Land-Ocean Interactions in the Coastal Zone LOICZ II Inaugural Open Science Meeting
Coasts and Coastal People - Scenarios of Change and Responses

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Egmond aan Zee, Netherlands

Water and Nutrients Budget in a Semi-enclosed Area of the Coastal Ligurian Sea: the Port of Genoa

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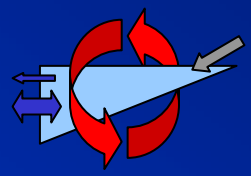


Università degli Studi di Genova

LaguNET

LaguNET

- We applied the LOICZ biogeochemical model to the Port of Genoa, a harbour in the Ligurian Sea subjected to high anthropogenic pressure.
- Our study is part of LaguNet, an observational network studying the fluxes of nutrients from lagoon catchments to Italian coastal environments.
- The Port of Genoa is of course not a natural lagoon, but it shares many characteristics of such systems.

Port of Genoa
Italy

(40.40°N, 8.90°E)

surface: 7 km^2

water depth: between 9 and 15 m

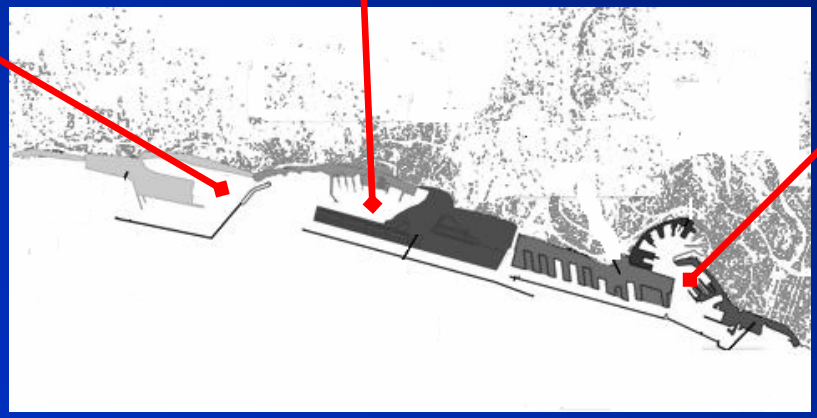
The harbour receives domestic and industrial effluents both through the watercourses and through sewage discharges.

Significant amounts of nutrients are released in semi-enclosed basins, producing phosphorus and nitrogen enrichment.

MULTEDO OIL TERMINAL

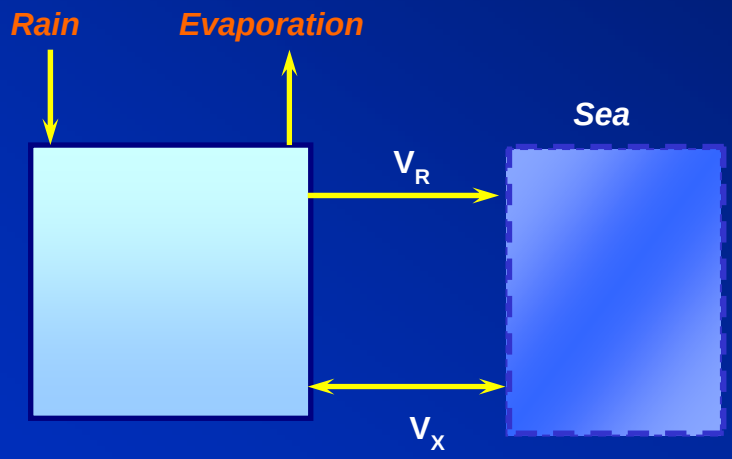
VOLTRI CONTAINER TERMINAL

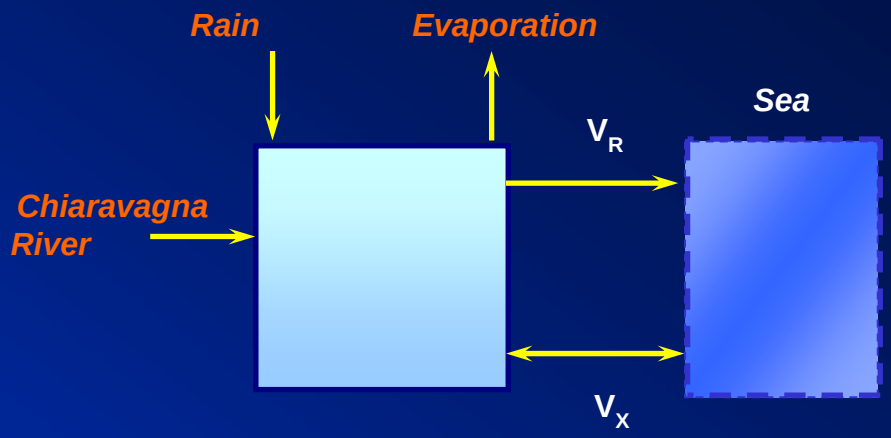
OLD PORT AREA



The port of Genoa can be subdivided into three separated basins. Each basin can be considered as an unitary system and the budgetary analysis has been performed separately, in order to understand the biogeochemical processes on a seasonal basis during 2002 and 2003 .

Application of the LOICZ model (one box, one layer)



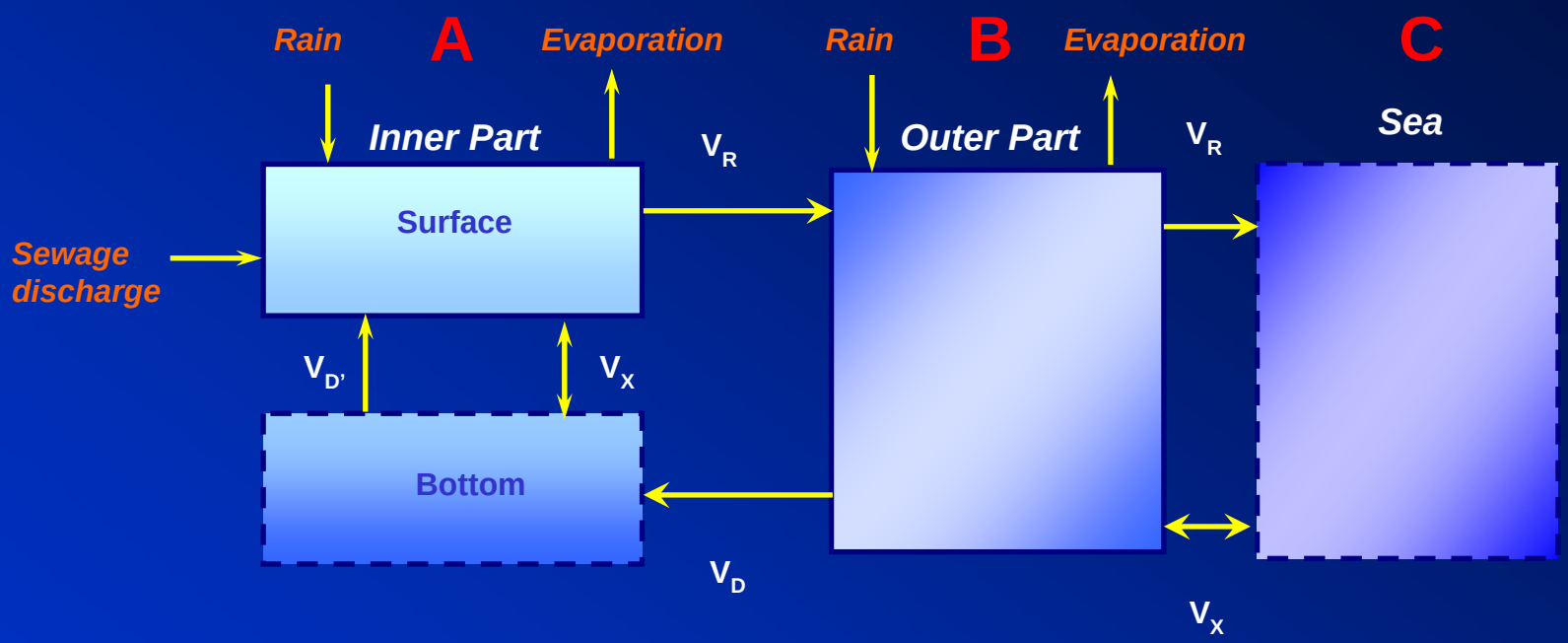


Voltri Container Terminal

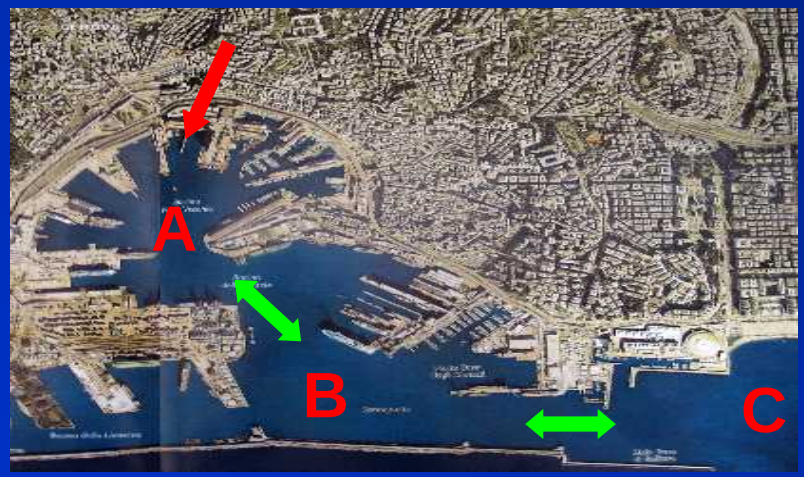
Multedo Oil Terminal

Water input Water fluxes

Application of the LOICZ model (two boxes, two layers)



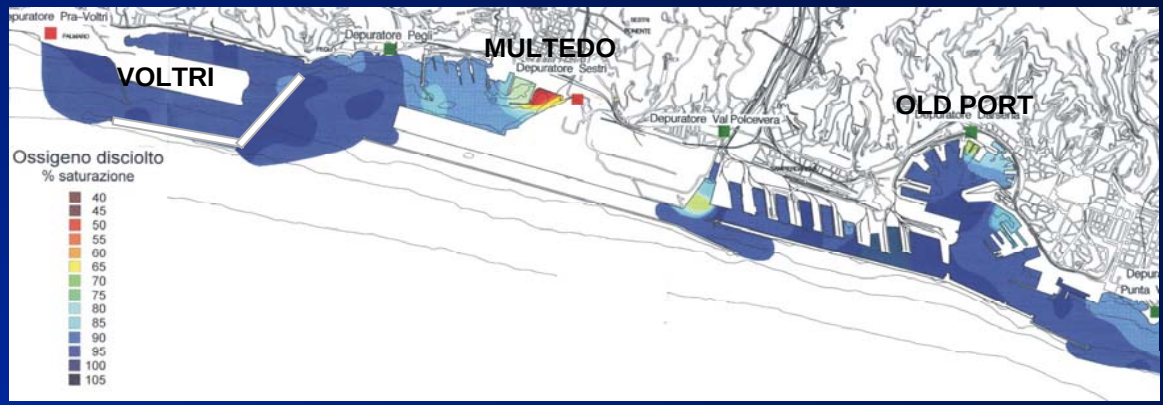
Old Port Area

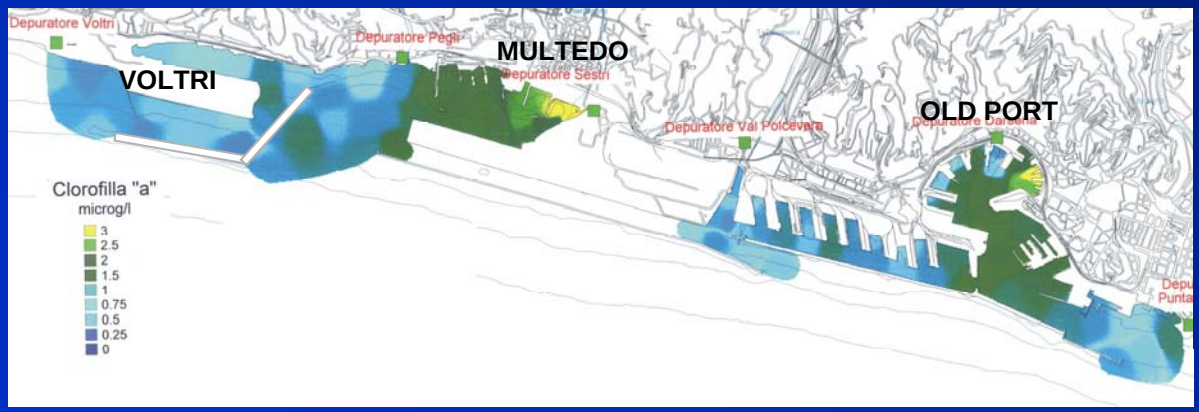


Water input Water fluxes

DISTRIBUTION OF BIOCHEMICAL PARAMETERS

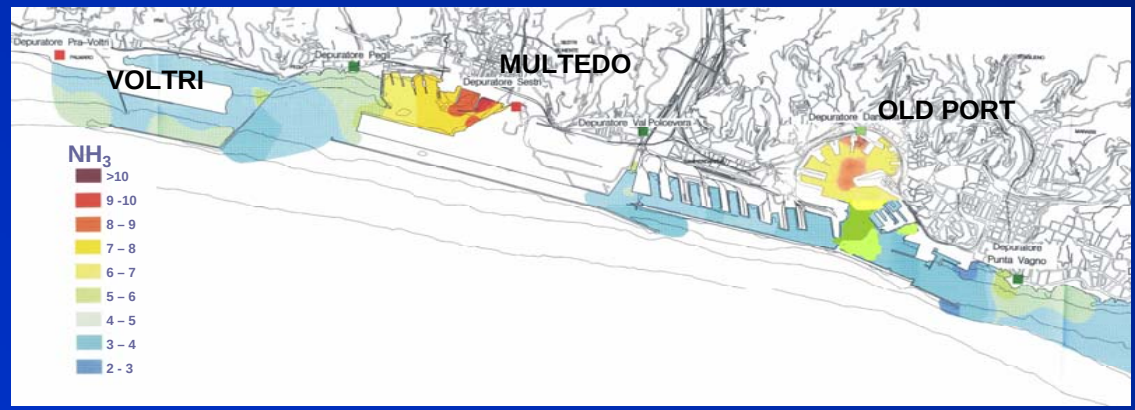
Dissolved Oxygen
(% saturation)





Chlorophyll-a
(μg/l)

N-NH_3
(μmol/l)

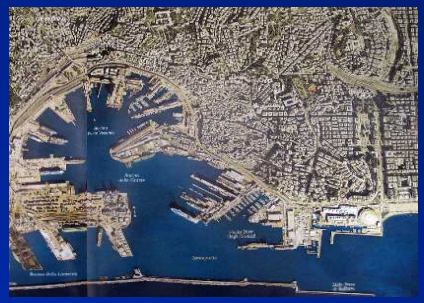


WATER FLUXES

VR (Residual Flux)

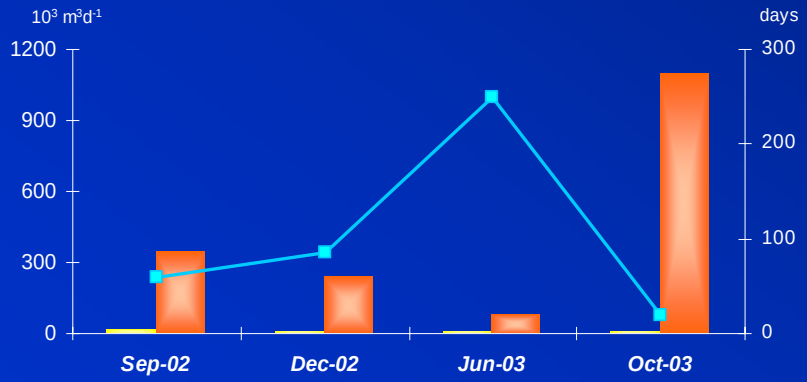
VX (Exchange Flux)

τ (Residence Time)

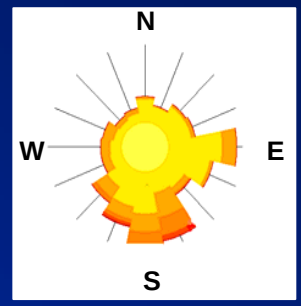


OLD PORT AREA

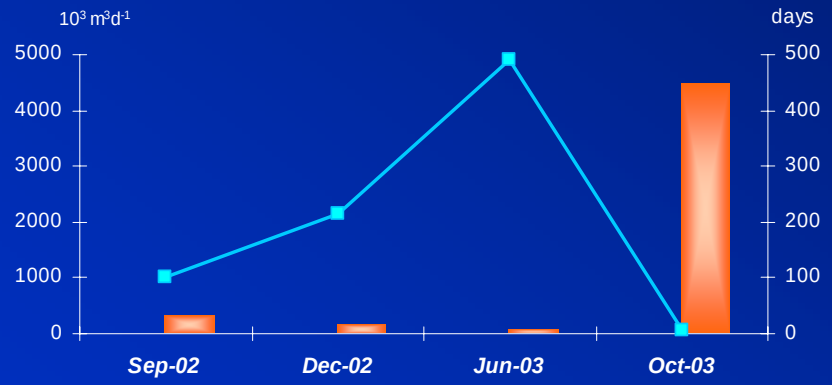
MULTEDO OIL TERMINAL



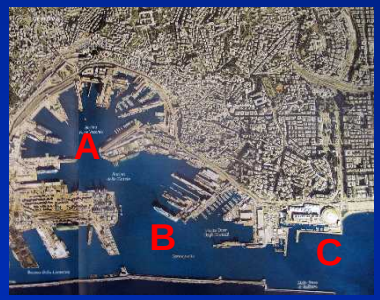
Autumn prevailing winds



VOLTRI CONTAINER TERMINAL



OLD PORT AREA

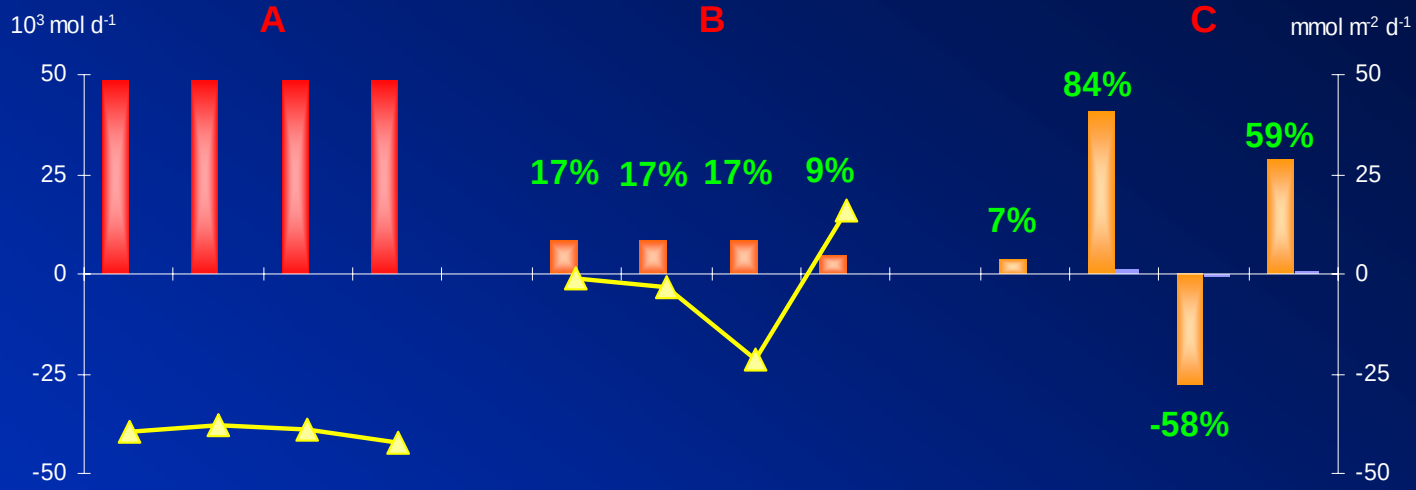


INPUT TO INNER → EXPORT TO OUTER ↔ EXPORT TO SEA

DIN BUDGET

DIN

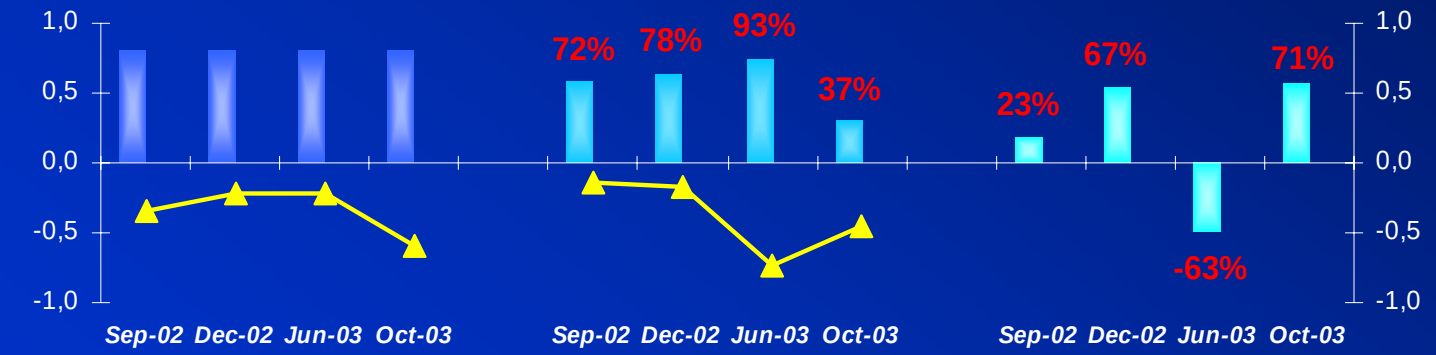
ΔDIN



DIP BUDGET

DIP

ΔDIP



MULTEDO OIL TERMINAL

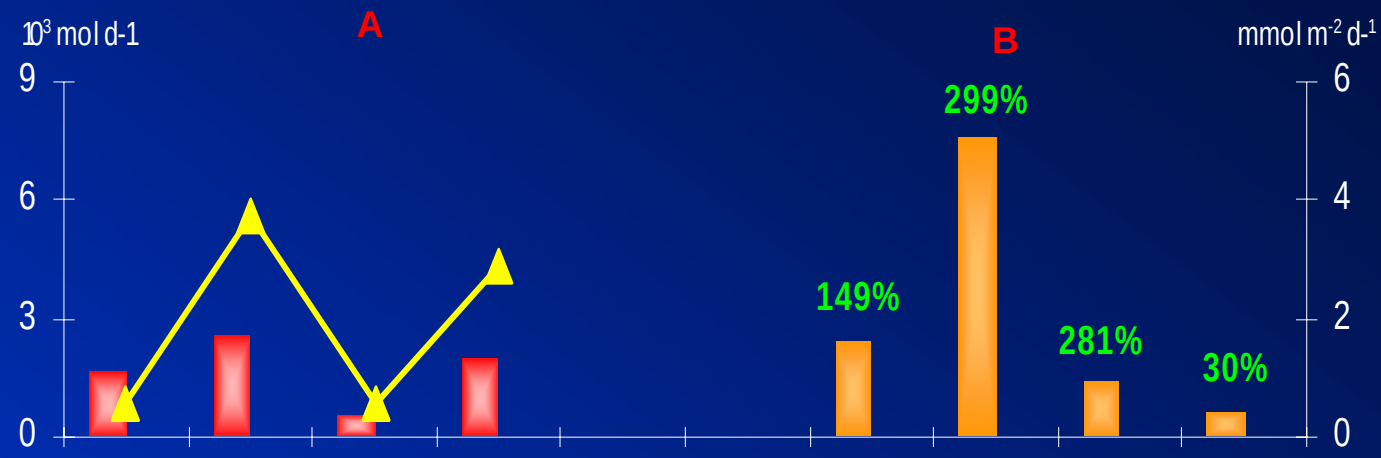
INPUT TO SYSTEM

EXPORT TO SEA

DIN BUDGET

DIN

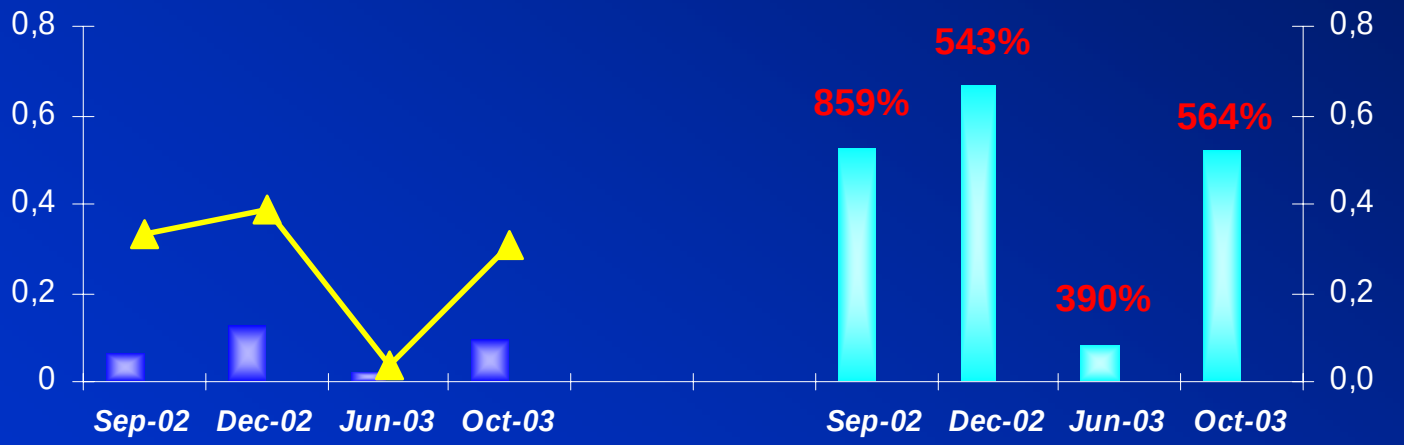
ΔDIN



DIP BUDGET

DIP

ΔDIP



VOLTRI CONTAINER TERMINAL

DIN BUDGET

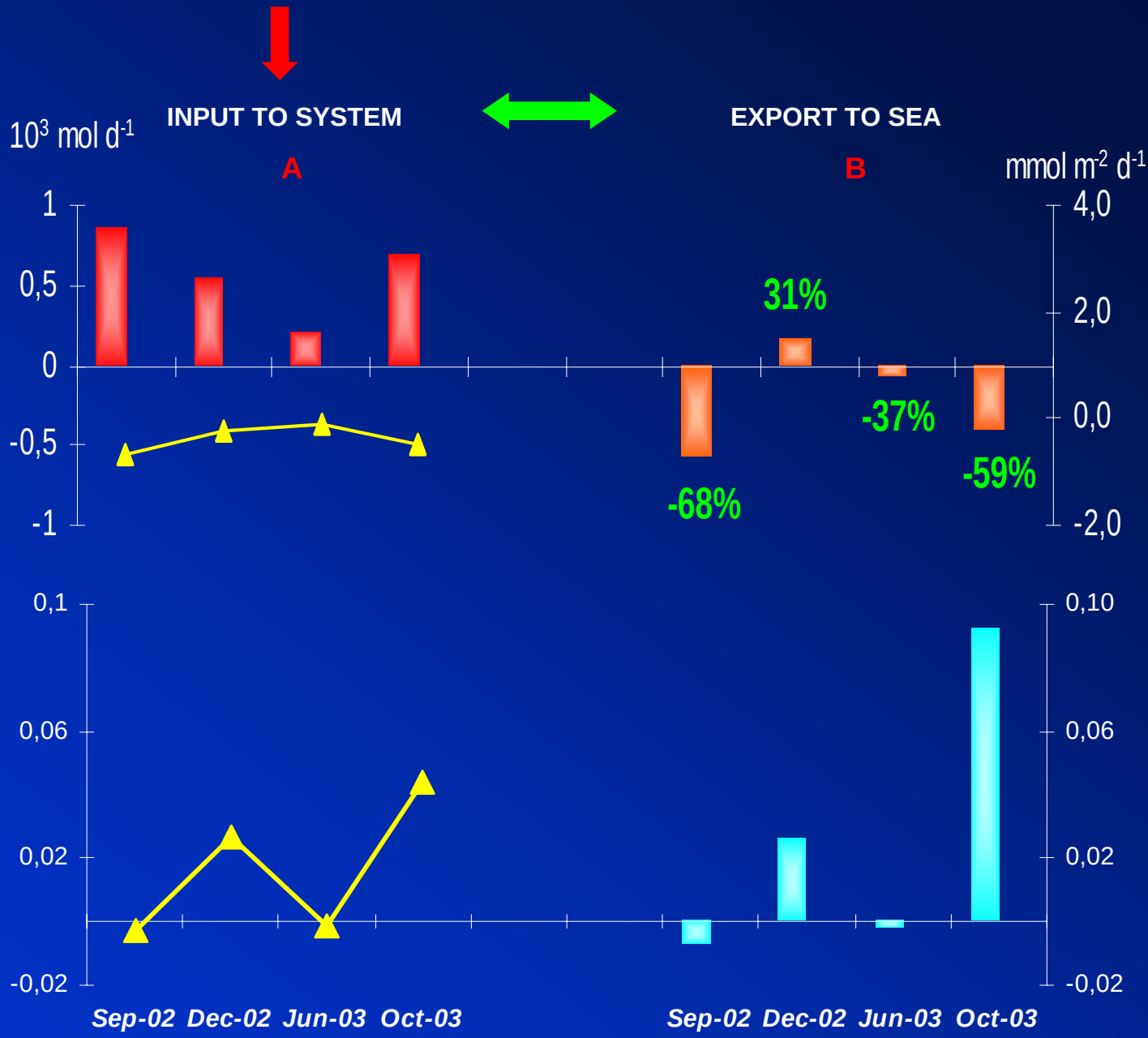
DIN

ΔDIN

DIP BUDGET

DIP

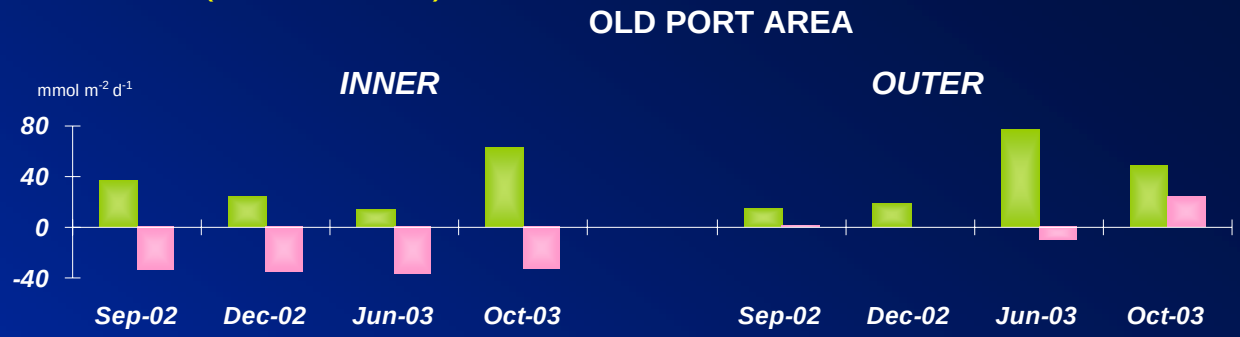
ΔDIP

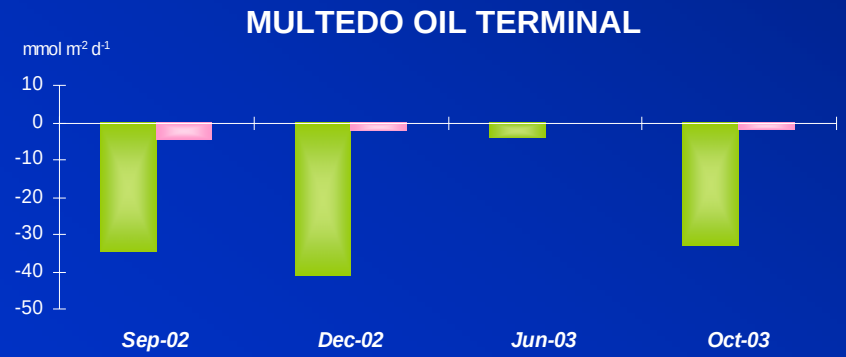


STOICHIOMETRIC CALCULATIONS (Redfield ratio)

NEM (Production –Respiration)

nfix-denit





Correlation between NEM and the autotrophic component (Chl-a)

Old Port: R^2 = 0,8118

Multedo: R^2 = 0,9067

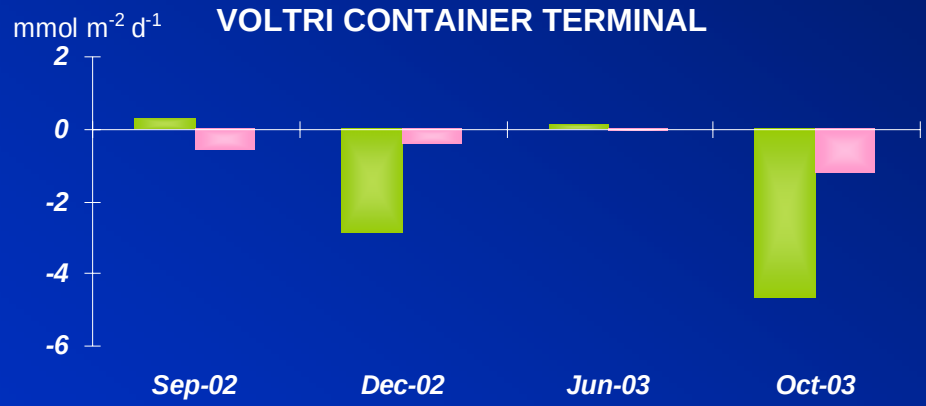
Voltri: R^2 = 0,9067

Heterotrophic-detrital component (POC/Chl-a)

Old Port: 150 - 400

Multedo: 1000 - 2000

Voltri: 250 - 450



SUMMARIZING….

Old Port Area

INNER PART

Sink of DIN and DIP
Source of POC and PON
Denitrifying system
Autotrophic system

OUTER PART

Sink/source of DIN, DIP, POC,
PON depending on the season
Denitrifying system
Autotrophic system

Multedo Oil Terminal

Source of DIN and DIP
Sink of POC and PON
Denitrifying system
Heterotrophic system

Voltri Container Terminal

Weak sink/source of DIN and DIP depending on the season
Weak sink/source of POC and PON depending on the season
Denitrifying system
Good balance between production and respiration

CONCLUSIONS

- The LOICZ model allows a useful simplification of complex sites, such as harbour areas, where local morphology and hydrodynamics may dramatically affect the water and nutrient exchange and additional pollution may alter the natural processes of production, consumption and storage in the sediments.
- Compared to in situ data the results provided by the model seem to be realistic and capable to predict some of the biogeochemical processes occurring in the studied system. They also provide useful information in order to compare to transitional systems where the LOICZ Model was applied.
- Difficulties arise from the limited data available on nutrient distributions and their seasonal variability, while source terms from land run-off and the atmosphere are often not well determined. Moreover, we have not taken into account the close coupling between the water column and the sediment, which can strongly influence the biogeochemical nutrient cycles.
- Hence, this model is a useful tool for assessing and predicting the environmental impacts and the potential vulnerability of coastal artificial area under high anthropogenic pressure.