

Turbulence aware and mitigation

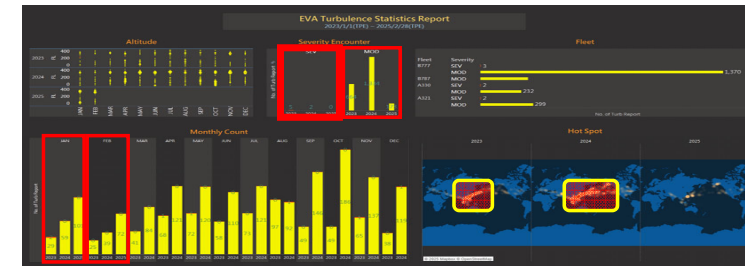


EVA Air

Corporate Safety & Security Div.

September 17, 2025

The most common challenges flight crews face in dealing with unexpected turbulence, especially in relation to weather prediction and pre-flight briefing?



(Mar 12, 2025)

Limited accuracy of turbulence forecast

CAT is difficult to predict, only 60-70% of accuracy

Probabilistic forecast, lack of vertical or route specific detail

Intensity may be underestimated or missed

Static and time lagged briefing

Data generated hours before departure covering large range of area and altitudes

Lack of tactical guidance: specific region or altitude to avoid

Actual WX condition may change drastically

Limited inflight update

Minimal access to real-time turbulence update e.g. oceanic, polar or remote region.

Without data uplink or advance system, pilot may fly into turbulence without warning.

Inconsistent Pilot Report(PIREPs)

Infrequent, delayed or subjective

Lack of automated turb reporting on some fleet

Information Gap between Cockpit and Cabin communication

Pilot may not be familiar with the work pace of cabin service, cabin crew lack of WX ahead information

Difficult to decide if readjustment of service is required based on a turbulence forecast

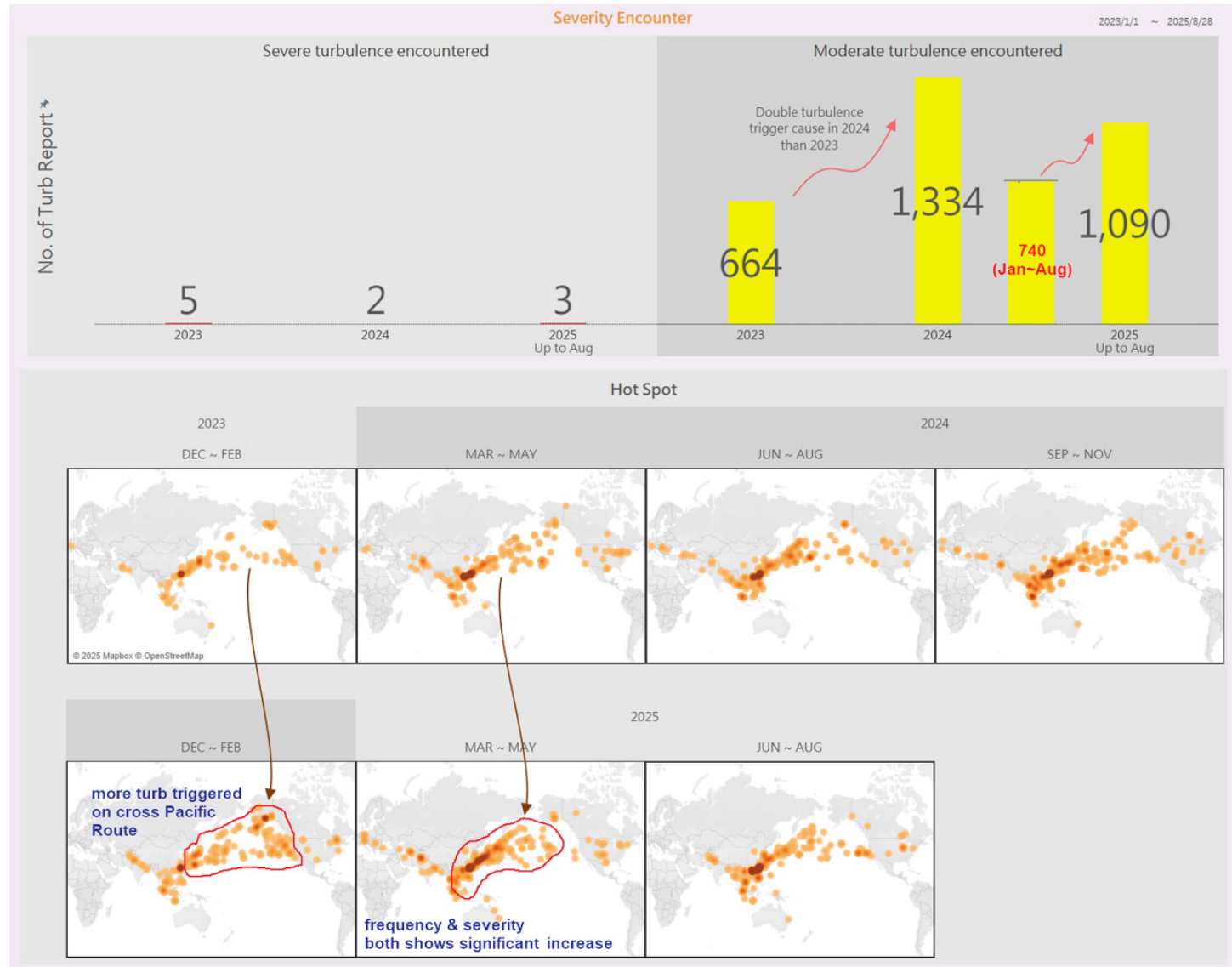
When and how long the seatbelt sign shall be switched on

Based on the forecast, onboard Wx radar, physical feeling of pilot?



From EVA's ERM(Enroute Risk Monitoring) data from Dec. 2023 to Aug. 2025 period, the statistics shows

1. Moderate turbulence triggered showed significant increase in last two years.
2. Hot spot remained to fall on the area between TPE enroute to Japan. North Pacific Route(NOPAC) also showed the trend of increase.



Lessons learned from a few turbulence hit cases which led to a few cabin crew and PX's minor to serious injury

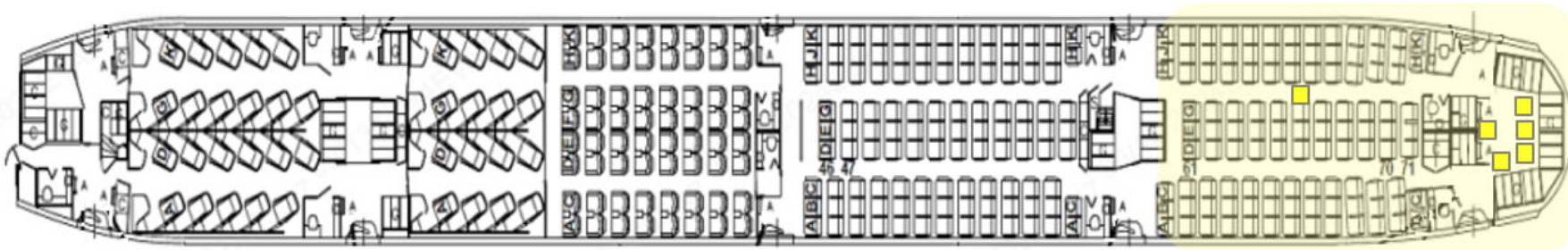


1. BR238/Aug. 11, 2024 encountered turbulence while on the cruising phase. Due to the convective weather enroute, the pilots had been focused on avoiding TS/CB by offset nearly 60 mile right of track from original OFP route.

2. The cabin crew were on the second half of meal service providing the drink and beverage to the passengers

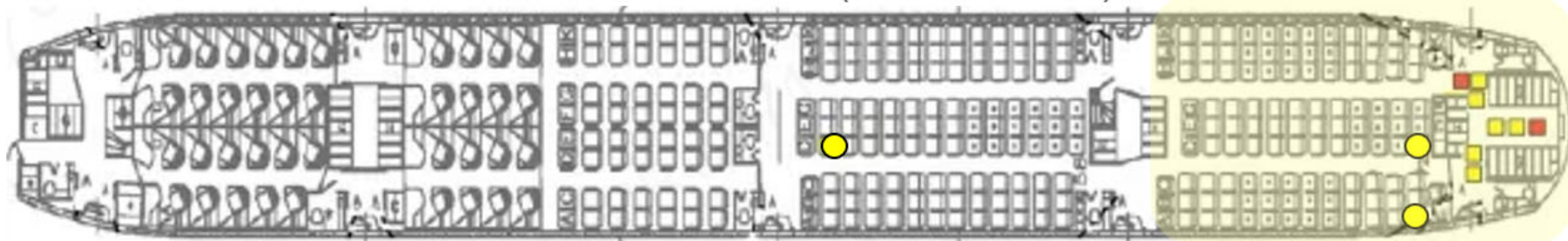
Adverse Weather – FWD vs AFT cabin

2024/8/11 BR238 (CGK-TPE, 77A)



- PAX Minor Injury 0
- PAX Serious Injury 0
- CREW Minor Injury 6
- CREW Serious Injury 0

2017/11/22 BR56 (TPE-ORD, 77M)



- PAX Minor Injury 3
- PAX Serious Injury 0
- CREW Minor Injury 6
- CREW Serious Injury 2



Adverse Weather – FWD vs AFT cabin



Forums Lifestyle Eat-Drink-Man-Woman

SQ321 turbulence: Thai doctor says many injured passengers were seated at plane's rear end

tripleme · May 26, 2024

Flight attendants had been serving breakfast at the time. Coffee and cups of water were thrown into the air, people's phones, shoes and cushions were flung around.

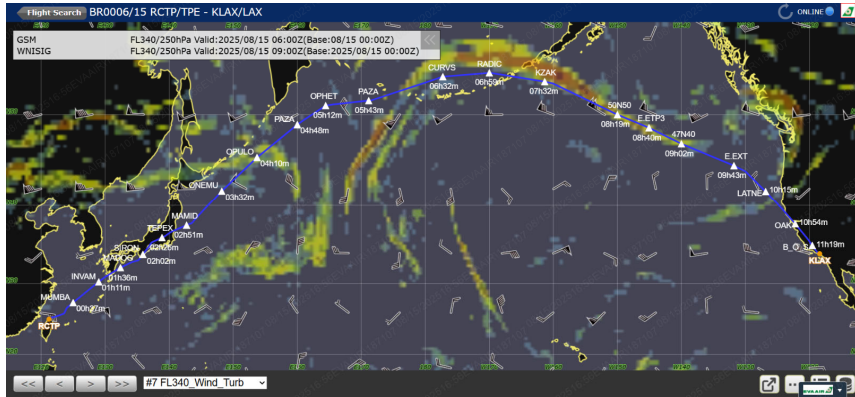
Location of flight attendants within airplane at time of serious injury during turbulence

Specific Area	Forward Cabin	Middle Cabin	Aft Cabin	Not Reported	Total
Galley	2	0	56	3	61
Aisle	3	1	5	0	9
Jumpseat	1	0	7	1	9
Lavatory	1	0	2	0	3
Crew Rest Area	0	0	0	1	1
Not Reported	1	1	4	8	14
Total	8	2	74	13	97

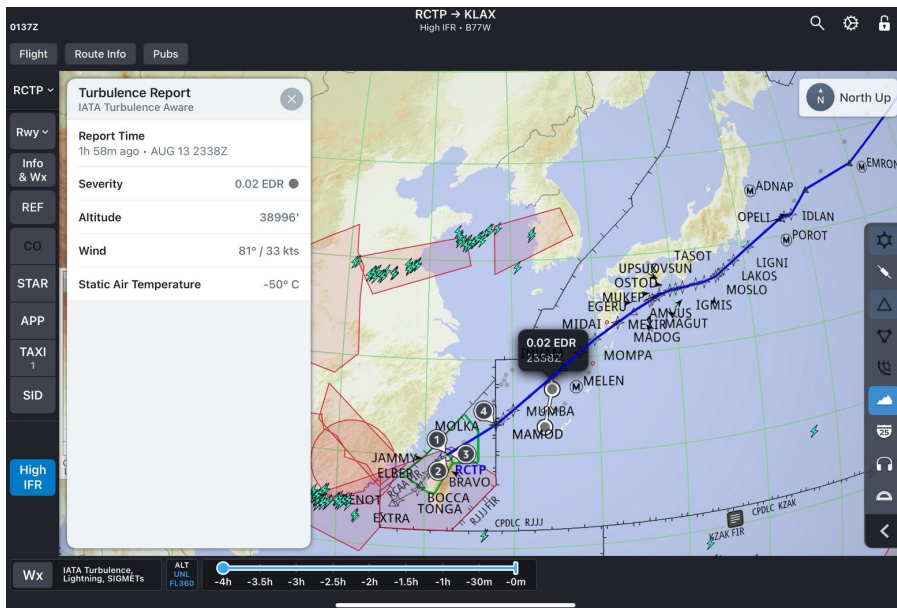
Location of passenger within airplane at time of serious injury during turbulence

Specific Area	Forward Cabin	Middle Cabin	Aft Cabin	Not Reported	Total
Lavatory	0	2	6	0	8
Seat	1	0	4	0	5
Aisle	0	0	1	0	1
Not Reported	0	0	3	9	12
Total	1	2	14	9	26

Mitigation effort 1: enhance the forecast tool for the pilots and real time information sharing between pilot and dispatcher



1. WNI Foster-EFB
2. IATA Turbulence Aware platform
3. ERM(Enroute Risk Management)
4. In the process to develop in-house alert system to remind BR's flights for which may head into potential turbulence active area. The crew can receive important EDR turbulence information and take the proper action without adding up extra workload for monitoring turbulence information all the time

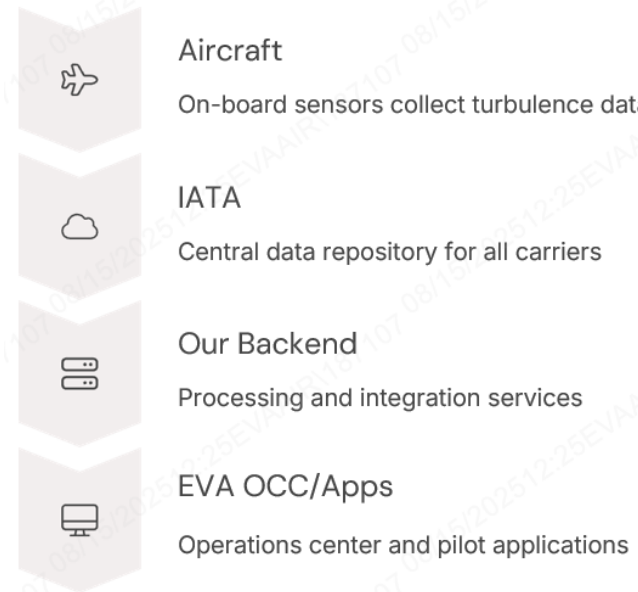
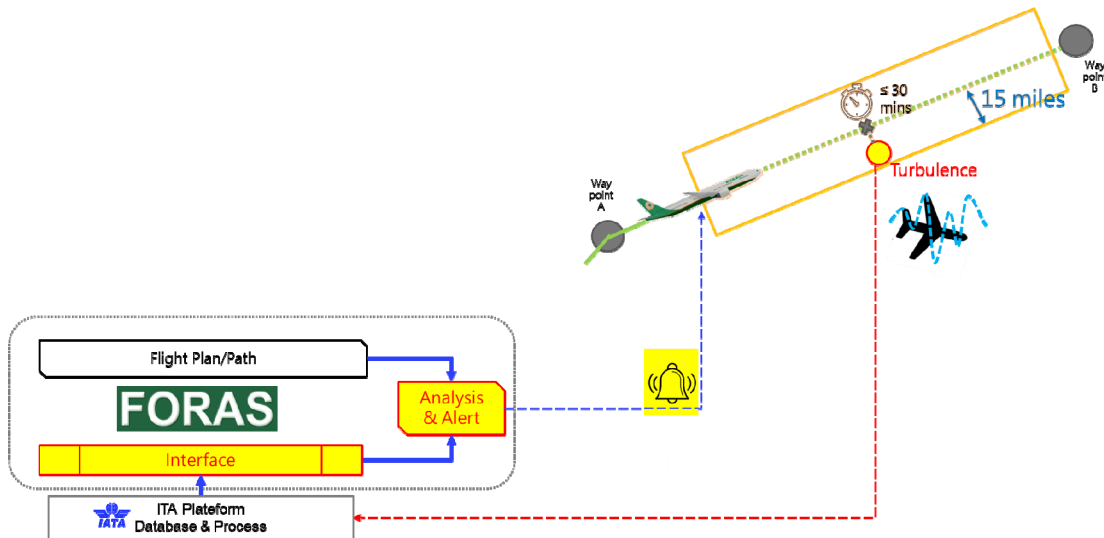


Turbulence Alert System Development

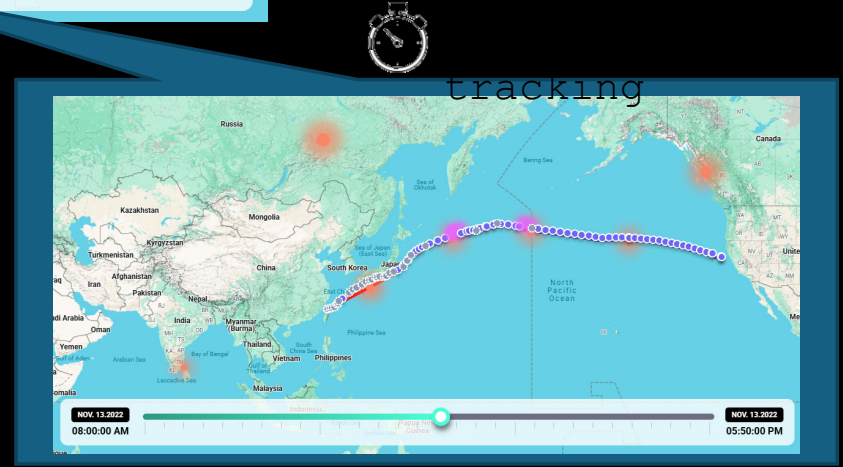
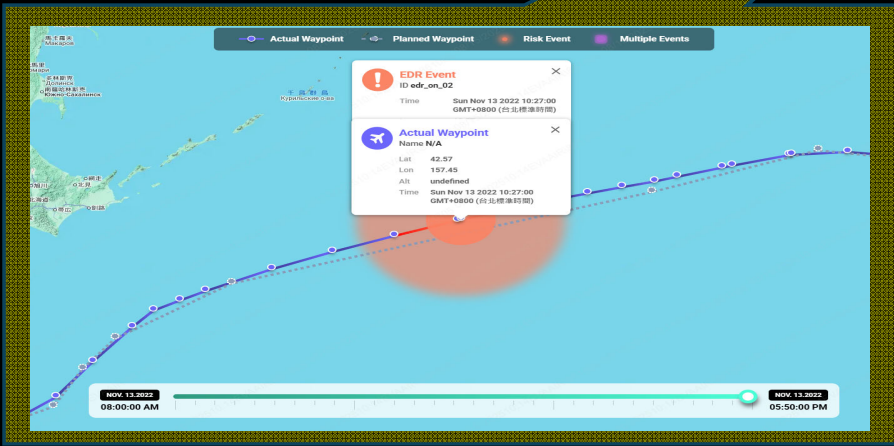
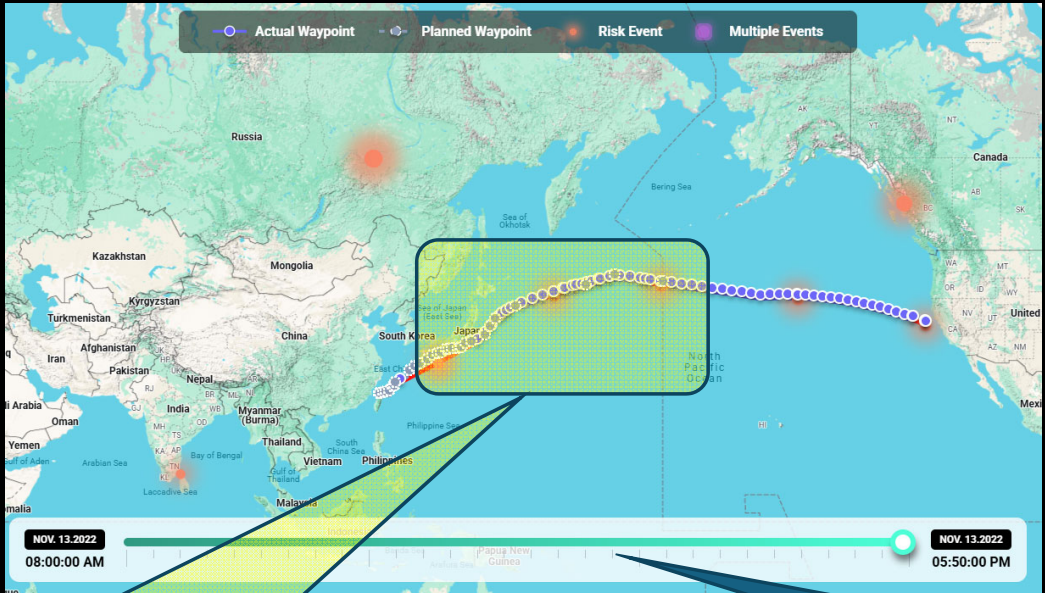
- Rules to trigger Turbulence alert
 - ✓ Position within 15 miles bandwidth along flight path.
 - ✓ Reach time is less than 30 mins.
 - ✓ Altitude difference is less than 2,000 fts.
- Go Live: Sep, 2025



System Architecture



UI demo – static screenshots Full route



Mitigation effort 2: Enhance effective communication between pilot and cabin crew

From Dependent Defensive approach to Interdependent Defensive approach



When briefed by PIC about a possible turbulence forecast or convective weather en-route, CP and all class leaders (especially L4) should exercise extra caution and the following steps to communicate with PIC regarding meal/service preparation and to inform them when the cabin crew is about to start.

- 1. Interaction (關心):** As pilots may be busy at that moment, a courteous greeting and an offer to assist with any service needs are always appreciated.
- 2. Inform and Inquire(關注):** Notify PIC that cabin crews are about to start meal preparation (followed by meal/beverage service) and inquire if there is any turbulence concern for the upcoming period.
- 3. Include(關係):** CP/Class leaders are encouraged to keep the PIC informed about the update of cabin conditions. If at any point the crew feels the condition is not suitable for continuing the service, they shall make decision to adjust or suspend the service and inform the cockpit.

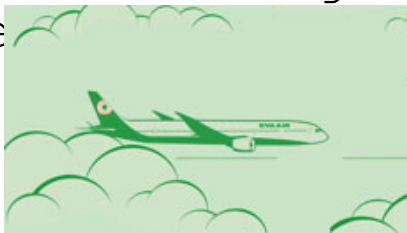
Mitigation effort 3: refine SOP and enhance pilots training

- Stricter seatbelt and cabin service rules
- Clear PA and Cabin action to SOPs
- Operational integration with dispatch/flight planning
- Respect the forecast such like MXSH information

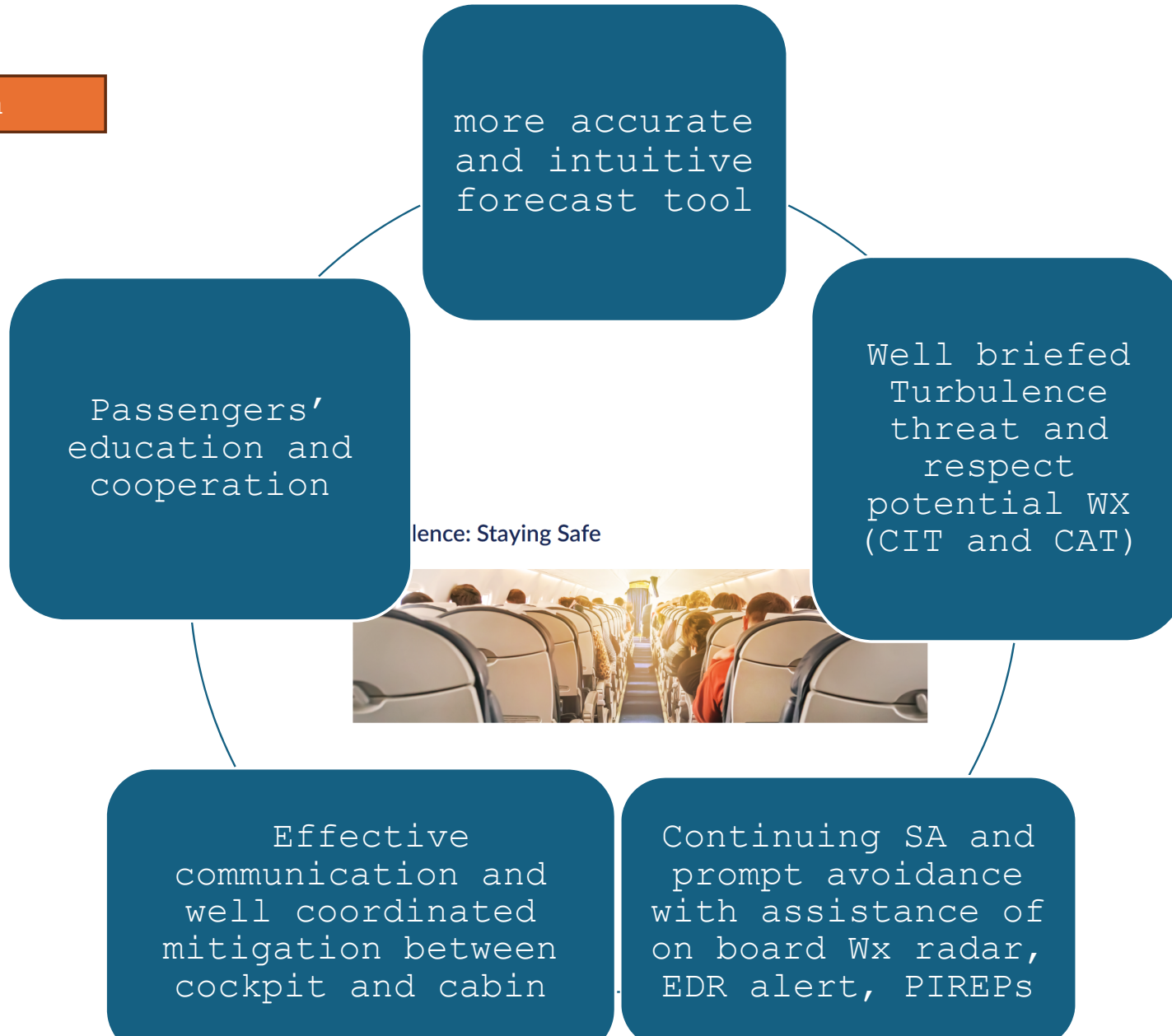
- Scenario-based and upset/turbulence drills
- Focus on PIREP & digital reporting in training
- Cabin crew injury-prevention emphasis, knowing rear cabin can be subject to higher injury threat than forward cabin

Mitigation effort 4: enhance passenger's turbulence awareness and educate PX to know how to prevent from injury while encountering turbulence

- While starting pushback of every BR flight, the safety video of 85 second role-played by the little green man will be displayed on PX's IFE to remind passenger always keep the seatbelt buckled at all time when seated and know how to react while walking on the cabin and encountering unexpected turbulence.



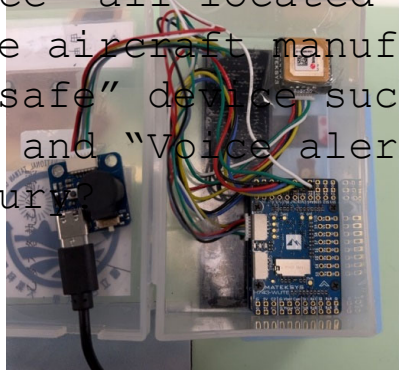
Conclusion



Ongoing cross-industry research project: EVA is currently sponsoring one study with the professor P. H. Lin from Atmospheric Science Department of Taiwan University to understand why cabin crew and passengers on rear cabin had more injury cases than those in the forward part of airplane during turbulence hit incidents.

1. Is there any difference on vertical G value during the turbulent condition between forward cabin and rear cabin?

2. Current sensor for on board accelerometer measurement and chain of command for "Reacting to Turbulence" all located on the front part of airplane. Shall the aircraft manufacturer and industry consider a "fail safe" device such like "automated Seatbelt sign on" and "Voice alert" to protect rear cabin more from injury?



PAS (Portable Accelerometer Sensor) assembled by Drone's



ISM330BXX

6-axis IMU with wide bandwidth, low-noise accelerometer, embedded AI and sensor fusion.

IMU (Inertial measurement unit)

Method: Putting two PAS, one on the front part and the other one on rear part of cabin of BR's flights. Analyze if there is any logged difference between the G force during



TPE <-> SGN, Br395 & Br392 (Back Row)

