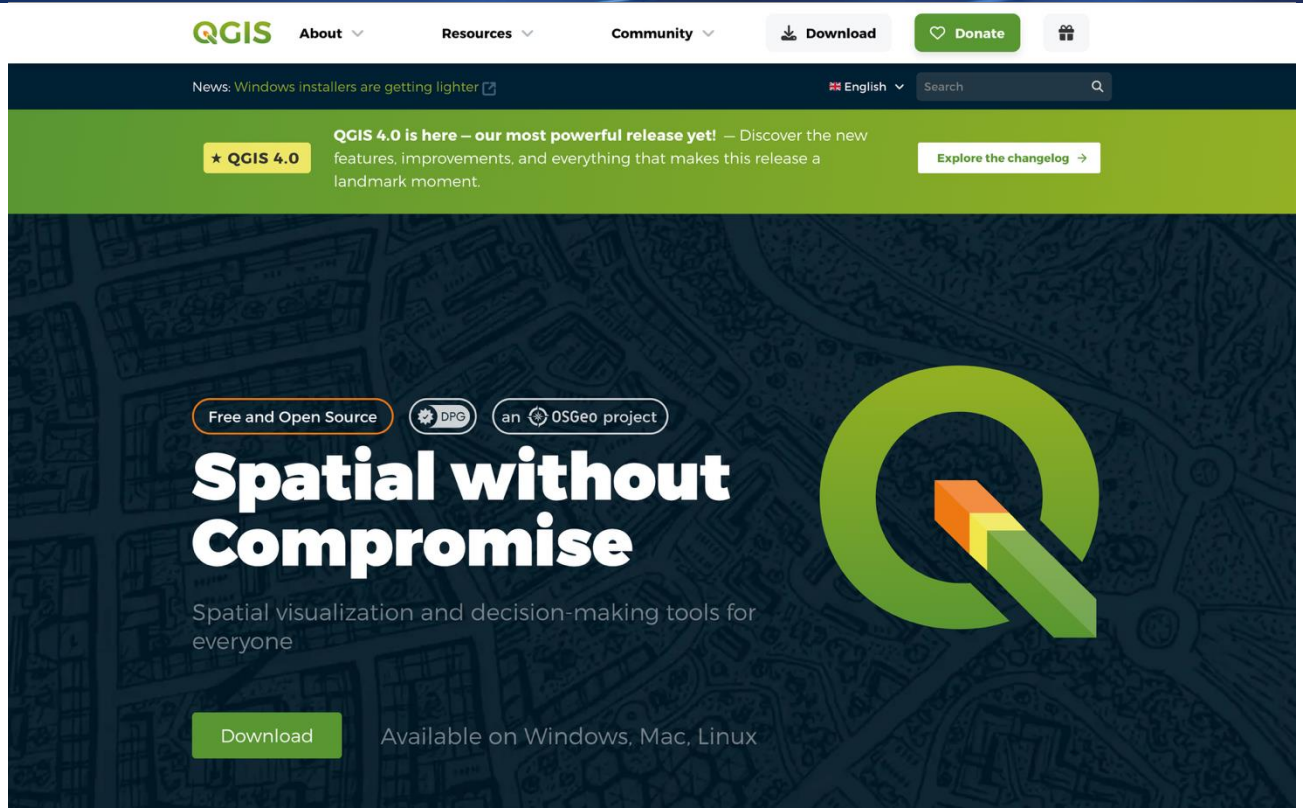
https://github.com/hotosm/ScaleODM/

NRP ScaleODM Helm Chart Deployment



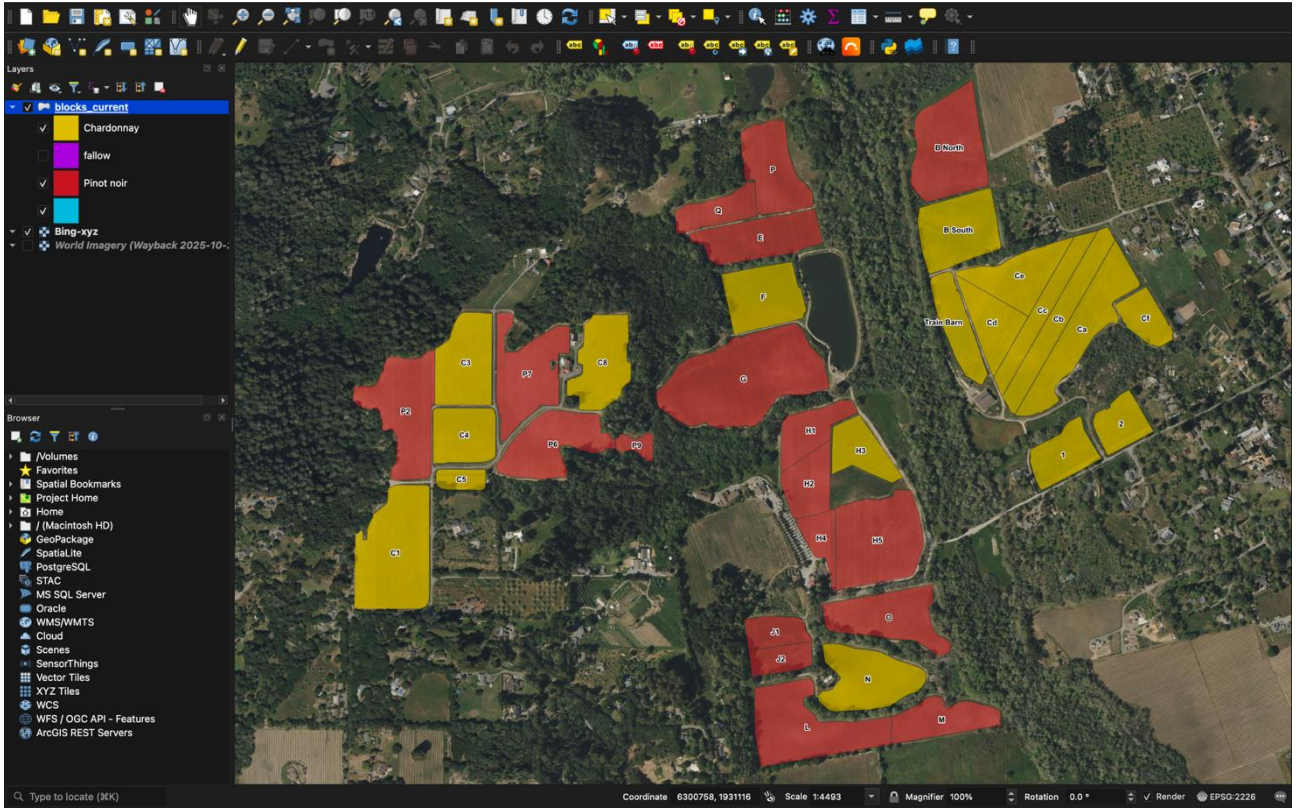
https://gitlab.nrp-nautilus.io/nrp/scaleodm/

QGIS GIS Mapping application



https://qgis.org/

QGIS GIS Mapping application



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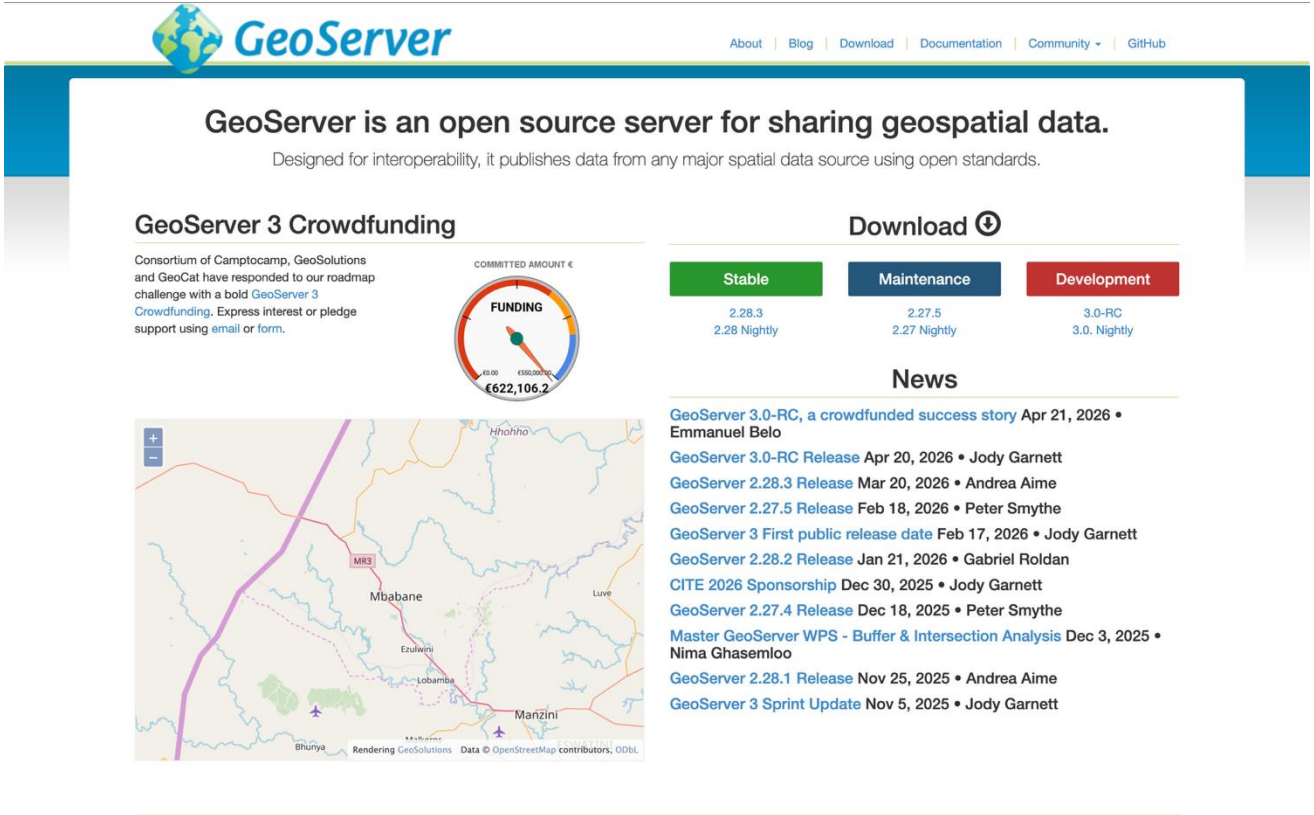
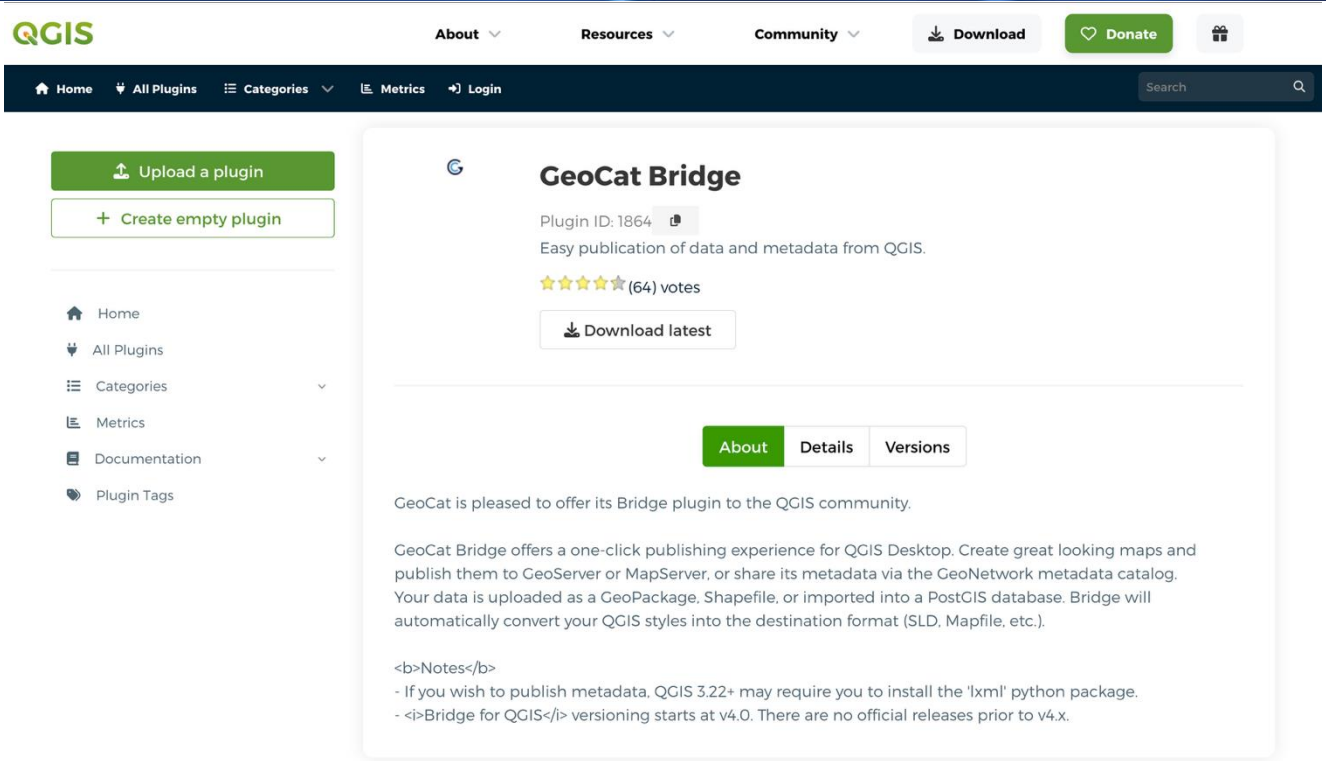
GeoServer geospatial data service



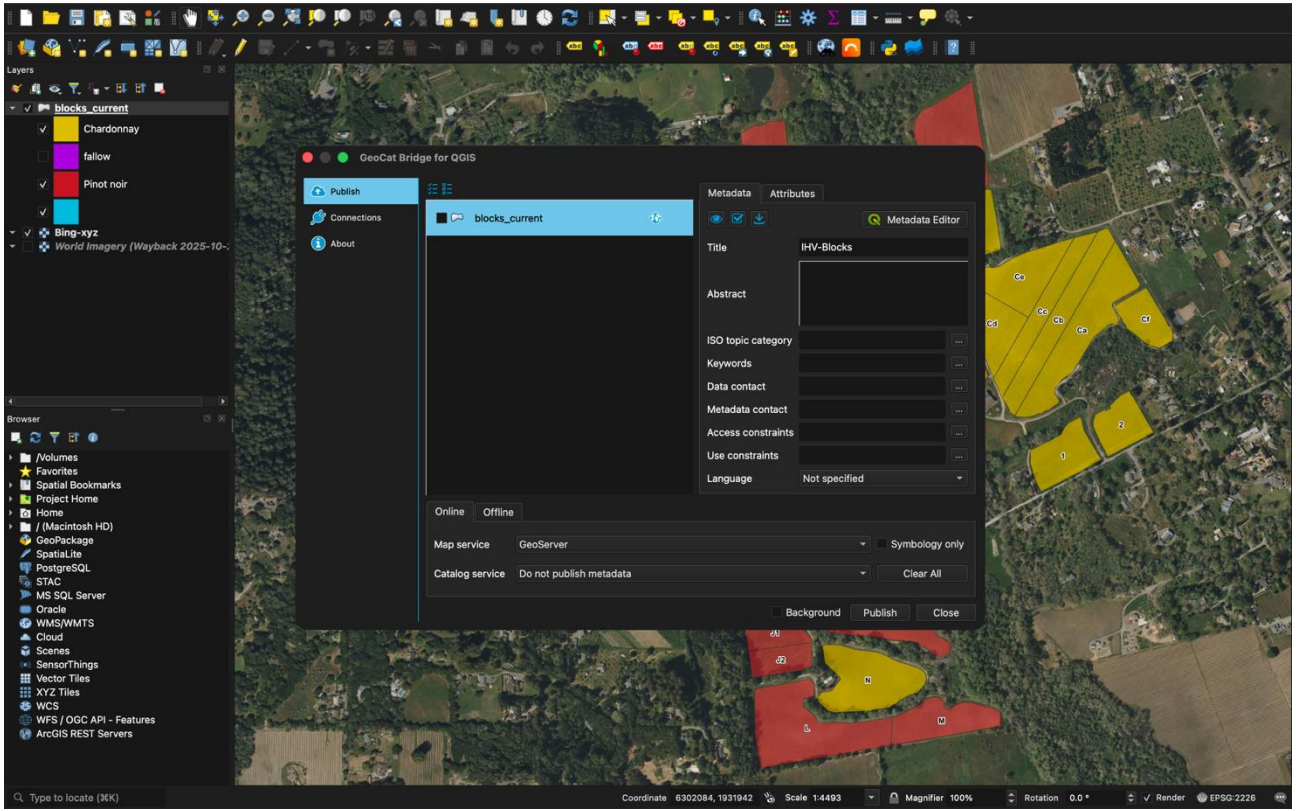
https://geoserver.org/

GeoCat Bridge – Publish QGIS to GeoServer



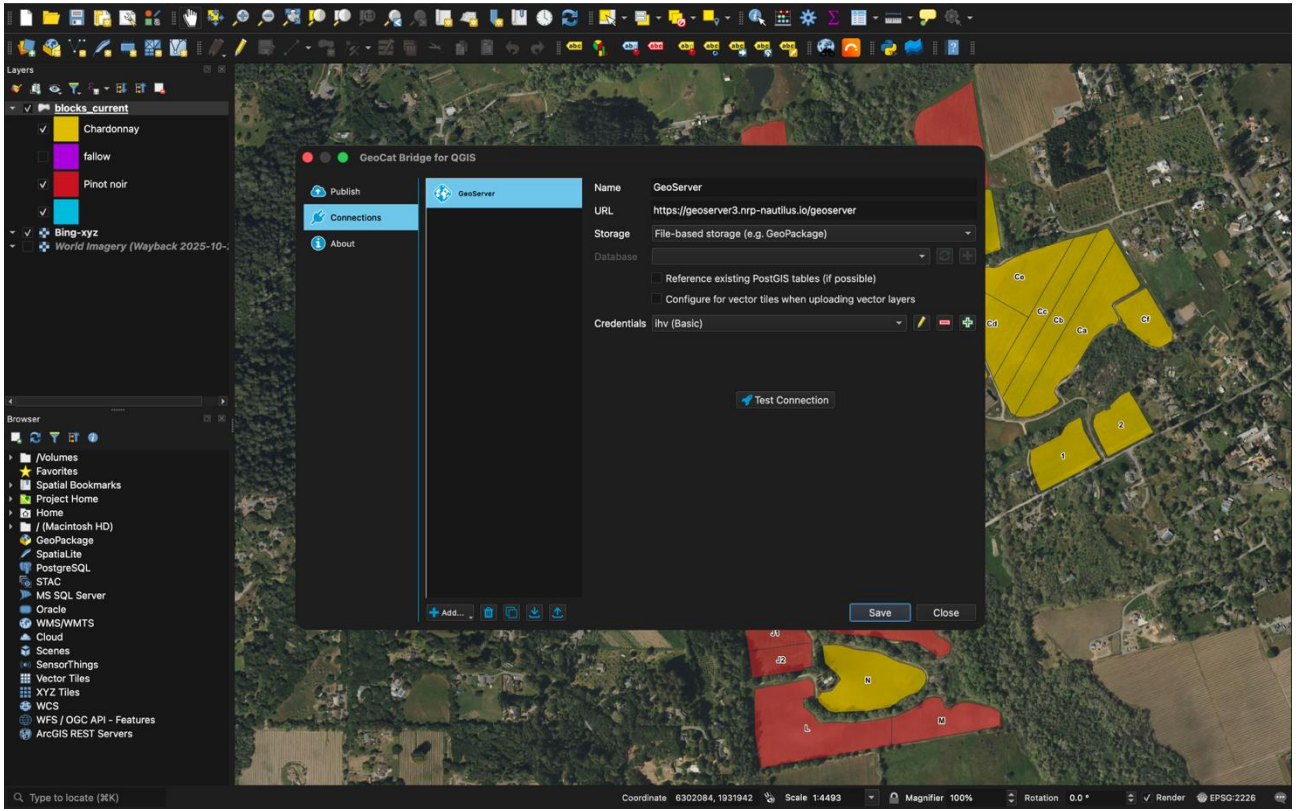
https://plugins.qgis.org/plugins/geocatbridge/

GeoCat Bridge – Publish QGIS to GeoServer



https://plugins.qgis.org/plugins/geocatbridge/

GeoCat Bridge – Publish QGIS to GeoServer



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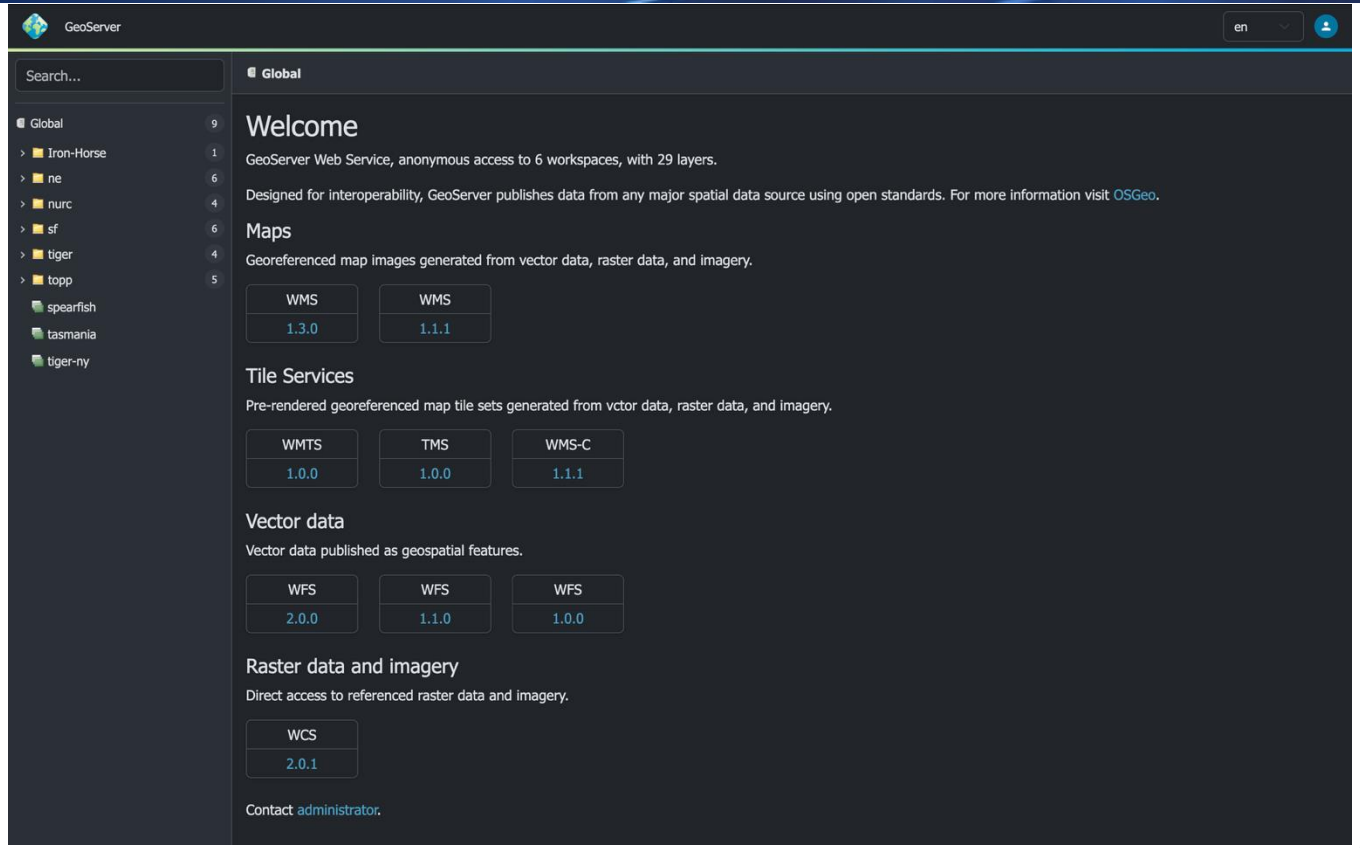
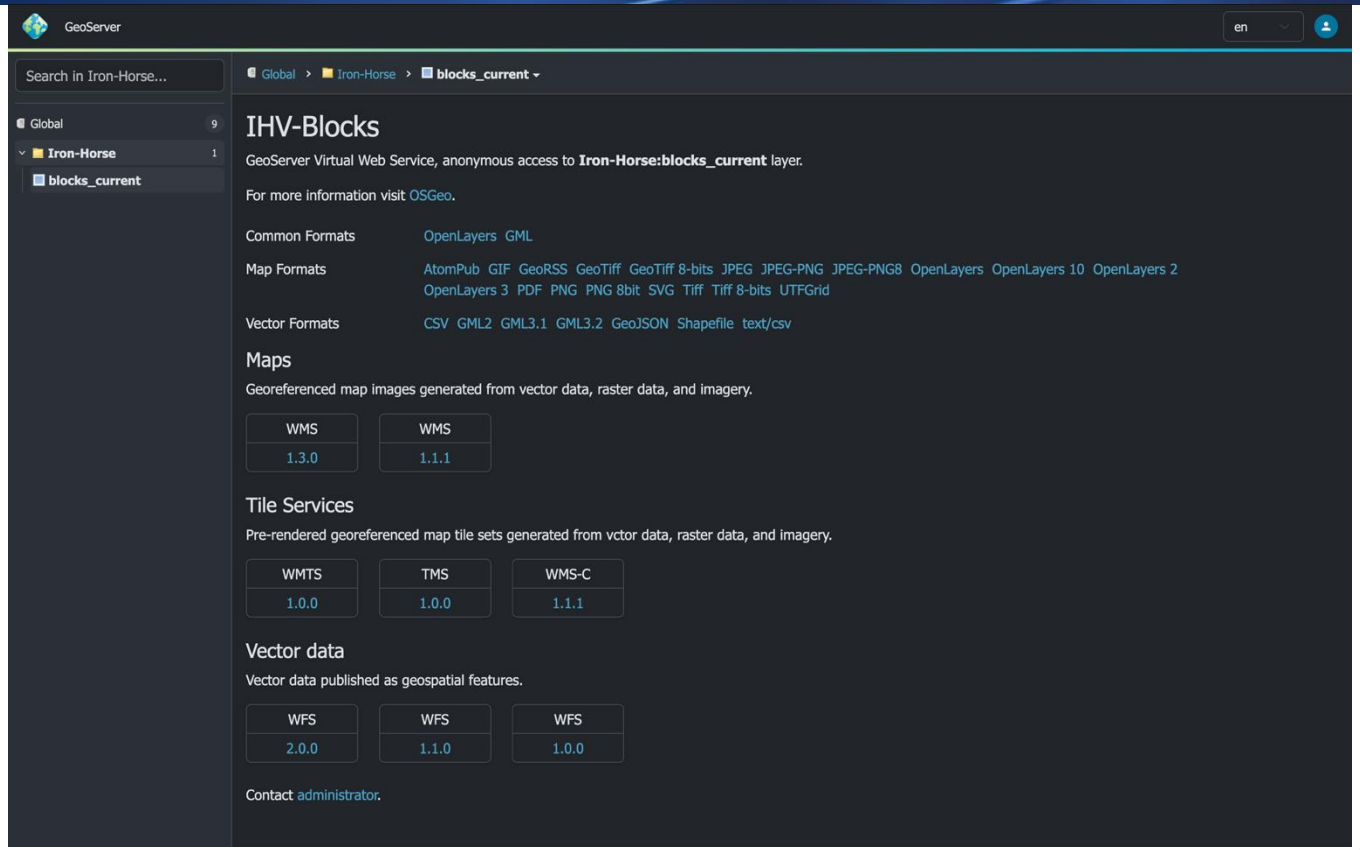
GeoServer Web Map services



https://geoserver3.nrp-nautilus.io/geoserver/

GeoServer Web Map services



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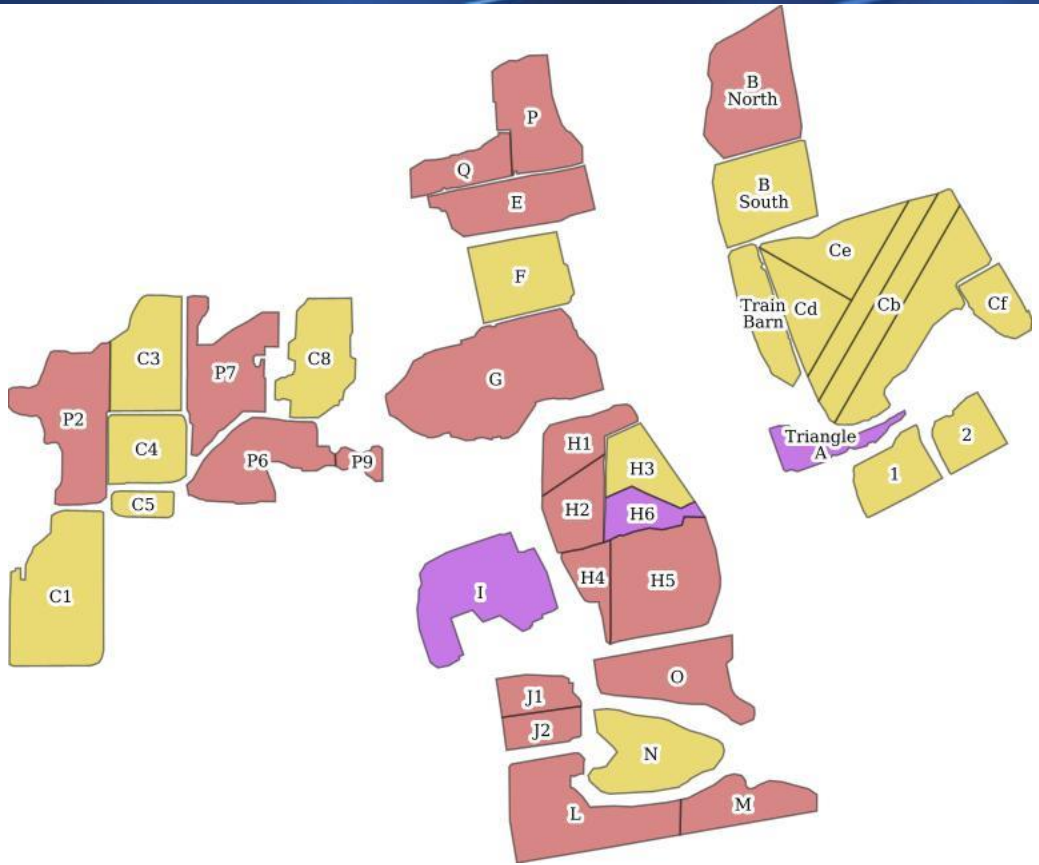
GeoServer JPEG-PNG



https://geoserver3.nrp-nautilus.io/geoserver/

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ChirpStack LoRaWAN Network Server

ChirpStack

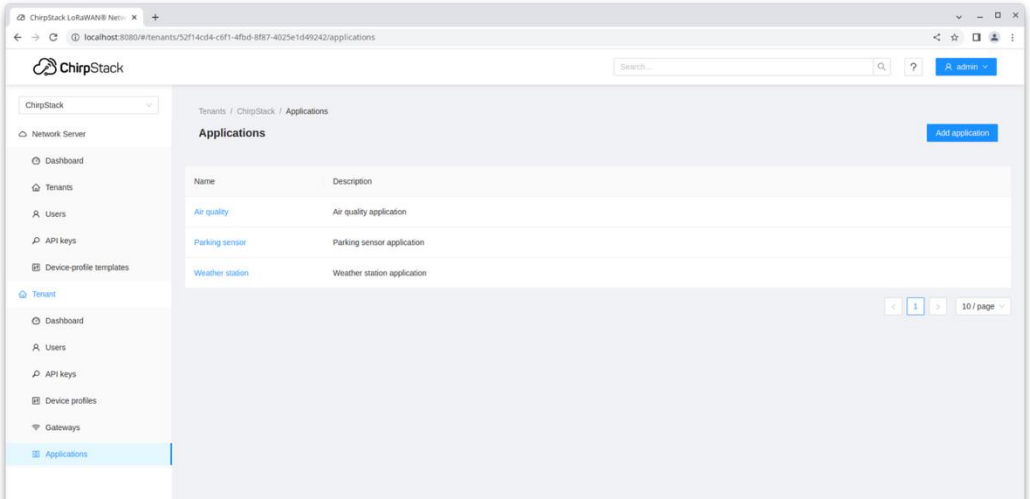
Home | Documentation (v4) | Documentation (v3) | Community support

Sponsor Star

ChirpStack, open-source LoRaWAN® Network Server

ChirpStack is an open-source LoRaWAN Network Server which can be used to setup LoRaWAN networks. ChirpStack provides a web-interface for the management of gateways, devices and tenants as well to setup data integrations with the major cloud providers, databases and services commonly used for handling device data. ChirpStack provides a gRPC based API that can be used to integrate or extend ChirpStack.

Documentation



https://www.chirpstack.io/

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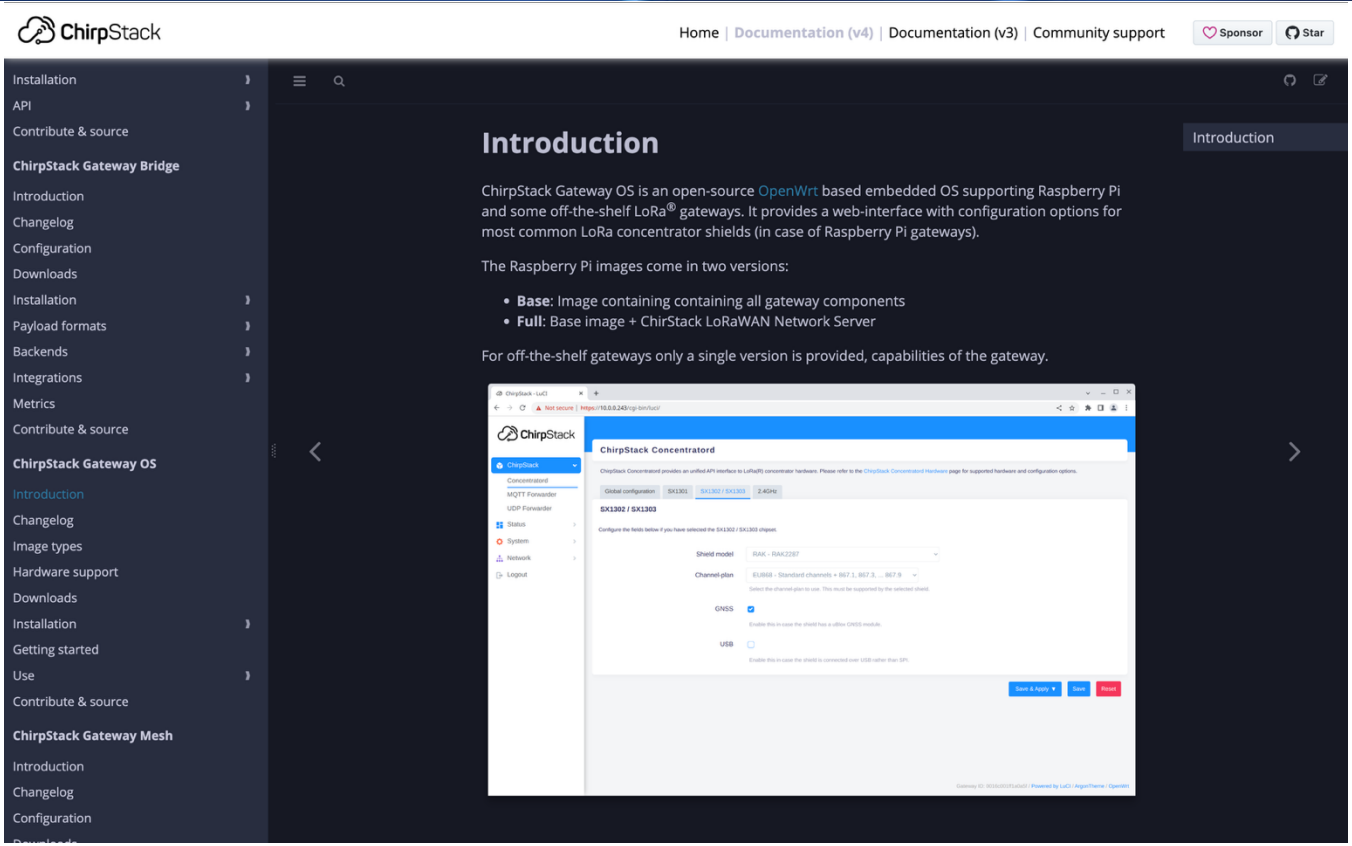
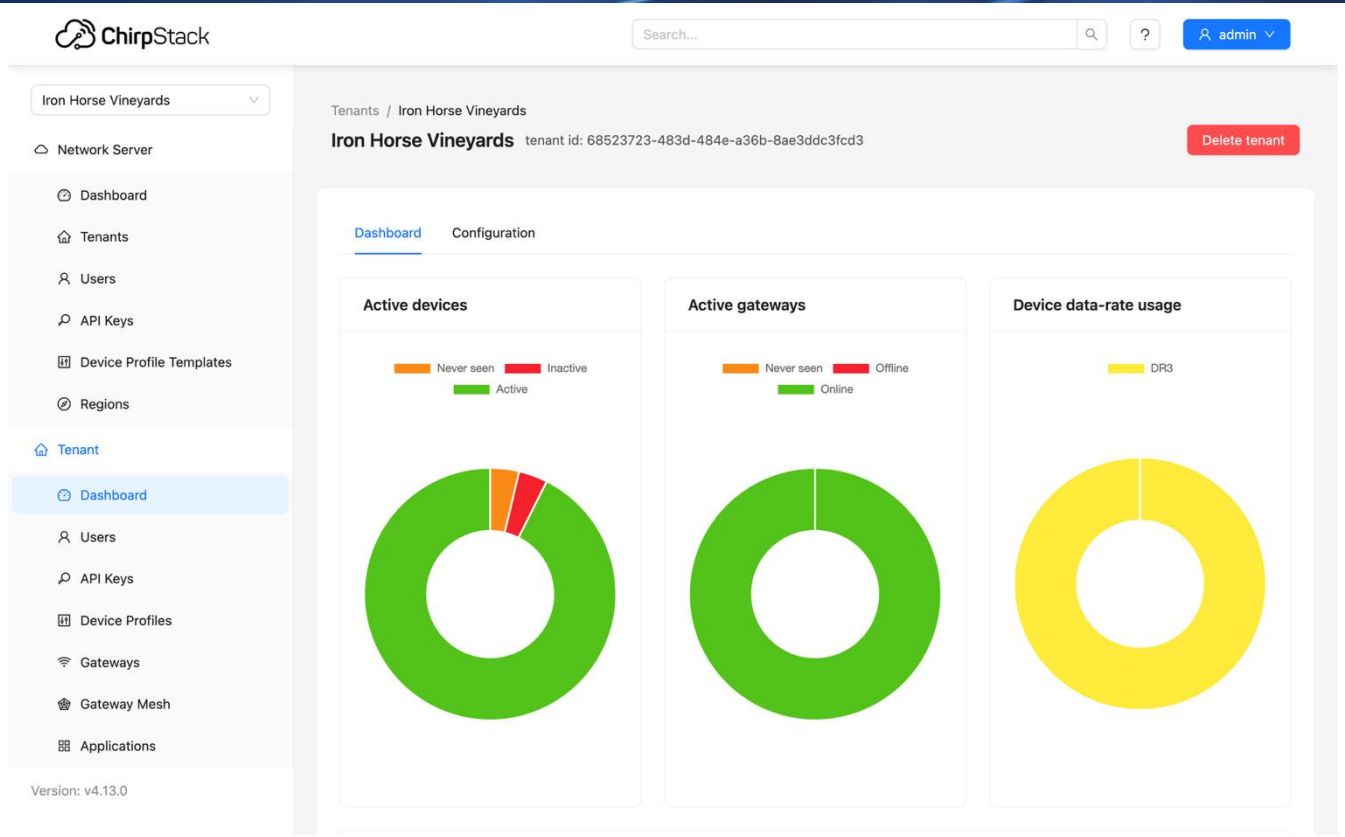
Chirpstack Gateway OS



https://www.chirpstack.io/docs/chirpstack-gateway-os/index.html

ChirpStack LoRaWAN Network Server



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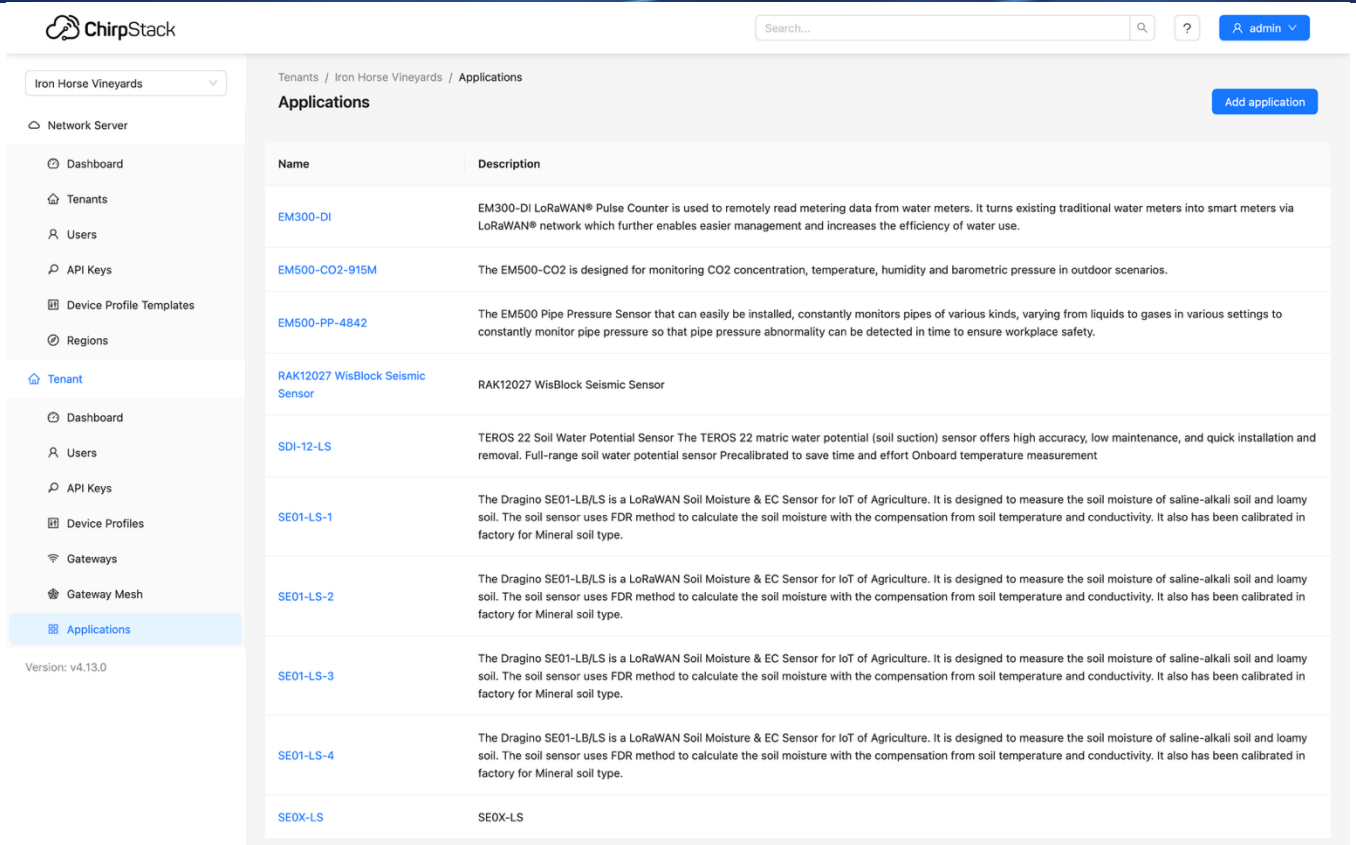
Chirpstack Device Applications



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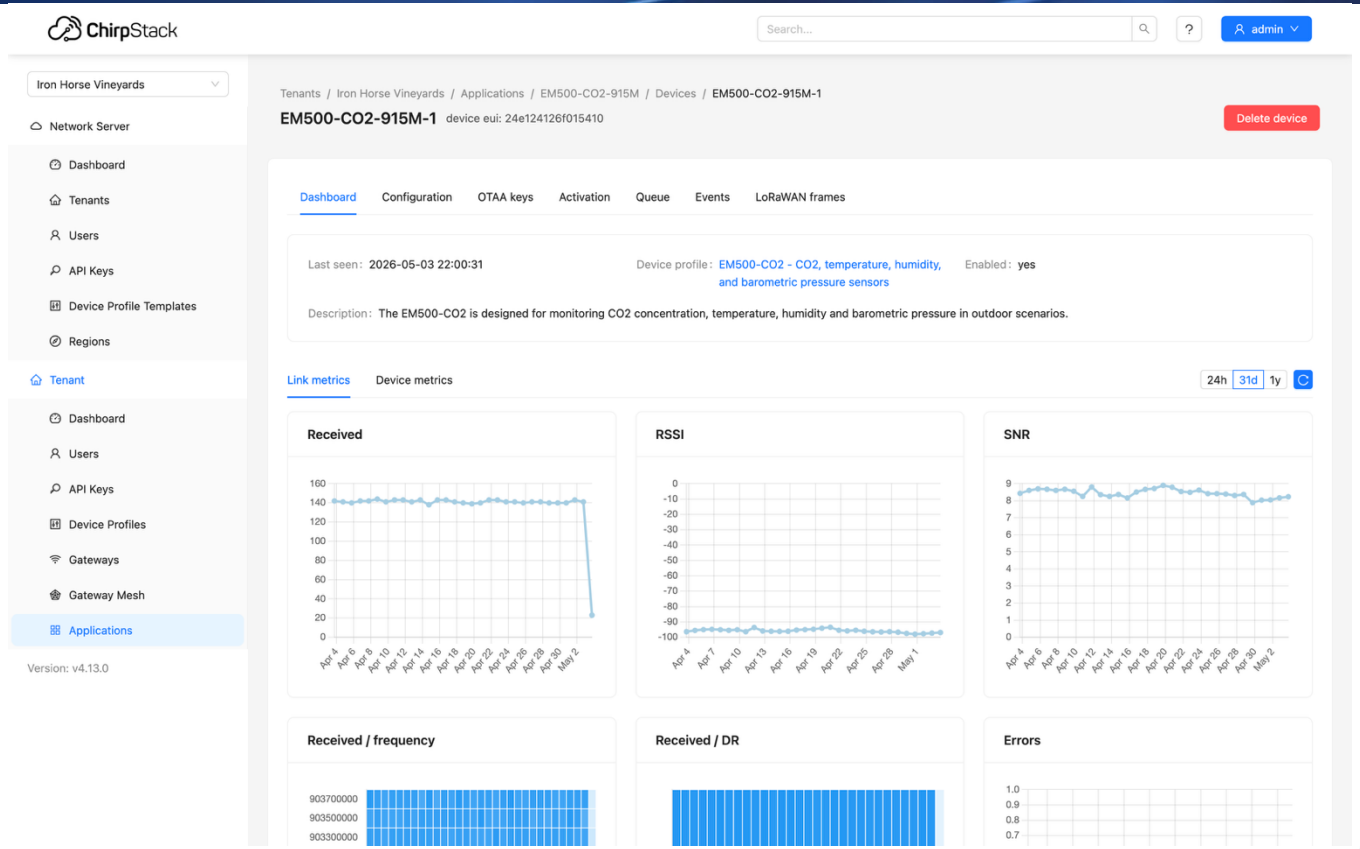
Chirpstack EM500 CO2 Sensor Application



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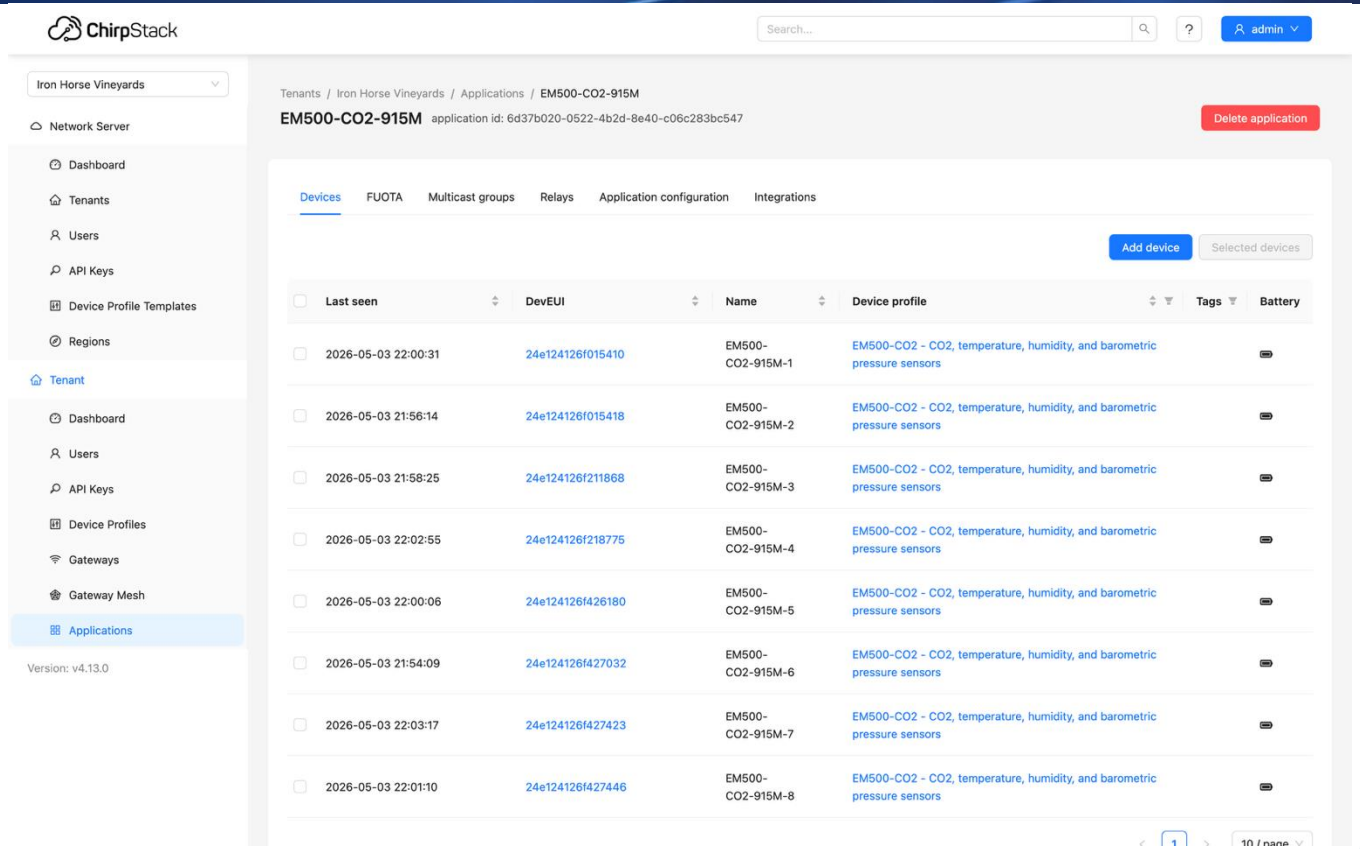
Chirpstack EM500 CO2 Application devices



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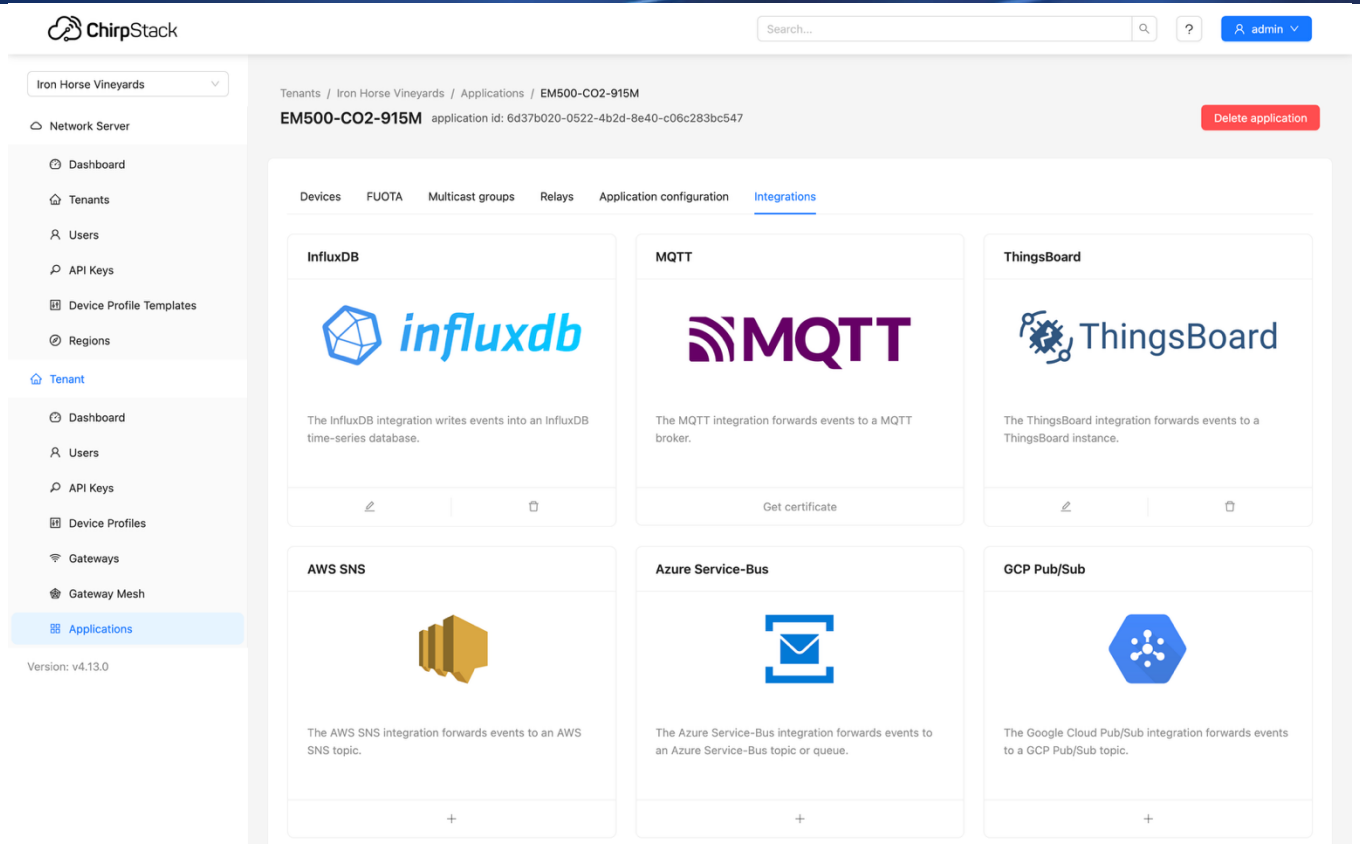
Chirpstack Application Integrations



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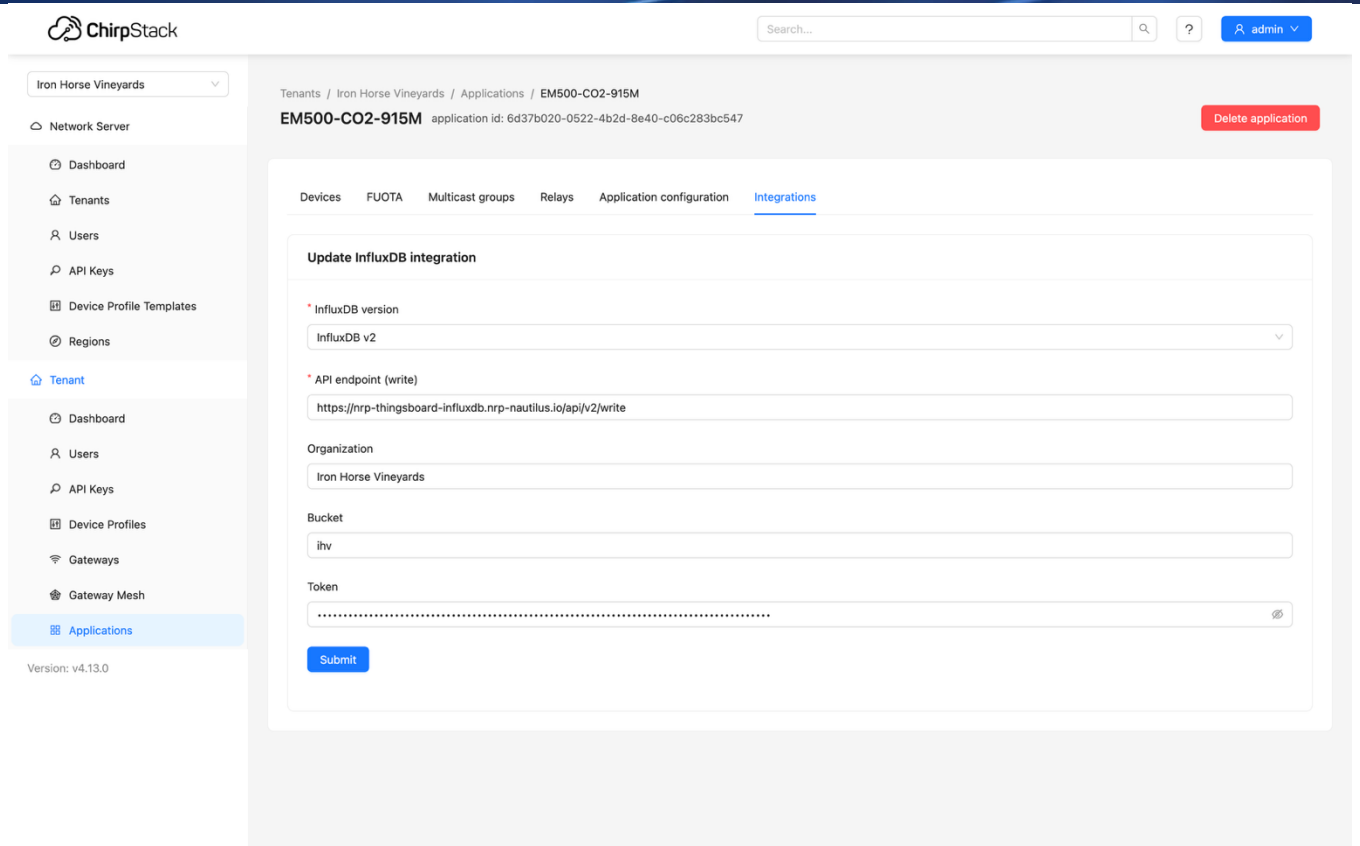
Chirpstack InfluxDB Application Integration



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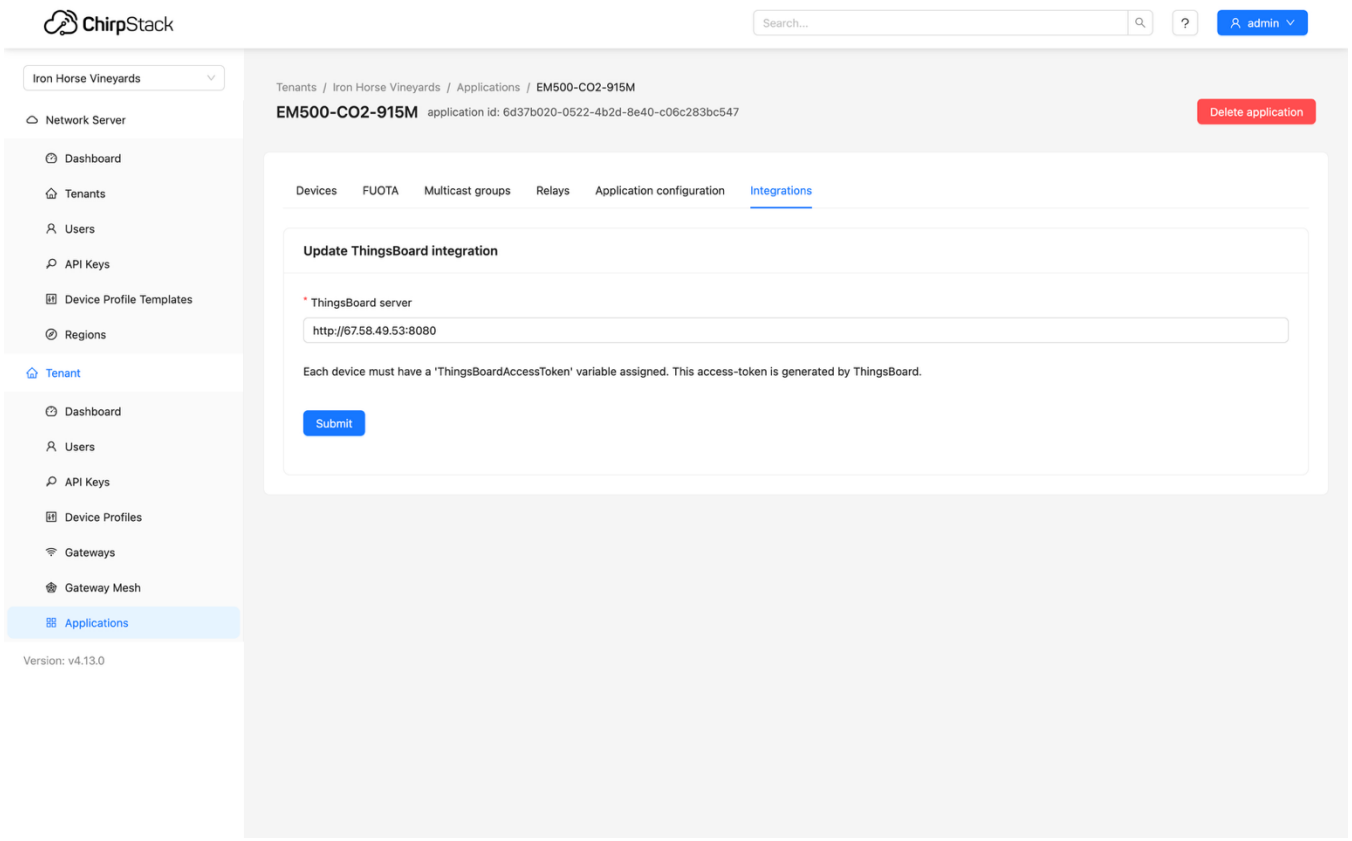
Chirpstack Thingsboard Application Integration



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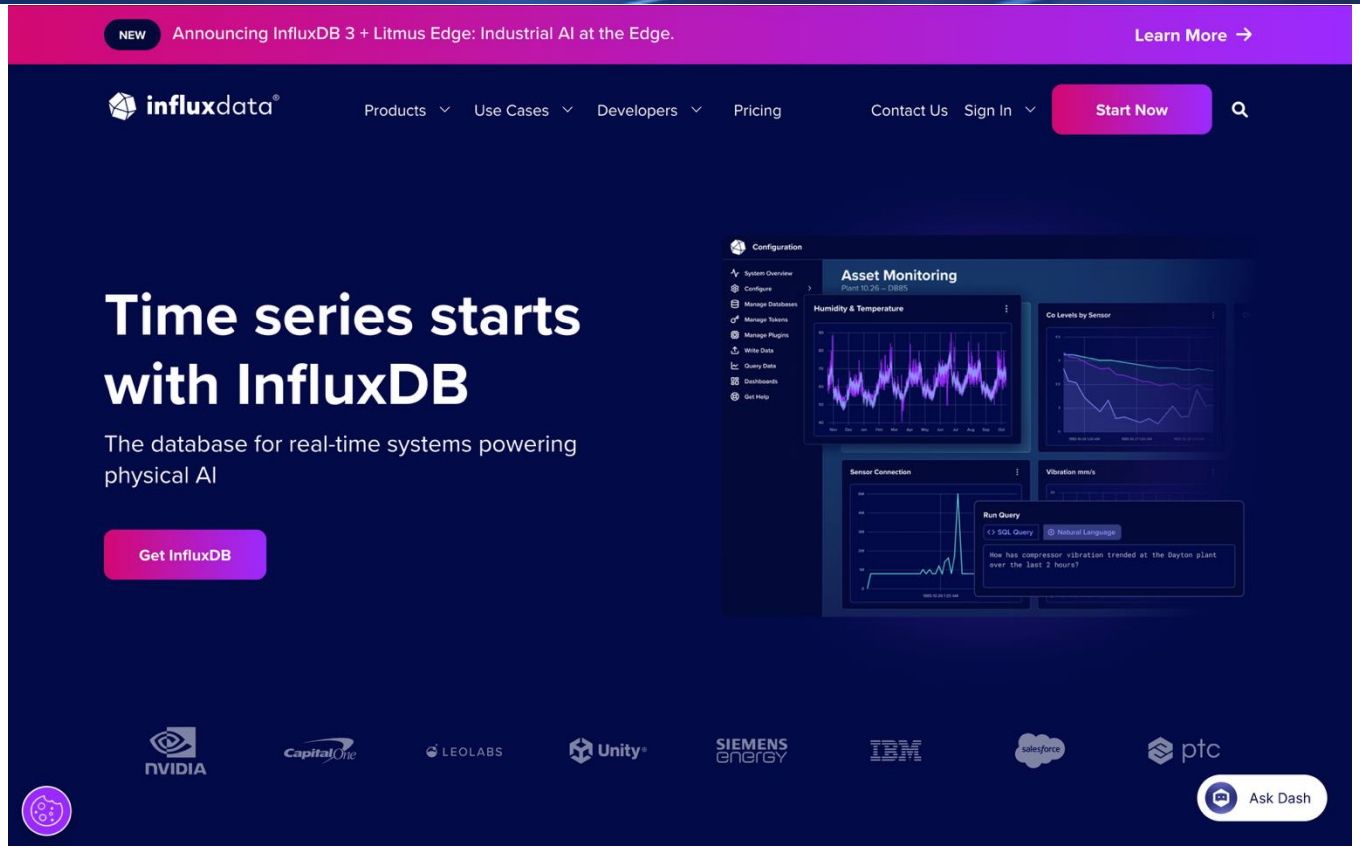
InfluxDB

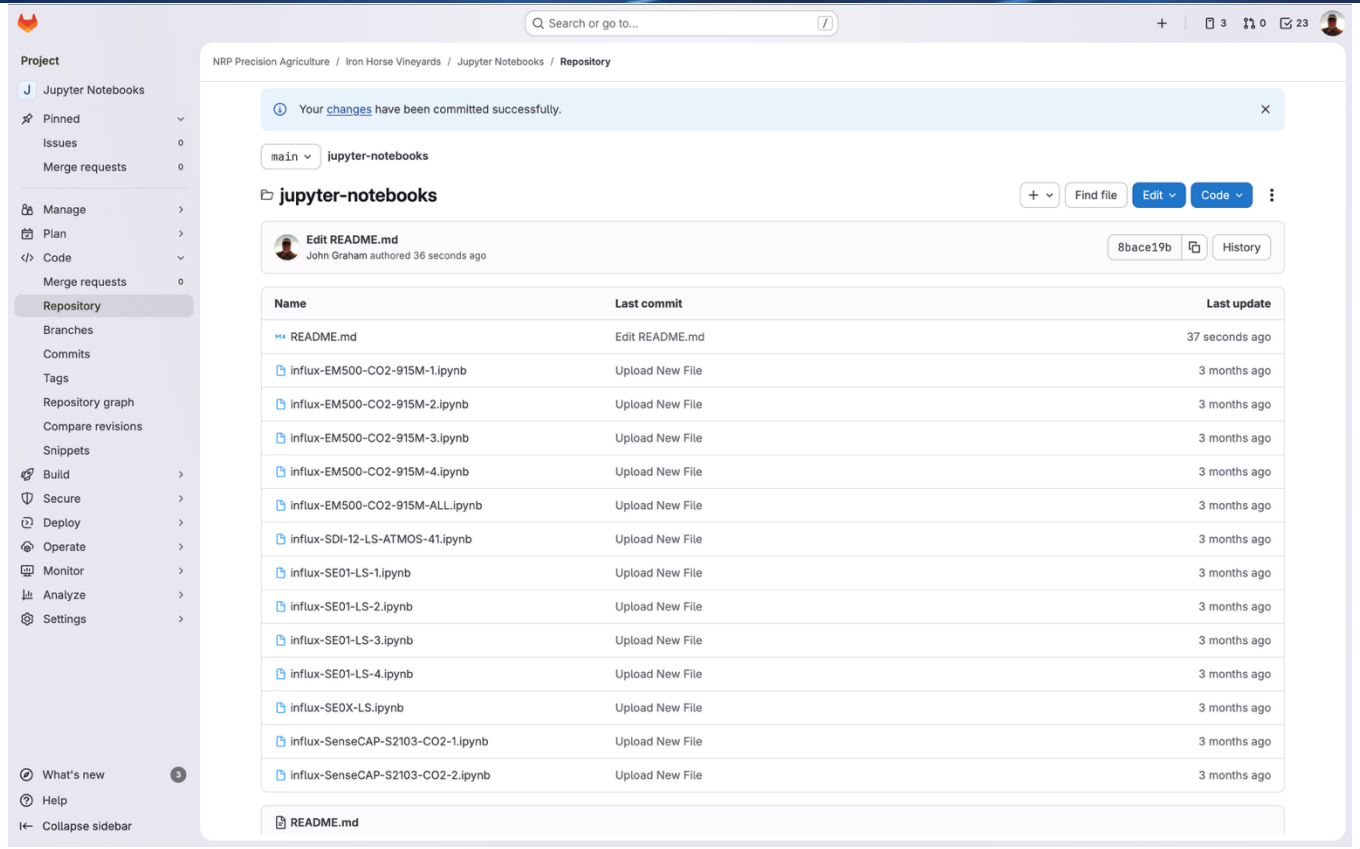


https://www.influxdata.com/

InfluxDB Data Explorer

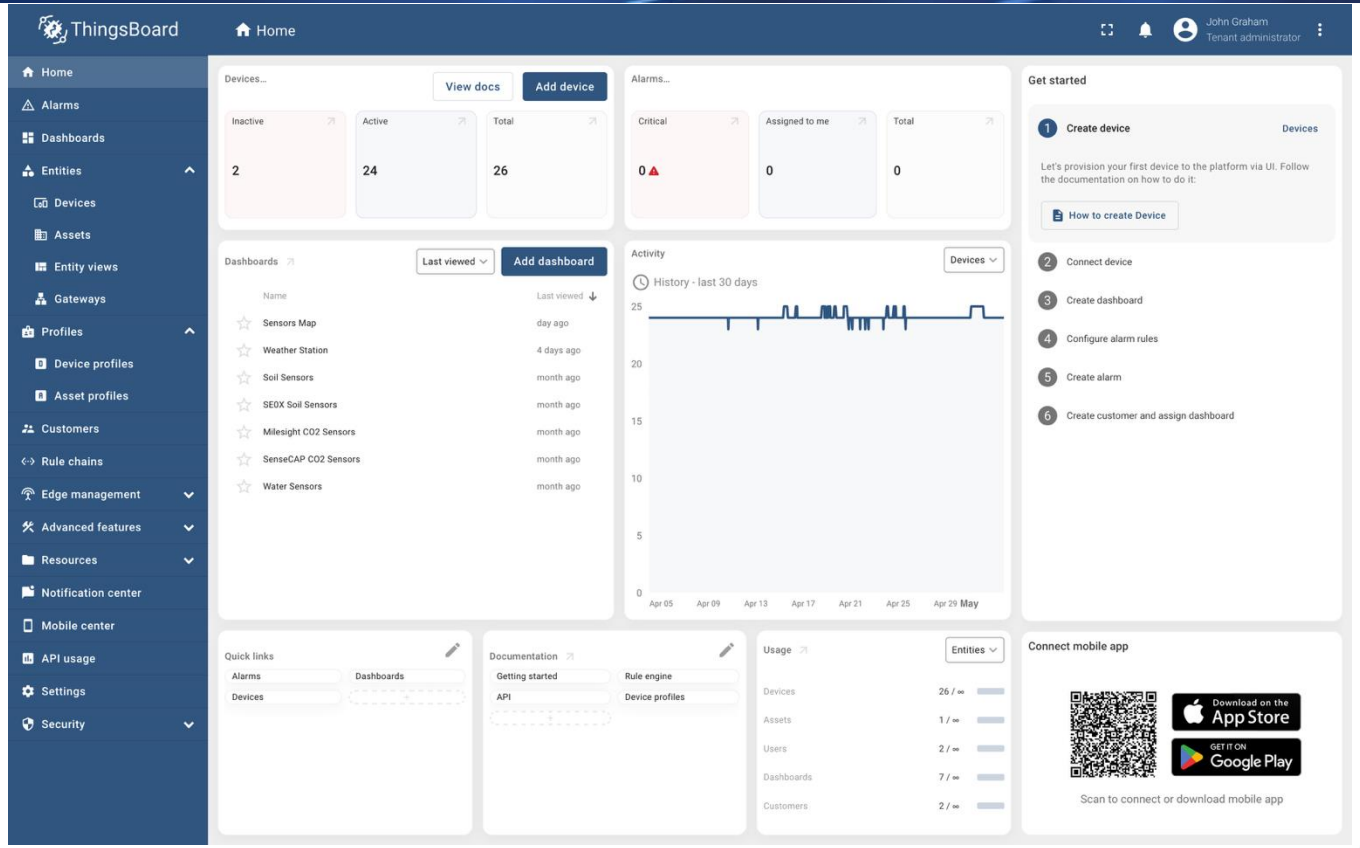
https://nrp-thingsboard-influxdb.nrp-nautilus.io/

InfluxDB API Access in Jupyter Notebooks



https://gitlab.nrp-nautilus.io/nrp-precision-agriculture/iron-horse-vineyards/jupyter-notebooks

Thingsboard Tenant Admin View



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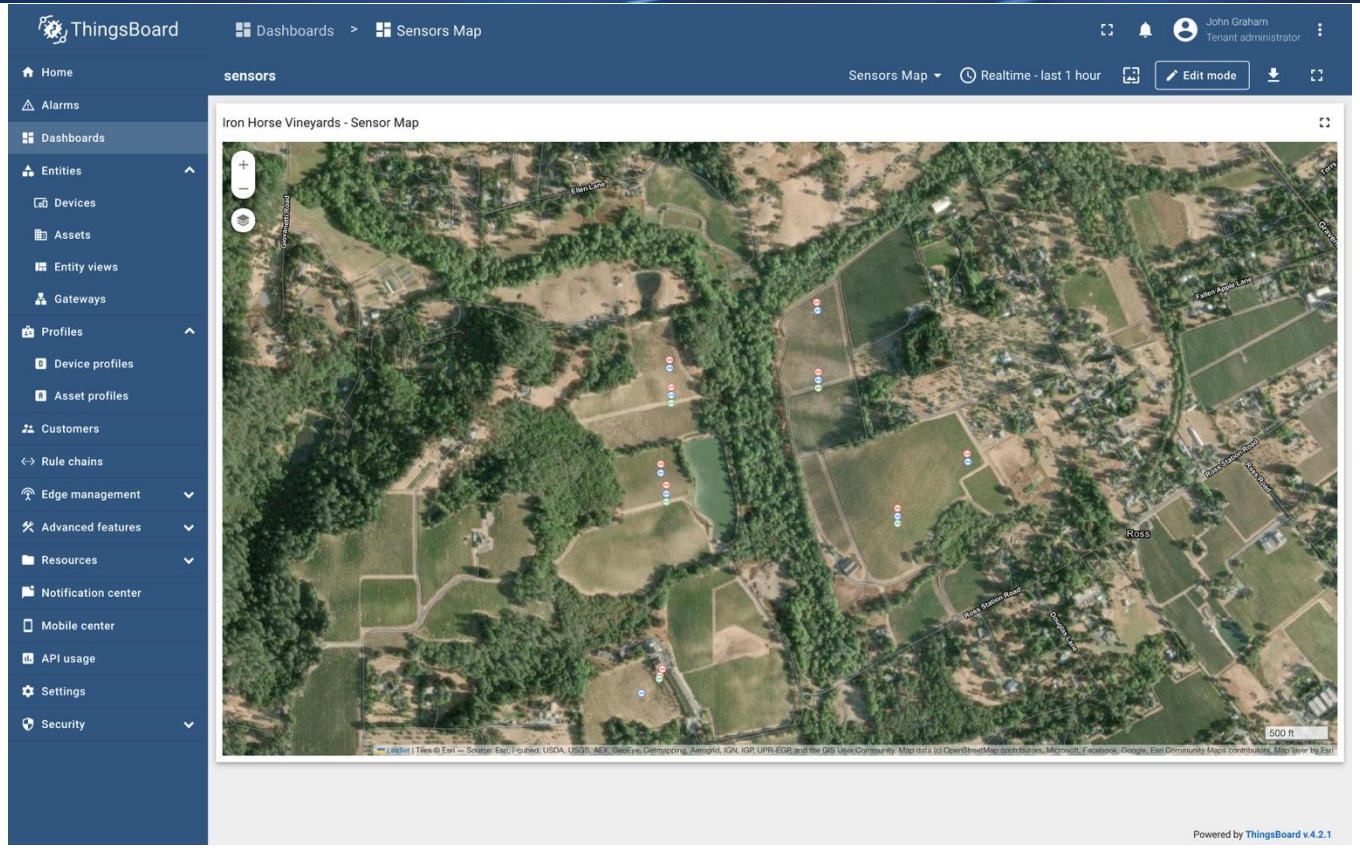
Thingsboard Sensor Map Dashboard



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Iron Horse Vineyards - Sensor Map

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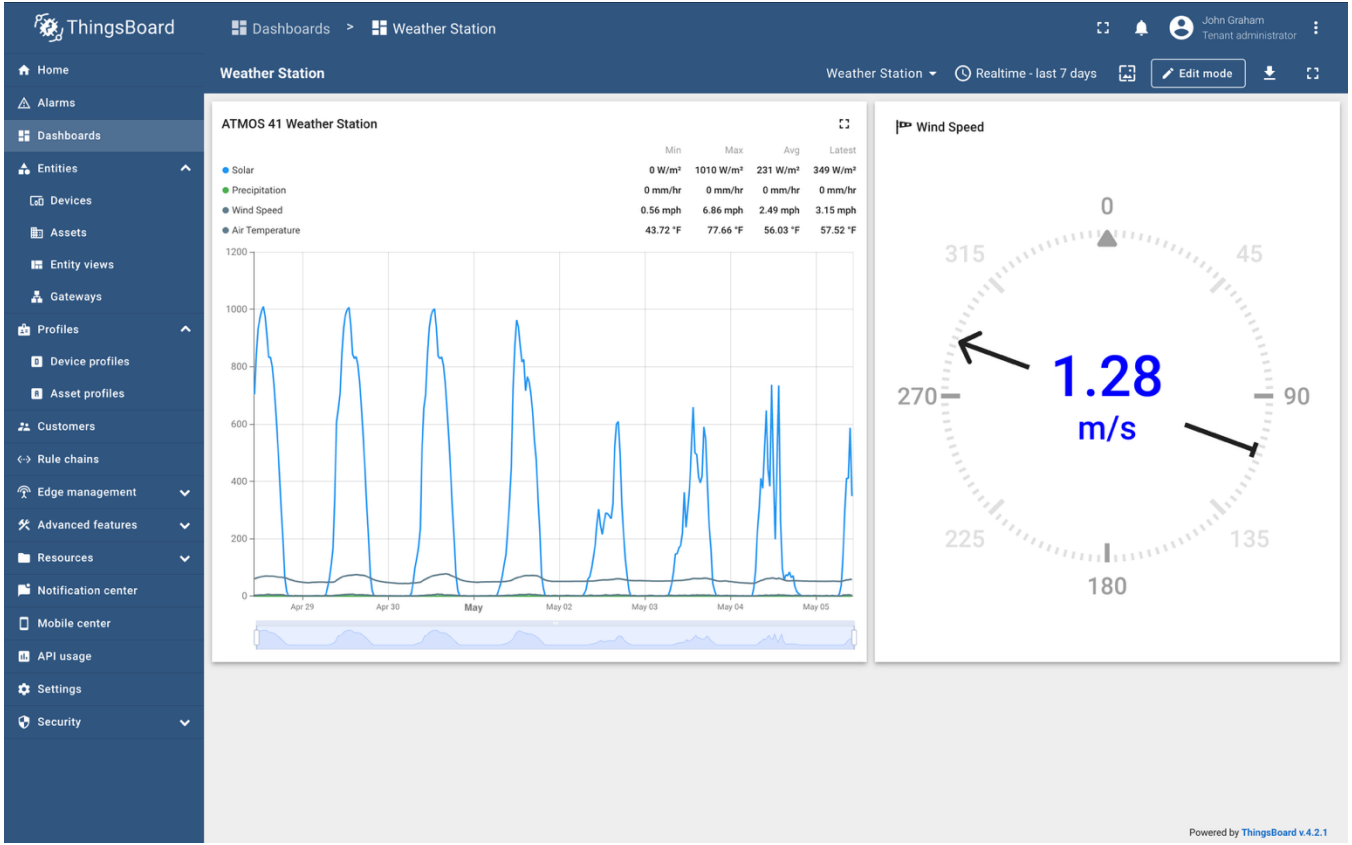
Thingsboard ATMOS 41 Weather Station Dashboard



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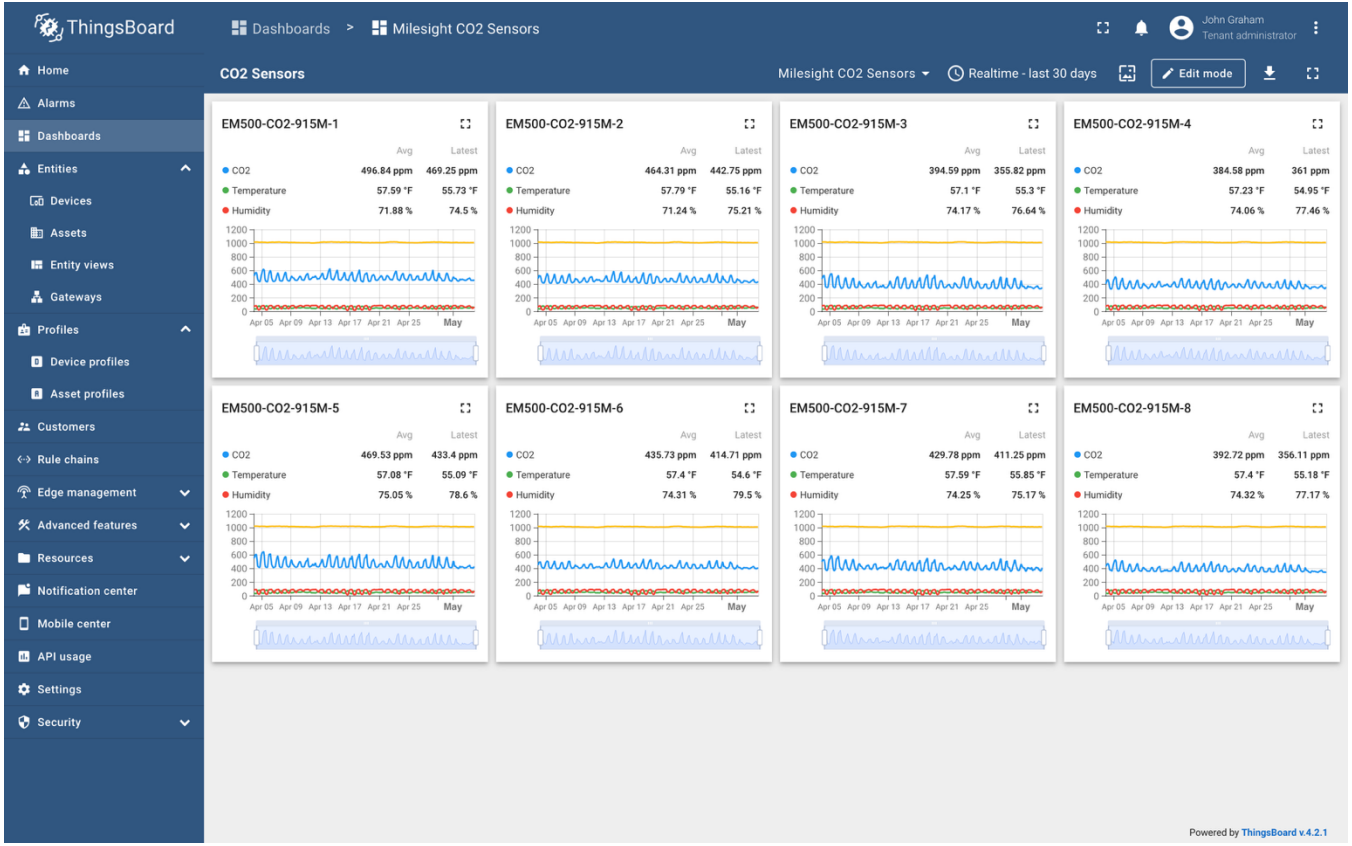
Thingsboard CO2 Sensor Dashboard



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Sharing: National Data Platform

Browse | Search

NDP STAC

Language: English

Iron Horse Vineyard - Multispectral Drone Imagery

Up | Source | Share

Description

Multispectral drone imagery for precision viticulture research at Iron Horse Vineyard. Features RGB and multispectral bands (green, red, red-edge, NIR) with centimeter-level positioning data for detailed vineyard analysis.

License	proprietary
Temporal Extent	2025-08-27 16:48:35 UTC – 2026-01-08 16:15:57 UTC

Metadata

General

Platform	DJI
Instruments	1. Multispectral 2. RGB
Bands	

Items

« First | ‹ Previous | Next › | Show Filters

RGB Visual Image
DJI_20260108161536_0335_point82
GeoTiff
2026-01-08 16:15:36 UTC

RGB Visual Image
DJI_20260108161547_0340_point83
GeoTiff
2026-01-08 16:15:47 UTC

RGB Visual Image
DJI_20260108161538_0336_point82
GeoTiff
2026-01-08 16:15:38 UTC

RGB Visual Image
DJI_20260108161550_0341_point84
GeoTiff
2026-01-08 16:15:50 UTC

RGB Visual Image
DJI_20260108161540_0337_point82
GeoTiff
2026-01-08 16:15:40 UTC

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DJI_20260108161552_0342_point84
GeoTiff
2026-01-08 16:15:52 UTC

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GeoTiff
2026-01-08 16:15:42 UTC

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GeoTiff
2026-01-08 16:15:54 UTC

NATIONAL DATA PLATFORM

NRP NATIONAL RESEARCH PLATFORM

Sharing: National Data Platform

NATIONAL DATA PLATFORM

Catalog Asset

0 Log in/Register

Catalogs

Education Hub

IoT Sensor Data

Organization: Iron Horse Vineyards

Creator Name: Kate O'Laughlin

Last Updated: March 26, 2026 at 5:00 PM PDT

IoT environmental sensor data from Iron Horse Vineyards. Includes temperature, humidity, soil moisture, CO2, and other environmental measurements from various sensor devices deployed throughout the vineyard for precision viticulture research.

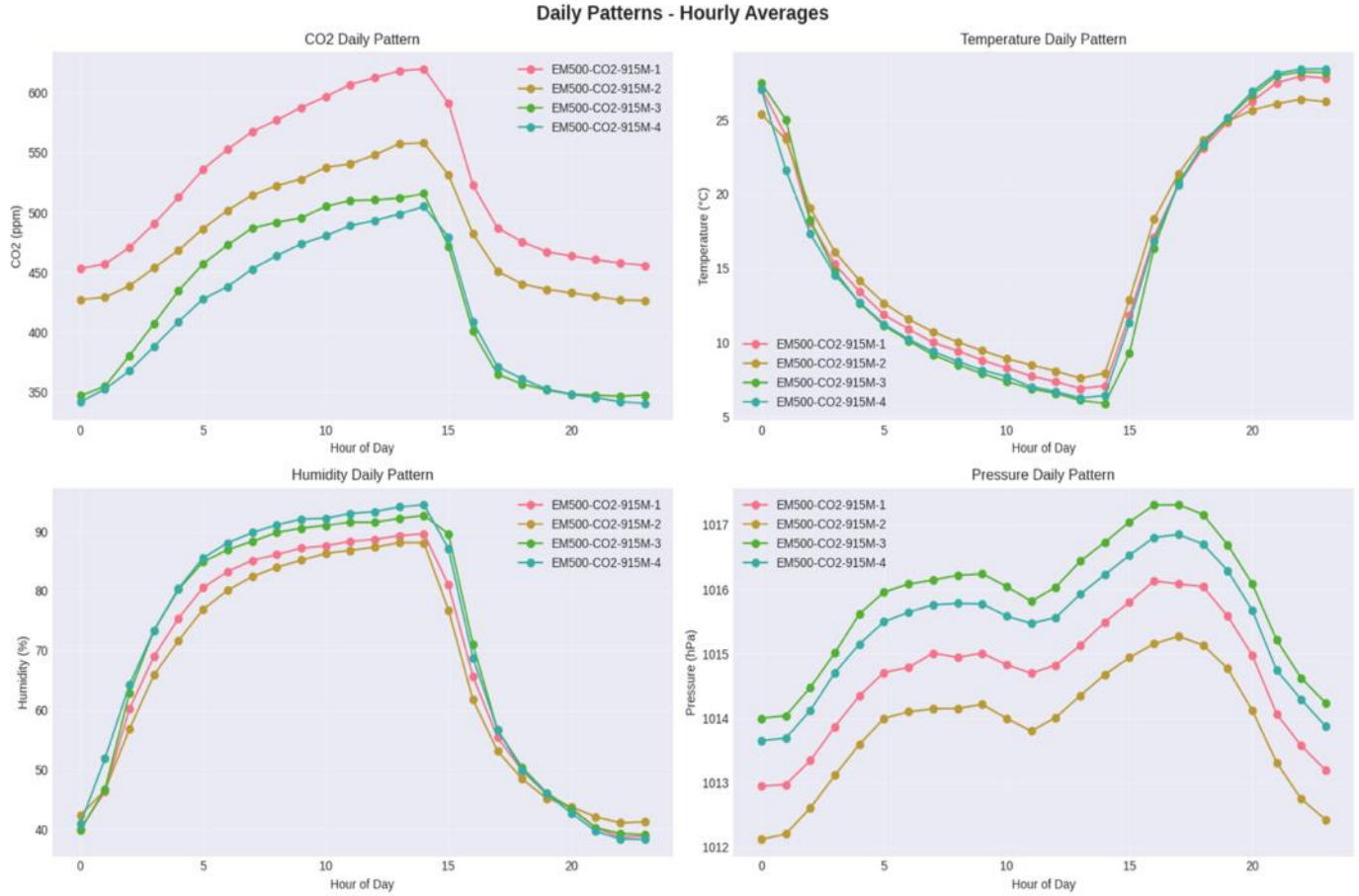
Data and Resources

- IoT Sensor Data InfluxDB — View More
- STAC Catalog — View More

Tags

environmental-sensors iot precision-viticulture

Sensor Data Available Now in the National Data Platform



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CENIC 10G-connected Iron Horse Vineyards Testbed

4 Sensor Sites Populated at Iron Horse Vineyards: O, 1, 2, C

- **Placement of 112 LoRaWAN Sensors in 26 modules at two vineyard top-of-hill locations (T1/2), two lower-hill locations (L1/2), mounted outside on or near the office (O), and inside on cellar wall (C):**
  - Four TEROS 22 Soil Water Potential Sensors (T1&T2)
  - Four Dragino SE01-LSs – Solar Powered LoRaWAN Soil Moisture & EC Sensor (T1&T2)
  - Four Dragino SE0X-LSs – Soil Moisture & Electrical Conductivity Sensor (L1&L2)
  - Two SenseCAP S2103s – CO2, Temperature and Humidity Sensor (O&C)
  - Eight Milesite – CO2, Temperature, Humidity, and Barometric Pressure Sensor (T1&T2)
  - One ATMOS 41 Gen 2 All-In-One Weather Station up hill (O)
  - One Milesite Water Pipe Pressure Sensor (O)
  - One Omron Earthquake Sensor (O)
  - One UV Sensor (O)
- **One Purple Air device (via WiFi) with 6 more sensors (O)**

10G-connected Mac Studio M4 and Ubiquiti Dream Wall

Mac Studio M4 (Apple M4 Max Chip)

- 16-core CPU, 40-core
- GPU, 16-core
- Neural Engine
- 128GB unified memory
- 2TB SSD storage
- Front: Two USB-C ports, SDXC card slot
- Back: Four Thunderbolt 5, ports, two USB-A ports, HDMI port, 10Gb Ethernet port

Ubiquiti Dream Wall

- Wall-mounted 10G cloud gateway
- WiFi 6, high-power PoE switching
- Full UniFi application support

Four PoE Fire Cameras Installed at Iron Horse Vineyards Connected via HPWREN to UC San Diego's WiFIRE Lab

John Graham Prepping Fiber, Testing 10G Connectivity

TEKTELIC KONA Enterprise LoRaWAN Gateway

TEKTELIC communications

SELECT PRODUCT CATEGORY

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KONA Enterprise Gateway with Ethernet and LTE - US915

Kona Enterprise

Sales Code
M0E2TLUS915

Outdoor LoRaWAN gateway with 8 receive channels, integrated RF cavity filter, Ethernet and LTE backhaul with built-in LTE and GPS antennas. Includes wall/pole mounting kit (supports 1.5 to 3.5 inch poles), built-in wall mounting fixtures, 2 by 3 inch U-brackets, SIM tray installation tool, and cable connector waterproofing kit. Supports US915 frequency plan.

Specs

User Guide

− 1 + Add to Inquiry

Region:

AS923 | AS923-2 | AS923-3 | AS923-4 | AU915 | EU868 | IN865 | **US915**

LTE Modem:

Yes | No

https://product-catalog.tektelic.com/product/MOE2TLUS915

TEKTELIC KONA Enterprise LoRaWAN Gateway

RAIGEN Helium Miner 10dBi Antenna LoRa 915 MHz 59in Outdoor Omni-Directional	
https://www.amazon.com/RAIGEN-Antenna-Omni-Directional-Sensecap-Separately/dp/B09PVB1M6Q?ref_=ast_sto_dp&th=1	$59.95
SensorWorks® Enterprise IoT Gateway Bundle | Includes Tektelic Kona Enterprise Gateway + 1-Year Unlimited Data Plan	
https://www.mouser.com/ProductDetail/TEKTELIC/T0007422?qs=IKkN%2F947nfCJW1QXxQFcsQ%3D%3D	$661.84
Skywalker 3” Heavy-Duty Double Wall Mount Pair for TV Antenna Mast with (2) Brackets & Lag Bolts	
https://www.amazon.com/Skywalker-SKY32811-Double-Mount-SKY	$18.99
5' Ft Galvanized Steel Antenna Mast Pipe Swedged End Length 1.25" OD	
https://www.amazon.com/gp/product/B00UULWJ5S/ref=ewc_pr_img_3?smid=A34PUGV9QVBZZY&psc=1	$25.00
Antenna Mast Mount for Pole Mounting Fixed U-Bolt Clamp Hardware Bracket Outdoor Roof	
https://www.amazon.com/Antenna-Mounting-Hardware-Sensecap-Synchrobit/dp/B09MKGFDPS	$16.95
XRDS -RF 6ft N Male to N Female Cable, 50 ohm KMR240 Low Loss N Connector Coax Extension Cable	
https://www.amazon.com/XRDS-RF-Connector-Extension-Amplifier/dp/B08MQ468LG/?th=1	$14.99
250' 8 AWG Solid Bare Copper Conductor Soft Drawn Wire	
https://nassaunationalcable.com/products/250-8-awg-solid-bare-copper-conductor-soft-drawn-wire	$125.00
Ethernet Surge Protection Outdoor - UACC-ETH-SP-Pro - 2 devices	
https://store.ui.com/us/en/category/accessories-poe-power/collections/pro-store-poe-and-power-surge-protection-outdoor/products/uacc-eth-sp-pro?variant=uacc-eth-sp-pro	$62.68
	$985.40

RAK Raspberry Pi 4 LoRaWAN Gateway

RAK® IoT Made Easy

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5G | Raspberry Pi (New) | LoRaWAN | Cellular IoT | Modular IoT Boards | Meshtastic | IoT End Devices | Powerline Modules | Enclosures | Accessories | Kits

Home > LoRaWAN > Gateway > Developer > RAK Raspberry Pi 4 Kit for LoRaWAN®

RAK®

RAK Raspberry Pi 4 Kit for LoRaWAN®

Raspberry Pi

SKU:816073

$204.99

The shipping fee is calculated at checkout.
Prefer another courier for your delivery? Contact us for special shipping arrangements.

LoRa Module

RAK2287 US915/AS923/AU915/KR920

Plug Type

US Standard

Quantity

1

Note: If you add the RAK9003 PoE Pi HAT, please be aware that due to the added height, the enclosure's lid cannot be fully closed.

Check to include

RAK9003 PoE Pi HAT

$23.00 USD

- 1 +

Add to Cart

https://store.rakwireless.com/products/rak-rapsberry-pi-4-basic-kit-for-lora

Soil Moisture Sensors

https://metergroup.com/products/teros-22/	$312.39	2	$624.78
TEROS 22 - Soil Water Potential Sensor			

TEROS 22

Soil Water Potential Sensor

The TEROS 22 matric water potential (soil suction) sensor offers high accuracy, low maintenance, and quick installation and removal.

- **Full-range soil water potential sensor**
- **Precalibrated to save time and effort**
- **Onboard temperature measurement**

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NRP NATIONAL RESEARCH PLATFORM

Dragino SDI-12 to LoRaWAN Converter

Dragino SDI-12 to LoRaWAN Converter | Dragino SDI-12-LB/LS

(1 customer review)

SKU: SDI-12-LS-US915

Brand: Dragino

$72.00 – $81.00

SDI-12 to LoRaWAN Converter

- IP66 Waterproof Enclosure
- 8500mAh Battery for long-term use
- AT Commands to change parameters
- Support wireless OTA update firmware
- US915 Support

Solar Powered

Yes Clear

https://www.choovio.com/product/sdi-12-lb-sdi-12-to-lorawan-converter/

2x2 LoRaWan-CO2-temperature-and-humidity-sensors

SE0X-LB -- LoRaWAN Soil Moisture, Temperature and Conductivity Sensor transmitter	https://www.choovio.com/product/dragino-se0x-lb-lorawan-soil-moisture-ec-sensor-transmitter/	$75.00	1	$75.00
Dragino DR-SE-6P – Soil Moisture Sensor Probe	https://www.choovio.com/product/dragino-dr-se-6p-soil-moisture-sensor-probe/	$107.00	4	$428.00

2x2 LoRaWAN CO2, Temperature and Humidity Sensors

https://www.choovio.com/product/sensecap-s2103-lorawan-co2-temperature-and-humidity-sensor/		$155.00		
SenseCAP S2103 – LoRaWAN CO2, Temperature and Humidity Sensor				

https://www.milesight.com/iot/product/lorawan-sensor/em500-co2	https://www.choovio.com/product/em500-co2-carbon-dioxide-sensor/	$279.00		
The EM500-CO2 is designed for monitoring CO2 concentration, temperature, humidity and barometric pressure in outdoor scenarios.				

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PurpleAir Zen Air Quality Monitor

https://www2.purpleair.com/products/purpleair-zen + Outdoor Power Supply - North America (Type A)		$359.00 1	$359.00

https://www2.purpleair.com/products/purpleair-zen + Outdoor Power Supply - North America (Type A)

Pressure, Temperature, Humidity, & Gas Sensor, Laser Particle Counters 0.3, 0.5, 1.0, 2.5, 5.0, & 10 µm, Experimental VOC (Bosch Static IAQ)

Featuring a swappable base mount, the Zen is built to be used inside or out. Powerful full-color LEDs show colors based on the US AQI scale, providing an instant visual representation of air quality at a glance.

Whether from across a room or across the yard, know your air quality with ease. Utilize its double-tap feature to cycle through brightness levels and connect it to WiFi to see its real-time PM2.5 data on the PurpleAir real-time map, accessible by any smart device.

The Zen's modular design provides easy access to internals and is perfect for residential, commercial, or industrial users.

TEROS and Dragino Soil Sensors

TEROS 22 Matric Water Potential (Soil Suction) Sensor

- Full-range soil water potential sensor
- Pre-calibrated to save time and effort
- Onboard temperature measurement

Dragino SE01-LS Solar LoRaWAN Soil Moisture & EC Sensor

- Ultra-long range spread-spectrum
- High-interference immunity
- Minimizing power consumption
- Measures Soil Moisture, Temperature and Conductivity
- Uploads the values via LoRaWAN IoT Server

Dragino SE0X-LS Soil Moisture & Electrical Conductivity Sensor

- Monitor Soil Moisture, Temperature, Conductivity
- Support wireless OTA update firmware
- IP66 Waterproof Enclosure
- Solar powered + Li-ion battery

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Research-grade Weather, Water Pipe Pressure, Quake Sensors

ATMOS 41 Gen 2 Weather Station

- Measures temp; humidity; vapor/barometric pressure; wind speed, gust, direction; solar radiation, precipitation, lightning strikes
- Designed for harsh climates

EM500-PP-915M Water Pipe Pressure Sensor

- Temperature Compensation for High Accuracy
- IP67 waterproof
- High-capacity battery 10 yrs

Omron D7S Earthquake Sensor (not yet)

- Quake detection, peak levels of seismic intensity
- Sends data over LoRaWAN or LoRa P2P to a gateway
- Option to shut down sensitive machines and equipment

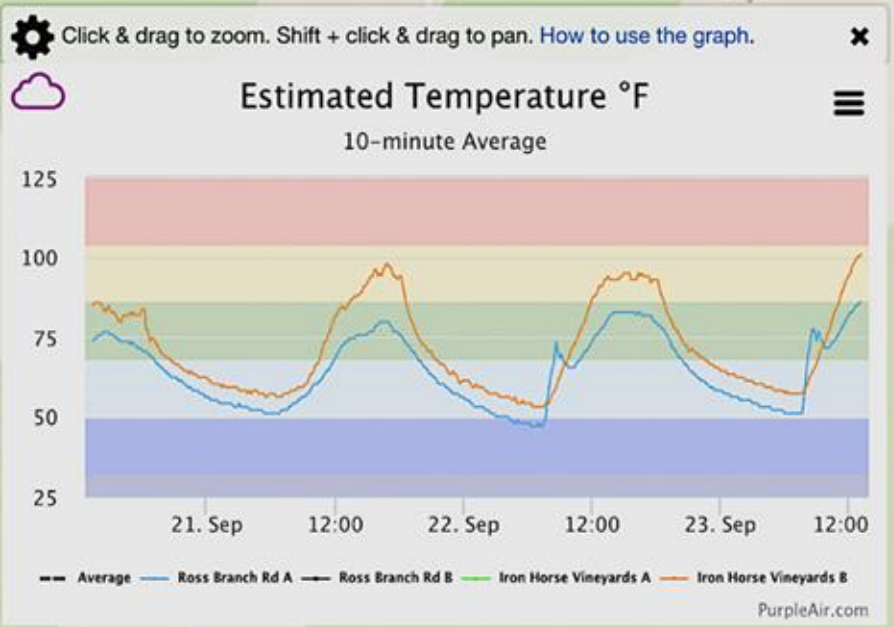
Milesite CO2, Temperature, Humidity, & Barometric Pressure Sensor

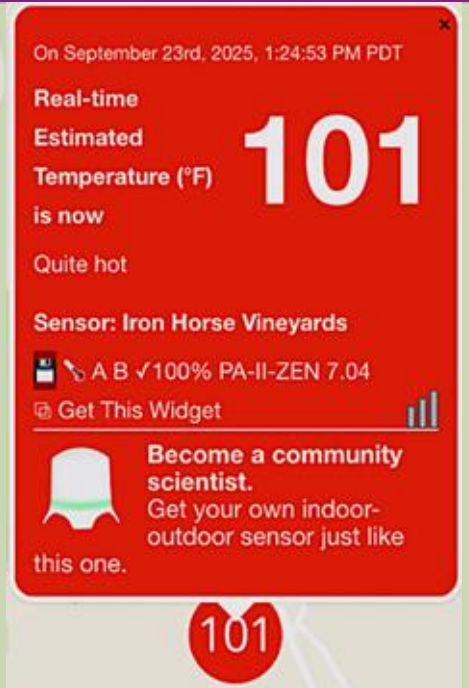
- Measures CO2 Ranges from 400 to 5,000 ppm
- 4 Sensors in 1 for Various Outdoor Usages
- LoRaWAN® Wireless Deployment with Low Power Consumption
- Long-Lasting Battery Life of up to 10 Years

Purple Air Sensor

PurpleAir

Map Sensors Data About





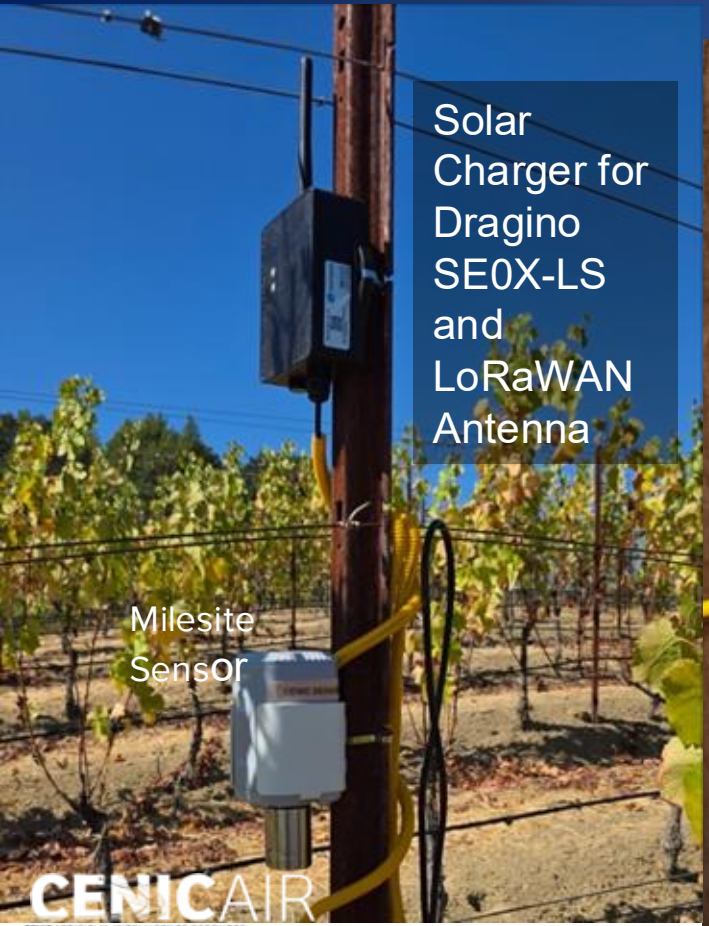
Office Wall Site (O)

View of Vines & Beyond

John and Tom Placed the First Sensors in the Ground

Jake, Joe, and John Installed the Second set of Sensors for Moisture, Temperature, Soil Conductivity & CO_2; Tom's Sienna Minivan AWD Got them out to the Blocks

CO2, Temperature, Barometric Pressure, and Humidity Sensors



Research-grade Weather, UV, Water Pipe Pressure, Quake Sensors

SCAN ME

ATMOS 41 Weather Station
Latitude: 38.4553240
Longitude: -122.8992430
Precipitation: 0.0 ml/hr
Solar: 754.10 W
Strikes: 0.00 count
StrikesDistance: km
windDirection: 96.50 deg
windSpeed: 1.77 km/hr

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VINEYARDS
50th ANNIVERSARY

Explore tinyl.co/4SIF

View the Drone Flight

CENIC

G6 PTZ UVC-G6-PTZ-W With AI Webhook—Train to See Bugs?

All-weather, 4K dual-lens camera with 10x hybrid zoom, 1/1.8" 8MP image sensor, Multi-TOPS AI Engine, and ultra-low latency pan-tilt-zoom control for motion tracking.

- IR Night Vision
- 30 m (98 ft)
- Zoom Mode
- 10x Hybrid
- Resolution: 4K
- Field of View:
- Wide: H: 109.9°, V: 56.7°, D: 134.1°
- Tele: H: 26.6°, V: 15.1° , D: 30.4°
- Pan-Tilt Range:
- Pan: 350° Tilt: 100°
- Two-way audio

Want to detect Lantern Flies! None seen yet west of the Rockies.

Deer detection might be appreciated Could yell at the deer day or night

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Questions, Suggestions
Interest in Participation?

Contact:

tdefanti@ucsd.edu
jjgraham@ucsd.edu