Automation of Observations

PMO-IV and Support to Global Ocean Observations using Ship Logistics
8-10 December 2010, Orlando, FL, USA

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Outline

AWS Systems

- ➢ AWS Overview
- ➢ E-SURFMAR S-AWS

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Data Communications

- ➢ Manual VOS sat comms
- ➢ AWS Sat comms
- ➢ Data Compression
- ➢ Alternative Communications Methods

……………..

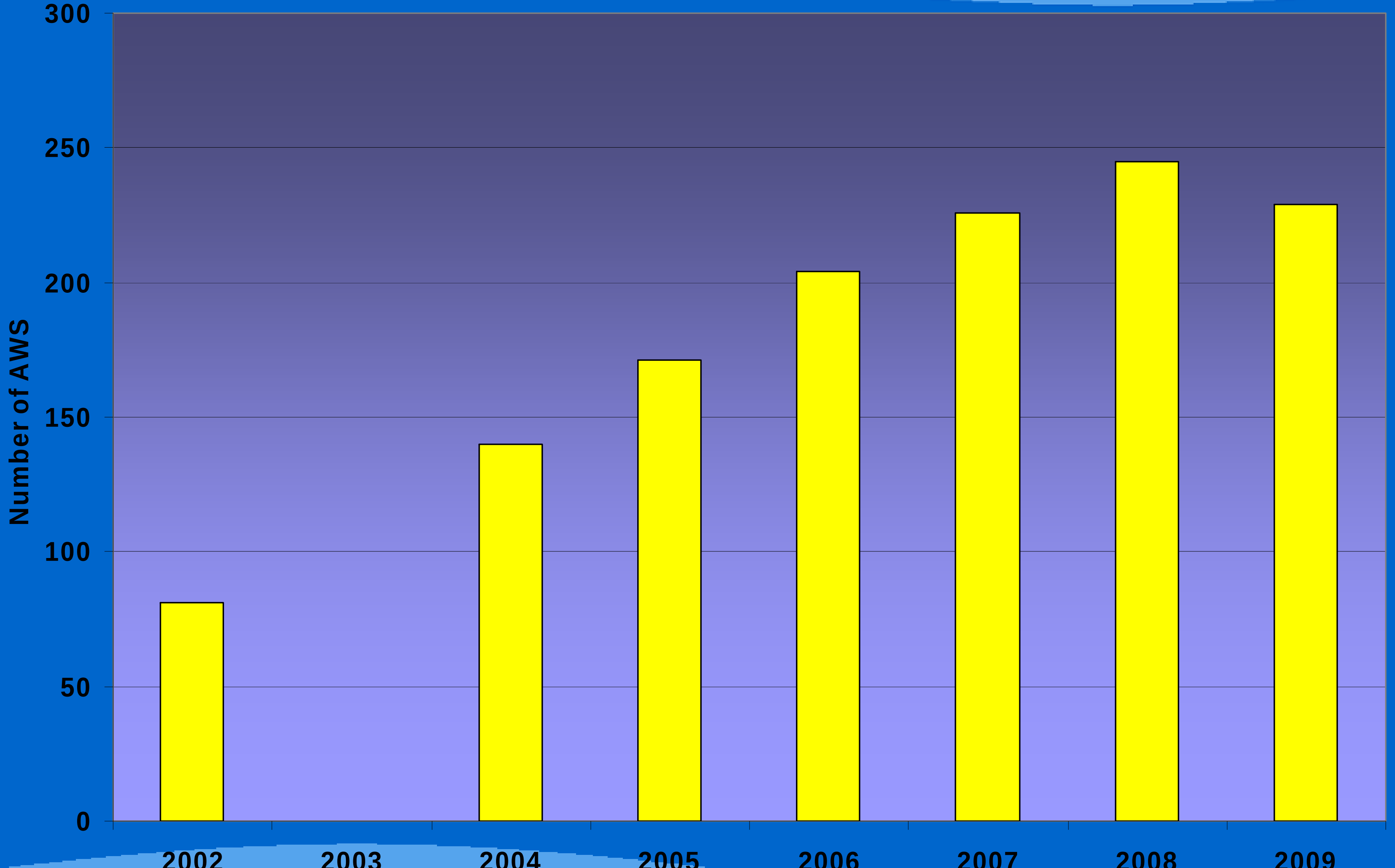
Bulletins for Asynoptic observations

AWS

AWS Overview

- In recent years VOS operators have been trialling a variety of shipborne AWS systems.
- Some NMS have already fully automated their VOS fleets e.g. Canada, Denmark and France.
- Other NMS are making plans towards the full automation of their VOS fleets e.g. Netherlands ?
- While other NMS are moving towards hybrid VOS fleets comprising a mix of shipborne AWS systems and manually reporting VOS/VOSClim ships e.g. UK and Germany

Growth of Shipborne AWS Systems



AWS Definitions

Integrated AWS

An AWS system which typically measures a variety of meteorological and / or oceanographic parameters and which requires integration with the host ships systems (e.g. ships compass, power supply, etc). Integrated S-AWS should ideally also permit observers to manually add visual observations using data display and entry software prior to data transmission, although this is not essential.

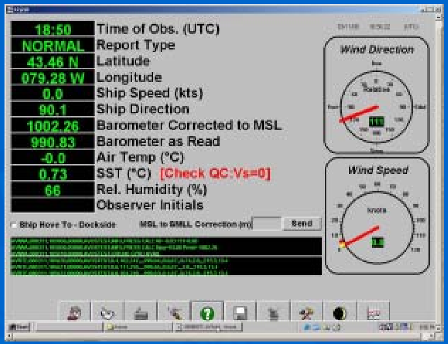
Autonomous AWS

An AWS system which typically measures a reduced number of meteorological and / or oceanographic parameters, but which is independent on the host ships systems (other than the ships power supply). Autonomous S-AWS can generally be considered as 'plug and play' systems as they require minimal interference with the host ships infrastructure or systems, and can be quickly installed or removed. They can incorporate a static data display of the measured parameters, but don't include a facility to enable observers to manually add visual observations prior to data transmission.

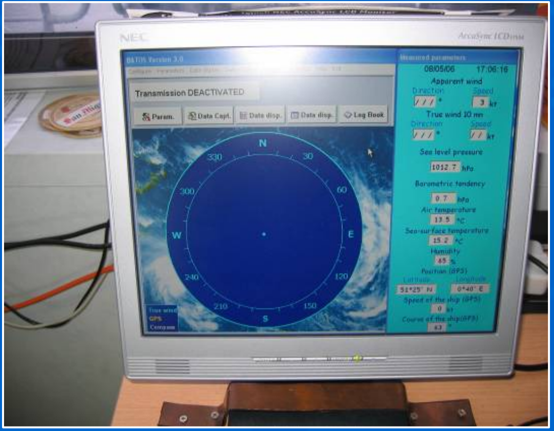
Typical AWS systems currently in use

Type of AWS	Communication	Type
Baros	Iridium SBD	Autonomous
Batos	Inmarsat-C or Data Reporting	Integrated
Minos	Argos	Autonomous
Vaisala Milos	Meteosat or Inmarsat C	Integrated
QLC-50	VSAT	?
CMR Automet	Inmarsat-C text	Autonomous
Avos	Inmarsat-C	Integrated

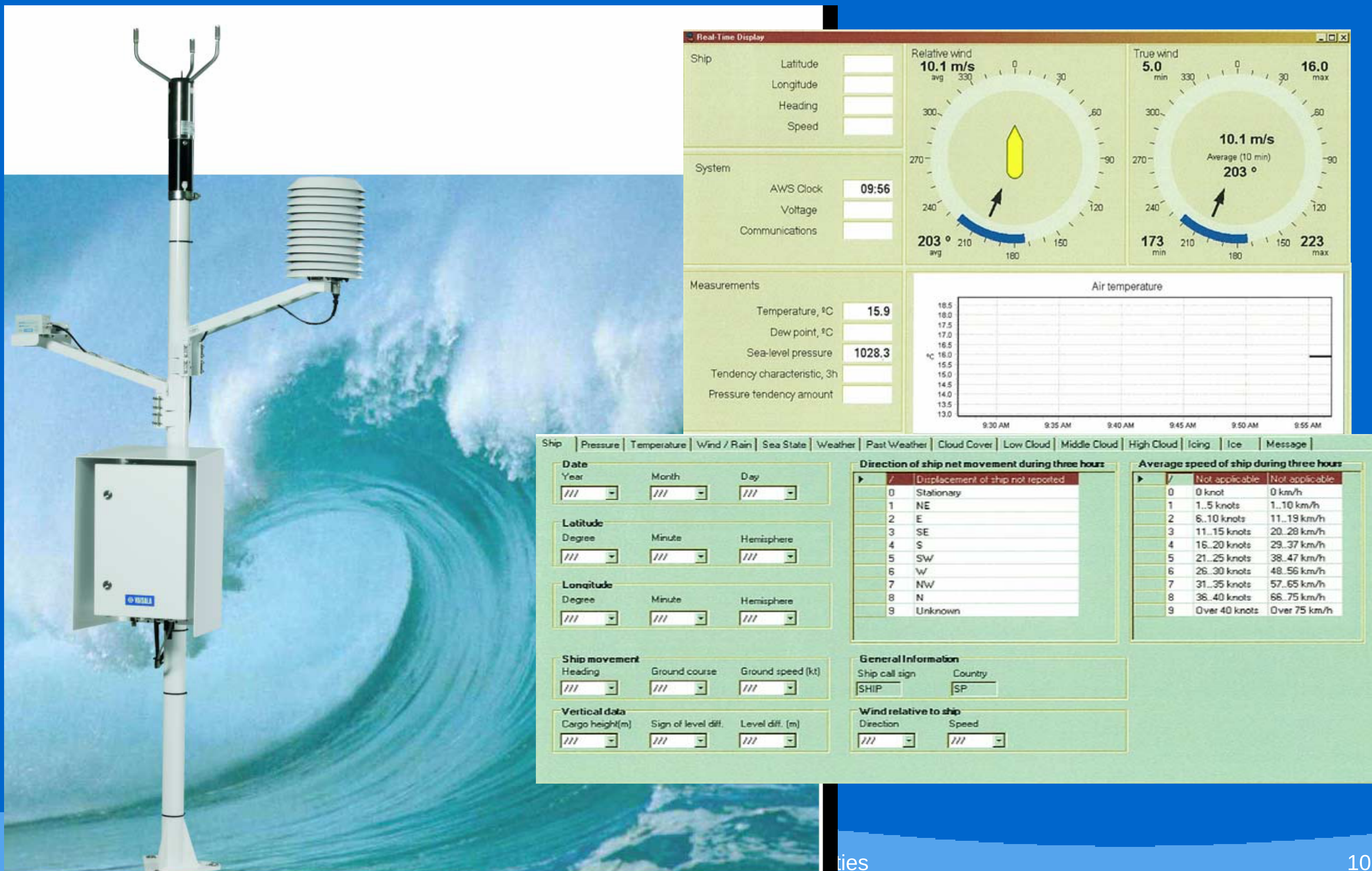
Integrated AWS Systems
AVOS



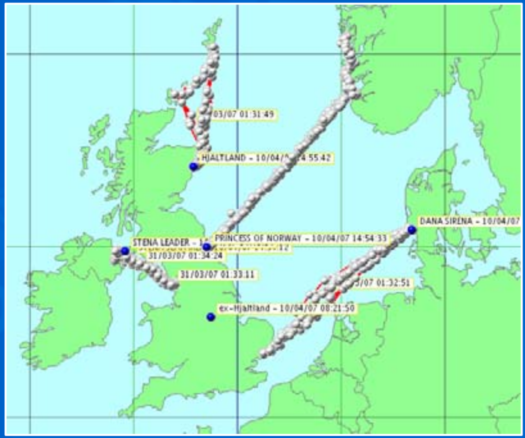
Integrated AWS Systems
BATOS



Integrated AWS Systems
MILOS



Autonomous AWS Systems MINOS



Timeliness poor
Variable pressure quality
Poor winds
Easy installation

Autonomous AWS Systems

Other systems used on VOS

AUTOMET

METPOD

BAROS

METOCEAN Deck Drifter

AWS Systems

Some examples of Other systems found on VOS

WEATHERPAK

Vaisala
WXT520

Lambrecht

MetPak

Observator

E-SURFMAR S-AWS
AWS Evaluation

- E-SURMAR members have evaluated the pros and cons of different shipborne AWS systems deployed on VOS
- The Data Availability, Timeliness and Quality of the various systems, together with issues related to their ease of installation
- This evaluation showed that there was a pressing need to develop a simple ‘plug and play’ AWS for the basic parameters (Pressure, Air Temp, Humidity) but with sufficient modularity to add other parameters when required (SST and Wind). Future systems should be
  - » Simple to install
  - » Cheap to purchase/manufacture
  - » Use low cost Comms. (e.g. Iridium)
  - » Require minimal (or no) cabling
  - » Independent of ships systems where possible

E-SURFMAR S-AWS
AWS Evaluation

- **E-SURFMAR set up a Task Team in 2008 to initiate its work on the development of common requirements for a future Shipborne AWS system. Meetings were held in DeBilt, Hamburg and Geneva and ship visits were arranged to assess the merits of existing AWS systems**

- **Based on its evaluation of different shipborne AWS systems the E-SURFMAR Task Team developed detailed recommendations and specifications for an autonomous AWS system that should be easy to install; relatively cheap to manufacture/purchase ; and require minimal cabling (only using ships power supply)**

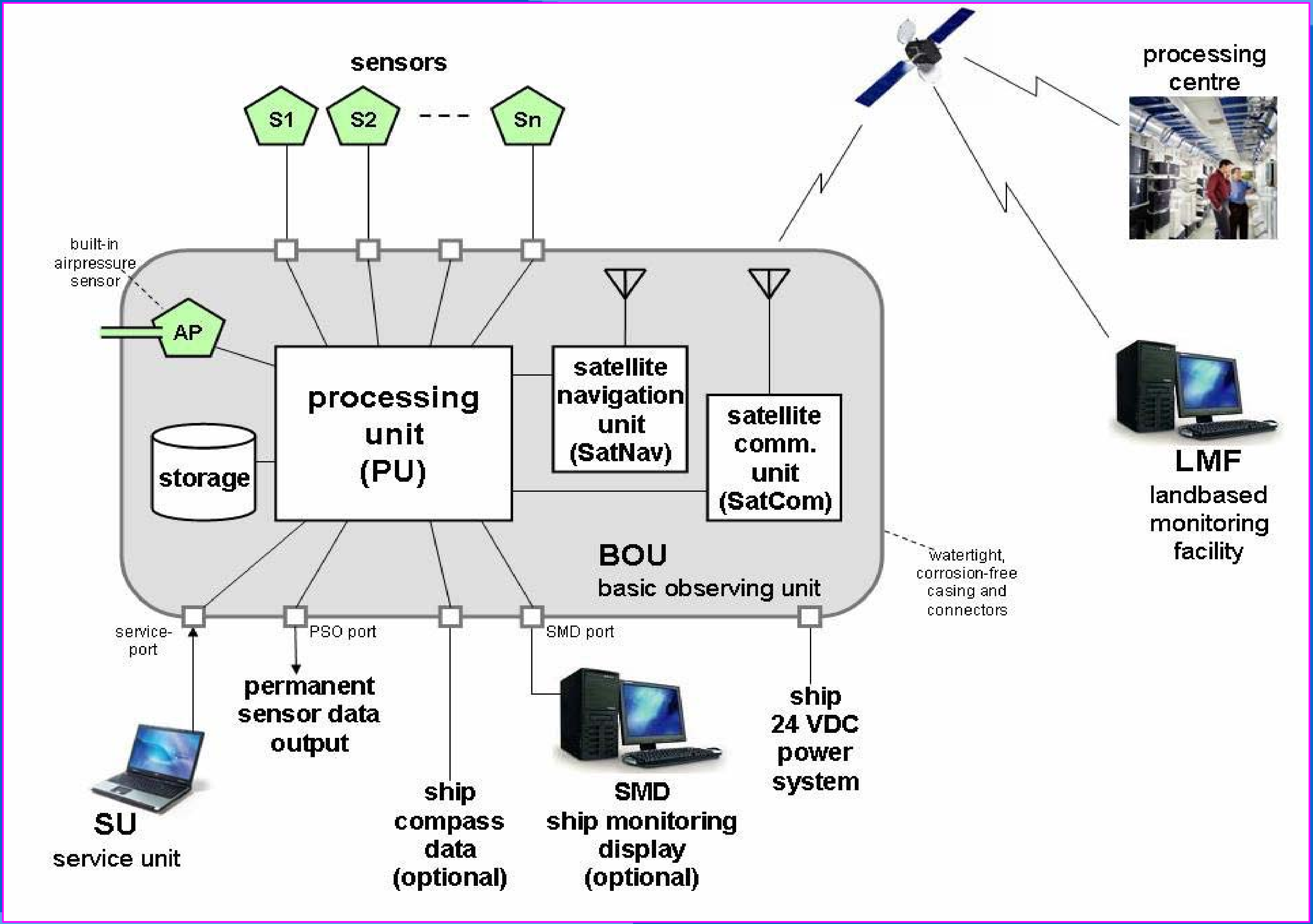
- **Tender documents are now being prepared by a new Task Team on Tendering with a view to going to tender for European S-AWS systems in Spring 2011. The basic AWS design concept has now been generally agreed by the E-SURFMAR members and there only remain some legal hurdles to overcome before going to tender.**

E-SURFMAR S-AWS
AWS Recommendations

- The E-SURFMAR Task Team recommended that future tender specifications should concentrate on an Autonomous AWS and considered that Integrated S-AWS systems should preferably only be used on research vessels, or merchant ships that are engaged on regular trading routes.

- The Team compared the national requirements of its VOS operating members and agreed common requirements for a future shipborne AWS (S-AWS).

E-SURFMAR S-AWS
AWS concept design



E-SURFMAR S-AWS
Components

A **Basic Observing Unit** which collects the measured data then transmits it ashore. It comprises:

- A **Processing Unit** with all necessary software to process the sensor data
- A **SatNav** system to obtain position data and providing global coverage
- A **SatCom** system for two-way communication with the processing centre(s) on the mainland, providing global coverage.

A **Service Unit** to allow a PMO or NMS technician to check and configure the S-AWS on board. It consists of a software program, to be installed on a portable computer which can be connected to the service port of the BOU by cable.

A **Ship Monitoring Display** to show the observed data. It consists of a software program, to be installed on a computer located anywhere on the ship, connected to the BOU by a cable(or alternatively via a wireless communication system that is suitable for use in the shipboard environment)

A **Land based Monitoring Facility** to enable NMS staff and technicians ashore to check and configure the S-AWS remotely. It consists of a software program to be installed on a computer on the mainland (i.e. where the NMS is located), that can communicate with the S-AWS via its SatCom unit.

E-SURFMAR S-AWS
AWS Recommendations

- The S-AWS systems should include, as a minimum, sensors to measure sea level pressure, air temperature and humidity
- The central unit of the S-AWS should consist of a weather/shock resistant cabinet, capable of connection to specified sensors, and to antennas (GPS and satellite communication systems)
- An optional connection should be provided to a PC installed on the bridge for displaying the data.
- The barometer may be installed inside the cabinet on condition that it has a suitable static air intake.
- A unique repeating masked call sign - according to the E-SURFMAR callsign masking scheme - should ideally be used.
- Ultrasonic wind sensors should be used whenever possible and wind reports should vector average the true wind over 10 minutes.
- The compressed data format developed by Météo France was recommended

E-SURFMAR S-AWS
AWS Recommendations

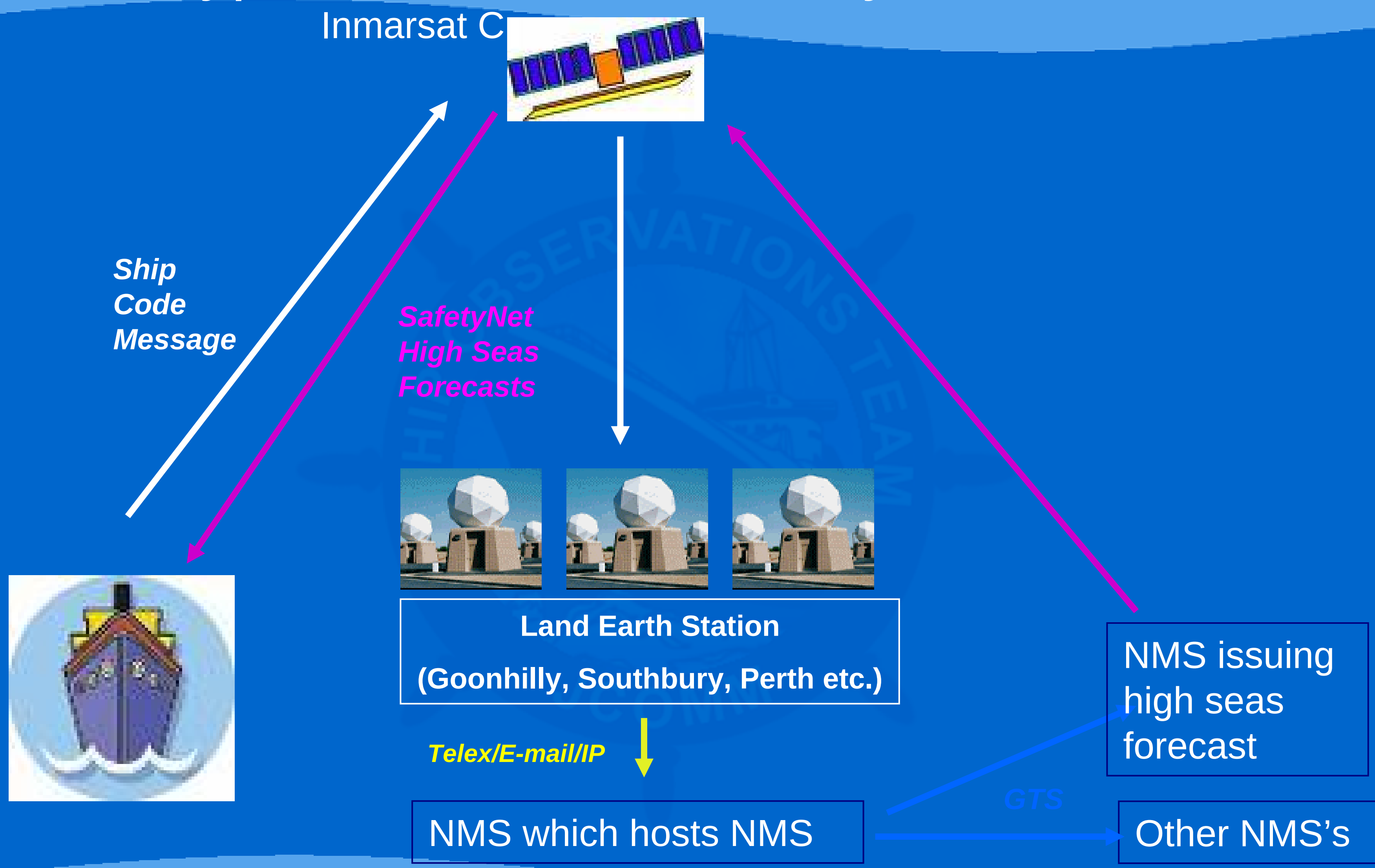
- SST probes should only be installed when considered feasible
- Additional visual observations should only be considered as an optional facility for integrated S-AWS systems.
- Autonomous S-AWS systems should have the optional capability of including a static data display for the ships navigating officers
- S-AWS systems should generate and store housekeeping data e.g. battery voltages, sensor engineering data, metadata adjustments etc.
- The S-AWS data transmission system should allow bidirectional communication, so that it can be used for remote status or housekeeping data requests' or to change key parameters of the system.
- S-AWS systems should be capable of transmitting weather reports at least hourly in near real time
- S-AWS systems should include a facility to allow the observations to be automatically switched off whilst in port

E-SURFMAR S-AWS
AWS Recommendations

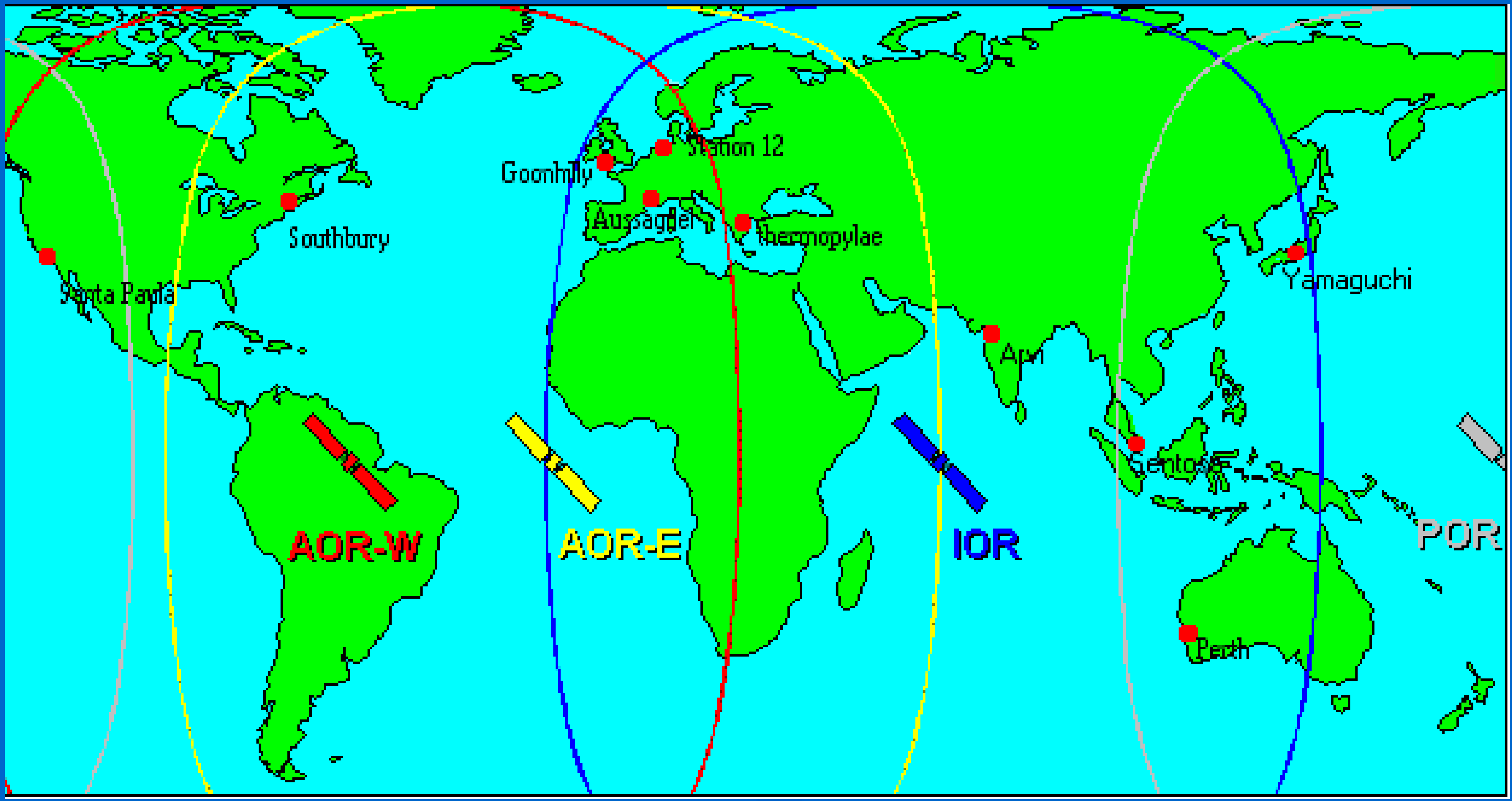
- Data logging/storage functionalities should only be considered as an optional requirement for integrated S- AWS systems, and are not required for autonomous S-AWS systems
- In addition to the normal operating mode a service or diagnostic mode should be included to allow PMOs or technicians to edit variable characteristics such as the barometer height, transmission frequency, call sign, data format, sensor setup etc.
- The service mode should allow the user to load updated S-AWS software and to access internal log files and system data.
- S-AWS systems should be capable of transmitting weather reports at least hourly in near real time.
- The power supply should be 24 Volts DC and the system should ideally have a low power consumption (less than 10 W).
- The S-AWS system should be compact, easy to carry and easy to install. Sensors should be also easily dismounted without their cables

Communications

Manual VOS sat comms
Typical VOS Data Flow by Inmarsat



Inmarsat Land Earth Stations



http://www.wmo.int/pages/prog/amp/mmop/inmarsat_les.html

Inmarsat Land Earth Stations

Name of station	Country	ID number
ATLANTIC OCEAN REGION-EAST (AOR-E)		
Name of station	Country	ID number
Aussaguel	France	121
Goonhilly/Burum	United Kingdom	102
Southbury	USA	104
Burum	Netherlands	112
Thermopylae	Greece	120
ATLANTIC OCEAN REGION-WEST (AOR-W)		
Name of station	Country	ID number
Goonhilly/Burum	United Kingdom	002
Southbury	USA	004
Burum	Netherlands	012
[Aussaguel]	France	021
INDIAN OCEAN REGION (IOR)		
Name of station	Country	ID number
Arvi	India	
Aussaguel	France	321
Eik (Oslo)	USA	304
Sentosa	Singapore	328
Burum	Netherlands	312
Thermopylae	Greece	305
Yamaguchi	Japan	303
Goonhilly/Burum	United Kingdom	302
PACIFIC OCEAN REGION (POR)		
Name of station	Country	ID number
Santa Paula	USA	204
Sentosa	Singapore	210
Burum	Netherlands	212
Yamaguchi	Japan	203
Goonhilly/Burum	United Kingdom	202
Aussaguel	France	221

Inmarsat Code 41 costs

- Code 41 costs are paid by the country that hosts the LES – irrespective of the country that recruited the observing ship
- Because the number of LES that can accept code 41 messages has reduced in recent years there has been an unfair cost burden on some countries
- JCOMM SOT is continuing to monitor the cost implications of Inmarsat satellite communications sent by Code 41
- Costs are coming down as a result of..
  - **Observing ships moving to the use of email in lieu of Code 41**
  - **Bi-lateral agreements between LES host countries and VOS Operating countries**
  - **The introduction of the transmission routes (e.g. for ASAP messages)**
  - **The use of alternative transmission systems (e.g. Iridium for AWS)**
  - **Initiatives such as the Inmarsat Half Compressed data format**

Data Compression for Manual VOS

- **To help reduce the Inmarsat cost burden from conventional manned VOS, E-SURFMAR has developed a 'HALF – COMPRESSED' system**
- **Messages remain alphanumeric but are contained within two blocks of 32 characters (compared with 5 blocks for a conventional uncompressed VOS message)**
- **Cost reduction is correspondingly reduced to approx 0.4 Euros (compared to ~1 Euro for a conventional VOS message)**
- **However the system cannot be used with SAC 41 - new SACs are needed. Currently the system is being tested using dedicated SAC 412 via Aussaguel LES.**
- **The new Half Compressed facility has been incorporated into TurboWin and has been satisfactorily tested on several ships**
- **Météo France is willing to make the necessary software available to other NMS so that they may also decompress the messages and insert them on the GTS.**

Data Compression for Manual VOS

- **The Half Compressed technique therefore offers the long term potential of becoming a fairer system whereby each NMS is responsible for paying the cost of its own VOS fleet transmissions**
- **To expand its use national VOS operators will need to establish individual arrangements with their Inmarsat LES providers. They will need to establish their own dedicated SACs**
- **As with Code 41 there are no charges incurred by the shipowner**
- **It could be run in parallel with the established Code 41 procedure**
- **Météo France is willing to make the necessary software available to other NMS so that they may also decompress the messages and insert them on the GTS.**

AWS Satellite Communication Systems

- **E-SURFMAR continues to evaluate the relative merits of different satcom systems for VOS and for AWS systems**
- **This work has mainly concentrated on the advantages and limitations of the Inmarsat, Iridium and Meteosat transmission systems which are now most commonly used for AWS systems**
- **Argos is still used for some AWS (Minos) and drifting buoys but is increasingly being replaced by iridium due to data timeliness issues**

AWS Satellite Communication Systems

	Inmarsat C		Meteosat DCP		Iridium SBD	
Type	GEO		GEO		LEO	
Coverage	Limited to 70N-70S		Limited to 60N-60S		Yes	
Transmitter + antenna cost	2,200 €		5,500 €		850 €	
Timeslots	No		Yes		No	
Risk to have a mask during transmission	Yes		Yes		Weak	
Transmission integrity	Ensured by the system		To be managed by the user ??		Ensured by the system	
Data format	Text (***)	Binary (DR)	Text	Binary	Text (***)	Binary
Data processing	Required for BUFR	Required	Required for BUFR	Required	Required for BUFR	Required
In use	Yes	Yes	Yes	??	??	Yes
Operating (*) cost/report	0.39 €	0.12 €	0 €	0 €	0.13 €	0.06 €
Total (**) cost/report	**0.46 €**	0.19 €	0.18 €	0.18 €	0.16 €	**0.09 €**

Caution - figures do not include VAT and are for guidance only

AWS Satellite Communication Systems

Iridium currently offers distinct cost advantages..

- **It is already in common use for drifting buoys and AWS systems (e.g. BAROS, MetPod, Vaisala MAWS etc)**
- **Messages can be received as email attachments to a number of different mailboxes**
- **It offers two way communications**
- **It has global coverage**
- **Data timeliness is excellent with the observation being received as an email only minutes after transmission**

Alternative Communications Methods– AIS over Satellite

- **The US Coast Guard established a contract with Orbcomm to develop and build the capability to receive process and forward AIS signals from space.**
- **At the start of 2009 Orbcomm's constellation of more than 30 spacecraft included six recently-launched satellites carrying AIS receivers, making it the first commercial provider of globally collected AIS data from space.**
- **Lloyd's Register – Fairplay has signed a global distribution agreement with ORBCOMM to allow it to distribute information obtained from ORBCOMM's AIS equipped satellite constellation).**
- **Norway has built a civilian AIS satellite to aid surveillance of the Arctic Sea**
- **A new application specific data format for ship observation reports has been agreed at IMO**

Bulletins for Asynoptic observations

It recently became apparent that some SHIP observations were not being put on the GTS e.g.

- » **non standard hour or intermediate hour observations that are sent to certain LES,**
- » **Observations that are sent from certain geographical areas, e.g. Antarctica below 60 deg South**

Bulletins for Asynoptic observations

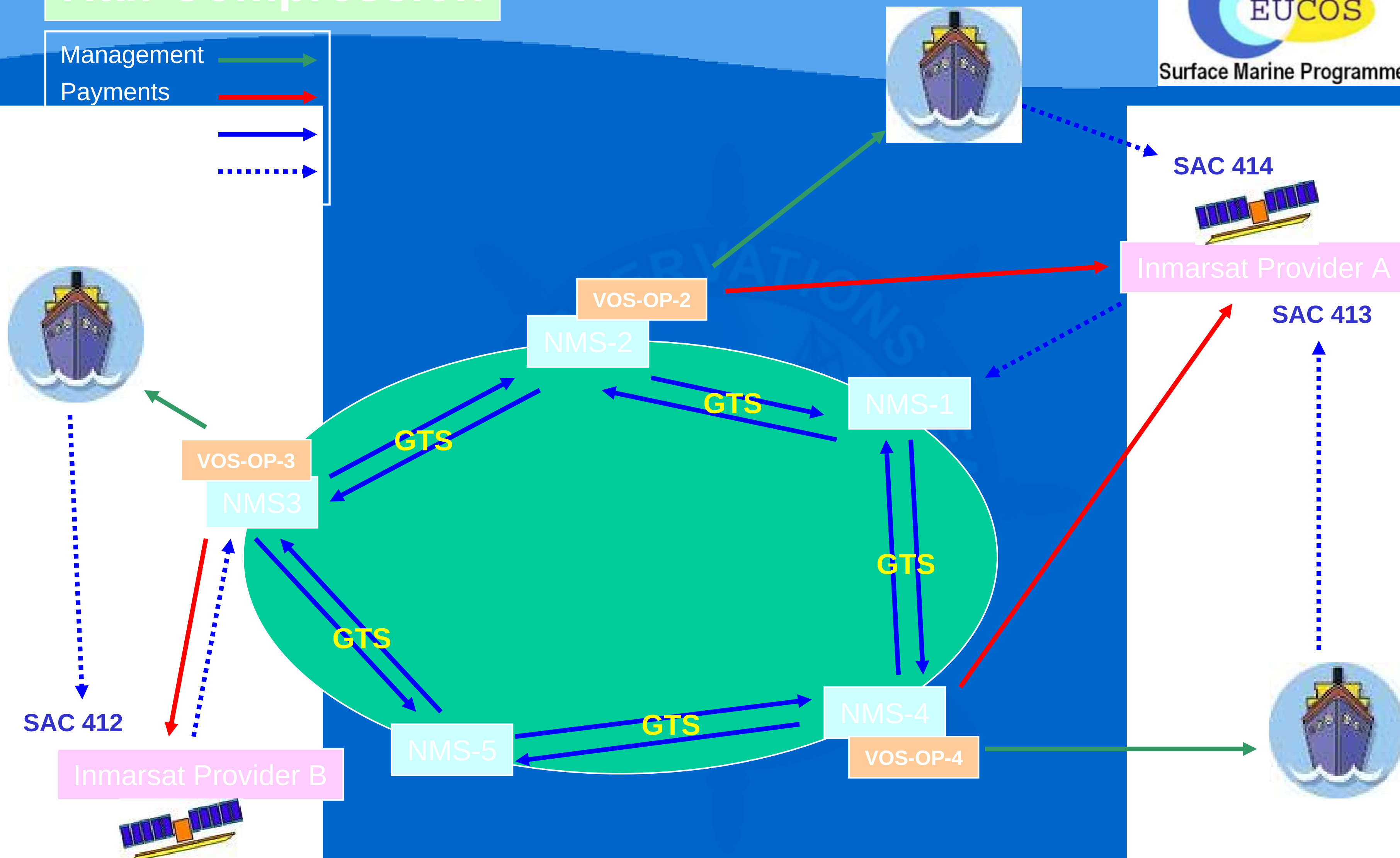
- Examination of WMO Volume C1 (Catalogue of Meteorological Bulletins) appears to suggest that non standard hour observations sent to some Land Earth Stations (e.g. Sentosa, Thermopylae and Burum were not being circulated on the GTS

- Given the value of these observations in real time, and the fact that SOLAS requires ships to undertake more frequent observations when in the vicinity of tropical cyclones, it is suggested that the WMO Secretariat should invite members to check the accuracy of their entries in WMO Volume C1 *[Action at SOT]*

SHIP OBSERVATIONS TEAM

JCOMM

Half Compression



- Each ship report to a single LES (belonging to a service provider)
- Communications are paid by the VOS operator of that ship
- A few NMSs are processing the raw HC data