The GHER hydrodynamical model is implemented in the Black Sea operational stochastic forecasting system. The seamod.ro Black Sea operational stochastic forecasting system from NOAA NCEP GFS bulk formulae using atmospheric fields downloaded from climatology sources. The ensemble is built by applying multiple, random but physically consistent perturbations to the members.

Validation of the ensemble

- perturbations are different in each ensemble member
- model parameters, inputs... that are not perfectly known
- atmospheric forcing fields are perturbed so that:
  - perturbation intensity is, on average, of the same magnitude as the difference between NCEP and ARGO profiles
  - perturbation in geostrophic current-aligned random perturbations on T,S fields
  - combination of EOFs of atmospheric timeseries

Operational forecasts of the ocean state and it's observations are assimilated using an EnKF (validation of the ensemble spread). The forecast uncertainty is evaluated a priori by their rms error is set as 0.25°C and 0.05psu. Also simulates well the large scales: semi-permanent eddies, Rim current position, areas and open sea ~ 20 cm, mixed layer depth, surface and deep salinity values, elevation difference from coastal, spatial and temporal evolution hydrodynamic regime on the shelf.

Model validation

- model performance is assessed (validation of the ensemble mean)
- observations are supposed uncorrelated
- model uncertainty is estimated (ensemble mean error) :
  - temperature rms error: 0.3°C
  - salinity: 0.71 psu
  - velocity: 0.76 cm/s
  - elevation: 0.92 cm

Example of ensemble spread for SSH (salinity), 5cm/s (velocity), 3cm (elevation) are publically available on http://www.seamod.ro

Also simulates well the mixed layer depth also simulates well shelf-open sea exchanges.

References

1 Vandenbulcke et al, Onboard implementation of the GHER hydrodynamic model
3 Barth et al, Dynamically constrained ensemble perturbation – application to tides on the West Florida Shelf. Ocean Science, 2009
4 Ocean Assimilation Kit, Barth et al, see publication list and data assimilation localisation radius ~ 100km
5 Temperature and salinity errors indicate that the ensemble slightly underestimates the error (e.g. that the ensemble slightly underestimates the error (e.g. temperature difference minus observations), suggesting that the ensemble corresponds well to the a priori error (estimated by the ensemble spread)
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