MONITORING AND DECISION SUPPORT SYSTEMS FOR IMPACT MINIMIZATION OF DESALINATION PLANT OUTFALL IN MARINE ECOSYSTEMS

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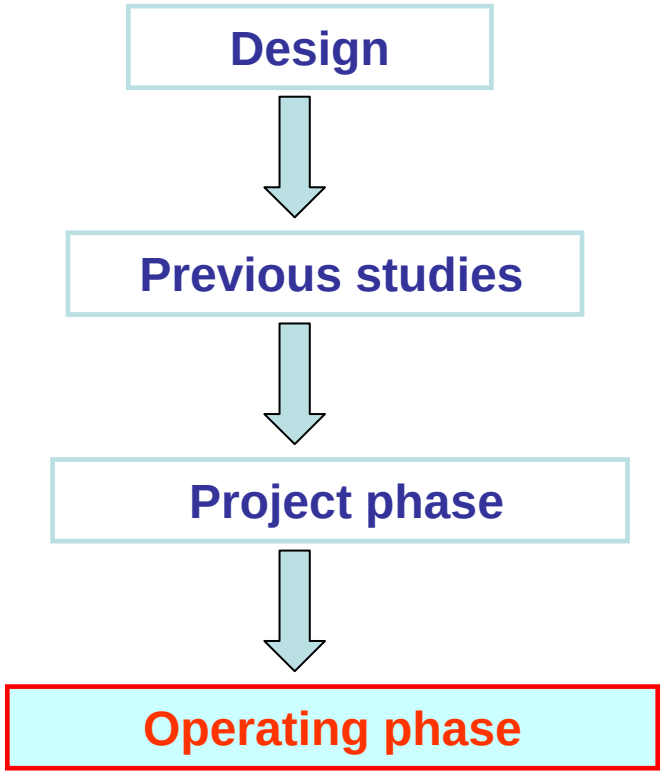
Index of the presentation

INTRODUCTION

- **ASDECO: Automated System for DEsalination Dilution COntrol.**
- **Subsidize within the Nation Program for Environmental Science and Technology of the National R&D Plan 2004-2007 (BOE num. 41, 16th of February 2007)**
- **It is coordinated by the Ministry of the Environment and Rural and Marine Affairs of Spain**
  - **Applicant: TECNOMA S.A.**
  - **Collaborator: SIDMAR**
- **Period: August 2007 – December 2009**
- **ASDECO is a research project for controlling desalination discharges in the marine environment.**

INTRODUCTION

DESALINATION PLANT



INTRODUCTION

- Development of the desalination industry in Mediterranean countries to alleviate water shortages. ⟶ Provide water for urban and agricultural uses
- Main problems: high energy consumption and brine discharge

Brine discharge into the sea

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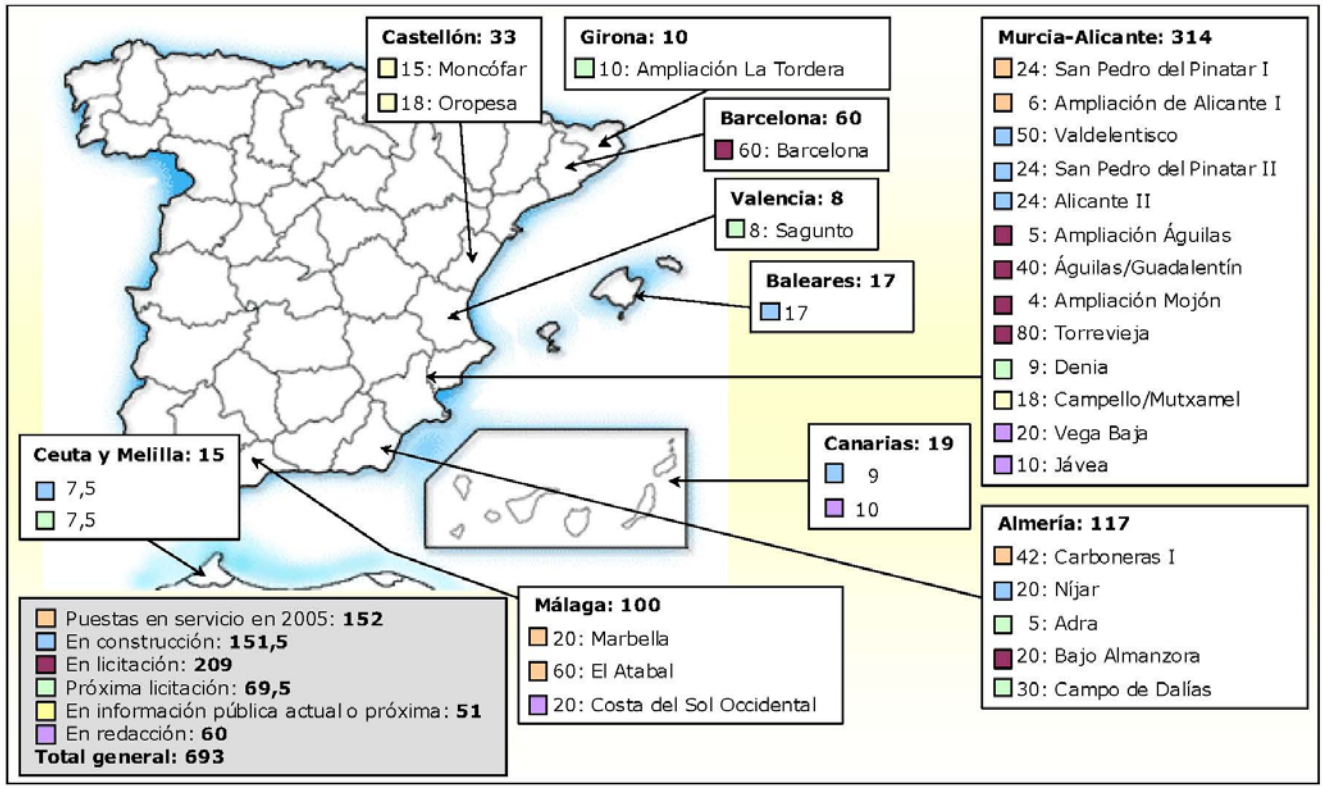
Hypersaline bottom layer

↓

Benthic communities



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Automated System for Desalination Dilution Control
Sistema Automático para el Control del Vertido de Desaladoras

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INTRODUCTION

DILUTION = One of the key process

If it is carried out properly, the marine environment will absorb the outfall

⇩

Marine ecosystems will not be affected

Factors that influence how brine is diluted into the sea

- **Hydrodynamics**
- **Seasonality**
- **Brine discharge**

How to carry out the brine discharge trough a proper dilution in order to minimize the potential negative effects on the marine environment??

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OBJECTIVES

Create a prototype that adapts and improves the operation control and adaptation of desalination plant discharges in the marine environment.

OPERATION CONTROL

- Supervise the correct operation of the plant and the brine discharge
- Compliance with the Environmental Impact Assessment and outfall authorization
- Have a real-time monitoring system that enables awareness of the behavior of the brine discharge.

ADAPTATION

Adapt the brine discharge management to the conditions of the receiving environment

→ MINIMIZING IMPACT

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OBJECTIVES

The main purpose of ASDECO is to offer this adaptation in the ordinary management of the desalination plant outfall.

Ocean-meteorological data in real time

Predict the behavior of hypersaline plume

Adaptative Management

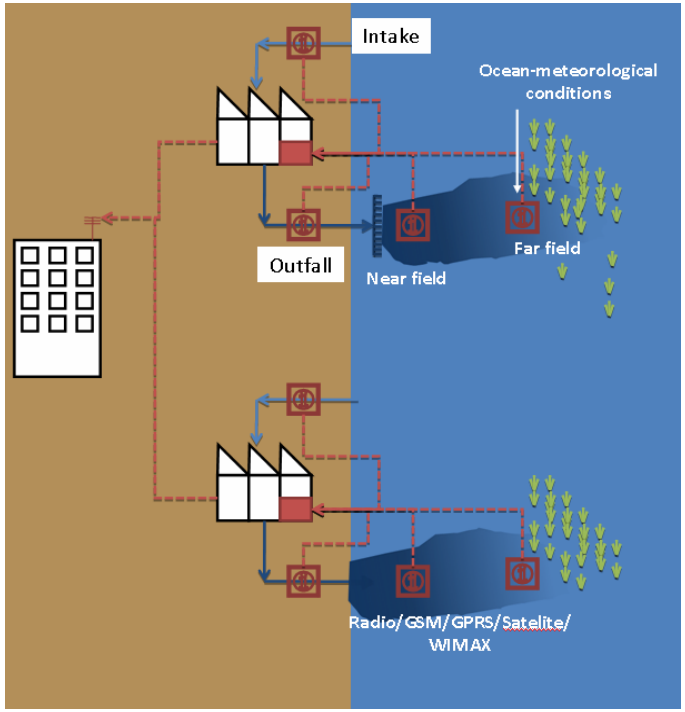
to be implemented in the desalination plant

Alarm and information tool

Development authorities

Companies operating the installation

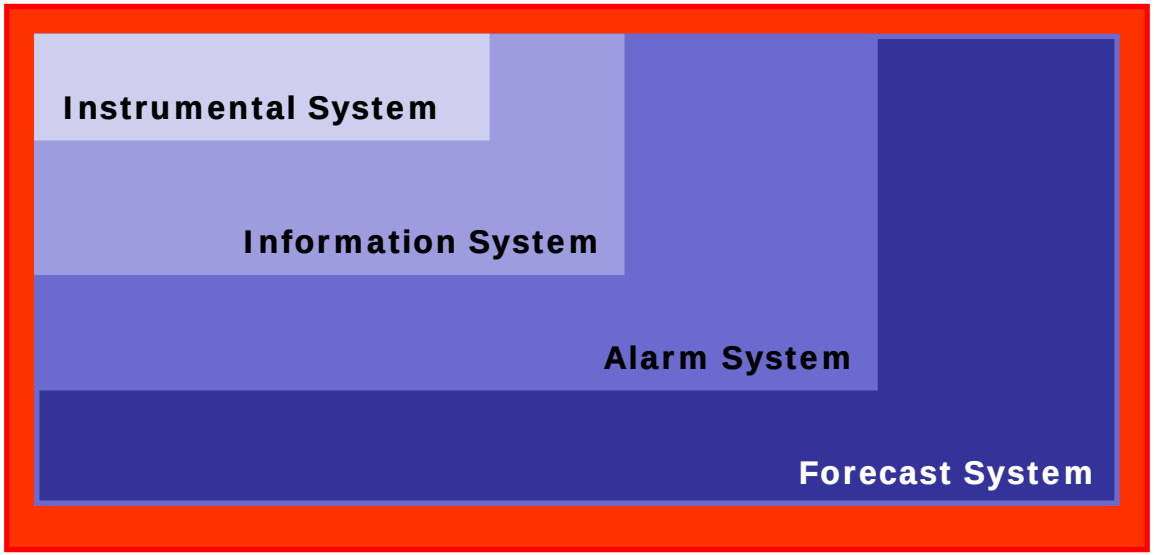
Environmental authorities



PHASES

ASDECO is currently develop in the following phases:

1. **Design and integration of the instrumentation**
2. **Development of an alarm and information system**
3. **Development of a Decision Support System (DSS)**
4. **Integration of the system into the Ordinary Management of a pilot installation**



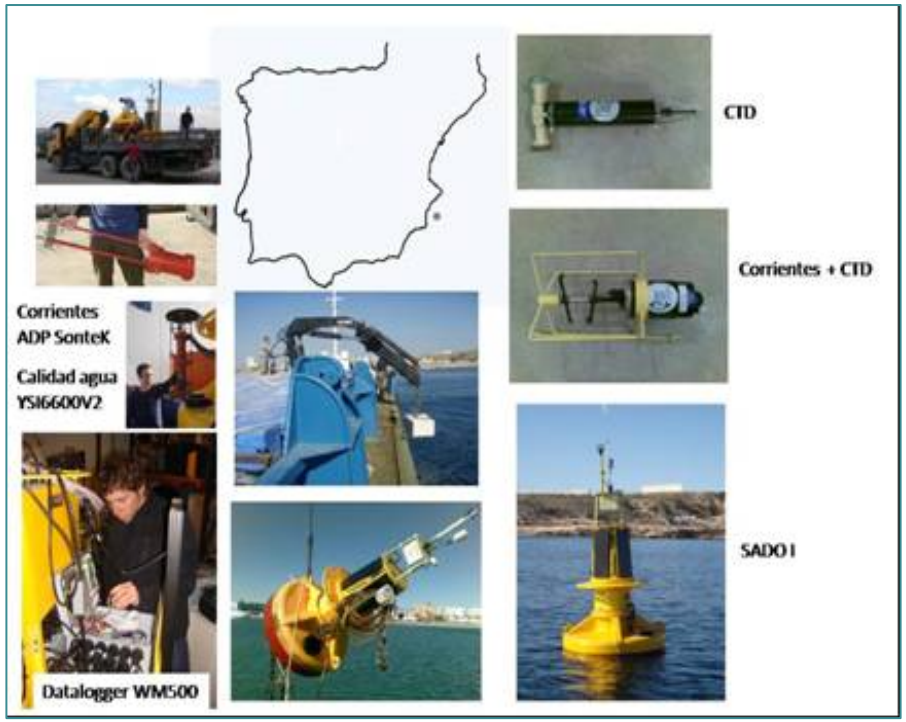
Decision Support System

PHASE 1. INSTRUMENTAL DESIGN

1. Design and integration of the instrumentation

- Ocean-meteorological data acquisition station characterized to:
  - ✓ Discharge of desalination plant effluent
  - ✓ Control of the hypersaline plumes in the marine environment

- The stations were optimized for plume control, both in near field and far field (to provide them with the precision and reliability requirements)



Objective: design a compact and reliable solution that allows the integration of a large number of sensors:

(CTD, current, wind and wave height profilers, and water quality)

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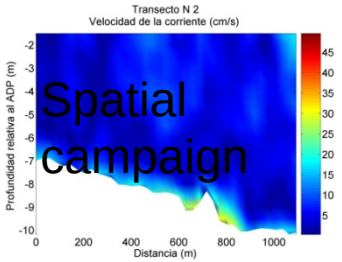
PHASE 2: Development of an Alarm and Information System



Desalination plant information

Geodatabase

Documental Management

Management the related environmental information

Reports

Monitoring EIA Reports of Management

Alarms

Communication (email or SMS)

Centralizing control

Control of the plant operating

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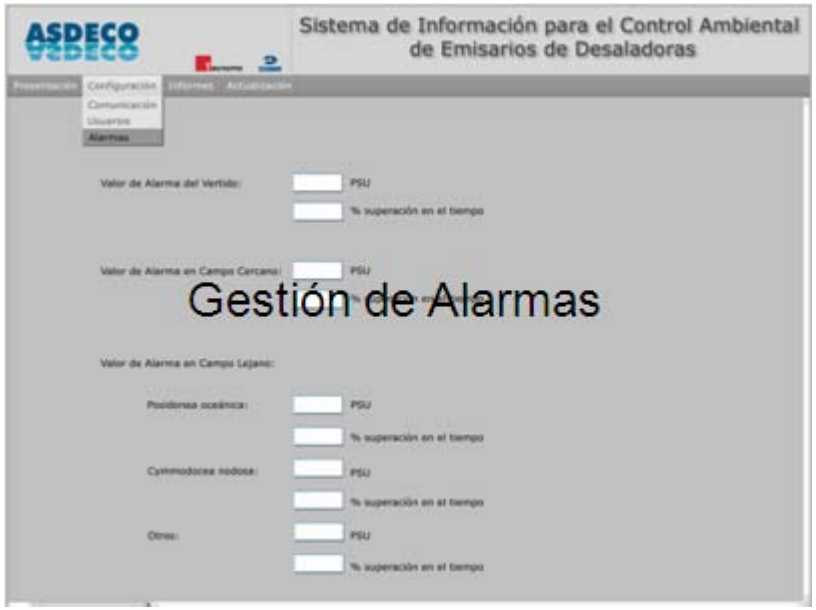
PHASE 2. Development of an Alarm and Information System



Applications:

- updating the desalination plant
- alarm contacts

PHASE 2. Development of an Alarm and Information System

The Information System allows:

- Acquiring information in real time by multiple systems to be recompiled and validated.
- Incorporating an error identification protocol
- Testing the state of the instrumentation
- Facilitating information analysis

The Information system uses a corporate database that is based on SQL and is integrated with a GIS viewer associated to each desalination plant.

The information system generates automated reports in an easy-to-use web environment (brine discharge, marine conditions, salinity values reached)

PHASE 2. Development of an Alarm and Information System

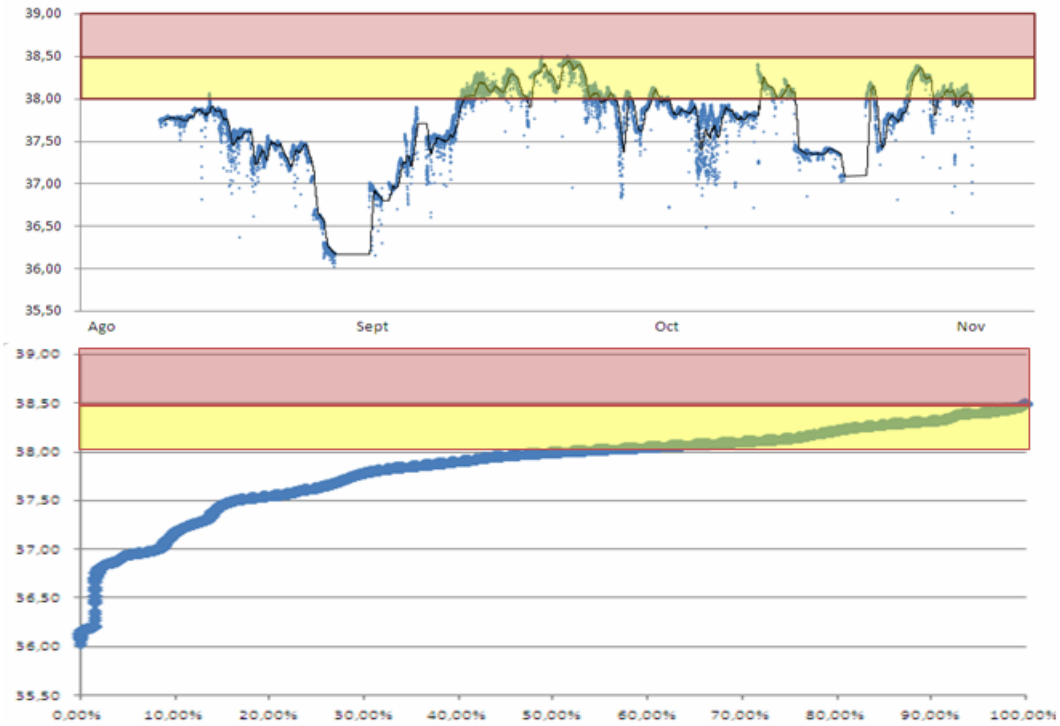
- The generation of alarms is useful when certain **salinity threshold values** are exceeded over certain periods of time
- These thresholds define **action levels** in accordance with the criteria defined in the **Environmental Impact Assessment (EIA)**
- The alarm system also defines the salinity period limit on a daily, weekly and monthly scale.

Observations

EIA: Continuous measurement

Assume 10-20 min, grouping by averages and medians

Predict effects of accumulation



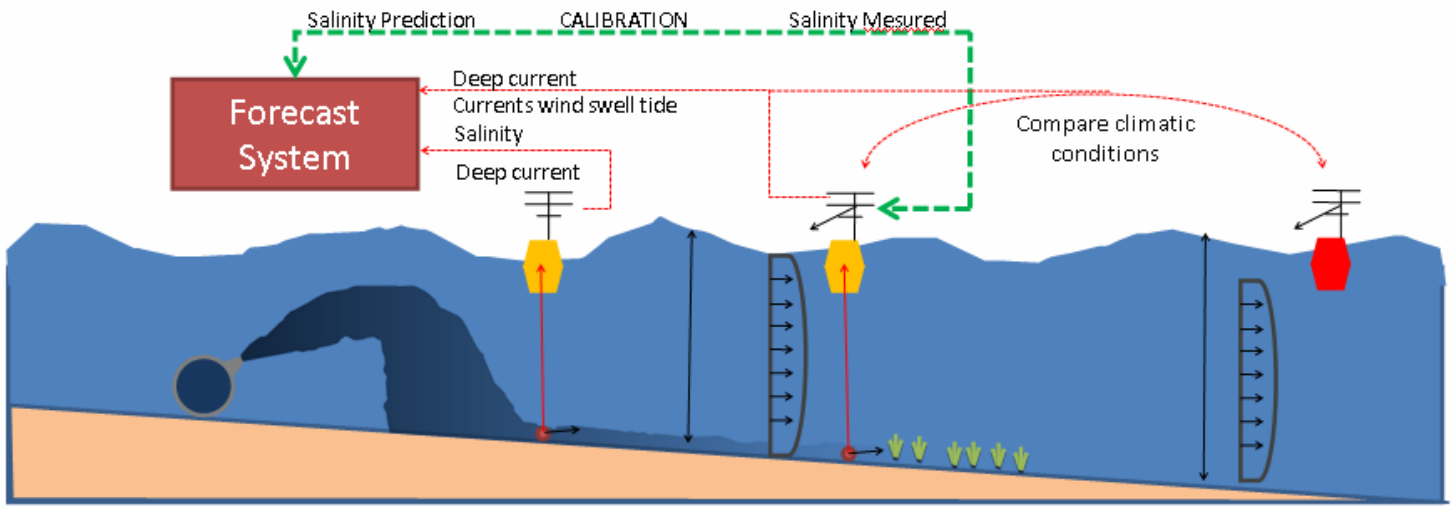
PHASE 3. Decision Support System

- **To create a decision tool that analyzes the instant and seasonal operation of the brine discharge**
- Forecast module: fuzzy logic + neural networks. Forecast

Distribution of the plume
Salinity levels in protection area

Instrumental network implemented to train and validate the neural network.

Adaptative Management by providing feed back data to the predictive system



PHASE 3. Decision Support System

Two management scenarios:

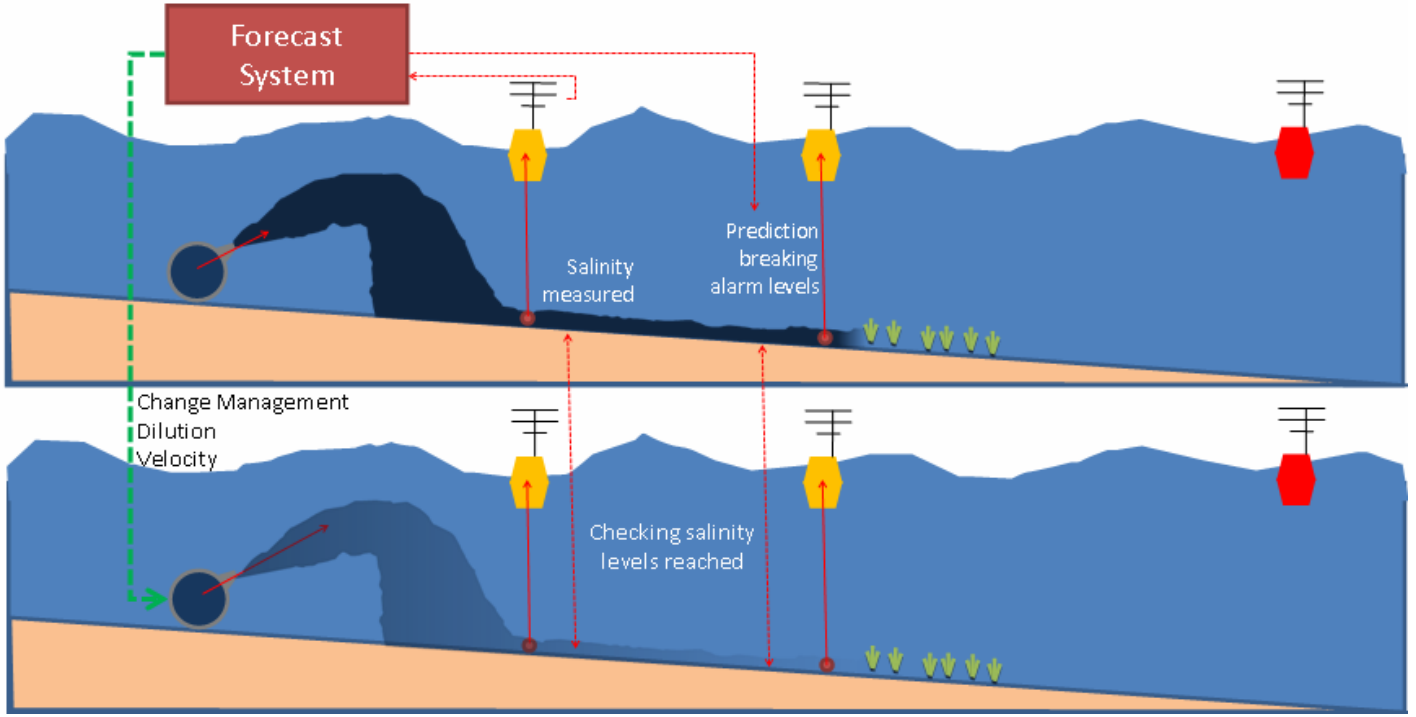
1. Detect salinity values in the near field that could be transported to the protection perimeter.

   The forecast tool continuously evaluates:

   -Salinity

   -Outfall

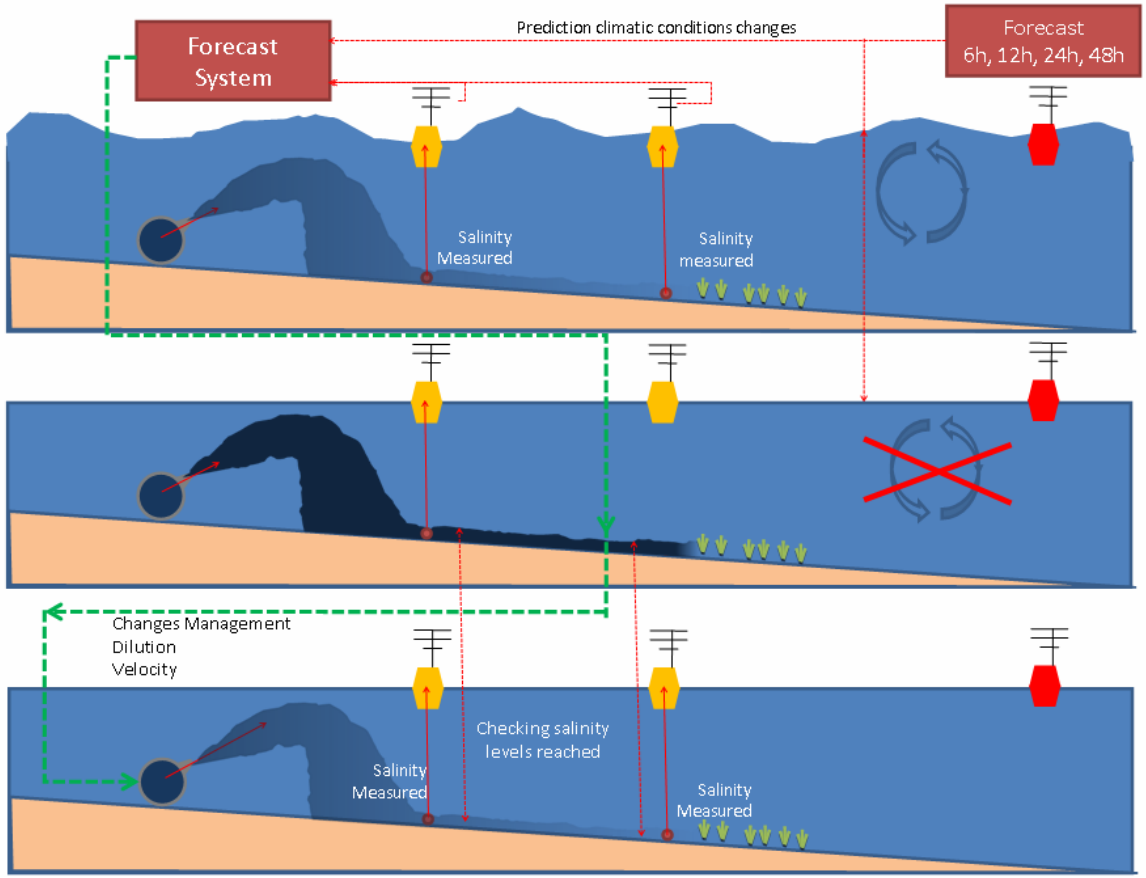
   -Bottom salinity conditions (near and far field)



PHASE 3. Decision Support System

2. Detect maritime climate.

Changes in the energy state of the sea implies changes in the dilution efficiency of the plume in both near-field and far-field.

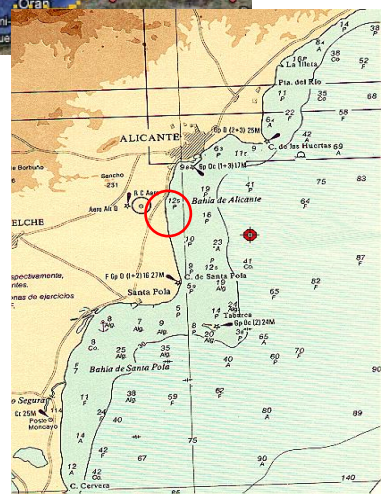


Pase 4. Integration of the pilot installation into ordinary management

Alicante Channel desalination plant (Alicante I y Alicante II)

Production: 130.000 m^3/day by reverse osmosis.

Dilution 1:6 Average flow: 10 m^3/s.



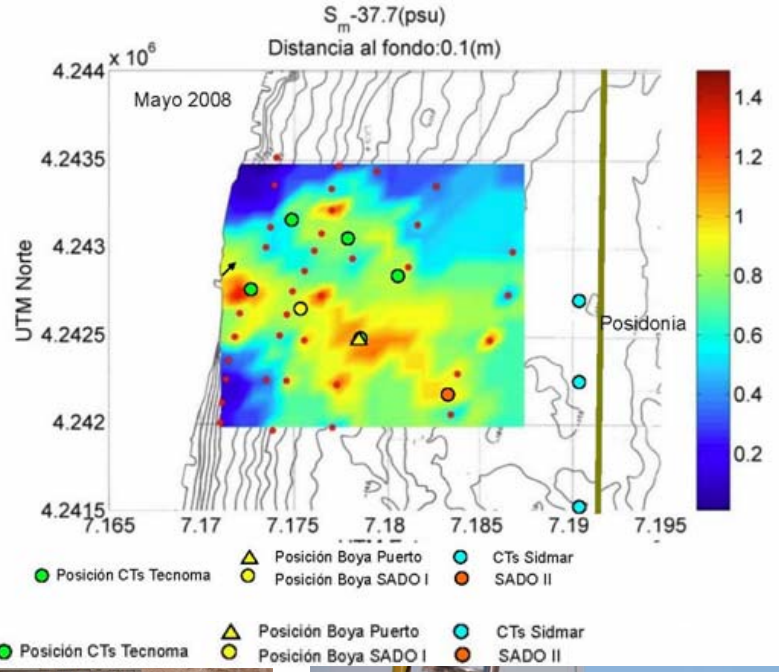
Pase 4. Integration of the pilot installation into ordinary management

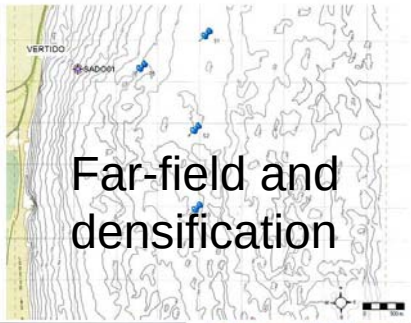
Acquisition System for Oceanographic Data

-Sado I

-CTDs (far and near field)

-Spatial campaign (plume behavior)





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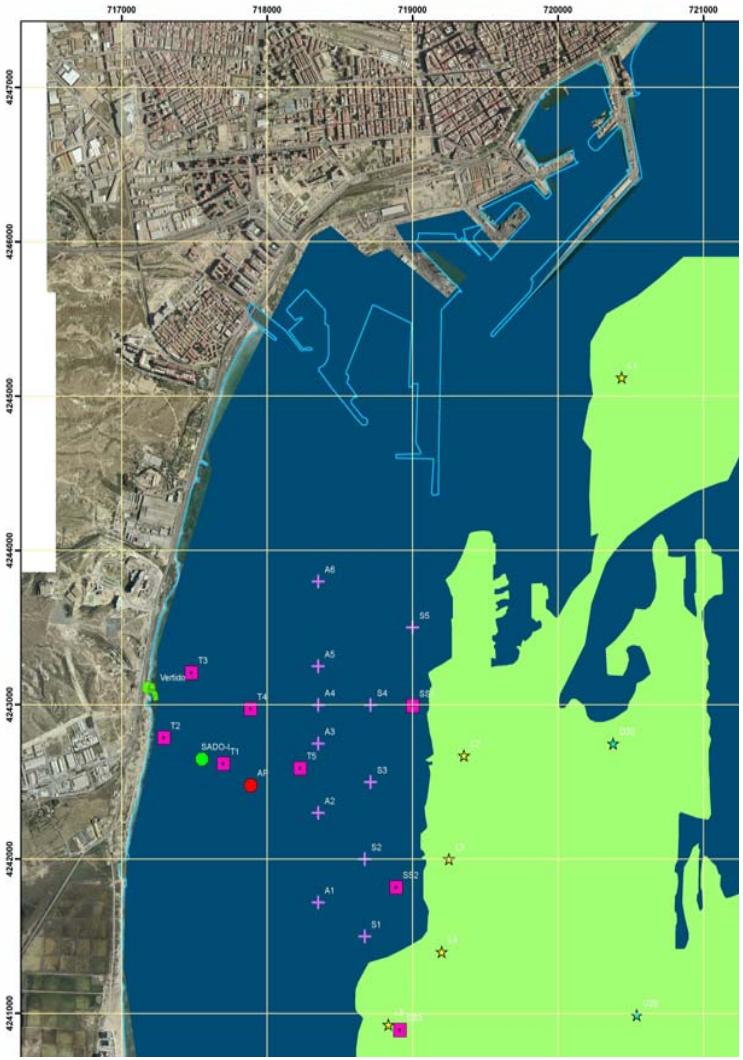
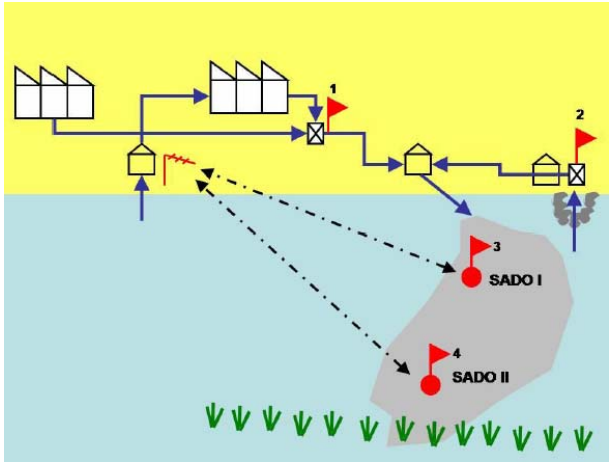
Pase 4. Integration of the pilot installation into ordinary management

Study area





CONCLUSIONS

• The ASDECO R&D project is close to achieving the complete development of an entire system that allows the implementation of Adaptive Management in brine discharges from desalination plants into the sea.

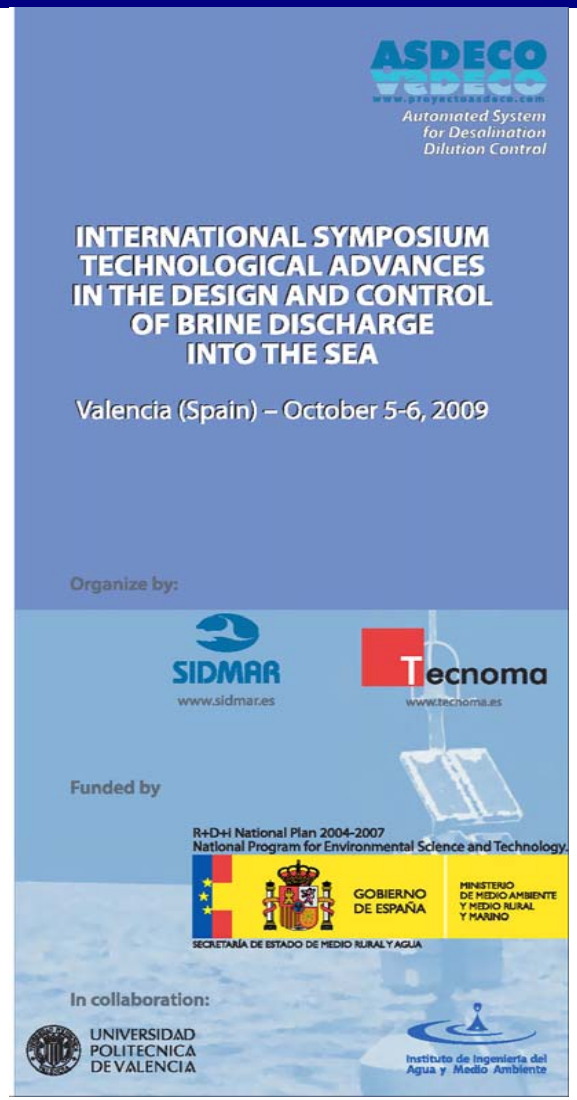
• The integration of this real-time acquisition system with a Brine Dispersion Forecast Tool represents a technical advance in creating a complete Decision Support Tool.

• A series of preliminary tests with some variables shows that:

- increase of salinity is higher when the parameter that represents the excess salt load is higher
- increase of salinity is lower when the maximum wave height is higher.

• The use of neural fuzzy types can be an acceptable initial option for the follow-up and control of waste brine into the sea.

DIFFUSION



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Thanks for your attention

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