



Artificial Intelligence applied to environmental monitoring

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IR0000032 – ITINERIS, Italian Integrated Environmental Research Infrastructures System
(D.D. n. 130/2022 - CUP B53C22002150006) Funded by EU - Next Generation EU PNRR-
Mission 4 “Education and Research” - Component 2: “From research to business” - Investment
3.1: “Fund for the realisation of an integrated system of research and innovation infrastructures”



Day 2

Time	Duration	Training Module - Topic
09:00 - 09:30	30m	Welcome & Introduction to Environmental AI
09:30 - 10:30	1h	Module 1: Biodiversity Monitoring with AI
10:30 - 10:45	15m	Coffee Break
10:45 - 11:45	1h	Module 2: Climate Modelling and Extreme Events Prediction
11:45 - 13:00	1h15m	Module 3: Remote Sensing with AI
13:00 - 14:00	1h	Lunch Break
14:00 - 15:30	45m	Module 4: Big Environmental Data Analysis
15:30 – 16:00	30m	Module 5: Language Models & NLP in Research
15:30 - 15:45	15m	Coffee Break
15:45 - 16:30	45m	Final Activity: Case Studies & Group Work

Welcome & Introduction to Environmental AI

- 🌐 Quick recap of Day 1 (AI/ML basics)
- 🌐 Why AI matters for environmental challenges
- 🌐 Overview of today's topics and tools




AI Algorithms





Module 1: Biodiversity Monitoring with AI

- Species recognition from audio (e.g., birdsong) and images (e.g., camera traps)
- Case studies (e.g., Cornell Lab of Ornithology, iNaturalist)
- Tools: Pretrained models, Google Teachable Machine, custom image classifiers
-  Activity: Group discussion – What biodiversity challenges could benefit from AI?

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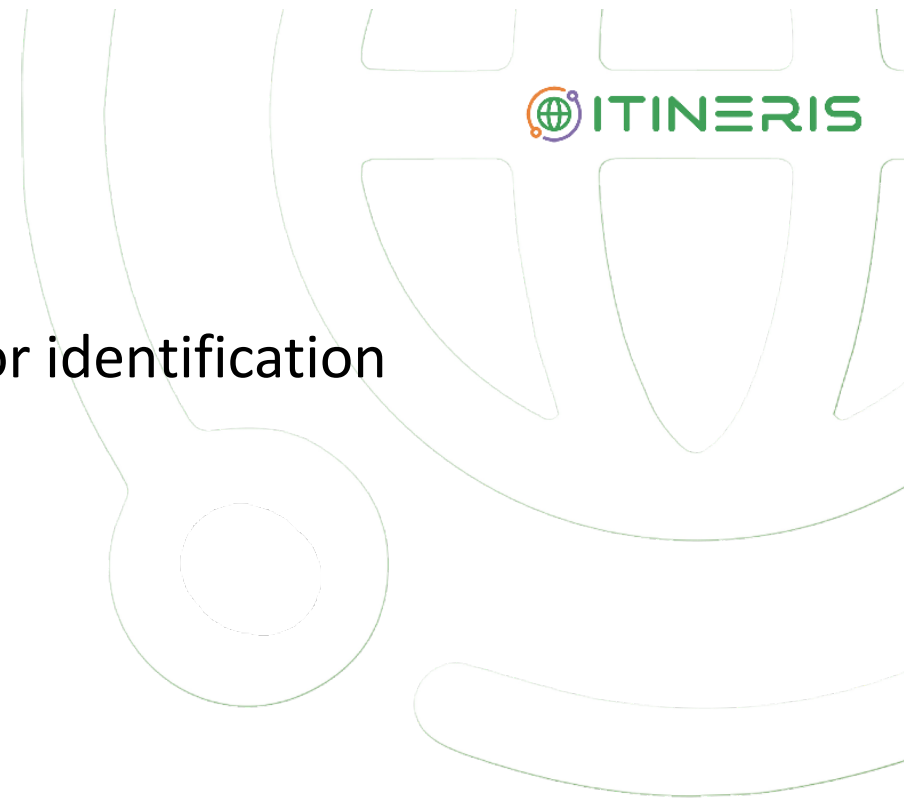


Introduction & Motivation

- 🌐 Why recognizing species matters (conservation, biodiversity monitoring, citizen science)
- 🌐 Challenges: manual data collection, human limitations

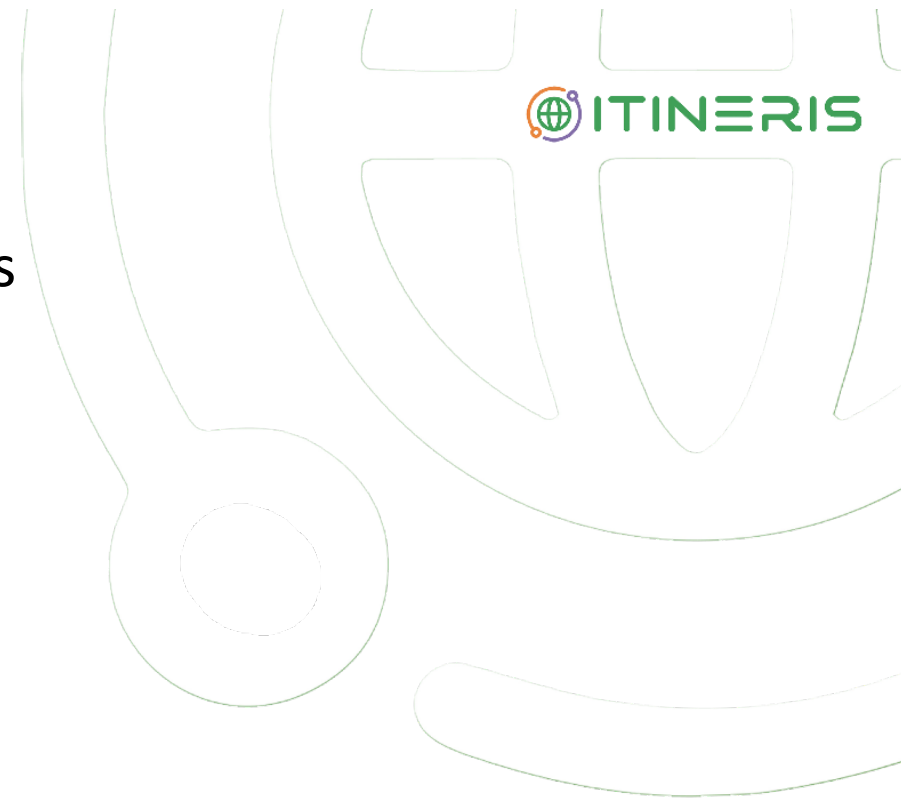
Species Recognition from Audio

- 🌐 What is bioacoustics?
- 🌐 How birdsong and animal sounds are used for identification
- 🌐 Key features: pitch, rhythm, spectrograms



Species Recognition from Images

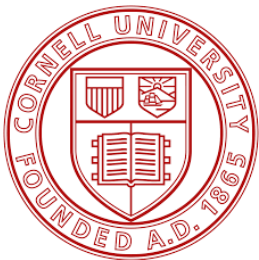
- 🌐 Role of camera traps and smartphone photos
- 🌐 Features: colour, shape, patterns
- 🌐 Detection vs classification



Case Study – Cornell Lab of Ornithology

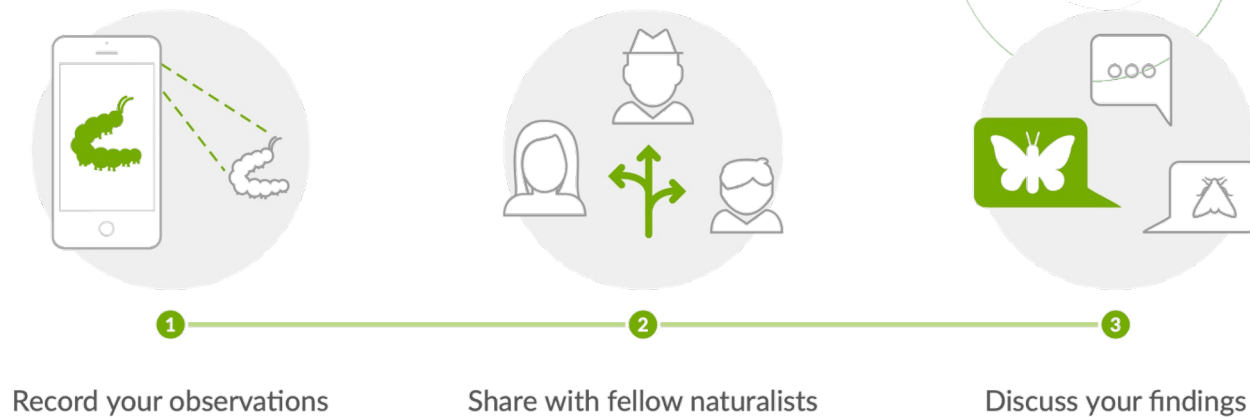


- 🌐 Merlin Bird ID: how it identifies birds from sound
- 🌐 Macaulay Library: large-scale annotated datasets
- 🌐 Machine learning behind the scenes



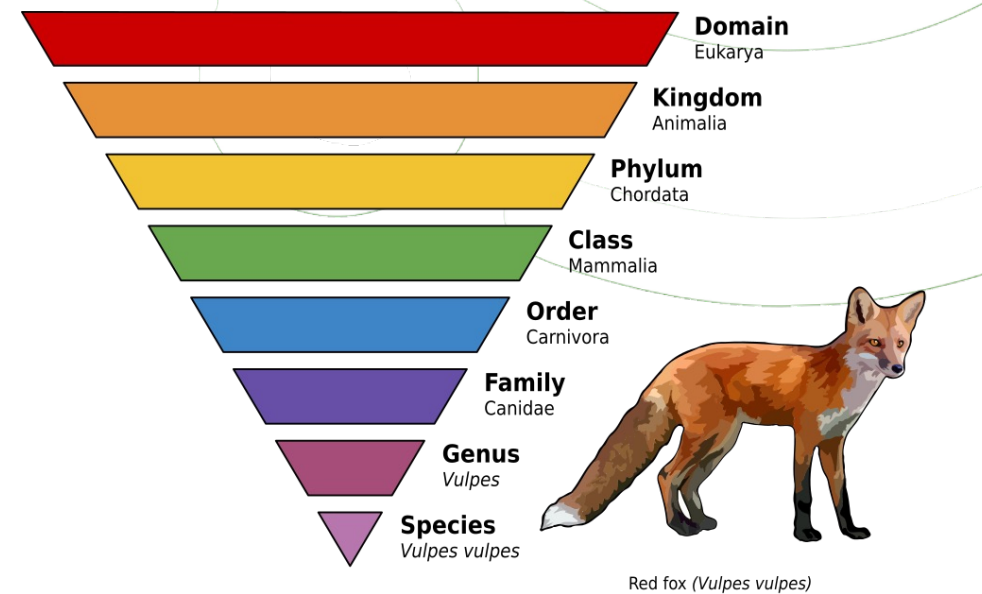
Case Study – iNaturalist

- 🌐 Citizen science at scale
- 🌐 How users contribute and models learn from labelled data
- 🌐 Collaboration with researchers



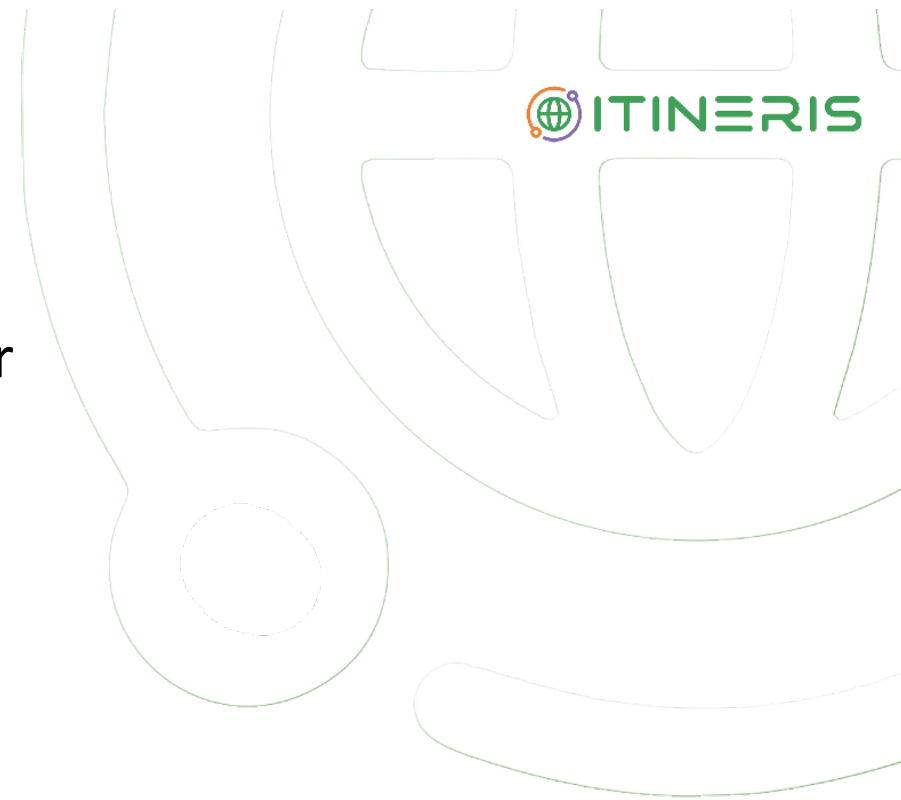
Tools – Pretrained Models

- 🌐 Introduction to pretrained models (e.g., [ResNet](#), [YAMNet](#))
- 🌐 Advantages: faster development, lower data needs
- 🌐 Examples of species classification models



Tools – Google Teachable Machine

- 🌐 Overview of Teachable Machine
- 🌐 Quick demo idea: train a bird vs. cat classifier
- 🌐 Pros & cons (accessibility vs flexibility)

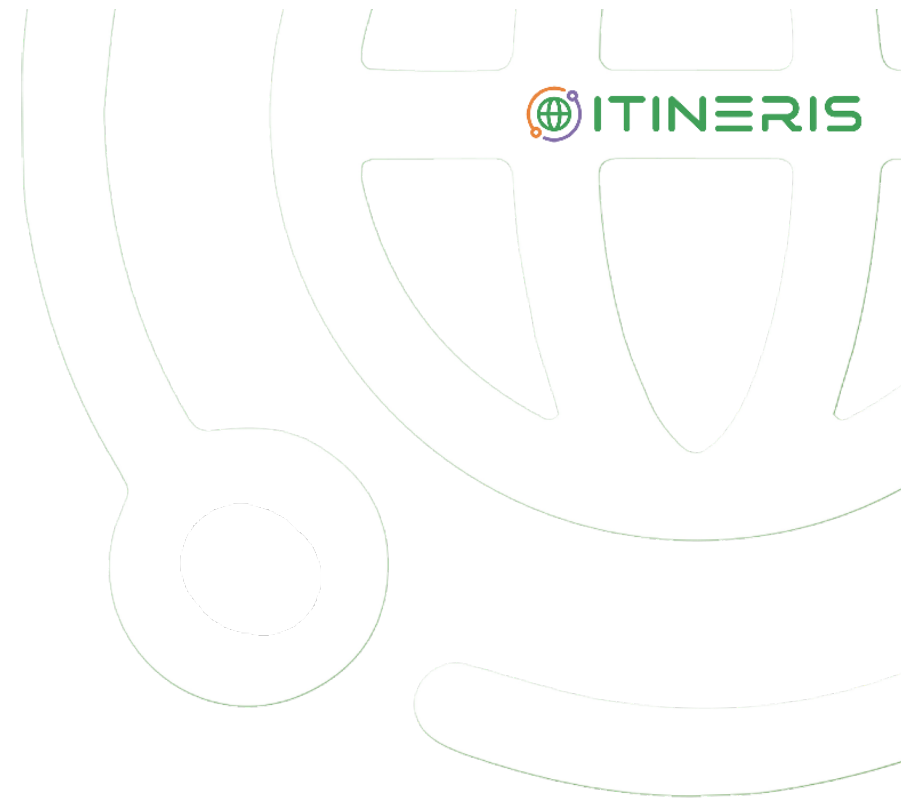


Tools – Custom Image and Audio Classifiers

- 🌐 Using TensorFlow or PyTorch for fine-tuning
- 🌐 Steps: data collection, preprocessing, training, deployment
- 🌐 When to build custom vs use existing tools

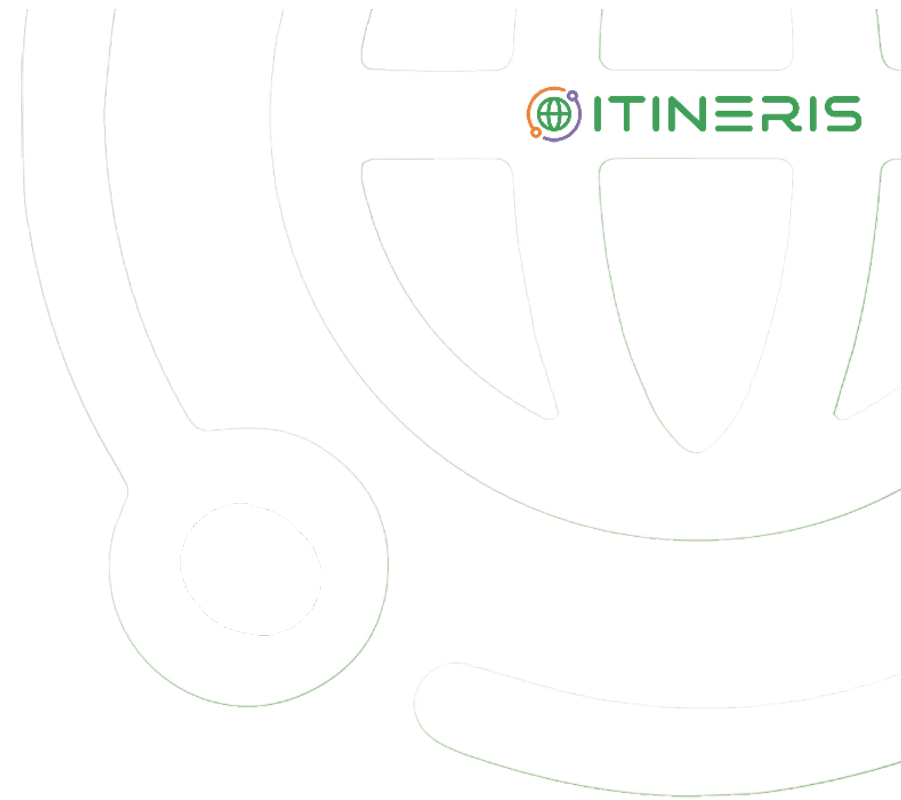
Real-World Applications

- 🌐 Wildlife monitoring
- 🌐 Invasive species detection
- 🌐 Habitat change analysis



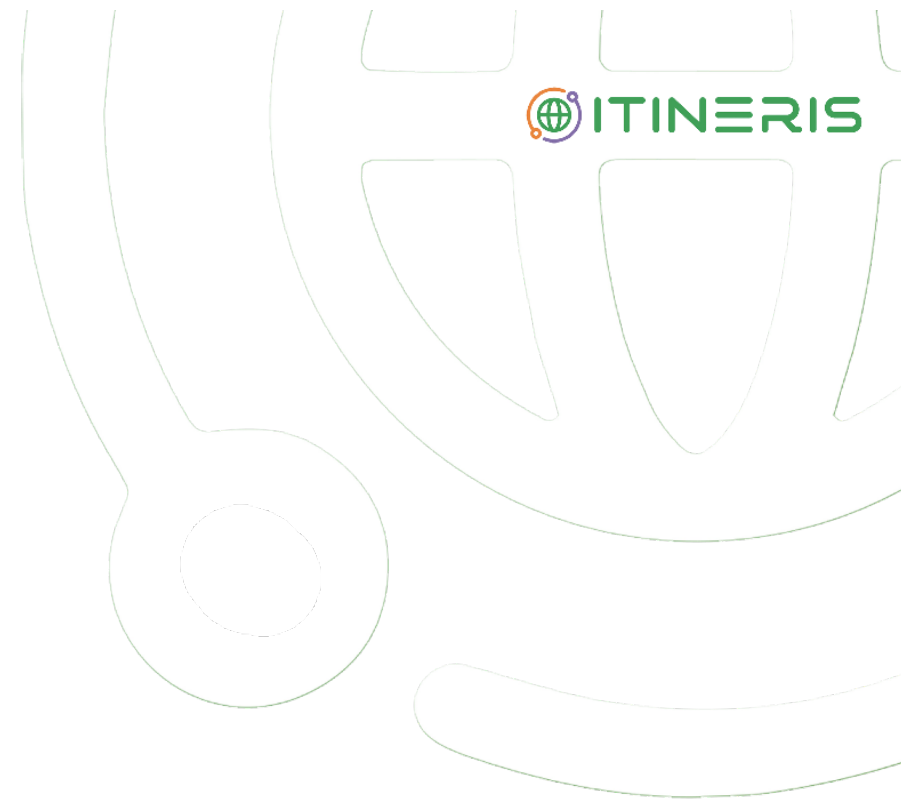
Challenges & Limitations

- 🌐 Data quality and bias
- 🌐 Generalization across regions and seasons
- 🌐 Need for human validation



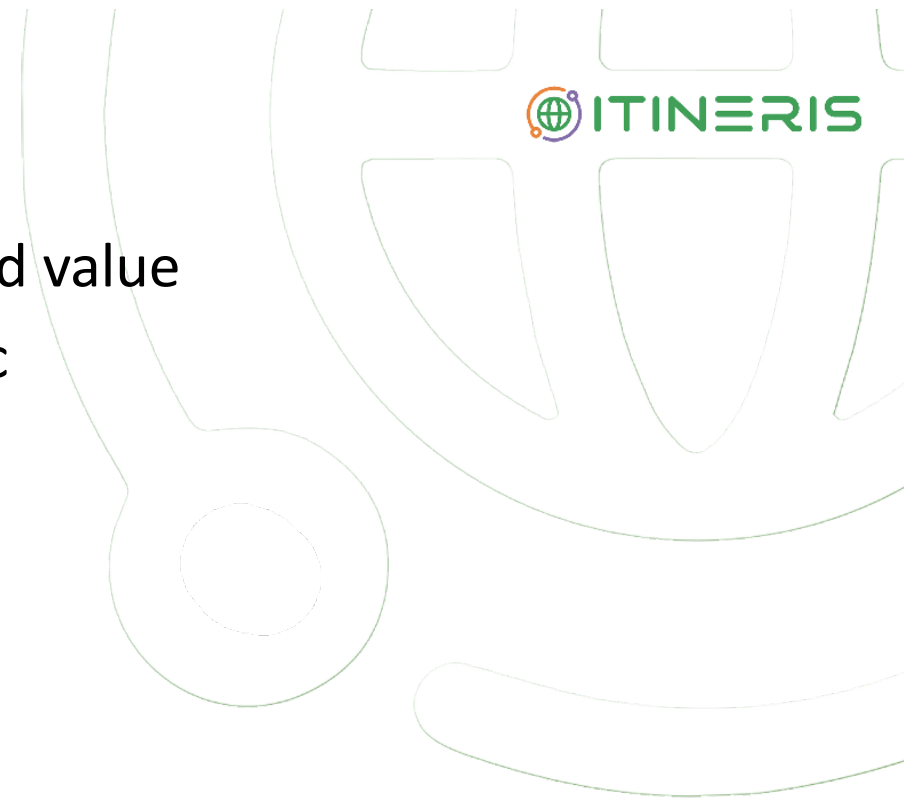
Future Directions

- 🌐 Edge AI for in-field recognition
- 🌐 Multimodal models (audio + image)
- 🌐 Citizen science platforms powered by AI



Recap & Key Takeaways

- 🌐 Summary of tools, techniques, and real-world value
- 🌐 Empowering both researchers and the public




Resources & Links

Recommended reading

- Practical Deep Learning for Coders – Jeremy Howard & Sylvain Gugger
Great for hands-on learning with image classification and transfer learning.
- "Deep Learning with Python" – François Chollet
Covers CNNs and sound/image classification with Keras.

Research Articles & Case Studies:

- "Bird species recognition using machine learning with spectrograms"
(Check journals like Ecological Informatics, PLOS ONE, or Bioacoustics)
- Papers with Code - Sound Classification Benchmarks:
 <https://paperswithcode.com/task/audio-classification>

Open Datasets

Cornell's Macaulay Library Dataset

- Includes bird sound and image datasets. Often used with BirdNET.
<https://www.macaulaylibrary.org>

Xeno-Canto – Community-collected bird sound dataset

- <https://www.xeno-canto.org>

iNaturalist Datasets

- Official datasets from iNaturalist competitions (e.g., FGVC)
<https://www.kaggle.com/c/inaturalist-2019-fgvc6/data>

Google AudioSet

- Large-scale dataset of sound events including animal sounds
<https://research.google.com/audioset/>

DCASE Challenges – Acoustic scene and sound event datasets

- <http://dcase.community/challenge2023>