JLH
ESSENTIAL SERVICES

METAR Error Detection System

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Instruction Manual

Record of Review

Date	Version	By
26 June 2024	1.0	RH
2 July 2024	2.0	RH
10 June 2025	3.0	RH

Overview

The METAR Error Detection System is a robust solution designed to address the critical need for accurate weather observation reports in aviation, particularly across the Pacific island countries. This system has been meticulously developed to eliminate human errors in METAR reports generated from manual weather observation stations, ensuring the integrity and reliability of meteorological data before submission to the World Meteorological Organization (WMO) Global Telecommunication System (GTS).

This tool is especially beneficial for Small Island Developing States (SIDS), where human and technological resources are often limited. MEDS provides an intuitive interface to eliminate common reporting errors, improve situational awareness, and enhance the credibility of submitted weather data. Its use supports aviation safety, climate data integrity, and institutional accountability by ensuring every METAR observation is vetted against international standards.

Purpose and Importance

The primary purpose of this system is to ensure that METAR reports, which are crucial for aviation safety, are error-free and adhere to the standards set by the International Civil Aviation Organization (ICAO) and the WMO. By providing a rigorous check on the data, the system supports Meteorological Services in delivering precise and reliable weather information, thus enhancing the safety and efficiency of air travel.

Key Features

1. Automated Error Detection: The system employs advanced algorithms to automatically detect and flag potential errors in METAR reports, minimizing the risk of human error.

2. Compliance with ICAO and WMO Standards: The system is built in accordance with the stringent requirements of ICAO and WMO, ensuring that all METAR reports meet international standards.

3. User-Friendly Interface: Designed with the end-user in mind, the system features an intuitive interface that simplifies the process of validating and correcting METAR reports.

4. Real-Time Feedback: The system provides immediate feedback on detected errors, allowing Meteorological Technicians to quickly address and rectify any issues before the reports are submitted.

Benefits

- Enhanced Accuracy: By ensuring error-free METAR reports, the system significantly improves the accuracy of weather information.
- Increased Efficiency: The automated error detection process reduces the time and effort required to manually review and correct METAR reports, allowing Meteorological Technicians to focus on other critical tasks.
- Consistency in Reporting: The system ensures that all METAR reports are consistent and adhere to international standards, facilitating better communication and coordination in the aviation sector.
- Improved Safety: Accurate weather information is vital for the safety of air travel. This system plays a crucial role in preventing accidents and incidents caused by erroneous weather reports.
- Audit Readiness: Maintains a verifiable list of verified METARs, useful for audits and performance reviews.
- Training Support: Aids new observers in learning proper METAR formatting through real-time validation.
- Standardization: Enforces WMO/ICAO format rules across observations.
- Minimal Setup: Operates through a modern web browser without requiring installation.

The METAR Error Detection System represents a significant advancement in the field of meteorology, providing a reliable tool for ensuring the accuracy and reliability of weather reports. By addressing the gap caused by human error in METAR reports, the system supports Meteorological Services in delivering high-quality data, ultimately enhancing the safety and efficiency of aviation operations.

Interface Overview

MEDS is divided into the following major parts:

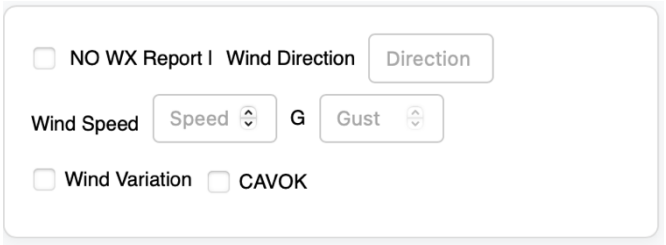
Header

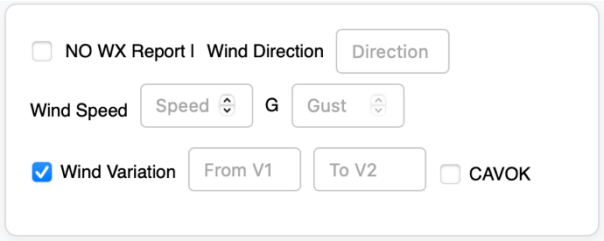
This is where users configure key administrative elements of the observation:

- **Country:** Depending on the selected country, it auto-populates relevant stations and codes.
- **Obs Type:** Select METAR or SPECI.
- **Station:** Airport/observation location (e.g., NFTF, NFFN).
- **UTC Time:** In DDHHMM format; validated for real-time or correction logic.
- **CCCC and TTAAii:** Auto-derived from country and obsType.
- **Settings Button** : Opens SMTP/email configuration modal.

Note:
Email Limitations: *In the demo version, the SMTP server, port, and user (system@jlh-tonga.com) are fixed. Only the recipient email can be changed.*

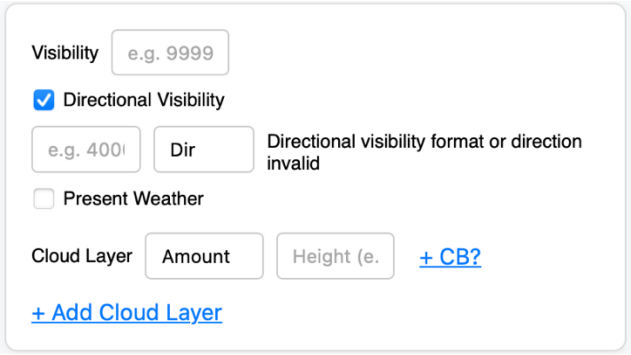
Wind Block





- **NO WX Report:** This option is checked if the station does not have any obs (NIL).
- Wind Direction: 3-digit (e.g., 120) or VRB.
- Wind Speed (knots).
- Gusts: Required if speed ≥15 KT.
- Wind Variation (V1/V2): Optional.
- CAVOK: Option to report “Ceiling And Visibility OK”. When checked, visibility, present weather and cloud layer fields will be disabled.

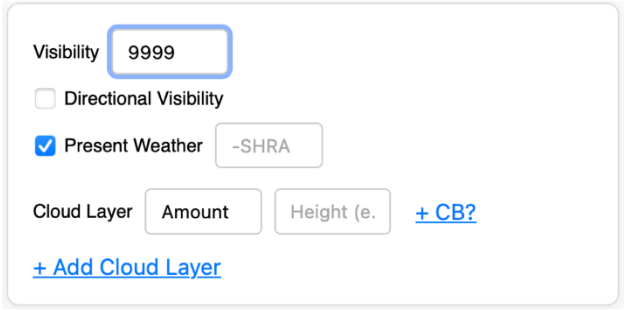
Visibility Details



Visibility: Standard 4-digit format (e.g., 9999).

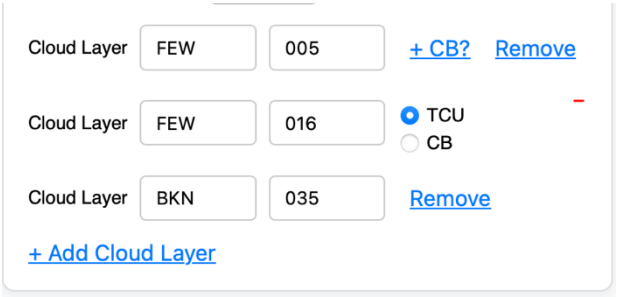
Directional Visibility: Optional value and direction (e.g., 4000NE). Inputbox only appear when the checkbox is ticked.

Present Weather



Present Weather: This field is enabled only when checkbox is checked. Optional code (e.g., -RA, +TSRA).

Cloud Layers



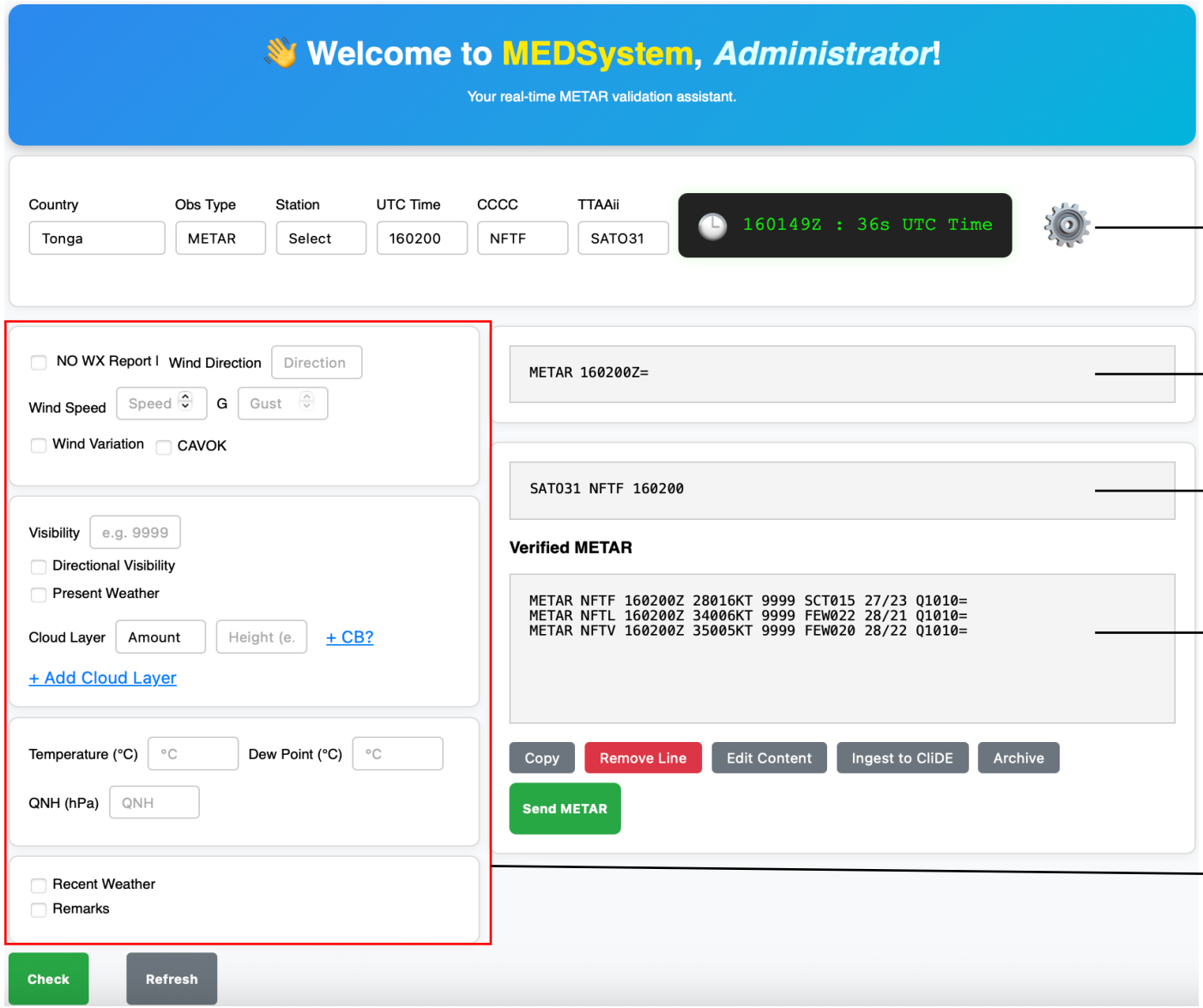
- User can add up to 4 cloud layers with amount and height by +Add Cloud Layer
  - Height: Must be 3-digit (e.g., 030)
- Cloud Layer can be remove by Remove
- Option of including "TCU/CB" only in first two layers. Choice can be remove by the red minus ("-").

Temperature | Dew Point | Pressure

- User enter value of reading in to respective fields to the nearest whole number.

No decimal point accepted

System Interface



Config module where user can set the recipient email

Observation Preview that display observation in Real-Time.

Display the WMO Header TTAAii associated with country.

Accumulation of METAR that had been verified by the system to be error free.

Weather observations are entered here then system checks for errors when user click “Check”.

Error Checks

This section describes the various error checks implemented in the METAR Error Detection System. Each error check ensures the correctness and reliability of the weather observation data entered.

General Input Checks

- Country Selection Notice:
  - Check: If the selected country is not valid, display an alert.
  - Purpose: Ensure that the system is used only for the allowed country in the demo version.

- Form Submission Check:
  - Check: Ensure that required fields are filled and no fields have a red border indicating an error.
  - Purpose: Ensure all necessary data is provided and correctly formatted before METAR report can be inserted.

Wind Data Checks

- Wind Speed Format and Range Check:
  - Check: Ensure wind speed contains only digits and is within a reasonable range.
  - Purpose: Validate that wind speed is a numeric value and flag any suspicious values above 100 knots and alert user to be aware of high wind speed to confirm.

- Wind Speed and Direction Consistency Check:
  - Check: If wind speed is zero, wind direction must also be zero.
  - Purpose: Ensure logical consistency between wind speed and direction.

- Wind Direction Format and Range Check:
  - Check: Ensure wind direction is a three-digit number or "VRB" and numeric values are multiples of 10 and <= 360.
  - Purpose: Validate the format and logical range of wind direction values.

- Gust Speed Enable/Disable Check:
  - Check: Enable gust input if wind speed is 10 knots or greater.
  - Purpose: Allow gust input only when relevant.

- Wind Speed and Gust Difference Check:
  - Check: Ensure the difference between wind speed and gust is at least 10 knots.
  - Purpose: Verify the logical relationship between wind speed and gust.

- VRB Wind Speed Limit Check:
  - Check: If wind direction is "VRB", wind speed must be 3 knots or less.
  - Purpose: Ensure "VRB" (variable) wind direction is only used for light winds.

- Wind Direction Variation Check:
  - Wind Direction Multiples of 10: It first ensures that the values entered for both initial and final wind directions are multiples of 10. If not, it alerts the user and highlights the input field in red to indicate an error.
  - Wind Direction Variation Calculation: For the final wind direction (windV2), it calculates the variation or change in wind direction from the initial wind direction (windV1). This calculation considers the directionality and ensures the variation is calculated in a clockwise manner.
  - Validation Based on Wind Speed and Direction Variation: It then checks the wind speed and the calculated wind direction variation to apply specific rules:
    - If the wind speed is 3 knots or more, and the variation is between 60° and 180°, it considers the input valid and resets any error indications on the input fields.
    - If the wind speed is less than 3 knots and the variation is within the same range (60° to 180°), but the current wind direction is not marked as "Variable" (VRB), it alerts the user that under these conditions, the wind direction should be considered variable.
    - For any other scenarios that don't meet the above conditions, it indicates an error by highlighting the input fields in red and alerts the user to review the wind directional variation, ensuring it varies by at least 60° but less than 180°.

  Purpose: Overall, the aim is to guide the user in providing accurate wind direction inputs by enforcing specific rules related to wind direction changes and wind speed, ensuring the data entered is logical and follows predefined meteorological standards.

Visibility Check

- Visibility Format Check:
  - Check: Ensure visibility contains exactly four digits.
  - Purpose: Validate the format of visibility data.
- Directional Visibility Format Check:
  - Check: Ensure Dir visibility contains exactly four digits.
  - Purpose: Validate the format of visibility data.

Cloud Levels Check

- Cloud Levels Count Check:
  - Check: Alert if more than four cloud levels are entered.
  - Purpose: Ensure a reasonable number of cloud levels are recorded.

- Cloud Levels Consistency Check:
  - Check: Ensure higher cloud levels do not have a lower cloud cover value than the levels below unless exceptions apply.
  - Purpose: Maintain logical consistency in cloud levels.

- Cloud Level FEW Restriction Check:
  - Check: Only the first two cloud levels can have the value "FEW".
  - Purpose: Restrict "FEW" to the appropriate cloud levels.

- Cloud Level CB/TCU Check:
  - Check: If the second cloud level is "FEW", it must end with "CB" or "TCU".
  - Purpose: Ensure specific cloud level classifications.

Temperature and Dew Point Checks

- Temperature Range Check:
  - Check: Alert if the temperature is outside the range of 0 to 50 degrees Celsius.
  - Purpose: Validate temperature data for reasonable values.

- Dew Point Range and Logic Check:
  - Check: Ensure dew point is within 0 to 30 degrees Celsius and less than or equal to the temperature.
  - Purpose: Verify dew point data for logical consistency and reasonable values.

Pressure Check

- Pressure Format Check:
  - Check: Ensure pressure contains exactly four digits.
  - Purpose: Validate the format of pressure data.

Date and Time Checks

- Datetime Format and Future Time Check:
  - Check: Ensure datetime contains only digits, is a multiple of 5, and is not in the past.
  - Purpose: Validate the format and logical correctness of datetime input.

- Datetime Difference Check:
  - Check: Ensure the difference between current UTC time and input time is not more than 60 minutes.
  - Purpose: Validate the timeliness of the datetime input.

Present Weather Checks

- Weather Phenomena Sequence Check:

  - Check: Validate the order of intensity, descriptor, and phenomena codes in present weather.
  - Purpose: Ensure correct sequence of weather phenomena.

- Descriptor and Phenomena Combination Check:
  - Check: Ensure valid combinations of descriptors like "TS", "FZ", and "SH" with their respective phenomena.
  - Purpose: Validate logical combinations of weather descriptors and phenomena.

- Proximity Code Check:
  - Check: Ensure "VC" (vicinity) is used correctly.
  - Purpose: Validate the logical use of proximity codes.

Recent Weather Check

Each of these error checks is designed to ensure the accuracy and reliability of the METAR reports by validating the input data against logical, numerical, and format-based rules.

- Check if Input Exists: It first checks if the user has entered anything in the "recent" input field. If the field is not empty, it proceeds with the validation.
- Feedback on Validation:
  - Valid Input: If the input matches any of the valid codes, it logs a message indicating the code is valid and resets any custom border color of the input field (indicating no error visually).
  - Invalid Input: If the input does not match any of the valid codes, it logs an error message, changes the input field's border color to red (indicating an error visually), and sets a flag to alert the user.
- User Alert: If the flag to alert the user is set (meaning there was an invalid input), it prevents the default form submission action, displays an alert message asking the user to check the "Recent Weather" input, and stops further processing by returning false.

References

1. World Meteorological Organization (WMO)
    i. WMO-No. 306: Manual on Codes - International Codes (WMO Code Form FM 15-XII METAR and FM 16-XII SPECI)
    ii. WMO-No. 49: Technical Regulations (C.3.1.3 - METAR/SPECI Reporting)
    iii. WMO-No. 732: Guide to Meteorological Instruments and Methods of Observation

2. International Civil Aviation Organization (ICAO)
    i. Annex 3: Meteorological Service for International Air Navigation
    ii. Doc 8896: Manual of Aeronautical Meteorological Practice

3. CLiDE Database Documentation
    i. User Guide: Comprehensive guide for accessing and using the CLiDE database.
    ii. Ingestion Protocol: Procedures and guidelines for ingesting METAR and SPECI data into the CLiDE system.
4. Quality Management Systems
    i. ISO 9001:2015 International standard for Quality Management Systems (QMS), emphasizing the requirement for accurate METAR reporting.
    ii. Civil Aviation Rules (CAR) Part 174: Regulatory requirement for the accurate reporting of METAR data to ensure aviation safety and efficiency.