

*Eastern Region Technical Attachment
No. 2009-02
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**Verification of Severe Weather Avoidance Plan (SWAP) Forecasts for the
New York Air Route Traffic Control Center (ARTCC) Issued by the
National Weather Service Center Weather Service Unit (CWSU),
Ronkonkoma, NY**

*Kirt Squires
Kyle Struckmann*

*NOAA/National Weather Service
Center Weather Service Unit
Ronkonkoma, NY*

Abstract

One of the most important forecasts provided by the Ronkonkoma, NY Center Weather Service Unit (CWSU) to the Federal Aviation Administration (FAA) New York Air Route Traffic Control Center (ARTCC) is the Severe Weather Avoidance Plan (SWAP) Statement. The SWAP Statement is the CWSU's forecast of the probability for the FAA to implement a SWAP when convection causes a significant number of aircraft reroutes and arrival/departure delays in New York ARTCC airspace (ZNY). The SWAP Statement is a decision-support planning tool used by the FAA and commercial airlines to anticipate impacts to the National Airspace System (NAS) that would significantly affect operations and staffing. SWAP originated from the need to improve planning due to the complexity of ZNY airspace and the impact on operations at other ARTCCs during convection. This technical note summarizes the verification of SWAP Statements issued by the Ronkonkoma, NY CWSU for ZNY during the 2008 convective season (April 15th through September 30th). Results indicate that the CWSU demonstrated excellent skill forecasting SWAP events, which aids the FAA, the airlines and other customers in planning for operational changes caused by convection.

1. Background of the Severe Weather Avoidance Plan (SWAP)

To ensure safety and efficient flow of air traffic within New York Air Route Traffic Control Center (ZNY) airspace, a Severe Weather Avoidance Plan (SWAP) is implemented when thunderstorms have caused a significant number of aircraft reroutes. Thunderstorms are avoided by aviators because severe turbulence, icing and lightning are assumed to occur with all convection.

When an isolated convective cell initiates, an aircraft may be able to deviate around it or fly over the top of it. However, when multiple cells develop and organize into clusters or lines, jet routes in the path of these storms are forced to close. Aircraft using these routes must deviate to other routes. A SWAP is implemented when a significant number of routes are either closed or forecast to close, thus lowering the capacity of the National Airspace System (NAS). Jet route closures may also cause closure of Terminal Radar Approach Control (TRACON) gates that feed specific jet routes, thus causing reroutes within TRACON airspace. The reduced airspace capacity and deviations result in a large number of arrival and departure delays at airports in or near the affected region (Figs. 1-3).

ZNY operations, therefore, are significantly affected by SWAP events. When a SWAP is implemented, changes are made to aircraft clearance procedures to regulate the number of departing aircraft and to direct them to available routes. Fast-changing weather causes available departure routes to change frequently as convection moves from one route or fix (a navigational aid defined by

a specific latitude/longitude) to another. Operations are managed by the ZNY Traffic Management Unit (TMU), which consists of the Supervisory Traffic Management Coordinator (STMC), the Departure Complex, the Departure Director and the Arrival Coordinator. Descriptions of each person's responsibilities during SWAP events are included in Appendix 1. The TMU must work closely with air traffic control area supervisors and terminal control towers to communicate important information and to implement tactical decisions (*Letter of Agreement*, 2005). The Center Weather Service Unit (CWSU) meteorologist supports each member of the TMU by providing frequent short-term forecasts about the evolution, location, tops and movement of convection throughout SWAP events.

2. The SWAP Statement

a) Motivation and anticipated value for issuing the SWAP Statement

The Federal Aviation Administration (FAA) has determined that SWAP "is of considerable value in areas that are particularly susceptible to severe weather" (*Federal Aviation Administration Operation and Administration Order #JO7210.3V*). In order to help the FAA and airline customers prepare for possible SWAP events, ZNY managers and the CWSU collaborated to produce an internal forecast product called the "SWAP Statement". The purpose of the SWAP Statement is to support air traffic efficiency, cost savings and safety during severe weather events in the following ways:

- Improved planning for the FAA, airlines and airport facilities to anticipate Traffic Management Initiatives, Miles-in-trail/Minutes-in-trail restrictions, Ground Delay Programs, Ground Stops and reroutes during convection.
- Improved planning for airlines to better utilize fuel and other resources. The SWAP Statement helps airlines plan fuel requirements by providing a convective forecast that is effective at least two hours before most thunderstorms initiate. It also provides information about forecast route availability, which also affects fuel requirements (*Federal Aviation Administration Air Traffic Control System Command Center Training, 2005*).
- Improved use of staffing at ZNY. For example, TMU staffing is generally increased during SWAP events to satisfy the high demand caused by reroutes. Requests for Annual Leave by air traffic controllers are generally denied if SWAP is possible the next day.
- Improved safety for airlines and their customers through optimal management of the NAS.

b) SWAP Statement content

The SWAP Statement consists of two parts:

1. A one-sentence subjective prediction of the chance of SWAP occurring and the earliest possible time of SWAP initiation. In Spring of 2008, the SWAP

Statement format was revised to establish four (4) categories that characterize the chance of a SWAP being implemented. These categories (listed below) assign a probability that a SWAP will be implemented based on the forecaster's prediction of convection. This quantitative element has made SWAP Statements easier to interpret for the customer and enabled the CWSU to verify forecast accuracy. Thus, the first sentence must include one of the four (4) established categories:

“SWAP is NOT EXPECTED”.
(Chance of SWAP is 0%.)

“SWAP is POSSIBLE”. (Chance of SWAP greater than 0% and less than 50%.)

“SWAP is PROBABLE”. (Chance of SWAP is between 50% and less than 95%.)

“SWAP is EXPECTED”. (Chance of SWAP is equal to or greater than 95%.)

2. A brief discussion of the convection including (NWS *SWAP Statement Drill, 2008*):

- a. where and when it will initiate
- b. movement
- c. evolution through the day/evening
- d. thunderstorm cell top height
- e. impact on jet routes and TRACON gates.

See Appendix 2 for examples of SWAP Statements.

c) SWAP Statement issuance, dissemination and usage

The SWAP Statement is issued daily during the local convective season (April 15th through September 30th) by 11:00 a.m. EDT (1500 UTC) (NWS *Station Duty Manual*, 2008). On occasion, the STMC has requested an early SWAP Statement, particularly during the peak of the convective season. Occasionally, a SWAP is implemented in the early or mid-morning hours before the SWAP Statement issuance deadline due to ongoing or early convection. When this occurs, a predictive SWAP Statement is not written. In 2008, this happened six (6) times during the April 15th through September 20th convective season (3.53%). The SWAP Statement is written as a word processing document and submitted by hand to the STMC. After discussing the statement with the STMC, he or she writes the statement into the National Traffic Management Log (NTML) and transmits it to the Air Traffic Control System Command Center (ATCSCC). The National System Strategy Team (NSST) at the ATCSCC adds pertinent information regarding route impacts, planned alternative routes and teleconference “Hotline” activation and issues the statement as a SWAP advisory, which is then available to airlines, airport facilities, air traffic control facilities and other customers. ATCSCC advisories are also available to the public [<http://www.fly.faa.gov/adv/advADB.jsp>] at the time of this writing. An example of a SWAP advisory is provided in Figure 4.

When severe weather conditions are forecast, the NSST contacts affected facilities and customers to apprise them of forecast conditions and routes that may be impacted and formulates a dynamic severe weather operations plan that may include traffic management initiatives, alternate routes, Miles-in-trail restrictions, advisory issuances and other necessary strategies.

3. Preparing SWAP Statements: Integrating Meteorology with Air Traffic Requirements

Preparing the SWAP Statement requires the CWSU meteorologist to integrate meteorological knowledge with his or her air traffic management knowledge about the operation of the NAS. The suite of meteorological analysis and forecast tools from the Advanced Weather Interactive Processing System (AWIPS), the FAA Weather and Radar Processor (WARP) and the Internet are used along with collaboration with Weather Forecast Offices (WFO), surrounding CWSUs and National Centers. Tools such as the Aviation Weather Center’s Collaborative Convective Forecast Product (CCFP) online chats, 12-Planet and phone calls are used to facilitate discussion between the CWSU meteorologist and other National Weather Service meteorologists issuing convective forecasts for regions that may be impacted. Once the CWSU meteorologist has developed a collaborated conceptual model of the day’s convection that includes location, movement, tops and coverage of convective cells, he or she must subjectively integrate it with knowledge of standard jet routes, climbing patterns, holding patterns and the anticipated air traffic volume for the given day to

determine the impact that convection will have on air traffic.

In general, convection in western ZNY airspace that has tops below 30,000 feet (FL300) will have little impact on air traffic leaving or arriving in New York, since these aircraft will be able to fly over the storms. Cells that reach close to 40,000 feet (FL400) are near the maximum cruising altitude of most aircraft and will force them to either deviate around the storm or close the jet route entirely. For example, if thunderstorms were expected to develop over the western part of ZNY airspace with cloud tops to FL300, and the expected movement was in a northeasterly direction rather than eastward (i.e. away from metropolitan New York), the SWAP Statement would be written as “Not Expected” or “Possible” as the CWSU meteorologist is aware that the normal climbing patterns of aircraft would have them above the convection before arriving at this location. However, these same thunderstorms would cause a SWAP if they were occurring further east and/or if their tops were significantly higher. Similarly, some widely scattered thunderstorm activity may not normally cause SWAP, but if these thunderstorms were located in the vicinity of frequently used fixes along primary departure routes out of the New York metropolitan area, SWAP would be much more likely.

Convection within the New York TRACON airspace, which extends approximately in a 50 nm radius around New York City, will frequently cause a SWAP because flights departing from and arriving at the major New York metropolitan airports will be at lower altitudes and unable to fly over cell tops.

Aircraft congestion in New York TRACON airspace also enhances the probability of a SWAP event.

In addition to weather located within ZNY airspace, the CWSU meteorologist must also consider impact from convection in neighboring regions since flights that originate from or arrive in ZNY airspace will pass through Boston, Cleveland and/or Washington ARTCC airspace. Convection in a different ARTCC airspace may cause deviations or route closures that can impact ZNY airspace, leading to SWAP implementation.

As described, the specific requirements of the ZNY air traffic system impose a greater degree of difficulty and complexity on the CWSU meteorologist when writing a SWAP Statement. In order to write an accurate and useful SWAP Statement, the CWSU meteorologist must have knowledge of the air traffic control system, the structure of the NAS and local area meteorology in order to provide meaningful information to the TMU. Much of this knowledge is acquired through face-to-face contact with the customer throughout the year.

4. Verification of SWAP Statements

After the end of the 2008 local convective season, a verification study was performed to determine skill in forecasting SWAP events, thereby demonstrating the usefulness of the SWAP Statement to the FAA and aviation customers. Verification of the SWAP Statements for the 2008 local convective season showed excellent overall skill, based on the number of SWAP events that occurred compared to the expected

ranges and bias goals for each forecast category. SWAP Statements were issued on 161 days during the April 15th through September 30th analysis period. SWAP was implemented on 57 of those days (35 percent of the time). Table 1 summarizes

the number of SWAP Statements by category and the number of times SWAP occurred, and did not occur, with each forecast.

Table 1. Summary of SWAP Statement categories, implementation and verification for the 2008 convective season.

SWAP Statement Category	Number of Forecasts	SWAP Implemented	SWAP Not Implemented	POSI(%)	POSI(%) Expected Range	POSI (%) Goal
Not Expected	65	1	64	1.5	<0.1	0
Possible	55	19	36	34.5	0.1-49.9	25
Probable	21	18	3	85.7	50.0-94.9	75
Expected	20	19	1	95.0	95.0-100.0	100

The Percent of SWAP Implementation (POSI) (Table 2) indicates the percentage of time that SWAP occurred with each forecast category. A monthly summary of SWAP forecasts, POSI, and actual SWAP implementations is also included (Table 3).

The “Not Expected” and “Expected” categories are considered deterministic yes/no forecasts. Although the sample size is small, analysis shows a hit rate of 98% (83/85) and threat score of 91% (19/21) for SWAP implementation. Note that the “no” forecasts are included in the hit rate calculation here because the “Not Expected” SWAP statements are required by the FAA during the convective season and the forecast affects planning even when no significant convection is expected. There were only two days (2.4%) when the SWAP Statement was wrong. One of these days occurred (when SWAP was “Expected,” but was not needed) on September 6th when Tropical Storm Hanna impacted ZNY airspace. The reason that a SWAP was not

implemented was very low air traffic, and not the lack of weather.

When deterministic forecasts of a SWAP implementation are not possible due to uncertainty, a probabilistic category is used. Analysis of the 2008 data indicates that 34.5% of “Possible” predictions resulted in SWAP occurring, which is within the expected range of 0.1% to 49.9%. The 85.7% occurrence for the “Probable” category is also within the expected range, though higher than the predetermined goal. This suggests that more SWAP implementations occurred than were expected for the given category. As the number of SWAP forecasts were less than the number of SWAP implementations, an under forecast resulted for the category. It should be noted that the CWSU does not control whether or not a SWAP is actually implemented. The expected POSI ranges were collaboratively developed between the CWSU and ZNY TMU as the most effective ways to communicate the probability of SWAP. The POSI

goals of 25% and 75% represent the mid-points of each probabilistic range. The 0% and 100% goals for the “Not Expected” and “Expected” categories, respectively, represent the optimal goals for these deterministic forecasts.

Deviation from the goal value for each category provides an indication of bias. Bias is defined here as the difference between the POSI and expected goal for the given category. If a given probabilistic category has a POSI that exceeds the goal, such as in the “Probable” and “Possible” cases

presented here (Table 2), then more SWAP events occurred than should have for that category. For example, when a "Probable" SWAP statement was issued, SWAP was implemented on 85.7% of those days. In order for the 85.7% POSI to be reduced to meet the "Probable" goal of 75%, either 1) additional "Probable" SWAP statements would have had to been issued for days when SWAP was not implemented, or 2) more “Probable” SWAP statements would have been issued as “Expected” SWAP statements,

Table 2. Bias of probabilistic SWAP Statements for the 2008 convective season.

SWAP Statement Category	POSI (%)	GOAL (%)	BIAS* (%)
Possible	34.5	25	-9.5
Probable	85.7	75	-10.7

*BIAS= (Goal %) – (POSI %)

which would have increased the POSI in the “Expected” category and lowered the “Probable” category POSI closer to the 75% goal. While the sample size is small and the period of study limited to 2008, it does suggest that the SWAP forecasts do have a slight negative bias. However, the biases for both probabilistic categories are near 10%, and with the excellent skill as described above, highlight the overall accuracy and usefulness of the SWAP products.

5. Conclusions

SWAP Statements are an integral part of the severe weather planning process utilized by both the ZNY TMU and the ATCSCC. SWAP planning is valuable

because “plans that are properly developed, coordinated, and implemented can reduce coordination and traffic management restrictions associated with rerouting aircraft around areas of severe weather resulting in better utilization of available airspace” (*Federal Aviation Administration Operation and Administration Order #JO7210.3V*). An accurate SWAP Statement written by the CWSU is an important first step in ensuring that air traffic is managed as smoothly as possible during a SWAP, which in turn minimizes delays. This Technical Attachment documents how the Ronkonkoma, NY CWSU provided direct support to its customer based on the customer’s need.

Table 3. SWAP verification calculations for April-September 2008.

	# Forecasts	SWAP Implemented	No SWAP	POSI
2008 Total				
Not Expected	65	1	64	0.015
Possible	55	19	36	0.345
Probable	21	18	3	0.857
Expected	20	19	1	0.950
<hr/>				
<u>April</u>				
Not Expected	12	0	12	
Possible	3	2	1	
Probable	1	0	1	
Expected	0	0	0	
<hr/>				
<u>May</u>				
Not Expected	19	0	19	
Possible	8	2	6	
Probable	2	2	0	
Expected	1	1	0	
<hr/>				
<u>June</u>				
Not Expected	2	1	1	
Possible	13	8	5	
Probable	4	4	0	
Expected	8	8	0	
<hr/>				
<u>July</u>				
Not Expected	3	0	3	
Possible	10	4	6	
Probable	11	10	1	
Expected	6	6	0	
<hr/>				
<u>August</u>				
Not Expected	9	0	9	
Possible	13	1	12	
Probable	3	2	1	
Expected	4	4	0	
<hr/>				
<u>September</u>				
Not Expected	20	0	20	
Possible	8	2	6	
Probable	0	0	0	
Expected	1	0	1	

(NOTE: Occasionally predictive SWAP Statements were not issued, usually due to early morning SWAP implementation caused by ongoing overnight convection or early convective initiation.)

References

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Federal Aviation Administration Air Traffic Control System Command Center Training, 2005: Report on S2K+5 Initiatives. p.15. Available online at: http://www.fly.faa.gov/Products/S2K/S2K5_Final_Report.pdf

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Letter of Agreement regarding New York Center Severe Weather Avoidance Plan between New York Center, New York TRACON, JFK/LGA/EWR/SWF/TEB/ISP Towers, effective 20 May 1999; revised 24 May 2005: Section 4.a.

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Author Biographies

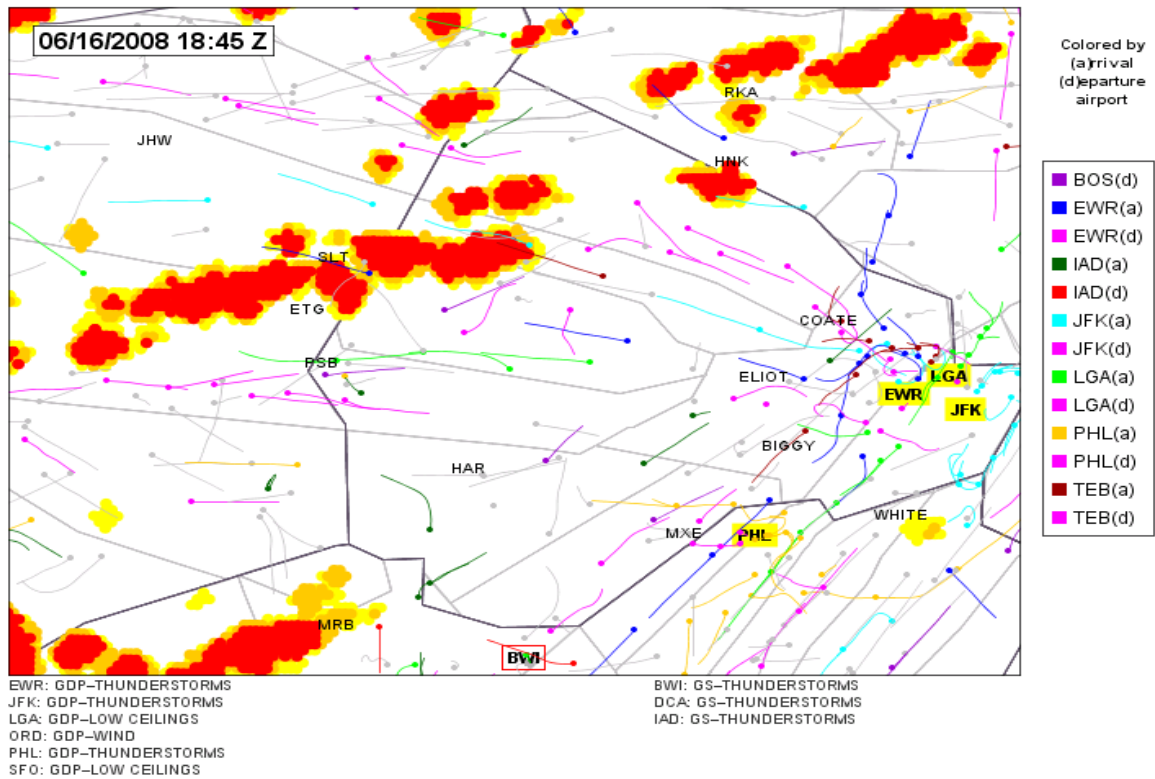
Kirt Squires

Kirt earned his Bachelor of Science degree in Meteorology from the University of Hawaii at Manoa in December of 2004. His career with the National Weather Service began in 2005 as a student volunteer intern at the New York City/Upton, NY Forecast Office, while studying for a Master of Science degree in Meteorology from University of Hawaii at Manoa. After earning his degree in November of 2006 he was the lead author for a paper published in the American Meteorological Society's *Monthly Weather Review*, titled "The Morphology of Eyewall Lightning in Two Category Five Hurricanes". In February of 2007 he returned home to Long Island and began working as a Meteorologist for the National Weather Service's Center Weather Service Unit (CWSU) in Ronkonkoma, NY.

Kyle C. Struckmann

Kyle's career with the National Weather Service began in 2005 as a student volunteer intern at the New York City/Upton, NY Forecast Office, while studying for a Bachelor of Science degree in Atmospheric Science from Stony Brook State University. After earning his degree in December, 2006 he transferred to southeast Virginia as a Meteorology Intern at the Wakefield Weather Forecast Office, where he developed skills as an aviation forecaster. In March, 2008 he returned to the New York area as a Meteorologist at the Center Weather Service Unit (CWSU) in Ronkonkoma, NY, where he provides aviation forecasts for the New York Air Route Traffic Control Center. Before becoming a meteorologist, he earned a Master of Business Administration degree from the University of Missouri-St. Louis and worked in the non-profit sector as a grants administrator. He also managed nationwide strategic planning training for a United Way of America early childhood initiative.

FIGURES



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FIGURE 1. Example of Aircraft deviations during a Severe Weather Avoidance Plan (SWAP) event. At 18:45 UTC June 16, 2008, a broken line of thunderstorms was entering New York Air Route Traffic Control Center (ARTCC) airspace over central Pennsylvania. Scattered thunderstorms were developing over northern Pennsylvania and southern New York State. Westbound aircraft (pink) are deviating around thunderstorms, with some going around the northern end of the line in central Pennsylvania and some deviating to the southwest ahead of the line. Arriving flights into JFK (light blue) and Newark (dark blue) are passing through breaks in the line, and may be flying over areas with lower thunderstorm tops. A SWAP with Ground Delay Programs was implemented as a result of this convection.

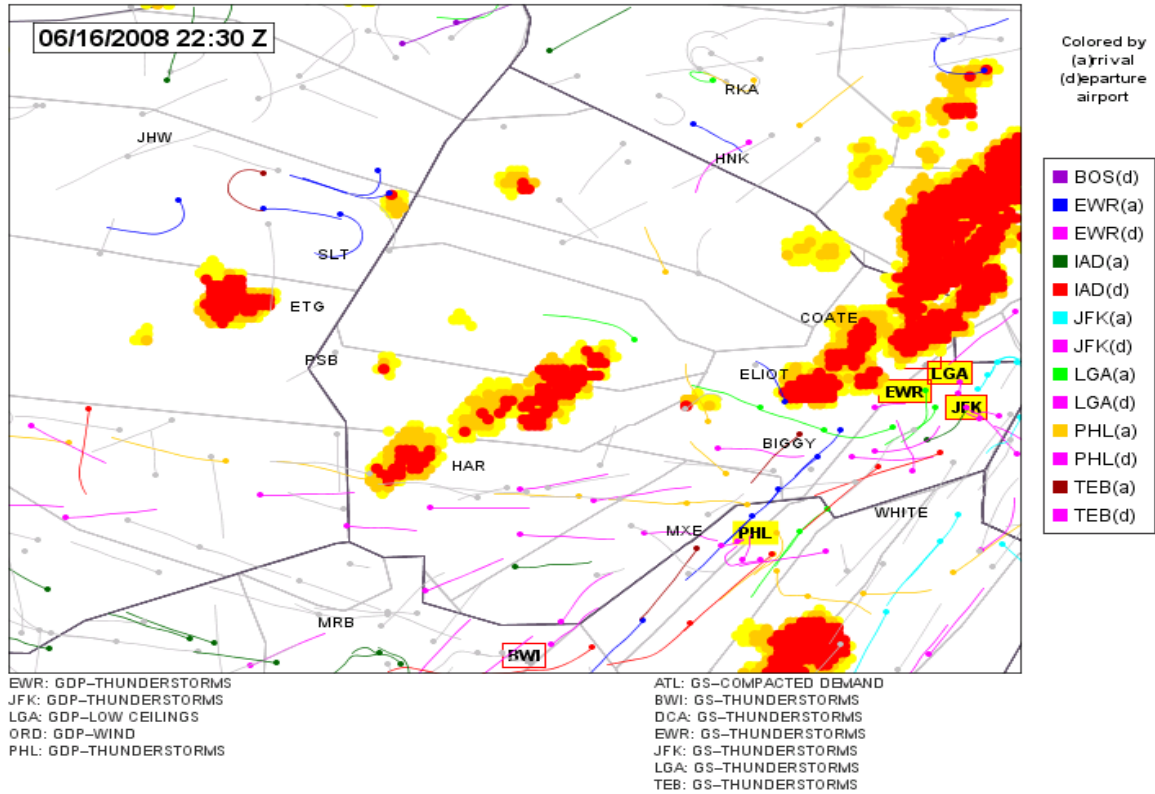


FIGURE 2. Same as in Figure 1 except for 22:30 UTC. The line of thunderstorms approaches the New York City metropolitan area. Jet routes have been closed over northern portions with all departing flights now using only the southern jet routes. Many arriving aircraft are holding (“spinning”). Ground Stops have been implemented at all New York major airports.

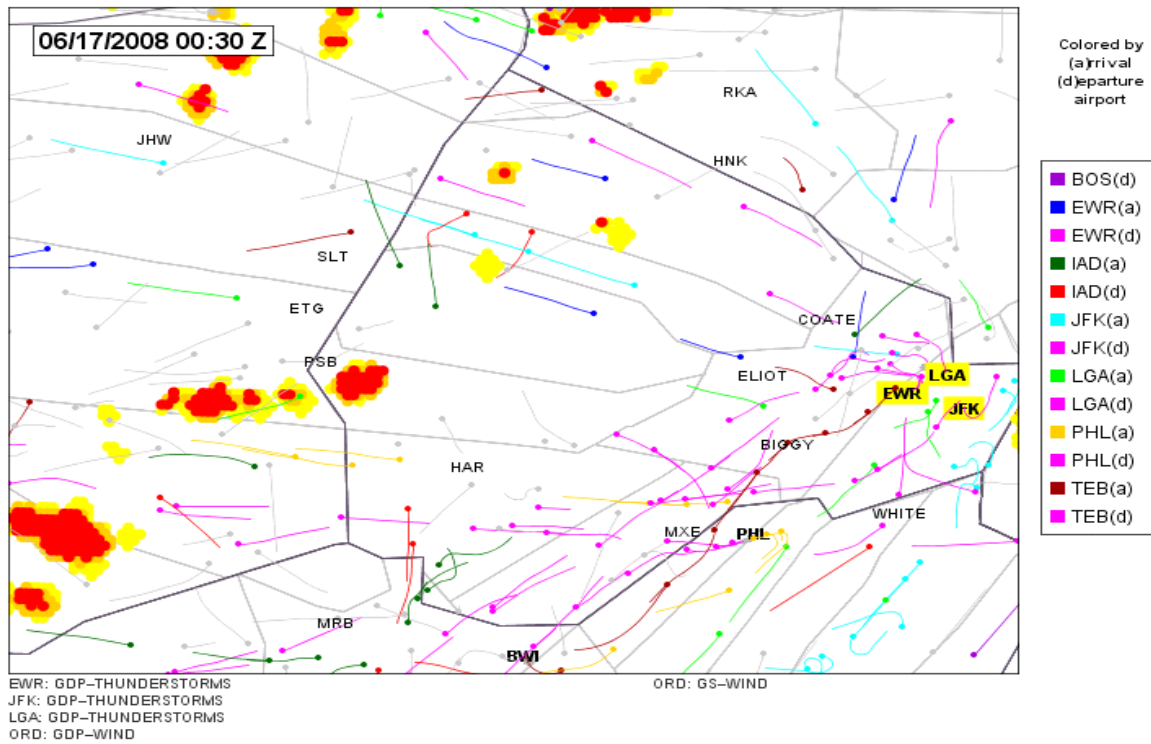


FIGURE 3. Same as in Figure 1 except for 00:30 UTC 17 June 2008. The main line of thunderstorms has moved east of the New York metropolitan area. Ground Delay Programs are still being implemented, but the number of departing flights is increasing. However, another area of convection is developing near Philipsburg (PSB), with outbound jet routes in this area still closed. SWAP continued until 03:30 UTC.

**ATCSCC ADVZY 037 DCC 06/16/2008 ZNY SWAP IMPLEMENTATION
PLAN_FYI**

MESSAGE: THIS ADVISORY IS FOR PLANNING PURPOSES ONLY. CUSTOMERS ARE ENCOURAGED TO FILE NORMAL ROUTINGS AND ANTICIPATE THE SPECIFIED ALTERNATE ROUTES.

SWAP STATEMENT:

SEVERE WEATHER AVOIDANCE PLANS ARE EXPECTED FOR THE NEW YORK CITY METROPOLITAN AREA AFTER 1700Z.

EXPECTED IMPACT AREA(S):

SCATTERED LINE OF THUNDERSTORMS WILL DEVELOP FROM WEST VIRGINIA NORTHEAST TO CENTRAL NY STATE AND EVENTUALLY THRU ALL OF NEW ENGLAND. MAX CB TOPS WILL BE ABOVE FL370. JET ROUTES MOST LIKELY AFFECTED WILL BE J60 THROUGH J6; LATER J95 AND J36. J48 THRU WHITE/WAVEY DEPARTURES LIKELY WON'T BE HEAVILY AFFECTED UNTIL THUNDERSTORMS MOVE INTO THE NY TRACON AIRSPACE.

PLANNED ALTERNATE DEPARTURE ROUTES:

CUSTOMERS CAN EXPECTED CDR'S, PLAYBOOK ROUTES, CAN 7 WEST ROUTE FOR 1700Z AND LATER.

PLANNED ALTERNATE ARRIVAL ROUTES:

PLAY BOOK ROUTES WILL BE IN PLACE FOR TRANSCON FLIGHTS. CUSTOMERS CAN EXPECT TACTICAL ADJUSTMENTS AND CAPPING FOR ZNY FIRST TIER CENTERS.

HOTLINE ACTIVATION: BY 1700Z

CUSTOMER ACCESS: PIN:

REMARKS: GROUND DELAY PROGRAMS FOR NY METRO/PHL AIRPORTS WILL BE USED. GROUND STOPS ARE ANTICIPATED FOR THE AREA AS WELL.

EFFECTIVE TIME: 161410 - 170359

SIGNATURE: 08/06/16 14:12

FIGURE 4. Example of a SWAP Advisory, with SWAP Statement included, issued by Air Traffic Control System Command Center (ATCSCC) on 16 June, 2008.

APPENDIX 1

Responsibilities of Traffic Management Unit (TMU) Team Members During a Severe Weather Avoidance Plan (SWAP) Implementation

Operations at the New York Air Route Traffic Control Center (ARTCC, a.k.a. “ZNY”) are managed by the Traffic Management Unit (TMU), which includes the Supervisory Traffic Management Coordinator (STMC), the Departure Complex, the Departure Director and the Arrival Coordinator. The TMU must also work closely with air traffic control area supervisors and terminal control towers to communicate important information and implement tactical decisions. The TMU must also work closely with the Center Weather Service Unit (CWSU) meteorologist in order to keep apprised of fast-changing weather and its impact jet route availability. The functions of each component of the TMU, the Tower, and the CWSU are:

- *Supervisory Traffic Management Coordinator (STMC):* The decision to implement a Severe Weather Avoidance Plan (SWAP) is made by the STMC. The STMC generally starts the planning process the evening before a possible SWAP event to have the necessary staff available for the following day. Staffing is generally increased during SWAP events to satisfy the high demand of reroutes. Requests for Annual Leave by air traffic controllers are generally denied if SWAP is possible the next day as part of the planning process.

STMC’s participate in a Strategic Planning Telcon (SPT) with surrounding centers, New York Terminal Radar Approach Control (TRACON), the Air Traffic Control System Command Center (ATCSCC) and airline customers every two hours. Supervisors are required to activate the “Hotline”, a continuous teleconference with New York TRACON and the Newark (EWR), John F. Kennedy (JFK) , LaGuardia (LGA) and Philadelphia (PHL) control towers, the ATCSCC and surrounding centers to ensure they are aware of current closed routes and reroutes.

- *Departure Complex:* ZNY is the only Center in the country to have a Departure Complex. This is due to the numerous departure routes that exist in a relatively small area across eastern Pennsylvania and western New Jersey. The Departure Complex issues departure clearances to terminal facilities consistent with available weather avoidance routes. The Departure Complex also provides the terminal control towers with clearances. During severe weather, the Departure Complex is invaluable at rerouting aircraft around impacted areas and quickly adjusting departure flow as the weather moves from one route or fix to another. The Departure Complex relies on the CWSU meteorologist to advise which outbound routes are expected to be impacted so that traffic can be re-routed efficiently.
- *Departure Director:* During SWAP, the Departure Director communicates directly with the towers about the departure lineup and ensures the Departure Complex has entered the appropriate routes into the flight plans.

- *Arrival Coordinator:* The Arrival Coordinator acts as focal point for arrival delay information, rerouted arrival flows and other issues related to the New York, Philadelphia and Washington DC metropolitan areas. The Arrival Coordinator also implements Miles-in-trail initiatives and monitors sector alerts.
- *Area Supervisors:* Area supervisors coordinate with the Departure Complex to clear departures from secondary airports in ZNY airspace, including Wilkes Barre-Scranton (AVP), Allentown (ABE), Harrisburg (HAR), Binghamton (BGM), and Elmira (ELM) concerning route availability. Area supervisors coordinate with the CWSU meteorologist and notify appropriate traffic management coordinators if weather conditions are expected in his/her area.
- *Towers:* Terminal control towers broadcast SWAP information to pilots on Automatic Terminal Information Service (ATIS) frequencies. They advise the Departure Complex when aircraft is in close proximity to takeoff position and does not have clearance. Towers can request verbal clearances.
- *CWSU Meteorologist:* SWAP underscores the value of the CWSU meteorologist at ZNY. During SWAP, the meteorologist closely monitors and forecasts the evolution of convection in ZNY and surrounding airspace, interprets its impact on air traffic and communicates this information in person to the STMC, the Departure Complex, Area Supervisors and other members of the TMU so that safe and efficient tactical decisions are made.

A SWAP also impacts operations over ZNY oceanic airspace. East Coast thunderstorms cause aircraft to deviate to the east over offshore waters. Thunderstorms over the offshore waters near New Jersey and Long Island also cause aircraft to deviate around key fixes south of New York. Oceanic controllers must balance the flow of inbound and outbound traffic around these key areas. Ground Delay Programs and Ground Stops caused by a SWAP also affect air traffic volume for flights to Europe. After the Ground Delay Programs and Ground Stops are discontinued, air traffic on oceanic jet routes increases sharply as international flight departures are restored from JFK and EWR.

APPENDIX 2

Examples of New York Air Route Traffic Control Center (ZNY) Center Weather Service Unit (CWSU) SWAP Statements

a) ZNY SWAP OUTLOOK FOR FRIDAY, JUNE 20TH, 2008

SWAP IS **POSSIBLE** ANY TIME AFTER 18Z. SCT TS MAY DEVELOP INITIALLY OVER SE OH AND WV...IMPACTING J80/J6. THESE STORMS WOULD MOVE INTO NRN VA AROUND 23Z AND AFFECT J48/J75. TOPS TO FL350. A SECOND AREA OF SCT TS MAY DEVELOP OVER NRN PA/CENTRAL NY AROUND 19Z WITH TOPS TO FL350. THESE STORMS WOULD IMPACT J95/J36. THESE STORMS MAY MOVE INTO OR REDEVELOP IN ERN ZNY AFTER 21Z...AND POSSIBLY IMPACT ANY/ALL JET ROUTES OUT OF NORTH AND WEST GATES.

Verification: SWAP was implemented at 1815z.

b) ZNY SWAP OUTLOOK FOR SUNDAY, JULY 6th, 2008

SWAP IS **PROBABLE** AFTER 1700Z FOR THE FOLLOWING REASONS:

1. SCATTERED TS ARE EXPECTED TO FORM THIS AFTN ACROSS ZNY AND INTO WRN PA DUE TO A COMBINATION OF A WEAK SURFACE FRONT AND AN UPPER LEVEL TROF APPROACHING FROM THE SSW. ROUTES FROM J60 – SOUTH ARE MOST LIKELY TO BE IMPACTED.
2. ADDITIONAL TS ARE EXPECTED TO FORM ACROSS WV AND WESTERN VA WITH IMPACTS LIKELY TO J6 AND J80.
3. SCATTERED TS ARE EXPECTED TO FORM ACROSS MD...ERN VA AND ERN NC WITH IMPACTS POSSIBLE TO ANY SRN ROUTE.

Verification: SWAP was implemented at 1745z.

c) ZNY SWAP OUTLOOK FOR MONDAY, JUNE 16TH, 2008

SWAP IS **EXPECTED** AFTER 17Z. SCATTERED LINE OF TS WILL DEVELOP FROM WEST VIRGINIA NORTHEAST TO CENTRAL NY STATE AND EVENTUALLY THRU ALL OF NEW ENGLAND. MAX CB TOPS WILL BE ABOVE FL370. JET ROUTES MOST LIKELY AFFECTED WILL BE J60 THROUGH J6; LATER J95 AND J36. J48 THRU WHITE/WAVEY DEPARTURES LIKELY WON'T BE HEAVILY AFFECTED UNTIL THUNDERSTORMS MOVE INTO THE NY TRACON AIRSPACE.

Verification: SWAP was implemented at 1715z.