DRAGONESS WP1

Review of in-situ observing system Activity Report 2009

September

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1. Marine Observing Station

2. Marine Buoy

3. ARGO

4. Marine Survey Ship

5. Glider

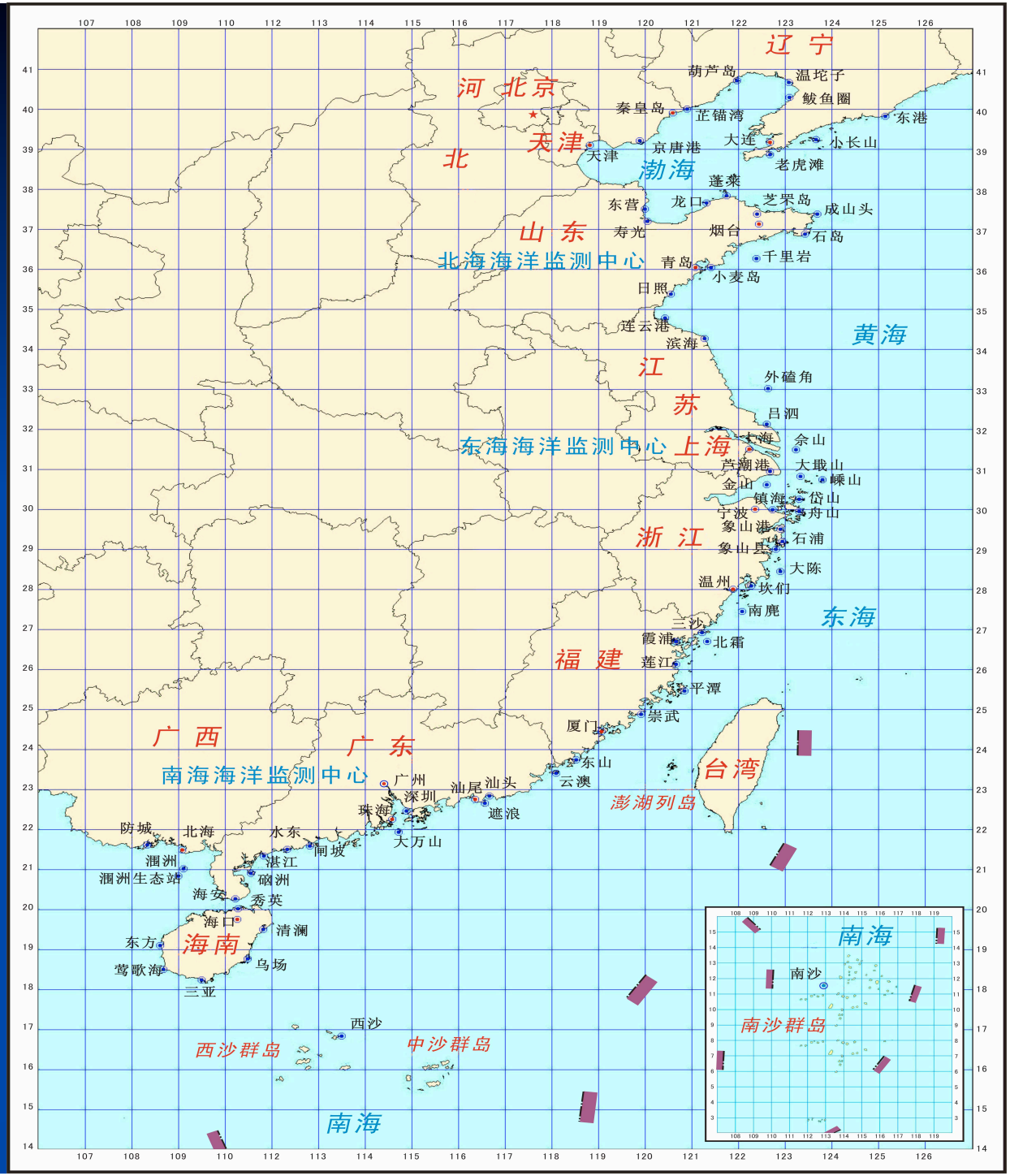
1. Marine Observing Station

At present, China has set up more than 130 marine observation stations along the coast (part at bayou), some of them are in the possession of the Water Conservancy Bureau, the Transportation and the Geological Department, about 60, are mainly in the possession of the SOA.

The most of these observation stations are tide level stations. The stations observe the wave, temperature, salinity, meteorology and other elements,

Figure 1-1 observation station distribution of SOA, More than 130 marine observation stations along the coast.

South to the Nansha Islands Yong shu reef （南沙群岛的永暑礁）, north to the mouth of Yalu River（鸭绿江）, west to the Yongxing Island of the Xisha Islands.（西沙群岛的永兴岛）



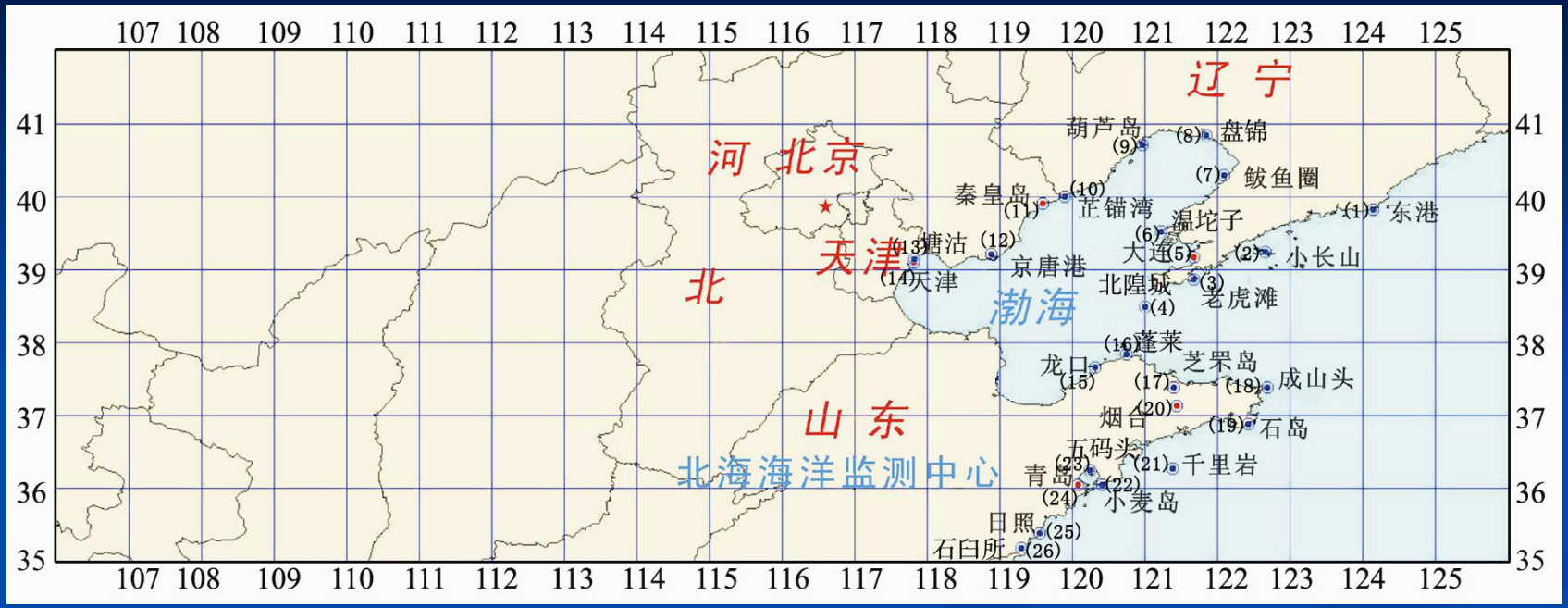


Figure 1-2 North Sea observation station distribution of SOA (22 stations)

(1) Donggang, (2) Xiaochangshan, (3) Laohutan, (4) Beihuangcheng, (5) Dalian, (6) Wentuozi, (7) Bayuquan, (8) Panjin, (9) Huludao, (10) Zhimaowan, (11) Qinhuangdao, (12) Jingtanwan, (13) Tanggu, (14) Tianjin, (15) Longkou, (16) Penglai, (17) Zhifudao, (18) Chengshantou, (19) Shidao, (20) Yantai, (21) Qianliyan, (22) Xiaomaidao, (23) Wumatou, (24) Qingdao, (25) Rizhao, (26) Shijiusuo.

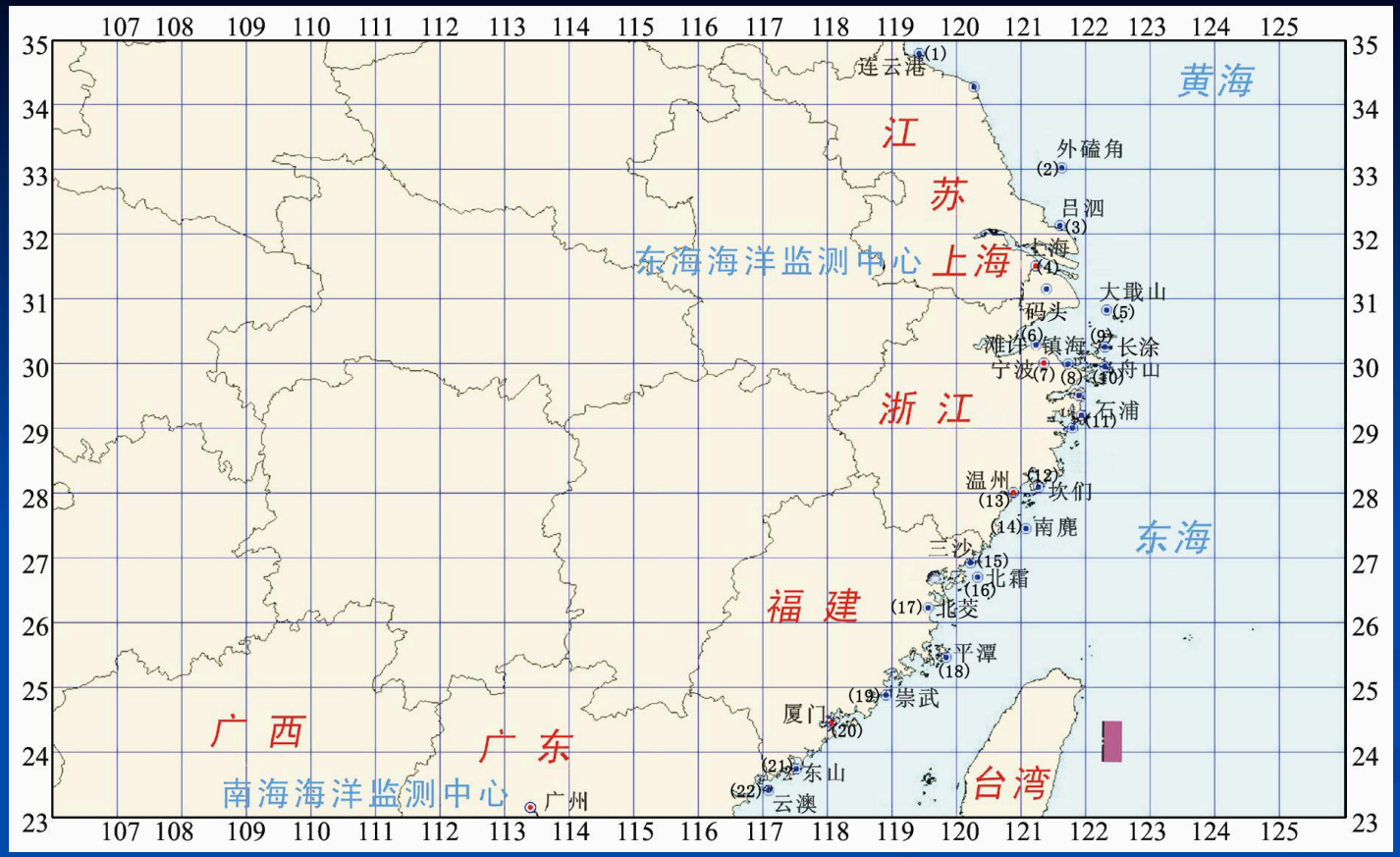


Figure 1-3 East Sea observation station distribution of SOA

(1) Lianyungang, (2) Waikejiao, (3) Lvsi, (4) Shanghai, (5) Dajishan, (6) Tanxui,

(7) Ningbo, (8) Zhenhai, (9) Changtu, (10) Zhoushan, (11) Shipu, (12) Kanmen,

(13) Wenzhou, (14) Nanji, (15) Sansha, (16) Beishuang, (17) Beijiao, (18) Pingtan,

(19) Chongwu, (20) Xiamen, (21) Dongshan, (22) Yunao,

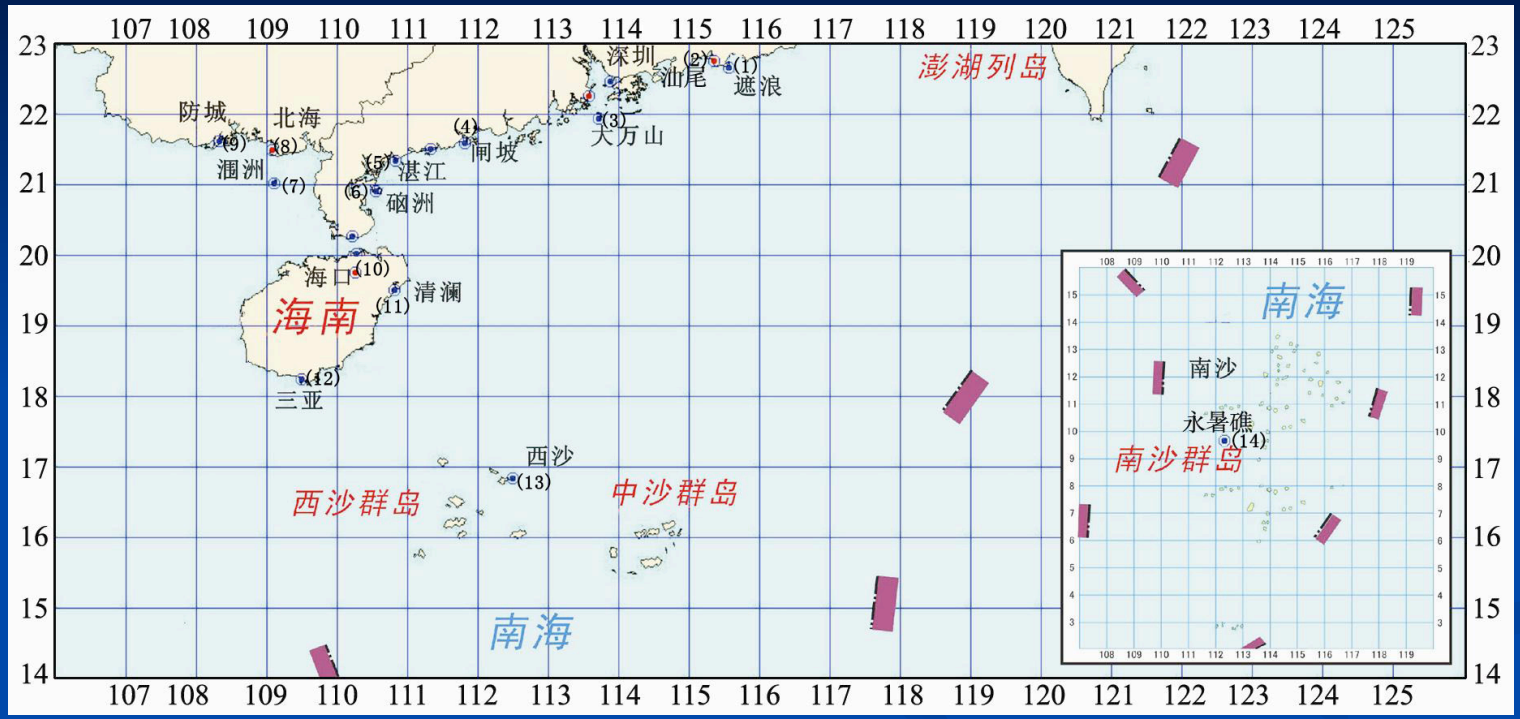


Figure 1-4 South Sea observation station distribution of SOA

(1) Zhelang, (2) Shanwei, (3) Dawanshan, (4) Zhapoi, (5) Zhanjiang, (6) Naozhou,

(8) Weizhou, (8) Beihai, (9) Fangcheng, (10) Haikou, (11) Qinglan, (12) Sanya,

(13) Xisha, (14) Yongshujiao,

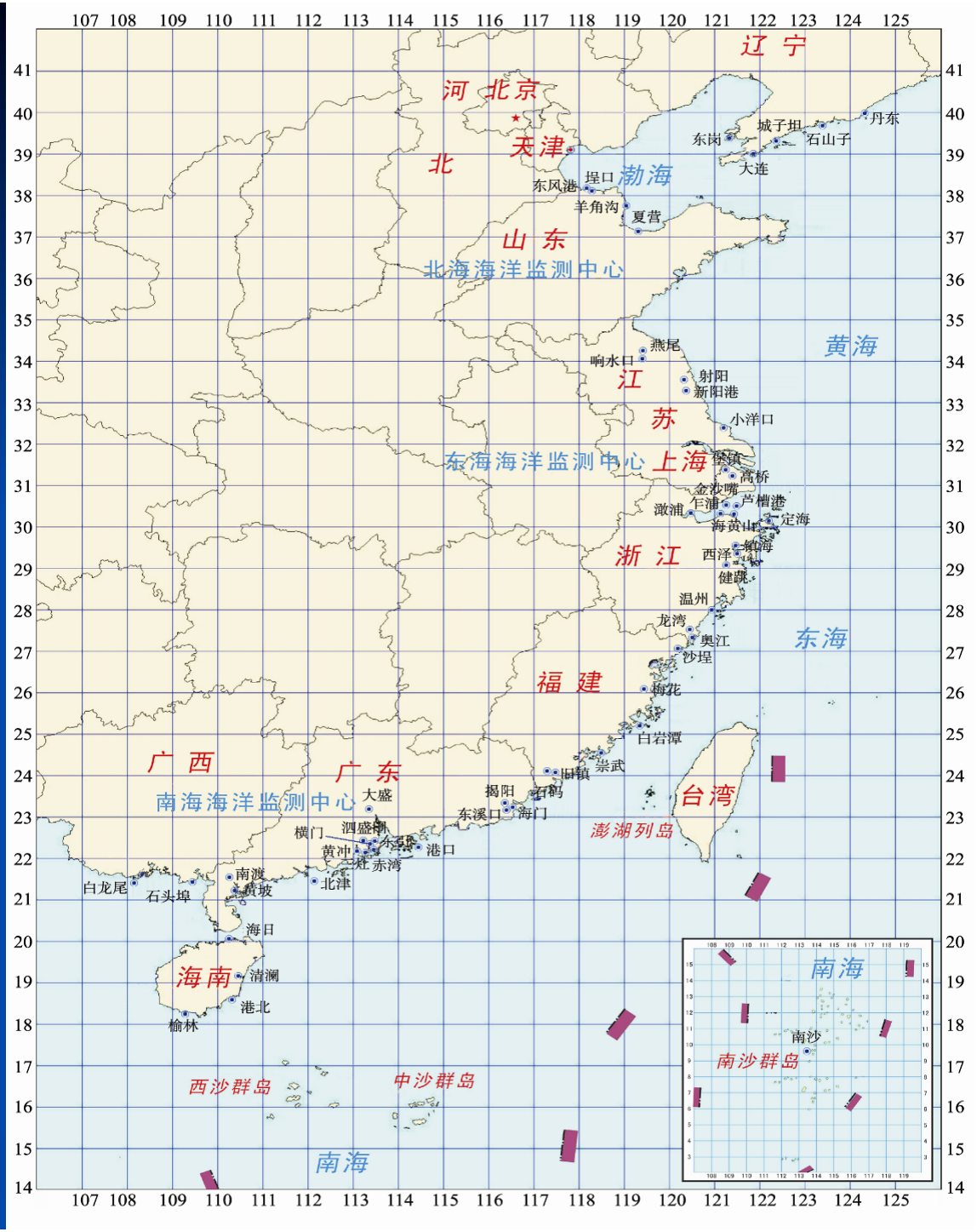


Figure 1-5 Water conservancy bureau estuary sea observation station distribution

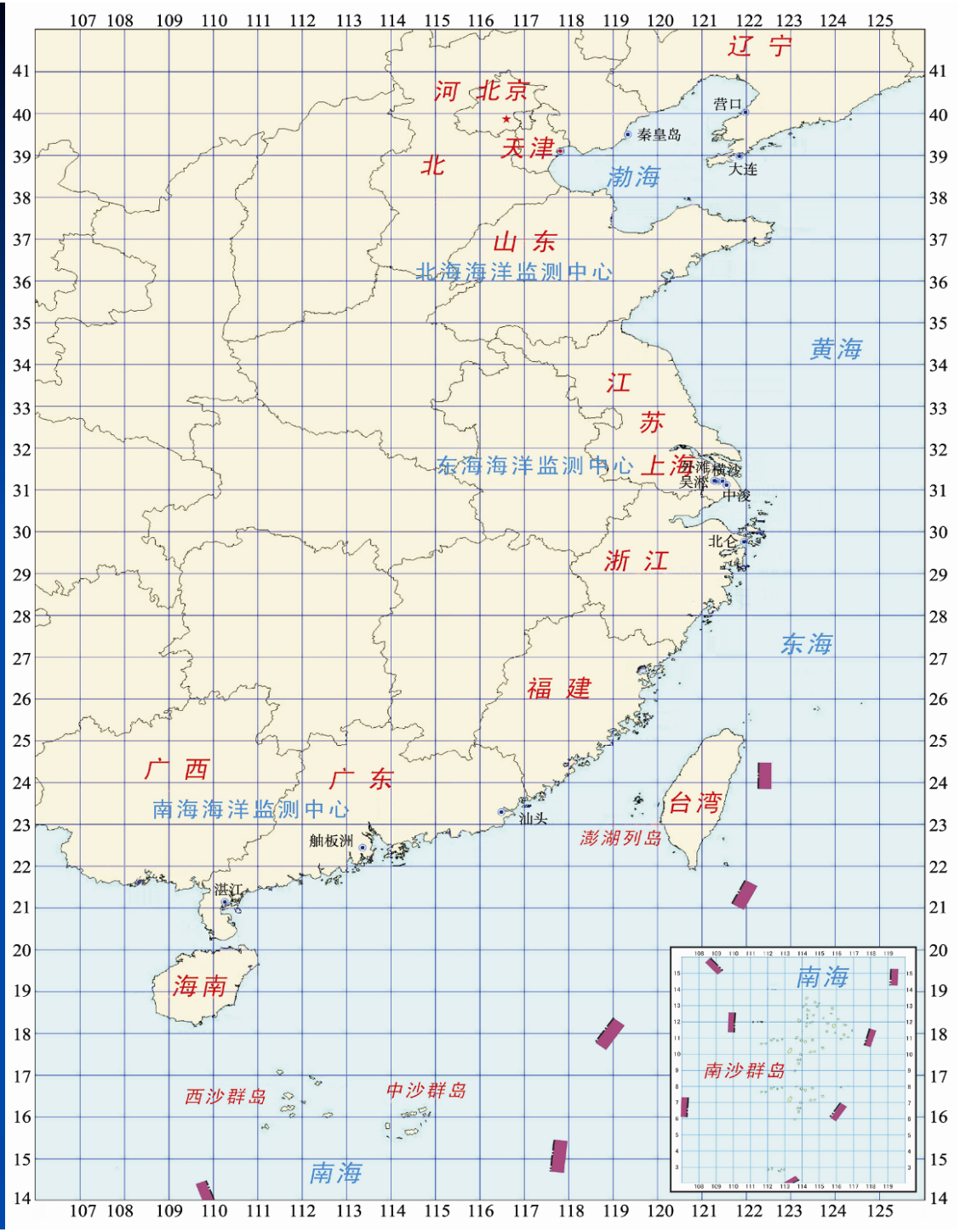


Figure 1-6 Distribution of transport, geologic marine observation stations

Automatic observation technology in the observation stations is widely used. There into, the Xiaomaidao stations's automatic observation system has been built up and put into use, has a certain representation.

Table 1-1 the observation elements of Xiaomaidao and technology indicators

Name	Measuring range	Accurate	Measuring time	Sampling Technology
Wind speed	0.5~60m/s	(±0.5+0.05*V)m/s(≤5m/s); ±10%(＞5m/s)	continuing	Photoelectric frequency, Induction
Wind direction	0°~360°	±10°	continuing	Photoelectric encoder
Temperature	-30℃~45℃	±0.3℃±0.5℃（extremum）	continuing	Platinum Resistance
Air pressure	850~1,050hPa	±1hPa	continuing	Air compress box
Humidity	0~100%	‹50%，±2%；≥50%，±5%	continuing	Lithium chloride
Precipitation rain fall	0~999mm	‹10mm，±0.2mm；≥10mm，2%	continuing	Precipitation Bottle
Marine wave	Wave height 0~20m Cycle 2~20s	≤±5% ≤±0.5s	continuing or timing	Ultrasonic sensors
Tide	0~10m	±1.0cm	continuing	Mechanical encoder
Water temperature	-5.0℃~30.0℃	±0.1℃	timing	Platinum Resistance
Salinity	25~35	±0.2	timing	conductivity

Main European Marine Observation station

In Situ Observing Status within Mersea

Time series activities within MERSEA

Main European marine observation stations

Fig 1-8 European ocean observatory station (11 stations)

Source： http://www.eurosites.info/sites.php

To process data acquired at sea by MERSEA observing system, the project will rely on the existing **European real-time data centers**, i.e. **Ifremer/CORIOLIS** for Floats and Research Vessels, the **SOC Animate data centre** for time-series, the MFSTEP data management structure for the Mediterranean network. **Glider data processing** will be handled by one of these centres

In Situ Observing Status within MERSEA

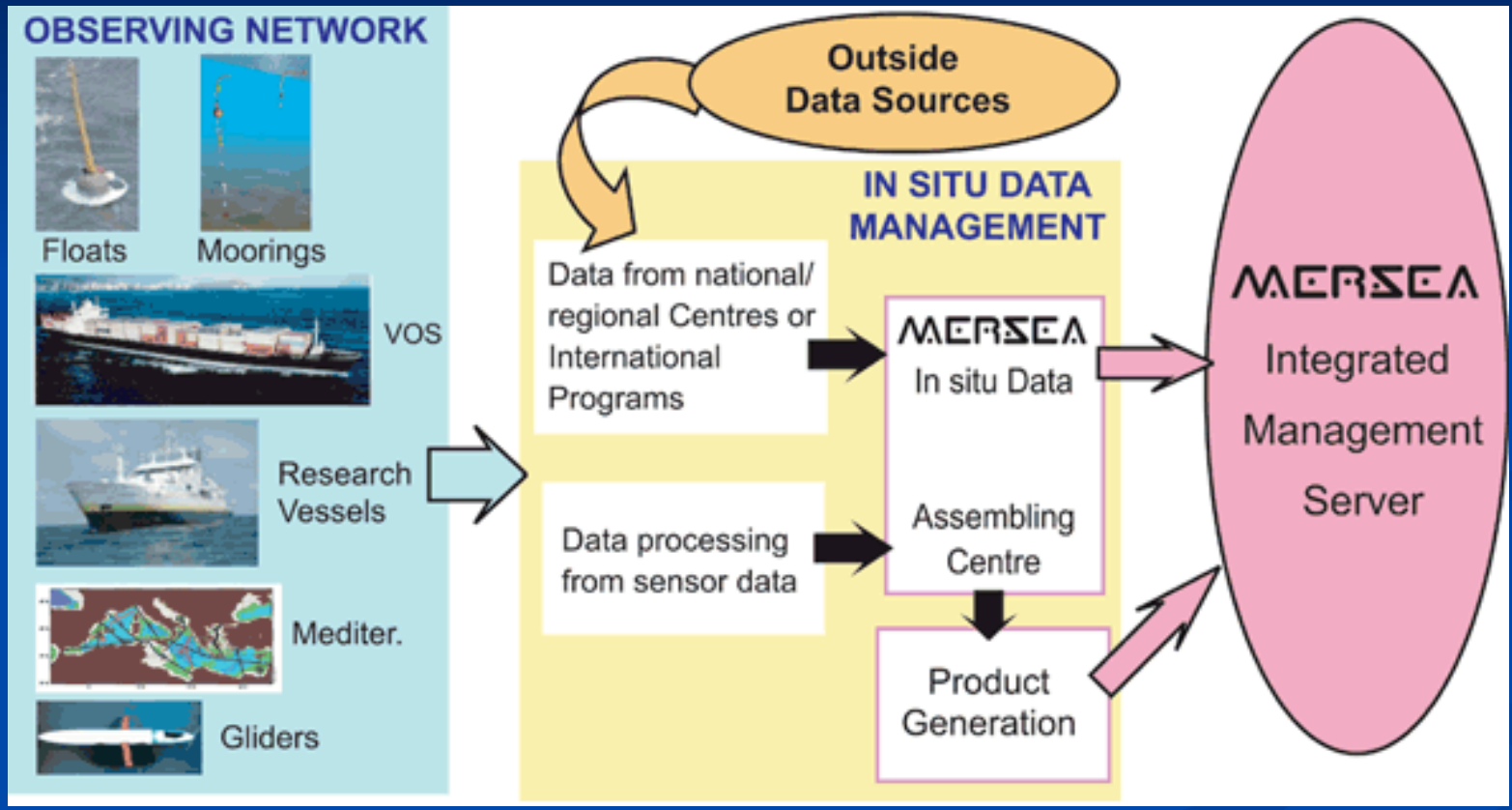


Fig 1-7 MERSEA data management mode

Atlantic Stations

Three time series stations in the Atlantic deployed within the European ANIMATE Project, are maintained. subpolar - CIS, subtropical - ESTOC, and boundary between subpolar and subtropics - PAP

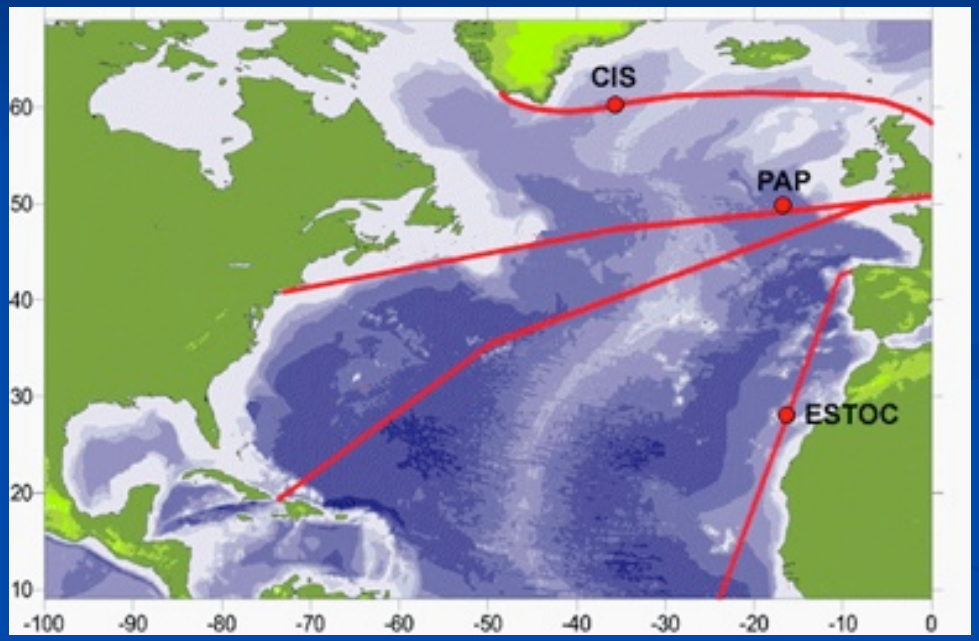


Fig 1-8 Positions of Atlantic moorings maintained under MERSEA.

The red lines indicate commercial shipping routes where Volunteer Observing Ships (VOS) take measurements of Carbon Dioxide and nutrients in surface waters.

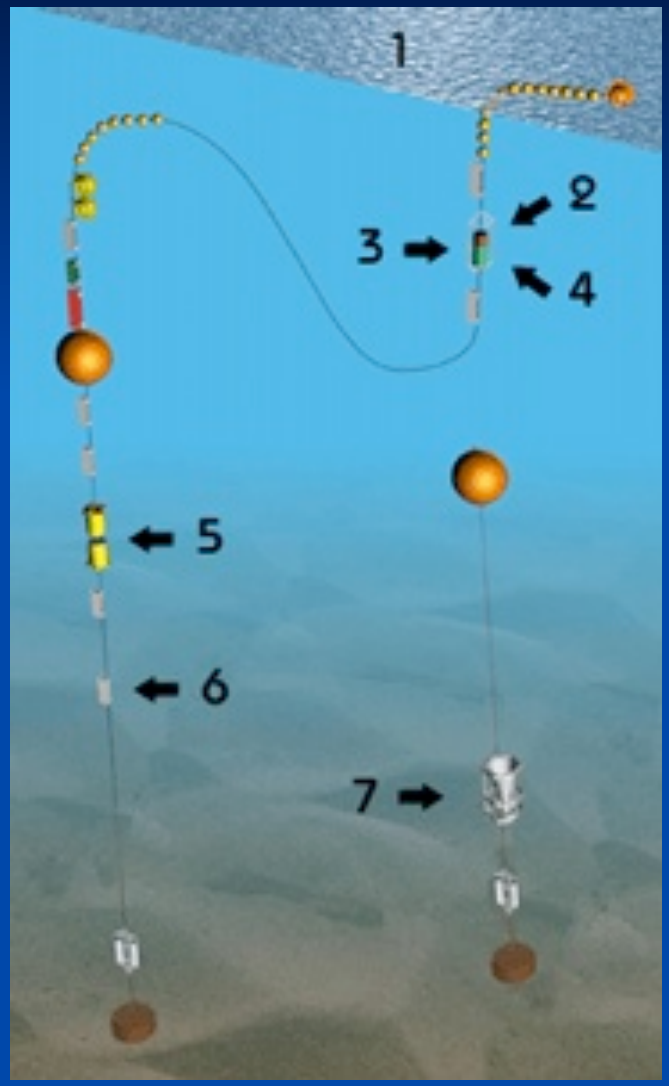


Fig 1-9 Typical configuration of a time series mooring as deployed for MERSEA

1、Telemetry;

2、SAMI-Carbon Dioxide Sensor,

3、Nutrient Analyzer,

4、Backscatter and Fluorescence Sensor,

5、ADCP Current Speed and Direction Sensor,

6、CTD Conductivity and Temperature Sensor,

7、Traps for sinking material

The Mediterranean M3A Network

The Mediterranean Moored Multi-sensor Array (M3A), was deployed in the Cretan Sea (Eastern Mediterranean) in January 2000 , able to provide real-time physical and biochemical measurements for the needs of the Mediterranean Forecasting System.

Fig 1-10 M3A system layout diagram

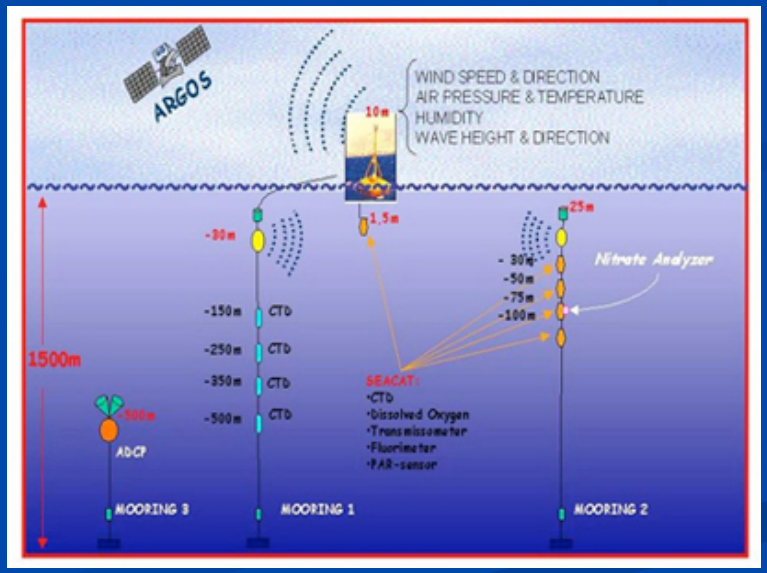
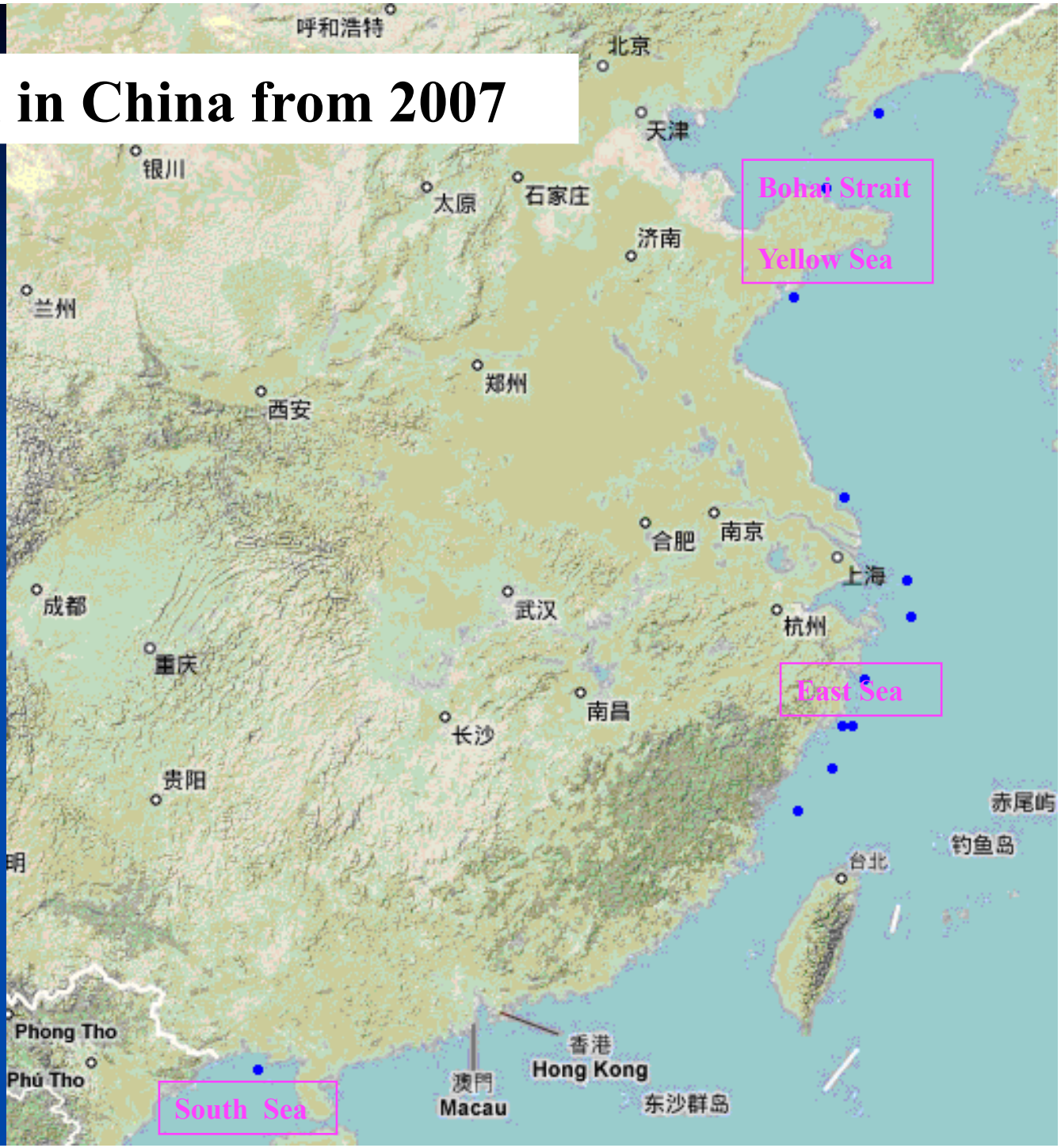


Fig 1-11 M3A typical model working pattern

2. Marine Buoy

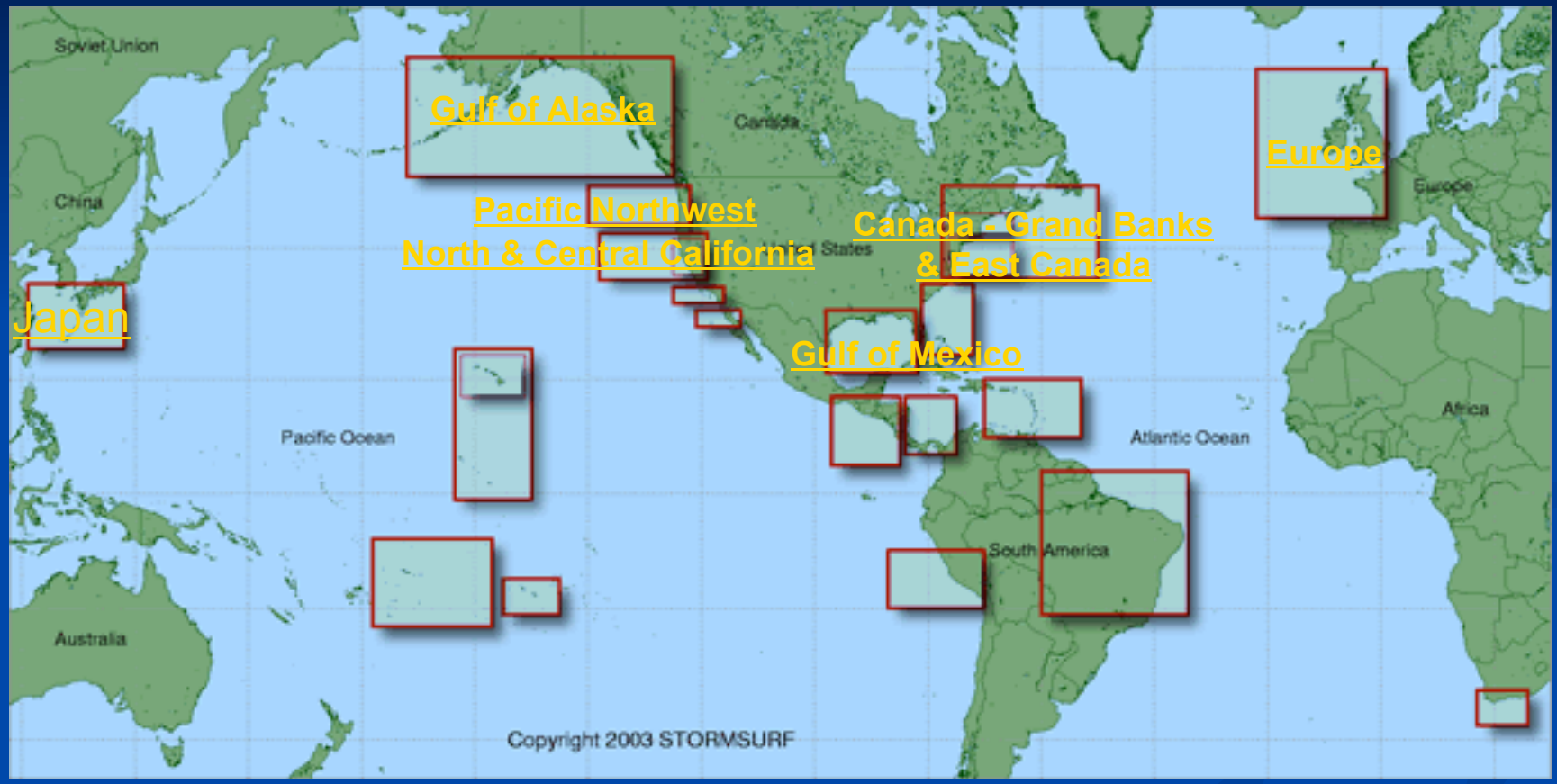
The main types of Chinese marine buoy are marine **data buoys, special marine buoys, measuring current dive buoys and drifting buoy**. And the marine data buoy is the development key, so far altogether China has developed the large-scale, medium and small-scale 14 sets of marine data buoy, and has built the corresponding shore receiving station separately in the South China Sea, East China Sea and North China Sea.

Buoys distribution in China from 2007



Most of the buoys (11 Buoys)deployment in china from 2007

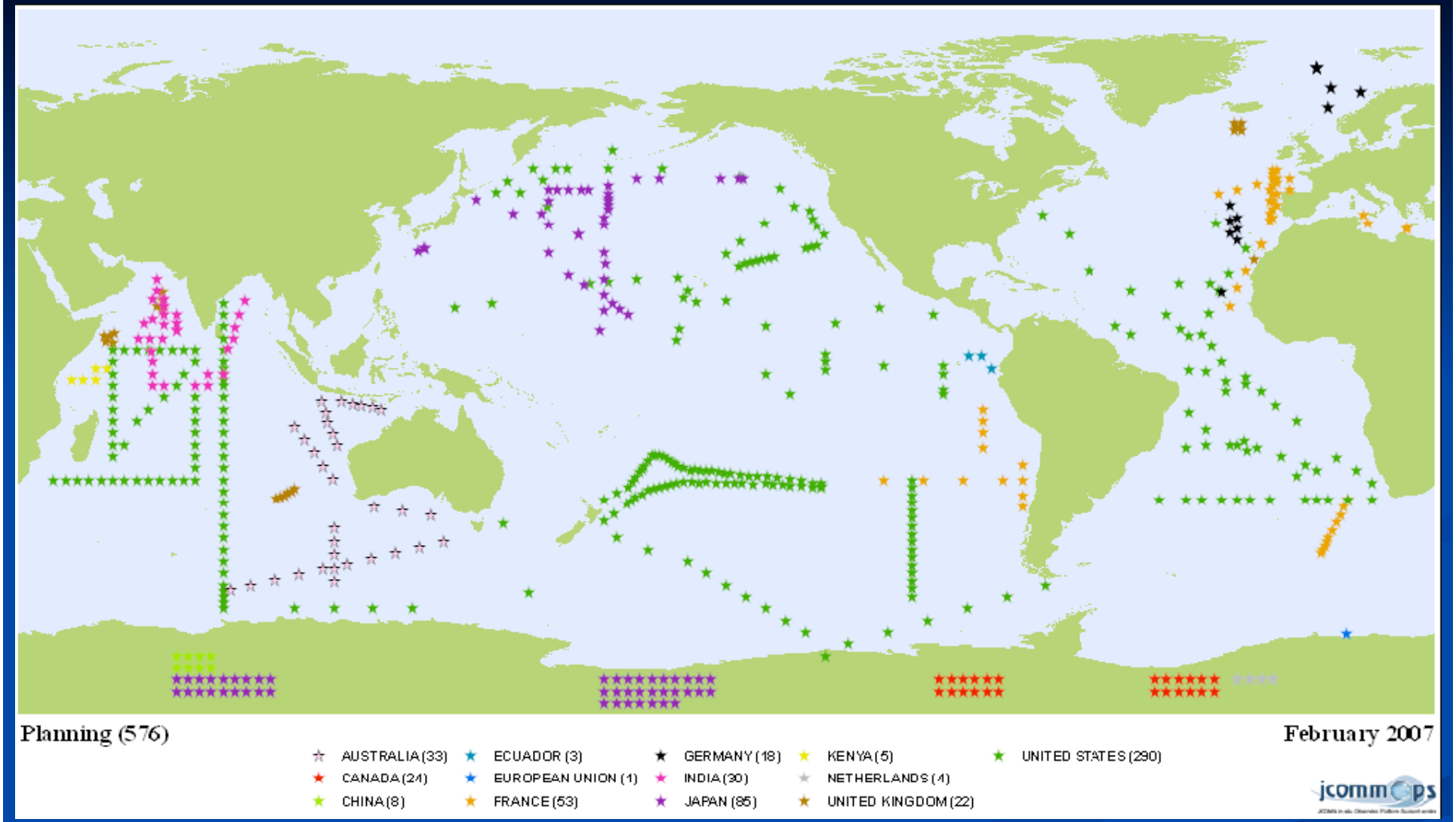
Buoys distribution for other countries



Source: http://www.stormsurf.com/buoy/mht/glob.html

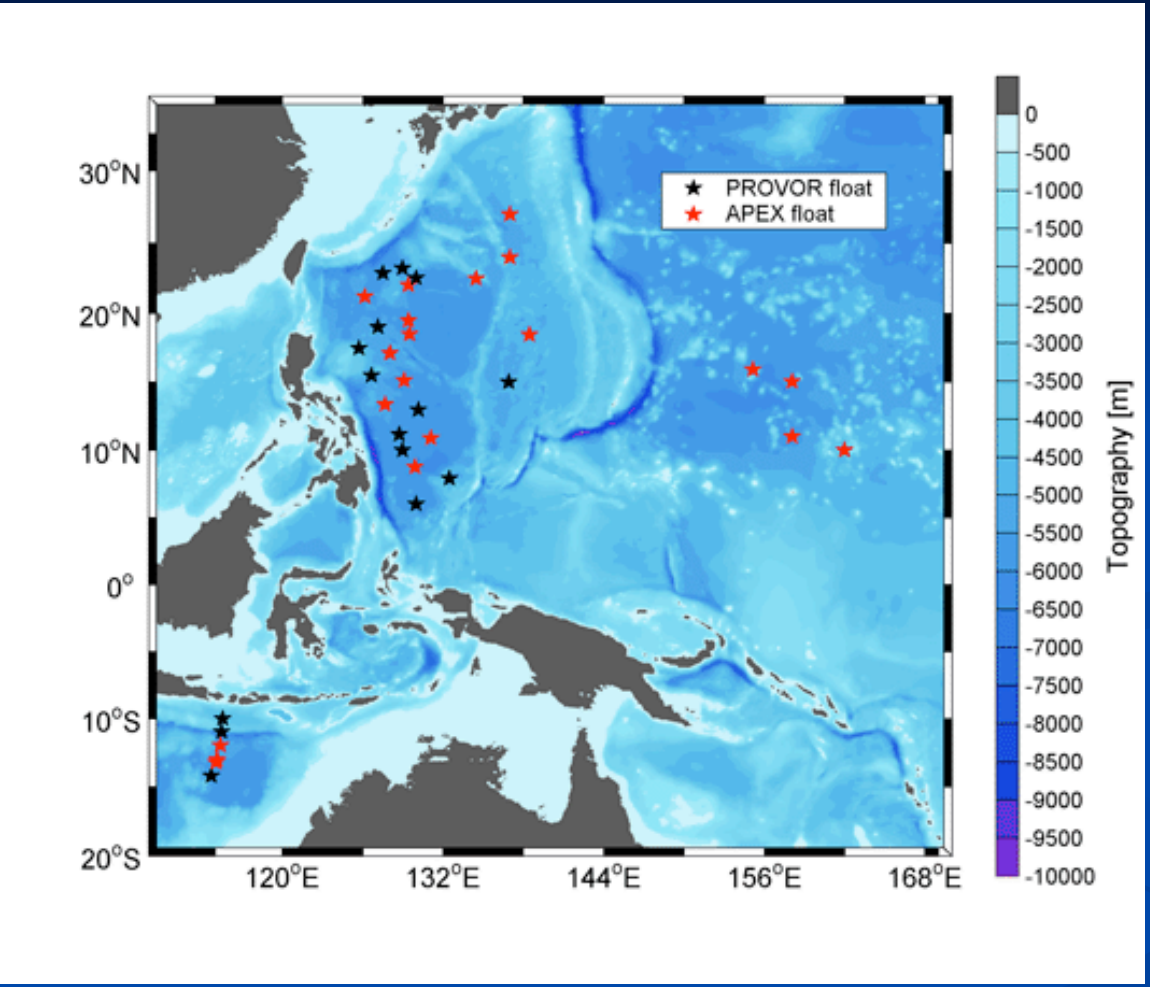
3.ARGO

ARGO global oceanic observation network. **It plans to deploy 3000 ARGO profiling buoys followed by satellite in global ocean at average 3-degree spacing. According to the latest data, the buoys deployed in global ocean by international Argo plan membership countries were more than 6000 during 1998 to the end of 2008. And derived temperature and salinity profiles were accumulated to more than 500,000, and annual profile number also increased from 30,000 at 2003 to more than 110,000 at 2008.**



Planned deployments for 2007

Argo deployments in China



China Argo Project has deployed 46 floats in the Western Pacific and Eastern Indian Marines. Now there are 20 floats still work.

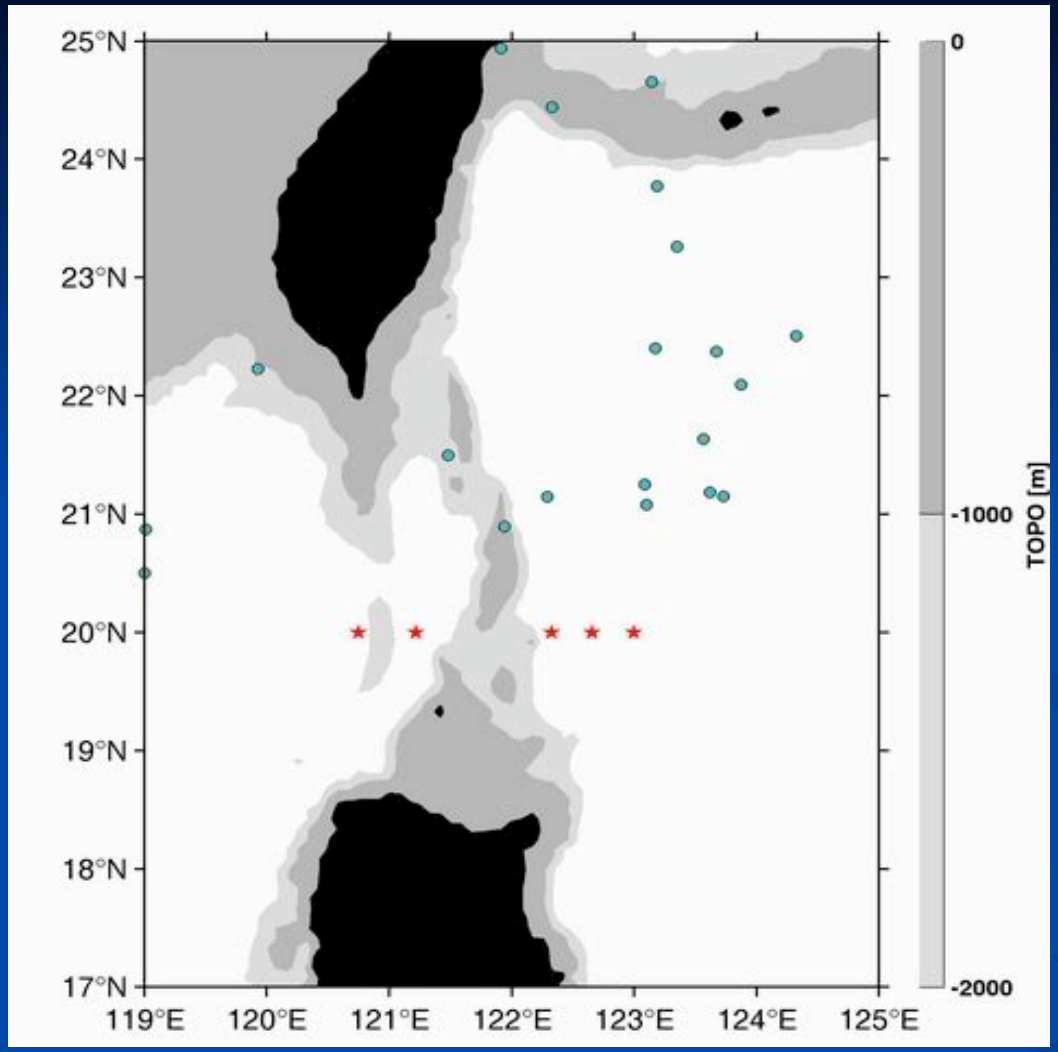
N	TT	WMO	FLOAT TYPE	DEPLOY			STATUS	META	DATA
				DATE	LONGITUDE	LATITUDE			
	73	5900019	APEX	2002-10-20	129.45	22.02	Active	>>	>>
	8509	5900020	APEX	2002-10-21	129.52	18.50	Inactive	>>	>>
0003	14905	5900198	PROVOR	2002-03-21	114.72	-14.21	Inactive	>>	>>
0004	21299	5900222	APEX	2003-01-09	126.18	21.22	Inactive	>>	>>
0005	21300	5900223	APEX	2003-01-08	128.07	17.12	Inactive	>>	>>
0006	21301	5900224	APEX	2003-01-03	129.92	8.76	Inactive	>>	>>
0007	21302	5900225	APEX	2003-01-02	126.67	15.50	Inactive	>>	>>
0008	21335	5900226	APEX	2003-01-08	129.10	15.12	Inactive	>>	>>
0009	21371	5900227	APEX	2003-01-05	131.12	10.89	Inactive	>>	>>
0010	21289	5900228	PROVOR	2003-01-08	127.17	19.03	Inactive	>>	>>
0011	21294	5900315	PROVOR	2003-01-07	130.16	13.00	Inactive	>>	>>
0012	21295	5900316	PROVOR	2003-01-05	132.50	7.92	Inactive	>>	>>
0013	21296	5900317	PROVOR	2003-01-04	130.00	6.00	Inactive	>>	>>
0014	21297	5900318	PROVOR	2003-01-03	128.74	11.16	Inactive	>>	>>
0015	24077	2900242	PROVOR	2002-11-26	128.97	10.00	No_Transmission	>>	>>
0017	23582	5900220	PROVOR	2003-08-11	130.02	22.54	Inactive	>>	>>
0018	23578	5900219	PROVOR	2003-08-11	129.00	23.22	Inactive	>>	>>
0019	23754	2900313	PROVOR	2003-08-04	127.53	22.88	Inactive	>>	>>
0020	26608	5900462	APEX	2004-11-08	115.08	-13.19	Active	>>	>>
0021	26609	5900463	APEX	2004-01-17	134.50	22.50	Inactive	>>	>>
0022	26618	5900464	APEX	2004-01-09	137.00	23.99	Inactive	>>	>>
0023	26619	5900465	APEX	2004-01-10	137.00	27.01	Inactive	>>	>>
0024	26596	2900322	APEX	2004-11-08	115.38	-11.97	Active	>>	>>
0025	26607	2900323	APEX	2004-11-08	115.14	-13.01	Active	>>	>>
0026	28201	2900457	PROVOR	2004-11-08	115.49	-10.95	Inactive	>>	>>
0027	28202	2900458	PROVOR	2004-11-08	115.57	-9.99	Inactive	>>	>>
0028	28203	5901603	APEX	2006-05-16	129.43	19.47	Active	>>	>>
0029	28204	5901604	APEX	2006-05-19	138.48	18.45	Active	>>	>>
0040	28205	5901605	APEX	2006-06-16	158.10	15.06	Active	>>	>>
0041	28206	5901606	APEX	2006-06-17	158.10	11.00	Active	>>	>>
0042	28207	5901607	APEX	2006-06-06	155.15	15.93	Active	>>	>>
0043	28208	5901608	APEX	2006-07-04	162.00	10.00	Active	>>	>>

Specific Information about 35 Argo floats

http://www.argo.org.cn/data/data.html

Position	Buoy serial number	Planned deployment latitude	Planned deployment longitude	deployment latitude	deployment longitude	Sensor
Argo01	4210	20.00°N	120.75°E	20.00°N	120.45°E	SBE41
Argo02	4211	20.00°N	121.22°E	20.00°N	121.10°E	SBE41
Argo03	4212	20.00°N	122.33°E	20.00°N	122.20°E	SBE41
Argo04	4213	20.00°N	122.66°E	20.00°N	122.40°E	SBE41
Argo05	4214	20.00°N	123.00°E	20.00°N	123.00°E	SBE41

Argo Deployment in July, 2009, by Dongfanghong 2 ,China



2009, Deployment position of Argo buoys (Star)

Argo status within MERSEA

they are important for Mersea models (Deep water formation, thermohaline, circulation) and are under-sampled.

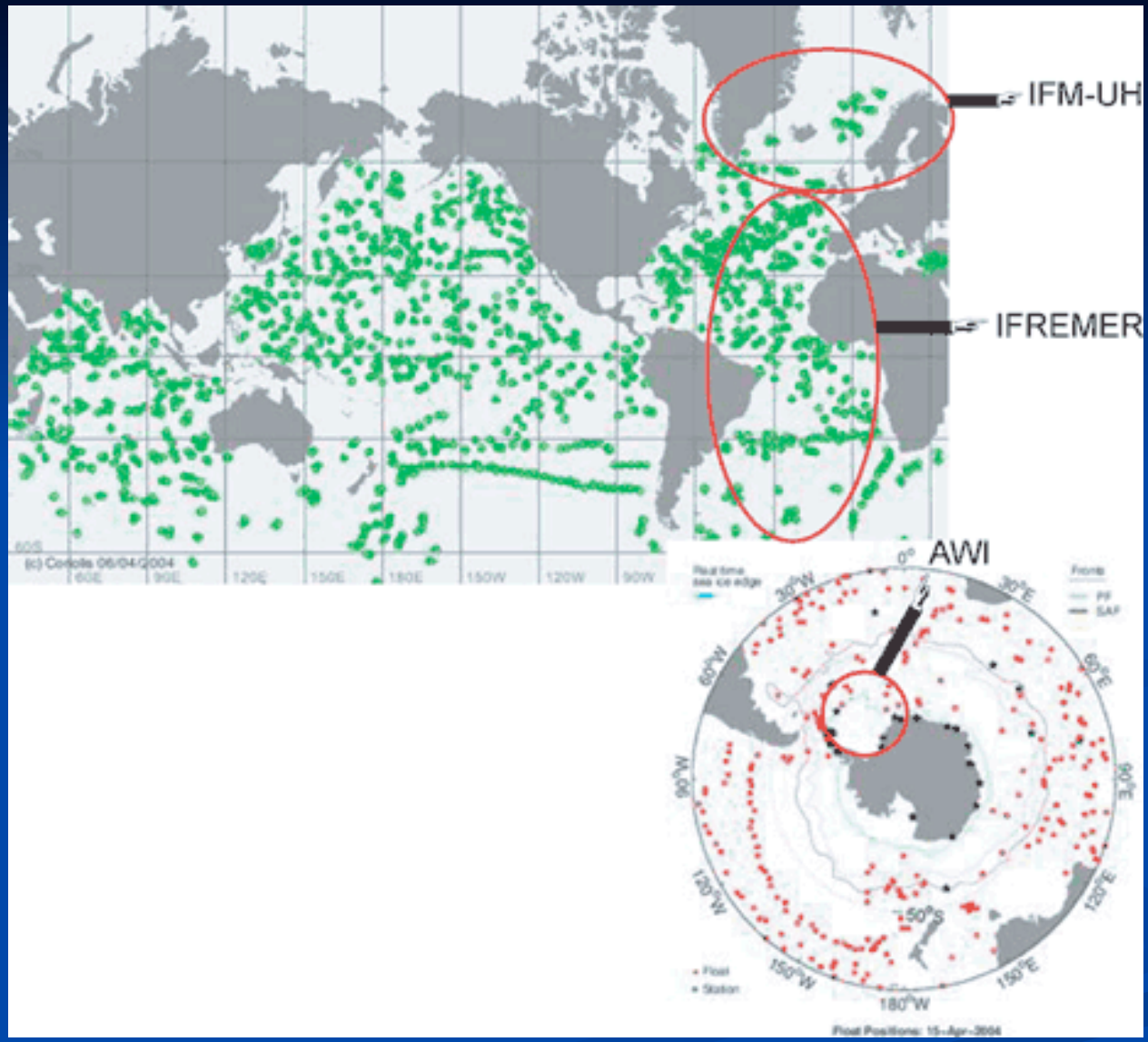


Fig 2-1 Argo deployment areas (24 floats - 6 active on 04/08/2009)

Float deployments in the Nordic Seas

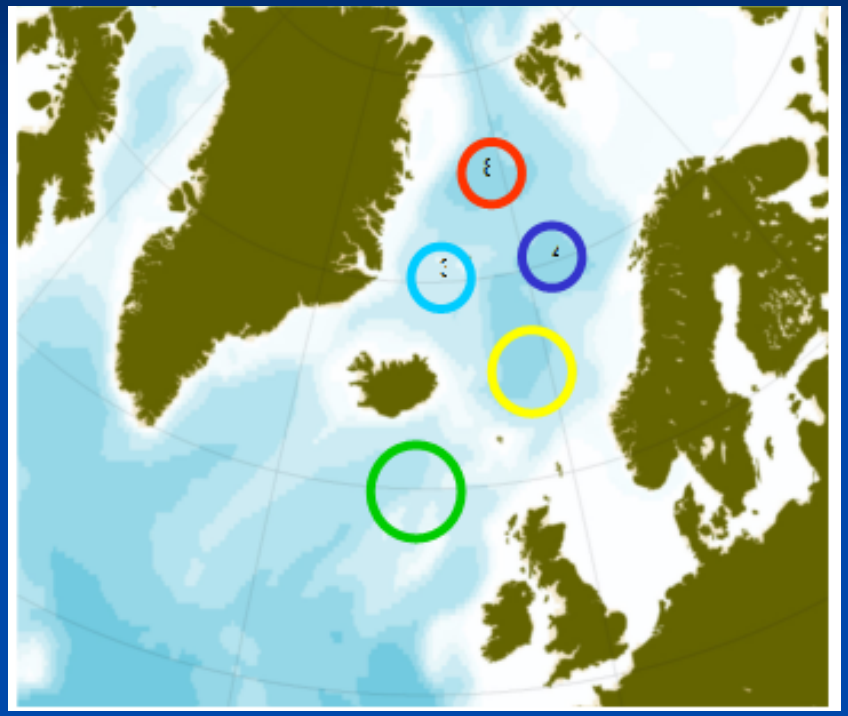


Fig 2-2 Nordic Seas float distribution
Red: Greenland Sea Blue: Lofoten Basin Cyan: Islandic Sea Yellow: Norwegian Basin Green: south of the Greenland-Scotland-Ridge

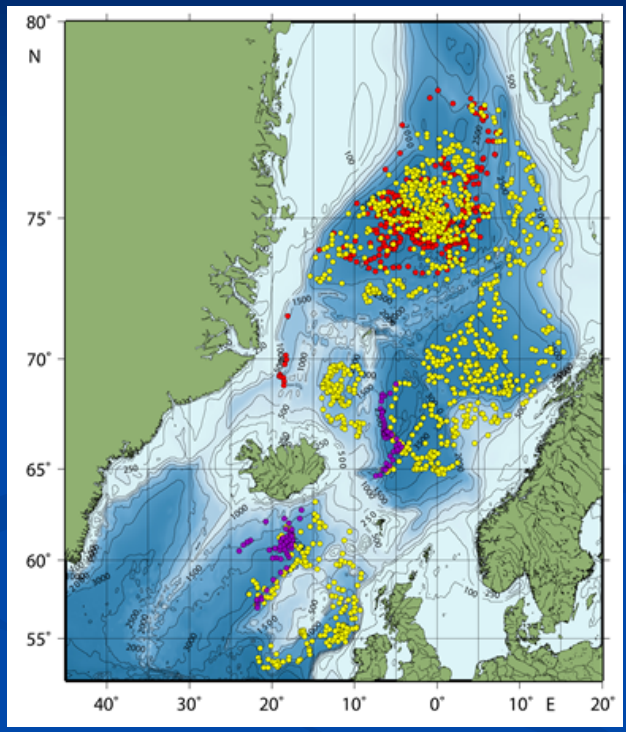


Fig 2-3 Nordic Seas float data distribution profile

Float deployments in the Atlantic Ocean

A total of 16 ARGO Floats were deployed during the Ovide cruise between Greenland and Spain in June 2006.

All the Provor floats are profiling to 2000m every 10 days and all are still active and working according to specification.

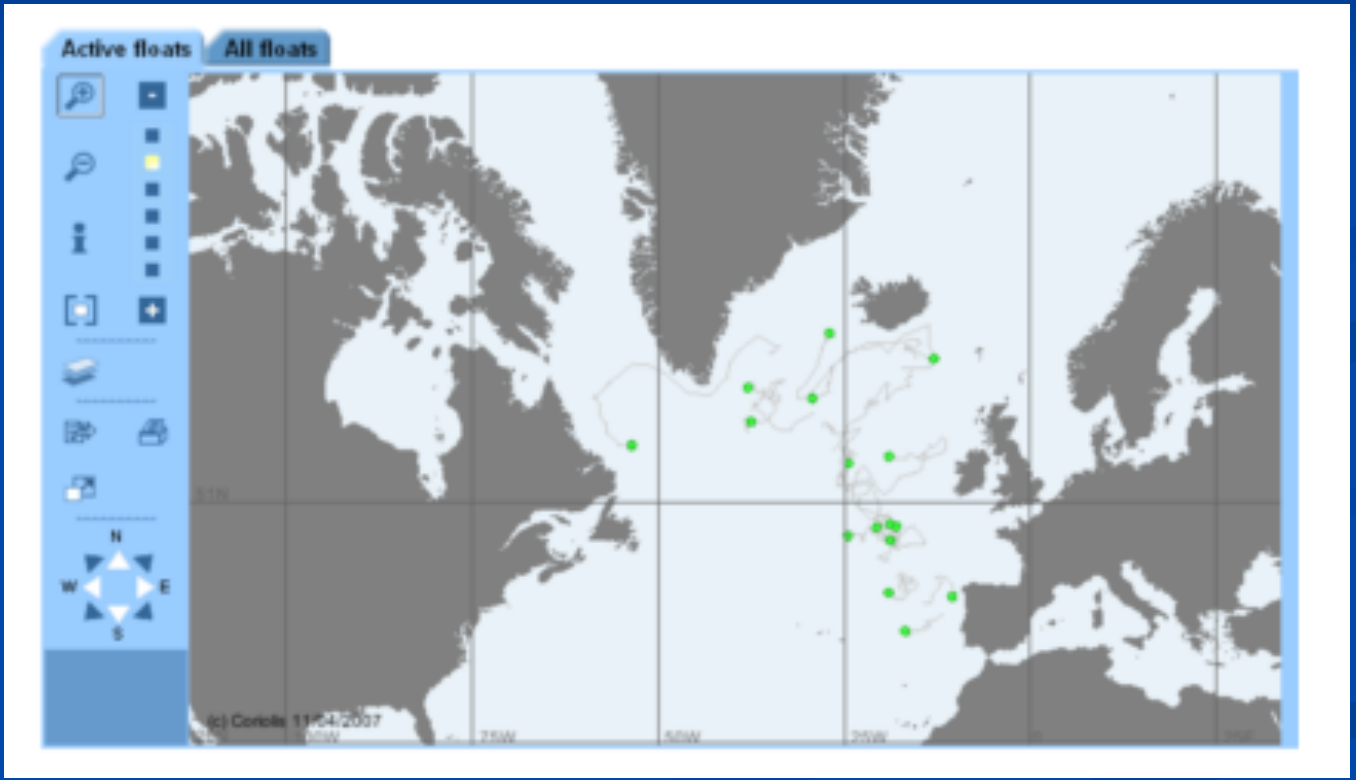
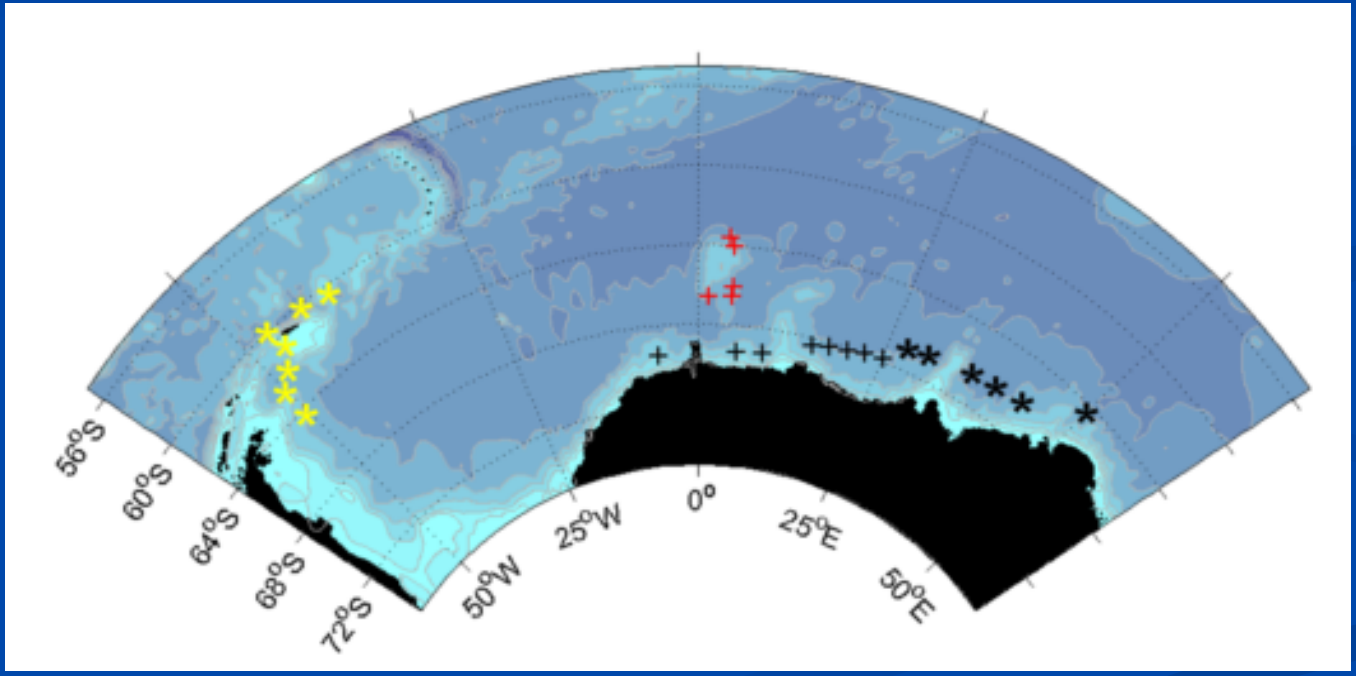


Fig 2-4 Float deployments during the Ovide cruise. All were Provor floats.

Float deployments in the Southern Ocean

A total of 27 ARGO Floats were deployed throughout the austral season 2006/7 . The Southern Ocean contributes significantly to the variability of the climate system through atmosphere-ice-ocean interaction processes. The Weddell Sea in particular is a key source for deep and bottom water of the world oceans.



Polarstern © AWI, Germany

Fig 2-5 Float deployments during RV Polarstern cruise ANT-XXIII.

Fig 2-6 NEMO (Navigating European Marine Observer) floats being prepared onboard Research Vessel Polarstern for deployment in the Southern Ocean.

The Chinese Argo plan is one of best systems in the Chinese ocean observation system which is developed rapidly and working the best.

The number of the buoys deployed by Chinese Argo plan has reached 68, and there are now 35 buoys still working.

We suggeste that the Chinese Ministry of Science and Technology, European Community should support China Argo plans to further development, particularly to support the China Argo data management in the data quality control and sharing to aspect with the international Argo plan trail connection.

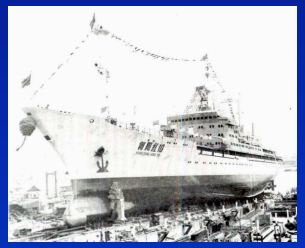
4. Marine Survey Ship

China has already established a large-scale, full range survey ship team, to meet the basic needs of the survey, including multi-purpose survey ship, professional survey ship and special survey ship from 1960 to now.

Multi-purpose Survey Ship In China (1)

Name	Tonnage	Instrument	Ascription
“Shijian” (“实践”号) 	2，955t	electric driving shallow water winch, electric driving geological winch, fluid drive hydrographic winch, deep water net winch, analyzer, transmitter, azimuth mirror, seismograph, distiller, thermostat	the Bureau of East China Sea, SOA
“Xiangyanghong 5” (“向阳红 5”号) 	13，650 t large	hydrology motor-winch, hydrology hydraulically-powered winch, geological motor-winch, conventional sea investigation instrument, radar, gravimeter, drying oven, electric heating constant temperature incubator	the State Bureau of Oceanic Administration South China Sea Substation.
“Xiangyanghong 7” (“向阳红 7”号)	1，178.9 t	shallow water motor-winch, hydrology motor-winch, exchange motor-winch, ocean current meter, CTD, acoustic meter, photoelectric colorimeter, radio transceiver, gravimeter	the State Bureau of Oceanic Administration North Sea Substation
“Xiangyanghong 8” (“向阳红 8”号)	1，178.9 t	shallow water motor-winch, hydrology motor-winch, exchange motor-winch, ocean current meter, CTD, acoustic meter, photoelectric colorimeter, radio transceiver, gravimeter	the State Bureau of Oceanic Administration North China sea Substation
“Xiangyanghong 9” (“向阳红 9”号) 	4，435 t	deep water drag net fluid drive winch, deep water hydrology hydraulically-powered winch, geological motor-winch, shallow water motor-winch, ships meteorograph, 10,0000m sounder, fish finder, sounder,gravimeter, magnetometer, CTD, guidance anemoscope, incubator and aquarium minority box	the State Bureau of Oceanic Administration North China Sea Substation

Multi-purpose Survey Ship In China (2)

“Xiangyanghong 10” (“向阳红 10” 号) 	12,467 .9 t large	hydrology hydraulically-powered winch, geological motor-winch, electric cable motor-winch, altogether 12, 675 acquisition radars, 711 measured that the rain radar, 843 typhoon radar, 704 radars, Doppler high LF receiver, satellite cloud picture receiver, 69-III fish finder, gravimeter, physiognomy meter, magnetometer, 5KW transmitter, 30KW transmitter, radar wave meter and converter	the State Bureau of Oceanic Administration East China Sea Substation
“Xiangyanghong 14” (“向阳红 14” 号) 	4, 440 t	deep water demersal drag net hydraulically-powered winch, geological motor-winch, shallow water motor-winch, electric cable motor-winch, ships meteorograph, repeater gyro-compass, full wave receiver, cloud chart receiver, 10,000m Echo Sounder, fish finder, gravimeter, Echo Sounder	the State Bureau of Oceanic Administration East China Sea Substation
“Xiangyanghong 16” (“向阳红 16” 号)	4, 440 t	deep water demersal drag net hydraulically-powered winch, geological motor-winch, shallow water motor-winch, electric cable motor-winch, ships meteorograph, repeater gyro-compass, full wave receiver, cloud chart receiver, 10,000m Echo Sounder, fish finder, gravimeter, Echo Sounder	the State Bureau of Oceanic Administration East China Sea Substation
“Shiyan 3” (“实验 3” 号)	2，571 t	each kind of specialized winch of 8, rain measurement radar, satellite nephogram receiver, facsimile meteorology receiver, meteorograph, magnetometer, 10,0000m sounder, submarine telecommunication, CTD, towed vehicle	Chinese Academy of Sciencer South China Sea Institute of Marineography
“Dongfanghong” (“东方红”号) 	2，345 t	hydrographic winch, physical winch, geological winch, hydraulic pressure hydrographic winch, electrically operated geological winch, crane	Ocean university of china
“Dongfanghong 2” (“东方红 2” 号)	3，235 t	6, 000 m bottom sampling motor-winch, 6,000 m hydrological hydraulic winch, 2,500 m temperature and salinity, depth measurement system (CTD) with a cable winch, 1 , 300 m hydrological hydraulic winch of 2, 2 tons of gantry crane, 6 tons of gantry crane	Ocean university of china

Special Survey Ship (polar region)In China

Name	Tonnage	Instrument	Ascription
“Jidi” 	12，904 t large	6,000 m geological winch, 3,000 m hydrological winch, gravimeter, azimuth mirror, sounder, daily production 24~30 t fresh water desalination system, airplane platform and hangar, “Dolphin” helicopter, sewage processor which may supply 80 people to use	the State Bureau of Oceanic Administration North Sea Substation
“Xuelong” 	21，025 t largest	6,000 m and 3,000 m winch used for investigations, each kind of marine inspect laboratory altogether sum to approximately 200 m^2, low-resolution satellite nephogram receiving equipment and conventional automatic meteorological observation equipment, CTD, Acoustic Doppler Current Profiler (ADCP)	the State Bureau of Oceanic Administration East China Sea Substation
“Dayang 1” 	5，660 t	10,000m fluid drive geological winch, deep water townet winch, hydrographic winch, "A" type rack, crane, deep water towed acoustic systems and optical systems, Sea Beam2100-type multi-beam system, XBT system, ZQC1-2 oceanography automatic data sampling and processing system, such as GPS and Depth Sounder.	the State Bureau of Oceanic Administration North Sea Substation

Survey Ship In France

Ship Name	Institute & Project	Data Type	Area of work	Ship schedule availability	Comment
 Pourquoi Pas © Ifremer	Ifremer /Coriolis	XBT/TSG	Global Ocean	More	Routine acquisition
 L'Atalante © Ifremer	Ifremer / Coriolis	XBT/TSG	Global ocean	More	Routine acquisition
 Thalassa © Ifremer	Ifremer / Coriolis	XBT/TSG	North Atlantic	More	Routine acquisition
 Le Suroit © Ifremer	Ifremer / Coriolis	XBT/TSG	North East Atlantic, Mediterranean Sea, East Atlantic, African coasts	More	Routine acquisition
 Le Beautemps Beaupré © SHOM	SHOM / Coriolis	XBT/TSG	West African coasts, Iceland, North Atlantic, Acores, Canarias	On request	Routine acquisition
 Le Borda © SHOM	SHOM	XBT/TSG		On request	Routine acquisition
 Le Marion Dufresne © G. Juin/IPEV	IPEV / Coriolis	XBT/TSG	Indian Ocean & Antartic	More	
 L'Astrolabe © A. Fornet/ IPEV	IPEV	XBT/TSG	Antartica	More	XBT from GTS & TSG in delay mode
 Tethys © CNRS/ INSU	CNRS	ADCP	Occidental Mediterranean Sea	on request	

Survey Ship In German

Ship Name	Institute & Project	Data Type	Area of work	Ship schedule availability	Comment
	Ifm-Geomar / Mersea	XBT/TSG		More	
mar	Ifm-Geomar / Mersea	XBT/TSG		More	
 omar	BGR / Mersea	XBT/TSG		More	
R	Ifm-HH / Mersea	XBT/TSG		More	
 H	AWI / Mersea	XBT/TSG		More	

Polarstern © AWI

Survey Ship In Spain

Ship Name	Institute & Project	Data Type	Area of work	Ship schedule availability	Comment
	IEO / Mersea	XBT/TSG	Iberian Peninsula	More	

Survey Ship In (UK) United Kingdom

Ship Name	Institute & Project	Data Type	Area of work	Ship schedule availability	Comment
	NERC / Mersea	XBT/TSG	South Indian Ocean, South Atlantic, North East Atlantic	More	
	NERC / Mersea	XBT/TSG	North Atlantic, Celtic and Irish Seas	More	
	BAS / Mersea	XBT/TSG	South Atlantic Wedel Sea, Greenland	More	

The number of Chinese survey ship (about 160) and tonnage (about 150,000 tons) has reached the marine survey needs. Compared with Europe, Chinese marine survey ship is very similar on the number and tonnage (according to China Academy of Engineering Zhang Bingyan, 2008).

1, In the technical performance, the ship's speed, the sea constant, the resistance, the laboratory area has achieved the level which the internationally survey ship approaches.

Name	Dongfanghong 2	Xiangyanghong 2	Oceanographer (US)
m^2/t	0.096	0.144	0.106

2, The rationalization of tonnage

Multipurpose survey ship is about 3000-4000 tons, such as "Dong Fang Hong 2" which is 3700 tons, the United States "AGS-60" and "AGOR-23" which is 5000 tons of each.

Professional survey ship is about 1000-2000 tons, such as the South China Sea Institute of Oceanography "Shiyan 2".

3, Speed: Maximum 18 knots (kn), commonly used speed of 13-14kn.

4, Chinese ocean survey ship has experienced 20-30 years of development at present, it has entered a "replacement" stage (upgrade of ships), at this period, it must further strengthen cooperation with European and the international marine survey ship research and manufacture.

Power problems: transition from diesel engine to the fuel cells,automation, communications, deployment and recycling buoy

4. Gliders

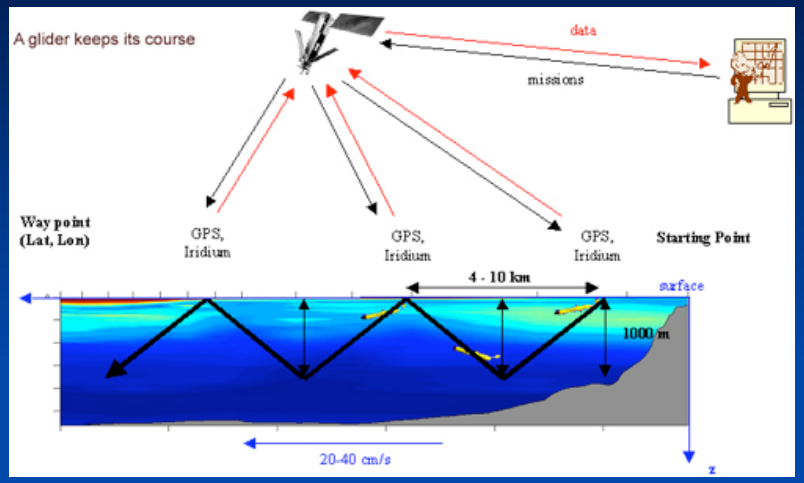


Fig 4-1 Gliders working Principle

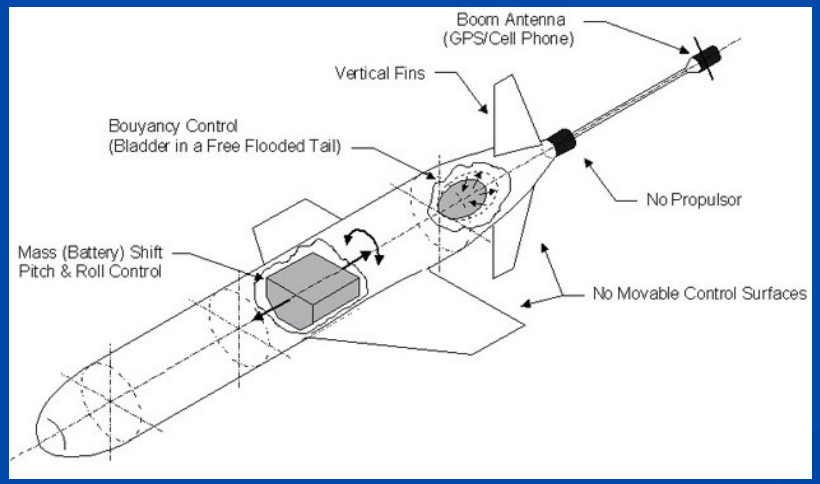


Fig 4-2 Gliders system structure

Gliders are autonomous submarine vehicles designed to observe for long time periods the interior of vast ocean Areas

Glider can collect conductivity, temperature and depth data.

NASA glider

Atlantic Ocean deployments

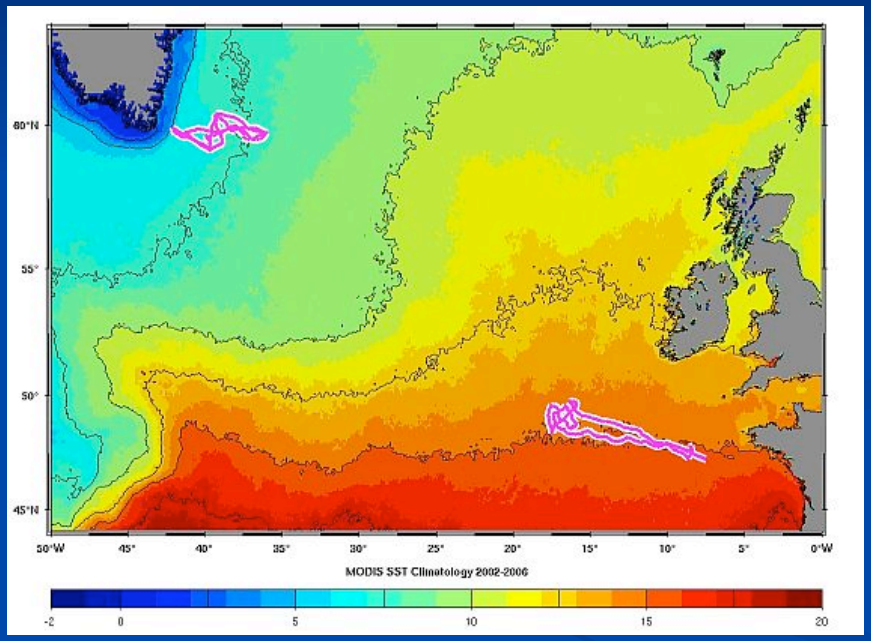


Fig 4-5 Spray-04 Glider trajectory of the of the PAP-1 and CIS-1 experiments

.Deep Mediterranean deployments

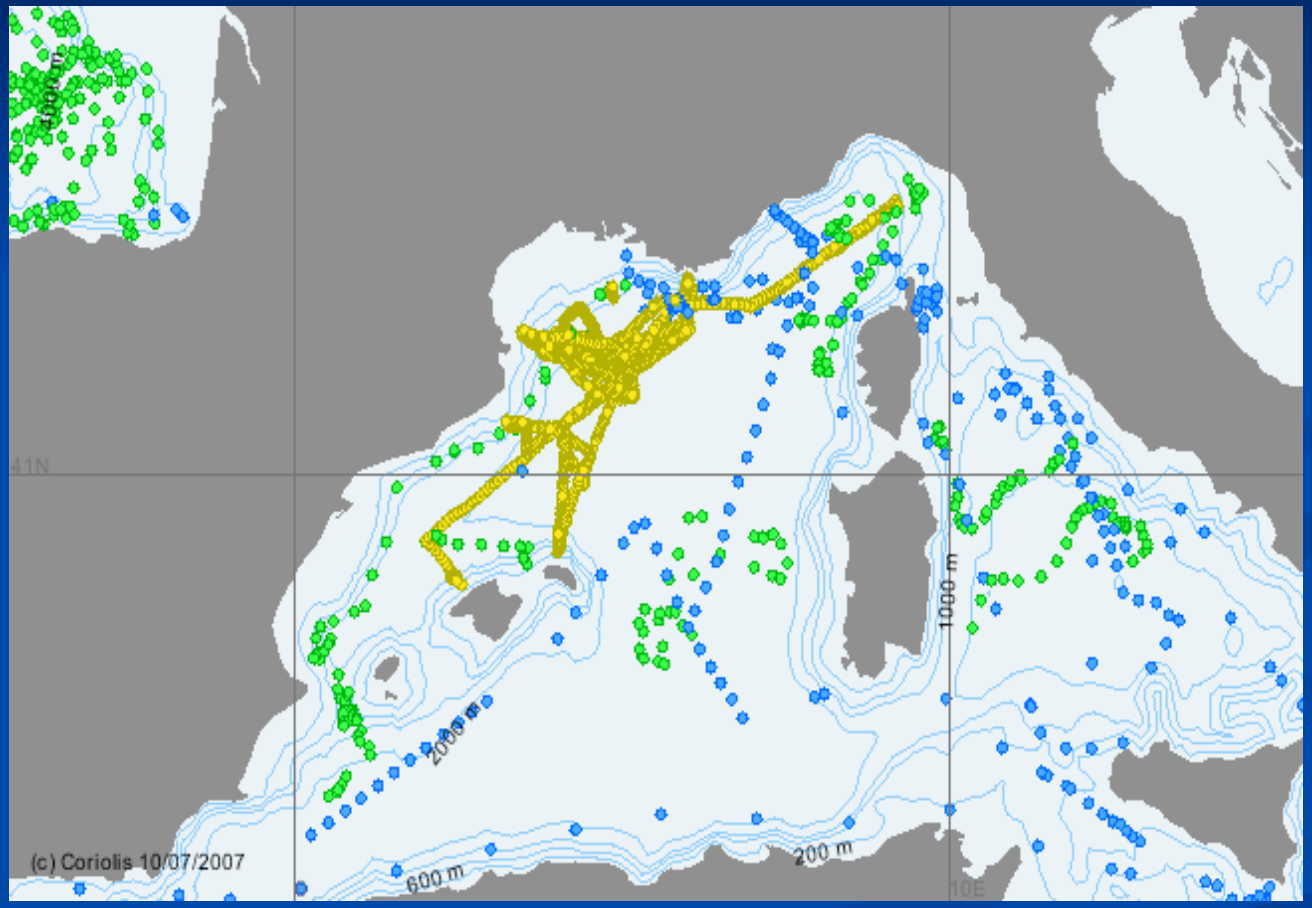
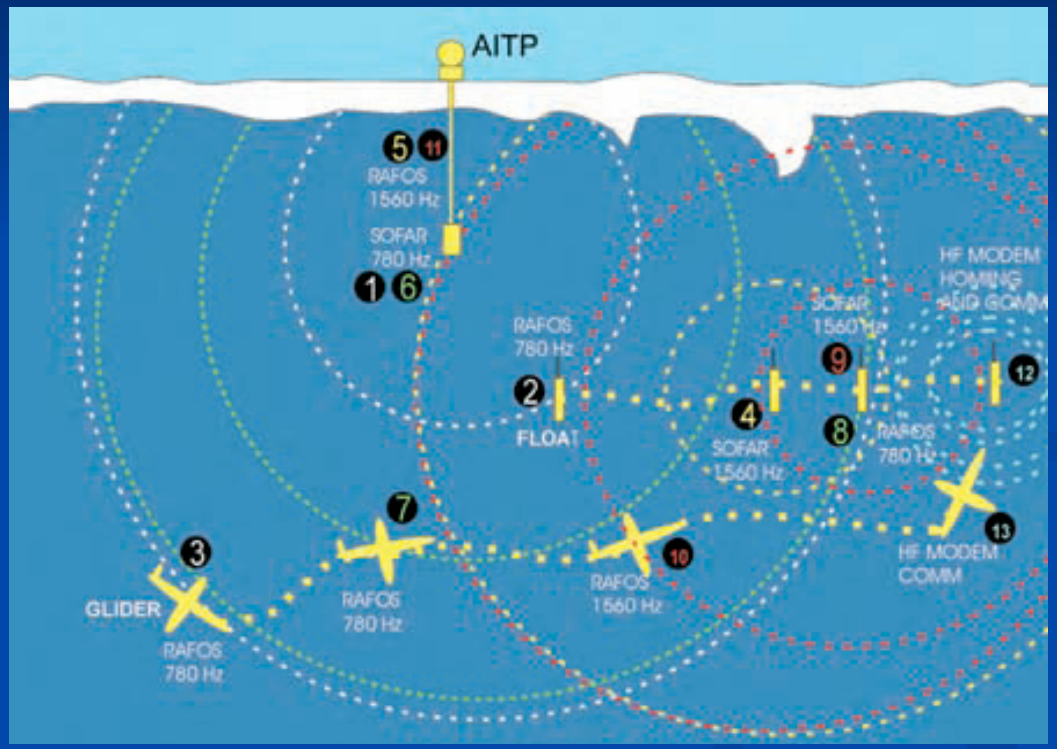


Fig 4-3 Gliders deployed and data distribution in the western Mediterranean Sea

Deployment in the Arctic Ocean

Deployment in the Arctic Ocean from the Chinese icebreaker Xuelong during CHINARE
cruise in August 2008.



Long range navigation under ice

Source: http://www.damocles-eu.org/artman2/uploads/1/poster_Sopot_task_8.3.1.pdf

Glider poster from damocles-eu

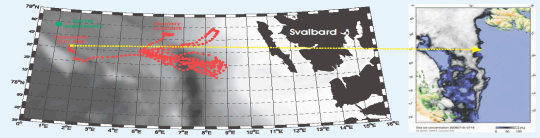
WP8.3 Integration of technological innovative subsystems: Gliders

Underwater gliders are buoyancy-driven devices, they alternately reduce and expand displaced volume to dive and climb through the ocean, just as do profiling floats. Unlike floats, gliders additionally carry wings and control their pitch attitude to effectuate a horizontal speed component through the ocean.

Seaglider in Fram Strait

The first AWI Seaglider was tested in February 2008 in Sognefjord, Norway. After the successful test the first operational mission took place in Fram Strait in July-Semptember 2008. The Seaglider SG127, developed by APL UW, Seattle and manufactured by SFG (Seaglider Fabrication Center) Seattle, was operated from the base station at OPTIMARE in Bremerhaven. SFG in Seattle served as the second, backup base station. SG127 was equipped with the SBE conductivity and temperature sensors, SBE43 dissolved oxygen sensor, Wetlabs chlorophyll a, fluoroscence and optical backscattersensors. In addition to oceanographic packages, the Seaglider carried RAFOS receiver for underwater acoustic navigation. One RAFOS sound source was deployed in the central Fram Strait for testing the range of RAFOS transmissions received by the glider.

- weight 52 kg
- length 1.8 m
- wing span 1 m
- max. profiling depth 1000m
- mean horizontal speed 12 Nm/day
- speed range 0.1-0.45 m/s
- min. vertical speed 0.06 m/s
- buoyancy range 840 g (5 kg/m3 density range = 250 g)



Deployment of the Seaglider took place from Polarstern in July 2008. The planned trajectory had to be changed due to ice conditions, the glider was deployed at the ice edge. The vehicle is at the moment not capable to operate under the ice, however was equipped with the RAFOS hardware for testing ranges of the acoustic signal. A map shows the glider track – positions of its each surfacing. When on the surface, the full measured data package together with glider's engineering data were sent to the base station and new commands were received by the glider when necessary. Due to strong currents the glider trajectory was often strongly deviated from the programmed one. In particular turning the glider in shallower water at the shelf slope west of Svalbard was difficult.

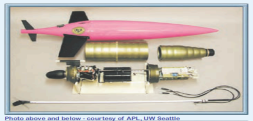
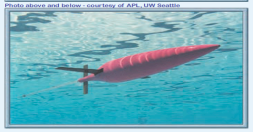
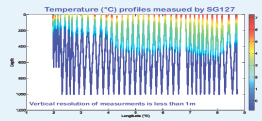
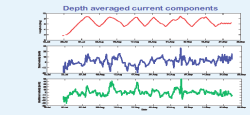
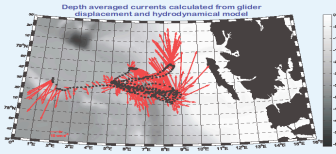


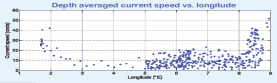
Photo above and below - courtesy of APL, UW Seattle

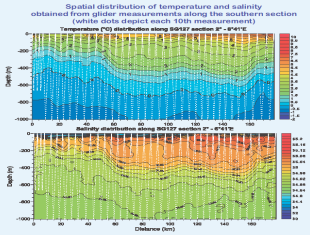




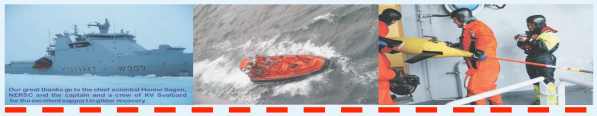






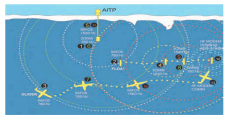


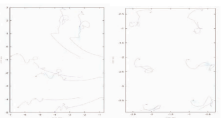
The Seaglider was recovered in September 2008 from KV Svalbard after the 68-day long mission. During 2.5 months SG127 performed 394 dives to the max. depth of 1000 m and travelled 721 Nm through the central and estern Fram Strait. 74% of energy was used and a power consumption was significantly higher during shallow dives performed to turn in the strong current of the WSC. After some adjustements to stronger currents the Kalman-Filter worked fairly good to navigate the glider most of time. But in the WSC it became necessary to steer the glider by hand westward out of the current. This was done dive by dive and in 2-hour intervals in shallow regions. The dive depth of 1000 m was always reached in the course of the mission whenever the glider was in deep water. While running up the shelf the glider used its build-in bathymetric charts to set the current dive depth.



Our great thanks go to the chief scientist Hanne Sagen, IMR/UiB and the captain and crew of the KV Svalbard for the excellent support in glider recovery!

Long range navigation under ice





The localisation and navigation algorithms have been tested during development on a simulator based on TOPAZ ice flow and sea currents estimates. Two examples of test runs are shown: one run with six AITPs lasting 30 days and second run with six AITPs lasting 60 days. In both simulations the initial locations of the AITPs are the same: a regular grid with about 150 km spacing. The glider is situated somewhere between the AITPs. The simulator is crude with a lot of information missgregating to glider dead-reckoning and under-ice acoustic performance. The model uses 120 km as the maximum range for the 780 Hz acoustic sources. The glider mission in this simulation was to move from one AITP to the next.

The development of reliable localisation estimation (odometry of the glider + low frequency acoustic information) method and suitable navigation algorithms for various tasks was continued. Robustness is the key in autonomous operations thus development needs to concentrate on non-ideal cases, where something goes not as expected. The algorithm must ensure that estimation does not diverge or that we can recover from divergence without human intervention. Robustness must be ensured by comparing several solutions from different algorithms, glider movement avoiding ambiguous configurations, ability to re-initialize an estimation and thorough testing.

The localisation algorithm is a kalman filter-like optimisation algorithm. Instead of filtering it estimates a latest trajectory with batch optimisation based of N latest measurements. The number N is a trade-off between accuracy and computational load. By being an iterative algorithm and by directly using history of measurements it is more accurate than extended kalman filter which is suboptimal in nonlinear case and whose performance degrades when there is high uncertainty in the estimates.

This algorithm coupled with appropriate movement patterns was found necessary in simulations of the under ice mission. We are waiting for a opportunity to test with real data and glider.

STERNE glider

Length 2.4m, wingspan 2m, weight 49 kg
« wet » nose (50 cm) and tail (80 cm)
« dry » body 1.2 m
Albacore profile
Tail payload: 50 cm, 10 cm diameter, 2.5 kg
Nose payload: iridium/GPS antenna, argos antenna
Operation depth 200m or 1000m
GOAL: ~ 6 m forward per m down/upward at 20 cm/s

In DAMOCLES:
- 12 test deployments in teh English Channel near Brest to validate new steering and diving capabilities.
- The Baltic Sea tests in the Bothnian Bay in October 2007. Glider lost due to communication and positioning problems.
- Deployment in the Arctic Ocean from the chinese icebreaker Xuelong during CHINARE cruise in August 2008. Glider lost.

In this report, we suggested that:

1, Under international cooperation's frame, European Community should carry out Glider cooperation with China.

2, Institutes of Oceanography and universities of China should develop Glider as soon as possible. The units of Chinese marine instrument development have ability to take Glider development and manufacture.

3, Chinese ARGO plan has received tens of millions of funding from the Ministry of Science and Technology of China, and obtains large amounts of data, organized a number of seminars on China ARGO; Ocean community of China should suggest the Ministry of Science and Technology to support Glider plan of China, and carry out the cooperation with International Glider or Europe (Mersea Glider) within five years.

Thanks for your attention!

Acknowledge Zhigang Li,Cuirong Yu, Decang Bi

Return

Bohai Strait, Yellow Sea

- The buoys observation system was deployed in the north of Yellow Sea in May 2009, including one for 2m vertical profile observation， one for 3m comprehensive observation, and three for 2m conventional observation.

- A large-scale buoy was deployed in the areas of Olympic sailing games in July, 2008.

The buoy in Bohai strait locating at Yantai coast

The buoy in the north of Yellow Sea

The buoy for Olympic Games

East Sea

Return

Seven buoys were deployed in East sea from 2007

The buoy in Taiwan Strait

The marine observation buoy in east of Shengshan (崍山)

Return

The south of Beihai city

The buoy in Beihai coast (Guangxi)

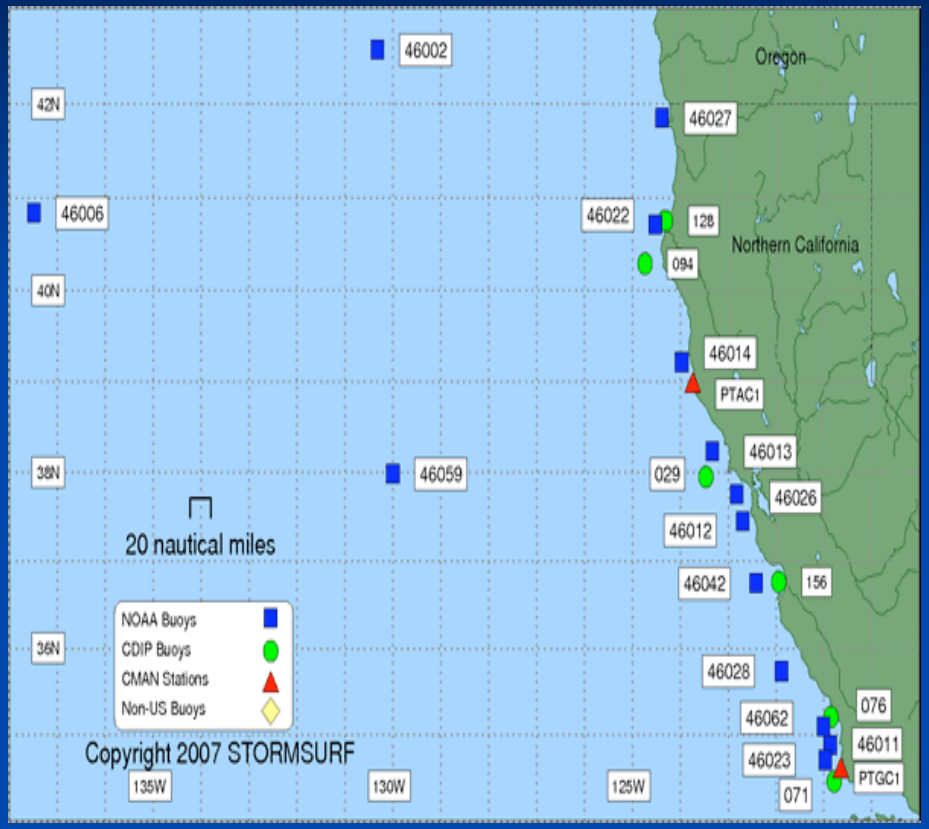
Western seashore buoys distribution in U.S.A

1, Gulf of Alaska

Gulf of Alaska			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
46066	South Aleutian	46072	Central Aleutians
46001	Gulf of Alaska	46080	Kennedy Entrance
46184	North Nomad	46081	Prince William Sound
46004	Middle Nomad	46082	Cape Suckling
46036	South Nomad	46083	Fairweather Grounds
		46084	Sitka Sound
		46205	W. Dixon Entrance
		46208	West Moressby
		46147	South Moresby
		46207	East Dellwood
		46132	South Brooks
		46206	La Perouse Bank
		46145	Central Dixon Entrance
		46185	South Hecate Strait
		46204	West Sea Otter
Total	5		15

Return

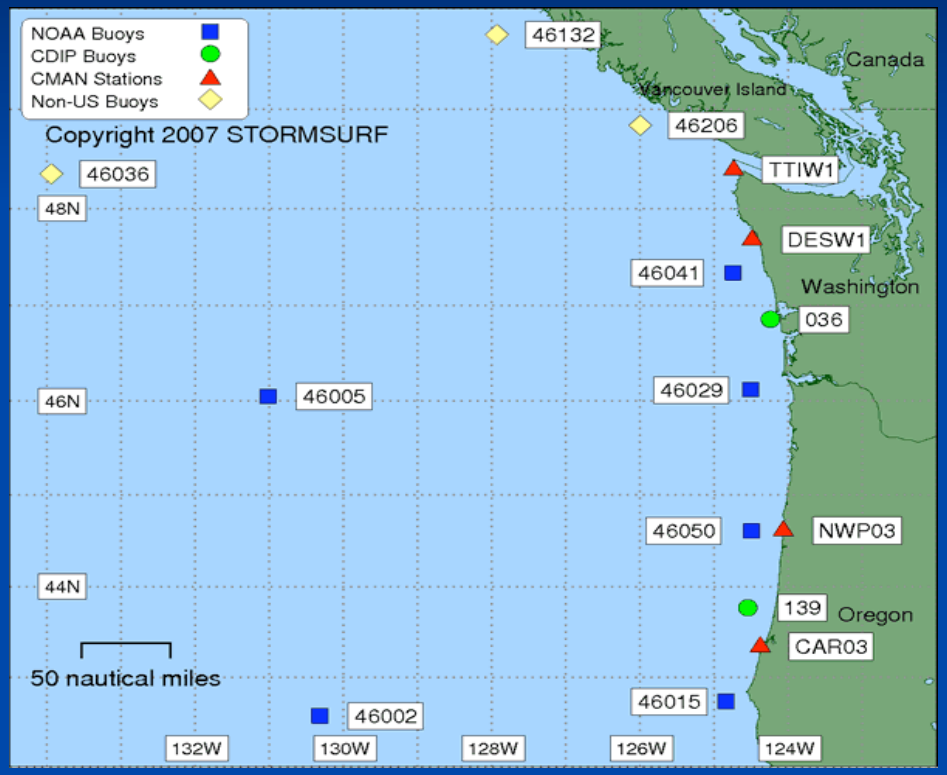
2, North & Central California



North & Central California			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
46002	Oregon	46027	St Georges
46006	South Papa	46022	Eel River
46059	California	128	Humboldt *New!*
		094	Cape Mendocino *New!*
		46014	Point Arena
		46013	Bodega Bay
		029	Pt Reyes
		46026	San Francisco
		46012	Half Moon Bay
		156	Monterey Canyon *New!*
		46042	Monterey Bay
		46028	Cape San Martin
		076	Diablo Canyon
		46062	Pt San Luis
		46011	Santa Maria
		46023	Pt Arguello
		071	Harvest
Total	3		17

Return

3, Pacific Northwest

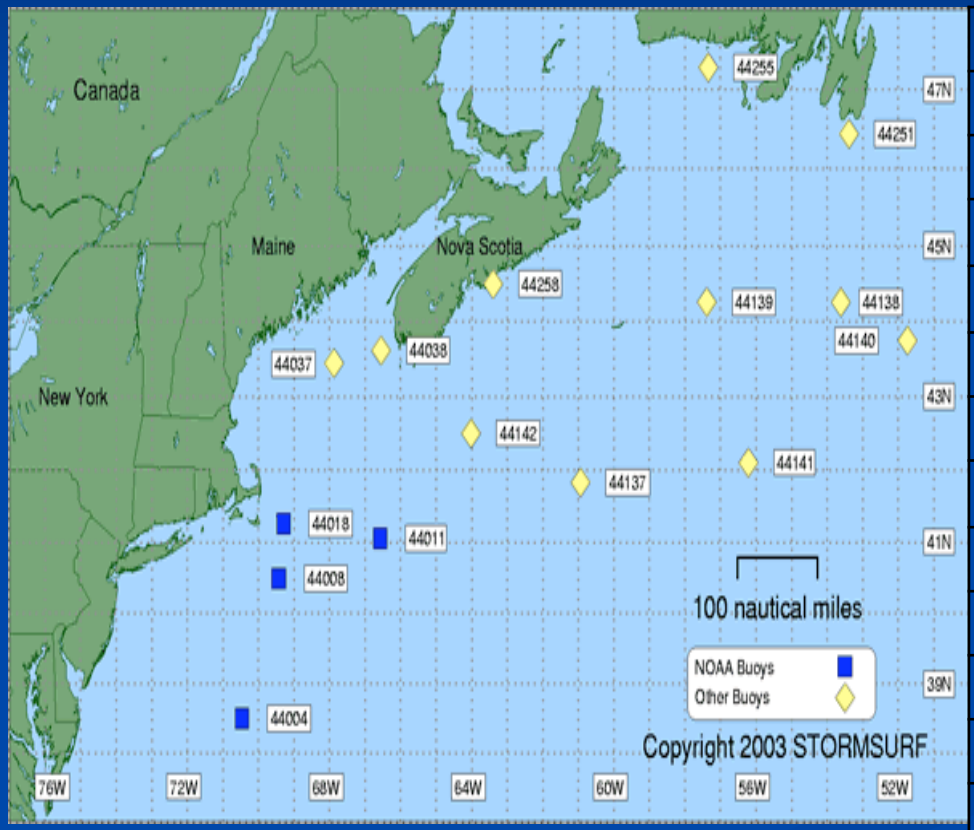


Pacific Northwest			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
46036	South Nomad	46132	South Brooks
46005	Washington	46206	La Perouse Bank
46002	Oregon	46041	Central Elizabeth
		036	Grays Harbor
		46029	Columbia River
		46050	Stonewall Bank
		139	Umpgua *New!*
		46015	Port Oxford
Total	3	8	

Return

Seashore buoys distribution in eastern America and Mexico gulf

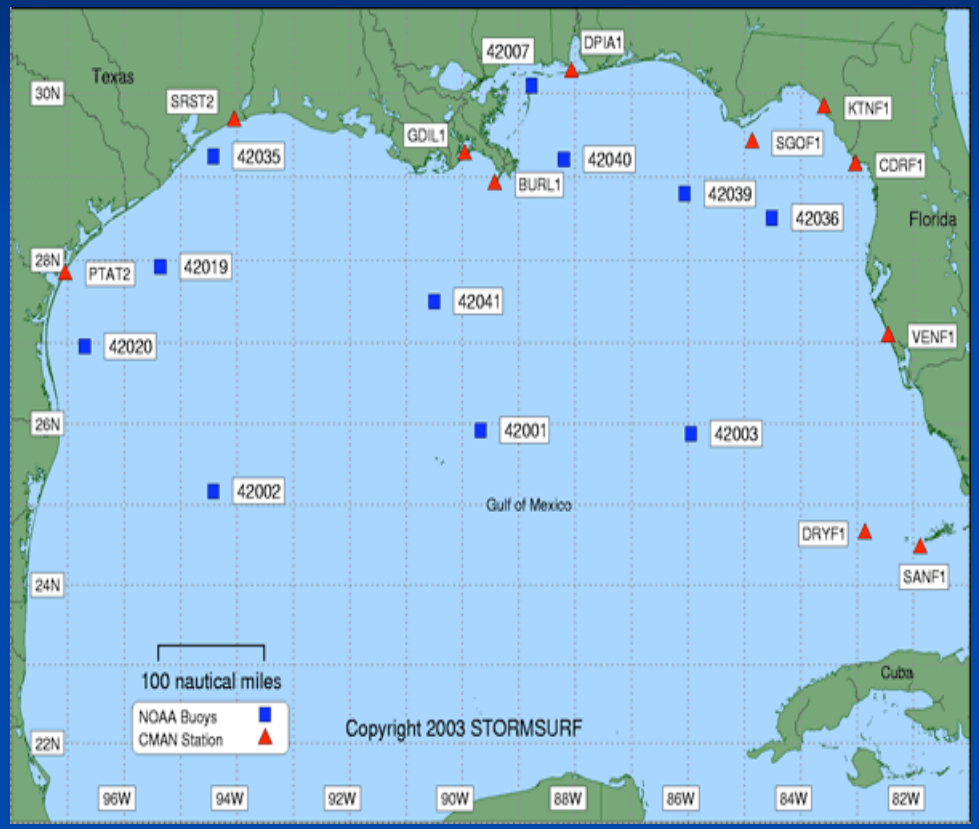
4, Seashore buoys distribution in Canada - Grand Banks & East Canada



Canada - Grand Banks & East Canada			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
44140	Tail of the Bank	44251	Nickerson Bank
44138	SW Grand Banks	44255	NE Burgeo Bank
44139	Banquereau	44258	Halifax Harbor
44141	Laurentian	44038	Scotian Shelf
44137	East Scotia Slope	44037	Jordan Basin
44142	La Have Bank	44011	Georges Bank
		44018	SE Cape Cod
		44008	Nantucket
		44004	Hotel
total	6		9

Return

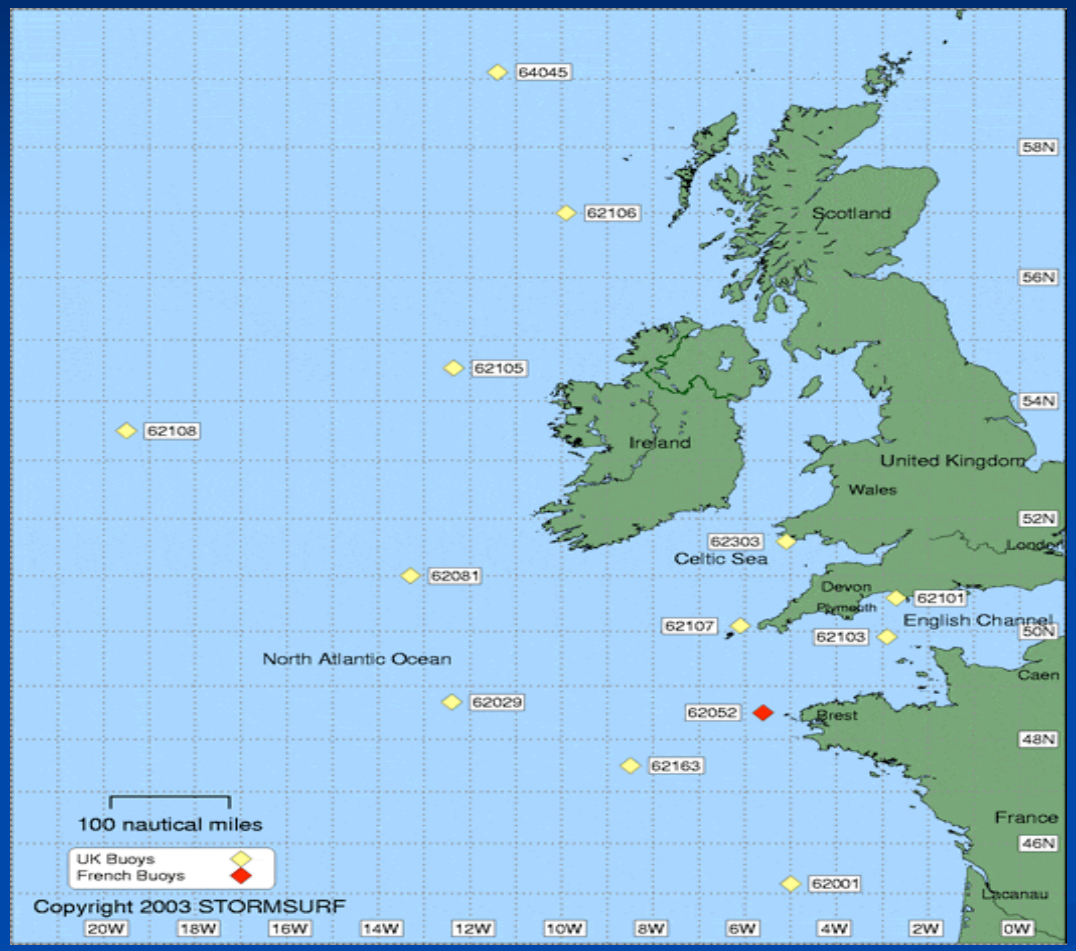
5, Gulf of Mexico



Gulf of Mexico			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
42003	Eastern Gulf	42036	West Tampa
42001	Middle Gulf	42039	Pensacola South
42041	North Mid Gulf	42040	Mobile South
42002	Western Gulf	42007	OPT
		42035	Galveston
		42019	Lanelle
		42020	Eileen
Total	4		7

Return

6, Seashore buoys distribution in Europe

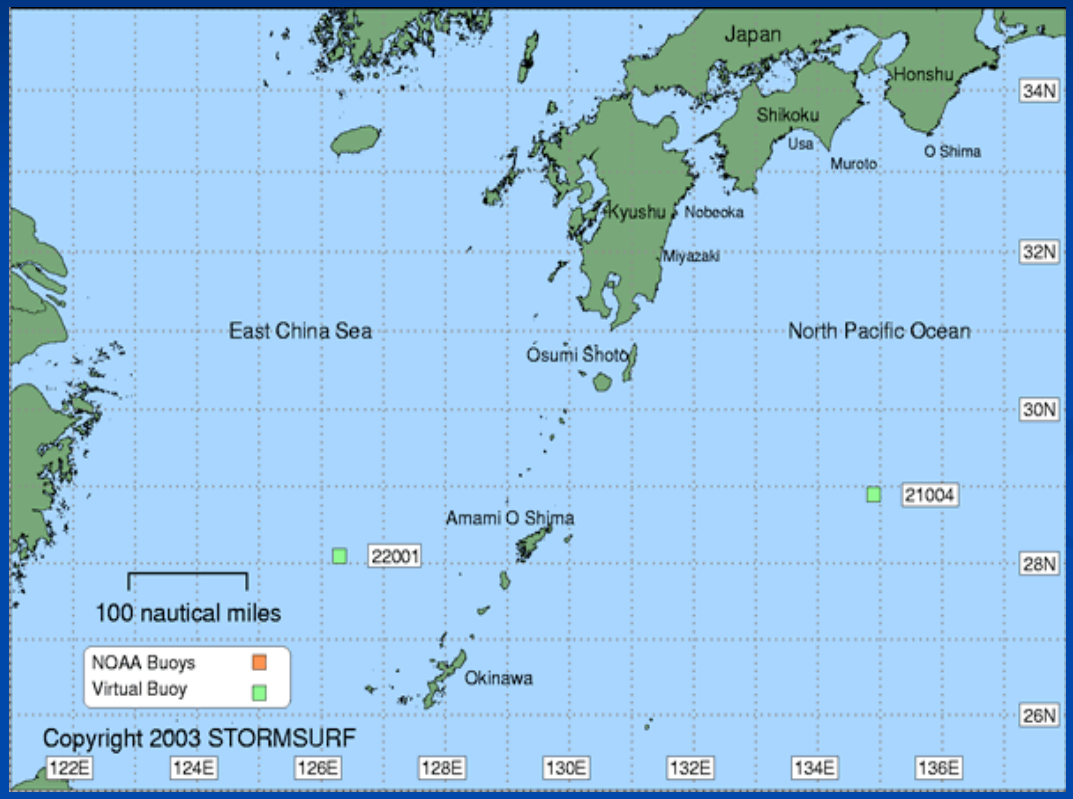


Europe			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
64045	K5	62303	Pembroke
62106	RARH	62107	Seven Stones
62105	K4	62103	Channel
62108	K3	62101	Lyme Bay
62081	K2	62052	Brest
62029	K1	62001	Gascogne
62163	Brittany		
Total	7	6	

Return

Seashore buoys distribution in Japan

7, Japan



Japan	
Offshore Buoys （Buoy Forecast）	
Buoy #	Name
21004	South Japan (Virtual)
22001	Southwest (Virtual)

Return

1, CIS (Central Irminger Sea)

Latitude and Longitude	59.4N, -39.4W
Depth	2800m
Oceanographic Region	Irminger Sea, North Atlantic

Parameter	Depths measured (m)	Sensor(s) used
Temperature	various to 1000m	MicroCAT
Salinity	various to 1000m	MicroCAT
Chl-a		WETLabs FLNTUSB
Nitrate		NAS2 NO3
PAR	-	
Dissolved Carbon Dioxide		Sunburst SAMI
POC	various	McLane Sediment Traps
Sea pressure	various to 1000m	MicroCAT
Dissolved Oxygen	-	
Wave Height	-	
Current Profile	various	ADCP, RCM
Turbidity		WETLabs FLNTUSB

Return

2, Station M

Latitude and Longitude	66N, 2E
Depth	Weather Ship
Oceanographic Region	Norwegian Sea

Parameter	Depths measured (m)	Sensor(s) used
Temperature	10, 25, 50, 75, 100, 150, 200, 300, 400, 500, 600, 800, 1000	CTD
Salinity	10, 25, 50, 75, 100, 150, 200, 300, 400, 500, 600, 800, 1000	CTD
Chl-a	10, 25, 50, 75, 100, 150, 200, 300, 400, 500, 600, 800, 1000	water bottle samples
Nitrate	10, 25, 50, 75, 100, 150, 200, 300, 400, 500, 600, 800, 1000	water bottle samples
PAR	-	
Dissolved Carbon Dioxide	-	
POC	-	
Sea pressure	-	
Dissolved Oxygen	50, 75, 100, 200, 300, 400, 500, 600, 800, 1000, 1200, 1500, 1800, 2000, 2200	
Wave Height	surface	
Current Profile	surface	
Turbidity	surface	

Return

3, Porcupine Abyssal plan (PAP)

Latitude and Longitude	49N, 16.5E
Depth	4800m
Oceanographic Region	Northeast Atlantic

parameter	Depths measured (m)	Sensor(s) used
Temperature	30,40,60,75,90,110,130,150,200,250,300,1000	Microcat
Salinity	30,40,60,75,90,110,130,150,200,250,300,1000	Microcat
Chl-a	30	HobiLabs HS2, WETLabs FLNTUSB
Nitrate	30	NAS3, SATLANTIC ISUS
PAR	-	
Dissolved Carbon Dioxide	30	Sunburst SAMI
POC	3000,3050,4700	McLane Sediment Trap
Sea pressure	-	
Dissolved Oxygen	-	
Wave Height	-	
Current Profile	-	
Turbidity	-	

Return

4, ANTARES

Latitude and Longitude	42.8N, 6.17E
Depth	2475m
Oceanographic Region	NW Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature	-	-
Salinity	-	-
Chl-a	-	-
Nitrate	-	-
PAR	-	-
Dissolved Carbon Dioxide	-	-
POC	-	-
Sea pressure	-	-
Dissolved Oxygen	-	-
Wave Height	-	-
Current Profile	-	-
Turbidity	-	-

Return

5, DYFAMED

Latitude and Longitude	43.25N, 7.52E
Depth	2300m
Oceanographic Region	Ligurian Sea, Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature		SBE 911plus CTD
Salinity		SBE 911plus CTD
Chl-a		WETLabs ECO-FLNTNS
Nitrate		Water Bottle Samples
PAR	-	
Dissolved Carbon Dioxide		TCO2 and alkalinity from bottle samples
POC	200, 1000	Sediment traps
Sea pressure	-	
Dissolved Oxygen		water bottle samples and SBE 43 Seabird Dissolved Oxygen Sensor
Wave Height	-	
Current Profile	-	
Turbidity	-	

Return

6, W1-M3A

Latitude and Longitude	43.79N, 9.16E
Depth	1300m
Oceanographic Region	Ligurian Sea (Western basin) Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature	0,6,12,20,28,36	
Salinity	0,6,12,20,28,36	
Chl-a	36	WETLabs ECO-FLNTUS
Nitrate	-	
PAR	-	
Dissolved Carbon Dioxide	-	
POC	-	
Sea pressure	Surface	
Dissolved Oxygen	36	
Wave Height	10	
Current Profile	-	
Turbidity	36	

Return

7, E2-M3A

Latitude and Longitude	41.836N, 17.756E
Depth	1204.6m
Oceanographic Region	Adriatic Sea, Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature	5,15,364,564,764,1014, 1170	MicroCAT
Salinity	5,15,364,564,764,1014	MicroCAT
Chl-a	-	
Nitrate	-	
PAR		
Dissolved Carbon Dioxide	-	
POC		
Sea pressure	5,15	
Dissolved Oxygen		
Wave Height	-	
Current Profile	350	ADCP upward looking
Current	1182	Aandera, combined instrument,

Return

8, Poseidon Pylos

Latitude and Longitude	36.8N, 21.6E
Depth	1660m
Oceanographic Region	Ionian Sea/Pylos, Mediterranean

parameter	Depths measured (m)	Sensor(s) used
Temperature	20, 50, 75, 1000 100, 250, 400, 600	Seabird 16plus-IMP Seabird 37-IM
Salinity	20, 50, 75, 1000 100, 250, 400, 600	Seabird 16plus-IMP Seabird 37-IM
Chl-a	-	
Nitrate		
PAR		
Dissolved Carbon Dioxide	-	
POC	-	
Sea pressure		
Dissolved Oxygen	-	
Wave Height		Fugro OCEANOR Wavesense
Current Profile	5-50, 10 bins of 5m	Nortek Aquadopp 400kHz
Turbidity		

Return

9, Poseidon E1-M3A

Latitude and Longitude	35.66N, 24.99E
Depth	1440m
Oceanographic Region	Aegean/ Cretan Sea, Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature	20, 50, 75, 100 250, 400, 600, 1000	Seabird 16plus-IMP Seabird 37-IM
Salinity	20, 50, 75, 100 250, 400, 600, 1000	Seabird 16plus-IMP Seabird 37-IM
Chl-a	20, 50, 75, 100	WETLabs FLNTUS-RT
Nitrate		ECOLAB NO2-PO4
PAR	20, 50, 75, 100	Licor LI-193
Dissolved Carbon Dioxide	-	
POC	-	
Sea pressure		
Dissolved Oxygen	20, 50, 75, 100	SBE43
Wave Height		Fugro OCEANOR Wavesense
Current Profile	5-50, 10 bins of 5m	Nortek Aquadopp 400kHz
Turbidity	20, 50, 75, 100	WETLabs FLNTUS-RT

Return

10, European Station for Time series in the ocean (ESTOC)

Latitude and Longitude	35.66N, 24.99E
Depth	1440m
Oceanographic Region	Aegean/ Cretan Sea, Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature	various	MicroCAT
Salinity	various	MicroCAT
Chl-a		WETLabs FLNTUSB
Nitrate		NAS2 NO3
PAR	-	
Dissolved Carbon Dioxide		Sunburst SAMI
POC	-	
Sea pressure	various	MicroCAT
Dissolved Oxygen	-	
Wave Height	-	
Current Profile		ADCP
Turbidity	-	

Return

11, TENATSO-Tropical Eastern Atlantic Time Series Obervatory

Latitude and Longitude	35.66N, 24.99E
Depth	1440m
Oceanographic Region	Aegean/ Cretan Sea, Mediterranean

Parameter	Depths measured (m)	Sensor(s) used
Temperature		MicroCAT
Salinity		MicroCAT
Chl-a		WETLabs FLNTUSB
Nitrate	-	
PAR	-	
Dissolved Carbon Dioxide	-	
POC	-	
Sea pressure	-	
Dissolved Oxygen		Aanderaa Optode
Wave Height	-	
Current Profile		RDI ADCP
Turbidity		WETLabs FLNTUSB

Return