**EO Application Package Best Practice** Pedro Gonçalves, Terradue

The 120<sup>th</sup> OGC Member Meeting

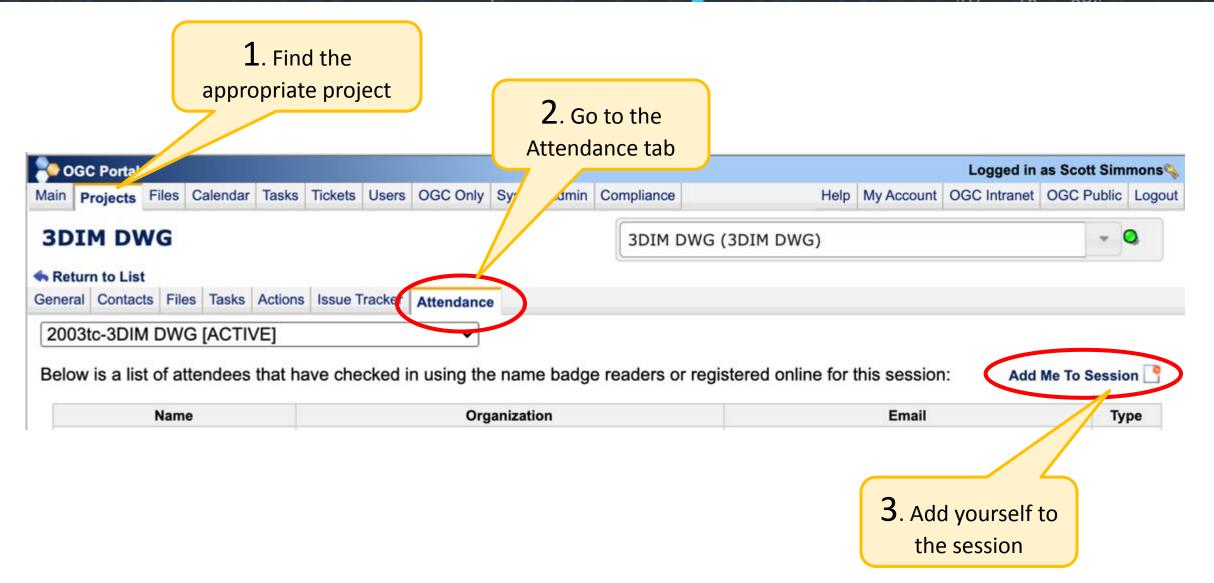
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### **Earth Observation Application Package**

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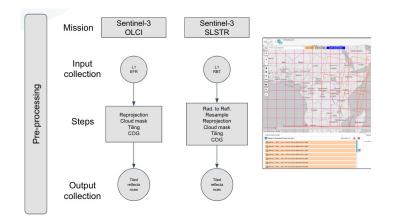
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|                               |            | OGC Engineer                               | Submission Date: 2020-09-03  |                                      |                   |
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|                               |            | Copyright (c) 2019 (                       | Reference URL for this document: <u>http://w</u>                       | ww.opengis.net/doc/PER/EOAppsPilot   | - <u>Terradue</u> |
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|                               |            | is subject to change                       | Title: OGC Earth Observations Application                              | s Pilot: Terradue Engineering Report |                   |
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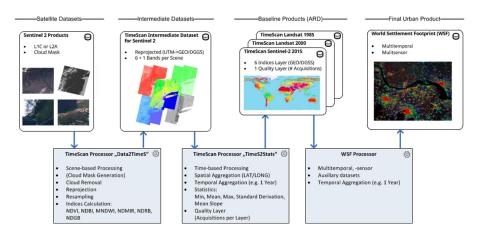
- Previous OGC Testbeds 13-16 initiated the design of an application package for Earth **Observation Applications in distributed Cloud Platforms**
- The application package provides information about the software item, metadata and dependencies

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Deployed and executed within an **Exploitation Platform in a service compliant** with the OGC API Processes specification

# **Earth Observation Applications Pilot 2020**





- Evaluated the maturity of Application Package in a real world environment with applications brought by several developers that work with data from Earth observation satellites.
- These developers brought different views and requirements in terms of data access and processing to challenge the application package architecture and platform readiness

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# The role of the Application Package

- Describes the data processing application by providing information about
  - o parameters, software item, executable, dependencies and metadata.
- Ensures that the application is fully portable and supports automatic deployment in a Machine - To - Machine (M2M) scenario.
- Application Package information model allows the deployment of the application as OGC API - Processes compliant web service.

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## **High Level Requirements**

- Decouple application developers from exploitation platform operators and from application consumers
  - Focus on application development by minimizing platform specific particularities
  - Make their applications available on any number of platforms

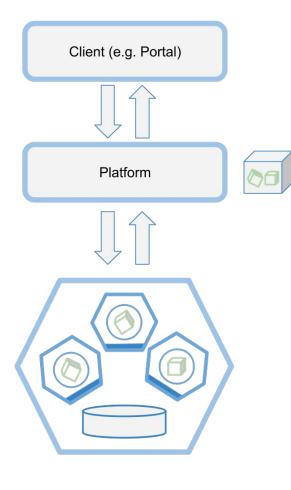
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• Enable exploitation platforms to virtually support any type of packaged EO application

# **EO Application Package**

- Application developers create containers with their runtime environment, dependencies and application binaries
- Application developers/integrators describe the Application package using the Common Workflow Language
- Applications needing more complex Data Flow Management can use a local catalogue encoded using STAC as a data manifest for application inputs and outputs metadata
- Application can be deployed in a Cloud provider and invocable in a service compliant with the OGC API Process specification

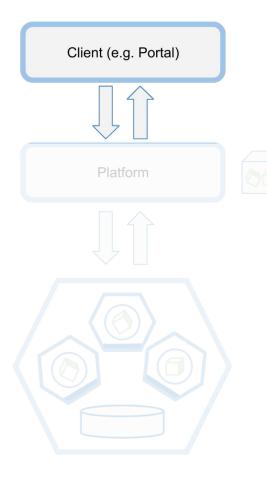
#### **EO Application Package Best Practices**

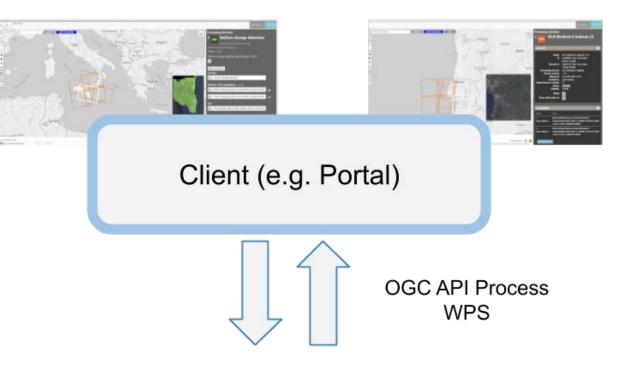


- The application (e.g. Python, R, JAVA, shell script, C++) is containerized and register in Container Registry
- The application package is created in Common Workflow Language
- The application is deployed in an Exploitation Platform
- The service is available for execution with the OGC API Processes specification
- The Platform converts the OGC API Processes

requests in a CW/L execution request

#### Service Request from Clients (e.g. Portal)



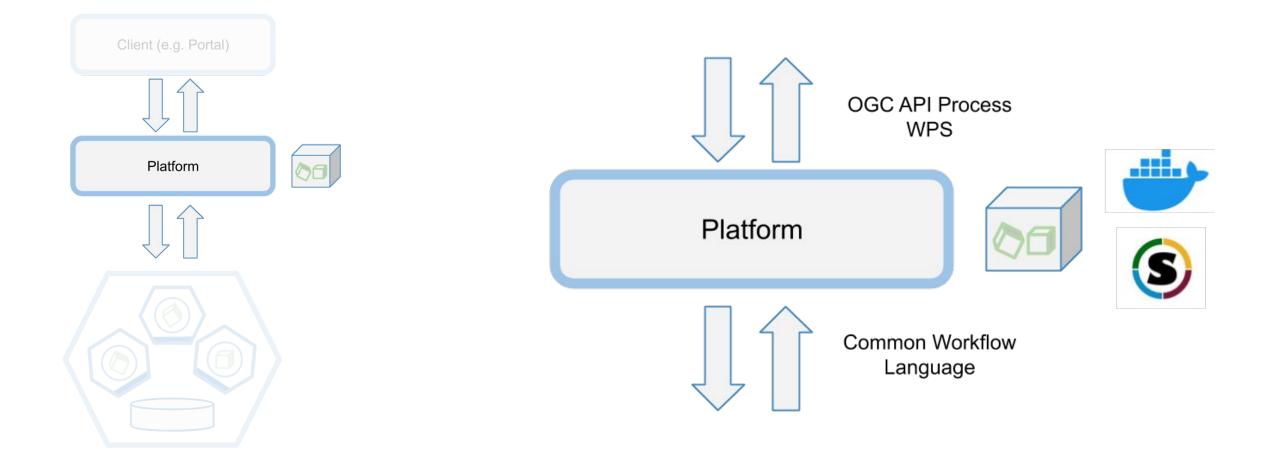


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#### **Service Request to Application Execution**



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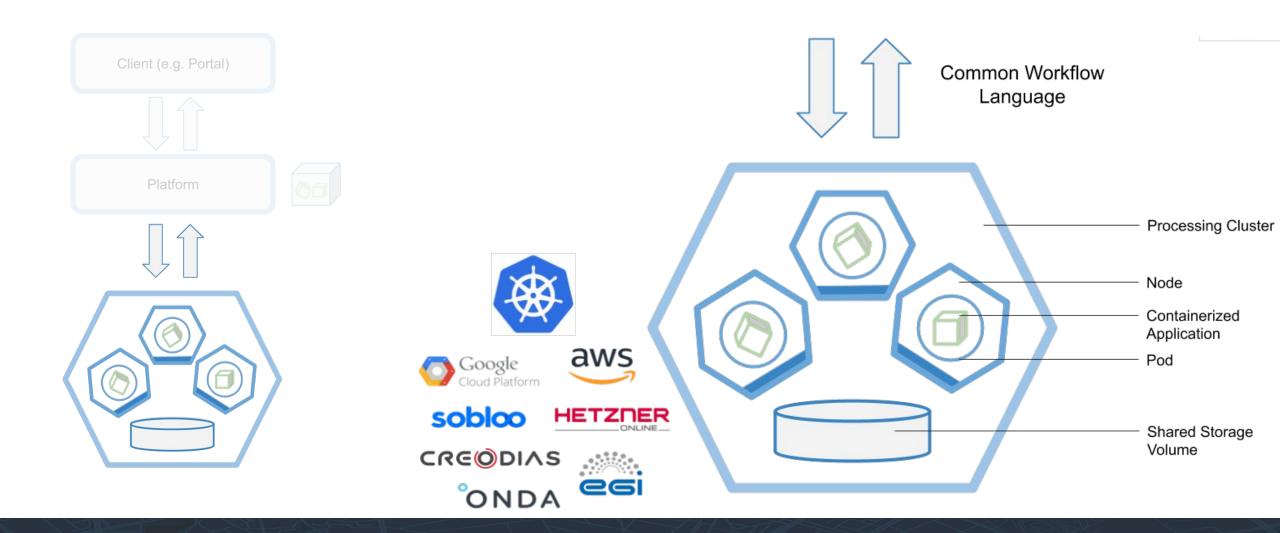
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#### **Application Execution**

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#### Viewpoints



#### OGC 20-089 defines guidance for the 3 viewpoints:

- For a **Developer** to adapt an application (or wrapper)
  - Optional data staging from a local STAC catalogue
  - Create and publish a Docker
- For an Integrator to package an application
  - $\circ$  Create the CWL document (command line, inputs, outputs ... )
- For an **Platform** to deploy and execute the application
  - Extract the CWL Workflow information
  - Create the OGC API Processes Service Parameters mapped from the CWL
  - Expose the OGC API Processes service

#### **GitLab Access**

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- Document published in pending documents
  - https://portal.ogc.org/files/?artifact\_id=98620
- Document source on OGC GitLab
  - opt-in 1st on the EOEP DWG page

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| Abbreviation:            | EO Ex Platform  | Primary Email   | List                                  |          |         |        |         |        |         |        |
| Start Date:              | 2019-01-27  | ( TList Arch  | ves ) 🛱 eo-ex-platform@lists.ogc.o    | rg   (su | ubscrib | ed)    |         |        |         |        |
| Target End Date:         |   | Click Here to   | Manage All List Subscriptions         |          |         |        |         |        |         |        |
| Actual End Date:         |   |   | •                                     |          |         |        |         |        |         |        |
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| Last Updated             | 2021-01-22 21:03:38 By Jonathan Fath  | Your Role in Project<br>Your individual role assignment for this project is Charter Member. A complete list is available<br>under the Contacts tab. |                                       |          |         |        |         |        |         |        |
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| forum for the discussion | roup charter defines the role for OGC a<br>and presentation of interoperability rec<br>ed to the OGC's Technical and Plannin  | quirements, use   | cases, pilots, and implementations of |          |         |        |         |        |         | en     |

# https://gitlab.ogc.org/ogc/ eoap-best-practice

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| Releases   | OGC 20-089 OGC Best Prac   | tice for Earth Observation Application Pa | ckage                     |                |
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| Packages & Registries  | UML                        | Initial upload                            |                           | 7 months ago   |
|  | abstract_tests             | Initial upload                            |                           | 7 months ago   |
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| Wiki   | 🖨 diagrams                 | Update datastagein.uml                    |                           | 2 months ago   |
| Collapse sidebar   | Figures                    | Initial upload                            |                           | 7 months ago   |

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#### **Best Practice for EO Application Package**

- Hands-on experience from Testbeds and Pilot
- Comments and suggestions tracked and resolved as GitLab Issues
- 11 submitters organisations (let's us know if you want to be added)



#### Motion to approve an electronic vote for releasing OGC 20-089 as a OGC Best Practice

The EO Exploitation Platforms DWG recommends that the TC approve an electronic vote for releasing OGC 20-089 "Best Practice for EO Application Package" as a OGC Best Practice.

- Pending any final edits and review by OGC staff
- Motion: Günther (ESA)
- Second: Ryan (Geo COnnections)
- Discussion:
- There was no objection to unanimous consent

This document defines the Best Practice to package and deploy Earth Observation Applications in an Exploitation Platform.

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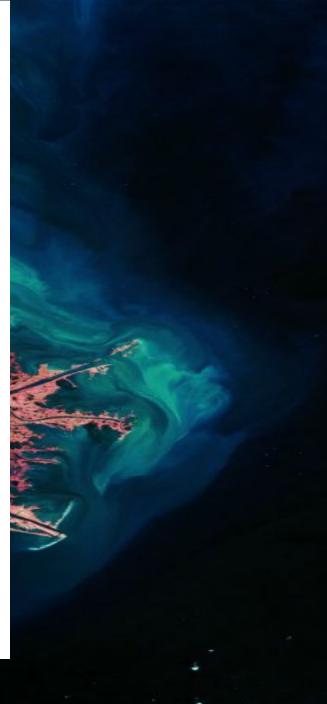
# Terra)ue

# Looking forward hearing from you!

https://www.terradue.com

Pedro Gonçalves

pedro@terradue.com



#### **Backup Slides**

- Usage Scenarios
- Common Workflow Language
- Data Staging with STAC
- Viewpoints explained

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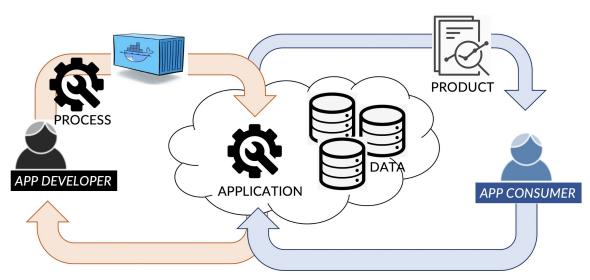
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#### **Usage Scenarios**

# Build to run operations from application testing, validation, and deployment to execution in production

- Alice to package an application
- Bob to script the execution of application
- Eric to deploy an application on platform Z
- Platform Z to accept the deployment of a new process
- Platform Z to execute a process with specific parameters



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### **Common Workflow Language**

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- The CWL is a specification for describing analysis workflows and tools
- Portable and scalable across a variety of software and hardware environments, from workstations to cluster, cloud, and high performance computing (HPC) environments
- Design to meet the needs of data-intensive science, such as Bioinformatics, Medical Imaging, Astronomy, Physics, and Chemistry

## **Application Package**

#### Application developers

- Create containers with their runtime environment and dependencies
- Describe the overall package using the Common Workflow Language (CWL).

| - class: Workflow<br>doc: ACME change detection with Sentinel-1 SLC<br>id: acme_cd<br>label: ACME change detection  | Service<br>definition |
|---|-----------------------|
| <pre>inputs:<br/>aoi_wkt:<br/>doc: Area of interest<br/>label: Area of interest<br/>type: string<br/>input_files:<br/>doc: Sentinel-1 SLC acquisition (same track)<br/>label: Sentinel-1 acquisitions<br/>type: Directory[]</pre> | Service<br>parameters |

#### **Data Flow Management**

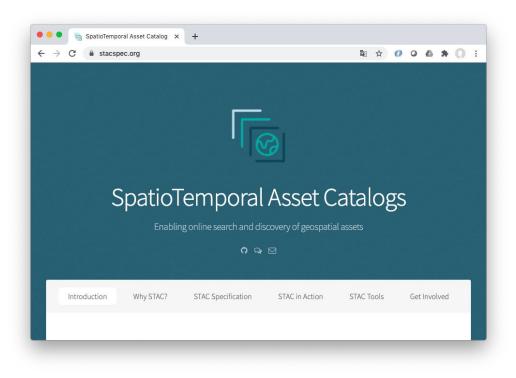
- The Platform stages-in the enclosures associated to the input references generating:
  - $\circ~$  a local STAC catalog for the fan-in pattern
  - several local STAC catalogs with a single item for the fan-out pattern



- The STAC catalog contains the items (product metadata) and assets (files with manifest and data (.xml, .jp2, tif, etc.))
- The assets have an href relative path which resolves to the full path on the docker mounted volume by cwltool

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#### **Data Flow Management**



- STAC identifies any file that represents information captured in a certain space and time (spatiotemporal assets)
- A STAC Item is a GeoJSON Feature with additional fields (e.g. time geo), links to related entities and assets (including thumbnails).
- An asset is an object that contains a link to data associated with the Item that can be downloaded or streamed

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#### **Data Flow Management**

#### Sentinel-2 fan-in

| * <c< th=""><th>atalog id=catalog&gt;</th></c<> | atalog id=catalog>   |
|---|--|
|   | <pre>* <collection id="collection"></collection></pre>   |
|   | <pre>* <eoitem id="S2A_MSIL2A_20181229T095411_N0211_R079_T33SWC_20181229T112231"></eoitem></pre> |
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#### Sentinel-1 interferometric pair

In [3]: cat.describe()

- \* <Catalog id=catalog>
  - \* <Collection id=collection>
  - \* <E0Item id=S1B\_IW\_SLC\_\_1SDV\_20200203T050405\_20200203T050432\_020100\_0260B2\_59CC>
  - \* <EOItem id=S1B\_IW\_SLC\_\_1SDV\_20200122T050405\_20200122T050432\_019925\_025B0B\_7EEB>

#### Sentinel-2 fan-out



#### An **Application** needs to:

- Be executed as a command line application.
- Read a STAC local catalog as input manifest
- Create a STAC local catalog as output manifest
- Be executed in a docker container docker image

#### An Application Package needs to:

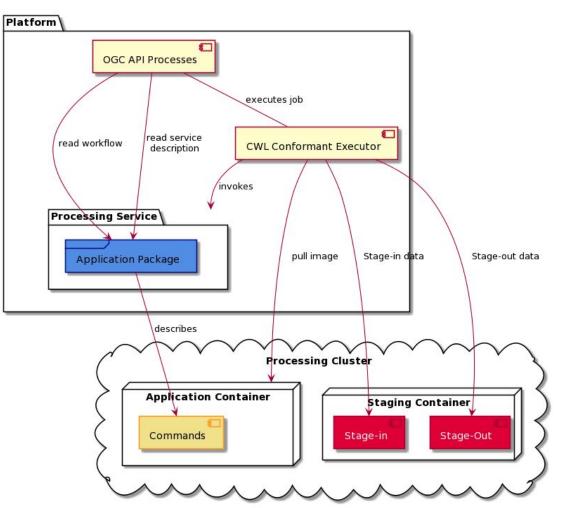
- Be a valid CWL document with a single CWL Workflow Class and at least one Command Line Class
- Define the command line and respective parameters and container for each Command Line
- Define the Application parameters
- Define the requirements for runtime environment

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## **Platform Viewpoint**

A **Platform** needs to provide mechanisms to

- deploy the Application Package
- **execute** the process defined by the Application Package (i.e. creates a new job) with specific parameters



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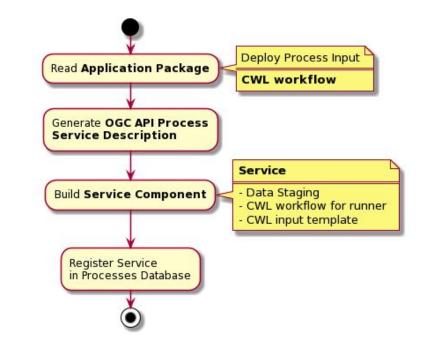
# Platform Viewpoint - deployment

For the **deployment**, the platform needs to:

- Accept a Post request with an Application Package (OGC API
  - Processes)

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- Translate Application Package metadata to add a process to a deployed OGC API - Processes server instance
- Translate Application Package Workflow Inputs defined in the CWL document as OGC API - Processes parameters



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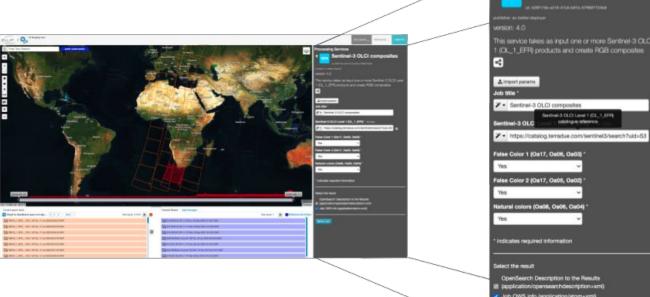
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For the **execution**, the platform needs to:

 Translate OGC API - Processes execute parameters to the Workflow Inputs defined in the Application Package (CWL document)



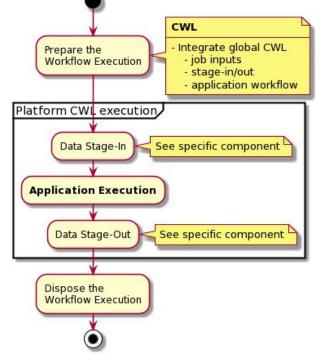
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ntinel-3 OLCI compos

12 : 45 : 87 FFB - 05 - 32 For the **execution**, the platform needs to:

- Translate OGC API Processes execute parameters to the Workflow Inputs defined in the Application Package (CWL document)
- If applicable, execute the data stage-in for the input EO products
- Orchestrate and execute CWL
- Translate output to OGC API process outputs



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