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Tel.: +1 514-315-2167

Ref.: AN 10/1 – 25/38 7 April 2025

Subject: Development of a Cost Recovery Mechanism for the Provision of Space Weather Information Services

Action required: Reply no later than 13 June 2025

Sir/Madam,

1. I have the honour to refer to the State Letter dated 21 December 2018, reference AN 10/1 – IND/18/9 (Attachment A), informing your Government that the ACFJ consortium (formed by Australia, Canada, France and Japan), the Partnership of Excellence for Civil Aviation Space Weather User Services (PECASUS) consortium (formed by Austria, Belgium, Cyprus, Finland, Germany, Italy, Poland, Netherlands and United Kingdom) and the United States would serve as global space weather information service providers.

2. This State Letter further stated that the service would be provided by the designated centres on the understanding that the space weather information services would be provided at no cost to the aviation user community for the first three years of operation. Subsequent to the issuance of this letter, the China/Russian Federation consortium, that had initially been named a regional centre, was also designated as a global space weather information service provider, whereas South Africa remains a regional centre.

3. ICAO Space Weather Information Services (SWIS) began coordinated operational services on 7 November 2019. Following the commencement of these services, the ICAO Council initiated discussions to explore cost recovery mechanisms for the service providers. These deliberations prioritize the safety of global air navigation by ensuring the continuity and efficiency of the SWIS. The Council's efforts, in this regard, align with the ICAO Assembly Resolution contained in A41-27, which requested that the Council "*address the issues of the appropriateness of a global cost recovery system for the provision of space weather information services for international civil aviation, including the development of a cost recovery mechanism consistent with ICAO's charging principles*". Background information on the development of the service, along with updates on the progress of work related to cost recovery, is provided in Attachment B.

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4. Following discussions in the Council, the following two distinct Concept Note options for a global cost recovery mechanism were developed: **Option – Operator Charge**, proposing a Global User Charge to Air Operators (technical details provided in Attachment C); and **Option – State Charge**, outlining a Global Charge Allocation to States (technical details provided in Attachment D). Service cost information and the cost implications of each option are outlined in Attachment E. The report of the Independent Oversight Task Force, which reviewed the aviation-related costs submitted by service providers, is provided in Attachment F. Details on the service cost components recovered by the Global Space Weather Centres is provided in Attachment G.

5. It is important to note that solar activity may present, at times, both a safety risk to aviation communication and navigation systems, as well as a health risk to crew and passengers through exposure to unusually high solar radiation level. Space weather information services provide a means for operators to avoid or mitigate both risks. As such, relevant standards have been adopted by ICAO Member States creating an obligation for space weather information to be considered before all flights. This obligation requires the establishment of a mechanism ensuring that reliable space weather information, covering all land and sea areas, can be accessed by all operators everywhere.

6. I kindly invite you to send your comments to SWIS@icao.int, on your preferred option, including any concerns or additional considerations you may have regarding **Option – Operator Charge** and **Option – State Charge**. Additionally, Member States could, in reviewing the two options proposed, also put forward alternative proposals for consideration, should they wish to do so. Your input will be instrumental in guiding further discussions on this matter and in developing a comprehensive and equitable cost recovery mechanism for this service.

Accept, Sir/Madam, the assurance of my highest consideration.

Juan Carlos Salazar
Secretary General

Enclosures:

Attachment A – SL AN 10/1 – IND/18/9
Attachment B – Background Information
Attachment C – Option – Operator Charge
Attachment D – Option – State Charge
Attachment E – Computation of the Charge Per Departure
Attachment F – Independent Oversight Task Force Report (English only)
Attachment G – Components of the Costs Recovered by the Space Weather Centres

Attachment A to State letter 25/38

State letter AN 10/1-IND/18/9

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Tel.: +1 514-954-8219 ext. 7079

Ref.: AN 10/1 – IND/18/9

21 December 2018

Subject: Designation of provider States of space weather information

Action required: a) to note the information provided; and b) reply by 15 January 2019

Sir/Madam,

1. I have the honour to inform you that the Council, at the seventh meeting of its 215th Session held on 13 November 2018, reviewed a proposal presented by the Air Navigation Commission for the establishment of a global space weather information service in accordance with the relevant Standards and Recommended Practices (SARPs) of Annex 3 — *Meteorological Service for International Air Navigation*, which became applicable on 8 November 2018.

2. In this regard, I am pleased to inform you that the Council decided that the ACFJ consortium (formed by Australia, Canada, France and Japan), the PECASUS consortium (formed by Austria, Belgium, Cyprus, Finland, Germany, Italy, Poland, Netherlands and United Kingdom), and the United States will serve as global space weather information service providers on the understanding that the space weather information services would be provided at no cost to the aviation user community for the first three years of operation. It also agreed that two regional centres, comprising the China/Russian Federation consortium and South Africa, be established no later than November 2022. An extract from C-DEC 215/7 is provided in the attachment.

3. May I kindly invite you to take action by joining the Meteorology Panel (METP) coordination group on the initial coordination and governance of the space weather information service, established at the fourth meeting of the Meteorology Panel (METP/4), held in Montréal, Canada from 20 to 24 September 2018. The referred coordination group was tasked, inter alia, to facilitate the coordination between the designated space weather centres in order to ensure the provision of the consistent information service, as soon as feasible, in accordance with the relevant Annex 3 SARPs. To this end, please confirm the names and coordinates of the representatives of your respective State/Consortium for the METP coordination group, at your earliest convenience and, no later than **15 January 2019**, to the METP Secretary, Mr. Raul Romero at rromero@icao.int, with a copy to Chief, Airport Operations and Infrastructure, Mr. Yong Wang at yongwang@icao.int and AOI@icao.int.

Accept, Sir/Madam, the assurances of my highest consideration.

Fang Liu
Secretary General

Enclosure:
Extract from C-DEC 215/7

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ATTACHMENT to State letter AN 10/1 – IND/18/9

EXTRACT FROM COUNCIL DECISION 215/7

" ...

Designation of provider States of space weather information (Subject No. 14.3.11)

1. The Council resumed (215/4) and completed consideration of C-WP/14800, whereby the Air Navigation Commission (ANC) presented a proposal for the establishment of a global space weather information service developed with the assistance of the Meteorology Panel (METP), which had provided an assessment of the audits of potential service providers conducted by the World Meteorological Organization (WMO). The ANC invited the Council to: a) appoint three global space weather information service providers, namely, the ACFJ consortium (comprising Australia, Canada, France and Japan), the PECASUS consortium (comprising Austria, Belgium, Cyprus, Finland, Germany, Italy, Netherlands, Poland and the United Kingdom) and the United States; b) agree that two regional centres, comprising the China/Russian Federation consortium and South Africa, be established no later than November 2022; and c) agree to review the global and regional centres' implementation in 2022 and reassess the optimal number of global and regional space weather information service providers by 2027.

2. Pursuant to the agreement reached previously (215/4), the President of the Council had undertaken informal consultations with the Secretariat, the President of the ANC and some Council Representatives on this subject, and prior to the start of the present meeting, had circulated to Representatives by e-mail proposed action by the Council as a compromise solution. The President proposed that: the Council agree to the action proposed by the ANC in C-WP/14800, on the understanding that space weather information services would be provided at no cost to the aviation user community for the first three years of operation: note the interest expressed at the Council's Fourth Meeting on 5 November 2018 by China and the Russian Federation to serve together as a global centre; task the ANC to: i) advise on the method to include as future providers – at global and regional levels – those candidates which had successfully satisfied the WMO audit process; and ii) facilitate the development of coordination methodologies between designated global and regional centres as necessary to ensure the provision of consistent space weather information; request the ANC to report thereon during the Council's 217th Session in May/June 2019; and agree to review in 2022 not only the global and regional centres' implementation but also the cost of provision of service after the first three years.

3. Comments and suggestions made and concerns expressed were noted, as were the clarifications provided. The President of the Council highlighted that there were three options before the Council based on the discussions: 1) accept the ANC's proposed action (C-WP/14800); 2) accept the President's proposed action as outlined above; or 3) take a political decision and appoint four global space weather information service providers, namely, ACFJ consortium, the PECASUS consortium, the United States and the China/Russian Federation consortium.

4. On the basis of an indicative show of hands on each of the said three options, the Council decided to take the action proposed by its President, as subsequently expanded to include a suggested additional ANC task, and:

a) agreed that, as recommended by the ANC, the ACFJ consortium, the PECASUS consortium, and the United States serve as global space weather information service providers, on the understanding that the space weather information services would be provided at no cost to the aviation user community for the first three years of operation;

b) agreed that, as recommended by the ANC, two regional centres, comprising the China/Russian Federation consortium and South Africa, be established no later than November 2022;

c) noted the interest expressed by China and the Russian Federation to serve together as a global centre;

d) tasked the ANC to:

i) advise on the method to include as future providers – at global and regional levels – those candidates which had successfully satisfied the WMO audit process;
ii) facilitate the development of coordination methodologies between designated global and regional centres as necessary to ensure the provision of consistent space weather information; and
iii) consider, with the support of the Secretariat, whether there was a continuing need for ICAO to designate global and regional centres.

e) requested the ANC to report on the progress with respect to sub-paragraphs a) to d) above to the Council during the 217th Session in May/June 2019; and

f) further agreed to review the global and regional centres' implementation and the cost of provision of service after the first three years in 2022, and reassess the optimal number of global and regional space weather information service providers by 2027.

5. With regard to paragraph 4 d) ii) above, the Council requested that the said two regional centres be invited to participate in the envisaged discussions on coordination methodologies. With respect to paragraph 4 d) iii), it was understood that if the Council were to decide in future, on the basis of a recommendation by the ANC, to no longer designate global and regional centres for the provision of space weather information, then Annex 3 would be amended accordingly.

6. The following lessons learned were retained from the process followed to designate providers of space weather information: the need to pay more attention to the procedural matter of developing substantive criteria with which to differentiate between the quality of the space weather information service offered by prospective providers; the need for the assessment/selection process of potential service providers to be fair and transparent and to be adhered to by all concerned, with a view to avoiding any potential issue of conflict of interest; the need for all technical issues to be resolved to a very large extent before the matter was brought before the Council; and the need for the Council to have a clear understanding of the role it would assume as a consequence of adopting any proposed SARPs and to raise any issues and concerns in that regard before their adoption.

7. It was highlighted: that the Annex 3 SARPs which set requirements for the provision of information on space weather had become applicable on 8 November 2018; and that from that date the PECASUS consortium had started to provide 24/7 space weather information service based on Annex 3, with two test space weather advisories having thus far been issued. It was noted that the dissemination of the PECASUS space weather advisories would be moved to the Aeronautical Fixed Telecommunication Network (AFTN) once the latter was ready to handle such advisories.

…"

— END —

ATTACHMENT B to State letter 25/38

BACKGROUND INFORMATION

1 Operational Developments

1.1 In March 2018, during its 213th Session, the ICAO Council approved the amendments to ICAO Annex 3, *Meteorological Service for International Air Navigation*, paragraphs 9.1.1 and 9.1.3 k), to include the requirement for States to provide space weather information to operators and flight crew members, with an applicability date of 8 November 2018. The Annex is further supported by ICAO Doc 10100, *Manual on Space Weather Information in Support of International Air Navigation,* Chapter 4 of this document outlines guidance for flight crews, aircraft operators, air navigation service providers, and civil aviation authorities on effectively utilizing space weather information.

1.2 In November 2018, during its 215th Session, the ICAO Council approved the establishment of a global space weather information service, as recommended by the Air Navigation Commission (ANC) and its Meteorology Panel (METP). This service is provided by a network of ICAO-designated Space Weather Information Centres (SWXCs). The key consideration for the global service was for users to access a coordinated source of expert, accurate, reliable and timely information, delivered at an appropriate cost, with built-in redundancy ensuring continuous and uninterrupted coverage.

2 Service Providers

2.1 ICAO, through the World Meteorological Organization (WMO), conducted technical assessments on prospective SWXCs to ensure their capability to meet ICAO's requirements before designation. Three service providers were designated ICAO global SWXCs in November 2018 (C-DEC 215/7 refers), namely the ACFJ consortium (comprising Australia, Canada, France and Japan), the Partnership of Excellence for Civil Aviation Space Weather User Services (PECASUS) consortium (comprising Austria, Belgium, Cyprus, Finland, Germany, Italy, Netherlands, Poland and the United Kingdom), and the United States; in addition, two regional centres were named, comprising the China/Russian Federation (CRC) consortium and South Africa. At the 219th Session of the Council, in April 2020, the Council agreed that the CRC should also serve as a global space weather information service provider (C-DEC 219/7 refers). The four designated SWXCs operate on a rotational basis, with each centre taking turns to serve as the primary provider while the others act as backups. This coordinated and cooperative approach ensures the availability of expert space weather information and ensures continuous and uninterrupted service.

2.2 The ICAO Space Weather Information Services (SWIS) commenced its operational service on **7 November 2019** and the coordinated single source of information from ICAO SWIS is disseminated via the ICAO Aeronautical Fixed Service (AFS) to each State, for onward dissemination to its operators and other end users in its State. South Africa is now preparing for its operational service as a regional space weather centre to support global space weather centres under the framework of SWIS.

3 Cost Recovery of Space Weather Information Services

3.1 During its 215th Session in November 2018, the ICAO Council noted that the space weather information services would be provided at no cost to the aviation user community for the first three years of operation.

3.2 At the 217th Council Session in May 2019, the ANC reported to Council that, under Article 15 of the Chicago Convention, it is the responsibility of ICAO to review the charges imposed by States and make recommendations to the State(s) concerned, and that services necessary to meet meteorological requirements under Annex 3 can be subjected to a cost recovery mechanism. The subsequent work to develop a cost recovery mechanism involved the Secretariat and the relevant panels of the Air Transport Committee (ATC) and the ANC.

3.3 Within ICAO, discussions on the cost recovery of space weather information services commenced during the 223rd Session of the Council (June 2021), with the presentation of C-WP/15202 to the Council via the ATC. At the time, the Council had requested that options be developed for an appropriate methodology and mechanism for the cost recovery of space weather information (C-DEC 223/6 refers).

3.4 ICAO Assembly Resolution A41-27, Appendix C, Section I, Paragraph 11, as adopted by the Assembly in September 2022, *requested the Council to address the issues of the appropriateness of a global cost recovery system for the provision of space weather information services for international civil aviation, including the development of a cost recovery mechanism consistent with ICAO's charging principles*.

3.5 During the 225th Session (February 2022), with the presentation of C-WP/15345, the Council confirmed that cost recovery should be applied globally to the provision of space weather information services by the ICAO-designated space weather centres, further requesting the relevant technical panels to conduct a detailed assessment of the cost associated with the provision of the service. The Council decision further requested that the work of the relevant technical panels be accelerated to develop fair, transparent and equitable options for an appropriate cost recovery mechanism at the global level (C-DEC 225/2 refers).

3.6 Council deliberations on C-WP/15447, during the 227th Session (November 2022), lead to C-DEC 227/3 which approved the selection of a global user charge as the cost recovery mechanism to be further developed to space weather information services, on the understanding that this option was, at the time, the most suitable cost recovery mechanism in the application of cost recovery for the ICAO space weather information services. This cost recovery mechanism Concept Note, **Option – Operator Charge,** is presented in **Attachment C**.

3.7 During the 227th Session, the Council requested that the Secretariat present a proposal for the establishment of an independent oversight body to ensure that the allocation of service provider costs to aviation is reasonable. It was clarified that this cost review exercise is distinct from any ongoing oversight function that may be incorporated into a future Agreement or Arrangement. The recommendations contained in the Report of the Independent Oversight Task Force, presented in **Attachment F** are intended to enhance the annual cost reporting process and strengthen oversight mechanisms within the framework of a future Agreement or Arrangement. The composition of the Task Force has been approved by the Council; however, its report is still pending Council approval.

3.8 Subsequently, at the second Meeting of the ATC, during the 230th Session of the Council, C-WP/15518 was considered. In the Appendix to this working paper, a draft of the proposed "*Arrangement on the Sharing of Costs of the Space Weather Information Services*" was presented on the global user charge model of global cost recovery. The Council decided to postpone making a final decision on the matter (C-DEC 230/5 refers). In order to facilitate the progress of this initiative, the Council also agreed to constitute a Small Group on Cost Recovery for the Provision of Space Weather Information Services under the ATC.

3.9 During the 233rd Session of the Council, an Oral ATC Report was presented to the Council that outlined an additional global cost recovery proposal for the provision of space weather services. A Concept Note on a global charging mechanism, based on the allocation of a charge to States, was developed by the Small Group of the ATC. This cost recovery mechanism Concept Note, **Option – State Charge,** is presented in **Attachment D.**

3.10 During its 233rd Session, the Council agreed to initiate a State Letter consultation with Member States regarding the two Concept Note options outlined in paragraphs 3.6 and 3.8. The consultation aimed to review the proposed options and invite alternative proposals for consideration, if desired.

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ATTACHMENT C to State letter 25/38

OPTION – OPERATOR CHARGE

At its 227th Session in November 2022, the Council approved the selection of a global user charge as the cost recovery mechanism to be further developed for ICAO Space Weather Information Services (SWIS). This decision was made with the understanding that it was the most appropriate cost recovery approach in the global context at that time.

The ICAO Council approved this option for further development based on discussions and outcomes from a meeting of the Meteorology Panel (METP) Working Group on Meteorological Cost Recovery Guidance and Governance (WG-MCRGG) ad hoc group, convened from 14 to 16 June 2022 in Washington, D.C. The meeting participants included representatives from the Airport Economics Panel and Air Navigation Services Economics Panel (AEP-ANSEP) Working Group 4 (WG/4), the International Air Transport Association (IATA), and the Civil Aviation Navigation Services Organization (CANSO).

The concept presented to the Council was based on recovering the service cost from both international and domestic aviation, as shown in paragraph 1 below. Paragraph 9 presents the cost per departure under two scenarios: cost recovery from both international and domestic traffic, and cost recovery from international traffic only.

The concept presented to Council is as follows:

1 The global charge is allocated to **Air Operators** based on its proportion of global **International and Domestic** scheduled and non-scheduled departures:

$$Global\ Charge_{Operator} = \frac{DEP_{Operator}}{DEP_{Global}}\ x\ (COST_{SWXC} + COST_{ADM})$$

$Global\ Charge_{Operator}$ = *Global Charge allocated to an Air Operator*
$DEP_{Operator}$ = *International and domestic departures of Air Operator*
DEP_{Global} = *International and domestic departures of Air Operators globally*
$COST_{SWXC}$ = *Aviation-related costs of SWXCs which will be reviewed by an independent oversight body to be decided by the Council*
$COST_{ADM}$ = *Billing and collection agency and Administrator cost*

2 The rationale is as follows:

a) Entity for allocation of global charge: **Air Operators** are the most appropriate entities for the allocation of the global charge as they are the users of air navigation facilities and services.

i. The ICAO key charging principle of Non-Discrimination is best met in that charges that may be imposed for the services shall not be higher than those that would be paid by national aircraft engaged in similar services.

ii. The ICAO key charging principle of Cost-Relatedness is best met, as it relates to the user pay principle in which charges should reflect the level of service being provided and the fact that users should not be charged for services they do not receive. This principle is also consistent with the avoidance of one user group cross subsidizing another user group.

b) Parameter for allocating the global charge: **International and domestic** (**scheduled and non-scheduled) departures** as:

i. A cost recovery mechanism based on departures would best meet ICAO's key charging principles, as assessed by the MET Panel;
ii. departure data was assessed by the MET Panel to be a reliable and comprehensive parameter to be applied, as compared to available tonne-kilometres and distance flown; and
iii. based on the nature of the service (i.e., meteorological information) and the benefits derived therefrom, which is used by both domestic and international aviation, the costs should be recovered from both.

3 Not all SWXCs seek to recover their cost. In cases where a State operating as a SWXC, does not pursue cost recovery, its operators shall not be allocated a global charge, provided the eligible SWXC costs borne by that State exceed the amount of the global charge it would otherwise have been allocated. The rationale is that, a State which bears more than its fair share of the global charge by choosing not to recover its costs, is effectively reducing the overall cost burden of the ICAO SWIS on States.

4 ICAO's role in relation to administration of the ICAO SWIS to be determined based on discussions in the Air Transport Committee (ATC) and Council.

5 States receiving and using the ICAO SWIS to supply space weather advisory information to operators and flight crew members shall accede to the Arrangement. All signatories to be Civil Aviation Administrations, or the State Entity designated by its State, as the entity to provide space weather information to the State's operators (obligation under Annex 3, Standard 9.1.3k).

6 States will need to make the necessary arrangements to allow the Billing and Collection Agency to bill and collect the charge from all air operators registered within their respective State. The State should also assume the service costs until such amendments are made.

7 The SWXCs will appoint a Billing and Collection Agency to invoice and collect the charges from air operators and distribute accordingly to the SWXCs. In the event that an air operator defaults on payment, the Billing and Collection Agency shall recover the charge from the air operator's State of Registry.

8 Based on this concept, the charge for each departure flight, as defined in paragraph 1, is estimated to be USD 0.23[1]. Details of the costs and calculations are provided in the Attachment E, page E-4. As

[1] This amount does not include the associated costs which may be recovered by the China/Russian Federation consortium (CRC). As per letters submitted to ICAO by the Representative of the People's Republic of China on the Council of ICAO on 1 November 2024 and the Ministry of Transport of the Russian Federation on 30 October 2024, the CRC Consortium has informed the Secretary General that they have extended the provision of their services at no cost for an additional two years. As a result, the free service period has formally been extended from

also shown in Attachment E, the addition of the Administrator charge estimate has the impact of increasing this charge by USD 0.01.

9 **Cost Per Departure: Option – Operator Charge**

Data parameter to determine unit cost	**Estimated Cost per Departure**
International and Domestic Departures (paragraph 8)	**USD 0.23**
International Departures (paragraph 9)	**USD 0.54**[2]

Details of the costs and calculations are provided in Attachment E, page E-4.

10 **Possible Implications of Operator Charge Option:**

To establish a sufficient legal basis for billing and collecting charges from operators, any future arrangement drafted under this option would include a provision requiring signatories to amend their domestic laws and regulations in reference to paragraph 6. These amendments would empower the designated billing and collecting agency to collect user charges directly from operators within the signatories' territories.

Until such amendments are enacted, States would bear the liability for the dues of their airline operators. This transitional arrangement ensures continuity in cost recovery while the necessary legal frameworks are being implemented. Given that the timeline for enacting these amendments will vary among States, this approach would temporarily create a hybrid mechanism that combines elements of both **Option – Operator Charge** (Global User Charge to Operators) and **Option – State Charge** (Global Charge Allocation to States).

This interim period would require careful coordination between States and the billing agency to manage obligations and minimize disruptions, ensuring the financial sustainability of the system while maintaining flexibility for diverse legal and administrative timelines.

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16 November 2024 to 15 November 2026. Should CRC then decide not to recover its costs, a determination will be made on whether the provision of Paragraph 3 applies.

[2] This amount also does not include the associated costs which may be recovered by the China/Russian Federation consortium (CRC). As per letters submitted to ICAO by the Representative of the People's Republic of China on the Council of ICAO on 1 November 2024 and the Ministry of Transport of the Russian Federation on 30 October 2024, the CRC Consortium has informed the Secretary General that they have extended the provision of their services at no cost for an additional two years. As a result, the free service period has formally been extended from 16 November 2024 to 15 November 2026. Should CRC then decide not to recover its costs, a determination will be made on whether the provision of Paragraph 3 applies.

ATTACHMENT D to State letter 25/38

OPTION – STATE CHARGE

During the 233rd Session of the Council, the Small Group formulated under the Air Transport Committee (ATC) to advance the work on cost recovery for the provision of space weather information services, proposed a cost recovery option for the ICAO Space Weather Information Services (SWIS) based on the allocation of the service cost to States.

The concept the Small Group presented to the Council was based on recovering the service cost only from international aviation, as shown in paragraph 1 below. Paragraph 8 presents the cost per departure under two scenarios: cost recovery from both international and domestic traffic, and cost recovery from international traffic only.

The concept is as follows:

1	The global charge is allocated to **States** based on the proportion of global **International** scheduled and non-scheduled departures by operators that are registered in that State:

$$Global\ Charge_{State} = \frac{DEP_{State}}{DEP_{Global}}\ x\ (COST_{SWXC} + COST_{ICAO})$$

$Global\ Charge_{State}$ = *Global Charge allocated to State by international departures of operators registered in that State*

DEP_{State} = *International Departures of Operators registered in that State*

DEP_{Global} = *International Departures of applicable registered operators globally*

$COST_{SWXC}$ = *Aviation-related costs of SWXCs which will be reviewed by an independent oversight body to be decided by the Council.*

$COST_{ICAO}$ = *Administrator cost*

2 The rationale is as follows:

a) Entity for allocation of global charge: **States** are the most appropriate entities for the allocation of the global charge as:

i. Under Annex 3, *Meteorological Service for International Air Navigation,* Paragraph 9.1.3, States are required to provide weather information, including space weather information, Paragraph 9.1.3(k), to operators; and

ii. the ICAO SWIS is given directly to the States through the ICAO Aeronautical Fixed Services (AFS), for subsequent dissemination to operators and other end users including air navigation service providers, and airport operators.

b) Parameter for allocating the global charge: **International (scheduled and non-scheduled) departures** as:

i. ICAO's core mandate is international civil aviation;
ii. a cost recovery mechanism, based on departures, would best meet ICAO's key charging principles, as assessed by the MET Panel; and
iii. departure data was assessed by the MET Panel to be a reliable and comprehensive parameter to be applied, as compared to available tonne-kilometres and distance flown.

3 Not all SWXCs seek to recover cost. For a State who is a SWXC, that does not seek to recover cost, it shall not be allocated a global charge, provided the allowable SWXC costs that are borne by that State is more than the global charge which it would have otherwise been allocated. The rationale being, a State which bears more than its fair share of the global charge by not recovering its costs, is reducing the overall cost burden of the ICAO SWIS on States.

4 ICAO's role in relation to administration of the ICAO SWIS to be determined based on discussions in the (Air Transport Committee) ATC and Council.

5 ICAO will develop the global charge allocation arrangement for the ICAO SWIS based on this concept note and consultation with the States. States that opt to receive and use the ICAO SWIS will accede to such arrangement. Accession is to be effected by notice, in writing, to the Secretary General, by the head of the civil aviation administration or other such designated entity in the State.

6 Based on this arrangement, the charge for each departure flight as defined in paragraph 1 is estimated to be USD 0.54[3]. Details of the costs and calculations are provided in **Attachment E**, page E-4. As also shown in Attachment E, the addition of the Administrator charge estimate has the impact of increasing this charge by USD 0.01.

7 It is important to clarify that a Global Charge Allocation to States does not constitute a State Assessment under the Regular Programme. As such, it does not carry the same implications typically associated with assessments under that framework. Specifically, the State Charge option does not entail any risk of State-level diplomatic consequences, including the loss of voting rights in the event of payment defaults. This distinction ensures that the financial mechanism operates independently of the formal obligations and privileges tied to State Assessments, maintaining a focus on equitable cost recovery without impacting diplomatic standing.

[3] This amount does not include the associated costs which may be recovered by the China/Russian Federation consortium (CRC). As per letters submitted to ICAO by the Representative of the People's Republic of China on the Council of ICAO on 1 November 2024 and the Ministry of Transport of the Russian Federation on 30 October 2024, the CRC Consortium has informed the Secretary General that they have extended the provision of their services at no cost for an additional two years. As a result, the free service period has formally been extended from 16 November 2024 to 15 November 2026. Should CRC then decide not to recover its costs, a determination will be made on whether the provision of Paragraph 3 applies.

8 **Cost Per Departure: Option – State Charge**

Data parameter to determine unit cost	**Estimated Cost per Departure**
International Departures (paragraph 6)	**USD 0.54**
International and Domestic Departures (paragraph 7)	**USD 0.23**[4]

Details of the costs and calculations are provided in Attachment E, page E-4.

9 **Possible Implications of State Charge Option:**

States may opt to recover their costs directly from airline operators. To streamline this process, invoicing can be structured based on airline departures registered within the respective State's jurisdiction. This method ensures a clear and transparent mechanism for allocating charges to the appropriate carriers.

In cases of payment defaults, the consequences could extend beyond financial concerns. Sustained and significant payment shortfalls may impair the service providers' ability to maintain essential operations, potentially leading to disruptions in service delivery. Such disruptions could adversely affect not only the airlines themselves but also the broader aviation network and passenger safety.

The impact on each State will vary depending on whether this charging option is based on both international and domestic traffic or on international traffic only. This variation may result in either an increase or a decrease in the overall cost allocation to a given State, depending on its traffic profile.

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[4] This amount also does not include the associated costs which may be recovered by the China/Russian Federation consortium (CRC). As per letters submitted to ICAO by the Representative of the People's Republic of China on the Council of ICAO on 1 November 2024 and the Ministry of Transport of the Russian Federation on 30 October 2024, the CRC Consortium has informed the Secretary General that they have extended the provision of their services at no cost for an additional two years. As a result, the free service period has formally been extended from 16 November 2024 to 15 November 2026. Should CRC then decide not to recover its costs, a determination will be made on whether the provision of Paragraph 3 applies.

ATTACHMENT E to State letter 25/38

COMPUTATION OF CHARGE PER DEPARTURE

Operational Cost Global Space Weather Centres

SWXC/State	Institutions (State-owned)	Estimated costs per annum (USD)[5]		% Aviation vs Full
		Full Space Weather Service	Aviation-related Space Weather Service	
PECASUS				
Finland	Finnish Meteorological Institute	3,745,000	824,042	22%
Netherlands	Royal Netherlands Meteorological Institute	947,000	179,913	19%
United Kingdom	UK Met Office	2,296,000	68,894	3%
Germany	The Deutsches Zentrum für Luft- und Raumfahrt	1,392,000	306,246	22%
Belgium	Royal Observatory of Belgium, Royal Meteorological Institute and Royal Belgian Institute for Space Aeronomy	2,847,000	564,301	20%
Poland	Space Research Centre of the Polish Academy of Sciences	1,047,000	327,785	31%
Austria	Seibersdorf Laboratories[6]	514,000	334,490	65%
Italy	National Institute of Geophysics and Volcanology	1,110,000	313,152	28%
Cyprus	Frederick University	94,000	17,041	18%
	Sub-Total	13,992,000	**2,935,864**	**21%**

[5] Costs reflect 2023 operational cost estimates as provided by the Service Providers for inclusion in C-WP/15447, presented to the Council during the 227th Session in November 2022.
[6] Majority State-owned

SWXC/State	Institutions (State-owned)	Estimated costs per annum (USD) [7]		% Aviation vs Full
		Full Space Weather Service	Aviation-related Space Weather Service	
ACFJ				
Australia	Australian Bureau of Meteorology[8]	6,753,136	742,845	11%
Canada	Natural Resources Canada	5,081,618	1,249,960	25%
France	Collecte Localisation Satellite, European Satellite Services Provider, Météo-France	1,727,502	1,641,127	95%
Japan	National Institute of Information and Communications Technology	3,000,000	20,700	1%
	Sub-total	16,562,256	**3,654,632**	**22%**
	Total Cost $_{SWXC}$	30,554,256	**6,590,496**	**22%**

Additional information:

The Independent Oversight Task Force (Attachment B, paragraph 3.7 refers), reviewed the reasonableness of the justifications for these aviation-related costs provided by the SWXCs. Their report is presented in Attachment F

The annual total service cost is calculated using estimated costs for the upcoming year, with an adjustment to account for the difference between the previous year's estimated and actual costs. The cost is allocated among airlines or States based on departure data from the previous year. The billing frequency will be established in consideration of the applicable charging option.

The costs comprise eight components: Observations, Information technology, Analysis and modeling, Forecasting and dissemination of advisories, Training, Quality and service management, Research and development, Administrative and Overhead costs as described in further detail at **Attachment G**.

As noted in Attachments C and D, the total aviation related service cost does not include the associated costs of the China/Russian Federation consortium (CRC). As per letters submitted to ICAO by the Representative of the People's Republic of China on the Council of ICAO on 1 November 2024 and the Ministry of Transport of the Russian Federation on 30 October 2024, the CRC Consortium has informed the Secretary General that

[7] Costs reflect 2023 operational cost estimates as provided by the Service Providers for inclusion in C-WP/15447, presented to the Council during the 227th Session in November 2022.
[8] Majority State-owned

they have extended the provision of their services at no cost for an additional two years. As a result, the free service period has formally been extended from 16 November 2024 to 15 November 2026. Should CRC then decide not to recover its costs, a determination will be made on whether the provision of Paragraph 3 of Attachments C and D applies.

As noted in Attachment B, paragraph 2.2, South Africa is currently preparing to commence operational service as a Regional Space Weather Centre in support of the global space weather centres under the SWIS framework. It is anticipated that the associated costs will be integrated into the overall cost structure.

Per Departure Charge

1 DATA

1.1 DATA - Domestic and International Departures (2019 data)

Total domestic departures	=	25,046,583
Total international departures	=	13,187,501
Total combined departures:		38,234,084
International and domestic departures of State of SWXC[9]	=	10,058,757
Domestic and International Departures (applicable)	=	28,175,327

1.2 DATA - International Departures (2019 data)

Total international departures	=	13,187,501
International departures of State of SWXC[10]	=	1,033,862
International Departures (applicable)	=	12,153,639

2 ADMINISTRATION COST ESTIMATES

2.1 Administrator Cost – provisional

Salary cost using 2025 budget rates:

G5 (317/day x 15)	=	CAD 4,755
P2 (716/day x 30)	=	CAD 21,480
P5 (1189/day x 30)	=	CAD 35,670
Total salary	=	**CAD 61,905**
Operational costs	=	**CAD 35,000**
Total cost	=	**CAD 96,905 per annum**
$Cost_{ICAO}$	=	**USD 72,000 per annum**

[9] Computation based on Paragraph 3 of Attachments C and D

[10] Computation based on Paragraph 3 of Attachments C and D

2.2 **Billing and Collection Agency** – costs to be determined

Option – Operator Charge	Option – State Charge
$Global\ Charge_{Operator} = \frac{DEP_{Operator}}{\boldsymbol{DEP_{Global}}}\ x\ (COST_{SWXC} + COST_{ADM})$ *Global Charge*$_{Operator}$ = *Global Charge allocated to an Air Operator* *DEP*$_{Operator}$ = *International and domestic or international departures of Air Operator* ***DEP***$_{Global}$ = ***International and domestic*** ***or*** ***International*** *departures of Air Operators globally* *COST*$_{SWXC}$ = *Aviation-related costs of SWXCs which will be reviewed by an independent oversight body to be decided by the Council* *COST*$_{ADM}$ = *Billing and Collection Agency and Administrator cost*	$Global\ Charge_{State} = \frac{DEP_{State}}{\boldsymbol{DEP_{Global}}}\ x\ (COST_{SWXC} + COST_{ICAO})$ *Global Charge*$_{State}$ = *Global Charge allocated to a State of operators registered in that State* *DEP*$_{State}$ = *International and domestic or international departures of Air Operators registered in a State* ***DEP***$_{Global}$ = ***International and domestic*** ***or*** ***International*** *departures applicable registered operators globally* *COST*$_{SWXC}$ = *Aviation-related costs of SWXCs which will be reviewed by an independent oversight body to be decided by the Council* *COST*$_{ICAO}$ = *Administrator cost*
Estimated Operator Charge per International and Domestic Departure **Administrator and Billing and Collection Agency costs not included** (Cost$_{SWXC}$ + Cost$_{ADMIN}$)/ International and Domestic Departures (USD 6,590,496 (E2) + Cost$_{ADMIN}$) / 28,175,327 (E3, para.1.1) **USD 0.23** **Estimated Operator Charge per International and Domestic Departure** **Administrator cost estimate included** **Billing and Collection Agency costs not included** (Cost$_{SWXC}$ + Cost$_{ADMIN}$)/ International and Domestic Departures (USD 6,590,496 (E2) + USD 72,000) (E3, para.2.1) / 28,175,327 (E3, para.1.1) **USD 0.24**	**Estimated State Charge per International and Domestic Departure** **Administrator costs not included** (Cost$_{SWXC}$ + Cost$_{ICAO}$)/ International and Domestic Departures (USD 6,590,496 (E2) + Cost$_{ICAO}$) / 28,175,327 (E3, para.1.1) **USD 0.23** **Estimated State Charge per International and Domestic Departure** **Administrator cost included** (Cost$_{SWXC}$ + Cost$_{ICAO}$)/ International and Domestic Departures (USD 6,590,496 (E2) + USD 72,000) (E3, para.2.1) / 28,175,327 (E3, para.1.1) **USD 0.24**
Estimated Operator Charge per International Departure **Administrator and Billing and Collection Agency costs not included** (Cost$_{SWXC}$ + Cost$_{ADMIN}$)/ International (USD 6,590,496 (E2) + Cost$_{ADMIN}$) / 12,153,639 (E3, para.1.2) **USD 0.54** **Estimated Operator Charge per International Departure** **Administrator cost estimate included** **Billing and Collection Agency costs not included** (Cost$_{SWXC}$ + Cost$_{ADMIN}$)/ International (USD 6,590,496 (E2) + USD 72,000) (E3, para.2.1) / 12,153,639 (E3, para.1.2) **USD 0.55**	**Estimated State Charge per International Departure** **Administrator costs not included** (Cost$_{SWXC}$ + Cost$_{ICAO}$)/ International (USD 6,590,496 (E2) + Cost$_{ICAO}$) / 12,153,639 (E3, para.1.2) **USD 0.54** **Estimated State Charge per International Departure** **Administrator cost included** (Cost$_{SWXC}$ + Cost$_{ICAO}$)/ International (USD 6,590,496 (E2) + USD 72,000) (E3, para.2.1) / 12,153,639 (E3, para.1.2) **USD 0.55**

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ATTACHMENT F to State letter 25/38

International Civil Aviation Organization

Independent Oversight Task Force

Cost Allocation to Aviation

REPORT

First Meeting, Virtual, 15 March 2023

Second Meeting, Virtual, 31 March 2023

Third Meeting, Virtual, 6 April 2023

Fourth Meeting, Virtual, 18 April 2023

Fifth Meeting, Virtual, 1 February 2024

Views expressed herein should be taken as advice of the group of experts to the Secretary General, but not as representing the views of the Organization.

IOTF-Report

Table of Contents

Table of Contents

IOTF-Report
Cost Allocation to Aviation

1. Establishment of the Independent Oversight Task Force

1.1 Pursuant to the work undertaken towards the establishment of a global cost recovery mechanism for the ICAO space weather information service, during the Third Meeting of the 227th Session held on 23 November 2022, the Council requested that the Secretariat present a proposal for the establishment of an independent oversight body (C-DEC 227/3 refers). As noted in the C-DEC 227/3, the purpose of the independent oversight body is "ensuring that the service provider cost allocated to aviation is reasonable".

1.2 To expedite the work, a Group was formed, taking into consideration the required work to complete and the timeline to implement a cost recovery mechanism for the service, a number of experts from across various regions, served in a preparatory oversight capacity and provided their preliminary input in relation to the allocation documentation, as presented in the Appendices of C-WP/15447.

2. Terms of Reference

2.1 The work of the Oversight Task Force (OTF) will be guided by the following approved Terms of Reference (ToR):

a) evaluate the technical merits and the reasonability of the justification supporting the costs allocated to aviation for both the Australia/Canada/France/Japan (ACFJ) and Partnership of Excellence for Civil Aviation Space Weather User Services (PECASUS) Consortia, as presented in C-WP/15447, Appendices A, B and C;
b) provide an in-depth analysis and report of the assessment of the findings including appropriate recommendations to guide the Council in its decisions on the issue; and
c) provide any other recommendations that could assist in the implementation of the project.

3. Secretariat

3.1 The Group was led by Joanna Zorbas, Joint Finance Officer of the Air Transport Bureau, who served as Rapporteur. Secretariat participation also included Jun Ryuzaki, Technical Officer, Meteorology Section of the Air Navigation Bureau. A comprehensive list of the Independent OTF Members is provided in **Appendix A**.

4. Meetings

4.1 The Group held five virtual meetings: 15 March 2023, 31 March 2023, 6 April 2023, 18 April 2023 and 1 February 2024. Maximum informality was maintained throughout, enabling the Task Force to complete its work in the communicated timeframe. Proceedings and all documentation were in English only. Service provider feedback to OTF enquiries were provided after the Second and Third meetings of the Group. A summary of each meeting discussion is contained in **Appendix B**.

Observations and Findings

5. General Observations

5.1 Cost allocation for each service provider Partner is determined independently at the Partner level, and consistency across Consortium Partners is challenging, as each Partner employs different cost accounting systems. Internal accounting processes, within each Partner organization, dictate how costs are recorded, analyzed, and reported. Also, Consortiums can include both private and governmental institutions, which operate in fundamentally different ways. Additionally, other organizational differences further impact these processes.

5.2 Some States or Partners adhere to an open data policy and conduct ongoing research, meaning certain observations are fully funded by local taxpayers and incur no cost allocation to aviation services and its users. Some Partners may provide highly specialized services tailored specifically to the aviation sector, whereas others may offer more generalized information and observations that serve a broader range of users.

5.3 When determining the allocation of services provided to the aviation industry and other business sectors, several key factors should be considered to ensure the process is fair, transparent, justifiable, reasonable, and reflective of the industry's actual usage of the service. Additionally, these considerations and the cost allocation method must be clearly documented to ensure consistent application each year and to provide a reliable audit trail for verification purposes.

6. Operational Structure and Information Sources

6.1 The Group requested clarification on the nature and origin of certain information sources used by Global Service Provider Partners. While **Appendix B** of C-WP/15447 outlines the cost components of Global Service Providers, additional specifics, such as whether a partner's operational structure includes multiple organizations or if the partner operates as a private or public entity, were not available.

6.2 Recommendation

6.2.1 Additional details on each Partner should be included in cost and cost allocation documentation, as well as in future Agreement/Arrangement Annexes. This information should specify each Partner's organizational structure, clarify whether they operate as a private or public entity, and outline their service capabilities. Additionally, any structural or operational changes must be promptly reflected in an updated Agreement/Arrangement Annex.

7. Redundancy

7.1 The PECASUS Consortium addressed concerns regarding potential redundancy, given the presence of multiple consortium members, within the same geographic area. This issue was further examined to determine if redundancy was factored into each member's cost determination. In response,

the Service Providers emphasized that some consortium members operate observation stations beyond their national borders to ensure the system's necessary global coverage. They clarified that maintaining multiple sites in critical, remote regions is not considered redundant; rather, it is a cost-efficient approach to system maintenance that preserves system integrity by providing a backup in case of site failure.

7.2 The Provider further noted that maintaining one or more sites in remote, critical regions is not seen as unnecessary redundancy but rather as a cost-effective strategy to enhance system availability and reliability. Leveraging the full capacity of modeling and data analysis methods is essential to achieve a deep understanding of product confidence levels, thereby supporting the generation of robust, consolidated advisories.

7.3 The ACFJ Consortium also addressed the issue of redundancy, noting that responsibilities within ACFJ are structured to minimize overlap, particularly in modeling capabilities. An exception is made in the field of radiation, where relying on two distinct radiation models is considered beneficial.

7.4 Recommendation

7.4.1 To improve clarity on the operational distinctions among Service Providers and Partners, each Partner's system contributions, roles, responsibilities, and other relevant details should be presented in a standardized format and style. Expanding these descriptions with greater detail and depth would also facilitate the execution of any future audits.

8. Work Division and the Operational Rotational Work Structure

8.1 The Group requested clarification from Service Providers regarding each Consortium's role within the rotational structure. Questions were raised about the need for continuous forecasting in the service model and the associated charges for maintaining active standby. Specific enquiries included how Partners internally allocate costs between space weather services and other activities within the operational rotation, how roles function within the overall Service Provider rotation, and how each Consortium operates as a unified entity to optimize resources and minimize costs associated with the number of Partners involved.

8.2 The rotation scheme was described as preventing any single center from operating continuously throughout a 24-hour period. Tasks and roles are managed within each center's normal working hours, with sequential handoffs aligning with the flow of time zones to maintain standard workday hours. Service Providers also noted that a thorough analysis had been conducted to ensure consistency in the underlying principles of the scheme.

8.3 Certain institutions offer specialized services, which can result in higher allocation percentages for specific providers. The OTF noted that a Partner, exclusively dedicated to serving only the aviation sector, may not be an economically efficient structure, as it limits opportunities to share costs with other sectors.

8.4 Recommendation

8.4.1 Recommendations regarding the service structure fell outside the specific scope of the OTF; rather, questions in these areas aimed to enhance understanding of the service provision as well as ensure that no undue cost would be added because of a potentially less than optimal service structure.

9. Cost Allocation Methods

9.1 Some Service Providers have adopted a direct costing approach, identifying specific costs directly attributable to the aviation sector, such as labor or equipment dedicated to this industry, and assigning allocation percentages for shared or common expenses (e.g., overhead) using a fair metric, such as hours worked. This chosen metric is clearly specified across sectors. Alternatively, some providers have implemented a proportional or activity-based costing approach, where costs are allocated based on the share of each activity driving these expenses, such as labor hours. A usage-based allocation system is also an option, in which costs are assigned according to the actual utilization of shared resources, reflecting each sector's percentage of total resource usage. Other cost allocation methods may also be applied.

9.2 The Service Providers note that the Partners have collaborated for over three years, allowing sufficient time to fully understand their total operational costs, the nature of these costs, and to refine an appropriate cost allocation structure.

9.3 Recommendation

9.3.1 Documentation included in the Agreement Annexes should specify the allocation methods used for each cost category. An example of additional disclosure to facilitate an audit process is shown in **Appendix C**.

10. Fair Allocation Between Various Industries

10.1 Some Service Provision Partners are outlining how costs are allocated across industries that use space weather services. One Partner, for example, has allocated one-third of the service cost to aviation, prompting questions about whether this allocation accurately reflects industry usage. Additional questions have arisen about whether all relevant sectors were considered in this determination and how the process ensures representation of all sectors, including the incorporation of emerging industries as necessary.

10.2 Recommendation

10.2.1 Service Providers should review their allocation to aviation annually to ensure that emerging industries are appropriately considered and factored into the allocation percentage as their service needs evolve or services become tailored to them. To support external audits or internal verification, an annual questionnaire can be distributed to Service Providers to gather insights on this and other relevant topics.

11. Consortium Partner is a New Organizational Structure

11.1 In response to an OTF question, a Partner noted that they were not initially established to meet ICAO specifications for space weather service provision; instead, they have utilized numerous pre-existing assets and human resources, effectively time-shared to optimize costs. This approach allows them to utilize existing resources to fulfill ICAO space weather service requirements.

11.2 Recommendation

11.2.1 No specific recommendation on this issue as the current service structure has been approved and established according to the requirements established and the audit conducted by the World Meteorological Organization (WMO).

12. Allocation to Aviation Questions to a Consortium Partner

12.1 A Service Provider was questioned about their comparatively high proportional cost allocated to aviation relative to other providers. In response, the provider offered a detailed explanation of the activity-based costing approach used to calculate and assign service costs specifically for aviation.

12.2 Recommendation

12.2.1 All Partners should briefly document their cost allocation methods for various services, beginning with a review of the appendix in C-WP/15447. Where information is lacking, they should enhance the description for each cost category, specifically detailing the process and criteria for allocating costs to aviation. Each partner should also confirm the continued applicability of this approach with an annual sign-off.

13. Cost for Research Work Related to Product Development

13.1 The OTF raised concerns about potential redundancy, noting that one Partner might be developing service capacities that already exist within another Partner's capabilities. In response, the Service Providers explained that the Consortium was established to leverage each Partner's unique expertise, ensuring each plays a distinct role in service provision. Certain modeling capabilities from prior applications did not fully meet the user requirements for civil aviation, and over the past three years, the costs of modifying this capability have been absorbed by the Service Providers.

13.2 To ensure consistent performance, further work by a single Partner is necessary to complete and optimize the High Frequency (HF) model. Since HF communication services at all Space Weather Centers rely on ionosonde data, which can be unreliable during storm events and offers limited spatial coverage, developing a system that incorporates additional information sources is essential for the future reliability of HF Communication (COM) services.

13.3 Recommendation

13.3.1 Research work should be conducted on a consolidated level to ensure the entire system benefits from output and knowledge gained from this activity. If the research work required is isolated to one Consortium Partner, or simply within one Consortium, the result of the research work should be made available to other Service Provision components. Furthermore, the nature and need for research work should be adequately documented in the annual cost and estimate information.

14. Infrastructure for the Service Provision

14.1 The OTF requested clarification regarding the infrastructure in place prior to the development of the current service structure. The Service Providers explained that meeting WMO audit requirements necessitated a baseline level of service capability. They specified that modifications or enhancements were made to align with Standards and Recommended Practices (SARPs) and Annex 3 requirements. Some Partners noted that they had to tailor their services accordingly. Additionally, Partners highlighted that the ICAO service has benefited significantly from extensive pre-existing expertise, research, activities, and assets in space weather.

14.2 Recommendation

14.2.1 If future operational changes are required due to updates in the SARPs, the associated costs for service modifications should be itemized separately in the first year, with clearly identified impacted cost areas.

15. Cyclical Nature of Sun Activity and Costs

15.1 Service Providers noted that the largest portion of system costs arise from continuous, near-real-time observation and monitoring functions, while the compilation and dissemination of advisories represents only a small fraction of the total costs. The cost estimates also account for the cyclical nature of solar activity, with historical evidence showing that extreme solar events can occur even during low-activity cycles. Although more advisories are typically issued during peak solar activity, the primary cost driver remains the monitoring of space weather phenomena, not the issuance of advisories.

15.2 Recommendation

15.2.1 Annual reporting should include the number of advisories issued throughout the year. If all Service Providers provide this information, it will enable an assessment of how much issuing advisories contributes to overall system costs. Understanding these cost drivers is important for developing an efficient and effective system.

16. Training Costs

16.1 The OTF raised questions regarding training costs and expressed concerns about the level of training charged by some Service Provider Partners. In response, it was noted that each Partner has different cost categories with varying allocations for aviation services. Given that international civil aviation is a new user group with distinct requirements, there is a significant ongoing need for training to ensure compliance and consistency among providers.

16.2 Service Providers emphasized that training needs encompass three key areas: radiation, HF communications, and Global Navigation Satellite System (GNSS). Although a considerable portion of training costs has been covered by the Service Providers during the free service period, staff turnover necessitates ongoing training. The complexity of advisories requires that staff remain well-informed about a wide range of products to effectively respond to detailed requests. Service Providers also identified an example of shared training exercises among Partners on GNSS and radiation.

16.3 Recommendation

16.3.1 Training is a cost component that could be optimized and potentially shared among partners. Each Consortium should communicate their training needs at the beginning of the year, and as necessary throughout, considering the possibility of combining training costs when skills and equipment are common across partners.

17. Quality Assurance

17.1 The OTF noted that the costs associated with this item should be commensurate with each Partner's role within the Consortium. Only those with a quality assurance role should incur these costs, while Partners without this role should only reflect service management costs, which the OTF believes should be lower than currently indicated in the cost estimates. The OTF also emphasized the importance of quantifying the total cost within the Consortium to assess its adequacy.

17.2 In response, the Service Providers explained that this cost category encompasses both quality assurance and service management, with the majority of costs related to service management activities, such as attending coordination meetings, ICAO Meteorology Panel (METP) meetings, and User Consultation meetings. For some Partners, this cost category also includes internal audit expenses. All Partners participate in coordination efforts and have a part-time manager who serves as the primary contact for their respective organization.

17.3 Recommendation

17.3.1 Refine the cost categories for clarity by distinguishing between quality control, service management, and administration. Communicate these distinctions to service providers to ensure

consistency in the costs allocated to each category. Consider optimizing the participation to coordination meetings such as the ICAO METP meetings to reduce the service management costs.

18. Administrative Overhead

18.1 According to the service providers, the inclusion or exclusion of items in this category is determined by each institution's accounting system, the number of users in the State where the provider operates, and the current service structure. Service providers have conducted due diligence to accurately report actual costs and establish appropriate allocations to aviation.

18.2 Recommendation

18.2.1 Since the costs are based on individual internal accounting systems, establishing and documenting admissible costs that are auditable can be challenging. Nonetheless, even when costs vary by partner, they should be clearly outlined in the final agreement, along with the applicable allocation rates for each Partner.

19. Clarity on the Actual Cost Elements

19.1 The Group emphasized the need for clarity in identifying which costs are included under the operational cost category to assess their reasonableness.

19.2 Recommendation

19.2.1 To ensure full transparency, the mechanism being developed should include a detailed breakdown of costs for annual audit purposes.

20. Conclusion

20.1 Considering the various perspectives shared throughout the OTF mandate, the group recommends that the Council carefully review all recommendations presented in this report and encourage Service Providers to proactively assess their cost allocation approaches and mechanisms before initiating the global cost recovery process. Conducting both an internal review at the individual Consortium level, and a collaborative review among all parties involved in the global cost recovery mechanism, will strengthen the reliability and fairness of cost allocations within the aviation structure. This will help ensure that the aviation industry is not cross-subsidizing other sectors, while also supporting a clear and justified allocation of costs to service provision.

20.2 Furthermore, Service Providers should enhance the documentation that is expected to form part of an Agreement to better allow for an annual audit of the costs in an effective manner. While recognizing the overall cost is composed and compiled from varying documentational sources and systems, this

complexity should be formatted in a concise and transparent manner to be informative while also facilitating an effective and efficient annual audit process.

20.3 An extensive review of the service structure was not conducted. While some enquiries regarding service structure and potential redundancies were raised, there was no evaluation of whether the current system exceeds the necessary requirements for effective and efficient service delivery or, if a streamlined service structure with reduced redundancy would expose the aviation industry to risks of service gaps in the event of equipment failure or other incidents that lack immediate backup access.

20.4 In conclusion, the cost allocation exercise has yielded logical explanations from the Service Providers, supporting the determination that a reasonably fair and equitable distribution of costs to the aviation industry has been achieved. However, the information presented in Appendices A and B of C-WP/15447 lacks the necessary detail, structure, and transparency required to confirm this assumption and for effective audits and future allocation reviews. When considering an Agreement or Arrangement inclusion, content enhancement is essential for continuous oversight and to strengthen the integrity of the overall cost allocation process.

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IOTF-Report
APPENDIX A
LIST OF OVERSIGHT TASK FORCE MEMBERS

State/Organization	Name
ARGENTINA	**Claudia Ribero** Directorate of Aeronautical Meteorology National Meteorological Service, Argentina Email: cribero@smn.gob.ar
GREECE	**Kalliopi Lykou** General Director of Economic Oversight and Administrative Support Hellenic Civil Aviation Authority Member of the Airport Economics Panel and Air Navigation Services Economics Panel (AEP-ANSEP) Email: k.lykou@hcaa.gov.gr
ICELAND	**Theodor Freyr Hervarsson** Director of Business Development Icelandic Meteorological Office Iceland Email: teddi@vedur.is
NIGERIA	**Daniel Okoh** Research scientist, the Space Environment Research Laboratory (SERL), United Nations African Regional Centre for Space Science and Technology Education - English (ARCSSTE-E), National Space Research and Development Agency (NASRDA), Nigeria Email: okodan2003@gmail.com

IOTF-Report
APPENDIX A
LIST OF OVERSIGHT TASK FORCE
A-2 **MEMBERS**

State/Organization	Name
IATA	**Ruby Sayyed** Air Traffic Management (ATM) Strategy Head International Air Transport Association Email: sayyedr@iata.org
IATA	**Jean-François Grout** Assistant Director ICAO relations DDG-Advocacy International Air Transport Association Tel: (438) 258-3386 Email: groutj@iata.org
ICAO	**Sijia Chen** Air Transport Officer Infrastructure Management Economic Regulatory Framework ICAO (Secretary AEP-ANSEP) Tel: (514) 954-8219 (ext. 6007) Email: SijiaChen@icao.int

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IOTF-Report
APPENDIX B
MEETING SUMMARIES

Report on Discussions First Meeting – 15 March 2023

The Oversight Task Force (OTF) observed the historical background and the events that led to the allocation of meteorological costs for delivering space weather information services. It was noted that the significance of space weather impacts was widely recognized during the Meteorology Divisional Meeting in 2002. In 2011, the International Air Transport Association (IATA) formally requested the International Civil Aviation Organization (ICAO) to expeditiously implement an operational space weather information service.

Furthermore, it was brought to the Group's attention that, during the Fifth Meeting of the 213th Session held on 7 March 2018, the Council adopted the Standards and Recommended Practices (SARPs) for space weather information services as part of Amendment 78 to Annex 3 — Meteorological Service for International Air Navigation, with an effective date of 8 November 2018. These SARPs outlined the requirements for the provision of information on space weather.

The discussion also encompassed the structure of the space weather service providers, and their operational framework, as well as their position on cost recovery. The Group received pertinent Council Decisions pertaining to cost recovery to summarize the ongoing discussions and to emphasize the evolution of a cost recovery mechanism for service provision and the role of the OTF in this project work.

Report on Discussions Second Meeting – 31 March 2023

The Group discussed the context of the initial questions and clarifications sought on the cost allocation details provided by the Service Providers. Concerns were raised regarding the role of each centre with a focus on redundancy of services predominately related to Consortium members from the same geographic area.

The Group also voiced the need for clarification regarding the variations in percentage allocations between service centers. It was recognized that different accounting systems and operational cost components might be contributing factors requiring more detailed information.

Additionally, the Group was informed that their comments and questions would be relayed to the Service Providers, and the responses gathered would be shared with the Group.

Report on Discussions Third Meeting – 6 April 2023

Prior to the Third Meeting of the Task Force, the Service Providers provided written responses to the clarifications sought by the Task Force. They also participated in the Third Meeting to elaborate on their responses and to allow for a real time discussion. This approach allowed for timely follow-up inquiries and responses to additional questions raised by the Task Force Group, as necessary.

Participating Service Providers:

David Boteler (ACFJ)
Research Scientist,
Head of the Space Weather Group,
Natural Resources Canada

Jaakko Nuottokari
Director, Customer Services Unit,
Finnish Meteorological Institute

Kari Österberg
Chief Operating Officer of PECASUS Space Weather Service
Customer services, Aviation and Military
Finnish Meteorological Institute

Dr. G.H.J. (Bert) van den Oord
Coordinating Advisor R&D Satellite observations Royal Netherlands Meteorological Institute (KNMI)

The Service Providers provided the rationale behind the various percentage allocations applied to their service. The key focus in this discussion was on considering the varying accounting systems behind the complied costs and the importance of benefits in maintaining a consistent level of descriptive details to ensure clarity and transparency. This was done while seeking a reasonable level of assurance that the allocation methodology would be fair and equitable to all stakeholders.

Another clarification was requested about redundancy in terms of observation areas, specifically applicable to Partnership of Excellence for Civil Aviation Space Weather User Services (PECASUS), as the Consortium members are from the same geographic area. The Service Providers emphasized that the Consortia was established based on the unique expertise of each partner. They clarified that each Provider played a distinct role in delivering the service and maintaining observation stations at multiple locations, including remote ones, outside of their own territories. They asserted that this approach wasn't redundant but a cost-effective solution ensuring high reliability and availability of measurements.

Additional clarifications were requested concerning the various operational cost components, training requirements, percentage cost allocations for aviation, and the impact of new service users. The Service Providers also highlighted that continuous observations were the primary cost driver to the service with advisories having a less significant impact on overall costs.

To address concerns about possible redundancies, PECASUS provided further information about the provisions of the service and role of each member. This was done to determine whether the number of observation capabilities had been optimized effectively.

Report on Discussions Fourth Meeting – 18 April 2023

The meeting focused on determining the nature of the recommendation(s) to be issued, in consideration of the overall project and an assessment, or evaluation, of overall reasonableness, fairness, and transparency in allocation.

The discussion also covered the importance of service providers reassessing cost allocations in the future, especially if there are changes in the service structure within the consortium or with the addition of a new service provider. Emphasis was placed on recognizing that the allocation of service costs is an ongoing process rather than a static one, as highlighted by its inclusion as an Annex to the Arrangement. Furthermore, it was acknowledged that Annexes to Agreements or Arrangements can be readily and regularly amended.

The Group also noted that considerations for a required audit trail underscore the necessity of clear formatting and presentation in the detailing of the cost allocation for each category. The information within the Annexes of the Agreement/Arrangement must encompass all necessary details and explanations essential for supporting the audit process and aiding oversight groups in their work. It is crucial to modify the structure in the final Agreement/Arrangement to enable a streamlined audit process, as minimizing administrative costs is paramount. Simplifying and making the Annexes more auditable would significantly facilitate the process, ensuring smoother operations and ease of understanding for all involved parties.

The Group raised the question of whether they could additionally propose enhancing the Service Providers' mechanisms or processes. This suggestion aims to ensure that the service is delivered in the most cost-efficient manner, particularly concerning the optimization of the observation network's operations and pertains to identifying who operates where and how many capabilities exist to provide similar information, in a given area. Once these aspects are clear, the goal is to assess if further optimization is viable for the observation network, focusing not just on cost recovery but also on enhancing operational efficiency. The Air Navigation Bureau (ANB) highlighted that operational aspects would be covered in the Meteorology Panel (METP) discussions. According to the Oversight Group's summary, the resulting recommendation might encompass two facets: one, involving a review of the cost recovery mechanism after a year of operation, and another aimed at optimizing operations efficiently, minimizing unnecessary overhead. Since this marks the initial consideration of how operations impact costs, it is rational to contemplate integrating operational aspects into the broader cost framework. Recommendations forwarded to the Meteorological Operations Group (MOG) would thus seem reasonable. The Group further noted that it is crucial that addressing structural issues need not necessarily wait until 2027. The ICAO Secretariat stressed that any contributions to working papers related to the Group's work must receive clearance from the Group before submission.

The Group will determine and confirm the date for the final meeting. The final report will be collectively agreed upon through correspondence following the conclusion of the Group's final meeting.

Report on Discussions Fifth Meeting – 1 February 2024

The Group observed delays in receiving feedback on several questions submitted to the Service Providers. These delays were partly attributed to recent changes in focal points and shifts in work responsibilities. Some questions remain unanswered, and several responses received show inconsistencies between the answers and the information in the Service Provider's report. To resolve these issues, and gather the information necessary to reach a conclusion, the Group scheduled further follow-up through targeted email inquiries.

The Group was reminded that its discussions, summarized findings, and recommendations on the documentation provided by the Service Providers will largely be prepared for inclusion in an Appendix to a forthcoming Agreement/Arrangement. The Group noted the technical complexity of the information presented and identified potential gaps in the required details, such as the absence of specific cost figures. Recognizing the novel nature of the Arrangement, the Group highlighted process-related issues that may be worth documenting. Additionally, the Group suggested that providing the Service Providers with a template could streamline the presentation of cost information in a format suitable for auditing.

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IOTF-Report
APPENDIX C
COST ALLOCATION DISCLOSURE

Extract from C-WP/15447, presented during the Third Meeting of the 227th Session of the Council, with the added content of the yellow labelled columns.

7.1 The cost shares of aviation space weather training from all space weather training per institute, are listed in Table 14*. Training costs include costs for the training of new forecast staff as qualified Space Weather forecasting personnel and ongoing training for operational staff as well as training for local aviation customers.

Table 14: Cost of SWX training costs allocated to global civil aviation per consortium and partner (%)

Ref.	PECASUS	Allocation % to Aviation	Ref.	ACFJ	Allocation % to Aviation
1	FMI	33 %	10	NRCAN	35 %
2	KNMI	0 %	11	ABOM	11%
3	UKMO	10 %	12	NICT	0%
4	DLR	22 %	13	SPECTRA	95%
5	STCE	30 %			
6	SRC	0 %			
7	SL	65 %			
8	INGV	30 %			
9	FU	0 %			

Table 15: Justification for the allocation to global civil aviation in Table 14

Ref.		Justification for the allocated percentage used	Direct Allocation Method	Proportional Allocation	Usage Based Allocation	Other
1	**FMI**	Costs are allocated based on the direct costs (share of the working hours allocated to global SWX services to civil aviation). The allocation is based on the data from the accounting system of FMI from the years 2020 & 2021.	Verify and document hours allocated.			
2	**KNMI**	In the past KNMI helped setting up these trainings, currently STCE provides these trainings. For training local aviation customers, no charge is asked because it is a task of KNMI as a national service provider and the cost is negligible				
3	**UKMO**	Forecaster training assumes one hour of training per year per forecaster			Compute one hour per forecaster.	

*Table reference mislabelled as Table 32 in C-WP/15447

IOTF-Report
APPENDIX C
C-2 **COST ALLOCATION DISCLOSURE**

Ref.		Justification for the allocated percentage used	Direct Allocation Method	Proportional Allocation	Usage Based Allocation	Other
4	**DLR**	Same as in section 1.0		Verify direct working percentage allocation. Estimated costs for services over the current total annual budget (for pre-operational services).		
5	**STCE**	Only internal training is counted. External training, such as training to customers is not included here. Trainings to customers are provided at a cost to the customer. The cost charged to aviation is calculated as a share of the overall cost in this category.		Verify that 30% of the total cost is applied.		
6	**SRC**	-				
7	**SL**	Includes all costs related to trainings. The share to this project is between 50% and 80% depending on economic situation.	Verify support for the applied allocation.			
8	**INGV**	Additional continuous training is needed for the management of observing infrastructure and for the analysis and modelling capability			Verify the percentage allocation to aviation.	
9	**FU**	-				
10	**NRCAN**	General training (for field work, computing, etc.) is obtained from external providers and online courses. This is shared by earthquake and space weather with 50% for space weather and one third of that for aviation, so 16.6% is allocated to aviation. Special training in space weather is provided through conference attendance and 33% of those costs are allocated to aviation. Salaries for staff while on training are counted under the activity for which training is needed.		Verify that 16.6% of the total cost is applied.		

*Table reference mislabelled as Table 32 in C-WP/15447

Ref.		Justification for the allocated percentage used	Direct Allocation Method	Proportional Allocation	Usage Based Allocation	Other
11	**ABOM**	ACFJ carries out annual training exercises to test its internal aviation space dissemination chain and provide a refresher to current and potential new forecasters on the service. Any major updates in software and forecasting procedures also require a mini test to be carried out amongst the forecasting team. The annual exercise usually runs for 48 hours and a significant amount of time goes towards planning and configuring the system to run these exercises. The total cost of the Australian space weather service has not been ascertained.	Verify total cost.			
12	**NICT**	Training costs for NICT are borne by regular budget and no cost allocated to aviation.				
13	**SPECTRA**	The space weather forecasters that operate the service get dedicated training provided through external institutes, with the costs related to travel and subsistence during the training period. Internal trainings are also provided to the technical operators which are not Space Weather experts.		Verify the reasonability and consistency of the proportion applied to aviation.		

IOTF-Report
APPENDIX D
SERVICE COST INFORMATION

State	Institutions	Estimated costs per annum (USD) [1]		% Aviation
		Full Space Weather Service	Aviation-related Space Weather Service	
PECASUS				
Finland	Finnish Meteorological Institute	3,745,000	824,042	22%
Netherlands	Royal Netherlands Meteorological Institute	947,000	179,913	19%
United Kingdom	UK Met Office	2,296,000	68,894	3%
Germany	The Deutsches Zentrum für Luft- und Raumfahrt	1,392,000	306,246	22%
Belgium	Royal Observatory of Belgium, Royal Meteorological Institute and Royal Belgian Institute for Space Aeronomy	2,847,000	564,301	20%
Poland	Space Research Centre of the Polish Academy of Sciences	1,047,000	327,785	31%
Austria	Seibersdorf Laboratories	514,000	334,490	65%
Italy	National Institute of Geophysics and Volcanology	1,110,000	313,152	28%
Cyprus	Frederick University	94,000	17,041	18%
	Sub-Total	13,992,000	**2,935,864**	**21%**
ACFJ				
Australia	Australian Bureau of Meteorology[2]	6,753,136	742,845	11%
Canada	Natural Resources Canada	5,081,618	1,249,960	25%
France	Collecte Localisation Satellite, European Satellite Services Provider, Météo-France	1,727,502	1,641,127	95%
Japan	National Institute of Information and Communications Technology	3,000,000	20,700	1%
	Sub-total	16,562,256	**3,654,632**	**22%**
	Total Cost $_{SWXC}$	30,554,256	**6,590,496**	**22%**

— END —

[1] Costs reflect 2023 operational cost estimates as provided by the Service Providers for inclusion in C-WP/15447, presented to the Council during the 227th Session in November 2022.
[2] Australian Service Provider costs were only available subsequent to the issuance of C-WP/15447.

ATTACHMENT G to State letter 25/38

COMPONENTS OF THE COSTS

RECOVERED BY THE SPACE WEATHER CENTRES

1 Observations

1.1 The provision of Space Weather information services is dependent upon the reliable collection, processing and analysis of observations on the sun's activity and its effects on Earth. Global Space Weather Centres (SWXC) were designated based on their pre-existing capability to monitor specific space weather phenomena and thus the capability preceded the introduction of the ICAO SWX information service to international civil aviation.

1.2 For each type of effect, Radiation Assessment Detector (RAD), High Frequency Communication (HFCOM) and Global Navigation Satellite System (GNSS), the relevant space weather parameters are monitored 24/7. This involves space-based measurements by the Geostationary Operational Environmental Satellite (GOES) of solar flare X-rays that lead to HF radio absorption on the dayside and the GOES measurements of the proton flux that causes HF radio absorption in the polar cap and radiation hazards at aviation altitudes.

1.3 The observations are carried out using a range of different observation equipment. The equipment includes, but is not limited to the following:

a) Riometers
b) Ionosondes
c) Magnetometers
d) GNSS receivers
e) Scintillation receivers
f) Neutron monitors

1.4 A wide range of ground-based instruments are used to measure ionospheric parameters that affect HF radio communication and GNSS positioning. Riometers are used to measure HF radio absorption and ionosondes are used to measure Maximum Useable Frequency (MUF) depression, both of which impact HF radio communications. GNSS receivers measure the total electron content (TEC) of the ionosphere that affects the accuracy of GNSS positioning and scintillation receivers detect the ionospheric effects that disrupt the reception of GNSS signals. Magnetometers also provide information on the magnetic activity that is an additional indicator of ionospheric disturbances and is used to generate the Kp magnetic index used as the trigger for auroral absorption advisories. Neutron monitor data are used in the assessment of radiation level at flight altitudes.

2 Information Technology

2.1 Extensive data collection, computing and distribution systems are needed to underpin the monitoring and modelling functions. The data from satellites, or often-remote ground-based monitoring sites, have to be transmitted, in close to real time, to central data collection sites. To provide robust services (and as specified in the ICAO requirements for space weather service

providers) these data collection sites are duplicated so that there is no interruption in service if one site is put out of action. The data collection sites provide the capabilities for reception, validation and storage of monitoring data and then onward distribution of monitoring data to the other global centres. In addition, these sites provide the computing infrastructure for running the models described in section (2) and distributing the model outputs to the other global centres.

3 Analysis and modeling

3.1 Extensive modelling capabilities are needed to produce the space weather advisories. These models use the measured values from the monitoring data, combined with physics knowledge, to generate the parameters that are of importance to aviation. For example, the GOES particle measurements at satellite altitude are used with magnetic field and atmospheric models to determine the latitudes reached by the particles and the radiation hazard that is produced at different altitudes.

3.2 For HF radio absorption, the D-Region Absorption Prediction (D-RAP) model uses GOES proton data and X-ray measurements with magnetic field and ionospheric physics to generate maps of the D- region absorption at high latitudes (due to the particles) as well as at low latitudes (due to the X-ray flux). Magnetic field monitoring data are utilized to produce the Kp-index which is currently used as a proxy for auroral absorption. More detailed auroral absorption models are under development. To identify regions of MUF depression requires processing of the raw ionosonde records to produce MUF values and then mapping and comparison with 'normal' conditions to provide a measure of the MUF depression needed for the space weather advisories.

3.3 To derive values of the ionospheric TEC, it requires processing of the raw GNSS measurements to produce slant TEC values along the satellite-receiver path, and then considerable work to generate global maps of TEC from which areas affected by space weather events can be identified. Similar work is needed to map the monitoring data obtained from scintillation receivers.

4 Forecasting and dissemination of advisories

4.1 The On-Duty Centre (ODC) is responsible for providing all necessary services to provide space weather advisories in real time. This involves systems that automatically check for threshold exceedances for any of the space weather parameters. Quality control checks to be certain that the threshold exceedance was not noise in the data but was due to a real space weather event. Generation of space weather advisories, either automatically or manually depending on the centre; then distribution of the space weather advisories via the Aeronautical Fixed Telecommunications Network (AFTN).

4.2 Due to the nature of the global service, costs are distributed between four global centres. This division of duties is reflected in the costs related to the forecasting and dissemination of advisories.

5 Training

5.1 Service Providers are required to provide training of new forecast staff as qualified Space Weather forecasting personnel and ongoing training for operational staff. The training requirement

extends also for local aviation customers to understand the products and ensure they are used as intended.

6 Quality and service management

6.1 The management of the global SWX information service includes attendance in relevant ICAO and consortium meetings and user consultations, operational management of the service provision, preparation of relevant documentation, audits, and reporting on operational aspects of the service.

7 Research and development

7.1 The aviation industry is being provided with the best information that is possible with current state of the art equipment. Space weather is not a mature science and there are many areas where new scientific findings can be expected in the future that will lead to improved space weather forecasts. Even with the existing models being used, there is considerable room for improvement. For example, models for some parameters are based on the limited data that was available in the past when the model was developed but now new data shows differences between the model outputs and observations, and this is being used to revise the models. In some cases, the models run by different centres produce different results.

7.2 The needs of the ICAO services are stimulating considerable collaborative work between the global centres. Ongoing research and development by the global centres, singly and jointly, is needed to take advantage of new developments in space weather science to improve the space weather services for aviation.

8 Administrative costs and overhead

8.1 Administrative costs and overhead include, but are not limited to, costs of support services (general IT-infrastructure services, general training, financial and personnel administration etc.), unit-level costs (general management, public relations and internal communications, premises, electricity & water, office supplies and other unit- level costs), 24/7 maintenance of the message switch and AFTN/AMHS connections as well as maintenance of communication tools between within consortia partners and between the four global centres.

— END —