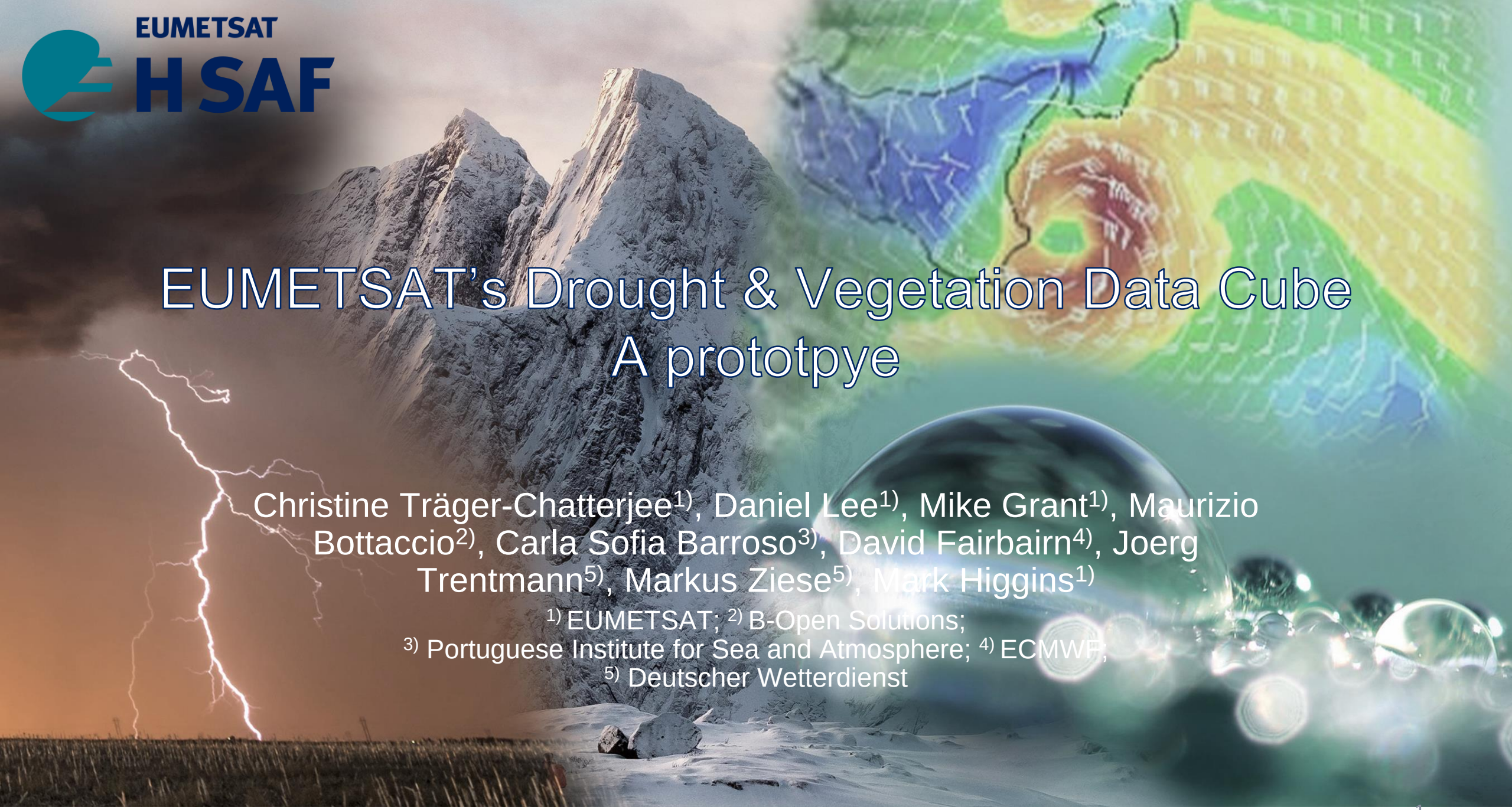


EUMETSAT's Drought & Vegetation Data Cube
A prototpye

Christine Träger-Chatterjee[1)], Daniel Lee[1)], Mike Grant[1)], Maurizio Bottaccio[2)], Carla Sofia Barroso[3)], David Fairbairn[4)], Joerg Trentmann[5)], Markus Ziese[5)], Mark Higgins[1)]

[1)] EUMETSAT; [2)] B-Open Solutions;
[3)] Portuguese Institute for Sea and Atmosphere; [4)] ECMWF;
[5)] Deutscher Wetterdienst

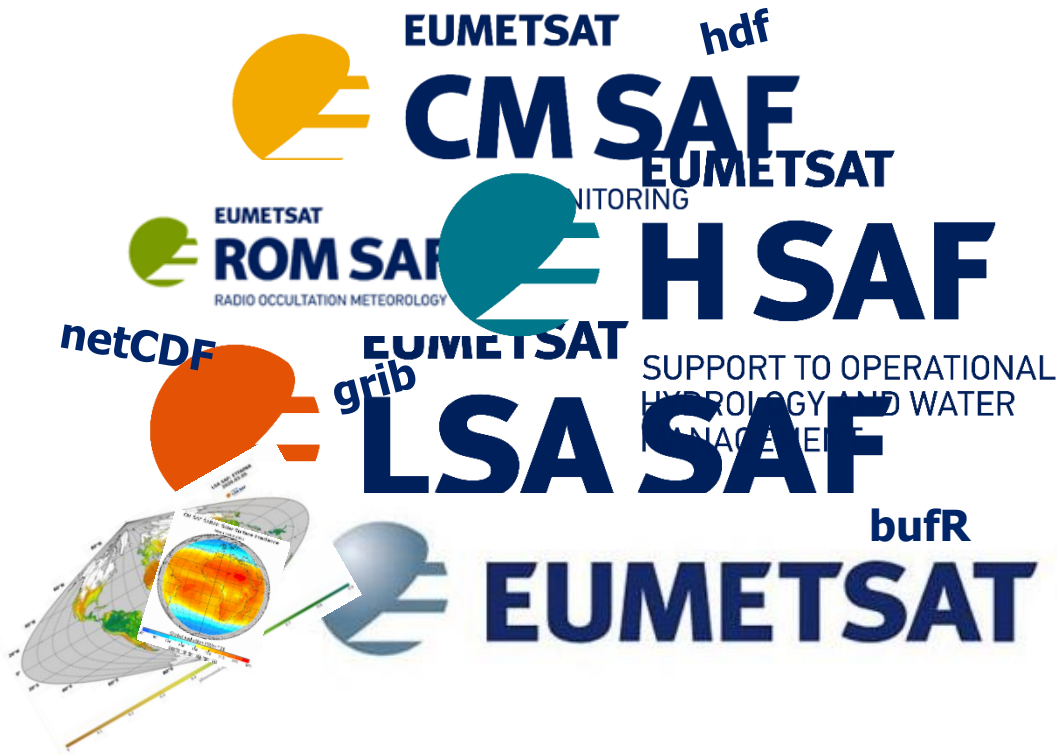
Why a Data Cube?
What is a Data Cube?
Lessons learnt from building the D&V Cube
Status and Outlook

Why a data cube?

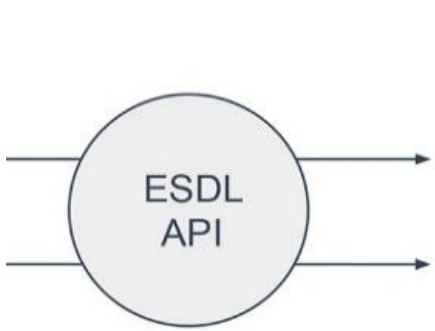
Satellite Application Facilities

- EUMETSAT has a network of different Satellite Application Facilities (SAFs)
- Each SAF is a consortium of entities from EUMETSAT member states
- SAFs are dedicated centers of excellence for processing satellite data
    - research, development and operational activities
    - each SAF is specialized in a different applications
- SAFs provide 80% of EUMETSAT's product portfolio
- Many (climate) data records ➔ real treasure

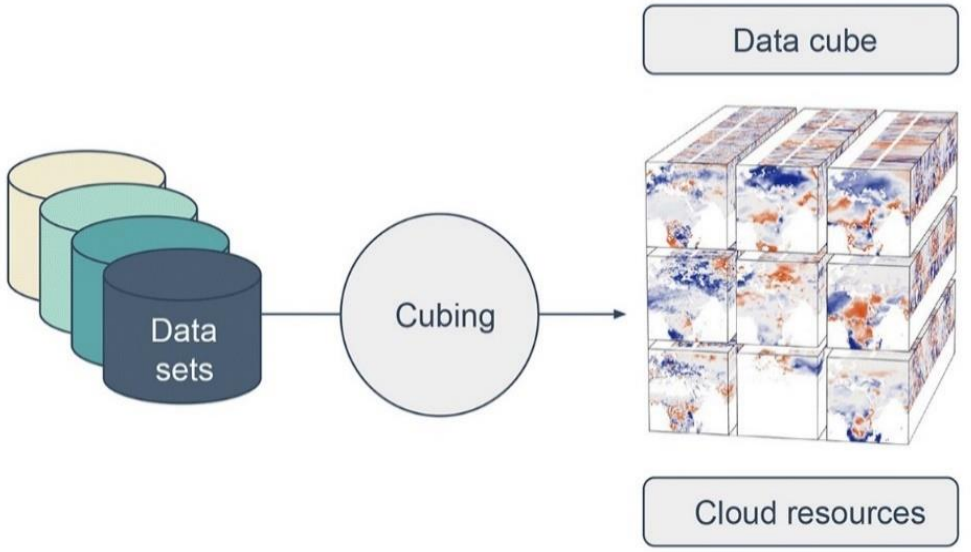
Status


EUMETSAT
hdf
CM SAF
EUMETSAT
ITORING
EUMETSAT
ROM SAF
RADIO OCCULTATION METEOROLOGY
H SAF
netCDF
EUMETSAT
grib
SUPPORT TO OPERATIONAL
WATER
LSA SAF
bufR
EUMETSAT

The idea of Data Cubes



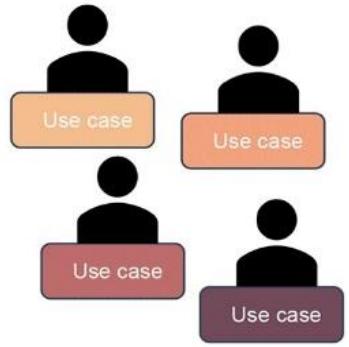
- Data access and analysis API for



- Selected data sets
- Sourcing data sets

- Data readers
- Pre-processing
- Common grids
- Chunking
- Metadata

- Cubes in the cloud
- Computing resources
- Distribution

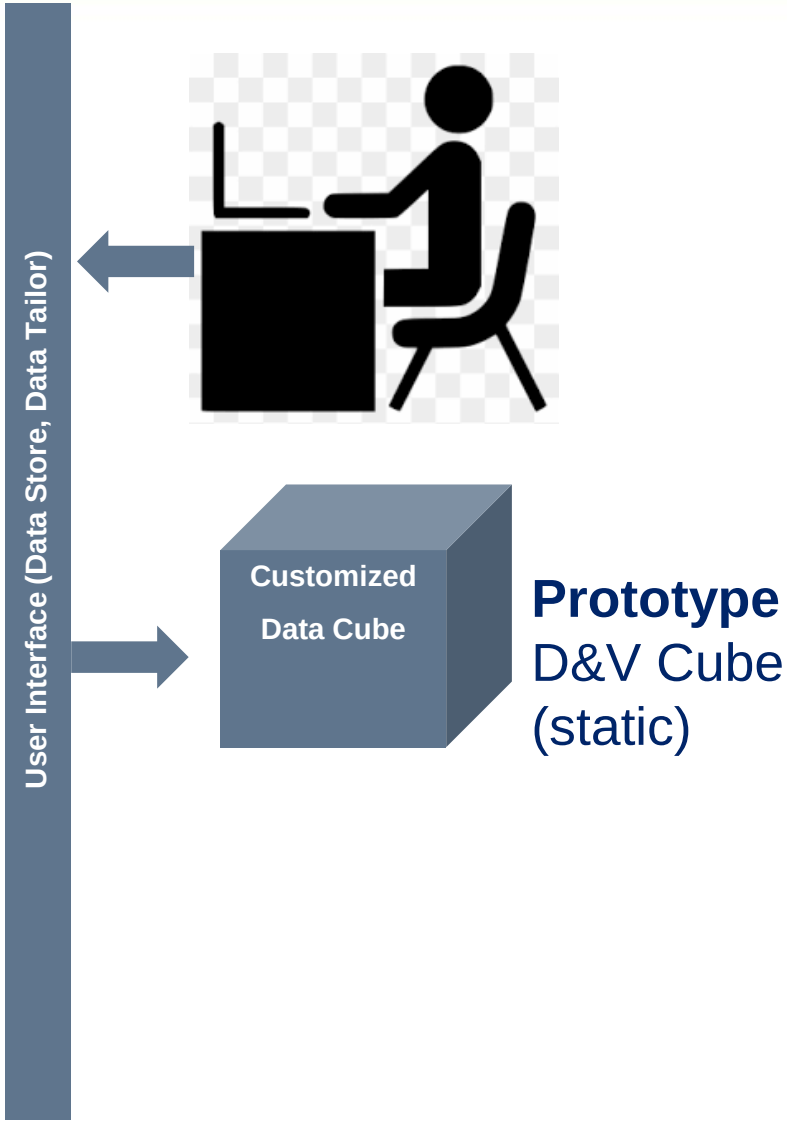


- Users implementing diverse use cases
- Sharing examples

Earth system data cubes unravel global multivariate dynamics Miguel D. Mahecha et al.; https://doi.org/10.5194/esd-11-201-2020

Facilitating data access and data handling saves time, which can be used to answer scientific questions.

Idea / Vision



Prototype
D&V Cube
(static)

Prototype D&V Cube at glance

Variable	Datasource	Temporal Coverage	Spatial Resolution	Temporal Resolution
Global Radiation	Satellite	Jan 1983 – Dec 2020	0.05°	Daily & monthly
Direct normal Solar Radiation	Satellite	Jan 1983 – Dec 2020	0.05°	Daily & monthly
Sunshine Duration	Satellite	Jan 1983 – Dec 2020	0.05°	Daily & monthly
Land Surface Temperature	Satellite	Jan 2004 – Dec 2020	0.05°	Hourly
Reference Evapotranspiration	Satellite	Jan 2004 – Dec 2020	0.05°	Daily
NDVI	Satellite	Mar 2007 – Dec 2020	0.01°	10-daily
Fractional Vegetation Cover	Satellite	Jan 2004 – Dec 2020	0.05°	Daily
Leaf Area Index	Satellite	Jan 2004 – Dec 2020	0.05°	Daily
Fraction of absorbed photosynthetically active radiation	Satellite	Jan 2004 – Dec 2020	0.05°	Daily
Soil Wetness Index (root zone)	Satellite	Jan 1992 – Dec 2020	0.1°	Daily
Precipitation	In situ	Jan 1982 – Dec 2020	1°	Monthly
T2m	Re-analysis	Jan 1979 – Oct 2020	0.1°	Monthly

Spatial Coverage:	**Europe**
Grid:	**Regular Lat / Lon**
Data Format:	**CF compliant netCDF4**

Users are able to

- access via THREDDS
- download the entire cube (3TB) or subsets / subsamples
- analyse the data on the VM using the CM SAF R Toolbox (and other Tools, e.g. Jupyter Notebooks)
  → work in progress

11 May 2021

Information Day

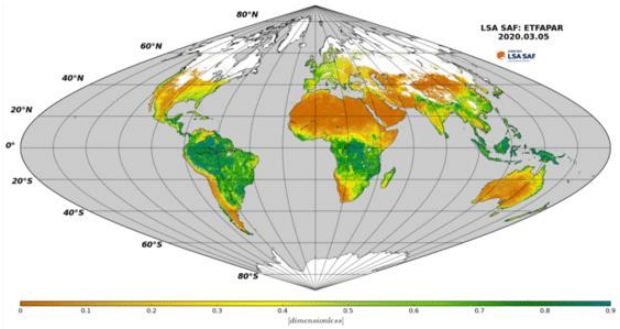
May 2021 – August 2021

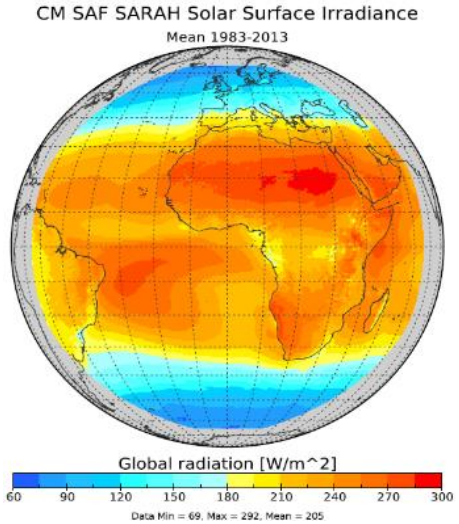
Exploration Phase

SALGEE meeting November 2021
D&V session during

Creating the cube

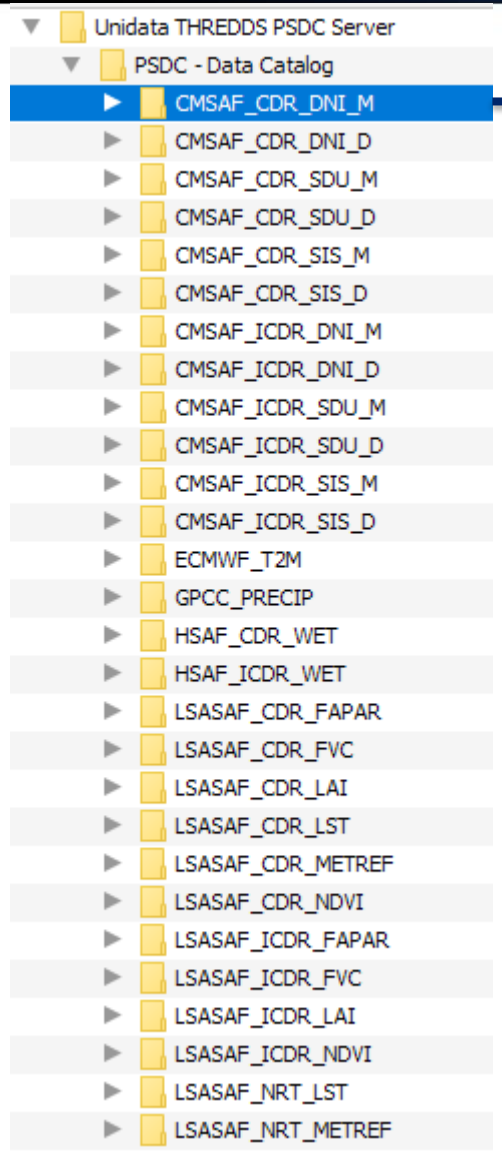
- Collecting the data from different providers
- Harmonize grid → re-gridding
  - Different methods available
  - Changing the data!
  - Impact on accuracy
  - Error measures and flags!!
- Harmonize metadata
  - Not trivial
  - cf-conventions helpful, but additional standard names needed
- Harmonize file format

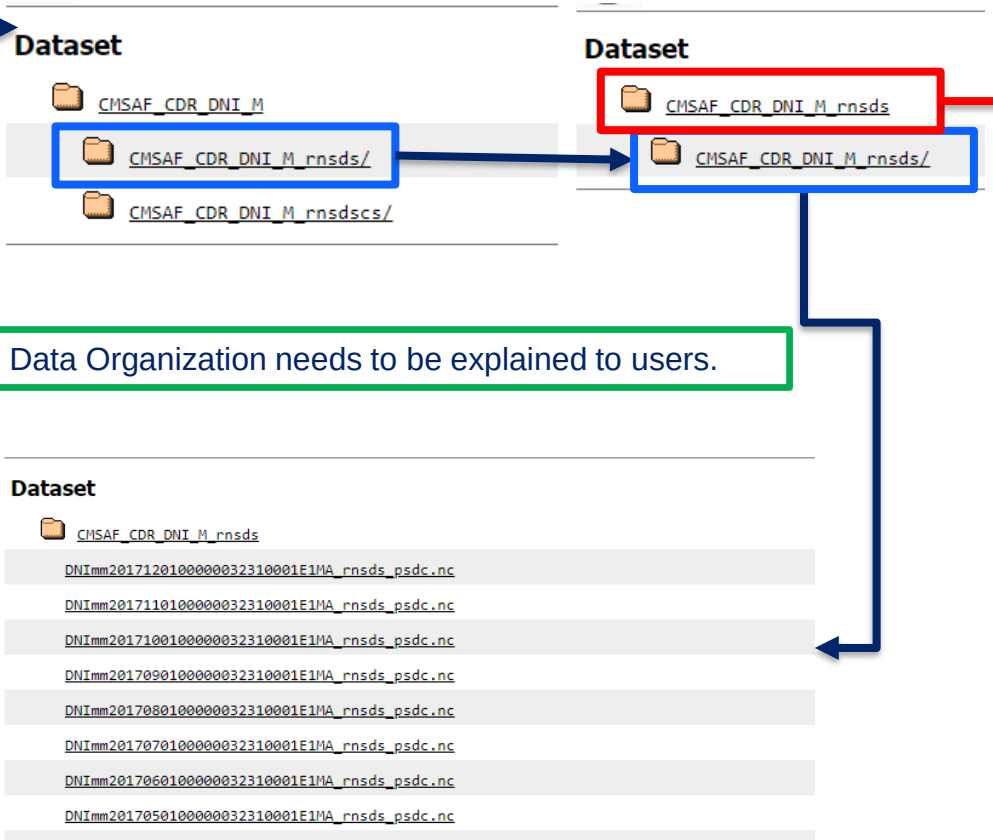




- Issues to consider:
  - Data are changed while re-gridding
    - Documentation not strictly applicable
    - Who is the provider of the data? EUMETSAT or the SAF?
    - …

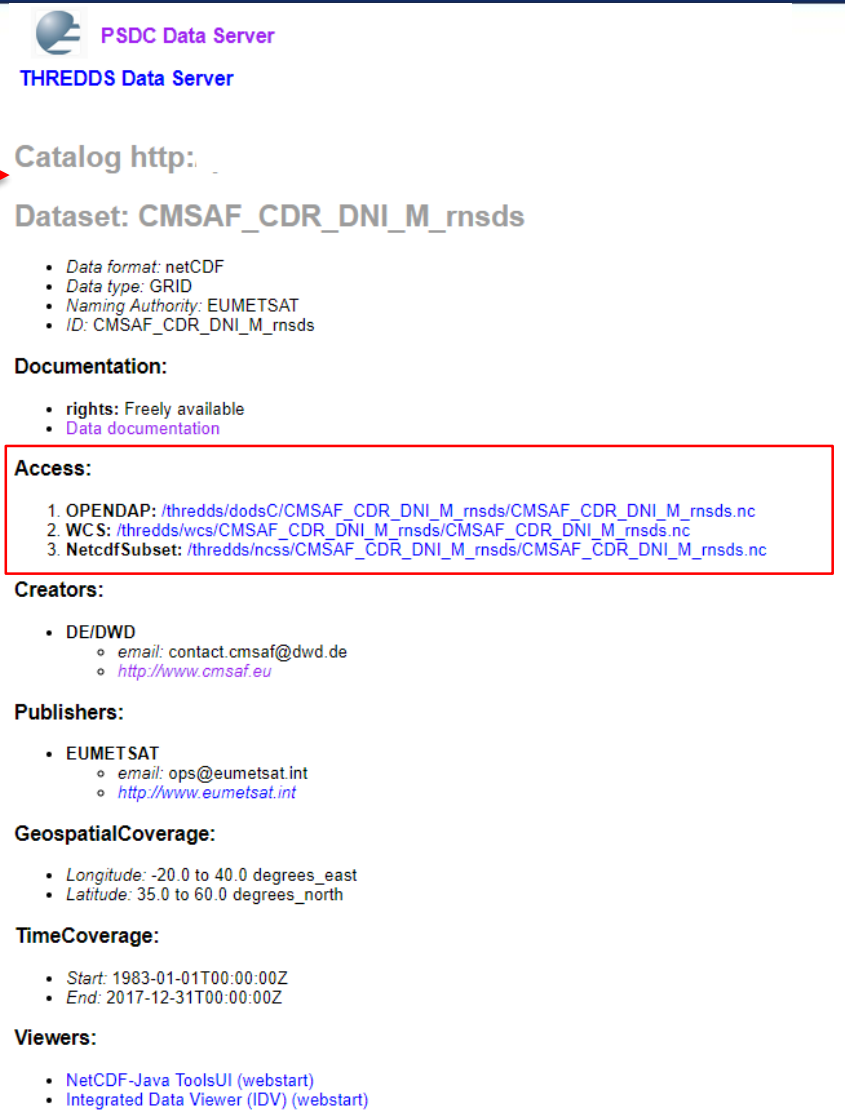
Accessing the D&V Cube





Data Organization needs to be explained to users.

Default currently: download and work locally
Work in progress: access directly via CM SAF R Toolbox
Planned: Jupyter Notebooks

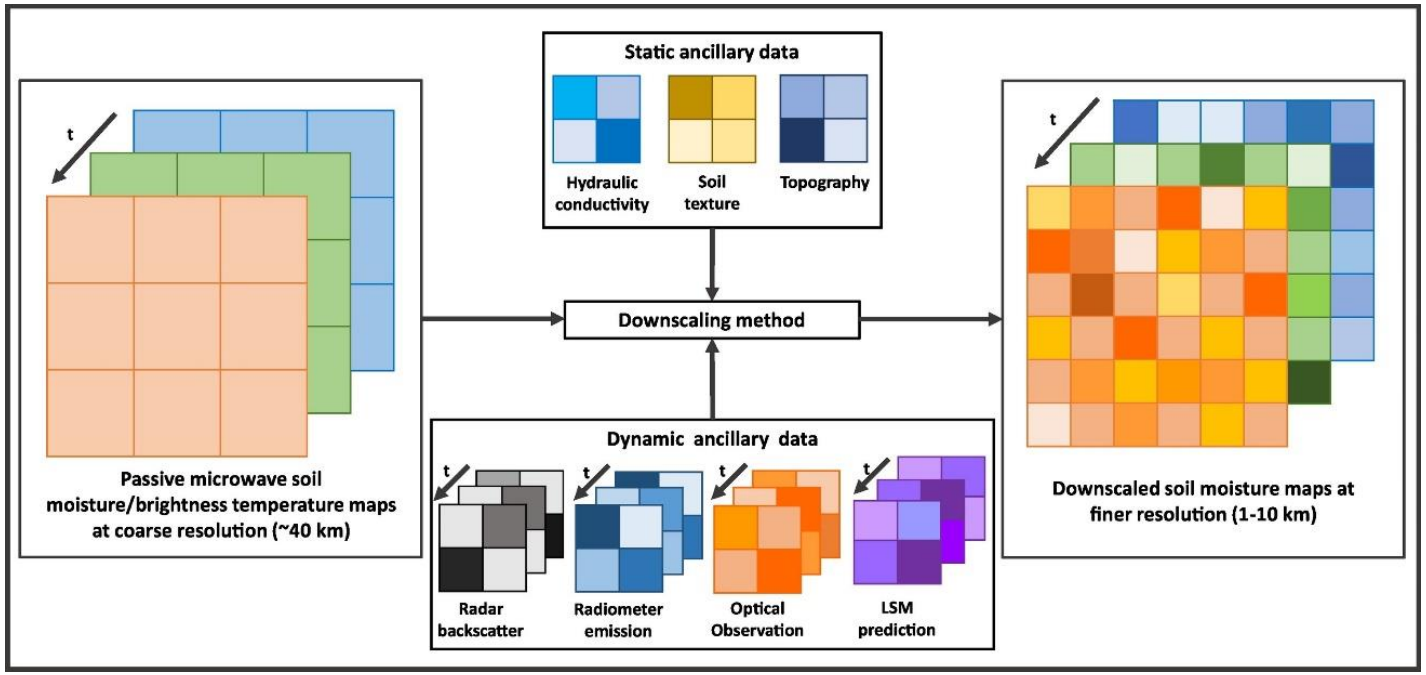


The Exploration Phase

- Cube Information Page
- Information Day: well attended
- Live-Touch Points
- Exchange with other Cube Explorers
- Get support from data experts

Example Application: Downscaling Soil Moisture

Agricultural and hydrological applications would benefit from SM with a sub-kilometer spatial resolution and daily revisit time



Sabaghy et al. 2018 (*Remote Sens. Environ*)

Idea:
Combine coarse resolution SM products and high resolution ancillary data, which drive/influence SM to get a high resolution SM.

Goal:
Downscale SSI SM from 25km to 5km spatial resolution

Dorigo et al. 2017 (*Remote Sens. Environ*

Courtesy: Luca Zappa, TU Vienna

Example Application: Downscaling Soil Moisture

DATASET	Spatial res	Temporal res	Start date	End date	Source
Global radiation	0.05°	Daily	2018-01-01	2020-12-01	**EUMETSAT DC**
Direct normal solar radiation	0.05°	Daily	2018-01-01	2020-12-01	**EUMETSAT DC**
LAI	0.05°	Daily	2016-01-01	2020-12-31	**EUMETSAT DC**
Land cover (% of level 1 CLC)	100 m → 0.05°	Daily	2018		CLC
SM (combined, v05.2)	0.25°	~Daily	1978	2019-12-31	CCI

Datasets (predictors) used to feed and train the Random Forest regression

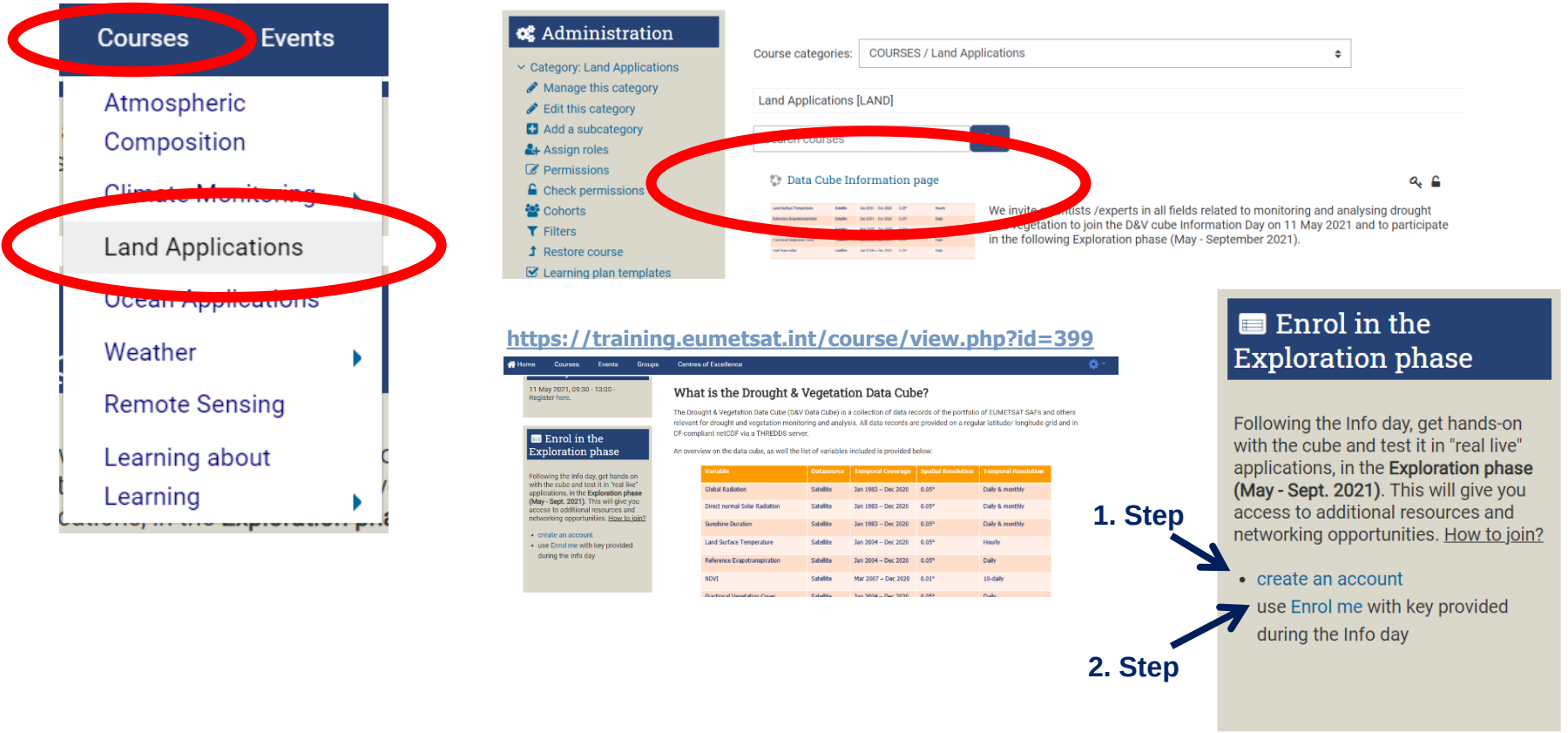
Courtesy: Luca Zappa, TU Vienna

Status & Outlook

- Still issues around data access via THREDDS
- Tutorials on accessing the D&V Cube using Python, R-based tools are being made available
- Collect user feedback
- Discuss applications with subject matter experts
- Continue the Exploration Phase
- Further cubes for other application areas
  - Atmospheric Composition
  - Marine Applications
  - ….

Participating in the Exploration Phase

- D&V Cube Page (moodle course): https://training.eumetsat.int



Enrolment key: explored&vcube21

You can un-enrol any time

or e-mail training@eumetsat.int