WAMIS Grid Portal – Recent Implementation

from Web Portal to Grid Portal under WIS umbrella
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ABSTRACT

As WIS evolves to provide a single entry point for any data request in the WMO context, CAgM is trying to extend its service to member countries under WIS umbrella as a DCPC "WAMIS". This includes making the CAgM WAMIS portal compliant with WIS by the addition of a metadata search and entry tool GEONETWORK which includes the ISO23950 Search and Retrieval by URL as agreed at ICG-WIS V in Brazil in 2008. Mr Lee noted the significant contribution of the WISPO in enabling this achievement. In addition, CAgM is implementing WAMIS into a Grid portal to share computer resources, especially for emerging countries in which limited IT resources are most critical barriers in improving its operational services in AgroMeteorology. Since operational agrometeorology requires diverse data and information from different disciplines for better services, future information system for AgroMeteorology should consider accommodating diverse data and information as well.

Although WIS is going to handle mainly weather/climate and water data, including NWP model outputs, it does not include functionalities for data processing, archiving, and analysis, However, CAgM recognized that it could initiate a dedicated information and resource sharing system with more extended services to members under WIS umbrella. It is, thus, now considering how to implement the sharing of other data as well as how to identify the ways of sharing IT resources including human resources for members.

An inevitable use of advanced ICTs such as information network, database, simulation models, tools for GIS, RS for agrometeorology should be made in its implementation. In this regard, sharing of resources including IT and human resources available among countries will be a promising way to solve the above mentioned problems. The concept of WAMIS grid portal will be able to reveal how WIS can play a leading role to meet extended future requirements by providing both data/information and computer resources for models, tools, and products for operational services based on NWP forecasts. A specialized or dedicated DCPC to support a WAMIS grid portal will be a promising solution in improving resource sharing among CAgM member countries by allowing them to make better use of remotely located resources for agrometeorological services at national/regional scale, especially when it provides interactive forecast-based agrometeorological services via simple Internet access.

1. Background

AgroMeteorological information is the most essential resources in Agriculture, since almost all agricultural activities in the fields are prone to changes in weather and climate. In addition, an increasing importance of non-climate/meteorological data, for example surface vegetation and soil moisture status from agronomy sectors, is getting more public recognitions ever before in improving the predictabilities of weather and

climate forecasts by NWP models because of their feedback to weather/climate systems through atmosphere-biosphere interactions. AgroMeteorological information sharing among member countries, thus, becomes one of the most critical and dynamic aspects of strengthening national weather services not only for sustainable Agriculture, but also for enhanced accuracy of weather/climate forecast models in the future.

The concept of Core AgroMeteorological Station recommended by CAgM of WMO (1999) has been evolved to contribute to the accomplishment of the above two goals in the future not only as an information provider of land surface information that are critical to implement the next generation NWPs through Land Data Assimilation Scheme (LDAS), but also as a promising user of forecasts because forecast-based AgroMeteorological service can provide more value-added services to end-users, compared with current nowcasting-based services. It also requires diverse data and information from different disciplines for operational agrometeorological services, including non-meteorological information that are mostly derived from more complicated data sources in terms of syntactic and semantic aspects. In order to meet these demands by CAgM member countries, CAgM established a Web portal named as World AgroMeteorological Information Service (WAMIS) in 2002 at NOAA USA with the additional mirror servers in Korea and Italy.

2. Rationale

As WIS evolves to provide a single entry point for any data request, CAgM is trying to extend its service to member countries under WIS umbrella by implementing WAMIS into a Grid portal to share computer resources, especially for emerging countries in which limited IT resources are most critical barriers in improving its operational services in AgroMeteorology. Since operational agrometeorology requires diverse data and information from different disciplines for better services, future information system for AgroMeteorology should consider accommodating diverse data and information as well.

Since WIS is going to handle only meteorological/climate data including NWP model outputs and to provide only limited functionalities for data processing, archiving, and analysis for the time being, CAgM recognized that it should initiate a dedicated information and resource sharing system to implement WIS for more extended services to members under WIS umbrella. CAgM is, thus, now considering how to implement the sharing of non-meteorological data as well as how to identify the ways of sharing IT resources including human resources for members.

Furthermore, as GEOSS becomes an active component of Earth System science, non-meteorological information sharing should also be considered seriously under the umbrella of WIS if WMO desires play a leading role of data/information Hub for GEOSS in the future. How to solve this problem will be a very critical factor in getting involved in GEOSS. To be a most promising partner of GEOSS, WIS should accelerate its implementation at operational level with the full support by legacy and leading edge technologies, particularly that can be easily extendable and applicable to sharing of diverse types of information from GEOSS. Interactive WAMIS grid portal will play a role of bridging between WIS and GEOSS at the initial stage of these two system developments, because WAMIS should consider handling of non-meteorological data as well as collecting and providing them to GEOSS in its nature at least to some extent.

An inevitable use of advanced ICTs such as information network, database,

simulation models, tools for GIS, RS for agrometeorology should be made in its implementation. In this regard, sharing of resources including IT and human resources available among countries will be a promising way to solve the above mentioned problems. The concept of WAMIS grid portal will be able to reveal how WIS can play a leading role to meet this future requirement by providing both data/information and computer resources for models, tools, and products for operational services based on NWP forecasts. A specialized or dedicated GISC/DCPC of WIS to support for WAMIS grid portal will be a promising solution in improving resource sharing among CAgM member countries by allowing them to make better use of remotely located resources for agrometeorological services at national/regional scale, especially when it provides interactive forecast-based agrometeorological services via simple Internet access.

3. WAMIS as a Web Portal

The main objective of WAMIS is to provide a dedicated web server for disseminating agrometeorological products issued by WMO members. By providing a central location for agrometeorological information, WAMIS will aid users to quickly and easily evaluate the various bulletins and gain insight into improving their own bulletins. The web site will also host training modules to further help Members improve the quality and presentation of their agrometeorological bulletins.

3.1 Overview
- Dedicated WMO Web server for AgroMeteorology in WMO
- Three sites including two mirrors: USDA(USA)/KMA(Korea)/BMC(Italy)
- Demonstration of sharing Bulletins among member countries
- Cyber tutorials are available, with continued development

3.2 Status (Issues)
- Diverse languages are being used
- Large gaps among countries in contents and technologies employed
- Rare standard format or style between bulletins from different members
- Poor user-friendly interfaces
- No request/reply functions
- Limited information & materials available
- No archival in DBMS

3.3 Requirements
- Extended elements, types, resolutions in time & space
- Successful case studies & pilot projects
- Cyber tutorials on applications
- Technical support on IT, tools, models, etc.
- Computer resources for DB, model operation
- Training/Education on advanced technologies
- Better communication frameworks

4. Implementation Strategy

As both future customer and information provider to WIS, WAMIS needs to be implemented as a grid portal to provide not only information but also computer resources that are critical for strengthening agrometeorological services in member countries, especially with limited computer resources for agrometeorological service. Under grid environment together with legacy technology for high performance computing, large-scale diverse data and analysis servers, WAMIS will provide an IT

framework for end-users with interactive remote operation of their service development and deployment based on NWP forecasts as a grid portal. Specific interface will be provided for interactive operation on region-specific applications at operational level that requires and provides non-meteorological information from diverse sources, e.g. AMBER(DWD), DSSAT(USA). WAMIS grid portal can be used as a initial step to collaborate closely with GEOSS in the near future that aims at integrating all the observations available on the Earth.

4.1 Web Portal : information sharing (current role of WAMIS)

- – Transit to XML-based service : standard schema development
- – Machine translation : multi-lingual interfaces needed
- – Operational applications based on Web service architecture
- – Tutorial interfaces for real practices

4.2 GRID Portal : Resource sharing (extended role of WAMIS)

- – Forecast-based AgroMeteorological services for researcher/extension
- – Benchmarking on AMBER(DWD), expanding with DSSAT(USA)
- – NCAR (WRF, MM5), DWD (GME, LM), KMA(GDAS) as NWPs considered
- – Super ensemble of Long-range/Seasonal Forecasts (APCC/METGRID.)
- – GISC/vDCPC dedicated to WAMIS be required (NCAR, DWD)
- – LIS (NASA) as a framework for LSM (GDS/LAS+GRID in the future)
- – uCAgM project -> WAMIS grid portal -> WIS pilot project ->GEOSS Hub

4.3 IT Implementations

- Computational Grid
    Korea Nat'l Supercomputing Center shall provide for Testbeds
    KMA will support for developmental and operational service
    MM5 under Globus, then extends to LM under Unicore environment
    AMBER(DWD) for AgMet Models, later extends to DSSAT (USA)
- Data Grid
    Globus DataGrid functions will be used primarily
    Legacy servers with links to Data Grid using Data Broker
- WIS umbrella
    Virtual DC/PC should be constructed among new and existing DC/PCs
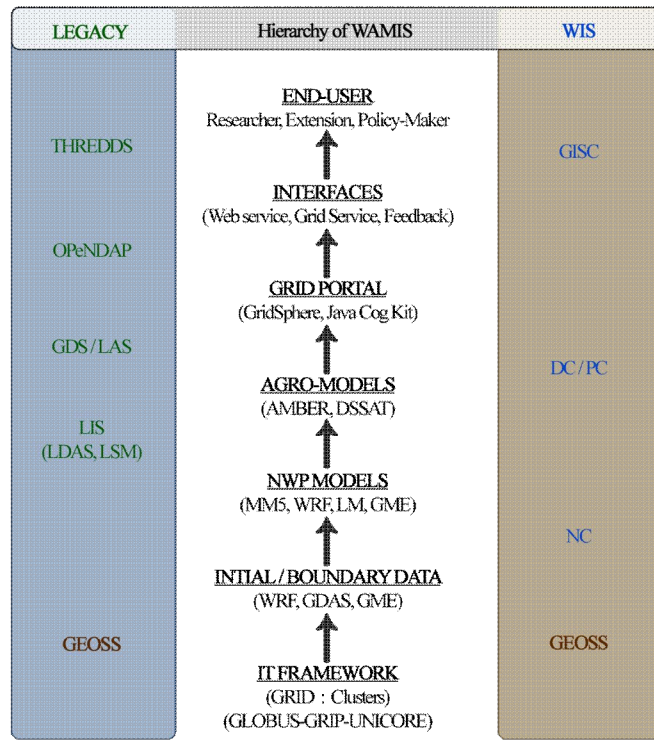   Specialized/dedicated GISC can be considered to accommodate non-meteorological data

Fig. 4.1 Logical Structure of WAMIS Grid Portal with Legacy and WIS components
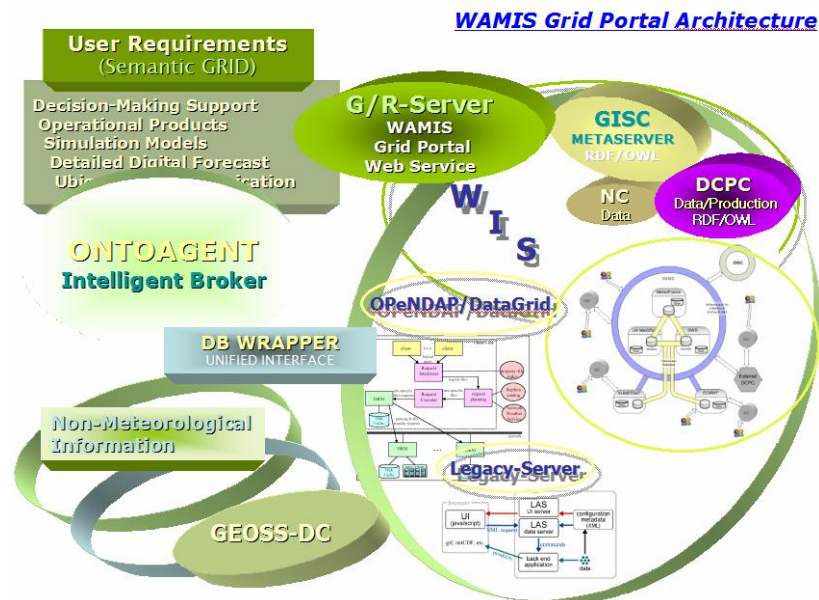

Fig. 4.2   Schematic Diagram of WAMIS Grid Portal Design

5. Components

In principle WAMIS grid portal will stick to WIS architecture and standards with the additional functions of providing computer resources and considering non-meteorological data/information sharing. Thus it should provide specific user interfaces to accommodate its specific user demands both from grid and legacy technology using service-oriented architecture, including semantic grid technology in its long-term perspectives.

5.1 System
- GRID Servers for Simulation models, Databases, System Analysis
- High speed network frame (APAN)
- Web service interfaces for simulation models with near real time DB access
- Multi-tiered Interface Architecture under distributed computing environment

5.2 Information
- Existing DB :   RS, Agronomy, Management, Climate, etc.
- Met Data resource : Synoptic data, Forecasts(S,M,L), Prognosis, Adaption data
- Development tools: Simulation models for climate, crop, resource management, root zone dynamics, farm management, etc.
- Derived Products: Climate change scenario, seasonal- and interannual-forecasts, crop growth and development, regional food demand/production

5.3 Interfaces
- TCP/IP based Internet Web service interface with GUI (JAVA)
- Object Oriented Client/Server architectures with free of OSs, languages, platforms, networks. (SOAP/WSDL)
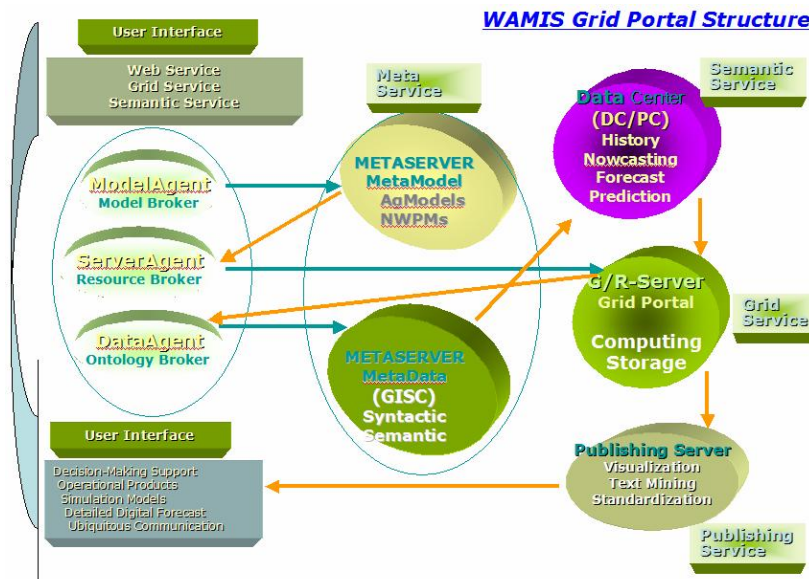- Multi-directional communication networks between end-users and researchers

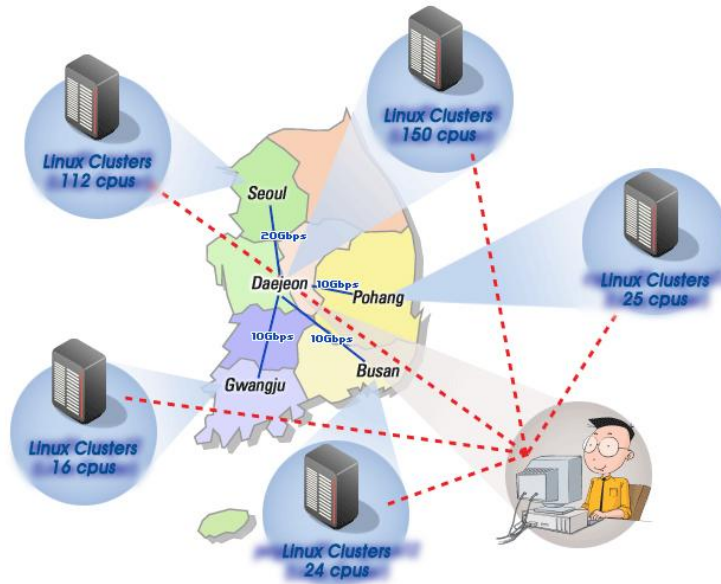Fig. 5.1   System Components of WAMIS Grid Portal Structure

Fig. 5.2   Schematic Diagram of Resource Flows within WAMIS Grid Portal

Fig. 5.3   Prototype System Diagram to run MM5/WRF in WAMIS Grid Portal

Fig. 5.4   Computer resources to run MM5/WRF and Agmodels in WAMIS Grid Portal
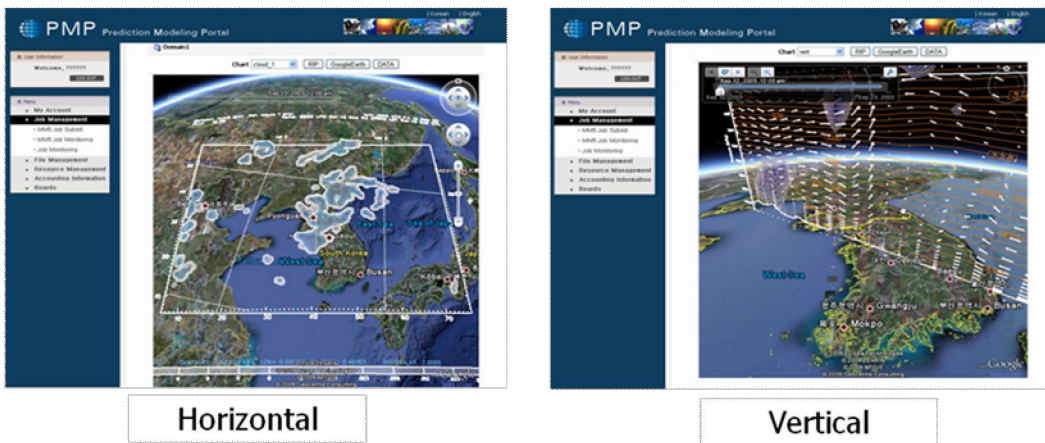

Fig. 5.5   Sample Display of AgModel Outputs based on MM5/WRF in WAMIS Grid
            Portal Environment

6. Service Architecture

WAMIS grid portal will try to make best use of service-oriented architecture while employing all the fundamental requirements under WIS framework. Key service layers consist of application, metadata, replica, resource and publishing services. This service architecture will be able to meet the GISC requirements in metadata catalogues, Internet portal with local administration, data acquisition, discovery, distribution services, monitoring, and synchronization. In addition, computational grid technology is an important component of grid services implemented in WAMIS grid portal to provide computing resources for model operations via Internet through Web Service technology in the future.

6.1 Application Service
- Web service   : Interactive user configuration on domain, applications
- Grid service   : Authorization/authentication, Brokers, Grid portal, ..

6.2 Metadata Service
- Ontology broker   : WMO Metadata Core Profile – extended with   key words
- Semantic Web   : Protege3.0 based Ontology development (RDF/OWL)

6.3 Replica Service
- Catalogue   : Globus with legacy catalogue (THREDDS)
- Data Grid   : Interface with legacy data servers (GDS, LAS, …)

6.4 Resource Service
- Model server   : AgroMeteorological Models, NWP models
- Tool server   : GIS, Graphic tools, Statistics, DBMSs
- Computational Grid : Globus, Unicore

6.5 Publishing Service
- GIS   : Map display, spatial analysis, Web interface
- Graphics   : NCAR graphics, GrADS,
- Interface   : Web interface with feedback
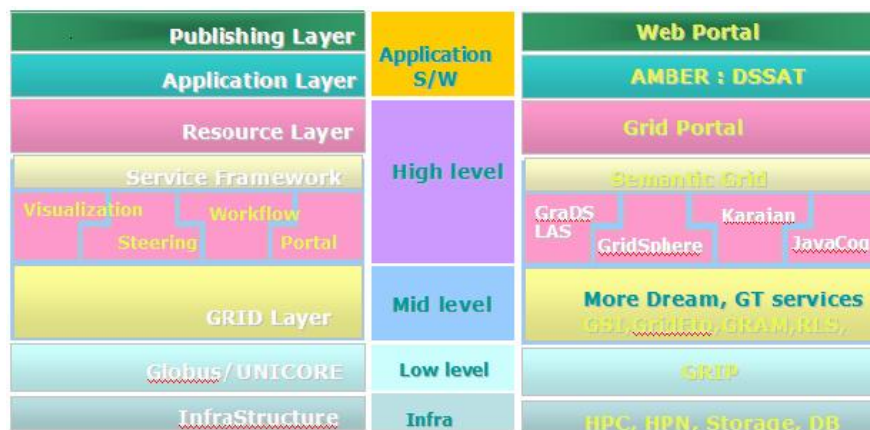- AccessGrid   : Partial supplement for members available

Fig. 6.1   Service Oriented Architecture of WAMIS Grid Portal

7. DB requirements

WAMIS grid portal should handle diverse data sources, formats, contents from synoptic data, forecasts(S,M,L), prognosis, adaption data, simulation models for crops, resource management, root zone dynamics, farm management, etc. It also has to take care of derived products such as climate change scenario, regional food demand/production, etc. It indicates that WAMIS needs highly elaborated data handling and distribution mechanisms, including ontology, because it consists of various contents in different formats depending upon the origin or process of data manipulations.

7.1 Data needed
> Meteorological data : historical, now-casting, forecast, prediction
> Non-meteorological : Energy flux, surface, vegetation, soil, moisture, ..

7.2 Time span : real-time, on-demand, fixed schedule

7.3 Prerequisites
> Interface to legacy servers
> Interface to non-meteorological information
> Extended Metadata, relevant ontology
> Metadata Catalogue, Replica service

7.4 Measures
> Dedicated GISC/DCPC to cover specific data/information
> Supporting interface between legacy and DataGrid Servers
> Computational Grid optional
> AccessGrid may be required
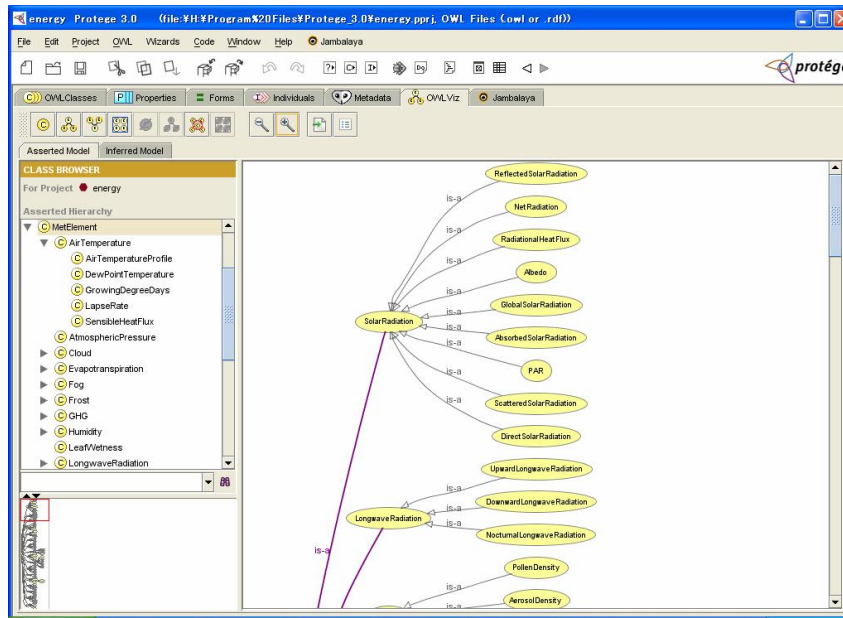> Grid service oriented architecture needed

Fig. 7.1 Prototype of Ontology using extended Keywords for AgroMeteorology illustrated on Protege3.0
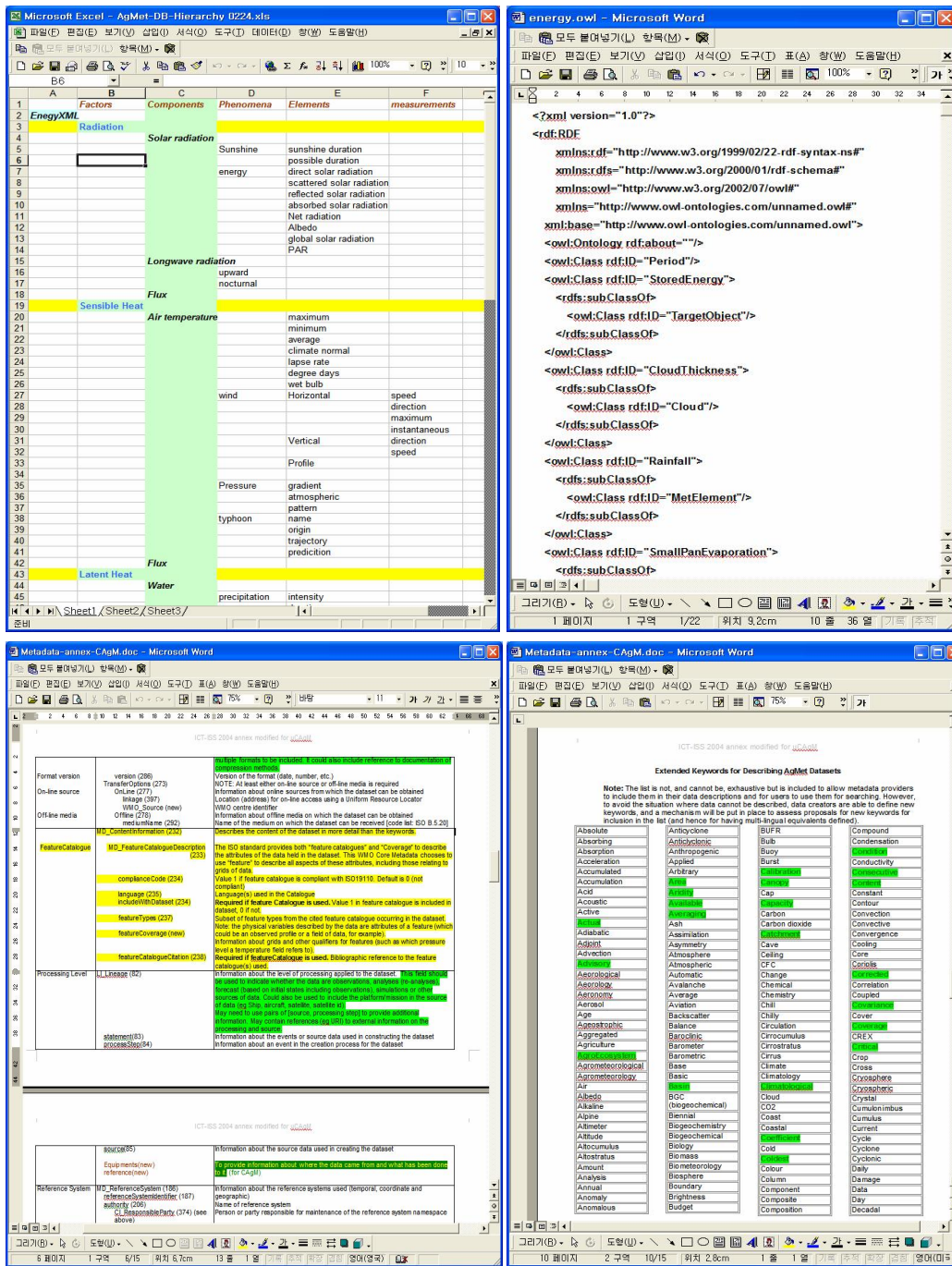
Fig. 7.2 Prototypes of Extended WMO Metadata Core Profile (Left Bottom), Keywords (Right Bottom), Hierarchy of weather elements (Upper Left), and its RDF/OWL presentation (Upper Right) for CAgM data management

8. Partners or Sponsors

8.1 Resource Providers
- Computing power : K*Grid, uMeteo-K, KMA-Grid, MAFFIN(J), NCAR(U), DWD(G)
- Storage : same as the above
- Network : APAN, TEIN2, Gloriad, GEAN, CA*4
- Information: Climate, Synoptic, Reanalysis, Derived, non-Met. data and products
- Middleware : WCCA/AFITA/EFITA, NARC(J), PRAGMA, Globus, UNICORE, etc.

8.2   Resources Available/Expected
- Computers : PC Linux Clusters (Xeon, Opteron) n*256 nodes, Sun, NEC, Cray
- AccessGrid : AG2.0 Venue server, Room nodes, PIGs compatible with DV
- GIS :Arc/View, ArcIMS, own web-interface on Servers
- RS : MODIS/MDS will be available via MAFFIN(J)
- Network : 100 MB – 1GB available
- Middleware : Globus 2.4, 3.2, 4.0, UNICORE 4, 5, MetBroker and more
- Storage : 1 ~ 50 TB available
- Tools : MyProxy, Ganglia, MPICH, MPICH-G2, GridSphere, WWW/Ftp servers, DBMS, etc
- Services : Grid services (GRAM, GIIS, GridFtp, etc), Web services
- Applications : MM5.mpp, AMBER, DSSAT(?), and more

8.3   Affiliates
- APAN : Asia-Pacific Advanced Network : Earth System WG
- K*Grid : National Grid Initiatives in Korea : Agreement with CAgM
- ESGII : Earth System Grid & ESMF :Global consortium discussed
- AFITA : Asia Federation of Information Technology in Agriculture
- METGRID : exchange of experts/staff with KMA
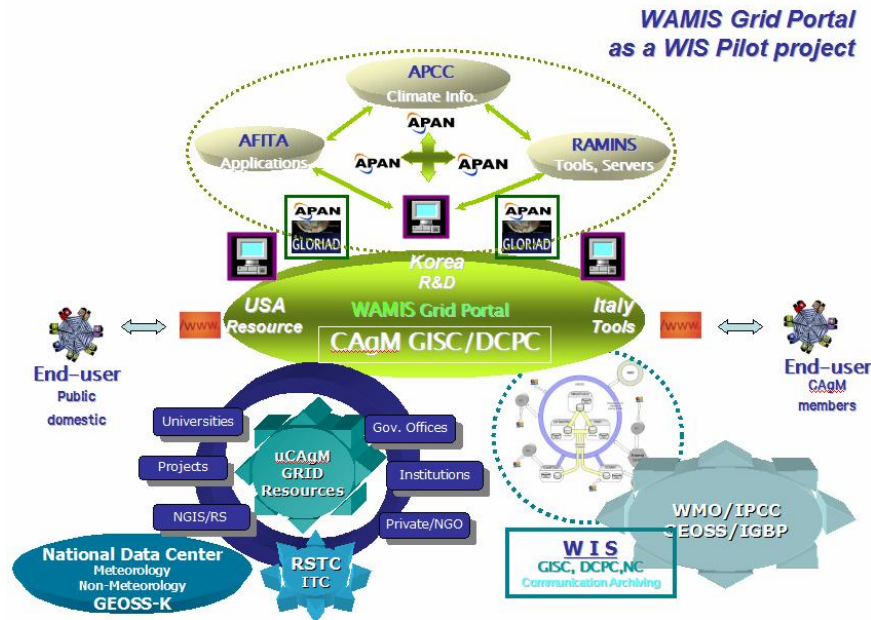- AsiaFlux : AsiaFlux-DIS proposed, steering committee.

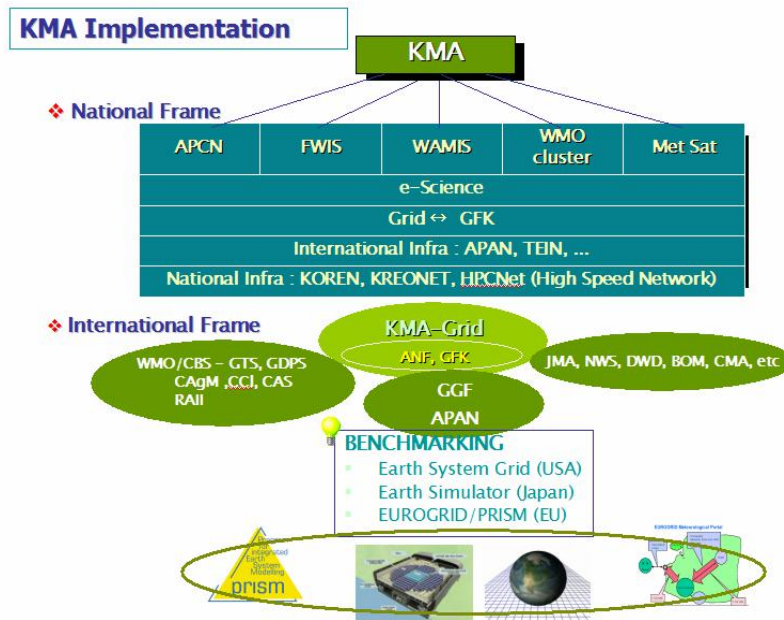Fig. 8.1   WAMIS Partners and Sponsors with WIS umbrella

Fig. 8.2   Implementation Scheme of IT frameworks for WAMIS Grid Portal
under WIS by Korea Meteorological Administration

9. Implementation Plan

9.1 Recent update (Eliot Christian, WIS Senior Scientific Officer/WMO)

KMA has installed a copy of the GeoNetwork opensource software to support the ISO 23950 interface required for interoperating with WIS. This software was developed and is maintained by the UN FAO, and it is widely used.

The next step is to actually create WAMIS metadata. To simplify metadata creation, an XML template was developed with about 20 elements. Eight of these identify the publisher of the metadata (name, address, phone, e-mail, etc.). Then, there is a title and abstract about the Bulletin, together with the WAMIS URL for access to the Bulletin. A place name as well as bounding box coordinates are provided, and the begin and end date can be entered as well.

We have made 41 draft metadata records using this simplified metadata template.   We have also developed an XML stylesheet which transforms this simplified metadata into the very complex format required for ISO 19115 metadata. This stylesheet also adds in many additional elements that are expected to be common to all WAMIS metadata records, such as keywords, a data quality statement, and text about constraints on access and use of the Bulletins.

As shown in the attached ppt diagram, it is the ISO 19115 form of the metadata

that is required for sharing with other systems. To support verification of the content by WAMIS managers, the full ISO 19115 metadata can be viewed in a browser as an HTML table. You can edit the simplified metadata and please let me know if any changes are needed elsewhere.

WAMIS metadata that has been OK'd is loaded into the GeoNetwork portal, using the "batch import" facility. The GeoNetwork portal makes WAMIS metadata accessible via a user interface with maps and other useful features for searching. I would suggest that the current WAMIS site link to this KMA GeoNetwork Portal as its facility for WAMIS portal visitors to search the WAMIS metadata.

As noted, the GeoNetwork portal will support the ISO standard search service in addition to the user interface. This required WIS interface allows WAMIS metadata to be searchable by outside systems (this includes not only WIS but GEOSS and many others). The GeoNetwork Portal could also be configured to let users search across many outside systems, including libraries as well as most of the major environemental systems.

For some purposes, it is also desirable to simply share copies of the WAMIS metadata records in ISO 19115 format. This can be supported using the Open Archives Initiative / Protocol for Metadata Harvesting (OAI/PMH), or via FTP, e-mail, etc.

Example WMO Metadata for a GTS Bulletin

The example bulletin collects FM 12-XII Ext. reports (SYNOP, Report of surface observation from a fixed land station)
The SMKO04 TTAAii Data Designators decode as:
-   T1 (S): Surface data
-   T2 (M): Main synoptic hour
-   A1A2 (KO): Korea, Republic of
The bulletin collects reports from stations:
Senbong, Samjiyon, Pungsan, Supung, Changjin, Kusong, Huichon, Sinpo, Anju, Yangdok, Nampo, Changjon, Sariwon, Singye, Ryongyon, Kaesong and Pyonggang

[click here to view metadata]

World Meteorological Organization

Fig.   9.1   Example WMO Metadata for a GTS Bulletin (2009, Eliot Christian)

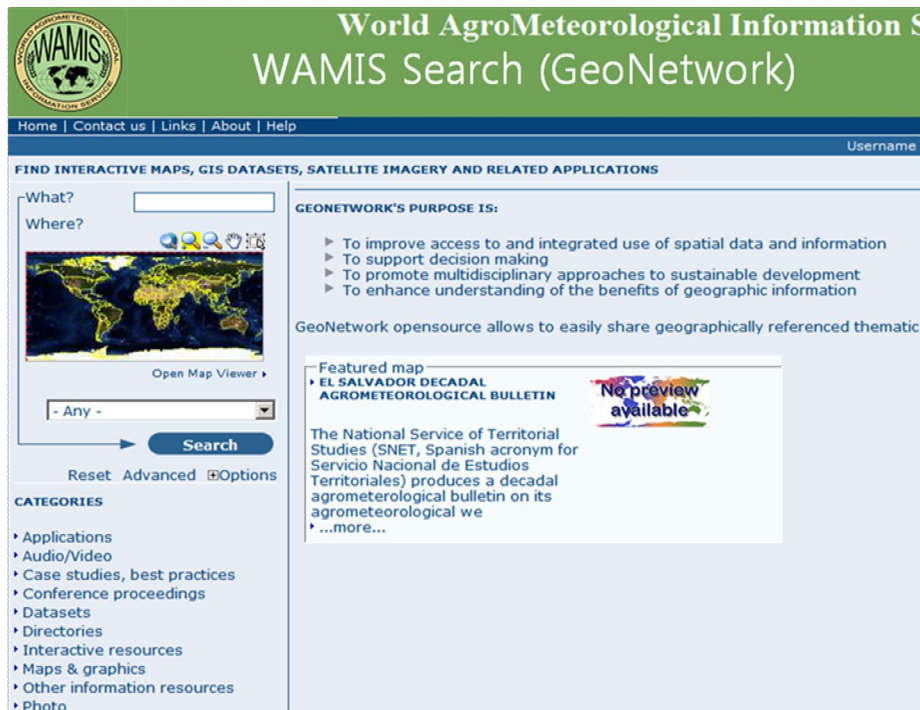Fig.   9.2   Metadata for WAMIS Bulletins (2009, Eliot Christian)

Fig.   9.3   GeoNetwork based WAMIS Search Home page (2009, Eliot Christian)

9.2 On-going implementation

- Implementation of WAMIS grid portal(WGP) as a pilot project of WIS

    Submission of the application for WIS-DCPC dedicated to WAMIS
    Collaborations with associated institutions in implementations
    Restoration of WAMIS mirror server at KMA with advanced network (Giga bit)
    Development of prototype user interface for Grid Portal
    Case study on linkage between NWP output and Applications
    Downscaling of NWP output to meet requirements from AgModels

- Securing ICT resources to support WGP for resource sharing

    Agreement on ICT resource support by KISTI for CAgM
        KREONET (Giga LAN) was linked without any charge to NCAM
        Linux Clusters and other computer resources will be arranged when needed
        High volume of information storage will be provided with DBMS
        Plan to make MoU among CAgM/KISTI/NCAM

    - Mobilizing Agricultural models and instruments available for CAgM activities

        DWD & KMA have a bilateral agreement on AMBER
        Prof. Hoogenbum agreed on joint development of DSSAT as an open source
        NARC/Japan is willing to provide JAVA based AgModels, MetBroker, FieldServer

    - Joint IT training program in AgroMeteorology for capacity building

        KOICA is going to support for the expanded AgMet ICT training course
        RTC-Nanjing and NCAM will work together for future joint training programs
        Seoul National University will provide training experts and facilities relevant
        KMA is going to offer hosting of international training center for ICT training

    - Lanuch of expanded National Center for AgroMeteorolgy as a framework

        Four institutions (KMA, RDA, FA, SNU) made MoU for closer collaborations in AgMet
        Expanded NCAM was launched as of 12 Nov at Seoul National University
        NCAM will give an emphasis on strengthening education & training program initiatives
            Dedicated division is included within NCAM umbrella
        Core ICT technologies will be developed based on IT infrastructure, GIS, RS, Model, etc.

9.3 Tentative Plan (by 2011)
    Further implementation of Prototypes on Interactive WAMIS Grid Portal
    Demonstration of WAMIS Grid Portal at semi-operational level
    Establishment of dedicated GISC/DCPC with WIS standards
    Open to member countries

10. Other diagrams related

Fig. 10.1   Key Components of WAMIS under uWISE Architecture

K*Grid
uMeteo-Korea

ES²
eScience/CyberInfrastructure

Campus Grid   KMA Grid
Earth System   Emergence Response
Global Consortium of Earth System Development
(GCESD: APAN/NR/ESWG)
Cyber-Infrastructure   eScience
ESG/LEAD/ESMF   MeteoGrid/PRISM
USA/NCAR   EU/DWD
GO-ESSP

Globus   Unicore
GRIP

WMO/CBS/WIS

uCAgM
WAMIS
(Web Portal)
USA   /   Korea   /   Italy
vDCPC
Non-Synoptic data/Surface Flux data

RA   III. VI   /   RA II, V   /   RA I, VI
Data   Computer   Data
Middleware   Interface   Middleware
Applications   Middleware   Applications
Webportal   Gridportal   Webportal

WMO/WIS/GISC
GISC-dedicated

uCAgM Grid Portal
Model/Tool/Middleware/Interface
(USA/Korea/Japan/Italy/Germany)

HPComputing/HPStorage
USDA/KMA/NARC/BMC/DWD

DSSAT, W-GIS, Broker, GIS, AMBER

HPNetwork   Application
APAN/TEIN/GLORIAD/CA*   WCCA/AFITA/EFITA
-    Multilingual translation
-    Middleware/Resource broker
-    Sensor Network
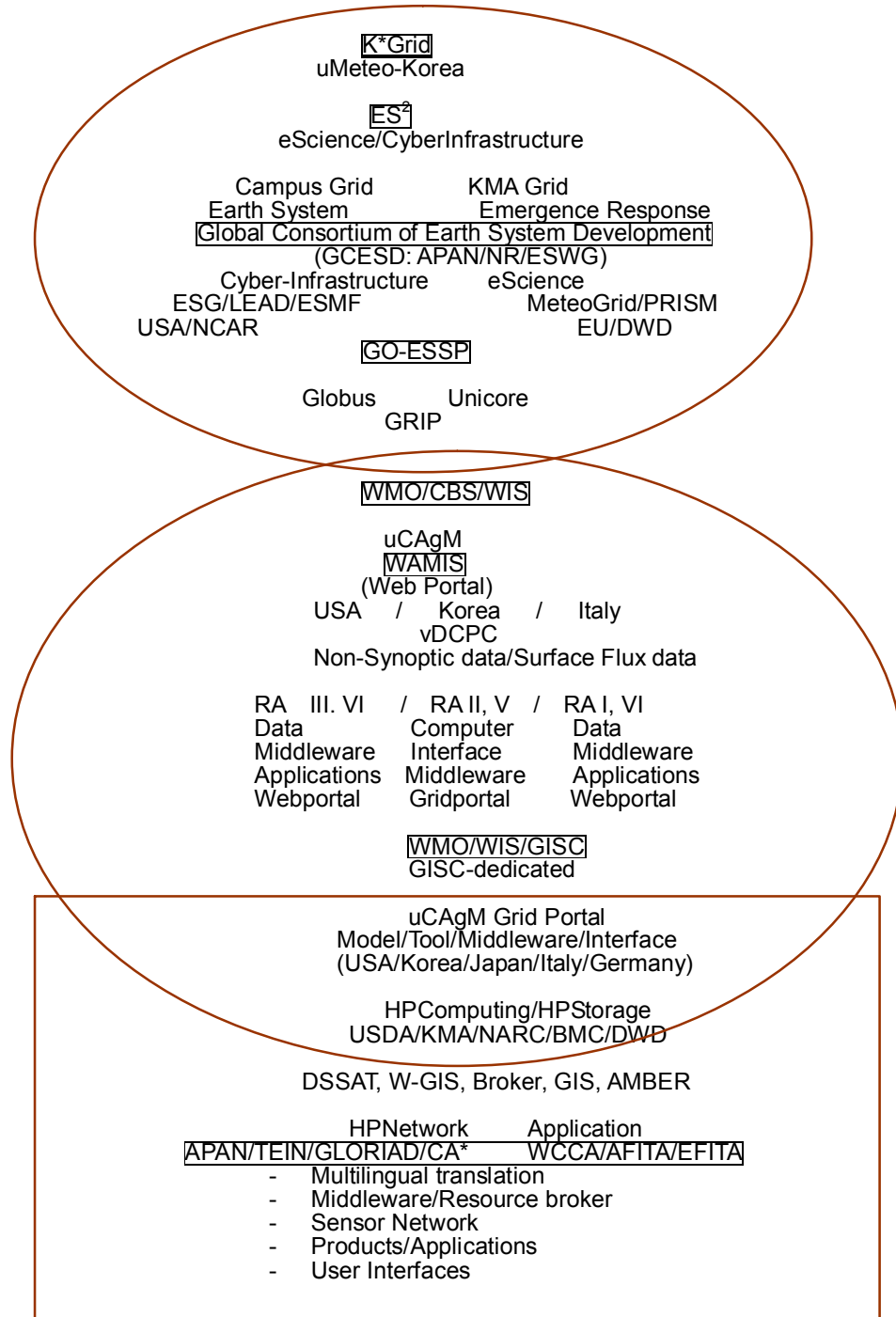-   Products/Applications
-    User Interfaces

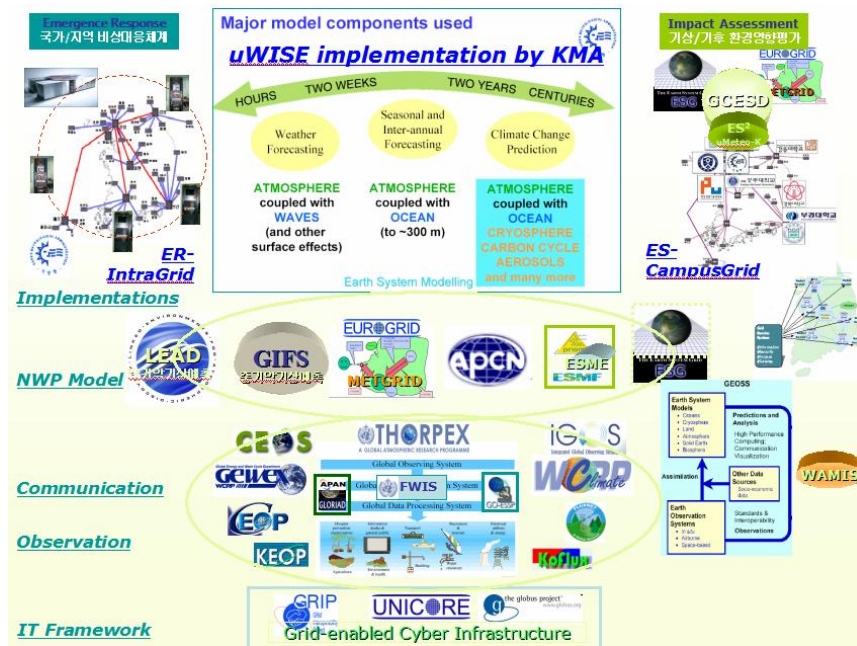Fig. 10.2   Collaboration Scheme for WAMIS Grid Portal

Fig. 10.3   Long-Term Perspectives of Ubiquitous Weather Information System Environment of KMA (uWISE)
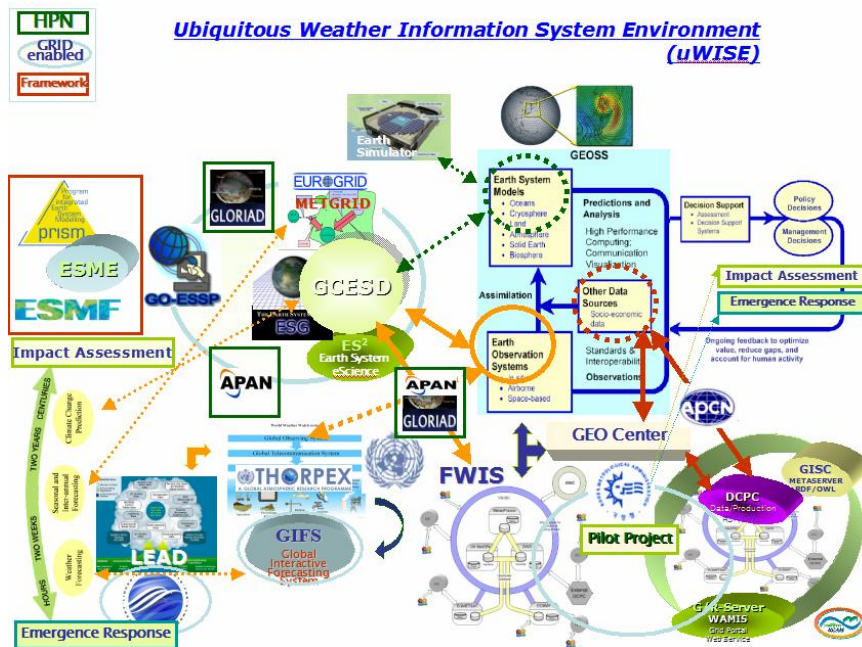

Fig. 10.4   Communication Architecture of WAMIS under uWISE with WIS and GEOSS (Dotted:indirect, Solid:direct communication)
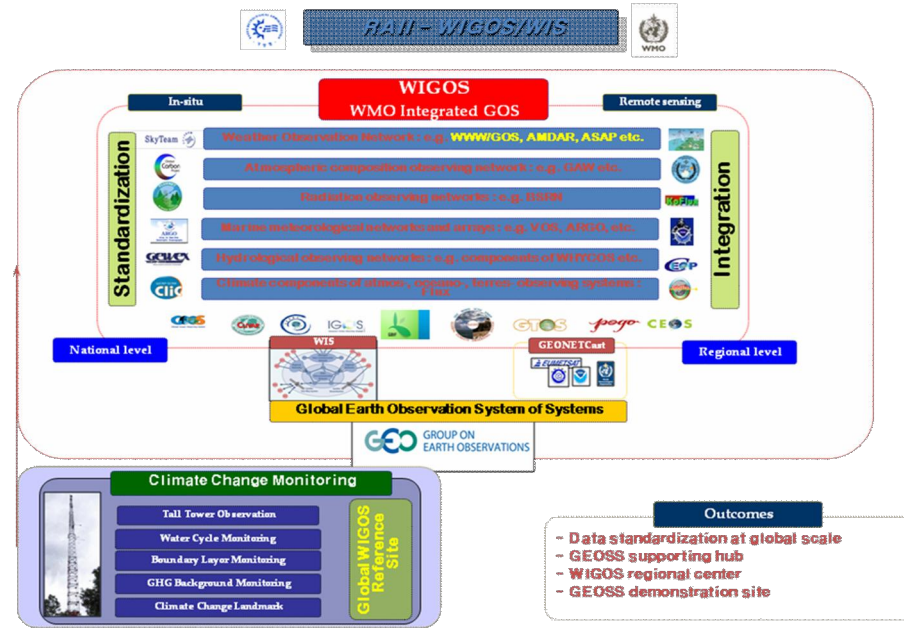
Fig. 10.5   WIGOS as a potential linkage with WAMIS under WIS and GEOSS

Fig. 10.6   Future role of WAMIS as either information provider or user of GEOSS, especially in disaster mitigation & climate change impact assessments

11. List of acronyms

AFITA   Asia Federation of Information Technology in Agriculture

APAN   Asia Pacific Advanced Network
CBS   Commission for Basic Systems
DCPC   Data collection or product centre
DWD   Deutscher Wetterdienst (German Weather Office)
ESG   Earth System Grid
ESMF   Earth System Modelling Framework
ESWG   Earth System Working Group in APAN
FAO   Food and Agriculture Organization
FWIS   Framework for WMO Information System
GEOSS   Global Earth Observation System of Systems
GIFS   Global Interactive Forecasting System
GISC   Global information system centre
GLORIAD   Global Ring Network for Advanced Application Development
GO-ESSP   Global Organization for Earth System Science Portal
GridFTP   Universal data transfer for the Grid
GRIP   Grid Inter-Operability project
IRRI   International Rice Research Institute
KISTI   Korea Institute of Science, Technology and Information
KMA   Korea Meteorological Administration
KOREN   Korea Research Network
LEAD   Linked Environment in Atmospheric Science
LIS   Land Information System
LDM   Unidata's local data manager of IDD
LDAS   Land Data Assimilation Scheme (System)
MAFFIN   Ministry of Agriculture, Forest and Fishery Information Network
NARC   National Agricultural Research Center (Japan
NCAM   National Center for AgroMeteorology
NCAR   National Center for Atmospheric Research
PRAGMA   Pacific Rim of Application, Grid Middleware Association
RA-II   Regional Association II of the WMO (covering mainly Asia)
SOAP   Small Object Access Protocol
TEIN   Trans-Eurasian Information Network
THORPHEX   THe Observing system Research & Predictability EXperiment
USDA   United States Department of Agriculture
uWISE   Ubiquitous Weather Information System Environment in Korea
WAMIS   World Agricultural Meteorology Information Service
WCCA   World Congress of Computers in Agriculture
WMO   World Meteorological Organization
XML   Extensible mark-up language

12. References

energy.owl
AgMet-DB-Hierarchy 0224.xls
Metadata-annex-CAgM.doc