Radar-based approaches for monitoring Aerial bioDiversity



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Birds, bats and insects take to the air for essential activities; yet, measuring their numbers and movements is extremely challenging. Radar systems provide long-term, continuous and automated monitoring of a broad range of species.

Weather radar Reflectivity

range

Radial velocity, spectrum width

 Differential reflectivity, correlation coefficient, differential phase Azimuth, beam elevation angle,

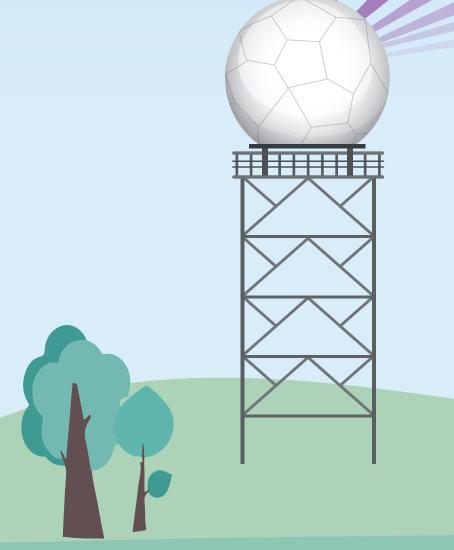
Small-scale radars

- Reflectivity/ radar cross section
- Direction and velocity
- Wing beat frequency
- Polarization
- Altitude



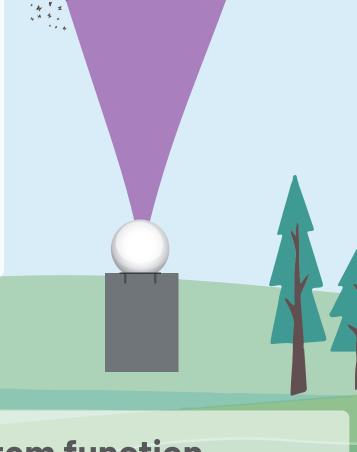
Aims

- 1. Derive biological data from radars
- 2. Develop tools for visualization and analysis of radar data
- 3. Harmonize radar systems
- 4. Demonstrate capacity for biodiversity monitoring
- 5. Data products and tools for stakeholders



Ecological information

- Bioscatterers group abundance and mass
- Shape, uniformity of individual shapes in the group
- Ground speed, group flight di-rection
- Altitude, distance from radar
- Individual size, shape and mass
 - Individual flight direction and
 - ground speed
 - Taxa or (size) class
 - Altitude
 - Flux/ traffic rate



Essential Biodiversity Variables

Species populations Abundance **Biomass**

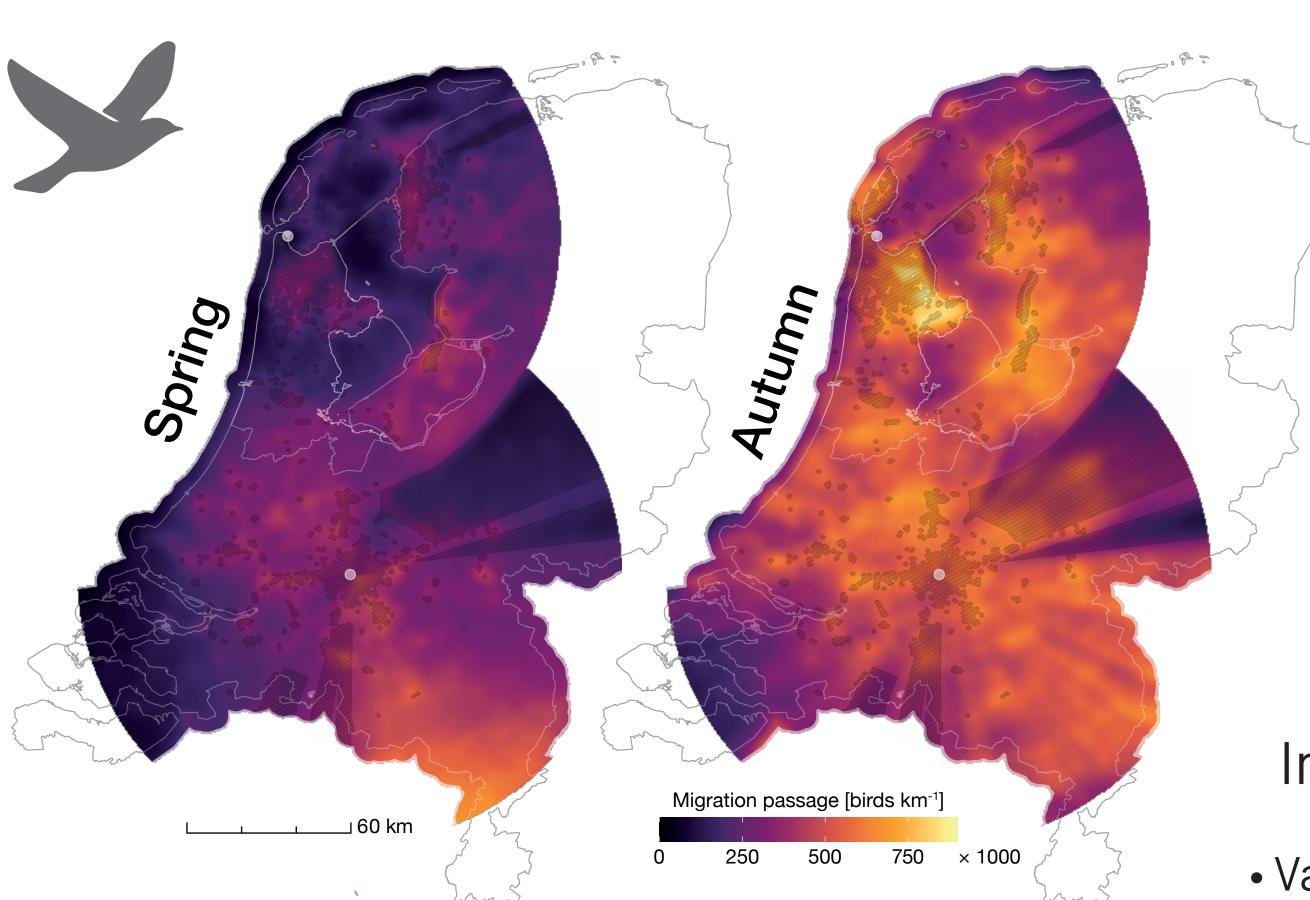
Species traits Phenology Flight behaviour Migration

Exemplary Outcomes

Community composition Taxonomic diversity

Species interactions

Ecosystem function Secondary production Nutrient retention and turnover



Common flight orientation 0.2 Spring Summer Autumn Spring Summer Autumn

Insect flight orientation

- More directed movement at night and more scattered during day
- More directed flights in autumn

Bird migration intensity

Weather-radar derived bird migration intensity over the Netherlands is higher in autumn than spring High regional variation in migration intensity

Insect activity

- Varied across Switzerland
- Grassland with more insects than agricultural and urban habitats
- Maximum >18'000 insects day⁻¹km⁻¹; minimum 1500

Habitat type Agricultural Season Grassland Urban

Swiss Federal Research Institute WSL, Switzerland

- University of Amsterdam, NL
- Research Institute for Nature and Forest, Belgium
- Finnish Meteorological Institute, Finland
- Agroscope, Switzerland

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