

# Discussion of changes to GRUAN manual following CBS expert team review

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# Overview

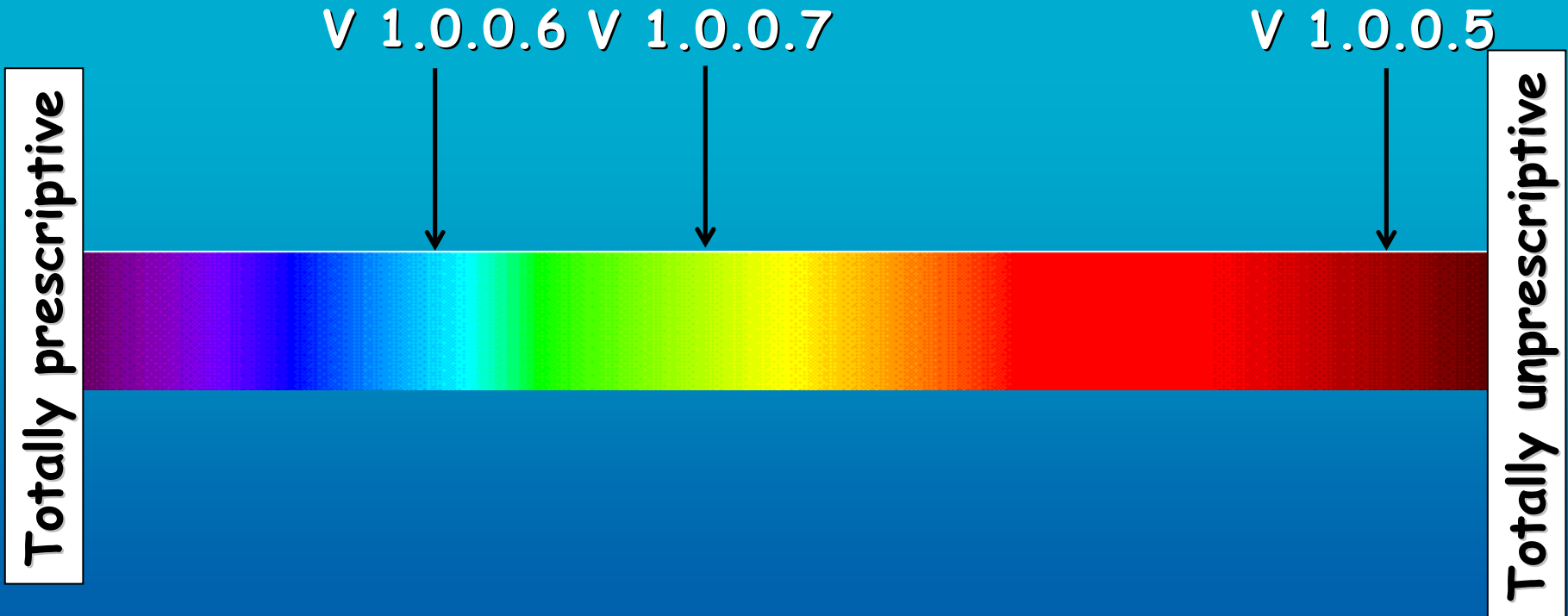
- Current version of the manual is version 1.0.0.7. The last version that you reviewed was 1.0.0.6. I will start by summarizing what has changed between the two versions.
- The process for getting from version 1.0.0.7 to version 1.1.0.0, the first official version of the manual.
- Bertrand will then present a few slides looking at the issues from an operational meteorology perspective.
- Discussion until 15:30.

# What's in a name?

- When I first started working on this project I was told I would be working on developing a guide to GRUAN operations i.e. The GRUAN guide.
- Later, on advisement from WMO, I was told that what I was writing, or at least should be writing, is more of a manual than a guide i.e. more prescriptive, telling the GRUAN community what they must do rather than what they should do.
- At the CBS expert team review meeting it was decided to take what had been the executive summary of the GRUAN manual (which was all of the prescriptive text) and make that into a new, standalone, **GRUAN manual** (11 pages) and then have what had been the main body of the manual become the **GRUAN guide** (91 pages).

# Level of specificity

Outcomes of CBS expert team review: Concern about disenfranchisement, sites operated by NMHSs would expect the manual to be prescriptive, overly accommodating guide would lead to an ineffectual network. Compliance with a more prescriptive guide would have funding implications, which may be more easily accommodated by some sites than others.



# Clearer statement of the goals of GRUAN

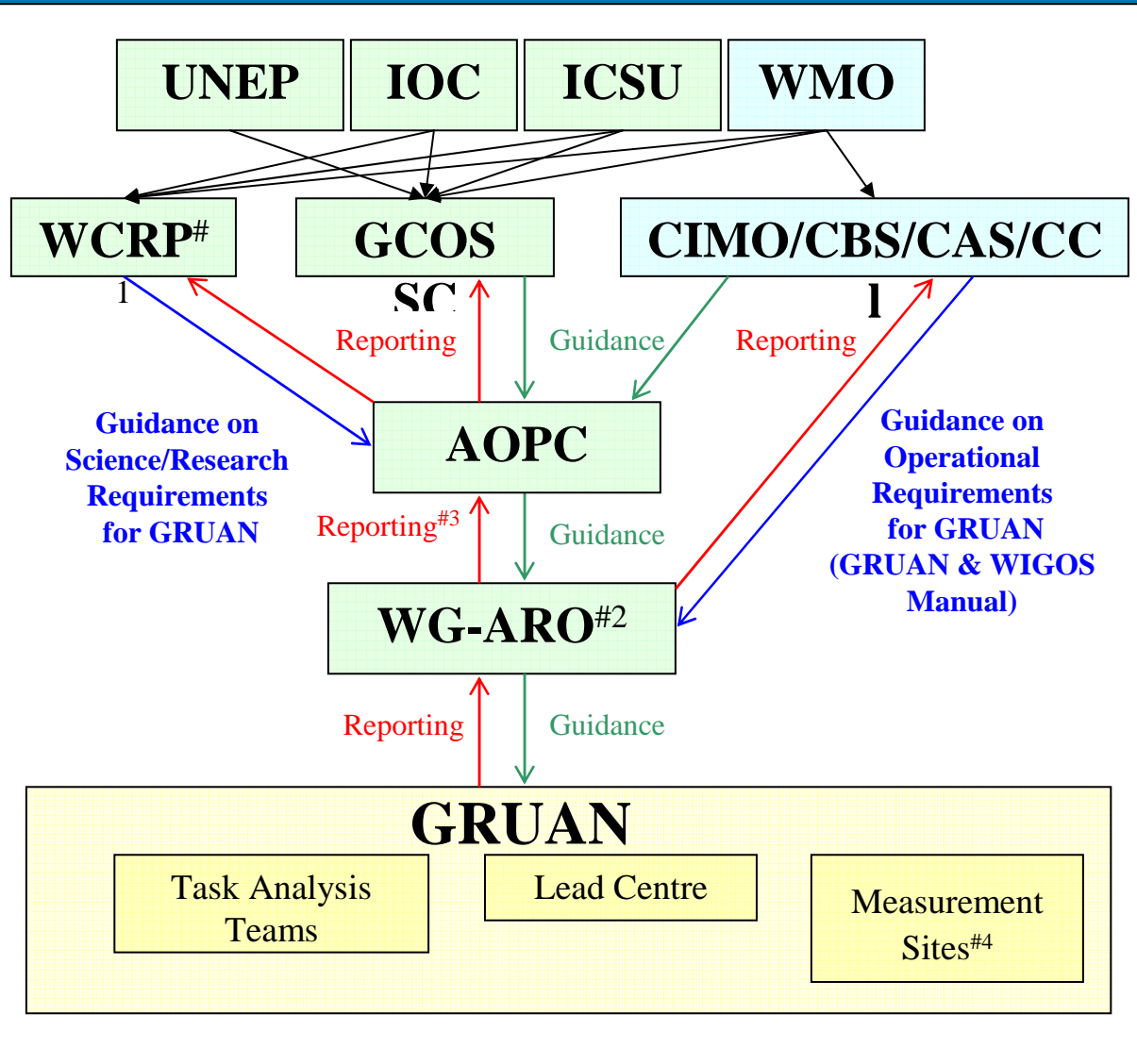
The purpose of GRUAN is re-iterated and taken verbatim from GCOS-112, viz.

- Provide long-term high quality climate records;
- Constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks); and
- Fully characterize the properties of the atmospheric column.

Four key user groups of GRUAN data products are identified:

- The climate detection and attribution community.
- The satellite community.
- The atmospheric process studies community.
- The numerical weather prediction (NWP) community.

# Completely revised section on organisation and design of GRUAN



Discussed in detail yesterday afternoon and so no need to go into detail here. You have the revised text for that section to please comment on that now or in writing later in response to my request for further input.

# Links to partner networks

- New short section pointing out the connection between GRUAN and GUAN. This is not the only place in the guide where this connection is described.
- Some minor wording changes to other sections.

# Revised terminology for description of reference measurements

These now follow the definitions in the *Guide to the Expression of Uncertainty in Measurement (GUM)*.

- True value
- Measurement accuracy
- Measurement uncertainty
- Measurement error
- Random error
- Systematic error
- Stability
- Independent measurement
- Correction lifetime



# Managing Change

Massively revised section following circulation as a separate document.

- Guiding principles
- The importance of meta-data
- Validating managed changes using parallel observations
- Data reprocessing
- Managing changes in instrumentation
- Managing changes in operating procedures
- Managing changes in data processing algorithms
- Managing changes in operators
- Managing changes in instrument location
- Managing changes in operating environments
- Procedure for network wide change implementation
- Procedure for site specific change implementation

# Development of climate data records of ECVs

Picks up on *Guideline for the Generation of Datasets and Products Meeting GCOS Requirements (GCOS-143)*.

- **Review** of climate data records produced by GRUAN should be undertaken by an external body to provide an independent assessment of its quality and thereby improve the confidence that the user community has in the product.
- Provide a facility for **user feedback** on the quality, usefulness and applicability of the data products.
- A quantitative **maturity index** describing the level of scientific maturity (1=initial, 2=experimental, 3=provisional, 4=demonstrated, 5=sustained, 6=benchmark) should be included in the description of the climate data record.
- A full description of the climate data record should be **published** in the international peer reviewed literature.

# Discussion of specific measurement requirements

- Distinguish between requirements consistent with current state-of-the-art and eventual requirements for GRUAN to achieve the science it wants to achieve.
- GRUAN measurement targets: discussion of target measurement attributes now occurs in a context of a particular anticipated scientific study. This has been done

for water vapour but now also needs to be done for temperature.

Attribute	Trend detection		Satellite validation and radiation studies		Process studies
	Upper troposphere	Lower stratosphere	Radiance comparisons	Comparisons in retrieval space	
Vertical resolution	<1 km	<1 km	no data	< 2km	10-100 m
Systematic error	profile: 5-10%	profile: 5-10% or better	column: 3% profile: 5% in lower and mid-troposphere, 10% in upper troposphere	column: 3% profile: 10% in 2 km thick layers	profile: 10%
Random error	up to 50% <sup>2</sup>	<10%	many comparisons: 10-20% individual comparison: ≤5%		<10-25%
Stability	no data	no data	no data	no data	N/A
Temporal resolution	<1 hour	no data	high as possible		1 minute

# Moving beyond priority 1 variables

Pretty much a whole new section following circulation as a separate document.

- *Requirements:* A task team and a central data processing facility within GRUAN.
- *Technical documents:* Standard operating procedures, Data and meta-data capture, Guidelines for assessment and certification, Central data processing, Creation of the GRUAN data product.
- *Procedures roles and responsibilities:* The roles of the Lead Centre, WG-ARO, Task Teams and GATNDOR.

A separate presentation on this will be given tomorrow afternoon.

# GRUAN sites

**Important:** Most of this chapter was circulated as a separate *Site Assessment and Certification* document. After many iterations we were able to achieve 100% sign off by the WG-ARO and >66% sign off by the site representatives. The document then became 'GRUAN law'. But now, following the CBS review, some changes have been made, specifically:

A whole new section (Section 5.2) that discusses levels of GRUAN operation, including definitions of:

- A fully compliant GRUAN site.
- A partially compliant GRUAN site.
- Minimum entry requirements.

The rest of section 5 is almost identical to what appeared in the *Site Assessment and Certification* document.

# A fully compliant GRUAN site

Make at least doubly redundant measurements of all GRUAN priority 1 and 2 ECVs and, specifically:

- 4xdaily radiosonde T to 30km, P, U in troposphere. NRT data submission. 00,06,12, 18 LST or UCT. Surface measurements to provide traceable link. Quantitative link between UTC/LST;
- Weekly ozone profile measurements;
- At least monthly water vapour profiles to ~30 km;
- Hourly observations of integrated precipitable water vapour.

Periods of high temporal and spatial resolution measurements capable of revealing variation of key atmospheric variables.

Fulfil all mandatory operating protocols (Section 5.3).

Strongly encouraged to measure priority 3 and 4 ECVs.

Adhere to all operational protocols defined in technical docs



# A partially compliant GRUAN site

Many GRUAN sites, while meeting the minimum entry level requirements, will not be able to be fully compliant.

Make redundant measurements of all GRUAN priority 1 ECVs and, specifically:

- Daily radiosonde measurements of temperature, pressure and humidity extending at least into the upper troposphere and with at least 2 satellite coincidences;
- Weekly ozone profile measurements;
- Minimum of 1 monthly water vapour profile measurements extending into the lower stratosphere.

Periods of high temporal and spatial resolution measurements capable of revealing variation of key atmospheric variables.

Fulfil all mandatory operating protocols (Section 5.3).

Adhere to all operational protocols defined in technical docs.

# Minimum entry requirements

As defined in GCOS-121, radiosonde observations at GRUAN sites should consist of (verbatim quote):

- 1 weekly production radiosonde with the best technology currently available at the site;
- 1 monthly radiosonde capable of capturing moisture signal in the UT/LS and all other priority 1 variables to the best level possible with current technology, launched together with weekly radiosonde;
- Regular 00 and 12 LST (as a preference over UTC) launches of a production radiosonde with best technology currently available;
- Dual launches of sondes with highest quality humidity sensing capability in the UT/LS (flying the monthly radiosonde together with a second sonde also capable of measuring water vapour in the UT/LS) ; and
- Periodic intercomparisons of a large range of sonde types.

Based on GCOS-121, only the first two criteria were deemed an initial requirement



# Remote sensing instruments (section 6.4.2)

Significantly expanded and improved thanks to Thierry et al.

- Lidars
- Microwave radiometers
- Microwave spectro-radiometers
- Fourier transform spectrometers

# Section 7 renamed from Methods of Observation to Measurement Scheduling

- Responsibilities
- Guiding principles
- Factors affecting measurement scheduling for trend detection
- Interplay of science goals and scheduling frequency: water vapour used as an example of measurement requirements considering applications for:
  - Trend detection: upper troposphere and lower stratosphere
  - Satellite validation and radiation studies: Radiance comparisons using a forward model and considerations of OLR errors, Satellite comparisons in retrieval space.
  - Process studies
- Instrument specific measurement schedules: picks up on the separate document circulated on measurement scheduling.

# Definition of new GRUAN data levels

Decided not to use numerical levels to avoid confusion with levels of satellite data.

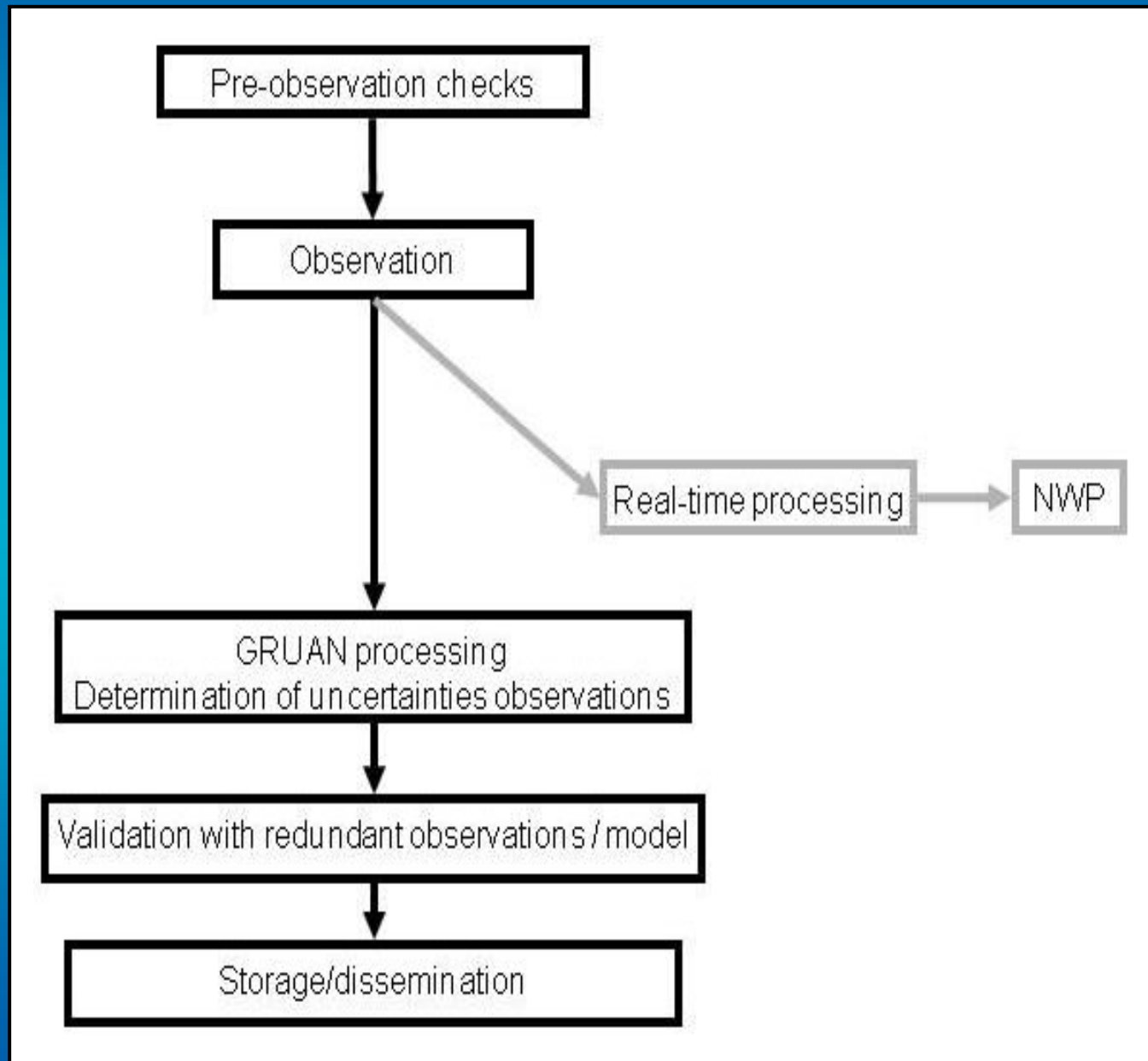
- **Primary Raw Data (PRD):** Rawest form of data available. PRD archived in perpetuity at the site, at Lead Centre, and at nominated GRUAN central data processing facility.
- **Converted Raw Data (CRD):** Pre-processed raw data. Might already represent parameters to be used in end-user's application e.g. brightness temperature for microwaves or zenith total delay for GPS. Stored at site, Lead Centre, and at nominated GRUAN central data processing facility.
- **Near-real-time Data (NRTD):** Data product resulting from preliminary processing, subject to as many GRUAN processing steps as can be achieved in 2 hour NRT window. NRTD flagged as originating at GRUAN site. Stored at site, CDPF, Lead Centre, and at analysis centres.

# Definition of new GRUAN data levels

- **Standard GRUAN Product Data (SGPD):** The GRUAN product resulting from all processing steps associated with a single instrument. SGPD are expected to be stored at the nominated GRUAN central data processing facility for that product, at the internal GRUAN data archive at the Lead Centre, and at NCDC.
- **Integrated GRUAN Product Data (IGPD):** This is a product that results from the combination of measurements from multiple instruments e.g. a SASBE product (Tobin et al., 2006). IGPD are expected to be stored at the nominated GRUAN central data processing facility for that product at the internal GRUAN data archive at the Lead Centre, and at NCDC.

Changes in the guide will need to be reflected in the GRUAN Data Management Manual.

# New figure showing NRTD processing stream



# GRUAN data policy

- Now includes words about NRT data submission (discussed in detail yesterday).

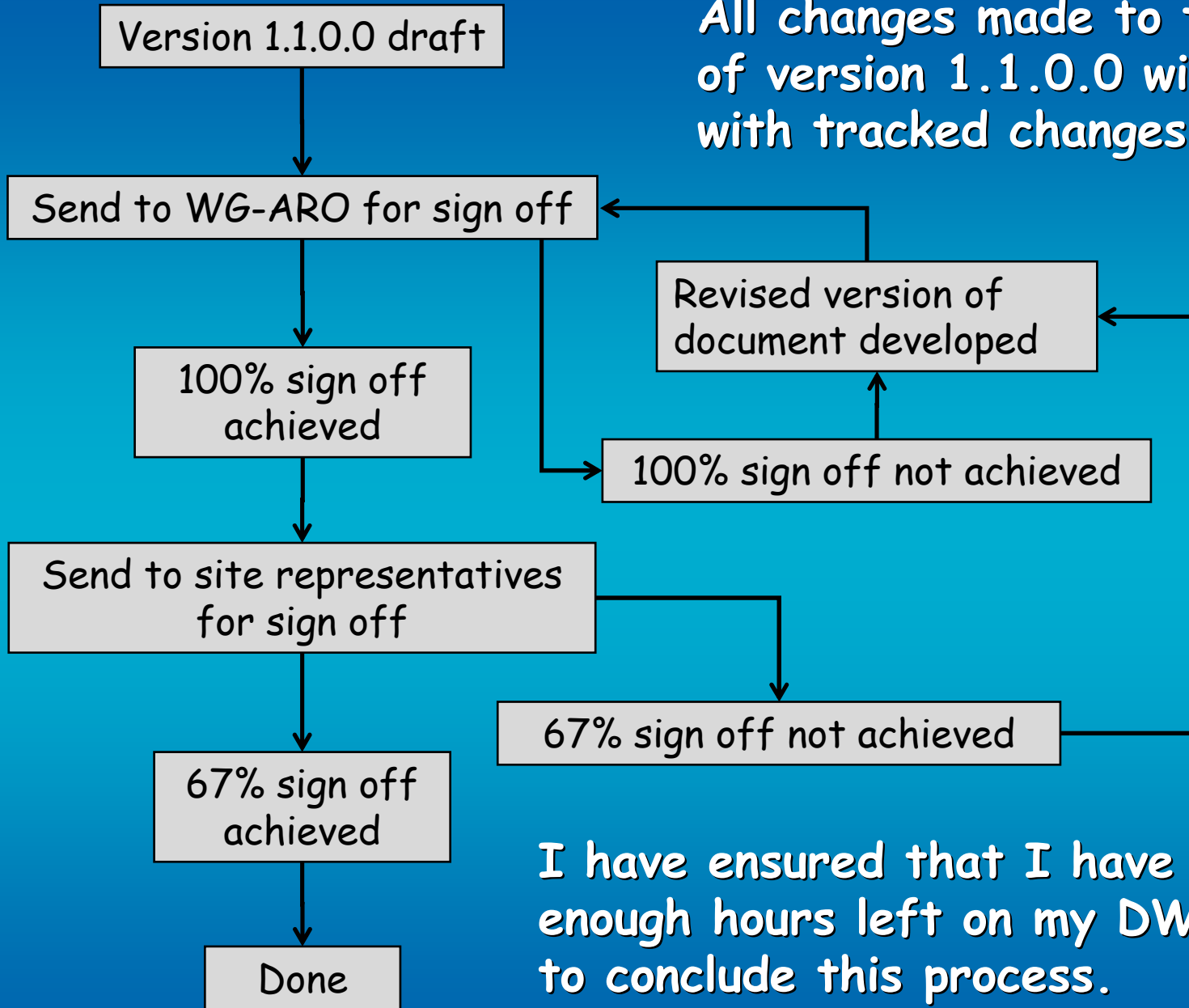
# The way forward

Based on

- Discussion of the manual at ICM-4
- Written feedback received from the GRUAN community in the form of suggested edits to version 1.0.0.7 (Word or PDF) - looking mostly for corrections rather than significant additions

I will develop a draft of version 1.1.0.0. We will then enter the following process...

All changes made to the draft of version 1.1.0.0 will be made with tracked changes



I have ensured that I have (hopefully) enough hours left on my DWD contract to conclude this process.



# Conclusions

- We are converging on a first official version of the GRUAN manual.
- Discussion at ICM-4 will be the last opportunity for us to discuss issues that require achieving consensus.
- There will be further opportunities to make minor changes (no major additions).
- Once version 1.1.0.0 has been completed, it will remain untouched until either:
  - A direct request to revise from GCOS AOPC, or
  - A request to revise from more than 50% of WG-ARO members or more than 33% of WG-ARO and the Lead Centre, or
  - A request to revise from two or more WMO commissions associated with GRUAN, or
  - More than 10 years in the case of the manual and 5 years in the case of the guide since last revision.

But before we start the discussion I would like to invite Bertrand Calpini to make a short presentation on the view of the GRUAN manual and guide from the operational meteorology point of view.