Tactical Oceanography

FRONTS AND EDDIES

FRONTS AND EDDIES

"There is a river in the ocean."

- LT Matthew Fontaine Maury,
discussing the Gulf Stream
1806 - 1873

Topic Learning Objectives

* State the characteristics of fronts and eddies in accordance with Fleet Oceanographic and Acoustic Reference Manual (RP-33).

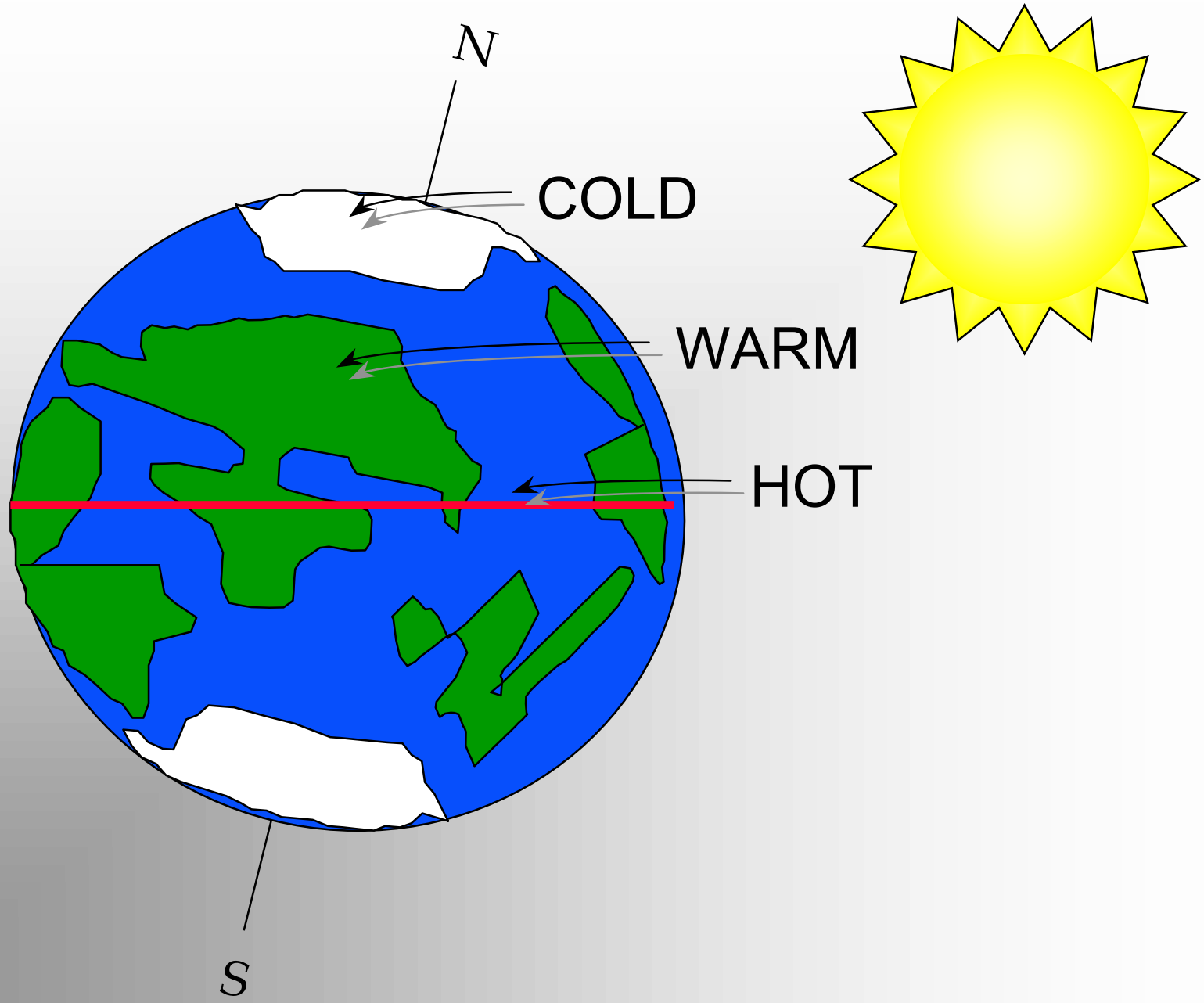
* Identify the effects of fronts and eddies in accordance with Fleet Oceanographic and Acoustic Reference Manual (RP-33).

References:

RP-33, Fleet Oceanographic and Acoustic Reference Manual
NWP 3-59.1, Tactical Use of the Ocean Environment

Ocean Fronts & Eddies

- Definition of Ocean Fronts/ Eddies
- Tactical Significance
- Support Products
- Search Tactics


N
COLD
WARM
HOT
S

Ocean Fronts
Definition

- Boundary between two distinct water masses.
- Narrow region of rapidly changing Temperature, Salinity, Sound Speed.
- Sharp changes in Sonic Layer, Sound Channel Axis, Critical Depths.

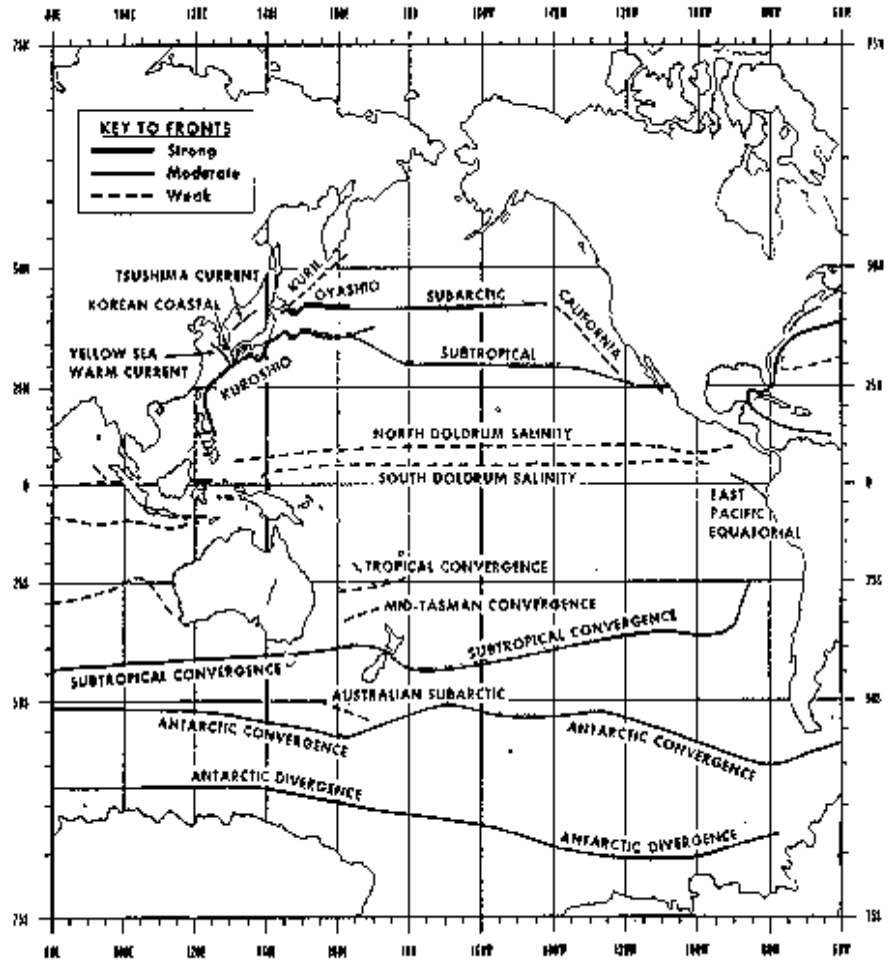
Ocean Fronts

Description

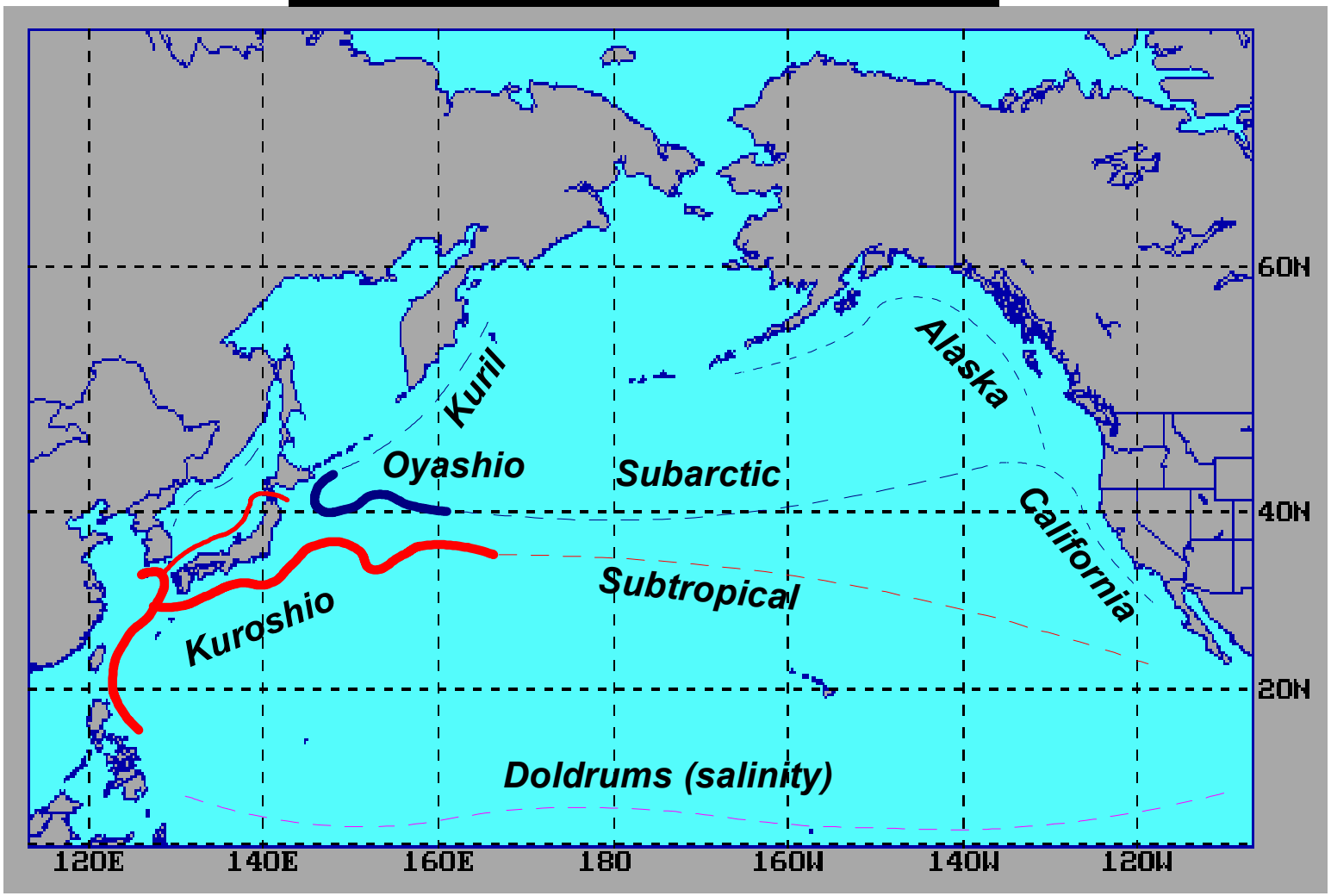
Feature	Strong Front	Weak Front
Sea Surface Temp	10 - 15 °F	1 - 5 °F
Surface Sound Speed	50 - 100 ft/s	5 - 30 ft/s
Sonic Layer Depth	300 - 600 ft	50 - 100 ft
Sound Channel Axis	2000 - 3000 ft	200 - 300 ft
Duration	All year	Seasonal

Note: SST, SS, SLD, SCA changes are per 60 NM

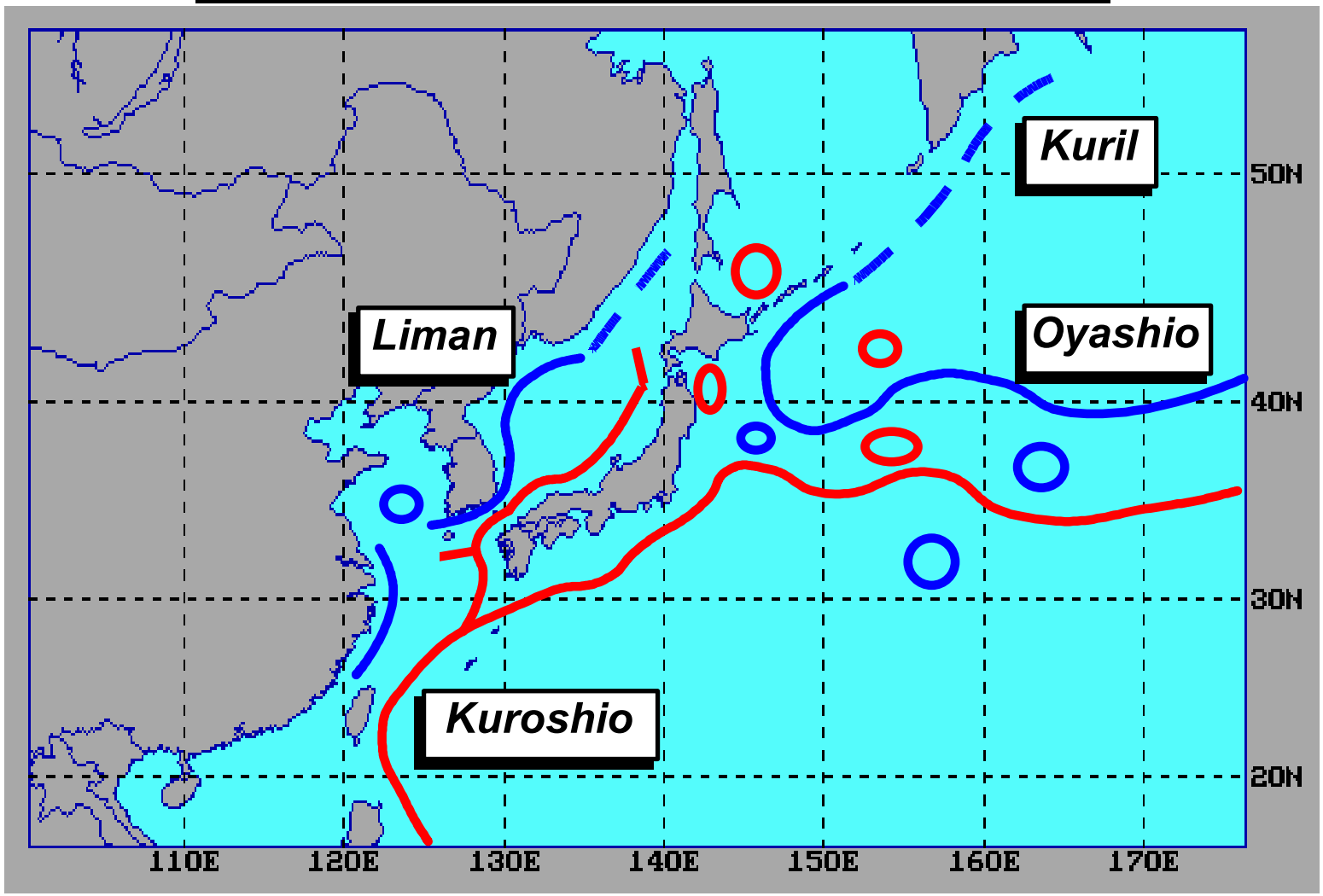
Mean Positions of Pacific Fronts



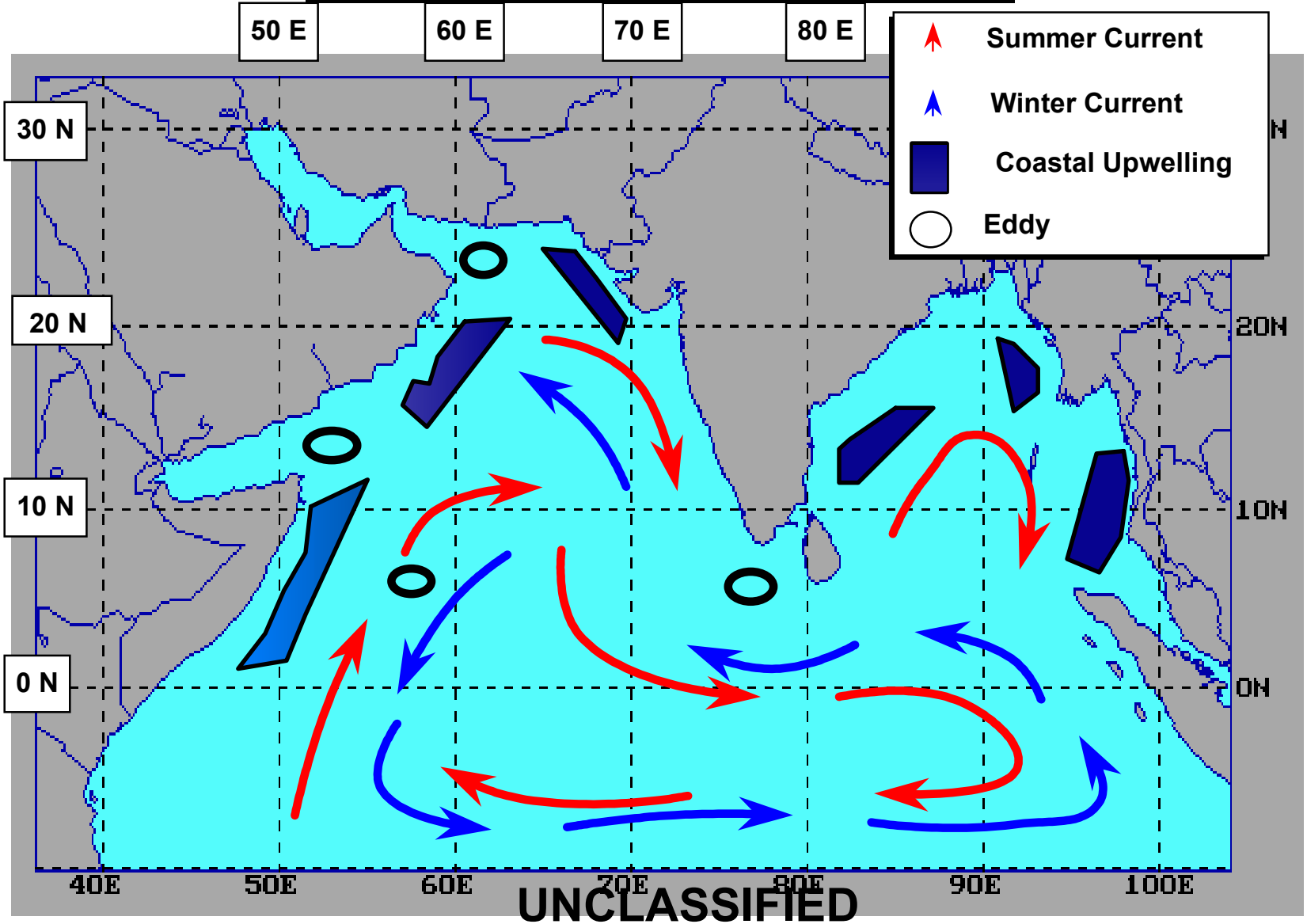
Pacific Ocean Fronts

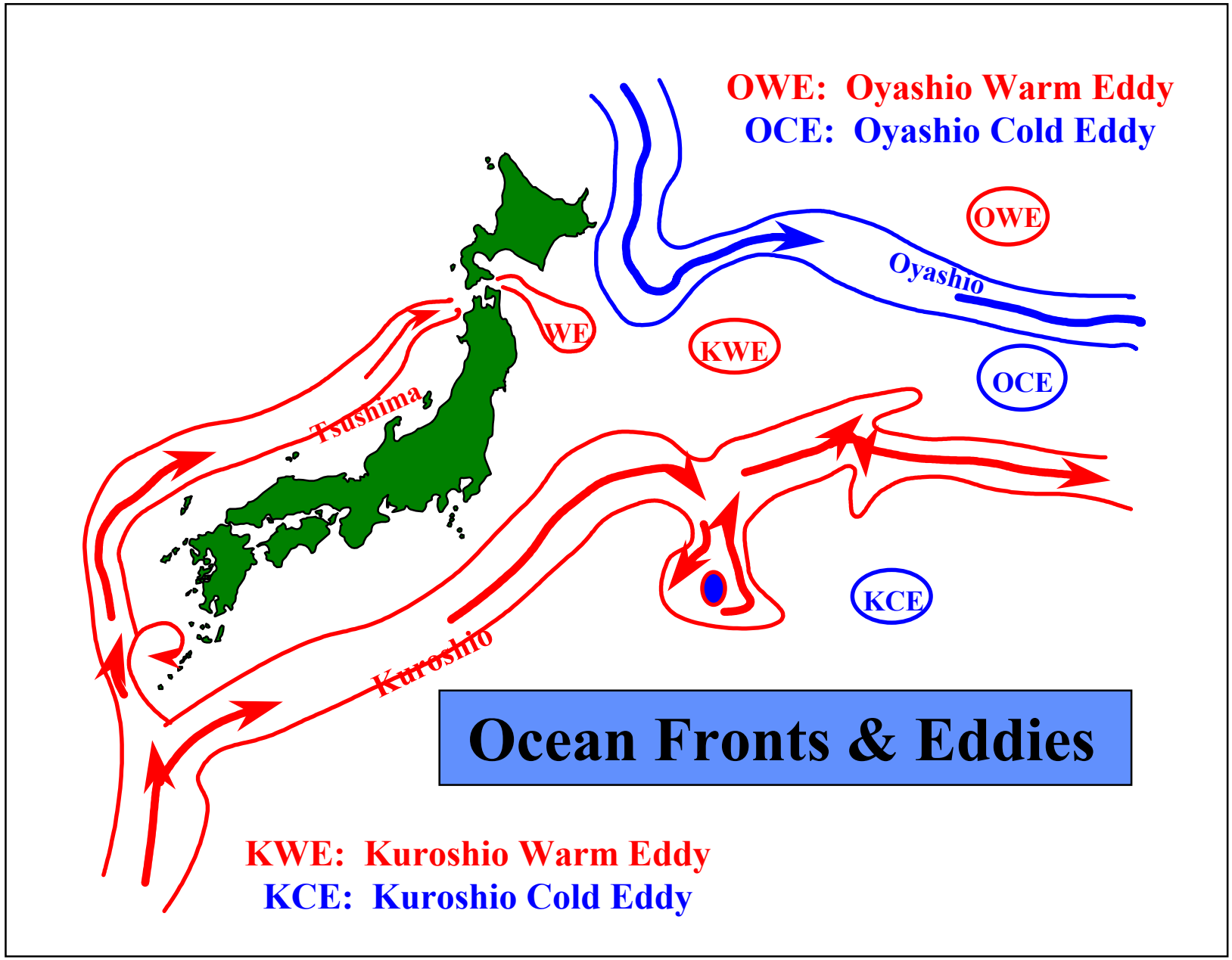


WESTPAC Fronts & Eddies

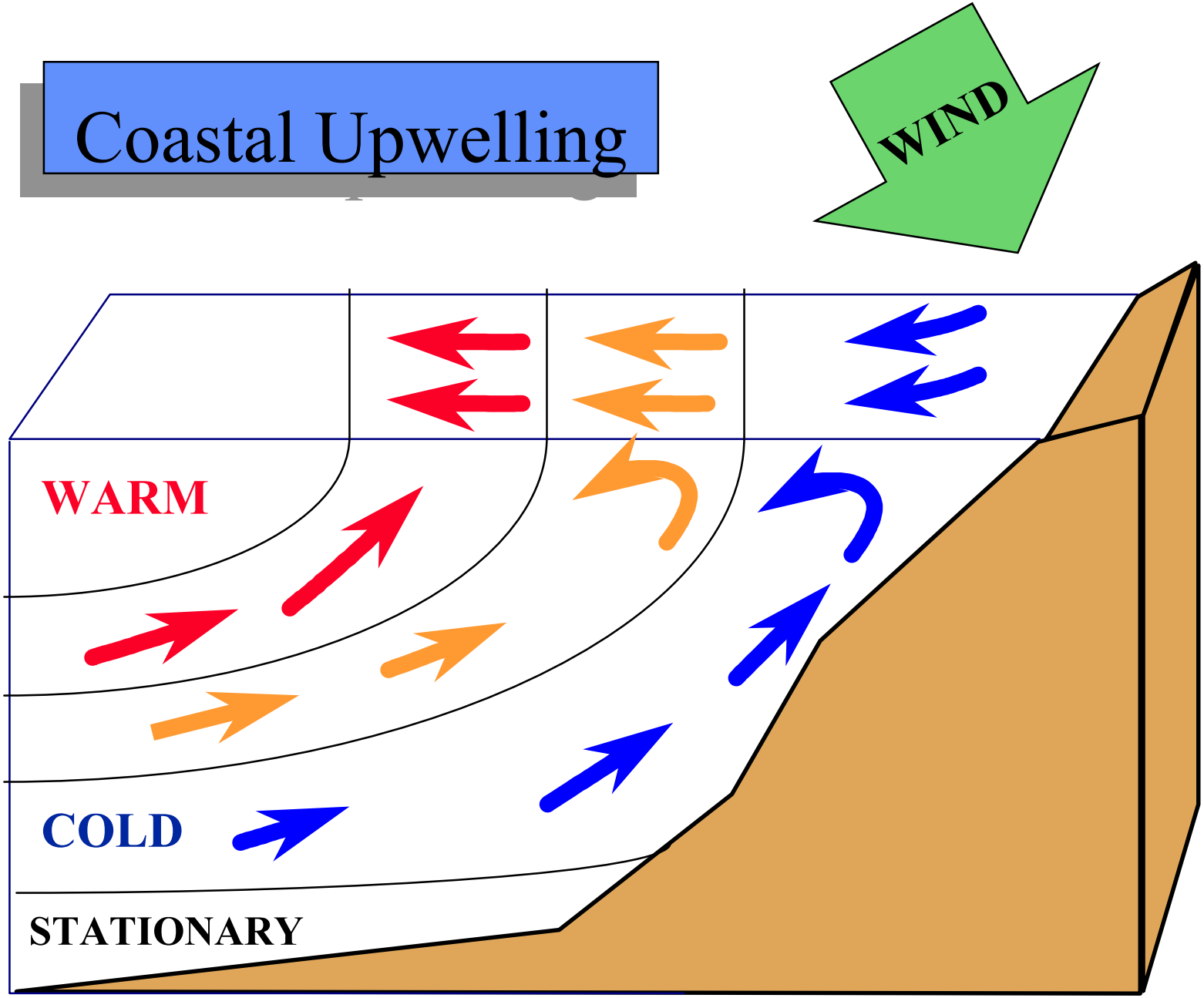


Indian Ocean Fronts



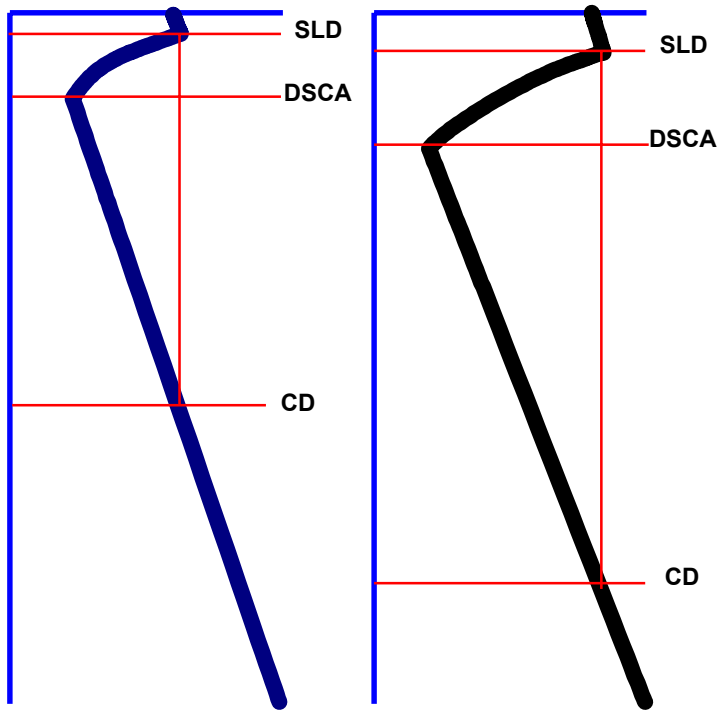

OWE: Oyashio Warm Eddy
OCE: Oyashio Cold Eddy
OWE
Oyashio
WE
KWE
OCE
Tsushima
KCE
Kuroshio
Ocean Fronts & Eddies
KWE: Kuroshio Warm Eddy
KCE: Kuroshio Cold Eddy

Coastal Upwelling



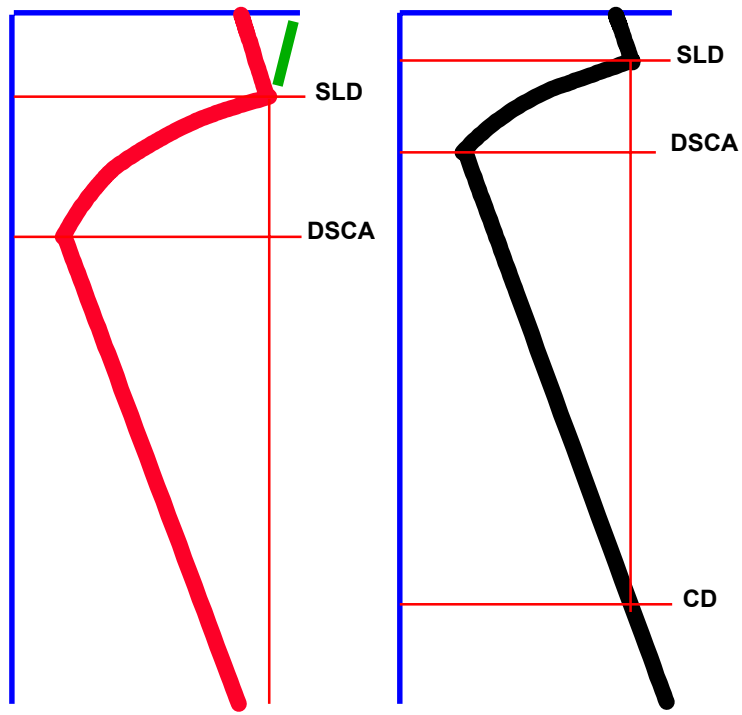
Ocean Eddies

Cold Core Eddy



Core SVP Outside SVP

Warm Core Eddy



Core SVP Outside SVP

Ocean Eddies
Physical Features

Feature	Cold Core Eddy	Warm Core Eddy
Size	100 - 200 NM	75 - 150 NM
Rotation	Counterclockwise	Clockwise
Duration	1 - 2 Yrs	6 - 9 Mos
SLD		
Winter	Shallow	Deep
Summer	Shallow	Shallow
DSCA	Shallow	Deep
Horiz Refraction	Convergent	Divergent

Ocean Fronts
Tactical Significance

SST/SVP Variability:

- Altered propagation paths.
- Increased propagation loss.
- Increased horizontal bearing error.
- Formation of Shallow Sound Channels.
- Sharp sea state and weather changes.
- Range–independent APPs inaccurate.

THE NORTH WALL EFFECT

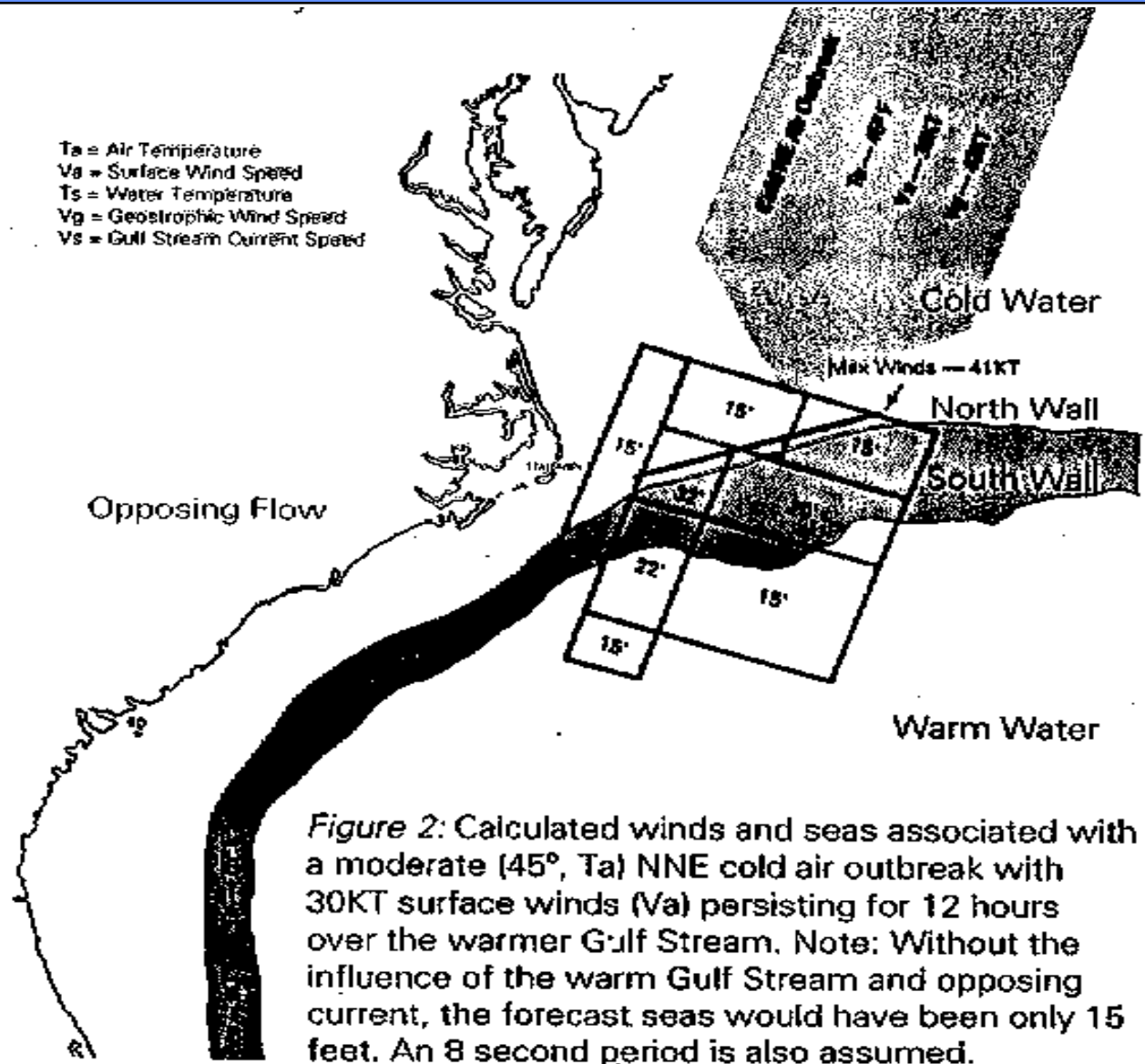


Figure 2: Calculated winds and seas associated with a moderate (45°, Ta) NNE cold air outbreak with 30KT surface winds (Va) persisting for 12 hours over the warmer Gulf Stream. Note: Without the influence of the warm Gulf Stream and opposing current, the forecast seas would have been only 15 feet. An 8 second period is also assumed.

Ocean Fronts
Tactical Significance

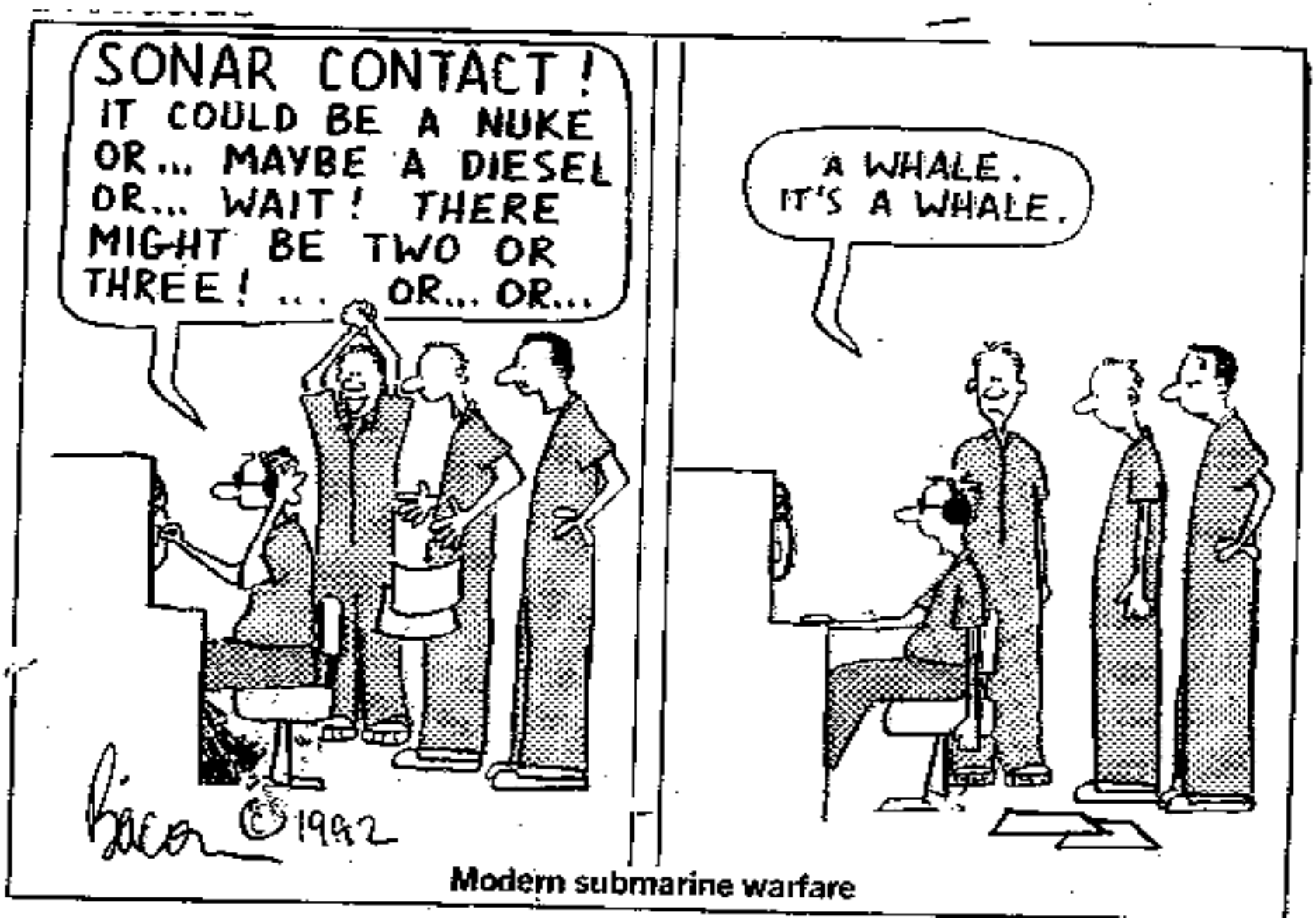
Increased Biologics:

- Increased ambient noise.
- Increased reverberation levels.
- Increased false targets.
- Increased platform/sensor fouling.
- Enhanced bioluminesence.

Sound Producers and False Targets

Animal	Sound Description	Frequency Range (Hz)	SPL (dB)
Snapping Shrimp	Crackling, snaps	200 - 6000	154
Fish	Thumps, knocks	50 - 4800	156
Porpoises and	Clicks	40 - 170,000	222
Dolphins	Whistles, squeals	200 - 40,000	125
Baleen Whales	Moans	15 - 200	189
	Stanzas, songs	20 - 8000	184
Toothed Whales	Clicks	200 - 35,000	184
	Whistles	500 - 9,000	160

Modern Submarine Warfare



Ocean Fronts
Tactical Significance

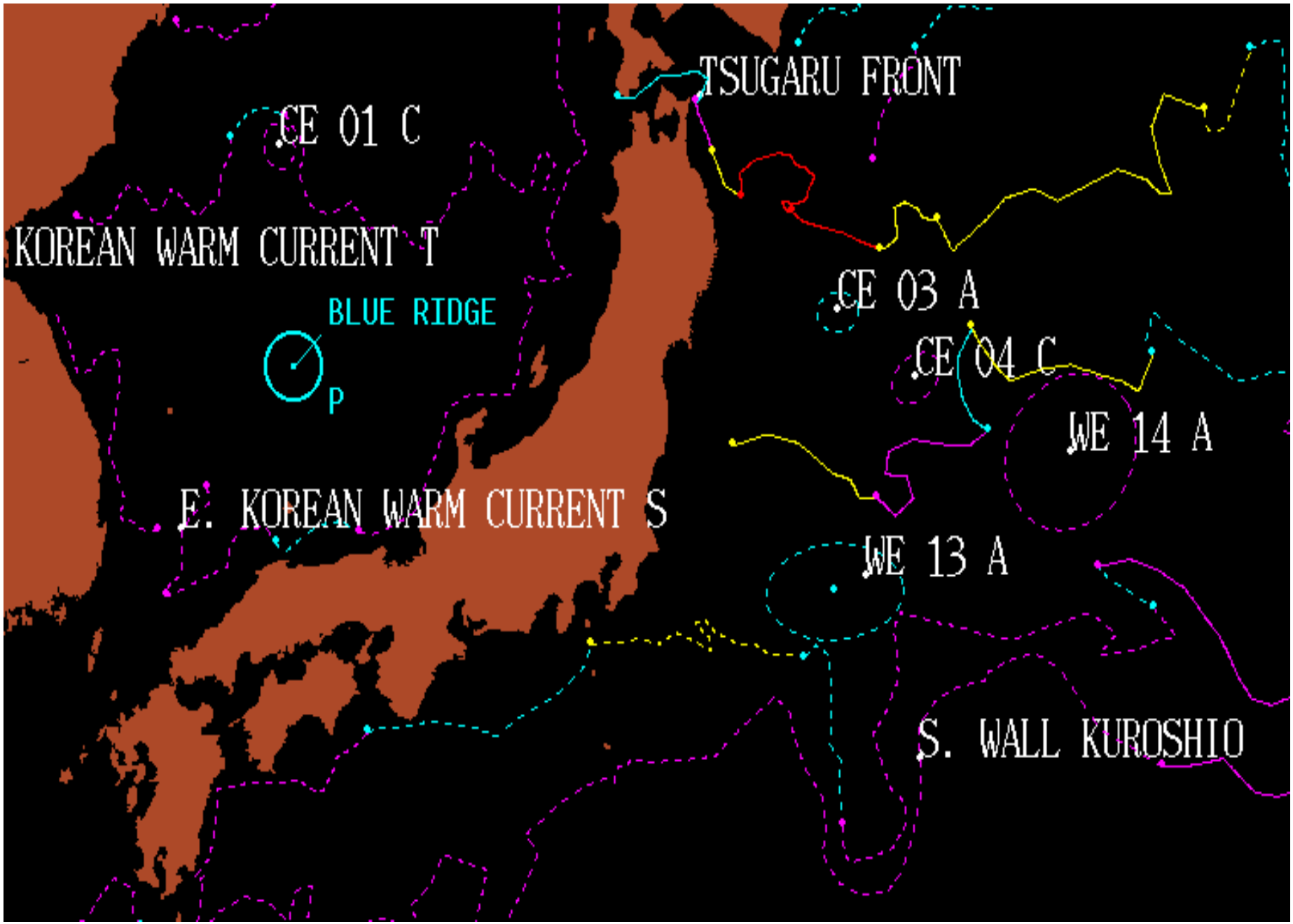
Current Effects:

- Current induced doppler.
- Platform set and drift.
- Sensor misalignment: bearing error.
- Degradation of sonobuoy pattern integrity.
- Increased ambient noise.
- Increased commercial shipping.

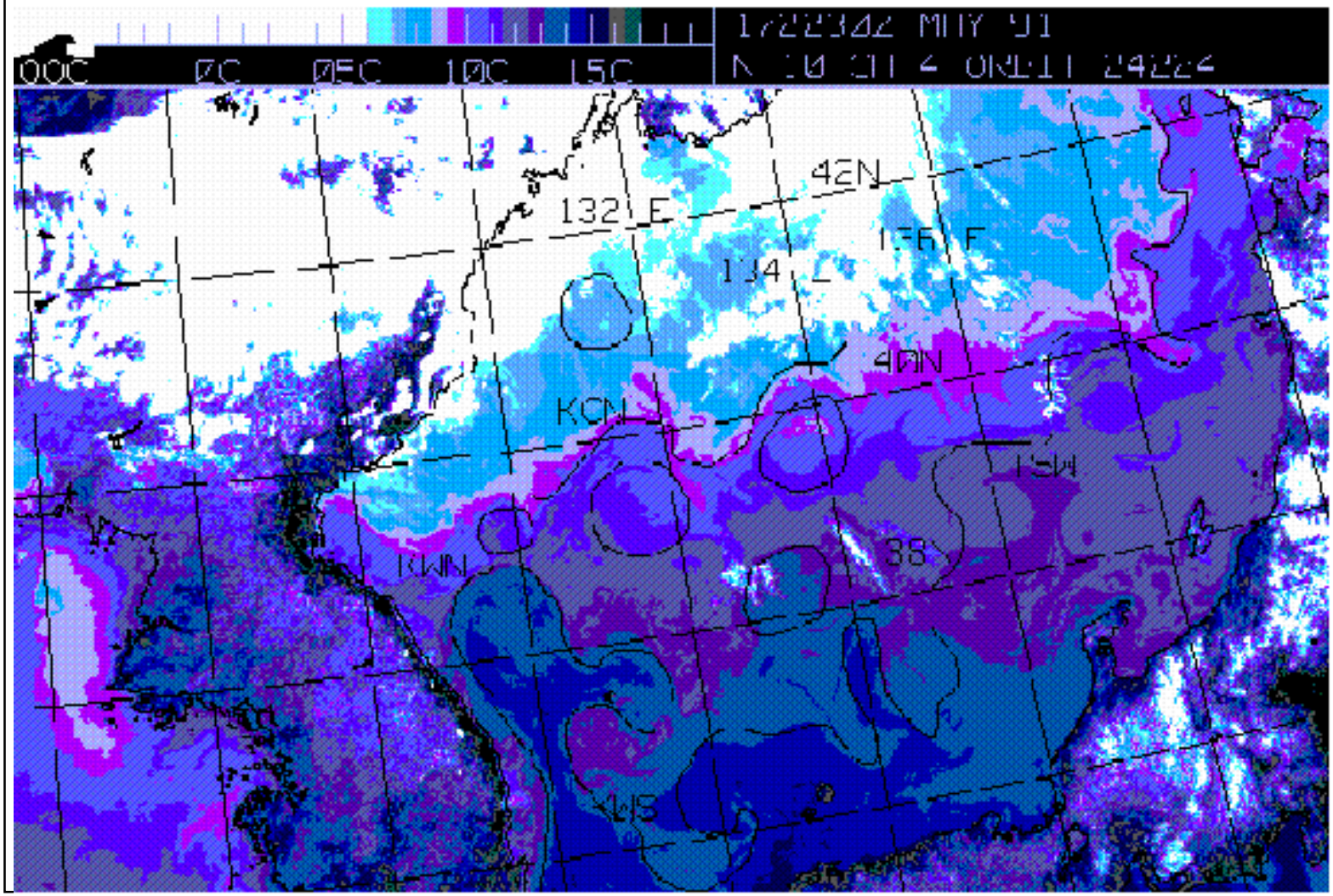
Ocean Fronts & Eddies

Support Products

- *JMCIS:* Fronts & Eddies overlay graphic.
  * Found in the Ocean/Met overlay file.
- *NAVPACMETOCCEN* FREDDIE message.
- *NAVOCEANO PICS:*
  * Enhanced 3D composite Temperature graphic
- *CV OA Division / Mobile Environmental Team:*
  * Analyzed XBT data.
  * Range-dependent acoustic predictions.
  * Enhanced satellite imagery.


TSUGARU FRONT
CE 01 C
KOREAN WARM CURRENT T
BLUE RIDGE
P
CE 03 A
CE 04 C
WE 14 A
E. KOREAN WARM CURRENT S
WE 13 A
S. WALL KUROSHIO

Enhanced Infrared (IR) Satellite Imagery



Ocean Fronts & Eddies
Search Tactics

- **Determine Fronts and Eddies locations:**
  - Climo Pub - Seasonal/Monthly
  - JMCIS Overlay - 3 days
  - Sample - On Scene
- **Conduct frequent water sampling:**
  - coordinated AXBT/SXBT drops.
  - AN/LE measurements.
- **Determine acoustic perfomance:**
  - use range-dependent PROPLOSS.
  - frequently update FOM (AN variability).

OCEAN FRONTS & EDDIES

Search Tactics (cont)

- **Target location unknown:** search cold side first
  - ⇒Generally _____
  - ⇒potential for _____
- **Target location known:** search same side.
  - ⇒minimize _____
  - ⇒place sensor _____
  - ⇒exploit _____
  - ⇒exploit _____

OCEAN FRONTS & EDDIES

Search Tactics (cont)

- **Towed Array placement:**
  - ⇒**Tow _____**
  - ⇒**Place array _____**
- **Sonobuoys:**
  - ⇒**Select short _____**
  - ⇒**Drop _____**
  - ⇒**Use _____**

OCEAN FRONTS & EDDIES

Avoidance Tactics

- **Utilize _____**
- **Exploit _____**
- **Place multiple _____**
- **Place _____**
- **Place _____**