

Summer typhoon season 2018 and airport disruptions in East Asia

Analysis of 13 typhoons that affected East Asia in Jul.-Sept. 2018

Typhoons and tropical depressions are a common occurrence in Asia-Pacific during summer-early fall. This year, only in the course of 2.5 months, the region was hit by 13 typhoons and strong storms. Even though not all of those typhoons were as destructive as Jebi or Mangkhut, they still brought about disruptions of transportation including flight cancellations and delays.

This report covers information on 13 typhoons and storms and the flight disruptions they brought to major airports in Mainland China, Taiwan, Hong Kong, Macau, Japan and South Korea in July – September 2018¹. Only the airports that took a “direct hit” from one or more typhoons during the selected period were included in the report.

The airports were analyzed by the following parameters:

1. On-time performance (OTP) rate
2. Average delay time
3. Flight cancellations

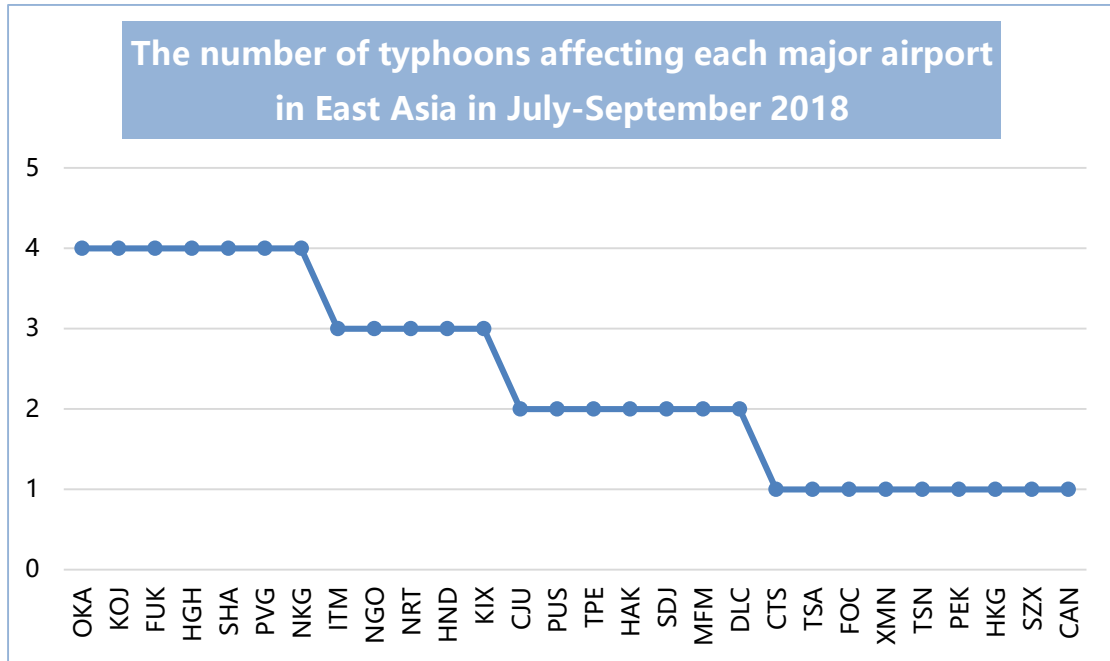
Additionally, typhoons were analyzed according to their influence on flight disruptions and cancellations.

- Lowest departure OTP rate: 4.47% - Naha Airport (OKA)
- Lowest arrival OTP rate: 5.41% - Dalian Airport (DLC)
- Longest average delay time: Jeju Airport (CJU) – 24 hours, Dalian Airport (DLC) – 7.5 hours
- Total number of cancellations caused by typhoons: 15,732.
- Airport with the largest number of cancellations: Shanghai Pudong Airport (PVG) – 1,349.
- The most severe typhoons: Jebi, Mangkhut.

Airports

Number of Hubs affected by Typhoons

Out of all the airports selected for the report, 7 were hit by 4 typhoons in total, including airports located in Japan: Naha, Kagoshima, Fukuoka, and in Mainland China: Hangzhou Xiaoshan, Shanghai Hongqiao, Shanghai Pudong and Nanjing Lukou. Each of the 5 largest civil aviation hubs in Japan, including Itami (ITM), Chubu Centrair (NGO), Narita (NRT), Haneda (HND), and Kansai (KIX), was affected by 3 typhoons.



Source: VariFlight

Figure 1: The number of typhoons that affected each major airport in East Asia in July-September 2018

On-Time Performance

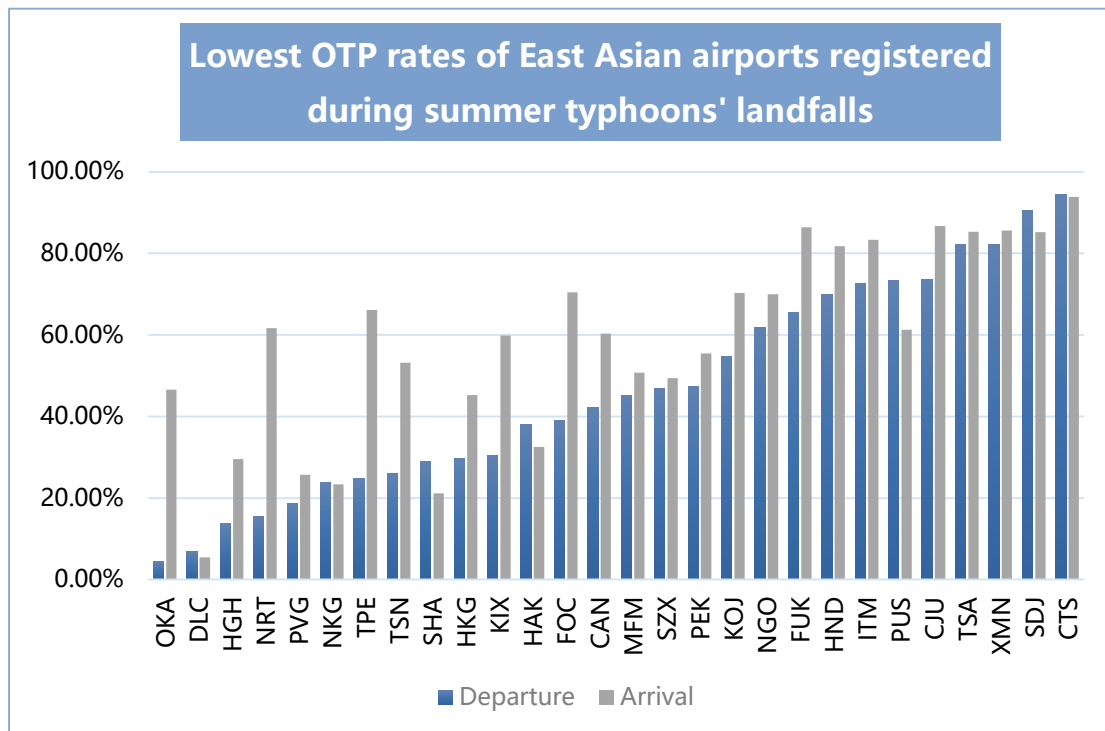
On-time performance is one of the major indicators of airports operations. For the report, the lowest registered OTP rates of major airports in East Asia during the days of a typhoon's landfall were chosen to reflect the weather effect on the airports' operations.

Ranking	IATA Code	Airport Name	Country/Region	Lowest Departure OTP	Typhoon	Lowest Arrival OTP	Typhoon
1	OKA	Naha	JP	4.47%	Prapiroon	46.56%	Prapiroon
2	DLC	Dalian Zhoushuizi	CN	6.87%	Rumbia	5.41%	Rumbia
3	HGH	Hangzhou Xiaoshan	CN	13.85%	Rumbia	29.51%	Rumbia
4	NRT	Narita	JP	15.51%	Shanshan	61.69%	Shanshan
5	PVG	Shanghai Pudong	CN	18.57%	Rumbia	25.68%	Ampil
6	NKG	Nanjing Lukou	CN	23.91%	Rumbia	23.35%	Rumbia
7	TPE	Taiwan Taoyuan	CN,TW	24.79%	Maria	66.10%	Maria
8	TSN	Tianjin Binhai	CN	25.97%	Ampil	53.19%	Ampil
9	SHA	Shanghai Hongqiao	CN	28.82%	Rumbia	21.15%	Rumbia
10	HKG	Hong Kong	CN,HK	29.71%	Mangkhut	45.26%	Mangkhut
11	KIX	Kansai	JP	30.49%	Simaron	59.85%	Simaron
12	HAK	Haikou Meilan	CN	38.02%	Bebinca	32.55%	Bebinca
13	FOC	Fuzhou Changle	CN	39.02%	Maria	70.45%	Maria
14	CAN	Guangzhou Baiyun	CN	42.24%	Mangkhut	60.29%	Mangkhut
15	MFM	Macau	CN,MO	45.07%	Bebinca	50.72%	Bebinca

16	SZX	Shenzhen Bao' an	CN	46.98%	Mangkhut	49.43%	Mangkhut
17	PEK	Beijing Capital	CN	47.34%	Ampil	55.44%	Ampil
18	KOJ	Kagoshima	JP	54.67%	Soulik	70.27%	Prapiroon
19	NGO	Chubu Centrair	JP	61.90%	Jongdari	70.00%	Jebi
20	FUK	Fukuoka	JP	65.55%	Jongdari	86.38%	Jongdari
21	HND	Haneda	JP	69.98%	Shanshan	81.74%	Jongdari
22	ITM	Itami/Osaka	JP	72.73%	Simaron	83.33%	Jebi
23	PUS	Gimhae	KR	73.33%	Prapiroon	61.29%	Prapiroon
24	CJU	Jeju	KR	73.58%	Soulik	86.70%	Prapiroon
25	TSA	Taipei Songshan	CN,TW	82.14%	Maria	85.29%	Maria
26	XMN	Xiamen Gaoqi	CN	82.24%	Maria	85.58%	Maria
27	SDJ	Sendai	JP	90.48%	Shanshan	85.19%	Jebi
28	CTS	New Chitose	JP	94.29%	Jebi	93.84%	Jebi

Source: VariFlight

Figure 2: The lowest OTP rate of major airports in East Asia recorded during typhoon/storm landfalls in July-September 2018



Source: VariFlight

Figure 3: The lowest OTP rate of major airports in East Asia recorded during typhoon/storm landfalls in July-September 2018

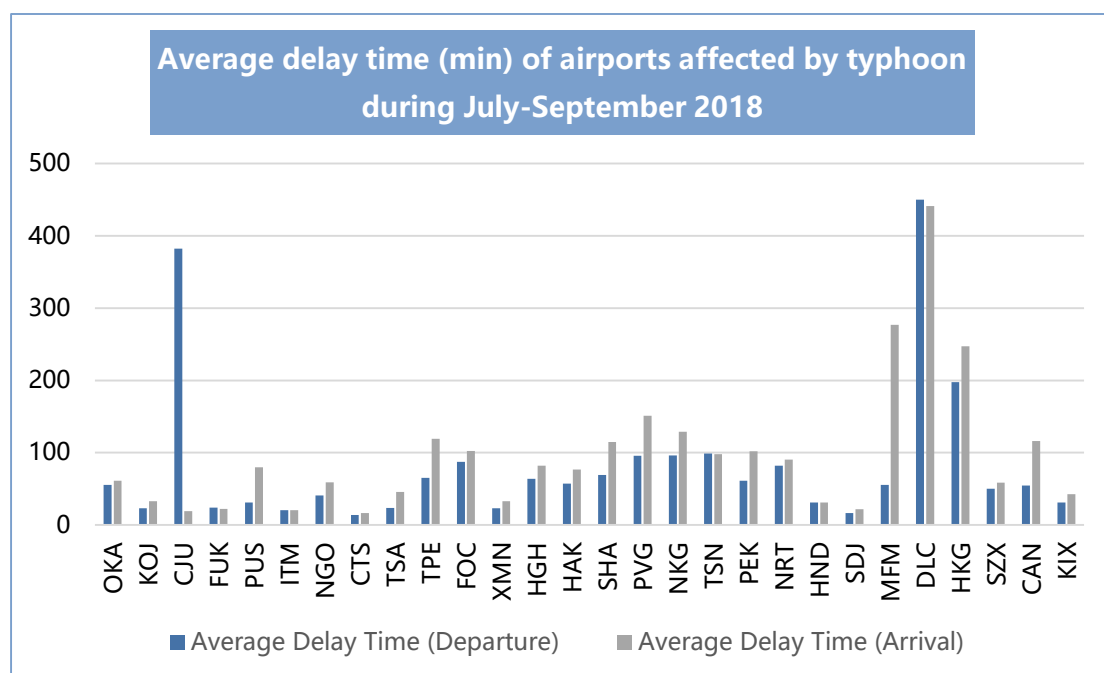
Naha Airport (OKA), Japan had the lowest on-time departure performance among 28 airports in July-September 2018. 4.47% of departures were conducted on time on July 2nd due to the effect of typhoon Prapiroon. At the same time, arrival OTP rate at the airport on the same day was significantly higher – 46.56%. That is, the numbers of

outbound and inbound flights (without cancellations) were close: with 179 actual departures and 189 actual arrivals.

While sustaining damage from only one typhoon, Rumbia, Dalian Airport (DLC) registered the second lowest OTP rate on the list with 6.87% of outbound and 5.41% of inbound flights conducted on time on August 20th 2018. Only 59 departures and 37 arrivals were registered at Dalian Airport (DLC) on that day with average delay time 7.5 hours and 483 flight cancellations.

Average Delay Time

Several airports sustained significant flight delays during typhoon hits. Only actual departures and arrivals were included to calculate this measure.



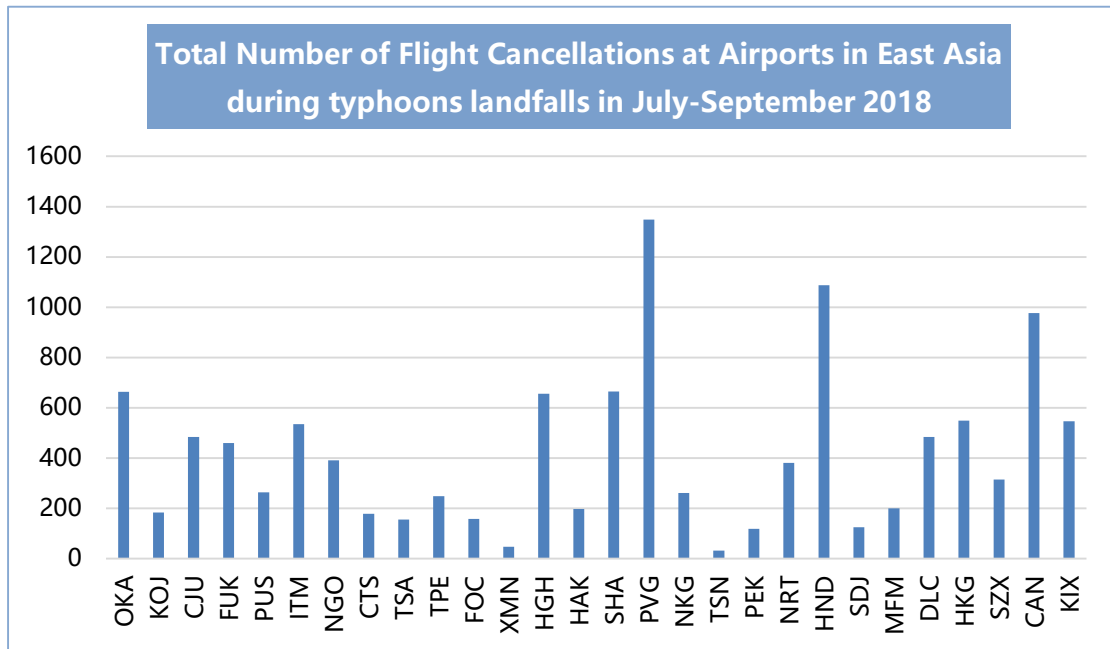
Source: VariFlight

Figure 4: Average departure and delay time of the airports affected by typhoons in July-September 2018

Although affected only during a single day, Dalian Airport (DLC) demonstrated the largest amount of total average departure and arrival delay times. Jeju Airport (CJU) had the second highest average departure delay time, and registered the highest average delay time – almost 24 hours, on August 23rd while being hit by typhoon Soulik.

Flight Cancellations

The number of flight cancellations is among the most transparent indicators when it comes to measuring flight disruptions under special conditions such as bad weather or natural disasters. Thus, flight cancellations were used to measure the effect of typhoons on major airports in the selected regions.



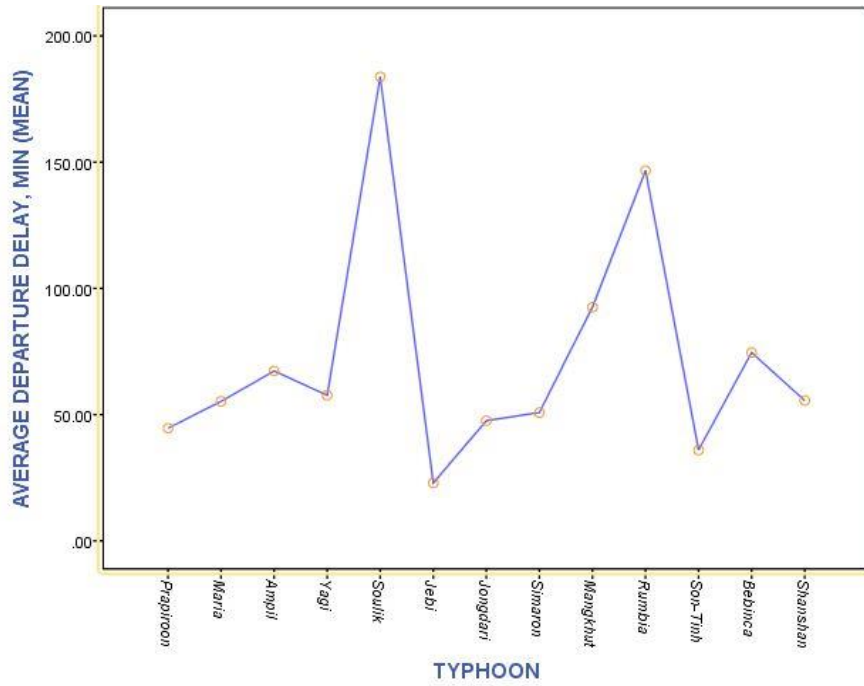
Source: VariFlight

Figure 5: Total Number of Flight Cancellations at Airports in East Asia during typhoons' landfalls in July-September 2018

Shanghai Pudong Airport (PVG) sustained the largest amount of flight delays due to typhoons in July-September 2018. While being hit by Ampil, Jongdari, Yagi and Rumbia, 1,349 cancellations, including outbound and inbound flights were recorded at the airport. Haneda Airport (HND) registered over 1,000 cancellations that happened when Jongdari, Shanshan and Jebi made landfalls in the area.

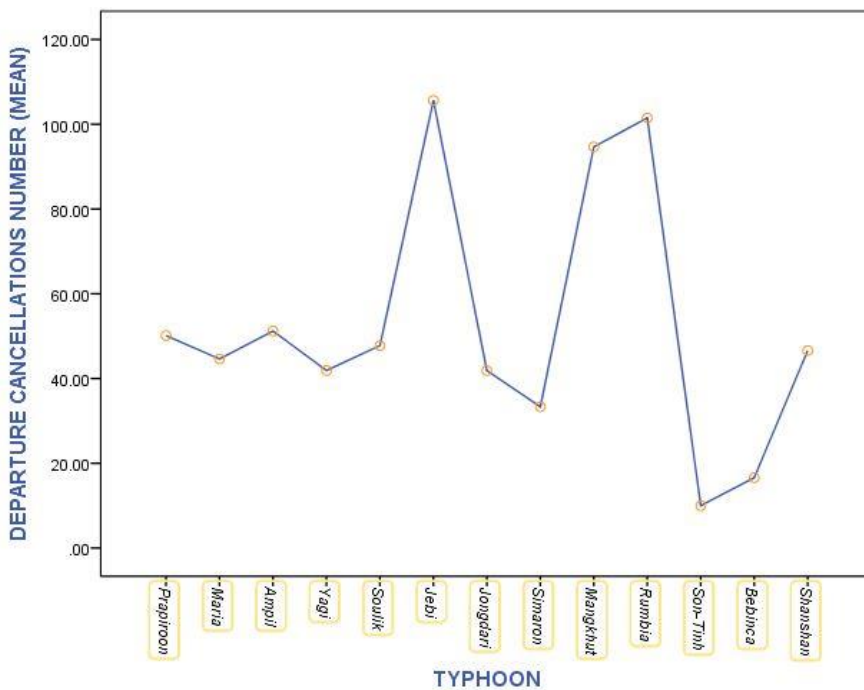
Typhoons' Severity and Flight Disruptions Scale

Average delay time and number of cancellations were chosen to measure the influence of 13 typhoons on major airports in the reported region. Each typhoon was analyzed in terms of severity and the effect on flight disruptions². Due to a certain level of ambiguity of the OTP indicator (considering different sizes of the airports and fluctuating numbers of actual flights), it was not used to analyze flight disruptions caused by severe weather conditions in July-September 2018.



Source: VariFlight

Figure 6: Typhoons' effect on airports in terms of average departure delay time, July-September 2018



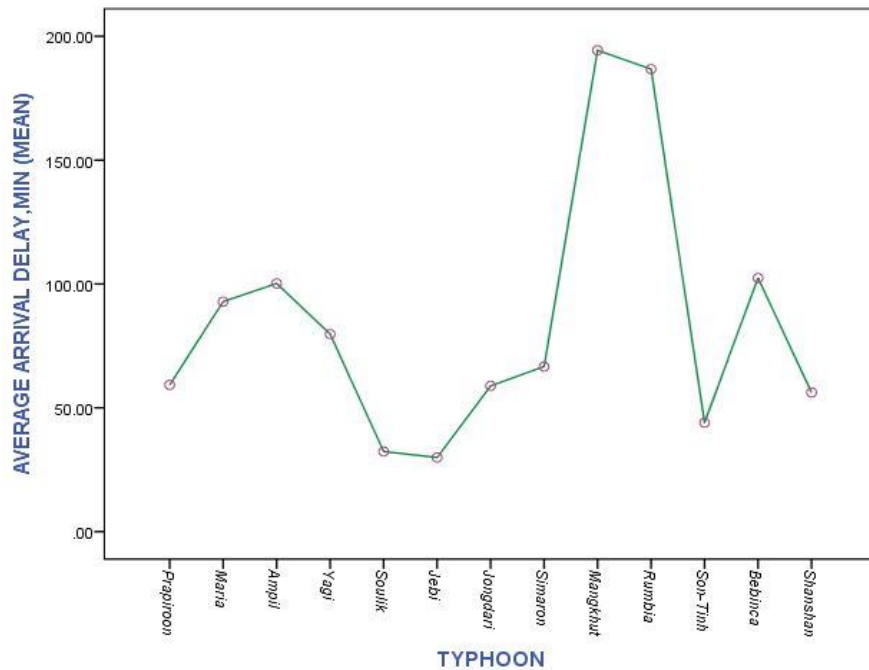
Source: VariFlight

Figure 7: Typhoons' effect on airports' departure flight cancellations, July-September 2018

Among all 13 typhoons, Soulik and Rumbia caused the longest flight delays. Making a landfall on the coast of Mainland China, Rumbia hit Shanghai Pudong, Shanghai Hongqiao, Hangzhou, Nanjing, and Dalian airports. Soulik affected operations of the airports in Japan, including Fukuoka, Kagoshima and in South Korea, Jeju, and Gimhae

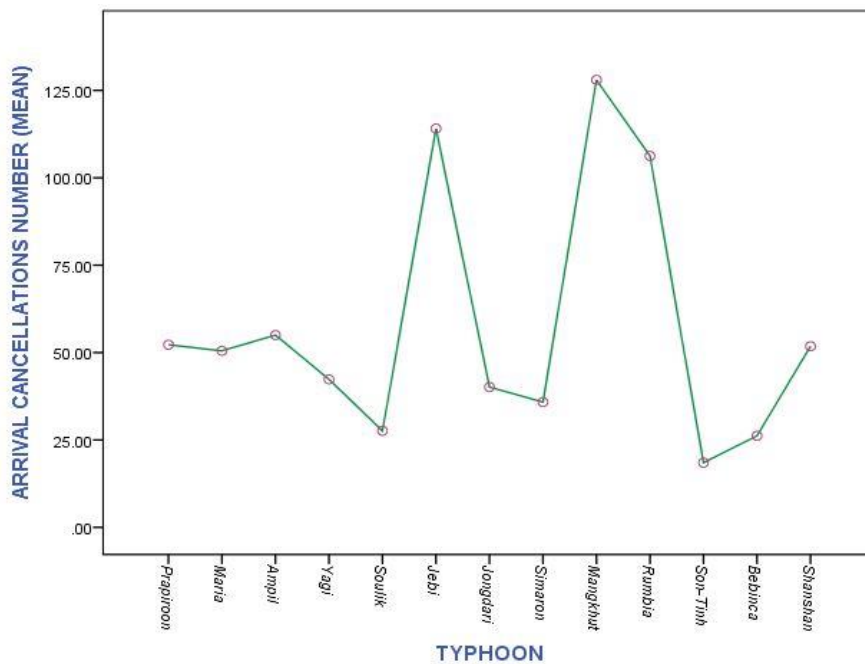
airports.

Typhoon Rumbia, Jebi, and Mangkhut had the most significant effects on departure cancellations. Jebi's landfall in Japan in the beginning of September 2018 caused havoc across the country, flooding Kansai Airport and leading to hundreds of flights being cancelled in two weeks. Mangkhut hit the southeast coast of Mainland China, Taiwan, and Hong Kong, disrupting operations in major airports of the region.



Source: VariFlight

Figure 8: Typhoons' effect on airports in terms of average arrival delay time, July-September 2018



Source: VariFlight

Figure 9: Typhoons' effect on airports' arrival flight cancellations, July-September 2018

Mangkhut and Rumbia caused the longest arrival delay time. These two typhoons and Jebi also led to the largest numbers of flight cancellations.

Therefore, Mangkhut, Jebi, and Rumbia caused more flight delays and cancellations compared to other typhoons. At the same time, according to a deeper analysis², Mangkhut and Jebi can be called the most severe typhoons in terms of airport operations' disruptions in July-September 2018.

Notes for editors

- **Time period:** July 1, 2018 – September 20, 2018
- **Large airports:** Airports with over 6000 actual departure flights monthly.
- **Medium-sized airports:** Airports with 2,000 to 6,000 actual departures per month.
- **On-time departures:** $ATD-STD < 30\text{mins}$
- **On-time arrivals:** $ATA-STA < 30\text{mins}$
- **On-time departure rate:** $\text{On-time Departure Flights} / \text{Actual Departure Flights} * 100\%$
- **On-time arrival rate:** $\text{On-time Arrival Flights} / \text{Actual Arrival Flights} * 100\%$
- **Average departure delay time:** $\text{Total Departure Delay Time} / \text{Actual Departure Flights}$

(Departure delay time of a single flight: $ATD-STD$. If a flight departs ahead of the scheduled time of departure, then the result is zero.)

Average departure delay time of the airports affected by typhoons was calculated with consideration of the number of days an airport was affected by a typhoon.

- **Average arrival delay time:** $\text{Total Arrival Delay Time} / \text{Actual Arrival Flights}$
(Arrival delay time of a single flight: $ATA-STA$. If a flight arrives ahead of the scheduled time of arrival, then the result is zero.)

Average arrival delay time of the airports affected by typhoons was calculated with consideration of the number of days an airport was affected by a typhoon.

- Information on the typhoons was acquired from 台风路径 <http://typhoon.zjwater.gov.cn/>
- The typhoon dataset excludes information on Trami and Kong-Rey typhoons, since the region was still under effect at the time this report was published.
- Present report only considers the disruptions of airport operations that were directly caused by typhoons (i.e. an airport's departure/arrival on-time performance rates, average delay time and cancellations are considered only on the day(s) when the city where airport is located was hit by a typhoon/storm).
- ¹For this report, 34 major airports located in Mainland China, Hong Kong, Taiwan, Japan and South Korea were selected. The full list includes the following air hubs:

- | | |
|--------|---------|
| 1. OKA | 8. KIX |
| 2. TPE | 9. NGO |
| 3. KOJ | 10. CTS |
| 4. CJU | 11. TSA |
| 5. FUK | 12. FOC |
| 6. PUS | 13. XMN |
| 7. ITM | 14. HGH |

15. CSX	25. SDJ
16. CGO	26. HND
17. HAK	27. MFM
18. SHA	28. HKG
19. PVG	29. TNA
20. NKG	30. DLC
21. TAO	31. KHH
22. TSN	32. MZG
23. PEK	33. SZX
24. NRT	34. CAN

7 out of 34 airports on the list that were initially selected for this report did not demonstrate any clear influence of a typhoon landfall (i.e. did not receive a “direct hit” according to <http://typhoon.zjwater.gov.cn/> or/and did not demonstrate any significant change in operations). Therefore, they were removed from the dataset.

- On 2018.09.06, after typhoon Jebi left Hokkaido, Japan, an earthquake happened in the area resulting in the shutdown of New Chitose Airport (CTS). Thus, the airport’s flight disruptions on that date and later were not included in the report.
- Due to the flood caused by typhoon Jebi at Kansai Airport, the hub was experiencing flight disruptions and cancellations for nearly 2 weeks after the typhoon landfall. Since the cause of those disruptions was clear, those days were included in the report.
- ²Fixed effect model was applied to analyze typhoons and the relationships between average delay time and cancellations. Jebi and Mangkhut typhoons were discovered to be significantly and positively affected by the relationship between these two factors. Though Rumbia was also among the airports causing the longest delays and the largest amounts of cancellations, it was not significantly affected by the relationship between average delay time and the number of cancellations.
- Flights: Commercial air passenger flights only. Cargo aircrafts, corporate jets and general aviation were excluded.