NEW FINDINGS ON DYNAMICS OF RIVER PLUMES IN COASTAL OCEAN

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Shirshov Institute of Oceanology, Russian Academy of Sciences

- Founded in 1946 and currently employing over 1200 scientists and engineers, SIO RAS is Russia's principal institute in the field
- SIO RAS conducts multidisciplinary research and offers graduate courses in physical oceanography, biological oceanography, geological oceanography, and ocean engineering
- SIO RAS operates a fleet of 7 research vessels ranging from 22 to 5700 tons in displacement

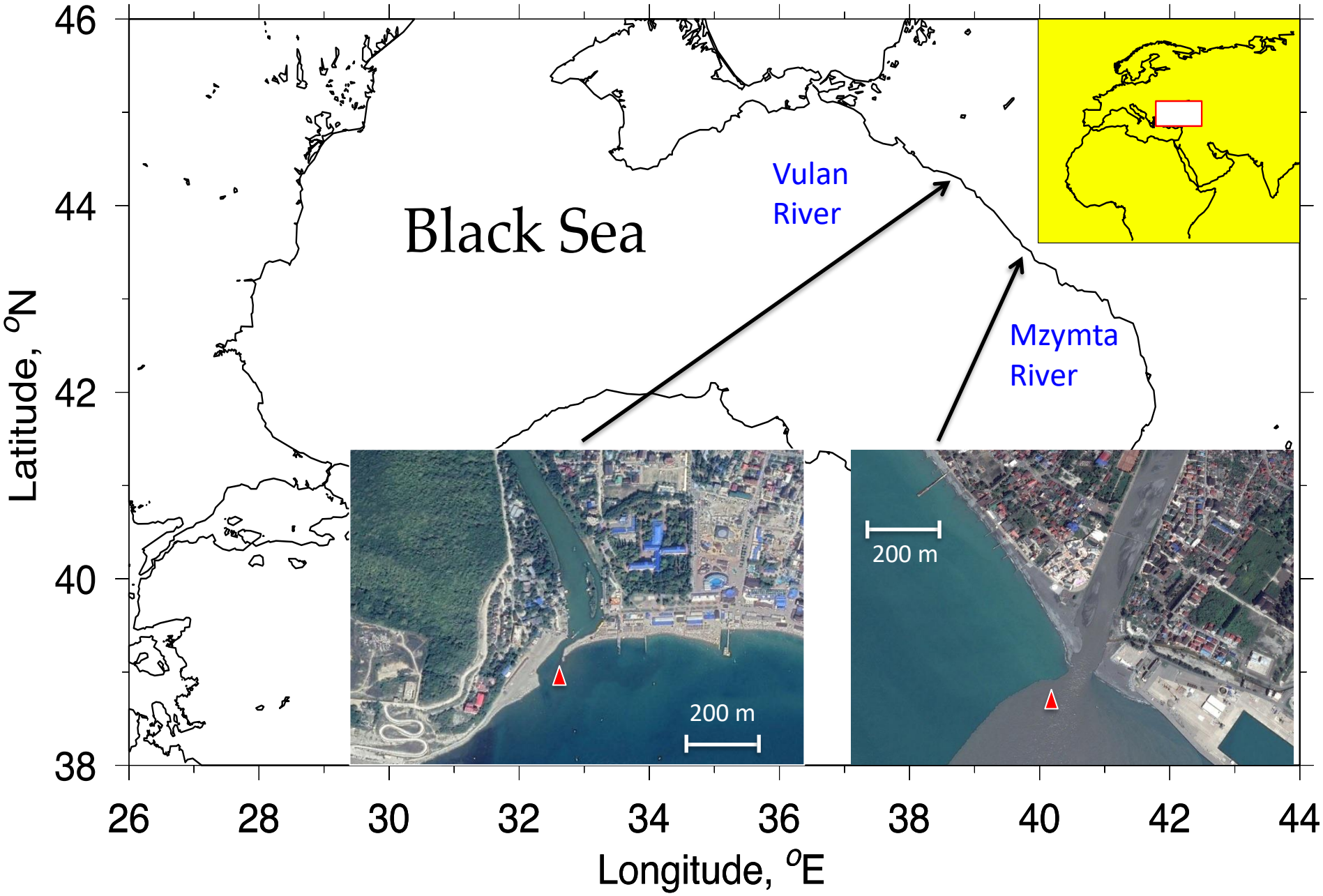
Priorities in Coastal Oceanography Research

- Land-sea interactions
- River plumes
- Sediment transport
- Marine pollution

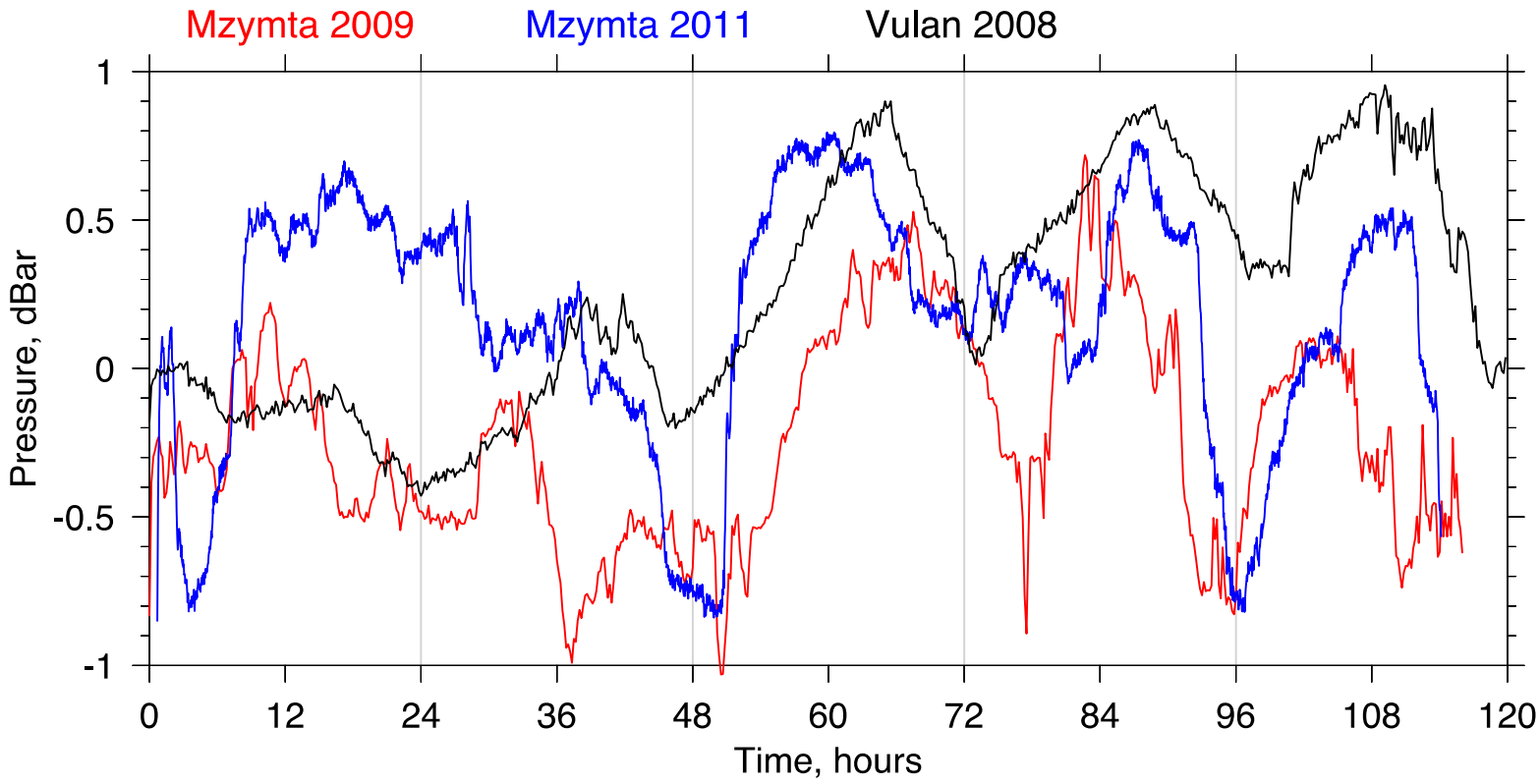
Focal regions of Coastal Studies

- Black Sea coasts
- Baltic Sea coasts
- Kara Sea and the coast of Novaya Zemlya
- Coasts of Brazil (in cooperation with Brazilian colleagues)
- Major lakes - Caspian Sea, Aral Sea, Issyk-Kul, Baikal, and others

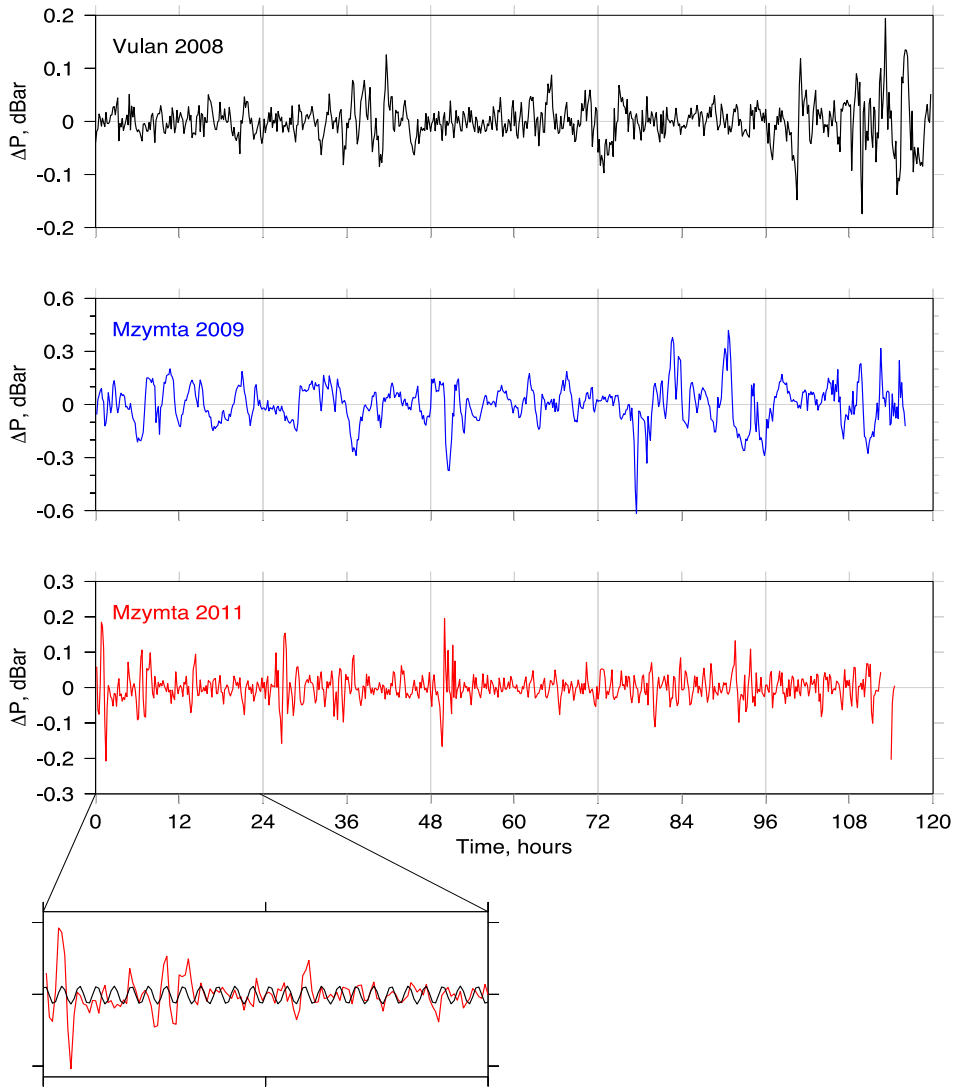
CASE STUDY 1: BLACK SEA. ***SSH*** *OSCILLATONS IN RIVER PLUMES*



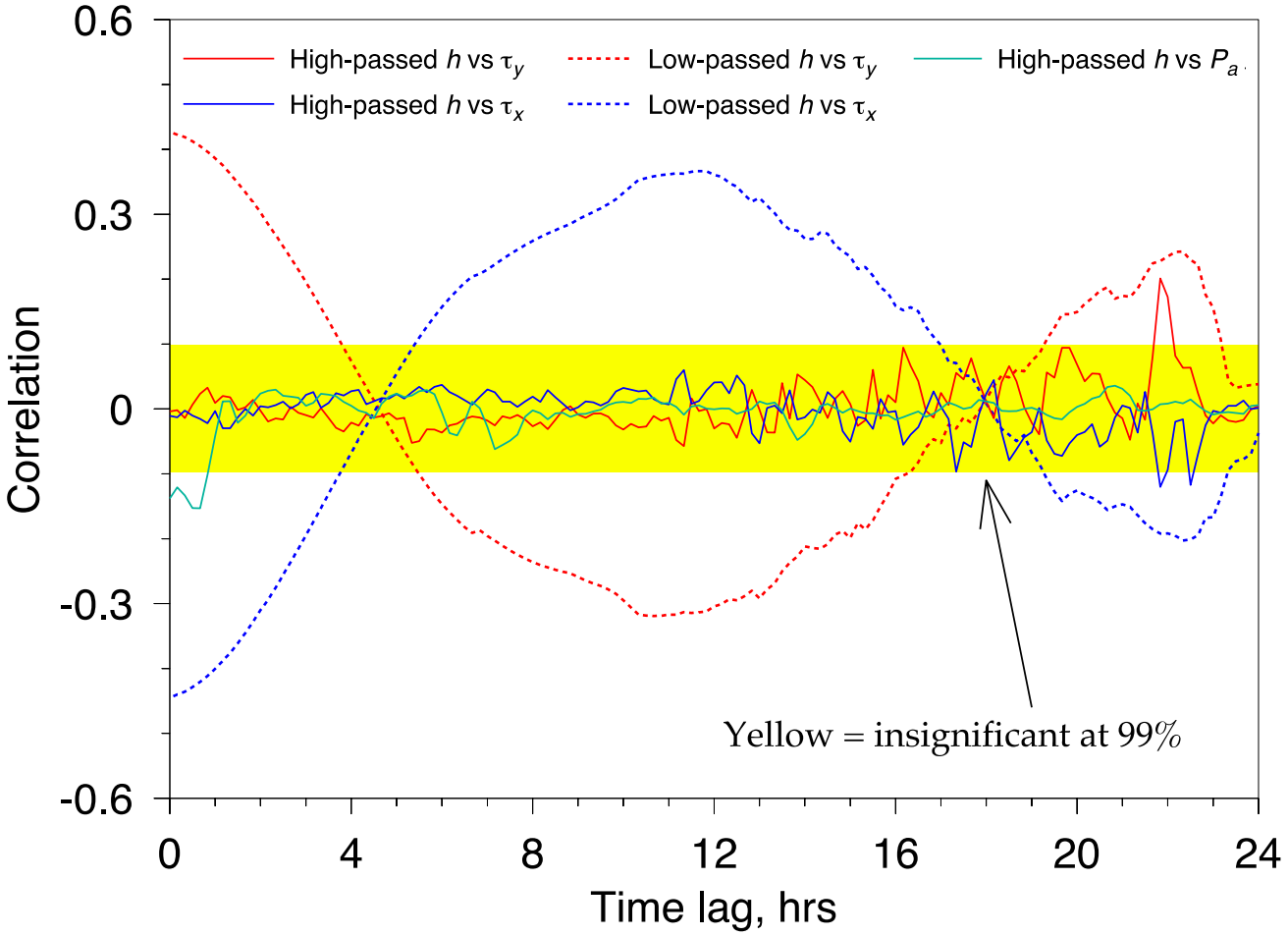
Raw data


Mzymta 2009
Mzymta 2011
Vulan 2008
Pressure, dBar
1
0.5
0
-0.5
-1
0
12
24
36
48
60
72
84
96
108
120
Time, hours

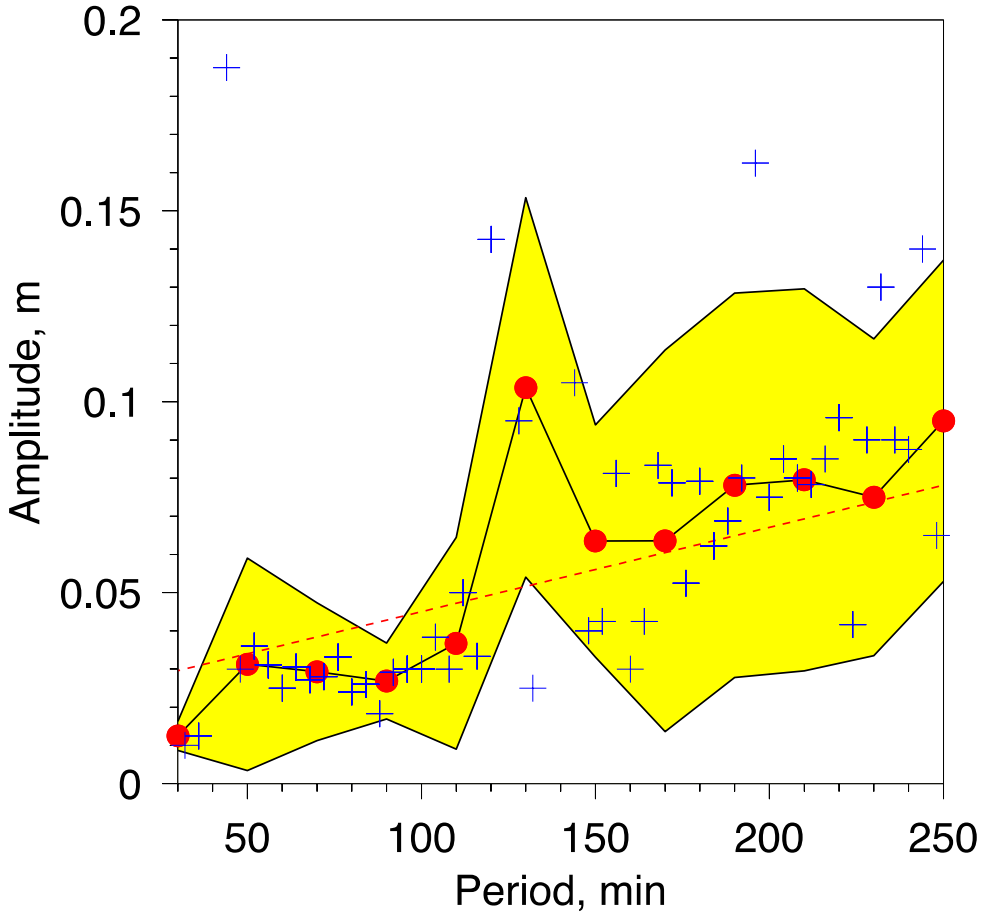
High-pass filtered data



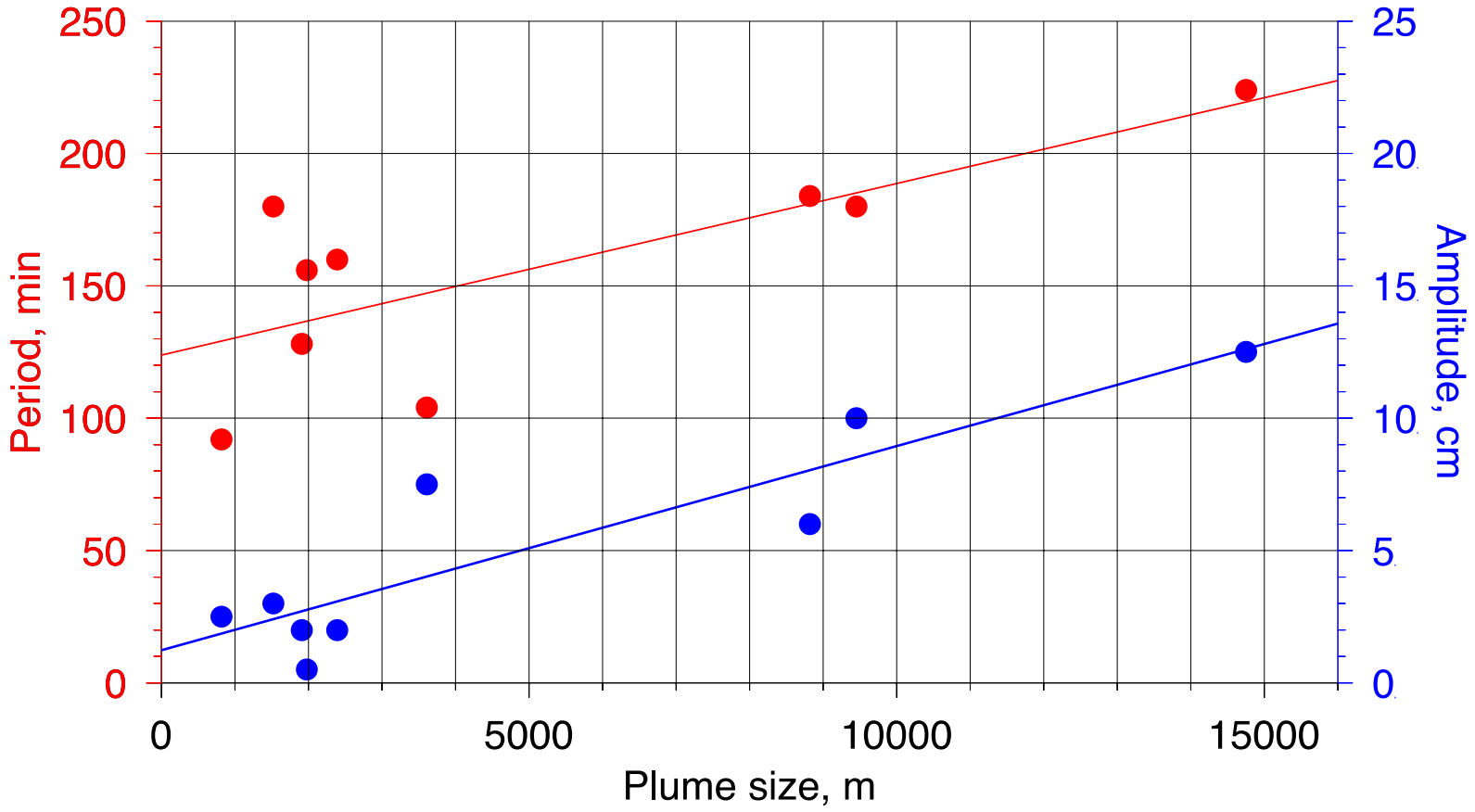
Lagged correlations

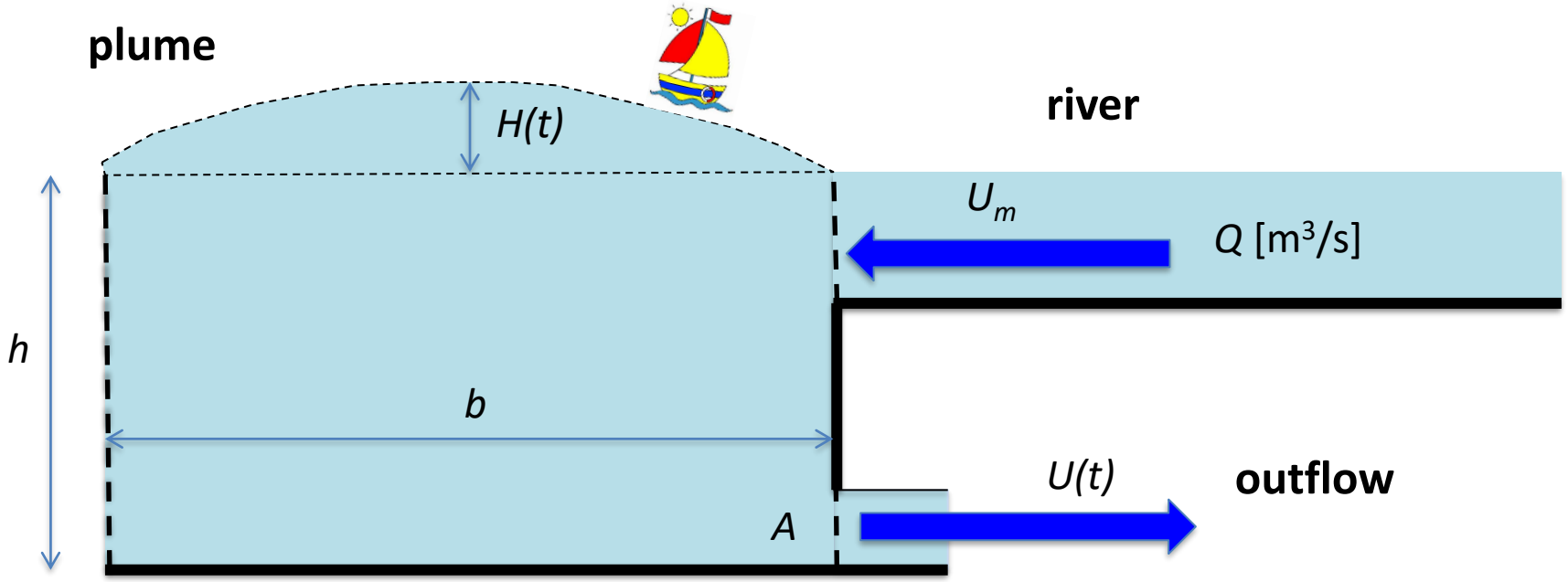


Amplitude vs Period



Period and amplitude vs plume size





$$b^2 \frac{dH}{dt} = Q - UA,$$ ← **mass budget**

$$\frac{dU}{dt} = -\frac{1}{\rho}\frac{\partial P}{\partial x} \simeq \frac{g}{b} H,$$ ← **momentum budget**

or

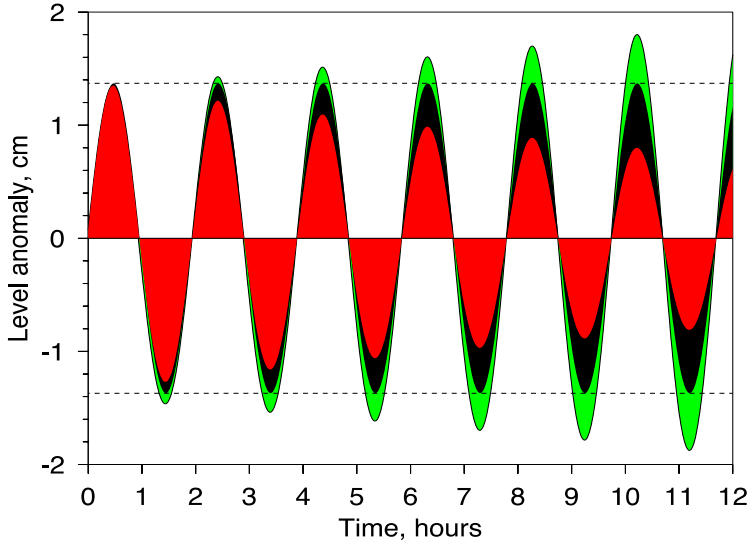
$$\frac{dU}{dt} = -g\frac{\partial H}{\partial x} - U\frac{\partial U}{\partial x} - C_D \frac{U^2}{h},$$

$$\frac{d^2H}{dt^2} + \frac{gA}{b^3} H = 0.$$

$$T = 2\pi\sqrt{\frac{b^3}{gA}}$$

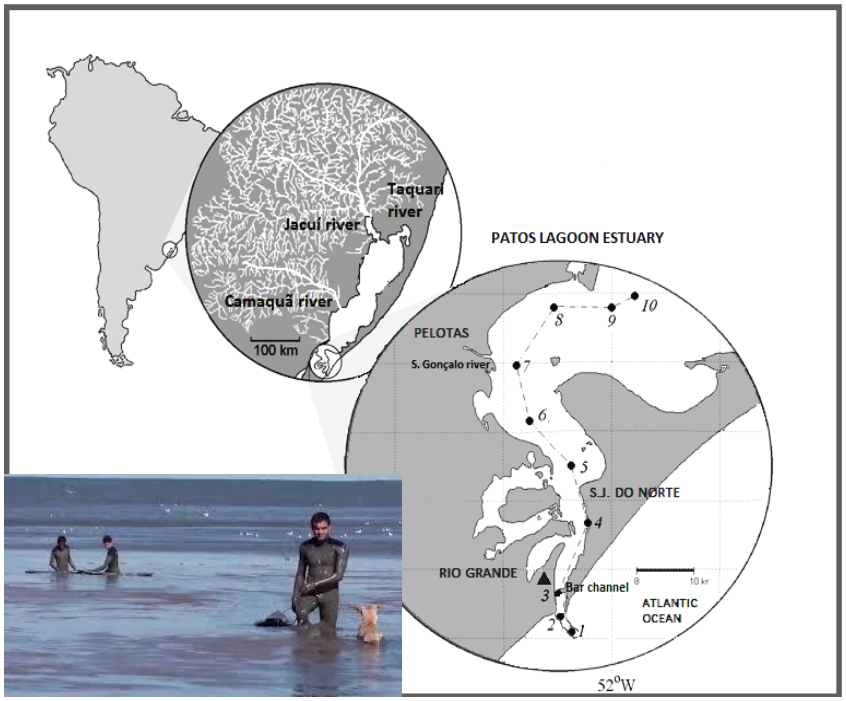
If $A \approx bh$, then

$$T = \frac{2\pi b}{\sqrt{gh}}$$



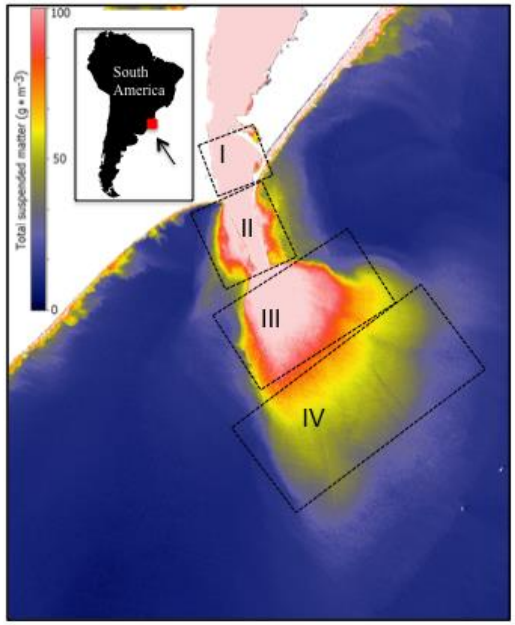
CASE STUDY 2: the PATOS LAGOON

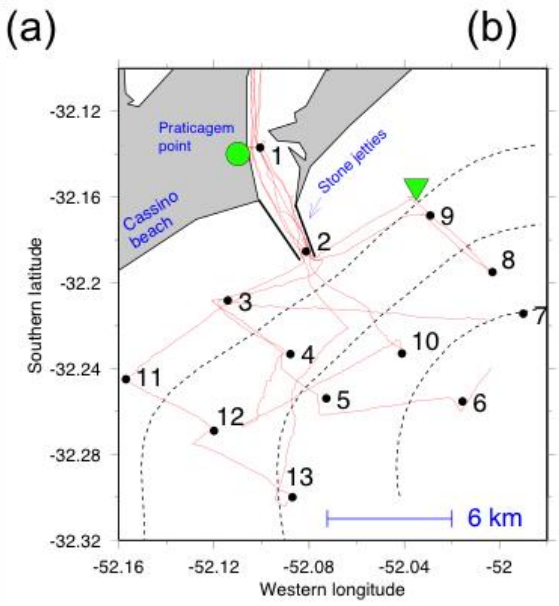
*MIXING OF **DOM** AND **SM** AND MIXING AND SETTLING OF **SM** IN RIVER PLUME*

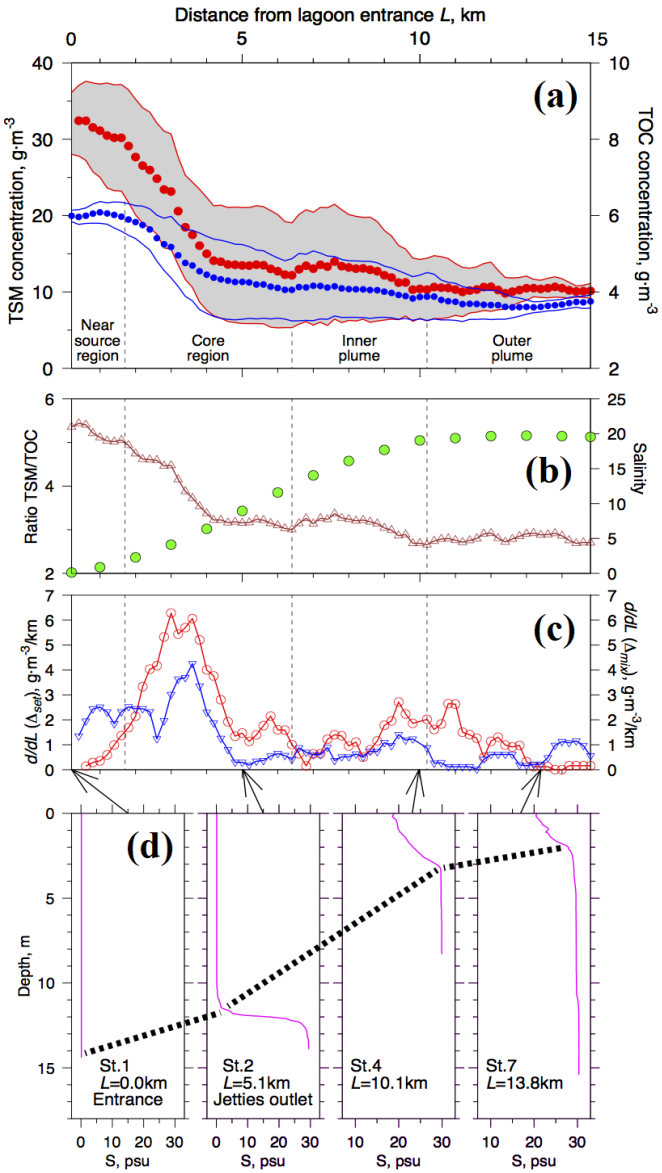


Fluorescent UV LiDAR: over **76k** simultaneous determinations of TOC and TSM on just one field day

Gravitational settling and mixing of suspended matter in different parts of the plume



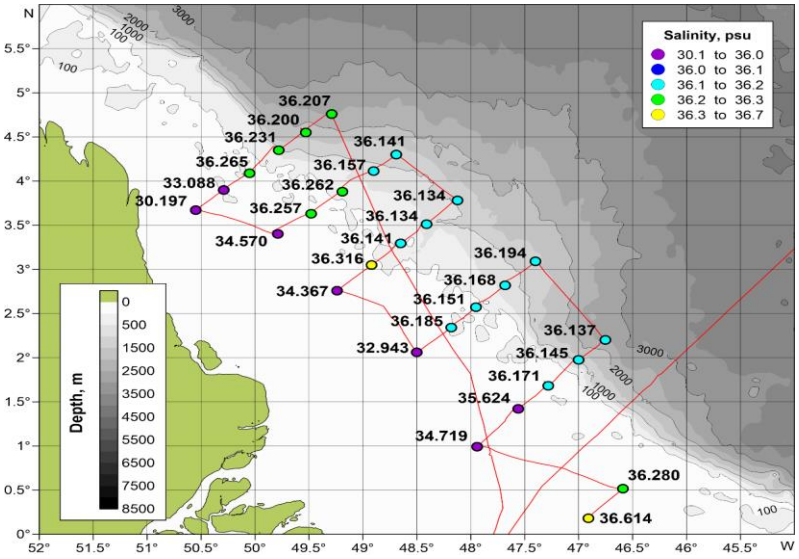


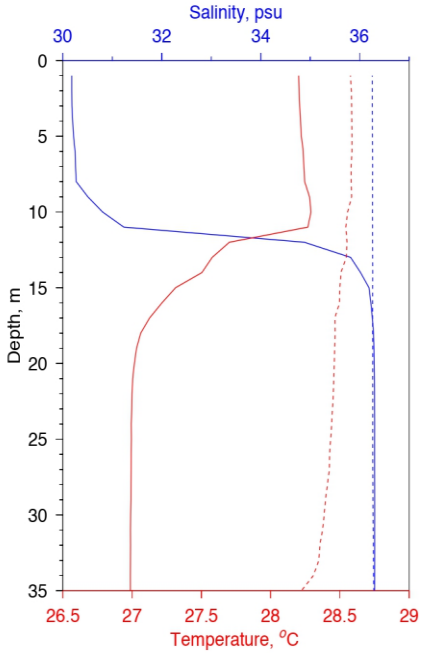


“Take-home messages”

- Periodic oscillations of SSH as intrinsic dynamic property of river plumes
- Specific areas of river plumes as hotspots of intense gravitational settling of SM
- Fluorescent UV LiDAR as advanced tool for mapping biogeochemical fields in coastal waters at very high resolution
- Shirshov Institute of Oceanology as a center of coastal research in Russia

Just one extra slide: Russian-Brazilian study of the Amazon River Plume (November 2022)





Thank you for your attention!