POST OPERATIONS ANALYSIS REPORT

June,2022

CENTRAL COMMAND CENTER, C-ATFM, DELHI

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A. Executive Summary

Domestic and international air traffic is estimated to have recorded 6 % and almost 1 % decrease respectively in the month of June 2022 as compared to May'22.

On average, the Indian Airports in the ATFCM area saw 3796 IFR flights per day.The peak day was on 24th June'22 (4068 IFR flights). Sunday's were the busiest days throughout this month with an average of 3953 flights per day.

Three (3)ATFM measure were applied this month. During other observed periods of congestion due to bad weather in Delhi, few flights were cherry picked and delayed. Compliance of such flights is not considered in this report.
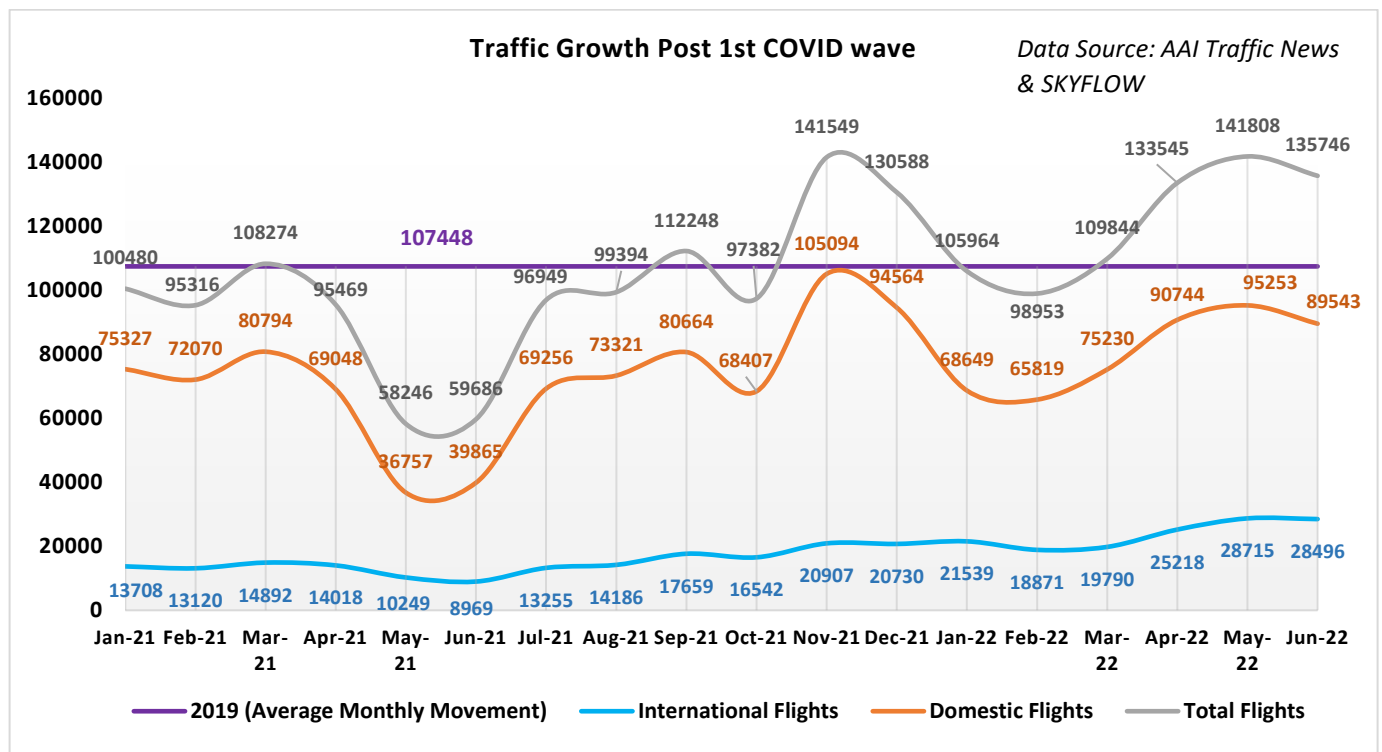
Figure 1: Traffic Growth Post 1st COVID wave

The graph above depicts the Domestic and international Air traffic in Indian ATFCM Area during the last 18 months (Jan' 2021 to June'2022). The traffic demand is visibly impacted by the Covid-19 infections through out the period.

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B. Traffic Analysis

I. Air Traffic Movement at Major Airports in India
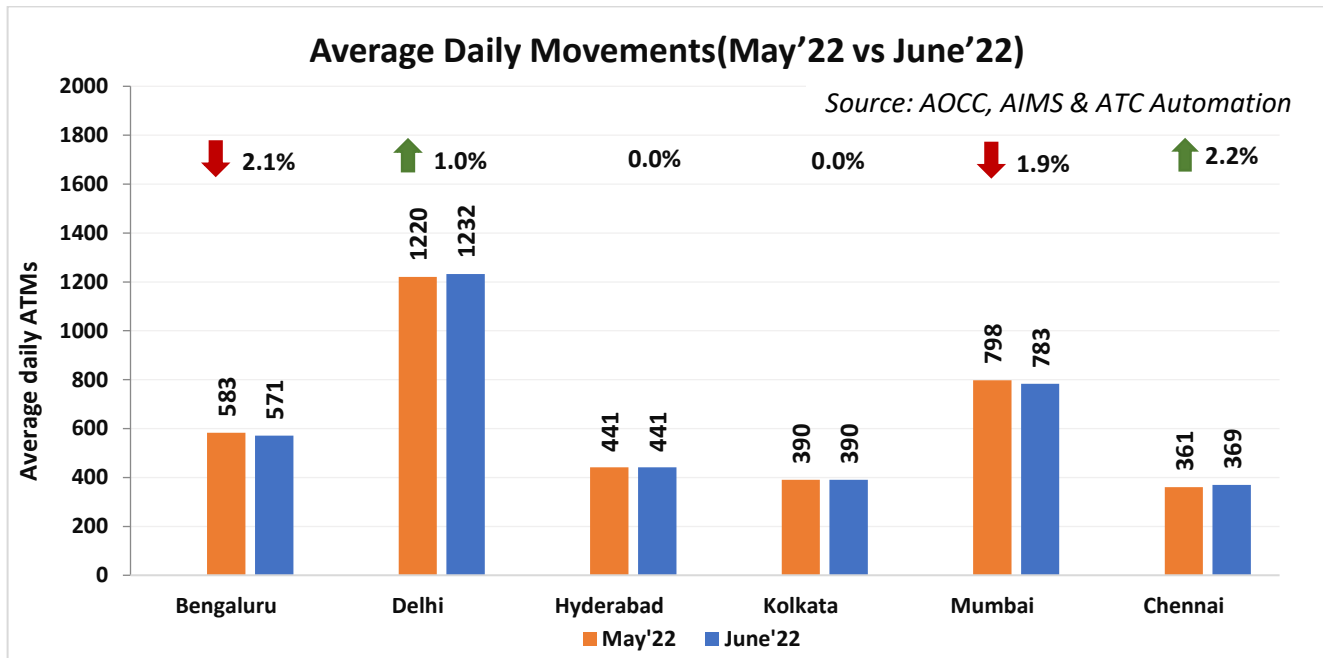
Figure 2: Average Daily Movements(May'22 vs June'22)

The above chart depicts the percentage change in average daily ATMs at six major Airports in India in June'22 as compared to the previous month.

Airports\Year	Avg. Daily ATMs (YoY) for six major airports			
	June'19	June'20	June'21	June'22
Bengaluru	628	167	221	571
Delhi	1259	417	584	1232
Hyderabad	493	138	176	441
Kolkata	437	158	151	390
Mumbai	849	146	299	783
Chennai	469	93	150	369

Major Airports - Bengaluru ,Delhi, Hyderabad, Kolkata, Mumbai and Chennai recorded average daily movements 91%,98%, 89%, 89%,89%,92% and 79% respectively of **June 2019** levels.

Air Traffic Movement for each day in June'22 is plotted for Delhi, Mumbai, Bengaluru and Hyderabad Airport along with the percentage change w.r.t. Avg. Daily Movement for the same month.
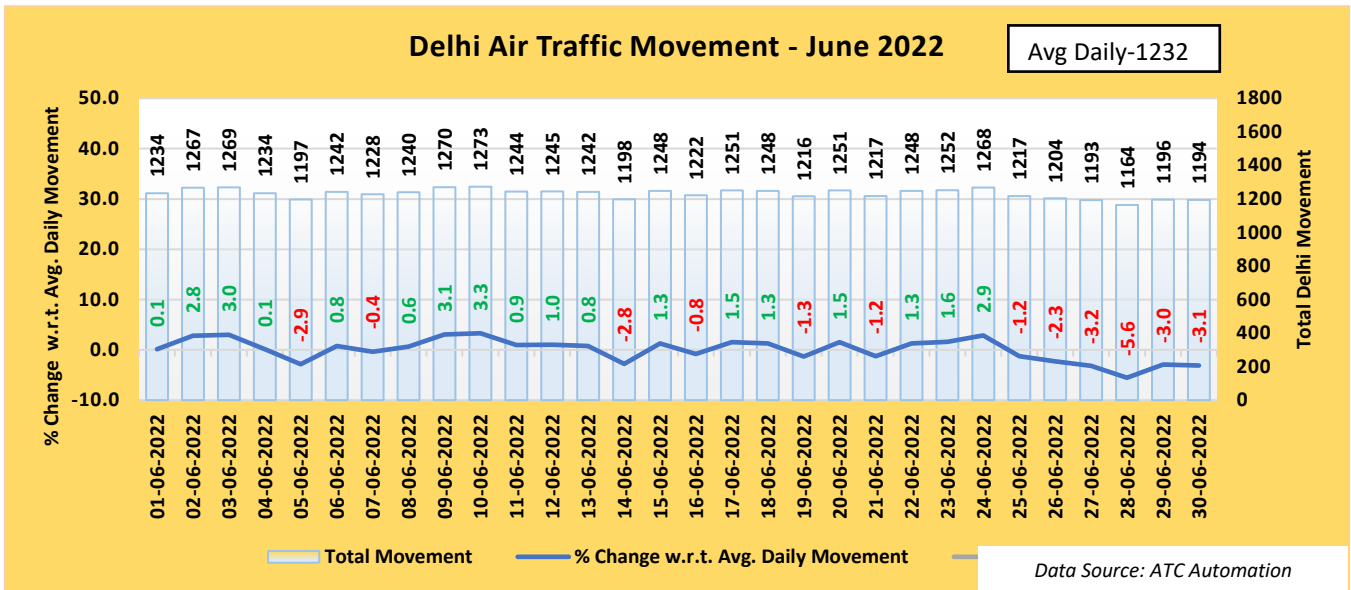
Figure 3: Air Traffic Movement for Delhi –June 2022

Figure 4: Air Traffic Movement for Mumbai - June 2022
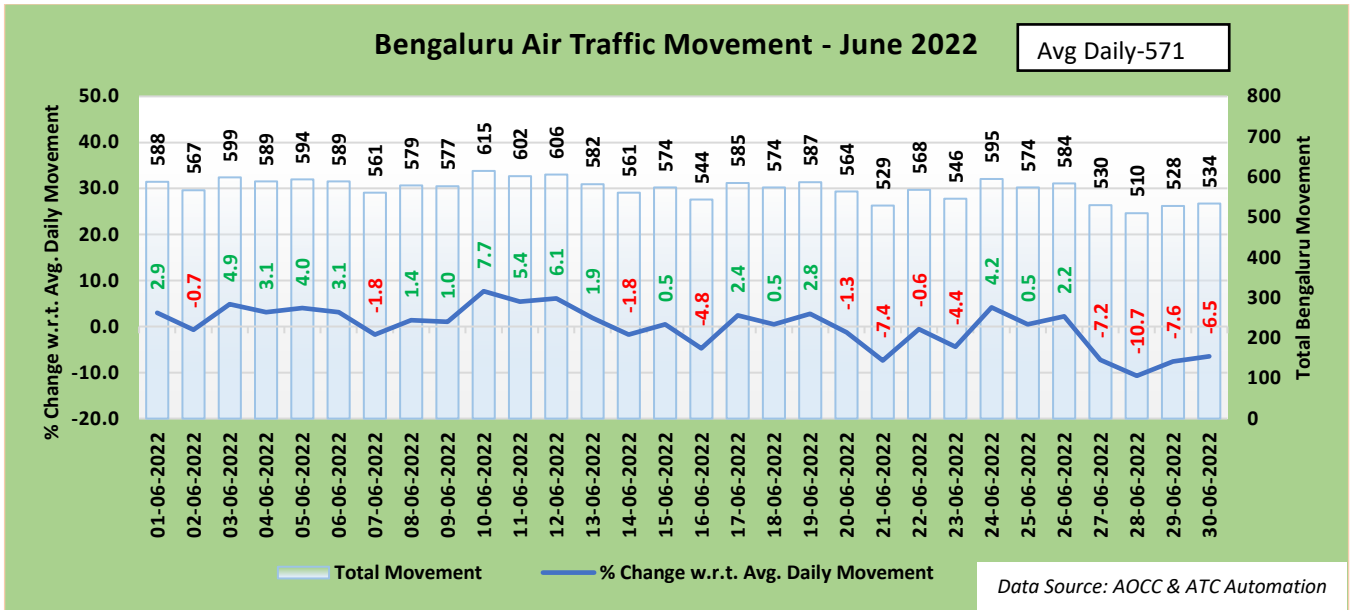
Figure 5: Air Traffic Movement for Bengaluru - June 2022
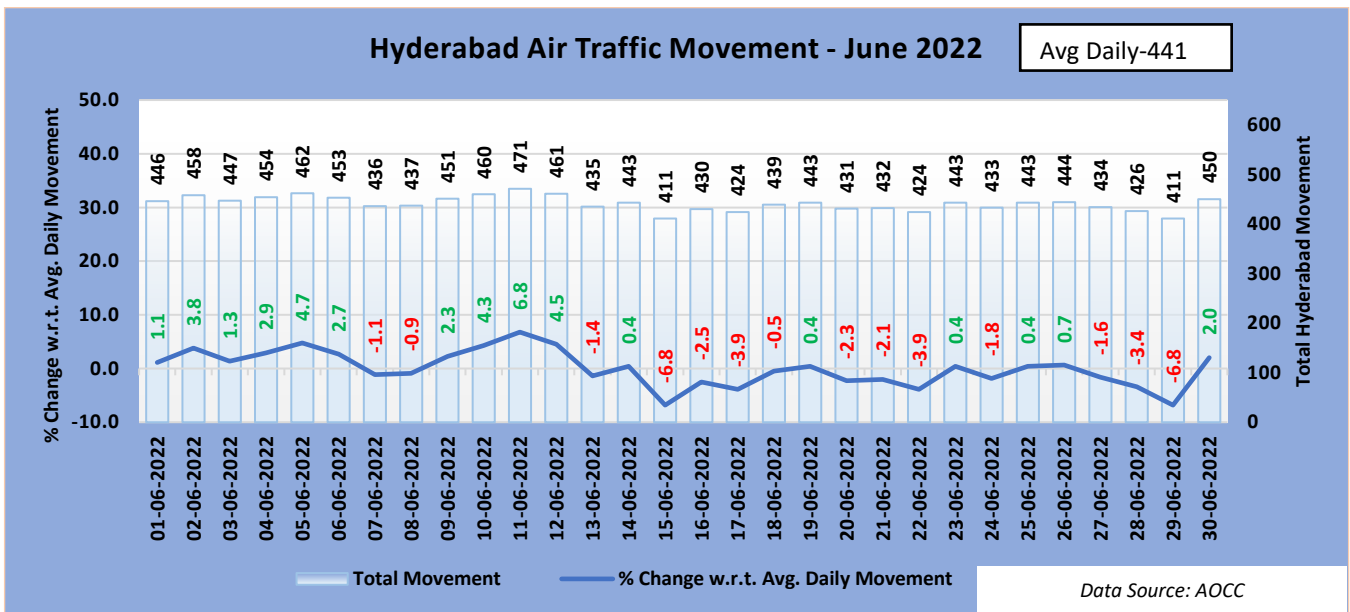
Figure 6: Air Traffic Movement for Hyderabad - June 2022

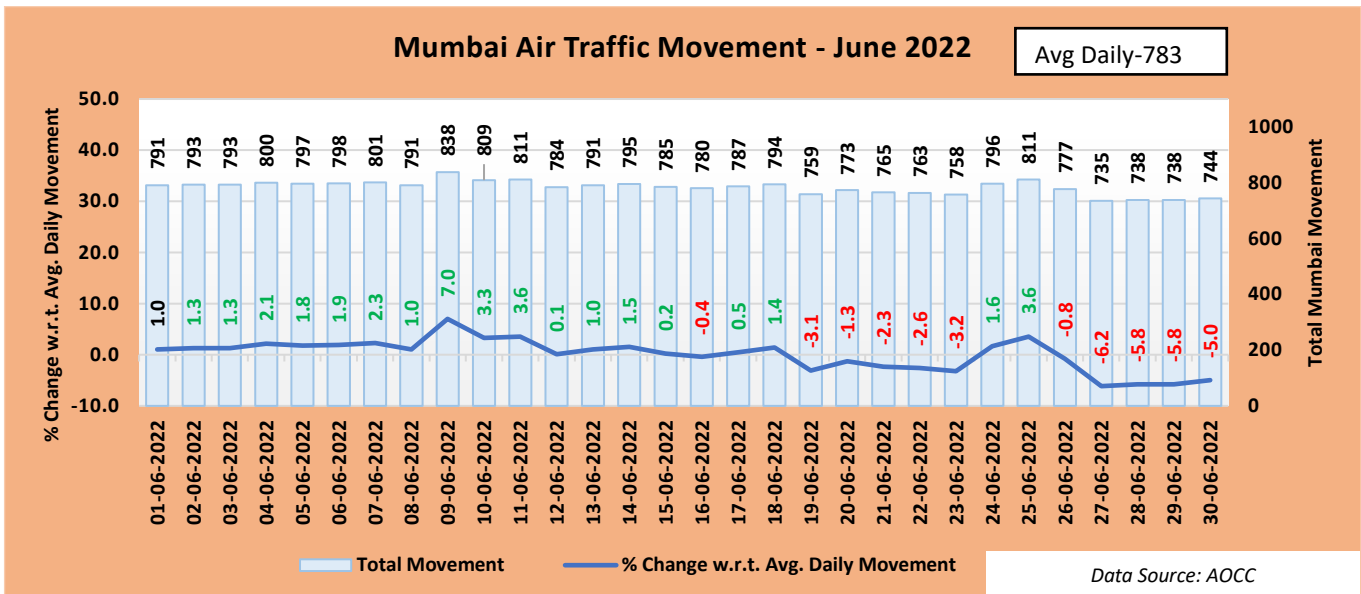It is evident from the above charts that on 30 [th] June'22 the ATMs at Delhi, Mumbai, and Bengaluru saw a decrease of 3.1% , 5.0 % and 6.5 % respectively as compared to the average daily movement for the month of June'22

whereas Hyderabad on the same day witnessed an increase of 2.0 % w.r.t. average daily movement captured for the month.

II.   Comparison of total ATMs (YoY) and Monthwise

The total Air traffic movement including Passenger and Combination of other flights i.e. All-Cargo flights, International scheduled, International non-scheduled, Domestic scheduled, Domestic non-scheduled, Air taxi & commercial business flights at six major Indian Airports namely Delhi, Mumbai, Bengaluru, Hyderabad, Kolkata and Chennai is plotted for the month of June for two consecutive years. Air Traffic movement is also plotted Airline wise for the last six months for the major Scheduled Operators.
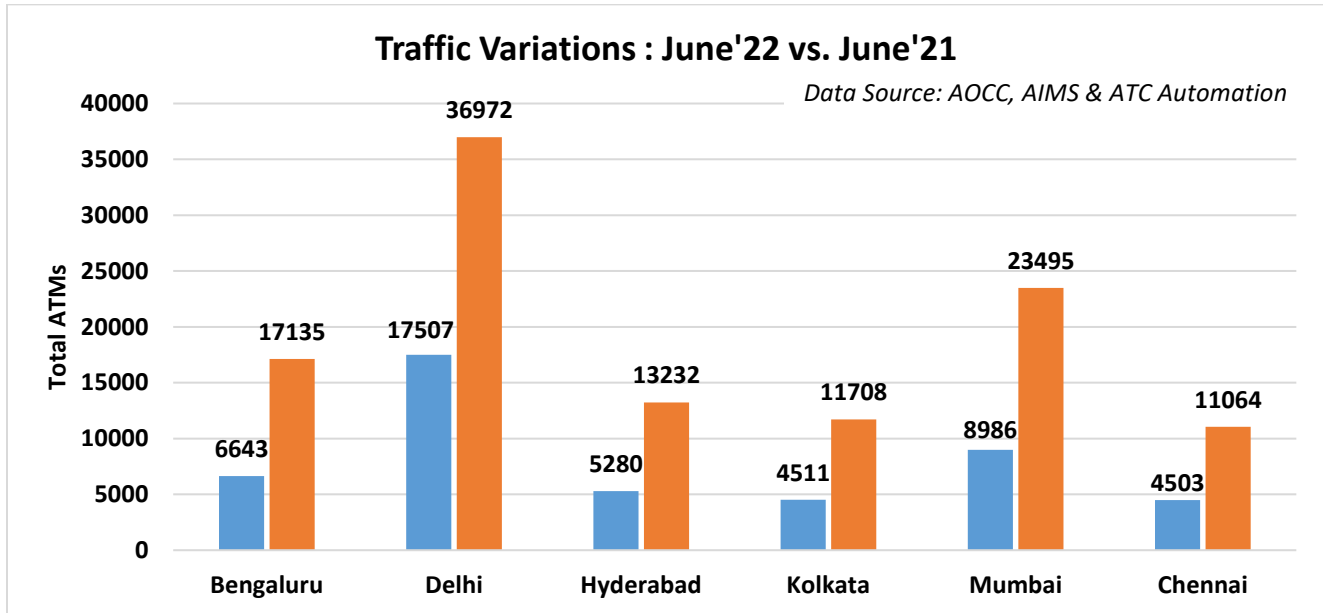
Figure 7: *Traffic Variation (YoY)*

Airports\Year	Total ATMs (YoY) for six major airports	
	June'22	June'21
Bengaluru	17135	6643
Delhi	36972	17507
Hyderabad	13232	5280
Kolkata	11708	4511
Mumbai	23495	8986
Chennai	11064	4503

III.   Flight Operations – Airlinewise

Flight Movements   *Data Source: SKYFLOW*
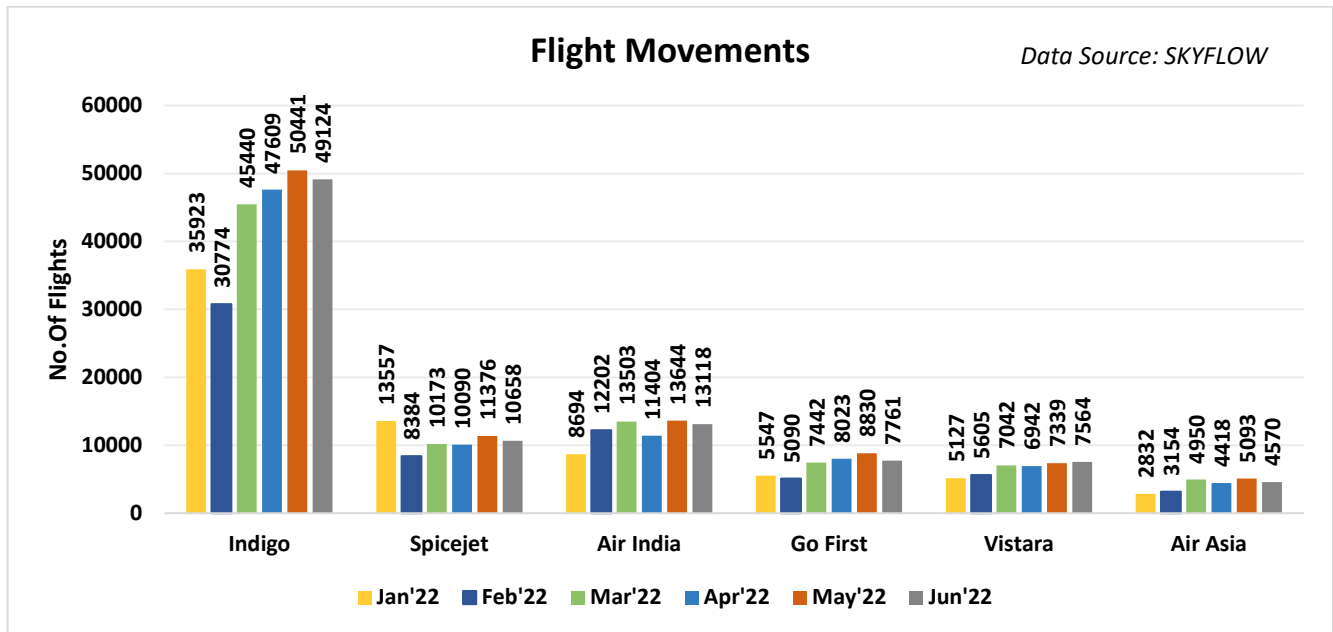
Figure 8: Flight Movements –Airlinewise

C.   ATFM Post Operations – CDM Analysis

I.   Introduction

Analysis Period   1st – 30th June'22

Back Ground   During the above mentioned period, **one(1)** ATFM measure was applied **for Delhi Airport**,**one(1)** ATFM measure was applied **for Mumbai Airport** and **one(1)** ATFM measure was applied **for Kolkata Airport** due to the following reason as illustrated in the bar chart below:–

ATFM MEASURES - June'22

Total no. of ATFM
Measures Applied = 3

■ Weather
■ Runway Closure

Kolkata: 1   Mumbai: 1   Delhi: 1

No. of ATFM Measures Applied
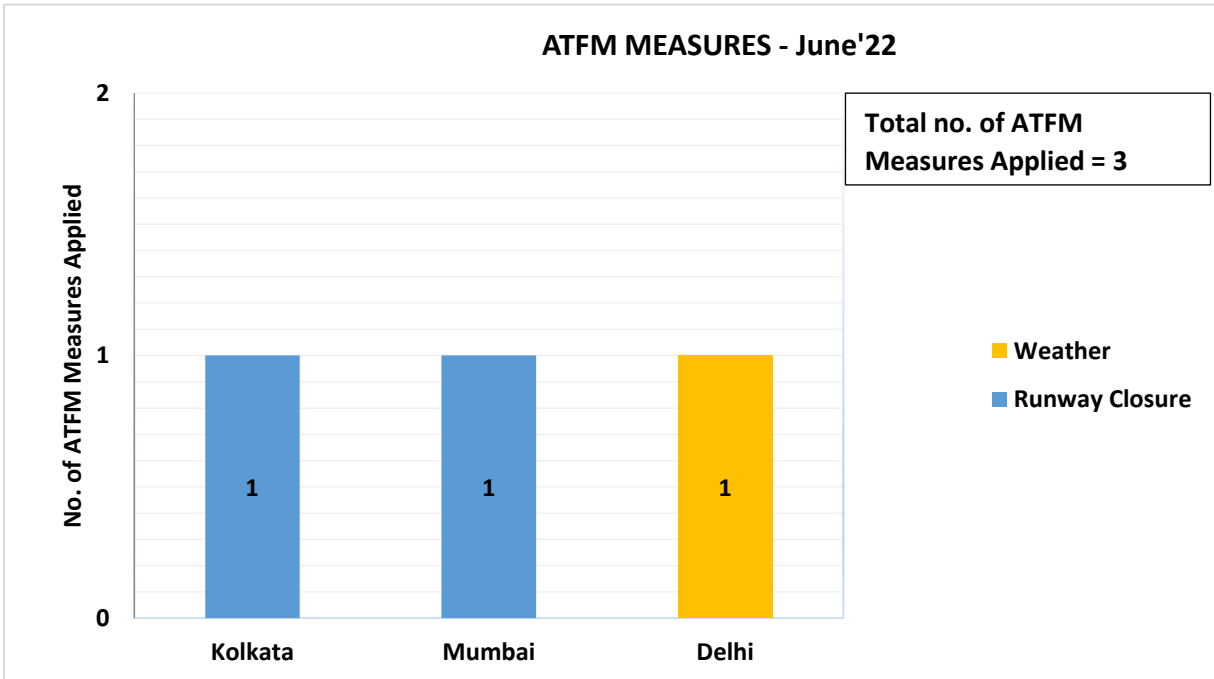
Figure 9: ATFM Measures –June'22

II. ATFM Measures Overview

Constrained Airport	Delhi Airport	Kolkata Airport	Mumbai Airport
Number of ATFM measures applied	1	1	1
Average ATFM Ground delay due to measures*	31 Min	5 Min	12 Min
Maximum ATFM Ground delay due to measures	121 Min#	12 Min	23 Min
% Compliance	49	89	90

Note: $* \ Average \ ATFM \ Delay = \frac{Total \ ATFM \ Delay}{Total \ Domestic \ Arrivals}$ *# Added Delay due no Revised EOBT available with CCC*

Total Arrivals		136
Total Exempted Arrivals	**International**	18
	Domestic(Srinagar,Jammu & Leh)	10
Total affected flights in scenario (Domestic Arrivals)		108
Total Domestic Arrivals with zero ATFM delay		1
Total Domestic Arrivals with ATFM delay		107

Affected Flight Statistics

Domestic Arrivals(no exemptions)-108

1%

99%

■ **Delayed flights**   ■ **Non-delayed flights**
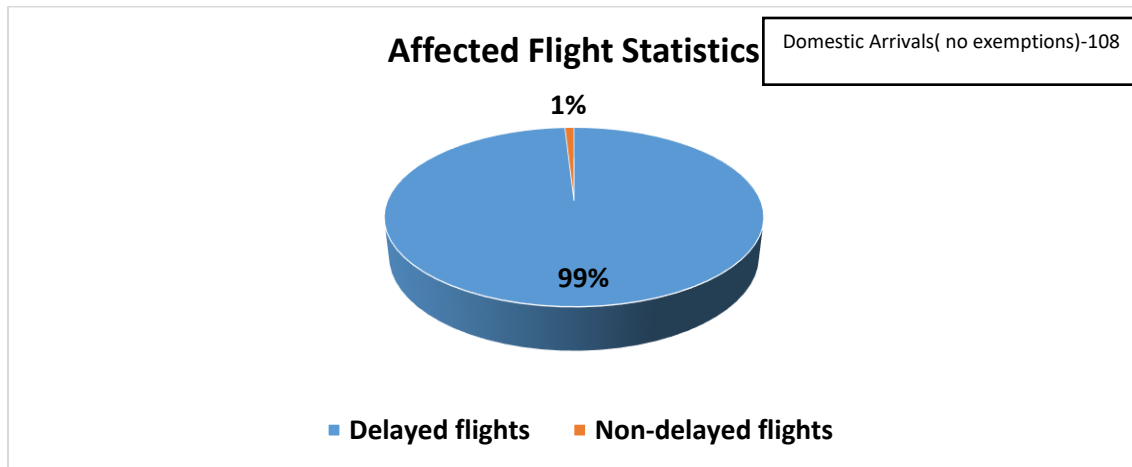
Figure 10: Affected Flight Statistics –June'22

III. Overall Compliance

Total arrivals	136
Domestic arrivals (without exemptions)	108
Flights with complete data (ATOT)	104
Flights with incomplete data	1
Flights Not Operated	3
Compliant*	70
Non-Compliant	34

*Total No. of Revised CTOTs issued = 15 (Compliance calculation for flights which were issued revised CTOT is w.r.t. new CTOT issued)
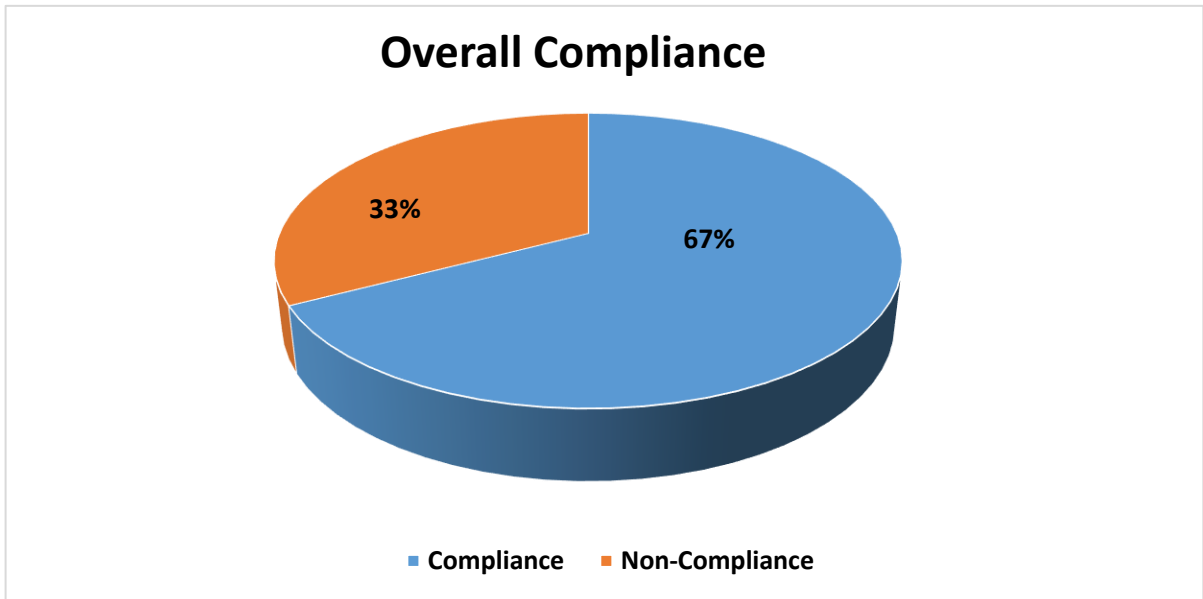
Figure 11: **Overall Compliance – June'22**

NOTE: Flights with required data (i.e. ATOT) are only considered for compliance measurement
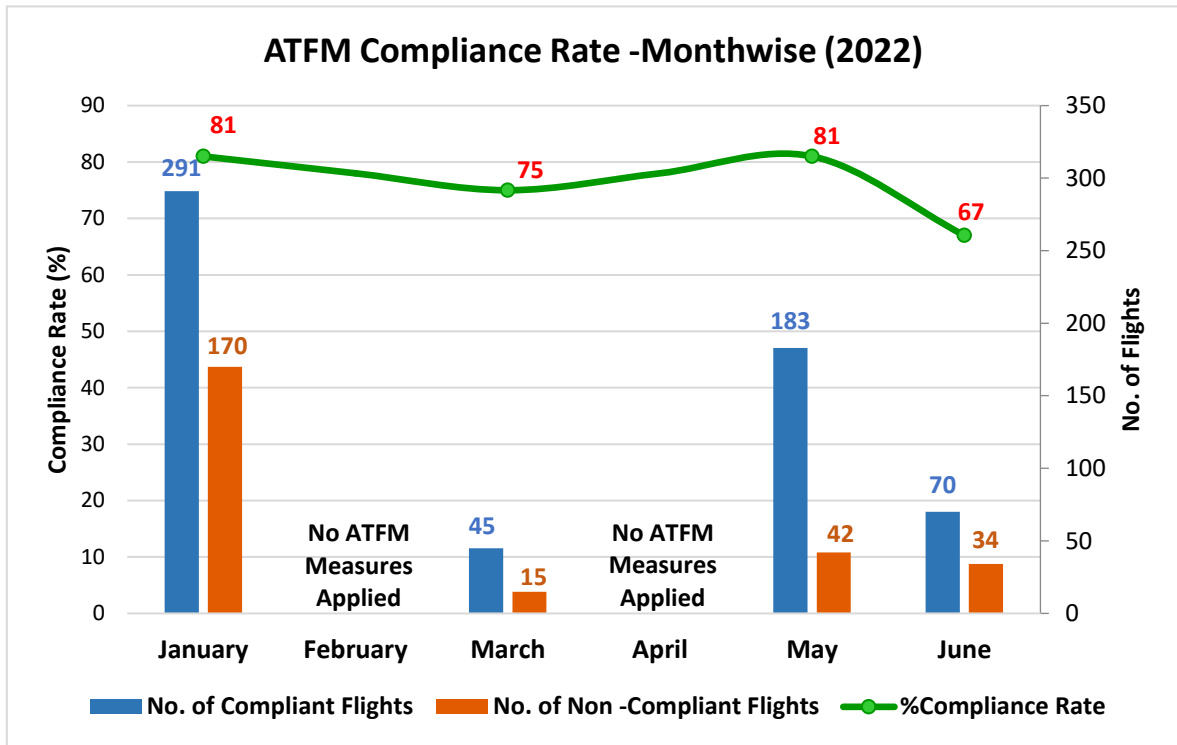
Figure 12: ATFM Compliance(Monthwise)

Inference

1. Out of the total arrivals captured for the constrained Airports during the CDM scenario, 79% of flights i.e. Domestic arrivals, are participating.

2. 8.5 % of Domestic flights were exempted from ATFM Measures.

3. Out of these Domestic Arrivals, 99% of arrivals are assigned ATFM ground delay.

4. Out of the total arrivals captured to the constrained Airport during the ATFM scenario, 79% of flights are assigned ATFM Ground Delay.

IV. CTOT Compliance rate – Airportwise

MUMBAI FIR (45%)*	Compliant	Non Compliant	%Compliant
Rajkot	1	0	100
Ahmedabad	0	2	0
Aurangabad	1	0	100
Udaipur	0	1	0
Mumbai	2	5	29
Jabalpur	0	2	0
Nagpur	0	1	0
Pune	2	1	67
Porbandar	1	0	100
Surat	1	0	100
Jamnagar	1	0	100
Kandla	1	0	100
KOLKATA FIR (63%)*			
Agartala	1	2	33
Bagdogra	4	2	67
Kolkata	0	1	0
Varanasi	1	0	100
Durgapur	1	0	100
Darbangha	2	0	100
Guwahati	4	2	33
Gorakhpur	0	1	0
Imphal	1	0	100
Jharsuguda	1	0	100
Silchar	0	1	0
Dibrugarh	1	0	100
Dimapur	1	0	100
Khajurao	0	1	0
Raipur	1	0	100
Patna	1	1	50
Ranchi	1	1	50
DELHI FIR (79%)*			
Chandigarh	3	3	50
Dehradun	2	1	67
Amritsar	2	0	100
Lucknow	1	0	100
Delhi	7	0	100

CHENNAI FIR (81%)*			
Goa	3	2	60
Bengaluru	4	1	80
Chennai	4	1	80
Begumpet	0	1	0
Port Blair	3	0	100
Shamshabad	6	1	86
Trivandrum	1	0	100
Hubli	1	0	100
Mangaluru	2	0	100
Vishakhapatnam	1	0	100

*FIR wise compliance rate

Note: The above list contains only those airports which had flights to the Constrained Airport and affected by ATFM measures.

V. Reason For Non Compliance

Reason For Non-Compliance

- Delay Due Airline 7%
- Coordinated With ATFM 7%
- Late Arrival from Previous Station 13%
- ATC Operational Reason 13%
- No Revised EOBT received 13%
- Military Flying 13%
- Abrupt CTOT Revision 34%

Figure 13: Reason for Non-Compliance as provided by FMPs

Inference

1. 34% of the CTOT Non- compliance was reported to be because of abrupt CTOT revision by CCC.
2. ATC Operational Reason and late arrival of the flight from previous station is identified as another important contributing factor for Non-Compliance by the FMP.
3. 13 % of flights didn't comply with the issued CTOT and didn't timely inform their revised EOBT to CCC. These flights operated beyond the CDM period.

VI. CTOT Compliance rate – Airlinewise
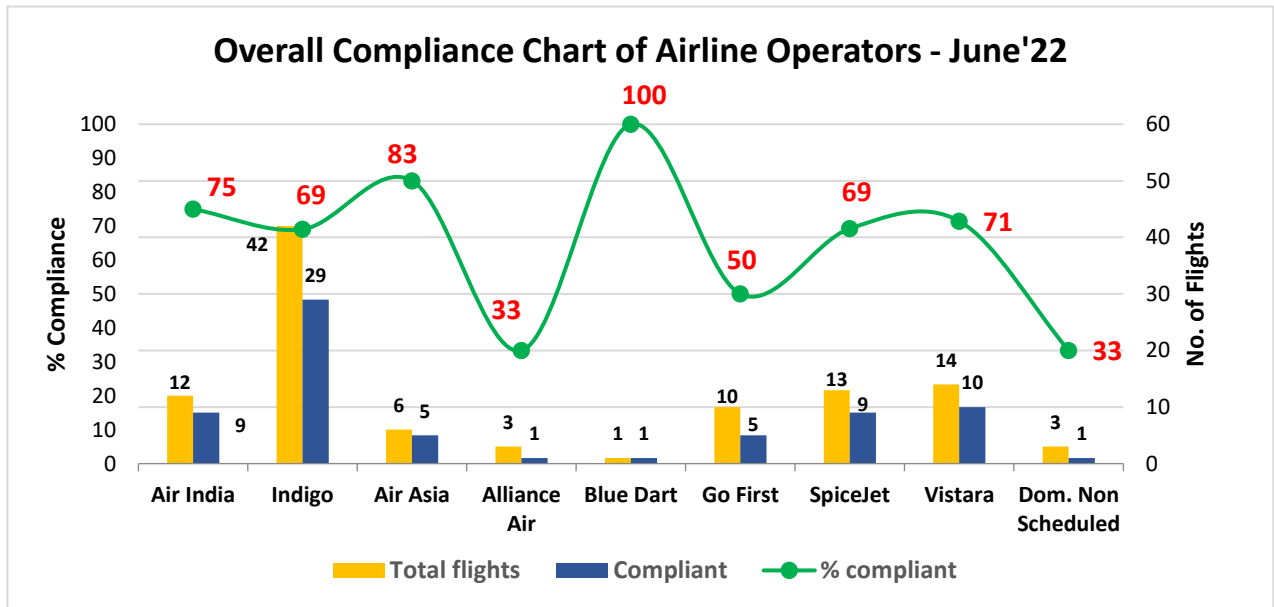
Figure 14: Airlines Overall Compliance –June'22

Inference

1. Out of the total domestic arrivals with complete data in the CDM scenario, 67% arrivals are compliant.

2. Mumbai region has the lowest compliance rate of 45% whereas Chennai region has the highest compliance rate of 81%.

3. Air India,Indigo, Air Asia ,Blue Dart,SpiceJet and Vistara Airlines have a CTOT compliance higher than the average recorded compliance for the month of June'22.

VII.   Air Delay during the CDM Scenario period

Average Air Delay to domestic arrivals* within the CDM Scenario period for Delhi, Kolkata and Mumbai is 8 minutes, 4 minutes and 10 minutes respectively.

*Note: Only calculated for domestic arrivals with both ATOT and ALDT information
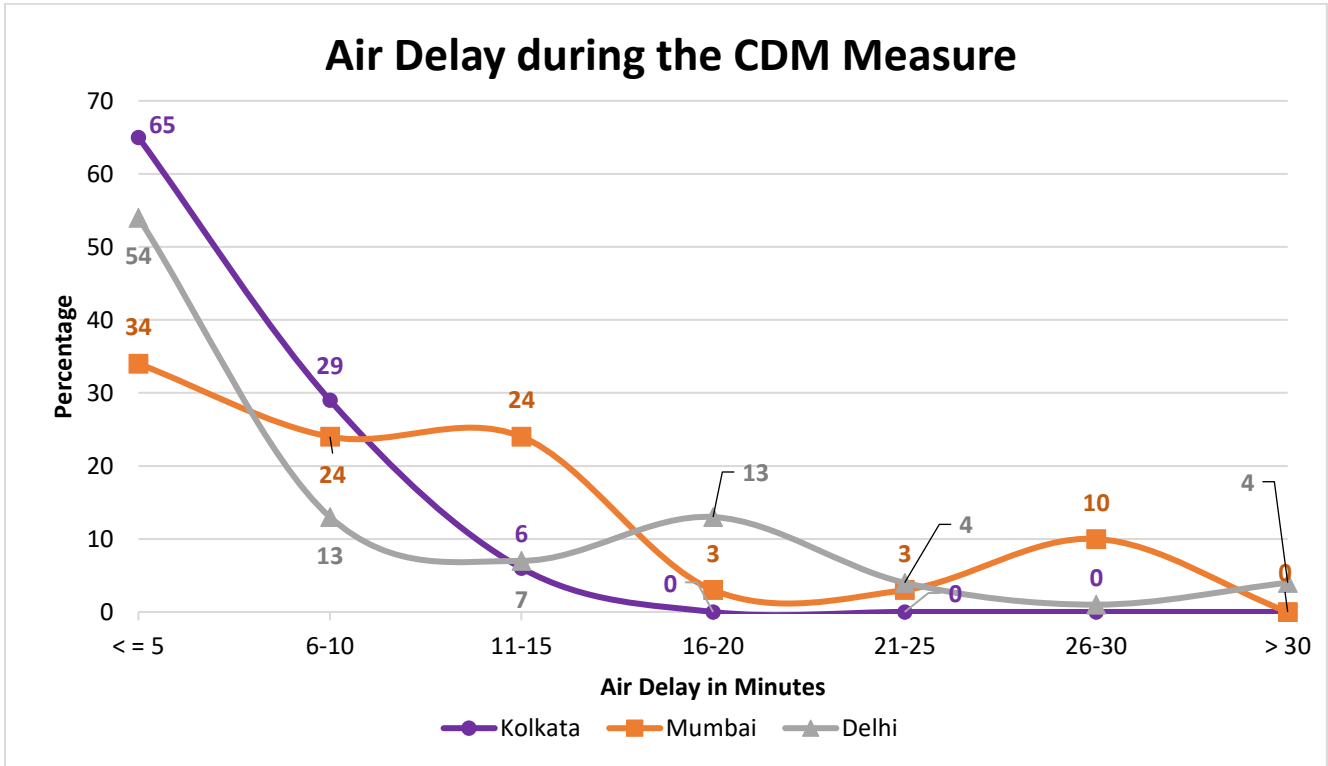
Figure 15: Air Delay distribution during the CDM period

Inference

1. 94% of domestic arriving flights to Kolkata had an Air delay of equal to or less than 10 minutes during the CDM period.
2. 58% of domestic arriving flights to Mumbai had an Air delay of equal to or less than 10 minutes during the CDM period.
3. 67% of domestic arriving flights to Delhi had an Air delay of equal to or less than 10 minutes during the CDM period.

VIII.   Tangible Benefits due to ATFM Measures

A modest attempt is made to find out the tangible benefit of ATFM measures applied.

Assumptions:

•When ATFM measures are not in force, all flights take off at their ETOT where Estimated take off time(ETOT)= Estimated off block time(EOBT) + default taxi time

•All flights have an Estimated elapsed time(EET) as calculated by SKYFLOW using the Flight Plan information and Basic Aircraft data.

Methodology:

Air delay (with ATFM measures in force) is calculated during the period when ATFM measures are in force by summing the air delay for all the flights landing at constrained Airport.

i.e. **Total Air Delay = ∑ (Actual Flying time – SKYFLOW calculated EET)**

Air delay (with no ATFM measures) is calculated as the sum of Air delay for all the flights during the above said period with no ATFM measures in place and the air delay for each flight is the difference in its ideal landing time and its ideal estimated landing time.

Total Air Delay (with no ATFM measures) = **∑ (Ideal LDT - Ideal ELDT)**

*Ideal LDT is taken by assuming every flight is landing at a specified interval based on the Arival acceptance rate(AAR) defined,

*Ideal ELDT = ETOT + SKYFLOW calculated Flying time

Fuel Saving Calculation :

Great Circle Distance(GCD)* was calculated for all the arrivals during the ATFM Measure from the point of origin to destination. Assuming Airbus 320 as reference for domestic flights (flight distance less than 5000 nm) and B777 for international flights (flight distance equal to or more than 5000nm):

Fuel consumption (Kgs / nm) for each affected flight in the scenario was then calculated using the Reference document: ICAO Carbon emissions calculator methodology, version10, Appendix C: ICAO Fuel Consumption Table.

The Fuel consumed per minute(Kg/min) was calculated for each affected flight.

Total Air Delay(with ATFM Measures)= 909 mins

Total Air Delay (with no ATFM measures) = 1317

Reduction in Air delay due to ATFM measures= (1317-909) = **408 mins**

Fuel Saving Calculation:

Total Fuel saved during the ATFM Measure: **21768.30 Kgs**

Total reduction in CO_2 emission : 3.16(KgCO_2/kg fuel)*21768.30 Kgs= 68787.82 Kg

*GCD (Great Circle Distance): The distance between origin and destination airports is derived from latitude and longitude coordinates originally obtained from ICAO Location Indicators database.

3.16 = constant representing the number of tonnes of CO2 produced by burning a tonne of aviation fuel.

D. Glossary

ATFM Parameters	Definition
Affected Flight statistics	An insight of participating traffic in the scenario i.e. ratio of the domestic arrivals to the constrained airport affected by ATFM measures (assigned delay by the Ground Delay Program) to the domestic arrivals not affected by ATFM measures (not assigned any delay) within the CDM scenario.
ATFM Ground delay	ATFM ground delay defined as CTOT-ETOT (Calculated take off time – Estimated take off time)
Average ATFM delay	$$\frac{Total\ monthly\ ATFM\ delay\ (in\ minutes)}{Total\ Domestic\ Arrivals}$$
Maximum ATFM delay	Maximum ATFM delay (in minutes) assigned in the month
Overall compliance rate	Defined as monthly ATFM departure slot adherence rate of regulated flights. Flights having ATOT within theATFM Slot Tolerance Window (STW) of minus 5 to plus 10 minutes of CTOTs, are considered as compliant flights
CTOT Compliance rate of Airline operators	An overview of CTOT compliance rate of various Airline operators
CTOT Compliance rate of Airports within different Regions	An overview of CTOT compliance rate of Airports within 4 FIRs
Air delay statistics	Air delay defined as difference between AET & EET, whereAET(actual elapsed time) can be obtained from (ALDT-ATOT) and estimated elapsed time(EET)can be obtained from FPL/RPL or (CLDT-CTOT). **Therefore, Air delay = AET-EET** Average Air Delay is calculated as: $$Average\ Air\ Delay$$ $$=\frac{Total\ Air\ Delay\ to\ domestic\ arrivals\ (with\ values\ greater\ than\ zero)}{Total\ Domestic\ Arrivals}$$ *CLDT: Calculated Landing Time* *CTOT: Calculated Take off Time* *ALDT: Actual Landing Time* *ATOT: Actual Take off Time*