In the name of God

Во имя Господа

Numerical modeling of physical oceanography properties in the southern Caspian Sea

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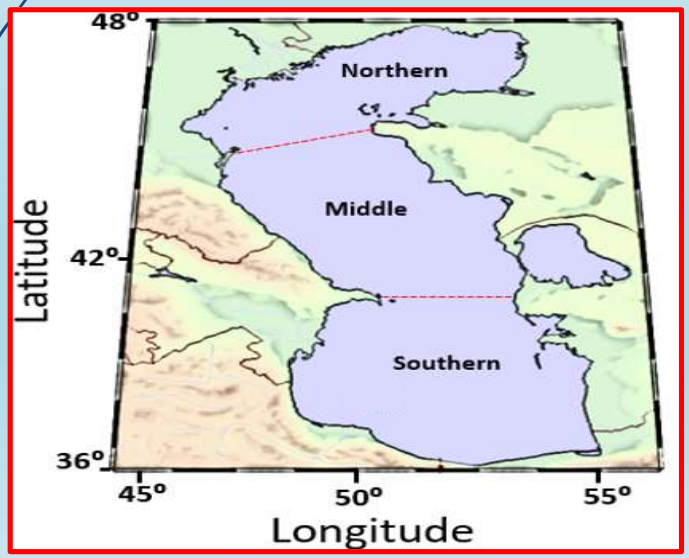
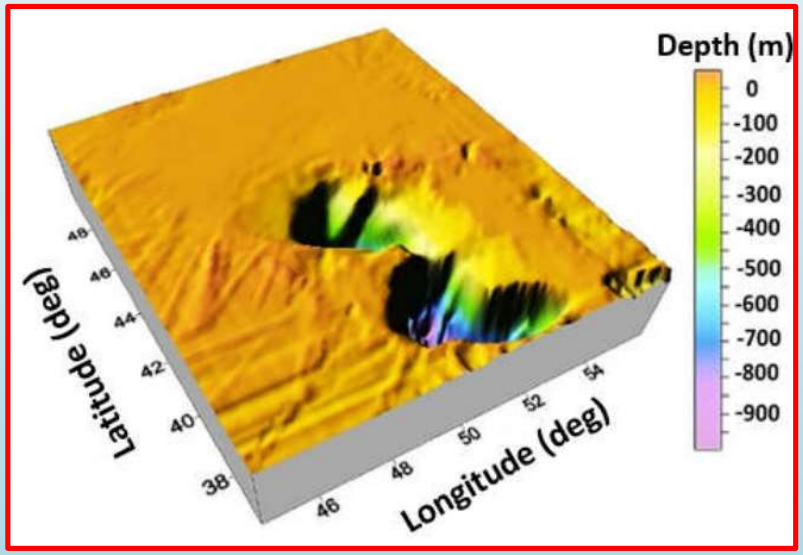
Caspian Sea features





ROMS (Regional Oceanic Modeling System)

Primitive equations: 7 equations – 7 unknowns
(3 velocity, temp, salt, density, pressure)
describing the motion of geophysical flows

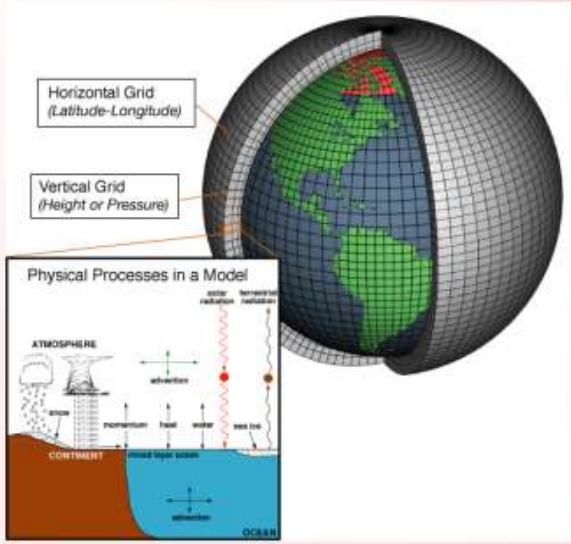
$x-$ momentum:
$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} - fv = -\frac{1}{\rho_0}\frac{\partial p}{\partial x} + \frac{\partial}{\partial x}\left(\mathcal{A}\frac{\partial u}{\partial x}\right) + \frac{\partial}{\partial y}\left(\mathcal{A}\frac{\partial u}{\partial y}\right) + \frac{\partial}{\partial z}\left(\nu_E\frac{\partial u}{\partial z}\right)$$

$y-$ momentum:
$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} + fu = -\frac{1}{\rho_0}\frac{\partial p}{\partial y} + \frac{\partial}{\partial x}\left(\mathcal{A}\frac{\partial v}{\partial x}\right) + \frac{\partial}{\partial y}\left(\mathcal{A}\frac{\partial v}{\partial y}\right) + \frac{\partial}{\partial z}\left(\nu_E\frac{\partial v}{\partial z}\right)$$

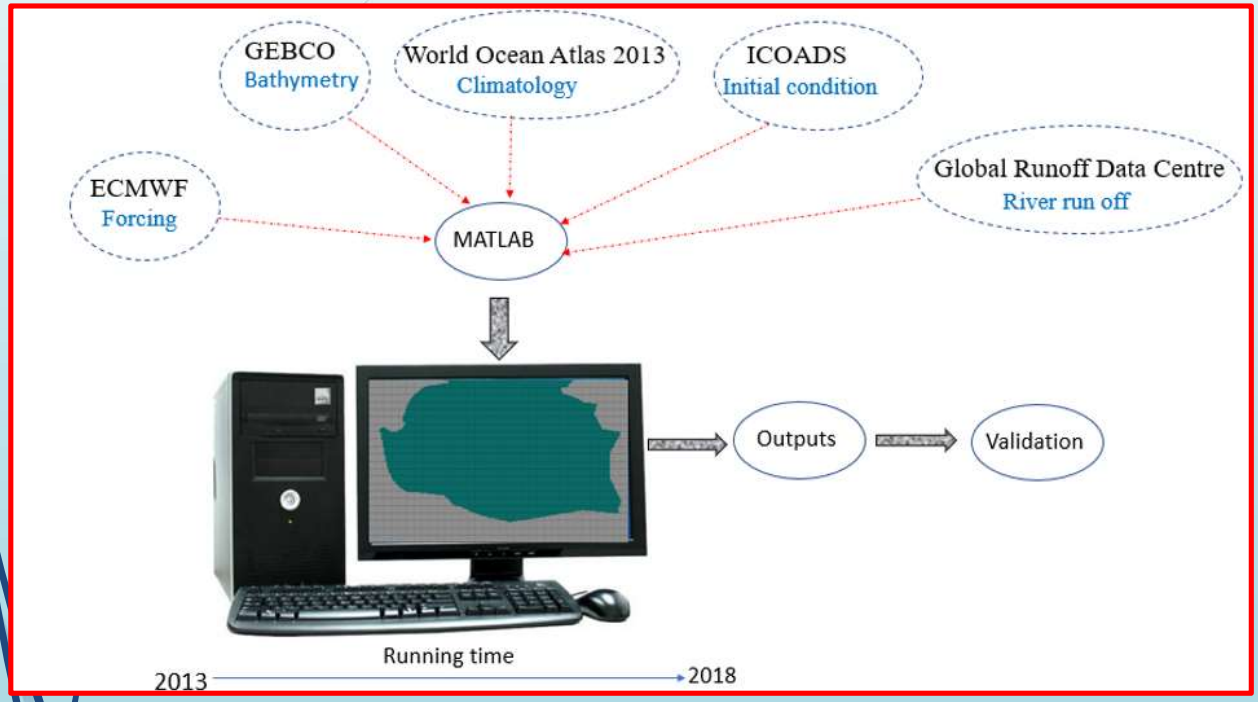
$z-$ momentum:
$$0 = -\frac{\partial p}{\partial z} - \rho g$$

continuity:
$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$$

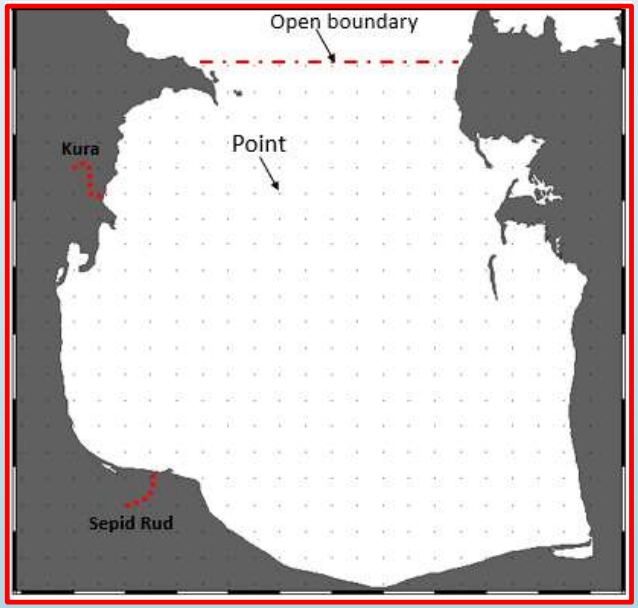
energy:
$$\frac{\partial \rho}{\partial t} + u\frac{\partial \rho}{\partial x} + v\frac{\partial \rho}{\partial y} + w\frac{\partial \rho}{\partial z} = \frac{\partial}{\partial x}\left(\mathcal{A}\frac{\partial \rho}{\partial x}\right) + \frac{\partial}{\partial y}\left(\mathcal{A}\frac{\partial \rho}{\partial y}\right) + \frac{\partial}{\partial z}\left(\kappa_E\frac{\partial \rho}{\partial z}\right),$$



Model set up

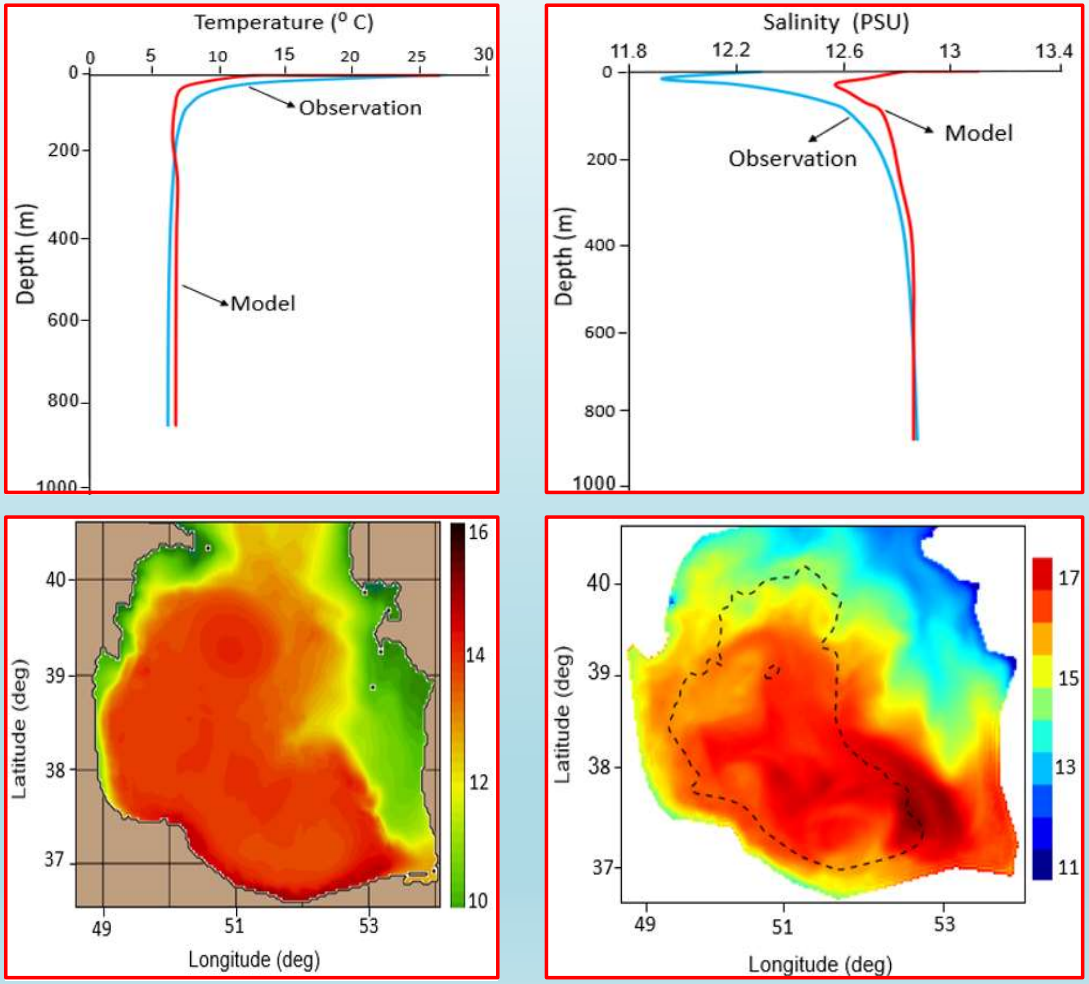


Configuration

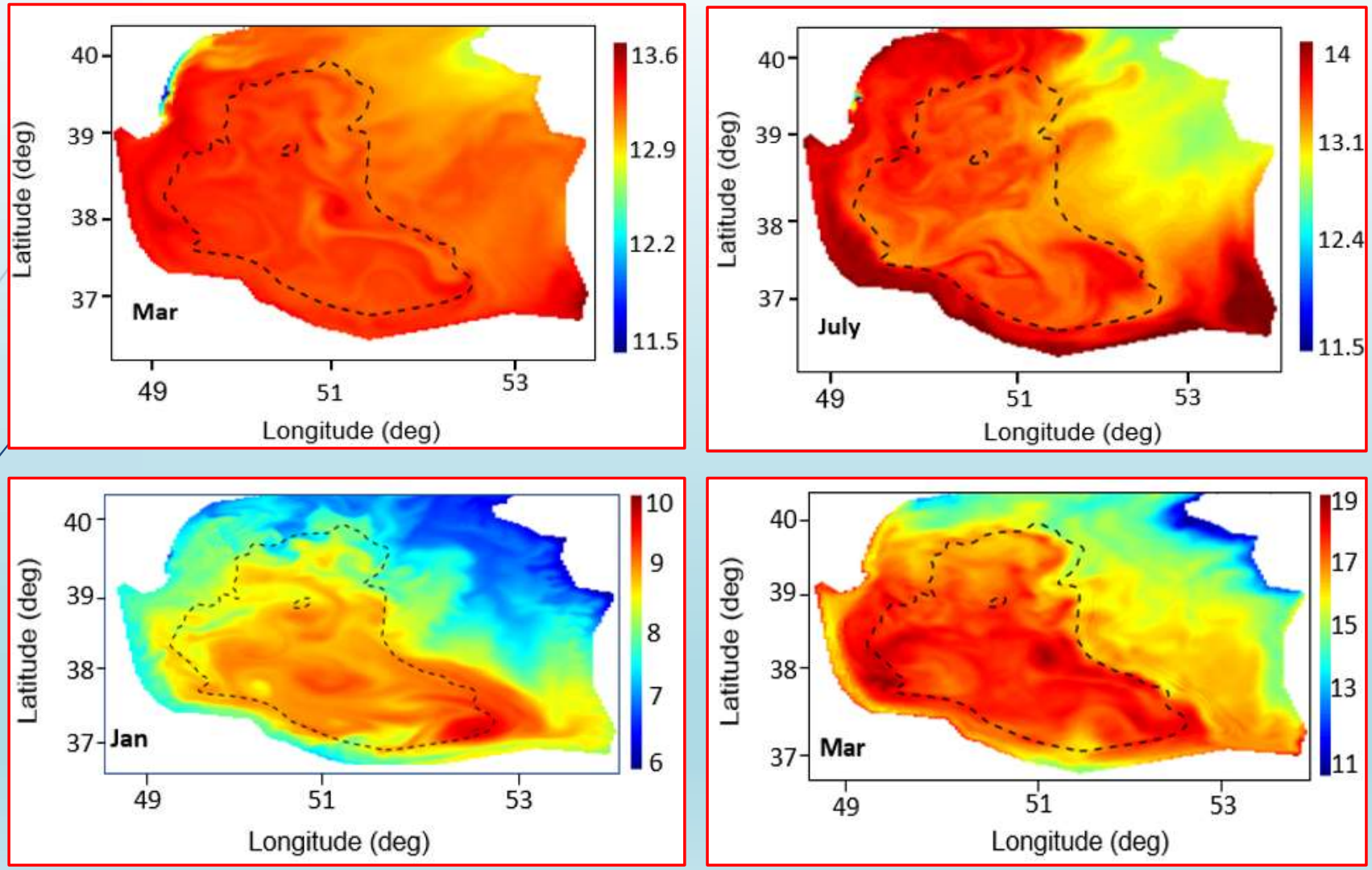


Domain

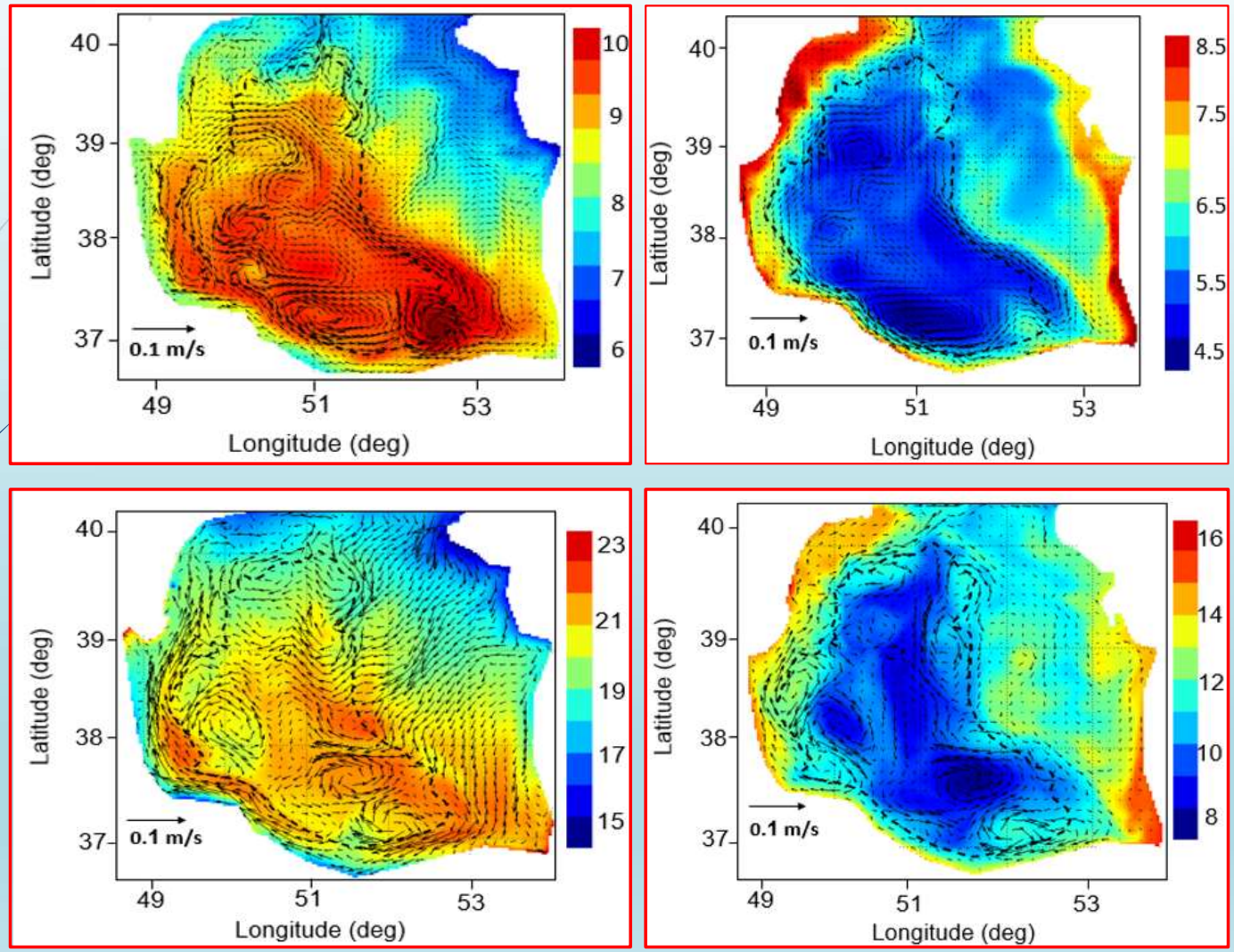
Model validation



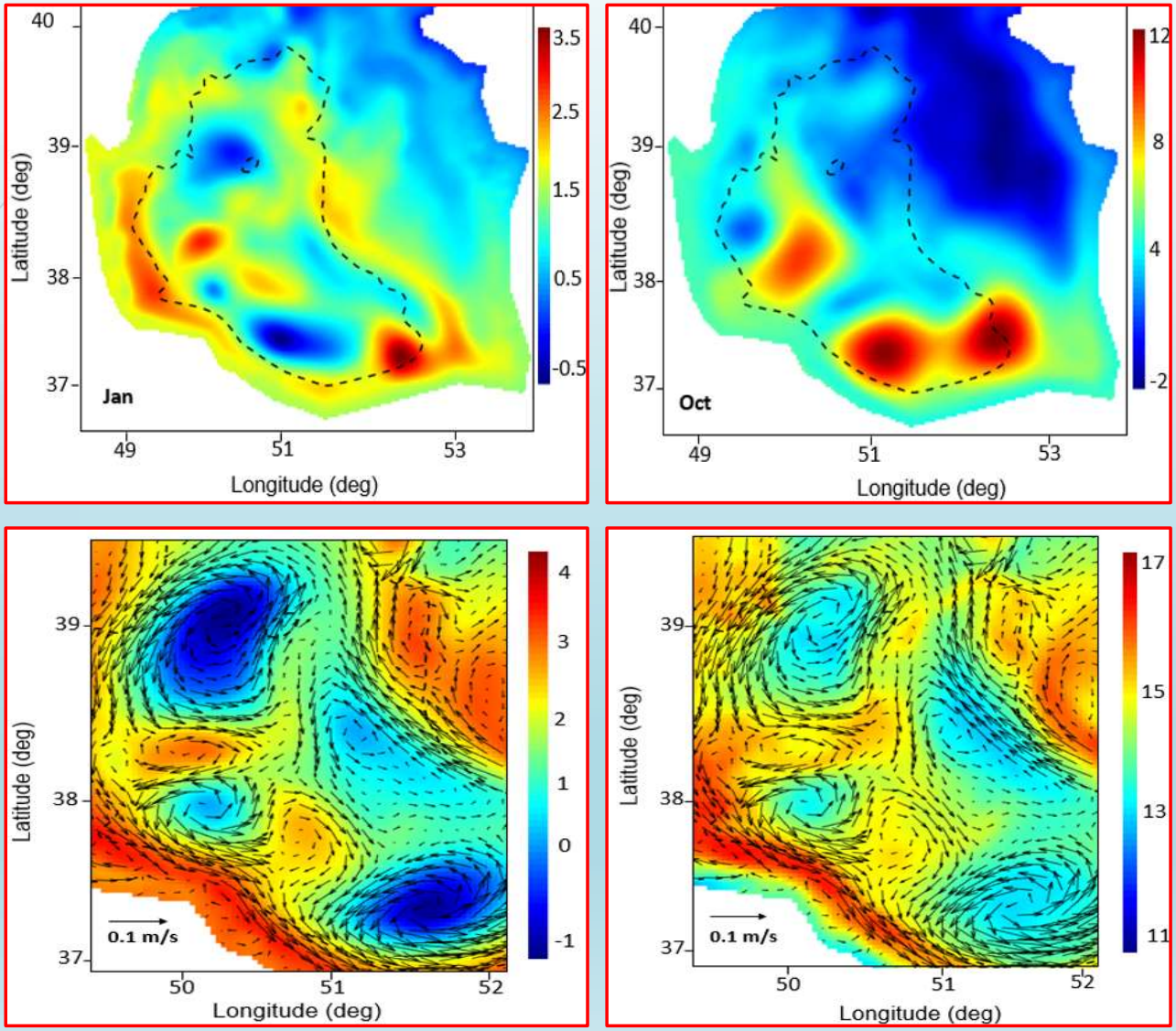
Results (Temperature and Salinity)



Results (Velocity)



Results (Sea Surface Height)



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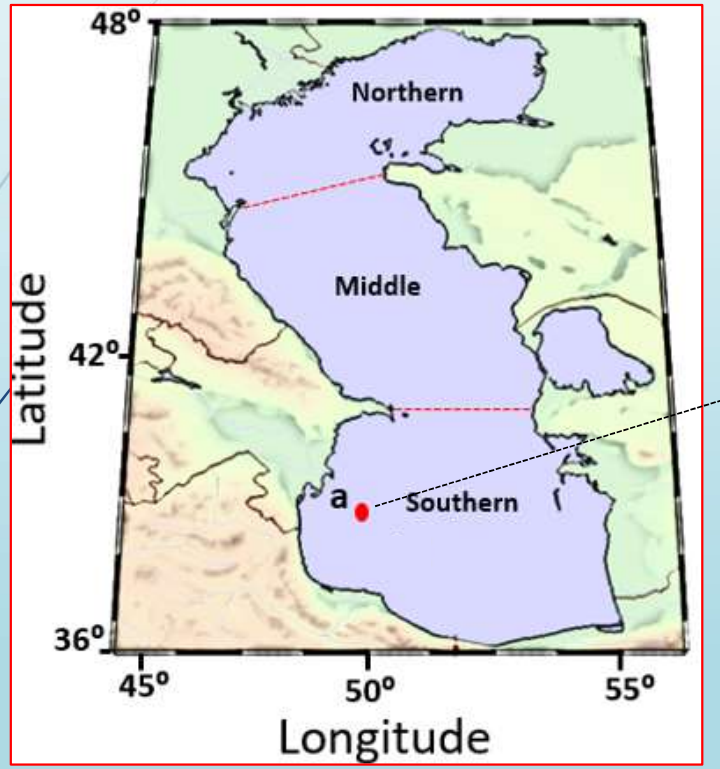
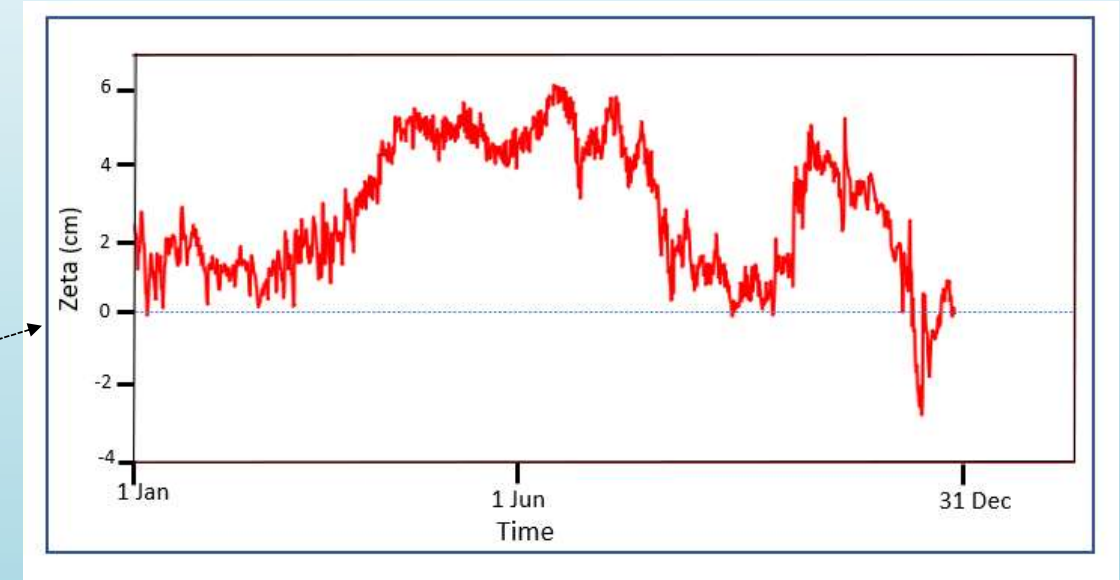
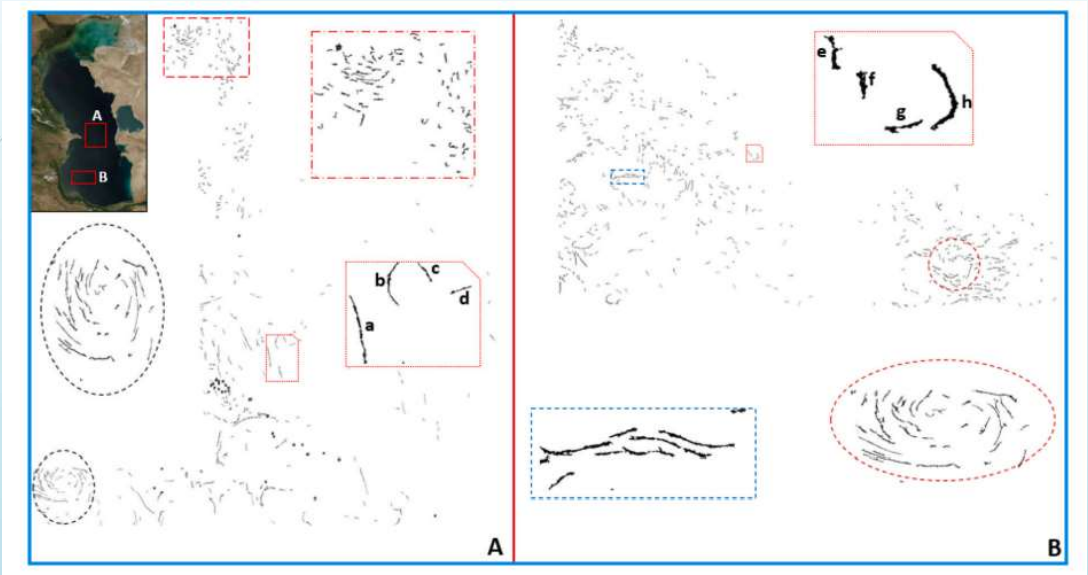
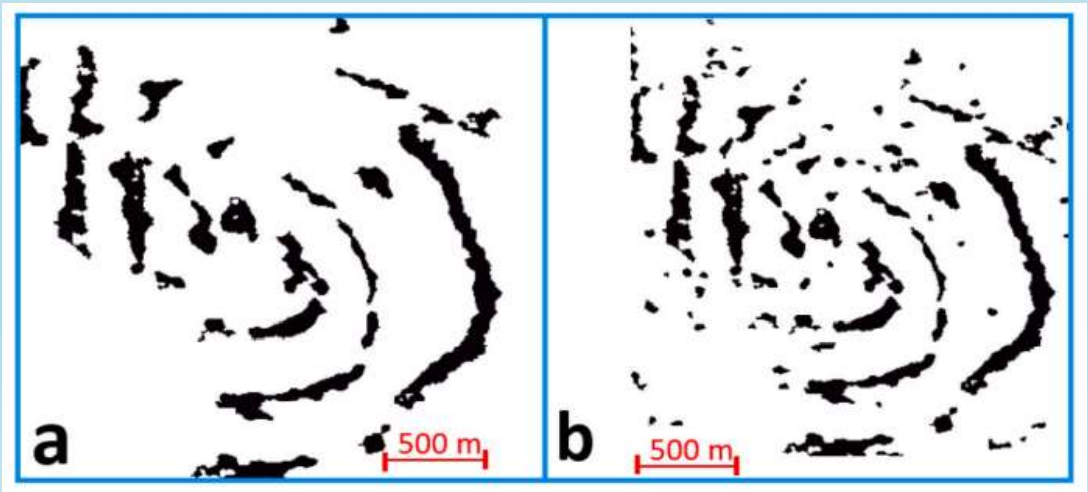




Time series(SSH)

Application (Oil contamination)





Results and conclusion

- The ROMS can be an appropriate model for simulation in this region
- The model simulates temperature better than salinity
- The model has recorded the mean value of 16-18 º for temperature; this value for salinity can be 13.5 PSU
- The fluctuation of the surface water, which varies from 5-10 cm due to these cyclonic and anticyclonic eddies
- This water mass can be 0.5-1º colder than the surrounded water in cyclonic eddies
- The sea surface height is higher than in anticyclonic eddies
- These eddies can be the main reason for oil contamination in the southern Caspian Sea

Thank you...