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Executive summary

The objective of the pilot harmonisation review is to review the pilot studies at kick-off and ensure that a harmonised approach to the development of the SubCoast services is used.

This document is a plan and sets out a framework to which the pilot harmonisation will be carried out. The plan is an evolving document that has been created with input from the work package three leader, each of the pilot study leaders, InSAR providers and the validation work package leader. This pilot harmonisation team, who will later become the Product Validation Workgroup, are responsible for reviewing the pilot studies and ensuring that they take a harmonised approach to the development of the SubCoast services.

In this document we outline how the pilot harmonisation team will work together, including how information will be passed amongst the team and when meetings will take place. The document also lists each of the objectives of the harmonisation process and a plan for how these objectives will be met is presented. The plan includes the work required, the deliverables, the timing of the deliverables and who will be responsible for the work.

Several harmonisation tasks have already started; the preliminary outcomes of these tasks are included as annexes in this document.

Contents

1 Introduction

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2 Definition of Harmonisation

Harmonisation is the process of developing common standards, processes and outputs. In the context of SubCoast the aim of the harmonisation process is to ensure a consistent approach to the development of the SubCoast services.

SubCoast services are developed at the local scale, but SubCoast is a pan-European project, and so these services need to be delivered at the European scale in the future. Therefore a service developed at one pilot study site must be transportable to any potential SubCoast study site. Ideally, it should also be possible for any SubCoast service provider to provide any SubCoast service.

Harmonisation could take the form of a prescribed set of rules to follow; an example of this would be the production of land-cover maps. In this case land-cover categories are prescribed and the classification process must then fit these categories. This approach is not suitable for SubCoast since one set of rules will not cover all circumstances in which a SubCoast service will be applied; nor will rules developed at one site necessarily be appropriate for all circumstances. The harmonisation process for SubCoast will therefore focus on the similarities and differences in the pilot services, the development of consistent products using shared workflows and recognised standards, and how these can be scaled up to the European scale.

3 Working Methodology

The pilot harmonisation team consists of the leader of each of the pilot studies (BGS, Deltares, TRE and PGI) and the leader of the validation work package (IG). This team will be chaired by BGS. The Pilot harmonisation team will also become the Product Validation Workgroup once harmonisation has been addressed. It is likely that the main harmonisation work will occur during the first half of the project and validation later in the project; however, it is important to recognise that these two tasks are interlinked and work done on one will facilitate work on the other.

Work package 3.1, the Pilot Harmonisation Review, stipulates that BGS have allocated time to complete the review process. This time is to be used to produce the formal output of the work group and to plan and chair meetings. Although the WP3 leaders do not have allocated time for this process it is necessary that they take the time from their work package allocations to provide input to the harmonisation process. It is important to the success of the SubCoast project that the services developed in the pilot studies are developed in a harmonised manner. A harmonised approach will allow greater understanding of the services by the users and facilitate the validation of the SubCoast services. This understanding and validation will provide re-assurance of the quality, consistency and wider applicability of the SubCoast services to the users.

3.1 Communication

Most routine contact will be through email; where specific information is required a questionnaire will be sent out to capture this information. To enable face to face discussion and calcification of any issues pilot harmonisation and product validation meetings will be held each time the WP3 team meet, as discussed in the next section.

For effective communication to take place it is necessary that everyone in the project has the same understanding of key technical terms. A ‘SubCoast Glossary’ will be developed (Annex 1). This glossary will start life as an annex to this document, but once sufficiently developed it will be issued to all partners as reference material. SubCoast has strong ties to the ESA GMES service element Terrafirma and also PanGeo, an FP7 project due to start in early 2011. The glossary will combine glossaries already produced for these projects.

3.2 Meetings

SubCoast allows for six WP3 meetings, which breaks down to two meetings a year. One WP3 meeting each year is to be held back to back with the SubCoast General Meeting, leaving one other dedicated WP3 meeting per year; these will either be stand-alone meetings or held in conjunction with a relevant meeting of another SubCoast WP, Terrafirma or PanGeo.

These work package meetings will offer a forum for discussion between the pilots but will be primarily focused on the pilot harmonisation and validation process. The pilot leaders will be given the chance to present progress made on the pilot deliverables. These presentations will enable communication between the pilot studies to generate a wider appreciation of what is taking place and the services that are being developed. Meetings will offer the opportunity to discus potential problems and hence act to address these at an early stage. Communication of pilot work will enable the sharing of ideas and so facilitate the harmonisation of the services.

It is proposed that the following WP 3 meetings take place.

Meeting	Date	Location
WP3 M1 (with GM1)	April 2010	TNO, Utrecht
WP3 M2	September 2010	BGS, Nottingham
WP3 M3 (with GM2)	May 2011	GEUS, Copenhagen

WP3 M4	October 2011	TBC
WP3 M5 (with GM3)	April 2012	TBC
WP3 M6	September 2012	TBC

Dates for Meeting 4 and Meeting 6 are not definitive and can be moved if the need arises. For example it might be necessary to hold meeting 6 earlier to hold discussions well in advance of the end of the project. Ideally meeting 4 and 6 should be held at the location of a pilot study.

The work group met prior to the kick off meeting to introduce each pilot, thereby enabling an understanding of the aims of each pilot. A second meeting was held in September 2010 (month 6). At this meeting the harmonisation process was planned resulting in further development of this plan and agreement on its objectives. The discussion also centred on the pilot information that had been gathered by the questionnaire sent to each pilot leader. In particular it was necessary to gather information relevant to the design of the validation activities to be carried out in WP 3.6.

3.3 Questionnaire: Pilot Information

In order to understand the pilot studies and plan the harmonisation and validation activities it was necessary to capture as much relevant information about each of the pilot services as possible. This was accomplished via a questionnaire designed to capture such information (Annex 3). The document was designed by the head of the validation and the chair of the harmonisation group. Information on the following was required:

1. Basic information about each Pilot
2. Input data: PSI and SAR-derived products
3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study
4. Input data: other data
5. Type of analyses to be carried out in the Pilot Study
6. Outputs: products and services and user needs
7. Outputs: products and services - Planned validation activities

This document was sent to each of the pilot study leaders in late June 2010. Each pilot leader was responsible for collating the required information and returning the completed document to BGS (pilot harmonisation leader) and IG (validation leader) by late August. BGS and IG then studied the responses by late September 2010. IG highlighted parts of the document that required further explanation and discussion at WP3 meeting 2. Following clarification at meeting 2 a further iteration will be required for the validation leader to completely understand each pilot. This work is part of the harmonisation process and so not reported on in this planning document. However the responses from the pilot studies are presented in Annex 4 of this document.

4 Objectives of the Pilot Harmonisation:

The following are the main aims of the harmonisation process. For each of these aims we explain why it is a necessary step, what we plan to do to achieve the aim and the time scale in which it will be completed.

4.1 Overview of each pilot and it's aim/objectives

4.1.1 WHY IS THIS NECESSARY

- To facilitate the harmonisation it is necessary to understand what each pilot study aims to achieve.
- This information is not only valuable to enable harmonisation and plan the validation, but is also important to distribute to all SubCoast partners to act as a reference.
- Completing this process is beneficial to the pilot studies as it encourages a review of the pilots aims and deliverables.
- It is very important for the harmonisation and validation teams to understand what the main SubCoast deliverables are and the steps that will lead to their creation. These will be the main SubCoast services.

4.1.2 STEPS TO ACHIEVE THE AIM

- To help communicate the aims and deliverables of each pilot we will produce brief summary sheets for each pilot study covering:
  - Geographical extent
  - Objectives
  - Outputs – services and reports
- These summary sheets will be a maximum of 2 sides of A4 and be mainly composed of bullet points to aid easy reference.
- Due to the geographical split in the Baltic pilot study it maybe necessary to produce one summary sheet for each of the Polish, Lithuanian and Danish cases.
- Discussion at meeting 2 concerned the main SubCoast deliverables for each pilot study. These will be used to develop our understanding of what the main categories of deliverable are for the SubCoast project as a whole.

4.1.3 DELIVERABLES

- Brief summary sheets for each pilot study

4.1.4 TIME SCALE

- To be completed for each pilot by January 2011.

4.1.5 RESPONSIBLE

- **BGS** to produce outline summaries for each pilot and distribute for comments
- **Pilot leaders to provide required information and comment on summary:**
  - **BGS** - European Integration
  - **PGI –** Polish Baltic area
  - **LGT –** Lithuanian Baltic area
  - **GEUS –** Danish Baltic area
  - **Deltares –** Rhine – Muse
  - **TRE** – Southern Emilia Romanga

4.2 Clarifying the scope of the SubCoast project

4.2.1 WHY IS THIS NECESSARY

- The harmonisation team, consisting of the pilot study leaders need to have a clear idea of the scope of the SubCoast project.
- A clear understanding of the scope will enable the developed SubCoast services to be as relevant as possible.

4.2.2 STEPS TO ACHIEVE THE AIM

- Revisit the description of work and extract all information relating to the project scope
- Create a brief document outlining what is and is not within the scope of SubCoast.
- Review this document with the SubCoast project coordinator to ensure it is correct

4.2.3 TIME SCALE

- Due by Month 9

4.2.4 DELIVERABLES

- Brief document outlining what is and is not within the scope of SubCoast.

4.2.5 RESPONSIBLE

- **BGS**

4.3 Comparison of user requirements

4.3.1 WHY IS THIS NECESSARY

- To identify common requirements and ensure that the SubCoast services developed will meet these requirements
- To identify unique requirements in certain environments or instances and ensure that the SubCoast services developed will cater for these where appropriate.

4.3.2 STEPS TO ACHIEVE THE AIM

- The user requirement outputs of WP1 and the user requirements for the European Integration will be used to perform an inter-comparison. The aim of the inter-comparison would be to establish similarities and differences between the users requirements for the different pilots
- Comparison to be made on the following areas:
    - Users regulatory framework
    - Area covered by SubCoast service
    - Format of SubCoast service
    - Type of information required in SubCoast service

4.3.3 TIME SCALE

- User requirements are to be produced as part of WP1, these will not be delivered until M12, and therefore work on the comparison cannot take place until M13 at the earliest.
- User requirements for the European Integration are due to be delivered by M6. However due to the requirement to compare these with other user requirements it is not possible to start until M13.
- Work will therefore start in M13 (May 2011) and be completed by M16 (July 2011)

4.3.4 DELIVERABLES

- Matrix of common and specific requirements.

4.3.5 RESPONSIBLE

- **BGS**.

4.4 Assessment of high-level SubCoast products

4.4.1 WHY IS THIS NECESSARY

- To fully understand the SubCoast project and services and communicate them to users it is necessary to group the end products in to high-level categories.
- This will facilitate the understanding of the SubCoast services and hence the harmonisation process and design of the validation.

4.4.2 STEPS TO ACHIEVE THE AIM

- During the analysis of the questionnaire answers the products from each pilot will be grouped into higher level categories.
- These categories were discussed at meeting 2 and a provisional list agreed on.
- This list forms annex 2 of this document.
- This list will be an evolving list.

4.4.3 TIME SCALE

- This is required prior to the design of the validation activities
- Meeting 2 takes place in September 2010
- A preliminary list will be completed by month 6 and updated periodically.

4.4.4 DELIVERABLES

- List of high-level SubCoast products

4.4.5 RESPONSIBLE

- Pilot harmonisation team.

4.5 Assessment of radar data requirements

4.5.1 WHY IS THIS NECESSARY

- So common requirements can be addressed across the entire project and specific requirements can be identified and highlighted.

4.5.2 STEPS TO ACHIEVE THE AIM

- A questionnaire (Annex 3) will be sent round all pilot study leaders.
- One section of this questionnaire concerns the input radar data required to produce the PSI and SAR-derived products.
- The collected information will be compiled into an assessment of all input radar data for the SubCoast project
- Consideration will be given to the true requirement to use a certain type of radar data – what is the cost/benefit of doing so? For example do we really need TerraSar-X data for certain routine SubCoast services?

4.5.3 TIME SCALE

- By month 18

4.5.4 DELIVERABLES

- Brief report detailing input radar data for SubCoast, common requirements amongst the pilots and specific requirements.

4.5.5 RESPONSIBLE

- **BGS**

4.6 Assessment of the PSI processing chains and products

4.6.1 WHY IS THIS NECESSARY

- Several service providers are involved in SubCoast; each uses a different, proprietary processing chain.
- If SubCoast is to have a harmonised approach then the PSI outputs need to be comparable.

4.6.2 STEPS TO ACHIEVE THE AIM

- An in depth review and certification exercise was completed for all Terrafirma service providers within the Terrafirma validation exercise. The leader of the Terrafirma validation exercise is the SubCoast validation leader, and therefore has knowledge of each processing chain.
- The information returned from the questionnaire highlight standard PSI products and non-standard PSI products.
- Revisit open questions from the Terrafirma validation exercise and consider if a practical protocol can be developed for each product.
- Discus and agree the format of the data, for example PSI colour bars.

4.6.3 TIME SCALE

- Month 18.

4.6.4 DELIVERABLES

- Brief review of PSI data to be used in SubCoast.

4.6.5 RESPONSIBLE

- **IG**

4.7 Assessment of the other data to be used and its acquisition and processing

4.7.1 WHY IS THIS NECESSARY

- To look for synergies and efficiencies in the acquisition and processing of ancillary data. For example several pilot studies may wish to purchase high resolution optical satellite data. If we know several teams wish to purchase similar data it might be possible to negotiate group discounts.

4.7.2 STEPS TO ACHIEVE THE AIM

- A questionnaire (Annex 3) has been sent to all pilot study leaders.
- One section of this questionnaire concerns the other input data required to make the SubCoast service.
- The collected information will be compiled into an assessment of all input data for the SubCoast project

4.7.3 TIME SCALE

- Month 12

4.7.4 DELIVERABLES

- Brief report detailing all ancillary data to be used in the SubCoast project

4.7.5 RESPONSIBLE

- **BGS**

4.8 Review of plans for validation/quality control within each pilot

4.8.1 WHY IS THIS NECESSARY

- Prior knowledge of validation to be completed within a pilot is important when designing the overall validation programme for the validation work package.
- Within SubCoast there are validation activities taking place within the pilot service and validation activities occurring in the validation work package (WP3.6). Generally, within a pilot it will be the PSI data that will be validated. Within the SubCoast validation work package the derived SubCoast product or service will be validated.
- It is important that any validation work completed within a pilot is compatible with work done in the validation work package. To this end we will be collecting information on validation work planned in each pilot study.

4.8.2 STEPS TO ACHIEVE THE AIM

- A questionnaire (Annex 3) will be sent round all pilot study leaders.
- One section of this questionnaire concerns the planned validation activities within the pilot study.
- The collected information will be compiled into an assessment of all validation activities panned within the pilot services.
- The validation work package leader will then assess each of the pilots and its validation activities. A discussion with each pilot leader will ensure that correct methodologies are used and that these are compatible with the overall validation strategy.

4.8.3 TIME SCALE

- Month 12

4.8.4 DELIVERABLES

- Discussion with each pilot about the suitability of validation activities.

4.8.5 RESPONSIBLE

- **IG**

5 Summary of Harmonisation Tasks

Harmonisation Aim	Deliverable	Responsible	Due
Overview of each pilot and it's aim/objectives	Brief summary sheets for each pilot study	BGS	M9, Dec 2010
Clarifying the scope of the SubCoast project	Brief document outlining what is and is not within the scope of SubCoast	BGS	M9, Dec 2010
Comparison of user requirements	Matrix of common and specific requirements	BGS	M16, July 2011
Assessment of high-level SubCoast products	List of high-level SubCoast products	Harmonisation team	Initial list M6, Sept 2010.
Assessment of radar data requirements	Input radar data for SubCoast	BGS	M9, Dec 2010.
Assessment of the PSI processing chains and products	Brief review of PSI data to be used in SubCoast	IG	M18, September 2011.
Assessment of the other data to be used and its acquisition and processing	Brief report detailing all ancillary data to be used in the SubCoast project	BGS	M12, April 2011
Review of plans for validation/quality control within each pilot	Discussion with each pilot about the suitability of validation activities	IG	M12, April 2011.

6 Annex 1: Glossary

SubCoast Glossary

Subsidence: Motion of the terrain surface this term includes both downwards movements and uplifting movements**.**

Harmonisation: The process of establishing common standards. In the case of SubCoast the same standards of data processing, interpretation and deliverables will be sought through the harmonisation process.

Hazard: is a situation with the potential to cause harm

Monitoring: To be aware of the state of a system

PSI: Permanent Scatterer interferometry; the processing of

Glossary of risk descriptors
Sourced from PanGeo DOW.

Sources: ISDR (2009) *UNISDR Terminology on Disaster Risk Reduction*, UNISDR, Geneva, Switzerland.
EC DG Environment (2008) *Assessing the potential for a comprehensive community strategy for the prevention of natural and man-made natural disasters*, DG environment, Brussels.

Acceptable risk: The level of potential losses that a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions.

Adaptation: The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Building code: A set of ordinances or regulations and associated standards intended to control aspects of the design construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage.

Capacity: The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals.

Capacity development: The process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvements of knowledge, skills, systems and institutions.

Climate change:
a) The Inter-governmental Panel on Climate Change (IPCC) defines climate change as: “a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use”.
b) The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as “a change of climate which is attributed directly or indirectly to human activity that alters the

composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

Coping capacity: The ability of people, organisations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.

Corrective disaster risk management: Management activities that address and seek to correct or reduce disaster risks which are already present.

Critical facilities: The primary physical structures, technical facilities and systems which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency.

Disaster: A serious disruption of the functioning of a community or society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster risk: The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Disaster risk management: The systematic process of using administrative directives, organisations and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster risk reduction: The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Disaster risk reduction plan: A document prepared by an authority, sector, organization or enterprise that sets out goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives.

Emergency: Any situation which has or may have an adverse impact on people, the environment and property.

Emergency management: The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps.

Environmental degradation: The reduction of the capacity of the environment to meet social and ecological objectives and needs.

Environmental impact assessment: Process by which the environmental consequences of a proposed project or program are evaluated, undertaken as an integral part of planning and decision-making processes with a view to limiting or reducing the adverse impacts of the project of program.

Exposure: People, property, systems or other elements present in hazard zones that are thereby subject to potential losses.

Extensive risk: The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts.

Forecast: Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area.

Geo(logical)hazard: Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage.

Georisk: The mix of a geohazard with levels of exposure and vulnerability that together constitute a risk.

Intensive risk: The risk associated with the exposure of large concentrations of people and economic activities to intense hazard events, which can lead to potentially catastrophic disaster impacts involving high mortality and asset loss.

Land use planning: The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long-term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses.

Mitigation: The lessening or limitation of the adverse impacts of hazards and related disasters.

Natural hazard: Natural processes or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Preparedness:
a) The knowledge and capacities developed by governments, professional response and recovery organisations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts likely, imminent or current hazard events or conditions.
b) A state of readiness and capacity of human and material means enabling them to ensure an effective rapid response to an emergency, obtained as a result of action taken in advance.

Prevention:
a) The outright avoidance of adverse impacts of hazards and related disasters.
b) Any action that supports Member States in preventing risks or reducing harm to people, the environment and property resulting from emergencies.

Public awareness: The extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards.

Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

Residual risk: The risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained.

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to, and recover from, the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Response: The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Risk: The combination of the probability of an event and its negative consequencies.

Risk assessment: A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

Risk management: The systematic approach and practice of managing uncertainty to minimise potential harm and loss.

Socio-natural hazard: The phenomenon of increased occurrence of certain geophysical and hydrometeorological hazard events, such as landslides, flooding, land subsidence and drought, that arise from the interaction of natural hazards with overexploited or degraded land and environmental resources.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

7 ANNEX 2: High-level SubCoast products.

Below is a preliminary list of high-level SubCoast products or services. This was generated from a study of information given on each pilot study and agreed by discussion at the second meeting of the WP3 leaders.

It is recognised that each of these headings are wide ranging and some products might fit in to more than one category.

1. **Subsidence Products**
    a. Large area subsidence product – similar to Terrafirma H1, will probably use ERS/Envisat
    b. Focused/detailed subsidence product, will probably use TSARX or Cosmo
        i. Water defence monitoring
        ii. Infrastructure/building monitoring

2. **Flood Hazard**
    a. Flooding due to groundwater, sea water, river water etc)

3. **Relative sea level change**

4. **Interpreted subsidence product** (Similar to Terrafirma H2)

5. **Forecasting products**
    a. Subsidence forecasts
    b. Flood forecasts

This list has subsequently been modified during email exchanges between Michele Crosetto, Rogier Westerhoff, Dick van den Bergh, Chris Bremmer, Kees van Ruiten, October 2010.

"PRELIMINARY LIST OF MAIN SUBCOAST PRODUCTS" (note that the definition of each product is still to be done – any suggestion is welcome). Note that full list of services/products is in table 1 of the DoW (page 12).

A) Subsidence product

This is an interpreted subsidence product. Different types of "Subsidence products" of the Pilots fall under this category, e.g.

i. Shallow subsidence product (i.e. originating from the first few tens of metres)

ii. Deep subsidence product

iii. Wide area subsidence product

iv. Detailed scale subsidence product

B) Subsidence forecast

A forecast from a geo(hydrological) model, that simulates subsidence for the coming tens of years.

C) Relative sea level change

Scenarios from national and international (IPCC) expert panels of sea level rise for the coming tens of years.

D) Flood risk/hazard

The result of sea level rise and subsidence maps translated to precipitation scenarios and water storage capacity of the area.

E) Flood defence product

A flood risk/hazard product, incorporating the derived strength of dykes/levees in areas that are lower than the surrounding river or sea water level.

F) Environmental impact

Proposed by C. Bremmer. To be defined.

8 ANNEX 3: Document sent to all WP3 leaders in June 2010.

Collection of information regarding the SubCoast Pilots

(Michele Crosetto and Luke Bateson, 22 June 2010)

Introduction

The objective of this document is collecting key information about the Pilots of the SubCoast project. This information will be needed for different activities of WP3, like the WP3.1, Harmonization of the Pilots, the WP3.6.1, Validation Initiation, etc.

In order to collect the information in a systematic way, we will refer in this document to the following scheme, which (tries to) describe the activities to be run in each Pilot.

1. Each Pilot will use a set of INPUT DATA that are divided in two main categories:
   - PSI and SAR-derived products.
   - Other data, which include all other types of input data.
2. The input data will feed different TYPES OF ANALYSES, to be roughly described in this document.
3. The different types of analyses will generate a RANGE OF OUTPUTS, which represent the products or services of the SubCoast project. This document can collect a preliminary list of the most relevant products and services that we expect from each Pilot.
4. The SubCoast products or services are then supposed to undergo a VALIDATION PROCESS, with the objective of providing the end users with re-assurance on the quality, consistency and wider applicability of the above products/services.

We interpret the above four points as FOUR COMPONENTS OF THE SAME CHAIN. In this stage of the project we need to collect and exchange information on each component, in order to plan the forthcoming steps. For this reason we have prepared seven sections:

1. Basic information about the pilot
2. Input data: PSI and SAR-derived products
3. Input data: PSI and SAR-derived products - Planned validation activities within each Pilot study
4. Input data: other data
5. Type of analyses
6. Outputs: products and services
7. Outputs: products and services - Planned validation activities.

1. Basic information about each Pilot

Please provide:

- Full name of the Pilot
- Key characteristics of the Pilot:
    - Surface
    - One figure that illustrates the geographic extent of the Pilot
    - The total area to be covered by each Pilot, including bounding coordinates
    - Mechanisms of ground motion thought to be present in the Pilot area
    - Etc.
- Person responsible for completing the information in this document for your Pilot.
- Contact details.

2. Input data: PSI and SAR-derived products

Please provide a comprehensive list of the SAR and Persistent Scatterer Interferometry (PSI) products that are going to be generated in your Pilot. For each product (a preliminary list of products is given at the end of this section) please provide:

- A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:
  - Name of data type
  - Amount of data required
  - Scene/Frame numbers
  - Dates of data acquisition
  - Source of data
- A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:
  - Name of the product
  - What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.
  - Key characteristics of the product, e.g. covered surface, etc.
  - Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.
- A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:
  - Used procedure/method/chain
  - Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).

This is a preliminary list of the products mentioned in the SubCoast DoW:

- Standard PSI products (Terrafirma H1): only displacement velocities
- Standard PSI products (Terrafirma H1): displacement velocities and time series
- New PSI product: Absolute Wide Scale
- New PSI product: Ad hoc analysis for defence structures
- New PSI product: Full 3D motion estimation
- New PSI product: High-resolution DEMs
- Etc.

3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

Ideally, and in line with the philosophy adopted in Terrafirma, all new or advanced PSI products should be properly validated. For each new product foreseen in your Pilot please provide:

- A description of the available ground truth to be used for the validation purposes
  - Type of ground truth
  - Data source
  - Key characteristics of the ground truth, e.g. quality, spatial coverage, etc.
- A description of the planned validation procedure:
  - Validation method
  - Validation outcomes, e.g. standard deviation of deformation velocity, geocoding quality, etc.
- In the case any validation activity is planned, please provide complementary information, e.g.
  - Validation outcomes coming from in-house activities
  - Validation outcomes coming from other projects
  - Other ways to characterize the (expected) performances of the new product.

4. Input data: other data

As mentioned in the Introduction, there is a four step chain that finally provides the SubCoast product and services. Even though the PSI products play a prominent role in this chain, we need to get a synoptic view of all possible input data of the chain. In fact, without any a priori and detailed information on the analyses to be run (see next section), any of the input data could have an impact on the quality of the final SubCoast product and services. Please describe each main "input data" (a list of data type is given at the end of this section), providing:

- A description of the input data type:
  - Name of the product
  - Data source (e.g. Official Cartographic Institution, etc.)
  - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
  - Key characteristics of the product, e.g. covered surface, etc.
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
- A description of the quality and reliability of the data:
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

This is a draft list of possible input data:

- Levelling data,
- GPS raw or processed data,
- Gravity measurements,
- Sea level data,
- Geo(hydro)logical data,
- Data on gas extraction,
- Data on gas injection,
- Cartographic mapping at different scales,
- Thematic maps (e.g. land cover, land use),
- Geological maps,
- Geological Models
- Optical EO data
- Etc.

5. Type of analyses

The different types of analyses to be run in the SubCoast project play a key functional role, i.e. transforming the multi-source, multi-scale and multi-quality input data (including PSI products) into the products and services that are needed by the SubCoast end-users.

Given their importance, it is of paramount importance to provide a clear description of these analyses. For each analysis to be run in the Pilot, please address the following issues:

- A brief description of the analysis:
  - Name of the analysis
  - Comprehensive list of input data
  - What is (are) its main outcome(s)?
  - Describe the type of analysis (note that the type of analysis is impacting the possible validation procedures – see next section), e.g.
    - It is based on a single computer-based model/software (i.e. it transform inputs in outputs through a fully automated procedure, which could be easily repeated).
    - Same as above, but based on a chain of computer-based models/softwares.
    - It is based on a single computer-based model/software, which requires a lot of interaction of an expert (i.e. it transform inputs in outputs through a fully semi-automated procedure).
    - It needs a complex sequence of data analyses, which include qualitative analysis steps, etc.
    - Etc.: please complete it.

6. Outputs: products and services and user needs

In this section we address the products and services generated by the different analyses, and which are needed by the SubCoast end-users. For each product/service please address the following issues:

- Provide a brief description of the products/services (see list at the end of this section):
  - Name of the product
  - Brief description of the product
  - Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - Main SubCoast product, maximum priority
    - SubCoast product of average importance
    - Auxiliary product, not a priority
    - Etc.
  - Describe the nature of the product, e.g.
    - A quantitative value, which is a single scalar
    - Quantitative values: a set of scalar values
    - A categorical value (categorical variables take a value that is one of several possible categories; they have no numerical meaning).
    - A 2D, 3D raster of quantitative values
    - A 2D, 3D raster of categorical values
    - Thematic maps
    - More complex output, please specify.

This is a draft list of possible products/services:

- Subsidence forecast,
- Flood risk
- Flood impact
- Dike safety assessment
- Indicators of environmental impact,
- Indicators of anthropogenic impact
- Indicators of economic impact,
- Relative sea-level rise
- Etc.

7. Outputs: products and services - Planned validation activities

Ideally all new or advanced products and services of SubCoast have to be properly validated. The objective of the validation is providing the end users with re-assurance on the quality, consistency and wider applicability of the above products/services. The whole validation activity will be only defined when all the components of the chain are well understood.

In order to plan the validation activities it is important to address the following points. Note that this should be done for each product/service:

- Aspects related to quality and reliability of the product:
  - Is the product a "standard product" (well characterized, of known quality, etc.) or is a new experimental product?
  - In case of a "standard product", do you know (or foresee to know) the specifications of each product? If possible, provide them.
  - In the second case, what is the procedure that you foresee to validate the product, or to characterize its quality (precision, accuracy, main limitations)?

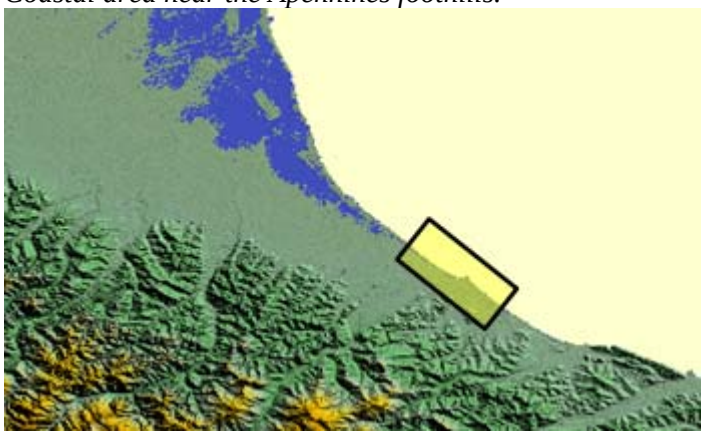
9 ANNEX 4: Completed Questionnaires

Southern Emilia Romagna

1. Basic information about each Pilot

Please provide:

- Full name of the Pilot: Southern Emilia Romagna
- Key characteristics of the Pilot:
    - *Coastal area near the Apennines foothills.*



    - *Valuable touristic area, with highly urbanized zones (Rimini city) and agricultural zones.*
    - *Recent increasing in water withdrawal from shallow depths, mainly for civil use.*
    - *Subsidence and erosion of the coastline, increase in the hazard of flooding.*
    - *Some actions have been taken with the aim of removing the causes of subsidence, protecting the coastline by sand replenishment, etc.*

- Person responsible for completing the information in this document for your Pilot: *Gabriele Bitelli*
- Contact details: *gabriele.bitelli@unibo.it*

2. Input data: PSI and SAR-derived products

***Expected deliverables**:*

1. *PSI LOS-database CosmoSkyMed: - Standard PSI products (Terrafirma H1): displacement velocities and time series*
2. *PSI LOS-database TerraSAR-X: - Standard PSI products (Terrafirma H1): displacement velocities and time series*
3. *3D-deformation maps: new product, containing average displacement velocities and time series for each estimated motion component*
4. *High Resolution DEM: new product, digital elevation/terrain model (tbd in due course)*

List of data to be used:

Satellite	*Estimated surface*	*km2*	*yrs*	*tracks*	*images/yr*
COSMO-SkyMed SAR Descending	*50x50 sqkm*	*2500*	*2*	*1*	*45*
TerraSAR-X Descending	*50x50 sqkm*	*2500*	*2*	*1*	*33*
TerraSAR-X Ascending Spot light	*5x10 sqkm*	*50*	*1*	*1*	*33*

3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

Satellite radar data will be metrically validated and integrated by information derived from high accuracy geodetic campaigns (mainly levelling and GNSS techniques) realized in the past and through specific surveys that will be carried out during the project. Long GPS time series will be analyzed both for technical validation purposes and for the establishment of the reference frame for SAR. Specific analysis will be performed on the evaluation of the quality of high resolution DEMs derived from interferometric process in different periods on a selected sub-area; reference data will be provided by means of publicly available terrestrial, photogrammetric, Lidar data, eventually integrated by local GPS kinematic surveys.
The distribution of permanent scatterers will be verified on the basis of created specifically GIS procedures, e.g. to highlight the presence of outliers. For these anomalous points will be made a further visual inspection with respect to a large scale satellite orthophotomosaic, in order to verify the nature of the PS characterized by speeds far from other points located in their immediate vicinities. If these reflecting objects are related to structures that could follow abnormal movements (eg due to loading and unloading phases, such as silos), or if a visual inspection shows that they are not suitable or immaterial items, then they will be removed from the dataset.
For these purposes application of object–based and pixel-based classification algorithms from high resolution optical multispectral imagery is also foreseen, for extraction of buildings and other significant features for PS characterization and evaluation of significance.

4. Input data: other data

Levelling data. A consistent dataset is in course of realization trying to collect and homogenize together results coming from levelling campaigns performed in the past in the area by different agencies, in order to build a geodetic reference frame for the analysis of subsidence. Precision and high precision surveys (publicly available data) will be preferred, and metadata of the surveys realized with available information. Data collected, in terms of height and subsidence velocity, will be stored in a GIS after a georeferencing phase.

During the project, a specific levelling campaign is planned in order to update the knowledge of subsidence phenomenon to the current date, contemporary to the acquisition of SAR products.

GNSS data. The data will be of two different types: results coming from campaigns carried out in the past for subsidence monitoring (very few points available) and raw data coming from one GPS permanent station active since some years in the area (if other data will be available, they will be of course used): after a dedicated processing performed in-house using state-of-the-art scientific post processing software (Bernese/Gamit/Gipsy), time series of coordinates will be available in order to support PSI analysis.

Geological data. Geological data are collected from Regional archives and works carried out by public agencies.

Cartographic database and thematic maps. Large scale vector and raster maps (mainly from regional authority) will be implemented in GIS environment after eventual operations in order to have all the datasets in a common geodetical-cartographical frame. Example of GIS layers: Landcover/Landuse, Infrastructures and transportations, Flood risk, …

Optical EO imagery. The project aims to use optical data coming from high resolution and very high resolution sensors in order to constitute a support for the PSI analysis and validation. Particular attention must be paid for a good georeferencing procedure in order to have all the data coherently harmonised. Multispectral imagery will be subject to data fusion procedures in order to improve the resolution of spectral images; pixel- or object-oriented classification will be furthermore realized on urban and rural contexts. For PSI validation and analysis, optical EO data will be useful either through visual interpretation and automatic procedures performed by GIS routines for characterization of PS points.

DEM. Publicly available Digital Terrain Models will be collected, produced by different methods (photogrammetry/Lidar/satellite/numerical cartography processing), and metadata realized in order to document their quality and reliability.

NOTE: High resolution DEM extraction and comparison with reference data (different techniques…) is scheduled for the research

Other available data...

5. Type of analyses

TBD, and will be described in the final report foreseen for the WP, deliverable D3.3.9

6. Outputs: products and services and user needs

InSAR derived LOS motion measurements will be used for characterization of the subsidence, upgrading the knowledge of the phenomenon for the area (this a specific request from the regional agency). Depending on the results, specific products will be defined in accordance with the end-user (regional agency).

7. Outputs: products and services - Planned validation activities

First at all, subsidence maps will be validated either by internal consistency checks made during PS production and by comparison with external information coming from other geodetic datasets. A part of the research will be dedicated to the elaboration of suitable check procedures between different data (to be developed mainly in a GIS environment).
Subsidence maps could be defined a standard product for this regional framework, and the specifications in terms of accuracy and precision will be derived from previous experience and following the expectance of the local agencies in performing campaigns for subsidence monitoring.

Rhine-Meuse Delta

1. Basic information about each Pilot

The full name of the pilot is Rhine-Meuse Delta. Contact persons for the pilot are Victor Hopman (victor.hopman@deltares.nl) and Rogier Westerhoff (rogier.westerhoff@deltares.nl). All pilot areas are depicted in Figure 1.

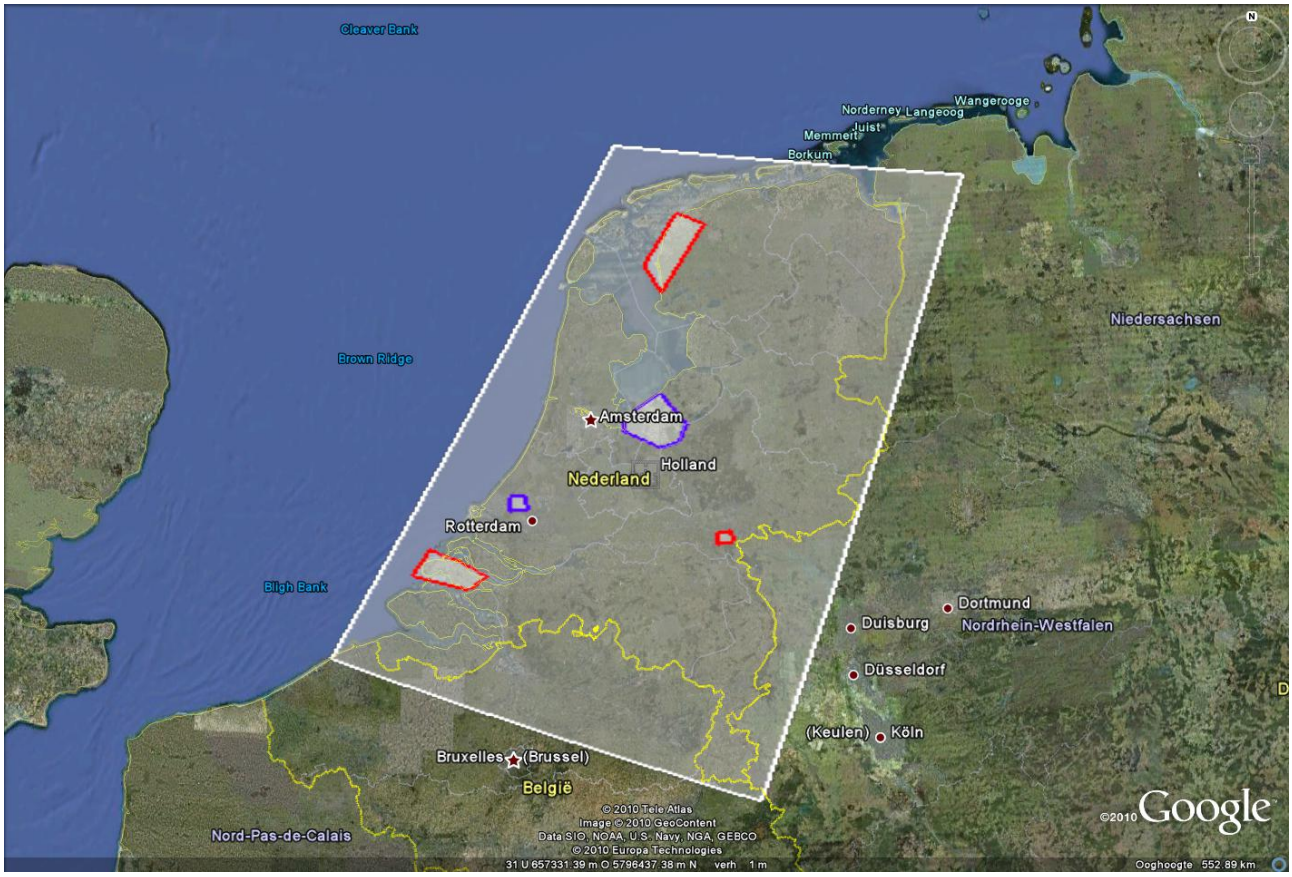


Figure 1 **All pilot areas: Netherlands wp3.2.1 (white), Harlingen, Nijmegen , Schouwen-Duiveland (wp3.2.2, red) Delft and Zuid-Flevoland (wp3.2.3, purple)**

The pilot consists of three cases, which are called:

3.2.1 – Nation wide subsidence map

Contact person Miguel Caro CuencaCuenca - m.carocuenca@tudelft.nl

Total area covered: 41256 km^2 (of which 7643 km^2 is water)

Bounding boxes: (WGS84, UTM 31 – degrees E , degrees N)

719768.610,5616988.178

810488.170,5932958.888

635617.341,5941274.243

502422.109,5681165.336

Mechanisms of ground motion: subsidence due to water management and gas extraction

3.2.2 – Case study 1: Dutch North Sea Coastal Region

Contact person Peter Fokker – peter.fokker@tno.nl

Total area covered estimated: (Harlingen, Nijmegen and Schouwen Duiveland: 2.500 km^2)

Bounding boxes Harlingen

(WGS84, UTM 31 – degrees E , degrees N):

667785.760,5908833.214

652782.624,5882130.668

661815.502,5868579.918

681898.341,5903562.657

Mechanisms of ground motion: subsidence due to gas extraction and water management, subsidence of water defence structures

Bounding boxes Nijmegen

(WGS84, UTM 31 – degrees E , degrees N):

693667.633,5750830.756

693758.677,5744618.231

701745.585,5746056.663

699703.235,5751356.064

Mechanisms of ground motion: subsidence of water defence structures

Bounding boxes Schouwen-Duiveland

(WGS84, UTM 31 – degrees E , degrees N):

550589.299,5737189.726

542006.148,5724114.349

570569.637,5717901.685

579102.527,5725037.132

565453.933,5732180.432

Mechanisms of ground motion: subsidence of water defence structures

3.2.3 – Case Study 2: Delft/Delfland and Zuiderzeeland water boards

Contact person: Victor Hopman – victor.hopman@deltares.nl

Total area covered: Delft/Delfland and Zuid-Flevoland 230 + 430 km^2 = 660 km^2

Bounding boxes Delft

(WGS84, UTM 31 – degrees E , degrees N):

589337.894,5765061.306

589491.627,5757822.999

598338.111,5758811.584

597911.570,5766086.995

Mechanisms of ground motion: subsidence due to water management, elevation due to the end of major water extraction by company DSM

Bounding boxes Delft

(WGS84, UTM 31 – degrees E , degrees N):

662833.420,5818797.370

644252.068,5805027.490

645862.245,5799034.105

663714.192,5791758.407

672954.419,5794947.088

676201.449,5803810.528

2. Input data: PSI and SAR-derived products

Nation wide subsidence map

The SAR data required to perform the tasks of WP3.2 are provided by the satellites ERS1/2 and Envisat.

For creating a nation wide deformation map long swaths are preferred to standard SLC, because with long swaths there is no need of merging the results, at least in the north-south direction. Estimation and removal of atmospheric artifacts and spatial ramps produced by orbital inaccuracies can also benefit from them.

In order to be able to create long swaths, longer that the standard length of 100 km, the data will be order "raw" (level 0) which means they need to be focused. In addition to that, the swath type required for Envisat is I2.

The total number of images is around 1000. Their width on the ground is 100 km and their length changes from 100 to 300 km.

The required tracks along with the acquisition date interval are listed next. They are divided in 4 tables depending on the satellite and orbit type (ascending/descending).

ERS1/2 SAR data ascending mode:

Track	nof images	Dates
344	37	from 1992 to 2001
72	39	from 1992 to 2001
301	50	from 1992 to 2001
29	68	from 1992 to 2001
258	52	from 1992 to 2001
487	41	from 1992 to 2001

ERS1/2 SAR data descending mode:

Track	nof images	Dates
108	78	from 1992 to 2001
380	81	from 1992 to 2001
151	80	from 1992 to 2001
423	88	from 1992 to 2001
194	80	from 1992 to 2001

Envisat SAR data ascending mode

Track	nof images	Dates
487	32	from 2003 to 2010
301	16	from 2003 to 2010

Envisat SAR data descending mode

Track	nof images	Dates
466	71	from 2003 to 2010
423	75	from 2003 to 2010
380	70	from 2003 to 2010

The European Space Agency will provide the data and they will be focused using ROI PAC. Interferometric processing will be performed with Doris.

The output product is a nation-wide map of surface displacements happening in the Rhine-Meuse Delta (The Dutch Delta), obtained mainly from PSI and leveling. GPS and gravimetry data will be employed for correcting spatial trends that can occur in PSI due to orbital inaccuracies. The total covered area is 41256 km^2 (of which 7643 km^2 is water).
Millions of observations are expected to be found therefore the results will be downsampled to a grid. The size of the grid cell is not determined yet. A balanced must be found between sampling properly the signal of interest and the maximum number of observations we can handle. It is expected that the cell size will be around 250 m x 250 m.

Each grid cell should include, in principle:

- Mean and variance of the time series of PS inside the cell. This is decomposed in vertical and horizontal (E-W)
- Mean and variance of the heights of PS inside the cell.
- PS characterization and likelihood that they are deep or shallow founded.
- Mean and variance of the time series of leveling benchmarks inside the cell.
- Benchmark description.
- Estimated deformation time series of the cell's and its variance. The observations will include leveling and PSI, over the total time period.
- Mean and variance of the topography of the area inside the cell provided by AHN.

This nation-wide map is therefore a new product.

The total processing chain is as follows:

1. Radar data focusing: Data focusing will be carried out using ROI_PAC. ROI_PAC stands for Repeat Orbit Interferometry PACkage. This software was created by the Jet Propulsion Laboratory division of NASA for processing SAR images.
2. Radar Interferometry: Interferograms will be created with DORIS, which is the InSAR processor developed in TU Delft.
3. PSI processing. PSI will be carried out with StaMPS. StaMPS is a matlab based tool developed by A. Hooper for extracting deformation from InSAR time series. Apart of having proved to be a useful tool for land deformation and being widely used, one of its major advantage is that it handles data very efficiently. The PSI analysis of study cases 3.2.2 and 3.2.3 will be processed independently of the nation wide map. Previous processing steps (radar focusing and radar interferometry) are however the same. Since the areas to process are smaller, computer load and data will decrease. This will allow us to set here less strict constrains to PS selection than in the case of the nation-wide map.

Case study 1: Dutch North Sea Coastal Region

For three areas water defense monitoring products will be delivered. The products are similar to Terrafirma's Flood Defense (FD) product. Depending on the availability of new data, the products will have a historical or updating nature.

The processing will be performed by Hansje Brinker's processing chain, composed of Doris, DePSI and inhouse software.

Coastal defense Harlingen

Satellite	Asc/dsc	Period	Track	Frame	Swath	#
ERS-1/2	asc	1992-2001	258**	-	-	52
ERS-1/2	dsc	1992-2001	151**	-	-	80
Envisat	asc	2003-2010	-	-	-	-
Envisat	dsc	2003-2010	423**	-	I2	75
Radarsat-2	dsc	2010-2011	202	-	S3	30

** Same data as for Nation wide subsidence map

Coastal defense Nijmegen

Satellite	Asc/dsc	Period	Track	Frame	Swath	#
ERS-1/2	asc	1992-2001	029**	-	-	68
ERS-1/2	dsc	1992-2001	380**	-	-	81
Envisat	asc	2003-2010	-	-	-	-
Envisat	dsc	2003-2010	380**	-	I2	70
Radarsat-2	dsc	2010-2011	302	-	S3	30

** Same data as for Nation wide subsidence map

Coastal defense Zeeland

Satellite	Asc/dsc	Period	Track	Frame	Swath	#
ERS-1/2	asc	1992-2001	344**	-	-	37
ERS-1/2	dsc	1992-2001	194**	-	-	80
Envisat	asc	2003-2010	-	-	-	-
Envisat	dsc	2003-2010	466**	-	I2	71
Radarsat-2	dsc	2010-2011	102	-	S3	30

** Same data as for Nation wide subsidence map

Case Study 2: Delft/Delfland and Zuiderzeeland water boards

Delft/Delfland

Satellite	Asc/dsc	Period	Track	Frame	Swath	#
ERS-1/2	asc	1992-2001	072**	-	-	39
ERS-1/2	dsc	1992-2001	423**	-	-	88
Envisat	asc	2003-2010	-	-	-	-
Envisat	dsc	2003-2010	423**	-	I2	75
Radarsat-2	dsc	2010-2011	102	-	S3	30

** Same data as for Nation wide subsidence map

Zuiderzeeland

Satellite	Asc/dsc	Period	Track	Frame	Swath	#
ERS-1/2	asc	1992-2001	029**	-	-	68
ERS-1/2	dsc	1992-2001	151**	-	-	80

Envisat	asc	2003-2010	-	-	-	-
Envisat	dsc	2003-2010	423**	-	I2	75
Radarsat-2	dsc	2010-2011	202	-	S3	30

** Same data as for Nation wide subsidence map

3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

Work package 3.2.1 – Nation wide subsidence map

A real validation of PSI time series will not be carried out, because all available data will be used to estimate surface deformation. However, we will perform statistical tests to detect inconsistency in the measurements.
Using ascending and descending acquisition modes of the satellites the deformation time series will be decomposed in vertical and horizontal. Then the deformation time series will be estimated for each grid cell of the map. The size of the grid cell is expected to be 250 x 250 m. The deformation of each resolution cell is estimated mainly using PS and levelling time series.

Spatial ramps in PSI time series will be removed and orbital errors assessed with GNSS positioning data of the continuous Dutch Active GNSS Reference System (AGRS) and gravimetric observations. GNSS and gravimetric data will be also employed to solve for long wavelength phenomena, such as the tilting of the Netherlands.

Overall model test (OMT) and outlier rejection test will be carried out to assure and assess the quality of the estimations. The variance of the PS will be calculated empirically. Assuming a certain stochastic model for the signal of interest, (land deformation), we will perform the OMT under the null hypothesis that all measurements observe the same signal. This means, that all available observations for a given area, which could include levelling, PSI results obtained from ascending and descending modes, plus overlapping tracks, will be employed in the test. If the OMT is rejected, the most probable cause of rejection will be searched for. We expect that with redundant information wrongly unwrapped PS can be detected.

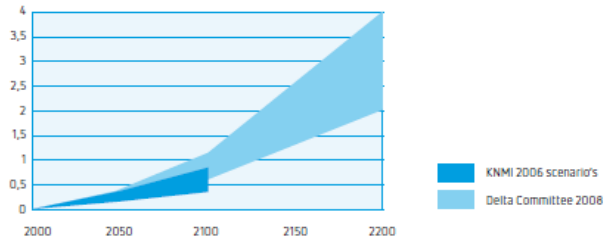
We will assess the validity of the PS characterisation method obtained from task 3.2.3, which also includes estimating the source type: shallow, (10 to 20 m) or deep (from hundreds of meters to kilometers), with in situ measurements and map of building foundations.

Topography is provided by General Elevation Model of the Netherlands (AHN), which is a filtered topography map made by Lidar data with a spatial resolution of 1 x 1 m at its best and 2 x 2 m at its worst. The vertical resolution is 5 cm (actually, a standard deviation of 5 cm and a systematic deviation of max 5 cm). More details on AHN can be found on this website (in Dutch): http://www.ahn.nl/bestellen/keuze_ahn_1_of_ahn_2

For the nation wide subsidence map, subsidence parameters derived from InSAR will be put in the national voxel model “Netherlands 3D”. This model has a spatial resolution of 250 x 250 x 1m and is a geological model. The model already has incorporated subsidence parameters as measured by subsidence sensors called ‘peilmerken’, which are subsidence poles standing on the Pleistocene sand and thus measuring the deep subsidence as caused by e.g. gas extraction, tilting and tectonics.

By using the information in the case studies 1 and 2, it will be shown that also information from the more detailed geological model will be used, which is called GEOTOP (a 100 x 100 x 0.5 m geological voxel model). However, this model is not yet covering the whole country.

Climate scenarios as handed out by the Dutch Meteorological Institute will be used for sea level rise data and have a known bandwidth, as shown in the figure below.



Rise in sea level in different scenarios [in m]

A description of the planned validation procedure for the subsidence model

Using the "Netherlands 3D" model, subsidence parameters will be estimated using known soil parameters or a parameterization that exists from other research in similar areas. We call this the draft model.

The draft model is enhanced by the ground truth data, including the Dutch Elevation model AHN, old maps provided by the Dutch Government. Manual expert sessions are organized to look at regions showing differences in data sources. First, expert judgement sessions are organized to look at all regions where large differences occur between all different data (also PSI). After this expert session, the subsidence model will be enhanced using all ground truth data. Afterwards, the subsidence model will be enhanced further using PSI data. The inversion procedure uses all data including the bandwidth / accuracy and also gives output with a bandwidth (Ensemble Kalman or alike). The spatial resolution of the subsidence model will be 250 x 250 x 1 m. In areas having more than one scatterer per 100 m, a stochastic parameter will be given for the voxel cell. The voxel in the model thus uses all PS data and shows a probability division of PS – subsidence. After the second enhanced session (using InSAR), the added use of the InSAR will be researched.

This will be done in the second enhancement of the model. First of all, for the entire area, PS will be defined that are different from other measurements or the estimation from the geological model. Using the knowledge from task 3.2.3 (a characterization of PS to asses if the source of the deformation is deep or shallow), the availability of reflectors in the area and expert judgement, it will be assessed and defined what the overall quality of the InSAR data. There will be a distinction for PS in urban and in rural areas.

Work package 3.2.2 – Case study 1: Dutch North Sea Coastal Region

We will decompose PSI time series in vertical and horizontal. Both, levelling and PSI will be used to estimate deformation. Levelling will also complement PSI results where no PS are available. The variance of the PS will be calculated empirically. As described in previous sections, we will perform OMT tests to detect inconsistency in the measurements. Special attention will be paid in detecting and removing unwrapping errors.

As before, spatial ramps in PSI will be removed and orbital errors assess with GNSS positioning data of the continuous Dutch Active GNSS Reference System (AGRS) and gravimetric observations.

Long wavelength phenomena, such as the tilting of the Netherlands, will be solved for with levelling and gravimetric observations.

The topography is provided by General Elevation Model of the Netherlands (AHN), which is a filtered topography map made by Lidar data with a spatial resolution of 1 x 1 m at its best and 2 x 2 m at its

worst. The vertical resolution is 5 cm (actually, a standard deviation of 5 cm and a systematic deviation of max 5 cm). More details on AHN can be found on this website (in Dutch): http://www.ahn.nl/bestellen/keuze_ahn_1_of_ahn_2

For the case study Dutch North Sea Coastal Region, subsidence parameters derived from InSAR will be put in the national voxel model "Netherlands 3D". This model has a spatial resolution of 250 x 250 x 1m and is a geological model. The model already has incorporated subsidence parameters as measured by subsidence sensors called 'peilmerken', which are subsidence poles standing on the Pleistocene sand and thus measuring the deep subsidence as caused by e.g. gas extraction, tilting and tectonics.

Other measurements that will be used in the case study are not yet known, but may involve local measurements on buildings as measured by the Dutch stakeholder NAM, who measures and models subsidence in these regions for many years. Specifications on these data are not yet know yet.

The estimated PS heights and characterisation will be validated with in-situ measurements based on their geolocation.

A description of the planned validation procedure for the subsidence model

The current existing (as given out by the Dutch Government and/or the water authority and/or the city) will be validated using ground-truth data, as well as the geological model. First, expert judgement sessions are organized to look at all regions where large differences occur between all different data (also InSAR). After this expert session, the subsidence model will be enhanced using all ground truth data. Afterwards, the subsidence model will be enhanced further using InSAR data. The inversion procedure uses all data including the bandwidth / accuracy and also gives output with a bandwidth (Ensemble Kalman or alike). The spatial resolution of the subsidence model will be 100 x 100 m. After the second enhanced session (using InSAR), the added use of the InSAR will be researched.

Work package 3.2.3 – Case Study 2: Delft/Delfland and Zuiderzeeland water boards

A description of the available ground truth to be used for the validation purposes
The same as in previous tasks: We will decompose PSI time series in vertical and horizontal. Both, levelling and PSI will be used to estimate deformation. Levelling will also complement PSI results where no PS are available. The variance of the PS will be calculated empirically. As described in previous sections, we will OMT tests to detect inconsistency in the measurements. Special attention will be paid in detecting and removing unwrapping errors.

As before, spatial ramps in PSI will be removed and orbital errors assess with GNSS positioning data of the continuous Dutch Active GNSS Reference System (AGRS) and gravimetric observations.

The estimated PS heights and characterisation will be validated with in-situ measurements based on their geolocation.

- the basic core-net of GPS calibration points ('kernnet') infrastructure

Long wavelength phenomena, such as the tilting of the Netherlands, will be solved for with leveling and gravimetric observations.

The topography is provided by General Elevation Model of the Netherlands (AHN), which is a filtered topography map made by Lidar data with a spatial resolution of 1 x 1 m at its best and 2 x 2 m at its worst. The vertical resolution is 5 cm (actually, a standard deviation of 5 cm and a systematic deviation of max 5 cm). More details on AHN can be found on this website (in Dutch): http://www.ahn.nl/bestellen/keuze_ahn_1_of_ahn_2

For the case study Delft/Delfland and Zuiderzeeland, subsidence parameters derived from InSAR will be put in the national geological voxel model "GEOTOP" in Delft, having a spatial resolution of 100 x 100 x 0,5 m and is a geological model. For the Zuiderzeeland area, the model used will be "Netherlands 3D". This model has a spatial resolution of 250 x 250 x 1m and is a geological model.

Both models already have incorporated subsidence parameters as measured by subsidence sensors called 'peilmerken', which are subsidence poles standing on the Pleistocene sand and thus measuring the deep subsidence as caused by e.g. gas extraction, tilting and tectonics.

In the Zuiderzeeland and Delft area, other ground truth sensors are local measurements of the shallow subsidence. These are made by tachymeters / theodolites that were used as reference measurements during building projects are short research by the water authority and city. These measurements are not consistent in time. The details about the measurements are not yet known.

A description of the planned validation procedure for the subsidence model

Validation of the subsidence data:

The current maps existing (as given out by the Dutch Government and/or the water authority and/or the city) will be validated using ground-truth data, as well as the geological model. First, expert judgement sessions are organized to look at all regions where large differences occur between all different data (also InSAR). After this expert session, the subsidence model will be enhanced using all ground truth data. Afterwards, the subsidence model will be enhanced further using InSAR data. The inversion procedure uses all data including the bandwidth / accuracy and also gives output with a bandwidth (Ensemble Kalman or alike). The spatial resolution of the subsidence model will be 100 x 100 m. In areas having more than one scatterer per 100 m, a stochastic parameters will be given for the voxel cell. This voxel uses all PS data and shows a probability division of PS – subsidence. After the second enhanced session (using InSAR), the added use of the InSAR will be researched.

4. **Input data: other data**

- Geological map "Netherlands 3D"
  - Name of the product: "Netherlands 3D"
  - Data source: TNO DINO (http://www.dinoloket.nl/en/DINOLoket.html)
  - The geological database TNO DINO contains many parameters (lithology, borehole information, geophysical measurements, analyses, etc.). The geological model, consisting of voxels, can hold any information given, including subsidence parameters.
  - Key characteristics of the product: covered surface 41526 km2, spatial resolution 250 m x 250 m x 1 m
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is part of the national database and should be considered standard. However, improvements are made continuously.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – This is part of the national database and should be considered standard. However, improvements are made continuously.
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – The voxel model contains stochastic information and thus contains all used data, showing the bandwidth.

- Geological map "GEOTOP"
  - Name of the product: "GEOTOP"
  - Data source: TNO DINO (http://www.dinoloket.nl/en/DINOLoket.html)
  - The geological database TNO DINO contains many parameters (lithology, borehole information, geophysical measurements, analyses, etc.). The geological model, consisting of voxels, can hold any information given, including subsidence parameters.
  - Key characteristics of the product: covered surface 41526 km2, spatial resolution 100 m x 100 m x 0.5 m
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is part of the national database and should be considered standard. However, improvements are made continuously.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – This is part of the national database and should be considered standard. However, improvements are made continuously.
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – The voxel model contains stochastic information and thus contains all used data, showing the bandwidth.

- Levelling data
  - Name of the product: "peilmerken"

- Data source: Input TNO wanted
- What does the product contain: Input TNO wanted
- Key characteristics of the product: covered surface 41526 km2, temporal resolution Input TNO wanted, number of peilmerken Input TNO wanted
- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is a standard product.
- Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – Input TNO wanted.
- What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – Input TNO wanted.

- Reprocessed GPS data
  - Name of the product: "GPS"
  - Data source: EUREF and AGRS network and Dutch cadastre
  - What does the product contain: Reprocessed GPS time series.
  - Key characteristics of the product: covered surface: 41526 km2, temporal resolution: hourly data starting in 1997, number of measurements: 8 GPS stations.
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is a standard product.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – They are good quality data the stations are maintained by the Dutch cadastre.
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – The RMS is 3 mm horizontally and 5 mm vertically in daily measurements. Time series may suffer a jump in 2008 due to antenna change.

- Gravity measurements
  - Name of the product: "Gravity"
  - Data source: TU Delft
  - What does the product contain: Gravimetric time series
  - Key characteristics of the product: covered surface 41526 km2, temporal resolution monthly data starting from 1996 (3 gravimeters) and 2004 (2 gravimeters), number of measurements 5 gravimeters.
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – Standard.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - –The gravimeters are maintained by TU Delft.

  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – The RMS is in the order of the microgal which translates to 300 mm.

- Sea level data
  - Name of the product: "Sea level"
  - Data source: IPCC, Netherlands Meteorological Institute. Rijkswaterstaat?, PSMSL????
  - What does the product contain: Estimations of the sea level rise
  - Key characteristics of the product: covered surface global and the Netherland
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – No.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – As everybody knows, there is a lot of discussion on these forecasts. However, the data has a bandwidth and this can be used in the analyses.

- Geo(hydro)logical data,
- Data on gas extraction
  - Name of the product: "Gas extraction"
  - Data source: Input TNO wanted
  - What does the product contain: Input TNO wanted
  - Key characteristics of the product: covered surface Input TNO wanted, temporal resolution Input TNO wanted, number of peilmerken Input TNO wanted
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is a standard product.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – Input TNO wanted.
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – Input TNO wanted.

- Data on gas injection
  - Name of the product: "Gas injection"
  - Data source: Input TNO wanted
  - What does the product contain: Input TNO wanted
  - Key characteristics of the product: covered surface Input TNO wanted, temporal resolution Input TNO wanted, number of peilmerken Input TNO wanted
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is a standard product.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - – Input TNO wanted.

- What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – Input TNO wanted.

- Thematic maps (e.g. land cover, land use)
  - Name of the product: "Land use"
  - Data source: Land use map of the Netherlands (LGN4-5)
  - What does the product contain: 39 kinds of land use (different types of argiculture, forest, water, urban, infrastructure and different types of nature) on a 25m grid
  - Key characteristics of the product: covered surface 41525 km2
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product? – This is a standard product.
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc. - GN is a standard in the Netherlands produced by Alterra, and used for many purposes (Hydrology, ecology, urban planning).
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc. – The product is validated using in-situ control points. Accuracy is proved to be around 80%. |Furthermore, the product is updated every 3-5 years.

- Optical EO data: see description PS-InSAR data

5. Type of analyses

The following data are planned to be used to analyse the cause of deformation (this is the same for each tasks):

1. Surface displacements estimated from leveling and PSI.
2. Characteristics of the PS (height and single or double bounce).
3. Depth of leveling benchmarks.
4. Geological data.
5. Water measurements
6. Gas extraction measurements.

From the data 1-3 we will to assess the source type: deep or shallow.

Input TNO wanted:

The different types of analyses to be run in the SubCoast project play a key functional role, i.e. transforming the multi-source, multi-scale and multi-quality input data (including PSI products) into the products and services that are needed by the SubCoast end-users.

Given their importance, it is of paramount importance to provide a clear description of these analyses. For each analysis to be run in the Pilot, please address the following issues:

- A brief description of the analysis:
  - Name of the analysis
  - Comprehensive list of input data
  - What is (are) its main outcome(s)?
  - Describe the type of analysis (note that the type of analysis is impacting the possible validation procedures – see next section), e.g.
    - It is based on a single computer-based model/software (i.e. it transform inputs in outputs through a fully automated procedure, which could be easily repeated).
    - Same as above, but based on a chain of computer-based models/softwares.
    - It is based on a single computer-based model/software, which requires a lot of interaction of an expert (i.e. it transform inputs in outputs through a fully semi-automated procedure).
    - It needs a complex sequence of data analyses, which include qualitative analysis steps, etc.
    - Etc.: please complete it.

6. Outputs: products and services and user needs

Work package 3.2.1 – Nation wide subsidence map

1) Nation-wide subsidence deformation map, giving also insight in:
    a. Subsidence due to compaction and settlement (shallow)
    b. Subsidence due to gas extraction and –injection (deep)
2) Map with predicted surface deformation of the Netherlands in a nation-wide scale.
3) Map of the land movement in Netherlands in terms of relative sea level rise.
4) Flood risk forecast maps (2015, 2050 and 2100).

Work package 3.2.2 – Case study 1: Dutch North Sea Coastal Region

1. Report on inversion of the pilot areas
2. Report on the analysis of water defence structures
3. Nation-wide prediction of subsidence based on improved parameters

Work package 3.2.3 – Case Study 2: Delft/Delfland and Zuiderzeeland water boards

1. Groundwater risk forecast maps: the effect of subsidence translated to the groundwater management task of the water board, taking into account extraction vs. compaction and water salinity
2. Urban planning map of city of Almere and/or Delft, plotted against the subsidence forecast
    2. Local knowledge to be used for nation wide prediction

7. Outputs: products and services - Planned validation activities

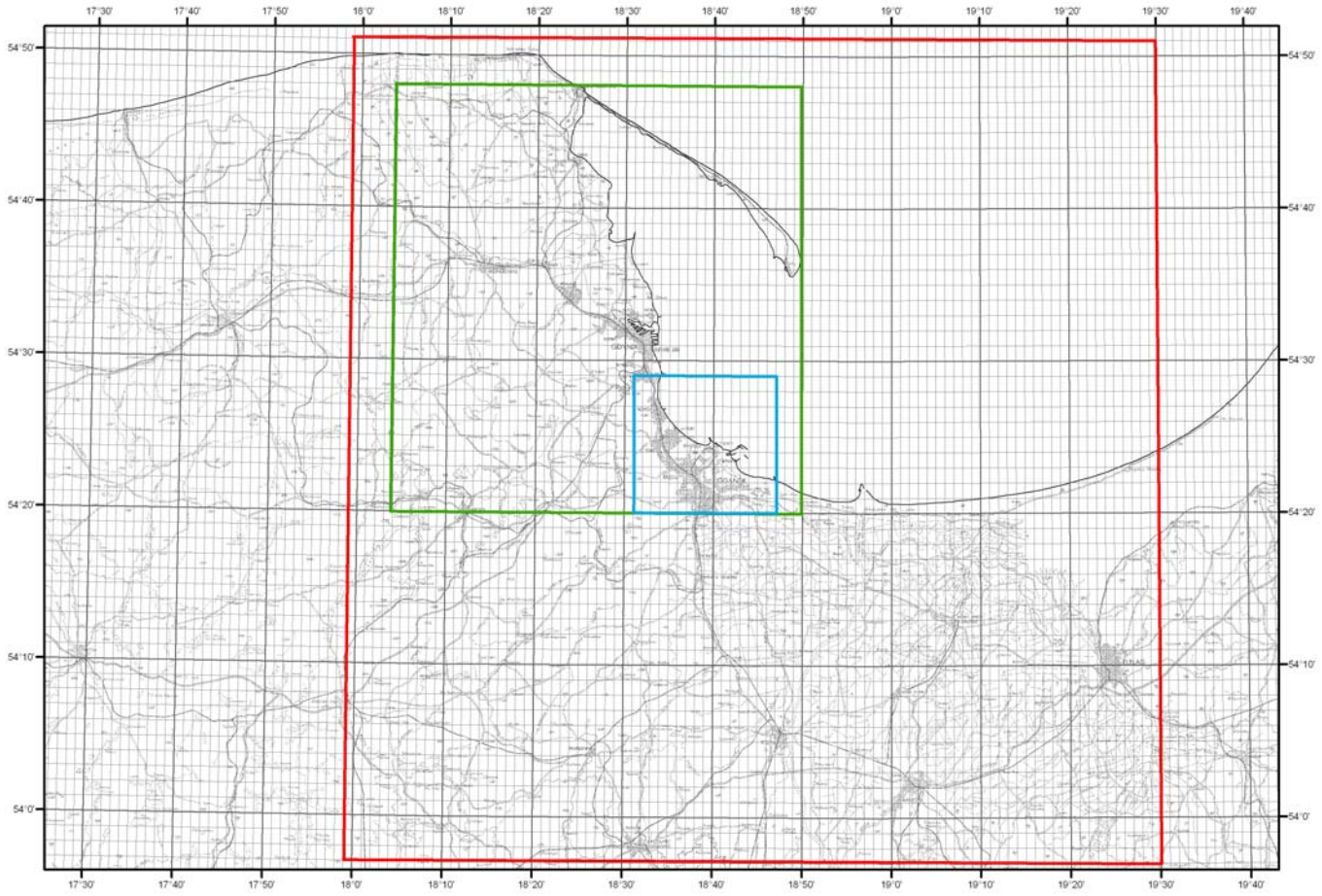
Baltic Pilot – Polish Coast

1. Basic information about Pilot

- Full name of the Pilot:

Gulf of Gdansk coastal area

- Key characteristics of the Pilot:
  - Surface: ERS 100 000 km^2, Terra SAR-X 2500 km^2, optical image 200 km^2
  - figure that illustrates the geographic extent of the Pilot



  - The total area to be covered by each Pilot, including bounding coordinates

100x100 km

φ 54°51’ λ 17°59’

φ 54°51’ λ 19°30’

φ 53°57’ λ 17°59’

φ 53°57’ λ 19°30’

50x50 km

φ 54°48’ λ 18°04’

φ 54°48’ λ 18°50’

φ 54°20’ λ 18°04’

φ 54°20’ λ 18°50’

17x17km

φ 54°29’ λ 18°31’

φ 54°29’ λ 18°47’

φ 54°20’ λ 18°31’

φ 54°20’ λ 18°47’

- Mechanisms of ground motion thought to be present in the Pilot area

Neotectonic related to Scandinavian glacioisostasy,

Compaction of Holocene deltaic sediments
Movements are caused by differential settlements induced by infrastructure loading of compressible sediments.

- Person responsible for completing the information in this document for your Pilot. Szymon Uscinowicz
    - Contact details. szymon.uscinowicz@pgi.gov.pl

2. Input data: PSI and SAR-derived products

- Name of data type: Standard PSI products (Terrafirma H1): displacement velocities and time series
- Amount of data required: 66 images available
- Scene/Frame numbers: ERS Track 36 descending,
- Dates of data acquisition?
- Source of data: ESA

- Name of data type: Standard PSI products (Terrafirma H1): displacement velocities and time series
- Amount of data required: ?
- Scene/Frame numbers: TerraSAR-X
- Dates of data acquisition?
- Source of data: DLR

3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

- A description of the available ground truth to be used for the validation purposes
  - Type of ground truth **regional and local rsl rise curves**
  - Data source PGI-NRI
  - Key characteristics of the ground truth, e.g. quality, spatial coverage, etc. coastline of the Gulf of Gdansk, tide-gauges in Łeba, Władysławowo, Hel, Puck, Gdynia, Gdańsk, Tolkmicko

  - Type of ground truth **Ground motion models**,
  - Data source published data (maps and papers)
  - Key characteristics of the ground truth, e.g. quality, spatial coverage:. Quality coastal area of the Gulf of Gdansk,

- A description of the planned validation procedure:
  - Validation method
  - Validation outcomes, e.g. standard deviation of deformation velocity, geocoding quality, etc.
- In the case any validation activity is planned, please provide complementary information, e.g.
  - Validation outcomes coming from in-house activities
  - Validation outcomes coming from other projects
  - Other ways to characterize the (expected) performances of the new product.

4. Input data: other data

Name of the product: **Sea level data**

Data source: Institute of Meteorology and Water Management

The product contain: annual averege tide-gauges data 1950-2010

Key characteristics of the product, covered surface: coastline of the Gulf of Gdansk, tide-gauges in Łeba, Władysławowo, Hel, Puck, Gdynia, Gdańsk, Tolkmicko

The data are high quality and reliability
This a standard product

Name of the product: **Levelling data**,

Data source: maps and articles

The product contain: maps and models

Key characteristics of the product, covered surface: Poland

data quality and reliability ???
This a scientific analyses

Name of the product: **Geological data**

Data source: PGI-NRI

The product contain: lithology, origin and age of geological formation, tectonic features and photolineaments vector and raster data

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

Name of the product **Cartographic mapping at different scales, 1;100000, 1:50000, 1:25000, 1:10000**

Data source: PGI-NRI

The product contain: lithology, origin and age of geological formation, tectonic features and photolineaments vector and raster data

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

Name of the product **Thematic maps land cover, land use, population density**

Data source: Institute of Geodesy and Cartography

The product contain: raster maps

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

- Name of the product: **Detailed Geological Map of Poland 1:50000 Geodynamic Map of Polish Coastal Zone 1:10000**

Data source: PGI-NRI

The product contain: lithology, origin and age of geological formation, tectonic features and photolineaments vector and raster data

Key characteristics of the product, covered surface: Poland and Polish coastal zone

The data are high quality and reliability
This a standard product

- Name of the product: **Hydrogeological map of Poland 1:50000,**
- Data source: PGI-NRI

The product contain: detailed hydrogeological data

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

- Name of the product **DTM model 1 :50 000**

Data source: **topographical maps in scale 1:10000**

The product contain: vector elevation data,

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

Name of the product: **Ground water extraction data**

- Data source: PGI-NRI

The product contain: Ground water extraction (location and amount) data

Key characteristics of the product, covered surface: Poland

The data are high quality and reliability
This a standard product

a. Type of analyses

b. Name of the analysis: Multi-quality analysis including PS – InSAR data in GIS environment

c. Comprehensive list of input data: ERS data, T-SAR X data VHR optical image, DEM, topographic and geologic maps, land use maps, geodetic data etc.

d. What is (are) its main outcome(s)
- Multi-thematic GIS database including results for mapping of coastal erosion, (neo)tectonic movements, Relative Sea Level Rise and flood risk.
- Digital Elevation Model of the test area
- Coastal difference maps based on VHR-optical and TerraSAR-X data
- PS – InSAR database and PS time series of the characteristic places containing dual vector land motion measurements

e. PS will be overlapped at the above mentioned materials. The correlation of different multi-thematic data will be analyzed. PS time series will be performed.. Special attention will be put on the higher subsidence and up-lifting zones. Using the SAR data procured, test the utility of coherence mapping for the change detection of natural barrier flood protection over appropriate sites.
It needs a complex sequence of data analyses, which include qualitative analysis steps, etc.

6. Outputs: products and services and user needs

Name of the product: **Flood risk**

Brief description of the product :Map in regional and local scale

Main SubCoast product, maximum priority

Describe the nature of the product: categorical value A 2D, raster

Name of the product: **Flood impact**

Brief description of the product :Map in regional and local scale

Main SubCoast product, maximum priority

Describe the nature of the product: categorical value A 2D, raster

Name of the product: **Relative sea-level rise**

Brief description of the product : regional and local scale rsl rise curves 1950-2010

Main SubCoast product: maximum priority

Describe the nature of the product: Quantitative values a 2D digital

7. Outputs: products and services - Planned validation activities

Name of the product: **Flood risk**

i. "standard product" validation trough multi-quality analysis

Name of the product: **Flood impact**

ii. "standard product" validation trough multi-quality analysis

Name of the product: **Relative sea-level rise**

iii. "standard product" validation trough multi-quality analysis

Baltic Pilot – Lithuanian Coast

1. Basic information about each Pilot

Please provide:

- Full name of the Pilot: ***Baltic Pilot – Curonian Spit and the Lithuanian Baltic Sea Coast***
- Key characteristics of the Pilot:
  - Surface: ***Throughout the Quaternary period Lithuania has been covered by continental ice sheets originated in Fennoscandinavia, which corresponds to all glaciations known so far in Eastern Europe. The sediments and landforms of a least of 6 glacial stages and 8 ice free periods can be observed in the stratigraphic cross-section of the Quaternary of Lithuania. The average thickness of Quaternary cover is 130 meters.***
  - One figure that illustrates the geographic extent of the Pilot:

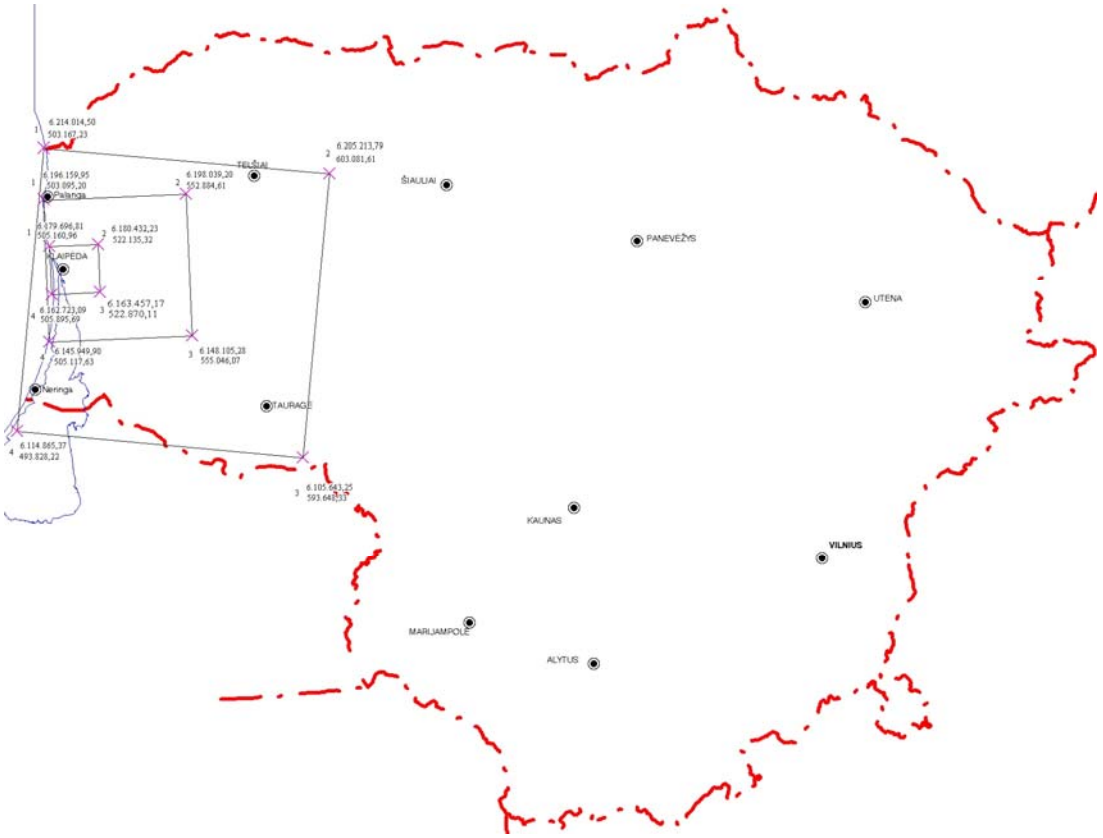
Promising PSI stack available from ERS for Lithuanian site according Fugro-NPA information shown in red colour quadrate. White colour quadrate indicates proposed ERS area by Lithuanian Geological Survey before.

  - The total area to be covered by each Pilot, including bounding coordinates:

Proposed areas by the Lithuanian Geological Survey for the Baltic Pilot – Curonian Spit and the Lithuanian Baltic Sea Coast:

Data type	Area of site	Projection category UTM Zone 34 (EUREF89)

		Corner point No.	x	y
ENVISAT, ERS1, ERS2	100x100 km	1	6214014.50	503167.23
		2	6205214.79	603081.61
		3	6105643.25	593648.33
		4	6114865.37	493828.22
TerraSAR-X	50x50 km	1	6196159.95	503095.20
		2	6198039.20	552884.61
		3	6148105.28	555046.07
		4	6145949.90	505117.63
VHR optical	17x17 km	1	6179696.81	505160.96
		2	6180432.23	522135.32
		3	6163457.17	522870.11
		4	6162723.09	505895.69



- Mechanisms of ground motion thought to be present in the Pilot area:

Rate and direction ***of the coast destruction and transformation (erosion, abrasion, mass movements, particles transportation by water and accumulation); subsidence of embankments and buildings; compaction of compressible grounds; flooding; neotectonic movements, etc.***

- Person responsible for completing the information in this document for your Pilot:

J. Čyžienė, V. Mikulėnas, V. Minkevičius

- Contact details:

Telephone number: ***+370 5 2330141***

E-mail address: ***jolanta.cyziene@lgt.lt***, ***vidas.mikulenas@lgt.lt***, ***vytautas.minkevicius@lgt.lt***

Governmental body: ***Lithuanian Geological Survey under the Ministry of Environment***

Address: ***S. Konarskio 35, LT-03123 Vilnius***

Country: ***Lithuania***

2. Input data: PSI and SAR-derived products

Please provide a comprehensive list of the SAR and Persistent Scatterer Interferometry (PSI) products that are going to be generated in your Pilot. For each product (a preliminary list of products is given at the end of this section) please provide:

- A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:
  - Name of data type: ***ERS***
  - Amount of data required: ***Track 222 descending***
  - Scene/Frame numbers: ***67 images available***
  - Dates of data acquisition:
  - Source of data: ***PSI from ERS***
- A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:
- Name of the product: ***Curonian Spit and the Lithuanian Baltic Sea Coast***
  - What does the product contain: ***vertical displacements, velocities and time series, etc.***
  - Key characteristics of the product, e.g. covered surface, etc.

- Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product. ***Standart PSI product (could be analogue like the Vilnius area H-1 and H-2 Terrafirma products): displacement velocities and time series. Also, if will be enough of available information from different satellites, could be possible new PSI product High-resolution DEMs.***

  Also expect to get Terra SAR-X and VHR optical information for Lithuanian Baltic Sea Coast.

- A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:

3. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

Ideally, and in line with the philosophy adopted in Terrafirma, all new or advanced PSI products should be properly validated. For each new product foreseen in your Pilot please provide:

- A description of the available ground truth to be used for the validation purposes
  - Type of ground truth: ***not available***
  - Data source
  - Key characteristics of the ground truth, e.g. quality, spatial coverage, etc.
- A description of the planned validation procedure:
  - Validation method: ***field verification***
  - Validation outcomes: ***standard deviation of deformation velocity, geocoding quality***, etc.
- In the case any validation activity is planned, please provide complementary information, e.g.
  - Validation outcomes coming from in-house activities: ***analysis of all available data – standard deviation values, GPS measurements, orthophoto maps, etc.***
  - Validation outcomes coming from other projects
  - Other ways to characterize the (expected) performances of the new product.

4. Input data: other data

- **Cartographic mapping data (vector)**
  - **Name of the product:** LTDBK50000
  - **Data source:** The copyright of Digital Data Base of the Lithuanian Space Imagery Map LTDBK50000 belongs to the National Land Service under the Ministry of Agriculture. Official authorized distributor of LTDBK50000 is the State Enterprise "GIS-Centras". LTDBK50000 licence for the State and academic institutions is financed from the State budget and EU and is assigned unrequitedly only paying data for administration, preparation and assignement expenses. LGT has signed licence agreement for using LTDBK50000.
  - **A description of the product:** Digital Data Base of the Lithuanian Space Imagery Map LTDBK50000 at scale 1:50000 consist of vector data base **LTDBK50000-V** and colourful raster data base **LTDBK50000-SR**. Digital Data Base of the Lithuanian Space Imagery Map LTDBK50000 at scale 1:50000 cover the whole territory of the Republic of Lithuania (65300 square kilometers). LTDBK50000 was compiled during the period of 1994–1996, by using the existing maps' information, digital data bases together with that time most up to date SPOT panchromatic orthophoto material (PAN) and geometrically corrected multispectral (XS) images. LTDBK50000-V map sheet division scheme is done according to ETRS-89 rectangular co-ordinate net and named "Baltija-93". LTDBK50000-V was recalculated to the co-ordinate system of Lithuania LKS-94 in the year of 1994.

- **Cartographic mapping data (vector)**
  - **Name of the product:** GDB10LT

- **Data source:** The copyright of Georeference Background of the Republic of Lithuania GDB10LT belongs to the National Land Service under the Ministry of Agriculture. Official authorized distributor of ORT10LT is the State Enterprise "GIS-Centras". LGT has signed licence agreement for using GDB10LT.
- **A description of the product:** Georeference Background of the Republic of Lithuania GDB10LT – the component of the whole Lithuanian Republic territory georeference data base at scale 1:10000, that consists of the Lithuanian Republic territory geodetic and topographic data bases, main elements, that were methodically organized according to the geoinformation principles. GDB10LT covers the whole territory of Lithuania – 2782 map sheets (2229 map sheets are of general usage and 553 map sheets of restricted usage). Basic scale of the georeference background of the Republic of Lithuania is 1:10000. The main cartographic material (basic map) that was used for creating geodata are digital orthophotographic maps at scale 1:10000. GDB10LT consists of separate graphic data layers: map sheet division scheme for the territory of Lithuania, points of geodetic network, geographic name annotations, the State border, rivers, streams and canals, roads, railroads, hydrographic objects expressed in area. GDB10LT information is stored in the State geodetic co-ordinate system and map sheet division scheme LKS-94.

- **Cartographic mapping data (raster)**
  - **Name of the product:** ORT10LT
  - **Data source:** The copyright of Digital Orthophotographic Map of Lithuania scale 1:10000 ORT10LT to the National Land Service under the Ministry of Agriculture. Official authorized distributor of ORT10LT is the State Enterprise "GIS-Centras". LGT has signed licence agreement for using ORT10LT.
  - **A description of the product:** Digital Orthophotographic Map of Lithuania scale 1:10000 ORT10LT is created during the period of 1995–1999 on the background of aerial photography and covers the entire territory of Lithuania. Information of aerial photography was geometrically corrected by reducing image location deformation error down to minimum during the process of orthophotographic map production. ORT10LT raster data resolution is 0.5 m.
- **Cartographic mapping data (colour raster)**
  - **Name of the product:** ORT10LT
  - **Data source:** The copyright of Digital Orthophotographic Map of Lithuania at scale 1:10000 ORT10LT to the National Land Service under the Ministry of Agriculture. Official authorized distributor of ORT10LT is the State Enterprise "GIS-Centras". Digital Orthophotographic Map of Lithuania at scale 1:10000 ORT10LT is distributed by signing 2, 3, 4 or 5 year duration licence agreement with the State Enterprise "GIS-Centras". LGT has signed licence agreement for using ORT10LT.
  - **A description of the product:** Lithuanian digital Orthophotographic Map ORT10LT at scale 1:10000 is created during the years of 2005-2006 on the base of Aerial photography and covers the whole territory of Lithuania. During the process of orthophotographic map production, information of aerial photography is geometrically corrected by minimizing deformation errors of location down to possible minimum. ORT10LT raster data resolution is 0.5 m on ground.
  - **Name of the product:** LIDAR
  - **Data source:** The National Land Service. LGT has signed licence agreement for using LIDAR product.

- **A description of the product:** data of the remote spatial laser scanning of the territory of Klaipeda city.

- **Thematic mapping data (vector)**
  - **Name of the product:** CLC06 - 2006 CORINE
  - **Data source:** The Environmental Protection Agency (EPA). LGT has signed licence agreement for using CORINE product.
  - **A description of the product:** land cover.

- **Geological mapping data**
  - **Name of the product:** Engineering geological map at scale 1:50000
  - **Data source:** LGT, 1997-2000
  - **A description of the product:** Vector engineering geological map of the Baltic Sea coast including Curonian Spit.
- **Geological mapping data**
  - **Name of the product:** Geological-geomorphological map at scale 1:5000
  - **Data source:** GGI and LGT, 2004
  - **A description of the product:** Vector geological and geomorphological map of the Baltic Sea coast.
- **Geological mapping data**
  - **Name of the product:** Engineering geological map of Klaipeda at scale 1:25000
  - **Data source:** Lithuanian Geological Survey (LGT), 1997
  - **A description of the product:** Vector engineering geological map of Klaipeda city
- **Geological mapping data**
  - **Name of the product:** Engineering geological map of Klaipeda Sea Port at scale 1:5000
  - **Data source:** Lithuanian Geological Survey (LGT), 2009
  - **A description of the product:** Vector engineering geological map of Klaipeda Sea Port southern part including harbour.
- **Gravity and magnetic mapping data**
  - **Name of the product:** Magnetic and gravity fields maps at a scale 1:50 000
  - **Data source:** Lithuanian Geological Survey (LGT)
  - **A description of the product:** A set of maps of the gravity and magnetic fields and their transformations at a scale 1:50 000
- **Geo(hydro)logical data**
  - **Name of the product:** GEOLIS database
  - **Data source:** LGT
  - **A description of the product:** Information on boreholes, wellfields, groundwater extraction data, groundwater heads and wellfields impact areas.

- **Data on oil extraction**
  - **Name of the product:** Lithuanian Geological Survey GEOLIS database
  - **Data source:** Lithuanian Geological Survey (LGT)
  - **A description of the product:** Information on boreholes, oil extraction data, oil fields.
- **Data of Klaipeda geothermal field**
  - **Name of the product:** Lithuanian Geological Survey GEOLIS database
  - **Data source:** Lithuanian Geological Survey (LGT)
  - **A description of the product:** Information on boreholes, water extraction data, geothermal energy field data.
- **Sea level data**
  - **Name of the product:** Centre of Marine Research data
  - **Data source:** Sea level data is collected and analysed by the Centre of Marine Research, an outpost of the Ministry of the Environment
  - **A description of the product:** State of the Coast of the South East Baltic: an indicators-based approach to evaluating sustainable development in the coastal zone of the South East Baltic Sea (2008).

All these products are a standard cartographic product at a given scale.

5. Type of analyses

- A brief description of the analysis:
  - Name of the analysis: **GIS based analysis**
  - Comprehensive list of input data: **PSinSAR, Cartographic mapping data (vector and raster), geological maps, geo(hydro)logical data, etc.**
  - What is (are) its main outcome(s)?: **Thematic maps**
  - Describe the type of analysis (note that the type of analysis is impacting the possible validation procedures – see next section), e.g.
    - **It is based on a single computer-based model/software, which requires a lot of interaction of an expert (i.e. it transform inputs in outputs through a fully semi-automated procedure).**

    Loading the PSinSAR data into a GIS and integrate it with other input data. This will allow to interpret the subsidence, extent and direction of developing of geological processes and phenomena.

6. Outputs: products and services and user needs

In this section we address the products and services generated by the different analyses, and which are needed by the SubCoast end-users. For each product/service please address the following issues:

- Provide a brief description of the products/services (see list at the end of this section):
  - Name of the product: **Seawater impact on Curonian Spit and Lithuanian coast area**
  - Brief description of the product: **Assessing of rate of geological processes and phenomena (mass movements due to coastal erosion, solid particles transportation by water and accumulation) along the Curonian Spit and Lithuanian Baltic Sea Coast;**
  - Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **Main SubCoast product, maximum priority**
  - Describe the nature of the product, e.g.
    - **More complex output, please specify:** Map of areas of coastal erosion, transportation and accumulation

  - Name of the product: **Wind impact on Curonian Spit and Lithuanian coast area**
  - Brief description of the product: **Assessing of rate of geological processes and phenomena (dunes movement due to blowing out and drifting) across the Curonian Spit and Lithuanian Baltic Sea Coast**
  - Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **SubCoast product of average importance**
  - Describe the nature of the product, e.g.
    - **More complex output, please specify: Map of areas of wind erosion, transportation and accumulation**

- Name of the product: **Effects of ground water (oil) extraction**
- Brief description of the product: **Assessing of rate of subsidence (displacement velocities and time series) in the areas of wellfields, oilfields impact zones.**
- Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **SubCoast product of average importance**
- Describe the nature of the product, e.g.
    - **A categorical value (categorical variables take a value that is one of several possible categories; they have no numerical meaning)**

- Name of the product: **Impacts to infrastructure of the Klaipėda Seaport**
- Brief description of the product: **Assessing of rate of subsidence (displacement velocities and time series) in the *Klaipėda Seaport territory.***
- Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **Main SubCoast product, maximum priority**
- Describe the nature of the product, e.g.
    - **A categorical value (categorical variables take a value that is one of several possible categories; they have no numerical meaning)**

- Name of the product: **Flood risk in Palanga city and adjacent areas**
- Brief description of the product: **Mapping territories of flood risk in Palanga and surroundings.**
- Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **Main SubCoast product, maximum priority**
- Describe the nature of the product, e.g.
    - **Thematic maps**

- Name of the product: **Assessing (neo)tectonic movements in relation to local sea level rise**
- Brief description of the product:
- Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - **Auxiliary product, not a priority**
- Describe the nature of the product, e.g.
    - **Thematic maps**

7. Outputs: products and services - Planned validation activities

- **Seawater & wind impact on Curonian Spit and Lithuanian coast area:**
  - **It is a new experimental product. Validation of the product could be provided by comparison to standard Engineering geological map compiled in 1997-2000 at 1:50000 scale for the Baltic Sea Lithuanian coast including Curonian Spit.**

- **Effects of ground water (oil) extraction**:
  - **It is a standard product. Validation of the product (in case of ground water extraction) could be provided based to experience of standard H-2 product to Vilnius area.**

- **Impacts to infrastructure of the Klaipėda Seaport**:
  - **It is a new experimental product. Validation of the product could be provided by comparison to engineering geological map compiled in 2009 at 1:5000 scale of Klaipeda Sea Port southern part including harbour.**

- **Flood risk in Palanga city and adjacent areas**:
  - **It is a new experimental product. Validation of the product could be provided by comparison to geological mapping information and geodynamic monitoring data available for the period from 1993 to 2008.**

- **Assessing (neo)tectonic movements in relation to local sea level rise**:

It is a new experimental product. Validation of the product could be provided by comparison to available geological information (tectonic and neotectonic maps of coastal area at a scale 1:50 000, potential fields maps at a scale 1:50 000, available sea level rise information, etc.) and archaeological information of Klaipėda City

Baltic Pilot – ERS/ENVISAT PSI products

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    Standard PSI product
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    Database of measurements for a network of PS points, including average annual velocity measurement and time series estimates.
  - *Key characteristics of the product, e.g. covered surface, etc.*

    AOIs are described below.
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    Standard product, like H1
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

Standard FNPA PSI processing chain, using the Gamma IPTA software and processing algorithms.

- *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

  ERS and Envisat SAR data, ~1992-2000 and ~2003-2010 respectively. Exact data described below.

- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*

Lithuania Descending ERS PSI:

- *Name of data type*

  ERS SAR data

- *Amount of data required*

  67 archive images ordered (some of these may prove unsuitable during processing)

- *Scene/Frame numbers*

  Descending : Track 222, Frame 2483

SAR footprint denoted by red box, user's AOI in white.

- *Dates of data acquisition*

Date				
17/05/1992	09/08/1995	24/07/1996	31/12/1997	27/10/1999
17/01/1993	12/09/1995	02/10/1996	04/02/1998	01/12/1999
21/02/1993	13/09/1995	06/11/1996	15/04/1998	05/01/2000
28/03/1993	17/10/1995	11/12/1996	20/05/1998	15/03/2000
06/06/1993	18/10/1995	15/01/1997	24/06/1998	19/04/2000
15/08/1993	21/11/1995	19/02/1997	29/07/1998	24/05/2000
24/10/1993	27/12/1995	26/03/1997	07/10/1998	02/08/2000
28/11/1993	05/03/1996	30/04/1997	16/12/1998	06/09/2000

25/04/1995	06/03/1996	04/06/1997	31/03/1999	11/10/2000
30/05/1995	09/04/1996	09/07/1997	05/05/1999	15/11/2000
31/05/1995	14/05/1996	13/08/1997	09/06/1999	20/12/2000
04/07/1995	15/05/1996	17/09/1997	14/07/1999	
05/07/1995	18/06/1996	22/10/1997	18/08/1999	
08/08/1995	19/06/1996	26/11/1997	22/09/1999	

- *Source of data*

  ESA

Poland Descending ERS PSI:

- *Name of data type*

  ERS SAR data

- *Amount of data required*

  66 archive images ordered (some of these may prove unsuitable during processing)

- *Scene/Frame numbers*

  Descending : Track 36, Frame 2506

SAR footprint denoted by red box, user's AOI in white.

- *Dates of data acquisition*

Date				
04/05/1992	31/08/1995	02/01/1997	17/12/1997	23/12/1999
04/01/1993	04/10/1995	06/02/1997	18/12/1997	27/01/2000
08/02/1993	05/10/1995	12/03/1997	25/02/1998	06/04/2000
15/03/1993	08/11/1995	13/03/1997	26/02/1998	11/05/2000
24/05/1993	21/02/1996	17/04/1997	11/06/1998	15/06/2000
02/08/1993	27/03/1996	21/05/1997	16/07/1998	20/07/2000
11/10/1993	05/06/1996	22/05/1997	24/09/1998	24/08/2000
15/11/1993	06/06/1996	26/06/1997	03/12/1998	28/09/2000
12/04/1995	10/07/1996	30/07/1997	18/03/1999	02/11/2000

17/05/1995	19/09/1996	31/07/1997	22/04/1999	07/12/2000
21/06/1995	23/10/1996	04/09/1997	27/05/1999	
22/06/1995	24/10/1996	08/10/1997	05/08/1999	
27/07/1995	28/11/1996	09/10/1997	09/09/1999	
30/08/1995	01/01/1997	13/11/1997	14/10/1999	

- *Source of data*

  ESA

Poland Ascending ERS PSI:

Note – two possible PSI stacks, one exceedingly small and unlikely to produce reliable results, and one with partial coverage of the AOI over a low-priority area. FNPA intend to liase with user to establish usefulness of processing either of these stacks.

- *Name of data type*

  ERS SAR data

- *Amount of data required*

  20-29 images (see below)

- *Scene/Frame numbers*
  Track 43 – 29 images, covers SE spit but not Gdansk or NW spit (left)
  Track 100 – 20 images, covers most of AOI coastline (right)

SAR footprint denoted by red box, user's AOI in white.

- *Dates of data acquisition*

  TBC

- *Source of data*

  ESA

Lolland PSI:

AOI not yet received from user, so no data searches can be performed. Intention will be to process ascending and descending PSI stacks over their chosen AOI, however it is anticipated that data availability may again prove problematic.

DifSAR products

Proposal suggested processing ascending and descending PSI stacks for both ERS and Envisat, for each AOI. However initial data searches have identified a lack of suitable PSI stacks (>25 images) in Lithuania Poland, and it is expected this may also be the case for Lolland. DifSAR stacking could represent an alternative method to produce data for these areas and will be considered in consultation with users.

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    DifSAR interferograms, stacking
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    LOS deformation measurement for each coherent pixel spanning the interval between two SAR dates. Where possible, stacked product with reduced atmospheric contribution, providing an average motion rate estimate.
  - *Key characteristics of the product, e.g. covered surface, etc.*

    AOI discussed below.
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    Standard product.
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

    Standard FNPA DifSAR processing chain, using the Gamma differential interferometry software and processing algorithms.
  - *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

    ERS and Envisat SAR data, ~1992-2000 and ~2003-2010 respectively. Available data described below.
- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*

Lithuania DifSAR:
Proposal suggested processing ascending and descending PSI stacks for both ERS and Envisat, for each AOI. However initial data searches have identified a lack of suitable PSI stacks (>25 images) in this area. Smaller numbers of images potentially suitable for DifSAR stacking analysis were also noted:

Ascending ERS:
Track 14 18 images, most of coast covered
Track 43 16 images, most of coast covered
Track 286 14 images, most of coast covered

Descending ERS:
Track 451 59 images, all of coast covered
Ascending Envisat:
Track 14 14 images, most of coast covered
Descending Envisat:
None suitable

Dependant on results of ERS descending PSI, one or more of these stacks may be processed using DifSAR if this is considered likely to be successful.

Poland DifSAR:
As discussed above for Lithuania:

Ascending ERS:
Track 43 29 images, covers SE spit but not Gdansk or NW spit
Track 100 20 images, covers most of AOI coastline
Descending ERS:
Track 22 24 images, good coverage
Track 265 66 images, missing NW part of coast
Track 308 55 images, only covers far NW part of AOI
Ascending Envisat:
None suitable
Descending Envisat:
Tr36 19 images, good coverage, poor temporal distribution

Dependant on results of ERS descending PSI, one or more of these stacks may be processed using DifSAR if this is considered likely to be successful.

TerraSAR-X PSI

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    TerraSAR-X PSI
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    Database of measurements for a network of PS points, including average annual velocity measurement and time series estimates.
  - *Key characteristics of the product, e.g. covered surface, etc.*

    AOI not yet finalised
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    Standard product
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

    Standard FNPA PSI processing chain, using the Gamma IPTA software and processing algorithms.
  - *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

    ~33 TerraSAR-X images, to be acquired 2010-2011.
- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*
  - *Name of data type*

    TerraSAR-X images
  - *Amount of data required*

    ~33 images
  - *Scene/Frame numbers*

    TBC
  - *Dates of data acquisition*

    Acquisition every 11 days
  - *Source of data*

    DLR/Infoterra DE

DEM product

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    Digital elevation model
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    Elevation values
  - *Key characteristics of the product, e.g. covered surface, etc.*

    TBC
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    TBC
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

    Proposal states 1:10k topo maps ?
  - *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

    N/A
- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*
  - *Name of data type*

    1:10k topo maps?
  - *Amount of data required*

    ?
  - *Scene/Frame numbers*
  - N/A

  - *Dates of data acquisition*

    ?
  - *Source of data*

    ?

Coherence maps

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    Coherence maps
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    Map of coherence values corresponding to SAR image pairs.
  - *Key characteristics of the product, e.g. covered surface, etc.*

    SAR footprints defined by PSI/DifSAR acquisitions.
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    Standard product
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

    Standard FNPA DifSAR processing chain, using the Gamma differential interferometry software and processing algorithms.
  - *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

    ERS and Envisat SAR data, ~1992-2000 and ~2003-2010 respectively. All data used for PSI/DifSAR analysis.
- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*
  - *Name of data type*

    Coherence maps
  - *Amount of data required*

    All data used for PSI/DifSAR analysis.
  - *Scene/Frame numbers*

    TBC
  - *Dates of data acquisition*

    TBC
  - *Source of data*

    ESA

VHR difference maps

- *A concise description of the product (this is particularly important for the "new or advanced products"). Suggested points:*
  - *Name of the product*

    VHR difference maps
  - *What does the product contain, e.g. deformation, deformation velocities, deformation time series, digital elevation model, etc.*

    Difference maps
  - *Key characteristics of the product, e.g. covered surface, etc.*

    AOI TBC
  - *Is this a standard product (e.g. like the H-1 of Terrafirma) or a new, experimental product.*

    Standard
- *A concise description of the PSI (or other) procedure/method/chain used to derive the product. Suggested points:*
  - *Used procedure/method/chain*

    TBC
  - *Input SAR data (sensor type, type of product, approximate number of SAR images, approximate temporal coverage).*

    Quickbird
- *A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:*
  - *Name of data type*

    VHR difference maps
  - *Amount of data required*

    6 (2 per site)
  - *Scene/Frame numbers*

    TBC
  - *Dates of data acquisition*

    TBC
  - *Source of data*

    Quickbird

European Integration

1. Basic information about each Pilot

Please provide:

- Full name of the Pilot
    - ***European Integration***
- Key characteristics of the Pilot:

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, in these gaps 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.

Although European Integration has the ultimate goal of providing an indication of the subsidence situation across all EU coastlines it is first necessary to develop a methodology for all levels of data availability. Therefore the methodology will be developed at test sites, with each site chosen for its availability of subsidence data.

1. ***A pilot site – full data access, (probably the Netherlands)***
2. ***A Terrafirma site – PSInSAR data (probably London)***
3. ***A site with no PSInSAR data availability (possibly the Baltic coastline between pilots)***

- The total area to be covered by each Pilot, including bounding coordinates
    - ***Entire EU coastline***
- Mechanisms of ground motion thought to be present in the Pilot area
    - ***All***

- Person responsible for completing the information in this document for your Pilot.

Luke Bateson

- Contact details.

lbateson@bgs.ac.uk

8. Input data: PSI and SAR-derived products

A detailed assessment of SAR data required to produce the products that will be generated. This is important to ensure that common requirements across the entire SubCoast project can be identified:

- ***No new SAR data is required***
- ***Input PSI data from:***
  - ***SubCoast pilots (described elsewhere in this document),***
  - ***Terrafirma WAP (under development) and***
  - ***existing Terrafirma studies (relevant ones below).***

- ***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)***

9. Input data: PSI and SAR-derived products - Planned validation activities within the Pilot study

- ***We have no plans to validate the input SAR data. We are assuming that all SAR inputs to the European validation are already validated:***
  - ***Terrafirma data – from a certified OSP, TF validation exercise***
  - ***TF WAP data – quality controlled and validated during the creation of the processing chain.***
  - ***PSI data from SubCoast pilots – validated in pilot, outline methodology available elsewhere in this document.***

4. Input data: other data

One Geology-Europe

- A description of the input data type:
  - Name of the product
    - ***One Geology Europe***
  - Data source (e.g. Official Cartographic Institution, etc.)
    - ***Official Geological Surveys around Europe***
    - http://www.onegeology-europe.org/portal
  - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)

- ***Geological map data at 1:1m scale.***
- ***Data are on Lithology and age***

- Key characteristics of the product, e.g. covered surface, etc.
  - ***GSML and/or ESRI shapefiles***
  - ***European Coverage for OneGeology-Europe (21 Geological Surveys)***
- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
  - ***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 lithologyA description of the quality and reliability of the data:***
- Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
  - ***Data is believed to be of good quality, however it does lack detail.***
  - ***No superficial geological data are included.***
  - ***These are standard cartographic products produced by national geological surveys so should be treated as good geological data***
- What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.
  - ***Difficult to assess accuracy without knowing the geology of the area. The main limitation is the small scale of the data. However these data are available for at no cost.***

MyOceans Sea level data

- ***http://www.myocean.eu.org/products-services/obtain-products.html***

- A description of the input data type:
  - Name of the product
    - ***MyOceans Sea level data - Sea surface height above sea level in meters***
  - Data source (e.g. Official Cartographic Institution, etc.)
    - ***MyOcean is a European project dedicated to operational oceanography. MyOcean Service provides the best set of information available 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)***
    - ***DUACS (Data Unification and Altimeter Combination System) is part of the CNES multi-mission ground segment (SSALTO)and provide the data to MyOcean***
    - ***Duacs gridded products are available free of charge for scientific studies or non-profit projects only.***
  - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
    - ***Data on seal levels and sea level anomalies from altimeters***

- ***all 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.***
- ***Real Time observations for operational use***
- ***Delayed time observations as a database – it is these that will be used in the European Integration.***

- Key characteristics of the product, e.g. covered surface, etc.
  - ***Sea surface height above sea level in meters***
  - ***Global coverage***
  - ***7km spatial resolution***
  - ***25/9/1992 to ongoing temporal coverage***
  - ***Updated biannually***
  - ***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.***

- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
  - ***Standard product produced by SSALTO/DUACS***
  - ***Procedure for creation outlined here:*** ***http://www.aviso.oceanobs.com/fileadmin/documents/data/tools/hdbk_duacs.pdf***

- A description of the quality and reliability of the data:
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***The Input Data Quality Control is a critical process applied to guarantee that DUACS uses only the most accurate altimeter data. Thanks 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.***
  - ***To ensure a production of homogeneous products in a high quality data with a short delay, are the key features of the Duacs processing system. But 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/***
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.
    - ***Main limitation is the 7km resolution but this is sufficient for the European integration***

Urban Atlas landcover data

- ***http://www.eea.europa.eu/data-and-maps/data/urban-atlas***

- A description of the input data type:
  - Name of the product
    - ***Urban Atlas***
  - Data source (e.g. Official Cartographic Institution, etc.)
    - ***Part of the GMES core land service***
    - ***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 production is based on a mix of CAPI (Photo-interpretation) and object oriented classification***
  - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)

- ***GIS vector data on the following:***

Artificial surfaces
Urban fabric
Continuous Urban fabric (S.L. > 80%)
Discontinuous urban fabric (S.L. 10% - 80%)
Discontinuous Dense Urban Fabric (S.L.:50% - 80%)
Discontinuous Medium Density Urban Fabric (S.L.: 30% - 50%)
Discontinuous Low Density Urban Fabric (S.L.: 10% - 30%)
Isolated Structures
Industrial, commercial, public, military, private and transport units
Industrial, commercial, public, military and private units
Road and rail network and associated land

Fast transit roads and associated land
Other roads and associated land
Railways and associated land
Port areas
Airports
Mine, dump and construction sites
Mineral extraction and dump sites
Construction sites
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***
Artificial non-agricultural vegetated areas
Green urban areas
Sports and leisure facilities
Agricultural - + Semi-natural areas + Wetlands 1 ha MMU
Forests 1 ha MMU
Water bodies 1 ha MMU

  - Key characteristics of the product, e.g. covered surface, etc.
    - ***ESRI shapefiles***
    - ***ETRS 1989 projection***
    - ***Based on 2005 – 2007 imagery***
    - ***1:10 000 scale, minimum mapping unit of 0.25Ha***
    - ***140 cities completed by April 2010***
    - ***All European cities by 2011***
  - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
    - ***Standard GMES product***
- A description of the quality and reliability of the data:
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***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***
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

Elevation data - SRTM

- A description of the input data type:
  - Name of the product
    - ***SRTM***
  - Data source (e.g. Official Cartographic Institution, etc.)

        - ***The data can be downloaded from the Global Landcover Facility portal at http://glcf.umiacs.umd.edu/data/srtm/.***
        - ***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.***
    - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
        - ***InSAR derived height data***
    - Key characteristics of the product, e.g. covered surface, etc.
        - ***90m resolution grid dataset of height values***
        - ***16m z accuracy***
        - ***60 degrees north to 60 degrees south coverage***
    - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
        - ***Standard established product***
- A description of the quality and reliability of the data:
    - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
        - ***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).***
    - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

Coasts and seas - Corline landcover 2000 coastline

- A description of the input data type:
    - Name of the product
        - ***European Environment Agency Coasts and Seas datasets***
            - ***Corline landcover 2000 coastline***
    - Data source (e.g. Official Cartographic Institution, etc.)
        - ***Corine landcover 2000 coastline***
        - ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***
    - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
        - ***Complete coastline features, with detailed descriptions on the environment and type of coastal areas***
    - Key characteristics of the product, e.g. covered surface, etc.

- ***Vector data***
- ***for all the European countries that produced Corine land cover 2000 and have a coastline (EU15, EU25, EU27, Albania, Bosnia and Herzegovina, Croatia)***
- ***Published 2/3/2006***
- ***1:100 000 scale***
- ***For non commercial use only***

- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
  - ***Standard product***

- A description of the quality and reliability of the data:
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***The shape of this European coastline is based on the Corine land cover 2000 features. The intersection between Corine land cover sea and oceanclass and any other class was selected as the initial coastline. Then the classes estuaries and intertidal flatswere added to the marine environment if they were connected to the sea, having a direct connection to the sea, or through other estuaries or ;intertidal flats. This is the shape of the coastline that has inherited the Corine land cover class attribute as well. The attributes from Eurosion coastline were added. Through a simple allocation process from the Eurosion coastline segments, and a identity procedure afterwards, the coastline was split in more segments, each of those inheriting the correspondent eurosion segment code.***
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

Coasts and seas - Sediment discharges

- A description of the input data type:
  - Name of the product
    - ***European Environment Agency Coasts and Seas datasets***
      - ***Sediment discharges***
  - Data source (e.g. Official Cartographic Institution, etc.)
    - ***http://www.eurosion.org/***
    - ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***
    - ***EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004***
  - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
    - **Sediment discharges, vector data (polygon) and point data**
  - Key characteristics of the product, e.g. covered surface, etc.
    - ***Vector data***

        - ***Published 6/9/2005***
        - ***EU15, Bosnia and Herzegovina, Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Liechtenstein, Lithuania, Malta, Norway, Poland, Romania, Slovakia***
    - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
        - ***Standard product***
- A description of the quality and reliability of the data:
    - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

Coasts and seas - Shoreline

- A description of the input data type:
    - Name of the product
        - ***European Environment Agency Coasts and Seas datasets***
            - ***Shoreline***
    - Data source (e.g. Official Cartographic Institution, etc.)
        - ***http://www.eurosion.org***
        - ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***
        - ***EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004***
    - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
        - ***The EUROSION shoreline is a seamless representation of the limit between land and sea.***
        - ***GIS data - vector***
    - Key characteristics of the product, e.g. covered surface, etc.
        - ***1: 100 000***
        - ***Published 29/3/2005***
        - ***EU15, Bulgaria, Cyprus, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovenia, Turkey***
    - Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
        - ***Standard product***
- A description of the quality and reliability of the data:

- Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004. 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 to connect EU territories (e.g. Slovenia with Greece, Greece and Black Sea region) and complete ultraperipheral regions. - 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 being improved locally as part of the process to produce the layer Geomorphology and geology - (see corresponding section). Improvements are based upon large scale maps (in general 1:50,000).***
- What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.
    - ***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. We strongly recommend that the accuracy of EUROSION shoreline is also assessed using IMAGE 2000 data when available.***

Coasts and seas- Geomorphology, geology and erosion trends and coastal defence works

- A description of the input data type:
    - Name of the product
        - ***European Environment Agency Coasts and Seas datasets***
            - ***Geomorphology, geology and erosion trends and coastal defence works***
    - Data source (e.g. Official Cartographic Institution, etc.)
        - ***http://www.eurosion.org***
        - ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***
        - ***EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004***
    - What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
        - ***GIS data***
        - ***The layer features both morpho-sedimentological and geological patterns of the European coastline at scale 1:100,000 and in vector format. The data consist in a segmentation of the EUROSION shoreline. Both a geomorphological and a***

geological code is assigned to each segment. 20 different geomorphological types (and thus codes) and 13 geological types have been defined.

- Key characteristics of the product, e.g. covered surface, etc.
  - ***1:100 000scale***
  - ***Vector format***
  - ***Published 22/2/2005***
  - ***Geographical coverage note: Romania, Bulgaria, Cyprus, and ultra-peripheral regions are only covered 20%. Also, only EU25 countries with coast are included in the data set.***
- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
  - ***Standard product from Eurosion***

- A description of the quality and reliability of the data:
  - Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***Source data have 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. Spatial adjustment method used was "rubbersheet".***
  - What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

Coasts and seas –Hydrodynamics and sea level rise

- ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***

- A description of the input data type:
  - Name of the product
    - ***European Environment Agency Coasts and Seas datasets***
      - ***Hydrodynamics and sea level rise***
  - Data source (e.g. Official Cartographic Institution, etc.)
    - ***EUROSION was a project commissioned by the General Directorate Environment of the European Commission 2002-2004.***
    - ***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) images collected by ERS-1 and***

ERS-2 using an algorithm developed by ARGOSS [Mastenbroek and de Valk, 2000]. Production of statistical estimate 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 (see screenshot above). As a consequence, data are provided with a 100km resolution along the European coast.

- ***Data on tidal range at the 237 locations are extrapolated from the database tidal-info.com 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.***
- ***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.***

- What does the product contain (e.g. raw GPS data, processed GPS data, etc.)
  - ***GIS data and tables***
- Key characteristics of the product, e.g. covered surface, etc.
  - ***Sea Level.***
    - ***Predicted relative sea level rise at the location centres in mm/Year***
  - ***Tidal Mean Amplitude***
    - ***At the location centres. It is defined as the square root of the sum of squared amplitudes of the harmonics. The tidal range is as expected largest in the North Sea and the Atlantic Ocean and almost vanishing in the Baltic Sea and Mediterranean. The unit is in meters.***
  - ***Hydrodynamics***
    - ***Direction. Centre of Directional sector***
    - ***Wave Height Significant Average. Mean significant wave height while wave direction is in the given sector (see dir) in meters***
    - ***Wave Height Significant Ten. Significant wave height exceeded during 10% of the time that wave direction is in the given sector in meters***
    - ***Wind Speed Average. Mean wind speed in m/s***
  - ***GIS point dataset***
  - ***Information for 237 locations along European coastline***
  - ***Published 25/2/2005***
- Is this a standard product (e.g. coming from a standard geodetic procedure) or a new, experimental product?
  - ***Standard product from Eurosion***

- A description of the quality and reliability of the data:

- Reasons to consider the data of good quality (e.g. they are a standard cartographic product at a given scale, whose specifications are known). Or, conversely, reasons to consider them of average, poor, etc.
    - ***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%.***
- What are the product specifications? If they are not available, are you able to characterize the data, assessing their quality (precision, accuracy and main limitations), etc.

5. Type of analyses

The different types of analyses to be run in the SubCoast project play a key functional role, i.e. transforming the multi-source, multi-scale and multi-quality input data (including PSI products) into the products and services that are needed by the SubCoast end-users.

Given their importance, it is of paramount importance to provide a clear description of these analyses. For each analysis to be run in the Pilot, please address the following issues:

- A brief description of the analysis:
    - Name of the analysis
        - ***Data Integration***
    - Comprehensive list of input data
        1. ***PSI data from Terrafirma, Terrafirma WAP, Pilot studies***
        2. ***One Geology/ One Geology Europe***
        3. ***MyOceans Sea level data***
            - ***http://www.myocean.eu.org/products-services/obtain-products.html***
        4. ***Urban Atlas landcover data***
            - ***http://www.eea.europa.eu/data-and-maps/data/urban-atlas***
        5. ***Elevation data***
            - ***SRTM***
        6. ***Coasts and seas***
            - ***http://www.eea.europa.eu/data-and-maps/data#c5=all&c11=coast_sea&c17=&c0=20&b_start=0***
            - ***Elevation breakdown***
            - ***Corline landcover 2000 coastline***
            - ***Sediment discharges***
            - ***Shoreline***
            - ***Hydrodynamics and sea level rise***
            - ***Geomorphology, geology and erosion trends and coastal defence works***
    - What is (are) its main outcome(s)?
        - ***A 1km gridded dataset with values relating to:***
            1. ***Subsidence risk***
            2. ***Effect on Sea Level Rise (i.e. relative SLR)***
            3. ***Impact of subsidence and flooding***
            4. ***Certainty Score***

- Describe the type of analysis (note that the type of analysis is impacting the possible validation procedures – see next section), e.g.
  - ***For areas where Terrafirma data are available they will be used to give an average subsidence value for the 1km cell.***
  - ***Where no Terrafirma data are available all other available data will be used to derive a subsidence score. This is likely to be based on an interpretation of the geology. This interpretation will be manually developed at various test sites with the goal of automating the classification process.***

6. Outputs: products and services and user needs

In this section we address the products and services generated by the different analyses, and which are needed by the SubCoast end-users. For each product/service please address the following issues:

- Provide a brief description of the products/services (see list at the end of this section):
  - Name of the product
    - ***European Integration; a methodology to provide an indication of the subsidence situation across all EU coastlines***
  - Relative importance of this product in the context of SubCoast (this is important to give priority to the validation activities), e.g.
    - ***Main SubCoast product, maximum priority***
  - Brief description of the product

This will be a new experimental product, in part derived from PSInSAR data but also derived via interpretation of other data sources (most notably geological data).

In the absence of PSInSAR subsidence data a subsidence risk will be interpreted from geological data. Knowledge has been gained through various PSInSAR 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.

Subsidence data will be integrated with other pan-European datasets, to derive a gridded dataset. Grid values will be derived from the input datasets and will relate to:

- ***Subsidence risk***
- ***Effect on Sea Level Rise (i.e. relative SLR)***
- ***Impact of subsidence and flooding***
- ***Certainty Score***

The grid size will be 1km2 and metadata will indicate how the grid values were derived. This product eventually aims to cover all coastal lowland areas around Europe. For the purpose of the product we define a coastal lowland area as continuous areas from the coastline at an elevation of less than 10m.

- Describe the nature of the product, e.g.
  - ***A 2D, 3D raster of categorical values***

European Integration products/services:

- ***Subsidence forecast,***
- ***Flood risk***
- ***Flood impact***
- ***Relative sea-level rise***

7. Outputs: products and services - Planned validation activities

Ideally all new or advanced products and services of SubCoast have to be properly validated. The objective of the validation is providing the end users with re-assurance on the quality, consistency and wider applicability of the above products/services. The whole validation activity will be only defined when all the components of the chain are well understood.

In order to plan the validation activities is important to address the following points. Note that this should be done for each product/service:

- Aspects related to quality and reliability of the product:
  - Is the product a "standard product" (well characterized, of known quality, etc.) or is a new experimental product?
    - ***This is not a standard product. In some cases, where Terrafirma data exists it will be a product derived from a H1 product. However the derivation of the subsidence risk scores is not currently a standard procedure.***
  - In case of a "standard product", do you know (or foresee to know) the specifications of each product? If possible, provide them.
  - In the second case, what is the procedure that you foresee to validate the product, or to characterize its quality (precision, accuracy, main limitations)?
    - ***Validation will be accomplished in a variety of manners. The products will be developed in test sites for which we have different levels of data. We need to develop a mechanism for obtaining a subsidence value for areas where no PSI data exist, this is via geological interpretation. This can be developed for an area where Terrafirma results exist, although the Terrafirma results will not be used to derive the subsidence value, they will be used to validate the interpretated subsidence value.***