



Developing a pan-European Database of Drainage Networks and Catchment Boundaries from a 100m DEM

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- ✓ Introduction (Why, What do we need?)
- ✓ Input Data
- ✓ Data Processing Steps
- ✓ Database Characteristics
- ✓ Quality Assurance
- ✓ Conclusions

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Introduction

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Starting Point:

- River basins are an important reference unit for environmental modelling and monitoring
- River basins do not stop at administrative or political boundaries
- Strong need for a European-wide database of river networks and river basins
(Expert meeting in 1999 (DG Environment, Eurostat, EEA, Academia))

Major Requirements:

- European or even pan-European coverage
- Homogeneous data with consistent high quality across whole area of interest
- Fully connected and hierarchical network of rivers (with correct flow directions)
- Link between different water bodies (rivers, lakes, seas,...) and their catchments
- Possibility to locate monitoring stations and to derive their catchments
- Implementing a hydrological feature code
- Characterisation and classification of catchments according to physiographic and socio-economic variables

CCM vers.1 in 2003
CCM vers.2 in 2007



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Continental DEM at 100m Grid-Cell Size


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Source:

1. SRTM 3 arcsec (up to 60° N)
2. DEM at 100m (NO, SE, FI)
3. SRTM 30 arcsec, GTOPO 30 (Northern Russia, Iceland)



**DEM Mosaic at 100m resolution in
Lambert Azimuthal Equal Area (LAEA) projection**




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Lakes and Wide Rivers

Source:


1. Space Shuttle Water Mask (up to 60° N)
2. Image2000 Detection (SE, FI)
3. WFD Article 3 (Norway)
4. UN 1 km Land Use (North-West Russia)



Constraining Rivers
(Rivers are routed through the lake centre)

Database Layer

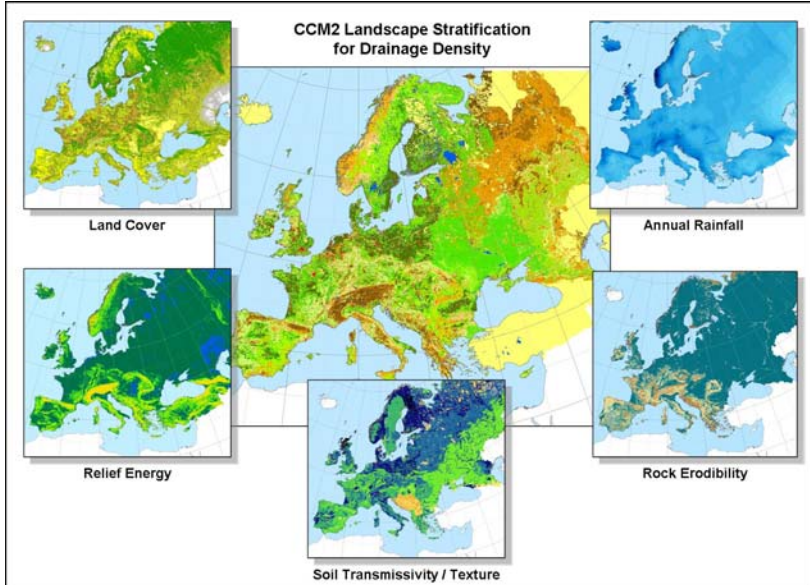
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CCM2 Landscape Stratification

CCM2 Landscape Stratification for Drainage Density



Land Cover


Annual Rainfall

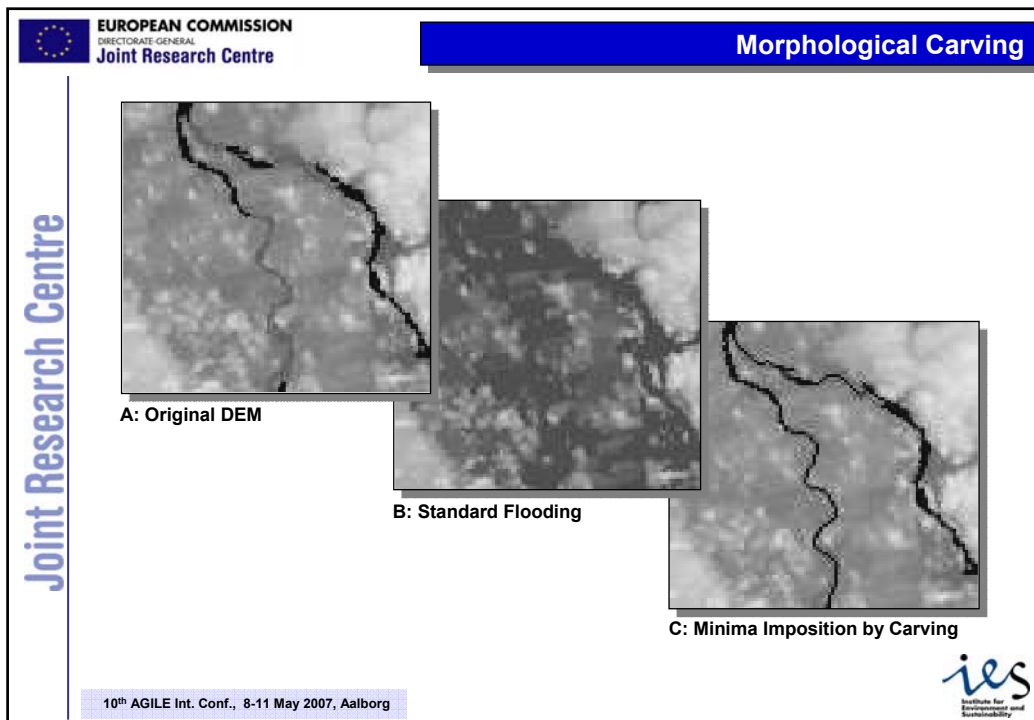
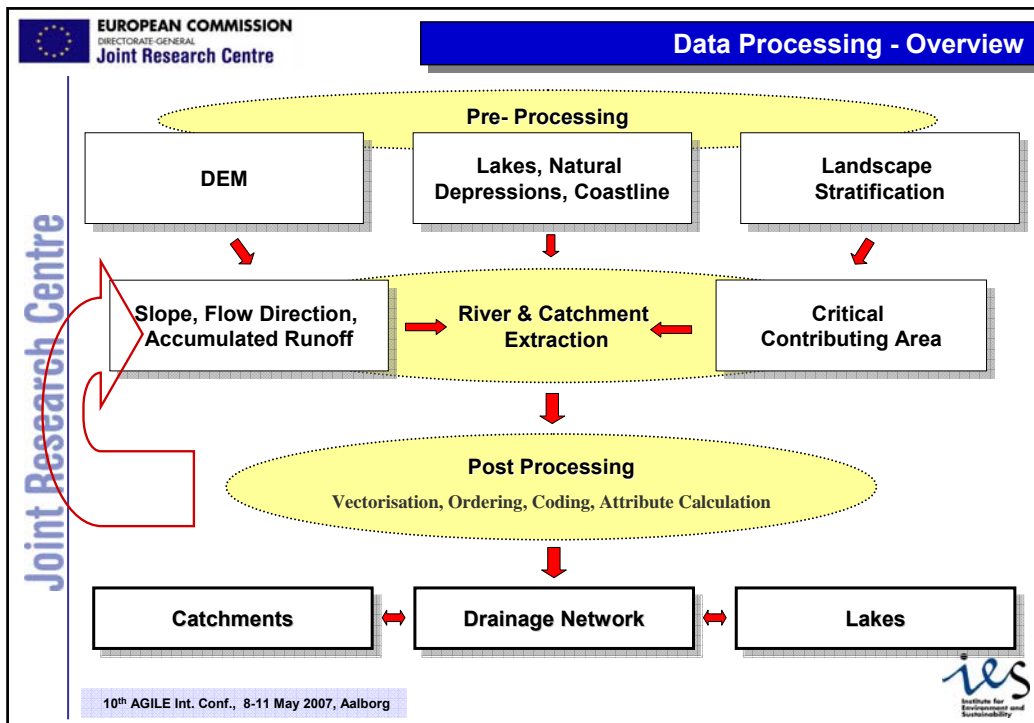
Relief Energy

Rock Erodibility

Soil Transmissivity / Texture

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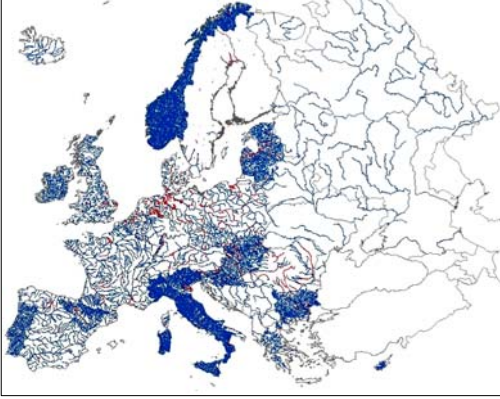
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Reference Rivers

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Source:


1. **WFD Art. 3 Main Rivers (edited & amended)**
Usage limitations (e.g., topology, geometric quality, generalisation)
2. **IMAGE2000 and other satellite image sources**
3. **GISCO 1:3,000,000 (edited)**



Version 4: Blue: optional, Red: mandatory

Injected when the elevation model does not yield a reliable solution

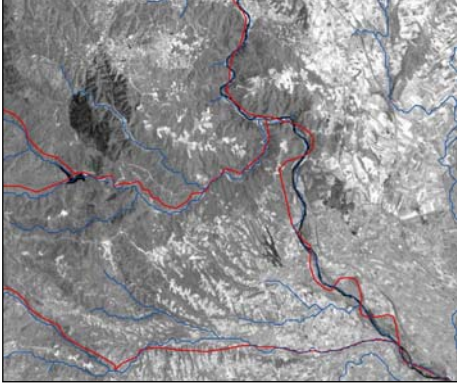
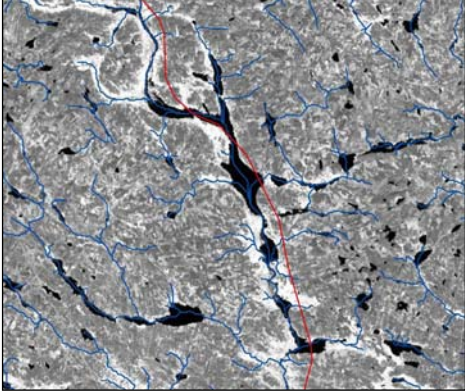
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Reference Rivers -Examples

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Red: Reference
**Blue: CCM2
Image 2000**

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Reference Rivers and Relief Mask

Blue: possible
Red: mandatory

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Adaptive Burning

DEM

Unconstrained River Net. (blue)
and Reference (red/yellow)

Result

Where to "burn" is decided automatically, based on relief and distance.

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CCM2 Results

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Major European Rivers and their Drainage Basins


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CCM2 Results

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The Ebro River Basin (ES)



The Thames River Basin (UK)

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CCM2 Attributes

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| <u>Catchment Attributes:</u> | <u>River Segment Attributes:</u> | <u>Lake Attributes:</u> |
|--|--|---|
| <ul style="list-style-type: none"> • WSOx-ID (hierarchical) • River Basin ID • Strahler Order • Pfafstetter Code (via river segment) • Area (km²) • Name(s) • Land Cover Statistics • Climate Statistics (Temp., Rainfall) • Terrain Statistics (Elevation, Slope) | <ul style="list-style-type: none"> • RIV-ID (hierarchical) • Strahler Order • WSO1- ID • River Basin ID • Pfafstetter Code • Area drained (direct & upstream) • Cumulative flow length (upstream) • Name(s) • Elevation gradient • River Type (perennial, intermittent, ephemeral, artif.) • Confidence | <ul style="list-style-type: none"> • ID • Area (km²) • Perimeter (km) • Name(s) • WSO1-ID (draining lake) • River Basin ID • Pfafstetter Code of River Segment draining the lake • Lake Type (natural, damed, reservoir, lagoon) |

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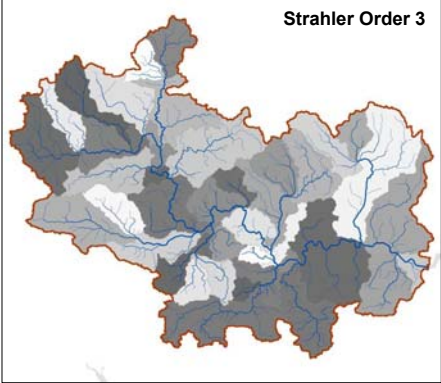


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CCM2 Attributes

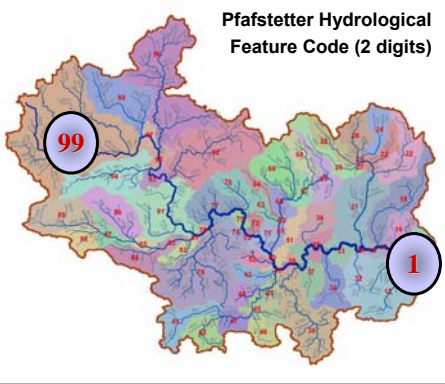
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Strahler Order 3




The Thames River Basin (UK)

Pfafstetter Hydrological Feature Code (2 digits)



The Pfafstetter code will be linked to a sea code as defined by the WFD Working Group on Hydrological Feature Coding

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CCM2 – Quality Control

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- **Quality Assessments**
 - JRC team has done 5 iterations for the complete geographic coverage
 - Verification against Image2000, Teleatlas and other data
 - Upon discrepancy:
 - Update of the Reference Coverage
 - Re-running the river and catchment extraction
 - Focus of verification: EU 27
- **Independent evaluation by EEA**
 - Evaluation of version 0.3
 - Positive feedback, highlighting some problems, which have been solved for version 0.4

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CCM2 Confidence on River Position
Calculated from the river grid

| | EU 27 (country average) | EU 27 (global) |
|--|-----------------------------------|--------------------------|
| DEM only (high confidence) | 68 % | 76 % |
| DEM only (lower confidence) | 15 % | 13 % |
| DEM and Reference (high confidence) | 17 % | 11% |
| Total | 100 % | 100 % |

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River Basin Area Comparison

| River Basin | Published Area (Km ²) | CCM2 Area (Km ²) | Difference (%) |
|--------------|-----------------------------------|------------------------------|----------------|
| Volga | 1380000 | 1391475 | 0.8 |
| Danube | 817000 | 802032 | -1.8 |
| Dniepr | 503000 | 512327 | 1.9 |
| Vistula | 194000 | 193894 | -0.1 |
| Rhine | 185000 | 160221 | -13.4 |
| Elbe | 148000 | 143655 | -2.9 |
| Oder | 125000 | 118938 | -4.8 |
| Loire | 120000 | 116981 | -2.5 |
| Rhone | 98000 | 96619 | -1.4 |
| Douro | 97200 | 97419 | 0.1 |
| Tagus (Tejo) | 88700 | 71203 | -19.7 |
| Ebro | 86000 | 85611 | -0.5 |
| Po | 74000 | 71327 | -3.6 |
| Guadalquivir | 57052 | 57052 | 0.0 |

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CCM2 – Quality Control

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UNEP-GRID (<http://www.grid.unep.ch>)

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Conclusions

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- ✓ First River and Catchment Database for the entire pan-European continent.
- ✓ Hierarchically structured rivers and catchments
- ✓ True network fully linked to the catchment layer
- ✓ A series of attributes, including a hydrological feature code, gives added value to the DB
- ✓ Input to the Water Information System of Europe (WISE)
- ✓ Freely available

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For more information visit

<http://www.agrienv.jrc.it/activities/catchments>

Thank you for your attention !



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