



World Meteorological Organization

Infrastructure Commission

Standing Committee on Earth Observing Systems and Monitoring
Networks

**Second Hybrid Meeting of the Joint Expert Team on Aircraft-Based
Observing Systems (JET-ABO)**

27 – 30 June 2022, Geneva, Switzerland

Final Report

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Agenda

1. Opening of meeting

1. Welcome from Chair
2. Adoption of agenda
3. Welcome from SC-ON Executive

2. Report of Chair

3. Reports of Subgroup Leads

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2. Coordination Group on WICAP
3. Subgroup on Derived & Third-party Data
4. Subgroup on Data Management
5. Subgroup on Technical Materials & Guidance
6. Subgroup on Turbulence
7. Subgroup on UAS
8. Subgroup on Water Vapour Measurement

4. High Priority Work Plan Tasks

1. Workshop on Aircraft Derived Data
2. UAS Demonstration Campaign
3. Development of the ABO Metadata Repository
4. ABO Lead Centre & Global Data Centre

5. ABO & WICAP Strategy & Planning

1. Future Outlook for Aviation
2. Regions II and V
3. Regions I and VI
4. Regions III and IV
5. Global Strategy and Planning

6. Future activities and priorities for JET-ABO 2024-2027

7. Reporting to INFCOM

8. Any other business

9. Closure of the meeting

General Summary

1. Opening of meeting

The second meeting of the WMO Infrastructure Commission Joint Expert Team on Aircraft-Based Observing Systems ([JET-ABO](#)) was conducted in both in-person and virtually over 27-30 June 2022.

As a Joint Expert Team, the JET-ABO is jointly managed by the SC-ON and the Standing Committee on Measurements Traceability and Instrumentation (SC-MINT), while also having a connection with a number of other teams within both SCs.

The meeting was opened by the Chair of the JET-ABO, Mr Curtis Marshall who welcomed the members of the team to its second formal meeting of the current WMO inter-sessional period. The meeting provisional agenda was presented and agreed as above.

The team was addressed by Ms Estelle Grueter, Chair of the Standing Committee on Earth Observing Systems and Monitoring Networks (SC-ON) who talked briefly about several key activities within the SC-ON with likely linkages to ABO activities, including capacity development, tiered networks and station clusters. Ms Grueter also mentioned several important activities of the JET, including the development of the ABO metadata repository and the ABO Lead Centre monitoring activities, which have linkages with primary WIGOS tools, OSCAR/Surface and the WIGOS Data Quality Monitoring System. She emphasized the importance of interacting with other teams within the INFCOM, particularly the ET on WIGOS Tools and the Joint Expert Team on Earth Observing System Design and Evolution (JET-EOSDE).

Mr Etienne Charpentier, Chief of the Observing Networks and Measurement Division of WMO, also welcomed present and online attendees, highlighting the importance of the contribution of ABO to the Global Basic Observing Network (GBON) and the Regional Basic Observing Network, which are both currently being defined at the station level, while highlighting the need for the INFCOM to make efforts to streamline business continuity, particularly when moving from one inter-sessional period to the next.

The attendance record of team members is provided in [Annex I](#).

2. Report of Chair

Mr Curtis Marshall, presented the Report of the Chair, particularly highlighting several key activities in the current work plan (see [Annex II](#)) of the JET and the need to commence development of plans for priority ongoing and new activities within the next inter-sessional period of WMO over 2024 – 2027. In particular, Mr Marshall mentioned:

- The need to strengthen efforts relating to WICAP development, noting that, while the WMO/IATA agreement and regional framework was in place in practice, very little had been achieved in relation to the establishment of new programmes. The team was urged to particularly target projects for development in data sparse areas, highlighting Africa and the Kenya AMDAR Programme and South America, where the LATAM programme had been greatly reduced in coverage recently.
- Efforts currently underway to review and revise the important ABO technical guides, including the Guide to Aircraft-Based Observations (WMO No. 1200) and Chapter 3 of Volume III of the Guide to Instruments and Methods of Observations (WMO No. 8), which need to be readied for submission at the INFCOM second session in October 2022.

- The importance of other sources of ABO in addition to AMDAR, including Automatic Dependent Surveillance – Contract (ADS-C), FLYHT AFIRS and TAMDAR and Mode-S and other related ADS – Broadcast (ADS-B) systems, for which there was a need to develop and improve data management and financial frameworks to ensure their enhancement and extension, their future availability and data quality.
- The excellent work that had been completed so far in relation to the development of the UAS Demonstration Campaign (UAS-DC).
- Data management issues and activities including quality issues such as the known AMDAR air temperature bias, the development of the Lead Centre role and functionality, and the development of the ABO Metadata Repository (ABO-MR).
- The upcoming JET-ABO Workshop on Aircraft Derived Data, to be held in-person and virtually in September 2022.

The Chair of the JET also expressed concern about the status of the AMDAR Operating Fund, for which contributions had generally decreased in recent years, at the same time as the JET was seeking to continue to support activities such as the availability of EUMETNET AMDAR data over Africa and the development of the ABO-MR, among others.

While the division of the team into subgroups had worked well in advancing the work plan of the JET, the Chair suggested it was important to try and make meetings more efficient and, if possible, reduce the frequency of meetings in favor of working on tasks and activities.

3. Reports of Subgroup Leads

Subgroup Leads each provided a brief presentation on the status of their respective subgroup work programs and status since the first session of the JET. The structure of the JET subgroups is provided within [Annex II](#).

3.1 JET-ABO Leadership Group

The JET-ABO Leadership Group had continued to meet at least monthly so as to progress the work plan activities assigned to it as well as to coordinate the activities and meeting of the JET.

The following are the key issues that were raised by the subgroup Lead and Chair of the JET, Mr Marshall:

- **Assessment of COVID Impact** - the subgroup and the JET had not made significant progress in relation to the analysis of the impacts and lessons learned from the COVID pandemic, which resulted in a cut in ABO data volume of up to around 80% in May 2020. In practice, there had been great success in some mitigation of these data losses through activities within the programme, such as:
 - Availability of FLYHT AFIRS and TAMDAR data;
 - Move to effective operational status of the EUMETNET/E-ABO/EMADDC Mode-S program and data availability;
 - Use of AMDAR Data Optimisation Systems functionality to increase data availability where possible.

The Chair informed that there was discussion within NOAA on a more formal study to leverage this insight so as to consider the possible reallocation of US funds from ABO redundancy over the US observing region, to the wider international and/or global region.

- Through the JET-ABO-LG, the JET continued to provide input to the JET-EOSDE and the SC-ON work groups of the SC-ON on various matters, including the reporting of JET-ABO activities and progress.
- The Chair recommended that the JET needed to concentrated efforts in the coming weeks and months to progressing the review of the ABO guidance materials.

3.2 Coordination Group on WICAP

Mr Steve Stringer presented the status and progress made by the Coordination Group on WICAP, highlighting that the group had made good progress in relation to the following activities and tasks:

- The Airline Participation Agreement had been advanced and was near completion.
- The Risk Register for the WICAP Implementation Plan had been maintained.
- Several promotional materials had been advanced or finalized, including:
 - 2 WICAP Videos (published in the WICAP website): Introduction to WICAP and Benefits of WICAP;
 - WICAP Airline Manual (near finalisation): A roadmap for airline participation in WICAP; and
 - WICAP Flyers (near finalisation): Introduction, requirements, benefits and how to join.
- Communications with airlines had commenced in some regions.
- A Target Airline Analysis had been completed focused on determining the technical readiness of the target airlines to join AMDAR and estimated costs to do so (see Annex 3), along with recommendations, strategies and activities for implementation of WICAP.

From the Target Airline Analysis, the following were recommended as the first priority steps:

1. Develop communication material on WICAP.
2. Contact airlines that responded to the survey and also continue to collect information from other airlines that have not yet responded through the survey.
3. Define, identify and allocate budget for initial development efforts for regional WICAP implementation.
4. Initiate concrete on-boarding actions with most mature Airlines jointly with IATA, Regional Entities and National ABO experts.

Mr Stringer also highlighted several concerns regarding the development of WICAP that include:

- Lack of momentum in the programme development.
- A need for development and strength of regional collaboration.
- The fact that negotiations with DSPs for cutting the costs of AMDAR downlink messages had not yet been addressed.
- There was a need to demonstrate that WICAP could reduce program costs.
- Resourcing and funding WICAP development and operation seems problematic.
- Despite the implementation of the WICAP Data Policy, sharing of meteorological data was still a concern.

The subgroup recommended the following priorities for WICAP for 2022/23:

1. WMO and IATA to consider opportunities on exchanging of meteorological data (wind & temp) between the organizations.
2. Determining how to best resource the development of national and regional AMDAR programmes.
3. Development of agreed processes and procedures for communicating with airlines, particularly considering one-to-one discussions versus joint promotional sessions.
4. Communication with OEMs avionics vendors to provide standardized AMDAR and turbulence reporting as option on new aircraft delivery and for retrofit.

In terms of AMDAR programme development, it was agreed that efforts should focus on development in Regions I and III.

3.3 Subgroup on Derived & Third-party Data

Mr Steve Stringer and Mr Jan Sondij jointly presented the progress and status of the Subgroup on Derived and Third-party Data, with the following key points made:

- The reports on ADS-C and Mode-S status were still under development and future work would focus on development of pages for the WMO Community Platform.
- **Funding of ABO global data sources** - While the availability of FLYHT TAMDAR and AFIRS data was ongoing and welcomed, there was a need to consider how these and other data sources, such as ADS-C and ADS-D might be collaboratively resourced and financed in the future. This should be followed up as an activity of the JET-ABO with possible recommendations being made to the SC-ON and INFCOM on possible solutions.
- **Workshop on ADD** - A draft program has been developed and plans made for the Workshop on Aircraft Derived Data, which would take place as an in-person and virtual event over 5-7 September in Geneva at the WMO Headquarters.

ADS-C Development

The Subgroup had requested the Secretariat to contact ICAO directly via a formal letter to request ICAO advice and assistance in furthering the aims of the JET to expand availability and access to meteorological data derived from ADS-C.

While the group has had some success with national level liaison with ANSPs, including most recently, provision of data over FIR Edmonton, it was hoped that ICAO might assist in supporting a unified approach to extending both production and availability of data so that it can be processed and provided to WMO through a global process, as is currently done under the arrangements NOAA has with Collins Aerospace. To this end, earlier in 2022, the Secretariat wrote a letter to ICAO formally requesting assistance on both ADS-C and the UAS demonstration campaign, however, this has not yet borne fruit and it may be worth considering undertaking the approach on a national basis, coordinated by WMO.

EMADDC Operations

Mr Sondij also provided an update to the meeting on the status and advances made at the EUMETNET/E-ABO EMADDC, in particular in relation to availability of Mode-S data and future plans to process ADS-C data, with the new EMADDC website now operating at: <https://emaddc.com/default.aspx>

3.4 Subgroup on Data Management

Mr Curtis Marshall provided a presentation on the status of activities and tasks of the Subgroup on Data Management (SG-DM), noting the following in particular:

- **Supplementary AMDAR Data** - The AMDAR Operating Fund continued to finance provision of supplementary AMDAR data over Africa from both the Kenya AMDAR and the EUMETNET E-ABO AMDAR programmes, for which 45k CHF is budgeted annually. The Secretariat was close to finalizing a tripartite agreement with Kenya Airways and Kenya Meteorological Department (KMD) that would ensure availability of data from the two B737 AMDAR reporting aircraft to the end of 2022 and backdated to April 2021. It is important that the Region I TT-ABO commence plans to consolidate the Kenya AMDAR Programme under the RA I regional AMDAR programme, for which the US is known to be interested in supporting with funding.
- Establishing Kenya as a regional data processing hub continued to be an aim of the Subgroup and the JET and this should be incorporated in plans to develop AMDAR and ABO over Africa under WICAP.
- Global FLYHT AMDAR and AFIRS was also being made available by the US under its arrangement with FLYHT. As would be expected, the supplementary AMDAR and FLYHT data provided has significant positive impact on NWP over Africa, as has been measured with ECMWF FSOI data when justifying the continued provision of these data.
- **Impact Studies** – The Subgroup is in the process of compiling a list of ABO impact studies that might be recommended to be adopted by JET-EOSDE to be supported by NWP Data Centres and reported at the next Impacts of Observing Systems Workshop, expected in 2024. The Subgroup also has an ongoing task to consolidate the [ABO newsletter article](#) on the 2020 impacts workshop into a more comprehensive report on recent ABO impact results.
- **Data Quality Issues** – Little progress has been made in relation to the known data quality issues that include in particular the “B787 wind direct” issue and the long-standing air temperature bias issue. It was agreed that the air temperature issue in particular required addressing as a priority in the next 12 months and over the next inter-sessional period.

Developments in relation to ABO metadata management are reported under 4.3.

Matters relating to the development of the functionality of the Lead Centre on ABO and the role of the Global Data Centre for ABO are reported under item 4.4.

3.5 Subgroup on Technical Materials & Guidance

Mr Dean Lockett reported on the status of progress and activities of the Subgroup on Technical Materials and Guidance.

Update of WMO No. 1200 and WMO No. 8

Current high priorities of the Subgroup and the JET are to complete the review of the Guide to Aircraft-Based Observations (WMO No. 1200) and the Chapter on Aircraft-based Observations with the Guide to Instruments and Methods of Observations (WMO No. 8, Vol. III, Chapter 3). The review program has been initiated by the Secretariat with all team members requested to contribute with the aim of having the draft of the update of these materials ready by end-July and ready for submission to the INFCOM session in October 2022.

Additionally, other activities of the Subgroup include:

- A future need to review and revise relevant sections of the Manual on, and Guide to WIGOS to ensure consistency. Of immediate concern was the need to ensure that these documents reflect requirements for issuing of WIGOS Station Identifiers by the ABO Metadata Repository.
- Continued coordination of 2 volumes per year of the ABO Newsletter.
- AMDAR Onboard Software Functional Requirements Specification, AOSFRS V1.1 – Mr Doug Body was currently working on a review of this document, which would be provided to the subgroup in due course with a view to producing an updated version in 2023.

3.6 Subgroup on Turbulence

Mr Greg Meymaris reported on the status of the Subgroup on Turbulence, noting the following in particular:

- To determine requirements for turbulence information by various user communities, the subgroup had progressed the design of a questionnaire that was expected to be released in the 2nd half of 2022.
- A list of EDR reporting software and compatible avionics was maintained by the group, however, this currently required updating. In terms of EDR compatibility with aircraft, the following was the current status:
 - Airbus has completed the implementation on A350 and is available for retrofit, and was working on others.
 - For Boeing EDR is already available on 777, 787, 737MAX, and in future 777X.
 - Teledyne has availability for 737NG, A32X, A330
- **EDR Standards** – the joint-working groups, RTCA SC-206/EUROCAE WG-76 SG-4 had commenced work on an EDR harmonization process which would lead to the production of a whitepaper with recommendations, expected March 2023. The whitepaper would seek to address the SG-4 task on whether the document, DO-370, Guidelines for In Situ Eddy Dissipation Rate (EDR) Algorithm Performance, should be updated or a new document produced to address new technologies that have emerged since DO-370 was published.
- Key issues in general relating to turbulence are:
 - Expansion of on-board software remains a challenge because of costs and effort and continuing to work with OEMs seems to be the best way forward.
 - Quality monitoring and control remains a challenge and the difficulty of comparing data produced by different algorithms is significant.
 - Data sharing – while airlines are happy to make the data available to the met. Community, they have concerns over its security and de-identification, and this remains a factor in convincing them to join the program.

The subgroup recommends that some of the activities suggested to be adopted by the ABO programme in the ABOS Strategy and Implementation Plan (A-SIP) should be integrated into the work plan of the JET-ABO and the Subgroup.

3.7 Subgroup on UAS

Ms Debbie O’Sullivan reported on the status and progress of activities coordinated by the Subgroup on UAS (SG-UAS).

In reality, the work of the Subgroup was almost entirely focused on the coordination and planning of the UAS Demonstration Campaign ([UAS-DC](#)), which is reported in detail under agenda item 5.1.

The subgroup is also advancing the development of the whitepaper on UAS, which follows from the BAMS paper which was an initial outcome of the CBS/IPET-ABO Workshop on UAS of August 2019.

Under agenda item 7, there was also a presentation and some discussion on the future integration of UAS into WIGOS.

The following issues were highlighted:

- The Subgroup was aiming to finish an initial first draft of the whitepaper and circulate by September 2022.
- Future work would include a need to work with UAS operators and regulators to improve access to airspace so as to support integration into operations.

In relation to INFCOM-2, the Subgroup was expecting:

- Submission of decision on the UAS CF-NetCDF adoption as a WMO standard by the SC-IMT/Task Team on CF-NetCDF.
- Submission of the UAS-DC plan, likely as an Information Document.

3.8 Subgroup on Water Vapour Measurement

Ms Carmen Emmel, Lead of the Subgroup on Water Vapour Measurement (SG-WVM) reported on the progress made by the subgroup on assigned activities, including:

- A [new page on WVM](#) has been incorporated on the ABOP Application Area of the WMO Community Platform, containing a history of WVSS-II, with the related section on TAMDAR/humidity still under development.
- A flyer on WVM has been developed and was expected to be published in the 2nd half of 2022.
- A draft business case for NMHS and airlines for WVM is under development and quite advanced.

The following issues were highlighted:

- While FLYHT had recently taken over the rights to manufacture and sell WVSS-II units, they did not take over the holding of the related Supplementary Type Certificates (STC) held by the previous owner. This means that all new implementations will have a STC process and associated costs.
- Global coverage WVM cover remains limited to the approximately 150 WVSS-II units implemented in the US and Europe (9) and that provided by the TAMDAR system. The limited coverage makes impact harder to assess, which also impacts the business case.
- Given the STC issues, cost of aircraft-based WVM remains high and it requires a strong business case and significant dedicated resources.
- Engagement with the industry will be critical to further expansion of WVM and it is hoped that IATA will be instrumental in that aspect via collaboration under WICAP.

In discussion, it was highlighted that contrail avoidance will be a future issue for the aviation industry and there would likely be potential to tie this to CORSIA and somehow link with water vapour measurement by participating aircraft.

Measurements required to establish an analysis of possibilities associated with contrail avoidance.

The Subgroup recommended that:

- The JET continue to focus efforts on WVM expansion through both WVSS and TAMDAR.
- Under WICAP, efforts should focus on industry engagement as well as the potential to leverage the ICAO CORSIA emissions reduction scheme.
- The JET members should assist in review of the developing business case document and flyers.

4. High Priority Work Plan Tasks

4.1 Workshop on Aircraft Derived Data

Under the SG-DTD, work has progressed on developing the program and speakers for this workshop, which would take place over 5-7 September 2022. The [WMO CP site](#) was already established and would be used to host the program and videoconferencing information.

The aims of the workshop are given below.

To raise awareness and share best practices on the potential opportunities and use of aircraft derived data in the meteorological domain. Including:

1. Technical aspects of Mode S, and ADS-B, ADS-C Aircraft Derived Data.
2. Share information and educate member ABO experts on ADD.
3. Identify the current status and provide likely future development scenarios.
4. Determine capabilities for global, regional expansion.
5. Identify ways to collaborate internationally and across the various sectors.
6. Identify risks and requirements for assuring access to data.
7. Present impact studies and work done in various NMHS agencies to operationalize Mode-S and other ADD data.

The workshop is aimed at: NMHS member experts, Aviation sector experts, Commercial operators & Service providers, Standards representatives, Aviation organization experts.

Speakers were being asked to pre-record presentations so that the material could be used as an online resource in the future.

4.2 UAS Demonstration Campaign

Under the SG-UAS, much work has been done on advancing planning and coordination of the UAS-DC.

The fundamental aspects of the scope of the campaign are summarized in the table below.

Element of Scope	Proposed
Observations Period	6 months, March – August 2024
Special Observing Periods (SOP)	2 x 2 - 4 week periods, higher temporal resolution, wider coverage <ul style="list-style-type: none"> • 1 in Q2 2024 • 1 in August 2024 overlapping with Paris Olympics
Geographical scope	Aiming at a global campaign - Highly dependent on participant operators

UAS Types	<ul style="list-style-type: none"> • Autonomous copter or fixed-wing small UAS • Remote-piloted copter or fixed-wing small UAS • Automated high altitude fixed-wing UAS • Remote-piloted high altitude fixed-wing UAS
Observations Locations & Modes	<ul style="list-style-type: none"> • Oceanic Atmospheric Boundary Layer (ABL) - Vertical profiles of the atmospheric boundary layer with UAS from stationary or moving platform location. • Remote land, mountain, coastal and cryosphere observations and vertical profiles with UAS. • Upper troposphere and lower stratosphere observations of UAS. • Testbed observations and vertical profiling UAS. • Symbiotic UAS observations collected by private UAS performing some other primary mission (e.g., package delivery).
Variables	Modes of operation (not limited to):
<p>Required Physical Variables (1 or more)</p> <ul style="list-style-type: none"> • Air temperature • Air pressure • Relative humidity <p>Examples of Additional Physical Variables</p> <ul style="list-style-type: none"> • wind speed • wind direction • snow cover • snow depth • soil moisture • albedo • roughness length • aerosols or particulates • volcanic ash • turbulence 	<ul style="list-style-type: none"> • Boundary layer vertical profiles • Profiling to above the boundary layer • Straight and level runs (SLRs) in the boundary layer • Straight and level runs (SLRs) above the boundary layer • High level (troposphere) profiling and SLRs • Very high level (upper troposphere/ lower stratosphere) profiling and SLRs • UAS dropped from larger aircraft or stratospheric balloons

Ms Debbie O’Sullivan reported in particular of the following progress that had been made:

- In addition to monthly meetings of the UAS-DC Scoping Planning and Organizing Committee (SPOC), regular meetings of 3 other groups with responsibility for collaborating on key areas of the UAS-DC have been held:
 - UAS-DC Data User Group
 - UAS-DC Subgroup on Airspace Regulation
 - UAS-DC Data Representation group
- The UAS-DC Plan has been developed and maintained and would be submitted to INFCOM-2.
- [UAS CF-NetCDF data representation](#) has been developed and is being readied for approval of INFCOM-2 (October 2022).
- Monthly meetings of Scoping Planning & Organising Committee ([SPOC](#)).
- Group on Airspace Regulation has been formed – met 3 times.
- [Participant certification form](#) approved and available.
- Updated letter to WMO Members has been sent and new survey on participation launched.
- Formalisation of membership of SPOC commenced.
- Pre-Participants Meeting 3 survey on issues and ideas of participants had been launched.
- The [UAS-DC Community Platform site](#) has been developed and maintained site.

The next important activities to be given priorities are expected to be:

- Finalization of CF NetCDF template ahead of INFCOM second session, start work on BUFR format for UAS.
- Finish White Paper on UAS ready to share with participants ahead of next participant meeting
- UAS-DC participant meeting, finalise, share and test the CF NetCDF UAS template
- INFCOM Second Session – Final approval to proceed
- WMO Congress – progress report, promotion
- UAS-DC Observing period – scope to be extended if participants have sufficient funding to do so.
- Finalization of reports, recommendations, report to INFCOM

4.3 Development of the ABO Metadata Repository

Mr Dean Lockett reported on progress with the development of the ABO Metadata Repository (ABO-MR) and in particular focused on the process for assignment of WIGOS Station Identifiers by the ABO-MR.

ABO-MR Development Progress

The team recalled that in January 2022, WMO had contracted the company, Wishtree, to develop the ABO-MR based on a tender specification adapted from the Guide to ABO, Appendix D and additional functional requirements that had been developed in the process of defining specifications for the original expected implementation within the central OSCAR/Surface system. While the project commenced 2 months later than expected, in April 2022 and progress has been slower than hoped in defining detailed requirements and the technical solution, there is an expectation that the completion of the project will be achieved within the first half of 2023.

ABO WIGOS Station Identifiers

In the course of developing the detailed specifications for the ABO-MR, it has been necessary to more carefully consider how best to handle aircraft identifiers within and by the ABO-MR and Mr Lockett described to the JET the specification that has been proposed as a solution. Following are the key aspects of this proposed solution:

- Under WMO policy, programmes and decentralized OSCAR/Surface systems can/must be provided with an Issuer of Identifier to be able to issue WSIs on behalf of programmatic stations. This requirement is related to the fact that it is considered technically too difficult to assure uniqueness when issuing WSIs with a country Issuer of Identifiers.
- ABO-MR will therefore have an Issuer of Identifier in the range 21011 – 21999, to be assigned by WMO via INFCOM-2 and an update of the Guide to WIGOS.
- Therefore, WSIs in the ABO-MR will have the form: 0.21011.0.N, where N will be an integer commencing at 1.

Based on the above, it is currently proposed that the Issuer of Identifier, 20005, currently assigned for WMO use for AMDAR aircraft, will not be used in the ABO-MR to incorporate the use of previous national AMDAR identifiers as previously expected. Instead, it is proposed to use the concept of a System Aircraft Identifier (SAI), which will allow ABO programmes to assign national aircraft identifiers at the ABO system level, which in turn are linked by the ABO-MR to the WSI. In this way, a single aircraft will have a unique WSI to which 1 or more SAIs can be linked. Additionally, WSIs will be able to be linked within the ABO-MR, which is necessary for ABO systems where a single aircraft may report in more than

one ABO system and even in more than one ABO programme, for example, an aircraft reporting AMDAR under the EUMETNET/E-ABO programme reporting ADS-C data under the US ABO programme.

The JET was informed that Appendix D of the Guide to ABO, which defines requirements for ABO metadata, would be updated to reflect this proposal, as well as changes to requirements and procedures arising from the development of the ABO-MR.

The JET requested that a follow up meeting on WSIs should be arranged to further discuss and agree on the proposal.

4.4 ABO Lead Centre & Global Data Centre

Lead Centre Development

Mr Dean Lockett provided a report to the JET on the status of the Lead Centre and Global Data Centre for ABO, for which activities are managed under the Subgroup on Data Management. The meeting was reminded that:

- The Lead Centre for Aircraft Observations was a designated Monitoring Centre under the WMO Global Data Processing & Forecast System, for which Terms of Reference are defined in the Manual on the GDPFS. Under the GDPFS, USA, Washington WMC is the Lead Centre for aircraft observations.
- Appendix 2.1.2 of the [Manual on GDPFS](#) contains Procedures and Formats for the Exchange of Monitoring Results, on a monthly basis.
- Under WIGOS, the Data Quality Monitoring System will provide a more comprehensive monitoring program for WIGOS component systems and the WDQMS for conventional surface-based systems is now operational and supported by Regional WIGOS Centres - [WDQMS \(wmo.int\)](#)
- Requirements for monitoring of ABO under WIGOS (WDQMS) are in [Guide to ABO](#), Appendix B, which provides extended requirements for monitoring of ABO, including:
 - Daily availability reports of ABO
 - Daily data quality reports T, H, U
 - Monthly monitoring
 - Functional requirements for Lead Centre Online Facilities.

[WMO No. 1224, Technical Guidelines for Regional WIGOS Centres on the WIGOS Data Quality Monitoring System \(wmo.int\)](#), provides requirements for WDQMS Regional WIGOS Centres for Land-surface and Upper-air Land stations. This means that, once the Lead Centre for ABO is established, RWCs could utilize the Lead Centre functionality to monitor ABO under the WDQMS, possibly requiring an update to WMO No. 1224.

It was therefore recommended that:

1. The JET-ABO should continue with development of the LC functionality as per the Guide to ABO.
2. The Secretariat should analyse options for establishing the Lead Centre under WIGOS.
3. JET-ABO should continue to liaise with ET-WIGOS Tools regarding integration of ABO into WDQMS with RWC functions.

The JET also decided that there would be no requirement for any decision relating to the Lead Centre for INFCOM-2.

Global Data Centre for ABO

The designation of the WMO Global Data Centre for Aircraft-Based Observations (GDC-ABO) was approved by EC-69 (Res. 6, May 2017), based on the Recommendation of CBS-16:

Recommends the Executive Council:

To designate the MADIS as the WMO GDC-ABO;

To request the Secretary-General, in collaboration with CBS, to establish an agreement with the United States, to be designated and authorized to operate the WMO GDC-ABO under the terms of reference defined by CBS and to come into effect as soon as possible.

At this point, the 2nd part of this resolution has not yet been completed.

While the work that the JET has done earlier to review and provide feedback on the AMDAR data viewer application available in the US MADIS platform had been consolidated in a recent update, the work to formalise the GDC as a WMO centre under INFCOM had not been progressed. In relation to this:

- It is confirmed that, while the GDC had been recommended to be designated by CBS, this decision had been confirmed by WMO Executive Council as a WMO centre and there was no need to make any formal changes to this designation at the WMO Constituent Body level.
- At the current time, NOAA does not require a formalized agreement with WMO on the GDC and its operation and there was no immediate high priority to advance this activity, particularly while there is a degree of future change expected within NOAA relating to MADIS operations.

Based on these considerations, it was agreed that the action taken by the JET-ABO in relation to the GDC should be:

1. The SG-DM to review and update functional requirements for the GDC, taking into account WICAP and 3rd party ABO data;
2. NOAA should be requested to assess whether it was still able to meet requirements to operate the GDC and identify needs for any development;
3. SG-DM to develop a proposed WMO/NOAA agreement, as required by Res. 6 (EC-69);
4. Make GDC operational and publicise its availability.

5. ABO & WICAP Strategy & Planning

5.1 Future Outlook for Aviation

Mr Kyu-Bin Lim, IATA Economist presented an overview of the outlook for the aviation industry, and airlines as the recovery from the downturn due to the pandemic continues. There are positive outlooks for the industry while the travel restrictions are globally easing, people have a willingness to travel, and cargo traffic is increasing. However, there are still risks to the recovery due to various factors, including the debt burden, increased labor costs, increased energy costs, concerns related to climate change and challenges related to geopolitical conflict.

Mr Lim explained that the cargo carrying sector has already reached the 2019-levels (cargo traffic ton kilometers, CTK), while passenger traffic has seen a strong recovery within the major domestic markets. European cargo carriers are impacted by the conflict but there is remarkable performance in Latin America, and overall Air cargo prices have become more competitive compared to marine cargo. International passenger traffic is also on the rise, however, the area of Asia Pacific lags, as uneven travel restrictions remain in place over the region. Forward bookings give a positive outlook for the future, and domestic traffic is already steadying whereas international travel sector is now accelerating.

5.2 Regional ABO and WICAP Strategy & Planning

As part of the ABO and WICAP Strategy and Planning, three separate sessions were organized on regional activities, combining Regions II & V, I & VI and III & IV. The sessions were led by the JET-ABO Region Leads for their respective session. Furthermore, the Regional Technical Coordinators, Mr Yongqing Chen for RA II and V, Mr Abubakr Babiker for RA I, Mr Daniel Vila for RA III and IV, and Ms Natalia Berghi for RA VI contributed to the sessions along with invited regional ABO experts.

5.3 Regions II and V

Regional Association II, Asia

Mr Yongqing Chen, RA II and V Technical Coordinator explained that the establishment of regional working group is going on, the structures are to be approved by MGs later this year, after which the development of plans and requirements for ABO/AMDAR can commence for both regions.

Mr Yui-Fai Lee introduced the current ABO Programmes and plans for RA II. The coverage is dominated by eastern countries with a big gap over central and west Asia. RA II data volumes are still very reduced as a result of the Covid-19 pandemic. TAMDAR coverage is relatively good and provides data over both Region II and V. ADS-C data being obtained by India.

Reported development: Saudi Arabia is developing a program with an expectation to have an AMDAR Programme later in 2022. Inter-regional collaboration especially with RA V was seen as feasible to consider. ADS-B coverage should also be taken advantage of where possible.

The meeting agreed that translation of benefits and other ABO/WICAP materials will be important, along with the use of impacts outputs, e.g., FSOI studies can be useful to justify development of ABO.

Regional Association V, South-West Pacific

Mr Douglas Body presented the status and plans for RA V. Covid-19 impact had a severe impact on the AMDAR programmes in the region, where only the New Zealand and Australian AMDAR Programmes are operational. NZ has extended their fleet over the past couple of years but the coverage for both programmes consists mainly of national flights. US development with FLYHT to provide AFIRS and TAMDAR has helped to improve coverage over the region.

Reported development plans: 4 target airlines have been identified for immediate addition to the program and there is potentiality for ADD development with Mode-S.

It was noted that BoM can use FSOI statistics to demonstrate impact, which can measure the impact of short-term data additions to programme and systems, e.g., 9 Air Niugini Aircraft with AMDAR reporting capability had a significant impact over the region.

It is important to also note that it is NMHS with NWP centres that have most interest in and benefit from AMDAR development, so finding wider common ground to prioritize funds for resourcing is not an easy aspect.

The RA V Expert Team on ABO/WICAP has not yet been formalised and it is important to activate WMO RA activities for better intra-regional collaboration. The RA V WICAP Workshop was held in 2019 with good attendance by regional representatives.

The meeting agreed that there are major gaps both in RAs II and V and a great deal of potential with a number of target airlines.

Discussion Points

The following aspects were further discussed based on the presentations given by Mr Lee and Mr Body:

- Those NMHSs which run the NWP models especially benefit from ABO - the relative and collective benefits should be emphasized in RAs;
- Actions to extend the coverage: The first contact with airlines is very important and motivation for their participation will depend on the NMHS interest in ABO. Many airlines don't have strong internal capability to benefit from ABO, and in such cases particularly, the funding and responsibility will lie solely with the NMHS;
- It is important to convince NMHSs of the benefits so that they are ready to fund the programme;
- A challenge for most NMHS is the consideration of national versus regional interest, relating to the equipping of either domestic or national fleets. Under a regional programme, it is critical to plan on a regional basis so as to derive a greater impact;
- Potentially, other ABO systems, such as ADD data, do not require funding for communications costs and can therefore be more cost-efficient. For this reason, such systems should be considered in parallel with AMDAR and decisions on priorities should be determined based on the resulting analysis;
- Global data processing capability for ADD data will be available by the end of the year;
- Regional development should focus on data sparse areas;
- Funding of an ABO programme at a regional/global level: Typically, and in the past, a programme is established based on national/NMHS funding, but this is problematic for many countries and so new funding mechanisms should be considered, e.g., a multi-lateral approach (consortium);
- For RA II, the regional approach is not considered very feasible but, even when resourcing at the national level, regional considerations should still be made and RA working groups will provide a forum for such collaboration;
- Water vapor measurement has a significant impact over tropical areas and is therefore likely to be beneficial for RA V especially. However, there is a strategic challenge to get the STC process completed. For RA II also, there is potential to develop WVM with existing AMDAR programmes;
- It is possible that a consortium of WMO Data User centres could provide a focus for identifying the benefits of ABO development globally, including WVM, and the possible extension to a global framework for supporting its resourcing.

5.4 Regions I and VI

Regional Association I, Africa

Mr Abubakr Salih Babiker, RA I Technical Coordinator for Africa introduced the RA I working structure and the role of RA I TT-ABO which is under the RA I Observations and Infrastructure Working Group alongside TT-WIGOS and TT-RIC.

Mr Francis Moseleho gave a presentation on current status of and plans for RA I ABO Programmes. There are currently two operational AMDAR programs: South Africa and Kenya. Other programmes where developments have been initiated are Morocco and Ethiopia. Over much of Africa, there are significant gaps in upper air vertical profile coverage with a radiosonde network that has been in decline in recent years.

Current status of ABO in the region:

- RA I ABO Regional Implementation Plan (A-RIP) has been endorsed by the task team.
- With the help of ECMWF, an impact study for AMDAR data has been done to support extension of the WMO/EUMETNET agreement.
- There is currently no designated regional data processing centre, but Kenya Meteorological Department has the capability and willingness to undertake this role.

RA I TT-ABO recommends for WMO to take over the payment for data collection over the entire RA I.

Regional Association VI, Europe

Ms Natalia Berghi introduced the structure and priority activities of RA VI where WIGOS support is considered to be one of the high priority items. Within the RA there are 4 high-level task teams and a working group on Observation Infrastructure and Information Systems under which a task team on ABO has been formed. The Regional ABO Implementation Plan was adopted by the RA Session in late 2021.

Mr Stringer, the chair of the RA VI TT-ABO, reported on the status, plans and issues related to the RA VI ABO activities. EUMETNET AMDAR has recovered to around 90%, however, the international flights have not recovered to extent that the domestic ones, and the WVM program back to 100+%. Seemingly no impact on data loss over Russia due to war due to other data sources available. Mode S is one of the key focuses and produces around 1M obs per hour. The communication with airlines has been resumed and the Polish airline LOT has been signed up to report from Embraer fleet. Global datasets are another focus of the region.

Regional issues reported: A new phase commences for EUMETNET in 2024 and Steve is retiring end-2023. The EUMETNET budget expected to be reduced due to reduced NMHS contributions. The establishment of the WICAP framework for eastern Europe is very doubtful due to the stress over the area.

Plans for the future:

There are plans in the region, under EUMETNET, to develop EDR turbulence reporting via AMDAR in partnership with Swiss Airlines, Lufthansa and Air France. Under this arrangement, it is preferred that EDR will be made available directly to NMHSs.

Efforts are being made to collaborate with cargo airlines, which tend to operate at different hours to passenger aircraft, thus offering the potential to extend temporal coverage.

EUMETNET/E-ABO is planning to transfer existing AMDAR airlines to the WICAP agreement as contracts are renewed.

There will be a study undertaken to determine where Mode-S might replace AMDAR coverage, allowing possible reallocation of funds for AMDAR optimisation.

Discussion Points

Following is a summary of the key points made in the discussion:

- There are now several global ABO data sets available on the WIS, such as ADS-C and FLYHT AFIRS and turbulence, which have contributed to improved coverage and impact both during and after the COVID pandemic.
- The success of the EUMETNET collaboration under E-ABO demonstrates the potential efficiencies and effectiveness of international collaboration, enhanced by national-level discussion between the NMHS and the Airlines.
- It was agreed that aviation and airline events, such as workshops and conferences, are important for creating airline contacts and promoting the program. This is particularly important after the pandemic, and the JET-ABO and RA ABO teams should endeavor to take advantage of such events through participation when possible.
- It was noted that the ECMWF FSOI statistical information for the RA I data impact study was very useful, and it was recommended that the JET-ABO should investigate the possibility for 1 or more data centres to provide routine reports of FSOI impact results to the ABOP.

5.5 Regions III and IV

Regional Association III and IV, South America and North America, Central America and the Caribbean

Mr Daniel Vila, Technical Coordinator for Infrastructure in RA III introduced the RA III and IV working structure where the RA III TT-ABO is under the Working Group on Infrastructure and Technical Development, and within RA IV ET-SBW is a combined working group with surface-based observations and WICAP activities in one expert team under the RA IV Infrastructure Committee.

It was noted that there is already an existing mechanism for collaboration between RA III and IV on satellite activities, and a similar kind of common approach could be adopted for ABO and WICAP.

AMDAR development is a priority in both RAs for 2022/23.

The RA III ABO-WICAP Workshop will be held in Cartagena, Colombia from 18th to 20th July 2022.

Regional Association III, South America

Mr Nicolas Rivaben, the chair of RA III TT-ABO reported on the status and plans for RA III ABO activities.

Unfortunately, LATAM has been gradually ceasing transmission of AMDAR data due to the associated communications costs. This has significantly weakened the ABO data coverage over South America. There is some ADS-C data from Brazil but these data are still not available on the WIS.

There are some new initiatives with the target airlines and JetSmart, a LATAM Argentina legacy airline, is interested in joining the program.

The TT-ABO has endorsed several key documents:

- The Terms of Reference for the TT-ABO;
- The ABO Regional Implementation Plan (A-RIP);
- The workplan; and
- The priority target airlines (LATAM, Avianca, Azul, Aerolineas Argentina, COPA).

In the region, many NMHS are not the primary entity responsible for aviation meteorology which causes issues for contacting the key people for the establishment of collaboration between NMHSs and ANSP METs. This represents a risk to WICAP.

The key issues in the region are related to human and financial resources, which are very limited, and to the lack of communication between NMHS and ANSP MET.

An ABO-WICAP Workshop will be held in Colombia in July in conjunction with the Technical Conference on WIGOS, which will give an opportunity to talk directly to the RA III Management Group and other regional experts.

The RA III TT-ABO recommends that:

- The JET-ABO should investigate different funding possibilities;
- The role of IATA in WICAP should be strengthened;
- OEMs should be encouraged to install AOS as a default option on new aircraft; and
- Efforts should be made to reduce communication costs.

Regional Association IV, North America, Central America and the Caribbean

Mr Curtis Marshall reported on activities in RA IV where the US, Canadian and Mexican ABO Programmes are operational. The US program has grown since 2014 with injection of “Sandy” funds and other sources, which have supported regional and global growth in AMDAR and other systems. TAMDAR and AFIRS data are provided as global data sets for the use of all members. Canada has had relatively stable program with recently added FLYHT AFIRS data from First Air. Over Mexico, the data volume has reduced during the past couple of years due to changes in the Air Mexico fleet configuration.

The US AMDAR/MDCRS program data coverage is effectively saturated and has redundancy. NOAA is therefore open to the possibility to examine possibilities to support improving regional and global coverage through a reduction in data redundancy over the US.

A better optimized data purchase by NOAA could lead to improved coverage and could in theory be achieved through better use of Mode-S, for example. However, in practice, while aircraft are fitted with transponders, there are only a few surveillance radar in the US that are interrogating aircraft for Mode-S information.

Under the ABO programme, efforts should be made to pursue global development of WVSS, and to consider future data provision from ADS-B.

The main risk for RA IV, as for other regions, is the dominating financial support to regional and global initiatives, which could change by a governmental decision and cause a significant decrease in ABO data availability. For this reason, a shared approach to funding global ABO data sources should be pursued as an activity of the JET-ABO.

To strengthen regional activities, the RA IV ET-SBW requires extended membership by other countries and the development of the RA IV ABO Regional Implementation Plan.

Discussion Points

The meeting discussed the following:

- EDR data availability from the US is a challenge, the data is currently processed by the National Center for Atmospheric Research (NCAR) and some airlines are willing to share EDR data, but others are not. FLYHT is considering adding EDR data to the AFIRS output
- Wind and temperature data associated with EDR monitoring could be provided, which would require further processing to be put on the GTS.
- Icing and turbulence provided by AMDAR, but EDR is calculate from True Airspeed rather than winds.
- We should talk to the PPE division in WMO about business models for engaging public entities like Airlines to be involved in ABO and WICAP

5.6 Global Strategy and Planning

Carbon Offsetting and Reduction Scheme for International Aviation (CORISIA) & discussion

Mr Michael Schneider, Assistant Director Environmental Programs of the IATA Environment and Sustainability introduced the concept of the Carbon Offsetting and Reduction Scheme for International Aviation (CORISIA) and how JET-ABO could potentially use the scheme for rationale of the direct airline benefits gained by participating the AMDAR and Water Vapor Measurement (WVM) Programme.

Mr Schneider explained that all airlines are subject to the scheme and requires airlines to report on their emissions output. The scheme is in a pre-operational phase with 112 states voluntary participating, and the mandatory phase begins in 2027. There are requirements to monitor emissions via fuel use and to offset growth of emissions through the scheme. Offsetting can be based on investment in offsetting schemes in several sectors.

In order to be adopted under CORISIA, emissions offsetting programs must meet certain criteria which ensure that emissions reductions are verifiable and count only once against the airline emissions.

The meeting discussed how CORISIA can be used to incentivise airlines to participate in ABO and noted that the process for the establishment of an ICAO approved eligible scheme for offsetting emissions requires very comprehensive calculations for demonstrating emissions savings, certificates and practices for the management of the offsetting scheme, including administrative and auditing processes.

Given that a claimed benefit of AMDAR is improved operations leading to fuel savings, the meeting agreed that the possibility to develop AMDAR participation as a CORISIA offset program should be investigated under WICAP.

It was suggested that a possible first step in this process, would be for WMO and IATA to engage a consultant to undertake an initial analysis of the potential of AMDAR being integrated into CORISIA as an offset program.

More about [the scheme](#) and [Eligible Emissions Units](#) can be found on the ICAO website.

Review of outcomes and recommendations from Item 5

Ms Minna Huuskonen introduced a summary and key points of the three regional sessions:

- There are still major gaps in 4 of 6 regions which should be addressed.
- Those NMHSs that operate NWP models especially benefit from ABO and might be encouraged particularly to contribute to resourcing ABO development and expansion.
- While it is not always necessary to share costs under a regional program, there is still a benefit in collaborating regionally to collaboratively optimise coverage from national programmes, including consideration of equipping regional fleets over domestic fleets.
- Overall, a collaborative approach at the regional and global levels is seen as the best approach for ABO development.

The following challenges specifically relating to implementation of WICAP were identified:

- There are difficulties in bringing existing programs into a collaborative programme.
- Communication with airlines is still a challenge and can be undertaken in various ways - IATA has recommended one-to-one discussions.
- Communications costs are still too high and prohibitive.
- Some Met services are not responsible for services to aviation.
- Regions need to be able to determine which ABO systems are best to meet their needs.
- IATA is seen as an important contributor in supporting negotiations with airlines and building the business case with them.

Other issues raised during the sessions

- The continued ability to exchange data internationally, particularly from global sources, can be an issue due to the limitations of WIS capabilities, for example, exchange of high-frequency Mode-S data.
- Lowering communications costs is a critical factor in reducing programmatic costs and, if this cannot be achieved with lowering costs associated with traditional ACARS, then alternatives should be sought. This could include:
 - Use of ACARS over IP.
 - Downloading of data on descent upon arrival over WIFI.
 - Use of alternative communications protocols over satellite links.
- Closer collaboration with OEMs, data service providers and avionics vendors was important and routine meetings should be arranged with them.

Summary of key recommendations

- Revisit the WICAP regional-based paradigm for the financial framework and analyse the potential advantages of a global framework which might include third-party global datasets.
- Investigated possibilities to access international development funds for supporting ABO development in sparse areas, especially for Regions I and III and those having a high potentiality for severe meteorological hazards in the community.
- Strengthen IATA's role with airline communications at the regional level.
- Negotiate with OEMs for factory floor availability of AMDAR onboard software.

- Work with DSPs to lower communications costs and investigate low-cost data communications alternatives and solutions.

WICAP Plans and Priority Activities

Mr Stringer provided a presentation and led discussion on plans and priority activities for WICAP, highlighting in particular the following aspects and activities:

- Financing WICAP with a current proposed regional financial framework will be difficult, but opportunities should continue to be sought for this approach, which has been successfully employed in Europe.
- IATA involvement is critical for encouraging the industry to participate the programme, engaging with OEMS, avionics and DSPs.
- An improved business case for airline participation will be critical.
- Removal of administrative overheads charged by airlines would reduce programme costs.
- In the longer term, IATA and airlines should encourage the industry to adopt ADS-B with MET as a standard.
- Data ownership is an issue for the industry at large and beyond AMDAR.

Mr Stuart Fox, IATA, informed the meeting that IATA was engaged with data service providers in seeking to reduce communications costs as a priority for its member airlines.

Regional versus Global Approach to Planning & Sharing of ABO Costs

Mr Dean Lockett led a discussion on the need to examine the funding model for both WICAP and other ABO global data sources.

It was noted that the regional approach to planning for ABO and WICAP seems sound and allows for future use of regional frameworks under WIGOS – Regional Associations, Regional WIGOS Centres, WDQMS, RBON, GBON, etc. However, when it comes to funding, the regional model may not be as effective. While it works well for in Europe because of the existence of EUMETNET, there are no signs in other regions as yet, that the WICAP Centre for Planning & Resource Mobilisation can be supported. It was therefore suggested that a global model for funding might be assessed, particularly given the requirement to consider global funding models to support global ABO data sources.

Six examples of global funding models were introduced and the pros and cons of each briefly discussed:

1. WMO Regular Budget – acknowledged as a difficulty for WMO as it effectively makes WMO part of the operational meteorological programme, which Members are, or have been against.
2. AMDAR Operating Fund – agreed that it would be possible but still effectively implies WMO becoming operational in WMO Member programmes.
3. Redevelop the WICAP concept to revert to a central funding model – seems the most reasonable but would require Member acceptance and support, with the handling of finances an issue. Essentially this would mean a WMO Member would act a global contracting and resource management centre for WICAP.
4. Consortium of NMHSs formed based on interest in funding ABO data sources (USA, EUMETNET, etc) – also considered viable but the sharing of costs and transfer of monies is problematic.

5. Seek grant funding for WICAP or specific WICAP development projects (e.g. Africa) – this is already a target for whichever framework is adopted and still requires a financial management framework.
6. Combination of 2 or more of 2 to 5

It was agreed that a follow-up session on this matter specifically should be conducted as soon as possible following the session.

Development of GBON & SOFF

Ms Minna Huuskonen introduced the Global Basic Observing Network (GBON) and the Systematic Observations Financing Facility (SOFF) which were approved by the Extraordinary Congress in 2021 (Cg-Ext-2021) for strengthening the world's weather and climate services through a systematic increase in much-needed observational data and data products from across the globe. SOFF intends to respond to the discrepancy between the ability to observe and the ability to pay with supporting financially and technically the Least Developed Countries (LDC) and Small Island Developing States (SIDS) on the implementation and operation of the mandatory standards and practices of the GBON network.

The GBON regulations were introduced with a note that aircraft-based observations are part of the recommended practices of the regulation, and therefore, not in a scope of the SOFF support. According to the regulation, Members are encouraged to operate aircraft-based observing systems with a horizontal resolution of 100km at the flight level, and 300m when taking off or landing, report every 1 hour, including wind, temperature and humidity and exchange the data to WIS per the data licence agreement. The GBON regulation is in consistency with the WMO Unified Data Policy (Res.1) which defines aircraft-based data as recommended data.

6. Future activities and priorities for JET-ABO 2024-2027

The Chair led the JET in a discussion relating to the priorities for the JET in the shorter-term to the end of 2023 and also for the longer-term in the next inter-sessional period of WMO – 2024 to 2027. In relation to this, presentations on the following key topics were also made:

- Water Vapour Measurement Development, Carmen Emmel
- Towards Making UAS Operational in WIGOS, Debbie O'Sullivan

A summary of the discussion, which also took into account outcomes from the previous days of discussion under items 4 and 5, is provided within [Annex 5](#), in terms of a list of priority actions for 2022/23 and proposed activities to be considered for the next inter-sessional period.

Work Practices of the JET-ABO

The meeting also discussed the practices related to the coordination of the activities of the JET-ABO and agreed on the following:

- Information was still difficult to find and so this aspect should be streamlined in the future.
- If Trello continues to be used, then it should be up to date, with all relevant links to SharePoint more clearly high-lighted.
- A consolidated actions list should be maintained to supplement the JET-ABO work plan.
- Where possible, the number of meetings should be reduced.

Regarding virtual meetings, the online participants made the following points:

- Physical meetings are still preferred, and where hybrid meetings are necessary, sessions should be kept shorter.
- Sound was not always clear and such meetings might benefit from individual microphones for attending participants to use.
- Funding for experts from least developed countries to attend meetings should be a priority.

7. Reporting to INFCOM

The meeting discussed the expected input and reporting to INFCOM and its Standing Committees and in particular agreed on the following inputs to the INFCOM second session in October 2022:

- A Decision with a Recommendation to approve the update of WMO No. 1200.
- The update of WMO No. 8, Vol. III, Chap. 3 would be addressed in collaboration with the SC-MINT and integrated into the relevant decision document.
- The update of WICAP Implementation Plan to be submitted as an Information document and referenced in the Report of the President of INFCOM.
- The update of the UAS-DC Plan to be submitted as an Information Document and referenced in the Report of the President of INFCOM.
- A Decision on the UAS NetCDF CF compliant data format would be formulated by the SC-IMT Task Team on CF-NetCDF

8. Any other business

No other business was raised.

9. Closure of the meeting

The meeting closed around 1400 UTC, 30 June 2022.

Annex I – Meeting Attendance

Attendee	27 June	28 June S1	28 June S2	29 June S1	29 June S2	30 June S1	30 June S2
	I = in-person, V = virtual attendance S1 = session 1 of the day, S2 = session 2 of the day						
Curtis Marshall, USA	I	I	I	I	I	I	I
Nicolás Rivaben, Argentina	I	I	I	I	I	I	I
Carmen Emmel, Germany	I	I	I	I	I	I	I
Stringer, Steve, U.K.	I	I	I	I	I	I	I
Jan, Sondij, The Netherlands	I	I	I	I	I	I	I
Yongqing Chen, WMO	V	V				V	V
Abubakr Salih Babiker				V			
Milan Dacic, WMO				V			
Natalia Berghi, WMO				V			
Daniel Vila Espigo, WMO					V		
Dean Lockett, WMO	I	I	I	I	I	I	I
Minna Huuskonen	I	I	I	I	I	I	I
Etienne Charpentier	I						
Jie Liao, China	V	V	V		V	V	V
Douglas Body, Australia	V	V	V		V	V	V
Shigeharu Nishikawa, Japan	V	V	V	V	V	V	V
Jun Ryuzaki, ICAO	V		V		V		V
Lee-Yiu FAI, Hong Kong China	V	V	V	V		V	V
Estelle Grüter, Switzerland	V						
Francis Moseitho, South Africa	V			V	V	V	V
Debbie O'Sullivan, U.K.	V	V	V	V	V	V	V
Ercument AVSAR, Turkey	V	V	V			V	
Elizabeth Wilson, HMEI	V		V		V		V
Greg Meymaris, USA	V		V		V		V
Murphy, Michael, FAA, USA	V	V	V	V	V	V	V
Fredrick Etemesi, Kenya	V	V	V	V	V	V	
Meredith Bell, HMEI	V	V	V	V	V	V	V
Jeannine Hendricks, HMEI	V		V		V	V	
Flowe, Tammy (FAA)							V
Frederic, Lenormand (ECCC)							V
Frank Grooters, Invited expert	V						V
Bruno Piguet, France		V					
Hanna (PAGASA) Philippines		V					
Philippines Hanna (PAGASA) (Guest)		V					
Richard (Guest)		V					
Fani Setyawan - Indonesia BMKG (Guest)		V					

Sohei Yoneda (JMA)		V					
PAGASA- Arnel Manoos (Guest)		V					
MetMsia-Nazri (Guest)		V					
Richard (Guest)		V					
Zunaidi Mat		V					
JUNG SUENGPIL (KMA, Korea)		V					
Babidhan		V					
Kyu-Bin Lim			V				
Angulu Humphrey (Guest)				V			
Abderrahim MOUHTADI (Guest)				V			
yasser elsayed (Guest)				V			
Juan Benito Valderrama Arteaga (DMA - SPM)					V		
Alexander Melgarejo IDEAM					V		
Vannia Jaqueline Aliaga Nestares (DMA)					V		

Annex 2 – Work Plan of the JET-ABO

SC-ON Joint Expert Team on Aircraft-Based Observing Systems

(Approved, January 2022)

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
1	1.1	Maintain the ABOP Strategy and Implementation Plan (A-SIP)	1. Update the A-SIP to reflect to the WICAP Framework and changes in strategies	JET-ABO Leadership	Oct 2020	Jan 2021	2	100	Updated A-SIP	Completed		
1	1.2	WICAP Implementation – assist in planning, implementation and coordination of operations	<p>Ongoing</p> <p>1. Maintain a coordination group under the JET-ABO to plan and undertake the team's activities on WICAP implementation.</p> <p>2. Report to the INFCOM and EC on WICAP progress.</p> <p>Budget 2022</p> <ul style="list-style-type: none"> 20K for 2 F2F workshops (25K to come from RB) <p>Budget 2023</p> <ul style="list-style-type: none"> 20K for workshops/training 30K for development support 	CG-WICAP	Oct 2018	Dec 2023	1	N/A	<p>1. WICAP Implem.</p> <p>2. Report to WMO CBs</p>	<p>See CG-WICAP Work Plan & WICAP Implementation Plan.</p> <ul style="list-style-type: none"> OPCT consultancy completed Dec. 2021; to be reemployed for 2022 via WMO reg. budget. Consultancy for WICAP webinars and AMDAR Coverage Analysis Tool completed in 2021 (7K) 	20	50
1	1.3	AMDAR Software Development & Availability	<p>1. Investigate potential for EFB based solution for AMDAR data and progress in collaboration with IATA</p> <p>2. Develop a plan for interacting with avionics vendors and developers on AMDAR software development & availability.</p>	CG-WICAP	Oct 2020	Dec 2023	2	1. 100 2. 0	<p>1. EFB software package</p> <p>2. Plan for AMDAR software dev.</p>	<p>No development & spending in 2021</p> <p>Study was undertaken on EFB potential but determined not currently worthwhile.</p>		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
1	1.4	ABO Water Vapour Measurement – coordinate expansion	<p>Ongoing</p> <ol style="list-style-type: none"> 1. Plan and coordinate and extension and development of WVM under the WICAP Framework. 2. Continue to collaborate with aircraft manufacturers re. factory equip of aircraft with humidity and re. potential data buy program. 3. Assist and report on collaboration with DWD and Lufthansa Technik to extend the collaboration and equip the Lufthansa Group airlines with WVSS. 4. Develop a business case on benefits and costs associated with WVM development for met services 5. Publish a flyer on WVM benefits 	SG-WVM, CG-WICAP	Oct 2020	<ol style="list-style-type: none"> 1. Dec 2023 2. Dec 2023 3. On hold 4. Dec 2022 5. Dec 2022 	2	N/A	<ol style="list-style-type: none"> 1. Updated planning in A-SIP 2. Report to JET 3. Report to JET 4. A business case 5. A flyer for WVM promotion 	<ol style="list-style-type: none"> 1. Annex 2 updated in A-SIP 2. Through FLYHT, collaboration and communication obtained 3. On hold 	1	

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
1	1.5	ABO EDR Turbulence measurement – coordinate expansion	Ongoing 1. Review and revise plans in view of WICAP. 2. Maintain list of compatible aircraft/avionics systems. 3. Work with JET-EOSDE and other relevant bodies to determine and document WMO data user requirements for EDR data. 4. Manage activities defined in Annex 2 of A-SIP	1. CG-WICAP 2. SG-Turb 3. SG-Turb	Oct 2020	1. Jun 2021 2. N/A 3. Dec 2021	1	1. 50 2. N/A 3. 50	1. Updated planning in A-SIP 2. List of systems on Comm. Platform 3. Defined user requirements in OSCAR/surface database	1. Annex 3 updated in A-SIP. Further planning with CG-WICAP required 2. Not updated yet in CP 3. The survey drafted and will be published in early 2022 4. No progress in 2021, focus for 2022		
1	1.6	Operational development of Aircraft Derived Data from Mode S.	Ongoing 1. Monitor the progress of ADD with regards transition from development to operational use. 2. Coordinate, encourage extension of coverage of ADD data 3. Monitor progress of European development under EUMETNET/E-ABO. 4. Monitor progress of US development with FlightAware and MIT. 5. Determine requirements & if needed coordinate development and approval of ADD BUFR template. 6. Workshop on ADD for June 2022	SG-ADD	Oct 2020	Dec 2023	2	25	1. Report to JET-ABO, update guidance 2. Update plan in A-SIP and relevant guides 3. Report to JET-ABO 4. Report to JET-ABO 5. Report to JET-ABO 6. Workshop on ADD	Work has progressed under SG-ADD, including planning for a workshop as a new activity. (2022 – 10K + 10K RB)	10	

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
1	1.7	AMDAR Supplementary Data Program	<ol style="list-style-type: none"> 1. Provide E-AMDAR data over Africa on an ongoing basis. 2. Measure and report on impact of data availability. 	Secretariat/ SG-DM	Oct 2020	N/A	2	N/A	Report to JET-ABO	<p>Data provision commenced from Feb 2017</p> <p>Expected around 20K for EUMETNET expended for 2021.</p> <p>Carryover of Kenya costs required for 2022 to pay data for Mar. to Dec. 2021.</p> <p>Budget:</p> <ul style="list-style-type: none"> • 2021: E-AMDAR 25K, Kenya 20K • 2022: E-AMDAR 25K, Kenya AMDAR 20K 	45	45
1	1.8	Provide expertise and assist in ABO and AMDAR national and regional programme development and operation	<p>Ongoing</p> <ol style="list-style-type: none"> 1. JET-ABO represented at relevant national/regional ABO meetings. 2. Contribute to WISER/Kenya AMDAR Program Development project. (2021, 5K) and seek to continue development of program beyond March 2021. 3. Support continuation of the Mexico and LATAM programs under WICAP. 	JET-ABO, Secretariat	Oct 2020	N/A	1	N/A	Report to JET-ABO	<p>Kenya project:</p> <ul style="list-style-type: none"> • Project has had limited success and appears to be unable to facilitate equipping of entire fleet including Embraer aircraft. Expect to be limited to only several B737 aircraft. Funding provided under 1.7. • Have developed a data processing system which is spec'd to act as a regional hub for data processing. • Kenya program to be supported under item 1.7. 		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
1	1.9	Coordinate provision and management of ADS-C derived data on the WIS	<ol style="list-style-type: none"> 1. Collaborate with ICAO, EUMETNET, Collins Aero, and SITA for obtainment of ADS-C data and provision on WIS. 2. Investigate requirements for meeting costs of ADS-C data in the future. 3. Coordinate development of data management and monitoring processes for ADS-C data via the Lead Centre ABO. 	SG-ADD	Oct 2020	Dec 2023	1	20	<ol style="list-style-type: none"> 1. All ADS-C Data available on WIS 2. Report to JET-ABO 3. Data monitored routinely by Lead Centre 	<ul style="list-style-type: none"> • Progress has stalled due to unwillingness of SITA to support a solution. An alternative solution is being sought. • E-ABO discussions with ANSPs continues – impact of COVID on resources • 2021: talks have commenced with ICAO to help with ADS-C availability via FIRs/ANSPs 		
1	1.10	Coordination provision and management of FLYHT ABO data on the WIS	<ol style="list-style-type: none"> 1. Investigate and coordinate means for supporting availability of FLYHT ABO data longer term. 2. Ensure data quality is monitored. 	SG-TPD	Oct 2020	Dec 2023	2	50	<ol style="list-style-type: none"> 1. FLYHT data available on WIS long term 2. Data monitored by Lead Centre. 	NOAA has secured data availability until April 2022. Data being distributed currently by Met Office, UK.		
1	1.11	Analyse outcomes from the COVID-19 situation and adapt plans to ensure future mitigation where possible	<ol style="list-style-type: none"> 1. Analyse and report on issue 2. Adapt A-SIP and A-RIPs 	<ol style="list-style-type: none"> 1. JET-ABO LG 2. JET-ABO LG 	Oct 2020	Jun 2021	2		<ol style="list-style-type: none"> 1. Report to JET-ABO 2. Input to planning materials 			
2	2.1	JET-ABO work plan maintenance	Ongoing	JET-ABO LG	Oct 2020	N/A	1	N/A		Draft work plan to be developed and fully finalised by JET first session, December 2020.		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
2	2.2	Plan & coordinate meetings of the JET-ABO	Ongoing <ul style="list-style-type: none"> Possible in-face virtual meeting for mid-2022 ahead of INFCOM-2 Hold routine remote meetings of JET at least quarterly on selected activities as required. 	JET-ABO LG, Secretariat	Oct 2020	N/A	1	N/A	JET-ABO 1 st session report and updated work plan. Online meetings held and minutes maintained.	Quarterly online meetings have been held. Funding: Supplement RB funding of meetings: <ul style="list-style-type: none"> 2021: Nil 2022: Nil 		
2	2.3	JET-ABO/CG-WICAP work plan maintenance	Develop and maintain the SG-WICAP work plan and report to INFCOM and EC as appropriate.	S. Stringer, Secretariat	Oct 2020	Dec 2023	1	N/A	Work plan & report to WMO CBs as required	2022/3 work plan & budget to be completed by January		
3	3.1	Humidity sensors testing and validation	<ol style="list-style-type: none"> WVSS and TAMDAR testing on FAAM – coordinate, document and report on results. WVSS testing on DENCHAR aircraft – coordinate, document, report on outcomes. Use of WVSS in aircraft icing management – coordinate, document and report on results – related to task 1.4.3 Monitor & report on impact assessment results of TAMDAR humidity & other parameters by MetOffice. 	SG-WVM	Oct 2020	3. On hold	3	<ol style="list-style-type: none"> 100 100 5 100 	<ol style="list-style-type: none"> IOM Report or report to JET-ABO Report to JET-ABO and SC-MINT Report to JET-ABO Report to JET-ABO 	<ol style="list-style-type: none"> WMO IOM Report No. 133 was published to consolidate all previous studies. Work completed. Several documents and reports published. Completed. On hold due to the outbreak and financial issues Completed and report published <ul style="list-style-type: none"> 		
3	3.2	Coordinate, monitor and report on outcomes of ABO impact studies, inter-comparison and testing.	<ol style="list-style-type: none"> Analyse and report on relevant impact studies, including WMO Impacts Workshop, 2020. Liaise with JET-EOSDE re future possible impact studies to be undertaken 	C. Marshall, F. Lenormand, J. Pinto	Oct 2020	Dec 2023	2	<ol style="list-style-type: none"> 50 20 	Report to JET-ABO and recommendations to SC-ON, INFCOM.	Newsletter article completed on results of impact studies from 2020 workshop. Commenced list of possible NWP studies to be recommended to be undertaken.		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
3	3.3	Activities related to development of UAS technology for operations.	<ol style="list-style-type: none"> 1. Study and report on potential meteorological applications of UAVs for WIGOS applications. 2. Study and report on Aviation. Developments (FAA/EASA) regarding UAV and shared airspace. 3. Develop and publish a white paper and AMS article on use of UAVs in operational meteorology. 4. Develop scope an initial plan for an international UAV demonstration. Obtain approvals and coordinate UAS-Demonstration Campaign. 5. Support attendance of ABOP expert to attend relevant events. 6. Review requirements for encoding of UAV data in BUFR and progress as required. 	SG-UAS	Oct 2020	<ol style="list-style-type: none"> 1. Dec 2020 2. Dec 2020 3. Jun 2021, Jun 2022 4. Dec 2021 5. Dec 2023 6. Dec 2023 	2	<ol style="list-style-type: none"> 1. N/A 2. N/A 3. 80 4. 20 5. N/A 6. 10 	<ol style="list-style-type: none"> 1. Report to JET-ABO 2. Report to JET-ABO 3. Report published in AMSB, White paper published as (WIGOS TR?) 4. Draft plan to be presented to SC-ON and INFCOM. 5. Report to JET-ABO 6. Report to JET-ABO 	<ul style="list-style-type: none"> Held workshop on potential operational use of UAVs, July 2019. Whitepaper on UAV technologies is nearly complete. Plan for UAS-DC nearly completed. Approvals expected in Jan 2022. <p>Budget:</p> <ul style="list-style-type: none"> 2022, 2023: 10K, support for organisation of demo. project 	10	10
3	3.4	Testing of FLYHT data quality and data provision system.	<ol style="list-style-type: none"> 1. For initial WMO data trial 2018, obtain and analyse impact results and quality information from NWP. 2. For FLYHT data generally, analyse data quality and impact and report. 	SG-TPD	Oct 2020	<ol style="list-style-type: none"> 1. Dec 2020 2. Dec 2023 	3	10	<ol style="list-style-type: none"> 1. Report to JET-ABO 2. WMO technical report 	<ul style="list-style-type: none"> Contract with flight was established in Q1 2018 – est. cost 80K chf Air Nuigini aircraft commenced reporting in August 2018 Contract completed All FLYHT data is now available on the WIS SG-TPD coordinating availability & monitoring of data. 		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
3	3.5	Coordinate/undertake analysis of ABO/AMDAR data quality issues	<ol style="list-style-type: none"> 1. Complete study on AMDAR air temperature bias. 2. Conduct study and analysis of pressure altitude encoding and quality issues. 3. Investigate and coordinate resolution of systemic issue with B787 avionics air temperature reporting error. With respect to this, analyse requirements for reporting ABO metadata within the AMDAR BUFR template. 4. Develop plans for dealing with air temperature bias issue. 	1.S. de Haan, SG-DM	1. Jun 2021 2. Dec 2023 3. Dec 2023 4. Dec 2023	1. Mar 2019	1	1. 100 2. 0 3. 50 4. 0	<ol style="list-style-type: none"> 1. Article in Atmospheric Measurement Techniques 2. Report to JET-ABO 3. Report to JET-ABO 	<ul style="list-style-type: none"> • Item 1 is completed – report has been published. • Appear to be issues with the reporting of negative value pressure altitudes in some programmes • Appears to be issues with the encoding of pressure altitude in 1 or more programmes <p>Item 3:</p> <ul style="list-style-type: none"> • Boeing have been alerted to the problem and are attempting to resolve. • No progress on metadata/BUFR issue. 		
3	3.6	Enhancement of ABO and AMDAR with new variables or methods of measurement	<ol style="list-style-type: none"> 1. Promote and encourage AMDAR icing monitoring and reporting. 2. Analyse potential for radio occultation reporting from ABO. 	1. TBD 2. TBD	Oct 2020	Dec 2023	3	0	Report to JET-ABO	No activities		
4	4.1	Maintain AMDAR Onboard Software Functional Requirements Specification (AOSFRS).	<ol style="list-style-type: none"> 1. Review and update as required and in line with INFCOM editorial procedures. 	SG-TMG	Oct 2020	Dec 2023	2	5	Updated IOM Report	<ul style="list-style-type: none"> • Should consider addition of section on requirements for EFB application. • Little progress made as at Dec. 2021 		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
5	5.1	Coordinate and promote ABO technical development in the aviation industry.	Ongoing <ol style="list-style-type: none"> Attend meetings of relevance to ABO and AMDAR technical development. Undertake a review of aviation related standards and other bodies to determine critical committees and work groups requiring JET-ABO representation. 	CG-WICAP	Oct 2020	Dec 2023	2	1. N/A 2. 0	<ol style="list-style-type: none"> Report to JET-ABO Report to JET-ABO 	<ul style="list-style-type: none"> S. Taylor and C. Marshall have attended DLUF meetings to promote AMDAR. The team should reassess requirements for attending aviation meetings in light of WICAP. F. Grooters had been attending joint RTCA/EUROCAE work groups on Mode S and ADS-B 		
6	6.1	Establish and maintain the Global Data Center for Aircraft-Based Observations (GDC-ABO).	<ol style="list-style-type: none"> Finalise ToR and functional requirements of the GDC. Establish GDC under INFCOM. Establish Agreement between NOAA and WMO on operation of the GDC. Coordinate implementation and required development of the GDC including compliance with WICAP data policy. 	SG-DM	Oct 2020	<ol style="list-style-type: none"> Dec 2022 Dec 2022 Dec 2022 Dec 2022 	2	10	<ol style="list-style-type: none"> WMO / NOAA Agreement in place Res. of INFCOM Agreement in place GDC functionality established. 	Progress delayed due to priority given to WICAP development and timing of INFCOM-2.		
6	6.2	Establish and maintain the ABO component of the WIGOS Data Quality Monitoring System.	<ol style="list-style-type: none"> Finalise ToR and functional requirements of the Lead Center and Monitoring Center for ABO roles. Establish agreement between NOAA and WMO on establishment of NOAA as a WDQMS Centre for ABO. Coordinate the implementation and required development of the WDQMS Centers. 	SG-DM	Oct 2020	Dec 2023	1	10		<ul style="list-style-type: none"> Progress delayed due to priority given to WICAP development and other priorities for the LC (NOAA). NOAA to support the development with in-kind funding of 100K USD, 2021/2. 		

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
6	6.3	Coordinate development of a central metadata repository for global ABO.	<ol style="list-style-type: none"> 1. Develop specifications and determine solution for development. 2. Coordinate and assist development and testing. 3. Coordinate member provision of metadata. 4. Coordinate provision of historical metadata. 	SG-DM	Oct 2020	<ol style="list-style-type: none"> 1. Apr 2021 2. Dec 2022 3. Dec 2023 4. Dec 2023 	1	<ol style="list-style-type: none"> 1. 100 2. 0 3. 0 4. 0 	<ol style="list-style-type: none"> 1. Specs completed, developer selected. 2. ABO metadata system implemented. 3. Metadata in database. 4. Historical seeding commenced. 	A quotation for development in OSCAR/Surface/ABOS has been given: 200K. Over 2021, a specification and tender process in WMO has been coordinated. A contractor has been selected for development of the system over 2022.	135	15
7	7.1	Maintain WMO-No. 1200 Guide to ABO.	<ol style="list-style-type: none"> 1. Review and update in line with WIGOS/TC editorial procedures. 	SG-RM	Oct 2020	Dec 2022	1	5	<p>Draft update of WMO No. 1200</p> <p>Particular focus will be on updates for UAV, WICAP and Mode S.</p>	Initial review has been made. Drafting to commence in Q1 2022.		
7	7.2	Maintain ABO material in WMO-No. 8.	<ol style="list-style-type: none"> 1. Review and update Part II, Chapter 3 as required and in line with INFCOM editorial procedures. 	SG-TMG	Oct 2020	Dec 2022	1	5	Draft update of Chap. 3	Initial review has been made. Drafting to commence in Q1 2022.		
7	7.3	Maintain ABO material in WIGOS Manual and Guide.	<ol style="list-style-type: none"> 1. Review WIGOS Guide and Manual and update as necessary in line with WMO procedures. 	SG-TMG	Oct 2020	Jun 2023	1	0	Draft update of ABO component of Manual, Guide on WIGOS.			

ToR	No.	Task	Sub-tasks, Description	Responsible	Start	Due / Comp.	Prior.	Status (%)	Deliverables/ Activities	Progress	2022 Budget Estimate	2023 Budget Estimate
7	7.4	Develop and maintain ABO guidance and technical publications.	1. Update WIGOS TR 2014-1 – Secretariat to engage a consultant over Q1 2020 to complete work.	SG-TMG	Jan 2020	Dec 2020	1	100		<ul style="list-style-type: none"> Priority raised due to importance to WICAP development. Consultant has been employed and WIGOS TR 2021-1 has been completed & published, Jan. 2021. 		
8	8.1	Coordinate and contribute to relevant outreach and promotional publications.	Ongoing 1. Produce 2 volumes annually of the WMO ABO/AMDAR Newsletter.	SG-TMG	Oct 2020	N/A	2	N/A	2 newsletters annually	Newsletters volumes 21 & 22 were published in 2021.		
8	8.2	Re-establish news site and newsletters on WMO Community Platform		Secretariat, JET-ABO	Oct 2020	Apr 2021	2	100	New site on CP	Completed.		
9	9.1	Work in collaboration and cooperation with other teams within WMO.	Ongoing 1. Chair to be member of JET-EOSDE and provide relevant input. 2. Other experts contributing to relevant teams	1. C. Marshall 2. Teams : ET-UAM: B. Piquet & D. O'Sullivan	Oct 2020	N/A	1	N/A				
10	10.1	Report on issues, activities and progress to SC-ON and SC-MINT.	Ongoing 1. S. Taylor to report to SC-ON. 2. N. Rivaben to report to SC-MINT	JET-ABO-LG	Oct 2020	N/A	1	N/A		LG has routinely reported to SC-ON and SC-MINT throughout 2021.		

JET-ABO Sub-Groups and Task Leads & Contributors

Work Plan Ref.	Activity/Task	Group	Lead	Contributors	Secretariat
1.2, 1.3, 1.8, 5.1	WICAP Implementation	CG-WICAP	Steve Stringer	See team here .	Minna
4.1, 7.1, 7.2, 7.3, 7.4	technical materials & guidance	SG-TMG		Lee Yiu-fai Nicolás Rivaben Doug Body	Dean
1.6, 1.9, 1.10, 3.4	ABO Derived & Third-party Data	SG-DTD	Jan Sondij	Doug Body Steve Stringer Curtis Marshall Meredith Bell Jie Liao Elizabeth Wilson Shigeharu Nishikawa Jun Ryuzaki	Dean
1.5	Turbulence	SG-Turb	Greg Meymaris	Tammy Flowe, Bruno Piguet	Minna
1.4, 3.1	Water vapour measurement	SG-WVM	Carmen Emmel	Bryce Ford Bruno Piguet	Minna
3.3	UAV	SG-UAS	James Pinto	Debbie O'Sullivan	Dean
1.7, 3.2, 3.5, 6.1, 6.2, 6.3	Data management	SG-DM	Curtis Marshall	James Pinto Frédéric Lenormand Ercument Avsar	Dean
3.6	New variables				Dean
8.1	Newsletters	SG-TMG			Dean, (Carl)
1.1, 2.1, 2.2, 2.3, 1.11, 9.1, 10.1	ABOP Governance	JET-ABO-LG	Chair JET-ABO	Chair, Vice-chair	Dean & Minna

INFCOM/SC-ON & SC-MINT
Joint Expert Team on Aircraft-Based Observing Systems (JET-ABO)
Proposed Terms of Reference

Within the WIGOS framework and the auspices of the WMO Aircraft-Based Observations Programme (ABOP), under the governance of INFCOM and the joint guidance of SC-ON and SC-MINT, act as the WMO primary working group on aircraft-based observations and systems with responsibility to:

1. Oversee and coordinate the programmatic, scientific, and technical development and operation of aircraft-based observing systems (including AMDAR, Mode-S, ADS and other commercial systems), and of aircraft-based instruments and methods of observations;
2. Develop and manage the work plan and associated activities of the expert team, including the budget for associated expenditure of the AMDAR Operating Fund in line with its Terms of Reference;
3. Coordinate the development, scientific testing, validation and inter-comparison of existing and new methods of observation (including humidity, turbulence and inflight icing) for aircraft-based observing systems, as well as for Unmanned Aerial Vehicles (UAVs);
4. Organize and conduct the development, maintenance and provision of technical standards and specifications associated with aircraft-based observations according to user requirements;
5. Collaborate with the aviation industry (including airlines, avionics vendors and applications developers and data service providers) and relevant international and regional organizations (including ICAO and IATA), on matters relevant to the work plan of the team;
6. Oversee the international and regional aspects of management of aircraft-based observational data, including:
 - i. Assist in the coordination of the development and implementation of the WMO-IATA Collaborative AMDAR Programme (WICAP), under the direction of its Governing Board and in collaboration with its Oversight Planning and Coordination Team and WMO Regional Associations;
 - ii. Development and maintenance of the aircraft-based observations component of the WIGOS Data Quality Monitoring System; and
 - iii. Development and maintenance of the Global Data Center for Aircraft-Based Observations.
7. Compile new and review, update and maintain existing regulatory and guidance material on aircraft-based observations and observing systems, including in particular, WMO-No. 8, WMO-No. 1160, WMO-No. 1165, and WMO-No. 1200;
8. Conduct and provide support for training and outreach activities of WMO, to support the development of aircraft-based observing systems and the use of aircraft-based observations;
9. Work in collaboration and cooperation with other teams within WMO on the above activities as appropriate and as necessary;
10. Report on issues, activities and progress to SC-ON and SC-MINT.

Annex 3 – Target Airlines Analysis, Estimated deployment and operational costs

Target Airline	Answer	Initial Development	Fleet Deployment	Total NRC Estimate (k€)	Yearly Reports	Yearly Com. Costs (k€)
Airlink						
EgyptAir						
Ethiopian airlines						
Royal Air Maroc	Yes	30	39	69	83 000	174
Saudia		120	146	266		
Qatar Airways	Yes	80	168	248	280 000	588
IndiGo						
Vietnam Airlines						
Iran Air						
Aerolíneas Argentinas						
Avianca Holding	Yes	60	104	164	250 000	525
Azul Brazilian Airlines	Yes	40	61	101	130 000	273
LATAM Holding						
COPA	Yes	40	70	110	150 000	315
Air Niugini						
AirAsia	Yes	20	99	119	1 000 000	2 100
Cebu Pacific						
Fiji Airways	Yes	20	5	25	7 000	15
Garuda	Yes	100	82	182	38 000	80
Virgin Australia	Yes	20	75	95	250 000	525
Aeroflot		20	71	91	360 000	756
Wizz Air						
S7	Yes	80	85	165	150 000	315
UIA						
UTAir						
Belavia	Yes	20	8	28	14 000	29

Annex 4 – Actions arising from JET-ABO-2

Agenda item	Action	Responsible	Timeframe / Deadline
3.1	JET-ABO to formulate some principles related to mitigating possible future risks associated with the ABO Programme – possibly add to the A-SIP.	JET-ABO-LG	End-2023
3.2	JET-ABO to plan for routine meetings with OEMs, DSPs and avionics vendors.	JET-ABO-LG	End-2023
3.3	JET-ABO to have 1 or more meetings to discuss and determine future action on a possible collaborative financial framework to support the availability of third-party ABO data sources.	JET-ABO	2022-23
3.4	JET-ABO to review list of recommended impact studies and JET-ABO-LG to consolidate and provide to JET-EOSDE.	Chair	End-2022
3.5	JET-ABO members to contribute to the review and update of relevant sections of the WMO No. 1200 and No. 8. In preparation for their submission to INFCOM 2 nd session.	JET-ABO	End-July 2022
	JET-ABO and the Secretariat to ensure that preparations are made to report to and request relevant decision of INFCOM-2 in relation to: <ul style="list-style-type: none"> i. Update of the Guide to ABO (1200) ii. Vol III, Chap 3 of the GIMO iii. WSIs for the ABO-MR 	JET-ABO, Secretariat	Mid-October 2022
	JET-ABO to undertake review of relevant parts of Manual and Guide to WIGOS.	JET-ABO	End-2024
3.6	JET-ABO to include appropriate turbulence-related activities from the A-SIP in the updated work plan and activities of the SG-Turb	JET-ABO-LG, SG-Turb	December 2022
3.8 and 5.6	CG-WICAP to have a focus on exploring possible ways to leverage CORSIA as an incentive for airlines to participate in WVM and AMDAR, i.e. Investigate the possibility for AMDAR to be an offset program in CORSIA.	CG-WICAP	2022/23 and coming inter-session period.
4.3	Secretariat to arrange a follow-up meeting of the JET-ABO on ABO WIGOS Station Identifiers.	JET-ABO-LG, Secretariat	Q3 2022
	Secretariat to commence determining & advising of requirements of programmes to contribute to testing of ABO-MR during development.	Secretariat	End-2022

	Interact with ET-WIGOS Tools on integration of the ABO-MR into WIGOS.	SG-DM, JET-ABO-LG	End-2022
4.4	In relation to the GDC: 1. The SG-DM to review and update functional requirements for the GDC, taking into account WICAP and 3rd party ABO data; 2. NOAA should be requested to assess whether it was still able to meet requirements to operate the GDC and identify needs for any development; 3. SG-DM to develop a proposed WMO/NOAA agreement, as required by Res. 6 (EC-69); 4. Make GDC operational and publicise its availability.	SG-DM, JET-ABO-LG	End-2023
5.5	Continue the discussion on opportunities for global funding models based on the six models introduced	JET-ABO	Dec. 2023
	Talk to the PPE division in WMO about business models for engaging public entities like airlines to be involved in ABO and WICAP	JET-ABO	Dec 2023
	Work with DSPs to lower communications costs and investigate low-cost data communications alternatives and solutions. <ul style="list-style-type: none"> As one solution, JET-ABO should analyse the possibility of downloading data over cheaper WIFI upon landing to reduce comms costs. If viable, this option should be incorporated with guidance in the AOSFRS. 	CG-WICAP, JET-ABO	Dec 2023
6	JET-ABO Work Plan to be updated in accordance with outcomes of the JET-ABO and relevant activities proposed in Annex 5.	JET-ABO-LG	Dec. 2022
	Trello board to be updated and an Action List to be developed and maintained.	Secretariat	Nov. 2022
	Longer-term activities proposed in Annex 5 to be considered for input to the formulation of plans of the INFCOM for next inter-sessional period.	JET-ABO-LG, Secretariat	End-2023
6	JET-ABO to investigate the possibility to collaborate with Data Centres for the routine provision of FSOI statistical information to support ABO impacts analysis.	JET-ABO	End-2023

Annex 5 – Proposed Priorities for Future Activities for JET-ABO

Topic/Issue/Area of ABO	Activity 2022/23	Activity 2024 – 2027
WICAP	<ul style="list-style-type: none"> • Planning for development of WICAP AMDAR, with a focus on Africa, Central Asia and South America. • WMO and IATA to consider opportunities on exchanging of meteorological data (wind & temp) between the organizations. • Determining how to best resource the development of national and regional AMDAR programmes. • Development of agreed processes and procedures for communicating with airlines, particularly considering one-to-one discussions versus joint promotional sessions. • Communication with OEMs avionics vendors to provide standardized AMDAR and turbulence reporting as option on new aircraft delivery and for retrofit. 	<ul style="list-style-type: none"> • Implementation of WICAP AMDAR • Use of funding grants and other mechanisms to support WICAP implementation. • Interaction with the aviation industry to ensure collaboration on WICAP.
Water Vapor Measurement	<ul style="list-style-type: none"> • Publish flyers • Complete business case document and promote WVM with NMHS and aviation industry 	<ul style="list-style-type: none"> • Promote business case • Advance assessment of ABO as component of CORSIA
UAS	<ul style="list-style-type: none"> • Planning for the UAS-DC • Completion and publication of the Whitepaper on UAS. • Consolidate data representation and exchange requirements, standards, etc. • Collaborate with UAS associations on UAS inter-comparisons. 	<ul style="list-style-type: none"> • Holding of the UAS-DC • Analysis and reports from the UAS-DC • Work with regulators to extend airspace access, particularly focusing on BVLOS operations. • Extend JET-ABO focus to high altitude platforms such as gondolas and balloons and use of dropsondes or similar. • Promote Detect and Avoid capability as requirement. • Develop UAS standards within WMO technical regulations and guidance. • Extend collaboration with other application areas for other applications, such as volcanic ash and plume monitoring, soil moisture, hydrology, etc.

		<ul style="list-style-type: none"> Investigate 3rd party participation as data source. Plan and coordinate UAS inter-comparisons, including with radiosondes. Facilitate tests for developing standards for UAS operations under adverse weather.
ABO Variables	<ul style="list-style-type: none"> Planning for expansion of turbulence under WICAP and other ABO. 	<ul style="list-style-type: none"> Extend turbulence monitoring. Explore access to other data sources such as Integrate new variables into ABO systems, including icing, GPS altitude, GNS, etc. Investigate provision of data from aircraft-based radar.
ICAO/Air Navigation Data Source	<ul style="list-style-type: none"> Prepare for advent of ADS-B Version 3 Extend availability of ADS-C data. Determine requirements for data representation 	<ul style="list-style-type: none"> Pursue availability of ADS-B met. Data. Extend availability of ADS-C data. Coordinate required development of data representation models.
Aircraft Derived Data	<ul style="list-style-type: none"> ADD workshop Plan for extension of Mode-S system globally. 	<ul style="list-style-type: none"> Extend Mode-S globally.
Data Management	<ul style="list-style-type: none"> Extend functionality of Lead Centre Implementation of the ABO-MR 	<ul style="list-style-type: none"> Establish Lead Centre as component of WDQMS ABO centres to be integrated into WIGOS centres. Develop business model and financial framework for ABO data sources. Consolidate ABO-MR operations, guidance and practices, including back-seeding of metadata. Establish Lead Centre for ABO under WIGOS and WDQMS.
Data quality issues	<ul style="list-style-type: none"> Develop plans for addressing data quality issues, particularly air temperature bias. 	<ul style="list-style-type: none"> Address data quality issues, including air temperature bias.
Standards, technical regulations and guidance	<ul style="list-style-type: none"> Update AOSFRS 	<ul style="list-style-type: none"> Maintain all technical materials including WMO No.s 1200 and 8
Interaction with the Aviation Industry	<ul style="list-style-type: none"> Make plans for improved interaction with the AI. 	<ul style="list-style-type: none"> Ensure membership of key AVI standards and other groups. Regular meetings with DSPs, OEMs and avionics vendors and related suppliers.