ASAP

Automated Shipboard Aerological Programme

4th International PMO Workshop
8-10 December 2010
Orlando, Florida (US)

Prepared by Rudolf Krockauer (Chairperson ASAP Task Team, E-ASAP Programme Manager),
presented by Volker Weidner (PMO supervisor, Deutscher Wetterdienst)

Contents

History

- Regular upper air soundings from ships date back to the 1950s. Soundings were performed on board dedicated weather ships with trained operators.
- After a peak in the early 1960s, several factors led to the discontinuation of radiosoundings at sea (e. g. lack of wind data, poor transmission techniques).
- Due to the increase in air and ocean traffic, meteorological data from ocean regions became more and more important.
- The reduction in the number of weather ships increased the need for ASAP stations on board commercial vessels in routine line service.
- ASAP operations (as we know it today) evolved in the 1980s.
- The last active weather ship terminated all sounding operations in 2009.

Purpose

- ASAP operations are the only source of routine upper air data in data sparse ocean regions.
- Comparable data coverage cannot be achieved with drop sondes or aircraft ascents/descents (AMDAR flights).
- Sounding data are transmitted to the GTS and are available to all NMS's.
- Main purpose is the enhancement of Numerical Weather Prediction (NWP) => data have to be available in due time.
- Several studies and OSE's (Observing System Experiments) confirm the importance of ASAP soundings for NWP.

Note: *'Automated Shipboard Aerological Programme'*
Possible misunderstanding: '*Automated*' is not 'Automatic'.
All soundings have to be performed by operators on board ships.

Contents

EUMETNET
Coordinating Member:
Deutscher Wetterdienst

ASAP fleets

There are only 2 regular ASAP fleets worldwide:

- European E-ASAP
  - 18 Ships under the umbrella of the European Meteorological Network EUMETNET,
  - 85% are container ships in line service,
  - Sounding area: North Atlantic (>90%).
- Japanese fleet
  - 5 governmental research ships,
  - Sounding area: mainly North Pacific.

plus

- Some independent research vessels which transmit their data to the GTS.

European E-ASAP

No	Station	Ship type	Operating area	Service
1	ASEU01	Research	Mainly Atlantic	Not Line
2	ASEU02	Container	North Europe – Chile	Line
3	ASEU03	Container	Western Mediterranean – Montreal	Line
4	ASEU04	Container	Western Mediterranean – Montreal	Line
5	ASEU05	Container	North Europe – East coast US	Line
6	ASDE01	Container	North Europe – East coast US	Line
7	ASDE02	Research	Worldwide	Not Line
8	ASDE03	Container	North Europe – East coast US	Line
9	ASDE04	Container	North Europe – Chile	Line
10	ASGB01	Container	Montreal – North Europe	Line
11	ASFR1	Container	North West Europe – French West Indies	Line
12	ASFR2	Container	North West Europe – French West Indies	Line
13	ASFR3	Container	North West Europe – French West Indies	Line
14	ASFR4	Container	North West Europe – French West Indies	Line
15	ASDK01	Container	Denmark – West coast Greenland	Line
16	ASDK02	Container	Denmark – West coast Greenland	Line
17	ASDK3	Container	Denmark – West coast Greenland	Line
18	ASES01	Hospital	Off Mauretania and Canary Islands	Not Line

Generic ASAP station name: char 1,2 = AS (fixed)
char 3,4 = 2 char country code (EU = EUMETNET)
char 5,6 = sequential number

EUMETNET
Coordinating Member:
Deutscher Wetterdienst

European E-ASAP

Fleet development from 2003 to 2010

Year	Lost ships*	New ships	Number of active stations at the end of the year
2003	- 1	+ 1	13
2004	- 0	+ 1	14
2005	- 1	+ 4	17
2006	- 1	+ 0	16
2007	- 1	+ 0	15
2008	- 4	+ 1	12
2009	- 1	+ 4	15
2010	- 0	+ 4	18

* Due to change of sailing area or taking out of service

European E-ASAP

Examples of E-ASAP ships:

ATLANTIC CONCERT in Hamburg, Germany

DUBLIN EXPRESS in Hamburg, Germany

Japanese fleet (research vessels)

No	Station	Ship name	Operating area	Service
1	JGQH	Ryofu Maru	North Pacific	Not Line
2	JDWX	Kofu Maru	Seas adjacent to Japan	Not Line
3	JIVB	Seifu Maru	Seas adjacent to Japan	Not Line
4	JCCX	Chofu Maru	Seas adjacent to Japan	Not Line
5	JNSR	Mirai	Variable areas	Not Line

Examples of Japanese ASAP ships:

Source: Unspecified internet sources

Independent research vessels

- Routine sounding operations:
  - POLARSTERN, Germany (operating mainly in polar regions)

Source: Alfred Wegener Institut, Bremerhaven

- Occasional sounding operations:
  - RONALD H. BROWN, United States
  - SONNE, Germany
  - KNORR, United States
  - AGULHAS, South Africa.

Weather ships

- The last active Weather Ship (POLARFRONT, Met Norway) ceased all observations in November 2009 due to financial reasons.
- By then, POLARFRONT provided 4 radiosoundings per day in the Norwegian Sea (ca. 1300 soundings per annum)

Weather Ship POLARFRONT in Aalesund, Norway

‚Layed up' station

- The Icelandic ASAP station is operated as temporary land station since Jan 2010 (after 3 years out of service).
- Decision pending whether the station shall become a permanent land station.

Installation of ASAP station at Egilsstadir Airport, Iceland

Contents

Distribution of gobal ASAP soundings 2009

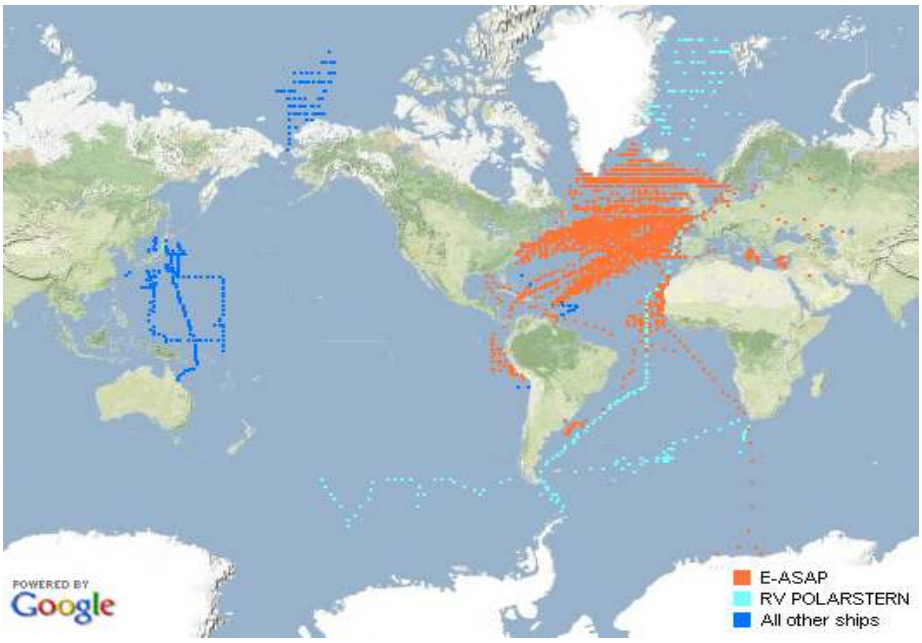
5460 Snd. on the GTS

85% E-ASAP fleet

5% RV Polarstern

10% All other (mainly Japanese)

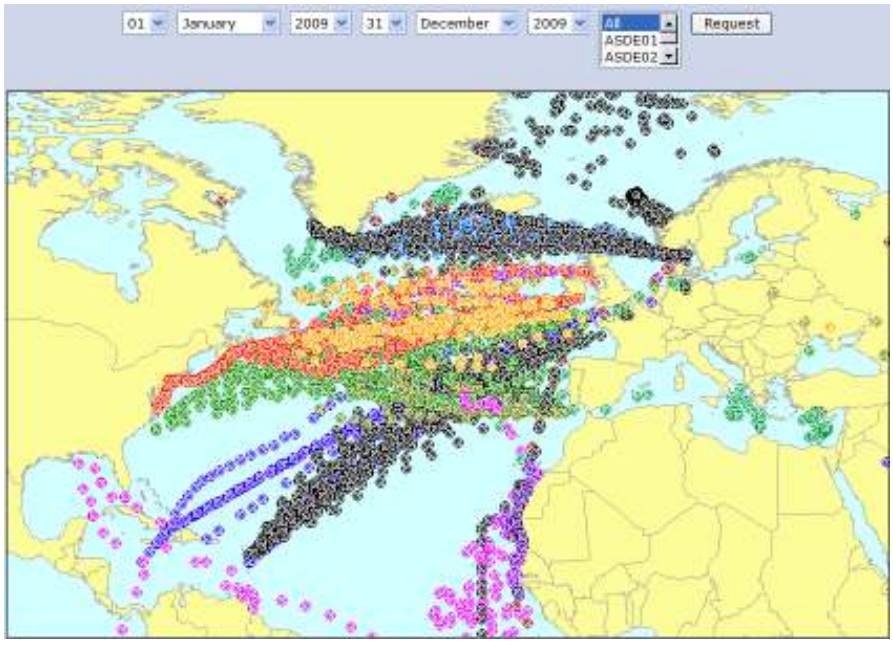
Note: Soundings over East Europe are due to longitude errors



Distribution of E-ASAP soundings 2009

Concentration on main transatlantic routes:

- Denmark – Greenland
- West Europe – East Coast US
- West Europe – Caribbean
- Mediterranean - Canada



Quality issues

E-ASAP 2009	EUMETNET Targets	Achievement	Comment
Total output	80%	85%	output = (no. of soundings on the GTS) / (no. of launches on board)
Timeliness HH+100 min	95%	95%	Targets relates to percentage of data actually received, not expected.
Burst height 100 hPa	90%	91%	
Burst height 50 hPa	75%	82%	

=> Quality targets are achieved although the launches are performed by non-professional crew members beside their nautical tasks

Quality issues (cont.)

- Meteo France issues quarterly reports on the quality of global ASAP soundings.
- Reports include information about errors and timeliness

Example from last quarterly report Q3-2010

Call-sign	Nb of messages recieved	Nb of messages in error	Percentage of messages in error	Nb of messages with operator action	Percentage of messages with operator action
ASEU01	222	0	0	0	0
ASEU02	297	0	0	0	0
ASEU03	210	0	0	0	0
ASEU04	290	0	0	0	0
ASEU05	248	0	0	0	0
ASDE01	352	0	0	0	0
ASDE02	383	0	0	0	0
ASDE03	338	0	0	0	0
ASDE04	312	0	0	0	0
DBLK	618	0	0	0	0
ASGB01	214	0	0	0	0
ASDK01	330	0	0	0	0
ASDK02	397	0	0	0	0
ASES01	83	0	0	0	0
ASFR1	232	0	0	11	4,74
ASFR2	266	0	0	0	0
ASFR3	244	0	0	0	0
ASFR4	203	0	0	5	2,46
JGQH	7	0	0	0	0
JNSR	576	0	0	0	0
ASDK3	333	0	0	0	0
Wrong or strange call-sign					
XXXXX	973	0	0	0	0
numer.	8	0	0	0	0

Contents

Launcher types

	Distributed system	Integrated system	Additional technical equipment
Container launcher	X	X	Heating, Air condition, Pneumatics
Open deck launcher	X		
Shed launcher	X		

- Distributed system: Balloon launcher and sounding equipment are separated (e. g. launcher on deck and sounding equipment in the wheelhouse).
- Integrated system: Balloon launcher and sounding equipment are combined in a container.

Container launcher

Example: 4 ASAP containers stored at Deutscher Wetterdienst, Hamburg

Most 20‘ containers are now replaced by 10‘ containers.

Container launcher (cont.)

Example of container launchers on board ASAP ships

ASEU05
Feb 05

ASEU05
Nov 08

ASEU04
Jan 05

ASEU01
May 09

Container launcher (cont.)

Video footage: Container launch, optimal launching conditions

ASEU04
Jan 05

Container launcher (cont.)

Video footage: Container launch, strong turbulences

ASEU05
Nov 08

Open deck launcher

Example of open deck launchers on board ASAP ships of Meteo France

Starboard launcher

Portside launcher

Open deck launcher (cont.)

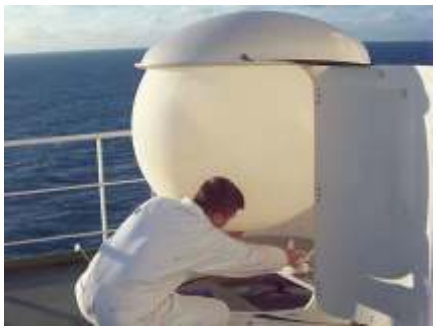
Example of open deck launchers on board ASAP ships

Vaisala launcher FB15

Shed launcher

Example of shed launchers on board ASAP ships

E-ASAP
Shed launcher

Shed launcher (cont.)

Video footage: Shed launcher

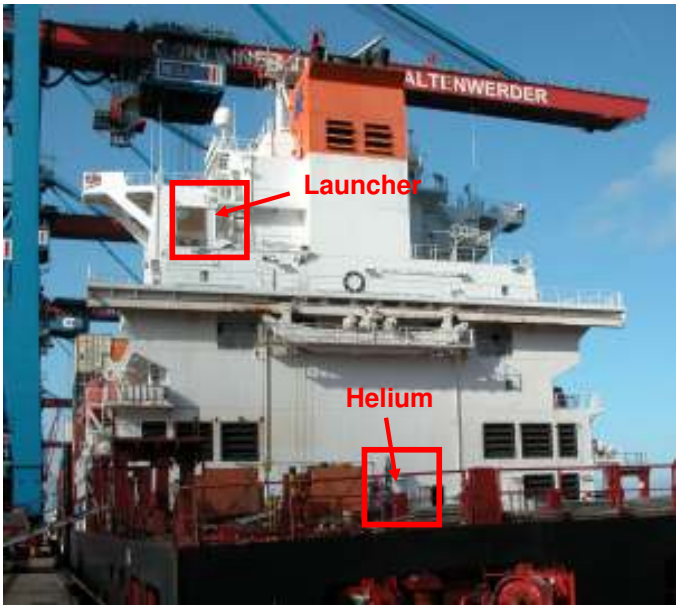
Helium supply

- Helium gas is essential for sounding operations and has to be provided on a regular basis.
  => Good re-supply logistics network required.
- Storage of helium depends on the available deck space.



Helium supply (cont.)

- Installation of helium supply sometimes cost intensive due to required pipe layout and safety regulations.



Sounding equipment

The sounding equipment comprises the electronics to receive, process, and transmit the data.

Main components:

- Receiver: The data are received from the radiosonde via telemetry. Receivers/sondes used on ASAP ships: Vaisala, MODEM, GRAW.
- Computer (laptop or PC): The received data are processed, coded, and stored as bulletin files (TEMP and/or Bufr).
- Satcom (Inmarsat-C, Iridium, MeteoSat): The data files are transmitted to land via satellite.

Peripheral components:

- 12 or 24 VDC power converter
- Uninterruptible power supply

Sounding equipment (cont.)

Examples of sounding equipments

French ASAP station:
- Receiver: MODEM SR2K2
- Computer: Industrial PC
- Satcom: Inmarsat-C

German ASAP station:
- Receiver: Vaisala SPS
- Computer: Laptop
- Satcom: Iridium

Contents

EUMETNET
Coordinating Member:
Deutscher Wetterdienst

Routine sounding operation

- Soundings at main synoptic hours 00, 06, 12, and/or 18Z (Launch of the balloon 90-45 min before).
- Usually 1-3 launches per ship per day (depending on availability of the operators).
- Required work time to perform the launch is around 30 min. Financial compensation is paid for the effort.
- Distribution of compensation depends on the shipping companies, e.g.:
  - Comp. is paid to the ship's cash box to purchase items for the crew (sports equipment, DVD players, etc.),
  - Comp. is forwarded to the operators as overtime payment,
  - Comp. is paid to the company to place an extra cadet on board,
  - Any other arrangements.

Sounding procedure

Basic steps to be performed by the operator:

- Open helium valve and inflate balloon,
- Prepare radiosonde and initiate new sounding at the sounding computer (e.g. on the bridge or in the ASAP container),
- Attach radiosonde to the balloon and launch the balloon,
- Check receiving of sounding data,
- Check satcom and complete log file,
- Close helium valve.

Total effort: ca. 30 min (ca. 2h on French ASAP ships since the operators check the data reception during the complete flight)

Comment: Not closing the helium valve is the main reason for helium loss due to small leakages.

Sounding procedure (cont.)

Processing chain after release of the balloon:

- Radiosonde data (PTU and position) are continuously transmitted to the receiver.
- Data are collected by the sounding software on the computer.
- 1st Bulletins (TEMP A, B and/or Bufr) are automatically created as soon as 100 hPa are achieved.
- 1st Bulletins are automatically transmitted via satellite.
- 2nd bulletins (TEMP C, D and/or Bufr) are automatically created at burst height (ca. 20-30 hPa).
- 2nd bulletins are automatically transmitted via satellite.

=> No interaction of the operator is required after release of the balloon.

Data format

- Sounding data are coded in TEMP SHIP format.
- ASAP stations with Iridium satcom already transmit high resolution binary data in Bufr format (not possible with Inmarsat-C).
- Reports sent from stations with Iridium satcom:

File	Content	KByte
TEMP A	Mandatory levels surface to 100 hPa	<1
TEMP B	Significant levels surface to 100 hPa	<1
Bufr 100	Mandatory and significant levels surface to 100 hPa	1
TEMP C	Mandatory levels 100 hPa to burst height	<1
TEMP D	Significant levels 100 hPa to burst height	<1
Bufr All	Mand., sign., and 20 sec levels surface to burst height	<10

=> All stations in the E-ASAP fleet will transmit HiRes Bufr via Iridium by beginning of 2011

Operational costs

- Costs per launch: 200 - 300 €, average 230 €, including
  - Radiosonde,
  - Balloon,
  - Helium (1.2 -1.7 m^3)
  - Operator fee,
  - Satcom.
- Repair costs for
  - Receiving unit,
  - Computer,
  - Satcom,
  - Compressor, air condition etc. (if container launcher).

- Installation costs: ca. 15000 – 30000 €
- Procurement costs: depending on type of launcher and sounding equipment

Contents

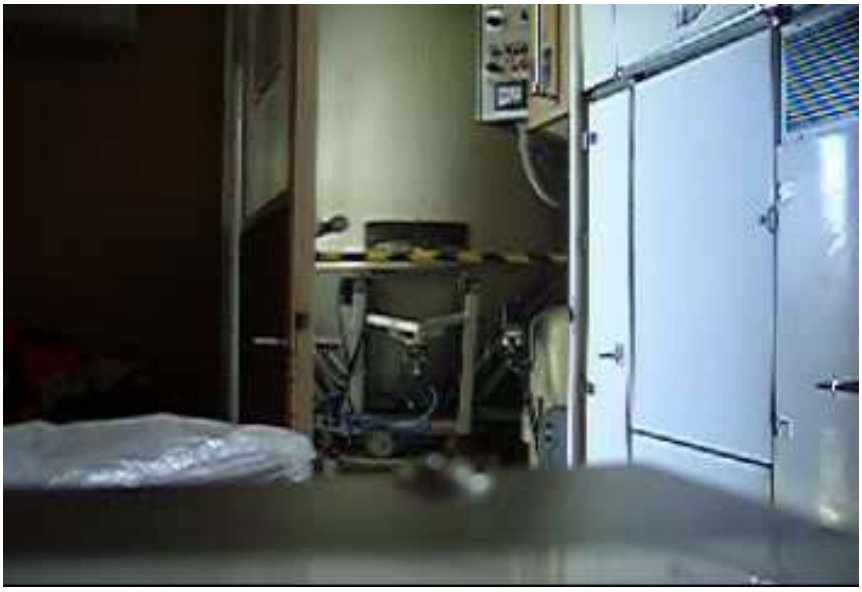
General problems

Cause	**Effect**
Adverse weather	Unsafe working conditions
Unfavourable relative wind	- Balloon hits the ship's superstructure or aerials - Downward winds aft of the ship
Unexperienced operator (due to crew change etc.)	Operating failures
Failing satcom	No data transmission despite successful sounding
Permanent vibrations (due to ship's machinery)	Repair or replacement of equipment required

=> Routine maintenance on board required to check the equipment and to provide advice to the operators.

General problems

Video footage: Permanent vibrations



Maintenance

Current base ports in the E-ASAP fleet for routine maintenance and re-supply of consumables (status 2010)

Port	Maintained by	No. of ships
Hamburg	DWD, Germany	5
Bremen/Bremerhaven	DWD, Germany	3
Genoa	DWD, Germany	2
Le Havre/Rouen	Meteo France, France	4
Aalborg	DMI, Denmark	3
Las Palmas de Gran Canaria	AEMET, Spain	1

Further base ports 2003-2009:
- Antwerpen, Rotterdam, [Houston]: maintained by DWD
- Southampton: maintained by UK Met Office

Tasks

Maintenance visits on board comprise following basic tasks:

- 4-10 visits on board per ship per annum, depending on effort and travel time.
- Check hardware (electronics, pneumatics, mechanics) for visible damages and obvious errors (red LED's etc.).
- Check software for error messages and warnings.
- Download relevant logs and data archives.
- Check helium valve, connections and pipeline/hose.
- Check inventory of consumables.
- Clean up work space and remove waste.
- Carry out small repairs, if necessary.
- Update system configuration, if necessary.
- Provide advise and training to the operators.
- Encourage motivation by showing monitoring results etc..

Problem of remote maintenance

- Routine maintenance is provided only by NMS's with own ASAP activities.
- Some ships do not call in ports with PMO or ASAP maintenance.
- Maintenance has to be reduced to ca. 2 visits per ship per annum due to high travel costs.
- Current situation (since 2005): Two ships have to be maintained by DWD (Germany) in Genoa (Italy).
- Thorough ASAP maintenance requires detailed knowledge of radiosounding technology and marine data acquisition.
  => very difficult to assign maintenance to NMS's without ASAP activities.

- **But**: Basic maintenance could also be provided by PMO's without ASAP experience. Main purpose is to visit the ships regularly and make clear that we care.

Contents

Summary

- Two ASAP fleets cover >90% of all global ASAP activites.

	Main sounding area	Ships	No. of ships (2010)	GTS (2009)
E-ASAP	North Atlantic	85% container ships	18	4630
Japan	North Pacific	Research vessels	5	430

- Launcher types: Container, Open deck launcher, Shed launcher (Available deck space required).
- Soundings are usually performed by crew members beside their everyday tasks (effort is around 30 min to prepare and launch the balloon).
- Transition from Inmarsat-C to Iridium to report HiRes Bufr data.
- Main problems are weather conditions, technical breakdowns, and operator failures.
- Routine maintenance is essential for efficient operations. Lack of maintenance in ‘remote’ ports.

Last slide

Video footage: Failed launch

Thank you for your attention