HEAT AND MOMENTUM FLUXES FOR HYCOM

AN EXAMPLE APPLICATION : 3.2 km BLACK SEA MODEL

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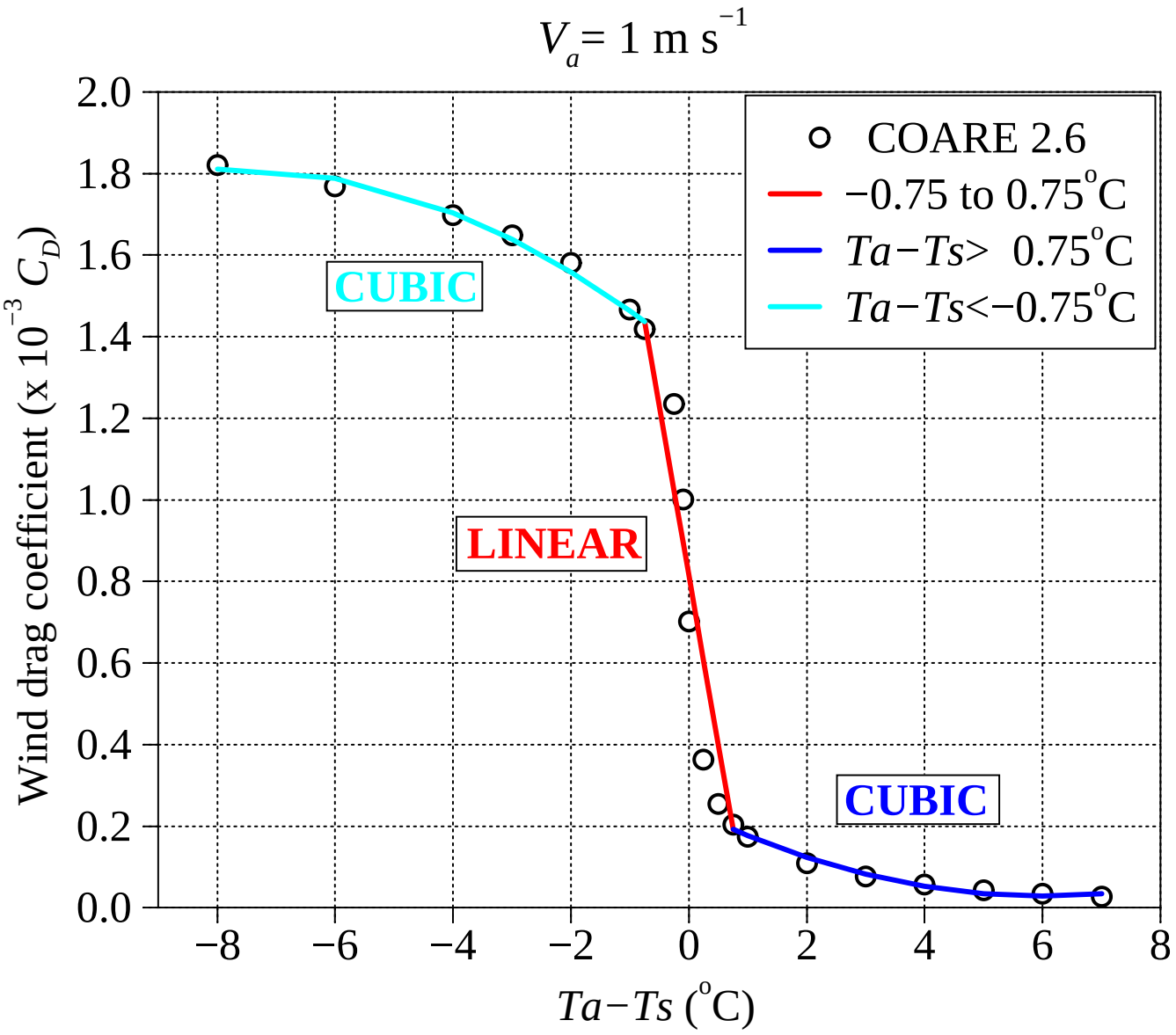
Contents

Atmospheric Forcing

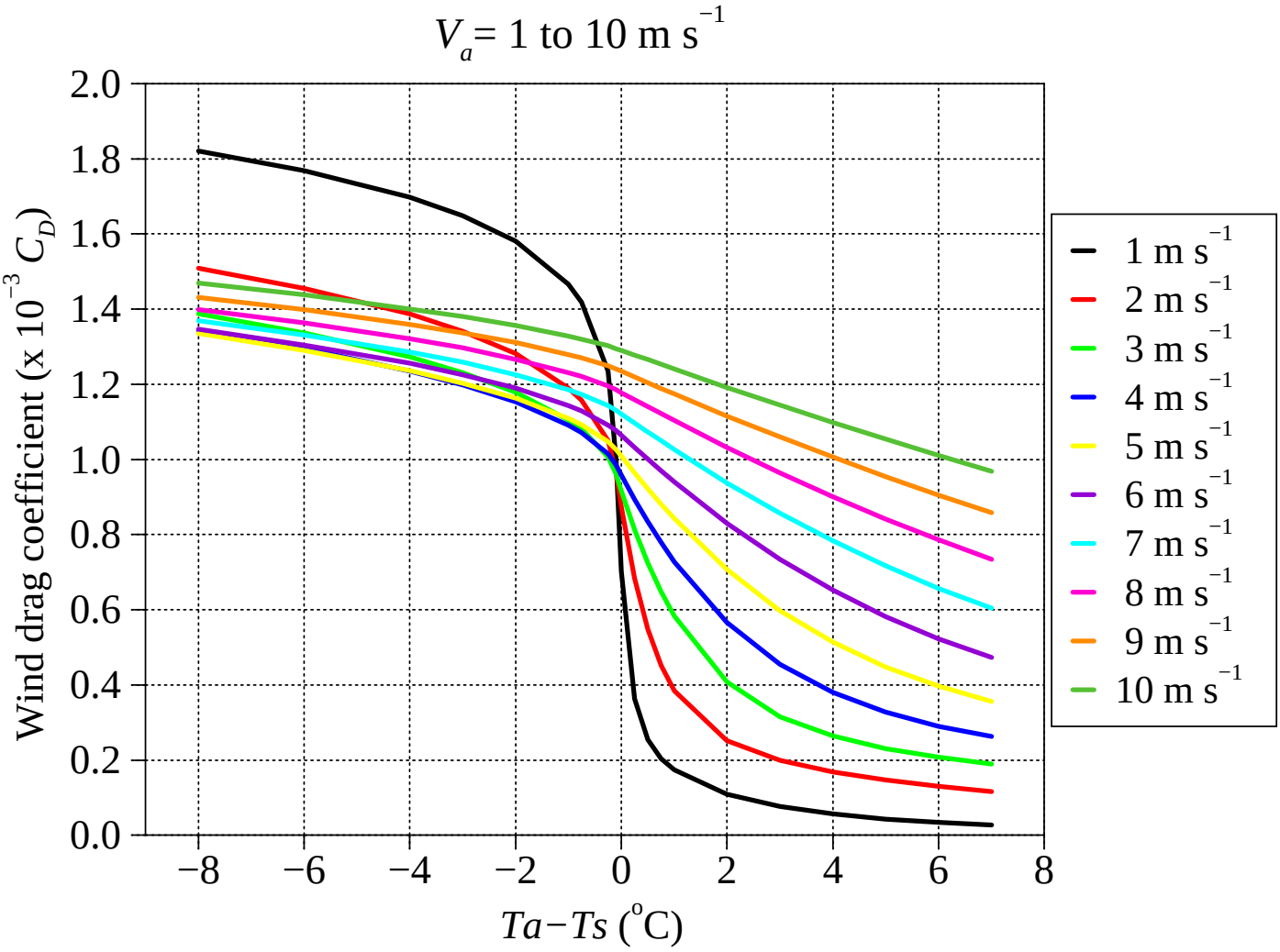
- Wind stress:
    - a bulk formula
    - air/sea stability on drag coefficient
- Latent and sensible heat fluxes:
    - bulk formulae
    - air/sea stability on exchange coefficients
    - calculated using HYCOM SST at each time step
    - realistic tendency towards the “correct” SST
    - keep the HYCOM SST on track
- Shortwave radiation at the sea surface
- Longwave radiation at the sea surface

WIND DRAG COEFFICIENT



- The methodology includes
  - stable case, unstable case, neutral case

WIND DRAG COEFFICIENT FOR DIFFERENT WIND SPEEDS



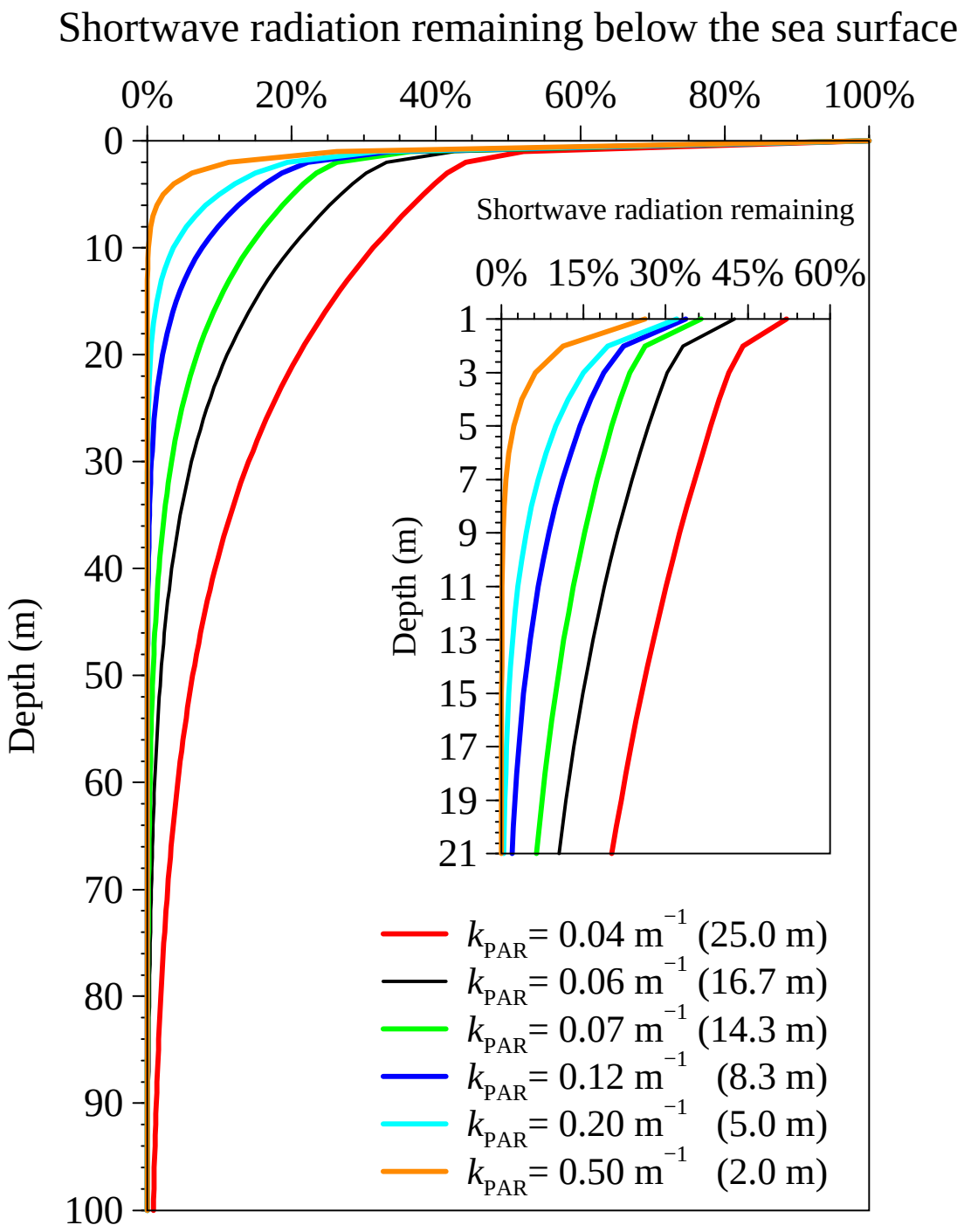
Shortwave Radiation Penetration

- Previous Subsurface Heating Parameterization in HYCOM
  - few discrete attenuation profiles

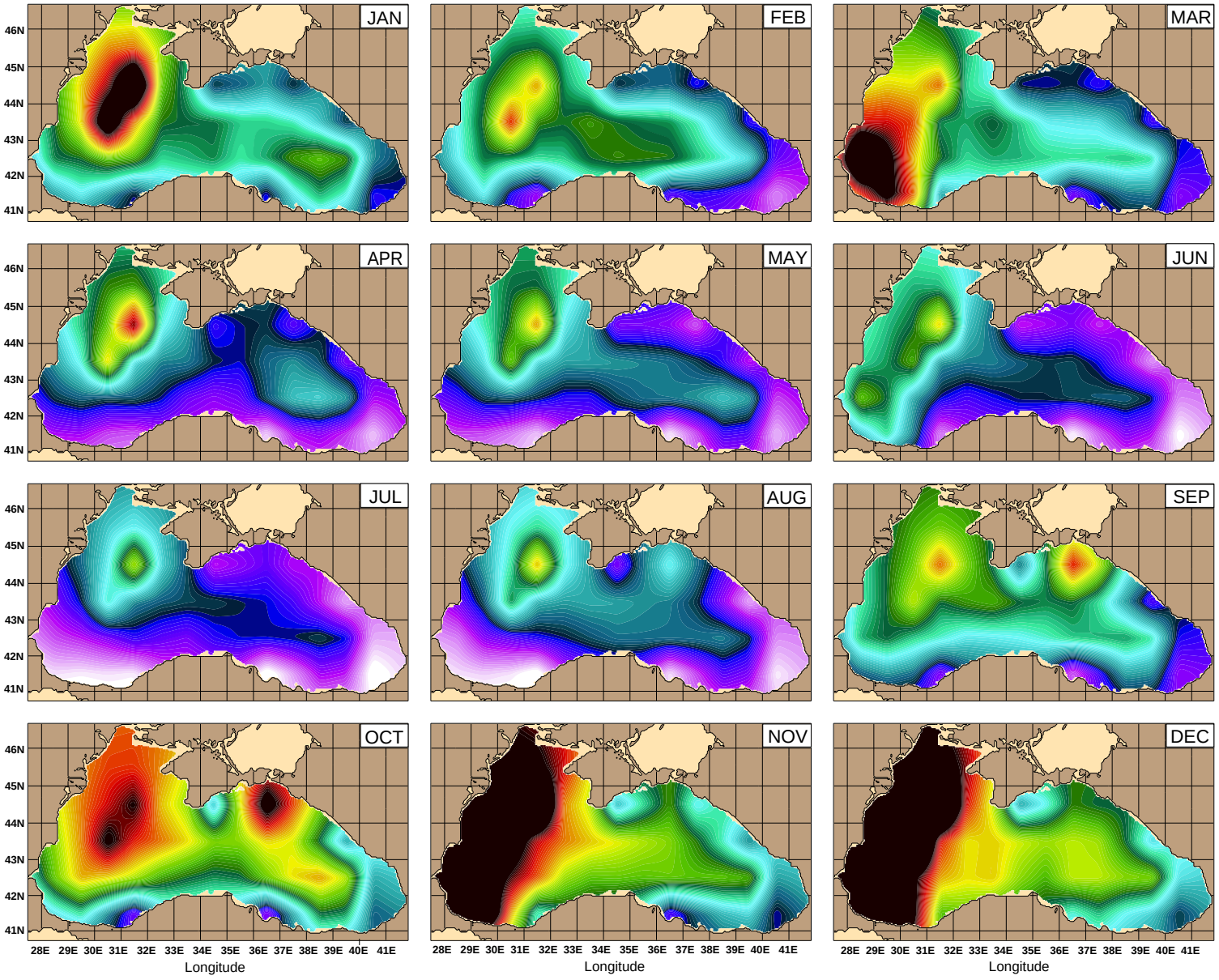
	Type	Red (%)	Blue (%)
1	I	58	42
2	IA	62	38
3	IB	67	33
4	II	77	23
5	III	78	22

- A new shortwave radiation penetration scheme for HYCOM
- Different than “bulk type” mixed layer models
  - spatial and temporal water turbidity from SeaWiFS
  - 2–band scheme:
  - red spectrum: absorbed near surface
  - blue spectrum: more deeply penetrating

SHORTWAVE RADIATION ABSORPTION



ATTENUATION COEFFICIENT CLIMATOLOGY



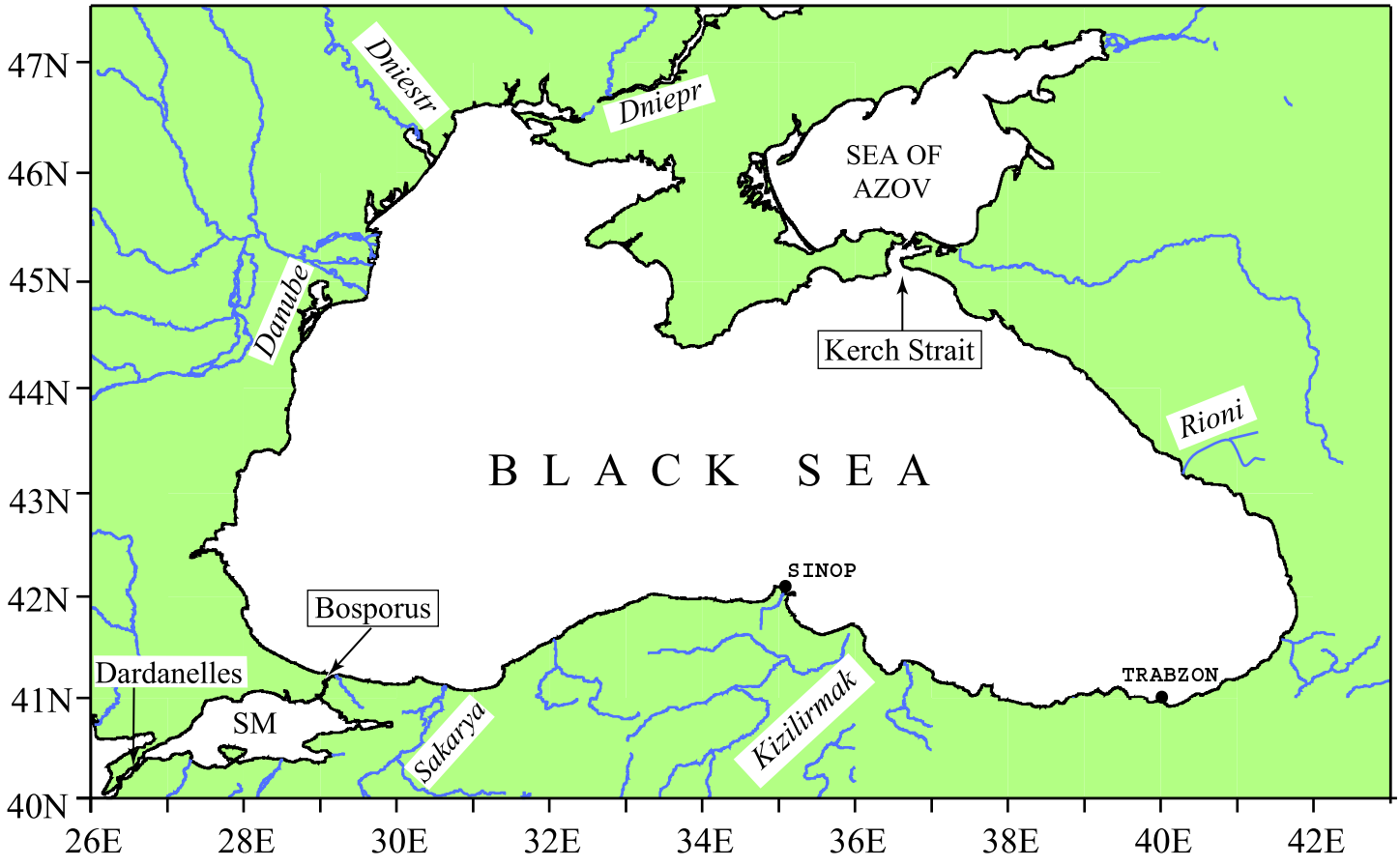
Longwave Radiation

- A correction is needed. Why ?
  - Longwave radiation from ECMWF or NOGAPS
  - Calculated using their model SST
- HYCOM now uses

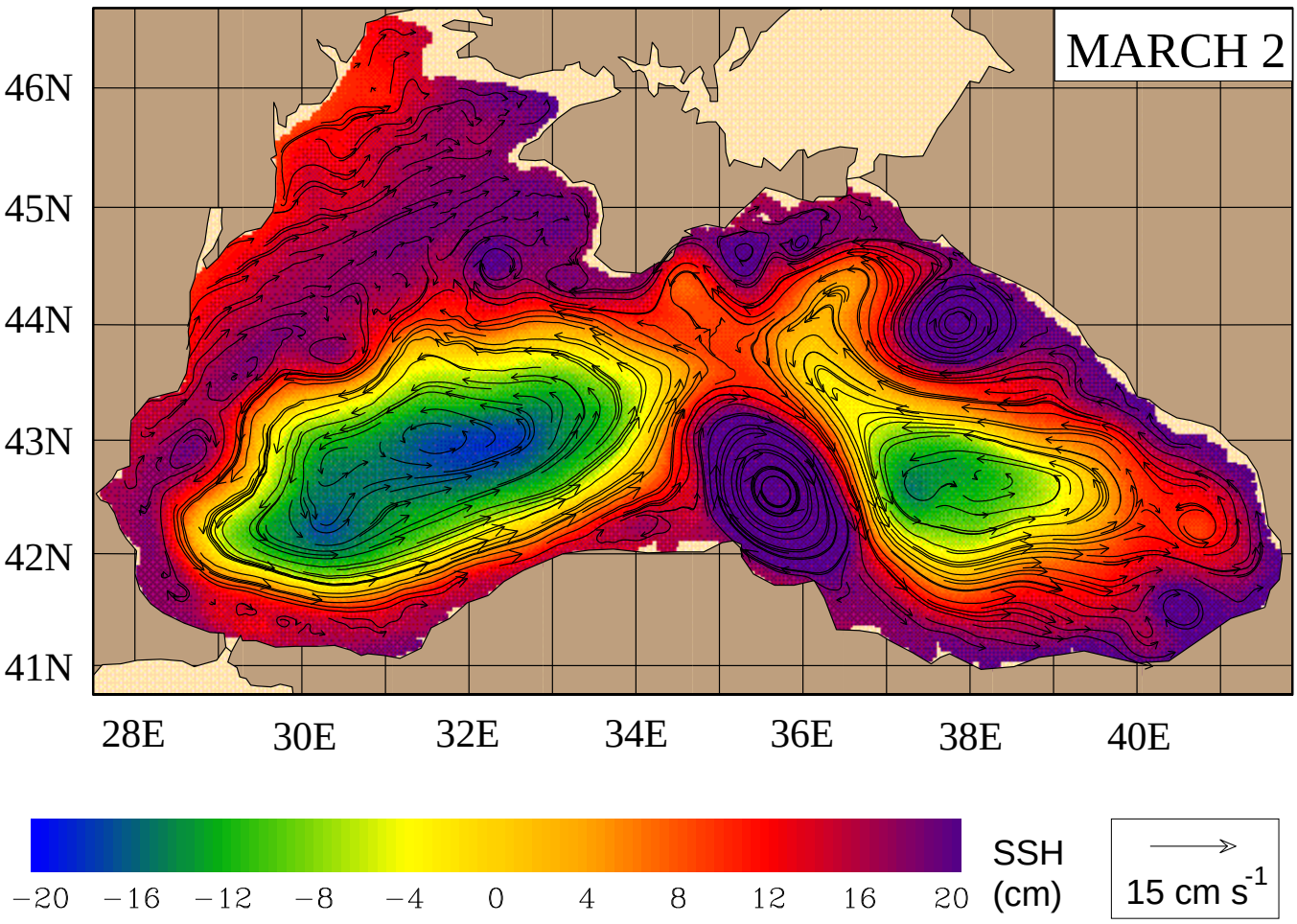
$$\mathbf{Q_{LW}(T_s) = Q_{LW}(T_c) - 5.3\,(T_s - T_c)}.$$

  - $\mathbf{T_s}$: HYCOM SST
  - $\mathbf{T_c}$: Climatological SST
- A constant value: $\mathbf{-5.3\ W\ m^{-2}\ C^{-1}}$ (relaxation term)

GEOGRAPHY OF THE BLACK SEA



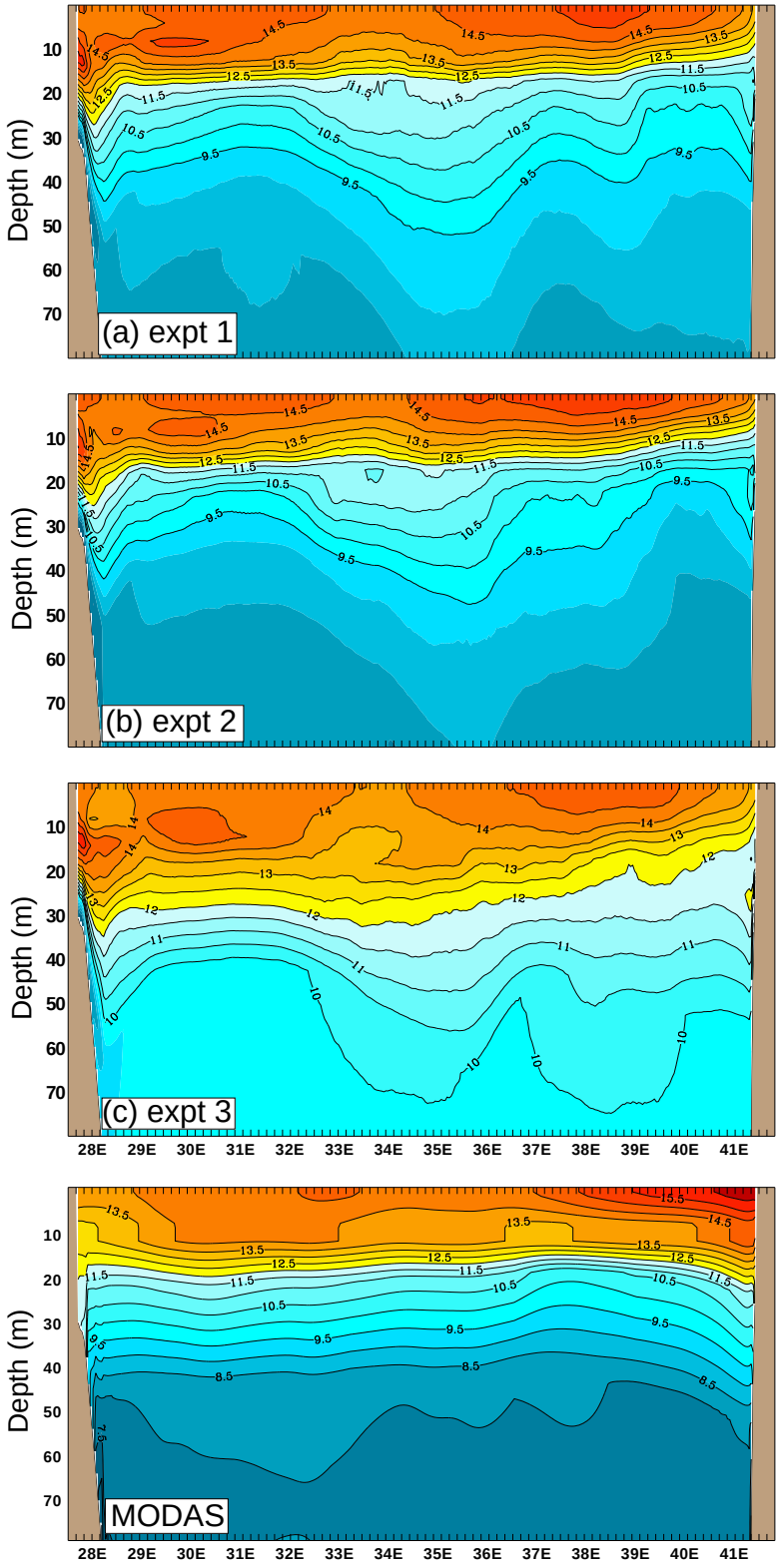
SNAPSHOTS OF SSH and SURFACE CURRENTS



- Climatologically forced HYCOM simulation:
- Wind and thermal forcing from NOGAPS

NOGAPS: Navy Operational Global Atmospheric Prediction System

ANUUAL MEAN SUBSURFACE TEMPS. ALONG 42.6°N

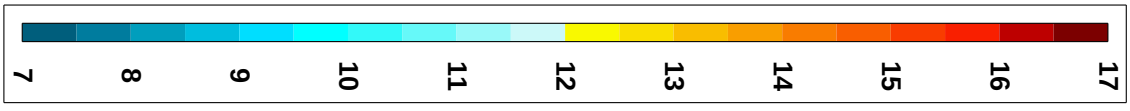


SeaWiFS BASED TURBIDITY

ALL RADIATION AT THE SURFACE

CLEAR WATER ASSUMPTION

MODAS TEMP. CLIMATOLOGY

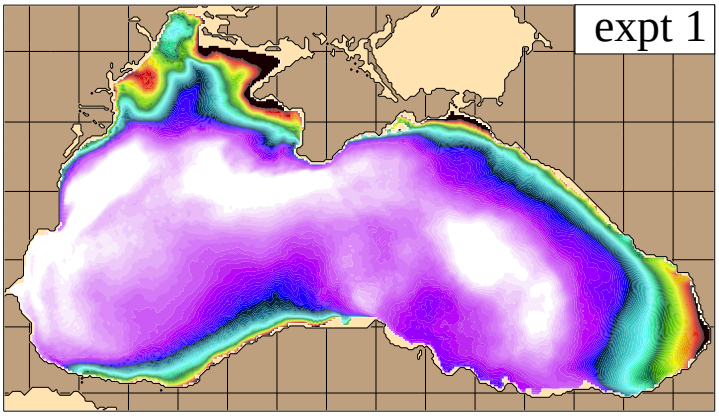


Temp. (^{o}C)

SST VALIDATION

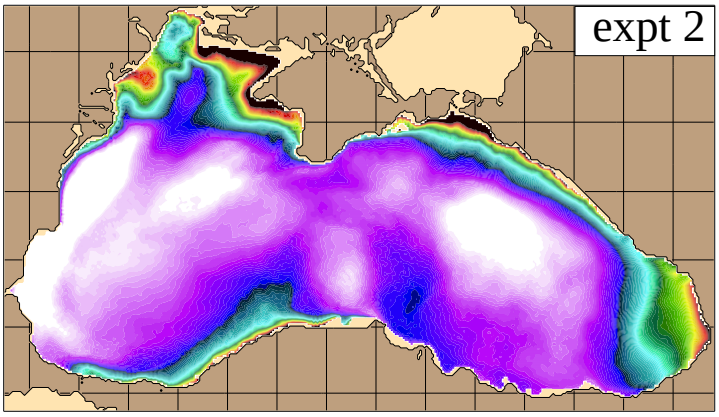
SST RMS difference with respect to the 1/8° Pathfinder SST clim.

12 monthly HYCOM SST versus 12 monthly Pathfinder SST



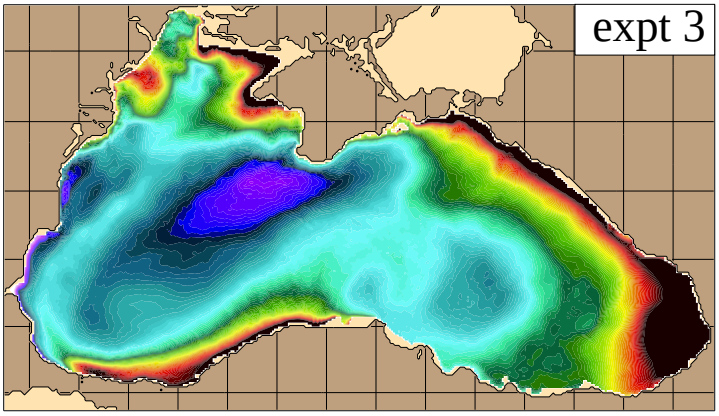
SeaWiFS BASED TURBIDITY

(RMS = 1.41°C)



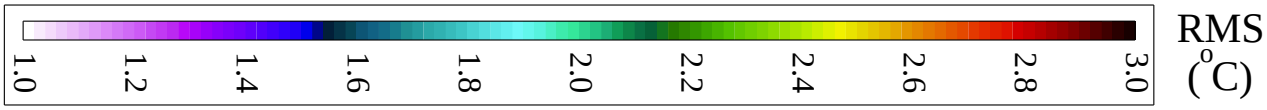
ALL RADIATION AT THE SURFACE

(RMS = 1.42°C)



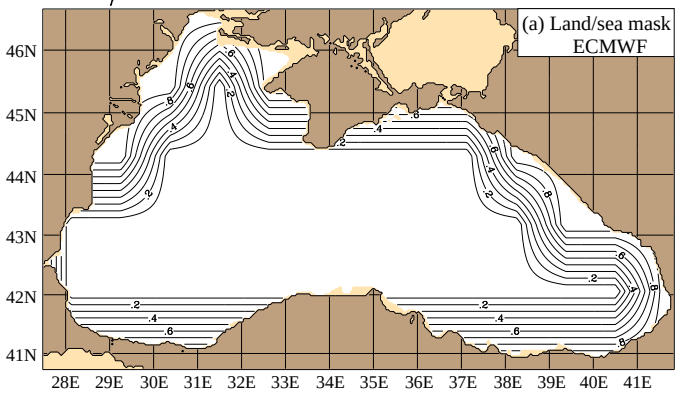
CLEAR WATER ASSUMPTION

(RMS = 2.06°C)

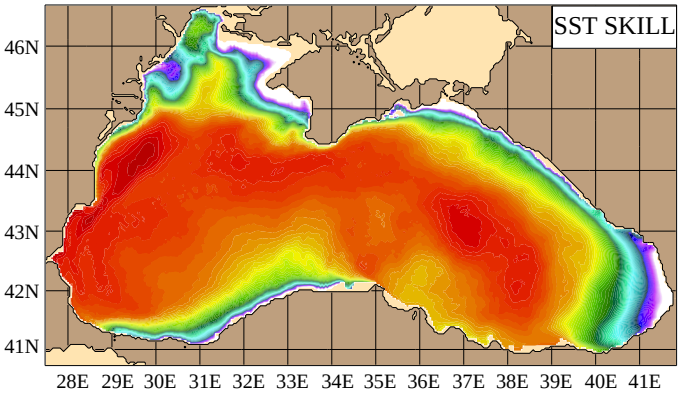


SST SKILL SCORE and LAND/SEA MASK

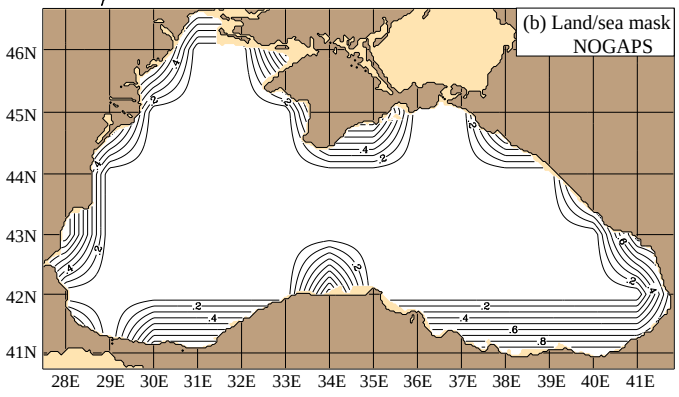
LAND/SEA MASK FROM ECMWF



HYCOM FORCED WITH ECMWF



LAND/SEA MASK FROM NOGAPS



HYCOM FORCED WITH NOGAPS