eratos

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FAHMA

Data Products - Developer Guidelines

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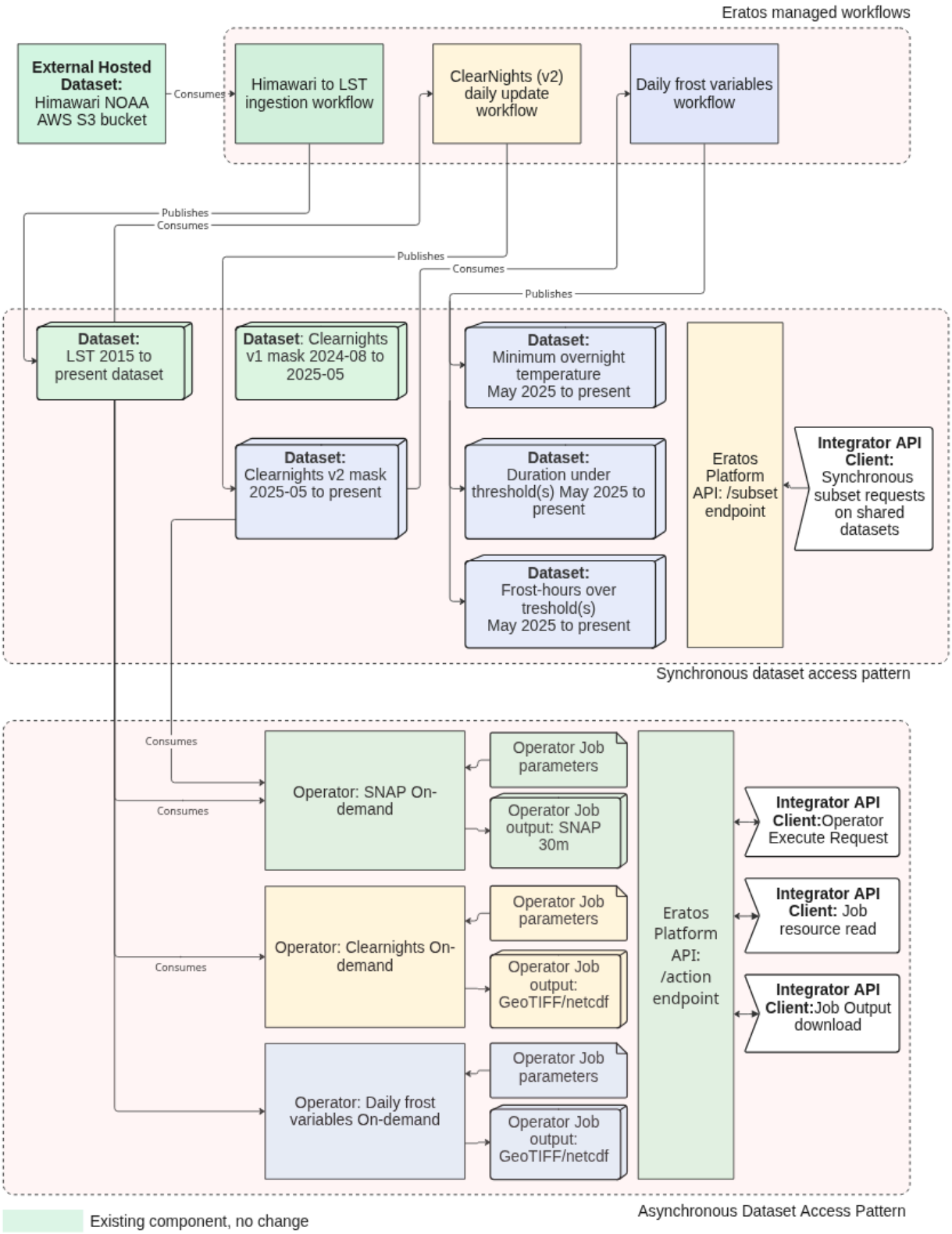
Table of contents

Architecture

The Eratos platform provides data hosting and workflow orchestration to operate the FAHMA data products. A background workflow ingests and calculates daily updates of Land Surface Temperature (LST) . A second workflow calculates the Clearnights mask daily. Finally, a third workflow calculates 2km resolution daily frost related variables on pixels not masked out by the Clearnights algorithm. These three workflows run sequentially each day to ensure the three datasets are updated on a daily basis.

Additionally, Eratos platform hosts on-demand Operators that allow integration partners to execute downscaling calculations (SNAP) and also historical runs of Clearnights and the daily frost variables.

An overview of components is shown in Figure 1.


Eratos managed workflows
External Hosted Dataset: Himawari NOAA AWS S3 bucket
Consumes
Himawari to LST ingestion workflow
ClearNights (v2) daily update workflow
Daily frost variables workflow
Publishes
Consumes
Publishes
Consumes
Publishes
Dataset: LST 2015 to present dataset
Dataset: Clearnights v1 mask 2024-08 to 2025-05
Dataset: Clearnights v2 mask 2025-05 to present
Dataset: Minimum overnight temperature May 2025 to present
Dataset: Duration under threshold(s) May 2025 to present
Dataset: Frost-hours over treshold(s) May 2025 to present
Eratos Platform API: /subset endpoint
Integrator API Client: Synchronous subset requests on shared datasets
Synchronous dataset access pattern
Consumes
Consumes
Consumes
Operator: SNAP On-demand
Operator: Clearnights On-demand
Operator: Daily frost variables On-demand
Operator Job parameters
Operator Job output: SNAP 30m
Operator Job parameters
Operator Job output: GeoTIFF/netcdf
Operator Job parameters
Operator Job output: GeoTIFF/netcdf
Eratos Platform API: /action endpoint
Integrator API Client:Operator Execute Request
Integrator API Client: Job resource read
Integrator API Client:Job Output download
Asynchronous Dataset Access Pattern
Existing component, no change
Existing component, changes required
New component
AgTech integration partner component
Clearnights : CSIRO's algorithm for detection of clear nights (not cloudy)
LST+2k : Land surface temperature at 2km resolution
LST+2k+CNv<n> : Clearnights v<n> mask generated from LST+2k
SNAP : CSIRO's Downscaling algorithm

Data generation timing characteristics

The Eratos managed workflows execute daily to calculate LST, Clearnights and frost variables. The approximate schedule for the release of these daily updates is described below in Table 1.

Timestamp (AEST)	Timestamp (AEDT)	Processing Step	LST latest available timestamp	Clearnights mask latest available timestamp	Daily frost variables latest available timestamp
10:00	11:00	Himawari LST ingestion and LST calculation workflow initiates	Yesterday 8:50 AEST, Yesterday 9:50 AEDT (yesterdays output)	Yesterday 8:50 AEST, Yesterday 9:50 AEDT (yesterdays output)	Yesterday 8:50 AEST, Yesterday 9:50 AEDT (yesterdays output)
~11:10	12:10	himawari LST ingestion and LST calculation workflow completes	Updated to: Today 8:50 AEST, Today 9:50 AEDT		
12:00	13:00	Clearnights workflow initiates			
~19:00	20:00	Clearnights workflow completes		Updated to: Today **8:50 AEST,** Today 9:50 AEDT	
19:00	20:00	Daily frost variable calculation starts			
~19:15	~20:15	Daily frost variable calculation completes			Updated to: Today **8:50 AEST,** Today 9:50 AEDT

Summary of key times (in AEST):

By 1:30pm each day, the raw LST will be updated to include data up to 9:50am on the same day.

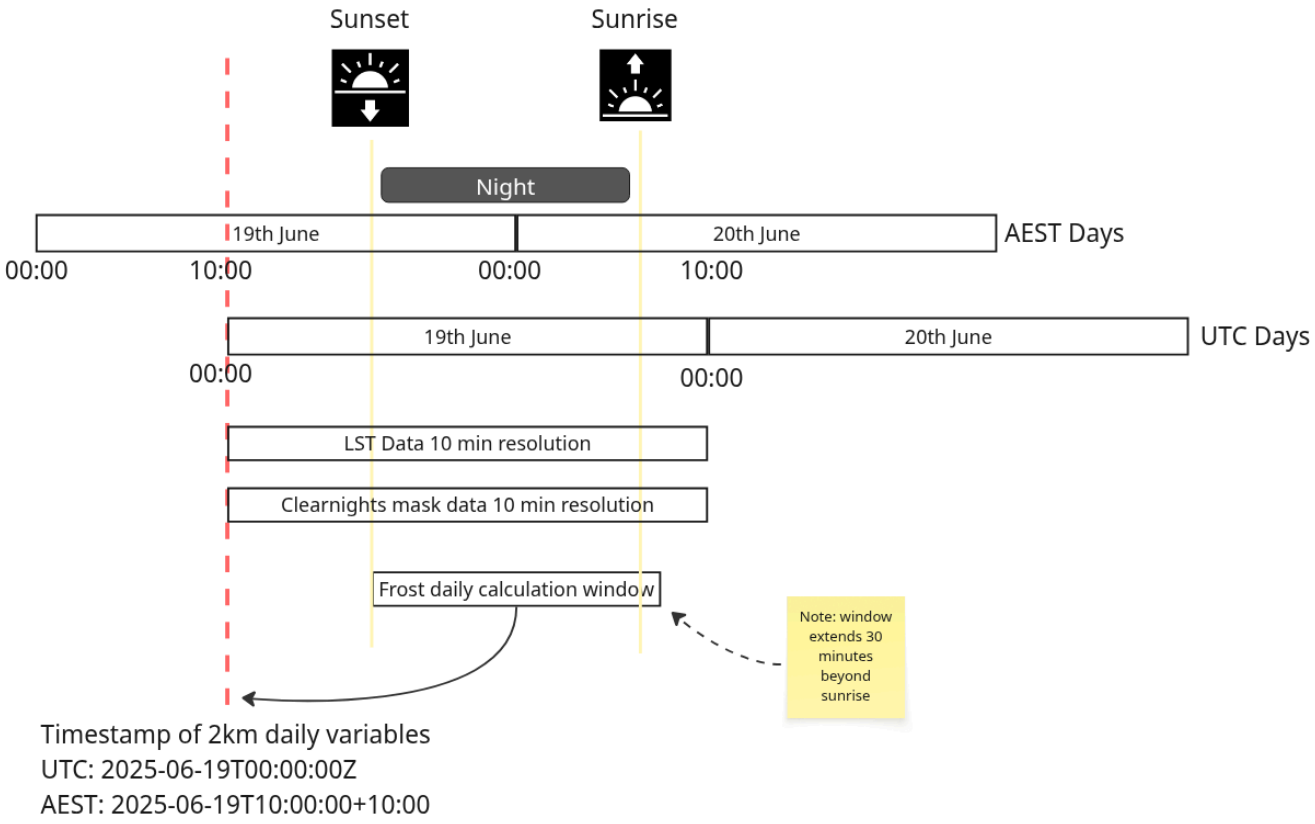
By 3:30pm each day, the Clearnights mask will be updated to include data up to 9:50am on the same day.

By 5:15pm each day, the 2km daily frost variables will be updated to include data up to 9:50am on the same day.

Timestamp alignment

The datasets described in this document cover multiple timezones and multiple resolutions. The following diagram describes how the daily first variable timestamps relate to the night of interest.

Daily frost variables: A timestamp of 2025-06-19T00:00:00 UTC will refer to the overnight period from sunset on the 19th of June to sunrise + 30 minutes on the 20th June.



2km Daily Frost Variables - Precalculated

The 2km daily first variables include the following datasets

1. Minimum overnight temperature
2. Duration under temperature threshold
3. Frost hours under temperature threshold

Variables 2 and 3 are currently available at 0 and 1 degrees celsius thresholds. These datasets are updated daily and the previous night is typically available by 7:15pm AEST.

The variables are calculated for all ‘clear night’ pixels in the LST datasets as determined by the Clearnights algorithm. The overnight interval is defined as the period from sunset to sunrise plus 30 minutes. For all three variables the 10minute resolution LST data is first masked by the 10minute resolution mask generated by Clearnights. This means that a

partially cloudy night may result in a calculated minimum that is above the true minimum LST.

All the datasets are listed in the Eratos FAHMA data space. Each dataset has a unique Eratos identifier (ERN):

NOTE: Datasets are split across years, please substitute the year of interest into the ERN to replace the {year} placeholder.

Dataset	ERN	Variable/s
2km daily overnight minimum temperature	ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.{year}.min.temp	min_temp
2km daily overnight frost duration (0 degree threshold)	ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.{year}.duration.0	duration
2km daily overnight frost duration (1 degree threshold)	ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.{year}.duration.1	duration
2km daily overnight frost hours(0 degree threshold)	ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.{year}.frost.hours.0	weighted_frost
2km daily overnight frost hours(1 degree threshold)	ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.{year}.frost.hours.1	weighted_frost

Data Access - Synchronous Access Pattern

As these data products are pre-calculated, clients can access the data using a 'subset' API endpoint which will extract the region of interest from the Australia wide dataset hosted on Eratos.

The `/subset` endpoint of the Eratos Workspace API enables the synchronous extraction of gridded geospatial datasets by specified spatial and temporal bounds. This interface supports integration with external systems requiring direct access to daily frost variables including minimum overnight temperature, duration under a threshold, and frost hours under a threshold.

Workspace API

The /subset endpoint is documented as part of the Eratos platform documentation, however this document provides an additional guide on using the API endpoint for the FAHMA use case. Please refer to the hosted API documentation for the most up to date API description.

Hosted API documentation for subset queries:
https://docs.eratos.com/reference/subset_geospatial_dataset_subset_get

Authentication

The Eratos Workspace API uses Basic Authentication and Bearer Token Authentication to authenticate requests. Please refer to the authentication section of the hosted API documentation: https://docs.eratos.com/reference/eratos-workspace-api-v1

Subset Endpoint

The subset endpoint supports extraction of a partial dataset within a bounding box of latitude and longitude coordinates along the time axis for a given variable or variables. The response can return the data in JSON (two structures are provided) or GeoTIFF formats.

Query Parameters

Parameter	Type	Required	Description
resourceId	string	Yes	The ID or ERN of the resource to extract data from. See above for table of 2km FAHMA dataset ERNs. Example: `ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.2024.min.temp`
bbox	string	Yes	A bounding box of latitude and longitude coordinates, e.g., bbox=minLongitude,minLatitude,maxLongitude,maxLatitude. Example: `148.751950, -33.131585, 148.937302, -33.008980`
variable	string	No	Comma-separated list of variables to extract from the dataset, e.g., `min_temp` Results are returned in natural order by default, however, the `direction` parameter can be used to reverse the order of the results.

			For GeoTIFF results, if no variable is specified only the first variable will be returned.
start	string	No	The inclusive starting timestamp in ISO8601 format. E.g. `2025-05-01`
end	string	No	The inclusive end timestamp in ISO8601 format. E.g. `2025-05-02`
direction	integer	No	Values from -1 to 1 (default: 1). Return results along the time axis in forward (1) or reverse (-1) order. For monotonic time, this results in ascending or descending order based on the dataset's natural order.
limit	integer	No	Range: 1 to 1000 (default: 10). Limit the number of results returned.
skip	integer	No	Minimum: 0 (default: 0). Skip the first N results (useful for pagination).

Constraints:

- The `start` date must be before the `end` date if both are provided and in ISO8601 format
- The bounding box coordinates must be within valid ranges: latitude between `-90` and `90` degrees, longitude between `-180` and `180` degrees
- The bounding box must be specified in the order of `minLongitude,minLatitude,maxLongitude,maxLatitude`
- The dimensional selection must not exceed 10000 cells

Response format

Results can be returned in different formats based on the `Accept` HTTP header.

Supported values include:

`Accept` header value	Response format comments

application/json	The response includes:
	• `results`: An array of timestamped records. Each record includes:
	  ○ `timestamp`: ISO8601 string.
	  ○ `values`: A dictionary of variable names (e.g., `max_temp`) mapped to 2D arrays.
	• `latitude`: 1D array of latitude values.
	• `longitude`: 1D array of longitude values.
	
	Each 2D array in `values` is organized as `[lat][lon]`, where:
	• Rows align with entries in `latitude`.
	• Columns align with entries in `longitude`.
	
	This structure represents a time series of geospatial grids.

image/tiff	The response is returned as a GeoTIFF. Multiband GeoTIFFs will be used to support the encoding of multiple timestamps. Only a single variable from the dataset can be returned as GeoTIFF in one request.

Best Practices

- Please cache results where applicable to reduce load on Eratos infrastructure.
- Align request timing to daily data update cycles (post 16:15 AEST).

Example requests and code

Request:

Subsetting the minimum overnight temperature

URL:

```
https://api.eratos.com/api/workspace/v1/subset?resourceId=ern:e-pn.io:resource:fahma.blocks.daily.frost.metrics.2025.min.temp&bbox=144.95,-37.8,145.05,-37.7&direction=-1&limit=1&skip=0
```

HTTP Method: GET

HTTP Headers:
Accept: image/tiff

Authorization: Basic <encode key and secret>

Response:

```
The response should return a 200 status code and include a GeoTIFF file download.
```

Eratos has also provided a functional Python based example in Google Colab.

https://colab.research.google.com/drive/1Wx0lIlSfpPYRlMFKtjqT9ZWAlCl9il0b?usp=sharing

2km Daily Frost Variables - Calculated On Demand

Description of operator

The on-demand 2km daily frost analysis operator processes Himawari8 Land Surface Temperature (LST) data using the latest Clearnight cloud mask algorithm. Unlike precomputed products, it dynamically generates cloud masks within the operator, based on user parameters.

Users must specify the following parameters:

- A geographic geometry (as WKT polygon/multipolygon string)
- Start and end dates in YYYY-MM-DD
- Two thresholds:
    - Frost accumulation threshold (°C)
    - Duration threshold (°C)

The operator analyses nighttime LST data from sunset on the date of interest to sunrise+30mins on the next day for each date in the specified range. For each day in the range, it calculates three gridded frost-related variables, which are calculated for all 'clear night' pixels in the LST datasets as determined by the Clearnights algorithm. Specifically, the 10-minute resolution LST data is masked by the corresponding 10-minute resolution Clearnights mask. As a result, on partially cloudy nights, the estimated minimum LST may be higher than the true minimum.

Three gridded frost related variables as NetCDF datasets are as follows.

2km frost variables:

- Minimum Overnight Temperature (degrees Celsius): The lowest LST recorded during the night
- Duration less than a temperature threshold (Hours): Total hours during the night where LST is below a user-defined temperature threshold.
- Frost Hours (Hours): Time-weighted cumulative hours(LST × time) where LST is below user-defined temperature threshold

Outputs are spatially gridded with:

- Dimensions: Latitude (lat), Longitude (lon), and Time (night windows starting from sunset that day till sunrise next day +30mins)
- Coverage: Limited to the geographic bounds of the input polygon
- Missing Data: Represented by `np.finfo(np.float32).max` (3.4028235e+38)

This enables the flexible identification of frost-prone zones by passing user-defined duration and frost hour threshold during critical overnight windows.

Data access - asynchronous access pattern

This section describes the process for triggering the operator and accessing the result using the Eratos Workspace API.

Authentication

The Eratos Workspace API uses Basic Authentication and Bearer Token Authentication to authenticate requests. Please refer to the authentication section of the hosted API documentation: https://docs.eratos.com/reference/eratos-workspace-api-v1

Workspace API

The POST `resource` endpoint of the Eratos Workspace API enables creating and triggering the frost metrics on demand workflow directly, without interacting with the workspace front end, by passing the user parameters into workflow payload, along with an authentication header into the post request.

Once the workflow completes, the result ERN will be returned as part of job outputs. The files can be retrieved via the GET /resources/{output-ern}/ endpoint and downloaded locally in NetCDF format.

Hosted API documentation for resource queries:

Creating the workflow: https://docs.eratos.com/reference/post_resources

Triggering the workflow: https://docs.eratos.com/reference/post_resources-rid-action

Accessing the workflow result: https://docs.eratos.com/reference/get_resources-rid

Example requests and code

Request: Getting the operator details

URL:

```
GET /resources/ern:e-pn.io:resource:fahma.operators.daily.frost.metrics
```

HTTP Method: GET

HTTP Headers:
Accept: image/tiff

Authorization: Basic <encode key and secret>

Response: operator properties with a workflow ern(`@id`)

Request: Triggering the workflow

URL: `POST /resources/{wf_ern}/action`

HTTP Method: POST

Payload:

"action": "Execute"

HTTP Headers:

"accept": “application/json”,

"content-type": “application/json”,

"authorization": “Basic <encode key and secret>”

Response: `ern` of daily frost variables including minimum overnight temperature, duration under a threshold, and frost hours under a threshold

Request: Accessing the workflow output

URL: `GET /resources/{output_ern}`

HTTP Method: GET

HTTP Headers:
Accept: image/tiff

Authorization: Basic <encode key and secret>

Response: gridded file metadata and file content

Eratos has provided an example within this Google Colab Notebook: https://colab.research.google.com/drive/1lg8-4CMLIH-jZKufNsMA89crjWTh7-A9?usp=sharing

30m Daily Frost Variables (SNAP) - Calculated On Demand

NOTE: Implementation needs review, validation and improved documentation.

Frost Damage Maps (APSIM based) - Calculated on demand

NOTE: Implementation needs review, validation and improved documentation.

Support

If you need help:

- Visit https://api.eratos.com/docs for full API references.
- Email support@eratos.com with your error logs for assistance.