1. **OBSERVING COMPONENT OF THE GLOBAL ATMOSPHERE WATCH (GAW)**

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**(…. The following headings provide a starting point, with an aim of consistency with other chapters, however adjustments can be made if necessary to cover this specific component observing system)**

* 1. **Requirements**

The rationale for the Global Atmosphere Watch (as formulated in the GAW Strategic Plan: 2008-2015) is the need to understand and control the increasing influence of human activity on the global atmosphere. The mission of GAW, taking into account the Integrated Global Atmospheric Chemistry Observations (IGACO) strategy, is to

Reduce environmental risks to society and meet the requirements of environmental conventions.

Strengthen capabilities to predict climate, weather and air quality.

Contribute to scientific assessments in support of environmental policy.

through

Maintaining and applying global, long-term observations of the chemical composition and selected physical characteristics of the atmosphere.

Emphasising quality assurance and quality control.

Delivering integrated products and services of relevance to users.

GAW also fulfils a mandate from WMO Members by responding to the needs and clearly linking to the plans of national, regional, and international observing projects, programmes, systems and strategies

* 1. **Design, planning and evolution**

Since its inception in 1992, GAW has matured and developed into a programme with support from a large number of WMO Members. More than 100 countries have registered more than 800 stations with the GAW Station Information System (GAWSIS).

Various GAW expert groups and central facilities exist under the oversight of the WMO Commission for Atmospheric Sciences (CAS) and its Joint Scientific Committee of the WMO Open Programme Area Group on Environmental Pollution and Atmospheric Chemistry
(JSC OPAG-EPAC). These include 7 Scientific Advisory Groups (SAGs) to organise and co-ordinate GAW activities by parameter, and the Expert Teams on World Data Centres (ET-WDC) and Near-Real-Time Chemical Data Transfer (ET-NRT CDT).

* + 1. **Review of observational user requirements**

The **Global Atmosphere Watch (GAW)** programme of WMO is a partnership that provides reliable scientific data and information on the chemical composition of the atmosphere, its natural and anthropogenic change, and helps to improve the understanding of interactions between the atmosphere, the oceans and the biosphere.GAW is considered the atmospheric chemistry component of the Global Climate Observing System ([GCOS](http://www.wmo.int/pages/prog/gcos/)).

The GAW programme supports global networks that deliver observations which are then used to address gaps in understanding of climate, weather and air pollution issues and to deliver services and products required by WMO Members in fulfilling their national mandate.

The GAW monitoring system focuses on six classes of variables (i.e. ozone, UV radiation, greenhouse gases, aerosols, selected reactive gases and precipitation chemistry). For these variables, GAW acts as a “steward of global coordination” supporting all components needed for a rational observing system. Each of the six variable groups has a SAG and GAW Central Facilities responsible for scientific guidance and technical details of the global network. An additional SAG exists for the GAW Urban Research and Meteorology Experiment (GURME).

At the core of the GAW mission is the identification of change, and understanding of its cause and effect. Users therefore require long-term data sets and stability, while GAW is looking for long-term commitments from its partners and stations.

* + 1. **Review of current and planned observing systems capabilities**

Currently GAW coordinates activities and data from 28 [Global stations](http://www.wmo.int/pages/prog/arep/gaw/GAW_Global_st.html), 410 Regional stations, and 81 Contributing stations operated by [Contributing networks](http://www.wmo.int/pages/prog/arep/gaw/GAW_contr_networks.html) (see [GAWSIS](http://gaw.empa.ch/gawsis/): <http://gaw.empa.ch/gawsis/default.asp>).

In recent years satellite programmes have produced important measurements of atmospheric compounds and related parameters that complement the GAW network measurements. When highly accurate local measurements from GAW ground-based stations are coupled with the near global coverage of satellite measurements it results in a more complete picture of atmospheric composition and processes on global scales, and provides complimentary checks of instrument calibrations. The Committee on Earth Observation (CEOS) has developed a strategy for such co-operation within an integrated system for monitoring of the atmosphere (WMO/GAW [Report No.140](http://www.wmo.int/pages/prog/arep/gaw/reports/pdf/gaw140.pdf) ).

* + 1. **Impact and design studies, and critical review**

5.2.3.1 Impact studies, OSEs, and OSSEs

5.2.3.2 Critical review and gap analysis

5.2.3.3 Design studies

* + 1. **Vision for the WIGOS**
		2. **Implementation Plan for the Evolution of WIGOS**
		3. **Monitoring observing systems implementation**
	1. **Instrumentation and Methods of Observation**
		1. **General requirements of Instruments/Sensor**

Instruments and sensors suitable for use at GAW sites are defined by the SAGs for each parameter, in terms of stability, precision and accuracy.

* + 1. **General requirements of (Observing Systems) – see "Definitions" section, use of this term needs to be clarified**

Since the GAW mission is to identify change the primary requirement of observing systems is stability and continuity, and a commitment to maintain high quality data collection for a prolonged period.

* + 1. **Calibration and Traceability**
* 22 Central Calibration Laboratories (CCLs) and World and Regional Calibration Centres
 (WCCs, RCCs) maintain calibration standards and provide instrument calibrations and
 training to the stations.
	+ 1. **Data and Metadata representation and format**
* 6 World Data Centres archive the observational data and metadata, which are integrated by the GAW Station Information System (GAWSIS). The data format for measurements of each parameter is defined by the associated data centre.
	+ 1. **General requirements of a meteorological station/platform**

Stations fall into 3 categories: Global, Regional and Contributing.

**Essential Characteristics of a GAW *Regional* or *Contributing* Station**

1. The station location is chosen such that, for the variables measured, it is regionally representative and is normally free of the influence of significant local pollution sources.

2. There are adequate power, air conditioning, communication and building facilities to sustain long term observations with greater than 90% data capture (i.e. <10% missing data).

3. The technical support provided is trained in the operation of the equipment.

4. There is a commitment by the responsible agency to long term observations of at least one of the GAW variables in the GAW focal areas (ozone, aerosols, greenhouse gases, reactive gases, UV radiation, precipitation chemistry).

5. The GAW observation made is of known quality and linked to the GAW Primary Standard.

6. The data and associated metadata are submitted to one of the GAW World Data Centres no later than one year after the observation is made. Changes of metadata including instrumentation, traceability, observation procedures, are reported to the responsible WDC in a timely manner.

7. If required, data are submitted to a designated data distribution system in near-real-time.

8. Standard meteorological *in situ* observations, necessary for the accurate determination and interpretation of the GAW variables, are made with known accuracy and precision.

9. The station characteristics and observational programme are updated in the GAW Station Information System (GAWSIS) on a regular basis.

10. A station logbook (i.e. record of observations made and activities that may affect observations) is maintained and is used in the data validation process.

**Additional Essential Characteristics Needed for a GAW *Global* Station**

In addition to the characteristics of Regional or Contributing stations, a GAW Global station should fulfill the following additional requirements, namely

11. Measure variables in at least three of the six GAW focal areas.

12. Have a strong scientific supporting programme with appropriate data analysis and interpretation within the country and, if possible, the support of more than one agency.

13. Make measurements of other atmospheric variables important to weather and climate including upper air radio sondes at the site or in the region.

14. Provide a facility at which intensive campaign research can augment the long term routine GAW observations and where testing and development of new GAW methods can be undertaken.

* + 1. **Methods of Observation**
	1. **Operations**
		1. **Observing Practices**

Members shall follow procedures specified in the GAW Standard Operational Procedures (SOPs) and Guidelines

* + 1. **Quality Assurance/Control/Monitoring/Evaluation**

Members should follow procedures specified in the GAW Standard Operational Procedures (SOPs) and Guidelines, and further documents provided by the SAGs and Quality Assurance/Science Activity Centres (QA/SACs) which perform network-wide data quality and science-related functions. Members should ensure that calibrations are traceable to GAW calibration centres, where available. Members shall permit WDCs to provide further quality evaluation.

* + 1. **Data and Metadata Reporting**

Data and metadata shall be reported to the GAW World Data Centre appropriate to each parameter measured on the timescale requested by the Data Centre.

Site metadata for all stations shall be made available through GAWSIS

* + 1. **Incident Management (Control)**
		2. **Change Management** – need a cross reference to 5.6.2.2

Planned change shall be carefully controlled to ensure continuity and consistency of service as specified in ..?? document?

NOTE: A primary purpose of GAW is to monitor long-term atmospheric change and identify causes of that change. Stability in the monitoring systems is therefore of paramount importance.

* + 1. **Maintenance (Preventative, Corrective and Adaptive)**

Members shall follow procedures specified in the GAW Standard Operational Procedures (SOPs) and Guidelines. Adaptive maintenance should consider the two requirement of stability and consistency, plus>90% data capture.

* + 1. **Calibration procedures**

Members shall follow procedures and calibration frequency specified in the GAW Standard Operational Procedures (SOPs) and Guidelines.

* 1. **Observational Metadata**

**(…. the first seven sub-headings here represent an initial brainstorming from TT-WRM-1. The list needs to be rationalised, then later refined based on the work of TT-WMD)**

**(…. Include the keeping of Historical metadata where appropriate)**

* + 1. **Instrument metadata**

Members shall provide instrument metadata as requested by the WDC for parameter, and GAWSIS.

* + 1. **Site/Station/Platform metadata**

Members shall provide such metadata as required by GAWSIS and any WDC to which they contribute

* + 1. **Network metadata**

Members shall provide such metadata as required by GAWSIS

* + 1. **Quality metadata**

Members shall provide such metadata as required by the appropriate WDC, SAG and GAWSIS. Oversight of quality is provided by QA/SACs.

* + 1. **Interpretation metadata**

Members shall provide such metadata as required by the appropriate WDC and SAG

* + 1. **Static/Dynamic metadata ??**
		2. **Maintenance metadata**

Members shall provide such metadata as required by the appropriate WDC and SAG

* + 1. **WIGOS Operational Information Resource**

5.5.8.1 Input to WIR

5.5.8.2 Use of WIR

(…. These two subheadings simply flag two aspects of the topic, more subheadings may be needed)

* + 1. **Enabling Discovery, Access and Retrieval (via WIS)**

**? Presumably GAWSIS will be linked to WIS somehow**

* + 1. **WIS Discovery metadata**

 **? GAWSIS can be searched through WIS**

* 1. **Quality Management**
		1. **WMO Quality Management Framework**
		2. **Development and Implementation of Quality Management Systems**

5.6.2.1 Performance Monitoring and Continuous Improvement

5.6.2.2 Management of Change – need a cross reference to 5.4.5

* + 1. **Documentation**

(…. Note: see TR Vol. IV on the WMO QMF, especially the description of hierarchy of docs in 4 levels)

* 1. **Capacity Development**

Members may apply to have a station or network of stations recognised as a GAW station: Global, Regional or Contributing. Potential stationsshall first meet the requirements listed in section 1.3.5, and operators shall agree to submit data to the appropriate WDCs. Approval of the SAGs and …??.. Liisais sought for such applicants.

In some regions of the world, and for some GAW variables, where there is a clear lack of capacity, members may be requested to help support a station, or existing stations may be approached to become a part of GAW. Such requests and invitations come after approval by the appropriate SAGs.