WMO Processes and Standards

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World Meteorological Organization
A United Nations Specialized Agency
Working together in Weather, Climate and Water
Contents

- WMO – what is it
- WMO World Weather Watch Programme
- WWW Data and volumes
- WMO Data and Service standards
  - Where is WMO now and where is it going?
  - Maintenance Update and Development
- So where does ISO/OGC come in?
WMO is the specialized agency of the United Nations for meteorology (weather and climate), operational hydrology and related geophysical sciences.

WMO is an intergovernmental organization with a membership of 187 Member States and Territories.

Established in 1950, WMO was created from the International Meteorological Organization (IMO), which was founded in 1873.
WMO structure

Six regional associations

- Africa, Asia, South America, North America, Central America and the Caribbean, South-West Pacific and Europe

- The Secretariat in Geneva

- Eight technical commissions

  - Basic Systems
  - Hydrology
  - Agricultural
  - Instruments and Observation
  - Climatology
  - Marine (jointly with IOC of UNESCO)
  - Atmospheric Sciences
  - Aeronautical

All commissions operate through management and task committees, R&D Programmes and Expert Teams
December 1961 the United Nations resolution 1721
- To advance the state of atmospheric science and technology
  …to develop existing weather forecasting capabilities
  …through regional meteorological centres.

UN General Assembly in 1962
- WMO and contributing agencies
  - International Atomic Energy Agency (IAEA)
  - International Telecommunications Union (ITU)
  - International Council of Scientific Unions (ICSU)
- presented the report on the “World Weather Watch”.
  - NOT - World Wide Web (1990, Berners-Lee, Cailliau)
GOS - Global Observing System

GTS Global Telecommunications System
Point-to-Point networks – not Internet

GDPFS Global Data Processing and Forecast System

Public Weather Service
Warnings and forecasts
Global Telecommunications System - started 1950

The Improved Main Telecommunication Network

Network I

Melbourne
Washington
Buenos Aires

Network II

Tokyo
Moscow
Prague
Sofia
Beijing
New Delhi
Jeddah
Offenbach
Nairobi
Toulouse
Dakar
Algiers
Cairo

Managed data communication network

Exeter
Operational Meteorology

What sort of data?

How much data?
GTS Real-Time Data in Exeter

- 640+ direct lines (not Internet)

- Main Message Switch
  - 400,000 bulletins received per day - 1.5 Gigabyte
  - 5.2 million bulletins sent/day - 15 Gigabyte.
  - minimum size ~ 20 bytes; average ~ 3000 bytes.

- Main File Server
  - 20,000 files received/day - 15 Gigabyte
  - 30,000 files sent/day 20 Gigabyte.
  - 0.7 Megabyte average size

- Other routes – e.g. Satellite data ~ 27GB/day
Data Coverage: Surface (24/5/2007, 0 UTC, qu00)
Total number of observations assimilated: 12994

LNDSYN (5790) SHPSYN (2108) BUOY (5096)
Data Coverage: Aircraft (24/5/2007, 0 UTC, qu00)
Total number of observations assimilated: 16269

AMDARS (15409) AIREPS (789) TCBOGUS (0) BOGUS (71)
Data Coverage: SatRad ATOVS (24/5/2007, 0 UTC, qu00)
Total number of observations assimilated: 31066

11982 METOP-A
7379 NOAA-18
8962 NOAA-16
2743 NOAA-17
Satellite Winds (from cloud movements) 000Z 24th May

Data Coverage: Satwind (24/5/2007, 0 UTC, qu00)
Total number of observations assimilated: 6208

JMA (698) EUMETSAT (1772) + (468) + (591)
+ (0) NESDIS (2679)
Data and service standards

Where is WMO now?

Where is WMO going?
WMO CBS - Data Management

- WMO Codes and Representation Forms
  - Data Formats, Codes and Standards

- Distributed Databases

- ISO 19115 Metadata WMO Core Profile

- WMO Information System
  - Portal for Operational Meteorology
  - Replacement for GTS
  - ISO/OGC standards – where appropriate
## Alphanumeric codes

<table>
<thead>
<tr>
<th>Alphanumeric codes</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYNOP</td>
<td>SHIP</td>
<td>SYNOP MOBIL</td>
</tr>
<tr>
<td>BUOY</td>
<td>RADOB</td>
<td>RADREP</td>
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<tr>
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<td>TEMP</td>
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<tr>
<td>SATEM</td>
<td>SARAD</td>
<td>SATOB</td>
</tr>
</tbody>
</table>

## Binary Codes - Table Driven Codes

- **GRIB**
- **BUFR/CREX**
Binary/Table Driven Codes

- **GRIB** – GRIdded Binary
  - Mathematically defined grids
  - GRIB1 – 2D
  - GRIB2 – 3D, 4D+

- **BUFR** Binary Universal Form
  - Table driven
  - Atmospheric – oceanographic – chemistry

- **CREX** – ASCII form of BUFR
Meteorological Grids

Numerical Weather Prediction Models
Global and Regional
Short term forecast – Climate models
Linked models – oceanographic / soil / ice

Mathematically defined grids
In horizontal
Special grids in vertical
terrain following at surface,
pressure coordinates at top

Temporal coordinates
T+00 – T+144
(0 to 6 days ahead)
Climate models use 360 day year!
The Improved Main Telecommunication Network
XI-2004

Network I

Melbourne
Washington
Brasilia
Exeter
Moscow
Tokyo

Network II

Beijing
New Delhi
Sofia
Prague
Jeddah
Offenbach
Nairobi
Cairo
Algiers
Dakar
Toulouse
METAR Code

- **WMO/ICAO**
  - METAR Meteorological Aerodrome report

- Rome Ciampino
  - LIRA 241245Z 28014KT 240V290 9999 FEW020TCU 31/10 Q1011

- Rome Fuimicino
  - LIRF 241250Z 28012KT 250V310 9999 FEW020 26/17 Q1012 NOSIG

- ~ 2-3 Million pilots understand this – whatever language they speak
Data and service standards
Maintenance, Update and Development
WMO Member states do the data exchange.

WMO Secretariat organises
- facilitates the work of Expert Teams who are nominated and paid by Member States
- Expert Teams develop, maintain and monitor programs and standards

WWW is the WMO Program for data exchange
- It is WMO’s SDI Spatial Data Infrastructure
- WWW costs 13M CHF per year
Codes – Maintenance and Updates

- Expert Team on Data Representation and Codes
  - Last meeting in April
  - ~200 changes
    - Most minor – table changes,
      - quick confirmation process (Jan 2008?)
    - About 30 major
      - 10 or so require formal agreement
      - Next CBS – anything up to 4 year cycle.
  - In recent years – more and more new data types
So where does ISO/OGC come in?
Developments

- **WIS process**
  - WMO Information System
    - Replacement of GTS
    - Portal for WMO data
      - not just real-time operational data
  - Data by request and dissemination through subscription
  - Data refactoring, extraction and aggregation
  - Registries
  - Metadata – but evaluation and use
Developments

- WMO Core Profile of ISO19115
  - WMO ET with help from D Danko, C Portele
  - 3rd version – proper extensions, 19139 coding
- Problems we encountered
  - Topic category, keywords – need
  - Temporal extent
  - DQ problems
  - Features and Coverages
  - Grid models not adequate/superfluous
WMO Problems with ISO 191xx model

- Main problem
  - Lack of experience
  - Extensive existing system and expertise
    - Natural caution and doubts

- Features and Coverages
  - Observation and Measurement

- Temporal can be more important than spatial

- GIS paradigm
  - Highly inadequate for Meteorology
    - Attributes at a spatial point - very high dimensionality
      - Minimum 6, max- chemistry 1000-10000 df at each 4D point

- RDBMS too slow
Questions & Answers