

# Using weather radars to monitor continent-wide aerial patterns of animal movement

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## Fact:

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

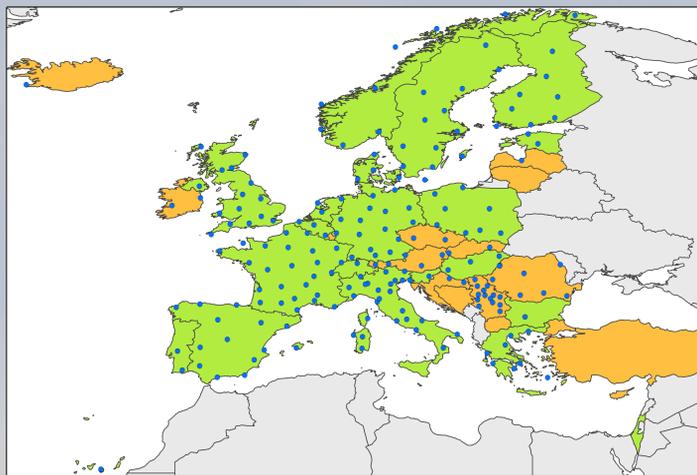
## Problem:

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



## Ambition:

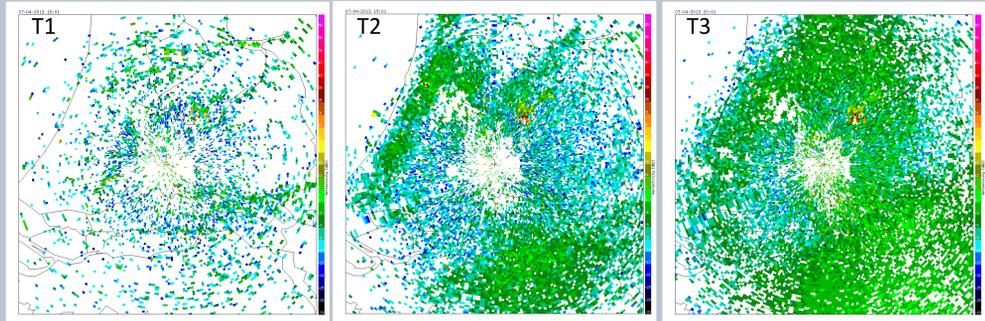
Use the current network of weather radars continuously operating all over Europe to record animal movement.



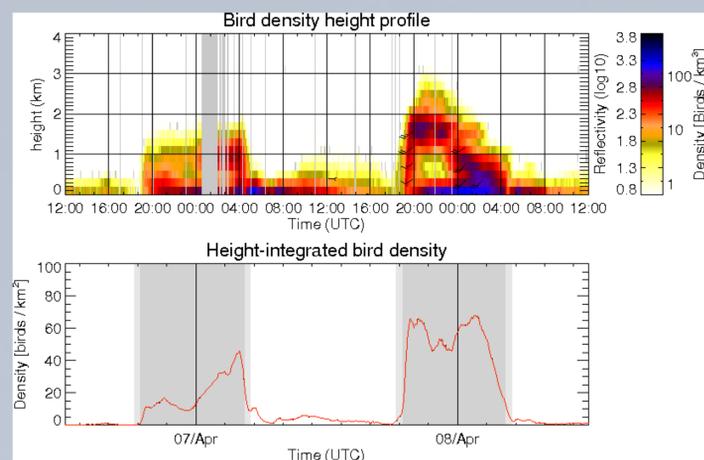
**Fig 1.** Distribution of 202 European weather radars (blue dots) and the 19 countries currently participating in ENRAM (green). Additional countries might join this action (orange).

## Solution:

1 - Attain weather radar reflectivity & radial velocity data.



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



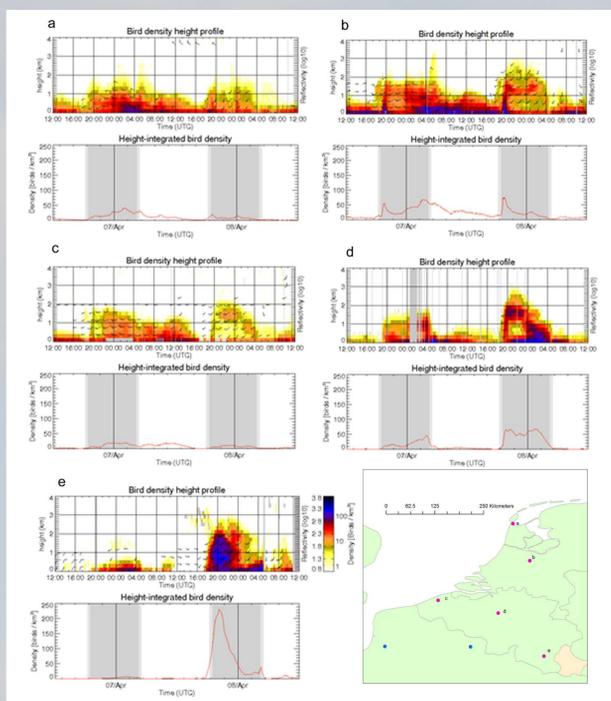
**Fig 2.** Weather radar processed bird density during nocturnal migration. Top: number of birds/km<sup>3</sup> with wind barbs indicating the birds' ground speed and direction; Bottom height-integrated bird density (birds/km<sup>2</sup>), with grey areas indicating periods between dusk and dawn.

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

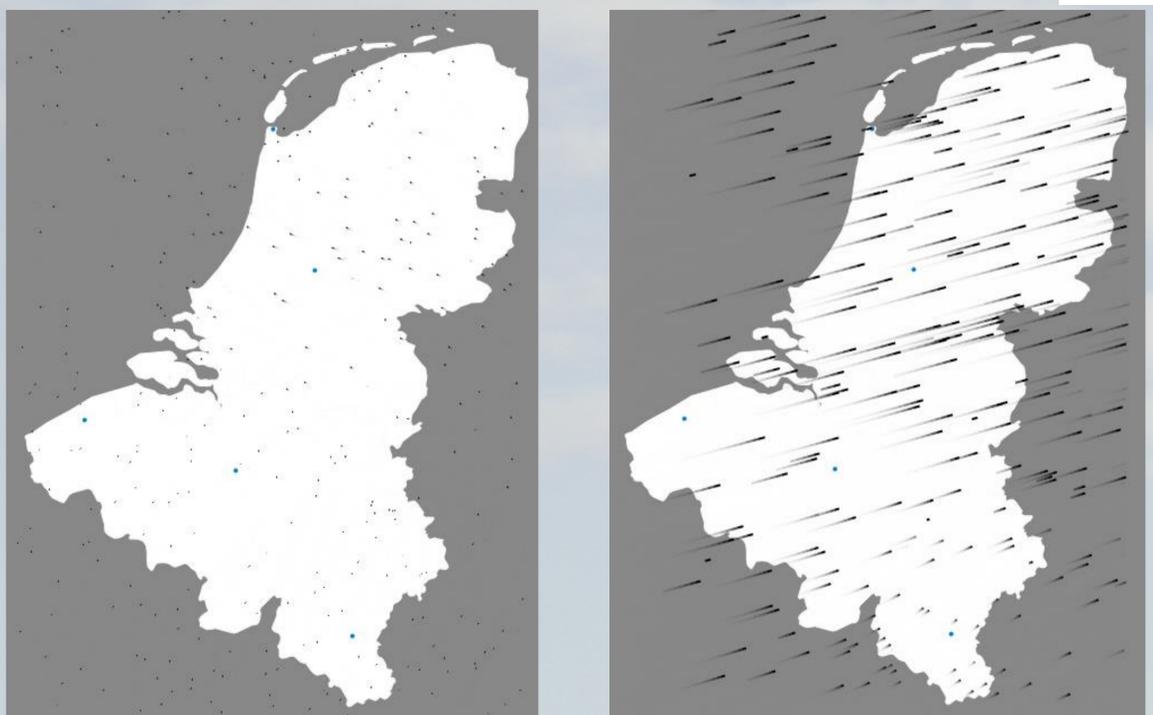
## Result

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 6<sup>th</sup> of April 2013; Right: fast moving birds on active migration recorded 16 hours later, at 00:40 on the 7<sup>th</sup> of April 2013.

Opera Network [www.eumetnet.eu/opera](http://www.eumetnet.eu/opera)

Movement Ecology Paper [www.movementecologyjournal.com/content/2/1/9](http://www.movementecologyjournal.com/content/2/1/9)

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

ENRAM website - [www.enram.eu](http://www.enram.eu)



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