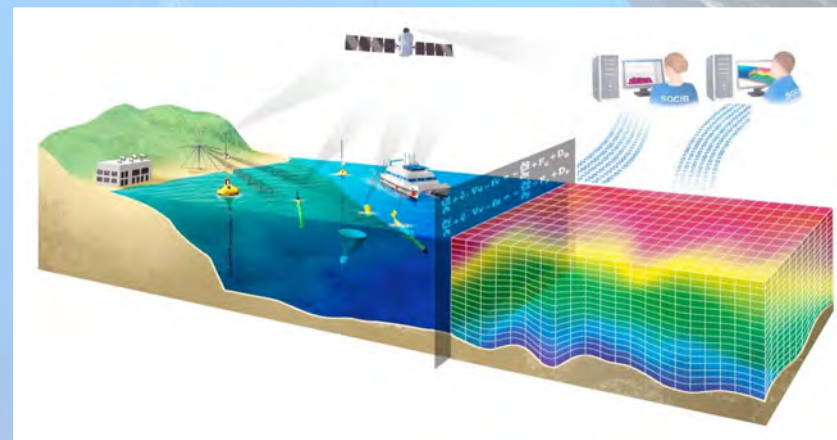


9th EuroGOOS International Conference, 3-5 May 2021

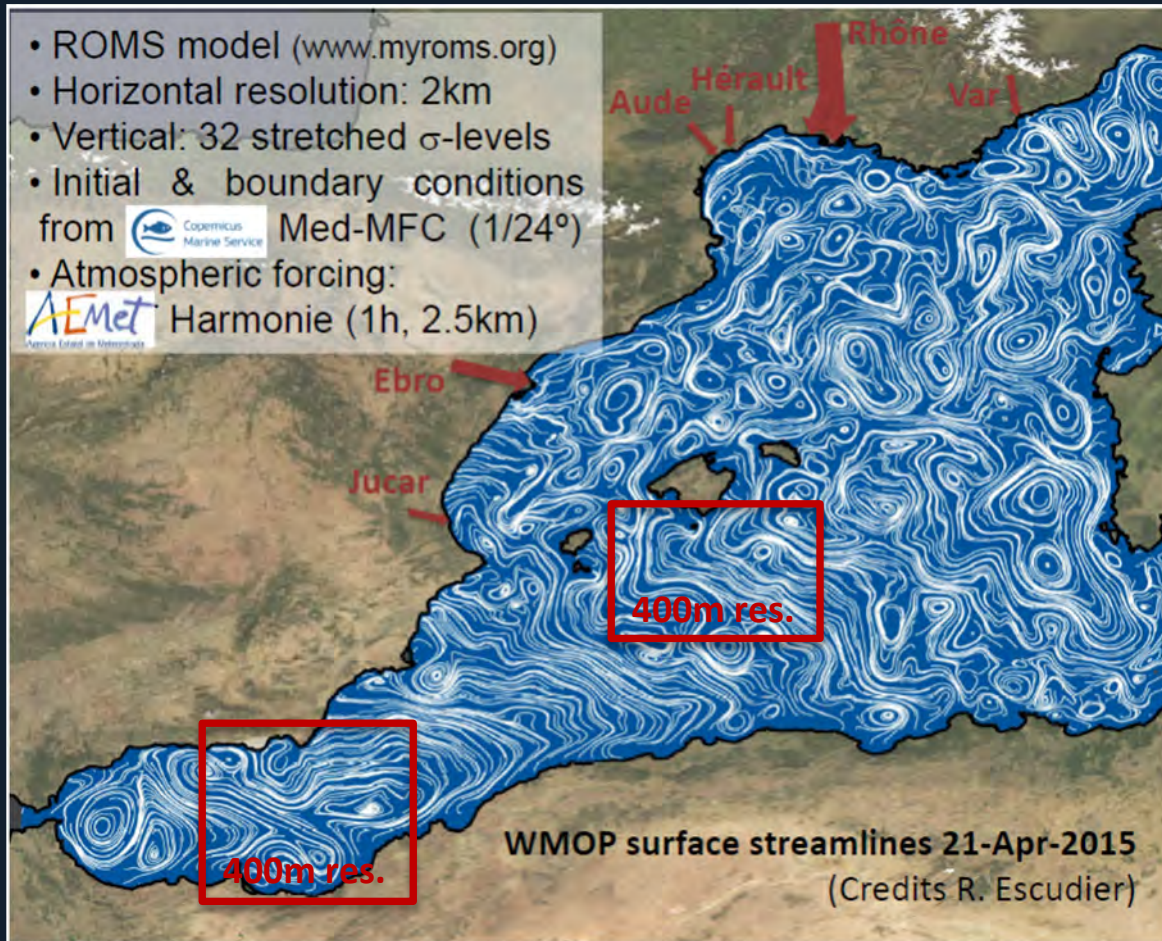
Coastal ocean forecasting advances and recent applications of the Western Mediterranean Operational modelling system (WMOP)

Baptiste Mourre
Alex Santana
Jaime Hernández-Lasheras
Eva Aguiar
Máximo Garcia-Jove
Eugenio Cutolo
Adèle Révelard
Emma Reyes
Luis Francisco Ruiz-Orejón
Nikos Zarokanellos
• Joaquín Tintoré
& SOCIB team

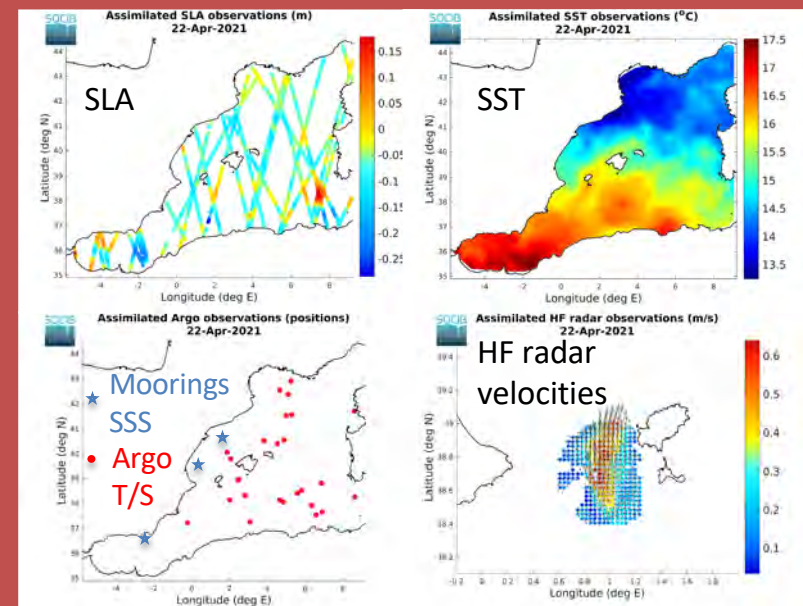


WMOP modelling system

[Juza et al. 2016; Mourre et al. 2018; Hernández-Lasheras and Mourre 2018; Aguiar et al. 2020]



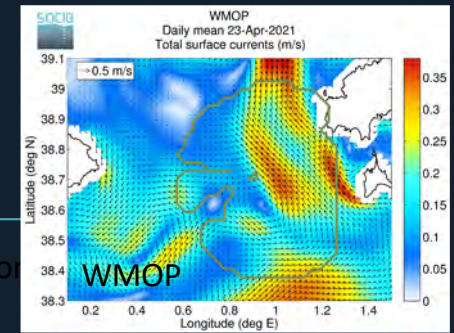
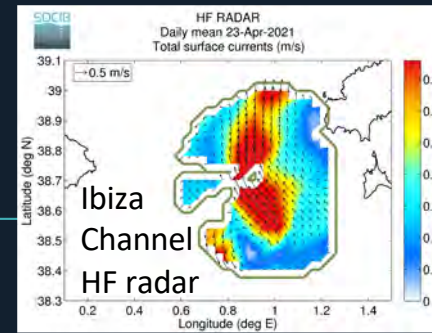
Data assimilation:
Ensemble Optimal Interpolation
with 3-day cycles



+ glider T/S in reanalysis simulations

? High-res. mesoscale-resolving simulations, from sub-basin to coastal scales
Daily predictions (72-hour horizon) @www.socib.es,
hindcasts [2009-2018] & reanalysis of specific periods of interest

Model evaluation



NRT & DT

[Link](http://www.socib.es)

www.socib.es



Glider



Ship-based
CTDs



Satellite



s

Mooring



Argo

fl ifremer



WMOP
simulations

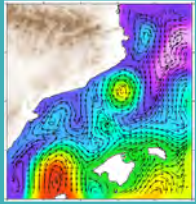
Surface



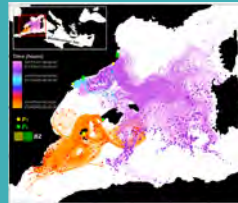
HF
Puertos del Estado
lar



WMOP applications



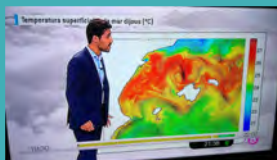
Science



- Ocean process studies: mesoscale to fine-scale
- Support to sea trial experiments and glider navigation
- Evaluation of the impact of observations
- Impact of hydrodynamics on ecosystems
- Analysis of larval and plastics dispersion
- Ocean connectivity studies



Society



- Search-and-rescue
- Response to emergencies
- Lifeguards Mobile App
- Forensic science
- Support to open water swimming

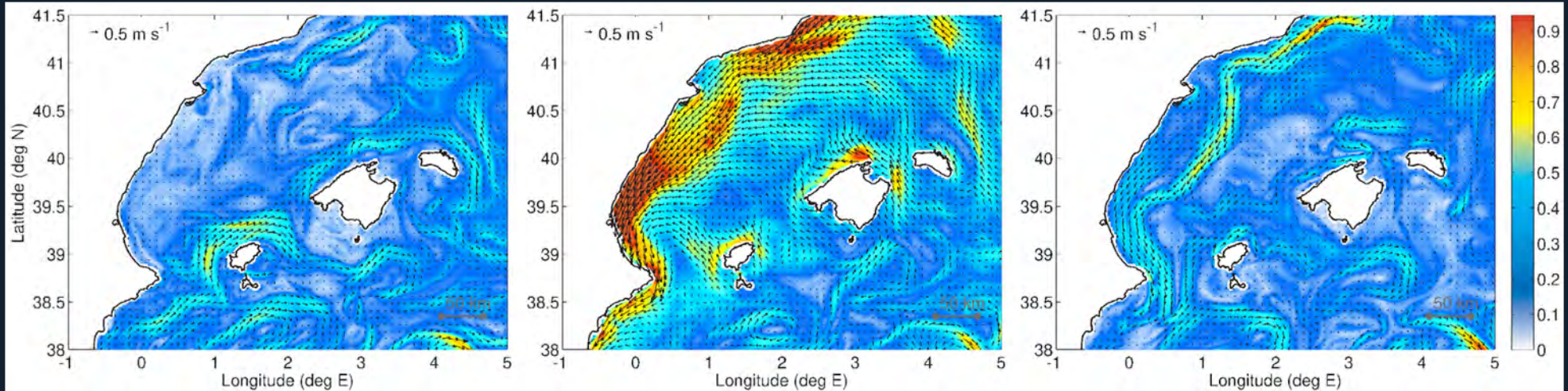
Model assessment during record-breaking Gloria storm

(Sotillo et al., 2021)

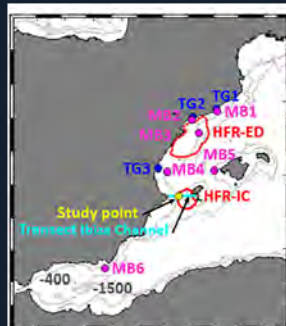
Pre-storm - 18 Jan 2020

Storm peak - 20 Jan 2020

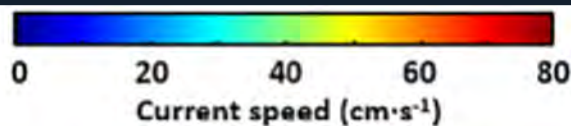
Post-storm - 23 Jan 2020



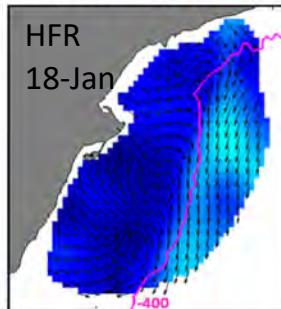
Model evaluation



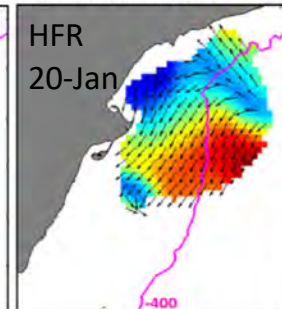
Ebro delta
HF radar data



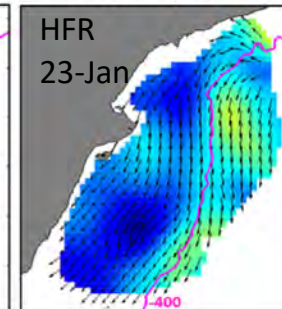
HFR-ED: 18 January 2020



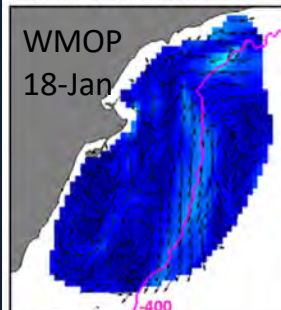
HFR-ED: 20 January 2020



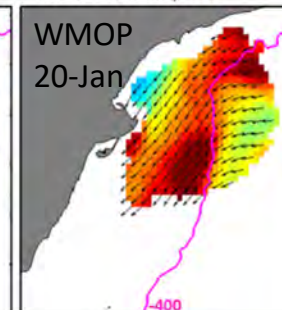
HFR-ED: 23 January 2020



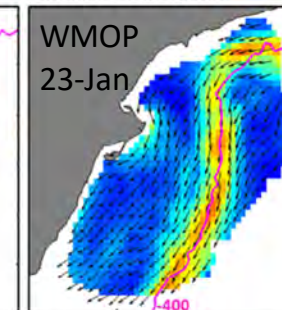
WMOP: 18 January 2020



WMOP: 20 January 2020



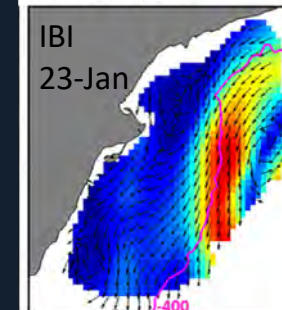
WMOP: 23 January 2020



(Credits P. Lorente)

+ comparison to
CMEMS models

IBI: 23 January 2020

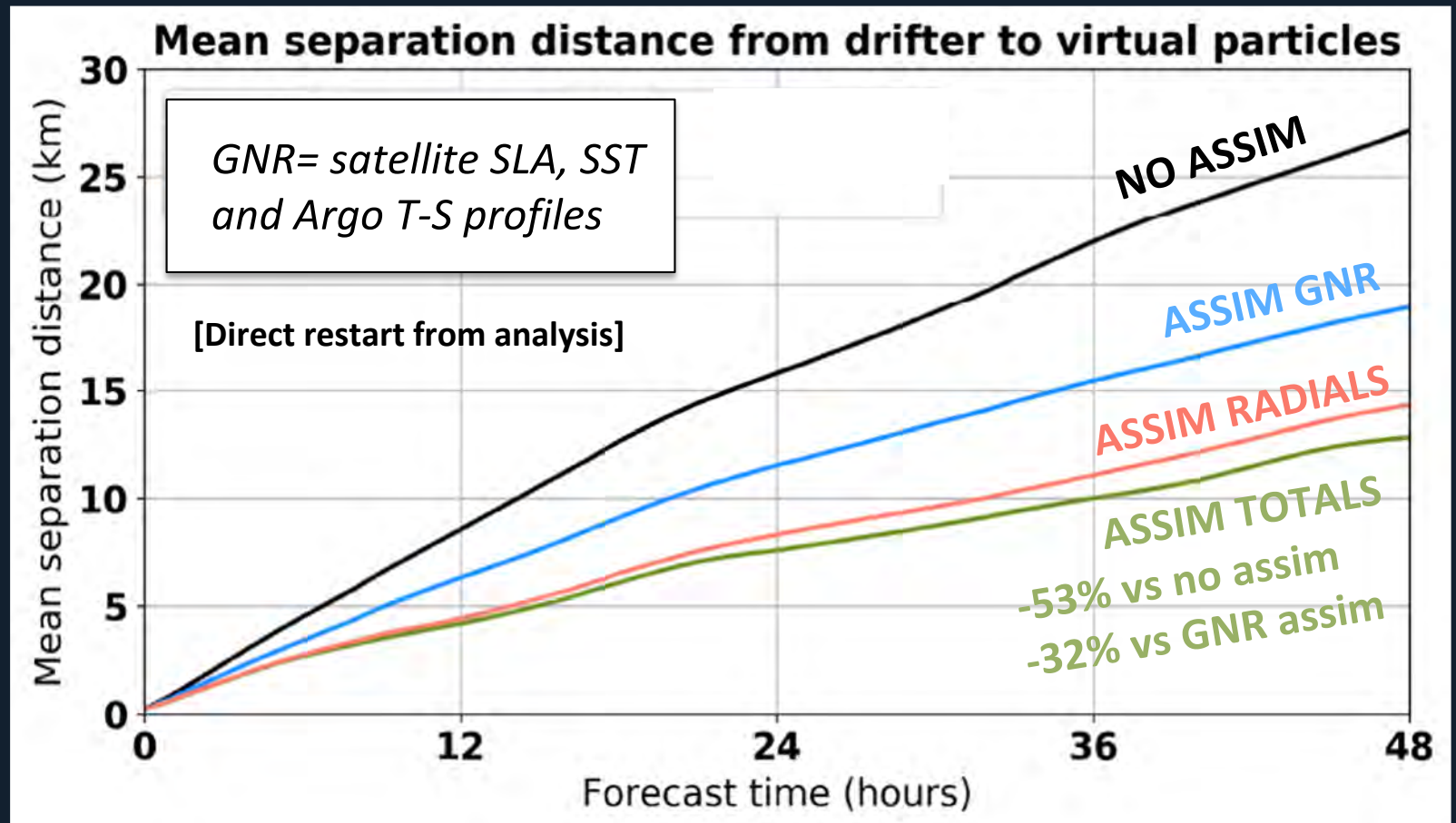
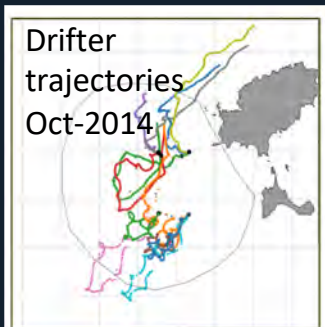


Impact of observations through data assimilation

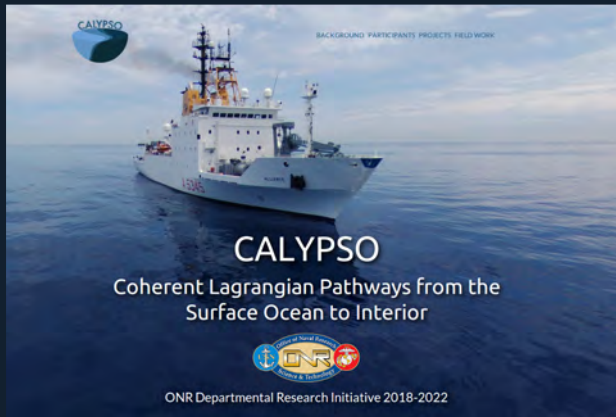
(Hernández-Lasheras et al., Ocean Science, 2021, submitted)

Impact of HF radar data assimilation in the Ibiza Channel

- Validation using the trajectories of 14 drifters during 10 days
- Comparison of the impact of HFR radial and reconstructed total velocities

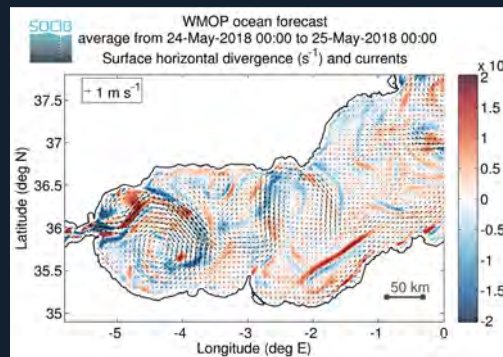
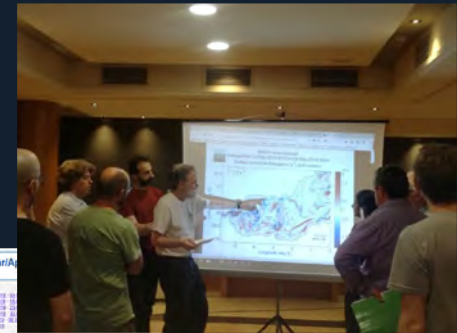


Support to sea trial experiment: CALYPSO



<https://calypsodri.who.edu/>

□ Focused on the understanding of three-dimensional pathways of water parcels in the upper ocean



CALYPSO Field Experiment Support

Date	Time	Lat	Lon	Depth	Temp	Sal	Chl	OC2	OC3	OC4	OC5	OC6	OC7	OC8	OC9	OC10	OC11	OC12	OC13	OC14	OC15	OC16	OC17	OC18	OC19	OC20
14 Apr 2019	00:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	01:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	02:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	03:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	04:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	05:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	06:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	07:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	08:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	09:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	10:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	11:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	12:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	13:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	14:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	15:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	16:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	17:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	18:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	19:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	20:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	21:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	22:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
14 Apr 2019	23:00	36.5N	5.0W	0.0m	18.5	35.8	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Model Products from the Latest 24hr SOCIB WMOP Forecasts Initialized
14 April 2019

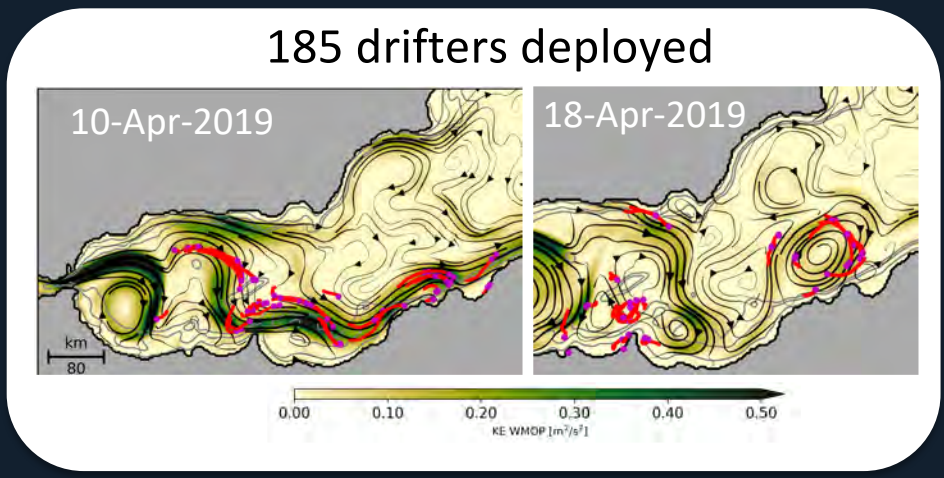
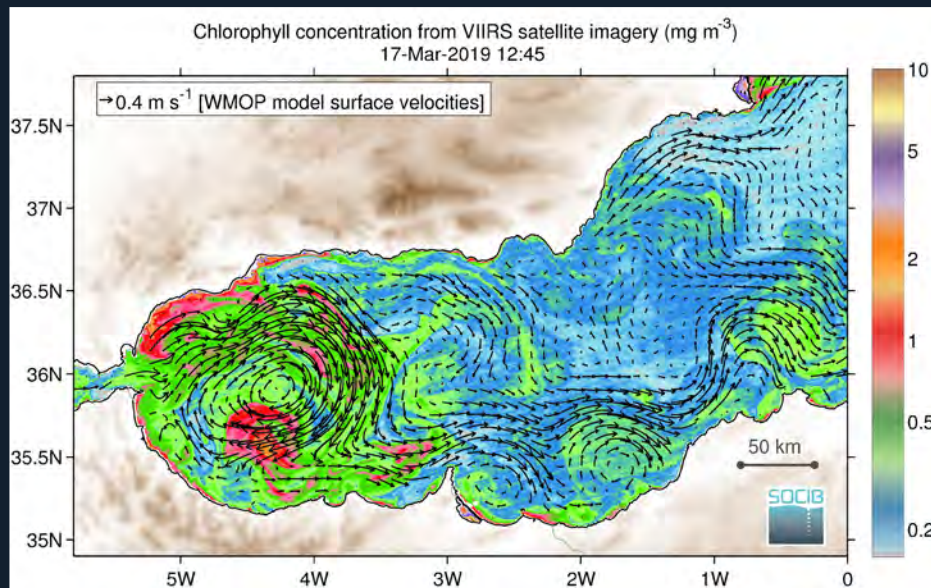
SOCIB WMOP (24 hr)

Field Experiments Animated 2-day Hypotheses D.E.

(H. Huntley, Univ. Delaware)

Real-time forecasting

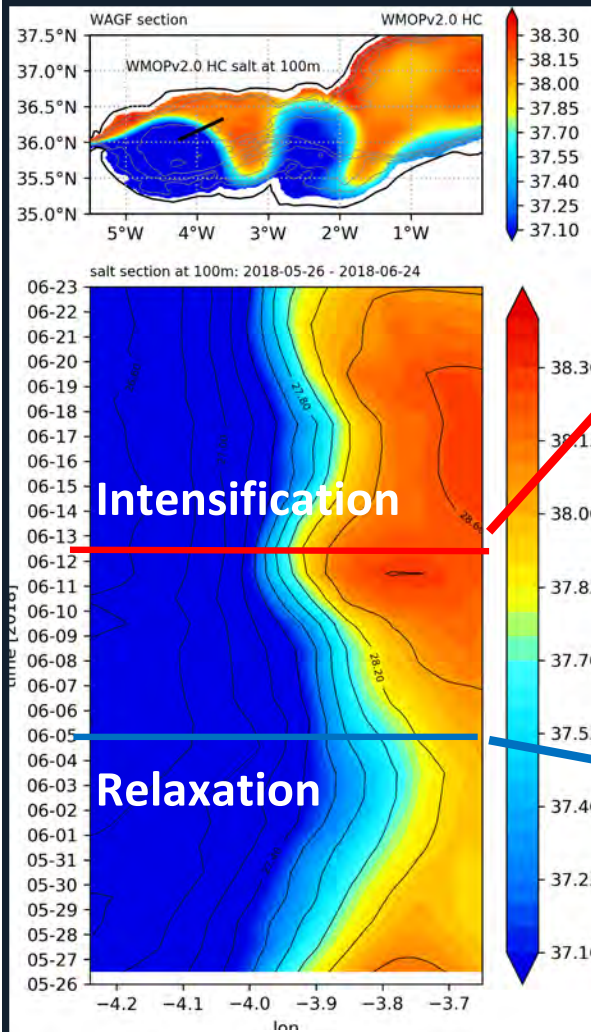
Model assessment using high-res. ocean color images and surface drifters



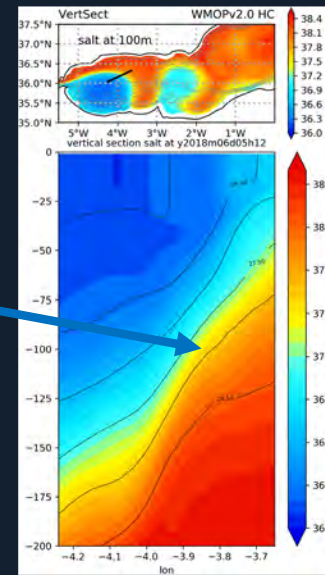
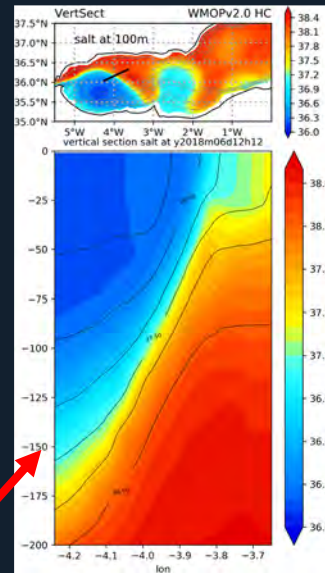
Mechanisms for vertical velocities at the Alboran fronts

(Garcia-Jove et al. 2021; Zarokanellos et al. 2021; J. Geophys. Res., submitted)

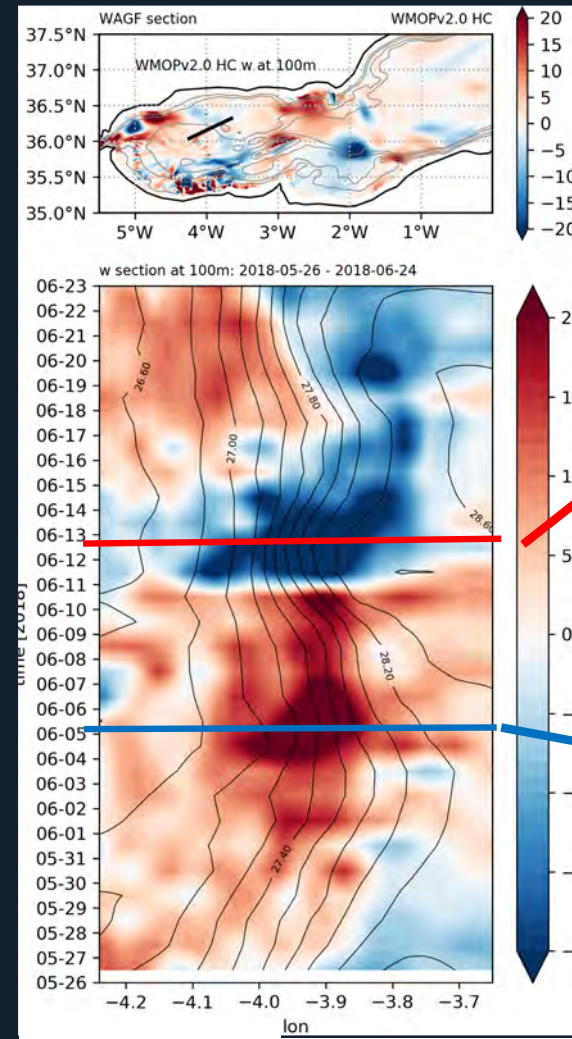
Salinity@100m



Longitude

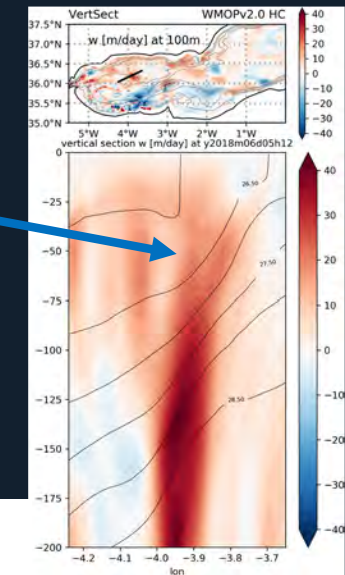
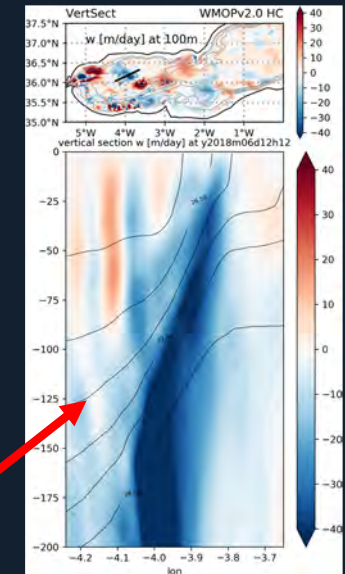


w@100m



Longitude

w+ max = 18m/day @57 m
w- max = 55m/day @156 m



w+ max = 42m/day @135 m
w- max = 8m/day @158 m

Tracking possible paths of *Pinna Nobilis* parasite

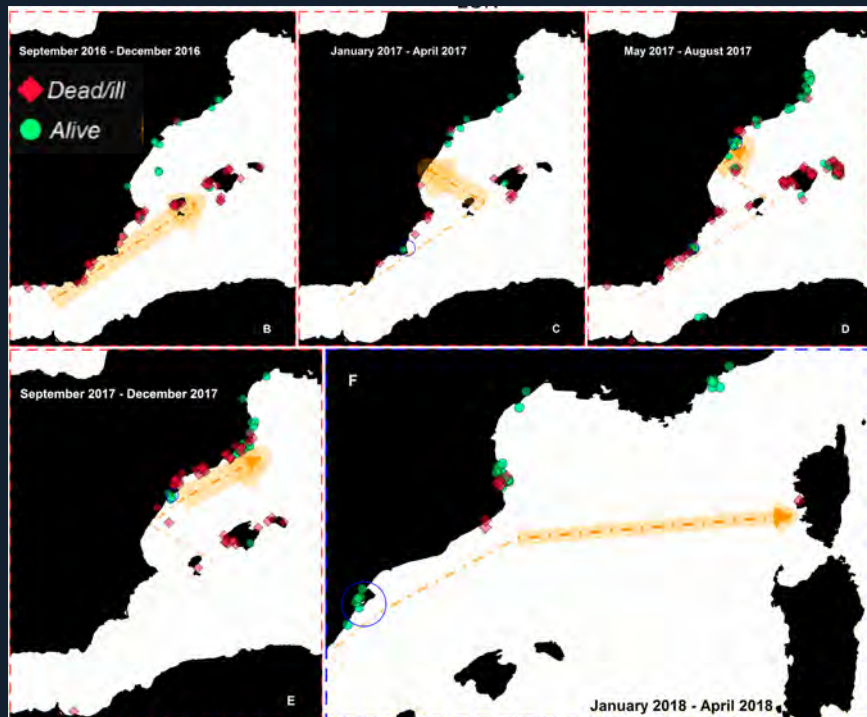


[Cabanellas-Reboredo et al., Tracking a mass mortality outbreak of pen shell *Pinna Nobilis* populations: A collaborative effort of scientists and citizens. *Sci. Reports*, 2019]



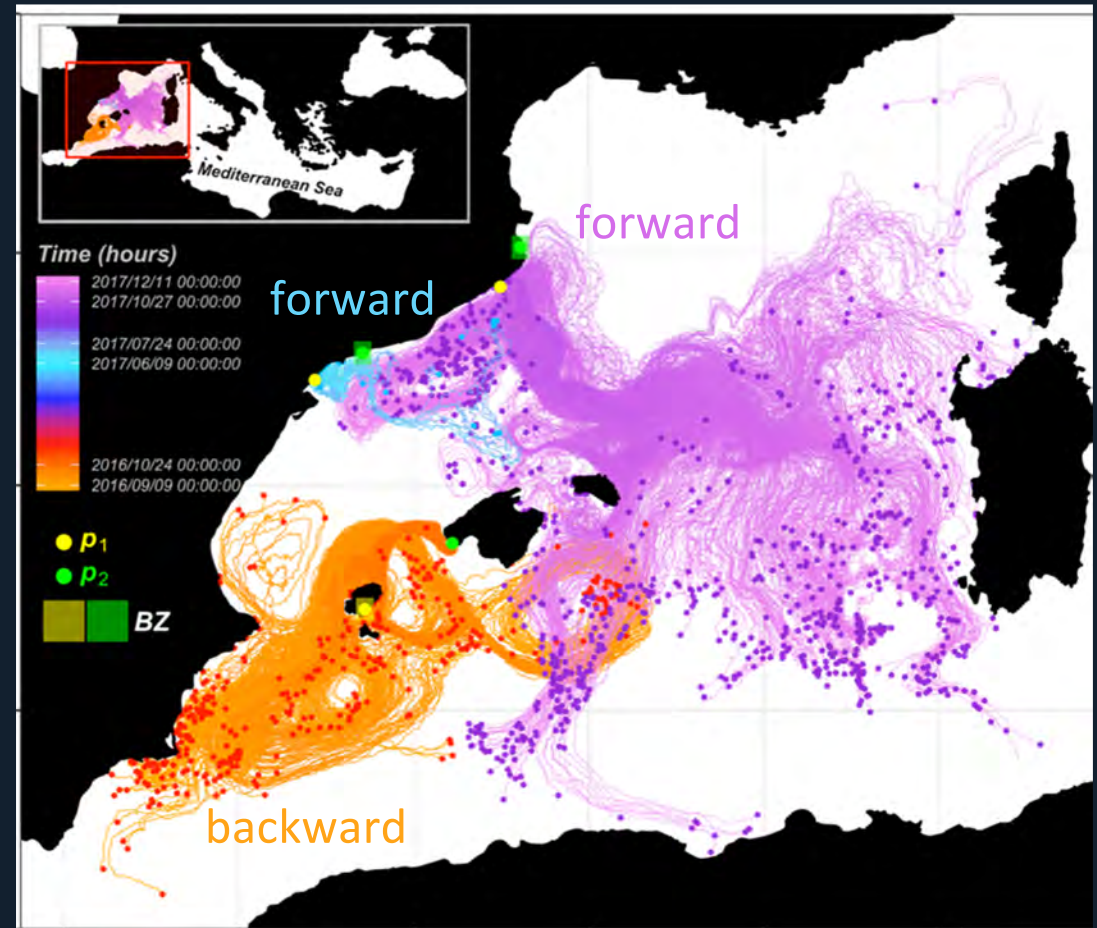
Mass mortality event

Observations from scientists & citizens



Disease propagation over the western basin from Sep 2016 to Apr 2018

Model simulations



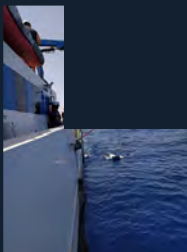
Drift simulations indicating the very likely important role of currents on the regional dispersion of the pathogen

Some of the future directions

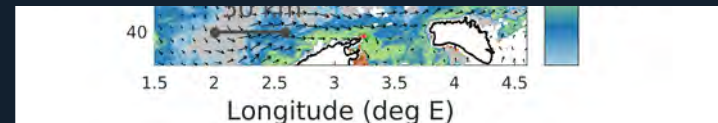
❓ Incorporate additional coastal data in the WMOP asimilation system (from moorings, HF radars, gliders, turtles?)



Thank you for your attention!



❓ Understand plastics distribution in the Balearic Sea



❓ Understand formation and impacts of anticyclonic eddies in the Catalano-Balearic Sea