Slide 1 – Meteorological Service for International Air Navigation

Slide 2 – Contents

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Slide 3 – Aviation's global impacts

- Set the scene
- Facts and figures to underline the significance of aviation's global impacts
- Today, air transportation plays a major role in driving sustainable economic and social development
- It directly and indirectly supports the employment of 58.1 million people and contributes $2.4 trillion to global Gross Domestic Product (GDP)
- Carries over 3 billion passengers annually on scheduled traffic and
- More than $6 trillion worth of cargo annually

Slide 4 – Modern air traffic growth

- And the air traffic system is growing
- Global air traffic has doubled in size once every 15 years since 1977 and will continue to do so.
- This growth occurs despite broader recessionary cycles and helps illustrate how aviation investment can be a key factor supporting economic recovery

Slide 5 – Modern air traffic growth

- As for the future
- ICAO is predicting that by 2030
- The number of passengers will reach 6 billion per year on scheduled services alone, twice that of today
- And that the number of aircraft departures will also double to well over 50 million per year

Slide 6 – Does MET matter to ATM efficiency?

- The answer of course is … absolutely YES

- Eurocontrol (independent) Performance Review Commission in 2009 estimated the annual cost of disruption to the European ATM system caused by adverse weather to be approximately €900 million
- Meteorological information is important to all phases of flight: strategic, pre-tactical and tactical
- And all stages from gate-to-gate

Slide 7 – Weather impacts on aviation

- And weather impacts on aviation safety, too
- According to the IATA SAFETY REPORT 2016
- Airline operations may be completely suspended by severe weather in some parts of the world.
- Meteorological threats were identified as factors in 31 percent of accidents in 2016 and 31 percent of accidents during the period of 2012 to 2016.
- Unnecessary weather penetration was a factor in 7 percent of the accidents in 2016.
- The graph shows the rate of accidents where this contributing factor was present.

Slide 8 – ICAO

- All this is of course well known to the aviation community
- The International Civil Aviation Organization (ICAO) is a United Nations specialized agency and was established by States in 1944 with the signing of the Convention on International Civil Aviation (a.k.a. the Chicago Convention, after the city in which it was first signed)
- The ICAO nowadays has 191 Member States and industry groups which work together to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies

Slide 9 – Why are Standards Necessary?

- Universally accepted standards are known as Standards and Recommended Practices, or SARPs
- Needed to ensure all aspects of flights are handled in the same, uniform manner: e.g., air traffic control, airport operations, aircraft operations, manufacturing and maintenance operations, monitoring and provision of products and services, etc.
- SARPs cover all technical and operational aspects of international civil aviation, such as safety, personnel licensing, operation of aircraft, aerodromes, air traffic services (including MET service), accident investigation and the environment
- Indeed, ICAO's website states that "Without SARPs, our aviation system would be at best chaotic and at worst unsafe"

Slide 10 – How are SARPs created?

- The so-called four "C's" of aviation: cooperation, consensus, compliance and commitment
- **Cooperation** in the formulation of SARPs
- **Consensus** in their approval
- **Compliance** in their application
- **Commitment** of adherence to this on-going process

- At the beginning of the process in the formulation of SARPs, proposals for action usually come from ICAO or from Contracting States or from international organizations
- It takes on average 2 years from the preliminary review of the technical proposal for a SARP through to its eventual approval and applicability date

Slide 11 – Meteorological Service for International Air navigation

- SARPs relating to meteorology were first adopted in 1948 and published in Annex 3 to the Chicago Convention
- Initially titled "Standards and Recommended Practices - Meteorological Codes", the title was amended to Annex 3 – "Meteorological Service for International Air Navigation" with Amendment 60 adopted in 1975
- Annex 3 sets out the core international Standards and Recommended Practices (SARPs) and the technical specifications for provision of aeronautical meteorological information. The Annex 3 provisions ensure the uniform application of meteorological services by States signatory to the Convention that are deemed necessary or desirable for safe, regular and efficient international air navigation.

Slide 12 – MET provision today

- Highly 'product-centric'
    - Text and graphical
    - Alphanumeric and digital code forms
- Primarily AFTN and AFS delivery to users
- Annex 3 SARPS and associated guidance
    - ATS/Pilot oriented
    - Limited ATM orientation
    - Aerodrome, terminal area en-route focus

Slide 13 – MET provision today

Traditional MET products, services and systems, including:

- World Area Forecast System/World Area Forecast Centres
    - Global gridded upper-air forecasts and significant weather (SIGWX) forecasts
- International Airways Volcano Watch/Volcanic Ash Advisory Centres
    - Volcanic ash advisories and volcanic ash advisories in graphical format
- State Volcano Observatories
    - Volcano observatory notification to aviation (a.k.a. VONA)
- Tropical Cyclone Watch/Tropical Cyclone Advisory Centres
    - Tropical cyclone advisories and tropical cyclone advisories in graphical format
- Aeronautical meteorological stations and reports
- Automatic observing systems
- Aerodrome Meteorological Offices
    - Local routine and special meteorological reports, METAR/SPECI, TAF, trend, take-off and landing forecasts, aerodrome warnings, wind shear warnings and alerts, etc
- Meteorological Watch Offices
    - SIGMET, AIRMET/GAMET
- Aircraft observations and reports

- ATIS (Automatic terminal information service), D-ATIS, VOLMET (Meteorological information for aircraft in flight), D-VOLMET
- Aeronautical climatological information
- Quality management of meteorological information
- Etc.

Slide 14 – Examples

- Significant weather (SIGWX) forecasts

Slide 15 – Examples

- Volcanic ash advisory information

Slide 16 – Examples

- Volcano observatory notification to aviation (a.k.a. VONA)

Slide 17 – Examples

- Tropical cyclone advisory information in graphical format

Slide 18 – Examples

- SIGMET information in traditional alphanumeric code and in graphical format

Slide 19 – Examples

- Routine report
- Aerodrome meteorological report in METAR format
- Aerodrome forecast in TAF format

Slide 20 – MET provision today

- **Traditional** means of dissemination:
    - AFTN
    - AFS or public Internet communication (including SADIS and ISCS/WIFS)
    - Aeronautical data-link service
    - Aeronautical broadcasting service
- Supplied to **traditional** users:
    - Operators and flight crew members
    - Air traffic service providers
    - Meteorological service providers
- For use in **traditional** forms:
    - Briefing, consultation and display
    - Flight documentation

- Automated pre-flight information systems for briefing, consultation, flight planning and flight documentation

Slide 21 – Future trends

- The aviation system (which is a system of systems) is coming under increasing pressure to meet the demands for aerodrome and airspace capacity.
- To meet the evolving needs of global air navigation planning, the 2016 fifth edition of ICAO's Global Air Navigation Plan (GANP) (Doc 9750) explores the need for more integrated aviation planning and introduces a rolling fifteen-year strategy to guide complementary and sector-wide air transport improvements to 2031 and beyond — that will eventually realize a fully-harmonized global air navigation system.
- Insofar as the GANP is concerned, aeronautical meteorological service is a thread running through the performance improvement area titled "globally interoperable systems and data". So, for example, the benefits of forecasts issued by TCACs should be realized as gate-to-gate seamless operations (for airlines) through common access to, and use of, the available tropical cyclone advisory information.
- Through system-wide information management (SWIM), meteorological information will be a key enabler to the realization of the global air traffic management operational concept envisioned by the GANP and companion ICAO publications.
- SWIM will be essential to ensuring the most efficient use of airspace, to managing air traffic under all meteorological conditions and to increasing common situational awareness. SWIM will enable automated systems to request/receive information when it is needed and to publish information and services as appropriate. In essence, SWIM will improve decision-making and streamline information sharing across all domains for improved flight planning, flight execution and post-flight analysis.

Slide 22 – Global Air Navigation Plan

- The 2016 fifth edition of ICAO's Global Air Navigation Plan (GANP) (Doc 9750) explores the need for more-integrated aviation planning at both the regional and State level, and addresses required solutions by introducing a consensus driven aviation-system block-upgrade (ASBU) methodology. The GANP identifies issues to be addressed in the near term alongside financial aspects of aviation system modernization, and the increasing importance of collaboration and partnership as aviation recognizes and addresses the multidisciplinary challenges that lay ahead.

Slide 23 – Global Air Navigation Plan / Aviation System Block Upgrades

- The ASBUs (or "block upgrades" as they are commonly referred) provide a systems engineering modernization strategy for international air navigation, comprising a series of modules across four performance improvement areas and four blocks. Each block represents the target availability timeline for a group of operational improvements – both technological and procedural – that will eventually realize a fully-harmonized global air navigation system. Every ASBU module serves to progress towards one of the four target performance improvement areas. The technologies and procedures for each block are organized according to modules that are based on the specific performance improvement area to which they relate.

Slide 24 – Global Air Navigation Plan / Aviation System Block Upgrades

- Where the GANP is concerned, aeronautical meteorological service is a thread running through the ASBU performance improvement area encompassing 'globally interoperable systems and data.' Through the concept referred to as system-wide information management (SWIM), meteorological information will be a key enabler to the realization of the global air traffic management operational concept envisioned by the GANP and other companion ICAO publications.

Slide 25 – Future trends

- **Trend towards digital information** – Until now, ICAO in close collaboration with WMO has ensured that the meteorological codes used to support aviation operations have evolved in line with user requirements and service provider capabilities.
- However, much of today's aeronautical meteorological information is formatted and disseminated in proprietary code forms that will render them incompatible with SWIM. The success of SWIM will be, in part, contingent upon the exchange of digital information that uses non-proprietary, open-source code forms such as the extensible markup language (XML) and the geography markup language (GML), since these will allow for the required streamlined sharing of information.
- To this end ICAO, in close coordination with WMO, has embarked on enabling the transition to digital meteorological information exchange that will support the meteorological-component of SWIM.
- As part of Amendment 77 (which was the last update to Annex 3 and became applicable in November 2016) an initial set of aeronautical meteorological messages (specifically METAR/SPECI, TAF, SIGMET, AIRMET, volcanic ash advisories and tropical cyclone advisories) should now be exchanged (as a Recommended Practice) in the new digital form using XML/GML in addition to the exchange of that information in TAC form.

Slide 26 – Digital Exchange of MET

- To support the transition to digital exchange of MET information, guidance on the information exchange model, XML/GML and the metadata profile is provided in the Manual on the Digital Exchange of Aeronautical Meteorological Information (ICAO Doc 10003)

Slide 27 – Future trends

- In the near future, Amendment 78 to Annex 3 will introduce further incremental additions to the digital exchange of meteorological information as a component of the system-wide information management (SWIM) environment by upgrading the status of Recommended Practice to a Standard – thus promoting full integration of MET information into the ATM system.
- The applicability of the Standards for digital exchange using XML/GML - including new provisions for space weather information – will be November 2020.
- It should be noted however, that the existing Standards for TAC, graphical and digital MET information are expected to remain for some time yet before the eventual full transition across to the provision of digital information only.

Slide 28 – MET provision tomorrow

- Availability of shared, timely, high-quality MET information will be the foundation for effective management of the (future) air traffic system
- Enhanced decision-making capability will be enabled through improved accuracy, capability, availability and use of meteorological information through the reliable identification of applicable ATM solutions when meteorological conditions are impacting or are forecast to impact aerodromes or airspace
- To do this, full ATM-MET integration is necessary as Meteorological information will be included in the logic of a decision process or aid

Slide 29 – MET provision tomorrow

- This schematic shows how the process will work
- ATM operational requirement will be supported by MET information and other aeronautical information from a digital database
- Together with information on airspace constraints and aerodrome events all the information will be converted into an ATM impact and this will feed the ATM decision support system

Slide 30 – Digital exchange of MET

To sum up:

- MET information in digital form will be designed to enable:
    - platform independent exchange of data
    - harmonized information
    - Interoperable MET information exchange covering all the needs of the air transport industry
- Major benefits will include:
    - Single representation/ common view of MET information for all stakeholders
    - Alignment of the information with ISO standards and (Open Geospatial Consortium) OGC best practices for geospatial information
    - Modularity to support future requirements – so new types of information (e.g. space weather information) can be easily integrated

Slide 31 – Thank you