Metabolism, transport, and distribution of typical herbicide in a bay of the northwest Pacific Ocean

Yu Zhang et al.

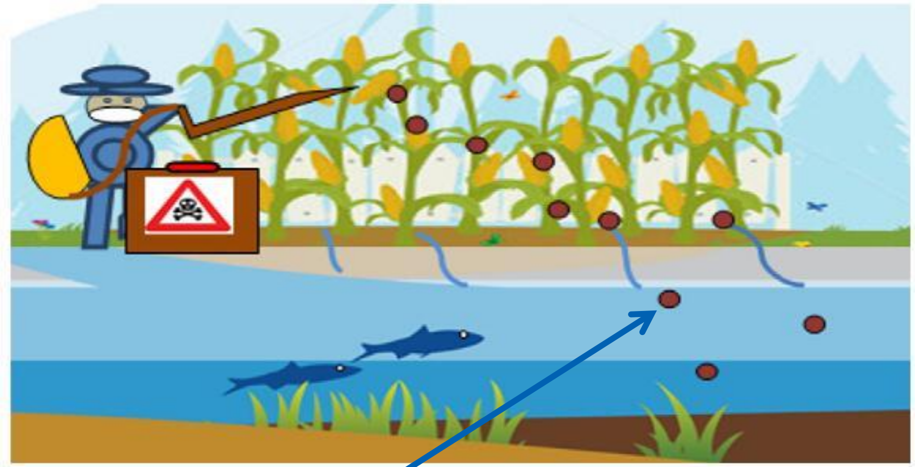
School of Environment, Beijing Normal University

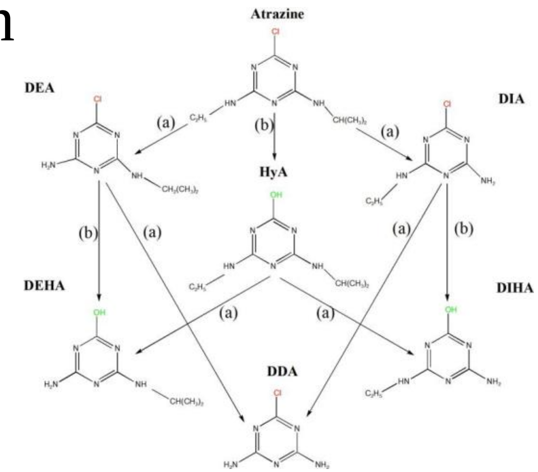
Contents

- **Research Background**
- **Occurrence, transportation and distribution difference of typical herbicides from estuary to bay**
- **Next step: simulation experiments for migration and transformation of herbicides**

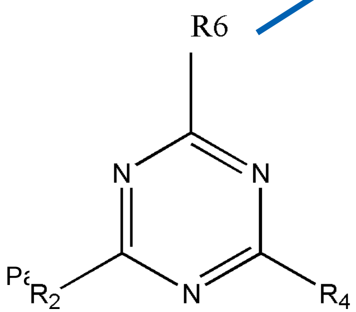
Research Background

- ✓ Source: agricultural use of atrazine
- ✓ Property: low solubility, long half-life, strong leaching, diffcult degrading
- ✓ Toxicity: endocrine disrupter, potential cancerogen





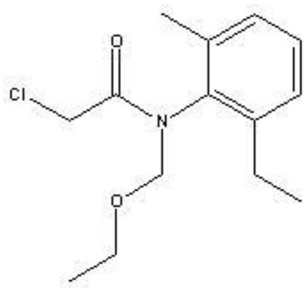
R_2=NHCH$(CH_3)_2$;NH_2 R4=NH_2;NHC_2H_5 R6=Cl;OH



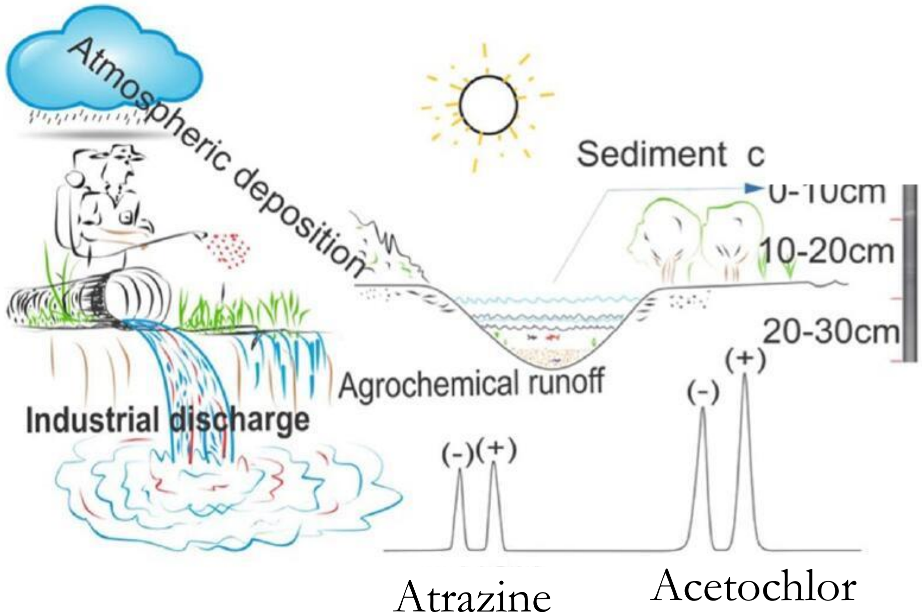
compound	abbr	substituent group			$LogK_{oc}$	$LogK_{ow}$	pKa
		R2-	R4-	R6-			
Atrazine	ATR	NHCH$(CH_3)_2$	NHC_2H_5	Cl	2.7	2.75	1.7
Deethylatrazine	DEA	NHCH$(CH_3)_2$	NH_2	Cl	1.6	1.24	1.3
Hydroxyatrazine	HyA	NHCH$(CH_3)_2$	NHC_2H_5	OH	1.4	1.94	4.9
Deisopropylatrazine	DIA	NH_2	NHC_2H_5	Cl	1.2	1.15	1.3
Hytroxydeethylatrzine	DEHA	NHCH$(CH_3)_2$	NH_2	OH	0.2	-0.08	4.5
Hydroxydeisopropylatrazine	DIHA	NH_2	NHC_2H_5	OH	-0.1	-0.3	4.6
Deethyldeisopropylatrazine	DDA	NH_2	NH_2	Cl	0	0.32	1.5

Research Background

- ✓ Source: agricultural use of acetochlor
- ✓ Property: high solubility, non-photolysis，non-volatile
- ✓ Usage: top three herbicides worldwide

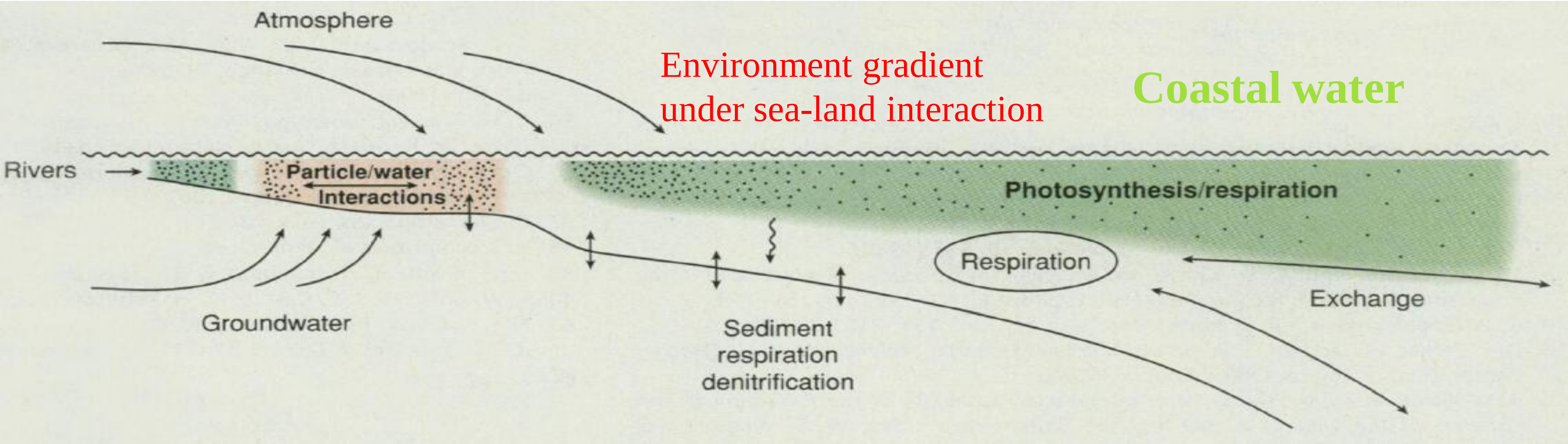


Acetochlor



Research Background

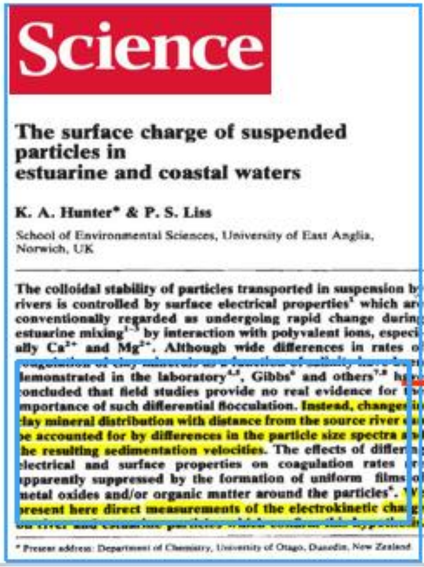
- Special habitat patterns under salinity gradient influenced by Multi-scale hydrodynamic process in the estuary.
- Bays are the ultimate recipients of agricultural nonpoint source pollution from continental watersheds
- Provide ecosystem services of Supporting, Provisioning, Regulating and Cultural: Biodiversity + Fishery Production + Economic Supports.
- Presently about 40% of the world's population lives within 100 km of the coast.



- What is distribution of herbicides during transport from river to bay? What are the mechanisms involved？ Technology of pollution control?

Hot topics in coastal zone and bay

- Transportation mechanism of herbicides



Science

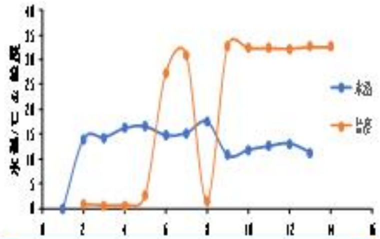
The surface charge of suspended particles in estuarine and coastal waters

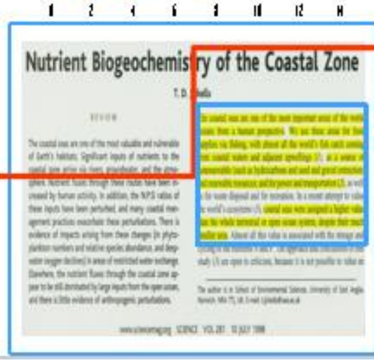
K. A. Hunter* & P. S. Liss

School of Environmental Sciences, University of East Anglia, Norwich, UK

The colloidal stability of particles transported in suspension by rivers is controlled by surface electrical properties[1] which are conventionally regarded as undergoing rapid change during estuarine mixing[1-3] by interaction with polyvalent ions, especially Ca^{2+} and Mg^{2+}. Although wide differences in rates of ... demonstrated in the laboratory[4,5], Gibbs[6] and others[7,8] have concluded that field studies provide no real evidence for the importance of such differential flocculation. Instead, changes in clay mineral distribution with distance from the source river can be accounted for by differences in the particle size spectra and the resulting sedimentation velocities. The effects of differing electrical and surface properties on coagulation rates are apparently suppressed by the formation of uniform films of metal oxides and/or organic matter around the particles[*]. We present here direct measurements of the electrokinetic charge ...

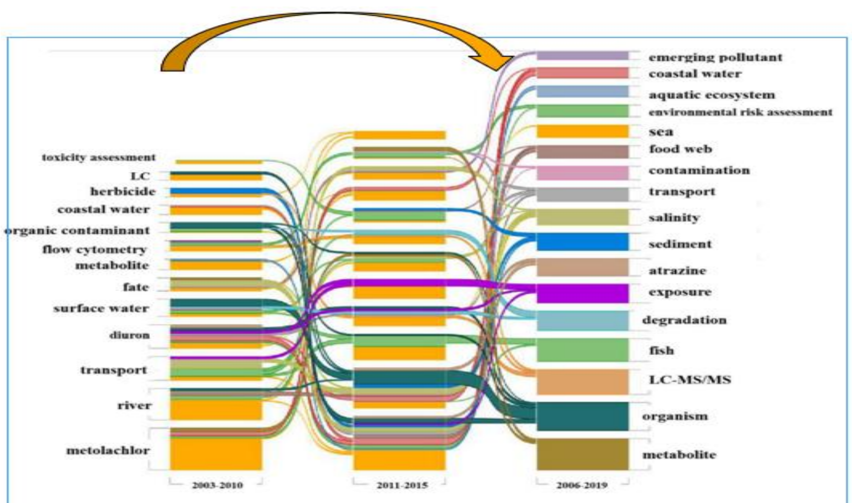
* Present address: Department of Chemistry, University of Otago, Dunedin, New Zealand





Nutrient Biogeochemistry of the Coastal Zone

- Environment stress： salinity, temperature......
- Interface process： water-particulate, sediment-mircroorganism, media-organism
- Marine condition: environmental factor, wave, tide
- Herbicide proterties

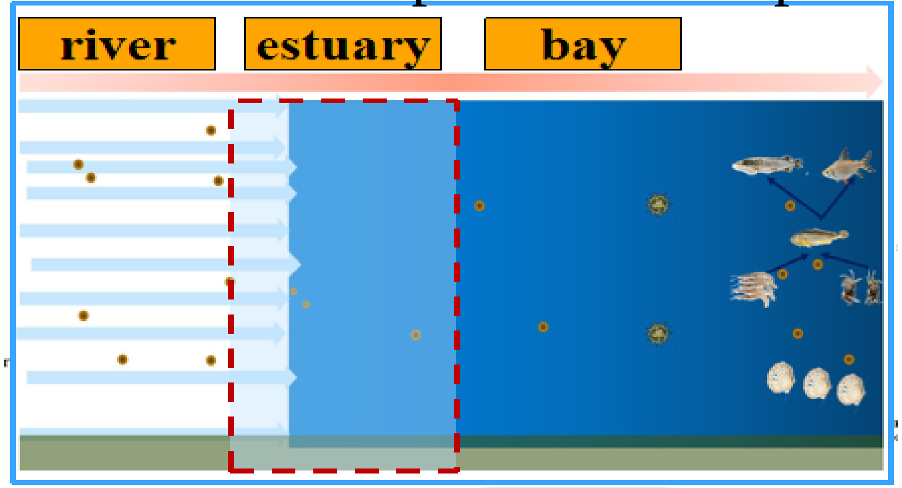


SO......

- Explore the migration,transformation, and degrading mechanism of herbicides in estuaries

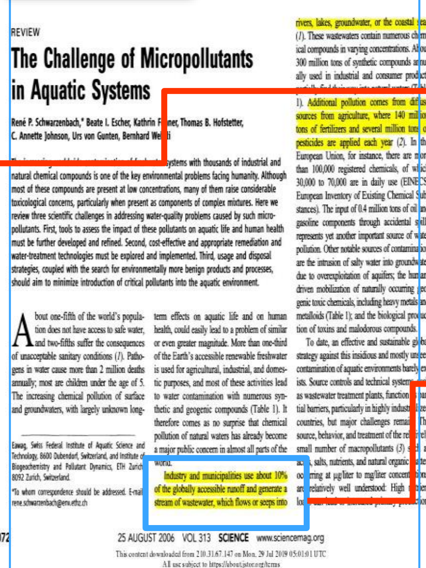
Hot topics in coastal zone and bay

- Herbicide response and adaption to marine conditions



- Fingding: spatial-temporal and vertical variation of typical herbicides are large

Review



How to……

- Understand the distribution of typical herbicides in marine conditions

Contents

- **Research Background**
- **Occurrence, transportation and distribution difference of typical herbicides from estuary to bay**
- **Next step: simulation experiments for migration and transformation of herbicides**

Occurrence, transportation and distribution difference of typical herbicides from estuary to bay

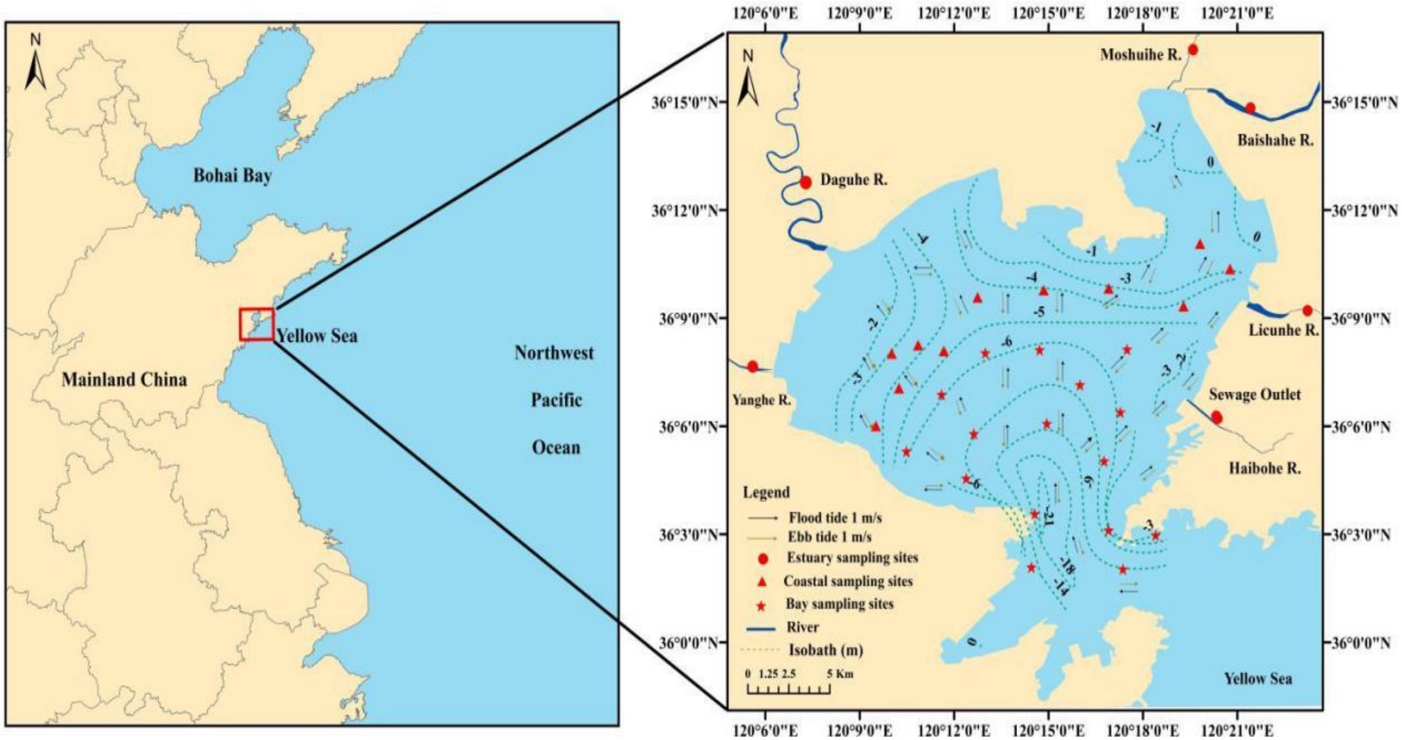


Fig. 1 Location of the study area, bathymetry, sampling locations, and tidal currents in the Jiaozhou Bay

- A total of 37 sampling sites, including 7 sites in the estuary, 11 sites in coastal areas and 16 sites in the bay, were investigated to express the transportation dynamics.

(1) Spatial transport of atrazine and acetochlor from the estuary to the bay

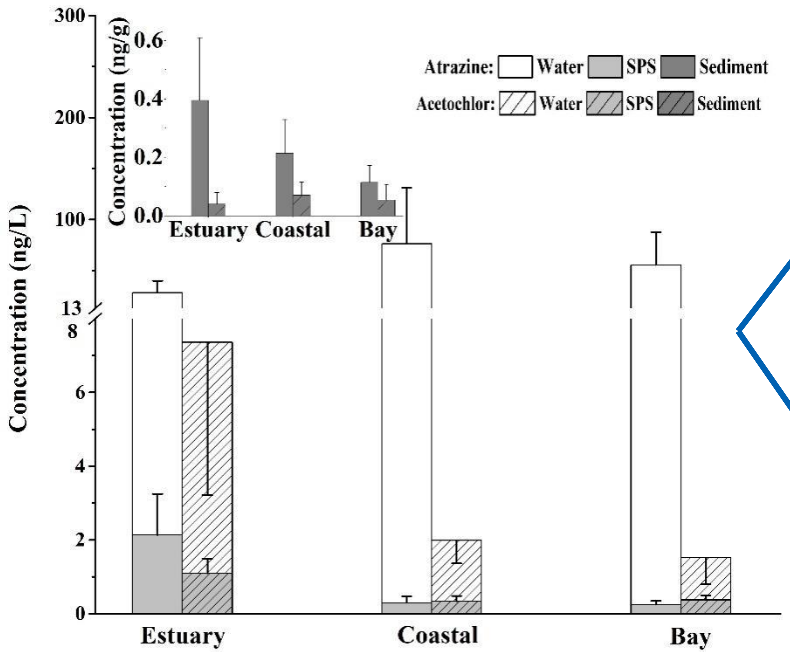
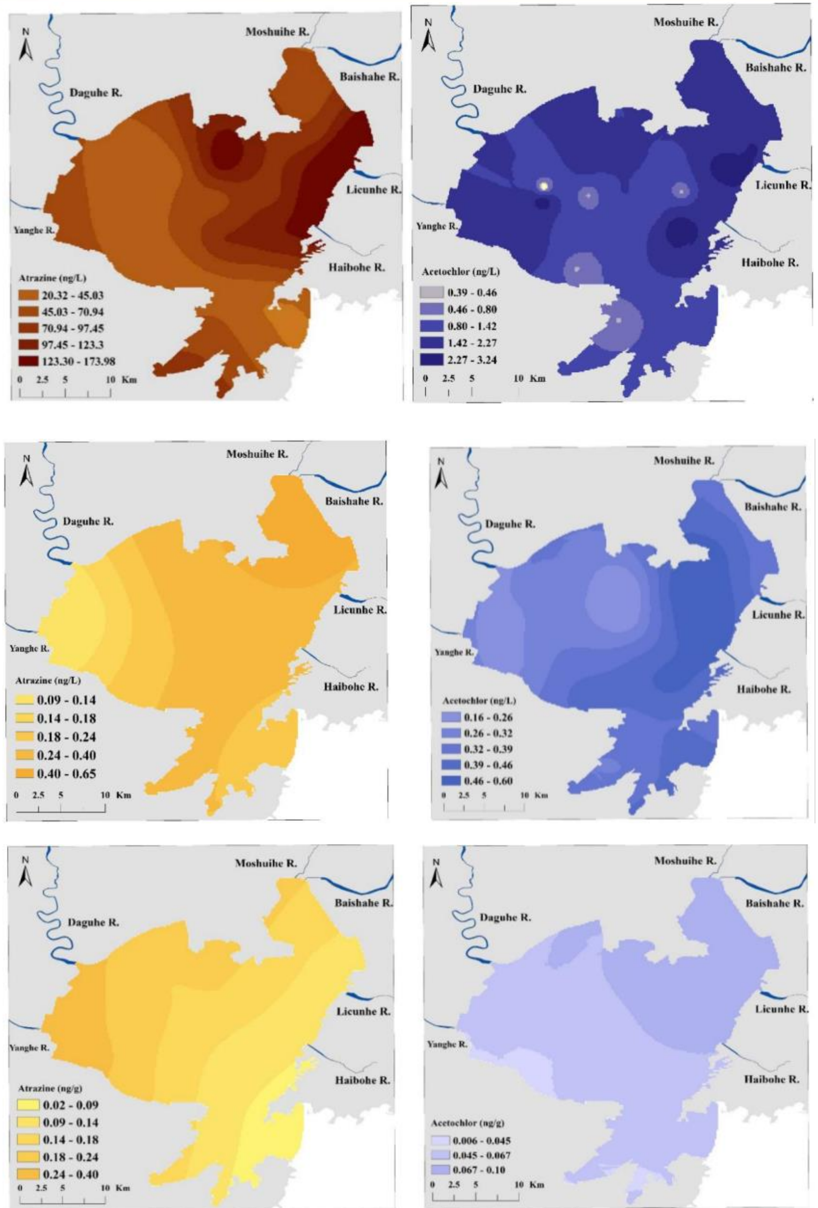


Fig. 2 Distribution of atrazine and acetochlor concentrations in water (ng/L), SPS (suspended particulate matter, ng/L), and sediment (ng/g dw) of three zones (estuary, costal and bay)

- Fingding: The total concentration of atrazine was higher in coastal areas and in the bay than in the estuary, which indicate that it accumulates and has a bigger resistance rate in marine water.

- Fingding:The concentration decreased significantly in coastal areas and the bay, showing that the acetochlor existence was sensitive to the marine environment and that its solubility may decrease in marine environments.

(2) Spatial distribution of atrazine and acetochlor

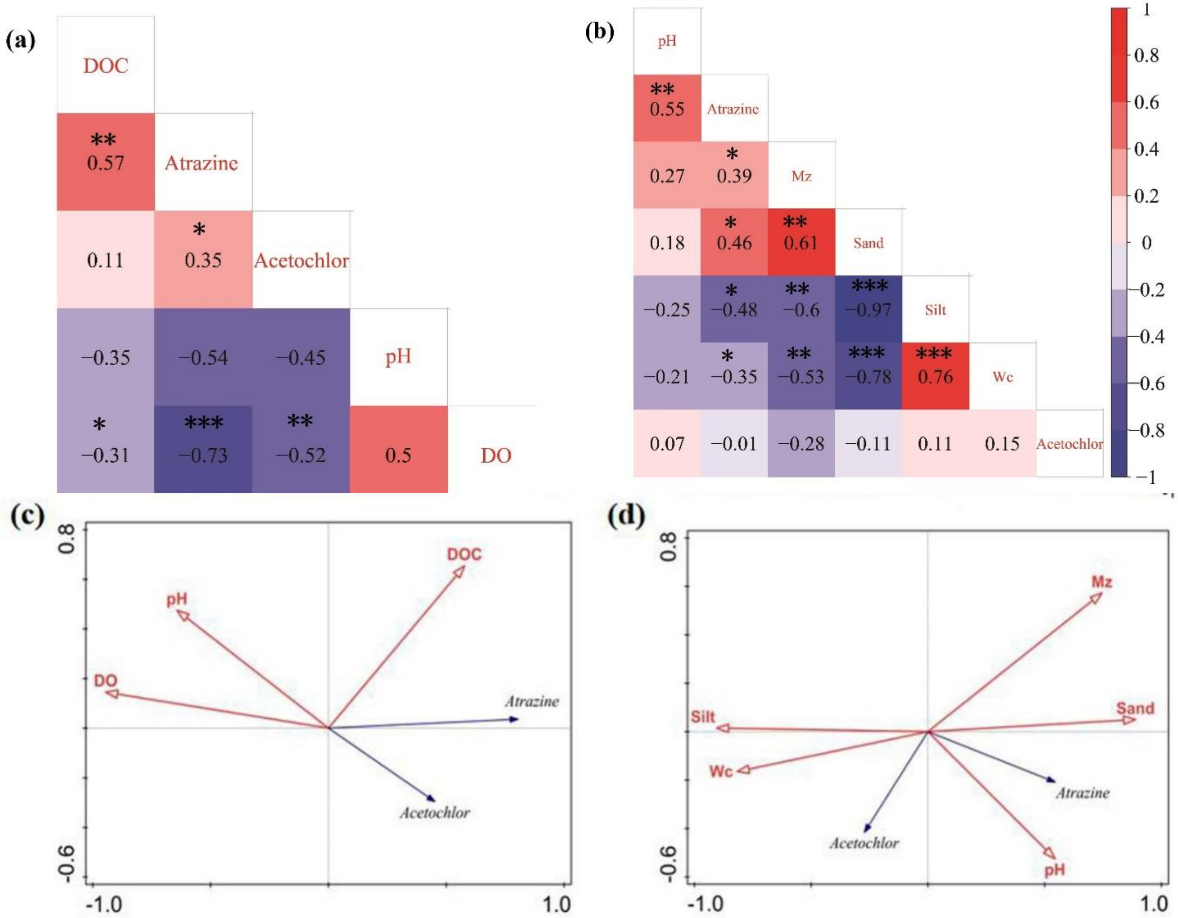


Water: Although their molecular structures, saturated solubility and concentrations in estuary water were different, the spatial patterns were similar.

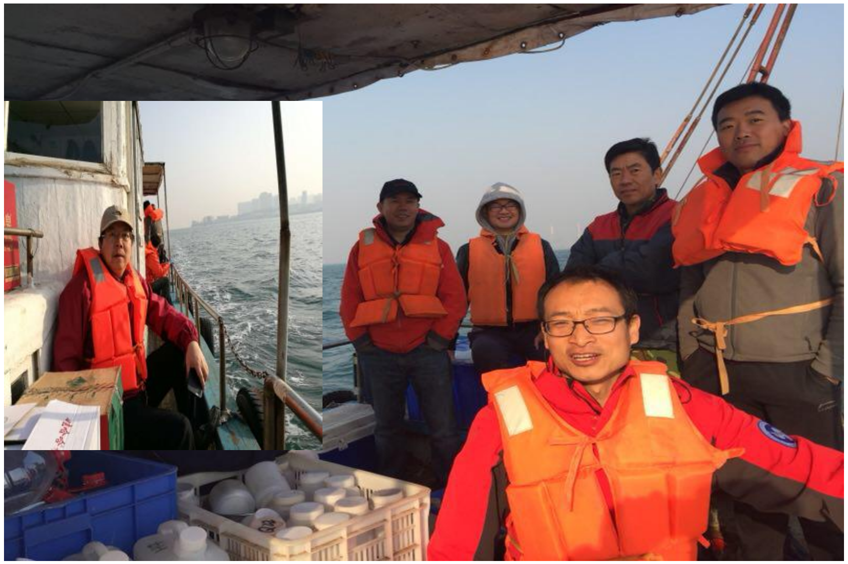
SPM: The trends of the two herbicides were reversed

Sediment: The higher atrazine concentration in the sediment near the river mouth proved that it quickly sinks during the transport process.The highest concentration of acetochlor occurred in the northeast, which was the same result as the previous two patterns

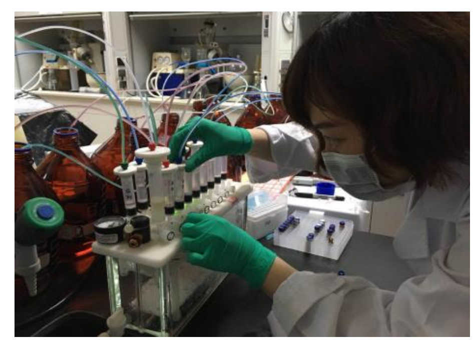
(3) Differences in transport factors for the two herbicide



- ➢ The atrazine and acetochlor shared more impacts related to water DO and DOC, but the DOC had a more direct influence on atrazine.
- ➢ The particle size and sand percentage were the positive factors related to atrazine sorption.





Contents

- **Research Background**
- **Occurrence, transportation and distribution difference of typical herbicides from estuary to bay**
- **Next step: simulation experiments for migration and transformation of herbicides**

Thank you for your attention!

Supported by
National Natural Science Foundation of China (Grant No. 41622110, U1706217, 91647105)