

Wind Networking in North Atlantic Oceanic Airspace

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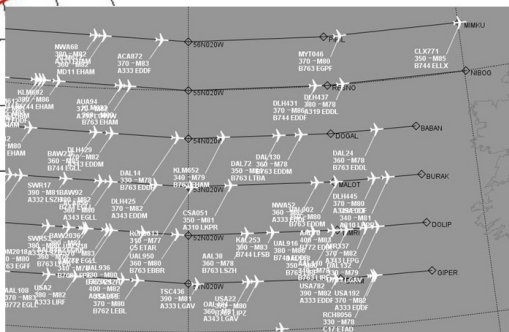
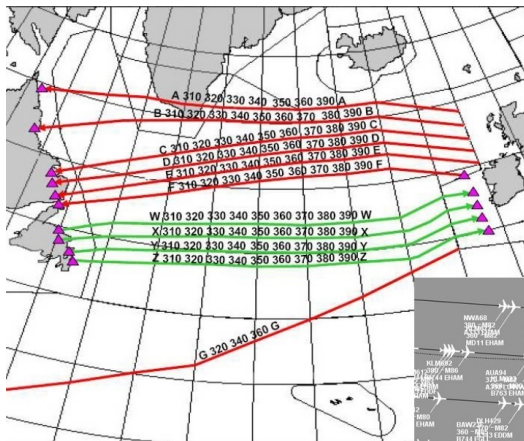
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- Context and objectives
- Wind networking concept
- Simulation results

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Organized Track System (OTS) in North Atlantic (NAT)

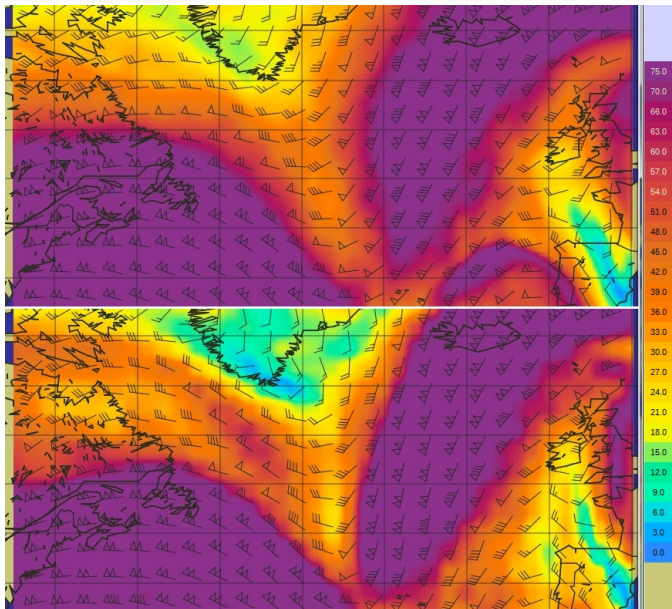


Objectives

- Ameliorate cruising time prediction
- Ameliorate conflict prediction

- Context and objectives
- Wind networking concept
- Simulation results

Real and estimated wind simulation



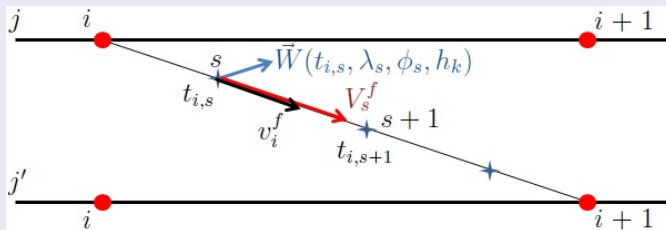
Real wind

10 December 2013
Time 0000UTC
Altitude 200hPa

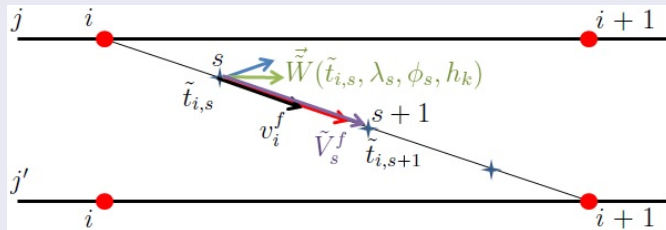
Estimated wind

Flight simulation

Flight simulation with real winds

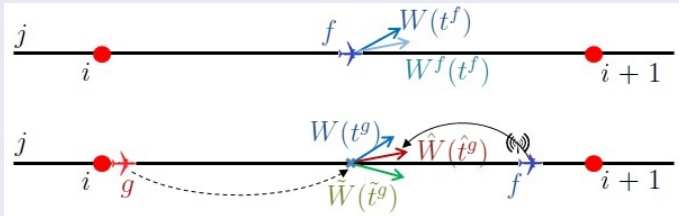


Flight prediction with estimated winds



Wind networking concept

Aircraft f precedes aircraft g on the same track



Wind adjusting by networking

Real wind $W(t_g, \lambda, \phi, h)$

\Leftrightarrow Real time t_g

Estimated wind $\tilde{W}(\tilde{t}_g, \lambda, \phi, h)$

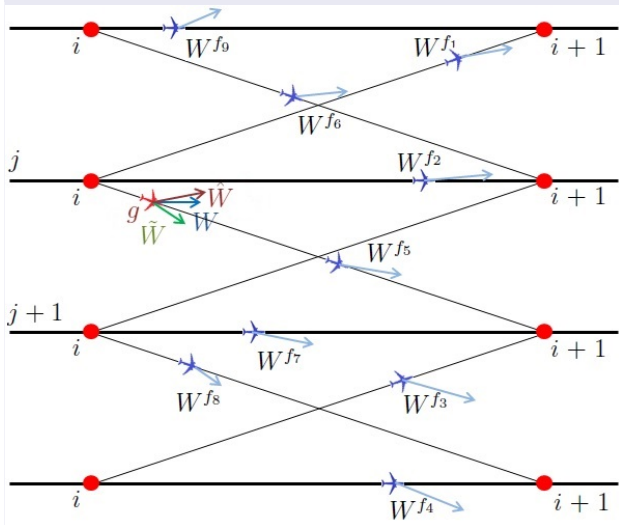
\Leftrightarrow Estimated time \tilde{t}_g

Adjusted wind: $\hat{W}(\hat{t}_g, \lambda, \phi, h) \approx W^f(t_f, \lambda, \phi, h)$

\Leftrightarrow Adjusted time \hat{t}_g

Wind networking with interpolation

Aircraft f_1, \dots, f_m precede aircraft g on the same or close tracks



Adjusted wind:
 $\hat{W}(\hat{t}^g, \lambda, \phi, h) =$
 $F[W^{f_n}], n = 1, \dots, m$

- Context and objectives
- Wind networking concept
- **Simulation results**

Time prediction comparison

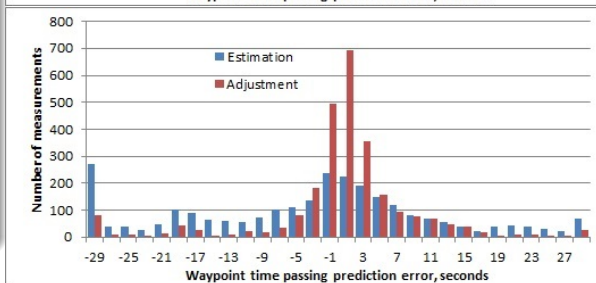
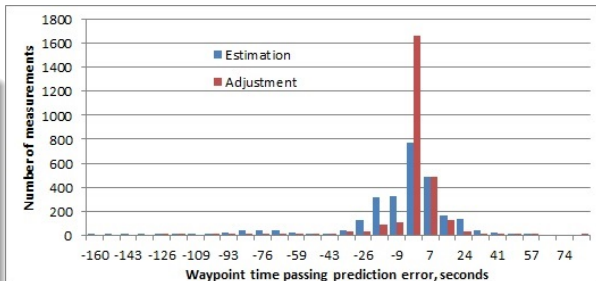
Purpose:

To compare the error of prediction of the time of passing the aircraft route points when using estimated winds \tilde{W} and adjusted winds \hat{W} :

- t - real time of passing the waypoint
- \tilde{t} - estimated time of passing the same waypoint
- \hat{t} - adjusted time of passing the same waypoint
- $\tilde{e} = \tilde{t} - t$ - prediction error with estimations
- $\hat{e} = \hat{t} - t$ - prediction error with adjustments

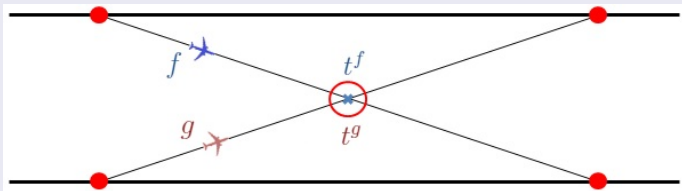
Time prediction comparison. Test for 378 flights

- 10 Decembre 2013
- 378 aircraft (real flight plans)
- from 0000UTC to 0900UTC
- 5 tracks
- 8 waypoints
- from FL320 to FL400
- 2646 measurements of waypoint time passing



Conflict prediction comparison

Conflicts in North Atlantic



Purpose: evaluate the difference between

- the number of real and predicted conflicts:
 - Conflicts that are **predicted** and **would happen** in the reality (C_t)
 - Conflicts that are **predicted** but **would not happen** in the reality (false alarm) (C_p)
 - Conflicts that are **not predicted** but **would happen** in the reality (urgency) (C_r)
- real and predicted conflict duration times.

Conflict prediction comparison. Test for 1000 flights

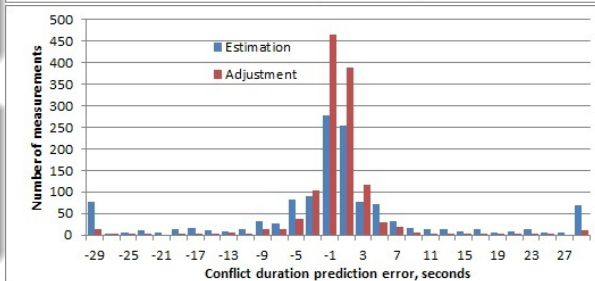
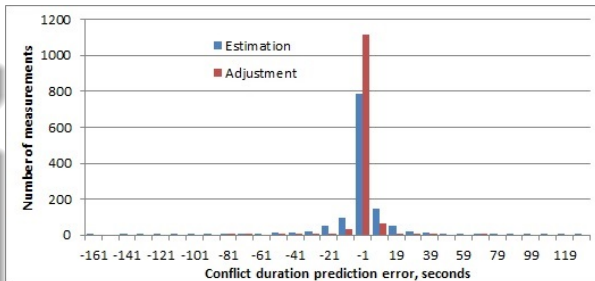
1000 aircraft (random)

Number of conflicts:

	Estim	Adjust
C_t	1175	1229
C_p	48	13
C_r	70	16

Total conflict duration prediction error (min)

	Estim	Adjust
	242.7	63.4



- Implementing new technologies enables aircraft to exchange the measured meteorological data with each other directly
- The data obtained with wind networking is much more accurate than the initial estimations
- Adjusted predictions of cruising time and conflicts are much closer to the reality
- Wind networking evolves great amelioration of flight prediction
- Wind networking is especially efficient in dense traffic conditions

Thank you for your attention!