DEVELOPMENT OF A NEURO FUZZY MODELLING TOOL FOR A DECISION SUPPORT SYSTEM IN DESALINATION IN COASTAL ZONES

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Conference on Desalination for the Environment – Clean Water and Energy

Baden-Baden, 19th May 2009

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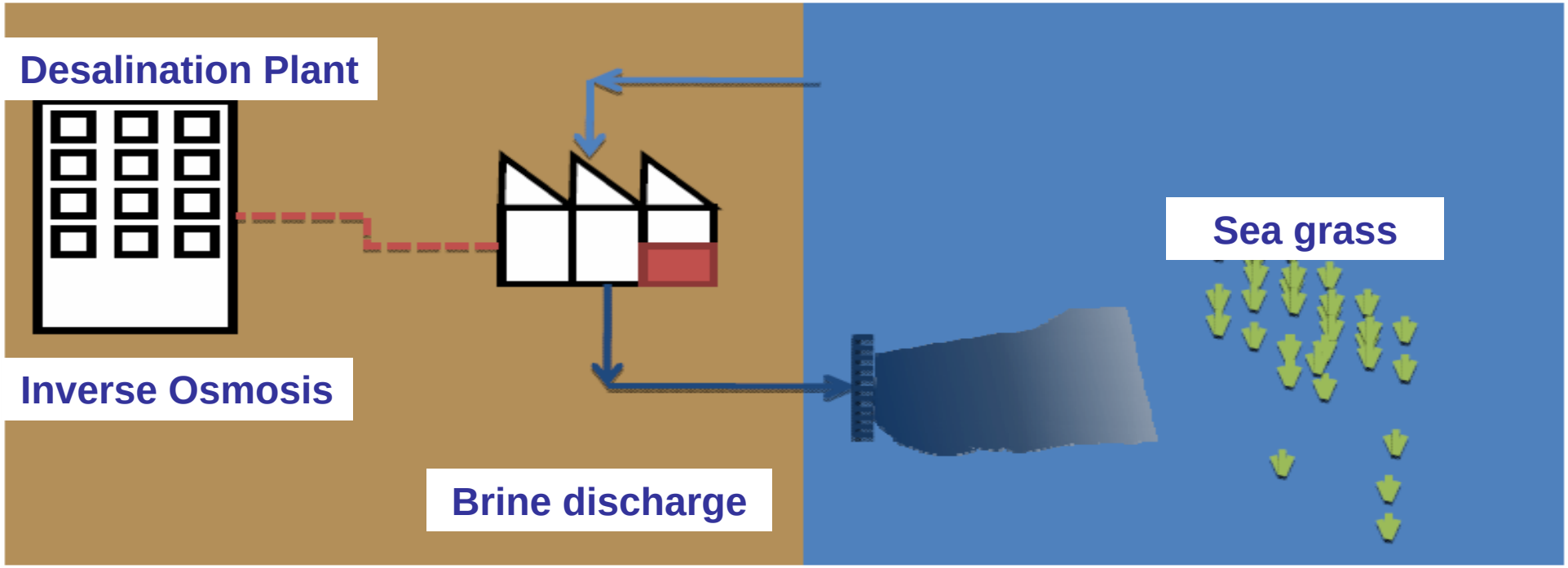
ASDECO

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

Tecnoma SIDMAR

1. Introduction



Currently increase in the use of reverse osmosis in the desalination process of sea water

↓

Placement of the brine: Coastal areas?

1. Introduction

Brine impact must be evaluated

LIMITATIONS

- **Models such as CORMIX are useful in the design phase but limited in the operation phase**
- **Deterministic models do not have capacity to solve the problem of transport and brine diffusion**
- **Slow development is partly caused by the lack of experimental data from the natural environment**

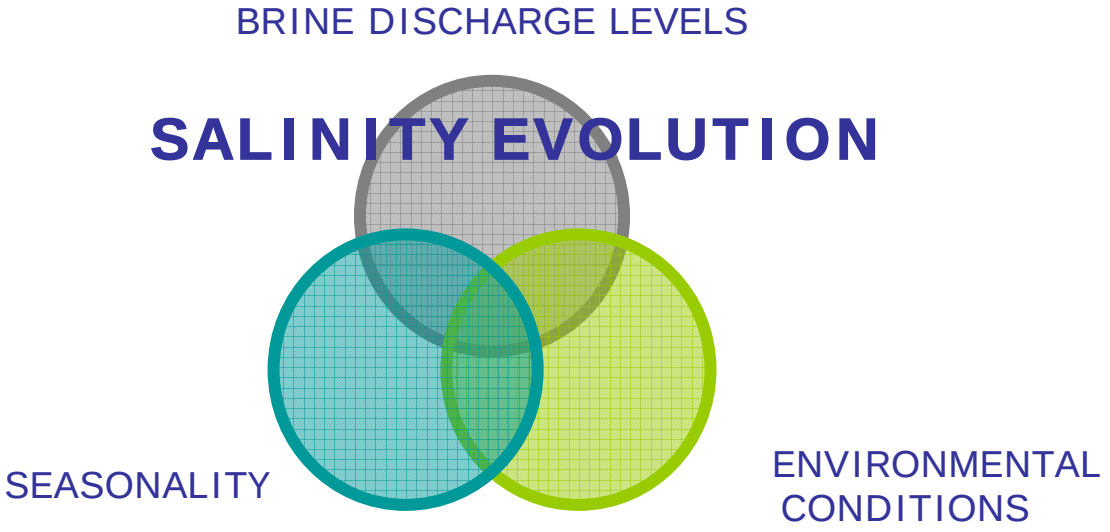
ASDECO

(Automated System for Desalination Dilution Control) pretends to evaluate salinity variations in the marine environment over periods of time.

A mathematical tool is needed

2. Objectives

The main objective of this research is to develop a computational requirements tool that, given the brine discharge levels and the environmental conditions, can predict salinity evolution in the marine environment.



2. Objectives

COMPUTATIONAL TOOL

FUZZY LOGIC

- **Permits multi-valued logic between 0 and 1**
- **Based on transparent, editable linguistic rules**
- **Practical framework to include human expertise into modelization**

NEURAL NETWORKS

- **Adaptative systems**
- **Similar to black-box inference machines**
- **Necessary training and validation phases**

3. Description and implementation of models

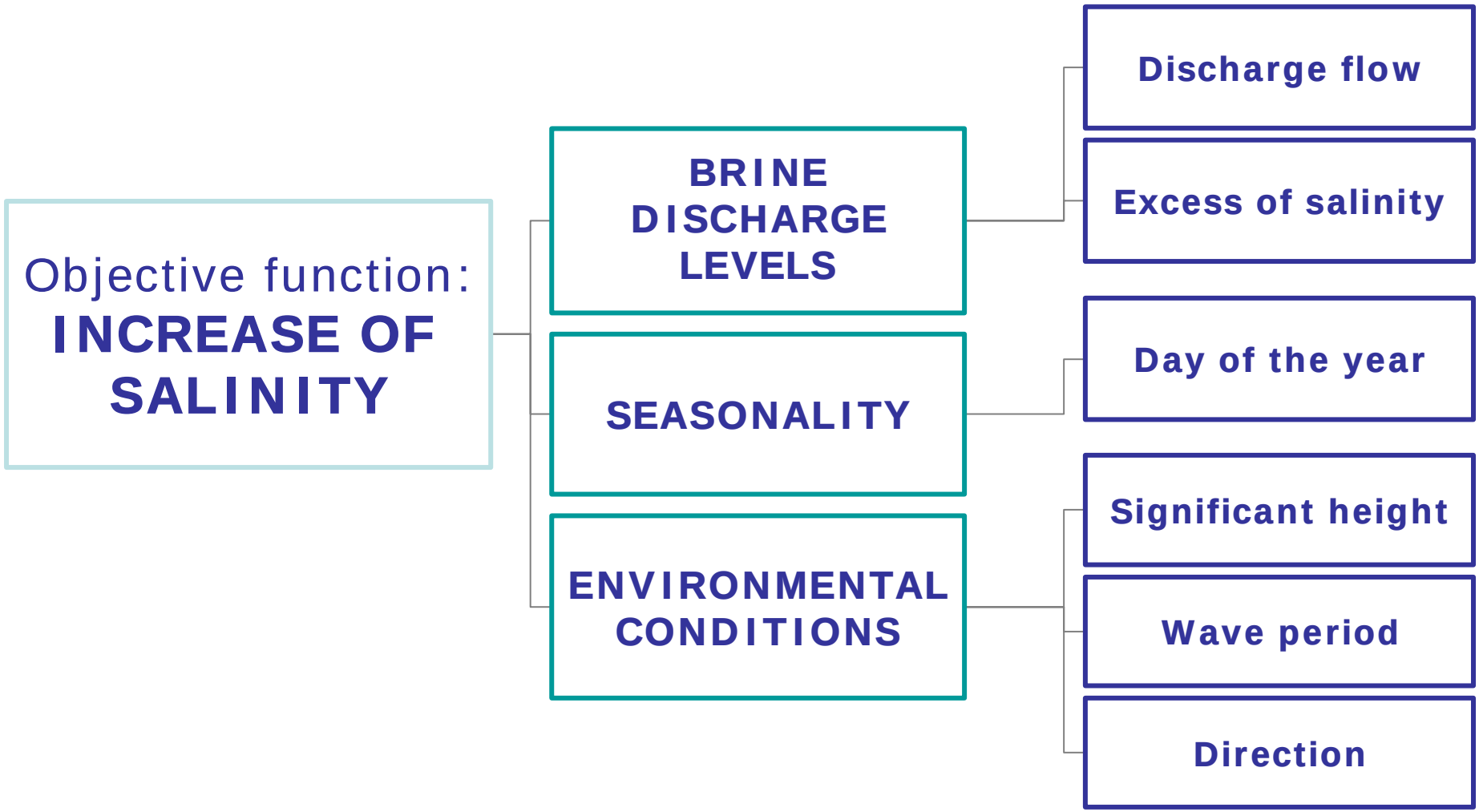
Adaptative Neuro-Fuzzy Inference Systems (ANFIS)

- Implemented by Matlab
- Neural fuzzy Sugeno-type model

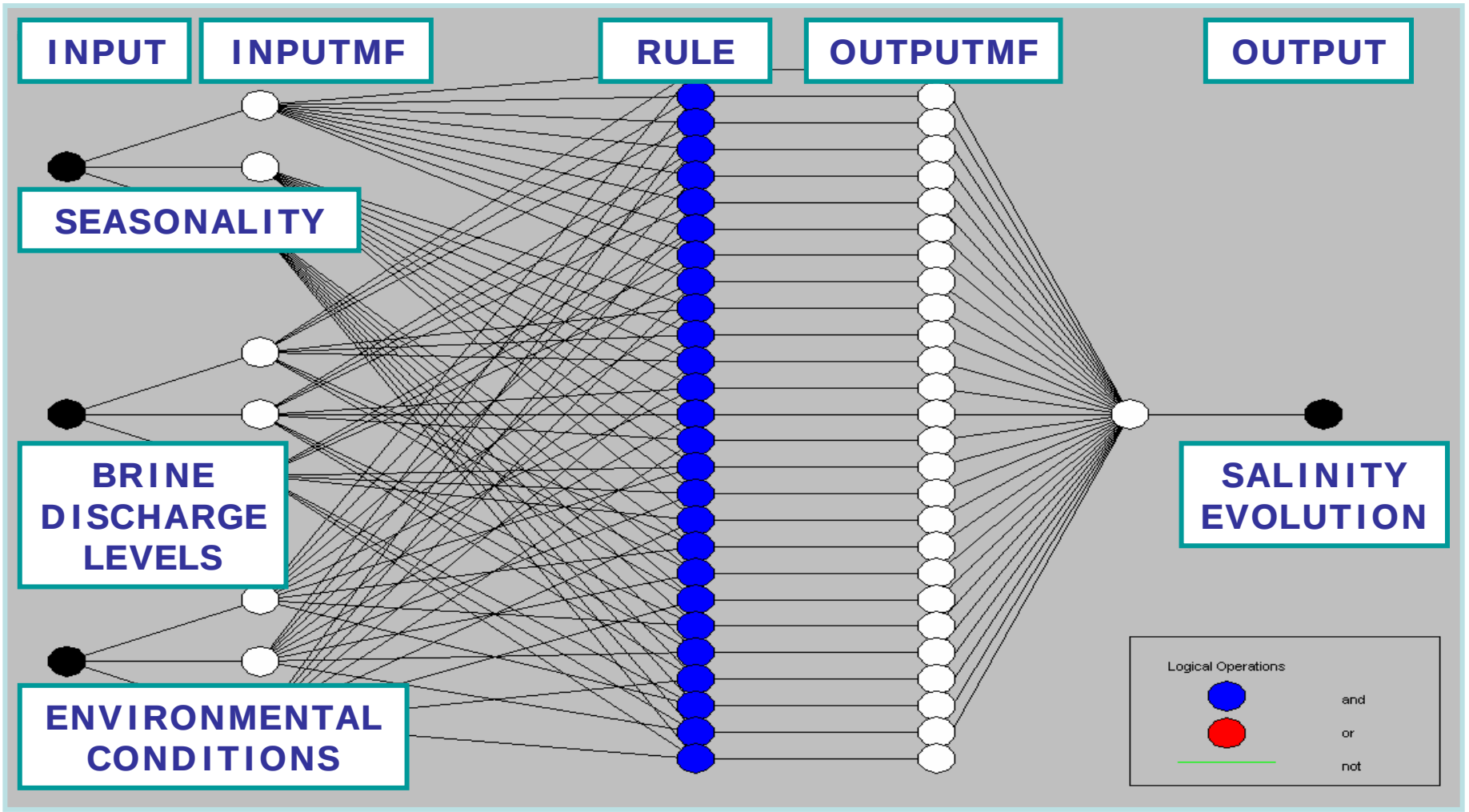
WHY ANFIS?

- A highly non-linear relationship between parameters
- The transformation of parameter field data does not provide statistically significant results
- Difficulty in using other more traditional regression models

3. Description and implementation of models

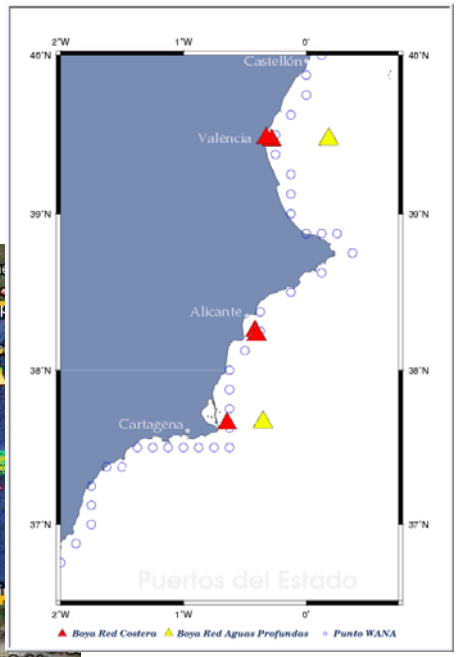


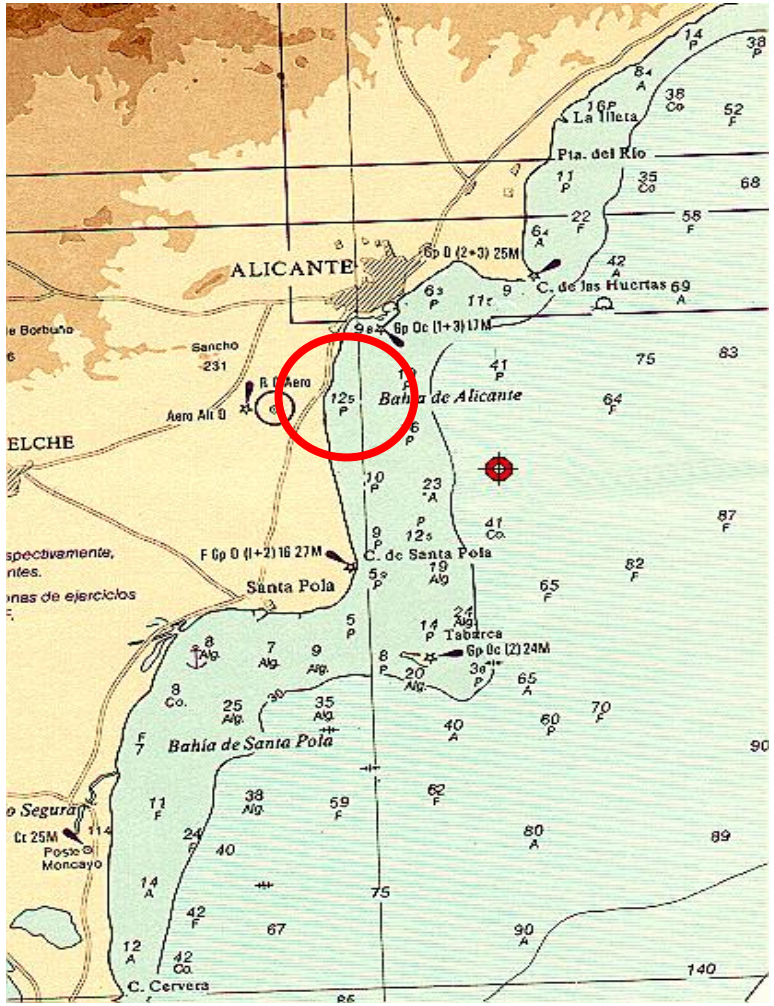
3. Description and implementation of models



3. Description and implementation of models

PLACEMENT





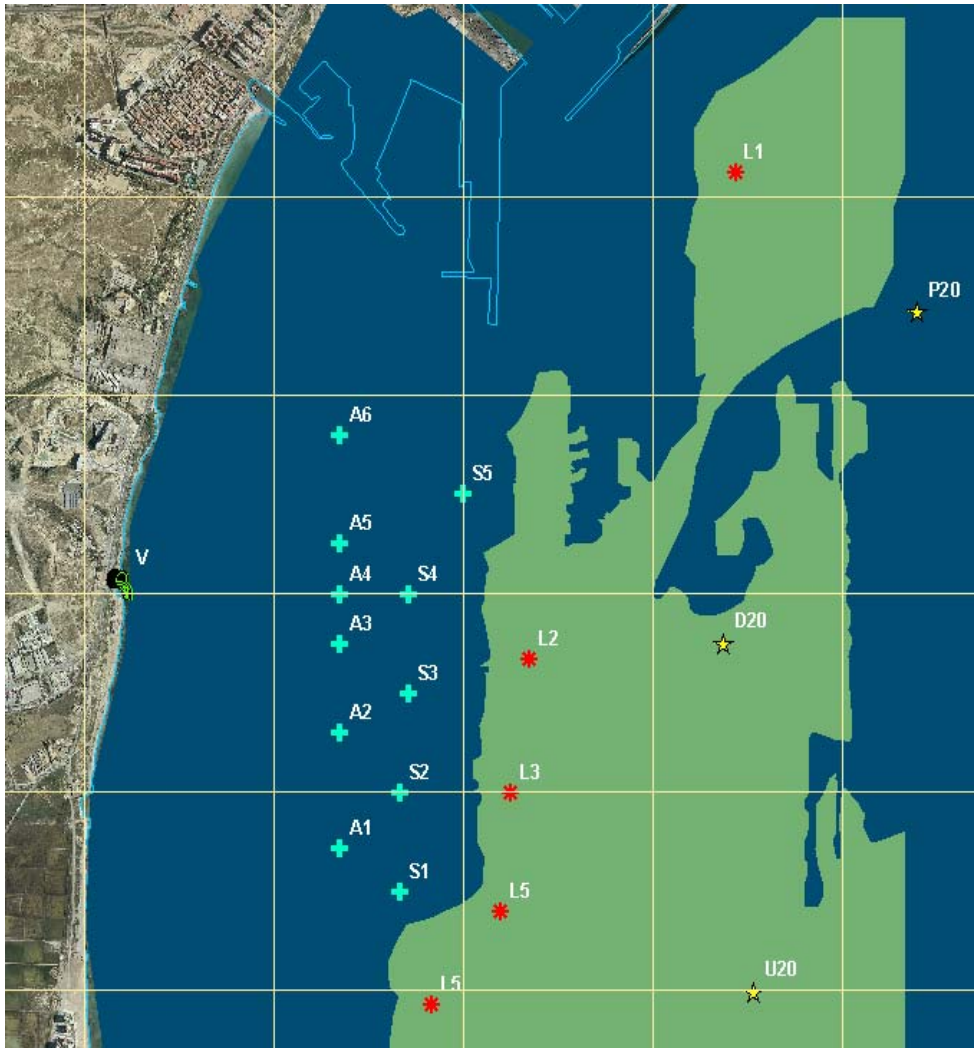
Production **130 000 m³/day**

Brine discharge **10 m³/second**

3. Description and implementation of models

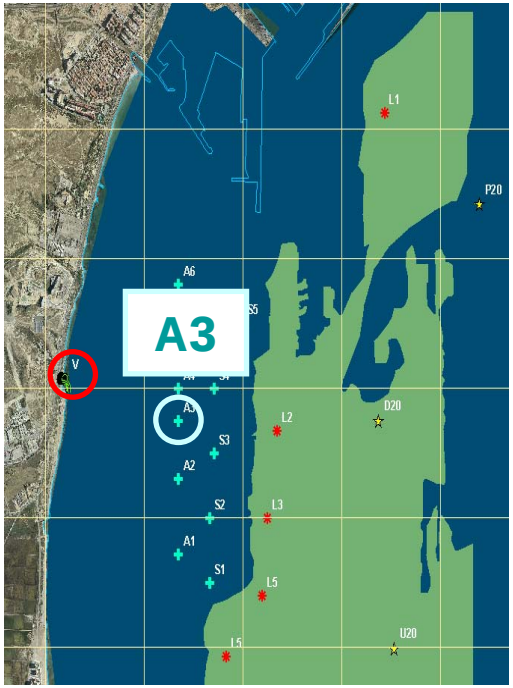
DATA AVAILABLE

- PVA 2004-2007 (Universidad de Alicante)
- Sado I Buoy
- ASDECO CTDs
- Mancomunidad de Canales del Taibilla
- Port authorities



4. Results

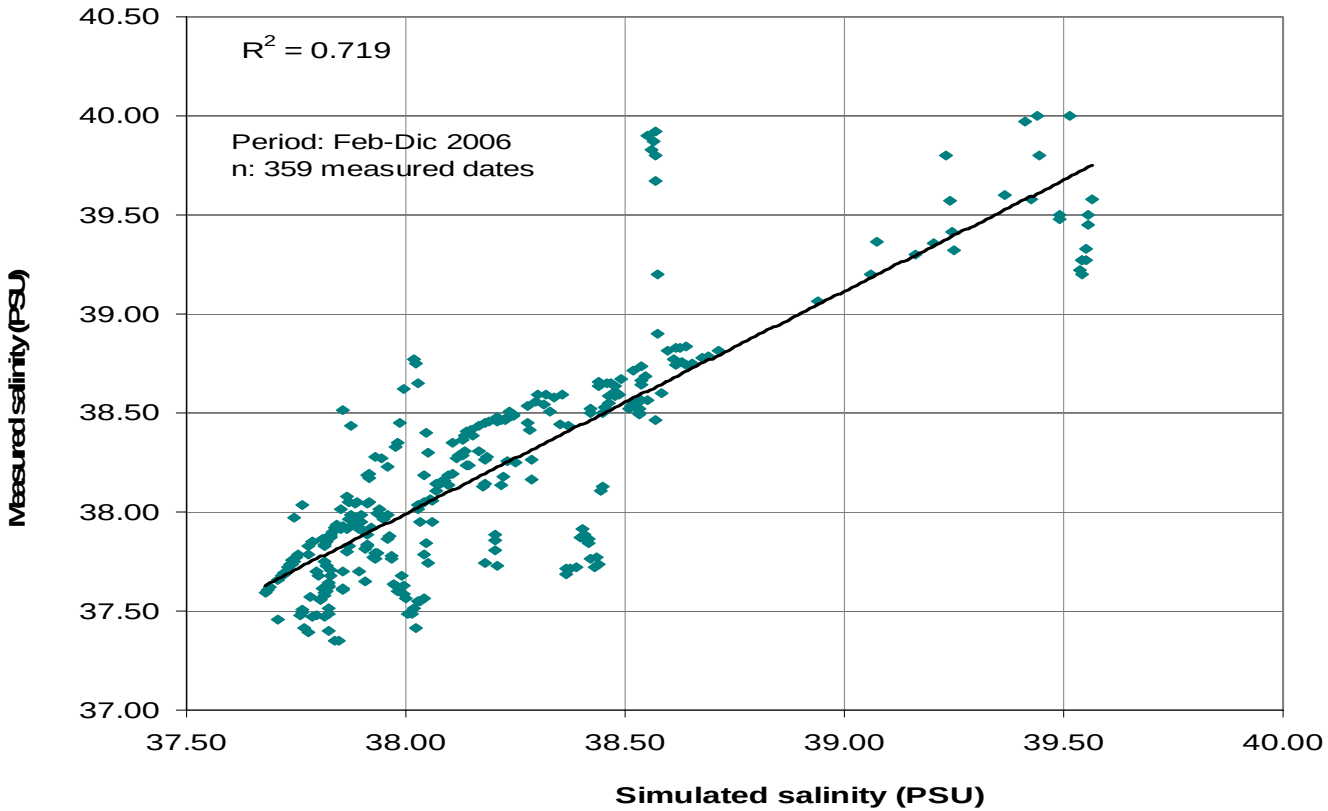
Model adjustment with data from the Monitoring Programme 2006



2 variables:

- **Day**
- **Excess salt load**

Simulated vs Measured
Station A3. Moving average (4 days)



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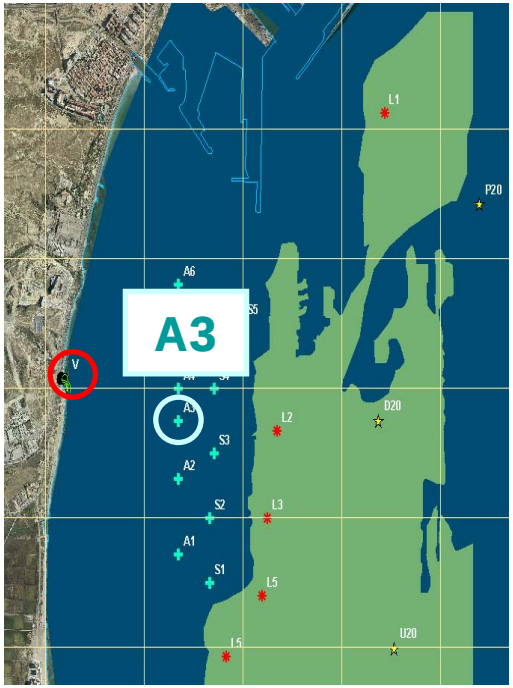
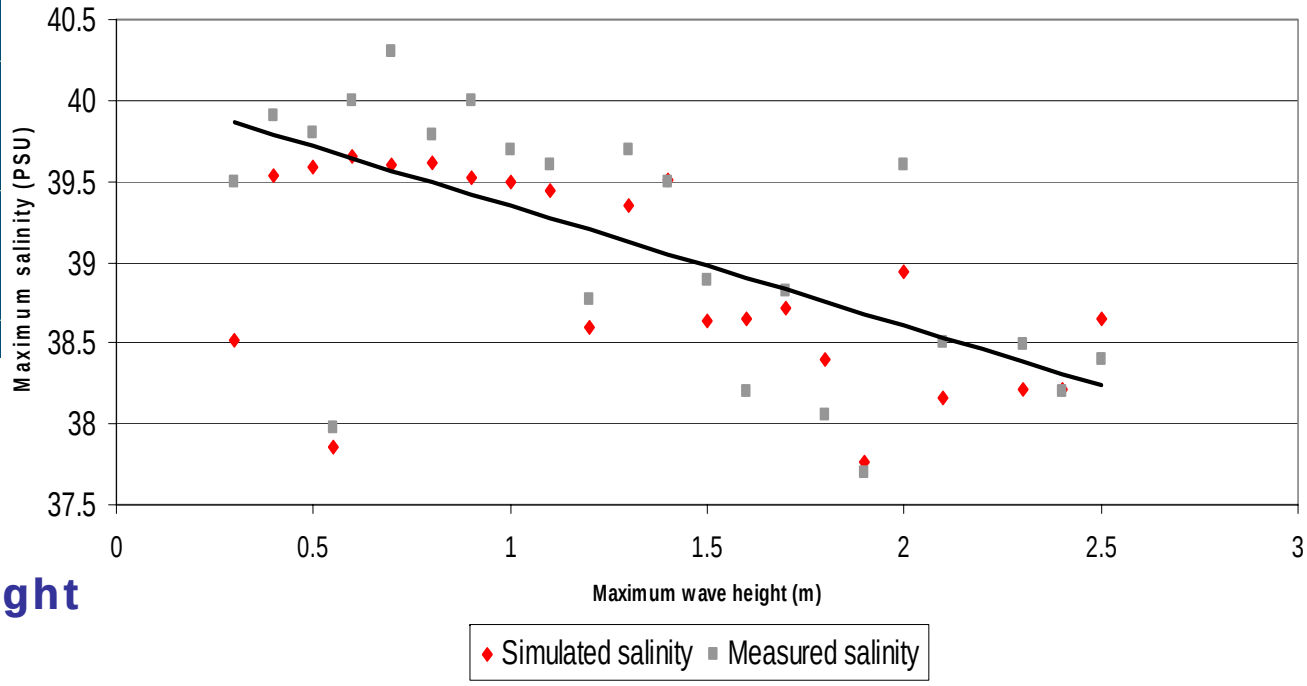


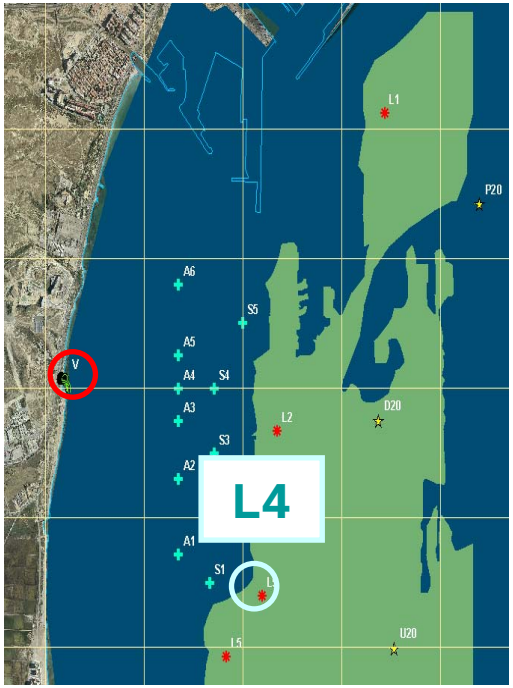
Max wave vs Max salinity
Station A3. Moving average (4 days)



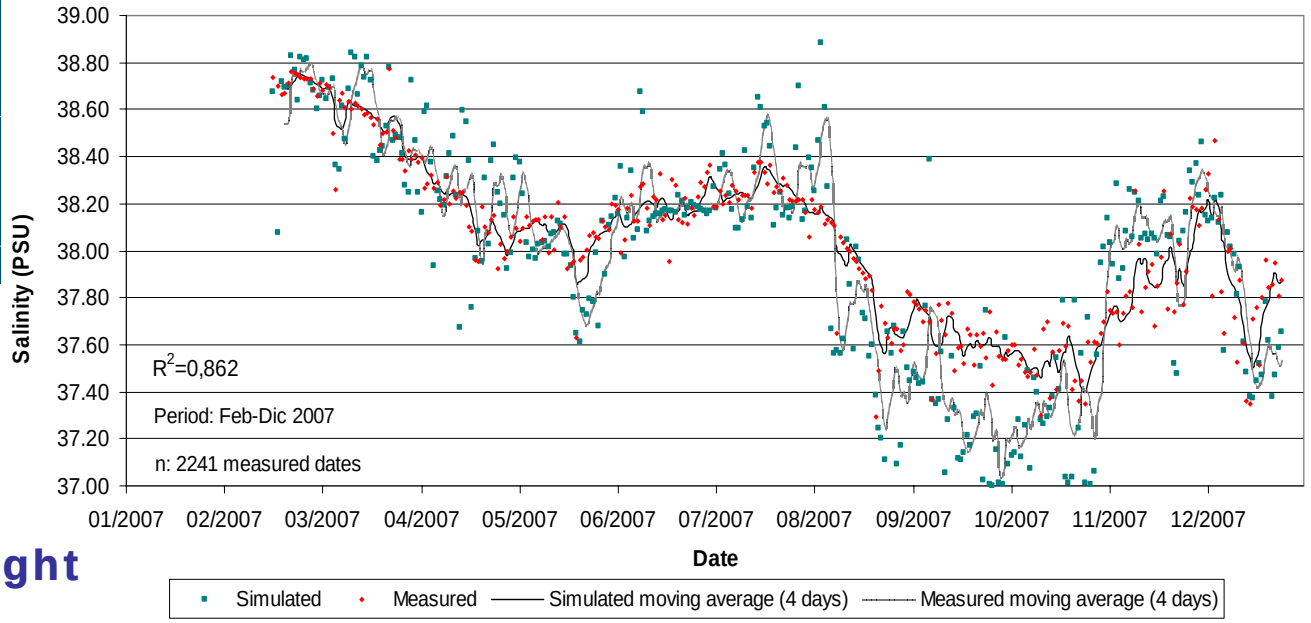
3 variables:
- **Day**
- **Excess salt load**
- **Maximum wave height**

4. Results

Model adjustment with data from the Monitoring Programme 2007



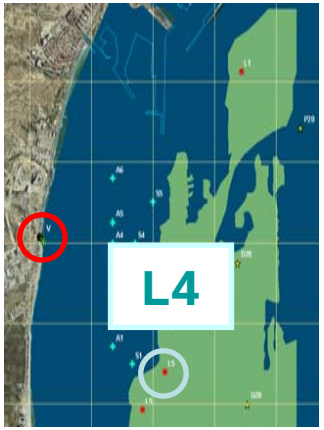
Time series
Station L4. Moving average (4 days)



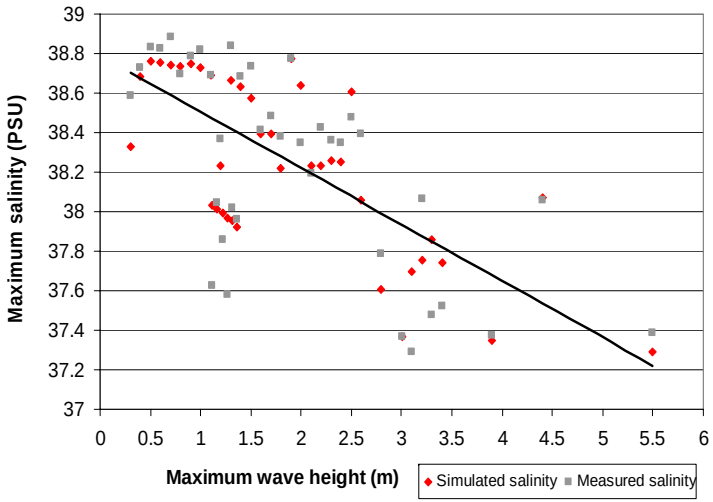
3 variables:
- **Day**
- **Excess salt load**
- **Maximum wave height**

4. Results

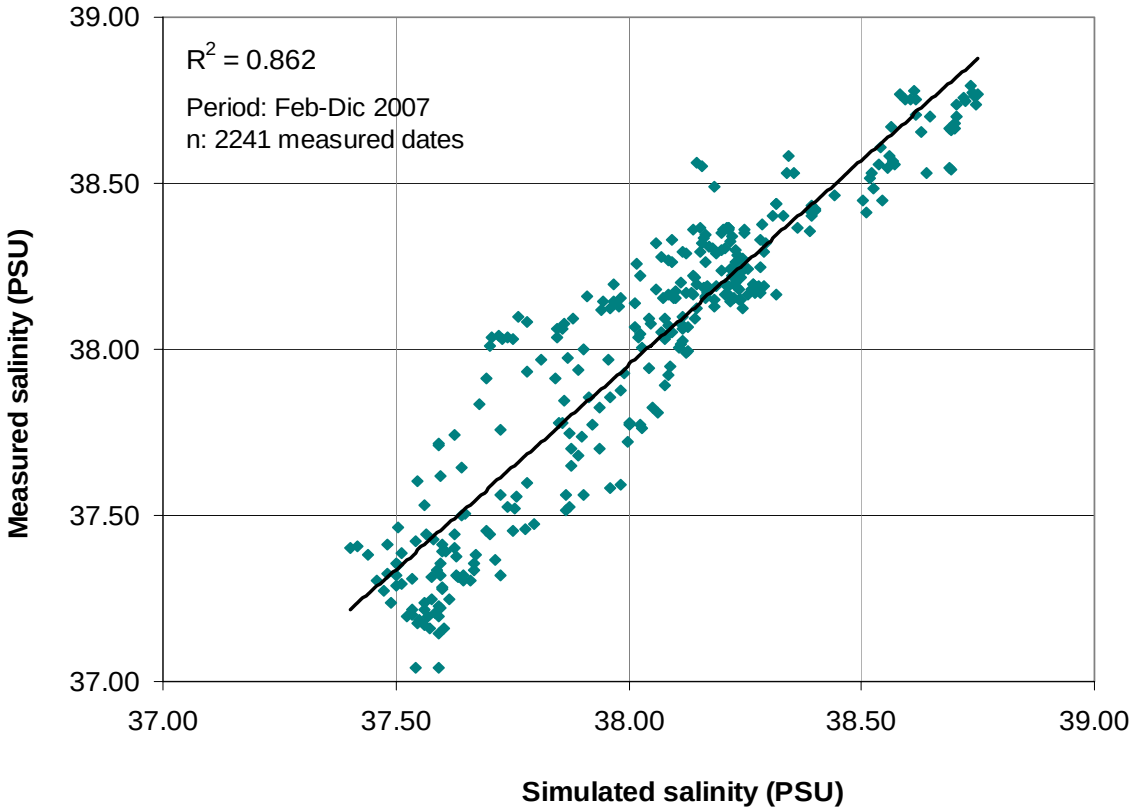
Model adjustment with data from the Monitoring Programme 2007



H max vs PSU max L4



Simulated vs Measured
Station L4. Moving average (4 days)



4. Results

Model adjustment with ASDECO data 2008-2009

- The data provided by the sensors installed in the SADO I buoy by the ASDECO project started to be available in October 2008
- The increase of salinity produced in the control point where the buoy was located is currently being studied.
- Introduction of new parameters to define the specific behaviors of the brine plume has been attempted in order to achieve better results
- Necessary to introduce a parameter that represents previous sea states.

5. Conclusions

- **A decision tool has been presented that allows the analysis of instantaneous and seasonal brine discharge behavior**
- **A fuzzy logic application combined with neural networks has been developed in order to simulate the increase of salinity**
- **The most influential variables are the day of the year, wave height and the excess salt load**
- **The results show that the supposed variables are right, just as expected**
- **Therefore the application of neural fuzzy types such as ANFIS are acceptable for the follow-up and control of brine discharge into the sea.**

More information at

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

Session 30 Environment 154

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Thanks for your attention