EUMETNET Composite Observing System (EUCOS) - Status of operational networks and future development plans

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Stefan Klink
EUCOS Operations Manager
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Tim Oakley, E-WINPROF PM, Met Office
Content

• About EUMETNET and EUCOS
• EUCOS objectives
• The current EUCOS network
• Quality Monitoring
• Studies Programme
• Outlook
About EUMETNET and EUCOS (1)

EUMETNET is a network grouping 26 European National Meteorological Services. EUMETNET provides a framework to organise co-operative programmes between the Members in the various fields of basic meteorological activities such as observing systems, data processing, basic forecasting products, research and development, training. Through EUMETNET Programmes, the Members intend to develop their collective capability to serve environment management and climate monitoring and to bring to all European users the best available quality of meteorological information. They will use EUMETNET to more efficiently manage their collective resources.
About EUMETNET and EUCOS (2)

EUCOS OPERATIONAL PROGRAMME

- E-AMDAR
- E-ASAP
- E-SURFMAR
- E-WINPROF

Territorial Segment (upper air and SYNOP stations)

Operations Monitoring

Studies Programme

Possible Future Programmes
  - Observation Targeting: E-VCOMP

Programme Components

Fully integrated programmes

since 2009

Collaborative components

Managed by EUCOS team

Evolving needs
EUCOS Information System (www.eucos.net)
EUCOS objectives (1)

Medium and extended range weather prediction over the Globe

Contributes to

- Warnings and Info Services
- Climate, Climate prediction

EUCOS: Serving the Regional Scale NWP requirement for observations over the European region

Provides a framework for

Very short range and nowcasting over national territories
EUCOS objectives (2)

- Design and coordinate the evolution of the ground based EUMETNET composite observing system (EUCOS) to be optimized at European scale with a view to improve short range forecast over Europe without increasing the overall cost.

- Monitor and control EUCOS performance.

- Ensure integrated management for agreed components such as E-ASAP, E-AMDAR, E-SURFMAR and E-WINPROF.

- Support the evolution of EUCOS through a studies programme.
EUCOS objectives (3)

EUCOS area (10N-90N, 70W-40E)
current EUCOS network

- All European ships of the **Automated Ship Aerological Programme** (10 E-ASAP integrated, 5 national)
- All measurements from European commercial aircraft (AMDAR)
- Ocean weather ship „M“ and Ekofisk oil platform
- Selected moored buoys and all European drifting buoys
- European Voluntary Observing Ships
- Selected European radiosonde stations
- Selected European synoptic weather stations
- Selected European wind profilers
current EUCOS network: E-ASAP

Responsible Member: DWD
current EUCOS network: E-ASAP

RS bulletins on a 2° x 2° grid during 2008
current EUCOS network: E-ASAP

Quarterly distribution of soundings from 2003 to 2009

Quarterly target according to 5000 snd./year

E-ASAP (ASEU01-ASEU05)
Nat. ASAP's (ASDExx, ASFRxx, ASDKxx, ASGB01, ASES01, ASIS01)
current EUCOS network: E-AMDAR

Data coverage: 18-19 Oct. 2009

Responsible Member: SMHI / Met Office
current EUCOS network: E-AMDAR
current EUCOS network: E-SURFMAR

Responsible Member: Météo-France
current EUCOS network: E-SURFMAR

Drifting buoy tracks

- Iridium SVP-B
- Argos SVP-B
- SVP-BW

◆ (moored buoys)

September 2009
current EUCOS network: E-SURFMAR

E-SURFMAR: EGOS then EUCOS drifting buoys, average number of hourly observations per day
current EUCOS network: E-SURFMAR

EUMETNET manned VOS - Data availability in the EUCOS area
Average number of observations per day

- Target: 250 obs/day

EUMETNET automated VOS - Data availability in the EUCOS area
Average number of observations per day

- Target: 1000 obs/day

Conventional VOS

Automated VOS (AWS)
current EUCOS network: E-WINPROF

Responsible Member: UK Met Office
current EUCOS network: E-WINPROF

E-WINPROF: wind profilers, which reach a certain level of quality and availability + Weather Radar Wind Profiles (WRWP) from about 100 sites which reach certain quality
EUCOS radiosonde station network
EUCOS Quality Monitoring

- Agreed performance standards for all networks;
- Web based Information Service [www.eucos.net](http://www.eucos.net) and Quality Monitoring Portal;
- Quarterly network performance summary.

EUMETNET data hubs

- CWINDE (WINPROF): Wind profiler and wind profiles from weather radar data
- OPERA: composite of weather radar data
- E-ADAS (E-AMDAR): data from commercial aircraft
- E-GVAP: water vapour measurements from GPS data

- Plans for a centralised data hub as a DCPC in the future WMO Information System under development
EUCOS Quality Monitoring Portal

Data availability, timeliness and NWP results for WINPROF stations

- 24h monitoring: All
- Monthly statistics: September 2008

Contact: EUCOS.PMT@dwd.de

[close]
## EUCOS network performance 2008

<table>
<thead>
<tr>
<th>2008 Network</th>
<th>Data availability</th>
<th>Timeliness HH+50 (Radiosonde: TEMP AB)</th>
<th>Timeliness HH+100 (Radiosonde: TEMP CD)</th>
<th>Achieving 100 hPa</th>
<th>Achieving 50 hPa</th>
<th>Individual target subprogrammes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface stations</strong></td>
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<tr>
<td>Target: 95%</td>
<td>93%</td>
<td>Target: 90%</td>
<td>Target: 95%</td>
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<tr>
<td><strong>Radiosonde stations</strong></td>
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<tr>
<td>Target: 95%</td>
<td>91%</td>
<td>New target: 75%</td>
<td>Target: 95%</td>
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<tr>
<td><strong>ASAP units</strong></td>
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<td>Loss rate</td>
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<tr>
<td>Annual target:</td>
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<tr>
<td>5150 obs</td>
<td>100%</td>
<td>New target: 75%</td>
<td>Target: 95%</td>
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<tr>
<td>3443 obs (equals 67%)</td>
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<tr>
<td><strong>Ocean platforms</strong></td>
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<tr>
<td>Average Target: 95%</td>
<td>94%</td>
<td>New target: 75%</td>
<td>Target: 95%</td>
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<tr>
<td>LDWR</td>
<td>95%</td>
<td>95%</td>
<td>96%</td>
<td>99%</td>
<td>96%</td>
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</tr>
<tr>
<td>Ekofisk</td>
<td>93%</td>
<td>87%</td>
<td>86%</td>
<td>93%</td>
<td>83%</td>
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<tr>
<td><strong>E-AMDAIR</strong></td>
<td></td>
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<td></td>
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<td>Profile distribution</td>
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<tr>
<td>Annual target:</td>
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<tr>
<td>12 Mio. obs</td>
<td>100%</td>
<td>Target: 90%</td>
<td>Target: 95%</td>
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<tr>
<td>13,670,000 (equals 114%)</td>
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<td>HH+50: 94%</td>
<td>97%</td>
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<td><strong>Moored buoys</strong></td>
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<tr>
<td>without Cabo Silleiro</td>
<td>Target: 90%</td>
<td>98%</td>
<td>Target: 95%</td>
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<tr>
<td><strong>Drifting buoys</strong></td>
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<tr>
<td>Target: 88%</td>
<td>98%</td>
<td>98%</td>
<td>Target: 95%</td>
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<tr>
<td><strong>Automated VOS ships</strong></td>
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<tr>
<td>Daily avg target:</td>
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<tr>
<td>1,000</td>
<td>90%</td>
<td>50%</td>
<td>Target: 95%</td>
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<tr>
<td>916 (equals 92%)</td>
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<tr>
<td><strong>Conventional VOS ships</strong></td>
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<tr>
<td>Daily avg target:</td>
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<tr>
<td>250</td>
<td>90%</td>
<td>79%</td>
<td>Target: 95%</td>
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<tr>
<td>291 (equals 116%)</td>
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</tr>
</tbody>
</table>

NEW TARGET on timeliness of TEMP parts AB for all radiosonde data (agreed at PB-OBS18): 75% instead of 50%

|                  |                  |                  |                  |                  |                  |                  |
| target achieved  | <10% below target| =>10% below target|                  |                  |                  |                  |

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## EUCOS network performance 2008

<table>
<thead>
<tr>
<th>2008 Network</th>
<th>Temperature RMSE</th>
<th>Wind Mean Vector</th>
<th>Specific Humidity Error dq/q*</th>
<th>O-B-Geopotential</th>
<th>Pressure RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface stations</strong></td>
<td>Target: 1 K 1.71 K</td>
<td>Target: 2.5 m/s 2.72 m/s</td>
<td>Target: 10% 8.63%</td>
<td>---</td>
<td>Target: 1 hPa 0.80 hPa</td>
</tr>
<tr>
<td><strong>Radiosonde stations</strong></td>
<td>Target: 1 K 1.11 K</td>
<td>Target: 2.5 m/s 4.15 m/s</td>
<td>Target: 10% 11.96%</td>
<td>Target: 65 m 21.56 m</td>
<td>---</td>
</tr>
<tr>
<td><strong>ASAP units</strong></td>
<td>Target: 1 K 1.10 K</td>
<td>Target: 2.5 m/s 4.31 m/s</td>
<td>Target: 10% 12.22%</td>
<td>Target: 65 m 18.89 m</td>
<td>---</td>
</tr>
<tr>
<td><strong>Ocean platforms Average</strong></td>
<td>Target: 1 K 1.03 K</td>
<td>Target: 2.5 m/s 3.78 m/s</td>
<td>Target: 10% 13.21%</td>
<td>Target: 65 m 24.15 m</td>
<td>---</td>
</tr>
<tr>
<td>LDWR</td>
<td>1.07 K</td>
<td>3.90 m/s</td>
<td>13.25%</td>
<td>23.80 m</td>
<td>---</td>
</tr>
<tr>
<td>Ekofisk</td>
<td>0.99 K</td>
<td>3.67 m/s</td>
<td>13.16%</td>
<td>24.50 m</td>
<td>---</td>
</tr>
<tr>
<td><strong>E-AMDAR</strong></td>
<td>Target: 1.5 K 1.07 K</td>
<td>Target: 2.5 m/s 4.25 m/s</td>
<td>Target: 10% not provided yet</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Moored buoys</strong></td>
<td>Target: 1 K 0.97 K</td>
<td>Target: 2.5 m/s 3.34 m/s</td>
<td>Target: 10% 7.79%</td>
<td>---</td>
<td>Target: 1 hPa 0.77 hPa</td>
</tr>
<tr>
<td><strong>Drifting buoys</strong></td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>Target: 1 hPa 1.06 hPa</td>
</tr>
<tr>
<td><strong>VOS ships</strong></td>
<td>Target: 2 K 1.10 K</td>
<td>Target: 5.0 m/s 3.18 m/s</td>
<td>Target: 15% 7.10%</td>
<td>---</td>
<td>Target: 1 hPa 0.74 hPa</td>
</tr>
<tr>
<td>Automated</td>
<td>1.42 K</td>
<td>4.98 m/s</td>
<td>9.79%</td>
<td>---</td>
<td>1.44 hPa</td>
</tr>
<tr>
<td>Conventional</td>
<td>---</td>
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</tr>
</tbody>
</table>

- **EUCOS target achieved**
- **within WMO target**
- **below WMO target**
Quality monitoring example: E-ASAP

- Improvements in timeliness through Iridium satcom (First test system installed on ASDE01 in July 2008).

![Timeliness ASDE01 graph]

Inmarsat-C  Iridium
Quality Monitoring example: radiosondes

Wind observation totals provided by all EUCOS radiosonde stations in June and July 2009

Failure of VAISALA GPS wind finding systems

subsequent recovery: a few radiosonde sites much delayed
Quality Monitoring example: E-WINPROF

timeseries of daily mean wind profiler OBS-MOD differences as obtained in COSMO-EU model domain:
for a specific wind profiler

visit of the system by wind profiler experts from another NMS

actual start of improvements: one week earlier!
Studies Programme

Impact Studies as a measure to guideline the evolution of EUCOS: WHY?

(External) drivers and developments:
• Different observation networks evolve differently (e.g. regarding availability, accuracy, cost, ...)
• Data assimilation algorithms improve and can make use of more data

EUCOS objective:
• Design and coordinate the evolution of the ground based EUCOS to be optimized at European scale with a view to improve short range forecast ...
→ modification of the meteorological observing network might become necessary

EUCOS needs approval for network changes or modifications from PB-OBS and EUMETNET Council respectively

In order to get the 26 Members convinced of such changes it was decided to base them on scientific analyses (e.g. impact studies)
Studies Programme

• The Space-Terrestrial Study (finished in 2007)
• current Observing System Experiments:
  • upper-air network redesign
  • OSE on impact of surface marine observations
• EURORISK PREVIEW Data Targeting System
• Second S-T study in 2009
Studies Programme: Data Targeting System

• Aim: make additional observations when and where they will be most beneficial to subsequent forecasts

• A pre-operational Data Targeting System (DTS) has been developed at ECMWF to assess the feasibility of operational adaptive control of the observing system

• DTS is described in issue No. 117 of the “ECMWF newsletter”

• Data Targeting might become operational within EUMETNET/EUCOS, if proven to be beneficial for NWP
Studies Programme:
Data Targeting System

1. Case selection
   - Forecast Products
   - Final Case selection
   - Suggest cases
   - View & comment on cases
   - Request for calculations
   - Observation Availability

2. SACs
   - Sensitive Area Calculations from ECMWF, Met Office and Meteo-France
   - View & comment on cases

3. Observation selection
   - Propose observations
   - Final obs selection
   - View & comment on proposed observations
   - Request for observations & Notification to providers

09:00 UTC 10:00 UTC 10:30 UTC 12:00 UTC 13:30 UTC 14:00 UTC
Studies Programme: Data Targeting System

• In 2008 an 11 months trial, financed by EUCOS and the EC and managed by UK Met Office
  • Targetable data:
    • radiosoundings from merchant ships (E-ASAP) and land stations (at 6 and 18 UTC when no ‘routine’ launches are performed)
    • measurements from aircraft (E-AMDAR)
  • A total of 628 cases had been proposed
  • SACs were computed for 548 of these cases
  • From these, 184 sets of observations were requested
  • From these sets of observations resulted: 1400 requests for extra radiosonde launches
  • 87% of requested radiosonde ascents from land stations had been deployed and data had been ingested into GTS
Outlook: E-AMDAR humidity trial

- Profile measurements are important for the improvement of Regional NWP
- Commercial aircraft measurements complement and have the potential to partly replace traditional radiosonde soundings
- For km scale models there is a strong requirement for humidity profile measurements
- Diode laser systems seem to fulfil the requirements on accuracy and operational stability
Outlook: E-AMDAR humidity trial

4.8 m

4 o’clock position

Air Sampler

Air Sampler
Outlook: E-AMDAR humidity trial

Timeseries of daily mean E-AMDAR aircraft mixing ratio BIAS (OBS-MOD) and RMSE, as obtained in COSMO-EU model domain, one LH A319.
Outlook

• upper-air network redesign studies to be finalised by Jan 2010 – afterwards proposal for a redesigned upper-air network to relevant bodies in EUMETNET

• Addition of humidity measurements to E-AMDAR observations

• Evaluation of the EUCOS/PREVIEW/MEDEX Data Targeting System Trial Phases by running data denial studies

• Establishing a centralised data hub for operational monitoring and product generation as a DCPC in the future WMO Information System
Questions and Comments?
Studies Programme: 
Upper-air network redesign - Motivation (1)

• Idea: definition of a European-wide network of ground-based upper-air observing systems for regional NWP requirements

• EUCOS upper-air network design for the previous programme phase 2003-2006 comprised of:
  • 50 selected radiosonde stations operated by Members,
  • The E-AMDAR network (3-hourly profile sites),
  • and was based on the WMO guidelines from 1999.
The EUCOS upper-air network now requires a redesign because:

- Of the need to take into account the significant evolution of the AMDAR network;
- Members were not able to install the proposed EUCOS radiosonde network design with 4 ascents per day at most of the sites;
- Results from the Space Terrestrial Studies are available with recommendations for the network design;
- Data assimilation of NWP models has improved significantly with advanced capability to make use of high time resolution data;
Studies Programme:
Upper-air network redesign - Motivation (3)

- expected result from the OSEs is to find an optimum setting of upper-air measurements in space and time which maintains forecast skill
- WMO user requirements for regional NWP are basis
- EUCOS configured a set of different networks (scenarios), each realising a specific setting of horizontal spacings of observations

- Current status: ECMWF, OMSZ (Hungary) and three HIRLAM members (IMO, Iceland; KNMI, The Netherlands; met.no, Norway) are contributing to this study and have partially completed their model runs.
Studies Programme:
Upper-air network redesign – example scenario

One of the scenarios under investigation:

- minimum horizontal spacing of airports/RS: 100km (right), could lead to a reduction of radiosonde launches, where airports are close
- all available airports and RS (left)