

# WHIFFLE

WEATHER FINECASTING

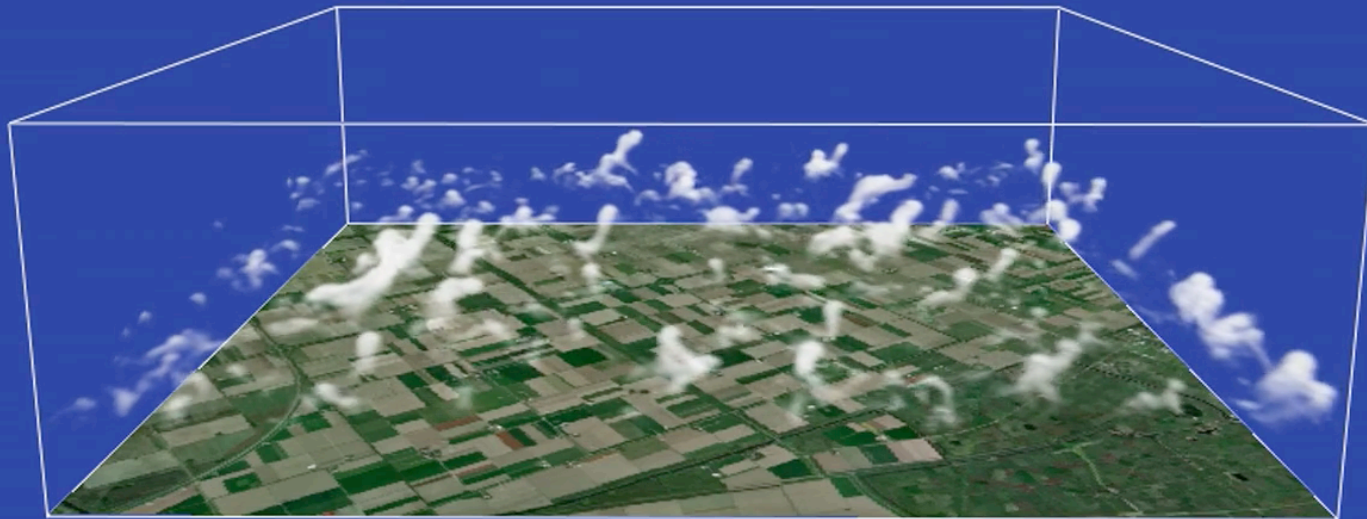
TURBULENCE RESOLVING WEATHER FORECASTING:  
APPLICATIONS AND OPERATIONAL ASPECTS

JUNE 7 2018

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HARMEN JONKER  
PIM VAN DORP  
EVERT WIEGANT  
PETER BAAS

# Finecasting: large-eddy simulation coupled to an NWP forecast

2017, Oct 27, 12:40



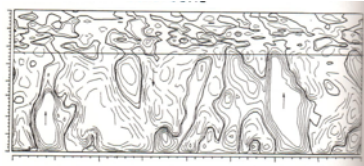
# Today's 00UTC run (valid tomorrow)

2018-06-08 05:05:41 CEST

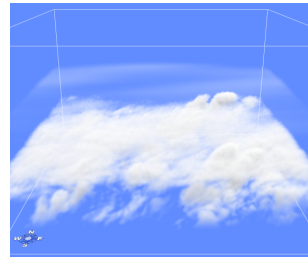
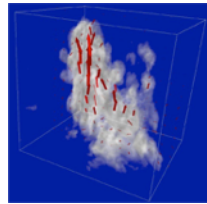
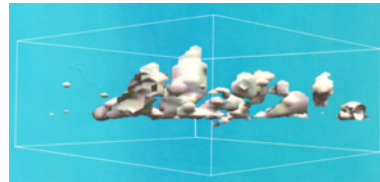
WHIFFLE  
WEATHER FINECASTING

<https://vimeo.com/273849333/8877e8c7ab>

# The history of the Dutch Atmospheric Large Eddy Simulation



1985



- Dry convection
- Shallow cumulus
- MPI – parallelism
- Heterogeneous surface
- Chemistry
- Radiation
- Deep convection
- Land-surface model (TESSEL)
- Microphysics
- ...



# Technological progress enabled operational LES forecasting



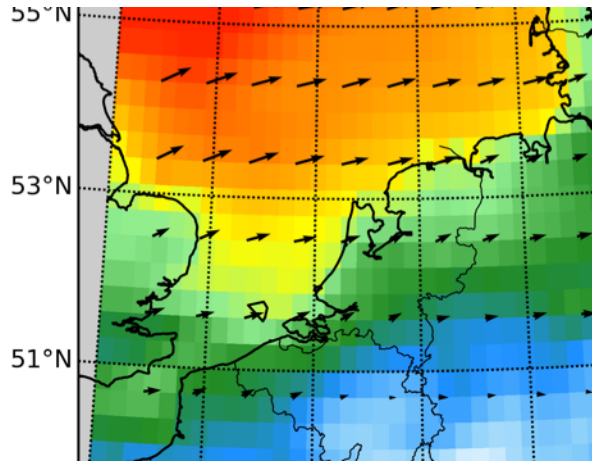
Schalkwijk, J., Griffith, E. J., Post, F. H. & Jonker, H. J. J. High-performance simulations of turbulent clouds on a desktop PC. *Bull. Am. Meteorol. Soc.* **93**, 307–314 (2012).

Schalkwijk, J., Jonker, H. J. J., Siebesma, A. P. & Bosveld, F. C. A Year-Long Large-Eddy Simulation of the Weather over Cabauw: an Overview. *Mon. Weather. Rev.* **143**, 828–844 (2015). DOI 10.1175/MWR-D-14-00293.1.

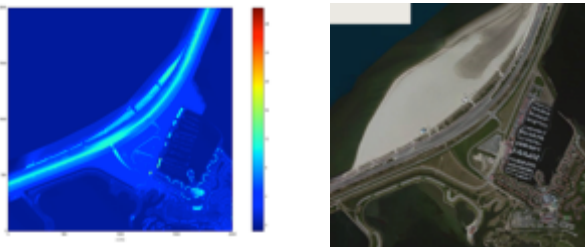
Schalkwijk, J., Jonker, H., Siebesma, A. & Van Meijgaard, E. Weather forecasting using GPU-based large-Eddy simulations. *Bull. Am. Meteorol. Soc.* **96** (2015). DOI 10.1175/BAMS-D-14-00114.1.

# Operational finecasting

## Large-scale weather forecast

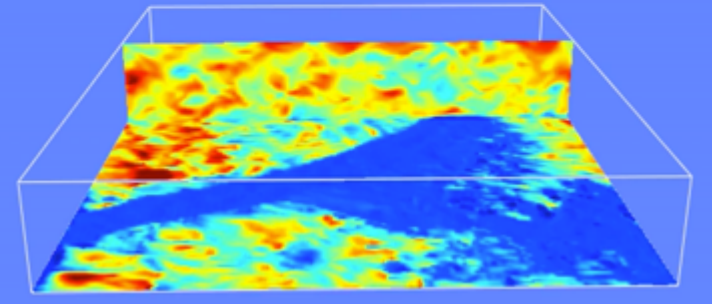


## Local terrain details

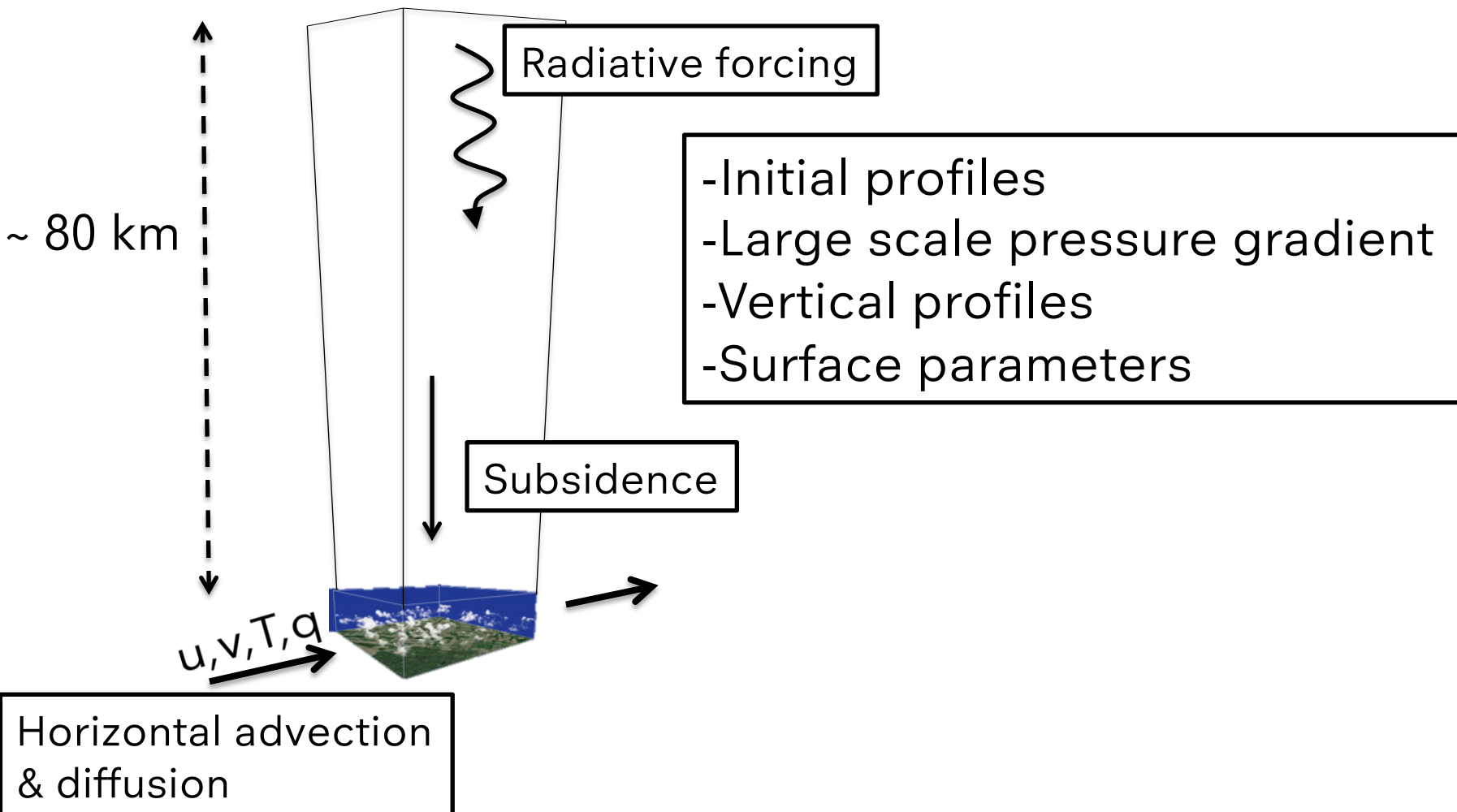


## Local weather forecast

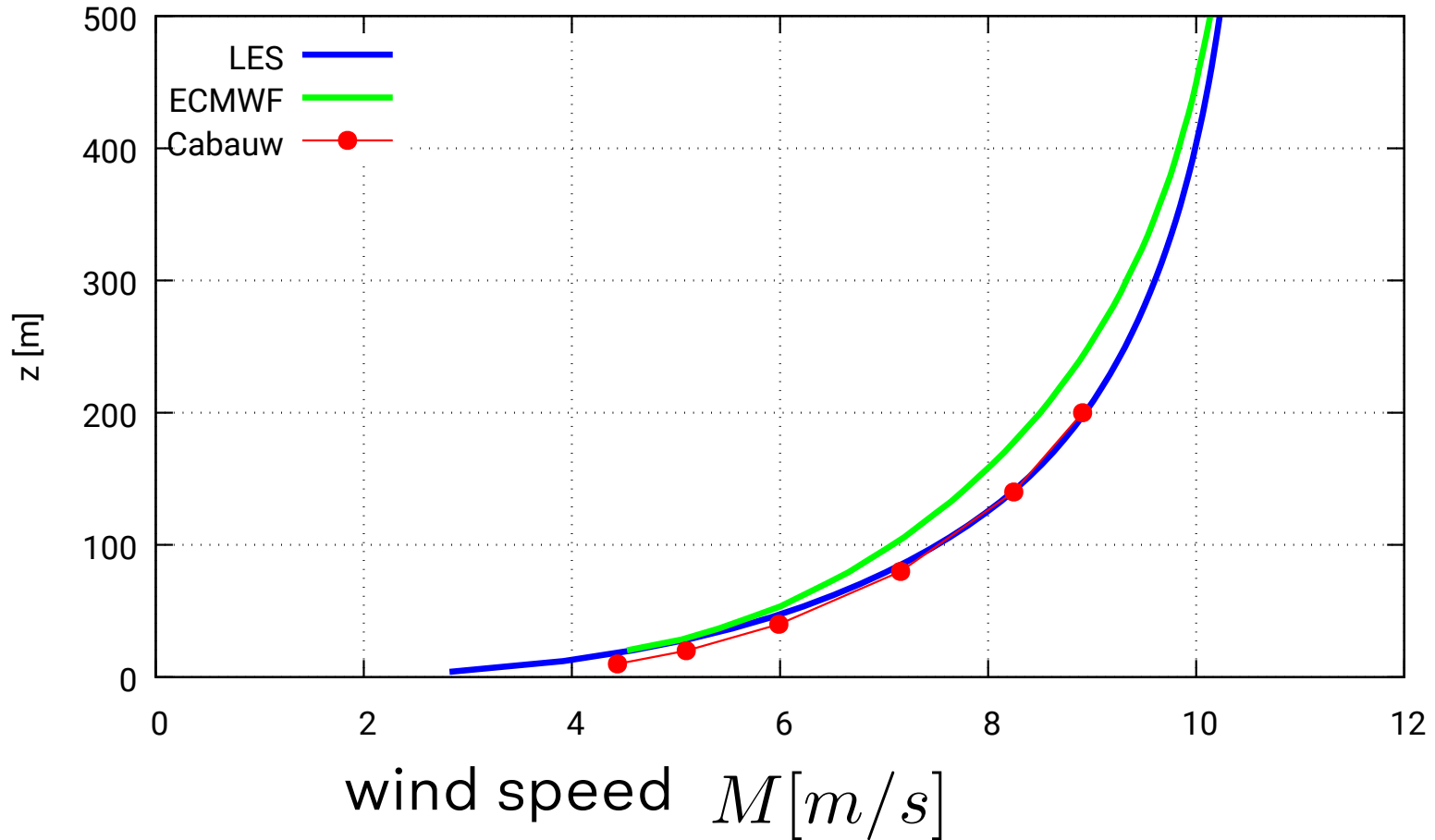
2017, Jun 13, 10:24



# Using ECMWF: boundary conditions for the large eddy simulation



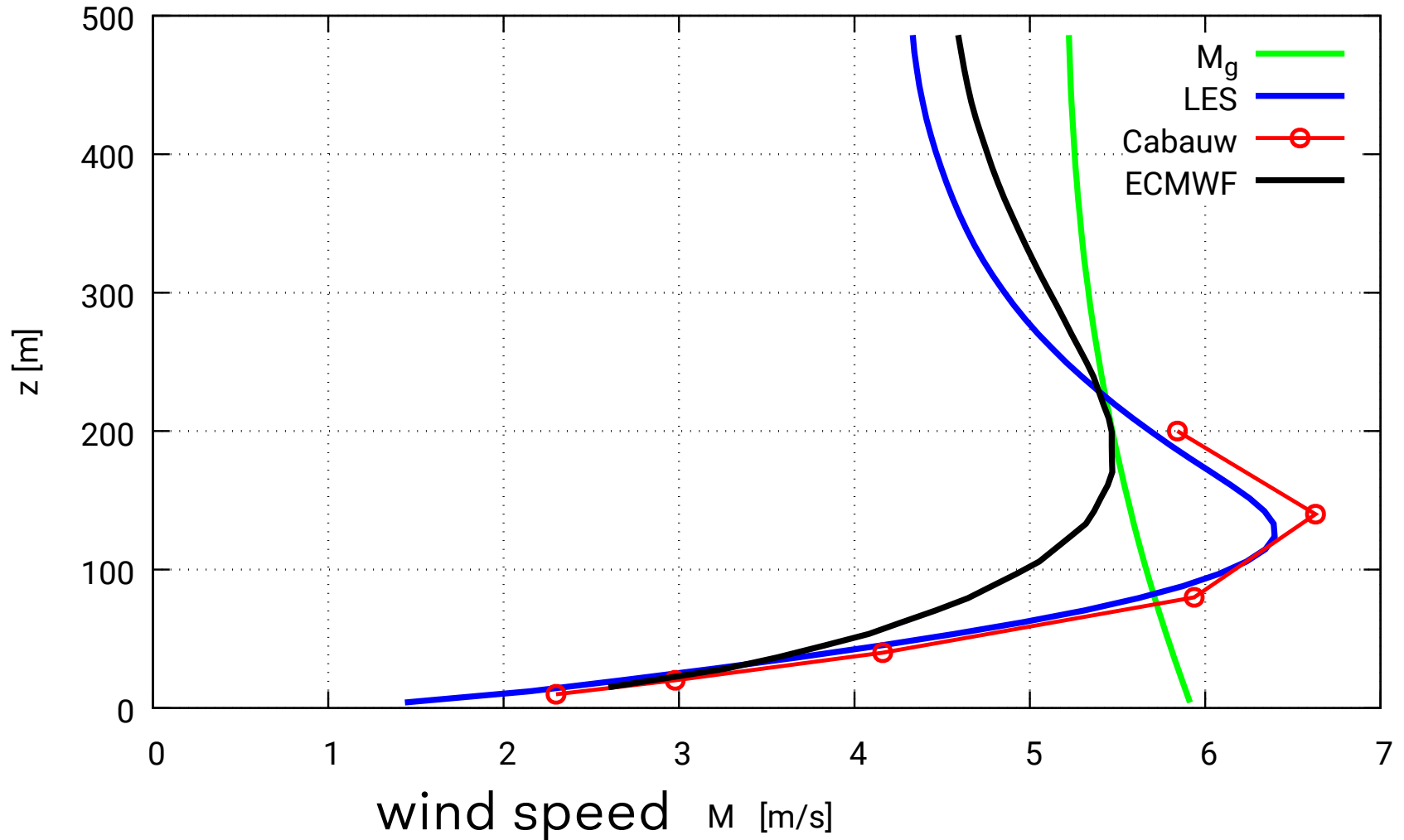
# Cabauw validation: yearly average wind profile



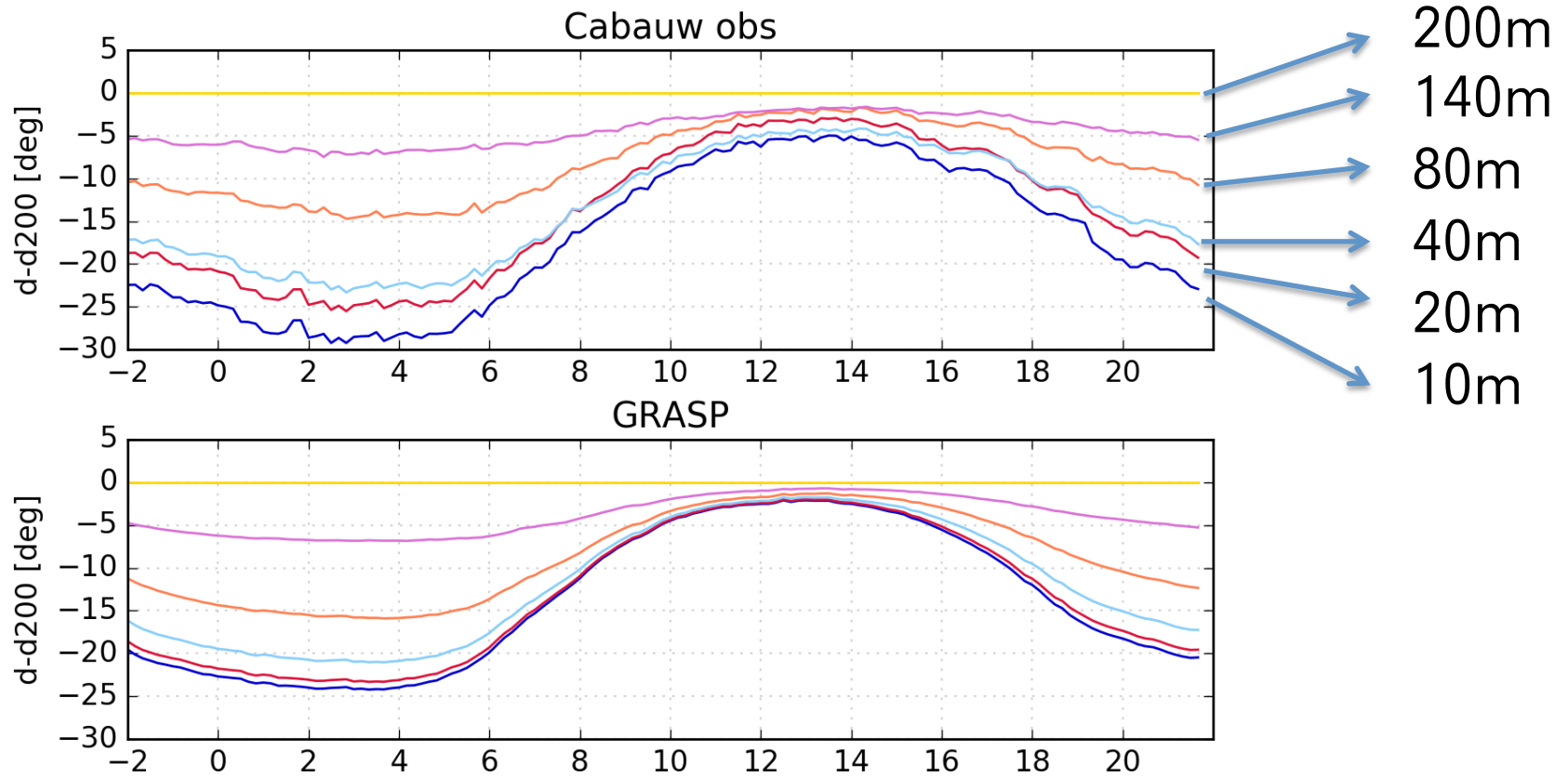


# LES predicts **low level jets** well

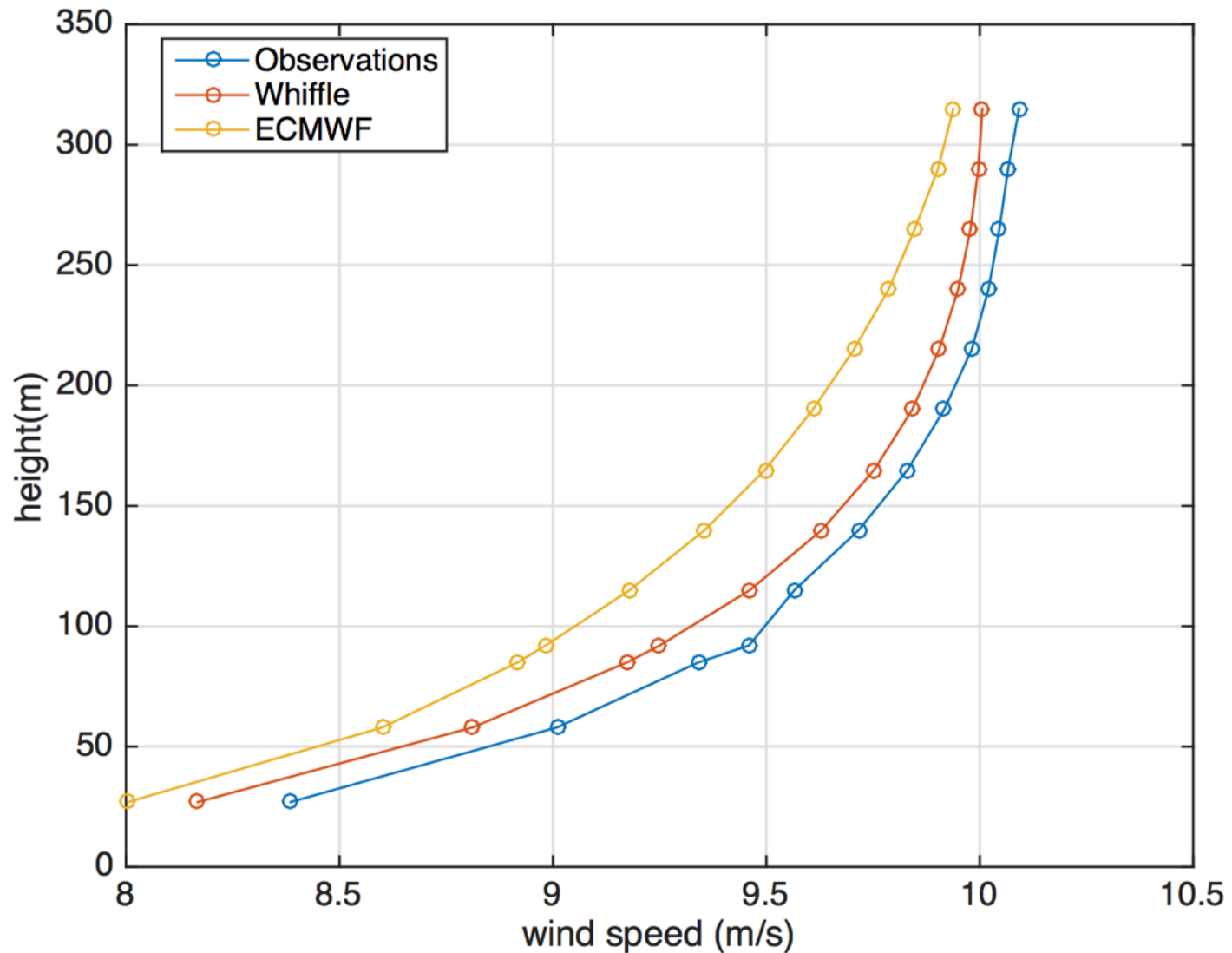
$$M(140m) > M(200m)$$



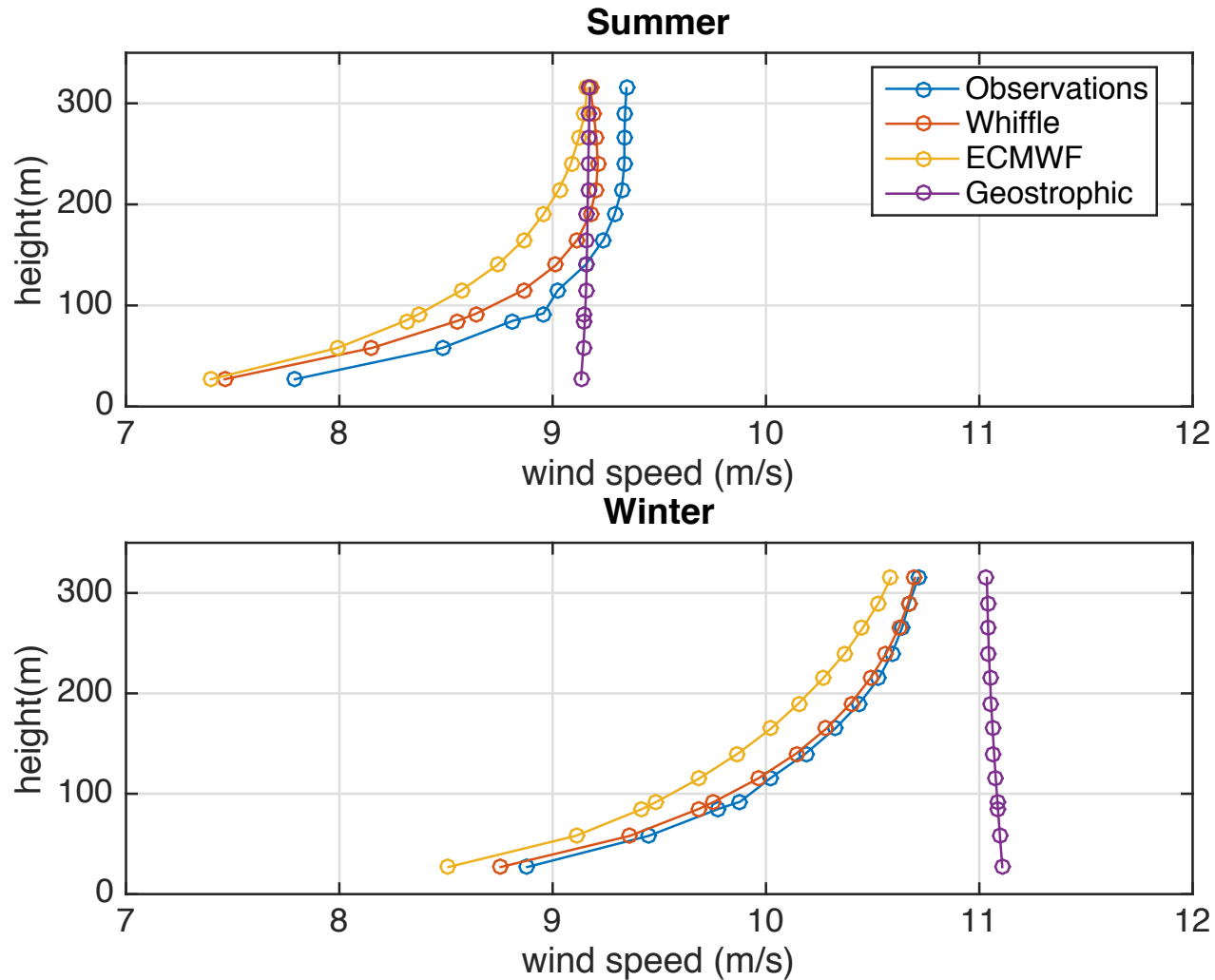
# Wind shear: diurnal cycle and height dependence



# IJmuiden (offshore) wind profiles



# Offshore wind profiles per season



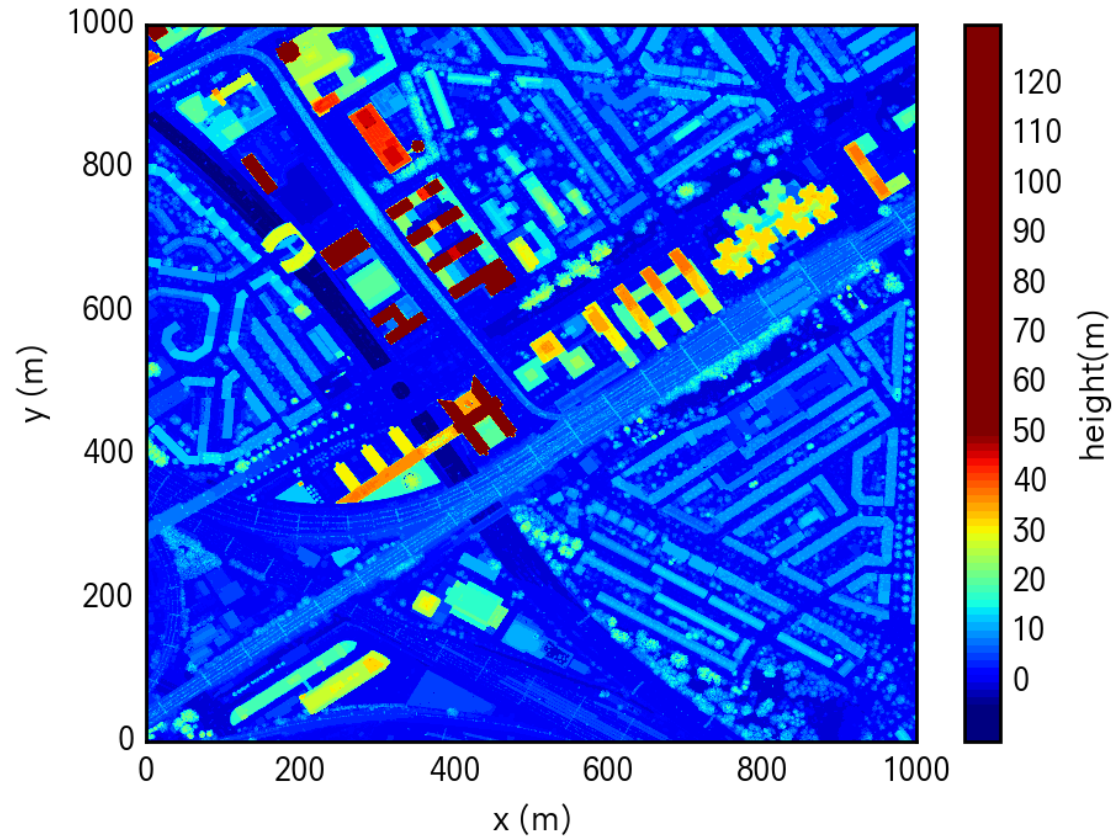


# A building resolving forecast for The Hague

Aerial photo

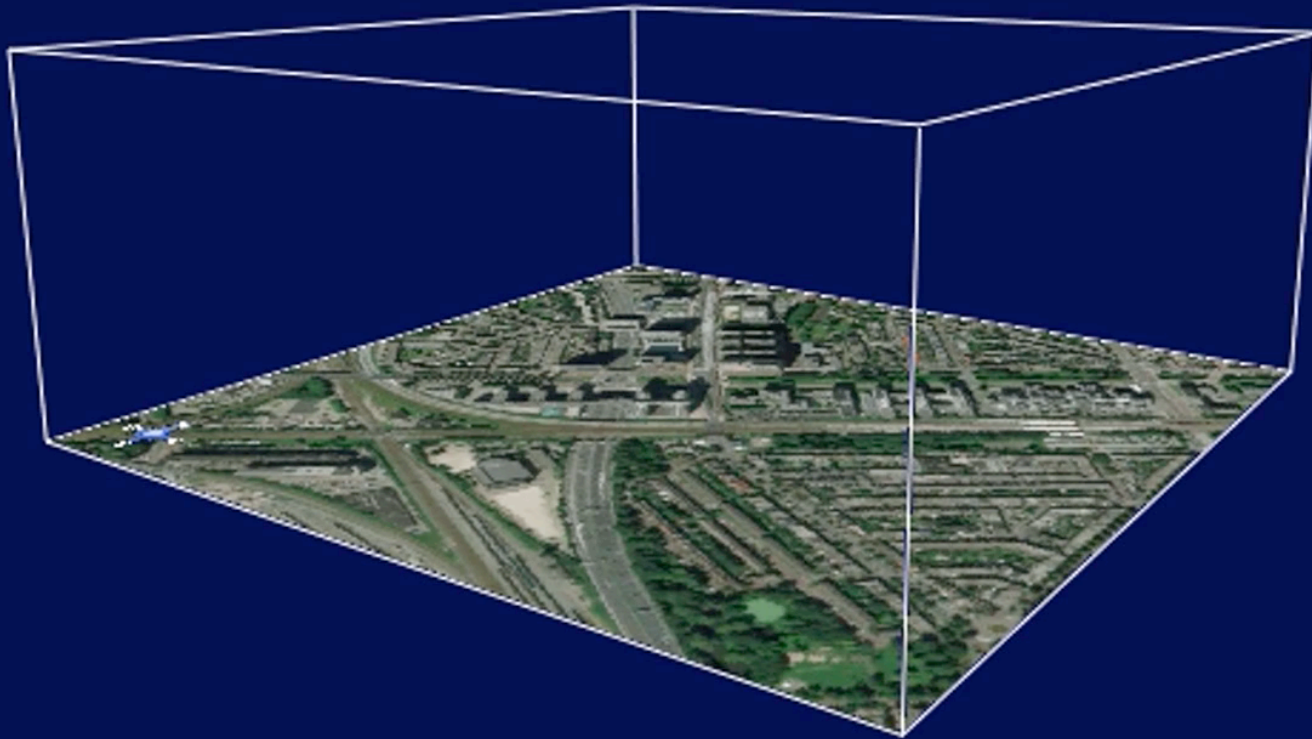


Digital height map



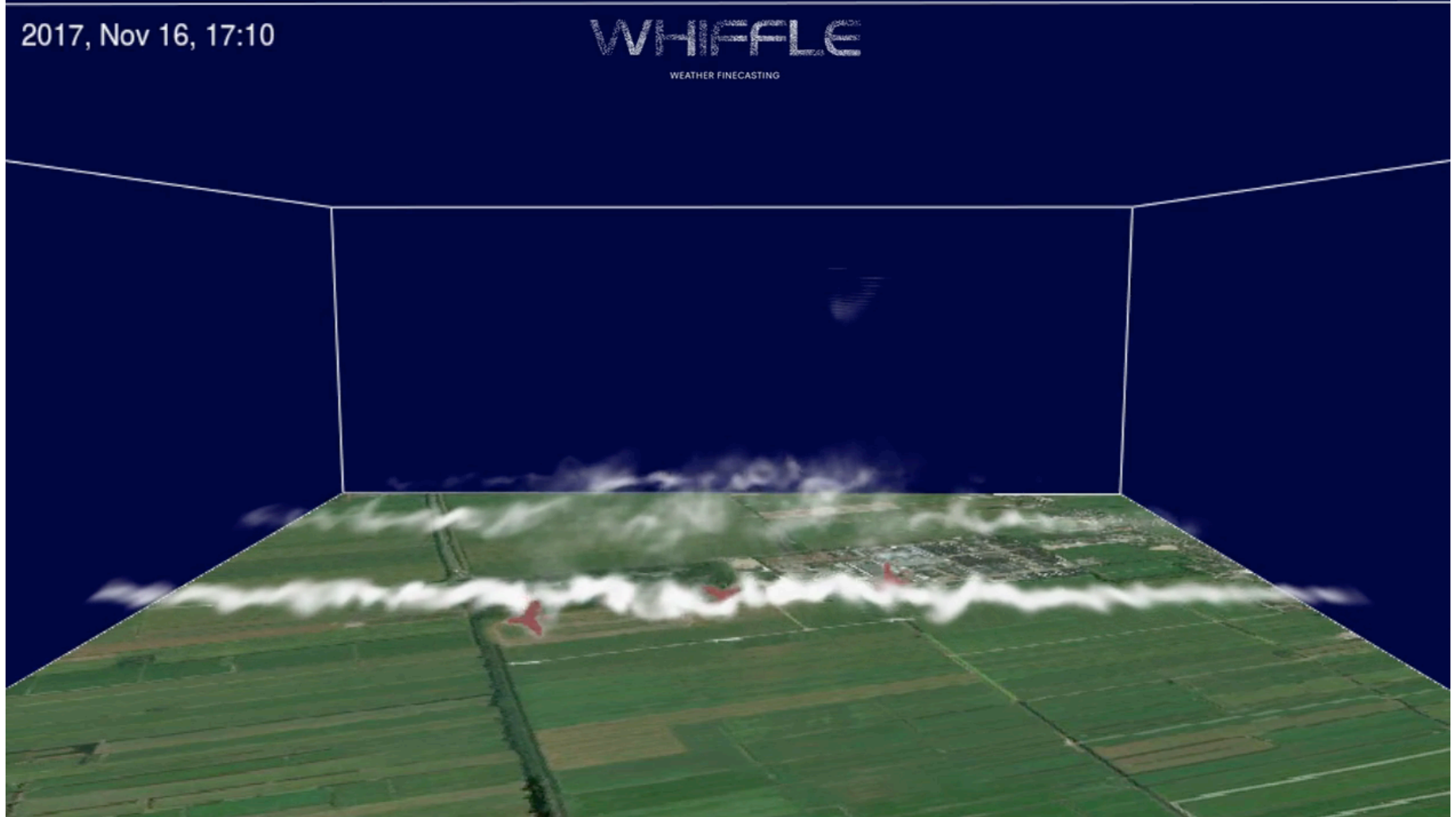
# Building resolving forecast for The Hague

2017, Sep 20, 06:05



<https://vimeo.com/264678124/02cf6755de>

# Small domain simulation demonstrates wind farms (and dispersion)



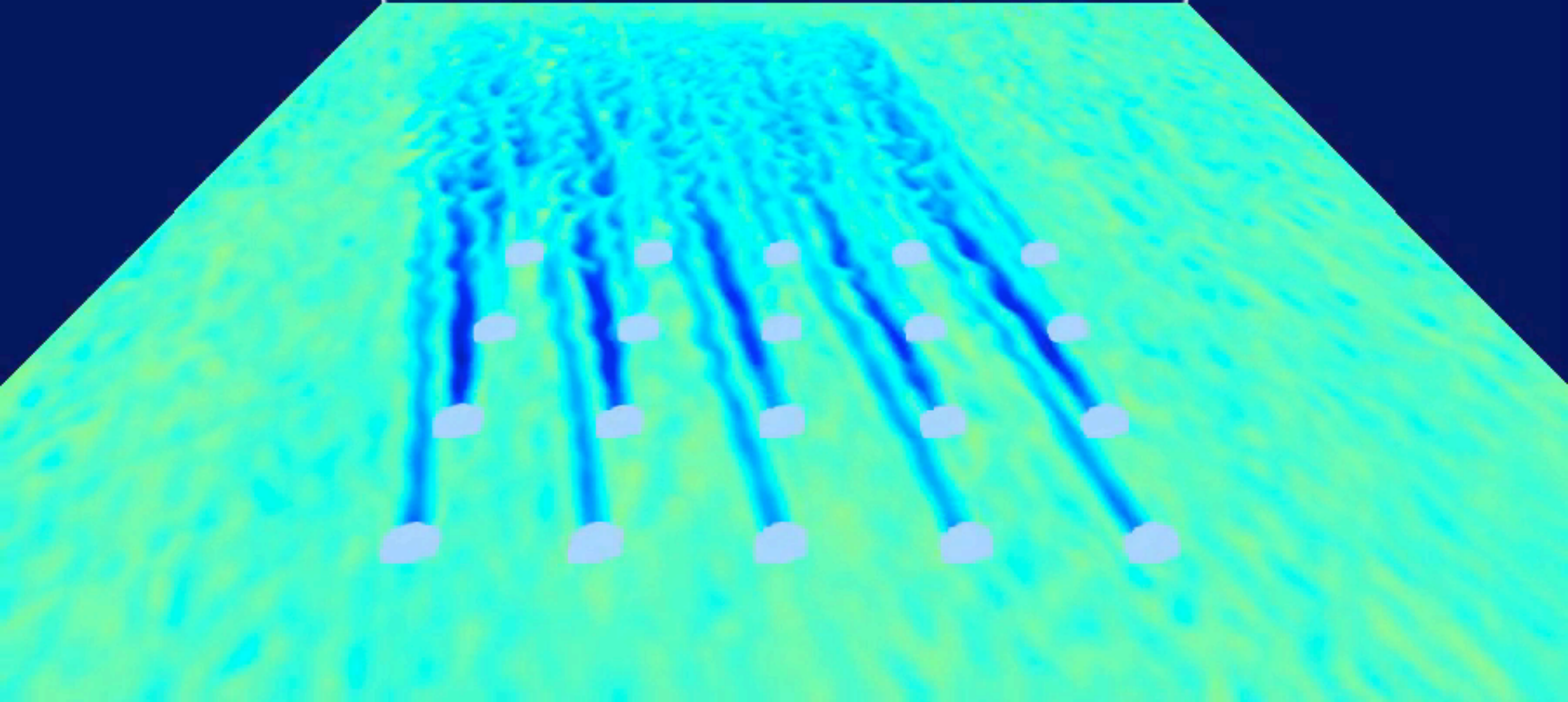
<https://vimeo.com/244809226/49dae5986f>



2017-08-23 18:00:00 UTC

# WHIFFLE

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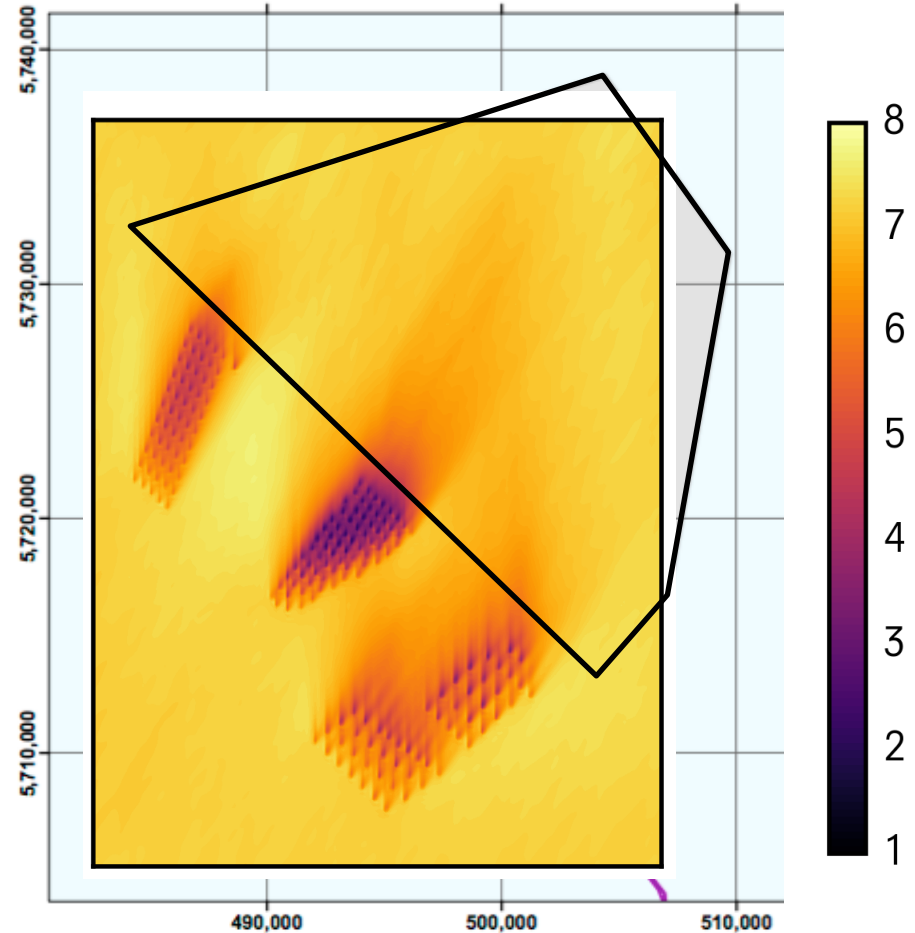
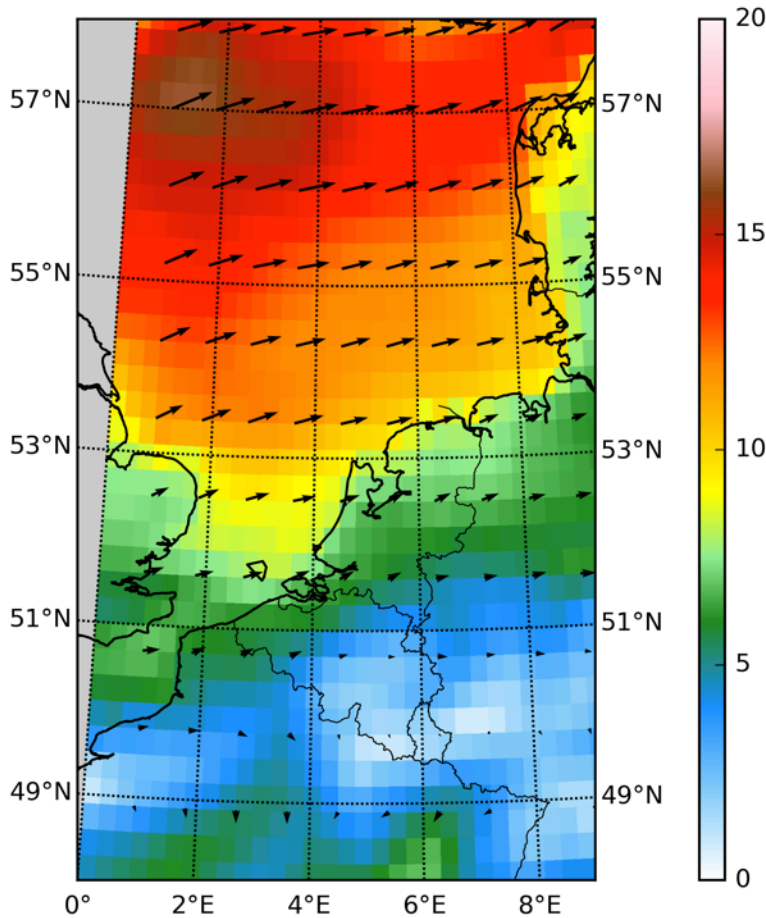


WHIFFLE <https://vimeo.com/254708472/79a3ef631e>



# Finecasting for offshore wind energy

## ERA 5 Wind speed (m/s)

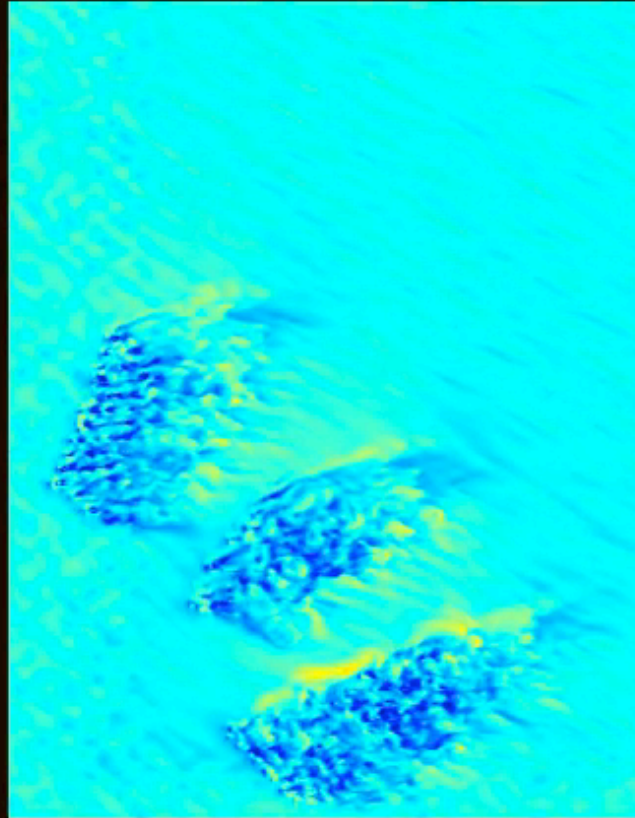


# Large domain wind farm forecast

2015-03-05 21:20:00 UTC

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WHIFF <https://vimeo.com/260071733/93935dd92d>

# Scaling up and growing up

LES FORECAST



SATELLITE IMAGE



ERA-INTERIM

