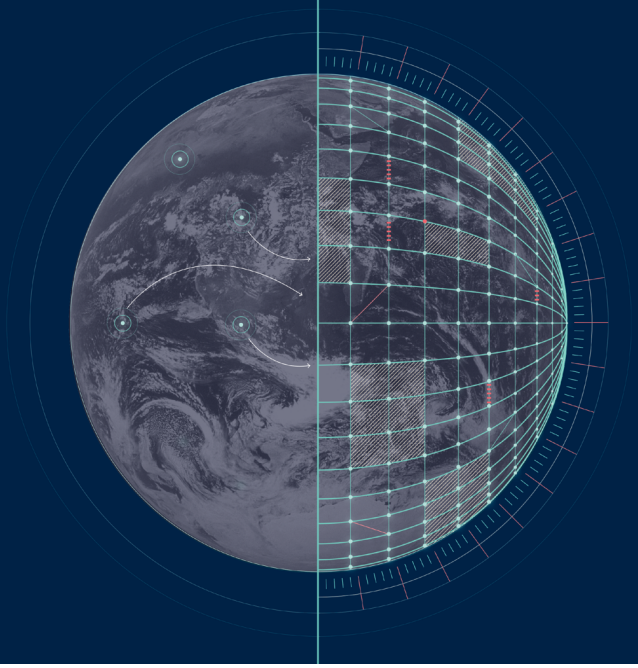

Destination Earth

Milestone Note – DT Data Delivery; Demonstrate a Prototype Data Access Workflow with Different Usage Patterns of the Continuous Extremes DT Data

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Change Log

Version	Date	Description
0.1	15/12/2022	Initial draft
1.0	16/12/2022	Internal review
1.1	14/02/2023	Updated data and catalogue links and retrieval keywords

Contents

Glossary

A glossary of relevant terms used in the context of DestinE is available at https://stories.ecmwf.int/destination-earth-glossary/index.html.

1 Executive Summary

The Digital Twin Engine (DTE) aims to simplify all aspects of data handling for Digital Twins, including the aspects of data delivery to users and other applications. Initial work on data delivery of high-resolution global forecast data has been completed, allowing delivery of prototype data from a 1.4km Integrated Forecasting System (IFS) simulation.

The technology and methodology for this data delivery, as well as information about the prototype dataset, is documented in deliverable DT-DTE-2-22.D4. For a higher-level view of the data management strategy and the Digital Twin Engine, refer to DT-DTE-2-22.D3; for more technical information on underlying I/O systems refer to DE-DTE-2-22.D1; and for more detail about the prototype catalogue of DT production data refer to DE-EDT-5-22.D3.

References

[DTE-TST-001] System Integration and verification test plan

[DTE-ADD-100] Data Lake - High Level Description & Architecture

[DTE-ADD-200] Digital Twins - High Level Description & Architecture

[DTE-USR-010] DT on Climate Adaptation – Architecture & Models

[DTE-USR-020] DT on Weather-induced and Geophysical Extremes – Architecture & Models

[DTE-ICD-200] Digital Twins – Interface Control Document

[DTE-OPS-200] Digital Twins – Operations Concept

[DE-ECMWF-AWP-2022] ECMWF Annual Workplan 2022

[DE-DTE-2-22.D3] DT Data Management Plan and Preparation for Data Interfaces

[DE-DTE-2-22.D1] Description of the High-Performance Data API and other Technical I/O Developments

[DE-EDT-5-22.D3] First prototype catalogue of DT production data

[DT-DTE-2-22.D4] Deliver DT Test Data

2 Purpose

This milestone note presents demonstrations of the data access to global forecast data through several different usage patterns. The dataset used for the tests is IFS global 1.4km resolution prototype data produced from a global forecast providing a flavor of the size and challenges of the data that may be produced by the Continuous Extremes DT. Access to the climate DT data is foreseen by the identical interface. As described in DT-DTE-2-22.D4, the Polytope Client can be used to retrieve the DT test data from the underlying MARS/FDB and in future from the DestinE data bridge / DEDL.

3 Workflow Demonstration: Interpolation

This demonstration shows the ability to download high-resolution DT test data interpolated to a lower resolution grid (1 degree resolution). The interpolation is executed server-side, by the Polytope Service, where there is fast access to the full data. Delivery of the data is fast, because the interpolated grid is small.

```
from polytope.api import Client

# Retrieve
c = Client(user_email='redacted', user_key='redacted')
request = {
    'class' : 'rd',
    'date' : '2018-11-01',
    'expver' : 'hs3g',
    'levelist' : '1',
    'levtype' : 'ml',
    'param' : '130',
    'step' : '0',
    'stream' : 'oper',
    'time' : '00:00:00',
    'type' : 'fc',
    'grid': '1/1'
}
c.retrieve('ecmwf-mars', request, "low-res.grib")
```

```
2022-12-15 15:55:27 - INFO - Request accepted. Please poll
https://polytope.ecmwf.int/api/v1/requests/redacted for status
2022-12-15 15:55:27 - INFO - Checking request status (redacted)...
2022-12-15 15:55:28 - INFO - The current status of the request is 'queued'
2022-12-15 15:55:29 - INFO - The current status of the request is 'processing'
2022-12-15 15:55:33 - INFO - The current status of the request is 'processed'
2022-12-15 15:55:33 - INFO - Starting data download (application/x-grib)...
2022-12-15 15:55:33 - INFO - Saving data into lowres.grib...
2022-12-15 15:55:33 - INFO - Data downloaded
successfully
2022-12-15 15:55:33 - INFO - Download rate 3.4MiB/s
2022-12-15 15:55:33 - INFO - Data saved successfully into lowres.grib
```

4 Workflow Demonstration: Area Cutout

This code demonstration shows the ability to download high-resolution DT test data, but only a cutout region over Europe. The data is also interpolated to a 0.1 regular lat-lon grid. The cutout and interpolation is executed server-side once again. As described in DE-DTE-2-22.D1, more complex sub-setting using polytopes will be available in the future.

```
from polytope.api import Client

# Retrieve
c = Client(user_email='redacted', user_key='redacted')
request = {
    'class' : 'rd',
    'date' : '2018-11-01',
    'expver' : 'hs3g',
    'levelist' : '1',
    'levtype' : 'ml',
    'param' : '130',
    'step' : '0',
    'stream' : 'oper',
    'time' : '00:00:00',
    'type' : 'fc',
    'area': '73.5/-27/33/45',
    'grid': '.1/.1'
}
c.retrieve('ecmwf-mars', request, "area.grib")
```

```
2022-12-15 16:01:08 - INFO - Request accepted. Please poll
https://polytope.ecmwf.int/api/v1/requests/redacted for status
2022-12-15 16:01:08 - INFO - Checking request status (redacted)...
2022-12-15 16:01:08 - INFO - The current status of the request is 'queued'
2022-12-15 16:01:09 - INFO - The current status of the request is 'processing'
2022-12-15 16:01:19 - INFO - The current status of the request is 'processed'
2022-12-15 16:01:19 - INFO - Starting data download (application/x-grib)...
2022-12-15 16:01:19 - INFO - Saving data into area.grib...
2022-12-15 16:01:19 - INFO - Data downloaded successfully
2022-12-15 16:01:19 - INFO - Download rate 4.9MiB/s
2022-12-15 16:01:19 - INFO - Data saved successfully into area.grib
```

5 Workflow Demonstration: Accessing Model Levels or Pressure Levels

The DT test data is available on model levels, pressure levels and selected sfc fields depending on the user's needs. The following demonstrations show how some of these alternatives are accessed.

5.1 Requesting Pressure on Model Levels

```
from polytope.api import Client
c = Client(user_email='redacted', user_key='redacted')
request = {
    'class':'rd',
    'date':'2018-11-01',
    'expver':'hs3g',
    'levelist':'1/to/137',
    'levtype':'ml',
    'param':'54',
    'step':'0',
    'stream':'oper',
    'time':'00:00:00',
    'type':'fc'
}
c.retrieve('ecmwf-mars', request, "output.grib")
```

The resultant data is 137 fields at full resolution (approximately 17GiB) and takes 26 minutes to retrieve from MARS, and a further 65 minutes to send over the internet to the user (highly dependent on the user's internet connection).

```
2022-12-15 14:08:36 - INFO - Request accepted. Please poll
https://polytope.ecmwf.int/api/v1/requests/redacted for status
2022-12-15 14:08:36 - INFO - Checking request status (redacted)...
2022-12-15 14:08:36 - INFO - The current status of the request is 'queued'
2022-12-15 14:08:36 - INFO - The current status of the request is 'processing'
2022-12-15 14:34:45 - INFO - The current status of the request is 'processed'
2022-12-15 14:34:45 - INFO - Starting data download (application/x-grib)...
2022-12-15 14:34:45 - INFO - Saving data into output.grib...
2022-12-15 15:39:24 - INFO - Data downloaded successfully
2022-12-15 15:39:24 - INFO - Download rate 4.8MiB/s
2022-12-15 15:39:24 - INFO - Data saved successfully into output.grib
```

5.2 Requesting Geopotential Height on Pressure Levels

```
from polytope.api import Client
c = Client(user_email='redacted', user_key='redacted')
request = {
    'class':'rd',
    'date':'2018-11-01',
    'expver':'hs3g',
    'levelist':'1/to/1000',
    'levtype':'pl',
    'param':'129',
    'step':'0',
    'stream':'oper',
    'time':'00:00:00',
    'type':'fc'
}
c.retrieve('ecmwf-mars', request, "output.grib")
```

The resultant data is 21 fields at full resolution (approximately 2.5GiB) and takes 4 minutes to retrieve from MARS, and a further 10 minutes to send over the internet to the user (highly dependent on the user's internet connection).

```
2022-12-15 13:53:46 - INFO - Request accepted. Please poll
https://polytope.ecmwf.int/api/v1/requests/redacted for status
2022-12-15 13:53:46 - INFO - Checking request status (redacted)...
2022-12-15 13:53:46 - INFO - The current status of the request is 'queued'
2022-12-15 13:53:48 - INFO - The current status of the request is 'processing'
2022-12-15 13:57:56 - INFO - The current status of the request is 'processed'
2022-12-15 13:57:56 - INFO - Starting data download (application/x-grib)...
2022-12-15 13:57:56 - INFO - Saving data into output.grib...
2022-12-15 14:07:06 - INFO - Data downloaded
successfully
2022-12-15 14:07:06 - INFO - Download rate 4.7MiB/s
2022-12-15 14:07:06 - INFO - Data saved successfully into output.grib
```

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Destination Earth

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