Observations on Continuous Nutrient Monitoring in Venice lagoon
The Venice Lagoon
The Venice Lagoon

Three Connections with the Adriatic

Fresh Water inflow

~ 50 km

~ 10 km

10 monitoring stations
The WARMER water quality monitoring platform

- **Nutrients:** ammonia, nitrate, nitrite, orthophosphate
- **Physical-chemical:** T, cond., salinity, pH, redox, DO, turbidity
- **Organic compounds:** total hydrocarbons, chlorophyll-A, cyano-bacterial pigments
- **Water current (flow) and direction**
- **Meteorological parameters:** (DV, VV, air temp., pressure, solar radiation, rain)

The pontoon was moored nearby three fixed monitoring stations
Field test in Venice lagoon
Nutrients analytical methods

- **AMMONIA:** OPA fluorimetric method, 6 ppb
- **NITRITE:** NED-SAA, 1 ppb
- **NITRATE + NITRITE:** UV reduction method + NED-SAA, 5 ppb
- **ORTHOPHOSPHATE:** Molibdate-Antimony, 3 ppb

<table>
<thead>
<tr>
<th></th>
<th>NH₄-N</th>
<th>NO₂-N</th>
<th>NO₃-N</th>
<th>PO₄-P</th>
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<tbody>
<tr>
<td>Recovery (%)</td>
<td>96</td>
<td>126</td>
<td>94</td>
<td>109</td>
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<tr>
<td>RSD (%)</td>
<td>22.3</td>
<td>1.2</td>
<td>8.6</td>
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<td>LOD (ppb)</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>3</td>
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<td>LOQ (ppb)</td>
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<td>3</td>
<td>15</td>
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Source: BOKU, Vienna
Integration in the monitoring platform

Nutrients probe

Monitoring platform

10 µm online filtration

Project funded by:
EUROPEAN COMMISSION
Information Society and Media Directorate-General
ICT for Sustainable Growth
VE-4 Fondamenta nuove

Data from 14-05 to 02-06-09

Some data NO2, NO3 < 0

29-05: sample blank reading modified

29-05: reagents pressurization adjusted

Project funded by:
EUROPEAN COMMISSION
Information Society and Media Directorate-General
ICT for Sustainable Growth
First deployment follow-up

Nutrients probe:

- better integration of probes (two cylinders nearby and under shadow)
- in-situ filter antifouling protection by copper
- periodic start-up of nutrients probe was updated
- shorter hydraulic connections -> better reagents protection
- internal standard verification procedure
- sampling line automatic backflush.
VE-7 Palude di Cona

Data from 07-07 to 22-07-09

Nutrients

- Ve-7 - NH₃-N (mg/l)
- Ve-7 - P⁰⁴-P (mg/l)
- Ve-7 - NO₂-N (mg/l)
- Ve-7 - (NO₃+NO₂)-N (mg/l)
VE-7 Palude di Cona

Data from 07-07 to 22-07-09

Nutrients

- anticorrelation between tide and NO3 due to Dese river outlet flow

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ICT for Sustainable Growth
VE-7 Palude di Cona

Data from 07-07 to 22-07-09

Nutrients

- NO3 vs. NH3 inversion with high temperature
VE-7 Palude di Cona

Removal of all the deployment tubing due too high fouling generation (bioreactor) before the beginning of last week:

Sensors at the end of the measurement session:
VE-7 Palude di Cona

Comparison between field and lab nutrients data

*(Magistrato alle Acque, Venice)*

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<th>Date</th>
<th>sampling time</th>
<th>DPA data output time</th>
<th>H-HO2 mg/L</th>
<th>H-HO2 mg/L</th>
<th>H-HO0x (H-HO3+H-HO2) mg/L</th>
<th>H-HO0x (H-HO3+H-HO2) mg/L</th>
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<th>P-P04 mg/L</th>
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VE-5 Marghera

Data from 07-08 to 24-08-09

Nutrients

Ve-7 - NH3-N (mg/l)
Ve-7 - NO2-N (mg/l)
Ve-7 - NO3-N (mg/l)
Ve-7 - (NO3+NO2)-N (mg/l)
VE-5 Marghera

Data from 07-08 to 24-08-

Nutrients

- direct correlation between tide and NO₃
VE-7 Marghera

Data from 07-08 to 24-08-09.

Nutrients

- NO3 vs. NH3 more complex relationship
VE-7 Marghera

Data comparison between DPA and WIZ probe

NH₃-N

(NO₃-N)₂-N

PO₄-P

NO₂-N
Experimental results

➢ Temporal trends in nutrients dynamics in the lagoon could be accurately and better interpreted by the use of continuous monitoring data rather than weekly or monthly series of grab samples information.

➢ High quality continuous nutrient data were acquired for three months with high temperature conditions and heavy bio-fouling effects.

➢ Continuous high frequency data is a useful source of informations to understand the seasonal chemical and biological changes in the lagoon.

➢ Two models of in-situ nutrient probes were successfully compared during the last period of deployment with a good correlation also at low concentration levels.
Thank you for your kind attention