G-IV Radar Support Guide

On the GROUND (Updated 17 June 2021)

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[Check in advance that you have the following: 1) a java-ready machine, 2) a new log in for submitting jobfiles (see John Gamache), 3) xchat/hexchat (or IRC client), 4) access to mts2.nasa.gov (contact Jason Dunion to set up access), 5) website "https://seb.noaa.gov" added to java security exception list, and 6) the launch file of the java jobfile app from https://seb.noaa.gov/pub/flight/hrd/bin.]

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

Open web browser: https://seb.noaa.gov/pub/flight/hrd/bin (go ahead and click 'Upload Jobfile' now to ensure that you can reach the upload page without issue)

Establish comms with the aircraft: xchat (join channels #hrd and #radar; join, but do not autojoin, #carcah for center fix info; join #tdr-status (if available) for TDR warning messages; join #hrd-status for HRD radar software status; join #hrd-sweeps-status for info on availability of TDR sweeps; join #hrd-scripts-status for info on radarsync and tdrProcSend scripts)

*Note: If the scripts below are not recognized, either the wrong login has been selected at boot-up on the HRD radar workstation or the scripts have been executed outside /home/sysop.

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

1. Open Xchat (not HexChat) **at HRD workstation** and ensure the following ground situational-awareness channels are joined: **#hrd-status, #hrd-sweeps-status, and #hrd-scripts-status**

*Note: If AOC is tunneling to HRD workstation from netman, make sure they execute 'ssh -Y' (and *not* 'ssh -X') to open terminals. This will ensure proper script execution.

2. Run 'check_sweeps'. On xchat, check #hrd-sweeps-status to view % use 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 (e.g., ls –ld 2021*/).

3. Run 'radarsync -u' (paste branch/commit info) and, when done, **run 'buildradaranalysis'** (takes a minute to complete) to obtain latest version of git repository code and to compile the analysis code (including creation of some scripts). [If radarsync gets stuck in a syncing with netman status, have the radar operator Ctrl-C and wait until after take-off to try again. Do not proceed with set up until successful.]

4. Run 'initial_cleanup'. (You should see no output on execution)

5. A minute or two after radar has been turned on, **run 'run_check_sweeps'**. It will open 1 window. On the ground check #hrd-sweeps-status and verify beginning/latest fore and aft sweep times. Gaps in fore/aft sweep recording, if any, will also be shown. Inform data tech of

any anomalies in fore or aft sweep recording (note: /home/sysop/YYYYMMDDAI should be populated with fore/aft sweep files nrm* and nrs* every 5 to 6 seconds)

6. Look at master (fore) and slave (aft) displays (labeled TM and TS) to ensure proper radar functioning. Make sure they are similar and both show return from the sea surface.

7. Run 'tdrProcSend'. It will open 2 windows (aircraftTailRadarProcessor.py and xferTDR) that should be left open for the whole flight. Use them to monitor the transfer of EMC data (*.dat). Monitor their status on the ground in #hrd-scripts-status. If the radar operator indicates either window has closed during flight, determine source of issue and then restart tdrProcSend.

8. Run 'radarsync -a' preferably in a new terminal. Monitor its status on the ground in #hrd-scripts-status. Note: It is not uncommon for radarsync to exit to command prompt with error status at least once during a flight. If "no new jobfiles on ground server…" ceases to appear in #hrd-scripts-status, ask the radar operator to verify that it has exited to command prompt and, if so, run again: radarsync -a.

9. Throughout the flight MONITOR the status of the TDR as in (6) above (TDR instrument messages should appear in #tdr-status (if available) … ensure xchat notifications are set to alert you to status changes on this channel). If in weather, make sure the patterns near the aircraft look similar.

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

Verify current radar recording in #hrd-sweeps-status as in (5) above. **Verify** in #hrd-scripts-status that the **radarsync status** is "no new jobfiles on ground server…"

Monitor flight track: https://mts2.nasa.gov (only seconds delay)

- (If no track data 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 ALxx2016, EPxx2016 or CPxx2016, 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 (superobs 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 Radar Scientist Form and indicate 'Y' for potential Level 2 reprocessing on the TC Flight Summary spreadsheet)

Most likely, the G-IV flight track will not pass close to the center. It is generally 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 the circulation center *during the analysis period*. In this case, the **Center Time** would be that corresponding 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** time 2 seconds before/after the **Center Time**.

If a *center pass is done* (penetration), **Center Time** MUST be your best estimate of when 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 motion value during the flight. ONLY do this if you are sure 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 also 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 location as well as the Start and End times of the radial cross-sections.

Select the **Event type**: For circumnavigation or synoptic surveillance legs this setting should be based on the *sampled winds*. 'Invest' for invest, 'Tropical Storm' for TD or TS, 'Hurricane' for Cat 1-2, and 'Major Hurricane' for Cat 3-5 hurricane.

The **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 horizontal 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. <u>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 the real-time graphics composite MUST have the *same* grid spacing.</u>

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

Verify radar sweeps past the End 3D time in #hrd-sweeps-status as in (5) above. **Verify** in #hrd-scripts-status that the **radarsync status** is "no new jobfiles on ground server…"

Click 'Write to Files' - creates *.tar.gz file of jobfiles. 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 on https://seb.noaa.gov/pub/flight/hrd/bin (site will ask for authentication using log in and password provided to you by John Gamache)

Browse for TimeStamp_YYYYMMDDAI_HHMMSS_jobfile.tar.gz (where HHMMSS is center time and hours will be on a 48-hour clock) in directory 'tmpjobfile' and **send**.

Communicate to aircraft via Xchat that jobfiles have been sent (e.g., copy and paste "*.tar.gz successfully uploaded to AOC ground server" message).

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). The 1st pass software is not run under the "major hurricane" setting.

(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, *_xy.nc.gz), AWIPS (AWIPS*.nc.gz): https://seb.noaa.gov/pub/flight/hrd/radar (subdirectory YYYYMMDDAI)

- EMC-primary: ftp://ftp.aoml.noaa.gov/pub/hrd/gamache/emclist (file for every 5 minutes of flight)

- EMC-alternate: https://tgftp.nws.noaa.gov/SL.us008001/DF.bb/DC.sluan/DS.recco/

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

NOTE: there can be a delay from when EMC files are actually sent to when they show up at the gateway site. Check with the netman operator to see if they show files leaving the aircraft.

>>THINGS TO CHECK IN DOWNLOADED FILES<<

In https://seb.noaa.gov/pub/flight/hrd/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

In ftp://ftp.aoml.noaa.gov/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.

In https://tgftp.nws.noaa.gov/SL.us008001/DF.bb/DC.sluan/DS.recco/: (if issue at EMC-primary)

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, the data tech can **end the 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 "no new jobfiles on ground server…" status, the radar operator can **stop 'radarsync -a'**, and close its terminal.

3. Once you verify in #hrd-scripts-status that the latest EMC files have transferred to netman, the radar operator can **quit xferTDR and aircraftTailRadarProcessor.py** windows.

4. (If HRD crew on board) Once science portion of mission is over, and all analyses have been completed, but before landing (ideally, at least 30 minutes), **run: './makearchive'**. This will produce file thumbYYMMDDAI_products.tar.gz which should be **copied to the portable drive**. If time permits, ask the data tech to transfer the TDR product-raw files to the portable drive.

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

****POTENTIAL ISSUES…**

>>TO RE-SEND ANALYSIS RESULTS<<

In the rare event that 'radarsync' gives errors during transmission phase of analysis results (errors like 'Connection timed out', 'Host unreachable'), the script will keep retrying every 10 seconds until successful. If it fails for too long, cancel the process with 'Ctrl-C' and inform of the situation. You may need to involve Dana Naeher (network) or Sonia Otero (software).

When ready to retry transmission phase alone, run 'radarsync --resend'.

The script will attempt to transmit the files sitting in ~/ftpdir from the last analysis. If it fails again, it will start the loop of retrying every 10 seconds.

Once 'radarsync --resend' is done, restart 'radarsync -a'.

>>SHOULD AN ANALYSIS END TOO QUICKLY OR PREMATURELY<<

If an analysis completes in far less time than the "Rule of Thumb" and yields empty analysis files, the issue is *usually* instrument related. But, before involving the data tech, make sure the jobfile was set up properly! If was a jobfile error, correct it, then submit the corrected jobfile 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: ftp://ftp.aoml.noaa.gov/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_aft1_output.txt
YYMMDDAI_HHMM_HHMM_analysis_fore1_output.txt
YYMMDDAI_HHMM_HHMM_analysis_aft1error_output.txt
YYMMDDAI_HHMM_HHMM_analysis_fore1error_output.txt

Second pass output:

YYMMDDAI_HHMM_HHMM_analysis_aft2_output.txt
YYMMDDAI_HHMM_HHMM_analysis_fore2_output.txt
YYMMDDAI_HHMM_HHMM_analysis_aft2error_output.txt
YYMMDDAI_HHMM_HHMM_analysis_fore2error_output.txt

Third pass 3d Cartesian output:

YYMMDDAI_HHMM_HHMM_analysis_3daft_output.txt
YYMMDDAI_HHMM_HHMM_analysis_3dfore_output.txt
YYMMDDAI_HHMM_HHMM_analysis_3dafterror_output.txt
YYMMDDAI_HHMM_HHMM_analysis_3dforeerror_output.txt

Third pass vertical profile output:

YYMMDDAI_HHMM_HHMM_analysis_profile_aft_in_output.txt
YYMMDDAI_HHMM_HHMM_analysis_profile_fore_in_output.txt
YYMMDDAI_HHMM_HHMM_analysis_profile_aft_in_error_output.txt
YYMMDDAI_HHMM_HHMM_analysis_profile_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 the entire sweeps list for the real-time sweep directory can be found at: ftp://ftp.aoml.noaa.gov/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.

>>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 the radar operator:

1. Run 'tdrProcSend'. It will open 2 windows (aircraftTailRadarProcessor.py and xferTDR) that should be left open for the whole flight.

2. Run 'radarsync -a' preferably in a new terminal. If the terminal had been in the middle of file transmission during the interruption, they may first need to resend as detailed above.

3. Run 'run_check_sweeps'.

If the software had been in the middle of execution and doesn't restart automatically, resend the last jobfile to restart the software. In any event, ensure that all EMC files and HRD radar product files have been transmitted off the aircraft.

>>SHOULD COMMUNICATIONS ON THE AIRCRAFT DROP OUT<<

Note: Occasionally, the radar operator may need to restart 'radarsync -a' after a comms lapse.

[Simply 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 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.]