ITU/WMO Seminar "Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction"

Session 5: Meteorological Aids Service (Radiosondes) and Other Systems

5.1.1 Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

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For : NOAA-National Weather Service

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Agenda

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

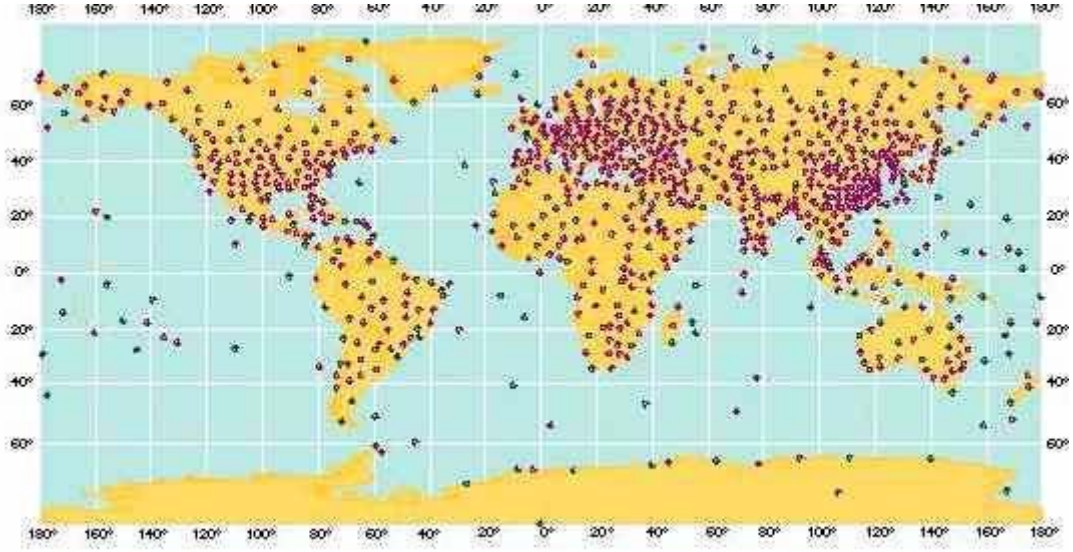
- **Operations**
- **System Overview**
  - **Equipment**
  - **Frequency Bands**
  - **Impact of Interference**
- **Relevant ITU Documents**
- **Looking Forward**
- **Conclusions**

Operations

Worldwide Operations

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **On a Worldwide basis observations are obtained from nation-wide and ship based networks**
  - **Over 1900 operational radiosonde stations**
  - **800,000 launches provide measures of pressure, temperature, humidity and winds**
  - **Approximately 15 commercial ships provide observations over sparsely instrumented oceanic regions.**

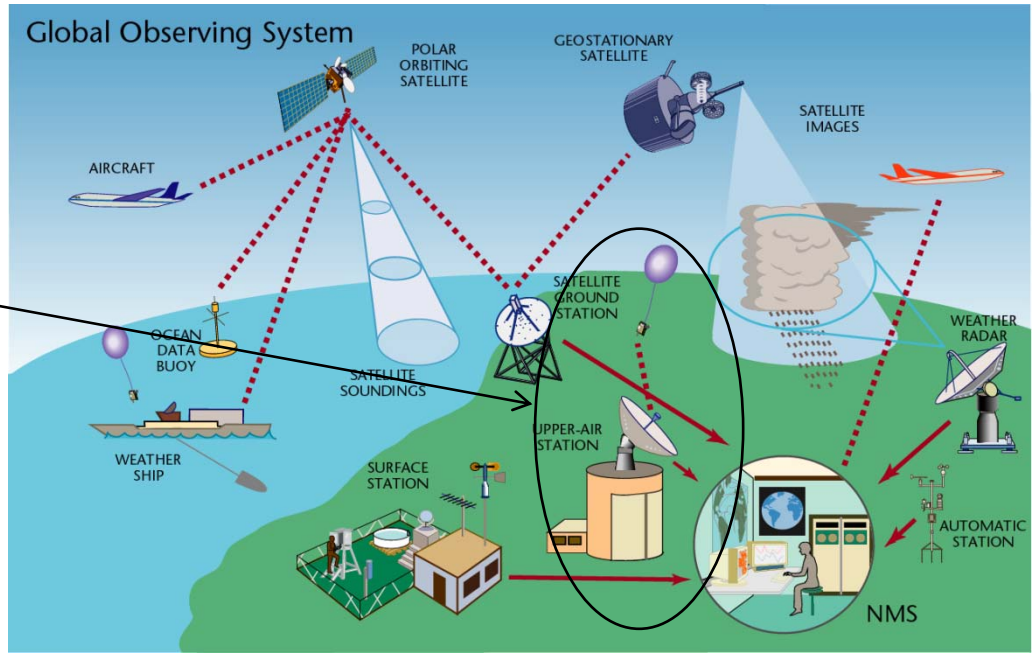


Operations

Worldwide Operations - GOS

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Radiosonde Operations are an integral part of the Global Observing System (GOS)**

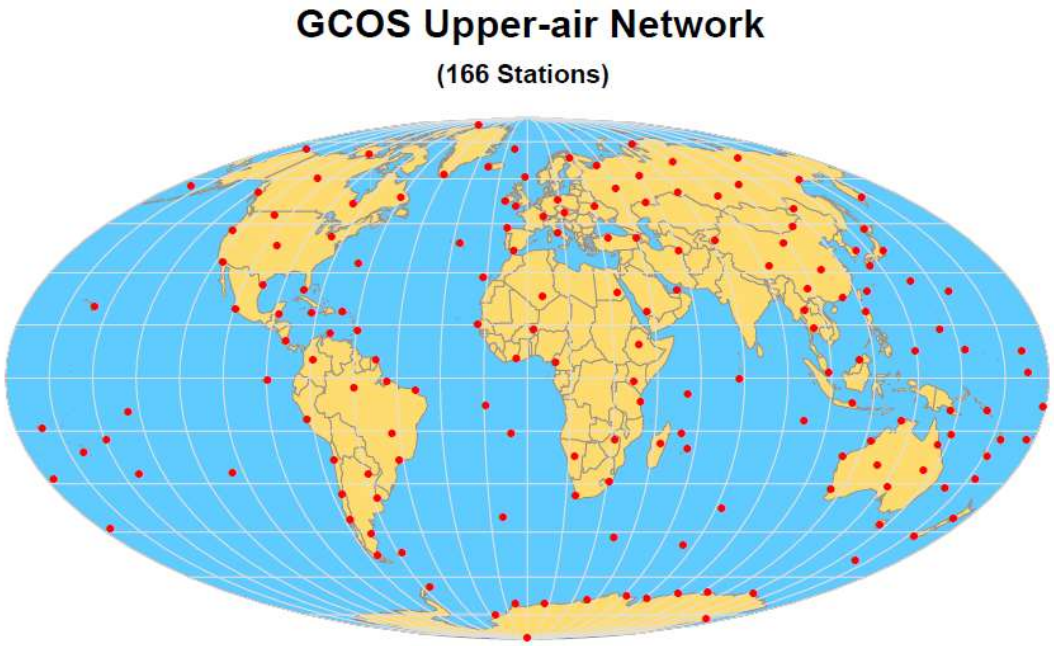


Operations

Worldwide Operations - GCOS

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Radiosonde Observations are an important element in the GCOS (Global Climate Observing System)**

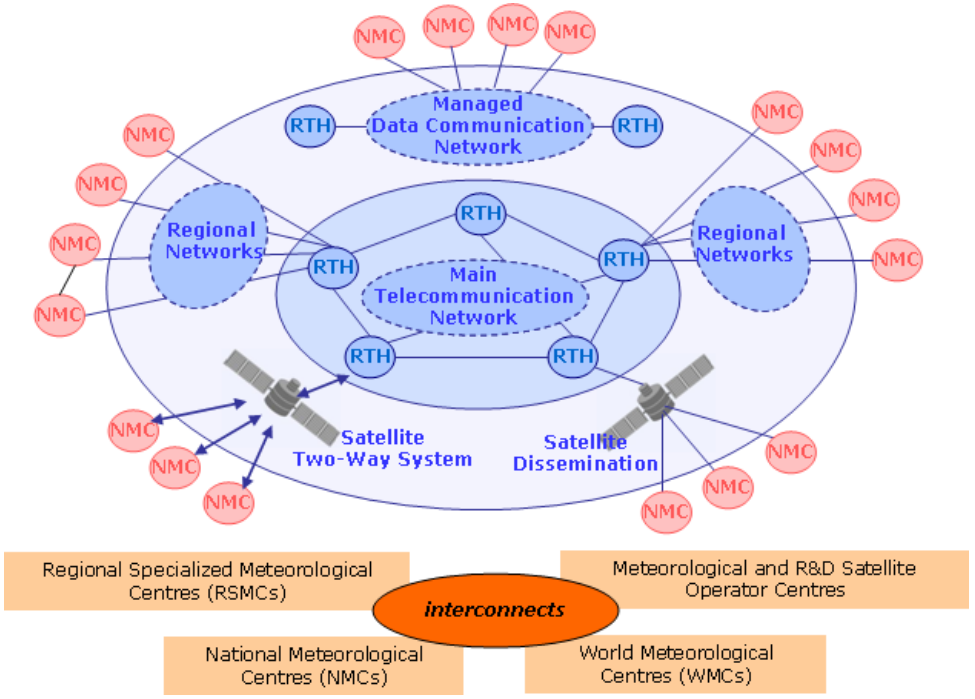


Operations

Worldwide Data Collection and Distribution (GTS)

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

Radiosonde and other measurement system data is collected at National Meteorological Centers (NMC's) and distributed throughout the WMO Regions (Africa, Asia, South America, North America, Central America, and the Caribbean, South-West Pacific, Europe and Antarctica.)



Operations

US Operations

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **In the US, observations are obtained from an extensive, nation-wide network**
  - **200 Radiosondes/day**
  - **Launched at 00 and 12 UTC (Coordinated Universal Time)**
  - **~78,000 Launches/Year**
  - **Provides measures of pressure, temperature, humidity and winds**
  - **Data archived at the National Climatic Data Center**

Operations

Data Utilization

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

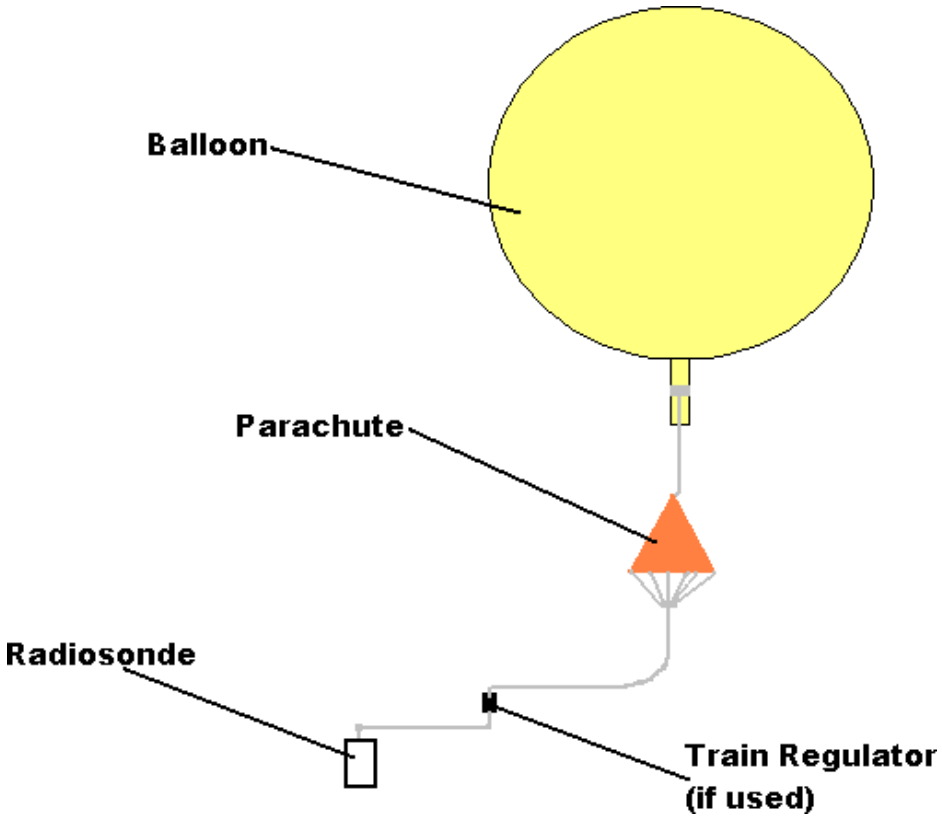
- **Utilized as input to and verification of computer based weather prediction models**
- **Monitoring of air pollution dispersion**
- **Provide data for operational weather, local severe thunderstorm and flash flood forecasting**
- **Utilized in developing aviation and marine forecasts**
- **Utilized for Weather and Climate studies and the development and archiving of Climatology records and atlases**
- **Calibration of Satellite and other remote sensing systems**
- **Atmospheric and Climate Research**
- **Input to GOS and GCOS**

http://badc.nerc.ac.uk/data/radiosglobe/

System Overview

Flight Train

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

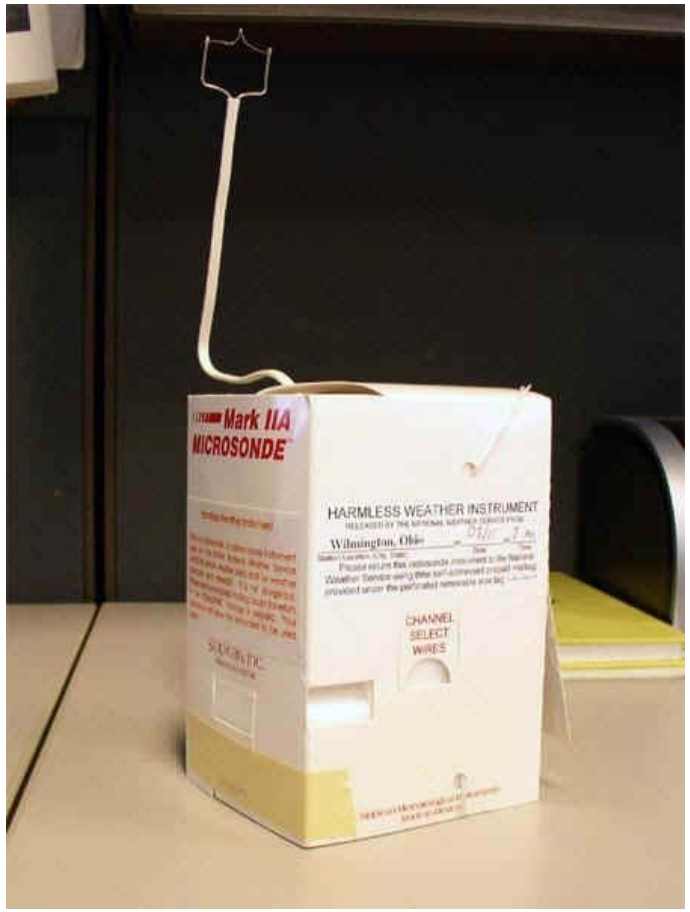


System Overview

Radiosonde Components

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Radiosonde Components**
  - **Transmitter**
  - **Battery**
  - **Sensor Pack**
    - **Temperature**
    - **Pressure**
    - **Humidity**
  - **GPS Receiver**



System Overview

Launching

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

System Overview

Launching

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

System Overview

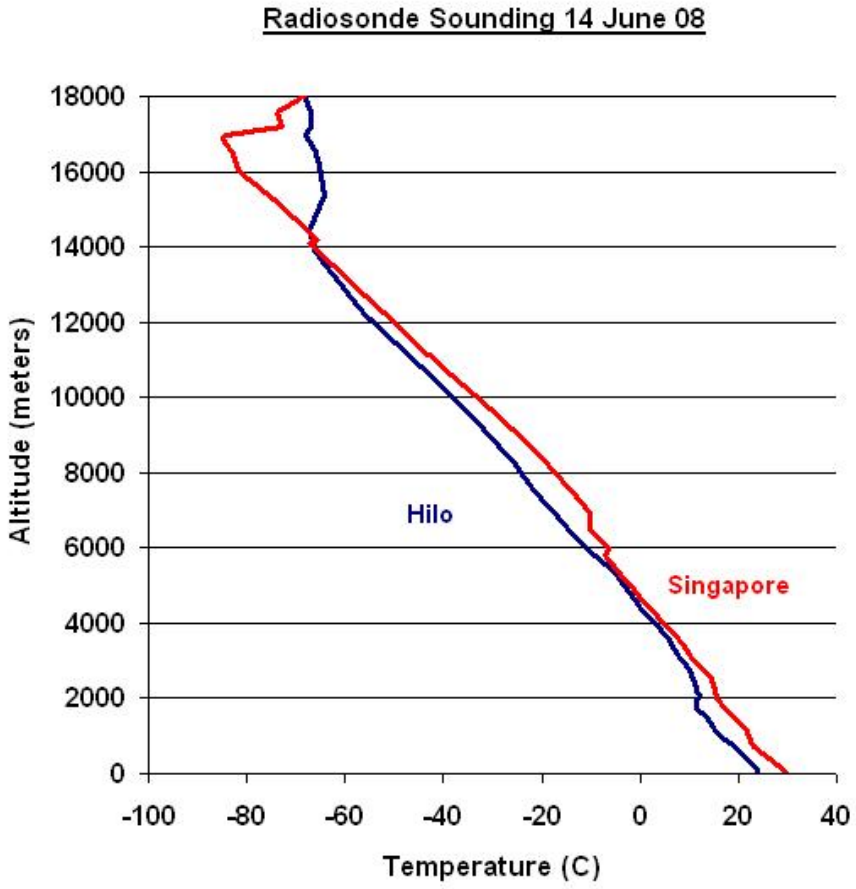
Tracking and Data Logging

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

System Overview

Tracking and Data Logging

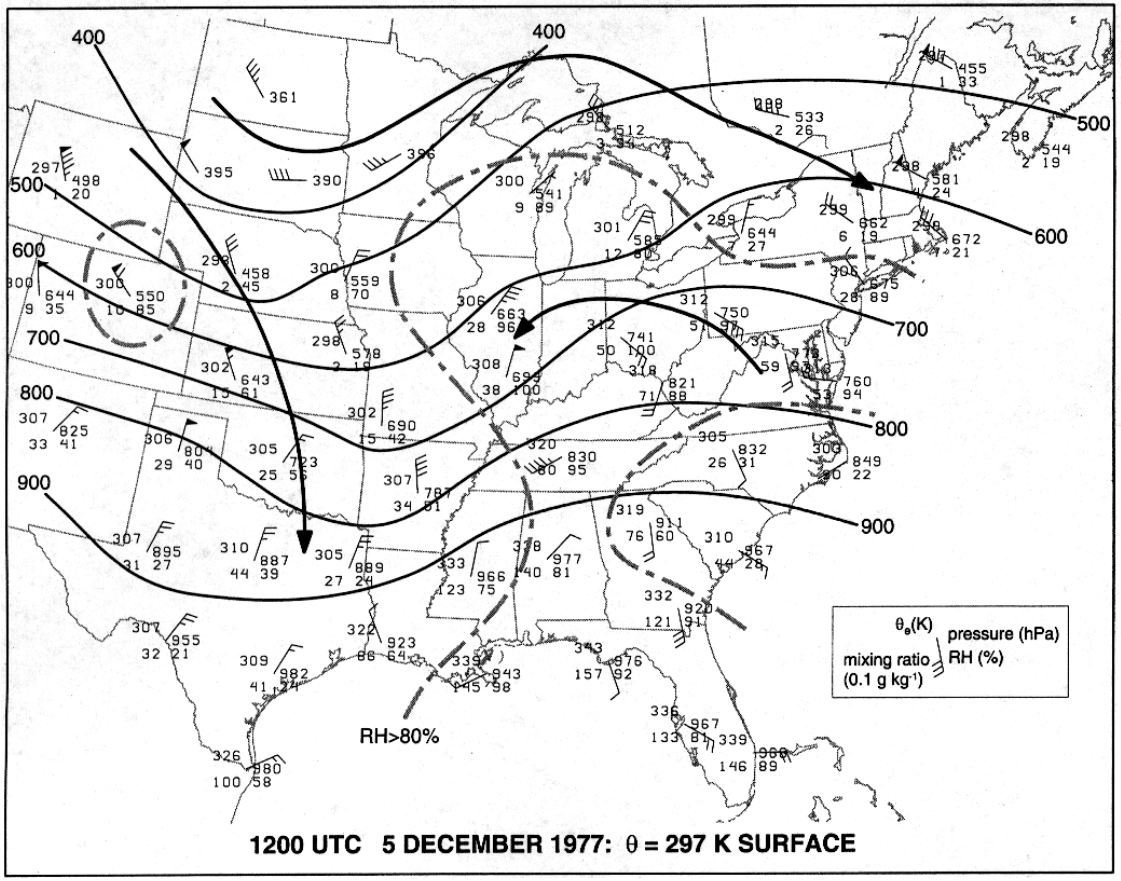
Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes



System Overview

Tracking and Data Logging

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes



System Overview

Frequency Bands

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

Frequency Band	Usage
400.14 – 401 MHz	MetAids
401-402 MHz	MetAids
402-403 MHz	MetAids
403-406 MHz	MetAids
1668.4 – 1670 MHz	MetAids MetSat
1670 – 1675 MHz	MetAids MetSat
1675 – 1690 MHz	MetAids MetSat
1690 – 1700 MHz	MetAids MetSat

System Overview

401-406 MHz Frequency Band

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **In Europe and many other regions of world the full 401-406 MHz Band is required for MetAids operations.**
- **The WMO has concluded that the entire 401-406 MHz band will be required for the foreseeable future.**
- **The WMO has also acknowledged that radiosonde operations in the 400.15 to 401 MHz band would not be possible as co-channel sharing with Satellite Services is not feasible.**

System Overview

1688.4 to 1700 MHz Frequency Band

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Entire band is allocated to MetAids and MetSat services on a co-primary basis**
- **Incompatibility between MetAids and MetSat services has resulted in segmentation of the band.**
- **Utilization of the band varies worldwide with some regions operating within the 1675-1683 MHz sub-band**
- **Most countries can conduct operations within 7-8 MHz bandwidth. Those that cannot typically require bandwidths of up to 15 MHz.**
- **Only a portion of the band is usually available.**

System Overview

Band Retention

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Availability of the 400 MHz Band and the 1600 MHz Band is required in order to guarantee successful Radiosonde Operations**
- **In Europe and North America both bands are required in order to meet the Spectrum Needs of MetAids operations.**
  - **Synoptic, research and other MetAids operations cannot be satisfied with just one of these bands.**
- **Each band provides unique characteristics which facilitate various MetAids operations**
  - **The 401-406 MHz band offers lower propagation loss.**
  - **The 1668.4 to 1700 MHz band is attractive from a budgetary perspective.**

System Overview

Impact of Interference

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Loss or corruption of temperature, humidity, pressure, location, wind speed and direction data.**
  - **Negatively impacts the ability of forecasters to accurately predict weather events.**
  - **Excessive interpolation of data resulting in unacceptable data quality and flight termination.**

ITU

Definitions

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- ***International Telecommunications Union (ITU)*** – U.N. organization responsible for international regulation of radio spectrum use
- ***International Radio Regulations –*** Treaty text maintained and enforced by the ITU that provides the regulations and table of frequency allocations for international radio spectrum use
- ***Radio Service -*** A type of radio operation, such as meteorological satellites, broadcasting, mobile-satellite
- ***Allocation*** – The authority for a radio service to use a particular frequency band
- ***License (or Assignment)*** – Authority for a particular radio station to use a specific frequency under the defined technical conditions and consistent with a frequency allocation

ITU

Definitions Applied To Radiosondes

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **In the ITU, radiosondes fall under the radio service of meteorological aids (MetAids)**
  - **MetAids include dropsondes and rocketsondes**
- **ITU Working Party 7C (WP 7C) is responsible for MetAids**
- **MetAids allocations: 400.15 – 406 MHz, 1668.4 – 1700 MHz and 35.2 – 36 GHz**
- **MetAids stations are licensed or provided frequency assignments by the country in which they operate**

ITU

Relevant Radiosonde Documents - ITU-R RS.1165-2

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Technical characteristics, operational characteristics, and performance criteria for MetAids systems**
- **Use: Provides technical and operational characteristics to others conducting sharing studies**

ITU

Relevant Radiosonde Documents - ITU-R RS.1263

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Interference criteria for MetAids systems**
- **Use: Provides aggregate interference levels for conducting sharing studies**
- **Currently under revision in ITU-R WP 7C**

ITU

Relevant Radiosonde Documents - ITU-R RS.1262

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Sharing and coordination criteria (levels applicable to individual interference sources)**
- **Use: Provides single entry interference levels for conducting sharing studies**
- **This recommendation is out of date and will be updated upon completion of the ITU-R SA.1263 update**

ITU

Relevant Radiosonde Documents - ITU-R RS.1264

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Addresses sharing between the mobile-satellite service and MetAids**
- **Use: Supported the work of the WRCs (WRC-97 through WRC-2003)**

ITU Documents

Relevant Radiosonde Documents - ITU-R RS.1346

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Recommended interference mitigation techniques for medical implant devices operating in the 401-406 MHz band**
- **Use: Guidance to administrations developing rules for medical implant devices**

ITU Documents

Relevant Radiosonde Documents – Handbook R-HDB-45-2008-MSW-E

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Content: Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction**
- **Use:**

> *"The Handbook provides comprehensive technical and operational information on current observation applications and systems and on the use of radio frequencies by meteorological systems, including meteorological satellites, radiosondes, weather radars, wind profiler radars and spaceborne remote sensing. It is intended for the meteorological (i.e. weather, water and climate) and radiocommunication communities, including governmental institutions, industry as well as the general public."*

Looking Forward

Future Trends

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Improvements in sensor performance and accuracy**
- **Greater tolerance to interference**
- **Improvements in GPS accuracy and robustness**
- **Improved data transmission error decoding**
- **Sensor redundancy**
- **Updates to ITU-R Documents ITU-R RS.1263 and ITU-R RS.1262**
- **New ITU-R Report on Determining Maximum Radiosonde Interference Levels**

Conclusions

Meteorological Aids Service (MetAids) – 400MHz and 1680 MHz Bands Radiosondes

- **Radiosondes are a critical data source for local and global weather forecasting operations and climate research**
  - **Primary data source for the initialization of NWS numerical weather prediction models**
  - **Provide input for pollution and climatology studies**
  - **Provide input for Atmospheric and Climate Research**
  - **Provide data for local severe storm, aviation and marine forecasting**
  - **Radiosondes are an integral element of the Global Observing System (GOS) and the Global Climate Observing System (GCOS)**