WEATHER CLIMATE WATER
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WIS2 in a box (wis2box) introduction and architecture

12 December 2024

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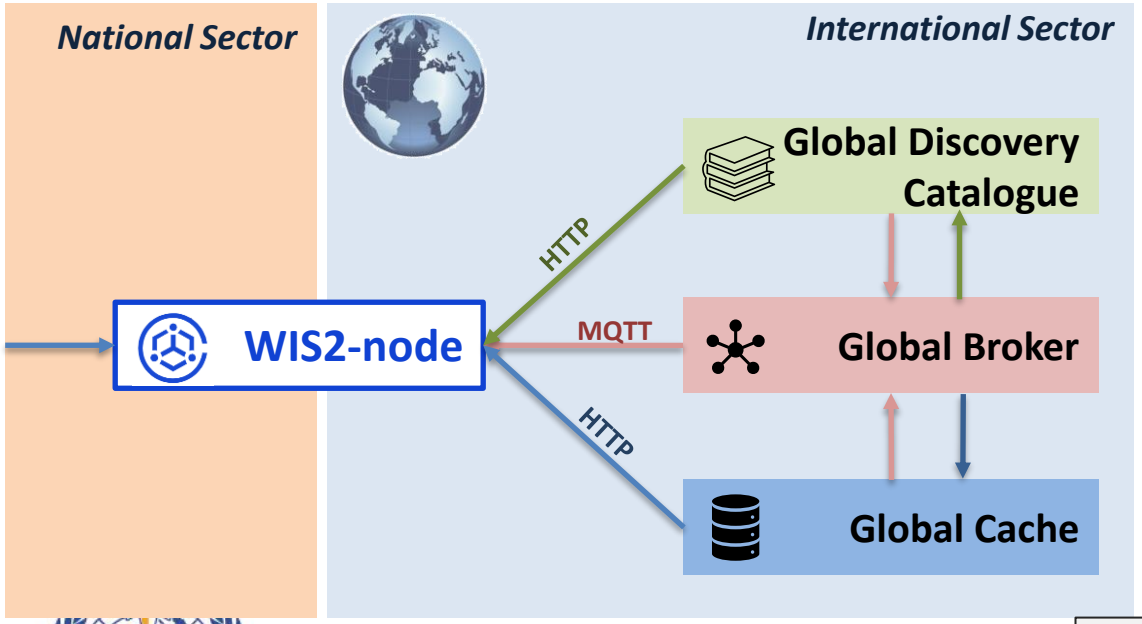
WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

Reminder: What is a WIS2 Node ?

The WIS2 Node serves as a gateway between National MET systems and the WIS 2.0 Network

A WIS2 node is composed of 2 endpoints that need to be exposed over the public internet:

- **MQTT broker**: to publish WIS2-notifications for metadata and data
- **HTTP endpoint**: to enable the download of data and metadata records



Global Discovery Catalogues download all valid WCMP2 records from the HTTP-endpoint for notifications on topic=*origin/a/wis2/+/metadata*

Global Brokers subscribe to topic=*origin/a/wis2/<centre-id>/#* on the WIS2 Node MQTT broker, and republishes all valid WIS2-notifications

Global Caches download data from the HTTP-endpoint for all notifications on topic=*origin/a/wis2/+/data/core/#*

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MQTT topic defined by the WIS2 Topic Hierarchy standard

Discovery Metadata records defined by WCMP2 standard

MQTT payload defined by the WIS2 Notification Message standard

What is WIS2 in a box?

- WIS2 in a box (wis2box) is a **Reference Implementation of a WIS2 Node**
- Developed as Docker Compose stack using existing Free and Open Source implementations and wis2box-specific components
- Free Open-Source Software (FOSS) https://github.com/wmo-im/wis2box
- Designed to be cost-effective and low-barrier to operate
- Developed by WMO **to help accelerate the implementation of WIS 2.0**

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wis2box hosting requirements:

- minimum 2 vCPUs with 4GB Memory and 24GB of local storage
- requires Python, Docker and Docker Compose pre-installed
- HTTP and MQTT ports routed to a publicly accessible address
- See documentation at https://docs.wis2box.wis.wmo.int

WIS 2.0 Training workshops

wis2box is used to enable practical exercises on exchanging data using WIS2.0 standard during training workshop

During the training each participant gets access to one virtual machine to setup their own WIS2 Node so they can practice preparing WIS2 datasets and publishing WIS2 data notifications

wis2box is Free and Open

Free and Open Source Software

NGINX
Leaflet
Vue.js
Grafana
pygeoapi
CODES
elasticsearch
MINIO
mosquitto
docker

https://github.com/wmo-im/wis2box

Open Standards

- MQTT
- GeoJSON
- OGC APIs

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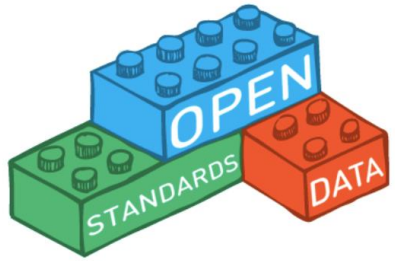
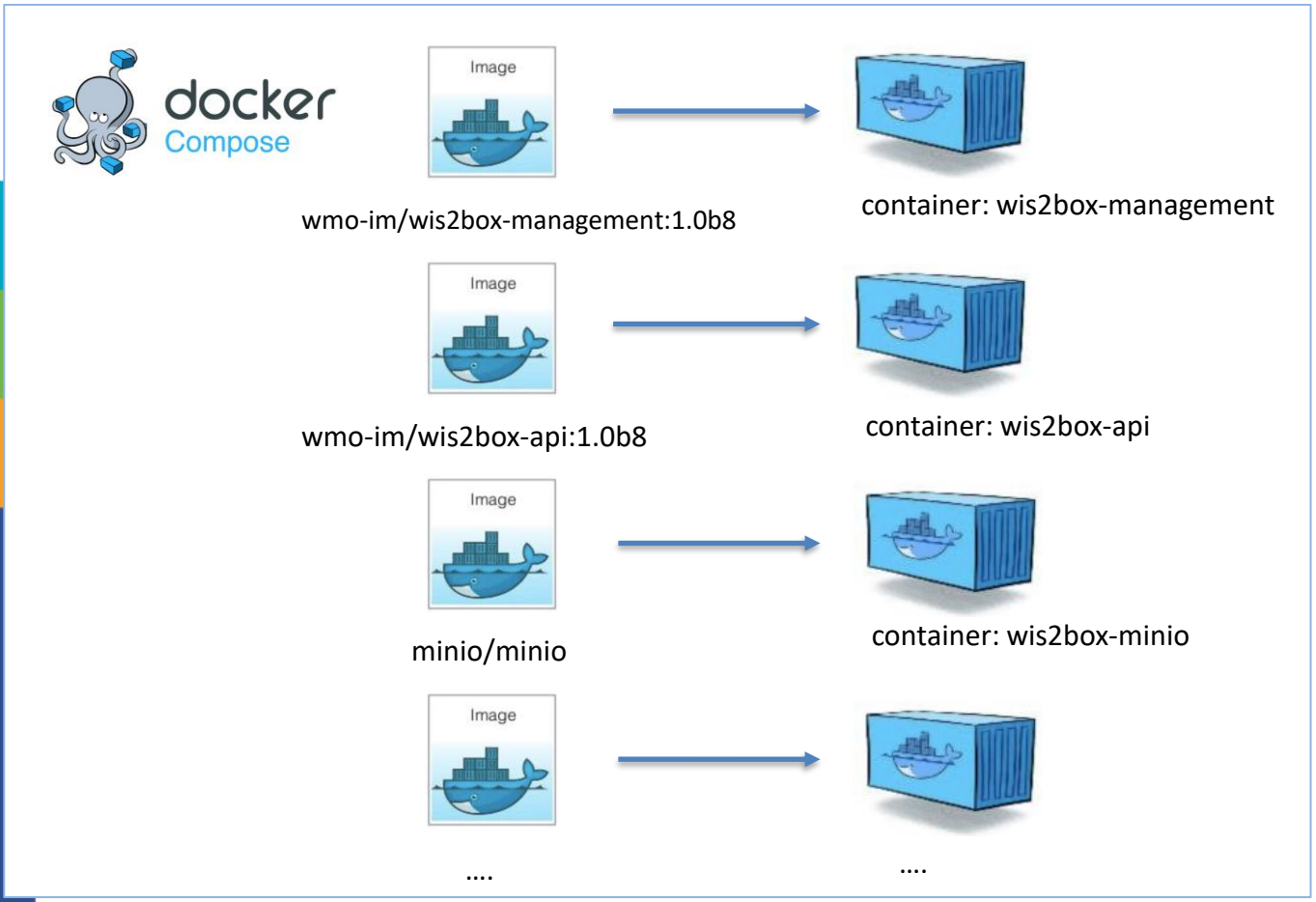


wis2box and docker

wis2box uses Docker and Docker Compose

- Using pre-built Docker images to create containers each providing a specific service running on the wis2box-instance
- Python script 'wis2box-ctl.py' provides a wrapper around Docker Compose commands to interact with wis2box



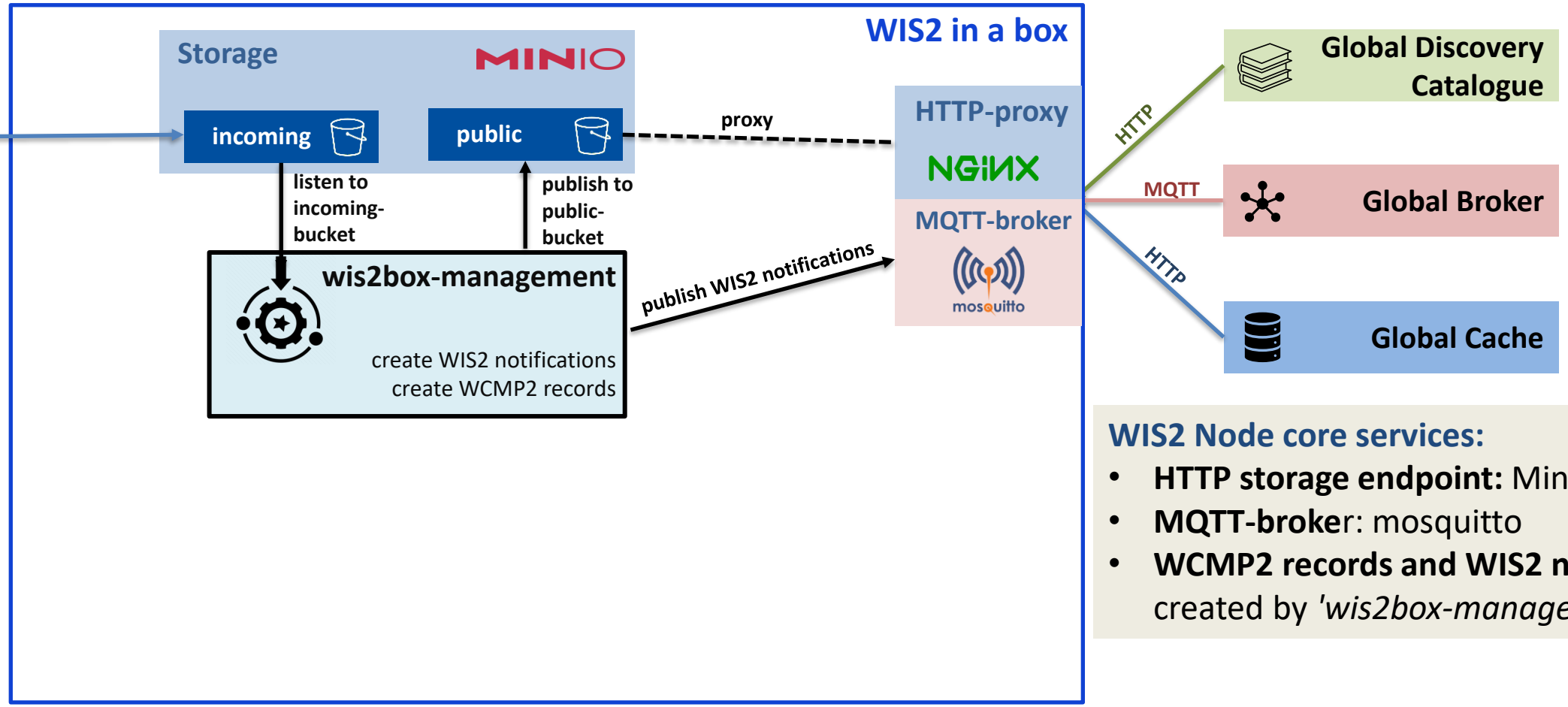
Why is wis2box composed as a set of Docker containers?

- Docker **containers contain all necessary dependencies**, libraries, and binaries required to run the service
- Docker containers **run on any system with Docker installed**, regardless of underlying hardware or operating system
- Docker containers **provide process and resource isolation**, enhancing security

Software requirements on the host:

- Python: 3.8 or higher
- Docker Engine: 20.10.14 or higher
- Docker Compose: 2.0 or higher

wis2box core services



WIS2 Node core services:

- **HTTP storage endpoint:** MinIO
- **MQTT-broke**r: mosquitto
- **WCMP2 records and WIS2 notifications**: created by *'wis2box-management' container*

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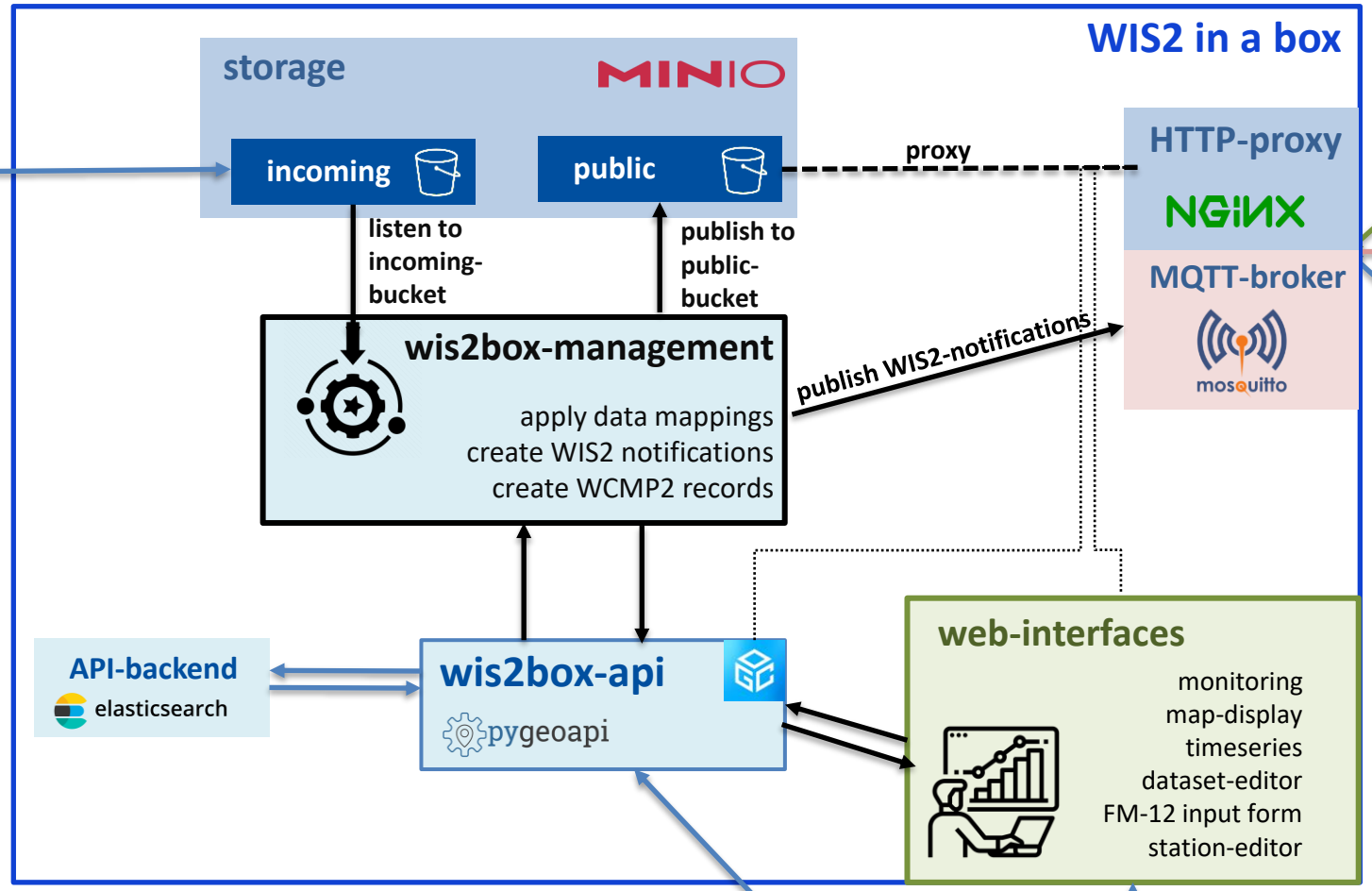
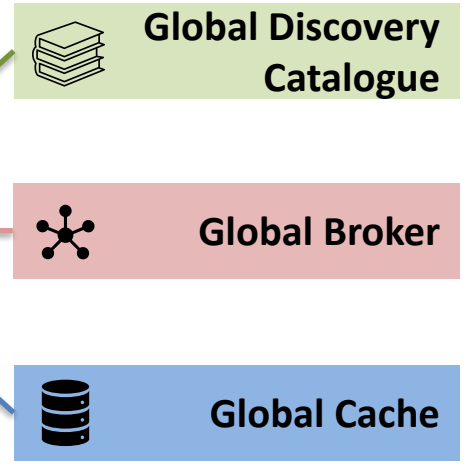
wis2box additional services





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WIS2 Node core services + <u>tools to facilitate international data sharing</u>:

- **Apply WMO data standards**: data-plugins to associate with WIGOS-station-metadata and convert to BUFR
- **OGC API** to make published data accessible programmatically
- **data visualization and monitoring** to detect issues and trigger corrective action
- **web-interfaces** for manual data input, configuring datasets and station metadata

Datasets in the wis2box

Two ways to configure a new dataset in the wis2box:

- Use the **dataset-editor** in the wis2box-webapp
- … or share an MCF file with the wis2box-management container and execute '**wis2box dataset publish <file-path>**'

new WCMP2 notification on origin/a/wis2/<centre-id>/metadata
for every new dataset published

update WCMP2 notification on origin/a/wis2/<centre-id>/metadata
for every updated dataset published

delete WCMP2 notification on origin/a/wis2/<centre-id>/metadata
whenever a dataset is unpublished

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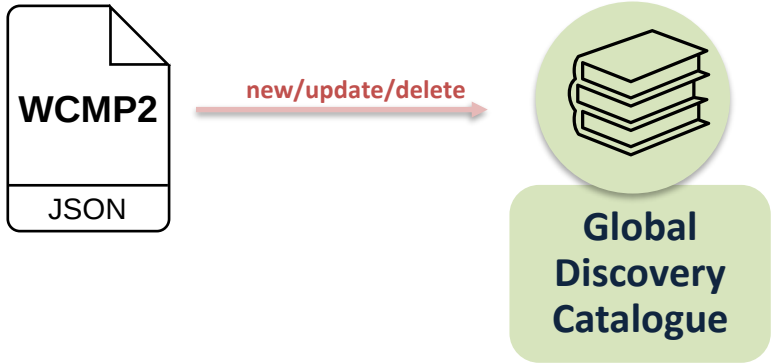
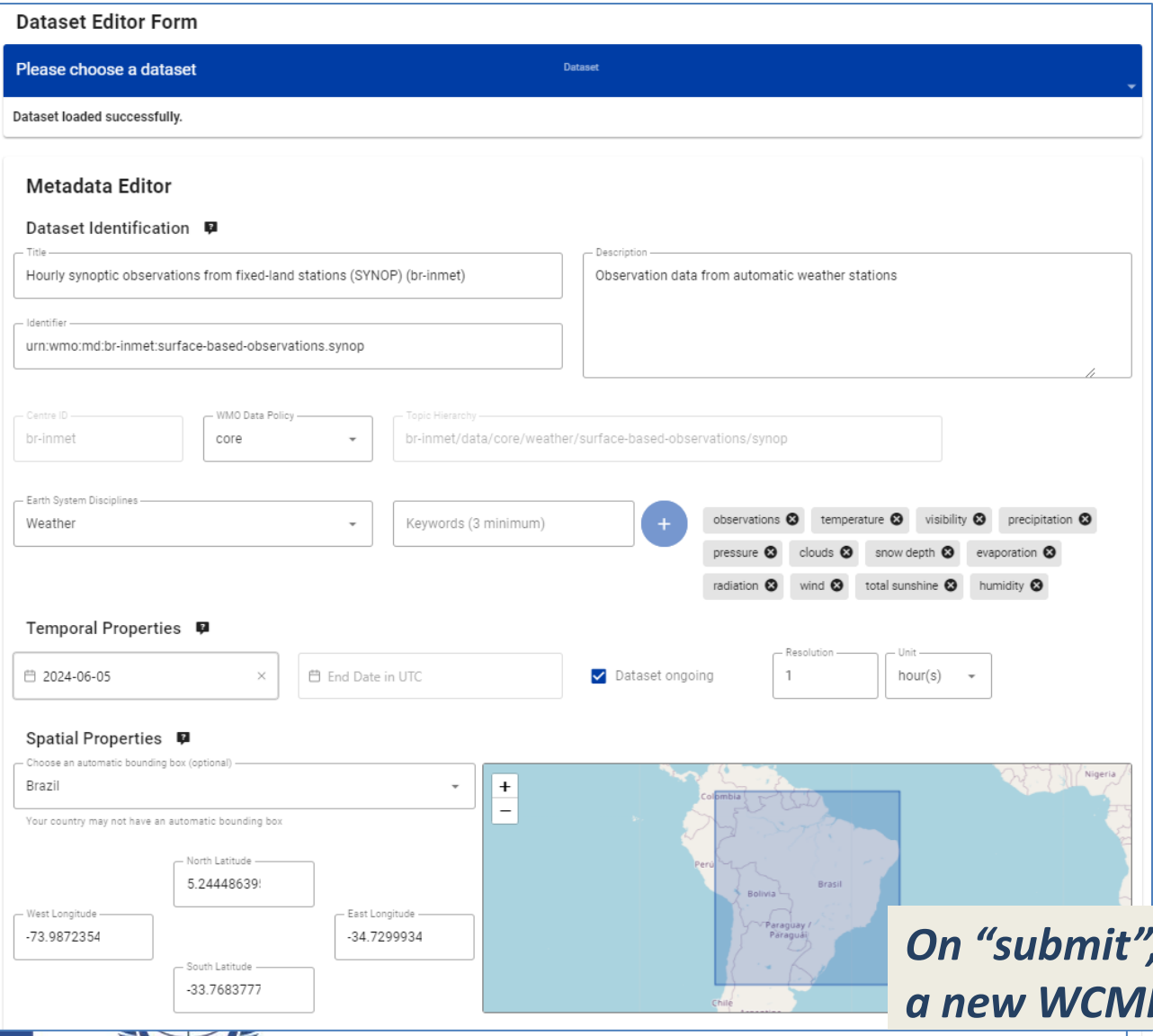
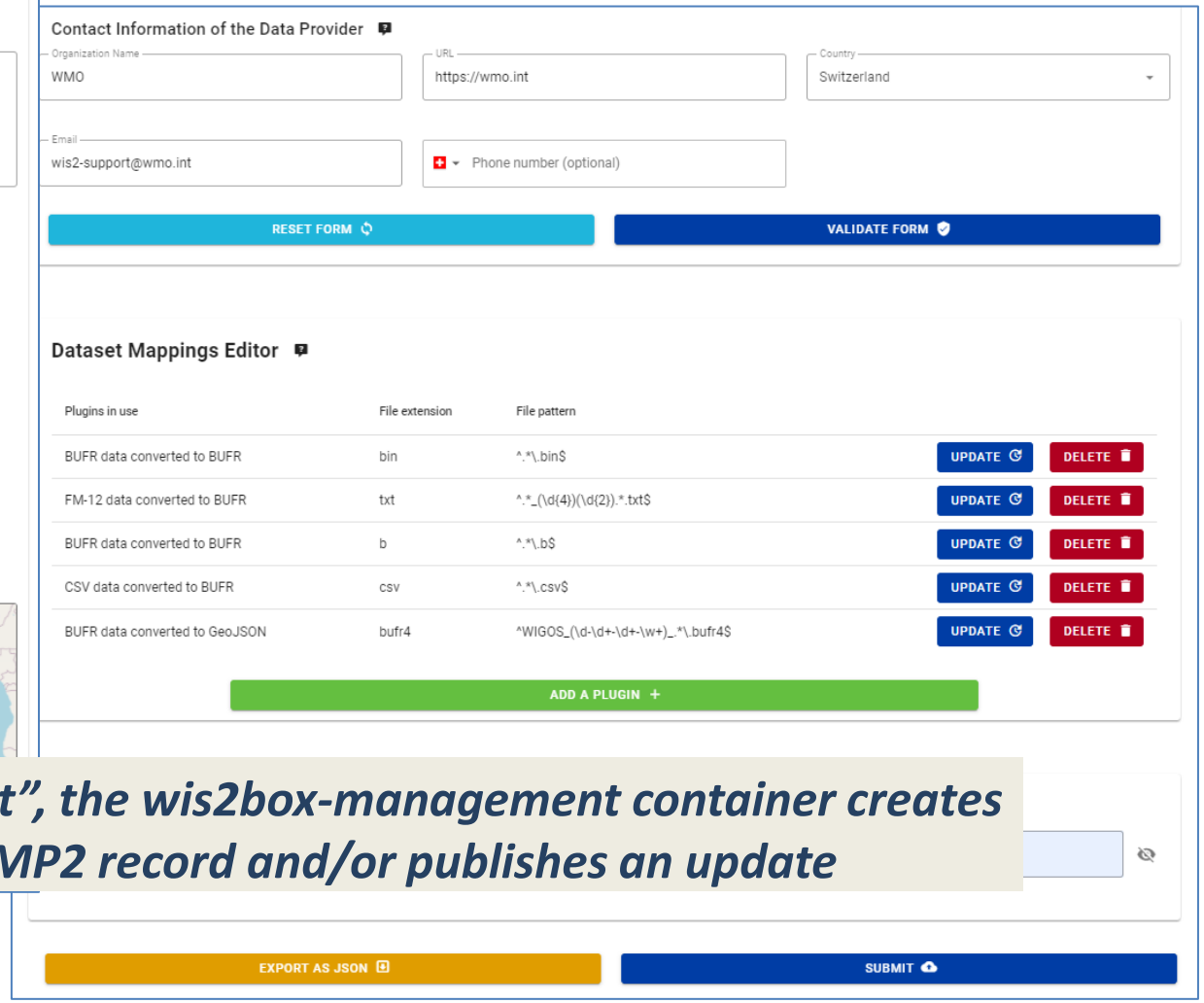


Dataset Editor in wis2box-webapp

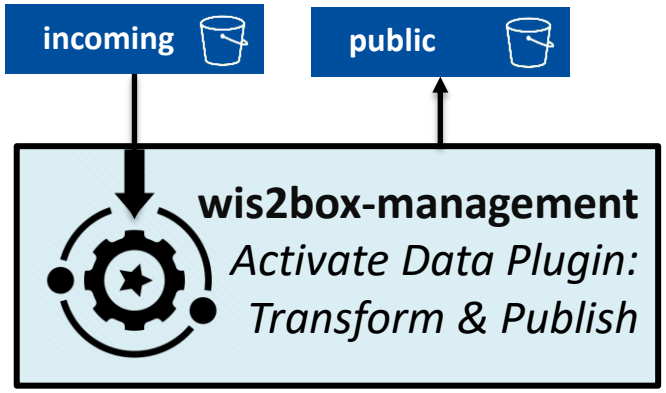


Step 1. Define <u>metadata</u> and validate form
Step 2. Define <u>data plugins</u>
Step 3. Submit the dataset for publication



On "submit", the wis2box-management container creates a new WCMP2 record and/or publishes an update

wis2box data plugins



In wis2box each dataset is associated to one ore more Data Plugins

A data plugin defines the actions taken to **transform** and **publish** the data

Data plugins use an abstract model/approach to enable extensibility and reuse

See github.com/wmo-im/wis2box/tree/main/wis2box-management/wis2box/data

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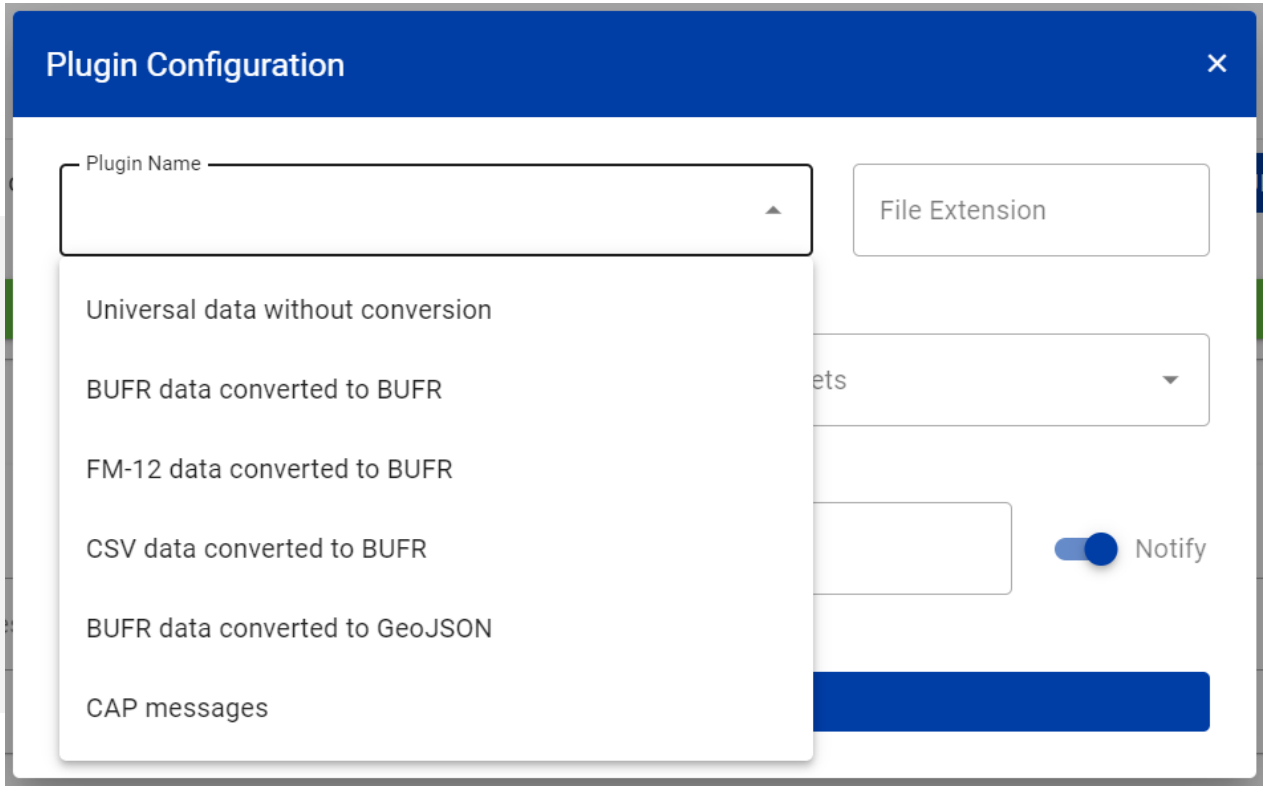
wis2box data plugins

wis2box contains the following built-in data plugins:

- wis2box.data.universal.UniversalData
- wis2box.data.cap_message.CAPMessageData
- wis2box.data.bufr4.ObservationDataBUFR
- wis2box.data.synop2bufr.ObservationDataSYNOP2BUFR
- wis2box.data.csv2bufr.ObservationDataCSV2BUFR
- wis2box.data.bufr2geojson.ObservationDataBUFR2GeoJSON



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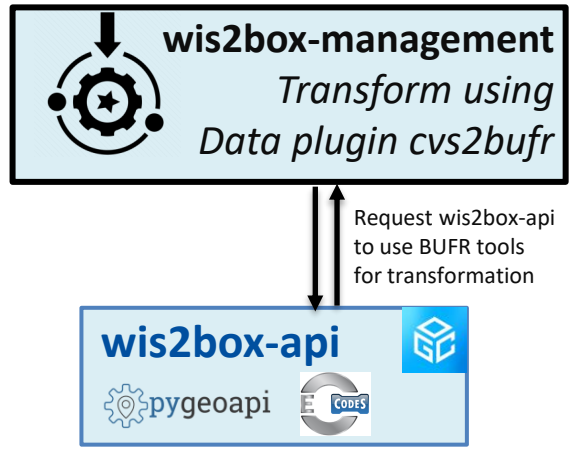
Developers are encouraged to contribute new data plugins to wis2box!

BUFR tools in wis2box

wis2box uses ECMWF's ecCodes software library to perform the BUFR encoding

'wis2box-api' container is based on a Docker image containing *ecCodes*

BUFR-conversion tools used by wis2box available as standalone python modules:
https://github.com/wmo-im/csv2bufr
https://github.com/wmo-im/synop2bufr
https://github.com/wmo-im/bufr2geojson



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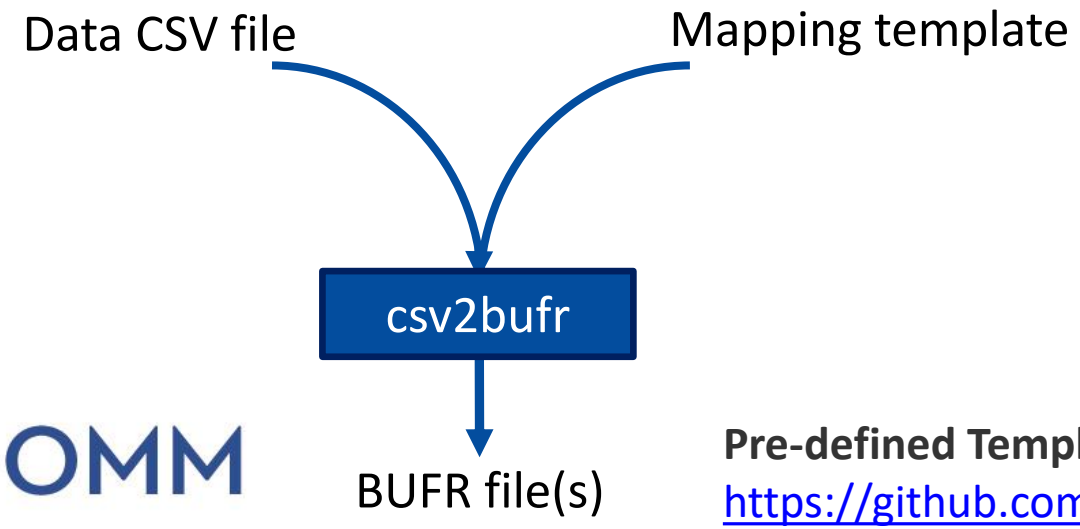
csv2bufr mapping template

csv2bufr uses a Mapping Template: JSON file defining the mapping between columns in the input CSV data to codes encoded in the output BUFR data

… using the human-readable eccodes_key rather than the 6 digit BUFR FXXYYY code


```
"data": [
        ....
    {"eccodes_key": "#1#nonCoordinatePressure", "value": "data:station_pressure", "valid_min": "const:50000", "valid_max": "const:150000"},
    {"eccodes_key": "#1#pressureReducedToMeanSeaLevel", "value": "data:msl_pressure", "valid_min": "const:50000", "valid_max": "const:150000"},
    {"eccodes_key": "#1#nonCoordinateGeopotentialHeight", "value": "data:geopotential_height", "valid_min": "const:-1000", "valid_max": "const:130071"},
    {"eccodes_key": "#1#heightOfSensorAboveLocalGroundOrDeckOfMarinePlatform", "value": "data:thermometer_height", "valid_min": "const:0", "valid_max": "const:655.35"},
    {"eccodes_key": "#1#airTemperature", "value": "data:air_temperature", "valid_min": "const:193.15", "valid_max": "const:333.15"},
   ... ]
```

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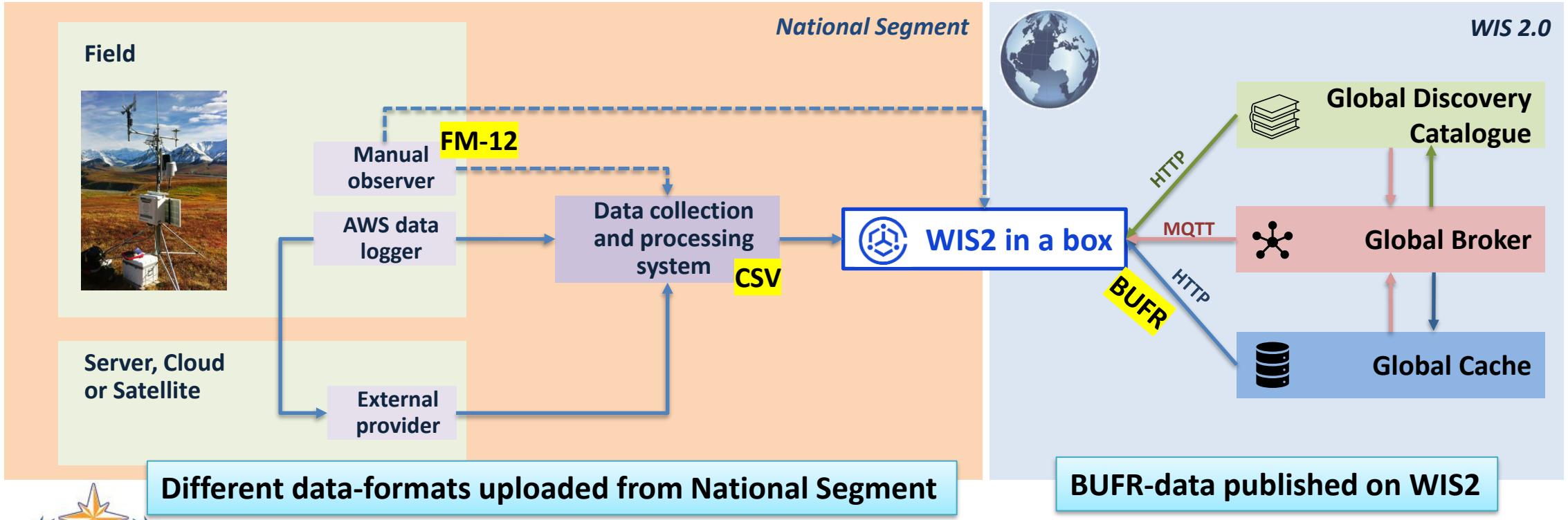
Pre-defined Templates used in wis2box can be found here:
https://github.com/wmo-im/csv2bufr-templates
… or custom templates can be defined by the user

wis2box data plugins

csv2bufr enables any system to prepare a data-extract for publication without needing local BUFR conversion tools

synop2bufr enables publication of FM-12 synop reports from manual observers



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SYNOP FORM in wis2box web-application

Submit FM 12–XIV Ext. SYNOP Bulletin

See the WMO Manual on Codes, Volume I.1, for a description of the FM 12-XIV Ext. SYNOP format

select month/year

12/2024

Month and year in UTC

Enter or copy-paste FM-12 SYNOP

FM 12

SMRO01 YRBK 121200
AAXX 17121
15015 01597 71702 10057 20036 39390 42628 50004 60021 78082 87300 333
4/000
55304 0//// 20643 3//// 69977 91003 91108=

Raw FM 12 bulletin

select dataset-id from dropdown

Dataset Identifier

urn:wmo:md:io-wis2dev-test2:core.surface-based-observations.synop

testing csv2bufr

provide wis2box auth token for processes/wis2box

wis2box auth token for 'processes/wis2box'

••••••••••

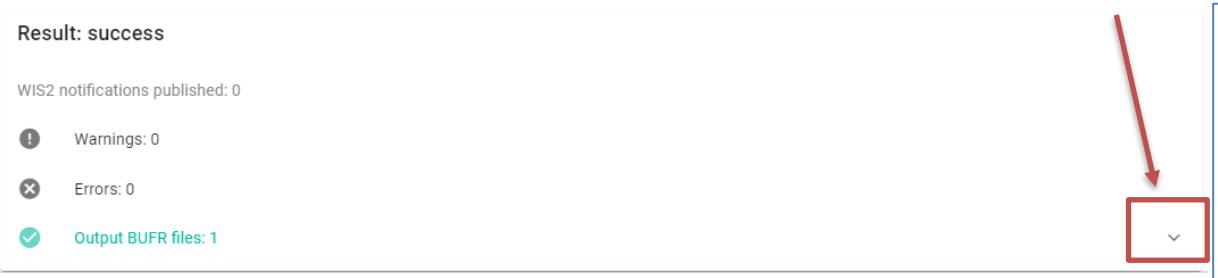
Turn off “Publish on WIS2” to test conversion without publishing

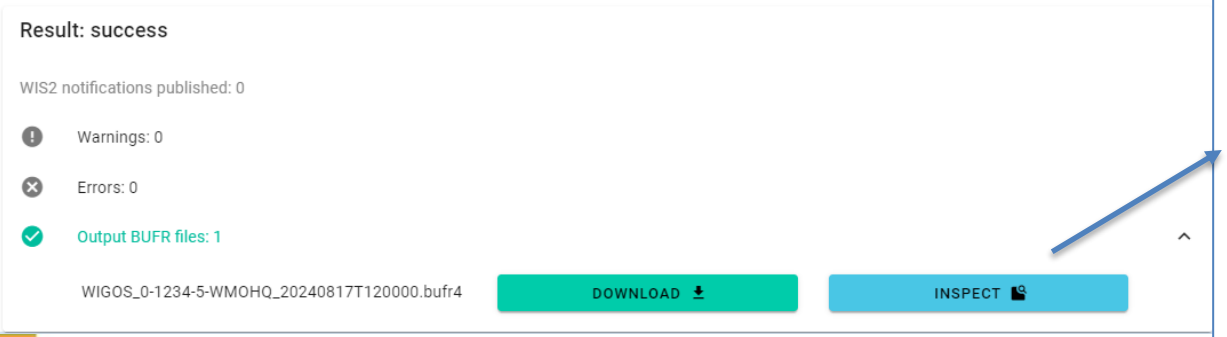
SUBMIT

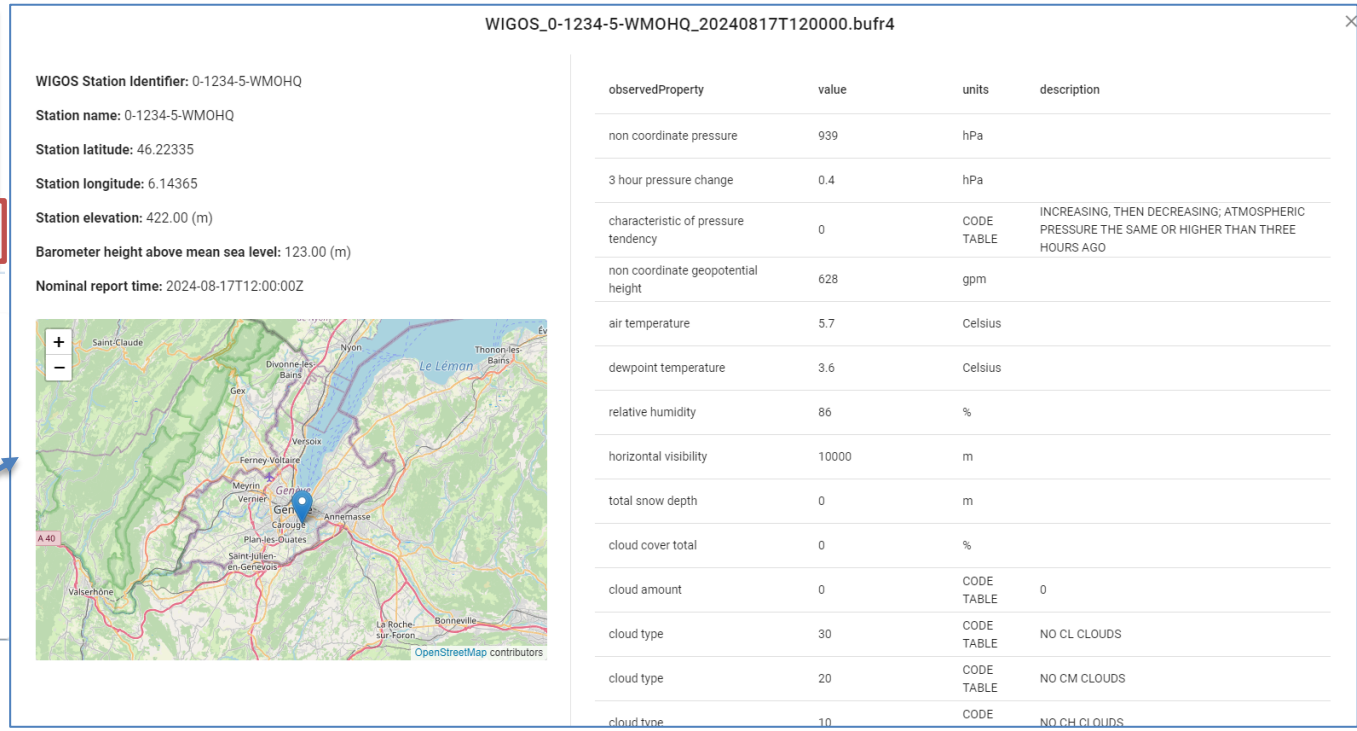
Publish on WIS2

SYNOP FORM in wis2box web-application

open output list







Buttons for each generated BUFR-file

DOWNLOAD: download the file

INSPECT: display the content of the BUFR

Use the INSPECT-option to check if the content of the BUFR is correct

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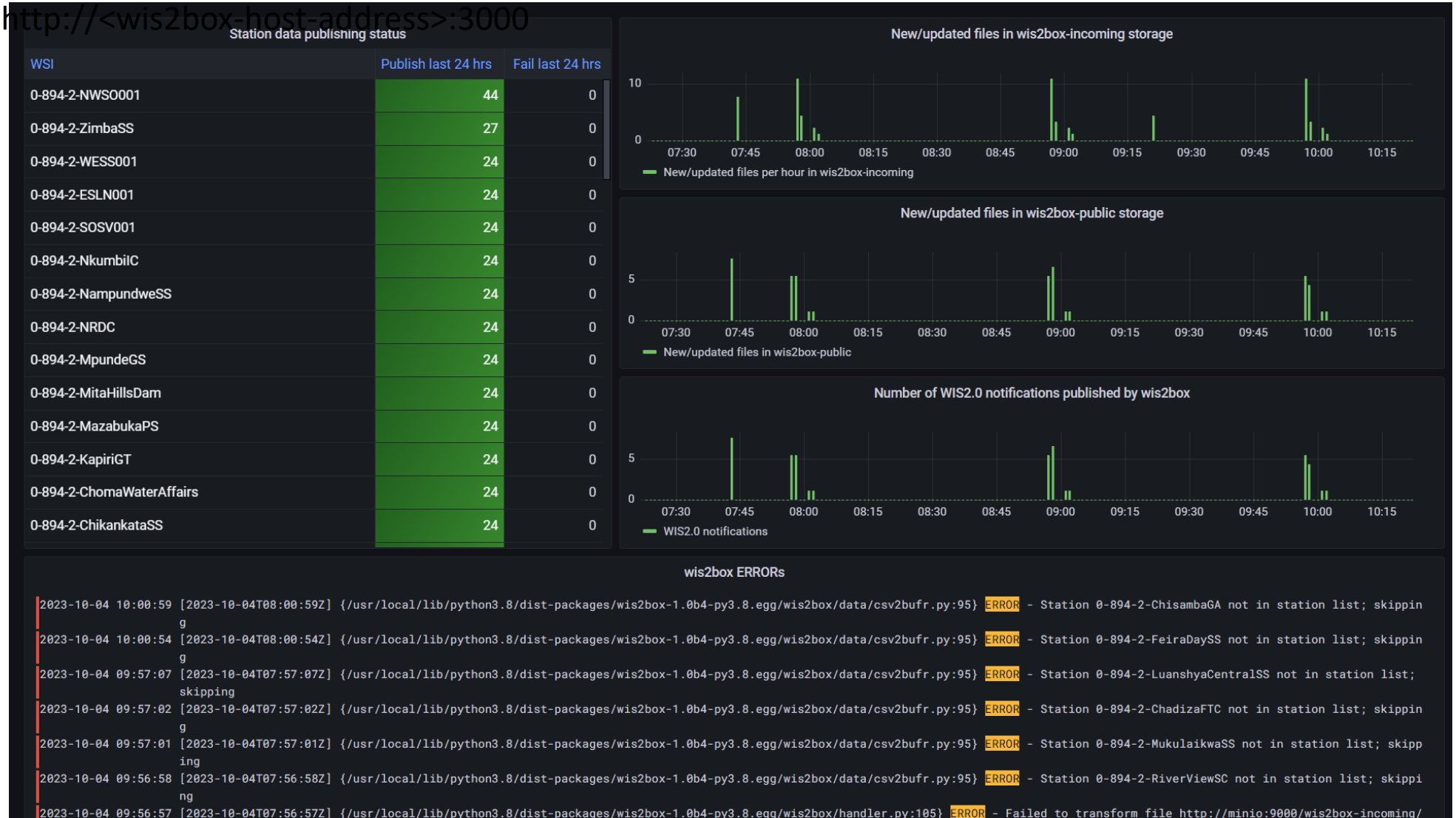
wis2box monitoring tools

Grafana, Prometheus and Loki included in wis2box-stack to enable monitoring the wis2box data publication and enable log access for debugging and corrective action

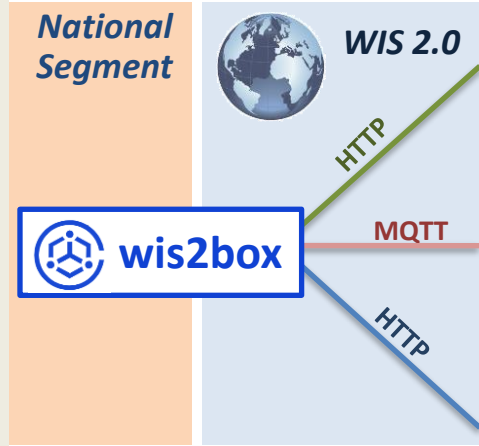
http://<wis2box-host-address>:3000



Summary

***wis2box* is an Open Source Reference Implementation of a WIS2 Node**

- Based on docker and docker-compose using pre-built images
- Using existing Open Source components: minio, mosquitto, nginx, pygeoapi
- Source code publicly available: https://github.com/wmo-im/wis2box
- Developed by WMO **to help accelerate the implementation of WIS 2.0**



wis2box provides additional tools to facilitate international data sharing

- Data conversion to BUFR (using extensible plugin-structure)
- Web-interfaces:
  - to visualize data content and monitor data publication
  - FM-12 input form for uploading manual observations
  - Enable configuring datasets and station metadata
- Monitoring using Grafana, Loki and Prometheus

wis2box is software not hardware

- requires a hosting solution: recommend to use **cloud** (public or private)
- host needs to be accessible via public IP address to function as WIS2 Node
- documentation: https://docs.wis2box.wis.wmo.int

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Thank you
Merci
谢谢

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