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Morphology and anoxia in enclosed seas: Aitoliko lagoon- Greece

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European Geosciences Union General Assembly 2011 Vienna | Austria | 03 – 08 April 2011

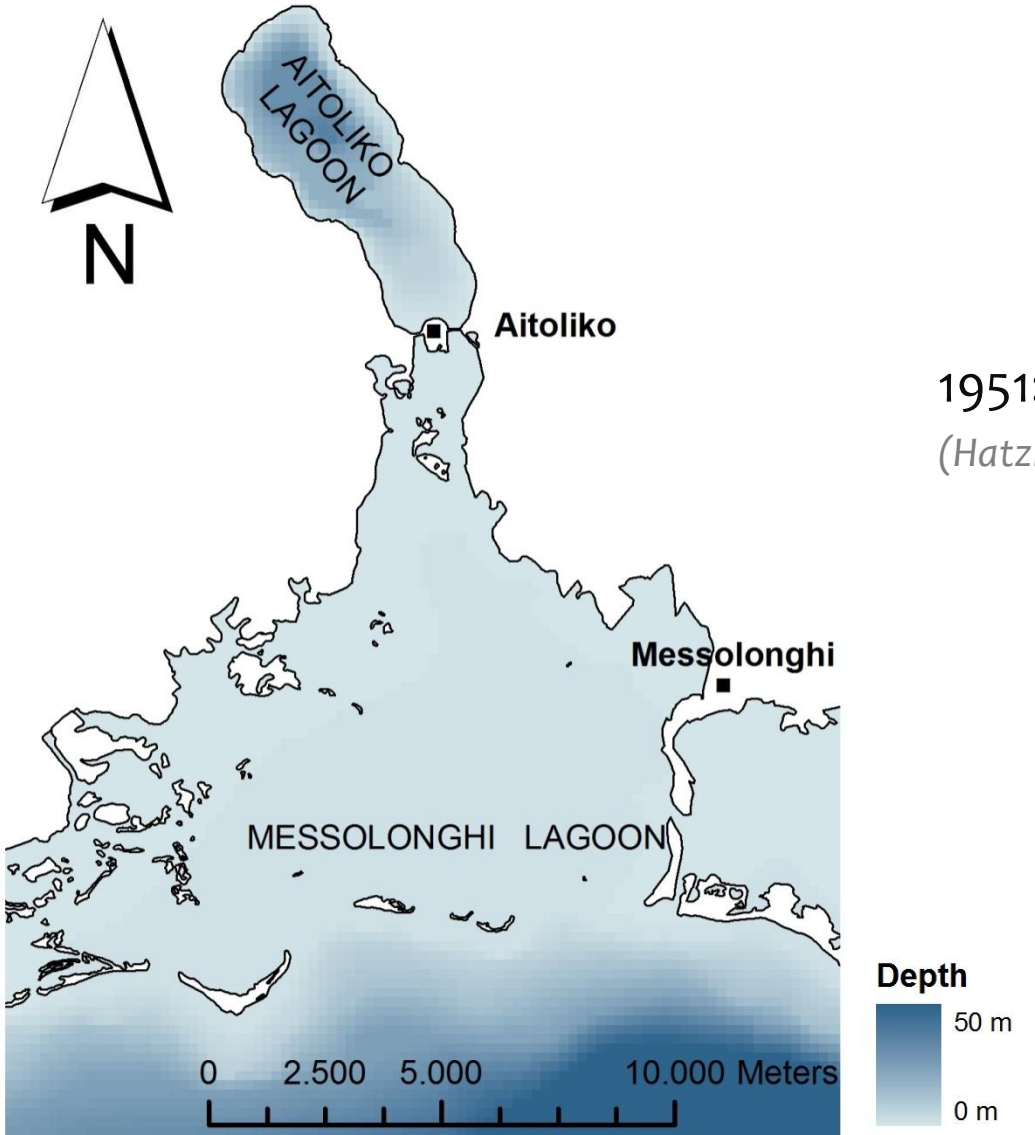
…… …Anoxic Basins… … …

- Anoxia normally occurs in **enclosed basins** where physical barriers (sills) and **density stratification** limits the advection of O2 to the deep waters
- Density gradient occurs because of a strong halocline or thermocline
- Basins with high primary productivity in the euphotic zone
- In oxygen depleted layers **H2S** is accumulating through the reduction of sulfates

Aitoliko Lagoon

- Western Greece
- Non typical lagoon
- Maximum dept: 30m
- Mesotrophic –Eutrophic basin
- Limited connection with the Mesolongi lagoon
- Permanent anoxic
- H_2S concentration up to 45mg/l

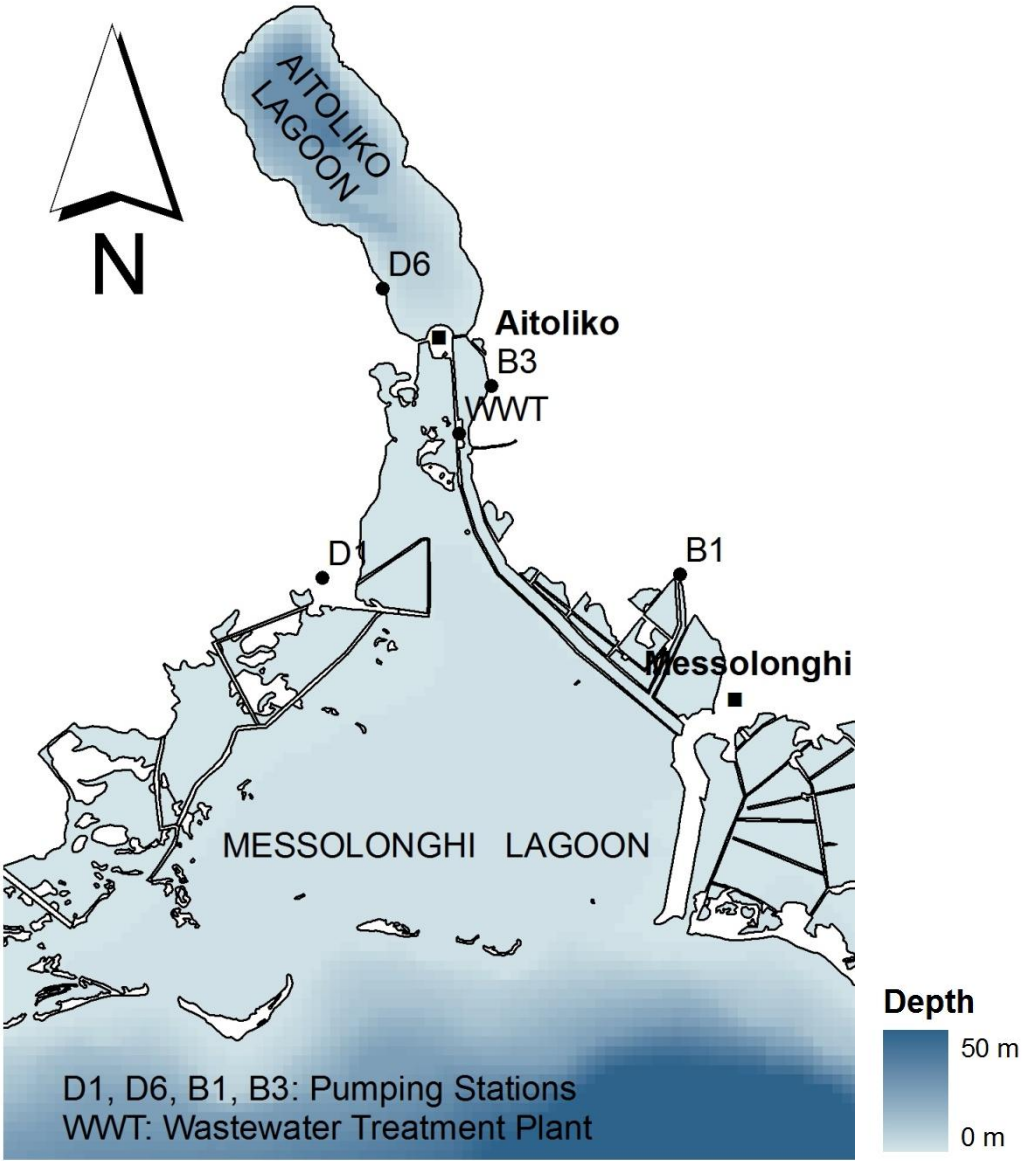
Aitoliko – Messolonghi lagoon morphology



1951: Depth of anoxic layer 13 – 17 m

(Hatzikakidis, 1951)

Aitoliko – Messolonghi lagoon morphology



Since 50s:

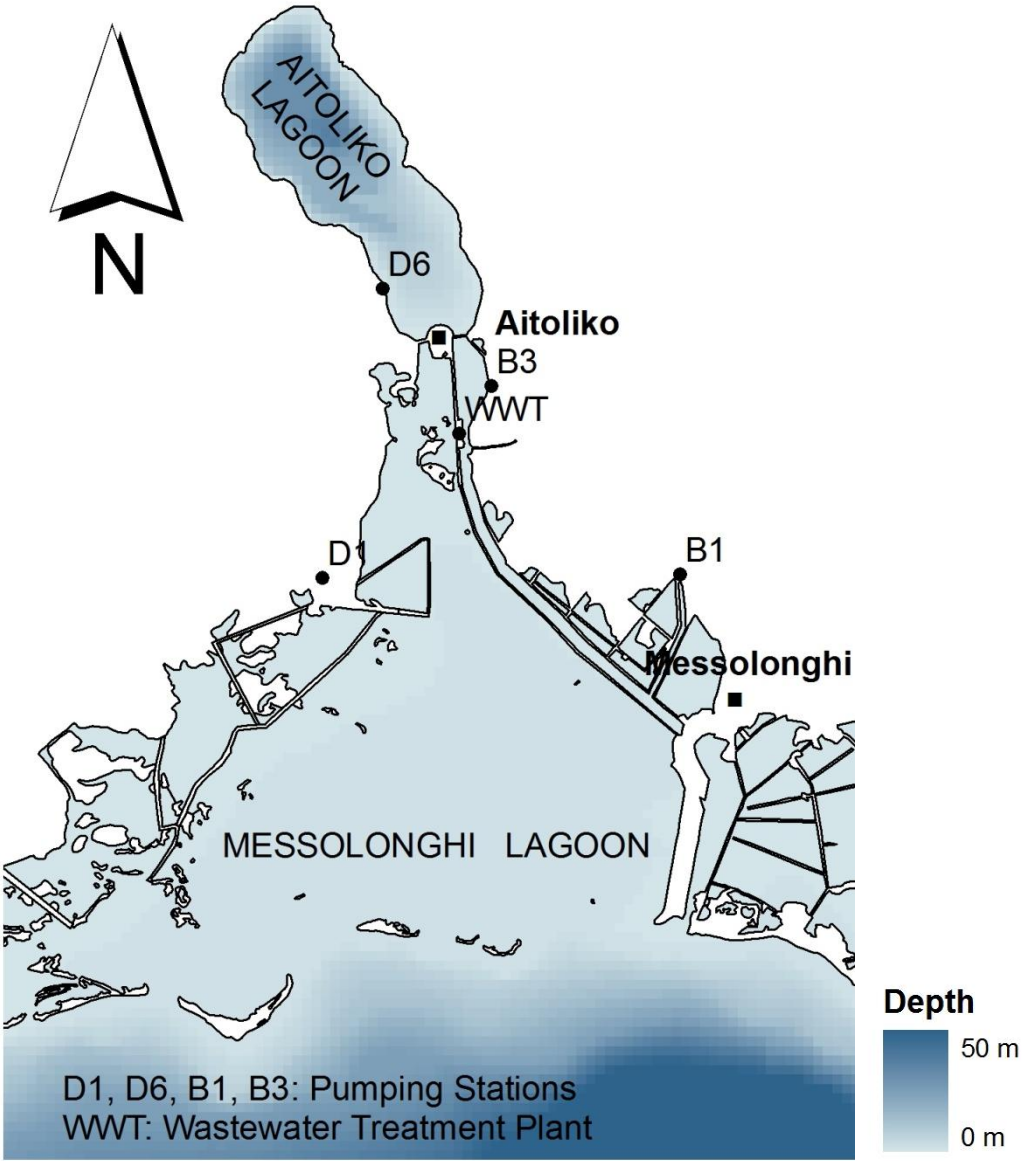
Increase in nutrient and organic load (*wastewater treatment plants*)

Increase of fresh water recharges (*drainage pumping stations*)

Restriction of water exchange between Aitoliko and Messolonghi lagoons (*banks*)

Enforced of anoxia in Aitoliko lagoon

Aitoliko – Messolonghi lagoon morphology



1984-1985:

Depth of anoxic layer 9 – 15m

(Daneilidis, 1991)

1995:

Depth of anoxic layer 10m

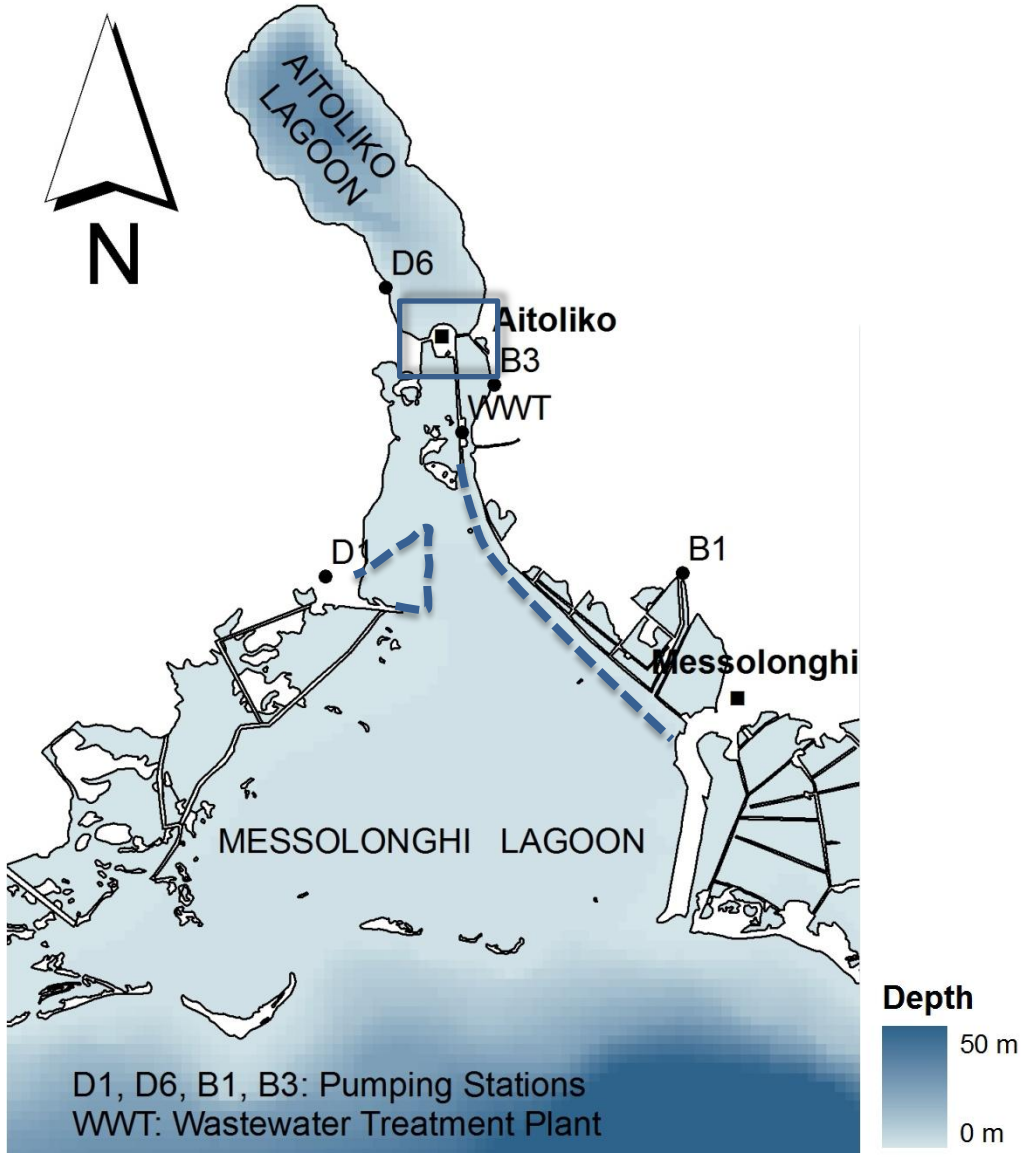
(Psilovikos, 1991)

2003-2004:

Depth of anoxic layer 5m

(Chalkias, 2006)

Aitoliko – Messolonghi lagoon morphology



During the latest years there was an effort to reverse the degradation of the system back to its natural state

The main objective was to facilitate the water exchange between the Aitoliko and Messolonghi lagoons

Some of the banks were broken up

The sill was dredged

Sill's Modification

44 Openings:

Mean width: 3m

Mean depth: 0,8m

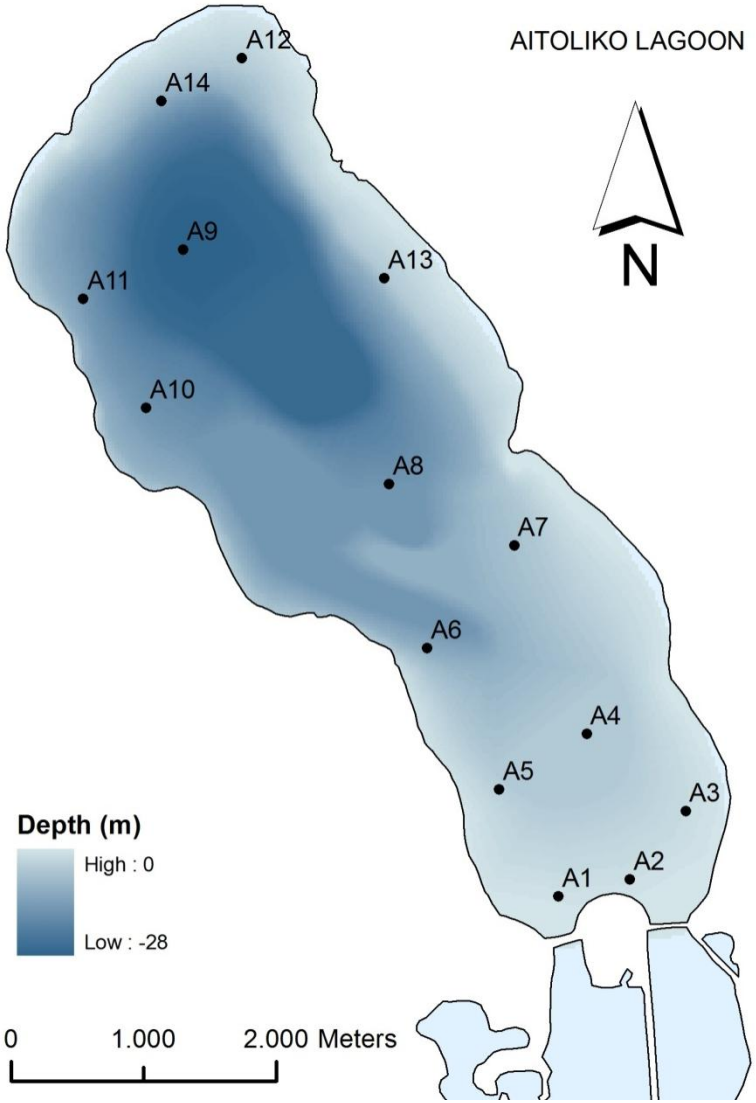
New openings:

Mean width: 8m

Mean depth: 3m

Samplings

MAY 2006-APRIL 2007



In Situ

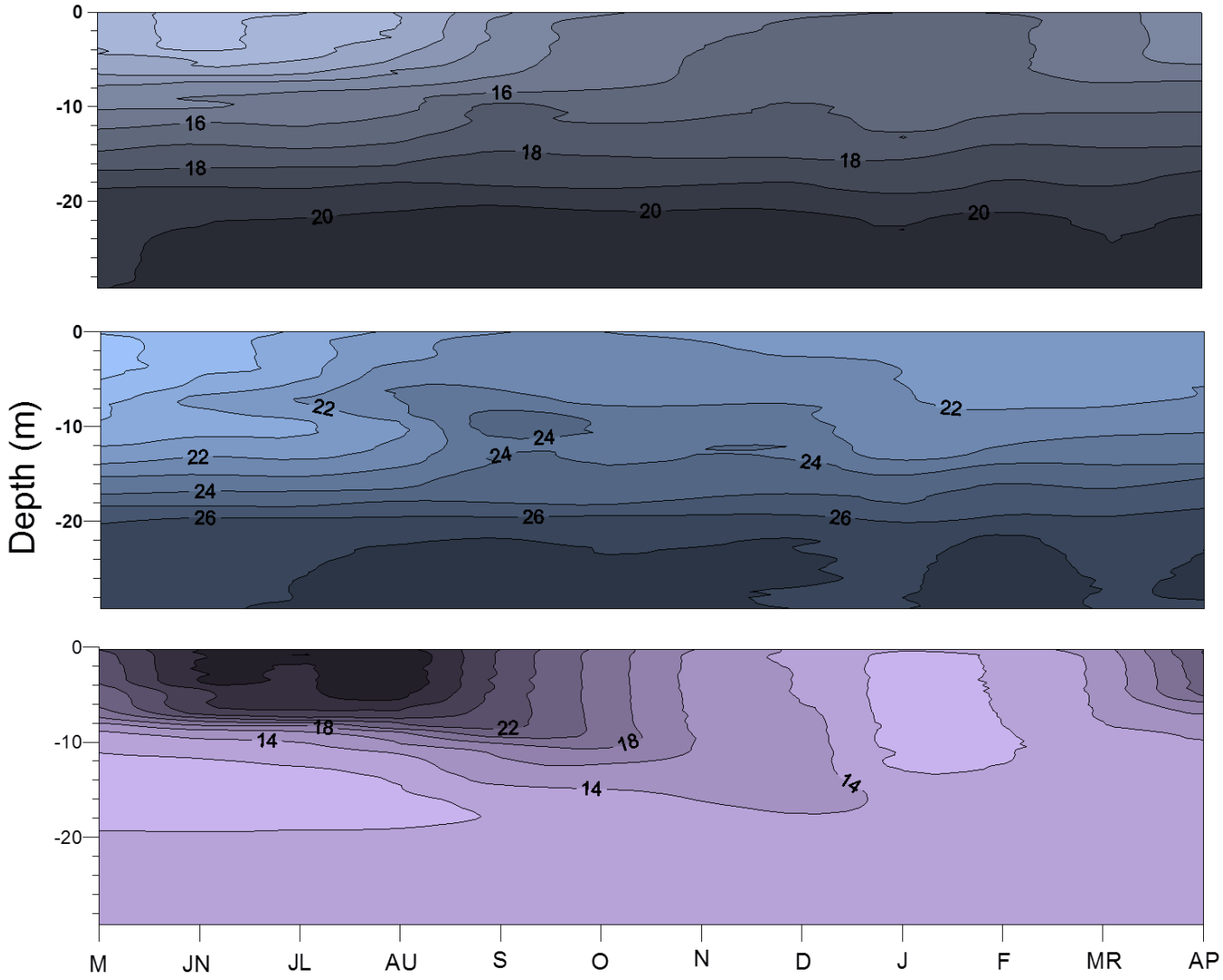
- Temperature
- Salinity
- Dissolved oxygen
- pH
- Redox Potential

Density and Stratification (Station A9)

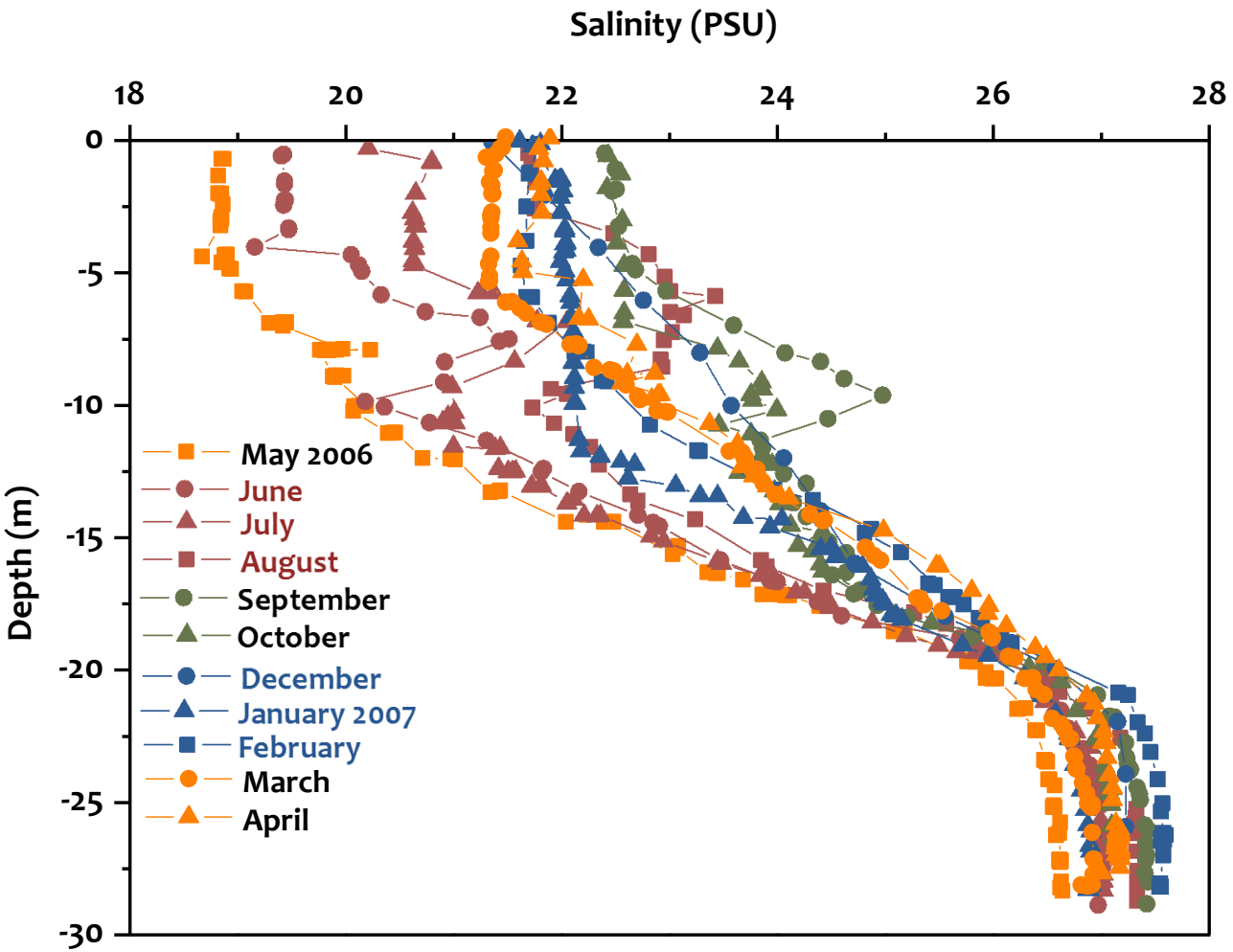
Density (Sigma–t)

Salinity (PSU)

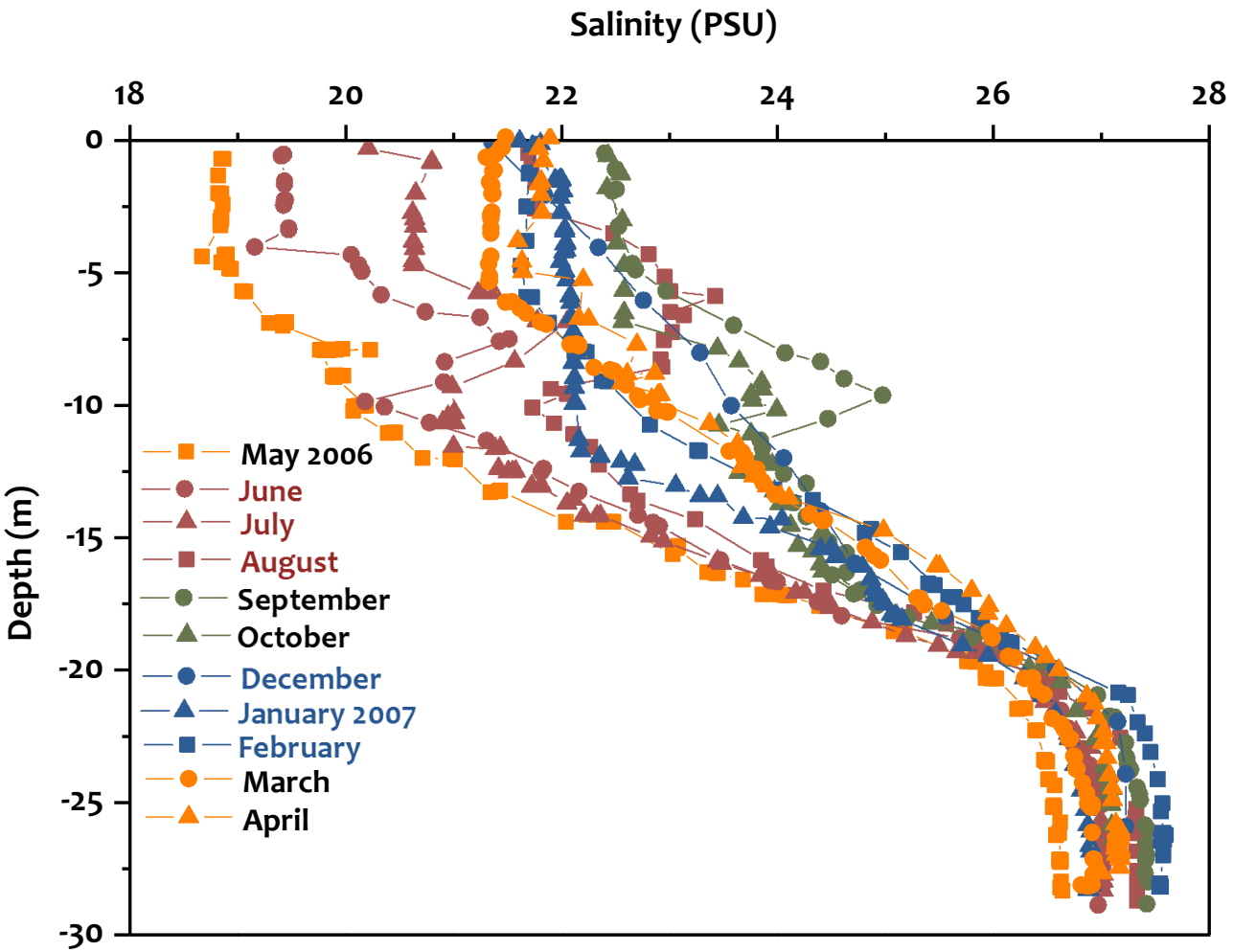
Temperature (°C)



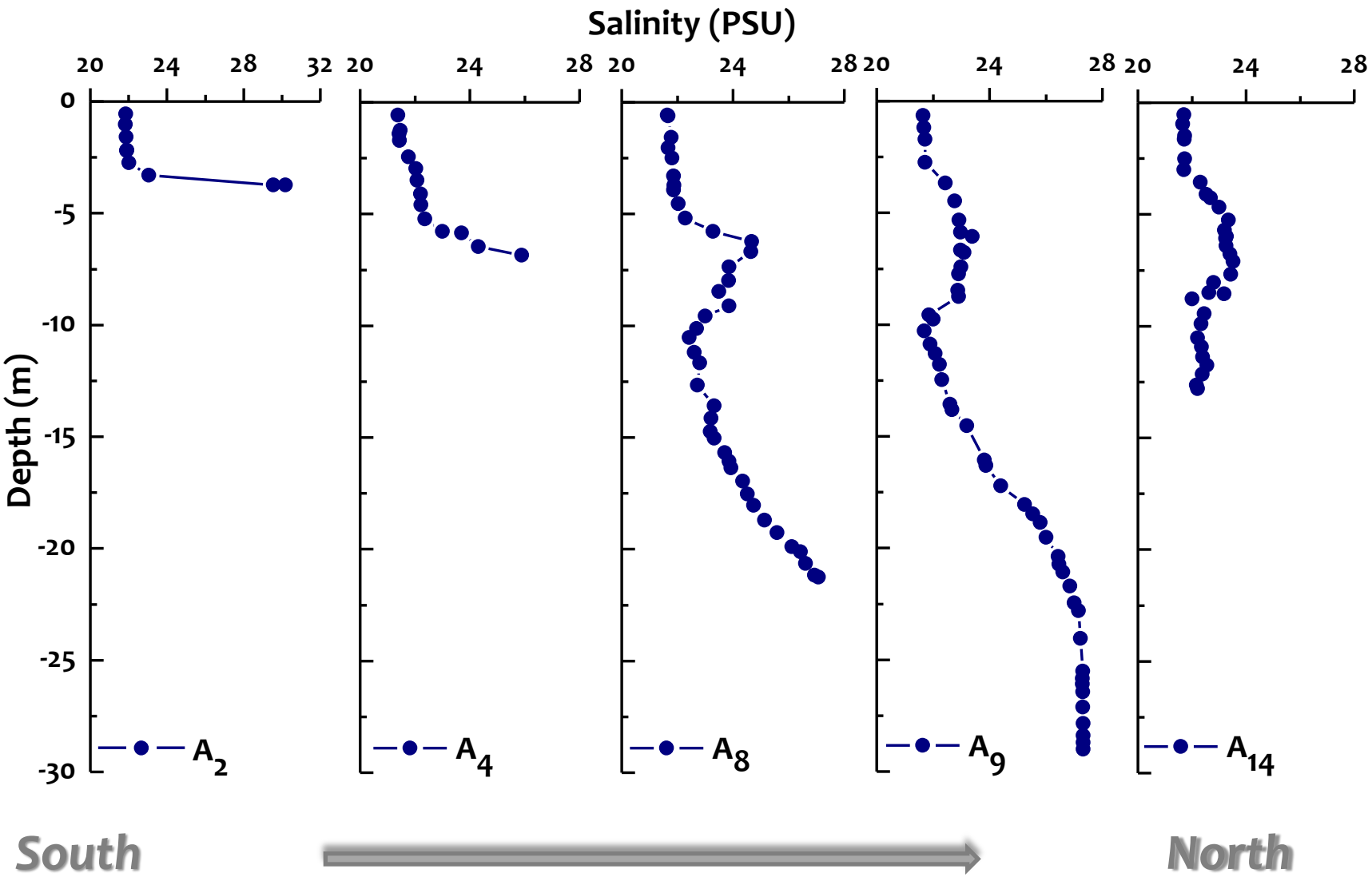
Salinity (Station A9)



Salinity (Station A9)

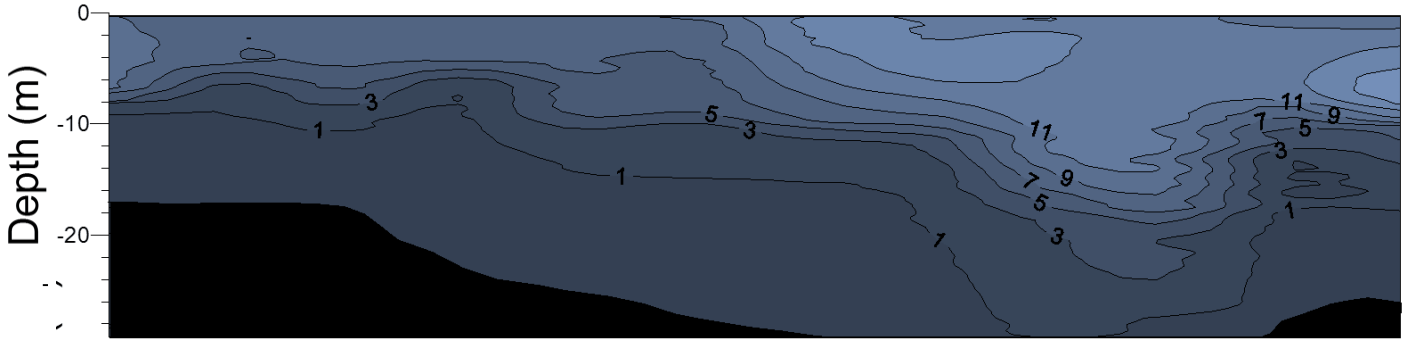


Salinity (August 2006)

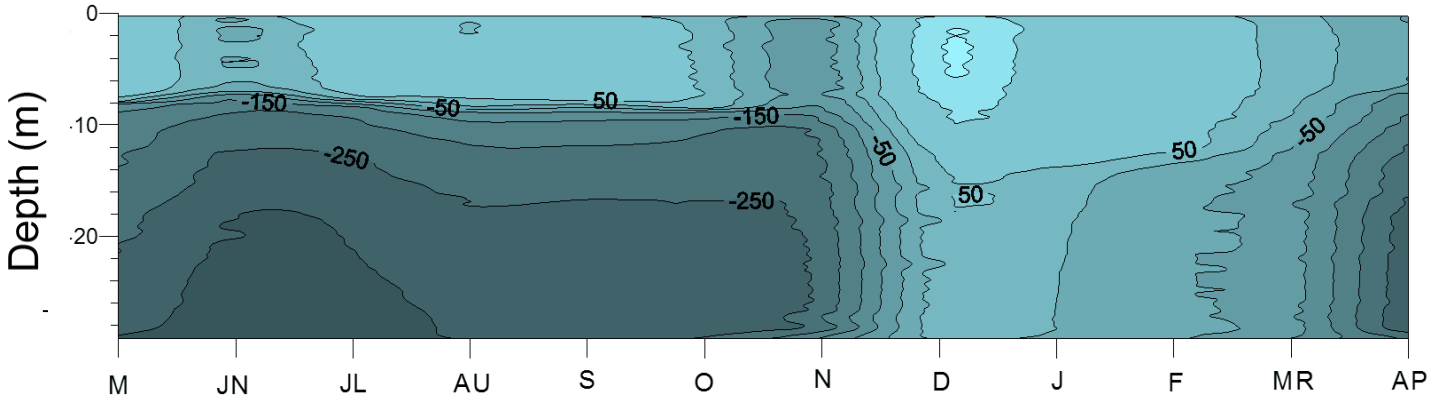


Dissolved Oxygen - Eh

Dissolved oxygen (mg/l)



Eh (mV)

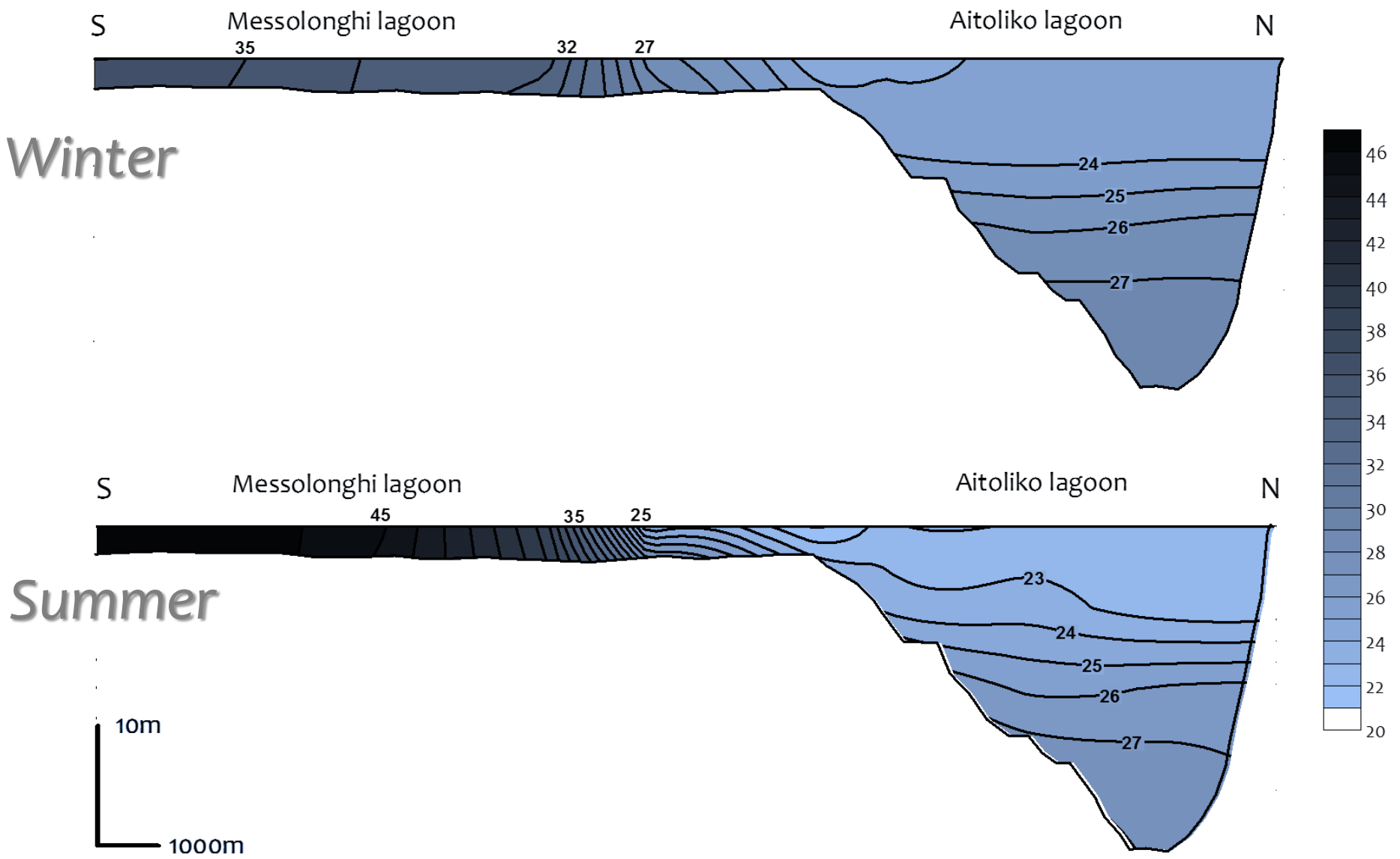


…. …New records for Aitoliko lagoon…. …

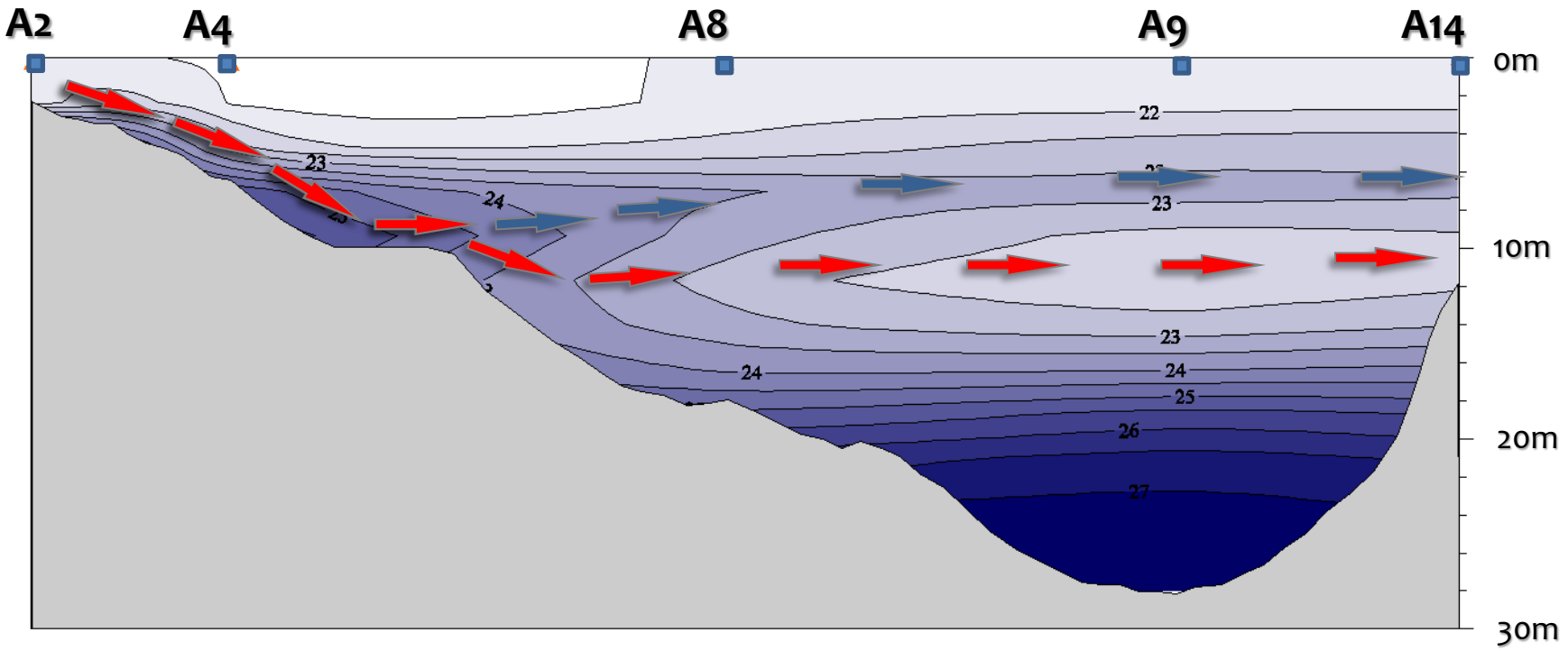
High salinity water at the upper metalimnion during the summer and autumn months

Oxygenation of the bottom layer during winter

Salinity distribution Messolonghi - Aitoliko lagoons



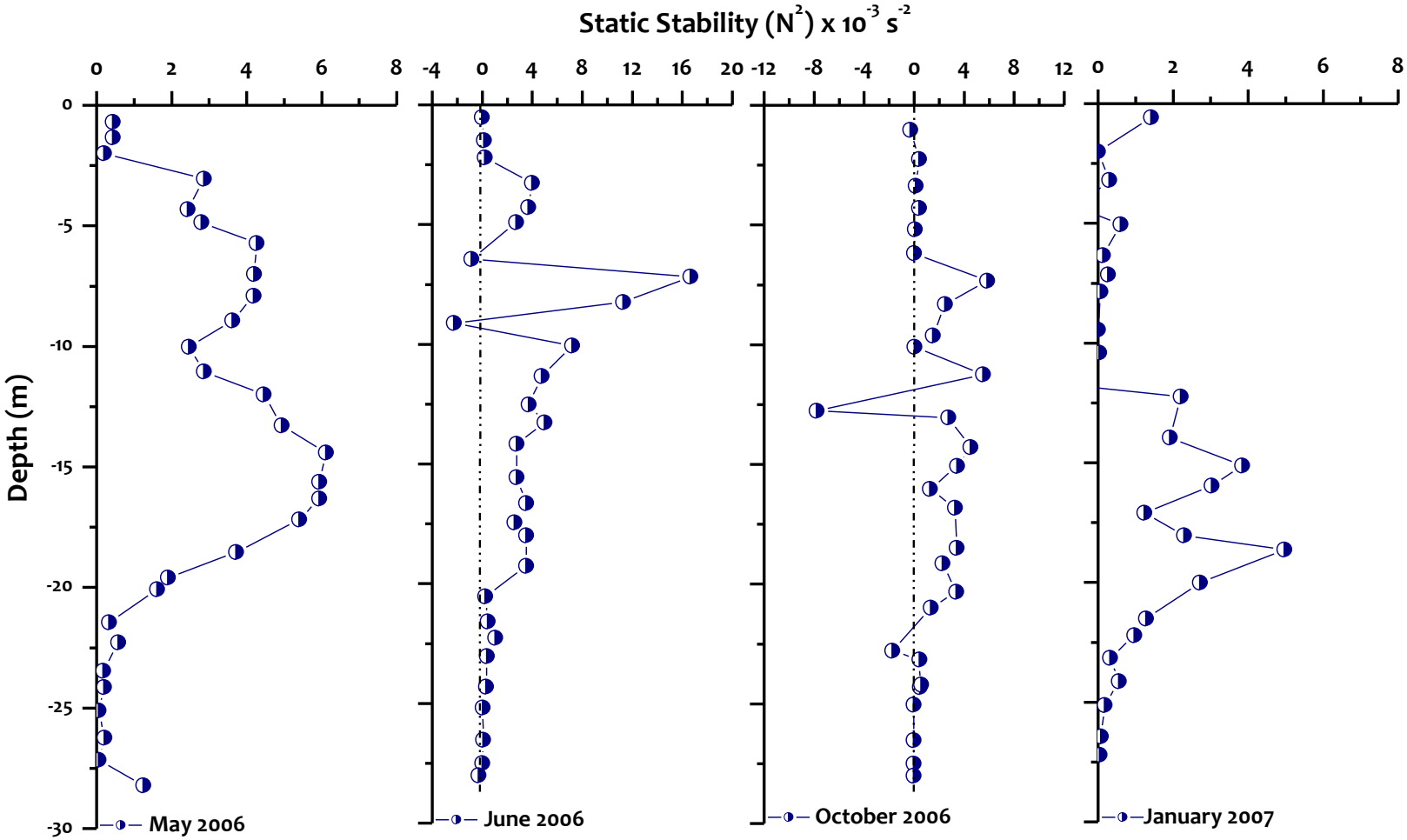
Salinity distribution – August 2006



South

North

Water column stability



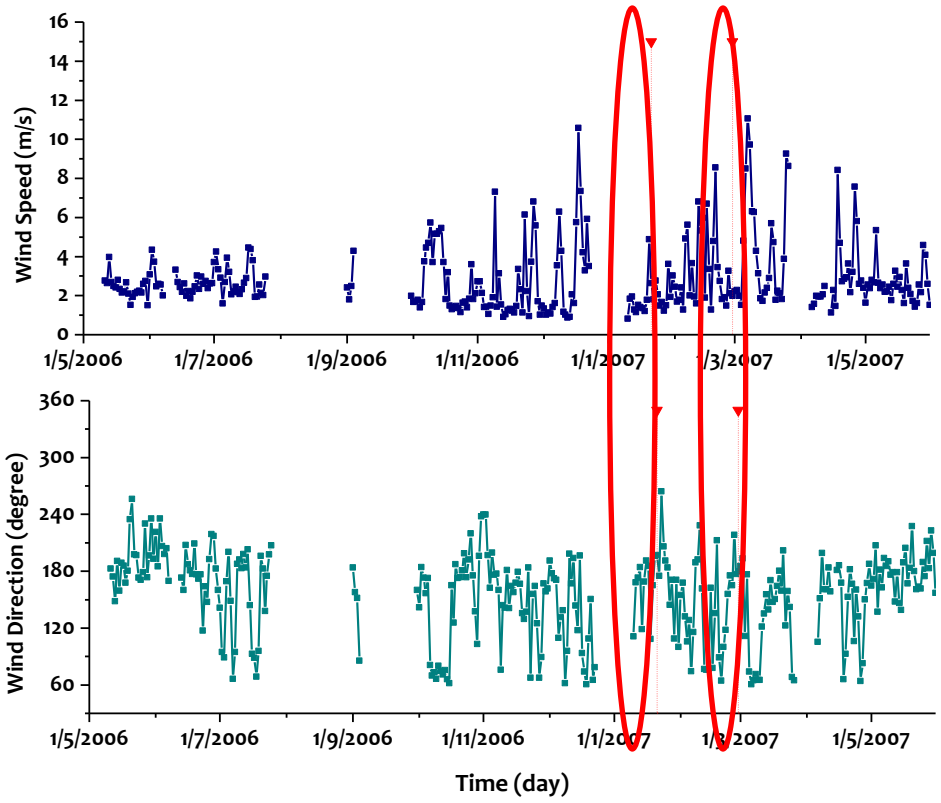
… … …

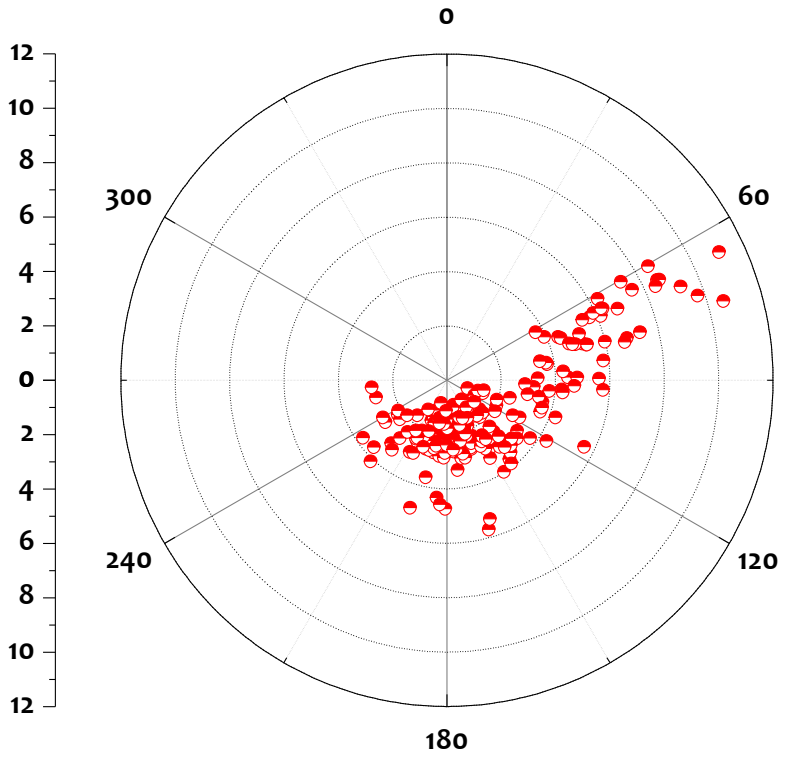
What caused this water instruction?

… … …

Wind

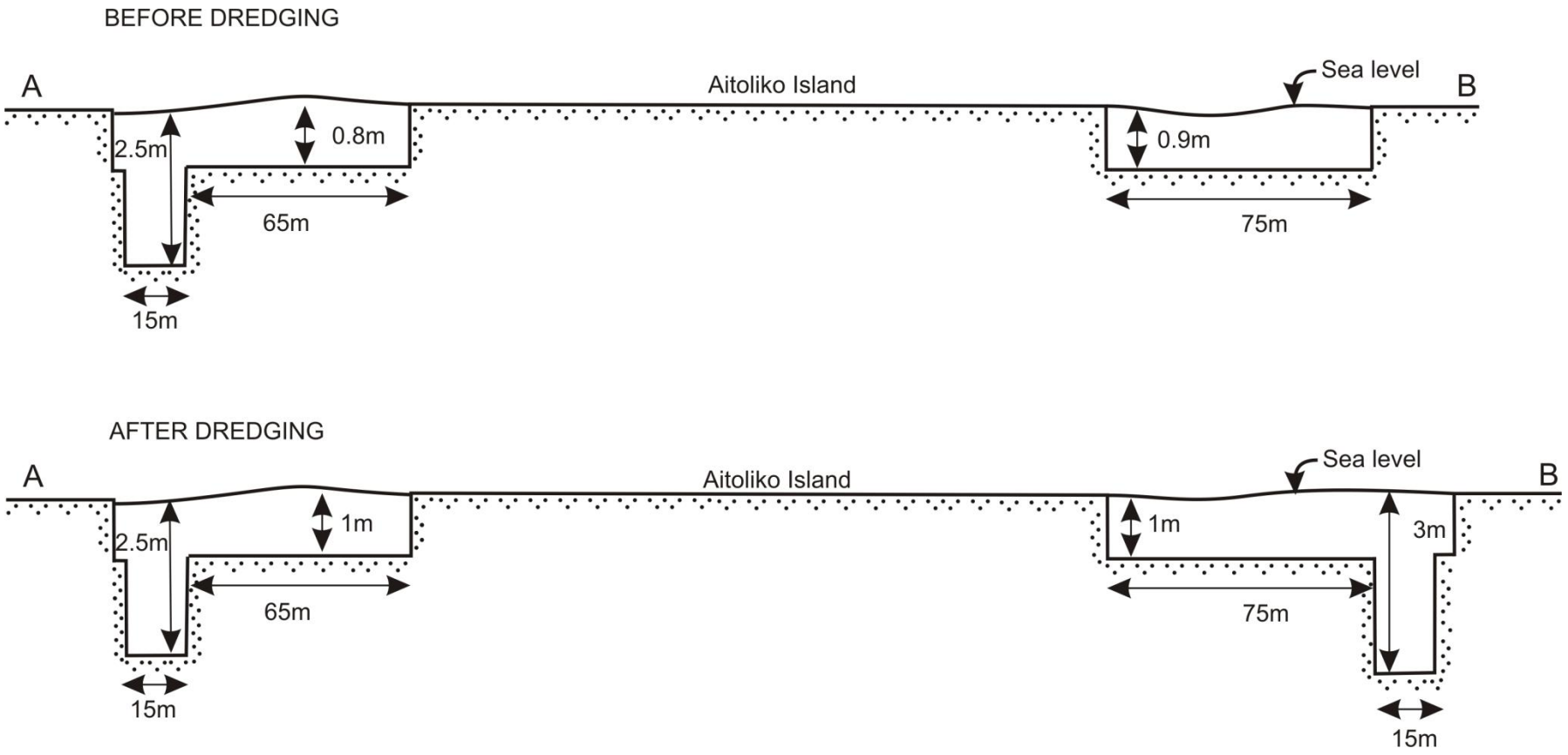
Dominant wind directions during the sampling period





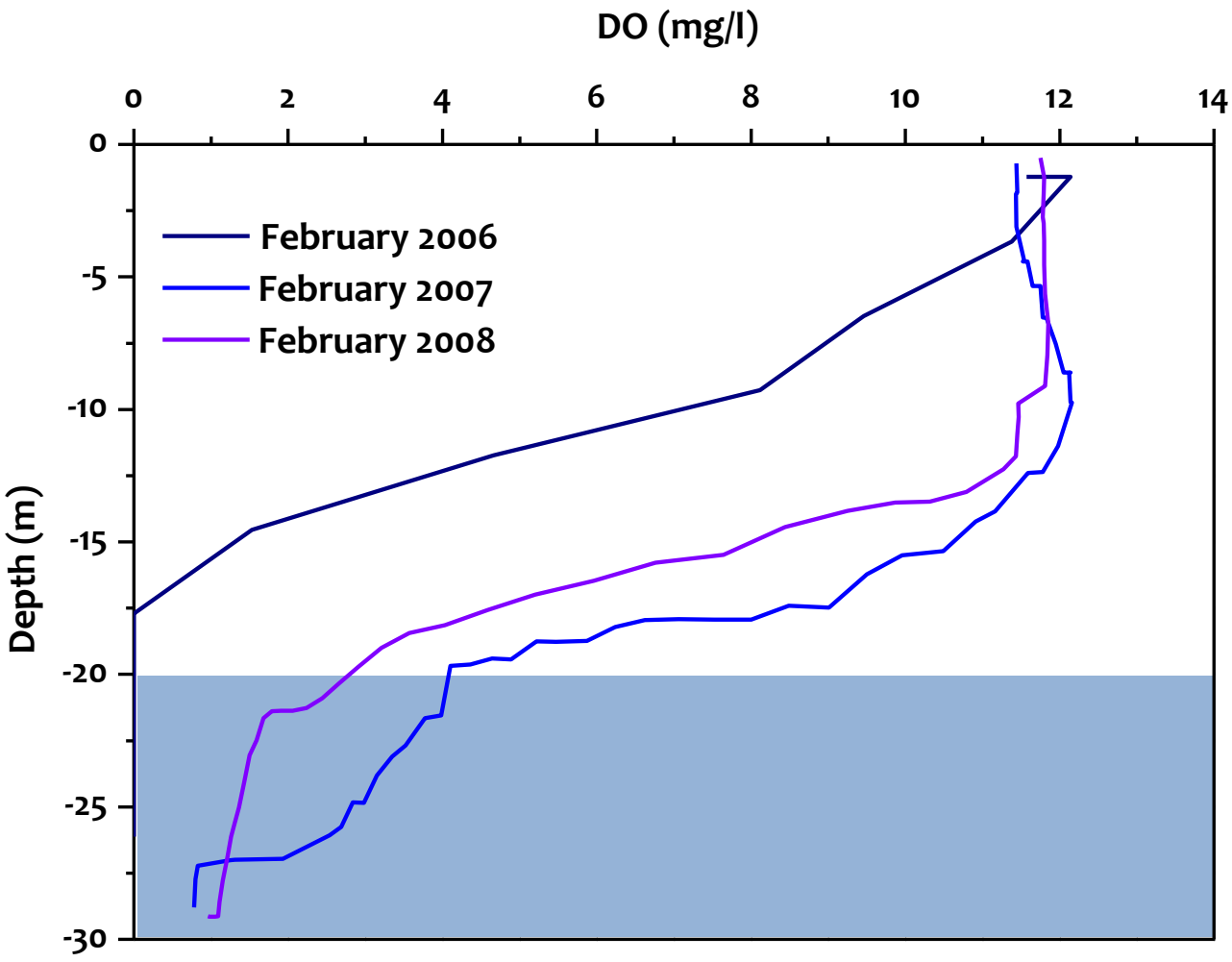
Daily mean wind speed and direction during the sampling period

Sill's dredging



30% increase in the cross section

Anoxia in Aitoliko lagoon



…… ……Conclusions…… ……

Aitoliko was reported as permanent anoxic lagoon up to 2004

Salty water inflow into Aitoliko lagoon was recorded during the sampling period and was correlated with monimolimnion oxygenation throughout the winter months

Meteorological conditions, prevailed during the sampling period, could not create strong water inflows into Aitoliko lagoon and consequently it was not the reason of the recorded alterations in the lagoon's water body anoxia

The limited deepening of the sill created mild increase of the water flow into the anoxic Aitoliko lagoon

This inflow of the saltier water, resulted in a weak mixing of the water column, introducing oxygen into the bottom water, without destroying the stratification

Aitoliko lagoon is referred as seasonal anoxic for first time