


# How radar aeroecology can contribute to flight safety

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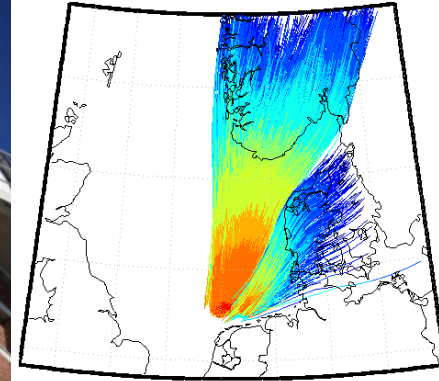
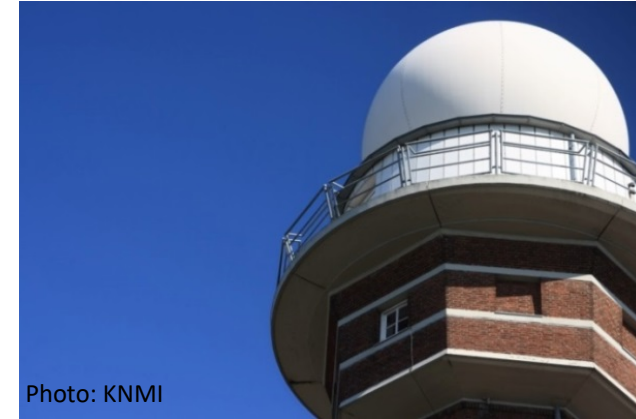
 @BaranesJudy



*virtual conference 2021*



# Interdisciplinary research to study interactions between birds and the aerosphere



## Interdisciplinary collaboration

Information Technology: SURFSara, NLeSC, LifeWatch

Close collaborators: NIOZ, Royal Netherlands Air Force, KNMI

Collaborators through UvA-BiTS and ENRAM/GloBAM networks (<https://globam.science> [www.enram.eu](http://www.enram.eu))



# Potential of radar aeroecology for diverse stakeholders



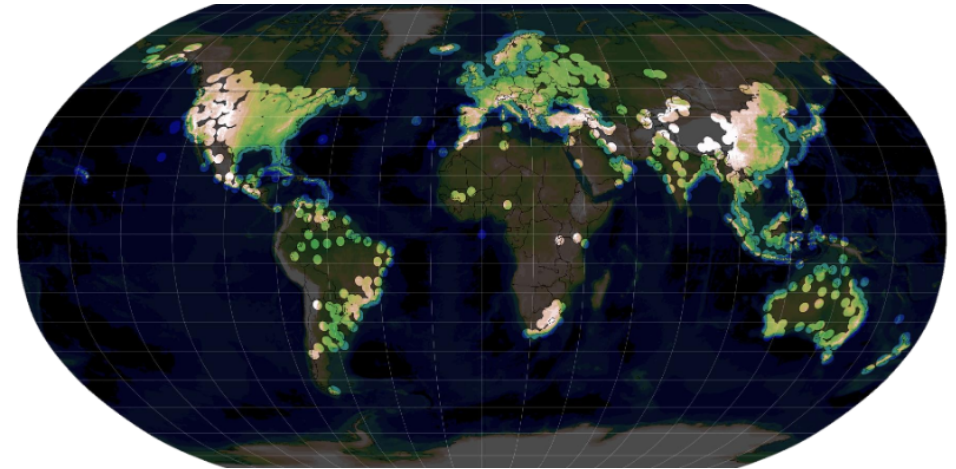
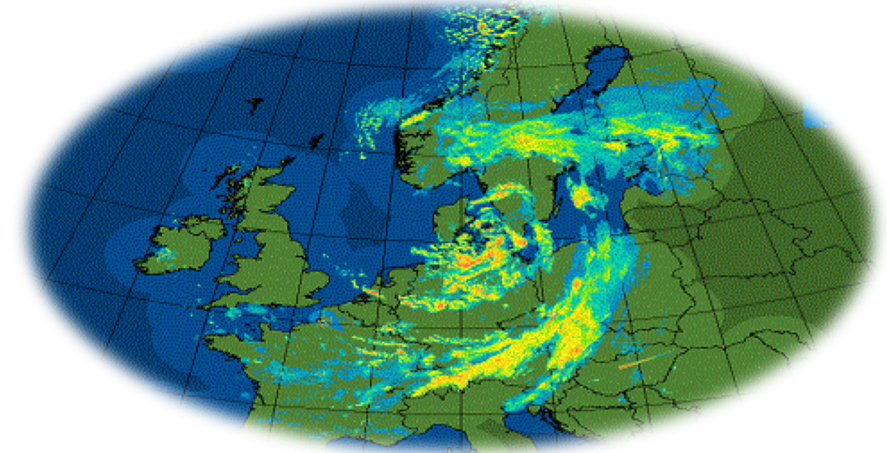
# Potential of weather radar networks for flight safety

- Existing hardware organized in networks, upgraded in many countries
- Software tools available for automated extraction of birds
- Ongoing research to improve target detection and data quality
- Online and freely available archive for USA
- Efforts underway to create European network for monitoring bird movement

<https://globam.science> [www.enram.eu](http://www.enram.eu)



@globam\_net



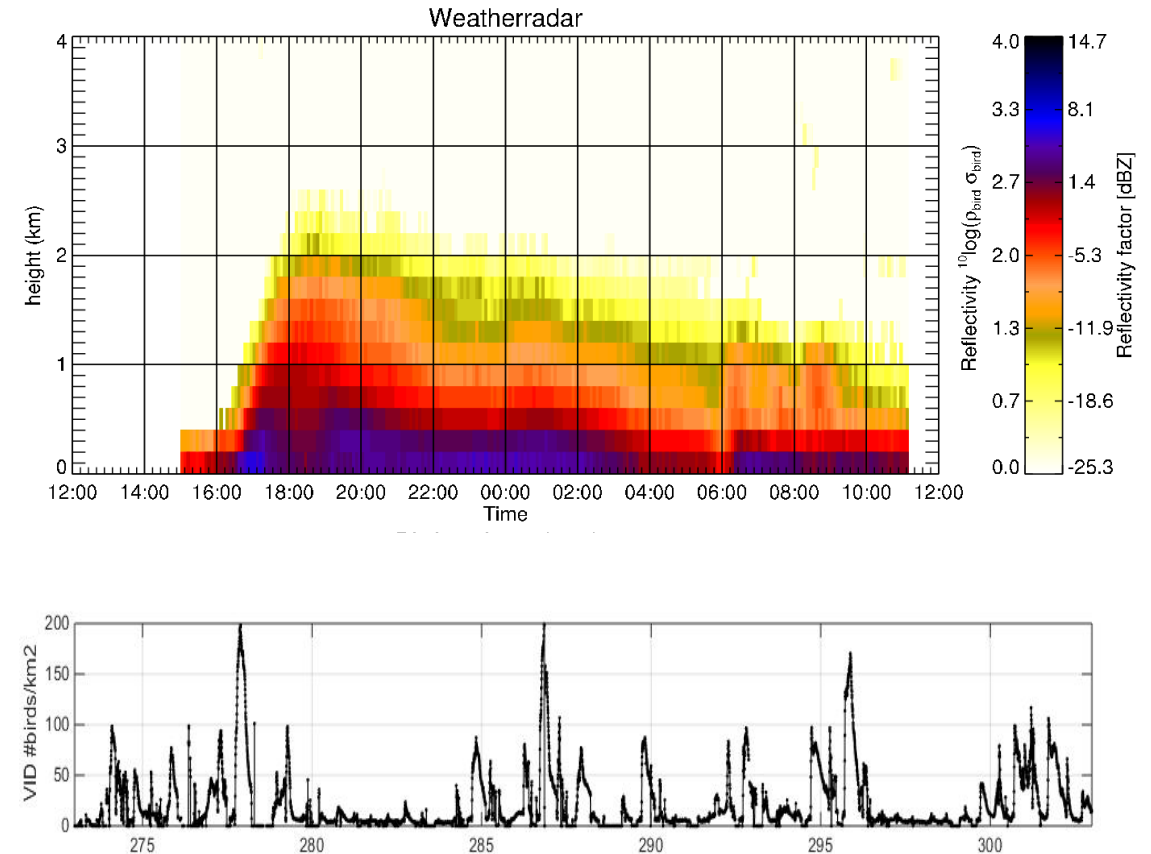
*Saltikoff et al 2019 BAMS*

*Global distribution of operational weather radars indicated with 200km buffer*



# Potential of weather radar networks for flight safety

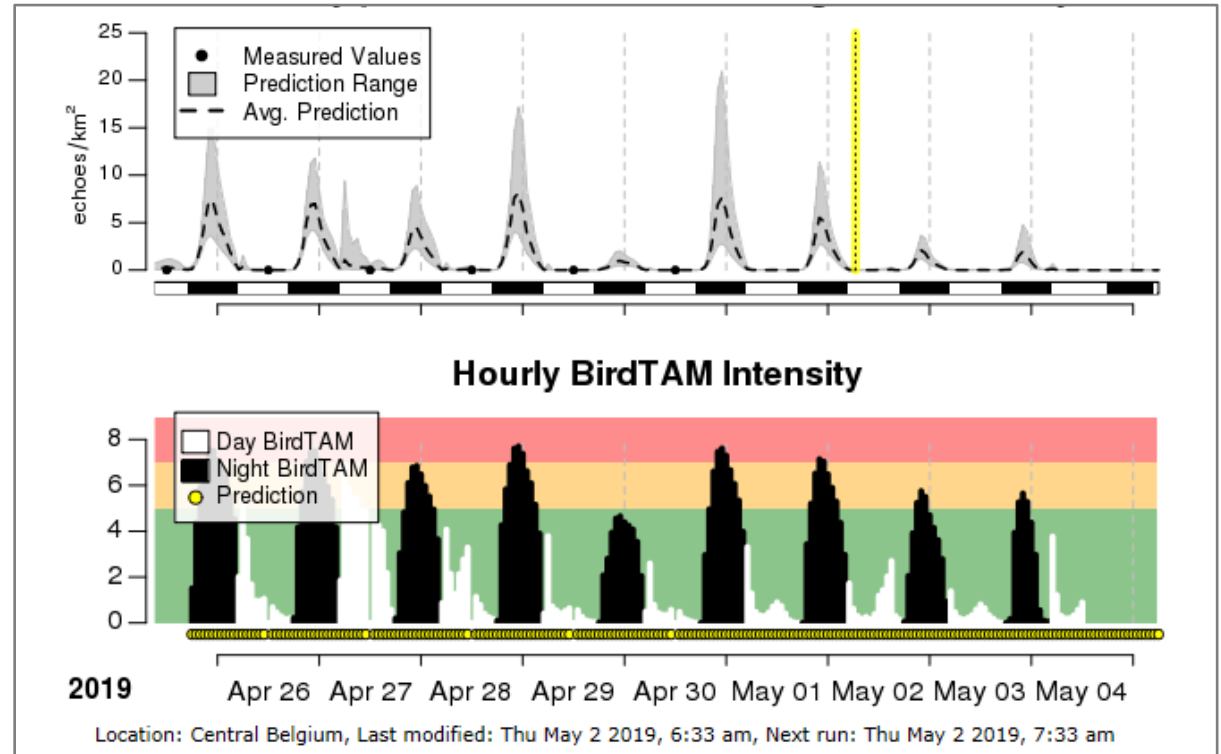
- Flight altitude distributions
- Seasonal and daily patterns
- Predict migration
- Map migration intensity, flight altitude, speed & direction at continental scales
- Identify long term changes in migration in space and time
- Influence of landscape features



*Examples where weather radar data is summarized per radar location*

# Predicting migration for flight safety warnings

- Migration abundance, flight altitude, speed and direction from radar as model input
- Atmospheric conditions & seasonal phenology as predictors
- Statistical ensemble models to forecast migration and provide BirdTAMs for military aviation

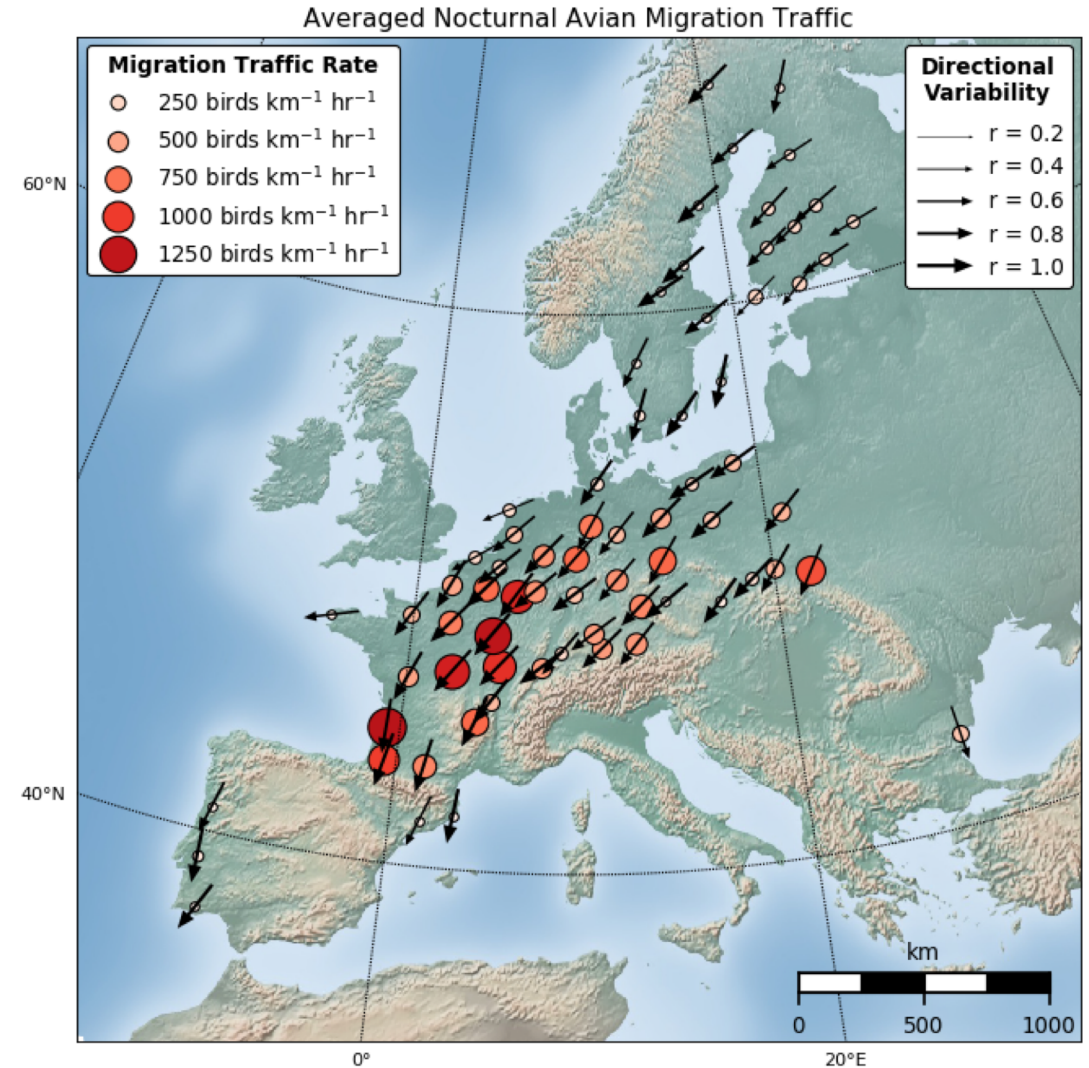


See <http://www.flysafes-birdtam.eu/>  
For NL & BE predictions & Western Europe composites

Postdoc Bart Kranstauber, PhD Michael Kemp

# Potential of weather radar networks for flight safety

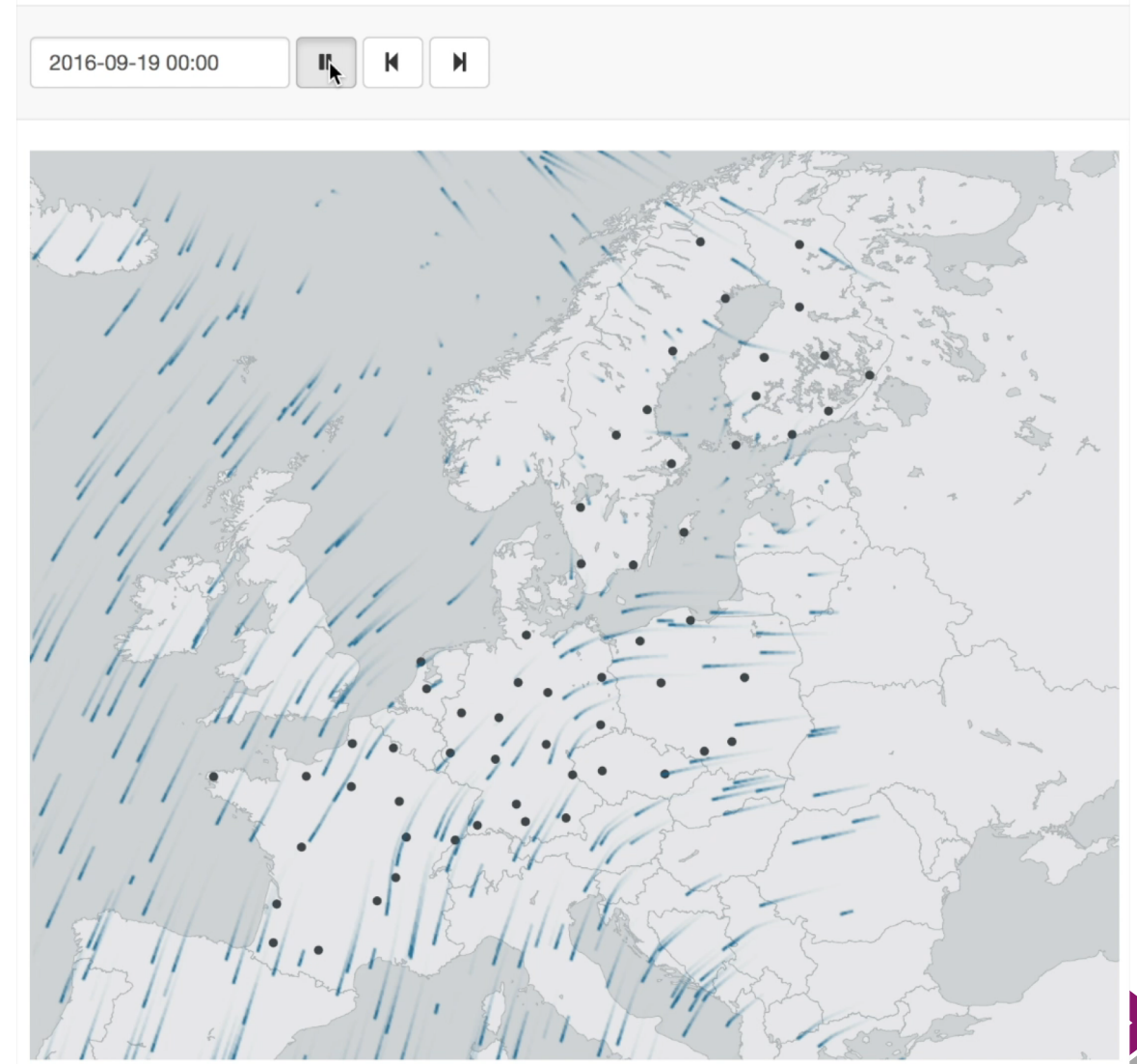
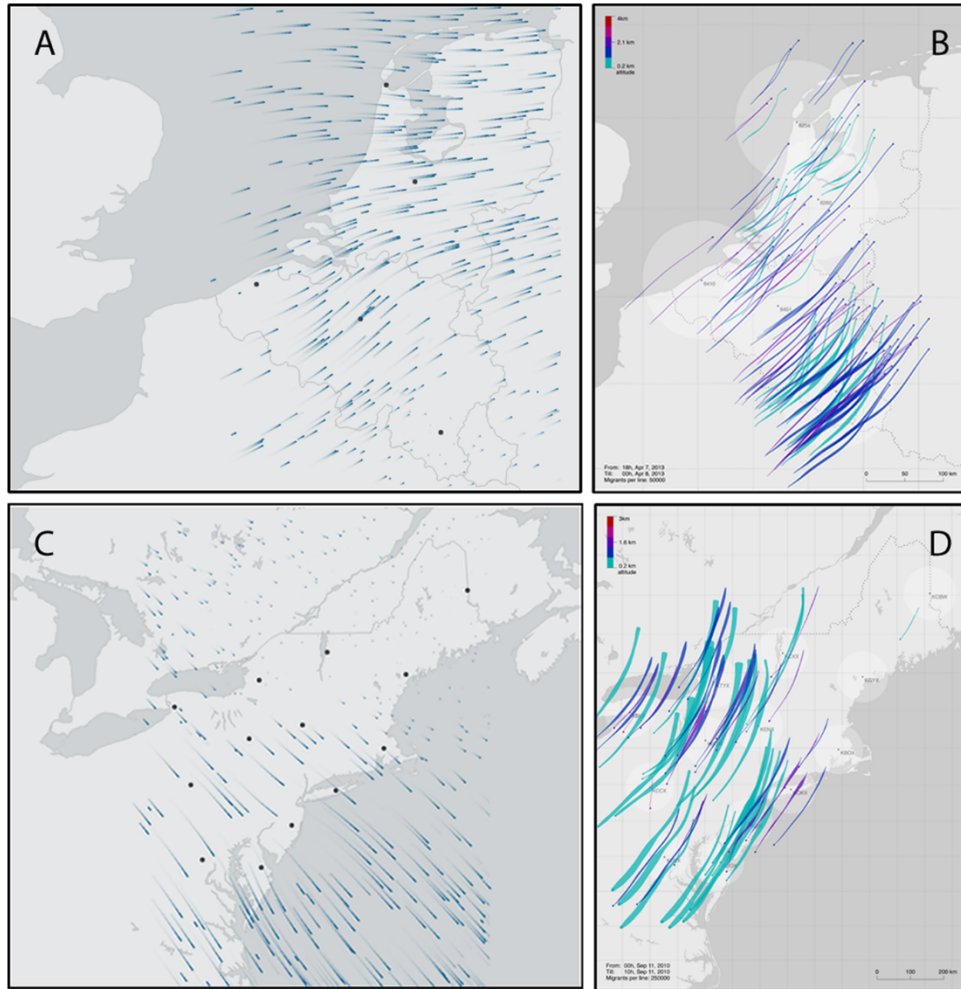
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*Examples where weather radar data is summarized per radar location*

*Nilsson et al 2019, Ecography;*

# Dynamic visualizations of migration flow patterns



Nilsson et al 2019, *Ecography*; Shamoun-Baranes, Farnsworth et al PLOS One 2016

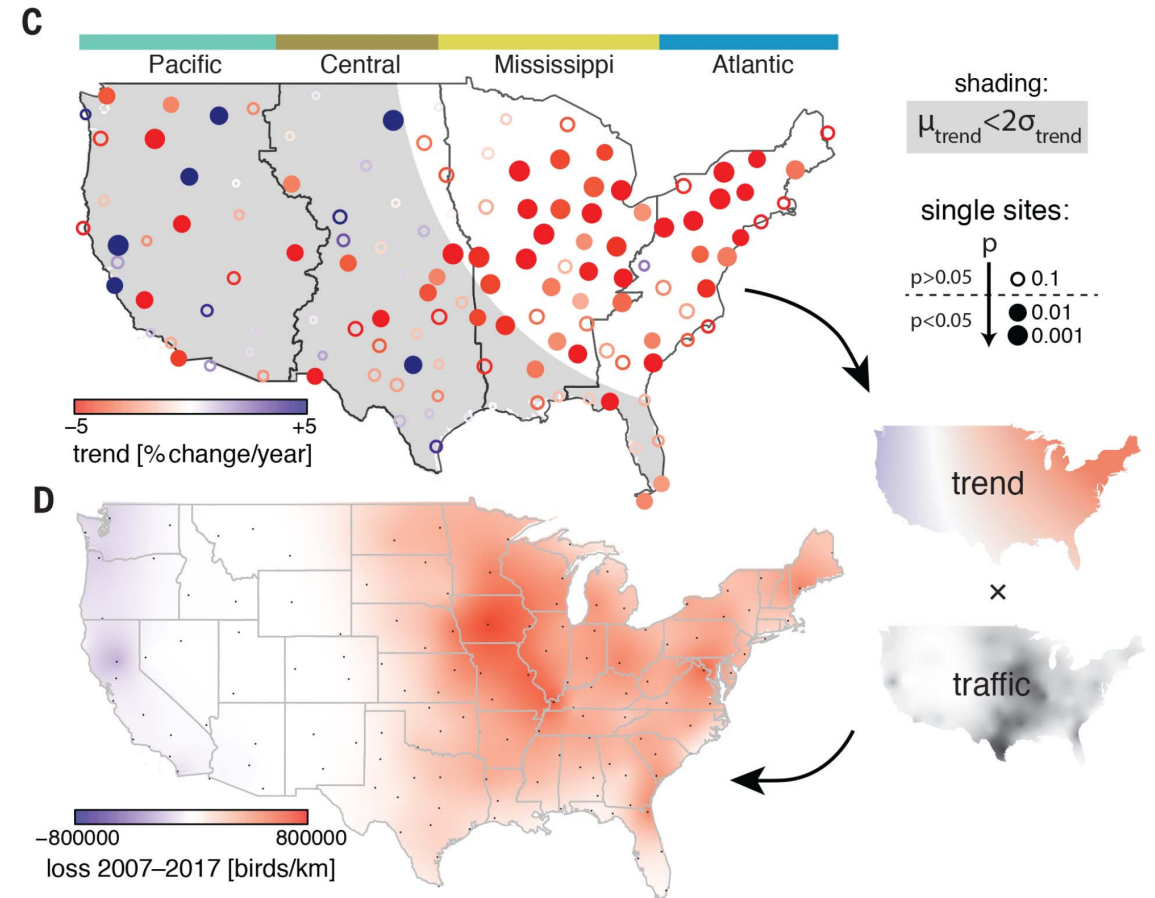
See BirdCast for live visualizations in USA: <https://birdcast.info/migration-tools/live-migration-maps/>



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Combining citizen science and radar data  
Net loss ~ 3 billion birds, or 29% of 1970 abundance



*Examples where weather radar data is summarized per radar location*

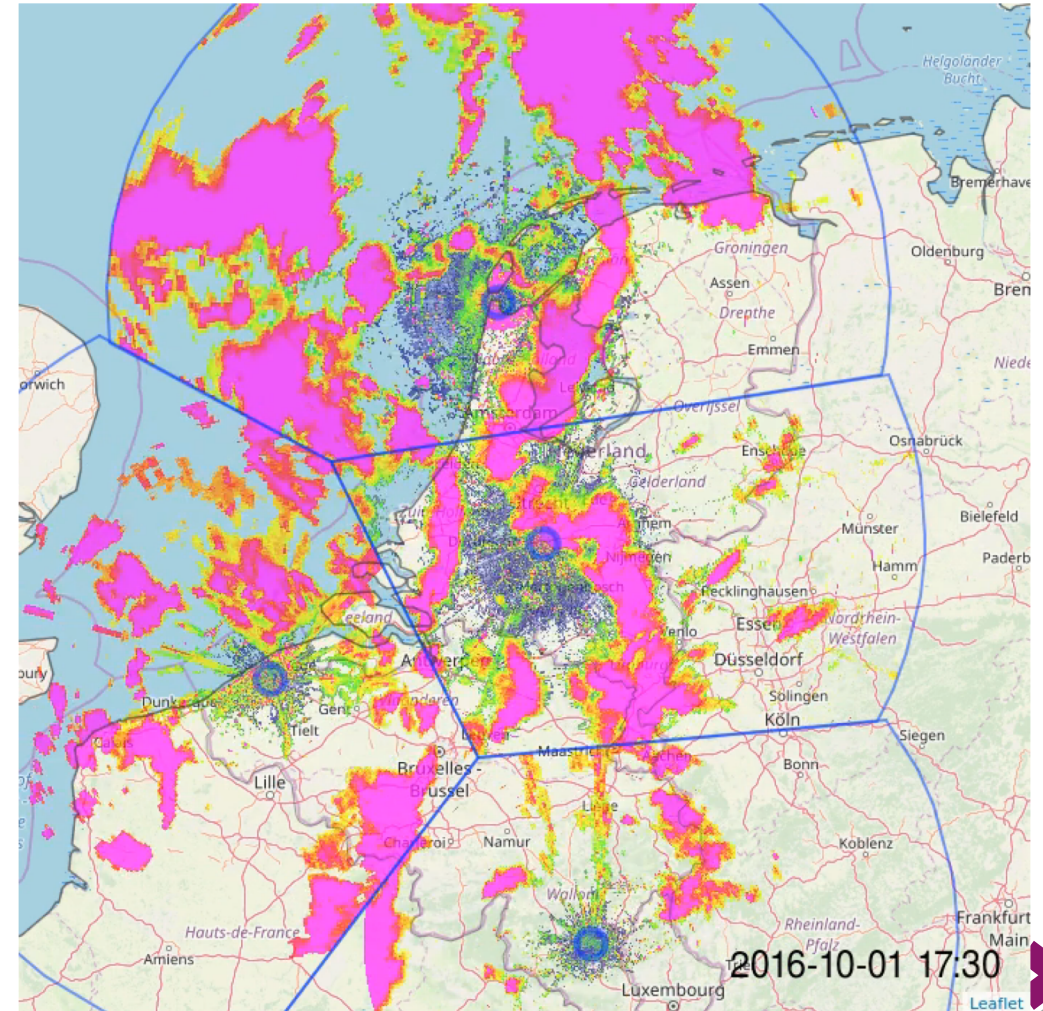
*Rosenberg et al. 2019 Science*

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*Methods available to study variation within a single radar*

*Kranstauber et al Remote Sens. 2020; Buler and Dawsen 2014 Condor*



# Potential for integrating information from different radar systems

## Diverse systems already used to monitor bird movements

### Large scale surveillance radars

- military
- air traffic control
- weather radars



Range for birds: ~20 – 50 km

### Small-scale dedicated bird radars

- tracking radar (selected targets)
- 360° surveillance radar
- Vertical-looking radar



Range for birds: < 10 km

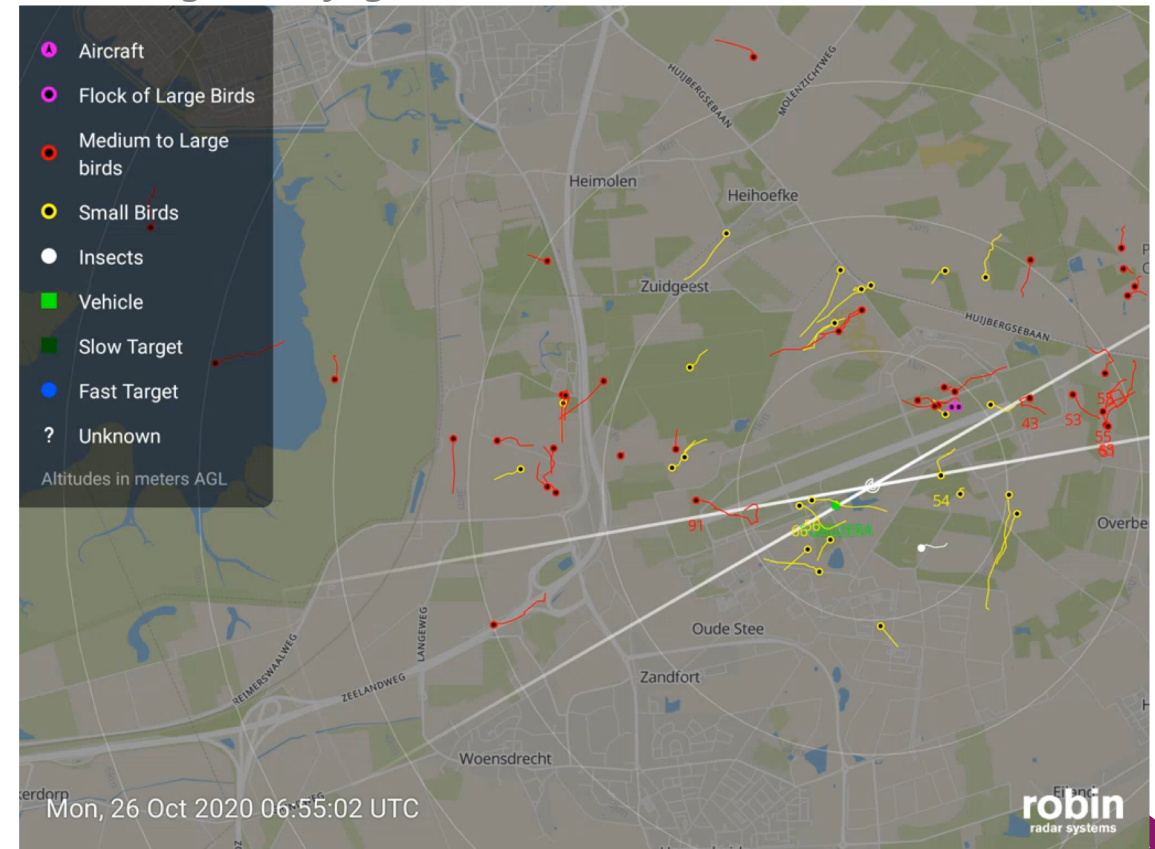


# Dedicated bird radars in use in airfields



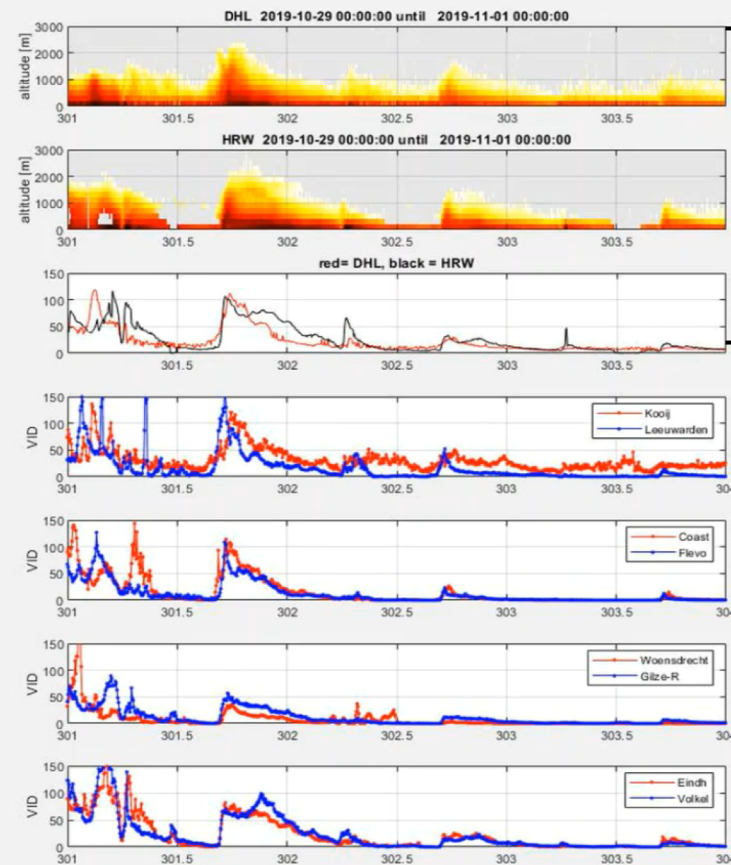
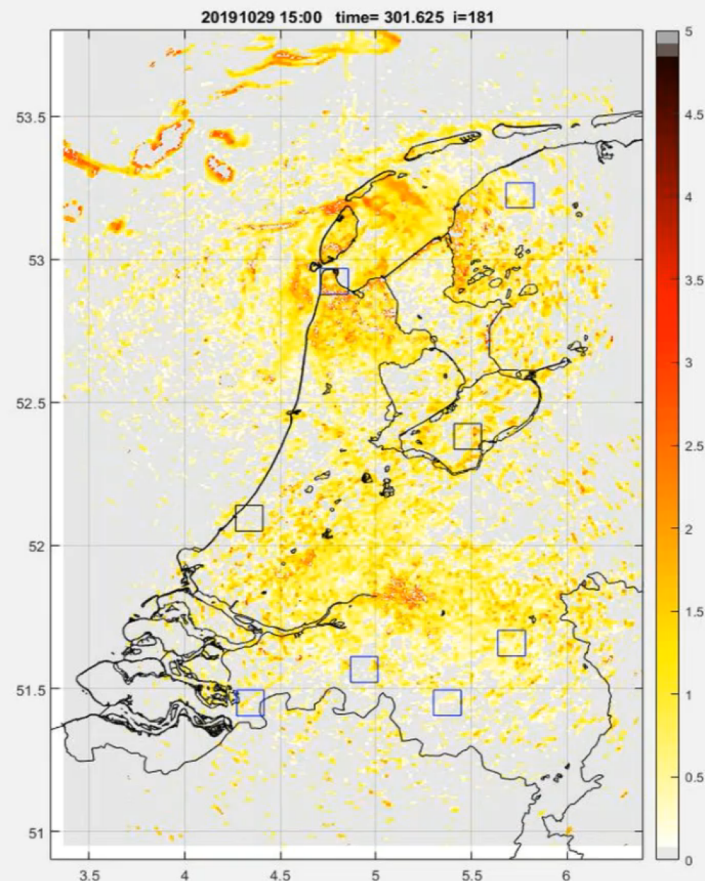
- Near real time warnings to alert bird control units
- Long term monitoring
- Research
  - impact of mitigation measures
  - factors influencing abundance and avian flight behaviour
  - Temporal variation in aerial abundance
  - develop predictive models

*Morning roost flights near Woensdrecht airbase*



# Potential for integrating information from different radar systems

Example from 29-30 October 2019, bird migration from mainland Europe to the UK



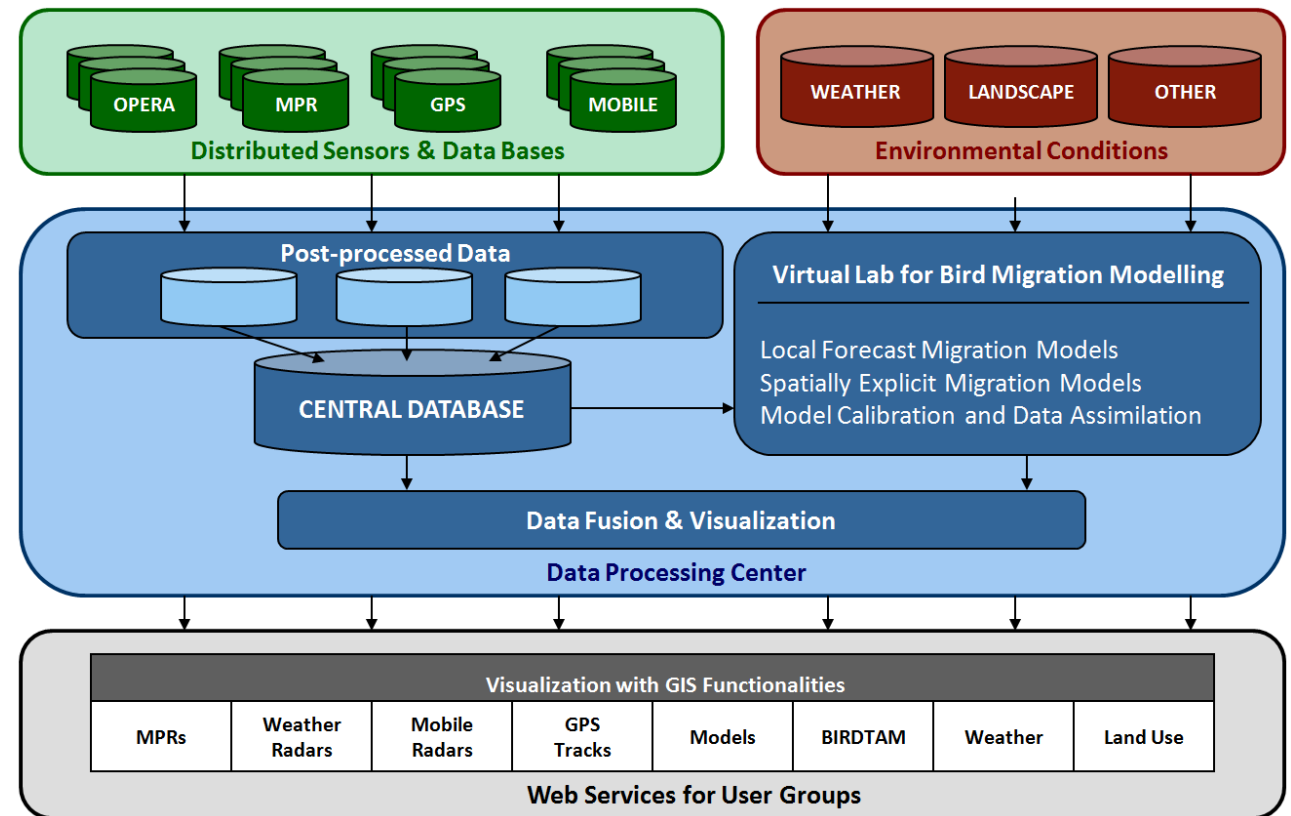
Weather Radars

Robin Radars

# Collaborative research & development infrastructure

Ambitions for the future:

- Global infrastructure to support research, development and web services for diverse interest groups
- Include access to diverse radar datasets
- Include post processing and quality control
- Enable integration of data
- Create long term and continuous dataset (data archive)
- Open access for research



*System currently under development at University of Amsterdam*



## Concluding remarks

- Using weather radar networks to monitor, understand and predict avian migration have great potential for flight safety
- More work is needed to utilize weather radar networks in an operational setting
- Radar systems still have limitations we should be aware of
- Integrate information from different systems to study patterns and processes at different scales & provide complementary data
- Use ecological knowledge to reduce aerial conflicts