REQUIREMENTS FOR THE

SURFACE BASED OBSERVING SYSTEMS PART OF THE

OBSERVING SYSTEMS CAPABILITIES ANALYSIS AND REVIEW TOOL (OSCAR)

(v0.8 29/1/2013)

1) Introduction

As part of the Rolling Review of Requirements (RRR) process[1], WMO is maintaining a data inventory and tool (referred to as the Observing Systems Capabilities Analysis and Review tool - OSCAR) on user requirements and observing system capabilities. Its primary aim is to determine the extent to which the global observing systems relevant to the WMO Integrated Global Observing System (WIGOS), comprised of the surface- and space-based observing systems, meets user requirements for observations.

OSCAR is addressing two fundamental requirements allowing to maintain and access information on: (i) technology-free user requirements for observation of geophysical variables, for all application areas; and, (ii) Observing Systems Capabilities for global observing systems relevant to WIGOS (both surface-based and space-based).

1.1) Observations User Requirements component of OSCAR (OSCAR/Requirements)

OSCAR/Requirements allows to records technology-free observations user requirements formulated by WMO and co-sponsored programmes: GCOS, GOOS, WCRP. The requirements are regularly reviewed by groups of experts nominated by these organizations and programmes.

For WMO, this process is coordinated by the CBS Inter Programme Expert Team on Observing System Design and Evaluation (IPET-OSDE) and its designated focal points for each of the WMO application areas (including Global NWP, High-resolution NWP, Synoptic meteorology, Nowcasting and Very Short Range Forecasting, Seasonal to Inter-annual Monitoring, Atmospheric chemistry, Aeronautical meteorology, Agricultural meteorology, Hydrology and water resources).

Requirements are expressed for geophysical variables in terms of 5 criteria: horizontal resolution, vertical resolution, observing cycle, timeliness and uncertainty. For each of these criteria the table indicates 3 values determined by experts:

- the “threshold” is the minimum requirement to be met to ensure that data are useful;
- the “goal” is the ideal beyond which further improvements would exceed requirements; and,
- the “breakthrough” is an intermediate level between “threshold” and “goal“ which, if achieved, would result in a significant improvement for the targeted application. The breakthrough level may be considered as an optimum, from a cost-benefit point of view, when planning or designing observing systems.

OSCAR/Requirements is available from the WMO website[2].

1.2) Observing Capabilities

The Observing Capabilities are comprised of the following two components:

1 http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html
2 http://www.wmo.int/oscar

- The Satellite component of OSCAR (OSCAR/Space[3]), which includes the space-based observing system capabilities database, maintained by the WMO Space Programme and available from the WMO website[3]; and,

- The Surface-Based observing systems component of OSCAR (OSCAR/Surface), which will be maintained by the WMO World Weather Watch Programme.

While the development of the Satellite component of OSCAR (OSCAR/Space[3]) of the OSCAR is well advanced and now operational, the OSCAR/Surface component is yet to be specified and implemented.

This document defines the requirements for OSCAR/Surface, including the module(s) that supports (i) the recording of capabilities of surface-based observing stations, and (ii) the Critical Review of the surface-based observing systems capabilities compared to observational user requirements.

2) OSCAR Architecture Within the WIGOS Operational Information Resource (WIR)

OSCAR will be integrated into the web-based WIGOS Operational Information Resource (WIR), which will provide all WIGOS related operational information, including:

- observations user requirements;
- a description of the contributing observing networks (instrument/site/platform metadata), and their capabilities;
- list of standards used in the WIGOS framework;
- data policies applicable;
- information on how to access data; and,
- information on WIGOS impacts and benefits to Members.

The WIR will provide a tool that will utilise OSCAR for conducting critical reviews as part of the RRR process, and assist Members and Regional Associations in conducting observational network design studies. This tool and the resulting studies will provide guidance on how to develop capacities in developing countries according to WIGOS requirements and could also be utilised for national observing network design as required and as appropriate. The information collected, when utilised in the RRR process, is intended in particular to identify the gaps within global, regional or national observational networks, identify areas where existing operational observing systems could be used to fill these gaps, or their scope expanded to most efficiently and optimally address the requirements of application areas. The information provided on standards will support the production of more homogeneous data-sets and assist in ensuring observations are traceable and of known quality.

The WIR will also include information on plans for development and evolution of both observing systems and observational networks, which will provide the ability to determine the structure and capabilities of future, planned global, regional, and national observational networks and the extent to which they will address user requirements.

The WIR is depicted schematically in Figure 1. The OSCAR component of WIR is shown in light green in this figure.

3 http://www.wmo.int/oscar

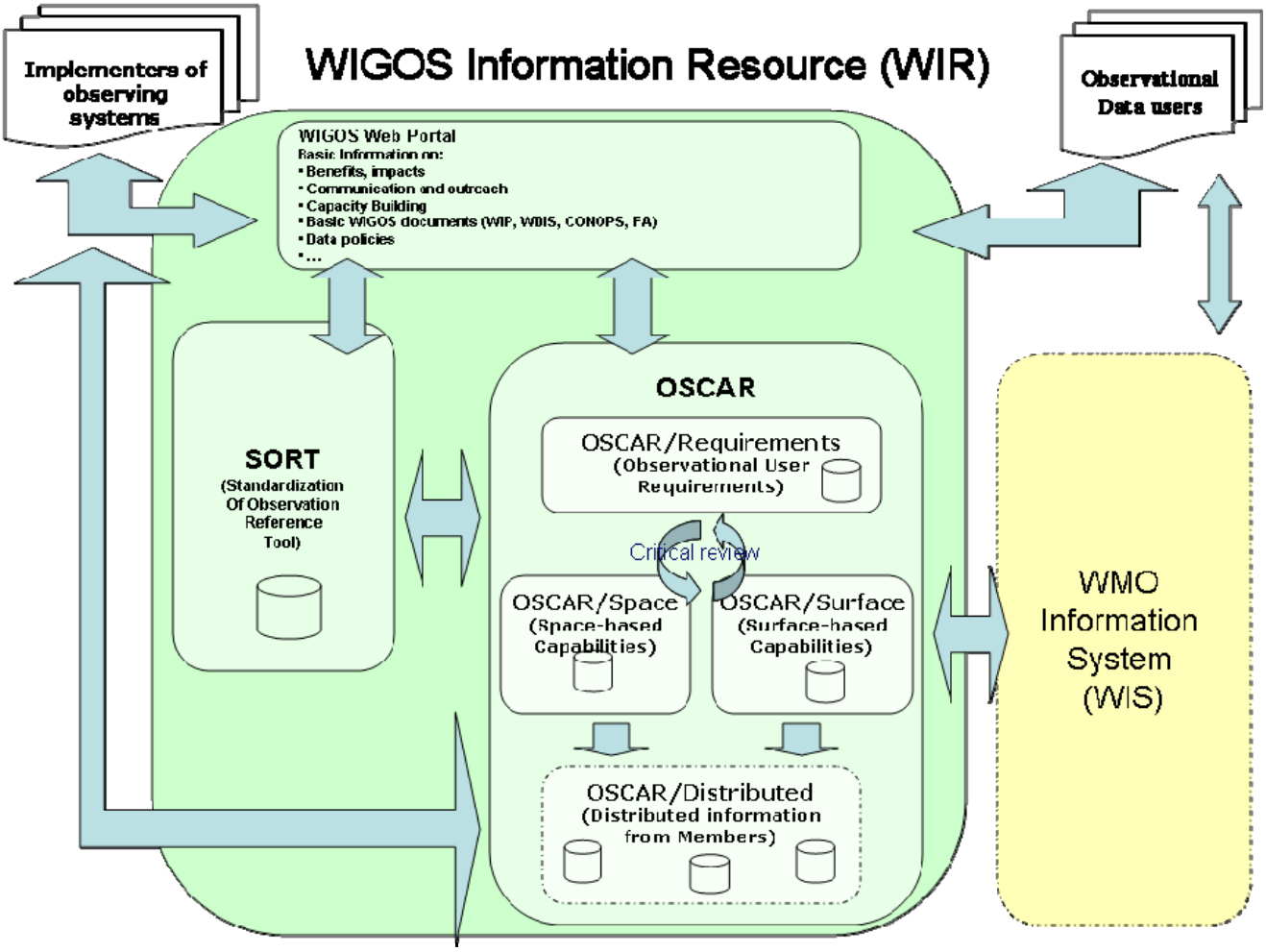


Figure 1: Architecture of the WIGOS Operational Information Resource (WIR) (in green), and its OSCAR component (in light green)

3) Requirements of OSCAR/Surface

There are two fundamental requirements of OSCAR/Surface:

1) To provide for the entry, storage, maintenance and retrieval of all historical, current and future metadata associated with WMO Publication No. 9, Volume A[4], Observing Stations and WMO Catalogue of Radiosondes.
2) To contribute to the process of carrying out the Rolling Review of Requirements for the surface-based systems relevant to WIGOS, which shall include both land-based and ocean-based observing systems capabilities.

OSCAR/Surface shall provide the following primary functions:

- Provide facilities for entry, storage, maintenance and retrieval of:
  - required reference material and metadata on WIGOS historical, current and future surface-based observing systems;
  - required reference material and metadata on WIGOS surface-based observing systems actual performance capabilities;
- By appropriate data and information exchange mechanisms, interface to third party databases that contain information on the status and performances of observing stations

4 http://www.wmo.int/pages/prog/www/ois/volume-a/vola-home.htm

managed by Members and partner organizations contributing to WIGOS (e.g. GAWSIS[5], JCOMMOPS[6]);
- By appropriate data and information exchange mechanisms, provide or provide access to all necessary data and information to the processes and applications that support the RRR process, including the critical review of capabilities of surface-based observing systems.
- Using information from both OSCAR/Requirements and OSCAR/Surface, critical review by comparing the performance of the instruments with the user requirements, and identify gaps in conjunction with the use of other tools such as Observing System Experiments (OSE) and Observing System Simulation Experiments (OSSEs). The critical review is particularly useful for producing the Statements of Guidance (SoGs) for each of the application area which provide for a gap analysis and specific recommendations to address those gaps. SoGs are used in turn to produce and update the Implementation Plan for the Evolution of the global observing system (EGOS-IP).

OSCAR/Surface shall meet the following additional requirements:

- The existing User Requirements Database, and the existing space-based capabilities database shall be integrated within OSCAR into a single physical database based on the same relational model.

In order to meet these fundamental requirements and functions, it is necessary to specify requirements for 4 primary components of OSCAR/Surface.

3.1) OSCAR/Surface Primary Components

OSCAR/Surface shall have the following primary components:

1. A Capabilities Dataholding Facility;
2. A Capabilities Dataholding User Interface to support entry to and update of information to the CD;
3. A Reporting and Statistics Module and User Interface to query the content of OSCAR/Surface.
4. A Critical Review Module and User Interface to support the RRR process.
5. An historical capability management module.

3.2) Requirements of the Capabilities Dataholding Facility

OSCAR/Surface will be part of the WIGOS Operational Information Resource (WIR), provide a linkage between WIS and WIGOS, and facilitate interoperability, standardization and management of metadata in support of WIGOS.

OSCAR/Surface shall contain the fields required to include all information from an evolution[7] ofWMO Publication No. 9, Volume A[8], Observing Stations and WMO Catalogue of Radiosondes and to provide an historical record of it. A subset of this metadata will particularly be used to define the actual surface-based observing systems and networks for the purpose of deriving the observations capabilities on a geographical basis as part of the Critical Review process.

The Observational Capabilities for surface-based observing systems is based on the following systems architecture definition:

- The Surface-based Global Observing System is comprised of a set of systems (observing platform types);
- Systems are comprised of a set of 1 or more platforms;

5 http://gaw.empa.ch/gawsis/
6 http://wo.jcommops.org/cgi-bin/WebObjects/JCOMMOPS
7 The data model of WMO No. 9, Volume A is meant to be updated to reflect the required evolutions in the WIGOS framework
8 http://www.wmo.int/pages/prog/www/ois/volume-a/vola-home.htm

- Platforms are comprised of a set of 1 or more measured variables; and,
- Measured variables are made at 1 or more layers (e.g. surface, low troposphere, high troposphere, etc.) with capabilities recorded at the layer level.

- Capabilities can be defined as specific to individual measured variables for measurements made at a specific layer (e.g. a weather radar has a coverage that is individually site, sensor, and layer specific);
- Capabilities can be defined as generic to sets of measured veraibles (e.g. all AWS using a particular sensor/instrument will have generic capabilities for the variable measured);
- Capabilities can be defined as generic to sets of platforms, e.g. only AMDAR Aircraft platforms that have a humidity sensor will be capable of measuring humidity with the same capabilities;
- Capabilities can be defined as generic to a complete set of platforms (systems), e.g. all AMDAR Aircraft platforms will be capable of measuring air temperature with the same capabilities.

OSCAR/Surface shall contain the fields necessary to define the capabilities for each system, for each variable measured by its sensors/instruments at the applicable layer (i.e. horizontal resolution, vertical resolution, observing cycle, timeliness, uncertainty, and stability), with the following functionality.

OSCAR/Surface shall facilitate the definition of predefined geographical regions of the globe (i.e. polygon shapes, e.g. defining regions, countries, radar footprint, climatologically significant areas), based on the highest required resolution (Base Resolution), e.g. 1º x 1º, so that Observational Capabilities for variables can be determined on a geographical basis for those regions, based on the integrated capability of individual systems and networks and facilitate all the requirements of the Critical Review Module and User Interface.

OSCAR/Surface shall facilitate the management of Observational Capabilities of variables at the Base Resolution for the following system platform sensing types:

Platform location (Fixed/Mobile platform)	***Type of measurement (in situ / Remotely sensed measurements)***	***Type of measurement (Surface / Profile measurements)***	***Examples of station type***	***Things to consider for recording and computing the capabilities***
Stationary	*in situ*	Surface	*AWSs*	*Capability at a point*
Stationary	Remotely sensed	Surface	Surface radars	Capability within the applicable region
Mobile	*in situ*	Surface	*Drifting buoys, ships, trucks*	*Representative snapshot of a network* *Capability at a point*
Mobile	Remotely sensed	Surface	n/a	n/a
Stationary	*in situ*	Profiling	*Radio-sondes*	*Capability at a point for each relevant layer*
Stationary	Remotely sensed	Profiling	*Wind profiler radars*	Capability within the applicable region for each relevant layer
Mobile	*in situ*	Profiling	*AMDAR, Argo floats,*	*Representative*

			gliders	*snapshot of a network; Capability at a point for each relevant layer*
Mobile	Remotely sensed	Profiling	n/a	n/a

Table1: Things to consider for recording and computing the capabilities depending on the platform characteristics and sensing types.

Each of these platform sensing types and the systems to which they belong requires specific methodologies to enable a process for deriving the Observational Capabilities from the metadata or, in some cases, data output (Table 1). In particular, in the case of Mobile platforms, the horizontal and vertical resolutions will necessarily be derived from "snapshots" of the network configurations at a particular instant in time that takes into account not only the number of platforms but also their location at that time. This will require access to a reliable source of platform positional information or metadata.

To support the definition of Observational Capabilities of systems that are not definable as a single-point in the horizontal and/or vertical (via layers), such as wind profiler radars, it will be necessary to allow the specification of capabilities with reference to pre-defined geographic regions, e.g. a circle with its coordinates (latitude, longitude, and radius), a polygon or set of polygons. A polygon will be a series of 3 or more ordered points that together form a polygon in horizontal geographical space [(lat1, lon1), (lat2, lon2), (lat3, lon3),….(latN,lonN]. In the database, the mechanism for defining polygons for capabilities can also be used to define geographical regions for the determination of integrated Observational Capabilities.

Proposed Architectural Solution

OSCAR/Surface shall use observational user requirements from OSCAR/Requirements in order to be able to perform the critical review by comparing the capabilities with the requirements.

The tentative embryo relational model proposed for OSCAR/Surface is provided in Appendix I, as well as the description of the required tables. The model proposed is a simplification of what will be required, and it is understood that the actual relational model may be adjusted (e.g. new or changed tables, fields, relationships, etc.) and become more complex as part of the database, once developed. In particular, the management of the history of the capabilities (for both the generic capabilities, i.e. by pre-defined geographic region, and the platform capabilities and status) is not specified and will be required to be specified later.

The generic capabilities (typically for pre-defined geographic regions, and layers[9]) for a component observing system (platform type, see Appendix III) and a variable are derived automatically from the capabilities of individual observing stations as explained below. Additional guidance is also provided in Appendix IV in this regard.

- For a pre-defined geographic region, a layer, and a variable, the capabilities are computed automatically according to the following. A selection of relevant platforms measured variable capabilities for the considered layer is made according to the following criteriae: (i) stations located in the considered pre-defined geographic region of Region_area km^2, (ii) stations of the considered platform type, (iii) stations declared operational in the database (operational status = OPER), (iv) station measured variable, with the sensor/instrument marked as functioning (operational status = OPER), and (iv) station measured variable capabilities for the considered layer.

9 For upper air and surface-based remotely-sensed systems, we will need to include the layers: LT, HT and LS. See Appendix IV for details.

- The total number of platforms (*n*) corresponds to the number of unique virtual observing platforms returned by the query, and computed as following.

  a. For platforms making measurements at a point (e.g. AWS, AMDAR), the number of virtual observing platforms is the number of actual observing platform of that type returned by the query.
  b. For platforms making measurements within an applicable area (e.g. a surface radar), the number of virtual observing platforms corresponds to the sum of virtual observing platforms equivalent to each of the actual selected platforms of that type. For one actual platform of that type, the number of virtual observing platforms corresponds to the total area (km^2) of the applicable area of the actual station (e.g. the radar circle, or the region where the radar is said to report useful observations) intersected with the pre-selected region of interest (as defined by the query) divided by the square of the typical horizontal resolution (km) of the product (grid) of the considered platform measured variable layer.
  c. The number of virtual platforms of type (a) and (b) above shall be added to obtain the total number of virtual platforms *(n).*

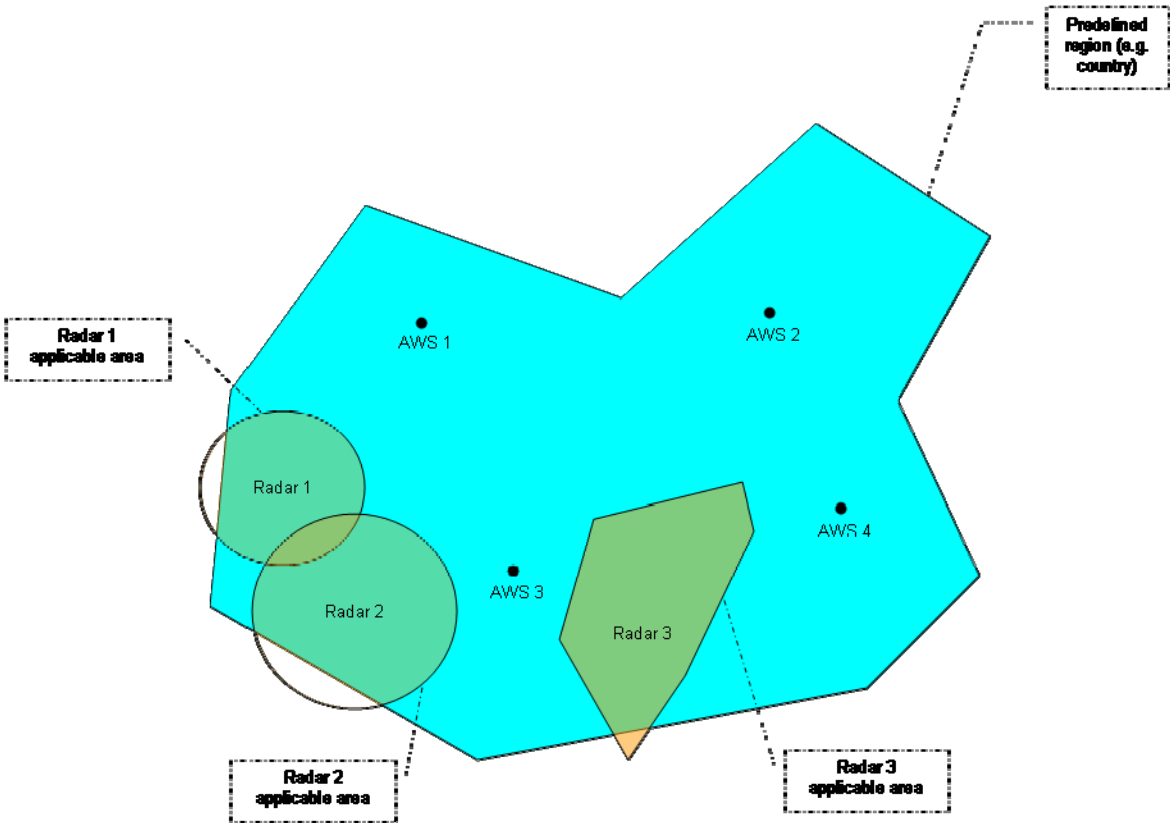


Figure 2: Example of applicable areas, and predefined regions. In this example, assuming Radars 1, 2, and 3 provide measurements for the considered variable at an horizontal resolution of 2km (i.e. typical product grid) if the applicable areas of Radar 1, 2, and 3 intersected with the predefined region are respectively 100 km^2, 200 km^2, and 120 km^2, then their total number of virtual platforms in that region would be 25, 50, and 30 respectively. Assuming the 4 AWS also provide the measurements for the same considered variable, the total number of virtual platforms would therefore be 105 (radars) + 4 (AWS) = 109.

- Horizontal resolution shall be deduced for the pre-defined geographic region by computing the square root of the total area (km2) of the region divided by the number of

virtual observing platforms meeting the selection criteriae within the region. Horizontal resolution (km) = $\sqrt{\frac{\mathrm{Re}\,gion\_area}{n}}$

- Vertical Resolution (m): A sub-selection is made for measured variables making profiles observations only (field profile = true). Vertical resolution is computed as the average vertical resolution of all returned measured variables weighted by their number of observations per minute (i.e. 1 / OC), i.e. Vertical Resolution = $\frac{\sum_{i=1}^{r}\left(n_i \times Vertical\_resolution_i / OC_i\right)}{\sum_{i=1}^{r} n_i / OC_i}$.

Where n_i is the number of virtual observing platforms for each actual platform, and OC_i is the observing cycle of the actual platforms returned by the query.

- Observing cycle (min) = inverse of the average number of observations per minute of all returned measured variables = $\frac{n}{\sum_{i=1}^{r} \frac{n_i}{OC_i}}$

- Timeliness = average of the timeliness of al returned virtual measured variables weighted by their number of observation per minute = $\frac{\sum_{i=1}^{r} n_i \times Timeliness_i / OC_i}{\sum_{i=1}^{r} n_i / OC_i}$

- Uncertainty = average of the uncertainty of all returned measured variables weighted by their number of observation per minute = $\frac{\sum_{i=1}^{r} n_i \times Uncert_i / OC_i}{\sum_{i=1}^{r} n_i / OC_i}$

- Stability = average of the stability of all returned measured variables weighted by their number of observation per minute = $\frac{\sum_{i=1}^{r} n_i \times Stability_i / OC_i}{\sum_{i=1}^{r} n_i / OC_i}$

3.3) Requirements of the Capabilities Dataholding User Interface

The database shall be organized in such a way to permit authorized focal points to enter information directly in the database through password protected access. Information is entered for individual platforms. Focal points could be national, or represent specific programmes in charge of specific types of observing platforms.

Online editing

Online editing of OSCAR/Surface content shall be possible for authorized users.

Authorized users will be amongst the following:

- o National focal points nominated by their Permanent Representatives; access shall be restricted only to the platforms operated by the WMO Member of the focal point.
- o Nominated focal points for a particular programme; access shall be restricted only to the platform operated in the framework of the programme which the nominated person is responsible for.
- o Nominated focal points for specific platform types (see Appendix III); access shall be restricted only the specific platform types for which the nominated person is responsible.
- o Responsible person in the WMO Secretariat with full access to OSCAR/Surface.

Capabilities shall be entered in OSCAR/Surface by observing platform with their corresponding capabilities and metadata. In addition, all information from WMO No. 9, Volume A shall also be integrated in OSCAR/Surface with the description of each relevant platform. For mobile platforms, the last operational position at the time of reporting shall be given.

Editing shall be made possible in the following ways:

- o Query OSCAR/Surface and edit specific records
- o Add new records in OSCAR/Surface
- o Delete records from OSCAR/Surface
- o The authorized focal points shall also have the opportunity to make a bulk upload for a number of records in OSCAR/Surface using and semi-column delimited ASCII file.

Editing shall be possible for each individual platform, their sensors/instruments (measured variables), capabilities, and applicable areas (poly-shapes).

The editor shall be given the option to copy all characteristics of one platform and its measured variables (except identification fields, and location) into a newly created platform. Another option shall allow to copy all characteristics of one measured variable (except identification fields) into a newly created measured variable.

Bulk upload

There shall also be the possibility to allow a bulk upload of platform characteristics and capabilities into OSCAR/Surface. The format of the ASCII files to be used will be discussed at some later stage, once the developments have actually started.

Frequency of updates

In principle the content of database shall be updated on a semestrial basis by the users of the database authorized to manage content. That's particularly the case for the bulk updates. However, it will be possible to update the database more frequently (e.g. monthly) or whenever the status of a particular station is changed (through online editing).

Avoiding duplication

Mechanisms shall be put in place to avoid duplicate information to be entered in the database (e.g. a platform to be listed twice in the database. This shall be done by prioritizing things:

- Platform focal points can create/edit/delete any platform of the type they are responsible of;
- Programme focal points can create/edit/delete any platform of the type they are responsible of, except those platform types which have a focal point. When creating a platform the focal point shall be asked to indicate the platform type; if it is a platform type with a focal point, the creation shall be rejected, and the programme focal point invited to contact the platform type focal point.

- National focal point can create/edit/delete any platform of their country, except those platforms belonging to a programme which has a focal point, or those platform types which have a focal point. When creating a platform the focal point shall be asked to indicate the programme and platform type; if there is a programme or platform type focal point, the creation shall be rejected, and the national focal point invited to contact the programme or platform type focal point as appropriate.

This implies that the platform types, programmes to which a platform belongs, and countries owning/operating the platforms shall be mandatory information to fill in.

Automatic updates

Initially, the information from WMO No. 9, Volume A shall be migrated to OSCAR/Surface. Then, based on the information on the capabilities of individual platforms, the generic capabilities (in pre-defined geographic region) shall be automatically computed on a semestrial basis based on algorithms described in section 3.2 above.

3.4) Requirements of the Reporting and Statistics Module and User Interface

It shall be possible to query the content of OSCAR/Surface to obtain the following information:

List of observing stations in the world, a Regional Association, a country, or predefined region. Optionally, the list could also be limited to a programme (i.e. stations belonging to a particular WMO programme or network), an application area (i.e. stations contributing to a particular application area), or to stations making specific measurements (1D, 2D, by variable) and conforming to specific criterias (observing cycle, timeliness, uncertainty of measurements, vertical resolution).

Maps of observing stations meeting specific criterias. Similar criterias could be used as for selecting lists of stations above. The maps could also be interactive in order to select a region of interest (e.g. a Lat/Lon box, pre-defined geographic region, country, or Regional Association).

Statistics on the number of stations meeting specific criterias. Similar criterias could be used as for selecting lists of stations above.

Summary reports for the world, Regional Associations, countries, predefined-regions. The statistics could also be provided in a summary form for the world, a Regional Association, a country, or predefined-region:

- Total number of stations
- Total number of stations belonging to particular networks
- Total number of stations contributing to particular application areas
- And in each of the categories above, providing the number of stations making specific measurements
- For each scale (world, Regional Association, Country, predefined-region), the report should include the global statistics, and all the statistics for the level below (i.e. word statistics plus statistics of all Regional Associations; or Regional Association statistics plus statistics of all the countries in that Regional Association; or a country statistics plus statistics of all predefined-regions in that country; or predefine-region statistics only).

3.5) Requirements of the RRR Critical Review Module and User Interface

The critical review consists of comparing the capabilities of both the surface-based and space-based observing systems with the observations user requirements. The final objective is to provide a first-level analysis that is system-agnostic, i.e. a specific requirement for an observation is directly compared with capabilities of both space and surface based systems.

As the critical review process is quite different in the space and surface segment, in a first version of OSCAR the critical reviews will be made available individually within the surface and space modules respectively.

For this, OSCAR/Surface needs to be interoperable with OSCAR/Requirements, where all requirements as well as variables and related information are described. The critical review for OSCAR/Surface shall be performed according to the following options:

Maps for a given application area, domain, layer, variable, and capability:

For a given application area, and selected domain(s) (all domains if not specified), layer(s) (all layers if not specified), variables (all variables if not specified), and capability, the query shall return for each variable, domain, and layer (i.e. as many maps as there are selected variables, domains, and layers), a map displaying the platform measured variables capabilities (i.e. either horizontal resolution, vertical resolution, observing cycle, timelines, or uncertainty depending on the selection) in each pre-defined geographic region on the map.

Color codes shall be used to indicate whether the obtained capabilities comply with the threshold, optimal, or goal values of the OSCAR/Requirements for the considered application area, domain, layer, variable, and capability:

Value range	***Color***	***Comment***
Value > Threshold	White	No impact
Optimum < Value ≤ Threshold	Blue	Significant impact
Goal < Value ≤ Optimum :	Green	Optimal
Value ≤ Goal :	Red	Oversampled
No requirements value	Gray	n/a

Appropriate computation shall be made in order to deduce the capabilities in each pre-defined geographic region.

An example of map is provided in Appendix II (using 5° x 5° boxes as pre-defined regions although in reality poly-shapes will be used for the predefined regions).

Table(s) for a given region and application area

For a given region (Lat/Lon box, pre-defined geographic region, country, or Regional Association), and selected application area(s), domain(s) (all domains if not specified), layer(s) (all layers if not specified), and variables (all variables if not specified), the query shall return for each application area (i.e. as many tables as there are selected application areas), a table listing the results. For each row the table shall provide the following information for the capabilities:

- For each selected region and variable:
  - Horizontal resolution (km)
  - Vertical resolution (km)
  - Observing Cycle (min)
  - Timelines (min)
  - Uncertainty (variable units)

Same color codes as above shall be used to indicate whether the obtained capabilities comply with the threshold, optimal, or goal values of the OSCAR/Requirements for the considered application area, domain, layer, variable, and capability.

An example of required output is given below:

Capabilities compared to requirements for Global NWP in <region>							
Domain	***Variable***	***Layer***	***HR***	***VR***	***OC***	***Timeliness***	***Uncertainty***
Atmosphere	Air pressure (at surface)	Surface	400km	n/a	70min	25min	0.4hPa
Atmosphere	Air temperature (at surface)	Surface	240km	n/a	3h	25min	2.5K
Atmosphere	Air pressure (at surface)	Over sea	1200 km	n/a	70min	25min	0.4hPa

Appropriate computation shall be made in order to deduce the capabilities in each region.

Table(s) for a given region and variable

For a given region (Lat/Lon box, pre-defined geographic region, country, or Regional Association), and selected variable(s) (all variables if not specified), application areas (all application areas if not specified), domain(s) (all domains if not specified), and layer(s) (all layers if not specified), the query shall return for each variable (i.e. as many tables as there are selected variables) a table listing the results. For each row, the table shall provide the following information for the capabilities:

- For each selected region and variable:
  - Horizontal resolution (km)
  - Vertical resolution (km)
  - Observing Cycle (min)
  - Timelines (min)
  - Uncertainty (variable units)

Same color codes as above shall be used to indicate whether the obtained capabilities comply with the threshold, optimal, or goal values of the OSCAR/Requirements for the considered application area, domain, layer, variable, and capability.

An example of required output is given below:

Capabilities compared to requirements for Air Temperature (at surface) in <region>							
Domain	***Application Area***	***Layer***	***HR***	***VR***	***OC***	***Timeliness***	***Uncertainty***
Atmosphere	Global NWP	Surface	240km	n/a	3h	25min	2.5K
Atmosphere	High Resolution NWP	Surface	240km	n/a	3h	25min	2.5K

Appropriate computation shall be made in order to deduce the capabilities in each region.

3.6) Historical capability management module

OSCAR/Surface shall allow the management of historical capabilities. This includes both (i) the generic capabilities (i.e. by pre-defined geographic region), and (ii) platform capabilities. This will done by adding a field “Reference_date” in the relevant table(s) (e.g. Platforms), initiated with the record creation date, and (i) automatically copying all records (i.e. all platforms, which have their

operational status not set to “dead”, and all surface capabilities) from those tables and associated tables on 1 January of each year to new records, and set this field to 1 January for the new record. That way, we would keep a year by year record of the capabilities.

The requirements described in the above sections for querying the database, obtaining statistics and reports, and managing content of the database shall be performed for a given year (current year by default, i.e. with Reference_date between 1 January and 31 December of the current year).

In addition, the following additional tools shall be provided to monitor the evolution of the capabilities.

1. **The requirements described in sections 3.1 to 3.5 above shall be addressed for any given year.**

2. **Evolution of the observing networks**

It shall be possible to monitor the evolution of the observing networks meeting specific criterias. Similar criterias could be used as for selecting lists of stations as described in section 3.4 above. The statistics could also be provided in a summary form for the world, a Regional Association, a country.

- Evolution of the total number of stations
- Evolution of the total number of stations belonging to particular networks
- Evolution of the total number of stations contributing to particular application areas
- And in each of the categories above, providing the number of stations making specific measurements

3. **Evolution of how the requirements are met (evolution of gaps per critical review)**

For a given region (Lat/Lon box, pre-defined geographic region, country, or a Regional Association), selected variable, application area, domain, and layer, the query shall return a table listing the results, year by year. For each row (a year), the table shall provide the capabilities:

Same color codes as above shall be used to indicate whether the obtained capabilities comply with the threshold, optimal, or goal values of OSCAR/Requirements for the considered application area, domain, layer, variable, and capability.

An example of required output is given below:

Capabilities compared to requirements for Air Temperature (at surface) in <region>, <Application Area>, <Domain>, and <Layer>					
Year	***HR***	***VR***	***OC***	***Timeliness***	***Uncertainty***
2011	240km	n/a	3h	25min	2.5K
2012	240km	n/a	3h	25min	2.5K

Appropriate computation shall be made in order to deduce the capabilities in each region.

3.7) Additional requirements

OSCAR/Surface needs to comply with the following additional requirements:

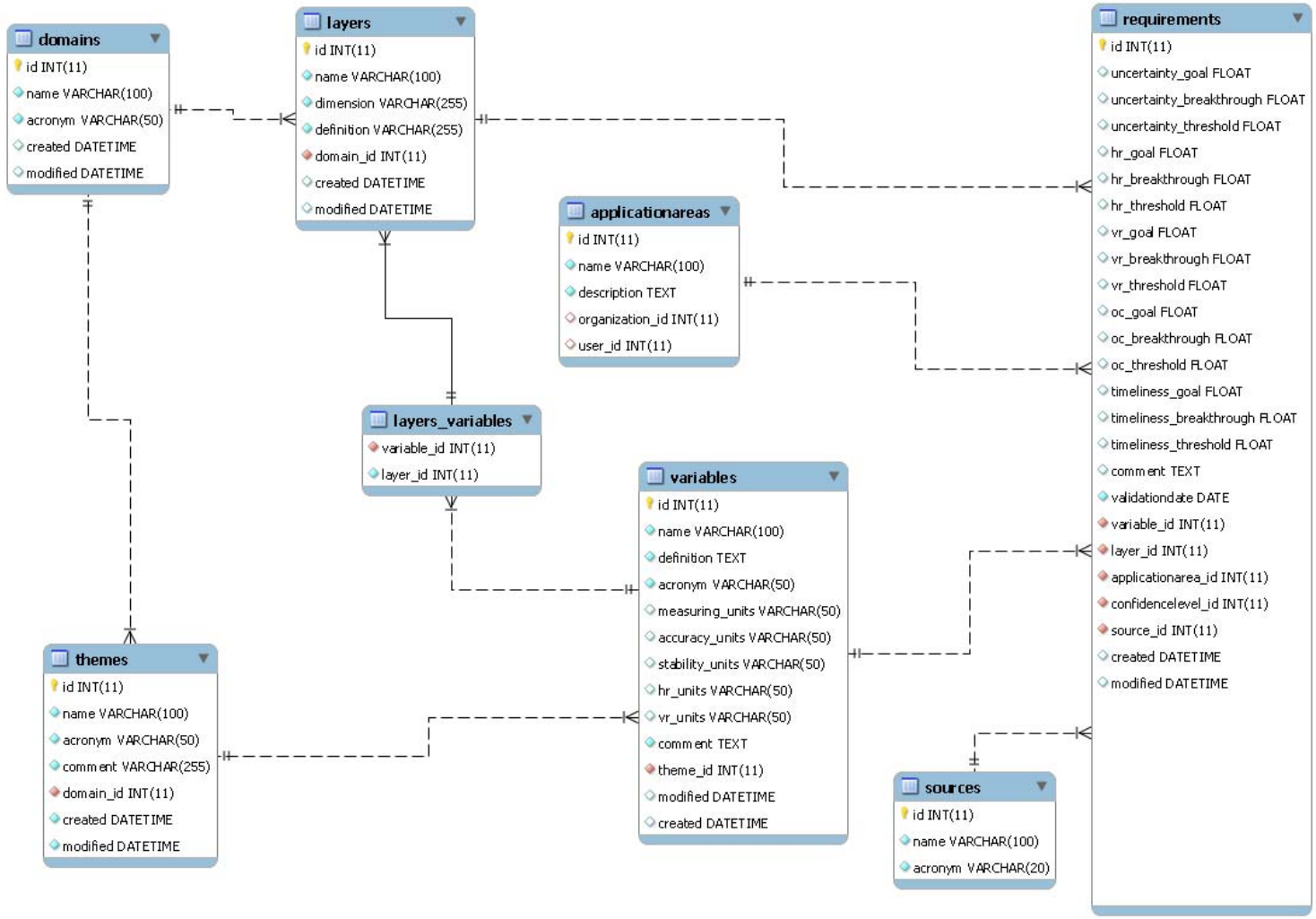
1) OSCAR/Surface must be fully integrated with the User Requirements database, and the OSCAR/Space[3] tool.
2) OSCAR/Surface is developed using open source software tools (PHP, MySQL) to avoid any lock-in effects and/or licensing issues, to facilitate easy migration and further development.
3) Development is based on a modular structure, which supports an evolutionary step-by step approach, allowing a standalone version of the requirements part before developing and populating the capabilities part or adding new functionality
4) OSCAR/Surface is fully available on-line via the web and users can query information from it based on standard query forms, and perform a critical review of how surface-based observing systems address the user requirements. Corresponding web pages shall be displayed as WMO pages with appropriate logo (and possibly using a "wmo.int" URL) to make it clear that this is a WMO application.
5) OSCAR/Surface includes a central user management, including specific access rights for different user groups, recognizing the different roles of agencies committed to maintain the different parts of it.
6) Each part of OSCAR/Surface provides tools for managing content, i.e. (i) on-line - password protected interfaces are available which permit designated experts to edit OSCAR/Surface and make small changes as required, and (ii) import tools to permit substantial changes.
7) OSCAR/Surface is available 24h every day. Staff must be available to monitor OSCAR/Surface to make sure it is properly running and available to outside users. Contact point shall also be available to report on possible problems, and provide assistance as needed. This includes correction of bugs, software/hardware upgrades as needed.
8) OSCAR/Surface documentation is available on-line including rationale, technical specifications, description of OSCAR/Surface, user manual, and description of quality control procedures and processes.

Detailed specifications and the relational model are provided in Appendix I.

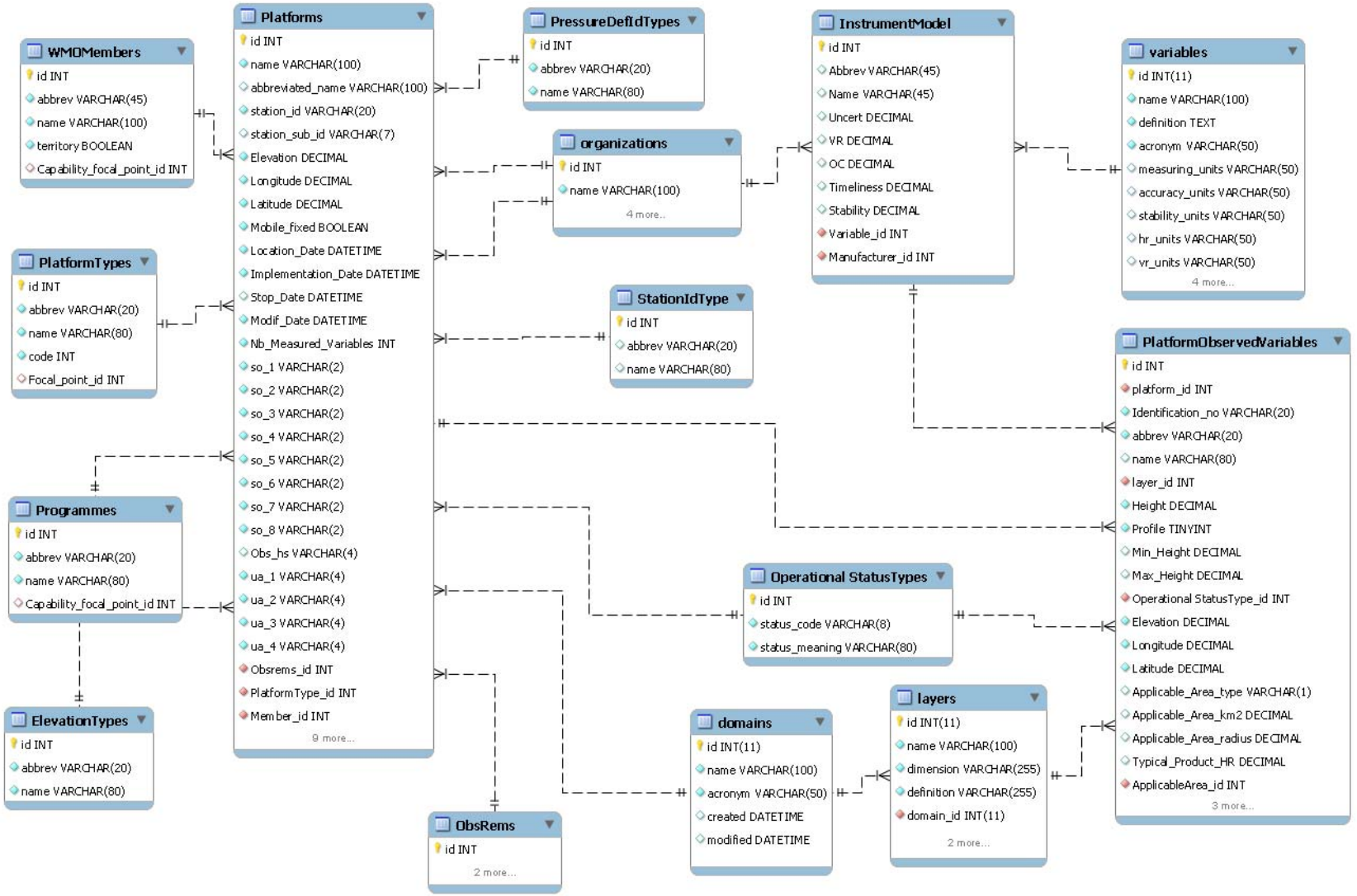
APPENDIX I
RELATIONAL MODEL OF OSCAR/SURFACE

Note: This is only a tentative and embryo relational model for OSCAR/Surface relational model, which will have to be adjusted according to actual requirements when developing the database.

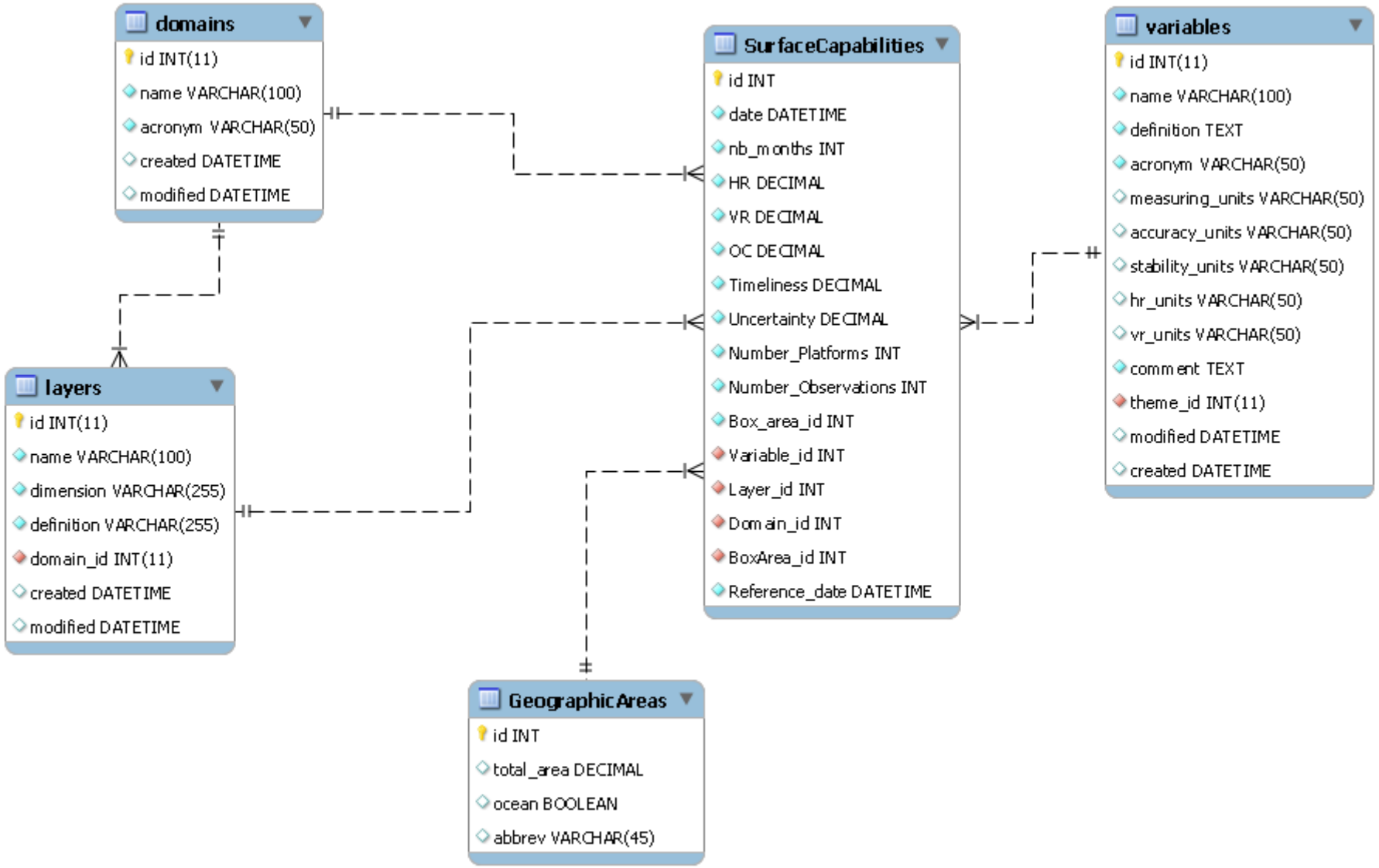
1) Relational model (entity-relationship diagram) – Requirements



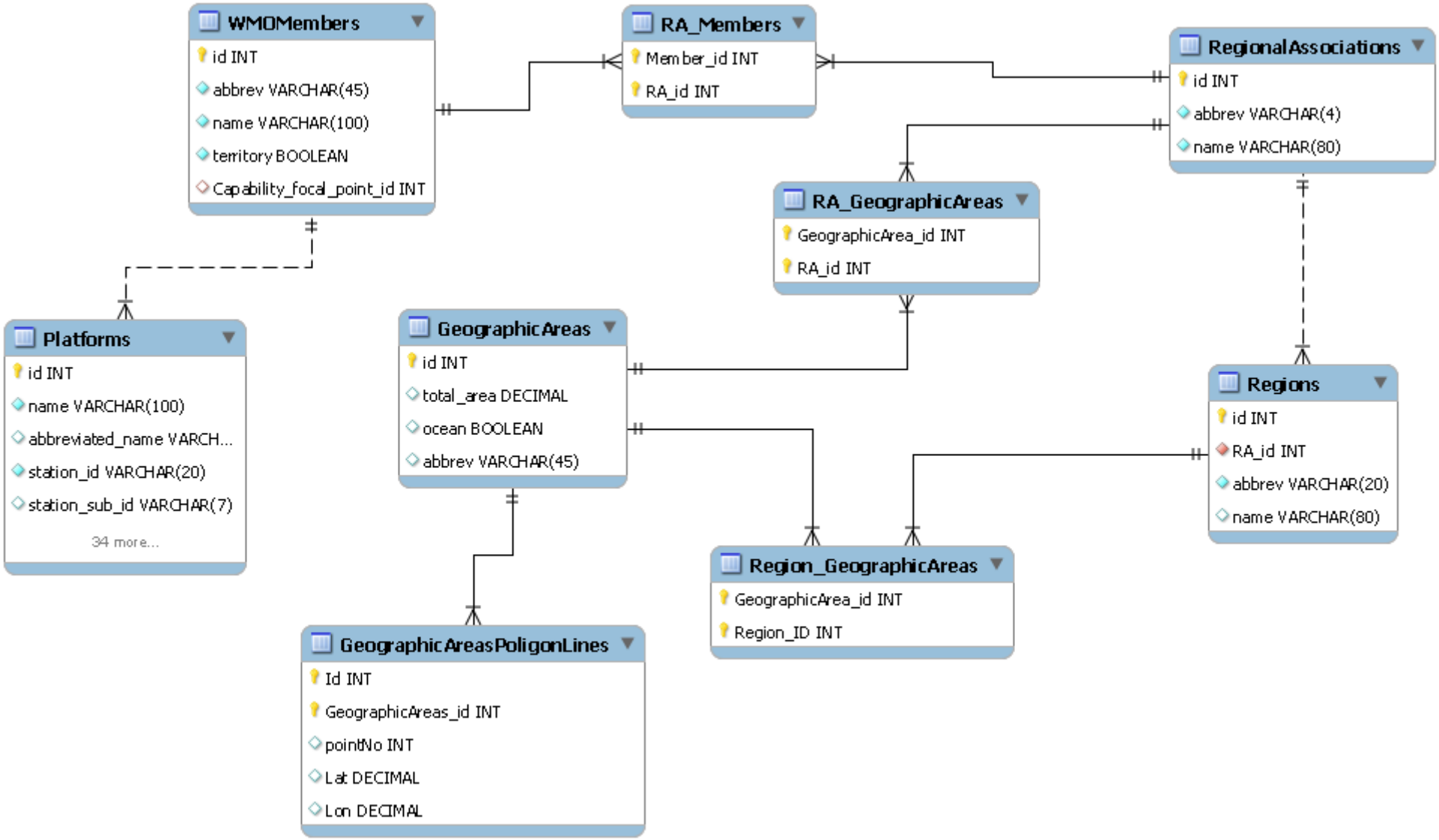
2) Relational model (entity-relationship diagram) - Platforms



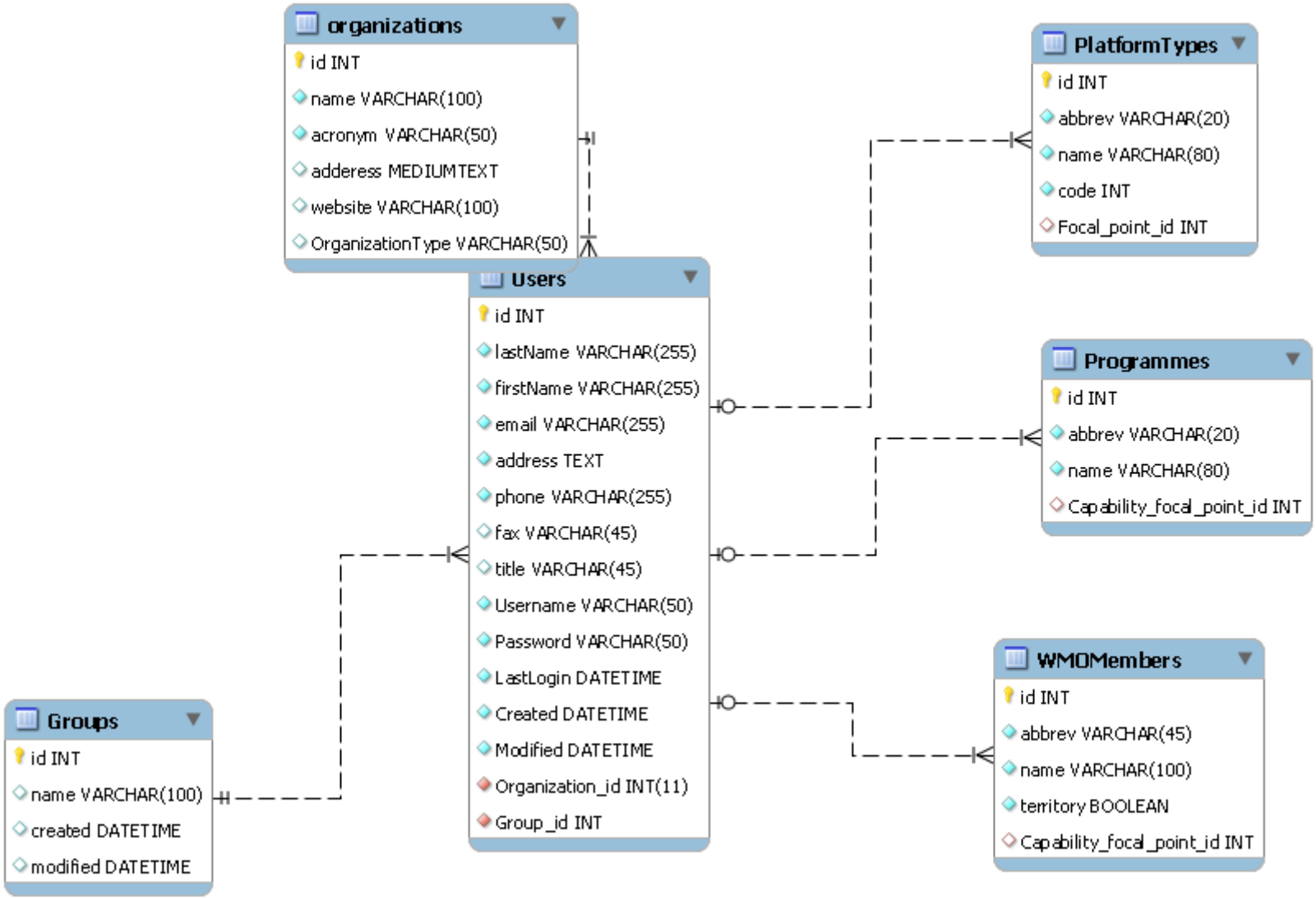
3) Relational model (entity-relationship diagram) - Capabilities



4) Relational model (entity-relationship diagram) – Geographic information



5) Relational model (entity-relationship diagram) - Users



6) List of database tables

Note: Tables are listed below in alphabetic order. Only the tables required for OSCAR/Surface are listed (i.e. other tables of the satellite capabilities database, and the user requirements database may not appear in the list).

Table name	***Description***	***Exists In UR DB[10]***	***Display & Edition[11]***	***Record owner***	***Access rights P-O-Adm[12]***
ApplicationAreas	WMO Application areas.	Y	List	Admin	r-r-w
GeographicAreas	Definition of geographic areas (polygons)	N	Panel	Admin	r-r-w
GeographicAreasPolygonLines	List of polygon lines defining a geographic area	N	GIS	Admin	r-r-w
Domains	Applicable domains (i.e. Atmosphere, Ocean, Terrestrial, or Space). Note:	Y	List	Admin	r-r-w
ElevationTypes	Station elevation types (see WMO No. 9, Vol. A) – possible values: Elev; Elev-approximate; H; HA; H-approximate; and HA-approximate	N	List	Admin	r-r-w
Groups	Database user groups	Y	List	Admin	r-r-w
InstrumentModel	Manufacturer's model of instrument	N	Panel	Admin	r-r-w
Layers	Spatial domains.	Y	List	Admin	r-r-w
Layers_Variables	Variables that can be measured in each layer.	Y	List	Admin	r-r-w
ObsRems	Information on additional observations made at the station, special types of stations, and additional information relating to other fields in the data file is shown here (Code Table A of WMO No. 9, Vol. A - Observations and Remarks)	N	List	Admin	r-r-w
OperationalStatusTypes	Types of Operational Status for a Platform or measured variable	N	List	Admin	r-r-w
Organizations	International Organizations	Y	List	Admin	r-r-w
Platforms	Table describing individual platforms	N	Panel(s)	CFP[13]	r-w-w
PlatformMeasuredVariables	Measured variables of an observing platform (or of a set of consistent platforms)	N	Panel(s)	CFP[13]	r-w-w
PlatformTypes	Types of surface-based platforms. See Appendix III for the list of platform types.	N	List, Panel	Admin	r-r-w

10 Indicates whether the table already exists in the User Requirements Database
11 Type of screen used for editing or displaying content: List (list of records in the form of a table), Panel (box or panel), Panel(s) (one or more panels), Map (map, clickable for the edition)
12 Access rights are indicated in the following order: Public, record Owner or authorized Focal Point(s), Administrator(s). For each actor, rights a granted for R (read), Write/Create/Delete (w), or are not granted / forbidden (f)
13 Capability Focal Point, i.e. the contact associated by order of priority to the (1) platform type (provided field Coordinated_Management of table PlatformTypes is set to true), (2) programme of the platform (provided field Coordinated_Management of table Programmes is set to true), or (3) WMO Member (national contact)

Table name	***Description***	***Exists In UR DB[10]***	***Display & Edition[11]***	***Record owner***	***Access rights P-O-Adm[12]***
PressureDefIdTypes	Information reported in lieu of group 4PPPP for stations which do not indicate air pressure reduced to mean sea level in their synoptic reports (group 4PPPP) (See corresponding field in WMO No. 9, Vol. A for possible values of this field)	N	List	Admin	r-r-w
Programmes	Observation Programme (for the purpose of collecting information for the surface-based capabilities, or metadata, e.g. AMDAR, SBRSO, DBCP, SOT, …)	N	List	Admin	r-r-w
RA_GeographicAreas	List of geographic areas describing a WMO Regional Association	N	Map	Admin	r-r-w
RA_Members	Table linking WMO Regional Associations and WMO Members (i.e. to record the list of Members in each Regional Association, see WMO website at http://www.wmo.int/pages/members/index_en.html)	N	Map	Admin	r-r-w
RegionalAssociations	WMO Regional Associations	N	List	Admin	r-r-w
Regions	Sub-Regions of WMO Regional Associations	N	List	Admin	r-r-w
Region_GeographicAreas	List of geographic areas describing a Region	N	List (for a region)	Admin	r-r-w
Requirements	User requirements for an application area, layer, and variable.	Y	Panel	RFP[14]	r-w-w
Sources	Sources of information for the database content.	Y	List	Admin	r-r-w
StationIDType	Type of station identification number	N	List	Admin	r-r-w
SurfaceCapabilities	Statistical capabilities of surface-based observing systems (for a geographic area, period, variable, layer, and domain)	N	Panel	Admin	r-r-w
Themes	Themes (e.g. Basic atmospheric, Clouds and precipitations, Aerosols and radiation, Ocean and sea ice, etc.).	Y	List	Admin	r-r-w
Users	Contact points and database users	Y	Panel	The contact him/herself	r-w-w
Variables	Standard variable.	Y	List, Panel	Admin	r-r-w
WMOMembers	WMO Members and territories. See list on the WMO website at : http://www.wmo.int/pages/members/membership/index_en.html	N	List	Admin	r-r-w

14 User Requirements Focal Point (managed through the application dedicated to the edition of the User Requirements Database)

4) Description of the tables

Note: Tables are listed below in alphabetic order.

ApplicationAreas		
WMO Application areas. Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
Id	INT(11)	Database ID of the record
name	VARCHAR(100)	Name of the application area
description	TEXT	Description of the application area
organization_id	INT(11)	Organization responsible for the application area (e.g. WMO, GOOS, …) (foreign key to table Organizations)
user_id	INT(11)	Focal point of the application area (foreign key to table Users)

GeographicAreas		
Definition of geographic areas (polygons)		
Field	***Type***	***Definition***
Id	INT	Database ID of the record
total_area	DECIMAL	Total area of the geographic area (km^2)
ocean	TINYINT(1)	Boolean to indicate whether most of the geographic area area is comprised of ocean or sea (true=ocean/sea)
Abbrev	VARCHAR2(45)	Abbreviation describing the geographic area (e.g. 5N/145E)

GeographicAreasPolygonLines		
Polygon lines of geographic areas		
Field	***Type***	***Definition***
Id	INT	Database ID of the record
geographicArea_id	INT	Geographic area to which this polygon line belongs
pointNo	INT	Point number (ordered points define the lines of the polygon)
lat	DECIMAL	Latitude of the point
lon	DECIMAL	Longitude of the point

Domains		
Applicable domains (i.e. Atmosphere, Ocean, Terrestrial, or Space) Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
id	INT	Database ID of the record
name	VARCHAR(100)	Name of the domain
acronym	VARCHAR(50)	Acronym of the domain
created	DATETIME	Date this record was created
modified	DATETIME	Date this record was modified

ElevationTypes		
Station elevation types (see WMO No. 9, Vol. A) – possible values: Elev; Elev-approximate; H; HA; H-approximate; and HA-approximate		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation of the elevation type
name	VARCHAR(80)	Full description of the elevation type

Groups		
Database user groups. Values: ***Name*** ***Role*** Administrator Administrator of the database Editor Editor of the user requirements SatelliteEditor Editor of space-based capabilities NFP National Focal Point (for editing of the surface-based capabilities) ProgrammeEditor Observing Platform Programme contact point (for editing of the surface-based capabilities) PlatformTypeEditor Contact point responsible for editing specific platform types (for editing of the surface-based capabilities)		
Field	***Type***	***Definition***
Id	INT	Database ID of the record
Name	VARCHAR(100)	Name of the user group
Role	VARCHAR(100)	Description of the role of the user group
Created	DATETIME	Date the user group was created
Modified	DATETIME	Date the user group was modified

Layers		
Spatial domains Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
Id	INT(11)	Database ID of the record
name	VARCHAR(100)	Name of the layer
dimension	VARCHAR(255)	Dimension of the layer (1D, 2D, 3D)
definition	VARCHAR(255)	Definition of the layer
domain_id	INT(11)	Applicable domain of the layer (foreign key to table Domains)
created	DATETIME	Date when this record was created
modified	DATETIME	Date when this record was modified

Layers_Variables		
Variables that can be measured in each layer Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
variable_id	INT(11)	Variable (foreign key to table Variables)
layer_id	INT(11)	Layer (foreign key to table Layers)

ObsRems		
Information on additional observations made at the station, special types of stations, and additional information relating to other fields in the data file is shown here (*Code Table A of WMO No. 9, Vol. A - Observations and Remarks*)		
Field	***Type***	***Definition***
id	INT	Database ID of the record
name	VARCHAR(80)	Description of this ObsRem

abbrev	VARCHAR(20)	Abbreviation used for this ObsRem

OperationalStatusTypes		
Types of Operational Status for a Platform or Measured variables Values: ***Code*** ***Meaning*** PLANNED Installation of the platform or sensor is planned DEPL Platform or measured variable is under deployment TEST Platform or measured variable is under test (pre-operational) OPER Platform or measured variable is operational SILENT Platform or measured variable is silent (can possibly resume operations) DEAD Platform or measured variable is dead (will not resume operations)		
Field	***Type***	***Definition***
id	INT	Database ID of the record
Status_code	VARCHAR(8)	Code for the platform or measured variable operational status type
Status_meaning	VARCHAR(80)	Meaning of the platform or measured variable operational status type

Organizations		
International Organizations or Programmes (WMO, GCOS, GOOS, WCRP, WMO-ISES). Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
id	INT	Database ID of the record
name	VARCHAR(100)	Description of this organization
accronym	VARCHAR(50)	Abbreviation used for this organization
address	MEDIUMTEXT	Address of the Organization
website	VARCHAR(100)	URL of the Organization's website
OrganizationType	VARCHAR(50)	Type of the organization (e.g. International, NMHS, University, Government Agency or Institute, Private company, Space Agency, …)

Platforms		
Table describing individual platforms		
Field	***Type***	***Definition***
id	INT	Database ID of the record
Reference_Date	DATETIME	Reference date of the platform metadata (for management of historical records; i.e. date the record was first created in the database, or 1 January of the year for subsequent records concerning the platform)
name	VARCHAR(100)	Name of the platform
Abbreviated_name	VARCHAR(100)	Abbreviated name of the platform
Station_id	VARCHAR(20)	Station ID according to the Station ID type (e.g. WMO Index number of the station)
Station_sub_id	VARCHAR(7)	Station sub ID according to the Station ID type (e.g. WMO Sub Index number of the Station)
Elevation	DECIMAL	Elevation of the platform (metres, see Vol. A definition)
Longitude	DECIMAL	Longitude of the platform
Latitude	DECIMAL	Latitude of the platform
Mobile_fixed	TINYINT(1)	Indication whether the platform is fixed or mobile
Location_Date	DATETIME	Date of last location of mobile station
Implementation_Date	DATETIME	Date of implementation of the station
Stop_Date	DATETIME	Date of closure of the station (if not operational anymore)
Modif_Date	DATETIME	Date of modification of the platform status (to keep an

		history of the evolution of the station; most recent record for a station is used for the display of capabilities)
OperationalStatusType_id	INT	Operational Status of the platform (foreign key to Table OperationalStatusTypes)
Nb_Measured_variables	INT	Number of measured variable making measurements on the platform
so_1	VARCHAR(2)	SO-1 from Vol. A
so_2	VARCHAR(2)	SO-2 from Vol. A
so_3	VARCHAR(2)	SO-3 from Vol. A
so_4	VARCHAR(2)	SO-4 from Vol. A
so_5	VARCHAR(2)	SO-5 from Vol. A
so_6	VARCHAR(2)	SO-6 from Vol. A
so_7	VARCHAR(2)	SO-7 from Vol. A
so_8	VARCHAR(2)	SO-8 from Vol. A
Obs_hs	VARCHAR(4)	ObsHs from Vol. A
ua_1	VARCHAR(4)	UA-1 from Vol. A
ua_2	VARCHAR(4)	UA-2 from Vol. A
ua_3	VARCHAR(4)	UA-3 from Vol. A
ua_4	VARCHAR(4)	UA-4 from Vol. A
Obsrems_id	INT	ObsRems (foreign key to Table ObsRems) – Other observations and remarks from Vol. A (code Table A)
Station_id_type_id	INT	Type of station ID (foreign key to table StationIdType)
PlatformType_id	INT	Platform type (foreign key to table PlatformTypes)
Member_id	INT	Member (foreign key to table WMO_Members)
Programme_id	INT	Programme (foreign key to table Programmes)
Domain_id	INT	Domain (foreign key to table Domains)
ElevationType_id	INT	Elevation type (Hp, H, Ha, approximate Hp, approx- H, approx. Ha) (foreign key to Table ElevationTypes)
PressureDefIdType_id	INT	PressureDefID fields on Vol. A (foreign key to Table PressureDefIDs)
Manufacturer_id	INT	Manufacturer of the platform (foreign key to table Organizations)
OwnerOrganization_Id	INT	Organization which is the owner of the platform (foreign key to table Organizations)

StationIdType		
Type of station identification number		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation of the type of identification number (e.g. WMO Index, WMO buoy number, …)
name	VARCHAR(80)	Description of the type of identification number

PlatformMeasuredVariable		
measured variable of an observing platform (or of a set of consistent platforms)		
Field	***Type***	***Definition***
id	INT	Database ID of the record
platform_id	INT	Platform hosting the sensor/instrument measuring the variable (foreign key to table Platforms)
Identification_no	VARCHAR(20)	Identification number of the measured variable
abbrev	VARCHAR(20)	Abbreviation for the measured variable
name	VARCHAR(80)	Name of the measured variable
layer_id	INT	applicable Layer (foreign key to table Layers)
instrumentModel_Id	INT	Mode of the instrument measuring the variable (foreign key to table InstrumentModels)
Elevation	DECIMAL	Elevation of the base of the sensor measuring the variable (metres, see Vol. A definition)
Longitude	DECIMAL	Longitude of the sensor measuring the variable

Latitude	DECIMAL	Latitude of the sensor measuring the variable
Applicable_Area_type	VARCHAR(1)	Type of applicable area / geographic coverage (P=point, A=area, C=Circle) (e.g. area or circle for radars)
Applicable_Area_km2	DECIMAL	Total area (km2) of the applicable area (for Applicable_Area_Type=A or C; 0 otherwise)
Applicable_Area_Radius	DECIMAL	Radius of the applicable area (for Applicable_Area_Type=C) (NIL of point or area)
Typical_Product_HR	DECIMAL	Typical Horizontal Resolution of product (km) (used to derive the number of virtual point stations equivalent to a radar) (for for Applicable_Area_Type=A or C; NIL otherwise)
Applicable_Area_id	INT	Geographic area defining the applicable area (foreign key to table GeographicAreas) (for Applicable_Area_Type=A; NIL otherwise)
Height	DECIMAL	Height/Depth of measurement (m) referring to the sensor base
Profile	TINYINT(1)	Boolean to indicate that profile type measurements are made
Min_Height	DECIMAL	Minimal Height/Depth of measurement (m) for profiles
Max_Height	DECIMAL	Maximal Height/Depth of measurement (m) for profiles
OperationalStatusType_id	INT	Operational Status of the sensor/instrument measuring the variable (foreign key to Table OperationalStatusTypes)
Operating_Start_Date	DATETIME	Date when the platform measured variable was implemented operationally
Operating_End_Date	DATETIME	Date when the platform measured variable ceased operating

InstrumentModel		
Manufacturer's model of instrument		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation of instrument model
name	VARCHAR(80)	Name of the instrument model
variable_id	INT	Variable measured (foreign key to table Variables)
Uncert	DECIMAL	Uncertainty (in the units of the variable measured)
VR	DECIMAL	Vertical resolution (m)
OC	DECIMAL	Observing cycle (min)
Timeliness	DECIMAL	Timeliness (min)
Stability	DECIMAL	Stability of the measurement in units per decade for the considered variable, geographical area and domain
Manufacturer_id	INT	Manufacturer of the sensor measuring the variable (foreign key to table Organizations)

PlatformTypes		
Types of surface-based platforms See Appendix III for the list of platform types.		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation of surface-based platform
name	VARCHAR(80)	Name of surface-based platform
code	INT	Code of surface-based platform
coordinated_management	TINYINT(1)	Boolean to indicate whether all platforms of this type are managed by the Platform type focal point
Focal_point_id	INT	Platform type focal point (foreign key to table Contacts)

PressureDefIdTypes

Information reported in lieu of group 4PPPP for stations which do not indicate air pressure reduced to mean sea level in their synoptic reports (group 4PPPP) *(See corresponding field in WMO No. 9, Vol. A for possible values of this field)*		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation used for this PressureDefIdType
name	VARCHAR(80)	Decription of the PressureDefIdType

Programmes		
Observation Programme (for the purpose of collecting information for the surface-based capabilities, or metadata, e.g. AMDAR, SBRSO, DBCP, SOT, …)		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(20)	Abbreviation of the observation programme
name	VARCHAR(80)	Full name of the observation programme
coordinated_management	TINYINT(1)	Boolean to indicate whether all platforms of this programme are managed by the programme focal point
Capability_focal_point_id	INT	Programme focal point for capabilities (foreign key to table Contacts)

RA_GeographicAreas		
List of geographic areas describing a WMO Regional Association		
Field	***Type***	***Definition***
Geographic_Area_id	INT	Geographic Area (foreign key to table GeographicAreas)
RA_id	INT	Regional Association (foreign key to table Regional_Associations)

RA_Members		
Table linking WMO Regional Associations and WMO Members (i.e. to record the list of Members in each Regional Association, see WMO website at http://www.wmo.int/pages/members/index_en.html)		
Field	***Type***	***Definition***
Member_id	INT	WMO Member (foreign key to table WMOMembers)
RA_id	INT	Regional Association (foreign key to to table RegionalAssociations)

RegionalAssociations		
WMO Regional Associations RA-I Africa RA-II Asia RA-III South America RA-IV North America, Central America and the Caribbean RA-V South-West Pacific RA-VI Europe		
Field	***Type***	***Definition***
id	INT	Database ID of the record
abbrev	VARCHAR(4)	Abbreviation of the WMO Regional Association (e.g. RA-I)
name	VARCHAR(80)	Full name of the WMO Regional Association

Regions
Sub-Regions of WMO Regional Associations

Field	*Type*	*Definition*
id	INT	Database ID of the record
RA_id	INT	Regional association to which this sub-region belongs (foreign key to table RegionalAssociations)
abbrev	VARCHAR(4)	Abbreviation of the Region
name	VARCHAR(80)	Full name of the Region

Region_GeographicAreas		
List of geographic areas describing a Region		
Field	*Type*	*Definition*
Geographic_Area_id	INT	Geographic Area (foreign key to table GeographicAreas)
Region_id	INT	Region (foreign key to table Regions)

Requirements		
User requirements for an application area, layer, and variable Note: This table already exists in the OSCAR/Requirements		
Field	*Type*	*Definition*
id	INT(11)	Database ID of the record
uncertainty_goal	FLOAT	Goal value of the uncertainty requirement
uncertainty_breakthrough	FLOAT	breakthrough value of the uncertainty requirement
uncertainty_threshold	FLOAT	threshold value of the uncertainty requirement
hr_goal	FLOAT	Goal value of the horizontal resolution requirement, given in the units indicated with the corresponding variable
hr_breakthrough	FLOAT	Breakthrough value of the horizontal resolution requirement, given in the units indicated with the corresponding variable
hr_threshold	FLOAT	Threshold value of the horizontal resolution requirement, given in the units indicated with the corresponding variable
vr_goal	FLOAT	Goal value of the vertical resolution requirement, given in the units indicated with the corresponding variable
vr_breakthrough	FLOAT	Breakthrough value of the vertical resolution requirement, given in the units indicated with the corresponding variable
vr_threshold	FLOAT	Threshold value of the vertical resolution requirement, given in the units indicated with the corresponding variable
oc_goal	FLOAT	Goal value of the observing cycle requirement, given in the units indicated with the corresponding variable
oc_breakthrough	FLOAT	Breakthrough value of the observing cycle requirement, given in the units indicated with the corresponding variable
oc_threshold	FLOAT	Threshold value of the observing cycle requirement, given in the units indicated with the corresponding variable
timeliness_goal	FLOAT	Goal value of the timeliness requirement, given in the units indicated with the corresponding variable
timeliness_breakthrough	FLOAT	Breakthrough value of the timeliness requirement, given in the units indicated with the corresponding variable
timeliness_threshold	FLOAT	Threshold value of the timeliness requirement, given in the units indicated with the corresponding variable
stability_goal	FLOAT	Goal value of the stability, given in the units indicated with the corresponding variable
Stability_breakthrough	FLOAT	Breakthrough value of the stability, given in the units indicated with the corresponding variable

Stability_threshold	FLOAT	Threshold value of the stability, given in the units indicated with the corresponding variable
comment	TEXT	Comment regarding this requirement
validationdate	DATE	Date when this requirement was validated
variable_id	INT(11)	Variable of the requirement (foreign key to table Variables)
layer_id	INT(11)	Layer of the requirement (foreign key to table Layers)
applicationarea_id	INT(11)	Application area of the requirement (foreign key to table ApplicationAreas)
confidencelevel_id	INT(11)	Level of confidence of this requirements (foreign key to table ConfidenceLevels)
source_id	INT(11)	Source of this requirement (foreign key to table Sources)
created	DATETIME	Date when this requirement was created
modified	DATETIME	Date when this requirement was modified

Sources		
Sources of information for the database content Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
id	INT(11)	Database ID of the record
name	VARCHAR(100)	Full name of the source
acronym	VARCHAR(20)	Abbreviation of the sources

SurfaceCapabilities		
Statistical capabilities of surface-based observing systems (for a geographic area, period, variable, layer, and domain)		
Field	***Type***	***Definition***
id	INT	Database ID of the record
Reference_date	DATETIME	Date of the capabilities record (start of the considered period; 1 January of the year in principle)
nb_months	INT	Number of months considered to derive the capabilities
HR	DECIMAL	Horizontal Resolution capability (km^2)
VR	DECIMAL	Vertical Resolution capability (m)
OC	DECIMAL	Observing Cycle capability (min.)
Timeliness	DECIMAL	Timelines capability (min.)
Uncertainty	DECIMAL	Uncertainty capability (in units of the corresponding variable)
Number_platforms	INT	Number of platforms (or estimate) that contributed to the computation of this capability
Number_observations	INT	Number of observations (or estimate) that contributed to the computation of this capability
GeographicArea_id	INT	Geographic area of the capability record (foreign key to table GeographicAreas)
Variable_id	INT	Variable of the capability record (foreign key to table Variables)
Layer_id	INT	Layer of the capability record (foreign key to table Layers)
Domain_id	INT	Domain of the capability record (foreign key to table Domains)

Themes		
Themes (e.g. Basic atmospheric, Clouds and precipitations, Aerosols and radiation, Ocean and sea ice, etc.) Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***

id	INT(11)	Database ID of the record
name	VARCHAR(100)	Name of the theme
acronym	VARCHAR(50)	Acronym for the theme
comment	VARCHAR(255)	Comment
domain_id	INT(11)	Domain to which this theme belongs (foreign key to table Domains)
created	DATETIME	Date when this record was created Note: This field has the type INT(11) in the User Requirements Database
modified	DATETIME	Date when this record was modified Note: This field has the type INT(11) in OSCAR/Requirements

Users		
Contact points and database users Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
Id	INT	Database ID of the record
Username	VARCHAR(50)	User name
Password	VARCHAR(50)	Password
Firstname	VARCHAR(255)	First name
Lastname	VARCHAR(255)	Last name
Organization_id	INT	Organization to which the contact belongs (foreign key to table Organizations)
Group_id	INT	Group to which the contact belongs (foreign key to table Groups)
address	TEXT	Address
email	VARCHAR(255)	E-mail address
phone	VARCHAR(255)	Telephone number
lastlogin	DATETIME	Date of last login in the database
created	DATETIME	Date the record was created
modified	DATETIME	Date the record was last updated
title	VARCHAR(45)	Title (Mr, Ms, Dr, Prof., …)

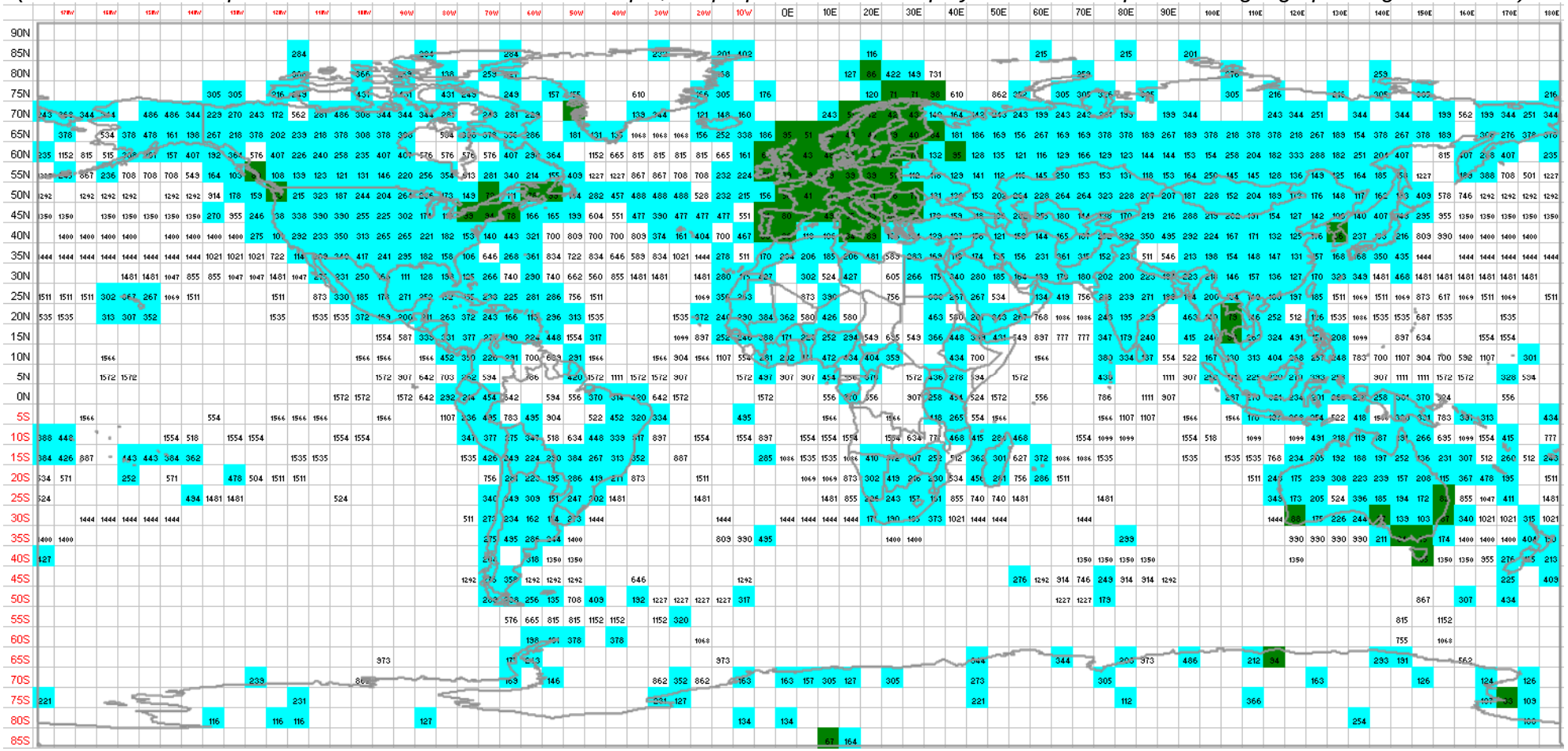
Variables		
Standard variable Note: This table already exists in the OSCAR/Requirements		
Field	***Type***	***Definition***
Id	INT(11)	Database ID of the record
Name	VARCHAR(100)	Name of variable
Definition	TEXT	Definition of the variable
Acronym	VARCHAR(50)	Acronym of the variable
measuring_units	VARCHAR(50)	Measuring units of the variable
accuracy_units	VARCHAR(50)	Units used for reporting accuracy of the variable
stability_units	VARCHAR(50)	Units used for reporting stability of the variable
hr_units	VARCHAR(50)	Units used for reporting horizontal resolution of the variable
vr_units	VARCHAR(50)	Units used for reporting vertical resolution of the variable
comment	TEXT	Comment
Theme_id	INT(11)	Theme (foreign key to table Themes)
modified	DATETIME	Date when this record was modified
created	DATETIME	Date when this record was created

WMOMembers
WMO Members and territories

See list on the WMO website at : http://www.wmo.int/pages/members/membership/index_en.html		
Field	***Type***	***Definition***
Id	INT	Database ID of the record
abbrev	VARCHAR(45)	Abbreviation of the WMO Member or Territory
name	VARCHAR(100)	Full name of the WMO Member or Territory
territory	TINYINT(1)	Boolean to indicate whether this record corresponds to a territory (true=territory)
Capability_focal_point_id	INT	National focal point for the capabilities (foreign key to table Contacts)

APPENDIX II - EXAMPLE OF CRITICAL REVIEW MAP FOR GLOBAL NWP, SURFACE LAYER, AIR PRESSURE[15]

(while information is presented in 5° x 5° boxes in this example, the purpose will be to display information in predefined geographic regions instead)



Colour codes:

Value range	*Color*	*Comment*
Value > Threshold	White	No impact
Optimum < Value ≤ Threshold	Blue	Significant impact
Goal < Value ≤ Optimum :	Green	Optimal

Value range	*Color*	*Comment*
Value ≤ Goal :	Red	Oversampled
No requirements value	Gray	n/a

15 Map extrapolated from ECMWF monitoring statistics, February 2012

APPENDIX III

Types of observing platforms forOSCAR/Surface[16]

Abbrev	*Name of Platform Type*	*Code*	*Information provided by*
Syn	Surface synoptic station	0001	Members, EUMETNET
Clim	Surface climatological station	0002	Members, EUMETNET (potentially)
AWS	Automatic Weather Station	0003	Members, EUMETNET
Radiation	Radiation station	0050	Members, and possibly other groups
UA	Upper-air synoptic and reference station	0100	Members, EUMETNET
ASAP	Automated Shipboard Aerological Profiler (ASAP)	0110	Members, EUMETNET
WP	Wind profiler	0150	Members, EUMETNET
RSPS	Remote sensing profiling station	0101	Members, EUMETNET (potentially)
Aircraft	Aircraft meteorological station	0200	Members, EUMETNET
GAW	Global Atmospheric Watch station	0300	TBD
Lightning	Lightning detection system station	0400	Members
Hydro	Hydrological station	0500	TBD
Ground_hyd	Ground water station	0501	TBD
W_Radar	Weather radar station	0600	Members, EUMETNET
RW_Radar	Road weather station	0700	Members
Aero	Aeronautical meteorological station	0800	Members
Agro	Agricultural meteorological station	0900	TDB
Urban	Urban meteorological station	1000	Members,
DB	Drifting buoy station	2000	JCOMMOPS
MB	Moored buoy station	2010	JCOMMOPS
Ship	Ship station	2020	JCOMMOPS
Rigs	Ocean rigs and other fixed platform station	2030	JCOMMOPS
ASS	Automatic sea station (fixed and mobile)	2040	JCOMMOPS
Float	Profiling float	2050	JCOMMOPS
Prof_Glider	Ocean sub-surface glider	2060	JCOMMOPS
Surf_Glider	Ocean surface glider	2070	JCOMMOPS
Tide_gauge	Tide gauge station	2080	JCOMMOPS
Tsunameter	Tsunameter	2090	JCOMMOPS

16 List to be completed as needed

APPENDIX IV

Methodologies for Determination of Observations Capabilities by Platform Type

Aircraft Meteorological Station

Sub-system	Variable	Capability	Methodology	Comments
AMDAR	Atmospheric Temperature	Uncertainty	Generic to all systems and layers and based on CIMO guide ref. Part II, Ch 3.	
		Horizontal Resolution, LT, HT & LS	See Note 1.	
		Vertical Resolution		
		Observing Cycle		
		Timeliness		
	Wind Horizontal		Generic to all systems and layers and based on CIMO guide ref. Part II, Ch 3.	
	Turbulence		Generic to all systems and layers and based on CIMO guide ref. Part II, Ch 3.	
	Specific Humidity		Generic to all systems and layers and based on CIMO guide ref. Part II, Ch 3.	
ADS-C				
ADS-B				

1. The Horizontal Resolution for AMDAR will be derived from data output on the GTS, either based on data and a process with the designated data monitoring centre or with the Operational Information Service, Quantity Monitoring Exercises. The horizontal resolution of all variable for each layer (LT, HT and LS), will be determined by…