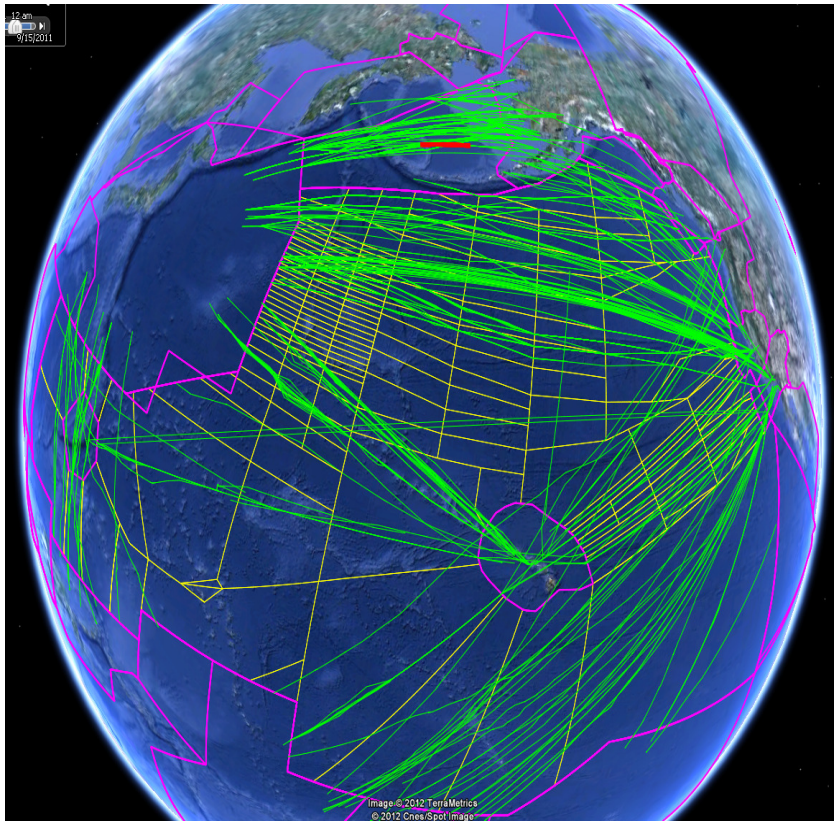
Pacific Project Study

FAA Oceanic Integration and Interoperability Facility (OIIF) Lab and FAA Oceanic and Offshore Services

Federal Aviation Administration

PACIFIC PROJECT FAA Technical Center
11 December 2012

Pacific Project Study



Purpose of initial study is to identify the effects on Oceanic traffic if aircraft are permitted to fly unrestricted User Preferred Routes (UPRs) generated by airlines for flights across the Pacific Ocean.

From the preliminary data we hoped to answer these questions:

- **How much penalty exists in current system?**
- **What are the technical and procedural problems that were exposed?**
- **What benefit can be gained from further study?**

Presentation Objectives

Introduce current US Air Traffic Oceanic procedures and traffic flows over the Pacific

Oceanic traffic flows and simulation

Demonstrate/Discuss UPR scenario generation

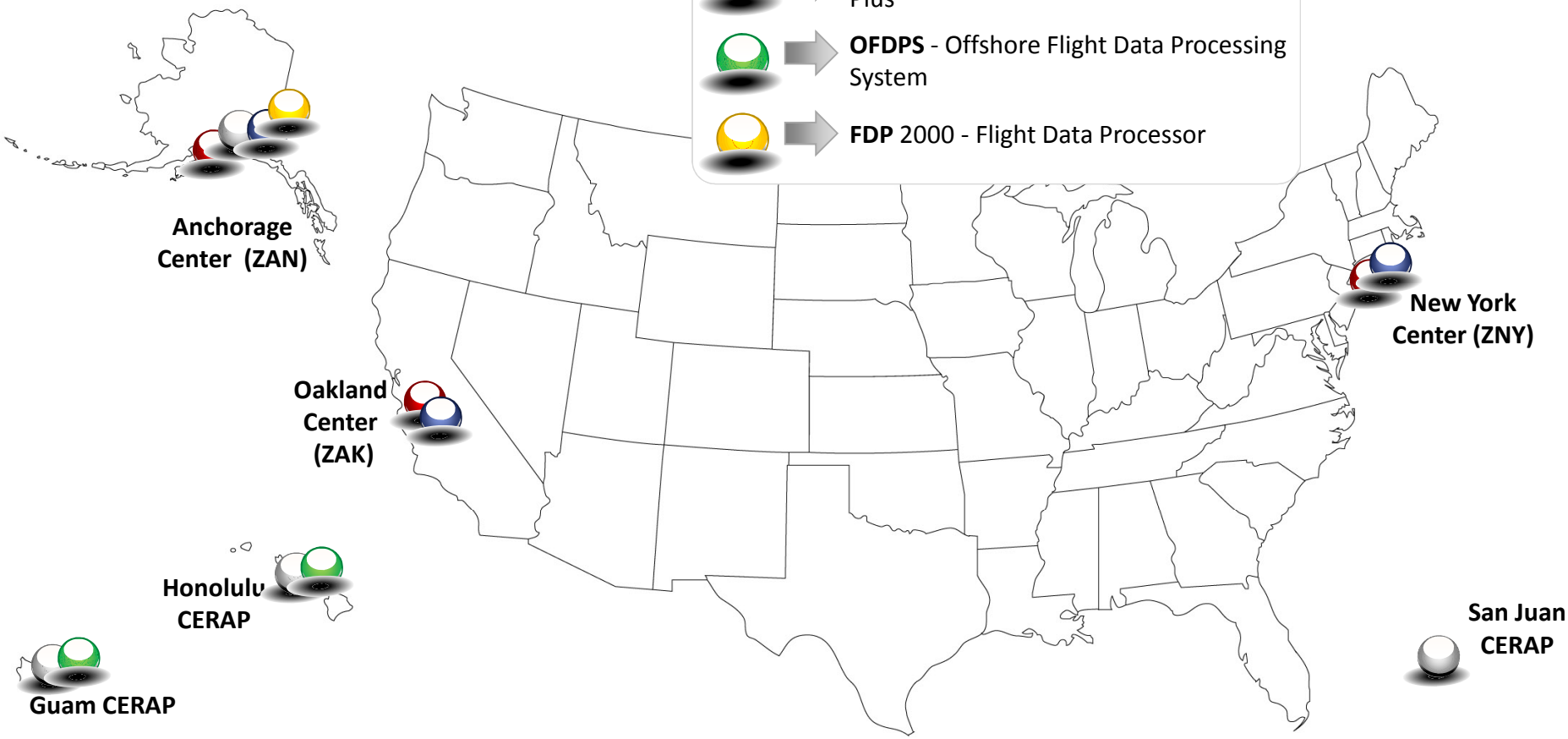
Demonstrate/Discuss UPR scenario findings

Show Pacific Tracks on Ocean21 display

Oceanic & Offshore Service Provision

Service Type

- **OCEAN21** - Advanced Technologies and Oceanic Procedures Automation System
- **Micro-EARTS** - Microprocessor EnRoute Automated Radar Tracking System
- **DOTS +** - Dynamic Ocean Track System Plus
- **OFDPS** - Offshore Flight Data Processing System
- **FDP** 2000 - Flight Data Processor



Features of the FAA OCEAN21 System

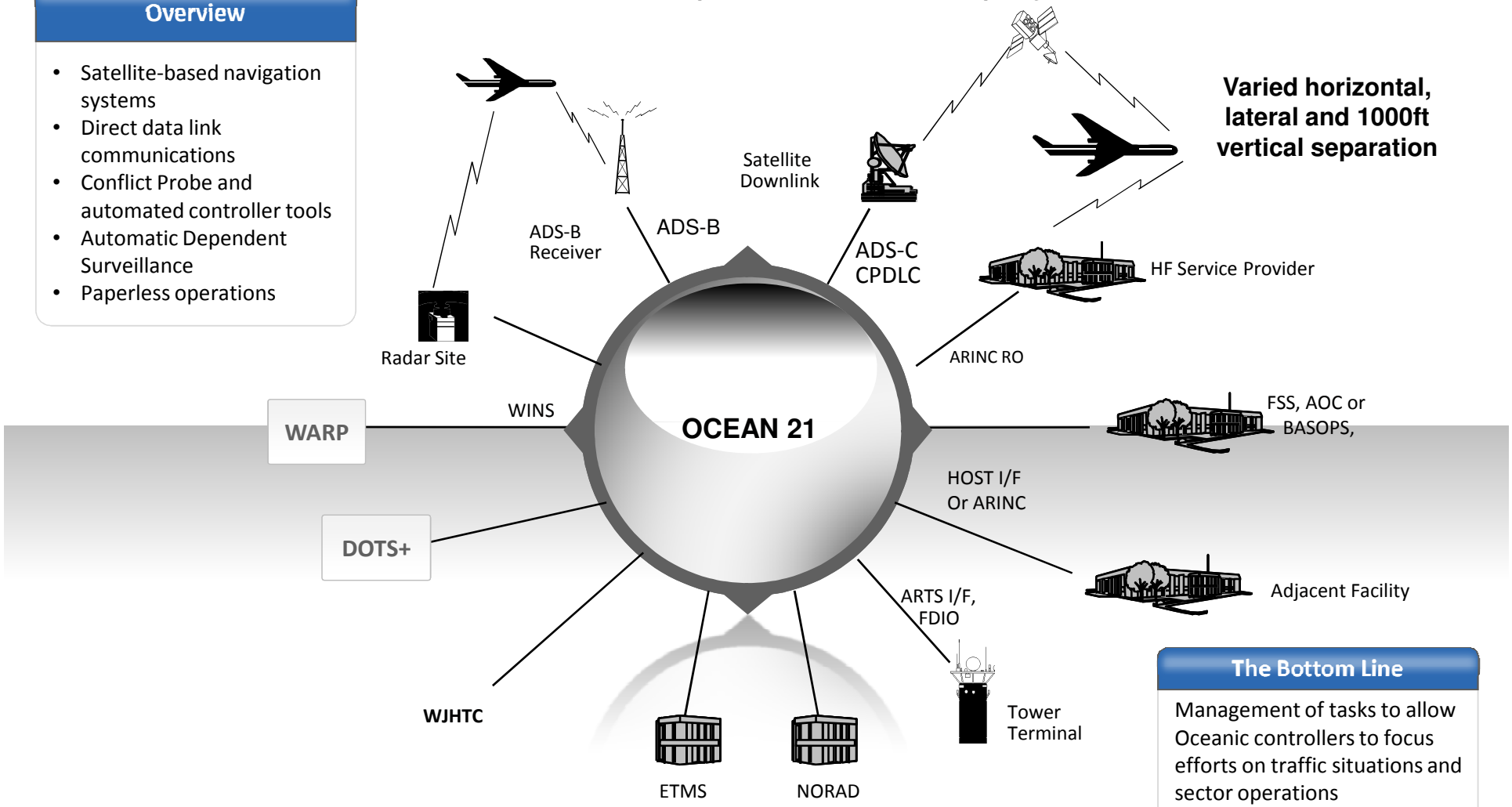
- Workstation Layout
- Paperless Environment
- Conflict Prediction and Reporting
- Controller Tools
- Automatic Processing of Position Reports
- AIDC Coordination
- ADS and full CPDLC message support
- Weather Dissemination
- Workload Allocation
- Simulation and Playback
- System Architecture

Oceanic Service with OCEAN21

End-to End Perspective in the Display-based Environment

Overview

- Satellite-based navigation systems
- Direct data link communications
- Conflict Probe and automated controller tools
- Automatic Dependent Surveillance
- Paperless operations



The Bottom Line

Management of tasks to allow Oceanic controllers to focus efforts on traffic situations and sector operations

Conflict Probe

CONFLICT SUMMARY

Override Help

Intruder	Att	Active	Att	Ovrd	Type	StartTime	EndTime
TEST8	-	TEST1	-		X	1901	1910

Conflict Report

crossing REQUIRED 15 minutes (50 nm) 1000 ft

89 degrees LOS 19:01 ACTUAL 3 min 12 sec (49 nm) 0 ft

		PASSING POINT			CONFLICT SEGM	
B744 TEST8 M085	F290				5843N 17356W 1901	5948N 17453W 1910
B744 TEST1 M085	F290				5922N 17245W 1901	5854N 17454W 1910

Draw Close

FANS-1/A Data Link Support

AFN

- Logon automatically accepted when FPL with REG is available
- Automatic transfer of data link to next facility

ADS-C

- Automatic contract initiation for equipped aircraft
- Contract parameters can be modified by controller
- Supports Periodic, Event, and On-Demand contracts
- Flight plan profiles are updated on every report
- Conformance monitoring

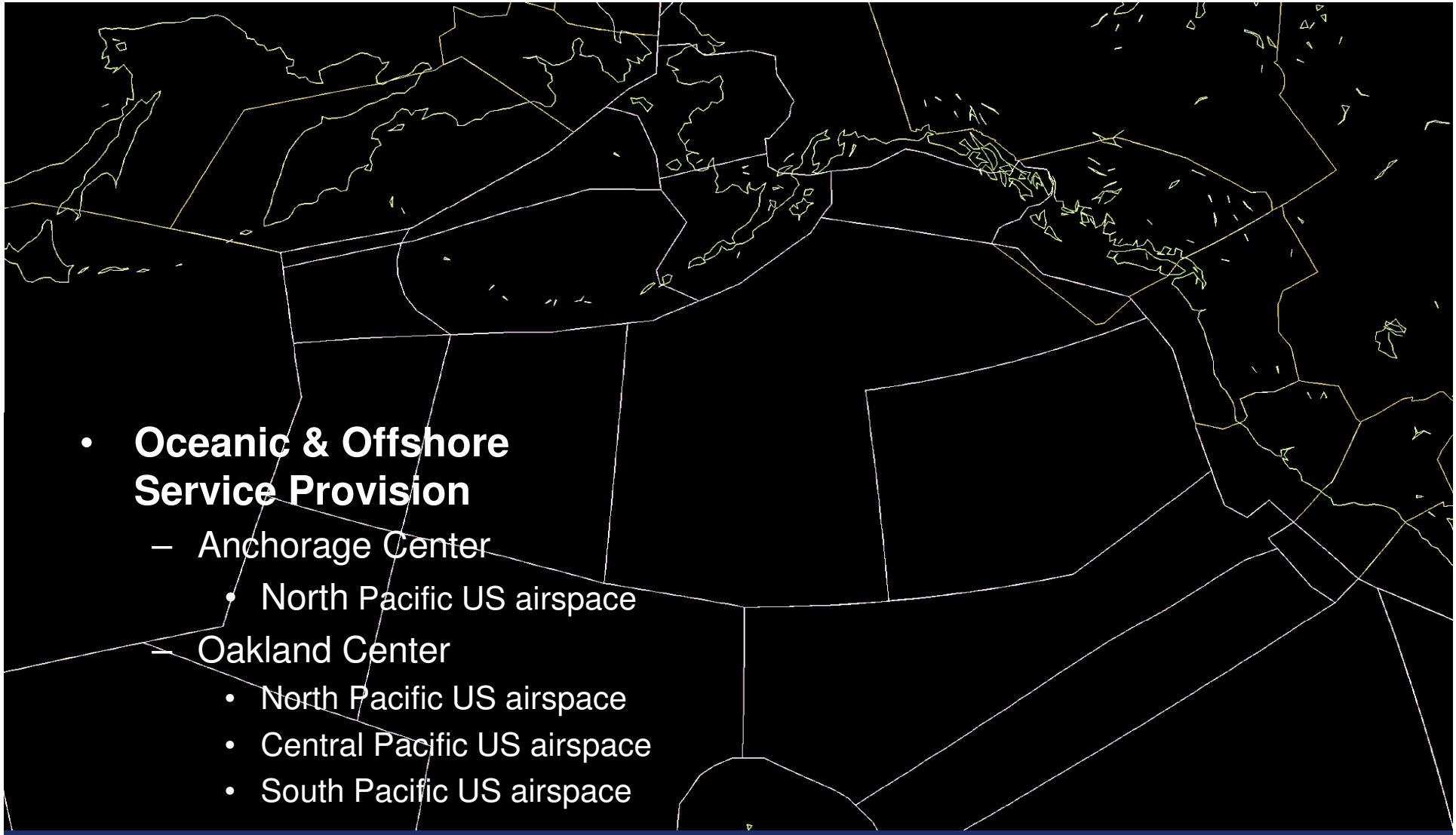
CPDLC

- CPDLC is the Command Language to the automation, regardless of controller/pilot communications method (HF, VHF, Datalink)
- Highly integrated with other sector operations
- Clearances always composed same way
- Automation determines appropriate routing (HF or Datalink)
- Downlinks routed to correct sector
- Indicators on ASD and Strips

Distance-Based Separation Minima in OCEAN21 Airspace

- **Aircraft avionics equipage requirements**
  - FANS 1A, ADS-C, and, CPDLC equipped
- **Filed flight plan requirements**
  - Field 10 – R and D1
  - Field 18 PBN/A1 for RNP-10 or PBN/L1 for RNP-4
- **ATOP implementation**
  - 50 NM lateral separation minima for RNP-10/RNP-4 authorized aircraft with PBN/A1 in field 18 of the flight plan
  - 50 NM longitudinal separation minima for RNP-10/RNP-4 authorized aircraft with the D–50 flag set, within adapted airspace
    - D–50 flag: Flight plan requirements, an active CPDLC connection, and an active ADS-Contract.
  - 30 NM longitudinal and 30 NM lateral separation minima for RNP-4 authorized aircraft with the 3 flag set, within adapted airspace
    - 30/30 flag: Flight plan requirements, an active CPDLC connection, and an active ADS-Contract. Additionally, a reported ADS Figure of Merit (FOM)/Accuracy of 4 or better.

US Oceanic Air Traffic Control over Pacific

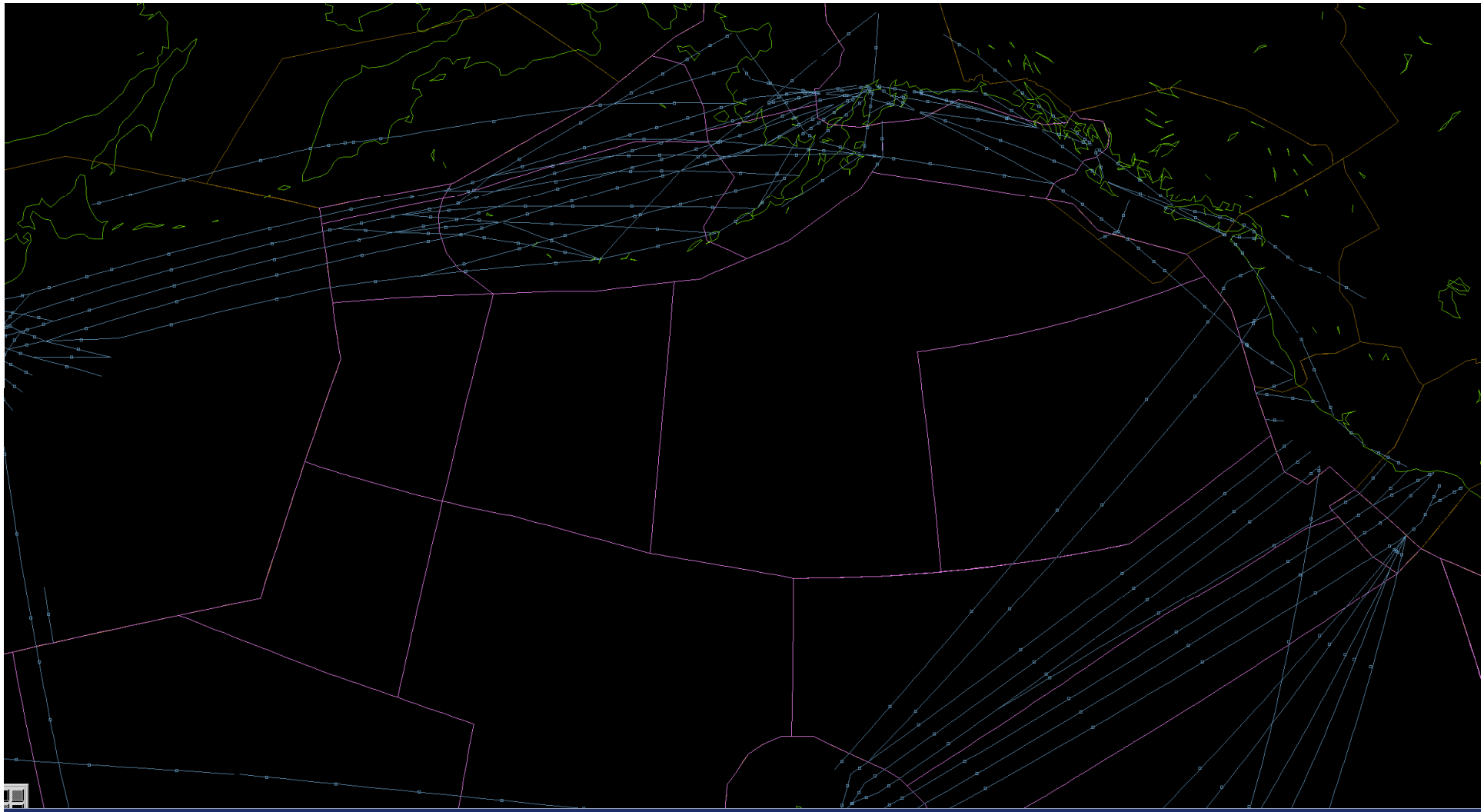


- **Oceanic & Offshore Service Provision**
  - Anchorage Center
    - North Pacific US airspace
  - Oakland Center
    - North Pacific US airspace
    - Central Pacific US airspace
    - South Pacific US airspace

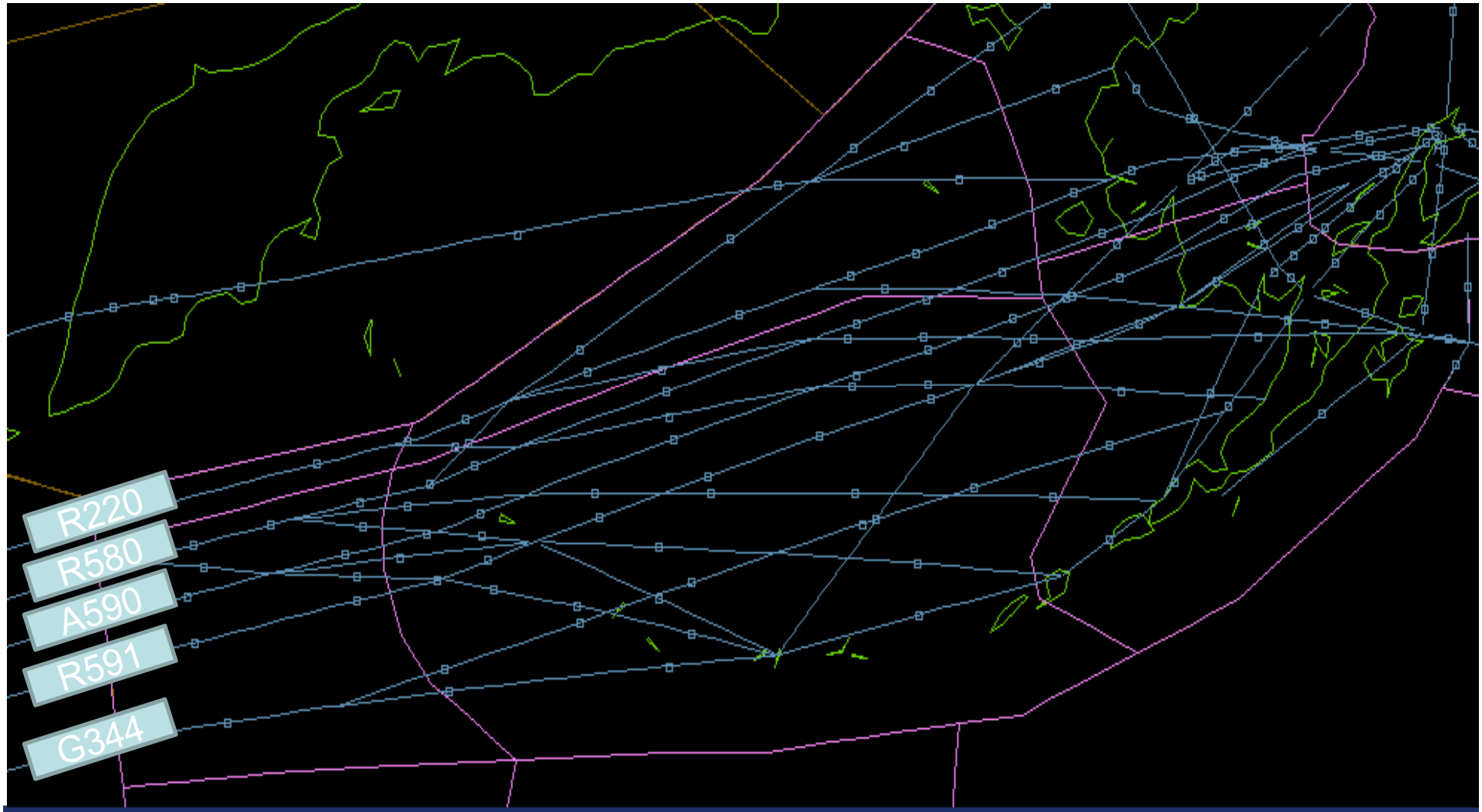
Current US Pacific Oceanic Practices and Procedures

- **Daily Generated DOTS Plus Routes (PACOTS)**
  - Generated and published daily by Oakland Center
  - Routes generated using 72 hour weather model
  - Westbound only
  - Generated routes may have some flight level restrictions
  - Routes have procedural limitations determined by Air Navigation Service Providers (ANSPs).
    - Routes are parallel to prevent crossing of routes
    - Routes established at least 50 NM apart
  - Route patterns change with seasons

Pacific Route System



NOPAC Routes



NOPAC Restrictions

- R220 track all altitudes westbound except FL310 entering Fukuoka FIR
- R580 track all altitudes westbound except FL310 and FL330 entering Fukuoka FIR
- A590 track all altitudes eastbound except FL360, FL380, FL400 entering Anchorage Center FIR
- R591 track right altitude for direction of flight unless specified as a westbound track
- G344 track right altitude for direction of flight unless specified as a westbound track

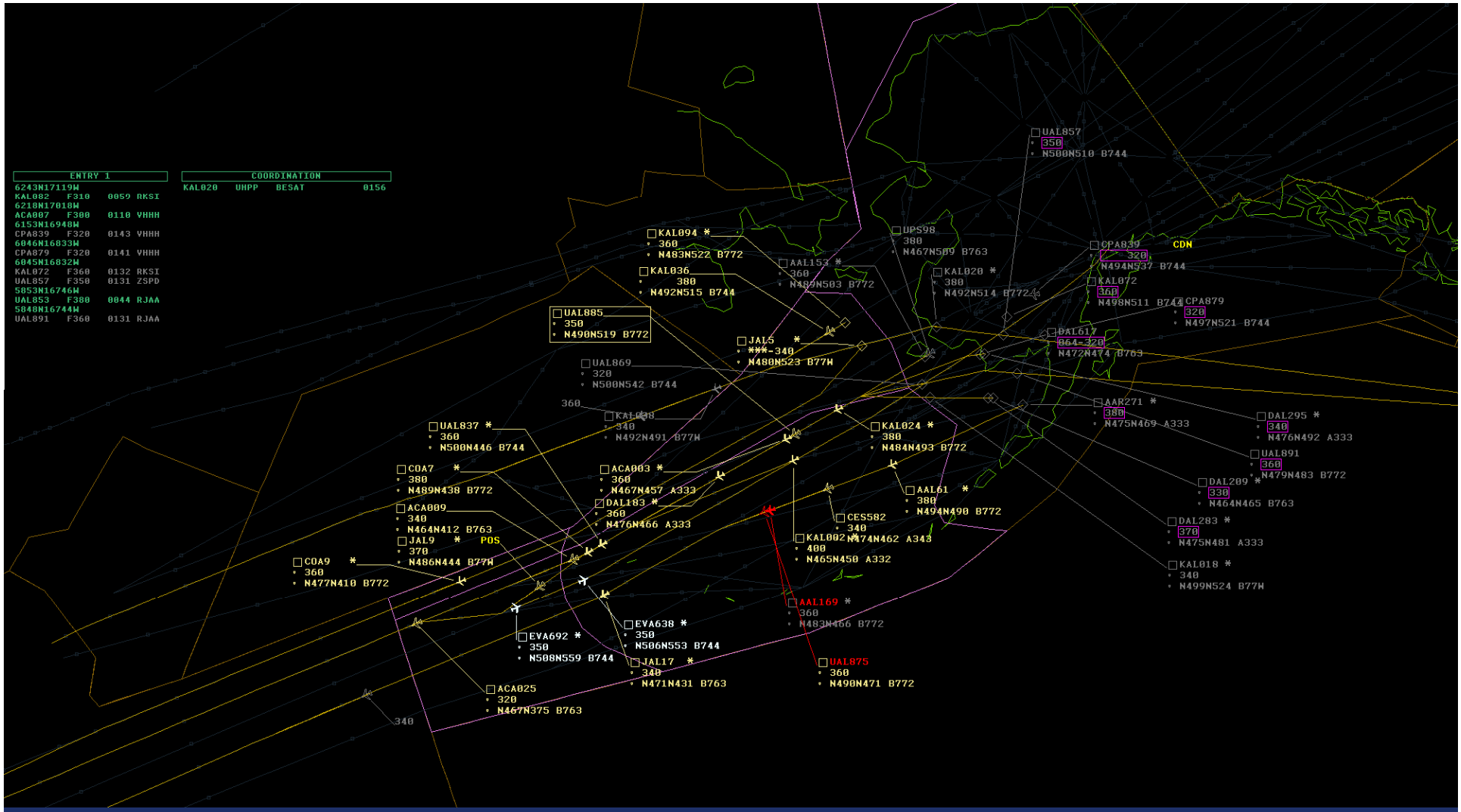
Current US Pacific Oceanic Practices and Procedures

- **Anchorage Center requires that the DOTS generated tracks that join NOPAC R220 and R580 merge within the Saint Paul radar volume**
  - This was deemed necessary because of traffic converging from different directions and crossing at many different points
- **Westbound routes joining NOPAC R220 and R580 start transitioning to all altitudes within the Saint Paul radar volume before they go non-radar and the eastbound track A590 transitions from all altitudes to correct altitude for direction of flight after they come into the Saint Paul radar volume**

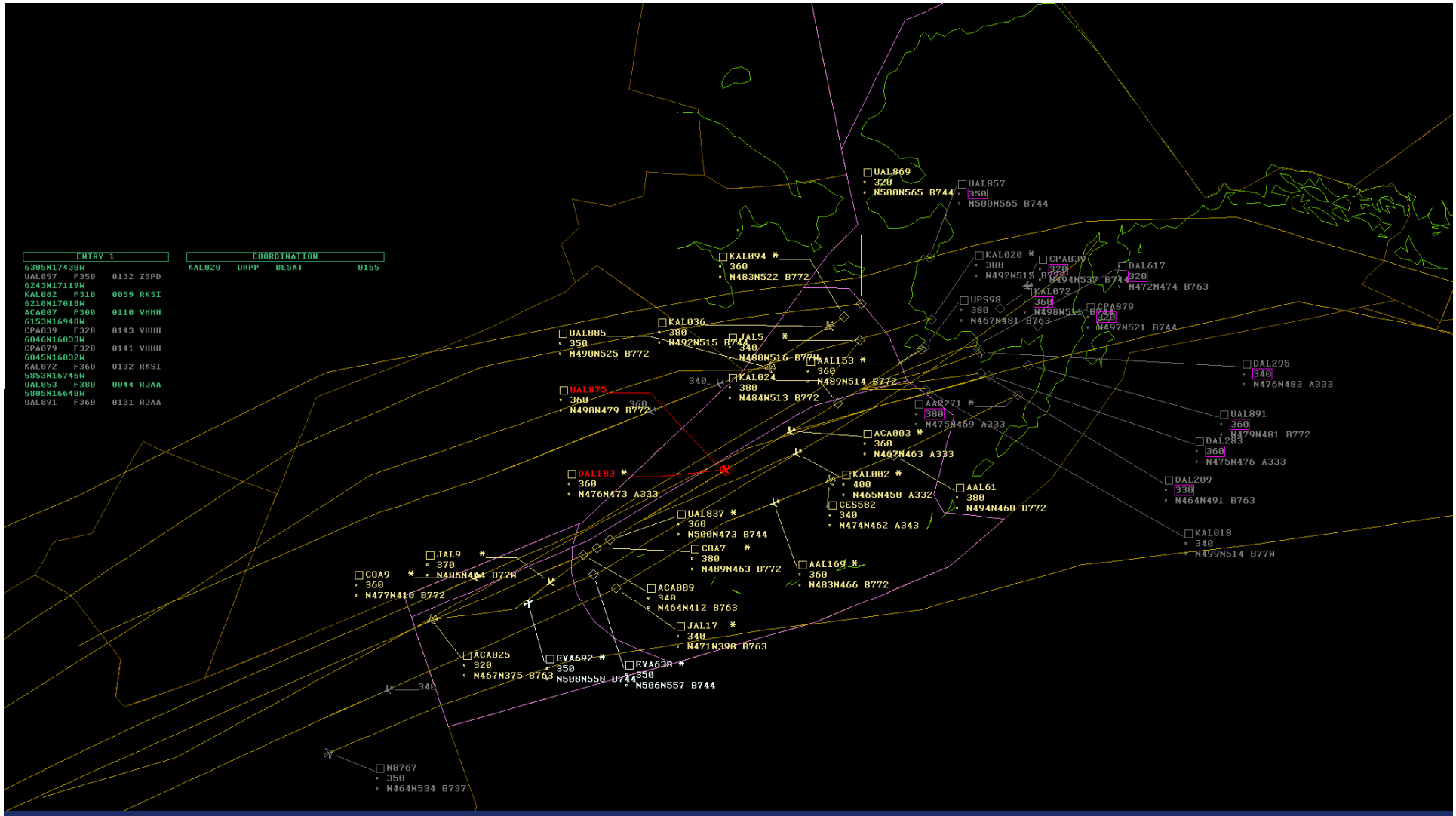
2011 Pacific Project Work

- **Identified 14 Sept 2011 for participating airlines and NASA to generate UPRs for their scheduled flights**
- **Each participating airline calculated UPRs, fuel burn, and time savings**
- **Attention focused on benefits and procedural difficulties in allowing airlines to fly unrestricted UPR routes**
- **Identified that some participating airlines had difficulty generating true "unrestricted" UPRs on their "live" systems**
  - Some UPR Flights were still coordinating into Anchorage Oceanic airspace under radar restriction
- **Suspended study until airlines, FAA, and NASA could come up with a way to simulate unrestricted UPRs**
- **Agreement reached to use DOTS Plus generated unrestricted routes to simulate what airlines would be requesting**

Target flight paths as filed during trial
14 September 2011



Airline User Preferred Routes (UPRs)
14 September 2011



2011 Study Observations on User Preferred Routes

- **Study in the Pacific to examine the effects of using airlines' UPRs rather than fixed tracks**
- **Initial study only included UPRs for participating airline flights**
- **Initial report indicated fuel and time savings without creating additional conflicting air traffic in the Pacific; however, only participating flights were given UPR routes**
- **Participating airlines fuel savings of 3.96% and average flight time savings of 13 minutes**
  - Fuel and time savings did not consider availability of routes if surrounding air traffic were also requesting UPR routes
  - These were not optimized for altitudes

Current Work - Baseline Study Data

- **Identified 19 September 2012 as target study date**
  - All OCEAN21 air traffic data recorded and archived from Anchorage and Oakland Centers from 1200 hours on 18 Sept to 1200 hours 20 Sept
  - Parsed air traffic data to identify the four hour period of peak west-bound traffic coordinating into Anchorage Oceanic airspace for initial study
    - Determined to be 2200 19 Sept to 0200 20 Sept
  - Since routes could encompass both Anchorage and Oakland airspace, a combined OCEAN21 adaptation was obtained for simulation
- **Identified target city pairs**
  - To reduce workload, merged west-bound routes to 12 “like” city pairs
  - 12 tracks encompass over 80% of Pacific Ocean traffic on a given day (May, June, July)
  - DOTS Plus team generated corresponding 12 unrestricted UPR routes

Identified City Pairs

- **TRACK 1 KSEA to RJAA includes departures from CYVR, KPDX, and KSEA and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 2 CYVR to RCTP includes departures from CYVR, KPDX, and KSEA and arrivals to VHHH and RCTP**
- **TRACK 3 KSEA to RKSI includes departures from CYVR, KPDX, and KSEA and arrivals to ZSPD and RKSI**
- **TRACK 4 KJFK to RJAA includes departures from KBOS, KEWR, KIAD and KJFK and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 5 KDFW to RJAA includes departures from KDFW and KIAH and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 6 KDFW to RKSI includes departures from KDFW and KIAH and arrivals to ZSPD and RKSI**

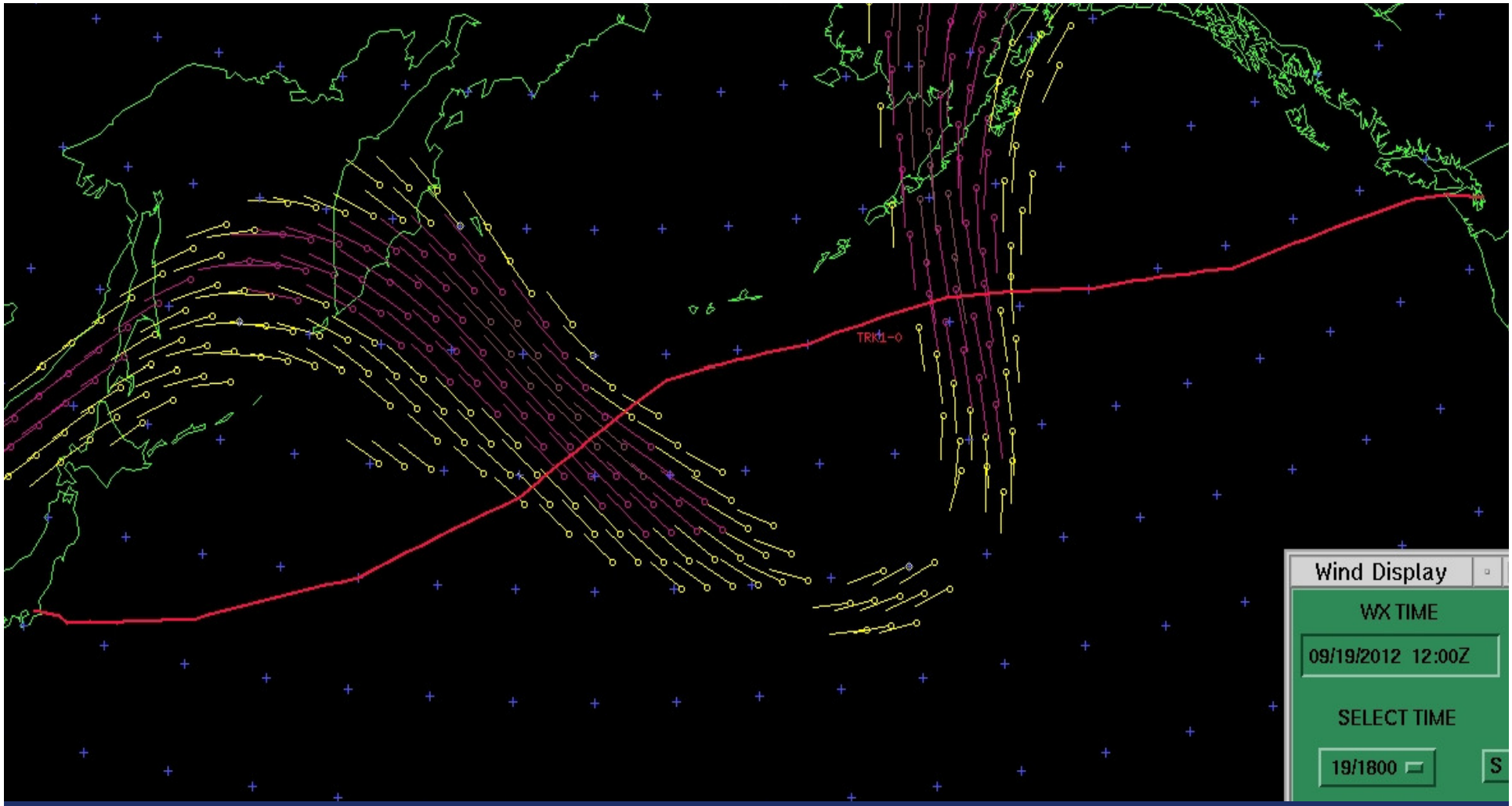
City Pairs Continued

- **TRACK 7 KORD to RJAA includes departures from KDTW, KORD, and KMSP and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 8 KLAX to RJAA includes departures from KLAX and KSFO and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 9 KLAX to RCTP includes departures from KLAX and KSFO and arrivals to VHHH and RCTP**
- **TRACK 10 KLAX to RKSI includes departures from KLAX and KSFO and arrivals to ZSPD and RKSI**
- **TRACK 11 PANC to RJAA includes departures from PANC and arrivals to RJAA, RJBB, and RJTT**
- **TRACK 12 PANC to RCTP includes departures from PANC and arrivals to VHHH and RCTP**

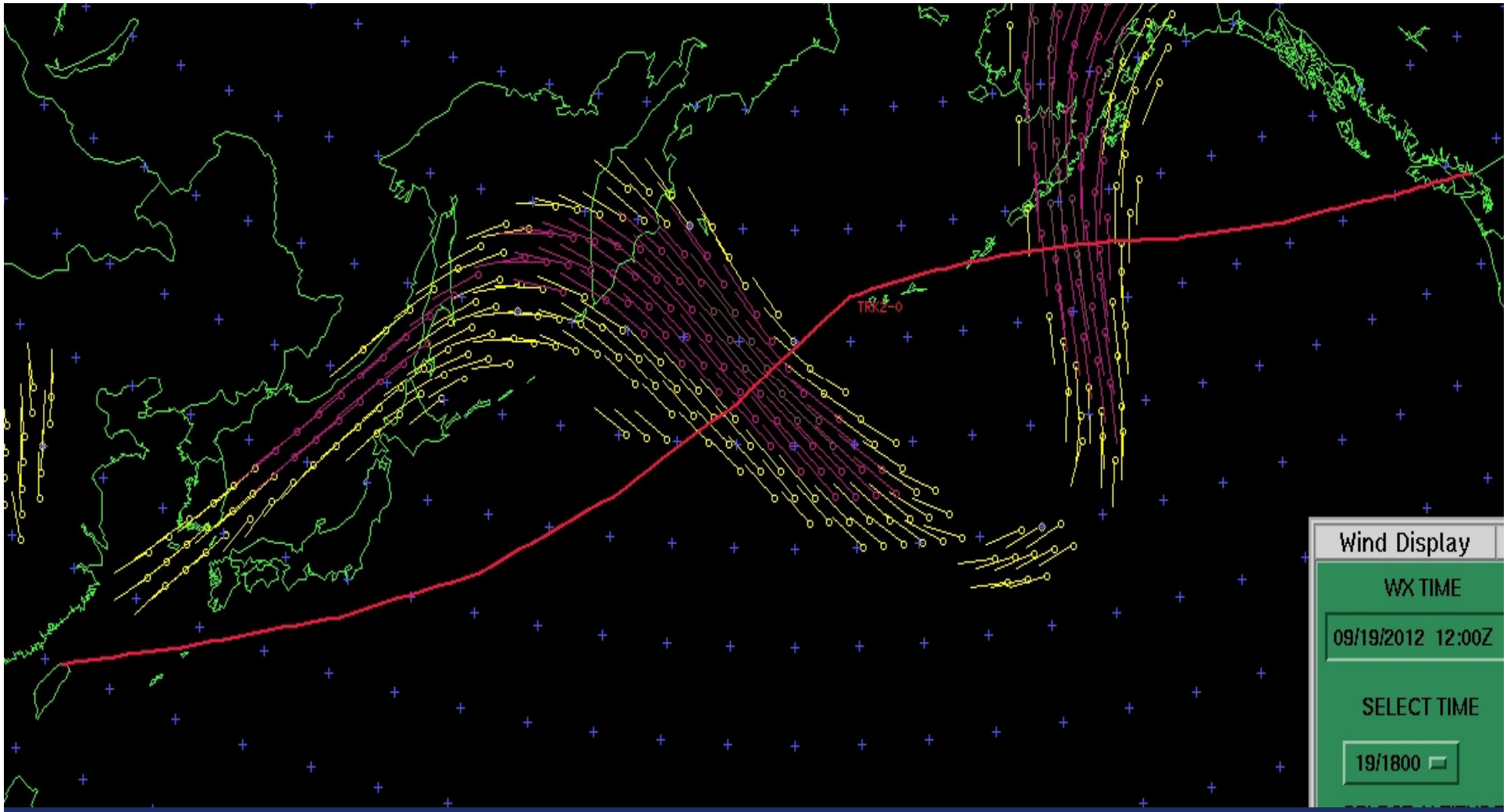
DOTS Generated UPRs

- **Based on the 2011 study it was decided to have DOTS generate UPRs to simulate unrestricted UPR requests from airlines**
- **DOTS Plus generated tracks for the 12 city pairs for the study time period and contained no restrictions to airspace or procedures**
- **DOTS Plus used the actual weather models for the study time period**
- **It is understood that airlines each have their own tools and methodology for calculating UPRs**
- **Airline UPRs may differ by many variables including city pair, aircraft type, weight, and altitude**
- **DOTS Plus generated UPR track variables:**
  - Aircraft type - 747-400
  - Aircraft weight – 870,000
  - Aircraft Flight Level - 340
- **DOTS Plus tracks were used to simulate the varying unrestricted airline UPR requests**

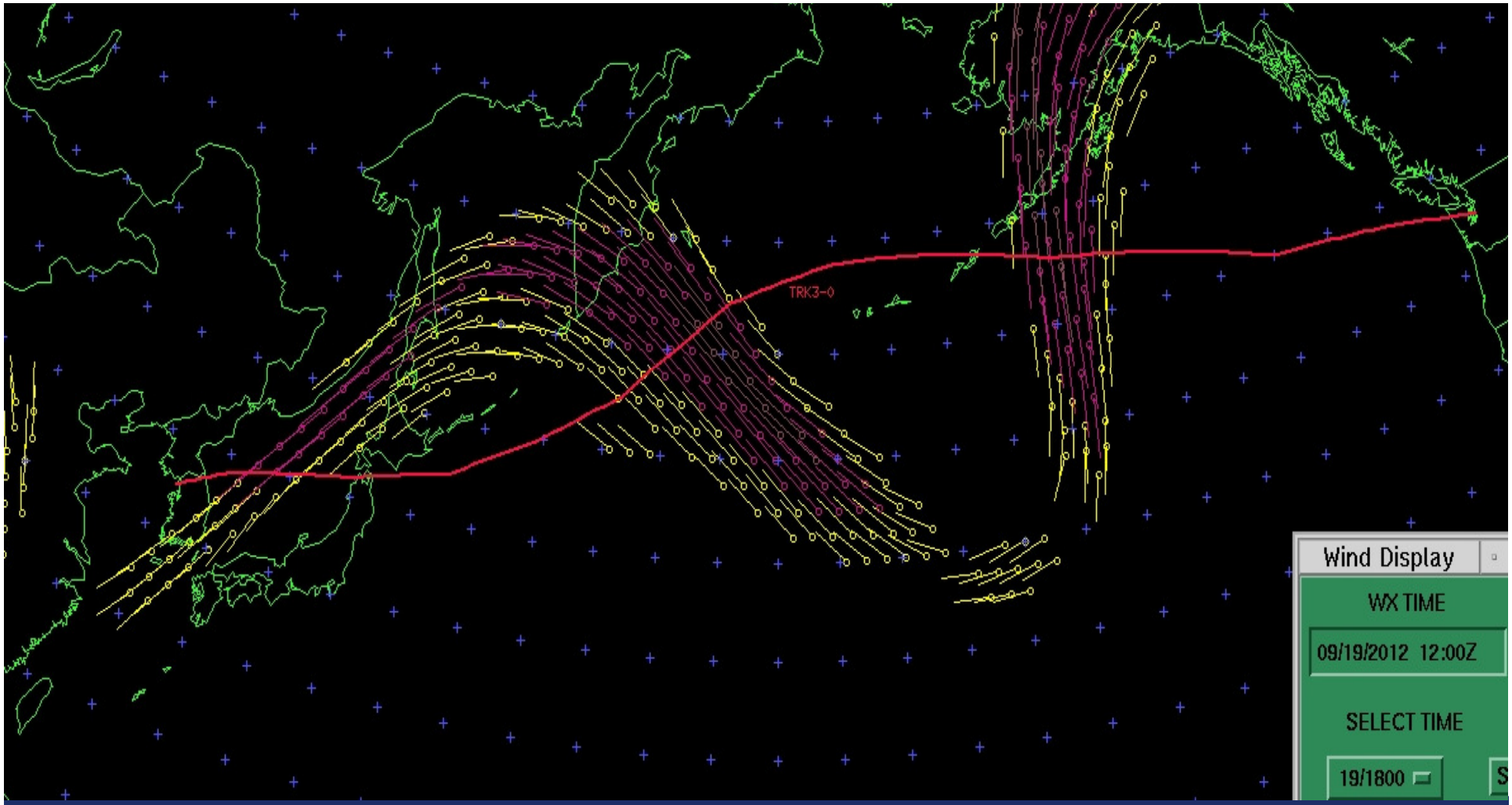
2012 UPR Track 1 KSEA - RJAA



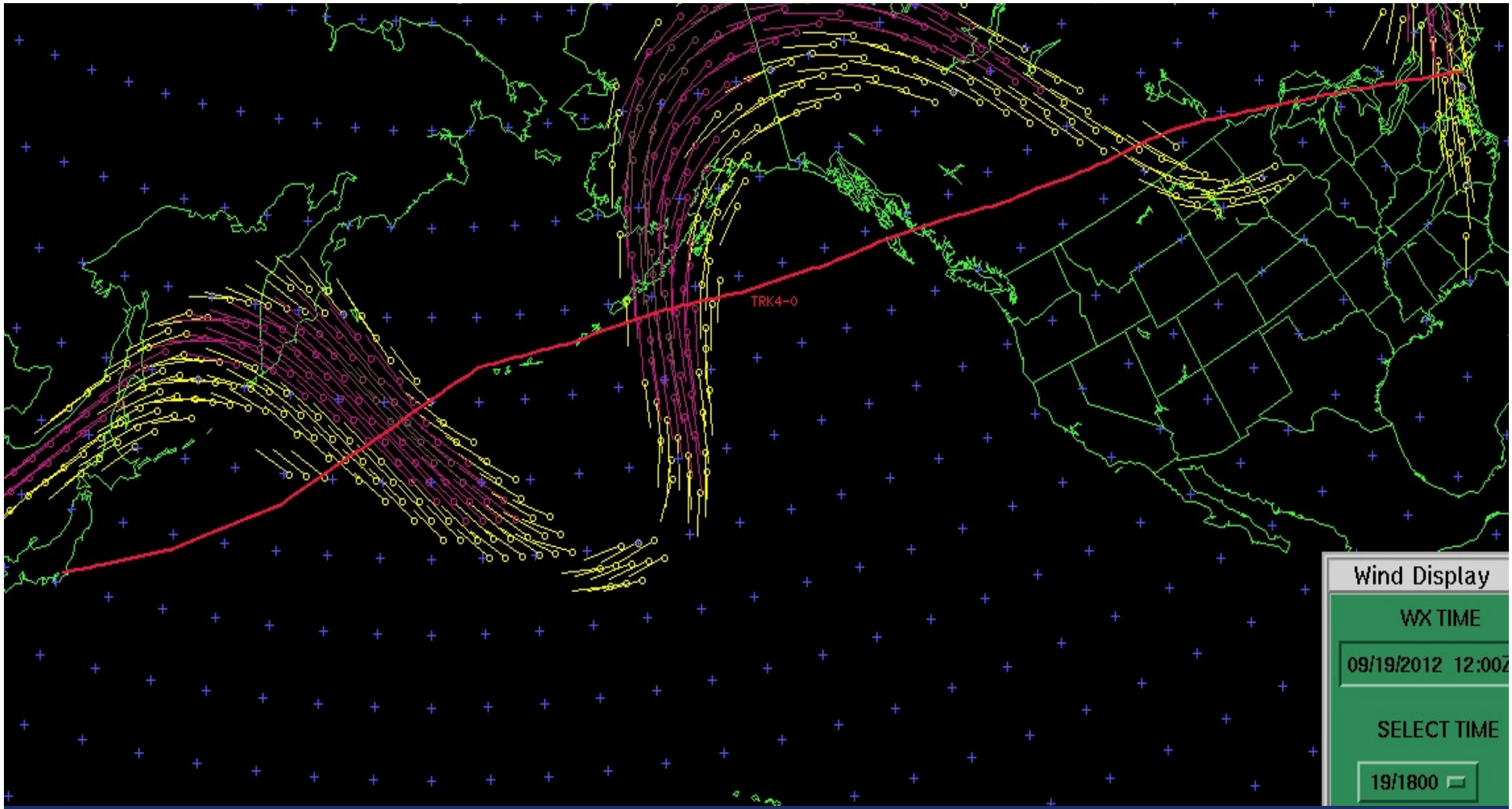
2012 UPR Track 2 CYVR - RCTP



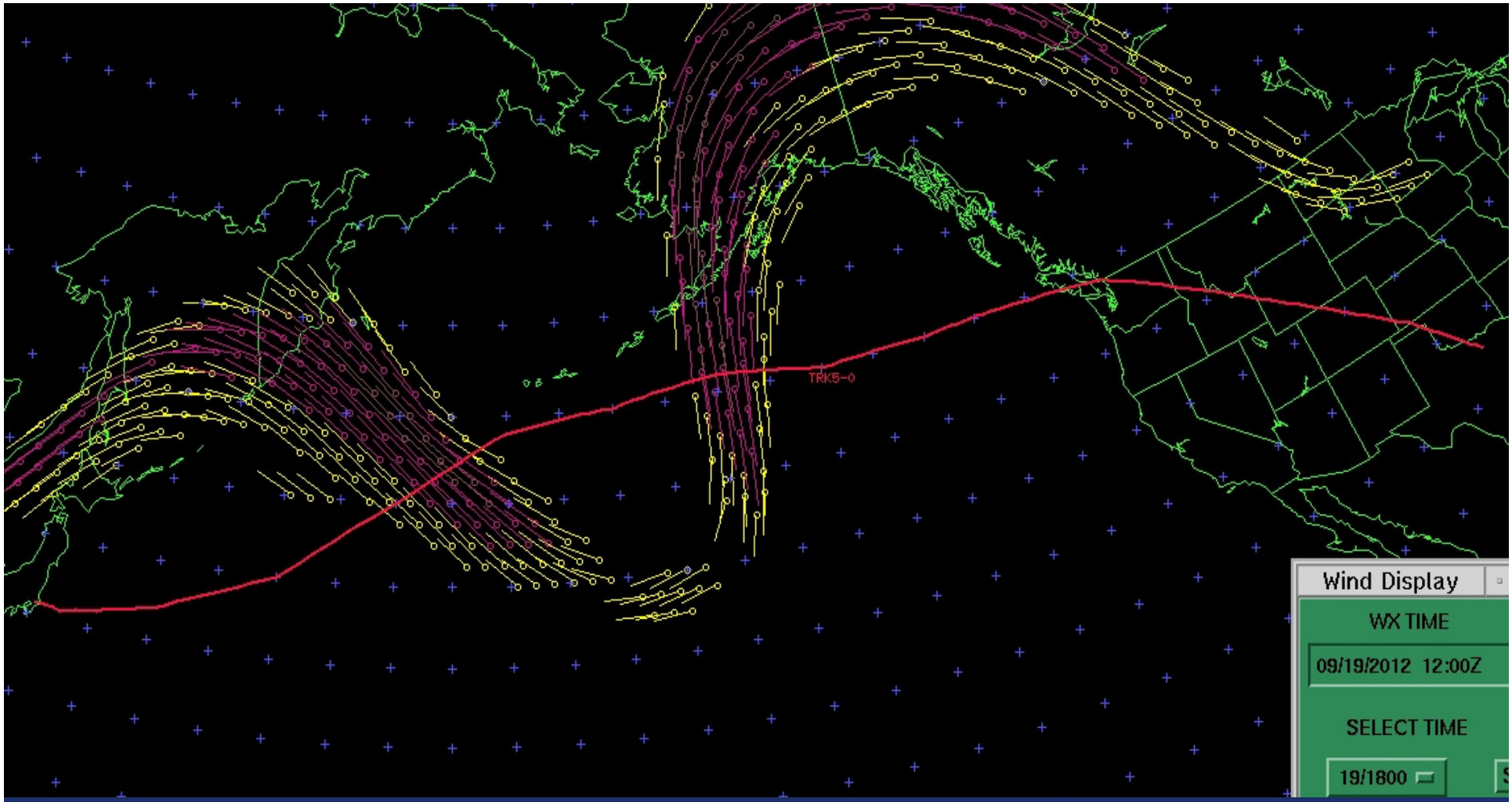
2012 UPR Track 3 KSEA - RKSI



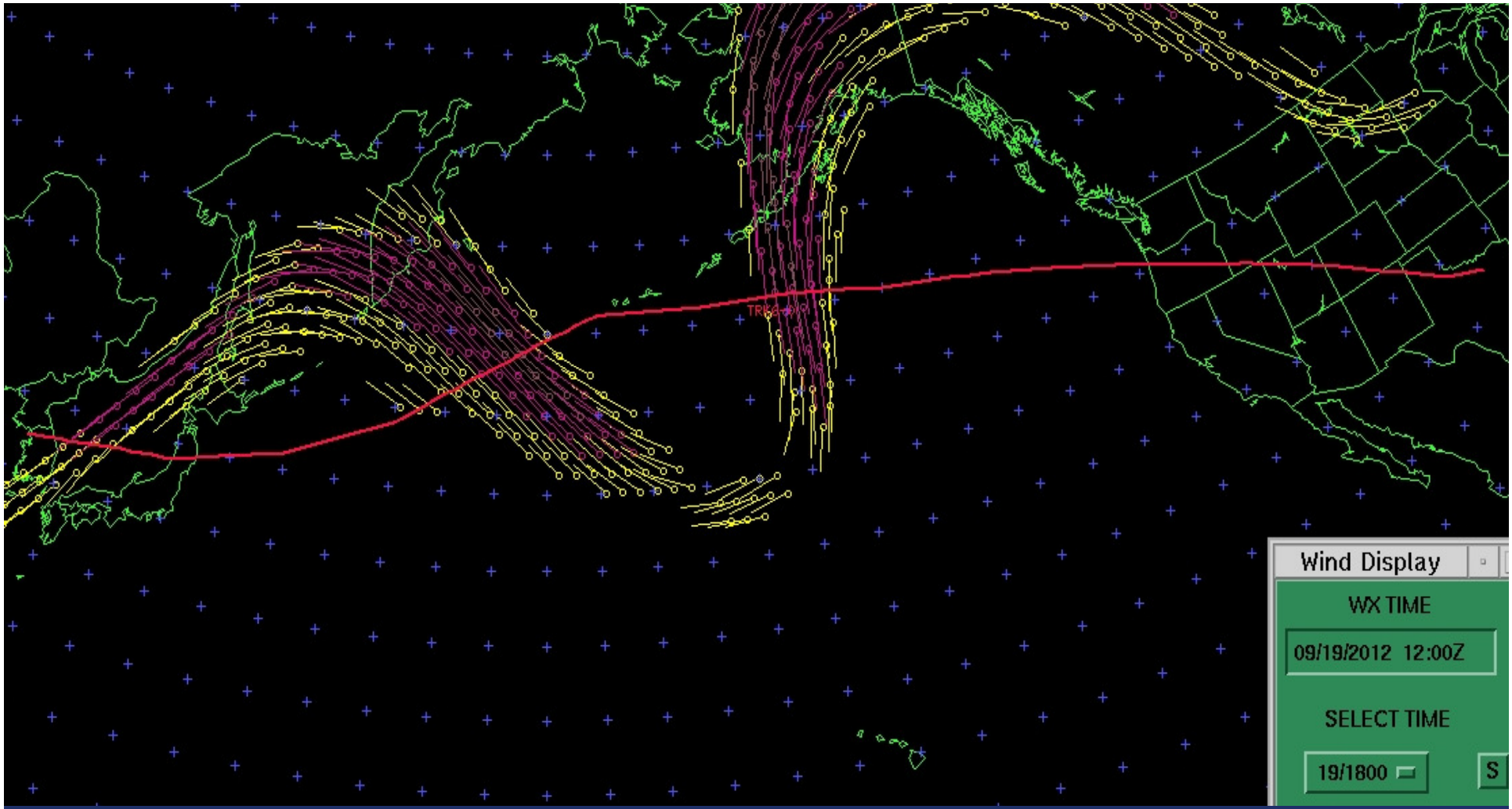
2012 UPR Track 4 KJFK - RJAA



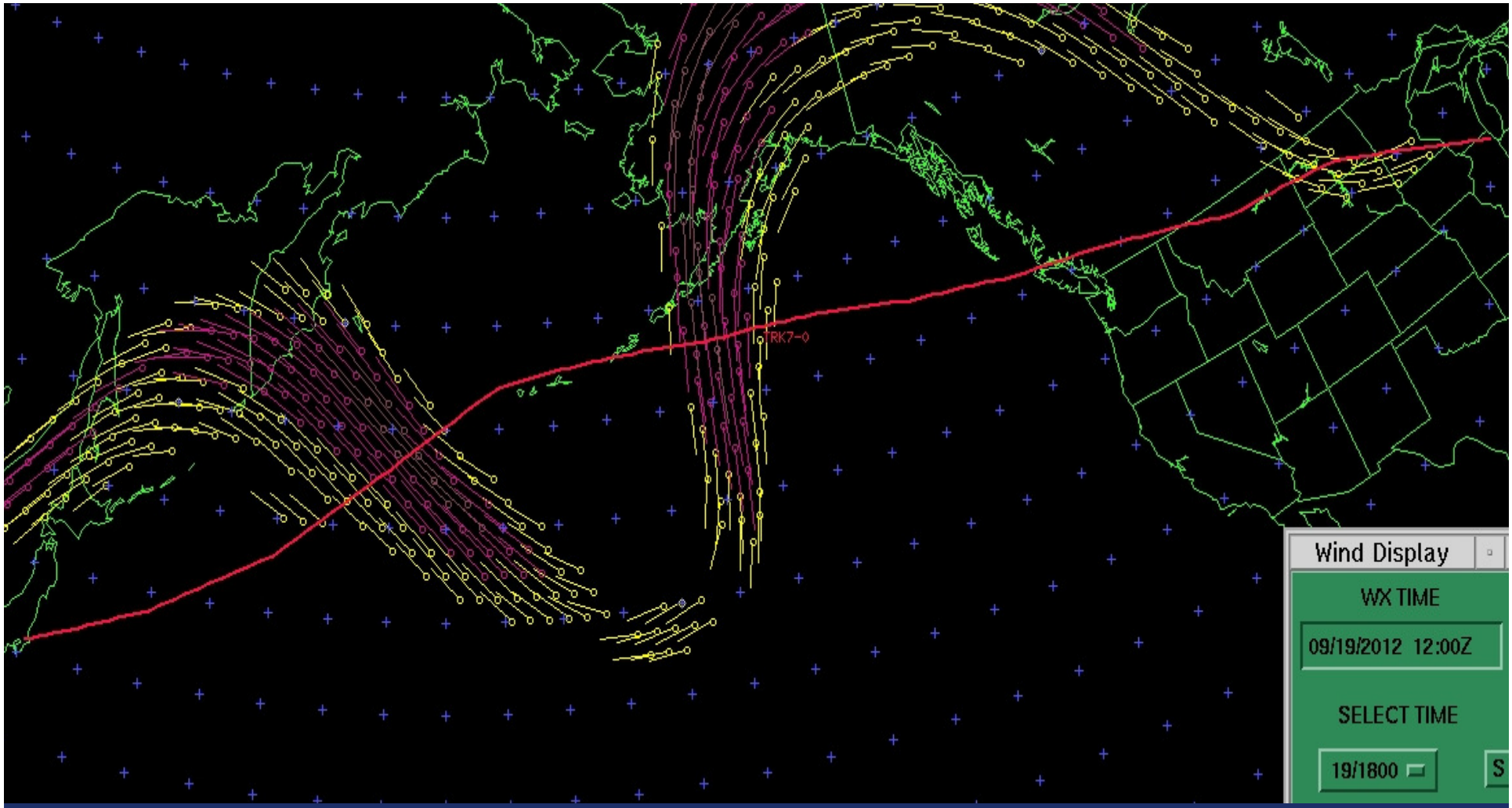
2012 UPR Track 5 KDFW - RJAA



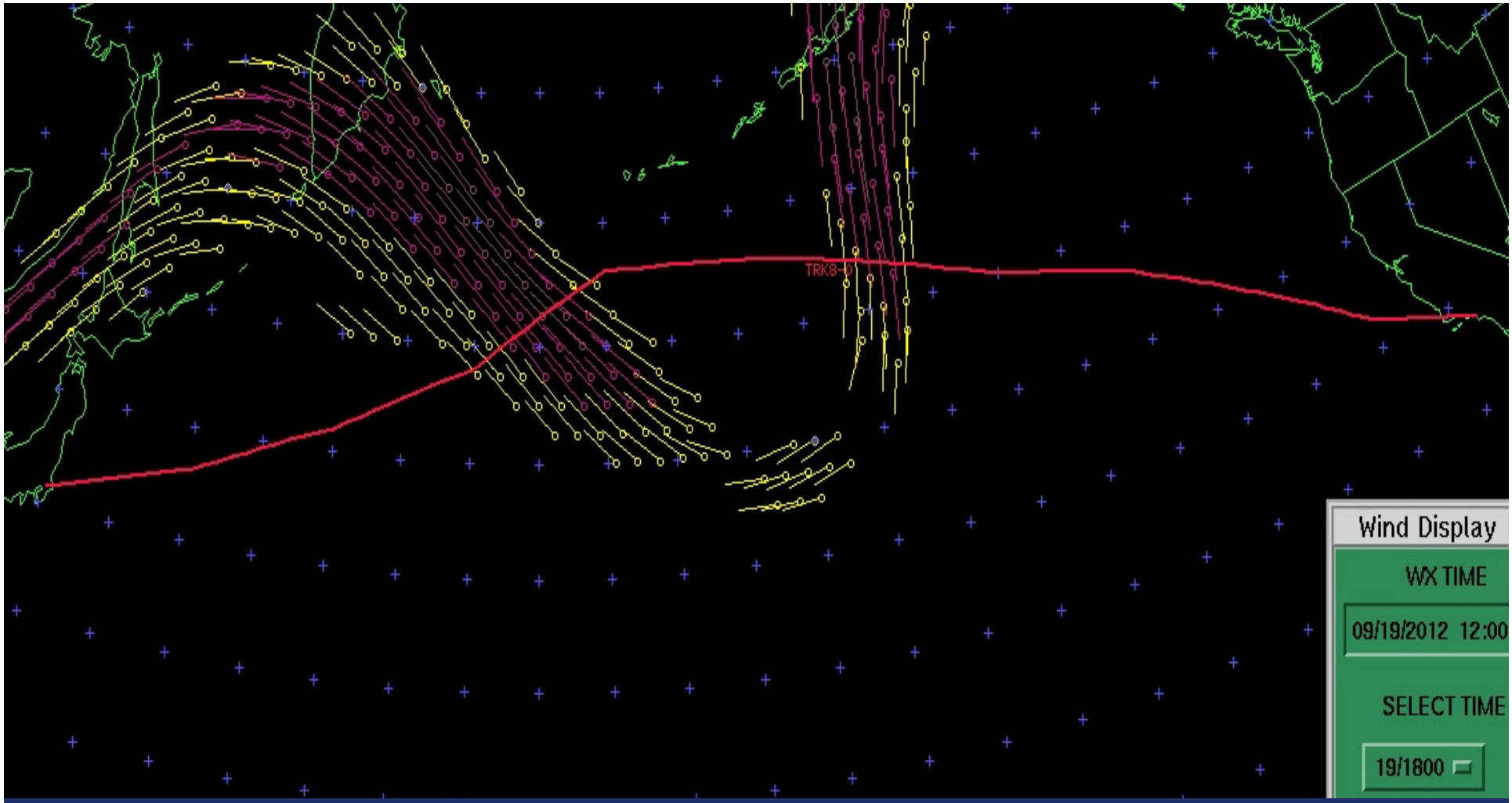
2012 UPR Track 6 KDFW - RKSI



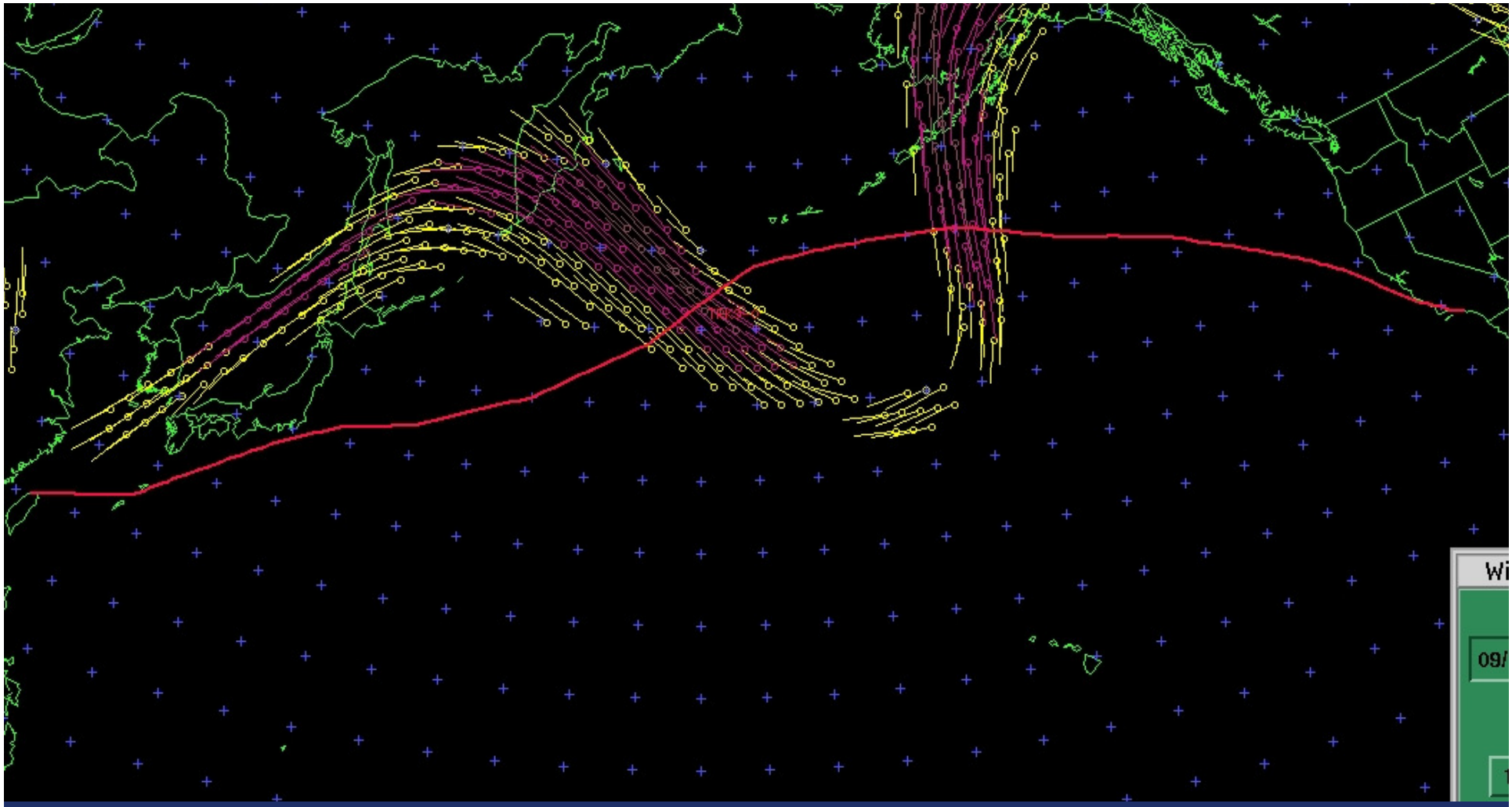
2012 UPR Track 7 KORD - RJAA



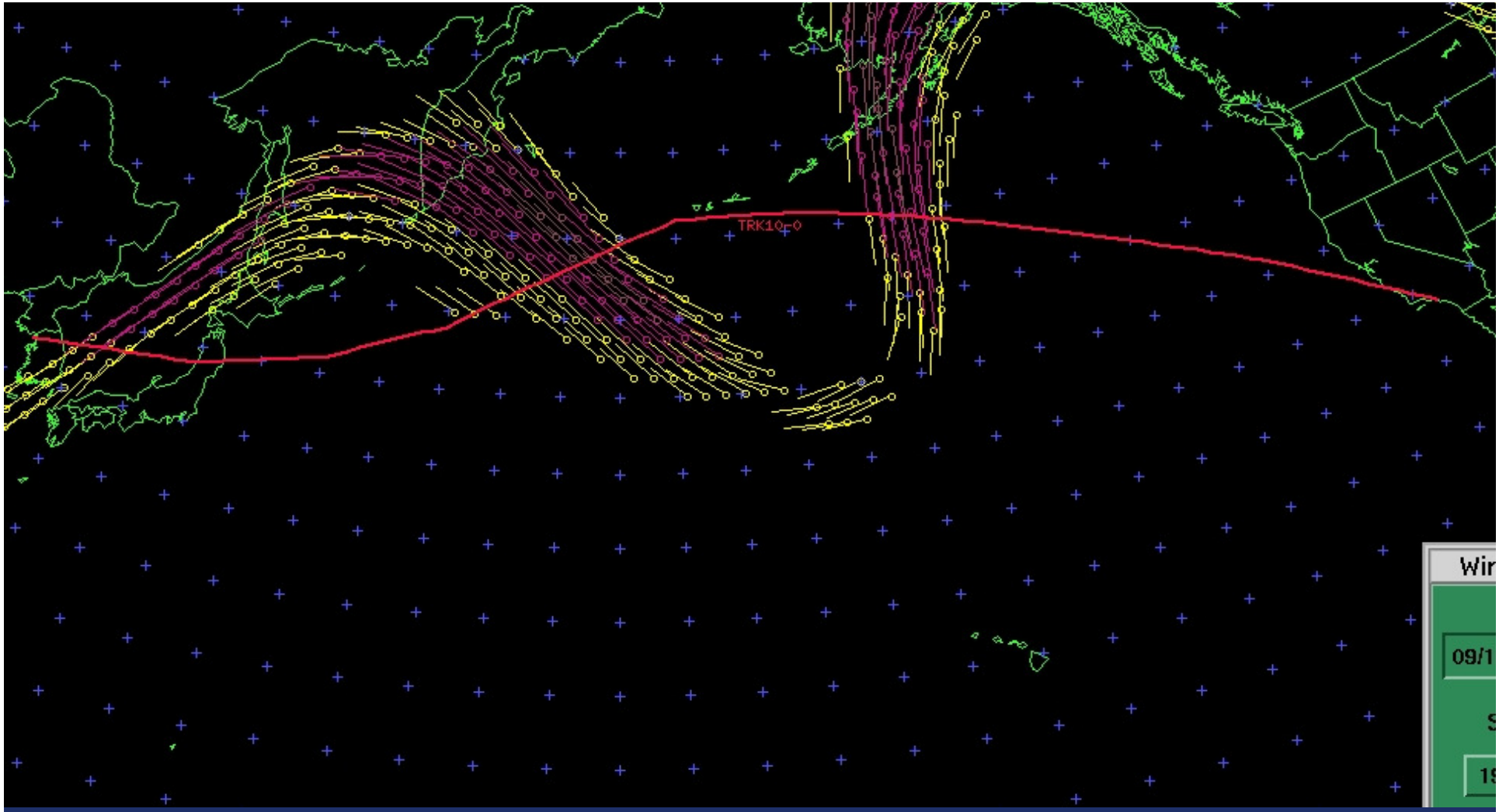
2012 UPR Track 8 KLAX - RJAA



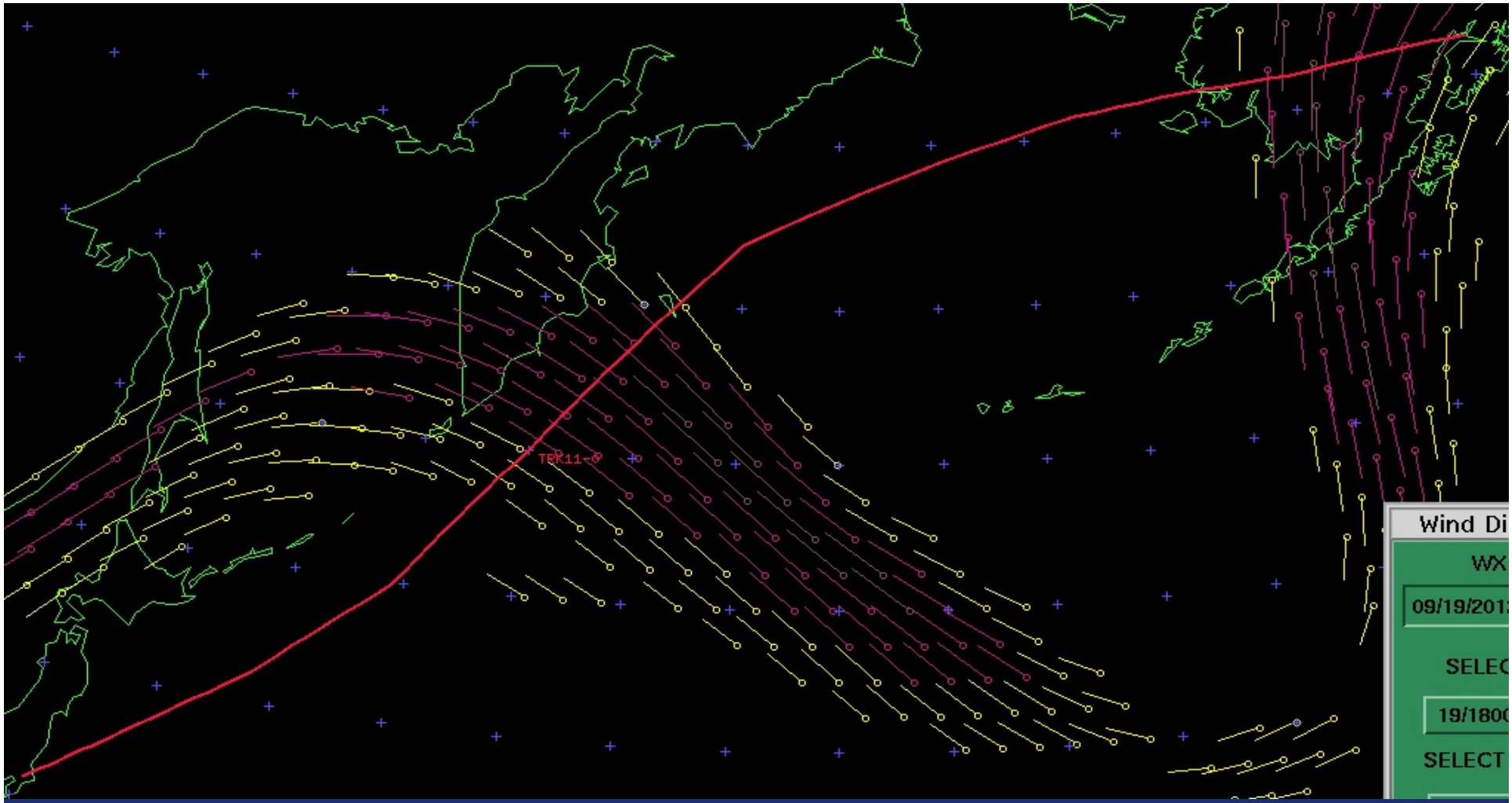
2012 UPR Track 9 KLAX - RCTP



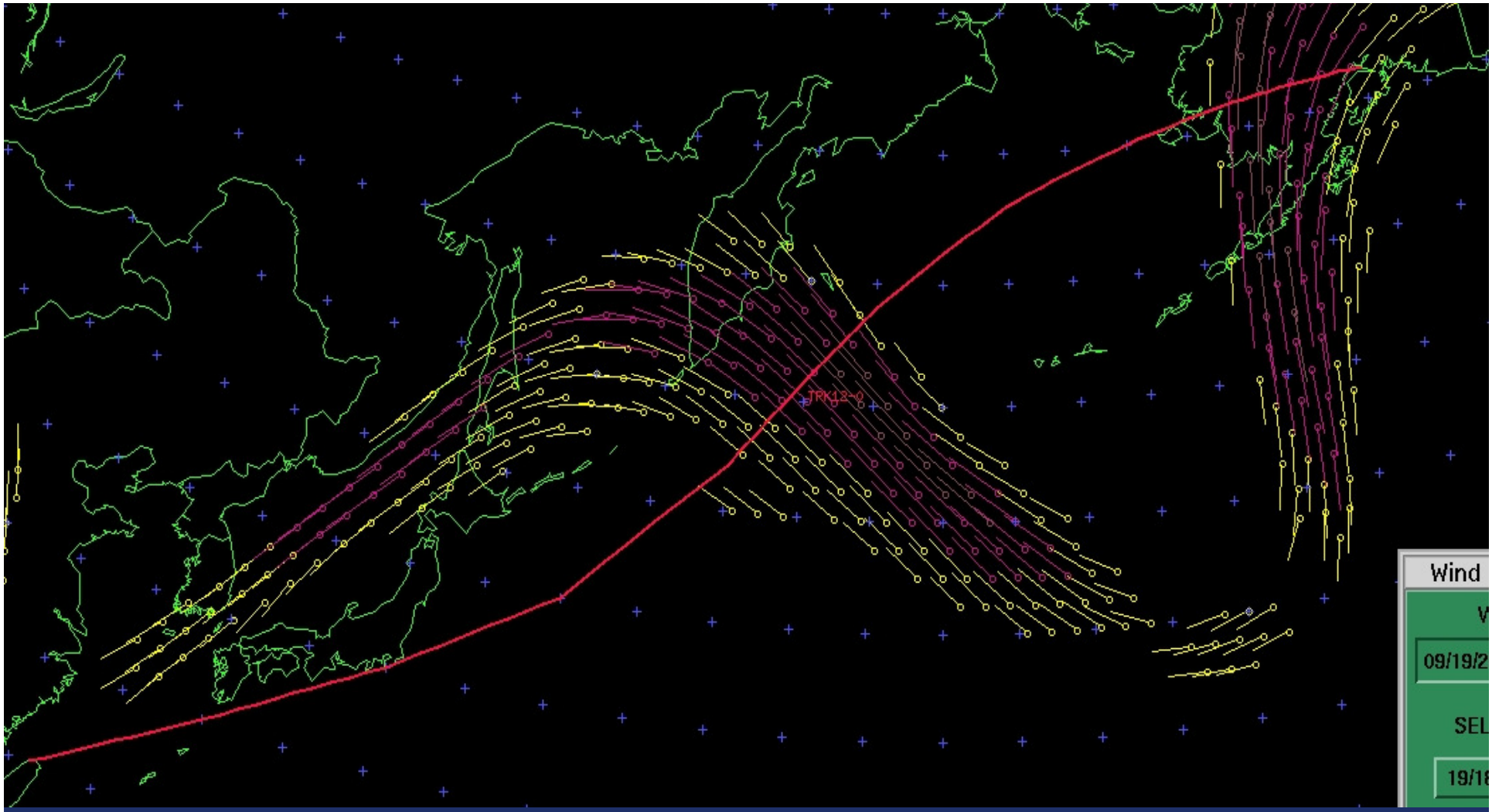
2012 UPR Track 10 KLAX - RKSI



2012 UPR Track 11 PANC - RJAA



2012 UPR Track 12 PANC - RCTP



Thirty (30) identified west-bound flights for study

- **During peak four hour period, 30 of the 32 flights coordinating into Anchorage oceanic airspace were on west-bound routes between the targeted 12 city pairs**
- **Breakout by airline of the 30 target flights**

American (2)	Cathay (1)
Asiana (1)	Delta (5)
Air Canada (5)	Eva (1)
All Nippon (4)	Japan Air (3)
Dynasty (1)	Korean (3)
China Eastern (1)	United (3)

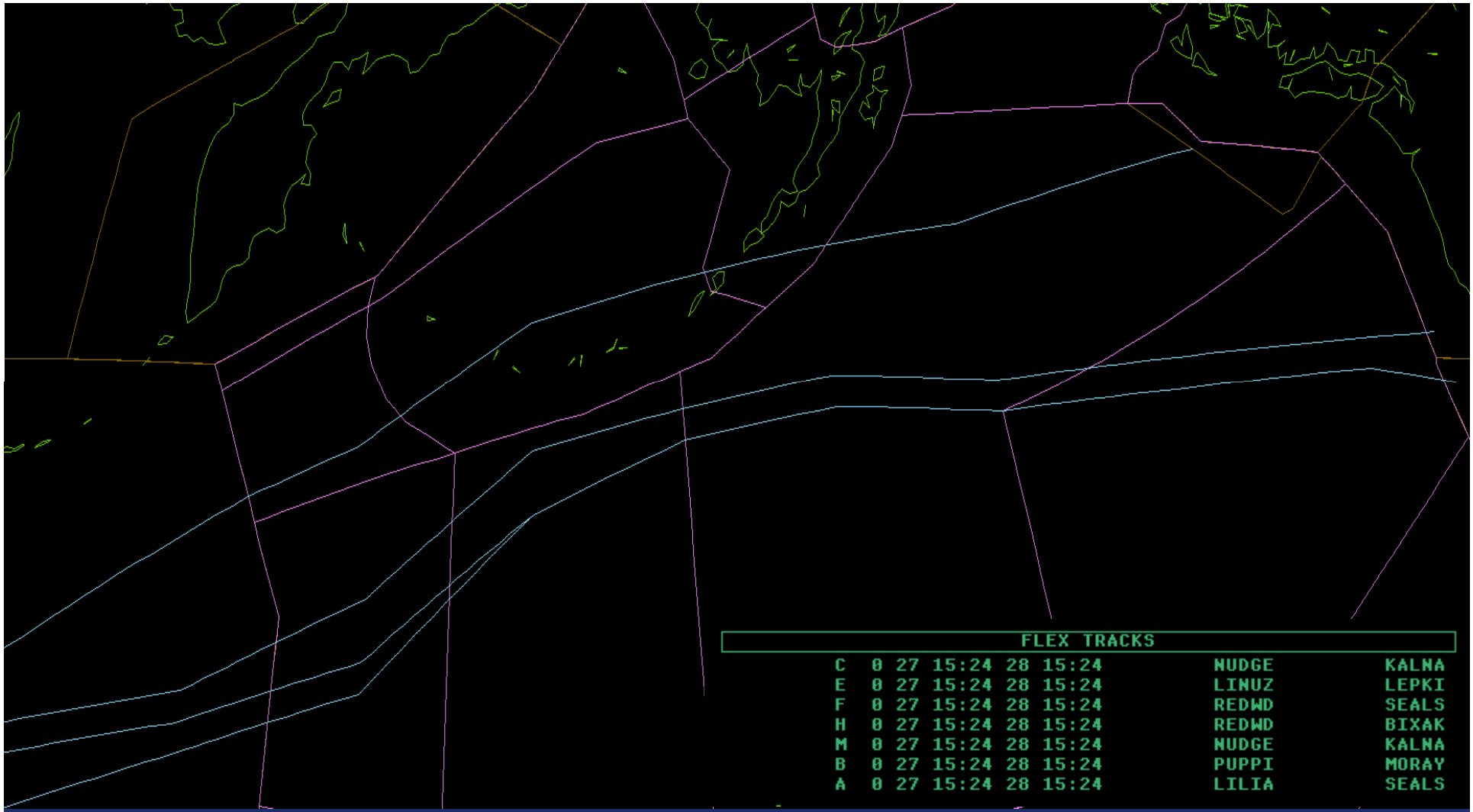
Frequency Break-out by Track

- TRACK 1 KSEA to RJAA (9)
- TRACK 2 CYVR to RCTP (2)
- TRACK 3 KSEA to RKSI (5)
- TRACK 4 KJFK to RJAA (3)
- TRACK 5 KDFW to RJAA (3)
- TRACK 6 KDFW to RKSI (1)
- TRACK 7 KORD to RJAA (6)
- TRACK 12 PANC to RCTP (1)

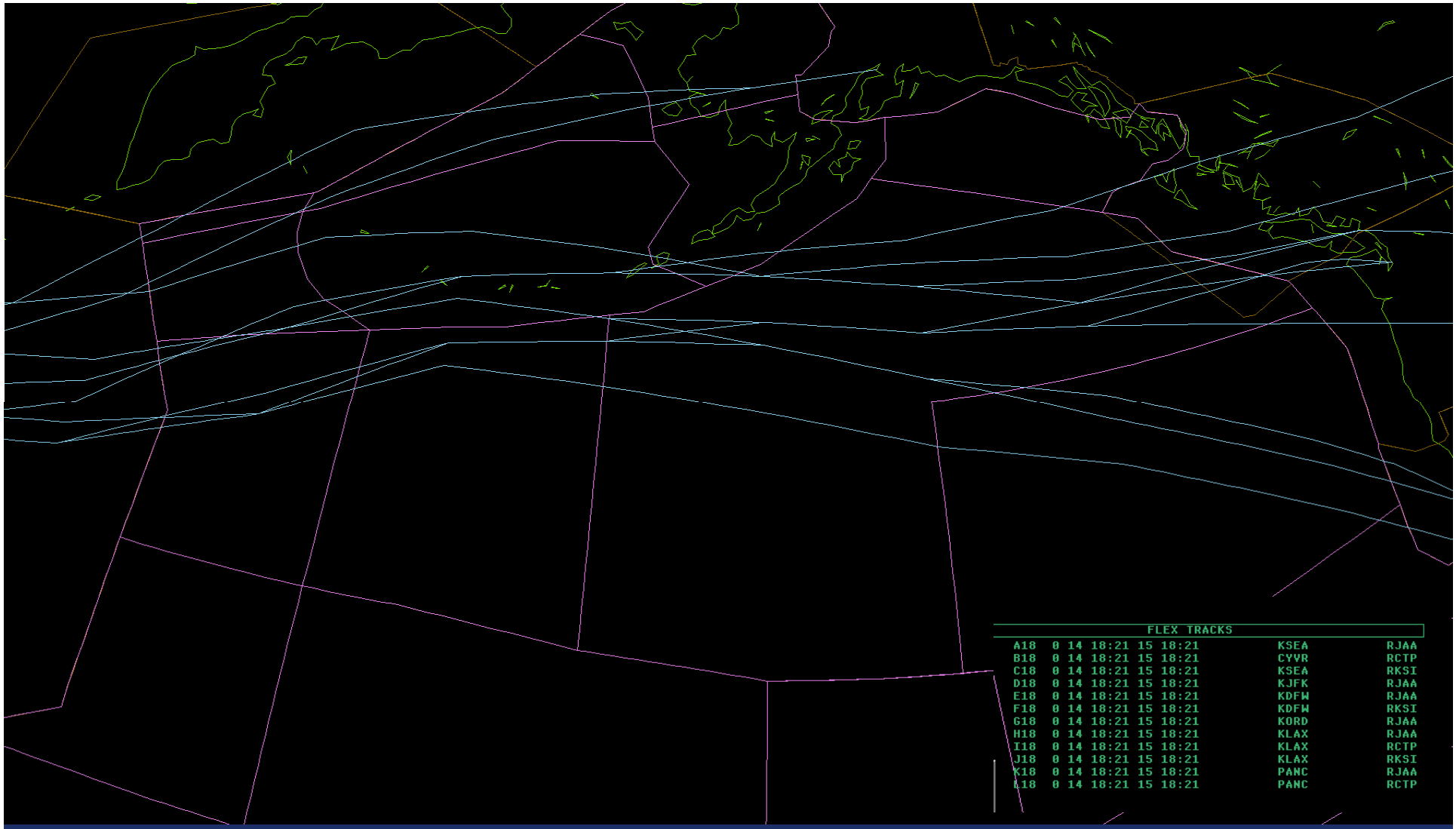
Approach to 2012 Pacific Project Study

- **Identify airspace, time period, tracks, UPR routes for initial study to narrow the scope to identify issues**
- **Obtain a combined Anchorage and Oakland airspace adaptation to view flights over broader airspace**
- **Develop an "as flown" baseline scenario from OCEAN21 recorded data**
  - Includes all pilot requests and controller responses
  - Includes filed flight plans, amendments, coordination, and all other activity
  - Includes "as flown altitudes"
- **Develop UPR scenario**
  - Replace all flight plans, and amendments with DOTS Plus generated UPR flight plans
  - Use initial "as flown altitudes" for coordination
- **Execute new simulated scenarios side-by-side and study impact on air traffic**

Published PACOTS Tracks for 19 Sept 2012



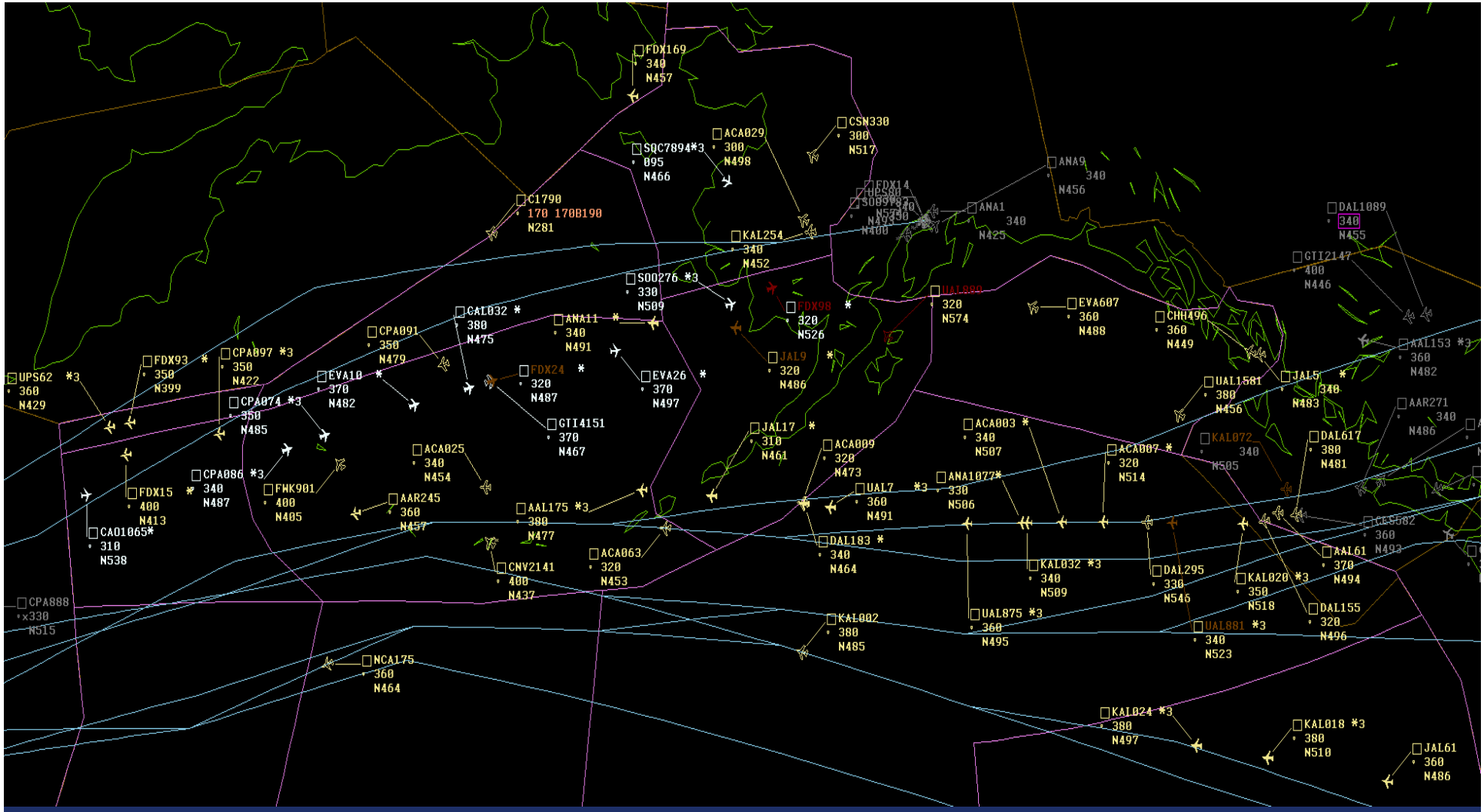
19 Sept 2012 UPR Generated Tracks



DOTS Plus UPR Observations

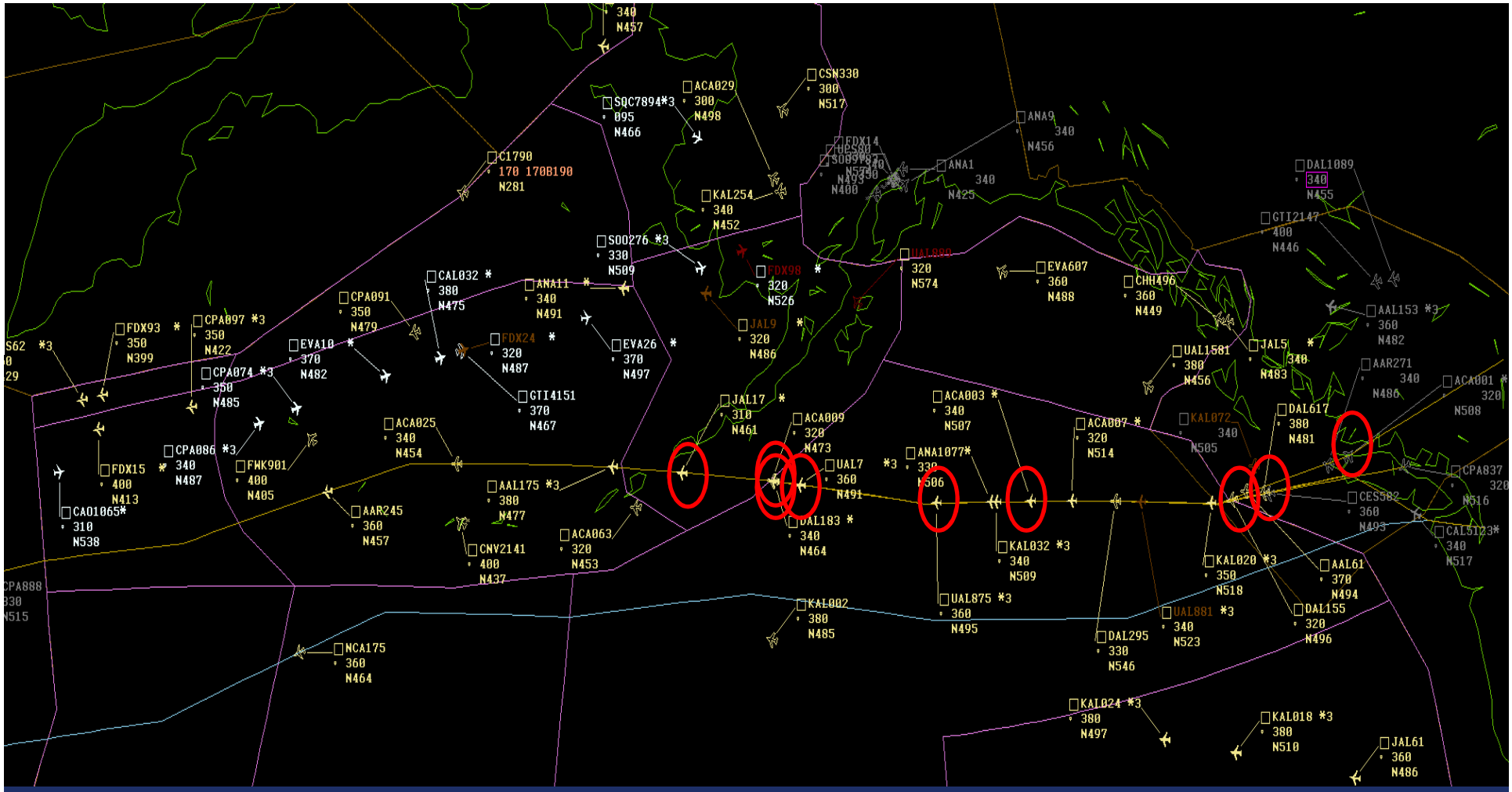
1. Unrestricted UPRs resulted in some crossing of routes. Could cause some crossing conflicts that will require separation by controllers. Will need to investigate impact on air traffic.
2. Resulting UPRs dropped some tracks further south out of Anchorage airspace.
3. Some UPRs coordinated into Oakland Oceanic, then into Anchorage Oceanic, and then back in to Oakland Oceanic.
4. Unrestricted UPRs generated did not consider costs of country airspace user fees.

2012 Actual Traffic Displayed with UPRs

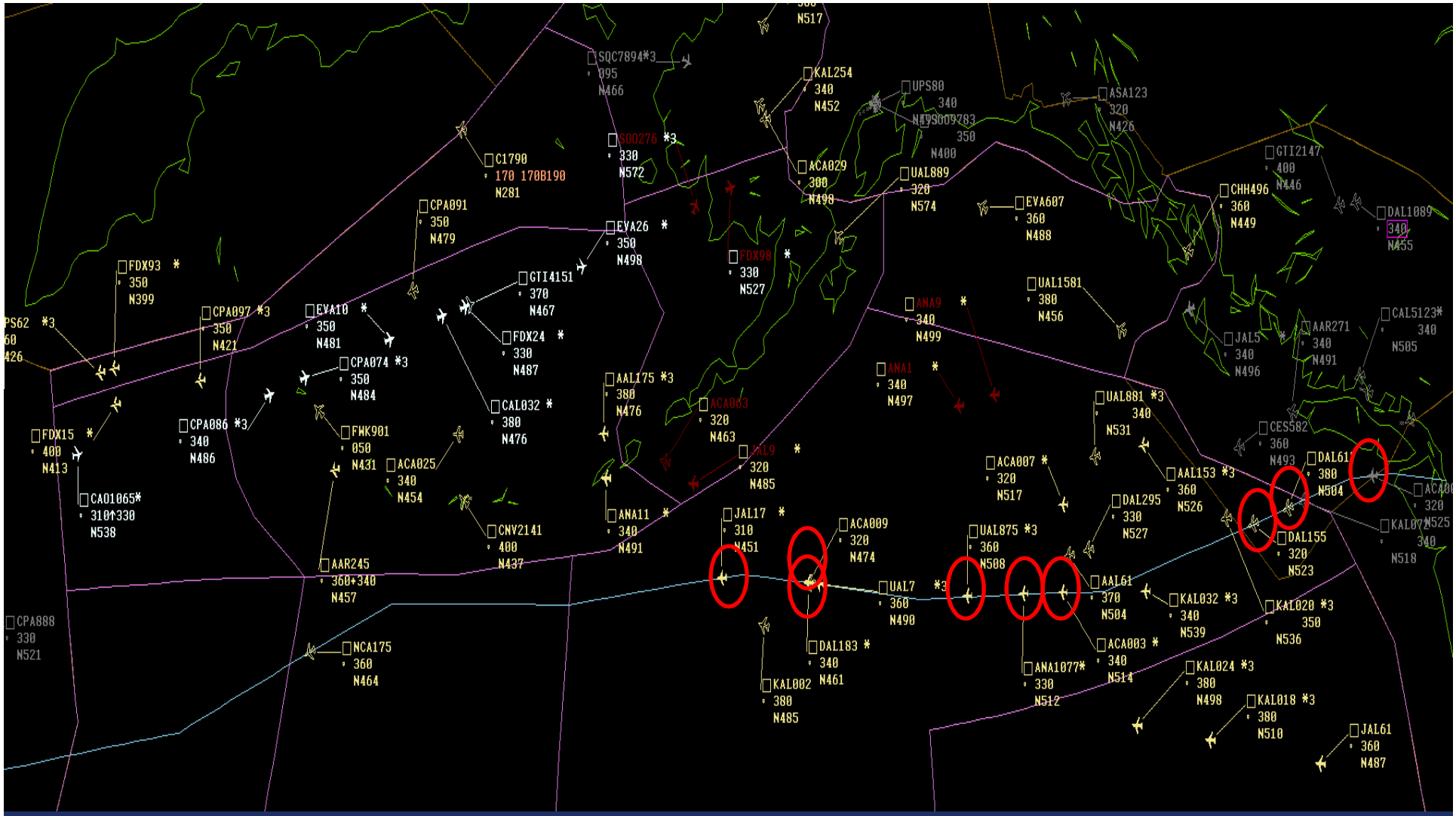


Track 1 Base and UPR

KSEA – RJAA (9)



Track 1 UPR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N466
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N452
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ASA123
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N426
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N281
SOO276 *3
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ACA029
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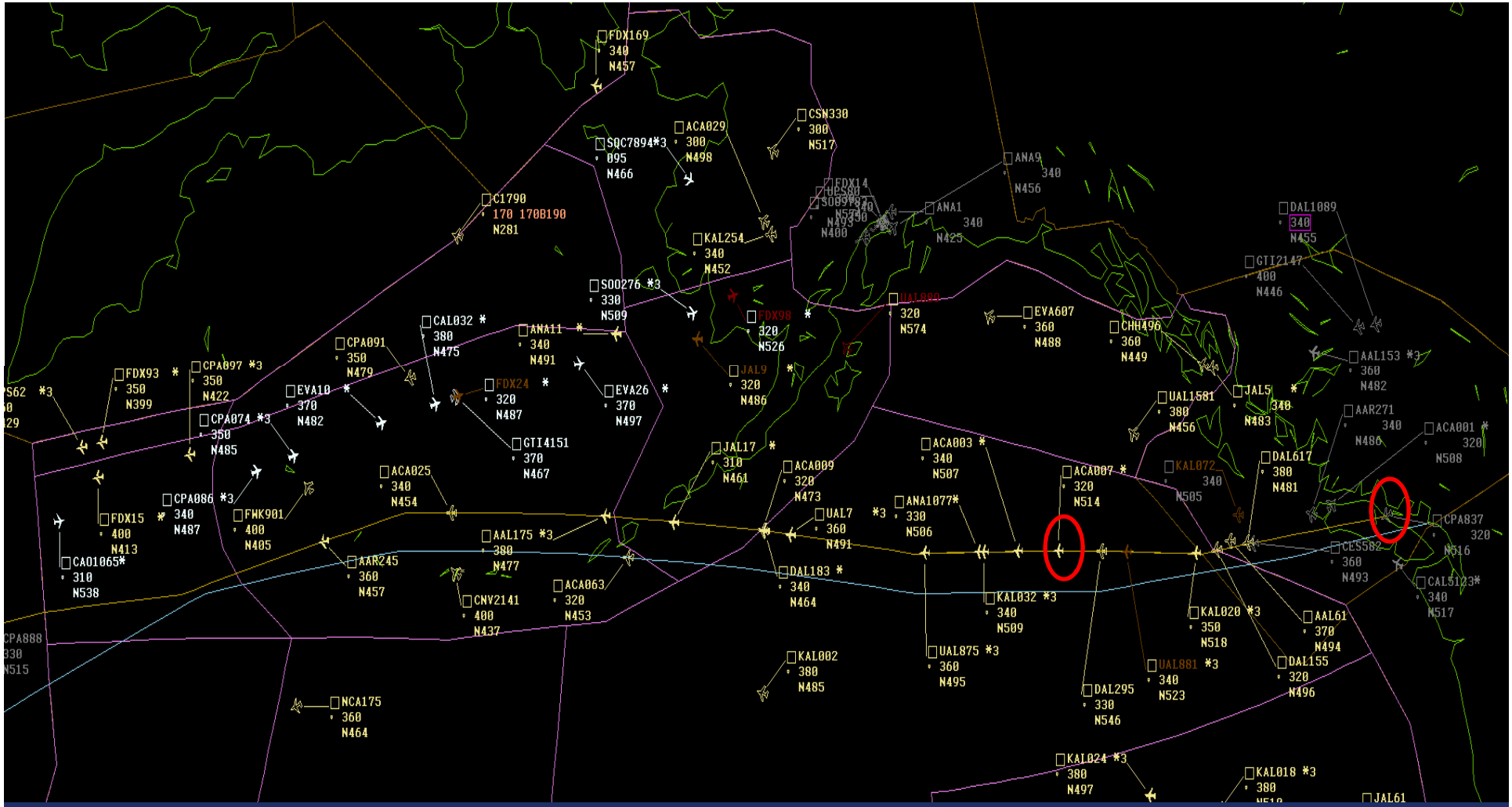
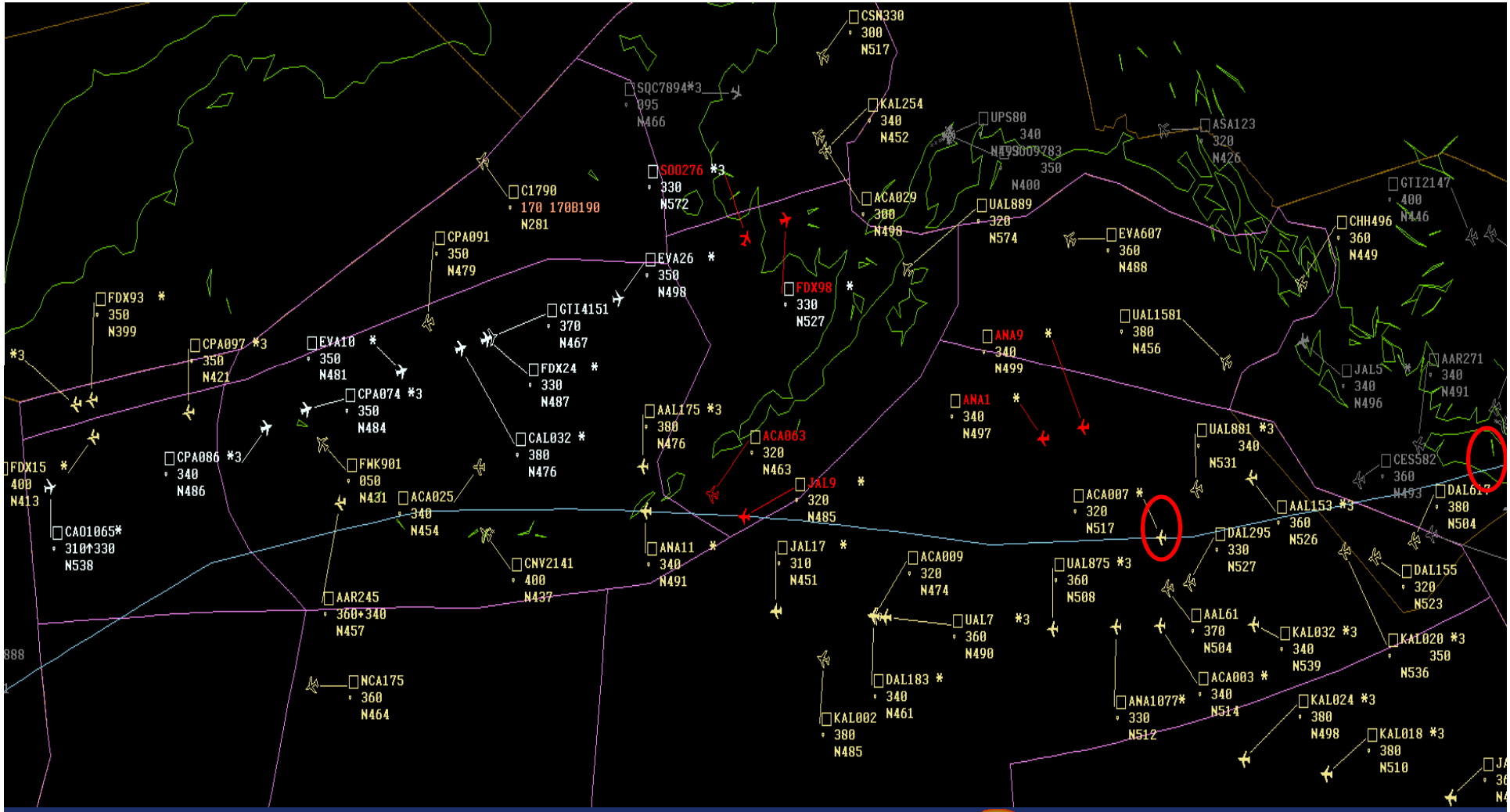
Track 2 Base and UPR

CYVR – RCTP (2)



Track 2 UPR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FDX24 *
330
N487
ANA9 *
340
N499
JAL5 *
340
N496
AAR271
340
N491
CPA074 *3
350
N484
AAL175 *3
380
N476
ANA1 *
340
N497
CAL032 *
380
N476
ACA063
320
N463
UAL881 *3
340
N531
CPA086 *3
340
N486
FWK901
050
N431
ACA025
340
N454
JAL9 *
320
N485
CES582
360
N493
FDX15 *
400
N413
ACA007 *
320
N517
AAL153 *3
360
N526
DAL617
380
N504
CAO1065*
310+330
N538
ANA11 *
340
N491
JAL17 *
310
N451
CNV2141
400
N437
ACA009
320
N474
UAL875 *3
360
N508
DAL295
330
N527
DAL155
320
N523
AAR245
360+340
N457
UAL7 *3
360
N490
AAL61
370
N504
KAL032 *3
340
N539
KAL020 *3
350
N536
NCA175
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N464
DAL183 *
340
N461
ACA003 *
340
N514
KAL002
380
N485
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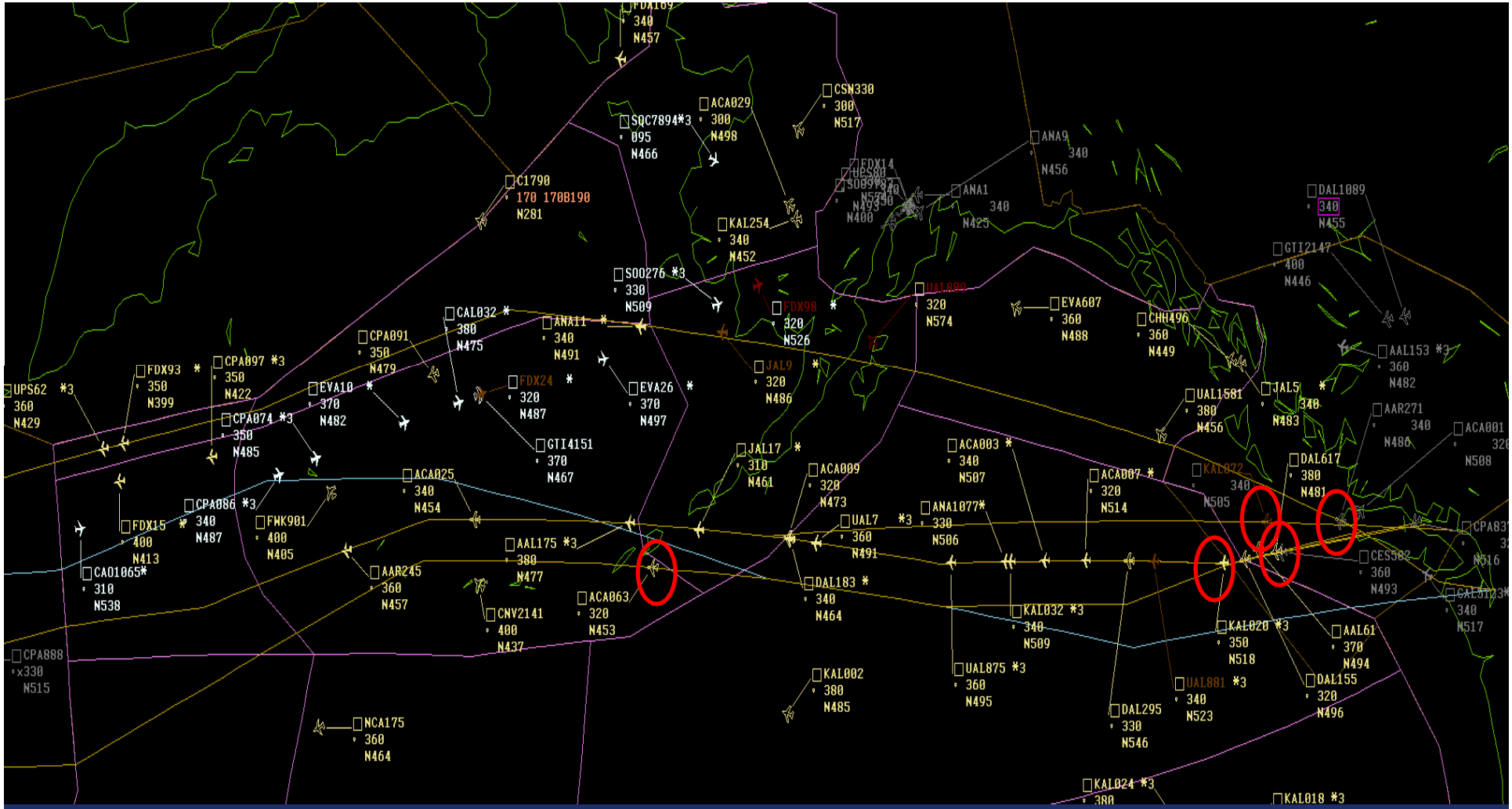
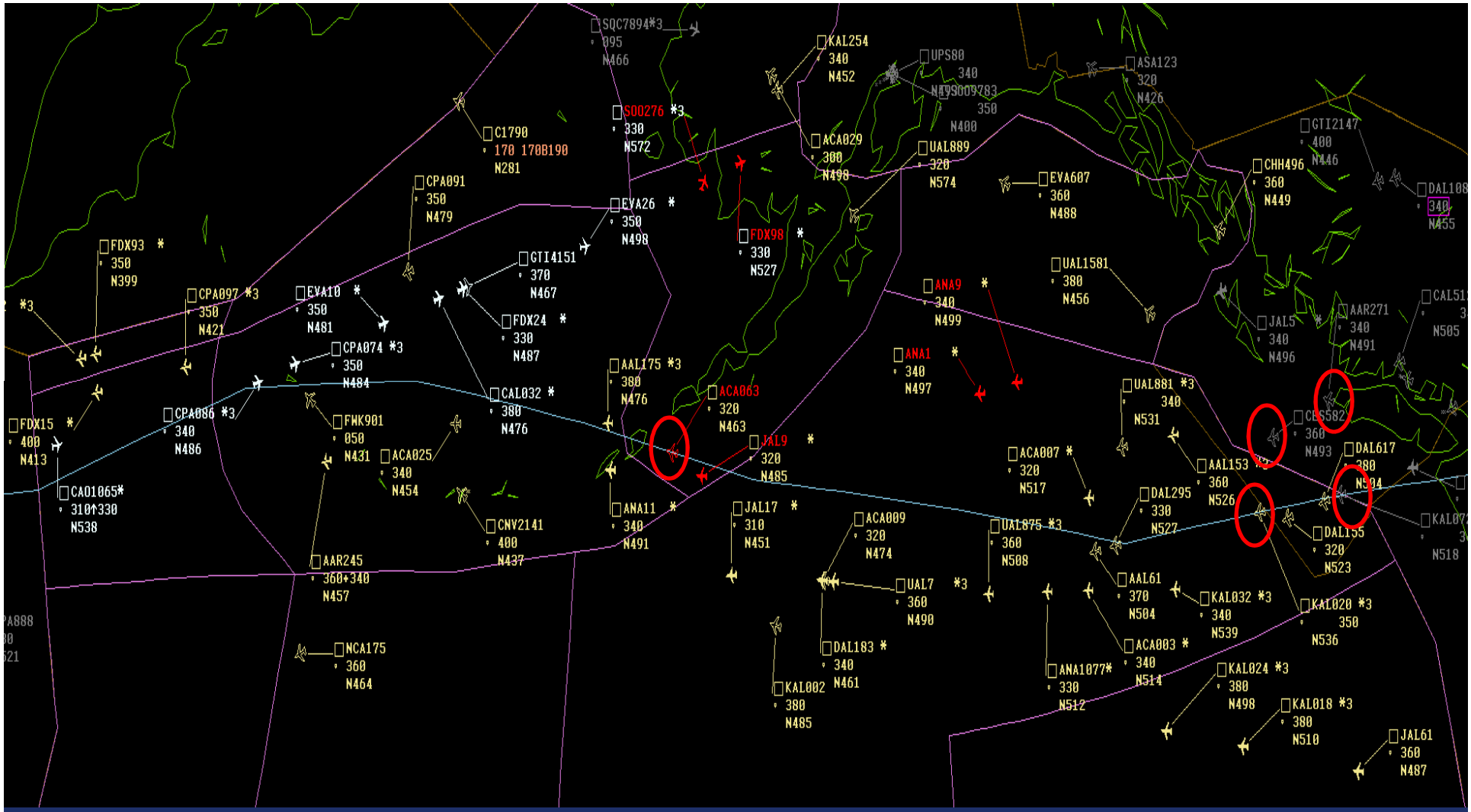
N498
KAL018 *3
380
N510

Track 3 Base and UPR

KSEA – RKSI (5)



Track 3 UPR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KAL254
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N400
ASA123
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N426
C1790
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N281
SOO276 *3
330
N572
ACA029
300
N498
UAL889
320
N574
EVA607
360
N488
CHH496
360
N449
GTI2147
400
N446
DAL108
340
N455
CPA091
350
N479
EVA26 *
350
N498
FDX98 *
330
N527
FDX93 *
350
N399
GTI4151
370
N467
UAL1581
380
N456
ANA9 *
340
N499
CPA097 *3
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N421
EVA10 *
350
N481
FDX24 *
330
N487
JAL5 *
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N496
AAR271
340
N491
CAL51
N505
CPA074 *3
350
N484
AAL175 *3
380
N476
ANA1 *
340
N497
UAL881 *3
340
N531
CAL032 *
380
N476
ACA063
320
N463
FDX15 *
400
N413
CPA086 *3
340
N486
FWK901
050
N431
ACA025
340
N454
JAL9 *
320
N485
ACA007 *
320
N517
AAL153 *3
360
N526
CES582
360
N493
DAL617
380
N504
CA01065*
310↑330
N538
CNV2141
400
N437
ANA11 *
340
N491
JAL17 *
310
N451
ACA009
320
N474
UAL875 *3
360
N508
DAL295
330
N527
DAL155
320
N523
KAL07
N518
AAR245
360+340
N457
UAL7 *3
360
N490
AAL61
370
N504
KAL032 *3
340
N539
KAL020 *3
350
N536
NCA175
360
N464
DAL183 *
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N461
ACA003 *
340
N514
ANA1077*
330
N512
KAL024 *3
380
N498
KAL002
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KAL018 *3
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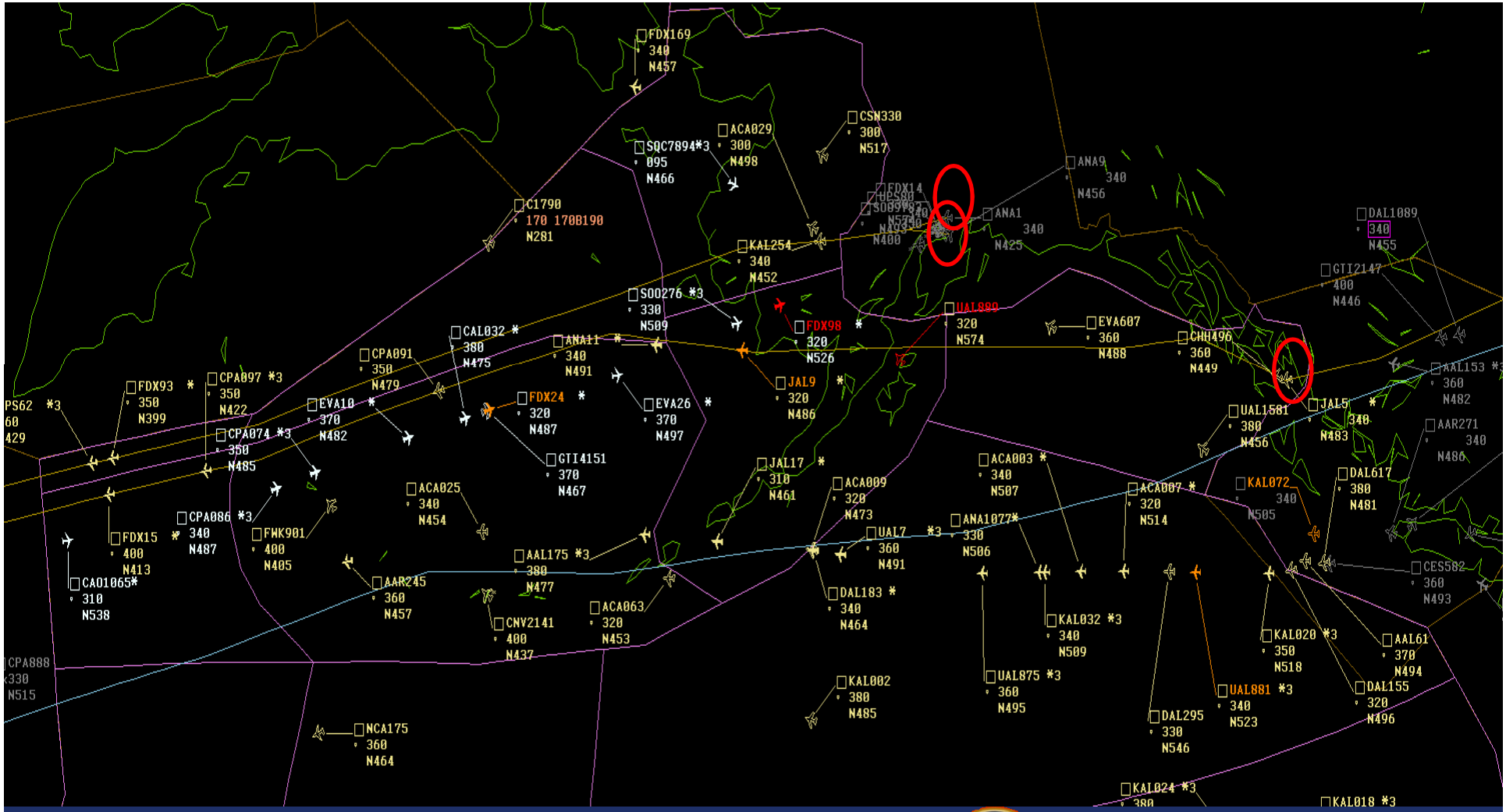
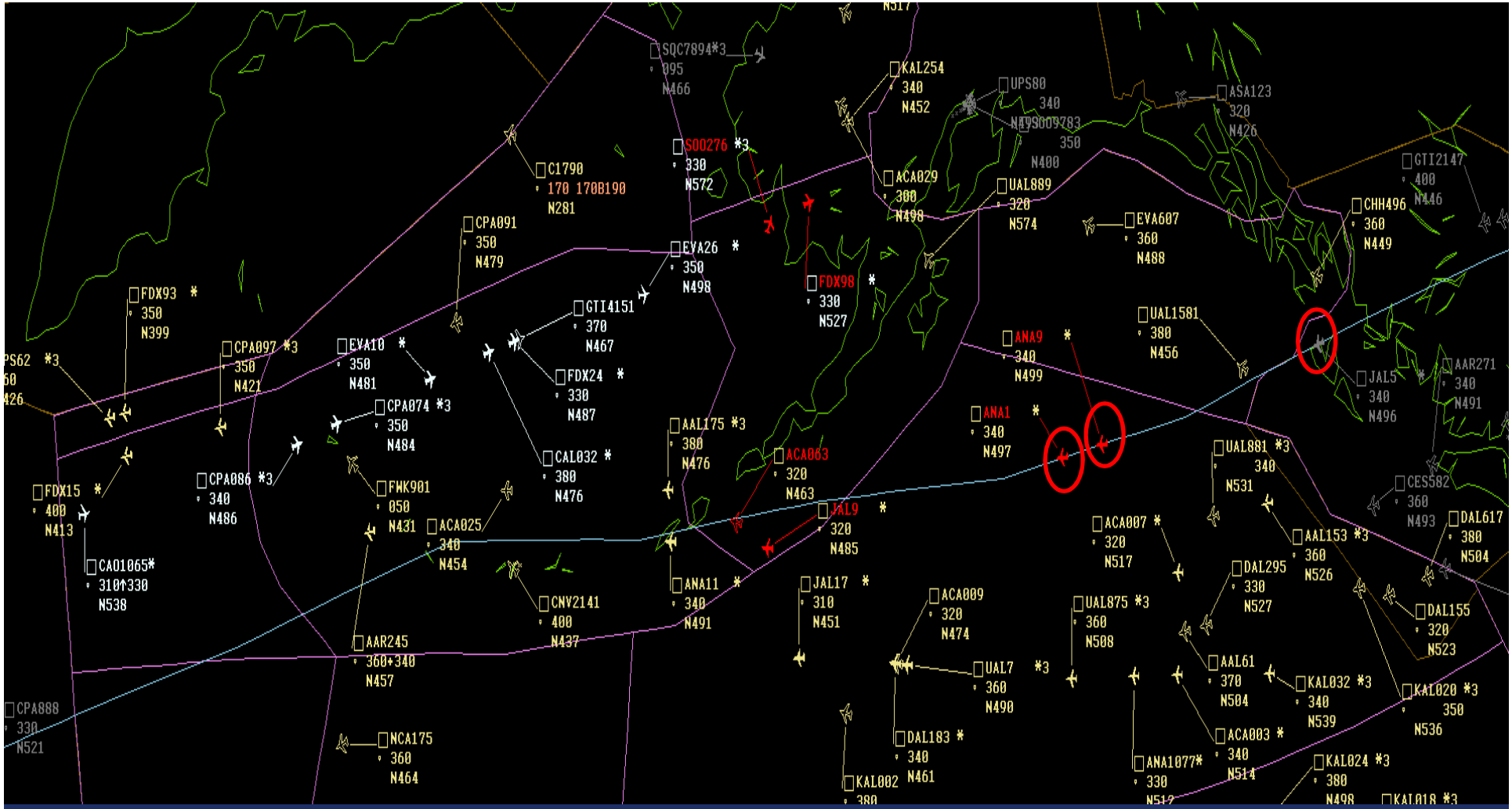
N510
JAL61
360
N487

Track 4 Base and UPR

KJFK – RJAA (3)



Track 4 UPR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UPS80
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N400
ASA123
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N426
SOO276 *3
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N572
C1790
170 170B190
N281
ACA029
300
N498
UAL889
320
N574
GTI2147
400
N446
CHH496
360
N449
CPA091
350
N479
EVA26 *
350
N498
EVA607
360
N488
FDX98 *
330
N527
FDX93 *
350
N399
GTI4151
370
N467
UAL1581
380
N456
ANA9 *
340
N499
CPA097 *3
350
N421
EVA10 *
350
N481
FDX24 *
330
N487
JAL5
340
N496
AAR271
340
N491
CPA074 *3
350
N484
AAL175 *3
380
N476
ANA1 *
340
N497
CAL032 *
380
N476
ACA063
320
N463
UAL881 *3
340
N531
CES582
360
N493
FDX15 *
400
N413
CPA086 *3
340
N486
FWK901
050
N431
ACA025
340
N454
JAL9 *
320
N485
ACA007 *
320
N517
AAL153 *3
360
N526
DAL617
380
N504
CA01065*
310↑330
N538
CNV2141
400
N437
ANA11 *
340
N491
JAL17 *
310
N451
ACA009
320
N474
UAL875 *3
360
N508
DAL295
330
N527
DAL155
320
N523
AAR245
360+340
N457
UAL7 *3
360
N490
AAL61
370
N504
KAL032 *3
340
N539
KAL020 *3
350
N536
CPA888
330
N521
NCA175
360
N464
DAL183 *
340
N461
ACA003 *
340
N514
ANA1077*
330
N512
KAL024 *3
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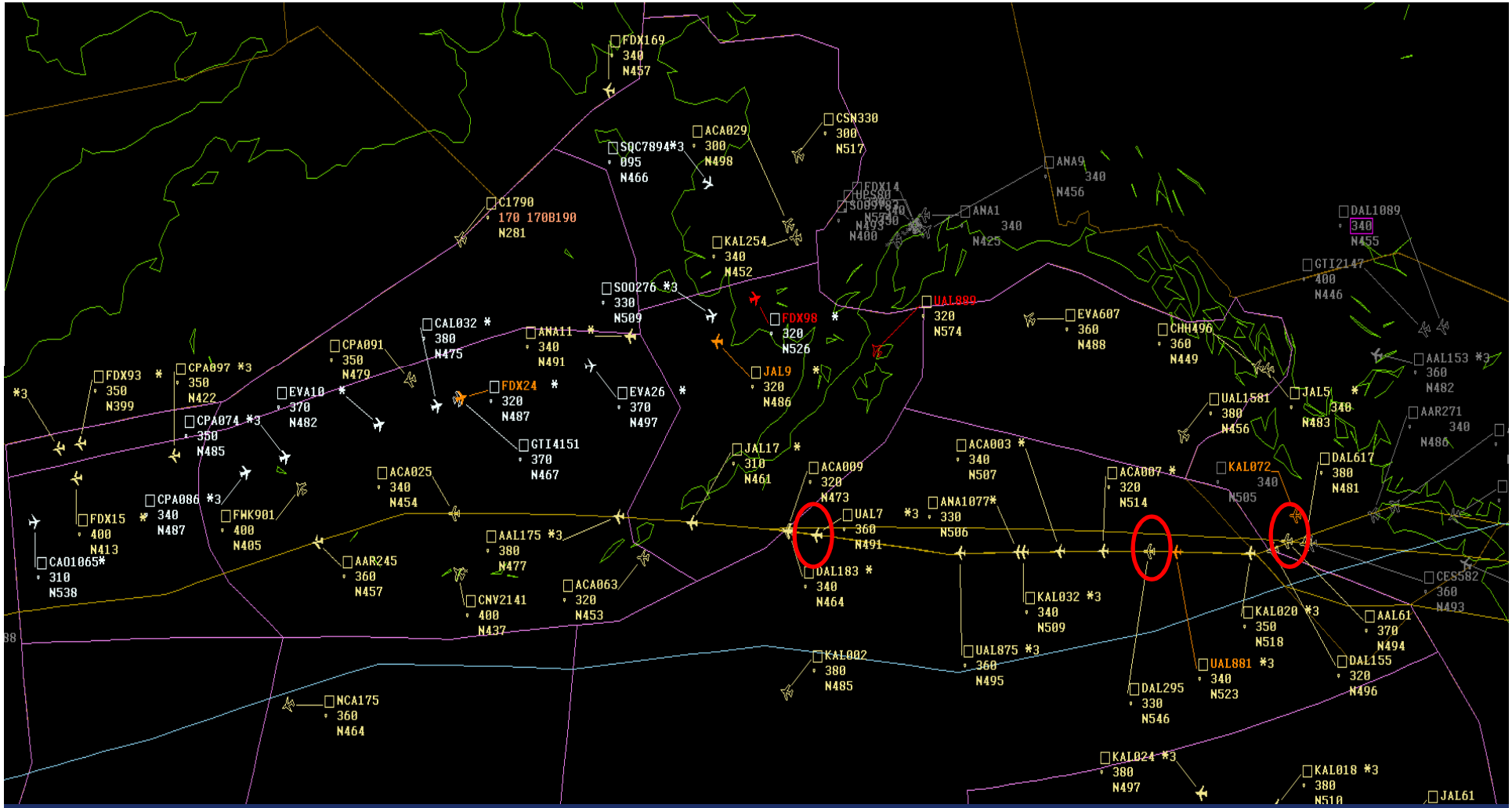
N498
KAL002
380

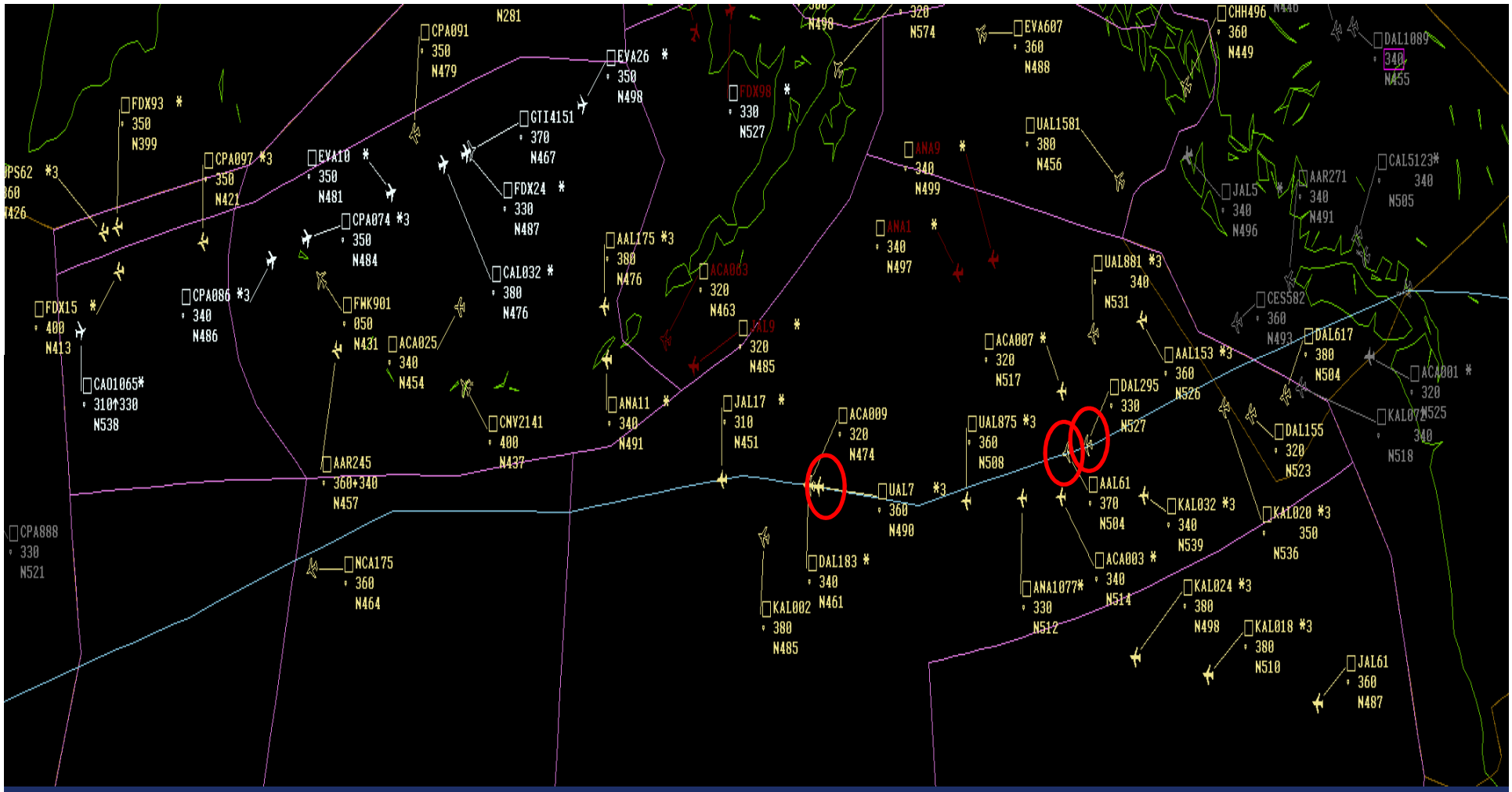
UPR Analysis for ANA1 & ANA9

Track 5 Base and UPR

KDFW – RJAA (3)



Track 5 UPR


N281
CPA091
350
N479
EVA26 *
350
N498
FDX98 *
330
N527
320
N574
EVA607
360
N488
CHH496
360
N449
DAL1089
340
N455
FDX93 *
350
N399
GTI4151
370
N467
UAL1581
380
N456
CPA097 *3
350
N421
EVA10 *
350
N481
FDX24 *
330
N487
ANA9 *
340
N499
JAL5
340
N496
AAR271
340
N491
CAL5123*
340
N505
CPA074 *3
350
N484
AAL175 *3
380
N476
ANA1 *
340
N497
CAL032 *
380
N476
ACA083
320
N463
UAL881 *3
340
N531
CPA086 *3
340
N486
FWK901
050
N431
FDX15 *
400
N413
ACA025
340
N454
JAL9 *
320
N485
CES582
360
N493
DAL617
380
N504
ACA007 *
320
N517
AAL153 *3
360
N526
ACA001 *
320
N525
CA01065*
310↑330
N538
ANA11 *
340
N491
JAL17 *
310
N451
ACA009
320
N474
DAL295
330
N527
UAL875 *3
360
N508
CNV2141
400
N437
KAL072
340
N518
DAL155
320
N523
AAR245
360+340
N457
UAL7 *3
360
N490
AAL61
370
N504
KAL032 *3
340
N539
KAL020 *3
350
N536
CPA888
330
N521
NCA175
360
N464
DAL183 *
340
N461
ACA003 *
340
N514
ANA1077*
330
N512
KAL024 *3
380
N498
KAL002
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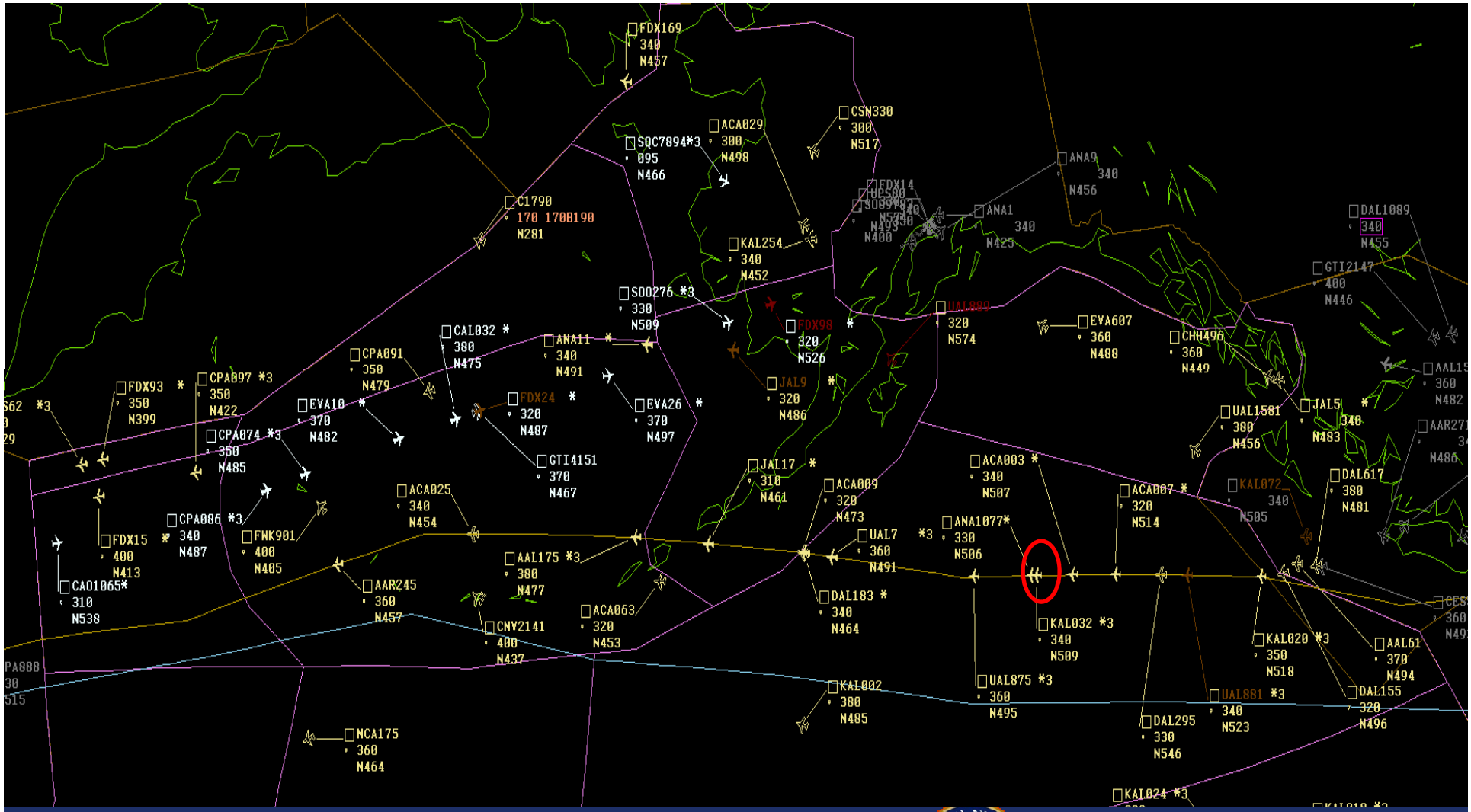
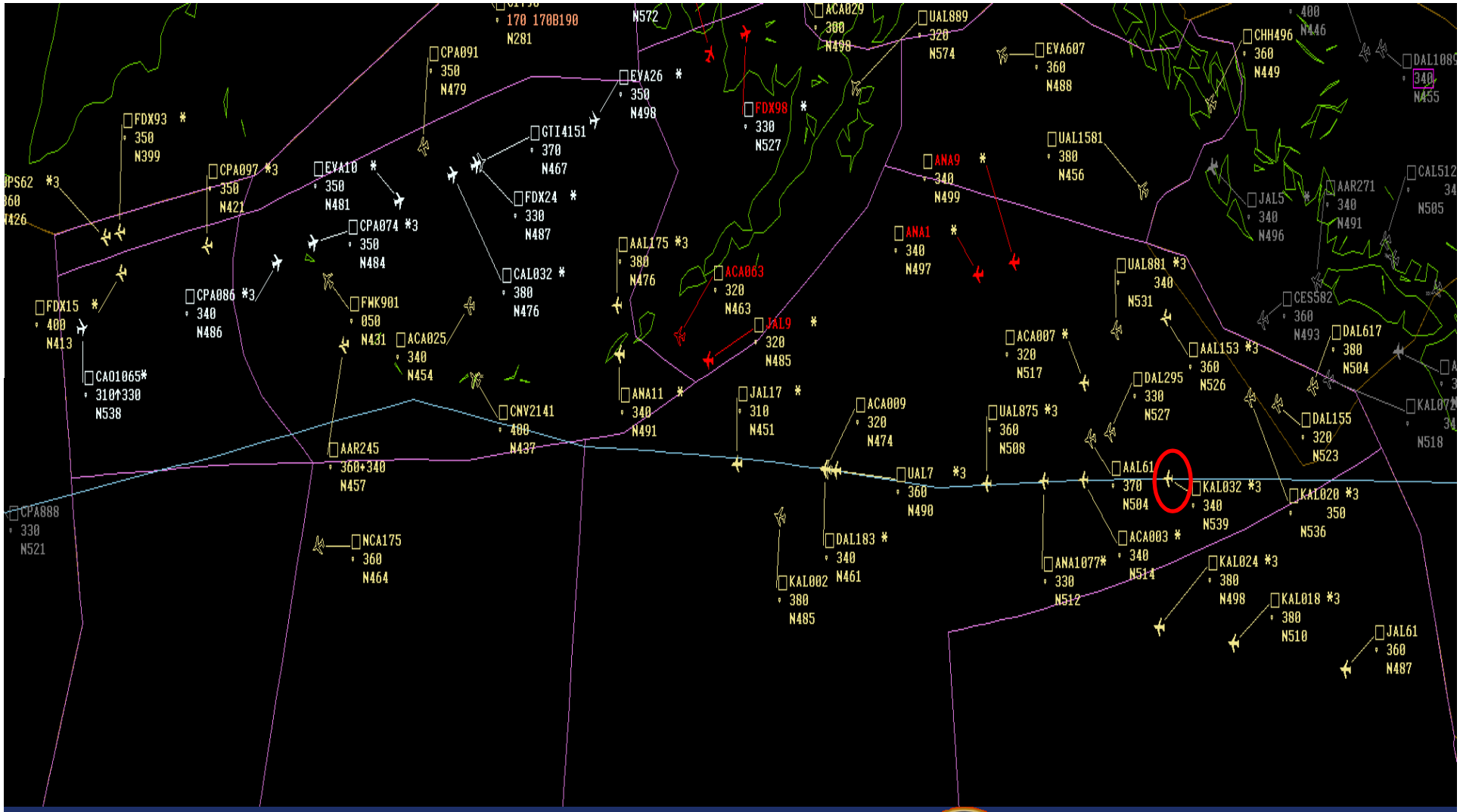
N485
KAL018 *3
380
N510
JAL61
360
N487

Track 6 Base and UPR

KDFW – RKSI (1)



Track 6 UPR


170 170B190
N281
N572
CPA091
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N479
EVA26 *
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N498
ACA029
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N498
UAL889
320
N574
EVA607
360
N488
CHH496
360
N449
400
N446
DAL1089
340
N455
FDX93 *
350
N399
GTI4151
370
N467
FDX98 *
330
N527
UAL1581
380
N456
CPA097 *3
350
N421
EVA10 *
350
N481
FDX24 *
330
N487
ANA9 *
340
N499
JAL5
340
N496
AAR271
340
N491
CAL512
N505
CPA074 *3
350
N484
AAL175 *3
380
N476
ANA1 *
340
N497
CAL032 *
380
N476
ACA063
320
N463
UAL881 *3
340
N531
CPA086 *3
340
N486
FWK901
050
N431
ACA025
340
N454
JAL9 *
320
N485
CES582
360
N493
DAL617
380
N504
FDX15 *
400
N413
ACA007 *
320
N517
AAL153 *3
360
N526
CA01065*
310↑330
N538
ANA11 *
340
N491
JAL17 *
310
N451
DAL295
330
N527
CNV2141
400
N437
ACA009
320
N474
UAL875 *3
360
N508
DAL155
320
N523
N518
AAR245
360↑340
N457
UAL7 *3
360
N490
AAL61
370
N504
KAL032 *3
340
N539
KAL020 *3
350
N536
CPA888
330
N521
NCA175
360
N464
DAL183 *
340
N461
ACA003 *
340
N514
ANA1077*
330
N512
KAL024 *3
380
N498
KAL002
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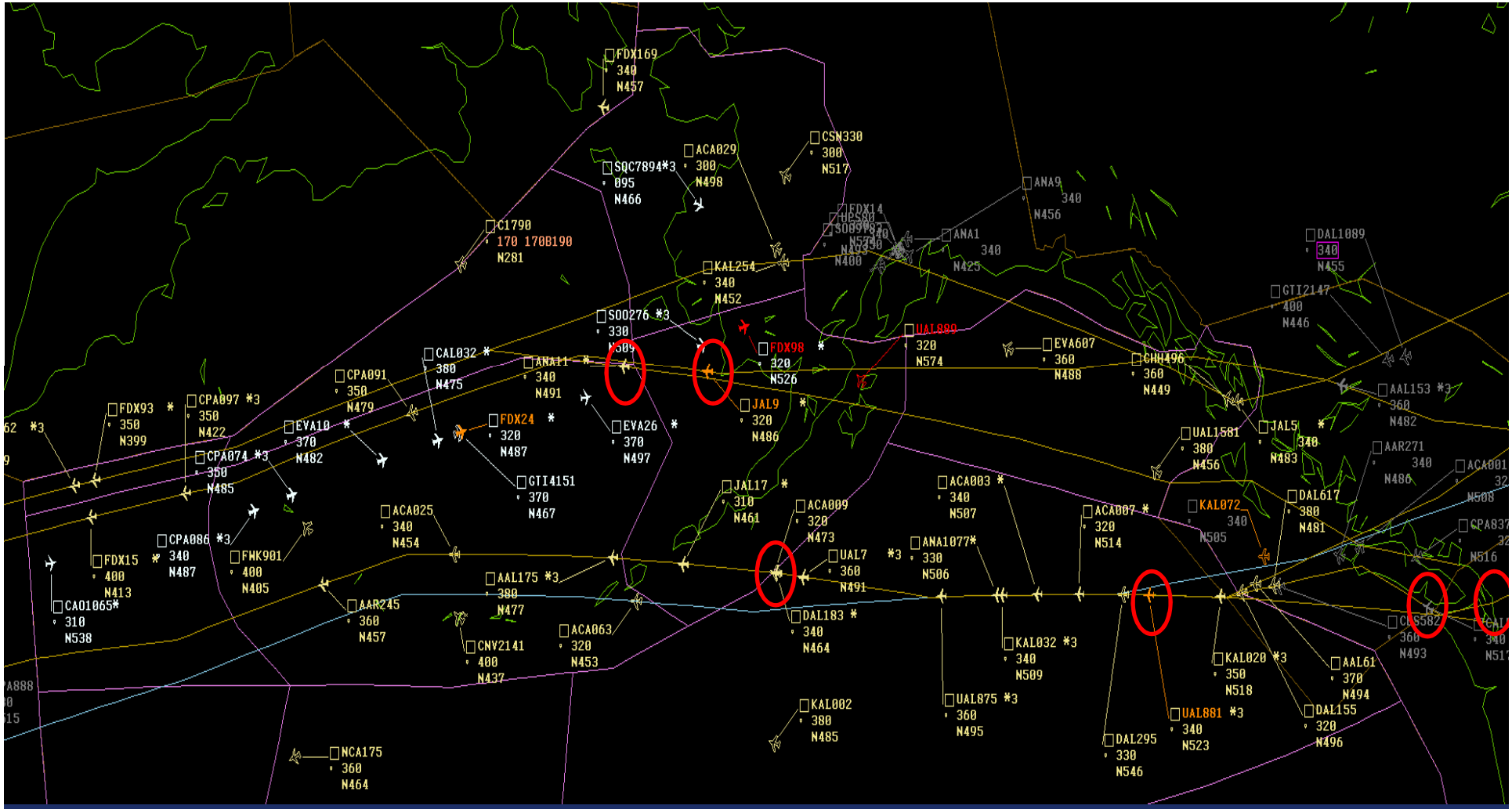
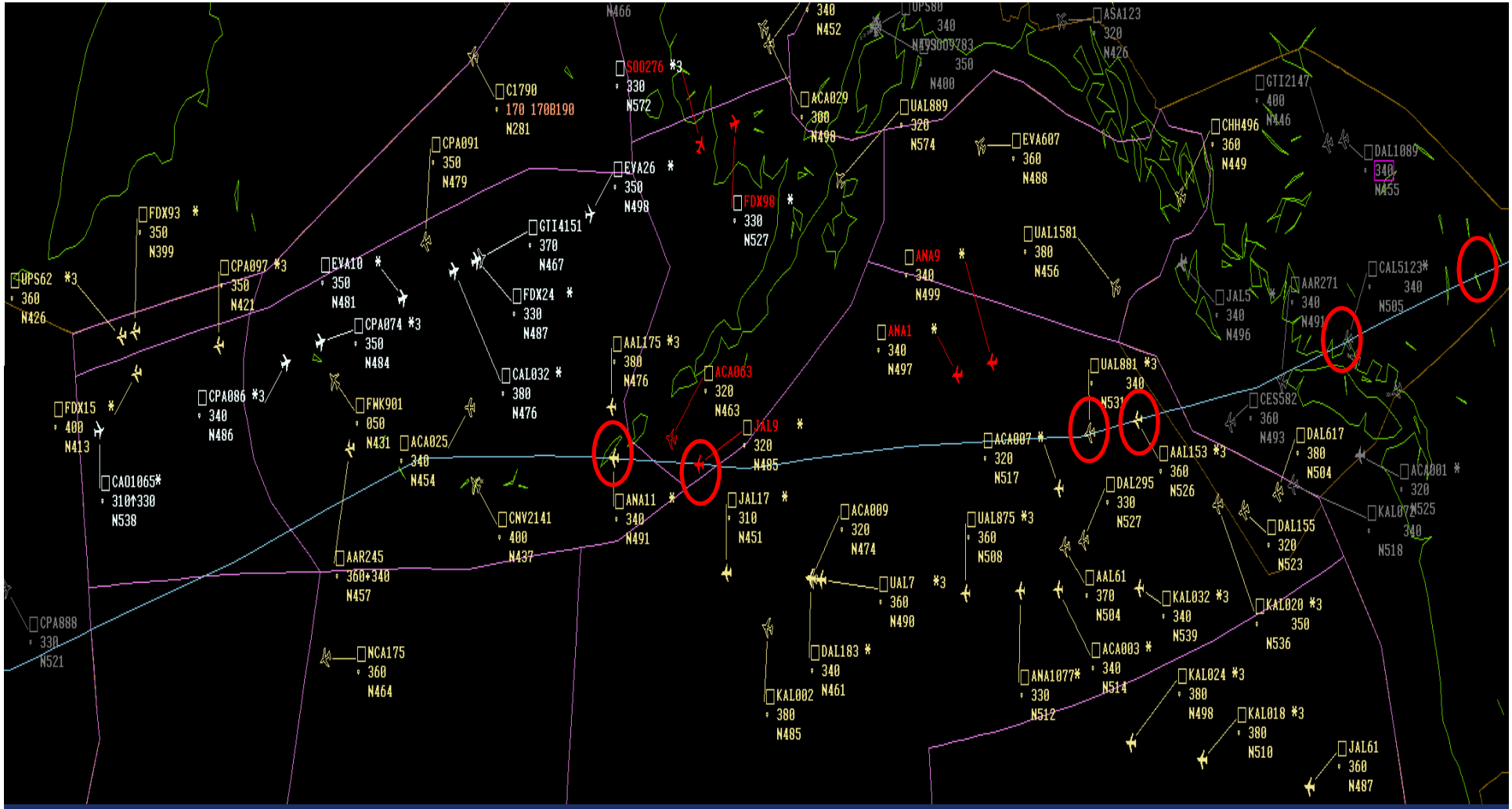
N485
KAL018 *3
380
N510
JAL61
360
N487

Track 7 Base and UPR

KORD – RJAA (6)



Track 7 UPR



UPS62 *3
360
N426
FDX93 *
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N399
CPA097 *3
350
N421
EVA10 *
350
N481
CPA091
350
N479
C1790
170 170B190
N281
SOO276 *3
330
N572
EVA26 *
350
N498
GTI4151
370
N467
FDX24 *
330
N487
CPA074 *3
350
N484
CAL032 *
380
N476
FWK901
050
N431
ACA025
340
N454
FDX15 *
400
N413
CAO1065*
310↑330
N538
CPA086 *3
340
N486
AAR245
360+340
N457
CNV2141
400
N437
NCA175
360
N464
CPA888
330
N521
AAL175 *3
380
N476
ANA11 *
340
N491
ACA063
320
N463
JAL9 *
320
N485
JAL17 *
310
N451
FDX98 *
330
N527
ACA029
300
N498
340
N452
UAL889
320
N574
ANA9 *
340
N499
ANA1 *
340
N497
ACA007 *
320
N517
ACA009
320
N474
UAL875 *3
360
N508
UAL7 *3
360
N490
DAL183 *
340
N461
KAL002
380
N485
ANA1077*
330
N512
EVA607
360
N488
UAL1581
380
N456
UAL881 *3
340
N531
DAL295
330
N527
AAL61
370
N504
ACA003 *
340
N514
KAL032 *3
340
N539
KAL024 *3
380
N498
KAL018 *3
380
N510
JAL61
360
N487
AAL153 *3
360
N526
ASA123
320
N426
CHH496
360
N449
GTI2147
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N446
DAL1089
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N455
JAL5
340
N496
AAR271
340
N491
CAL5123*
340
N505
CES582
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N493
DAL617
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N504
ACA001 *
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DAL155
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N523
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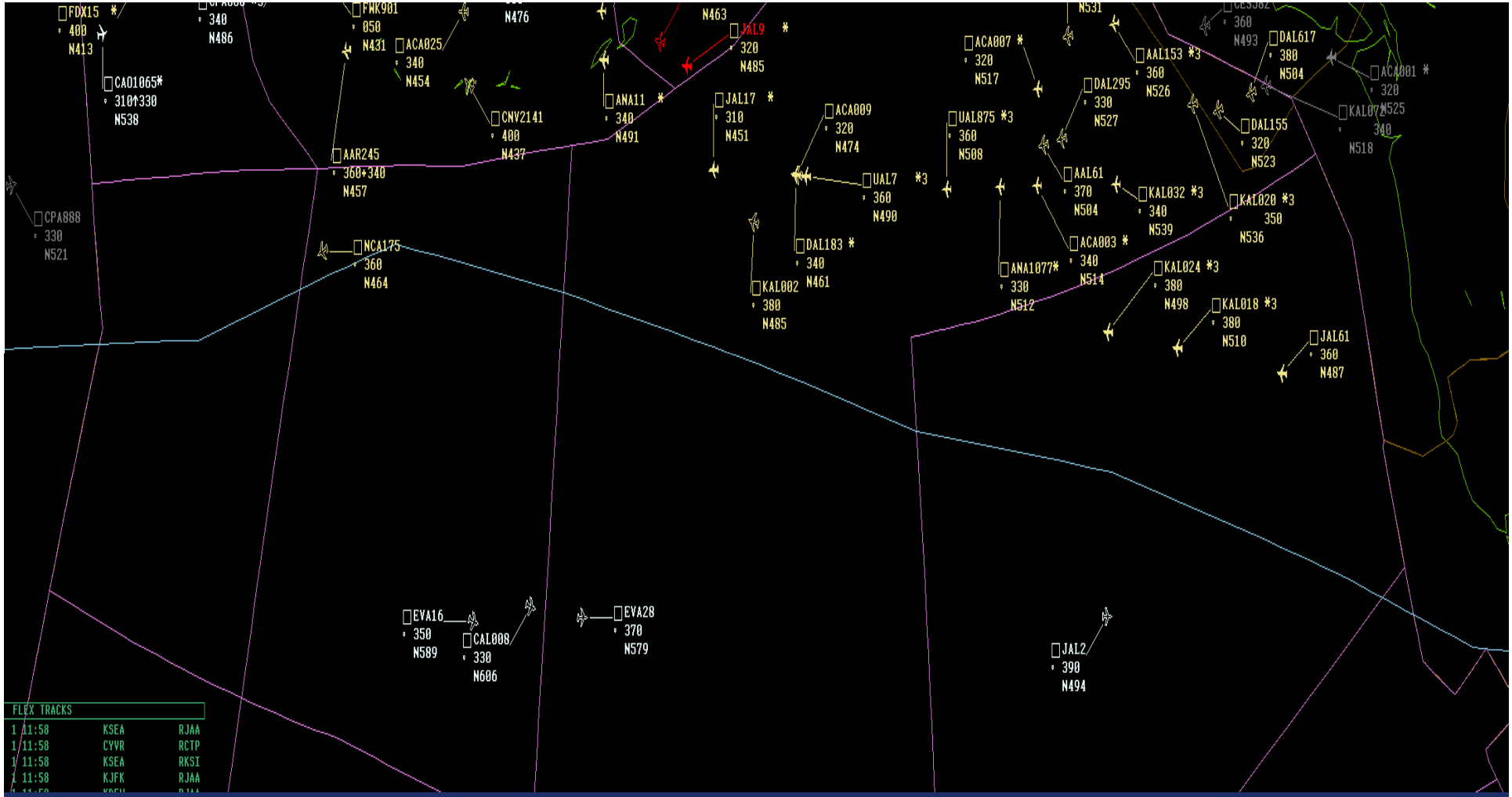
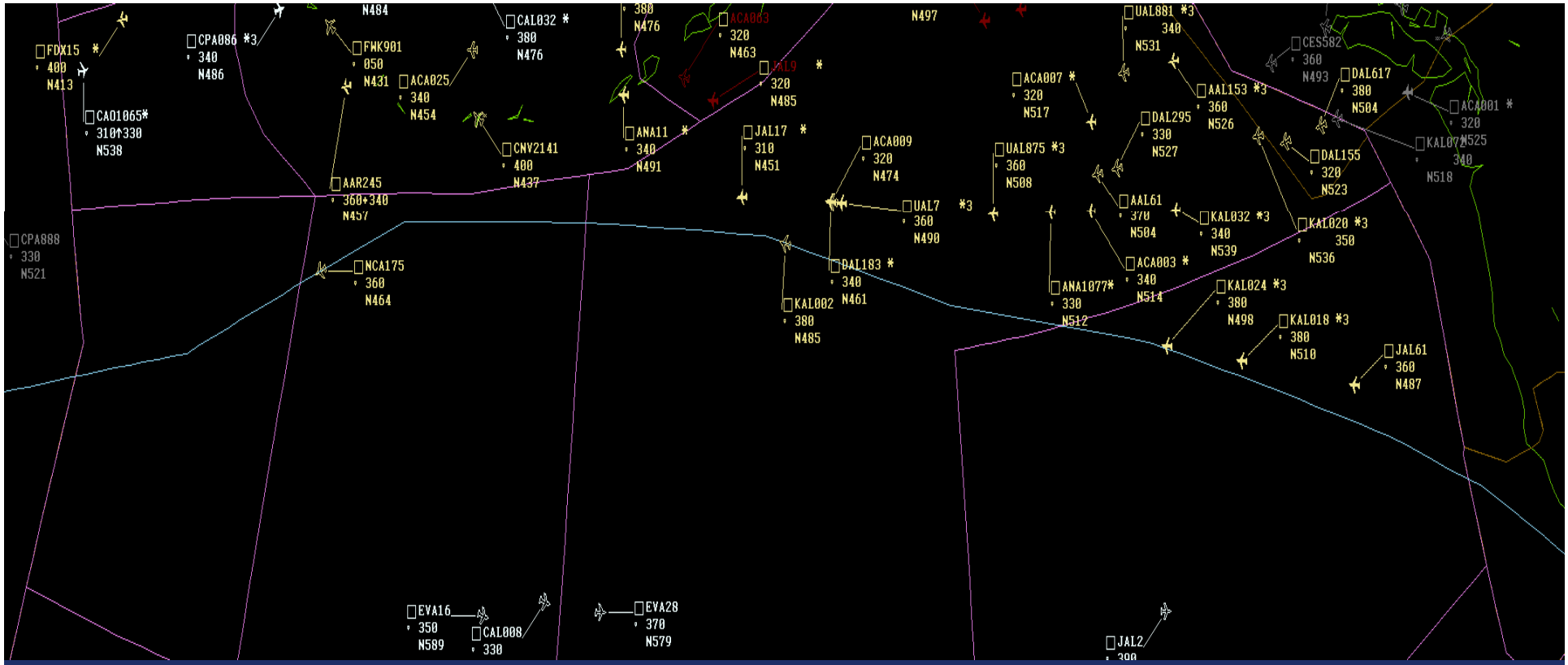
N536

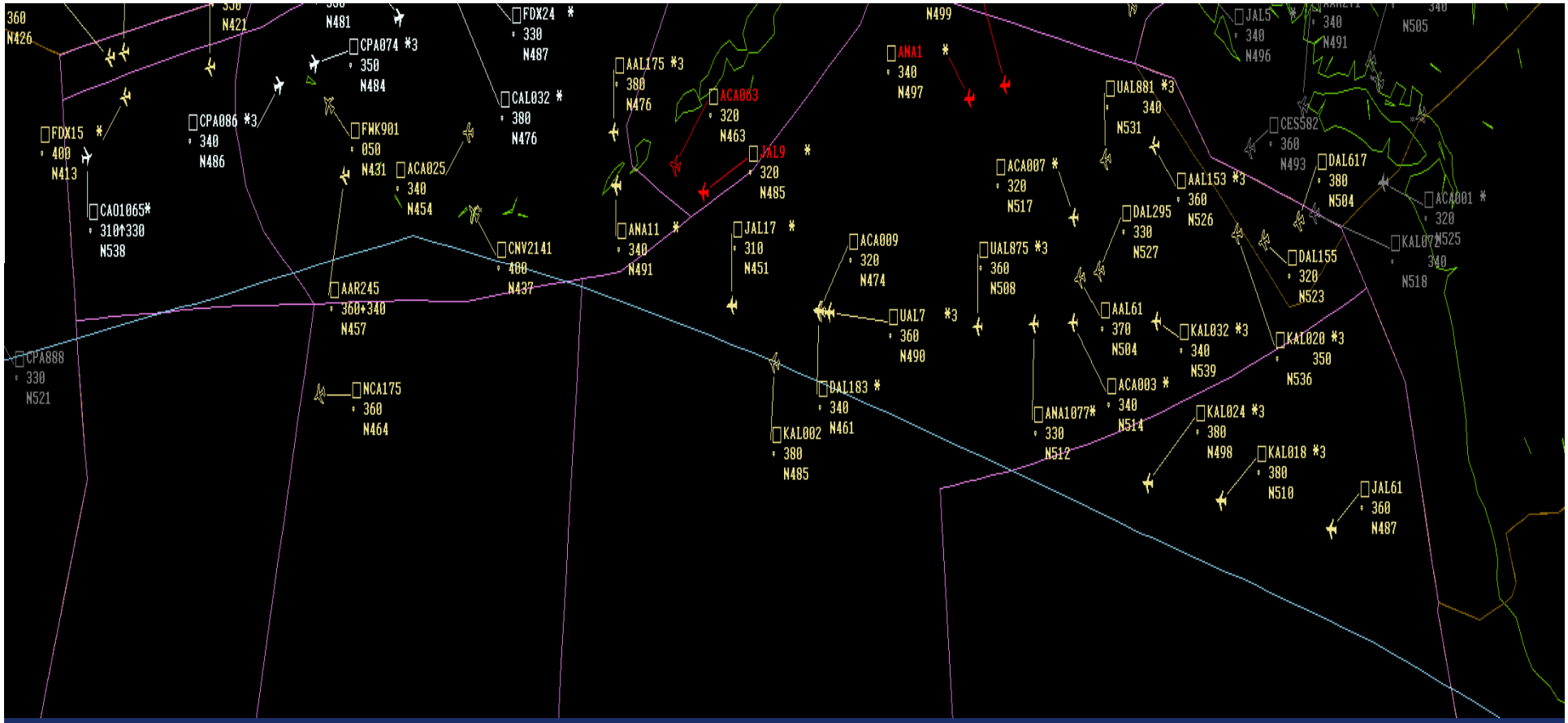
Track 8 UPR
KLAX – RJAA



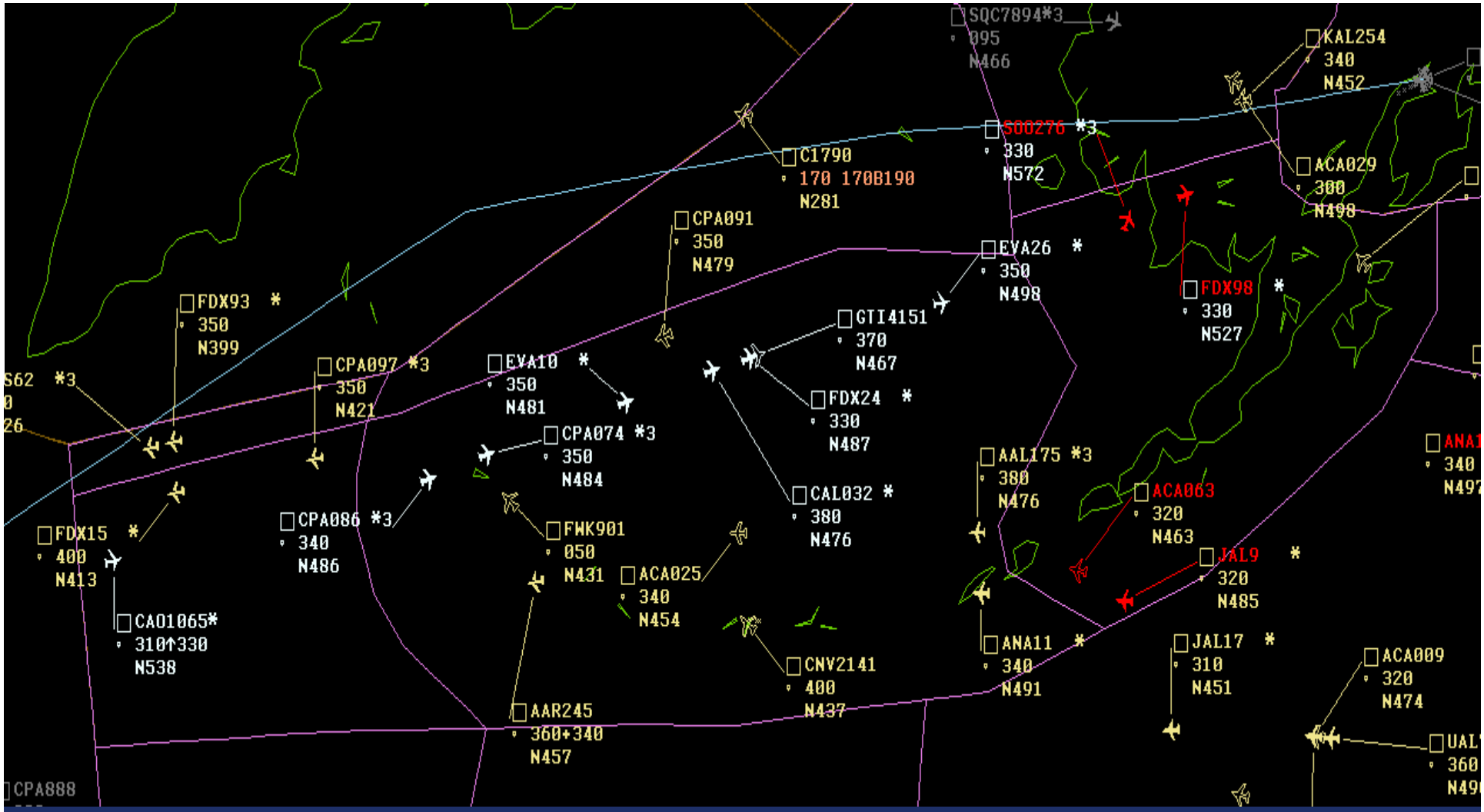
Track 9 UPR
KLAX – RCTP



Track 10 UPR
PANC – RKSI

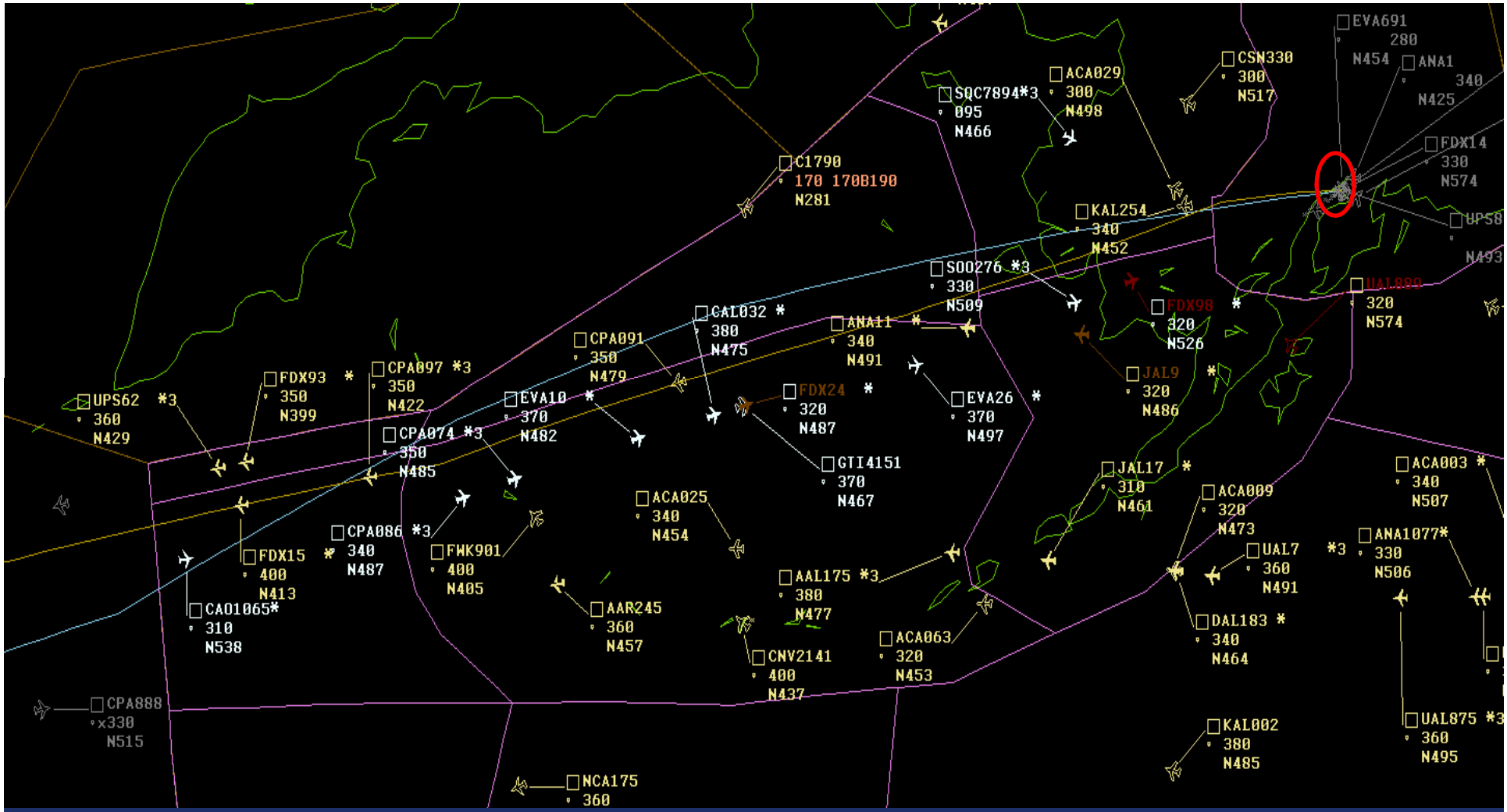


Track 11 UPR
PANC – RJAA

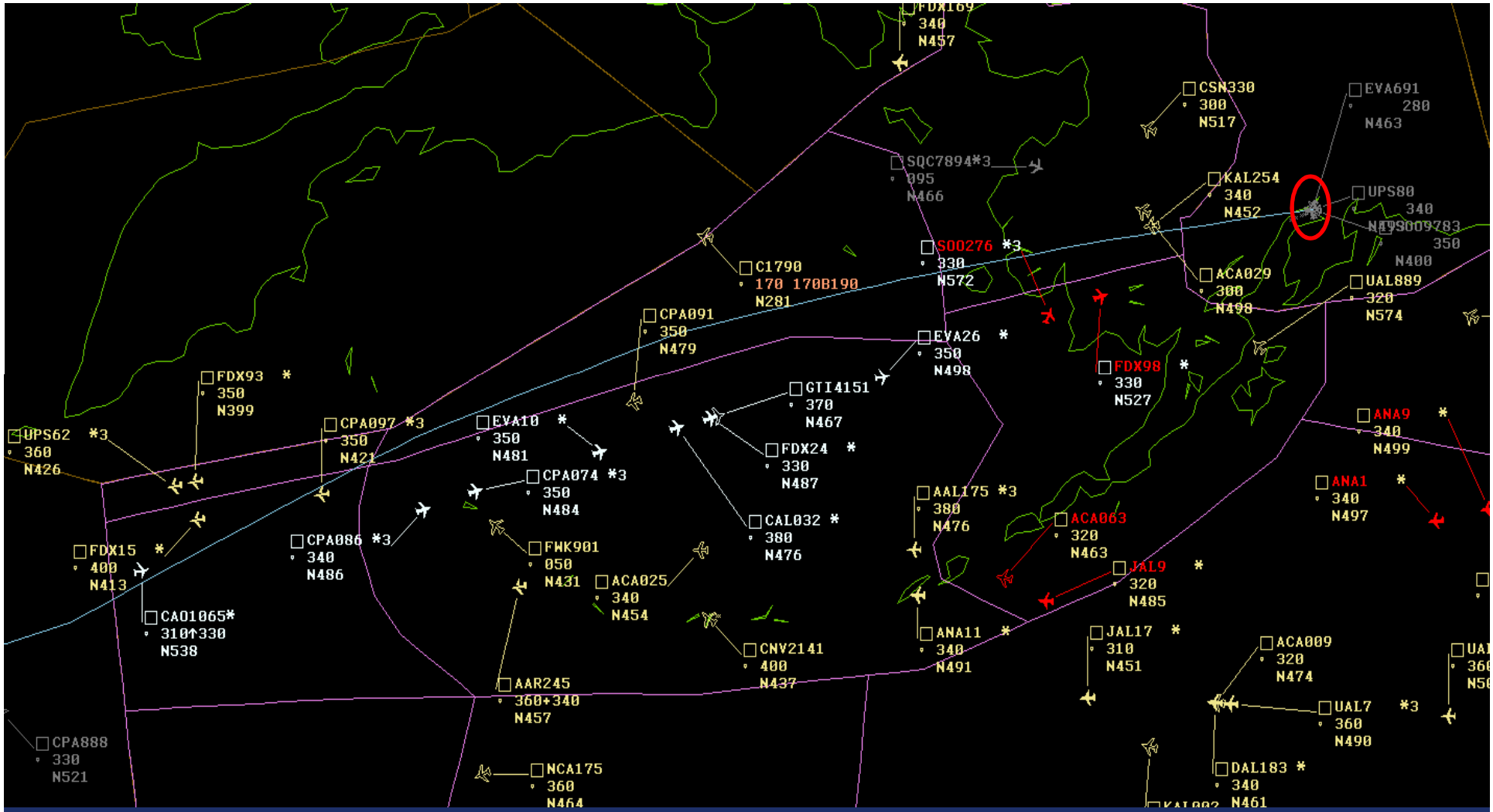


Track 12 Base and UPR

PANC – RCTP (1)



Track 12 UPR



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KAL254
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N452
UPS80
340
N400
SOO276 *3
330
N572
C1790
170 170B190
N281
ACA029
300
N498
UAL889
320
N574
CPA091
350
N479
EVA26 *
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N498
FDX98 *
330
N527
FDX93 *
350
N399
GTI4151
370
N467
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N426
CPA097 *3
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N421
EVA10 *
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FDX24 *
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N487
ANA9 *
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N499
CPA074 *3
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N484
AAL175 *3
380
N476
ANA1 *
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N497
CAL032 *
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ACA063
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FDX15 *
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CPA086 *3
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FWK901
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N431
ACA025
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N454
JAL9 *
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N485
CAO1065*
310↑330
N538
ANA11 *
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N491
JAL17 *
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N451
ACA009
320
N474
CNV2141
400
N437
AAR245
360+340
N457
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CPA888
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NCA175
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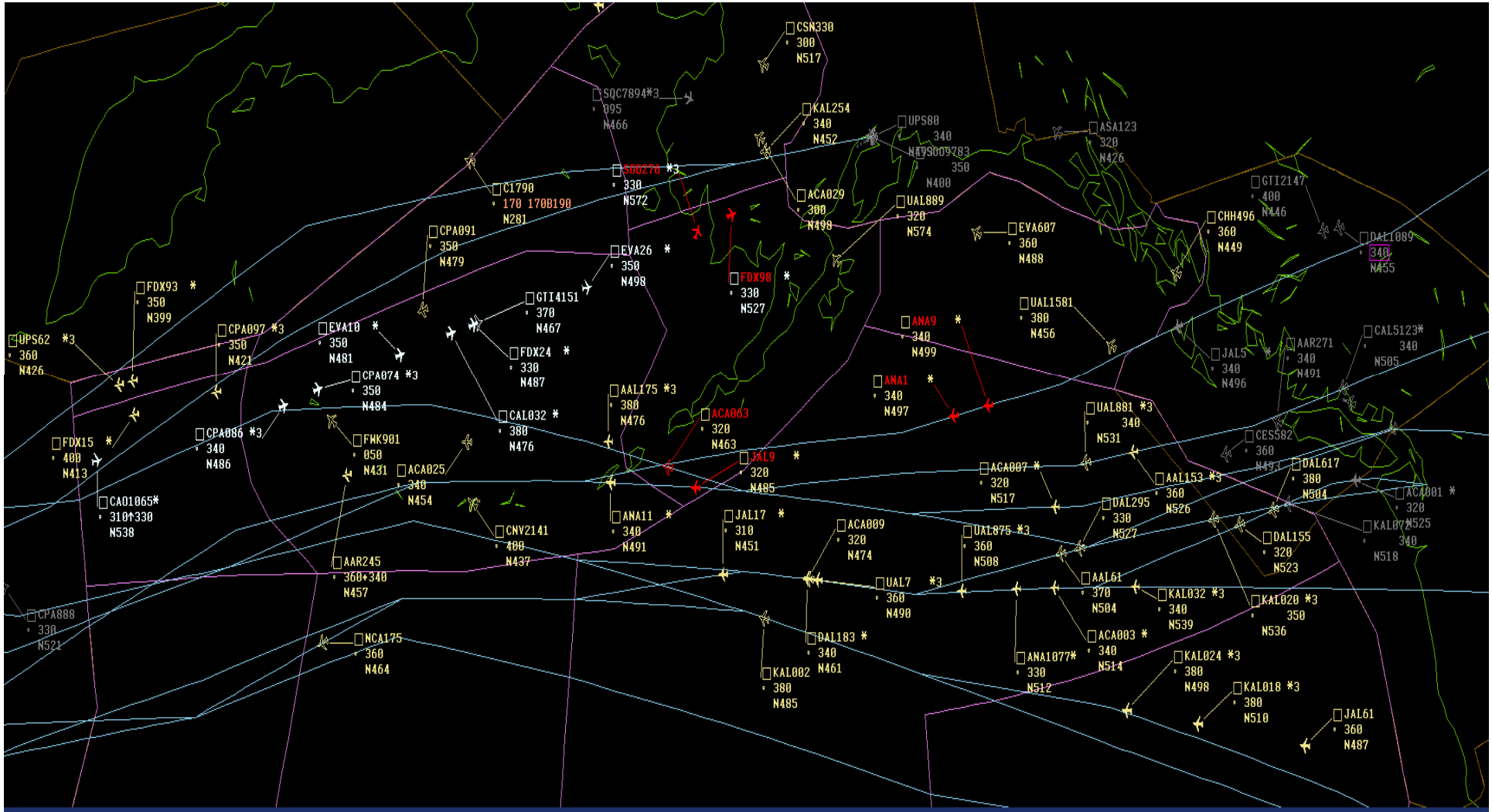
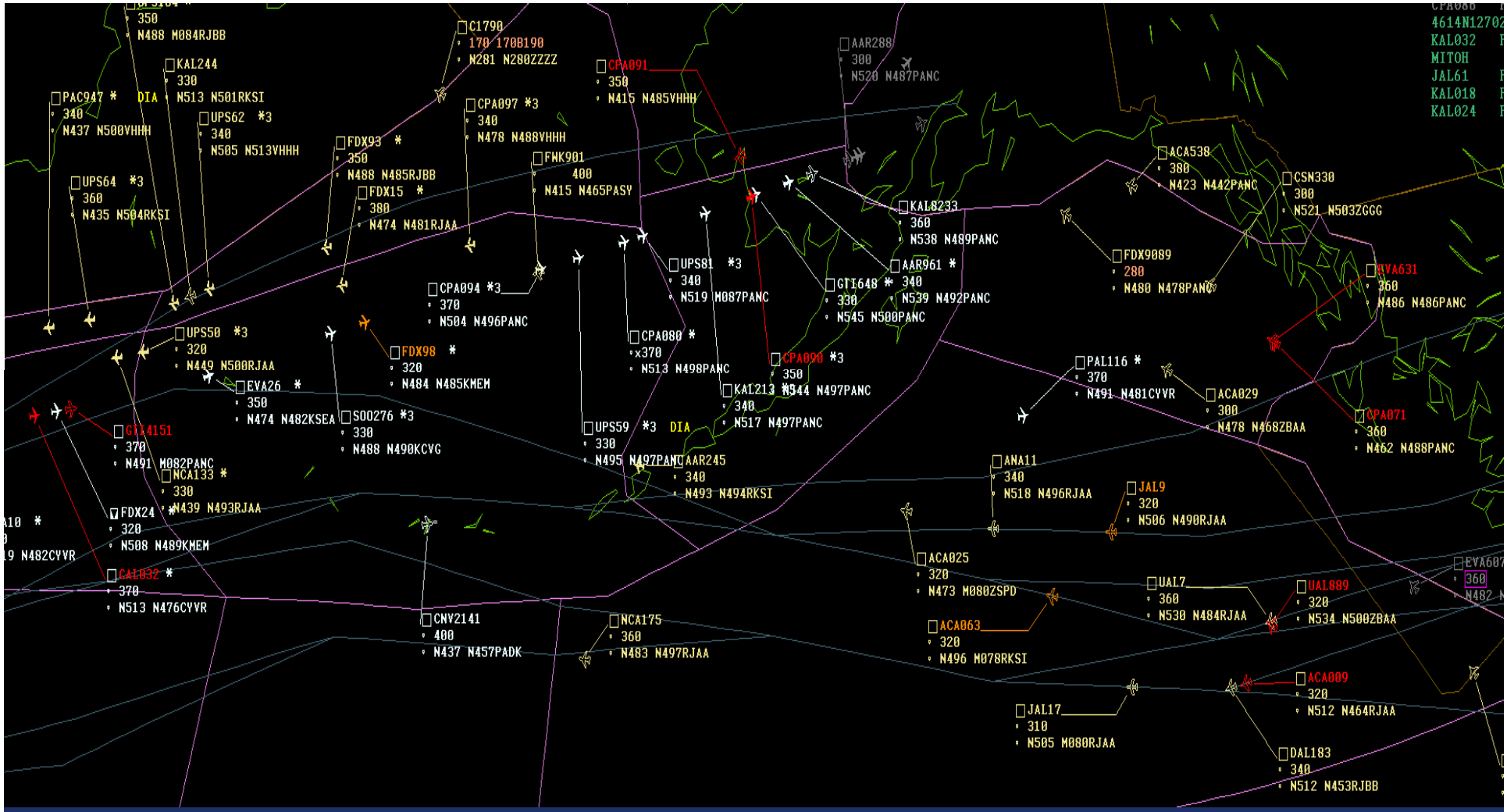
DAL183 *
340
N461

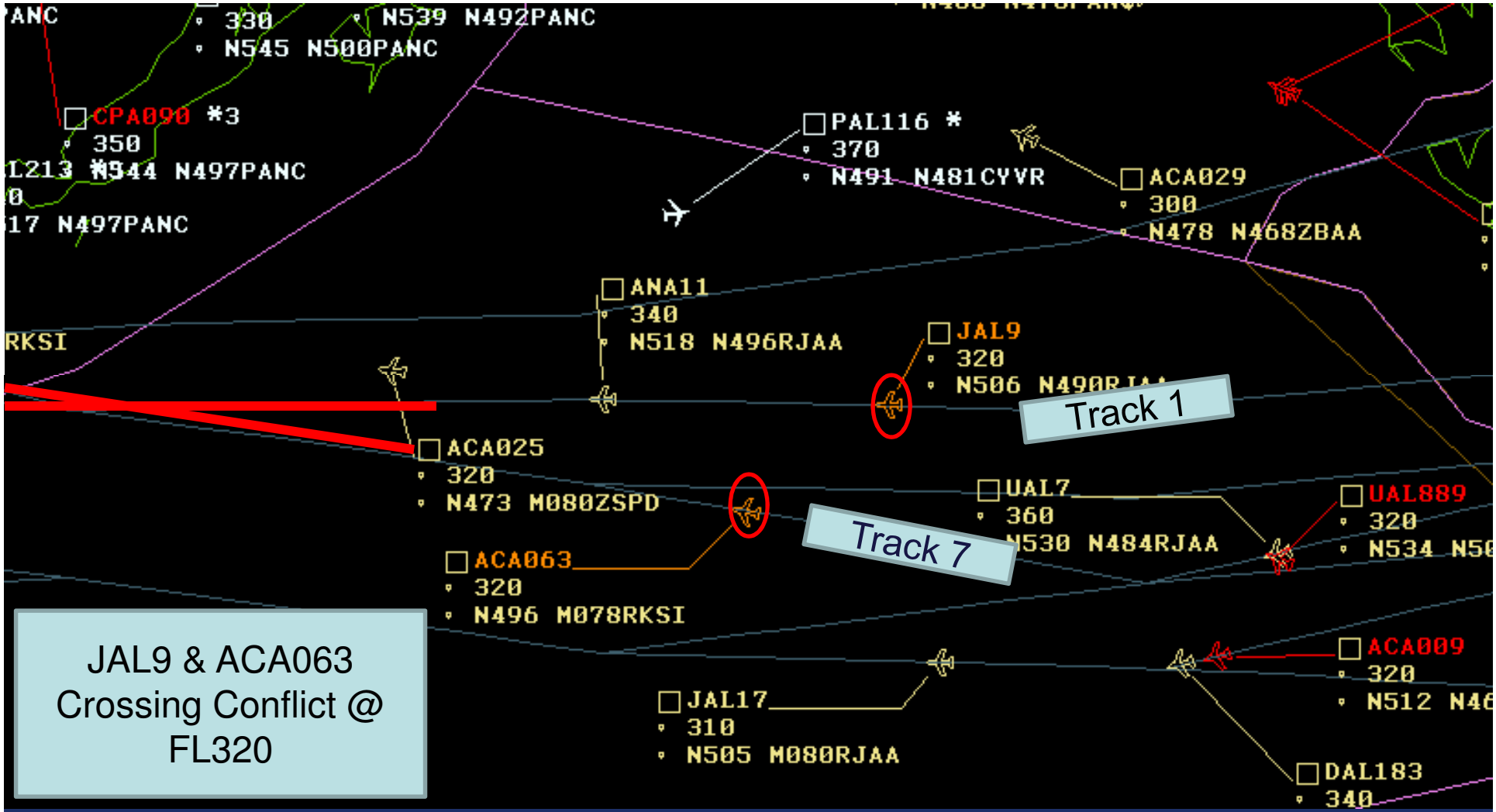
2012 UPR Simulated Traffic at 2216 Hours



2012 UPR Simulated Traffic at 2053 Hours

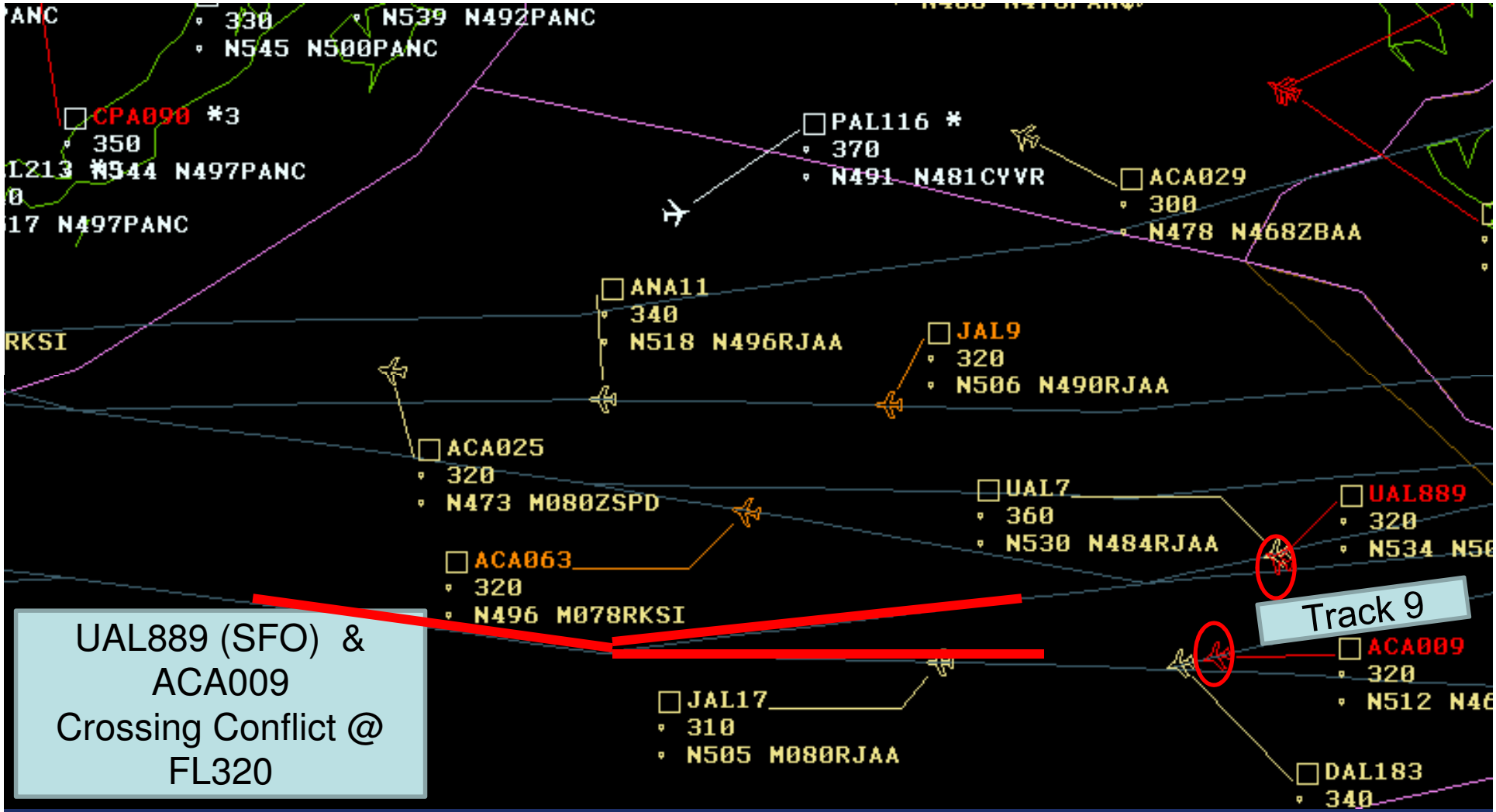


UPR Analysis for JAL9 (Track 1)& ACA063 (track 7)



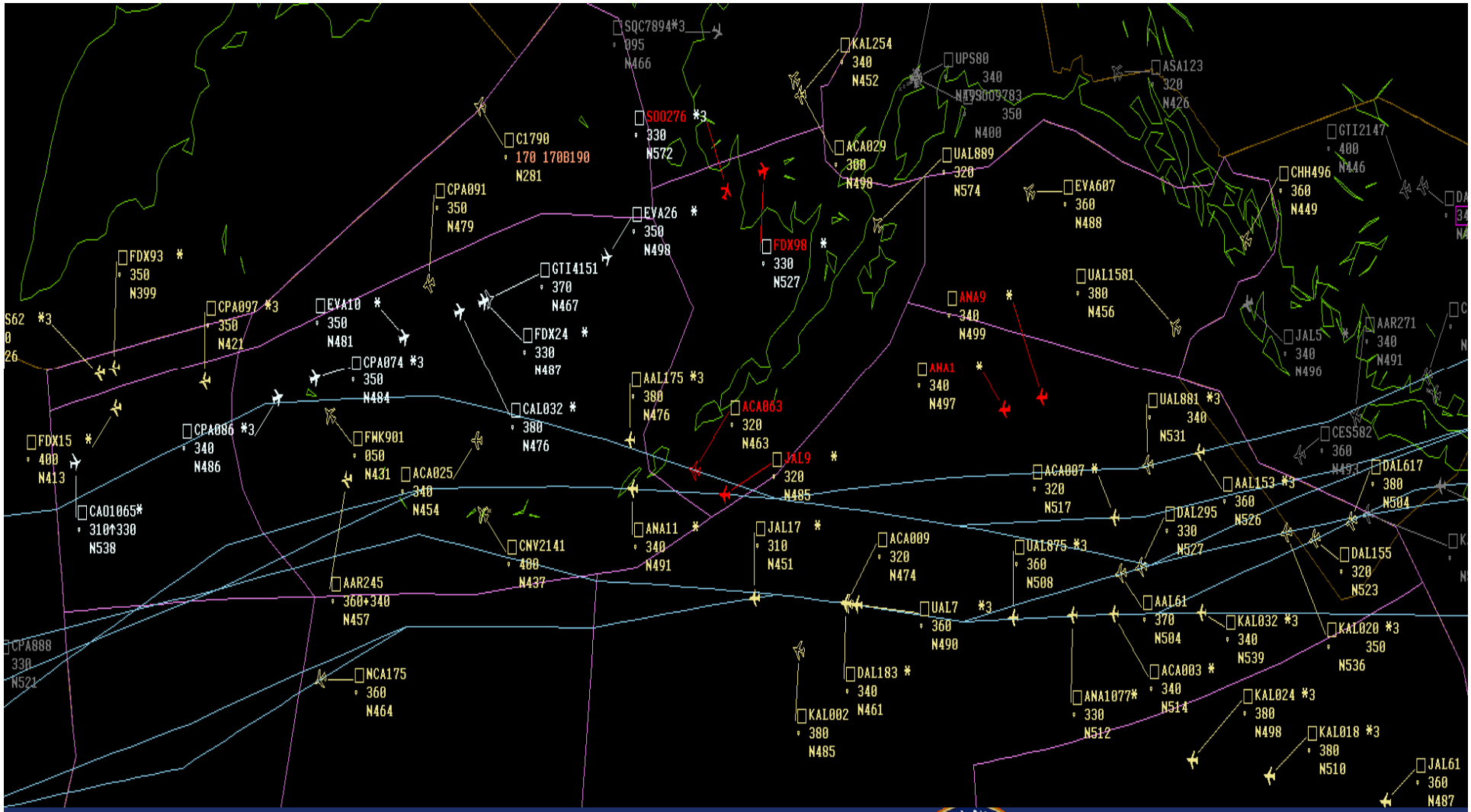
JAL9 & ACA063 Crossing Conflict @ FL320

UPR Analysis for UAL889 & ACA009



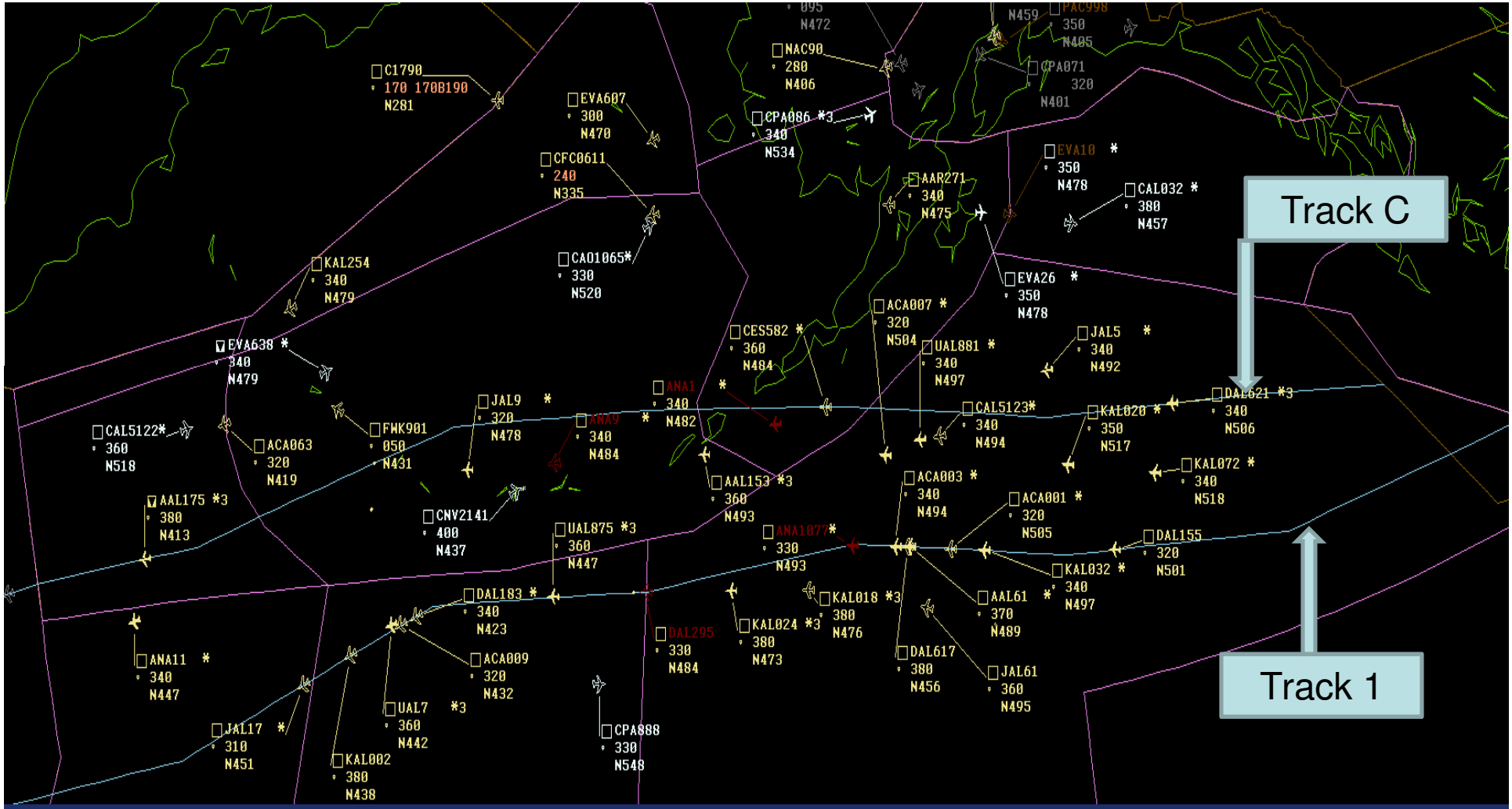
UAL889 (SFO) & ACA009 Crossing Conflict @ FL320

Published Track C vs UPR Track 1,2,3,5,6,7

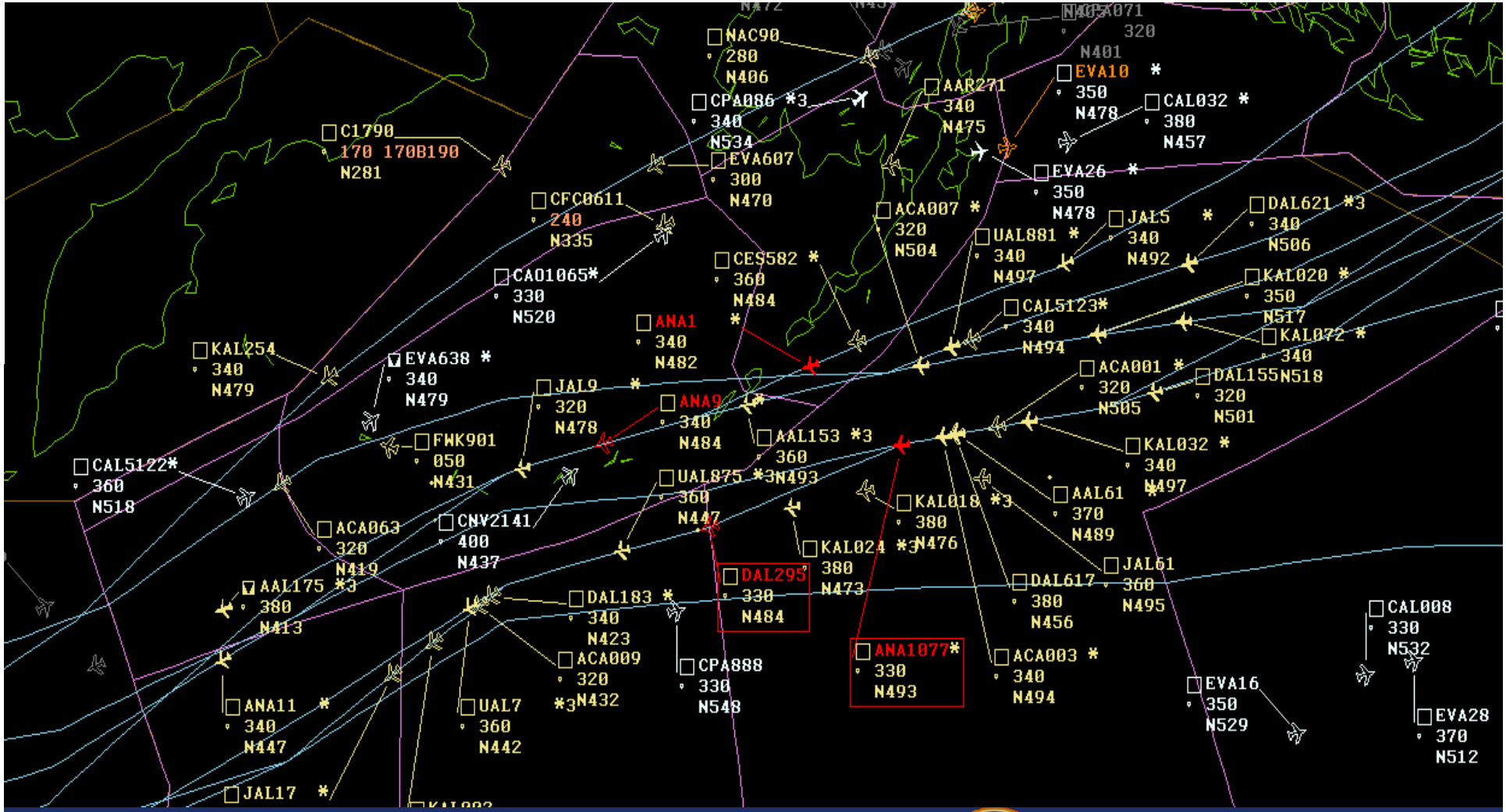


2012 UPR Simulated Traffic at 0030 Hours

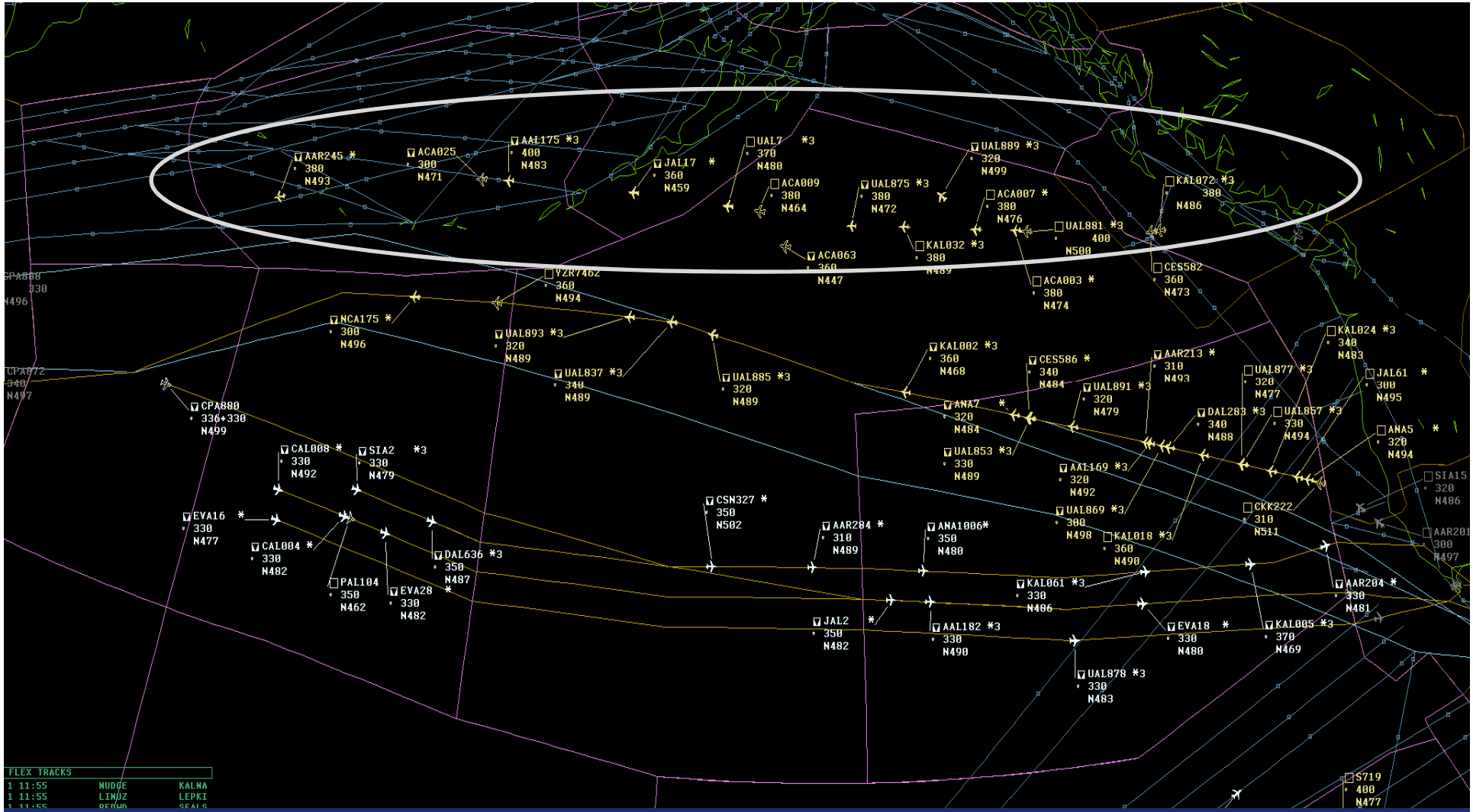
Published DOT Track C vs UPR Track 1



2012 UPR Simulated Traffic at 0030 Hours



ZOA Simulated Scenario at 2220 Hours

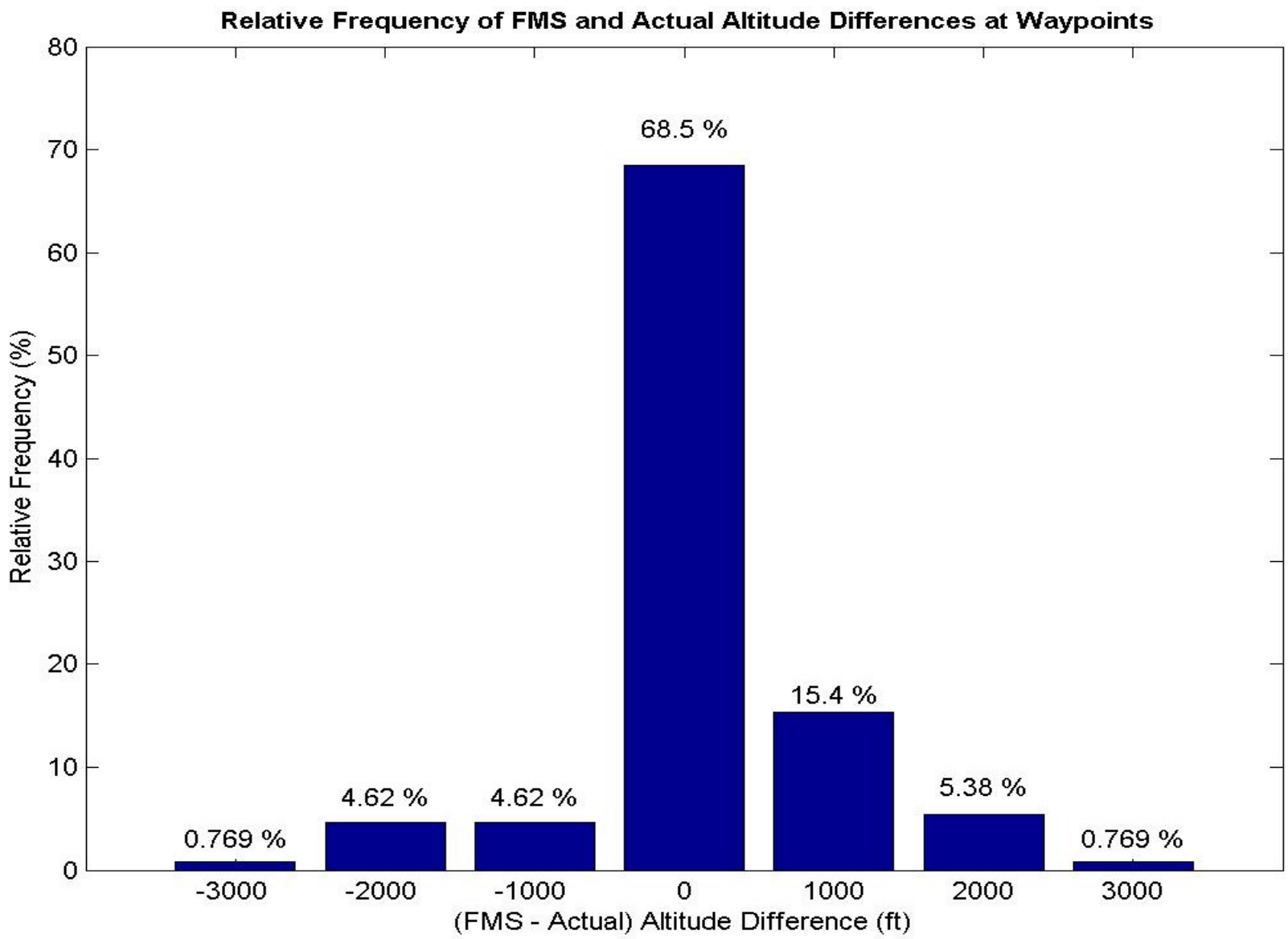


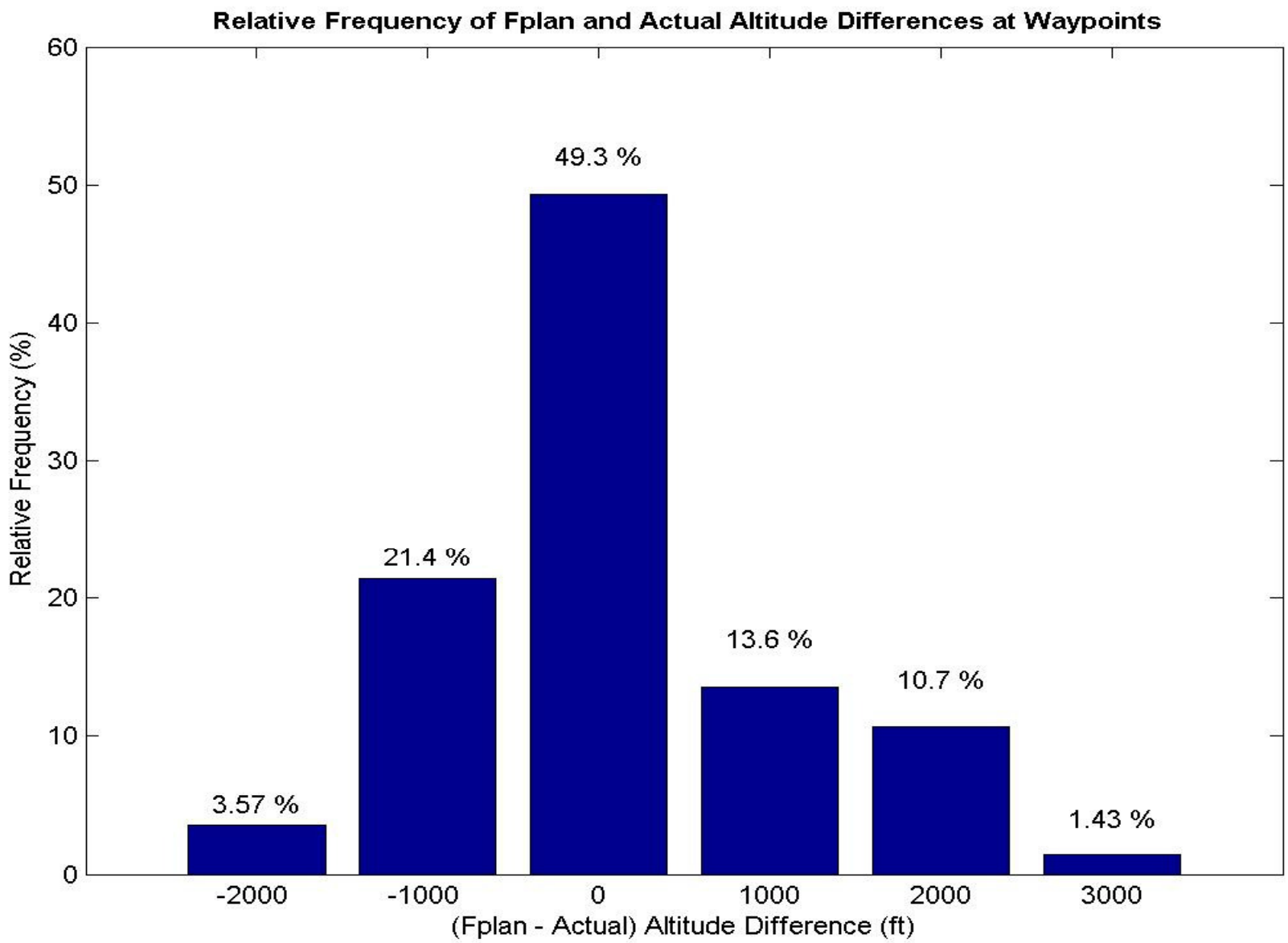
Observed Outcomes

- **Route Distribution**
  - Originally published DOTs tracks are always automatically laterally separated
    - Controllers only concerned with having to separate longitudinally
  - UPR tracks are not laterally separated and at times cross each other
    - UPR tracks may require controllers to separate aircraft both laterally and longitudinally
    - UPR tracks may cause more flight level changes to resolve conflicts
    - Aircraft are not restricted to be separated under radar coverage
- **Air Traffic Concerns**
  - Merging and diverging traffic
    - Some "corner cutting" observed on UPR routes (Track 6,7,10,11).
    - Some UPR traffic converges at airports instead of feeder tracks
  - Possible that UPR routes could drop into or cross opposite direction traffic flows
    - Could result in loss of up to half available altitudes (see ZOA UPR slide)
  - Fanning out of air traffic (1 airway - Track C to 3 UPRs)
    - Potential to have multiple routes to same destination as each airline creates their own UPRs
- **Conflicts**
  - Introduced 1 additional crossing conflict (see slide 60) – using baseline altitudes
  - Introduced 1 additional same direction conflict (see slide 52) – using baseline altitudes
  - Additional conflicts created outside US Oceanic airspace boundaries cannot be determined by this simulation
- **Equipage**
  - 90% of aircraft are equipped for 30 NM lateral/30 NM longitudinal separation
  - 34% of aircraft filed equipage to qualify for 30 NM lateral/30 NM longitudinal separation

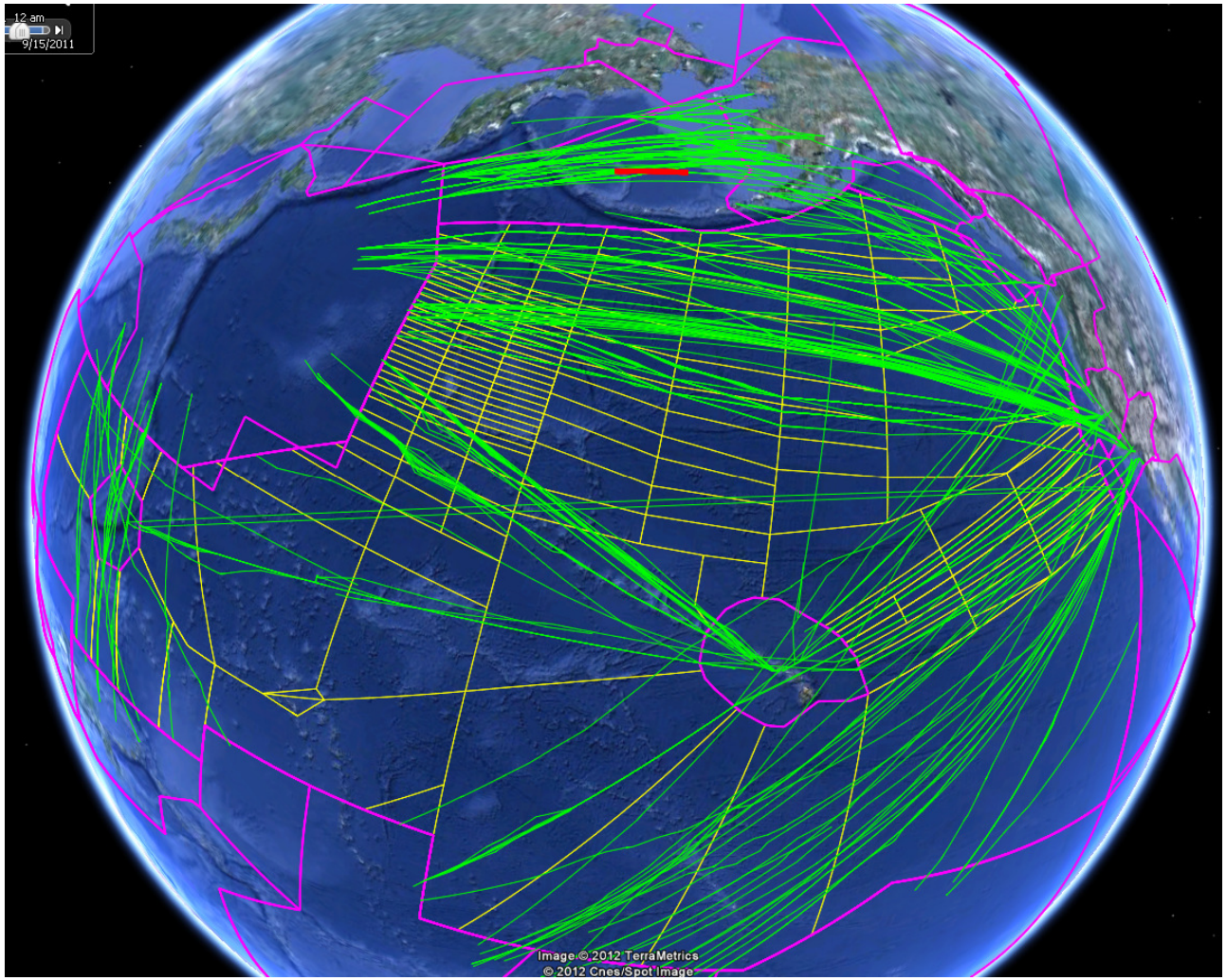
Possible Analysis to Consider

- **Every aircraft on own UPR (East and/or Westbound)**
  - Identify how risk and workload change with different companies and different aircraft profiles
  - Identify how many UPR tracks overlap or cross
  - Study the effects of UPRs generated by airlines using various aircraft types, weights, equipage, and airline procedures
- **Merge in Oakland data to create single US Pacific airspace**
  - Identify how the Oakland traffic affects the UPR tracks
  - Identify how east-bound traffic affects UPR traffic
- **Increase study time**
  - Identify if there are more critical time periods in the day
  - Analyze the entire day to identify complex time periods
  - Identify if there are day to day variations
  - Identify seasonal variations that may be critical
- **Participation by neighboring ANSPs**
  - Identify system limitations of various ANSPs
  - Identify UPR traffic impact on adjacent ANSPs
- **Safety analysis study**
  - Identify any safety risk associated with generated UPRs
- **Run more sample DOTs Plus tracks**
  - How they change throughout year
  - Different aircraft types, weights, and altitudes


Relative Frequency of FMS and Actual Altitude Differences at Waypoints
Relative Frequency (%)
80
70
60
50
40
30
20
10
0
68.5 %
15.4 %
5.38 %
4.62 %
4.62 %
0.769 %
0.769 %
-3000
-2000
-1000
0
1000
2000
3000
(FMS - Actual) Altitude Difference (ft)


Relative Frequency of Fplan and Actual Altitude Differences at Waypoints
Relative Frequency (%)
60
50
40
30
20
10
0
49.3 %
21.4 %
13.6 %
10.7 %
3.57 %
1.43 %
-2000
-1000
0
1000
2000
3000
(Fplan - Actual) Altitude Difference (ft)

??? Questions ???



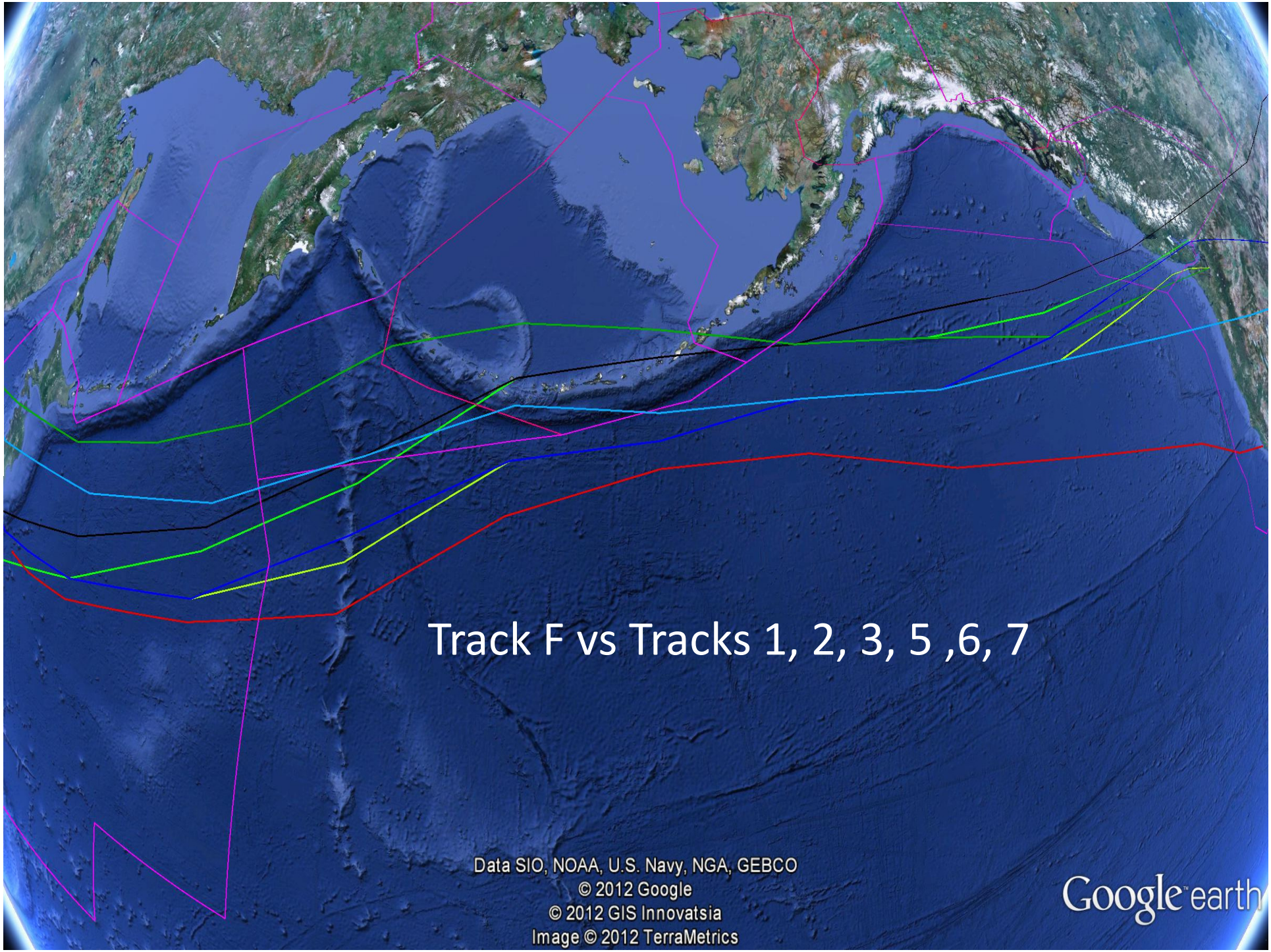
Backup Slides

- **Simulation Recordings**
  - Baseline Simulation
  - UPR Simulation

Thirty Flights Frequency Breakout by Track

Original by track

- **TRACK F (0)**
  - 2 on Track 4
  - *1 on Track 7*
  - 1 on Track 12
- **TRACK E (5)**
  - 1 on Track 3
  - 1 on Track 4
  - *2 on Track 7*
- **TRACK C (21)**
  - 9 on Track 1
  - 2 on Track 2
  - 3 on Track 3
  - 3 on Track 5
  - 1 on Track 6
  - *3 on Track 7*
- **Random (??) -** On Track 3


Track F vs Tracks 1, 2, 3, 5 ,6, 7
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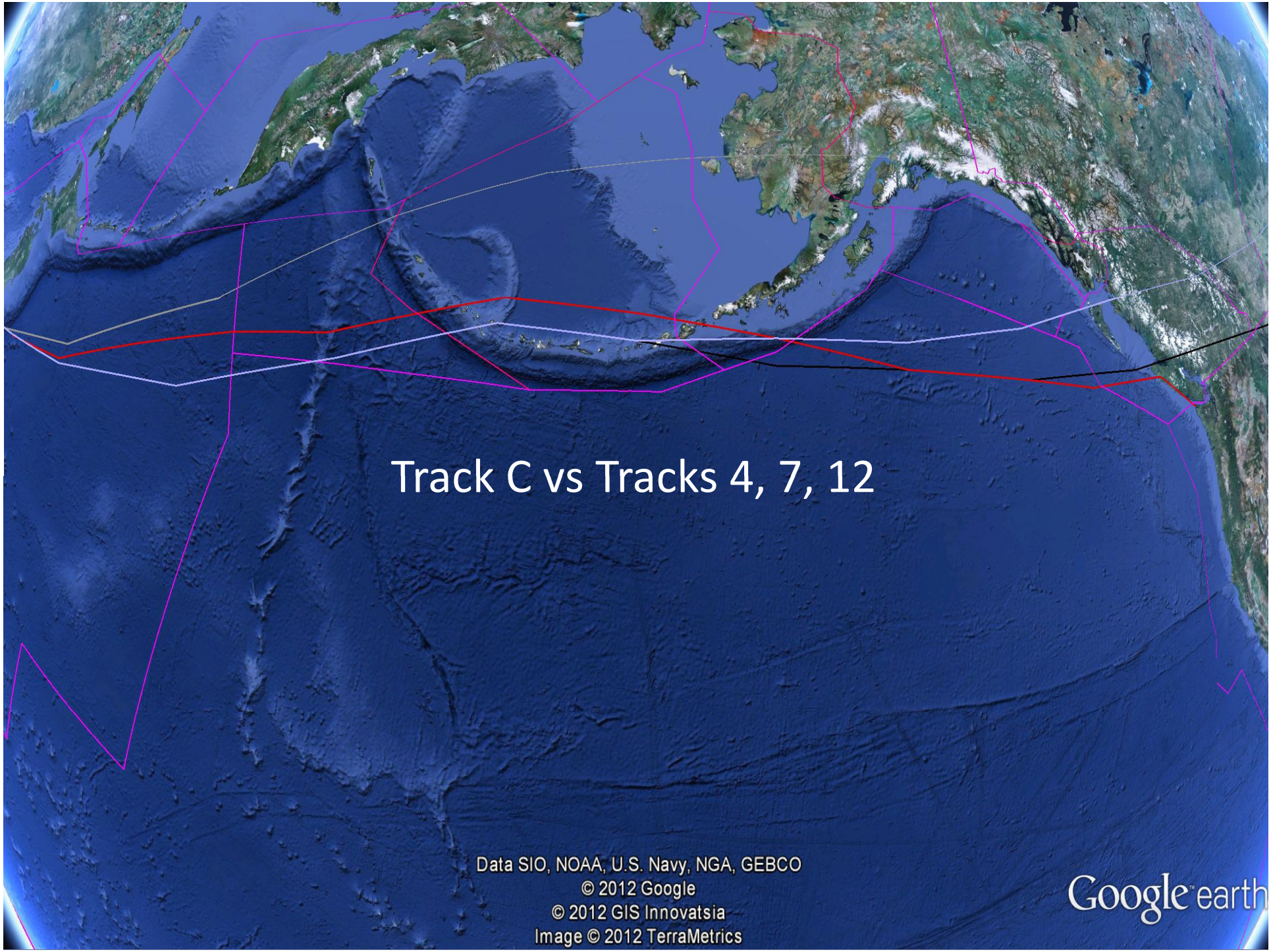
Track C vs Tracks 4, 7, 12
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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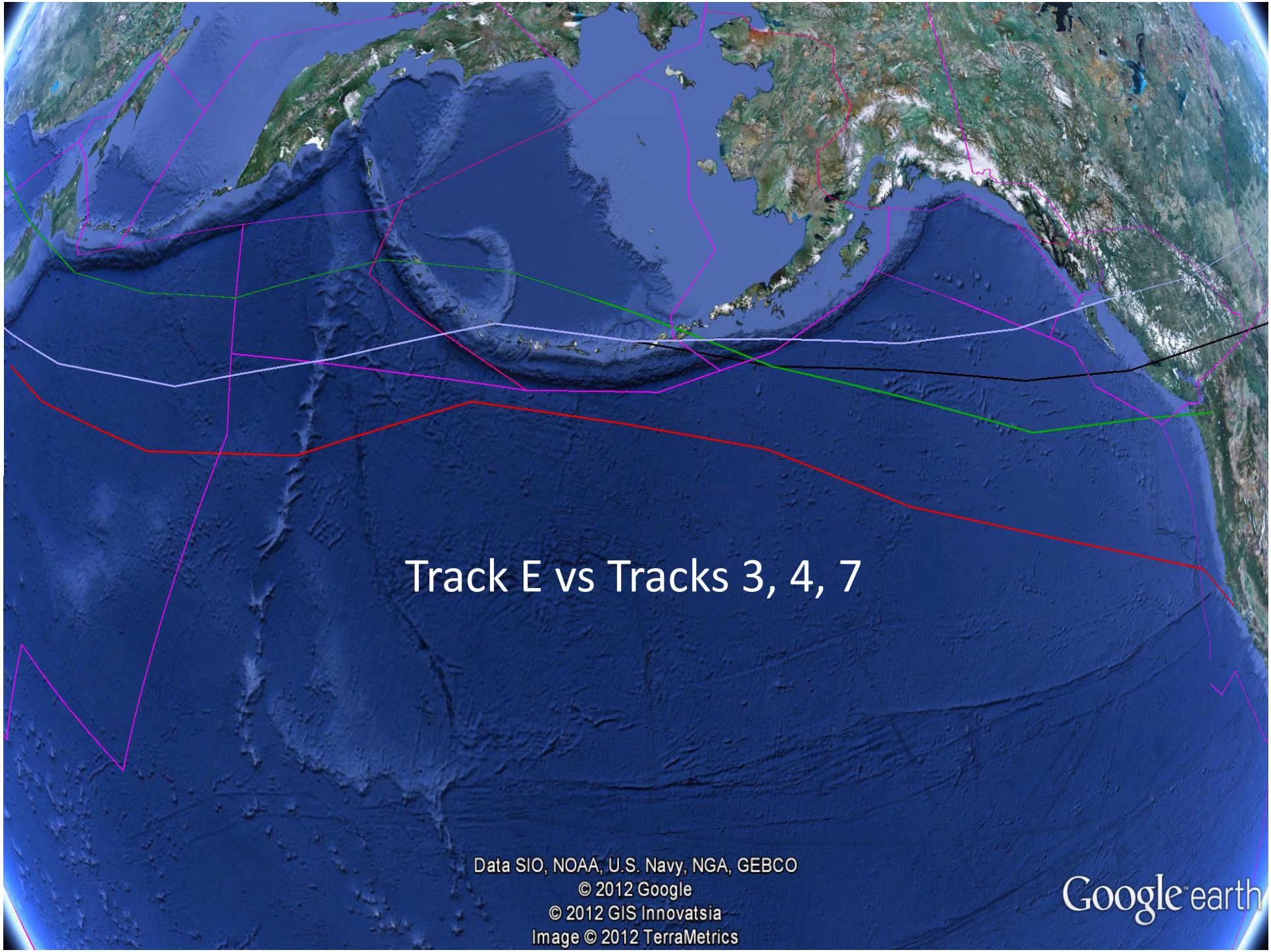
Track E vs Tracks 3, 4, 7
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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