Estimation of Freshwater Transport and Dispersal Pathway discharged from the Changjiang River in the East China Sea

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1. Introduction

The Changjiang River (CR) mouth is located in the east coast of mainland China (Fig. 1). Its discharge is the third largest in the world and has high levels of nutrients, phytoplankton and organic matters. The Changjiang diluted water (CDW) flows southward along the Chinese coast in winter, but in summer it extends farther offshore. In this study we attempt to estimate more realistic transport of the CDW in the East China Sea (ECS), and address the freshwater pathway.

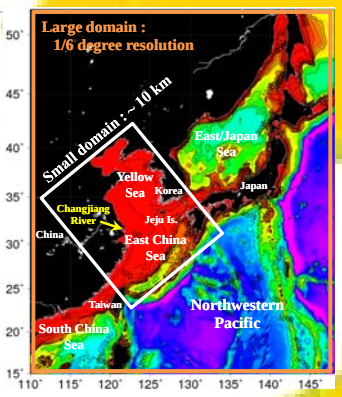


Fig. 1
Model domains and bathymetry.

We here pay strong attention on the pattern of freshwater transport of 1996 and 1998 since the two cases provide a distinct difference in the freshwater transport and the pathways, as shown in Fig. 2.

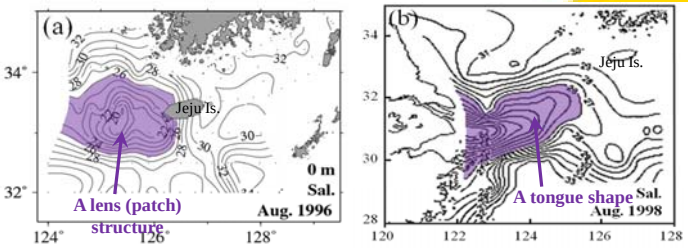


Fig. 2 Horizontal distributions of surface salinity in August (a) 1996 investigated by NFRDI and (b) 1998 obtained from Wang et al., 2003.

2. Model configurations

- ✓ ROMS: Regional Ocean Modeling Systems
- ✓ Horizontal & vertical resolutions: about 10 km and 20 layers.
- ✓ Bottom topography: A combination of SKKU 1m [*Choi et al.*, 2002] & ETOPO5.
- ✓ Initial & boundary conditions: Northwestern Pacific model (Fig. 1, large domain)
  - ▷ RIAM ocean model: 3D, PE, 1/6 degree and 60 z-level [*Moon et al.*, 2009].
- ✓ Atmospheric forcing: NCEP reanalysis-II 6-hourly data
- ✓ Surface fluxes: Bulk formulation
- ✓ 8 tidal constituents obtained from NOA99.JB [*Matsumoto et al.*, 2000] assimilating TOPEX/POSEIDON altimeter and 219 coastal tide gauge data.
- ✓ Realistic Changjiang River discharge [lower panel of Fig. 6, *Senjyu et al.*, 2006].
- ✓ Enhanced KPP scheme for both surface and bottom boundary layers [*Li et al.*, 2005]
- ✓ Bottom stress is parameterized with a quadratic drag law (Cd = 0.0025).
- ✓ Advection is third-order and upstream bias.
- ✓ 11-year (1995-2005) simulations with the first year used as a spin-up.

3. Freshwater pathways in the ECS

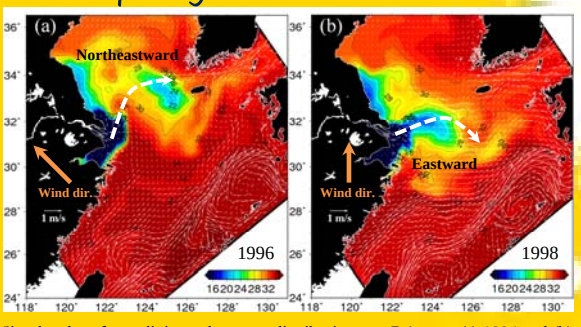
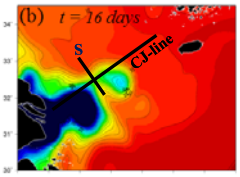


Fig. 3 Simulated surface salinity and current distributions on 7 August (a) 1996 and (b) 1998.

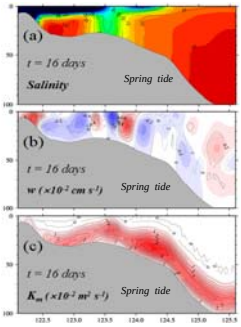
4. Offshore detachment of CDW

Of particular interest is the offshore detachment of CDW in the northeastern shelf of the Changjiang Bank in 1996 under the conditions of strong southeasterly wind and spring tide. This result basically supports the interpretation of *Moon et al.*, [2010; in press, JPO] for detachment process.

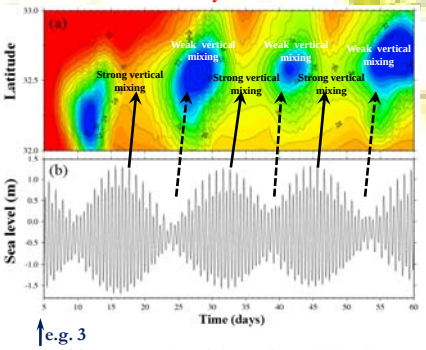
✓ **Result of *Moon et al.* [2010] for the condition of the constant southeasterly wind and realistic tides.**



e.g. 1 Horizontal distributions of daily mean surface salinity.



e.g. 2
Vertical structure of mean (a) salinity, (b) vertical velocity (w) and (c) vertical eddy viscosity (Km) along the CJ-line at day 16 in spring .



e.g. 3
(a) Time-space plot of the surface salinity along S-line and (b) the sea level variation at the center of S-line.

5. 10-year mean freshwater transport and pathway

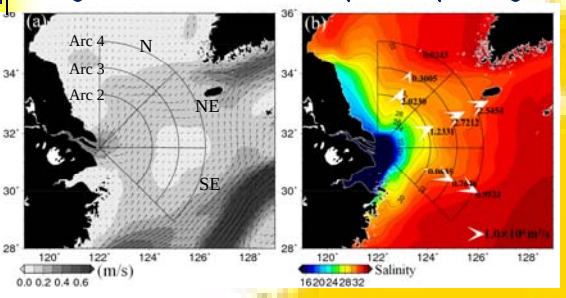


Fig. 4
Summer mean surface (a) current, (b) salinity and spatially integrated freshwater transport across each portion of the arcs. These fields are averaged for July to August from 1996 to 2005.

6. Discussion and Conclusions

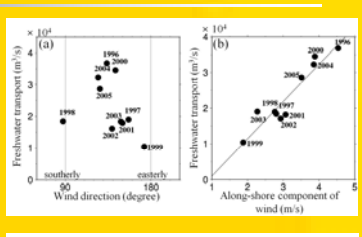


Fig. 5
(a) Scatter diagram for summer mean freshwater transport across the NE and wind direction. (b) Relation of northeastward freshwater transport with along-shore comp. of wind.

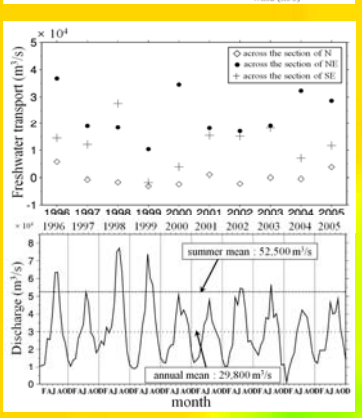


Fig. 6
Year-to-year variation of (upper) the summer mean freshwater transport across each portion of the arc 4 and (lower) the discharge of the CR from 1996 to 2005.

✓ **The along-shore (southeasterly) wind** plays a critical role in determining the northeastward freshwater export to Jeju Island in the ECS (see Fig. 5).

✓ **There is virtually no relationship** between the summer discharge from the CR and the northward freshwater flux to Jeju Island (see Fig. 6).

✓ **The weak along-shore wind allows one more freshwater pathway** to the central ECS along the shelf (e.g. Fig. 7).

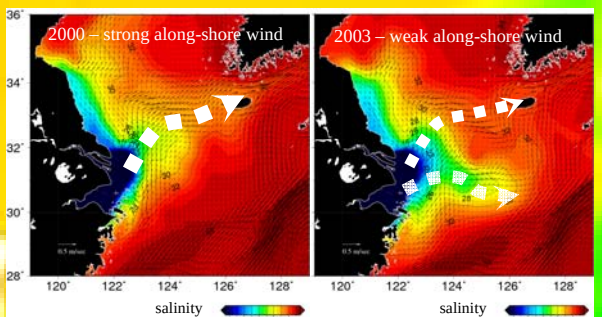


Fig. 7 Summer mean surface salinity and current distributions in (a) 2000 and (3) 2003.