G-IV (with INE corrections) Radar Support Guide

On the GROUND (Updated 10 June 2022)

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[Check in advance that you have the following: 1) java-ready machine, 2) access to AOC_tdrJob on Google drive, 3) xchat/hexchat (or IRC client), 4) access to mts2.nasa.gov (contact Jason Dunion to set up access), 5) website seb.omao.noaa.gov added to java security exception list, and 6) launch file of java jobfile app from seb.omao.noaa.gov/tdrjob.]

****BEFORE AND SHORTLY AFTER TAKE-OFF...**

Open in web browser the shared Google drive folder: AOC_tdrJob (jobfiles will be placed here)

Establish comms with the aircraft: Xchat (join channels: #hrd and #radar, #carcah for center fix info (don't autojoin), #hrd-status for HRD radar software status, #hrd-sweeps-status for availability of TDR sweep data, #hrd-scripts-status for data transfer scripts status, #n49-ine-corrections for monitoring time of latest ine corrections)

On #radar, make sure aircraft radar support does the following *in the order shown* below:

1. Open Xchat or HexChat at HRD (radar) workstation. Ensure the following ground situational-awareness channels were autojoined: **#hrd-status, #hrd-sweeps-status, #hrd-scripts-status, and #n49-ine-corrections**

*Note: If AOC data tech is tunneling to HRD workstation, ensure 'ssh -Y' (*not* 'ssh -X') is executed to open terminals. This will ensure proper script execution.

2. Run 'diskusage' (Is there enough disk space for this flight?)

- On the ground: Check #hrd-status for disk usage in /home. If less than 30GB remaining, advise which old files to remove. Start with oldest thumb*master.tar.gz and thumb*slave.tar.gz files and then corresponding sweep directory (ls –ld YYYY*/).

3. Run 'updateradar' (Update the radar repository on the HRD workstation)

4. Run 'buildradaranalysis' (Compile the radar analysis code and generate scripts, ~1 minute)

- On the ground: Check #hrd-status for correct branch/commit info and size of 'listerror' file (should be 20-25K when there are no analysis code compilation errors)

5. Run 'initialcleanup' (Start fresh: remove some old files and create a new emcdata/)

- On the ground: Check #hrd-status for "initial_cleanup finished"

6. Run 'checksweeps' (Monitors TDR data files on HRD workstation - opens 1 window)

- On the ground: Monitor #hrd-sweeps-status after TDR is turned on.
    - Verify begin/latest fore and aft sweep times. Any gaps in sweep recording will be shown (note: /home/sysop/YYYYMMDDAI should be populated with fore/aft sweep files *TM*/*TS* every 5 to 6 seconds).
    - Verify similar average size of fore and aft sweep files (updated every 3 min).
    - Immediately inform AOC data tech of anomalies in fore/aft sweep recording.

7. Run 'checkcorrections' (Monitors ine corrections files on HRD workstation - opens 1 window)

- "0,10,20,30,40,50 * * * * /home/sysop/bin/giv_ine_correction_script 1> giv_scriptoutput 2> giv_scriptoutput_error" will be *uncommented* in HRD sysop crontab
- Once radar recording begins, 'ine_corrections.dat' is created at the subsequent 10-min mark and then appended to every 10 minutes. 'corrections.txt' containing the ine correction file path is created and triggers use of corrections in the radar analysis software. 'swps_list' lists the radar sweep headers used for the latest corrections and 'ine_corrections.png' displays the most recent 10 minutes of ine corrections.
- On the ground: Monitor #n49-ine-corrections for current ine_corrections.dat file

8. Run 'tdrProcSend' (Controls EMC radial processing and netman transfer - opens 2 windows)

- On the ground: Monitor tdrProcSend status in #hrd-scripts-status. Initially, it should remain in an "aircraftTailRadarProcessor: No files in /home/sysop/emcdata; xferTDR: waiting for dat files" status.

9. Run 'radarsync' preferably in a new terminal (Controls radar analysis software execution)

- On the ground: Monitor radarsync status in #hrd-scripts-status. Initially, it should remain in a "radarsync: Checking for new jobfiles; radarsync: NO jobfiles on netman" status.

****BEFORE REACHING IP...**

Verify current radar recording and similar fore/aft file size in #hrd-sweeps-status as in (6) above. **Verify** in #hrd-scripts-status that the **radarsync status** is "radarsync: Checking for new jobfiles"

Monitor flight track: mts2.nasa.gov

- (If no track data is showing up, first verify that aircraft has turned on iwg1 … then, communicate with Jason Dunion to see if it is an MTS2 issue)

- Get time/lat/lon along flight track via waypoints (turn off barbs and swaths to access)

Open jobfile creator by clicking on java app. (This can be done before takeoff, but make sure Flight Director has first entered a Mission ID. If you see no value in that field, close the app and wait a bit longer. It will be populated before takeoff.)

- **Select** 'Flight' and 'Add from AOC'. Choose the current flight. Enter the values of the fields with yellow background.

- If there is not an appropriate value already in the **Storm ID** field, enter one in the form ALxxYYYY, EPxxYYYY or CPxxYYYY, where xx is the TD number or 90-99 for an invest—in a tasked mission (note: a recent NHC storm discussion will have the correct ID).

- Uncheck the '**Acceptable for Composite**' box if present analysis should not to be included in the real-time graphics composite (radials and analysis will still be transmitted to EMC and AWIPS-II, respectively). Paul Reasor can advise if unsure, but the default is box checked.

****WHILE IN PATTERN...**

(If some portion of the in-pattern TDR data is not analyzed, detail this in the Radar Scientist Form and indicate 'Y' for potential Level 2 reprocessing on the TC Flight Summary spreadsheet)

(The G-IV flight track will likely not pass close to the center. It is best for the QC method, especially if analyzing the inner 90-n-mi circumnavigation or a center overflight, to center the analysis on your estimate of circulation center *during the analysis period*. **Center Time** would correspond to your center estimate. For flight segments further away from the circulation center, you may center the analysis on those segments and use the midpoint time as the **Center Time**. Set the **Start/End Cross-section** times 2 seconds before/after the **Center Time**.)

If a *center pass is done* (penetration), **Center Time** MUST be your best estimate of when the aircraft passed closest to storm center ... otherwise inbound and outbound profiles may fail.

Get from MTS: **Start/End 3D** and **Start/End Cross-section** times. For a 90-n-mi circumnavigation, one could set: **Start 3D** = first drop point and **End 3D** = last drop point.

Get via Xchat: **Center Time**, **Center Lat/Lon** (in decimal, as reported in #carcah Vortex Data Message, VDM) may be available from low-altitude aircraft or estimated from an NHC advisory.

Get the **Storm Direction/Motion** (met heading/kt) from NHC website. If actual motion based on center fixes appears significantly different from NHC estimate, you can modify the motion value during the flight. ONLY do this if you are sure the difference is not the result of transient track "wobbles". For systems with an ill-defined center, it is best to use the NHC estimate.

Click 'Draw/Save Cross-section' to **set** the **Track IN/OUT** after Start/End Cross-section and Center fix info are filled. This plots the flight track through the End Cross-section time. ALWAYS do this step since it bundles flight track data with the jobfile for use in real-time radar graphics

applications. It also serves as a check on the accuracy of the storm Center Time and Lat/Lon as well as the Start/End times of a Cross-section.

Select the **Event type**: For circumnavigation or synoptic surveillance legs this setting should be based on the *sampled winds*. For 180 n mi and beyond, 'Invest' or 'Tropical Storm' is common. For 90 n mi, 'Hurricane' is used if sampling the large gradient region of hurricane winds.

Radius may be expanded beyond 250 km to encompass observations over larger scales (e.g., a 90-n-mi circumnavigation that is substantially offset from the circulation center). Note that entering a radius > 250 km will automatically adjust grid spacing from the 2-km default, and possibly the radius value, to keep the grid point domain 250 x 250 and horizontal grid resolution a multiple of 0.5 km. If such a change must be made, note clearly in the Radar Scientist Form and on the TC Summary spreadsheet that Level 2 reprocessing will be necessary. Note also: all analyses in a real-time graphics composite MUST have the *same* grid spacing.

****AFTER COMPLETION OF FLIGHT SEGMENT FOR ANALYSIS...**

Verify valid radar sweeps past the End 3D time in #hrd-sweeps-status as in (6) above. **Verify** an ine_corrections.dat file with timestamp past the End 3D time in #n49-ine-corrections. **Verify** in #hrd-scripts-status that the **radarsync status** is "radarsync: Checking for new jobfiles"

Click 'Write to Files' - creates *.tar.gz file of jobfiles. Carefully review the summary information presented and **click** 'Yes' if correct. Path to jobfile will be shown in top-right field.

Upload *.tar.gz file to AOC ground server:

1. Rename YYYYMMDDAI_HHMMSS_jobfile.tar.gz in your local 'tmpjobfile' directory userX_YYYYMMDDAI_HHMMSS_jobfile.tar.gz, where 'user' is your first name and 'X' indicates which jobfile in the sequence (e.g., '1' for the first jobfile submitted).
2. Place userX_YYYYMMDDAI_HHMMSS_jobfile.tar.gz into AOC_tdrJob on Google drive

Communicate to aircraft radar support via Xchat that jobfile has been sent.

Check #hrd-scripts-status for **jobfile message** "radarsync: start analysis with /home/sysop/ *_jobfile.tar.gz". While the software is running, there will be no radarsync messages. Afterwards, it should return to "radarsync: Checking for new jobfiles" status.

Check #hrd-status for **software status** (review summary info, 1st pass, 2nd pass, 3rd pass, superobbing, EMC data dumped, 3D solution, listing of files, then job done).

Check #hrd-scripts-status for **processing and transmission of EMC radials messages** "aircraftTailRadarProcessor: *_radials.txt.gz has size #; aircraftTailRadarProcessor: Processing *_radials.txt.gz; xferTDR: *.dat sent to netman; xferTDR: Transfer to netman complete"

(Leave app open to build future jobfiles. If closed, launch again and select 'Load Last Session'. Don't forget to reset 'Acceptable for Composite' as needed.)

****AFTER ANALYSIS AND SUPEROBBING COMPLETE...**

(**Rule of Thumb**: For a standard pattern, G-IV analysis and superobbing should complete in about 1/3 the time it took to fly the pattern.)

Monitor files being sent off the aircraft (nc files are generated on the ground):

- Superobs (*_radials.so.gz), Analyses (*_xy.w.gz, *_vert*.w.gz), AWIPS (AWIPS*.nc.gz): seb.omao.noaa.gov/pub/flight/radar/YYYYMMDDAI

- EMC:
tgftp.nws.noaa.gov/SL.us008001/DF.bb/DC.sluan/DS.recco/ ("gateway site")
www.aoml.noaa.gov/ftp/pub/hrd/gamache/emclist (file for every 5 min of flight)

- HRD's real-time radar graphics site for looking at wind analyses:
www.aoml.noaa.gov/ftp/pub/hrd/data/RTradar/YYYY/YYYYMMDDAI

NOTE: there can be a delay from when EMC files are transmitted to when they show up at the gateway site. Check with the AOC data tech to see if they show TDR files leaving the aircraft.

>>THINGS TO CHECK IN TRANSMITTED FILES<<

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seb.omao.noaa.gov/pub/flight/radar/YYYYMMDDAI:

File name	Approx. size (for a full analysis)
inbound, *outbound*.w.gz	40-70 Kbytes
*xy.w.gz	1-2 Mbytes
*analysis.tar	0.6-0.8 Mbytes
_so*.gz	1-2 Mbytes

www.aoml.noaa.gov/ftp/pub/hrd/gamache/emclist:

Files with the name YYYYMMDDHHMM_SSS_AA.list.gz, where SSS is storm number (100-199 is Atlantic, 200-299 is east Pacific, 300-399 is central Pacific), and AA is the aircraft number. There should be a file for every five minutes of data. These files contain ASCII versions of the Doppler radial velocity data that will be superobbed by EMC.

tgftp.nws.noaa.gov/SL.us008001/DF.bb/DC.sluan/DS.recco/:

sn.*.bin could represent one or multiple TDR WMO messages. The gateway ingester combines messages when they arrive within a certain time window. Size could range from 2 to 25 MB. (Note: the ~200 byte files are for triggering the HWRF full ensemble)

****NEAR END OF FLIGHT...**

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1. Once the aircraft reaches the end point of the pattern and/or mission science is complete, notify the AOC data tech that they can **end TDR recording**. Generally, this should be at least 20 min before touchdown to allow sufficient time for data compression, etc.

2. Once you verify in #hrd-scripts-status that radarsync has returned to "radarsync: Checking for new jobfiles" status, aircraft radar support can **Ctrl-C 'radarsync'**, and close its terminal.

3. Once you verify in #hrd-scripts-status that the latest EMC files have transferred to netman, aircraft radar support can **close tdrProcSend** windows. All other scripts can be closed as well.

4. Have aircraft radar support **run: './makearchive'**. The files thumbYYMMDDAI_products.tar.gz and YYYYMMDDAIine_corrections.dat will be uploaded by AOC to seb.omao.noaa.gov/pub/acdata/YYYY/RADAR_TDR/ with the TDR product-raw files.

****END OF GROUND SUPPORT DUTIES****

****POTENTIAL ISSUES…**

>>SHOULD THE WORKSTATION GO DOWN<<

If the workstation power is interrupted or the workstation needs to be restarted, then after the workstation is restarted have aircraft radar support:

1. Run 'tdrProcSend'

2. Run 'radarsync'

3. Run 'checksweeps'

4. Run 'checkcorrections'

If the software had been in the middle of execution, it should restart from the beginning once radarsync is executed again: In any event, ensure that all EMC files and HRD radar product files have been transmitted off the aircraft.

>>SHOULD RADAR ANALYSIS PRODUCTS NOT FULLY TRANSMIT<<

If a glitch should ever happen where analysis products are not fully transmitted from the aircraft, the following should be done:

In a terminal, **run: resendradar** (note: you can leave radarsync running while you do this)

>>SHOULD COMMUNICATIONS ON THE AIRCRAFT DROP OUT<<

Wait until comms are reestablished and then submit any outstanding jobfile. If comms goes down while the software is running (so that you cannot see its status in #hrd-status), ask the radar operator to provide the last status update in the radarsyn terminal when comms are reestablished. (Currently, it is not possible to execute runJobFileApp on the aircraft when comms are down. In the future, we want this capability so that the software could run at the HRD radar workstation while waiting for comms to be reestablished.)

>>SHOULD AN ANALYSIS END TOO SOON OR A JOBFILE ERROR IS QUICKLY DISCOVERED<<

If an analysis completes in far less time than "Rule of Thumb", a common reason is a substantial error in the jobfile (e.g., longitude on the wrong side of the earth), or an issue with the fore or aft antenna. In the former case, analysis files may not be transmitted at all. In the latter case, files void of wind data may still be transmitted. If the issue can be resolved with a new jobfile,

- Correct any jobfile errors (if an analysis was transmitted to the ground, it may be best to alter MM in Center Time (HHMMSS) to distinguish it from the bad analysis
- Submit corrected jobfile (with new 'userX_' prefix) to restart the process

If a jobfile error is discovered as the summary information is being presented in #hrd-status, have aircraft radar support quickly Ctrl-C in the radarsync terminal, then

- Correct any jobfile errors
- Have aircraft radar support move the bad jobfile in /home/sysop on the HRD workstation to ~/tdr/fail
- Run 'radarsync'
- Submit corrected jobfile (with new 'userX_' prefix) to restart the process

For more advanced debugging… The ja* script and the programs it calls write output.txt files which should end up at: www.aoml.noaa.gov/ftp/pub/hrd/gamache/realtime_output

The main files, in order of production, are

First pass output (if you did not run ja_major):

YYMMDDAI_HHMM_HHMM_analysis_aft(fore)1_output.txt
YYMMDDAI_HHMM_HHMM_analysis_aft(fore)1error_output.txt

Second pass output:

YYMMDDAI_HHMM_HHMM_analysis_aft(fore)2_output.txt
YYMMDDAI_HHMM_HHMM_analysis_aft(fore)2error_output.txt

Third pass 3d Cartesian output:

YYMMDDAI_HHMM_HHMM_analysis_3daft(fore)_output.txt
YYMMDDAI_HHMM_HHMM_analysis_3daft(fore)error_output.txt

Third pass vertical profile output:

YYMMDDAI_HHMM_HHMM_analysis_profile_aft(fore)_in_output.txt
YYMMDDAI_HHMM_HHMM_analysis_profile_aft(fore)_in_error_output.txt

Merging output from 3d Cartesian for EMC data and AOML superob:

YYMMDDAI_HHMM_HHMM_analysis_mergepass_output.txt
YYMMDDAI_HHMM_HHMM_analysis_mergereal_output.txt

The process to make superobs:

YYMMDDAI_HHMM_HHMM_analysis_makeradarfiles_output.txt
YYMMDDAI_HHMM_HHMM_analysis_airborne_output.txt
YYMMDDAI_HHMM_HHMM_analysis_airborneVr2so.sh_output.txt

The process to produce inbound profile analysis:

YYMMDDAI_HHMM_HHMM_analysis_wind_rt_auto_guess_profile_in_output.txt
YYMMDDAI_HHMM_HHMM_analysis_wind_rt_auto_guess_profile_in_error_output.txt

The process to produce the 3d Cartesian wind analysis:

YYMMDDAI_HHMM_HHMM_analysis_wind3_fill_auto_guess_output.txt

The process to produce outbound profile analysis:

YYMMDDAI_HHMM_HHMM_analysis_wind_rt_auto_guess_profile_out_output.txt
YYMMDDAI_HHMM_HHMM_analysis_wind_rt_auto_guess_profile_out_error_output.txt

Output from script that makes analyses and interpolates outbound profile, and also makes netcdf files and archives the data: YYMMDDAI_HHMM_HHMM_analysis_windfiles_output.txt

Generally, any process that went well will have a gzipped error_output.txt file that is 1 KB or less (gunzipped, it probably has 0 size).

aft1, aft2, 3daft, profile_aft_in, profile_aft_out, and the corresponding fore files have output for each sweep so you can see that the process ran to completion. Otherwise, you can see the last sweep file successfully interpolated before the program ended in error.

You also should be able to see that wind3_fill_auto_guess (3d Cartesian synthesis), wind_rt_auto_guess_profile_in and wind_rt_auto_guess_profile_out ended properly and wrote output.

The sweeps_list used for an analysis, as well as entire sweeps list for real-time sweep directory can be found at: www.aoml.noaa.gov/ftp/pub/hrd/gamache/realtime_sweeplists

with names original_sweeps_list.txt & YYMMDDAI_HHMM_HHMM_analysis_sweeps_list.txt

original_sweeps_list.txt will have all the files in directory at the time the analysis started, including any with the wrong data. YYMMDDAI_HHMM_HHMM_analysis_sweeps_list.txt will have the sweeps list actually used by the software, which should have any sweep file names from prior flights removed.