



The European Sea Level Service (ESEAS): Potential Contributions to GMES

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The *European Sea Level Service* (ESEAS, see <http://eseas.org>) started its work in June 2001 and has the major objective to provide sea-level and sea-level related information for the European waters to scientific and non-scientific users both from inside and outside Europe. The ESEAS aims to achieve this goal in cooperation with other relevant organisations such as the *Permanent Service for Mean Sea Level* (PSMSL), EuroGOOS, GLOSS, EUREF and *International GPS Service* (IGS). The ESEAS strives to guarantee and co-ordinate the long-term monitoring activities and data exchange along the entire European coastline. This includes, among others, tasks like setting up standards for observations and data processing, quality control of the large European database of hourly sea level data, upgrading of the ESEAS Observing Sites, collocation of tide gauges with CGPS, and provision of derived products such as secular trends and estimates of extremes.

The ESEAS is based on three networks: (1) The *physical network* of Observing Sites including National Centres is largely existing. However, cooperation between different authorities was on a low level and is strongly promoted through the ESEAS. (2) The *institutional network* of the ESEAS is based on voluntary commitments of national authorities, who have to provide the necessary funds both for running the physical network and setting up the application network. The institutional network is represented through the Governing Board, the Central Bureau and the Technical Committee. (3) The *application network* uses the data from the physical network to produce products relevant for users of the ESEAS. The link between the application network and the users is primarily through the ESEAS web side.

In Europe, the physical network for observing sea level at coastal sites is well developed in most geographical regions. However, in some crucial parts (particularly Arctic Sea, the Eastern Baltic Sea, the Mediterranean, and the Black Sea), the network needs upgrading of the gauges to modern standards. Augmentation of the observing sites with equipment to monitor the stability of the tide gauge and vertical land movement is another urgent issue. Currently, access to more than 50 individual sea-level databases in European countries is still severely hampered due to national diversity in operation, uneven technological developments, non-standardised products, and different levels of quality assurance. The ESEAS is in the process of building up one integrated virtual sea-level information source. Eventually, this source will provide a standardised access to most of the sea-level data and information available in Europe, through both national sea-level databases and quality-assured high-level products derived from the ESEAS tide gauges, GPS and satellite altimetry.

The EU-funded *ESEAS - Research Infrastructure* project (ESEAS-RI, see <http://eseas.org/eseas-ri>) started on 1 November 2002 with participation of 25 institutions from 17 countries. The project runs over three years and provides substantial resources for improving the observational network as well as the tools for exploitation of the data. In particular, Work Package (WP) 1 (Quality Control of Sea Level Observations) will make available a quality-controlled data set of hourly tide gauge data from most ESEAS Observing sites. WP2 (Absolute sea level variations) concentrates on the determination of vertical land motion at the ESEAS Observing Sites. WP3 (Decadal to inter-decadal sea level variations) will produce as main result an empirical model of the sea level variations in the European Seas for the last hundred years. Finally, in the frame of WP4 (Improving the sea level observing system), a number of ESEAS Observing Sites are being upgraded and/or augmented with CGPS.

The primary technological objective of the ESEAS-RI project is to support the ESEAS research infrastructure as a major research infrastructure for all aspects related to sea-level, and to facilitate the transnational coordination, the upgrading of the network of observing sites and the standardisation of the network, operational routines, databases, and quality-control as a prerequisite for a full scientific exploitation of the present and future sea level observations. The primary scientific objective of the project is to study sea level variations at inter-annual to century time scales and to quantify potential future changes in mean sea level. In order to reach the objectives, the following main steps are

necessary:

- (1) quality control of the hourly tide gauge data accessible through the ESEAS;
- (2) determination of vertical land movements at tide gauges in order to decontaminate the relative sea level records for this bias;
- (3) determination of sea level variations on inter-decadal time scales in the North Atlantic and the semi-enclosed European seas as well as assessment of secular relative sea level trends for the European coasts;
- (4) improvement of the network of ESEAS Observing Sites through upgrading of selected tide gauges and co-location of gauges with continuous GPS.

The availability of a quality-controlled database of hourly tide gauge data, and the successful upgrading of the ESEAS network as well as a major improvement of the research infrastructure comprised in the ESEAS are major milestones. The research carried out in the project will result in an empirical model of sea level variations, which provides a unique basis for future studies of climate processes at decadal to inter-decadal time scales, particularly the North Atlantic Oscillation, as well as a coherent description of the occurrence of extreme sea levels.

The project embedded into the ESEAS is stimulating the integration of European sea level research community into a larger network and thus promotes coordinated research. The ESEAS directly contributes to environmental assessment reports, and also gives information with respect to obstacles for the exploitation of existing multi-national databases in terms of e.g. technical, data quality and policy, legal and organisational issues.

In terms of potential contributions of the ESEAS to the *Global Monitoring for Environment and Security* (GMES) programme, it has to be pointed out that the ESEAS is a non-governmental organisation representing the European "Sea Level Domain". As such, the ESEAS is the partner for addressing sea level related topics in the frame of GMES. In the operational phase, ESEAS could contribute with several aspects, namely:

- Operational contribution to GMES with extreme sea level forecasting. This application requires real time or near-real time sea-level data in relevant areas.
- Assessment of risks with respect to long-term sea level changes. Here we point out that security has not only a near-real time component but also long-term, precautionary aspects. A question to be answered is whether the present sea level observing system has sufficient monitoring capacity for this application.
- Global monitoring. The ESEAS is the European implementation of GLOSS and as such contributes to GOOS.
- Capacity building. The ESEAS is actively involved in support for sea level monitoring outside of Europe, particularly in the frame of GLOSS.

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