Kvk Midterm Assessment – 4 October 2012

WindVisions

O.K. Hartogensis,
D. van Dinther

The Problem

- The operations at Mainport Schiphol are highly sensitive to a number of critical weather parameters, most notably precipitation, the *local wind field* and *visibility*.

- For save and efficient airport operation now and in the future, under the condition of a changing climate, *routinely monitoring* and prediction of these critical weather parameters is essential.

Objective

Develop a Wind and Visibility Monitoring System (WindVisions) at Mainport Schiphol:

- WindVisions will consist of:
  - a cross-wind scintillometer:
    - → *horizontal* long range wind and visibility sensor
  - a SODAR (Sound Detecting And Ranging):
    - → *vertical* scanning wind sensor

- The area of interest to monitor is the landing and take-off course of air-planes ranging from the surface to about 300m height along a runway.

People

Prof. Dr. AAM Holtslag – Chair of WUR-MAQ

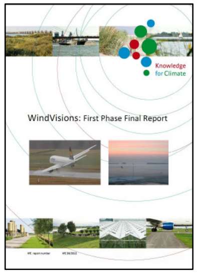
Dr. Ir. OK Hartogensis – Daily Supervisor and Project Leader

Ir. D Van Dinther – Project PhD student

Drs. P. van den Brink; Ing. J.O. Haanstra; Ing. R. ten Hove (Schiphol Group)

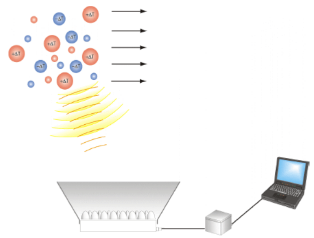
Ir. L.E.M. Smit (LVNL)

Organization of the Project



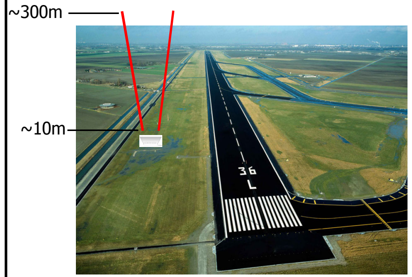
- **Phase 1:** Hotspot MainPort Schiphol – HSMS01
  - ➢ Technology Development
  - ➢ Location: Mainly Wageningen + Cabauw
  - ➢ Time: Feb 2010 – Feb 2012
- **Phase 2:** Theme 6 - Climate Projections – WP1.3
  - ➢ Deployment WindVisions
  - ➢ Location: Mainly Schiphol
  - ➢ Time: Feb 2012 – Feb 2014

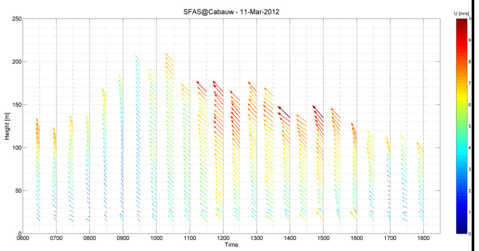
Hardware - SODAR



- A SODAR emits short acoustic pulses into the atmosphere.
- A SODAR receives reflected (backscattered) acoustic pulses from temperature inhomogeneities (turbulent eddies) in the air

Hardware - SODAR



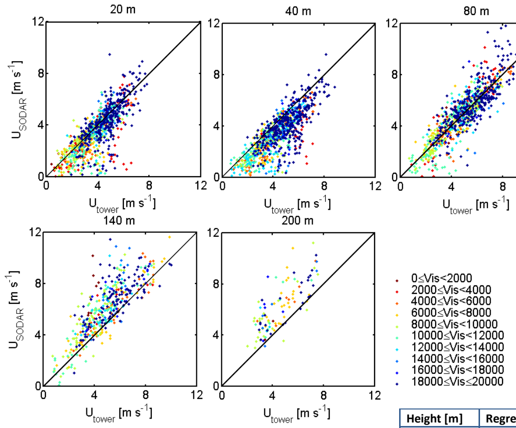


- Doppler frequency shift → wind speed and direction @ many heights
- Amplitude → turbulence intensity @ many heights

Hardware - SODAR

Wageningen mobile mini-SODAR

Hardware - SODAR



Height [m]	Regression equation	R^2 [-]	RMSE [m s^{-1}]	N [%]
20	$0.93 \cdot U_{tower}$-0.14	0.60	1.1	94
40	$0.85 \cdot U_{tower}$-0.30	0.63	0.97	96
80	$1.0 \cdot U_{tower}$+0.076	0.75	0.99	88
140	$1.0 \cdot U_{tower}$+1.0	0.72	1.2	44
200	$1.0 \cdot U_{tower}$+1.5	0.62	1.2	11

Hardware - Scintillometer

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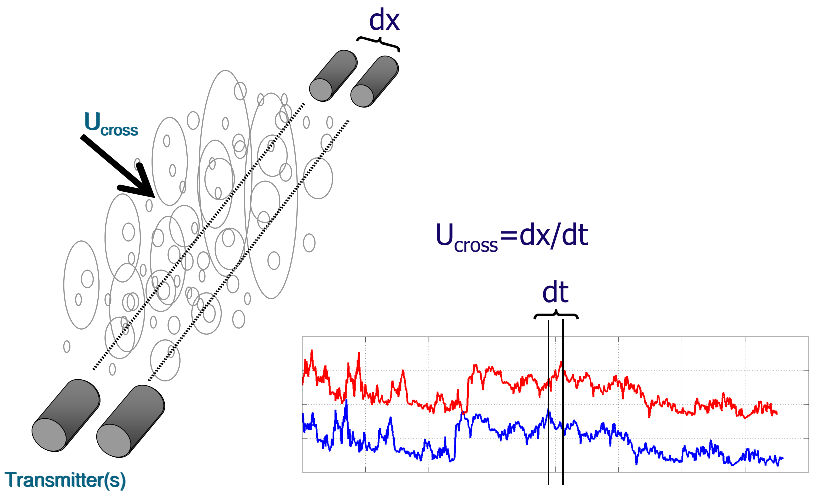
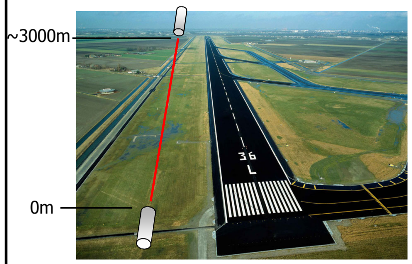
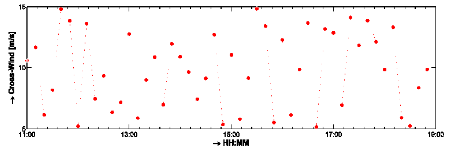


Hardware - Scintillometer



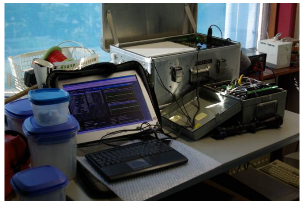


- Intensity fluctuations → line-averaged cross wind speed @ one height
- Intensity mean → line-averaged visibility @ one height

Hardware - Scintillometer

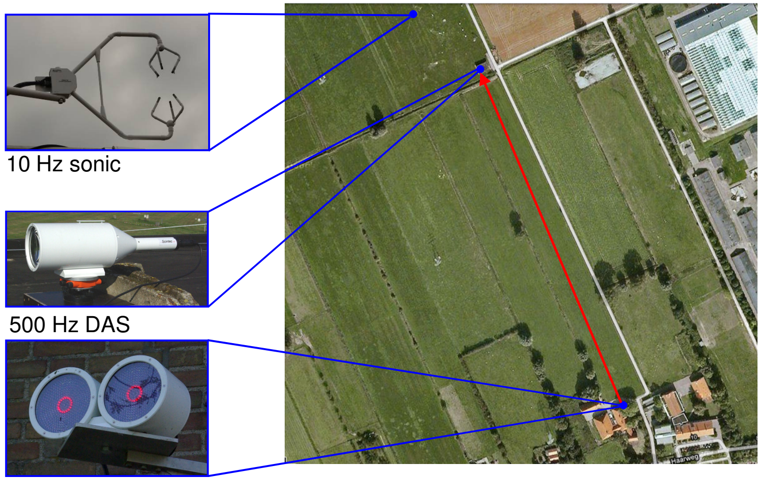
Transmitter

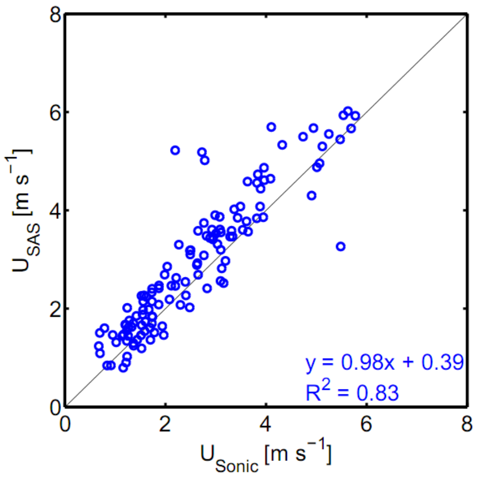
Processing Unit



Receiver

Single Aperture cross-wind techniques





MAIN RESULT

10-minute variables plotted:

- **U_{Sonic}:** Crosswind of scintillometer path derived from Sonic Anemometer
- **U_{SAS}:** BLS operated as a SAS – Crosswind based on ***10min FFTs***

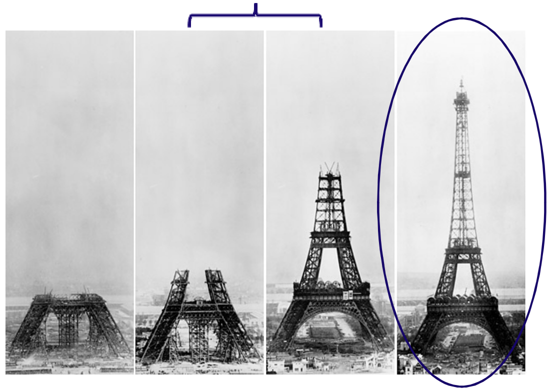
- **Towards Application of WindVisions at Schiphol airport**

- Synergy/Embedment with Modeling approaches:
  - ➢ Harmonie (IMPACT)
  - ➢ WRF
- PhD thesis!

The END

Conclusion: Need to Proceed to Phase 2

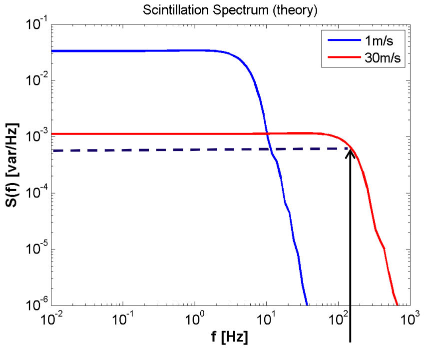
We are here

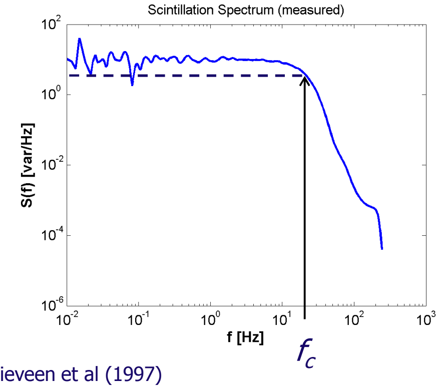


We need to get to here

Scintillometer Spectrum: $S(f) = 4\pi^2 K^2 \int_0^L \int_{2\pi f/v}^{\infty} k\phi_n \sin^2\left(\frac{k^2 x(L-x)}{2KL}\right)\left[(kv)^2 - (2\pi f)^2\right]^{-1/2} dk\,dx$

Clifford (1971)





$$f_c = \frac{v}{1.25D}$$ Nieveen et al (1997)