

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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UgCS - Photogrammetry

Mission of 8/1/2025 11:56 PM

circles DJI Mavic 3 Multis... JHV-1 DJI Mavic 3 Multis... JHV-2 DJI Mavic 3 Multis... Mavic3Multispect...

Photogrammetry tool #1/1

Basic Advanced Actions (2)

AGL Tolerance, ft 1.00

Direction angle (0-360) 308.79

Overshoot, ft

Overshoot speed, ft/s

Action execution Every point

Trajectory smoothing

Max slope, %

Minimal gap, ft

Double grid

Additional waypoints

Allow partial calculation

Avoid obstacles

Camera top facing forward

Export route

Mavic3Multispectral-1581f5fcc249b00dmp06 (last known location)

Battery	GPS	Telemetry	RC
N/A	N/A	N/A	N/A

Raw altitude	AGL altitude	AMSL altitude
N/A	N/A	N/A

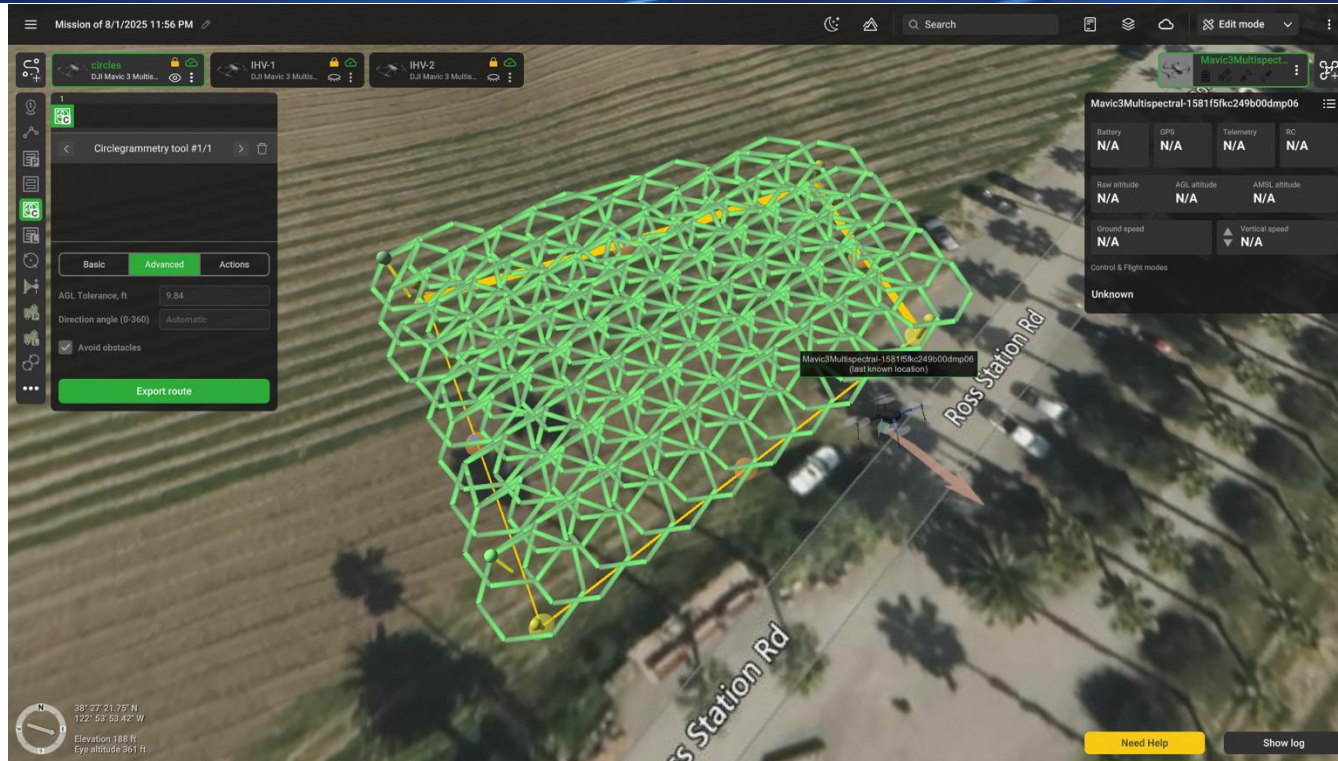
Ground speed N/A Vertical speed N/A

Control & Flight modes Unknown

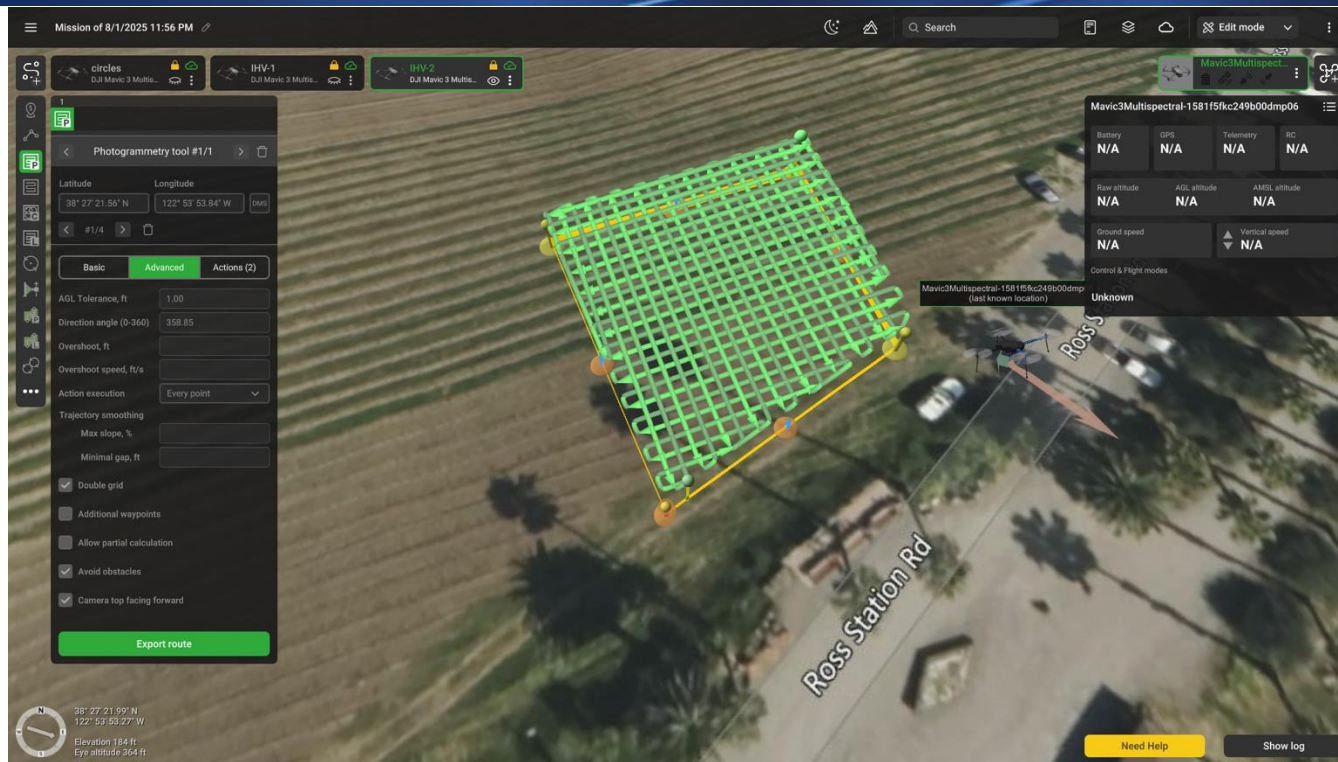
Need Help Show log

38° 27' 25.13" N
122° 53' 50.98" W
Elevation 149 ft
Eye altitude 1127 ft

UgCS - Circlegrammetry



UgCS – Photogrammetry Low Altitude Terrain Following



PIX4Dfields – crop analysis software

PIX4Dfields

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Compatible with



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).

PIX4Dfields – PDF report generation

IHV-8-27-2025

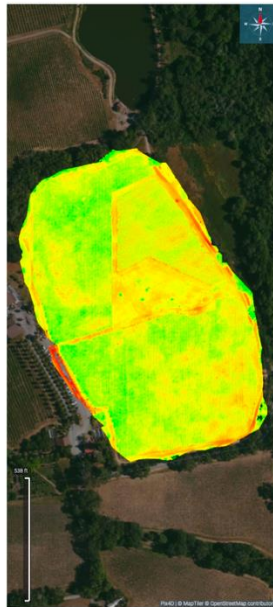


MS 100' mission

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

PIX4Dfields – PDF report generation

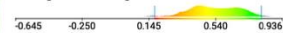
GNDVI
Index



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



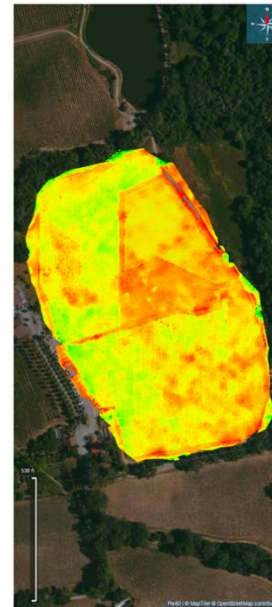
Visualization settings

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



Visualization settings

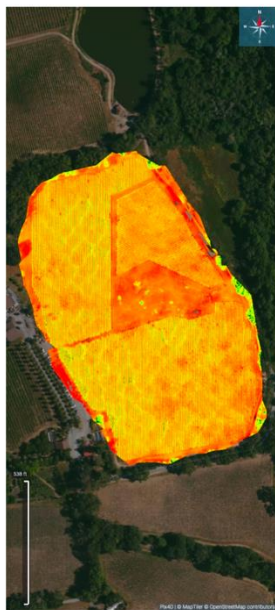
Histogram equalization: Off
Selected minimum value: 0.039
Selected maximum value: 0.555
Values out of range: Transparent

Statistics

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

PIX4Dfields – PDF report generation

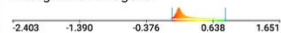
MCARI
Index



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



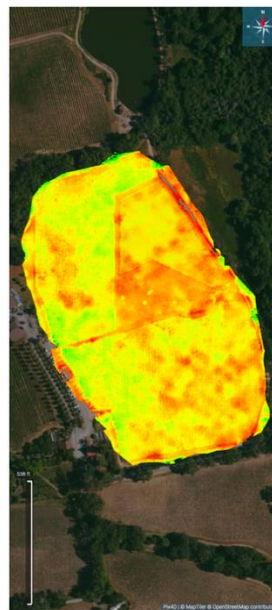
Visualization settings

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

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



Visualization settings

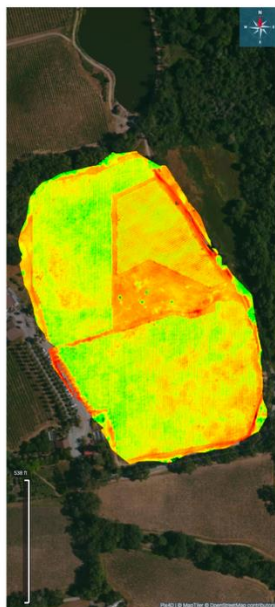
Histogram equalization: Off
Selected minimum value: 0.034
Selected maximum value: 0.444
Values out of range: Transparent

Statistics

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

PIX4Dfields – PDF report generation

NDVI 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



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

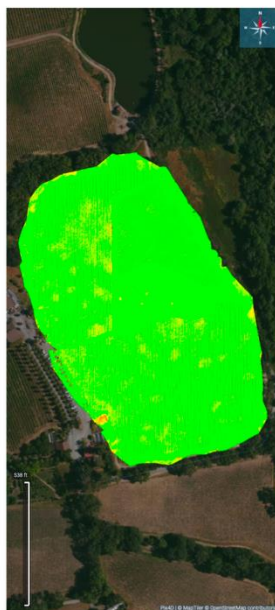


Layer details

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)

PIX4Dfields – PDF report generation

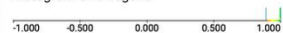
SIP12
Index



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



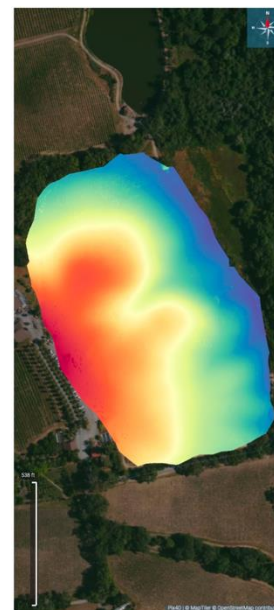
Visualization settings

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



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

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



[Download](#) [Datasets](#) [Gallery](#) [Docs](#) [Community](#) [Swag](#) [Code](#)

🔥 **WebODM has officially decoupled from OpenDroneMap!** [Read the announcement](#)

WebODM

The free and open source drone mapping software.

Generate maps, point clouds, DEMs and 3D models from aerial images. Runs on your computer, even offline.

[Download](#)

[Documentation](#)



Everything You Need

To get started with drone mapping, minus the price tag.

<https://webodm.org/>

NRP WebODM Service

WebODM + Add Project

Dashboard
Cloud Import
Diagnostic
Lightning
OpenAerialMap
GCP Interface
Processing Nodes
Administration
About

1 2 3 4 5 6 7

IHV-Cd Select Images and GCP Import Cloud Import

IHV-10-3-2025 Salmon Habitat Select Images and GCP Import Cloud Import

Iron Horse Vineyards - 10/3/2025 384 06:30:37 Completed

Task ID: b47b79e3-19a9-414f-911c-9f2eba7e71b3
Created on: 12/3/2025, 8:16:46 PM
Options: auto-boundary:true, dsm:true, feature-quality:ultra, pc-quality:ultra, sfm-algorithm:triangulation, use-hybrid-bundle-adjustment:true
Average GSD: 5.84 cm
Area: 220,167.92 m²
Points: 216,110,524
Georeferencing: GPS
CRS: WGS 84 / UTM zone 10N
Disk Usage: 4.91 Gb
Task Output: On Off

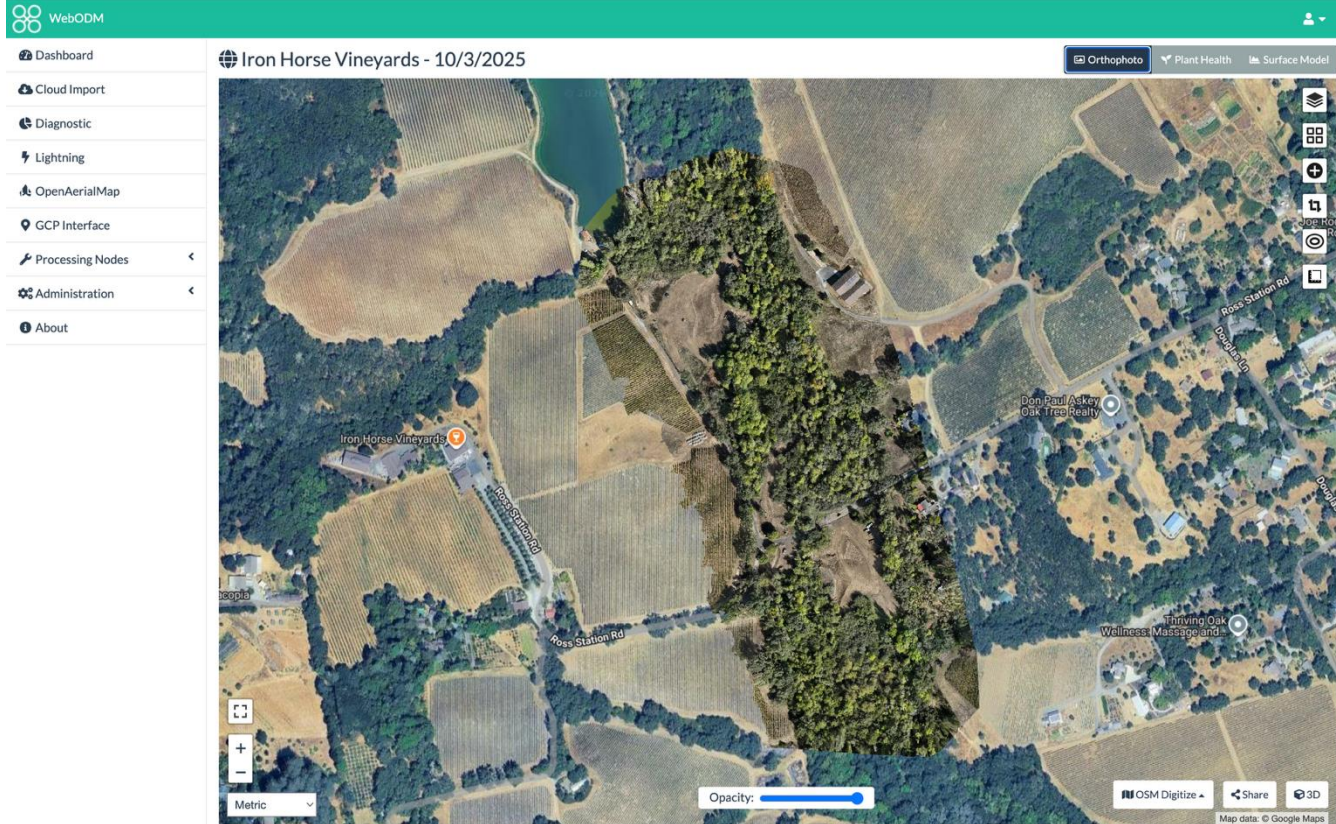
Download Map 3D Model Report Edit Restart Delete

Orthophoto
5-1 Surface Model
Point Cloud
Textured Model
12- Textured Model (gTF)
Camera Parameters
Camera Shots
Quality Report
VV All Assets
Backup

Wallhaven Select Images and GCP Import Cloud Import

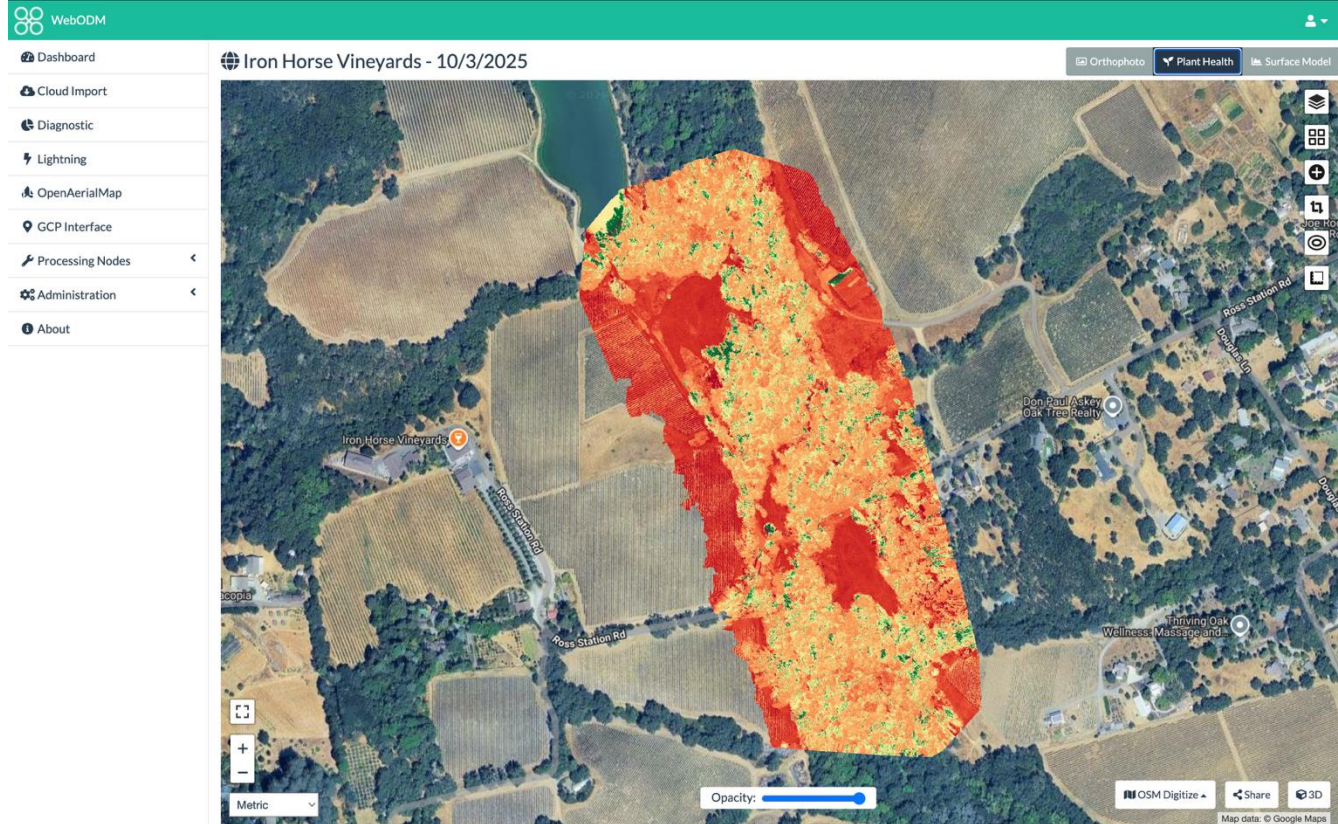
<https://webodm.nrp-nautilus.io/>

NRP WebODM Orthophoto



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

NRP WebODM NDVI



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

NRP WebODM 3D Point Cloud

The screenshot displays the NRP WebODM 3D Point Cloud interface. The main view shows a 3D point cloud of a vineyard, with a dirt road and a building visible. The interface includes a sidebar on the left with navigation options: Dashboard, Cloud Import, Diagnostic, Lightning, OpenAerialMap, GCP Interface, Processing Nodes, Administration, and About. The main control panel on the right contains the following sections:

- Cameras**: Textured Model, Appearance, Tools
- Measurement**: Show/Hide labels (Show/Hide buttons), Clipping (Clip Task: None, Highlight, Inside, Outside; Clip Method: Inside Any, Inside All)
- Navigation**: Navigation icons, Camera Projection (Perspective, Orthographic), Speed: 247.6
- Scene**: Filters, About

At the bottom right, there are buttons for Metric, a settings icon, a share icon, and a 2D button.

NRP WebODM 3D OBJ Textured Model

The screenshot displays the NRP WebODM web application interface. At the top, a green header bar contains the WebODM logo and a user profile icon. Below the header, a sidebar on the left lists navigation options: Dashboard, Cloud Import, Diagnostic, Lightning, OpenAerialMap, GCP Interface, Processing Nodes, Administration, and About. The main content area is titled "Iron Horse Vineyards - 10/3/2025" and features a large 3D textured model of the vineyard. The model is rendered in a perspective view, showing a dense forest of green trees and a cleared area with a dirt road and several vehicles. The interface includes a control panel on the right side with the following sections:

- Camera:** Textured Model, Show Model (checked).
- Appearance:** Tools.
- Measurement:** A set of measurement tools including a ruler, a circle, a square, and a crosshair.
- Show/Hide labels:** Show and Hide buttons.
- Clipping:** Clipping Task (None, Highlight, Inside, Outside) and Clipping Method (Inside Any, Inside All) buttons.
- Navigation:** A set of navigation tools including a compass, a hand, a first-person view, a third-person view, and a reset button.
- Camera Projection:** Perspective and Orthographic buttons.
- Speed:** A speed slider set to 247.6.
- Scene:** Filters and About buttons.

At the bottom right of the 3D view, there are buttons for Metric, a settings icon, a share icon, and a 2D button.

ScaleODM Helm Chart

hotsos / ScaleODM

Code Issues 4 Pull requests Actions Projects Security and quality Insights

main ScaleODM / README.md

spwoodcock feat: big overhaul to make repo production ready 7490c3b · last week History

Preview Code Blame 72 Lines (54 loc) · 2.08 KB

ScaleODM

Kubernetes-native orchestration for OpenDroneMap workloads, with a NodeODM-compatible API and S3-native task I/O.

Security

Warning

ScaleODM does not provide authentication or authorization. Run it only on trusted private/internal networks. Do not expose the API directly to the public internet.

Quick start (Helm OCI)

This is the shortest path from zero to a running install on an existing Kubernetes cluster.

1. Create namespace and required runtime secret:

```
kubectl create namespace scaleodm

kubectl create secret generic scaleodm-secrets \
  --namespace scaleodm \
  --from-literal=SCALEODM_DATABASE_URL="postgresql://user:pass@your-db:5432/scaleodm?sslmode=require" \
  --from-literal=AWS_S3_ENDPOINT="https://s3.amazonaws.com" \
  --from-literal=AWS_ACCESS_KEY_ID="YOUR_ACCESS_KEY" \
  --from-literal=AWS_SECRET_ACCESS_KEY="YOUR_SECRET_KEY" \
  --from-literal=AWS_DEFAULT_REGION="us-east-1"
```

2. Install the chart:

```
helm upgrade --install scaleodm oci://ghcr.io/hotosm/charts/scaleodm \
  --namespace scaleodm \
```

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

NRP ScaleODM Helm Chart Deployment

The screenshot displays the GitLab interface for the repository `nrp / ScaleODM`. The main content is the `README.md` file, which provides the following information:

- Helm deployment configuration:** Instructions for running ScaleODM on NRP Kubernetes with prerequisites: Existing Argo installation, Zalando Postgres operator for database, and External Ceph S3-compatible storage.
- Files in this repo:** A list of files including `deploy/values.nrp-existing-argo.yaml`, described as safe Helm values overrides.
- Prerequisites:** A list of requirements including the existence of the `scaleodm` namespace, Argo Workflows CRDs, and secrets for database and S3 access.
- Install example:** A terminal snippet showing the command to upgrade the chart:

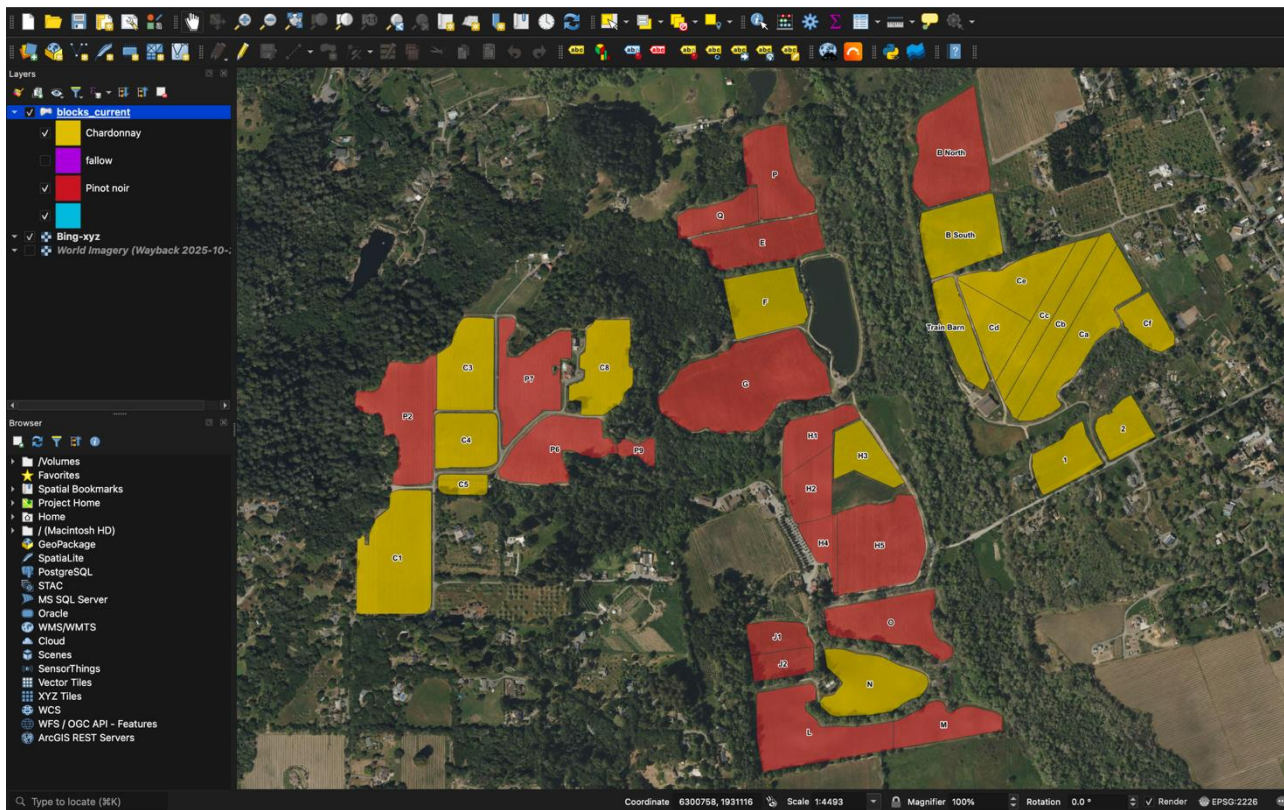
```
helm upgrade --install scaleodm oci://ghcr.io/hotosm/charts/scaleodm \
--namespace scaleodm \
--values deploy/values.nrp-existing-argo.yaml
```
- Notes:** A note stating that the repo intentionally keeps credentials out of git and that users should use operator-managed DB credentials.

QGIS GIS Mapping application



The screenshot shows the QGIS website homepage. At the top, there is a navigation bar with the QGIS logo, menu items for 'About', 'Resources', and 'Community', and buttons for 'Download', 'Donate', and a gift icon. Below the navigation bar, there is a news section with the headline 'News: Windows installers are getting lighter' and a language selector set to 'English'. A prominent green banner features the text '★ QGIS 4.0' and 'QGIS 4.0 is here – our most powerful release yet!' with a link to 'Explore the changelog'. The main content area has a dark background with a faint map pattern. It includes the text 'Free and Open Source', 'an OSGeo project', and the large headline 'Spatial without Compromise'. Below this, it says 'Spatial visualization and decision-making tools for everyone' and provides a 'Download' button and the text 'Available on Windows, Mac, Linux'. A large, stylized green 'Q' logo with a 3D cube is positioned on the right side.

QGIS GIS Mapping application



GeoServer geospatial data service



[About](#) | [Blog](#) | [Download](#) | [Documentation](#) | [Community](#) | [GitHub](#)

GeoServer is an open source server for sharing geospatial data.

Designed for interoperability, it publishes data from any major spatial data source using open standards.

GeoServer 3 Crowdfunding

Consortium of Camptocamp, GeoSolutions and GeoCat have responded to our roadmap challenge with a bold [GeoServer 3 Crowdfunding](#). Express interest or pledge support using [email](#) or [form](#).



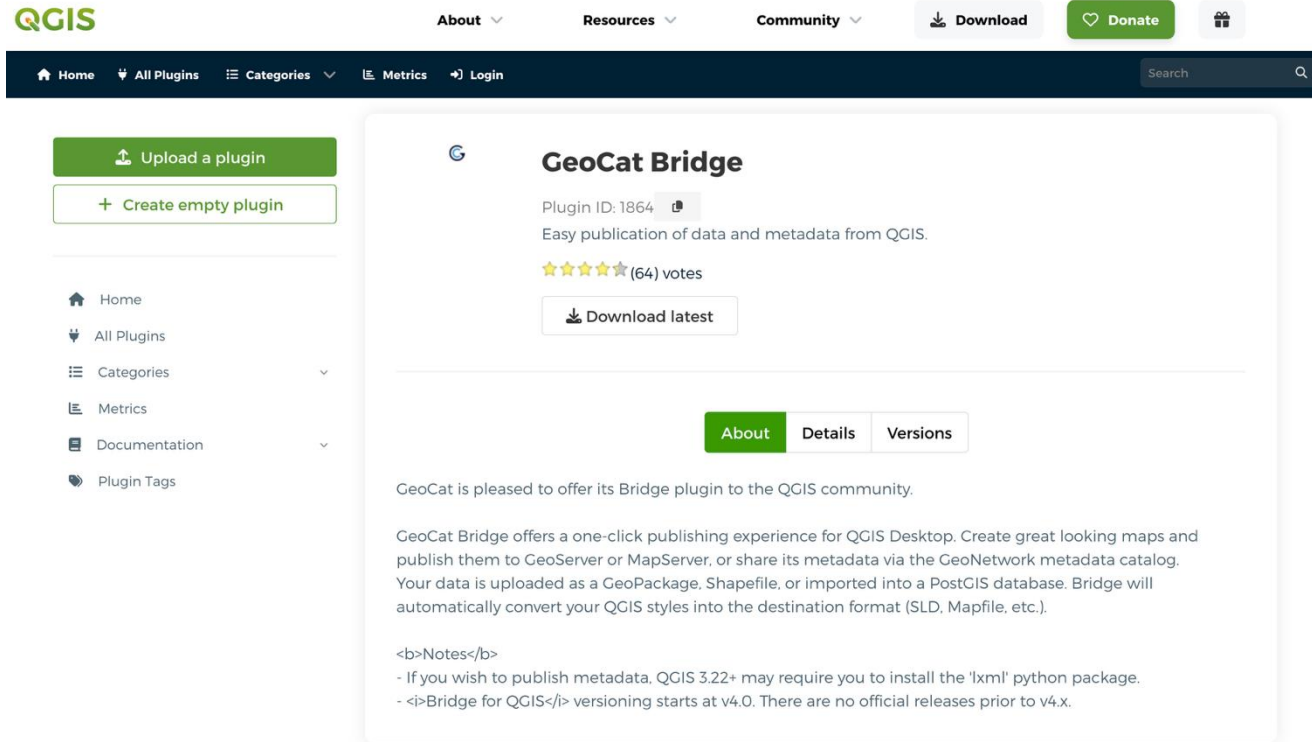
Download

Stable	Maintenance	Development
2.28.3 2.28 Nightly	2.27.5 2.27 Nightly	3.0-RC 3.0. Nightly

News

- [GeoServer 3.0-RC, a crowdfunded success story](#) Apr 21, 2026 • Emmanuel Belo
- [GeoServer 3.0-RC Release](#) Apr 20, 2026 • Jody Garnett
- [GeoServer 2.28.3 Release](#) Mar 20, 2026 • Andrea Aime
- [GeoServer 2.27.5 Release](#) Feb 18, 2026 • Peter Smythe
- [GeoServer 3 First public release date](#) Feb 17, 2026 • Jody Garnett
- [GeoServer 2.28.2 Release](#) Jan 21, 2026 • Gabriel Roldan
- [CITE 2026 Sponsorship](#) Dec 30, 2025 • Jody Garnett
- [GeoServer 2.27.4 Release](#) Dec 18, 2025 • Peter Smythe
- [Master GeoServer WPS - Buffer & Intersection Analysis](#) Dec 3, 2025 • Nima Ghasemloo
- [GeoServer 2.28.1 Release](#) Nov 25, 2025 • Andrea Aime
- [GeoServer 3 Sprint Update](#) Nov 5, 2025 • Jody Garnett

GeoCat Bridge – Publish QGIS to GeoServer



The screenshot shows the QGIS Plugins website interface. At the top, there is a navigation bar with the QGIS logo on the left and links for 'About', 'Resources', 'Community', 'Download', 'Donate', and a gift icon. Below this is a dark navigation bar with 'Home', 'All Plugins', 'Categories', 'Metrics', and 'Login' links, along with a search bar. The main content area is divided into two columns. The left column contains a green 'Upload a plugin' button, a 'Create empty plugin' button, and a sidebar menu with links to Home, All Plugins, Categories, Metrics, Documentation, and Plugin Tags. The right column displays the 'GeoCat Bridge' plugin page. It features the plugin title, ID (1864), a description ('Easy publication of data and metadata from QGIS.'), a star rating (5 stars, 64 votes), and a 'Download latest' button. Below the description are tabs for 'About', 'Details', and 'Versions'. The 'About' tab is active, showing a paragraph of text and a list of notes.

QGIS About Resources Community Download Donate

Home All Plugins Categories Metrics Login Search

Upload a plugin

+ Create empty plugin

Home All Plugins Categories Metrics Documentation Plugin Tags

GeoCat Bridge

Plugin ID: 1864

Easy publication of data and metadata from QGIS.

★★★★★ (64) votes

Download latest

About Details Versions

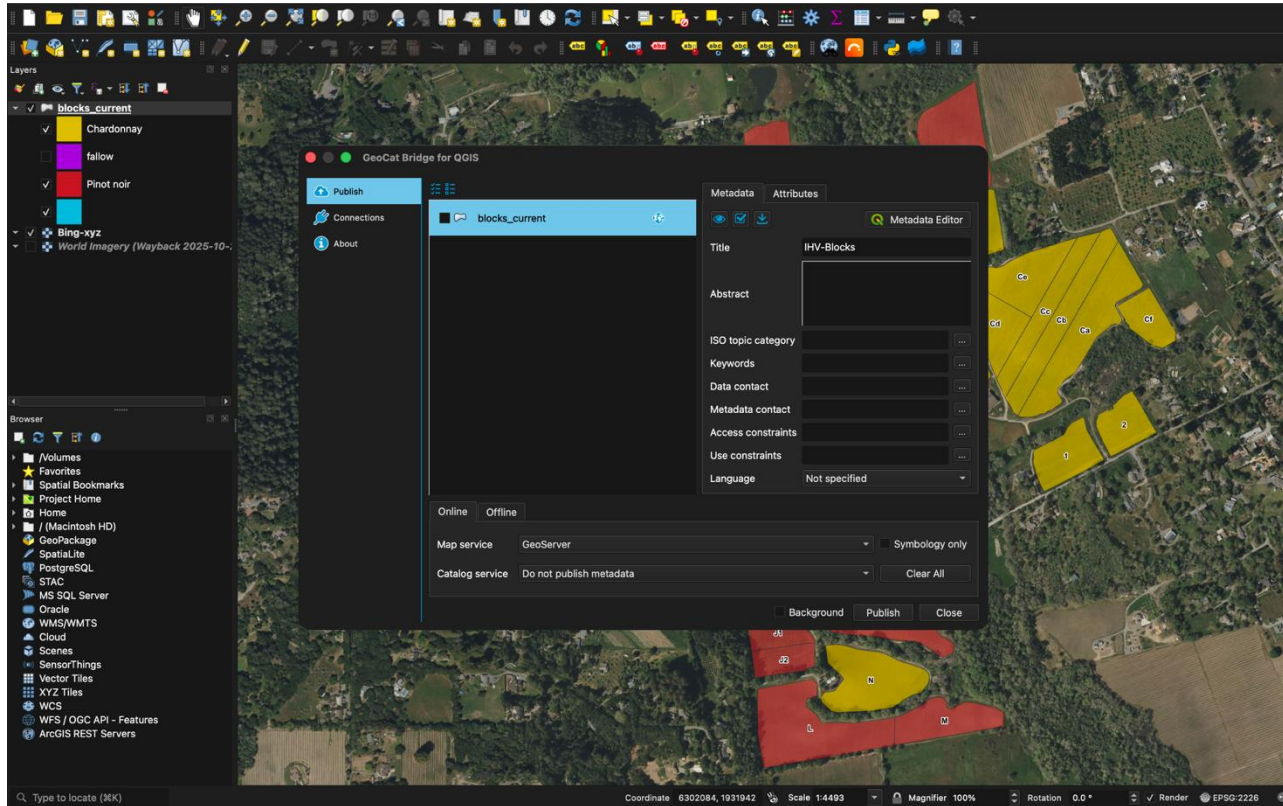
GeoCat is pleased to offer its Bridge plugin to the QGIS community.

GeoCat Bridge offers a one-click publishing experience for QGIS Desktop. Create great looking maps and publish them to GeoServer or MapServer, or share its metadata via the GeoNetwork metadata catalog. Your data is uploaded as a GeoPackage, Shapefile, or imported into a PostGIS database. Bridge will automatically convert your QGIS styles into the destination format (SLD, Mapfile, etc.).

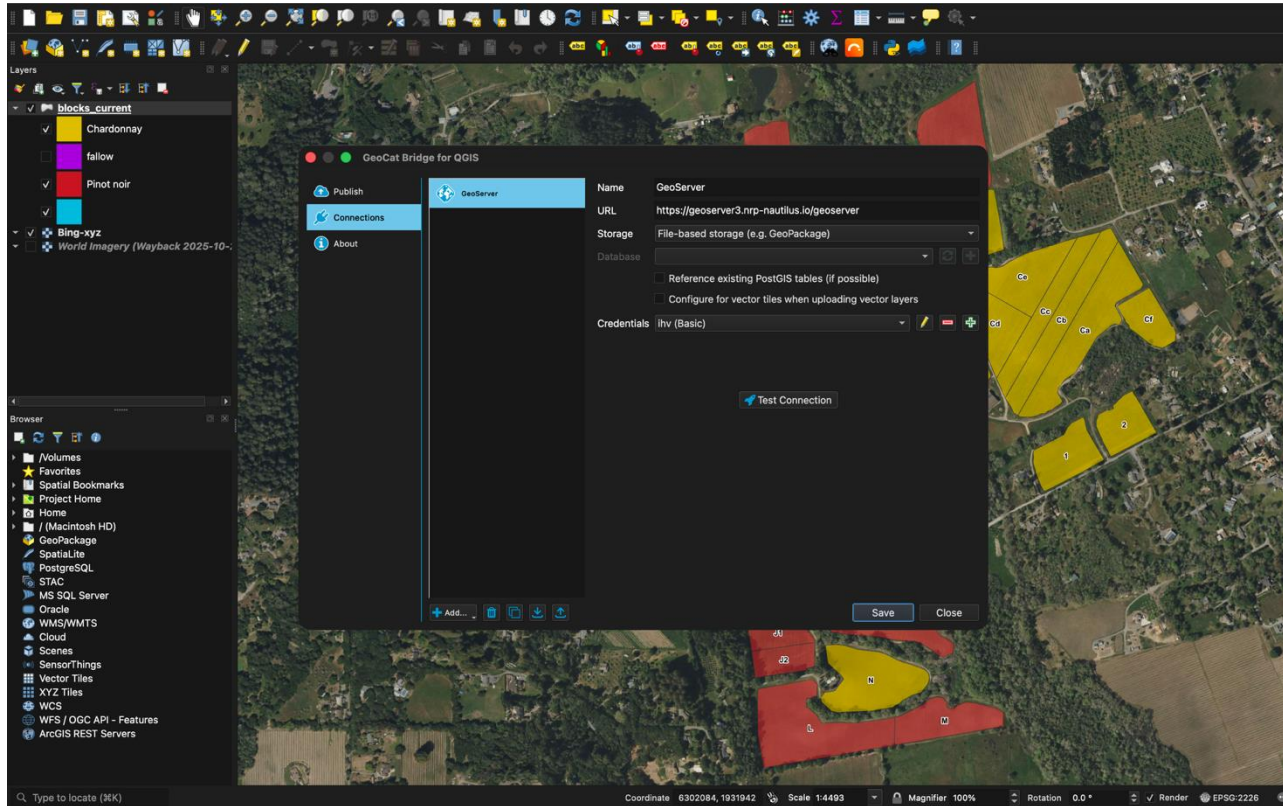
Notes

- If you wish to publish metadata, QGIS 3.22+ may require you to install the 'lxml' python package.
- Bridge for QGIS versioning starts at v4.0. There are no official releases prior to v4.x.

GeoCat Bridge – Publish QGIS to GeoServer



GeoCat Bridge – Publish QGIS to GeoServer



GeoServer Web Map services

The screenshot displays the GeoServer web interface. On the left is a navigation sidebar with a search bar and a tree view of workspaces: Global, Iron-Horse, ne, nurc, sf, tiger, topp, spearfish, tasmania, and tiger-ny. The main content area is titled 'Global' and features a 'Welcome' message. Below this, it lists 'Maps' (Georeferenced map images) and 'Tile Services' (Pre-rendered georeferenced map tile sets). Under 'Vector data', it shows 'Vector data published as geospatial features'. Finally, it lists 'Raster data and imagery' with direct access to referenced raster data and imagery. At the bottom, there is a link to contact the administrator.

GeoServer

en

Search...

Global

Global

9

1

6

4

6

4

5

Iron-Horse

ne

nurc

sf

tiger

topp

spearfish

tasmania

tiger-ny

Welcome

GeoServer Web Service, anonymous access to 6 workspaces, with 29 layers.

Designed for interoperability, GeoServer publishes data from any major spatial data source using open standards. For more information visit [OSGeo](#).

Maps

Georeferenced map images generated from vector data, raster data, and imagery.

WMS	WMS
1.3.0	1.1.1

Tile Services

Pre-rendered georeferenced map tile sets generated from vector data, raster data, and imagery.

WMTS	TMS	WMS-C
1.0.0	1.0.0	1.1.1

Vector data

Vector data published as geospatial features.

WFS	WFS	WFS
2.0.0	1.1.0	1.0.0

Raster data and imagery

Direct access to referenced raster data and imagery.

WCS
2.0.1

Contact [administrator](#).

GeoServer Web Map services

GeoServer

Search in Iron-Horse...

Global > Iron-Horse > blocks_current

IHV-Blocks

GeoServer Virtual Web Service, anonymous access to **Iron-Horse:blocks_current** layer.

For more information visit [OSGeo](#).

Common Formats [OpenLayers](#) [GML](#)

Map Formats [AtomPub](#) [GIF](#) [GeoRSS](#) [GeoTiff](#) [GeoTiff 8-bits](#) [JPEG](#) [JPEG-PNG](#) [JPEG-PNG8](#) [OpenLayers](#) [OpenLayers 10](#) [OpenLayers 2](#) [OpenLayers 3](#) [PDF](#) [PNG](#) [PNG 8bit](#) [SVG](#) [Tiff](#) [Tiff 8-bits](#) [UTFGrid](#)

Vector Formats [CSV](#) [GML2](#) [GML3.1](#) [GML3.2](#) [GeoJSON](#) [Shapefile](#) [text/csv](#)

Maps

Georeferenced map images generated from vector data, raster data, and imagery.

WMS	WMS
1.3.0	1.1.1

Tile Services

Pre-rendered georeferenced map tile sets generated from vector data, raster data, and imagery.

WMTS	TMS	WMS-C
1.0.0	1.0.0	1.1.1

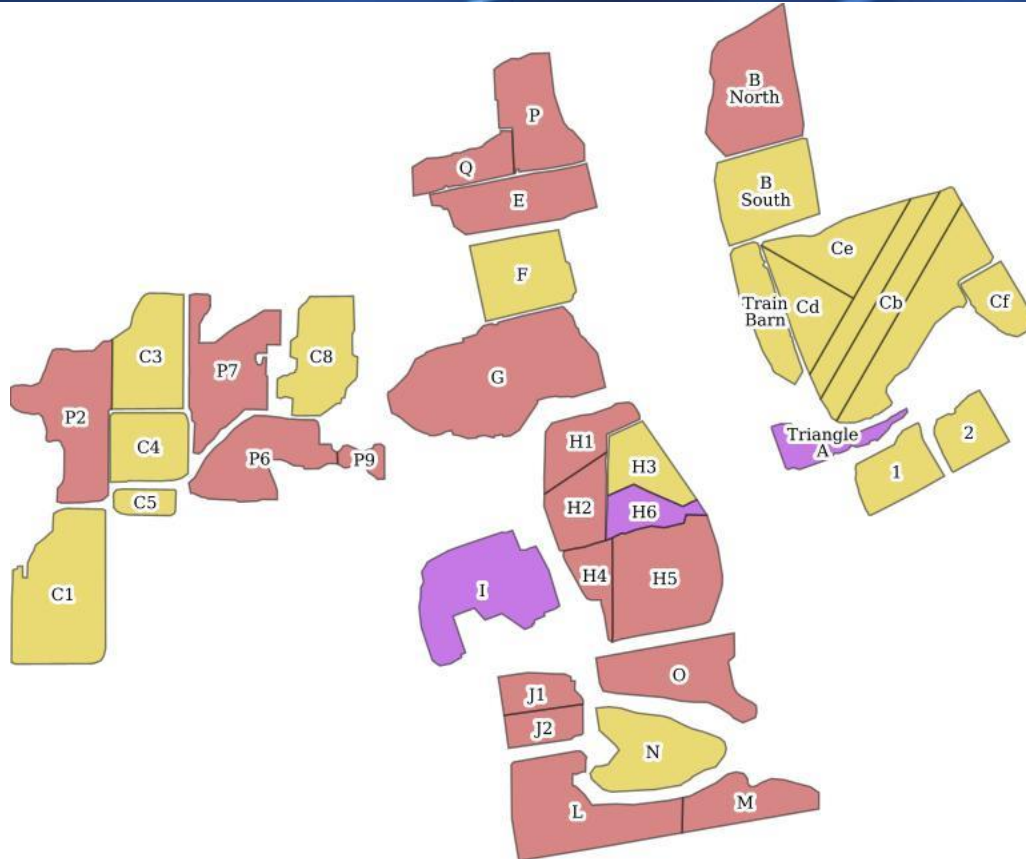
Vector data

Vector data published as geospatial features.

WFS	WFS	WFS
2.0.0	1.1.0	1.0.0

Contact [administrator](#).

GeoServer JPEG-PNG



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

ChirpStack LoRaWAN Network Server



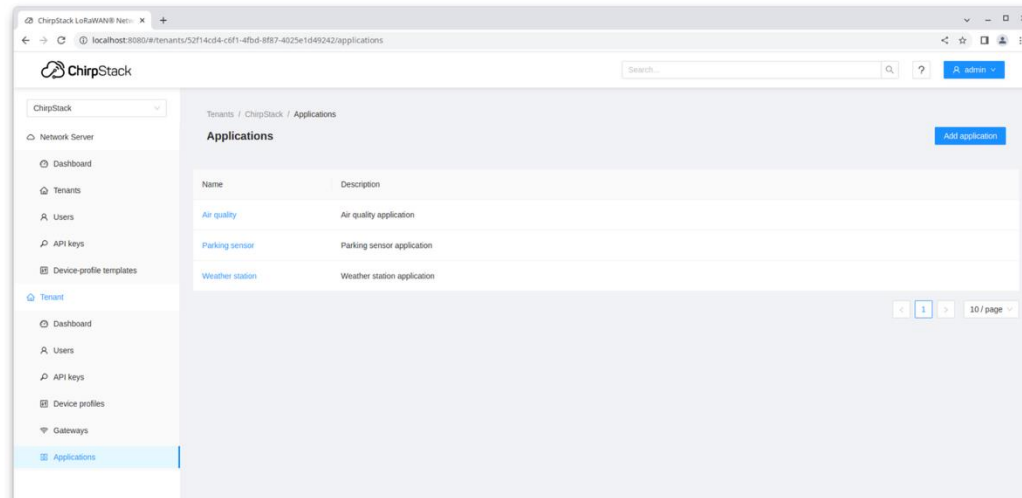
Home | Documentation (v4) | Documentation (v3) | Community support

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/>

Chirpstack Gateway OS

The screenshot shows the ChirpStack website interface. On the left is a dark sidebar with a navigation menu. The main content area is titled "Introduction" and contains text about the OS being OpenWrt-based and supporting various LoRa gateways. Below the text is a screenshot of the ChirpStack Concentrator web interface, which shows configuration options for a concentrator, including shield model, channel plan, and GNSS/USB settings.

ChirpStack

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

Installation | API | Contribute & source

ChirpStack Gateway Bridge

Introduction | Changelog | Configuration | Downloads | Installation | Payload formats | Backends | Integrations | Metrics | Contribute & source

ChirpStack Gateway OS

Introduction | Changelog | Image types | Hardware support | Downloads | Installation | Getting started | Use | Contribute & source

ChirpStack Gateway Mesh

Introduction | Changelog | Configuration | Downloads

Introduction

ChirpStack Gateway OS is an open-source OpenWrt based embedded OS supporting Raspberry Pi and some off-the-shelf LoRa[®] gateways. It provides a web-interface with configuration options for most common LoRa concentrator shields (in case of Raspberry Pi gateways).

The Raspberry Pi images come in two versions:

- **Base:** Image containing all gateway components
- **Full:** Base image + ChirpStack LoRaWAN Network Server

For off-the-shelf gateways only a single version is provided, capabilities of the gateway.

ChirpStack Concentrator

ChirpStack Concentrator provides an certified API interface to LoRa[®] concentrator hardware. Please refer to the [ChirpStack Concentrator hardware](#) page for supported hardware and configuration options.

Global configuration: SX1302 | SX1302 / SX1302 | 2.409P

SX1302 / SX1302

Configure the fields below if you have selected the SX1302 / SX1302 option.

Shield model: SX1302 - RAK2287

Channel plan: EU868 - Standard channels + 867.1, 867.3, 867.5

GNSS: Enable this in case the shield has a different GNSS module.

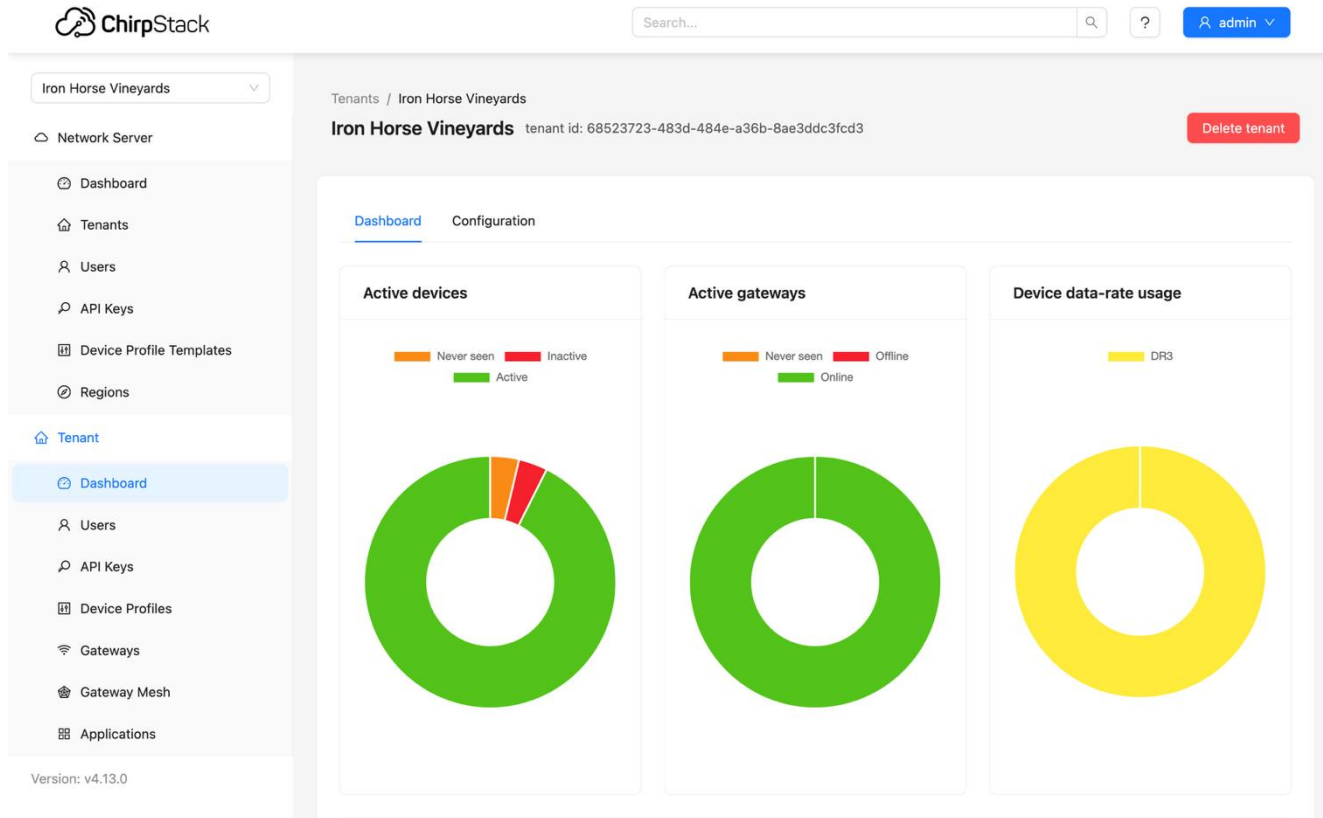
USB: Enable this in case the shield is connected over USB rather than SPI.

Save & Apply | Submit | Reset


Copyright © 2024 ChirpStack. Powered by LUT | [Agenda](#) | [Privacy](#)

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

ChirpStack LoRaWAN Network Server



Chirpstack Device Applications

Search... admin

Tenants / Iron Horse Vineyards / Applications

Applications

Add application

Name	Description
EM300-DI	EM300-DI LoRaWAN® Pulse Counter is used to remotely read metering data from water meters. It turns existing traditional water meters into smart meters via LoRaWAN® network which further enables easier management and increases the efficiency of water use.
EM500-CO2-915M	The EM500-CO2 is designed for monitoring CO2 concentration, temperature, humidity and barometric pressure in outdoor scenarios.
EM500-PP-4842	The EM500 Pipe Pressure Sensor that can easily be installed, constantly monitors pipes of various kinds, varying from liquids to gases in various settings to constantly monitor pipe pressure so that pipe pressure abnormality can be detected in time to ensure workplace safety.
RAK12027 WisBlock Seismic Sensor	RAK12027 WisBlock Seismic Sensor
SDI-12-LS	TEROS 22 Soil Water Potential Sensor The TEROS 22 matrix water potential (soil suction) sensor offers high accuracy, low maintenance, and quick installation and removal. Full-range soil water potential sensor Pre-calibrated to save time and effort Onboard temperature measurement
SE01-LS-1	The Dragino SE01-LB/LS is a LoRaWAN Soil Moisture & EC Sensor for IoT of Agriculture. It is designed to measure the soil moisture of saline-alkali soil and loamy soil. The soil sensor uses FDR method to calculate the soil moisture with the compensation from soil temperature and conductivity. It also has been calibrated in factory for Mineral soil type.
SE01-LS-2	The Dragino SE01-LB/LS is a LoRaWAN Soil Moisture & EC Sensor for IoT of Agriculture. It is designed to measure the soil moisture of saline-alkali soil and loamy soil. The soil sensor uses FDR method to calculate the soil moisture with the compensation from soil temperature and conductivity. It also has been calibrated in factory for Mineral soil type.
SE01-LS-3	The Dragino SE01-LB/LS is a LoRaWAN Soil Moisture & EC Sensor for IoT of Agriculture. It is designed to measure the soil moisture of saline-alkali soil and loamy soil. The soil sensor uses FDR method to calculate the soil moisture with the compensation from soil temperature and conductivity. It also has been calibrated in factory for Mineral soil type.
SE01-LS-4	The Dragino SE01-LB/LS is a LoRaWAN Soil Moisture & EC Sensor for IoT of Agriculture. It is designed to measure the soil moisture of saline-alkali soil and loamy soil. The soil sensor uses FDR method to calculate the soil moisture with the compensation from soil temperature and conductivity. It also has been calibrated in factory for Mineral soil type.
SE0X-LS	SE0X-LS

Version: v4.13.0

Chirpstack EM500 CO2 Sensor Application



Search...



admin

Iron Horse Vineyards

Network Server

Dashboard

Tenants

Users

API Keys

Device Profile Templates

Regions

Tenant

Dashboard

Users

API Keys

Device Profiles

Gateways

Gateway Mesh

Applications

Version: v4.13.0

Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M / Devices / EM500-CO2-915M-1

EM500-CO2-915M-1 device eui: 24e124126f015410

Delete device

Dashboard Configuration OTAA keys Activation Queue Events LoRaWAN frames

Last seen: 2026-05-03 22:00:31

Device profile: EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors Enabled: yes

Description: The EM500-CO2 is designed for monitoring CO2 concentration, temperature, humidity and barometric pressure in outdoor scenarios.

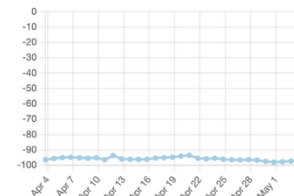
Link metrics Device metrics

24h 31d 1y

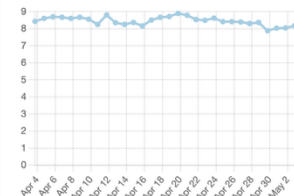
Received



RSSI



SNR



Received / frequency



Received / DR



Errors



Chirpstack EM500 CO2 Application devices

ChirpStack

Search... ? admin

Iron Horse Vineyards

Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M

EM500-CO2-915M application id: 6d37b020-0522-4b2d-8e40-c06c283bc547 Delete application

[Devices](#) [FUOTA](#) [Multicast groups](#) [Relays](#) [Application configuration](#) [Integrations](#)

Add device Selected devices

<input type="checkbox"/>	Last seen	DevEUI	Name	Device profile	Tags	Battery
<input type="checkbox"/>	2026-05-03 22:00:31	24e124126f015410	EM500-CO2-915M-1	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 21:56:14	24e124126f015418	EM500-CO2-915M-2	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 21:58:25	24e124126f21868	EM500-CO2-915M-3	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 22:02:55	24e124126f218775	EM500-CO2-915M-4	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 22:00:06	24e124126f426180	EM500-CO2-915M-5	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 21:54:09	24e124126f427032	EM500-CO2-915M-6	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 22:03:17	24e124126f427423	EM500-CO2-915M-7	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		
<input type="checkbox"/>	2026-05-03 22:01:10	24e124126f427446	EM500-CO2-915M-8	EM500-CO2 - CO2, temperature, humidity, and barometric pressure sensors		

Version: v4.13.0

1 / page

Chirpstack Application Integrations

The screenshot displays the ChirpStack web interface. At the top, the ChirpStack logo is on the left, and a search bar, help icon, and user profile (admin) are on the right. The main content area is for tenant 'Iron Horse Vineyards' and application 'EM500-CO2-915M'. A 'Delete application' button is visible in the top right. The left sidebar contains navigation menus for 'Network Server' and 'Tenant'. The 'Integrations' tab is active, showing six integration options in a grid:

- InfluxDB**: The InfluxDB integration writes events into an InfluxDB time-series database.
- MQTT**: The MQTT integration forwards events to a MQTT broker. Includes a 'Get certificate' button.
- ThingsBoard**: The ThingsBoard integration forwards events to a ThingsBoard instance.
- AWS SNS**: The AWS SNS integration forwards events to an AWS SNS topic.
- Azure Service-Bus**: The Azure Service-Bus integration forwards events to an Azure Service-Bus topic or queue.
- GCP Pub/Sub**: The Google Cloud Pub/Sub integration forwards events to a GCP Pub/Sub topic.

Each integration card includes a logo, a brief description, and a plus sign at the bottom for further configuration.

Chirpstack InfluxDB Application Integration

The screenshot displays the ChirpStack web interface. At the top left is the ChirpStack logo. A search bar and a user profile dropdown (admin) are at the top right. The left sidebar contains a navigation menu with options like Network Server, Dashboard, Tenants, Users, API Keys, Device Profile Templates, Regions, Tenant, and Applications. The main content area shows the breadcrumb path: Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M. Below this, the application name 'EM500-CO2-915M' and its ID are displayed, along with a 'Delete application' button. The 'Integrations' tab is active, showing a form titled 'Update InfluxDB integration'. The form includes fields for 'InfluxDB version' (set to 'InfluxDB v2'), 'API endpoint (write)' (set to 'https://nrp-thingsboard-influxdb.nrp-nautilus.io/api/v2/write'), 'Organization' (set to 'Iron Horse Vineyards'), 'Bucket' (set to 'ihv'), and 'Token'. A 'Submit' button is at the bottom of the form.

ChirpStack

Search... ? admin

Iron Horse Vineyards

Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M

EM500-CO2-915M application id: 6d37b020-0522-4b2d-8e40-c06c283bc547 Delete application

Devices FUOTA Multicast groups Relays Application configuration Integrations

Update InfluxDB integration

* InfluxDB version
InfluxDB v2

* API endpoint (write)
https://nrp-thingsboard-influxdb.nrp-nautilus.io/api/v2/write

Organization
Iron Horse Vineyards

Bucket
ihv

Token
.....

Submit

Version: v4.13.0

Chirpstack Thingsboard Application Integration

The screenshot shows the ChirpStack web interface. At the top left is the ChirpStack logo. A search bar and a user profile dropdown (admin) are at the top right. A breadcrumb trail reads: Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M. Below this, the application name **EM500-CO2-915M** is displayed with its ID and a red 'Delete application' button. A navigation menu on the left includes 'Network Server' and 'Tenant' sections. The 'Integrations' tab is active. The main content area is titled 'Update ThingsBoard integration' and contains a form with a 'ThingsBoard server' field containing 'http://67.58.49.53:8080'. A note states: 'Each device must have a 'ThingsBoardAccessToken' variable assigned. This access-token is generated by ThingsBoard.' A blue 'Submit' button is at the bottom of the form. The version 'v4.13.0' is shown at the bottom left.

ChirpStack

Search... ? admin

Iron Horse Vineyards

Tenants / Iron Horse Vineyards / Applications / EM500-CO2-915M

EM500-CO2-915M application id: 6d37b020-0522-4b2d-8e40-c06c283bc547 [Delete application](#)

Devices FUOTA Multicast groups Relays Application configuration Integrations

Update ThingsBoard integration

* ThingsBoard server

Each device must have a 'ThingsBoardAccessToken' variable assigned. This access-token is generated by ThingsBoard.

[Submit](#)

Version: v4.13.0

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The database for real-time systems powering physical AI

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[Ask Dash](#)

InfluxDB Data Explorer

The screenshot displays the InfluxDB Data Explorer interface. On the left is a navigation sidebar with options: Load Data, Data Explorer (selected), Notebooks, Dashboards, Tasks, Alerts, and Settings. The main area shows a line graph with multiple data series plotted against a time axis from 2026-04-04 to 2026-05-02. The y-axis ranges from 0 to 1000. Below the graph is a query configuration panel for 'Query 1 (1.39s)'. It includes a 'FROM' section with a bucket search, a 'Filter' section with 'application_name' set to 'EM500-C02-915M', and three additional filter sections for '_field' (set to 'value') and '_measurement' (set to 'device_frmpayload_dat_'). The 'WINDOW PERIOD' is set to 'AUTO' (Past 30d), and the 'AGGREGATE FUNCTION' is set to 'AUTO' (mean). A 'SCRIPT EDITOR' and 'SUBMIT' button are also visible.

InfluxDB API Access in Jupyter Notebooks

The screenshot shows a GitLab repository page for 'jupyter-notebooks'. At the top, a notification states: 'Your changes have been committed successfully.' Below this, the repository path is shown as 'main > jupyter-notebooks'. The main content area displays a list of files with columns for 'Name', 'Last commit', and 'Last update'. The files listed include 'README.md' (edited 37 seconds ago) and several InfluxDB notebook files (e.g., 'influx-EM500-CO2-915M-1.ipynb' through 'influx-SenseCAP-S2103-CO2-2.ipynb'), all of which were uploaded as new files 3 months ago. The left sidebar contains navigation options such as 'Project', 'Repository', 'Build', 'Secure', 'Deploy', 'Operate', 'Monitor', 'Analyze', and 'Settings'. The bottom of the sidebar shows 'What's new' and 'Help' sections.

Name	Last commit	Last update
README.md	Edit README.md	37 seconds ago
influx-EM500-CO2-915M-1.ipynb	Upload New File	3 months ago
influx-EM500-CO2-915M-2.ipynb	Upload New File	3 months ago
influx-EM500-CO2-915M-3.ipynb	Upload New File	3 months ago
influx-EM500-CO2-915M-4.ipynb	Upload New File	3 months ago
influx-EM500-CO2-915M-ALL.ipynb	Upload New File	3 months ago
influx-SDI-12-LS-ATMOS-41.ipynb	Upload New File	3 months ago
influx-SE01-LS-1.ipynb	Upload New File	3 months ago
influx-SE01-LS-2.ipynb	Upload New File	3 months ago
influx-SE01-LS-3.ipynb	Upload New File	3 months ago
influx-SE01-LS-4.ipynb	Upload New File	3 months ago
influx-SE0X-LS.ipynb	Upload New File	3 months ago
influx-SenseCAP-S2103-CO2-1.ipynb	Upload New File	3 months ago
influx-SenseCAP-S2103-CO2-2.ipynb	Upload New File	3 months ago

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

Thingsboard Tenant Admin View

The screenshot displays the Thingsboard Tenant Admin View interface. At the top, the Thingsboard logo and 'Home' button are visible on the left, and the user profile 'John Graham, Tenant administrator' is on the right. A dark blue sidebar on the left contains a navigation menu with items like Home, Alarms, Dashboards, Entities, Devices, Assets, Entity views, Gateways, Profiles, Device profiles, Asset profiles, Customers, Rule chains, Edge management, Advanced features, Resources, Notification center, Mobile center, API usage, Settings, and Security.

The main content area is divided into several sections:

- Devices...:** A summary section with three cards: 'Inactive' (2), 'Active' (24), and 'Total' (26). It includes 'View docs' and 'Add device' buttons.
- Alarms...:** A summary section with three cards: 'Critical' (0), 'Assigned to me' (0), and 'Total' (0). It includes 'View docs' and 'Add device' buttons.
- Get started:** A section with a '1 Create device' step and a 'How to create Device' link. It provides instructions on provisioning a device and lists six steps: 1. Create device, 2. Connect device, 3. Create dashboard, 4. Configure alarm rules, 5. Create alarm, 6. Create customer and assign dashboard.
- Dashboards...:** A table listing various dashboards such as 'Sensors Map', 'Weather Station', 'Soil Sensors', 'SEOX Soil Sensors', 'Milesight CO2 Sensors', 'SenseCAP CO2 Sensors', and 'Water Sensors', along with their last viewed dates.
- Activity:** A line chart titled 'History - last 30 days' showing activity levels over time from April 5th to May.
- Quick links:** A section with links for Alarms, Dashboards, Devices, Documentation, Getting started, API, Rule engine, and Device profiles.
- Usage:** A section showing usage statistics for Devices (26 / ∞), Assets (1 / ∞), Users (2 / ∞), Dashboards (7 / ∞), and Customers (2 / ∞).
- Connect mobile app:** A section featuring a QR code and buttons to 'Download on the App Store' and 'Get it on Google Play', with the text 'Scan to connect or download mobile app'.

Thingsboard Sensor Map Dashboard

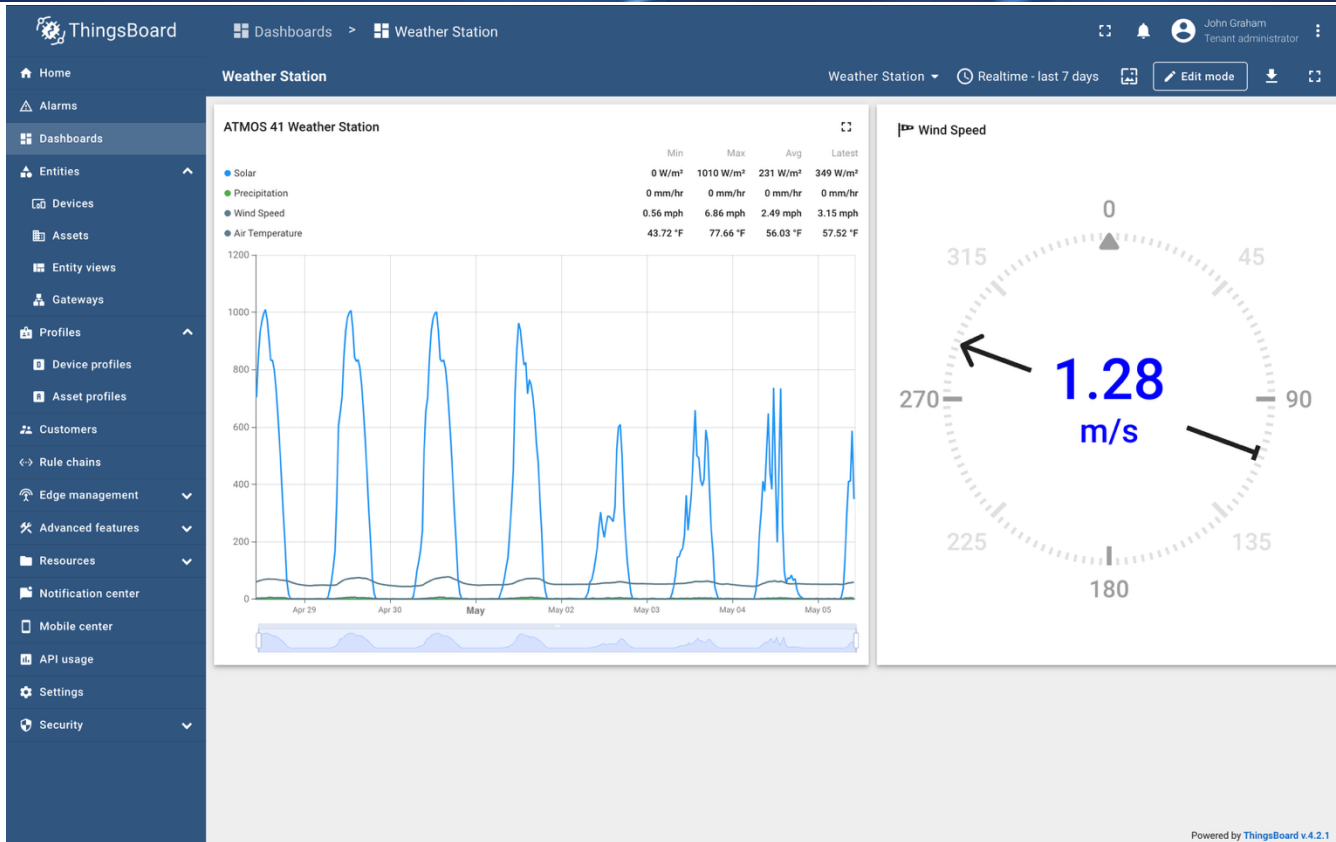
The screenshot displays the Thingsboard interface for a sensor map dashboard. The top navigation bar includes the Thingsboard logo, a breadcrumb trail for 'Dashboards > Sensors Map', and user information for John Graham, a Tenant administrator. A sidebar on the left lists various system components such as Home, Alarms, Dashboards, Entities, Devices, Assets, Entity views, Gateways, Profiles, Customers, Rule chains, Edge management, Advanced features, Resources, Notification center, Mobile center, API usage, Settings, and Security. The main content area is titled 'Iron Horse Vineyards - Sensor Map' and features an aerial satellite map with several colored sensor icons (red, blue, green) overlaid on the landscape. The map includes street names like 'Green Hill Road', 'Falcon Apple Lane', 'Ross', 'Ross Station Road', and 'Dorchester Lane'. A scale bar at the bottom right of the map indicates 500 feet. The interface also includes a 'sensors' tab, a 'Realtime - last 1 hour' filter, and an 'Edit mode' button.

Powered by ThingsBoard v.4.2.1

Iron Horse Vineyards - Sensor Map

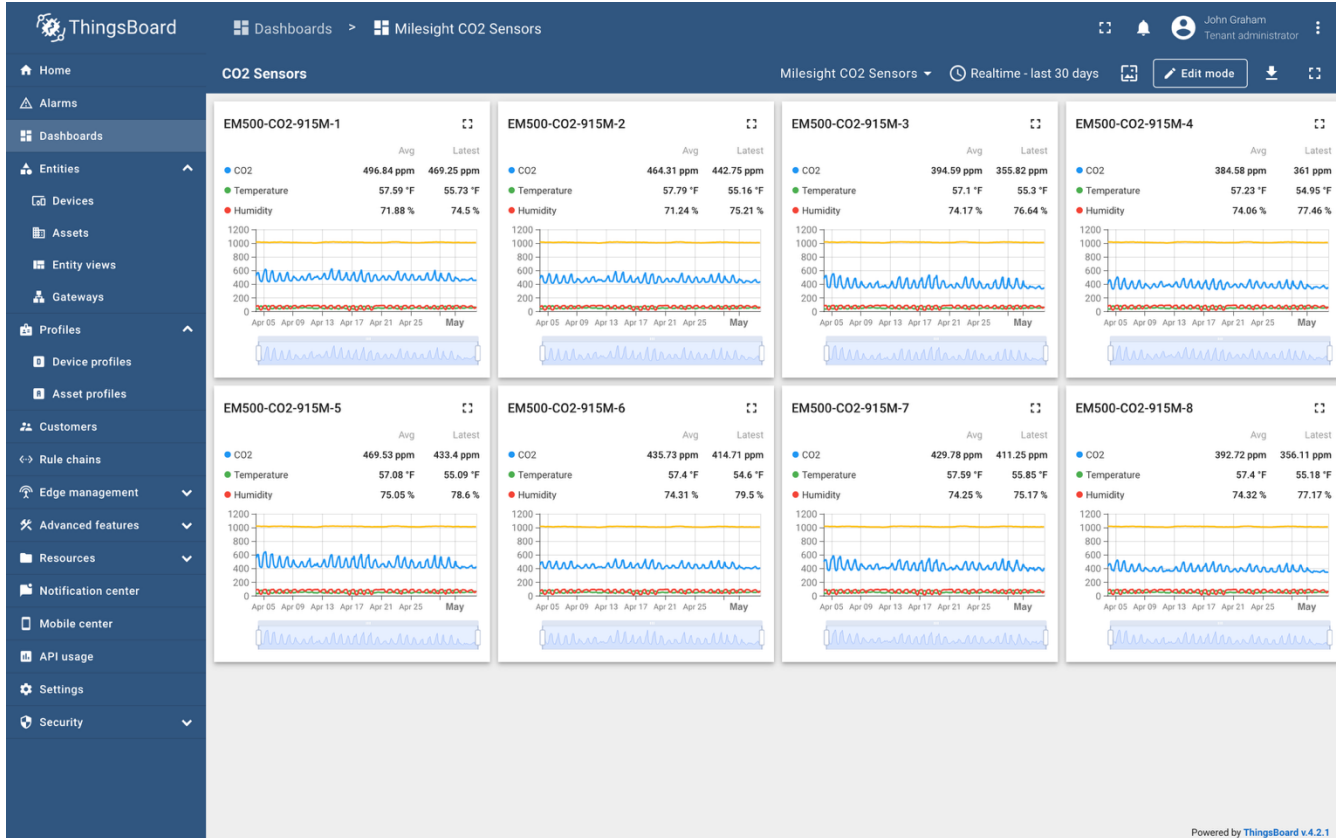


Thingsboard ATMO5 41 Weather Station Dashboard



Powered by ThingsBoard v.4.2.1

Thingsboard CO2 Sensor Dashboard



Powered by ThingsBoard v.4.2.1

Sharing: National Data Platform

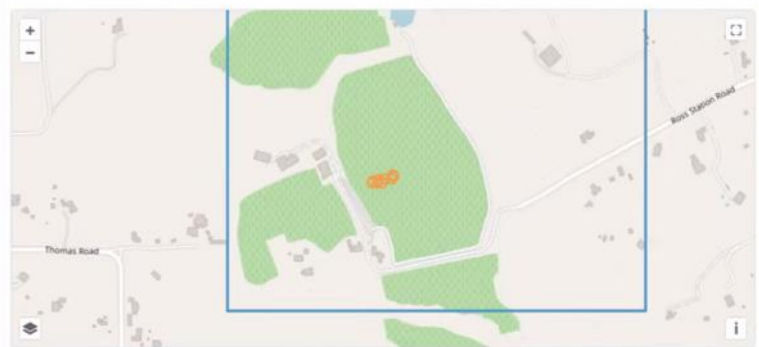
Iron Horse Vineyard - Multispectral Drone Imagery

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



Items

First Previous Next Show Filters

- DJI_20260108161536_0335_point82 (GeoTiff) 2026-01-08 16:15:36 UTC
- DJI_20260108161547_0340_point83 (GeoTiff) 2026-01-08 16:15:47 UTC
- DJI_20260108161538_0336_point82 (GeoTiff) 2026-01-08 16:15:38 UTC
- DJI_20260108161550_0341_point84 (GeoTiff) 2026-01-08 16:15:50 UTC
- DJI_20260108161540_0337_point82 (GeoTiff) 2026-01-08 16:15:40 UTC
- DJI_20260108161552_0342_point84 (GeoTiff) 2026-01-08 16:15:52 UTC
- DJI_20260108161542_0338_point83 (GeoTiff) 2026-01-08 16:15:42 UTC
- DJI_20260108161554_0343_point85 (GeoTiff) 2026-01-08 16:15:54 UTC

Metadata

General

Platform	DJI
Instruments	1. Multispectral 2. RGB
Bands	



Sharing: National Data Platform



Catalog Asset



[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](#)
- [STAC Catalog](#)

[View More](#)

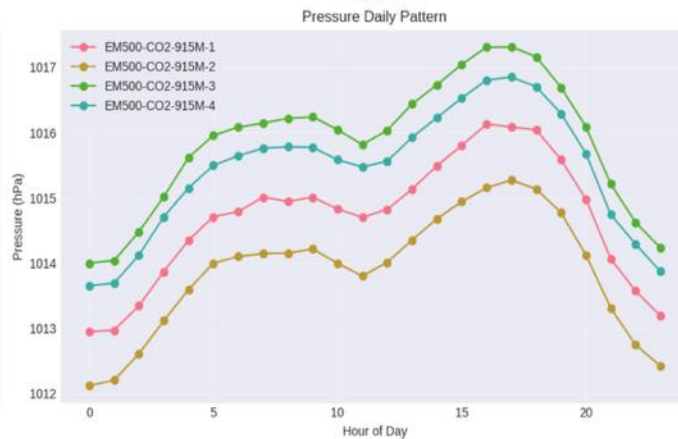
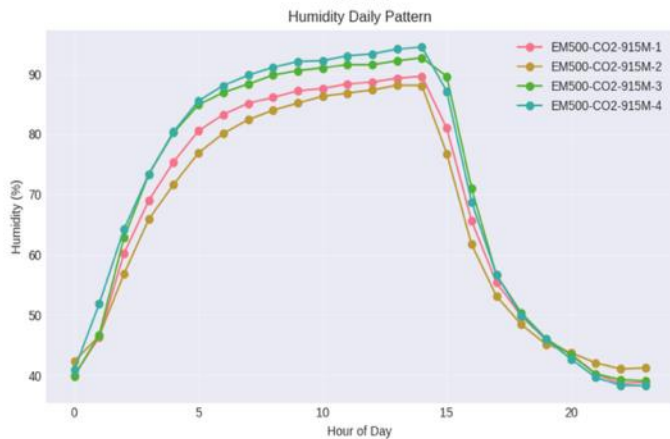
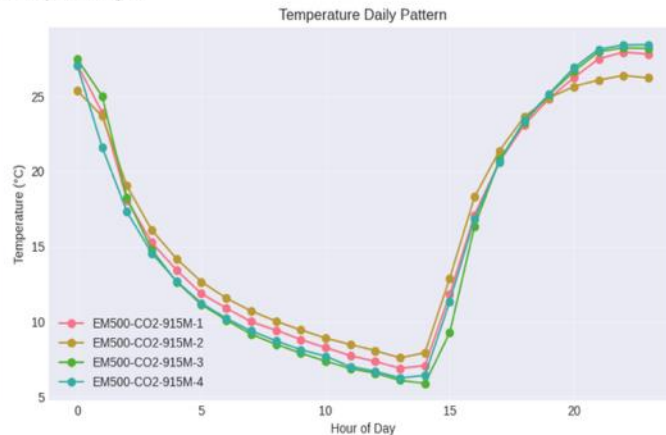
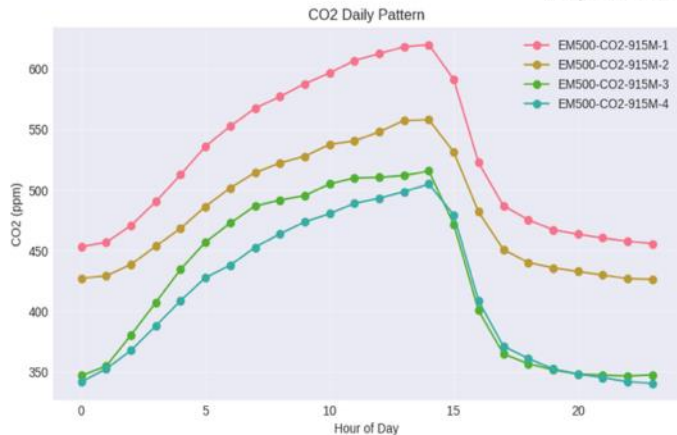
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Tags

[environmental-sensors](#) [iot](#) [precision-viticulture](#)

Sensor Data Available Now in the National Data Platform

Daily Patterns - Hourly Averages



CENIC 10G-connected Iron Horse Vineyards Testbed

LoRaWAN Antennas and Fire Cameras

AT&T/CENIC 10G network connection

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)**

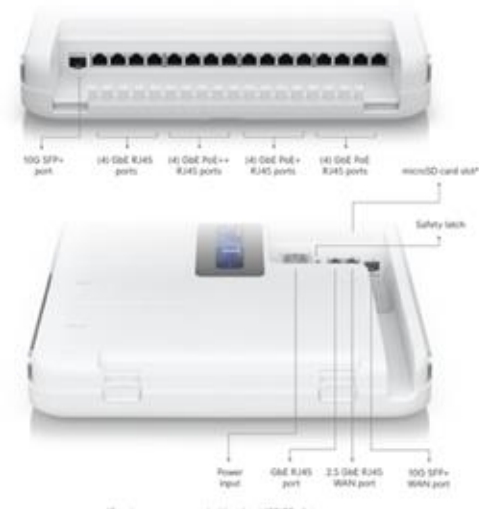
10G-connected Mac Studio M4 and Ubiquiti Dream Wall

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 ▾

INQUIRE NOW

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KONA Enterprise Gateway with Ethernet and LTE - US915

Kona Enterprise

Sales Code
MOE2TLUS915

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

TEKTELIC KONA Enterprise LoRaWAN Gateway

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

RAK Raspberry Pi 4 LoRaWAN Gateway



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

Soil Moisture Sensors

<https://metergroup.com/products/teros-22/>

TEROS 22 - Soil Water Potential Sensor

\$312.39 2 \$624.78

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



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](#)

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
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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
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2x2 LoRaWAN CO2, Temperature and Humidity Sensors

<https://www.choovio.com/product/sensecap-s2103-lorawan-co2-temperature-and-humidity-sensor/>

SenseCAP S2103 – LoRaWAN CO2, Temperature and Humidity Sensor

\$155.00

<https://www.milesight.com/iot/product/lorawan-sensor/em500-co2>

The EM500-CO2 is designed for monitoring CO2 concentration, temperature, humidity and barometric pressure in outdoor scenarios.

<https://www.choovio.com/product/em500-co2-carbon-dioxide-sensor/>

\$279.00



PurpleAir Zen Air Quality Monitor

[https://www2.purpleair.com/products/purpleair-zen + Outdoor Power Supply - North America \(Type A\)](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 μ m, 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

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

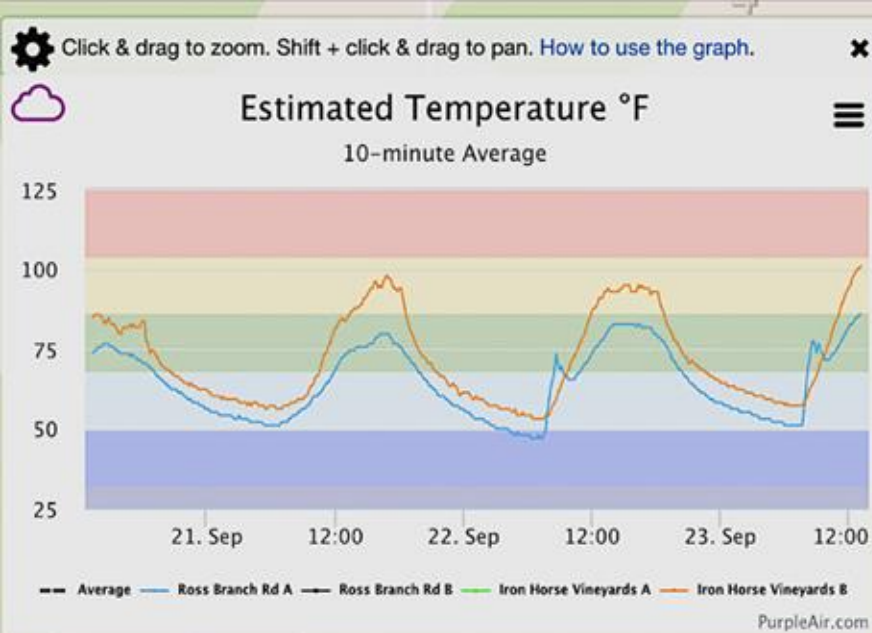
- Measures CO2 Ranges from 400 to 5,000 ppm
- 4 Sensors in 1 for Various Outdoor Usages
- LoRaWAN® Wireless Deployment with Low Power Consumption
- Long-Lasting Battery Life of up to 10 Years



Purple Air Sensor



Map ▾ Sensors ▾ Data ▾ About ▾



On September 23rd, 2025, 1:24:53 PM PDT

Real-time
Estimated
Temperature (°F)
is now

101

Quite hot

Sensor: Iron Horse Vineyards

A B ✓ 100% PA-II-ZEN 7.04

Get This Widget

Become a community scientist.
Get your own indoor-outdoor sensor just like this one.



Office Wall Site (O)



View of Vines & Beyond

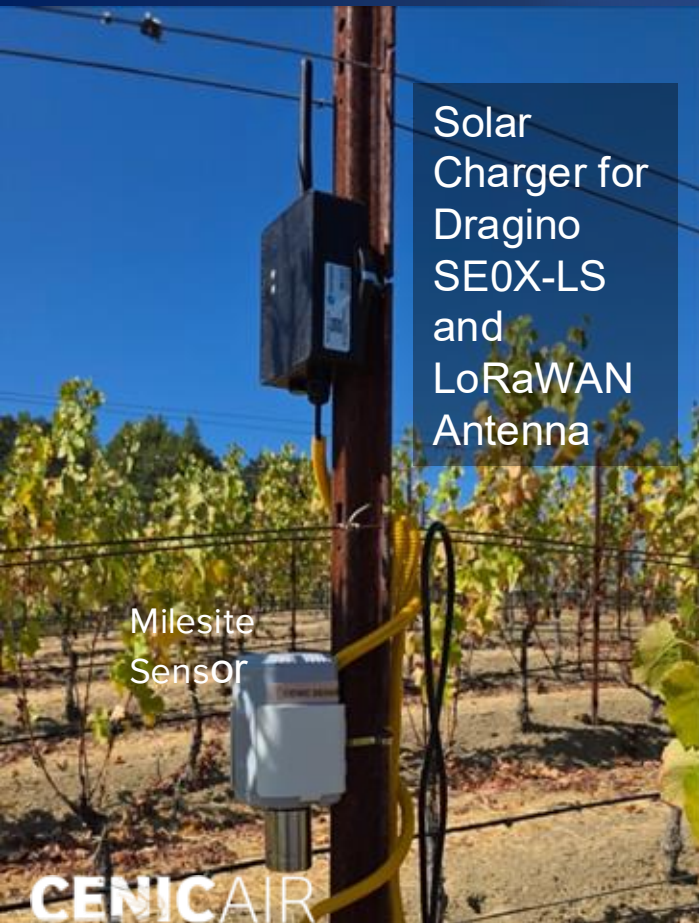
John and Tom Placed the First Sensors in the Ground



Jake, Joe, and John Installed the Second set of Sensors for Moisture, Temperature, Soil Conductivity & CO2; 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



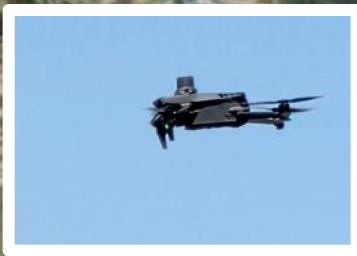


SCAN ME

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



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

Questions, Suggestions
Interest in Participation?

Contact:

tdefanti@ucsd.edu

jjgraham@ucsd.edu

