



“LitterDrone: Development and Exploitation of Innovative Tools for Remote Marine Litter Control and Management through UAV’s”

Universidade de Vigo



Supported by:



With the collaboration of:



Co-funded by the UE



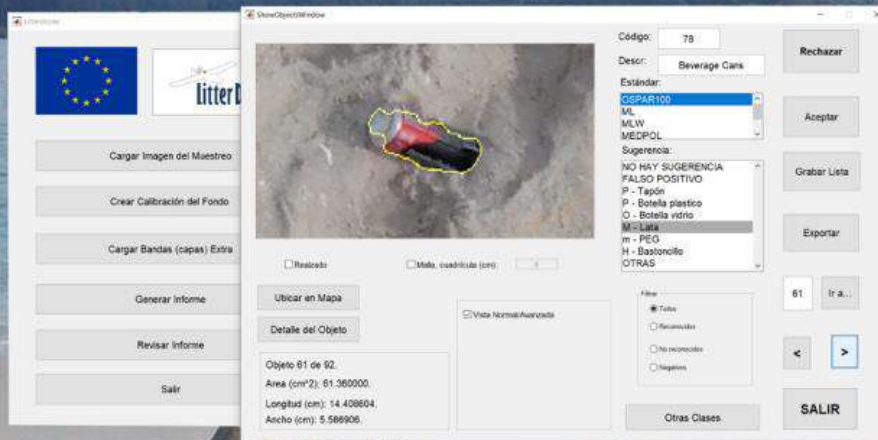


THE PROJECT



Litter Drone

DRONE-BASED IMAGE ACQUISITION + COMPUTER BASED IMAGE ANALYSIS



¿WHAT IS MARINE LITTER?

Man made solid waste that, for any cause, are abandoned in marine or coastal environment



SOURCE: PNUMA

LITTERDRONE ORIGIN

- Marine litter **characterization** as a key factor to eradicate them
- Official **monitoring** program for marine litter on beaches (MAPAMA)
- **Standardization** and **automation** of marine litter characterization



SOURCE: Surfrider España

FUNDED BY EU (BLU-LABS PROGRAM)



➤ EASME/EMFF/2016/1.2.1.4

Blue Labs

Innovative Solutions for Maritime Challenges



➤ Supported by:



➤ With Collaboration of:



➤ Partners:



UniversidadeVigo



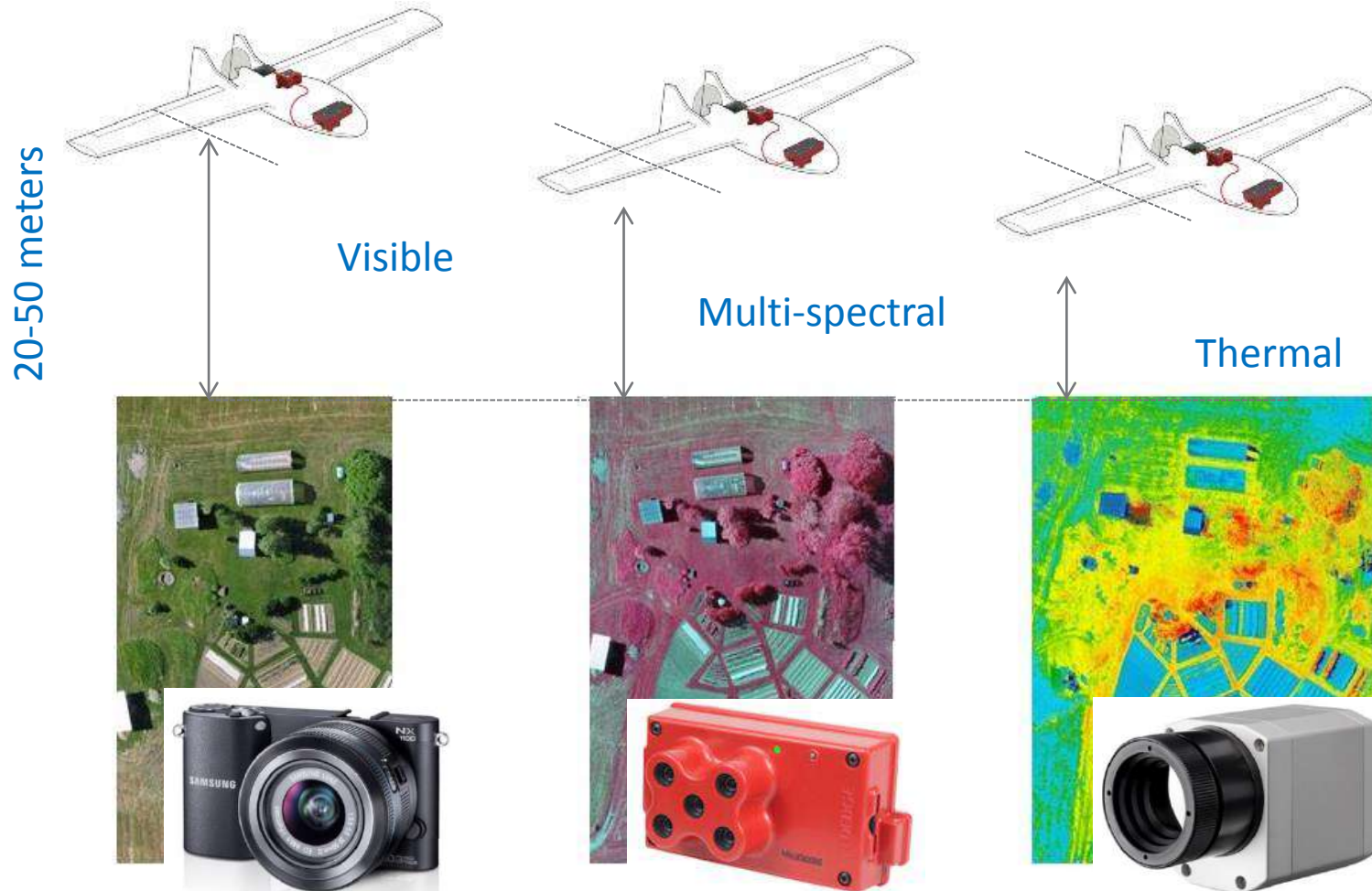


DRONES & FLIGHTS



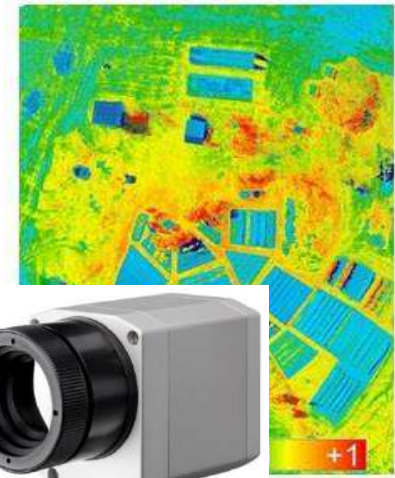
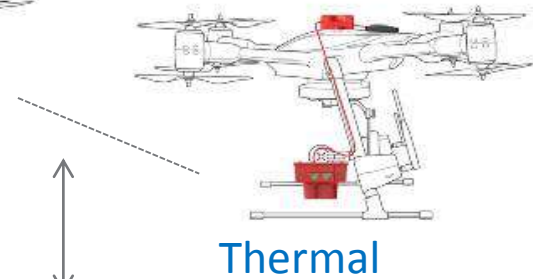
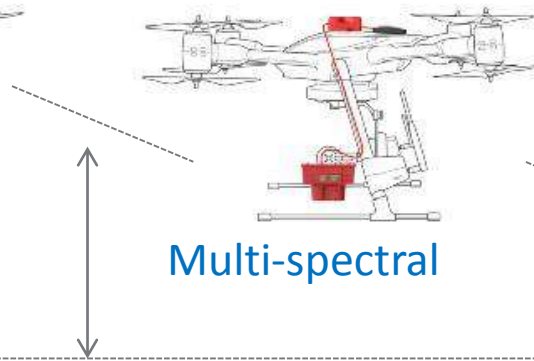
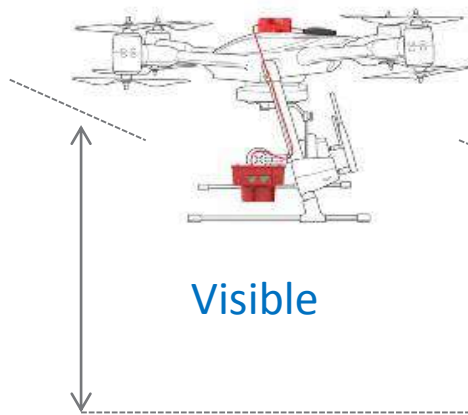
Litter Drone

UAV'S & CAMERAS



UAV'S & CAMERAS

10-15 meters



REAL FLIGHTS



IMAGE ACQUISITION: ORTHO-PHOTO

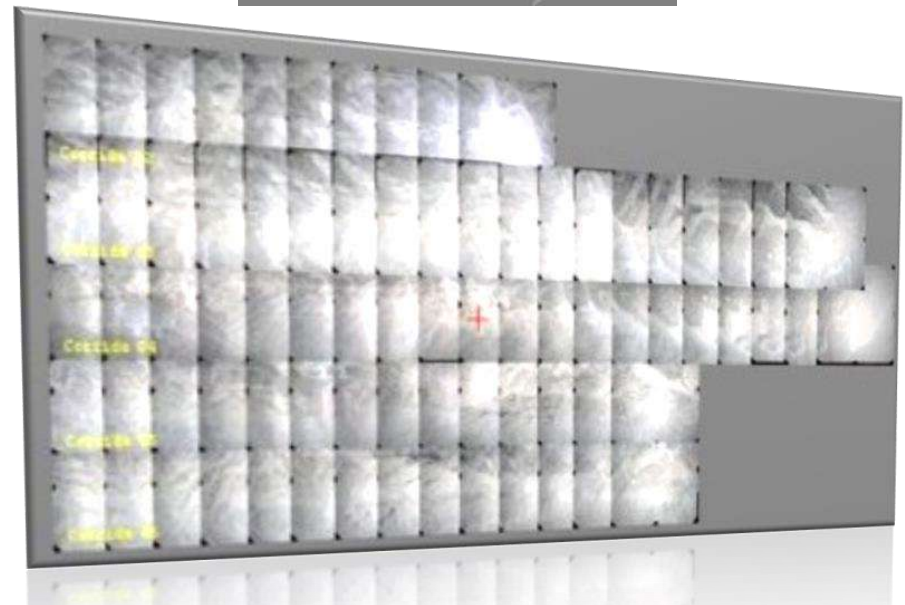
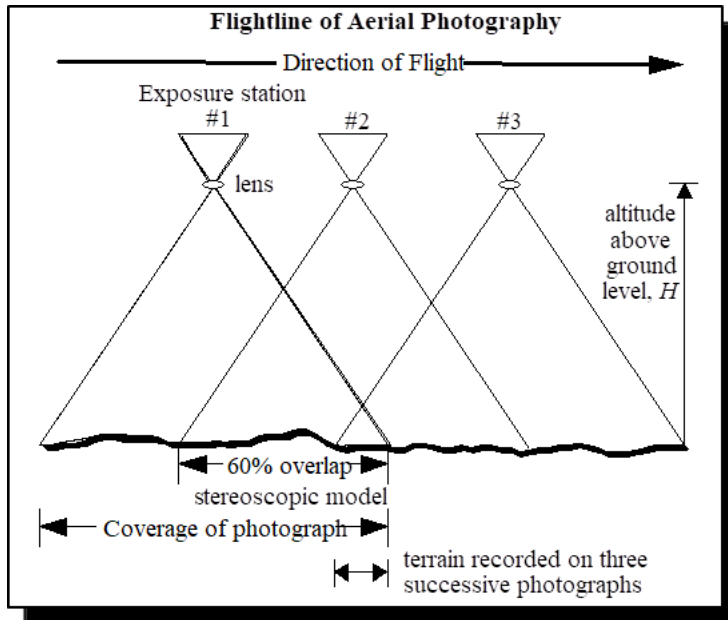
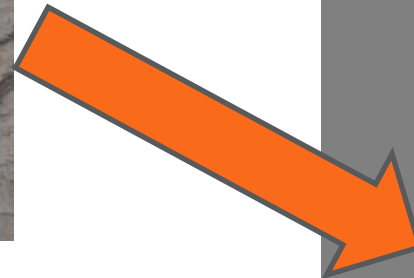


IMAGE ACQUISITION: ORTHO-PHOTO



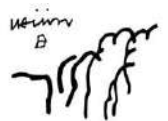
Photomodeler: from photos to
Ortho-photo (geo-referenced,
exact)



TEST ZONE



- Flying on one of the monitored beaches: “playa de Rodas” (Galician Atlantic Islands Maritime-Terrestrial National Park)
- Detection of true marine litter and comparison with official data
- Flying on another (non monitored) beach



PARQUE NACIONAL MARÍTIMO TERRESTRE
DAS ILLAS ATLÁNTICAS
DE GALICIA

With the collaboration of

REAL FLIGHTS

Flight transects



Flight with individual
photo shots labelled





IMAGE PROCESSING

Litter Drone

IMAGE PROCESSING

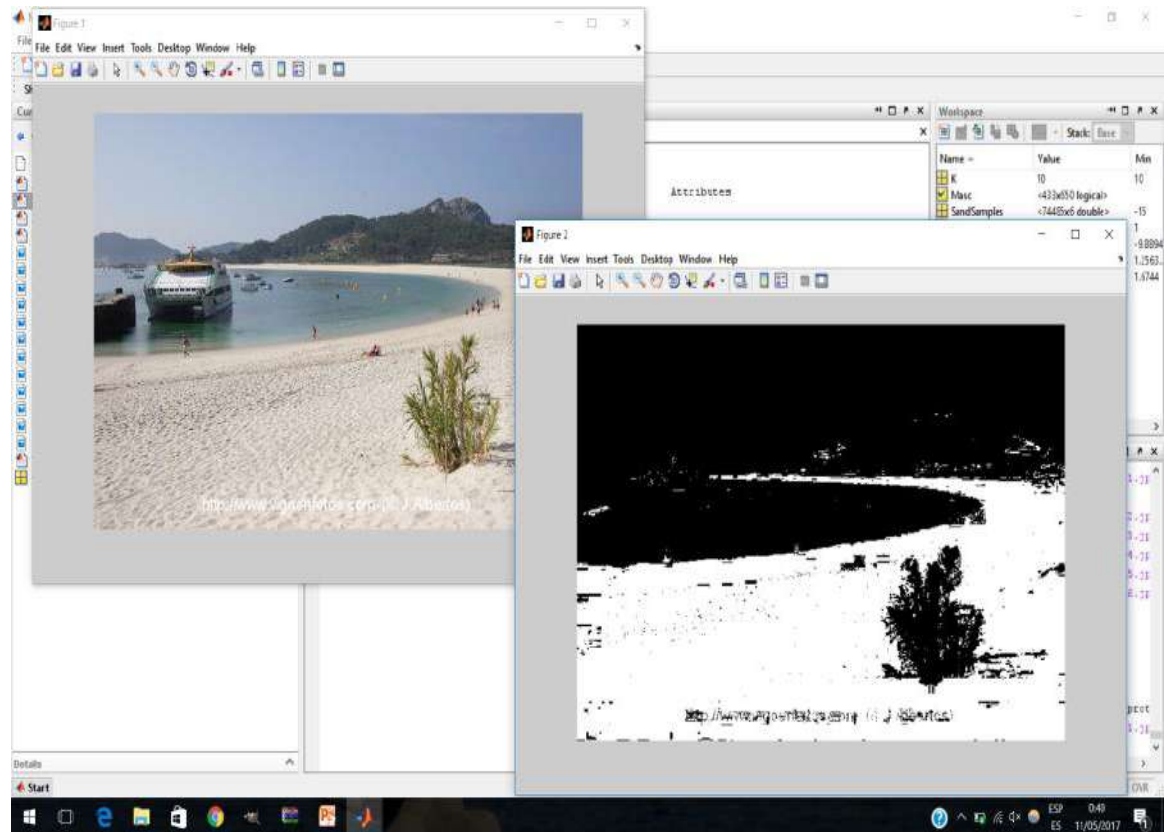


Objects detection with beta version:
sand characterization

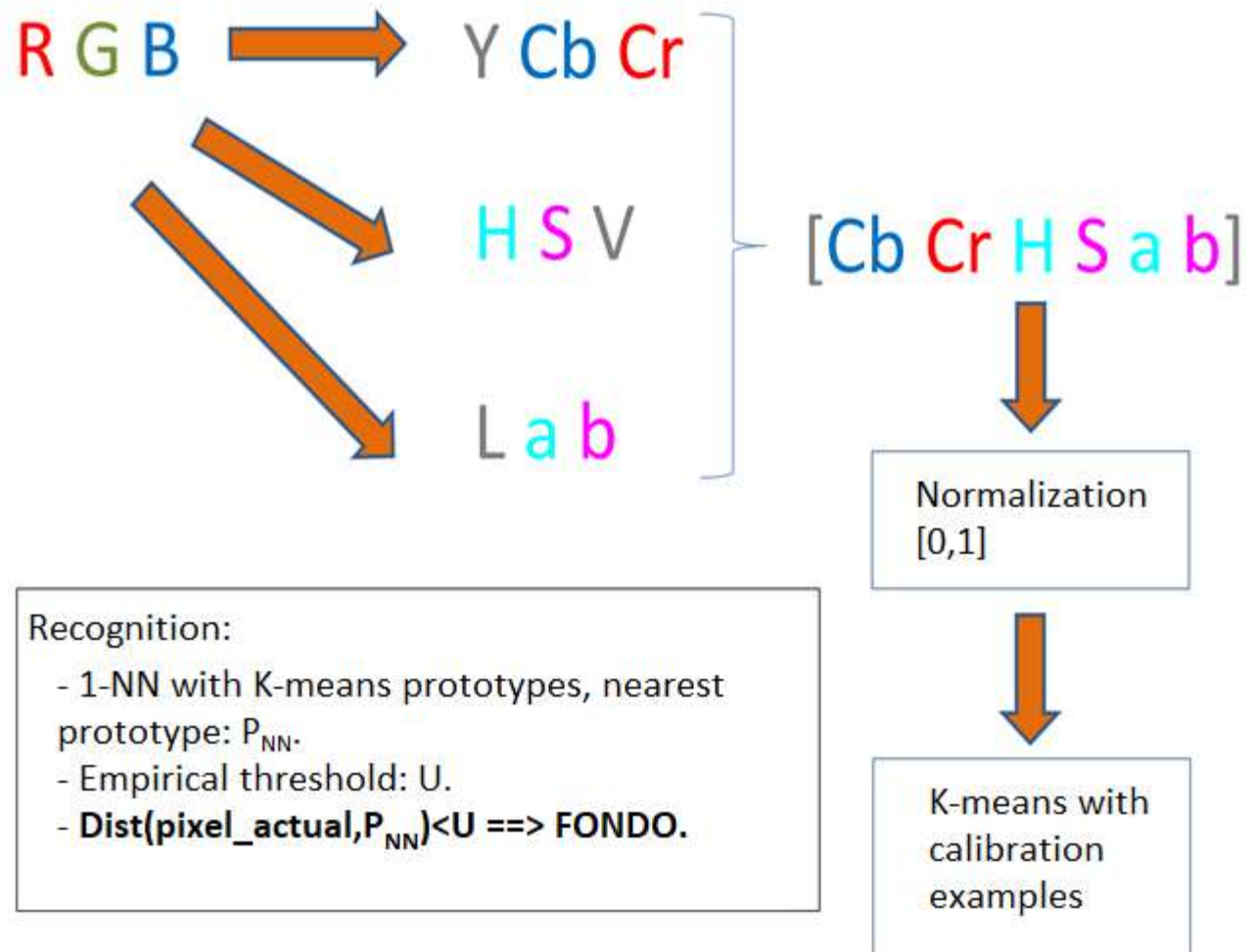
IMAGE TYPE: RGB

VISIBLE

CONVENTIONAL CAMERA

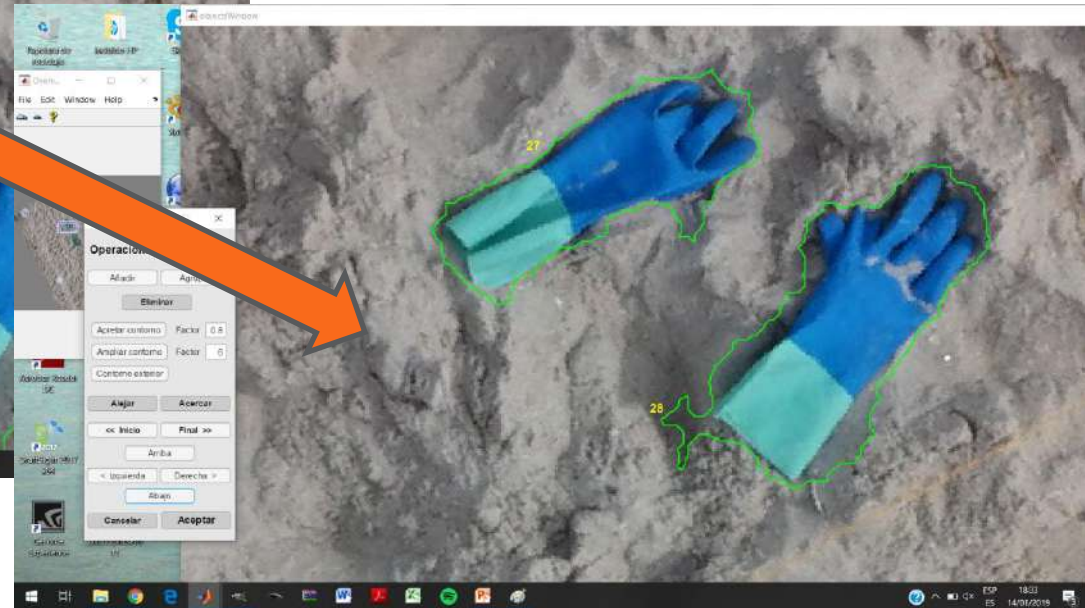
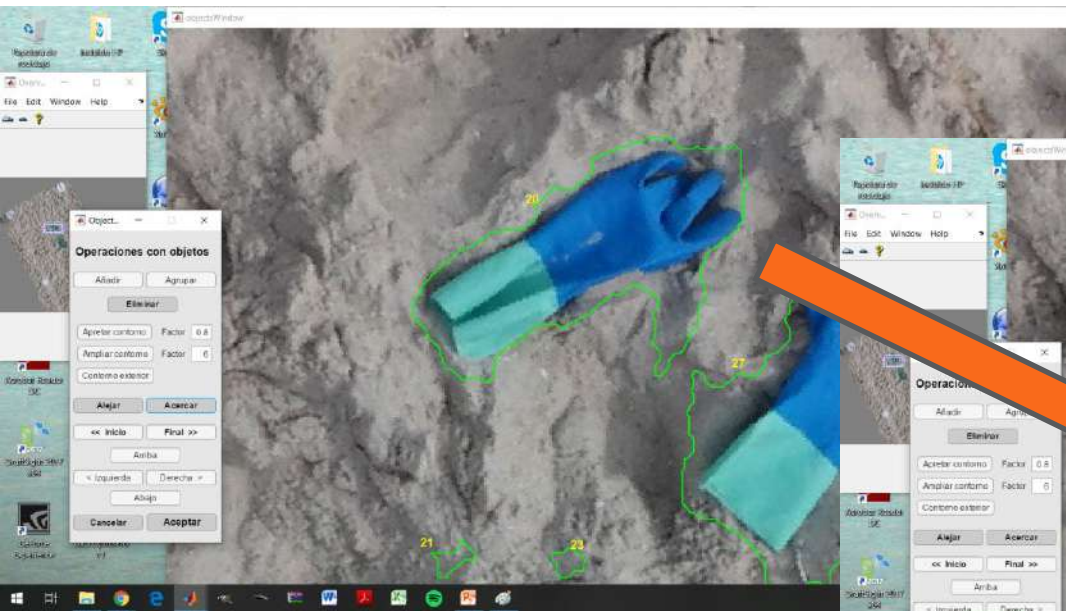


SAND CHARACTERIZATION



SAND CHARACTERIZATION (method II)

Use of differential components (R-G, R-B, G-B).



Future Lines:

Use of normalized differential indexes: $(c2-c1)/(c1+c2)$

OBJECT DETECTION

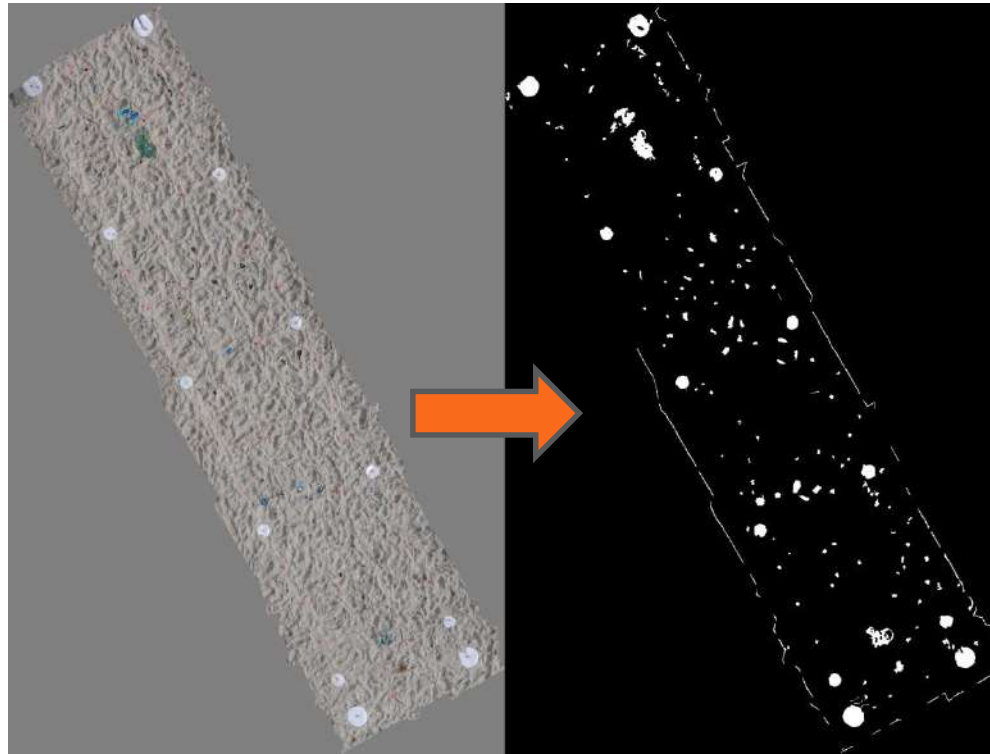
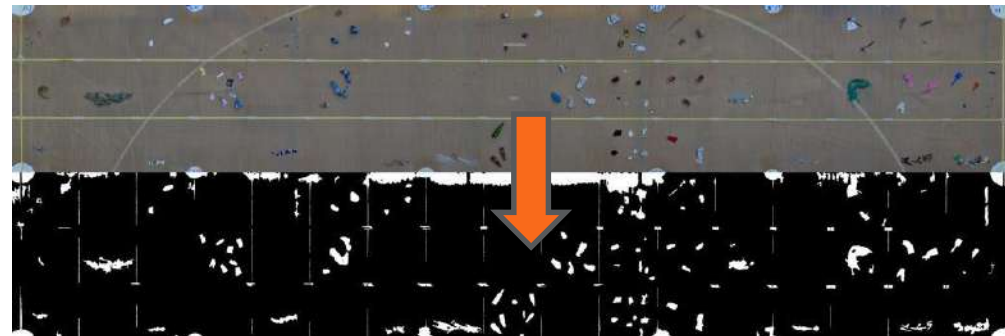


IMAGE TYPE: RGB

VISIBLE,
CONVENTIONAL CAMERA



GLOBAL REPORT



**FAST &
AUTOMATIC**

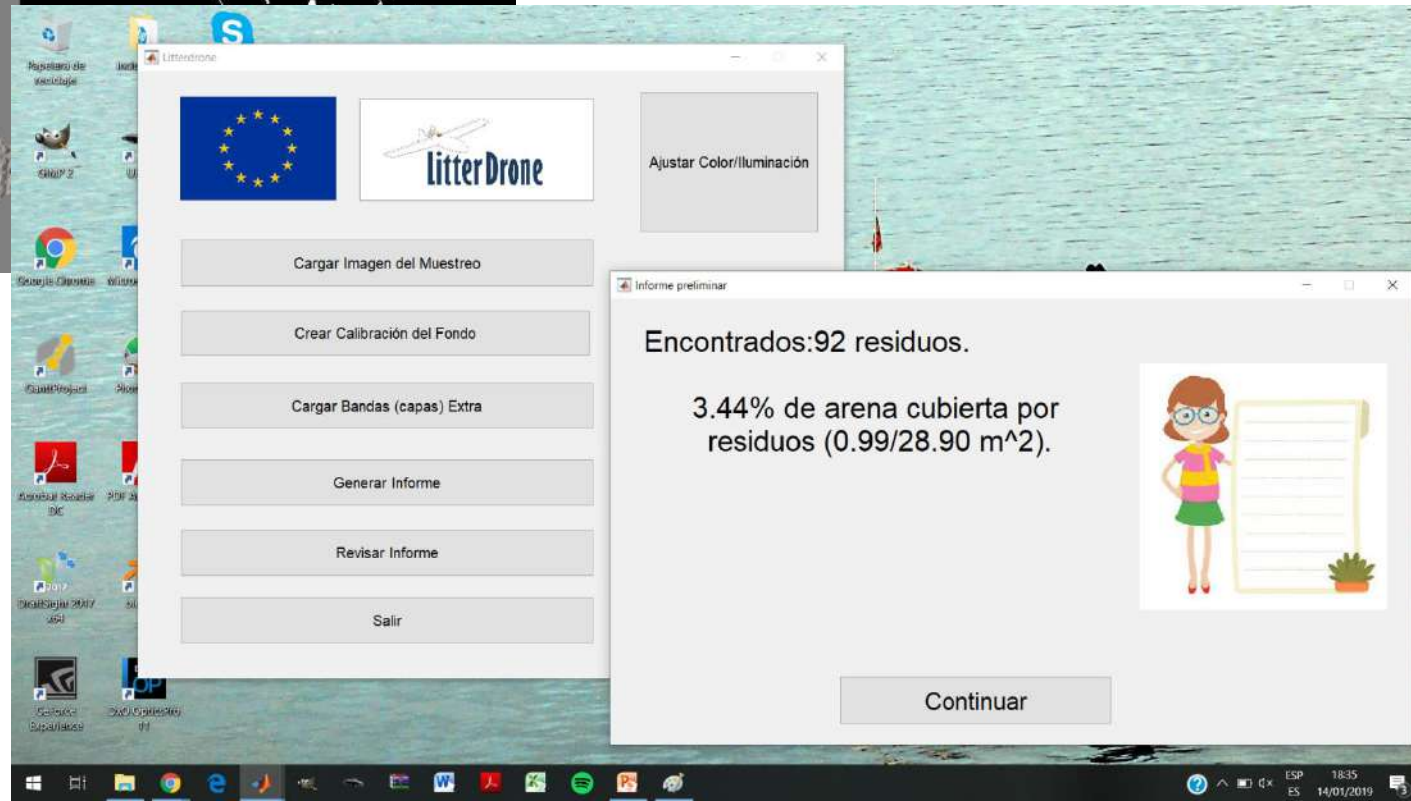


IMAGE SUPERPOSITION

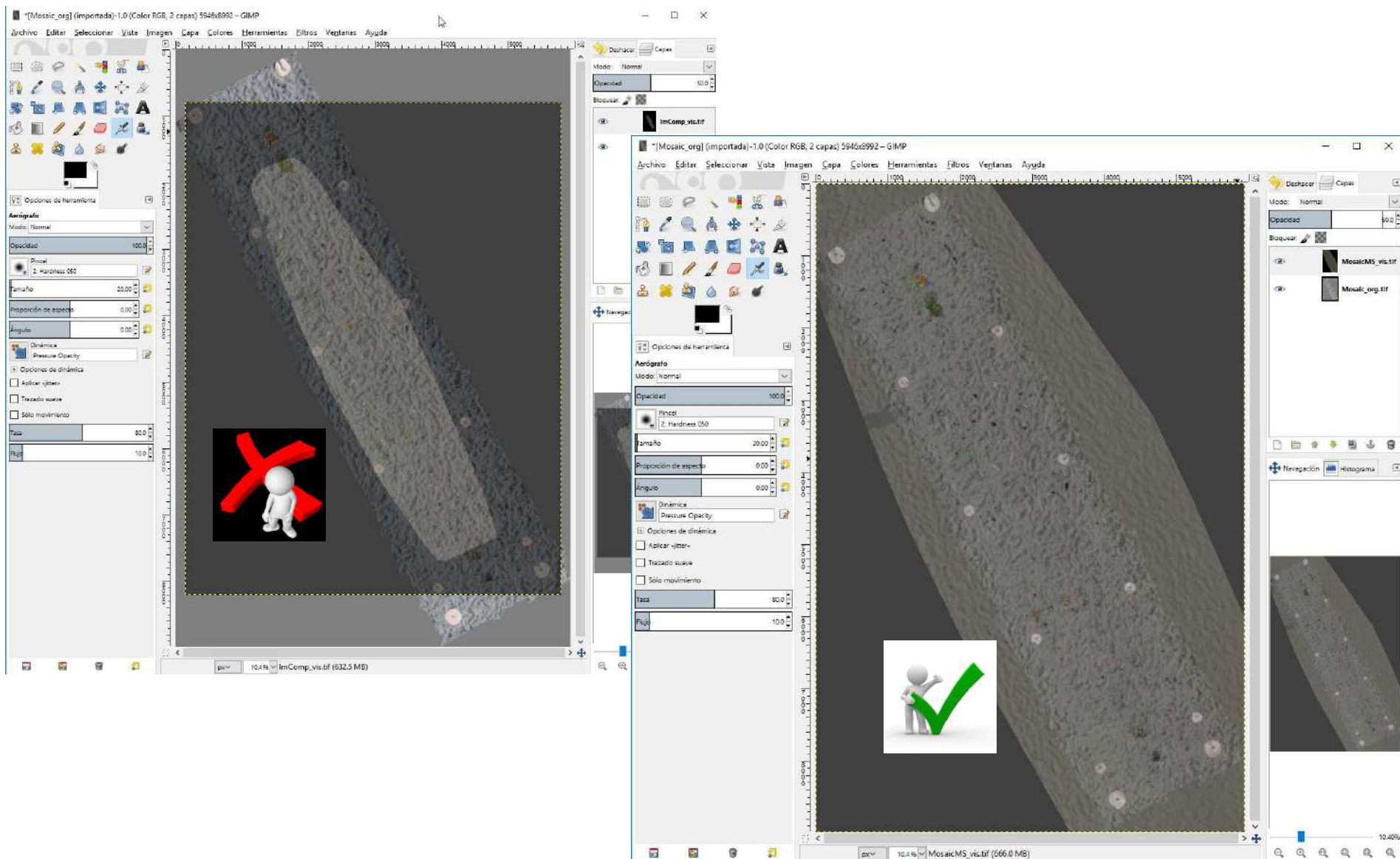


IMAGE SUPERPOSITION: methods



- Manual selection of (at least three control points) and affine transformation.
- Use of geo-referentiation files: scale info + one control point from image origins.
- Manual introduction of scale info + one control point (for displacement).

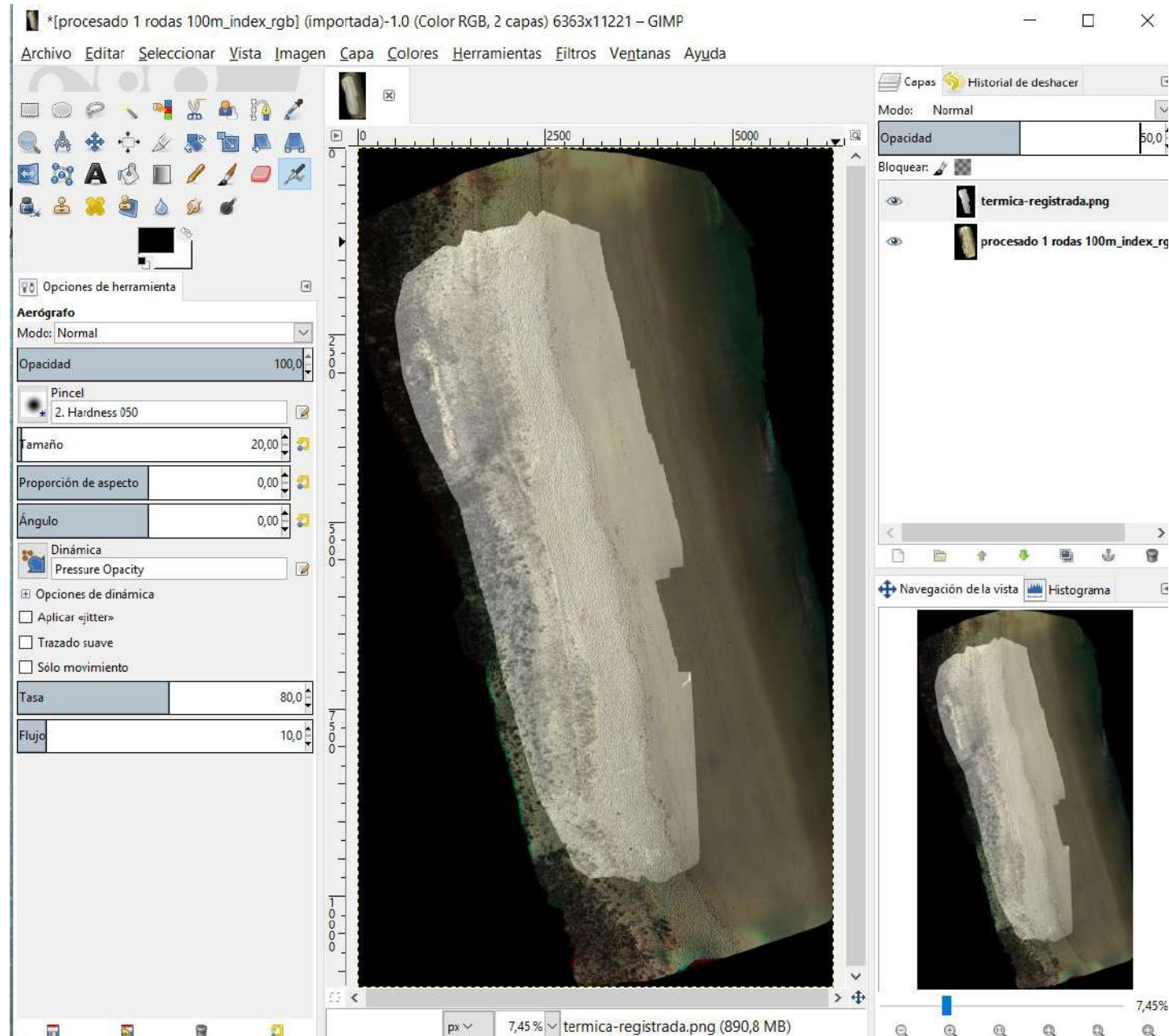
Future Lines:

- Two control points → definition of two “control vectors” → enough to deduce scale info and displacement).

IMAGE SUPERPOSITION:



e
x
a
m
p
l
e



OBJECT RECOGNITION

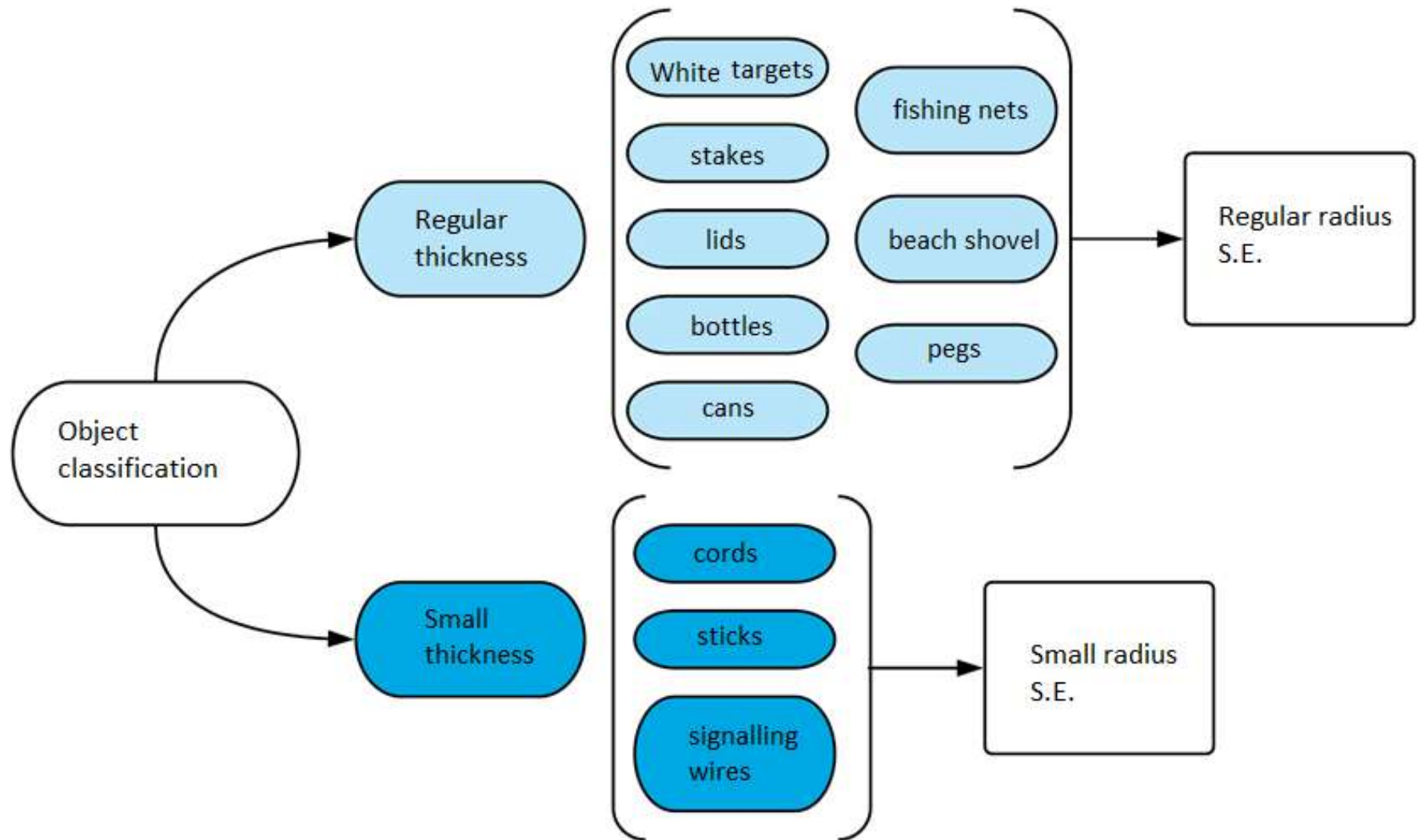


Automatic recognition of more common objects: lids, bottles, cans, sticks...
and also auxiliary objects (white targets)

The screenshot displays the Litter Drone software interface. On the left, a sidebar contains buttons for 'Cargar Imagen del Muestreo', 'Crear Calibración del Fondo', 'Cargar Bandas (capas) Extra', 'Generar Informe', 'Revisar Informe', and 'Salir'. The main window, titled 'ShowObjectsWindow', shows a satellite image of a red and black beverage can with a yellow bounding box. Below the image are checkboxes for 'Realzado' and 'Malla, cuadrícula (cm): 5'. To the right of the image is a list of object classes: 'Código: 78', 'Descr: Beverage Cans', 'Estándar: OSPAR100', 'Sugerencia: NO HAY SUGERENCIA, FALSO POSITIVO, P - Tapón, P - Botella plástico, O - Botella vidrio, M - Lata, m - PEG, H - Bastoncillo, OTRAS'. Below this list are buttons for 'Rechazar', 'Aceptar', 'Grabar Lista', 'Exportar', and 'SALIR'. At the bottom, there are buttons for 'Ubicar en Mapa', 'Detalle del Objeto', and 'Otras Clases'. The 'Detalle del Objeto' section shows: 'Objeto 61 de 92.', 'Area (cm^2): 61.360000.', 'Longitud (cm): 14.408604.', and 'Ancho (cm): 5.586906.'.

Objeto 61 de 92.
Area (cm²): 61.360000.
Longitud (cm): 14.408604.
Ancho (cm): 5.586906.

OBJECT RECOGNITION



OBJECT RECOGNITION



Decision tree is implemented computing discriminant functions.
For class i , at stage n , we take into account feature value x :

$$D_i^{n+1} = D_i^n \cdot d_i(x)$$

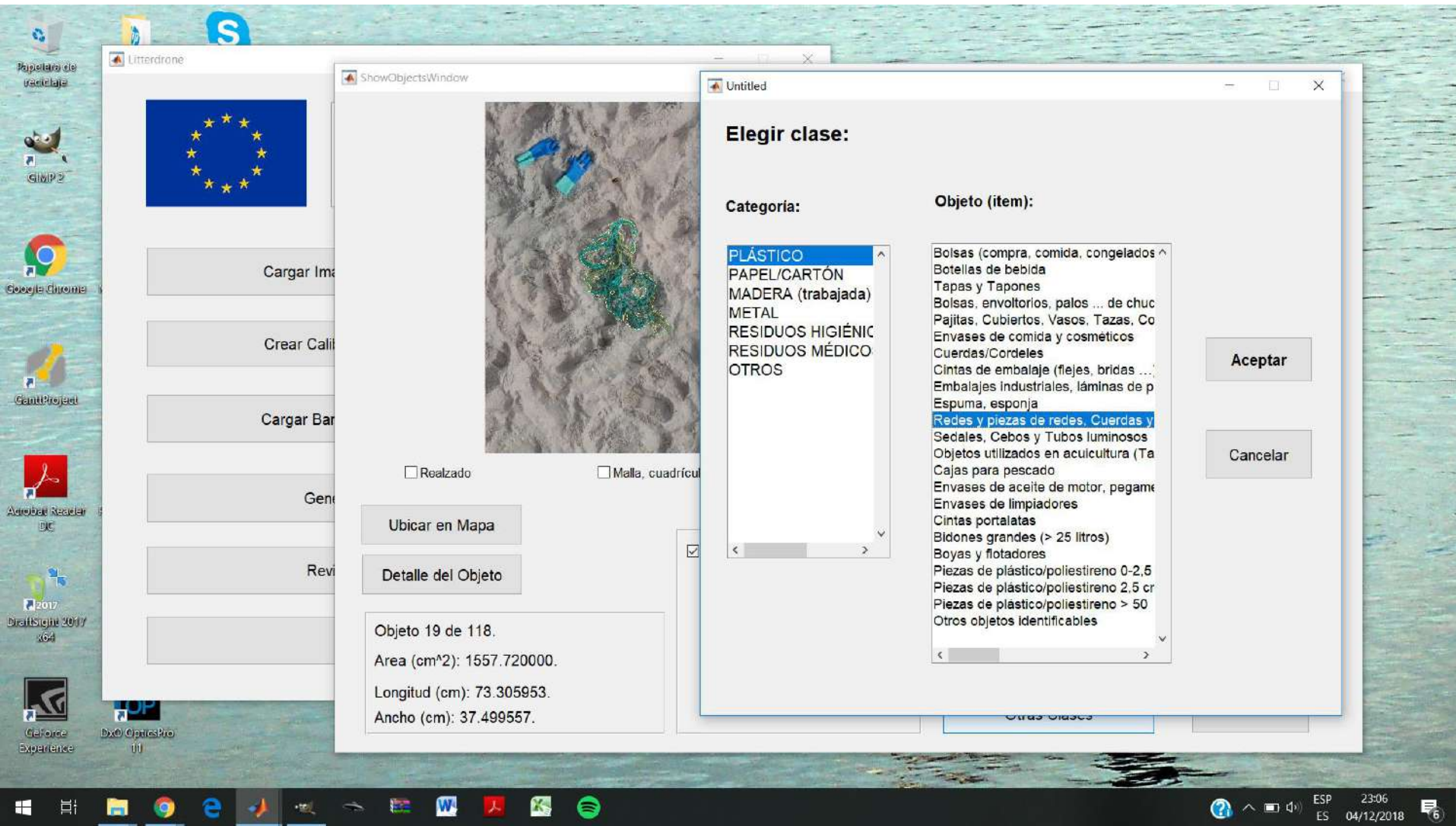
$$d_i(x) = \begin{cases} 0, & x > x_{max} \cup x < x_{min} \\ \exp \left[-\frac{1}{2} \left(\frac{x - x_{med}}{x_{desv}} \right)^2 \right] & \end{cases}$$

Empirical equations inspired by Bayes rule and gaussian distribution.

OBJECT RECOGNITION



Human correction of non recognized objects





CONCLUSIONS



Litter Drone

CONCLUSIONS



➤ Interesting project, ended at January, 2019.

➤ Future Lines:

- ✓ Testing New Cameras.
- ✓ Improving Object Recognition.
- ✓ Jump to Market.

**MEETING OF DRONE TECHNOLOGY, REMOTE
SENSING AND COMPUTER VISION,
MORE PROJECTS OF THIS KIND ARE EXPECTED IN
THE FUTURE**

THANK YOU !

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LITTERDRONE PROJECT

The **LitterDrone** project seeks to develop innovative tools for the control and management of marine litter through unmanned drones.

[PROJECT](#)[CONTACT](#)

www.litterdrone.eu