

# Monitoring continent-wide aerial patterns of bird movement using weather radars.

*Jose A. Alves, Judy Shamoun-Baranes, Peter Desmet, Adriaan Dokter, Silke Bauer, Ommo Hueppop, Jarmo Koistinen, Hidde Leijnse, Felix Liechti, Hans van Gasteren & Jason W Chapman*



# Why track migrants and their migrations?



# Why track migrants and their movements?



Oikos 118: 624–626, 2009  
doi: 10.1111/j.1600-0706.2008.17309.x,  
© 2009 The Authors. Journal compilation © 2009 Oikos  
Subject Editor: Hamish McCallum. Accepted 3 November 2008

**The natural link between Europe and Africa – 2.1 billion birds on migration**

*Intense connectivity between continents*

Steffen Hahn, Silke Bauer and Felix Liechti

*Link ecological communities across the globe*



Bauer & Hoyer 2014, Science

# Tracking a migrant bird is challenging!



Nolet & Drent 1998, *J Avian Bio.*



Small



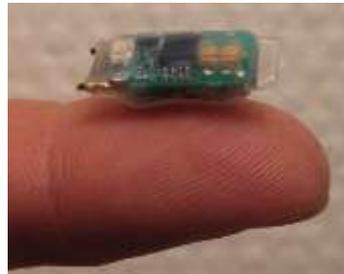
Hake *et al.* 2001, *J Avian Bio.*



Tinny



Smith *et al.* 2014, *IBIS*



Bairlein *et al.* 2012, *Bio. Letters*

But tracking thousands of birds during migration is near impossible!



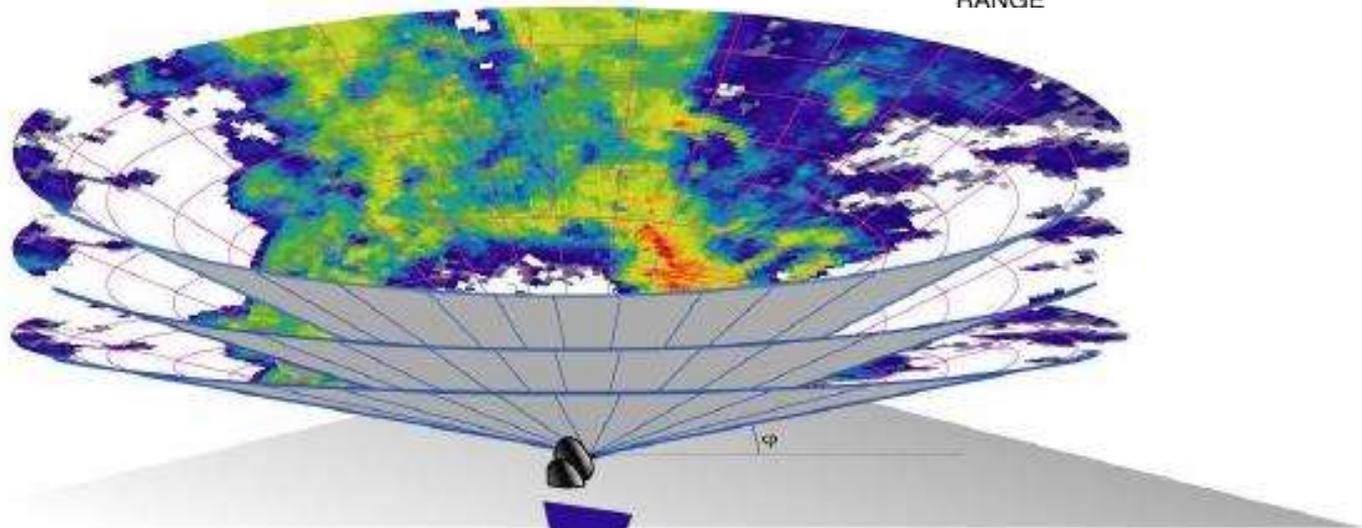
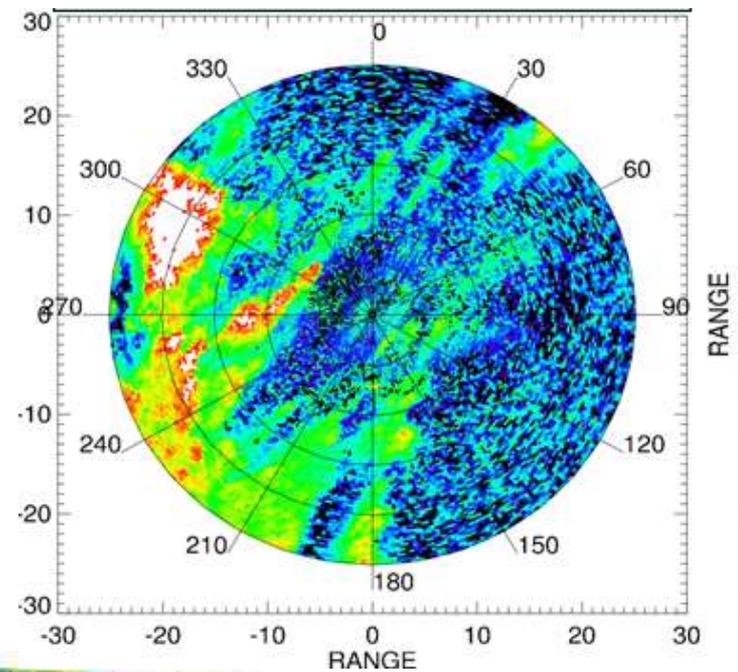
Large



MASSIVE

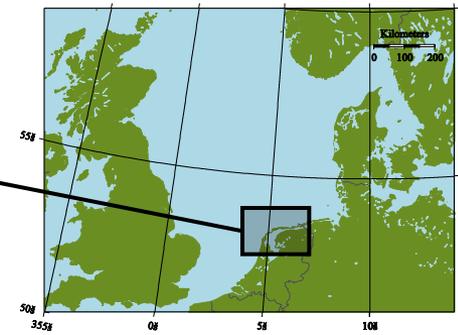


# How can weather radars detect birds?



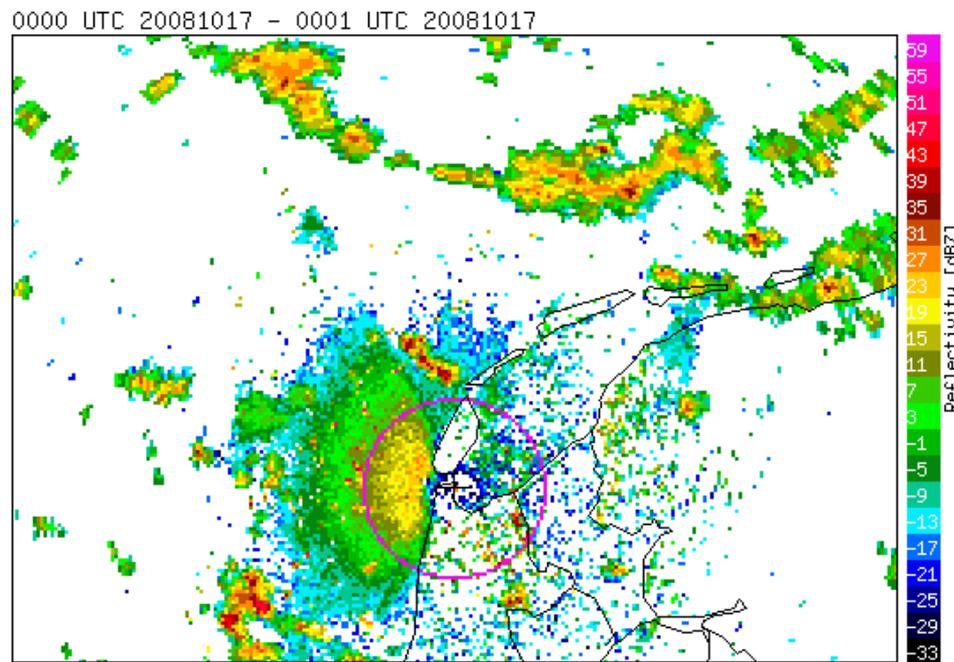
# What data can we get from weather radars?

Den Helder  
(The Netherlands)

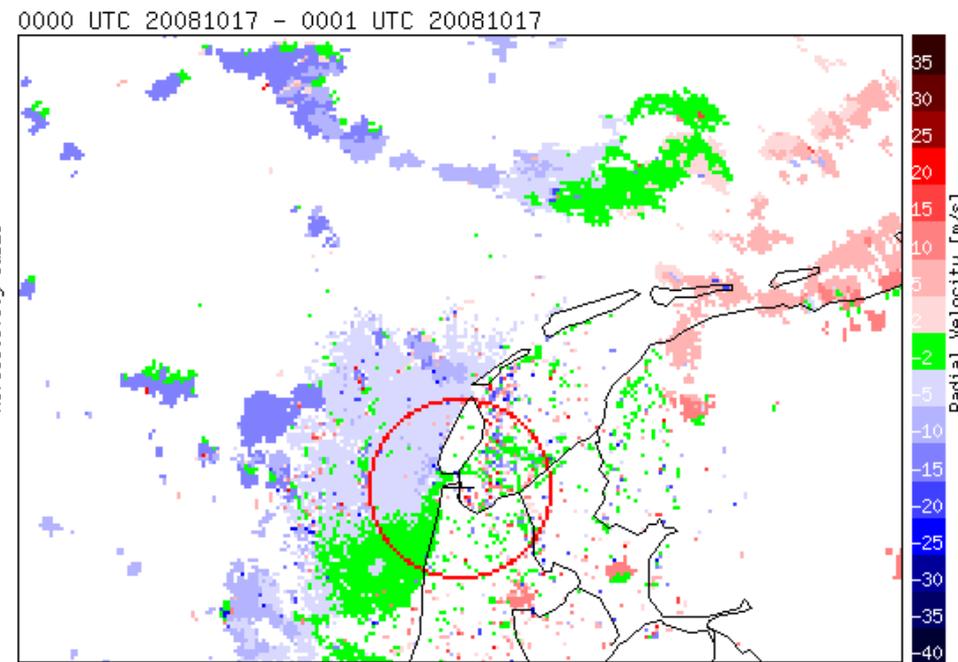


## Reflectivity

## Radial velocity



Den Helder, 17 Oct 2008



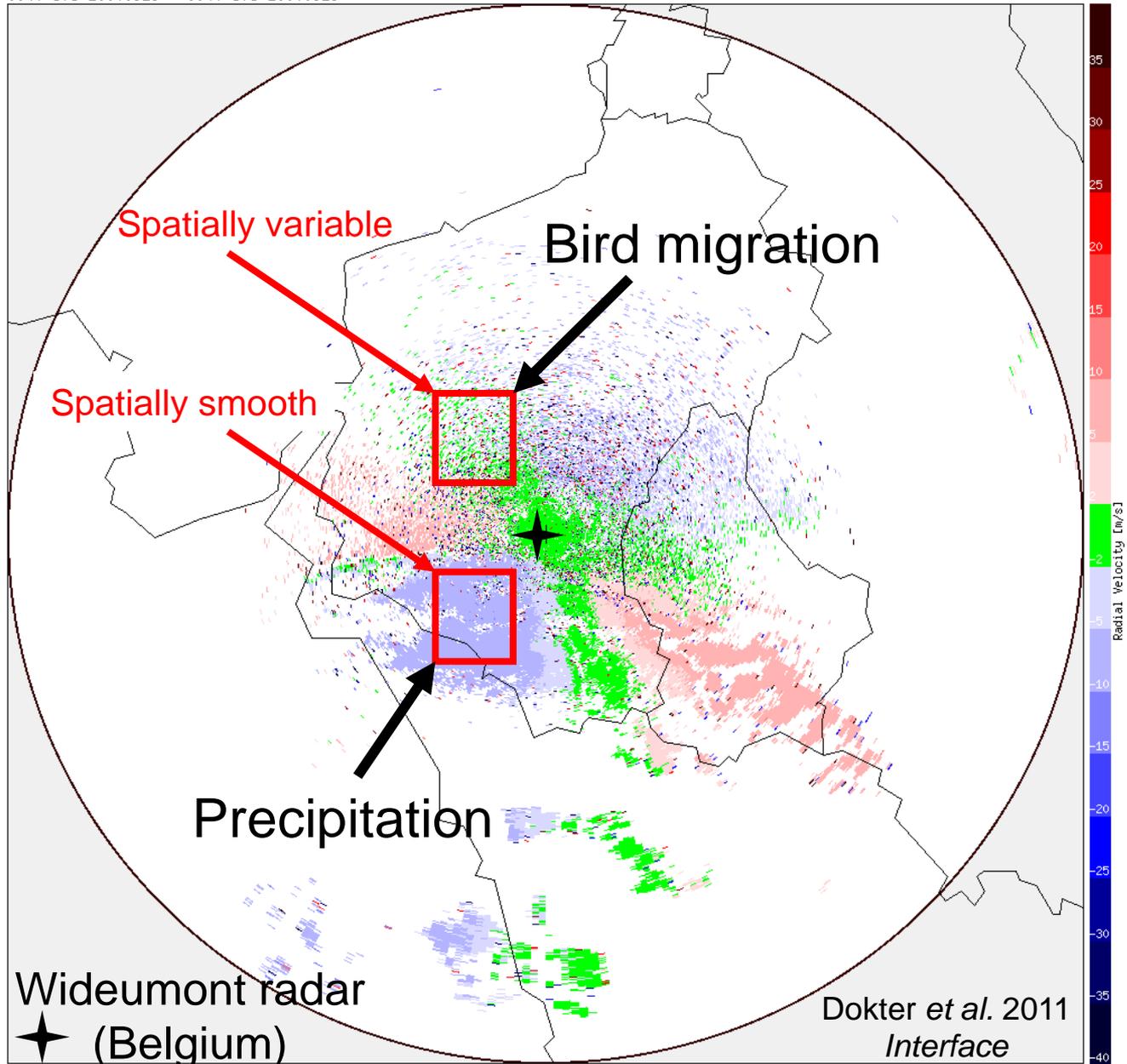
Dokter et al. 2011 *Interface*

# How to quantify bird movement data?

0047 UTC 20070929 - 0047 UTC 20070929

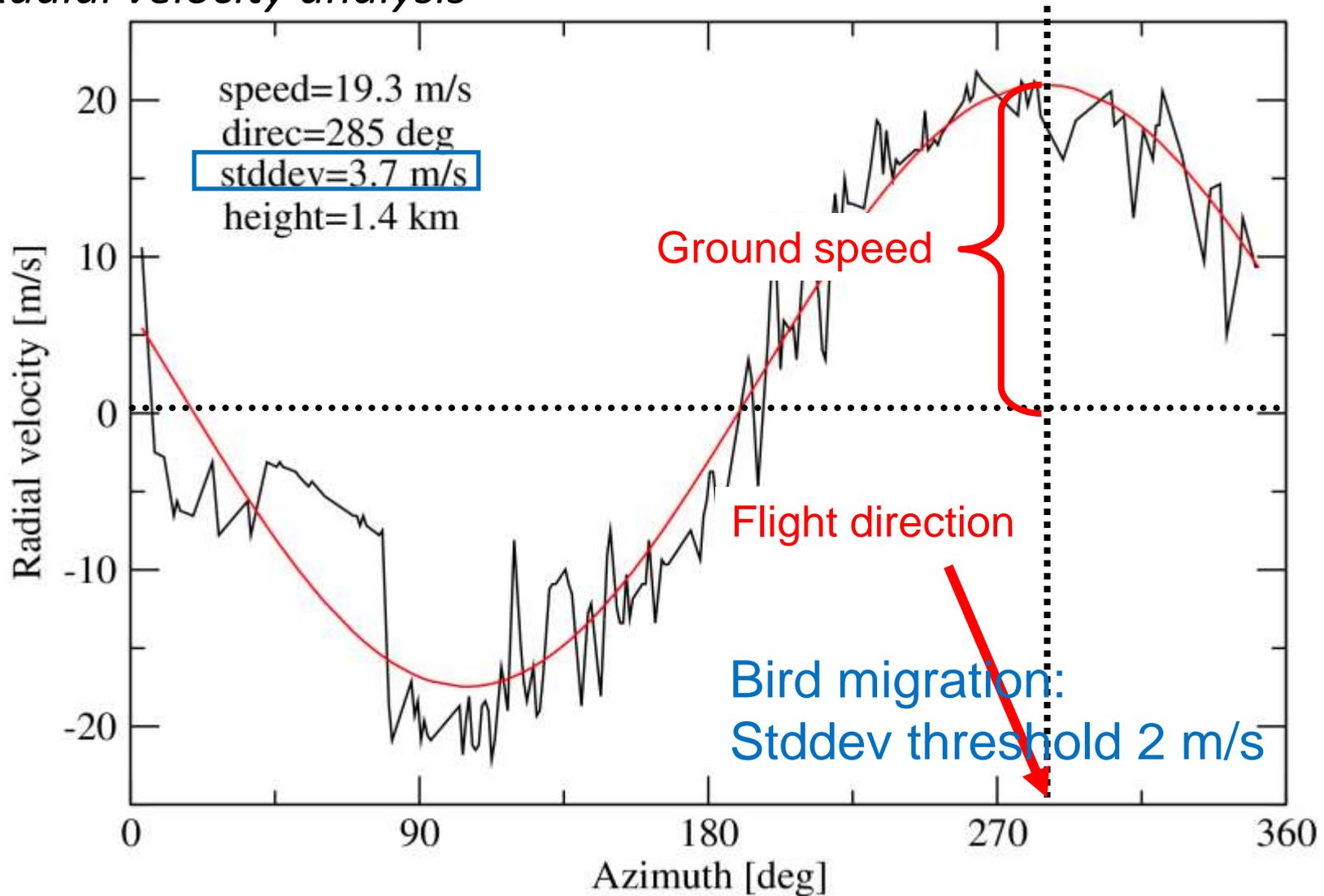
1. Reflectivity  
↓  
Identify targets

2. Radial velocity  
↓  
Extract birds



# How to quantify bird movement data?

## *Radial velocity analysis*



# But how many birds are flying?

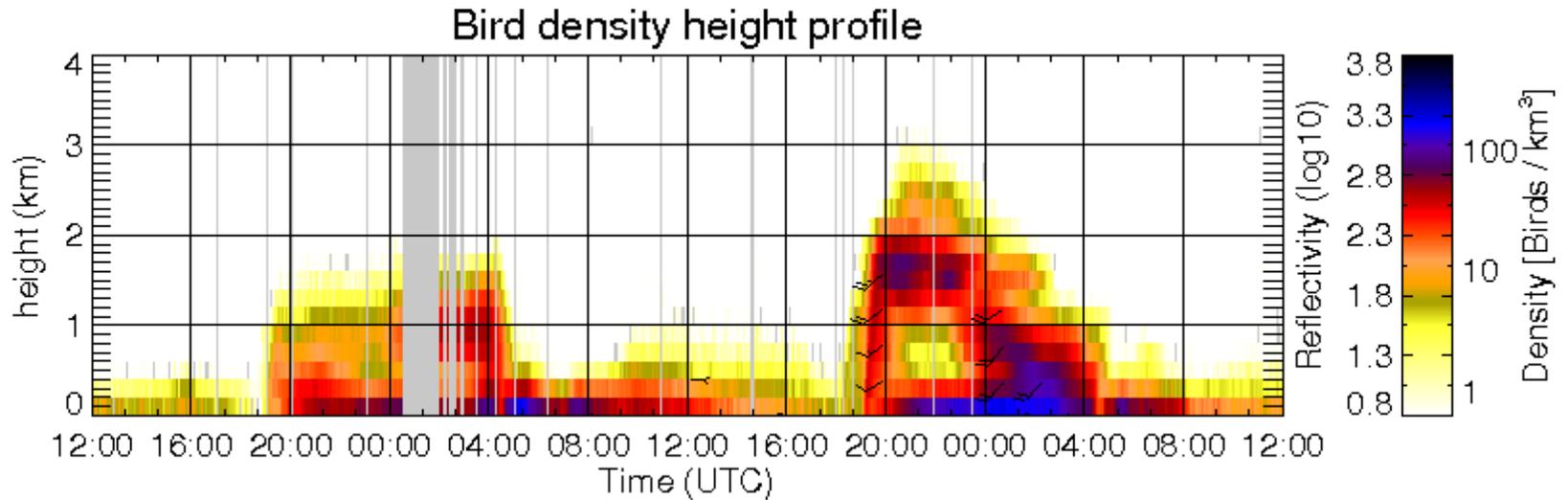
1. Speed

2. Direction

Radial velocity

Reflectivity

→ 3. Density



# ENRAM

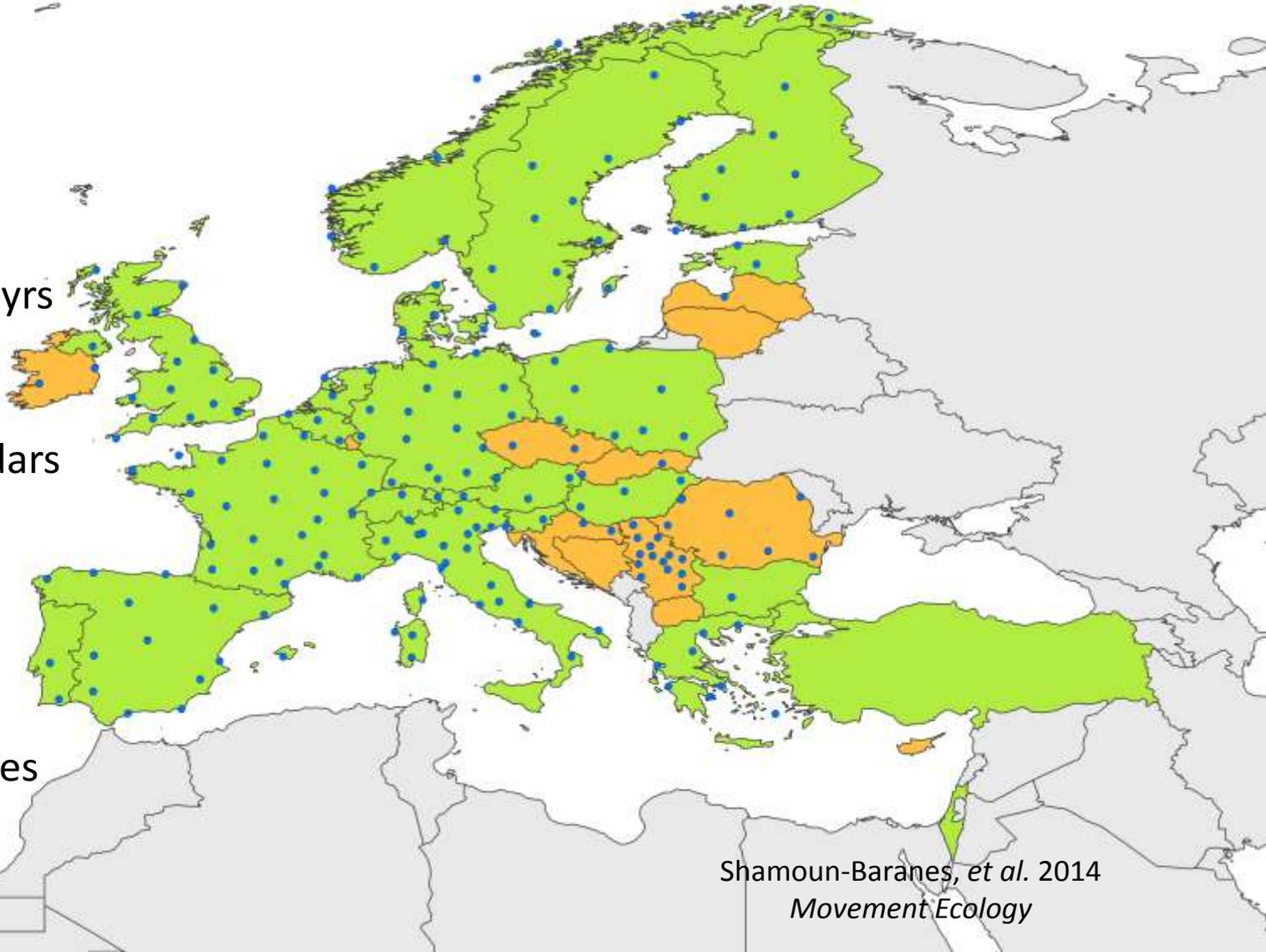
EUROPEAN NETWORK FOR THE RADAR SURVEILLANCE OF ANIMAL MOVEMENT



Started 2013 - 4 yrs

23 Countries

219 Weather radars



■ ENRAM countries

■ COST countries

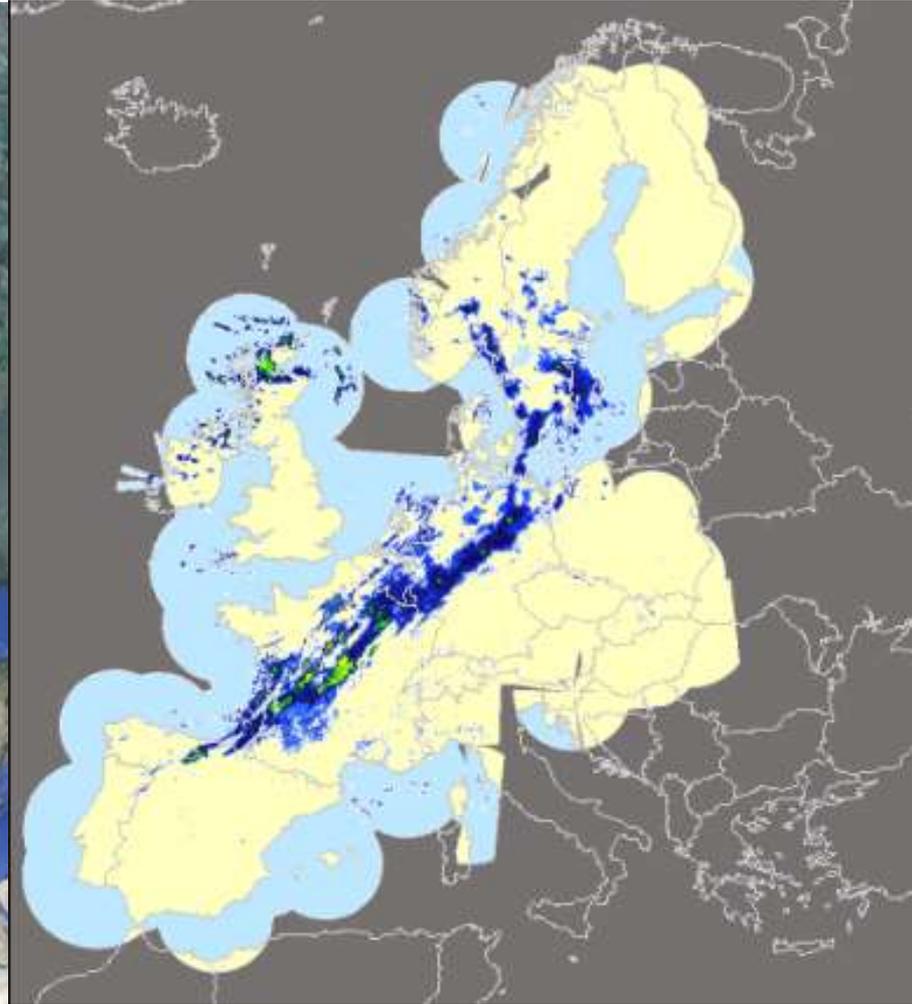
Shamoun-Baranes, *et al.* 2014  
*Movement Ecology*

# How can we monitor bird movement at the continental scale?

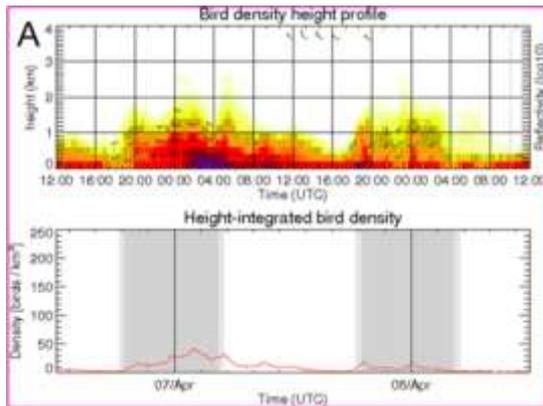
*ENRAM weather radars*



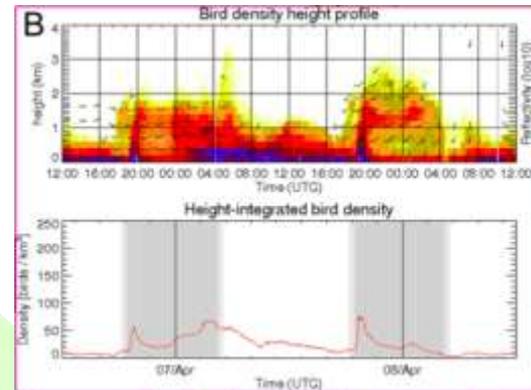
*ENRAM coverage*



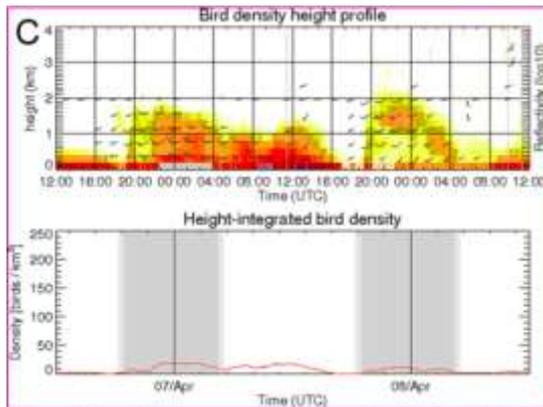
# How to combine data from multiple radars?



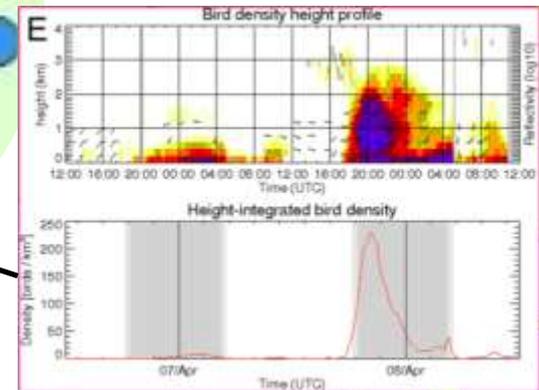
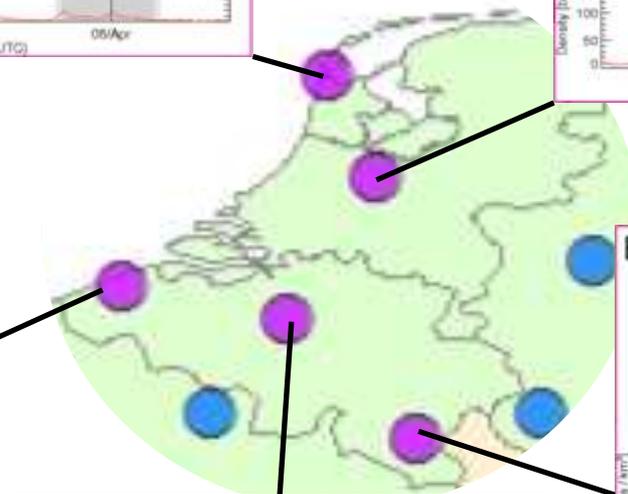
Den Helder



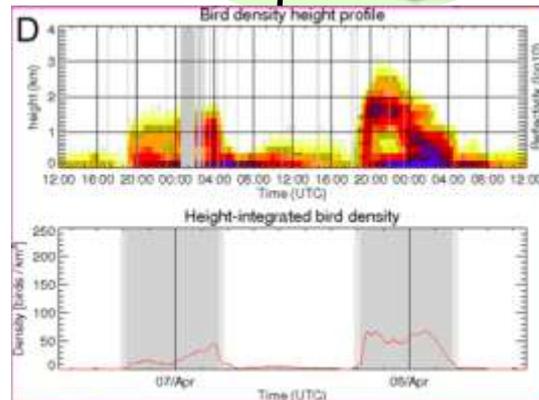
De Bilt



Jabbeke

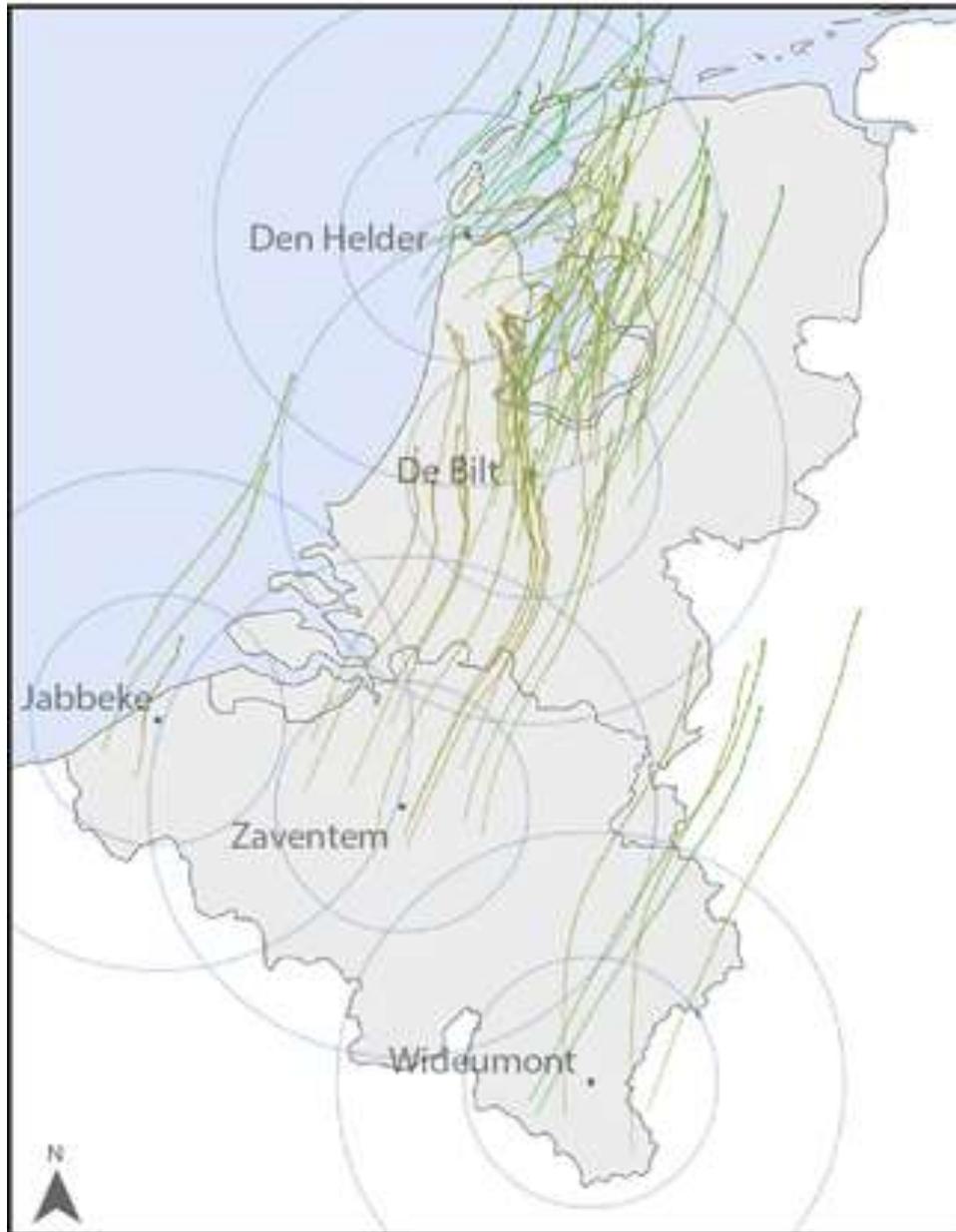


Wideumont



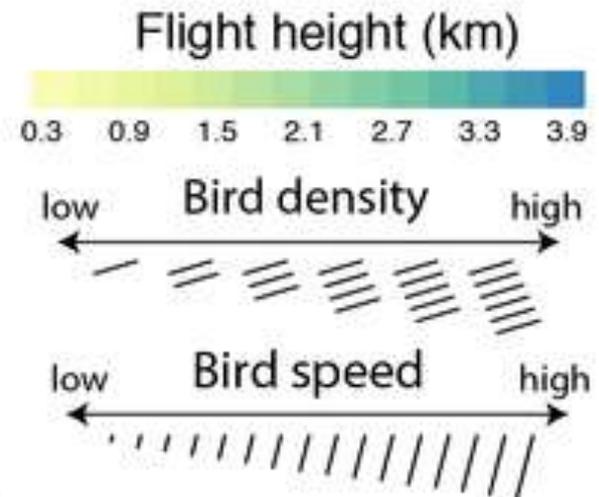
Zaventem

# Visualizing the data from multiple radars

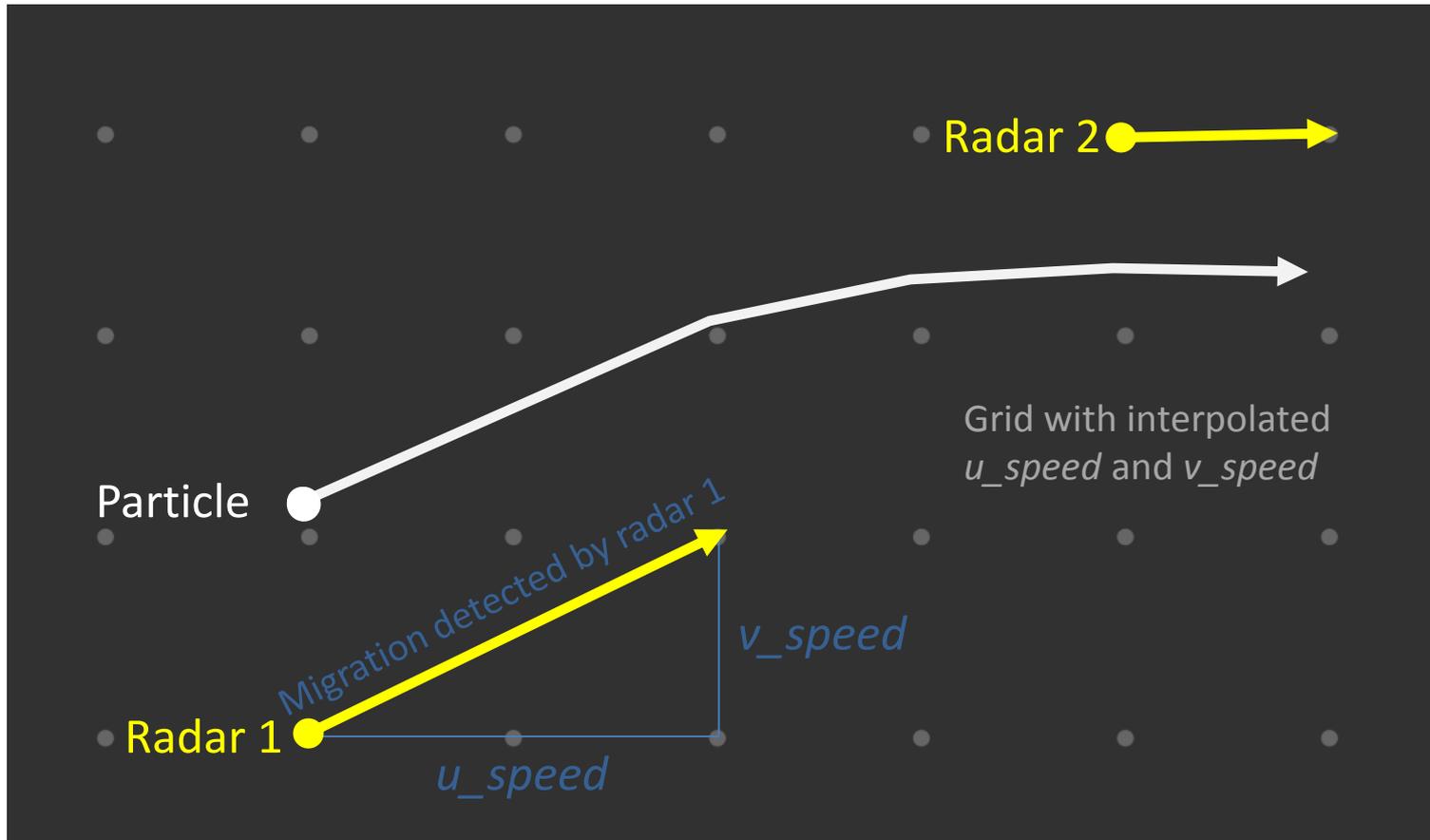


*TIMAMP* – Branco, S., Horton, K., Van den Broeck, W. & Van den Meersche, J.K. 2015

## Migration paths integrated over 8-hours



# Visualizing bird migration data from multiple radars



Desmet, P, Aelterman, B, Azijn, K. 2014

<http://enram.github.io/bird-migration-flow-visualization/viz/>

April 7 2013, 16:00



Altitude band 200-1600m



# ENRAM

EUROPEAN NETWORK FOR THE RADAR  
SURVEILLANCE OF ANIMAL MOVEMENT



Thank you

