

# International Conference on Monitoring, Modelling and Management of River Basins

June 11-12, 2026, Karlsruhe (Germany)



Land Monitoring

11 June 2026

# EU-Hydro 2.0: A Copernicus high- resolution hydrography dataset across Europe based on latest generation elevation and ancillary data

**Linda Moser (GAF AG)**

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# What is EU-Hydro?

EU-Hydro is a **Hydrographic reference dataset** part of the Copernicus Land Monitoring Service (**CLMS**) portfolio, implemented by the European Environment Agency (**EEA**).

- developed since 2012 → updates until 2020 → version 1.3
  - outdated input data
  - inconsistencies in network topology → limited usability for hydrological applications

Therefore... **EU-Hydro 2.0** based on **latest generation Digital Elevation Model** (Copernicus DEM) at 10m resolution + best-suitable ancillary data)



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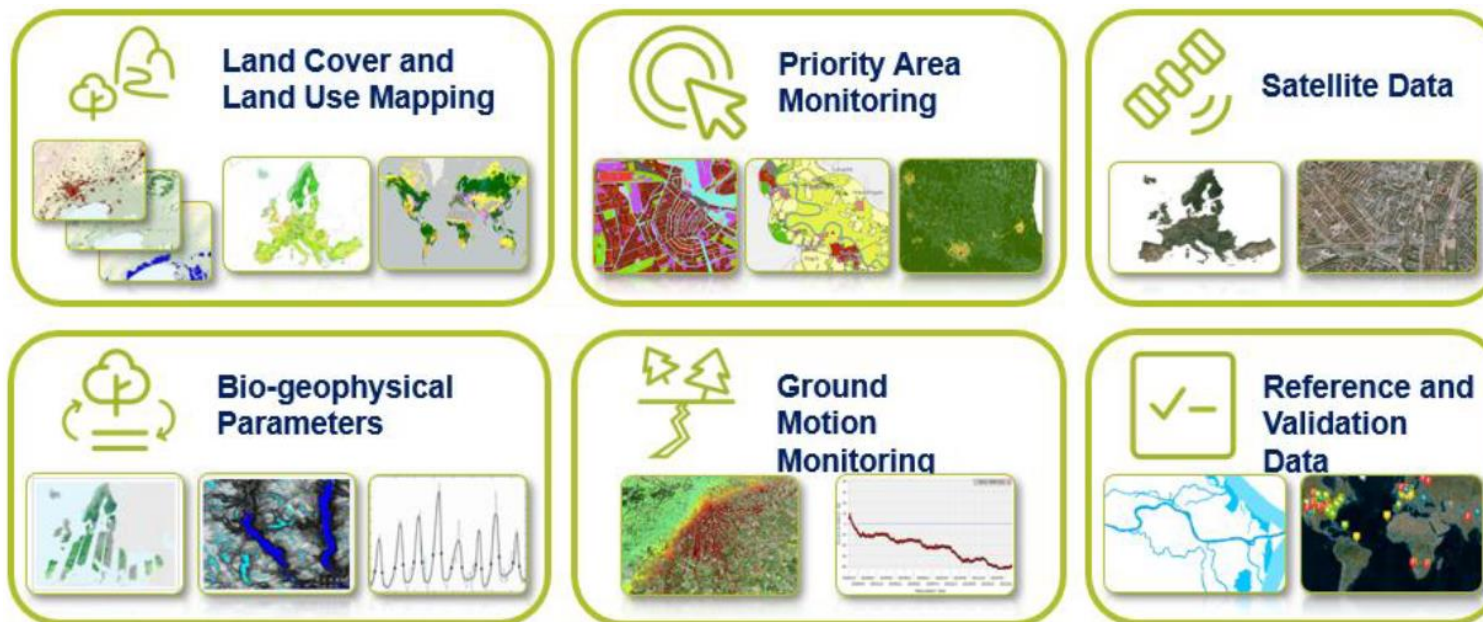


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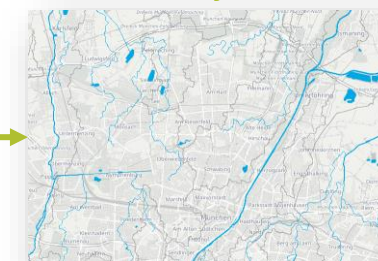
# Copernicus Land Monitoring Service

- Copernicus Programme = Earth observation component of the EU's Space Programme
- Copernicus Land Monitoring Service (**CLMS**): one of 6 Services (Land, Atmosphere, Marine, Climate, Security, Emergency)
- CLMS product categories:

free & open  
data access



EU-Hydro



<https://land.copernicus.eu/en>



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# EU-Hydro 2.0 Update

## Consortium:



CONFLUVIO



## Main goal:

- 1) New baseline for **hydrographic mapping** in Europe (particularly for CLMS services)
  - 2) Basis for **hydrological modelling** applications in Europe
    - Homogeneous dataset over Europe (EEA38+UK)
- Ramp-Up Phase → Production phase (incl. stakeholder feedback & external validation)
- Planned to be available March 2027 on CDSE (<https://dataspace.copernicus.eu/>)



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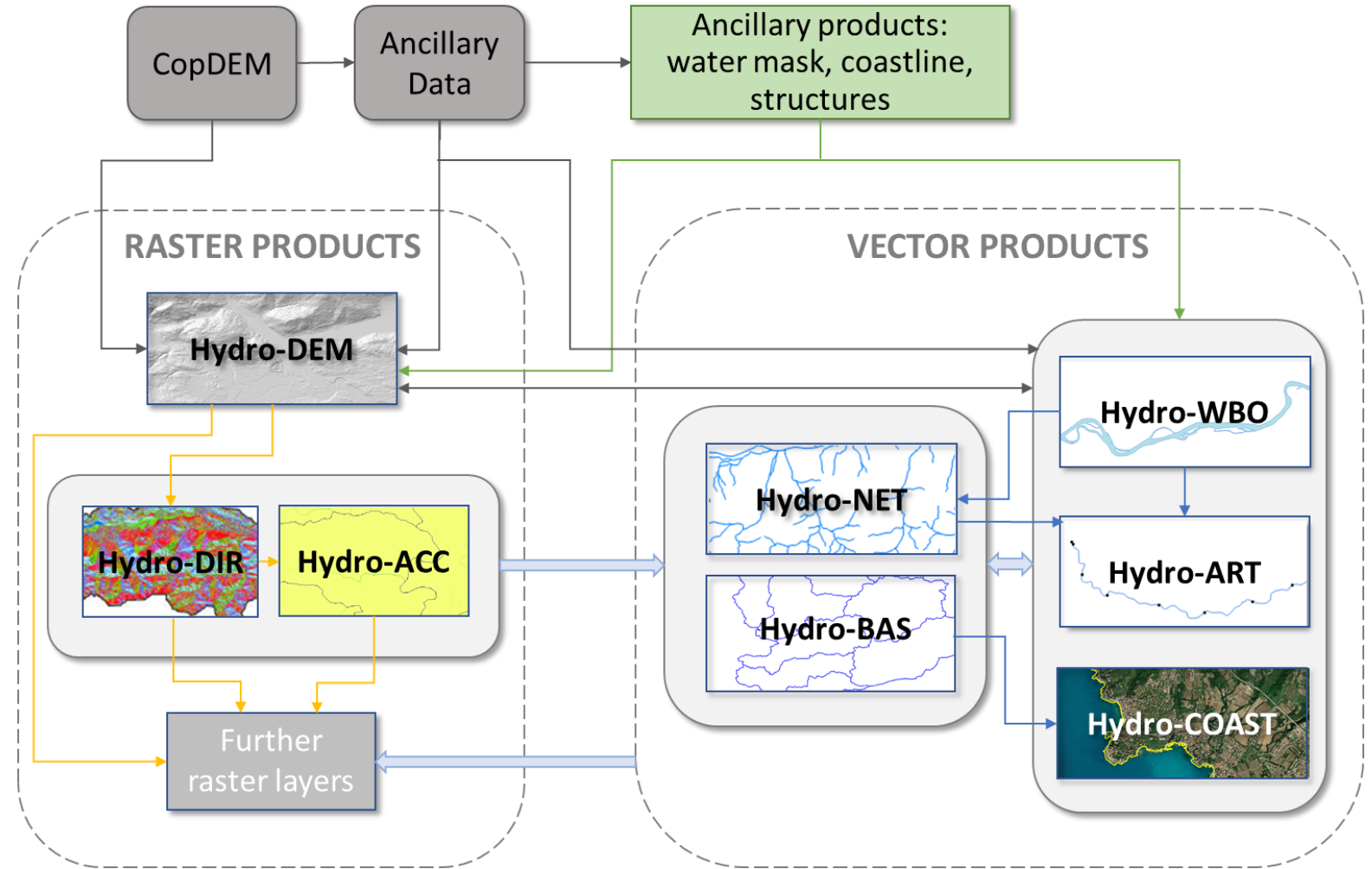
# EU-Hydro 2.0 Update

## 3 Raster layer:

- Hydro-conditioned
- DEM (DEM)
- Flow direction (DIR)  
Flow accumulation (ACC)

## 5 Vector layer:

- River network (NET)
- Basins and sub-basins (BAS)
- Water bodies (WBO)
- Artificial structures (ART)
- Coastline (COAST)



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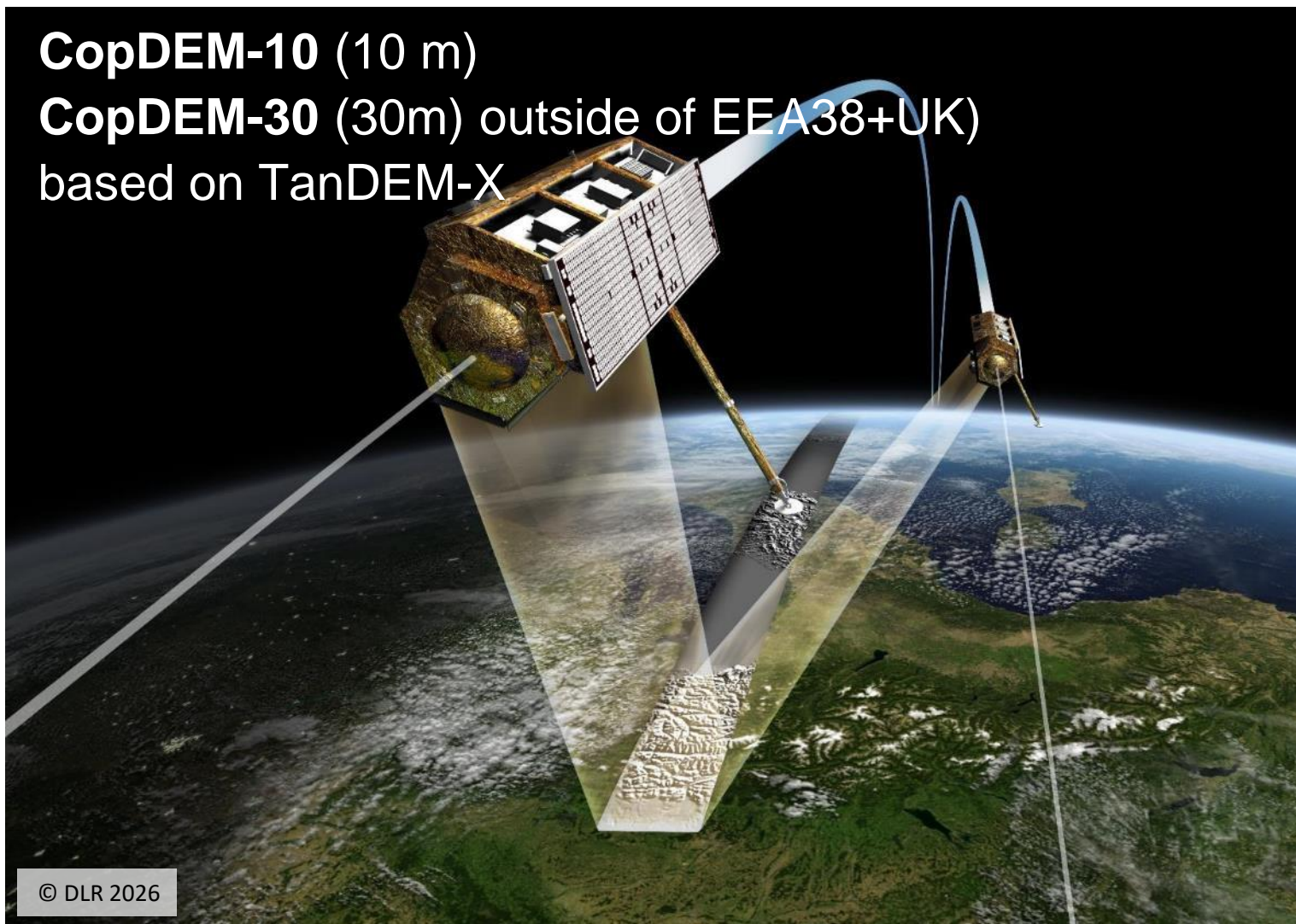


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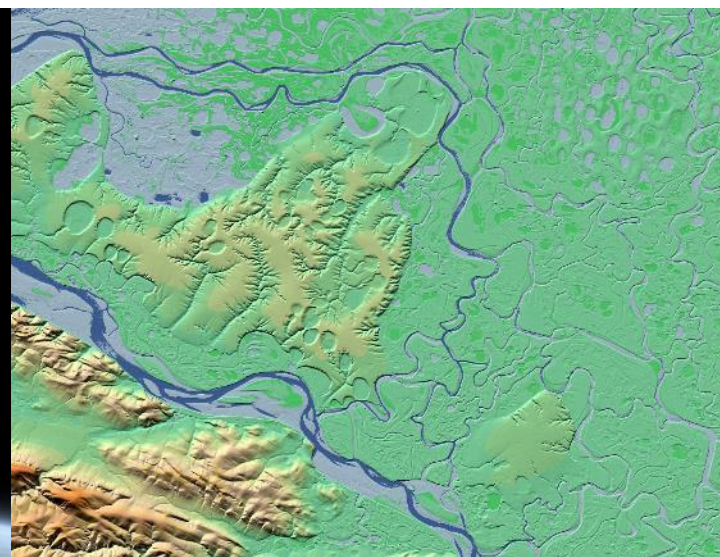
# Input Data: Copernicus DEM & Ancillary data

**CopDEM-10 (10 m)**

**CopDEM-30 (30m) outside of EEA38+UK)**  
based on TanDEM-X



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**Adding high quality  
ancillary data:**

- Hydrography
- Land cover
- Infrastructure
- Satellite data



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# Ancillary data used in EU-Hydro

Selection of ancillary/reference data use:

- **River line data:** to force the water flow in the DEM in a certain direction (DEM hydro-conditioning)
- **Water bodies and river polygons:** helping the incorporation of water surfaces into the elevation model and enabling elevation adjustments; for DEM hydro-conditioning and generation of Hydro-WBO
- **Forest / Vegetation:** for DEM editing
- **Infrastructure and buildings:** for DEM editing
- **Coastline:** for DEM conditioning; for generation of Hydro-COAST
- **Human made objects** (dams & culverts, lateral structures, coastal protection structures etc.): largely based on ancillary data on European and national level – for generation of Hydro-ART

CLMS HRL Water and Wetness (WaW)

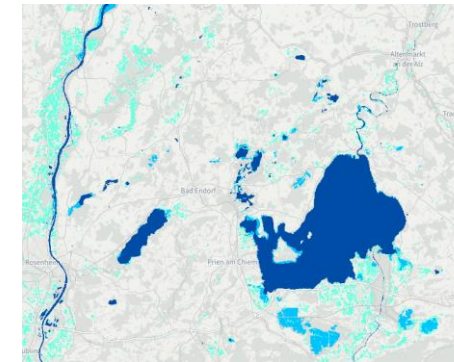
\*Lang et al., 2023, Lang et al., 2020

Open Street Map (OSM) – waterways

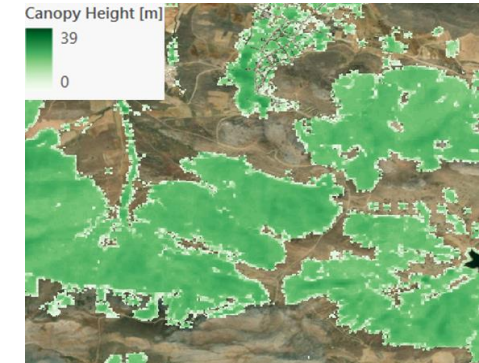
CLMS Small Woody Features (SWF)

CLMS Riparian Zones (RZ)

\*\*WSF: <https://geoservice.dlr.de/web/maps/eoc:wsf2019>



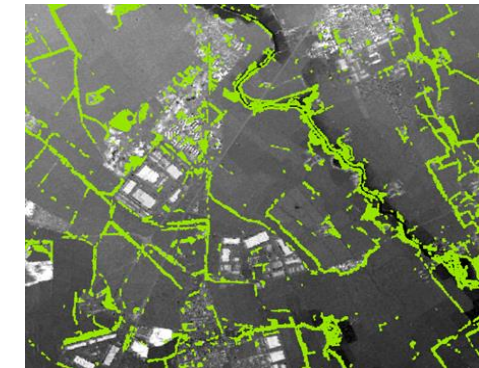
CLMS WaW



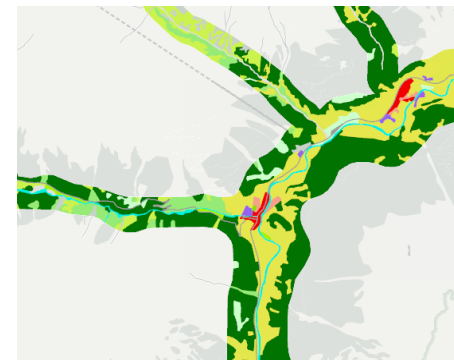
Global Canopy Height (ETHZ)\*



Canals: OSM (blue), Hydro-ART (pink)



CLMS SWF



CLMS RZ



World Settlement Footprint (WSF)\*\*

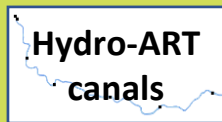




# Workflow – EU-Hydro 2.0 Production

Copernicus DEM & Ancillary Data preparation

Interim Layers



Raster layer production

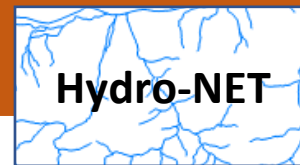
Vector layer extraction/production

DEM-based derivation

DEM Pre-conditioning (terrain editing)

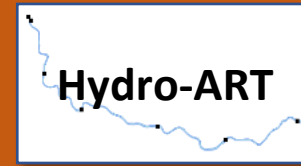
DEM Hydro-conditioning & manual corr.

Hydro-DEM



Ancillary data-Based mapping

Vector layer mapping/production



Internal QC & Verification

Delivery & Dissemination

External validation

Internal Quality Control



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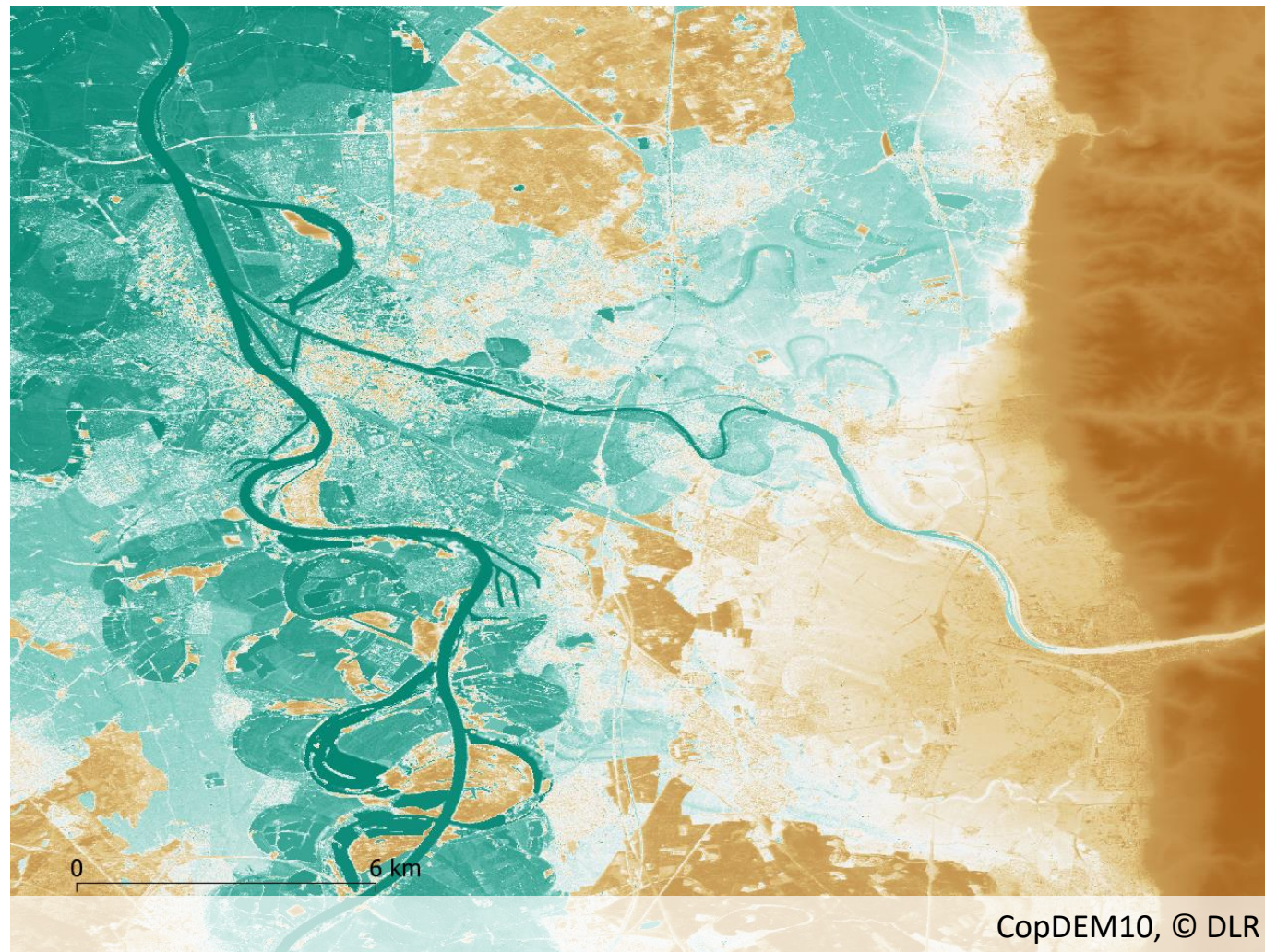


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# DEM Corrections

## Region: Rhein-Neckar (Germany)

- Original CopDEM



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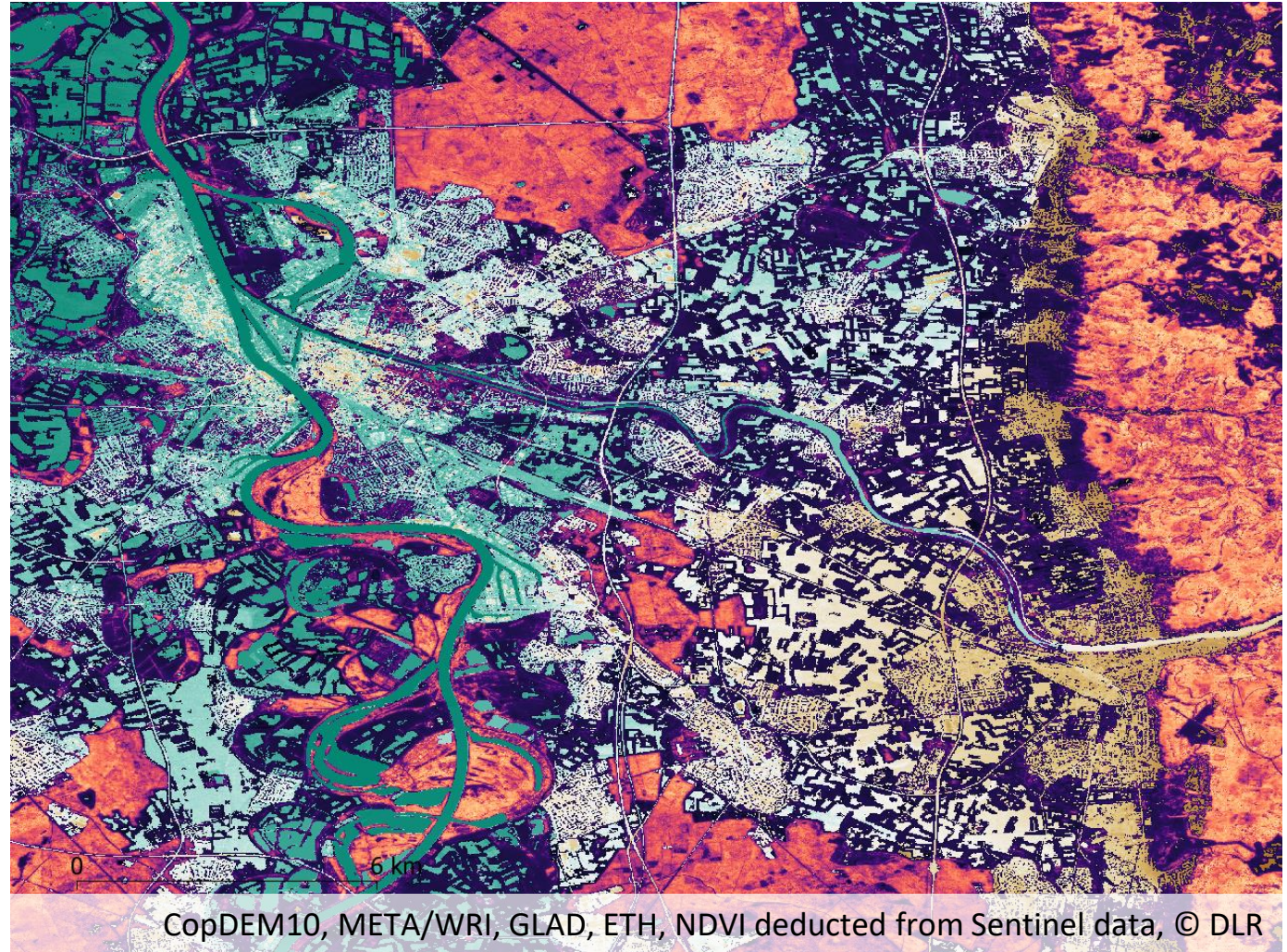
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# DEM Corrections

## Region: Rhein-Neckar (Germany)

### Forest/vegetation correction

- META/WRI Canopy Height Maps
- GLAD Forest Extent and Change
- ETH Global Canopy Height
- NDVI



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# DEM Corrections

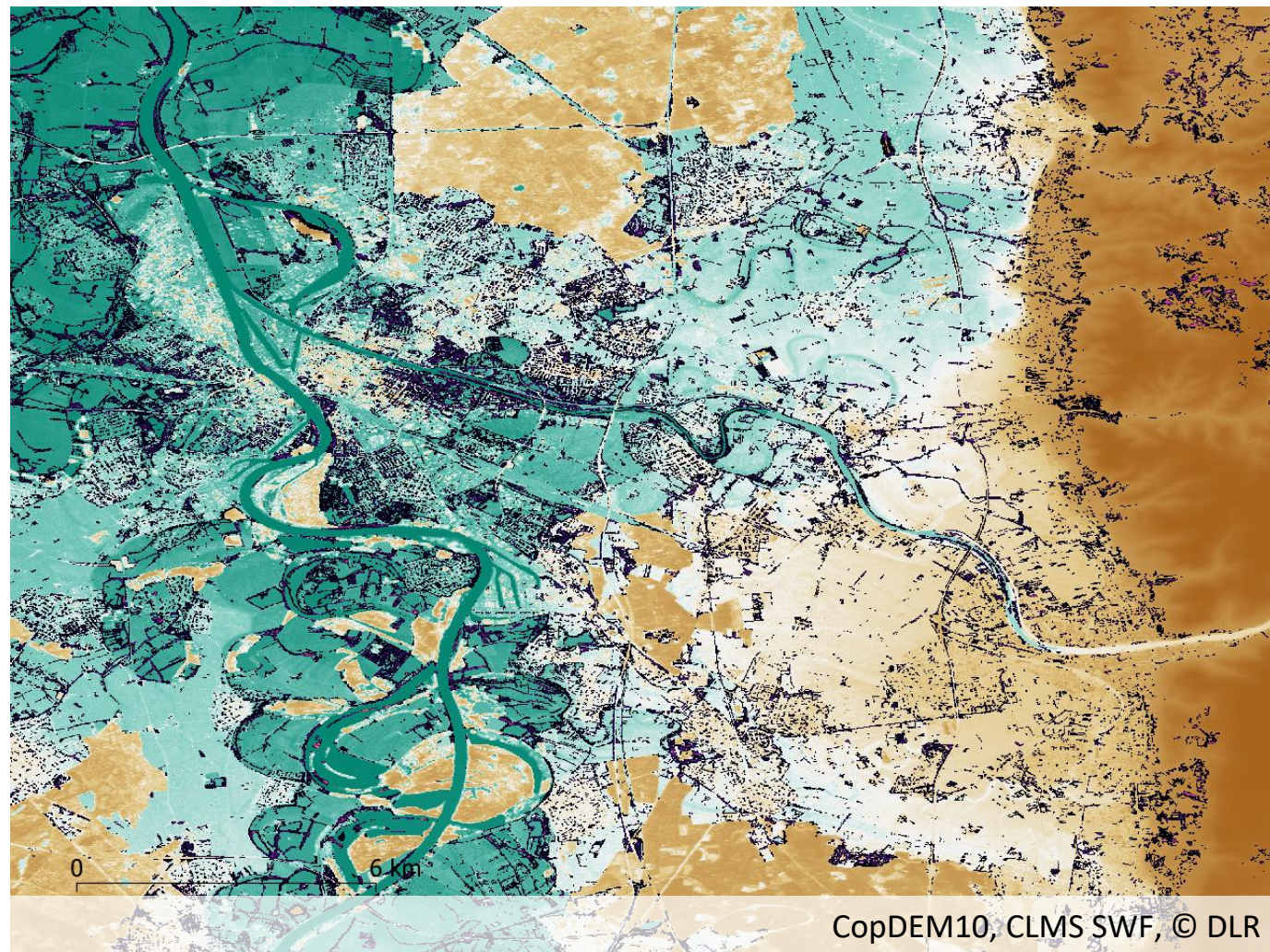
## Region: Rhein-Neckar (Germany)

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- METAWRI Canopy Height Maps
- GLAD Forest Extent and Change
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### Hedgerow correction

- CLMS Small Woody Features



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# DEM Corrections

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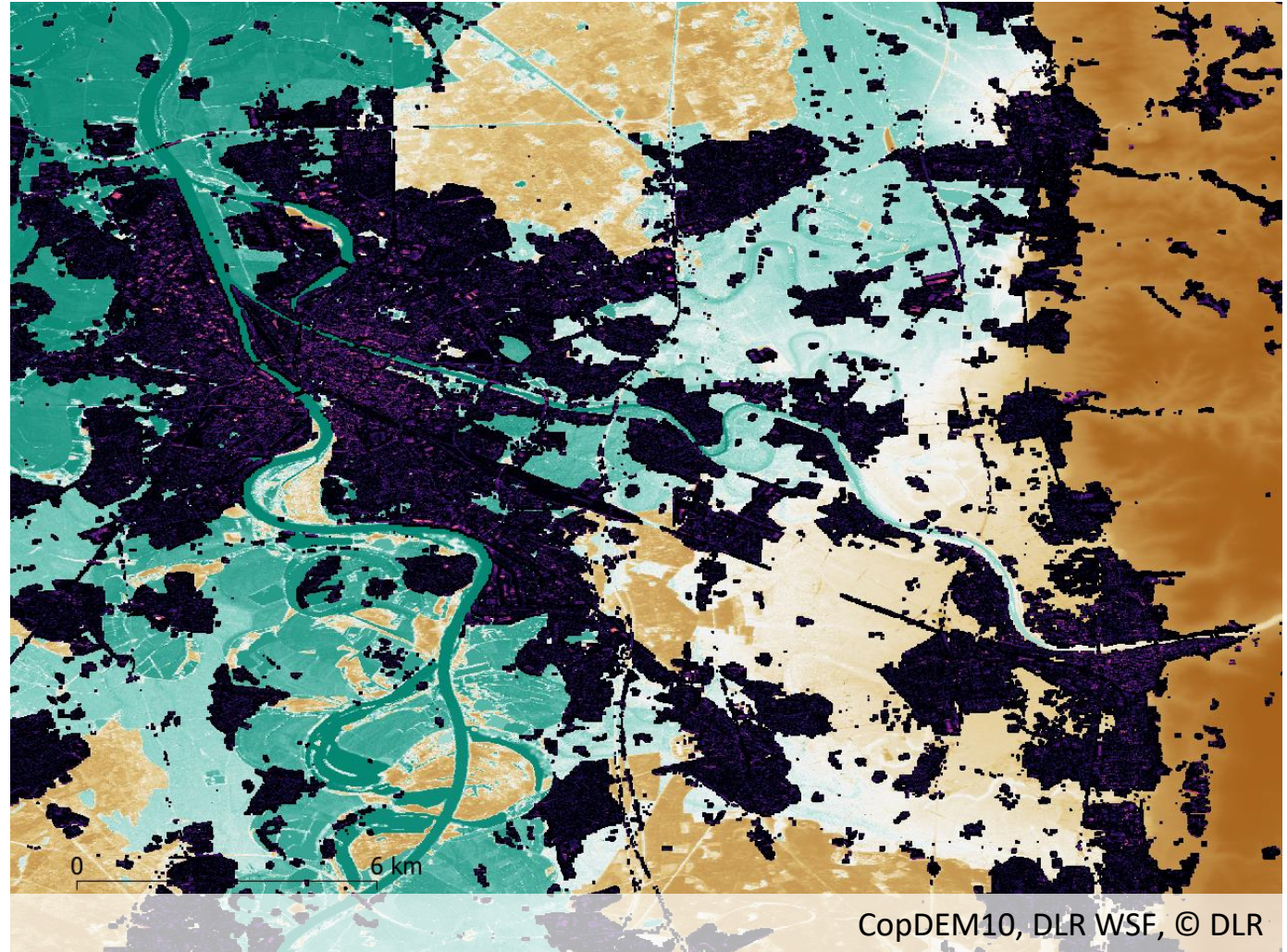
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### Hedgerow correction

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### Urban area correction

- DLR World Settlement Footprint



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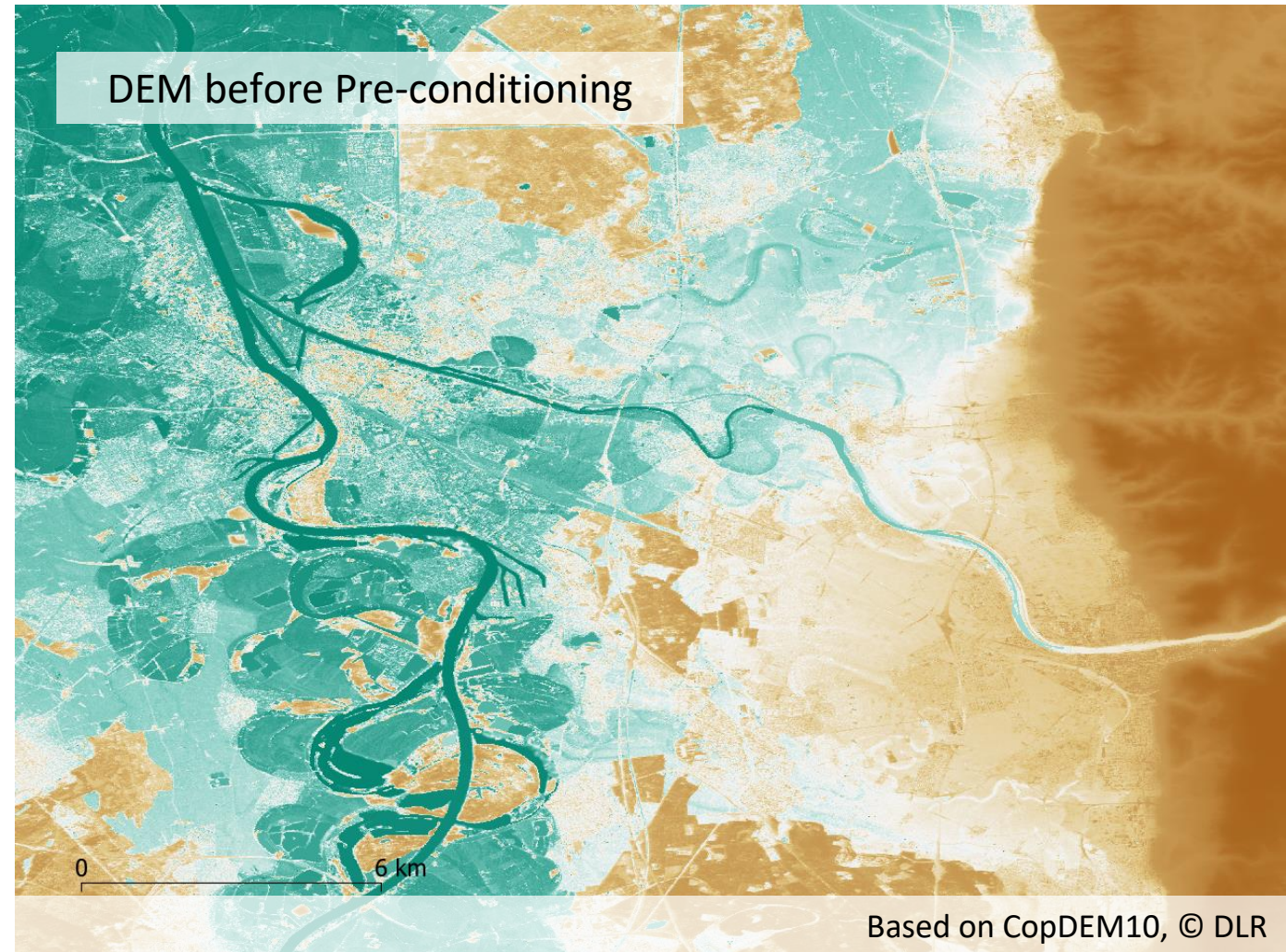
### Hedgerow correction

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→ **Pre-conditioned DEM**



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# DEM Terrain Editing

## Region: Rhein-Neckar (Germany)

### Forest/vegetation correction

- METAWRI Canopy Height Maps
- GLAD Forest Extent and Change
- ETH Global Canopy Height
- NDVI

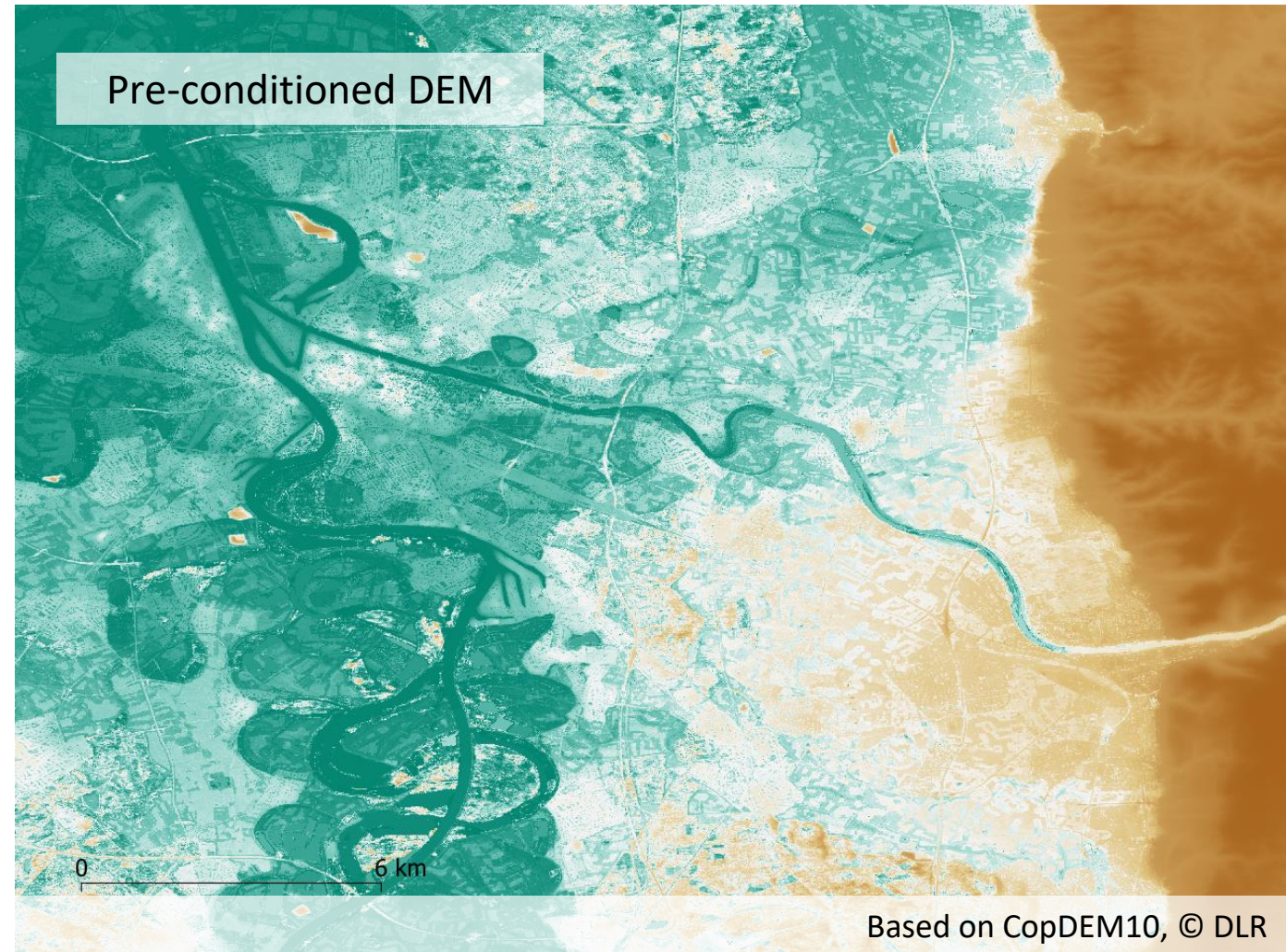
### Hedgerow correction

- CLMS Small Woody Features

### Urban area correction

- DLR World Settlement Footprint

→ **Pre-conditioned DEM**



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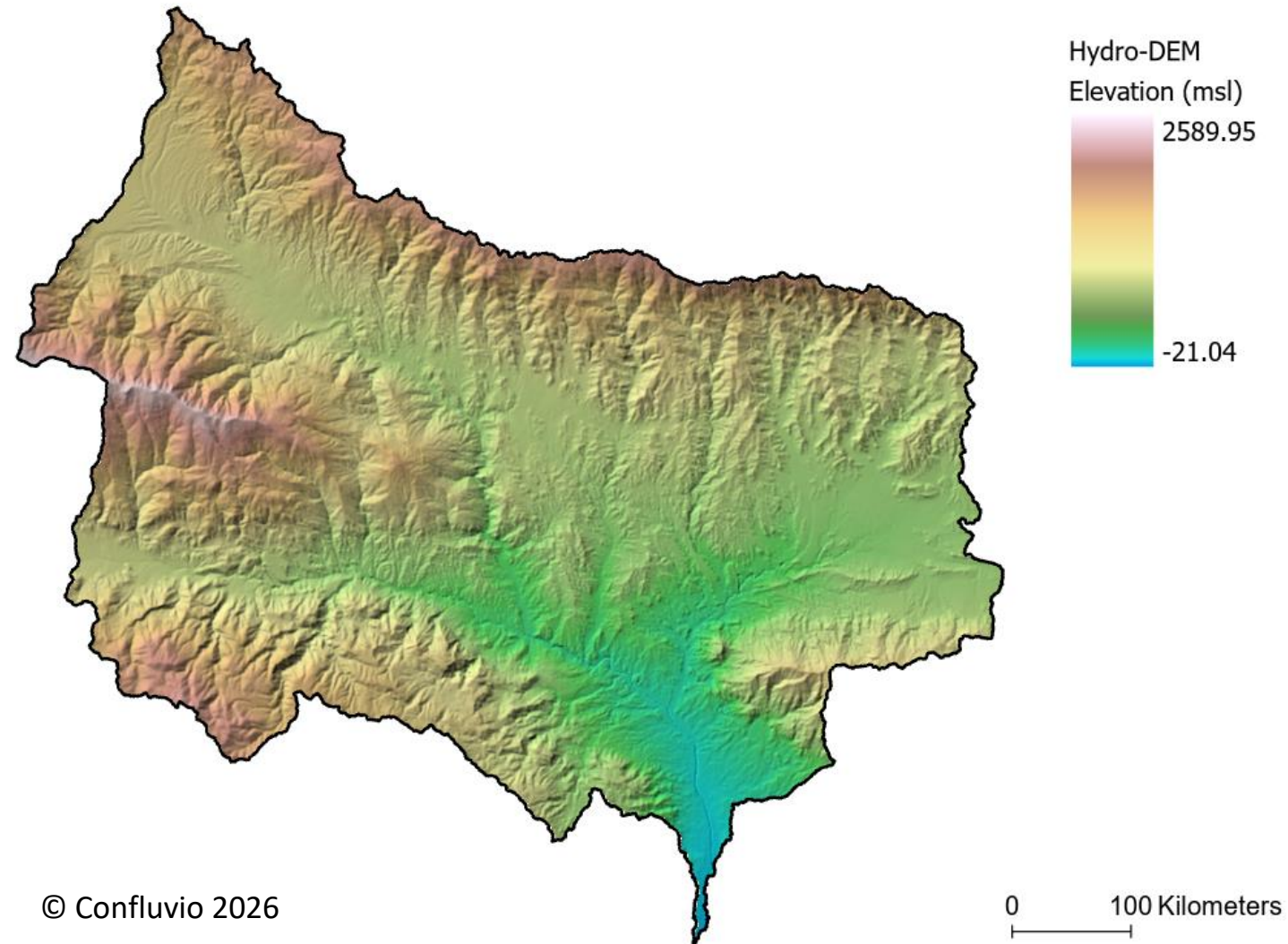




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# Hydro-DEM

- **Hydro-DEM = hydrologically conditioned DEM**
  - advanced DEM terrain-editing & hydrological conditioning
  - elevation values altered to represent actual water flow in the terrain → different to DTM



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*Example of the Hydro-DEM product (Spain site; elevation with hillshade).*



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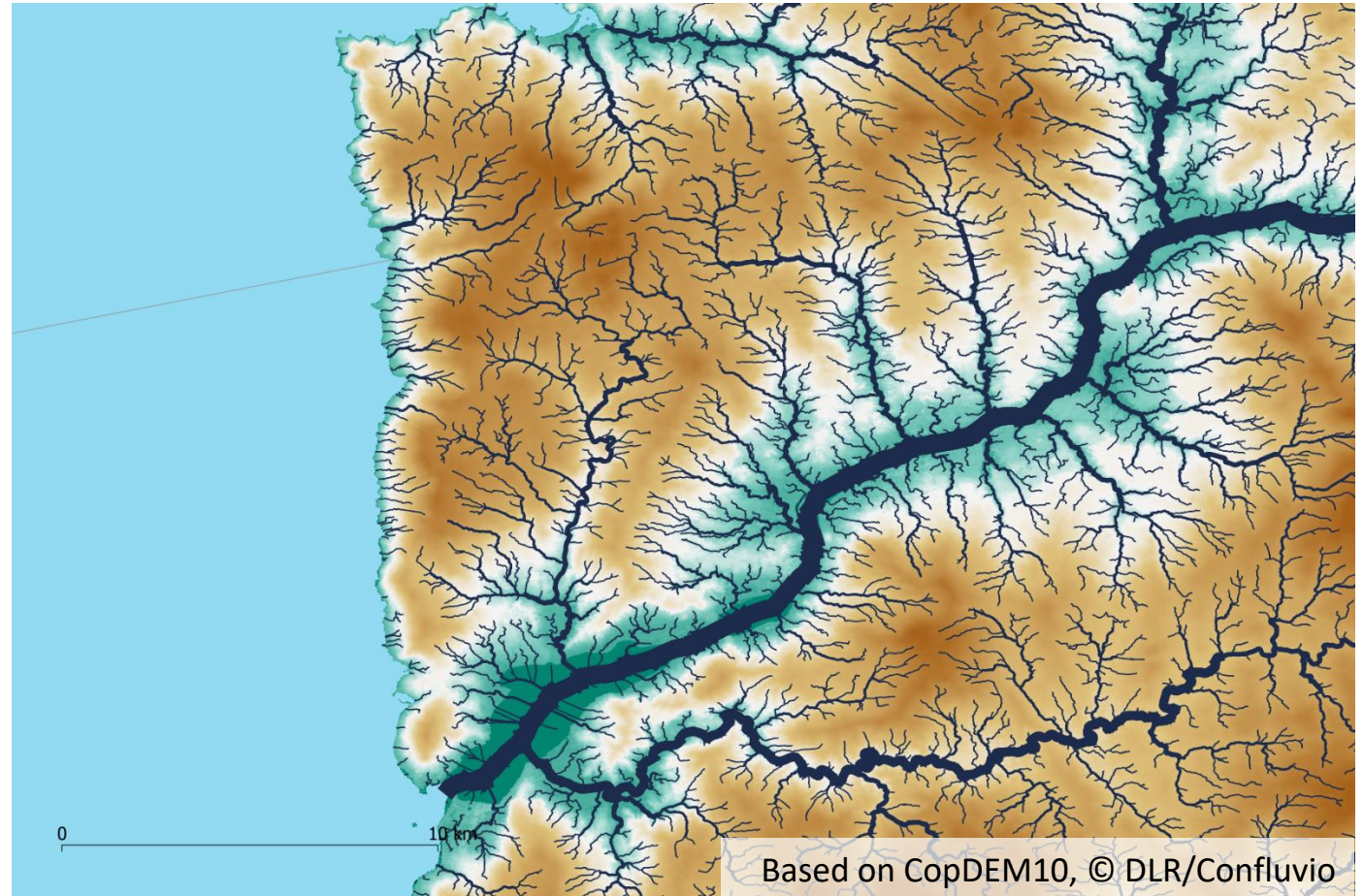


# DEM Hydro-conditioning

## Example: Spain/Portugal, Rio Miño

- Centrelines are traced through waterbodies (using a skeleton approach) → **river extraction**
- Manual corrections (on Hydro-DEM) using ancillary maps of rivers and canals

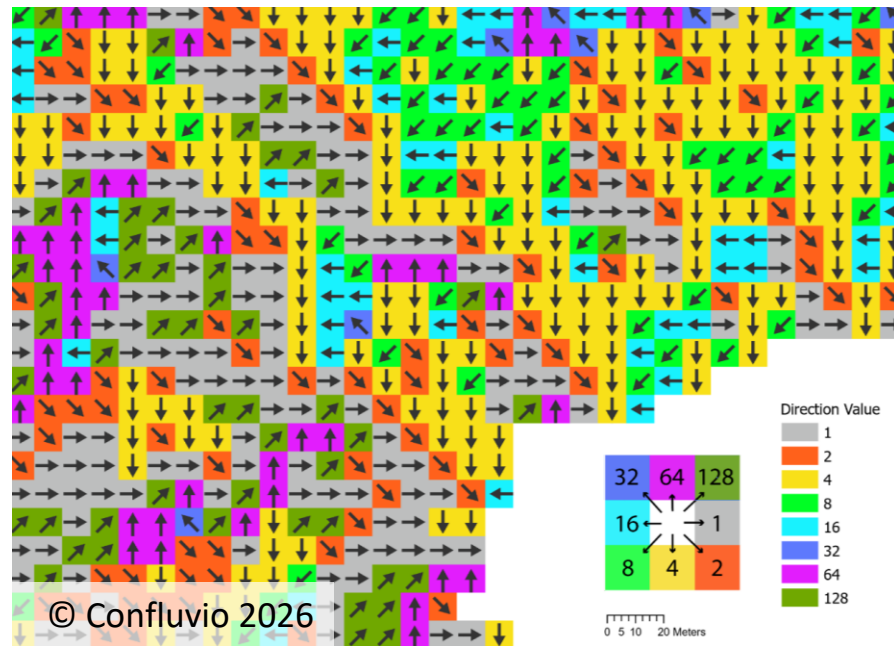
→ **Improvements of Hydro-DEM**





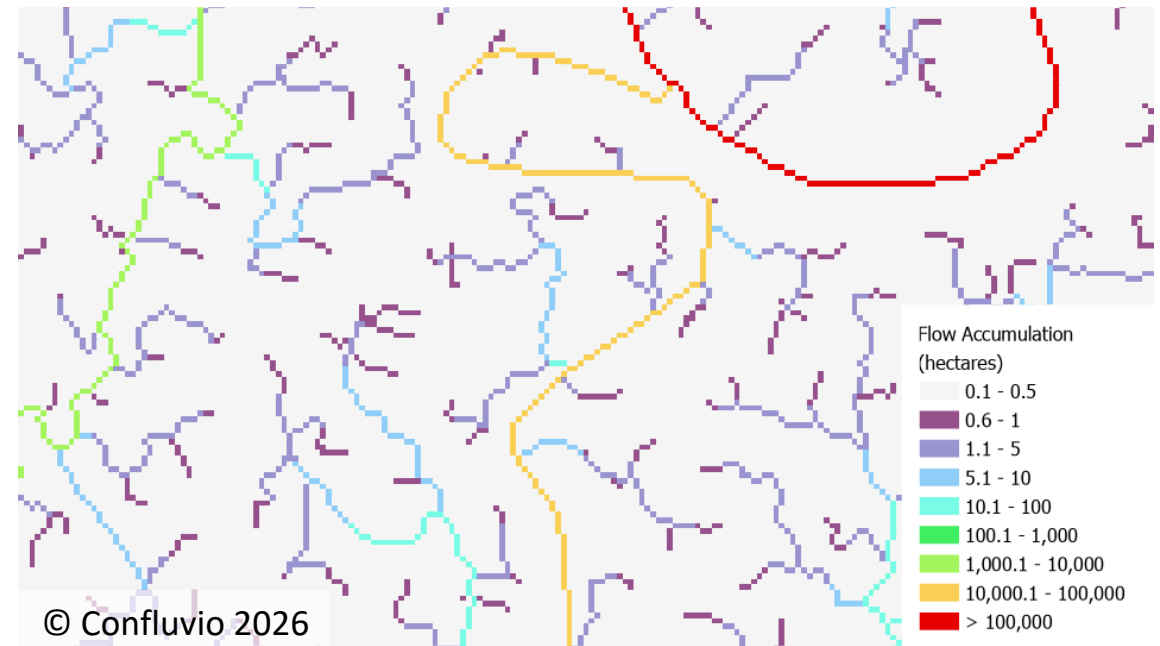
# Hydro-DIR and Hydro-ACC

**Hydro-DIR** = flow direction (D8 methodology, single downstream direction based on steepest slope)



*Example: Hydro-DIR product (coastal area, Sweden)*

**Hydro-ACC** = flow accumulation = size of the area discharging into each grid cell



*Example: Hydro-ACC product (Po area, Italy)*



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# Hydro-NET & Hydro-BAS

**Hydro-NET & BAS:** Extracted from DIR/ACC; topologically coded → allows for network tracing through river and basin network

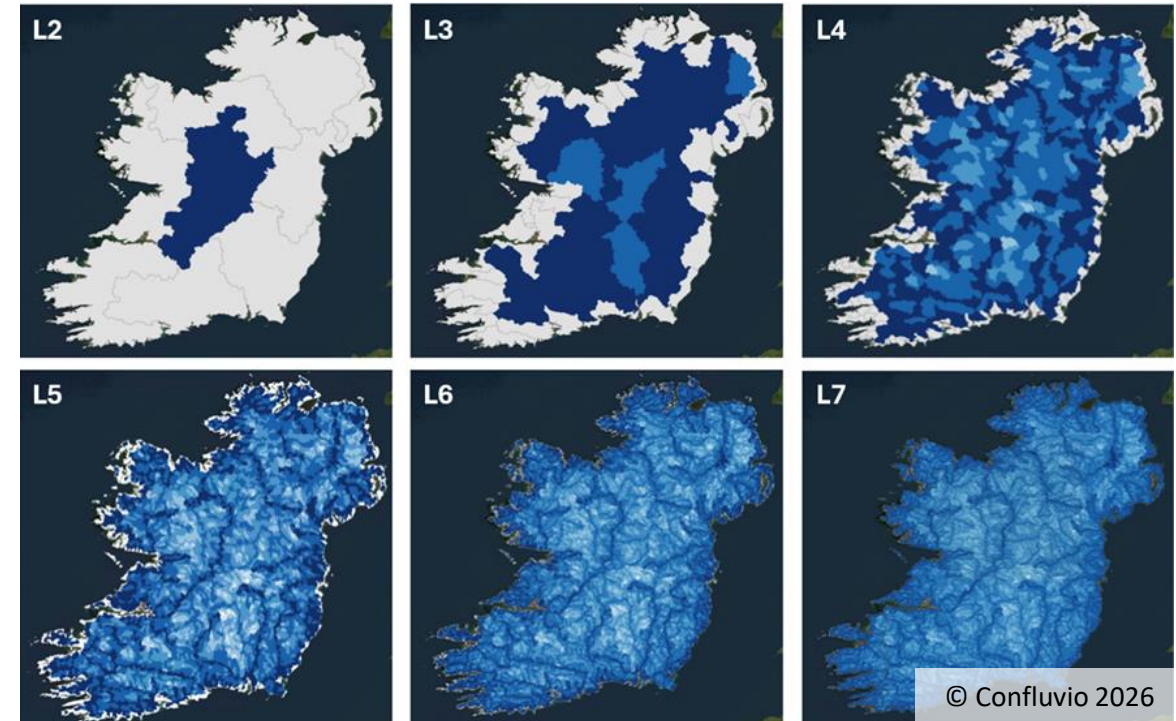
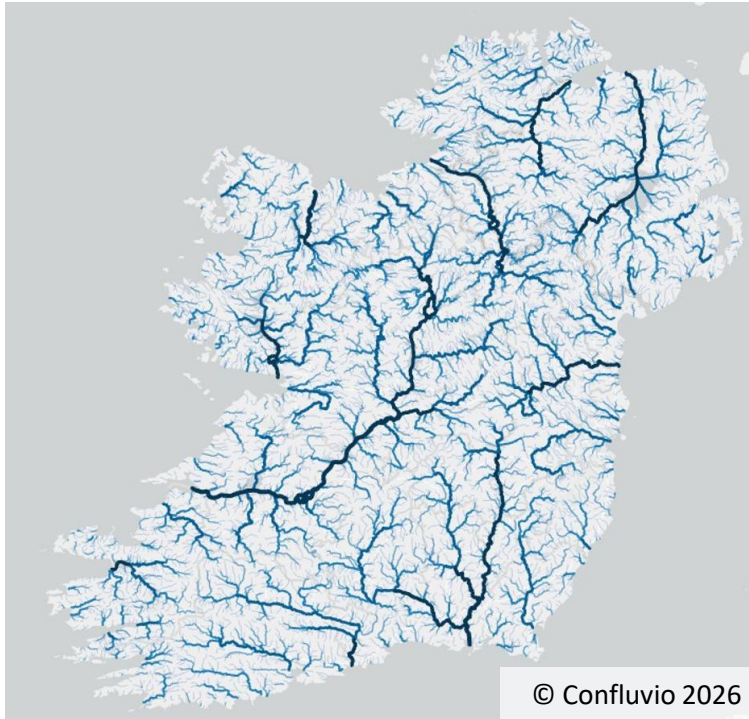
**Hydro-NET:** River network

Threshold 0.1 km<sup>2</sup> (upstream area) for river extraction;

Attributes: river orders (Strahler, Hack), routing...

**Hydro-BAS:** Hierarchically nested watershed units

EU-Hydro V1.3:  
river\_net\_1  
15,321 river  
reaches



Hydro-BAS product (7 levels for Ireland/Northern Ireland)



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# Hydro-NET & Hydro-BAS

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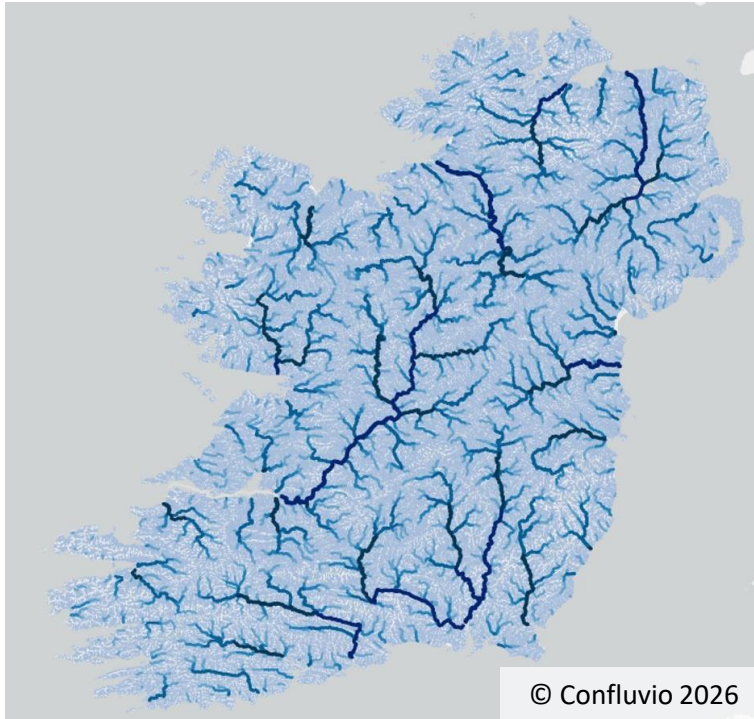
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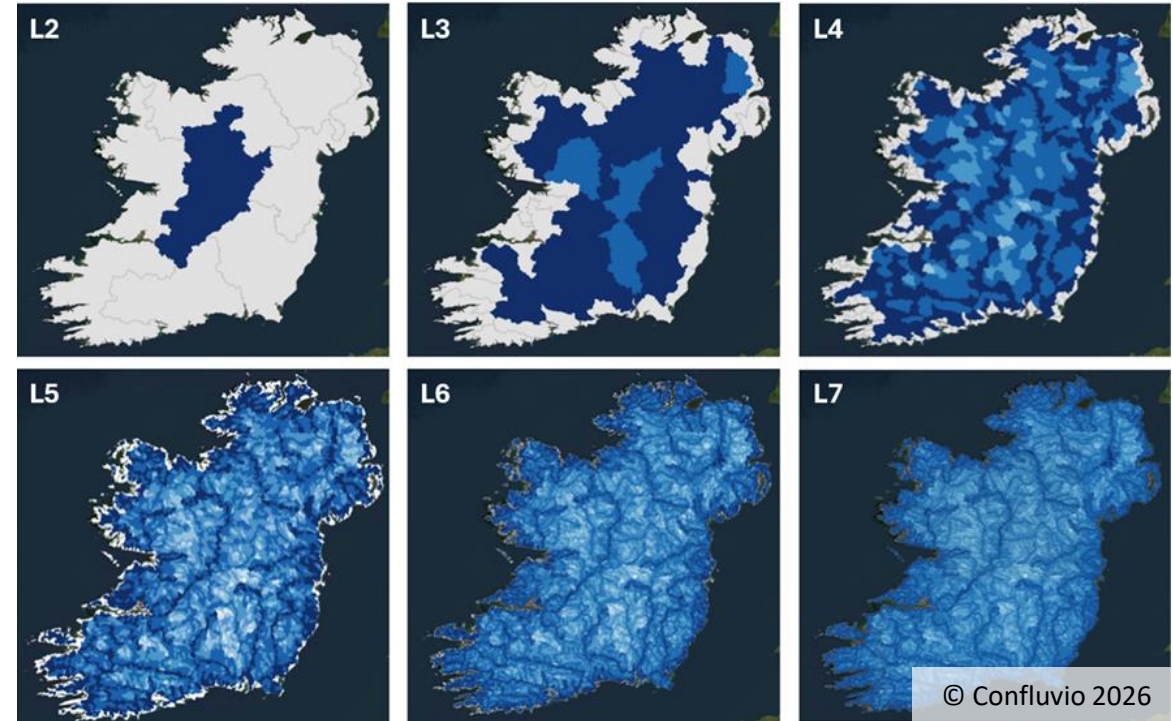


EU-Hydro V2.0:  
Hydro-NET  
432,595 river  
reaches



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Hydro-NET product (Ireland/Northern Ireland)



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Hydro-BAS product (7 levels for Ireland/Northern Ireland)



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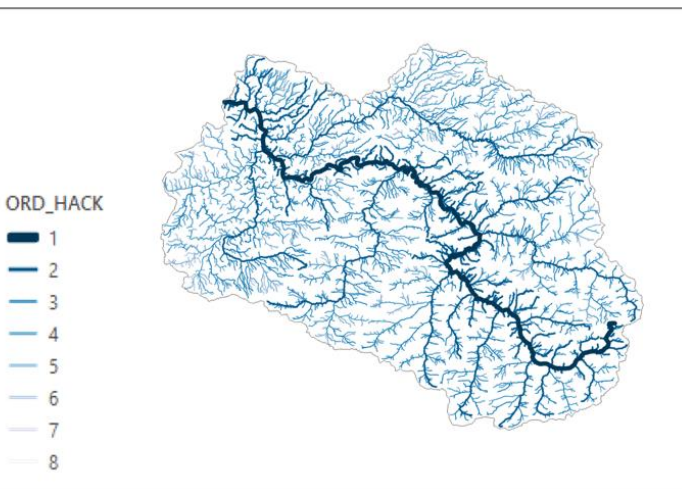
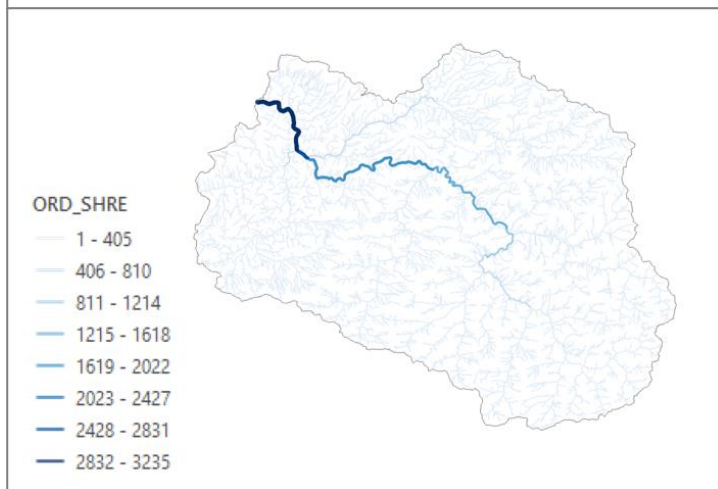
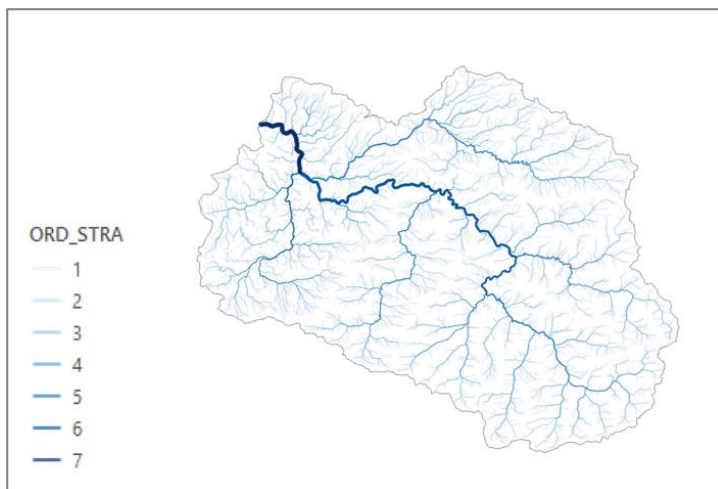


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STRMID	414116
STRM_DN	414252
STRM_UP	
HYBAS_ID	1081_05_01_05_08_04

STRMID	414319
STRM_DN	414408
STRM_UP	414228_414252
HYBAS_ID	1081_05_01_05_08_02



NET attributes contain connectivity (upstream & downstream), linkage to BAS and stream order information among others. NET-nodes also contain connectivity data.



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# Hydro-BAS (Delineation and Levelling)

- Watersheds were derived following the principles established in the HydroBASINS and BasinATLAS products (Lehner & Grill, 2013)
- Sub-watersheds are delineated at any confluence where the inflowing branches (i.e., a tributary and its main stem) exceed a certain size threshold based on the number of upstream pixels or the upstream catchment area.
- Nested **levels** of watershed units where finer basin levels add detail inside coarser parents basins
- **Coastal basins:** Basins that did not meet the size threshold at the respective level were grouped to create aggregated basins

*Basin levels and thresholds currently set in Hydro-BAS*

Level	Role	Threshold (subject to change)
L1	Regional Grouping	—
L2	Main basin	>100M cells (~10,000 km <sup>2</sup> )
L3	Major tributaries	>10M cells (~1,000 km <sup>2</sup> )
L4		>1M cells (~100 km <sup>2</sup> )
L5		>100k cells (~10 km <sup>2</sup> )
L6		>10k cells (~1 km <sup>2</sup> )
L7	Finest tributaries	>1k cells (~0.1 km <sup>2</sup> )





# Hydro-BAS (Hydro-BAS ID)

- Basin ID's are generated using coding scheme that is similar to the Pfafstetter system, but relies on network thresholds –
  - Each parent gets a 2-digit code at its level.
  - Each child keeps the parent prefix and appends its own 2-digit suffix.
  - Within each parent, children are grouped and numbered sequentially.
  - Full ID length reflects hierarchical level; prefixes identify upstream parents

*Illustration of nesting and Hydro-BAS ID generation*

PARENT L1	PARENT L2	Level 3 ID	HYDRO BAS 1	HYDRO BAS 2	HYDRO BAS 3	HYDRO BAS ID
1	10	101	01	01	01	01_01_01
1	10	102	01	01	02	01_01_02
1	11	103	01	02	01	01_02_01
2	20	104	02	01	01	02_01_01

- Example (using 3 levels):
  - a sub-basin at Level 3 will be represented by a string of 3 individual codes: “L1-code\_L2-code\_L3-code”, e.g., “01\_07\_15”.
  - In this example, the sub-basin would be sub-basin #15 at Level 3, nested within sub-basin #7 at Level 2, nested within sub-basin #1 at Level 1.



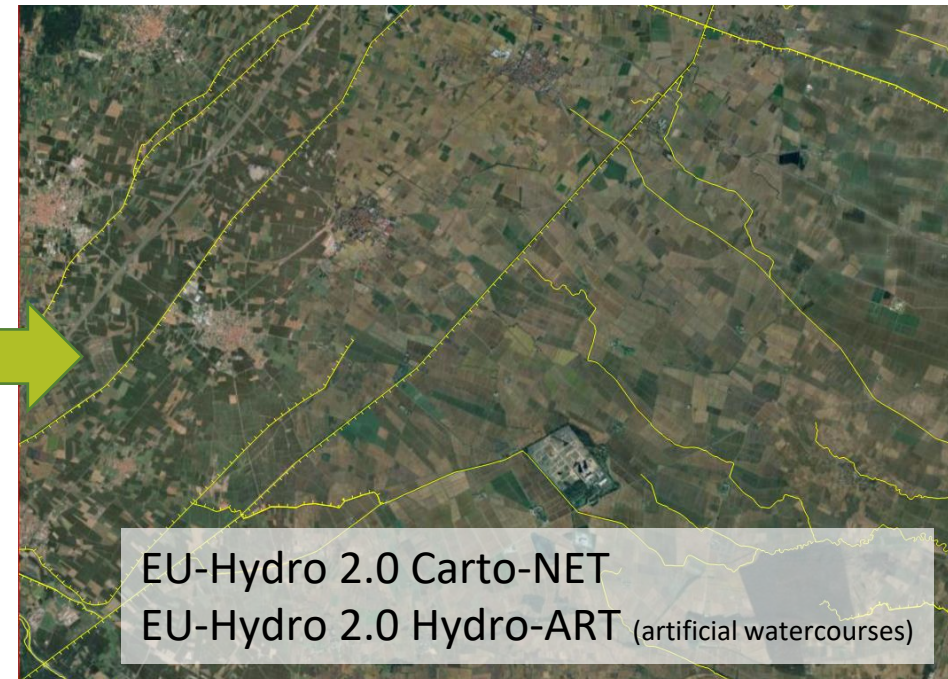
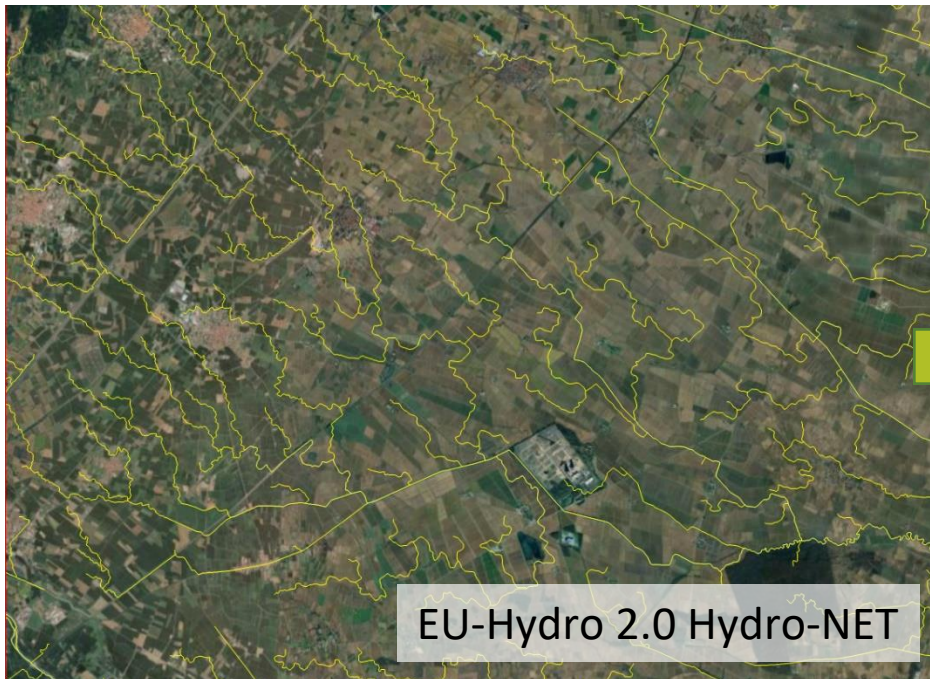


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# Carto-NET

A new proposed layer “Carto-NET” for cartographic improvements in **focus regions**:

- Clean / removal of ‘overland flow’ by attributes (no deletion from Hydro-NET → important for hydrology/network connectivity and routing)
- Rivers to be replaced with better canal geometries (in case of duplications)
- Alignment of Hydro-ART canals with reduced river network



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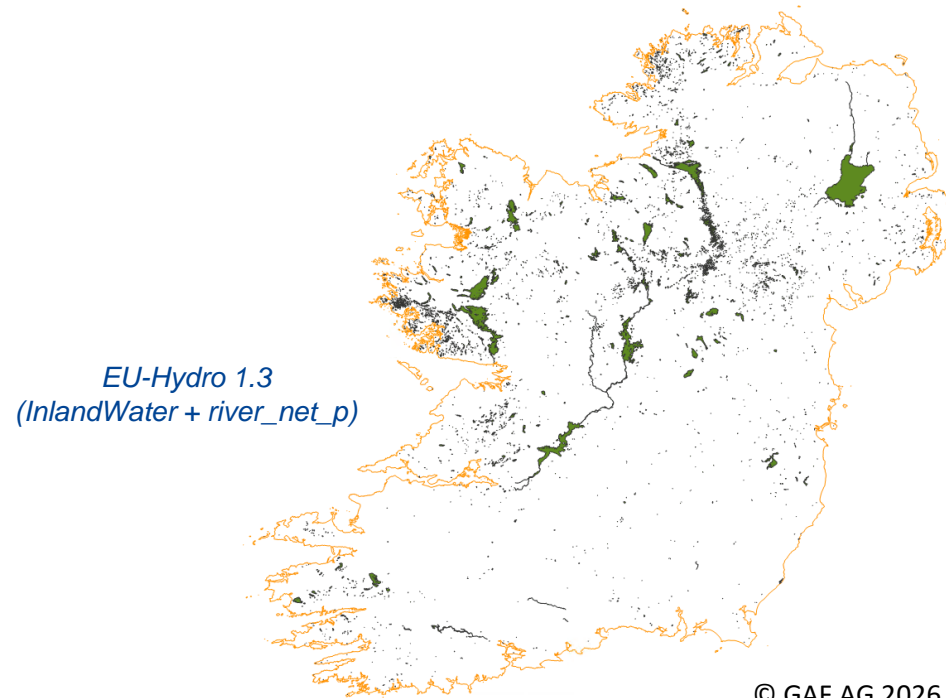


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# Hydro-WBO & Hydro-ART

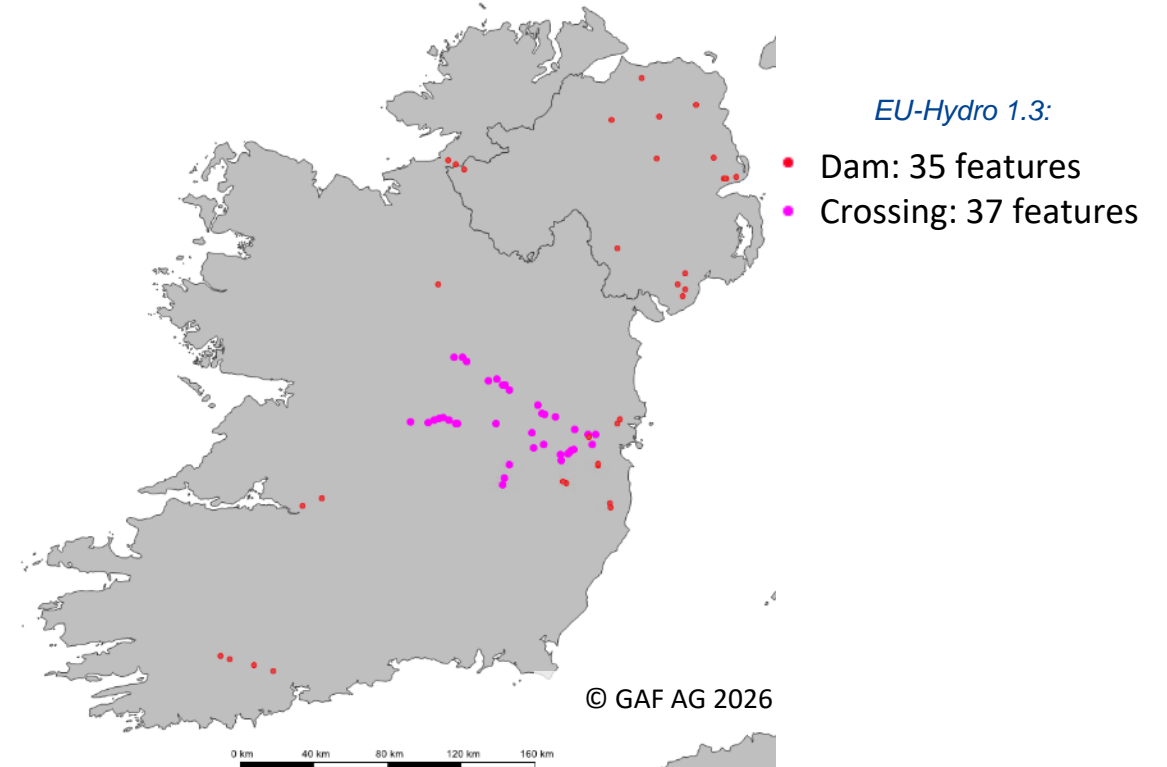
## Hydro-WBO: Water Bodies

- Lakes/Reservoirs > 0,5 ha
- Rivers > 10m width
- Update: EU-Hydro v1.3 → CLMS RZ, CLCplus 2023, WaW, HydroSHEDS-2, new TDX (EU-Hydro 2.0), OSM
- River network as centrelines



## Hydro-ART: Artificial Structures

- Stand-alone cartographic product
- Input: ancillary data (regional-global)
  - Artificial watercourses (e.g. canals)
  - Longitudinal barrier structures (e.g. dams)
  - Lateral barrier structures (e.g. embankments)
  - Coastal protection structures



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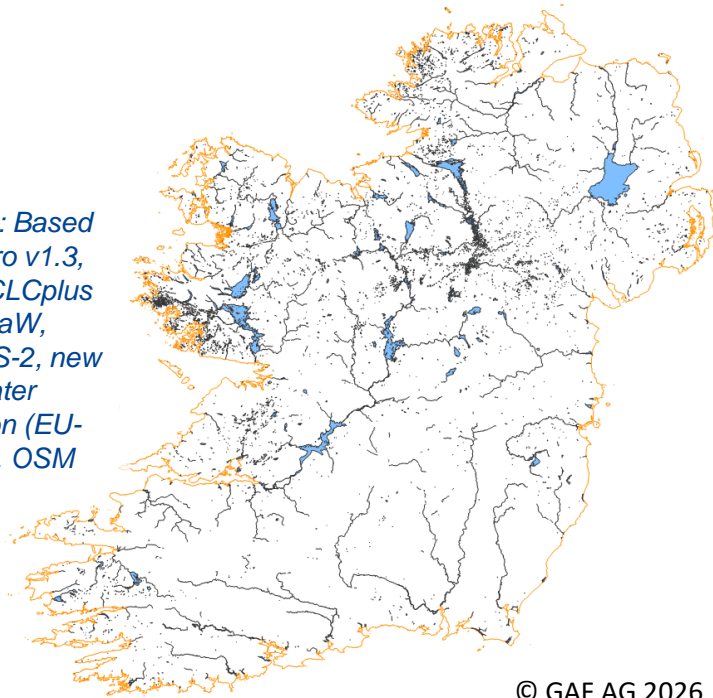
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# Hydro-WBO & Hydro-ART

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*Hydro-WBO: Based on EU-Hydro v1.3, CLMS RZ, CLCplus 2023, WaW, HydroSHEDS-2, new TDX water classification (EU-Hydro 2.0), OSM*

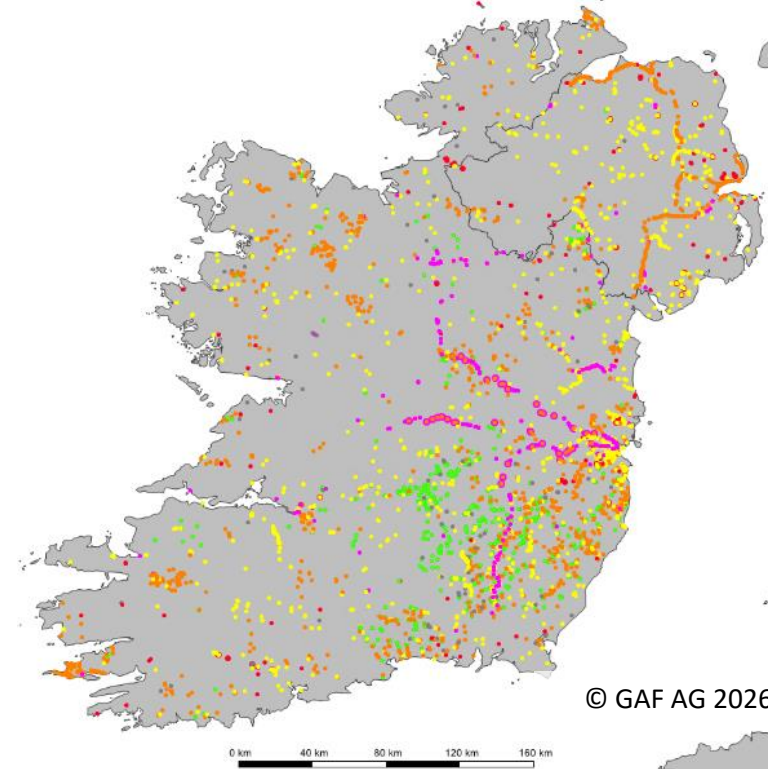


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*Hydro-WBO product (Ireland/Northern Ireland)*

## Hydro-ART: Artificial Structures

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*Hydro-ART - Longitudinal barrier structures: dam, weir, ramp, sluice/lock, crossing, other (Ireland/Northern Ireland)*

*EU-Hydro 1.3:*

- Dam: 35 features
- Crossing: 37 features



- Dam: 180 features
- Crossing: 1610 features
- Other: 139 features
- Ramp: 600 features
- Sluice/lock: 499 features
- weir: 1702 features

*Hydro-ART: Based on OSM, WISE, AMBER, national and regional data*



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Europe's eyes on Earth

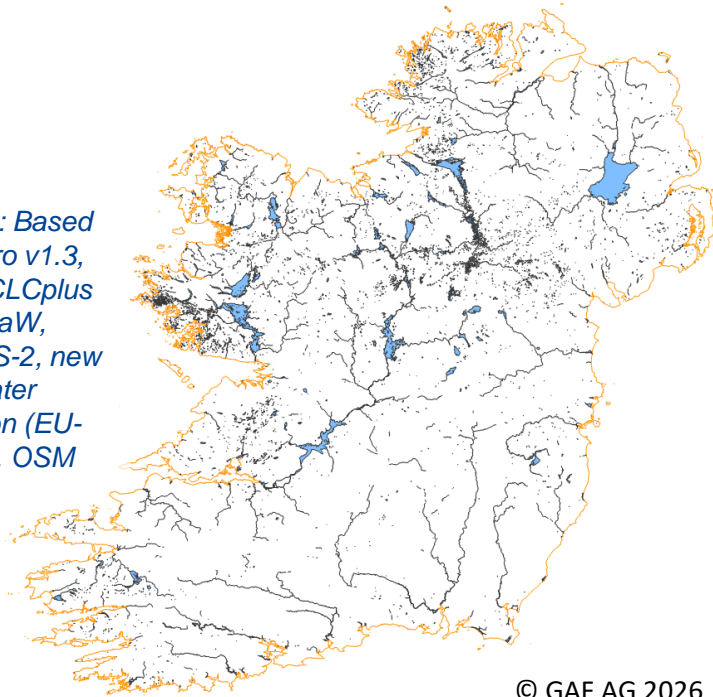


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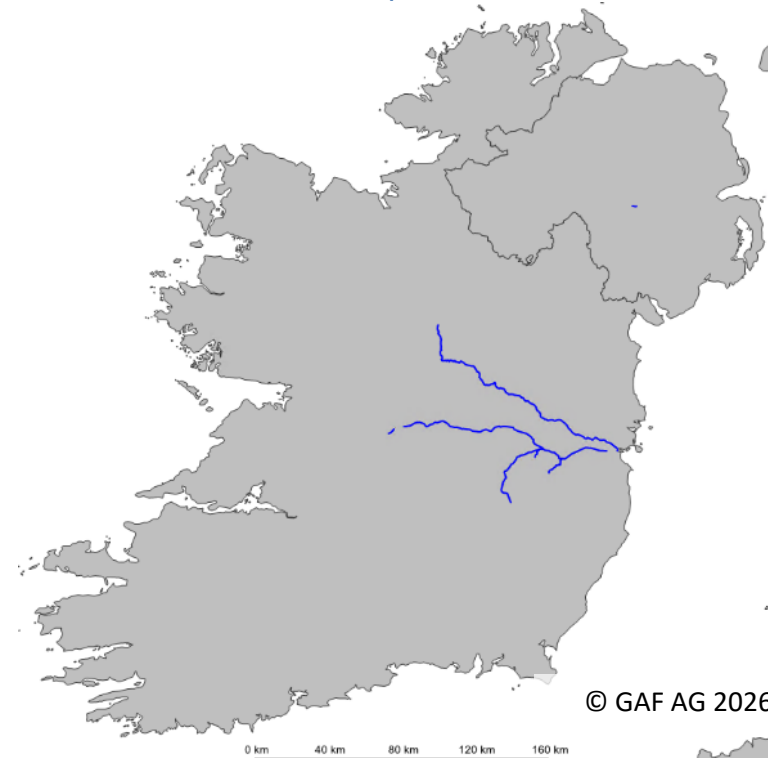


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*Hydro-WBO product (Ireland/Northern Ireland)*

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*EU-Hydro 1.3:  
(canal\_1)*

— Canals: 343,266 m

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0 km 40 km 80 km 120 km 160 km



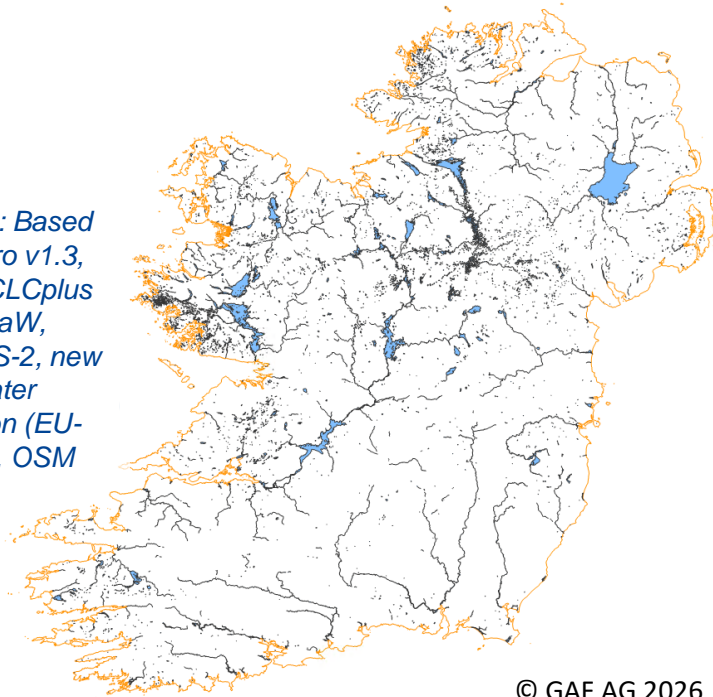


# Hydro-WBO & Hydro-ART

## Hydro-WBO: Water Bodies

- Lakes/Reservoirs > 0,5 ha
- Rivers > 10m width
- Update: EU-Hydro v1.3 → CLMS RZ, CLCplus 2023, WaW, HydroSHEDS-2, new TDX (EU-Hydro 2.0), OSM
- River network as centrelines

*Hydro-WBO: Based on EU-Hydro v1.3, CLMS RZ, CLCplus 2023, WaW, HydroSHEDS-2, new TDX water classification (EU-Hydro 2.0), OSM*

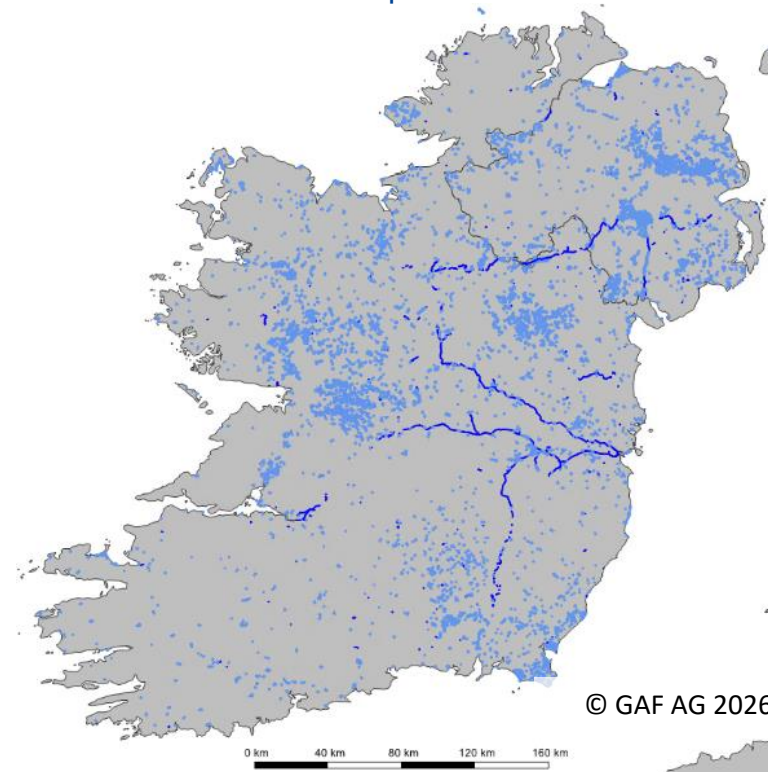


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*Hydro-WBO product (Ireland/Northern Ireland)*

## Hydro-ART: Artificial Structures

- Stand-alone cartographic product
- Input: ancillary data (regional-global)
  - Artificial watercourses (e.g. canals)
  - Longitudinal barrier structures (e.g. dams)
  - Lateral barrier structures (e.g. embankments)
  - Coastal protection structures



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*Hydro-ART product: Artificial watercourses: canals and ditches (Ireland, Northern Ireland)*

*EU-Hydro 1.3:  
(canal\_I)*

— Canals: 343,266 m



— Canals: 786,559 m

— Ditches: 4,146,299 m

*Hydro-ART: Based on OSM, WISE, national und regional data*



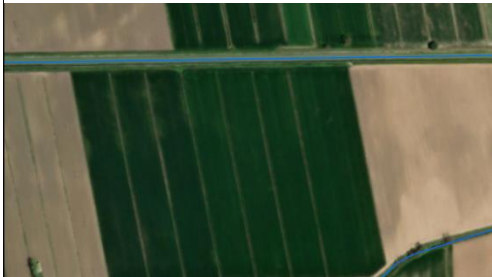


# Hydro-ART

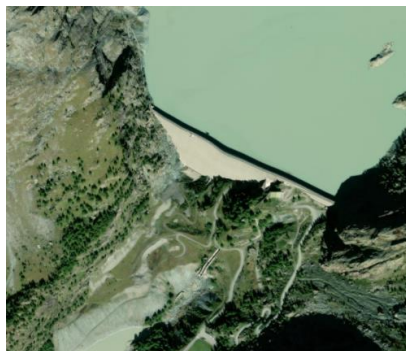
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Canal - South -Sweden; background: ESRI World Imagery



Ditch - Italy; background: ESRI World Imagery



Alpa-Gera-Dam Italy; background: ESRI World Imagery



Weir, AMBER barrier Atlas



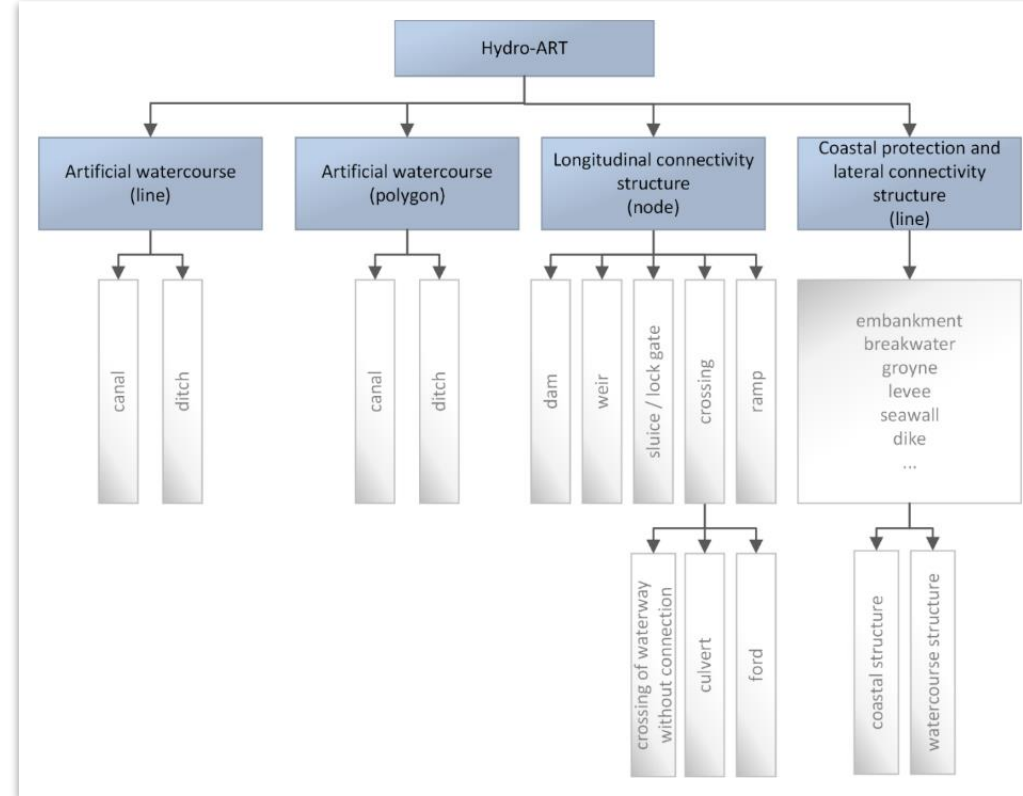
Lock gates, Canal Bianco Italy, background: ESRI World Imagery



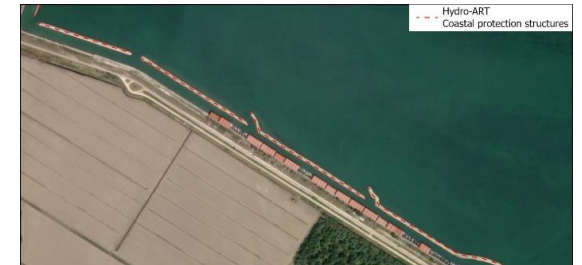
Crossing - Culvert, AMBER Barrier Atlas



Path-overs - Italy, background: ESRI World Imagery



Breakwater - Spain; background: Maxar, Microsoft



Groyne - Italy; background: Maxar, Microsoft



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Weir, AMBER barrier Atlas



European Environment Agency



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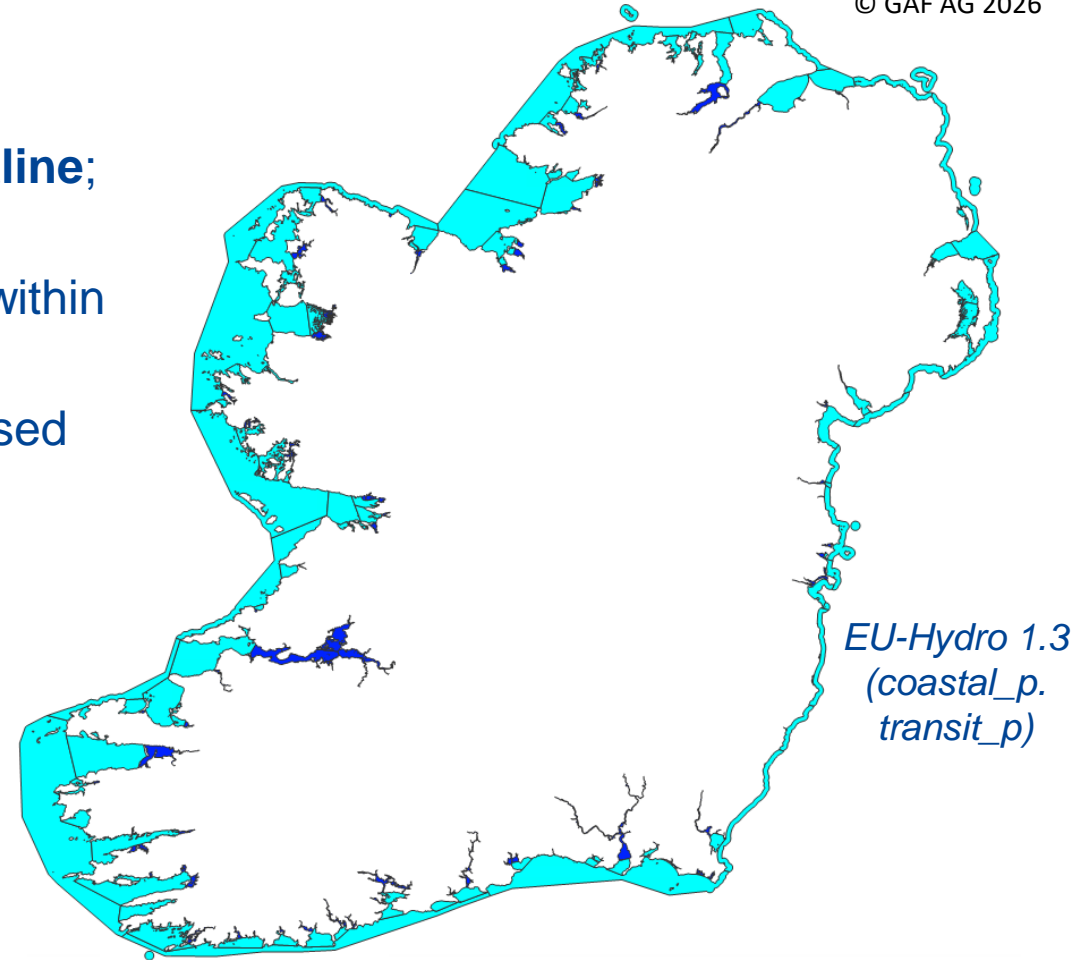


# Hydro-COAST

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## Hydro-COAST: Coastline

- Basis = **modified CLMS Coastal Zones (CZ) coastline**; adapted with **TanDEM-X HydroSHEDS-2 coastline**
- Different coastline definition at river outlets, agreed within requirements of CLMS und modelling community
- Higher level of detail: small islands (>0.5 ha); increased accuracy at artificial harbour area



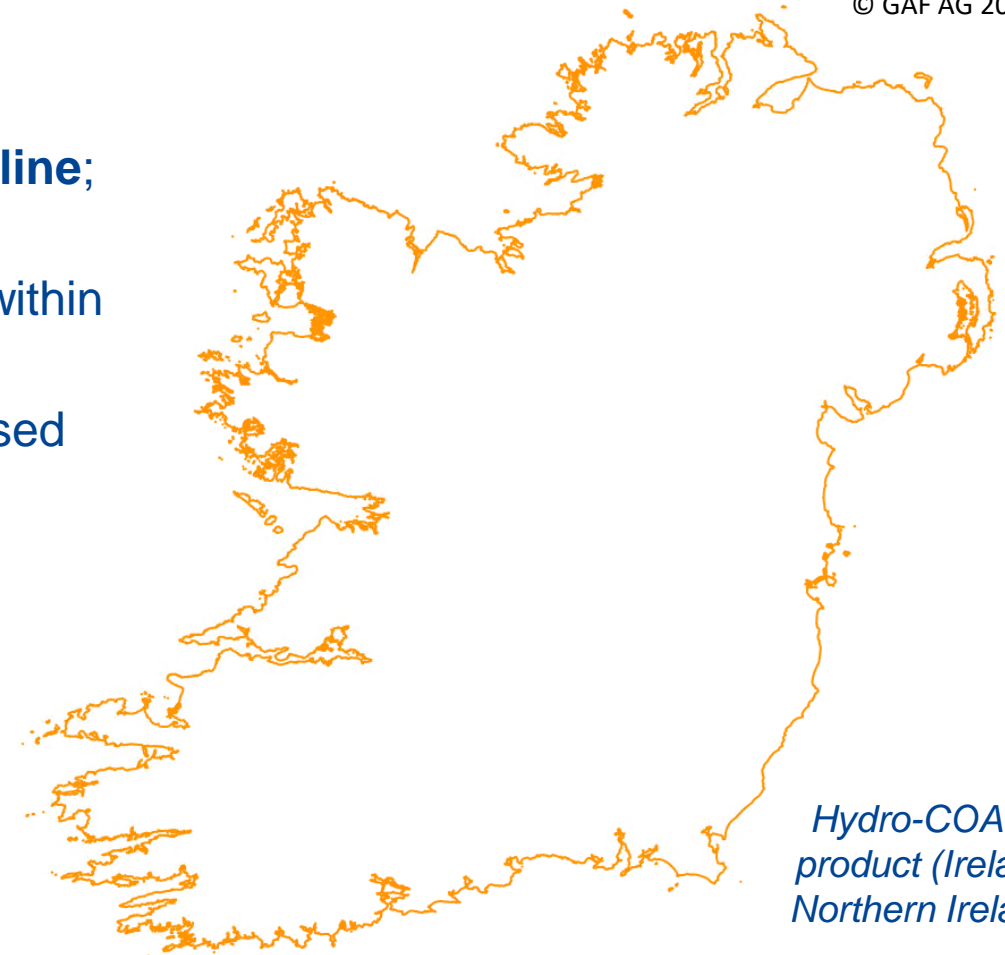


# Hydro-COAST

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## Hydro-COAST: Coastline

- Basis = **modified CLMS Coastal Zones (CZ) coastline**; adapted with **TanDEM-X HydroSHEDS-2 coastline**
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*Hydro-COAST  
product (Ireland/  
Northern Ireland)*





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# Hydro-COAST

## Hydro-COAST: Coastline

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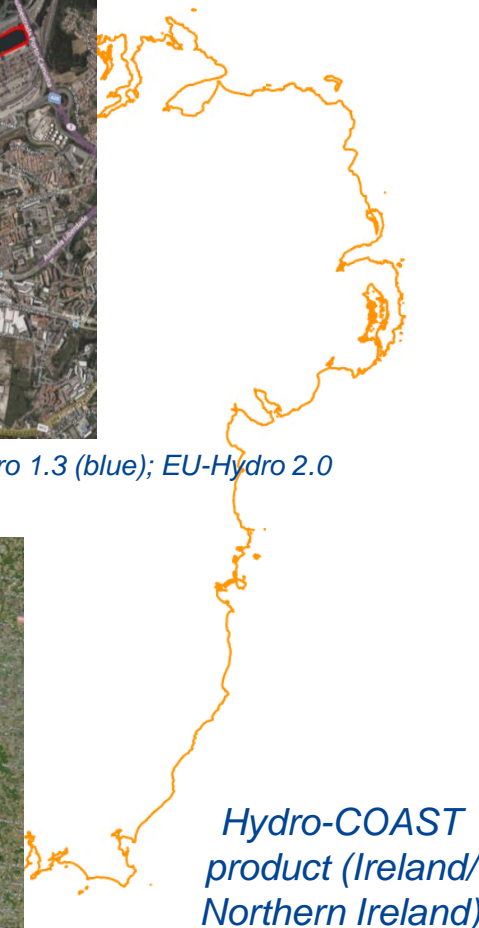
Hydro-COAST product: EU-Hydro 1.3 (blue); EU-Hydro 2.0 (red) in Sweden



Hydro-COAST product: EU-Hydro 1.3 (blue); EU-Hydro 2.0 (red) in Porto, Portugal



Hydro-COAST product: EU-Hydro 1.3 (blue); EU-Hydro 2.0 (red), Gironde Estuary, France



Hydro-COAST product (Ireland/  
Northern Ireland)



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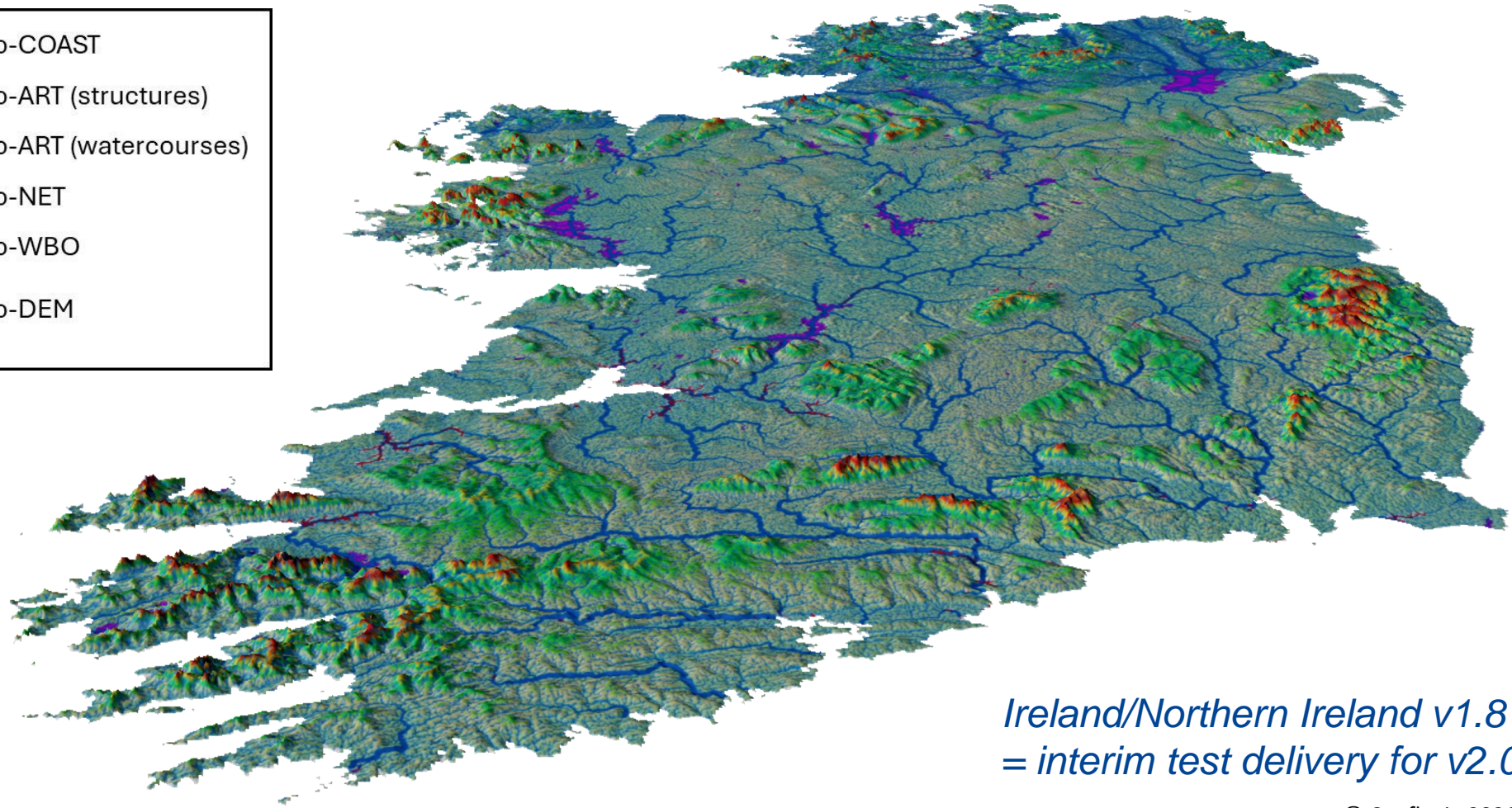
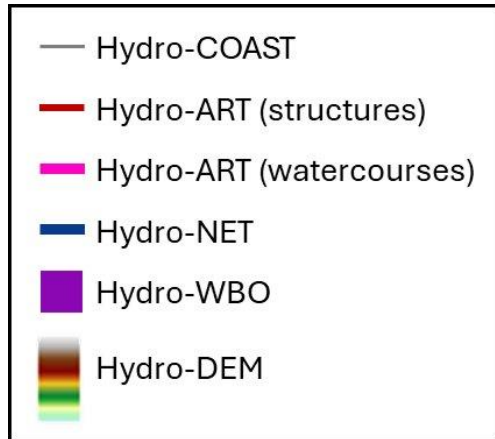
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# EU-Hydro 1.8 Products (Ireland / Northern Ireland)



*Ireland/Northern Ireland v1.8  
= interim test delivery for v2.0*

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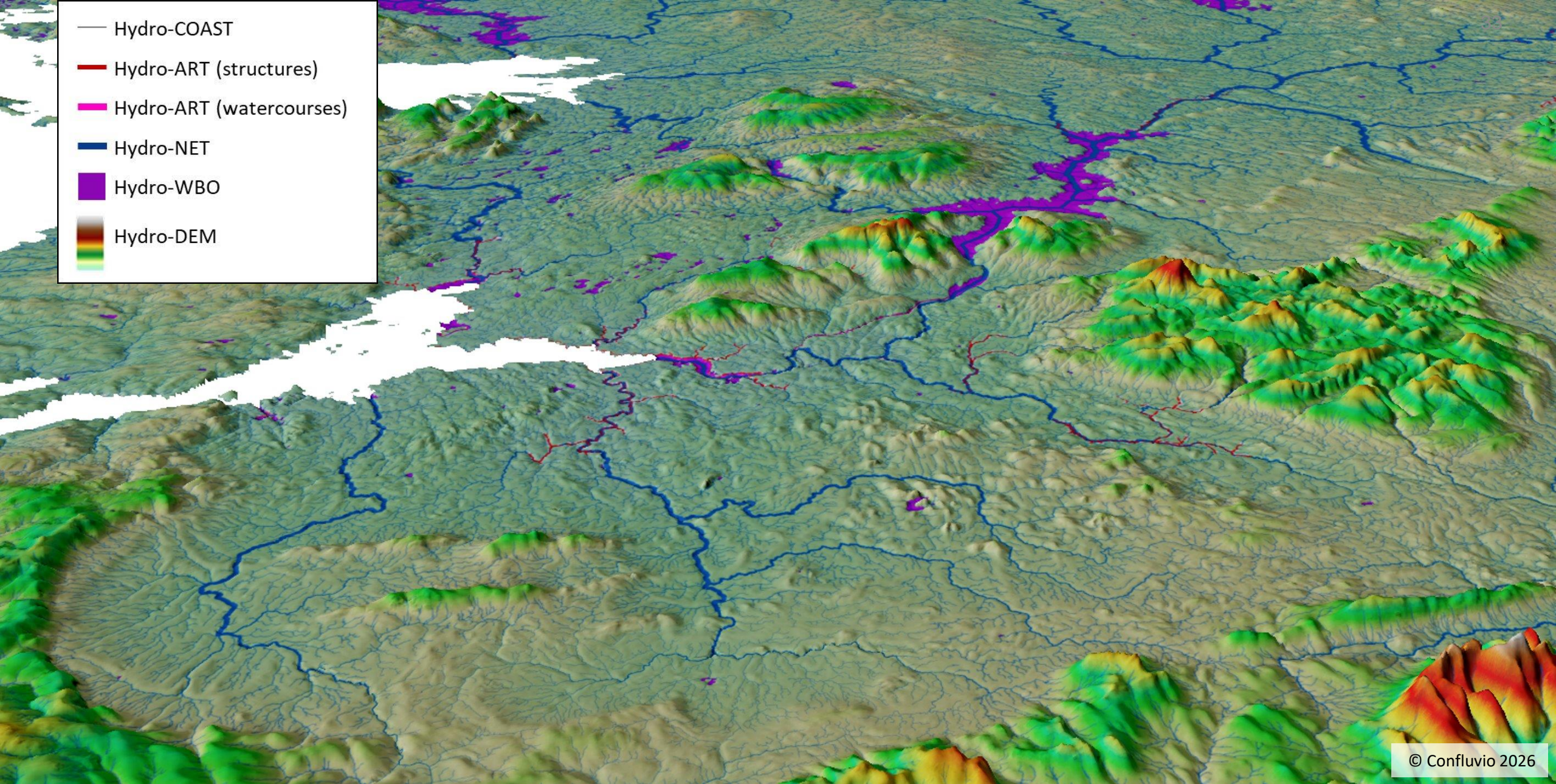


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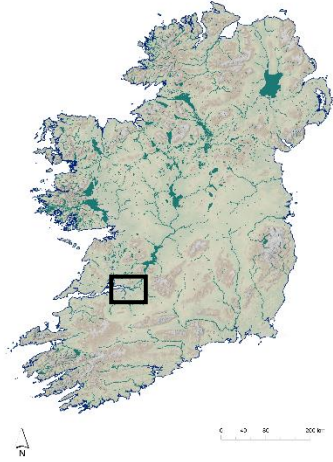


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0 5 10 20 km

### Hydro ART Structures

-  Artificial watercourse
-  Longitudinal connectivity
-  Coastal protection & Lateral connectivity

### Hydro NET

Strahler Order

-  1
-  2
-  3
-  4
-  5
-  6
-  7
-  8

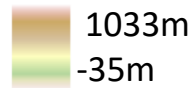
### Hydro WBO



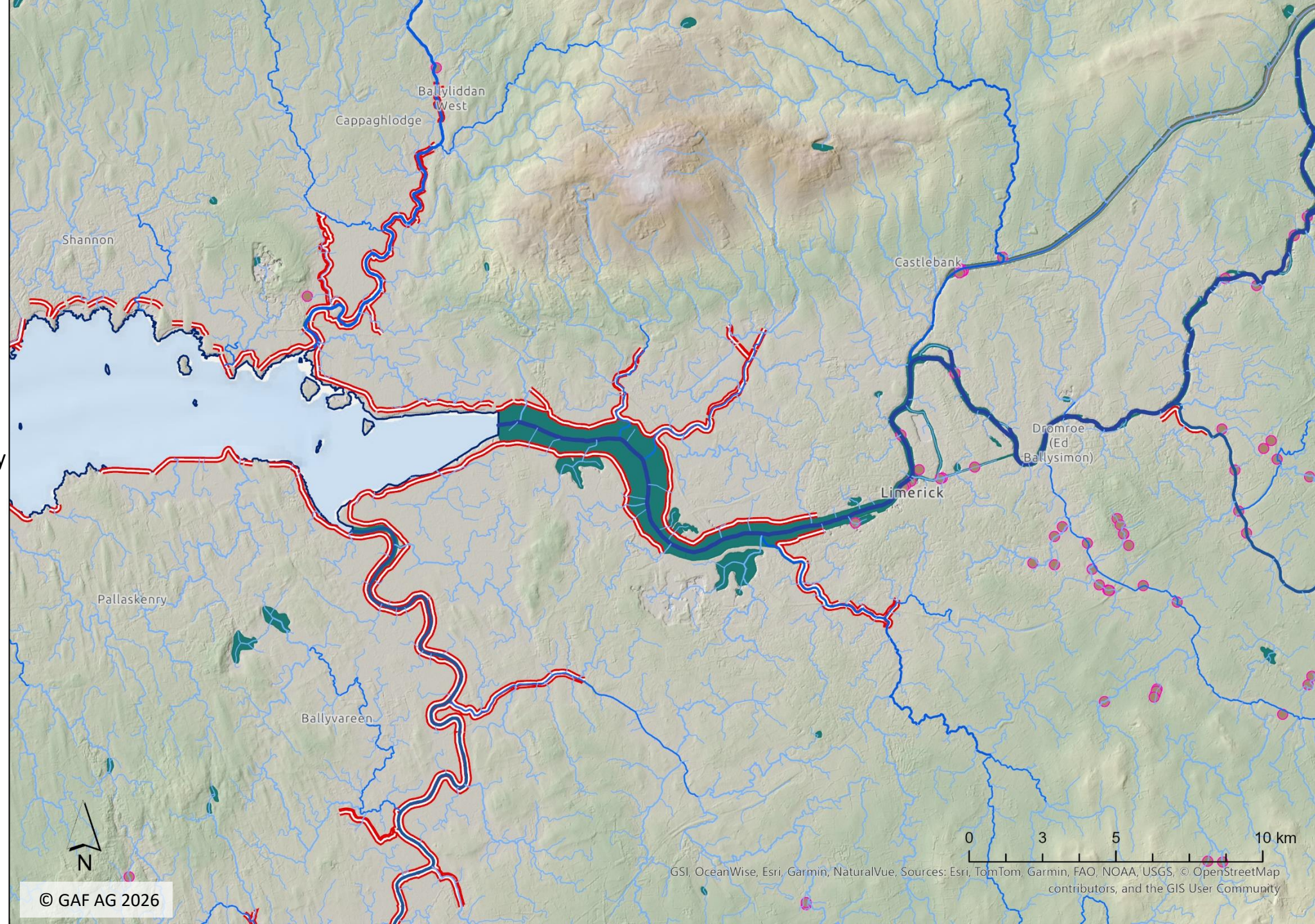
### Hydro COAST



### Hydro DEM



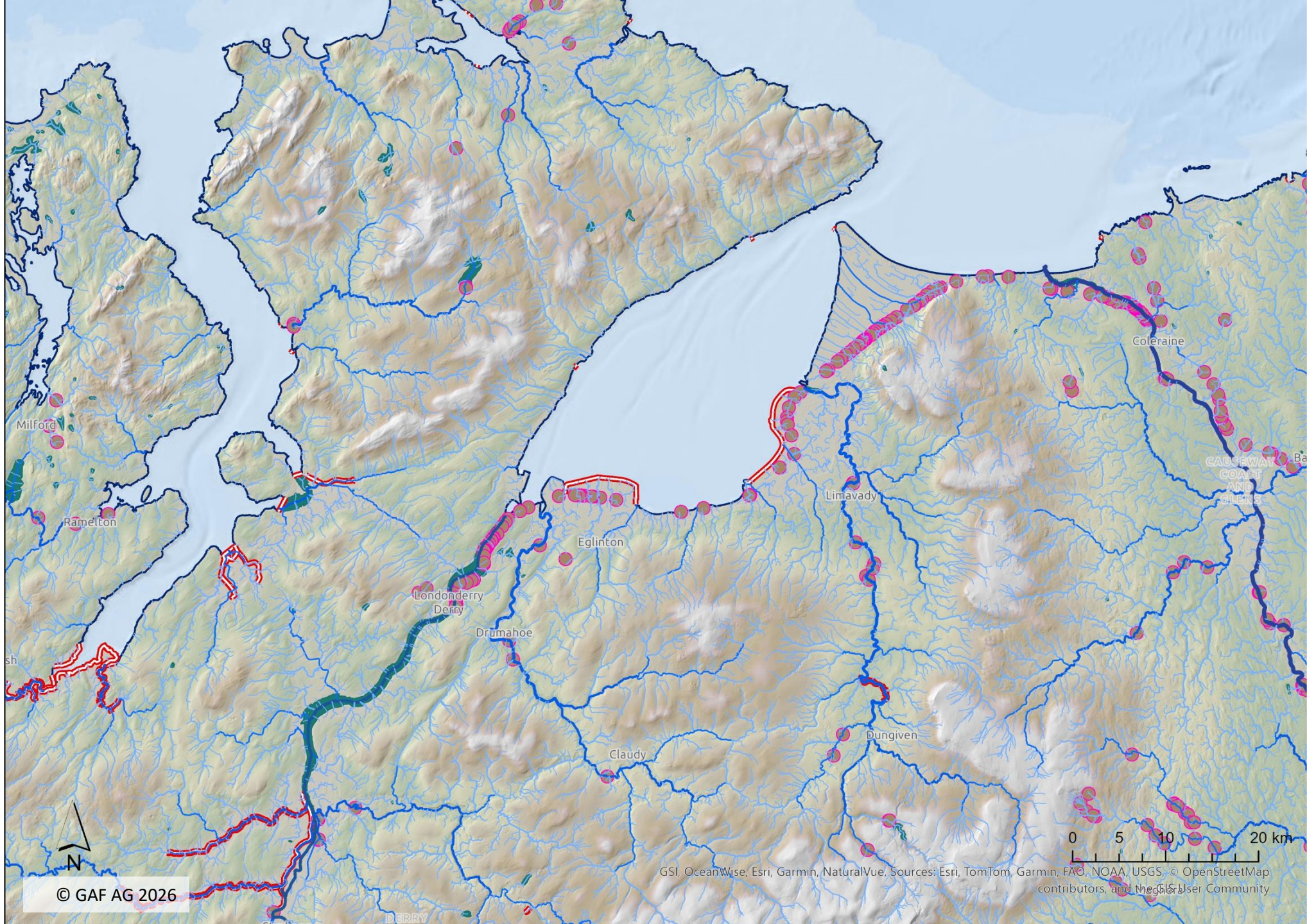
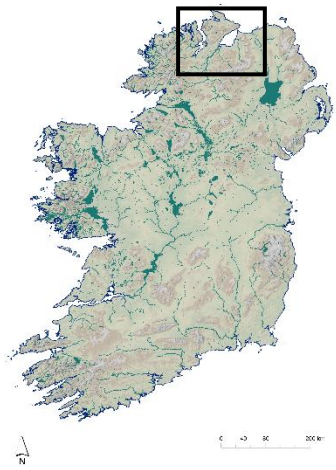
1033m  
-35m






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0 3 5 10 km

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### Hydro ART Structures

-  Artificial watercourse
-  Longitudinal connectivity
-  Coastal protection & Lateral connectivity

### Hydro NET

Strahler Order

-  1
-  2
-  3
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-  5
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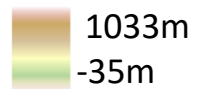
### Hydro WBO

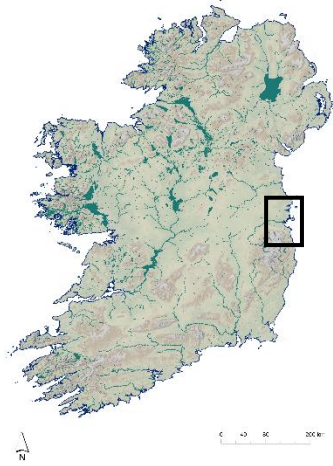


### Hydro COAST






### Hydro DEM













0 50 100 200 km

### Hydro ART Structures

-  Artificial watercourse
-  Longitudinal connectivity
-  Coastal protection & Lateral connectivity

### Hydro NET

Strahler Order

-  1
-  2
-  3
-  4
-  5
-  6
-  7
-  8

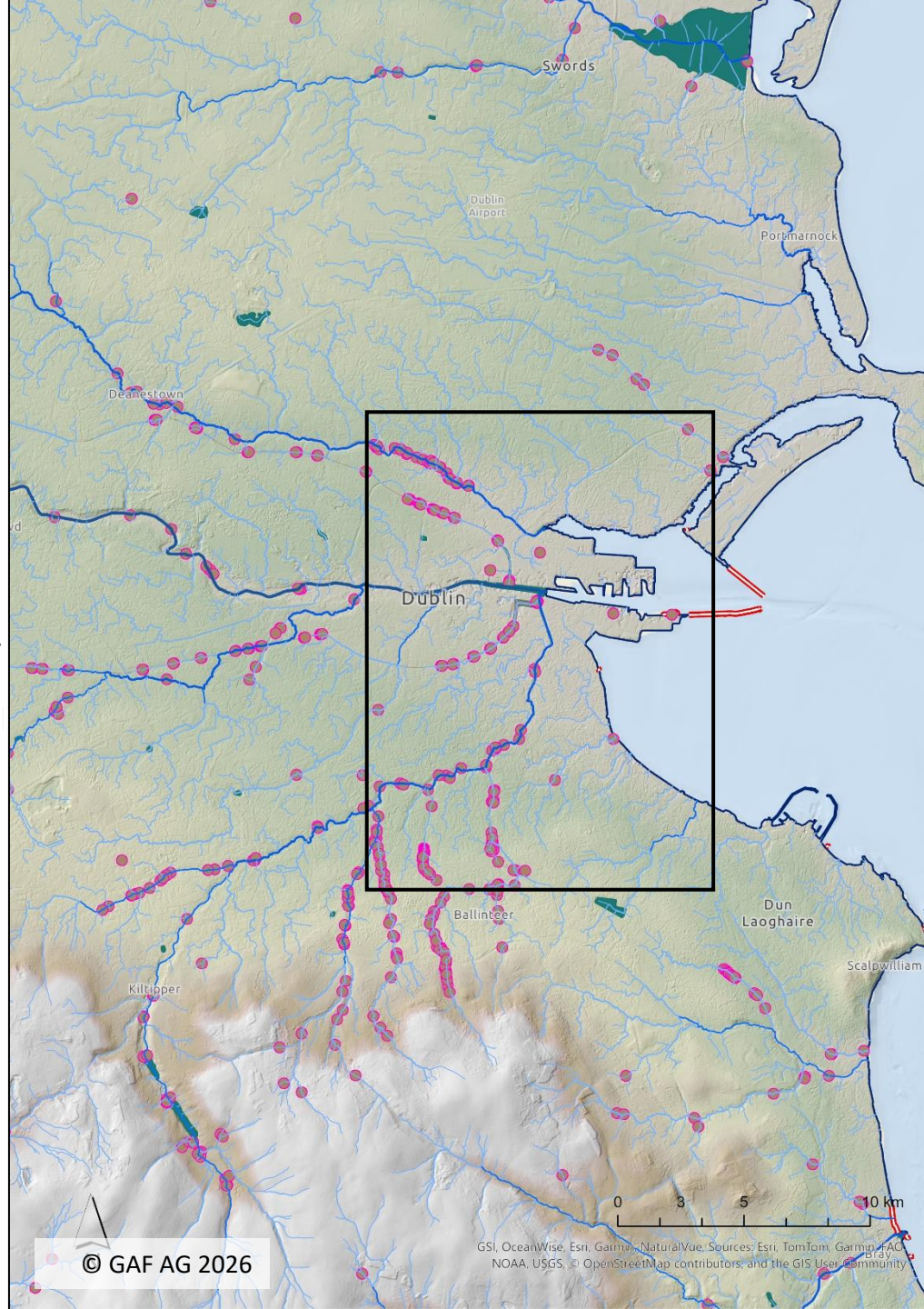
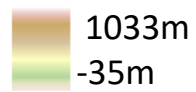
### Hydro WBO



### Hydro COAST

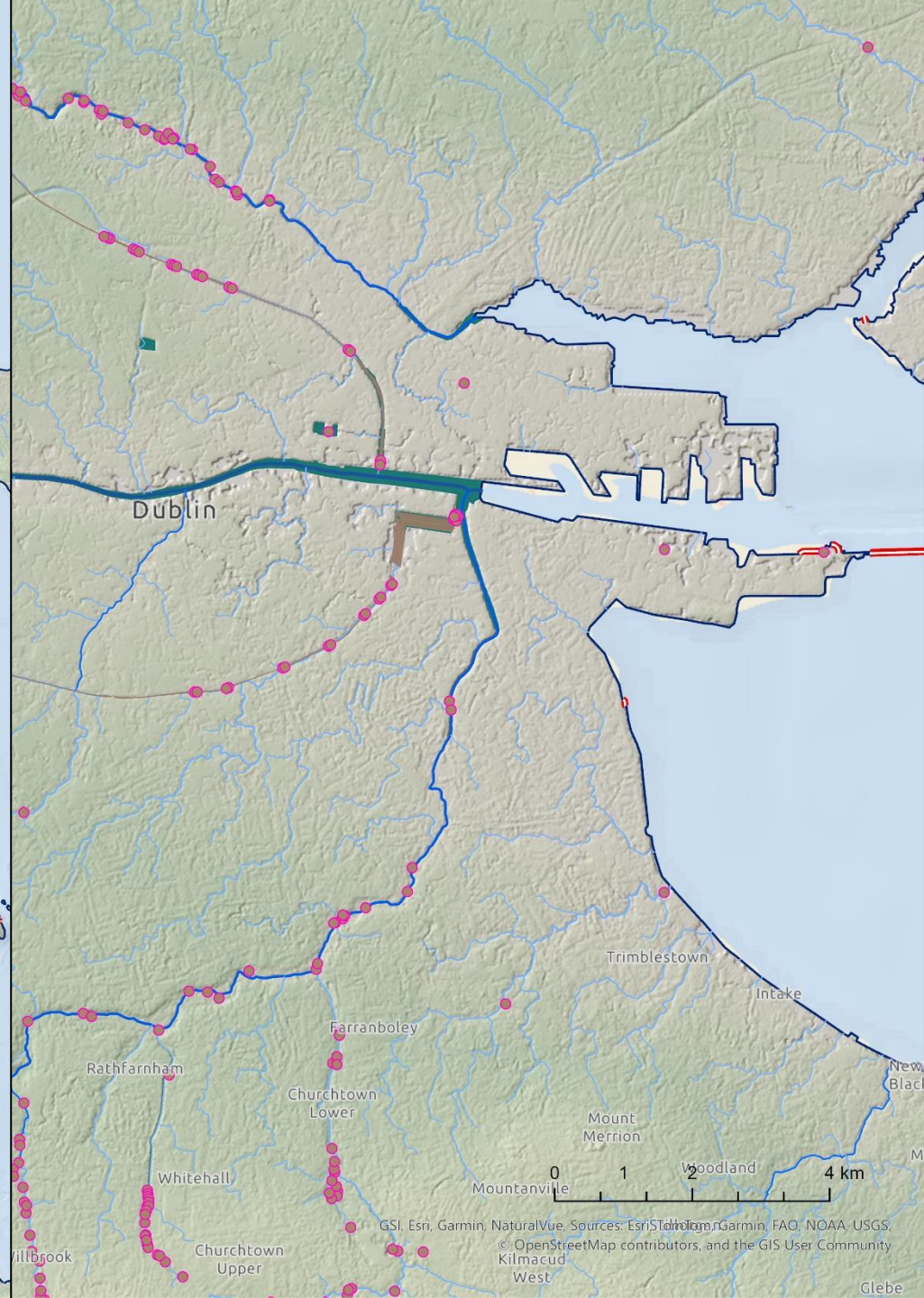


### Hydro DEM



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# Internal Verification & Independent Validation

## Internal Quality Control (QC) and Verification

- QC: Automatic checks (within and across layers), during production and at final delivery
- Verification: positional accuracy assessment: Hydro-NET & Hydro-WBO

## External Validation Consortium (from Q1 2027):

- QC checks within and across layers
- Validation: independent positional accuracy assessment
- Fitness for use cases

→ *very promising evaluation after Ramp-Up Phase!*





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# Highlights & Improvements (version 1.3 to 2.0)

## New products

- Artificial Structures (**Hydro-ART**)
- Improved cartographic river representation in focus areas (**Carto-NET**)
- Raster layers (**Hydro-DEM, -DIR, -ACC**)

## Higher detail and quality of hydrographic feature extraction

- CopDEM10 (latest generation DEM, 10 m resolution, homogenous quality)
- Latest & best-quality ancillary data
- Modern algorithms + manual correction

## Consistency/harmonization – within and between layers

- Traceable and systematic layer generation
- Fully integrated products; correct routing for rivers and sub-basins
- Linkages between layers (raster & vector layers at best efforts)

## Fit for various applications/use cases

- Main use cases: (CLMS) mapping; hydrologic modelling
- Input to flood modelling, risk analysis, impact assessment, supporting water quality and availability analysis, environmental analysis
- EU Nature Restoration Regulation (NRR) - Free Flowing Rivers (FFR)



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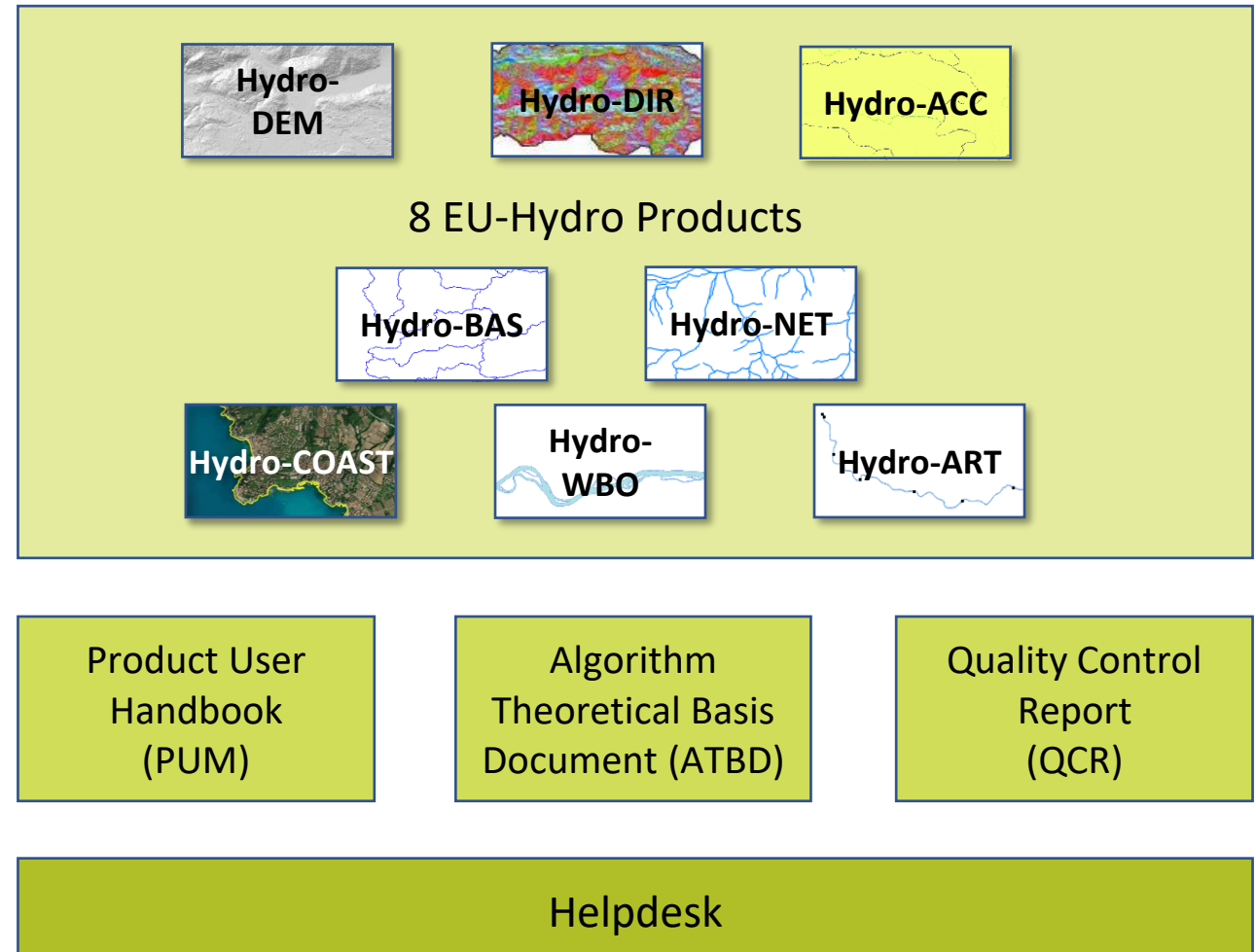
# Outlook

## EU-Hydro Suite of Products:

- Production planned until end 2026
- Products freely available from **~March 2027 on CDSE**

<https://dataspace.copernicus.eu/>

Future developments on EU-Hydro planned by the EEA



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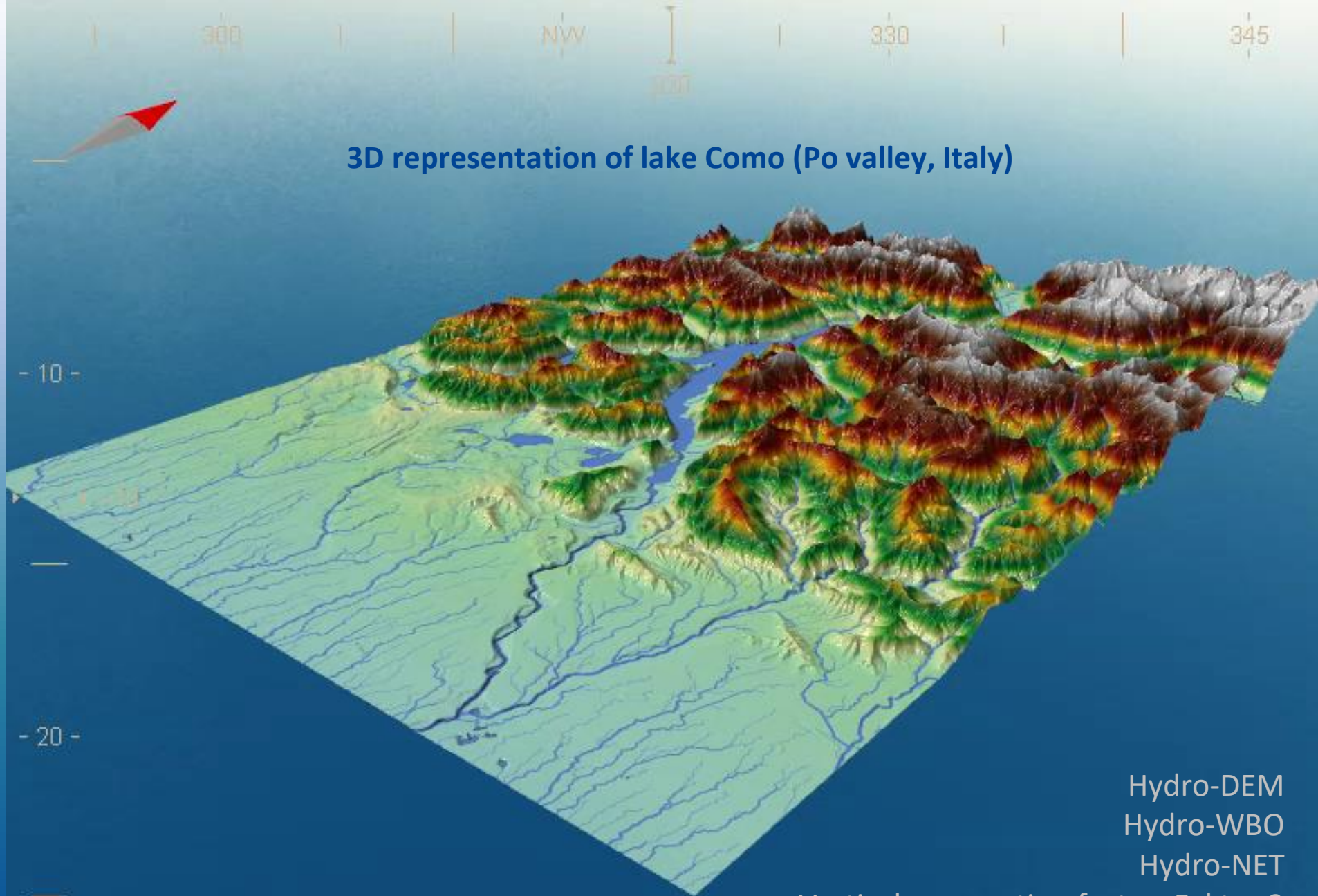
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### 3D representation of lake Como (Po valley, Italy)



Hydro-DEM  
Hydro-WBO  
Hydro-NET

Vertical exaggeration factor: Faktor 3

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EURC



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**More discussions in the break and at...**

**CLMS General Assembly (Valencia): TUE, 23 – WED, 24 June**



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<https://land.copernicus.eu/>

# Thanks

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[copernicus@gaf.de](mailto:copernicus@gaf.de)



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