

**IMDIS 2016**

International conference on marine data and information systems  
ECS - Gdansk, Poland, October 15-17, 2016

# **Oceanographic system to control the impact of construction works in the sea in a sensitive coastal area - Case Study**

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# Introduction



- Construction work at sea
- Sediment



# Station and Data Transfer

- Embedded linux with GPRS
- Meteo sensor
- Sea currents sensor
- One minute measurements and sending interval
- Sending using FTP

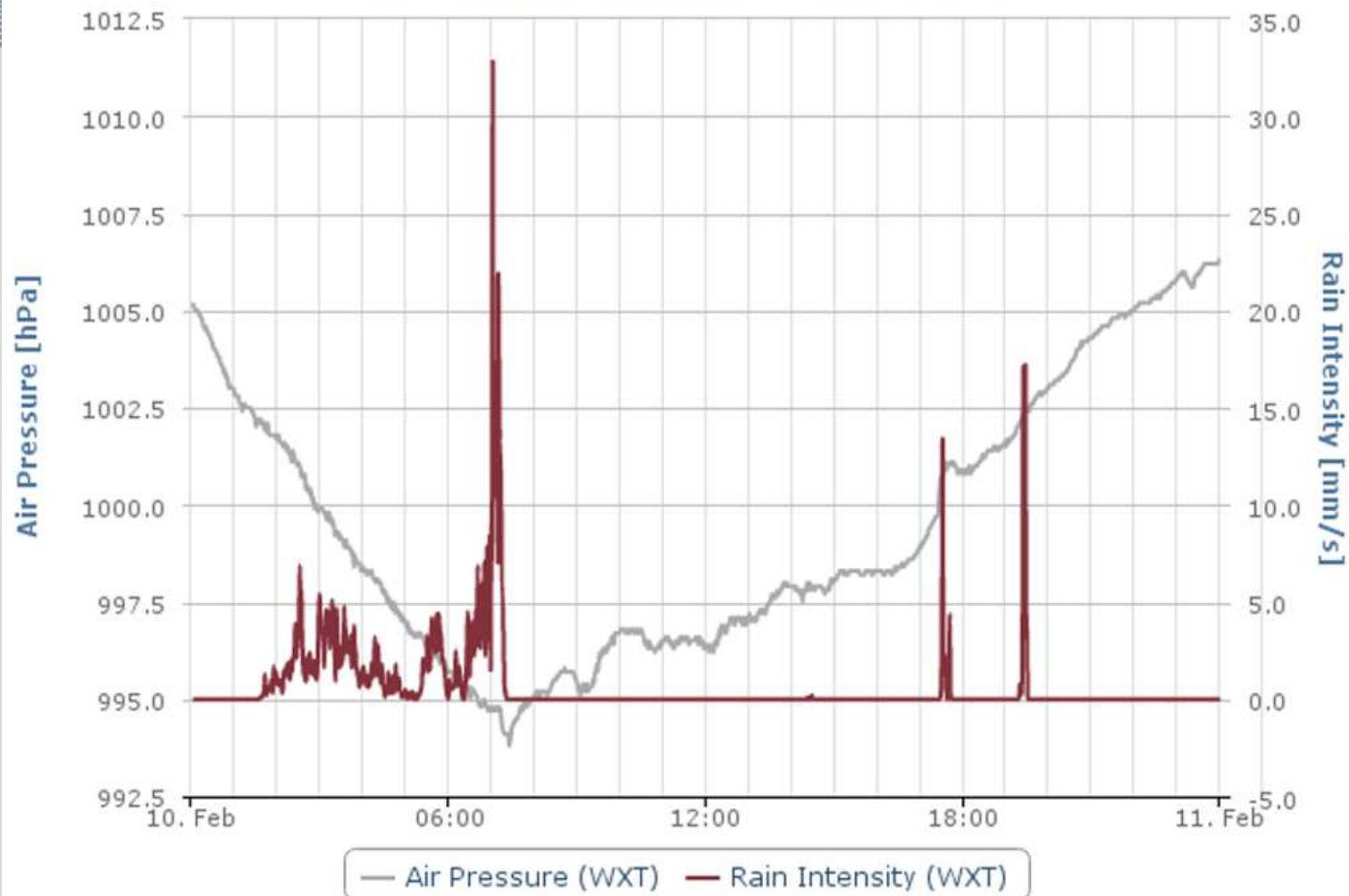
## Note:

**biweekly control of biochemical parameters at 6 stations**



# Data Visualizations 1/3

Čiovo bridge: Air Pressure [hPa]  
from 10.02.2016. 00:00 until 11.02.2016. 00:00



Air Pressure-WXT

Rain Intensity-WXT

Monthly view

Monthly view

Day: 10.02.2016

Refresh graph

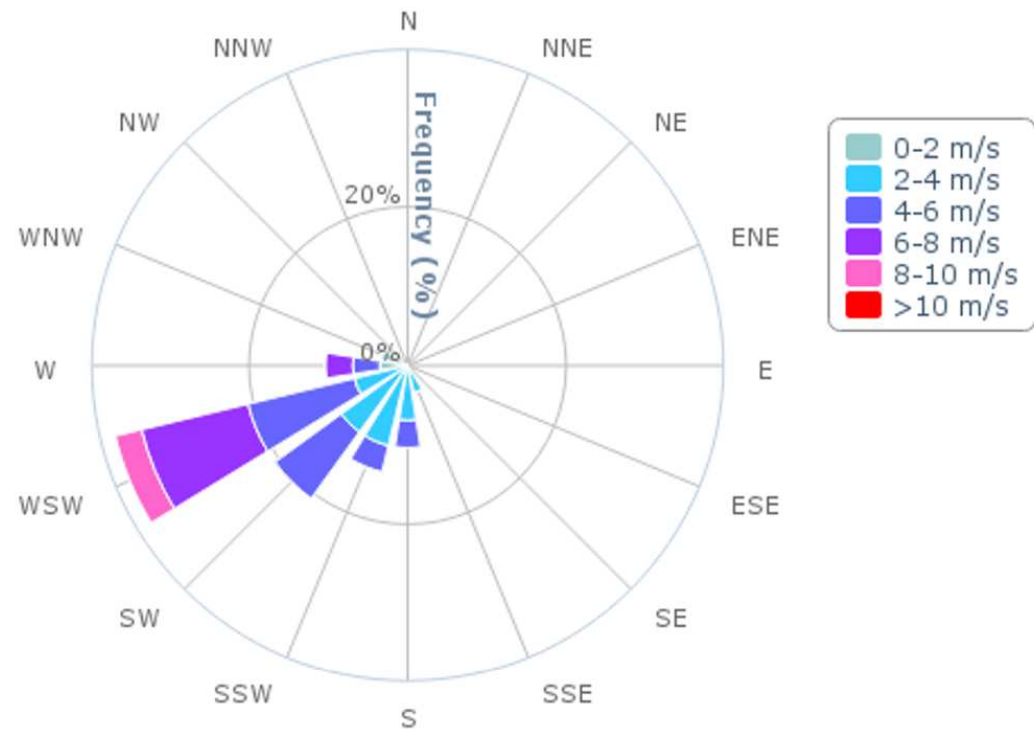
Two parameters 24 hours view



# Data Visualizations 2/3

## Wind rose and basic statistics

Čiovo bridge: Wind rose  
from 10.02.2016, 07:00 until 10.02.2016, 07:30



**Frequency table (sample contains 29 measurements)**

| Direction | 0-2 m/s | 2-4 m/s | 4-6 m/s | 6-8 m/s | 8-10 m/s | >10 m/s | Total |
|-----------|---------|---------|---------|---------|----------|---------|-------|
| N         | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| NNE       | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| NE        | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| ENE       | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| E         | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| ESE       | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| SE        | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| SSE       | 0       | 3.45    | 0       | 0       | 0        | 0       | 3.45  |
| S         | 0       | 6.90    | 3.45    | 0       | 0        | 0       | 10.35 |
| SSW       | 0       | 10.34   | 3.45    | 0       | 0        | 0       | 13.79 |
| SW        | 0       | 10.34   | 10.34   | 0       | 0        | 0       | 20.68 |
| WSW       | 0       | 6.90    | 13.79   | 13.79   | 3.45     | 0       | 37.93 |
| W         | 3.45    | 0       | 3.45    | 3.45    | 0        | 0       | 10.35 |
| WNW       | 3.45    | 0       | 0       | 0       | 0        | 0       | 3.45  |
| NW        | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| NNW       | 0       | 0       | 0       | 0       | 0        | 0       | 0     |
| Total     | 6.90    | 37.93   | 34.48   | 17.24   | 3.45     | 0.00    | %     |

Day:

\*Click on legend to disable/enable wind class

[hide background map](#)  
[show background map](#)

# Data Visualizations 3/3

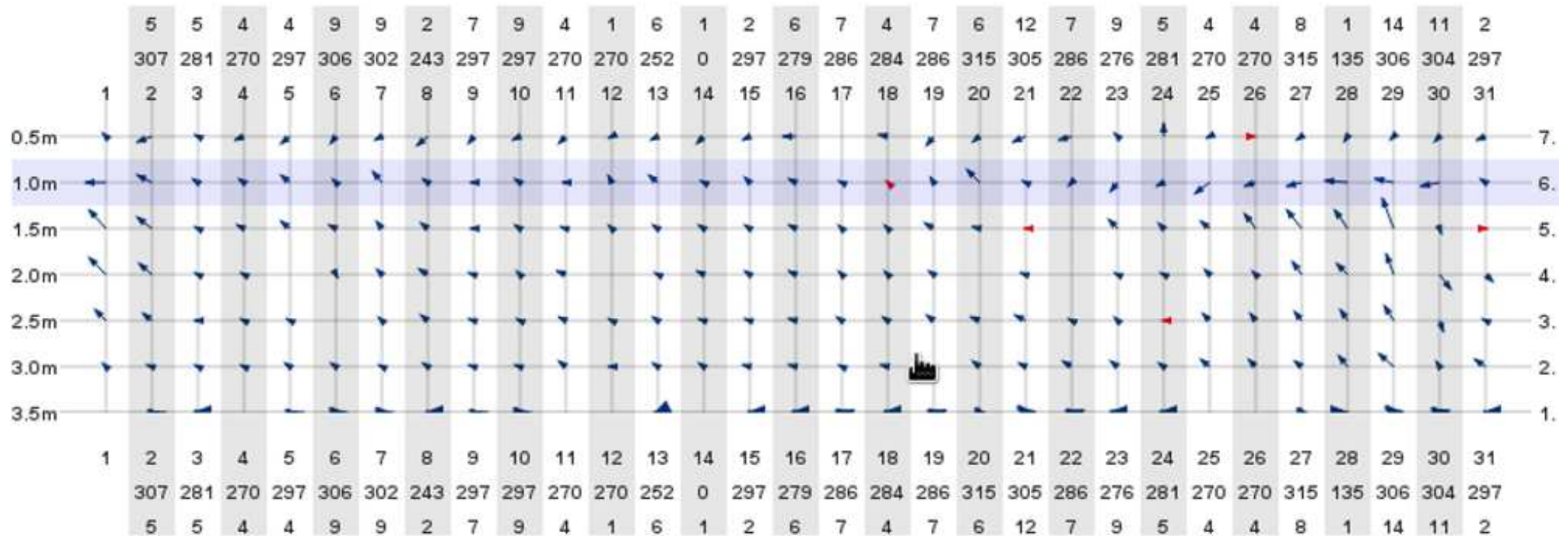
Station Ciovo - currents - daily averages for 01.2016.

15

012016

[02/2016 >](#)

→  
100 cm/s

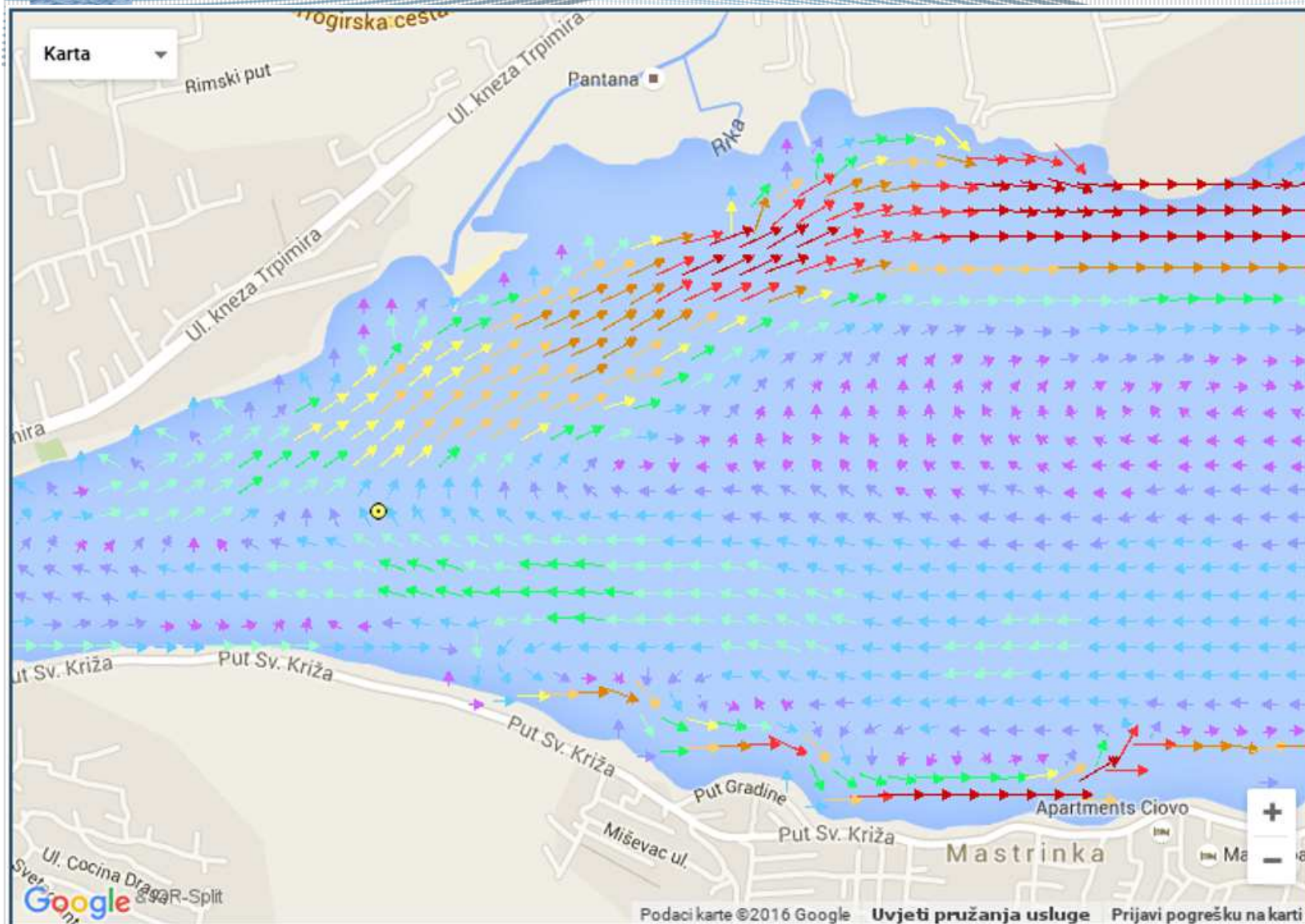


[Show all cells \(levels\)](#)

## Sea currents



# Numerical Modeling ( Experimental )



- ROMS model, station data
- PARTRACK model- sediments distribution

[ cm/s ]    0-5    5-10    10-15    15-20    20-25    25-30    30-35    35-40    40-50    >50

6 sati-    3 sata-    1 sat-    10.02.2016. 09:05    1 sati+    3 sati+    6 sati+

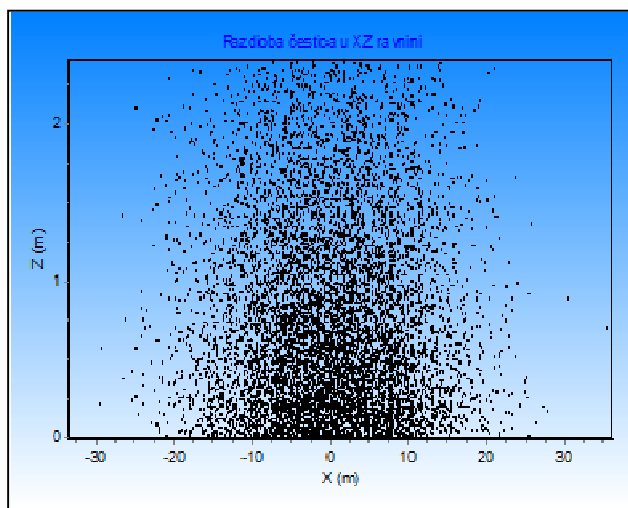
Površinske struje

Vertikalno usrednjene

Pridnene struje

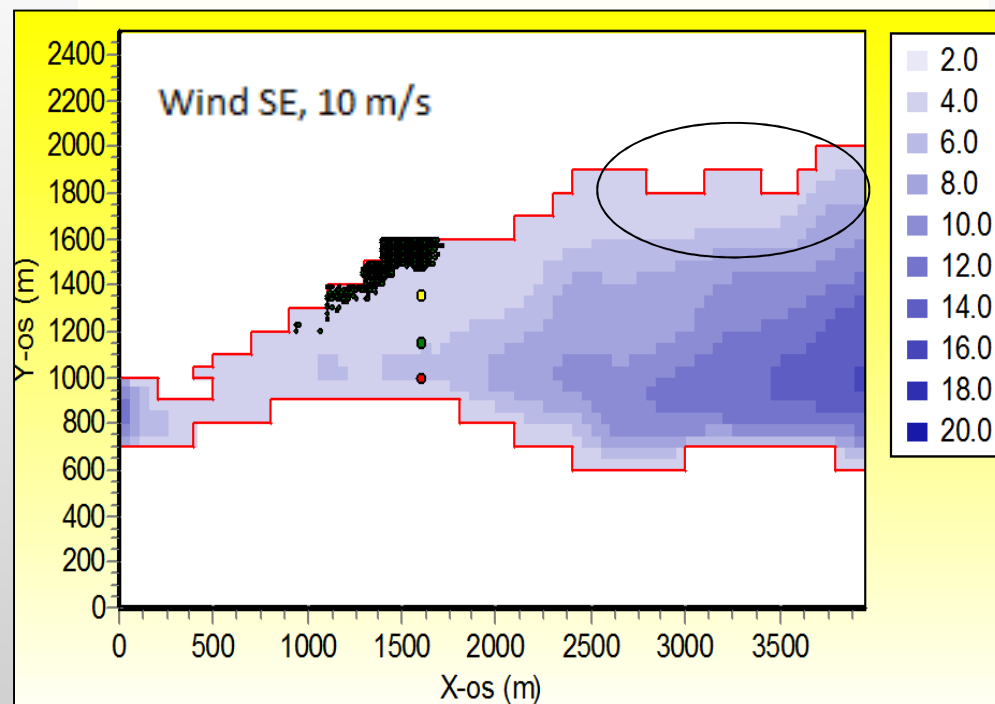
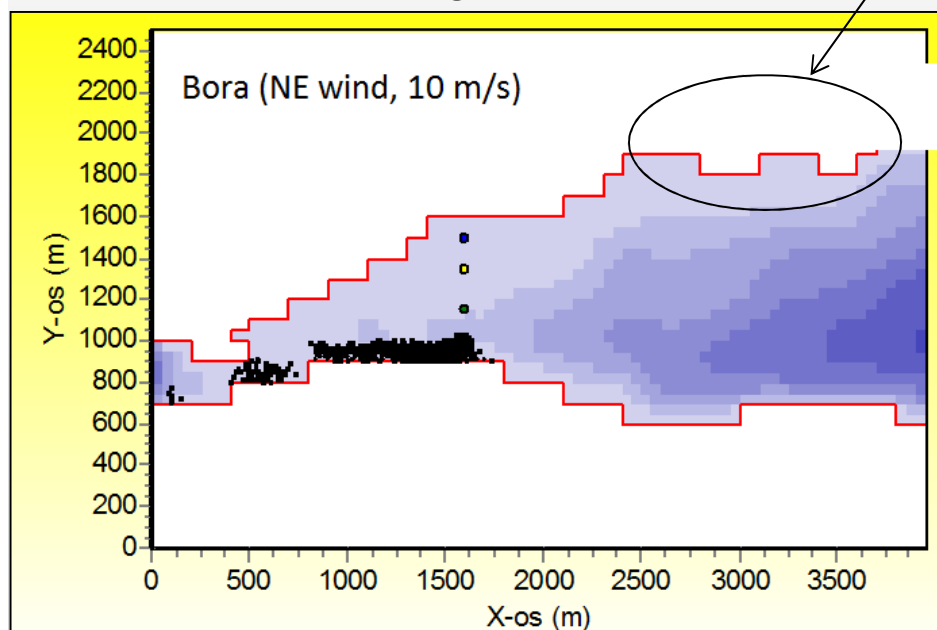
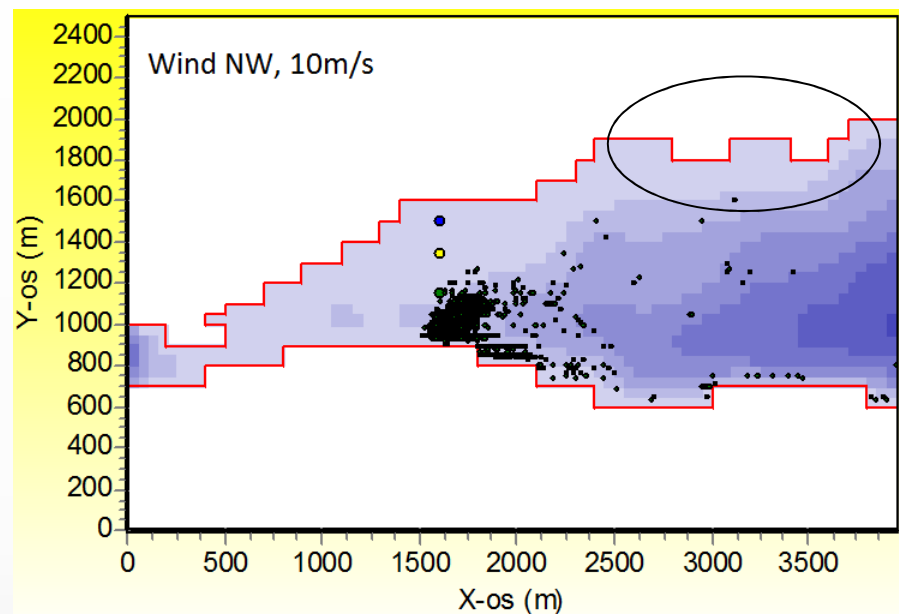


# Influence of winds and currents on of sediment particles movements after 1 hour (PARTRACK model)



Modeling of sediments distribution in water column during digging for central bridge pillar

Protected area





# Data validation

## Automatically by database:

- broad ranges (min, max, std)
- gradient: in space and time
- parameters data comparison
- measuring data and model results comparison

## Control of red alarm switch on/switch off

- predefined number of acceptable speed and direction of wind and currents
- Predefined number of over speed values of wind and currents
- Delay in red alarm switch on/switch off

# Data Processing

Postaja Čiovo x Čiovo p. alarma x  
faust.izor.hr/automjerenja/ciovo\_parametri\_alarma

## Postavljanje kriterija automatskog pokretanja alarma, postaja Čiovo:

Aktivni kriteriji:

| Info    |                      | Mjerenja          |                      | Prostorni uvjeti |     | Parametri paljenja |    | Parametri gašenja |    | Promjeni |
|---------|----------------------|-------------------|----------------------|------------------|-----|--------------------|----|-------------------|----|----------|
| rbr     | 3                    | broj mjerenja     | 60                   | smjer od         | 203 | period             | 60 | period OK         | 10 |          |
| vrsta   | vjetar               | maksimum          | 6.60                 | smjer do         | 347 | iznos              | 7  | iznos OK          | 4  |          |
| kreiran | 11.08.2015.<br>14:06 | vrijeme maksimuma | 10.02.2016.<br>18:26 |                  |     | min br mjerenja    | 25 | min br mjer OK    | 6  |          |
| autor   | dadic                | Broj mjerenja OK  |                      |                  |     | odmak paljenja     | 30 | odmak gašenja     | 30 |          |
|         |                      | iznos max ok      | 0.00                 |                  |     |                    |    |                   |    |          |
|         |                      | vrijeme ok        |                      |                  |     |                    |    |                   |    |          |

| Info    |                      | Mjerenja          |                      | Prostorni uvjeti |     | Parametri paljenja |    | Parametri gašenja |    | Promjeni |
|---------|----------------------|-------------------|----------------------|------------------|-----|--------------------|----|-------------------|----|----------|
| rbr     | 1                    | broj mjerenja     | 60                   | smjer od         | 45  | period             | 60 | period OK         | 10 |          |
| vrsta   | vjetar               | maksimum          | 11.28                | smjer do         | 202 | iznos              | 12 | iznos OK          | 7  |          |
| kreiran | 11.08.2015.<br>14:10 | vrijeme maksimuma | 03.01.2016.<br>02:27 |                  |     | min br mjerenja    | 25 | min br mjer OK    | 6  |          |
| autor   | dadic                | Broj mjerenja OK  |                      |                  |     | odmak paljenja     | 30 | odmak gašenja     | 30 |          |
|         |                      | iznos max ok      | 0.00                 |                  |     |                    |    |                   |    |          |
|         |                      | vrijeme ok        |                      |                  |     |                    |    |                   |    |          |

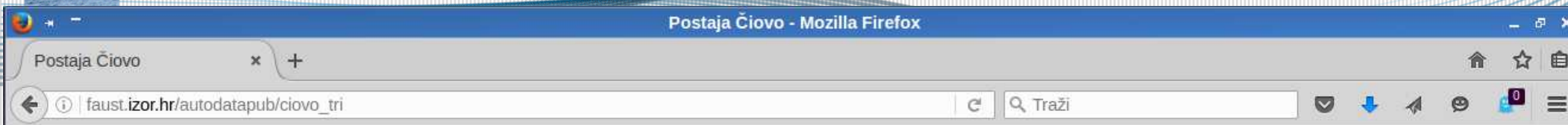
  

| Info    |                      | Mjerenja          |                      | Prostorni uvjeti |     | Parametri paljenja |    | Parametri gašenja |    | Promjeni |
|---------|----------------------|-------------------|----------------------|------------------|-----|--------------------|----|-------------------|----|----------|
| rbr     | 4                    | broj mjerenja     | 240                  | smjer od         | 45  | period             | 60 | period OK         | 10 |          |
| vrsta   | struje               | maksimum          | 17.46                | smjer do         | 120 | iznos              | 20 | iznos OK          | 10 |          |
| kreiran | 11.08.2015.<br>14:10 | vrijeme maksimuma | 03.02.2016.<br>02:09 | dubina od        | 1   | min br mjerenja    | 25 | min br mjer OK    | 6  |          |
| autor   | dadic                | Broj mjerenja OK  |                      | dubina do        | 4   | odmak paljenja     | 30 | odmak gašenja     | 30 |          |
|         |                      | iznos max ok      | 0.00                 |                  |     |                    |    |                   |    |          |
|         |                      | vrijeme ok        |                      |                  |     |                    |    |                   |    |          |

- Loading process (crontab)
- Wind and sea currents criteria



# Alarm Notification



**13.09.16 - 10:13**      **Postaja Čiovo**    **uvjeti: nepovoljni!!!**      **Potvrda**

**Trenutne vrijednosti:**

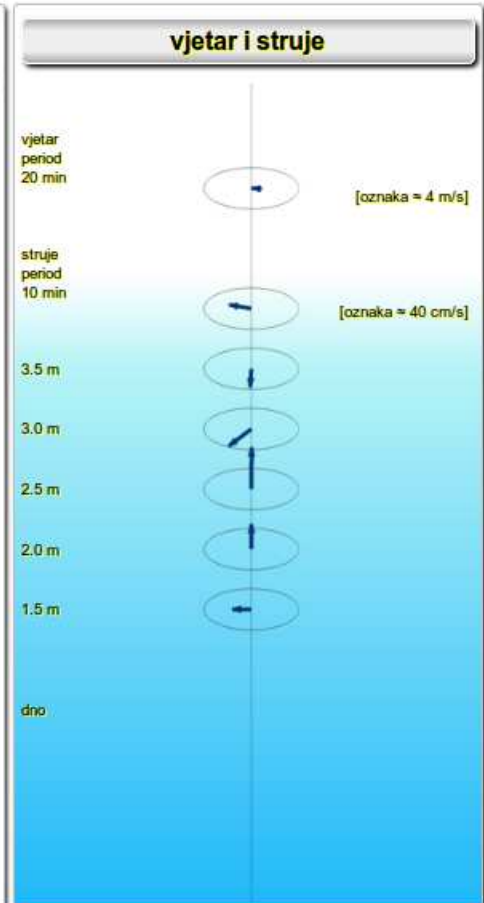
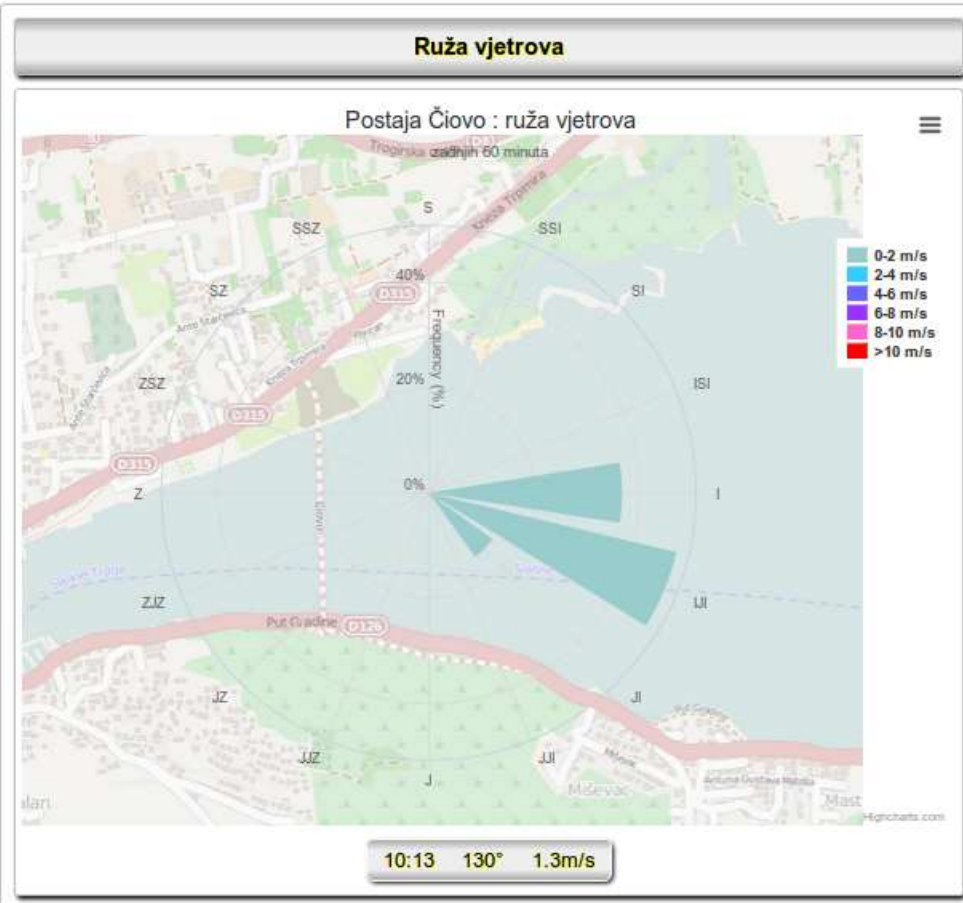
Temperatura zraka: **23.4 °C**

Tlak zraka: **1016.1 hPa**

Relativna vlažnost: **65.9 %**

Kiša: **0 mm/h**

Temperatura mora: **23 °C**



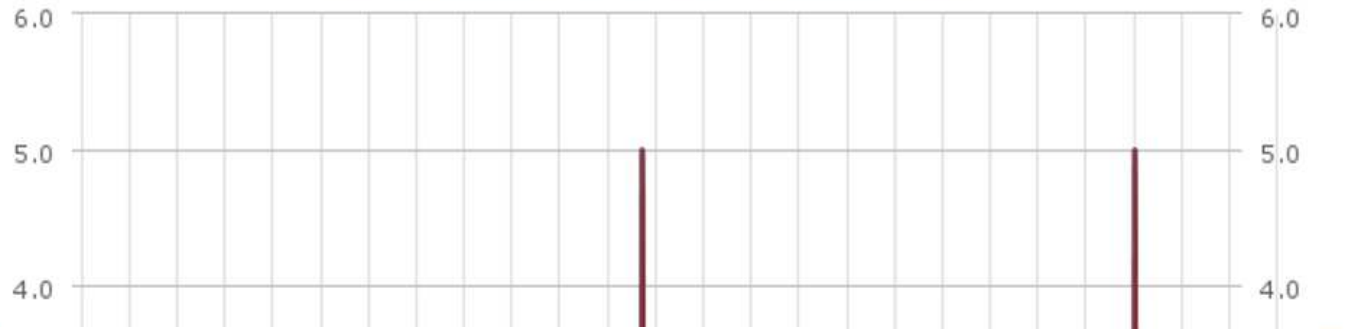
Special web page and Email

# Results 1/2

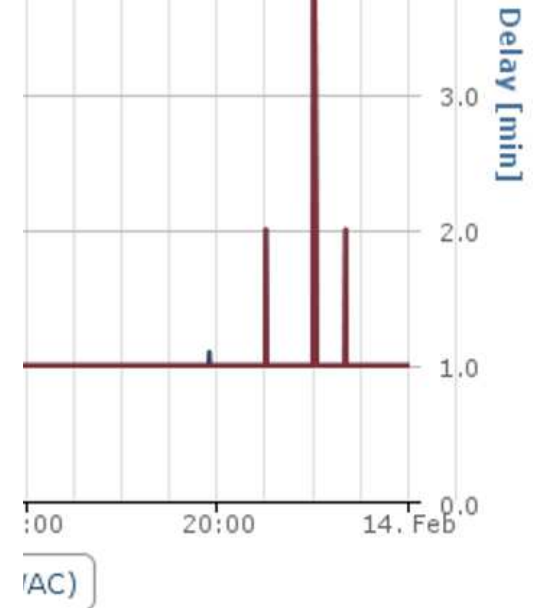


- Data delay usually 1 minute

Čiovo bridge: Delay [min]  
from 13.02.2016. 00:00 until 14.02.2016. 00:00



Čiovo bridge: Delay [min]  
from 06.09.2016. 00:00 until 07.09.2016. 00:00



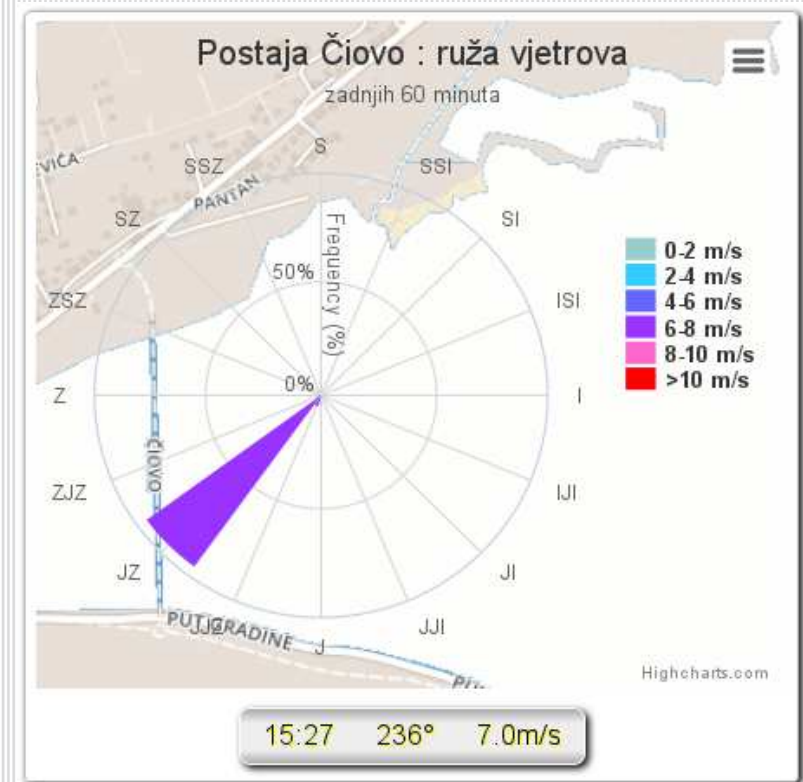
## Results 2/2 (Statistics)

- From 24.07.2015. until 11.10.2016. (445 days) measurement percentage is 99,93% (number of measurements / number of minutes \* 100)
- Average time from measurement to transferred and processed data is 1.4 minutes. There was 640325 measurements.
- Standard delay is one minute, and standard delay because of station restart (once a day) is six minutes.



# Red alarm Statistics

- In 445 days there was total 466 alarms
- Average alarm duration is 87.97 minutes
- Alarm was on (works should be stop) 6.4% of total time
- 86% of alarms are caused by sea currents and rest of 14% is caused by winds



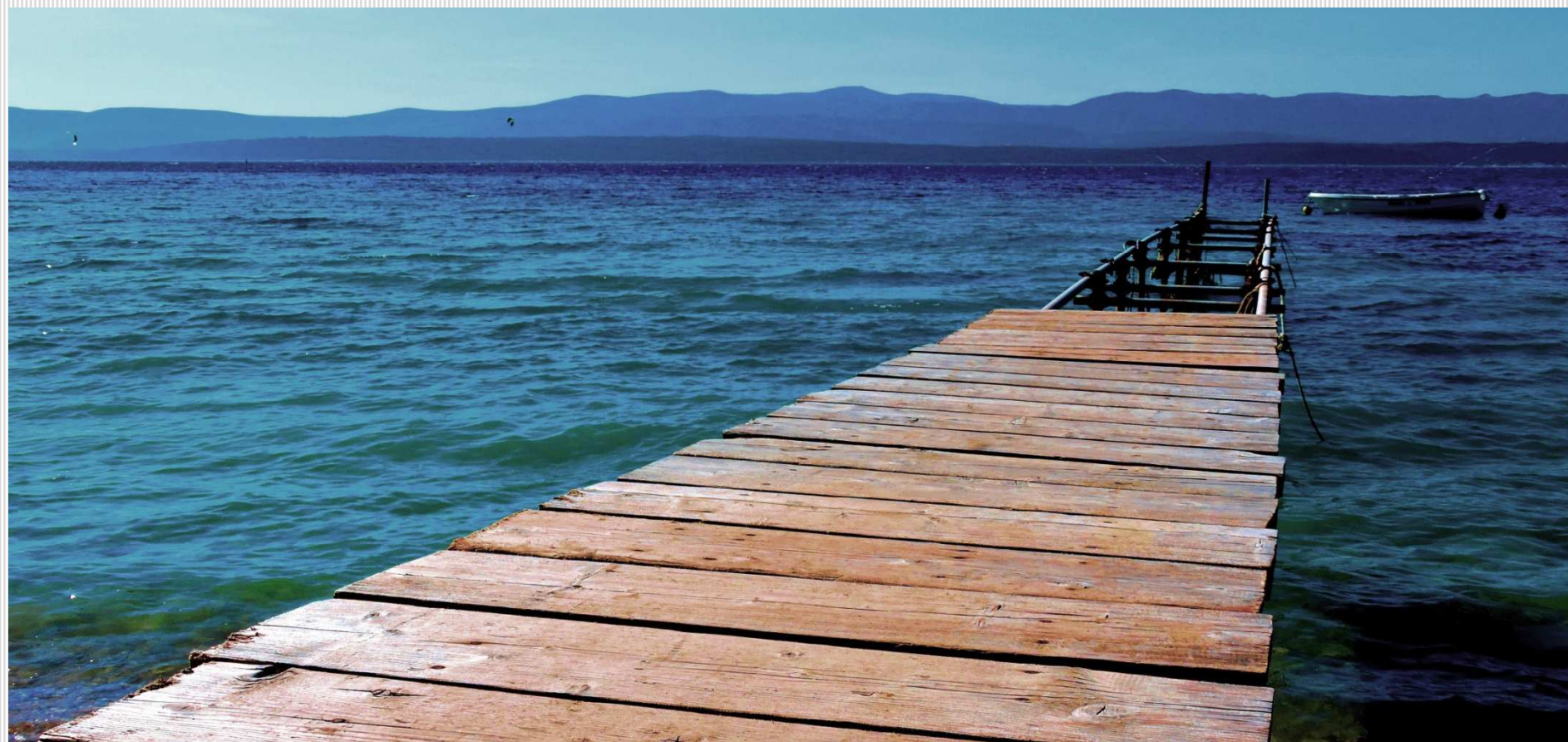
# Conclusions

Regular and on-line measurements with data assimilation into numerical models can:

- help in protection of ecologically important area located in vicinity of construction work in the sea
- many important alerts can be issued: meteo-tsunami alerts, big wave alerts etc
- system like this can be used for beaches monitoring (fecal and other pollutants spreading) and for informing wide public about conditions at the sea (tourism, fisheries and safety at the sea)



[Http://faust.izor.hr/autodatapub/coastal\\_station](http://faust.izor.hr/autodatapub/coastal_station)



Thank you for attention!



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