



RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

RTCA Paper No. 096-21/SC230-057
April 7, 2021

RTCA SC-230 Plenary #25 Meeting Minutes (March 15-17, 2021)

Attendance list:

| March 15th - WG10 | |
|-------------------------------------|------------------|
| Name | Company |
| <i>Karan Hofmann</i> | <i>RTCA</i> |
| <i>Lee Nguyen</i> | <i>FAA</i> |
| <i>Moin Abulhosn</i> | <i>FAA</i> |
| <i>Jean-Baptiste Berthier</i> | <i>Airbus</i> |
| <i>Kenny Ren</i> | <i>Boeing</i> |
| <i>Dawn Gidner</i> | <i>Honeywell</i> |
| <i>Jan Lukáš</i> | <i>Honeywell</i> |
| <i>Thomas Dobbins</i> | <i>Honeywell</i> |
| <i>William Blake</i> | <i>Garmin</i> |
| <i>Mariusz Starzec</i> | <i>Garmin</i> |
| <i>Jeff Finley</i> | <i>Collins</i> |
| <i>Venkata Sishtla</i> | <i>Collins</i> |
| <i>Mark Smith</i> | <i>Collins</i> |
| <i>Marius Irimia</i> | <i>Collins</i> |
| <i>Bob Avjian</i> | <i>MITRE</i> |
| <i>Steve Harrah</i> | <i>NASA</i> |
| <i>Rockee Zhang</i> | <i>OU</i> |

| March 16th - WG10 | |
|-------------------------------------|------------------|
| Name | Company |
| <i>Karan Hofmann</i> | <i>RTCA</i> |
| <i>Lee Nguyen</i> | <i>FAA</i> |
| <i>Moin Abulhosn</i> | <i>FAA</i> |
| <i>Jean-Baptiste Berthier</i> | <i>Airbus</i> |
| <i>Kenny Ren</i> | <i>Boeing</i> |
| <i>Dawn Gidner</i> | <i>Honeywell</i> |
| <i>Jan Lukáš</i> | <i>Honeywell</i> |
| <i>Thomas Dobbins</i> | <i>Honeywell</i> |
| <i>William Blake</i> | <i>Garmin</i> |
| <i>Mariusz Starzec</i> | <i>Garmin</i> |
| <i>Jeff Finley</i> | <i>Collins</i> |
| <i>Venkata Sishtla</i> | <i>Collins</i> |
| <i>Marius Irimia</i> | <i>Collins</i> |
| <i>Steve Harrah</i> | <i>NASA</i> |
| <i>Fred Proctor</i> | <i>NASA</i> |
| <i>Patricia Hunt</i> | <i>NASA</i> |
| <i>Bob Avjian</i> | <i>MITRE</i> |
| <i>Rockee Zhang</i> | <i>OU</i> |
| <i>Yunish Shrestha</i> | <i>OU</i> |

| March 17th - WG10 | |
|-------------------------------------|------------------|
| Name | Company |
| <i>Karan Hofmann</i> | <i>RTCA</i> |
| <i>Lee Nguyen</i> | <i>FAA</i> |
| <i>Moin Abulhosn</i> | <i>FAA</i> |
| <i>Jean-Baptiste Berthier</i> | <i>Airbus</i> |
| <i>Kenny Ren</i> | <i>Boeing</i> |
| <i>Dawn Gidner</i> | <i>Honeywell</i> |
| <i>Jan Lukáš</i> | <i>Honeywell</i> |
| <i>William Blake</i> | <i>Garmin</i> |
| <i>Mariusz Starzec</i> | <i>Garmin</i> |
| <i>Jeff Finley</i> | <i>Collins</i> |
| <i>Venkata Sishtla</i> | <i>Collins</i> |
| <i>Marius Irimia</i> | <i>Collins</i> |
| <i>Steve Harrah</i> | <i>NASA</i> |
| <i>Bob Avjian</i> | <i>MITRE</i> |
| <i>Rockee Zhang</i> | <i>OU</i> |
| <i>Yunish Shrestha</i> | <i>OU</i> |



RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

RTCA Paper No. 096-21/SC230-057
April 7, 2021

3/15/2021 (8:00-12:00 PST) WG-10 discussions

Administrative and agenda review:

Welcome/Administrative Remarks – RTCA Opening remarks on Anti-Trust Laws, IP Policy, and Membership Policy provided by Karan Hofmann. Jeff led introductions.

Introductions/Agenda/Minutes Approval - Minutes from January 2021 (Meeting #24) were approved without comment

Jeff review agenda and schedule:

□ Tuesday Mar 15 (all times Eastern Standard Time)

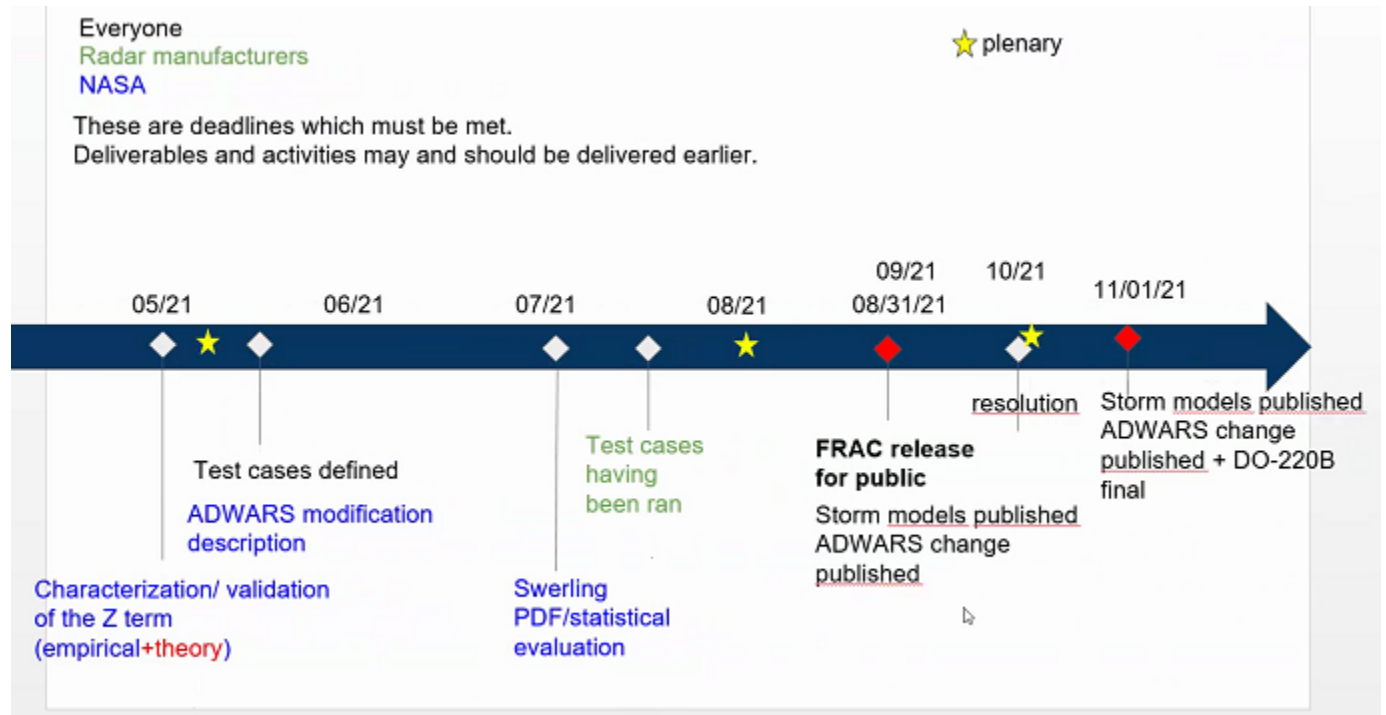
- | | |
|---|--------------------------------------|
| ○ Opening Announcements | 11:00 – 11:05 A.M. (RTCA/FAA) |
| ○ Introductions | 11:05 – 11:10 A.M. (Committee) |
| ○ Summary of January 2021 Plenary | 11:10 – 11:15 A.M. (Ren) |
| ○ Review Schedule/Deliverables | 11:15 – 11:20 A.M. (Finley/Gidner) |
| ○ WG-10 HAIC Working Group Status/Review | 11:20 – 2:50 P.M. (Harrah, Berthier) |
| ■ Discuss final project plan for a summer FRAC-ready draft. This will include a list of specific tasks and expected completion dates for these tasks. Jean-Baptiste and Steve have the action to discuss this project plan prior to the plenary next week. | |
| ■ Continue discussing the root cause for pulse to pulse reflectivity variation as a function of ice crystal content and attempt to reconcile empirical results from NASA flight tests with microphysical simulation and analysis from University of Oklahoma. Rockee will present his latest data at the plenary next week. | |
| ■ Finish examining the NASA TASS files in an attempt to derive must and must-not indicate test cases. | |
| ■ Radar manufacturers to report any progress on simulation and analysis of the test cases proposed two weeks ago. | |
| ■ Discuss the logistics of ADWRS modifications to simulate pulse to pulse reflectivity variance. | |
| ■ NASA presentation of the Swerling PDFs and analysis of the buffer area to be considered for the truth model (if available) | |
| ■ Line by line review of statistical requirements and associated test procedures | |
| ■ Discuss language for flight test expectations | |
| ○ Review Action Items | 2:50 – 3:00 P.M. (Ren) |
| ○ Adjourn | 3:00 P.M. |



RTCA, Inc.
 1150 18th Street, NW, Suite 910
 Washington, DC 20036
 Phone: (202) 833-9339
 Fax: (202) 833-9434
 www.rtca.org

RTCA Paper No. 096-21/SC230-057
 April 7, 2021

Jean-Baptiste reviewed project plan to DO-220B release:



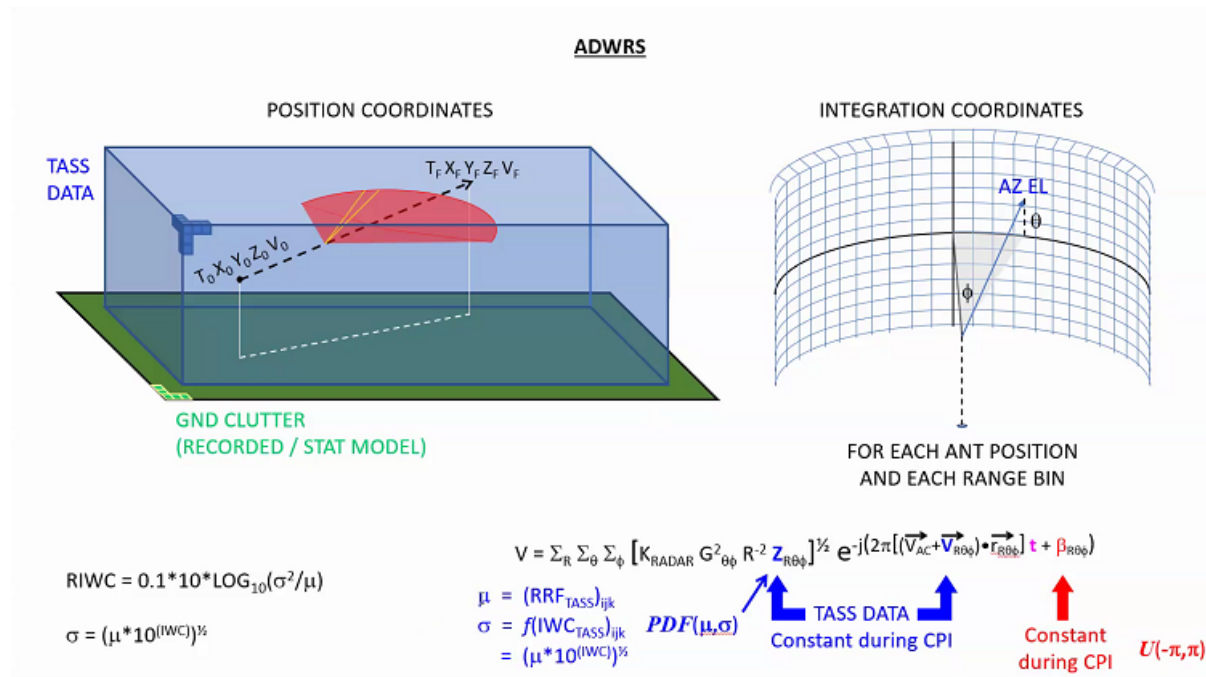
[Action Jean-Baptist/Steve] organize dedicated sessions to discuss Characterization/validation of the Z term since it is a key item and will need to be discussed in greater details, Radar manufacturers are willing to shoulder some data processing burden from NASA if requested.

Venkata reviewed TASS storm models and continue with choices of test cases

The proposed test cases captured in Venkata’s presentation slides

[Action Ven] upload the test cases slides to working group, radar manufacturer will start working on the cases

Steve shared “recommended changes to NASA’s ADWRS to Incorporate HIWC attributes into simulated in-phase & quadrature I/Q) voltages



[Action Radar Mfrs] since NASA currently has no SW engineering resources to support the update of ADWRS, the group agreed it is worthwhile to keep ADWRS updated for continuity, radar manufacturers will explore possibility to use their resources to update ADWRS to support HIWC radar simulations

[ACTION GROUP] Dawn also proposed that it is also possible to propose future work for industry to update ADWRS since the radar manufacturers are currently using their own simulation tools, this will require a change to the TOR.

3/16/2021 (8:00-12:00 PST) WG-10 discussions

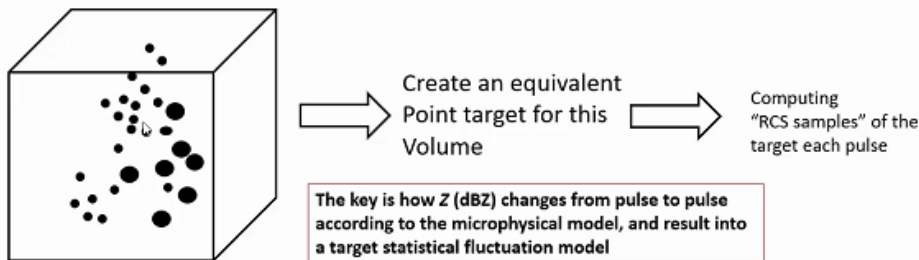
Continue discussion on TASS/ADWRS:

Jeff started the discussion on correlation between reflectivity and TASS model, the group attempts to address the question on whether Reflectivity is a random phenomenon or does it have some correlation.

Rockee presented ice particle simulation methods single cell Monte Carlo simulation

Fundamental Problem: RCS fluctuation model of a V6 Cell containing Ice crystals

A rectangular grid volume defined by NWP Model Output



$$dBZ \propto \frac{RCS}{Volume}$$



Model Parameter Set (to compute the σ_i)

| Model Parameter | Physical Meaning | Unit | Allowable Range | User [TASS]/Internal | Update Interval |
|-------------------|--|--------------------------|-------------------------------|----------------------|-----------------|
| N_0^* | Intercept parameter of DSD | m^{-4} | 10^6 to 10^8 | Internal from IWC | Scan |
| N_t | Total concentration | $\#/m^3$ | 10^4 to 10^6 | Internal | Scan |
| D_{eq} | Mean equivalent volume diameter | mm | 0.1 to 1 mm | Internal | Scan |
| D_v | Volume equivalent diameter | mm | 0.1 to 1 mm | Internal | Scan |
| L | Axis ratio | NA | 0.5 to 0.7 | Internal | Scan |
| c, d | Shape parameters | NA | 0.01 to 1 | Internal | CPI |
| σ_{θ} | Curving angle distribution | deg | 10 -20 | Internal | Pulse |
| Λ^* | Slope of DSD | m^{-1} | 1 to 10 | Internal | Scan |
| α | ρ -D relation parameter | $g \cdot \mu m^{-\beta}$ | 0.01 to 0.1 | Internal | CPI |
| β | m-D relation parameter, default=1 | NA | | Internal | CPI |
| IWC | Ice water content of the radar resolution volume | g/m^3 | 0.5 to 5 | User input | Scan |
| f | Radar frequency | GHz | X band | User input | Scan |
| ρ_{ice} | Effective density of ice | g/cm^3 | X-band, temperature Dependent | Internal | Scan |
| ϵ_{ice} | Permittivity of ice | f/m | X-band, temperature dependent | Internal | Scan |
| T | Temperature | C | -50 - 0 | TASS | Scan |

*Assuming M-P DSD here. In the latest model, the PSD shape is described by a set of 8 parameters (double-Gamma)

Currently, the simulation does observe a general positive correlation between variance and IWC although there are some remaining issues still need to be addressed when the models are examined at higher resolution. NASA believes it is possible to publish some pulse to pulse reflectivity radar simulations by the summer for industry evaluation. Swerling PDF plots are being worked by NASA

In addition, Rockee also presented overview/potential of using NEXRAD IWC product (available as research product at the moment but to be released in MRMS tool). This NEXRAD IWC product can potentially be used as a truth field. MRMS provides multiple functions to fuse multiple radar images, convert raw radar measurements into 3D space and it's easily accessible.

[Action Rockee] upload the slides to workspace

[Action Rockee] meet with NOAA MRMS team to get/push the timeline to add the IWC product to be used as a truth field for flight test.



RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

RTCA Paper No. 096-21/SC230-057
April 7, 2021

As a prelude into DO-220B draft review, Jeff inquired about indication at a standing range. 2km range or resolution of pulse volume of the radar beam, whichever is larger.

Continue review of DO-220B draft

Review performance specification/requirement

Group continued with discussing 2.4.3.6.4 bullet 5. High Altitude Ice Crystal awareness Detection Range. Since the radar will have different capabilities at different ranges, wording was changed to reflect that fact.

Continue discussion with appendix D.1.



RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

RTCA Paper No. 096-21/SC230-057
April 7, 2021

3/17/2021 (8:00-12:00 PST) WG-10 discussions

□ Thursday Mar 17 (all times Eastern Standard Time)

- Opening Announcements 11:00 – 11:05 A.M. (RTCA/FAA)
- Introductions 11:05 – 11:10 A.M. (Committee)
- WG-10 HAIC Working Group Status/Review 11:10 – 2:30 P.M. (Harrah, Berthier)
 - Continue action item list from Mar 16 as necessary
- Other Group Discussion Topics 2:30 – 2:45 P.M. (Committee)
 - Discuss the planning towards FRAC and confirm that we will meet the deadline.
 - Discuss potential interferences between the weather radar and 5G (not specifically related to the ice crystal topic) and if we think that SC-230 should work on that topic.
 - Discuss the future of SC-230 once the HAIC topic will be completed. New topics? Planned meetings? Associated travel.
- Review Action Items 2:45 – 2:55 P.M. (Ren)
- Confirm time and place of next plenary 2:55 – 3:00 P.M.
- Adjourn 3:00 P.M.

Continue review of DO-220B draft

Group continued to review section D.1.

Group discussed whether/how to include NASA Swerling algorithm reference or more detailed description of the algorithm. Currently, the document has references to the NASA SAE paper.

[Action Jeff] to add references to NASA work to section D.1

It is noted that there are four requirements for must indicate/must not indicate, must detect/must not detect (2.4.3.6.5-8), currently in section D2, there are only 3 validation methods as compared to 4 requirements.

In section D2, Ven had a comment on whether or not to test at max range or min range (40 NM) assuming perfect icing condition (beam filling).

Much discussions occurred regarding how detection capabilities beyond minimum range should be tested and certified, the group consented a blanket statement to be added to address the purpose of the MOPS and stress the point that any feature beyond the MOPS should have its performance demonstrated.

In section D2.1, add a table to indicate applicability and location for ADWRS (since ADWRS in its current form does not support IWC simulation). The plan is to only publish change for HIWC, not a new version of ADWRS. Current ADWRS source code is in RTCA store associated with DO-220A ch1, group proposes to copy all content from the current supplement to create a new supplement for DO-220B and add additional documents and changes



RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

RTCA Paper No. 096-21/SC230-057
April 7, 2021

Propose to turn section 2.2.6.8 into false alarm probability.

Then the group had a renewed discussion on whether to have a two threshold system or a single threshold system. The discussion will reconvene on section 2.2.6.8 after NASA presents flight test data PDF.

[**Action** Steve] continue to work on flight test data PDF

[**Action** OEMs] continue to develop language for flight test, to be discussed during working group meeting on week of 3/22

[**Action** Jean-Baptiste/Steve] arrange one of the working groups to invite NWS MRMS team to talk about IWC measurement tool using NEXRAD (Rockee confirmed 4/6 working group meeting)

5G interference:

There are some on-going research conducted by NIST to study the effect of 4GLTE/5G

Administrative items:

Schedule discussion:

Document ready for public comment (FRAC) by end of August 2021, the goal is make for December 2021 PMC. Updated TSO to be expected ~4-6 months after release of MOPS

Next plenary virtual: June 28, 29, 30, 2021



RTCA, Inc.
 1150 18th Street, NW, Suite 910
 Washington, DC 20036
 Phone: (202) 833-9339
 Fax: (202) 833-9434
 www.rtca.org

RTCA Paper No. 096-21/SC230-057
 April 7, 2021

Action item summary

| Action Item # | Action | Person(s) | Estimated Completion Date |
|------------------------------|--|----------------------------------|---------------------------|
| Day 1 WG-10 - HAIC: | | | |
| 1 | organize dedicated sessions to discuss Characterization/validation of the Z term since it is a key item and will need to be discussed in greater details | Jean-Baptist Steve | Next Plenary |
| 2 | upload the test cases slides to working group, radar manufacturer will start working on the cases | Venkata | 4/6/2021 |
| 3 | Explore possibility to use their resources to update ADWRS to support HIWC radar simulations | Radar Mfrs | Next Plenary |
| 4 | To consider a future working group to update ADWRS | Group | Next Plenary |
| Day 2 – WG-10 – HAIC: | | | |
| 1 | Upload presentation slides to working group folder | Rockee | 4/6/2021 |
| 2 | meet with NOAA MRMS team to get/push the timeline to add the IWC product to be used as a truth field for flight test | Rockee | 4/6/2021 |
| Day 3 – WG-10 – HAIC: | | | |
| 1 | Add references to NASA work to section D.1 | Jeff | Upcoming Working meetings |
| 2 | continue to work on flight test data PDF | Steve | Next Plenary |
| 3 | continue to develop language for flight test, to be discussed during working group meeting on week of 3/22 | Aircraft Mfrs | 3/22/2021 |
| 4 | Arrange one of the working group meetings to invite NWS MRMS team to talk about IWC measurement tool using NEXRAD | Jean-Baptiste Steve Rockee | 4/6/2021 |

CERTIFIED as a true and accurate summary of the meeting.

Kenny Ren, SC-230 Secretary

Jeff Finley, SC-230 Co-chair

Dawn Gidner, SC-230 Co-chair