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# **GML Application Schema for Meteorological Objects**

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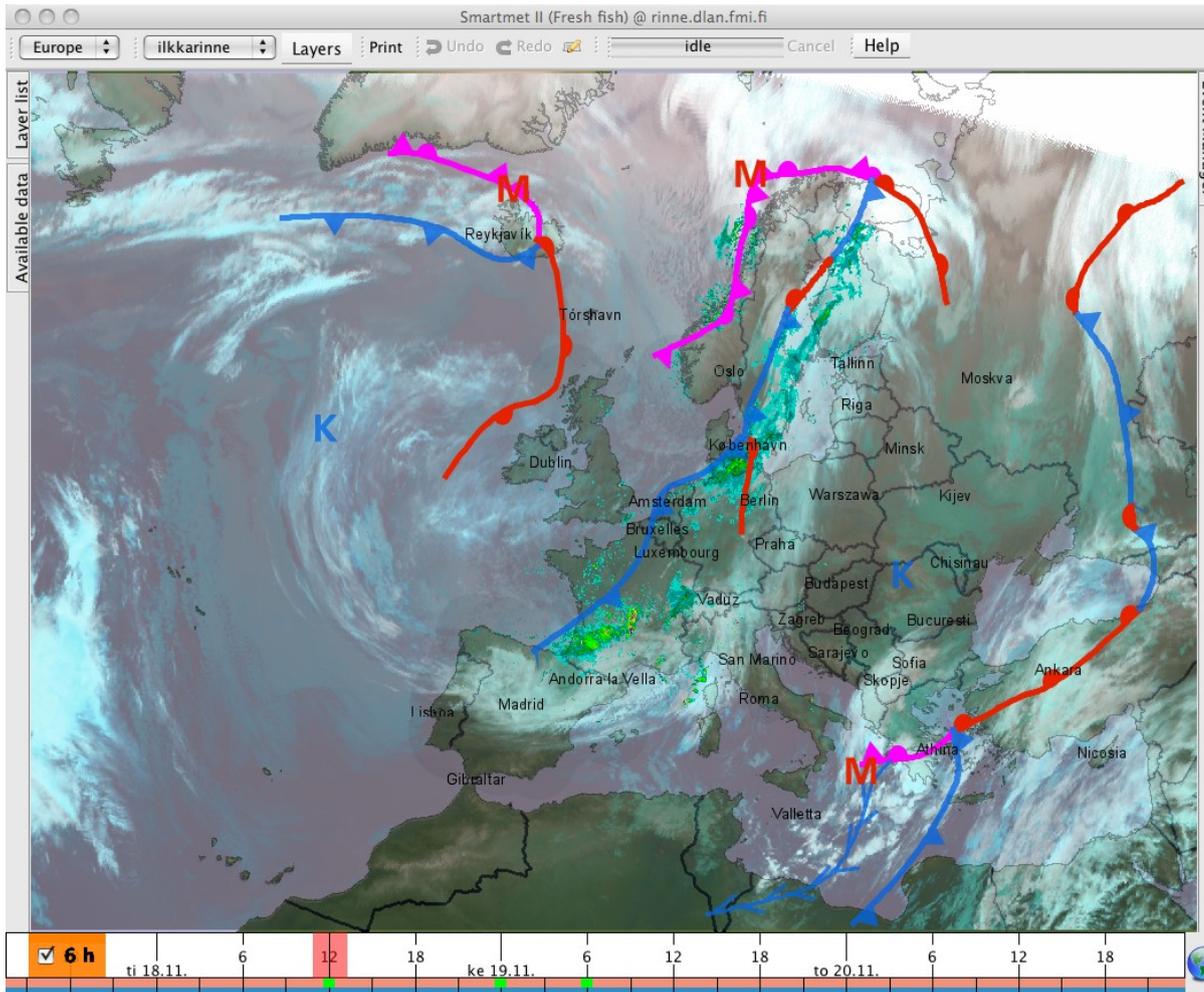


## Prepare for INSPIRE, Learn OGC Web Services

- **OGC Web Service interfaces for public access weather data will be mandated by the INSPIRE directive in EU member states in the next 5-10 years.**
- **Common transfer and archiving formats and protocols will be increasingly important in the Met domain community in the near future:**
  - Climate change, rough and rapidly developing weather conditions, international military and rescue operations, flight weather needs,...
- **Acting early is seen clearly beneficial at FMI:**
  - Possibility to influence the developing standards.
  - Time to learn the new technologies and possibilities.
- **FMI became OGC associate member in early 2009**
  - Learn by start using the OGC Web Services also in internal development projects.



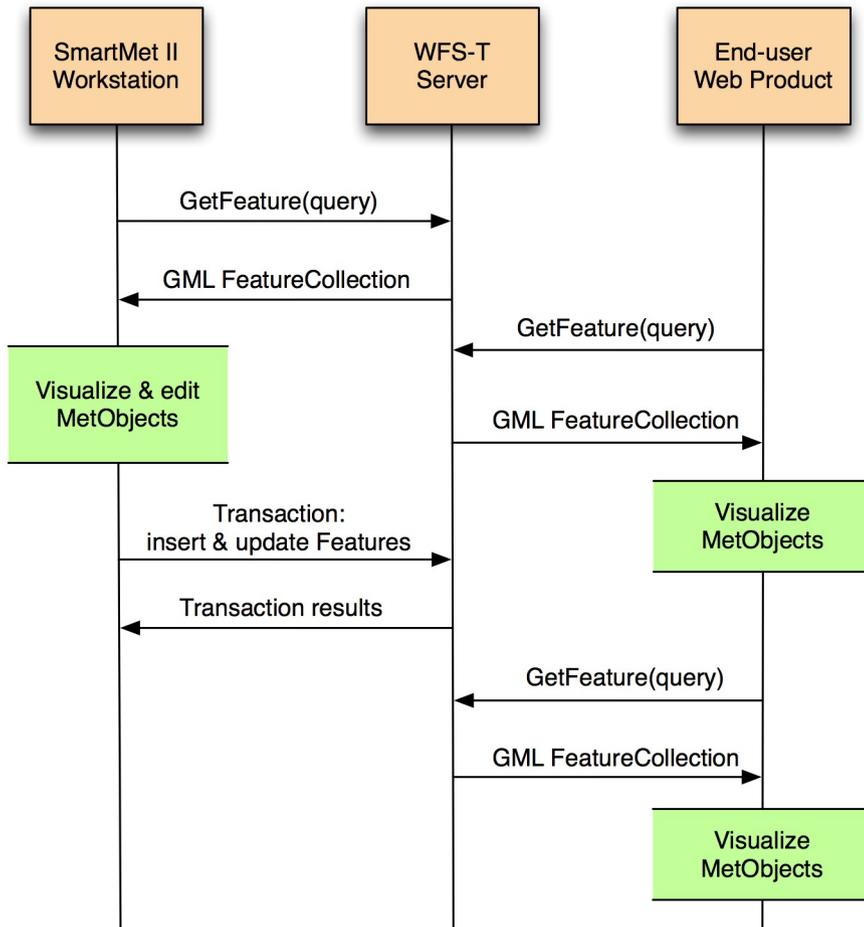
## Meteorological Objects at FMI



- Created by meteorologists on duty using SmartMet II workstation.
- Objects with semantics, not static map images.
- Corrected as new information emerges.
- Used for generating different client-specific products.



## Goal: MetObjects storage and retrieval using WFS-T



- **MetObjects are stored in a (relational / object) database.**
- **The middle-tier “application server” needs to talk WFS-T and handle the XML ↔ DB queries and responses.**
  - The implementation technology doesn't really matter. All access through the WFS protocol.
- **Any WFS capable clients can access the stored MetObjects.**
  - Production systems, view-only clients,...



## **FMI MetObjects GML Application Schema**

- **An XML language for describing Meteorological Objects**
  - Domain-specific schema based on Geography Markup Language (GML) = GML Application Schema.
- **Defining MetObjects as GML Application Schema was started in autumn 2008 at FMI.**
- **Primary goal was to model the meteorological objects hand-drawn by the meteorologists as GML Features.**
  - GML has well-defined, ready-to-use geometry properties.
  - Cross-platform and programming language solution, easy to post-process and transform if necessary.
  - Directly usable as data payload between Smartmet II editor and the permanent storage server using WFS-T.
- **We also wanted to keep the inter-office data exchange in mind.**



## FMI MetObjects GML Application Schema

- **Designed to be easily extendable**
  - a couple of abstract Feature types based on the primary geometry (point, line, surface area, volume) and MetObject collections, concrete MetObject types and elements are derived from these.
  - Modeling work still in the beginning: Some synoptic features (fronts, jets, troughs), generic symbols, cloud and rain areas defined at the moment (version 2009/04/28).
- **Hand-written XML Schema due to lack of GML methodology knowledge**
  - An automated approach for UML-to-XML-Schema generation is usually preferable, using ShapeChange or FullMoon tools.
  - Writing a valid GML Application Schema directly as XML Schema is tedious and hard work even with good XML tools: *Learning GML the hard (but oh so educating) way.*



## FMI MetObjects GML Application Schema

- **Eight versions have been published this far, the latest version is “2009/04/28”**
  - Documentation, XML Schema files and release notes:  
<http://xml.fmi.fi/namespace/meteorology/conceptual-model/meteorological-objects/2009/04/28/>
- **Not very stable yet, change requests keep on emerging from the real-life forecasting work.**
- **Urge to do international co-operation on this subject.**
  - Goal: a common, OGC (and INSPIRE) compliant MetObjects transfer language for the Met domain.
  - Cross-office weather analysis and forecast information exchange using web services (WFS).
  - Off-the-shelf software tools for handling the MetObjects GML.

# It's amazing what you can find in the EGOWS archives while preparing for your presentation abstract...

## EGOWS 1990-2009

From this website the electronic versions of almost all presentations of the EGOWS meetings from 1990 up to now are available.

<a href="#">20th EGOWS</a>	<b>De Bilt, Netherlands</b>	<b>2009</b>	link to EGOWS2009-site
<a href="#">19th EGOWS</a>	<b>Ljubljana, Slovenia</b>	<b>2008</b>	link to EGOWS2008-site
<a href="#">18th EGOWS</a>	<b>Dublin, Ireland</b>	<b>2007</b>	link to EGOWS2007-site
<a href="#">17th EGOWS</a>	<b>Budapest, Hungary</b>	<b>2006</b>	link to HMS-site
<a href="#">16th EGOWS</a>	<b>Exeter, United Kingdom</b>	<b>2005</b>	link to presentations
15th EGOWS	<b>Potsdam, Germany</b>	<b>2004</b>	
<a href="#">14th EGOWS</a>	<b>Tromsø, Norway</b>	<b>2003</b>	pdf, 59.4 mb (if too large, download the smaller parts)
<a href="#">or part 1</a>			pdf, 17.9 mb
<a href="#">&amp; part 2</a>			pdf, 21.3 mb
<a href="#">&amp; part 3</a>			pdf, 19.9 mb
13th EGOWS	<b>Rome, Italy</b>	<b>2002</b>	
<a href="#">12th EGOWS</a>	<b>Zürich, Switzerland</b>	<b>2001</b>	pdf, 17.9 mb
<a href="#">11th EGOWS</a>	<b>Helsinki, Finland</b>	<b>2000</b>	pdf, 10.9 mb
<a href="#">10th EGOWS</a>	<b>De Bilt, Netherlands</b>	<b>1999</b>	pdf, 14.3 mb
<a href="#">9th EGOWS</a>	<b>Norköping, Sweden</b>	<b>1998</b>	pdf, 13.5 mb
<a href="#">8th EGOWS</a>	<b>Toulouse, France</b>	<b>1997</b>	pdf, 12.0 mb

# Proceedings of EGOWS 2003, Tromsø, Norway:

**DRAFT**

**METEOROLOGICAL OBJECTS IN OPERATIONAL USE: STEPS TOWARDS A  
STANDARD FORMAT FOR EXCHANGE**

Submitted by Dick Blaauboer (KNMI), Eric Brun (Météo-France), Chris Little (MetOffice)

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## 1. Terms of Reference

The goal of the Working Group is to define a common list of Met Objects with their attributes and to propose it as a standard to WMO. To that purpose the WG will have links with National Hydro-Meteorological Services outside Europe.

This goal should be reached within a relatively short time period because some user applications are already using Met Objects with their own definitions.

The Working Group on Met Objects will be a permanent subgroup of EGOWS and have annual meetings in parallel with EGOWS.

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## **Working Group on Meteorological Objects (wgMO)**

- **Working Group on Meteorological Objects in Interaction with Gridded Fields (wgMO) was founded after the Workshop on Graphical Interaction (within COST-78) in Helsinki in December 1998.**
- **Meetings: ECAM 1999 in Norrköping, EGOWS 2000 in Helsinki, EGOWS 2001 in Zürich, EGOWS 2003 in Tromsø.**
- **Paper on Meteorological Objects presented at WMO CBS Expert Teams on Data Representation and Codes (ET-DR&C), Arusha, Tanzania, Feb 2003, and Integrated Data Management (ET-IDM), Geneva, Dec 2003.**
  - Paper describes the wgMO background and goals.
  - 104 object types defined: 19 “Action Centers”, 53 “Synoptic Typical Features”, 26 “Sensible Weather Objects”, 6 others.
  - BUFR and XML mentioned as possible transfer formats.

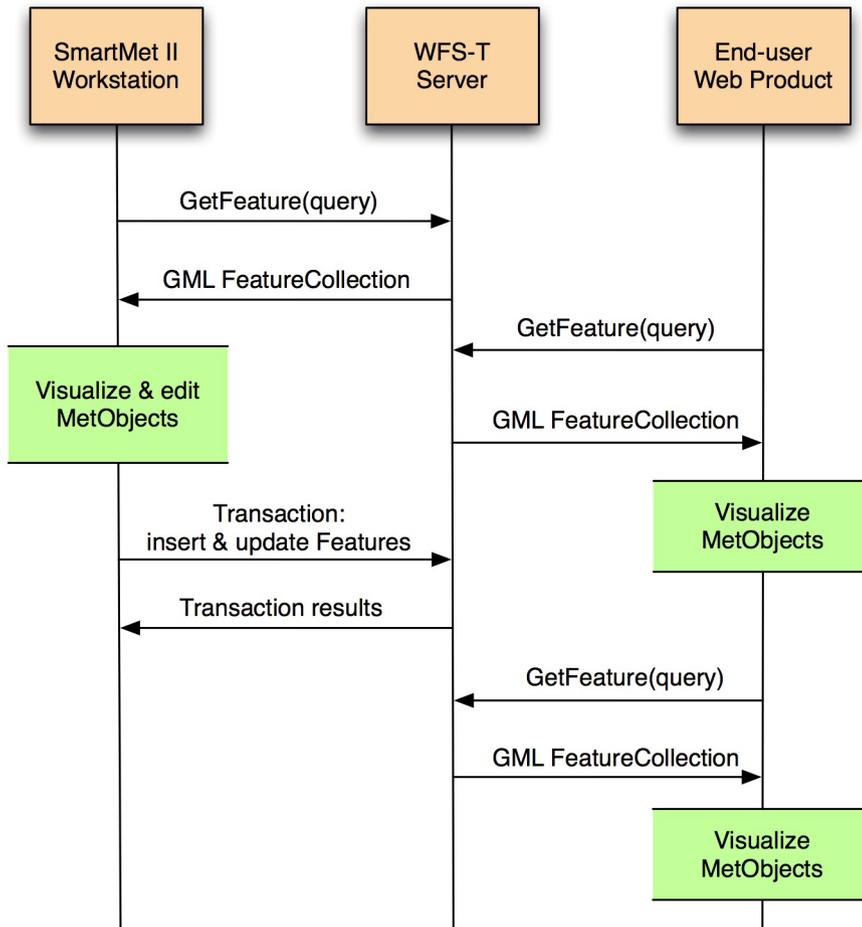


## What happened to the MetObjects work?

- **Was WG meeting held at EGOWS 2002 in Rome or 2004 in Potsdam (no proceedings available in the archive)?**
- **wgMO is not mentioned in proceedings of the later EGOWS meetings.**
  - Was the issue forgotten, put to hold to wait for the WMO ET actions, discontinued for some reason?
  - I'm too fresh to remember (my first EGOWS was in Budapest in 2006). Maybe someone here knows more?
- **The wgMO work on meteorological objects should be continued and improved based on the FMI MetObjects schema:**
  - Re-model the current features in UML, auto-generate the XML Schema.
  - Review the 2003 MetObject list and continue adding them to the Application Schema.



## MetObjects storage and retrieval using WFS-T



- **So, we have the MetObjects GML under control, how about the technology stack? We need:**
  - a WFS-T server with Complex Feature and GIS (PostGIS, Oracle Spatial, ...) support, and
  - a java library for accessing and modifying the MetObjects data in the Workstation as well as in the end-user product visualization.



## WFS-T for Complex Features: ~~Deegree~~ WFS

- **Client**: the library code and architecture seemed promising for handling the MetObjects GML with Java.
  - Only a limited amount of extension work to be done for the needs of the SmartMet II MetObject editor.
- **Server**: the WFS server implementation supported transactions of Complex GML Features, something no other open source WFS could do at the time (as far as I know).
- **BUT** (as we learned during a couple of man months):
  - The GML handling and visualizing library proved to be difficult or impossible to extend due very limited class visibility and non-replaceable Factory implementations.
  - We were unable to configure the Deegree WFS server to map our GML Application Schema to PostGIS.
  - Configuration error handling and documentation is poor.



## **WFS-T for Complex Features: GeoServer 2.0?**

- **GeoServer “Community Schema” AKA support for full ISO Feature model (including Complex Features) has been under development CSIRO in Australia since late 2007.**
- **It seems that the Complex Feature support will be included in the GeoServer 2.0 release (beta2 should be out in mid June 2009)**
  - Not officially announced yet.
  - Documentation and tutorials are still incomplete?
  - No possibility to do the Complex Feature mapping using the GeoServer web GUI?
  - We are really looking forward for the 2.0 release at FMI.
- **Maybe we should broaden the GeoServer/GeoTools developer community, participation from other met/hydro offices and/or companies?**



## **XML ↔ Java Object Binding: Apache XMLBeans**

- **So, the server side implementation looks rather good, how about the client (workstation)?**
- **After the Deegree failure we decided to generate the Java classes for the MetObjects Application Schema using the Apache XMLBeans framework.**
  - Works nice, but classes for all the XML Schema elements must be generated in the same build: In this case major part of the whole GML schema in addition to the MetObjects schema, 2600+ classes in a 3.9 MB jar file.
- **Wrappers for the generated XMLBean classes had to be implemented in order to build a convenient API for MetObjects Domain Model objects including Swing undo/redo support and modification tracking needed by the SmartMet II MetObjects editor.**
  - Candidate for co-operative open source project? Must be hand-in-hand with the App Schema development process.



## Conclusions

- **Technology and data modeling activities for making meteorological data web-accessible are continuing at FMI**
  - Pressure from INSPIRE directive, will to be at the technology front line in adopting the OGC Web Service standards.
- **An extendable, met community agreed GML Application Schema for the Meteorological Objects is needed.**
  - Revival of the EGOWS wgMO, activities in the brand new OGC Met DWG?
  - Bottom-up testbed activity gradually leading into standardization.
- **Open source technology stack for accessing complex MetObject GML using WFS-T standard is coming together.**
  - Interesting new possibilities in code/library level developer co-operation being good candidates for open sourcing.