Ideas on Observing Eddies and Their Biogeochemical Functions

Cyclone C1 in 2004
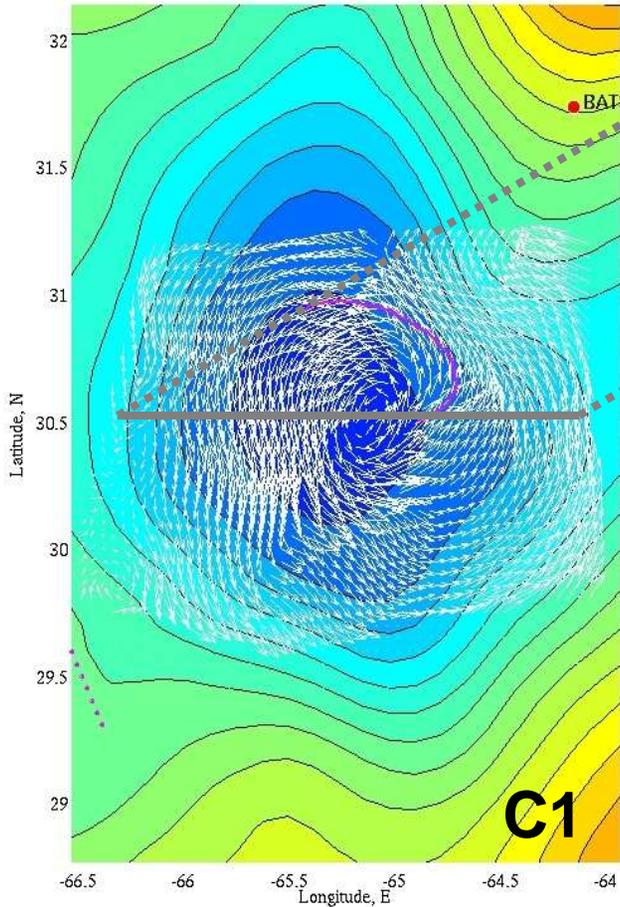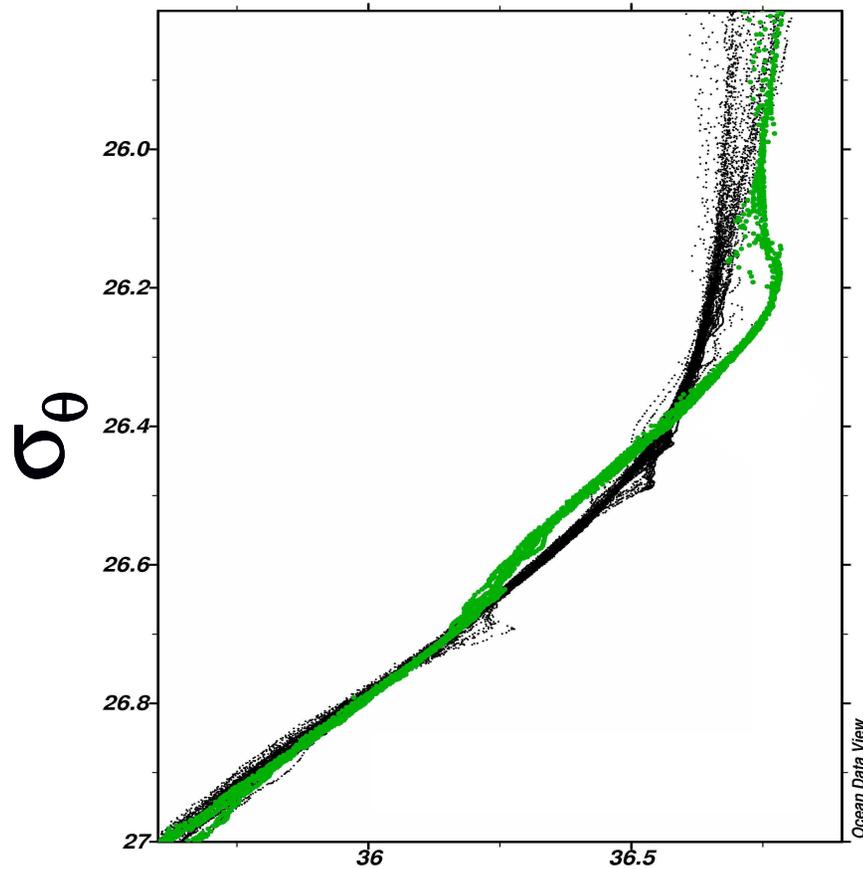

SLA and ADCP
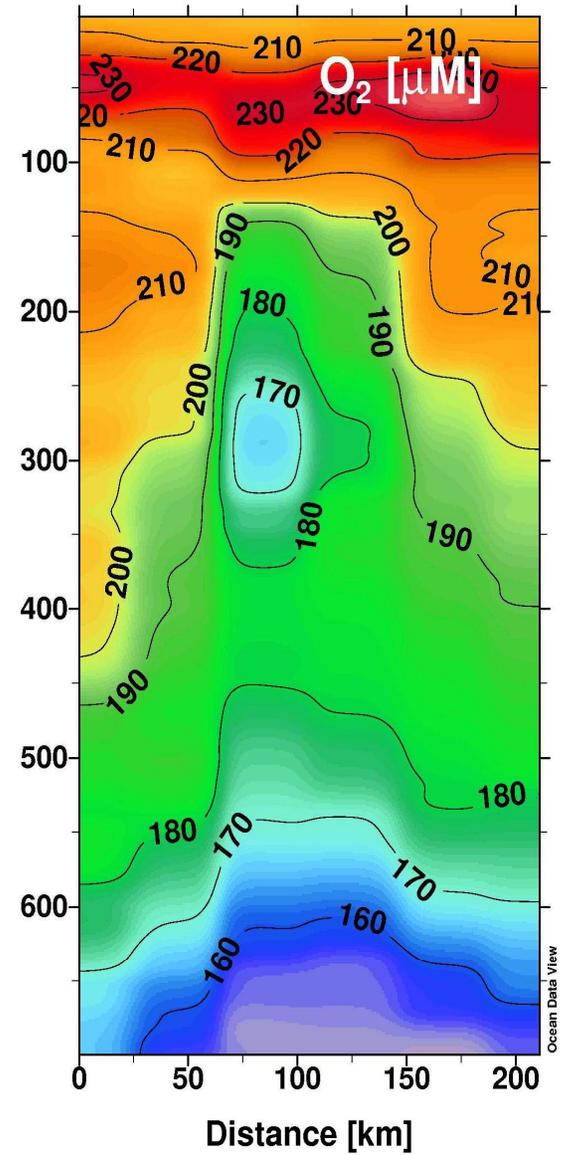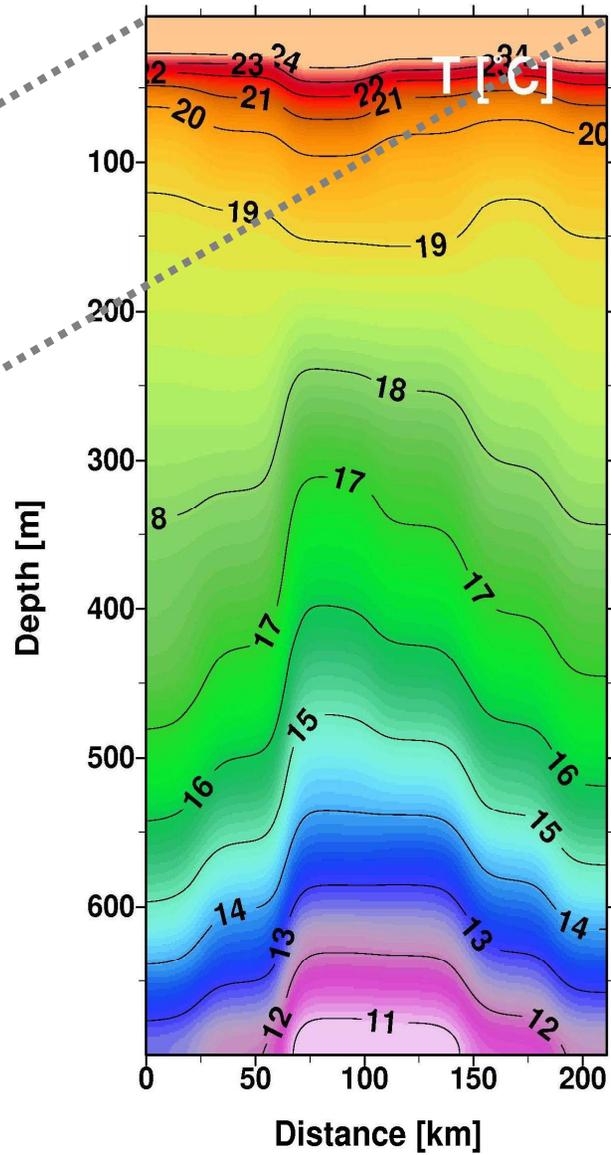
Hydro Section: 0-700m
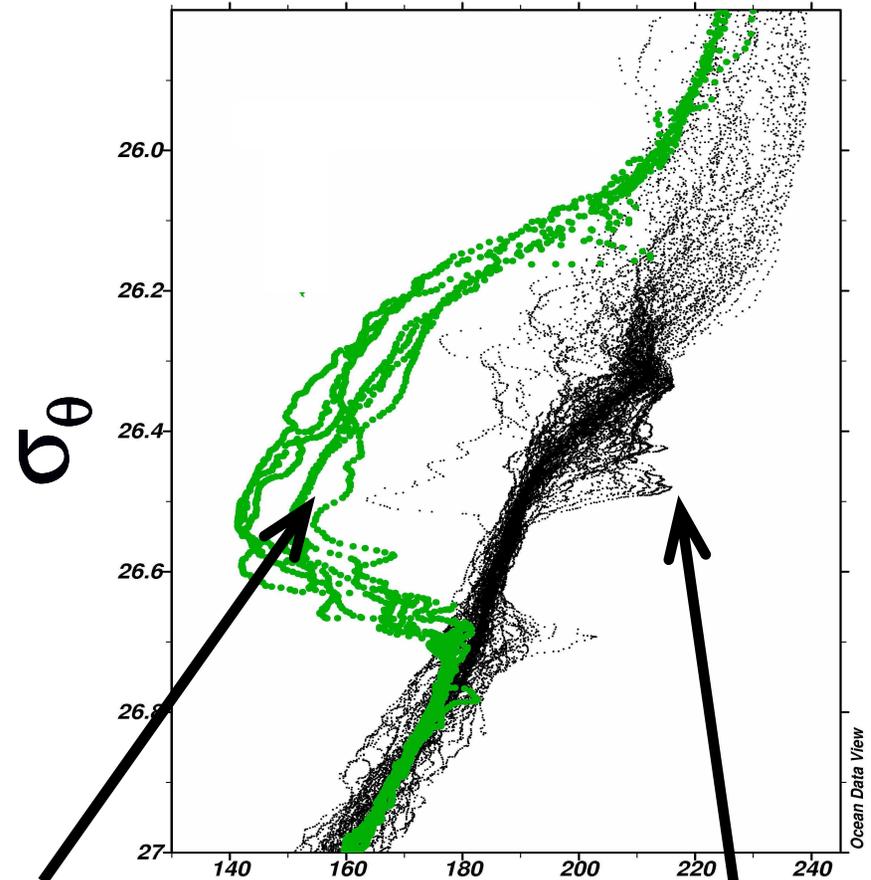
T/S and Oxygen Anomalies in the C1

Eddy Core
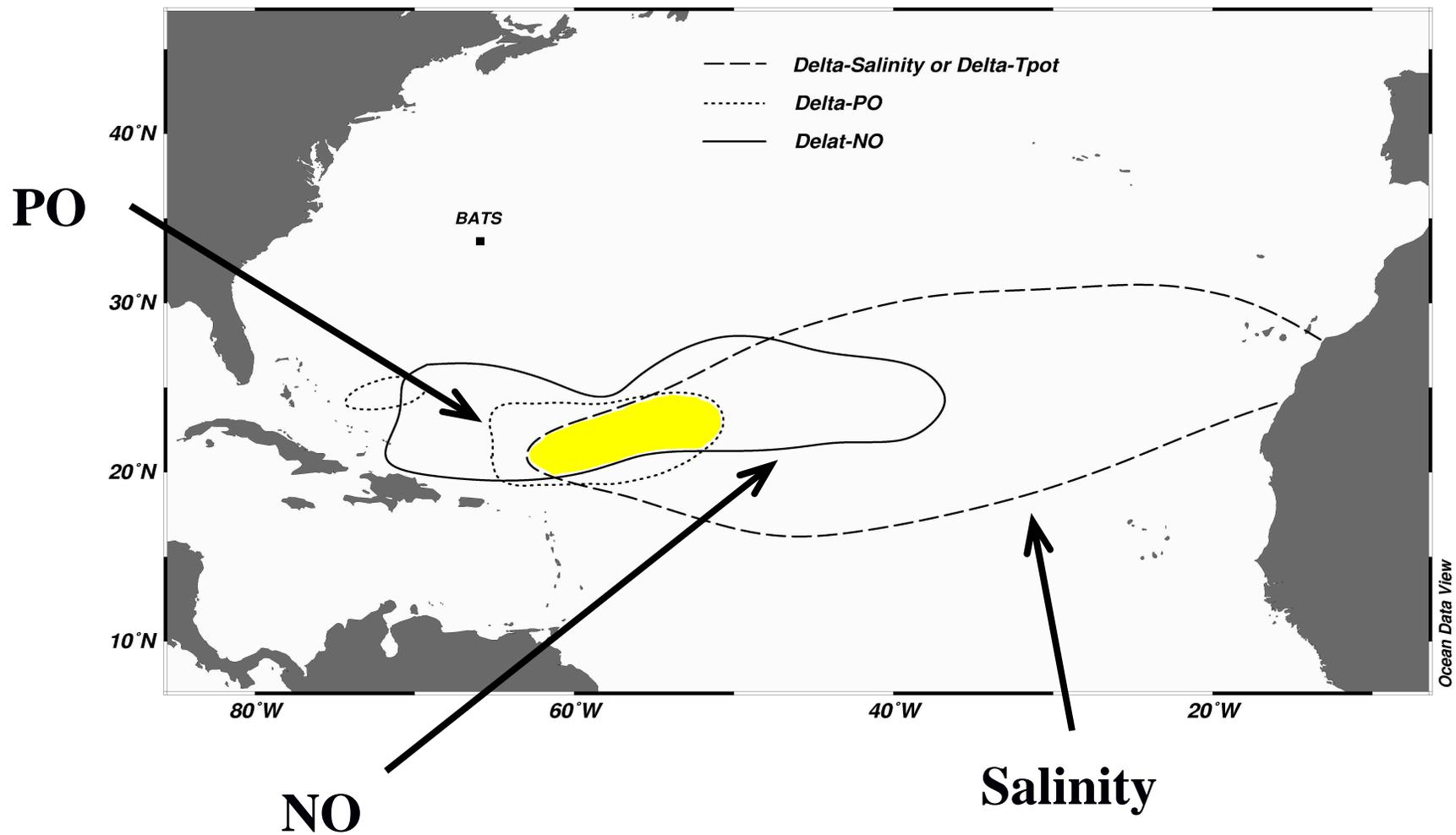
Survey 1

Outside Eddy

Overlay of multi-tracers at σ_θ of 26.2

T/S and Oxygen During 1st and 2nd Surveys
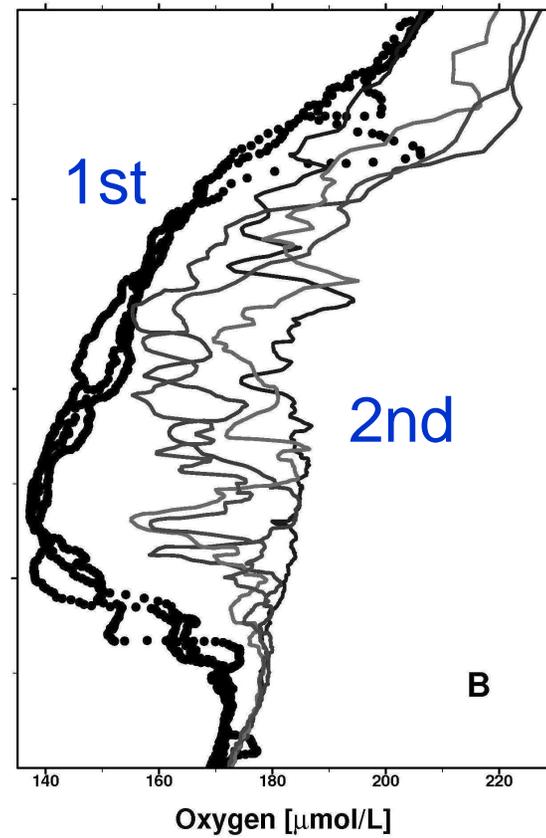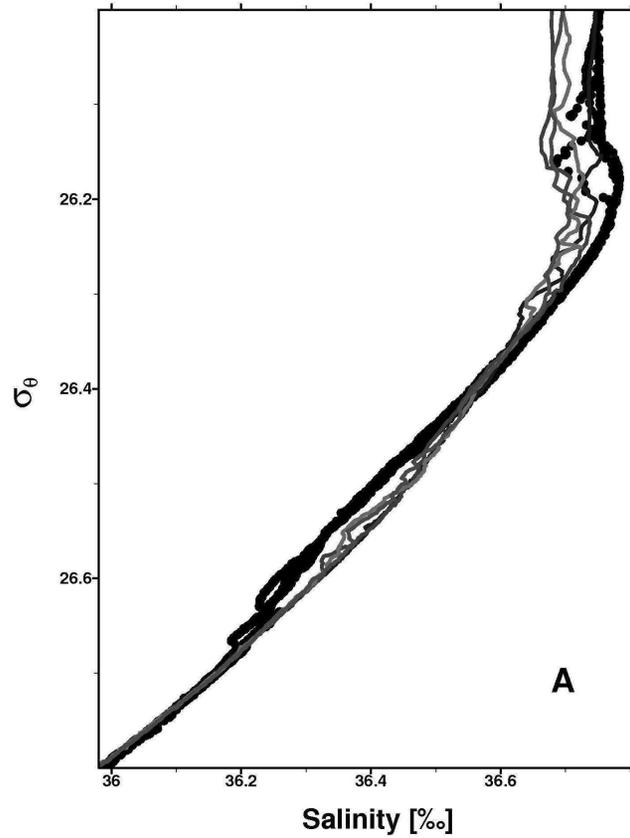
Eddy transport of AOU into the North Atlantic Subtropical Gyre

Gulf-stream / western boundary current

AOU

AOU

AOU

AOU
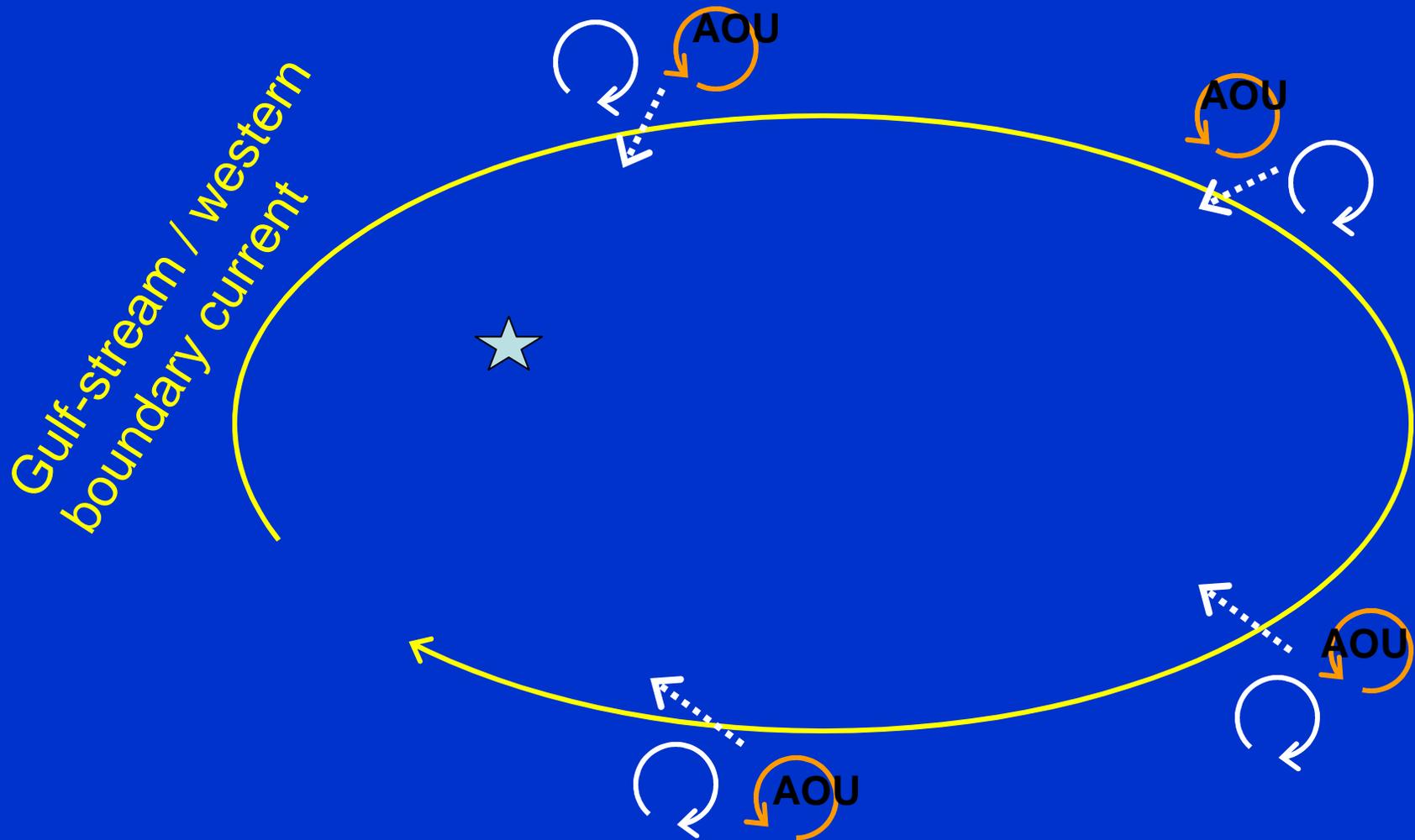
How does eddy impact the AOU and related New Production estimation?

Li and Jenkins, in progress

Drop packages
by aircraft

Intelligent
Enough?

The
"Dr. 'Strangelove'
McGillicuddy
Intelligent Deployment
Into An Eddy" Technique

MATHIS ET AL.: EDDY TRANSPORT IN THE ARCTIC OCEAN

Surface Layer Circulation

Mathis et al. (2007)

Cold Arctic air freezes seawater

Newly formed ice

Multiyear pack ice

Salt is released

Cold, fresh water

50 meters

Denser, salty water sinks

ARCTIC

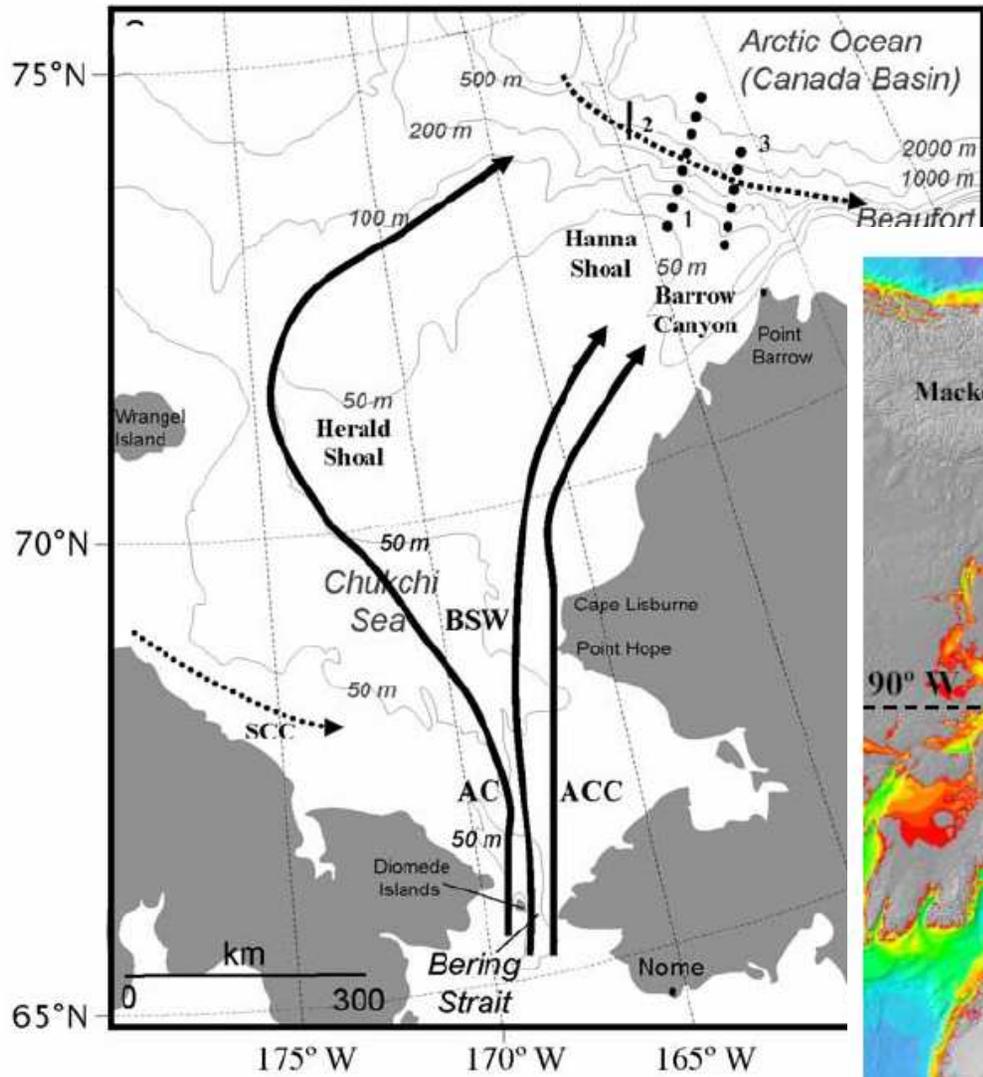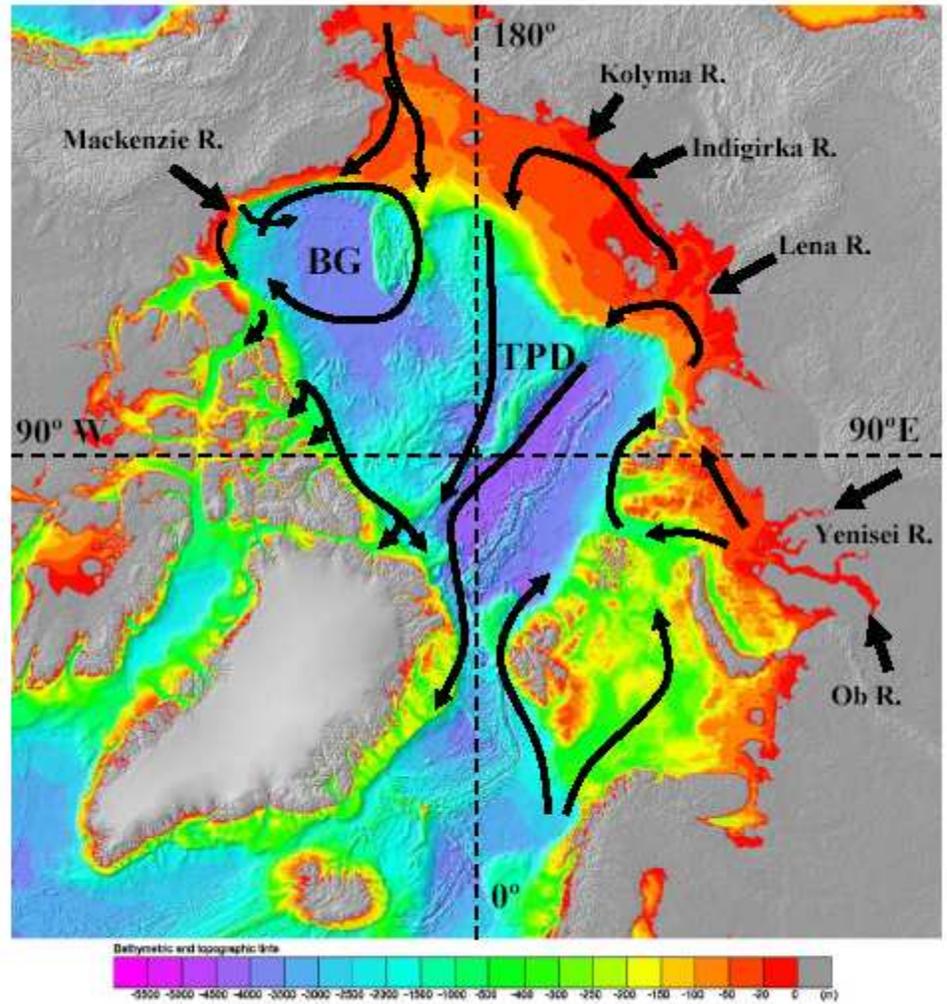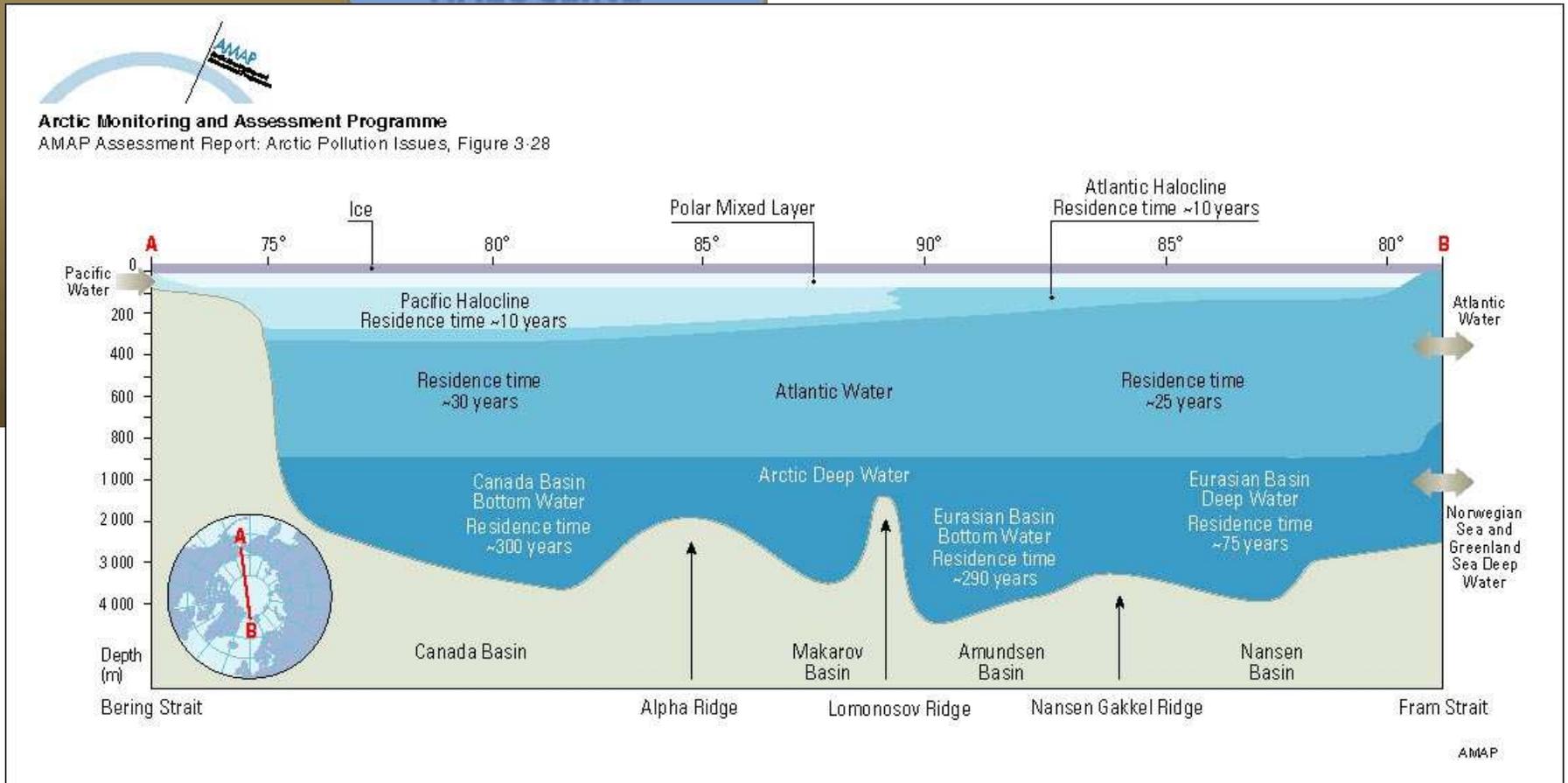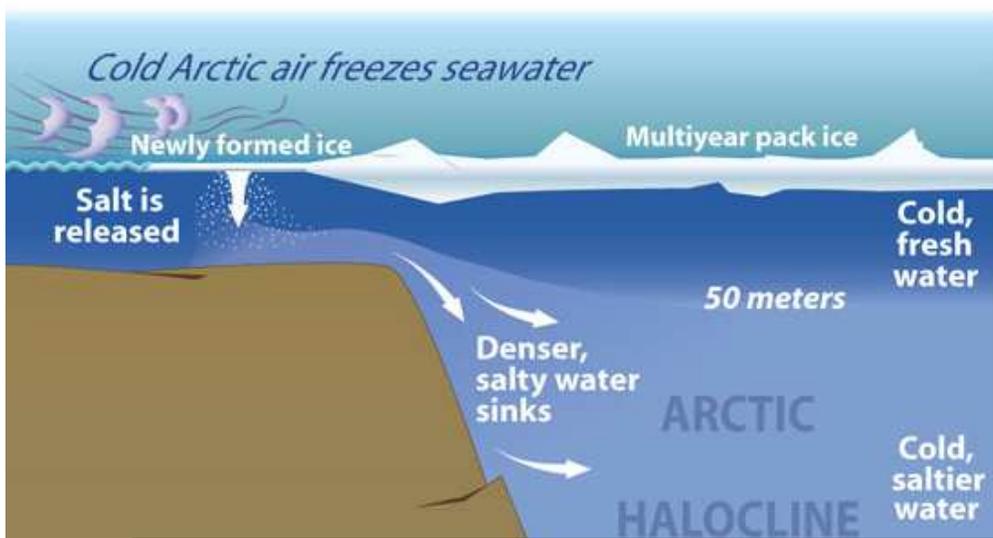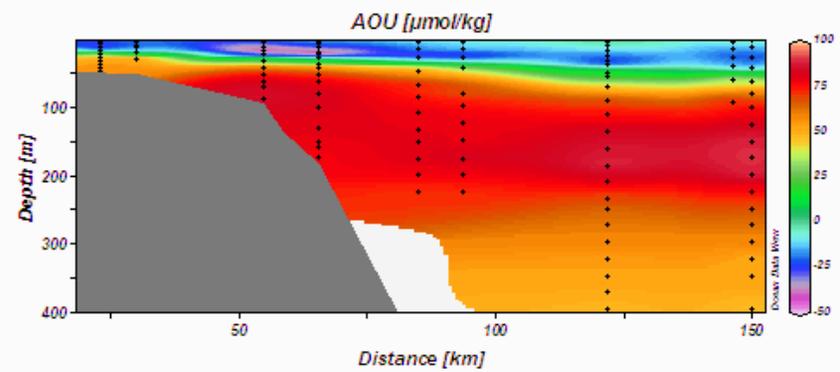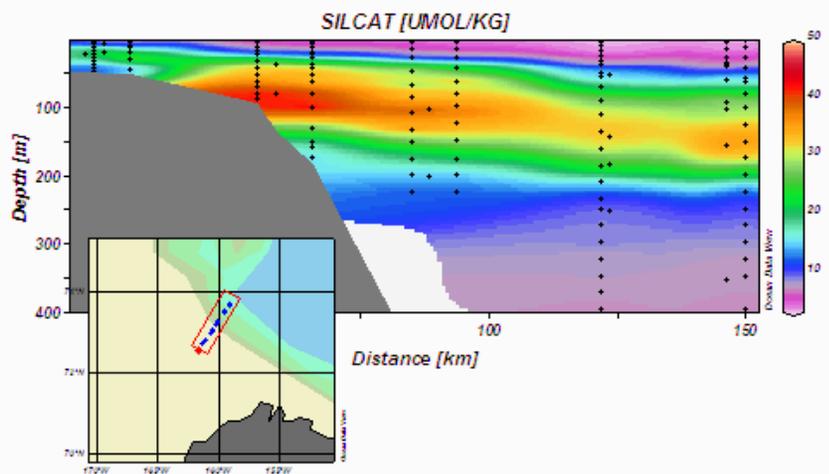Cold, saltier water

HALOCLINE

Arctic Monitoring and Assessment Programme
AMAP Assessment Report: Arctic Pollution Issues, Figure 3·28

Ice

Polar Mixed Layer

Atlantic Halocline
Residence time ~10 years

A   75°   80°   85°   90°   85°   80°   B

Pacific Water   0

Pacific Halocline
Residence time ~10 years

Atlantic Water

200

400

Residence time ~30 years

Atlantic Water

Residence time ~25 years

600

800

1 000

Canada Basin Bottom Water
Residence time ~300 years

Arctic Deep Water

Eurasian Basin Deep Water
Residence time ~75 years

2 000

Eurasian Basin Bottom Water
Residence time ~290 years

Norwegian Sea and Greenland Sea Deep Water

3 000

4 000

Depth (m)

Canada Basin

Makarov Basin

Amundsen Basin

Nansen Basin

Bering Strait

Alpha Ridge

Lomonosov Ridge

Nansen Gakkel Ridge

Fram Strait

Atlantic Water

AMAP

SBI Project
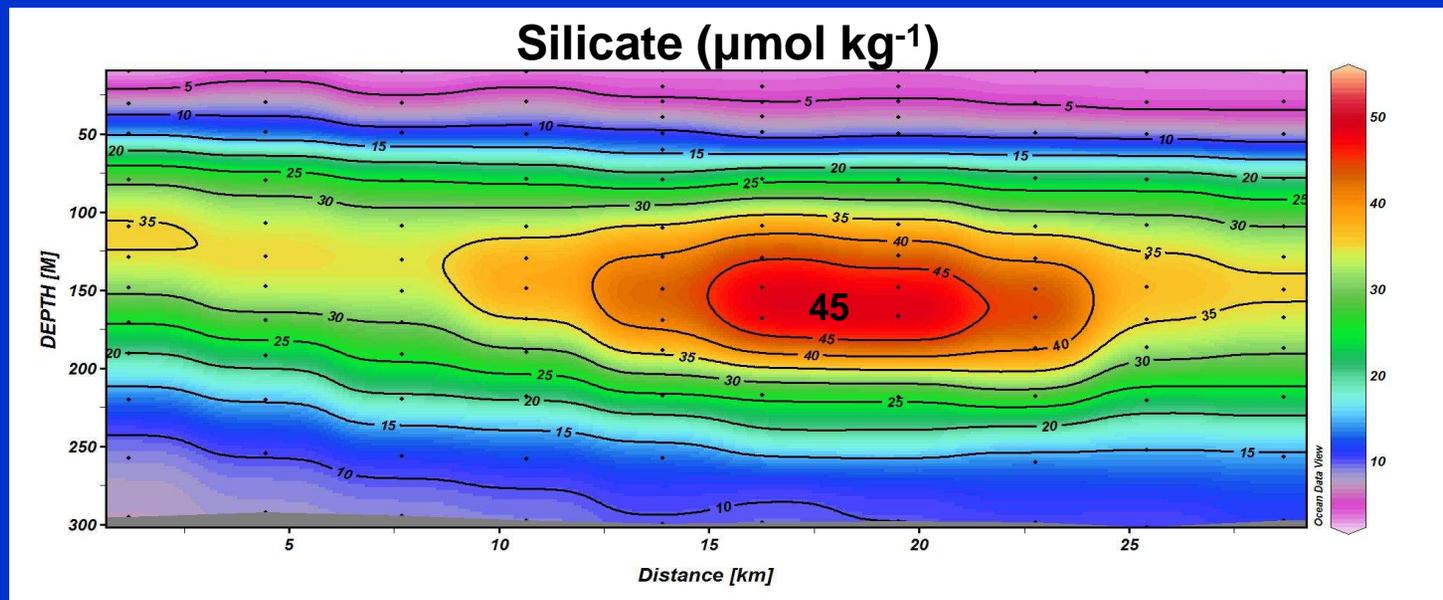# Summer 2002
Chukchi Shelf Break
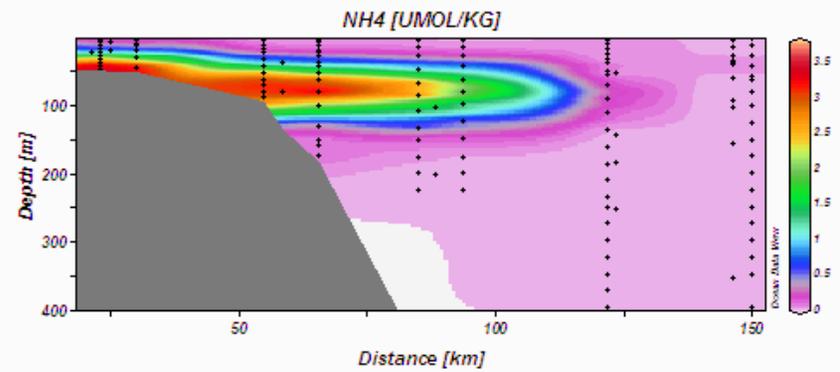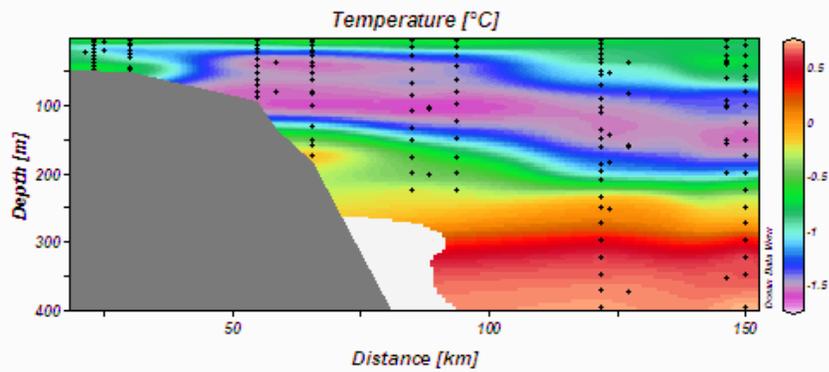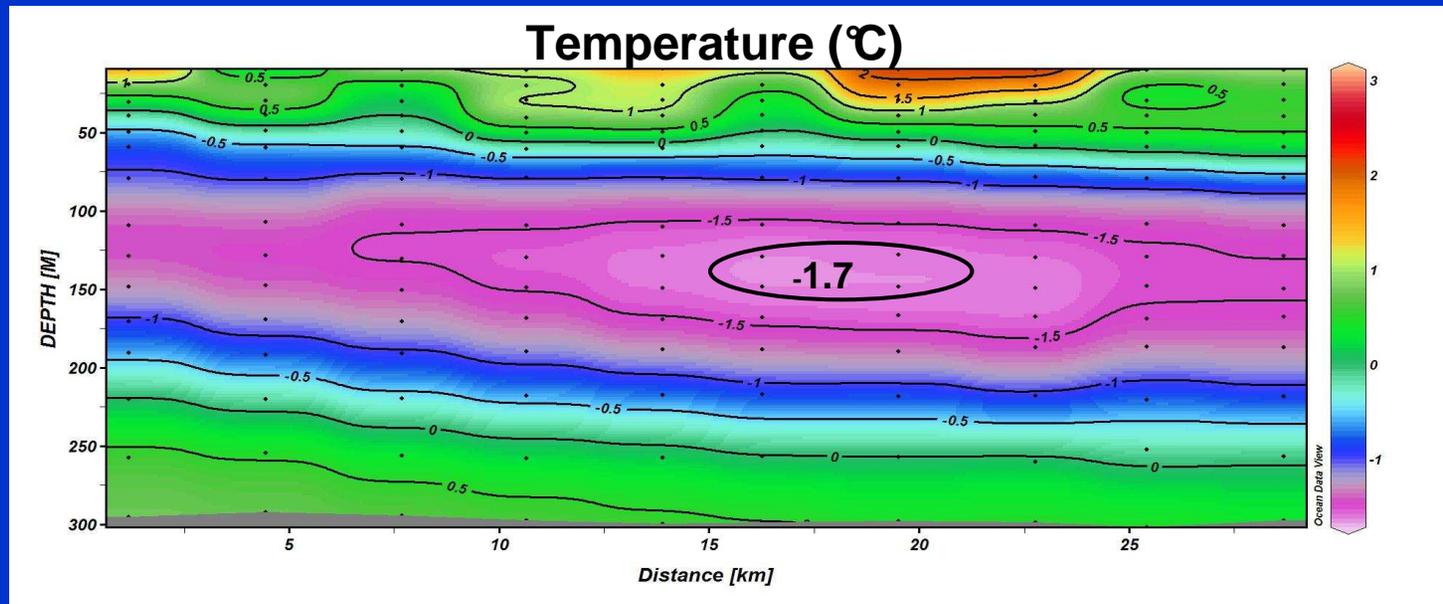
Region of Eddy Formation
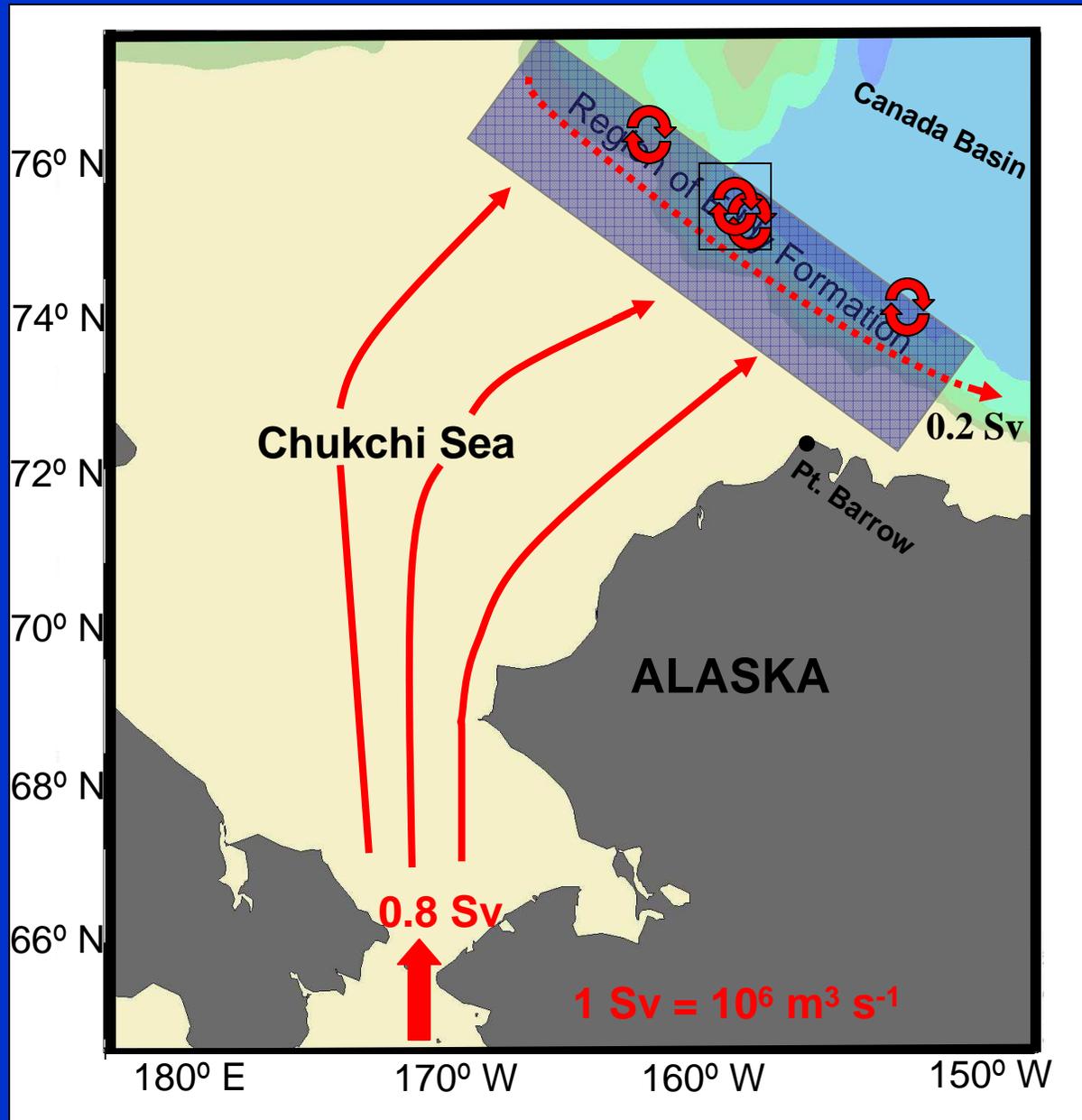
• **The eastward flowing current has been shown to be unstable and capable of generating subsurface eddies that transport water from the current offshore.**

Canada Basin

Region of Eddy Formation

Chukchi Sea

0.2 Sv

Pt. Barrow

ALASKA

0.8 Sv

$1 \text{ Sv} = 10^6 \text{ m}^3 \text{ s}^{-1}$

76° N
74° N
72° N
70° N
68° N
66° N

180° E
170° W
160° W
150° W

EDDY CORE PROPERTIES

Temperature (°C)

Silicate (µmol kg⁻¹)

Particulate Organic Carbon

POC [ug/L]
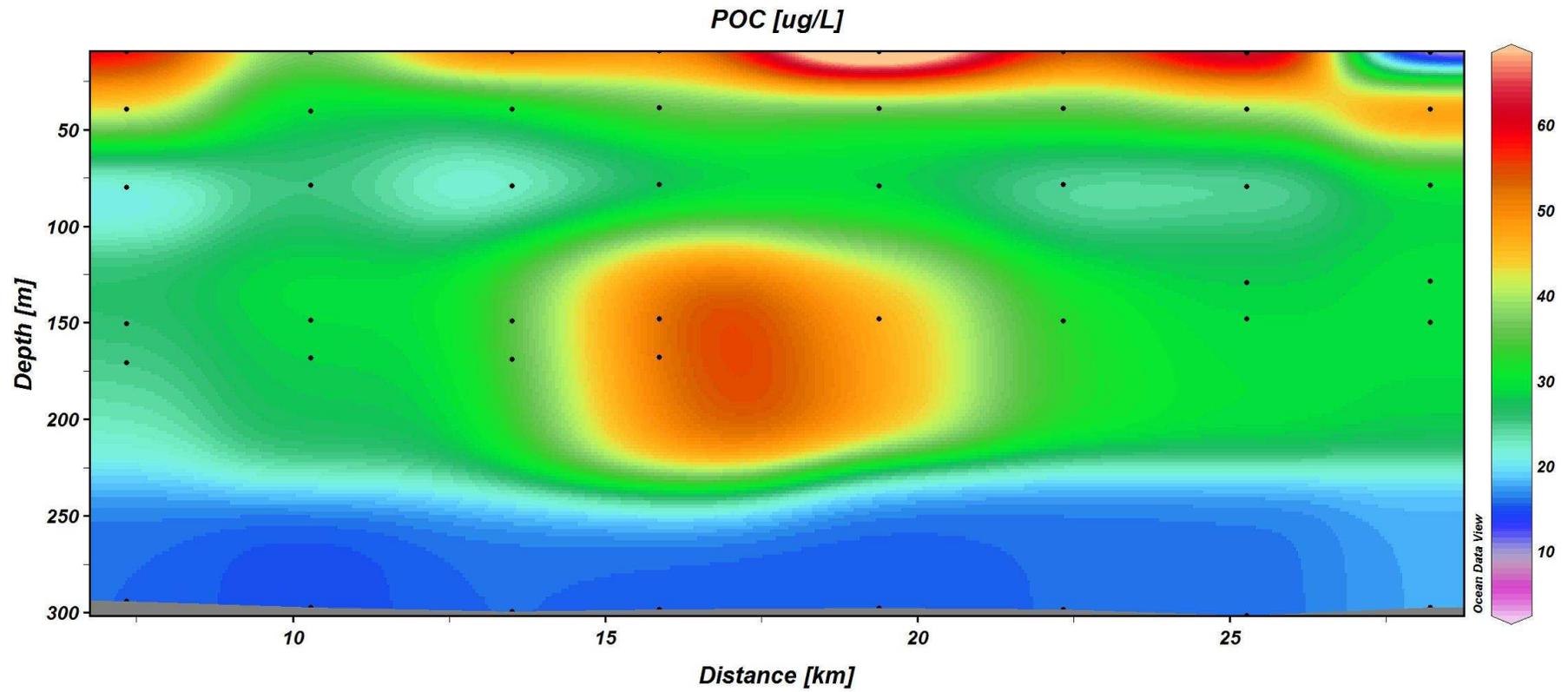
Organic Carbon and Oxygen Utilization

Canada Basin

Chukchi Shelf

Vertical Export Production

Horizontal Export from Eddies

4.2×10^{10} **mole-C yr^{-1}**

4.6×10^{10} **mole-C yr^{-1}**

zone of low DO due to remineralizarion

- Rates of vertical export production estimated from O_2 utilization in the halocline should be considered too high.

Eddies

- Can we catch an eddy at formation?

- We can observe them after formation, so we can observe their role in horizontal transport and contribution to export production signatures in the mesopelagic