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ASAPP-XVI
ISSUES FOR THE ASAP

(Submitted by the Secretariats with input from Rudolf Krockauer and Sarah North)

Summary and purpose of document

This report provides information on several ASAP issues, including basic information concerning ASAP ship recruitment, satellite transmission difficulties, and improvement of data quality, ASAP routes, and costs. Possible solutions are being explored.

ACTION PROPOSED

The Ship Observations Team is invited to:

(a) Review the information contained in this report and comment as appropriate;

(b) Take this document into account when considering potential strategies for increasing ASAP recruitment levels;

(c) take note the current status of ASAP ship routes and to consider the potential to establish new routes;

(d) Approve the recommendations contained in the report.

Appendices: A. Factors to be considered when recruiting a new ASAP ship;

B. Existing ASAP Routes

C. JCOMMOPS map of ASAP TEMP Reports February 2007

D. Scholar Ship Routes 2007-2008

DISCUSSION

1. Ship recruitment

(text provided by Sarah North, Chairperson of the ASAP Panel)

1.1 Recruitment of a merchant ship to host a new ASAP unit requires significant financial and human resources. Following recruitment the ongoing cost of ASAP consumables (helium, radiosondes and balloons), and of ASAP data transmission, is extremely high when compared to the cost of surface marine observing networks. Specialist technical skills are also needed to maintain the ASAP system when in service, and to ensure the quality of the upper air data

1.2 Container ships are the most common ships recruited to host ASAP units because they are engaged on established trans-ocean liner trade routes. However choice of a suitable host ship can also be a high risk decision, as the nature of shipping is highly dynamic and ships can change their routes, their crews, their owners or their managers with very little prior notice Furthermore, because modern container ships are increasingly designed to maximise cargo space this usually results in there being very little available superstructure or deck space for housing ASAP containers and equipment. A list of basic factors that need to be taken into consideration when recruiting a new ASAP ship is at **Appendix A**.

1.3 For the above reasons it is often difficult for National Met. Services to justify the risks involved in recruiting and establishing a new ASAP unit. Recruitment of ships under financially integrated ASAP regional programmes, such as that established by E-ASAP, will therefore help to mitigate such risks. It may also be possible to collaborate on a global basis as was originally intended with the WRAP project or by contributing to international initiative such as the ScholarShip. However if such regional or global initiatives are to work then it is essential to establish ongoing financial commitments from participants at the outset.

1.4 Research ships perform occasional soundings for particular scientific projects, but their activities aren't always reported to the ASAP Panel, because they don't contribute to and established ASAP programme. Although research cruise routes can vary greatly it is nevertheless suggested that closer links with research institutions may offer an opportunity to make use of existing sounding equipment and installations, and to provide soundings in more data sparse areas.

2. Satellite transmission difficulties

(text provided by Rudolf Krockauer, E-ASAP Programme Manager)

2.1 Usual practise for the transmission of upper air soundings from the ships under E-ASAP management is the transmission via Inmarsat-C. All units are equipped with their own transceiver and do not use the ships Inmarsat system. Trials to implement Globalstar as cheaper system have not proved satisfactory because the communication procedures differ between the East and West Atlantic. Further, the coverage of Globalstar is not 100% in the relevant area. Basically, Globalstar is still an option in combination with Inmarsat-C as backup system, but further tests have been postponed.

2.2 Inmarsat-C is a very reliable sat com system. Nonetheless, there are only two geostationary satellites, which can be used in the EUCOS area over the North Atlantic and Mediterranean. This requires an optimum position of the antenna to ensure proper communication with the satellite. Interference with the ships communication systems must be avoided. Therefore most antennas are mounted on or near the launcher. On several ships the antenna is relocated from starboard to portside, depending on the east- or westward crossing.

2.3 In some cases successful soundings were not transmitted due to configuration errors in the interface between the sounding software and the transmission software. The combination of these two softwares is difficult to oversee by non-skilled operators like the nautical officers on board.

2.4 The data messages are transmitted using Special Access Code 41. In Europe only the UK Met Office and Meteo France accept TEMP messages using code 41. Therefore only the Land Earth Stations Goonhilly and Aussaguel can be used. The processing steps are different at the Met Office and at Meteo France, but both rely on telex lines for the transmission from the LES to the Met Service. To avoid problems (e. g. due to different headers) Goonhilly (LES 002 AOR-W and LES 102 AOR-E) was chosen as default station for all E-ASAP units.

2.5 In November 2006 Goonhilly was closed without further notice. All transmissions were planned to be seamlessly re-routed to the station Burum (Netherlands). But the provider did not expect the following massive loss or delay of data from all ships transmitting to Goonhilly. All crews on the E-ASAP ships were advised to change the configuration from Goonhilly to Aussaguel. Nonetheless the timeliness of the data suffered from this change. The reason is unknown because all messages are processed manually at Meteo France. Possible reason is that TEMP messages are only accepted from LES 121 (Aussaguel, AOR-E), thus reducing the available satellites from two to one.

2.6 Following the closing of Goonhilly the issue was discussed between the E-ASAP management and KNMI regarding transmissions to Burum. Since all transmissions are paid by E-ASAP and the ASAP operating countries, KNMI is open to implement modern communication procedures to accept TEMP messages from ships and to insert them onto the GTS.

2.7 The transition from TEMP to BUFR is an ongoing issue at the WMO. Purpose is to have high-resolution data. TEMP files are of approx. 2-3 KByte and cost approx. 8-10 € per transmission (including confirmation) via Inmarsat-C. Therefore, high resolution BUFR data would be extremely expensive to transmit. As long as there is no agreed template for ASAP radiosounding data of practicable file size the ASAP units should continue to transmit TEMP files. These files can be decoded to BUFR at the receiving Met Service and transmitted to the GTS in BUFR format. Further benefit of alphanumeric files is the option to transmit the data manually by e-mail, if required.

3. Improvement of data quality

(text provided by Rudolf Krockauer, E-ASAP Programme Manager)

3.1 The quality targets for E-ASAP consist of timeliness and burst heights. Table 1 gives an overview of the development of the quality since 2003, including all European ASAP units (10 E-ASAP units and 6 national ASAP units).

Table 1: Quality improvement 2003-2006

	2003	2004	2005	2006(1)
Percentage of soundings achieving 100 hPa Target: 90%	85	88	82	85
Percentage of soundings achieving 50 hPa Target: 75%	**75**	**75**	73	**78**
Percentage of soundings received HH+120 Target: 85%	84	**91**	**89**	**95**

(1) Analysis for Jan-Oct 2006

3.2 Achieving the targets for the burst heights depends mainly on the balloons. All units use Totex balloons. The size differs between 200g and 350g. Since all balloons are proper stored before usage on board there are no measures possible do improve the quality. Using 350g ballons instead in 200g launchers to achieve better burst heights is also not possible. Launching a half filled balloon would result in higher crash rates at start due to the higher sensitivity to turbulences.

3.3 Improvements were made regarding the timeliness of the soundings. In 2003 only 84% of the soundings were received within HH+120. In the following years the target was fully achieved and the percentage of timely received soundings increased to 95%. This was achieved by following:

- Launching time is set to HH-85. This gives sufficient time for launches and re-launches.
- Optimization of transmission configuration regarding LES's and repeat times.

- Transmitting all bulletins (part A to D) in a single file. This procedure helps to speed up re-transmissions if the first attempt failed.

3.4 In 2006, the most reliable transmission technique proofed to be the manual transmission by the crew via the ship's e-mail system. But this is not recommended as general solution. Most crews would be reluctant to return to manual transmission, since they are used to finish the work after successfully launching the balloon

3.5 All soundings are performed by the ships' crews. Simplifying the work as much as possible can reduce operational errors or damages to the sensor. It was decided to rather accept small amounts of faulty radiosondes instead of performing ground checks before each launch. Obvious sensor errors are usually detected during initalisation of the sonde. No negative impact was reported so far.

4. ASAP routes

(text provided by Sarah North, Chairperson of the ASAP Panel)

4.1 ASAP ship routes continue to be predominantly focused on two geographical areas of operation – the North Atlantic and the Western Pacific – although research ships are also contributing occasional upper air soundings in the Southern and Indian Oceans. Maps showing the shipping routes currently involved are attached at Appendix B. A map produced by JCOMMOPS and showing location of ASAP TEMP ship reports in February 2007 is also attached at Appendix C.

4.2 ASAP routes are highly dependant upon the type of ship chosen to host the ASAP units. Liner trade container ships remain the primary type of merchant ship used by the E-ASAP programme as they are engaged on regular repeat trading routes crossing the EUCOS area of interest. However, because the nature of container shipping can be highly variable, routes, ownership and crews can often change with little prior notice. Research ships, such as those used by Japan and South Africa, are the only other type of vessel known to be currently engaged in routine ASAP operations. However their areas of operation can vary depending on the scientific research cruises they have been engaged to undertake.

4.3 When WRAP operations ceased the opportunity to extend upper air data on a more global basis, and to fill some of the climatologically sensitive or data sparse areas, was unfortunately greatly reduced. However a potential new opportunity to resurrect the WRAP principle, in the form of the round the world Scholar Ship, has recently arisen. Whilst the cruise ship chosen for this initiative would apparently have sufficient deck space to house an ASAP container and the research staff on board may be able to assist in launches, the cost of equipment, transmissions and consumables would still have to be found by the national meteorological services. Maps showing the planned routes for this cruise ship are at Appendix D.

4.4 The need to establish new ASAP routes will inevitably be driven by modeling centre requirements and the need to target areas that are considered sensitive for NWP. Such requirements will act as the driver for investing in future upper air sounding routes at sea, whether on a global or regional basis

4.5 In this respect ECMWF recently issued a Technical Memorandum[1] examining the effect of removing all types of observations from most of the Pacific and Atlantic in order to interpret the impact of targeted observations. These data denial studies (which covered a total period of six months) showed that Pacific oceanic data is more important in terms of 2 day forecast impact over North America than the Atlantic oceanic data in terms of 2 day forecast impact over Europe, although both denial experiments showed a degradation downstream. This appears to suggest that there may be a case for targeted ASAP observations in the North Pacific

4.6 Clearly SOT members will need clear guidance from the modelers for other oceanic areas (including, in particular, those in the southern hemisphere) where upper air observations are likely to have the greatest impact, before they can justify the large expenditure required to establish and

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1 *The value of targeted observations Part 1: Data denial experiments for the Atlantic and the Pacific – February 2007 – Graeme Kelly, Jean-Noel Thepaut, Roberto Buizza and Carla Cardinali.*

maintain new ASAP programmes and routes.

5. Costs

(text provided by Rudolf Krockauer, E-ASAP Programme Manager)

5.1 The costs of ASAP operations are composed of operational and maintenance costs. Operational costs include consumables, operator fees, satellite communication, etc., while maintenance costs cover support and repair.

5.2 Maintenance is estimated at 5,000 to 12,000 EUR per unit per year, if no major refurbishment is required.

5.3 More than 50% of the operational costs of a launch are caused by the radiosonde. The price per sonde depends mainly on the windfinding method (Loran-C or GPS) and is approx. 100-160 EUR.
5.4 According to the information received from the European ASAP operating countries, the total operational costs range from 200 to 300 EUR per launch.

5.5 The table below gives an 'average example' of the costs per launch of an E-ASAP unit.

Example of average costs per launch (in 2006)

Item	Description	Costs (EUR)
1	GPS Radiosonde	150
2	Helium (2 m^3), rental of cylinders, loading/unloading by crane	35
3	Operator fee	35
4	Balloon (350 g)	15
5	Satellite transmission	10
6	Small parts	5
7	Ship agent fee	5
	Total	**255**

5.6 It has to be noted that these costs are the costs per launch, not per timely received sounding data on the GTS. Considering a loss rate of 20%, the costs per sounding on the GTS amount to approx. 250 to 375 EUR.

5.7 Usually the radiosondes are equipped with a pressure sensor while some manufacturers use the GPS receiver to convert the height to pressure. Since GPS is the dominant windfinding method, it is likely that future radiosonde types will have no pressure sensor at all. It remains to be seen whether the price for radiosondes will decrease rather than increase.

Appendices: 4

APPENDIX A

FACTORS TO BE CONSIDERED WHEN RECRUITING A NEW ASAP SHIP

1. Initial ship selection and survey

When recruiting a new ASAP ship it will, in the first instance, be necessary to determine the willingness of the proposed host ship to become involved in ASAP operations, and the suitability of the ship concerned to undertake ASAP operations.

Initial contact should be made with the ship owners or managers (usually via the Marine Superintendent). Subject to a positive response, a visit to the proposed ship can be arranged to discuss the possibility further with the Master

When selecting a ship suitable for hosting an ASAP unit consideration should, inter alia, be given to the following factors;

- The trading pattern of the proposed ship e.g. whether the trading route passes though data sparse or sensitive areas, time spent in port, whether the trading route is likely to alter in the future, etc.
- The age of the ship i.e. its anticipated remaining service life
- The number of ASAP ascents that could realistically be performed on ocean passages
- The willingness of the shipping company and ship's staff to become involved in ASAP operations,
- The amount of available deck space for locating launching systems and helium gas pallets
- The available space in the wheelhouse to locate the ground station and associated electronic equipment
- The availability and suitability of deck space to locate required aerials (usually on the monkey island or on the mast) bearing in mind the possibility of interference to/from the ship's aerials
- The availability and type of ship's voltage supply (AC or DC) and electric sockets, and the possible need for transformers/adapters
- The likelihood of the ship's structure hampering successful launches e.g. due to large funnel structure in way of launch zone, and the effects of wind eddies created by the ship’s superstructure
- The suitability of the ships arrangements for installing piping systems to transfer the helium gas to the launching arrangement
- The availability of Port Met Officers to attend the ship when in port
- The anticipated cost of installing the system
- The possibility that the installation may interfere with ship's safety systems e.g. the launching system interfering with the ship's emergency embarkation arrangements, the possibility that systems installed on the bridge could interfere with the safe navigation of the ship

Having confirmed the suitability of the proposed host ship it will be necessary to discuss with the Ship Manager and the Master the possibility of one of the ship's staff being employed to perform the required ascents (normally at least two ascents/day, but in data sensitive areas as many as four ascents/day).

It may be possible to arrange for one of the ship's navigating officers or cadets to perform the ascents, either as part of their training or in return for remuneration. Where remuneration is involved the arrangements for payment, the frequency of payments and the payments involved should be formally established with the Shipowner/Manager and agreed with the Master.

2. Installation considerations

Types of ASAP system

ASAP designs can be based upon a 'modular' configuration, with all the ASAP systems housed within standard 10 or 20 foot shipping containers, or on a with 'distributed' configuration. In a distributed system a 10-foot container can be used to house the radiosonde balloon launcher, while the ground station and associated transmission system can be located in the host ship's wheelhouse. Alternatively a dedicated transportable deck launcher can also be used for balloon launches

Launching systems

The choice of launch system (i.e. containerised or deck launcher) will largely depend upon the suitability of the ship's arrangements and availability of deck space. Other factors, which should be considered, include;

- The availability of space for storing radiosondes and balloons
- The suitability of deck launchers for the marine environment
- The ability to transfer deck launchers to either side of the ship
- The risk of the balloon or sonde being snagged against ship structure during the launch
- The deck securing arrangements for containers or lashing arrangements for deck launchers
- The possibility of wind eddy currents affecting the launch
- The availability of power supply to containerised launchers
- The strength and suitability of design of deck launchers
- The accessibility to containerised systems with sufficient space allowed for opening the launch door
- The maintenance of the air compressor which is used to open the launch door e.g. the need to top up oil, open drain valves etc.
- The relative costs of a deck launcher compared with a containerised launcher (and associated installation, transportation etc. costs)
- The proximity to ship's access hatches or doors, escape routes, lifeboat embarkation areas, vents, etc.
- The ease of access for connecting radiosondes and for connecting flexible helium filling hoses

Helium System

The helium balloon gas is usually supplied and stored in a standard bottle pallet arrangement and should be located on convenient deck space that is acceptable to the ship's master, clear of ships embarkation or escape arrangements, and readily accessible to the ship's crane for replacing depleted helium pallets. Consideration should also be given to the following factors

- The type of piping arrangement for conveying the helium from the bottle rack to the launch arrangement. This will normally be flexible plastic piping as it is easy to install, although copper piping can occasionally be used
- The run for the pipe e.g. whether it is likely to interfere with ships working or safety areas
- Shut off valves may need to be inserted in the piping system e.g. on both sides of the ship to facilitate inflation of the balloon from either side. Consideration could also be given to the use of a flow meter to measure the volume of gas inserted in the balloon.
- There will normally be a gauge on the pallet to display the pressure within the whole bottle rack (usually in the order of 300 bar). Regulators and connectors will usually need to be purchased separately to gauge the pressure at the manifold pipe (usually 60 Bar) and the filling pressure.

Sounding system

For distributed systems suitable space and a power supply will be needed to install the ground station, usually in or adjacent to the wheelhouse. While there are several different types of ground station available on the market the type currently most commonly in use is the Vaisala MW-21 system. This system and has the advantage over the earlier DigiCORA systems in that it is an entirely PC based system. All the necessary editing, graphing and message transmission software, and associated help files, are therefore installed on the one computer. This makes the system considerably easier to operate and simplifies the training necessary in its use. Copies of the manufacturer's handbooks should be placed on board the ASAP ships to assist operators in the event of any faults arising.

A variety of radiosondes are currently available with varying merits e.g. GPS (Vaisala RS90, Vaisala RS80-15GH, Vaisala RS92, VIZ) and Loran (Mark II Microsonde, Vaisala RS80-L) etc. Care should be taken with the unwinders for the radiosonde, as failure to unwind correctly will prevent transmission of accurate wind data. An observations sounding log should be completed by the operator to keep a record of successful ascents, and to help to identify any bad sonde batches in order that redress can be pursued

Inmarsat is currently the most commonly used transmission system for sending the completed upper air message in Temp Code, although consideration should be given to the use of other communications systems to reduce transmission costs

Aerials

The ASAP system usually requires the following aerials;

- A dedicated aerial for receiving the raw data from the radiosonde. This could be a directional mushroom aerial (e.g. RB21) or a multi-directional dipole aerial (e.g. RM21)
- An Inmarsat Sat C aerial for transmitting the observations back to the National Met Service
- Independent GPS aerial for determining the relative position of the ship and radiosonde

Factors that should be taken into account when locating the aerials include

- Obstructions that could prevent the aerials receiving or transmitting signals e.g. masts, large funnels containers etc
- The possibility of interference from other ship's aerials
- The necessary cable runs and deck/bulkhead penetrations (the ships fire protection standards should not be infringed)
- Available deck space, or feasibility of location on the mast.
- The ship's trading route i.e. in some cases it may be advantageous to site the Sat-C aerial on one side rather than the other to ensure clear vision to the satellite.
- Installation fittings and arrangements e.g. aerials such as the RB21 will need to be rigidly fixed to the deck and aligned in accordance with the manufacturers instructions. Lugs may need to be welded to the deck and a stand plate may be needed to secure the aerial pedestal.

3. Pre-Installation arrangements

Prior to installation on board of a new system a number of arrangements are necessary. These should be clearly scheduled and include

- Obtaining costings for equipment, consultants etc and budgeting for anticipated expenditure,
- Arranging purchase of required items
- Arranging delivery and transportation (including any customs or excise implications)
- Ensuring adequate and suitable storage prior to delivery to the ship
- Arranging transportation to the ship while in port

- Ordering necessary consumables
- Arranging any necessary preparatory work onboard e.g. welding, electrical connections etc (Ships staff may be willing to assist in some of this on board work)
- System proving before delivery e.g. testing the groundstation and launcher

Training

Training of the onboard operator can either be done ashore by inviting the operator to the recruiting Meteorological service for training prior to installing the ASAP equipment on board or, alternatively, training can be done while the vessel is in port (providing there is sufficient time).

If considered appropriate, the operator can also be accompanied on board during the initial trials voyage by an experienced ASAP operator to provide practical on the job training as necessary.

Test Flights & System proving

Once the system has been installed on board a number of test flights should be performed to test the system and to familiarise the on board operator with the procedures that will need to be followed once the ship proceeds to sea. Before performing test flights in port it should be ensured that;

- the local air traffic control authorities have been notified that test ascents will be performed
- shore cranes are clear of the expected ascent path
- the transmission system is showing that the required Inmarsat satellite has been locked onto
- a parachute is attached to the sonde if there is a possibility of the sonde falling over land when the balloon reaches bursting height.

Having performed a test ascent it will be necessary to confirm that the observation in TEMP code has been successfully transmitted and inserted on to the Global Telecommunication System (GTS).

On board documentation

The onboard operator should be provided with

- a sounding log (in electronic and/or hardcopy format) to be completed on passage.
- copies of all manufacturers operating manuals relevant to the system
- sufficient copies of the radio-sonde failure sheet
- details of necessary ASAP Programme team contact points (e.g. email and Inmarsat/telex addresses) in case it is necessary for the operator to seek help or advice during the voyage

4. Post Installation arrangements

Supply of Consumables when in service

Once the system is fully operational it is necessary to ensure that there are sufficient supplies of consumables (i.e. helium, radio sondes, balloons and associated equipment) on board to perform the required number of ascents;

New helium cylinders are normally ordered when the ship operator reports that the pressure gauge on the bottle pallet is running low, or when it is determined from the number of ascents performed that gas is likely to be running low. Arrangements will need to be made for delivery when in port and suitable lifting appliances will be needed to take the helium racks on board. It may be possible to use ships cranes but in some cases shore cranes may be needed

Routine Inspections/Visits and Records

Although the frequency of inspections will depend on the trading patterns of the ship in question, such visits provide the opportunity to;

- Collect the archive of edited data, which is downloaded by the operator. The operator normally does this after each round trip.
- Collect copies of the operators sounding logs.
- Provide encouragement to on board operators and present awards where appropriate
- Issue remuneration payments, if relevant.
- Inspect the system and rectify any identified faults or problems.

Upon receipt of the downloaded archive data and sounding log data the ASAP management team will determine the number of ascents being achieved and received on the GTS, the average burst heights, failure rates, standard deviations etc.

APPENDIX B

EXISTING ASAP ROUTES

Figure 1 – E-ASAP Routes December 2006 to February 2007

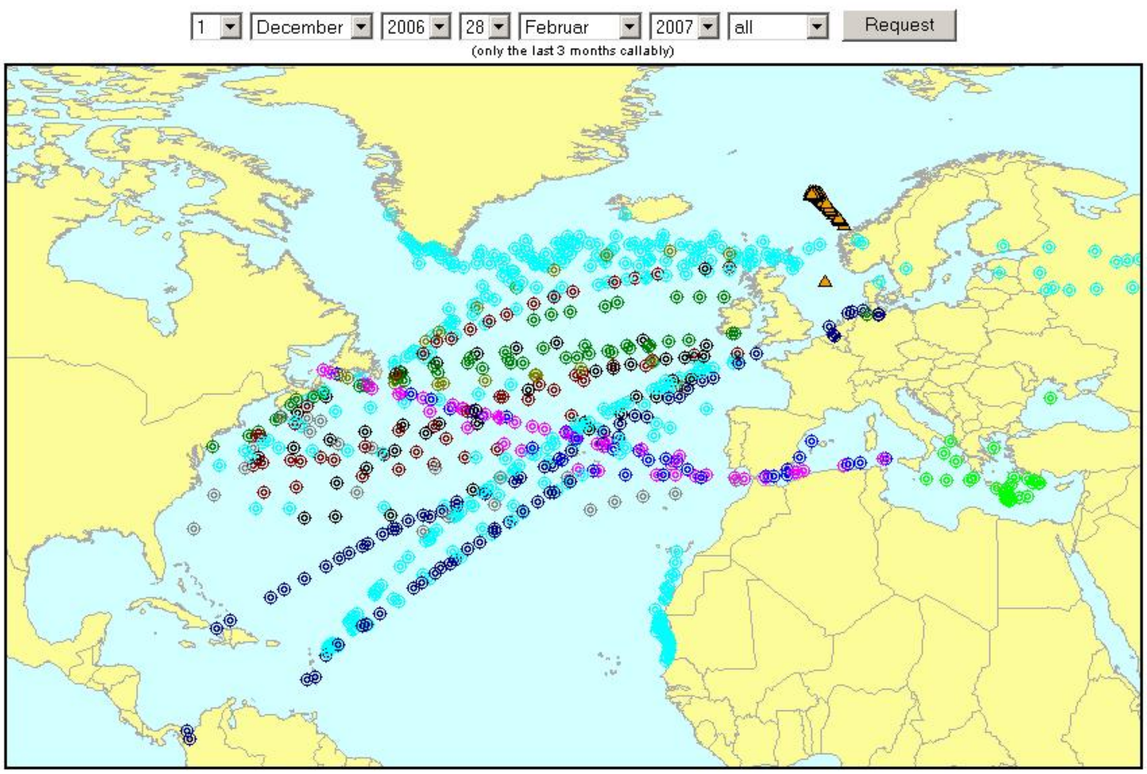
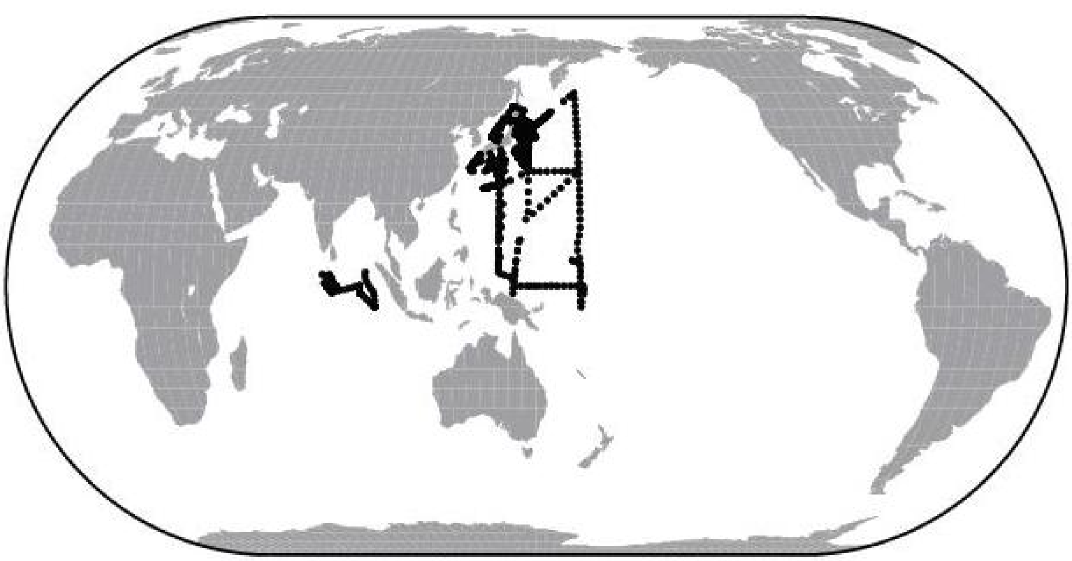
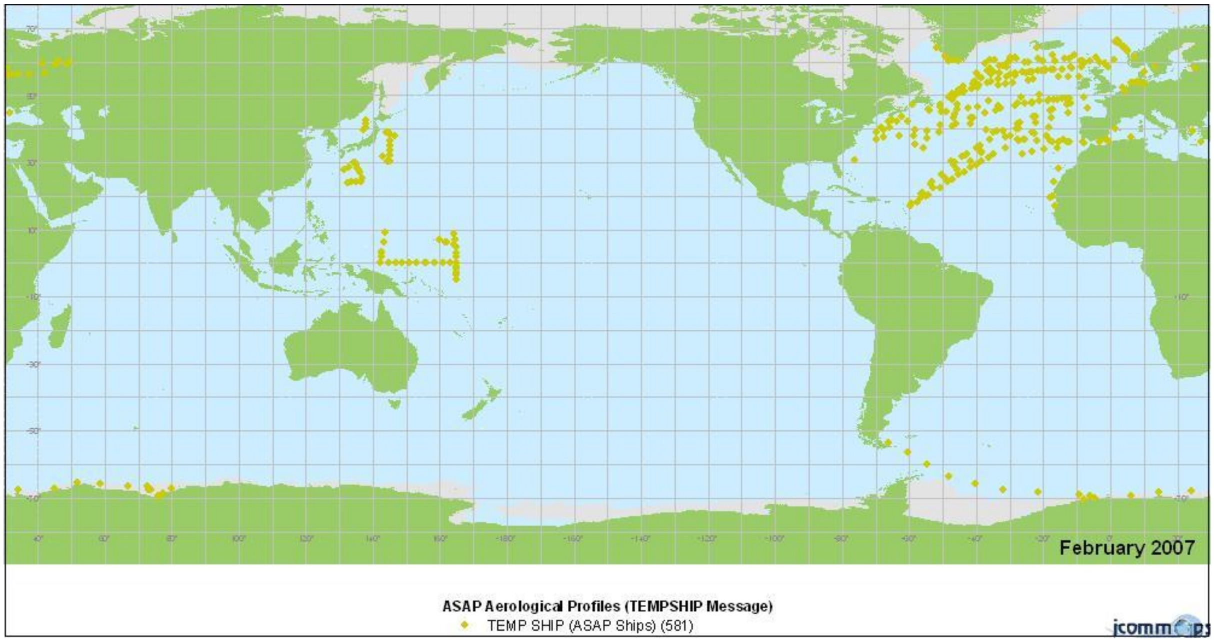


Figure 2 – Japanese ASAP Routes 2006



APPENDIX C

JCOMMOPS MAP OF ASAP TEMP REPORTS FEBRUARY 2007



APPENDIX D

SCHOLAR SHIP ROUTES 2007-2008