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GMES-Service for Assessing and Monitoring Subsidence Hazards in Coastal Lowland Areas around Europe

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Executive summary

This document is version two of the user requirements for SubCoast work package 3.5, it is SubCoast deliverable 3.5.1. Work package 3.5 aims to provide a European integrated GIS product on subsidence and relative sea level rise. The first step of this process was to contact the European Environment Agency as the main user to discover their user requirements.

This document presents these requirments, the outline methodology that will be used to carry out the integration and the datasets that will be used. In outline the main user requirements of the EEA are:

1. Gridded approach using an Inspire compliant grid
2. The grid would hold data on:
    a. Likely rate of subsidence
    b. RSLR
    c. Impact (Vulnerability)
    d. Certainty (confidence map)
    e. Contribution of ground motion to RSLR
    f. A measure of certainty in the data provided
    g. Metadata
3. Spatial Coverage - Ideally entire coastline of all 37 member states
    a. Spatial resolution - 1km
4. Provide a measure of the degree of contribution of ground motion to RSLR

The European integration will be based around a GIS methodology. Datasets will be integrated and interpreted to provide information on data vlues above. The main value being a likelyhood of Subsidence. This product will initially be developed at it's lowest level of detail for the London area. BGS have a wealth of data for london this will enable this less detialed product to be validated and also enable the generation of a more detailed product usig the best data availible. One the methodology has been developed it will be pushed out to other areas of the ewuropean coastline.

The initial input data that have been reviewed for their suitability for the European integration are listed below. Thesea re the datasets that have European wide availibility, It is expected that more detailed datasets will be used in areas where they are avaiilble.

1. Terrafirma Data
2. One Geology
3. One Geology Europe
4. Population Density (Geoland2)
5. The Urban Atlas (Geoland2)
6. Elevation Data
    a. SRTM
    b. GDEM
    c. GTOPO 30
    d. NextMap Europe
7. MyOceans Sea Level Data
8. Storm Surge Locations
9. European Environment Agency-
    a. Elevation breakdown 1km
    b. Corine Land Cover 2000 (CLC2000) coastline
    c. Sediment Discharges
    d. Shoreline
    e. Maritime Boundaries
    f. Hydrodynamics and Sea Level Rise

g. Geomorphology, Geology, Erosion Trends and Coastal Defence Works
h. Corine land cover 1990
i. Five metre elevation contour line

10. FutureCoast

Contents

1 Introduction

Work Package 3.5, European Integration (EI), aims to provide spatially distributed datasets relevant to flood risk around Europe's coastlines. This dataset will extend the SubCoast service to the European scale at a less detailed resolution.

In this document we aim to asses the user requirements for the European Integration. The main user is the European Environment Agency (EEA). However the current version of this document will not contain the full, detailed requirements for the reasons outlined below.

This document was due to be delivered in Month 6 (September 2010). This deadline was fulfilled by version 1 of this document. This document, version 2 is the final version of the European Integration user requirements. It has been revised in light of a meeting held with the European Environment Agency in January 2011.

1.1 Scope of the document

This is a user requirements document; it has been updated from version 1 following a meeting with the European Environment agency. This report contains the full user requirements from the EEA.

We recognise that the development of the European Integration methodology cannot take place in isolation from the user requirements. This document presents the EEA's user requirements for a European wide product on ground subsidence in coastal lowland areas. These requirements have been gained from at meeting held between the BGS and the EEA at the EEA offices in Copenhagen in January 2011. The attendees at this meeting were**:**

Andrus Meiner (EEA)
Hans-Martin Füssel (EEA)
Iiona Schiøler (EEA)
Trine Christiansen (EEA)
Johnny Reker (EEA)
Luke Bateson (BGS)
Stuart Marsh (BGS)

1.2 Introduction to the EEA

The EEA is an EU body set up to provide independent, reliable and comparable environmental information for decision makers and the public. Their information aims to help the European Community and Agency member countries make informed decisions on improving the environment and move towards sustainability.

This document addresses the following:

- User requirements from the EEA
- Areas of the user requirements to be established in more detail
- Outline methodology of integration
- Outline European Integration products
- Review of input datasets

2 Regulatory frameworks

The policy driver for much of the EEA's work in coastal and maritime zones is ICZM (2002/413/EC). The specific objective of EEA work is to contribute to the follow-up of the recommendation of the European Parliament and the Council concerning implementation of ICZM (2002/413/EC). There is also a proposed development of maritime spatial planning approaches.

2.1 Approach of EEA

User needs for the SubCoast pilot projects are gathered using the Adaptation Tipping Point (ATP) concept. These user needs are captured via the SubCoast assessment framework. The EEA are following a similar approach to the adaptation tipping point. However in the scope of this document and the SubCoast WP3.5 work it is impossible to produce a full ATP account for every possible user need in the EU environment.

The EEA approach their work using the following:

- Pressures on the environment
- The responses of the environment to those pressures
- The environments vulnerability to the change of these pressures.

3 Opportunities for SubCoast to input to EEA work

3.1 European Wide Reporting

Datasets produced by SubCoast, such as a likelihood of subsidence for coastal lowland areas, may be adopted in European wide reports.

One such report: 'The changing faces of Europe's coastal area' originally written in 2006, is due to be updated and released at the end of 2012. This document reports on the state of the European Coast and how it is changing. The update is required due to changes in policy and availability of new datasets.

The time scale for the report update is:

- **2010** Project plan and annotated outline, project data support established
- **2011** Main implementation effort, including analysis and drafting
- **2012** Consultation (TBC), finalisation, editing, production, dissemination
- Tentative publishing date Q4 2012 (±½ year)

Another report: 'Impacts of Europe's changing climate' 2008, is to be updated on the same time scale as above. This report focuses on indicators, of which the more relevant to SubCoast are the Vulnerability of coastal population and marine biodiversity and ecosystems.

An important change to these reports that the EEA would like to make is the change from sea level rise to relative sea level rise – therefore taking into account the role of subsidence. This is where SubCoast data can play a role.

There is an opportunity for SubCoast to input two things in each report:

1. Detailed case studies to illustrate specific examples. E.g. an example where ground motion increases sea level rise significantly.
2. One or more datasets within either report, probably focused on the 'changing faces of Europe's coastal area'

Datasets are eligible for use in these reports if they are high quality and arrive in time for publication and fit the policy drivers. These would be very high impact deliverables from the SubCoast project. The EEA would be using a dataset created by SubCoast.

3.2 EEA work units:

In his role at the EEA Andrus Meiner is generally interested in ecosystem assessment and the use of spatial analysis. Due to the increase in GIS capability and availability of geospatial data this has become more realistic and prominent in recent years. He is also interested in other topics such as use of environmental accounting for reporting.

Andrus described the EEA work in the coastal zone:

- There is a decision to take a more integrated approach.
- Current EEA strategy combines thematic work areas with cross-cutting themes – the maritime work area, that is relevant to coastal zones is a cross-cutting theme.
- The coastal zone assessment touches upon several EEA work areas such as marine, biodiversity, climate change adaptation and land use.

Indicators related to climate change in coastal zones used by the EEA relate, among others, to the ICZM policy/legislation. These indicators have been drawn up by an expert group and

can be found here: www.deduce.eu/results.html. Such indicators may also be used to support the development of EU policy on adaptation to climate change as outlined in the White Paper on Adaptation published by the European Commission in 2009.

Hans-Martin Füssel: Primary responsibility is the update of the report 'Impacts of Europe's changing climate', which is scheduled for 2012, and support to the development of the Adaptation Clearinghouse for Europe, which is scheduled to go online in 2012. Marine/maritime assessments are expected to remain important for EEA beyond 2012, which would provide an opportunity in the future for the EEA to make use of SubCoast datasets. However, no specific products are currently planned beyond those mentioned above.

Hans-Martin also talked about the DIVA model that has been used in EEA work to assess impacts of climate change on coastal regions. This model uses SLR data and has an allowance for subsidence in Deltas that is pre-determined at about 2mm a year. Other approaches for assessing the vulnerability of coastal zones to climate change could use RSLR, so if SubCoast can improve the RSLR dataset then we can contribute the model inputs.

Vulnerability of coastal areas is another important area for the EEA. An analysis of the Andalusian coast was shown as an example of the kind of vulnerability to sea level rise analysis that would be useful, to the EEA, at a European scale. As a alternative to DIVA a Coastal Vulnerability Index (CVI) might be used (as used in Andalucía). In the Andalusian case CVI is derived from:

- Geomorphology
- Erosion
- Topography
- Sea Level
- Significant ocean swells
- Tide Rank

It would be useful if the SubCoast European Integration dataset could support analyses of the vulnerability of coasts to sea-level rise at the European scale.

4 EEA User needs for SubCoast European Integration Product

A product that would be of use to the EEA would have the following characteristics:

1. Gridded approach

2. Inspire compliant grids
    a. lambert azimuthal projection
    b. Inspire grids are nested at 1, 10 100km2 etc. This might provide an opportunity to deliver large areas at lower resolutions and smaller areas in more detail.

3. The grid would hold data on (grid values):
    c. Likely rate of subsidence
    d. RSLR
    e. Impact (Vulnerability)
    f. Certainty (confidence map)
    g. Contribution of ground motion to RSLR

4. Need a measure of certainty in the data provided
    h. Could be done in the form of confidence maps

5. Metadata – need to know what data has been used to produce the data values in the grid cells and also for that source data to be traceable.
    i. We should provide links to the location of the source data

6. Spatial Coverage
    j. Ideally entire coastline of all 37 member states
    k. But SubCoast is only concerned with coastal lowland areas therefore can subset this down using the 10m contour.

7. Spatial resolution
    l. 1km ideally but see above for nested idea.
    m. High resolution case studies are also very relevant, especially to the reports

8. Future of data
    n. Concern expressed as to what would happen after the project, would the data still be available. The Inspire compliance of portal meant that originating institute would host the data they produce so will be available after project. Also the SubCoast sustainability work package will address issues such as data availability.

9. What SLR data will be used
    o. MyOcean as we are tied to GMES serivces
    p. Other datasets may be better so will be investigated

10. Provide a measure of the degree of contribution of ground motion to RSLR
    q. When a RSLR product is created it would be useful to break down the contribution to the Relative bit of RSLR.
    r. This would allow the EEA to determine how relevant previous estimates of SLR are considering they do not account for the land motion.

11. EEA require the ability to scale up the data to give overall statistics for the purpose of communication to the public. E.g. based on this area 5% of the EU coastline is subsiding etc.

5 Data limitations and open questions

The following problems were discussed:

1. Lack of a coastal protection dataset
    a. Needed for improved assessments of the socio-economic impacts of SLR
    b. Past assessments have generally estimated coastal protection levels based on wealth and/or population density

2. Future projections of RSLR?
    a. Vulnerability assessments generally address future risks
    b. Our data will be based on the present situation

6 Preliminary User Requirements from the EEA.

6.1 Main use for a SubCoast service:

Climate change and vulnerability analysis relevant to coastal zones.

6.2 Main challenge:

The main problem that the EEA experience is the lack of relevant data, especially spatially distributed datasets relating to relative sea level rise. They have data on sea level rise but no means of tying this to ground motions to give a relative picture of what the sea level is doing when compared to the land surface.

6.3 Why is this important?

Information on relative sea level rise is of high value, because it makes modelled predictions of sea level rise more relevant to coastal management practices at regional/local level.

6.4 What would the EEA ideally like from a SubCoast service?

With regards to subsidence of low lying coastal areas the EEA would be interested to have an indication of the subsidence for all EU coastlines. They suggest a grid based approach with a 1km^2 grid size. They do recognise that a European-wide subsidence dataset will not suddenly emerge.

7 Outline Methodology

The main aim of the European Integration work package is to extend the SubCoast services to the European scale. To accomplish this it is necessary to fill in the gaps between the pilot services, where less detailed data exists therefore the resulting product will be at a lower resolution. The output will be an entry level screening product relevant to estimating relative sea level rise and flood risk around European coastlines.

Here we present an outline methodology for how the European SubCoast product may be developed. This is likely to change when we fully understand the user requirements in light of the assessment framework.

The European integration will be based around a GIS methodology. Datasets will be integrated and interpreted to provide information on data vlues above. The main value being a likelyhood of Subsidence. This product will initially be developed at it's lowest level of detail for the London area. BGS have a wealth of data for london this will enable this less detialed product to be validated and also enable the generation of a more detailed product usig the best data availible. One the methodology has been developed it will be pushed out to other areas of the European coastline, including the SubCoast pilot sites where further validation of the product can be made.

The output of the European Integration will be a gridded dataset for coastal lowland areas. Grid values will be derived from the input datasets and will give information on:

- Likelyhood of subsidence
- Effect on Sea Level Rise (i.e. relative SLR)
- Impact of subsidence and flooding
- A value relating to the certainty of the grid value

The grid size will be 1km^2 and metadata will indicate how the grid values were derived. This product eventually aims to cover all coastal lowland areas around Europe.

PSI data (where available) will be interpolated to derive a subsidence risk value for each grid cell. In the absence of PSI subsidence data a subsidence risk value will be interpreted from geological data. Knowledge has been gained through various PSI studies, such as Terrafirma, which enables geologists to make interpretations on the risk of subsidence given certain conditions. For example we know that if unconsolidated sediment, such as estuarine sands, is built on then the added weight is likely to lead to subsidence through differential settling.

Rules such as these will be developed to enable a GIS interpretation, integration and classification of the available geological data. Other datasets will be integrated with the subsidence risk values to add value. An example of this would be the combination of subsidence risk with sea level change data to provide information on relative sea level change.

8 Review of Input Datasets

Annex 1 reviews the input datasets that will be used for the European Integration. Datasets reviewed are currently limited to those with European wide availability. The following datasets are reviewed in Annex 1.

1. Terrafirma Data
2. One Geology
3. One Geology Europe
4. Population Density (Geoland2)
5. The Urban Atlas (Geoland2)
6. Elevation Data
    a. SRTM
    b. GDEM
    c. GTOPO 30
    d. NextMap Europe
7. MyOceans Sea Level Data
8. Storm Surge Locations
9. European Environment Agency-
    e. Elevation breakdown 1km
    f. Corine Land Cover 2000 (CLC2000) coastline
    g. Sediment Discharges
    h. Shoreline
    i. Maritime Boundaries
    j. Hydrodynamics and Sea Level Rise
    k. Geomorphology, Geology, Erosion Trends and Coastal Defence Works
    l. Corine land cover 1990
    m. Five metre elevation contour line
10. FutureCoast

For each dataset the characteristics are described and the suitability for the integration process outlined. The following are discussed for each dataset:

- Data description
- Data source (downloaded from and produced by)
- How was the data derived/produced
- What format is the data (can we easily use this format?),
    - Geographic reference system
- What area is covered/European coverage
- Resolution
- Availability (free etc)
- Perceived quality
- Perceived use for European integration

9 Annex 1.

Review of European wide datasets.

9.1 Terrafirma Data

9.1.1 Data description

Terrafirma is a European Space Agency GMES project. Within TerraFirma the latest technology is used to measure terrain motion from satellite radar data. These PSInSAR data are then interpreted by national geoscience organisations to provide a pan-European ground motion hazard information service.

There are 54 sites that have been studied in Terrafirma, of this 23 are on coastal lowland area and are therefore relevant to SubCoast:

- London
- Bristol
- Cork
- Alkmaar
- Amsterdam
- Lisbon
- Stockholm
- Vaasa (Finland)
- St, Petersburg
- Parnu (Estonia)
- Riga (Latvia)
- Esbjerg (Denmark)
- Murcia (Spain)
- Rome (Italy)
- Ancona (italy)
- Haifa (Israel)
- Palermo (Italy)
- Athens (Greece)
- Hamburg (Germany)
- Valletta (Malta)
- Gulf of Corinth (Greece)
- Rio-Antirio Bridge (Greece)
- Istanbul (Turkey)

So far Terrafirma processing has occurred on a city by city basis; during phase 3 of the project (2010-2013) the Wide Area Product is being developed. This product aims to offer a PSinSAR result for the entire European area. The data are likely to represent an average motion, along the satellite line of site, for a certain time period only. These measurements will be derived using an automated method with no operator input.

9.1.2 Data source

These PSInSAR datasets have resulted from the GMES service element Terrafirma (http://www.terrafirma.eu.com/). Data have been produced by one of 5 Operational Service Providers (OSPs), within the Terrafirma project the OSPs have been certified to ensure a consistent approach and quality product. This certification was conducted within a validation exercise, in which PSInSAR results from each OSP were compared to control data. More information on the validation can be found here: http://www.terrafirma.eu.com/product_validation.htm.

9.1.3 How was the data derived/produced

InSAR is a technique in which the phase component of the returning radar signals of two or more synthetic aperture radar (SAR) scenes of the same location are processed to allow the detection of ground movements. PSInSAR is a non-invasive surveying technique used to calculate fine motions of individual ground and structure points over wide-areas covering urban and semi-urban environments. The technique uses an extensive archive of satellite radar data (dating back to 1992) to identify networks of persistently scattering (i.e. radar

reflecting) features such as buildings and bridges, or natural features such as rocky outcrops, against which precise millimetric motion measurements are calculated retrospectively over the time spanned by the radar data archive. The unique benefit of PSInSAR is its ability to provide both annual motion rates and multi-year motion histories for individual scatterer points. More information can be found at http://www.terrafirma.eu.com/about_PSI.htm#2. An example of the average motion rate for a study period is shown in Figure 1.

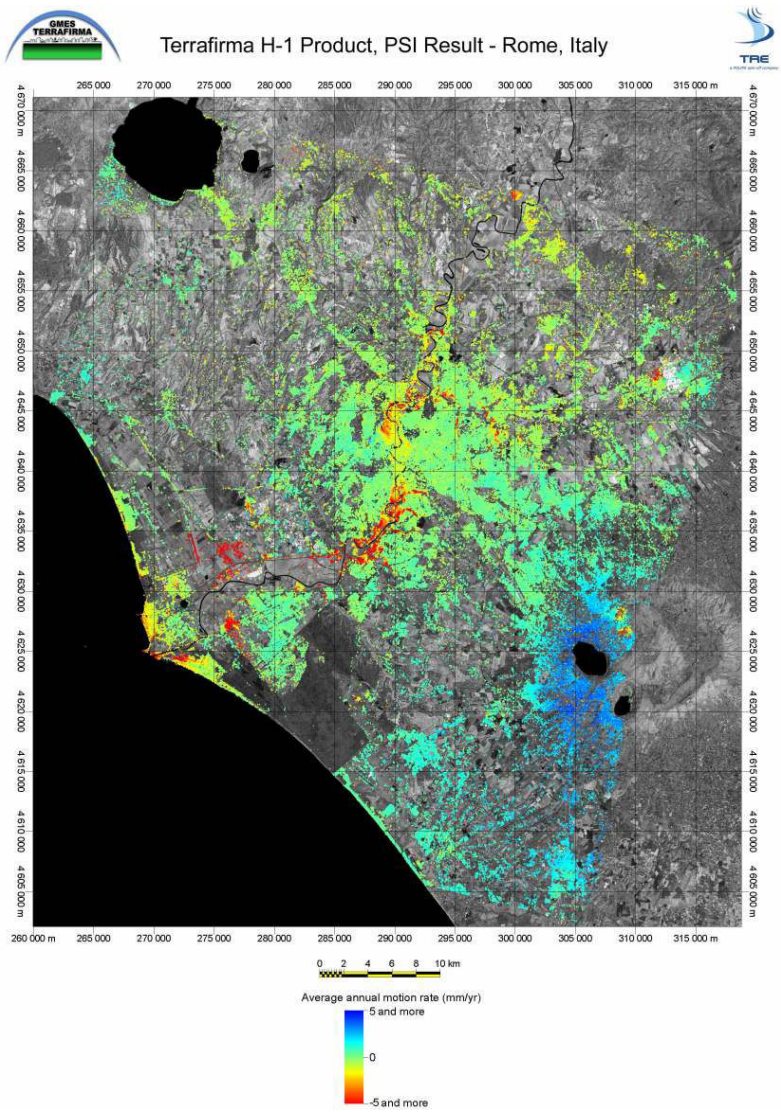

Figure 1: PSInSAR data for Rome showing the average annual motion rate in mm/yr.

9.1.4 What format is the data

The format of the data is text based tabular files containing the history of motion of each identified Permanent Scatterer. X and Y values allow each scatterer to be spatially located and average motions for the time period processed allow a first look at the areas motion pattern. Since the data is tabular and spatial it is suitable for GIS display and manipulation so will be suitable for European integration.

9.1.5 Area covered/European coverage

23 European cities in coastal lowland areas have been processed by Terrafirma. Each processed area is of a different size. The Wide Area Product will cover all Europe.

9.1.6 Resolution

This is a point dataset. It should be noted that points are only available where a scattering object has been identified on each image used to produce the time series. If a scattering object is not present then no PS point will be present and so no data will be available.

9.1.7 Availability (free etc)

Agreement exists with Terrafirma project to access data – may require SLA?

9.1.8 Perceived quality

High quality

9.1.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

Terrafirma data will be very useful, providing the first choice for subsidence information in areas where it is available. Subsidence information can the be tied to Sea Level Rise data to give a relative sea level rise and to highlight areas which are likely to be at higher risk from sea level rise in the future.

9.2 One Geology

9.2.1 Data description

OneGeology's aim is to create dynamic digital geological map data for the world. It is an international initiative of the geological surveys of the world who are working together to achieve this ambitious and exciting venture.

The project's aims are to:

- create dynamic digital geological map data for the world.
- make existing geological map data accessible in whatever digital format is available in each country. The target scale is 1:1 million but the project will be pragmatic and accept a range of scales and the best available data.
- transfer know-how to those who need it, adopting an approach that recognises that different nations have differing abilities to participate.
- the initiative is truly multilateral and multinational and will be carried out under the umbrella of several global organisations.

9.2.2 Data source

All OneGeology data can be viewed via the Portal: http://portal.OneGeology.org

9.2.3 How was the data derived/produced

Data have originated from contributing geological organisations such as national geological surveys. The data are therefore produced using the standard mapping techniques used by that organisation.

9.2.4 What format is the data

Data are viewed in the portal as a WMS (Web Map Server), this is basically an image of the data that is then viewed in the viewer. This data can be exported as a KML file, which can then be imported to ArcGIS. However this KML file does not have any attributes included with it.

9.2.5 Area covered/European coverage

The aim is to have a global dataset at 1:1millions. Currently all Europe is covered at a scale of at least 1:5m, in some instances the resolution is much higher (up to 1:50 000 in the UK).

9.2.6 Resolution

The aim is for 1:1million scale or better, however it can be as low as 1:50million.

9.2.7 Availability (free etc)

OneGeology aims to use Free and Open Source software wherever possible however the provider organisation retains full ownership and responsibility and is able to change or modify data whenever necessary.

OneGeology material is freely available for non-commercial use only. OneGeology gives non-exclusive permission to reproduce free of charge:

- OneGeology images,

- posters,
- maps

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Where illustrations, map extracts or images are used as the basis of specifically generated illustrations, the source of the material should be cited as follows: *'Based upon [source details], with the permission of OneGeology'.*

9.2.8 Perceived quality

Good quality data only limited by low resolutions in some countries.

9.2.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

In the absence of subsidence data it would be nice to use the geological data from OneGeology will form the basis of an interpretation of susceptibility to subsidence. However the lack of proper attributes in the available vector data may limit this. Fortunately OneGeology Europe does have this facility therefore it is likely that the European integration will use this data.

9.3 One Geology Europe

http://www.onegeology-europe.org/

9.3.1 Data description

OneGeology-Europe aims to create dynamic digital geological map data for Europe. OneGeology-Europe is a natural offshoot of the global OneGeology initiative and consists of a consortium of European geological surveys and representatives from the user community.

Unlike the Global OneGeology initiative, where what ever data is available is taken, OneGeology-Europe uses a common data model. Data from each of the participating 21 geological surveys is taken and transformed into GSML format. The data are classified into common classifications for age and lithology. These are part harmonised, however at present there are still edge matching issues between countries, these are expected to be resolved over time.

9.3.2 Data source

http://www.onegeology-europe.org/portal

9.3.3 How was the data derived/produced

Data have originated from contributing geological organisations such as national geological surveys. The data are therefore produced using the standard mapping techniques used by that organisation. Data are then transformed to GSML and classified to common classifications for age and lithology.

9.3.4 What format is the data

Data are served as a WMS – i.e. a static image. However all data are available to download from the site or from the individual organisations as GSML or ESRI shapefiles with attributes relating to age and lithology.

9.3.5 Area covered/European coverage

Coverage of all Europe is envisaged. 21 Geological surveys have signed up to make their data available for use by the end of September 2010.

9.3.6 Resolution

The aim is for a 1:1m dataset, however scale varies from 1:625 000 to 1:1 350 000.

9.3.7 Availability (free etc)

Data are available for free for use in any manner.

9.3.8 Perceived quality

Good quality data only limited by low resolutions in some countries.

9.3.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

In the absence of subsidence data the geological data from OneGeology-Europe will form the basis of an interpretation of susceptibility to subsidence.

9.4 Population Density (Geoland2)

9.4.1 Data description

Geoland2 is a FP7 GMES collaborative project which runs from 2008 – 2012. Geoland2 aims to support the monitoring, protection and sustainable management of our environment. Benefiting from Earth Observation satellite data, the GMES Land Service provides accurate and cross-border harmonised geo-information at global to local scales. Geoland2 is organised into core mapping services which then support the core information services:

The core mapping services are:

- EUROLAND
- BioPar
- SATchMo

The core information services are:

- Spatial Planning
- Agri Environmental Monitoring
- Water Monitoring
- Forest Monitoring
- Land Carbon
- Natural Resource Monitoring in Africa
- Global Crop Monitoring

There is a wealth of information available from Geoland2. Two datasets are the most relevant to SubCoast; the Urban Atlas and population density data. The Urban Atlas is described in the

The Urban Atlas section. Also of interest from Geoland2 is the population density data – these are described below.

Population density is available at two resolutions; population per 500m grid cell and per 10km grid cell. Population density is broken down into 6 categories.

9.4.2 Data source

From the EUROLAND core mapping service.

All Geoland2 data maybe accessed from the GMES land monitoring portal: http://www.land.eu/portal/. This portal allows data from several projects to be viewed.

The Expert SDI Portal (http://www.geoland2.eu/index.jsp) allows greater interaction with and downloading of the data. Population density data is found in the 'Spatial planning services' under the 'Geoland2 services'.

9.4.3 Area covered/European coverage

Currently only Denmark, Poland, Chech Republic, Slovakia and Austria

9.4.4 Resolution

500m or 10km.

9.4.5 Availability (free etc)

Needs to be ordered – ordering process is unclear at present

9.4.6 Perceived quality

Good quality

9.4.7 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

Very useful for impact analysis however limited spatial resolution limits usefulness.

9.5 The Urban Atlas (Geoland2)

9.5.1 Data description

"The Urban Atlas is part of the implementation of the Global Monitoring of Environment and Security (GMES) service. Compiled from thousands of satellite photographs, the Urban Atlas provides detailed and cost-effective digital mapping. The Urban Atlas will enable urban planners and the public to assess risks and opportunities, ranging from threat of flooding and impact of climate change, and to identify new infrastructure needs. All cities in the EU will be covered by the Urban Atlas by 2011. This map will provide for the first time homogeneous and up-to-date information on urban environments, allowing for a comparison of different cities all across Europe." From http://dataservice.eea.europa.eu/map/UrbanAtlasBeta/about_urbanatlas.html

The map data are composed of vector GIS layers, the layers are shown in Table 1. the scale of the dataset is 1:10000.

UrbanAtlas No.	Vector Data Code	Nomenclature
1		Artificial surfaces
1.1		Urban fabric
1.1.1	11100	Continuous Urban fabric (S.L. > 80%)
1.1.2	11200	Discontinuous urban fabric (S.L. 10% - 80%)
1.1.2.1	11210	Discontinuous Dense Urban Fabric (S.L.:50% - 80%)
1.1.2.2	11220	Discontinuous Medium Density Urban Fabric (S.L.: 30% - 50%)
1.1.2.3	11230	Discontinuous Low Density Urban Fabric (S.L.: 10% - 30%)
1.1.3	11300	Isolated Structures
1.2		Industrial, commercial, public, military, private and transport units
1.2.1	12100	Industrial, commercial, public, military and private units
1.2.2	12200	Road and rail network and associated land
1.2.2.1	12210	Fast transit roads and associated land
1.2.2.2	12220	Other roads and associated land
1.2.2.3	12230	Railways and associated land
1.2.3	12300	Port areas
1.2.4	12400	Airports
1.3		Mine, dump and construction sites
1.3.1	13100	Mineral extraction and dump sites
1.3.3	13300	Construction sites
1.3.4	13400	Land without current use Excluded from thematic accuracy assessment to limit cost / avoid unnecessary effort in mapping and QA as this class requires local knowledge
1.4		Artificial non-agricultural vegetated areas

1.4.1	14100	Green urban areas
1.4.2	14200	Sports and leisure facilities
2	20000	Agricultural - + Semi-natural areas + Wetlands 1 ha MMU
3	30000	Forests 1 ha MMU
5	50000	Water bodies 1 ha MMU

Table 1. layers within the Urban Atlas

The current publish date is 28/5/2010, this will be updated. Image data used to compile the atlas is from 2005 – 2007.

9.5.2 Data source

The European Environment Agency (EEA) has an online data portal, which allows the data to be viewed and inquired into. The portal is available here: http://dataservice.eea.europa.eu/map/UrbanAtlasBeta/. An example of the data for Leicester is shown in Figure 2.

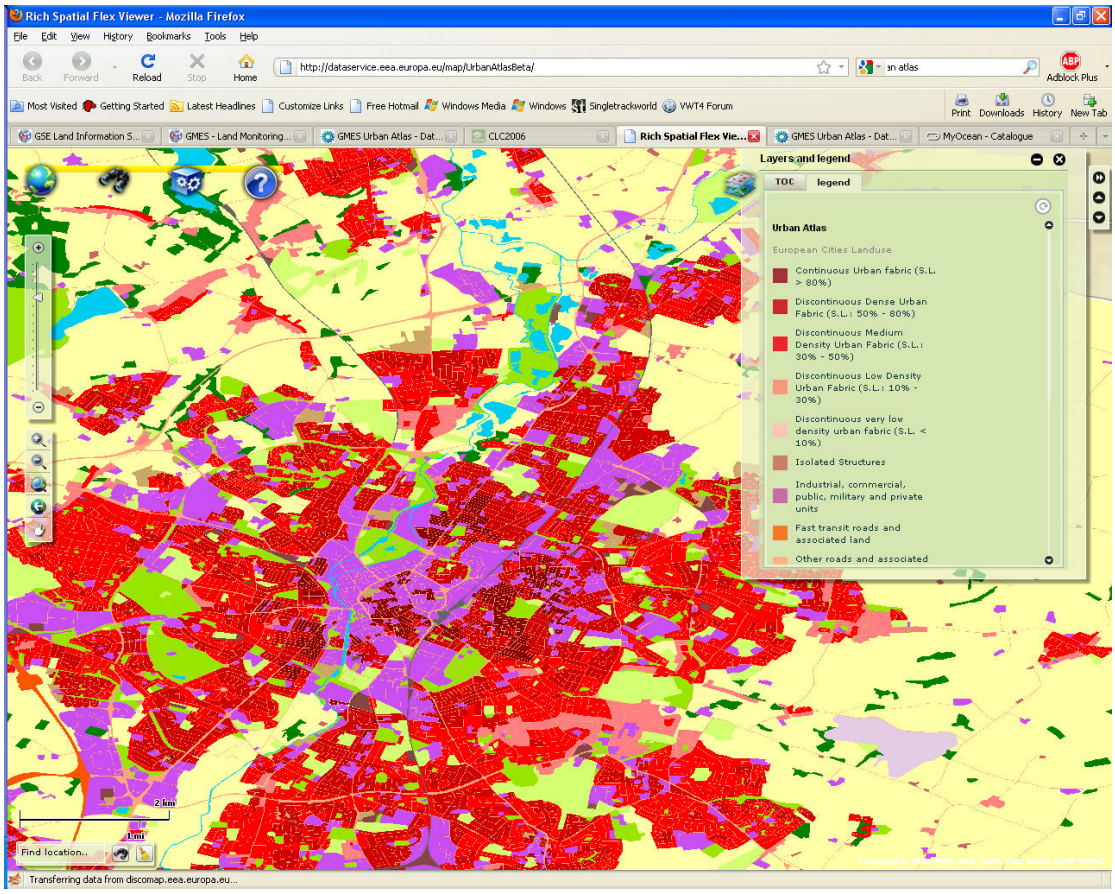

Figure 2: urban atlas data for Leicester (UK). Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

The GIS vector data (ESRI shapefiles) can be downloaded from the EEA (http://www.eea.europa.eu/data-and-maps/data/urban-atlas). Data are arranged by cities and downloadable as zip files.

9.5.3 How was the data derived/produced

The Urban areas have been mapped using very high resolution (2.5 m) EO data (Spot 5, Formosat-2, Kompsat-2 and ALOS data) for the reference year 2006 ± 1 year. The Urban Atlas cities are mapped at a nominal scale of approximately 1:10.000, using 20 classes with a minimum mapping unit of 0.25 ha. The urban fabric (CLC classes 1.1 and 1.2) are differentiated by their degree of imperviousness which is integrated from the LMCS high resolution soil sealing layer.

The production is based on a mix of CAPI (Photo-interpretation) and object oriented classification with a 3-step validation involving a project internal quality assessment (carried out by IGN-FI), independent experts and a technical review by the ETC LUSI. So far the quality of products is good, errors have been reprocessed by the contractor and the production is going on quite smoothly, except some problems with the availability of required EO data.

9.5.4 What format is the data

ERSI shapefiles are suitable for use by SubCoast. The reference system is ETRS 1989, a prj file is available which defines this further:

Projection system “ETRS_1989_LAEA_L52_M10"
GEOGCS "GCS_ETRS_1989",
DATUM "ETRS_1989",
SPHEROID "GRS_1980",6378137.0,298.257222101,
PRIME Meridian "Greenwich",0.0,
UNIT "Degree",0.0174532925199433
PROJECTION "Lambert_Azimuthal_Equal_Area",
False_Easting",4321000.0,
False_Northing",3210000.0,
Central_Meridian",10.0,
Latitude_Of_Origin",52.0,
UNIT"Meter",1.0

9.5.5 Area covered/European coverage

All cities in the EU will be covered by 2011. The first edition was planned to be delivered in 2009 covering 185 cities, but by April 2010 140 cities had been completed

9.5.6 Resolution

The Urban Atlas cities are mapped at a nominal scale of approximately 1:10.000, using 20 classes with a minimum mapping unit of 0.25 ha.

9.5.7 Availability (free etc)

Free download from EEA.

9.5.8 Perceived quality

Good, the data are being independently verified by a separate project. Areas found to be in error have been reprocessed. A scale of 1:10 000 is greater than we require but this can be subsampled.

9.5.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The Urban Atlas will be a valuable dataset when the impact of subsidence and sea level rise is considered. The impact of sea level rise is linked to the land use, infrastructure and population of the area under threat. The Urban Atlas will therefore be used to derive the impact score in the integrated product.

9.6 Elevation Data

9.7 Shuttle Radar Topography Mission

9.7.1 Data description

Shuttle Radar Topographic Mission (SRTM) consists of a set of digital elevation models (DEMs). SRTM is an international project led by the National Geospatial-Intelligence Agency (NGA) and the National Aeronautics and Space Administration, the Italian Space Agency (ASI) and the German Aerospace Centre (DLR). Information about the data can be found at http://www2.jpl.nasa.gov/srtm/

9.7.2 Data source

The data can be downloaded from the Global Landcover Facility portal at http://glcf.umiacs.umd.edu/data/srtm/.

9.7.3 How was the data derived/produced

SRTM are derived from a C-band radar system that was flown on-board the Endeavour Space Shuttle over an 11-day period in February 2000.

9.7.4 What format is the data

The data for Europe is available in 1 kilometre and 90 meter resolutions. The primary file formats are GeoTIFF, Band SeQuential (BSQ), Hierarchical Data Format (HDF), ArcInfo Interchange (ArcGrid), compressed raster (MrSid) and shapefiles (SHP).

Primary file formats

Format	Translation	Extension	Comment
GeoTIFF	Geostationary Earth Orbit Tagged Image File Format	.tif	a TIFF with location
BSQ	Band SeQuential	.bsq	binary
HDF	Hierarchical Data Format	.L1G	NASA
Fast	fast	.fst	Landsat
Arc Grid	Arc/Info Interchange	.e00	ESRI
Mr.Sid	Mr.Sid	.sid	proprietary
Shapefile	Shapefile	.shp	vector standard

Secondary files

Extension	Description
.dbf	dBase database file, accompanies shapefiles; by ESRI
.gz	compressed using Gzip, by GNU Zip
.jpg	Joint Photographic Experts Group image file (non-spatial)
.png	Portable Network Graphics image file (non-spatial)
.prj	text file, with projection details
.shx	spatial index file, accompanies shapefiles; by ESRI
.sbx	spatial index file, accompanies shapefiles; by ESRI
.sbn	spatial index file, accompanies shapefiles; by ESRI
.sid	Mr.Sid compressed image file, an option with Landsat mosaics
.tfw	world file, sometimes accompanies GeoTIFF

Metadata files

Extension	Collection(s)
.met	Landsat GeoCover, Landsat GeoCover Mosaics, GLS 1990- Landsat TM, GLS 2000- Landsat ETM+
.hdr	Landsat , IKONOS
.cof	Landsat
.ddr	Landsat MSS
.hd	Landsat NLAPS
.H1	Landsat MSS
.HI	Landsat; processing history
.ip3	Landsat
HPN.fst	Landsat Fast
HRF.fst	Landsat Fast
HTM.fst	Landsat Fast
HDF.L1G	Landsat HDF
MTL.L1G	Landsat BSQ and HDF
.wo	Landsat NLAPS
.dif	various, for GCMD
.hdf.met	ASTER
.txt	MODIS VCF, UMD Land Cover, Tree Cover
.metadata.txt	IKONOS
.RPB	QuickBird
.TIL	QuickBird
.IMD	QuickBird
.PVL	OrbView
MTL.TIF	GLS 2005- Landsat ETM+
MTL.txt	GLS 2005- Landsat TM and ETM+
MTL_L1T.TIF	EO-1 ALI

Examples of how to load file formats in selected software

GeoTIFF	HDF	BSQ	Software	Company
			ArcExplorer	ESRI
tutorial	tutorial	tutorial	ArcGIS 9.x	ESRI
tutorial	tutorial	tutorial	ArcView GIS 3.x	ESRI
		BSQ	ER Mapper	Geospatial Imagery Solutions
tutorial	tutorial	tutorial	Envi 4.x	ITT Visual Information Solutions
tutorial	tutorial	tutorial	IDRISI Andes	Clark Labs
			ImageJ	US NIH RSB
tutorial	tutorial	tutorial	Imagine 9.x	Leica
			MultiSpec	Purdue Research
				Foundation
			MyWorld GIS	GEODE, Northwestern
			Photoshop	Adobe

All elevations are in meters referenced to the WGS84 EGM96 geoid and horizontally referenced to the WGS84 ellipsoid.

9.7.5 Area covered/European coverage

Near global coverage land surface (Figure 3).

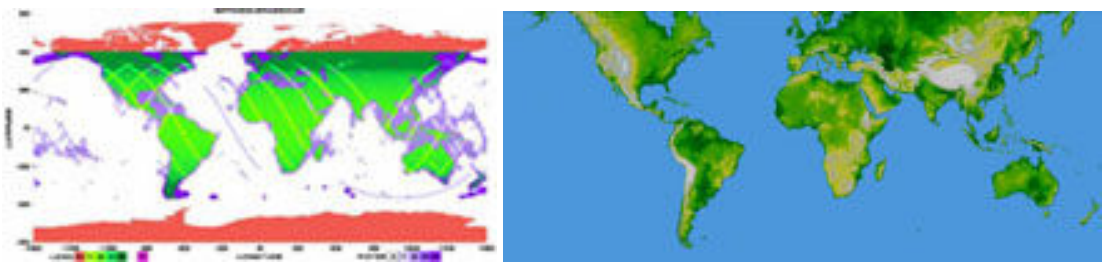

Figure 3. SRTM Area coverage

9.7.6 Resolution

Europe is covered with 90m data in x and y. The elevation is within 16m of Z.

9.7.7 Availability (free etc)

SRTM 90m data are free.

9.7.8 Perceived quality

The quality is good. The CGIAR Consortium for Spatial Information report that the vertical error of the DEMs is reported to be less than 16m (http://srtm.csi.cgiar.org/).

The Jet Propulsion Laboratory (JPL) released an accuracy report (Rodriguez, E., C.S. Morris, J.E. Belz, E.C. Chapin, J.M. Martin, W.Daffer, S. Hensley, 2005, An assessment of the SRTM topographicproducts, Technical Report JPL D-31639, Jet Propulsion Laboratory,Pasadena, California, 143 pp).

9.7.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The SRTM data provides a base level of land elevation at 90m resolution for February 2000.

9.7.10 GDEM

9.7.11 Data description

GDEM is a global DEM that is derived from measurements from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite. Japan's space agency (JAXA) and NASA collaborated on the production of the dataset. Further information on the data can be found at http://asterweb.jpl.nasa.gov/gdem.asp.

9.7.12 Data source

The data can be downloaded from two portals, NASA's EOS data archive at http://asterweb.jpl.nasa.gov/gdem-wist.asp and Japan's Ground Data System at http://www.gdem.aster.ersdac.or.jp/index.jsp.

9.7.13 How was the data derived/produced

Stereo correlation was conducted on 1.3 million ASTER very near infrared (VNIR) satellite scenes.

9.7.14 What format is the data

The GDEM is formatted in 30 meter postings and in 1x1 degree tiles in GeoTIFF format.

9.7.15 Area covered/European coverage

The data covers the Earth's land surface between 83N and 83S latitudes. Some voids have been filled using external DEM data (Figure 4).

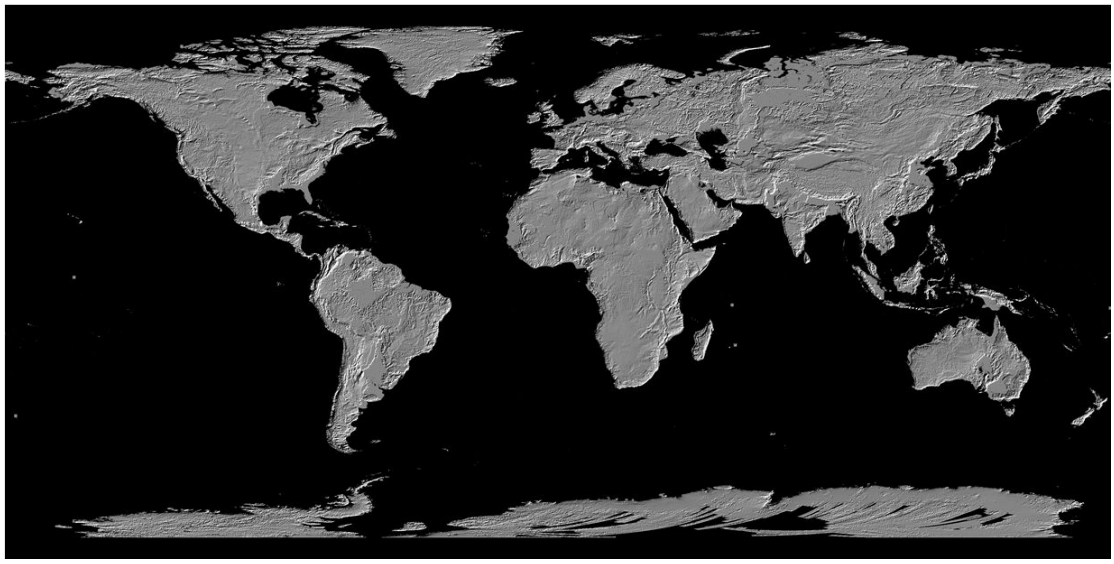

Figure 4. Spatial coverage of GDEM

9.7.16 Resolution

The elevation model is 30m horizontal resolution and nominally 10m vertical resolution.

9.7.17 Availability (free etc)

Pursuant to an agreement between Japan's Ministry of economy, trade and Industry (METI) and NASA, the product is distributed at no cost to users worldwide as a contribution to the Global Earth Observing Systems of Systems (GEOSS).

9.7.18 Perceived quality

Mixed. The VNIR sensor is susceptible to interference e.g. it cannot see through clouds, so there are some voids, pits and bumps that have been replced with other datasets. Furthermore, the data is derived from individual scenes so there are steps at scene boundaries. The Validation Summary Report (http://asterweb.jpl.nasa.gov/gdem.asp) found that the vertical accuracy was approximately 10m but warned that "the ASTER GDEM was found to contain significant anomalies and artifacts which will affect its usefulness for certain user applications".

There is a quality assessment (QA) file with each 1x1 degree tile. The QA file shows the number of scene-based DEMs contributing to the final DEM value at each pixel or the location of the data anomalies that have been corrected and the data source used for the correction.

9.7.19 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The data will provide a baseline for land elevation at a horizontal resolution of 30m. The 'perceived quality' issues noted above suggest that the dataset should be used with caution and that the QA files must be studied prior to use.

9.7.20 GTOPO 30

http://www.eea.europa.eu/data-and-maps/data/digital-elevation-model-of-europe
http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/gtopo30_info

9.7.21 Data description

GTOPO30 is a global DEM.

9.7.22 Data source

GTOPO30 data can be downloaded from a portal at http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/gtopo30_info with a mirror site in Japan at http://www1.gsi.go.jp/geowww/globalmap-gsi/gtopo30/gtopo30.html.

9.7.23 How was the data derived/produced

The dataset took three years to compile and it was completed in 1996 in a joint effort led by the United States Geological Survey (USGS) Centre for Earth Resources Observations and Science (EROS)

It was derived from a combination of several raster and vector sources. For Europe these sources comprise digital terrain elevation data (DTED) and digital chart of the world (DCW). The DTED is a raster topographic database produced by the U.S. National Imagery and Mapping Agency (NIMA). The DCW is a vector cartographic data set based on the 1:1,000,000-scale Operational Navigation Chart (ONC) series, which is the largest scale base map source with global coverage.

9.7.24 What format is the data

The data are projected in lat/long to WGS84 in decimal degrees with the elevation in meters above mean sea level. The data are tiled, with 4 tiles are required to cover Europe. Each tile is provided as a set of eight files as listed below.

Extension	Contents
DEM	digital elevation model data
HDR	header file for DEM
DMW	world file
STX	statistics file
PRJ	projection information file
GIF	shaded relief image
SRC	source map
SCH	header file for source map

The DEM is a 16-bit signed integer ni a simple binary raster.

Details on the format can be found at
http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/gtopo30/README.

9.7.25 Area covered/European coverage

The entire globes land surface is covered, with ocean areas masked as values of -9999.

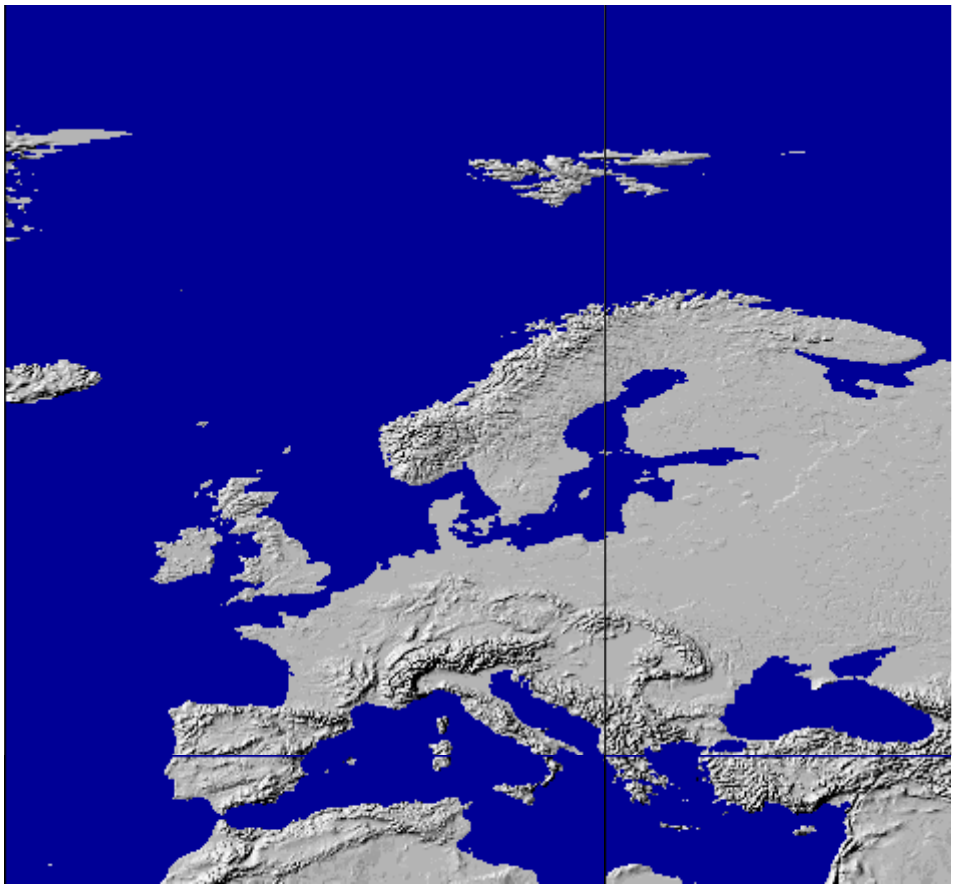

Figure 5. Four tiles of GTOPO30 cover Europe.

9.7.26 Resolution

Horizontal grid spacing of 30 arc seconds (approximately 1km). “Approximately 30% of the tiles have an absolute vertical accuracy worse than the product specification of +/- 30m at 90% confidence” source Section 8.2 ‘Topographic detail and Accuracy’ of the official GTOPO30 Documentation at http://www1.gsi.go.jp/geowww/globalmap-gsi/gtopo30/README.html#h34.

9.7.27 Availability (free etc)

The data are freely available.

9.7.28 Perceived quality

Medium. The data are derived from different sources and this produces artefacts at their boundaries. Additional artefacts include striping, mounds, depressions, stepping (or terracing).

9.7.29 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

This would form a low resolution baseline of the ground elevation.

9.7.30 NextMap Europe

9.7.31 Data description

This is a very high resolution seamless elevation dataset covering Europe. The DEM will serve as the elevation data theme for the Initial GMES Geospatial Reference Data.

9.7.32 Data source

The data is available from Intermap Technologies Ltd. Information on obtaining the dataset can be found at http://www.intermap.com/.

9.7.33 How was the data derived/produced

The dataset is derived from airborne interferometric synthetic aperture radar (IFSAR) surveys. The LearJet operated at a nominal altitude of 10km AGL.

9.7.34 What format is the data

The elevation data are delivered in Digital Surface Model (DSM) and Digital Terrain Model (DTM). The DSM contains all earth surface features (including manmade) while the DTM is a 'bare earth' model with the cultural features digitally removed from the DSM.

The vertical datum (geoid) is EVRS2000 (EGG 2007), the horizontal (geodetic) datum is RTRS89. The default projection used is Geographic coordinate system (Lat/Long), but others are available.

The elevation data can be supplied in a variety of formats including GRID and ascii xyz.

9.7.35 Area covered/European coverage

The dataset covers all of the land surface of western Europe: Austria, Benelux, Britian, Czech Republic, France, germany, Ireland, italy, Portugal, Spain, Switzerland.

9.7.36 Resolution

The accuracy of the NEXTMap DSMs and DTMs is predominantly 1 vertical meter RMSE. Horizontal resolution is 5m.

9.7.37 Availability (free etc)

The data is available for purchase from Intermap Technologies.

9.7.38 Perceived quality

Very high. The data is very high resolution (considering the wide coverage). The accuracy has undergone third-party verification by eleven independent agencies including the EA (Environment Agency) of England and the University of Stuttgart.

9.7.39 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

This dataset would provide a very high resolution baseline of ground elevation across Europe.

9.8 MyOceans Sea Level Data

9.8.1 Data description

A series of sea surface and ocean current data derived from the MyOcean FP7 Project (the implementation of the GMES Marine Core Service). MyOcean began in 2009 and is due to complete in 2011. MyOcean is a European project dedicated to operational oceanography, providing information on the Ocean for the large and regional scales (European seas), based on the combination of space and in situ observations, and their use into models: temperature, salinity, currents, ice extent, sea level, primary ecosystems (see www.myocean.eu.org).

Relevant sea surface datasets from MyOcean are:

a) Global Ocean Along-track Sea Surface Heights NRT (Near Real Time)
b) Global Ocean Along-track Sea Surface Heights Reanalysis
c) Global Ocean Mean Dynamic Topography
d) Global Ocean Mean Surface

The preferred MyOcean dataset for the SubCoast project is Global Ocean Along-track Sea Surface Heights Reanalysis. It is a standard product that contains sea surface height above sea level in meters. A User Handbook on the product is available from http://www.aviso.oceanobs.com/fileadmin/documents/data/tools/hdbk_duacs.pdf.

9.8.2 Data source

Datasets can be obtained via the portal at http://www.myocean.eu.org/products-services/catalogue.html after completing the Service Level Agreement (SLA) at http://www.myocean.eu.org/products-services/obtain-products.html.

9.8.3 How was the data derived/produced

The data were derived from a combination of in situ and remote measurements. Data on seal levels and sea level anomalies is from altimeter missions: OSTM/Jason-2, Jason-1, Topex/Poseidon, Envisat, GFO, ERS-1&2 and even Geosat. At this time DUACS is using three different altimeters.

DUACS (Data Unification and Altimeter Combination System) is part of the CNES multi-mission ground segment (SSALTO) and provide the data to MyOcean.

Real Time observations are for operational use and the delayed time observations are held in a database. The delayed time observations will be used in the European Integration in SubCoast.

The procedure for creation of the data is outlined at http://www.aviso.oceanobs.com/fileadmin/documents/data/tools/hdbk_duacs.pdf

9.8.4 What format is the data

The data are available via FTP. The storage format used for SSALTO/DUACS products is outlined in Section 6 of the SSALTA/DUACS handbook that is available at http://www.aviso.oceanobs.com/fileadmin/documents/data/tools/hdbk_duacs.pdf.

The products are stored using NetCDF (Network Common Data Form) using a Lat/long coordinate system.
The reading software needed to read products stored in NetCDF are available on the AVISO FTP site
ftp://ftp.aviso.oceanobs.com/pub/oceano/AVISO/software/. NetCDF data can be browed and used through other software like:

ncBrowse: http://www.epic.noaa.gov/java/ncBrowse/, and

NetCDF Operator (NCO): http://nco.sourceforge.net/.

9.8.5 Area covered/European coverage

Global coverage.

9.8.6 Resolution

7km spatial resolution
The data have been recorded since 29/9/1992.
The dataset is updated bi-annually.

Gridded products at 1/3 degree Mercator grid:

- High resolution Maps of Sea Level Anomaly (DT-MSLA) combining all satellites
- High resolution Maps of Absolute Dynamic Topography (DT-MADT), merging all satellites.
- High resolution Maps of geostrophic velocities anomalies derived from maps of Sea Level Anomaly combining all satellites,
- High resolution maps of absolute geostrophic velocities derived from maps of Absolute Dynamic Topography combining all satellites.

9.8.7 Availability (free etc)

Access to products is open and free.
DUACS gridded products are available free of charge for scientific studies or non-profit projects only. Products older than 1 month are freely available via FTP. Commercial use of gridded products or applications not in line with the standard license agreement is subject to separate agreement and license. Contact aviso@oceanobs.com for further information on commercial use or applications not in line with the standard license agreement.

9.8.8 Perceived quality

The Input Data Quality Control is a critical process applied to guarantee that DUACS uses only the most accurate altimeter data. Due to the high quality of current missions, this process rejects a small percentage of altimeter measurements, but these erroneous data could be the cause of a significant quality loss. The quality control relies on standard raw data editing with quality flags or parameter thresholds, but also on complex data editing algorithms based on the detection of erroneous artefacts, mono and multi-mission crossover validation, and macroscopic statistics to edit out large data flows that do not meet the system's requirements.

The key features of the DUACS processing system are to ensure production of high quality homogeneous products with a short delay. However, some events (failure on payload or on instruments, delay, maintenance on servers), can impact the quality of measurements or the data flows. A strict quality control on each processing step is

indispensable to appreciate the overall quality of the system and to provide the best user services.

The Quality Control (QC) is the final process used by DUACS before product delivery. In addition to daily automated controls and warnings to the operators, each production delivers a large QC Report composed of detailed logs, figures and statistics of each processing step. Altimetry experts analyse these reports twice a week. A shorter report is delivered to DUACS users upon each product delivery. This QC activity is used as a modest Cal/Val activity on NRT products. It provides level2 product centres with a detailed feedback on potential anomalies for a fast reprocessing of erroneous IGDR flows.

Download them from ftp://ftp.aviso.oceanobs.com/pub/oceano/AVISO/SSH/duacs/quality_report/.

9.8.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The product will provide bi-annual gridded sea surface elevations for the entire European coastline. The main limitation is the 7km resolution but it is estimated that this is sufficient for the European integration component of SubCoast.

9.9 Storm Surge Locations

The location of storm surges could be important for SubCoast as a storm surge could increase the elevation of the sea surface plus add considerable force to the sea water thereby increasing its erosive power. MyOceans provides ocean current products, but these do not appear to include storm surge locations.

There is a Europe storm surge hazard maps from the European Spatial Planning Observation Network (ESPON) which shows the approximate probability of having storm surges. It is available from http://www.preventionweb.net/english/professional/maps/v.php?id=3830 but we have not been able to find information on how the map was derived.

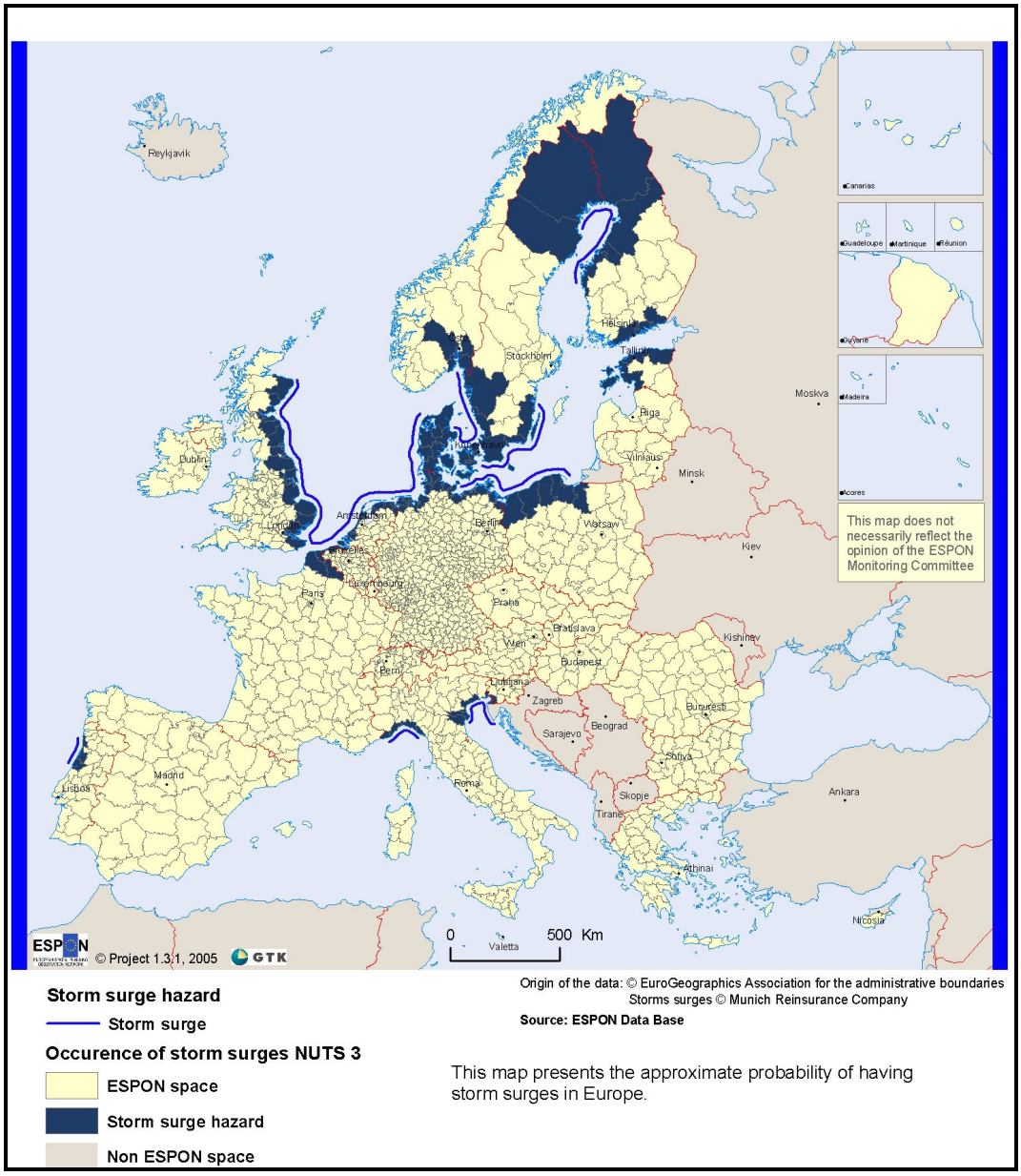

Figure 6. ESPON Storm Surge Hazard Map. Source:

http://www.preventionweb.net/files/3830_stormsurgehazardN3.jpg

The EEA have information on storm surges in Europe http://www.eea.europa.eu/data-and-maps/indicators/storms-and-storm-surges-in-europe/storms-and-storm-surges-in. The EEA contact is Ricardo Fernandez Bayon (Ricardo.Fernandez@eea.europa.eu). The EEA key messages on storm surges are:

- There has been considerable variation, but no clear long term trend in storminess in Europe. Storm frequency was relatively high during the late 19th and early 20th century; then decreased in central and northern Europe. The recent high level is similar to the late 19th century level of storminess.
- Despite the variation in storminess, water levels along most vulnerable European coastlines of the North Sea and Mediterranean Sea have shown no significant storm-related variation.
- Extra-tropical storm tracks are projected to move pole-wards, with consequent changes in wind, precipitation, and temperature patterns, continuing the broad pattern of observed trends over the past half-century.
- Climate models indicate a slight decrease in the number of storms and an increase of the strength of the heaviest storms.
- Projections to the end of the 21st century show a significant increase in storm surge elevation for the continental North Sea and south-east England.

There is an ESA Storm Surge Project. A User Consultation meeting was held in September 2009 to define the detailed set of user requirements for the project including identifying the priority EO information, services and priority regions of interest. The project scope is 'development and demonstration of EO to improve storm surge applications'. A follow-up meeting was held in Hamburg from 13-17 September 2010: (http://www.loicz.org/calender/Congress/index.html.en).

For info. paper online called "*Assimilating satellite altimeter data in operational sea level and storm surge forecasting*" Philillart & Gebraad (2007) Elsevier Oceanography Series Vol.66 pp469-479.
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B8CXS-4P6SMB2-1W&_user=1001893&_coverDate=12%2F31%2F2002&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&view=c&_searchStrId=1475513693&_rerunOrigin=google&_acct=C000027978&_version=1&_urlVersion=0&_userid=1001893&md5=fdcc902ef70204ea425748d6e478e02f&searchtype=a

9.10 European Environment Agency- Elevation breakdown 1km (EBK1KM)

9.10.1 Data description

EBK1KM allocates land cover changes into homogeneous areas as a function of height, slope and distance to the sea. It defines five relief typologies: Low coasts, high coasts, inlands, uplands and mountains.

9.10.2 Data source

http://www.eea.europa.eu/data-and-maps/data/elevation-breakdown

9.10.3 How was the data derived/produced

Land units, defined using the LEAC 1 km grid (http://www.eea.europa.eu/data-and-maps/data/reference-grid-for-land-cover-accounts-leac), are classified according to height, slope and distance to the sea using the 1km GISCO digital elevation model and a reference coastline (http://dataservice.eea.europa.eu/dataservice/metadetails.asp?id=921).

Areas < 10km from the coastline are considered to represent 'Coasts' and are split in two categories: 'Low coasts' (< 50m) and 'High coasts' (> 50m). 'Inland' areas are those between 0 and 2km outside the coastal strip. 'Upland' areas are the zones between 200 and 500 m plus any flat areas between 500 and 1000. Steep areas between 500 and 1000m and all areas over 1000m are classified as 'Mountains'.

9.10.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/elevation-breakdown). A zipped TIFF file suitable for import into ArcGIS is provided.

9.10.5 Area covered/European coverage

The data covers the following regions: EU15, EU25, EU27, Albania, Andorra, Bosnia and Herzegovina, Croatia, Switzerland (Figure 7).

Figure 7. Coverage of European Environment Agency- Elevation breakdown data. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.10.6 Resolution

The dataset scale is 1:1,000,000. Geographic accuracy is believed to be 1,000m.

9.10.7 Availability (free etc)

The EEA standard re-use policy applies: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.

9.10.8 Perceived quality

The reference coastline used to define the 10 km coastal buffer was created by omitting the intertidal flats, coastal lagoons and estuaries. Thus, the most inland edge of these features is defined as the shoreline and the coastal strip may be wider than the pre-determined 10 km. The European Environment Agency rates the data as having an excellent temporal accuracy and logical consistency, a good thematic accuracy and completeness. Positional accuracy is currently undefined but believed to be 1,000m. Ongoing improvements include using a more detailed DTM and working with a higher resolution (100m pixels).

9.10.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

EBK1KM data will be very useful in defining coastal lowlands and, thus, areas potentially susceptible to subsidence.

9.11 European Environment Agency- Corine Land Cover 2000 (CLC2000) coastline

9.11.1 Data description

The Corine Land Cover 2000 coastline provides a detailed reference coastline for all countries that produced Corine Land Cover 2000 and have a coastline. Coastal geometry as well as descriptions of the environment and type of coastal areas are provided. Each coast segment has inherited the Corine Land Cover 2000 class along with attributes from the Eurosion shoreline version 2.1 2004, regarding geomorphology, type of coast and erosion trends. This coastline excludes artificial infrastructure.

9.11.2 Data source

http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-coastline

9.11.3 How was the data derived/produced

Coastline geometry was created by selecting Corine Land Cover 2000 polygons which intersect the sea. This coastline inherits the Corine attributes and Eurosion attributes are also assigned.

9.11.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-2000-coastline). Maps are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive, vector data and polyline shapefiles.

9.11.5 Area covered/European coverage

The data covers the following regions: EU15, EU25, EU27, Albania, Bosnia and Herzegovina, Croatia (Figure 8).

Figure 8. Coverage of Corine Land Cover 2000. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.11.6 Resolution

The dataset scale is 1:100,000. Geographic accuracy is believed to be 100m.

9.11.7 Availability (free etc)

For the original data-The data is available for non commercial use only. An agreement form must also be completed. Copyright holder: European Environment Agency.

For the produced maps- The EEA standard re-use policy applies: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged (http://www.eea.europa.eu/legal/copyright). Copyright holder: European Environment Agency.

9.11.8 Perceived quality

The reference coastline used to define the 10 km coastal buffer was created by omitting the intertidal flats, coastal lagoons and estuaries. Thus, the most inland edge of these features is defined as the shoreline and the coastal strip may be wider than the pre-determined 10 km. The Corine Land Cover 2000 data was supplemented with satellite imagery from the IMAGE 2000 Project. Any discrepancies in land classification between the two datasets were investigated. The European Environment Agency rates the data as having an excellent temporal accuracy, logical consistency, positional accuracy and thematic accuracy and a good level of completeness.

9.11.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

CLC2000 data will allow identification of the coastline as of 2000. Attributes regarding geomorphology, type of coast and erosion trends will aid identification of areas potentially susceptible to subsidence. Artificial infrastructure has been excluded from this dataset so any conclusions resulting from its use must be checked against coastal defence data.

9.12 European Environment Agency- Sediment Discharges

9.12.1 Data description

This dataset is composed of 3 layers: 1) GISCO watersheds, 2) Total Suspended Solid delivery downstream within the sea and 3) Sediment flow from quality stations.

9.12.2 Data source

http://www.eea.europa.eu/data-and-maps/data/sediment-discharges

9.12.3 How was the data derived/produced

The EUROSION consortium has prepared a trend analysis which examines the issues that influence coastal erosion. A cartographic assessment of the
European coasts' exposure to coastal erosion was undertaken based on spatial data and GIS analysis.

9.12.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/figures/sediment-discharges-total-suspended-solids). Maps are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive, vector data (polygon) and point shapefiles.

9.12.5 Area covered/European coverage

The data covers the following regions: EU15, Bosnia and Herzegovina, Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Liechtenstein, Lithuania, Malta, Norway, Poland, Romania, Slovakia (Figure 9).

Figure 9. Overage of Sediment Discharges data. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.12.6 Resolution

The GIS database scale is 1:100,000.

9.12.7 Availability (free etc)

Original data-The EEA standard re-use policy applies: unless otherwise indicated, re-use of content on the EEA website for commercial or non-commercial purposes is permitted free of charge, provided that the source is acknowledged

(http://www.eea.europa.eu/legal/copyright). Copyright holder: Directorate-General for Environment.
For more information see: http://www.eea.europa.eu/data-and-maps/data/sediment-discharges/d2-13-4 data_access_conditions_v2.0.pdf

Produced maps- Access is managed by the Directorate-General for Environment. Please contact the owner for more information about their data policy.

9.12.8 Perceived quality

The Global quality approach of the EUROSION project consists of a constant follow-up through all the stages of the project implementation. All participants have to elaborate and follow their own internal Quality Insurance/Management Plan to provide coherent work process and document base to possible appraisal or audit. Quality controls for databases or products to be integrated into the EUROSION database is to be performed with respect to the terms of reference. Relations between various participants are clearly regulated in terms of contracts and relations through elaboration of common quality parameters on the foreseen and final results. Comprehensive metadata is provided.

The data set was undertaken at a level suitable for the assessment of European policy questions. Therefore the proposed indicators are not able to provide answers to complex local or regional issues.

9.12.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The data will provide a baseline for coastal erosion trends and thus, susceptibility to subsidence. The data should be used in conjunction with other coastal erosion indicators. The dataset has been produced at a European-wide scale and, as such, is not suitable for the examination of complex local scales.

9.13 European Environment Agency- Shoreline

9.13.1 Data description

The construction of the EUROSION shoreline results from a three-step process: - a baseline shoreline for the whole European coastline has been compiled using different sources of data: (i) the first version of CORINE Coastal Erosion for EU countries as of 1990 (this version was derived from digitisation of topographical maps), (ii) SABE CoastLine at scale 1:100,000 - for countries which joined EU after 1990 and Centre East European Countries, (iii) the World Vector Shoreline (WVS) at scale 1:250,000 for some specific territories such as Crete and other Greek islands, Malta, Cyprus, Baltic States and Romania. GISCO 1:1 Million is used for EU territories such as Slovenia with Greece, Greece and Black Sea region. Comparison of the baseline shoreline with declassified LANDSAT satellite images distributed by NASA has made it possible to identify and fill data gaps (especially the delineation of estuaries and missing islands). The baseline shoreline is then improved from large scale maps (in general 1:50,000).

9.13.2 Data source

http://www.eea.europa.eu/data-and-maps/data/shoreline

9.13.3 How was the data derived/produced

The EUROSION shoreline is derived from the Corine Coastal Erosion Version 1 (CCEr). This shoreline has been geometrically improved and extended to applicant countries to cover the whole area of interest of EUROSION project. For that purpose, additional sources have been used:

- SCOL (SABE shoreline),
- World Vector Shoreline (WVS),
- GISCO Shoreline.

This allows shoreline geometry to be modified (new vertices, add or split coastal segments) from more detailed maps. Improvements are taking part of a pro active process to provide *in fine* the EUROSION Shoreline.

9.13.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/shoreline). Maps are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive containing polyline shapefile.

9.13.5 Area covered/European coverage

The data covers the following regions: EU15, Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Turkey. For Turkey, only the shoreline west of Bosporus is included in the dataset (Figure 10).

Figure 10. Coverage of Shoreline data. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.13.6 Resolution

The dataset scale is 1:100,000. EUROSION shoreline has an average accuracy estimated to 50 meters. This accuracy is estimated by comparing the EUROSION shoreline representation with declassified LANDSAT satellite images distributed by NASA.

9.13.7 Availability (free etc)

The EUROSION shoreline is a hybrid product derived from various copyrighted and copyright-free data sources. Its use is without restriction within the European Commission.

9.13.8 Perceived quality

The European Environment Agency rates the data as having an excellent completeness, temporal accuracy, logical consistency and thematic accuracy and a good positional accuracy.

9.13.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

A useful alternative/ addition to the Corine Land Cover 2000 (CLC2000) coastline. This dataset contains fewer attributes and is based on an older version of Corine Land Cover (1990). However, the use of additional data sources may aid accuracy.

9.14 European Environment Agency- Maritime Boundaries

9.14.1 Data description

The data features the following elements: - The textual content of international conventions establishing maritime boundaries in Europe. Maritime boundaries featured in this layer include territorial waters, bi- or multi-lateral boundaries (e.g. in the North Sea) as well as contiguous and exclusive economic zones. Some fishing areas are also defined; - The coordinates of points listed in these conventions are vertices of maritime boundaries and; - The maritime boundaries themselves, defined as the segments which links the different points listed in the international conventions.

9.14.2 Data source

http://www.eea.europa.eu/data-and-maps/data/maritime-boundaries

9.14.3 How was the data derived/produced

The main source of data comes out of the United Nations Convention on the Law of the Sea (UNCLOS), where nations define and update their sovereign claims to the ocean. Information provided by UNCLOS has been geocoded by EUROSION.

9.14.4 What format is the data

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/maritime-boundaries). Maps are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive containing vector data and polyline shapefiles. PDF text with links to the GIS dataset also exist.

9.14.5 Area covered/European coverage

This layer covers the coast and surrounding seas of EU-25 as well as the sea arround Island and Greenland.

9.14.6 Resolution

The dataset scale is 1:100000.

9.14.7 Availability (free etc)

Original Data- The Maritime boundaries layer of EUROSION database is available without any restriction, since source documents are freely and publicly accessible at: http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/europe.htm.

Produced maps- Access is managed by the Directorate-General for Environment. Please contact the owner for more information about their data policy.

9.14.8 Perceived quality

Quality appraisals have been performed by an international offshore-nearshore and maritime delimitations expert.

9.14.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

Useful for the identification of administrative organisations.

9.15 European Environment Agency- Hydrodynamics and Sea Level Rise

9.15.1 Data description

Data contained in this layer are threefold: 1) Wave and wind climate. 2) Mean tidal range. 3) Relative sea level rise. For wave and wind climate data, the data included in this layer provide the following parameters for each location: - average wind speed - wind speed exceeded by 10% of the measurements - wind speed exceeded by 1% of the measurements - average wave height - wave height exceeded by 10% of the measurements - wave heights exceeded by 1% of the measurements - average wave period - wave period exceeded by 10% of the measurements - wave period exceeded by 1% of the measurements These parameters are provided for the following directional sectors: 0, 45, 90, 135, 180, 225, 270, and 315 degrees.

9.15.2 Data source

http://www.eea.europa.eu/data-and-maps/data/hydrodynamics-and-sea-level-rise

9.15.3 How was the data derived/produced

1) Wave and wind climate: Data were entirely generated from the EUROSION project. The parameters listed above were statistically processed from the database waveclimate.com distributed by the Dutch company ARGOSS. waveclimate.com database contains up to 17 years of wind- and wave data (1985-2001). Observations of wave height and wind speed come from altimeters carried by ERS-1, ERS-2, Topex/Poseidon and Geosat satellites. The scatterometer sensors onboard ERS-1 and ERS-2 supplied the wind speed and wind direction data. Wave spectral parameters were derived from spectra of Synthetic Aperture Radar (SAR) imagettes collected by ERS-1 and ERS-2 using an algorithm developed by ARGOSS [Mastenbroek and de Valk, 2000]. Production of statistical estimates for the parameters listed above were carried out over boxes of 200kmx200km. Each box overlaps with the adjacent boxes with an approximate 50% rate, and results are attached to the box centre. As a consequence, data are provided with a 100km resolution along the European coast.

2) Data on tidal range at the 237 locations are extrapolated from a database distributed by ARGOSS. This database contains tidal harmonics for the eight most important components, i.e. M2, S2, N2, K2, K1, O1, P1 and Q1. The harmonics were computed by assimilating eight years of radar altimeter orbit height measurements and tide gauge measurements from approximately 7300 coastal stations into a shallow-water tidal model. The satellite measurements give a good overview of the tidal patterns on deep water, whereas the stations give accurate information for certain locations close to the shoreline. The combination of the two, assimilated in a tidal model, provides good information in shallow coastal seas where tidal effects are most prominent.

3) Relative sea level rise (RSLR) at the 237 locations are extrapolated from the digitization of two maps, namely : - the map by [Douglas et al., 2001] which provides an estimate of RSLR for the whole of Europe - the map by [Lambeck et al., 1997] which covers a smaller area in more detail, i.e. the North Sea.

9.15.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/hydrodynamics-and-sea-level-rise). Maps of mean tidal amplitude and sea level rise are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive containing vector data and polyline shapefiles. PDF text with links to the GIS dataset also exist.

9.15.5 Area covered/European coverage

Geographical coverage note: data set covers locations situated 50 to 100 km away from the shoreline of EU-25.

9.15.6 Resolution

The data has a 100km resolution along the European coast.

9.15.7 Availability (free etc)

Original Data- Though ARGOSS database is copyrighted, statistics generated from the layer Wind and wave climate are copyright-free and are therefore publicly available inside and outside the European Commission.
Though ARGOSS database is copyrighted, the extrapolated data on tidal range derived from EUROSION are copyright-free and are therefore publicly available inside and outside the European Commission.
As a EUROSION assignment, the layer Sea level rise is publicly available inside and outside the European Commission.

Produced Maps- Access is managed by the Directorate-General for Environment. Please contact the owner for more information about their data policy.

9.15.8 Perceived quality

The European Environment Agency rates the data as having an excellent logical consistency and good completes. Thematic accuracy, temporal accuracy and positional accuracy are, as yet, undefined. Source data have been severely checked and corrected with observation of tide gauges. Double control on the quality of the produced database is currently ensured on wind and wave climate as well as tidal range. The overall accuracy of tidal range estimates lies between 10 and 15%. Residual Mean Square Error (RMSE) of wave height estimates does not exceed 15%, though the RMSE of wind speed does not exceed 20%.

9.15.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The wave and wind climate and mean tidal range data will be useful coastal erosion indicators. These represent current wind, wave and tidal climates and are likely to change with predicted future climate changes. The relative sea level data will provide a useful overview of sea level rise risk. However, the source data possess a relatively coarse resolution and so should be used with caution.

9.16 European Environment Agency- Geomorphology, Geology, Erosion Trends and Coastal Defence Works

9.16.1 Data description

The dataset consists of two layers: 1) morpho-sedimentological and geological patterns of the European coastline and 2) erosion trends and the existence of coastal defence works along the coast.

9.16.2 Data source

http://www.eea.europa.eu/data-and-maps/data/geomorphology-geology-erosion-trends-and-coastal-defence-works

9.16.3 How was the data derived/produced

EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004. The data mainly results from an update of CORINE Coastal Erosion version 1.0 (CCEr v1.0). CCEr v1.0 was carried out by the European Commission from 1985 to 1990. This version covers European Union countries as of 1990. The update of CCEr version 1.0 and the extension of the database to countries which joined EU after 1990 and to accession countries was part of EUROSION assignments. These new or updated data are mainly derived from ancillary data such as national geological maps, reports, or existing database (such as FutureCoast for England and Wales). Both a geomorphological and a geological code are assigned to each data segment. 20 different geomorphological types (and thus codes) and 13 geological types have been defined. 3 codes have been defined to depict erosion trends (stable, erosion, accretion) and 2 codes to depict coastal defence works (presence, absence).

9.16.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/geomorphology-geology-erosion-trends-and-coastal-defence-works). Maps of erosion trends, coastal erosion pattern in Europe and geology and geomorphology are provided as high resolution TIFF, medium and high resolution PNG and high resolution GIF files. Original data is provided as a ZIP archive containing vector data and polyline shapefiles.

9.16.5 Area covered/European coverage

The data covers the following regions: Belgium, Bulgaria, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden, United Kingdom (Figure 11).

Figure 11. Coverage of Geomorphology, Geology, Erosion Trends and Coastal Defence Works. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.16.6 Resolution

Both layers are provided at a scale of 1:100,000

9.16.7 Availability (free etc)

Original Data- As a EUROSION assignment, this layer is publicly available inside and outside the European Commission.

Produced Maps- Access is managed by the Directorate-General for Environment. Please contact the owner for more information about their data policy.

9.16.8 Perceived quality

The European Environment Agency rates the data as having an excellent logical consistency, temporal accuracy and thematic accuracy and an excellent completeness and positional accuracy. The source data have also been severely checked and corrected. Double control on the quality of the produced database is currently ensured. This version has been geometrically modified using ESRI's ArcMap spatial adjustment on SABE 2001 v1.0 coastline. The spatial adjustment method used was "rubbersheet".

9.16.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

This dataset will aid recognition of coastal lowland areas, provide coastal erosion indicators and help identify protected sections of the coast.

9.17 European Environment Agency- Corine land cover 1990

9.17.1 Data description

Land cover data, classified into 44 classes, is provided in vector format (polygons) at a scale of 1:100,000.

9.17.2 Data source

http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-1990-clc1990-and-corine-land-cover-changes-1975-1990-in-a-10-km-zone-around-the-coast-of-europe

9.17.3 How was the data derived/produced

The minimum polygon size is 25 hectares. Land cover is organised into 44 different classes distributed into 5 categories (urbanised areas, agricultural areas, natural and semi-natural areas, wetlands, and water bodies). The level of detail varies: land cover changes since 1975 are provided in vector format (polygons) and at scale of 1:100,000. Land cover changes since 1975 only report which polygons had a change of their land cover type since 1975. Data of this layer are restricted to the 10 km land strip from the coastline.

Sources of data on land cover and land cover changes are threefold:

1) CORINE Land Cover version 1990 provides data which result from a visual analysis of LANDSAT and SPOT satellite images (mainly from 1987 to 1994) and are interpreted with the support of ancillary data (such as aerial photographs, topographical maps, or ecological maps). CORINE Land Cover version 2000 has been developed by the European Environment Agency.

2) LaCoast is a research project undertaken in the mid 1990s under the lead of the Joint Research Centre (JRC) which aimed at quantifying the changes of land cover types in a 10 km land strip from the coastline. LaCoast uses CORINE Land Cover version 1990 as its reference dataset and tracks differences of land cover changes using LANDSAT satellite images from the mid-1970's.

3) EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004. EUROSION is extending the methodology of LaCoast to other European countries not currently covered by LaCoast. The same methodology was used to ensure consistency, easy comparison, and quick aggregation.

9.17.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-1990-clc1990-and-corine-land-cover-changes-1975-1990-in-a-10-km-zone-around-the-coast-of-europe). The data are provided as a ZIP archive containing vector data and polyline shapefiles.

9.17.5 Area covered/European coverage

The data covers the following regions: Belgium, Bulgaria, Denmark, Estonia, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovenia, Spain (Figure 12).

Figure 12. Coverage of Corine land cover 1990. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.17.6 Resolution

Layers are provided at a scale of 1:100,000

9.17.7 Availability (free etc)

LaCoast data should be requested from the Joint Research Centre (JRC).
Further information is available at: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-1990-clc1990-and-corine-land-cover-changes-1975-1990-in-a-10-km-zone-around-the-coast-of-europe/d2-12-1 coastal erosion indicators study.pdf.

9.17.8 Perceived quality

The European Environment Agency rates the data as having a good temporal accuracy but a poor completeness, positional accuracy and logical consistency. Thematic accuracy is, as yet, undefined. CORINE Land Cover data have undergone several quality controls. Geometrical accuracy is relatively good however some inconsistencies exist at the border between different countries (e.g. France and Belgium). The quality of LaCoast data is currently being controlled by the JRC. Results will be shortly known. As for the extension to accessing countries quality results look very satisfactory. Spatial adjustment method used was "rubbersheet".

9.17.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

This dataset will aid recognition of coastal lowland areas. However, it currently has a relatively poor completeness, positional accuracy and logical consistency.

9.18 European Environment Agency- Five metre elevation contour line

9.18.1 Data description

Elevation data are provided in two forms: A Digital Terrain Model (DTM) which consists of grid data with a 90 to 100m resolution and 5 meters height contour lines, in vector format, derived from the DTM and completed where needed with other sources of data.

9.18.2 Data source

http://www.eea.europa.eu/data-and-maps/data/five-meter-elevation-contour-line

9.18.3 How was the data derived/produced

EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004. The Digital Terrain Model, MONA PRO Europe, is a copyrighted product provided by Geosys Data. To derive contour lines of 5 and 10 meters, the data were locally complemented with other sources, namely national DTM and digitised topographical maps.

9.18.4 What format is the data?

The data are available for download from the European Environment Agency website (http://www.eea.europa.eu/data-and-maps/data/five-meter-elevation-contour-line). The data are provided as a ZIP archive containing vector data and polyline shapefiles.

9.18.5 Area covered/European coverage

The data covers the following regions: Austria, Belgium, Bulgaria, Cyprus, Denmark, Estonia, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Spain, United Kingdom

Figure 13. Coverage of Five metre elevation contour line. Source http://www.eea.europa.eu Copyright holder: Copenhagen Resource Institute.

9.18.6 Resolution

The resolution of grid data is 90 to 100 meters.

9.18.7 Availability (free etc)

MONA PRO Europe© is copyrighted. A multi-posts "agency" license has been acquired for the European Commission, which makes the product available for applications developed within the European Commission. Dissemination outside the European Commission is

restricted to raster representations (i.e. images) of the DTM. However, most of contour lines are copyright-free and publicly available.

9.18.8 Perceived quality

This dataset has errors in the 5 m contour line. It is strongly advised not to use it for geoprocessing or statistical purposes. The resolution of grid data is 90 to 100 meters. Its geometrical accuracy in x,y and z does not exceed 5 meters for lowlying areas and 15 meters for mountainous areas. The European Environment Agency rates the data as having an excellent thematic accuracy but a poor completeness and positional accuracy. Logical consistency and temporal accuracy are, as yet, undefined.

9.18.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

The Digital Terrain Model will provide a high resolution baseline of ground elevation across Europe. The 5m contour will be useful in identifying coastal lowland areas susceptible to sea level rise. However, this latter dataset should be used with caution as errors exist within the data.

9.19 FutureCoast

9.19.1 Data description

Commissioned in 2000 by the Department of Environment, Foods and Rural Affairs (DEFRA) of UK government, The FUTURECOAST study aimed at providing predictions of coastal evolutionary tendencies over the next centuries for England and Wales. The FUTURECOAST study is an attempt to understand how the English and Welsh coastal zones function on a wider scale both in time and space.

9.19.2 Data source

The results of the FUTURECOAST project are available on CD, from DEFRA.

9.19.3 How was the data derived/produced

A 'behavioural systems' approach was adopted. This approach involves
the identification of the different elements that make up the coastal structure and developing an understanding of how these elements interact on a range of both temporal and spatial scales. The first stage has been to understand how various influence factors, i.e. estuarine influences, hydrodynamics,
nearshore and offshore sediment dynamics, geomorphology and geology (both onshore and offshore), interact to affect the coastal evolution over various time scales. Sections of coastline that exhibit characteristic behaviour tendencies have also been identified. Mapping of supra-tidal and intertidal morphology, together with an understanding of lithology and topography,
enabled the identification of these individual geomorphic features and combinations of these that could be considered together at the local-scale.

For further information see: Reeve, D., Chadwick, A. J., Fleming, C. (2004). Coastal Engineering: Processes, Theory and Design Practice E & FN Spon
DEFRA 2002. The Futurecoast Project. Project code FD2002 and Burgess, K., Jay, H. & Hosking, A. 2004. Futurecoast: Predicting the future coastal evolution of England and Wales. *Journal of Coastal Conservation 10:* 65-71.

9.19.4 What format is the data?

The results of the FUTURECOAST project are available on CD, from DEFRA (http://ww2.defra.gov.uk/).

The CD's comprise: A single interactive CD-ROM containing the entire Futurecoast analysis for 6000km of shoreline, containing approximately 3000 pages of reported analysis and over 70,000 mapped features. This includes a variety of framework reports, data, thematic reports, and interpretative reports, plus mapping of a variety of features and mapping of predictions.
Two further CD-ROMs containing complete aerial oblique-imagery coverage for the entire English shoreline.

The following layers are provided at scales of up to 1:50.000:

- Bathymetry with contour depth lines of 5, 10, 20, 30, 50m
- A detailed coastline
- Offshore sediment transport (directions)
- Solid Geology
- Backshore geomorphology (beach ridges, cliff, dune, rising ground, lowland)

- Foreshore geomorphology (rock, mud / clay, sand, sand & shingle, shingle)
- Managed frontage (presence of coastal defence works)
- Future shoreline change without interaction
- Future shoreline change with present management (direction, foreshore, changes, hotspots)
- Historic changes (beach profiles, graphs).

FUTURECOAST analysis is supported by a nation-wide database compiled from various data sources and publications. It contains documents, cartographic and tabular data, as well as aerial photographs.

9.19.5 Area covered/European coverage

England and Wales.

9.19.6 Resolution

GIS layers are provided at scales up to 1:50.000.

9.19.7 Availability (free etc)

FUTURECOAST is the property of DEFRA and is accessible through bilateral arrangements.

9.19.8 Perceived quality

In depth analysis is provided for the studied areas. This is supported by mapping of supra-tidal and intertidal morphology. The scale is local and regional rather than national.

9.19.9 Perceived use for European integration – i.e. how much will it help to ID areas at risk of sea level rise?

This dataset will provide detailed information on coastal erosion and susceptibility to subsidence and sea level rise. It has been used to contribute to some of the above European Environment Agency datasets. However, its geographic coverage is limited to England and Wales.

10 Additional data to consider:

The following are datasets that have not been fully investigated at this point but may be considered in the future

- European tide gauge data from the ESEAS project: http://www.eseas.org/products/?page=eda/eda
- GLOSS – Global Sea Level Observing System http://www.gloss-sealevel.org/
- Corine Land Cover 2006 seamless vector data - version 13 (02/2010)
- Corine Land Cover 2006 raster data - version 13 (02/2010)
- Natura 2000 data - the European network of protected sites (impact on protected sites)
- EEA Fast Track Service Precursor on Land Monitoring - Degree of soil sealing 100m (relates to impact)
- Nationally designated areas (National - CDDA) (relates to impact)
- Waterbase - Groundwater (relates to impact)