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EGU 2020 – OS4.9

Marine Pollution Monitoring, Prediction and Risk Mapping

Estimate hydrodynamic connectivity through Lagrangian experiments in a high resolution shelf sea model

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Regione Toscana

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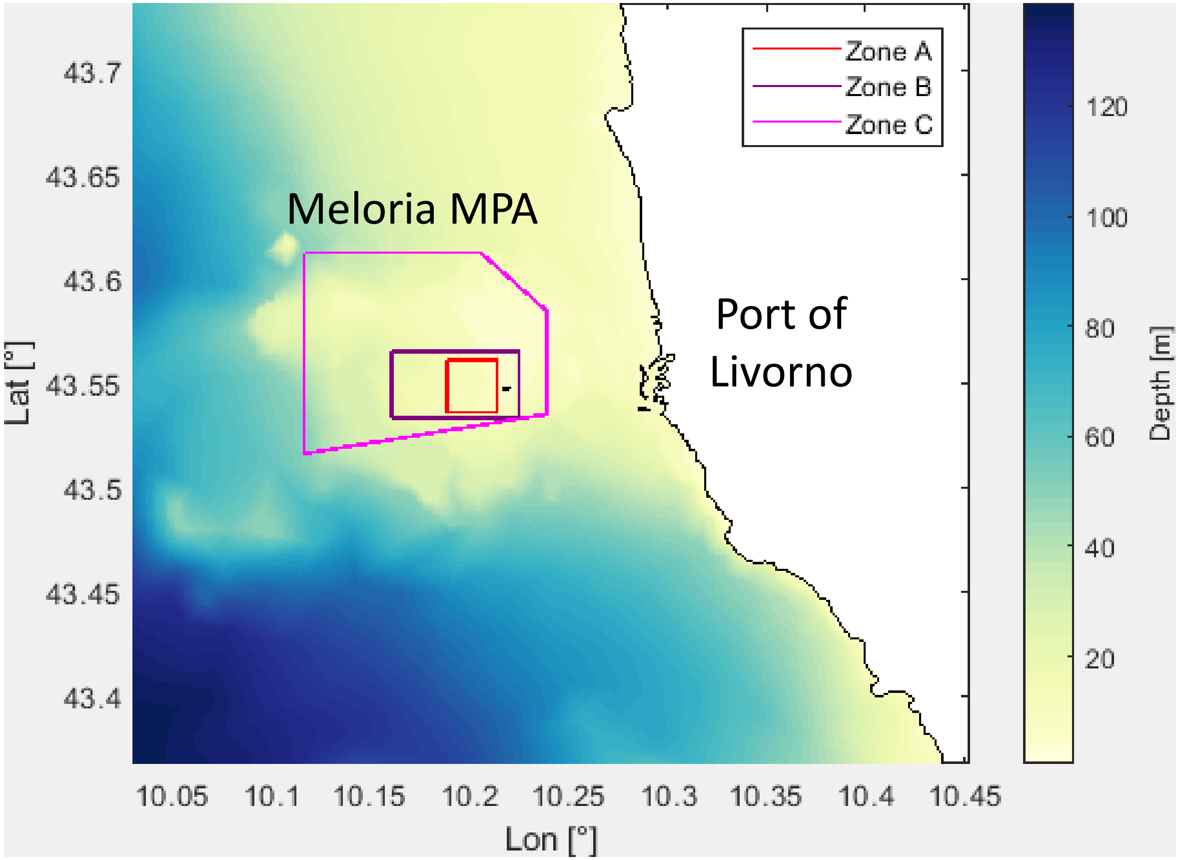
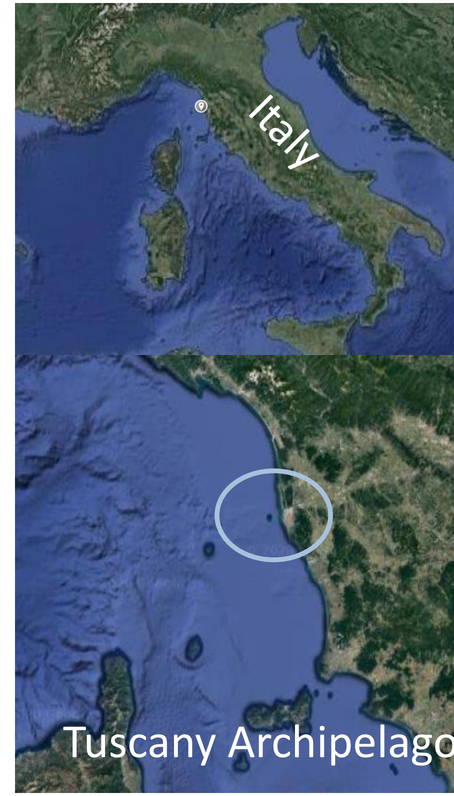
Meloria Marine Protected Area (MPA) and Port of Livorno





www.portolivorno.it

www.secchedellameloria.it

Objective: quantify the degree of hydrodinamic connectivity between the port and the MPA

Metodology: Lagrangian modelling of passive particles released from the port using high-res hydrodynamics

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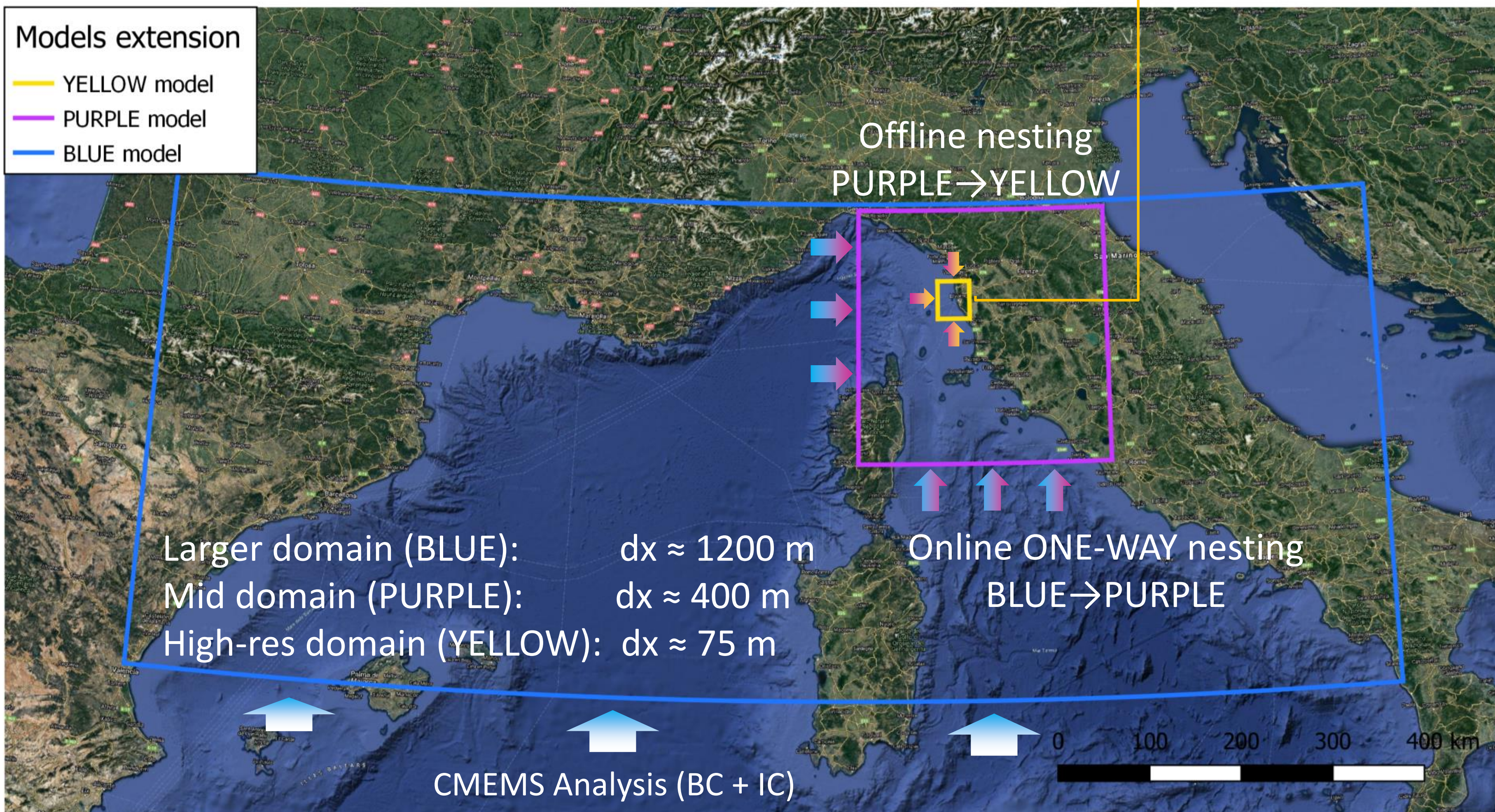
- ROMS model in nested configuration
- Simulation of year 2017, 10 days run (3 spin-up + 7)

Lagrangian simulation (ARIANE) using YELLOW output

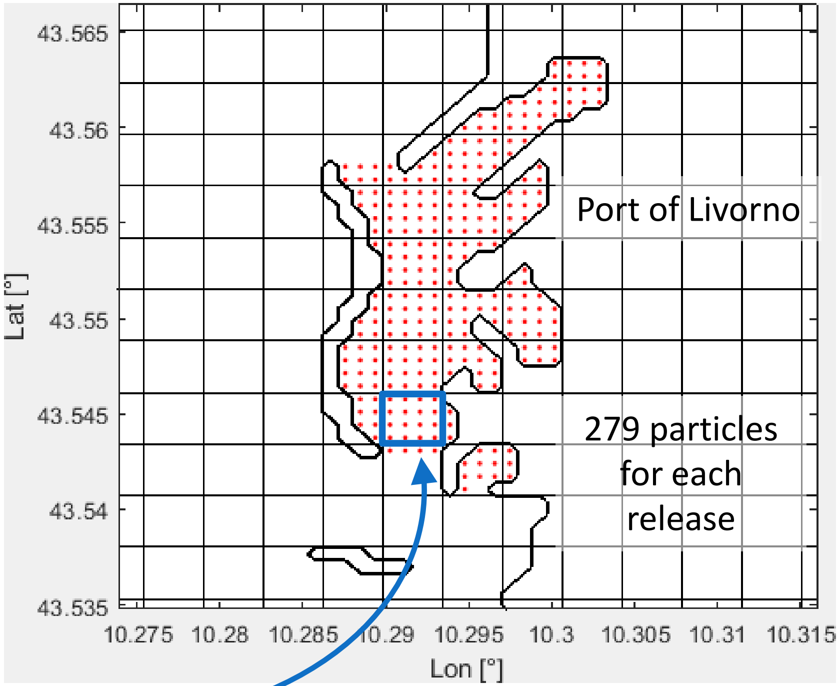


Atmospheric forcing from downscaling of ERA 5 dataset

Lagrangian Modelling with ARIANE – Setup

Repeated releases of particles inside the port:

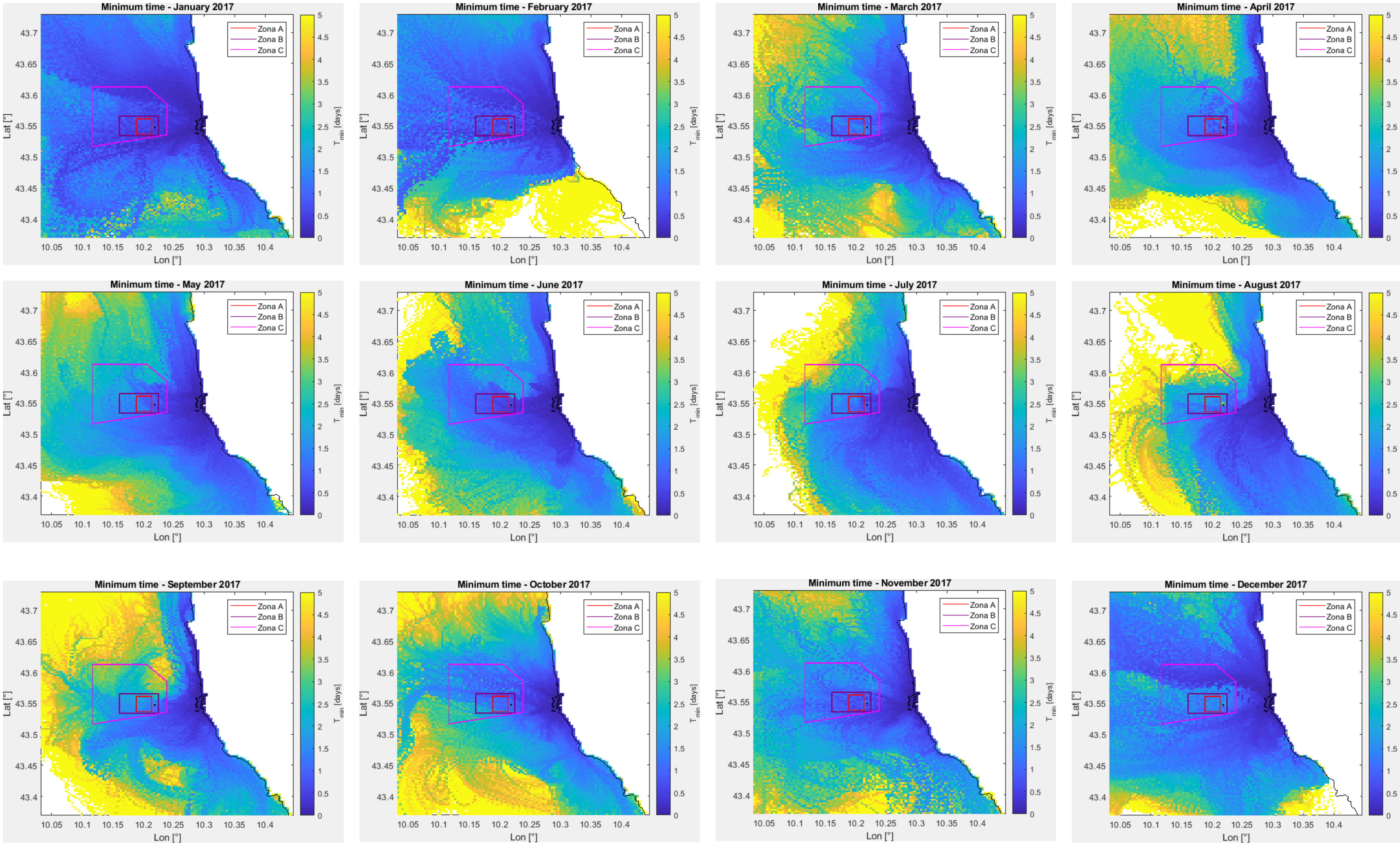
- 4 releases every day for all the year (2017)
- particles followed for 10 days
- no additional dispersion
- hourly output particle position



Map of the domain into patches $C_p(i,j)$ (4x4 cells)

- **T_{min}(i,j)**: minimum time a particle takes to reach a specific patch Cp(i,j) of the domain
- **T_{avg}(i,j)**: averaged cumulative time a patch C_p(i,j) is characterized by the presence of particles
- **P(i,j,t*)**: measure of the average probability a patch C_p(i,j) is reached by at least a particle after time t* from the release

Minimum Time - Monthly Time Scale



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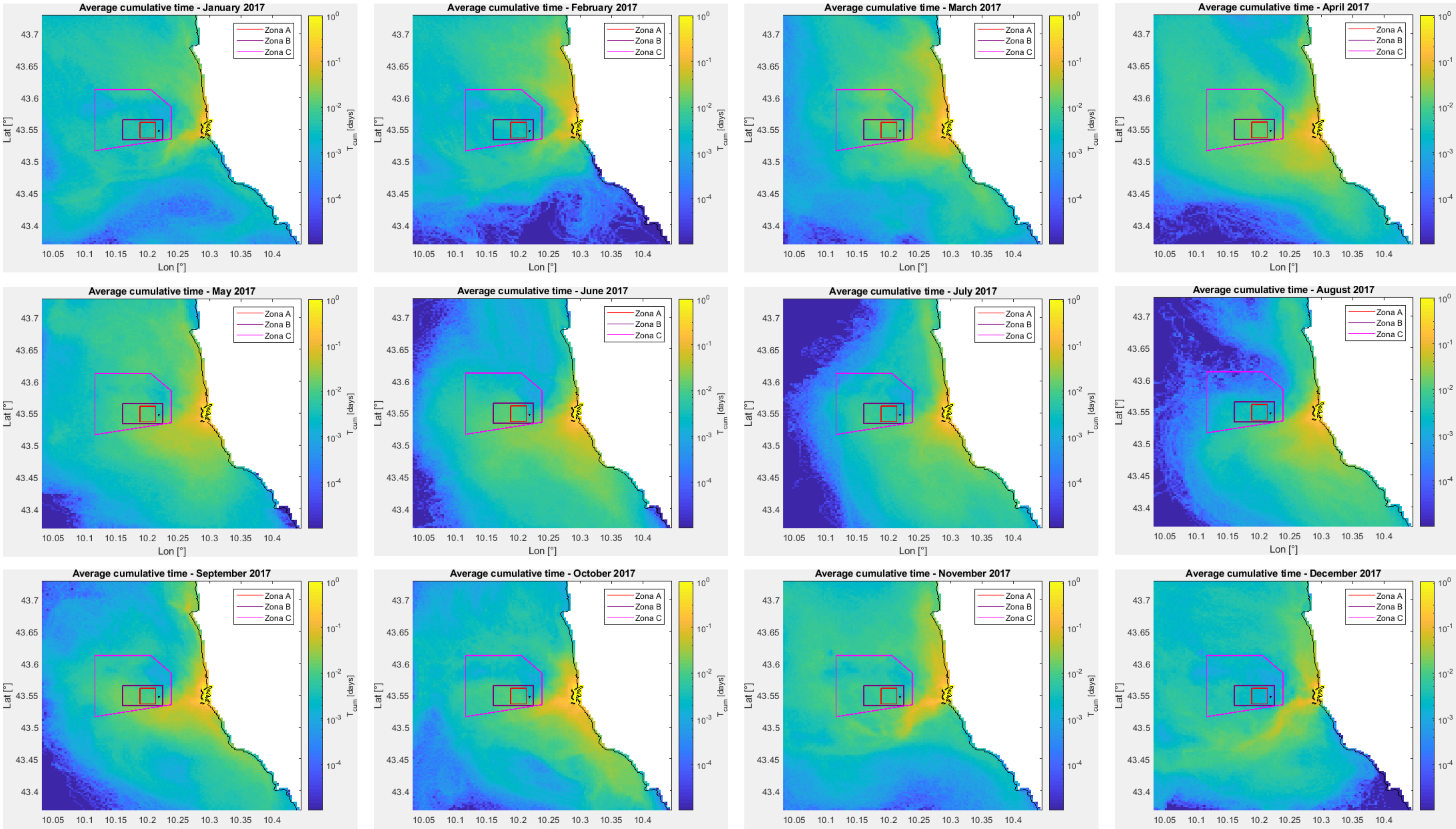
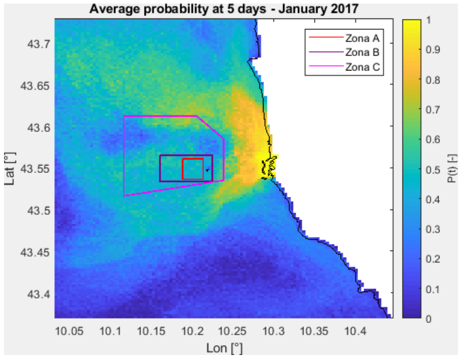
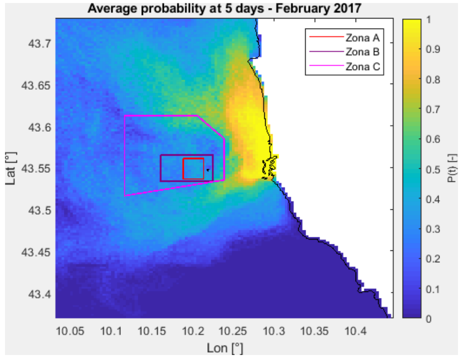
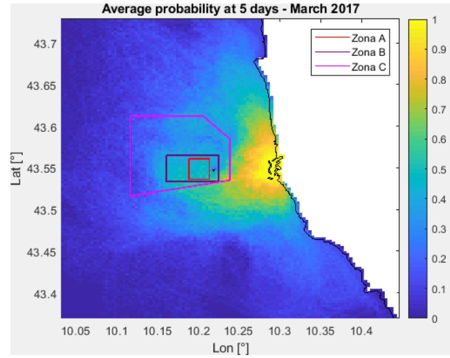
Averaged Cumulative Time - Monthly Time Scale

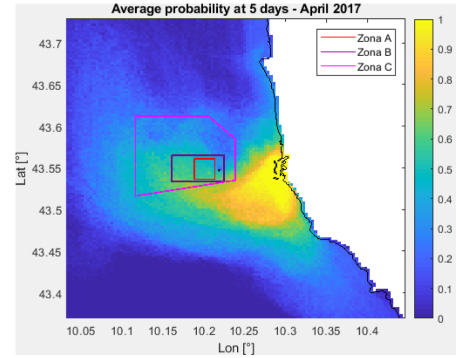


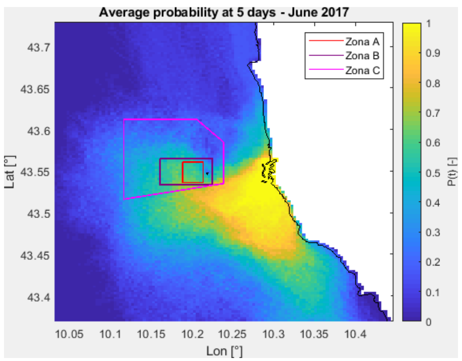
Time Dependent Probability - Monthly Time Scale - t = 5 Days*

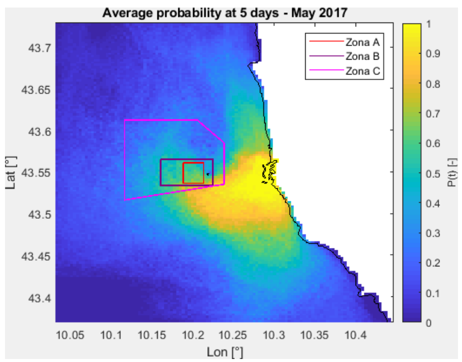


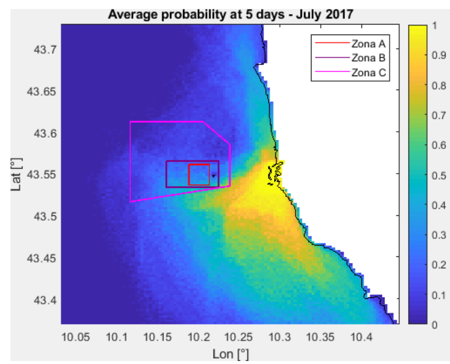


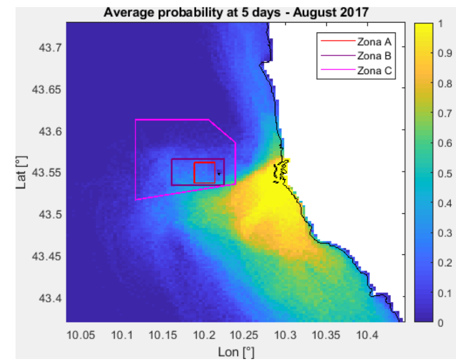


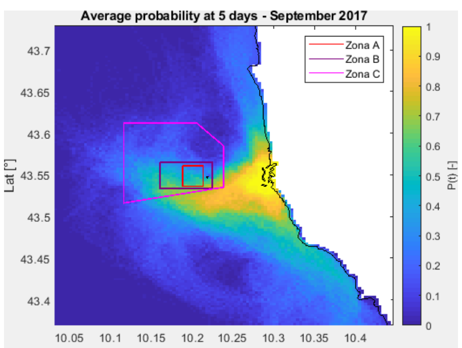


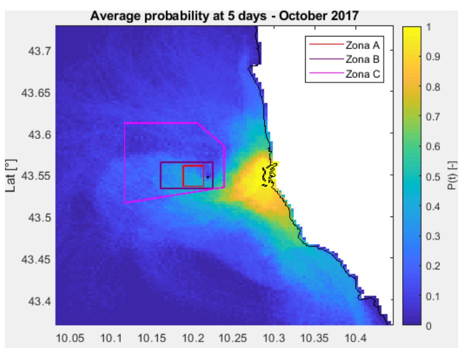


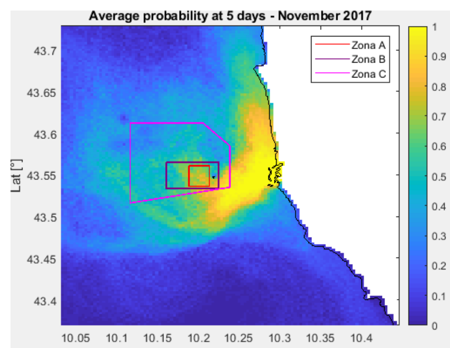


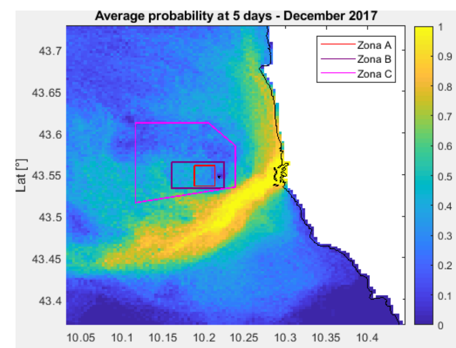




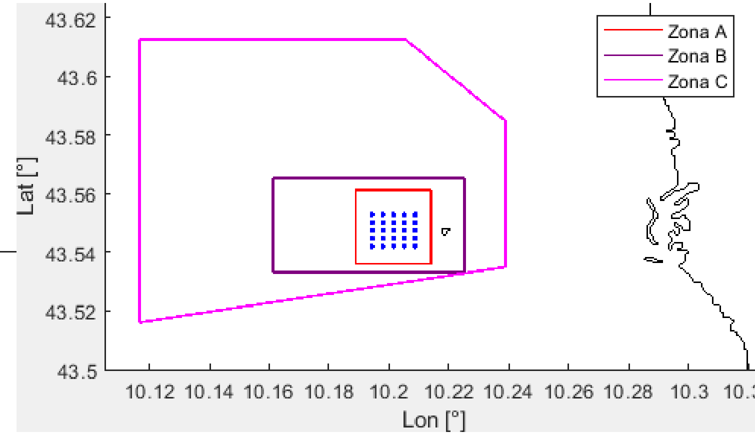




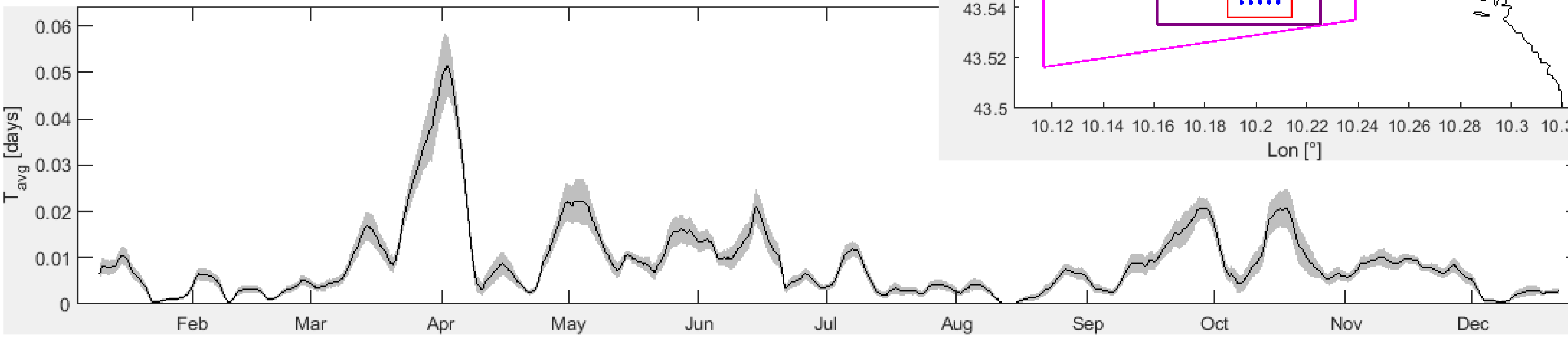




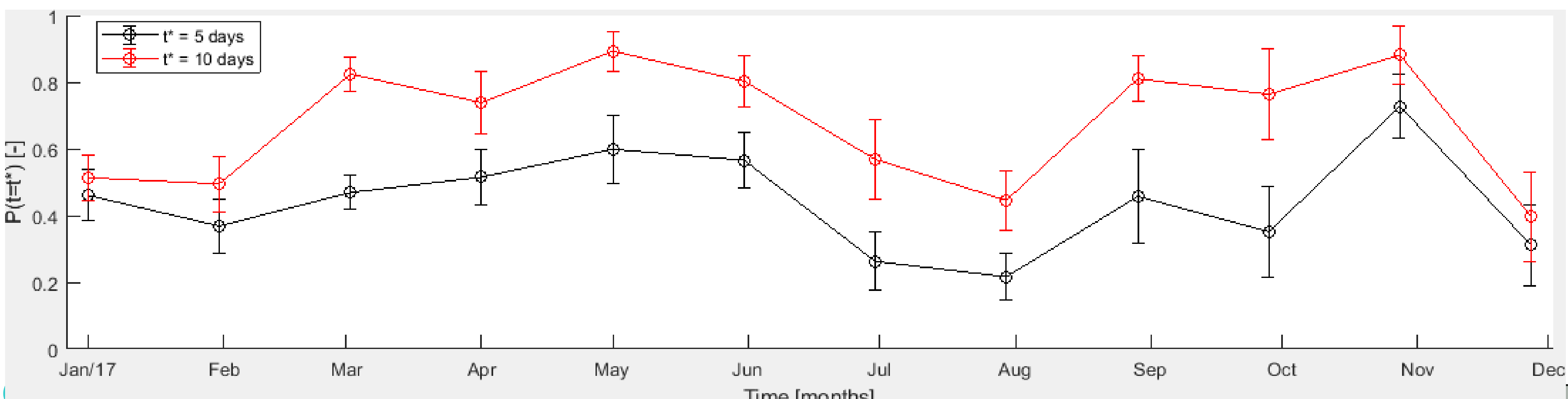
T_{avg} at Weekly Time Scale and P(t) – Zone A*



Mean ±std (grey area) for the moving averages on weekly base of T_{avg} for points inside zone A



Mean ±std (bar) of monthly P(t*) after 5 and 10 days from release for points inside zone A



ToRemember:

- Seasonal (cold/warm) variability for T_{min} and P(t) distribution
- Seasonality affects T_{avg} with respect to particle presence in A zone Meloria MPA (higher values in March-April)
- Probability of arrival in Zone A lower in July-August and December.
- Meloria MPA less impacted by particles with respect than the area South of the port (April to December) and the area North of the port (January to March).

ToDo:

- Complete validation meso-scale (PURPLE) hydrodynamic model through HF radar data
- Analyze the effects of port structures and check sub-mesoscale hydrodynamics through ad-hoc modelling of flow interaction with port structures
- Add tide
- Additional statistics + identification of hydrodynamic provinces
- Effect of port area expansion