



HiSEA DELIVERABLE 6.4

HiSEA AUDITING PROCEDURES MANUAL

WORK PACKAGE NUMBER: 6

**WORK PACKAGE TITLE: SERVICE OPERABILITY, VALIDATION, AND
DEMONSTRATION**



HiSea Project Information

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Deliverable title	Report on service test and validation
Description	<p>The maintenance of a complex service chain such as the one that is offered by HiSea platform requires the maintenance of periodic audits to the system in order to early detect possible problems and adopt the required corrective and preventive.</p> <p>The objective of this deliverable is to describe a set of auditing procedures adopted in HiSea to guarantee the service quality.</p>
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1 Executive Summary

The maintenance of a complex service chain such as the one that HiSea proposes requires the definition and maintenance of periodic audits to the system to adopt the required corrective and preventive measures that arrive after the analysis of the failures or inefficiency records.

The objective of this deliverable is to define appropriate auditing procedures aiming to keep a continuous verification of the service quality. These auditing procedures will take into consideration specific requirements to improve the quality of the services following three steps: 1) procedures; 2) indicators for each procedure and; 3) quantification of each indicator.





2 Introduction

HiSea platform aims to provide a set of tools and services to deliver customized and ready to use information focused on different coastal user's needs, and particularly on the targeted port and aquaculture sectors. The platform gathers data from various sources, enabling the exploitation of the added value of integrated Earth Observation (EO) technologies, Copernicus Marine Service, and ICT. Local high-resolution forecasts (e.g. meteo-oceanographic conditions at specific locations), as well as an early warning system and key performance indicators.

Because of the large number of data sources and parameters managed by HiSea services, it is necessary to keep a continuous auditing procedure to identify the processes that are failing, assess the respective causes, and adopt the required corrective or preventive measures. This document summarizes some of the standard procedures adopted in HiSea services to assure a continuous improvement of the service quality and guarantee the required levels of accuracy and service reliability.





3 Audit requirements

The audit report aims to verify the quality of provided services in meteo-oceanographic activities via an operational platform. An audit report is done under specific requirements to improve the quality of the services.

The requirements evaluated are done in three steps: 1) procedures; 2) indicators for each procedure and 3) quantification of each indicator.

Step1 - Procedures

The procedures audited are:

- Information Technology (IT) services - to guarantee the operability of daily tasks. It is important to ensure that automatic actions in HiSea operating platform are regularly performed and that the availability of data sources is permanent.
- Services accuracy – to provide a quantitative estimate of the expected quality of the provided services (forecasts, data analytics, etc.). The quality of the forecasts is performed by comparing the model results with data recorded at monitoring stations based on the calculation of statistical indicators.

Step 2 - Indicators

The proposed indicators to be evaluated are:

IT Services	Server accessibility *
	Data sources (remote sensing and locally acquired data, real time data, and model forecasts)
	Client Interface
	Alerts and reports

** In the case of server accessibility the service-level agreement (SLA) of 99.9% must be fulfilled*

Forecasting accuracy	Correlation coefficient (R)
	Root Mean Square Error (RMSE)
	Normalised Root Mean Square Error (NRMSE)

Step 3 - Quantification





The quantification of such indicators shall cover at least 6 months to guarantee that statistical metrics are representative. The quantification of indicators must be made by the following methodology for the days defined to audit.

IT Services	Server accessibility	A query is runned in order to ask to databases the data flow periods of each data source scheduled on platform. Downtimes server larger than 1 hour are crossed with data flow periods
	Data sources (real time data and model forecasts)	Quantified evaluating the successful/unsuccessful tasks scheduled in the platform for the total days audited $Data\ Source = \frac{N^{\circ}\ days\ sucessful}{Total\ days\ audited} \times 100$ <p>All data sources configured on the platform are checked every day, ensuring the availability of the information. These sources include all the information available in HiSea: operational models that run daily on external models (for example, model WWIII of NOAA) and data from monitoring stations (weather stations, wave buoys, tide gauges). In current operating systems, the level of execution efficiency of internal models is above 90% and the availability of external models and data from monitoring stations is dependent on the source (however, whenever data is available, it is inserted into the platform operational).</p>
	AquaSafe Interface Client	It is assumed that the number of days calculated for the server accessibility is the same that interface client is unavailable. The services currently implemented have values that vary between 99.9% and 100% of server operability.
	Alert reports disseminations via email	This is quantified evaluating the number of reports sent via email for the total days audited. Note that the number of reports must be concordant with the type of report (e.g., daily, weekly, monthly) $Reports = \frac{N^{\circ}\ Reports\ per\ day/week/month}{Total\ days\ audited} \times 100$

Forecasting	Correlation coefficient	$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}}$
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	RMSE	$RMSE = \sqrt{\frac{\sum_1^n (p_i - a_i)^2}{n}}$
	NRMSE	$NRMSE = \frac{RMSE}{4 * STDEV}$





4 Practical application

The audits are performed regularly covering a minimum period of 6 months (semi-annual or annual audits) and evaluating the levels of accessibility and functionality of the system, the level of efficiency of the availability of all data sources, the quality of forecasts and the level of success sending reports automatically sent. In detail, the audit evaluates the main requirements and procedures listed below:

- **Server Accessibility:** The system is located on an external server, which certifies and guarantees hardware operability. Internally, a continuous and constant control and maintenance of hardware accessibility is carried out by the HiSea IT team. If any disturbance in the hardware is detected, an assessment is made of the impacts caused on the system provided by the IT team communicates with the entity responsible for the hardware (by email or phone). Over the past few years, these situations are very punctual, the problem is immediately detected and resolved in the shortest possible period, on a minute / hour scale.

These quick interventions allow to reduce the impact on the end user and, ideally, that the disturbances have no effect on the end user. If the disturbance in the hardware causes any impact on the service, the end users are informed via email and are also informed after the problem is resolved. Subsequently, the identified disturbances are also mentioned in the corresponding audit report.

It is essential to guarantee this continuous control of the hardware to guarantee the correct functioning of the system, responding appropriately to service requests. Audits perform an evaluation of the accessibility and functionality of the system during the audited period, identifying, if any, hardware disturbances.

- **Data sources:** Identify all executions/failures associated with the type of information available in the system. Every day a check of the success / failure of all the data sources configured in the system is made, taking actions in the case of failure. In audits, a summary is made of the assessment of the level of execution efficiency of each data source during the audited period.

The data sources can be divided into internal models (predictions of the models that run on the HiSea forecast services), external models (download of models from other providers) and data recorded by monitoring stations (buoys, tide gauges, weather stations, etc).

The internal models are checked daily, ensuring the supply and the daily update of the forecast. The first failure can occur due to an instability that normally recovers in the next run. For this reason and due to the forecast horizon (minimum of 3-4 days), only on the second consecutive failure of the model is an action taken to analyse the problem, ensuring that the model is successfully completed in its next execution.





External models and measured data from monitoring stations depend on the availability of the data at the source of origin and the communication on data transfer. To optimize the process, several download attempts are made, covering the situations of delay in making files available and problems with file transfer. Currently, failures to download of these types of data sources occur because the data is not available during hours of attempted download or because the original file structure has been altered by the source. That is, the failures of these sources in the system correspond to failures of the external model / measured data. If the external data source has a consecutive failure greater than 2 days, an email is sent to the data provider asking for clarification as to whether the data is unavailable.

- **HiSea Interfaces:** Identify inconsistencies associated with the graphical representation of information and functionality of the tools in HiSea software.
- **Reports:** Evaluate the automatic reports supplied to the client. This includes the revision of the daily execution report, sea level predictions report, and weekly newsletter. The HiSea maintenance team reviews each of these reports, ensuring that the reports are sent complete and with updated information.
- **Alerts:** Alerts Service is a feature still under development. An entity Alert is a stored configuration used to generate Alerts. This configuration enables to define: alert levels (varying according to the intensity level), a specific location or region, a time series or a set of time series and a certain Alert Type, being the latter a property which defines the internal procedures to generate the consequent Alerts).

Despite early implementations where Alert Reports are generated only with a client-side request, it is under assessment an implementation of this feature to send alert notifications once they are generated by the service. At the same time an alert is sent to a client, it is also stored on a database for further audit. The validation of the alerts will be presented in the regular audits to the system, through the comparison with measured data, whenever available.





4.1 Procedures and providers

The requirements and procedures identified for the auditory of the software implemented in the aim of HiSea are presented in Table 1. The providers and type of procedure are also indicated.

Requirements	Procedures	Procedures Type*	Providers
Hardware Accessibility	Hardware Accessibility	External	HiSea
Sources of Information	HiSea Databases Accessibility	External	HiSea
	Models Executions	Internal	Hidromod
	NOAA/GFS Available files	External	NOAA
	NOAA/GFS Download request	Internal	Hidromod
AQUASAFE Interfaces	HiSea Databases Download request	Internal	Hidromod
	Client Interface	Internal	Hidromod
OSS Interface			
Reports	Daily Execution Report	Internal	Hidromod
	Sea Level Predictions Report		
	Weekly Newsletter		

4.2 Example of an audit evaluation

A typical evaluation of an audit is summarized in the following Table.

Register	Procedure	Number of Days	Successful Days	Failure Days	% Failures	% Successes
1	Servers Accessibility	90	88	2	2.2	97.8
2	HiSea Database Accessibility*	90	88	2	2.2	97.8
3	MOHID Executions	90	84	6	6.7	93.3
4	NOAA/GFS Available Files	90	86	4	4.4	95.6
5	NOAA/GFS Download	90	90	0	0	100.0
6	Databases Download	90	90	0	0	100.0
7	Client Interface	90	90	0	0	100.0
9	Daily Execution and Sea Level Predictions Report	90	88	2	2.2	97.8



