Investigation Report

CCR 10-00049

INVESTIGATE THE OPERATIONAL UTILITY OF A STORM-BASED AUTO PRF SELECTION

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Prepared by: Joe N Chrisman
Radar Operations Center
Engineering Branch

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Background: Currently, the Auto PRF algorithm selects the Doppler PRF that results in the least amount of range folded (purple) data for the entire area within a 230 km radius of the radar.

Proposed Solution: Implement a function would accept a storm ID, as input by the operator, and use the Storm Tracking and Forecast algorithm to project the location of the selected cell for the next volume scan. Then, for this forecast location, the function would select the PRF that provides the fewest number of obscured 1km bins over the storm of interest. Each subsequent volume scan, it would automatically use the SCIT Storm ID forecast location for the storm of interest and select the "Best PRF" based on this forecast location.

The result of this application is a dynamic PRF selection that tracks a storm of interest and continuously assigns the "Best" Doppler PRF for a storm of interest.

Constraints: Allow this function to be activated/deactivated via GUI by the radar operator.

Overview of Initial Test Function: The Auto PRF algorithm executes as normal to assign a Doppler PRF for the subsequent VCP definition. The Storm-Based Auto PRF adds a PRF sector to the VCP definition prior to it being sent to the RDA for execution.
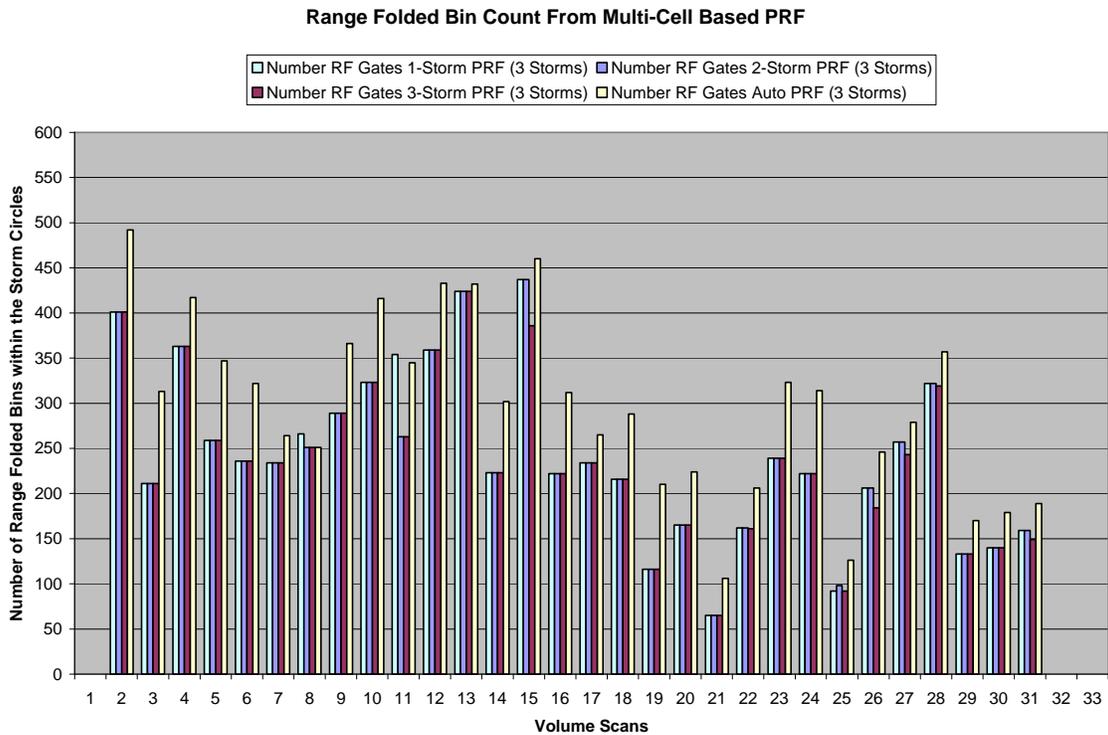
1. Modify the PRF Selection Window to display the STI overlay on the reflectivity product
2. Add a Storm-Based Auto PRF option button (toggle On/Off) to the PRF Selection Window
3. Modify the PRF Selection Window to record the coordinates of a selected "storm"
4. Correlate the selected storm coordinates to the closest a SCIT Storm ID
5. Calculate the "storm circle" which is defined as the boundary of a 25km radius circle around the selected Storm ID centroid location (centroid location as determined by the SCIT algorithm)
6. Modify the Auto PRF algorithm to:
   a. Execute as normally to derive the "best" PRF
   b. Calculate the "obscured" data within the "storm circle" for each Doppler PRF
   c. Select the PRF that results in the least amount of obscuration within the "storm circle"
   d. Define a PRF sector that extends ±15º from the centroid location
   e. Assign the Storm-Based PRF to this PRF sector
   f. Download the modified VCP to the RDA

g. Each subsequent volume scan, recalculate the "storm circle" based on the new location of the associated storm ID (SCIT storm ID centroid location)
h. Repeat steps 6a through 6g until the one of the conditions in Step 7 are satisfied
7. Continue to use this storm ID as the basis for the Auto PRF algorithm until either:
a. the Storm ID moves beyond 230 km from the radar,
b. the particular Storm ID is no longer indentified by SCIT,
c. the HCI operator turns off the Storm-Based Auto PRF option (toggle button on the Modify the PRF Selection Window), or
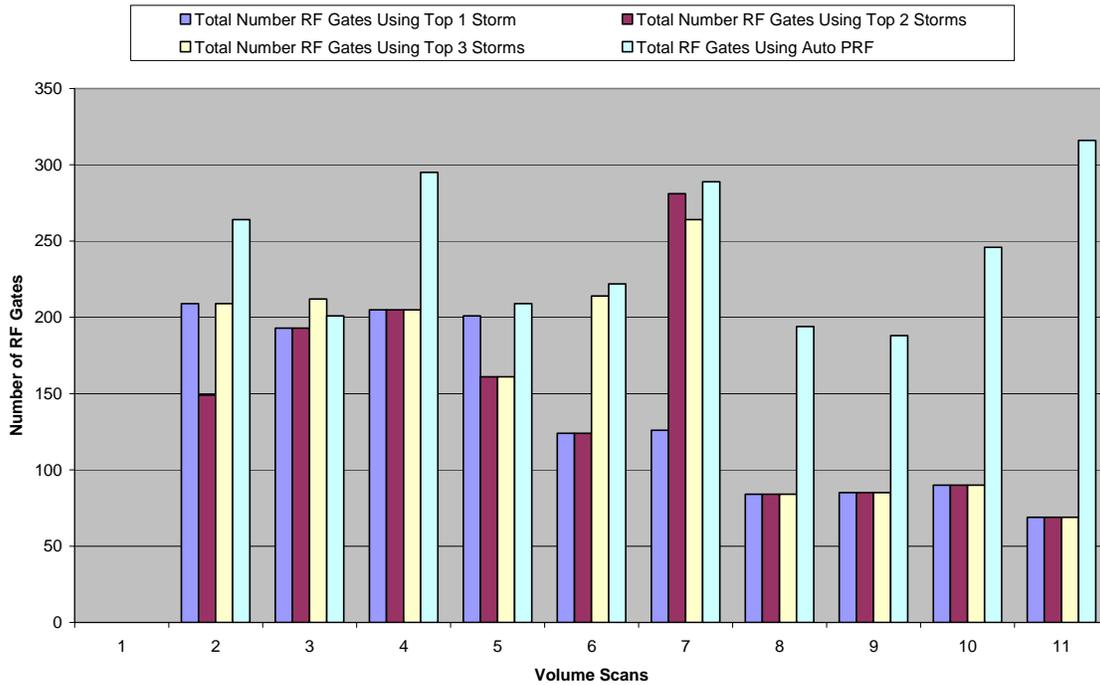d. the HCI operator selects a different "storm of interest"

Investigation: To support investigative testing, the a function was installed on a Radar Operations Center (ROC) test bed Radar Product Generator (RPG) that enabled me to select a storm of interest. During Level II replay events, the function would track the selected storm and estimate the number of obscured bins based on the available Doppler PRFs.

Initial Test Results:

The following are representative of the results:

Range Folded Bin Count From Multi-Cell Based PRF

Legend:
□ Number RF Gates 1-Storm PRF (3 Storms) □ Number RF Gates 2-Storm PRF (3 Storms)
■ Number RF Gates 3-Storm PRF (3 Storms) □ Number RF Gates Auto PRF (3 Storms)

Multi_Storm Auto PRF Performance - KTLX Mar 2 2008

Legend:
- Total Number RF Gates Using Top 1 Storm
- Total Number RF Gates Using Top 2 Storms
- Total Number RF Gates Using Top 3 Storms
- Total RF Gates Using Auto PRF

Y-axis: Number of RF Gates
X-axis: Volume Scans

For information and result examples, see the SREC Briefing (April 2010).

Findings: The Storm-Based Auto PRF Selection function, as designed and implemented for testing, provides fewer range obscured range bins than simply relying on the Auto PRF Selection algorithm.

Enhancement of Storm-Based Auto PRF Selection function Based of Test Results: Testing revealed a need for automatic storm selection that was not originally included in CCR 10-00049. The following enhanced function logic is suggested for implementation:

Proposal: Add two selections to the Auto PRF function.

Option 1:   Operator-Selected Storm-Based Auto PRF:

Implement a Storm-Based Auto PRF function that automatically tracks a selected storm of interest and assigns the best PRF for that storm.

Upon selection of this option, this function would accept a storm ID, as input by the operator, and use the Storm Cell Identification and Tracking (SCIT) algorithm to project the location of the selected cell for the next volume scan. Then, for this forecast location, the function would select the PRF that provides the fewest number of obscured 1km bins over the storm of interest. Each subsequent volume scan, the function would

automatically use the SCIT Storm ID forecast location for the storm of interest and select the "Best PRF" based on this forecast location.

Detail:

1. Add a Storm-Based Auto PRF option button that includes three options (Single Cell, Automatic, or Off) to the PRF Selection Window
2. Modify the PRF Selection Window to display the STI overlay on the reflectivity product
3. Modify the PRF Selection function to accept a Storm ID, when the toggle button is set to Single Cell
4. Use the "forecast position" from SCIT to project where the storm of interest will be next volume scan
5. Using this forecast location, calculate a "storm circle". The "storm circle" is defined as the boundary of a 20km[*1] radius circle around the projected storm location
6. Modify the Auto PRF algorithm to:
   Calculate the number of "obscured" 1km bins within the "storm circle" for each Doppler PRF
   Select the PRF that results in the fewest obscured 1km bins within the "storm circle"
   Download the modified VCP to the RDA
7. Each subsequent volume scan, recalculate the "storm circle" based on the new projected location of the storm ID
8. Repeat steps 4 and 5 until the one of the following conditions are satisfied
9. Continue to use this storm ID as the basis for the Auto PRF algorithm until either:
   the Storm ID moves beyond 230 km from the radar,
   the particular Storm ID is no longer identified by SCIT,
   the operator turns off the Storm-Based Auto PRF option, or
   the operator selects a different "storm of interest"

The result of this application is a dynamic PRF that tracks a storm of interest and continuously assigns the "Best" Doppler PRF for that storm.

Option 2:   Fully Automated Storm-Based Auto PRF:

Implement a Storm-Based Auto PRF function that automatically tracks the 3[*2] most significant storms (from the Combined Attribute Table) and assigns the PRF that results in the fewest range-obscured 1km range bin for those storms.

Upon selection of this option, this function identifies the 3 most significant storms based on the Combined Attribute Table (CAT) ranking. Using the Storm Tracking and Forecast algorithm, project the location of the 3 identified cell for the next volume scan. For each projected storm location, calculate a "storm circle". Calculate the number of range obscured 1km range bins within each storm circle for each Doppler PRF. Select the PRF that provides the fewest total number of range folded 1km bins. Each subsequent volume

scan, repeat the sequence of events to dynamically forecast the location of the 3 most significant storms and select the best PRF for those storms.

The result of this application is a dynamic PRF that tracks the four most significant storms and continuously assigns the "Best" Doppler PRF for those storms.

Detail:
1. When the toggle button is set to Automatic, automatically select the 3 most significant storms based on the CAT ranking
2. Use the "forecast position" from SCIT to project where these storms will be next volume scan
3. Using the forecast locations, calculate a "storm circle" for each storm. The "storm circle" is defined as the boundary of a 20km[1] radius circle around the projected storm location
4. Modify the Auto PRF algorithm to:
   > Calculate the number of "obscured" 1km bins within each "storm circle" for each Doppler PRF
   > Select the PRF that results in the fewest obscured 1km bins within the "storm circles"
   > Download the modified VCP to the RDA
5. Each subsequent volume scan, select the top 3 storms from the CAT
6. Recalculate the "storm circles" based on the new projected location for each storm
7. Repeat steps 4-6 until the one of the following conditions are satisfied:
   > the operator turns off the Fully Automated Storm-Based Auto PRF option, or
   > there are no storms identified by the SCIT algorithm

Note*[1]: The 20km radius was based on the same logic as used in determining the correlation distance for Mesocyclone Detection Algorithm to associate a "Low Core" circulation with a SCIT identified cell location.

Note*[2]: The function will track and process up to 3 storms. If there are fewer than 3 storms then use the number of storms available.

Recommendation: I recommend that the Storm-Based Auto PRF Selection function as described in the precious section be integrated into the WSR-88D RPG Build 13 software baseline.