International Civil Aviation Organization

THE NINTH MEETING OF PERFORMANCE BASED NAVIGATION IMPLEMENTATION COORDINATION GROUP (PBNICG/9)

Video Conference, 22 - 24 March 2022

Agenda Item 5: CDO/CCO Implementation

CDO Implementation status - Australia
(Presented by Airservices Australia)

SUMMARY

This paper presents a summary of existing practices and activities underway to implement improvements to CDO in Australia.

1. INTRODUCTION

1.1 An opportunity for improvement to Continuous Descent Operations (CDO) in Australia has been identified as part of a wider 'Trajectory Based Operations' program that aims to implement efficiencies through improved aircraft and ATC system technology.

1.2 Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO) are currently embedded into normal aircraft operations in Australia. Air Traffic Controllers (ATC) are trained to plan for, and provide, continuous climb and descent as far as possible. Where a level is expected to be maintained or sequencing strategies employed, ATC provide aircrew with that advice, however this advice is generally not in advance and often serves only to advise aircrew the reason behind ATC actions. There is no specific communication in relation to CDO and pilots are not aware of what level of intervention may be expected on a flight-by-flight basis.

1.3 A trial of modified CDO procedures will commence later in 2022. Planning and preparation work is currently underway for this trial.

2. CONTEXT

2.1 Australian airspace is modelled on ICAO airspace classes. Our routes are designed to support PBN or PBCS requirements, but not designated as compulsory. Arrival routes normally incorporate closed STAR to IAP design (except Sydney where vectoring is used). Published IAP support RNP navigation including LNAV/ VNAV. Australian AIP contains flight planning requirements to control inbound and outbound flight routes at major airports. There are generally only minor terrain considerations, and the weather often supports visual approaches.

2.2 Airports operate with mixed fleets ranging from small regional aircraft such as DHC8 to large international aircraft up to A380. Aircraft equipment carriage requirements support RNAV and RNP navigation. Most common navigation approvals are RNP2, RNP4, RNP10 (RNAV10) and RNAV5. A mix of approach navigation capabilities exist including RNP AR.

2.3 Air Traffic Management consists of three flow management stages:

- **Strategic** - schedule coordination that generally occurs more than one day prior to the day of operation - managed by the specific airport operator.
- **Pre-tactical** - Occurs on the day prior to operation through the implementation of traffic management initiatives such as a Ground Delay Program (GDP). The GDP provides pilots with an 'off-blocks' time to achieve delay prior to becoming airborne - managed by Airservices' National Coordination Centre.
- **Tactical** - Occurs on the day of operation using real time traffic information to sequence traffic to the destination airport. ATC manage this service.

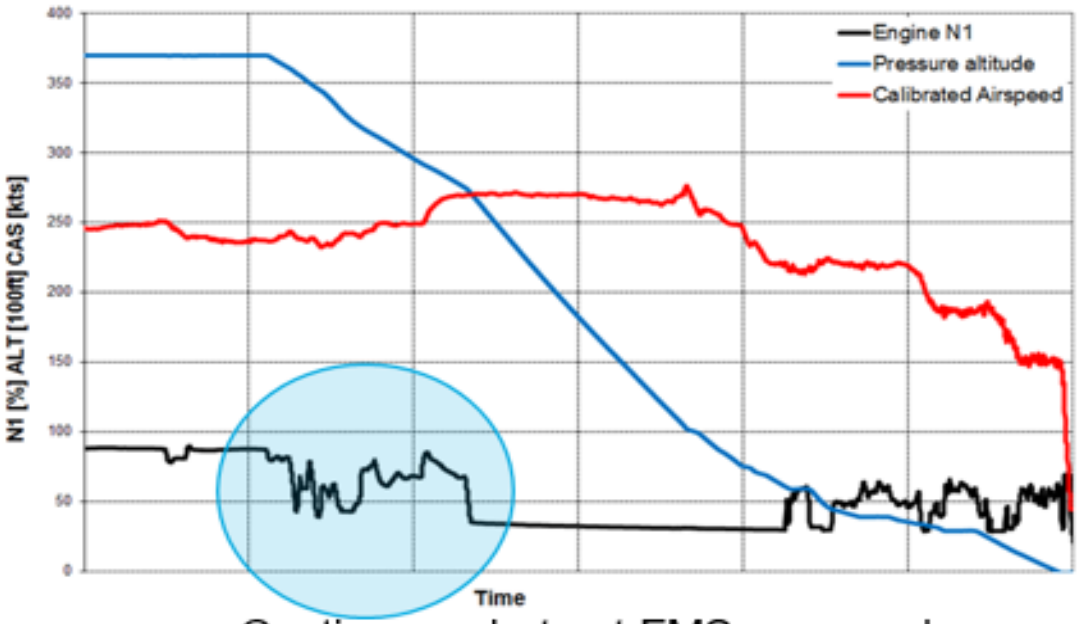
2.4 ATC operate a full surveillance environment. A Flow Controller directs arrivals through a common traffic sequencing tool for major airports. Feeder-fixes (sequencing points located on a STAR and within arrival sector airspace) are designated for each arrival procedure and traffic is managed via pilot met feeder-fix times, speed control, vectoring and holding.

3. DISCUSSION

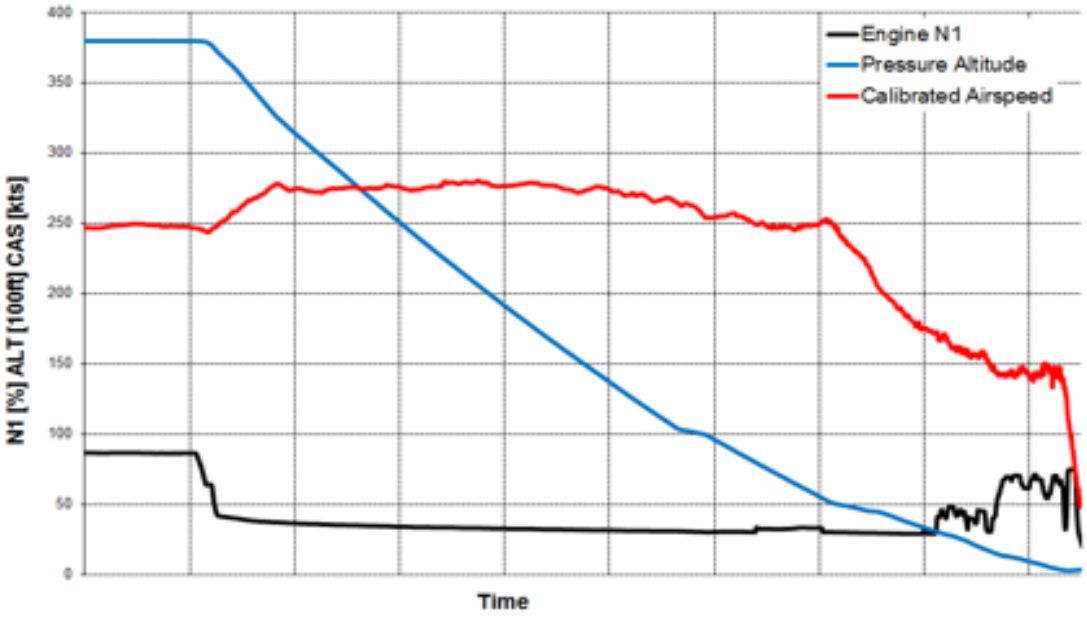
Continuous Descent vs Managed Descent

3.1 The review of aircraft arrival operations in Australia commenced with collaboration and data gathering with industry partners.

3.2 Metric analysis (see Appendix A) revealed that although 'conventional' CDO was achieved by a large proportion of flights, FMS managed CDO was only present around 50% of the time.



Continuous, but not FMS managed



FMS managed descent

3.3 A reduction in traffic numbers during COVID have not necessarily resulted in a corresponding increase in FMS managed CDO. Other factors influencing CDO rates include ATC staffing requirements (during COVID), runway operating constraints including noise regulation, procedure design constraints, flight priorities and demand compression.

3.4 Review of international practice combined with arrival data analysis led to the development of a multi-stage project (See Appendix B) aimed at:

- Reducing ATC and flight crew workload
- Improving flight efficiency and on time performance
- Reduced CO_2 emissions and aircraft noise.

3.5 The initial stage consists of a trial for implementing Optimised Profile Descent (OPD) – a form of CDO that provides better expectation for aircrew and ATC regarding descent and intervention. The trial will be implemented in Melbourne. Airport selection involved analysis of data to determine the greatest opportunity for gaining value, lowest risk through reduced implementation complexity and absence of other factors that could undermine the effectiveness of the procedures (see point 3.3 above).

3.6 The trial will require development of the following artefacts:

Document/ item	Comment
Safety case	Contains all safety related information related to the trial, including how the trial will proceed, who will be involved, constraints, hazard analysis and risk assessment.
Agreed set of procedures and parameters	Developed in collaboration with industry participants and ATC. Procedures must be fit for purpose to support the trial within local conditions, but must also allow flexibility for future

	expansion, alignment to ICAO and provide the safest outcome.
Letter of Agreement	Between ATC and industry participants, setting out ATC and aircrew procedures and obligations.
Temporary Local Instruction	Instruction to ATC setting out ATC only procedures eg coordination requirements and management of flow tool.
Post implementation report	Includes ATC and pilot feedback, de-identified data, analysis and recommendations for changes and improvements.

3.7 Future stages of the project include:

- Refined procedures and operating parameters
- System enhancements to support OPD
- Expansion of OPD applications to more operators and more airports
- Increased sequencing time horizon to provide longer look-ahead for delay absorption
- Formalised track stretching – new waypoints added to allow track stretching for absorbing delay prior to TOD while give aircrew know track miles to feeder fix and touchdown.

3.8 Other related activities include:

- Future re-design of SID/ STAR structures to improve CDO performance.
- LR-ATFM (Long Range Air Traffic Flow Management) – aerodrome demand/ capacity management to allow initial delay absorption by long-haul aircraft several hours prior to arrival.
- RA-CDM (Regional Aerodrome Collaborative Decision Making) – data sharing by airlines to manage departures from nearby regional aerodromes within the existing arrival sequence.

4. ACTION REQUIRED BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper; and
b) discuss any relevant matters as appropriate.

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Summary of the paper to be included in the meeting report

A summary of existing practices and activities underway to implement a program of improvements to CDO in Australia. A trial will be conducted later in 2022 as the initial stage and involves several airline partners operating at one airport. Data from this trial will inform future stages to expand and refine CDO procedures.

CONTINOUS DESCENT OPERATIONS (CDO) & OPTIMISED PROFILE DESCENT (OPD) TRIAL

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CMATS is the new platform that will provide air traffic management services for our customers

Our customers are interested in the associated benefits that OneSKY brings to them (*what's in it for me?*)

The Benefits Enabling Program focuses on optimising the capabilities delivered through OneSKY into operational solutions that benefit Australian airspace users

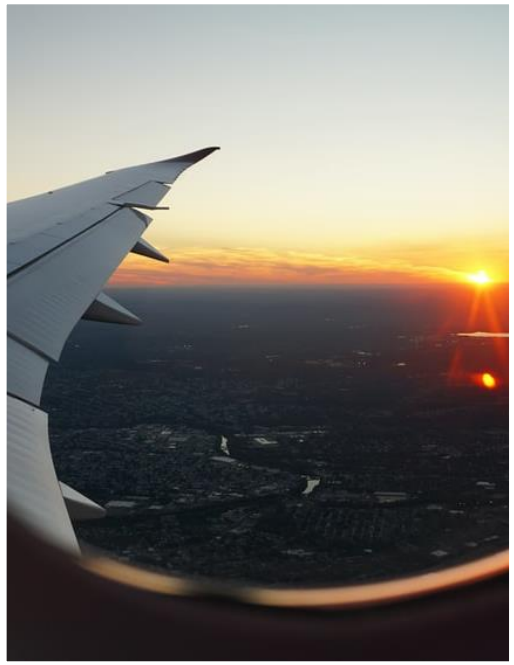
CONTINUOUS DESCENT OPERATIONS (CDO)/OPTIMISED PROFILE DESCENT (OPD)

Project Overview

Introduces a process whereby the descent sequence will be established prior to the top of descent to allow for uninterrupted idle cruise descent into capital city aerodromes.

This will provide improved predictability in descent.

Currently, the capability exists but is limited by a system designed for tactical intervention during the arrivals phase of flight.



- Decreases descent noise, saves fuel, reduces carbon emissions
- Optimises traffic flow incl. maximised runway use and reduced travel delays
- Optimal aircraft trajectories and performance through redesigned airspace, route structure and arrival procedures
- Improves accuracy of arrival times
- Flight crews can manage delay prior to descent
- Slow aircraft are not penalised by using parallel inbound routes, while allowing others to achieve CDO
- Predictability in aircraft arriving from close regional ports
- Reduces pilot and controller workload by removing manual handling of aircraft

airservices | OneSKY AUSTRALIA

Supports trajectory based operations benefits to the value of $116m over a 20 year period

PROBLEM STATEMENT

Current Capability

Australia's current capability is limited by a system designed around the concept of tactical intervention during the arrival phase of flight.

Efficiency Vs Flexibility

The current system compromises flight efficiency in exchange for flexibility.

Limitations

The limitations of the current state (demand and capacity balancing, system predictablity and arrival procedures) means that aircraft are mostly unable to absorb delays at cruise in order to achieve the most efficient and optimal descent profile.

DESIRED CUSTOMER PERFORMANCE OUTCOME IMPROVEMENTS

Effort	Known delay equates to less tactical ATC intervention on descent, allowing predictable dissipation of aircraft energy in the descent phase and reducing crew workload.
On Time Performance (OTP)	Improved on-time performance through system-wide information sharing.
Environment	Reduced CO2 emissions and aircraft noise due to reduced fuel consumption/burn.
Cost-Efficiency	FMS-managed descent allowing for most efficient operations while including known constraints.

CUSTOMER JOURNEY IMPACTS

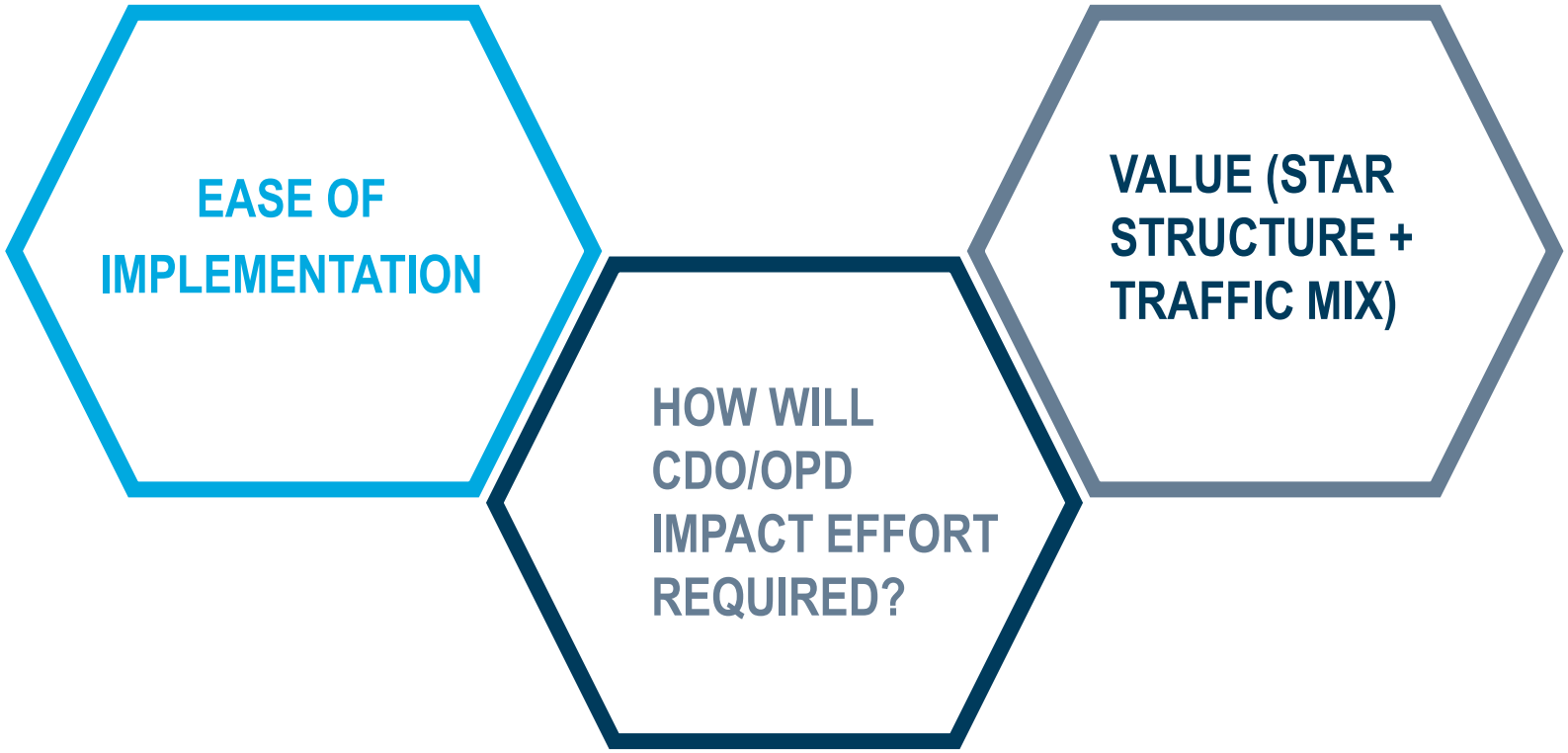
SCOPE CONFIRMATION OF TRIAL

- CMATS will introduce additional capabilities and enhancements to network and traffic management
- The OneSKY Program will deliver $1.2 billion of economic benefits to airline customers over a 20-year period
- Through enhanced trajectory-based management tools, CDO/OPD can be introduced at a number of aerodromes with supporting STAR structures to reduce fuel burn and CO2 emissions, allowing aircraft users to manage descent in the most optimum way
- An opportunity exists to conduct a trial of CDO/OPD at an aerodrome to determine:
  - what additional procedures need to be developed to facilitate CDO/OPD
  - how to measure the benefits of CDO/OPD in Australian airspace
  - how the airline customer journey can be improved through CDO/OPD
- Airservices is co-designing the CDO/OPD trial with our airline customers

AERODROME ASSESSMENT CRITERIA

To finalise the Trial Aerodrome Assessment, the following were considered:

1. assessing and assigning scores to determine where trials can be undertaken
2. agreement on assessment criteria
3. agreed timeframes
4. ongoing airline participation
5. any other considerations



TRIAL AERODROME ASSESSMENT CONSIDERATIONS

(AIRSERVICES ASSESSMENT)

YMML

Implementation Complexity
Well-established traffic patterns and procedures with staff specialising in sequencing and minimal change to procedures or training required initially.

Value (Traffic Mix and STAR structure)
Lower mix of turbo-prop traffic.

High percentage of domestic jets, closed STARs support CDO/OPD.

YBBN

Implementation Complexity
Outer sector airspace design not tested with peak traffic.

Value (Traffic Mix and STAR structure)
PIR will add complexity in being able to adjust operations.

New STARs for parallel runways not tested with peak traffic.

YPPH*

Implementation Complexity No negative impact on effort likely; restricted airspace and close inbound/outbound routes limit opportunities.

Value (Traffic mix and STAR structure)
Traffic during peak periods remains high, so reduced opportunity for assessing possible benefits.

STAR structure can support CDO/OPD, but arrivals sector complexity does not.

YSSY*

Implementation Complexity
STAR structure may inhibit CDO/OPD SYD; cross-boundary messaging limits options.

Value (Traffic mix and STAR structure)
Higher mix of turbo-prop traffic adds complexity to sequence.

Open STARs do not support CDO/OPD. FIR boundary will not be conducive.

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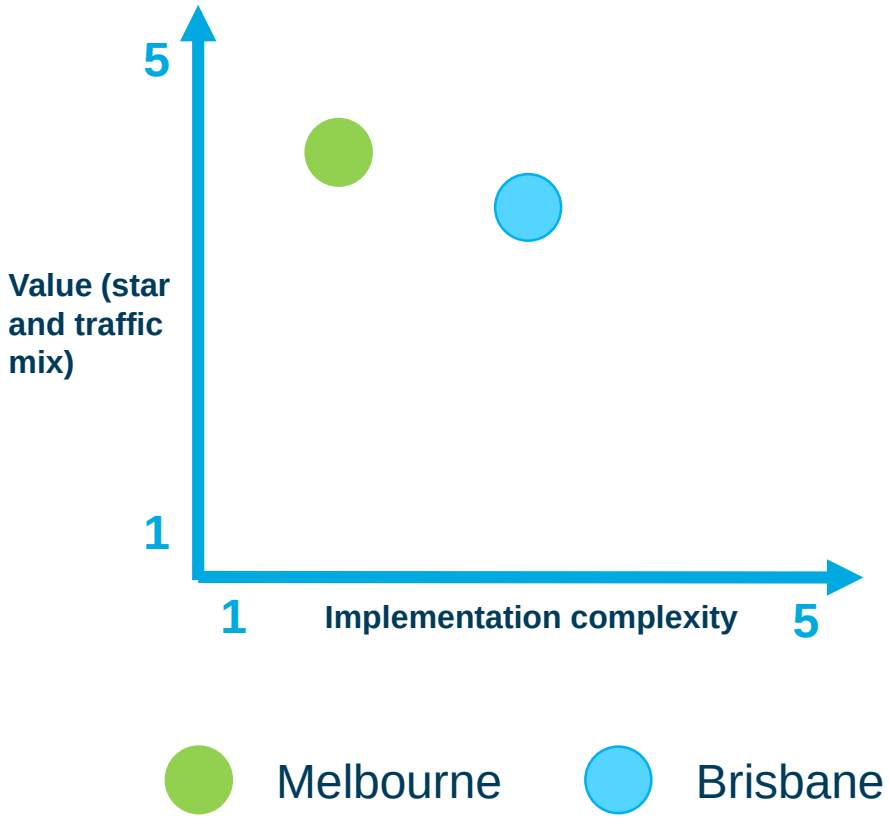
Still need to be discussed: Customer procedures development and interface with Airservices procedures, timing and length of the trial.

***PH and SY deemed not suitable at an industry workshop**

TRIAL AERODROME ASSESSMENT

Completed during an industry workshop



WHAT DOES SUCCESS LOOK LIKE?

QUANTITATIVE

Effort
- Net increase or decrease in effort where CDO/OPD was a contributing factor

Fuel
- How much fuel was saved, compared to a non-CDO/OPD arrival

Time
- How much time was saved, compared to a non-CDO/OPD arrival

Flow on Effects
- Net increase or decrease in delays at other aerodromes

On Time Performance
- Improvement or decrease in OTP

Noise & emissions
- Improvement or decrease in environmental footprint

QUALITATIVE

Pilot Feedback
- What was the experience of pilots that flew CDO/OPD? How will this be captured, when and how often? How did the aircraft perform?

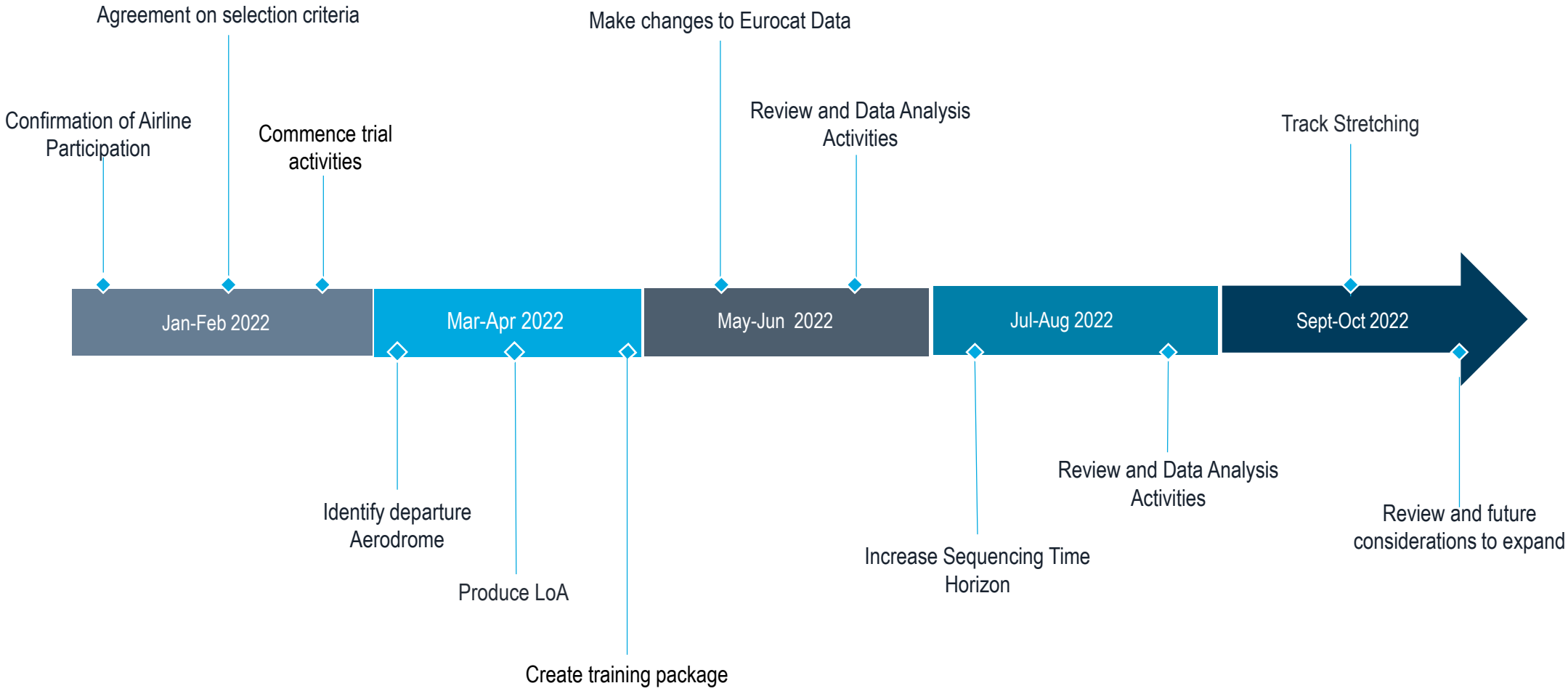
ATC Feedback
- What was the experience of ATC that monitored CDO/OPD? Did they have to intervene?

Network Impacts
- What was the overall impact to network operations? Did CDO/OPD improve network operations?

General Commentary
- Is the trial operating as designed? Is it having the expected impacts?

How do we source the data?

OPD (TRIAL) STAGED APPROACH 2022



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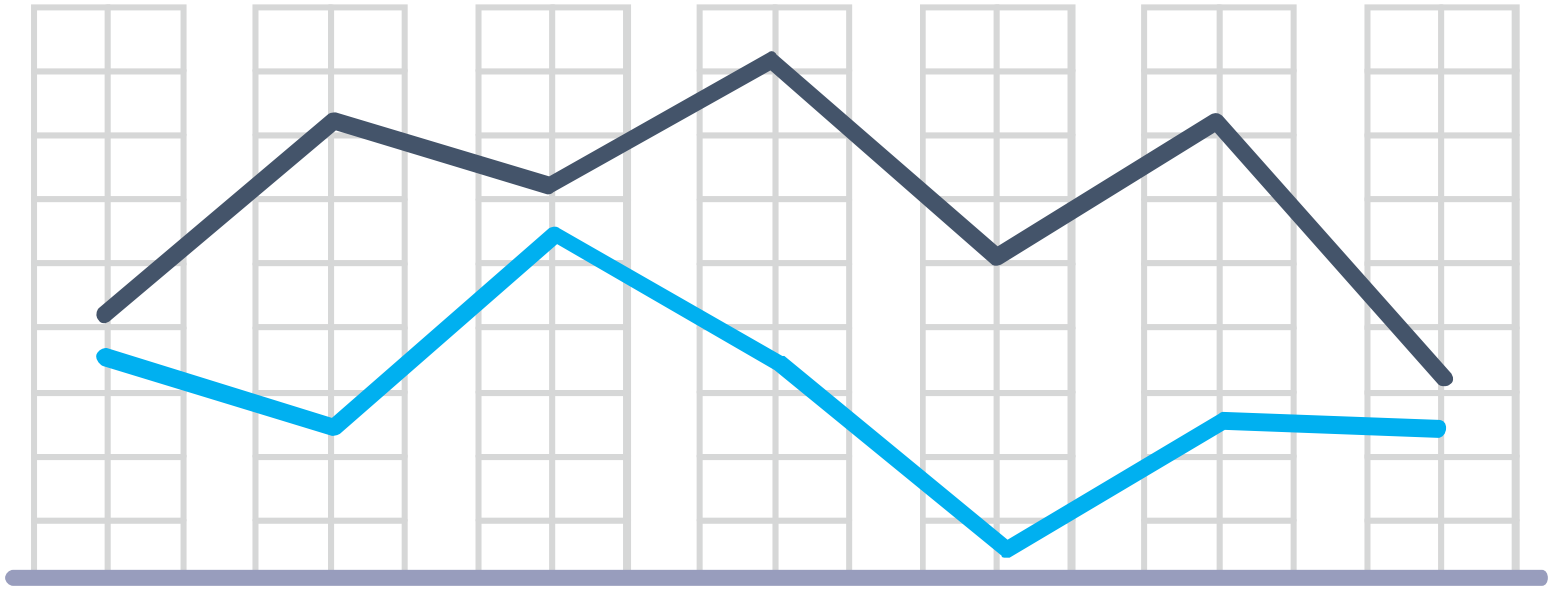
DATA TRACKING AND REPORTING



Analysis supporting the trial will rely on Airservices data and analytics capability

Collaborate with airline data teams

Airservices will request sample data from the airlines to validate analysis

TRIAL REQUIREMENTS

What commitment do we need from industry?

01. Agreement on what success looks like
Letter of agreements to be updated

02. Commitment from airlines for time and effort required for the trial
Including Pilot's awareness and training required for the OPD Trial

03. Bi-monthly meeting (2 hours) to discuss progress

04. Airlines to provide Airservices with sample data we can use to validate the accuracy of data already available to us

16 February 2021

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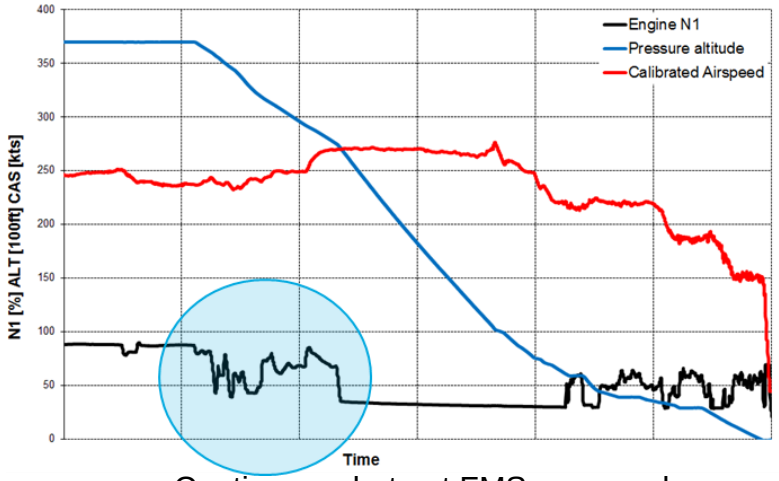
NETWORK PERFORMANCE & ANALYSIS

FLIGHT EFFICIENCY – CDO METRICS

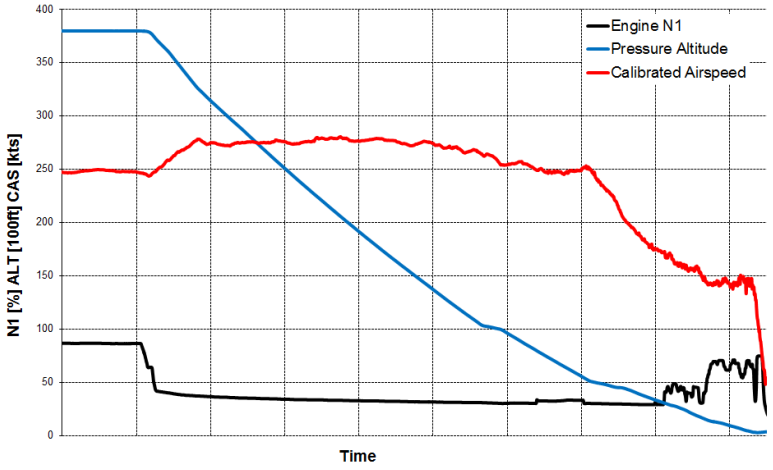
MANAGED DESCENT

- Facilitating a descent operation that
  - allows for predictable dissipation of the aircraft's energy,
  - at the lowest cost to the operator (i.e. Cost Index),
  - including any known constraints.
- Improved efficiency, lower noise and risk

→ *Managed* Descent rather than a Continuous Descent



Continuous, but not FMS managed

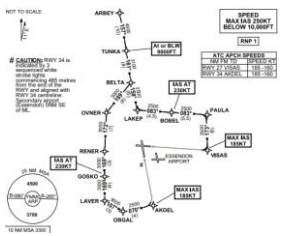


FMS managed descent

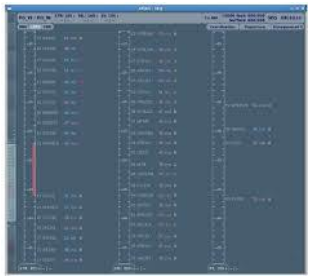
CONTINUOUS DESCENT OPERATIONS

Optimised Profile Descent (OPD) + Managed Descent = 'Continuous Descent Operations' (CDO)

Procedures



Operations



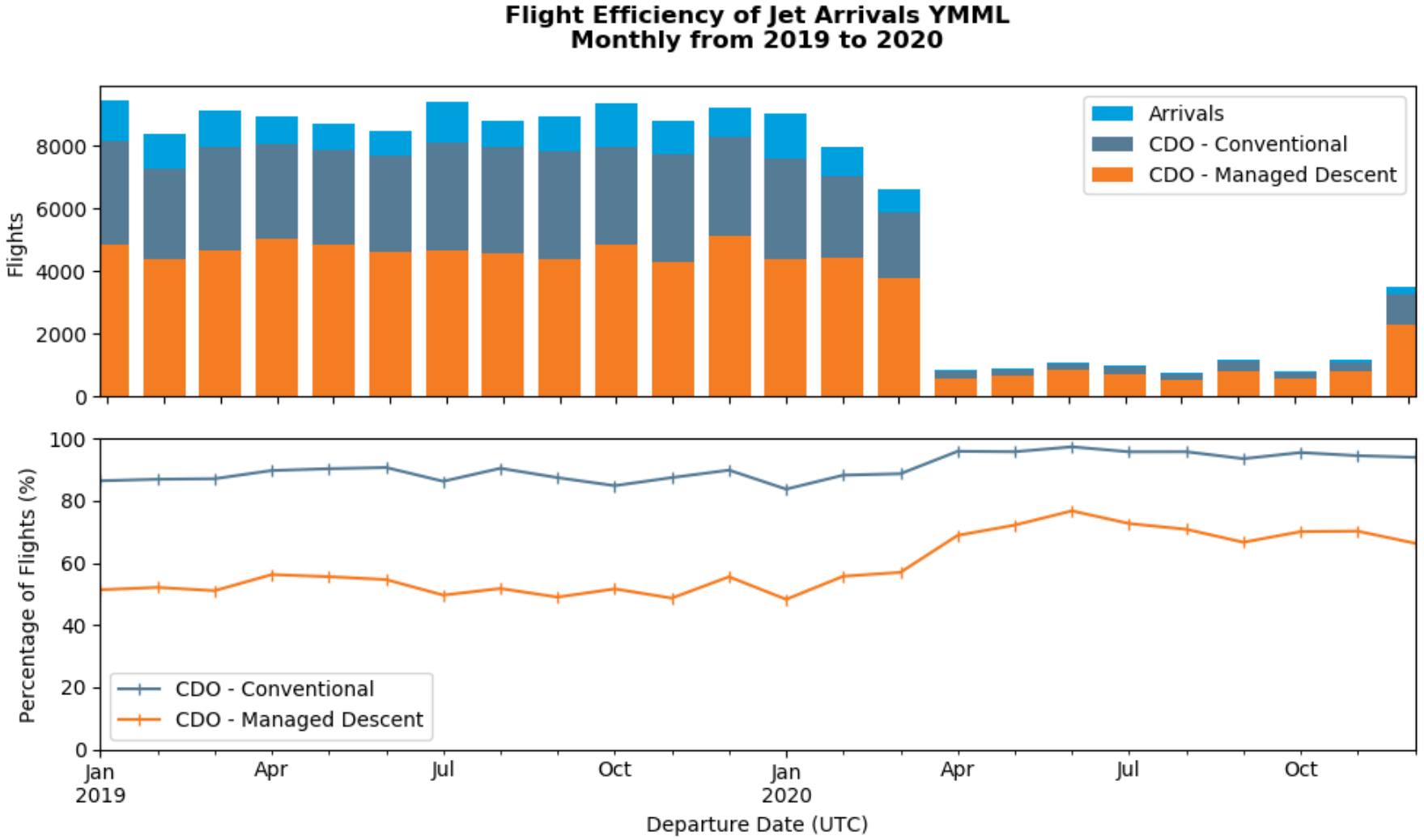
AIRPORT CDO METRICS

NEXT SLIDES CONTAIN:

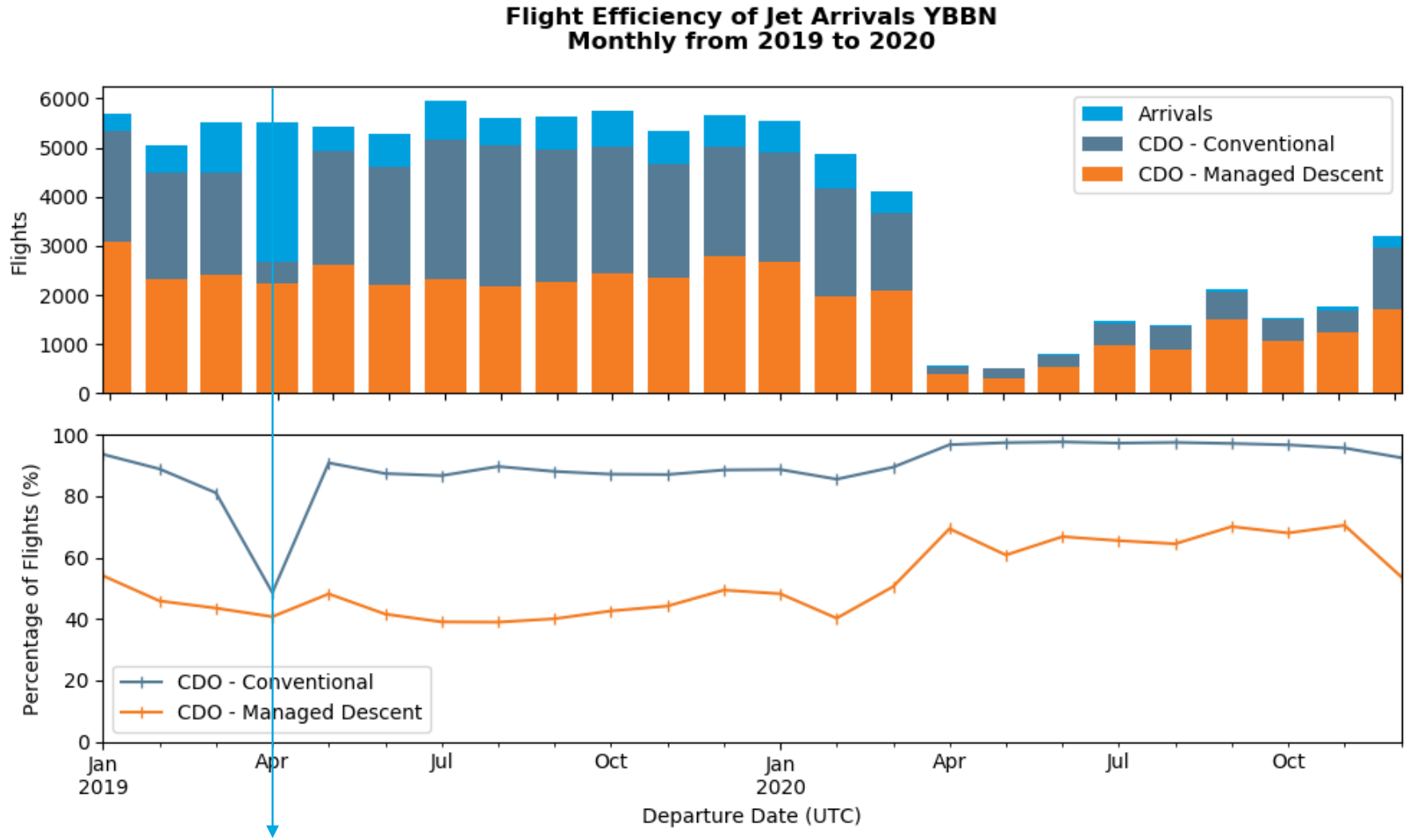
- **Region**: Airport arrivals
- **Timeframe**: Daily, pre and post COVID
- ***Metrics**:
  - Number of CDO conventional
  - Number of CDO managed descent
  - Percentage of CDO conventional
  - Percentage of CDO managed descent

*See the Appendix for details on metrics.

MELBOURNE AIRPORT



BRISBANE AIRPORT



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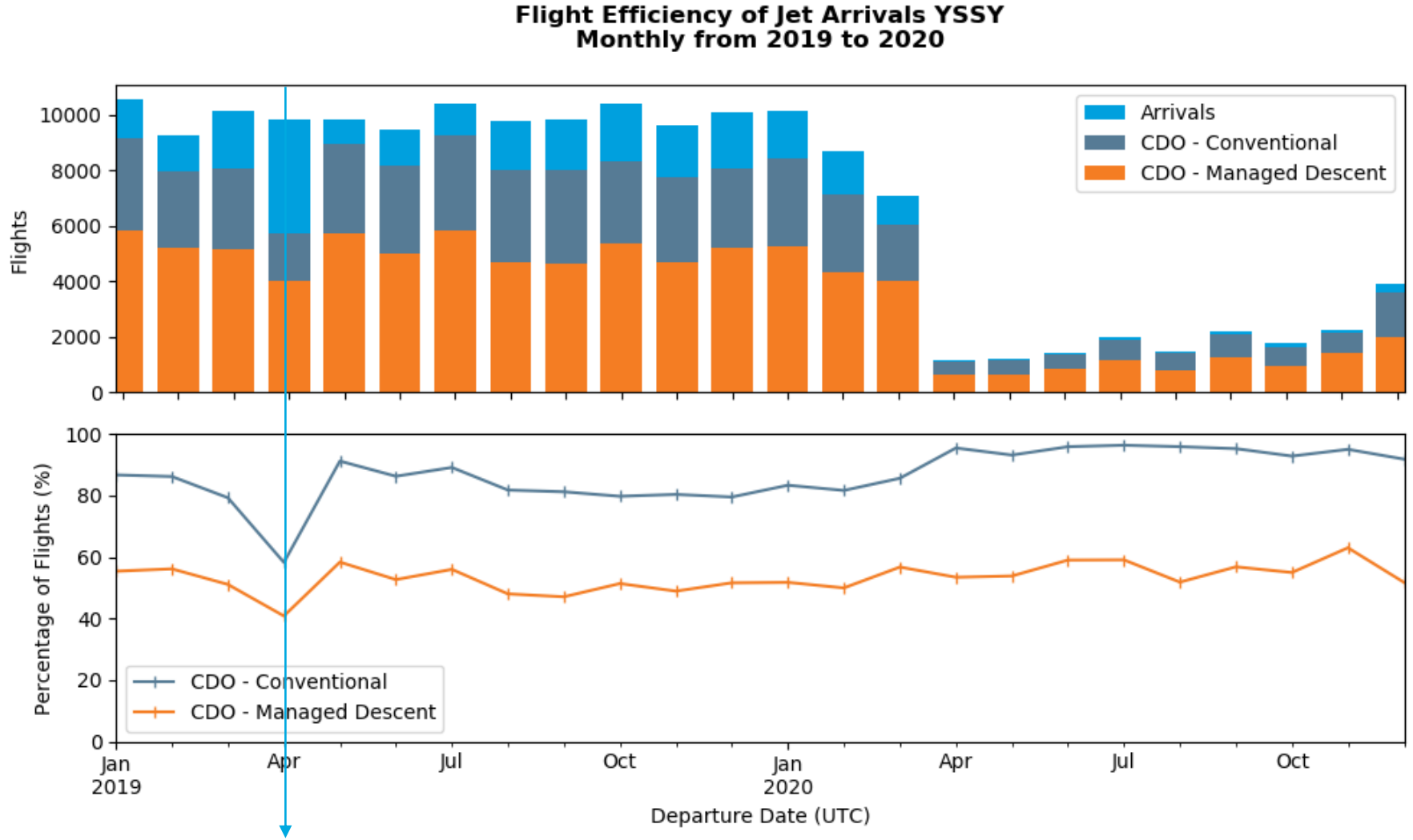
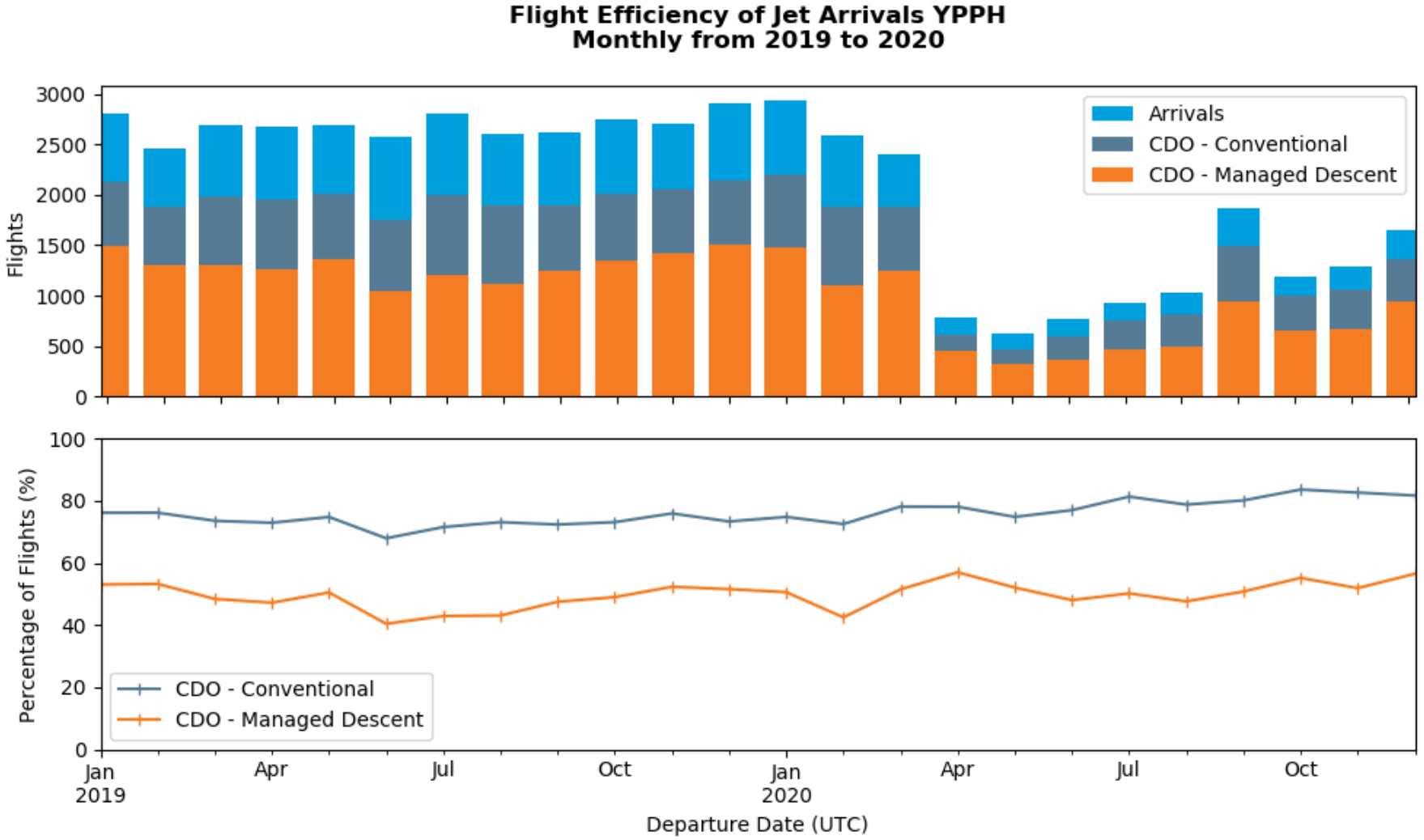
SYDNEY AIRPORT



APR 2019 data issue

PERTH AIRPORT



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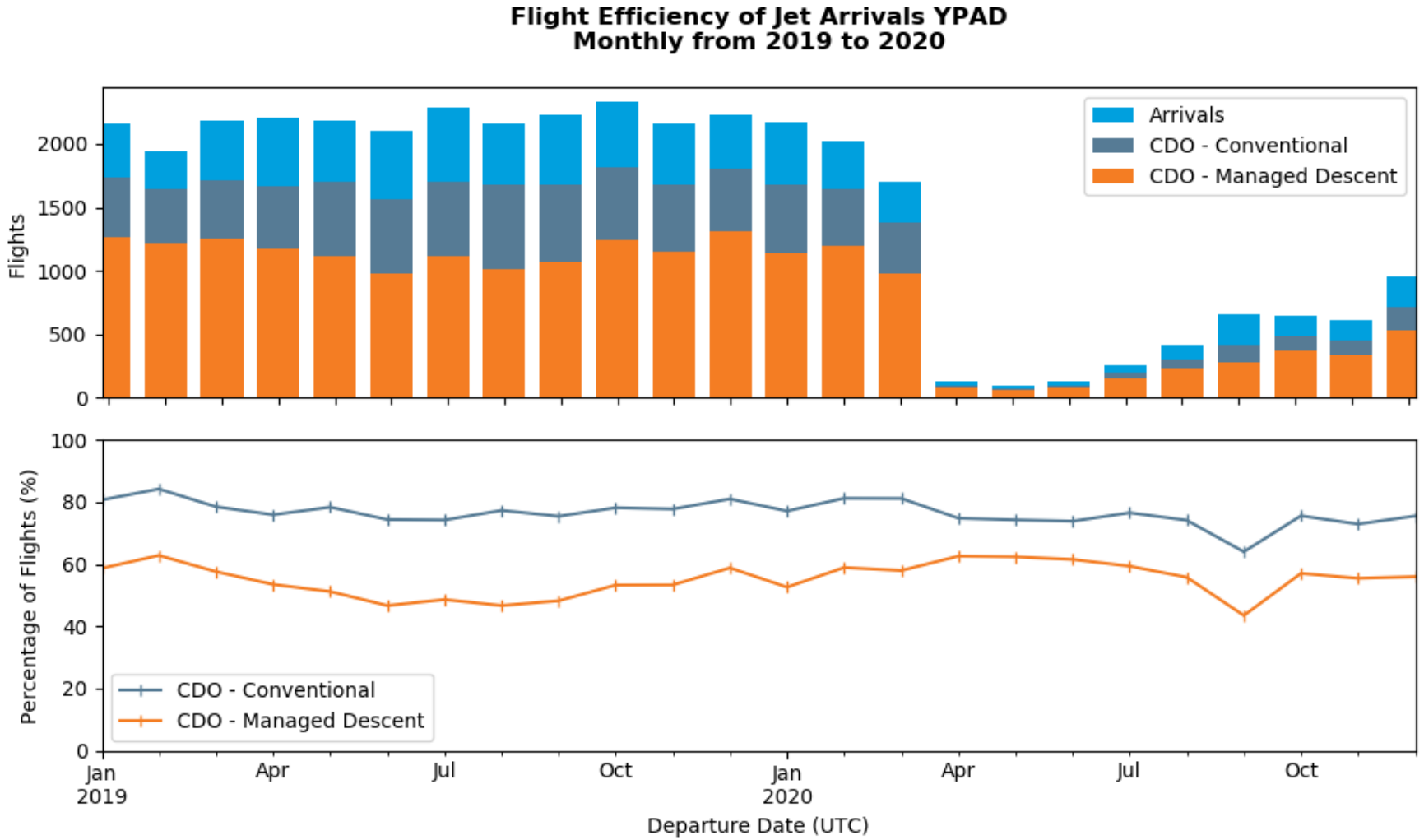
ADELAIDE AIRPORT



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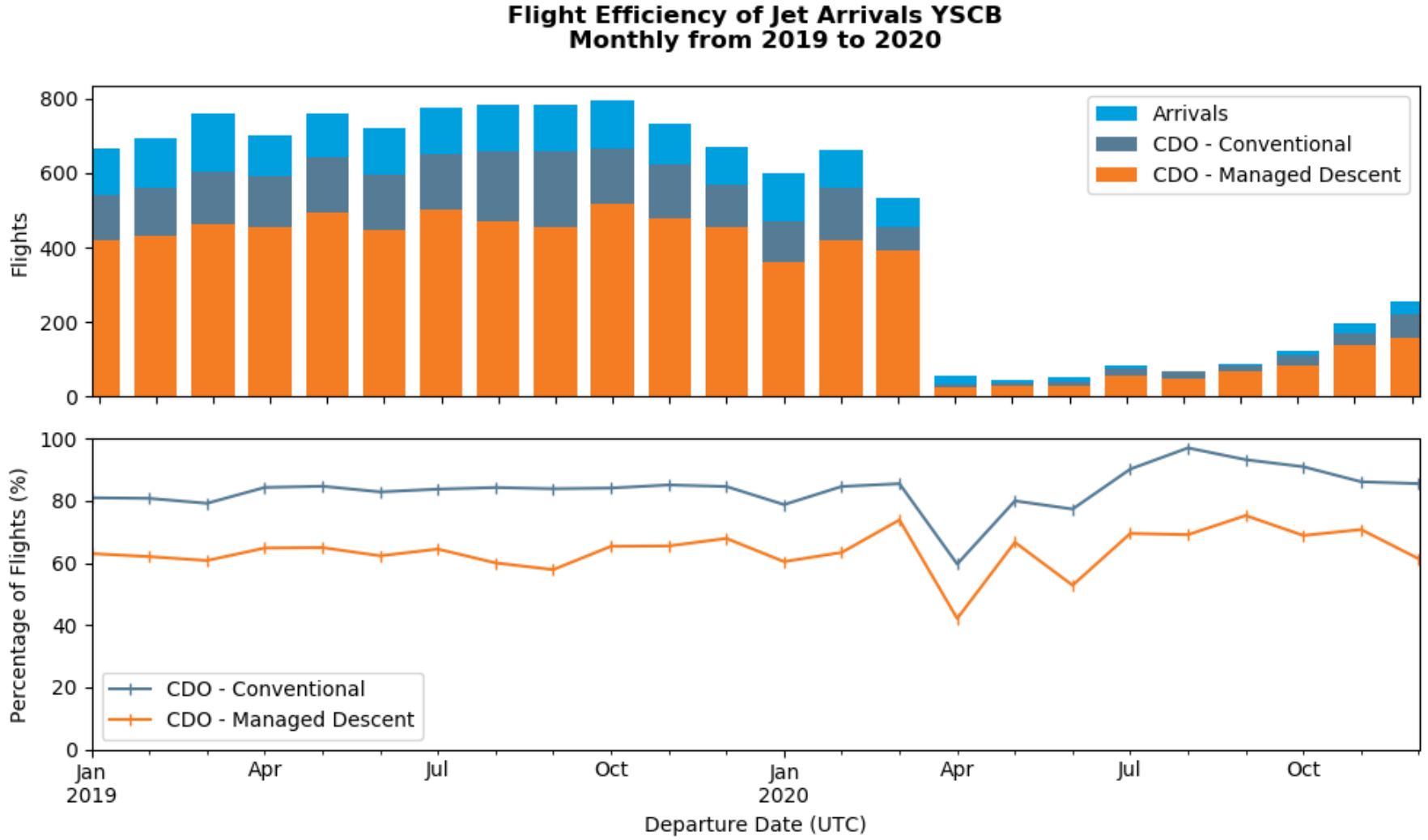
CANBERRA AIRPORT



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RESULTS

CONVENTIONAL VS MANAGED

- Conventional CDO was being achieved by a large proportion of flights
- However, managed descent CDO showed flight efficiency deviations for over 50% of flights

PRE VS POST COVID

- SY: Managed descent CDO did not increase despite the reduction in demand. Possibly this was due to the corresponding reduction in capacity of single runway ops during COVID.
- PH: Conventional CDO and managed descent CDO did not increase despite the reduction in demand. Possibly this was due to demand compression, FIFO, and military activity.
- ML and BN: Conventional CDO and managed descent CDO increased as expected during COVID due to less demand. However, managed descent needs to be improved due to deviations in speed profile.

IMPROVEMENT AREAS

- Dependent on airport:
  - Airspace design
  - Enroute
  - Point merge
  - Flow on effects from TMA to enroute
- TOD to 110FL segment where managed descent can improved

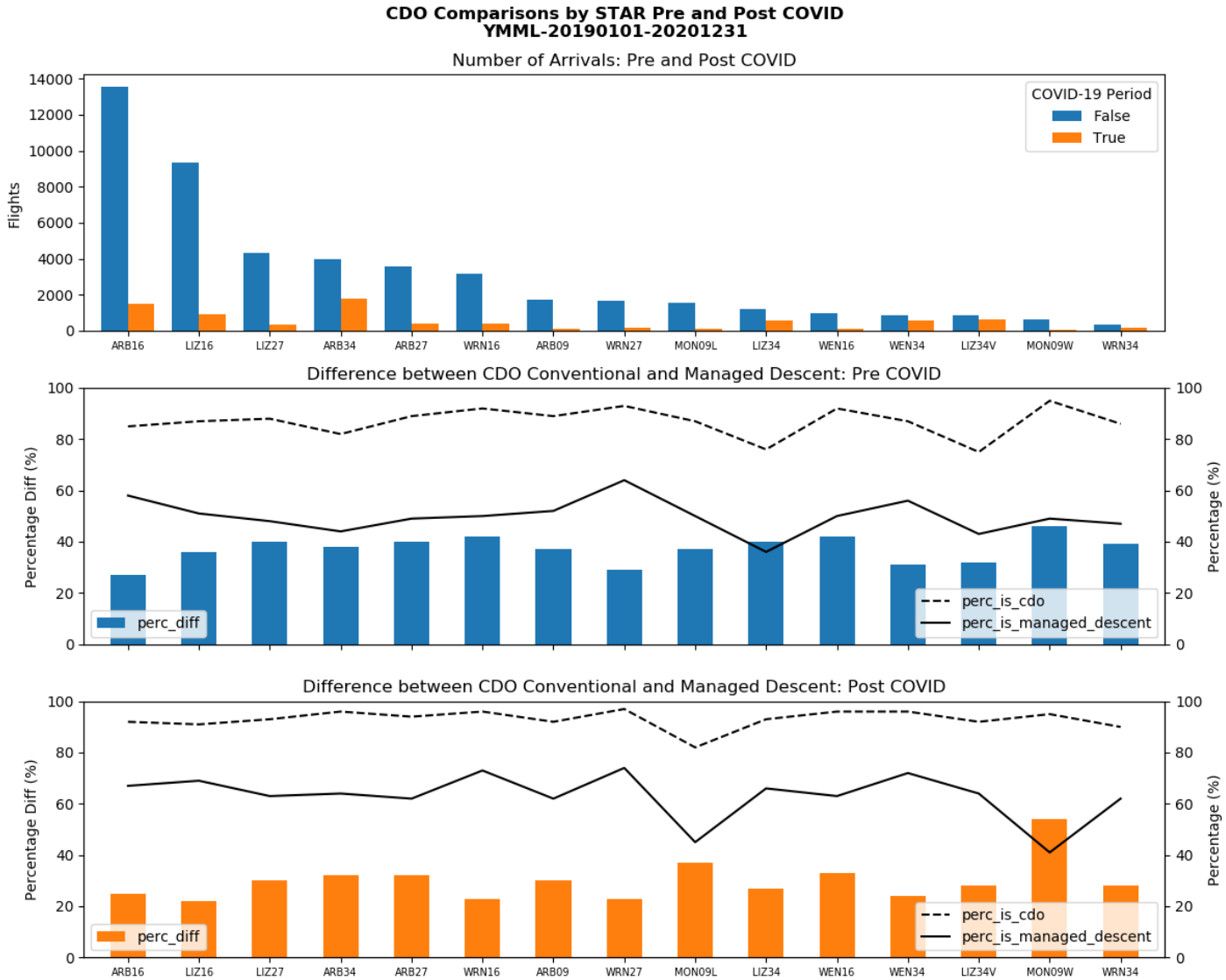
AIRPORT CDO METRICS – STAR COMPARISON

NEXT SLIDES CONTAIN:

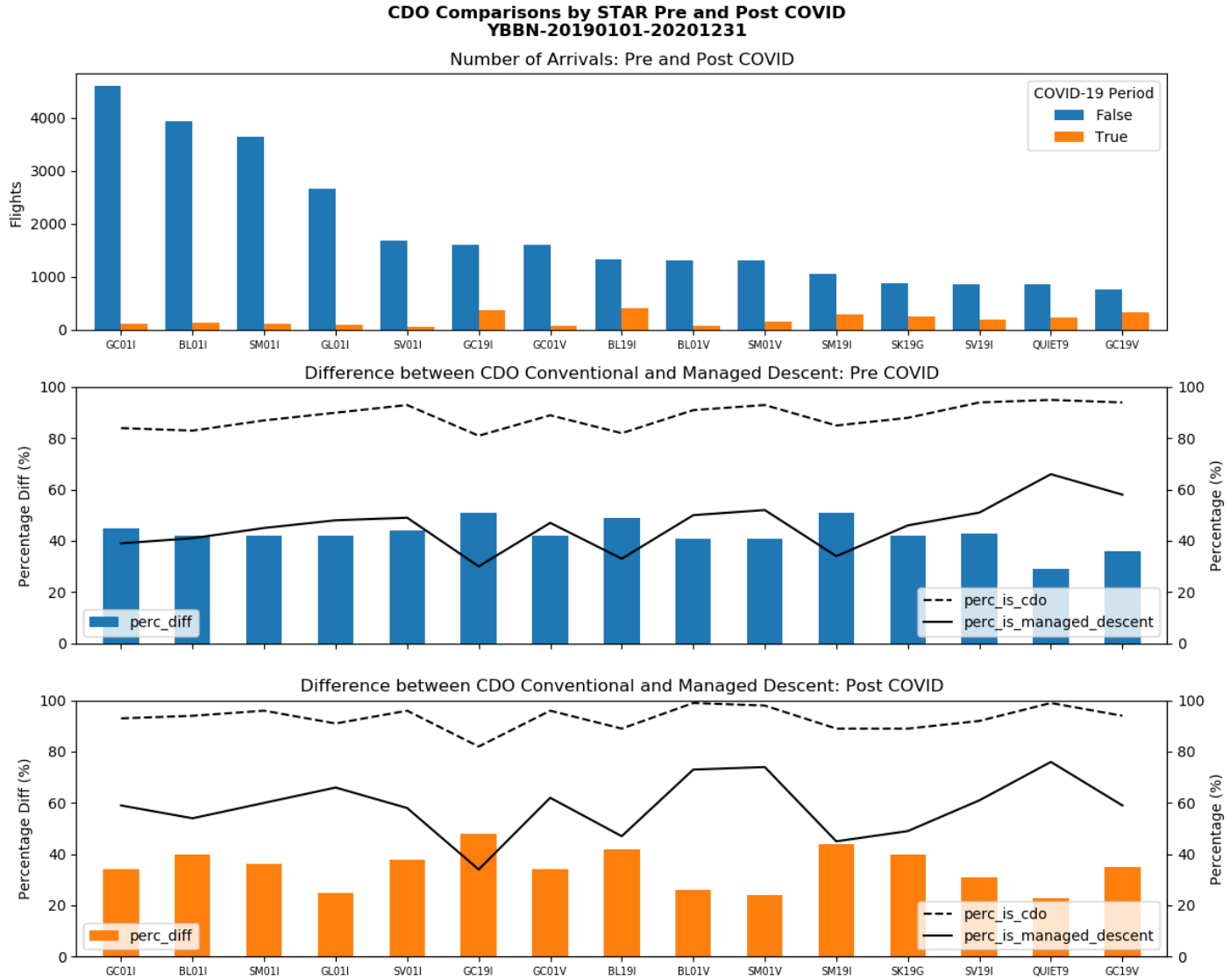
- **Region**: Airport arrivals by STAR
  - Top 15 by total traffic
- **Timeframe**: Pre and post COVID
- **Metrics***:
  - Difference in CDO conventional and CDO managed descent
    - Pre COVID
    - Post COVID

*See the Appendix for details on metrics.

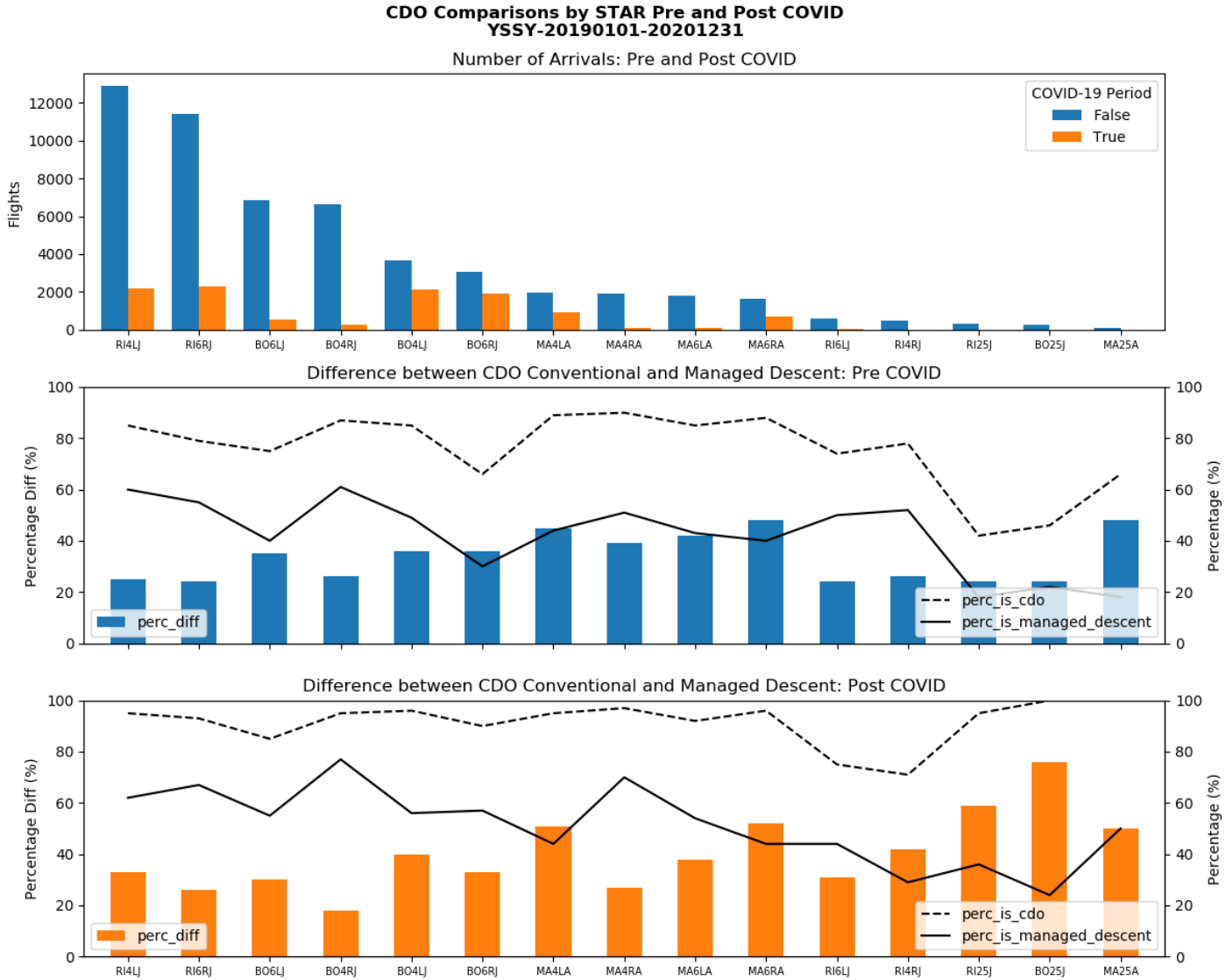
MELBOURNE AIRPORT



BRISBANE AIRPORT



SYDNEY AIRPORT



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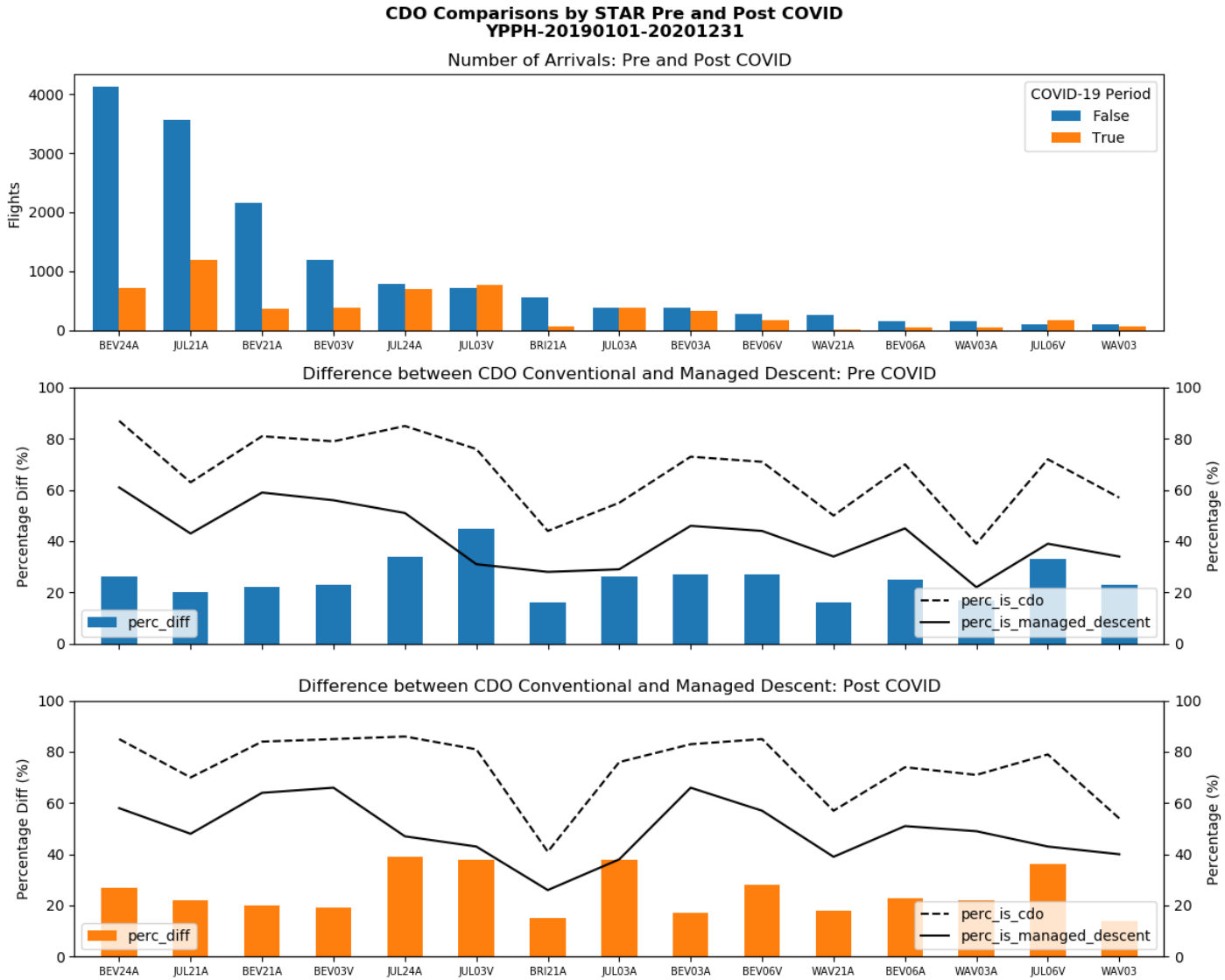

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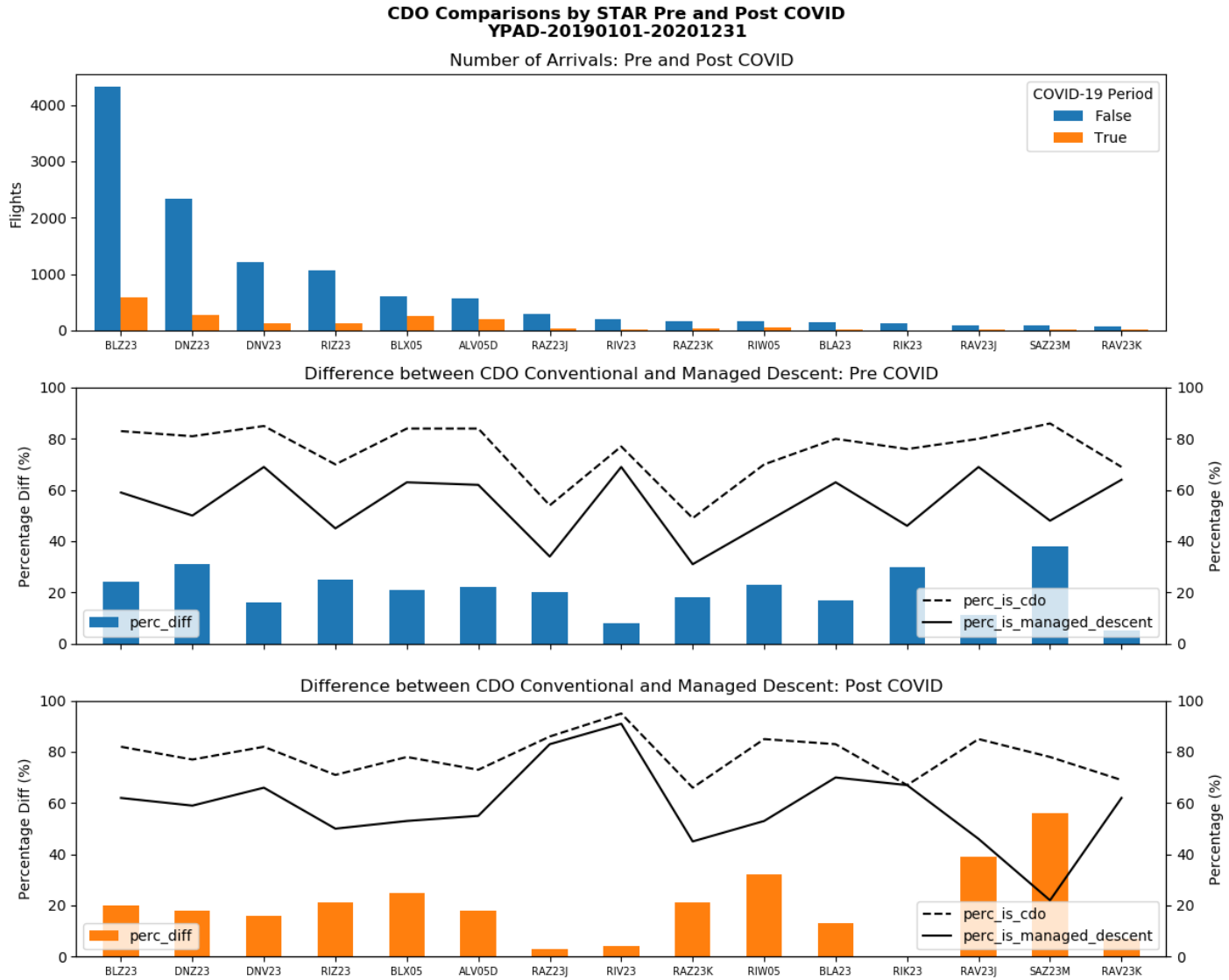

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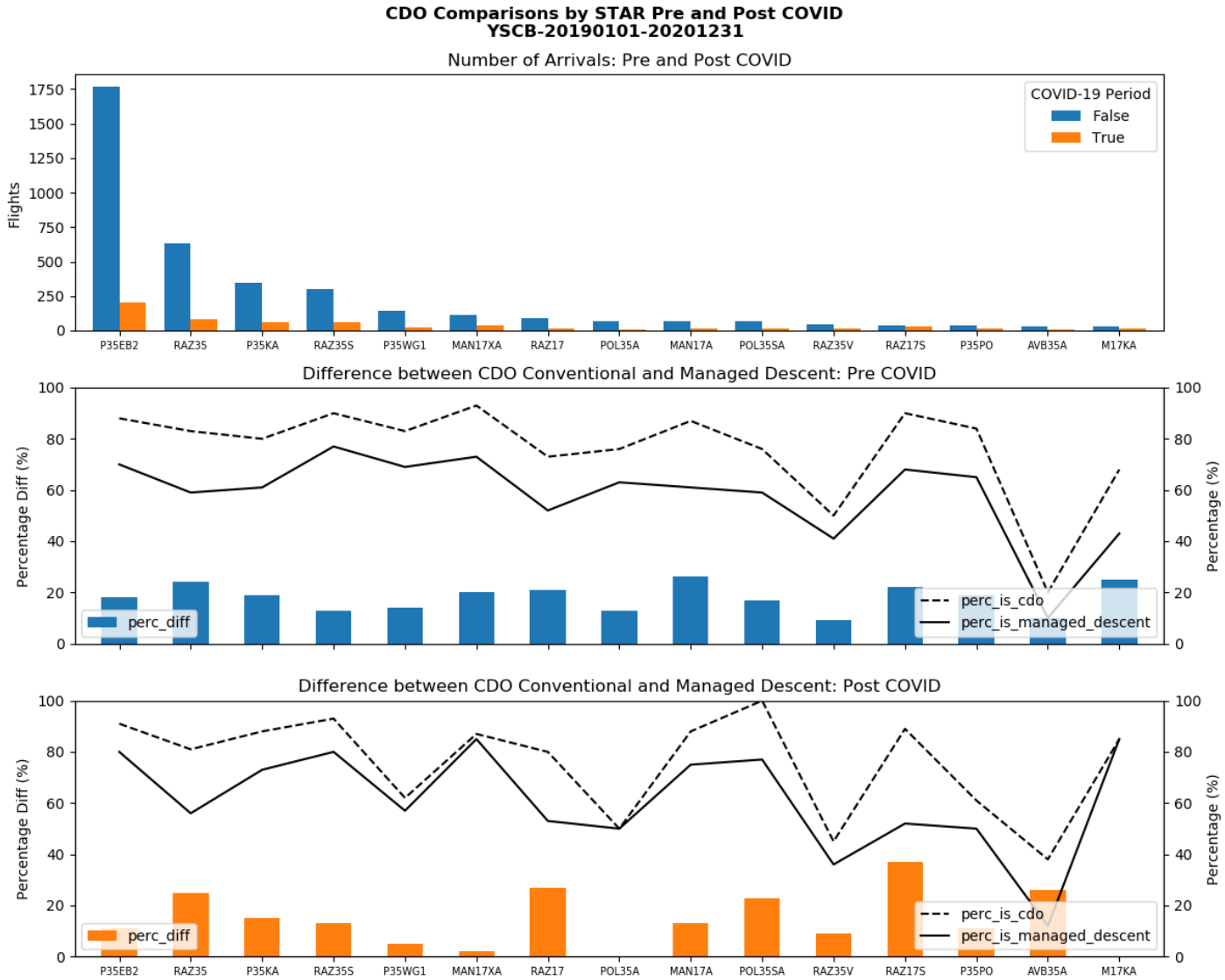

APPENDIX

CDO MEASUREMENT:

Rule	Criteria	Segment	CDO Conventional	CDO Managed Descent
Altitude	No level segments With the following rules: * Level segments must be < 2.5NM	TOD to landing	✓	✓
Speed	Constant MACH/CAS speed profile With the following rules: • < 7.5KTS average deviation • < 15KTS maximum deviation • For medium and large jets with this characteristic	TOD to 110FL	✗	✓