

Introducing the New OpenAIRE Graph API: Enhanced functionalities and real-world applications

29 Apr 2025

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This project has received funding from the European Union's Horizon Europe framework programme under grant agreements No. 101095129 and 101058573. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency. Neither the European Union nor the European Research Executive Agency can be held responsible for them.



Today Webinar: Scope

- Quick intro on the OpenAIRE Graph API
- Go through some interesting simple examples
- Get insights on the potential ways the API can be used
- Discuss some improvements that are expected in v2.0 (to be released soon)

- A more detailed API Training event is upcoming

Onboarded data sources

OpenAIRE Interoperability Guidelines

Repositories OA Journals Aggregators
Publishers Registries CRIS

Notable examples:

zenodo EPIsciences

PROVIDE

Metadata Validator

OpenAIRE BROKER

Instrumental data sources

From OpenAIRE partners:

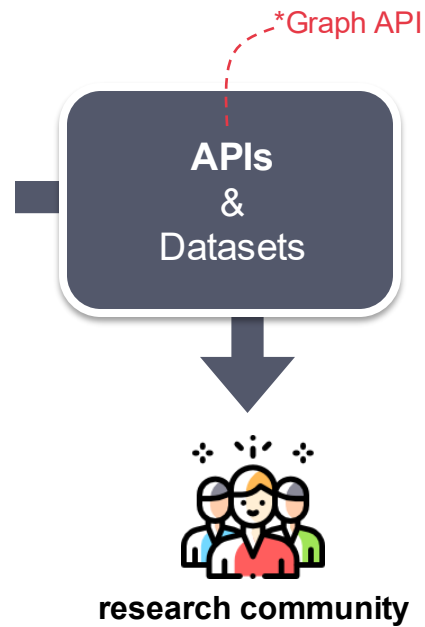
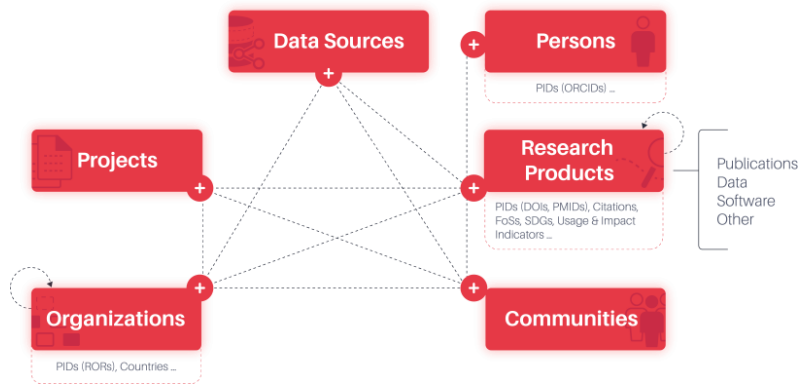
OPEN ORGS open@PC
OpenCitations

Funder databases

SciNoBo BIPI DB OpenAIRE UsageCounts DOAJ

Microsoft Academic ORCID unpaywall

DataCite EMBL-EBI PubMed Crossref



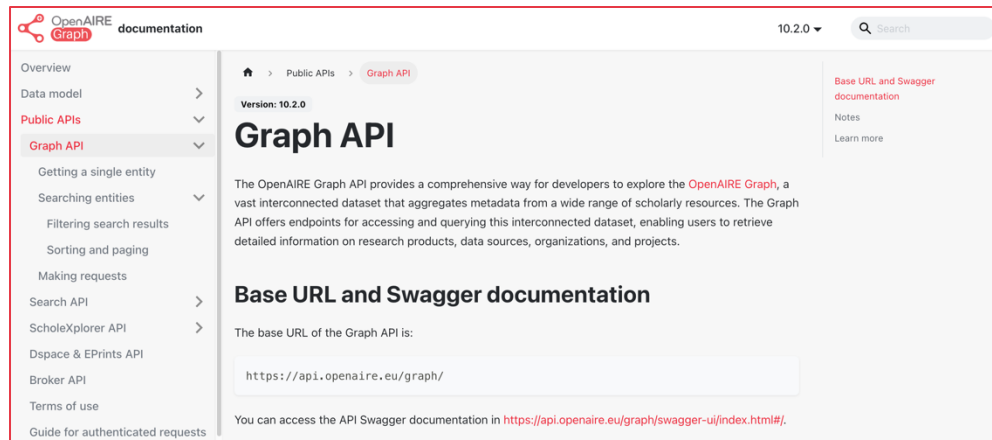
- **Open Graph Dataset**

- If heavy processing is involved (e.g., complex analytics or training ML models).
- If batch processing is needed (consecutive API calls will introduce significant delays).

- **Graph API**

- Need to have up-to-date data without moving frequently the large dataset.
- Avoid needing extremely large storage space.
- Avoid using distributed computation models (like Spark).
- If only small slices of the data are needed.

- RESTful API with responses in JSON format
- Main technologies used under the hood: Java & Solr
- Useful Links:
 - Base URL: <https://api.openaire.eu/graph/>
 - Documentation: <https://graph.openaire.eu/docs/apis/graph-api/>



The screenshot shows the OpenAIRE Graph API documentation page. The page title is "Graph API" and the version is "10.2.0". The main content area contains the following text:

The OpenAIRE Graph API provides a comprehensive way for developers to explore the OpenAIRE Graph, a vast interconnected dataset that aggregates metadata from a wide range of scholarly resources. The Graph API offers endpoints for accessing and querying this interconnected dataset, enabling users to retrieve detailed information on research products, data sources, organizations, and projects.

Base URL and Swagger documentation

The base URL of the Graph API is:

```
https://api.openaire.eu/graph/
```

You can access the API Swagger documentation in <https://api.openaire.eu/graph/swagger-ui/index.html/>.

The left sidebar contains a navigation menu with the following items:

- Overview
- Data model
- Public APIs
- Graph API
- Getting a single entity
- Searching entities
- Filtering search results
- Sorting and paging
- Making requests
- Search API
- Scholar Explorer API
- Dspace & EPrints API
- Broker API
- Terms of use
- Guide for authenticated requests

The right sidebar contains the following items:

- Base URL and Swagger documentation
- Notes
- Learn more

Graph API: Endpoints

Organizations API endpoints to explore organizations

GET **/v1/organizations** Search for organizations

GET **/v1/organizations/{id}** Retrieve an organization by id

Data sources API endpoints to explore data sources

GET **/v1/dataSources** Search for data sources

GET **/v1/dataSources/{id}** Retrieve a data source by id

Research products API endpoints to explore research products

GET **/v1/researchProducts** Search for research products

GET **/v1/researchProducts/{id}** Retrieve a research product by id

GET **/v1/researchProducts/links** Retrieve scholix links

Projects API endpoints to explore projects

GET **/v1/projects** Search for projects

GET **/v1/projects/{id}** Retrieve a project by id

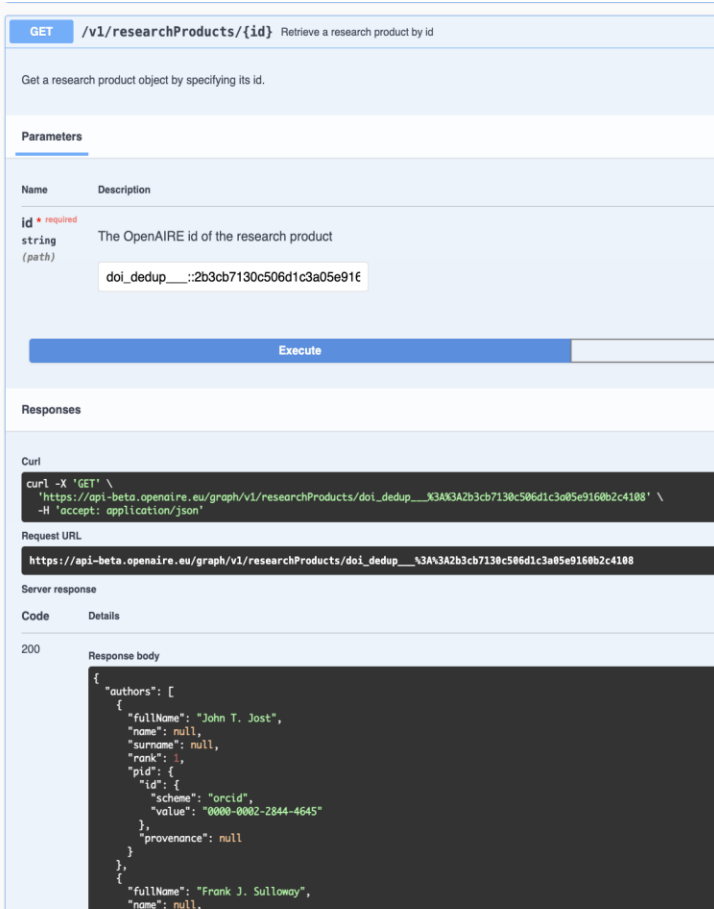
- Starting point: Search API (now deprecated)
- June 2024: internal testing
- July-August 2024: beta testing
 - external volunteers (60% existing users of the Search API)
 - > 1mo for experimentation
 - ticketing mechanism to collect bugs & features
 - final questionnaire for additional feedback on the experience
- February 2025: Graph API v1.0 release
- May 2025: Graph API v2.0 release
 - backwards compatible

Most important updates compared to the Search API:

- Improved JSON responses
- Better alignment with the OpenAIRE Graph data model
- Improved documentation
- Additional or extended endpoints, parameters, and fields
- Cursors mechanism

How to Use: Swagger UI

- Go to <https://api.openaire.eu/graph/swagger-ui/index.html#/>
 - it displays all available endpoints visually.
- You can click on a method, fill in parameters, and press “Try it out” to make a request without coding.
- It will show you the URL, request and the response directly.



The screenshot shows the Swagger UI interface for the endpoint `GET /v1/researchProducts/{id}`. The description is "Retrieve a research product by id" and "Get a research product object by specifying its id." The parameters section shows a required string parameter `id` (path) with the value `doi_dedup____:2b3cb7130c506d1c3a05e91f`. The "Execute" button is visible. The "Responses" section shows the curl command, the request URL, and the server response. The response code is 200 and the response body is a JSON object containing authors information.

```
curl -X 'GET' \
  'https://api-beta.openaire.eu/graph/v1/researchProducts/doi_dedup____X3A3A2b3cb7130c506d1c3a05e91f60b2c4108' \
  -H 'accept: application/json'
```

```
https://api-beta.openaire.eu/graph/v1/researchProducts/doi_dedup____X3A3A2b3cb7130c506d1c3a05e91f60b2c4108
```

```
{
  "authors": [
    {
      "fullName": "John T. Jost",
      "name": null,
      "surname": null,
      "rank": 1,
      "pid": {
        "id": {
          "scheme": "orcid",
          "value": "0000-0002-2844-4645"
        },
        "provenance": null
      }
    },
    {
      "fullName": "Frank J. Sulloway",
      "name": null,
      "surname": null,
      "rank": 2,
      "pid": {
        "id": {
          "scheme": "orcid",
          "value": "0000-0001-9122-4444"
        },
        "provenance": null
      }
    }
  ]
}
```


How to Use: Command Line (with curl)

- Open Terminal (or other shell if not using macOS).
- Use the `curl` command to make requests
- Example:

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?page=1" -H "accept: application/json"
```

type of request (GET)

user query

set HTTP headers
(can be omitted – it is the default)

endpoint parameter

How to Use: Other options

- There are various **desktop apps** (like Postman or Insomnia) that can be used to send REST API requests.
- Using a **programming language** like Python (with requests library)
- We will not examine such solutions during this webinar.

```
import requests

url = "https://api.openaire.eu/graph/v1/researchProducts"
params = {
    "search": "OpenAIRE Graph",
    "type": "publication",
    "page": 1,
    "pageSize": 10,
    "sortBy": "relevance DESC"
}
headers = {
    "accept": "application/json"
}

response = requests.get(url, headers=headers, params=params)

if response.status_code == 200:
    data = response.json()
    print(data)
else:
    print(f"Failed to retrieve data: {response.status_code}")
```

Graph API: Rate Limits & Data License

- Free-to-use by any third-party service.
- Can be accessed over HTTPS by authenticated & unauthenticated requests.
- Rate limits
 - Authenticated: up to 7200 requests/hour,
 - Unauthenticated: up to 60 requests/hour.
- To make an authenticated request, you must first register. Then, you can go to the personal access token page in your account, copy your token and use it for up to one hour, find out more.
 - More info on the documentation page
- OpenAIRE Graph license: CC-BY (can be freely re-used by commercial and non-commercial partners as long as OpenAIRE is acknowledged as a data source).

Example: Fetch a Research Product of Interest

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts/doi_dedup____:e53bb5954eb17d91de21d2769c85828"
```

```
{
  "authors": [
    {
      "fullName": "Serafeim Chatzopoulos",
      "name": "Serafeim",
      "surname": "Chatzopoulos",
      "rank": 1,
      "pid": {
        "id": {
          "scheme": "orcid",
          "value": "0000-0003-1714-5225",
          "provenance": null
        },
        "fullName": "Thanasis Vergoulis",
        "name": "Thanasis",
        "surname": "Vergoulis",
        "rank": 2,
        "pid": {
          "id": {
            "scheme": "orcid",
            "value": "0000-0003-0555-4128",
            "provenance": null
          },
          "fullName": "Dimitrios Skoutas",
          "name": "Dimitrios",
          "surname": "Skoutas",
          "rank": 3,
          "pid": {
            "id": {
              "scheme": "orcid",
              "value": "0000-0002-6118-5227",
              "provenance": null
            },
            "fullName": "Theodore Dalamagas",
            "name": "Theodore",
            "surname": "Dalamagas",
            "rank": 4,
            "pid": {
              "id": {
                "scheme": "orcid",
                "value": "0000-0002-5002-7901",
                "provenance": null
              },
              "fullName": "Christos Tryfonopoulos",
              "name": "Christos",
              "surname": "Tryfonopoulos",
              "rank": 5,
              "pid": {
                "id": {
                  "scheme": "orcid_pending",
                  "value": "0000-0003-0640-9088",
                  "provenance": null
                },
                "fullName": "Panagiotis Karras",
                "name": "Panagiotis",
                "surname": "Karras",
                "rank": 6,
                "pid": {
                  "id": {
                    "scheme": "orcid",
                    "value": "0000-0003-0509-9129",
                    "provenance": null
                  },
                  "openAccessColor": null,
                  "publiclyFunded": false,
                  "type": "publication",
                  "language": {"code": "und", "label": "Undetermined"}
                },
                "countries": null,
                "subjects": [
                  {
                    "subject": {
                      "scheme": "keyword",
                      "value": "FOS: Computer and information sciences",
                      "provenance": null
                    },
                    "subject": {
                      "scheme": "keyword",
                      "value": "Computer Science - Databases",
                      "provenance": null
                    },
                    "subject": {
                      "scheme": "keyword",
                      "value": "Databases (cs.DB)",
                      "provenance": null
                    },
                    "subject": {
                      "scheme": "keyword",
                      "value": "Information Retrieval (cs.IR)",
                      "provenance": null
                    },
                    "subject": {
                      "scheme": "keyword",
                      "value": "Computer Science - Information Retrieval",
                      "provenance": null
                    }
                  ]
                },
                "mainTitle": "Atrapos: Real-time Evaluation of Metapath Query Workloads",
                "subTitle": null,
                "descriptions": ["Heterogeneous information networks (HINs) represent different types of entities and relationships between them. Exploring, analysing, and extracting knowledge from such networks relies on metapath queries that identify pairs of entities connected by relationships of diverse semantics. While the real-time evaluation of metapath query workloads on large, web-scale HINs is highly demanding in computational cost, current approaches do not exploit interrelationships among the queries. In this paper, we present ATRAPOS, a new approach for the real-time evaluation of metapath query workloads that leverages a combination of efficient sparse matrix multiplication and intermediate result caching. ATRAPOS selects intermediate results to cache and reuse by detecting frequent sub-metapaths among workload queries in real time, using a tailor-made data structure, the Overlap Tree, and an associated caching policy. Our experimental study on real data shows that ATRAPOS accelerates exploratory data analysis and mining on HINs, outperforming off-the-shelf caching approaches and state-of-the-art research prototypes in all examined scenarios. -- Note that this version of our work is more extended than the one presented in TheWebConf 2023 (doi: 10.1145/3543507.3583322)", "13 pages, 19 figures"],
                "publicationDate": "2023-04-30",
                "publisher": "ACM",
                "embargoEndDate": "2022-01-01",
                "sources": ["Crossref"],
                "formats": null
            }
          }
        }
      }
    }
  ]
}
```

JSON
formater



```
{
  "authors": [
    {
      "fullName": "Serafeim Chatzopoulos",
      "name": "Serafeim",
      "surname": "Chatzopoulos",
      "rank": 1,
      "pid": {
        "id": {
          "scheme": "orcid",
          "value": "0000-0003-1714-5225"
        },
        "provenance": null
      }
    },
    {
      "fullName": "Thanasis Vergoulis",
      "name": "Thanasis",
      "surname": "Vergoulis",
      "rank": 2,
      "pid": {
        "id": {
          "scheme": "orcid",
          "value": "0000-0003-0555-4128"
        },
        "provenance": null
      }
    },
    {
      "fullName": "Dimitrios Skoutas",
      "name": "Dimitrios",

```

Example: Search for Publications

- Fetch first 10 publications (default pageSize= 10) related to the “Knowledge Graph” keywords ranking results based on (descending) keyword relevance:

space character (not allowed
in raw form in URLs)

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?search=Knowledge%20Graph&type=publication&page=1&sortBy=relevance%20DESC"
```

- Do the same but rank results based on (descending) citation counts:

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?search=Knowledge%20Graph&type=publication&page=1&sortBy=citationCount%20DESC"
```

- There are also other citation-based indicators (e.g., “popularity”) or usage-based ones (e.g., “Downloads” or “Views”) that can be used for ranking.
 - All details can be found in the API documentation page:
<https://graph.openaire.eu/docs/apis/graph-api/searching-entities/filtering-search-results>

Example: Pagination & Cursors

- Traditional pagination, like the one we used in previous examples (using “page” and “pageSize” parameters) has limitations due to performance issues (a hard limit of 10k records is enforced).
- To overcome this difficulty, for retrieving subsequent pages of a query, a cursor mechanism has been implemented.
- We start with the following query (to initiate the cursor mechanism):

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?search=Knowledge%20Graph&type=publication&cursor=*&sortBy=citationCount%20DESC"
```

- We use the “nextCursor” value returned to go to the next page:

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?search=Knowledge%20Graph&type=publication&cursor=[next]&sortBy=citationCount%20DESC"
```

placeholder (you can find the value to include in the response retrieved by the previous query).



Example: Fetch Most Cited Publication Produced by an Organization of Interest

- First find the identifier of the organization of interest

```
curl -X GET "https://api.openaire.eu/graph/v1/organizations?search=ATHENA,RESEARCH,INNOVATION&page=1"
```

- Found "ATHENA RIC" with id: openorgs_____:b84450f9864182c67b8611b5593f4250
- Then search for the most cited publication related to the organization.

```
curl -X GET "https://api.openaire.eu/graph/v1/researchProducts?reIOrganizationId=openorgs_____:b84450f9864182c67b8611b5593f4250&type=publication&page=1&sortBy=citationCount%20DESC"
```

Simple Example: Find the topic of a project based on its publications

- First find the identifier of the project of interest

```
curl -X GET "https://api.openaire.eu/graph/v1/projects?search=GraspOS&page=1"
```

- We found the project of interest with id: corda_____he::6f17d6d6d3e7c3ed44ad6f92b76e870d
- Then return its recent publications and get the subjects (e.g., fields of science).

```
curl -X GET  
"https://api.openaire.eu/graph/v1/researchProducts?relProjectId=corda_____he::6f17d6d6d3e7c3ed44ad6f92b76e870d  
&type=publication&page=1&sortBy=citationCount%20DESC"
```

- You can incorporate the previous calls into a script to aggregate the results and produce intuitive visualisations (e.g., a word cloud).

Example: Get the Citations of a Given Publication

- Example query:

```
curl -X 'GET' \  
'https://api.openaire.eu/graph/v1/researchProducts/links?targetPid=10.1007%2Fs11356-023-25894-w&relation=Cites&page=0' \  
-H 'accept: application/json'
```



Graph Portal

<https://graph.openaire.eu/>

User Forum

<https://openaire.flarum.cloud/>

Email

vergoulis@athenarc.gr

Support

<https://graph.openaire.eu/helpdesk>

THANKS