

Connecting the Cockpit: Providing Real-Time Weather Information to Pilots

Captain Don Dobias Air Line Pilots Association, International (ALPA) Aviation Safety Organization, Air Traffic Services Group Chairman <u>Don.Dobias@alpa.org</u>



## Thank You!









#### A little bit of this



#### ...and more of that







WMO / The COMET Program

Weather Ship

Aircraft









FLIGHT SAFETY





72nd annual INTERNATIONAL AIR SAFETY SUMMIT IASS 2019 ----









![](_page_12_Picture_0.jpeg)

![](_page_12_Picture_1.jpeg)

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2nd annual

![](_page_14_Picture_0.jpeg)

![](_page_14_Picture_1.jpeg)

![](_page_15_Picture_0.jpeg)

![](_page_15_Figure_1.jpeg)

![](_page_16_Picture_0.jpeg)

## KSFO to RCTP

![](_page_16_Picture_2.jpeg)

![](_page_17_Picture_0.jpeg)

## Los Angeles to Orlando

![](_page_17_Figure_2.jpeg)

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# KLAX--KMCO

- ACCEPT: 1522
- VRFY: 1711
- OUT: 1731
- OFF: 1745
- 1812: Good afternoon Colonel
- 1814: Hey. Were those images of today's convection...good ride so far at FL330...
- 1818: BTW...New MCO TAF while you were taxiing out....BTW...Hello FO Awesomeness (forecast update was published within one minute of the pushback)

![](_page_19_Picture_0.jpeg)

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# KLAX--KMCO

- 1825: Zak is wondering why all our dispatchers have the first name ....CHIDD...so cute...
- 1826: LOL...That's funny...
- 1827: You have a ways to go yet but ATC just issued ground stop for MCO for first tier centers...to be expected
- 1840: Oh my...you've got to be chidding me...har har....is First Tier the same as adjoining.....looks like we dodged bullet taking off early

1841: LOL...Yes, adjoining ATC Centers

![](_page_20_Picture_0.jpeg)

## Between SJN and CNX

![](_page_20_Figure_2.jpeg)

![](_page_21_Picture_0.jpeg)

# KLAX--KMCO

- 1857: We are doing some minor jinking around these storms Southwest of ABQ.
- 1900: Yes, thanks. After the one you're dealing with now you have one more to go. Should be OK for a while after that.
- 1909: I think for your next one, I'd recommend SPS...SWB...OTK.
- 1911: That'd be to avoid CB's TXK-80NM to KM18K.
- 1912: Possibly even SPS...AEX...OTK...AEX is a smidge further south of SWB. A little further away from the WX that moving SE.

![](_page_22_Picture_0.jpeg)

## Weather Reroute after TXO

![](_page_22_Figure_2.jpeg)

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![](_page_23_Picture_0.jpeg)

# KLAX--KMCO

- 1918: FYI...ATC says call later for reroute...trying....looks good to us...shucks
- 1919: OK, thanks.
- 1930: Fixin to do shift change here. Your dispatcher for the remainder of your flight will be Ms. Dalia D.
- 1932: Have a great day Bill.
- 1932: Thanks. You too.
  - **1935:** FYI—Now SPS AEX OTK...Happy drive home...
  - 1935: Thanks!
  - 1939: (ATC Reroute published to airplane printer)

![](_page_24_Picture_0.jpeg)

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# KLAX--KMCO

- 2031: Hi. It looks like it would be desirable to approach MCO from west vs North...any suggestions from you welcome...thanks
- 2037: It looks like most of the conv wx is off to the Northeast of the field so both Nrth and West look good currently...see other 2 flts coming in from the west
- 2039: Thanks Dalia
- ON: 2220
  - IN: 2225

![](_page_25_Picture_0.jpeg)

![](_page_25_Figure_1.jpeg)

![](_page_26_Picture_0.jpeg)

## 13 KM Resolution

![](_page_26_Figure_2.jpeg)

international air safety summit

![](_page_27_Picture_0.jpeg)

## 3 KM Resolution

![](_page_27_Figure_2.jpeg)

![](_page_28_Picture_0.jpeg)

#### • In Flight Icing Forecast Depiction

1998

INTEGRATED ICING ALGORITHM 981130 -21 Z MAXIMUM POTENTIAL FOR ICING IN COLUMN EXPERIMENTAL PRODUCT - RESEARCH USE ONLY!

![](_page_28_Figure_4.jpeg)

![](_page_29_Picture_0.jpeg)

### Inflight Icing Forecast Progression 2019

![](_page_29_Figure_2.jpeg)

![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_1.jpeg)

![](_page_31_Picture_0.jpeg)

## **Turbulence Scales and Model Forecasts**

![](_page_31_Figure_2.jpeg)

![](_page_32_Picture_0.jpeg)

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### Turbulence Efforts

- 65,000 encounters with moderate or greater turbulence
- 75% of all weather-related accidents and incidents.
- Graphical Turbulence Guidance (GTG): vertical and horizontal
  - Convectively Induced Turbulence
  - Low Level Turbulence
  - Clear Air Turbulence
  - Mountain Wave Turbulence
- GTG Nowcast (GTGN)
- Turbulence Avoidance Model (TAM)

![](_page_32_Picture_11.jpeg)

![](_page_32_Picture_12.jpeg)

![](_page_33_Picture_0.jpeg)

## Aviation Turbulence Nowcast System GTGN

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## Turbulence: #1 Cause of Part 121 Accidents

FLIGHT

UNDATION

SAFFT

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**ASS** 2019

![](_page_34_Picture_1.jpeg)

- More serious Flight Attendant and passenger injuries than any other class of accident.
- Although rare fatal events have occurred!

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## NTSB Turbulence Study 2008-2017

![](_page_35_Figure_2.jpeg)

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## Part 121 Injuries: 2008-2017

 Average of 12 turbulencerelated serious injuries per year due to turbulence

- 80% Flight Attendants
- 20% Passengers
- Accounted for 47% of Part 121 serious or fatal injuries

![](_page_36_Figure_7.jpeg)

![](_page_37_Picture_0.jpeg)

### Aviation Weather Research Program

![](_page_37_Figure_2.jpeg)

- Applied research to minimize the impact of weather on the NAS
  - Collaborate with National Weather Service to support NextGen
  - NextGen Operational Improvements in NextGen Implementation Plans
  - > Operations oriented mitigation of weather related safety and efficiency issues

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### Percentage of Delays Due to Weather

% of Total NAS Delayed Operations Due to Weather

![](_page_38_Figure_3.jpeg)

NAS delays caused by weather: 68% in 2005 to 55% in 2018.

Source: Bureau of Transportation Statistics – FAA OPSNET

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## Weather Information Flow

• ATC

- Air Traffic National Command Center
- Traffic Management Units
- Air Traffic Controllers
  - Enroute
  - Approach
  - Tower/Ground
- Dispatchers
  - Long range load planners six to twelve hours
  - Flight plans to pilots one to three hours prior
  - Monitor hazardous weather trends in flight

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# Weather Information Flow

• Pilots

- Review one to two hours prior to departure
- Monitor NOWCASTs and real-time weather
  - PIREP/AIREPs: turbulence and icing emphasis
  - Radar and Lightning: convection
  - Satellite infrared imagery: algorithms depict convection in non-radar areas
  - Satellite photo imagery: mesoscale weather patterns and gravity waves
  - High altitude Ice Water Content
  - FICON NOTAMs

![](_page_41_Picture_0.jpeg)

# ATC Decision Making Barriers

Work stations need improved weather overlays
Dependent on updates from Traffic Managers
Controllers react to input from pilots

Flow and planning disruptions

Playbook communication shortfalls

Decisions lack context and explanation

![](_page_42_Picture_0.jpeg)

# Dispatcher Decision Making Barriers

- Updated product education and training Clarified decision making standards Sources sometimes differ from pilot references Confusing map for the territory • Pilot observations sometimes conflict Task saturation • How many flights?
  - How many regions?

![](_page_43_Picture_0.jpeg)

## Pilot Decision Making Barriers

 Demonstrate Weather Product Innovations GTG and Icing Forecasts • GTG Nowcasts • FICON NOTAMs Learn Probablistic thinking and terminology Avoid over-reliance on dispatcher monitoring • Make and seek PIREPs and AIREPs

<sup>7</sup>2nd annual

![](_page_44_Picture_0.jpeg)

# CONCLUSIONS

- Provide direct flight deck access to current and forecast weather during flight
  - Enhances strategic and tactical decision making
    - Normal and exceptional weather dynamics
  - Balances operational safety and efficiency
    - Improves accurate visualization of threats
    - Prevents excessive weather deviations
  - Avoids severe turbulence and convection
    - Mitigates inflight injuries due to turbulence
    - Reduces aircraft damage from hail

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