AUTOMATIC RIVER DISCHARGE MONITORING SYSTEM, PRELIMINARY RESULTS

D. Deponte

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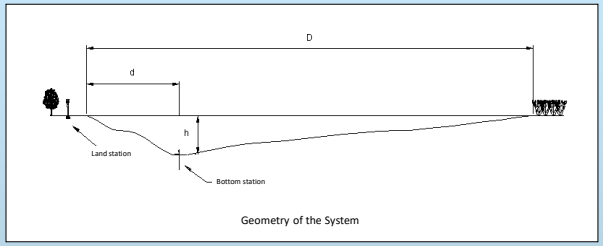
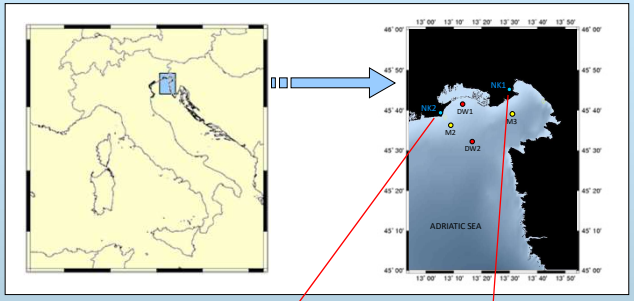
Standard methods used at sea for flow and discharge measurements are not easily applicable in the proximity of river mouths for different reasons, particularly in the case of strong river outflow events.
Usually, water level measurements are used in discharge computations, but these are greatly influenced by tides in a tidally-dominated system. Additionally, the river mouth zone is characterized by a bi-directional flow, with salty water entering the river over the bottom and freshwater exiting at the surface. Also, a standard current-meter cannot be safely moored at the surface during strong river outflow events. On the contrary, an Acoustic Doppler Current profiler positioned over the river bottom can measure the water velocity in the entire water column.
The OGS, within a framework of the Palme project (a Civil Defense-sponsored project for the coastal monitoring of the Friuli-Venezia-Giulia Region) has developed 2 innovative permanent stations for the continuous real time measurement of the river flow at the mouth of the Isonzo and Tagliamento Rivers. The monitoring stations are equipped with 2 Nortek 1000 kHz Aquadopp profilers fixed at the river bottom by means of an immobile stainless steel structure. The profilers acquire data every 5 minutes (cell size = 0.5 m) over the entire water column. Each instrument is connected with a submarine cable to a station on land located about 10 m from the river bank. The land station is equipped with a gsm modem and a power supply system with batteries recharged by solar panels. The monitoring system is therefore completely autonomous with respect to the power supply and the data transfer. The data are automatically downloaded every 6 hours (every 20 minutes or less when necessary) and are available at the main office of the Civil Defense of the Friuli Venezia Giulia region where they can be used immediately to support decisions in case of extreme outflow events.
The 2 stations are active since February 2004.
The collected data are then processed using additional data coming from other instruments also (i.e. atmospheric pressure data). They are then extrapolated close to the surface and along the entire section of the river, and finally the discharge value is calculated at 5 minute intervals using the morphological data of the river bed.



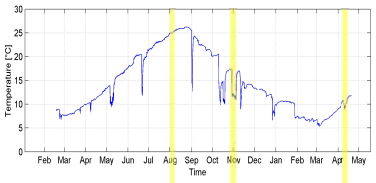
Geometry of the System



Isonzo River

Tagliamento River

Figure 1



Water temperature (°C) in proximity of the ADCP (above) and current intensity (m/s) at about 7 m depth (below) between 18 February 2004 and 20 April 2005.
Three periods, selected as examples of low, medium and high river discharge rates, are indicated and the correspondent acquired data are shown in the figures 2-3-4. Abrupt decay in the temperature correspond to increased fresh water river outflow.

ISONZO RIVER DATA IN THREE DIFFERENT CONDITIONS

Water Level (Pressure) (a), temperature (b), ADCP current (c), echo intensity (d) and river discharge (e) for low (left), medium (center) and high (right) river outflow rates.
These data correspond to the periods indicated in yellow in figure 1.
In low discharge conditions, the outflow is completely dominated by tides and calculated discharges are highly correlated to water level time derivative.
During high river outflow events, the water column is completely invested by exiting fresh water and no correlation is found between discharge and water level. Stratification is re-established at the end of the outflow events, with salty water on the bottom and fresh water on the top. The separation line between the two water masses is also marked with a maximum in echo intensity.

Figure 2

Low river discharge rates

Data from 01 august 2004 to 04 august 2004

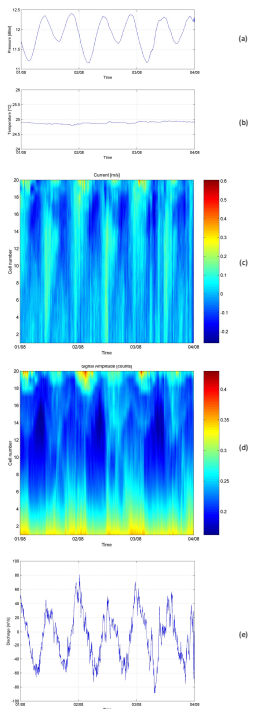


Figure 3

Medium river discharge rates

Data from 09 april 2005 to 13 april 2005

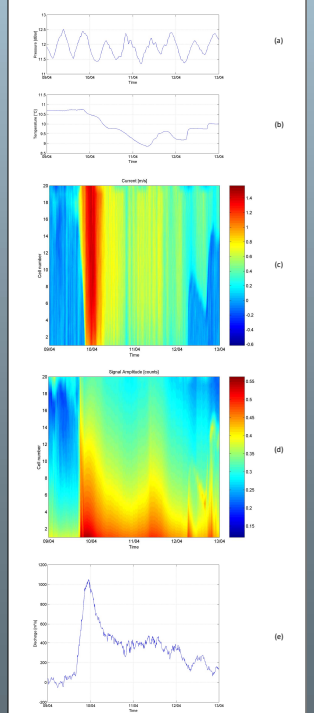
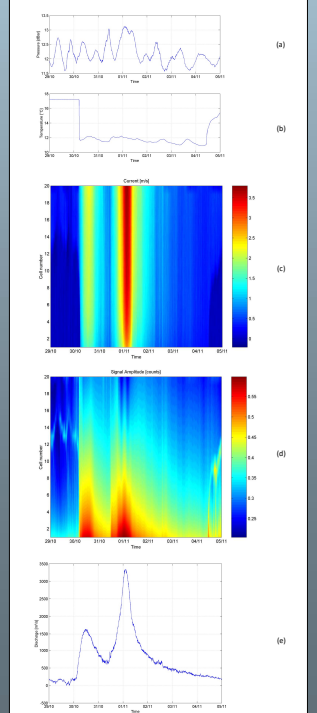


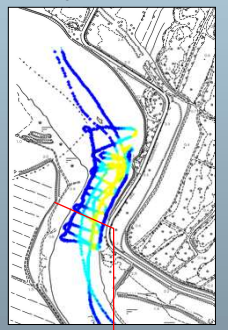
Figure 4

High river discharge rates

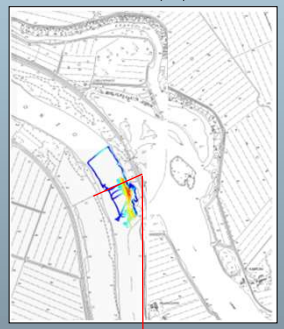
Data from 29 october 2004 to 05 november 2004

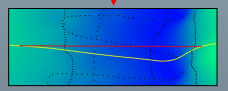


Tagliamento River (NK2)

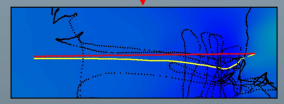


Isonzo River (NK1)





Tagliamento River Section



Isonzo River Section

CONCLUSIONS

The system described in this work has been proved to be strong enough also in very high river discharge rates conditions, with currents up to 3.5 m/s.

The choice of the instrumentation site, of the sampling methods and of the analysis procedures permit to obtain calculated discharge values with an accuracy of about 10 m^3/s. This allows to monitor the river outflow both in low and high river discharge conditions.

The calculated river discharge values have been proved to be useful in driving the hydro-dynamical models of the gulf of Trieste.

ACKNOWLEDGEMENTS

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