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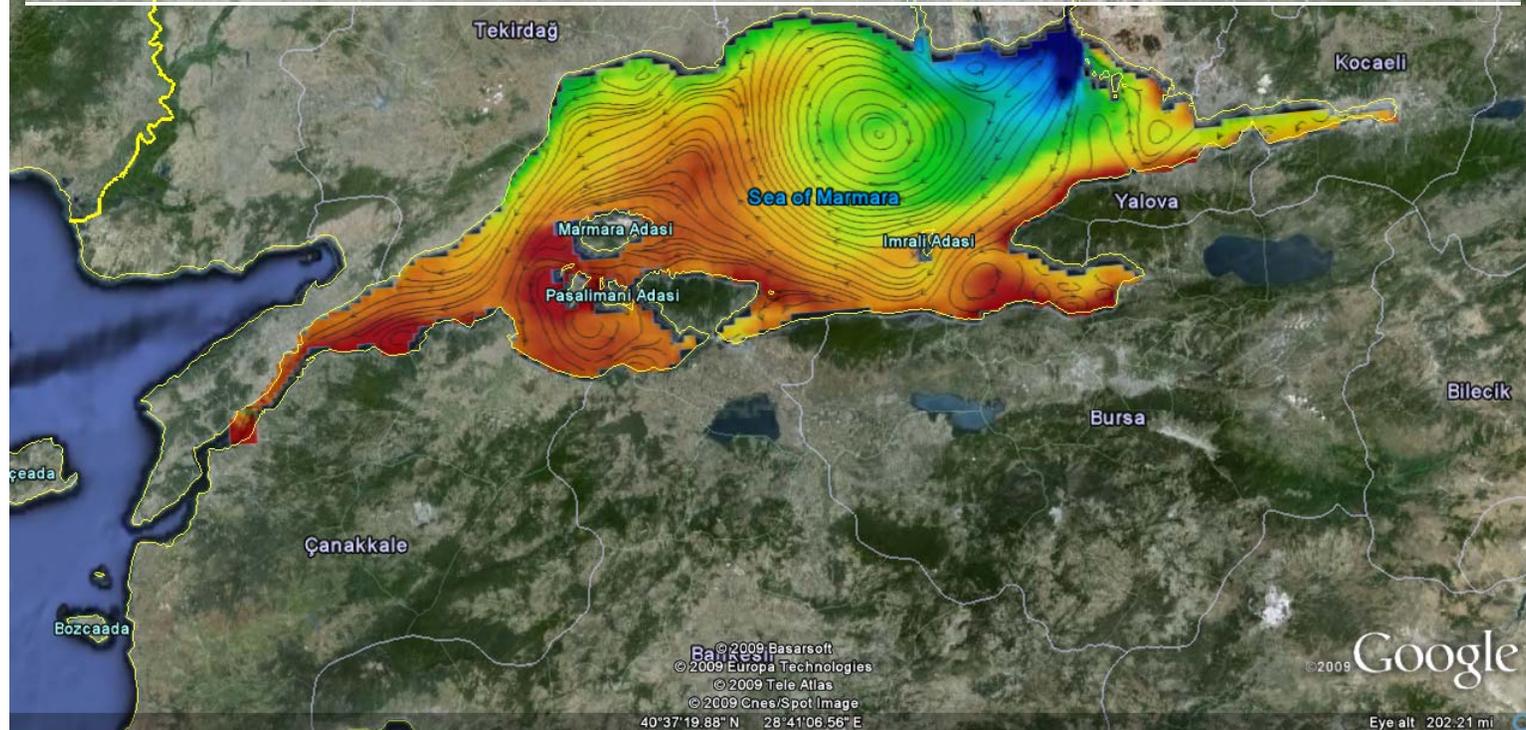
NURC - Partnering for Maritime Innovation



Numerical modeling of the surface circulation in the Sea of Marmara during the TSS experiment

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The TSS Trial

Turkish Straits System Trial

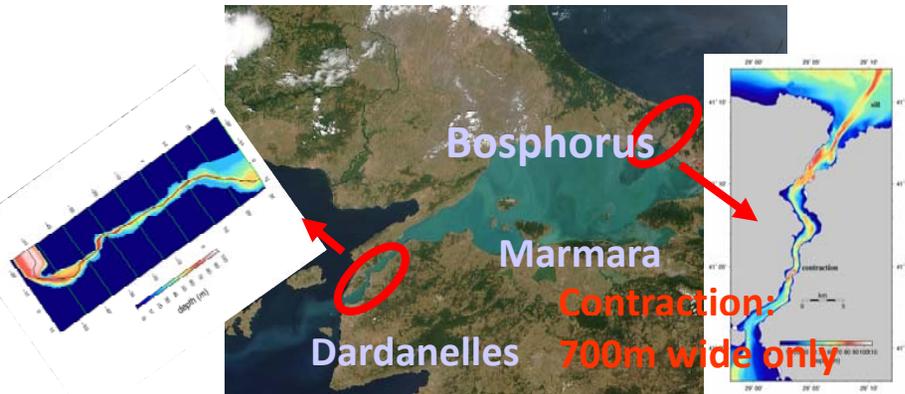




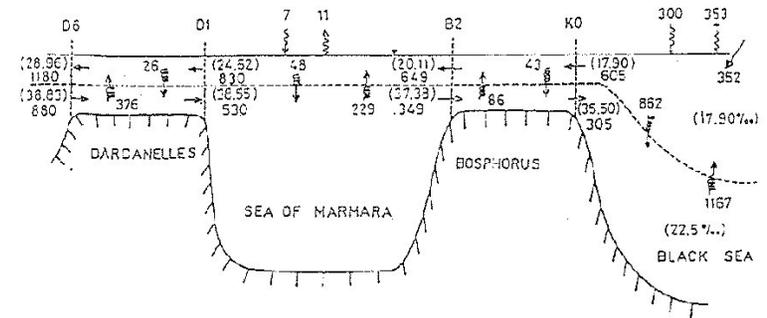
The Marmara Sea

The Turkish Strait System (TSS): 2 bottlenecks, 1 buffer zone

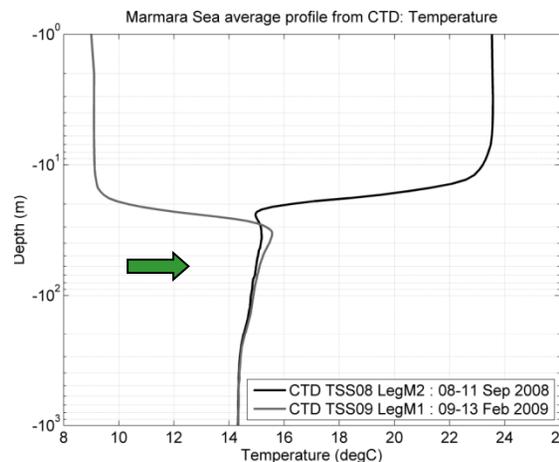
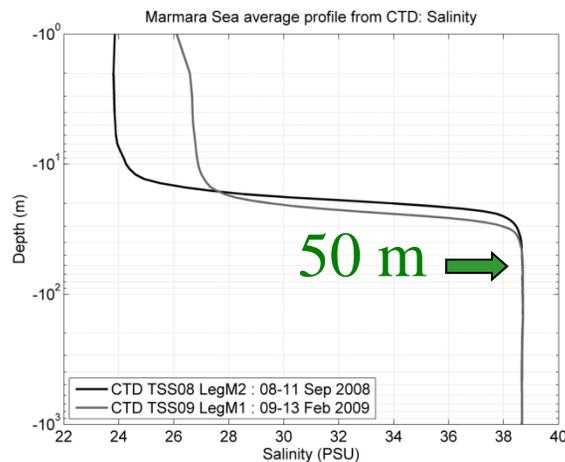
Turkish Straits System Trial



~ 60 km
~ 1400 m!
~ 200 km



From: Besiktepe et al., Progress in Oceanography 1994



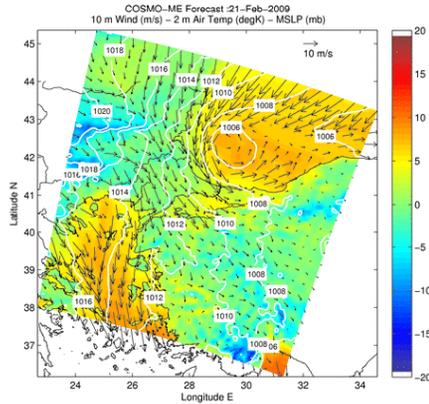
Black - 8-13 Sep 2008
Gray = 9-13 Feb 2009

→ Most of the variability is above 50 m



TSS ROMS

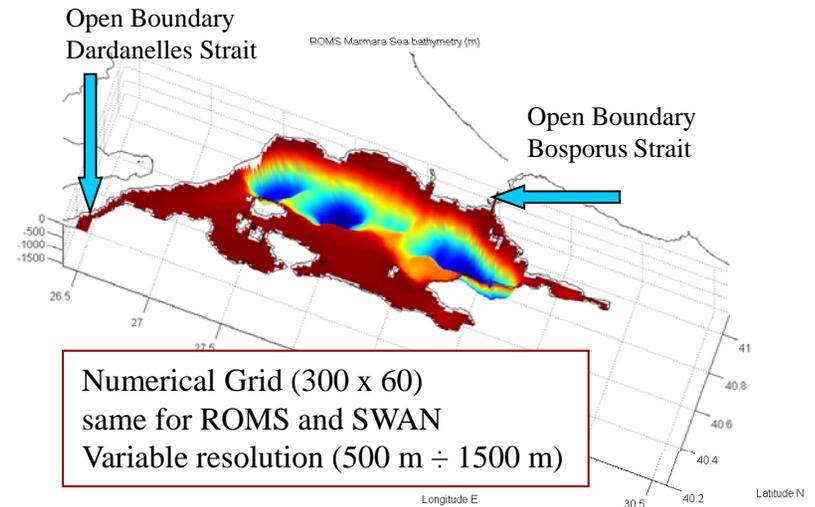
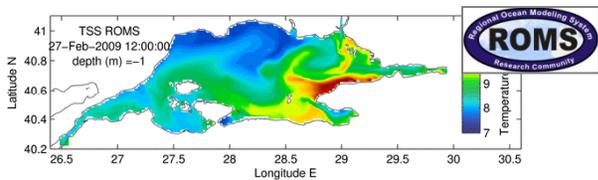
Modeling System



COSMO-ME atmospheric forcing

- wind 10 m
- mean sea level pressure
- air temperature 2 m
- dew temperature 2 m
- total cloud cover
- net short-wave radiation

Ocean Model ROMS

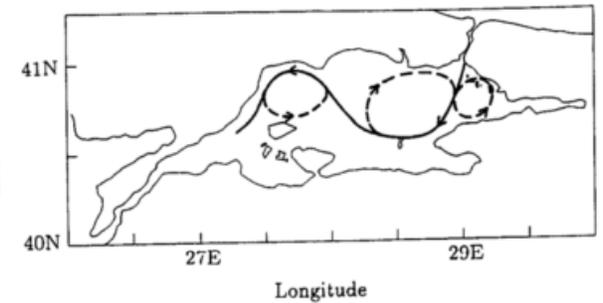
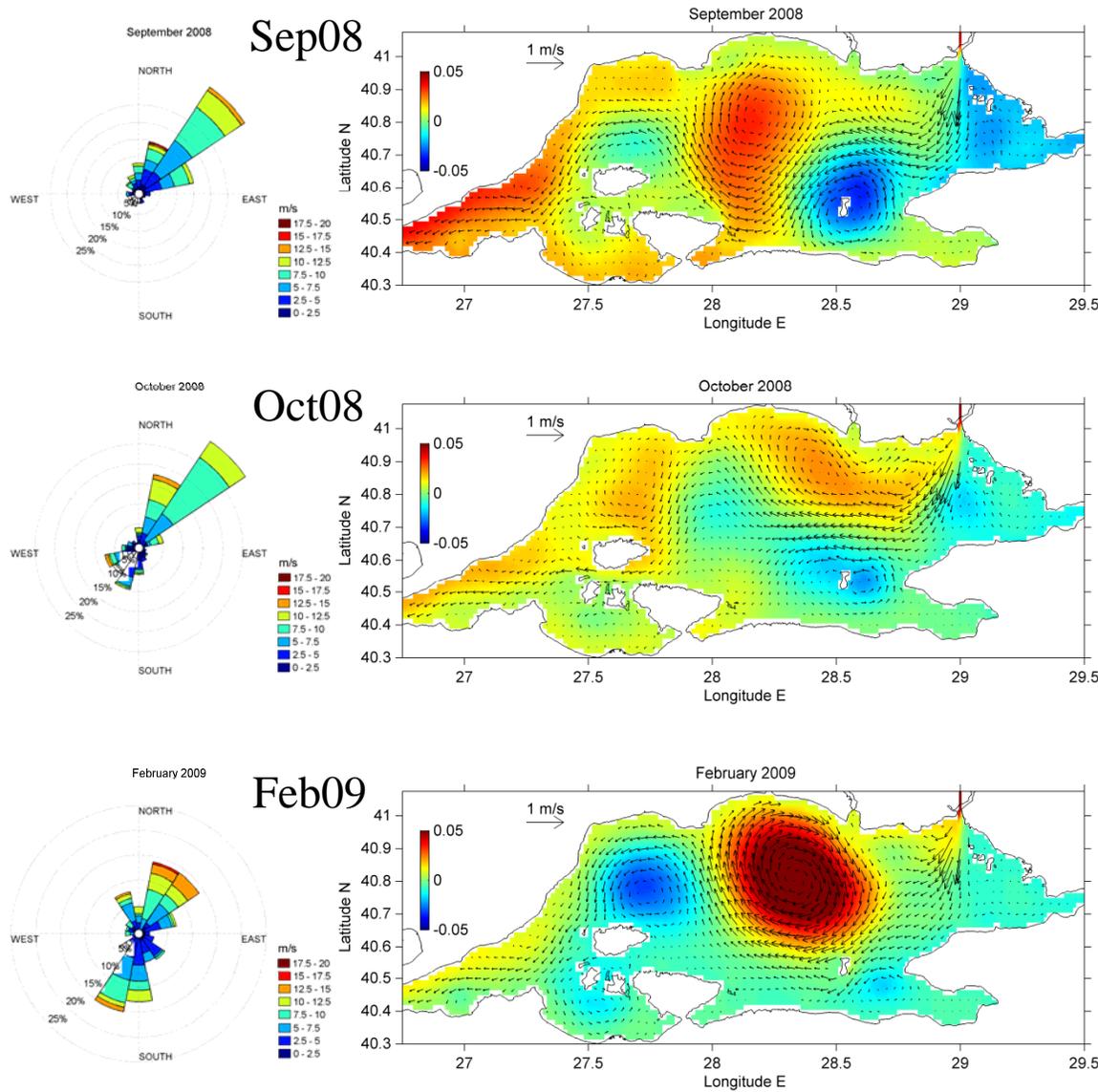


- Ocean model initialized in late August 2008 based on cruise CTD;
- Meteorological forcing provided by operational forecasts of the non-hydrostatic, 7 km horizontal resolution, limited area model COSMO (courtesy of Italian Airforce); ROMS computes heat fluxes and momentum stress via COARE 3.0 formula using its own SST.
- Open boundaries (straits): Daily averaged volume fluxes (Flather (1976) condition). Climatological data are used for missing temperature and salinity measurements (upper layers) and nudging to low-pass filtered NRL Barnys and T/C moorings data with relaxation timescale of 1 day for the baroclinic component.

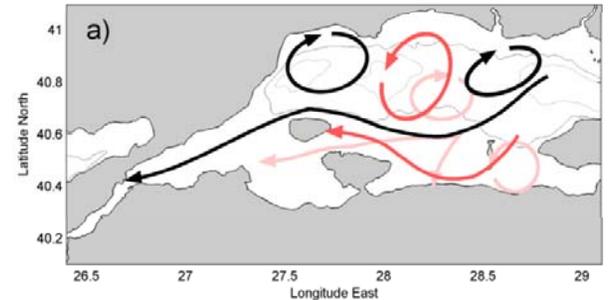


General Circulation

Results



From: Besiktepe et al., Progress in Oceanography 1994



From: Gerin et al., in preparation; also available at MREA10 in the poster session

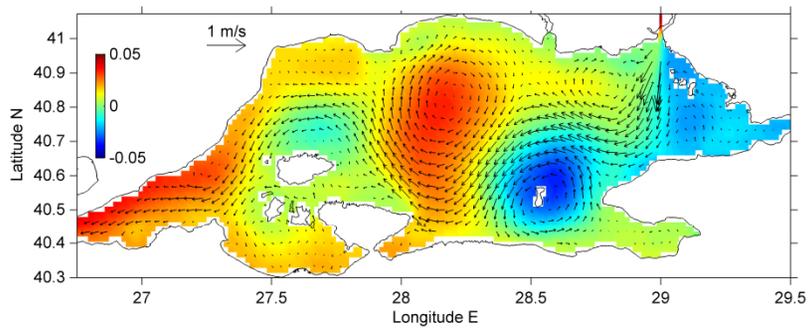


Role of the forcing

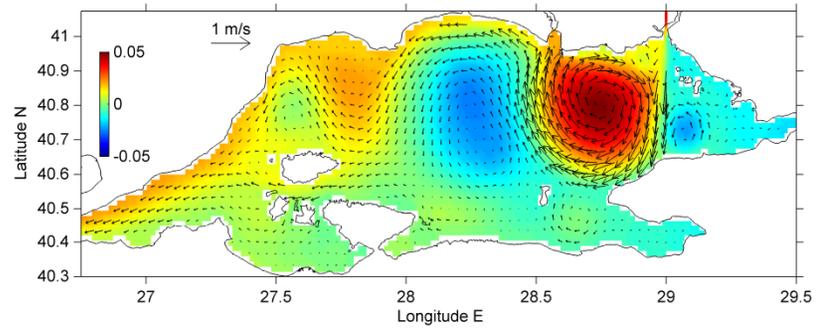
Sep 08 monthly average

Results

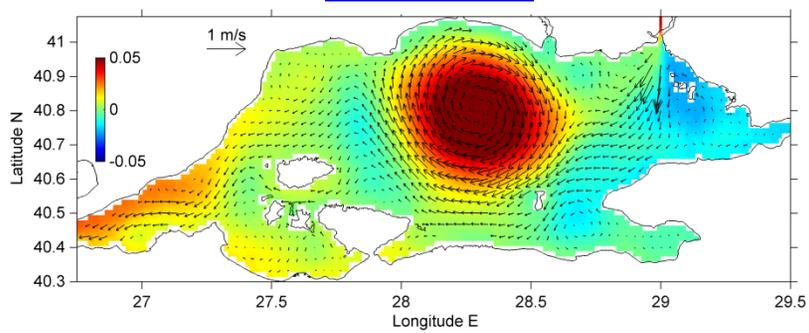
COSMO



COSMO no-curl

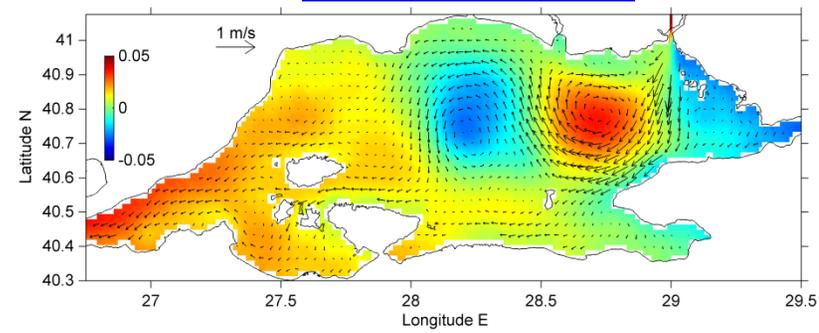


COAMPS



COAMPS fields are courtesy of J. Dykes, NRL-STENNIS

MetBuoy (no-curl)



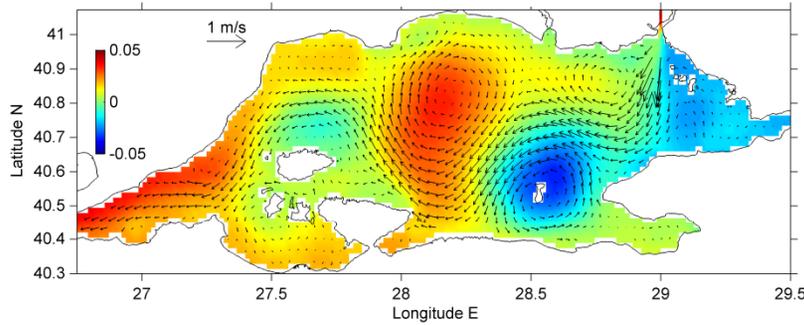


Role of the forcing

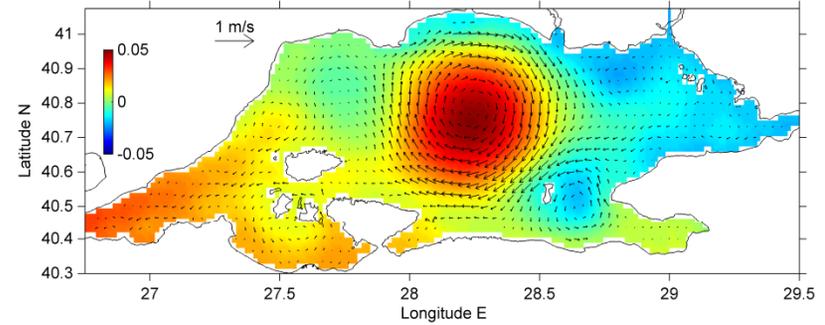
Sep 08 monthly average

Results

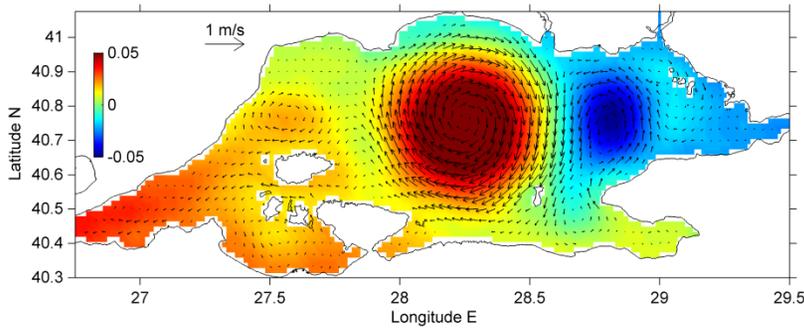
Realistic



No Straits, Homogeneous Initialization



No Straits

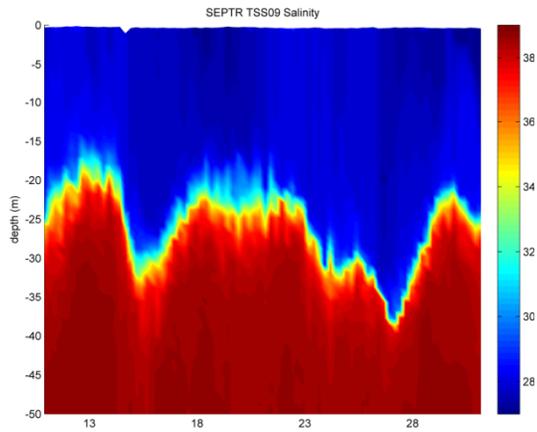




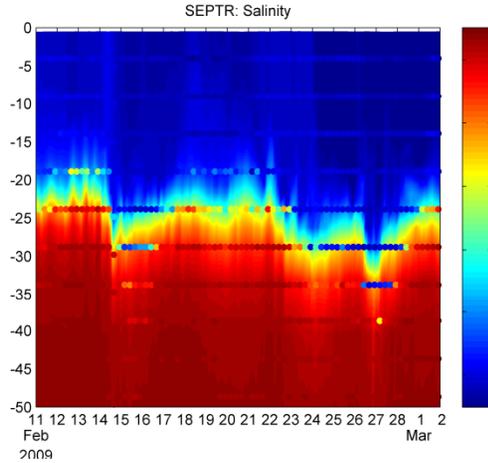
Pycnocline displacement

Results

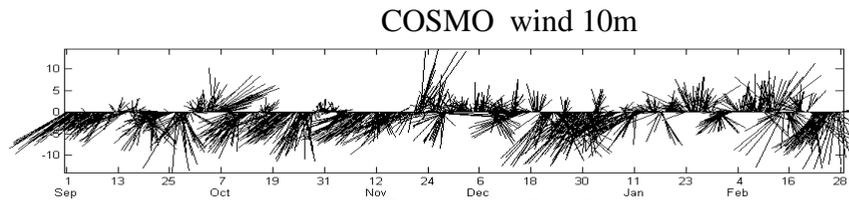
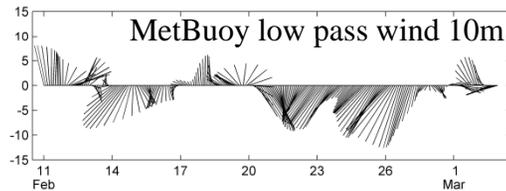
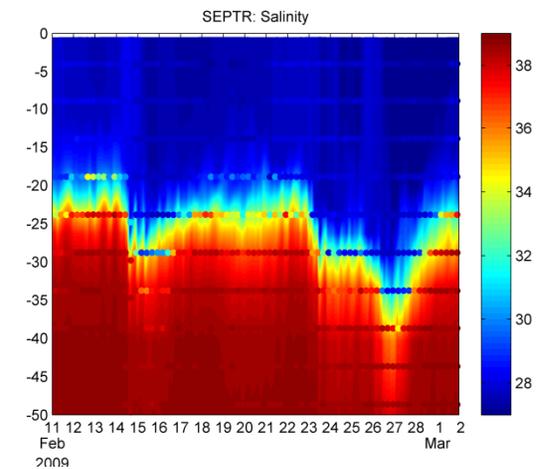
SEPTR



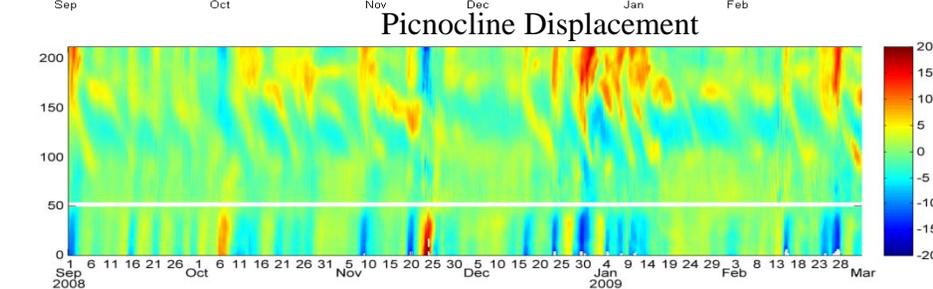
ROMS/COSMO



ROMS/MetBuoy



SEPTR





Final remarks

Conclusions

1. First realistic modeling experiment focused on the Marmara Sea circulation;
2. ROMS result show well known persistent features (meandering jet + wide anticyclon) as well as small scale transient cyclonic eddies that were not clearly identified before TSS trial;
3. High sensitivity to passing disturbances; eventually straits flow blockage (or reversal), reversal of the basin-wide circulation, large pycnocline displacements (upwelling/downwelling dynamics); *[part of this will be detailed in an upcoming talk by J. Book et al.]*
4. Outcome: knowledge of this behavior is relevant for biological processes (e.g. drift of larvae and fish eggs), drifting of floating objects (e.g. Search and Rescue operations), dispersion of pollutants/oil spills and risk mitigation considering in particular that the Marmara Sea is a basin of transition between the Black Sea and the Aegean Sea marine ecosystems and the impact of the Istanbul megalopolis and sustained ship traffic.

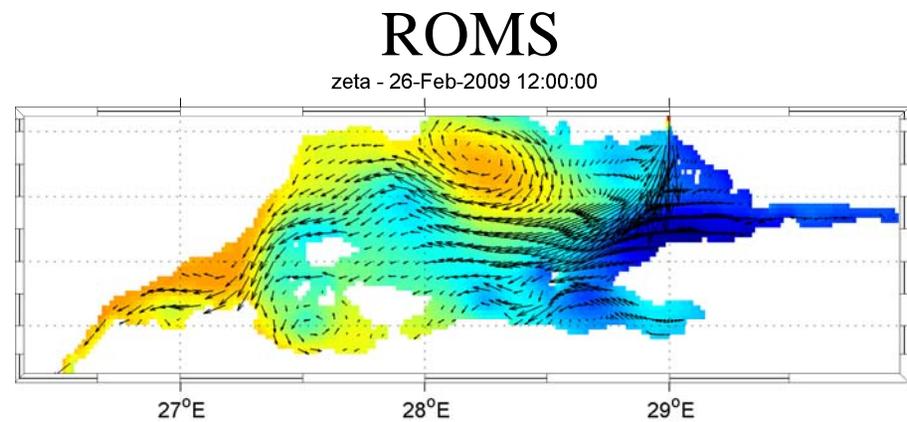
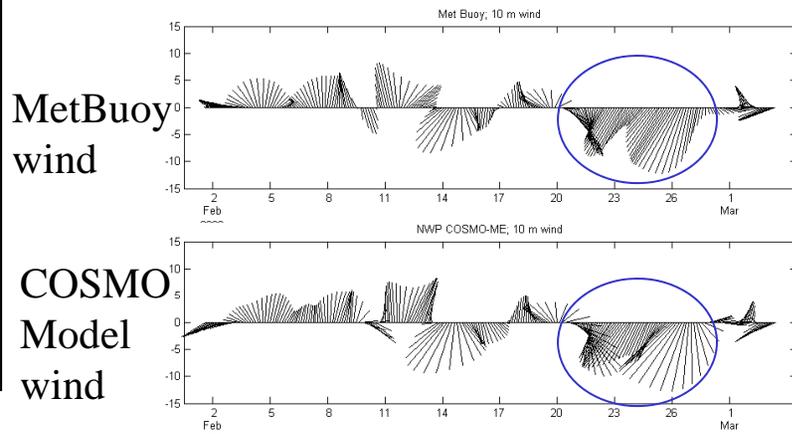
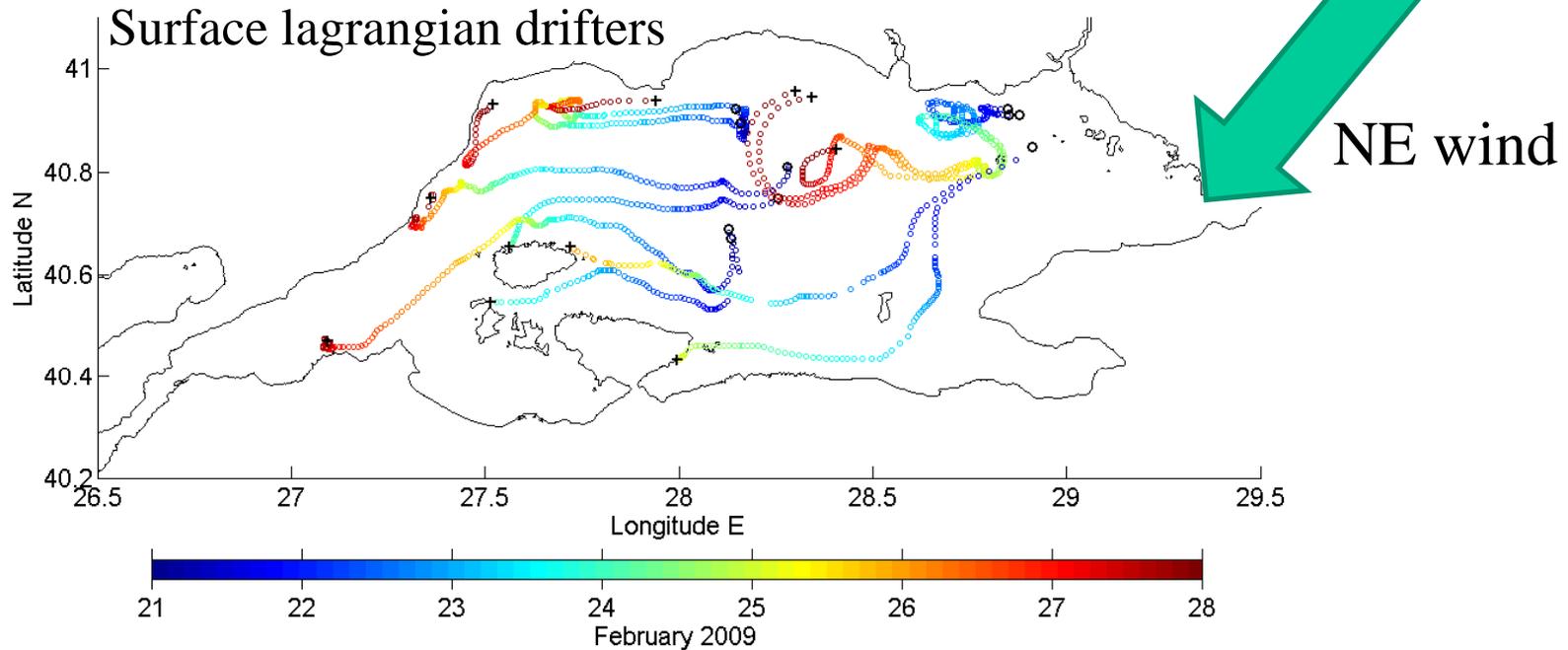


Thanks



Windstorm from North-East: Feb 09

Results





Windstorm from North-East: Drifter – Sep 08



Results

