NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 12, 2020

Attachment 11 – United Airlines Dispatch Operations Manual

[Excerpt]

OPERATIONAL FACTORS

DCA20CA058

TURBULENCE AVOIDANCE

Turbulence is the leading cause of injuries in commercial aviation. It occurs when a disturbance interrupts the normal atmospheric flow generating wind shear and atmospheric waves which may steepen and break similar to waves on a large body of water. Breaking waves result in turbulence across multiple scales of atmospheric motion (e.g. jet streams, convective anvil, low-level windshear). There are two basic sources for wave generation, **Clear Air Turbulence (CAT)**, and **Convectively-Induced Turbulence (CIT)**. Dispatchers shall use the processes described below to address turbulence hazards.

- Review upper-air depictions, enroute hazard forecasts (e.g. TWC SIGMETs and FPGs), PIREPS, and other relevant information to ascertain areas of potential turbulence when planning flights.
- Continuously monitor conditions along the routes of flights enroute for indications of turbulence. This includes but is not limited to:
  - Evaluating satellite imagery for indicators of possible turbulence such as sharply-curved jet stream axes, sharply-defined darkening bands on water vapor imagery loops, and transverse banding.
  - Soliciting and processing PIREPs from company flights and monitoring reports from other carriers.
  - Continuously monitoring and advising the Pilot of newly issued turbulence advisories and forecasts.

Clear-Air Turbulence (CAT)

Clear Air Turbulence is defined as all turbulence in the free atmosphere that is not in or adjacent to visible convective activity, including turbulence found in cirrus clouds. CAT is generated by synoptic scale events involving rapid changes in wind direction and/or speed across a short horizontal or vertical distance (wind shear). Dispatchers are expected to be aware of and monitor the following potential causes or indicators of clear-air turbulence.

- Shear across the Tropopause (TROP) can magnify the intensity of waves generated by the jet stream or convective activity, resulting in a greater likelihood and intensity of turbulence reports. The threat is most pronounced within 5,000 FT of the boundary.
- Mountain wave turbulence typically occurs immediately along and to the lee side of a mountain range axis and gradually decreases downwind. However, under certain conditions wave/turbulence activity can propagate 100 miles or more downwind of the mountain range. Wave action and turbulence is most pronounced within 10,000 feet of the mountain tops and within 5,000 feet of the Tropopause (TROP).

Convectively-Induced Turbulence (CIT)

Convectively-Induced Turbulence is defined as turbulence in or near thunderstorm activity. CIT can occur great distances from areas of radar reflectivity, and in cloud free environments. According to NTSB statistics, CIT encounters are responsible for 75% of all turbulence-related injuries. Dispatchers are expected to be aware of and monitor the following indicators of CIT using the latest satellite imagery:

- Rapid vertical development of convective cells.
- Rapid anvil expansion.
- Transverse banding or striations in cirrus anvil outflow on northern periphery of an MCS.
- Overshooting tops and enhanced-V ("warm-wake") signatures.

THUNDERSTORM AVOIDANCE

Thunderstorms offer one of the greatest challenges to airline flight operations. Pinpointing the timing and location of events is difficult given the short life cycle and motion of thunderstorms. However, the science has evolved to where forecasters are able to outline areas where TS are likely to occur. Most forecasts offer information regarding location, time, echo top, coverage, and degree of confidence in occurrence.

Radar Imagery

- Base Reflectivity mode is generally used to detect and monitor falling precipitation. The radar antenna is set to 0.5 degree tilt angle above the horizon to capture reflectivity at the cloud base level.
- In Composite Reflectivity mode, the radar scans the cloud and paints the highest detected return from multiple elevation scans. It is important to note the highest return may be found in the middle or upper part of the cloud. This is especially true in newly formed or rapidly developing cells.

Enroute Deviations

It is not uncommon to receive reports of aircraft deviating in areas where radar reflectivity would not necessarily dictate the need. This often generates discussion, especially when this occurs in the terminal area and affects airport arrival and departure capacity. Dispatchers should be mindful of the following items when evaluating potential route deviations due to convective weather:

- Flight deviations are typically based on radar reflectivity (i.e. rainfall) gradients and FOM avoidance criteria, and in no way ensure the avoidance of lightning, hail, or turbulence in areas where deviations are occurring.
- Most flight deviations are related to convective activity. However, since deviations are typically based on radar returns, deviations can and do occur in areas where little or no convection is observed.

- When evaluating radar, echo returns are typically defaulted to base reflectivity and will not display gradients aloft. If available, evaluate a composite picture as well.
- The most effective way to evaluate deviations is to monitor terminal traffic via one of the company approved flight monitoring tools. Soliciting Pilot input via ACARS is also effective.

Convective Forecast Products

There are numerous detection tools and forecast products available for use. These products vary in effectiveness and accuracy. As with any weather forecast, it is important to be familiar with what the product is attempting to convey, the data it uses, and any known biases in the output. Product explanations can be found on the Internet, company training materials, and/or through company-contracted weather service providers.

TFM Convective Forecast (TCF)

The Traffic Flow Management (TFM) Convective Forecast is a primary tool used by FAA air traffic management decision-makers to minimize the air traffic delays, reroutes and cancellations caused by significant convective weather over the NAS. TCF graphics are produced every 2 hours and valid at 4-, 6-, and 8- hours after issuance time to depict high-confidence areas of forecasted convection that meet all of the following criteria:

- Coverage of at least 25% with composite radar reflectivity of at least 40 dBZ;
- Coverage of at least 25% with echo tops at or above FL250;
- Forecaster confidence of at least 50% that criteria will be met

Blue polygons or solid purple lines are used to depict areas of convection in the TCF. Coverage is indicated by broken (25-39%) or striped (40-74%) hatching. Maximum echo tops are identified in one of four classes:

- 25,000 - 29,000 feet MSL identified as 290
- 30,000 - 34,000 feet MSL identified as 340
- 35,000 - 39,000 feet MSL identified as 390
- 40,000 feet MSL and above identified as >400

The TCF domain covers all Flight Information Regions (FIRs) over the 48 contiguous states and adjacent coastal waters. It also includes the Canadian airspace south of a line from Thunder Bay, Ontario to Quebec City, Quebec.

Corridor Integrated Weather System (CIWS)

CIWS serves as the industry accepted radar display tool for the FAA and airlines. It is used heavily by ATC in decisions to open or close arrival and departure fixes during thunderstorm events. The CIWS display combines radar reflectivity with satellite, lightning, echo tops, and cell movement data into a single, comprehensive package. CIWS also provides a 0-2 hour tactical view that compliments the strategic view provided by the CCFP. This 02-hour forecast is simply an extrapolation forecast of future position based on average

speed and movement of already-developed storm cells and is not designed to accurately account for acceleration, deceleration, or growth and decay trends. The CIWS graphics are updated every 5 minutes (every 2.5 minutes if the 2 hour forecast feature is not selected) and can be "looped" from 2 hours in the past to 2 hours into the future in 15 minute increments.

Use the following login information to access CIWS at:
http://ciwswww.wx.ll.mit.edu/

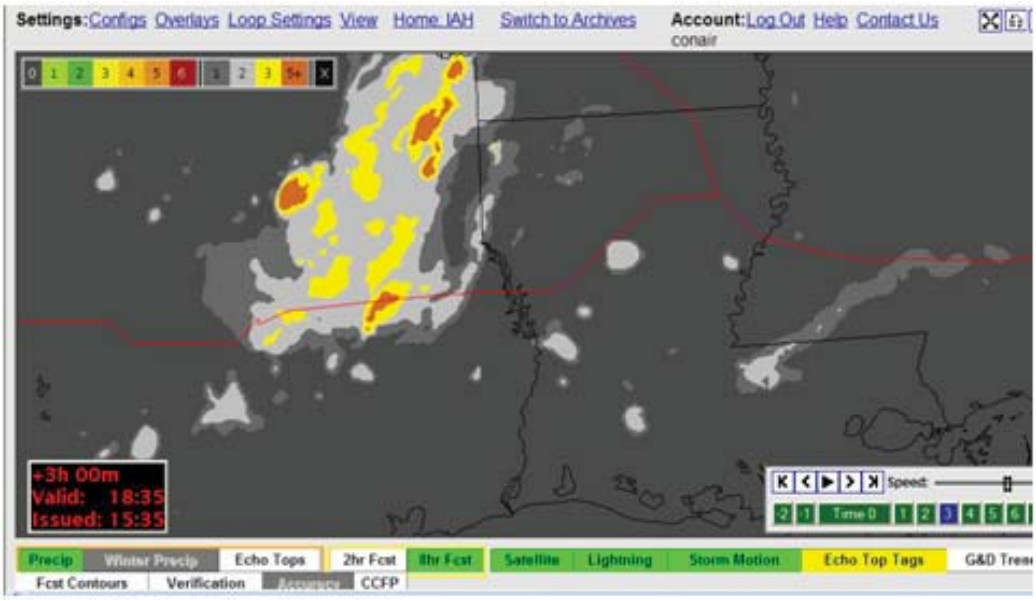
Note: *Use Firefox to access CIWS and CoSPA to ensure accurate display of radar information*

Consolidated Storm Prediction for Aviation (CoSPA)

CoSPA builds on the CIWS suite of 0-2 hour forecast products by providing high-fidelity 2-8 hour deterministic forecasts of radar VIL and Echo Tops. The look and feel of the 0-8 hour forecasts provides a deterministic "radar-forward" animating presentation that does not require advanced meteorological interpretation. CoSPA is integrated with the CIWS product on a hybrid website: http://cospa.wx.ll.mit.edu. Users must create a unique user name and password combination.

The CIWS 'Forecast' status button is replaced by two forecast buttons: "2hr Fcst" and "8hr Fcst". When 2hr Fcst is selected, CIWS products are displayed. When 8hr Fcst is selected, CoSPA products are displayed.

Main CIWS/CoSPA display window illustrating the 03-hr CoSPA precipitation forecast



- The **8-Hour Precipitation** forecast product consists of state-of-the-art, completely automated forecasts of levels 1, 2, 3-4, and 5+-precipitation intensity and location. The colors used to display the four forecast intensity

levels are shown in the Precip Forecast Color bar in the upper-left corner of the main window.

- The **8-Hour Echo Tops** product provides forecasts of radar echo tops altitudes of < 30k FT, 30 to < 35k FT, 35 to < 40k FT, and 40+k FT. The colors used to display the 8-Hour Echo Tops Forecast product are shown in the Echo Tops Forecast Color bar.

Dispatchers should note the following conditions and limitations when interpreting CoSPA forecasts:

- The current CoSPA product is a purely deterministic display of computer-simulated radar intensity and has no direct measure of uncertainty.
- Forecast verification contours are available to assess past forecast performance by selecting the '**Verification**' tab.
- Users should assign greater confidence to forecasts that are consistent over time.
- CoSPA is better at forecasting long-lived, organized convective systems than isolated, short-lived storms.
- CoSPA forecasts show skill in depicting the areal coverage and mode of thunderstorms (i.e. squall line, MCS, scattered cells), but the location of individual storm cells may not be correct.
- As with all forecast tools, the near-term CoSPA forecasts tend to be better than the longer-term forecasts.
- CoSPA 0-2hr forecasts are identical to CIWS 0-2hr forecasts.

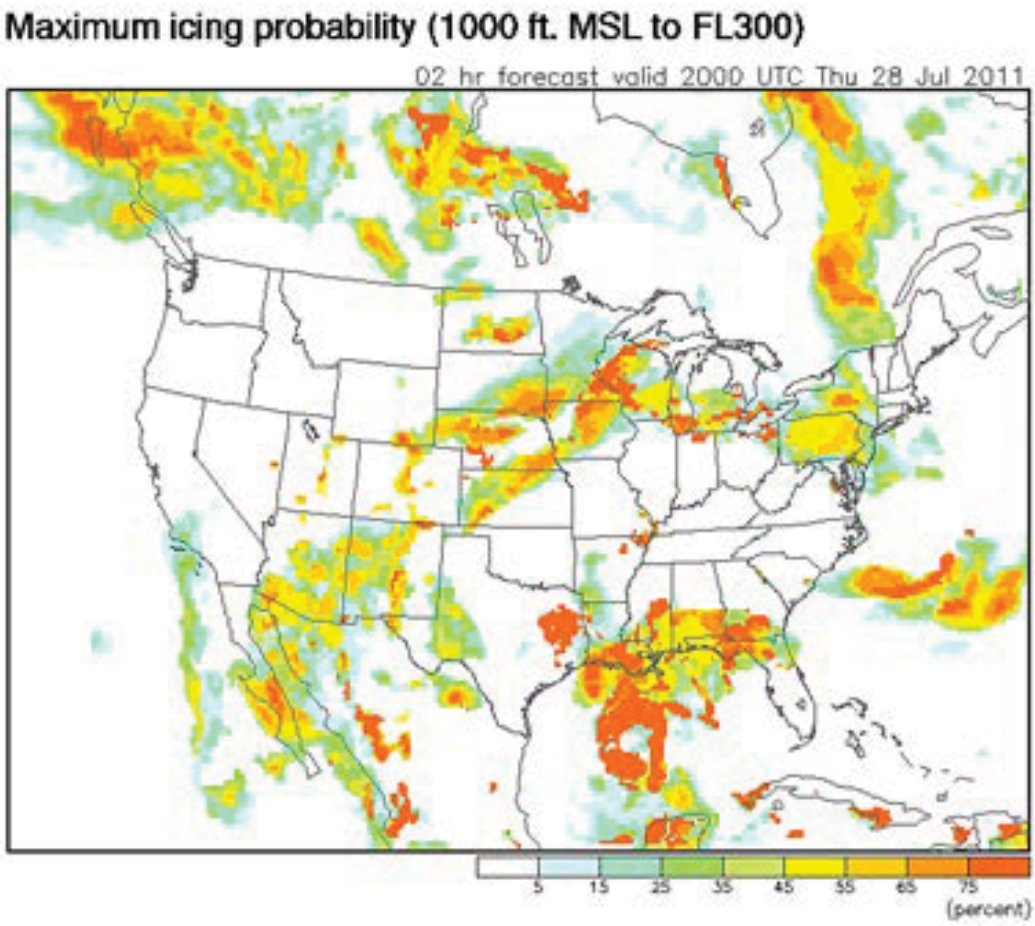
ENROUTE ICING

Atmospheric conditions conducive to ice formation on aircraft can have a significant impact on operations. However, the most common impact occurs on flight segments facing MEL restrictions related to known or forecast icing conditions.

AWC Current Icing Product (CIP) and Future Icing Potential (FIP)

One of the more comprehensive icing forecast products available for domestic operations is the CIP/FIP graphics suite from the Aviation Weather Center ADDS website (http://aviationweather.gov/adds/icing/icing_nav.php). The CIP/FIP algorithm generates a diagnosis of icing conditions with no human modification based on an intelligent combination of observations (satellite and radar, surface, and PIREPs) and numerical weather prediction model output from the Rapid Update Cycle (RUC) model.

Figure 7.2. Example of CIP/FIP 02-hr forecast graphic.



Although the CIP/FIP is a supplementary product for enhanced situational awareness, it contains information not available from primary sources. In the event there is a conflict or uncertainty in interpreting the product, contact the approved EWINS weather provider for assistance.

HIGH ALTITUDE ICING

Traditionally, the threat for ice accumulation is confined to lower altitudes (generally below FL270) where moisture content and temperatures are conducive to formation. However, significant ice accumulation on critical aircraft systems has been reported at high altitudes in clouds associated with convective activity. The ingestion of ice affects aircraft engines as well as probes and sensors, resulting in engine power excursions despite full anti-ice bleed protection, and airspeed and/or TAT° anomalies. It is important to note that standard thunderstorm avoidance criteria will not necessarily provide protection from this threat.

Scientific studies reveal the following characteristics associated with high-altitude icing events:

- Often associated with large convective systems located from the tropics into the mid-latitudes. Such systems appear as a large mass of clouds with very cold cloud-top temperatures on color-enhanced infrared (IR) satellite imagery.
- Presentation of liquid or icy precipitation on the aircraft windscreen at altitude is a strong indicator of this type of icing condition.
- Looping infrared satellite images indicate a gradual warming trend of convective cloud tops.
- Events occurred during flight in IMC conditions within the convective cloud mass.
- Events occurred in areas of weak or low cockpit radar returns at altitude while overflying areas of high reflectivity.
- Often associated with Total Air Temperature (TAT) anomalies and/or OATs significantly warmer than ISA.
- Flights were adhering to published thunderstorm avoidance procedures when incidents occurred.

Dispatchers should use the following techniques to identify and mitigate the risks associated with high-altitude icing:

- Overlay and animate the TWC HIWC forecast graphics in conjunction with IR satellite imagery, Global Lightning, and TWC Convective SIGMETs/FPGs to identify risk areas associated with large mesoscale convective systems (MCS). Consider adjusting the planned route to avoid HIWC risk areas associated with MCS cloud shields greater than 60nm in diameter during the planning phase
- Closely monitor thunderstorm growth trends in satellite imagery (and radar where applicable).
- Remain vigilant to obtain and review PIREPs from other aircraft operating in and around large thunderstorm complexes.
- For flights passing in or near HIWC risk areas where cloud tops are warming on infrared satellite, alert the pilots to the potential for icing while traversing the area in IMC conditions.
- Query other flights in the area for PIREPs and advise the pilots of these flights and their relative location. If PIREPs indicate the presence or threat of ice crystal icing, consider altering the route of flight to the extent possible and/or appropriate.

TWC HIWC FORECAST PRODUCT

The TWC High Ice-Water Content (HIWC) Forecast graphics are derived from TWC's in-house global RPM computer model. The model applies algorithms to identify where ice-water content is elevated across standard flight levels (FL300 and above) in tropical air masses. The resulting output is assigned one of the following color-coded threat levels:

- Low
- Medium

- High

The HIWC forecast output is generated 4x daily (00z, 06z, 12z, 18z) for hourly time steps out to T0+24 hrs.

VOLCANIC ASH AVOIDANCE

Dispatchers shall apply the following guidance to the control of flight operations in and around volcanic activity that is imminent or may be occurring.

- Do not dispatch or fly into areas of discernible (known or forecast) volcanic ash as depicted by the custom hazard forecasts issued by TWC. The guidance issued by TWC shall be used as controlling, primary information for the planning and enroute phases of flight (ref. EWINS Operations Manual Ch. 3).
- Verify appropriate separation buffers from discernible (known or forecast) volcanic ash have been applied in any guidance provided by TWC. In certain cases, it may be prudent to consider building additional buffers around areas of discernible (known or United-forecast) volcanic ash.
- Planned overflight of discernible ash is permitted only if decompression and driftdown profiles ensure continued lateral and vertical separation.

  Note: *Use an assumed decompression profile descent gradient of 6-to-1 (6000 feet horizontal-to-1000 feet vertical) to determine the maximum allowable distance for overflight of known of forecast areas of volcanic ash. Consider winds. (Overflight rule of thumb: One nautical mile for each thousand feet above the ash cloud, with consideration for turns required to remain clear in the event of a required descent.)*

- Under-flight of discernible volcanic ash is permitted only if accurate altitude information is available with regard to the base of the ash layer and only if required for departure or approach or when essential for mission completion.
- Use products and guidance provided by the United-approved commercial weather provider(s) to avoid penetration of sulfuric acid or SO2 clouds. Avoid sulfuric acid clouds by at least 1000 feet above or at any altitude below.
- For flights that will operate in the vicinity of an active eruption or ash cloud, the following MEL items require consultation with the Captain prior to departure:
  - Air Conditioning Pack
  - Pressure Regulating and Shutoff Valve (PRSOV)
  - Engine Bleed Valve
  - Auxiliary Power Unit (APU)
  - Auto Pressure Control System
- In the event a volcanic ash or sulfuric acid cloud is observed through satellite imagery analysis, alert any flights which may be impacted, and alert the commercial weather provider to determine if the area will persist and possibly impact other flights.

- If a flight reports an inadvertent encounter with actual or suspected volcanic ash or a sulfuric acid cloud, alert flights in the vicinity, other Dispatchers whose flights may be impacted, the MDO, and TWC.

Note: *Due to the unique nature of each volcanic eruption, there may be cases where uncertainty in the location of ash necessitates an increase to the separation margins outlined above. In other circumstances, if it can be reliably determined through observation that an area of volcanic ash as plotted by the approved weather provider can be avoided, a flight may be operated within the boundaries of a forecast ash cloud upon concurrence of the Captain, Dispatcher, and Chief Pilot.*

- Evaluate the need for diversion if ash is observed at the destination airport and forecast to exist at the flight's ETA.

THE WEATHER COMPANY VOLCANIC ASH FORECASTING

TWC Forecaster Offices

TWC delegates forecast services for United Airlines between the Global Forecast Center in Andover, MA and TWC's on-site office embedded in the United Airlines Network Operations Center.

- On-site NOC meteorologists are responsible for providing custom products specific to United's operation such as the 5-day Hub Weather Outlook, custom WSI TAFs and Forecast Discussions for United hubs and other key airports, and Special Weather Event Risk/Impact forecasts on a 24x7 basis
- The Andover, MA office is responsible for issuing all other terminal and enroute hazard forecasts, including FPGs, SIGMETs, other alerts, forecasts, and discussions for turbulence and volcanic activity

Who to Contact

- On-site meteorologists should be the main point of contact for dispatchers. Local forecasters will respond to individual ad hoc requests or general inquiries, and refer specific questions to the Andover office as necessary.

  Note: *The on-site staff are currently not equipped or contracted to provide proactive formal briefings to the entire group.*

- On-site TWC forecasters regularly communicate and coordinate with the Global Forecast Center and United's on-duty MDO when enroute hazards such as thunderstorms or volcanic activity threaten United hubs and/or other operations of interest.

Volcanic Ash Response Levels

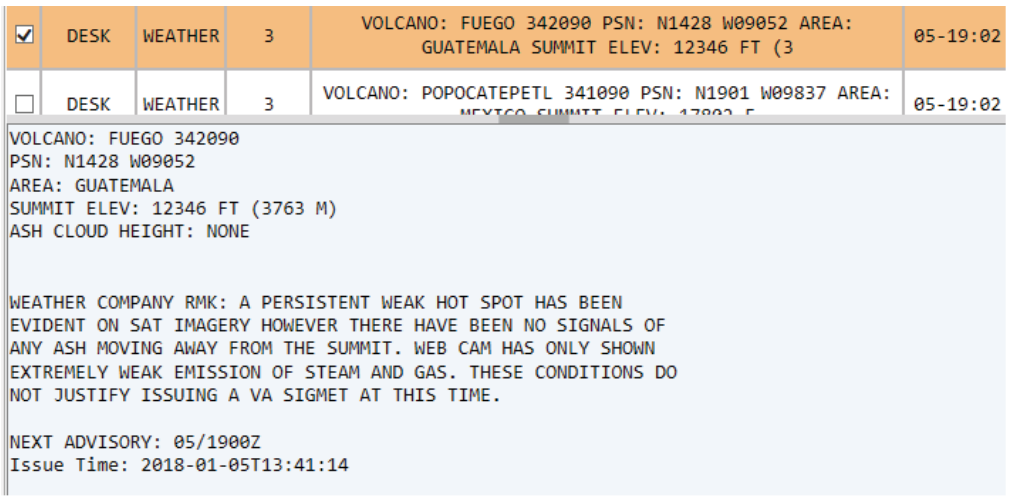
TWC issues one or more of the following products based on the significance of each ash event.

LEVEL 1 – Volcanic Ash Alert Messages

- TWC forecasters customize and reissue a condensed version of the VAAS messages issued by the government VAACs. The message highlights the

most important information and includes a custom textual remark/discussion about the event and any visible ash cloud.

- TWC will continue to issue subsequent VASH alerts for an event only if/when conditions do **not** warrant issuance of a custom WSI SIGMET (ref. LEVEL 2 criteria below).
- The custom VASH messages will be delivered as DESK alerts to the WX queue in Dispatch View (example below).



☑	DESK	WEATHER	3	VOLCANO: FUEGO 342090 PSN: N1428 W09052 AREA: GUATEMALA SUMMIT ELEV: 12346 FT (3	05-19:02
☐	DESK	WEATHER	3	VOLCANO: POPOCATEPETL 341090 PSN: N1901 W09837 AREA:	05-19:02

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VOLCANO: FUEGO 342090
PSN: N1428 W09052
AREA: GUATEMALA
SUMMIT ELEV: 12346 FT (3763 M)
ASH CLOUD HEIGHT: NONE


WEATHER COMPANY RMK: A PERSISTENT WEAK HOT SPOT HAS BEEN
EVIDENT ON SAT IMAGERY HOWEVER THERE HAVE BEEN NO SIGNALS OF
ANY ASH MOVING AWAY FROM THE SUMMIT. WEB CAM HAS ONLY SHOWN
EXTREMELY WEAK EMISSION OF STEAM AND GAS. THESE CONDITIONS DO
NOT JUSTIFY ISSUING A VA SIGMET AT THIS TIME.

NEXT ADVISORY: 05/1900Z
Issue Time: 2018-01-05T13:41:14
```

LEVEL 2 – Custom Ash SIGMET

TWC will issue a custom volcanic ash SIGMET when one or more of the following thresholds are met:

- Aerial coverage of ash cloud >3,000 square miles
- Ash cloud rises >6000 ft above the volcano summit OR above FL100
- Ash is observed or expected to be within 50nm of a known customer destination airport

TWC will reissue SIGMETs 30-60 min prior to expiration when hazardous ash conditions are expected to persist.

WARNING: TWC custom Ash SIGMETs are to be treated as no-fly zones.

LEVEL 3 – Flight Plan Guidance (FPG)

In addition to ash SIGMETs, TWC will issue FPG forecast polygons to project up to 12 hrs of ash cloud movement when ash is expected to persist above FL300. Dispatchers must flight plan to avoid ash FPGs.

LEVEL 4 – Volcanic Ash Email Discussion

TWC forecasters at the Andover, MA office will begin issuing email discussions during a major eruption and/or when TWC forecasts differ significantly from the VAAC. The email updates are intended to supplement custom SIGMETs/FPGs by providing additional detail and insight into the rationale behind TWC's forecast and why it may differ from the VAAC, including screenshots of the latest multispectral satellite imagery the forecaster may be referencing to justify his/her reasoning.

Due to the limitations of group email distribution, these messages are being automatically routed and posted to the "TWC Weather Products" SharePoint (http://noc.ual.com/Pages/WeatherMaps.aspx) page under the Volcanic Ash Forecast header (example below). Dispatchers managing a volcanic ash event should reference these posts for the latest information prior to contacting TWC's on-site forecaster staff.

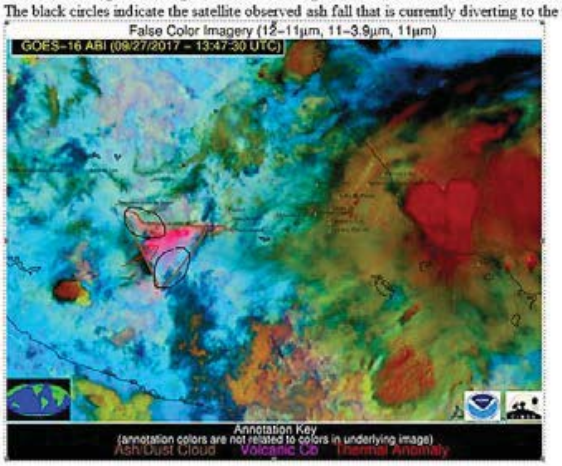
Volcanic Ash Forecast

Type	Name	Modified	Modified By
	FW Popocatepetl Volcano Update 16z 122917	12/29/2017 10:07 AM	Polderman, Nathan
	FW Popocatepetl 261630Z	12/26/2017 10:35 AM	Polderman, Nathan
	FW Popocatepetl	12/25/2017 11:27 PM	Polderman, Nathan
	FW Popocatepetl Update 2600007	12/25/2017 5:54 PM	Polderman, Nathan

From: Aviation Operations [mailto:avops@weather.com]
Sent: Wednesday, September 27, 2017 9:04 AM
To: Volcano - WSI <volcano@wsi.com>
Subject: Popocatepetl Ongoing Eruption

Volcano Popocatepetl continues to emit a continuous and dense vash plume to the west of the summit. The estimated height is to FL220 with the current vash plume pushing past 70nm west of the summit. Some of the ash fall below is departing to the wnw and wsw but this does not occur until about 50nm west of the summit. The current WSI sigmet is out until 21Z and extends aboot 80nm west of Popo. The current government sigmet (Sigmet 1) is positioned to the north. This seems to be out of agreement with the satellite and the Washington VAAC Advisory and latest statement. I expect this to be corrected by the government as there is currently no direct threat to MMMX. MMTO may see some haze/light va as some of the ash fall below extends to the wnw.

Below is an image indicating the various vash regions of concern. The red arrow indicates the main plume extending from Popocatepetl to the west. The black circles indicate the satellite observed ash fall that is currently diverting to the wnw and wsw from the main plume.



Please contact us if you have any further questions. This situation will continue to be monitored and updated as the situation permits.

Aviation Forecasting
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For questions, please contact WSI Aviation Forecasting
Phone: 978-983-6356
Email: avops@wsi.com

SULFUR DIOXIDE (SO2) GAS CLOUDS

SO2 is a clear gas with a sulfur smell that commonly associated with volcanic eruptions and ash clouds. An SO2 cloud may be present with or without volcanic ash.

In daylight, SO2 clouds may have a reddish or yellow-brown tint. SO2 clouds can precede an eruption of volcanic ash. If an SO2 gas cloud is encountered, follow the FM procedure and exit the cloud. Pilots are directed to report an encounter to ATC and Flight Dispatch just as described above for a volcanic ash encounter.

OZONE

Ozone forms a layer through the stratosphere, starting from a height of 5 miles above the poles and 11 miles above the equator, up to an altitude of approximately 30 miles above the Earth's surface. Exposure to high concentrations of in-cabin ozone may cause shortness of breath, headaches, dry throats, and chest pains. Ozone distribution varies with latitude, altitude, season, and weather conditions. Ozone concentrations exceeding maximum allowable in-cabin levels are most likely to occur above 50°N latitude at altitudes above the tropopause over top of upper-level low pressure centers and trough lines. Significant levels of ozone typically do not extend below FL370.

Ozone concentrations in aircraft cabins are governed by 14 CFR 121.578:

> *(b) Except as provided in paragraphs (d) and (e) of this section, no certificate holder may operate an airplane above the following flight levels unless it is successfully demonstrated to the Administrator that the concentration of ozone inside the cabin will not exceed.*
>
> > *(1) For flight above FL320, **0.25 parts per million** by volume, sea level equivalent, at any time above that flight level; and*
> >
> > *(2) For flight above FL270, **0.1 parts per million** by volume, sea level equivalent, time weighted average for each flight segment that exceeds 4 hours and includes flight above that flight level. (For this purpose, the amount of ozone below flight level 180 is considered to be zero).*

TWC applies cabin air retention factors to ambient ozone levels outside the aircraft to derive equivalent in-cabin ozone concentrations for aircraft not equipped with ozone catalytic converters (i.e. "scrubbers"). Ozone FPG polygons are then drawn to represent where in-cabin concentrations are expected to exceed 0.25 ppm.

Flight Planning Considerations

Aircraft without ozone converters must be flight planned to avoid FPG-defined areas of 0.25ppm, which results in avoidance of 0.10ppm for 4-hour time-weighted averages.

Note: *The only product appropriate for making the above determination is the Ozone FPG. This product alone addresses in cabin ozone concentrations.The ambient ozone 100 ppb and 250 ppb products shall not be used for flight planning or monitoring considerations.*

Non-Scrubber Aircraft

The following fleets are ***not*** equipped with ozone catalytic converters ("scrubbers"):

- B737NG (all subtypes)
- B757-222
- B757-224
- B757-324 (3851-3859)

TROPICAL SYSTEMS

Terminology

Tropical Disturbance or Depression: closed circulation of tropical origin with winds up to 34 knots.

Tropical Storm: closed circulation of tropical origin with maximum surface winds of 35-64 knots.

Hurricane: closed circulation of tropical origin with maximum surface winds greater than 64 knots. Depending on location these storms have different names:

- Hurricane - the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean east of 160E.
- Typhoon - the Northwest Pacific Ocean west of the dateline.
- Severe tropical cyclone or Category 3 cyclone and above - the Southwest Pacific Ocean west of 160°E or Southeast Indian Ocean east of 90°E.
- Very severe cyclonic storm - the North Indian Ocean.
- Tropical cyclone - the Southwest Indian Ocean.

Operating in the vicinity of tropical systems should follow the guidelines that govern all safety of flight. Tropical depressions, tropical storms and weaker disorganized hurricanes pose the greatest threats aloft as they favor the vertical development of thunderstorms with a heightened potential for significant icing at much higher altitudes than normally encountered. Stronger hurricanes actually exhibit less of a threat of such conditions to **enroute** operations at altitude as most of the energy is expended horizontally rather than vertically in the form of very high surface winds.

Terminal Operations

Cessation or resumption of company flight operations into a station prior to and following the impact of a tropical storm will be determined by the Network Director based on considerations such as wind limitations to ATC tower operations and NAVAID availability, and the availability of both airport security and company station personnel.

Flight operations into a station in the vicinity of an approaching tropical system will be conducted based on criteria which govern all safety of flight.

- Particular attention should be paid to wind and crosswind limitations, especially for wet runway restrictions.
- NOTAMs should be carefully monitored for possible NAVAID and other closures.

En Route Operations

Tropical systems pose the greatest impacts to flights at cruise altitude during their weaker phases when storms are typically more disorganized. These conditions allow for the greatest amount of vertical development, increasing the threat of significant turbulence and icing aloft.

Organized, mature hurricanes develop a thick cloud shield aloft called a Central Dense Overcast (CDO) that exhibits cold cloud temperatures on infrared satellite, but is generally more benign in terms of turbulence aloft.

- The perimeter of the CDO does not correspond to the radius of hurricane force winds below.
- Overflight of and/or flight through a CDO can be conducted following general principles of safety of flight.
- For routes of flight which traverse a CDO, consideration must be made to ensure a flight remains within range of an adequate airport.

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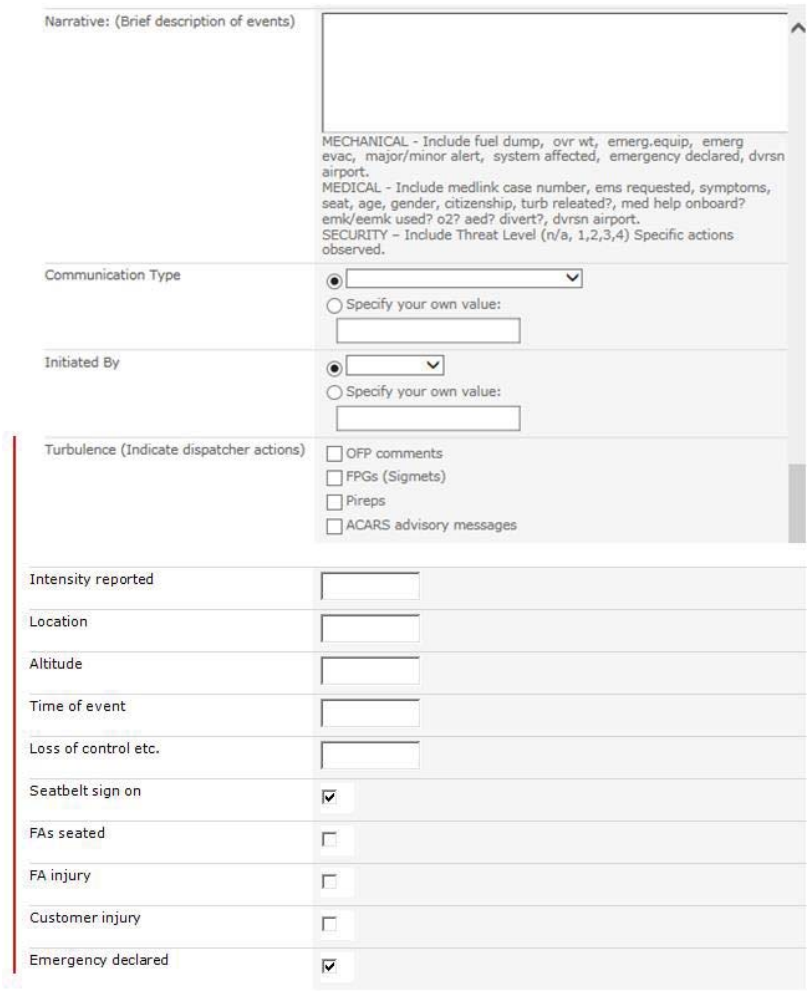
TURBULENCE INCIDENT LOGGING

The Dispatcher Log turbulence area has been modified to include: intensity, location, altitude, time, loss of control, seatbelt sign on, FA/FAs seated, FA/FAs injury, customer/s injury and if an emergency was declared. Use the check-mark to indicate a positive response. Please also indicate if the OFP contained any turbulence remarks, if FPGs/Pireps were issued and if any ACARS advisory messages were sent to the flight. The purpose is to standardize information collection and eliminate follow-up questions arising from event publication.

The additional turbulence related data will only display when the turbulence event type is selected.



PIREPS (PILOT REPORTS)

Pilot Reports (PIREPS) provide the only direct information on actual conditions encountered inflight. Dispatchers and Pilots are responsible for actively soliciting PIREPs to validate forecast conditions and promptly advising each other of any report of hazardous conditions deemed relevant to the safety of flight (14 CFR 121.551, 121.561, 121.601). Reports of the absence of a condition, such as a "smooth ride", or "no icing" are as important as reports of stronger or more severe conditions.

PIREP PROCESSING

PIREP POLICY

PIREP entry is a key responsibility for the Dispatcher. Timely use of the Unimatic based Enhanced Airep Reporting System is required. The tool transmits Pireps to the National Weather Service. Additionally PIREPS are stored in NOC databases for quick access.

Pilots Providing PIREPs to Other Flights

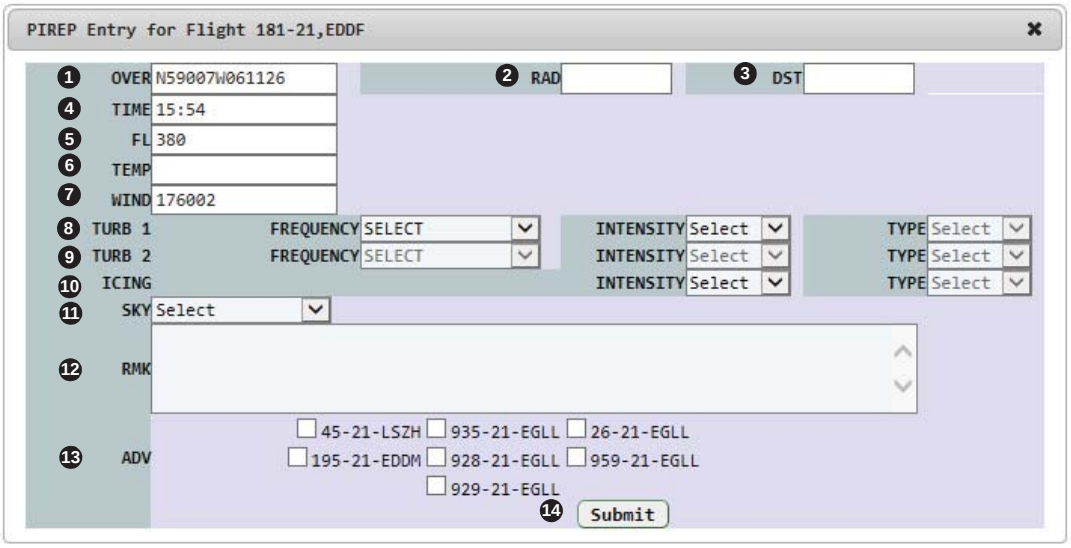
Encourage pilots sending ride-report information in free-text form to other flights to use the ACARS SUBMIT-PIREP page instead. The pilot can add “CC (flight# flight# etc.)” to the remark field (by itself or AFTER any other remark they give).

The resulting PIREP will be available to all. The "CC (flight#)" entry will provide the given flight(s) an uplink message of the PIREP directly from the processor. The dispatcher for the receiving flight(s) will be notified by USM message of the PIREP sent to their flight

DV PIREP ENTRY TOOL

The PIREP Entry form is accessible on the DV main page via the right-click menu. Selecting PIREP Entry will open a window that pre-populates with the planned waypoint closest to the last reported position recorded in DV for the selected flight.

PIREP Entry Tool



❶ **OVER** Pre-populated with last actual waypoint if report occurred within the previous 30 minutes. If no report within last 30 minutes the field will be blank. Click inside the box to modify pre-populated data. Acceptable formats include:

- Waypoints/NAVAIDs:
  - Length of 2 (combination of letters and numbers) (e.g., AB)
  - Length of 3 (combination of letters and numbers) (e.g., JFK)
  - Length of 4 (combination of letters and numbers) (e.g., KJFK)
  - Length of 5 (combination of letters and numbers) (e.g., SEMTO, 5030N, H5930)
- Latitude/Longitude:
  - (N/S) DD (W/E) DDD (e.g., N40W010, S10W175)
  - (N/S) DDmm (W/E) DDDmm (e.g., N4030W03000)
  - (N/S) DDmmm (W/E) DDDmmm (e.g., N40300W030000)
  - (N/S) DDmm.m (W/E) DDDmm.m (e.g., N4030.0W03000.0)
  - DD (N/S) DDD (W/E) (e.g., 40N030W)
  - DDmm (N/S) DDDmm (W/E) (e.g., 4030N03000W)
  - DDmmm (N/S) DDDmmm (W/E) (e.g., 40300N030000W)

❷ **RAD** Radial degree from waypoint. **Optional** (e.g., 150)

❸ **DST** Radial distance (NM) from waypoint. **Optional** (e.g., 010)

Note: *RAD/DST only available for waypoints/NAVAIDs up to 5 characters*

❹ **TIME** Time over last reported position recorded in DV (UTC) (e.g., 15:17)

❺ **FL** Flight level (340, 040)

❻ **TEMP** Temperature in Celsius. **Optional** (e.g., -45)

❼ **WIND** Direction (3 digits) and speed (3 digits). **Optional** (e.g., 090085)

❽ **TURB1** Frequency, Intensity and Type (e.g., OCNL LGT CHOP) Choose from menu

❾ **TURB2** Frequency, Intensity and Type Optional (e.g., OCNL LGT CHOP INTM MDT TURB) Choose from menu

Note: *TURB 2 not accessible until TURB 1 is used*

❿ **ICING** Intensity and Type (choose from menu). **Optional**

⓫ **SKY** Sky condition (choose from menu).**Optional**

⓬ **RMK** Free text remark (e.g., NATW LASTED 10 MIN) (Do not use special characters such as / or @)

⓭ **ADV** Select flight(s) to receive PIREP

⓮ **Submit** Submit button will transmit PIREP to NWS, DV, and any selected flights. Error message will appear when format correction is required.

PIREP VIEWER

SIRD/DD041/*357 simplifies the process of entering PIREPS. The PIREP will be transmitted to the NWS and stored in local NOC databases. Refer to Appendix i.7 "Enhanced AIREP Reporting System" for more information

The PIREP Viewer is designed to display PIREP data file content maintained by the company's PIREP processor. Data from the following sources:

- Family of Services data stream of meteorological data received by Unimatic
- PIREPs submitted by via the SIRD and JSXDD screen input methods
- Company flights submitting PIREPS using the POSITION/WEATHER ACARS screen or MISC/PI pages

Viewer Setup

Accomplish the following steps to configure the PIREP Viewer on the workstation desktop.

1. Locate a blank area of the Windows desktop; right-click and select **New** then **Shortcut**
2. In the Create Shortcut dialog, select **Browse….** Click the small triangle next to **Computer**, then click the small triangle next to "Shared (\\global.ual.com\united\FLIGHT_OPS\OPS_CONTROL\OCC_SYSTEM_OPS)(S:)"
3. Left click the **PIREPS** folder.
4. Select **PIREPViewer.exe** then select **OK**

Note: *Ensure the .exe file is selected*

5. Select **Next**
6. Select **Finish**

The program shortcut is now on the desktop, but with a generic icon. Accomplish the following to display the distinctive PIREP symbol icon:

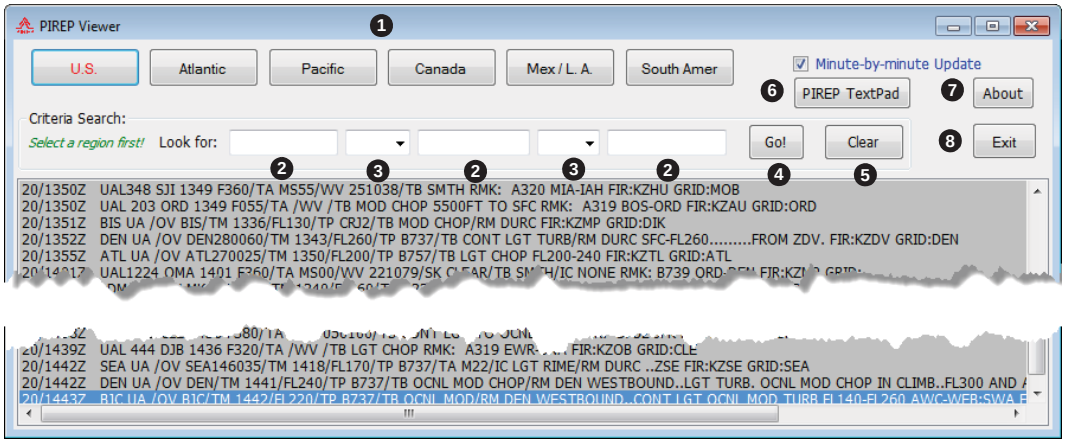
1. Locate the new icon on the desktop, right click and select **Properties**
2. Select the **Change Icon** button. In the Change Icon dialog, press **Browse…**
3. Select **PIREP.ico**
4. Select **Open**
5. Select **OK**
6. Select **OK**

These steps are specific to individual workstations and must be repeated when relocating to a new workstation.

PIREP Viewer

The viewer is an intuitive tool that allows for searches by different geographical regions. Output may be filtered to aid in locating specific information. The following is a brief description of the tool. Select the **About** button to access the Users' guide.

PIREP Viewer



❶ **Geographical Region**

❷ **Free Text Entry** Enter the desire search term

❸ **AND/OR Qualifier**

❹ **Go!** Execute the search based on selected parameters

❺ **Clear** Clears all entered information in preparation of a new search

❻ **PIREP TextPad** Place highlighted Pireps on an editable text pad for use in other applications

❼ **About** Opens the Users' guide

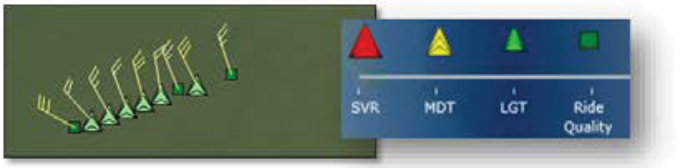
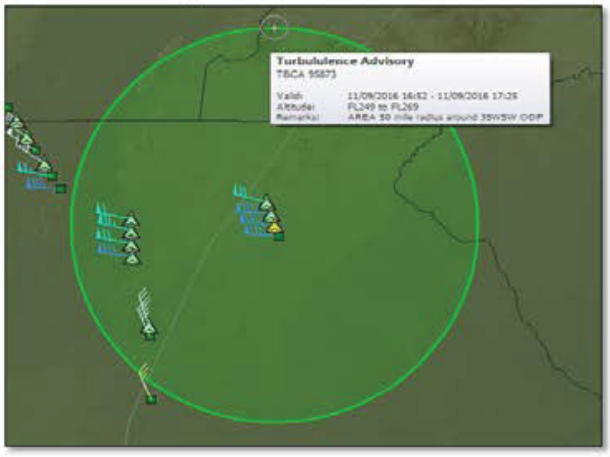
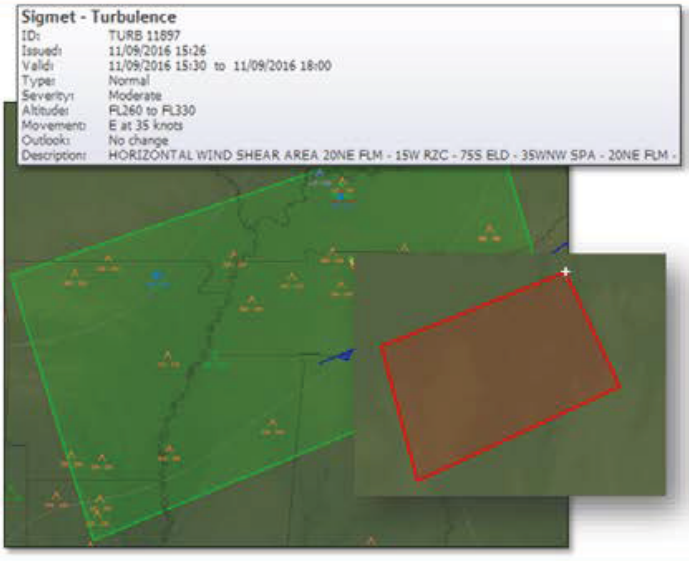
❽ **Exit** Closes the program

AUTOMATED TURBULENCE REPORTING

Automated flight-specific turbulence alerts in the Dispatch View WX button queue has been implemented as part of The Weather Company's Turbulence Auto-PIREP System (TAPS). This process automatically sends tailored ACARS messages simultaneously to the flight deck and Dispatcher when a flight is projected to intersect one of five different turbulence reports and advisories.

MESSAGE TYPES

Automated alerts will be triggered based on intersection with or proximity to the following turbulence reports and advisories:

Message Type	Description
1. TAPS Event	TAPS Events are automated PIREPs generated by one of 500+ aircraft equipped with the TAPS reporting software. *(Ref. TAPS Intensity Levels table on Page 3 below).* 
2. Traditional PIREPs/AIREPs	PIREP Turb: LGT MOD SEV
3. TWC Turbulence Advisory Area	Cylindrical turbulence warning areas that are more significant than an FPG, but not yet enough to warrant a TWC SIGMET. Turbulence Advisories are generated when strong turbulence is reported and verified by TWC forecasters as an area of operational importance. If the turbulence continues or intensifies, forecasters may issue a SIGMET; however, this is not always the case. 
4. TWC Turbulence SIGMET **5. TWC Convective SIGMET**	

TAPS INTENSITY LEVELS

Intensity	Icon	Hazard Metric (rms-g)	WSI Enroute Hazard Criteria	Aircraft Reaction (AIM)	Reaction Inside Aircraft (AIM)
Smooth		< 0.075g	No SIGMET or FPG	No turbulence that causes airspeed and/or altitude variations.	No impact on crew services or passenger comfort
Ride Quality		0.075g to ≤ 0.1g	No SIGMET FPG Guidance: OCNL LGT	Turbulence that causes little or no airspeed and/or altitude variations.	Occupants feel discomfort if exposed for more than 15 minutes. Food service may be conducted and no difficulty is encountered in walking.
Light		0.1g to < 0.2g	No SIGMET FPG Guidance: LGT LGT OCNL MDT	Turbulence that momentarily causes slight, erratic changes in altitude and/or attitude.	Occupants may feel a slight strain against seatbelts or shoulder straps. Unsecured objects may be displaced slightly. Food service may be conducted and little or no difficulty is encountered in walking.
Moderate		0.2g to < 0.3g	SIGMET & FPG: MDT MDT OCNL SVR	Turbulence that is similar to light turbulence but of greater intensity. Changes in altitude and/or attitude occur but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed.	Occupants feel definite strains against seatbelts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult.
Severe		> 0.3g	SIGMET & FPG: SVR EXTM	Turbulence that causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed or momentary loss of control.	Occupants are forced violently against seatbelts or shoulder straps. Unsecured objects are tossed about. Food service and walking are impossible.

ALERTING LOGIC & THRESHOLDS

Intersection Predictions

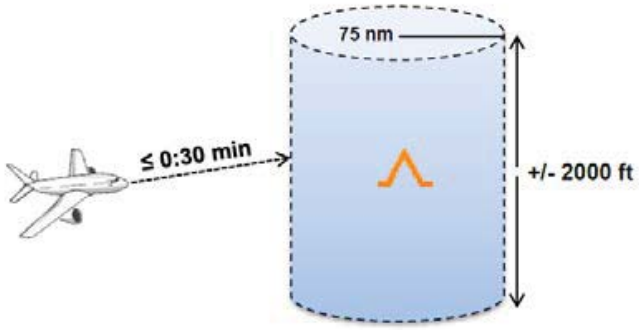
TWC's alerting engine projects a flight's present and future location based upon the best combination of the following sources of information:

- UAL-provided flight plan filings taken from the active Dispatch Release in FPM. United re-sends the FPL each time a re-release is issued.
- FAA and EuroControl ASDI data
- UAL-provided ACARS position reports
- UAL-provided FLIFO data from ODS

Alert Thresholds

A flight will be alerted when its projected path meets the following intersection and/or proximity criteria for each type of turbulence report or advisory:

Turbulence Report/Advisory	Criteria
TAPS Event **Traditional PIREP**	• PIREP ≥ **MOD** intensity from transport category aircraft *or* • TAPS Report of Turbulence Level (RMS-g) of ≥ **0.15** *(high end of LIGHT)* • Within **75nm** radius and **+/- 2000 ft** of report in ≤ **0:30** min *(see graphic below)* • Each PIREP or TAPS Event will continue to trigger alerts until the report is 30 minutes old
Turbulence Advisory	Flight intersects or is within the Advisory cylinder: • ≤ **50 nm** radius around specified NAVAID fix/radial • **+/- 1000 ft** from triggering report(s) • Valid for **30 minutes**
TWC SIGMETs **(Turbulence & Convective)**	Flight is within or projected to intersect an active SIGMET polygon (lateral/vertical coordinates, and valid period) **in the next 0:30 min**.



Note: *Flights more than 30 minutes out whose projected flight path meets the lateral/vertical intersection criteria will receive an alert upon reaching the 30 minute threshold provided the route does not change and the report or advisory is still valid.*

Filtering

Filters on alert type and intensity will be used to mitigate over-alerting, especially on days with widespread turbulence. If TWC's engine generates multiple alerts of the same type and intensity within a 10 minute period, only the first message will be sent. The process is chronological and resets after 10 minutes.

Message Formats

Alert Type	Message Sample	Description
TAPS Event Intersection	TURB ADVISORY (1) UAL833-31 KBOI KDEN (2) YOUR FLIGHT IS IN CLOSE PROXIMITY TO A MODERATE TURB TAPS REPORT EVENT REPORTED (3) AT 1320Z FL380 LOCATION 35NNW LAR (4) TURBULENCE LEVEL 0.201 CLOSEST POINT TO EVENT (5) AT 1357Z FL370 LOCATION N4102.4 W10727.0	(1) The flight receiving this alert (2) Description of what is triggering the alert (3) Specific time, altitude, and location of the original event triggering the alert (4) The RMS-g value reported by the TAPS software on the aircraft which experienced the turbulence (5) The time, altitude, and location along the planned or active route when this flight will be closest to the triggering event
PIREP Intersection	TURB PIREP UAL1932-02 KIAH KSEA YOUR FLIGHT IS IN CLOSE PROXIMITY TO A (1) MOD TURB PIREP EVENT REPORTED BY A B738 AT 1806Z FL340 LOCATION 45WNW CHE (2) RMK TB LGT-MOD CHOP YOUR CLOSEST POINT TO EVENT AT 1837Z FL360 LOCATION N4016.8 W10640.8	Alerts generated by traditional PIREPs will appear similar to TAPS Event alerts. Note the following: (1) Indicates that the alert was generated by a standard PIREP of Moderate intensity (2) The full contents of the **RMK** field included in the original PIREP
Turbulence Advisory Intersection	TURB ADVISORY UAL746-31 KBIL KDEN (1) YOUR FLIGHT IS WITHIN A TURBULENCE ADVISORY AREA ID TURB 93140 VALID 1320Z - 1355Z AREA IS 50 mile radius (2) around 80S DDY ALTITUDE FL370 - FL390 SEV MOD TYPE CAT OUTLOOK NC	Alerts are generated to flights whose projected flight path intersects the Advisory as defined in (2). Note the following: (1) This flight happened to already be inside of ("within") the Turbulence Advisory cylinder when it was issued. (2) The basic parameters of the advisory are similar to those included in a SIGMET or FPG.
SIGMET Intersection	TURB SIGMET UAL1680-02 KPHX KIAH YOUR FLIGHT ENTERS A (1) TURBULENCE SIGMET AREA AT 1845Z FL349 (2) LOCATION N3119.8 W10103.0 ID TURB 54618 ISSUED 02 Nov 1727Z VALID 02 Nov 1800Z TO 02 Nov 2200Z SIGMET AREA IS 45ESE TUL,20ESE (3) OLF,70SE FST,15SE PER,45ESE TUL TYPE CAT SEVERITY MOD ALTITUDE FL340 - FL380 OUTLOOK NC DISCUSSION TRANSVERSE BANDING...REPLACES SIGMET 54427	Dispatchers should already be familiar with the format of TWC's custom SIGMETs (3), which are currently received as WX alerts in Dispatch View. The new flight-specific automated alert appends intersection information, (1) and (2), to these same SIGMETs based on the time, altitude, and location where the flight will ***first enter*** the SIGMET polygon.

Erroneous TAPS Reporting

The Dispatcher or Chief Dispatcher should report any issues with TAPS or the automated alerting, via email, to [redacted]

Note: *Consider requesting the pilot submit a report to Pilotbrief support as well*

Include the following on the report:

[redacted]

Dispatch View Alerts

Automated turbulence alerts will be displayed in the WX button in Dispatch View

- The alerts are coded as Severity 2, which highlights the WX button and affected flight number cell (Flt# Radio#) in red, and requires acknowledgment
- The alerts will be stored in a new “TAPS” Sub Type category
- Turbulence alerts received in WX are simultaneously uplinked via ACARS to the affected flight. Dispatchers will only receive alerts in the WX button that are also sent via ACARS. Alerts inhibited by sterile cockpit rules will not appear in the WX queue.
- Turbulence alerts will be generated for one flight at a time
- Turbulence alert uplinks are routed directly to ACARS history to avoid duplication of red alerts to the ACARS button in DV
- Closely monitor ACARS rejection messages for turbulence alerts that may not have been received in the flight deck

Flight Monitoring Considerations

The automation is intended to assist in the dissemination of information pertinent to the safety of flight by providing timely, flight-specific information for imminent (impact within 30 minutes), and/or rapidly-changing conditions, where a few seconds or minutes can mean the difference in securing the cabin and avoiding a flight attendant or passenger injury.

The intersection calculations are only as good as the accuracy of position information available to TWC. The following conditions and limitations could degrade the efficacy of the alerting:

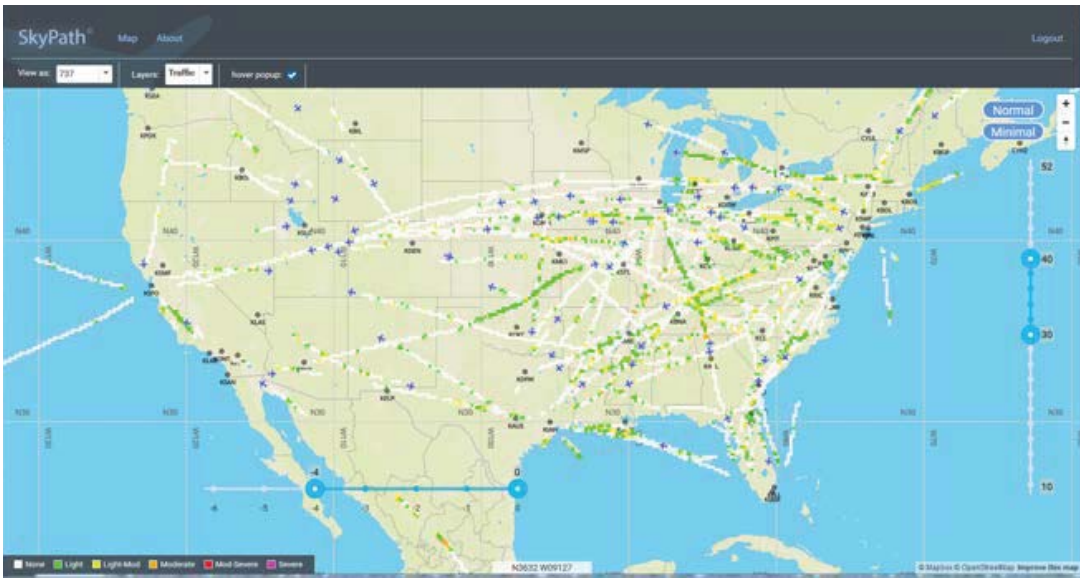
- Flights operating in an area where they are unable to transmit position reports via ACARS
- Flights operating in non-radar environments outside of available ASDI or ADS-B feeds
- Flights operating in an area with limited ACARS communication

Maintain situational awareness by recognizing when/where the automation may not function and take action to relay updated turbulence information to flights that may be subject to these limitations and/or those operating outside of the automated alerting thresholds

SKYPATH TURBULENCE TOOL

SkyPath is an application available on both the iPad (EFB) and PC that displays real-time turbulence. This supplemental tool provides pilots and dispatchers with an awareness of ride conditions reported by users of other SkyPath-equipped EFBs. When the EFB is docked and calibrated, the app uses the accelerometers in the iPad to measure turbulence and converts the movements into color-coded tiles representing different turbulence severities. An algorithm filters out any device shaking, screen tapping or button pressing. When connected to inflight Wi-Fi, SkyPath shares the information to other users; if Wi-Fi is unavailable, the app will send the data when reconnected.

Skypath Home Page



Skypath Usage

SkyPath tiles represent turbulence data aggregated over a 10km x 10km x 2,000ft cube updated every minute and are not to be treated as a PIREP. SkyPath shall be treated as an additional data source and may be used in conjunction with (not in lieu of) other approved sources for weather evaluation Refer to Section 7.20 "Turbulence Avoidance" for more information.