SJU P6.8.1

WakeNet 3 Europe Workshop
London, 8th of February

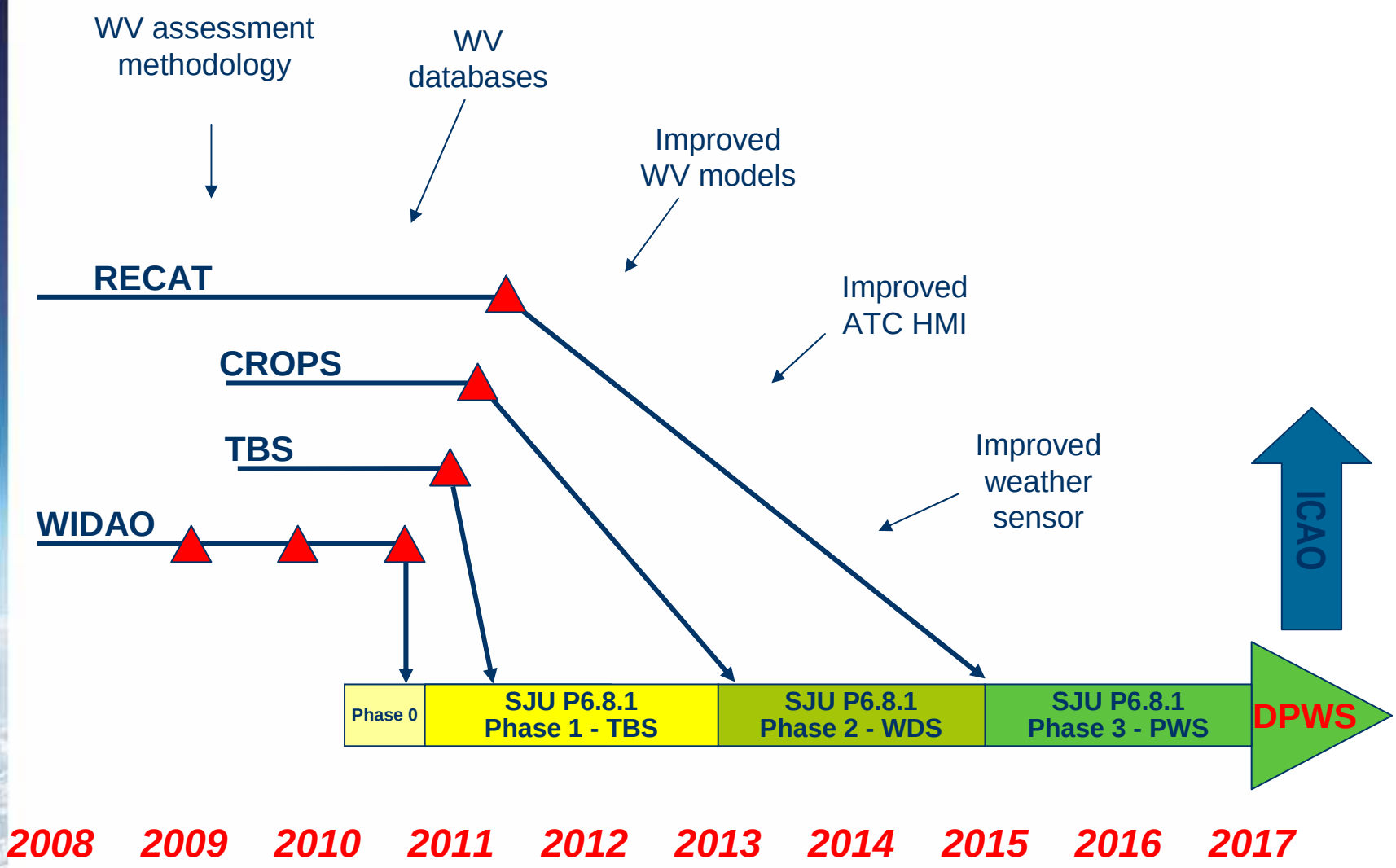
Vincent TREVE, EUROCONTROL

P6.8.1 Flexible and Dynamic Use of Wake Turbulence Separations

The objective of P6.8.1 is to develop solutions to:

- Permanently provide arrival capacity resilience to challenging wind conditions to redress the current impact of such conditions on the achieved capacity (TBS)
- Conditionally provide arrival and departure throughput increases in favourable prevailing meteorological conditions to more efficiently handle peaks and queues in arrival and departure demand (WDS)
- Permanently provide arrival and departure capacity increases across all conditions for both more contingency provision for non-nominal conditions and more provision for capacity declaration across all conditions (PWS)

SJU P.6.8.1 and short term projects



Project's partners

ONERA
THE FRENCH AEROSPACE LAB

direction générale de l'Aviation civile
DSNA

AIRBUS
AN EADS COMPANY

EUROCONTROL

NATS

THALES

Project Tasks

Task 1 – Project management plan

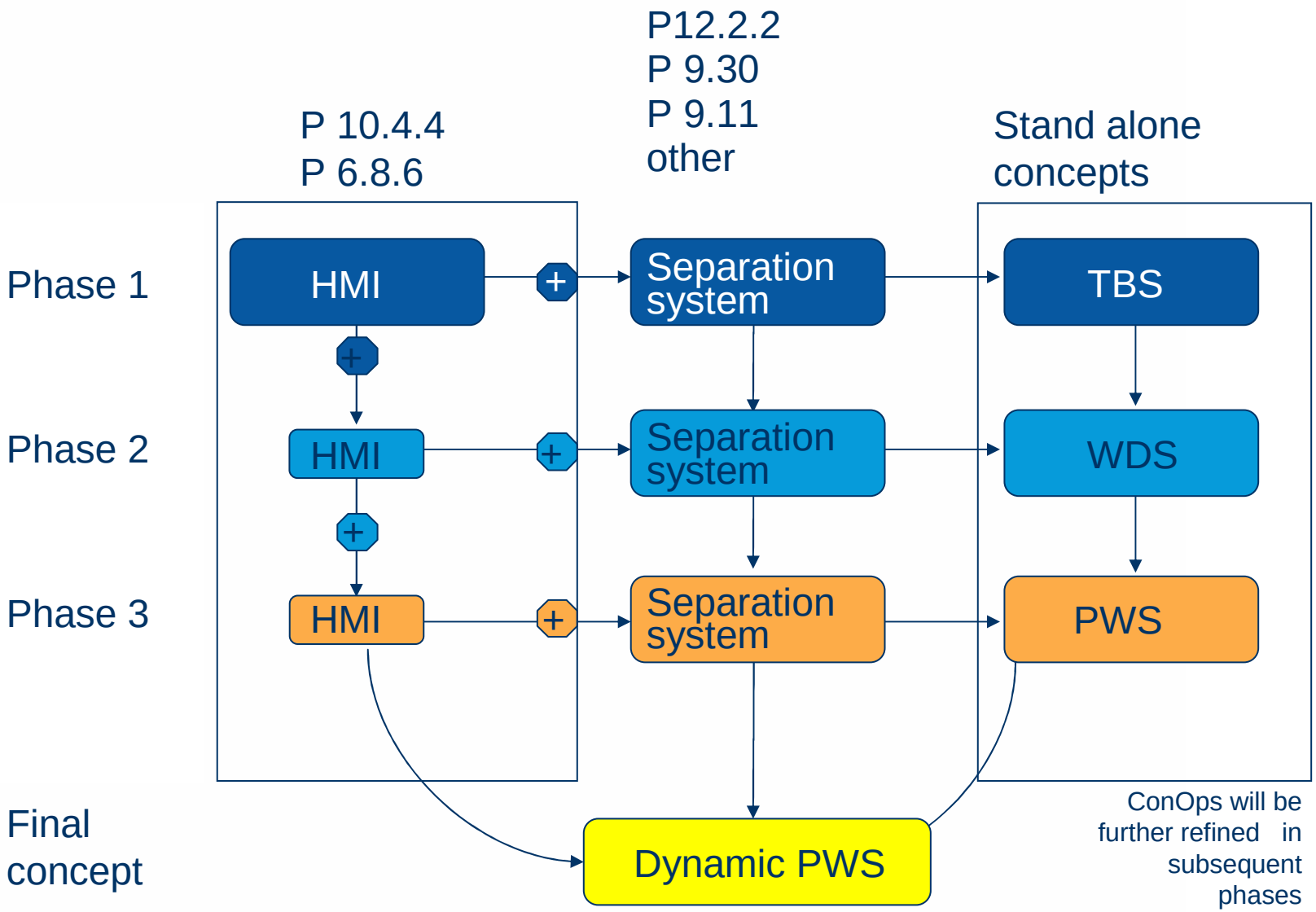
Task 2 – Project management reporting

Task 3 – High-level OCD preparation Task 4 – High level OSED preparation	**Completed**
Task 5 – (TBS) - State concept and assumptions Task 6 – (TBS) - Set validation strategy	**Ongoing**
Task 7 – (TBS) - Determine the exercise needs Task 10 – (TBS) - Conduct exercises Task 11 – (TBS) - Determine the results Task 12 – (TBS) - Disseminate information	**2011 - 2012**
Task 8 – Research on Wake Vortex Encounter severity metrics Task 9 – Permanent data collection	**Ongoing**

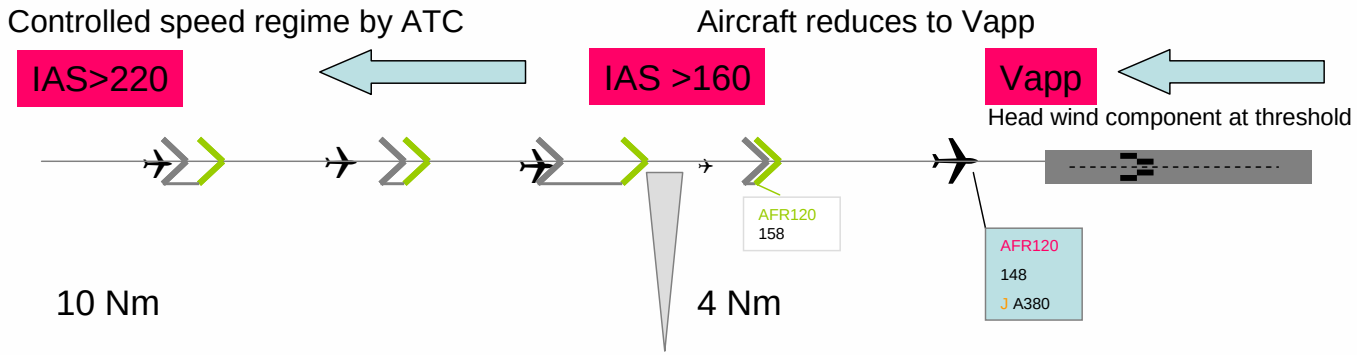
Project Tasks

Task 13 – (WDS) - State concept and assumptions Task 14 – (WDS) - Set validation strategy Task 15 – (WDS) - Determine the exercise needs Task 16 – (WDS) - Conduct exercises Task 17 – (WD) - Determine the results Task 18 – (WDS) - Disseminate information	**2013 - 2014**
Task 19 – (TBS) - State concept and assumptions Task 20 – (TBS) - Set validation strategy Task 21 – (TBS) - Determine the exercise needs Task 22 – (TBS) - Conduct exercises Task 23 – (TBS) - Determine the results Task 24 – (TBS) - Disseminate information	**2015 - 2016**

Task 3&4 - High Level OCD and OSED Definition

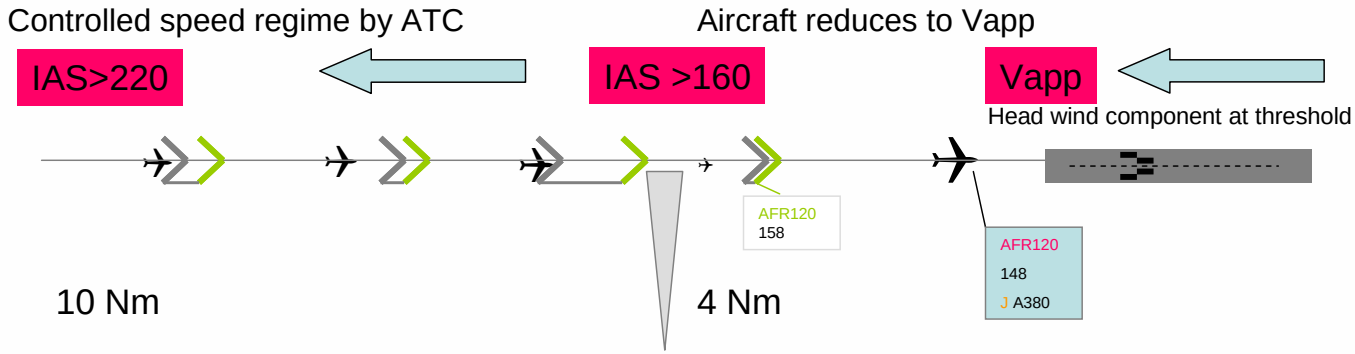


Task 5 - Detailed TBS OSED Definition (preliminary)



- Minimum time separation based on preceding aircraft's past position **(T_Sep)** translated into distance **(D_Sep)**
- Minimum time separation based on preceding aircraft's past position **(T_Sep)** translated into distance **(D_Sep)** + expected catch-up time (T_CatchUp) translated into distance (D_CatchUp)

Task 5 - Detailed TBS OSED Definition (preliminary)



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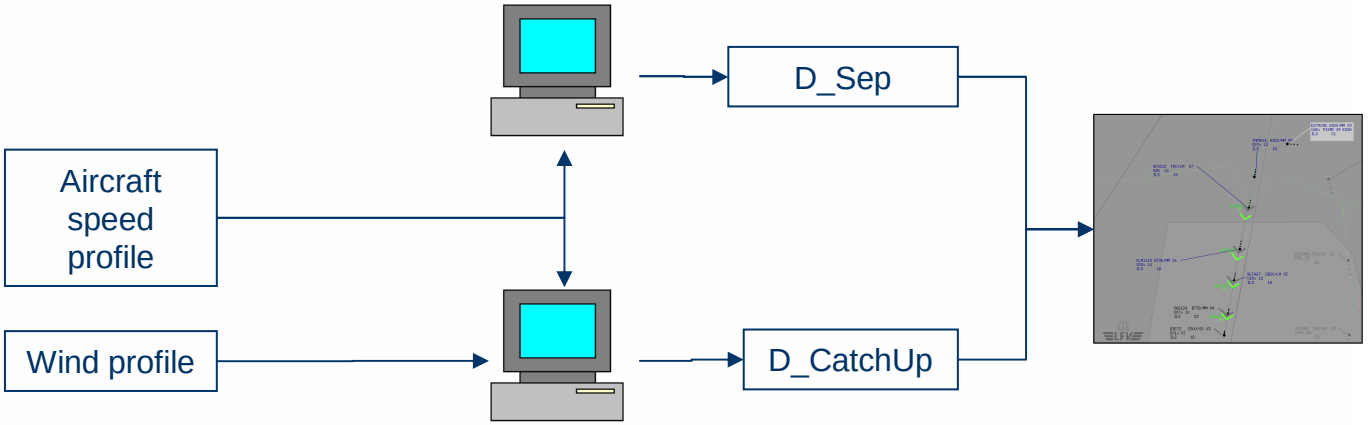

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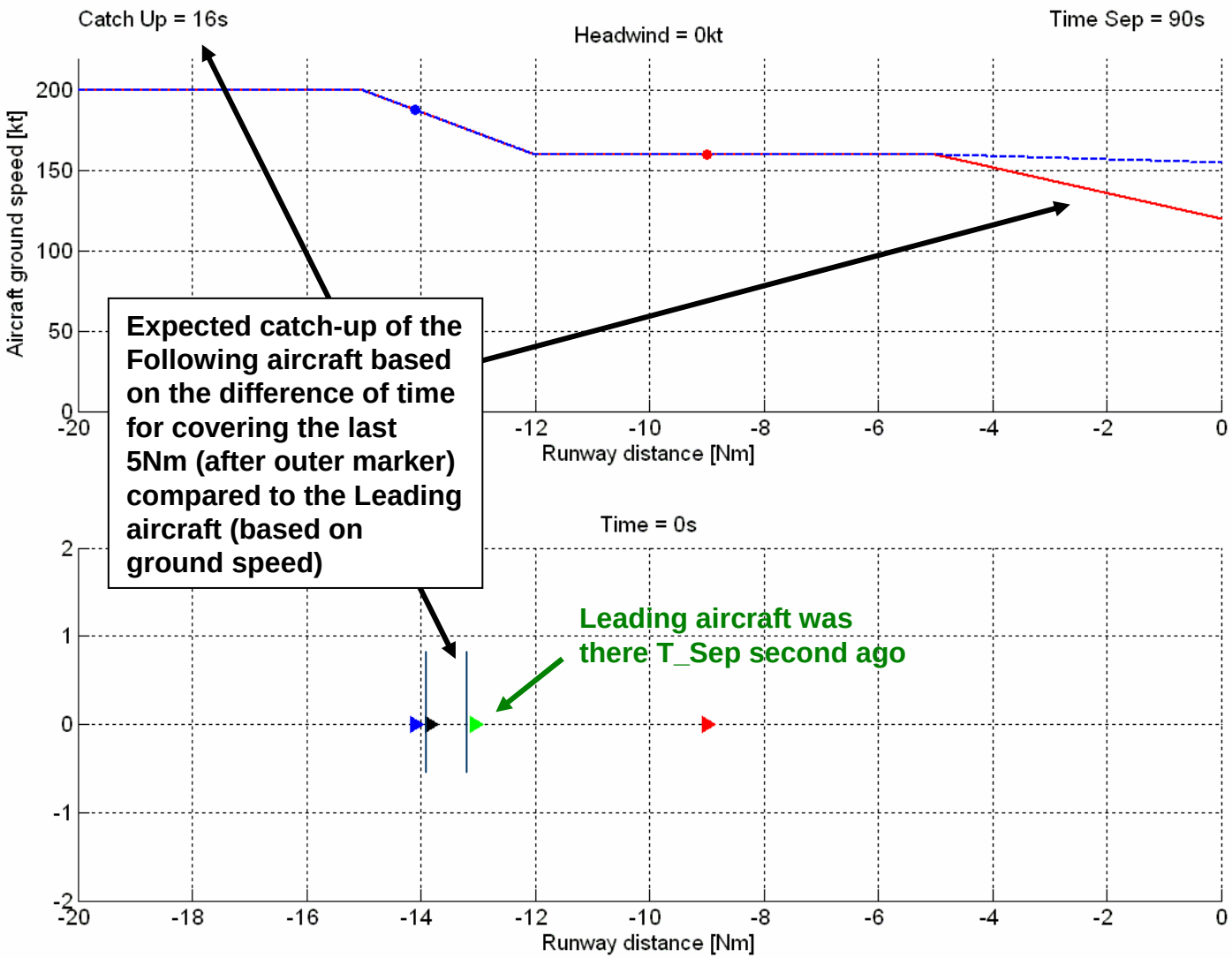

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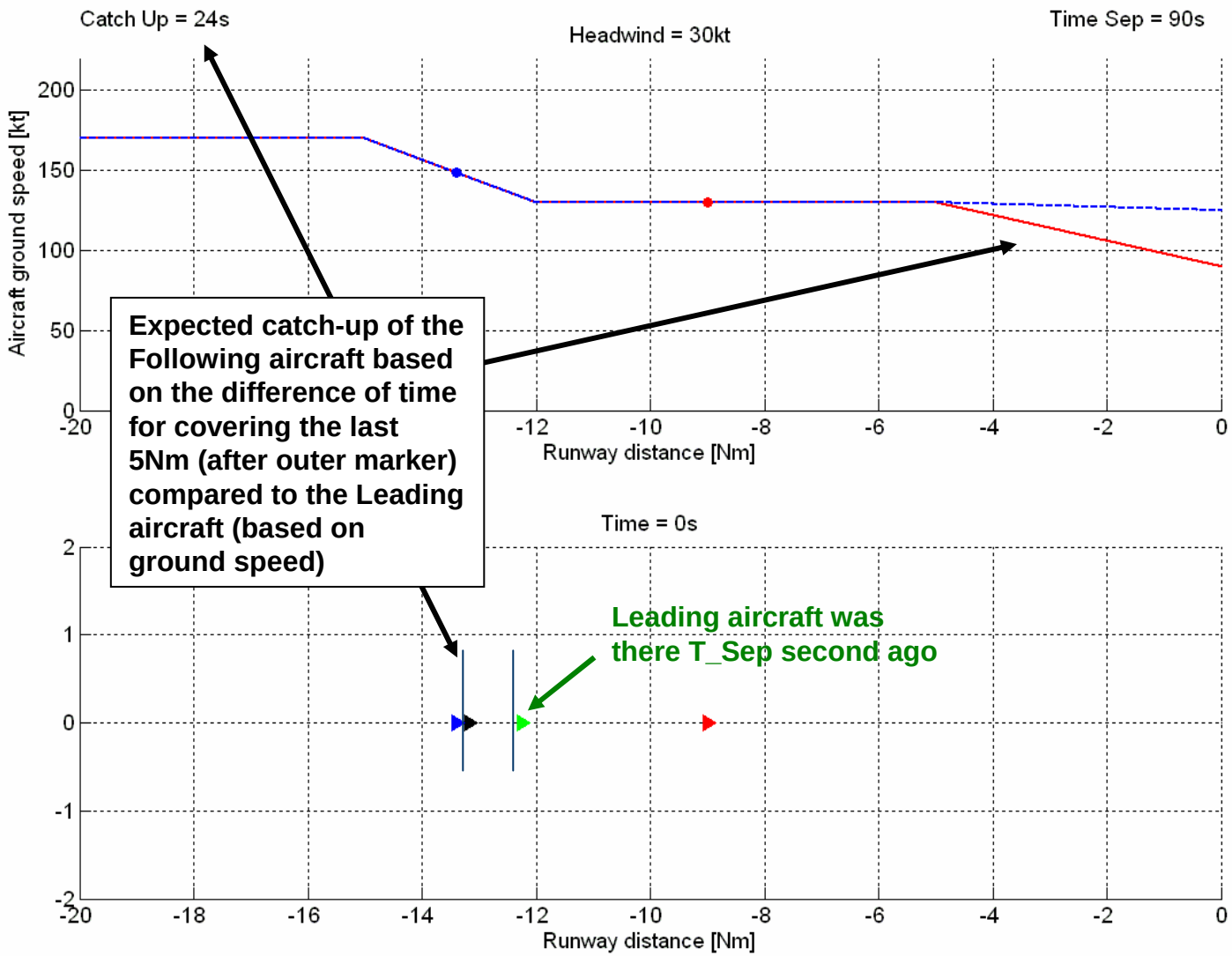

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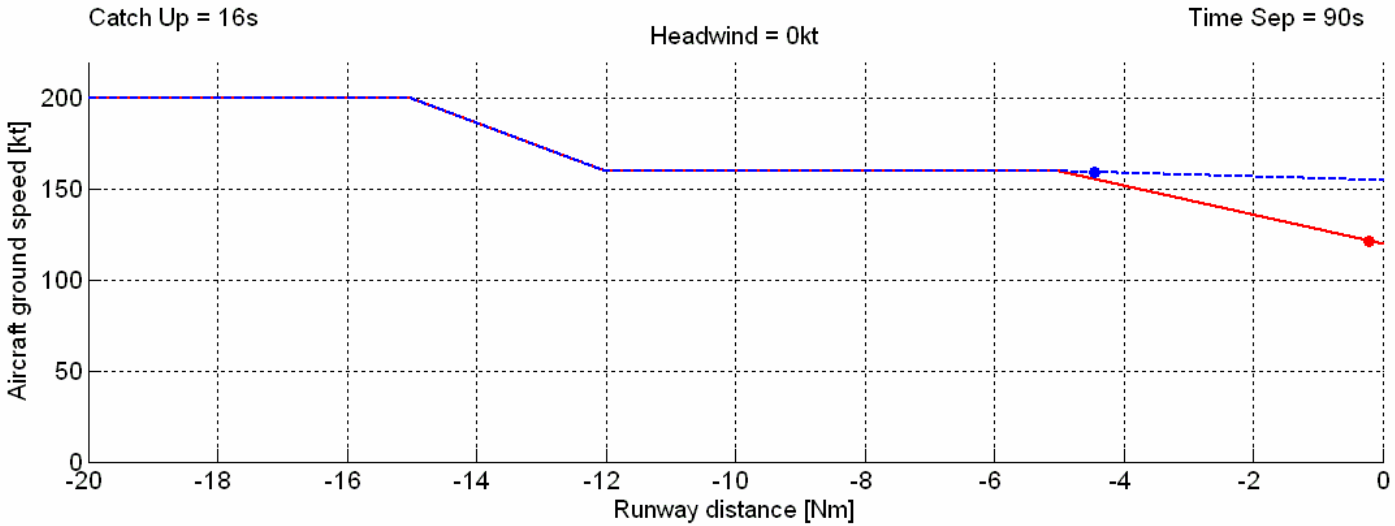

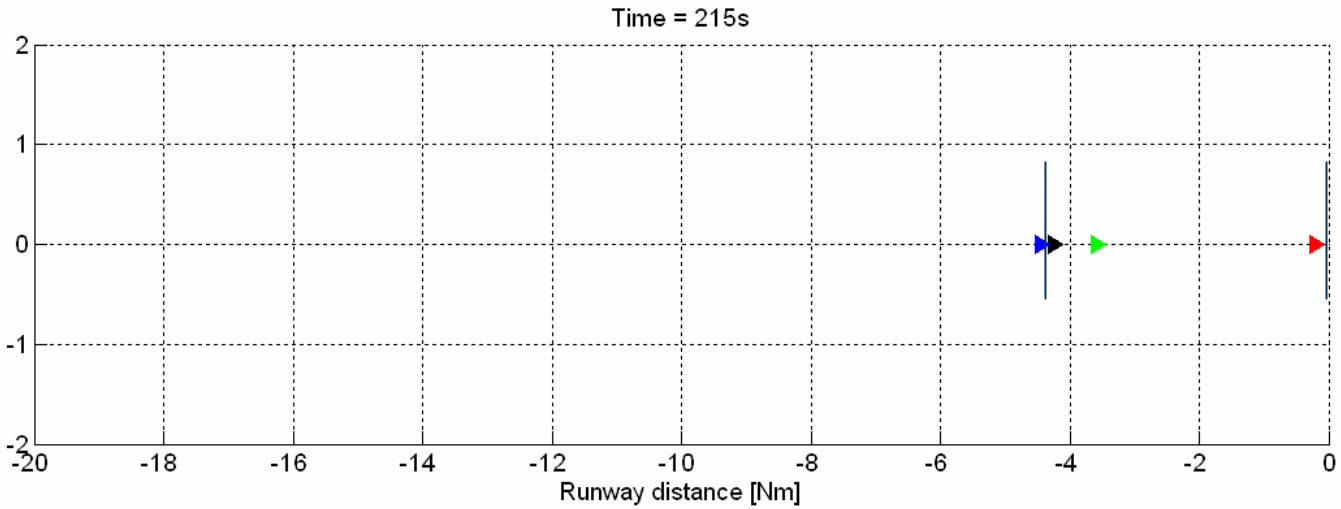

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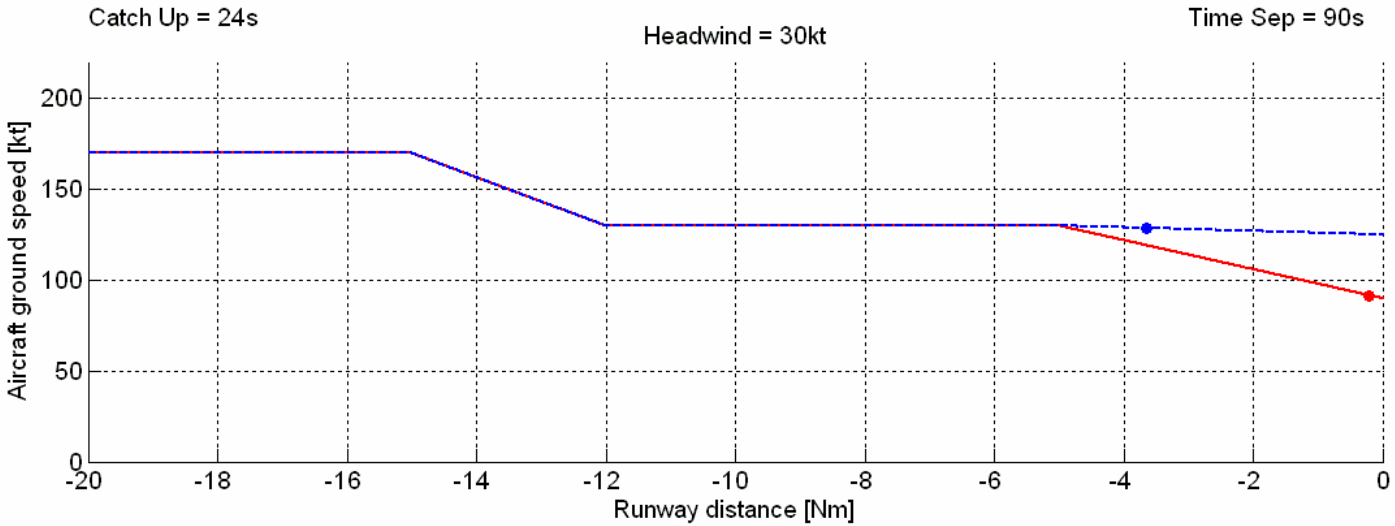

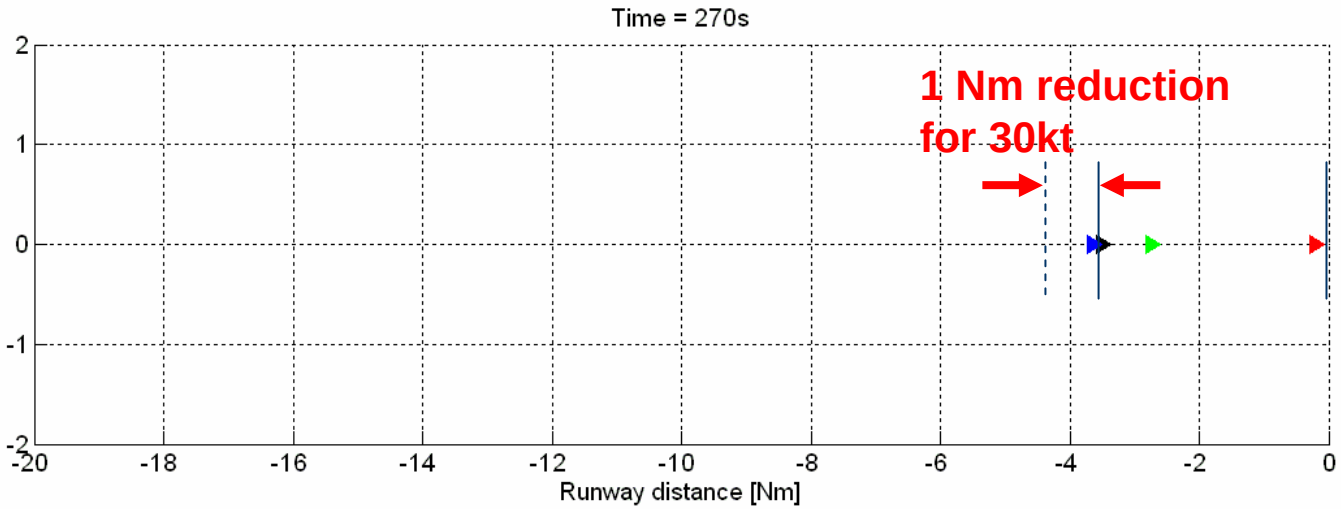

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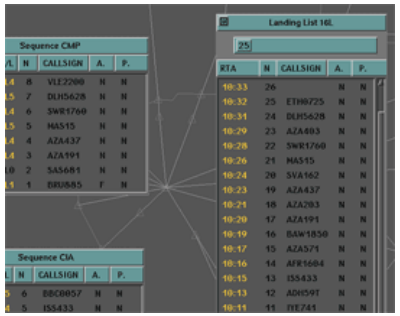
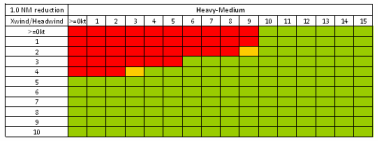
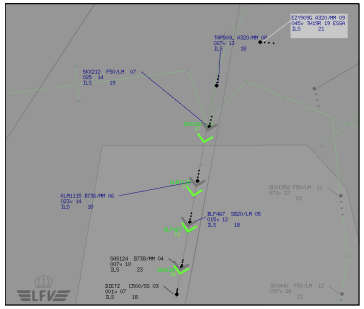


Advanced arrival sequence manager



Validation of the new separations



Controller separation tool

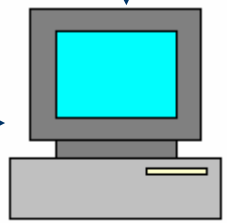
T_Sep

D_Sep

D_CatchUp

OR

Aircraft TAS profile

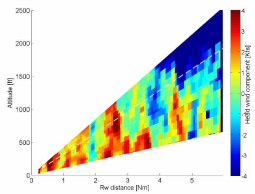


Separation definition

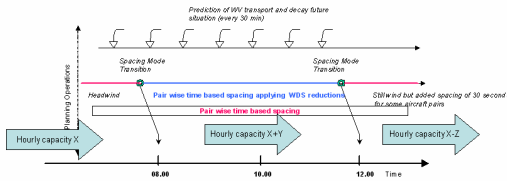
Runway capacity

Aircraft downlink

Headwind profile



Spacing mode planning



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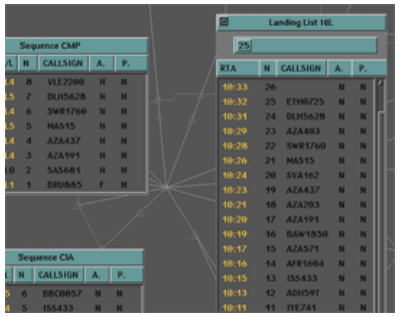
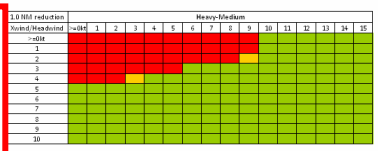


Advanced arrival sequence manager

OR

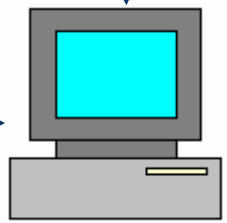
Aircraft downlink

Aircraft TAS profile



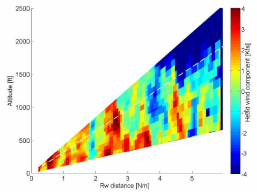
Validation of the new separations

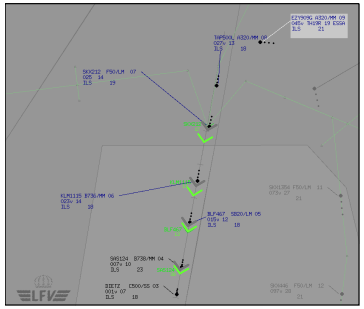
T_Sep



Separation definition

Headwind profile





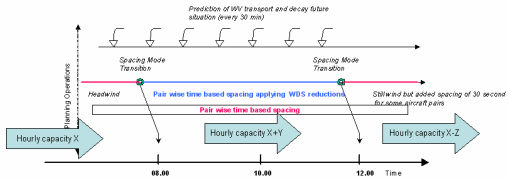
Controller separation tool

D_Sep

D_CatchUp

Runway capacity

Spacing mode planning



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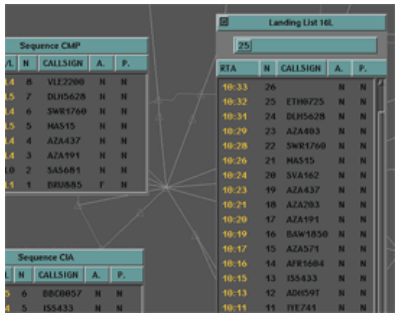

Advanced arrival sequence manager

OR

Aircraft downlink

Generic speed profile based on aircraft type provided by the sequence manager

OR

Generic speed profile + Landing speed defined by aircraft type or broadcasted

OR

Expected speed profile broadcasted by the aircraft (ADSB Out?)

OR…

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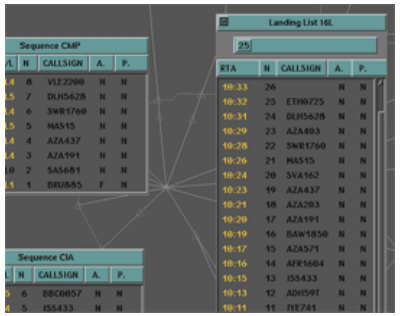

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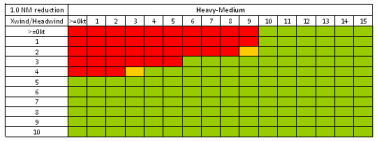

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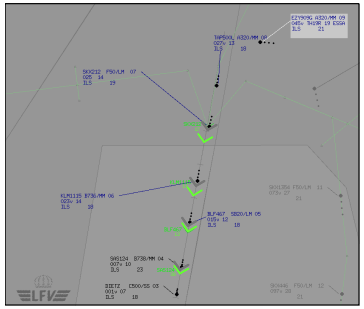


Controller separation tool

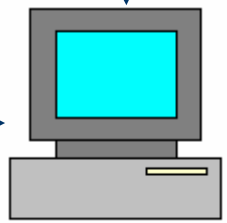
T_Sep

D_Sep

D_CatchUp

OR

Aircraft TAS profile

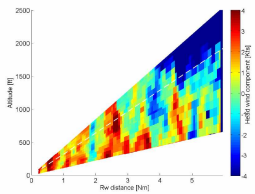


Separation definition

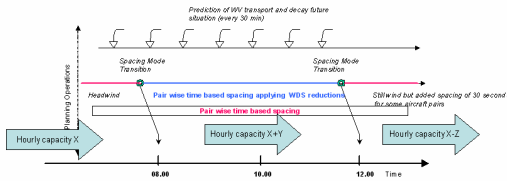
Runway capacity

Aircraft downlink

Headwind profile



Spacing mode planning



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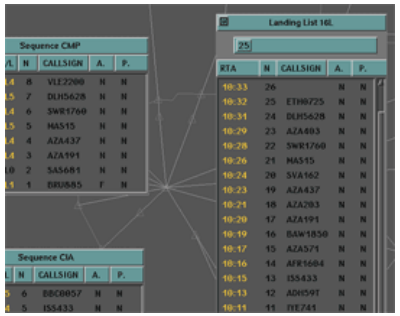
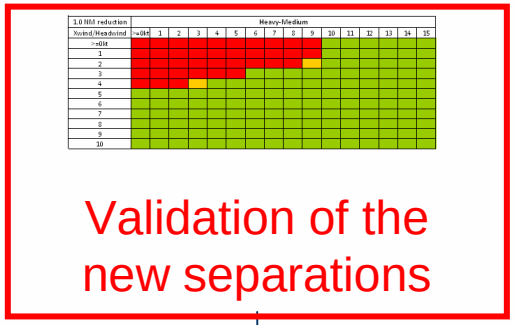


Advanced arrival sequence manager



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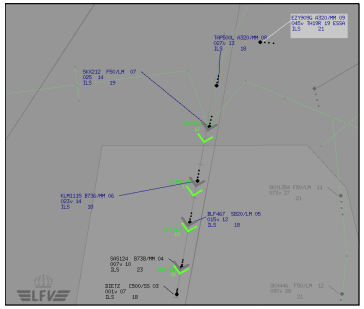


Controller separation tool

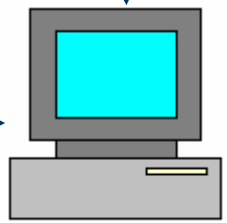
T_Sep

D_Sep

D_CatchUp

OR

Aircraft TAS profile

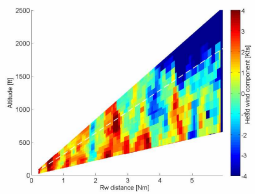


Separation definition

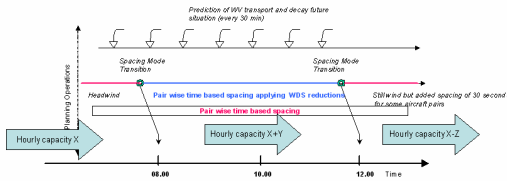
Runway capacity

Aircraft downlink

Headwind profile



Spacing mode planning



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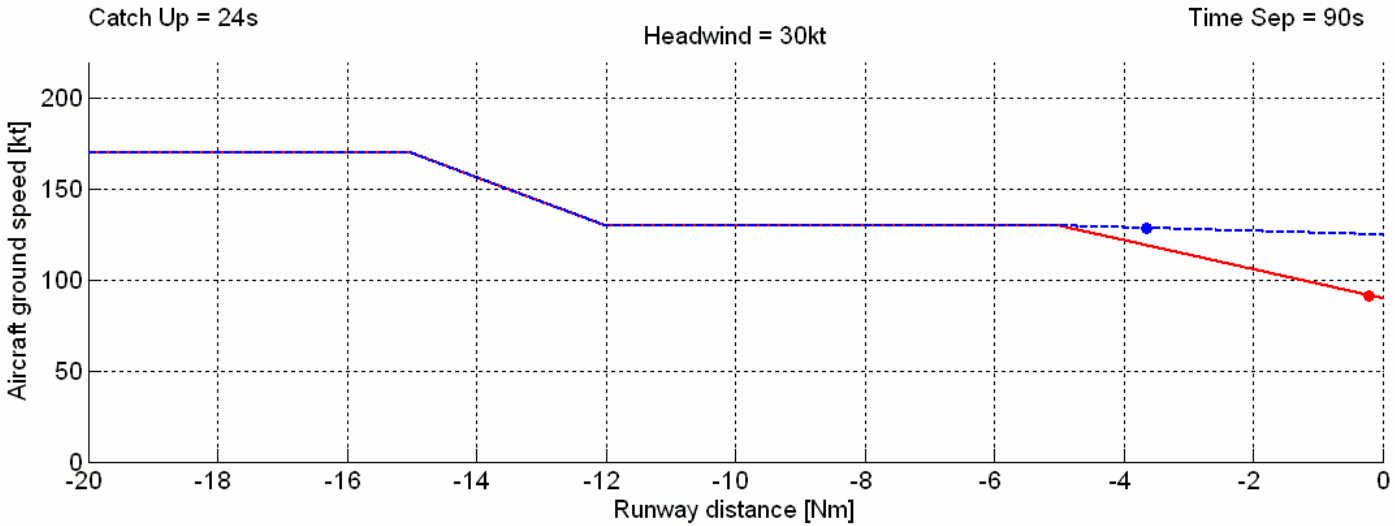

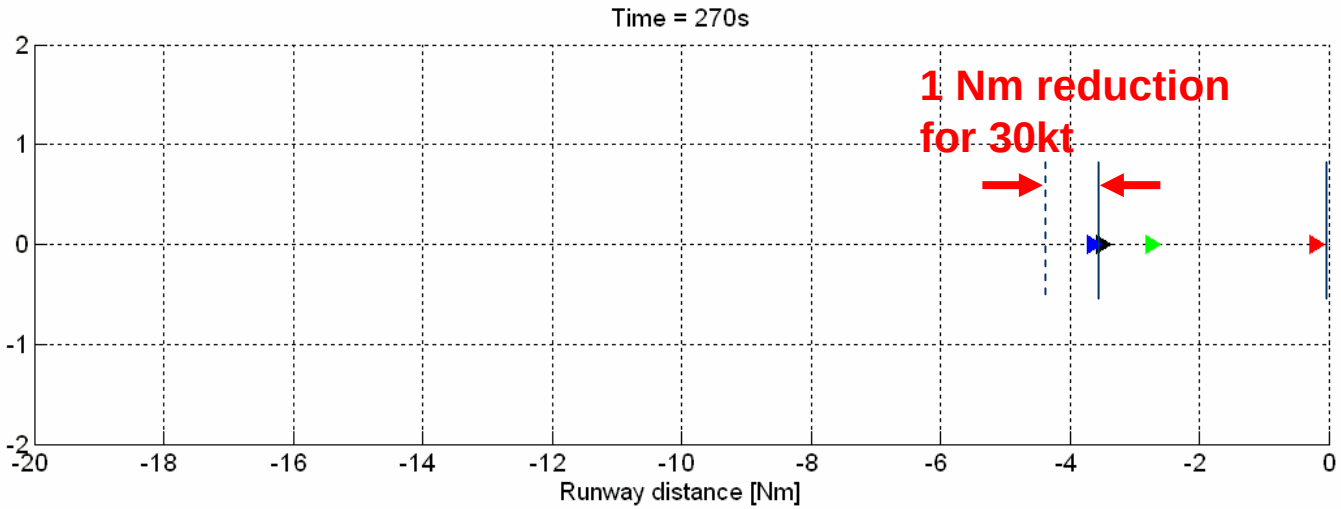

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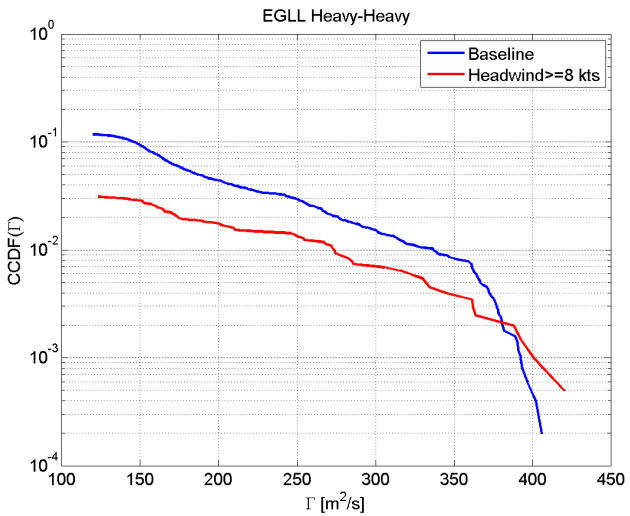
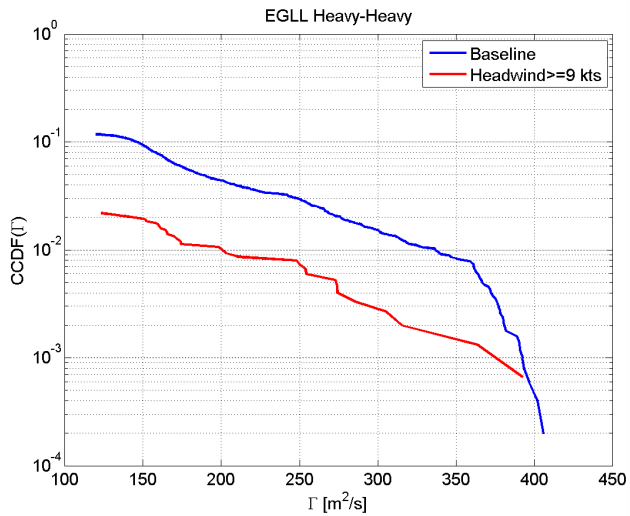
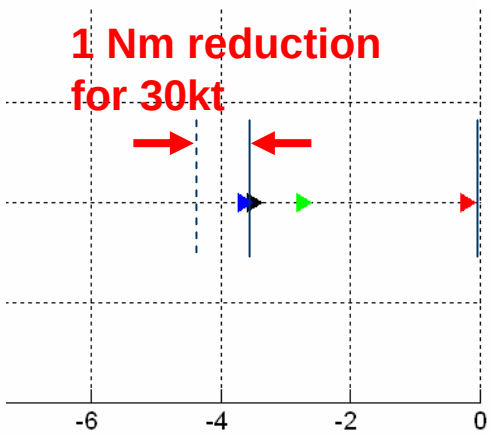
1.0 NM reduction	Heavy-Heavy															
Xwind/Headwind	>=0kt	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
>=0kt																
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																







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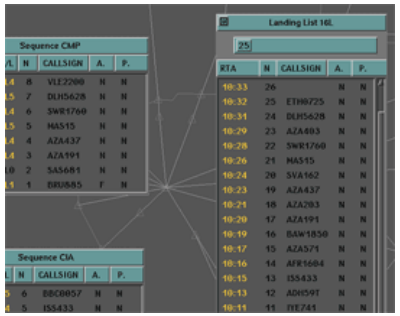
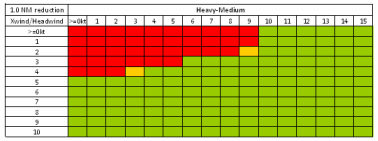


Advanced arrival sequence manager



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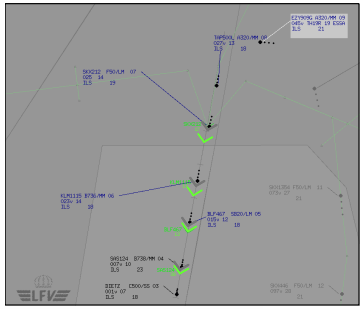


Controller separation tool

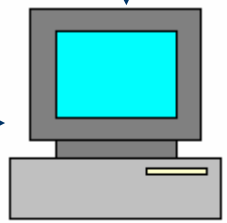
T_Sep

D_Sep

D_CatchUp

OR

Aircraft TAS profile

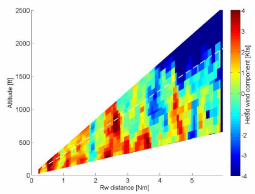


Separation definition

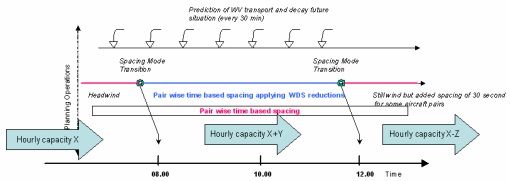
Runway capacity

Aircraft downlink

Headwind profile



Spacing mode planning



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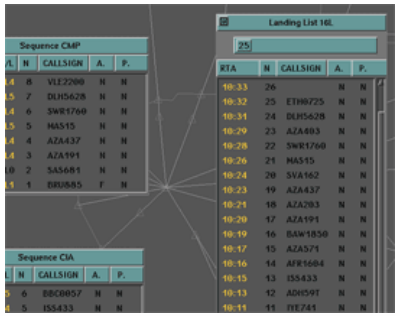
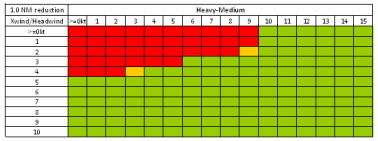
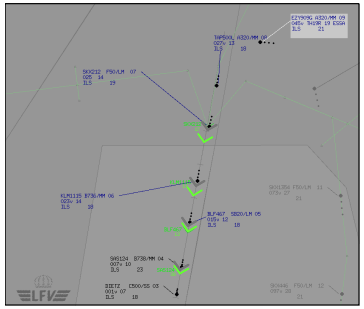


Advanced arrival sequence manager



Validation of the new separations



Controller separation tool

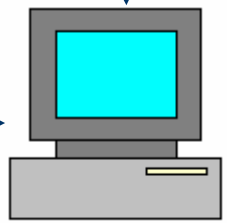
T_Sep

D_Sep

D_CatchUp

OR

Aircraft TAS profile

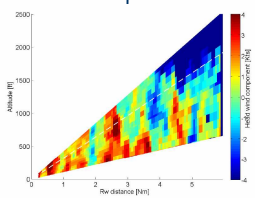


Separation definition

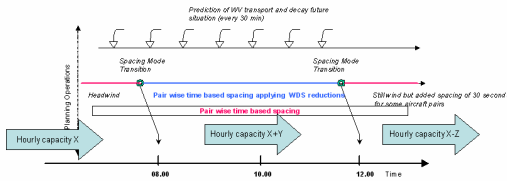
Runway capacity

Aircraft downlink

Headwind profile



Spacing mode planning



Task 5 - Detailed TBS OSED Definition (preliminary)

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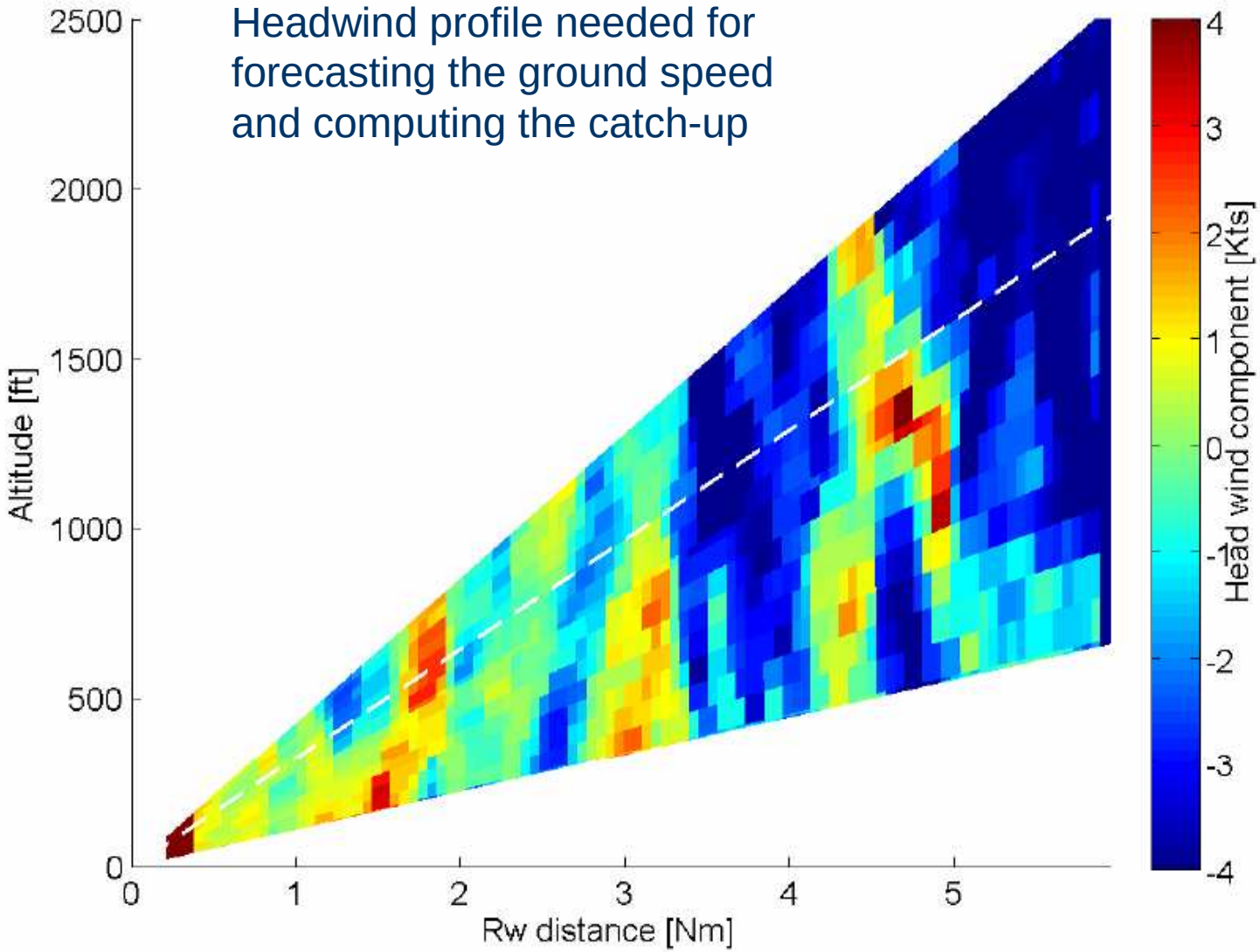

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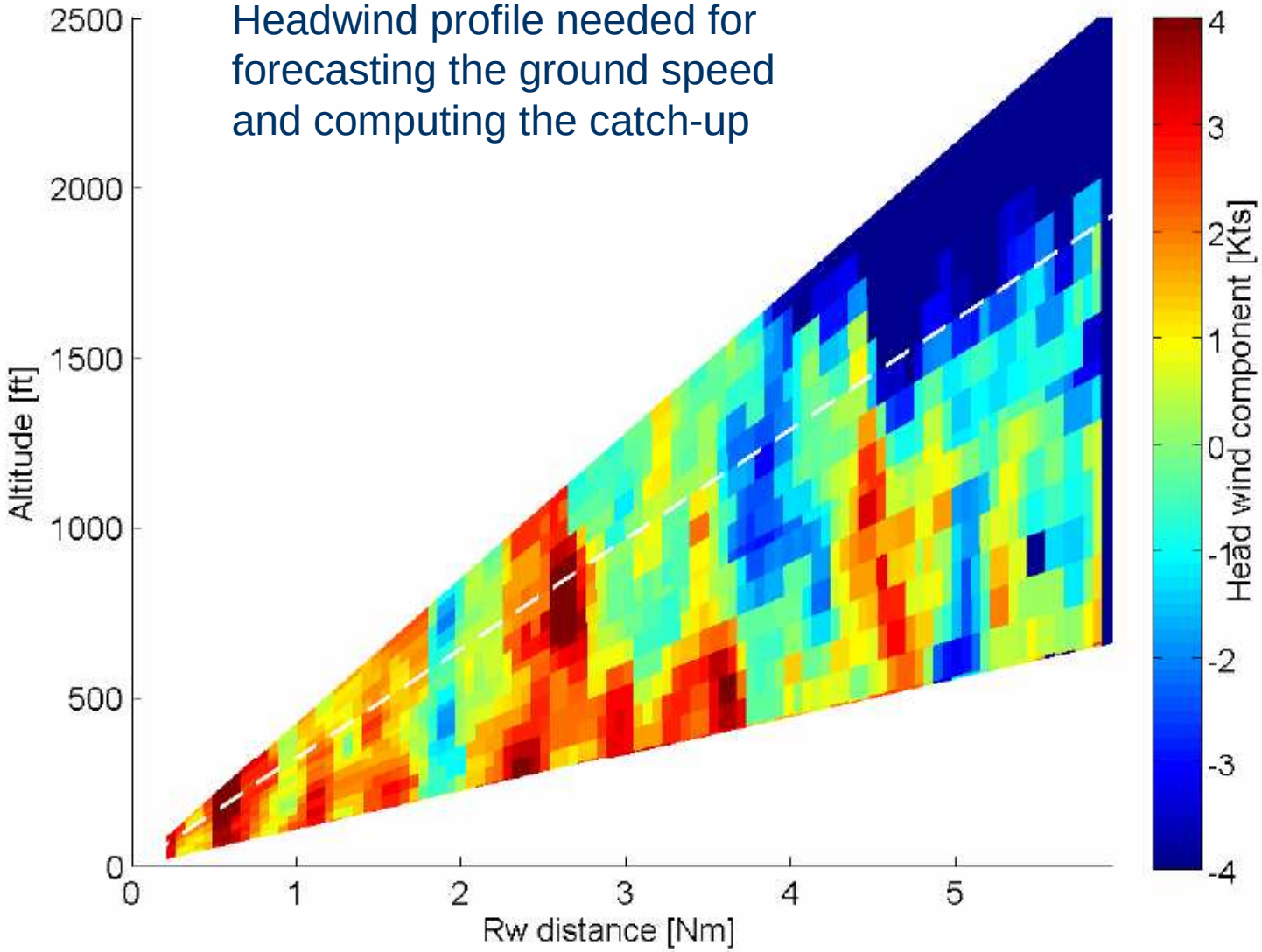
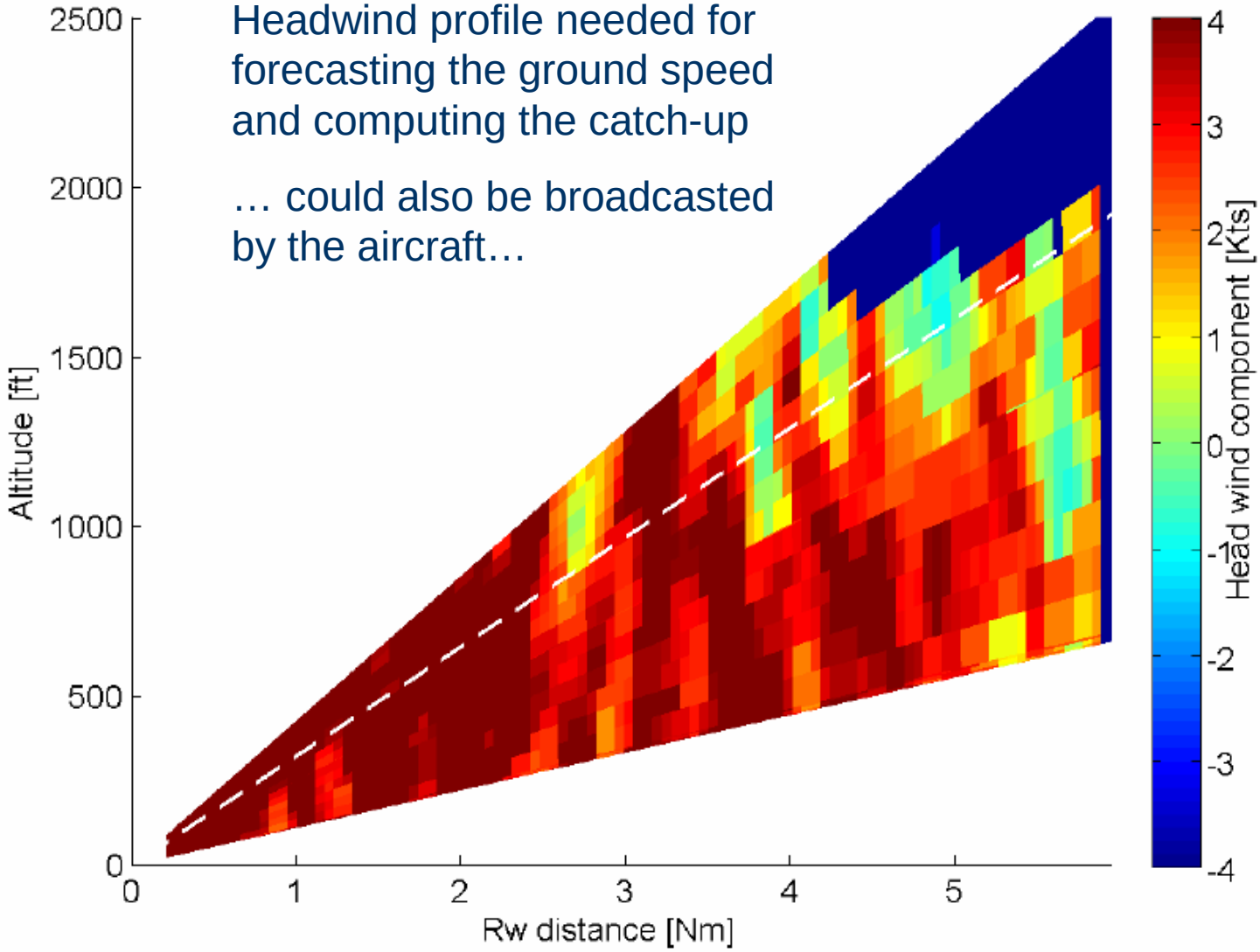


Task 5 - Detailed TBS OSED Definition (preliminary)

Headwind profile needed for forecasting the ground speed and computing the catch-up

… could also be broadcasted by the aircraft…



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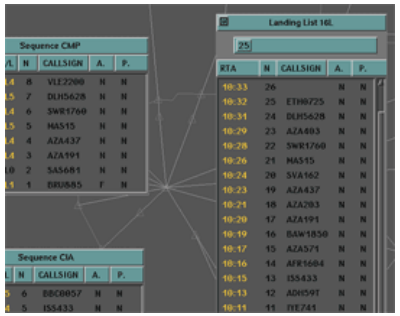

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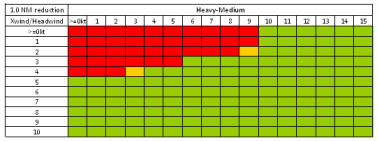

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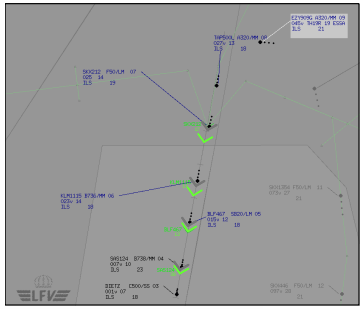

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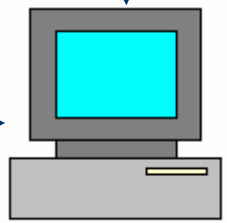

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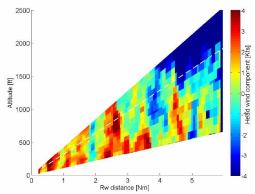
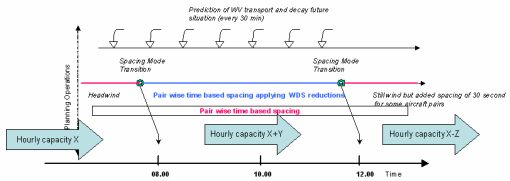


Spacing mode planning



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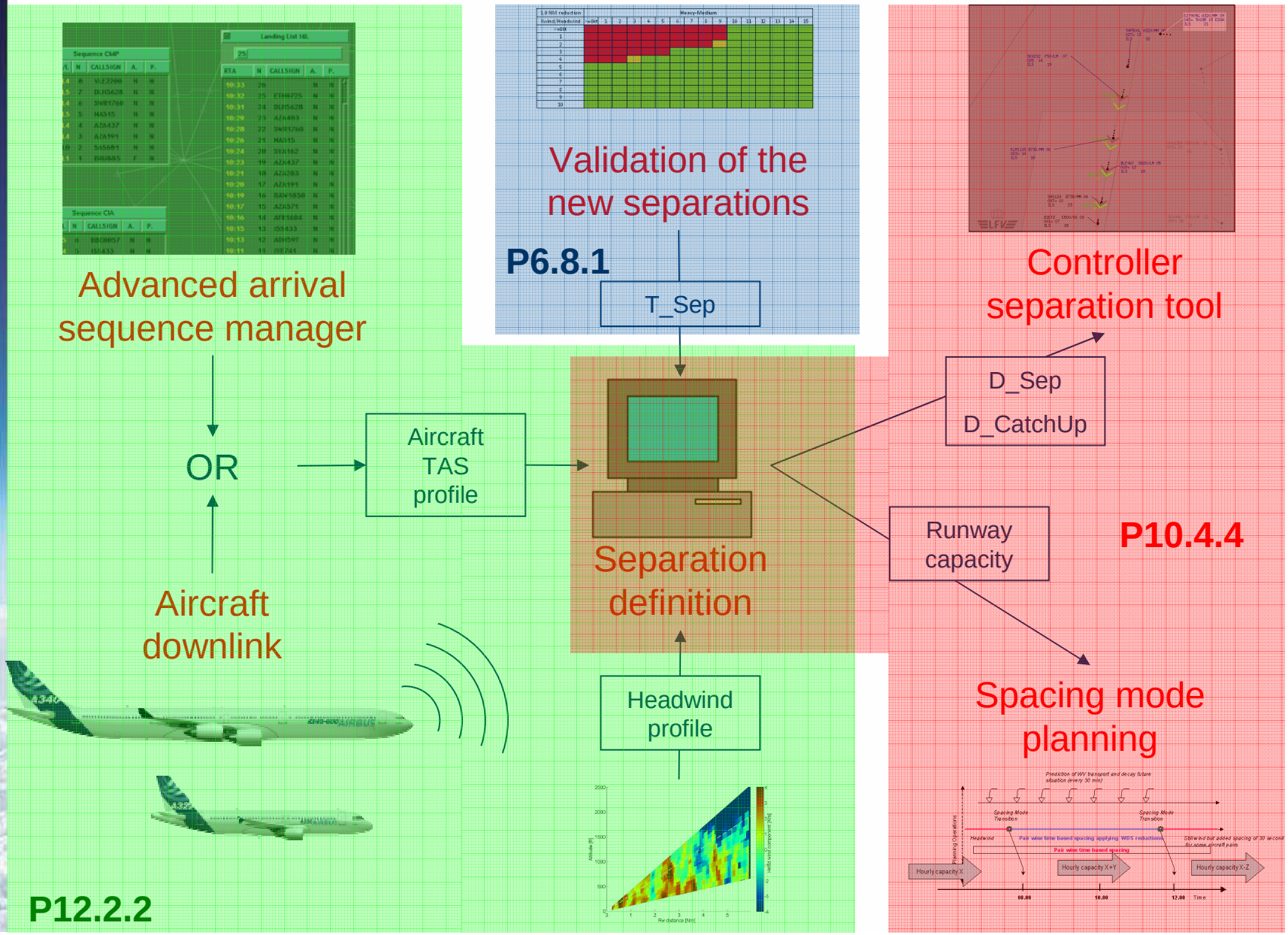
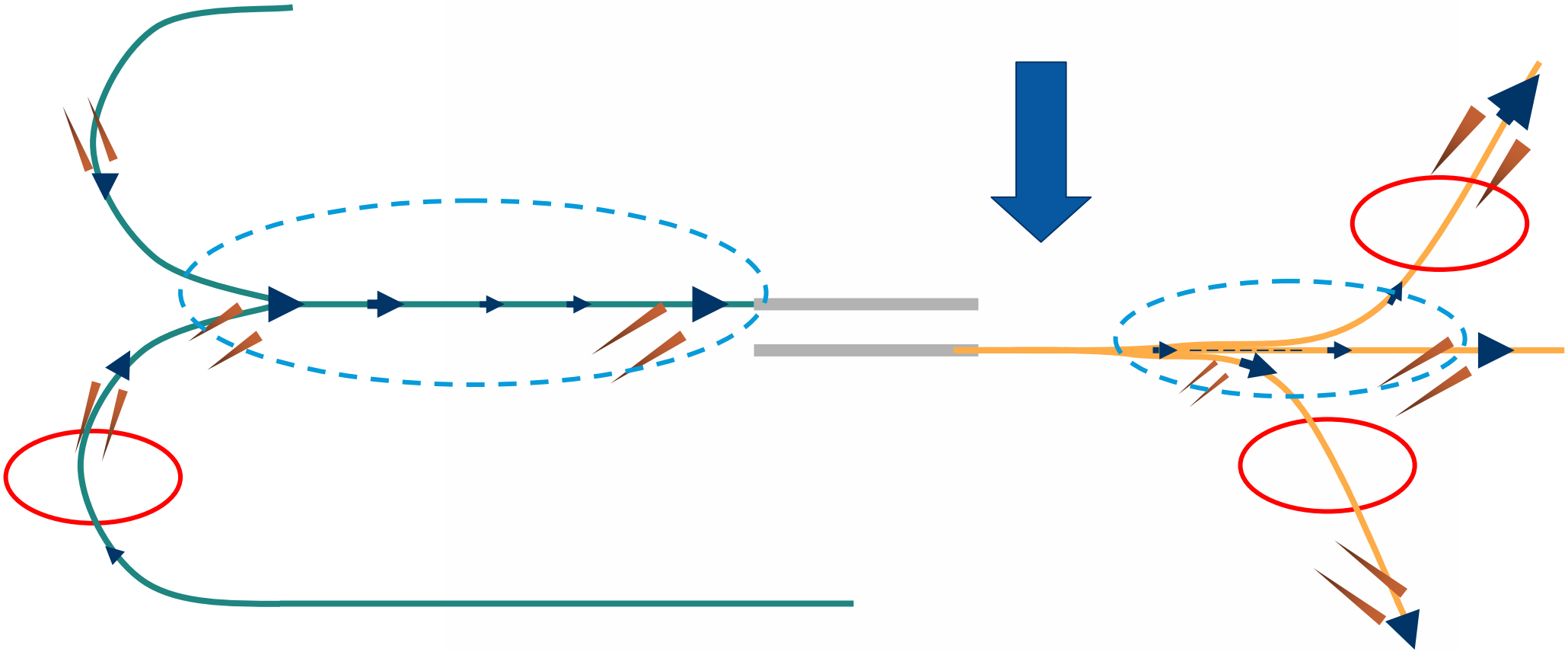


Task 3 - High Level OCD Definition - ***WDS***

Key enabler:

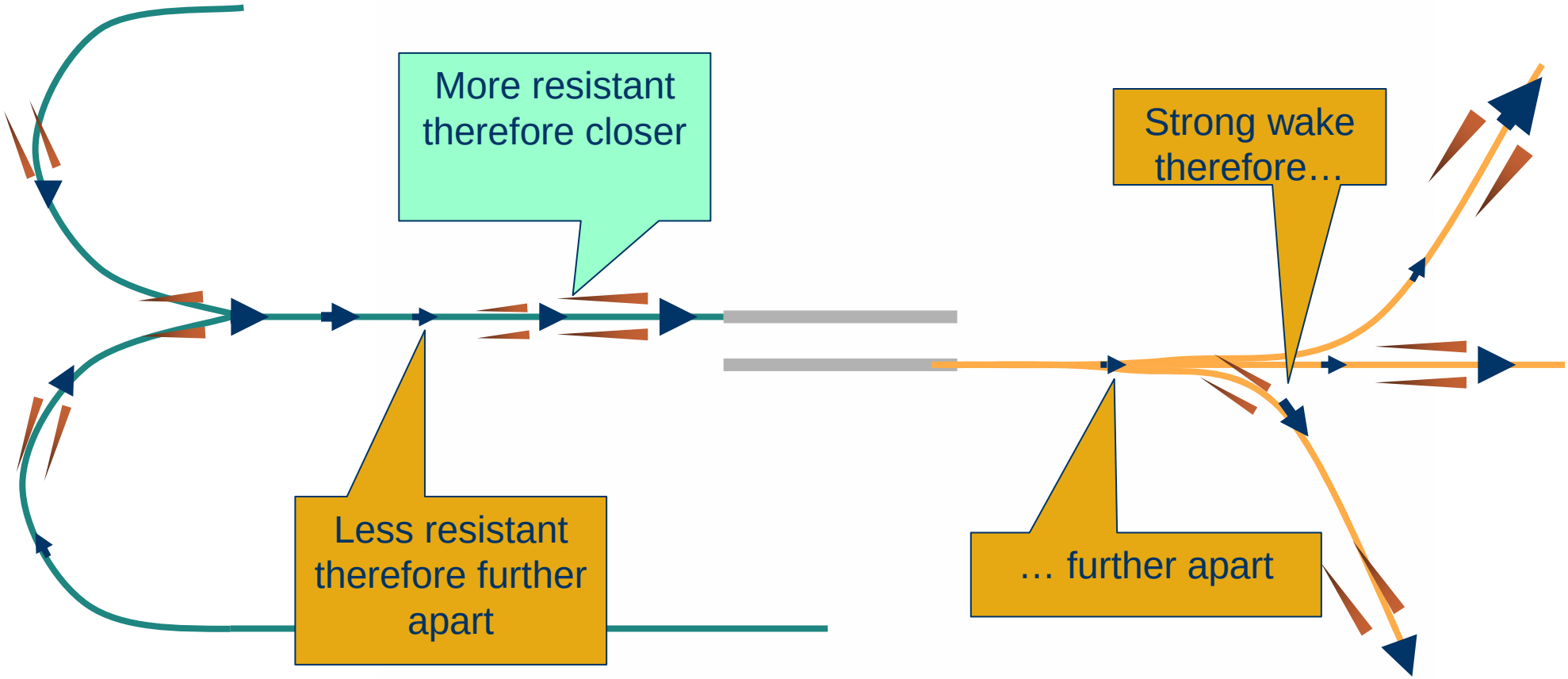
- Weather forecasting and monitoring capabilities (Sys WPs)
- WV databases for validation (Task 9)



Task 3 - High Level OCD Definition - ***PWS***

Key enabler:

- Validated metric for characterising WT risk (Task 8)
- WV databases for validation (Task 9)



Task 8 - Research on WV Encounter Severity Metrics - Ongoing

Approach: Derive “simple” models for roll axis disturbance

- Sufficiently simple for generalization (any aircraft type)
- Sufficiently accurate to include relevant characteristics of the generator and follower aircraft, incl. new systems

(1) Wake-induced max. static roll acceleration on follower A/C:

$$\dot{p}_{WV} = \frac{4\rho V_f}{GM_f R_{Xf}^2 \left(\Lambda_f + 4\right)} \Gamma(t) C_{WV,c}\left(\lambda_f, \frac{b_v}{b_f}, \frac{r_c}{b_f}\right)$$

(2) Maximum bank angle upset on follower A/C:
(to include controllability aspects of follower aircraft)

$$\Phi_{\max,WV} \sim \left(\dot{p}_{WV} + \dot{p}_p + \dot{p}_\xi\right)$$

Static wake-induced roll acceleration

Roll damping

Roll control

AIRBUS AN EADS COMPANY

ONERA THE FRENCH AEROSPACE LAB

Task 9 - Permanent Data Collection - Ongoing

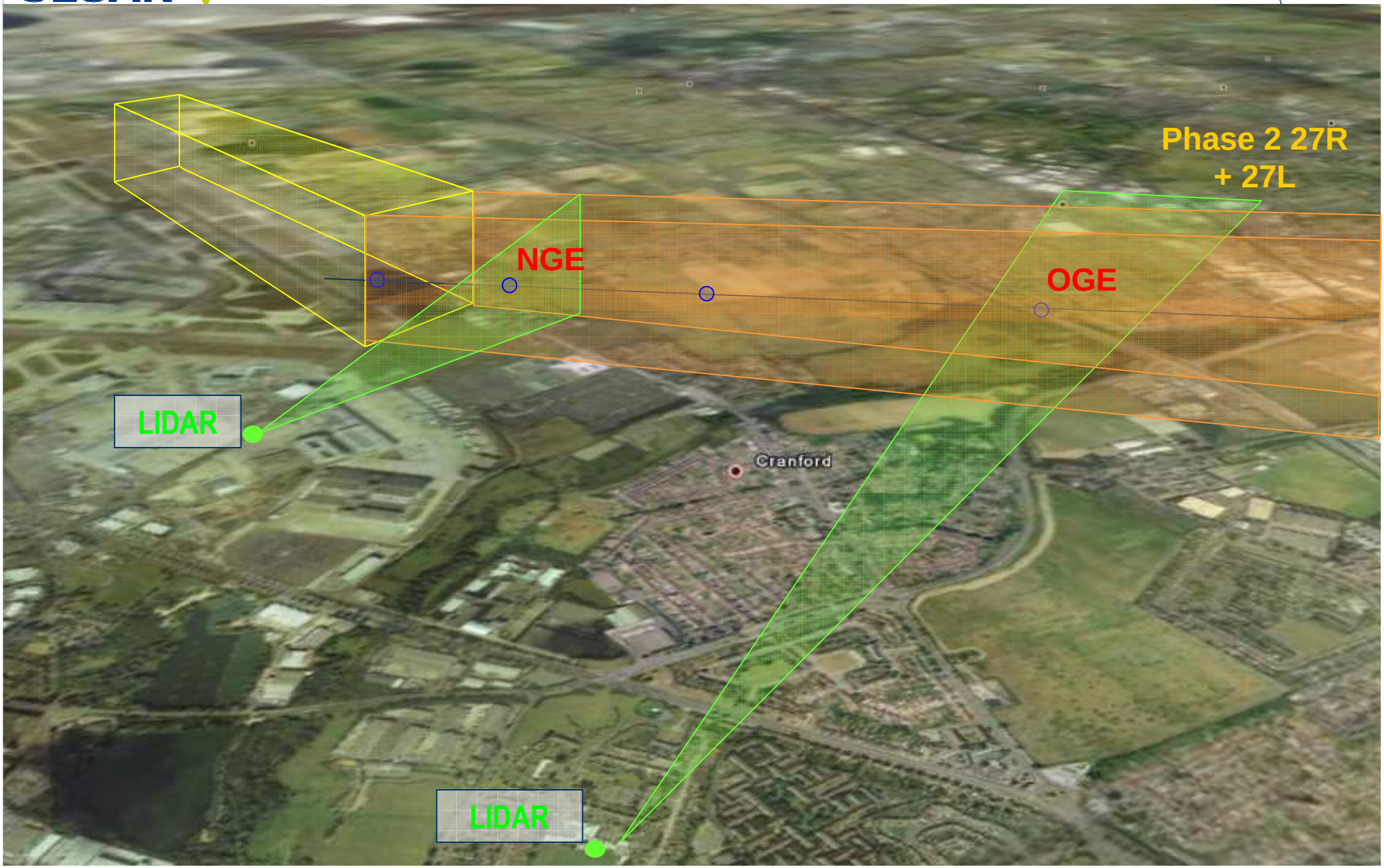
LIDAR and Aircraft data correlated for first 21 months of measurements

85 028 vortex tracks from Oct ‘08 until Sep ’10

- A380 ~ 600 tracks
- Heavy ~ 46,000 tracks
- Upper Medium ~ 4,600 tracks
- Lower Medium ~ 60,000 tracks
- Small ~ 500 tracks
- Light ~ 10 tracks

METAR & Wind data processed

- RWY anemometers
- LIDAR headwind data along the glide slope
- LIDAR cross- and head-wind data reconfigured (scan elevation from 3 to 15 degrees between the two runway centrelines)
- Correlation of vortex and MET data


Phase 2 27R
+ 27L
NGE
OGE
LIDAR
Cranford
LIDAR

Open issues or research subjects

- Usability of the proposed HMI logic (catch-up management)?
- Availability of wind information broadcasted by aircraft
- Conditional separation reductions (with human in the loop) vs real time adaptation of separations (system based)
- Can we go below today MRS?
- How to deal with the up-wind SID concept?
- How to deal with the lost of awareness for the pilot especially for PWS?
- Acceptability of new severity metric?
- Need for more wake measurement campaigns?

QUESTIONS?