

Tactical and Financial Analysis of Pre-Flight and Inflight Uplink of Weather data

By

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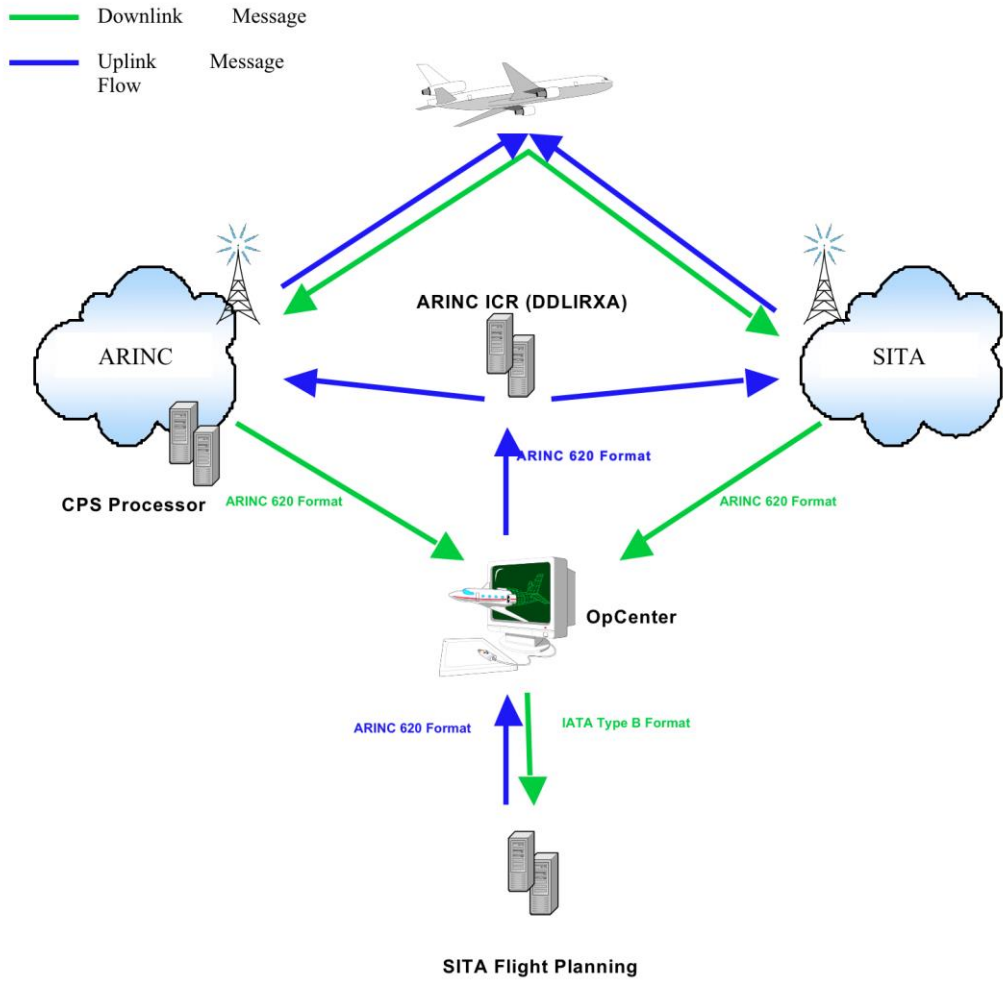


UPLINK FUNCTIONALITY

- Pre Departure
 - Route, City Pair, Alternate
 - Wind,
 - Climb 5 Flight Levels
 - Cruise 3 Flight Levels
 - Descent 4 Flight Levels plus destination surface wind
 - Cruise Temperature
 - Turbulence, CAT plus Convective
- Inflight
 - DEW, Dynamic Enroute Wind

UPLINK FUNCTIONALITY

- Improved AUTOMATED SYSTEM
- MANUAL VS AUTOMATIC
- Using the ACARS (Aircraft Communication and Addressing System) to acquire and insert the later wind prognosis and temperature.
 - PRE-FLIGHT
 - INFLIGHT
- Routing of messages, VHF – SATCOM - HF



FMD

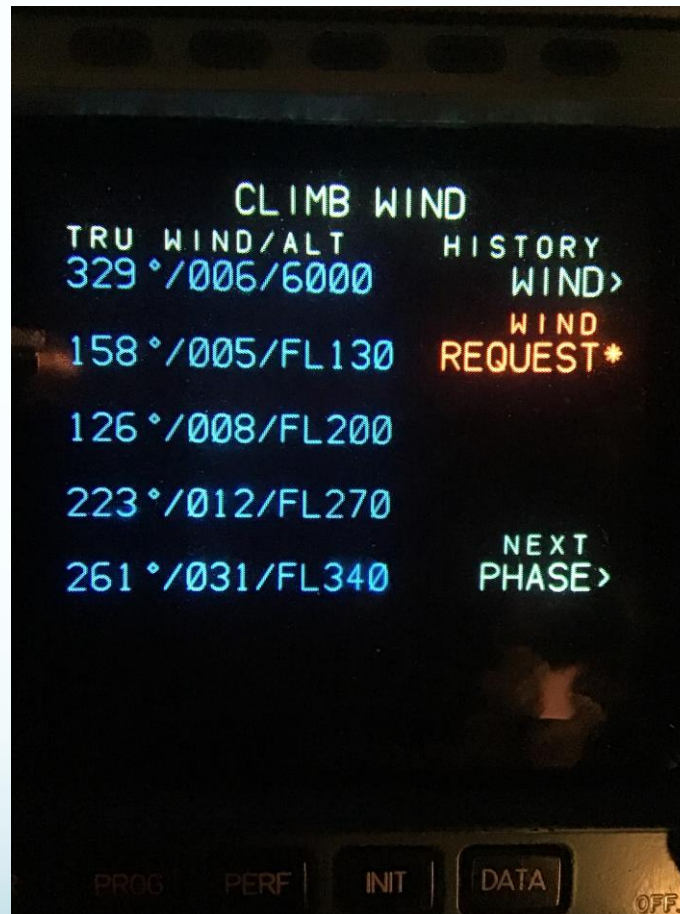
AN ZS-SXA

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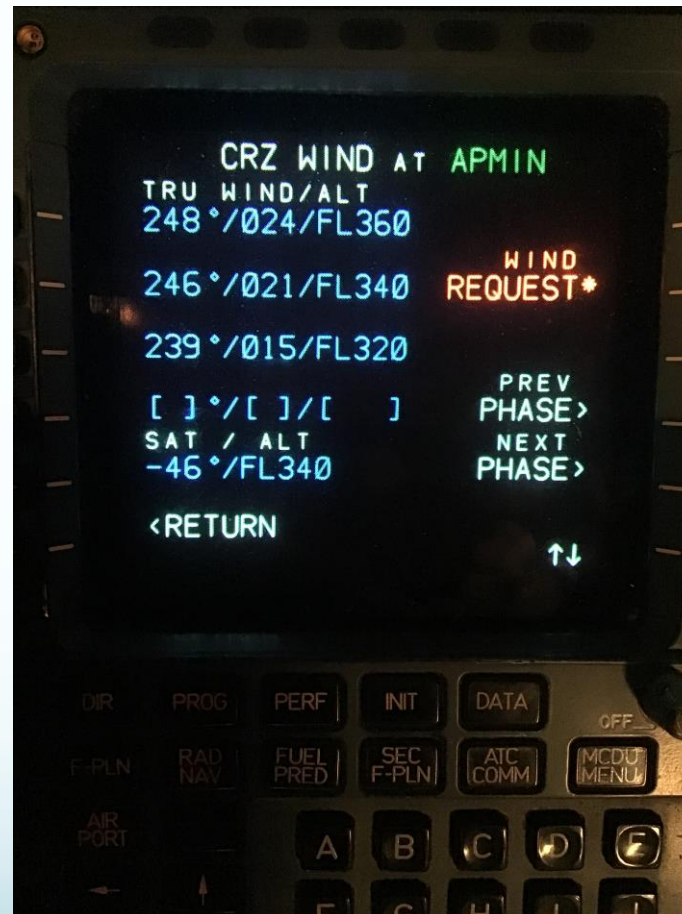
PWI/WD410,S20492E030207,292003,410M56.GWV,260007,410M56/WD400,S20492E030207,272004.GWV,257009/WD380,S20492E030207,260007.GWV,251010/DD400285011.315255008.230177007.145141017.060117010/SNQA
YT20B29



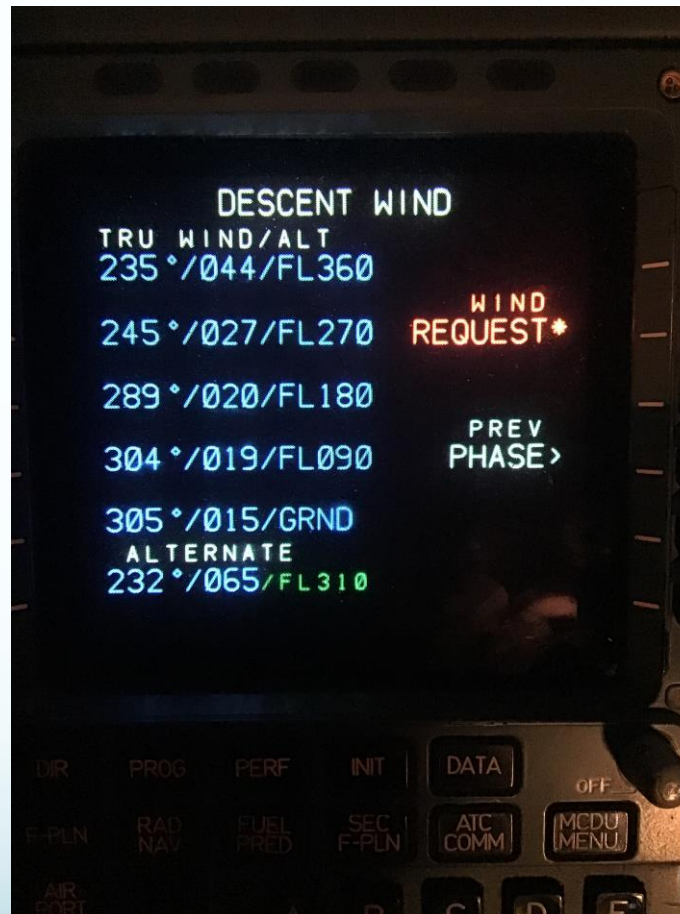
CLIMB WIND



CRUISE WIND



DESCENT WIND



PROGNOSIS PERIODS

- Standard release prognosis period from WAFC
- 0000Z – 0600Z – 1200Z – 1800Z
- Available to customer for flight planning purposes
- 0400Z = 0000 prognosis, 1000Z = 0400 prognosis
 - 4 hour variance, pre-flight and inflight
- Weather modeled to look forward for a number of prognosis periods to cover the period of flight, ie up to 36 hours.

DEW – Dynamic Enroute Wind

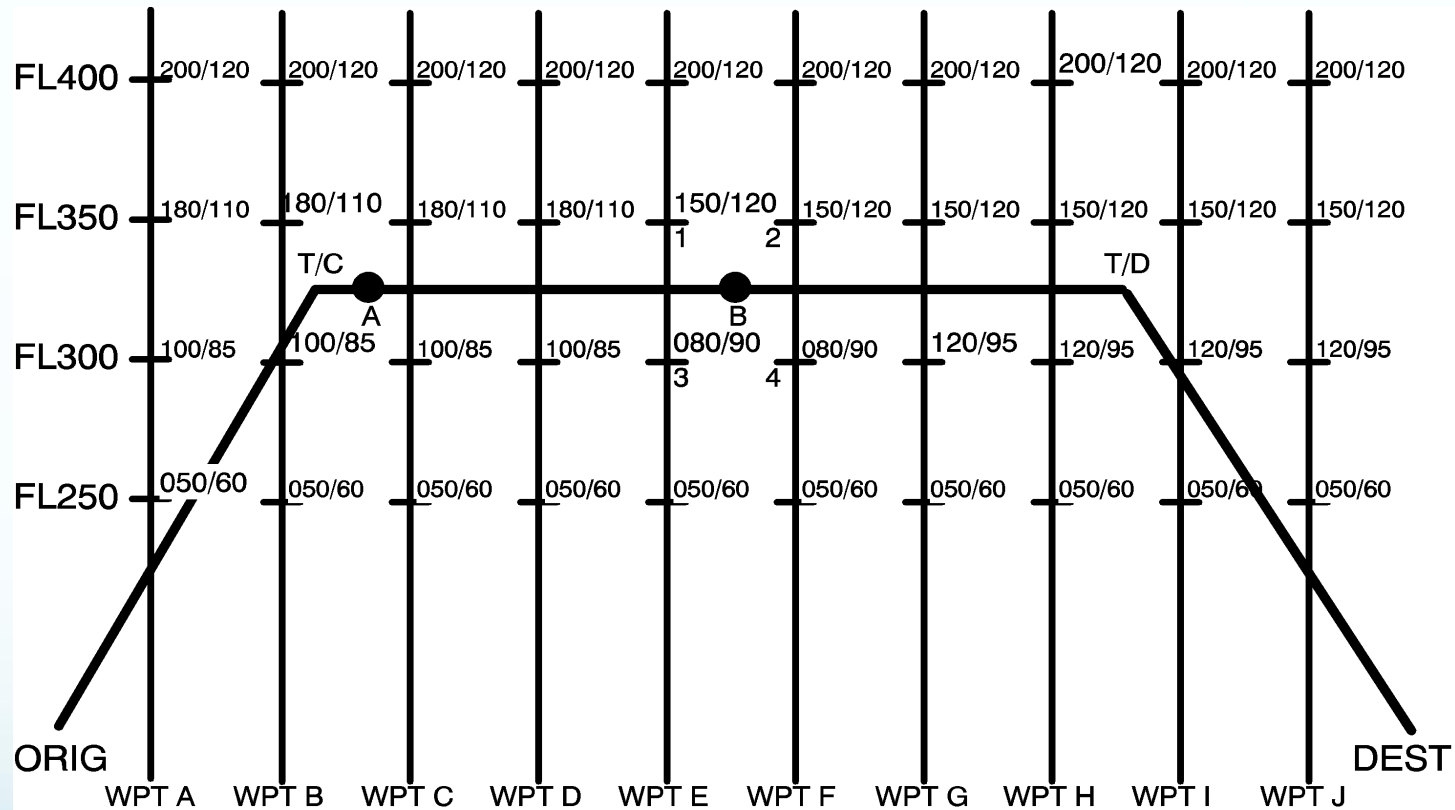


DEW UPDATE

- UPDATE
 - Cruise and Descent ONLY – INFLIGHT ENHANCEMENT
 - FMS BASIC STANDARD Airbus A340 only
 - 3 levels, 33 waypoints
 - 4 levels, 24 waypoints
 - FMS STEP1A Airbus A320 and A330
 - 3 levels > 50 waypoints
 - 4 levels, 40 waypoints

Three parameters will be indentified,

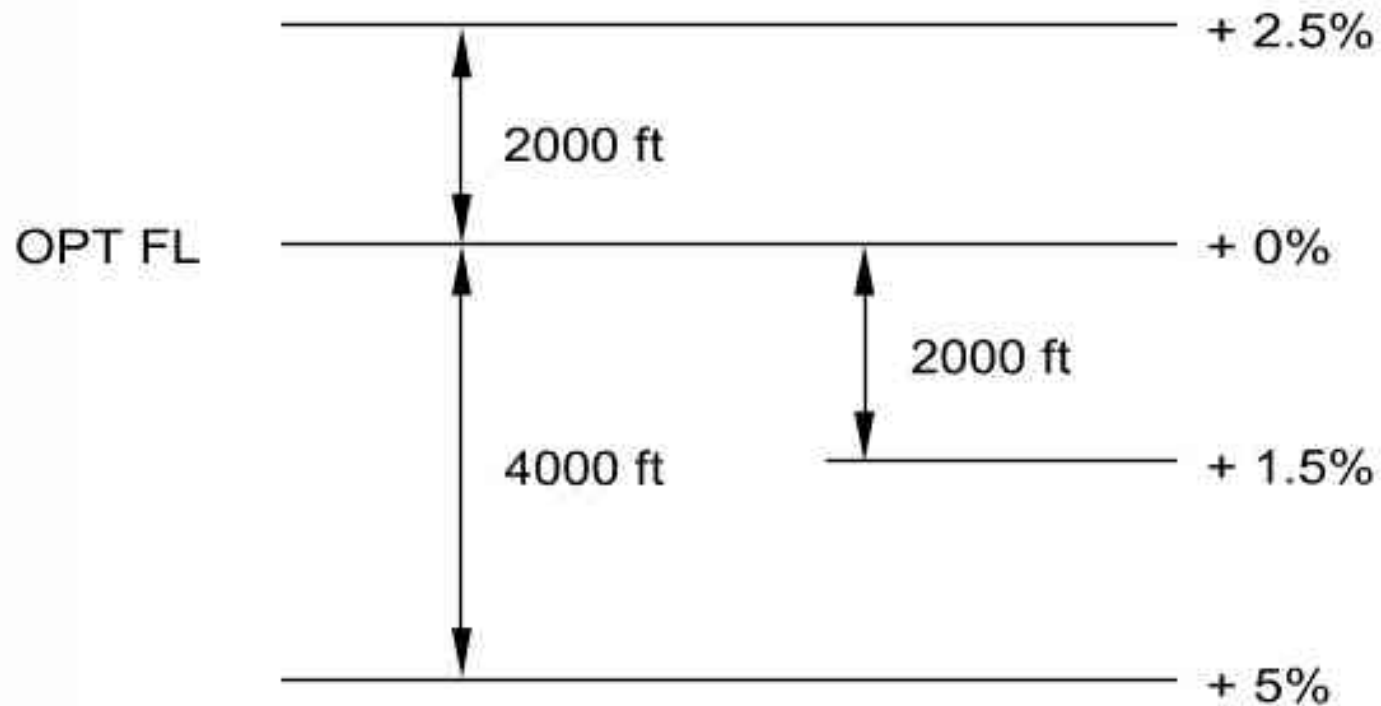
- Fuel remaining before and after the DEW, determining Δ fuel.
- ETA before and after the DEW, determining Δ time
- Change in Optimum altitude.



LARGE FONT(200/120) = Pilot Entry of Wind
 SMALL FONT(180/110) = Propagation of Wind Entered by Pilot



fuel penalty versus OPT FL



- Flight plan: Fuel/time/distance predictions
 - ▶ During flight preparation: based on forecasted wind/temperature
 - ▶ During cruise: predictions based on predicted and forecasted weather

- ▶ Impact of wind and temperature on EFOB/ETA
(CI = 30, A320 weight=65000kg, A330 weight=205000kg)
 - **A320:**
 - On 1000NM, a **30kt** wind difference leads to **500kg** difference on EFOB and **15min** on ETA.
 - **A330:**
 - On 2000NM, a **30kt** wind difference leads to **2000kg** difference on EFOB and **25min** on ETA.

Team of 7 selected Training and Check Captains,

- A340, 31 Data sets.
- A330, 76 Data sets.
- 96%, 1 or more changes to Fuel/Time/OPT ALT.
- Change in FUEL. **QUANTITATIVE.**
- Change in TIME. **TACTICAL**
- Change in Optimum altitude. **TACTICAL**



Airbus A330

- 76 DEW uplinks completed
- FUEL, 45% 100kg or better.
- TIME, 35% 1 min improvement or better.
- ALTITUDE, 75% remained the same, or improved.

	Decrease	Stay Same	Increase
Optimum Altitude	13%	43%	43%
Fuel	24%	32%	45%
Time	36%	41%	24%

Airbus A340

- 31 DEW uplinks completed
- FUEL, 39% 100kg or better.
- TIME, 39% 1 min improvement or better.
- ALTITUDE, 68% remained the same, or improved.

	Decrease	Stay Same	Increase
Optimum Altitude	13%	39%	48%
Fuel	32%	29%	39%
Time	39%	32%	29%

Annual Savings

FUEL
\$1.06/kg

- A340
 - 17 Sectors per day, 6205 sectors per year.
 - 39% realise a fuel gain, 2172 sectors per year.
 - >217 200 kg Fuel/year
 - \$230 232/year
 - COST <\$1/Uplink
- A330
 - 6 Sectors per day, 2190 sectors per year.
 - 45% realise a fuel gain, 986 sectors per year.
 - >98 600 kg Fuel/year
 - \$104 516/year
 - COST <\$1/Uplink



Annual Savings

CARBON EMISSIONS

3.2kg CO₂/kg JETA1

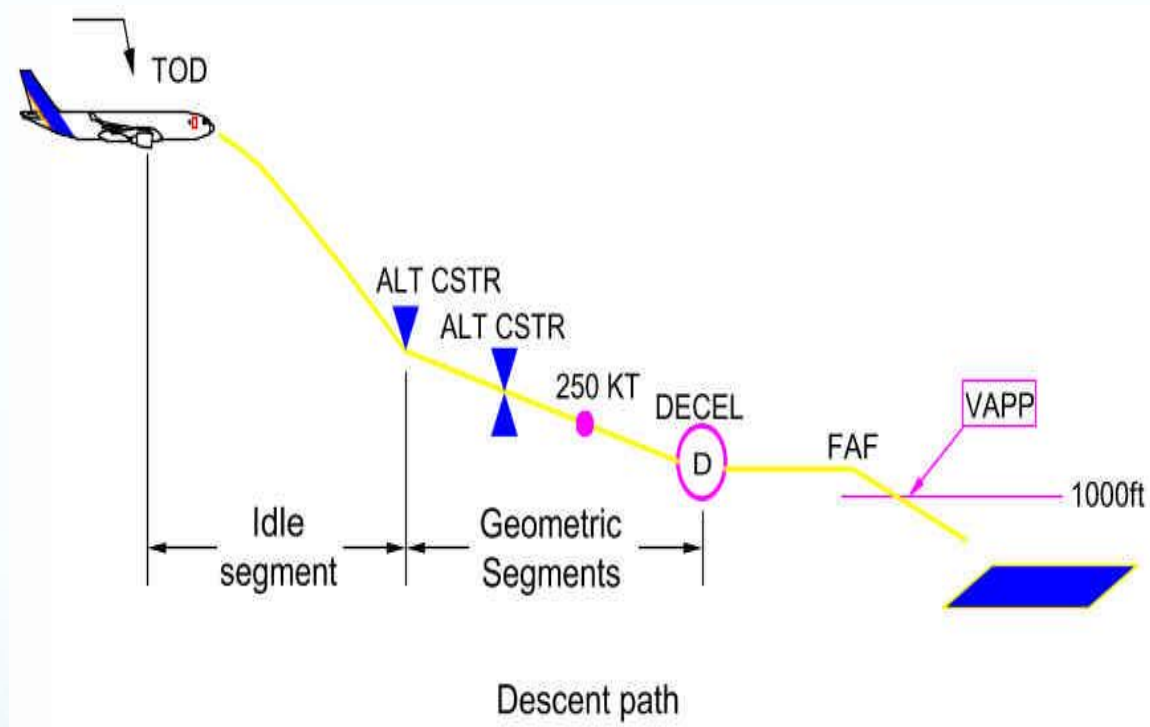
- A340
 - 17 Sectors per day, 6205 sectors per year.
 - 39% realise a fuel gain, 2172 sectors per year.
 - >217 200 kg Fuel/year
 - CO₂
 - 217 200 @ 3.2kg
 - 695 040 kg CO₂
- A330
 - 6 Sectors per day, 2190 sectors per year.
 - 45% realise a fuel gain, 986 sectors per year.
 - >98 600 kg Fuel/year
 - CO₂
 - 98 600 @ 3.2kg
 - 315 520 kg CO₂



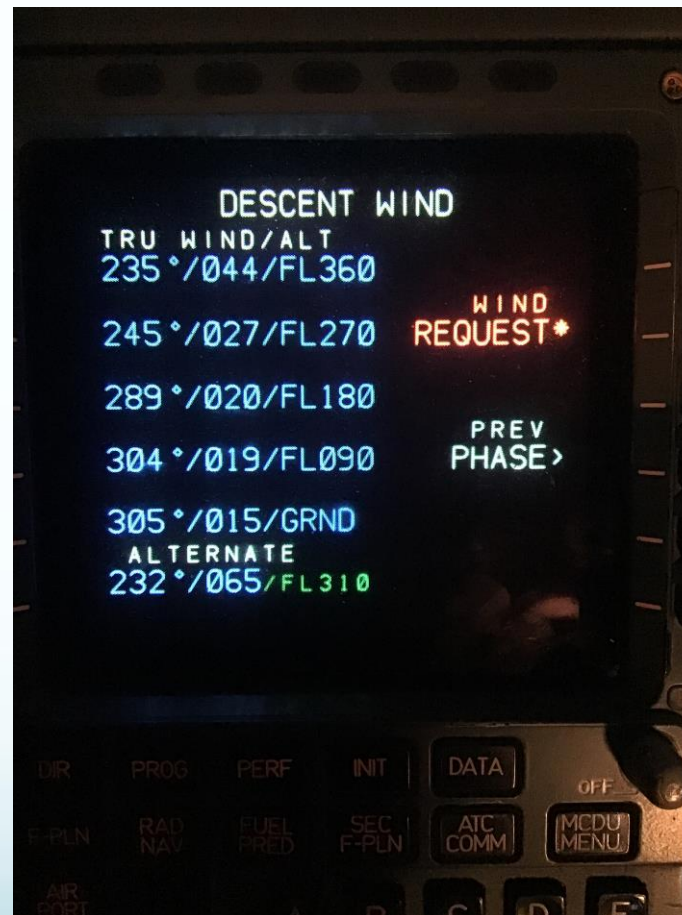
Summary

- A340
 - >217 200 kg Fuel/year, =\$230 232/year
 - CO₂
 - 695 040 kg CO₂
- A330
 - >98 600 kg Fuel/year,=\$104 516/year
 - CO₂
 - 315 520 kg CO₂
- Improved Optimum Altitudes
- Improved Approach Times reduce holding time.

Descent path



Descent Winds PRE-FLIGHT



Amend Descent Levels



Advantage of Improved Descent Winds

- 1 cruise waypoint. PROG update prior to TOD
- CONTINUOUS DESCENT PLANNING, to the deceleration phase.
- Airbus Geometric phase.
- IDLE THRUST TO 1000ft above destination aerodrome.
- Bracketing of JET STREAMS

TURBULENCE

- CAT – Clear Air Turbulence
- Convective Turbulence, proximity to CB's.
- Cooperative between SAA/SITA/WAFC UK Exeter
- Relationship of 'predictability' versus 'actual'.
- Seat belt SIGNS ON versus Turbulence, retrospective assessment of inflight 'g'

SEAT BELTS ON

0-3 Light
4-7 Moderate
7< Severe

Altitude levels bracket

JET STREAMS

FL280-FL320

FL320-FL360

FL360-FL410

.ZS-SZD ---- SAA171 15AUG19 1127Z
WEATHER

PART 1 OF 1

Ref ESYR3
A/C ZS-SZD / SA171
Calc at 15AUG2019 1127Z
Data at 15AUG2019 1016Z

FL 280 320 360
TO 320 360 410
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NO CAT OR CB
FORECASTED UNTIL
TIDUP 1
UTUPU 1
APMUX 1

END OF REPORT