sibic 2012
IV JORNADAS IBÉRICAS DE ICTIOLOGIA
IV JORNADAS IBÉRICAS DE ICTIOLOGÍA
IV JORNADES IBÈRIQUES D'ICTIOLOGIA
Situación actual y retos de futuro
17 al 20 de Julio | Universidad de Girona

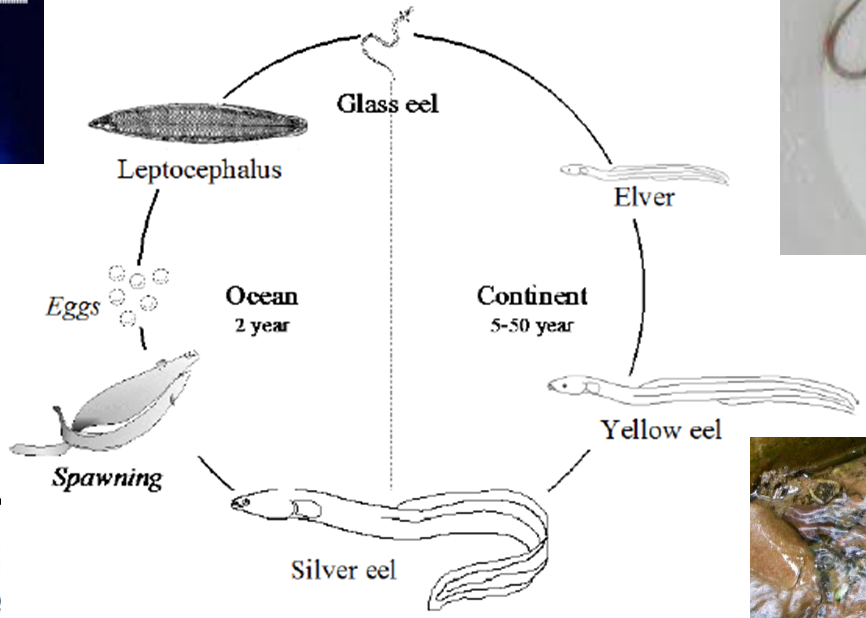
EDA2.0: A PROMISING MODEL TO PREDICT THE SPAWNING STOCK OF SILVER EEL *(Anguilla anguilla)* IN SPAIN.

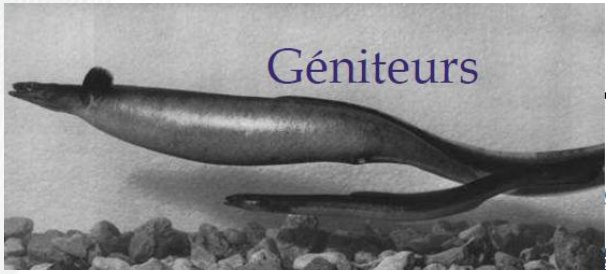
AIZKORRI ARANBURU[1], EIDER ANDONEGI[1], ESTIBALIZ DÍAZ[1], MARIA KORTA[1], IKER AZPIROZ[2], CÉDRIC BRIAND[3], LAURENT BEAULATON[4], PATRICK LAMBERT[5], CÉLINE JOUANIN[5].

aaranburu@azti.es

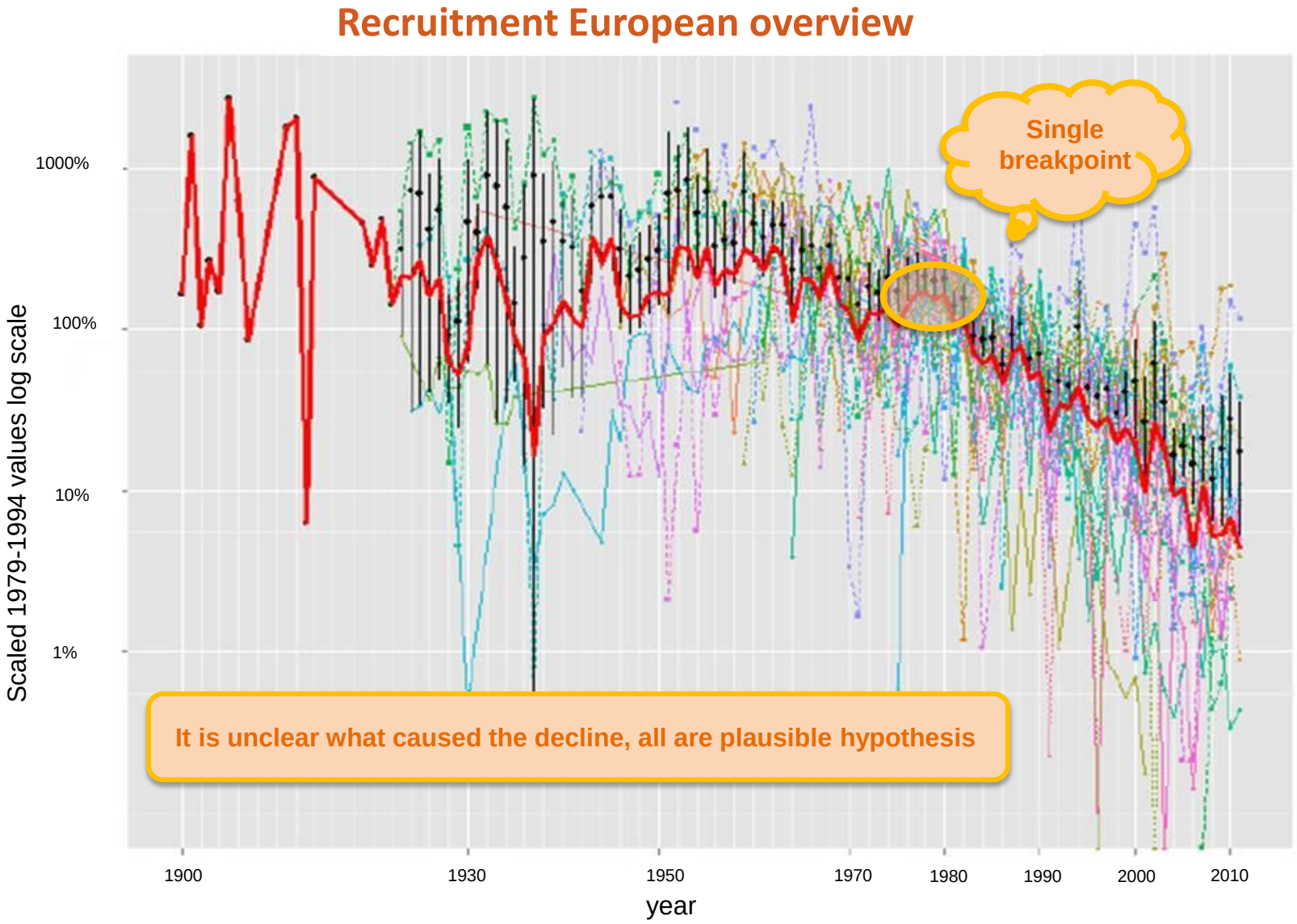
[1]*AZTI-Tecnalia, Marine Research Division, Txatxarramendi z/g 48395 Sukarrieta (Spain)*
[2] *EKOKUR Asesoría Ambiental S.L.L, Camino de Astigarraga, 2-PL 4º Dcha-Of.8. 20180 Oiartzun (Spain)*
[3] *Institution d'Aménagement de la Vilaine, Boulevard de Bretagne, 56130 La Roche Bernard (France)*
[4] *ONEMA , Direction de l'Action Scientifique et Technique, "Le Nadar" Hall C, 5, Square Félix Nadar, 94300 Vincennes (France)*
[5] *IRSTEA Estuarine ecosystems and diadromous fish research unit, 50 Avenue Verdum, 33612 Cestas (France)*

INTRODUCTION





INTRODUCTION



INTRODUCTION

Impacts to eel production

Commercial and Recreational Fisheries

Obstacles to migration

Habitat loss and water quality

Predation

Ocean currents and climatic change

Loss of quality of the parents

Estimation of the following biomasses:

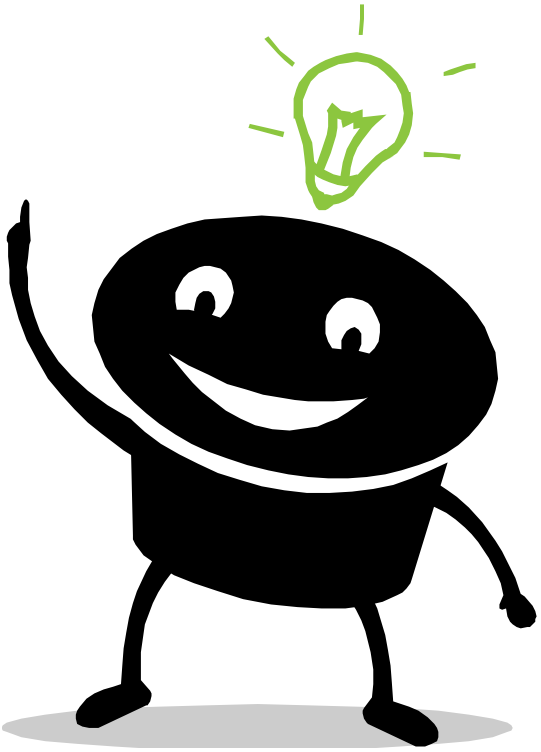
- **$B_{current}$ the biomass of the escapement in the assessment year.**
- **B_o the biomass of the escapement in the pristine state.**

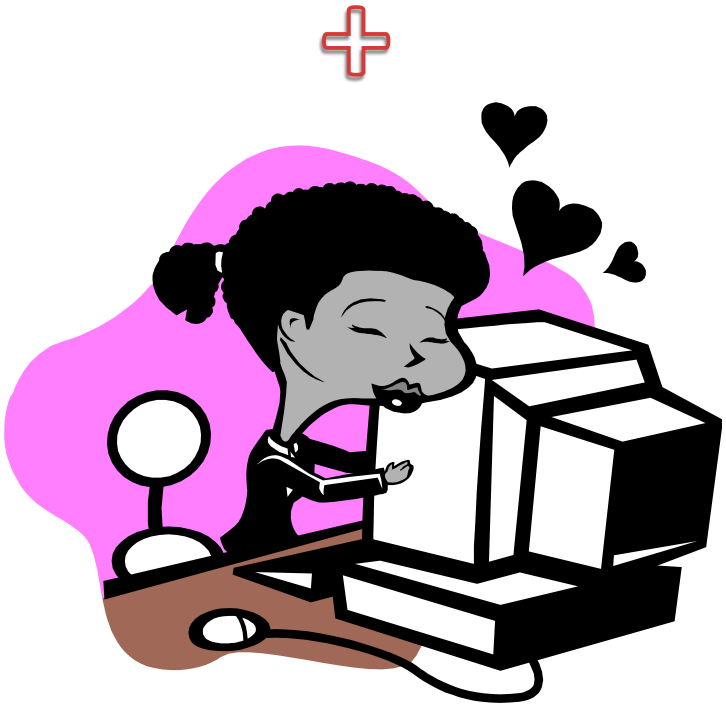
and if this was not enough…

B_{best} → the estimated potential biomass in the assessment year, assuming no anthropogenic impacts (and without stocking) have occurred and from all potentially available habitat.

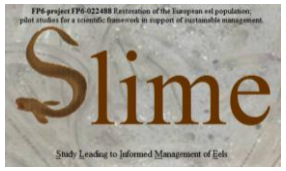
INTRODUCTION

INTRODUCTION

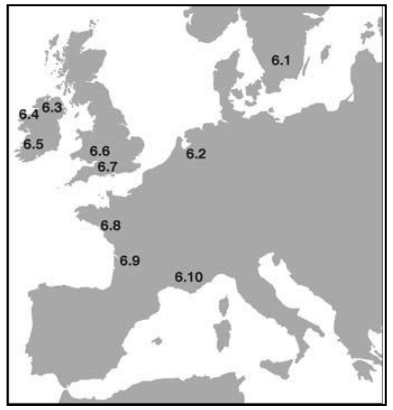




- **Study Leading to Informed Management of Eels, 2006**



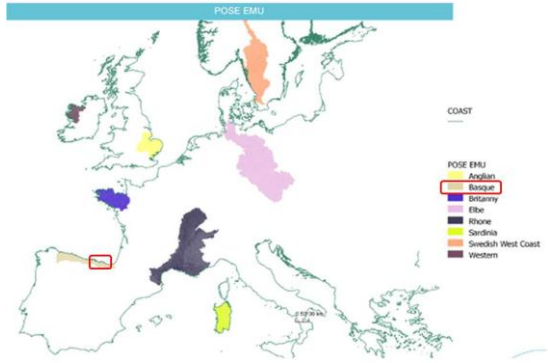
MODELS	CASE STUDIES
Gemac	Burrishoole
GlobAng	Camargue
LVPA	Gironde
DemCam	Ijsselmeer
SMEP	Lough Neagh
SWAM	Piddle & Frome
	Severn
	Shannon
	Swedish coasts
	Vilaine



- **Pilot projects to estimate potential and actual escapement of silver eel, 2009-2011**

POSE

MODELS	CASE STUDIES
DemCam	River Elbe Basin District
EDA	Anglian River Basin District
GEM	West Coast River Basin District
SMEP II	Western River Basin District
	Brittany Eel Management Unit
	Basque River Basin District
	Rhone Eel Management Unit
	Sardinian Eel Management Unit



- **Recuperando la anguila: desarrollo de herramientas científico-técnicas para la implementación de planes de gestión en las cuencas europeas, 2011-2012**

RECANG

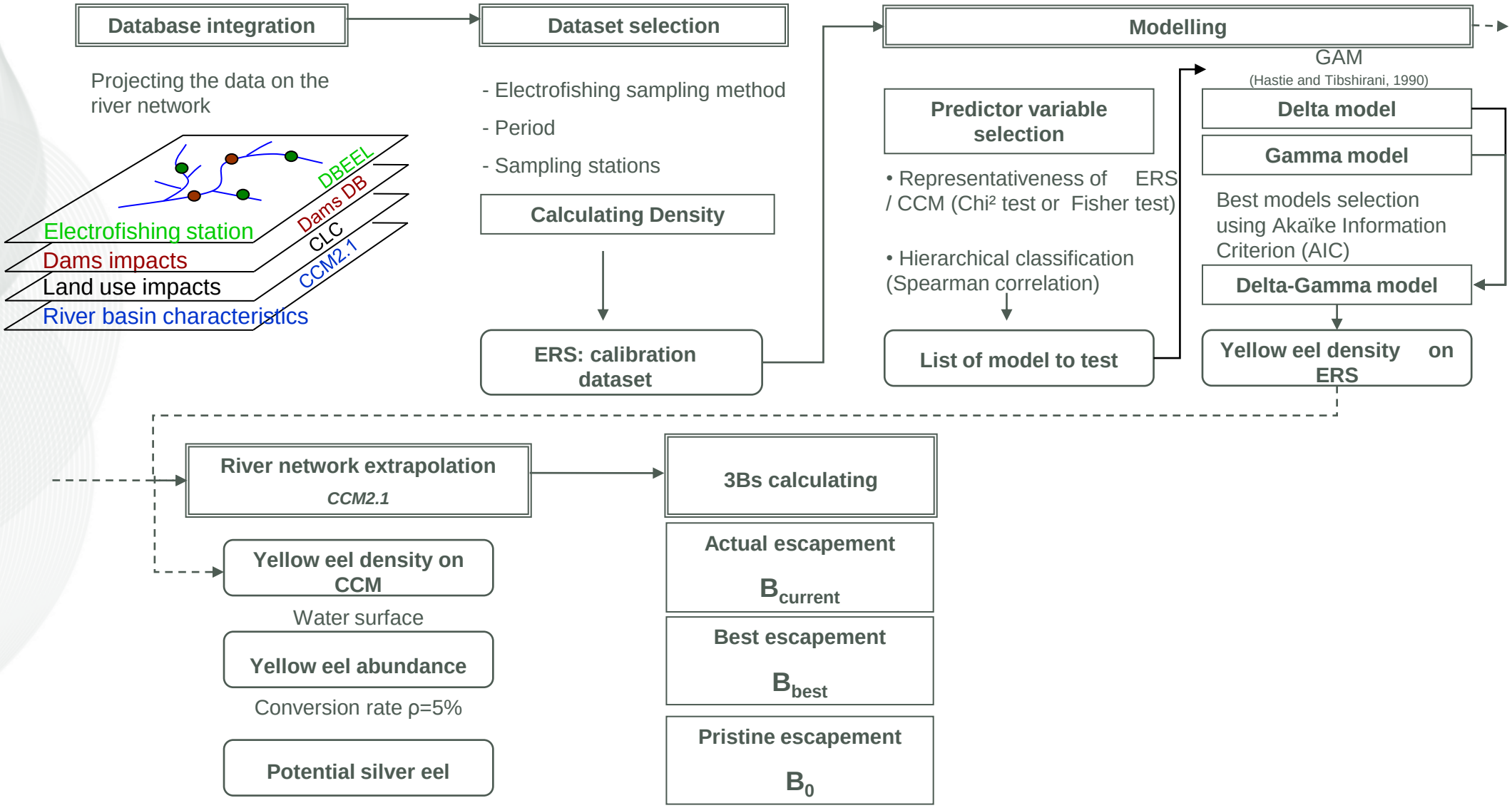
Applying a model → EDA 2.0 (Eel Density Analysis)

↓

Prediction of yellow eel densities and silver eel escapement

EDA is a modelling tool based on free software (R, PostgreSQL and PostGIS) that allows the evaluation of yellow eel stock and the estimation of the abovementioned 3 Bs (Bcurrent, Bbest and Bpristine)

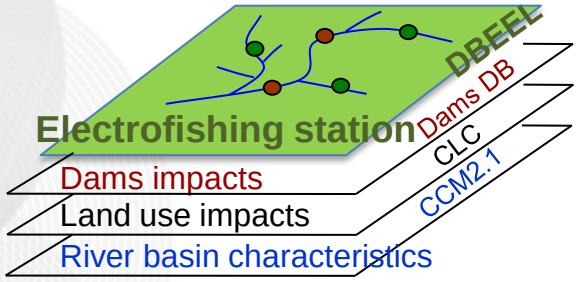
Modelling strategy



IMPLEMENTATION OF THE MODEL

Database integration

Projecting the data on the river network



Electrofishing station

Basque water Agency (URA)

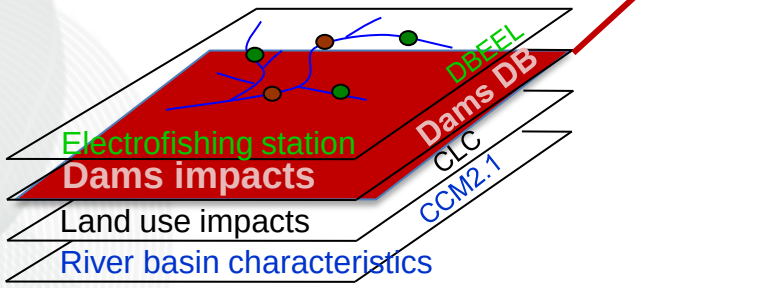
+

Probincial Council of Gipuzkoa

EDA database

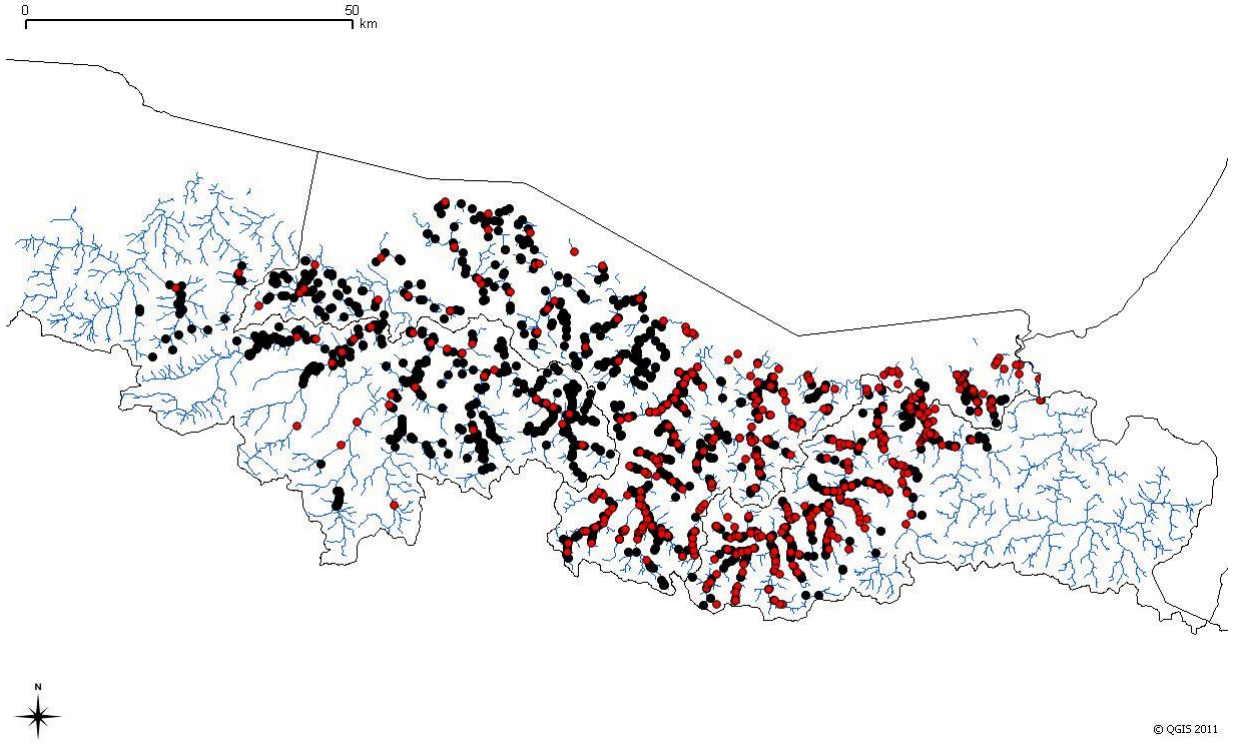
Database integration

Projecting the data on the river network



Dams impacts

- **Cumulative number of from the sea to the sampling strecth**
- **Accumulation of scores for the passability of eel at each structure**

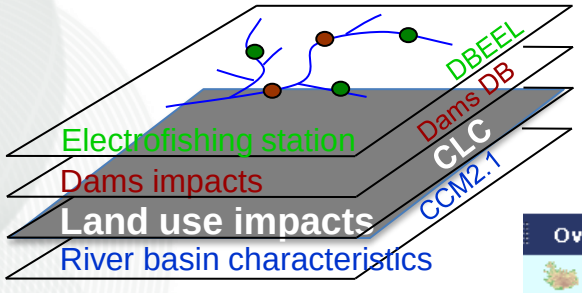


Sampling sites (in red) in the Basque EMU catchment on the CCM river network (in blue) with the dam locations (in black).

IMPLEMENTATION OF THE MODEL

Database integration

Projecting the data on the river network

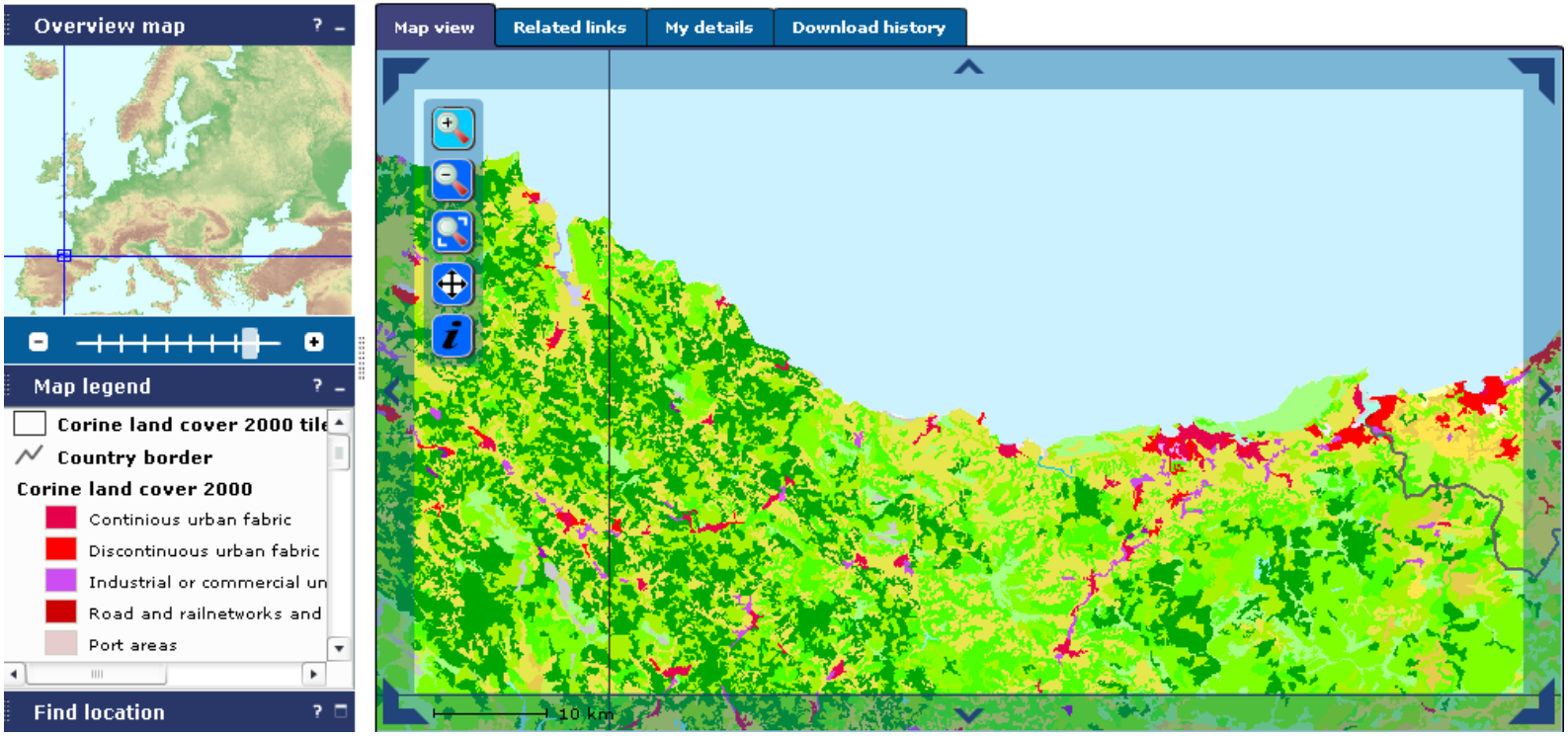


CLC; Corine Land Cover

Land use impacts

Anthropogenic conditions:

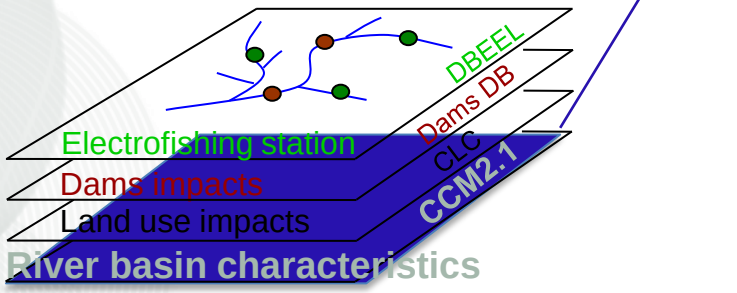
- **Land-use (Urban, Agricultural, No impact)**
- **Fishery**



IMPLEMENTATION OF THE MODEL

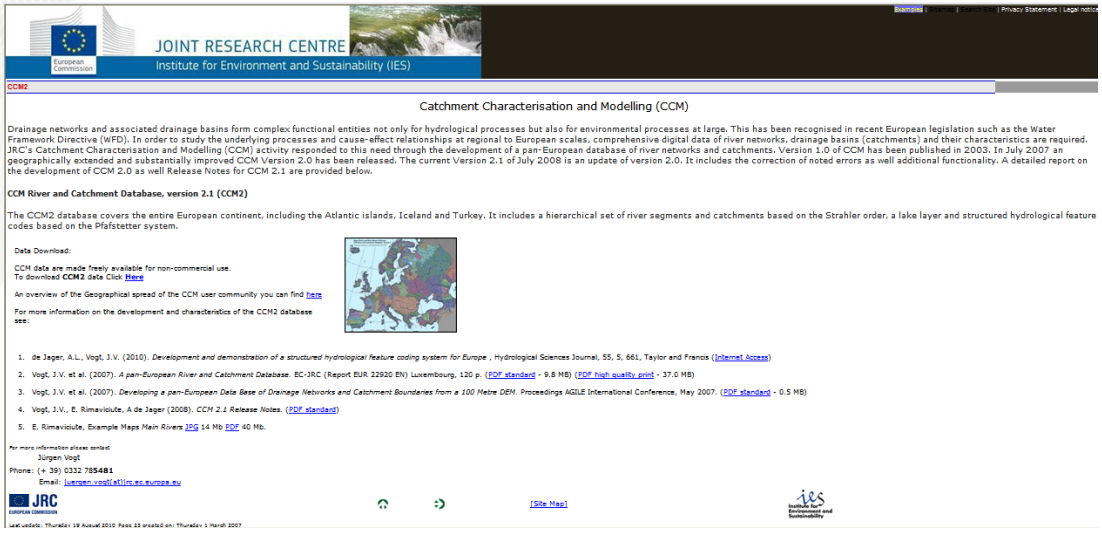
Database integration

Projecting the data on the river network



River basin characteristics

- Distance from the sea
- Distance from the source
- Relative distance
- Strahler and Shreve orders
- Mean elevation
- Mean slope
- Altitudinal gradient
- Area of drainage directly into the stretch
- Area of drainage upstream of the river stretch
- Temperature
- Rainfall



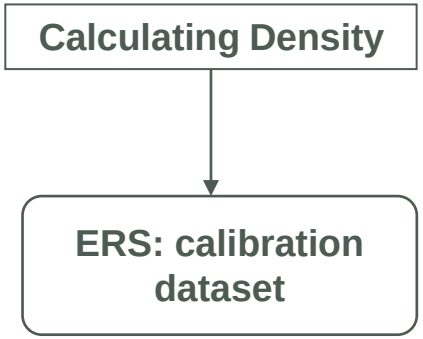
**CCM-
Catchment Characterisation y Modelling, Vogt y cols., 2007;
http://ccm.jrc.ec.europa.eu/**

IMPLEMENTATION OF THE MODEL

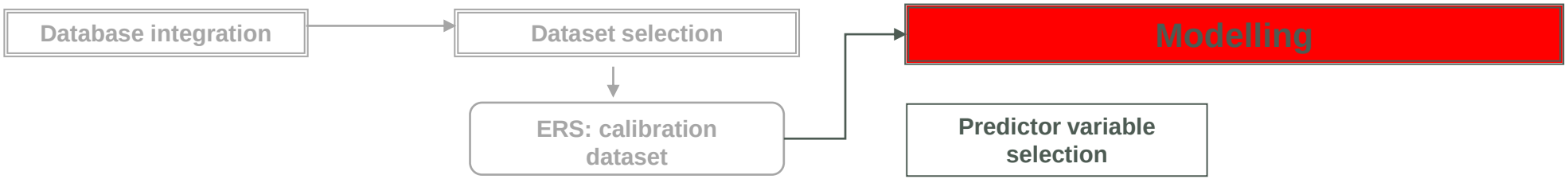
- Electrofishing sampling method →897 electrofishing operations

- Period → Between June and November from 1981 to 2009

- Sampling stations →277



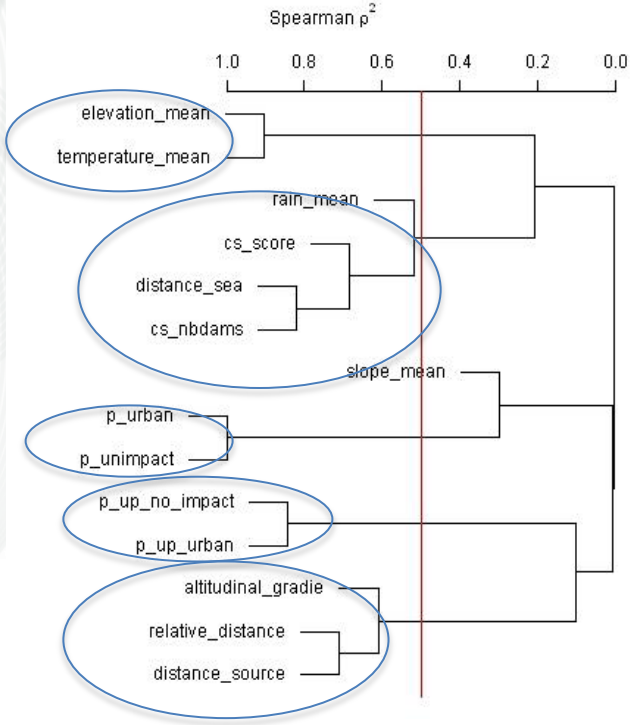
IMPLEMENTATION OF THE MODEL



- Representativeness of ERS / CCM (Chi² test or Fisher test)
- Hierarchical classification (Spearman correlation)

List of model to test

A combination of 16 variables was tested

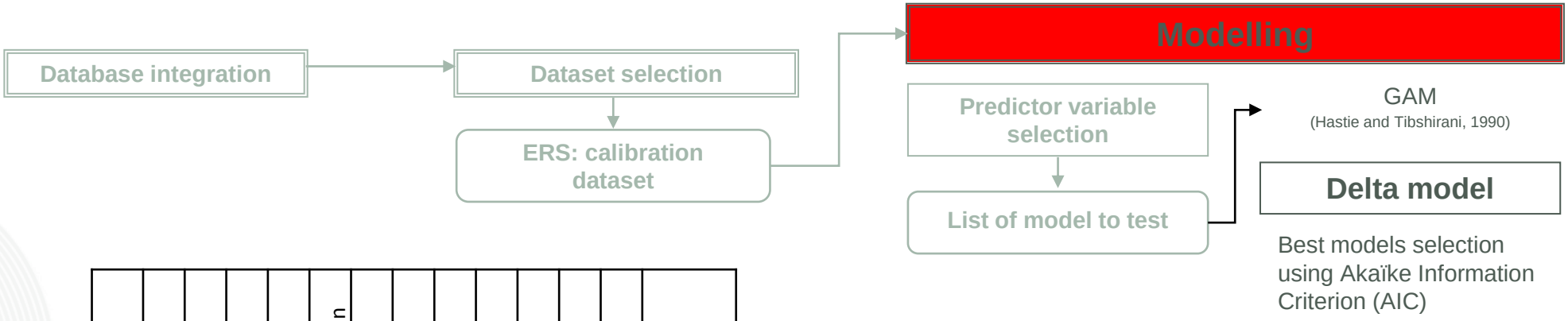


Several variables with tightly correlated predictors:

- Elevation and temperature
- Rain, cumulative number of scores, distance form the sea, cumulative number of dams
- P_urban, p_no_impact
- P_up_no_impact and p_up_urban
- altitudinal gradient, relative distance and distance from the source

The combination of the different groups resulted in 765 models to be tested

IMPLEMENTATION OF THE MODEL



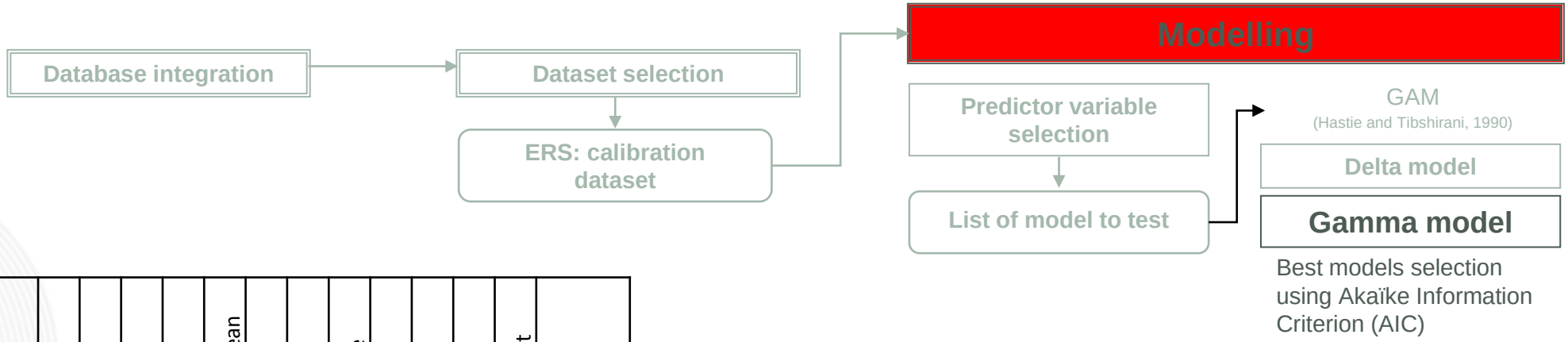
Model	year	month	elevation mean	rain mean	temperature mean	distance sea	distance source	relative distance	cs_nbdams	cs_score	p_up_urban	p_up_no_impact	AIC s=3
1	x	x	x			x			x		x		599.6
2	x	x	x				x		x		x		601.0
3	x	x		x				x		x		x	601.6
4	x	x	x			x			x			x	602.6
5	x	x		x				x	x			x	605.1
6	x	x	x					x	x			x	605.6
7	x	x	x					x	x		x		606.1
8	x	x	x				x		x			x	606.3
9	x	x	x						x			x	606.9
10	x	x	x						x		x		607.3

Kappa = 0.668 +- 0.028

Df Npar Df Npar Chisq P(Chi)
(Intercept) 1
s(annee, 3) 1 2 44.208 2.514e-10 ***
s(month, 3) 1 2 26.185 2.061e-06 ***
s(elev_mean, 3) 1 2 16.221 0.0003003 ***
s(distance_sea, 3) 1 2 12.243 0.0021941 **
s(cs_nbdams, 3) 1 2 15.311 0.0004736 ***
s(p_up_urban, 3) 1 2 17.249 0.0001796 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

IMPLEMENTATION OF THE MODEL

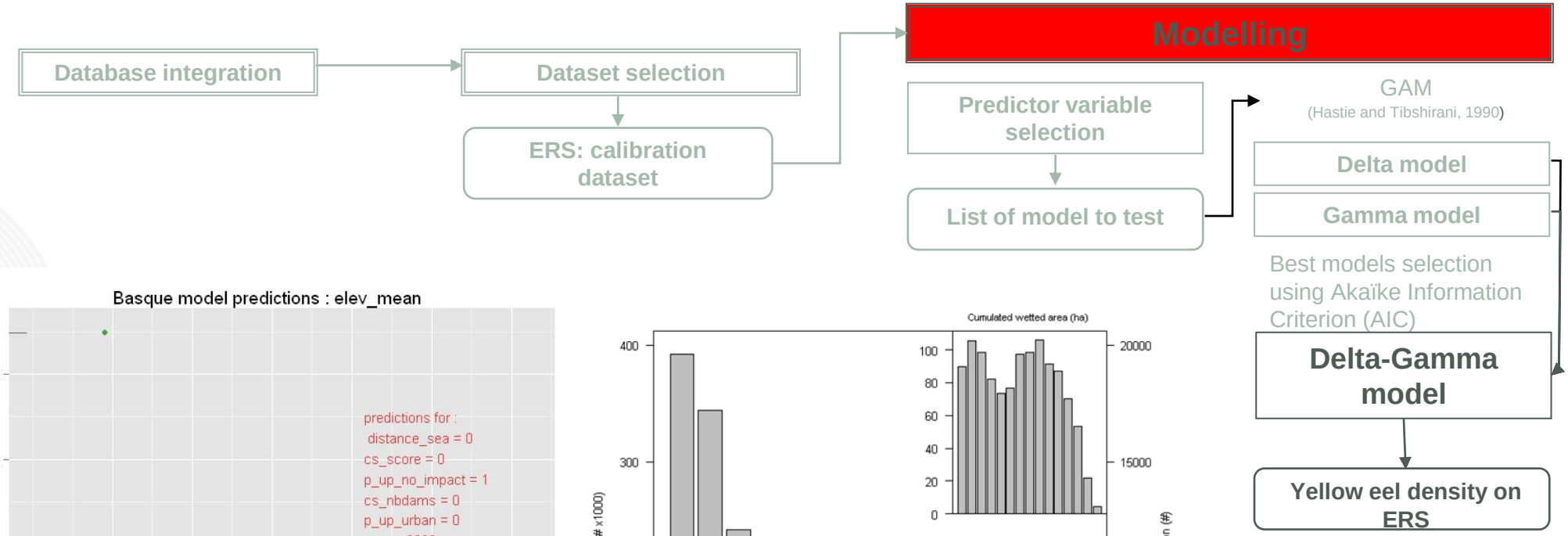


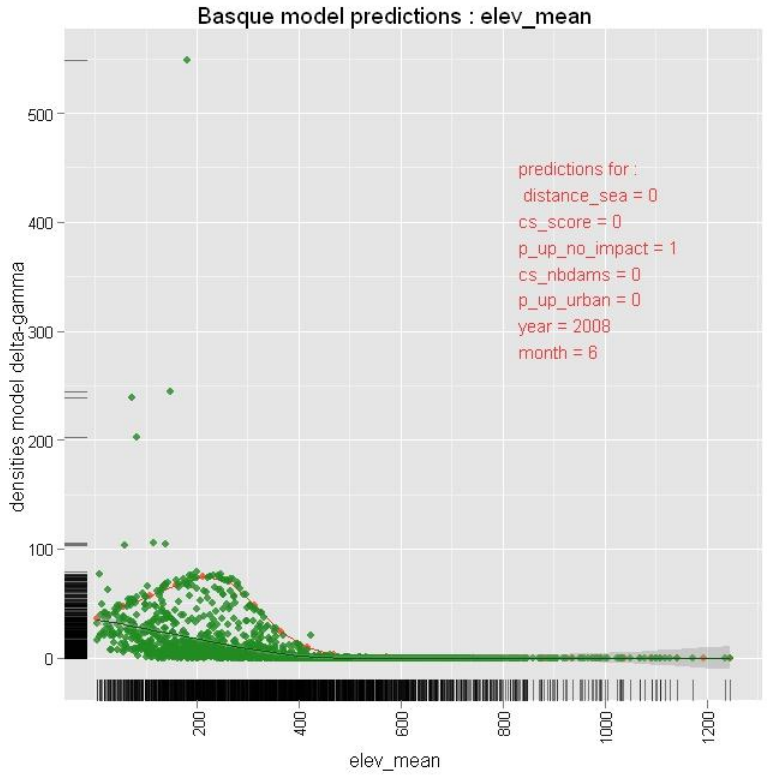
Model	year	month	elevation mean	rain mean	temperature mean	distance sea	distance source	relative distance	cs_nbdams	cs_score	p_up_urban	p_up_no_impact	AIC s=3
1	x	x	x			x				x		x	1552.6
2	x	x	x			x				x			1555.2
3	x		x			x				x		x	1555.4
4	x	x	x			x				x	x		1555.6
5	x	x	x				x					x	1555.7
6	x		x			x				x	x		1557.6
7	x		x			x				x			1557.8
8	x	x	x			x							1559.4
9	x	x	x			x	x						1560.4
10	x	x	x			x						x	1560.8

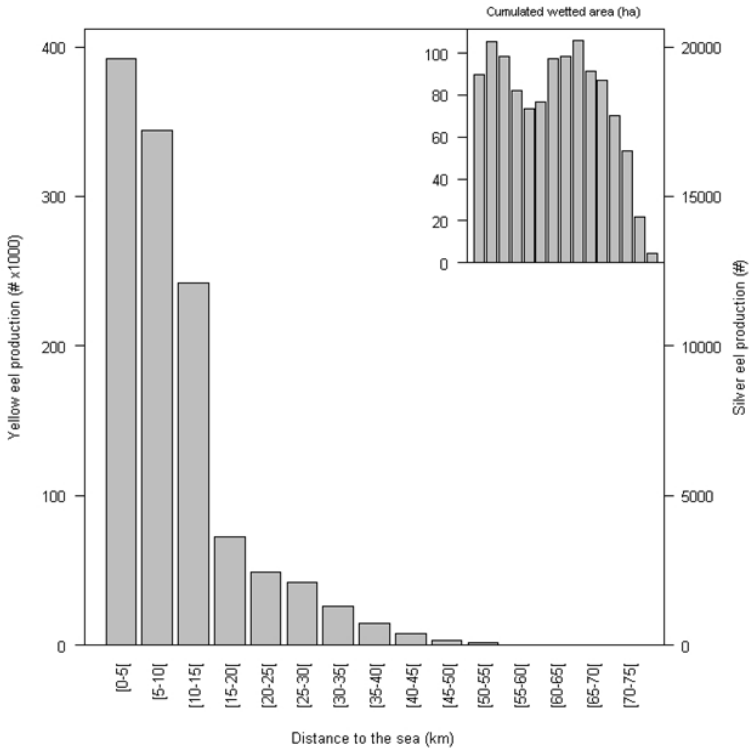
Df Npar Df Npar F Pr(F)
(Intercept) 1
s(annee, 3) 1 2.0 0.9403 0.39195
s(month, 3) 1 2.0 2.6477 0.07291 .
s(elev_mean, 3) 1 2.0 21.5014 2.629e-09 ***
s(distance_sea, 3) 1 2.0 1.7430 0.17723
s(cs_score, 3) 1 2.0 3.6828 0.02660 *
s(p_up_no_impact, 3) 1 2.1 3.4107 0.03220 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

IMPLEMENTATION OF THE MODEL

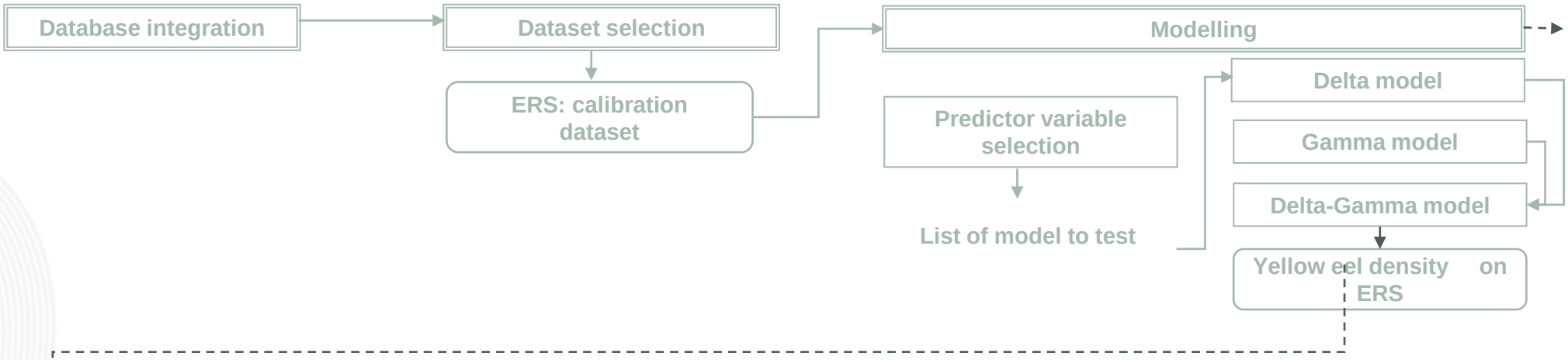


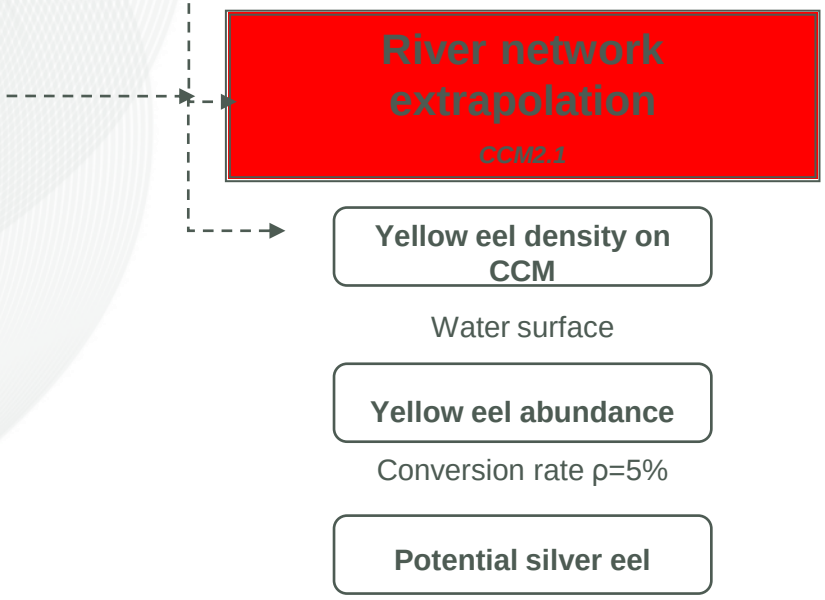




Yellow and silver eel production along the distance to the sea.

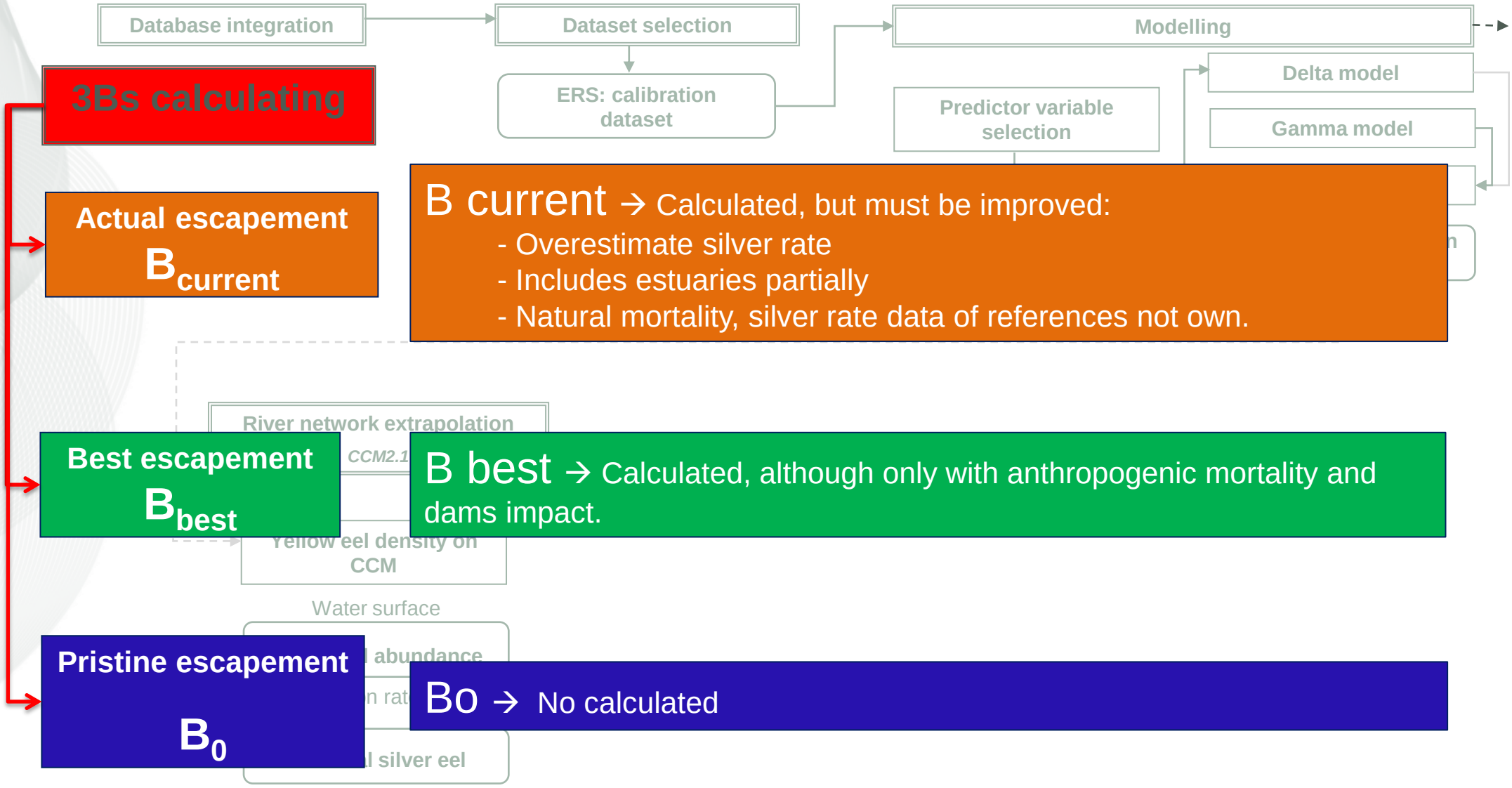
IMPLEMENTATION OF THE MODEL





MODEL OUTPUT		Data of Management Plan
Total water surface (km²)	11,56	13,7
Average number of yellow eel per 100 m²	10,34	7-10
Average number of silver eel per 100 m²	0,517	0.23- 0.28
Total number of yellow eel	1.195.163	
$N_{current}$: Total number of silver eel	59.758	

IMPLEMENTATION OF THE MODEL



Stregths

- The main stregth of EDA is that the method is widely applicable to the whole European rivers since it uses European river network databases.
- Open-source software.
- The approach is based on actual data of yellow eel abundance; data which are classically collected during surveys like those conducted for the European Water Framework Directive (WFD).
- The model is applied in France EMU at the national level and positive evaluation within the POSE project.

Weaknenesses

- Requires a considerable amount of historical (pseudo-pristine) and recent data (present or after management actions)
- Users have to know R and SQL language
- Requires knowledge of yellow-to-silver conversion rates (which are, generally poorly known)
- Absence of framework for uncertainty evaluation
- Does not include the minor streams, lakes and lagoons so the wetted area producing eel within an EMU may be underestimated

FUTURE WORK

- **Improvements in the implementation of EDA in the Basque Country**
  - **Adding our own data regarding:**
    - **Silvering**
    - **Natural Mortality**
    - **Antropogenic mortality**
  - **Compare EDA output with field sampling points data.**

ACNOWLEDGEMENTS

Project founded by Fundación Biodiversidad the Provincial Council of Gipuzkoa (Diputación Foral de Gipuzkoa) and the Basque Water Agency (URA).
A.Aranburu benefits from a Ph.D scholarship granted by the Department of Environment, Territorial Planning, Agriculture and Fisheries of the Basque Government.

REFERENCES

ICES (2010). Report of the Study Group on International Post-Evaluation on Eels (SGIPEE), 10-12 May 2010, Vincennes, France. ICES CM 2010/SSGEF:20, 42 pp.

Jouanin C., Briand C., Beaulaton L. & Lambert P. (2011). Eel Density Analysis (EDA 2.x) Un modèle statistique pour estimer l'échappement des anguilles argentées (Anguilla anguilla) dans un réseau hydrographique. Rapport final, Convention ONEMA-Cemagref. Cemagref, 103 p.

R Development Core Team (2011). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Vogt J., Soille P., and al. (2007). A pan-European river and catchment database. Luxembourg, Joint Research Centre-Institute for Environment and Sustainability: 120.

Walker A.M., Andonegi E., Apostolaki P., Aprahamian M., Beaulaton L., Bevacqua P., Briand C., Cannas A., De Eyto E., Dekker W., De Leo G., Diaz E., Doering-Arjes P., Fladung E., Jouanin C., Lambert P., Poole R., Oeberst R., Schiavina M. (in press) Studies and pilot projects for carrying out the common fisheries policy. Lot 2: Pilot projects to estimate potential and actual escapement of silver eel for The European Commision, Directorate-General for Maritime Affairs and Fisheries, Final Report, October 2011.

Thank you very much for your attention!!!!

Moltes gràcies per la seva atenció!!!

Muito obrigado pela vossa atenção!!!

Eskerrikasko zuen arretagatik!!!

www.azti.es | www.alimentatec.com | www.itsasnet.com

T. +34 94 657 40 00

Txatxarramendi ugartea z/g
48395 Sukarrieta, Bizkaia

Herrera Kaia, Portualdea z/g
20110 Pasaia, Gipuzkoa

Astondo Bidea, Edificio 609
Parque Tecnológico de Bizkaia
48160 Derio, Bizkaia