ENRI International Workshop on ATM/CNS
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A Case Study of Operational Delay at Japanese Airports

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Outline

Instances of Aircraft Operational Delay Study

- Background
  - ATM Performance Assessment
- Study Instances
  - Data Collection
  - Arrival Delays at Japanese Airports Compared
  - ATFM Influence at Block-Out Delay

Background

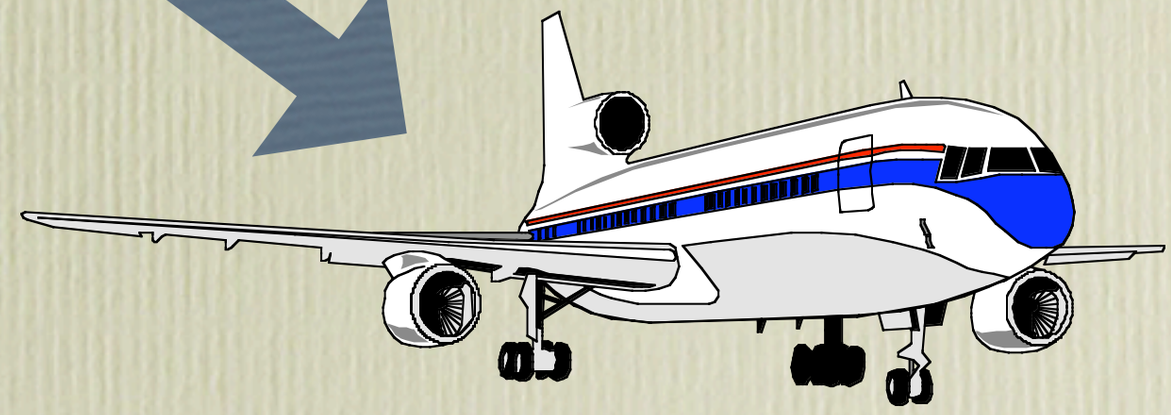
Air Traffic Management (ATM)

ATM

Dynamic & Integrated
Management of
Air Traffic & Airspace

- Safety
- Efficiency
- Punctuality

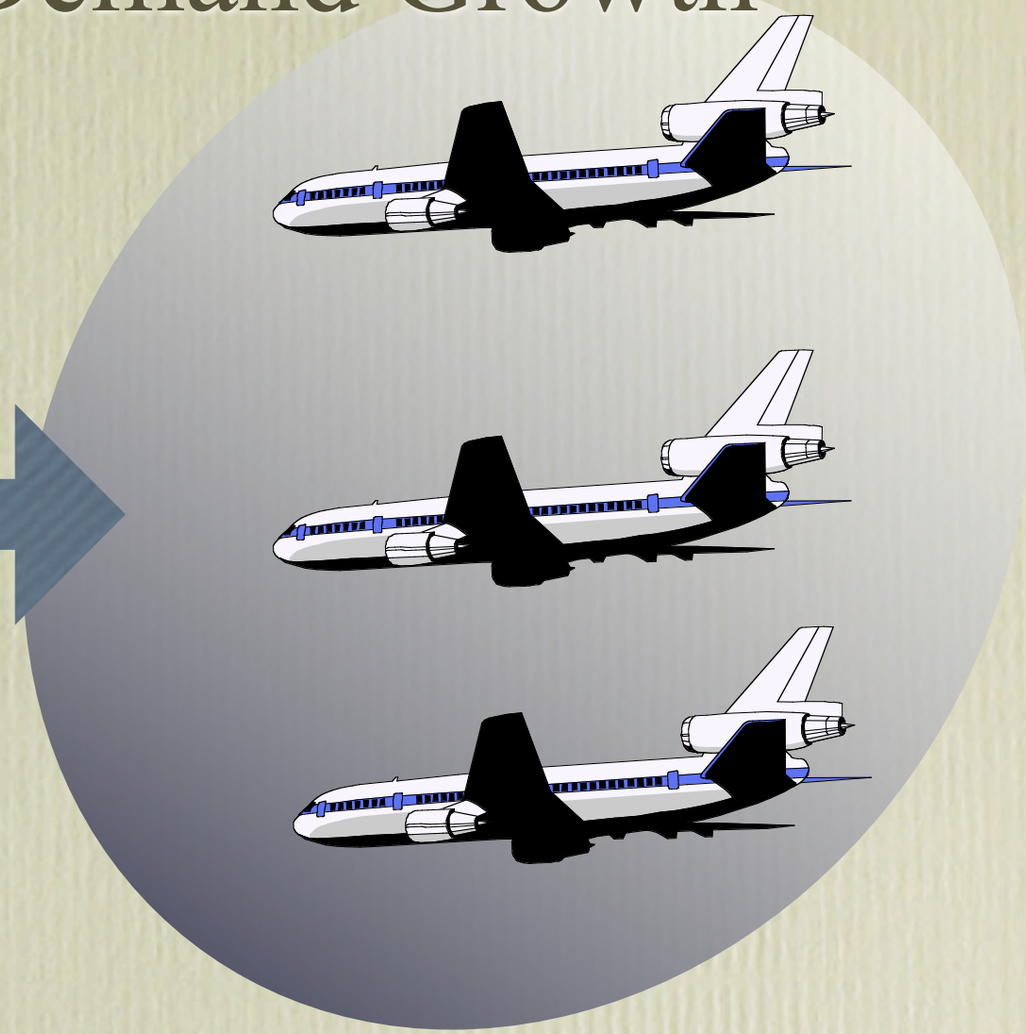
Air Traffic Services



Aircraft Operation

ATM Performance

Traffic Demand Growth



Accommodate :
Performance Improvement

ATM Performance

Traffic Demand Growth

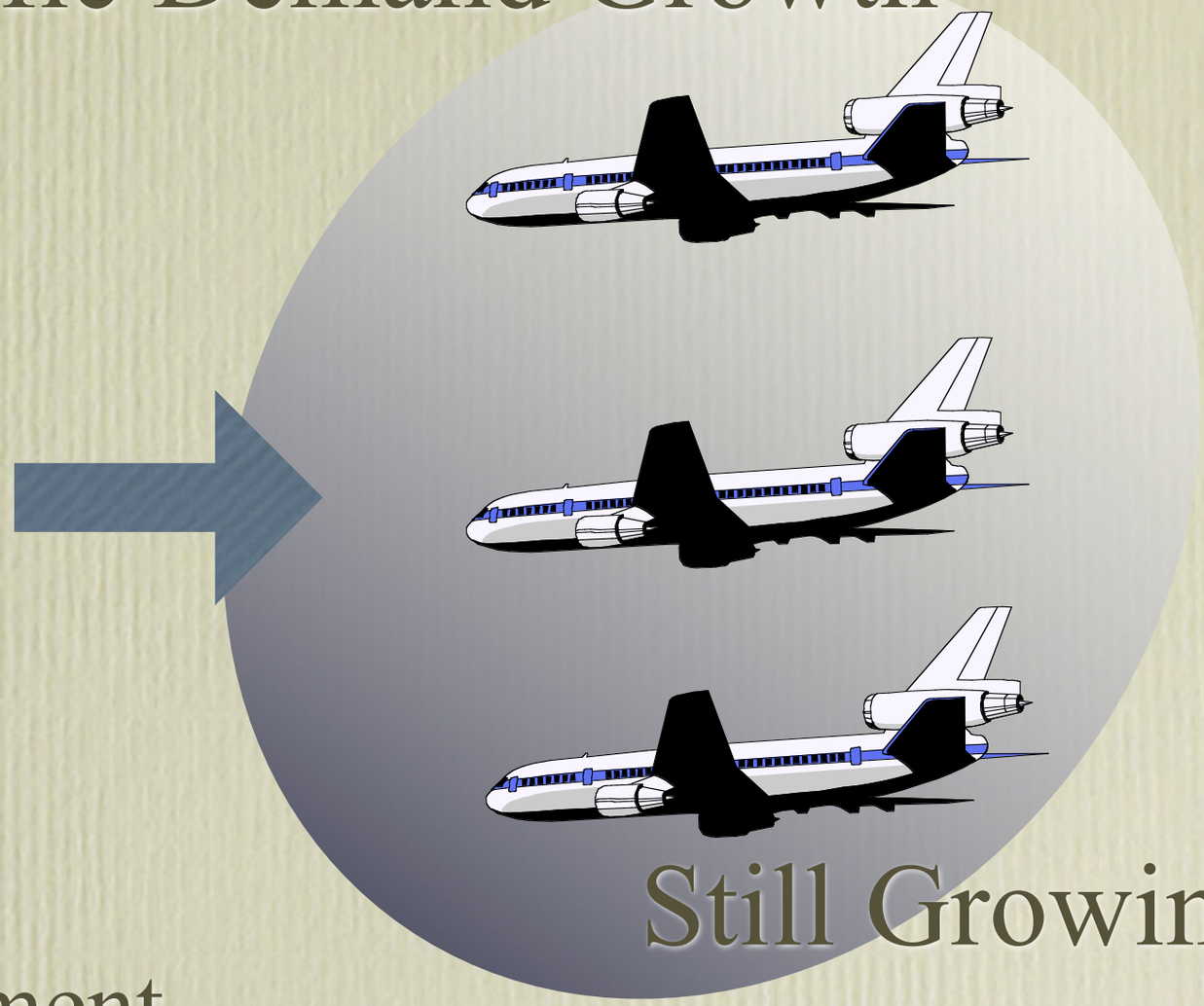
Accommodate :
Performance Improvement

Still Growing

Further & Continuous Improvements Required

ATM Performance

Traffic Demand Growth



Accommodate :
Performance Improvement

Still Growing

Further & Continuous Improvements Required

ATM Performance Assessment

ATM Performance Assessment

Assessment

- Priority Items for the Improvement can be Identified
- The Effect of Planned Improvement can be Estimated

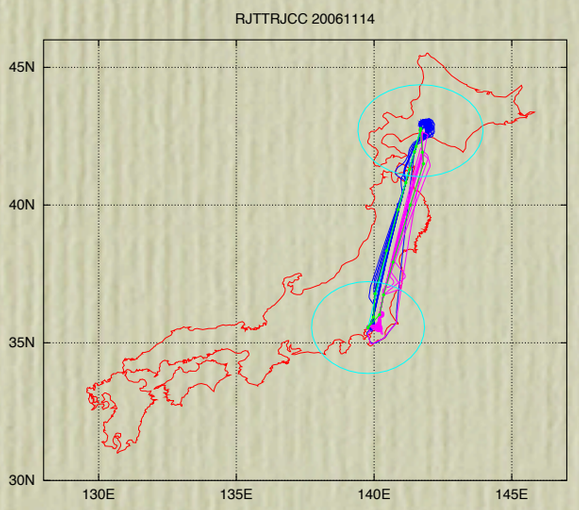
ATM Performance Assessment

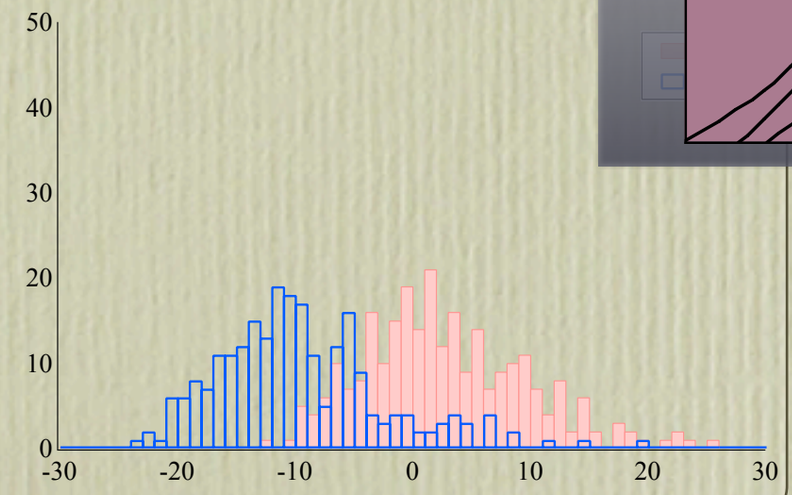
Strategy for the Performance Improvement

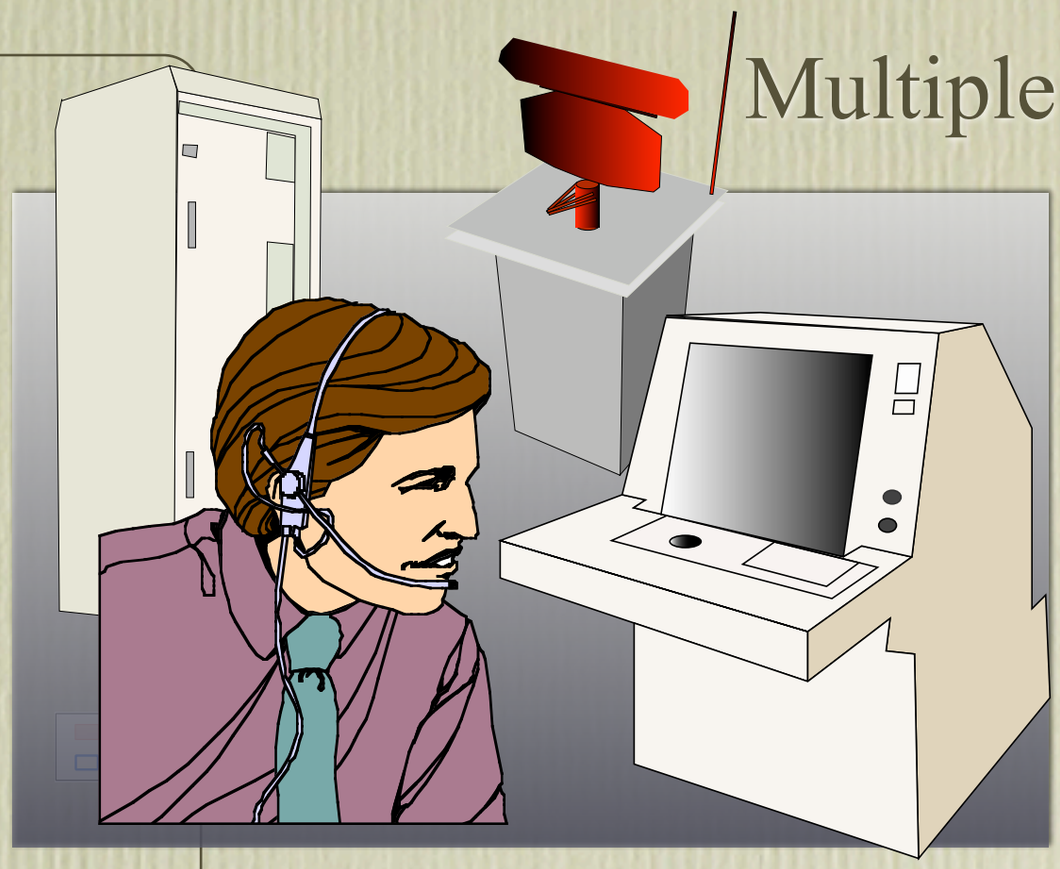
Assessment

- Priority Items for the Improvement can be Identified
- The Effect of Planned Improvement can be Estimated

Perspective of ATM Performance





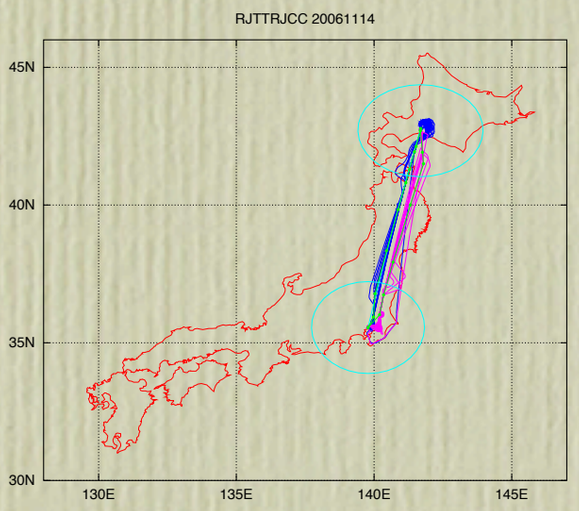


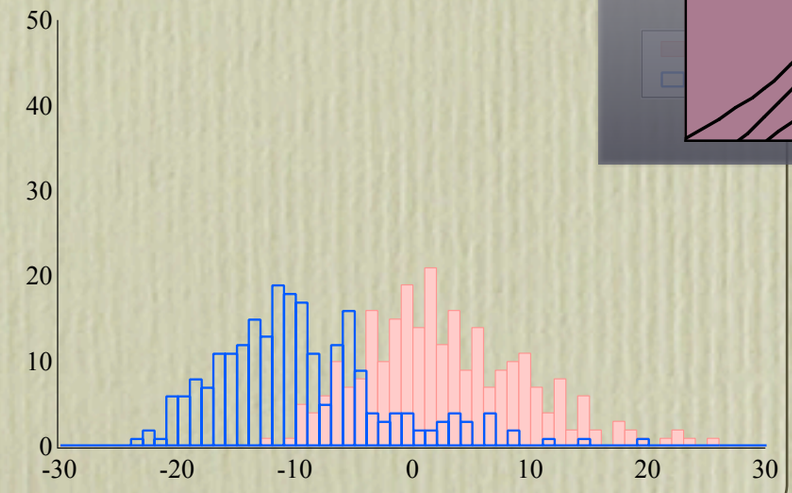
Multiple Objectives

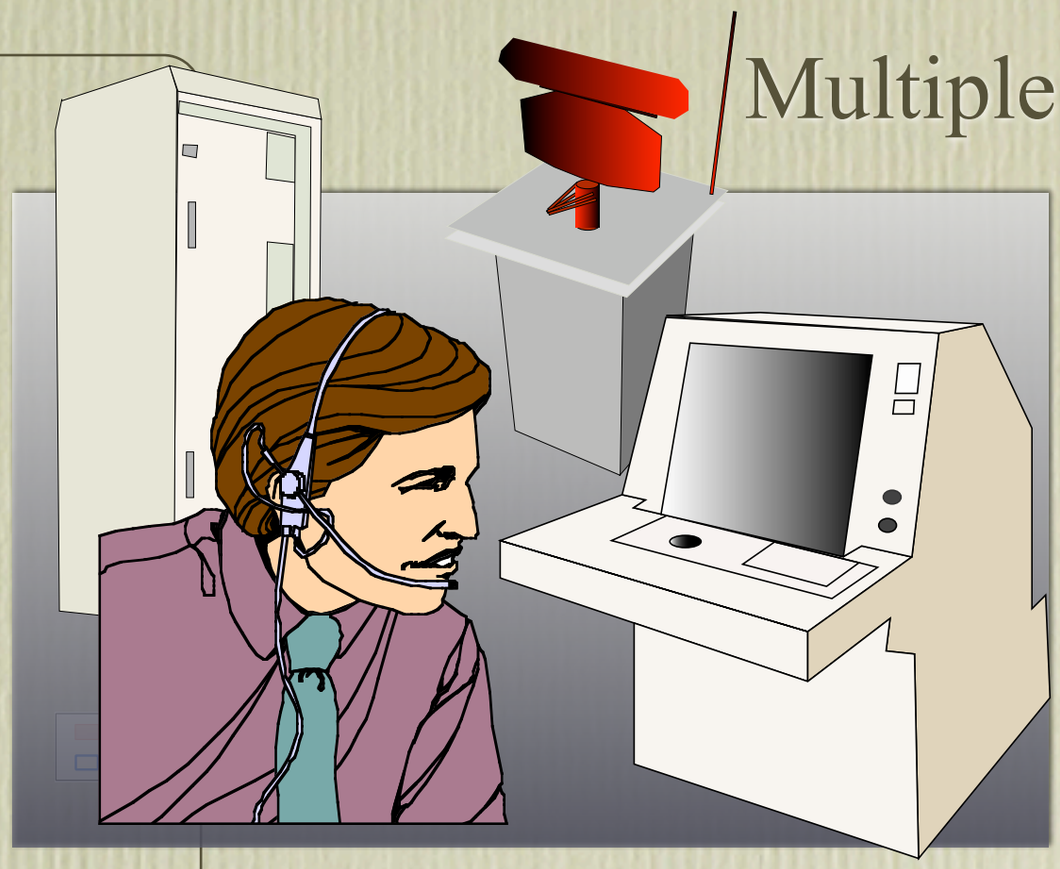
Assessment through

Multiple Perspectives

Perspective of ATM Performance







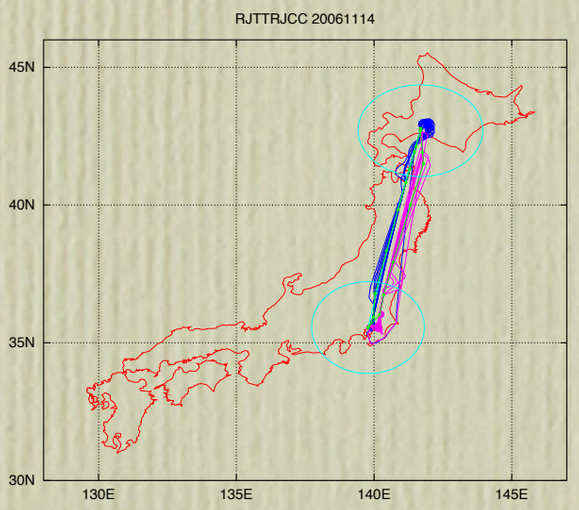
Multiple Objectives

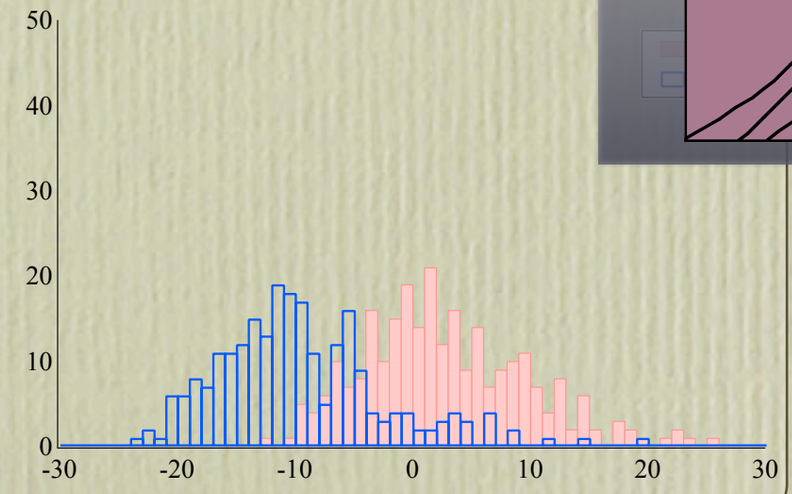
Assessment through

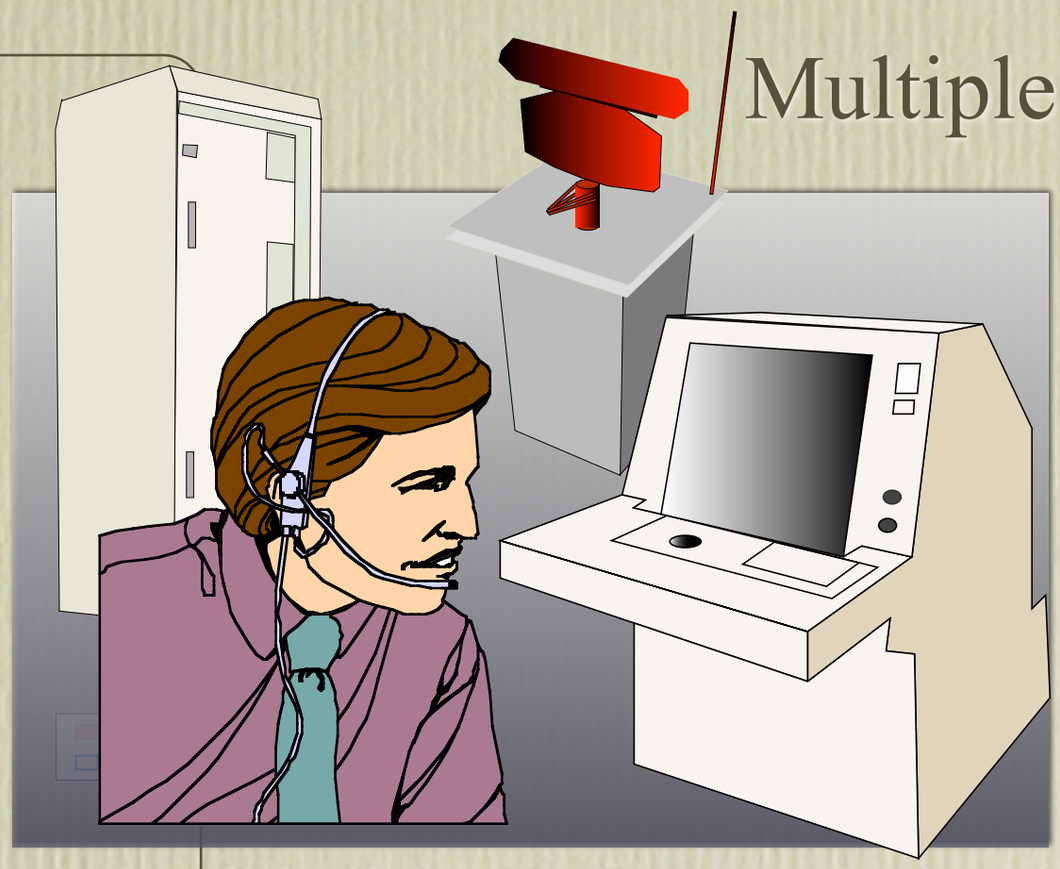
Multiple Perspectives

ICAO Definition : Key Performance Areas (KPA)

Perspective of ATM Performance







Multiple Objectives

Assessment through

Multiple Perspectives

ICAO Definition : Key Performance Areas (KPA)

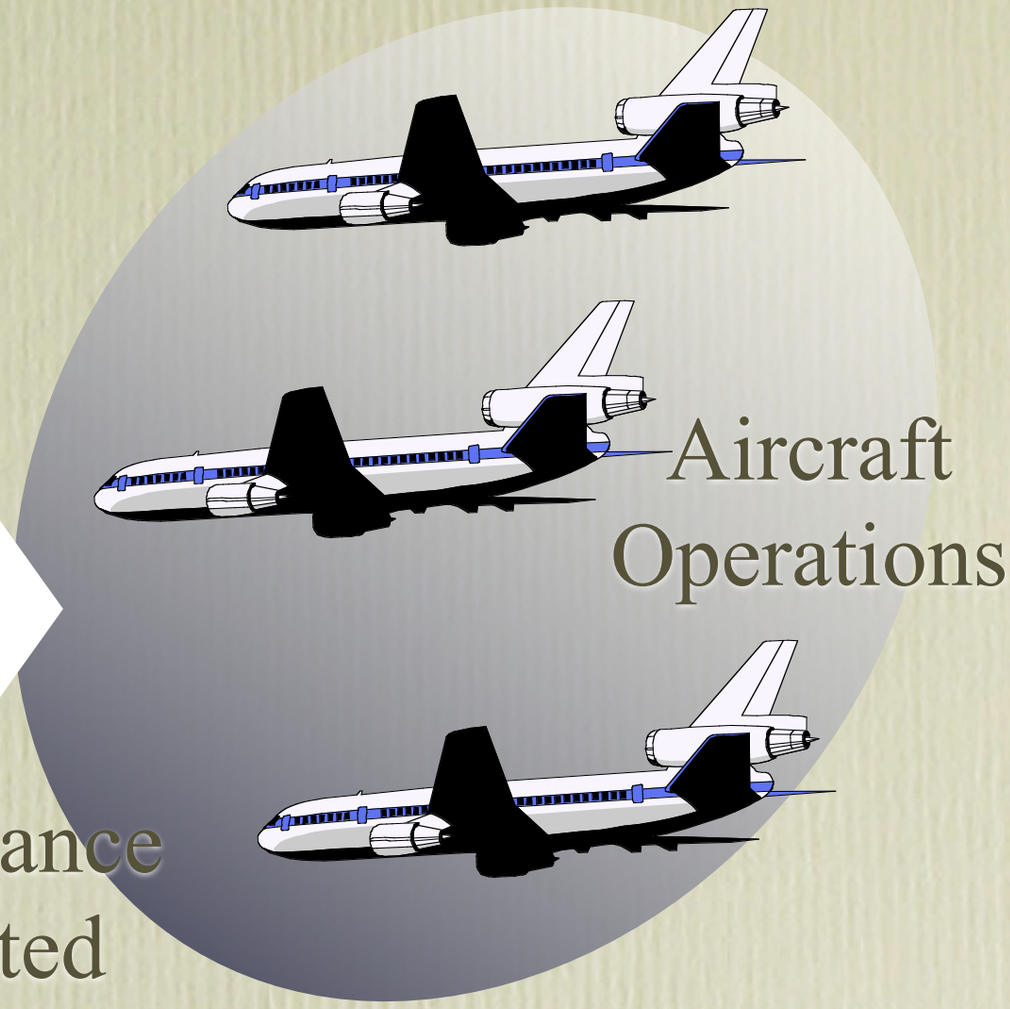
- *Capacity, Efficiency, Predictability* and Others

Data Collection

Data for the Assessment

Mechanism for
Supporting & Safeguarding

Performance
Reflected



Aircraft
Operations

Data for the Assessment

Mechanism for
Supporting & Safeguarding

Performance
Reflected

Aircraft
Operations

Partially
Recorded

ATM System Journals

Analysis : Performance Assessed

Examples of ATM Systems

Data Items in Distinct ATM System Journals

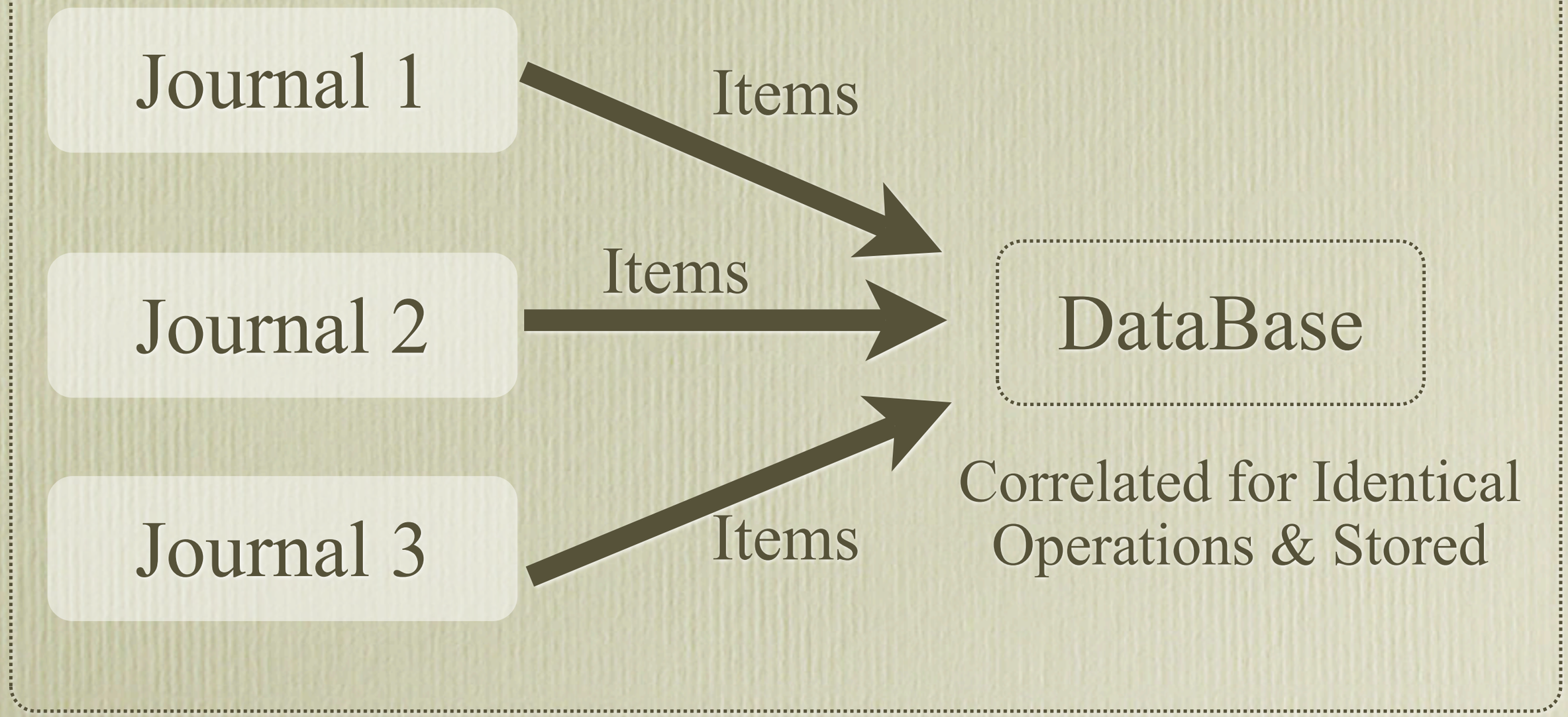
System	Recorded Data Item
Flight Data Management System	Take-off/Landing Times
Radar Data Processing System	Trajectory (in Radar Coverage Areas)
Oceanic Data Processing System	Trajectory (in Non-Radar Coverage Areas)
Gate Management & Planning System	Departure/Arrival Times at Gates
Air Traffic Flow Management System	Revised Take-off Times for ATFM (EDCT)

Challenges for Efficient Analysis

- Data Items
  - Correlation for Identical Operations Required
- Substantial Data Volume
  - Due to Traffic Volume Growth & Numbers of Items

Database Implementation

DBMS (DataBase Management System) Exploited

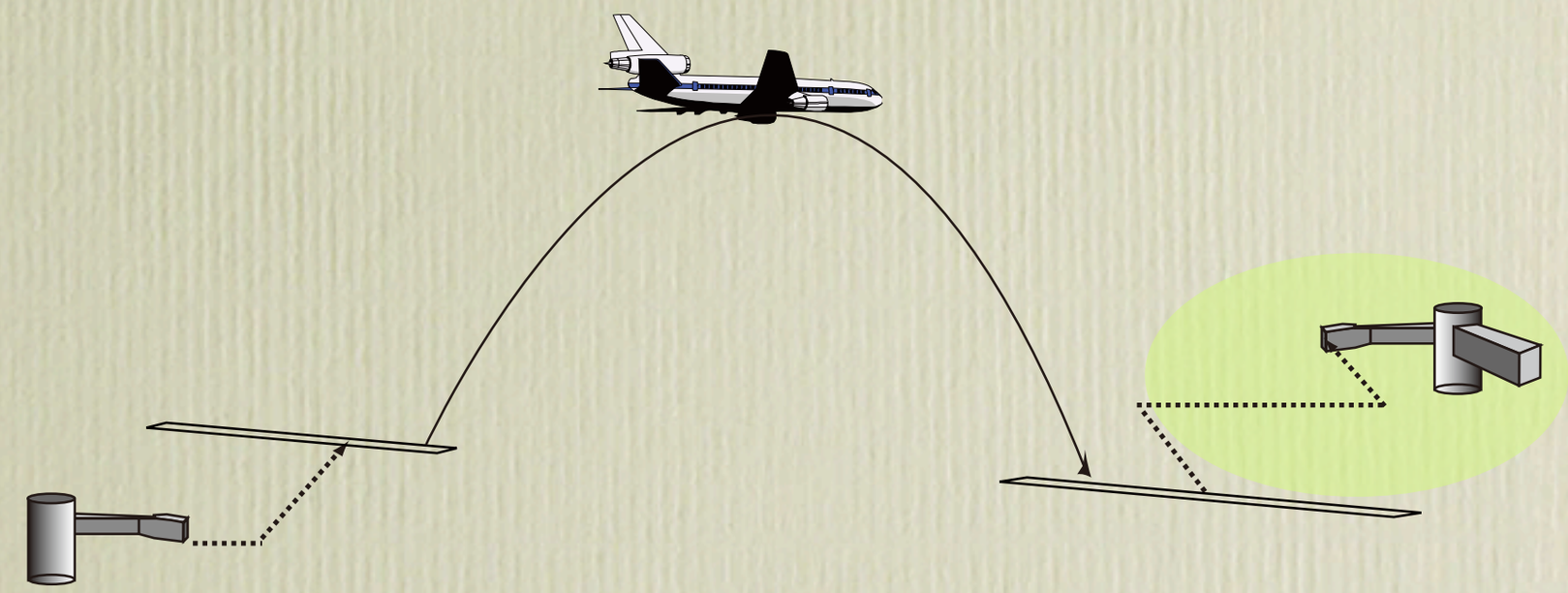


Fast Data Retrieval for the Efficient Computation

Comparison of Arrival Delay

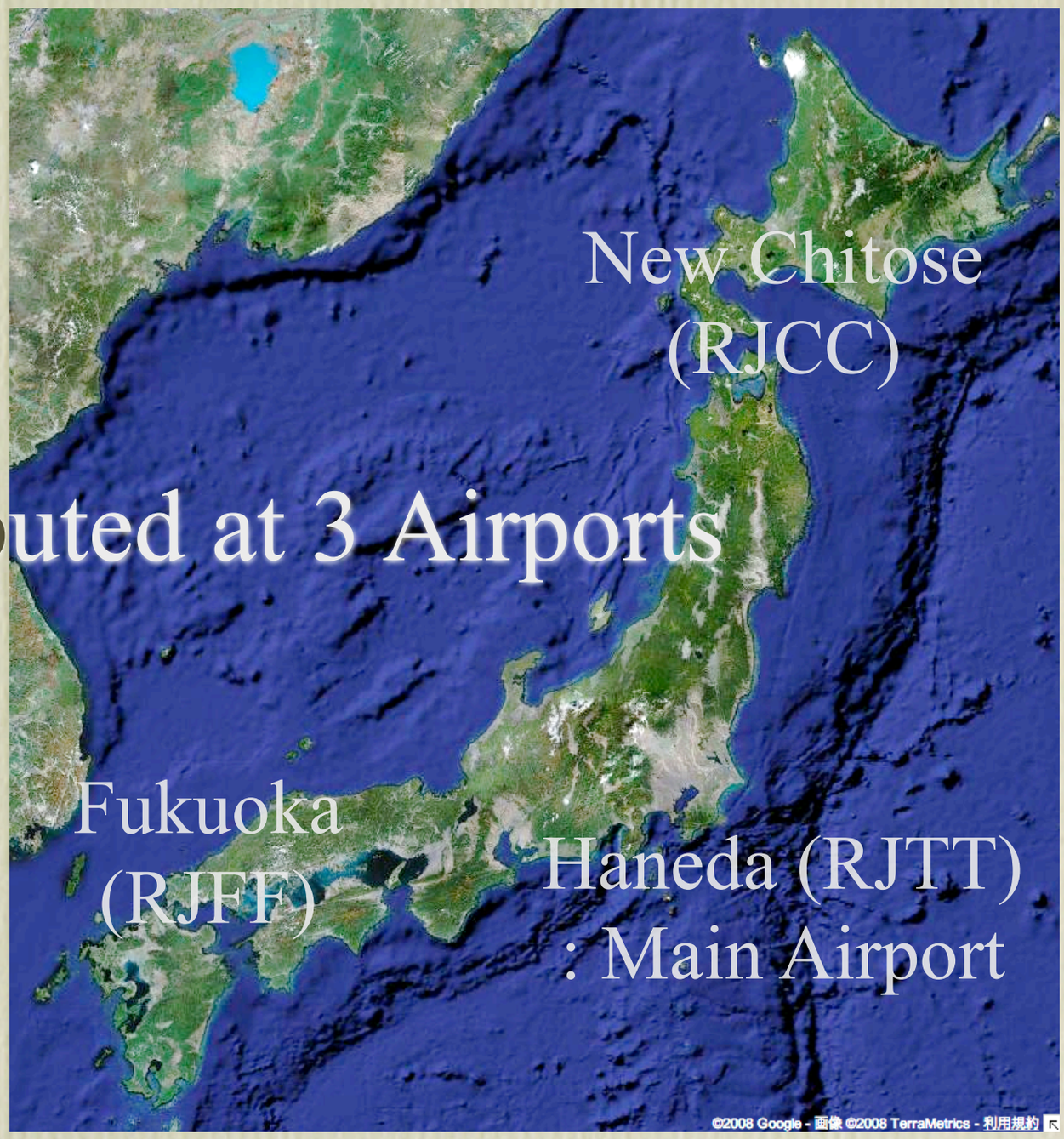
Subject : Delay

- Closely Related to *Efficiency & Predictability* of KPA
  - Important Index for Operational Performance
- Arrival Delay
  - Block-In at the Destination Airports
  - Between Schedule & Actual Time



The Analyzed Data

- 62 Days Worth of Data Gathered
  - 2007/2, 6, 8, 10, 12
  - 2008/4, 6, 8, 10
- Arrival Delays : Computed at 3 Airports



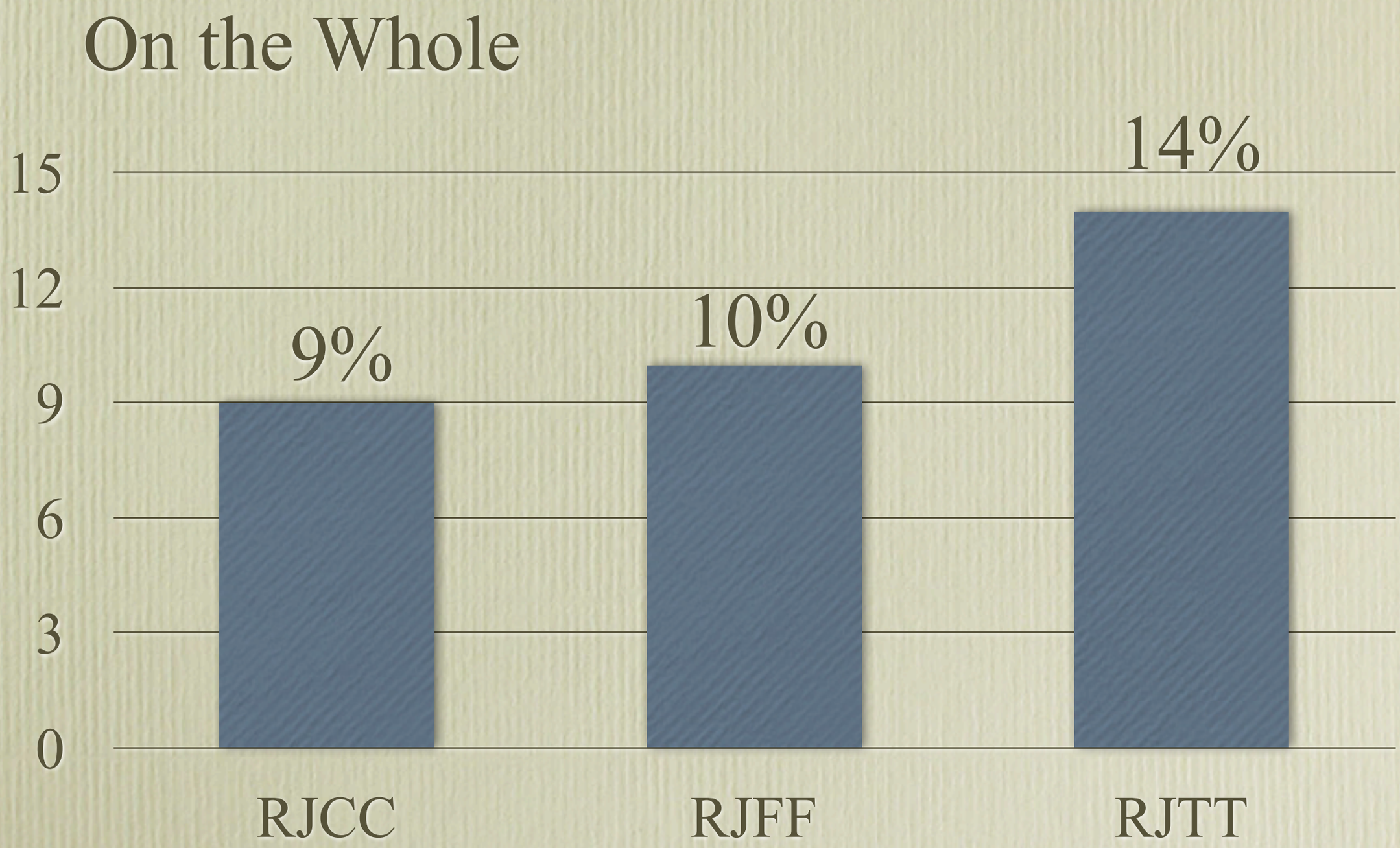
Arrival Delay Index

Late Arrivals

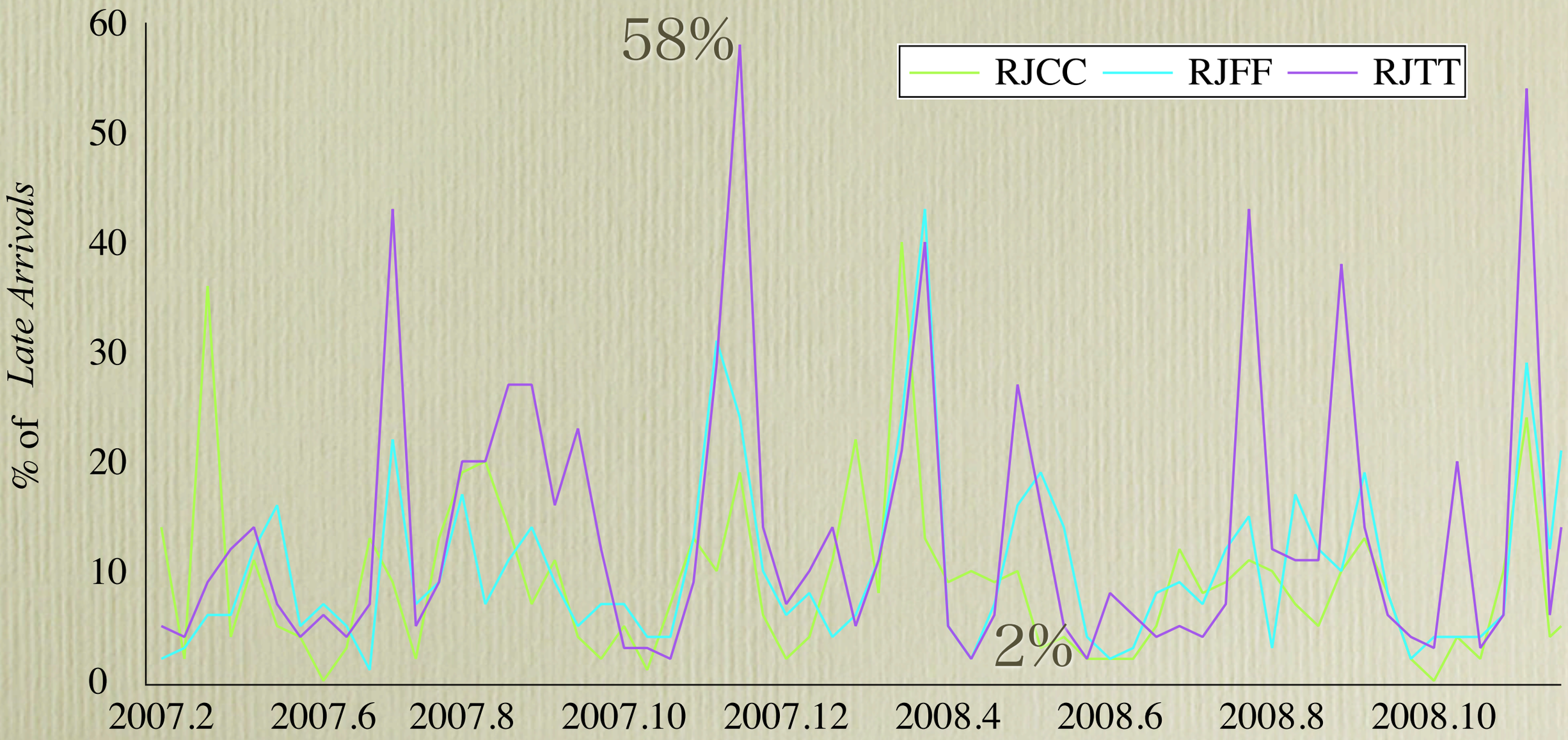
Actual Block-In Time **–** Scheduled Block-In Time **>** *15 min.*

The Percentages Computed : Index

The Percentages of *Late Arrivals*



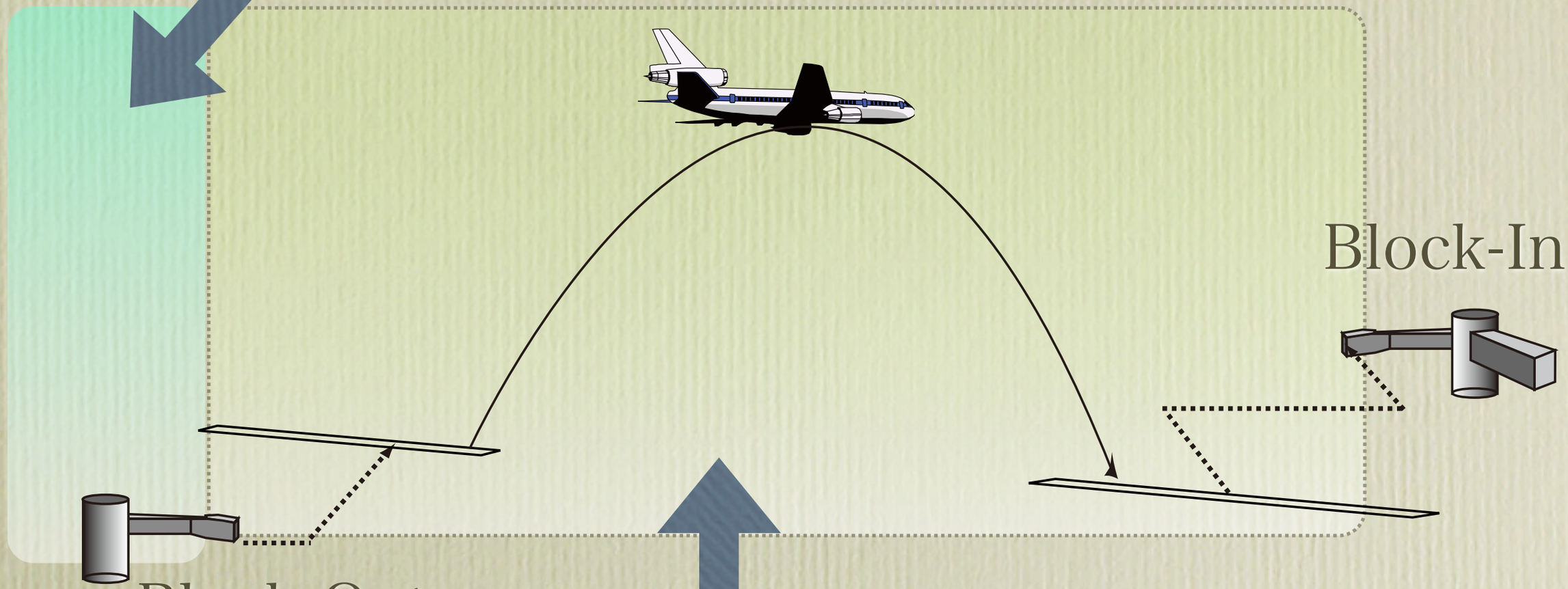
The Daily Percentages of *Late Arrivals*



Fluctuation Among the Dates

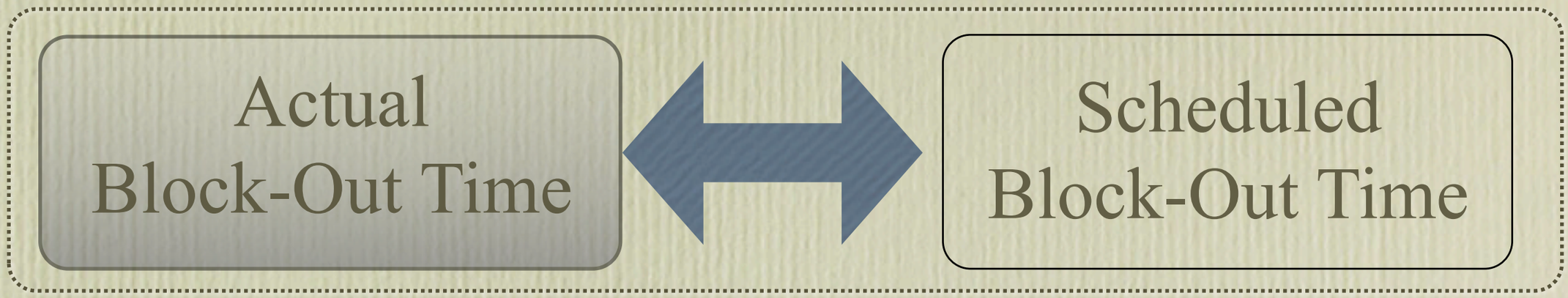
Decomposition of Arrival Delay

Pre-departure Delay by Block-Out



Block-time Delay between Block-Out &Block-In

Pre-departure Delay



ATM Related Factors :

- Airport Surface Design
- Runways / Taxi-ways Congestion
- Air Traffic Flow Management (ATFM)

Block-time Delay

Scheduled Block-time

Scheduled Block-In Time - Scheduled Block-Out Time

Actual Block-time

Actual Block-In Time - Actual Block-Out Time

ATM Related Factors :

- Runways / Taxi-ways / Airspace Congestion

The Index of the Items

Late Departed

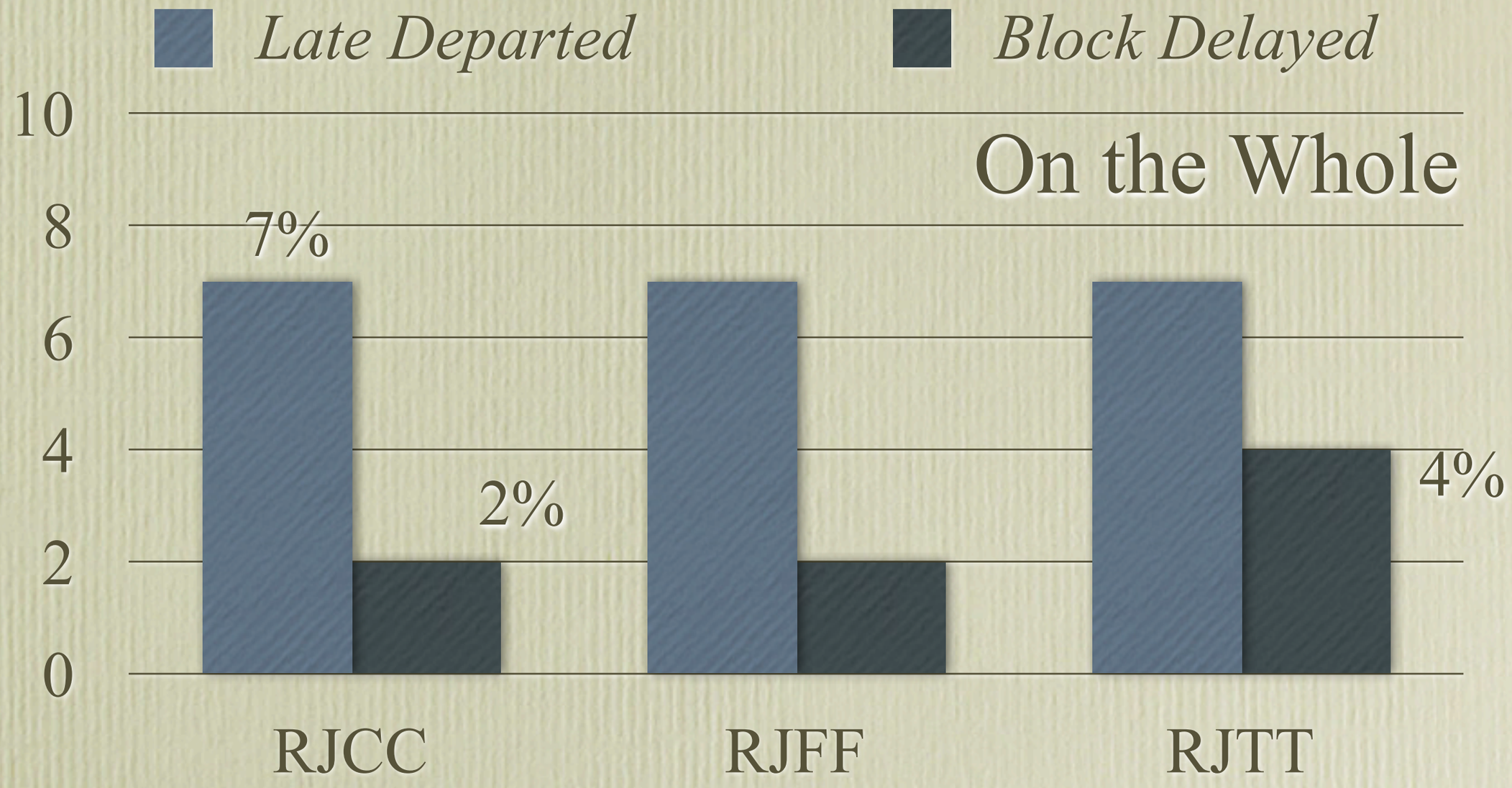
Actual Block-Out Time – Scheduled Block-Out Time > *15 min.*

Block Delayed

Actual Block-time – Scheduled Block-time > *15 min.*

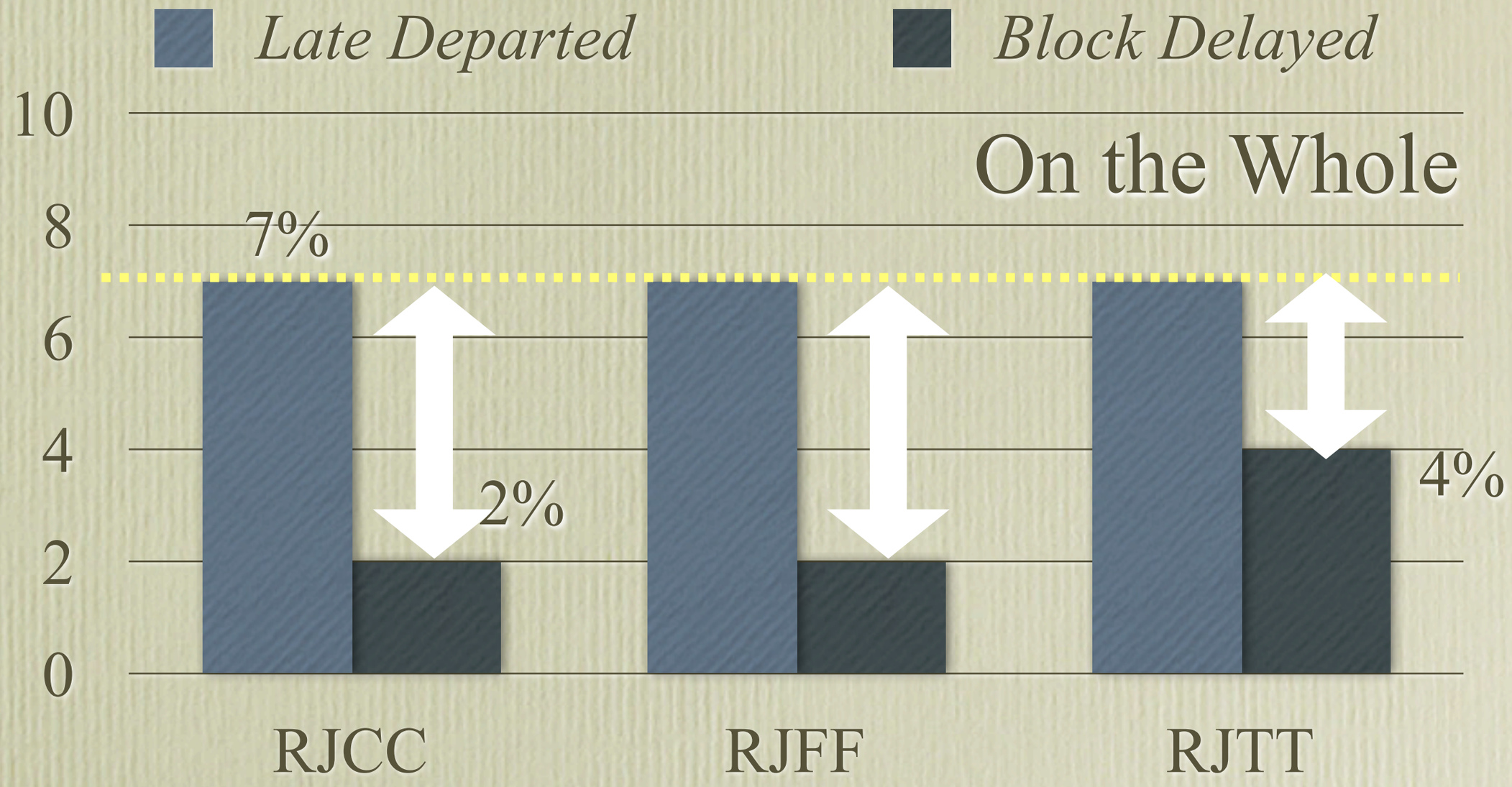
The Percentages Computed : Index

The Percentages at the Airports



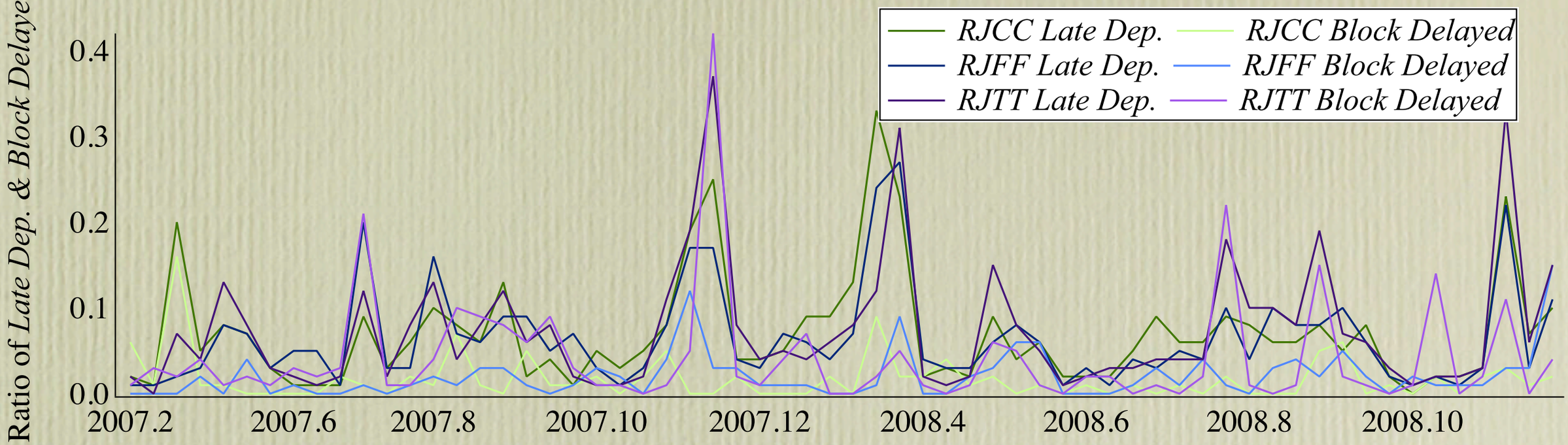
- More Block-Delay at Haneda Airport
- More and Constant Pre-departure Delay

The Percentages at the Airports

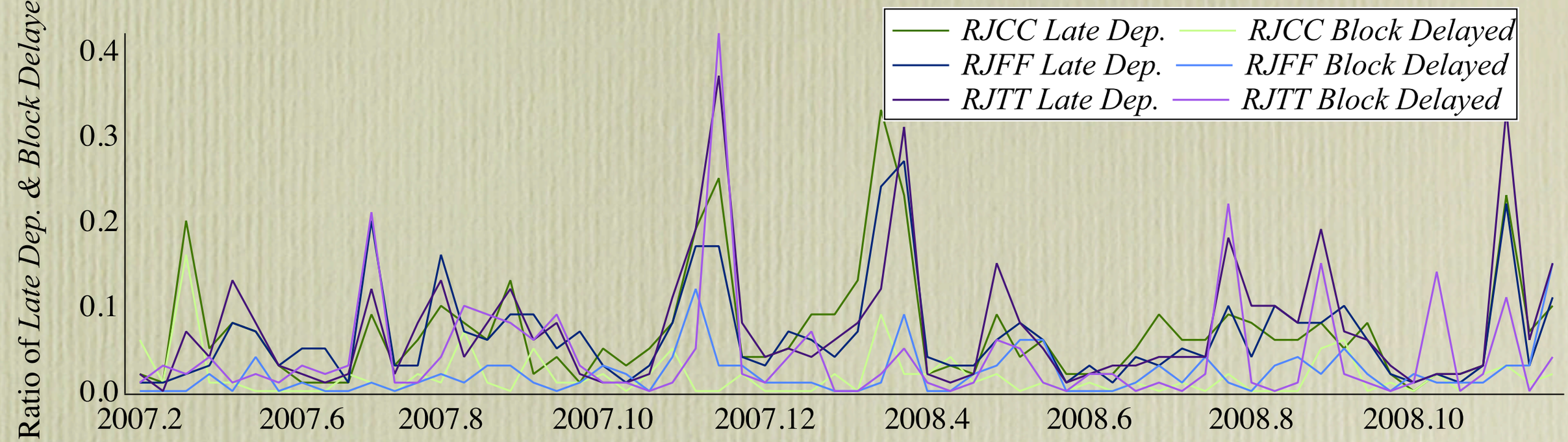


- More Block-Delay at Haneda Airport
- More and Constant Pre-departure Delay

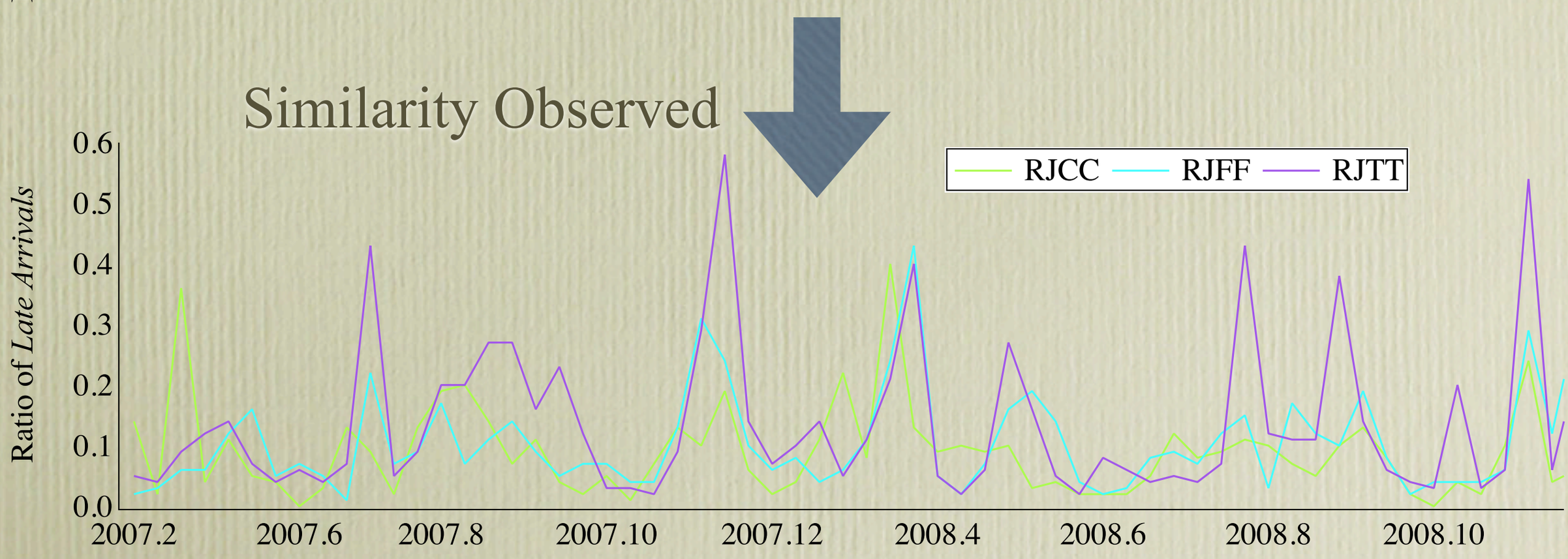
The Tendency of the Percentages



The Tendency of the Percentages

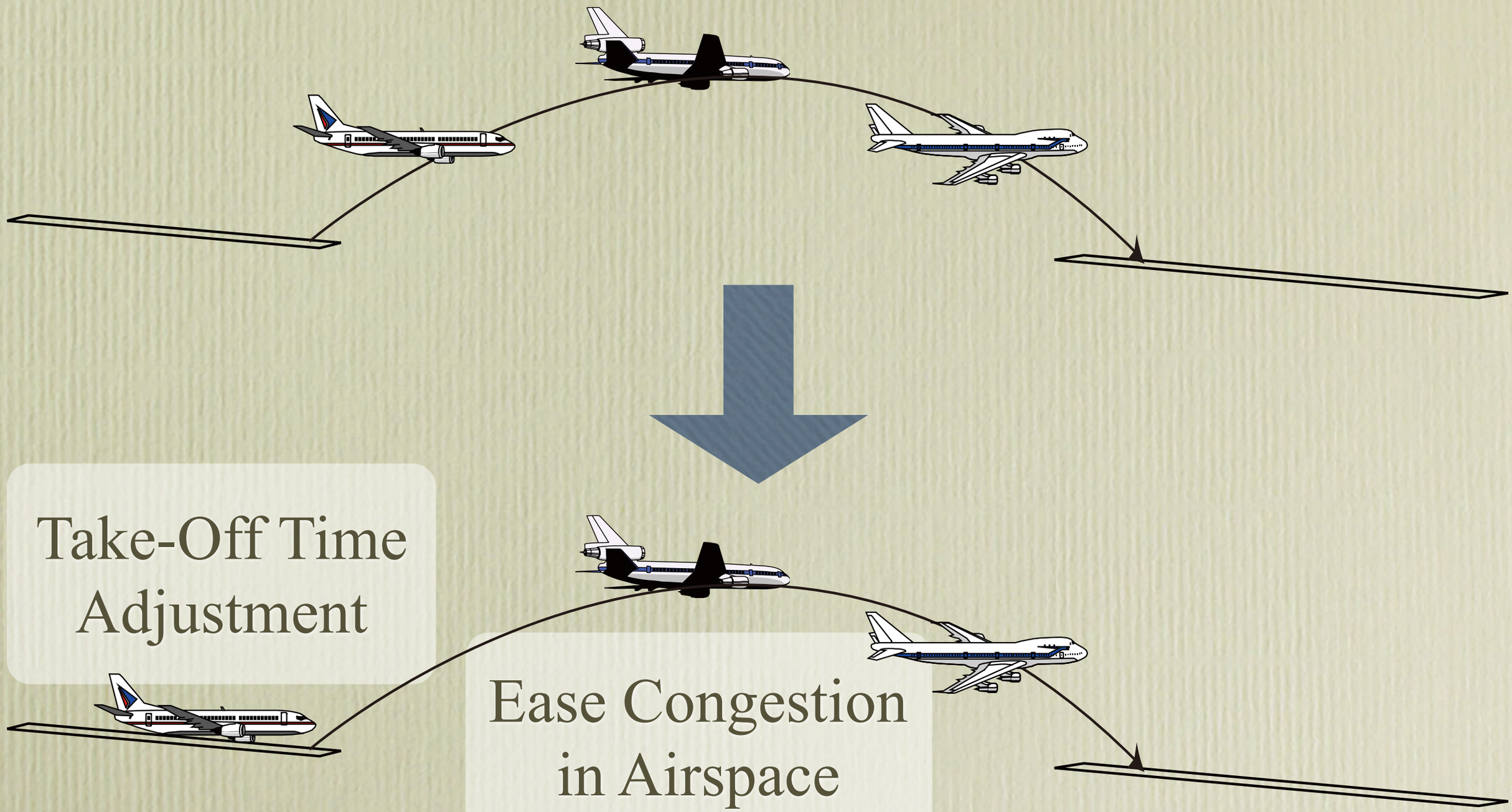


Similarity Observed



Analysis on ATFM Influence

Air Traffic Flow Management



Take-Off Time Adjustment

Ease Congestion in Airspace

Influence on Pre-departure Delay Studied

ATFM Delay Index

ATFM Delay

Revised Take-Off Time (EDCT) − Planned Take-Off Time (ETD)

Pre-Departure Delay caused by ATFM

The Average Used as the Index

$\sum$ ATFM Delay / # of All the Arrivals

Pre-Departure Delay

Actual Block-Out Time − Scheduled Block-Out Time

The Average Computed

$\sum$ Pre-Departure Delay / # of All the Arrivals

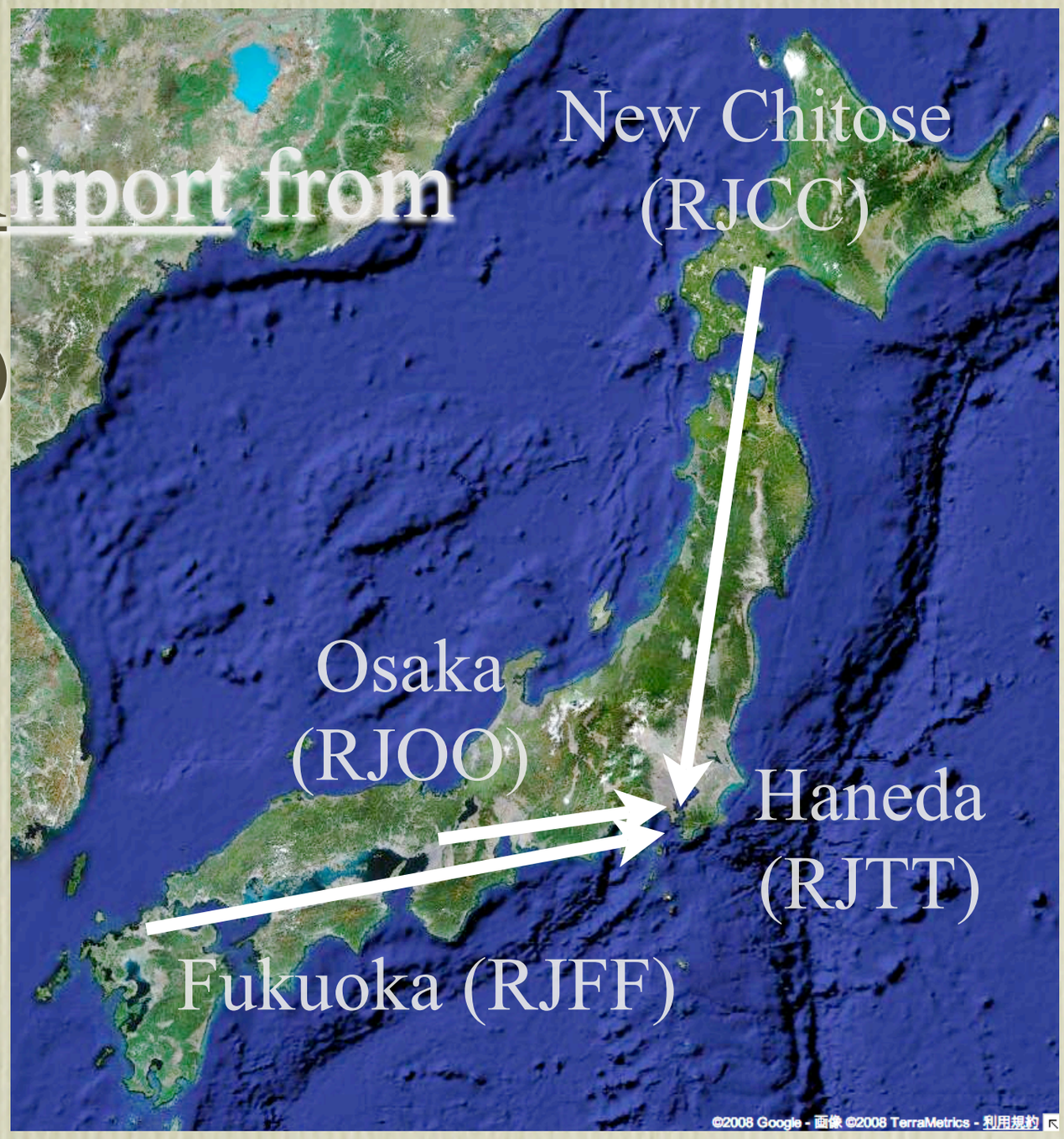
Compared with the Ave. of ATFM Delay

Analyzed Data : ATFM Delay

Data Recorded in 62 Days

Arrivals at Haneda Airport from

- New Chitose (RJCC)
- Osaka (RJOO)
- Fukuoka (RJFF)



The Average on the Whole

(3 Routes Combined)

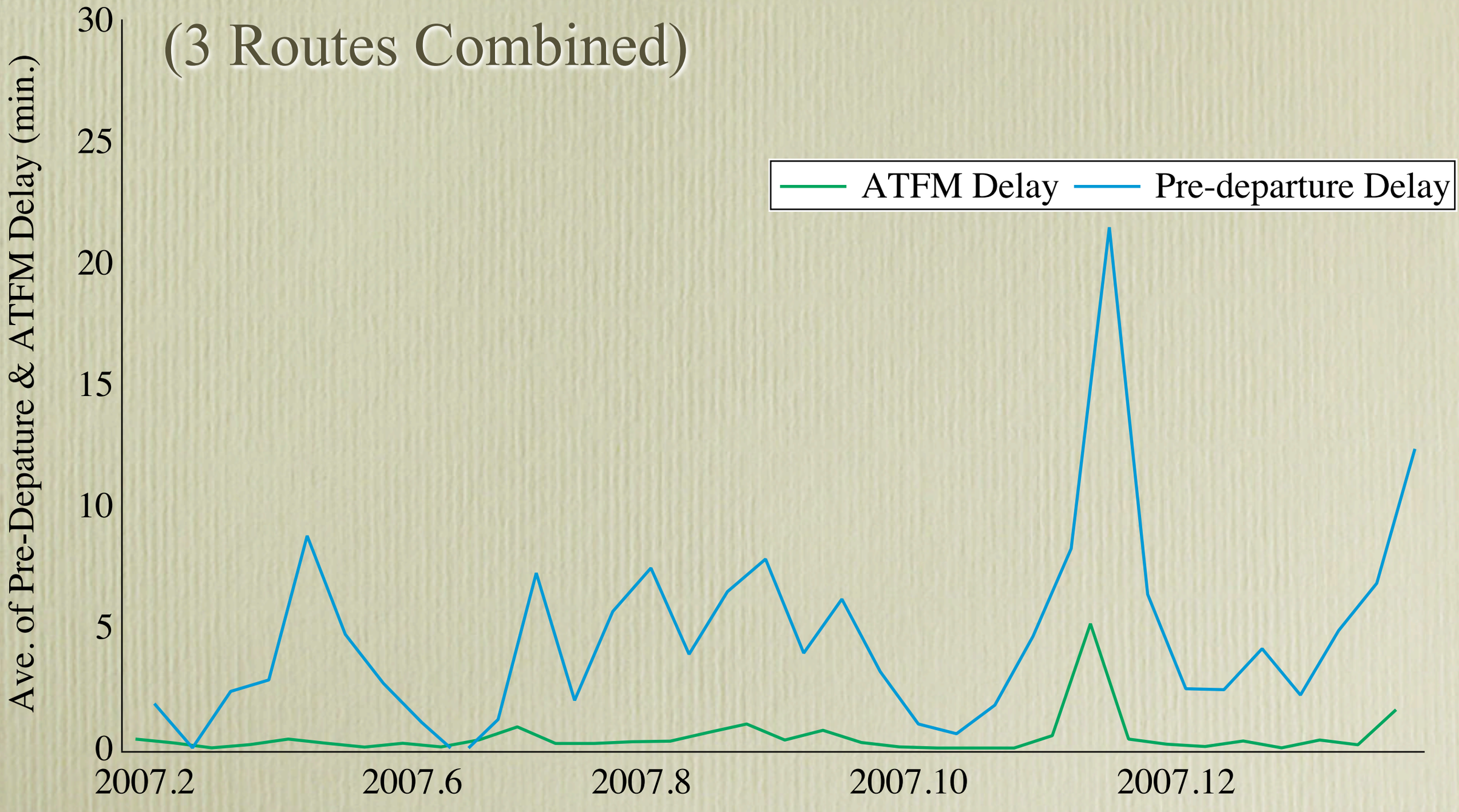
	Pre-Departure	ATFM
Ave.	4.34	0.24

(minutes)

ATFM Delay : About 5% for Pre-Departure Delay
(Small Percentage)

Daily Average of ATFM Delay Index

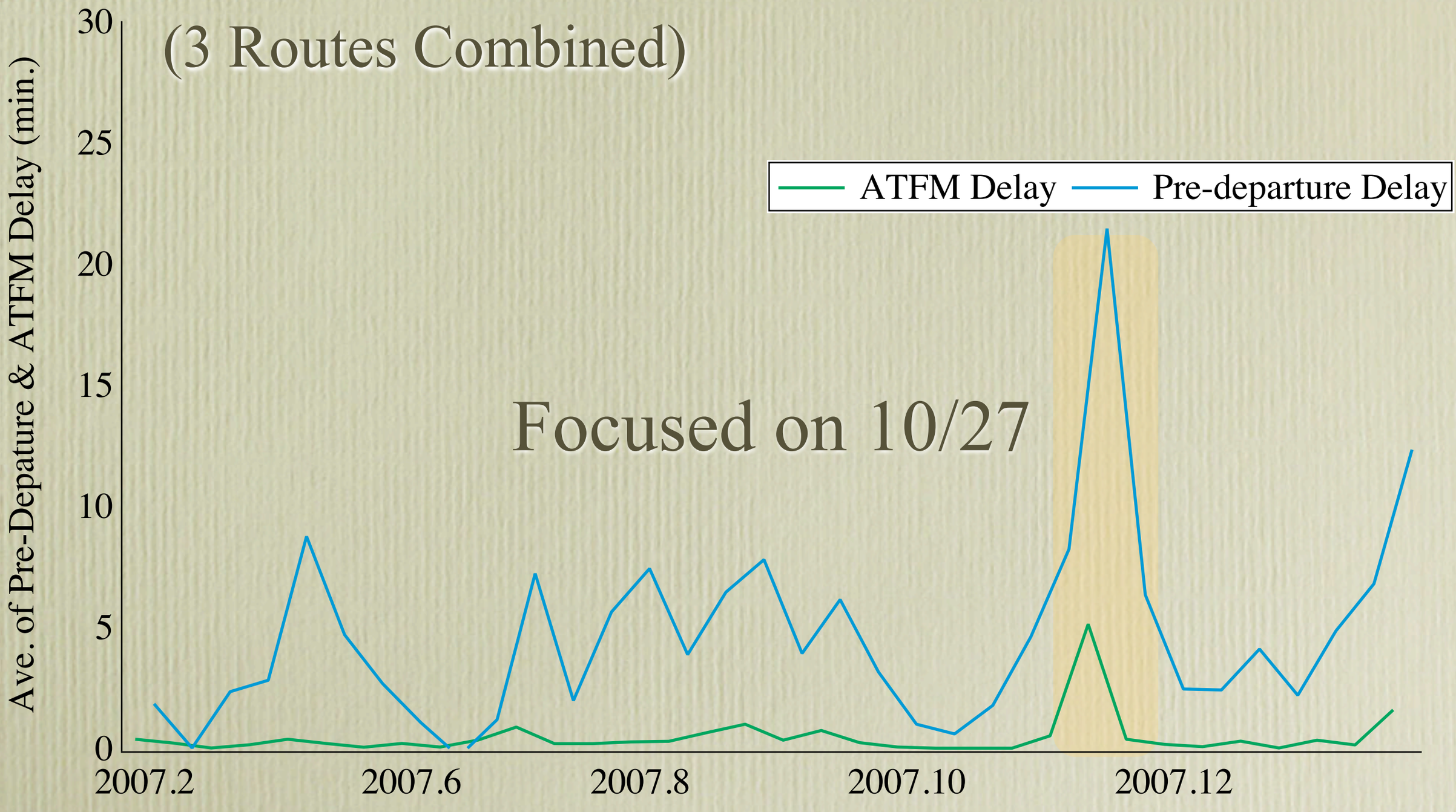
(3 Routes Combined)



Less Correlation on the Whole

Daily Average of ATFM Delay Index

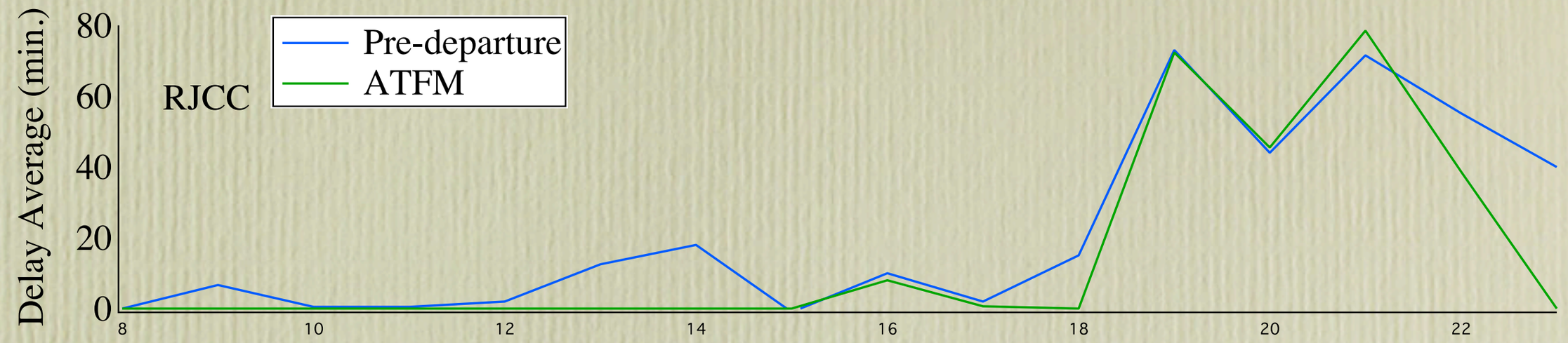
(3 Routes Combined)

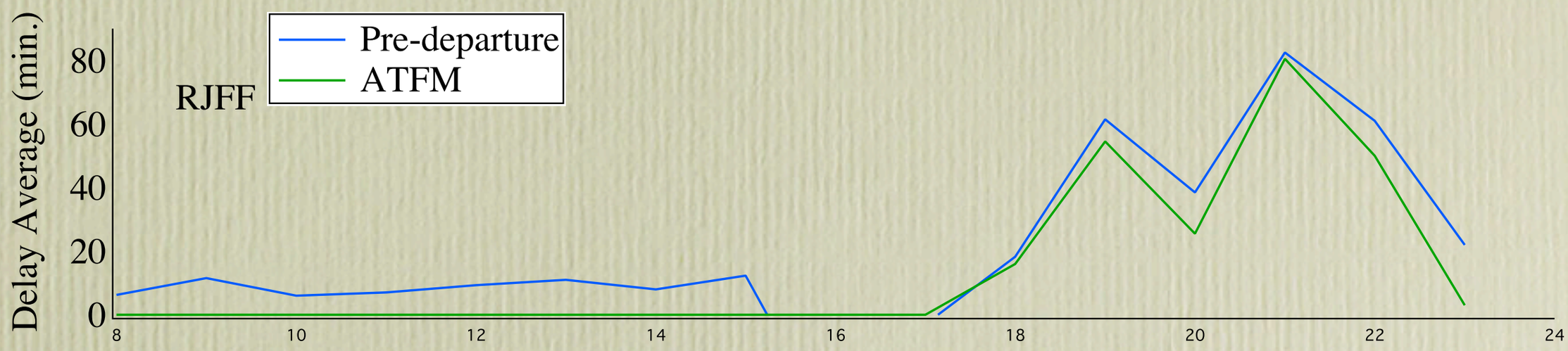


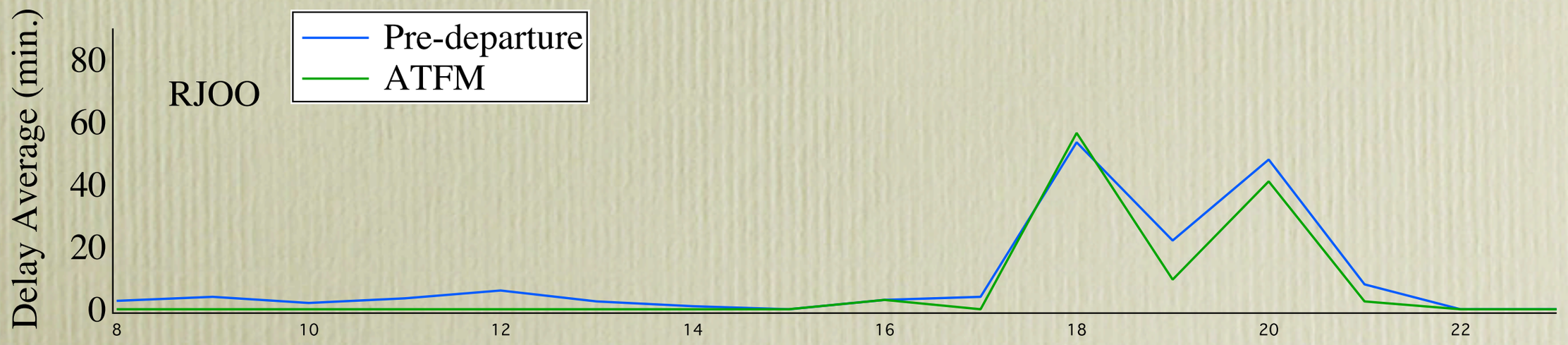
Focused on 10/27

Less Correlation on the Whole

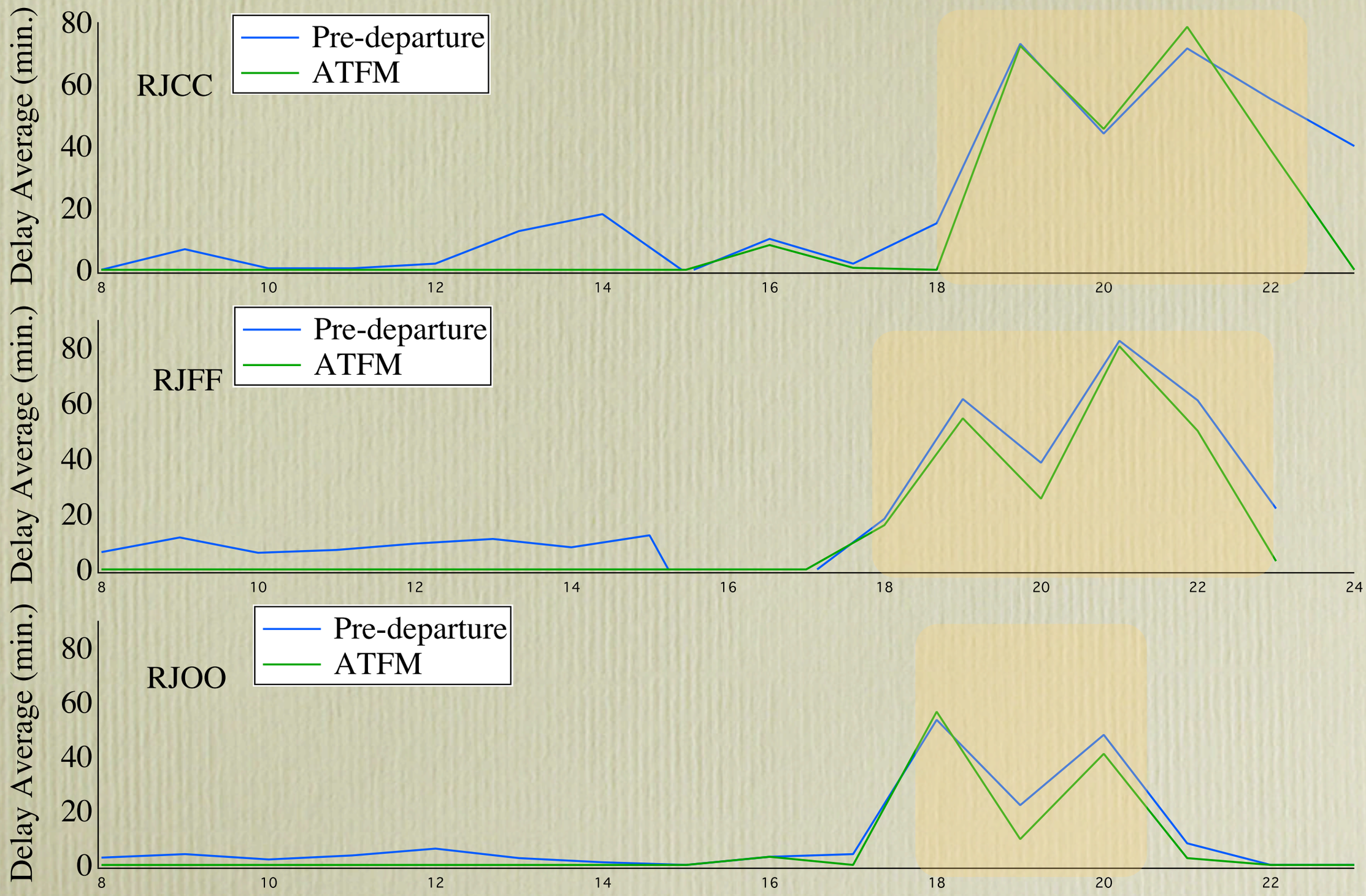
Hourly Average of ATFM on 10/27







Hourly Average of ATFM on 10/27



Localized Time-Periods : Significant Effect from ATFM

Summary

Summary

- ATM Performance Assessment
- Analysis Instance
    - Arrival Delay
        - More Influence from Pre-departure Delay
    - ATFM Impact for Pre-departure Delay
        - Small on the Whole
        - Significant Impacts in Localized Time Periods

Future Work

- Continuous Delay Monitoring Required
- For a Detailed ATM Performance Assessment

Significant Insights on Future ATM Improvements

Thank You for Your Attention