



Dragoness Annual Meeting

Progress Report of Work Package 3

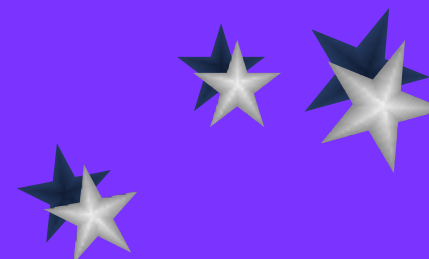


Review of Level of Data Integration and Information Management

G. Chen, X. Yan, S. Cui and Z. Wang

Ocean Remote Sensing Institute
Ocean University of China

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CONTENTS

1. Description of Work Tasks

2. Scientific Data Policy in China

3. Level of Data Integration and Sharing

4. Methods for Utilizing Data in Models



Main Tasks

T1 Assess the status of existing Chinese facilities and investigate the possibility of converging with MERSEA in order to meet GEOSS requirements.

T2 Assess whether the existing data policies are suitable for generating an integrated data system. Identify the differences between Chinese and European data policies.

T3 Evaluate the methods for utilizing in situ and satellite data in oceanic and atmospheric prediction models.



CONTENTS

1. Description of Work Tasks

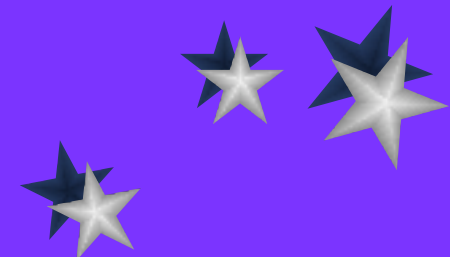
2. Scientific Data Policy in China

3. Level of Data Integration and Sharing

4. Methods for Utilizing Data in Models



Levels of Scientific Data Policy in China



Project Data Policy

Scientific projects in China can be largely divided into four categories:

- Basic research
- Technological innovation
- Application promotion
- Military and defense

Data are usually open and free within the project team, but are not allowed to release to the outside scientific community or to the general public.



Institutional Data Policy

Institutions which have the following facilities may have their own archive of marine observational data:

- Satellite receiving station
- Oceanic research vessel
- Mobile observation facility

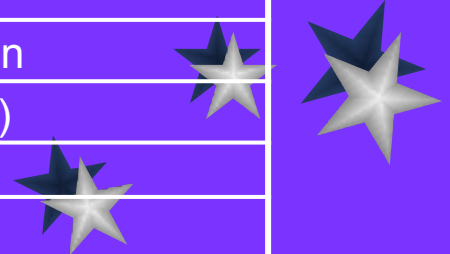
Data obtained from these facilities are normally open and free within the institution or its sub-units, but are usually not directly available to the outside community (unless a data sharing agreement is signed). One may have to register and/or pay in order to obtain these data.



MODIS Ground Receiving Station in China

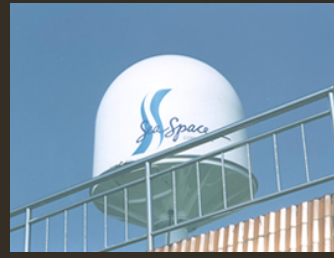
According to semi-official information, China has some **40** ground receiving stations of MODIS, in contrast to some **20** in the USA. There are at least **8** stations in Beijing alone.

| No. | Administration or Agency |
|-----|---|
| 1 | Chinese Academy of Sciences |
| 2 | State Oceanic Administration |
| 3 | State Meteorological Administration |
| 4 | Ministry of Land and Resources |
| 5 | Ministry of Industry and Information Technology |
| 6 | Ministry of Agriculture |
| 7 | Ministry of Environmental Protection |
| 8 | Ministry of Education (Universities) |
| 9 | Military and Defense Agencies |
| 10 | |



MODIS Ground Receiving Station in China

- National Satellite Ocean Application Service, SOA
- Meteorological Observation Center, SMA
- Institute of Geographic Sciences and Natural Resources Research, CAS
- Wuhan University, MOE
-



MODIS Data Service Website

National Earth Observing Data Center Building Capacity, Scientific Data Service Administration

The screenshot displays the National MODIS Data Center website. The top navigation bar includes links for Home, Project Overview, Satellite Introduction, Technical Guidance, Data Services, and Typical Applications. The date shown is 2009年8月31日 星期一. The main content area features a 'Project Background' section with the following text:

项目背景

项目概况

- 国家对地观测系统EOS/MODIS数据共享平台是在中国科学技术部的大力倡导和支持下，由国家科技基础条件平台重点支持的项目。其目的是按照科学规划和布局，形成国家MODIS地面接收站网；建立国家MODIS数据中心，处理、保存和发布MODIS数据及其相关数据产品；开展典型应用示范研究；建立共享制度，形成标准体系，是我国对地观测数据共享应用的示范。

项目建设背景

- 为了深入研究和调查全球气候变化、全球气候变化和自然灾害增多等全球性问题，从1991年起，美国国家宇航局正式启动了把地球作为一个整体环境系统进行综合观测的地球观测系统(EOS)计划。
- EOS计划的目标是由一系列低轨道大型卫星平台搭载先进仪器，以获得大量的先进卫星遥感资料，进而通过反演获得能反映地球这个复杂系统变化的多方面的确切信息。
- 近3年来我国MODIS地面站的建设存在着严重的重复建设问题，为充分发挥MODIS数据资源在促进我国科技和全社会的可持续发展的作用，为解决MODIS地面站重复建设问题，2003年10月国家科技部做出重要决策：建设我国对地观测系统MODIS共享平台。

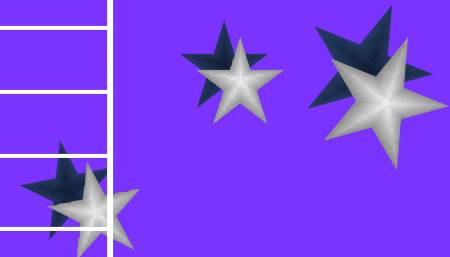
项目建设的意义和必要性

- 环境遥感数据的需求日趋强烈。**中国是一个人口和资源拥有量最多的国家之一，政府十分重视环境变化和生态平衡，每年都投入巨资用于环境监测评估、防灾减灾服务。而卫星遥感资料在环境监测评估、防灾减灾方面起着越来越重要的作用，MODIS数据在其中将发挥重要作用。
- 建立MODIS数据共享体系将丰富我国科学数据共享体系。**在全球经济一体化进程中，信息资源已成为推动经济增长的决定性因素，基础数据的积累、开发和利用程度标志着一个国家的综合实力。在我国实施“可持续发展战略”和“科技创新工程”中，信息资源已成为国家的重要战略资源，对国家科技发展和科技基础设施建设具有重要意义。
- 建立MODIS数据共享体系将大大推进我国环境遥感为民服务的能力。**我国是一个地学大国，对于地球科学系统的研究来讲，任何单一的数据和信息接收站都不可能解决覆盖全国的和综合性的科学问题，只有走数据共享的道路才能促进地球科学系统的发展。迅速建设EOS/MODIS数据共享系统，最大程度地发挥MODIS数据在国家发展中的作用，以满足科学研究和社会公益服务的需求已成为迫在眉睫的科学问题。
- 建设覆盖全国的MODIS数据获取和汇集系统是我国MODIS科学数据共享的基石和保障。**建设覆盖全国的MODIS数据获取和汇集系统，并保障其业务化稳定的运行，使其稳定连续地获取每一条经过我国上空的轨道资料，是保障全国科研、业务、应用部门不分区、不分行业的人员能够充分地利用覆盖全国的MODIS数据，为建立我国MODIS科学数据共享系统提供最可靠的数据来源。
- 在建设覆盖全国的MODIS数据获取和汇集系统的基础上建立我国MODIS科学数据共享系统是避免我国MODIS接收站重复建设的唯一手段。**通过对国内现有接收系统的整合，建设覆盖全国的MODIS数据获取和汇集系统，将实现卫星接收站网统一接收、统一处理、统一发布、统一应用、统一标准、统一管理的科学目标。

Oceanographic Research Vessels in the World

According to the statistics of 2000, China has 15 research vessels in operation, which is roughly 2.8% of the total number in the world—**537**.

| No. | Country | Number of R/V |
|-----|------------|---------------|
| 1 | USA | 105 |
| 2 | Japan | 93 |
| 3 | Russia | 87 |
| 4 | UK | 25 |
| 5 | Germany | 19 |
| 6 | China | 15+3 |
| 7 | France | 14 |
| 8 | Netherland | 13 |
| 9 | Ukraine | 13 |
| 10 | Canada | 12 |
| 11 | Korea | 12 |



Oceanographic Research Vessels in China

| Name | Administration or Agency |
|--------------------|--|
| KE XUE III | Institute of Oceanology, Chinese Academy of Sciences |
| JIN XING II | Institute of Oceanology, Chinese Academy of Sciences |
| SHI YAN III | South China Sea Institute of Oceanology, Chinese Academy of Sciences |
| DA YANG I | North China Sea Branch, State Oceanic Administration |
| XIANG YANG HONG IX | North China Sea Branch, State Oceanic Administration |
| XUE LONG HAO | State Oceanic Administration |
| DONG FANG HONG II | Ocean University of China, Ministry of Education |
| BEI DOU HAO | Yellow Sea Fisheries Research Institute, Ministry of Agriculture |
| YAN PING II | Fujian Institute of Oceanography |
| HAI YANG IV | Guangzhou Marine Geological Survey |
| YE ZHI ZHENG HAO | Qingdao Institute of Marine Geology |



Cruise Data Sharing between IO and SCSIO

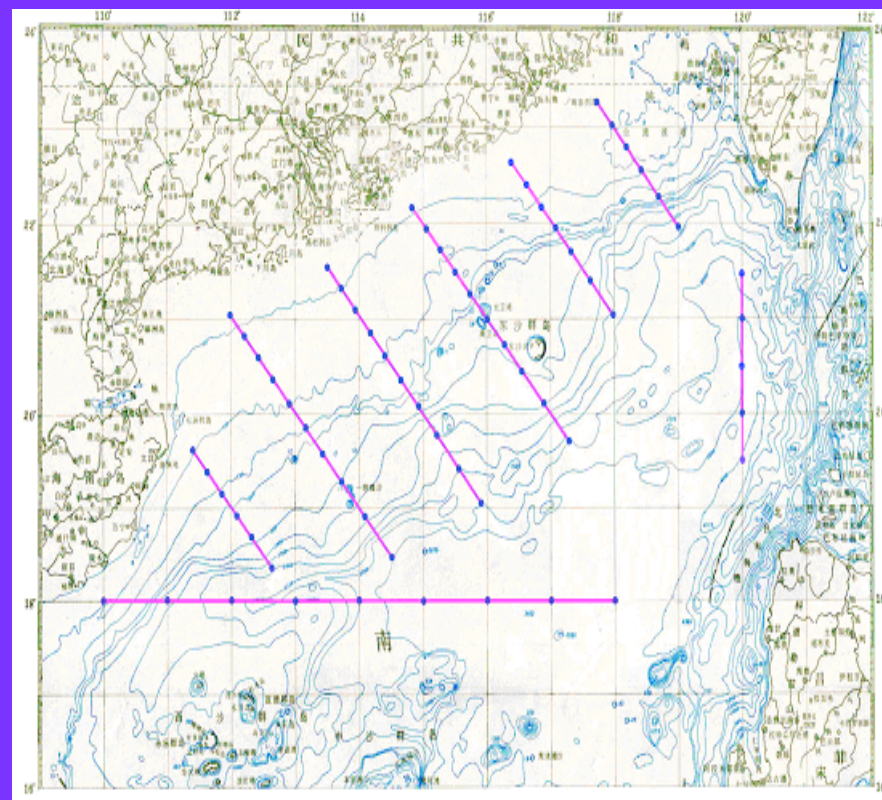
KEXUE-III (IO/CAS)

Basic sections and stations
in Eastern China Seas



SHIYAN-III (SCSIO/CAS)

Basic sections and stations
in Northern South China Sea



Agency Data Policy

Agencies which have the following facilities may have their own archive of observational data:

- Operational observation stations
- Satellite missions
- Regional data observation facilities

These data are supposed to be publicized at a given level either free of charge or at production cost to the scientific community and even the general public, because the facilities are mostly invested and maintained by the central or local government.



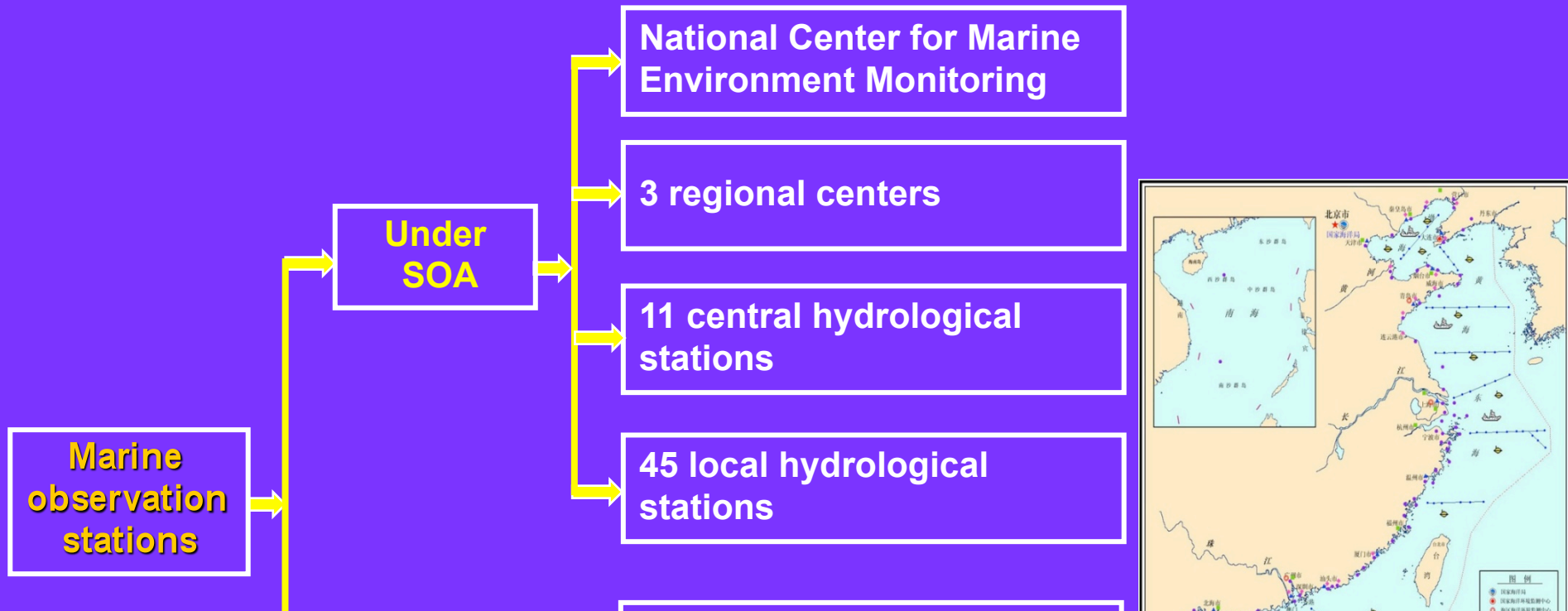
National Satellite Ocean Application Service



Satellite data from HY series are available to all users at the cost of production, which is 30 (60) Yuan/orbit for data volume less (more) than 100M.



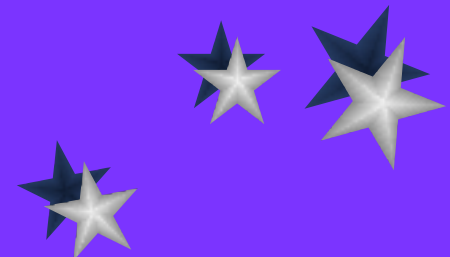
Marine Observation Stations



Data policy: Original data from station observations are generally unpublicized and confined to limited sharing. While products generated out of these original data are available to the public free of charge.

National Data Policy

At national level, due to security and copyright reasons, scientific data are divided into **five** confidential levels as for other sensitive or valuable data in China.



National Policy for Meteorological Data

➤ Absolutely confidential

➤ ~~Highly confidential~~ Meteorological data (especially for important

➤ ~~Confidential~~ Meteorological data (especially for activities of Party and National leaders);

● ~~Internal~~ Data obtained from special meteorological stations

➤ ~~Public~~ Internal confidential tasks by civilian or military agencies;

● Special meteorological data for military tasks;

● Spatial air surveillance data for high-technology or specific scientific experiment.

● Weather report data and gridded data collected from observation data from meteorological stations located abroad;

● Foreign meteorological data obtained by means of exchange;

● Meteorological data published before the founding of PRC;

● Contour maps of basic meteorological variables.



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Project Data Integration and Sharing

At project level, an intranet-based data library is usually constructed for the purpose of data integration and internal sharing. Such a system often includes simple functions of data management, statistical analysis and map based visualization.

Example

A MAGIS system for the national 973 project entitled “The evolution of physical field and its effect on the environment in the eastern marginal seas of China”.





海洋信息集成网络服务平台

Ocean Information Integration Platform

Home

数据服务

时空分析服务

关于我们

用户登陆 User Login

用户名

密码

登录

注册

忘记密码?

Ocean Information Integration Platform DEMO

海洋信息集成网络服务平台

数据服务成果展示 Data Service Show

- 数据服务二：提供统一格式数据的查询，下载保存。
- 数据服务意义：为数据的进一步分析、可视化提供数据来源
- 数据库包含七加一数据等

数据快捷查询

东经

西经

北纬

南纬

起始时间

终止时间

查询

更高级查询，请点击这里

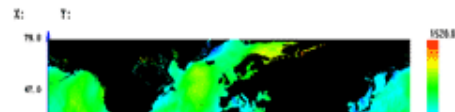
详细查询

时空分析

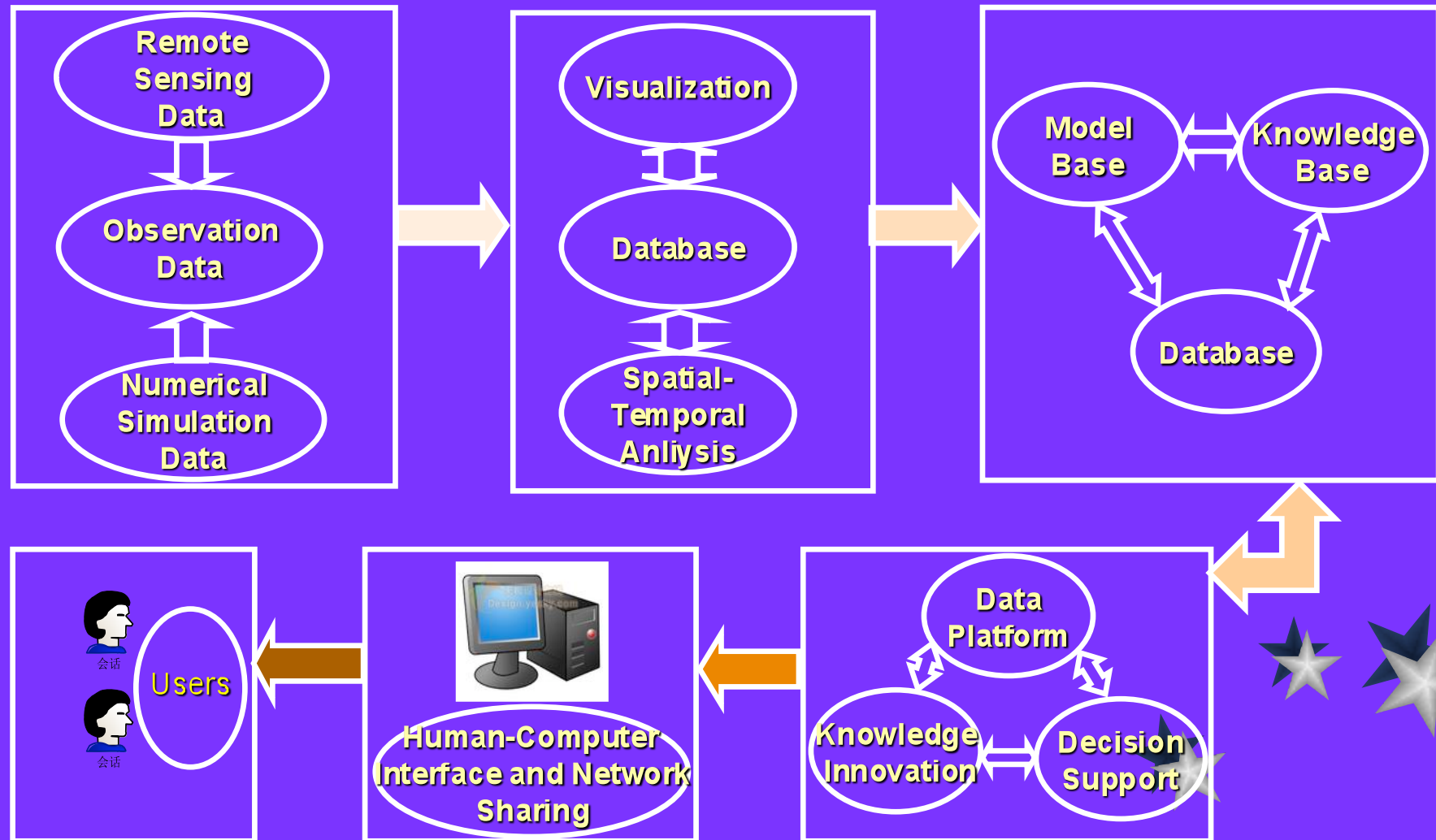
- 时空分析服务：可以将查询到的数据库数据进行统计分析。
- 提供的分析方法：基础统计分析，EOF等高级统计分析

时空分析的意义：通过对比数据，揭示地理规律，揭示规律

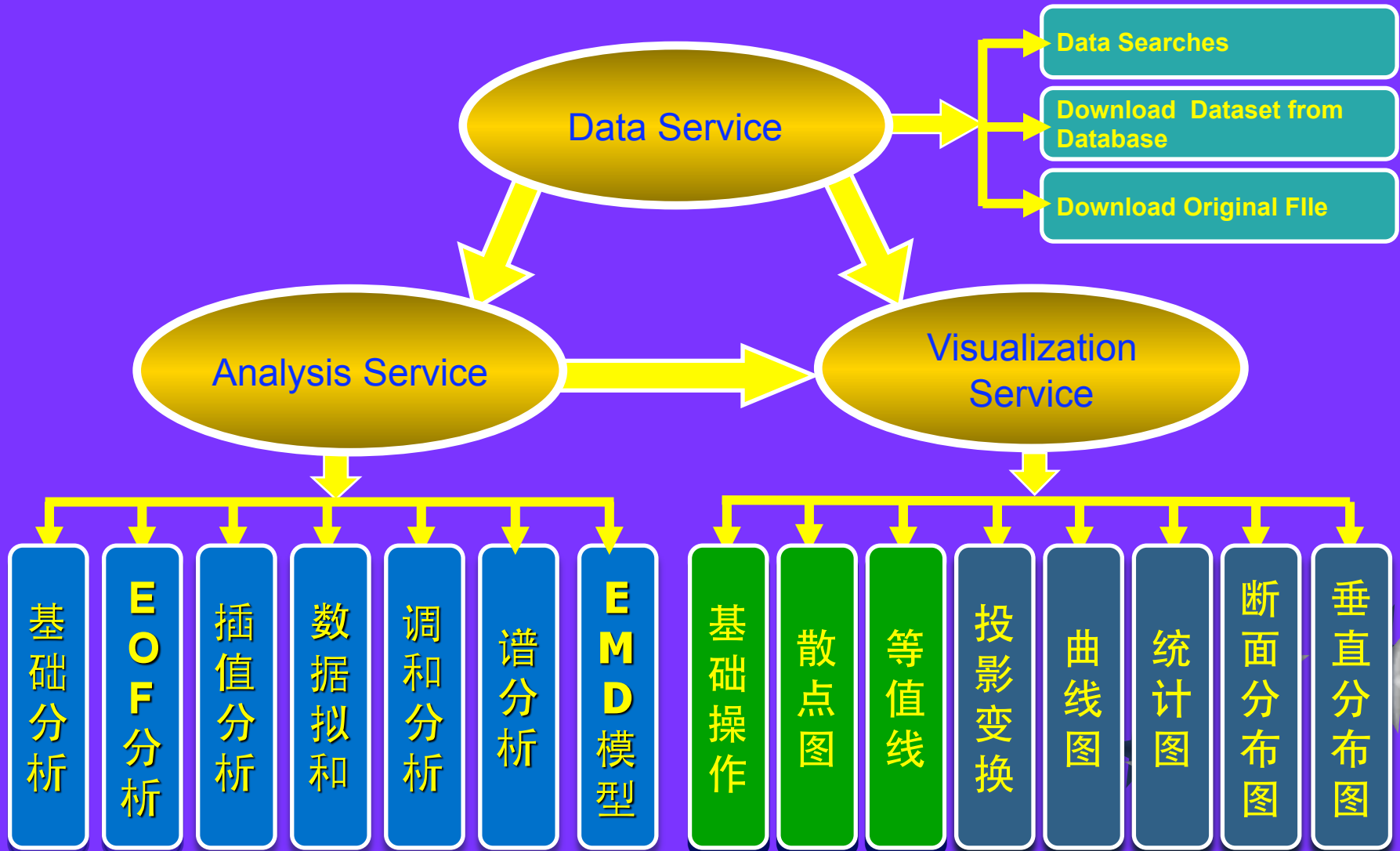
可视化服务



MAGIS General Configuration



MAGIS Main Functions



Institutional Data Integration and Sharing

At institution level, a tendency of self-protection in data management prevails for two reasons:

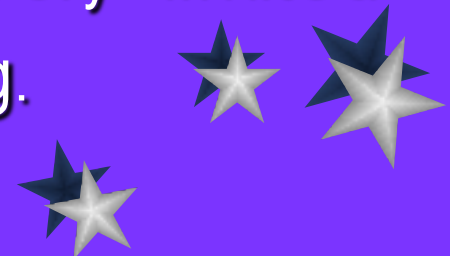
- Data ownership is considered as a kind of **competitive advantage**. As a result, institutional data, although sometimes well archived, are usually available only at metadata level, and the owners are very often reluctant to provide data to external users free of charge.
- Data are considered as resources or products from which money can be made.



Institutional Maine Data Distribution Website

- Institutions affiliated to MOE (e.g., ORSL)
- Institutions affiliated to SOA (e.g., SIO)
- Institutions affiliated to CAS (e.g., IRSA)

Institutionally owned databases are a very important component of the earth observation data bank. But their utilization is very limited with little integration and poor sharing.



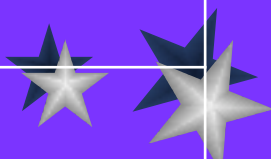

Institutional Marine Data Distribution Website

IOCAS marine data sharing platform
Southern China Seas marine data sharing platform
Northern China Seas marine data sharing platform

The screenshot shows the website for the Ocean University of China Satellite Ground Station. The main content area includes:

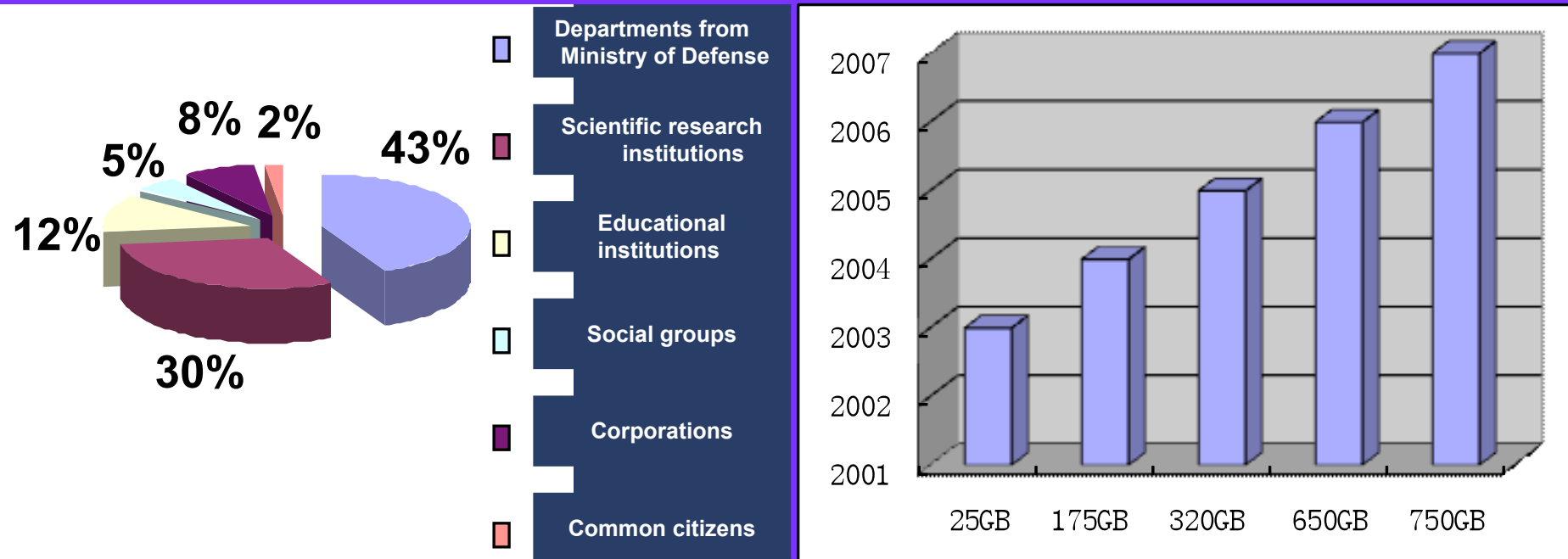
- Header:** www.STATION.orssi.ouc.edu.cn, English, 加入收藏, 设为首页
- Navigation:** 简介, 数据浏览, 在线订购, 可视化, 参考文档, 相关链接
- 最新公告 (Latest News):** 台风黑格尔监测云图, 台风北冕监测云图
- 最新NOAA/AVHRR卫星图片 (Latest NOAA/AVHRR Satellite Image):** NOAA 17 AVHRR SST, 1817 100 11 Aug 2009. A map of the North Pacific showing sea surface temperature with a color scale from 0 to 22.
- 典型图像 (Typical Images):** Several smaller satellite images.
- 累计接收数据 (Cumulative Data Received):** A bar chart showing data reception over time.

Survey of Institutional Marine Data Integration and Information Management in China

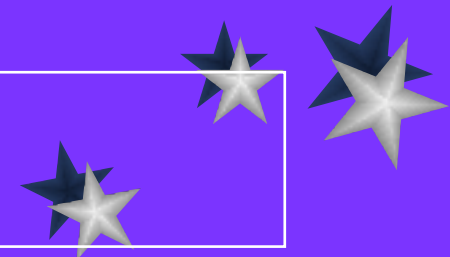
| Agency | Institution | Data service website | A | B | C | Remarks |
|--------|--|---|----------------|------------|---|---|
| CAS | Institute of Remote Sensing Applications | N/A | — | — | — | |
| | Institute of Oceanography | http://www.qdio.ac.cn:8000/Query.htm | — | — | — | |
| SOA | First Institute of Oceanography | http://www.nsfcodc.cn/ | By contact | Image only | — | |
| | Second Institute of Oceanography | http://www.soed.org.cn/station.asp | — | — | Y | |
| | East China Sea Branch | http://share.eastsea.gov.cn/ | By application | — | — | Registration failed since Aug. 25 |
| | South China Sea Branch | http://www.southseadata.cn/default.asp | — | Image only | — | |
| | North China Sea Branch | http://222.173.119.130/Index.aspx | By application | Y | — | |
| | National Satellite Ocean Application Service | http://www.nsoas.gov.cn/default.asp | By contact | Image only | Y | |
| MOE | Ocean University of China | http://211.64.133.112:8080/rice/index | By application | Image only | Y |  |
| CMA | NSMC (National modis data center) | http://satellite.cma.gov.cn/eos/project.html | By Application | Y | Y |  |

A. Means to get data; B. Whether the data can be downloaded online; C. Whether the data updated timely.

Statistical Analysis About Offline Service of Marine Data



Total offline service requests: 741;
Total volume of data delivered: 1920 GB.



Agency Data Integration and Sharing

National agencies such as Chinese Academy of Sciences (**CAS**) and State Oceanic Administration (**SOA**) have the best available data processing, archiving and distribution facilities in China. They usually function on an operational and commercial basis. Some of them also serve as state representative for the collection and integration of observation data from national missions and projects.



RSSGS (CAS)

The China Remote-Sensing Satellite Ground Station was inaugurated and put into operation in December 1986. China RSGS can receive and process remote sensing data from domestic and international satellites which cover 80% of the Chinese territory.



Satellites Data Received and Archived at RSSGS

| Satellites | Nation | Satellite operation organization | Period |
|---------------------------|--------------|--|-------------|
| LANDSAT-5 | American | NASA/NOAA/EOSAT | 1986 — |
| JERS-1 | Japan | NASDA | 1993 — 2001 |
| ERS-1 | ESA | ESA | 1994 — 2000 |
| ERS-2 | ESA | ESA | 1996 — |
| RADARSAT-1 | Canada | CSA/RSI | 1997 — |
| SPOT-2 | France | CNES/SPOT IMAGE | 1997 — |
| SPOT-4 | France | CNES/SPOT IMAGE | 1997 — |
| LANDSAT-7 | American | USGS | 2000 — |
| ENVISAT-1 | ESA | ESA | 2003 — |
| CBERS-1 | China/Brazil | | 1999 — |
| QuickBird | American | Digital Globe company | 2001 — |
| ASTER | American | NASA / METI | 1999 — |
| TERRASAR-x | Germany | DLR/EADS Astrium company/ Infoterra company | 2007 — |
| ALOS | Japan | JAXA | 2006 — |
| RESOURCESAT-1(I RS-P6) | India | ISRO | 2003 — |



Standard Product: Example

| Satellites | Level |
|------------|--|
| LANDSAT-5 | Product Level 0: raw data, without fundamental corrections. |
| | Product Level 1: radiometrically corrected data. |
| | Product Level 2: radiometric ally and systemically corrected data. |
| | Product Level 3: radiometric ally and geographically corrected data with GCP. |
| | Product Level 4: radiometrically and geographically corrected data with GCP and DEM. |
| LANDSAT-7 | Product Level L0R: raw data, without any fundamental corrections. |
| | Product Level L1G: radiometrically and systemically corrected data. |
| | Product Level L1P: radiometrically and geographically corrected data with GCP. |
| | Product Level L1T: radiometrically and geographically corrected data with GCP and DEM. |

Price List I: Example

| Digital products | Full scene | 1/2 scene | 1/4 scene |
|---|-------------------|------------------|------------------|
| Landsat 5 (7 bands) ——Data acquired before Dec. 31, 1998 | USD700 | USD450 | USD300 |
| Landsat 5 (7 bands) ——Data acquired after Jan. 1, 1999 | USD500 | USD400 | USD260 |
| Landsat 5 (1 band) ——Data acquired before Dec. 31, 1998 | USD200 | | |
| Landsat 5 (1 band) ——Data acquired after Jan. 1, 1999 | USD150 | | |
| Landsat 7 (7 bands + Pan) | USD600 | USD450 | USD300 |
| Landsat 7 (7 bands) | USD500 | USD400 | USD260 |
| Landsat 7 (Pan) | USD500 | USD400 | USD260 |
| Landsat 7 (1 band) | USD150 | USD100 | USD70 |

To purchase multiple bands:

Total price = Number of bands × Unit price per band

National Marine Data & Information Service (SOA)

The National Marine Data and Information Service (NMDIS) is an advanced facility under the State Oceanic Administration (SOA) of China for archiving, integrating and distributing data and information concerning the marine environment.

国家科学数据共享工程—
海洋科学数据共享

首页 | 本站简介 | 用户指南 | 项目动态信息 | 基础数据 | WebGIS | 世界海洋渔业资源 | 信息产品 | 元数据 | 注册

用户登陆

用户名:
密码:
登陆 新会员注册

WEBGIS

- 1:100万海洋基础地理信息
- 1:400万海洋基础地理信息
- 海洋资源信息空间数据库
- 海洋生态信息空间数据库
- 海洋环境信息空间数据库
- 海洋灾害信息空间数据库

世界海洋渔业资源

- 世界国家渔业产量
- 世界海洋渔业资源数据库

项目动态信息

- 海洋科学数据中心动态
- 海洋信息标准规范

海洋基础数据

- 水文数据: 南深站数据, CTD数据, BT数据, 表层海流
- 海洋生物数据: 叶绿素数据, 浮游植物数据, 浮游动物数据
- Near-Goos气象数据: 气象数据, 水位数据
- 海洋环境监测站数据: 海面气象数据, 海洋化学数据, 地球物理数据, ARGO, GTSP数据, modis数据, 中巴资源卫星元数据

公告栏

- 海洋科学数据共享中心《工作简报》2008年第1期(总7)
- 新数据入库: 世界海洋渔业资源
- 本网站对注册用户及权限进行了重新分类与调整
- 海洋科学数据共享中心《工作简报》2007年第4期(总6)

National Marine Data & Information Service (SOA)

➤ ***As a National Oceanographic Data Center***

NMDIS maintains and develops the national marine database: a collection and integration of marine data sets originating mainly from China marine observation establishments.

➤ ***As a Marine Data Service Provider***

Provide marine data and information services, as well as technical support for national marine economic development, sea area management, marine environmental protection, and marine research community.

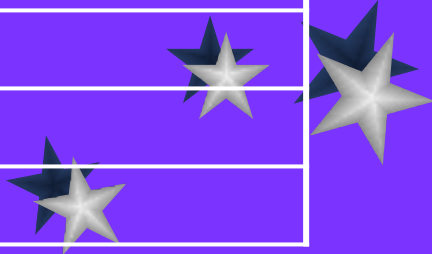
➤ ***As a National Coordinator for International Marine Data Exchange***

NMDIS also serves as the World Data Center for Oceanography, China Argo Data Center, China Delayed Mode Database for NEAR-GOOS.




Contents of Database

| No. | Database |
|-----|---|
| 1 | ARGO float database |
| 2 | Sea surface meteorological database |
| 3 | Marine environment observation station database |
| 4 | GTSP (global temperature salinity profile project) database |
| 5 | Marine chemical database |
| 6 | MODIS database |
| 7 | NEAR-GOOS meteorological database |
| 8 | Hydrological database |
| 9 | Marine biological database |
| 10 | Geophysical database |
| 11 | CBERS database |



National Data Integration and Sharing

Ministry of Science and Technology (**MOST**) is the national administration in charge of making policies on scientific data integration and sharing, and monitoring the implementation of those policies. Although MOST does not handle scientific data by itself, it is the top authority which coordinates and regulates the activities of data standardization, collection, management, archiving and distribution in China.



Example of National Policy on Scientific Data Integration and Sharing

MOST issued a regulation of data integration and archiving for the national basic research project (the so-called 973 project which is one of the major categories of scientific projects in China) in the scientific field of resource and environment in 1998. The key points are summarized here as an example of Chinese effort in scientific data integration and sharing.



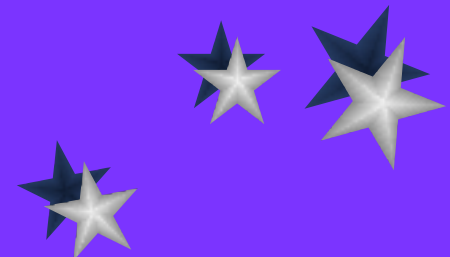
Responsibilities of MOST

- To make rules and regulations for data I/A;
- To evaluate and authorize data I/A centers;
- To review and approve data I/A plans;
- To monitor data I/A and sharing activities.



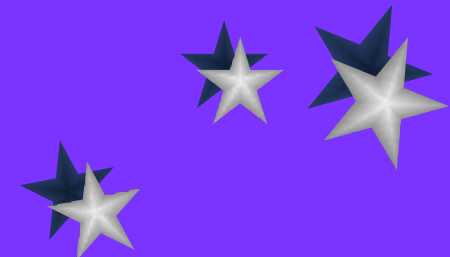
Responsibilities of PI

- To write a data I/A plan;
- To prepare the data according to the I/A plan;
- To perform the quality control of project data to be submitted and archived;
- To submit to project data to a designated I/A data center.



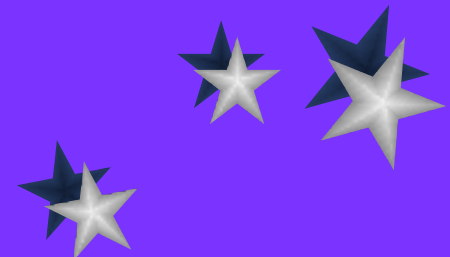
Responsibilities of Data I/A Center

- To make standardizations for data I/A;
- To provide advices for data I/A;
- To receive submitted project data and ensure their safety;
- To check the quality of submitted data;
- To perform proper data maintenance and provide authorized data service.



Contents of Data to Be Integrated

- Original observation data;
- Reanalyzed product data;
- Software used to process and/or analyze the data.



Procedures for Project Data Integration, Management and Distribution

1

Data should be submitted to a designated data I/A center **2 months** before the end of the project, along with a data description (metadata) and quality report;

2

The data I/A center should complete the evaluation of data within **1 month** after their submission;

3

The metadata of project data will be released to the public **1 month** after the completion of submission;

4

Under normal circumstances, the project data should be provided to the public upon request after a protection period for no more than **2 years**.



Summary of Marine Data Integration and Information Management in China


| | Level | A | B | C | D |
|-----------------|--------------|----------|----------|----------|----------|
| Policy | Project | | | | × |
| | Institution | | | × | |
| | Agency | | × | | |
| | National | × | | | |
| Practice | Project | × | | | |
| | Institution | | × | | |
| | Agency | | | × | |
| | National | | | | × |

A: Best; B: Good; C: Poor; D: Worst.



Problems and Advices (I)

(1) There is no **current** marine data and information system which can include data from all observing approaches in the form of system of systems. Though the marine scientific sharing platforms under NMDIS can provide much data and information, it is still under construction and **most of** the remote sensing data are still **not included**. The collaborations between the NMDIS, NSOAS and China RSGS are **insufficient** and more works need to be done **in this**



Problems and Advices (II)

(2) As far as marine data and information are concerned, there is no unified format for both data and metadata from all different sources. It is necessary to define a unified data and metadata format which can be applied to all data from various sources. Moreover, there is no common data transfer protocol for all data facilities. That also needs to be defined clearly and

Problems and Advices (III)

(3) The marine data and information provided by different platforms are overlapped with each other to some degree. In other words, data redundancy exists under many circumstances. More efforts should be made to ensure that marine data and information can be managed more efficiently and also more cost effectively.

CONTENTS

1. Description of Work Tasks

2. Scientific Data Policy in China

3. Level of Data Integration and Sharing

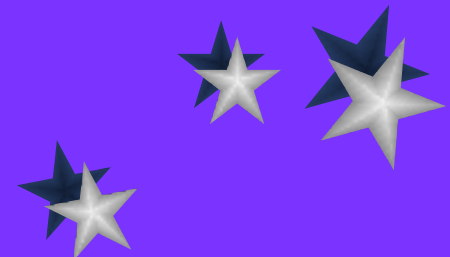
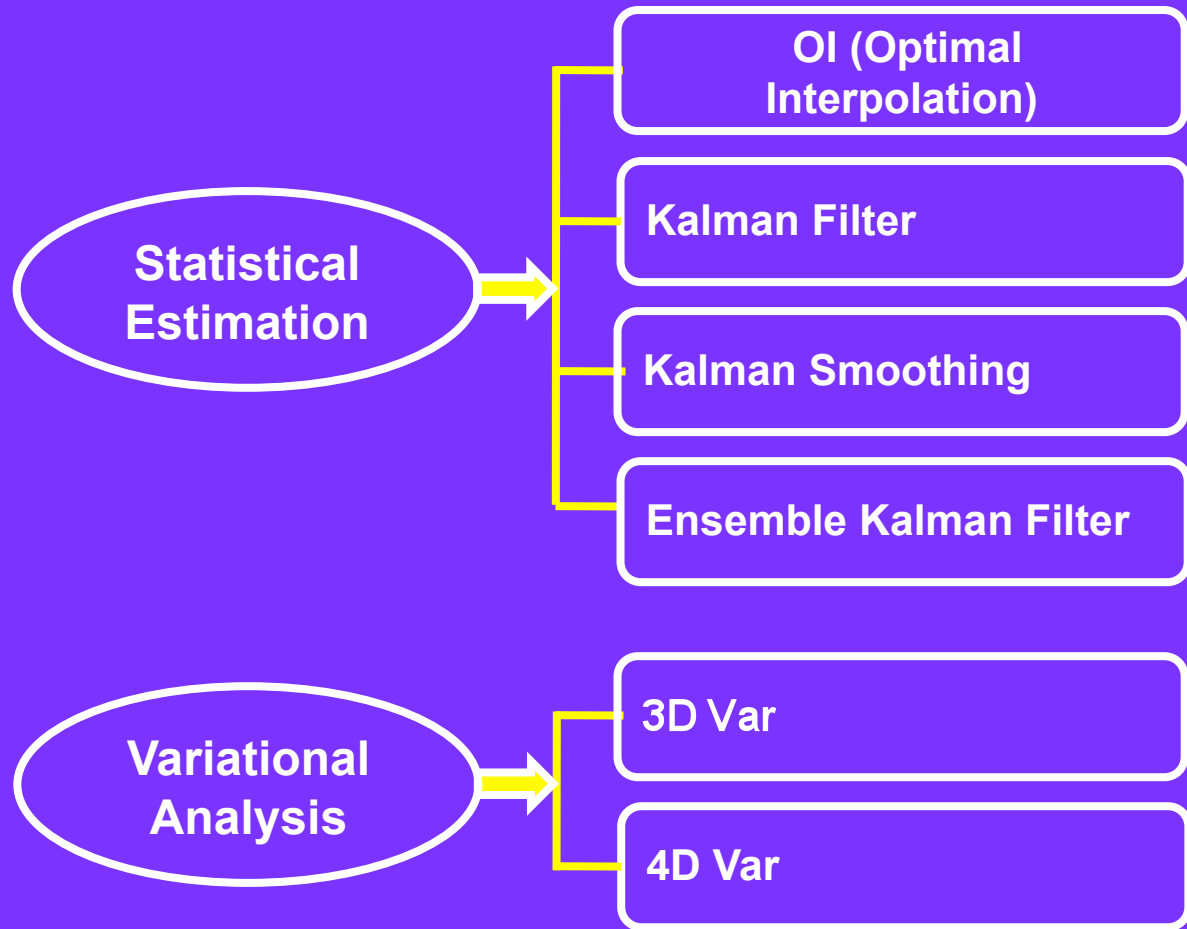
4. Methods for Utilizing Data in Models



A Partial List of Oceanographic and Atmospheric Models

| Model type | Full name | Remarks |
|--|--|--|
| Ocean/Atmosphere Circulation Model | POM (Princeton Ocean Model) | Sea Surface Elevation, Currents, Salinity and Temperature |
| | ECOM-si | Similar to POM |
| | FVCOM | |
| | POP (Parallel Ocean Program) | |
| | HYCOM (Hybrid Coordinate Ocean Model) | |
| | BOM (Bergen Ocean Model) | Coupled to Biological, Resuspension and Contaminant Models |
| | GOTM (General Ocean Turbulence Model) | |
| | ROMS (Regional Ocean Modeling System) | |
| | MM5 (Mesoscale Model) | |
| | IAP | General Circulation Model |
| Sea Ice Models | CSIM | |
| | CICE (the Los Alamos Sea Ice Model) | |
| | Meteorological Institute Ice Model (MI-IM) | |
| Surface Wave and Nearshore Circulation Models | NOPP | |
| | WAVEWATCH | A Third Generation Wave Model |
| Tide Models | CCAR Global Tide Model | |
| | NAO Tidal Prediction System | |
| Numerical Weather Forecast Models | JMA—TL959L60 | Operational |
| | ECMWT—TL977L91 | Operational |
| | NMC/CMA—TL639L60 | Operational |
| | NECP—TL382L64 | Operational |

Data Assimilation Methods



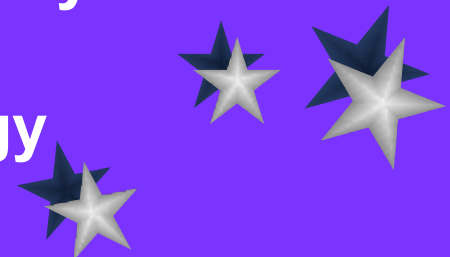
Data Assimilation System: OVALS

OVALS: Ocean Variational Analysis System

Authors: Jiang Zhu et al.

Institutions:

- International Center for Climate and Environment Sciences
- Key Laboratory of Meteorological Disaster Ministry of Education, Nanjing University of Information Science & Technology
- Beijing Institute of Applied Meteorology



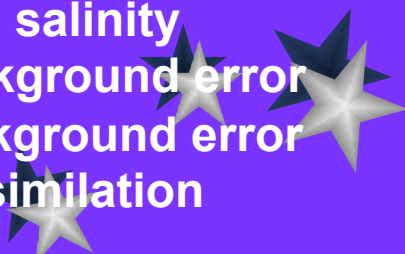
Model, Data and Scheme

Model: IAP general circulation model for the tropical Pacific Ocean

Data:

- TAO temperature and salinity data
- GTS ship reports temperature data
- T/P and Jason-1 altimetry data
- ARGO temperature and salinity data

Scheme:

- 3D-Var
 - Nonlinear balance constraint between temperature and salinity
 - Vertical correlation of the temperature and salinity background error
 - Improvement of the horizontal correlation scale of background error
 - High efficiency decomposition of the altimetry data assimilation
- 

OVALS Application in Tropical Pacific

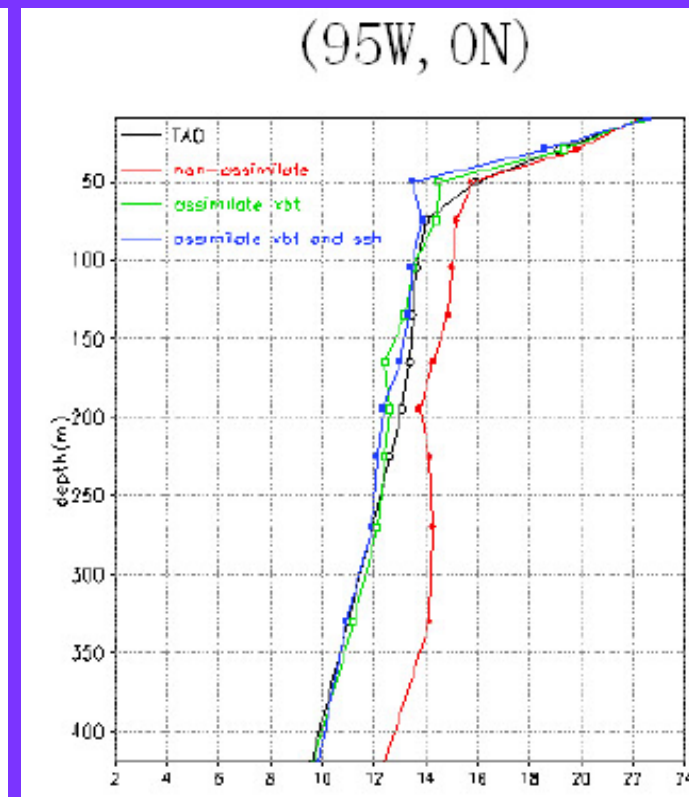
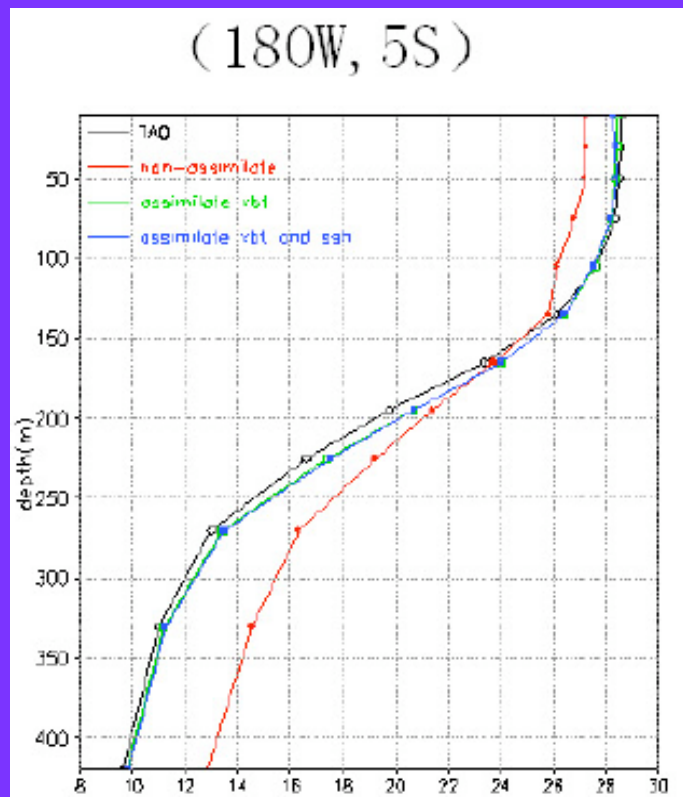


Result of XBT and SSH Assimilation



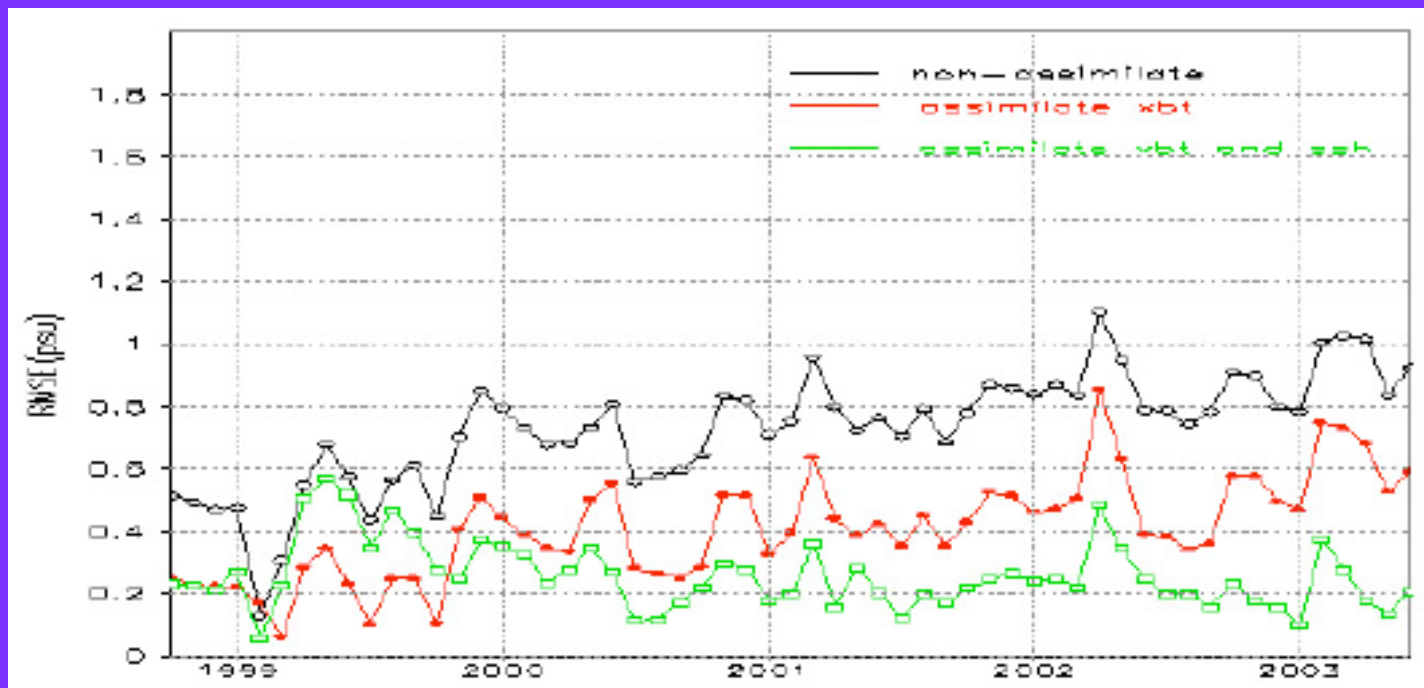
Temperature RMSE relative to TAO for all layers

Result of XBT and SSH Assimilation



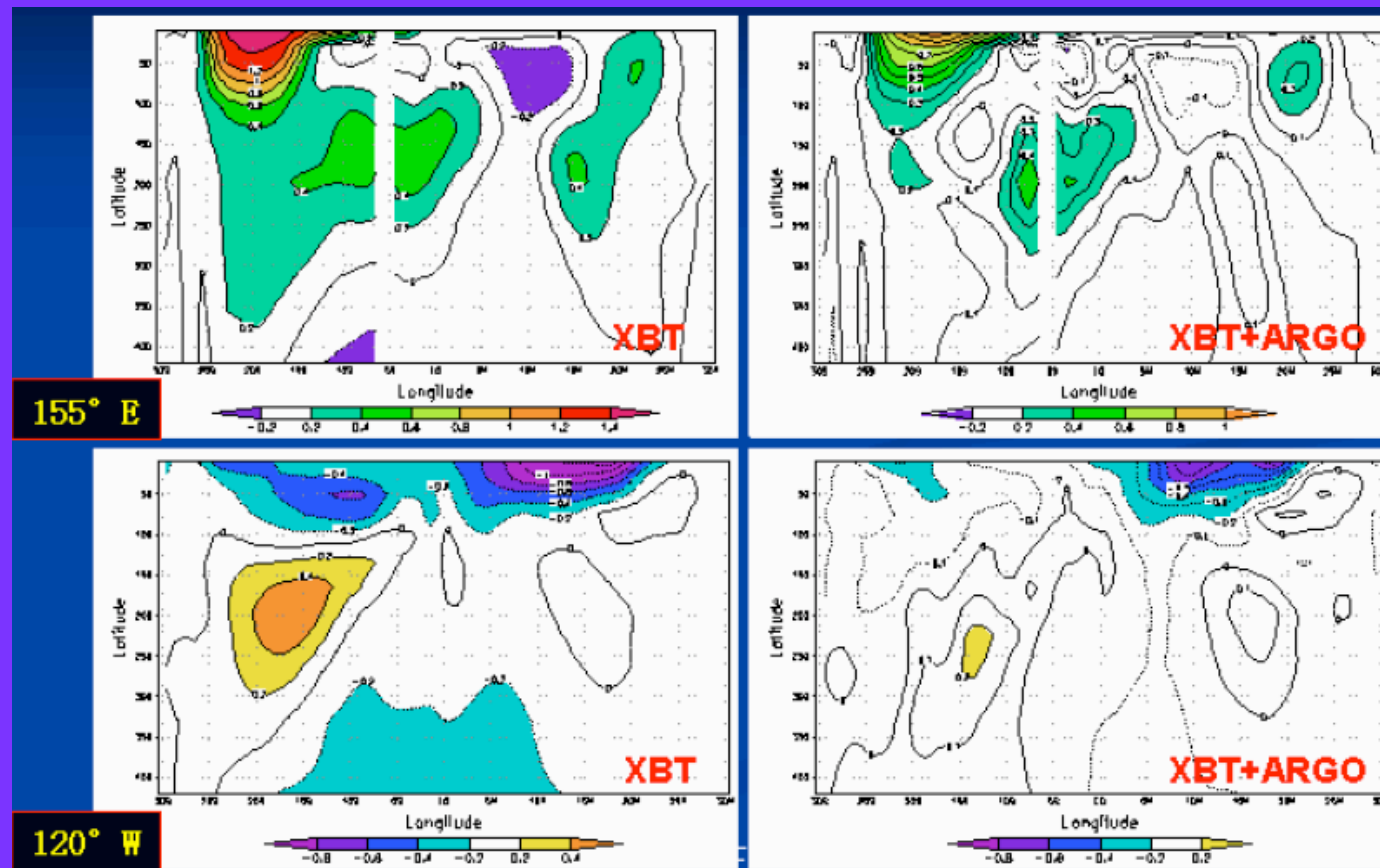
Temperature comparison with TAO in Jan, 1999

Result of XBT and SSH Assimilation



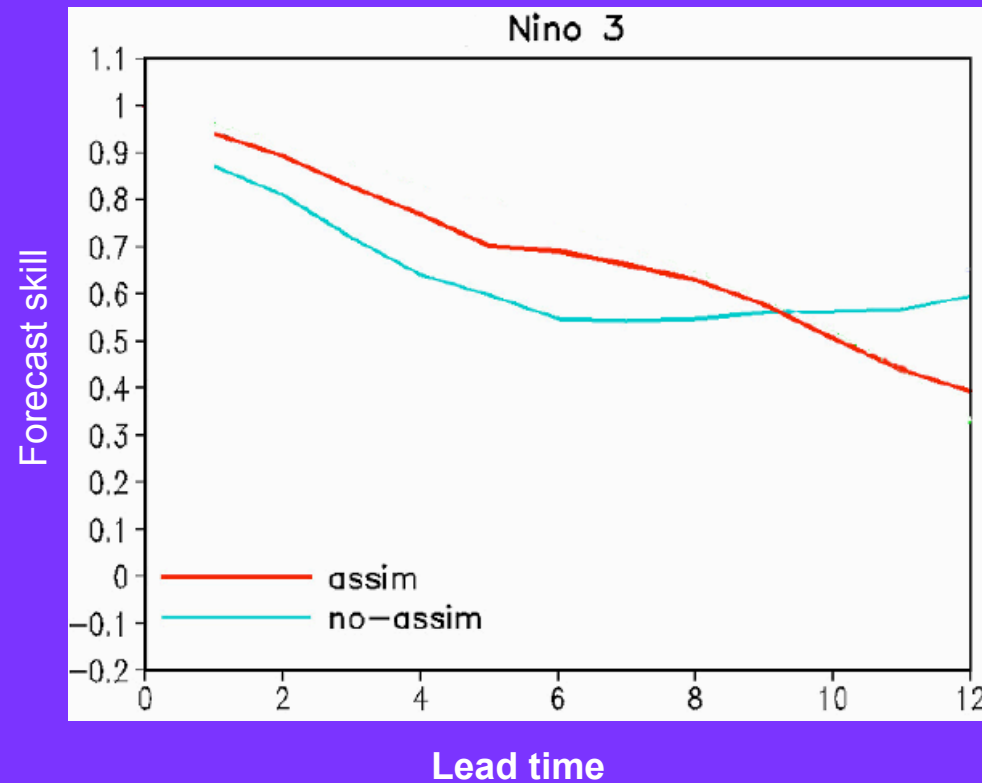
Salinity RMSE relative to TAO for all layers

Result of XBT and ARGO Assimilation

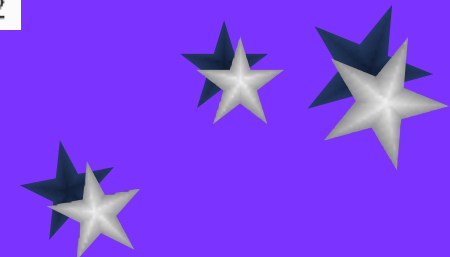


Annual mean salinity along longitude (interval is 0.2psu): WOA98-assimilation

Result of ENSO Forecast



ENSO prediction skill (1982-1993 Handicast)



OVALS Application in Tropical Pacific: Summary

- **Temperature**
Improvement from XBT assimilation is the best;
Improvement from altimetry and ARGO is not notable.
- **Salinity**
Improvement from altimetry assimilation is the best;
ARGO is also useful.
- **Assimilation resolution**
Temperature: 0.5degree;
Salinity: 0.3psu.

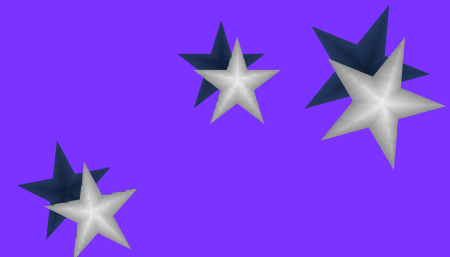
The OVALS assimilation system can improve the ENSO prediction especially when forecast time is less than 6 months.

Assimilation Example: Altimeter Data

Title: Assimilation of TOPEX/Poseidon data into a Global Ocean Model

Authors: Juan Liu et al.

Institutions: Institute of Atmospheric Physics, Chinese Academy of Sciences, etc.



Assimilation Example: Altimeter Data

Model:

- LICOM110 (LASG/ IAP Climate Ocean Model, Version 1.0)
- Resolution: $1^\circ \times 1^\circ$
- Scope: $90^\circ\text{N} \sim 79^\circ\text{S}$
- Vertical layers: 30 layers with varying distance

Assimilation system: LICOM-3DVM

- Basis: 4D-Var of LICOM 1.0 in LASG/ IAP
- Assimilation method: 3DVM (3-dimensional variational data assimilation of mapped observation)
- Assimilation window: 5d
- Optimal analysis value at the end of the window Ta



Assimilation Example: Altimeter Data

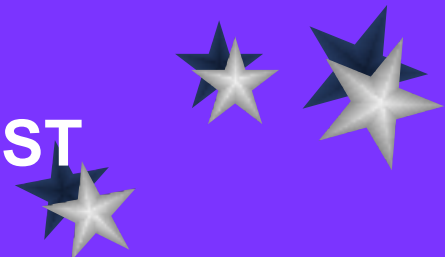
Model data:

- Wind stress: NCEP/DOE Reanalysis 2 monthly data
- Net shortwave radiation, non-shortwave heat flux, couple coefficients: monthly forcing field of OMIP from MPI
- Monthly SST and sea surface salinity: WOA98 from NODC

Assimilation data: TOPEX/Poseidon altimetry data

- Spatial resolution: $1^\circ \times 1^\circ$
- Temporal resolution: 5d

Comparison data: SODA, WOA01, HadISST



Assimilation Example: Altimeter Data

Experiment design:

- CTRL: Control experiment with no altimetry data
- ASSM: Assimilation experiment with altimetry data

Experiment results:

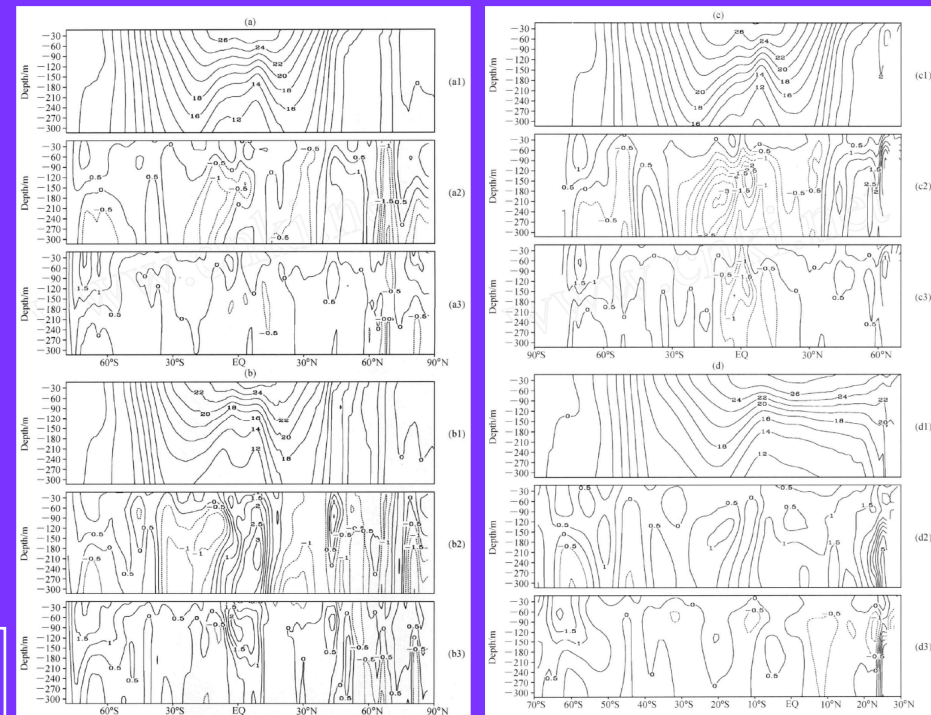
The zonal averaged temperature profile in (a) the whole ocean, (b) the Atlantic ocean, (c) the Pacific Ocean and (d) the Indian Ocean.

The contour interval is 0.5°C .

- (a1), (b1), (c1), (d1): WOA01;
(a2), (b2), (c2), (d2): CTRL-WOA01;
(a3), (b3), (c3), (d3): ASSM-WOA01;



**ASSM is better than
CTRL.**



Assimilation Example: Radiometer Data

Title: Assimilation of NOAA-ATOVS Data Into a Global Weather Forecast Model

Model: TL639

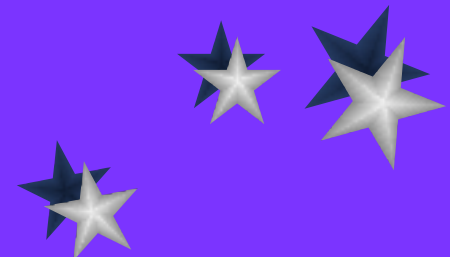
Institutions: National Meteorological Center

Model data:

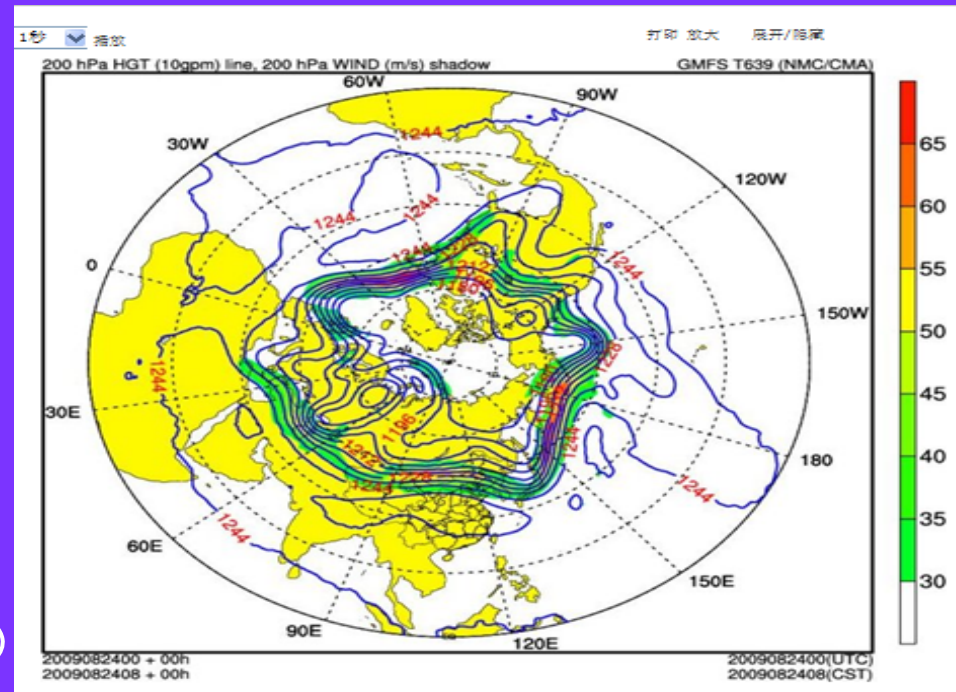
- GTS ship reports temperature data
- Coastal station observation data
- Buoy data

Assimilation data:

- ATOVS data from NOAA-15/16/17



Assimilation Example: Radiometer Data



Conclusion:

The assimilated 30% of satellite data not only significantly improved the forecast quality but also increased the spatial resolution up to $0.28125^\circ \times 0.28125^\circ$.

Assimilation Example: Scatterometer Data

Title: Assimilation of Quikscat data into a wind field forecast model in the presence of typhoon

Model: MM5

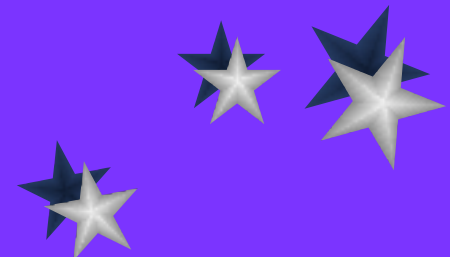
Institutions: National Marine Environment Forecasting Center

Model data:

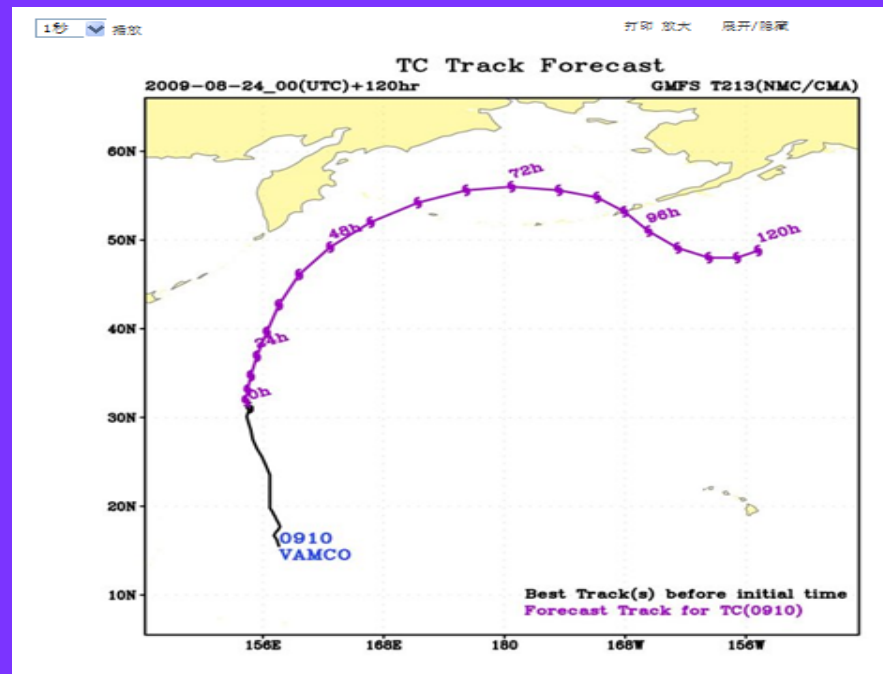
- GTS ship reports temperature data
- Coastal station observation data
- Buoy data

Assimilation data:

- Quikscat data



Assimilation Example: Scatterometer Data



Conclusion:

The assimilation of scatterometer data into MM5 model can significantly improve the forecast accuracy of the path and intensity of a typhoon.

Assimilation Example: Argo Data

Title: Reconstruction of Pacific temperature arena with Argo data based on the Kriging methods

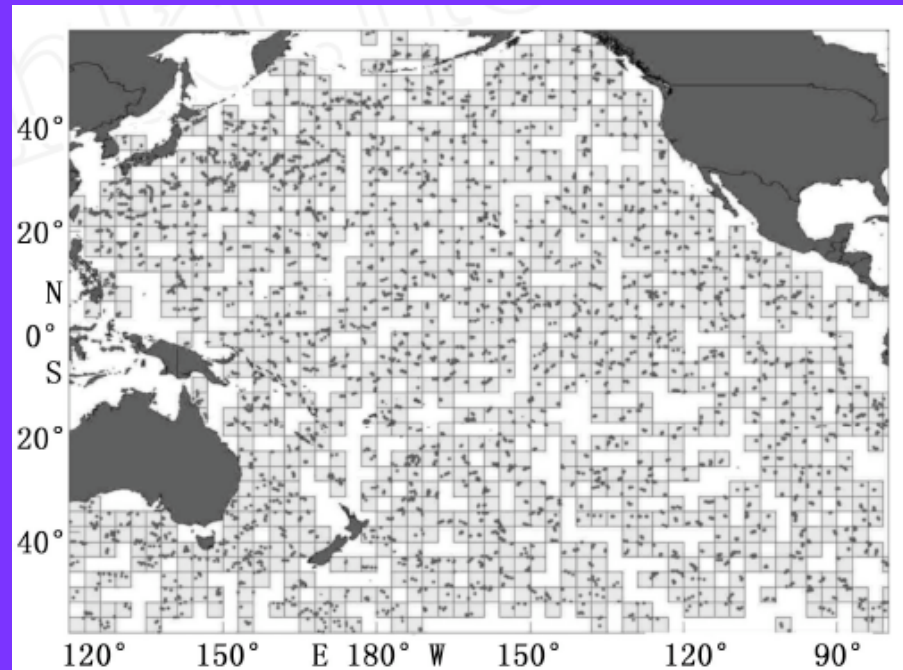
Authors: Sheng-long Yang et al.

Institution: Key and Open Laboratory of Remote Sensing Information Technology in Fisheries Resources, East China Sea, Fisheries Research Institute, Chinese Academy of Fishery Sciences

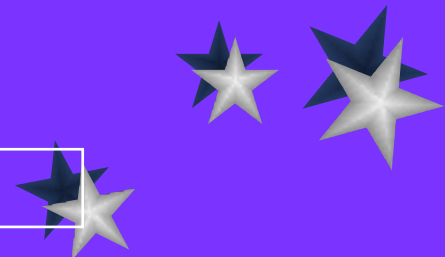


Assimilation Example: Argo Data

Data—Argo data in the Pacific from January to December, 2007



The distribution of Argo data in 3°×3° grid

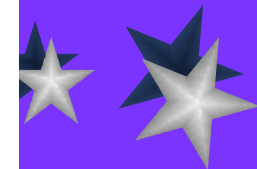


Assimilation Example: Argo Data

The results are generally satisfactory. The reconstructed Pacific temperature arena could reveal the seasonal variation of Pacific warm pool and western boundary currents, as well as western boundary currents temperature front. As compared with interpolated data and actual measurements in same period, the results show that the maximum error is 0.7°C , the mean error is 0.3°C , the mean relative error is 0.7%, the standard error is 0.06°C .

Tab 1 Comparison between in situ SST and interpolate data

| 编号 Number | 经度 (°) Lon | 纬度 (°) Lat | 实测值 (°C) Insitu data | 插值 (°C) Intepolate data | 误差 (°C) Error | 相对误差 (%) Relative error |
|--------------|---------------|---------------|-------------------------|----------------------------|------------------|----------------------------|
| 1 | 124.59 | -48 | 9.1 | 9.1 | 0 | 0 |
| 2 | 128.36 | 27.43 | 28.2 | 27.8 | 0.4 | 1.41844 |
| 3 | 132.11 | 17.81 | 28.5 | 28 | 0.5 | 1.754386 |
| 4 | 137.16 | -55 | 3.4 | 3 | 0.4 | 11.76471 |
| 5 | 137.67 | -55.2 | 3.4 | 2.9 | 0.5 | 14.70588 |
| 6 | 137.78 | 28.38 | 26.5 | 27.1 | -0.6 | -2.26415 |
| 7 | 141.61 | 28.74 | 28.1 | 27.5 | 0.6 | 2.135231 |
| 8 | 146.80 | 34.6 | 26.1 | 26 | 0.1 | 0.383142 |
| 9 | 154.25 | -14.9 | 27.4 | 27.3 | 0.1 | 0.364964 |
| 10 | 154.69 | -17.8 | 26.7 | 26.6 | 0.1 | 0.374532 |



A Non-Assimilation Example

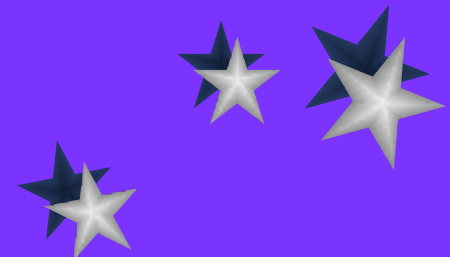
Title: Operational Forecast of 3-D Sea Temperature and Ocean Current in The China Seas

Model: MM5

Institutions: National Marine Environment Forecasting Center

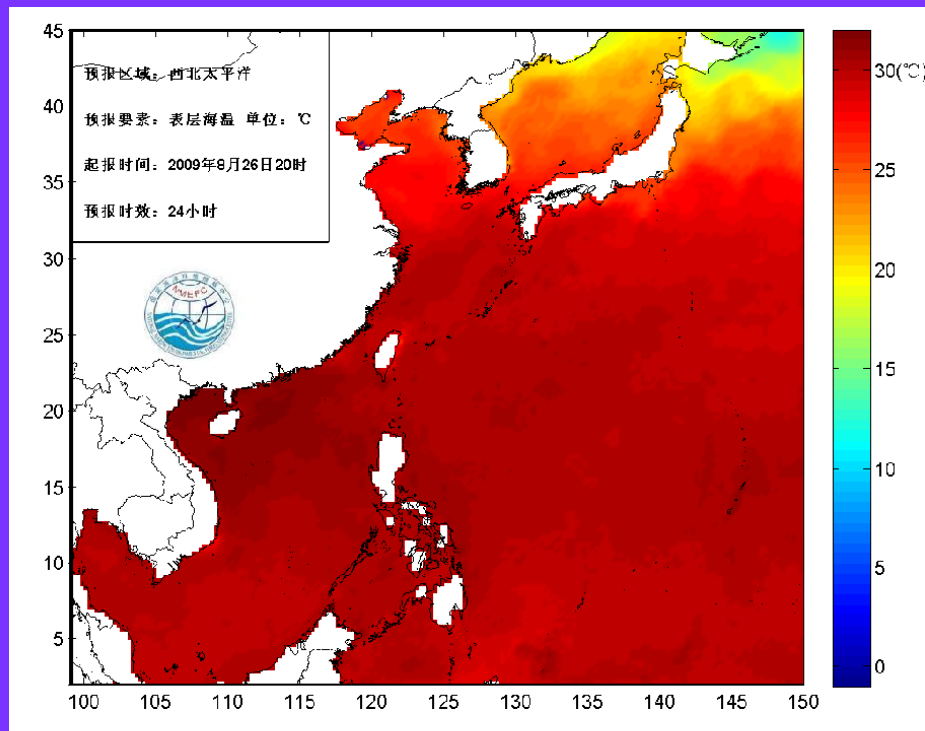
Model data:

- Coastal station observation data
- Buoy data

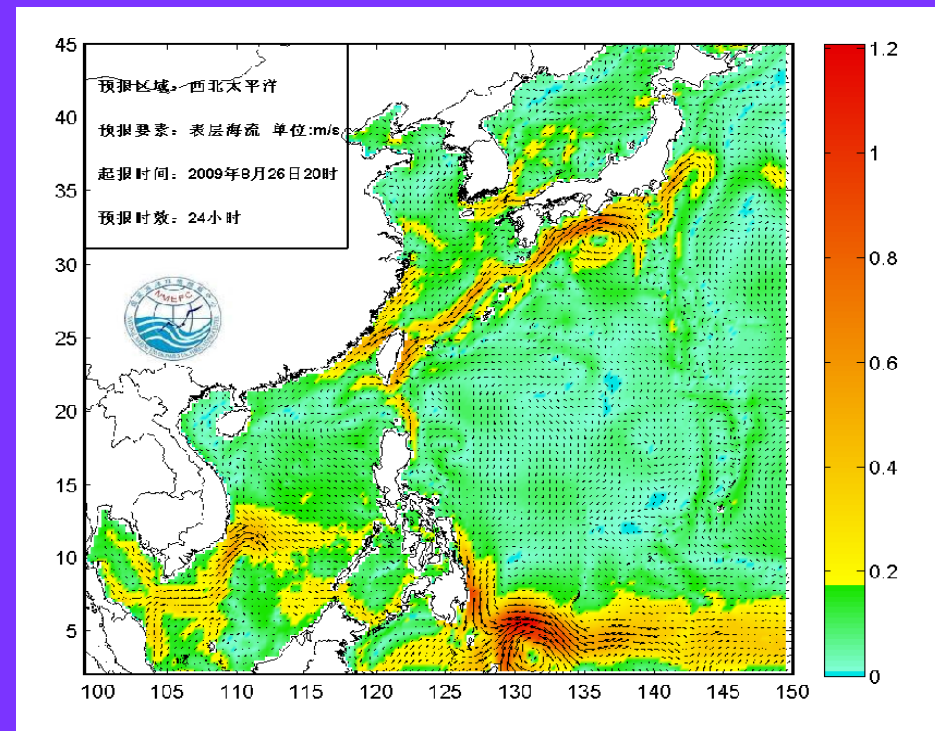


A Non-Assimilation Example

Temperature



Current



Evaluation of Data Assimilation into Models

- 1 A majority of oceanic and atmospheric models use station and ship data as input in China.
- 2 Satellite data from altimeters, scatterometers and radiometers as well as buoy data from ARGO are also assimilated into numerical models with a percentage of 0-30%.
- 3 All assimilated satellite data are from abroad. Chinese remote sensing data are rarely used in this context.
- 4 The assimilation of satellite data are found to improve the quality of model output in terms of accuracy and resolution.
- 5 The current status of real time availability and continuity of satellite data has prevented most of them from being used operationally.

The End

Thank you!
谢谢!

