



Changes in Physical Oceanographic Environments in Saemangeum Area

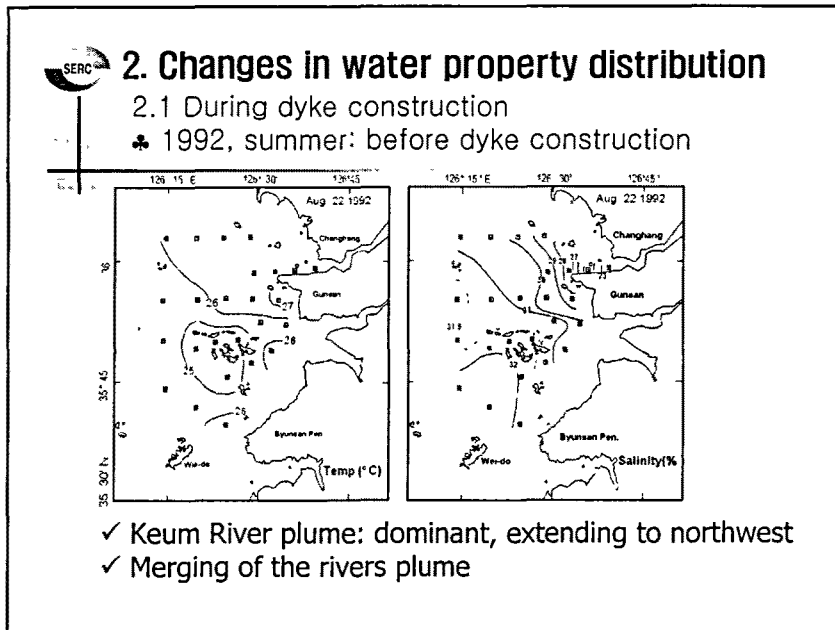
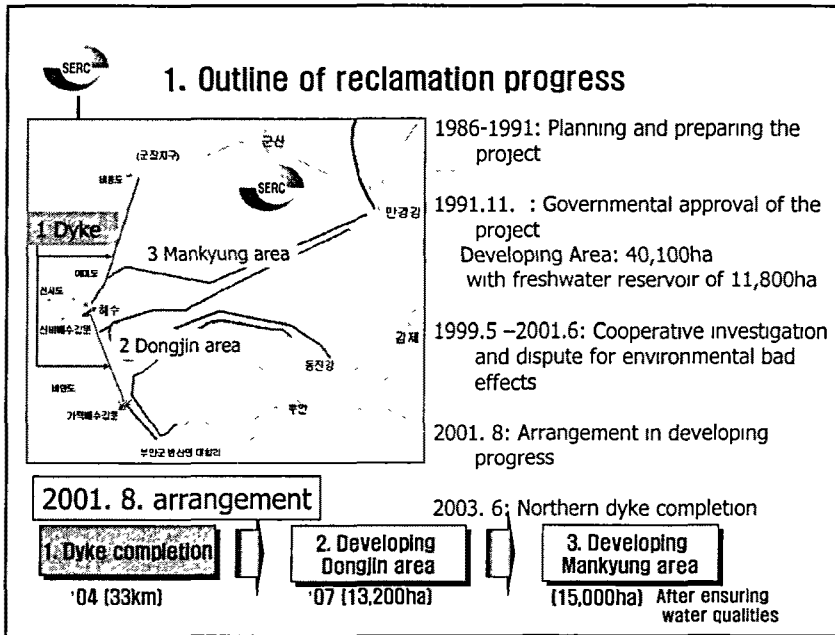


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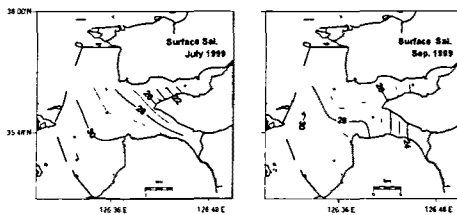
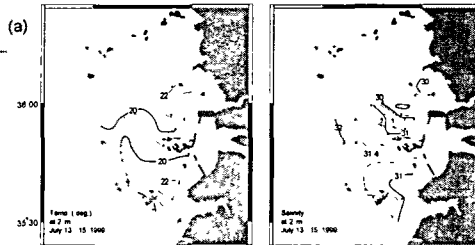




1999, summer: 80% dyke construction, three gaps

● Outside of the dyke

- ✓ Strong plume front off the Keum River mouth
- ✓ Secondary front off the Gomso Bay

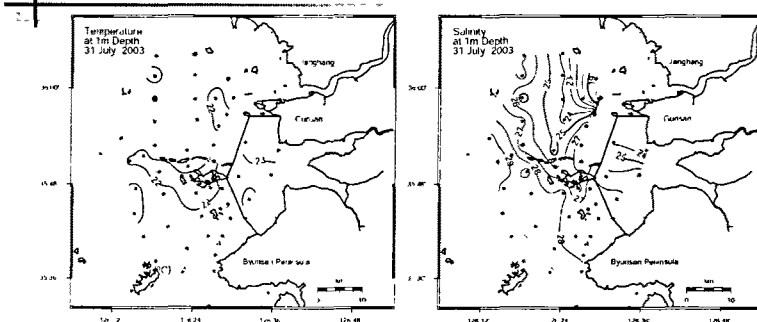


● Inside of the Dyke

- ✓ mixing of two river water
- ✓ outflow toward northern gap



2.2 After construction of northern dyke (July 2003)

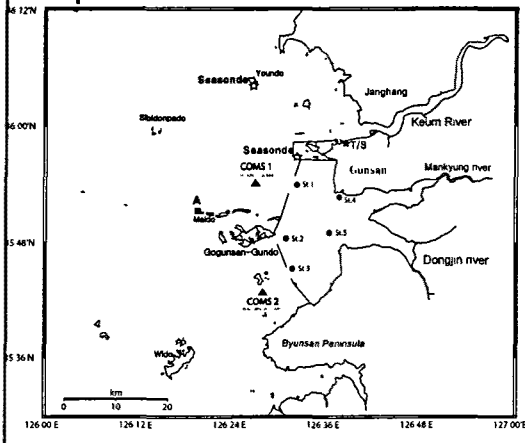


- ✓ Blocking the merge of plumes by northern dyke
- ✓ Accumulation of low salinity water within the dyke → enhancing vertical stratification
- ✓ No plume-development but low salinity water out of southern gaps



3. Changes in tidal and costal currents

3.1 Before northern dyke completion

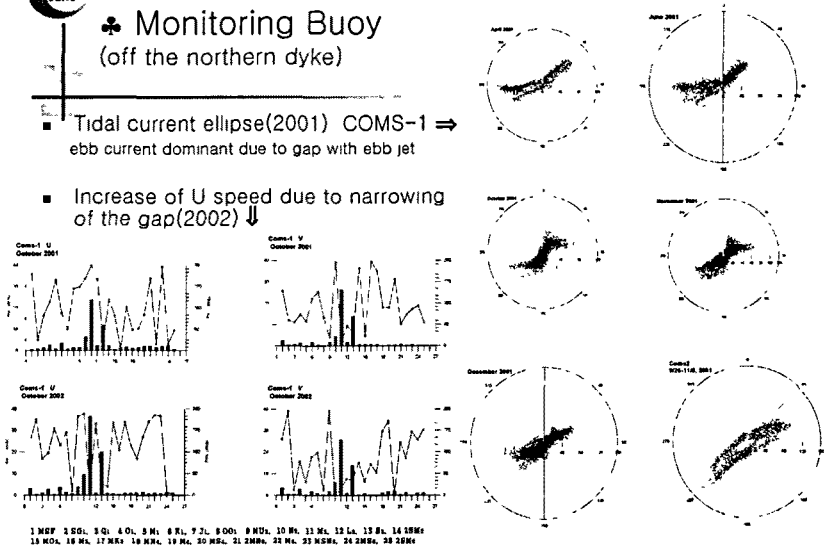


- Observations
 - Long term monitoring Buoy. 2 sites
 - Short term anchoring. 5 sites
 - HF Radar operation off the northern dyke
 - Tide. Kusan Outerport
 - Wind. Mal-do AWS



♣ Monitoring Buoy (off the northern dyke)

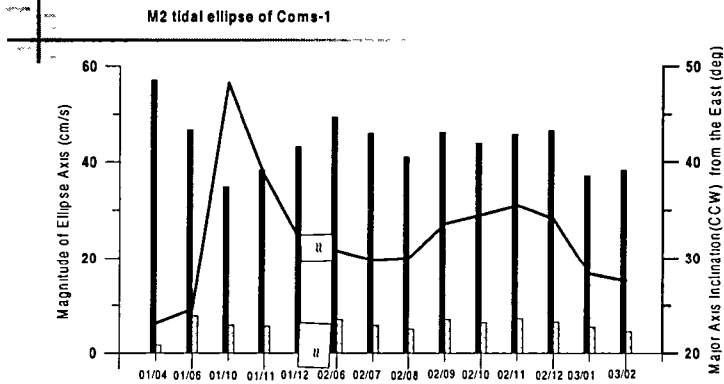
- Tidal current ellipse(2001) COMS-1 ⇒ ebb current dominant due to gap with ebb jet
- Increase of U speed due to narrowing of the gap(2002) ↓



1 MFP, 2 SOL, 3 Q, 4 O, 5 M, 6 FL, 7 J, 8 OOD, 9 HU, 10 PL, 11 M, 12 L, 13 B, 14 SH, 15 MO, 16 H, 17 NS, 18 KH, 19 M, 20 MB, 21 MHA, 22 W, 23 MSH, 24 MSA, 25 SHM



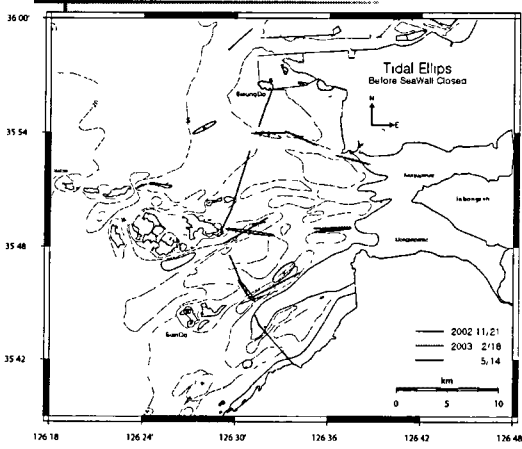
♣ Changes of the M_2 current ellipse



Monthly variations of M_2 current ellipse characteristic analyzed using hourly data of Coms1. Numbers in horizontal axis indicates year/month. Bar denotes magnitude of major and minor axis and solid line does inclination angle of major axis



♣ Distributions of observed M_2 current ellipses



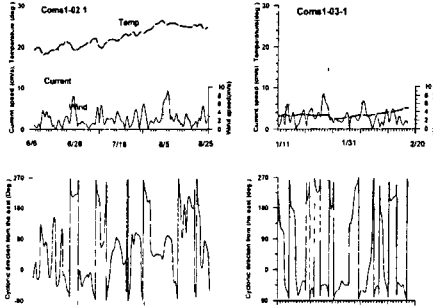
Align of major axis along the tidal channels and three gaps



Sub-tidal flows

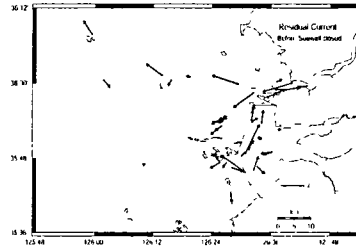
Long term Monitoring Buoy
(2002. 6-8, 2003. 1-2)

Dotted line: current, solid line: wind



- Current speed: summer > winter
- direction: southwestward in summer, southward in winter(wind drift)

Residual current from short term anchoring



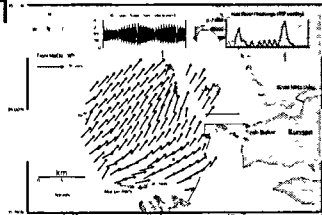
- Northwestward extension of Keum river plume
- Anticlockwise circulation through the dyke gaps in the inner area



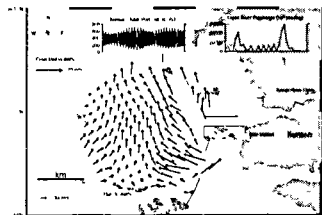
HF Radar observation (2002 summer, flood period)

Effect of fresh water discharge

Surface Current(Raw)02 07 24_0000

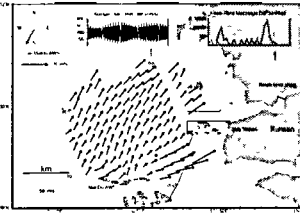


Surface Currents(Filtered) 02 07 24_0000

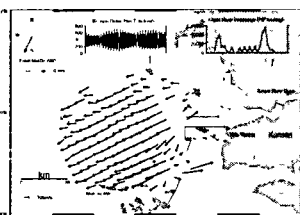


Northeasterly wind effect

Surface Current(Raw)02 07 26_0200



Surface Currents(Filtered) 02 07 26_0200

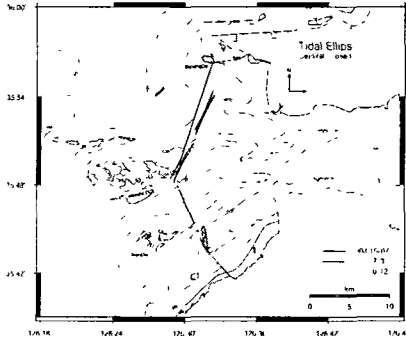




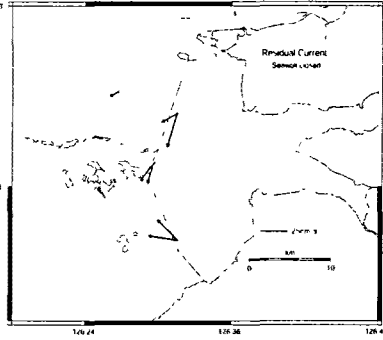
3.2 After northern dyke completion (June 9, 2003)

♣ Short term Anchoring

Tidal ellipses

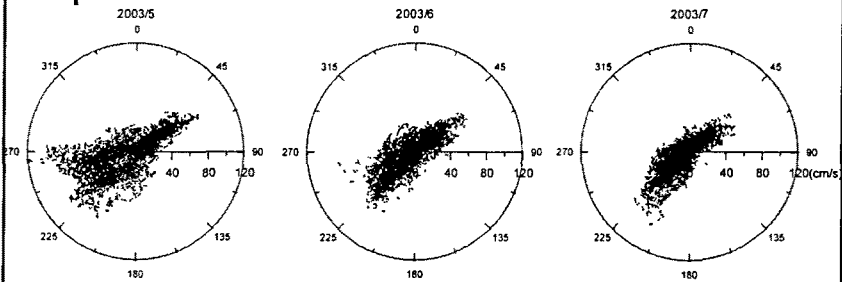


Residual currents



- Ellipses change near the dyke
- Outflow through the southern gaps

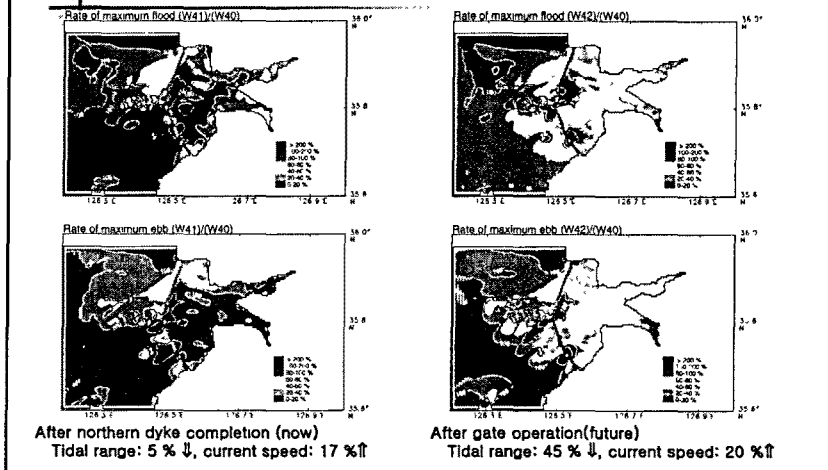
♣ Monitoring Buoy



- Decrease of tidal current scattering \Leftarrow Disappear of ebb current jet
- Decrease of current strength

4. Predicted changes after gate operation

4.1 Tide and tidal currents (KORDI)



4.2 water properties and circulations

- After completion of the dyke(gate opened):
 - inner area: vertical stratification due to river water accumulation
 - decrease of tidal exchange to 45%→ weak inner area circulation
 - very low salinity water south of Gogunsan-gundo
 - offshore circulation change
- After reclamation of Dongjin area(river water reservoir):
 - decrease of tidal exchange to 47 %
 - depositional environment around Byunsan coast
 - ecological impact of artificial freshwater plume separated from the Keum River plume



5. Summary and suggestions

- ... Small changes in water property distributions, tidal current and coastal circulation due to water exchange through three gaps before completion of the northern dyke
- After June 2003 (northern dyke completion), tidal currents changes significantly->
 - 1) Inner area low salinity water accumulation, strengthened stratification, decrease of water exchange
 - 2) off dyke blocking of anticlockwise coastal circulation, low salinity water off the southern gaps
- Dyke gates operation stage (predicted bad effects)
 - 1) acceleration of vertical stratification with low salinity water very small water exchange -> possibility of algae bloom, no oxygen layer and water quality worsening -> transition of inner area ecological community
 - 2) artificial freshwater plume extension off the southern dyke-> impact on offshore ecology
 - 3) possibility of depositional condition off the southern dyke
- Suggestions research to remove of the bad effects effectively
 - 1) freshwater quality control reduce of pollution source and circulation of reservoir water
 - 2) new design on the usage of inner developing area
 - 3) estimation and preparations to reduce the bad effects on offshore area