NEW METHOD FOR QUANTIFYING ADVECTION, TURBULENT MIXING, AND GRAVITATIONAL SETTLING OF RIVER-BORNE SUSPENDED SEDIMENTS IN COASTAL AREAS FROM THERMOHALINE AND OPTICAL MEASUREMENTS

Alexander Osadchiev, Peter Zavialov, Vadim Pelevin
Shirshov Institute of Oceanology, Moscow, Russia

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General idea of the method

- Salinity as a quantifier of mixing
- Misfit between salinity dilution and suspended matter concentration drop as a proxy for settling
Settling = $2\left[v(C_{\text{max}}-C_{\text{min}})+C_{\text{min}}-C_{\text{obs}}\right]/(2+v)$, where $v=(S_{\text{max}}-S_{\text{obs}})/(S_{\text{max}}-S_{\text{min}})$.
Classical methods of sampling
Novel instruments

Photo 1: SBE 911 in working position in a flow-through container on the deck

Salinity at resolution ~10 m

Photo 2: Ultraviolet fluorescent lidar УФЛ-8 in working position on the deck

Total suspended matter
Resolution ~10 m
Example of data

Salinity

Suspended matter
Settling of suspended matter
Mixing of suspended matter
Dependence of settling on distance from the river mouth normalized by inertial radius
Dependence of settling on wind stress

\[ R^2 = 0.51 \]
Modified method

\[
S(t) = S_{rw} + \frac{S_{sw} - S_{rw}}{C_{rw} - C_{sw}} \int_0^t w_{TM}(x(\tau), y(\tau)) d\tau,
\]

\[
C(t) = C_{rw} - \int_0^t w_{TM}(x(\tau), y(\tau)) d\tau - R \int_0^t w_{TM}(x(\tau), y(\tau)) d\tau =
\]

\[
= C_{rw} - (R + 1) \int_0^t w_{TM}(x(\tau), y(\tau)) d\tau,
\]

\[
R = \frac{(S_{sw} - S_{rw})(C_{rw} - C(t))}{(S(t) - S_{rw})(C_{rw} - C_{sw})} - 1
\]
Mzymta River

Salinity, PSU

Turbidity, NTU

(a) R, relative units

(b)
Peinan River (2)
Conclusions

1. A new method is developed based on joint analysis of very high resolution TSM and salinity data. The method allows for estimating and mapping the settling and mixing rates for river-borne sediments.

2. Preliminary results from a case study in the Black Sea’s Mzymta River and South China Sea’s Peinan River areas:
   - the maximum settling rates occur at the distance of about 0.3R_{in} from the mouth, where R_{in} is the inertial radius;
   - settling drops sharply by about a factor of 3 at D/R_{in} ≈ 1 and farther away from the mouth;
   - generally, settling exceeds turbulent mixing by an order of magnitude or so. However, there are localized “mixing vents” where mixing may exceed settling.
THANK YOU FOR YOUR ATTENTION!