The Use of Observations in the Transition of Research Aviation Weather Products into Operations

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Forecast Impact and Quality Assessment Section (FIQAS)

1 CIRA

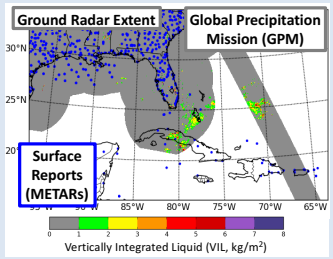
2 CIRES

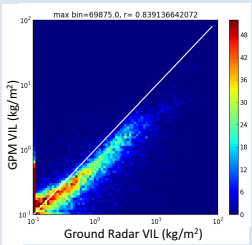
Offshore Precipitation and Oceanic Convection

Supporting transition of: Offshore Precipitation Capability (OPC) and Ensemble Probabilistic Oceanic Convective Hazards (EPOCH)

Filling Data Gaps

Global Precipitation Mission (GPM) satellite data and surface reports (METARs) were investigated prior to assessing OPC, which provides radar-like variables, used by aviation, for areas offshore.





GPM and Surface Radar

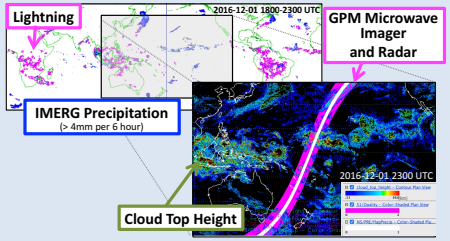
Vertically Integrated Liquid (VIL) derived from ground radar was compared to GPM satellite-derived VIL to better understand agreement where the products overlap and determine biases useful in assessing the OPC.

METAR vs Radars

OPC product was evaluating against surface reports by establishing the distribution of ground-based and satellite radar signatures with each METAR-based present weather category.

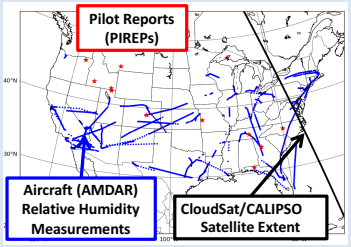
Lightning, Echo Tops, Cloud Top Height

Global lightning, GPM global precipitation and radar echo tops, geostationary cloud top heights, and CloudSat reflectivity were investigated to verify EPOCH, which gives probabilities of thunderstorms and convective clouds > 10,000 ft. (9144 m).



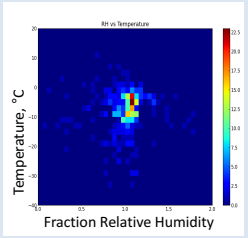
Aircraft and Satellite Data for Icing Verification

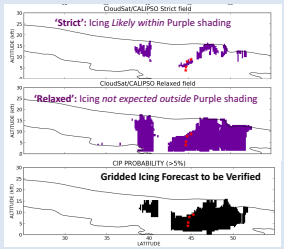
Supporting Current and Forecast Icing Products (CIP and FIP) and Icing Product-Alaska Forecasts (IPA-F) Transition



AMDAR versus PIREPs

Aircraft (AMDAR) observations of relative humidity were compared to icing PIREPs in order to identify the distributions of temperature and moisture associated with an icing event.





Satellite Data for Icing

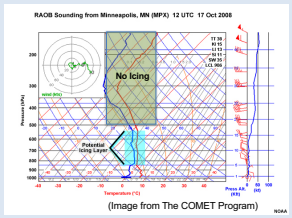
CloudSat and CALIPSO cloud classification vertical cross-sections are used to implement icing verification because they help to differentiate microphysical properties and determining icing potential.

Icing Severity to Soundings

Icing potential – "Inside Class 1":
- RH > 67%,
- -15°C < T < -2°C

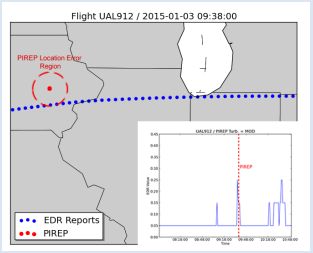
No Icing potential – "Outside Class 1":
- RH < 50%,
- -25°C < T < 0°C

Classes defined by Schultz and Politovich (1992)



PIREP and EDRs Matching for Turbulence Verification

Supporting Graphical Turbulence Guidance: GTG-3, GTG Nowcast (GTG-N), GTG-Global Transition



Eddy Dissipation Rate (EDR)

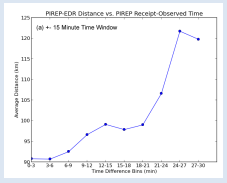
- Aircraft-independent measure of atmospheric turbulence.
- EDR measurements from Delta and United Airlines are compared to PIREPs.

Matching PIREPs to EDRs

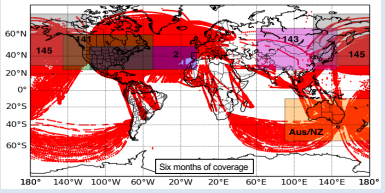
- PIREPs are matched to their corresponding set of EDRs from the same aircraft.
- Different time windows (around a PIREP) are used to match the maximum peak EDR value to the PIREP.
- Jan 2013 – Jun 2015 period is analyzed.

Matching Summary

- PIREP location errors show sensitivity to the choice of time window for matching.
- Location error statistics for ±7.5 minutes window agree with prior studies.
- Strong relationship exists between the PIREP report lag and location errors.



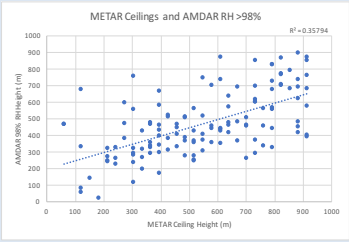
Global Turbulence Observation Coverage



- PIREP, AIREP (pilot reports)
- EDR, TAMDAR (automatic aircraft sensor-derived)
- WMO Regions (rectangles)

METARS and AMDAR to verify Ceiling and Visibility

In support of the transition of new AWC Ceiling and Visibility products

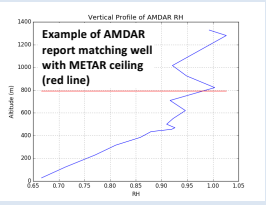


Compare AMDAR to METAR

AMDAR observations of relative humidity, temperature, and dewpoint were compared with METAR ceiling heights. AMDAR were matched to METARs for the first 3,000 feet during take-off and within ±5 minutes.

- METAR ceiling height and first occurrence of an AMDAR relative humidity > 98% were weakly correlated (figure above).
- Large disagreements occurred with two scenarios:
  - AMDAR RH threshold height > METAR ceiling when ceiling is "broken"; aircraft flies through a gap in the clouds.
  - AMDAR RH threshold may occur at lower height than the METAR ceiling when "few" or "scattered" clouds occur below the ceiling.

Additional work is needed to investigate why the AMDAR relative humidity measurements do not reliably match the METAR ceiling heights.



Greatest observational needs

- Observations of icing and turbulence that are unbiased (i.e., unbiased by pilot choices, etc.)
- Observations from aircraft sensors that report when the sensor is iced, rather than current practice of reporting only at regular intervals, which may miss some icing events.
- Spaced-based measure of low altitude cloud bases.

Acknowledgements

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GPM data were provided by the NASA Goddard Space Flight Center's GPM science team and PPS, which develop and compute the GPM IMERG as a contribution to GPM. Data are archived at the NASA GES DISC.