



International Civil Aviation Organization

**STUDY NOTE**

METPWGMOG/7/SN/23  
21/03/18

**MEETING OF THE METEOROLOGY PANEL (METP)  
WORKING GROUP MOG (WAFS)**

**SEVENTH MEETING**

**Offenbach, Germany, 11 to 13 April 2018**

**Agenda Item 3.3: Work required in support of WAFS Developments  
3.3.2 Matters relating to the Significant Weather Provision**

**NEXT GENERATION SIGWX CHART PRODUCTION**  
(Presented by the WAFS Provider States)

**SUMMARY**

The WAFSs have developed plans on how to deliver SIGWX forecasts fit for the next 10+ years through the introduction of multiple time-step SIGWX forecasts in November 2022.

This paper describes the provision of SIGWX charts in png format for these new forecast times, and proposes a series of changes that are required in order to enable the automation process.

Action by the METP-WG/MOG is in paragraph 4.

**1. INTRODUCTION**

1.1 METP-WG/MOG/7 SN/21 describes the 10 year plan for the next generation of SIGWX forecasts. Feedback received from SIGWX users has highlighted how the existing provision of T+24 hour SIGWX objects (data) and charts does not meet the needs of the aviation industry for several reasons, namely in providing fully harmonised, multiple time-step SIGWX data.

1.2 The WAFSs have been formulating plans for how multiple time-step SIGWX charts can be delivered, and have concluded that automation is possible for most data sets. Changes to SIGWX object data sets are described fully in METP-WG/MOG7 SN22.

1.3 The production of png format SIGWX charts needs to change in order accommodate the automation process. This paper presents a discussion of each issue, and proposes a series of changes that require the groups approval.

## DISCUSSION

2. When SIGWX forecasts were first published in BUFR format in 2005 the intention was to retire the provision of png format SIGWX charts. Thirteen years on, a series of 17 SIGWX charts are still being produced for T+24 for each model run.

2.1 In order to deliver the next generation of SIGWX forecasts desired by the aviation industry, the provision of png format SIGWX charts must be reviewed as simply replicating the current chart set will result in 255 charts per model run (15 time steps x 17 charts). In addition to this, it will not be possible to replicate some of the objects from the available data sets.

2.2 Many consumers of SIGWX object data sets visualise the BUFR data sets using flight planning software or SADIS/WIFS workstations. Users of these systems are able to customise the data sets with user defined map areas, projections, and colour schemes. They do not use the black and white, fixed area png format charts.

2.3 Whilst the WAFCs would like to retire png chart provision entirely, we appreciate that there is still a need to provide charts to users slow to adapt to new technology. For this reason the WAFCs will continue to provide high-level SIGWX charts for T+24 covering 13 areas until November 2028, with some formatting changes.

2.4 The WAFCs also appreciate that there is a need to produce visualised SIGWX that operators can use to check that their software is properly decoding and displaying the SIGWX object data. For this reason the WAFCs are proposing to provide a set of three png format charts for each of the new time-steps of SIGWX data that is produced.

## NEXT GENERATION SIGWX CHART PROVISION

2.5 From November 2022 multi-time-step SIGWX data (will be produced operationally. It is proposed that the following .png format charts are produced for each time-step:

- One Mercator projection chart which extends from 75N to 60S and circles the globe
- One polar stereographic chart centred on the North Pole, which extends out to at least 45N
- One polar stereographic chart centred on the South Pole, which extends out to at least 45S.

2.6 The new .png format charts will contain the following data:

- Significant weather between FL100 and FL530
- Jet Stream information, including height of the jet core.  
*Note: jet depth will not be included.*
- Cumulonimbus areas (extent) with a maximum spatial coverage equivalent to 50% or more. Cumulonimbus top information.
- Areas of moderate or severe turbulence
- Information that relates to volcanic eruptions that are producing ash clouds significant to aircraft operations
- Information on the location of a release of radioactive materials into the atmosphere
- Information on the location of tropical cyclones either as a marker symbol or in the legend (this is discussed in METP-WG/MOG/7 SN/24)

- *Note: the following elements will not be depicted on these charts: moderate or severe icing areas; tropopause height, and cumulonimbus base.*

2.7 The primary purpose of these charts is to enable operators to verify their software is visualising the SIGWX object data sets correctly.

2.8 Example charts are shown in Appendix A.

## HIGH-LEVEL CHARTS (EXISTING)

2.9 Continuing the provision of the high-level (FL250-FL630), T+24 SIGWX charts for 13 areas until 2028 requires some changes to be made with regards to the information depicted in the charts, as it is not possible to automate the production of all parameters.

2.10 Each parameter is discussed in the table below;

Parameter	Discussion	Proposed changes to charts applicable from November 2022
Jet Stream	<p>Jet stream position, speed, and height of the jet core remains unchanged.</p> <p>Jet depth information will be removed as this information is provided by the high resolution gridded WAFC wind data sets.</p>	Remove jet depth information.
CAT areas	<p>The new Graphical Turbulence Guidance system will produce an Eddy Dissipation Rate (EDR) for both Clear Air Turbulence and Mountain Wave Turbulence. This will enable objects to be drawn for both types of turbulence. Areas of moderate and severe turbulence will be drawn using the EDR thresholds. The specific type of turbulence will not be designated.</p> <p>The uppermost GTG turbulence level is FL530, therefore turbulence above this level cannot be calculated</p>	<p>Areas of MOD and SEV turbulence will be marked</p> <p>Lower the top of the chart to FL530</p>
Cumulonimbus	<p>By November 2022 the underlying gridded data set will be based on probabilistic information therefore criteria relating to “spatial coverage” will need to be adjusted slightly. CB objects will be created using a probability that closely matches the “50 per cent or more” spatial coverage. It will not be possible to determine whether a CB is embedded or concentrated along a line.</p> <p>The existing high level charts have a lower limit of FL250 and therefore short winter time CBs are often not depicted. CB bases, are usually labelled as XXX (below the base of the chart) therefore this field is not adding value.</p>	<p>CB forecasts will be based on probabilistic information, and areas will be depicted using a probability that closely matches 50 per cent or more spatial coverage</p> <p>Lower the base of the chart to FL100</p> <p>CB base information will not be depicted.</p>

Severe Squall Lines	It will not be possible to identify this parameter separately to other types of CB.	Remove the depiction of severe squall lines
Tropopause Height	Attempts to automatically generate tropopause height markers in a way that places the labels in “empty” chart space have not delivered satisfactory results. In addition to this, most changes in tropopause height are near to jet streams, and the placement of these markers near jet streams will renders charts unreadable.  Users can determine this information from the high resolution gridded WAFC temperature data sets.	Remove tropopause height markers.
Sandstorms and dust storms	No advisories or forecast data or advisories are available that permit sand and dust storms to be depicted.	Remove sand and dust storms.
Tropical Cyclones	Tropical Cyclone Advisories can be used to plot Tropical Cyclone positions, however data is only available for the T+6, T+12, T+18 and T+24 time-steps. This issue is discussed in more details in METP-WG/MOG/7 SN/24.	Under review.
Volcanic Eruptions	Volcanic Ash Advisories can be used to mark the location of volcanic eruptions.	Unchanged
Radioactive Incidents	Radioactive Release Advisories can be used to mark the location of radioactive incidents.	Unchanged

*Note: Areas of icing associated with non-convective cloud will not be included in png format SIGWX charts.*

2.11 Examples showing the appearance of SIGWX charts post November 2022 are shown in Appendix B. It is important to note that the chart range has been adjusted to FL100 to FL530 in these examples.

2.12 METP-WG/MOG/7 SN/26 proposes the Amendment 80 changes to Annex 3 and PANS-MET that would be required to facilitate these changes.

## MID-LEVEL CHARTS (EXISTING)

2.13 The WAFCs believe that there is no clear user requirement for the provision of separate medium level SIGWX charts and would like to retire them in November 2022.

2.13.1 Annex 3 states the following:

*“1.3.2 Types of SIGWX forecasts*

*SIGWX forecasts shall be issued as high-level SIGWX forecasts for flight levels between 250 and 630.*

*Note.— Medium-level SIGWX forecasts for flight levels between 100 and 250 for limited geographical areas will continue to be issued until such time that flight documentation to be generated from the gridded forecasts of cumulonimbus clouds, icing and turbulence fully meets user requirements”*

2.13.2 The medium-level SIGWX charts are only currently produced for 4 areas, and as a result cannot be used by many operators for flight planning as the charts do not offer global coverage.

2.14 At present the mid-level charts do not meet the requirements specified in Annex 3, paragraph 1.3.2, as they are produced for flight levels between FL100 and FL450. This means that there is a large amount of duplicate information being depicted on the high and mid-level charts.

2.15 From November 2022 the WAFc gridded turbulence data will change to use the GTG algorithms. This algorithm will enable objects to be drawn both Clear Air Turbulence and Mountain Wave Turbulence (note: the specific type of turbulence will not be designated). It will not be possible to automatically produce the “turbulence areas associated with non-convective cloud” areas that are currently depicted on medium level charts.

2.16 Cumulonimbus clouds can be captured on high level charts simply by lowering the base of the chart to FL100. Therefore the only parameter directly affected by the retirement of medium-level SIGWX charts is icing.

2.17 Operators requiring icing information for extended diversion time operations (EDTO) (formally known as ETOPS) planning do not use the medium-level charts due to their lack of global coverage. Instead the gridded WAFc Icing data is used. Also, EDTO refers to all icing, not just moderate or severe. Trials carried out by WAFc London in plotting moderate Icing objects on the high-level SIGWX chart areas renders them unreadable, thus including all icing is not possible.

2.18 There is no intention for WAFcs to stop providing Icing object data sets, therefore users can create their own bespoke SIGWX charts which display areas. Users can also use the gridded icing data sets, which permits the use of threshold values relevant to their own operations.

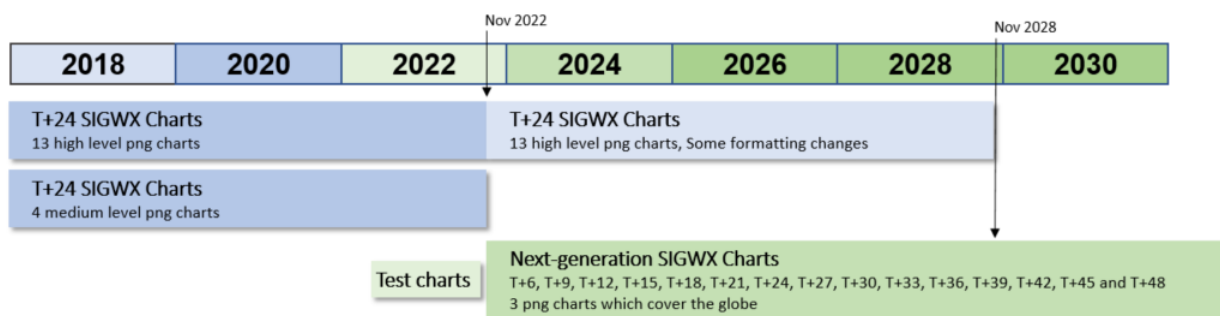
2.19 The table below summarises alternatives to the medium level information available to operators when the medium-level SIGWX charts are retired in November 2022.

<b>Medium-level SIGWX Today</b>	<b>Next-generation SIGWX charts and T+24 High Level chart (from Nov 2022)</b>
Jet Stream information; position, speed, height of jet core	Provided
Jet depth	Not provided. Users can determine this from the WAFC gridded wind data sets.
Cumulonimbus extent and top	Provided
Cumulonimbus base	Not provided. Users can determine this from the WAFC gridded data sets.
Icing areas associated with non-convective clouds	Not provided on charts, but this information will be provided as a SIGWX object data layer.
Tropopause height	Not provided on the SIGWX charts. Users will continue to receive the information from the WAFS gridded flight level and temperature of the tropopause data sets.
Turbulence associated with cloud other than CB	Not provided. Turbulence due to CAT and MTW will be available.
Sand and Dust Storms	Not Provided
Severe Squall lines	Not Provided
Tropical Cyclones	Provided in a format consistent with METP-WG/MOG7 SN/24
Volcanic Eruptions	Provided
Radioactive Incidents	Provided

2.20 Users will be able to generate their own bespoke charts including icing area forecasts using the SIGWX object data sets, which will provide global coverage. Most WIFS and SADIS workstation providers, and flight planning software already has the ability for users to create customised charts.

## IMPLEMENTATION TIMELINE

2.21 The implementation timeline for the proposed changes is shown below.



*Note: From November 2022 the T+24 high level charts will be identical in content to the T+24 next-generation charts.*

### 3. CONCLUSION

3.1 The use of traditional format high and medium level SIGWX charts in png format is declining with the development of sophisticated visualisation systems which can utilise the BUFR SIGWX, and in future IWXXM format, object data. Users of these systems are able to customise the data sets and chart areas to best suit their operating needs.

3.2 From 2022 provision of SIGWX object data for 15 different time-steps makes the current provision of png format charts unmanageable, and therefore changes need to be made.

3.3 Provision of T+24 High level SIGWX charts covering 13 different areas will continue until November 2028 to provide charts to users slow to adopt new technology or visualisation systems. Three new multi time-step SIGWX charts will be produced, primarily to enable users to cross check the data sets against their visualised data. The WAFCs believe that this information provides an adequate alternative to data currently provided in medium-level SIGWX charts, and therefore the medium-level charts can be retired in 2022.

3.4 The group is invited to formulate the following draft actions:

#### **Action 7/xx – Retirement of the medium-level SIGWX png charts**

That the METP-WG/MOG include in their working paper to METP/4 on the planned improvements to the provision of WAFS information, to recommend the retirement of the medium level SIGWX charts in November 2022.

#### **Action 7/xx – Changes to the high-level SIGWX png chart provision**

That the METP-WG/MOG include in their working paper to METP/4 on the planned improvements to the provision of WAFS information, to recommend that the adjustments proposed in Appendix C are implemented in November 2022.

*Note. - Changes to Annex 3 in Amendment 80 (and PANS-MET) to accommodate these adjustments are detailed METP-WG/MOG/7 SN/26).*

**Action 7/xx – Provision of SIGWX png charts for multi time-step SIGWX forecasts**

That the METP-WG/MOG include in their working paper to METP/4 on the planned improvements to the provision of WAFS information, to recommend that three new SIGWX charts are provided to accompany each time-step of next-generation SIGWX data from November 2022. These charts will include the parameters described in Appendix D.

**4. ACTION BY THE METP-WG/MOG**

4.1 The METP-WG/MOG is invited to:

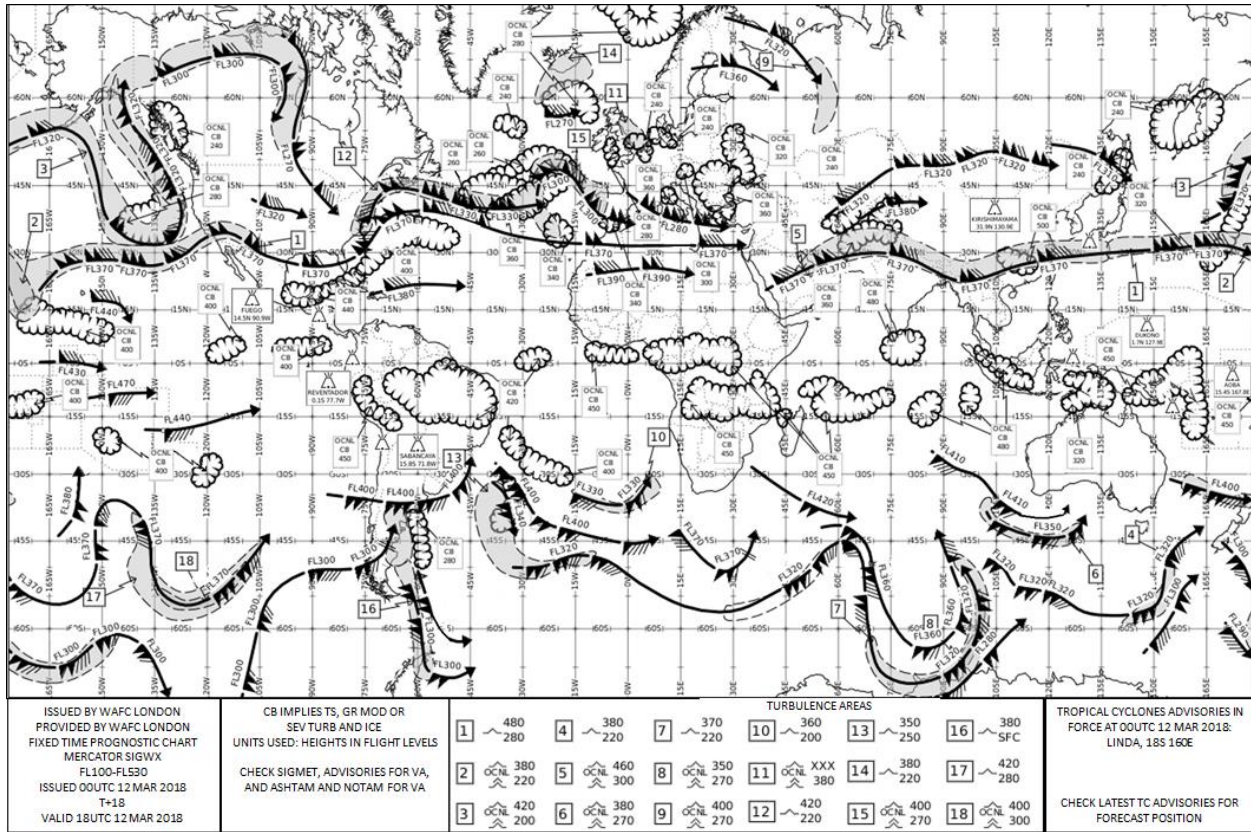
- a) note the information contained in this paper
- b) agree to the draft actions contained in 3.4.



# APPENDIX A

## NEXT GENERATION SIGWX CHART EXAMPLES

### 1) Mercator Chart



## 2) North Polar Chart



ISSUED BY WAFc LONDON  
 PROVIDED BY WAFc LONDON  
 FIXED TIME PROGNOSTIC CHART  
 N POLAR SIGWX  
 FL100-FL530  
 ISSUED 00UTC 12 MAR 2018  
 T+18  
 VALID 18UTC 12 MAR 2018

CB IMPLIES TS, GR MOD OR  
 SEV TURB AND ICE  
 UNITS USED: HEIGHTS IN FLIGHT LEVELS

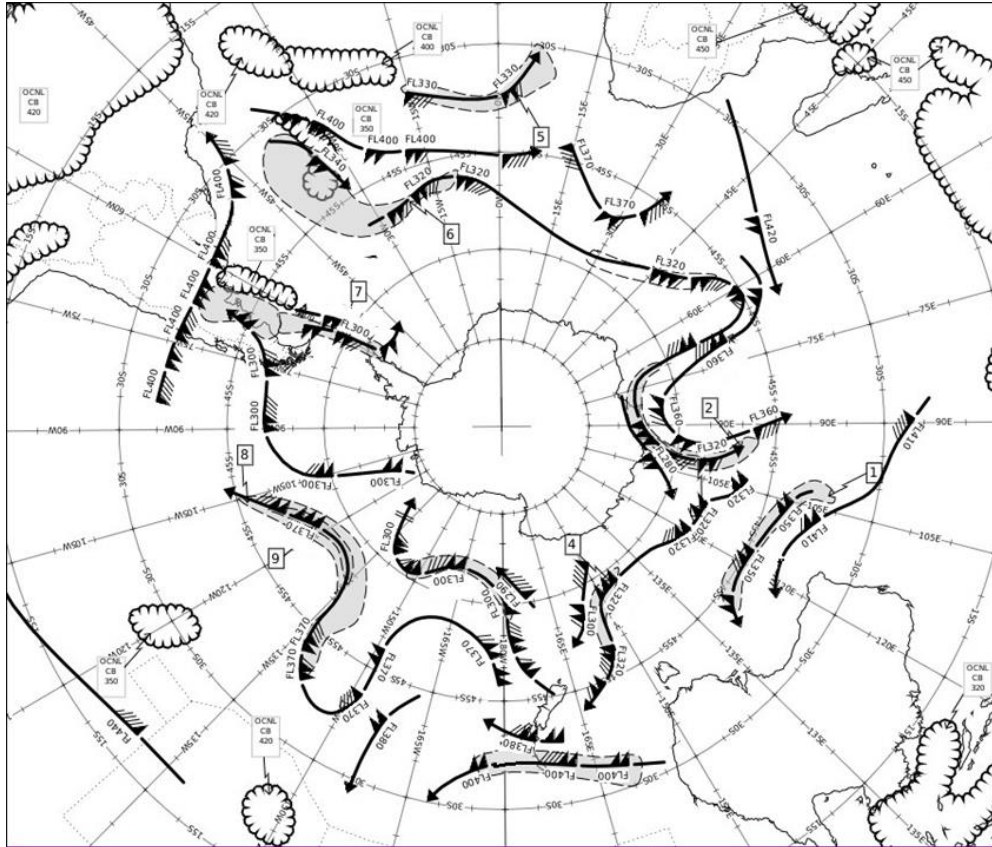
CHECK SIGMET, ADVISORIES FOR VA, AND  
 ASHTAM AND NOTAM FOR VA

TURBULENCE AREAS			
1	480 280	4	400 270
2	380 220	5	380 220
3	420 200	6	XXX 380
7	420 220	8	400 270

TROPICAL CYCLONES ADVISORIES IN FORCE  
 AT 00UTC 12 MAR 2018:  
 LINDA, 18S 160E

CHECK LATEST TC ADVISORIES FOR  
 FORECAST POSITION

### 3) South Polar Chart



ISSUED BY WAFIC LONDON  
 PROVIDED BY WAFIC LONDON  
 FIXED TIME PROGNOSTIC CHART  
 S POLAR SIGWX  
 FL100-FL530  
 ISSUED 00UTC 12 MAR 2018  
 T+18  
 VALID 18UTC 12 MAR 2018

CB IMPLIES TS, GR MOD OR  
 SEV TURB AND ICE  
 UNITS USED: HEIGHTS IN FLIGHT LEVELS

CHECK SIGMET, ADVISORIES FOR VA, AND  
 ASHTAM AND NOTAM FOR VA

TURBULENCE AREAS (CAT AND MTW)

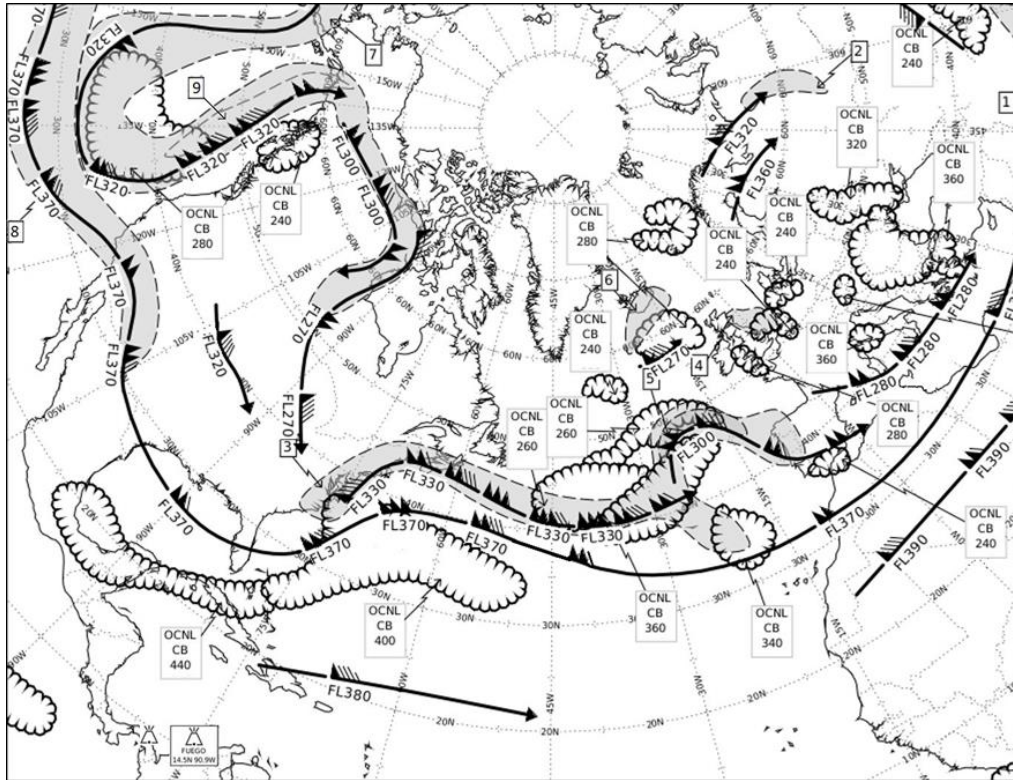
1	OCNL 380 CB 270	4	380 220	7	380 SFC
2	370 220	5	360 200	8	420 280
3	350 270	6	350 250	9	400 300

TROPICAL CYCLONES ADVISORIES IN FORCE  
 AT 00UTC 12 MAR 2018:  
 LINDA, 18S 160E

CHECK LATEST TC ADVISORIES FOR  
 FORECAST POSITION

# APPENDIX B

## 1) Area H SIGWX



ISSUED BY WAFc LONDON  
 PROVIDED BY WAFc LONDON  
 FIXED TIME PROGNOSTIC CHART  
 ICAO AREA H SIGWX  
 FL100-FL530  
 VALID 00UTC 13 MAR 2018

CB IMPLIES TS, GR MOD OR  
 SEV TURB AND ICE  
 UNITS USED: HEIGHTS IN FLIGHT LEVELS

CHECK SIGMET, ADVISORIES FOR VA,  
 AND ASHTAM AND NOTAM FOR VA

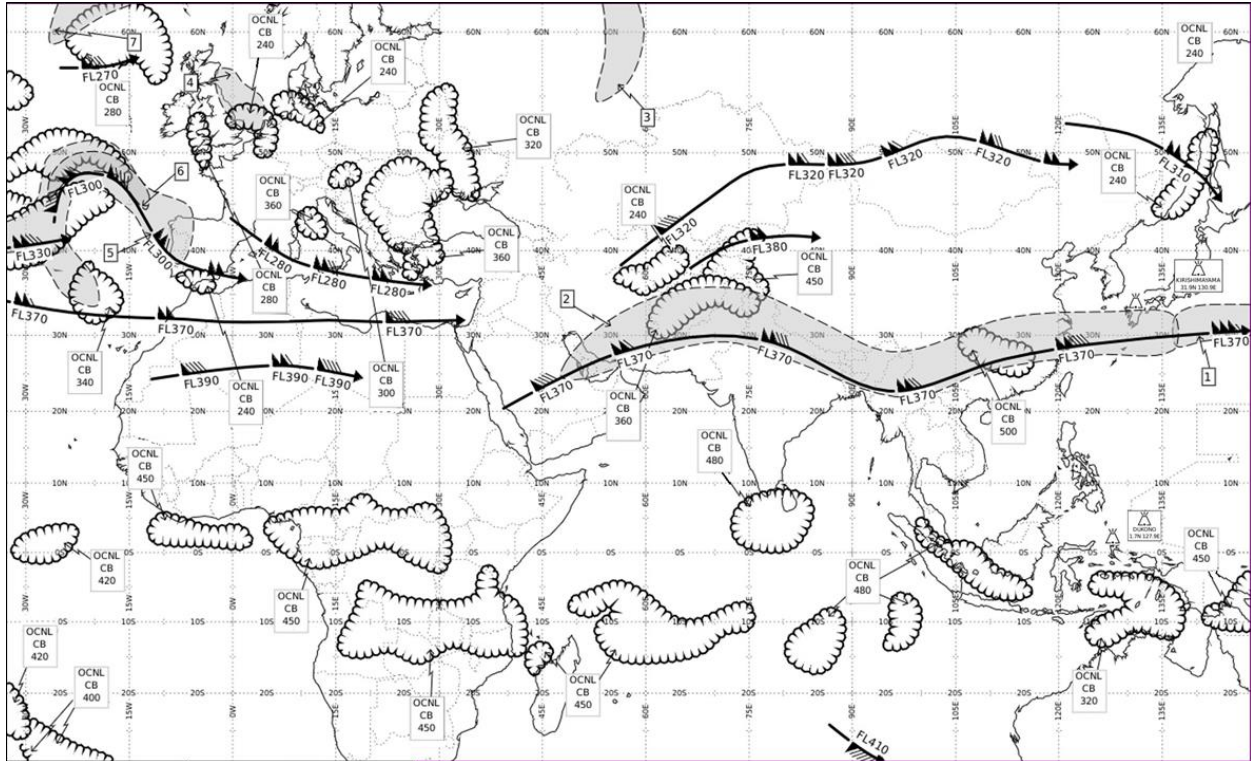
TURBULENCE AREAS)

1	460 300	4	430 380	7	420 200
2	400 270	5	400 270	8	480 280
3	420 220	6	380 220	9	400 270

TROPICAL CYCLONE ADVISORIES IN  
 FORCE AT 00UTC 12 MAR 2018:  
 LINDA, 18S 160E

CHECK LATEST TC ADVISORIES FOR  
 FORECAST POSITION

## 2) Area D SIGWX



<p>ISSUED BY WAFc LONDON          PROVIDED BY WAFc LONDON          FIXED TIME PROGNOSTIC CHART          ICAO AREA D SIGWX          FL100-FL500          VALID 00UTC 13 MAR 2018</p>	<p>CB IMPLIES TS, GR MOD OR          SEV TURB AND ICE          UNITS USED: HEIGHTS IN FLIGHT LEVELS          CHECK SIGMET, ADVISORIES FOR VA, AND          ASHTAM AND NOTAM FOR VA</p>	<p>TURBULENCE AREAS</p> <p>1 400-280          2 460-300          3 400-270</p> <p>4 xxx-300          5 420-220          6 400-270</p> <p>7 280-220</p>	<p>TROPICAL CYCLONE ADVISORIES IN          FORCE AT 00UTC 12 MAR 2018:          LINDA, 18S 160E</p> <p>CHECK LATEST TC ADVISORIES FOR          FORECAST POSITION</p>
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**APPENDIX C – SUMMARY OF CHANGES TO HIGH LEVEL SIGWX PNG FORMAT CHARTS, FROM NOV 2022**

Retain	Adjust	Remove
	Change the applicable height range of the charts to FL100-FL530	
Jet stream position, speed, and height of the jet core		Jet depth information.
Areas of MOD and SEV turbulence (due to CAT and MTW) to be marked		
CB top information	CB forecasts will be based on probabilistic information, and areas will be depicted using a probability that closely matches 50 per cent or more spatial coverage	Embedded CB or CB concentrated along a line, and severe squall lines. CB base information
		Tropopause height markers.
		Sand and dust storms.
	Tropical cyclone depiction - to be consistent with the decision reached in METP-WG/MOG/7 SN/24	
Marker to show the location of volcanic eruptions.		
Marker to show the location of radioactive incidents.		

## APPENDIX D – MULTI-TIME-STEP SIGWX CHART PROVISION FROM NOVEMBER 2022

### **TIMESTEPS**

T+6, T+9, T+12, T+15, T+18, T+21, T+24, T+27, T+30, T+33, T+36, T+39, T+42, T+45, T+48

### **CHART AREAS:**

- One Mercator projection chart which extends from 75N to 60S and circles the globe
- One polar stereographic chart centred on the North Pole, which extends out to at least 45N
- One polar stereographic chart centred on the South Pole, which extends out to at least 45S.

### **INFORMATION DEPICTED ON THE CHART**

- Significant weather between FL100 and FL530
- Jet Stream information, including height of the jet core.
- Cumulonimbus areas (extent) with a probability that closely matches 50 per cent or more spatial coverage.
- Cumulonimbus top information.
- Areas of moderate or severe turbulence
- A marker depicting volcanic eruptions that are producing ash clouds significant to aircraft operations
- A marker depicting the location of a release of radioactive materials into the atmosphere
- Information on the location of tropical cyclones (in the format agreed in METP-WG/MOG/7 SN/24)

*Note. - Changes to Annex 3 in Amendment 80 (and PANS-MET) to accommodate these adjustments are detailed METP-WG/MOG/7 SN/26).*