

Using weather radars to monitor continental scale patterns of avian movement

José A. Alves¹, Judy Shamoun-Baranes², Peter Desmet³, Adriaan Dokter^{2,4}, Silke Bauer⁵, Ommo Hüppop⁶, Jarmo Koistinen⁷, Hidde Leijnse⁸, Felix Liechti⁴, Hans van Gasteren^{2,9} & Jason W. Chapman¹⁰

Fact:

Billions of insects, birds and bats use the aerosphere for migration, dispersive movements or foraging.

Problem:

How to simultaneously monitor & track multiple organisms with different size, movement patterns and ecology?



Ambition:

Use the current network of weather radars continuously operating all over Europe to record animal movement.

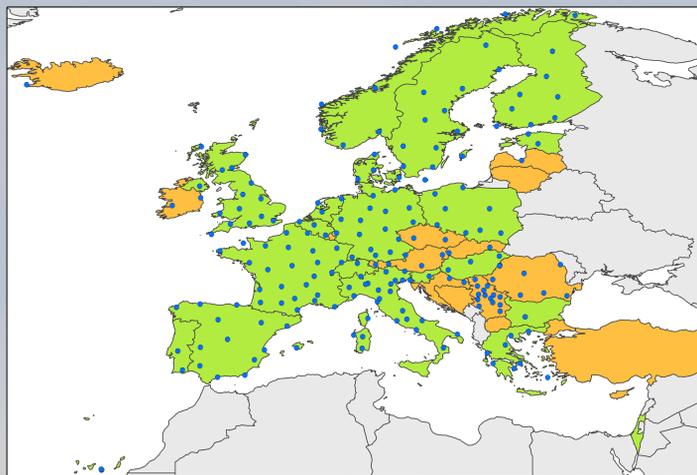
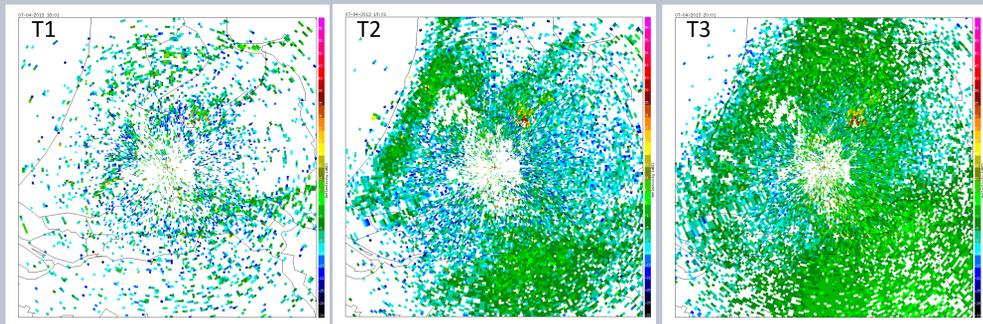


Fig 1. Distribution of 202 European weather radars (blue dots) and the 19 countries currently participating in ENRAM (green). Additional countries might join this action (orange).

Solution:

1 - Attain weather radar reflectivity & radial velocity data.



2 - Develop and implement bird detection algorithm and convert bird data into "moving targets".

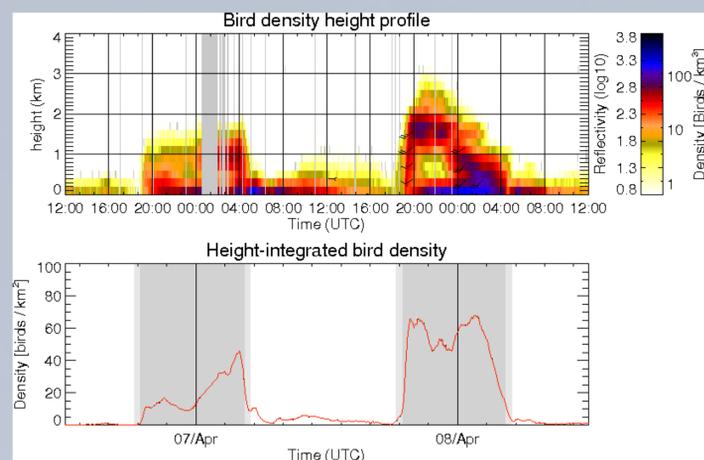


Fig 2. Weather radar processed bird density during nocturnal migration. Top: number of birds/km³ with wind barbs indicating the birds' ground speed and direction; Bottom height-integrated bird density (birds/km²), with grey areas indicating periods between dusk and dawn.

3 - Compositing bird information of multiple radars to obtain large scale movement information.

Result

Tracking bird migration over Belgium and the Netherlands

(check it out on-line :<http://enram.github.io/bird-migration-flow-visualization/viz/>)

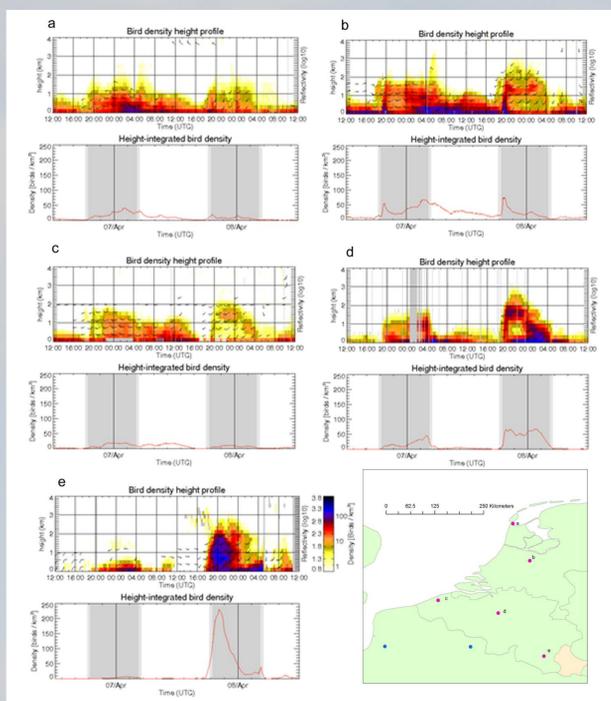


Fig 3. Bird migration measured by operational weather radars in the Netherlands (a. Den Helder and b. De Bilt) and Belgium (c. Jabbeke, d. Zaventem and e. Wideumont) on 7 and 8 April 2013.

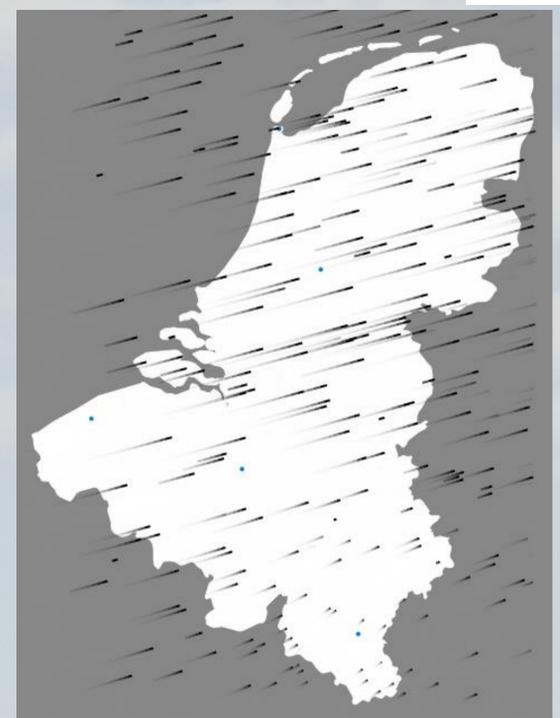
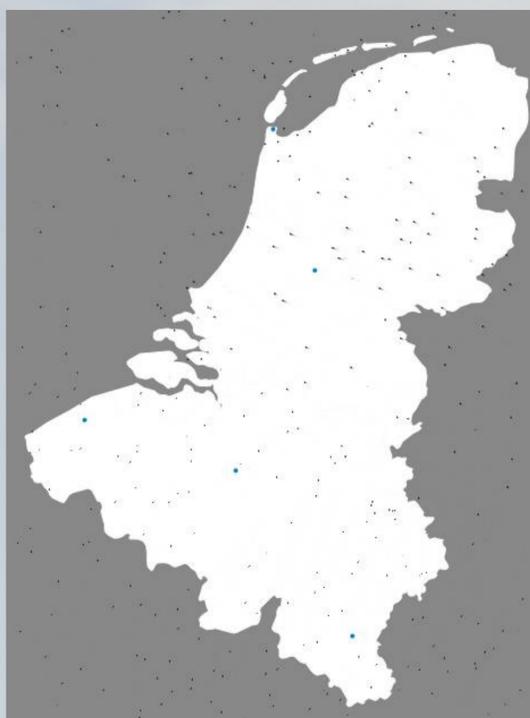


Fig 4. Bird movement (black points/streaks) visualized by interpolating mean ground speed and direction of bird flight measured simultaneously at 5 weather radars in Belgium and the Netherlands (blue points). Left: slow moving birds recorded at 8:40 on the 6th of April 2013; Right: fast moving birds on active migration recorded 16 hours later, at 00:40 on the 7th of April 2013.

Opera Network www.eumetnet.eu/opera

Movement Ecology Paper www.movementecologyjournal.com/content/2/1/9

JRS Interface Paper <http://rsif.royalsocietypublishing.org/content/8/54/30.long>

ENRAM website - www.enram.eu



Affiliations: ¹U. Aveiro & U. Iceland, ²U. Amsterdam, ³INBO, ⁴NIOO-KNAW, ⁵Swiss Ornithological Institute, ⁶Institute of Avian Research, ⁷Finnish Meteorological Institute, ⁸KNMI, ⁹Royal Netherlands Air Force, ¹⁰Rothamsted Research