A Stochastic Collision Risk Model for Seabirds in Flight

First ScotMER symposium
Victoria Quay, Edinburgh
2nd October 2018

- Purpose and aims;
- Approach taken;
- Questionnaire;
- Recommendations;
- Comparison of Band (2012) and Masden (2015);
- Implementation;
- Final product.

Purpose

- develop a **stochastic** version of the **Band** model in **R**;
- incorporate **gaps** identified by industry and statutory agencies;
- **robust** and **transparent** method;
- accounting for **uncertainty** in collision rates;
- **easily** applied to real-world situations.

Approach

- Identify gaps;
- Question stakeholders;
- Determine feasible changes;
- Create beta tool (in R);
- Consult (steering group);
- Amend and finalise tool (Shiny app).

Stakeholder questionnaire

- Anonymous;
- Online or PDF or hard copy
- 13 questions
- 41 stakeholders contacted – 25 responses
- Mix of multiple choice and free text

Stakeholder requested changes to sCRM

- Create shiny or user friendly interface for non-R users;
- Speed up code;
- Number of turbines – user input;
- Output predicted collisions probability data;
- Seasonal (as well as monthly & annual) assessment (default + user defined);
- Error checking inputs and collision probability;
- Monthly or seasonal flight height inputs.

Comparisons of Excel-Band and Masden R-code

- The extant code was given detailed comparison with the (non-stochastic) Excel version, with the Excel taken as gold standard
- Stochasticity was supressed to check point estimates – some minor bugs and discrepancies were found and fixed
- One bug was found which leads to modest bias in mean collisions relative to the Excel versions (due to a shift in flight-heights relative to turbine position). This was corrected.

Modifications to core Masden code

- Restructured for general increases in efficiency and improvements in consistency & clarity – so easier to debug, alter and maintain.
- Fine-scale profiling of the code led to increases in speed (>4x).
- All code was version-controlled and made publicly accessible through a GitHub repository (so can be community maintained)

Shiny

- An R package that helps you build interactive web applications
- Basically it gives users an interface your R code/programs through a web-browser
- The application can housed/used on your local machine or on a remote server

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Shiny – some benefits

- Users can interact with R without any coding
- The GUI can be made very user-friendly
- Being a web/browser based app, it is platform independent
- The application, if housed remotely means:
  - Users don't need to have R locally, or maintain R in anyway
  - Updates and fixes are done on the server-based code, so are propagated to all users

Shiny- CRM added functionality

- Pop-up help-prompts, input checking, default values (in some cases)
- Editable input fields
- Can import user-defined flight-height distributions and bootstraps
- Speed increases
- Extended outputs, including files logging the inputs used in the simulations

Shiny-CRM in action

- The project GitHub repository containing code, links & documentation is here:

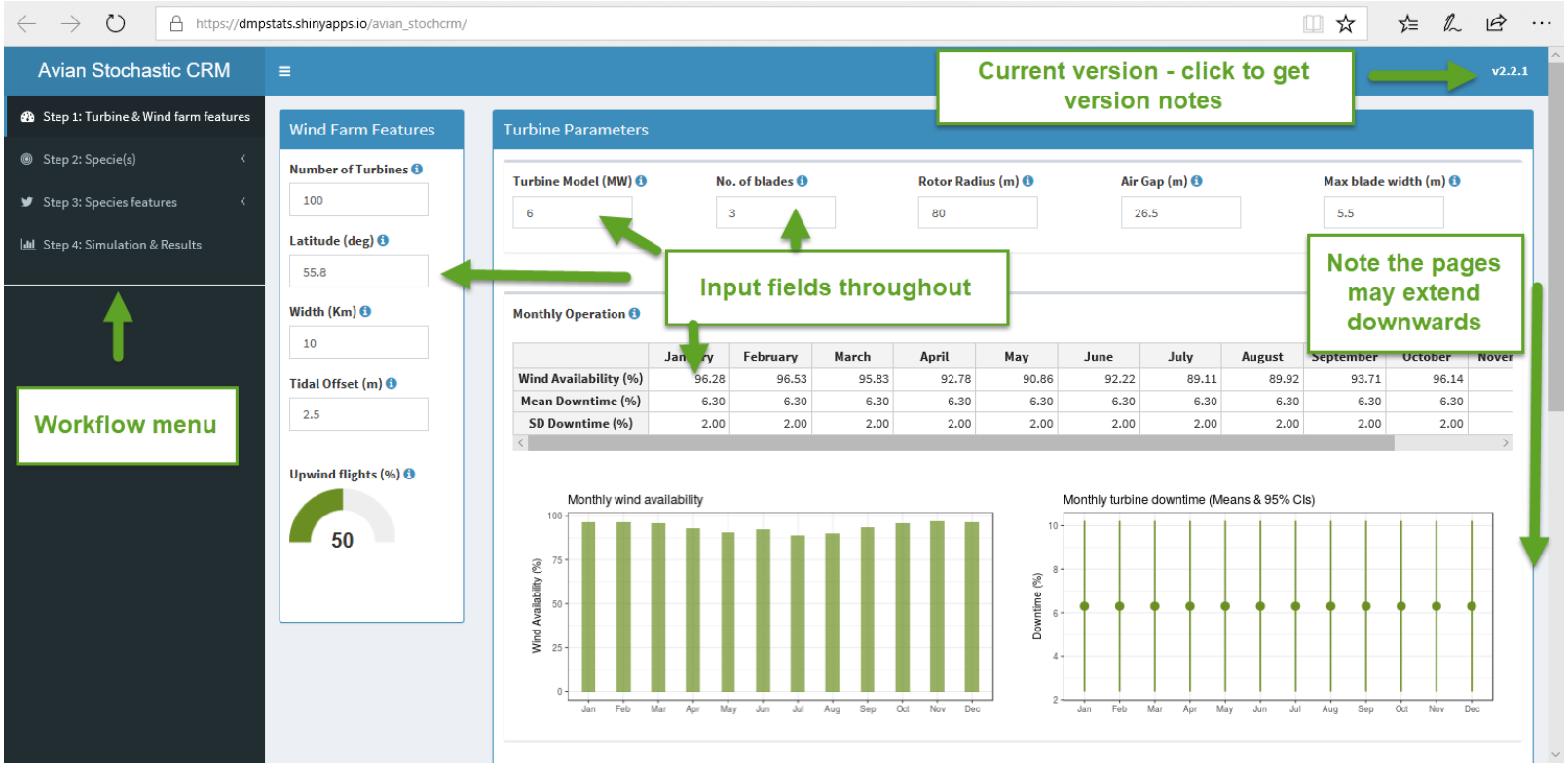
https://github.com/dmpstats/stochCRM

- The app is accessible from the shiny server via this URL

https://dmpstats.shinyapps.io/avian_stochcrm/

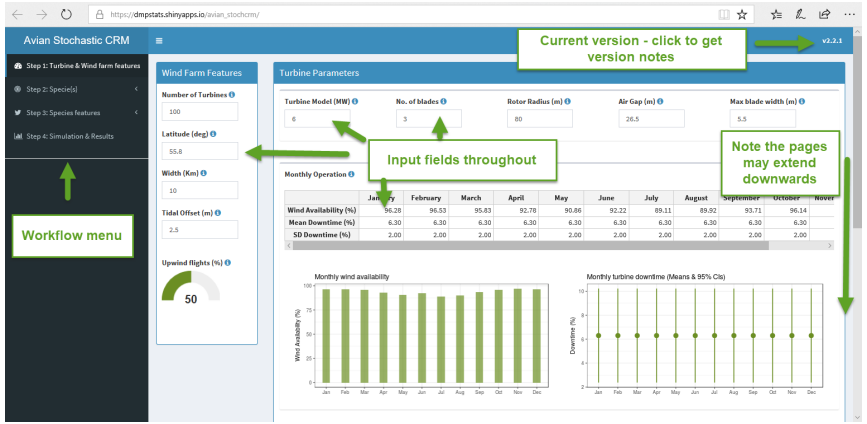
- Project documentation via this URL

https://www.gov.scot/Topics/marine/marineenergy/mre/current/StochasticCRM


https://dmpstats.shinyapps.io/avian_stochcrm/
Avian Stochastic CRM
v2.2.1
Current version - click to get version notes
Step 1: Turbine & Wind farm features
Step 2: Specie(s)
Step 3: Species features
Step 4: Simulation & Results
Workflow menu
Wind Farm Features
Number of Turbines
100
Latitude (deg)
55.8
Width (Km)
10
Tidal Offset (m)
2.5
Upwind flights (%)
50
Turbine Parameters
Turbine Model (MW)
6
No. of blades
3
Rotor Radius (m)
80
Air Gap (m)
26.5
Max blade width (m)
5.5
Input fields throughout
Note the pages may extend downwards
Monthly Operation
February March April May June July August September October
Wind Availability (%) 96.28 96.53 95.83 92.78 90.86 92.22 89.11 89.92 93.71 96.14
Mean Downtime (%) 6.30 6.30 6.30 6.30 6.30 6.30 6.30 6.30 6.30 6.30
SD Downtime (%) 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00 2.00
Monthly wind availability
Wind Availability (%)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Monthly turbine downtime (Means & 95% CIs)
Downtime (%)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Shiny-CRM in action

Live/video demo



Current & ongoing development

- Users can log bugs and suggestions through the GitHub repository – so modifications are ongoing
- Further speed increases are likely – it still takes some minutes to perform the simulations
- Seasonal flexibility

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Overview

- The stochastic CRM has been extended and improved
- It is now accessible via a user-friendly, browser-based application
- The entire project is transparent, open-source and amenable to community-driven improvements

Acknowledgements

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