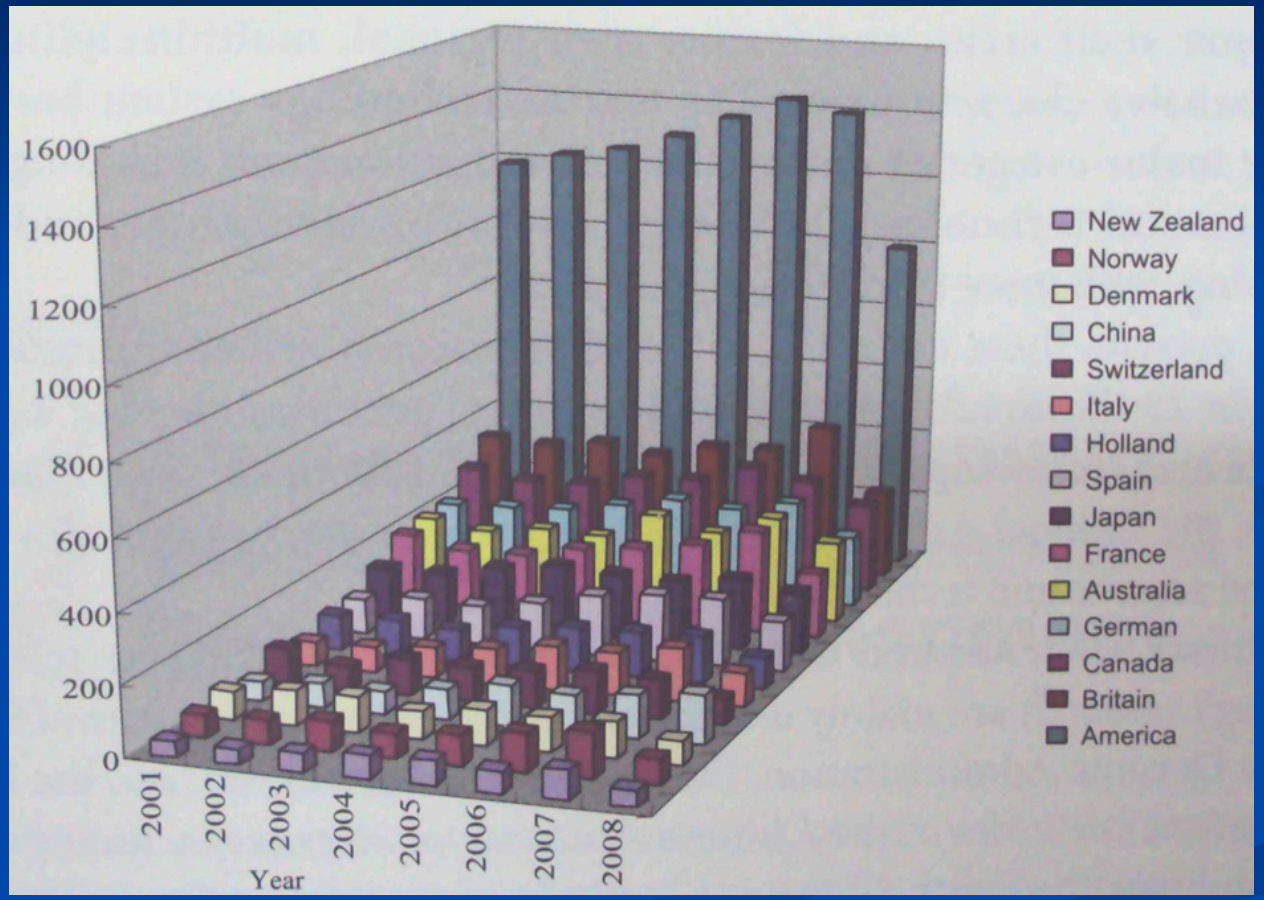
Challenges of Ocean Observation Technology and System of China

- China's marine science and technology has gone through the course of development for more than 50 years. Encouraging achievements have been made which greatly improved China's international status. China is a large maritime country, but China's overall level of marine science and technology still can not meet the national and industrial needs.

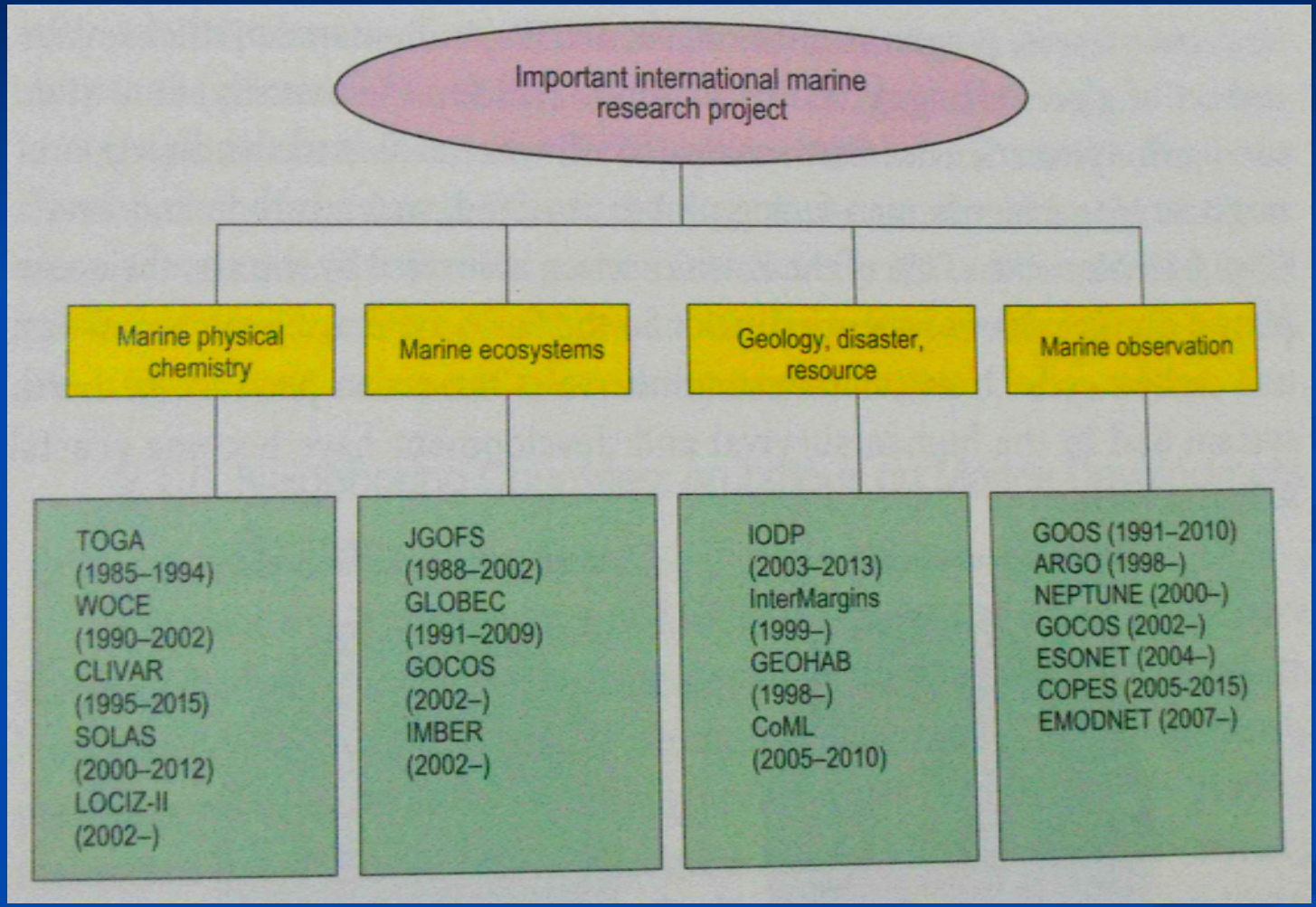
I. Overall Level of Marine Observation Technology and System Needs to Be Improved

- Compared with the European maritime countries, China's overall level of marine observation technology and system is relatively behind.
- **If papers divided by population ??**



Top 15 countries in ranking number of published paper in marine science from 2001 to 2008

II. Marine Observation Technology Needs Change from Follow-up to Innovation



classification of major international research programs

carried out a large number of international cooperation, but role in most is subordinate; China-led ones are rare. only passively involved;

there is no China-proposed international project ;

Independent innovation is still relatively weak.

China have ability to propose a large international marine observation Program?

4、3-D marine environment monitoring technology:

China's three-dimensional marine observation network, lacking near-shore platform for systematic observations. The new means of observation have not yet been widely applied. High-performance, automated sampling system is rare The Standardization of observation needs to be promoted .Data transmission is limited as the result of lacking national data sharing and global data exchange.

Ocean three-dimensional environmental monitoring

technology that is to monitor the marine environmental elements from space, seashore stations, sea surface and underwater simultaneously.

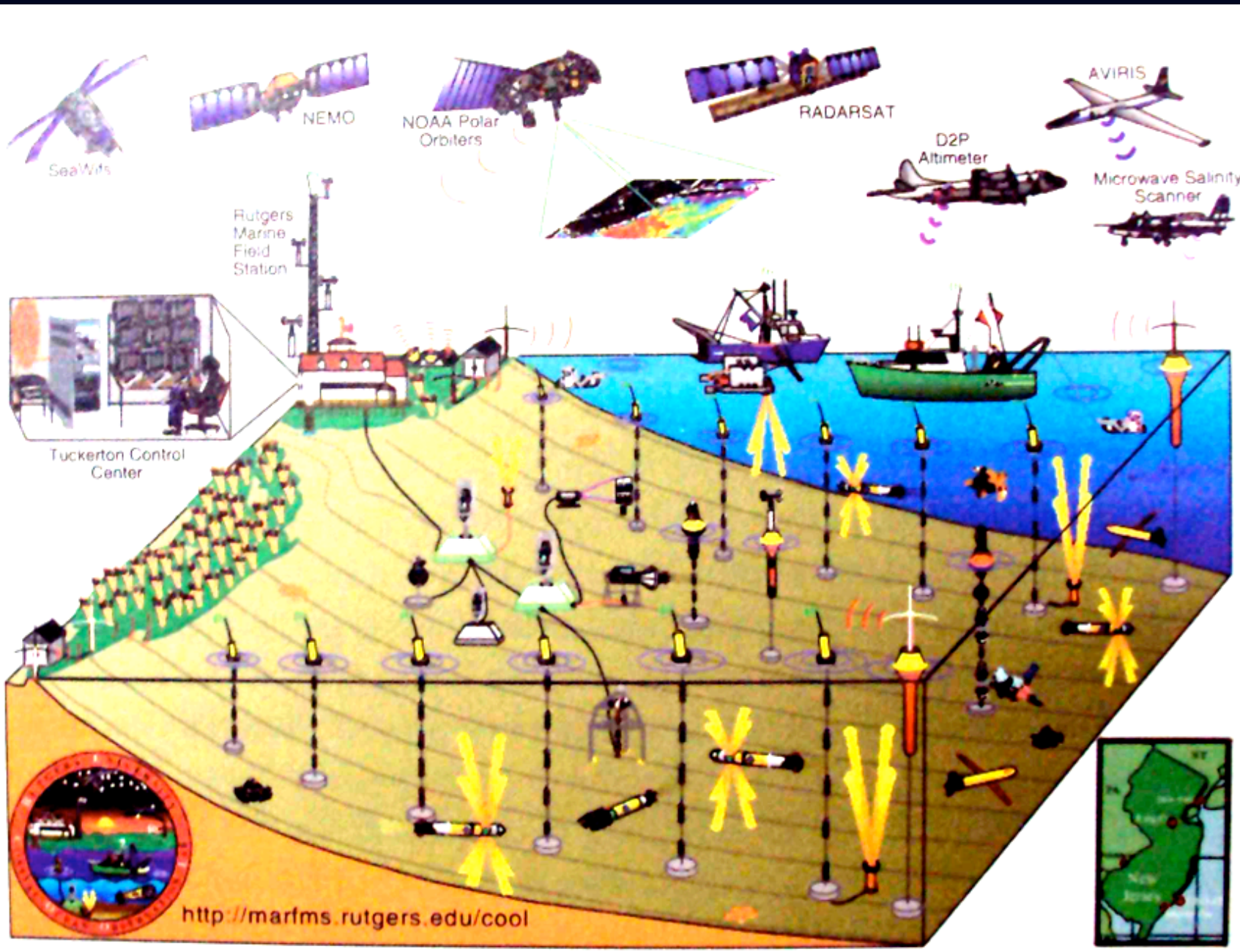


Fig. 2.12 Three-dimensional network of marine observation (Source: http://marfms.rutgers.edu/cool)

Essential Components of an Observation Network

Sensors to measure continuously and automously physical, chemical and biological parameters

- salinity, temperature
- turbidity, oxygen
- chlorophyll, nutrients
- pH, alkalinity
- bathymetry
- primary production

Platforms or structures anchored on the seabed, floating in the water column or drifting at the sea surface, and remote sensing from satellites.

- buoys, floats
- gliders
- mooring
- AUVs, lander
- FerryBox
- cabled networks
- remote sensing
- living Argo

Sampling and consecutive laboratory analyses from research ships, or shore, including water, sediments and biota (phytoplankton, bacteria, zooplankton, fish)

- inorganic trace compounds
- gases, e.g. CO2, CH4, DMS
- organic micropolluants
- abundance & function of biota
- food web
- HABs

Communication systems to transfer in real-time data from sensors to the network and to the land stations

- satcom
- GSM, GPRS
- fibre optics
- acoustics

Data collection and management system for direct control of data quality, and data storage systems to enable data analysis and use for model applications

- data bases
- quality control
- data standards

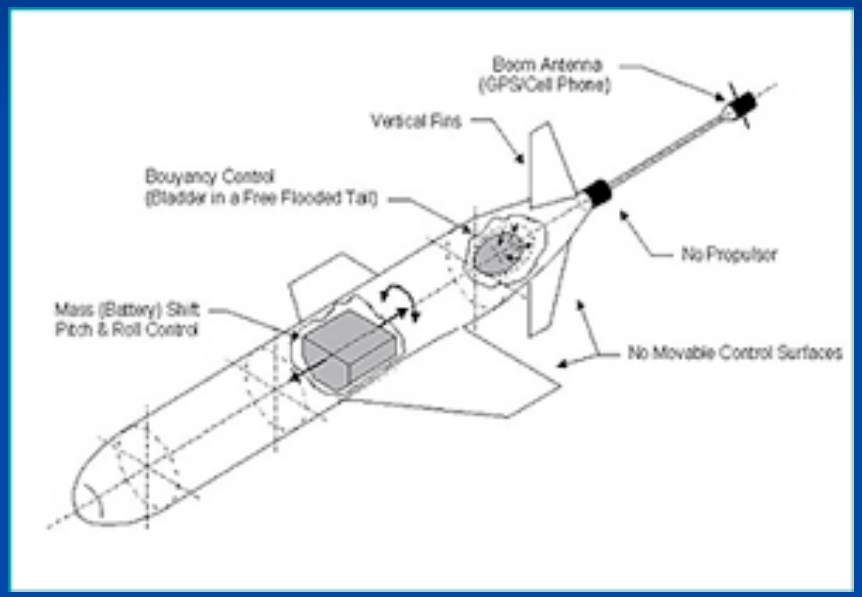
Software and web based information tools to analyse data for trends, compliance to EU directives, to distribute and disseminate data to end users

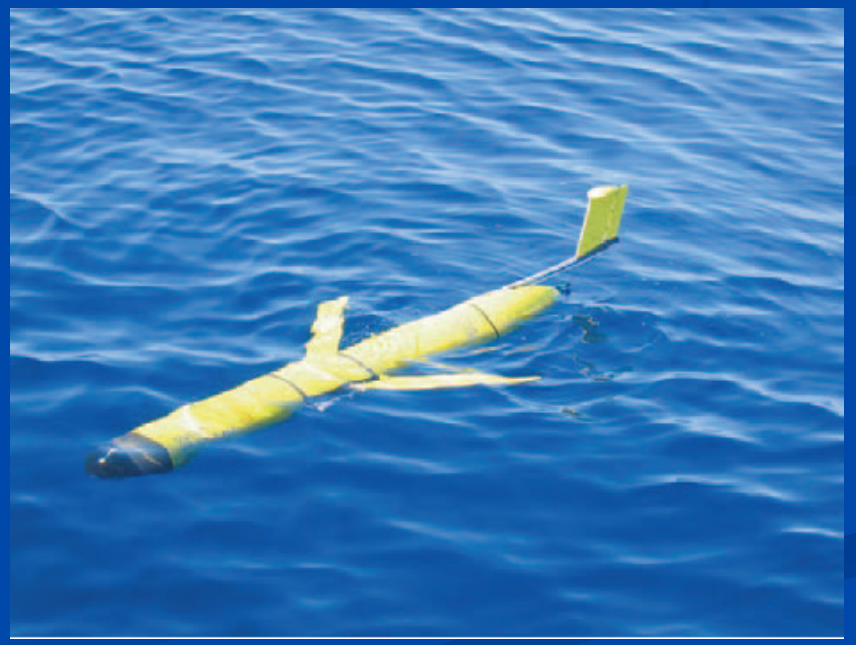
- analysis
- Presentation
- web
- GIS

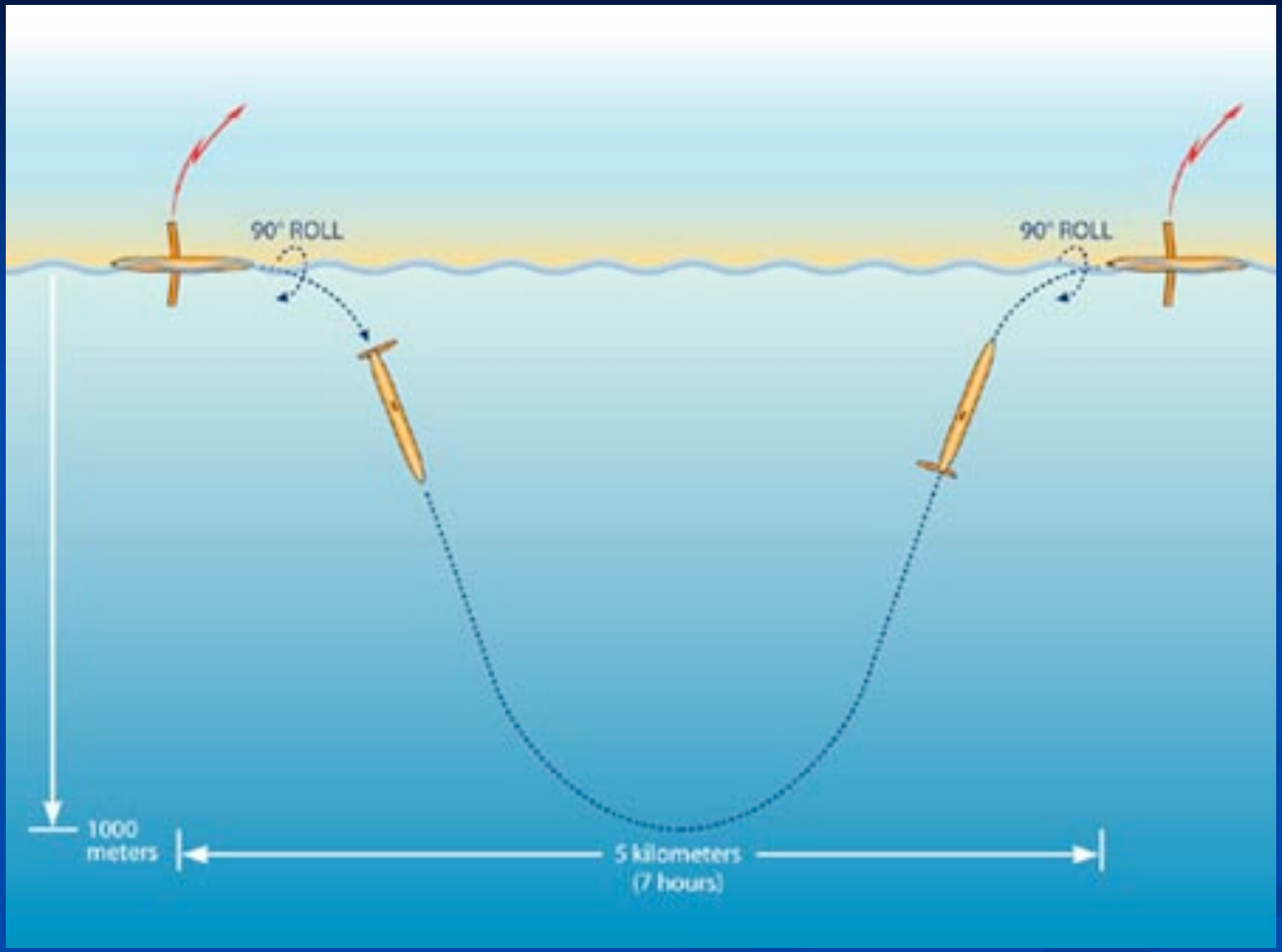
Learn from EMODNET, establish a network of existing and future Chinese observation systems, linked by a data management structure covering all Chinese coastal waters, shelf seas and surrounding ocean.

Learn from **EMODNET,** system has an end-to-end system linking the modules "Sensors & Platforms", "Surveys", "Communication Systems", "Data Management " and "Information Tools". Depending on the diffenrence tasks and problems in the different sea regions there may be differences in details on the application of strategies and methods.

5. Develop Gliders in China

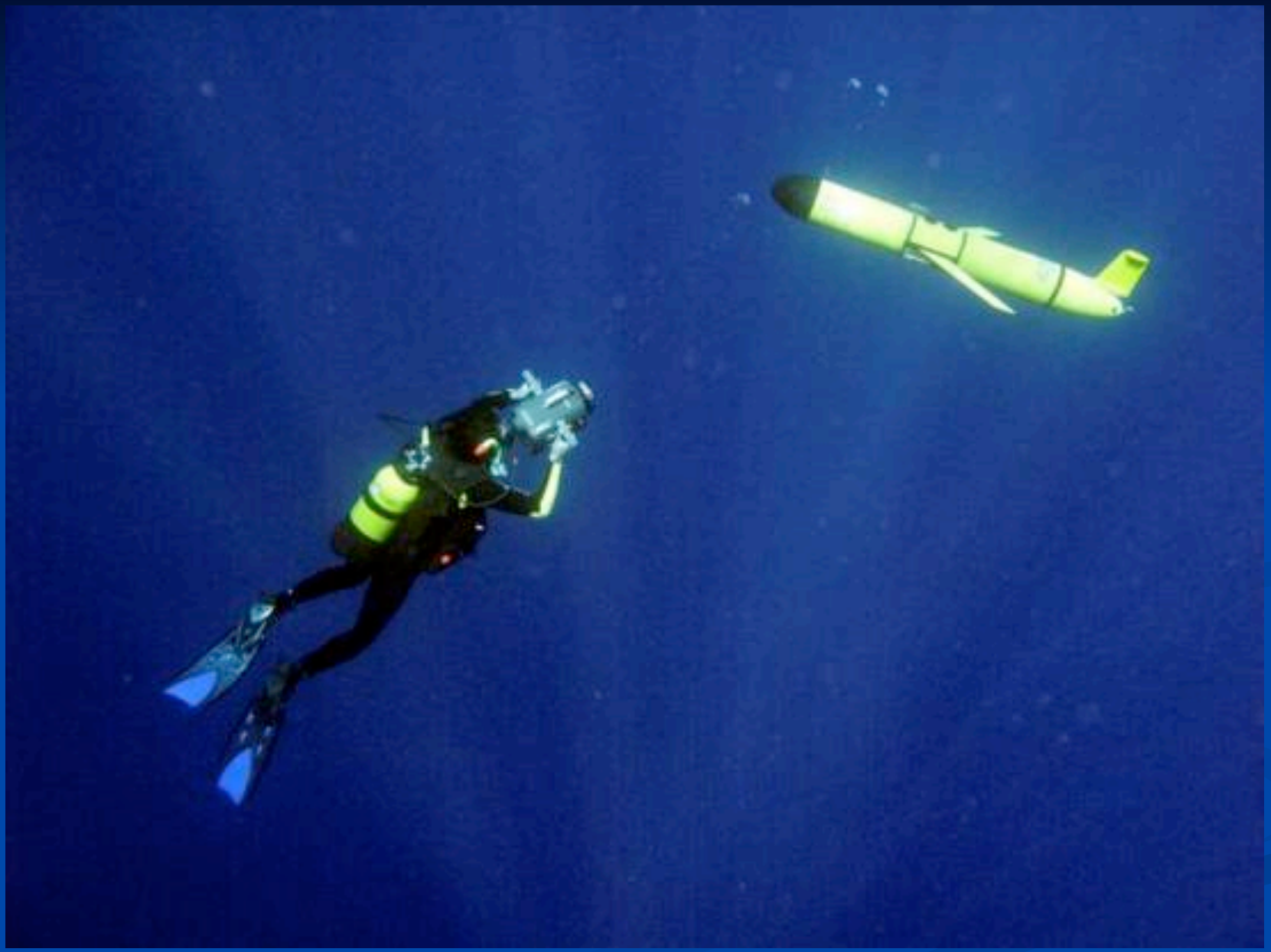






Glider motion in the water vedieo

An underwater glider is a type of autonomous underwater vehicle (AUV) that uses small changes in its buoyancy in conjunction with wings to convert vertical motion to horizontal, and thereby propel itself forward with very low power consumption.



Gliders are autonomous submarine vehicles designed to observe for long time periods the interior of vast ocean areas at lower cost than oceanographic ships and moorings.

The high spatio-temporal variability of these processes and their interactions make difficult the study of the physical state of ocean and the marine ecosystem:

First, because they imply the need to measure physical, chemical and biological parameters simultaneously and

Second, because they impose to carry out ocean measurements at high spatial and temporal resolutions.

Several gliders have been deployed in the western Mediterranean Sea in the framework of the MERSEA project between mid January and mid June. Around 1500 deep casts (down to ~1000m depth) and 1700 shallow casts (down to ~200m depth) have been carried out by these autonomous platforms

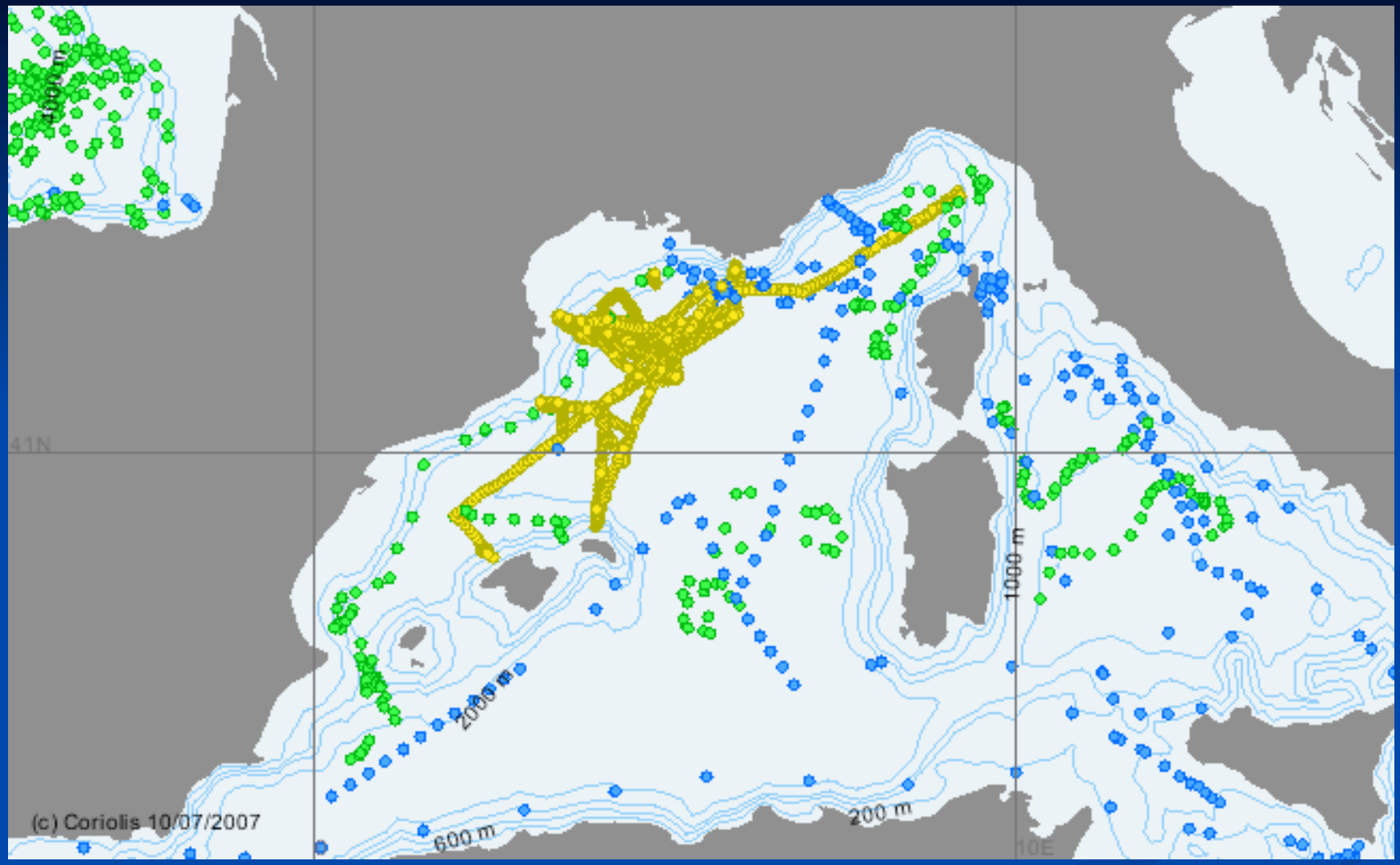
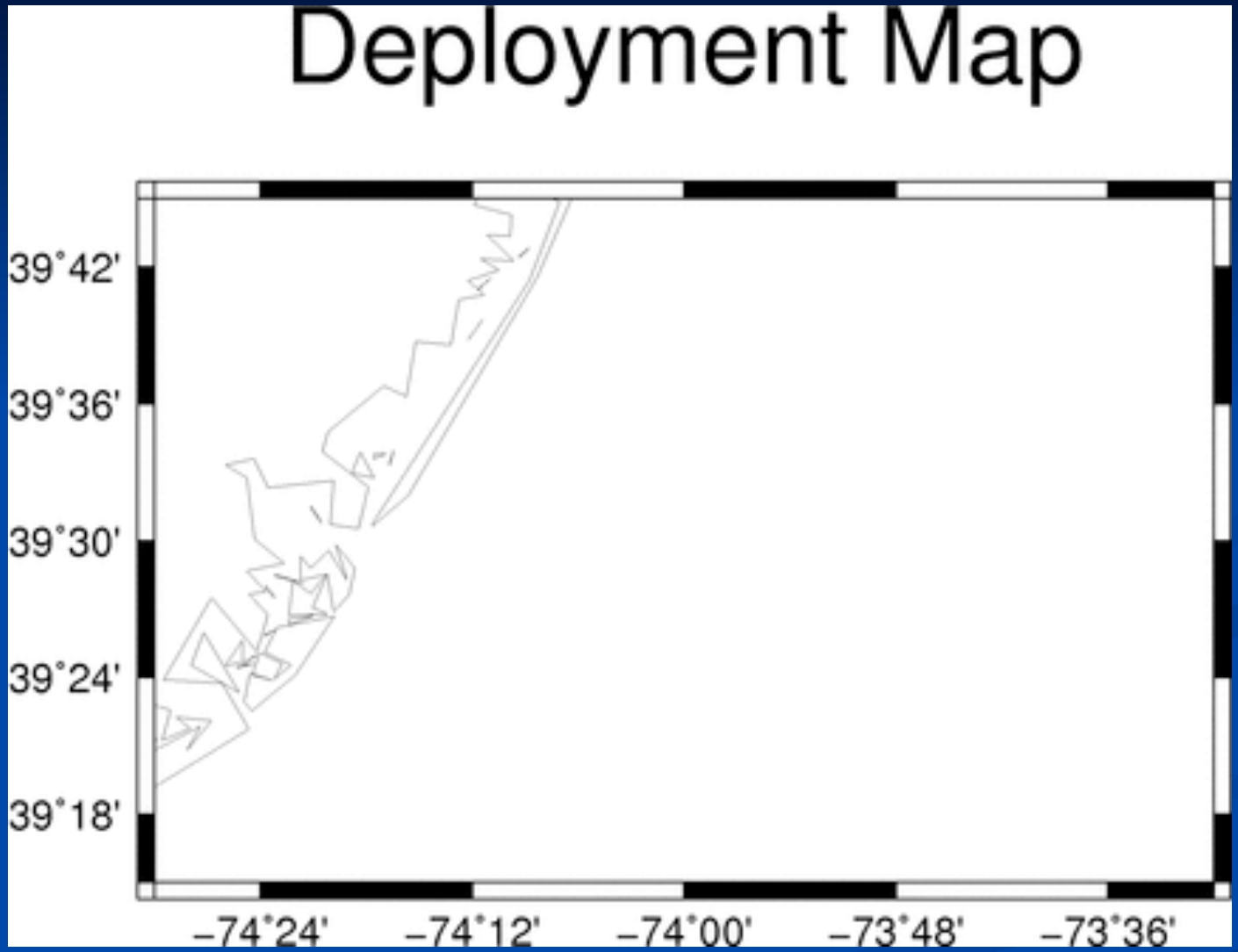


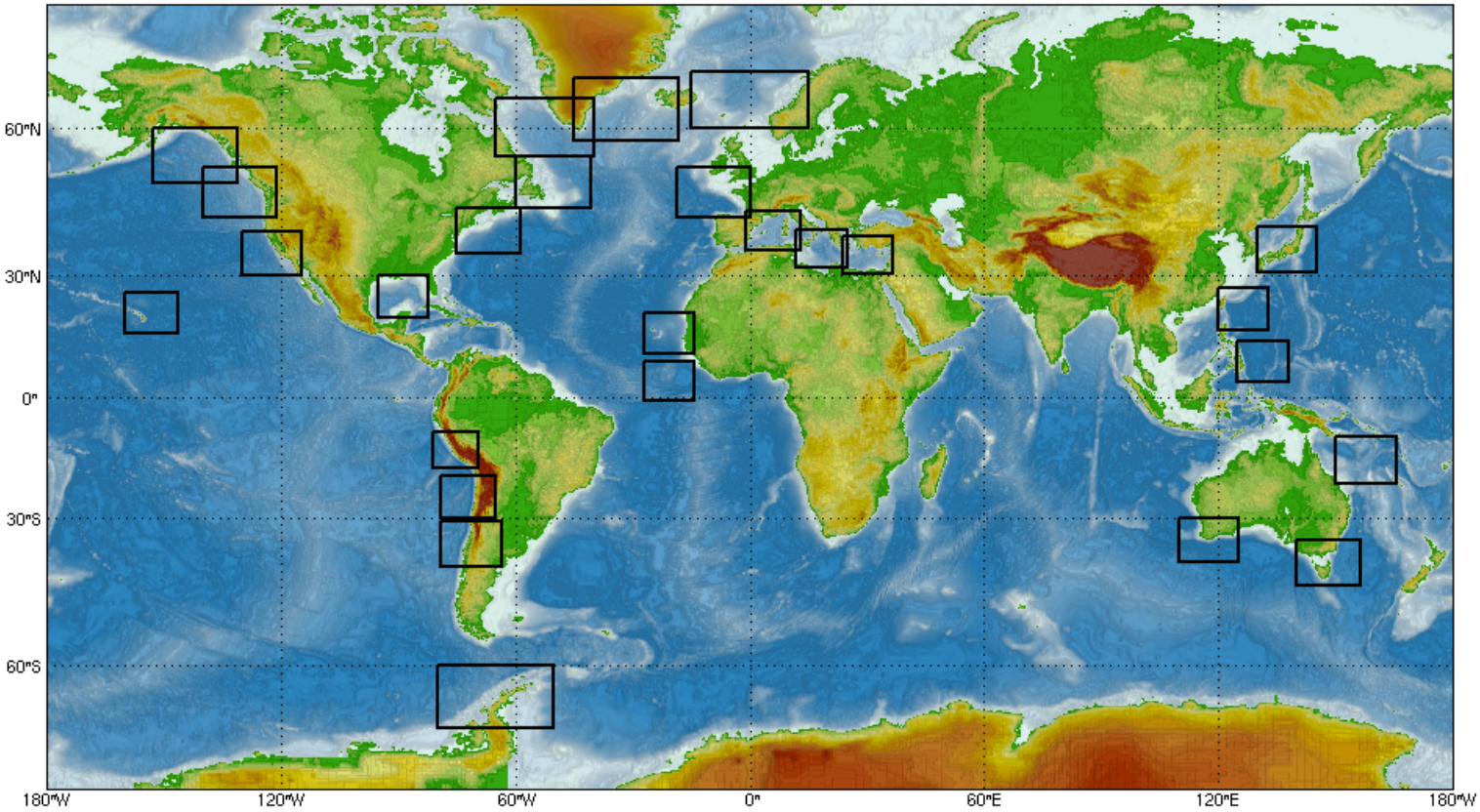
Figure 2-27 Gliders deployed and data distribution

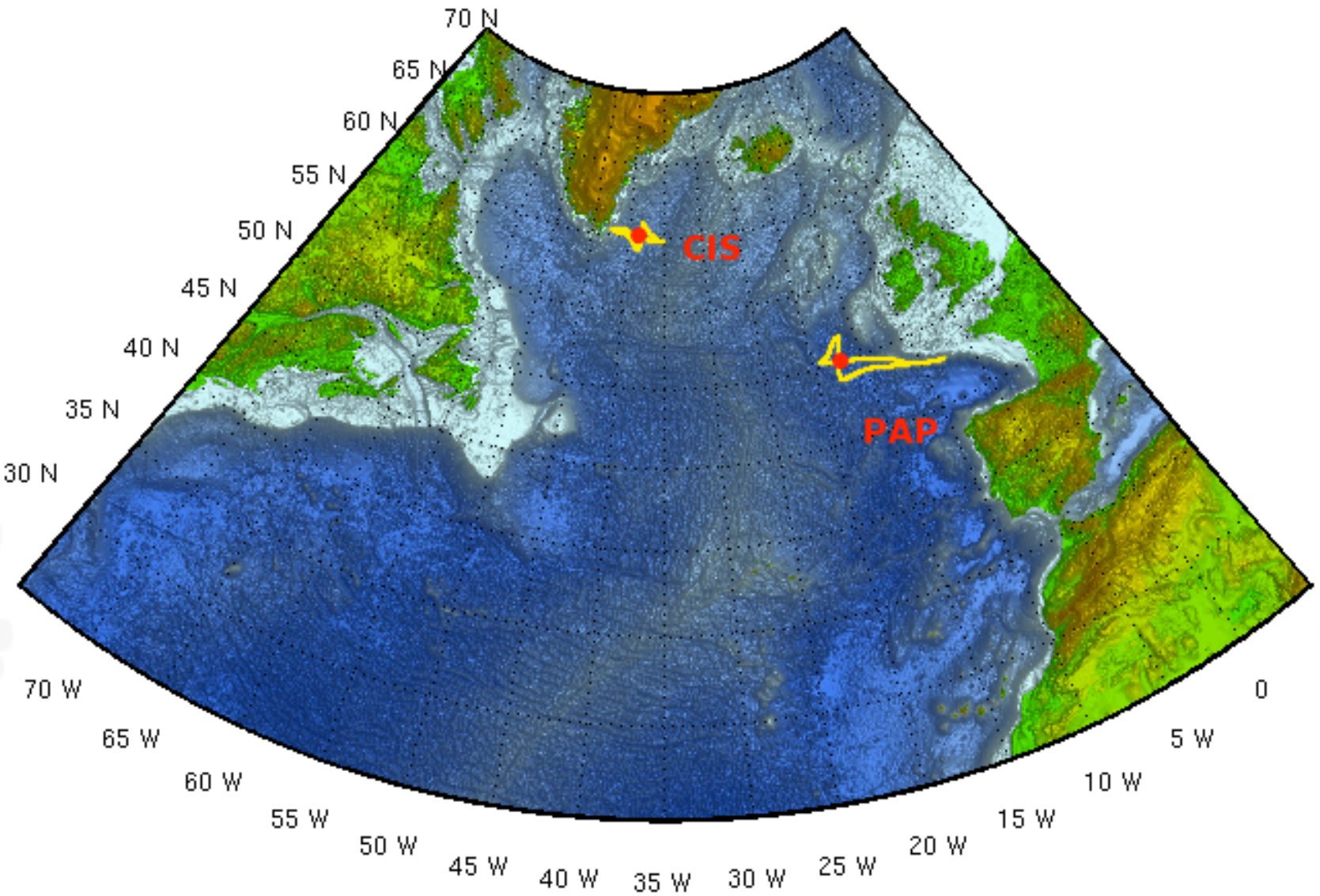


This movie spans a 6 day time period

Here, the figure shows glider experiments sorted by regions where gliders projects have been carried out.

China Has not this kind of program!!!





Glider operations in the North East Atlantic were carried out in the framework of the MERSEA

EGO (European Gliding Observatories) members:

China should organize this kind of project as soon as possible !!!

suggested that:

A, Under international cooperation's frame, Europe community should carry out Glider cooperation with China.

B, Institute of Oceanography and university of China should develop Glider as soon as possible. The units of Chinese marine instrument development have ability to take Glider development and manufacture.

C, 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;

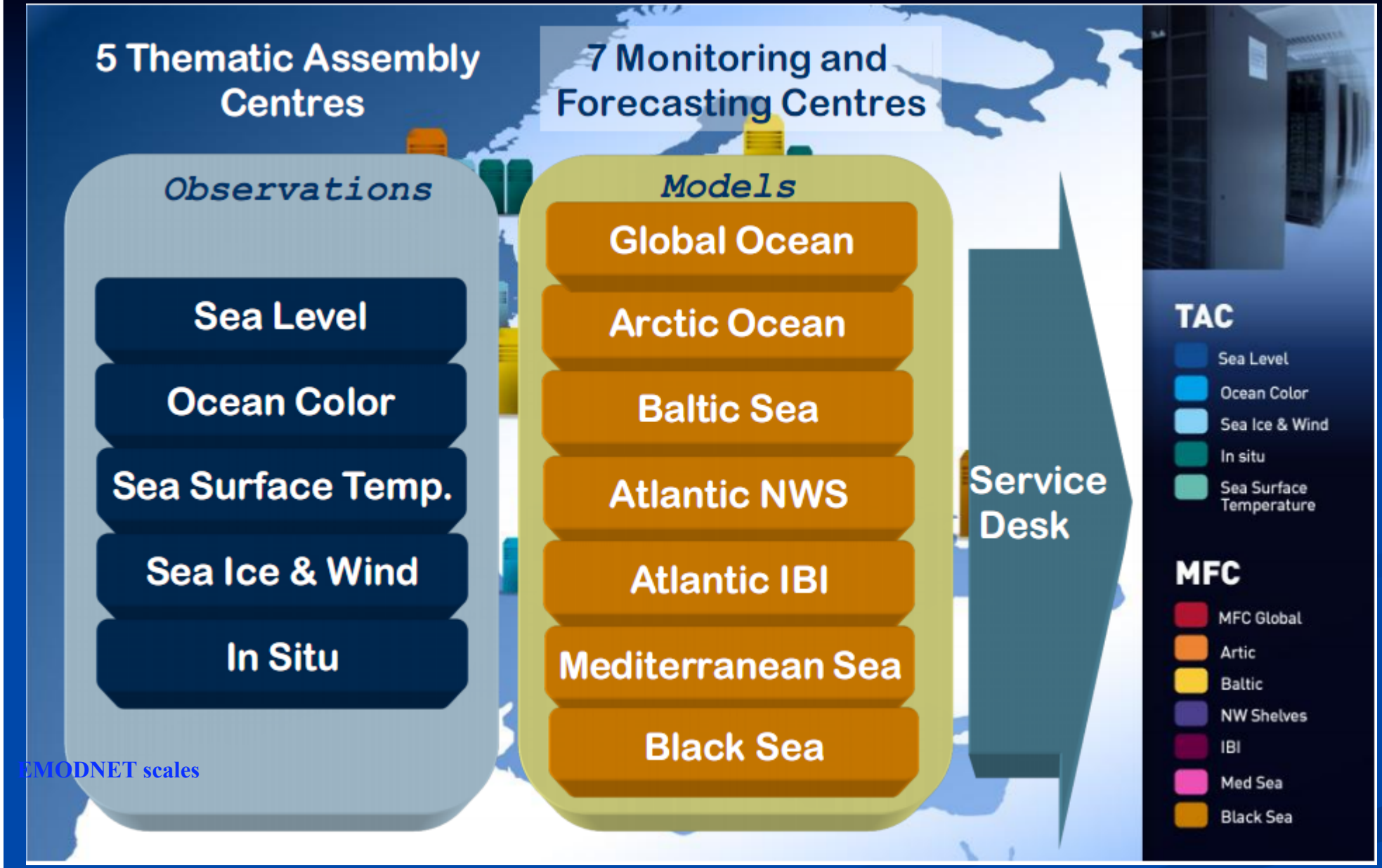
Ocean community of China should suggest the Ministry of Science and Technology to support Glider plan of China, and carry out the cooperation with International Glider or Europe (EGO Glider) within five years.

6,Long-term, Real-time Observation Means of Far-reaching Ocean

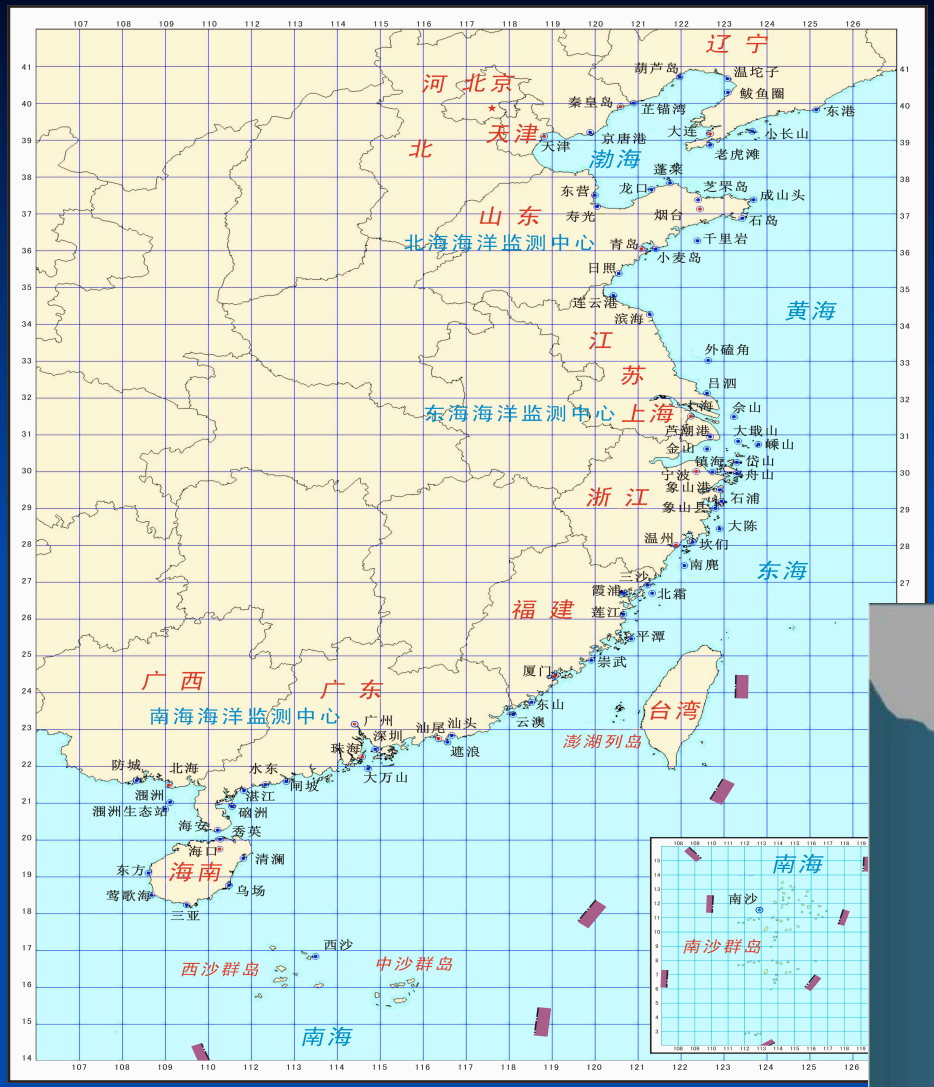
In the research of ocean circulation, it is necessary to develop long-term, real-time observation means of far-reaching ocean. If investigation of large-scale and high-frequency are developed in the Western Pacific, Eastern India Ocean and far areas, the issue of cost-effectiveness of science research expense will become more prominent.

To avoid its happening, it is required to develop comprehensive marine environment detection buoys, submerge buoys and bottom founded buoys which can be deployed in the sea bottom for a long time.

The main technical bottleneck are the design of integrated observation system in deep sea and accurate measurement of elements of marine environment, such as temperature, salinity, velocity, density, etc.



EMODNET scales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浙 江
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芷锚湾
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京唐港
大连
北长山
天津
老虎滩
蓬莱
东营
龙口
芝罘岛
成山头
寿光
烟台
石岛
千里岩
青岛
小麦岛
日照
连云港
滨海
外磕角
吕泗
大洋
佘山
芦潮港
大戢山
嵊山
金山
镇海
岱山
宁波
舟山
象山港
石浦
象山县
大陈
温州
坎门
南麂
三沙
霞浦
北霜
莆江
平潭
渠武
厦门
东山
云澳
广州
深圳
汕尾
汕头
珠海
遮浪
大万山
防城
北海
水东
闸坡
湛江
涠洲
涠洲生态站
硇洲
海安
秀英
海口
清澜
东方
乌场
莺歌海
三亚
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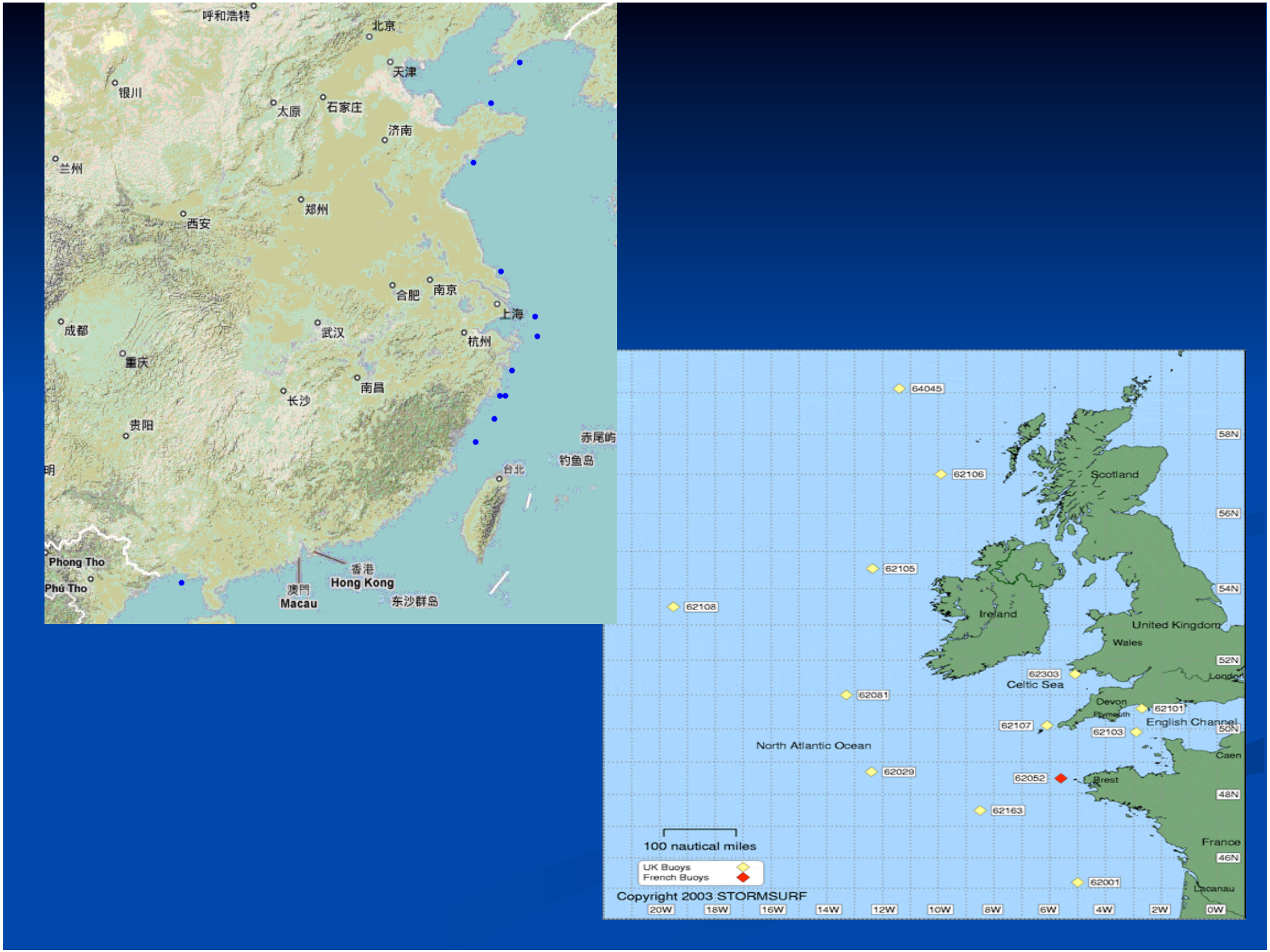
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上海
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Wales
Celtic Sea
Devon
Plymouth
English Channel
North Atlantic Ocean
Caen
Brest
France
Lacanau
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UK Buoys
French Buoys
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6W
4W
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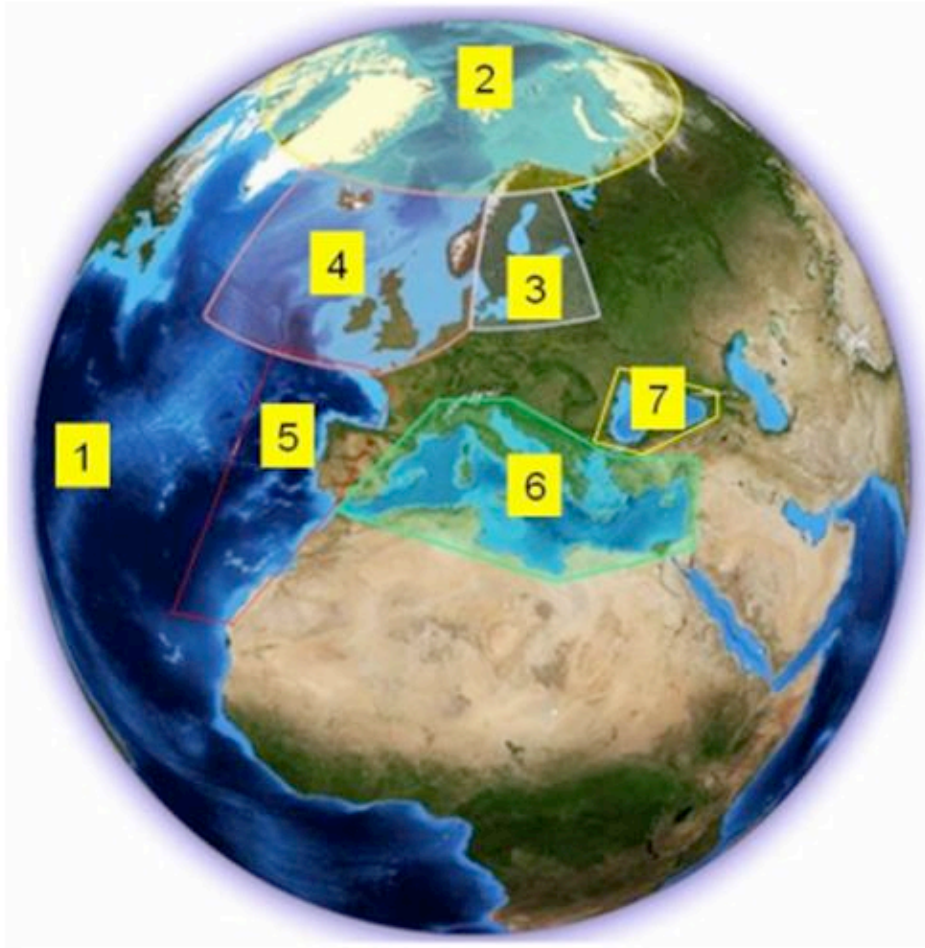
0W

MyOcean Offer

The global ocean +6 European seas

Marine Core Service



- (1) **Global** Ocean
- (2) **Arctic** Ocean
- (3) **Baltic** Sea
- (4) Atlantic North-West Shelves (**NWS**)
- (5) Atlantic Irish-Biscay-Iberic (**IBI**) area
- (6) **Mediterranean** Sea
- (7) **Black Sea**

7,Long-term Deep-sea Observatories Based On Lander Technology

It has been estimated that a complete high resolution mapping of sea-beds would cost €100 million for all of EU Member States deep water and €900 to €2000 million for their continental shelf.

(20) Ocean seabed multi-parameters rapid detection technology

The contents are to detect the multi-parameters of seabed Geophysics, Geochemistry, Biochemistry synchronously, realizing real-time information transportation technology.

(22)Deep ocean work technology

The deep ocean work technology is the support of the deep sea and seabed engineering work and resources exploration mining marine technology.

modular design of the lander system (IFM - GEOMAR).

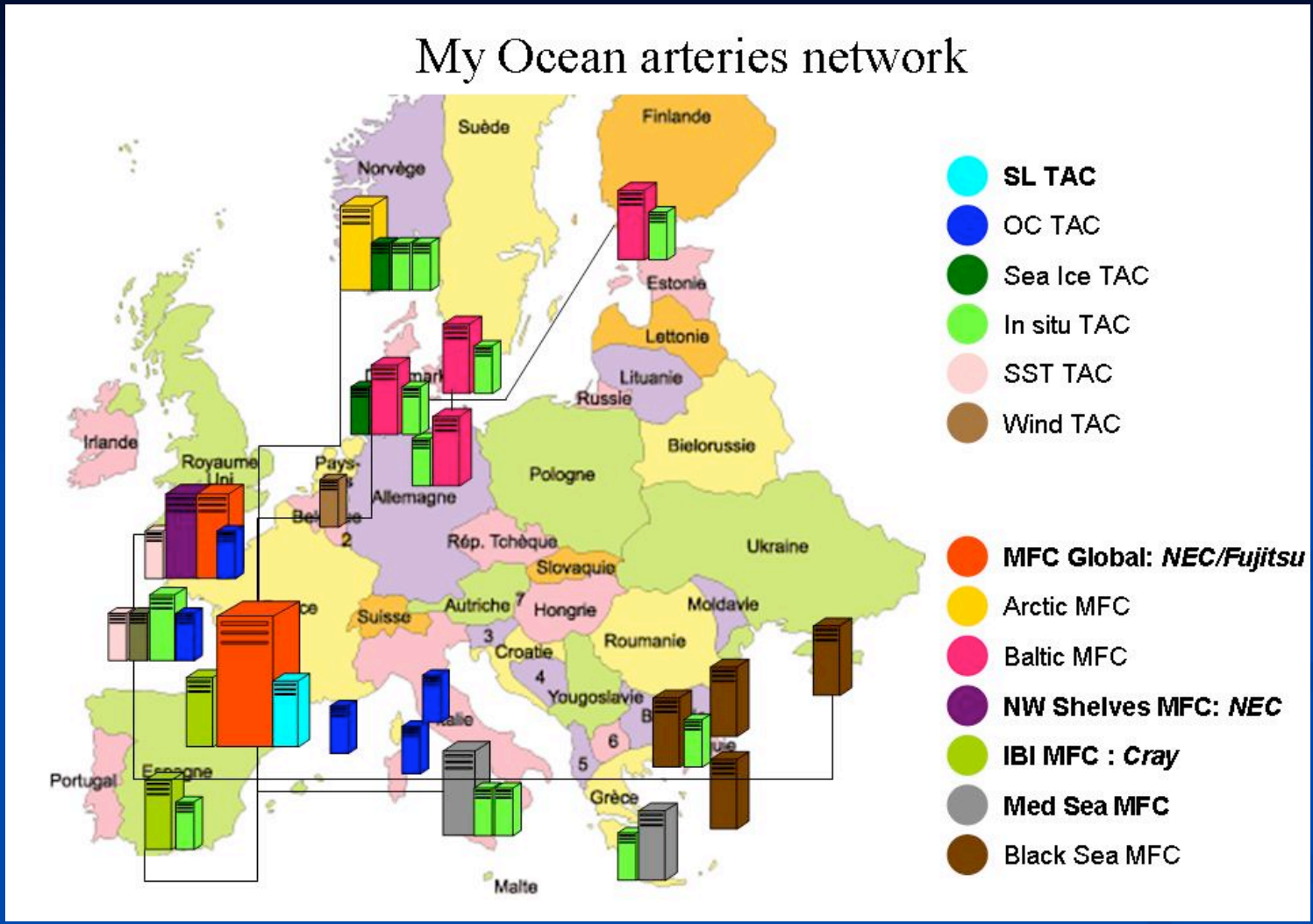
Ocean Bottom Seismic Recorders

8,Communication, positioning and other Common Technology

Communication, positioning and other Common Technology are also needed. Other common technologies include the control, navigation, positioning, new detection sensors and collaborative detection of multi-sensors,

EMODNET, a good model of communication, will be a network of existing and future European observation systems, linked by a data management structure covering all European coastal waters, shelf seas and surrounding ocean basins, accessible to everyone.

EMODNET will provide an end-to-end system linking the modules "Sensors & Platforms", "Surveys", "Communication Systems", "Data Management " and "Information Tools".



Ocean arteries network

l Components of an Observation Network

Sampling and consecutive laboratory analyses from research ships, or shore, including water, sediments and biota (phytoplankton, bacteria, zooplankton, fish)

- inorganic trace compounds
- gases, e.g. CO2, CH4, DMS
- organic micropolluants
- abundance & function

Communication systems to transfer in real-time data from sensors to the network and to the land stations

- satcom
- GSM, GPRS
- fibre optics
- acoustics

Data collection and management system for direct control of data quality, and data storage systems to enable data analysis and use for model applications

- data bases
- quality control
- data standards

Status of Ocean Observation in China

V-1. Institutional Mechanisms Are Hard to Adapt to the Rapid Development of Marine Science and Technology Progress

- **The states marine-related research institutions and organizations belong to different administerial departments, lacking of co-ordination among agencies, and a unified organization and co-ordination; the resources and the data of marine observation can not be effectively shared, resulting in significant duplication and waste of resources.**

In the research project arrangement, due to institutional reasons, research institution and departments repeated low-level studies, on the one hand, causing a waste of research resources, and On the other hand, resulting in scattered research power unable to solve major scientific and technological problems. Loose relationship between marine scientific research institutions and the industrial sectors hampered the transformation for many projects from research results to a real productivity.

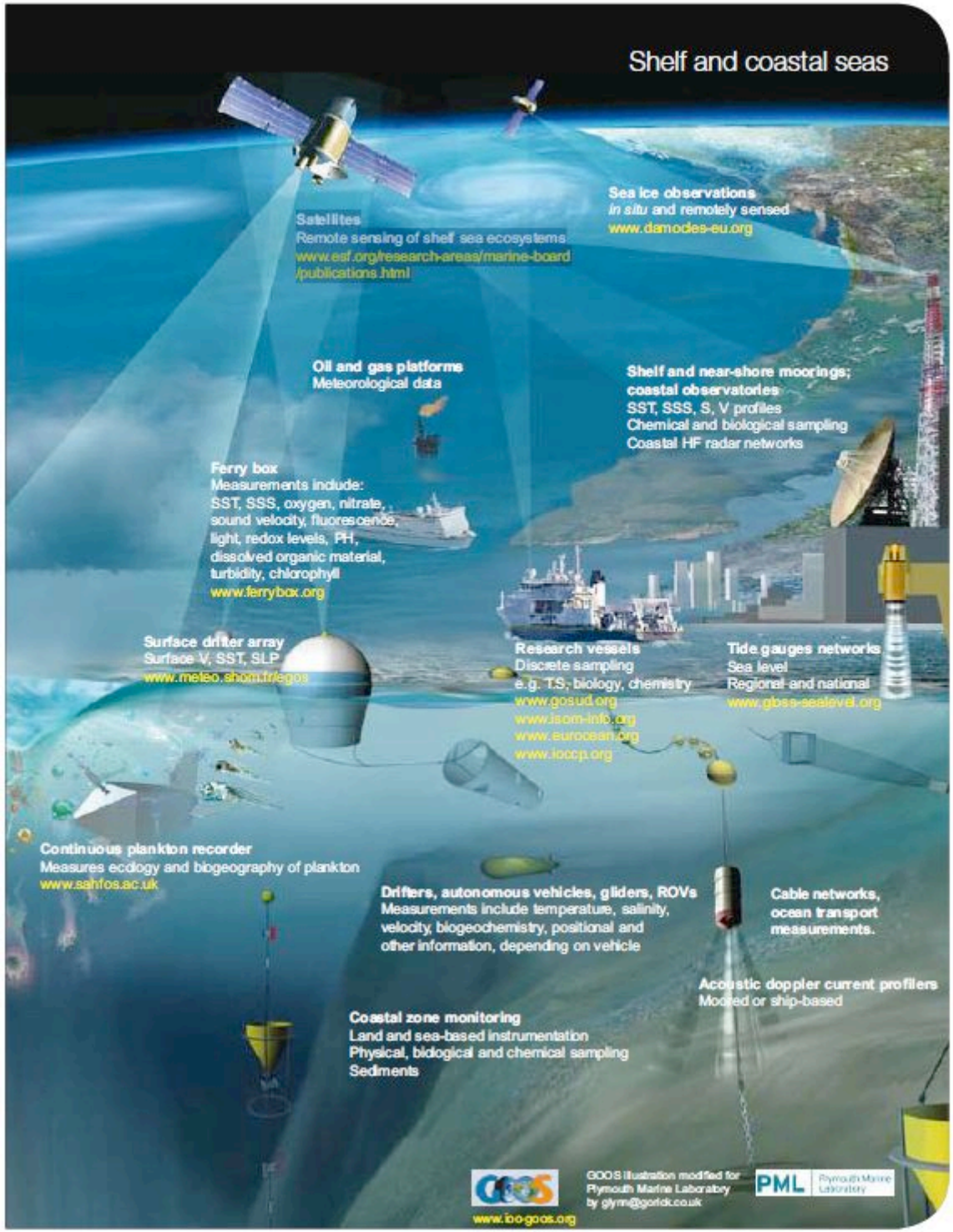
V-2. Overall Level of the Professional Man Power Needs Urgent Upgrade

- After decades of reform and opening-up, shortage in the professional human resource of marine science and technology in China has been eased to a certain extent, but the capable, independent and creative high-level researchers and high-capacity personnels are still lacking.

In fact, China's teams of marine science and technology lack in overall of good comparative top-notch talent, cultivating and attracting more marine scientists or technologists in to the marine exploration cause. In particular it is urgent to train a large group of top-notch leading scientists and technologists for piloting research and technological groups in the international arena.

Thanks for your attention!

Acknowledge Zhigang Li,Cuirong Yu, Decang Bi



For EMODNET to be successful efforts must be made to both maintain and extend the present network of observing systems and to ensure continuity of remote sensing satellite missions. Strong investment in new and emerging technologies is also needed.

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 (崧山)

Return

The south of Beihai city

The buoy in Beihai coast (Guangxi)

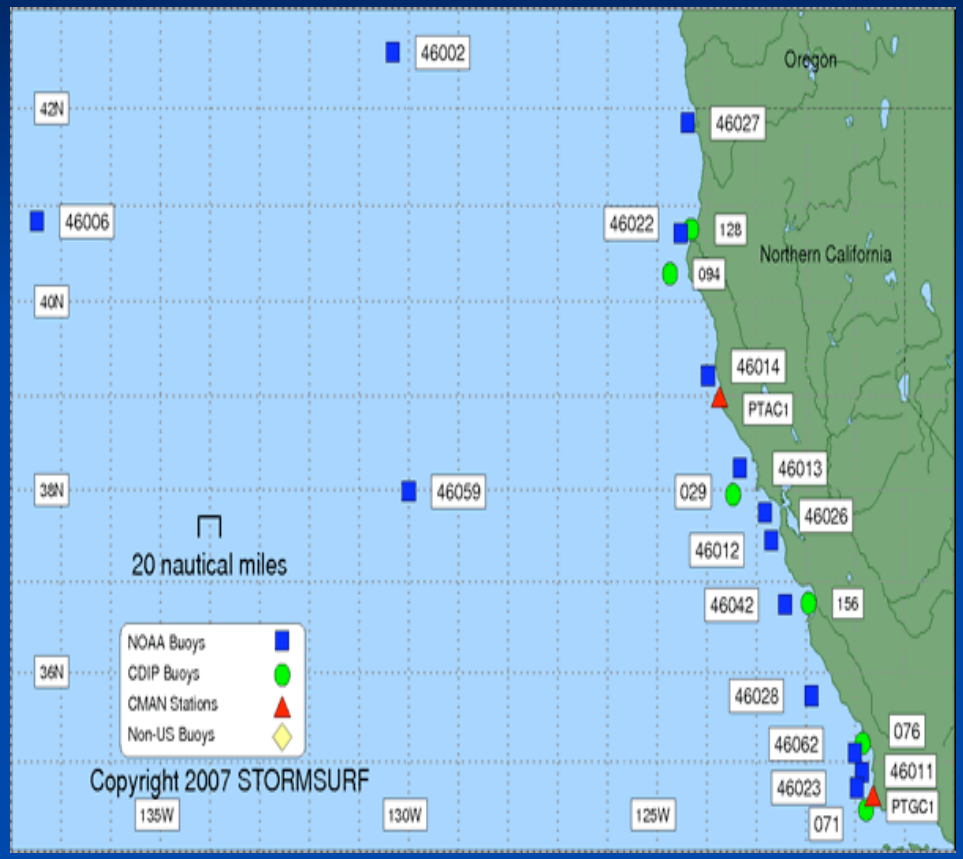
Western seashore buoys distribution in U.S.A

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

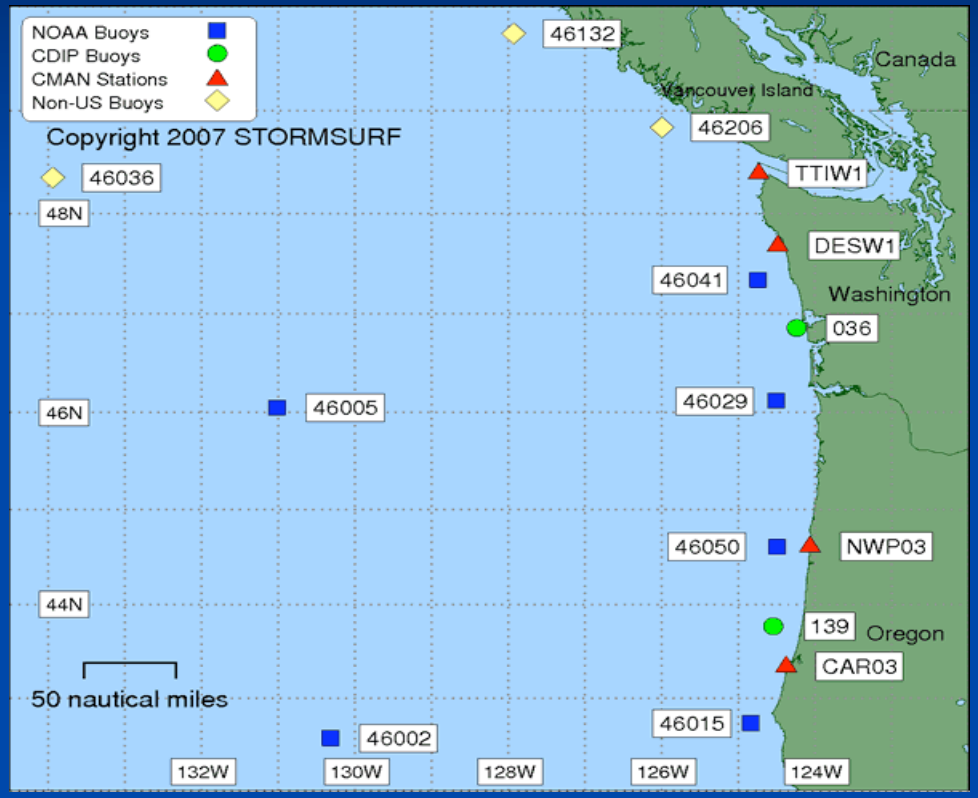
2, North & Central California



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

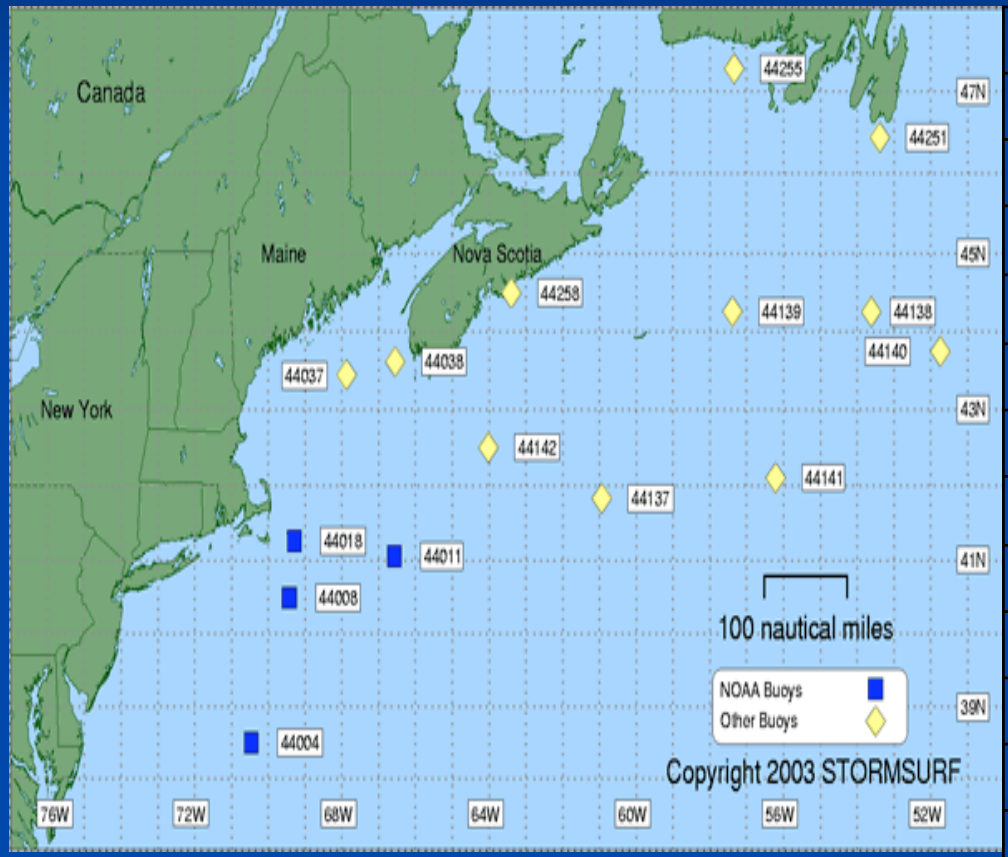


Pacific Northwest			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
46036	South Nomad	46132	South Brooks
46005	Washington	46206	La Perouse Bank
46002	Oregon	46041	Central Elizabeth
		036	Grays Harbor
		46029	Columbia River
		46050	Stonewall Bank
		139	Umpgua *New!*
		46015	Port Oxford
Total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

Return

Seashore buoys distribution in eastern America and Mexico gulf

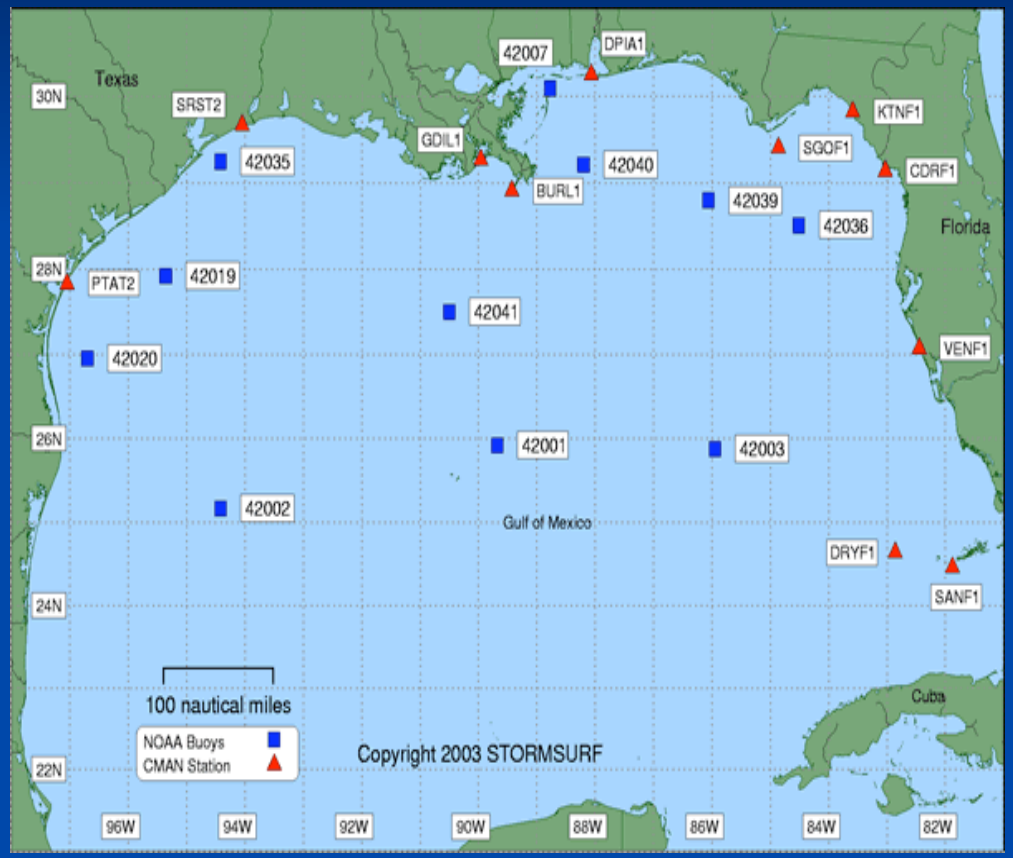
4, Seashore buoys distribution in Canada - Grand Banks & East Canada



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

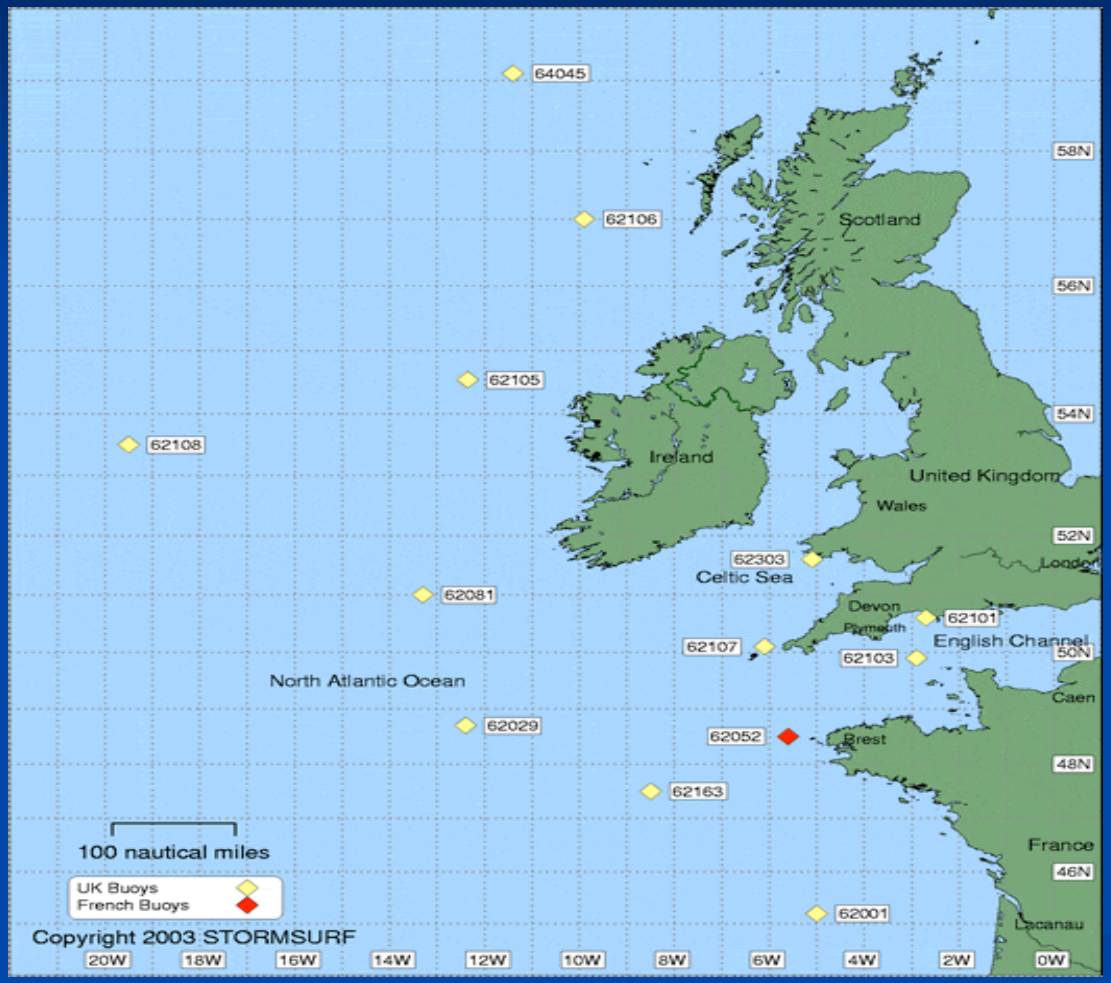
5, Gulf of Mexico



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

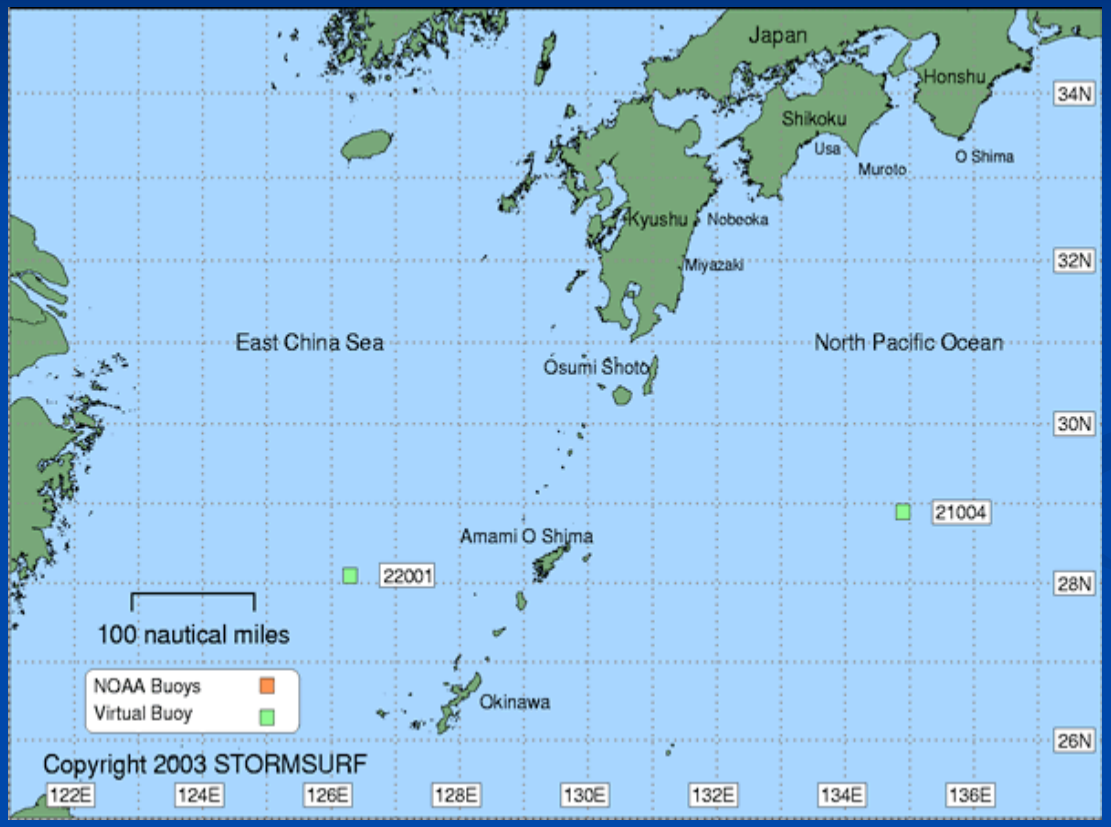


Europe			
Offshore Buoys		Nearshore Buoys	
Buoy #	Name	Buoy #	Name
64045	K5	62303	Pembroke
62106	RARH	62107	Seven Stones
62105	K4	62103	Channel
62108	K3	62101	Lyme Bay
62081	K2	62052	Brest
62029	K1	62001	Gascogne
62163	Brittany		
Total	7	6	

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

Buoy Data List

Country	Station Name /Buoy No.	Lat. (N)	Long. (E)	Format
China	22016	3800	12330	Format (c)
Korea	Pusan	350432	1290614	Format(k1)
Korea	Marado	330728	1261516	Format(k1)
Korea	Hongdo	344332	1251113	Format(k1)
Korea	Pohang	360526	1293240	Format(k1)
Korea	Duckjeokdo	3714	12601	Format(k2)
Korea	Chilbaldo	3448	12542	Format(k2)
Korea	Keomundo	3400	12730	Format(k2)
Korea	Keojedo	3446	12854	Format(k2)

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Ship Data Format (China)

Column	Parameter	Description	Condition
1-7	Sign of Ship		
8-14	Date		
15-21	Time	UTC	
22-28	Lat.	0.01	(°)
29-35	Long.	0.01	(°)
36-42	Visibility	Code Value	
43-49	Air Temperature	0.1	℃
50-56	Dew Point Temp.	0.1	℃
57-63	Wind Direction	0.1	(°)
64-70	Wind Speed		m/s
1-7	Air Pressure	0.1	hpa
8-14	Total Cloud Amount	10	
15-21	Low Cloud Amount	10	
22-28	Present Weather	Code Value	
29-35	Sea Temp	0.1	℃
36-42	Wave Period	0.1	s
43-49	Wave Height	0.1	m
50-56	Surge Direction	0.1	(°)
57-63	Surge Period	0.1	s
64-70	Surge Height	0.1	m

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Meteorological Data List

Country	Station Name	Lat. (N)	Long. (E)	Format
Korea	Duckjeokdo	3714	12601	Format
Korea	Chilbaldo	3448	12542	Format
Korea	Keomundo	3400	12730	Format
Korea	Keojedo	3446	12854	Format

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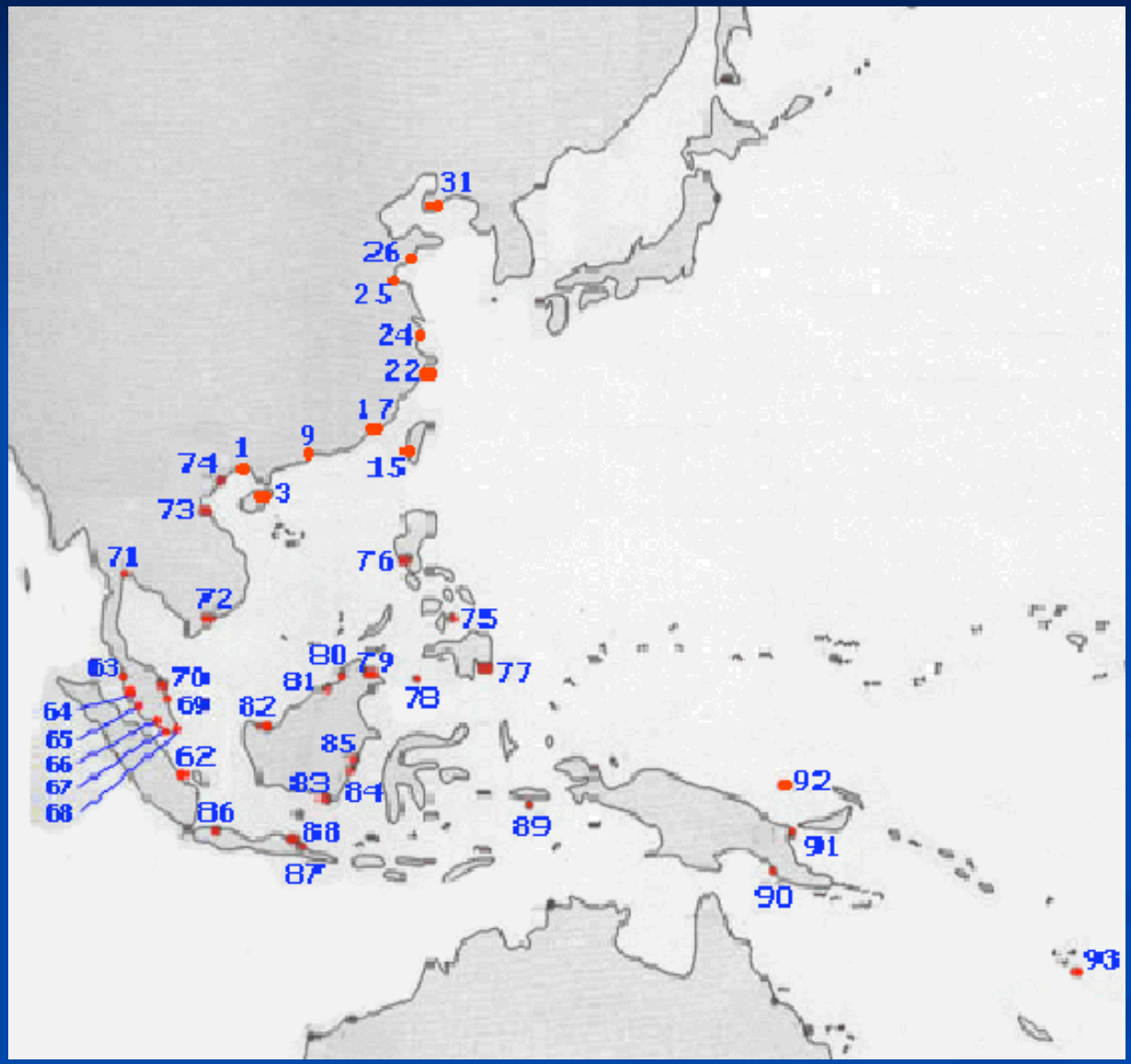
Tide forecast



1.beihai

3.haikou

9.guangzhou

15.gaoxiong

17.xiamen

22.zhenhai

24.wusong

25.lianyungang

26.qingdao

31.dalian

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Beihai (21°29′N 109°05′E)
April 2010

date	pom	tt	th	tt	th	tt	th	tt	th	tt	th
日	月相	潮时	潮高	潮时	潮高	潮时	潮高	潮时	潮高	潮时	潮高
1		0204	86	0851	303	1337	248	1853	395		
2		0324	71	1939	434						
3		0449	70	2029	452						
4	S	0612	76	2120	453						
5		0736	86	2211	442						
6		0901	92	2305	427						
7		1005	96								
8		0003	412	1055	101						
9	A	0106	396	1135	112						
10		0217	378	1208	130						
11	E	0334	360	1230	156	1821	235	2134	219		
12		0446	341	1235	185	1806	260	2313	196		
13		0552	321	1225	211	1803	294				
14	●	0034	165	0654	300	1207	230	1809	334		
15		0140	132	0755	275	1151	240	1826	375		
16		0243	104	0910	248	1118	240	1852	412		
17		0344	83	1925	441						
18	N	0453	71	2003	460						
19		0606	67	2044	468						
20		0726	69	2130	468						
21		0847	71	2223	461						
22		0946	76	2328	449						
23		1027	88								
24	P	0045	431	1102	110						
25	E	0214	406	1125	143	1646	218	1958	200		
26		0349	375	1137	184	1639	266	2238	167		
27		0521	340	1133	222	1653	328				
28	○	0013	119	0653	300	1138	246	1719	391		
29		0138	81	0842	260	1110	255	1756	441		
30		0258	62	1840	470						

时区：-0800

潮高基准面：在平均海面下255cm

time zone -0800 tidal height datum:

255cm below the average sea surface

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Qingdao (36°05′N 120°18′E)
April 2010

date 日	pom 月相	tt 潮时	th 潮高	tt 潮时	th 潮高	tt 潮时	th 潮高	tt 潮时	th 潮高	tt 潮时	th 潮高
1		0013	8	0537	436	1232	41	1747	430		
2		0051	6	0619	424	1310	62	1823	413		
3		0131	15	0703	404	1350	89	1902	389		
4	S	0212	32	0752	377	1433	120	1944	360		
5		0258	56	0852	348	1523	153	2035	330		
6		0352	82	1012	325	1626	181	2145	303		
7		0500	104	1149	318	1751	193	2322	291		
8		0623	115	1305	324	1921	184				
9	A	0043	295	0741	113	1401	336	2027	163		
10		0147	311	0840	105	1441	350	2114	138		
11	E	0237	333	0926	96	1514	364	2152	113		
12		0317	356	1005	89	1542	376	2225	90		
13		0352	376	1040	84	1608	386	2257	71		
14	●	0424	393	1112	81	1634	395	2329	54		
15		0456	405	1143	80	1700	401				
16		0000	42	0528	411	1216	82	1728	404		
17		0033	34	0602	413	1250	89	1759	402		
18	N	0108	32	0640	409	1327	101	1834	394		
19		0147	35	0723	398	1409	119	1915	379		
20		0231	44	0817	380	1458	140	2005	359		
21		0325	57	0923	361	1601	159	2111	338		
22		0433	70	1044	350	1719	164	2238	328		
23		0552	75	1209	355	1844	151				
24	P	0011	337	0712	71	1317	370	1957	122		
25	E	0125	359	0820	63	1409	389	2055	88		
26		0224	384	0916	59	1452	405	2145	58		
27		0315	405	1005	59	1532	417	2230	35		
28	○	0400	420	1050	64	1609	422	2312	21		
29		0442	428	1132	72	1646	420	2352	14		
30		0523	427	1212	83	1723	412				

时区：-0800

潮高基准面：在平均海面下239cm

time zone -0800 tidal height datum:

255cm below the average sea surface

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