UK Centre for
Ecology & Hydrology

SCAIL-Combustion: User guide

June 2023

Contents

1 Introduction

Simple Calculation of Atmospheric Impact Limits from Combustion Sources (SCAIL-Combustion) is a screening tool for assessing the impact from Combustion plants on human health and on semi-natural areas like SSSIs and SACs. The model provides an estimate of the amount of acidity, nitrogen and sulphur deposited on a habitat from the combustion source as well as particulate PM_{10}, NO_2 and SO_2 concentrations for human health receptors. These values can then be used to assess whether impact limits for human health or habitats are exceeded or not.

The SCAIL-Combustion user guide provides information on the Industrial Emissions Directive (IED), critical loads and the model, as well as providing a walk-through of the system itself. You will be shown how to complete a query using the web form and how to interpret the results.

1.1 Legislative background

To control industrial emissions, the EU has developed a general framework based on integrated permitting. This means the permits must take account of a plant's complete environmental performance and priority should be given to preventing pollution by intervening at source and ensuring prudent use and management of natural resources. The Industrial Emissions Directive (IED)_and Medium Combustion Plant Directive (MCPD) is covered under The Environmental Permitting (England and Wales) Regulations 2016; Pollution Prevention and Control (Scotland) Regulations 2012; Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 ('The Regulations'); and, Environmental Protection Agency (Industrial Emissions) (Licensing) Regulations Republic of Ireland) 2013. Permits are required for combustion installations of a certain MW – different countries in the UK apply different thermal outputs to be permitted. Applications for permits need to be assessed for their potential impacts on the environment including the impact of deposition downwind of the installation. If there is the potential for deposition to have an impact on a site with a conservation designation (made or proposed) under the Conservation Regulations 1994 – known as European sites (e.g. Special Area of

Conservation – SAC) – or a national Site of Special Scientific Interest (SSSI) then this potential impact needs to be considered.

A summary of the IED and MCPD can be found on the EU IED and MCPD pages. The following links will direct the user to the relevant guidance specific to the agency regulating the installation.

- England:
    - Medium combustion plant – Medium combustion plant: apply for an environmental permit - GOV.UK (www.gov.uk)
- Wales: https://naturalresourceswales.gov.uk/permits-and-permissions/installations/information-about-installations/?lang=en
- Scotland: http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control
- Northern Ireland: https://www.daera-ni.gov.uk/topics/pollution
- Republic of Ireland: http://www.epa.ie/pubs/forms/lic/ipc/#d.en.46362.

If there is the potential for pollutant concentrations or deposition to have an impact on a site with a conservation designation [*e.g.* Special Area of Conservation (SAC) or in the UK an Area/Site of Special Scientific Interest (ASSI/SSSI)] then this potential impact needs to be considered.

PM_{10} legislation - Air quality regulation within the EU is based upon the Ambient Air Quality Directive (2008/50/EC) and Directive 2004/107/EC, which set limits for concentrations of pollutants in outdoor air. These are promulgated in national legislation. Air quality is a devolved matter, though the UK government leads on international and European legislation. Administrations in Scotland, Wales and Northern Ireland are responsible for their own air quality policy and legislation. The Air Quality (Standards) Regulations 2010 transpose into English law the requirements of Directives 2008/50/EC and 2004/107/EC on ambient air quality. Equivalent regulations have been made by the devolved administrations in Scotland, Wales and Northern Ireland. The equivalent in the Republic of Ireland is the Air Quality Standards Regulations 2011.

Further, guidance can be found at:

http://www.scottishairquality.co.uk | http://www.sepa.org.uk | http://www.apis.ac.uk | Environment Agency - GOV.UK (www.gov.uk) |http://naturalresourceswales.gov.uk | http://www.epa.ie | http://www.daera-ni.gov.uk.

1.2 Emission sources and impacts

Sulphur dioxide, SO2 - Sulphur dioxide (SO2) is produced when a material, or fuel, containing sulphur is burned. Globally, much of the SO2in the atmosphere comes from natural sources, but in the UK the predominant source is power station burning of fossil fuels, principally coal and heavy oils. Widespread domestic use of coal can also lead to high local concentrations of SO_2.

Ecosystem impacts – see APIS Overview Sulphur dioxide (SO2)

Nitrogen oxides, NOx - Nitric oxide (NO) is mainly derived from road transport emissions and other combustion processes such as the electricity supply industry. NO is not considered to be harmful to health. However, once released to the atmosphere, NO is usually very rapidly oxidised to nitrogen dioxide (NO_2), which is harmful to human health. NO_2 and NO are both oxides of nitrogen and together are referred to as nitrogen oxides (NOx).

Ecosystem impacts – see APIS Overview Nitrogen Oxides (NOx)

Nitrogen (N) deposition - describes the input of reactive nitrogen from the atmosphere to the biosphere both as gases, dry deposition and in precipitation as wet deposition. Enhanced reactive nitrogen deposition is a consequence of global emissions of oxidised nitrogen (NO, HNO_3 and NO_2 – often referred to as NO_y) from fossil fuel combustion, and reduced N (NH_x) from agricultural sources. Effects of ammonia gas and dry deposition of ammonia (NH_3) is assessed in the SCAIL Agriculture. tool.

Ecosystem impacts – see APIS Overview Nitrogen Deposition

Acid deposition – represents the mix of air pollutants that deposit from the atmosphere leading to acidification of soils and freshwaters. It mainly consists of pollutants emitted by the combustion of fossil fuels (e.g. power generation). The removal of these pollutants from the atmosphere is in the form of wet deposition in rainfall, cloud-water or occult deposition, mist and dew, but also includes dry deposited acidifying gases. Rainfall that is acidic, possesses elevated H+ ion concentrations, and has been commonly known as 'acid rain'.

Ecosystem impacts – see APIS Overview Acid Deposition

Particulate matter, PM_{10} - Particulate pollution is composed of particles that are small enough to remain suspended in the air. Particulate matter pollution consists of very small particles floating in

the air, which can include smoke, soot, dust, salts, acids, metals, and semi-volatile liquids. Particulate matter also forms when gases emitted from industrial and combustion sources, and motor vehicles undergo chemical reactions in the atmosphere. Particulate pollution also can include materials that can be highly toxic. Exposure to such particles can affect both the lungs and heart.

Human Health Impacts: PM_{10} refers to particulate matter less than 10 microns in diameter, about one seventh the thickness of a human hair. Major sources of PM_{10} include motor vehicles; wood burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning, industrial sources, windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

1.3 Critical Loads/Levels and Air Quality Limits

Critical Loads/levels are the threshold level for the deposition or concentration of a pollutant above which harmful indirect effects may occur on a habitat or species, according to current knowledge. Additional deposition above the Critical Load/Level is termed Critical Load/Level Exceedance. For combustion processes we are primarily interested in SO2 and NOx emissions which lead to sulphur and nitrogen being deposited onto vegetation which may be harmful. Deposition is always quoted in kg of sulphur or nitrogen per hectare per year (kg S/ha/yr and kg N/ha/yr respectively). If 15 kg of nitrogen were deposited to a sensitive bog ecosystem every year, where the bog has a critical load of 5-10 kg N/ha/yr over time the integrity of the bog would decrease. Critical loads have been set to protect the vegetation but symptoms may not be visible for up to 10 to 20 years.

Further information on critical loads and levels.

SCAIL Combustion also assesses human health receptors using the National Air Quality Objectives. In SCAIL we provide the user the option to test against PM_{10}, NO2 and SO2 air pollutants. Details of the air quality limit values can be found in the following UK AIR web pages and document.

1.4 Meteorology

The SCAIL-Combustion screening model uses an approach that uses data from nearby meteorological stations. The Typical Meteorological Year approach is used to derive meteorological data to best represent the long-term dataset based on the similarity of the annual wind direction distribution to the long-term average (five year). Similarity of long-term wind direction distributions of nearby stations has been used to reduce the number of meteorological stations used. The 109 stations included in the model for the UK are shown in Figure 1 below:

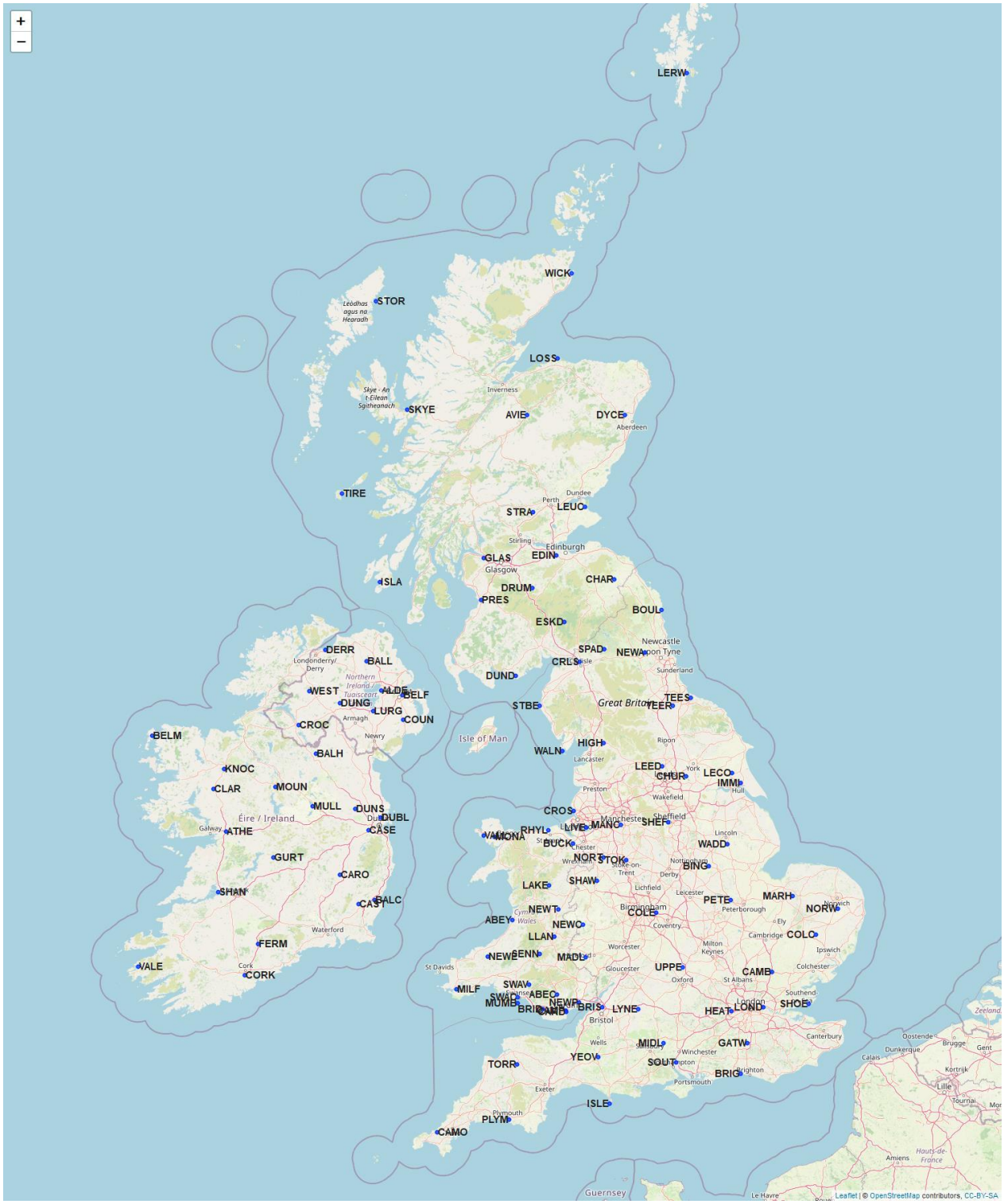
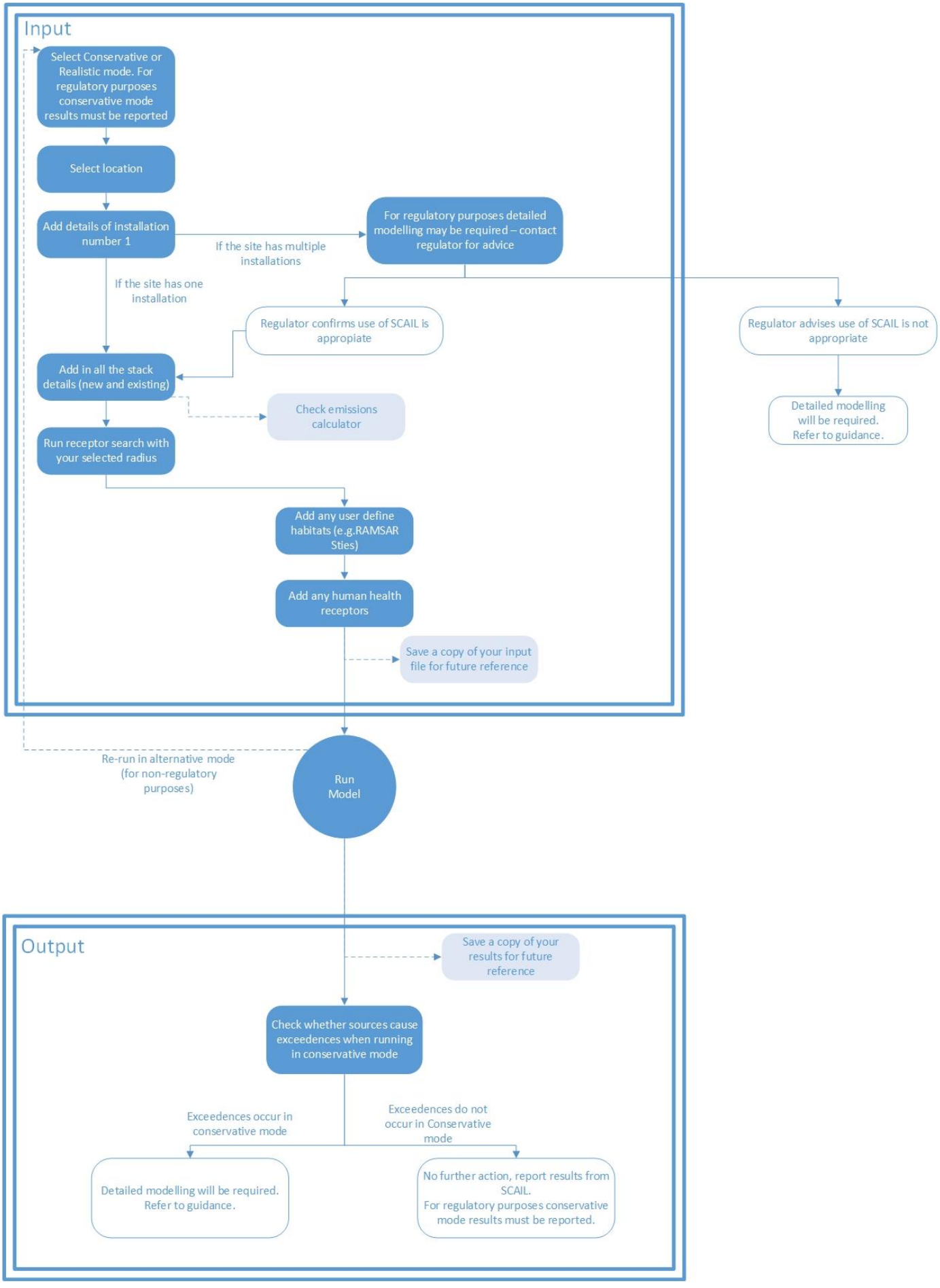


Figure 1: 109 Meteorological Station used in SCAIL-Combustion


Input
Select Conservative or Realistic mode. For regulatory purposes conservative mode results must be reported
Select location
Add details of installation number 1
If the site has multiple installations
For regulatory purposes detailed modelling may be required – contact regulator for advice
If the site has one installation
Regulator confirms use of SCAIL is appropiate
Regulator advises use of SCAIL is not appropriate
Add in all the stack details (new and existing)
Check emissions calculator
Detailed modelling will be required. Refer to guidance.
Run receptor search with your selected radius
Add any user define habitats (e.g.RAMSAR Sties)
Add any human health receptors
Save a copy of your input file for future reference
Re-run in alternative mode (for non-regulatory purposes)
Run Model
Output
Save a copy of your results for future reference
Check whether sources cause exceedences when running in conservative mode
Exceedences occur in conservative mode
Exceedences do not occur in Conservative mode
Detailed modelling will be required. Refer to guidance.
No further action, report results from SCAIL.
For regulatory purposes conservative mode results must be reported.

2.2 Filling out the Form

Throughout the SCAIL-Combustion web system the user is provided with guidance notes by using the information icon ( ). By clicking the mouse on the icon (see Figure 3) text is displayed in the grey box on the right of the form giving guidance on the relevant input field.

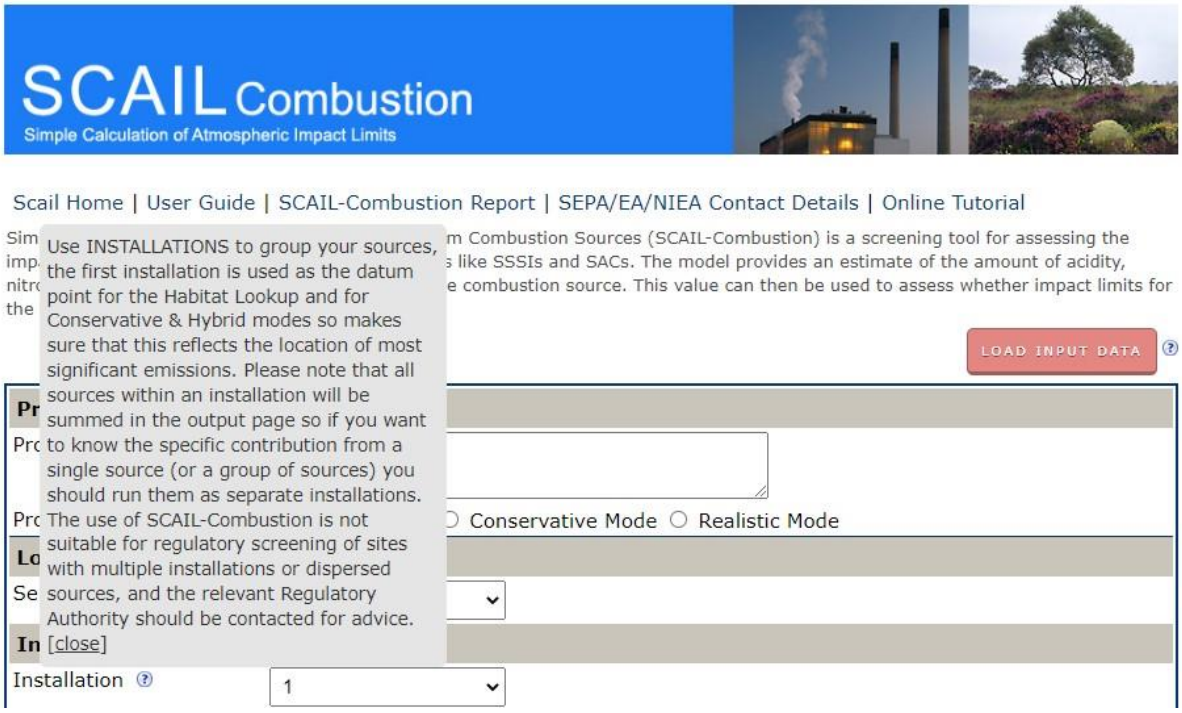


Figure 3: How to use the guidance info tool

2.2.1 Entering Input Data

All the information needed to run the model is entered on the web form. However, if you have saved input data from a previous run, this can be loaded by clicking on the **Load Input Data** button at the top-right of the form. This will bring up a window where the input file can be selected and loaded (Figure 4). This will populate the form with the saved input data, ready to edit or run.

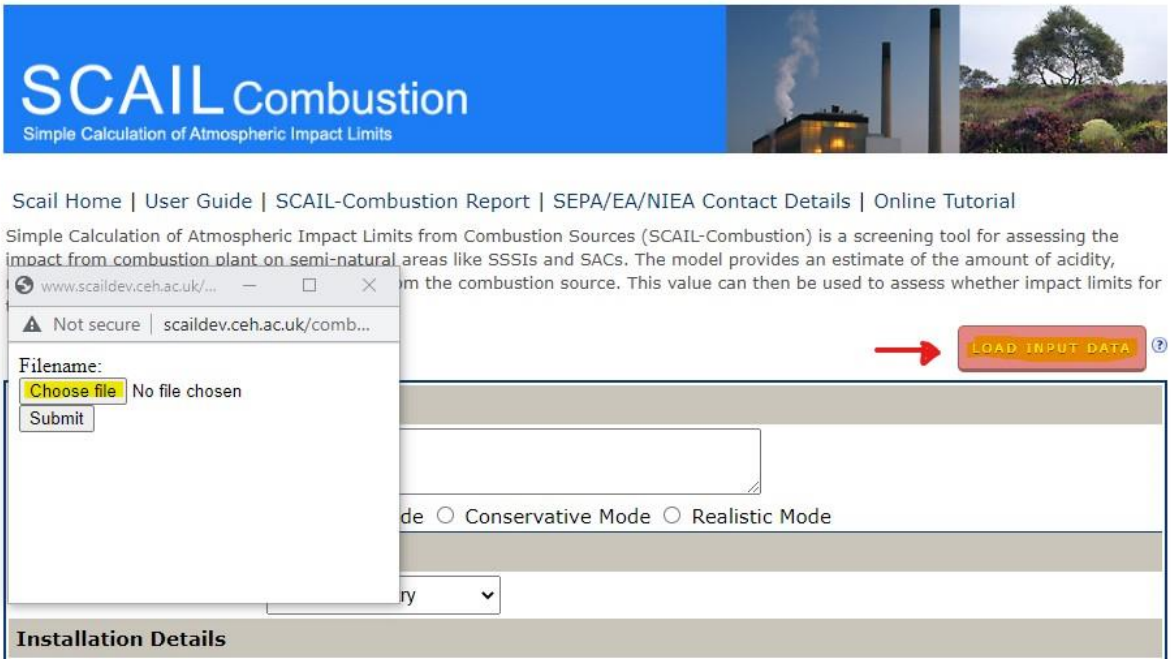


Figure 4: Specifying file for loading input data

2.2.2 Project Details & Run Modes

In the **Project Notes** box you can enter details on the sources to be modelled and the type of run being carried out, *e.g*. 'hybrid' or 'conservative. This information is copied onto the output screen and also to any output files saved (Figure 5).

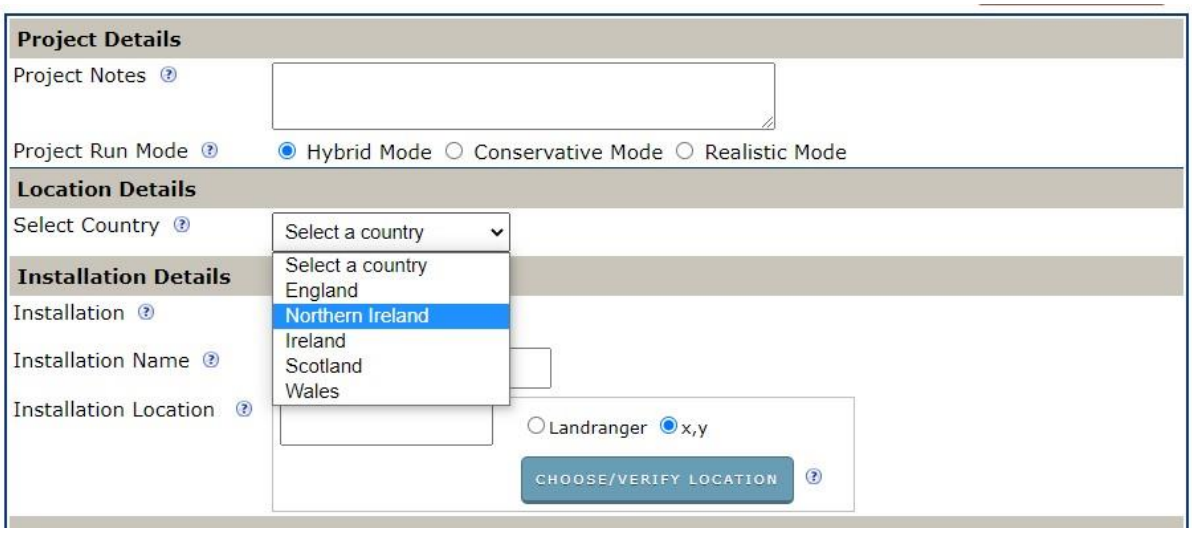


Figure 5: Initial project setup

For the Project Run Mode, either **Hybrid** or **Conservative** (or **Realistic** mode) can be chosen (Figure 5).

Where SCAIL-Combustion results are to be reported to the relevant regulatory authority, results must be produced using the Hybrid or Conservative run mode.

Run Modes

SCAIL-Combustion can be used in either mode as a guide for non-regulatory purposes such as exploratory investigations for planning, pre-application or research.

Conservative Mode:

In Conservative mode the source to receptor bearing will rotate the habitat site so that it is in the prevailing wind direction for the meteorological file being used and hence receive the highest amount of pollutant concentration and deposition. The 'Conservative Mode' assumption can help to ensure that the effects of local wind fields are captured. However, the method works best for situations where there are either single sources or sources are closely grouped, and care needs to be taken with sources that are widely spaced apart. For this reason, **the use of SCAIL-Combustion is not suitable for regulatory screening of sites with multiple installations or dispersed sources, and the relevant Regulatory Authority should be contacted for advice.**

The prevailing wind direction at each of the meteorological sites is listed in Table A1.1, 'Wind Direction (degrees)'.

The following examples illustrate the use of the 'Conservative Mode' option. The left hand and centre figures illustrate that the rotation of the receptor locations into the prevailing wind direction works well when Installation and sources (e.g. stacks) are located close to a source. The source midpoint is determined by the location of Installation as defined by the user. The methodology does not work well when sources are distant from Installation as shown in the far right-hand figure.

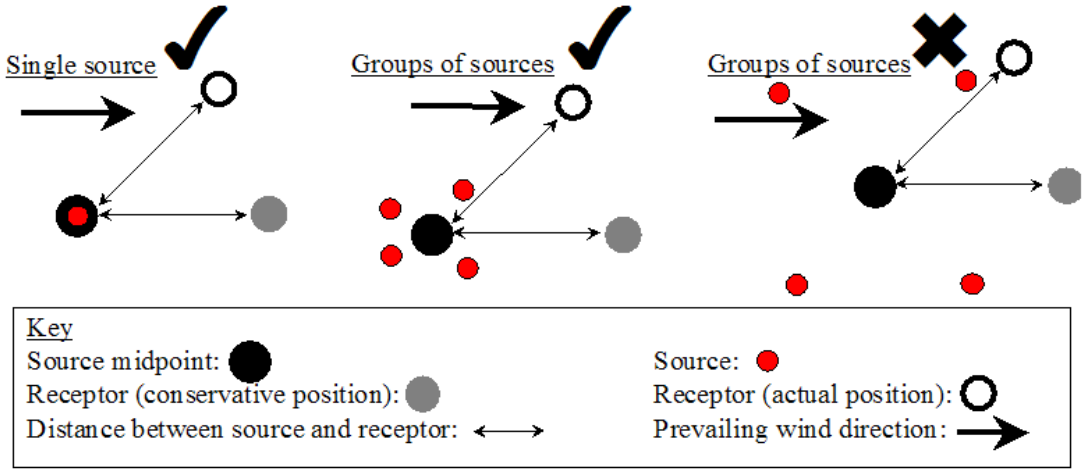


Figure 6: Conservative mode together with use of running SCAIL Combustion with single source, grouped sources and multiple 'dispersed' sources.

Hybrid Mode:

In the conservative mode, the bearing between the source and receptor is 'rotated' till a new bearing is aligned to the prevalent wind direction (for the nearest met station). This results in a worst case scenario, in terms of pollutant concentrations, at the receptor. Sometimes, this method is seen as too conservative and an alternative **Hybrid mode** is available to users. With the new update, the Hybrid mode will return the maximum concentration from the predictions among the arc points from ±40° to ±10° and the receptor. For each receptor, including the protected sites in the "search radius" function of SCAIL, there will be 9 calculations at 10° apart (Figure 7). A maximum concentration value from those calculations will be presented to the user.

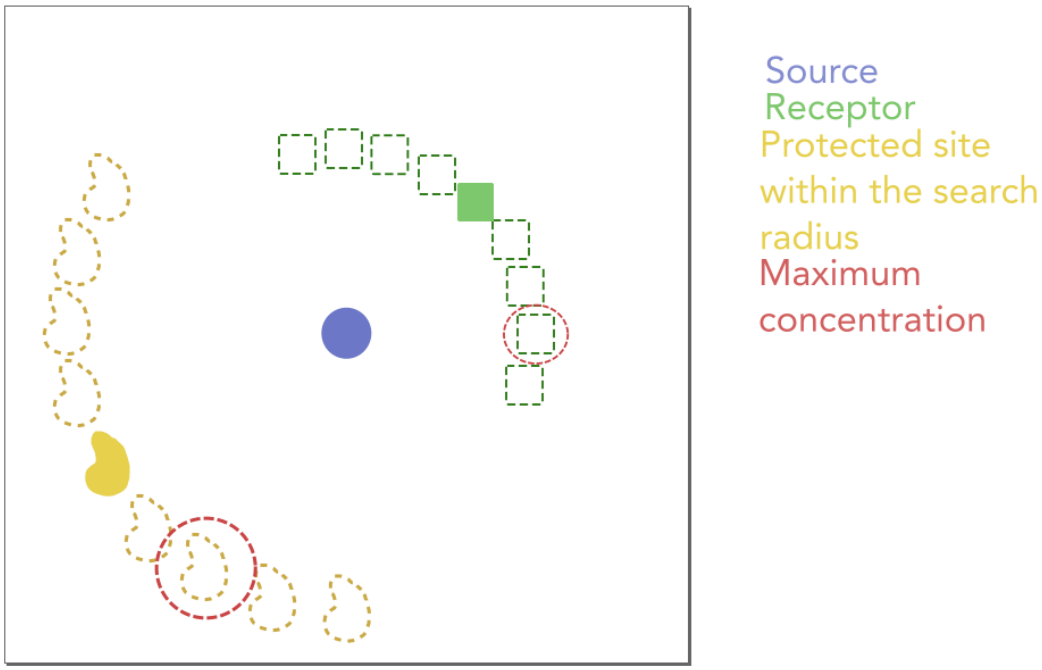


Figure 7: SCAIL Combustion in Hybrid mode showing source and receptor and the four 10 degree bearings either site of the receptor location. The maximum concentration is presented to the user in the results page.

Realistic Mode:

Realistic mode will use the actual position of the receptor site and the bearing to the source.

Where SCAIL-Combustion is not being used for regulatory purposes, in situations where a large number of sources are being modelled across a wide geographical area, the modeller should use the actual source position as applied through the "realistic met" option.

Details of the meteorological sites included in SCAIL-Combustion can be seen in Appendix 1.

2.2.3 Installation Details

An Installation is the facility or group of Stacks for which the assessment of releases is required. More than one Installation can be specified if the assessment is for a number of releases from different locations or if you want to see detailed output from a particular Stack in isolation from the other Stacks being modelling. **The use of SCAIL-Combustion is not suitable for regulatory screening of sites with multiple installations or dispersed sources (as per Figure 6).** For dispersed sources please run them separately and add up the concentrations/deposition for each receptor. **If in doubt the relevant Regulatory Authority must be contacted for advice.**

Click on the down arrow next to the Installation to add another Installation, otherwise select the Installation identifier for which you are about to enter details (the default is 1 for the first Installation). If other Installations have been added, more than 1 identifier will be present (Figure 8). To delete an Installation, select the Installation then click on the cross next to the Installation selection box.

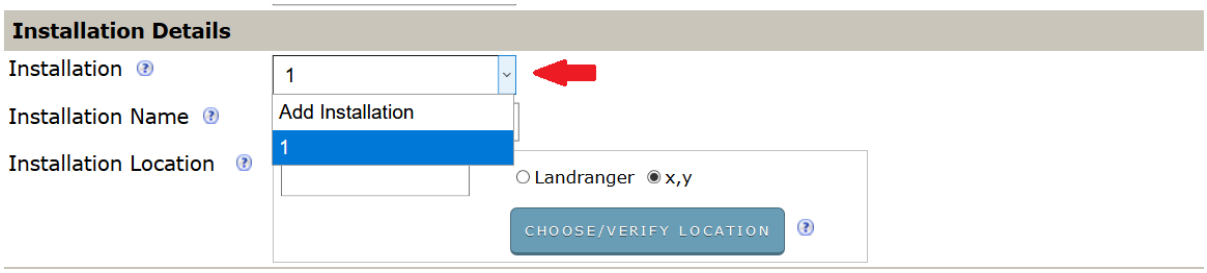


Figure 8: Specifying an installation

Add the installation location in the 'Installation Location' box, this can be done in two ways;

- Enter the grid reference of your installation (See Figure 7)
    - If your gird reference is in the landranger format i.e. NY587803 please select the "landranger" option and add your gird reference in the box.
    - If your grid reference is in the x,y format i.e. 358784,580380 please select the "x,y" option and add your grid reference in the box. Note that there should be no spaces after the coma.

    You can verify your location by clicking in "**choose/verify location**" to make sure the red location marker is in the correct place. Close the Map box when finished.

- Choose a location in the map - if you don't have a grid reference you can leave the "Installation Location" box empty and click in the "**choose/verify location**" button. Another window with a map will show (see Figure 8). Navigate through the map (use the zoom + and - buttons) and look for your installation location. When you locate your installation, click on the map to add a marker where your installation is located. Click the "OK" button in the grey box in the map and the new location co-ordinates will be transferred to the **Installation Location** box.

The new location co-ordinates are transferred back to the **Installation Location** box. Click OK to close the map window when finished.

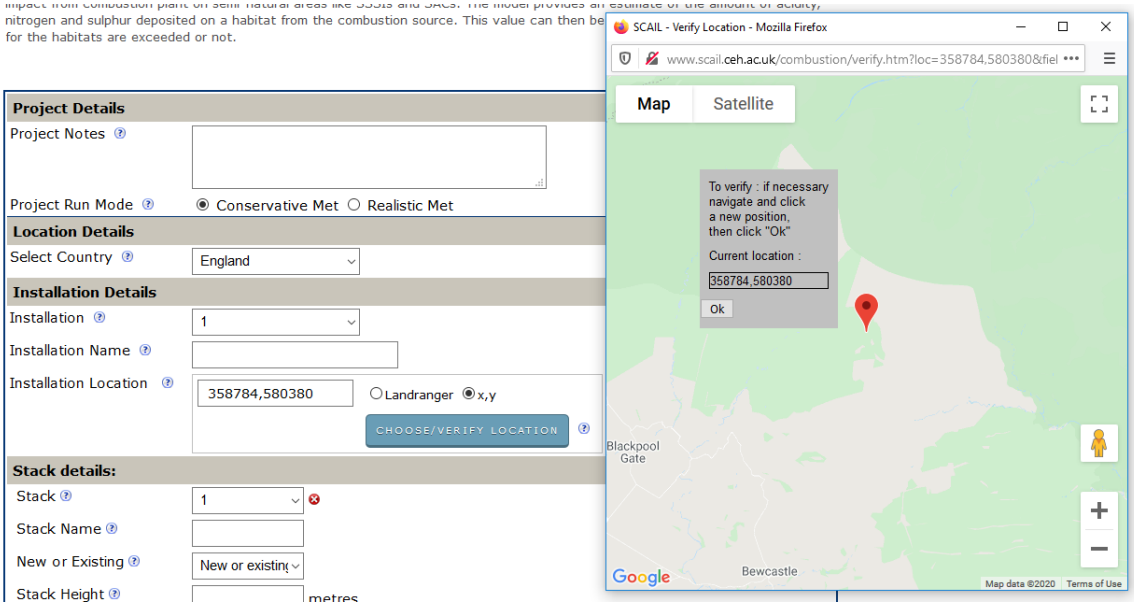


Figure 9: Verifying the location details after adding the location in the box

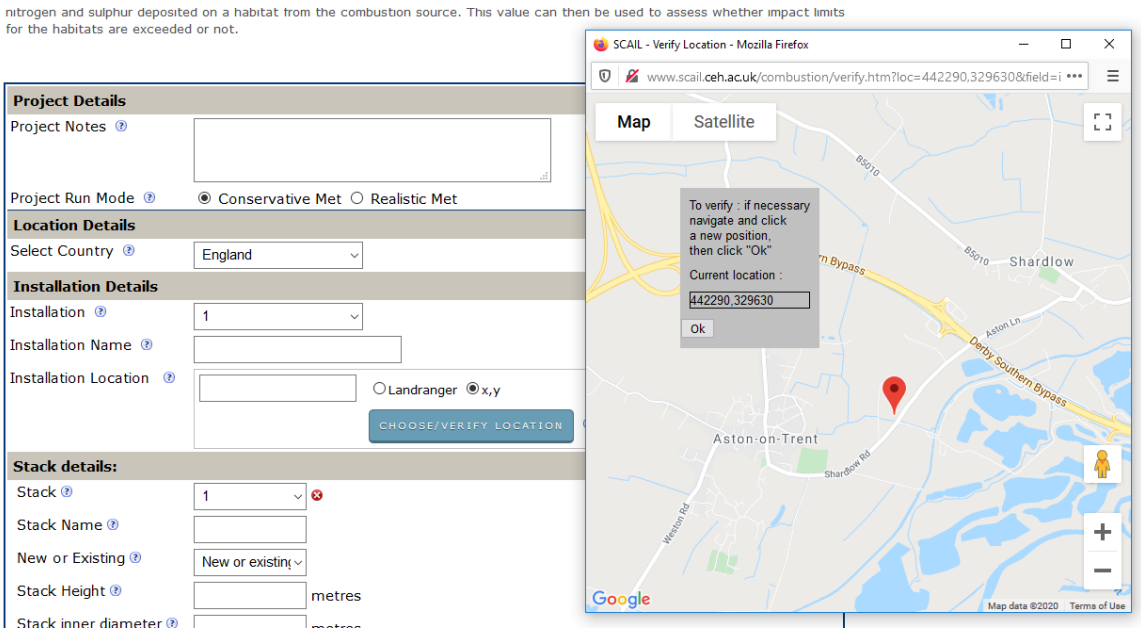


Figure 10: Choosing the location details

2.2.4 Source Details

Each Installation is made up of a number of discrete Sources representing component contributions on the farm from which pollutants are emitted. It should be noted that SCAIL-Combustion groups all the contributing sources in an Installation and therefore you will not be able to tell how much contribution to the total concentration or deposition a particular Stack made. Where you require details of the specific contributions then simply create a separate Installation and put the source you want to specifically identify into this Installation (Installations can overlap each other).

The Stack details section allows the specification of each Stack at an Installation. Enter the details for each Stack. If you want to use multiple Stacks, fill in the details for one Stack, then select **Add Stack** from the **Stack** drop-down and fill in the details for the additional Stack. Stacks can be removed using the red delete button (Figure 11). Up to 20 sources can be added.

For each Stack, enter a Stack name and a location. This process is identical to the specification of Installation location (see Installation details). Enter the relevant co-ordinates, then click on Verify location to open the map window allowing the source location to be confirmed or moved by clicking at a new location and clicking "**OK**" to confirm the new location (Figure 9: Verifying the location details after adding the location in the box).

If your application is for a new Installation or Stack, select '**New**'. If you are including an existing Stacks, select '**Existing**' (see Figure 9).

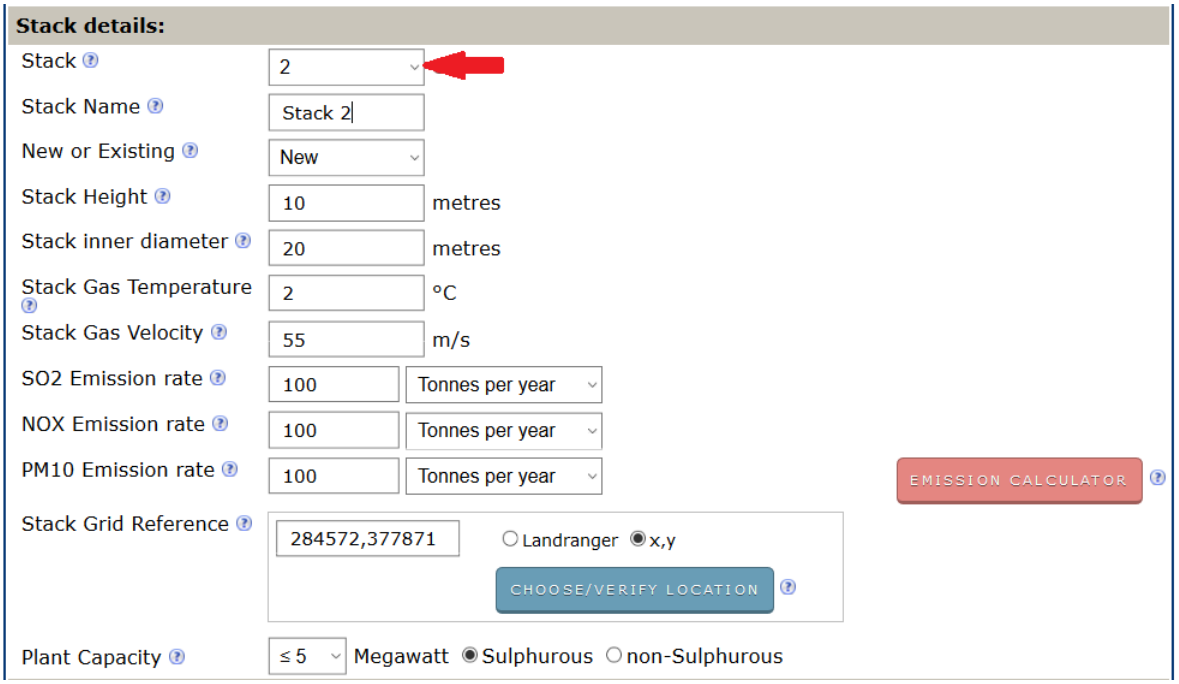
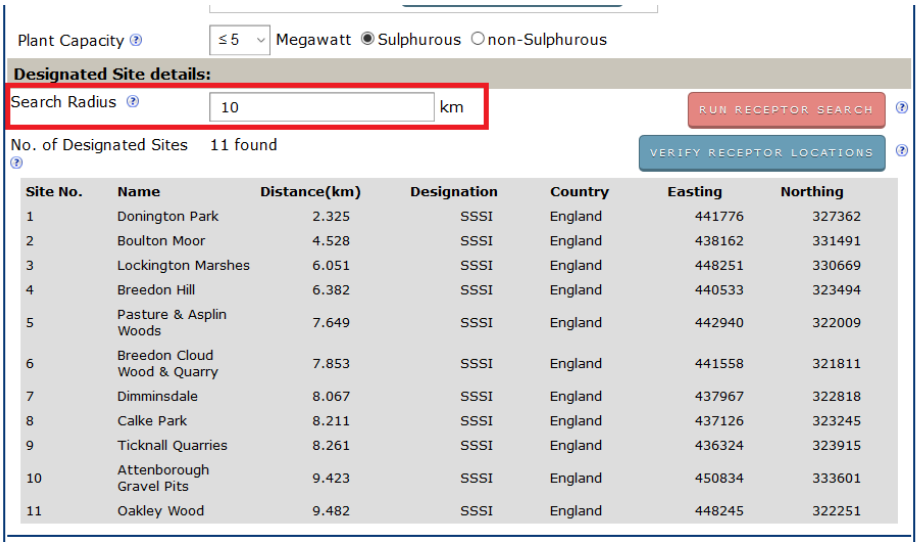


Figure 11: Specifying Stack details

2.2.5 Entering designated site details

Enter the radius over which you would like an automated search of designated sites, then click on the "Run receptor search" button. It should be noted that this search will be centred on the location that was specified for Installation number 1. This searches on-line databases for designated sites within the specified radius from the Installation and produces a list of all sensitive designated sites found (Figure 12). This list shows the site name, the distance to the Installation and the designated sites. There is a default radius search but you can set your own radius – 5 to 10 km is about right.



Site No.	Name	Distance(km)	Designation	Country	Easting	Northing
1	Donington Park	2.325	SSSI	England	441776	327362
2	Boulton Moor	4.528	SSSI	England	438162	331491
3	Lockington Marshes	6.051	SSSI	England	448251	330669
4	Breedon Hill	6.382	SSSI	England	440533	323494
5	Pasture & Asplin Woods	7.649	SSSI	England	442940	322009
6	Breedon Cloud Wood & Quarry	7.853	SSSI	England	441558	321811
7	Dimminsdale	8.067	SSSI	England	437967	322818
8	Calke Park	8.211	SSSI	England	437126	323245
9	Ticknall Quarries	8.261	SSSI	England	436324	323915
10	Attenborough Gravel Pits	9.423	SSSI	England	450834	333601
11	Oakley Wood	9.482	SSSI	England	448245	322251

Figure 12: Receptor details within a specified distance of an Installation

Clicking on the Verify Receptor Locations button produces a map showing the Installation and identified receptor locations (Figure 13). Further information on the specific habits is provided by

hovering the mouse over the blue “Receptors” pins; these show the closest edge of the identified habitats. The red “Receptor” pin shows the location of the first Installation that was added.

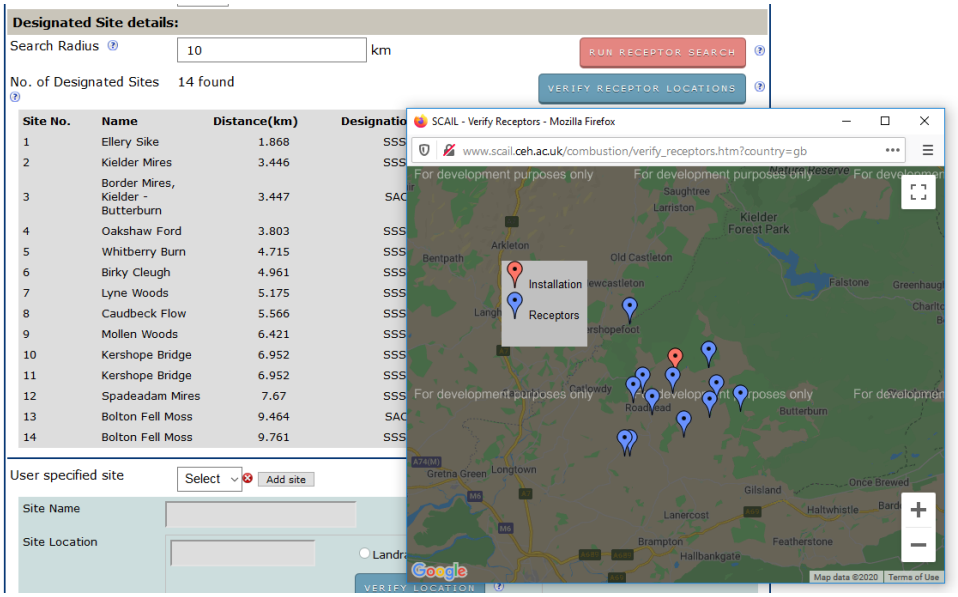


Figure 13: Confirming Designated sites in relation to an Installation

2.2.6 User-specified Habitats

There is also the facility to add User-specified sites. This can be used where new sites may have arisen, for example, or where other semi-natural areas need assessing. Click on Add site, then enter a name and location for the site. You should also select the habitat type within the Receptor site (Figure 14).

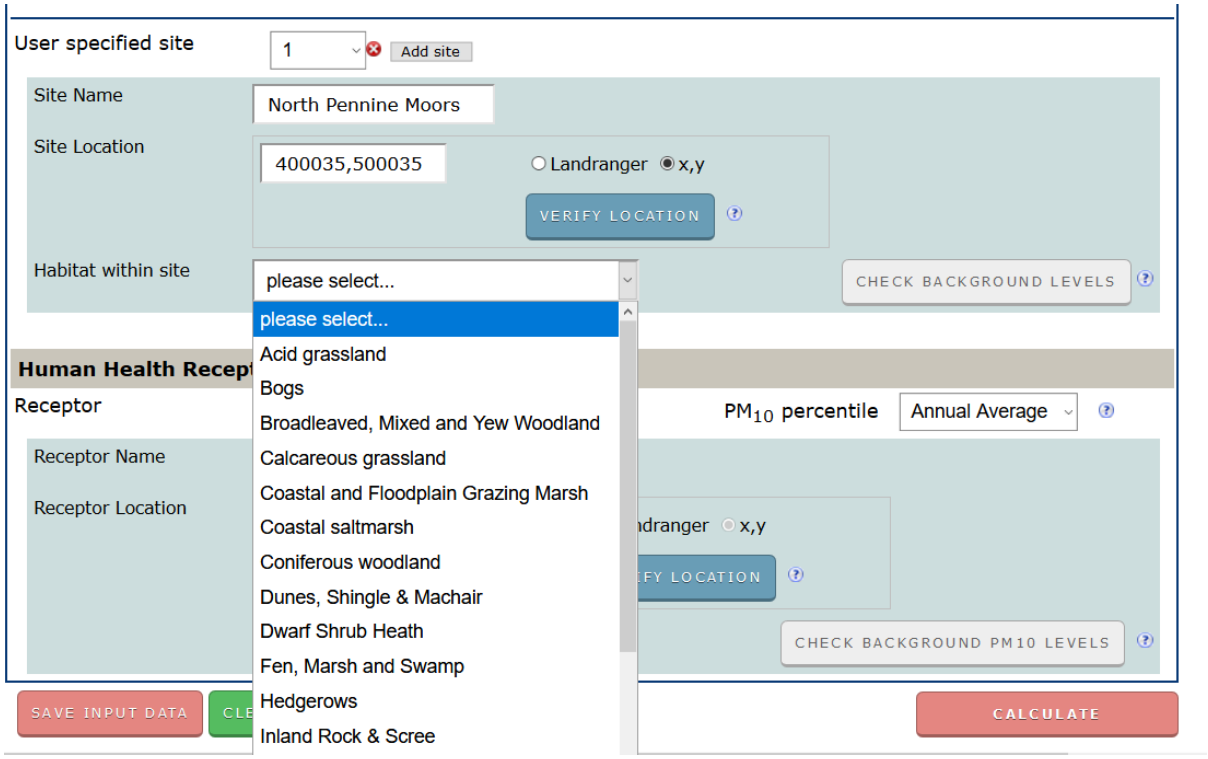


Figure 14: Specifying habitat type for a user defined receptor

Confirm the site location using the map, then at this stage you can use the **Check Background Levels** button to check the background concentration and deposition levels for each pollutant at the habitat grid reference entered and then compare these levels with the Critical Load/Level of the selected Habitat Type (Figure 15). This information will open in a new window. More User-specified sites can be added in the same way and individual sites can be deleted by selecting the site, then pressing the red delete button next to the Add site button.

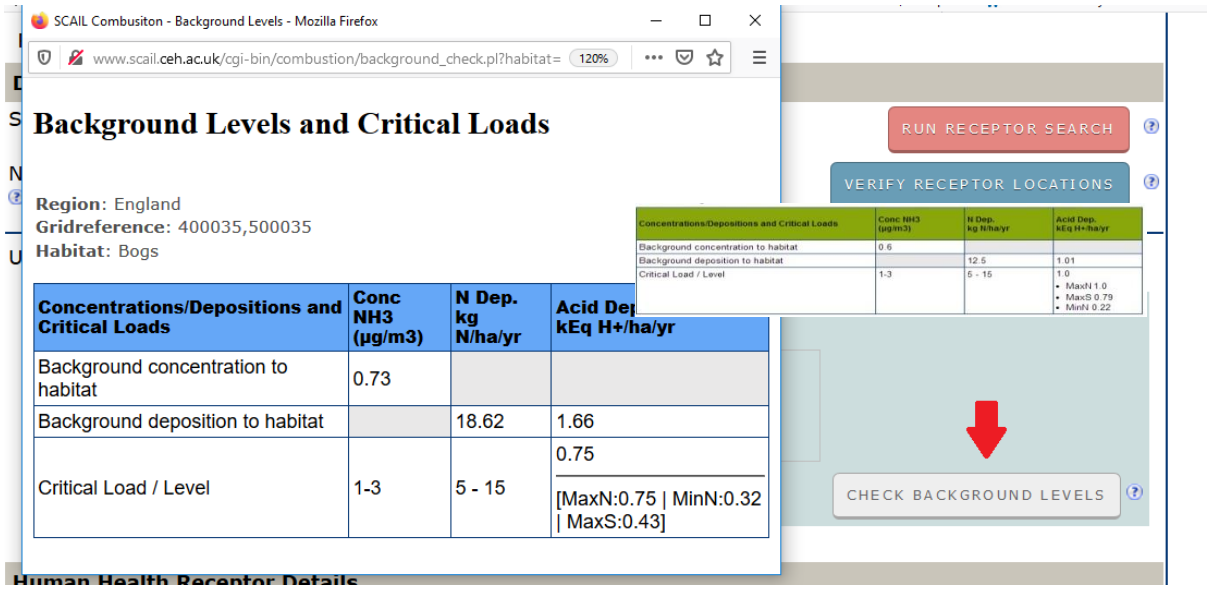


Figure 15: Background levels at User-specified habitat sites.

2.2.7 Entering Human Receptor details

There is also the facility to add User-specified Human Receptor sites. These are used to assess concentrations of PM_{10} and odour. There are a number of statistics that are relevant for PM_{10}, SO_2 and NO_2 exposure hence SCAIL Combustion allows the user to specify the relevant National Air Quality Objective Limits shown in Figure 16.

The method is very similar to the addition of user-specified habitat sites as described in the previous section. Click on **Add receptor**, then enter a name and location for the Receptor. Confirm the site location using the map, then at this stage you can use the **Check Background Levels** button to check the background concentrations at the location read from APIS (Figure 17). As before, more Human Receptor sites can be added in the same way and individual receptors can be deleted by selecting the receptor, then pressing the red delete button next to the **Add receptor** button. It should be noted that background concentrations for odour are not required in the assessment.

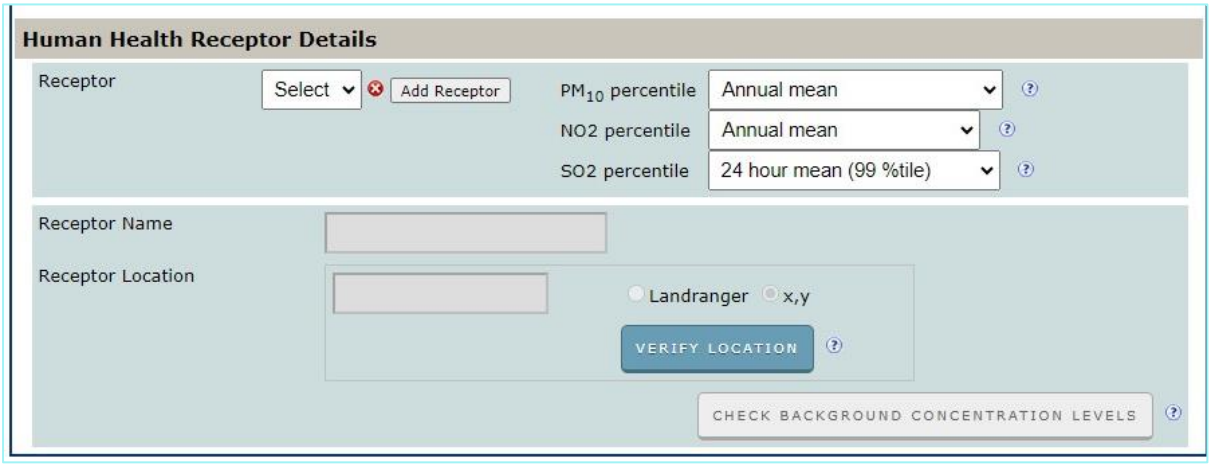


Figure 16: Options for selecting

Background Levels and Critical Loads

Region: Select a country
Gridreference: 464500,1206500
Receptor:

Concentrations	Conc NO2 (µg/m3)	Conc SO2 (µg/m3)	Conc PM10 (µg/m3)
Annual Mean Background concentration to receptor	1.26	0.2	4.33

Figure 17: Checking PM10 background at specified receptors and selecting the output statistic for PM10 assessments.

2.2.8 Saving the input file

Use the **Save input data** button to save all the information entered on the form for this project (Figure 18 and Figure 19). This will enable the same scenario to be run again or modified without having to enter all the information again. A user-specified file can be saved (Figure 18) although this depends

on the internet browser that you are using. This file should be renamed if you want to save multiple runs in the same folder. If you forget to save the input data at this stage, it can be saved from the results page after the model has run.

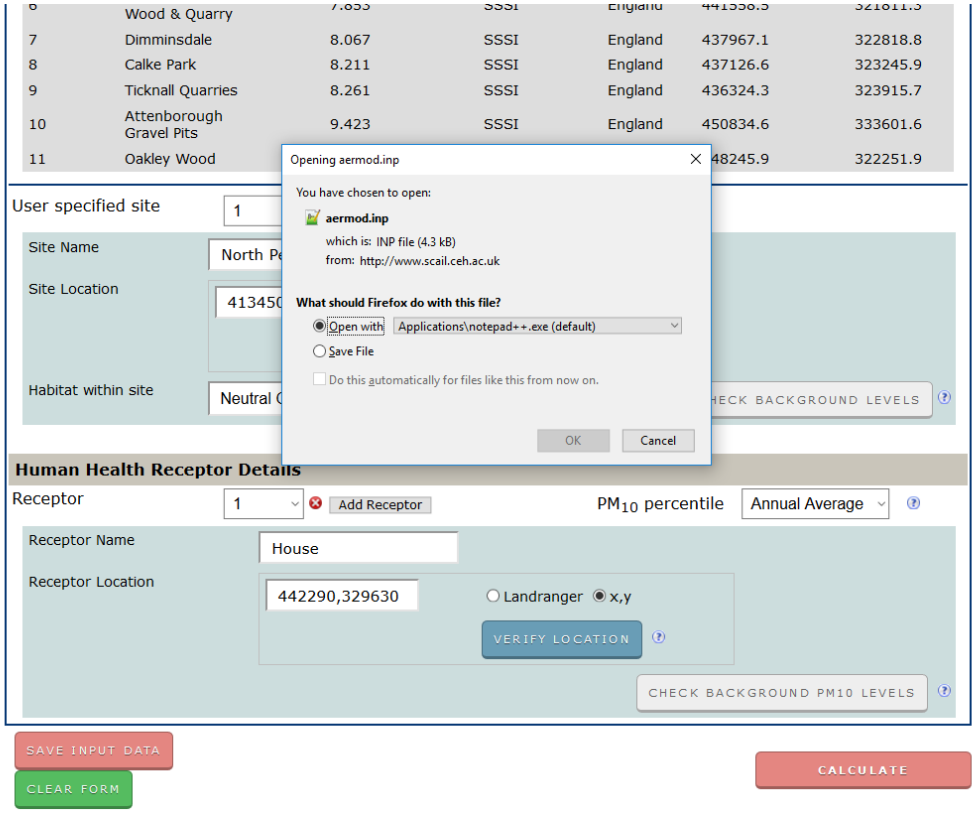


Figure 18: Specifying file name for saving input data (options depend on the browser that you are using).

2.2.9 Clearing the Form

If you want to clear the form, deleting all the Sources that have been set up, click on the **Clear Form** button (Figure 19). If the input data is required later, make sure you have saved the data first using the **Save Input Data** button.

2.2.10 Running the model

Before running the assessment tool you can add any additional information about the Assessment in the notes box. Save the input file if you wish to re-use the input data. Once you are happy that all the information has been correctly entered on the form, click the **Calculate** button to run the assessment (Figure 19).

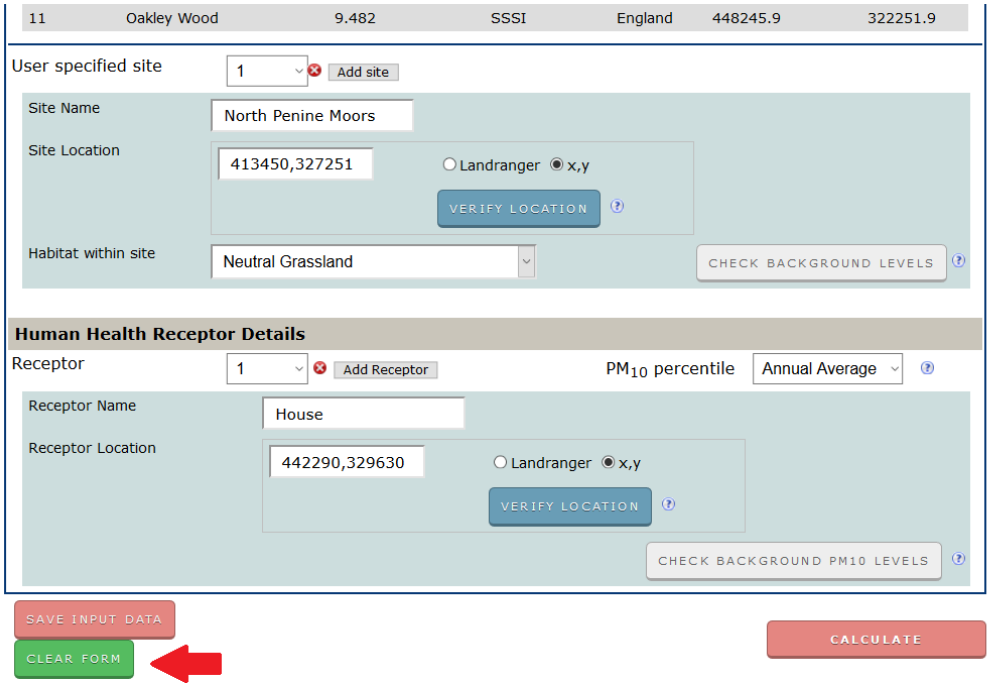


Figure 19: Buttons to run the model, Save the input data or clear the form or Calculate to run the model

A holding screen is displayed while the calculations are being undertaken (Figure 20).

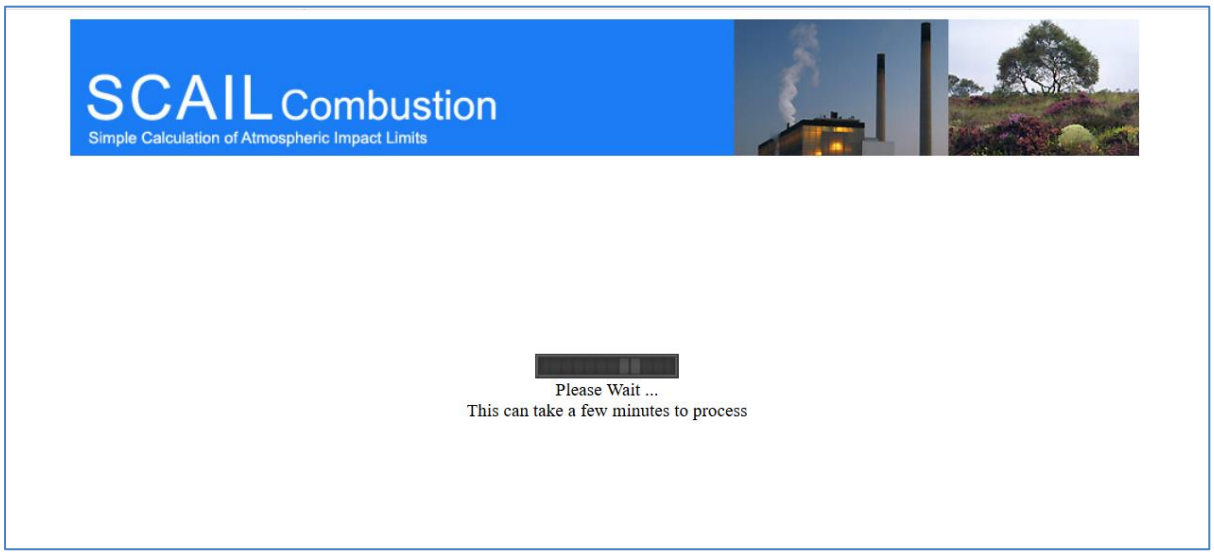


Figure 20: Holding screen while calculation is on-going

2.3 Interpreting the Results

Once the assessment has run, you will be presented with the results page. To display the results for different receptor site click the box in top left of the Results form (Figure 21). Help text can be accessed by clicking on the information icon ( ). Text relating to the application appears in the "Content Specific Help Text" box at the top of the screen as shown in Figure 18.

The output screen is split into:

- Site Information – information on the selected site (name, location, distance from Installation No. 1 etc.) as well as generic information on the model run (met. site, run mode and the PM_{10} percentile that was applied).
- Installation Information – emissions, concentrations and deposition values subdivided by each Installation included in the assessment. This includes information on the total number of Stacks included in each Installation and the number of Stacks that were flagged as being "New" Staks.
- Total Deposition/ Concentrations and Exceedances – concentrations and deposition values totalled for all Installations included in the assessment. These can include information on the relevant Environmental Assessment Level or Critical Load/Level based on the pollutant and receptor type being modelled.

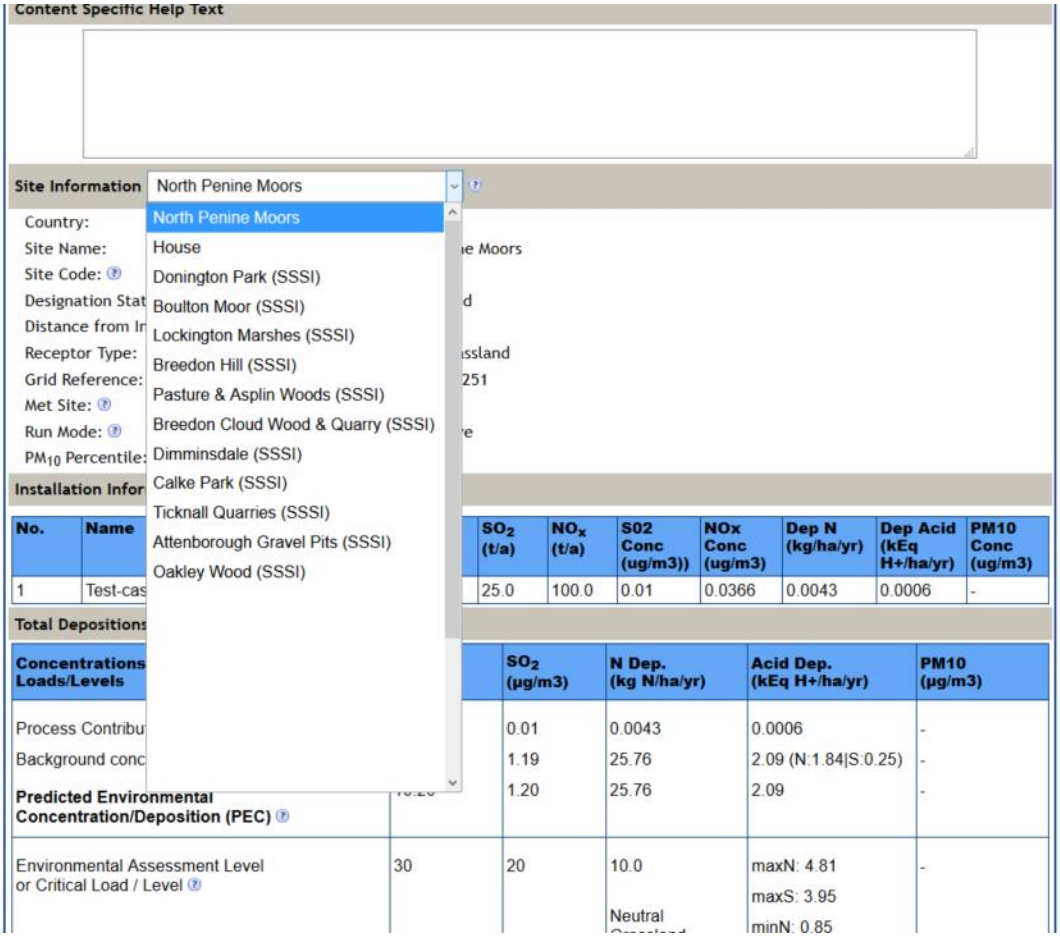
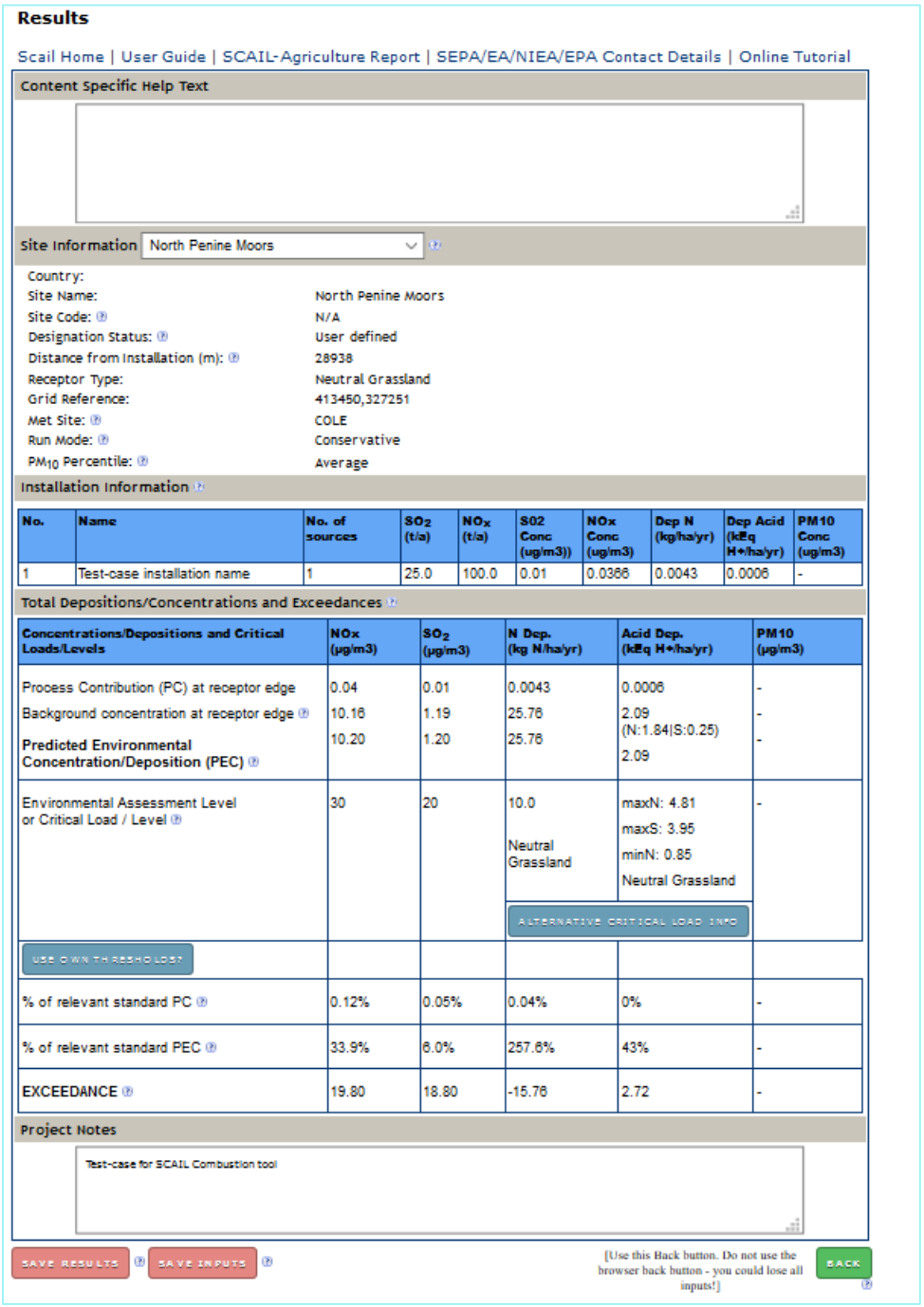


Figure 21: Selecting different receptor sites to display

Results are displayed for NOx, SO2, PM_{10}, Nitrogen deposition and acid deposition (Figure 22). A breakdown of the total concentration and deposition to the habitat is given together with the background concentration/deposition, based on the grid reference supplied for the habitat. An exceedance (total value – environmental standard) is then calculated and displayed as both a percentage and an absolute value.

The relevant regulatory authority should be contacted for advice regarding as to whether further detailed modelling will be required if one or more of the following threshold levels are met or exceeded (based on results produced using the Conservative Met run mode):

For more information on how to interpret the results please consult the relevant regulatory Guidance Document for the country that the assessment is being conducted.



Results

Scail Home | User Guide | SCAIL-Agriculture Report | SEPA/EA/NIEA/EPA Contact Details | Online Tutorial

Content Specific Help Text

Site Information: North Penine Moors

Country:	
Site Name:	North Penine Moors
Site Code:	N/A
Designation Status:	User defined
Distance from Installation (m):	28938
Receptor Type:	Neutral Grassland
Grid Reference:	413450,327251
Met Site:	COLE
Run Mode:	Conservative
PM_{10} Percentile:	Average

Installation Information

No.	Name	No. of sources	SO_2 (t/a)	NO_x (t/a)	S02 Conc (ug/m3))	NOx Conc (ug/m3)	Dep N (kg/ha/yr)	Dep Acid (keq H+/ha/yr)	PM10 Conc (ug/m3)
1	Test-case installation name	1	25.0	100.0	0.01	0.0366	0.0043	0.0006	-

Total Depositions/Concentrations and Exceedances

Concentrations/Depositions and Critical Loads/Levels	NOx (µg/m3)	SO_2 (µg/m3)	N Dep. (kg N/ha/yr)	Acid Dep. (keq H+/ha/yr)	PM10 (µg/m3)
Process Contribution (PC) at receptor edge	0.04	0.01	0.0043	0.0006	-
Background concentration at receptor edge	10.16	1.19	25.76	2.09 (N:1.84|S:0.25)	-
Predicted Environmental Concentration/Deposition (PEC)	10.20	1.20	25.76	2.09	-
Environmental Assessment Level or Critical Load / Level	30	20	10.0 Neutral Grassland	maxN: 4.81 maxS: 3.95 minN: 0.85 Neutral Grassland	-
			ALTERNATIVE CRITICAL LOAD INFO		
USE OWN THRESHOLDS?					
% of relevant standard PC	0.12%	0.05%	0.04%	0%	-
% of relevant standard PEC	33.9%	6.0%	257.6%	43%	-
EXCEEDANCE	19.80	18.80	-15.76	2.72	-

Project Notes

Test-case for SCAIL Combustion tool

SAVE RESULTS | SAVE INPUTS

[Use this Back button. Do not use the browser back button - you could lose all inputs!] BACK

Figure 22: results page (displayed Critical Load values are examples only)

2.3.1 Options after running the model

At the bottom of the results page are several options (Figure 23). The **Save Results** button will save the output data in CSV (comma separated variables) format, which can be opened in Microsoft Excel.

The **Save Inputs** button can be used to save the input data for this model run if it was not saved on the input form before running the model.

You can return to the Input Page by clicking on the **Back** Page button at the bottom of the page.

<u>If you use your browser's Back button to go back to the input page, you may lose the input data you filled out on the form.</u>

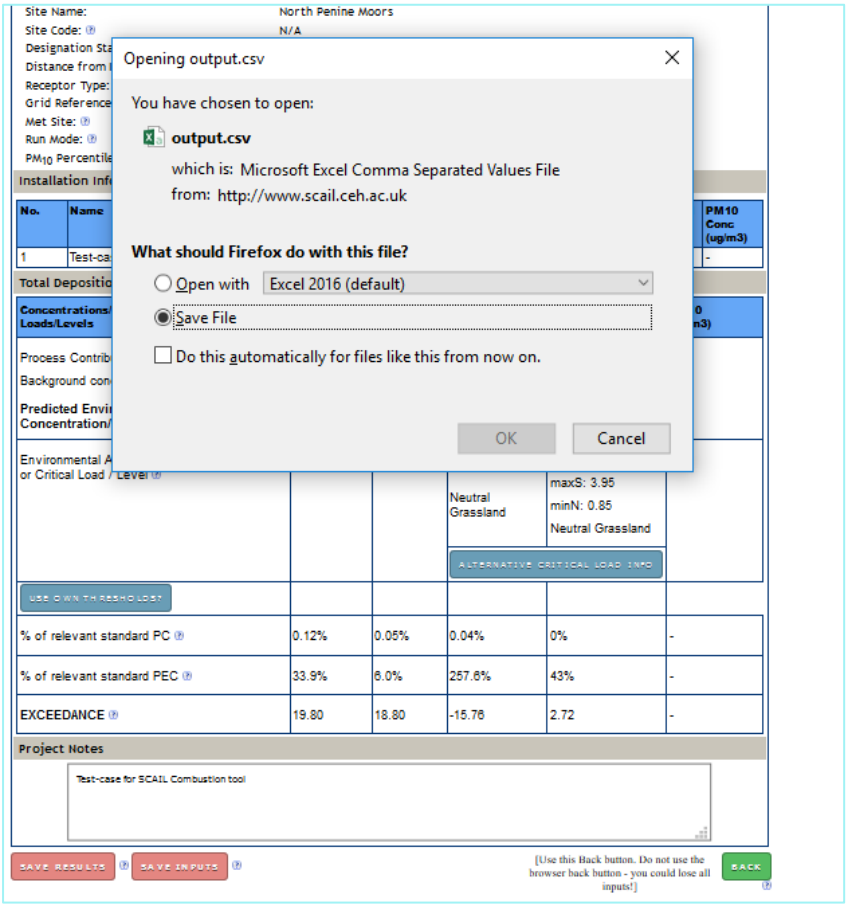


Figure 23: Foot of page showing Save Results as an .csv file, Save Inputs and Back buttons

Appendix 1 : Typical Meteorological Year Wind Roses

Table A1.1: Details of meteorological sites included in SCAIL-Combustion

Station	Station Elevation (m)	Wind Direction (degrees)	Name (Short)	Station X Coordinate (m)	Station Y Coordinate (m)
Aviemore	228	210	AVIE	289652	814315
Boulmer	23	250	BOUL	425300	614200
Cardiff Weather Centre	52	230	CARD	318200	176100
Church Fenton	8	270	CHUR	452818	438027
Coleshill	96	200	COLE	421090	286940
Crosby	9	150	CROS	329940	400570
Edinburgh Gogarbank	57	250	EDIN	316100	671400
Eskdalemuir	242	190	ESKD	323500	602600
Glasgow Bishopton	59	210	GLAS	241788	671073
Heathrow	25	210	HEAT	507700	176700
Islay Port Ellen	17	140	ISLA	132900	651300
Isle of Portland	52	250	ISLE	367798	69251
Lerwick	82	170	LERW	445392	1139660
Leuchars	10	260	LEUC	346800	720900
Lossiemouth	6	250	LOSS	321249	869822
Lyneham	145	210	LYNE	400629	178255
Mumbles Head	32	270	MUMB	262700	187000
Plymouth	50	90	PLYM	249219	52714
Skye Lusa	18	210	SKYE	170593	824888
Spadeadam No.2	285	250	SPAD	364700	573000
Stornoway Airport	15	190	STOR	146443	933104

Valley	10	210	VALL	230885	375849
Dyce	62	170	DYCE	387810	812800
Prestwick RNAS	10	250	PRES	236902	627653
Tiree	10	190	TIRE	99900	744600
Wick	30	150	WICK	336490	952230
Bristol Filton	59	250	BRIS	360057	180491
Camborne	87	230	CAMO	164123	40307
Gatwick Charlwood	67	230	GATW	527047	140598
Marham Kent	21	220	MARH	573608	308938
Newcastle Albemarle	142	270	NEWA	407700	569500
Peterborough Wittering	73	250	PETE	504288	302621
Shoeburyness	2	230	SHOE	596079	187772
Walney Island	15	310	WALN	319209	465529
Abercynon	80	320	ABEC	308350	195270
Aberystwyth	50	190	ABEY	259800	281270
Bridgend	20	280	BRID	292214	179019
Buckley	140	240	BUCK	329113	364738
Cardiff Bute Park	10	270	CAMP	317684	177235
Lake Vyrnwy	300	230	LAKE	301541	318810
Llandrinod Wells	210	210	LLAN	306000	261500
Milford Haven	50	250	MILF	193600	205000
Mona	62	210	MONA	242137	374057
Newcastle Emlyn	30	100	NEWE	230770	240830
Newport	10	250	NEWP	333165	186070
Newtown	110	260	NEWT	311673	291730

Rhyl	5	160	RHYL	302373	379405
Sennybridge No.2	307	240	SENN	289406	241777
Swansea	150	240	SWAC	263200	193900
Swansea Valley	60	230	SWAV	276200	207900
Immingham / Humber Estuary	2	210	IMMI	512393	431263
Leeds / Bradford (not Bingley)	210	270	LEED	426501	448082
Manchester City Centre	69	190	MANC	381494	384371
Liverpool John Lennon Airport	22	280	LIVE	343790	381965
Southampton (Solent)	11	230	SOUT	445001	116734
Brighton / Eastbourne	2	230	BRIG	520373	105397
London Weather Centre	32	230	LOND	544114	182251
Cambridge / Stansted Airport	101	220	CAMB	553215	222553
Sheffield	267	280	SHEF	434033	387260
St Bees Head	125	170	STBE	295654	514798
Stoke-on-Trent	118	330	STOK	387349	346027
Teesside	26	220	TEES	456874	521933
Aldergrove Int. Airport	63	220	ALDE	127638	538057
Belfast harbour no2	4	210	BELF	149713	531340
Dungannon / Omagh	152	270	DUNG	82885	527376
Lurgan	19	190	LURG	117627	516265
Crocknacrieve / Thomastown	62	160	CROC	36427	507111

West Tyrone	118	130	WEST	50840	542360
County Down	4	280	COUN	149322	505376
Derry airport	20	220	DERR	70916	584426
Ballymena / Ballymoney 2	64	180	BALL	113637	569865
Charterhall	112	220	CHAR	376031	646239
Drumalbin	245	210	DRUM	290853	638412
Dundrennan	113	70	DUND	271089	547194
Strathallan	35	230	STRA	293300	716186
Carlisle	33	250	CRLS	339136	560271
Tees-side	34	190	TEER	437758	513656
High Bentham / Kirkby Lonsdale	81	120	HIGH	363600	473699
Leconfield	7	270	LECO	503008	442321
Northwich	65	230	NORT	362400	348799
Waddington	68	230	WADD	499151	364342
Bingham / Grantham	27	220	BING	479000	339999
Shawbury RAF	72	250	SHAW	355058	322738
Norwich Weather Centre	41	230	NORW	624700	296799
Newcastle On Clun	120	180	NEWC	338930	273939
Madley	78	190	MADL	341697	237600
Upper Heyford RAF	126	210	UPPE	451559	226404
Close to Colchester	66	240	COLC	600700	266499
Middle Wallop	90	220	MIDL	430306	139118
Yeovil	20	210	YEOV	354998	123196

Nr Great Torrington and Burrington	197	210	TORR	260650	116809
Belmullet	9	220	BELM	-121393	510967
Casement	91	220	CASE	104385	387928
Cork	155	230	CORK	-46478	236429
Dublin	71	250	DUBL	118380	400712
Knock	201	210	KNOC	-47461	467110
Mullingar	101	220	MULL	44861	417894
Shannon	15	120	SHAN	-67279	332843
Valentia	24	270	VALE	-165987	258840
Athenry	40	260	ATHE	-51946	398415
Ballyhaise	78	220	BALH	52621	474765
Carlow Oakpark	78	170	CARO	69273	340616
Claremorris	68	210	CLAR	-61176	446597
Dunsany	83	250	DUNS	91193	412238
Fermoy Moore park	46	290	FERM	-28151	270257
Gurteen	75	200	GURT	-2623	365536
Mount Dillon	39	200	MOUN	5699	442238
Ballycanew	32	230	BALC	106285	310207
Castledockerell	5	210	CAST	88409	306854

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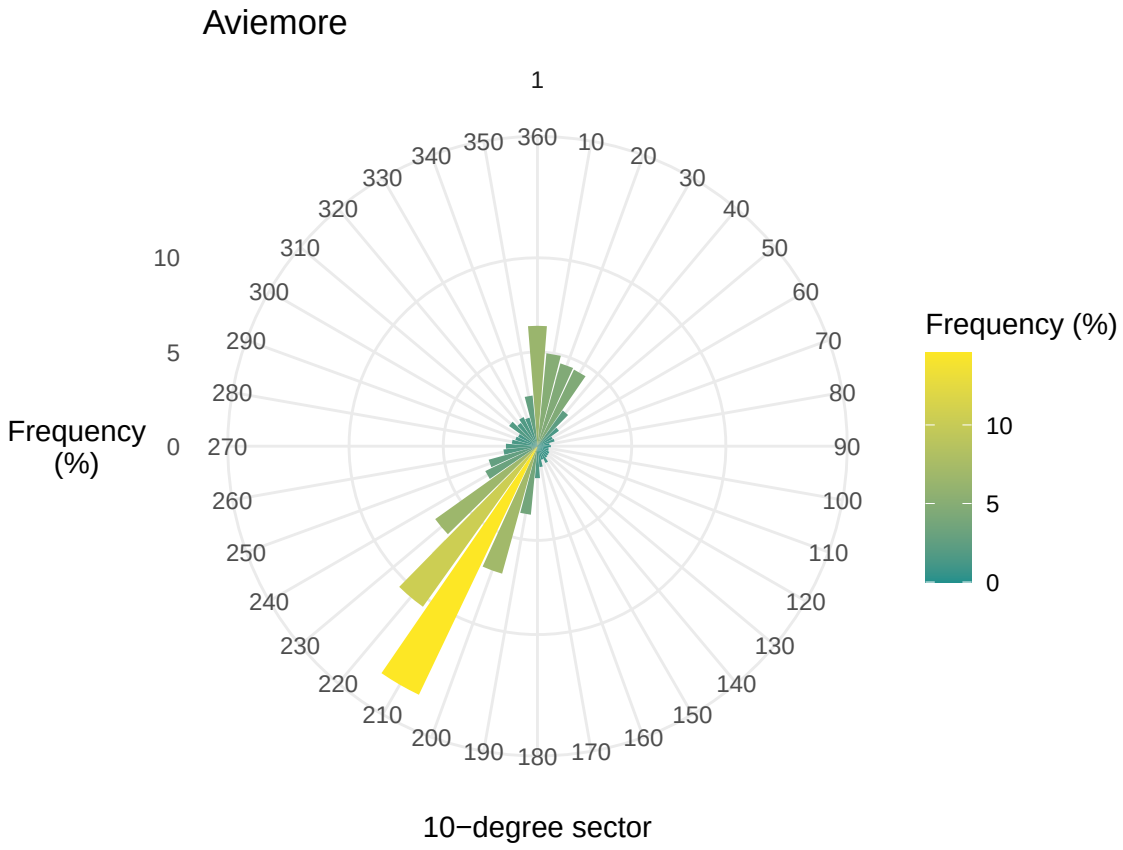
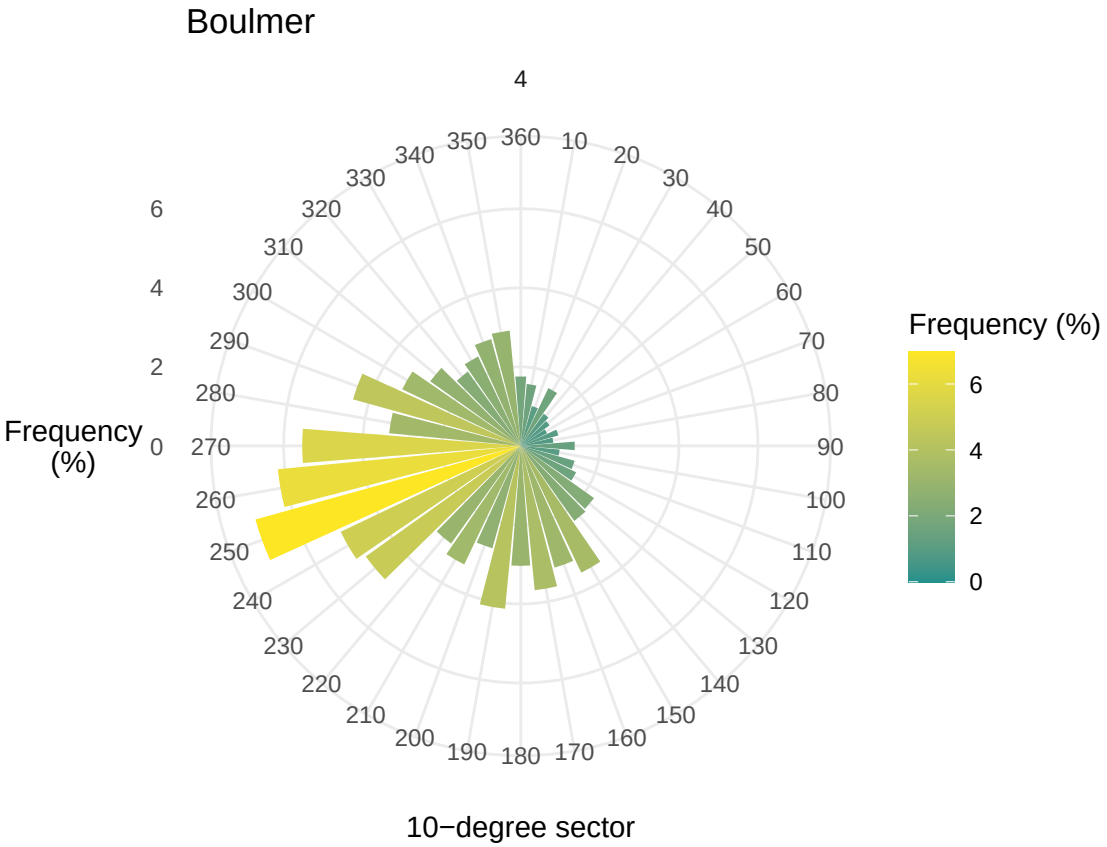
Wallingford
Oxfordshire
0X10 8BB
United Kingdom
T: +44 (0)1491 838800

SCAIL combustion wind roses

UKCEH




Boulmer
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330
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120
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Frequency (%)
Frequency (%)
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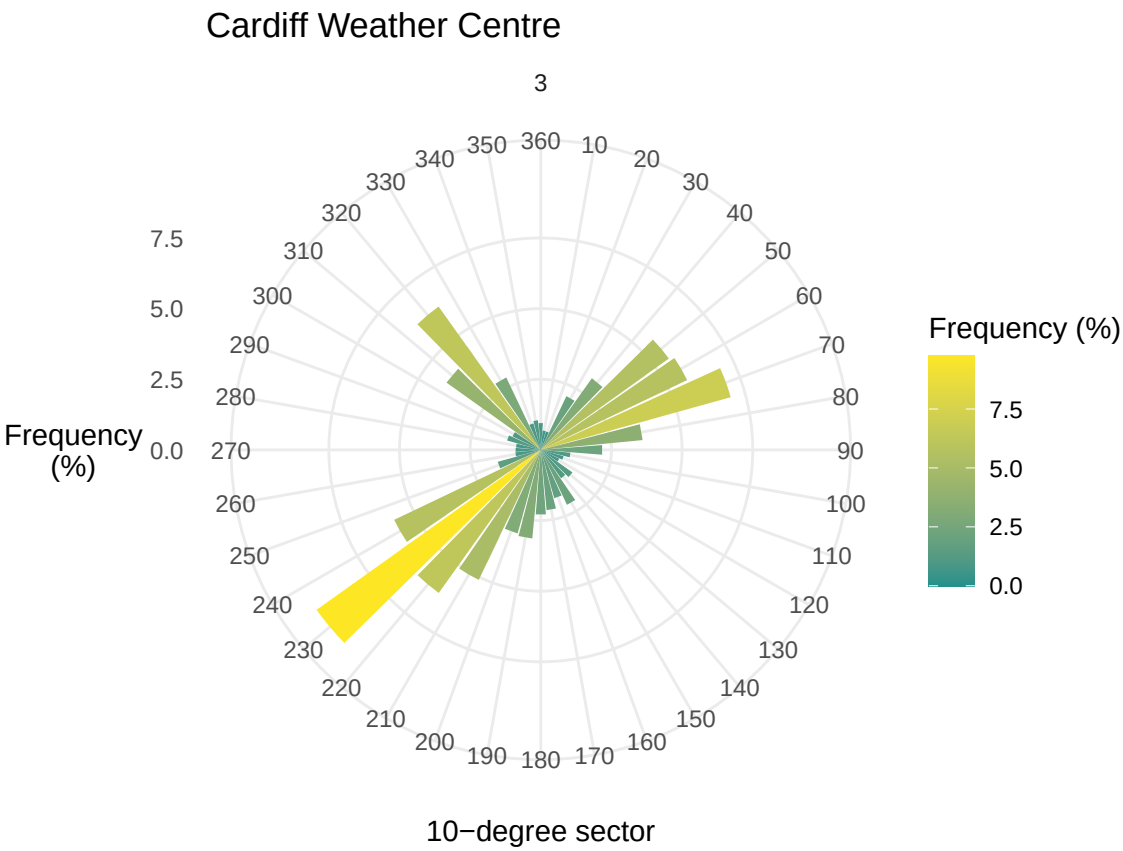
10−degree sector


Cardiff Weather Centre
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Frequency (%)
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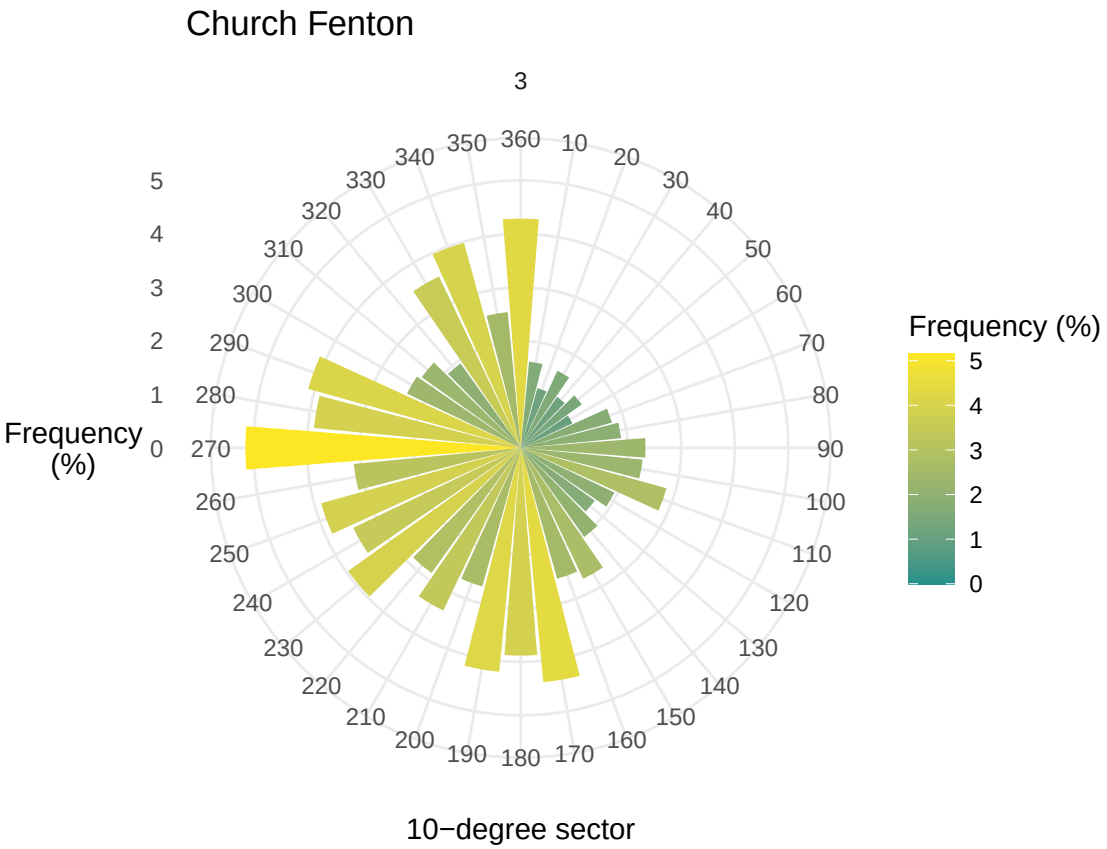
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Frequency (%)
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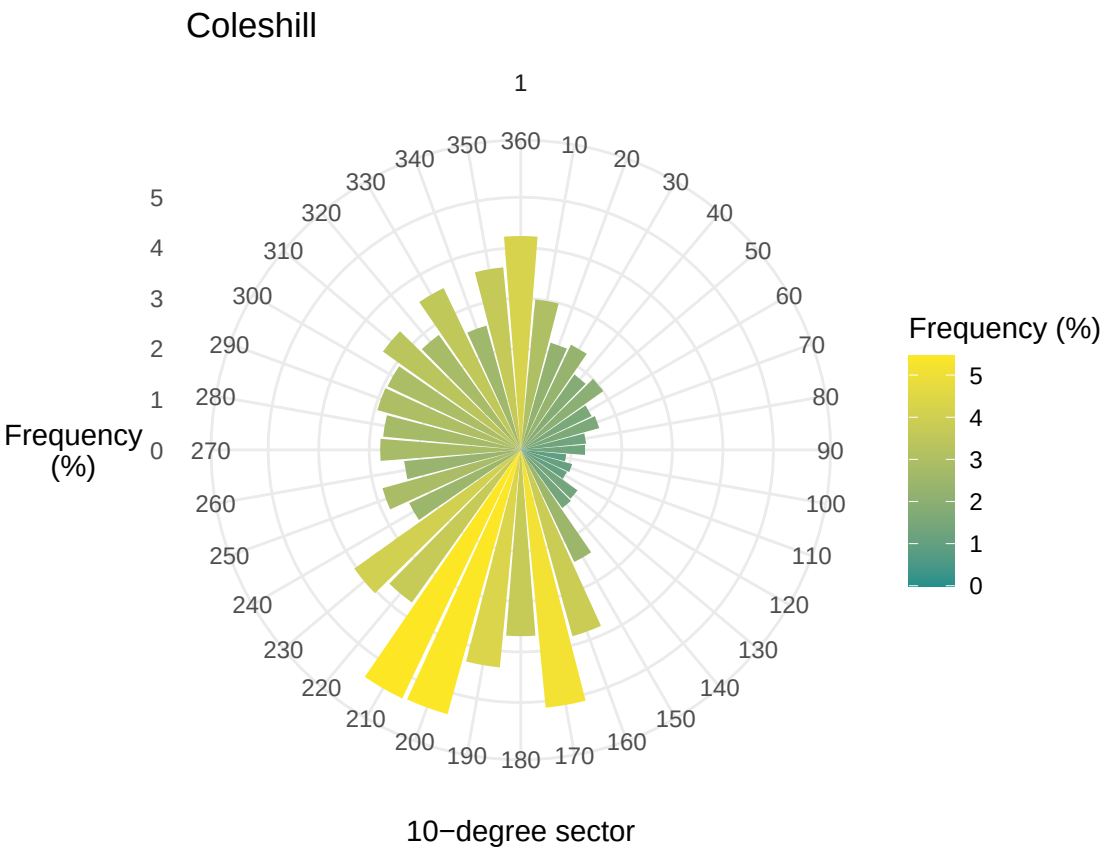
Coleshill
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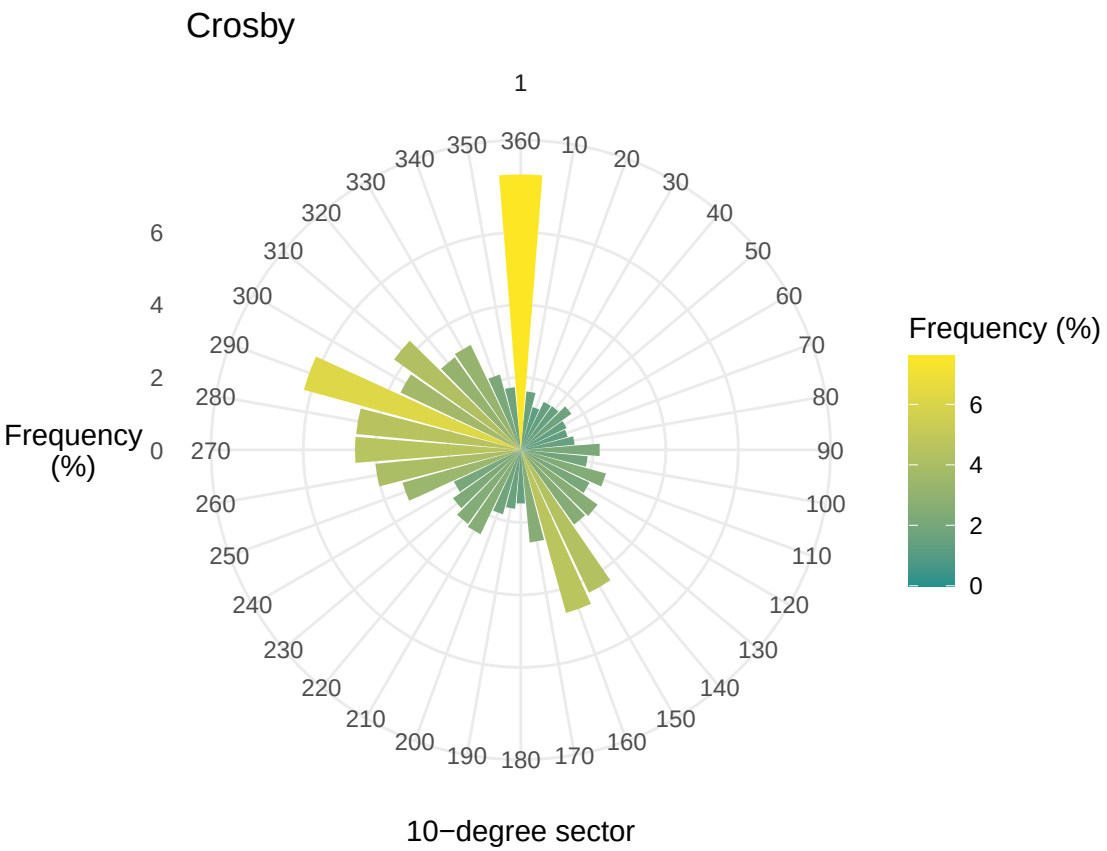
10−degree sector


Crosby
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Frequency (%)
10−degree sector
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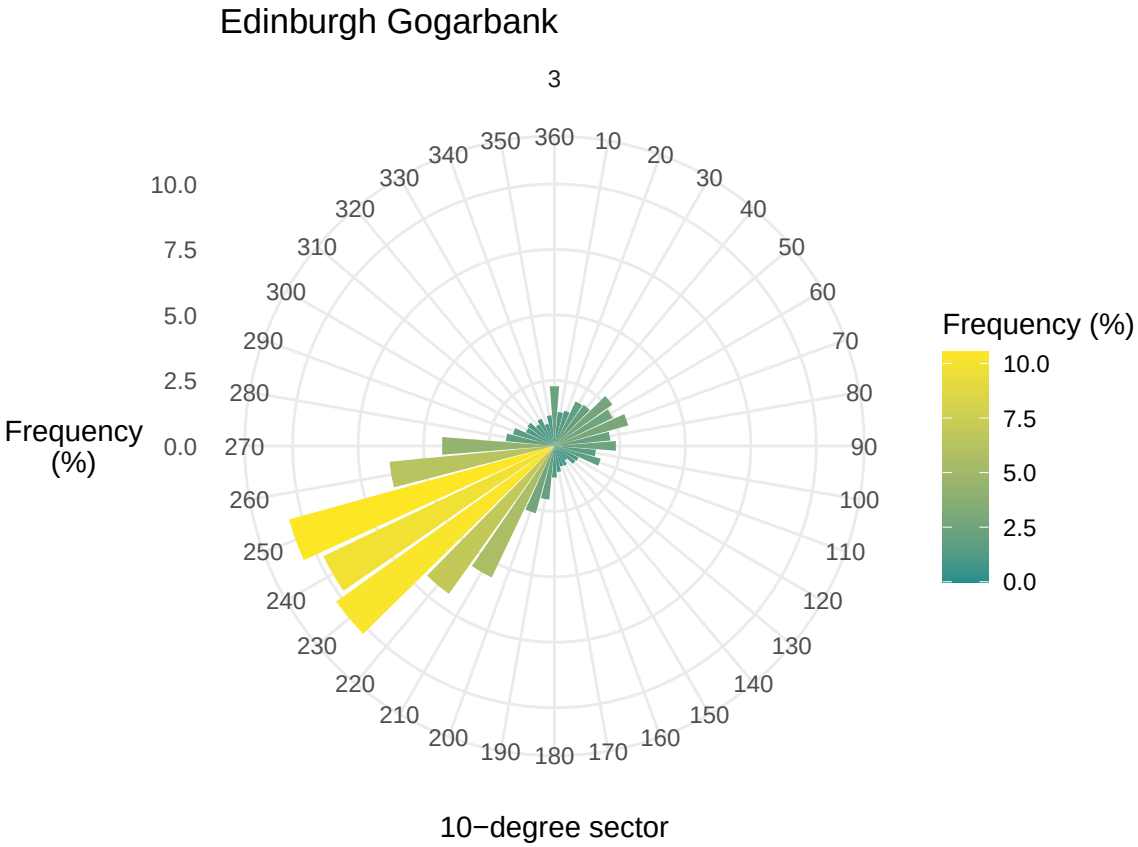
Edinburgh Gogarbank
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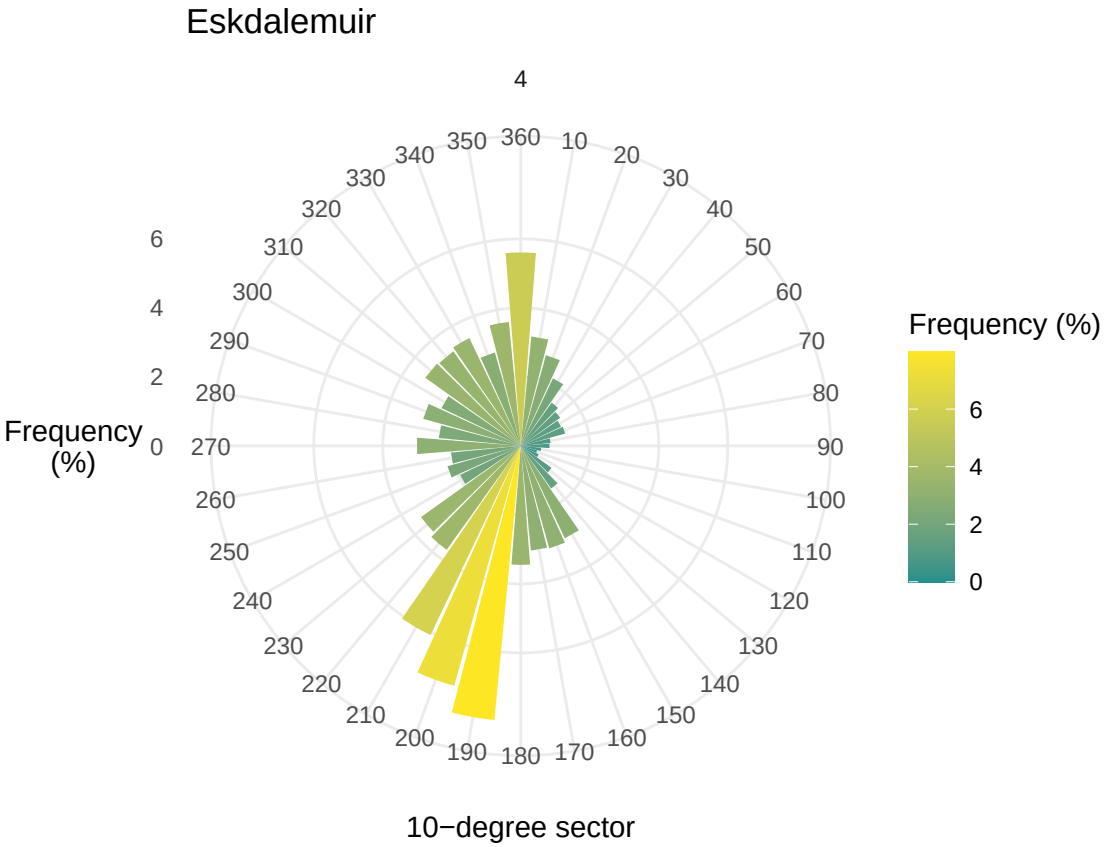
Eskdalemuir
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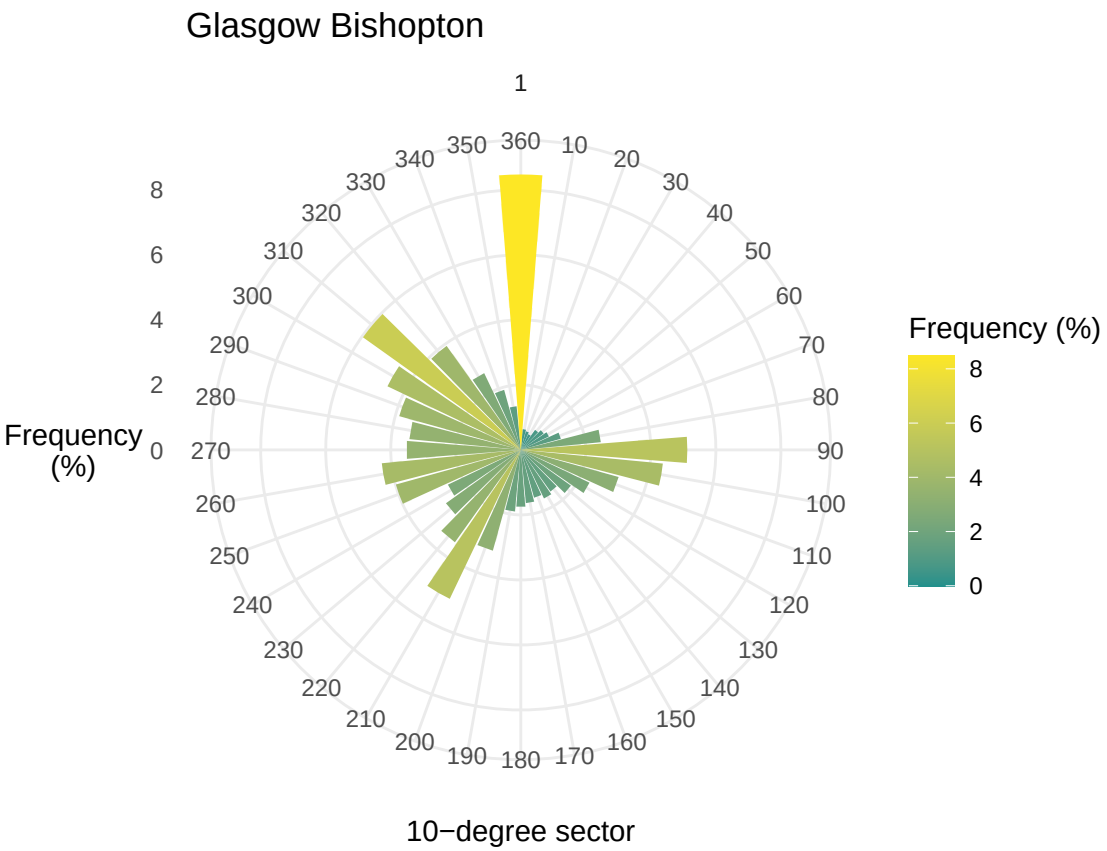
10−degree sector


Glasgow Bishopton
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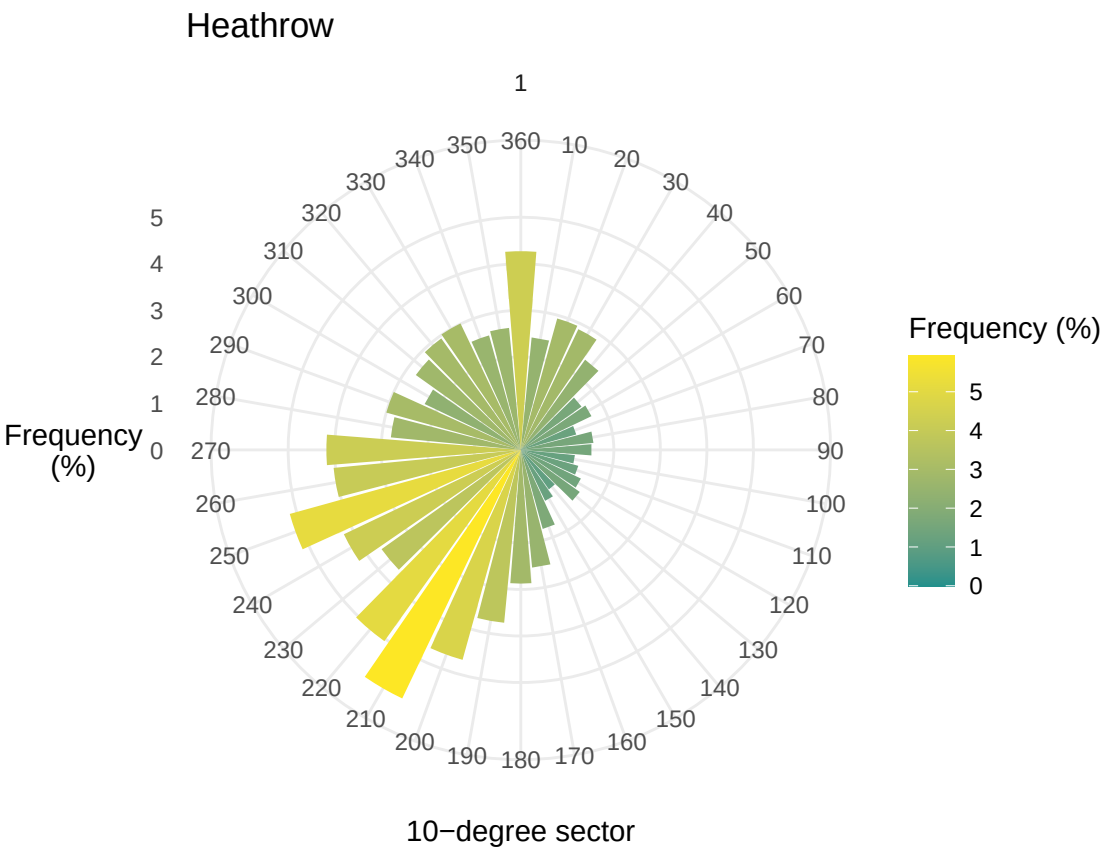
10−degree sector


Heathrow
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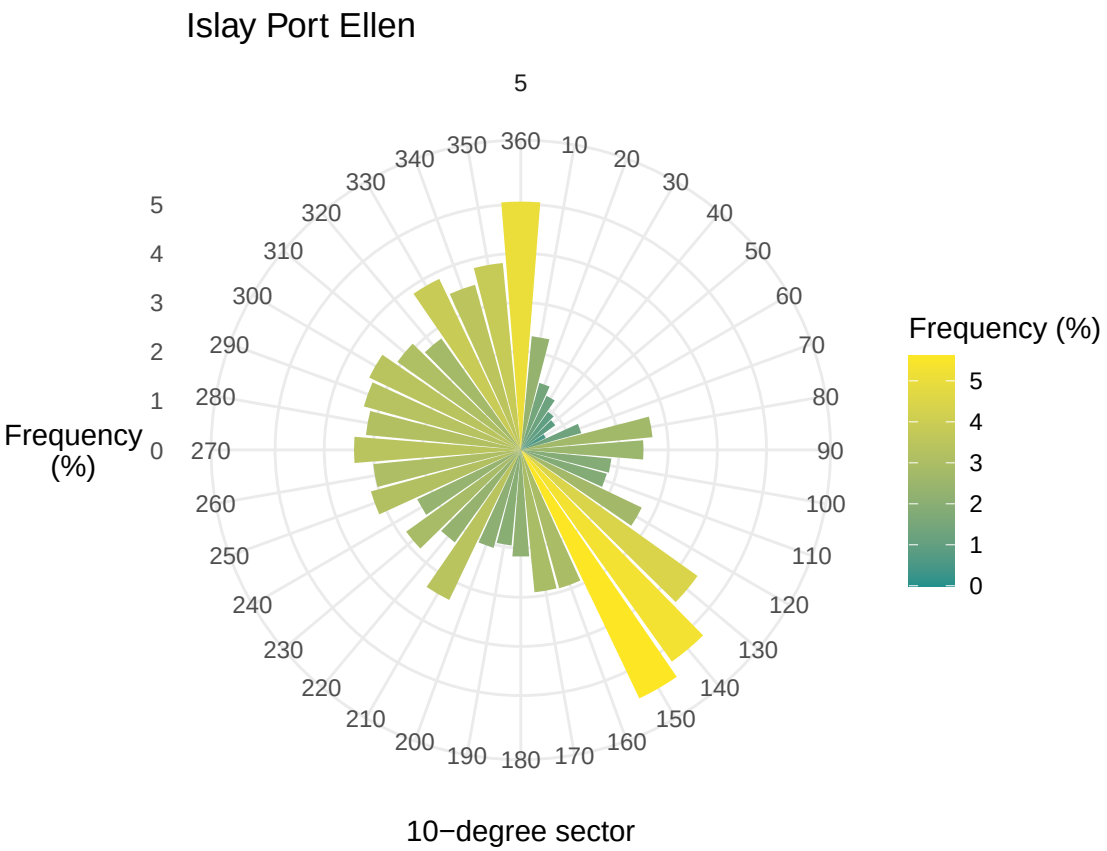
10−degree sector


Islay Port Ellen
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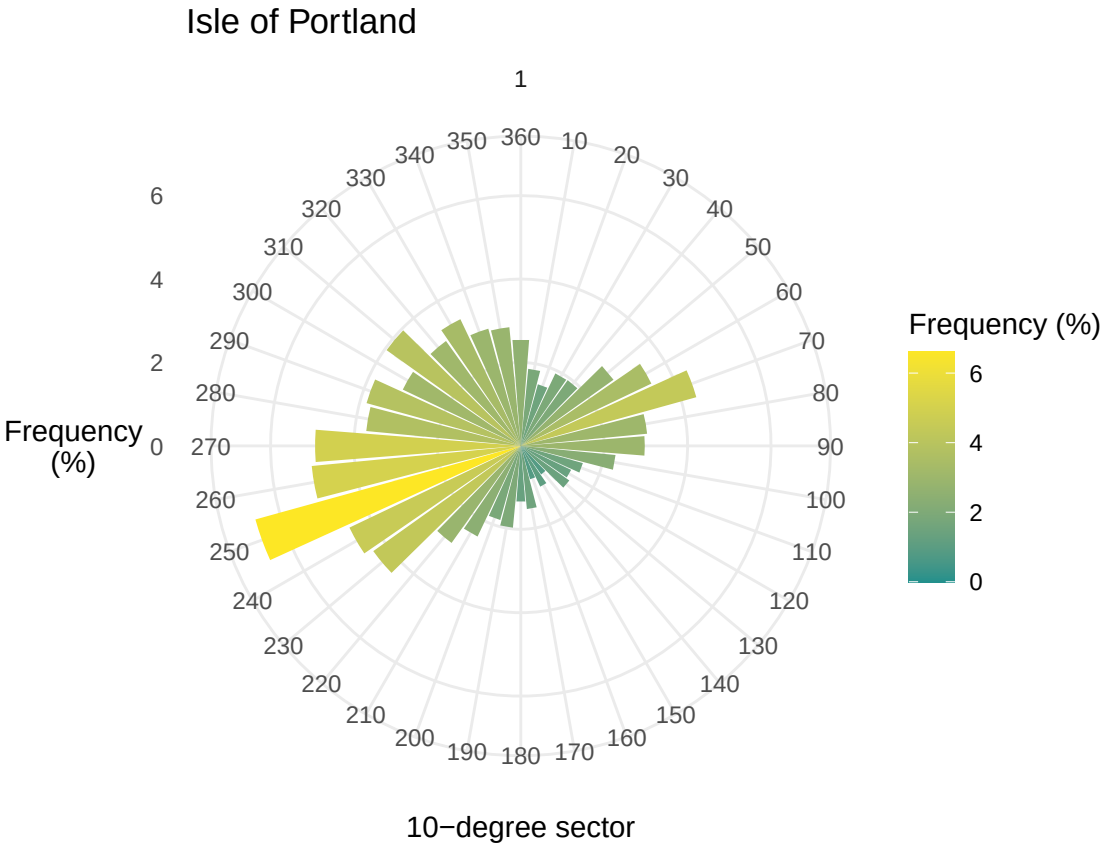
10−degree sector


Isle of Portland
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Frequency (%)
Frequency (%)
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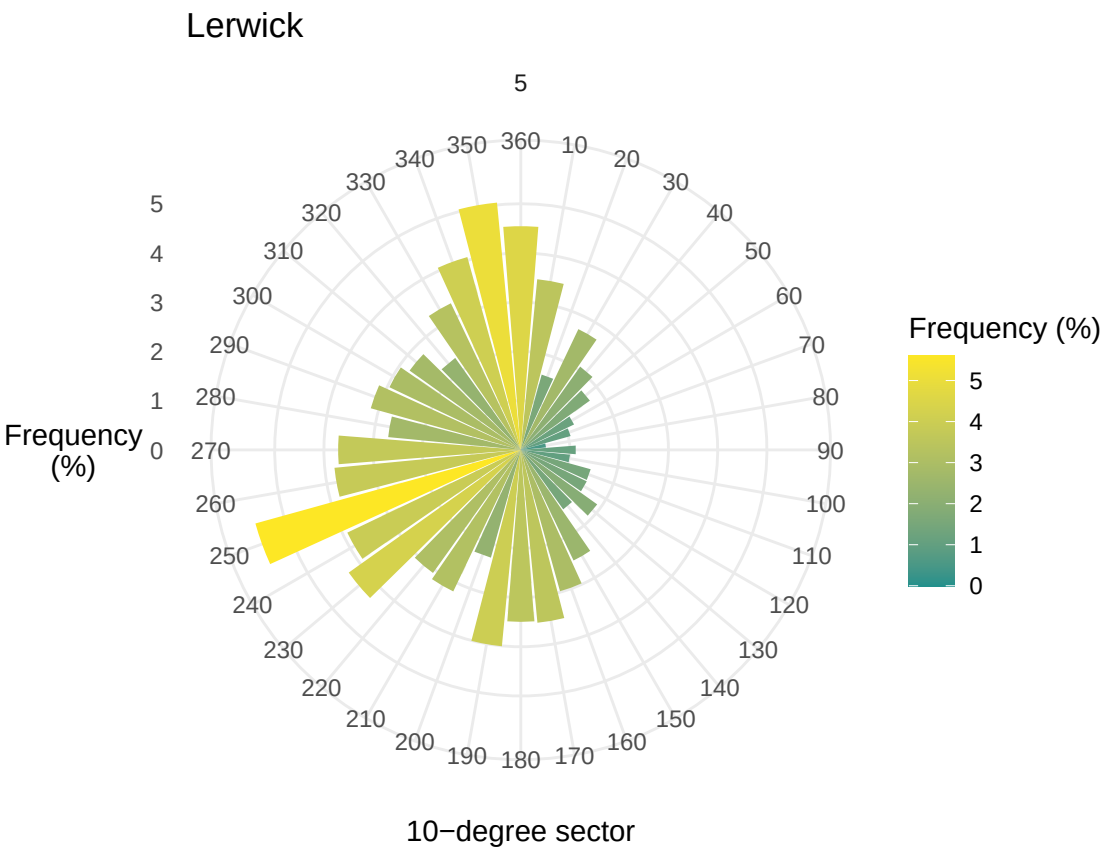
4
2
0
10−degree sector


Lerwick
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250
260
270
280
290
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Frequency (%)
10−degree sector
Frequency (%)
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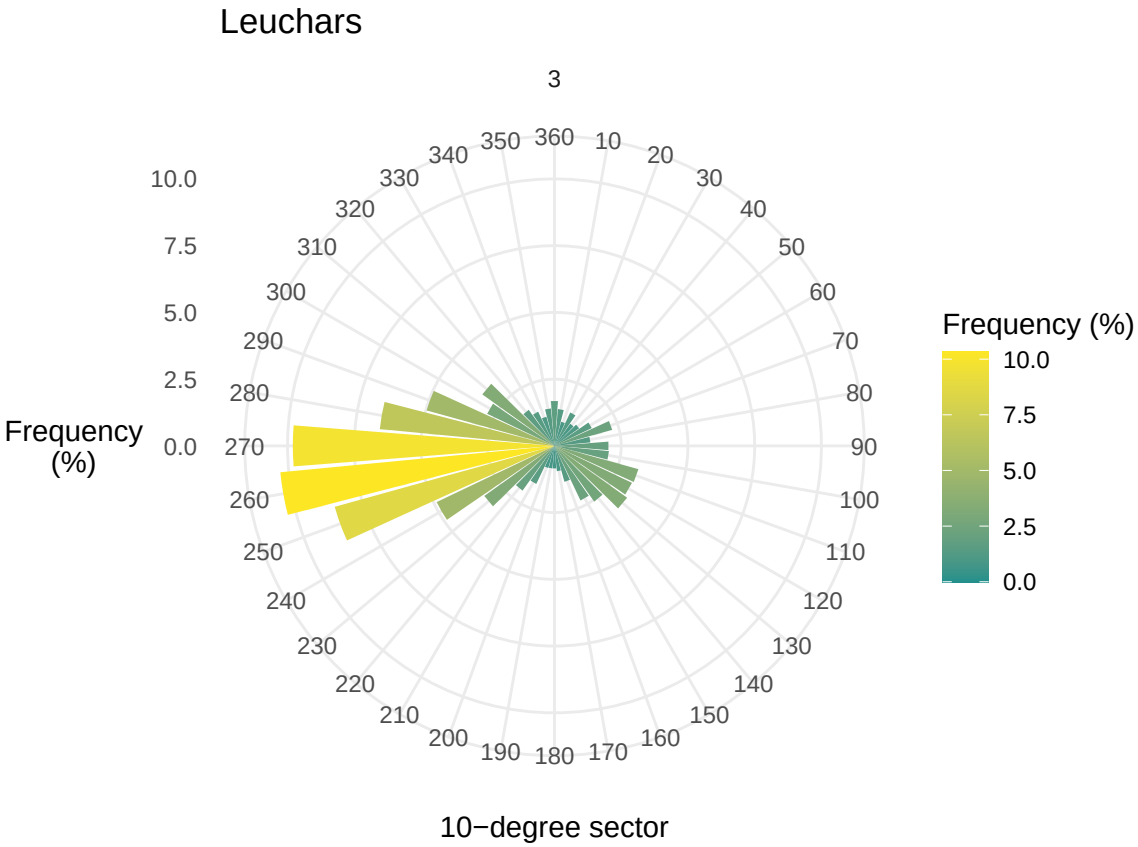
Leuchars
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310
320
330
340
350
10.0
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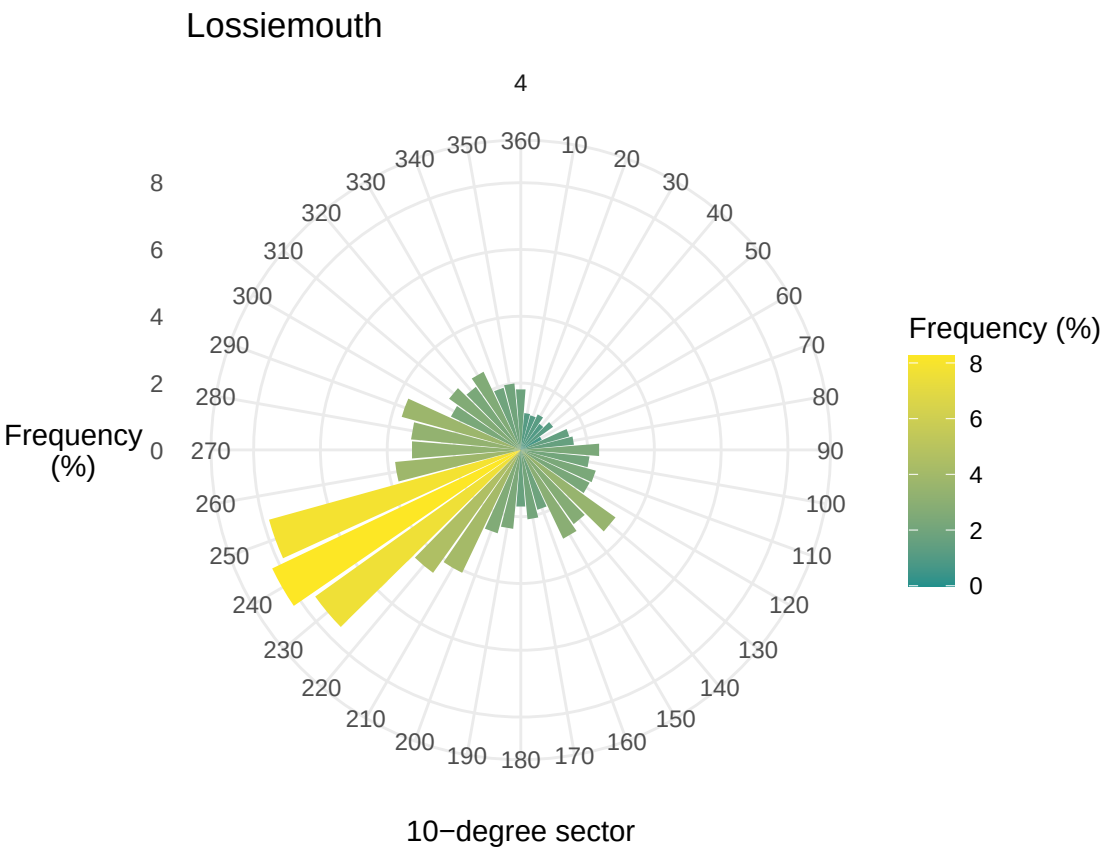
5.0
2.5
0.0
Frequency (%)
Frequency (%)
10.0
7.5
5.0
2.5
0.0
10−degree sector


Lossiemouth
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8
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Frequency (%)
Frequency (%)
8
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2
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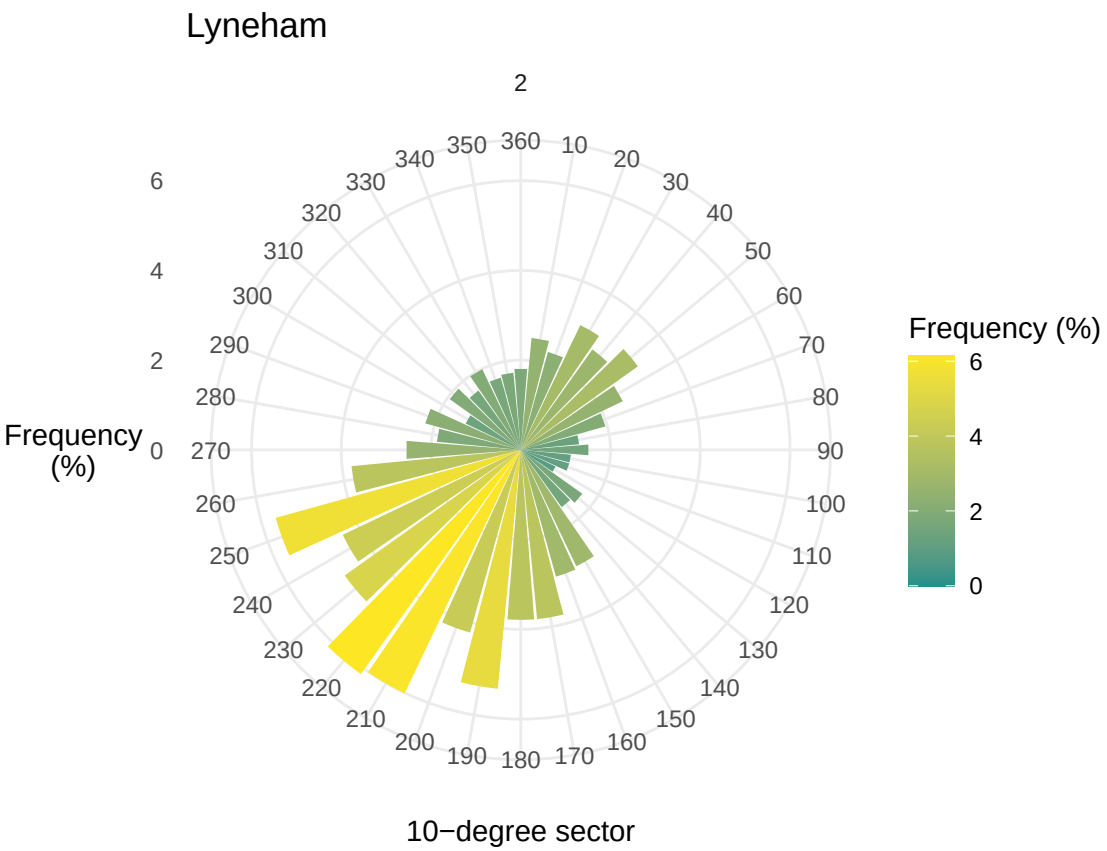
10−degree sector


Lyneham
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360
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330
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6
4
2
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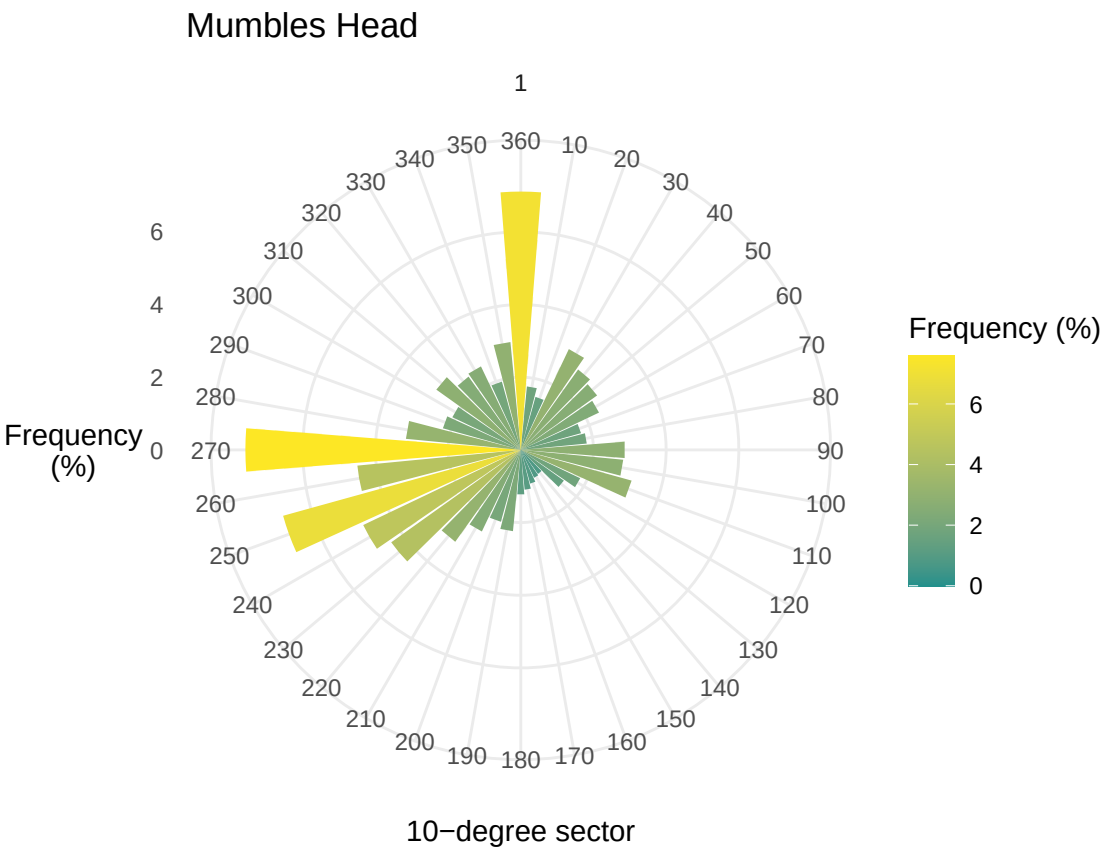
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Mumbles Head
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360
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330
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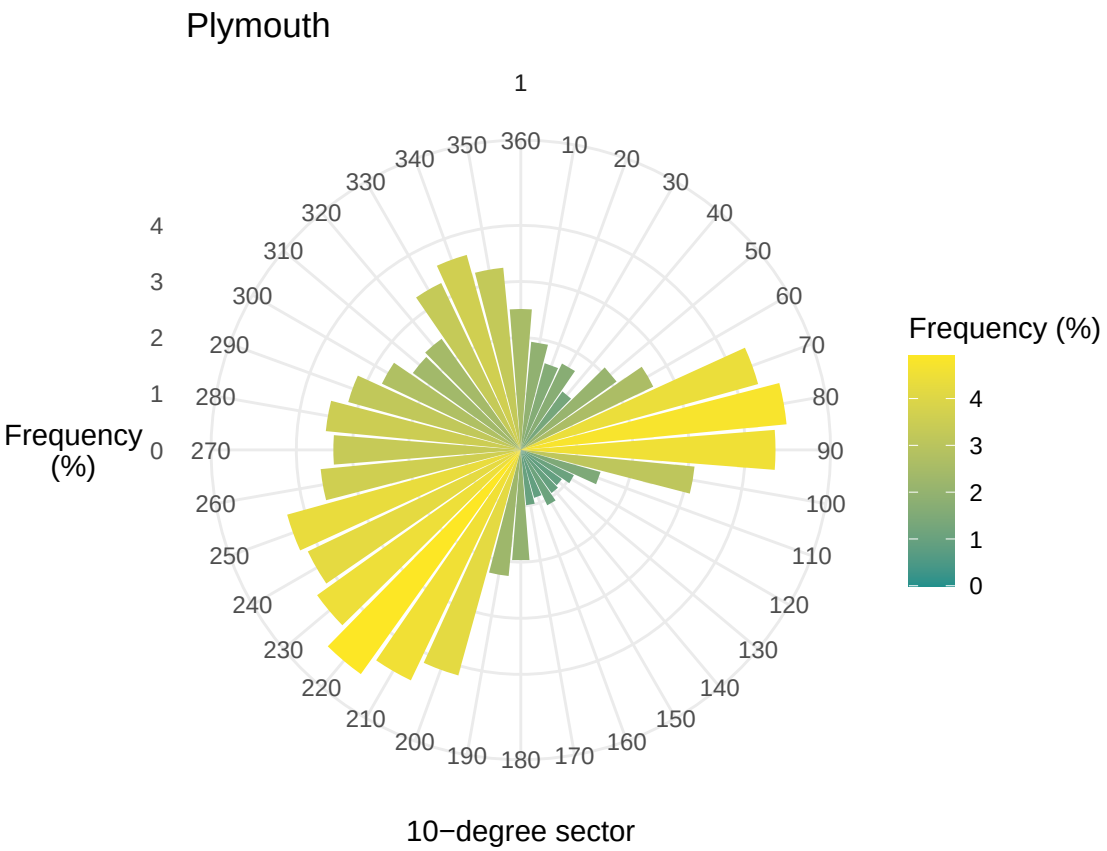
350
6
4
2
0
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Plymouth
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4
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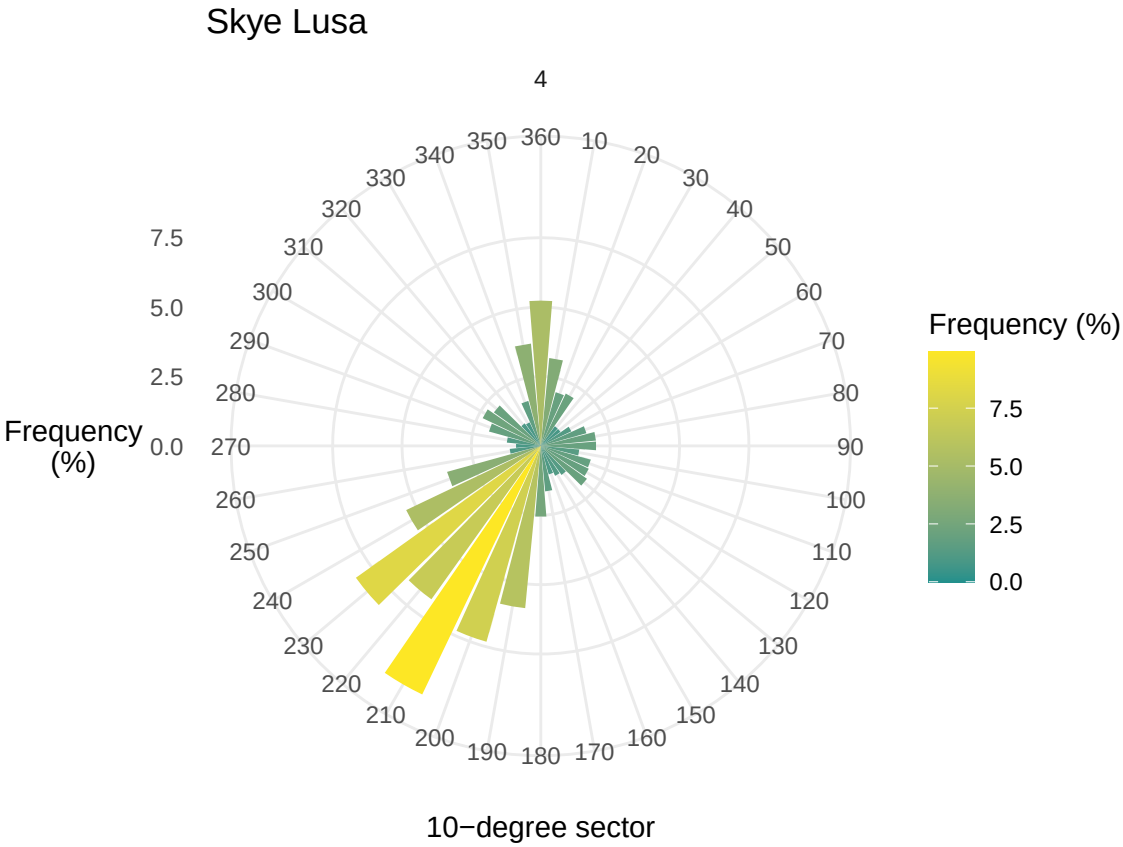
0
Frequency (%)
Frequency (%)
4
3
2
1
0
10−degree sector


Skye Lusa
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360
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320
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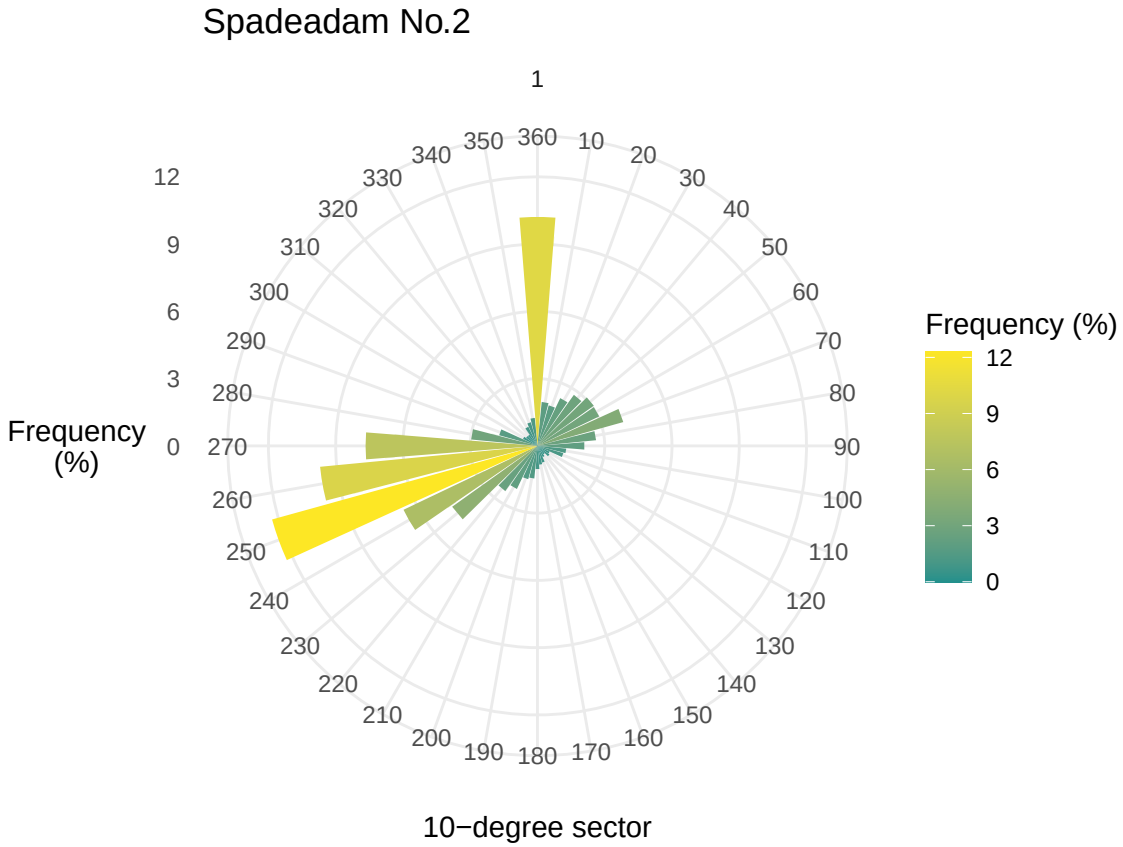
340
350
7.5
5.0
2.5
0.0
Frequency (%)
Frequency (%)
7.5
5.0
2.5
0.0
10−degree sector


Spadeadam No.2
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12
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6
3
0
Frequency (%)
Frequency (%)
12
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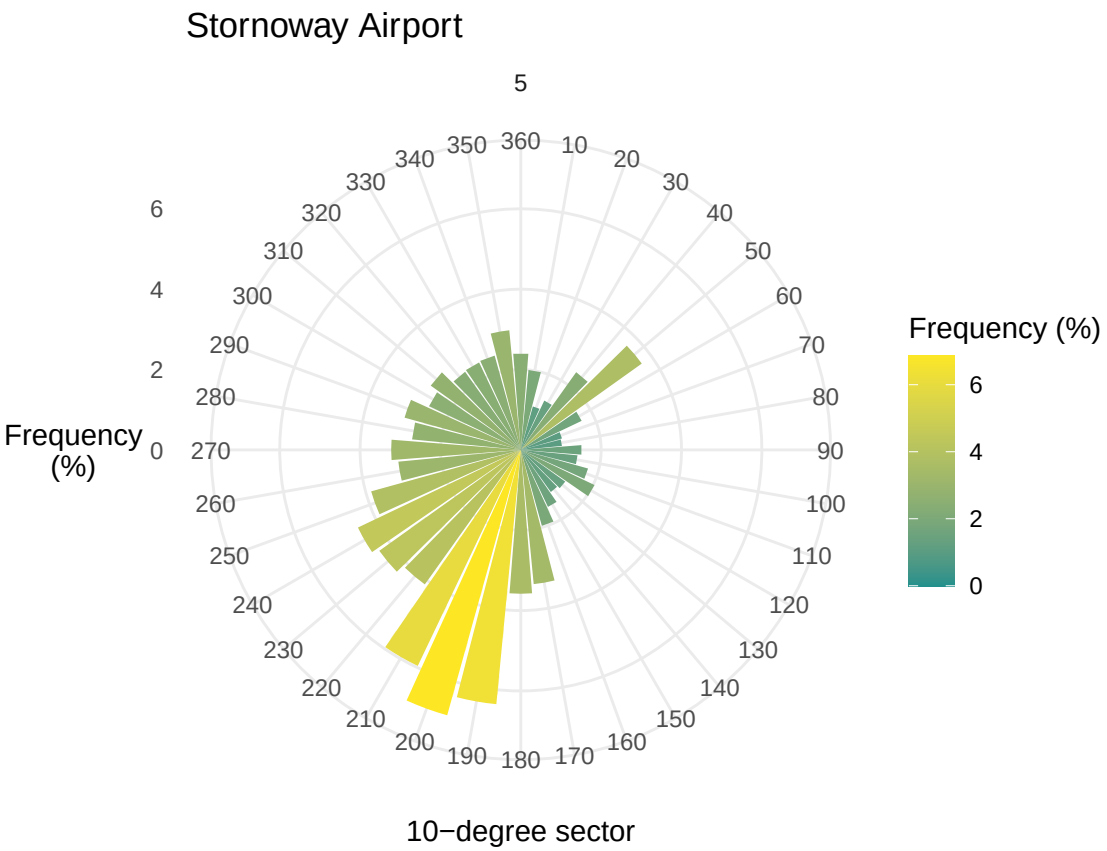
6
3
0
10−degree sector


Stornoway Airport
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Frequency (%)
Frequency (%)
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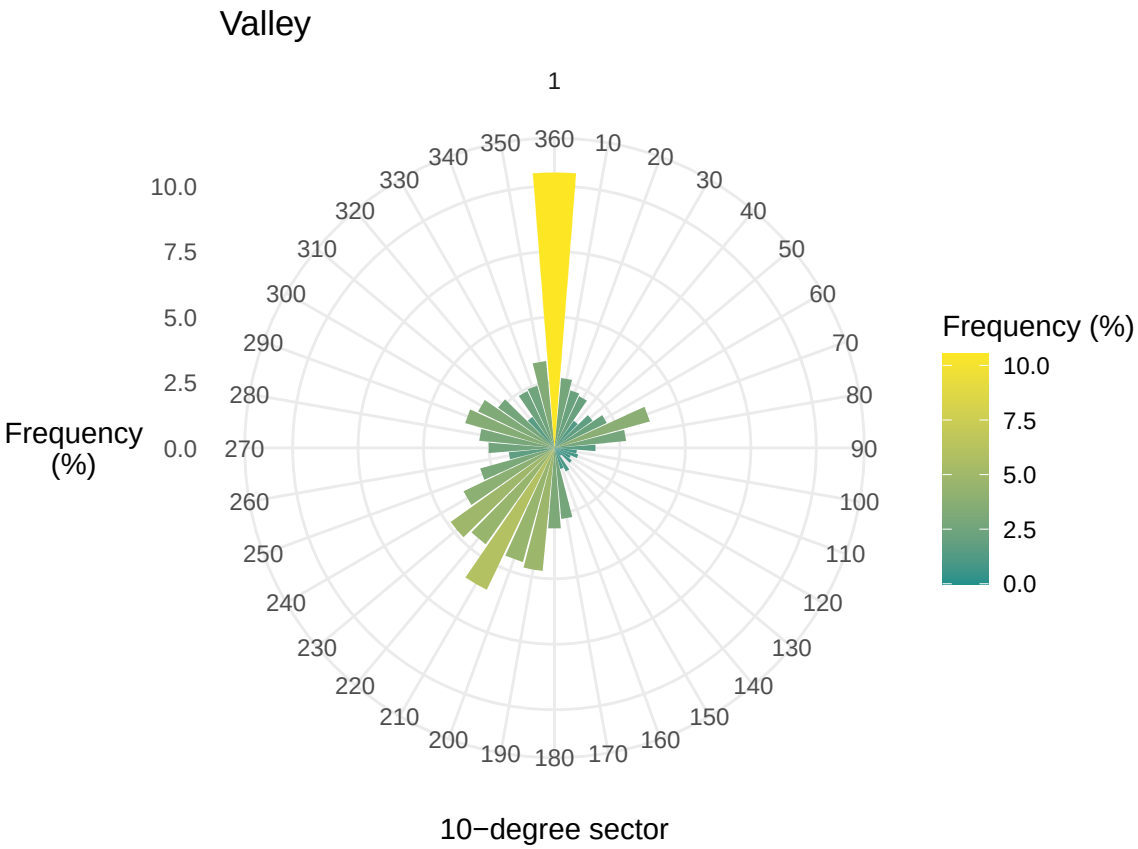
10−degree sector


Valley
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Frequency (%)
10−degree sector
Frequency (%)
10.0
7.5
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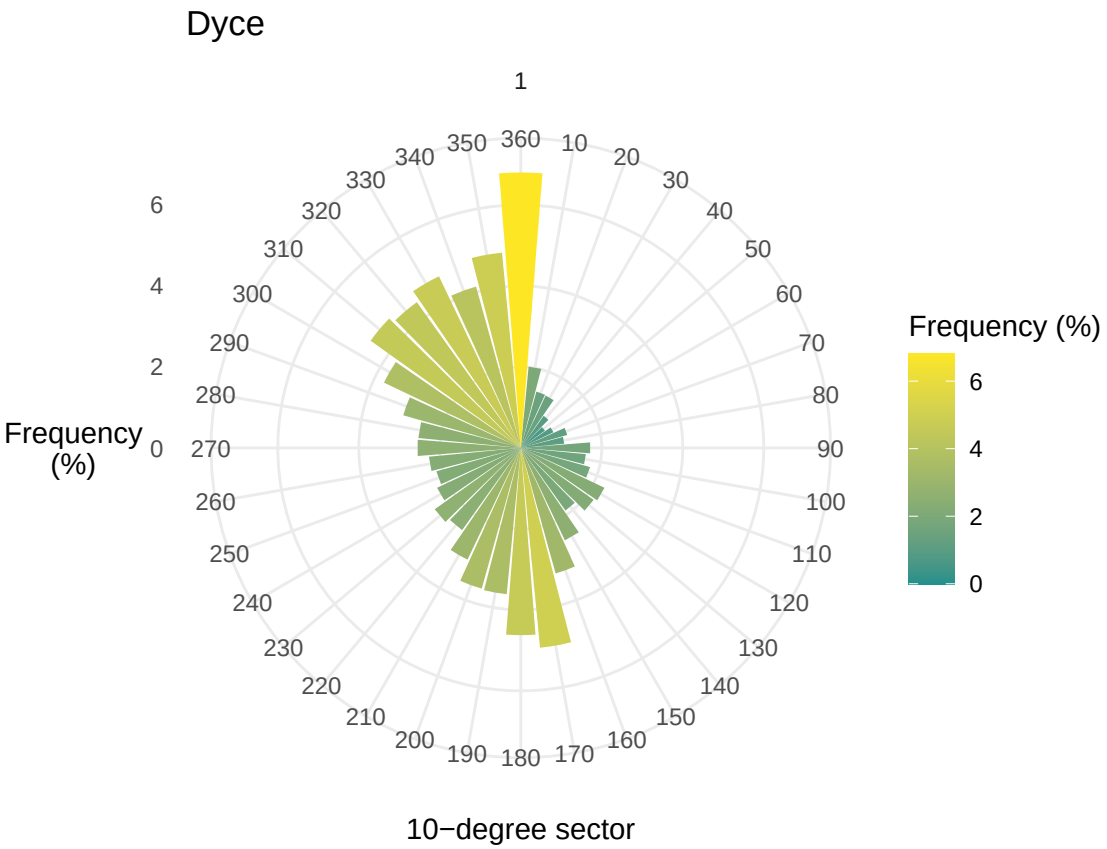
Dyce
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Frequency (%)
10−degree sector
Frequency (%)
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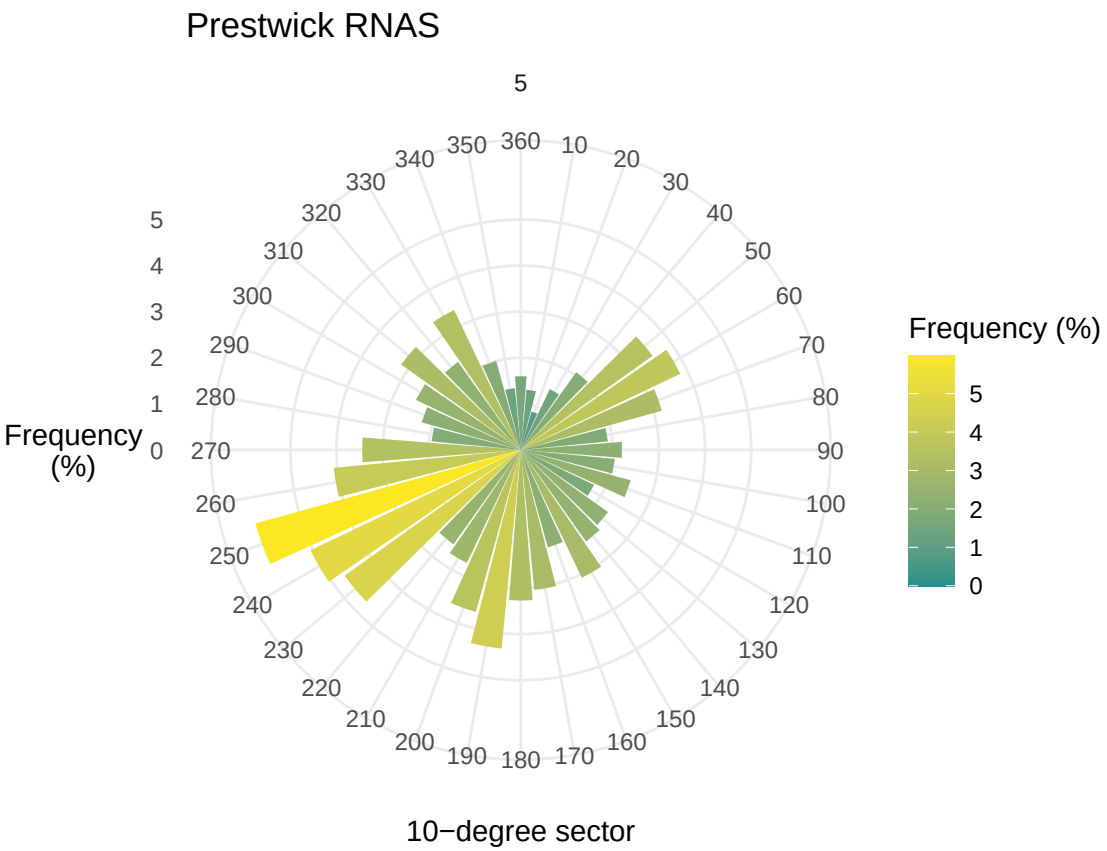
Prestwick RNAS
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Frequency (%)
Frequency (%)
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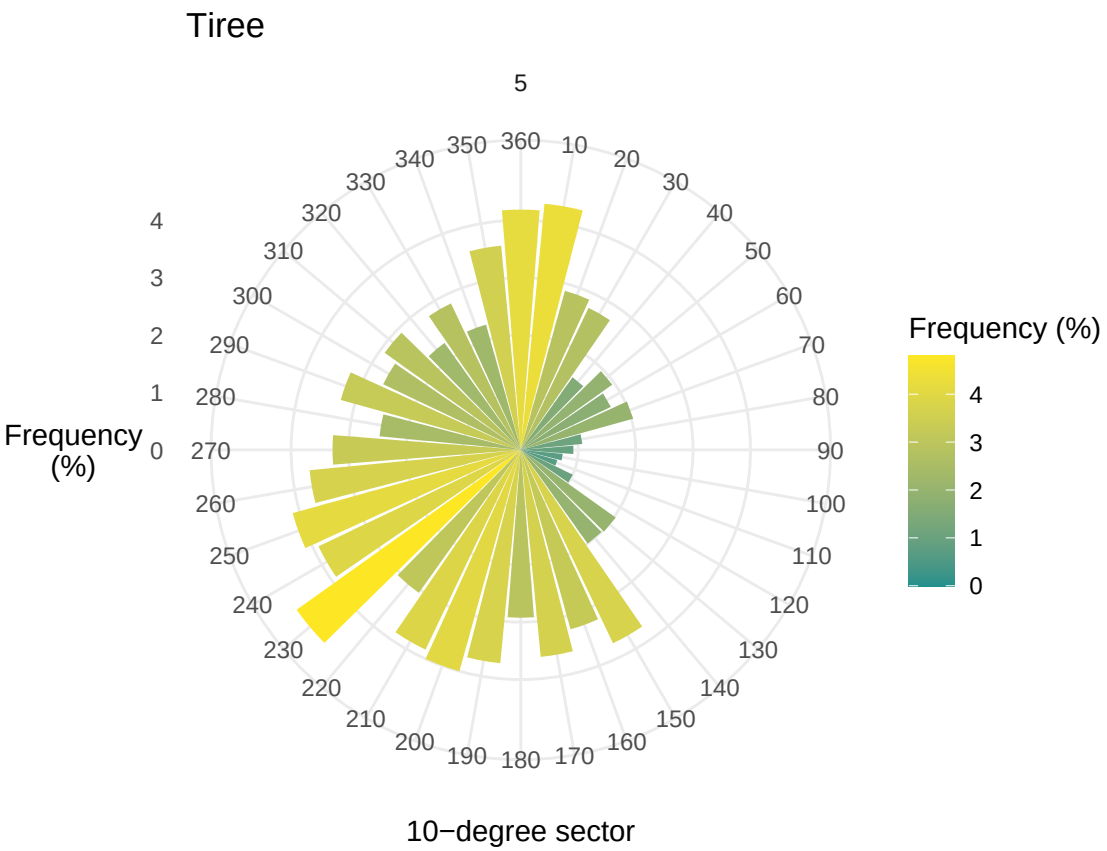
1
0
10−degree sector


Tiree
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Frequency (%)
Frequency (%)
4
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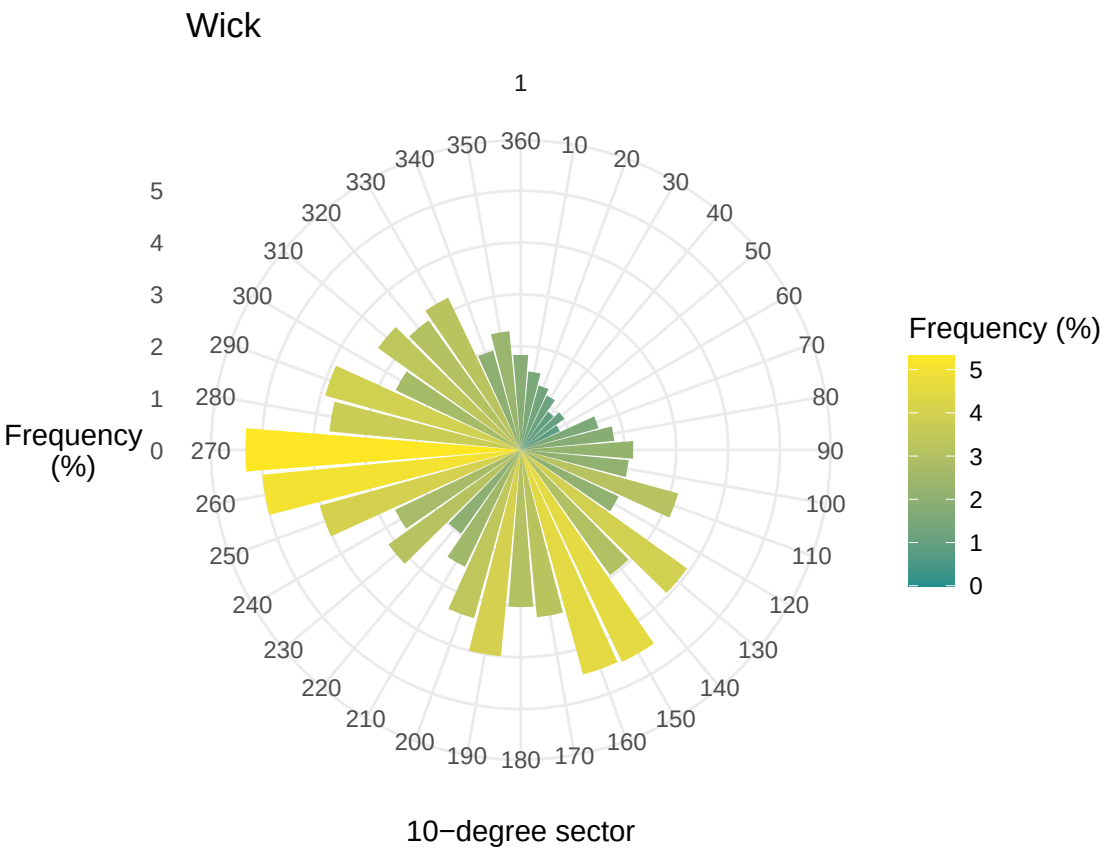
0
10−degree sector


Wick
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Frequency (%)
10−degree sector
Frequency (%)
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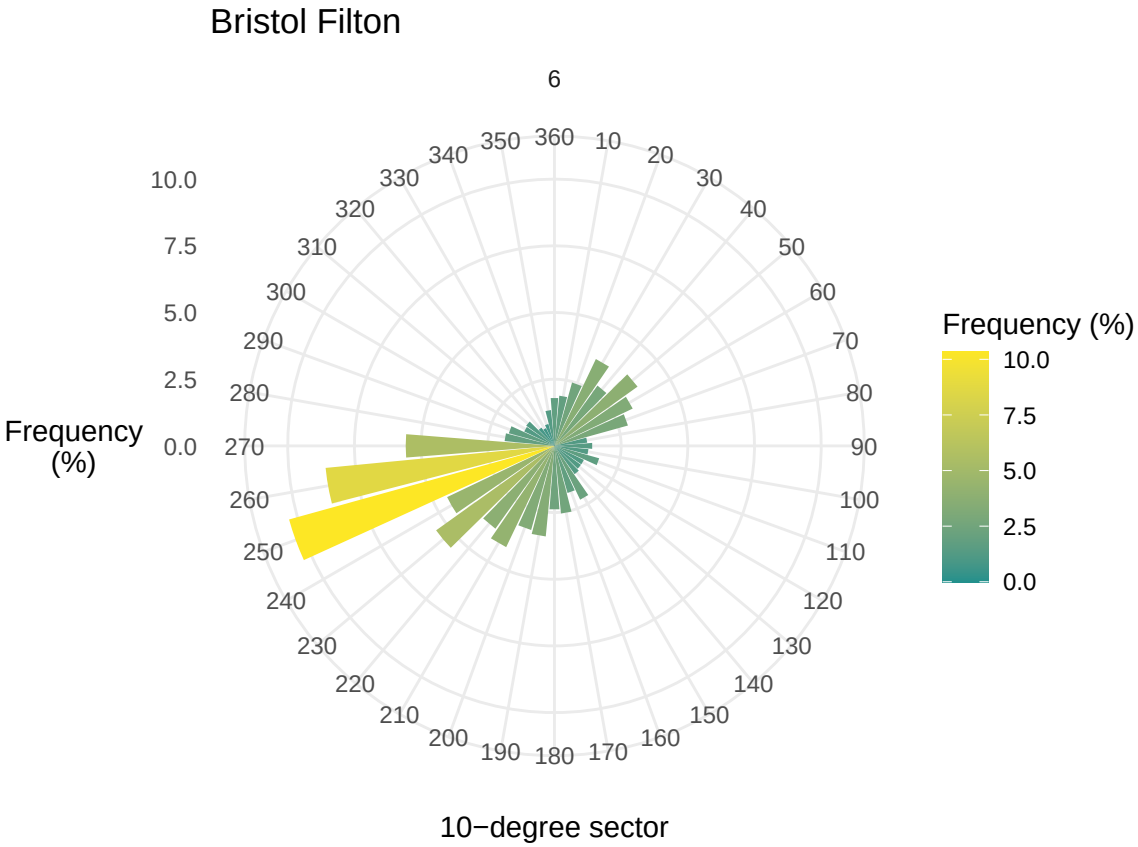
Bristol Filton
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10.0
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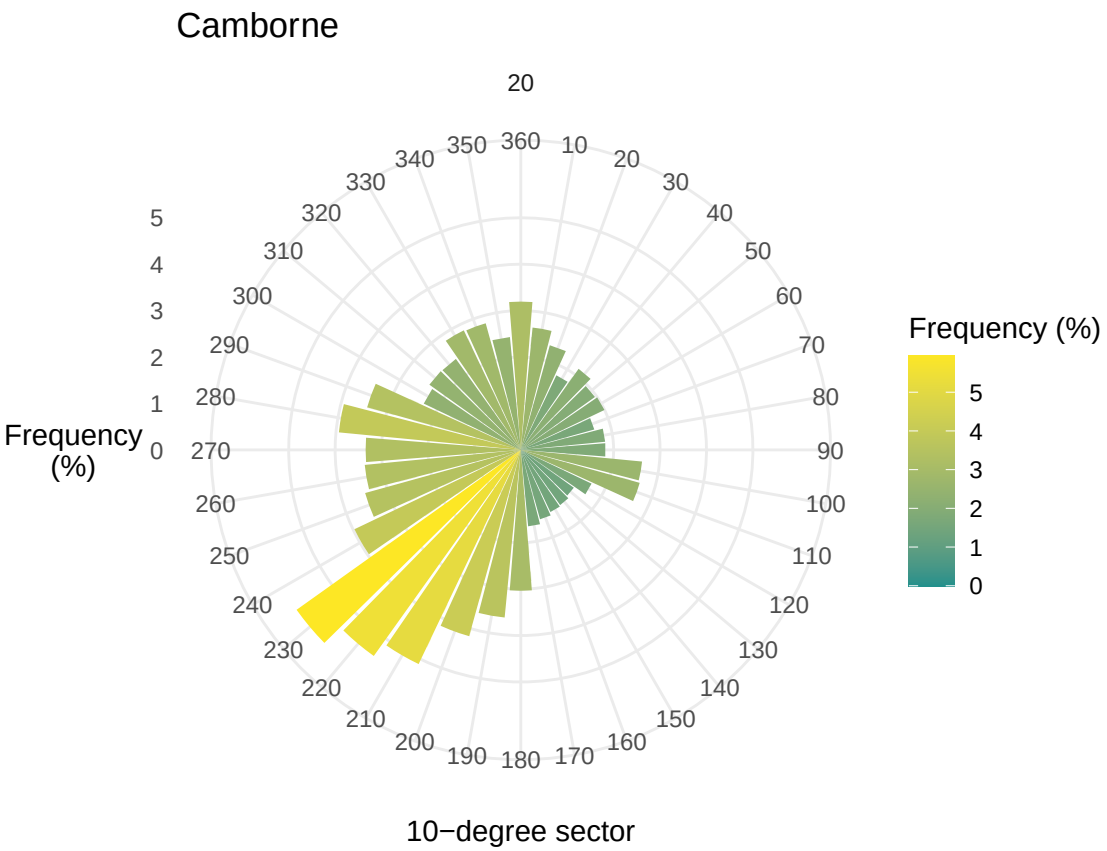
0.0
Frequency (%)
Frequency (%)
10.0
7.5
5.0
2.5
0.0
10−degree sector


Camborne
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Frequency (%)
Frequency (%)
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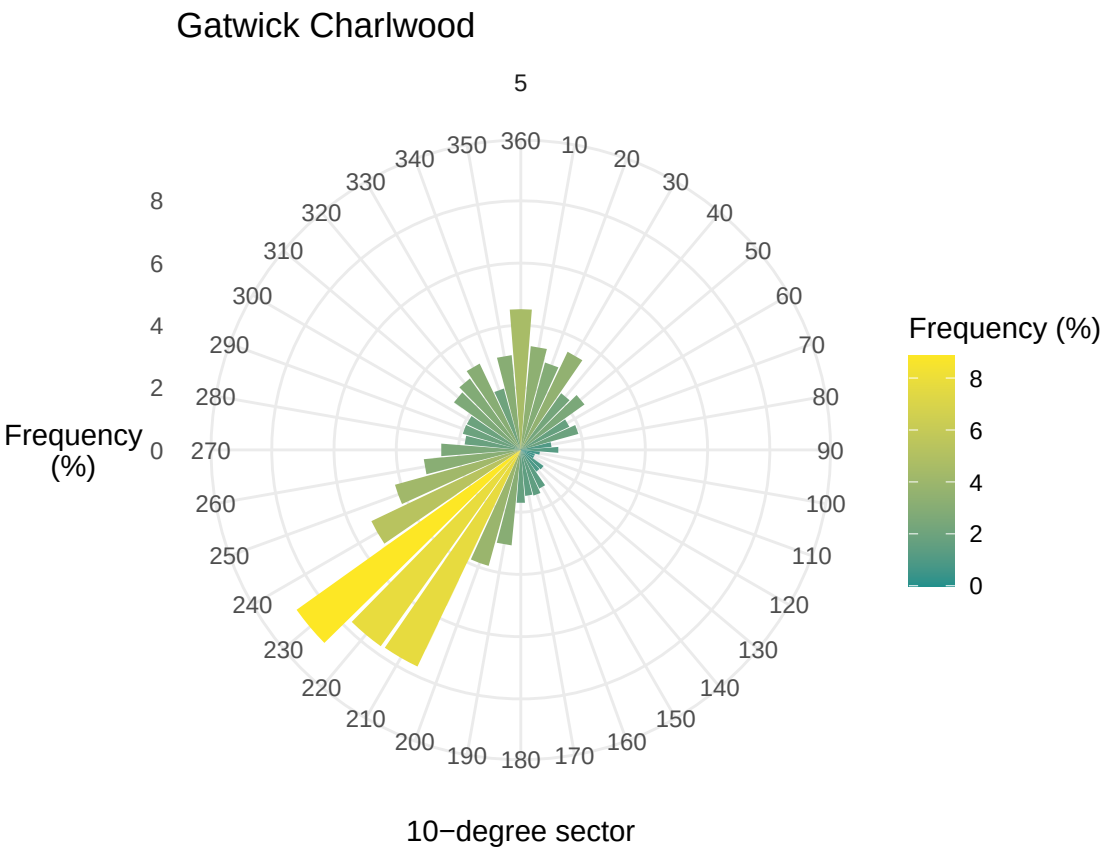
0
10−degree sector


Gatwick Charlwood
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Frequency (%)
10−degree sector
Frequency (%)
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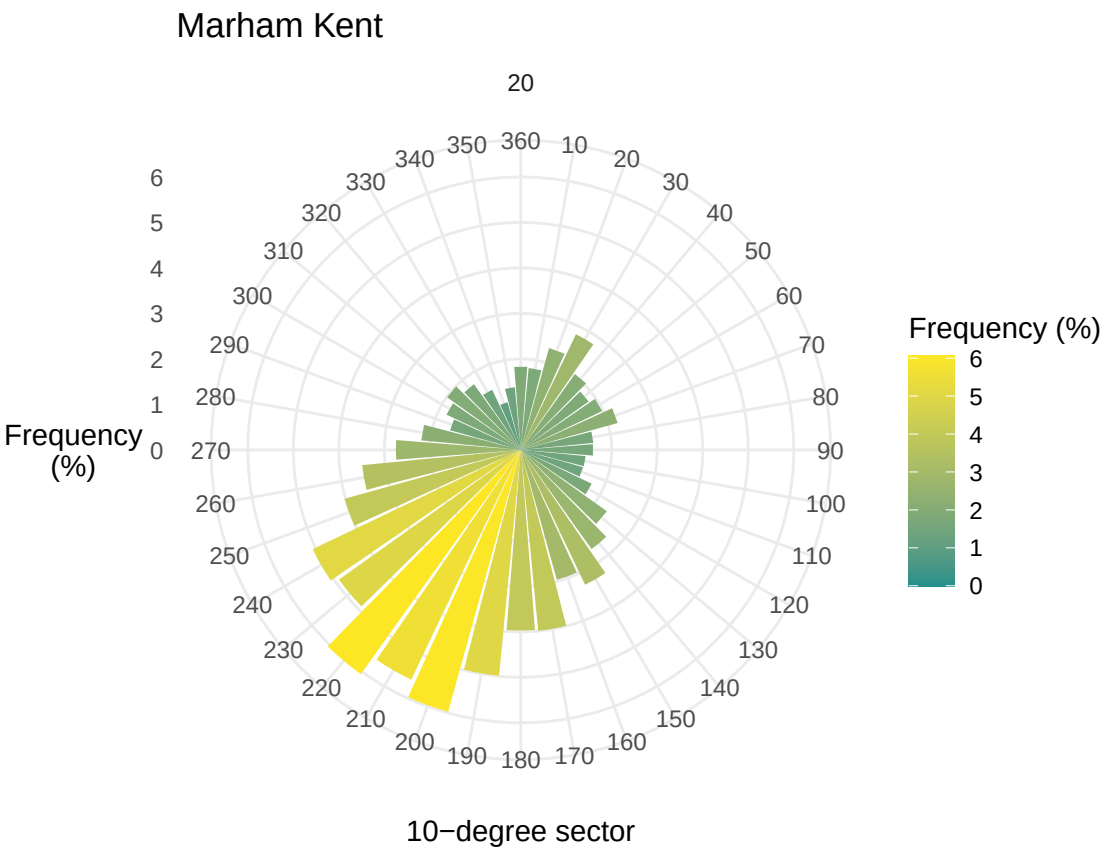
Marham Kent
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Frequency (%)
Frequency (%)
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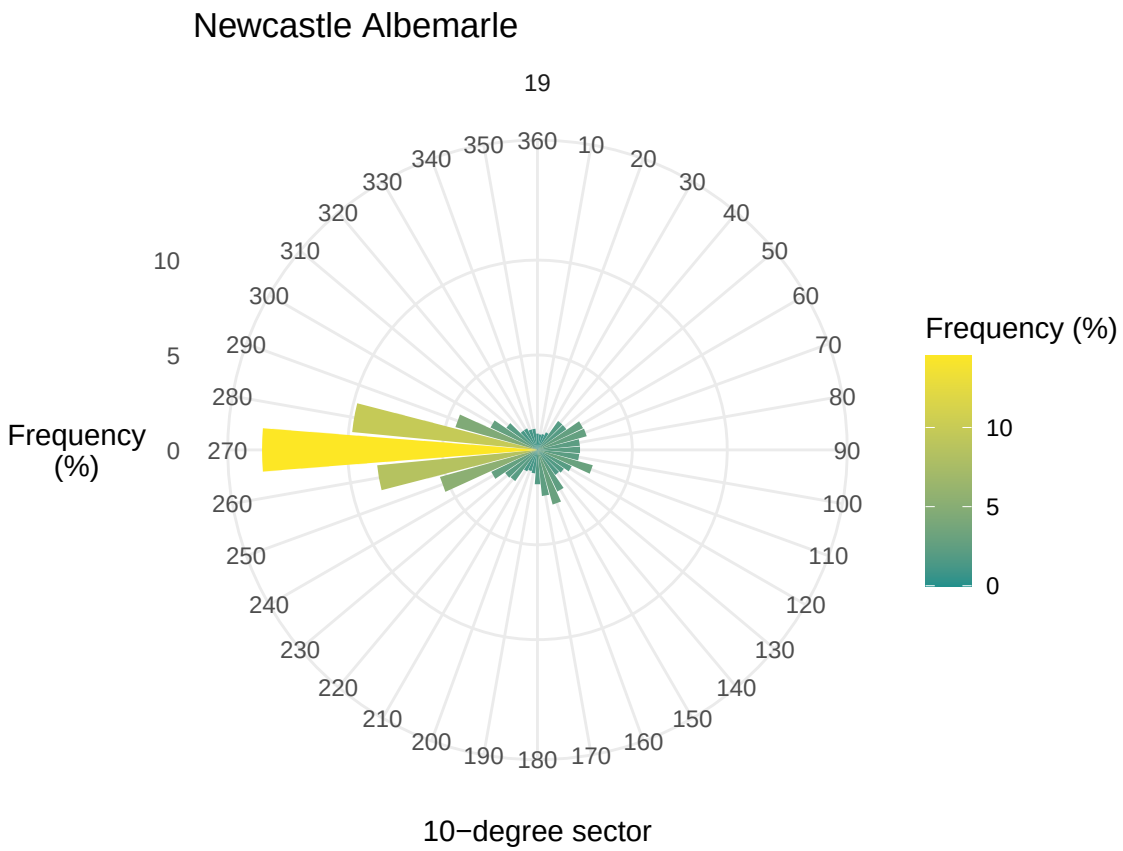
0
10−degree sector


Newcastle Albemarle
19
360
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Frequency (%)
Frequency (%)
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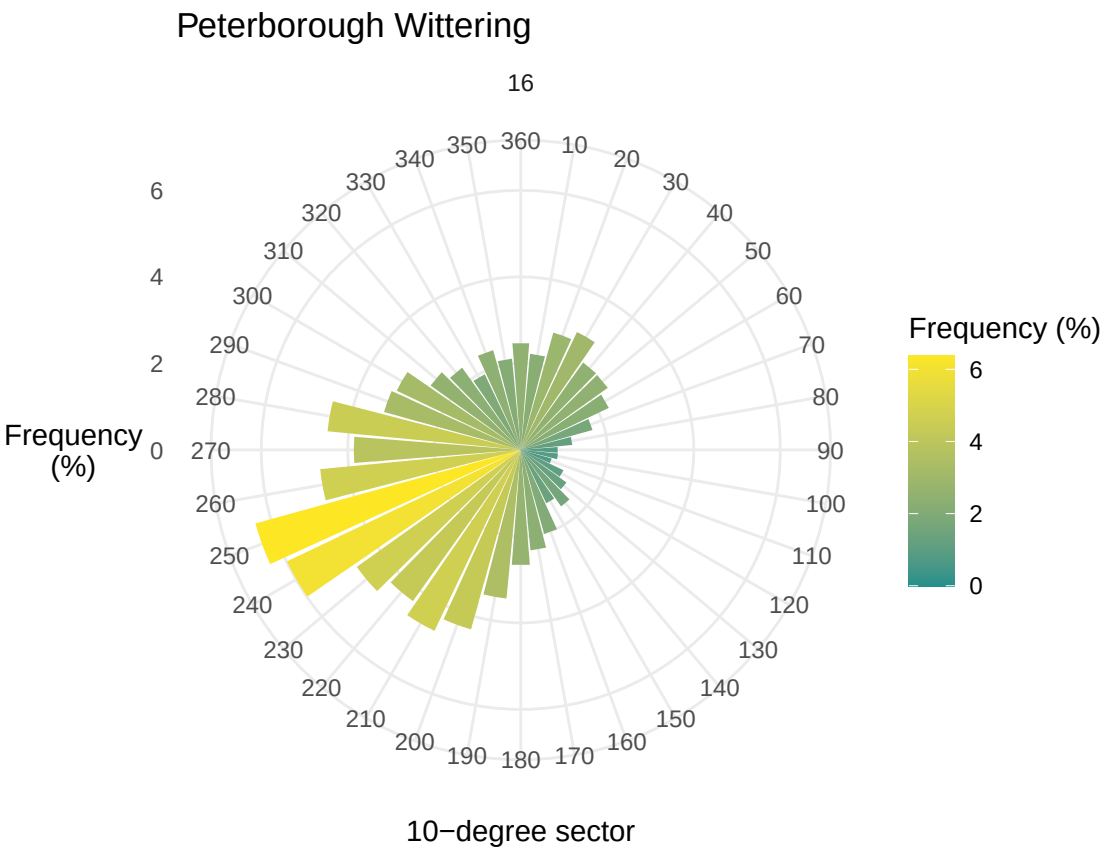
5
0
10−degree sector


Peterborough Wittering
16
360
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Frequency (%)
10−degree sector
Frequency (%)
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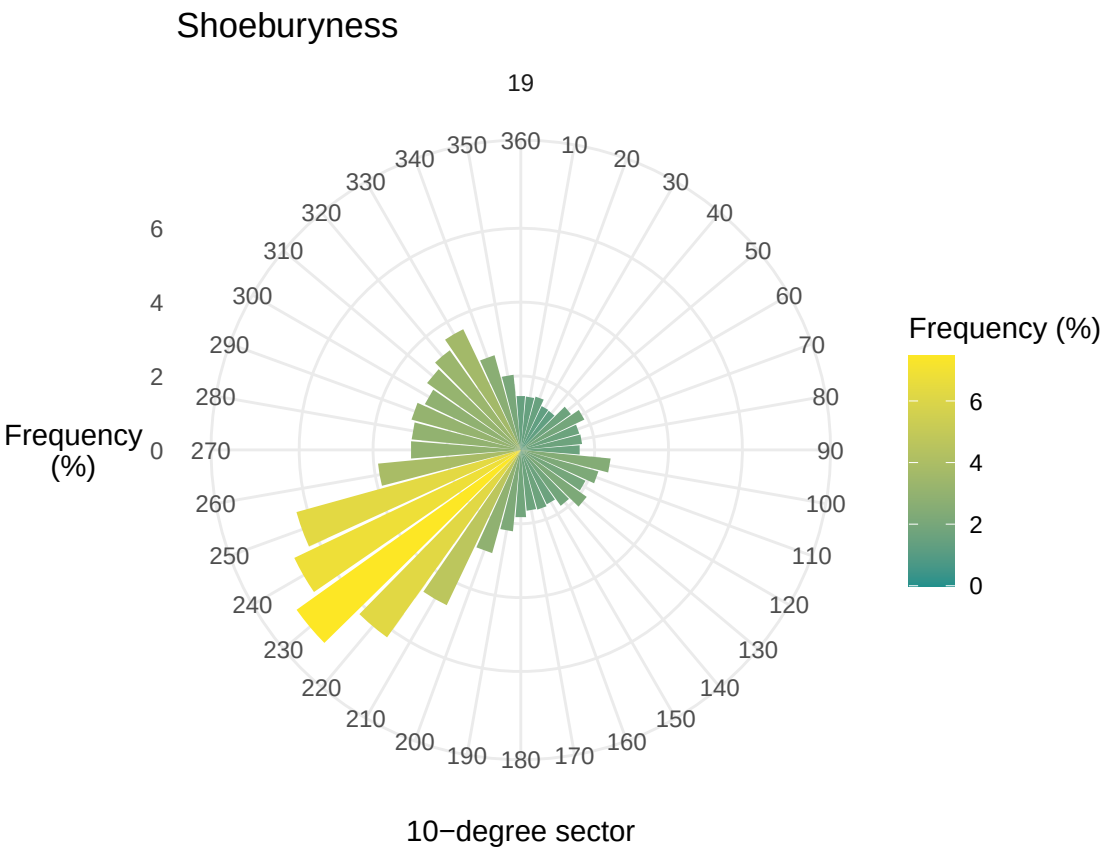
Shoeburyness
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Frequency (%)
Frequency (%)
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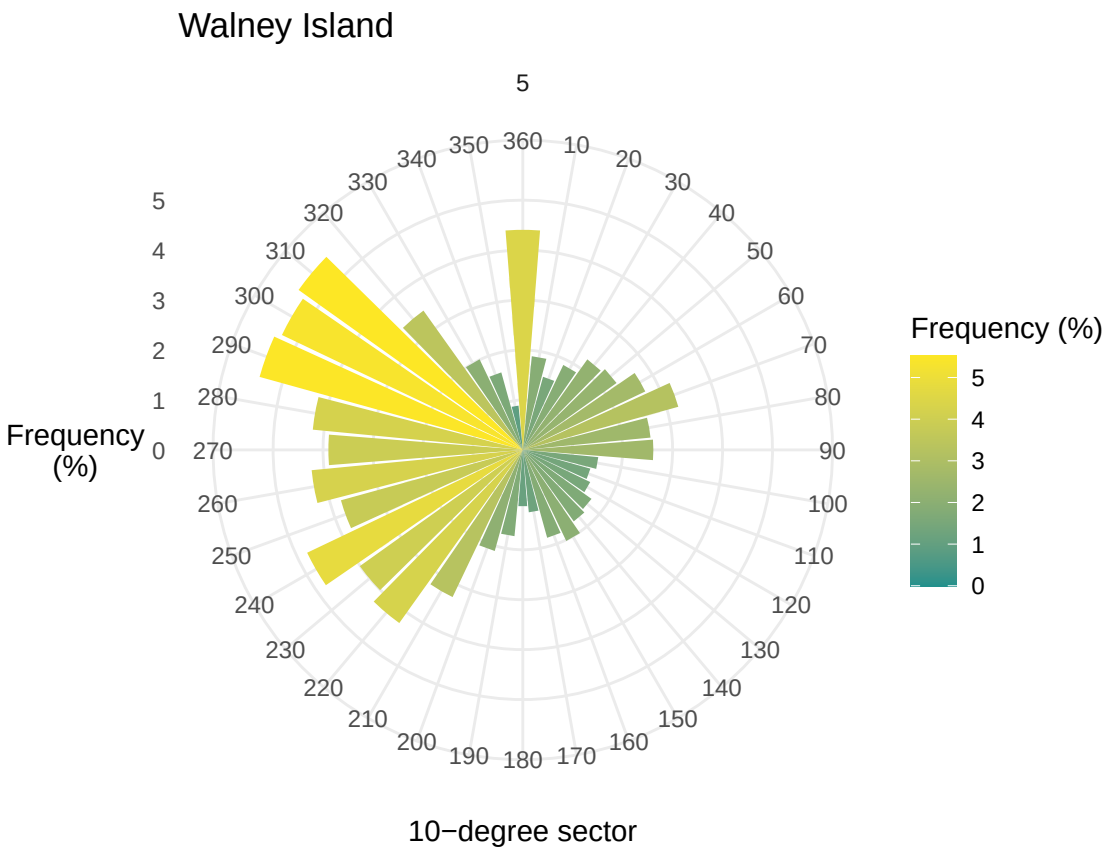
10−degree sector


Walney Island
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Frequency (%)
10−degree sector
Frequency (%)
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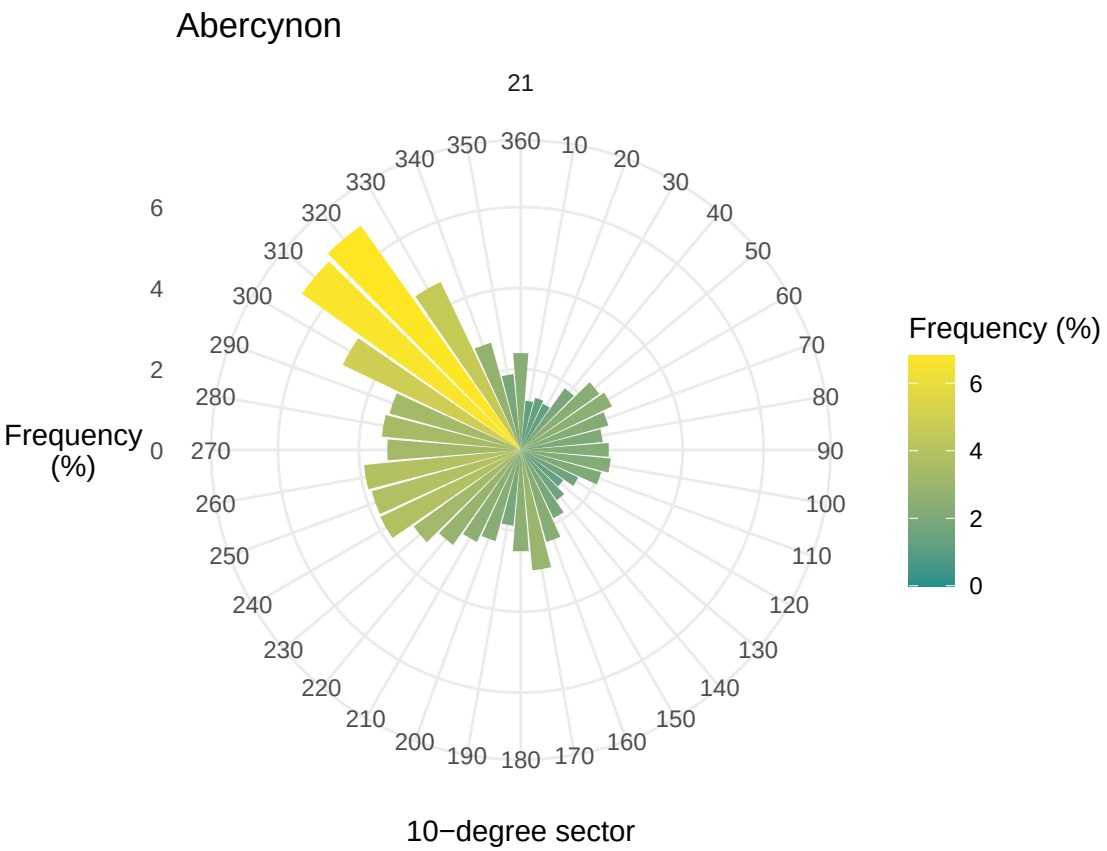
Abercynon
21
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Frequency (%)
Frequency (%)
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4
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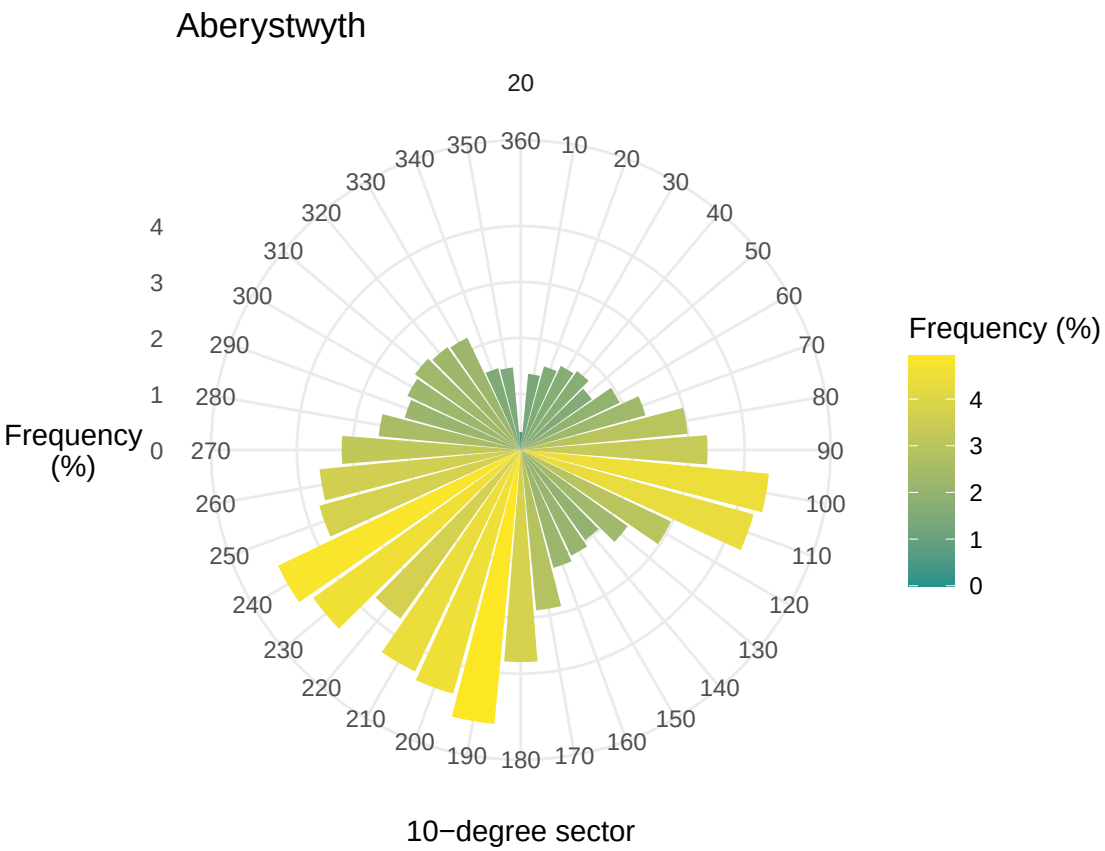
0
10−degree sector


Aberystwyth
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Frequency (%)
Frequency (%)
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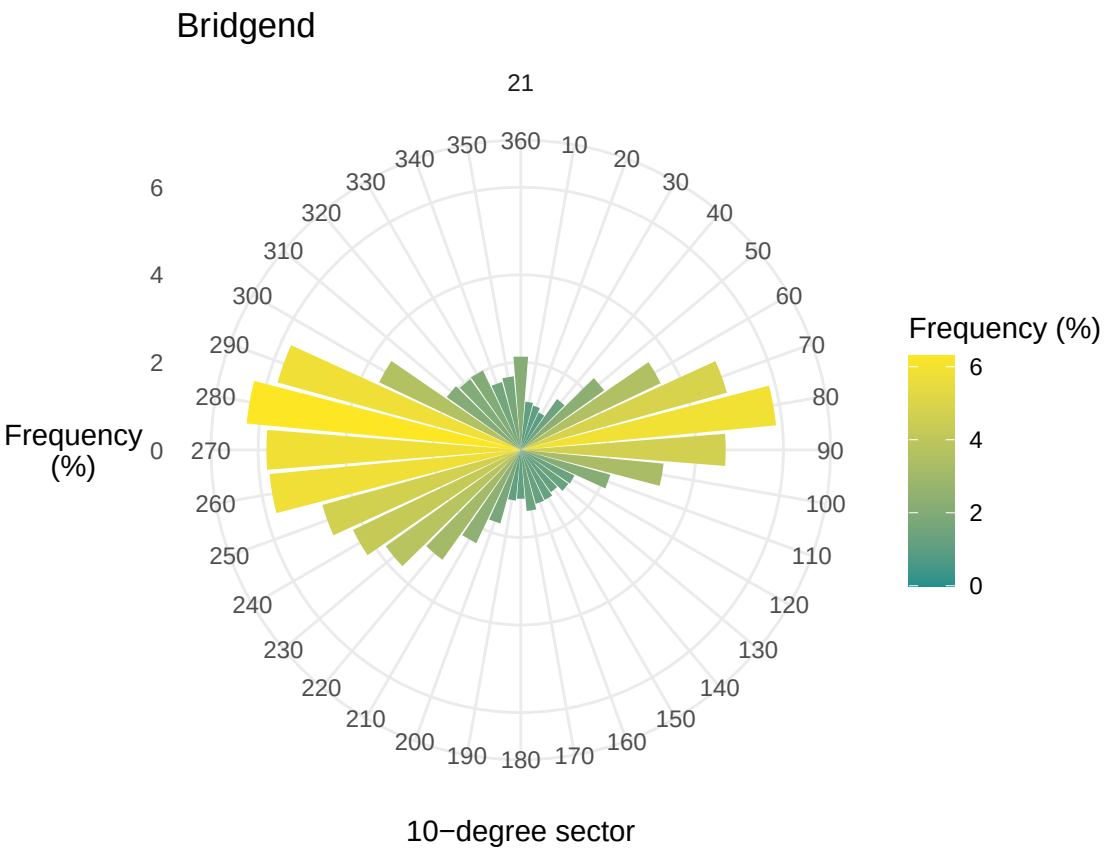
0
10−degree sector


Bridgend
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Frequency (%)
Frequency (%)
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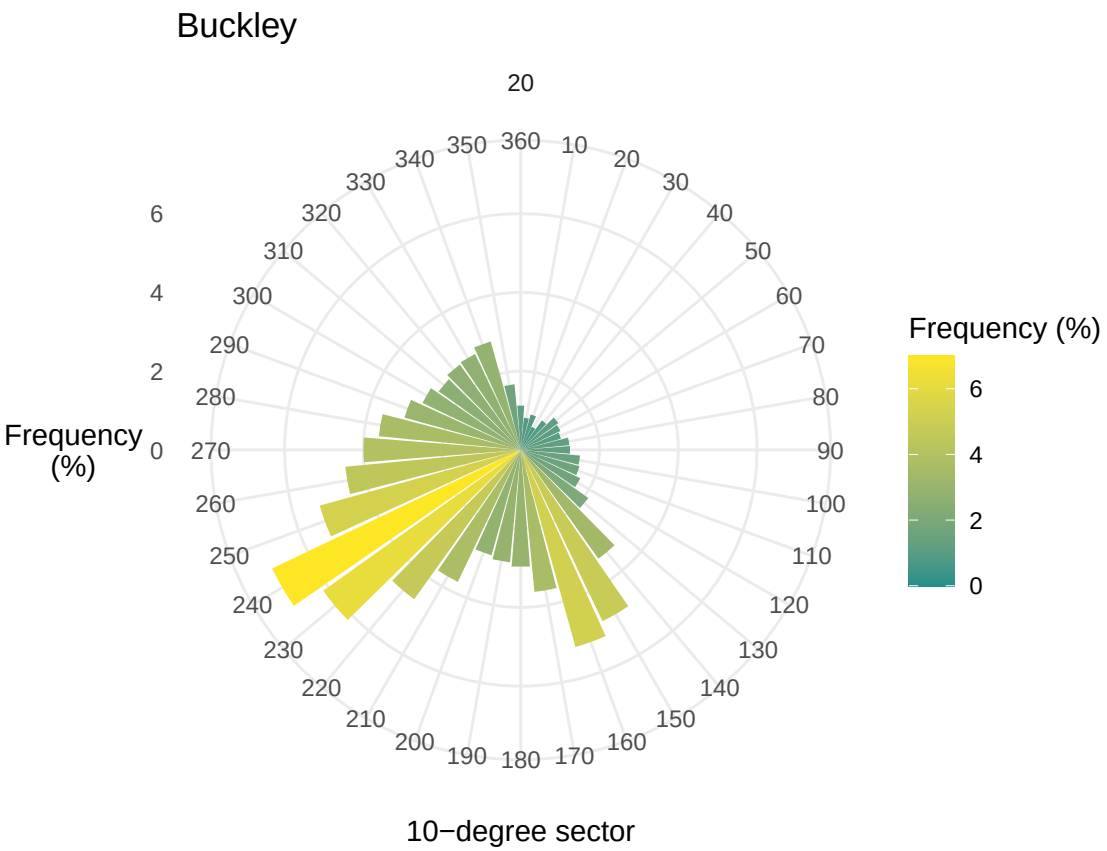
10−degree sector


Buckley
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Frequency (%)
Frequency (%)
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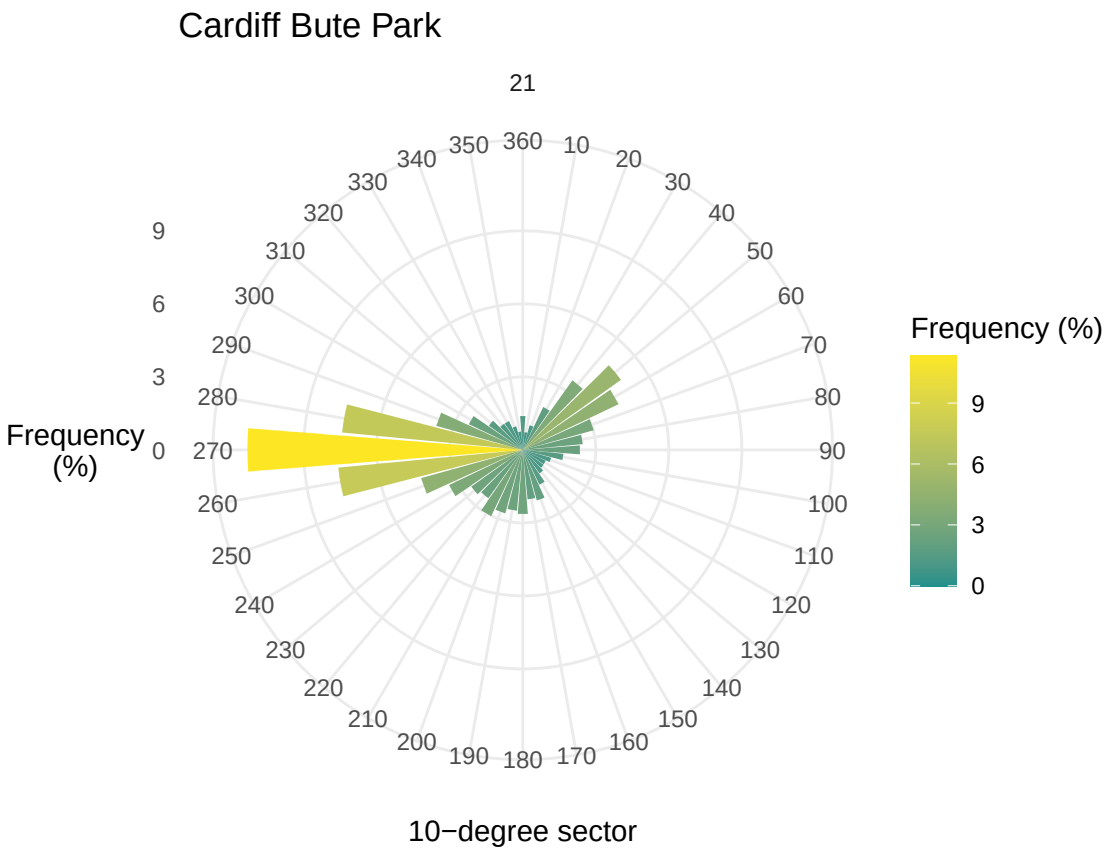
10−degree sector


Cardiff Bute Park
21
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Frequency (%)
Frequency (%)
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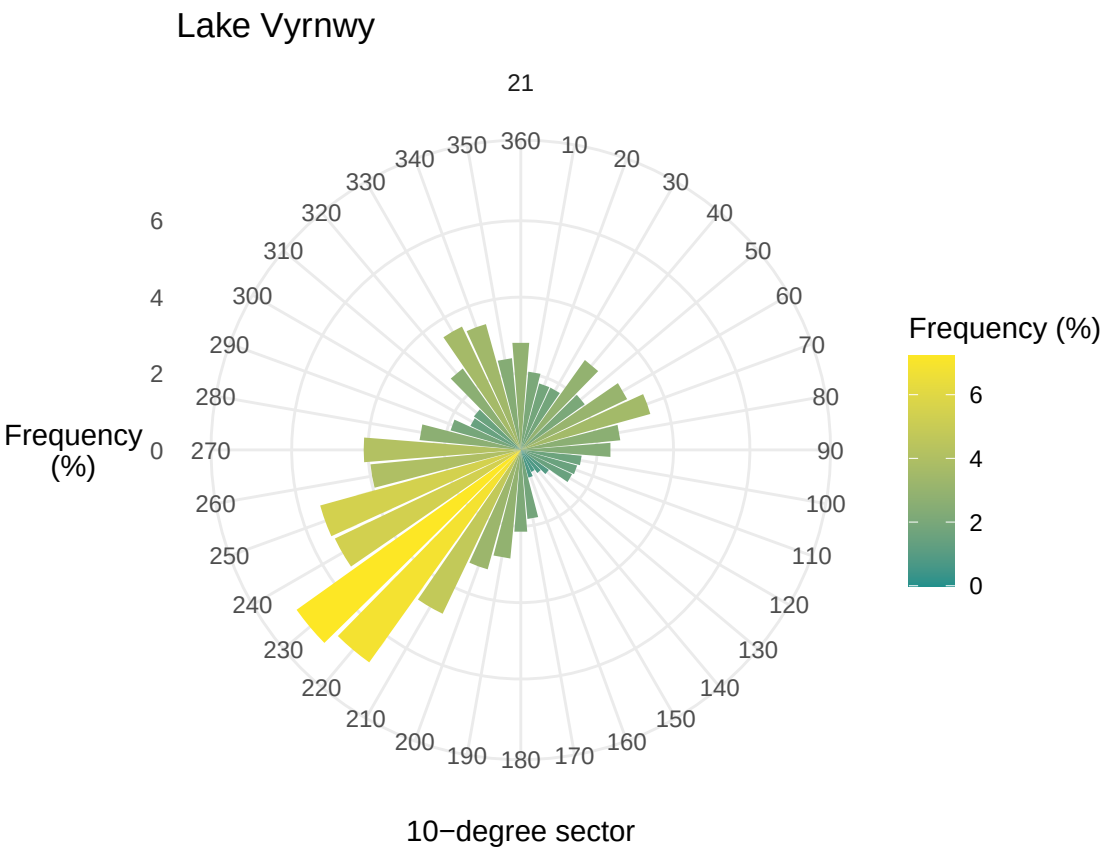
10−degree sector


Lake Vyrnwy
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Frequency (%)
Frequency (%)
6
4
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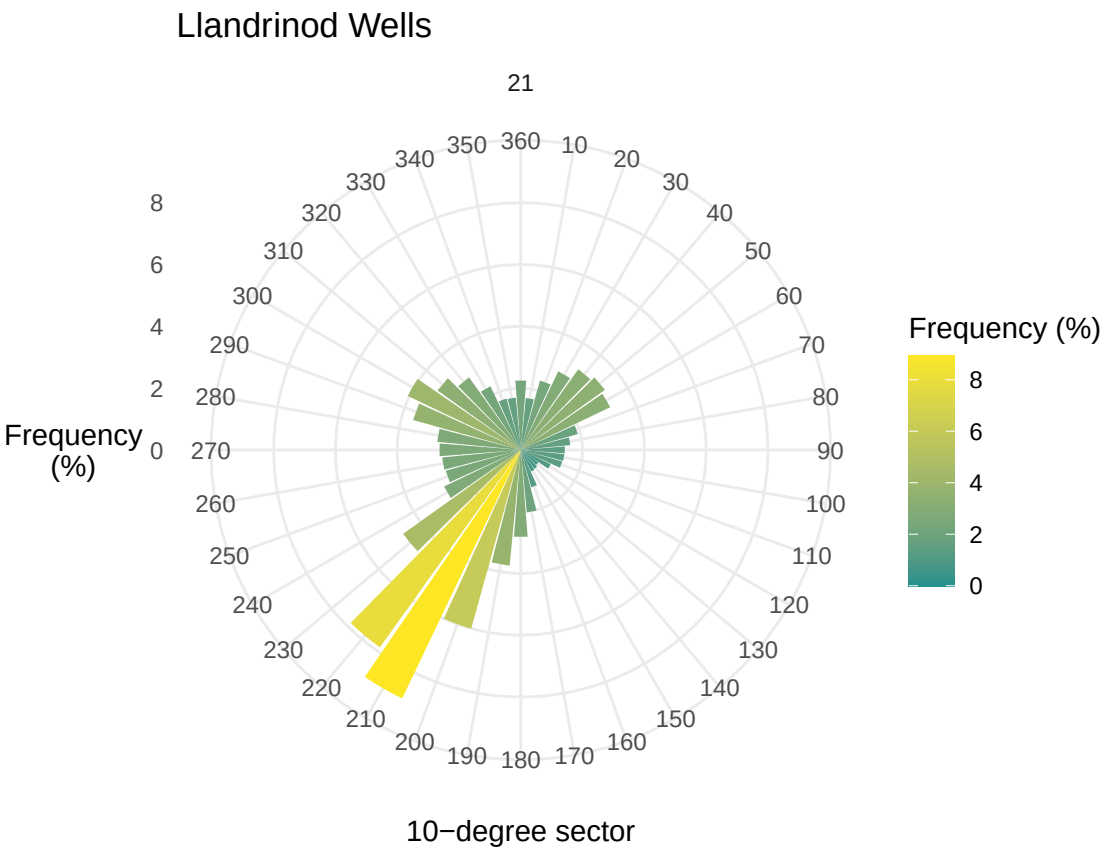
0
10−degree sector


Llandrinod Wells
21
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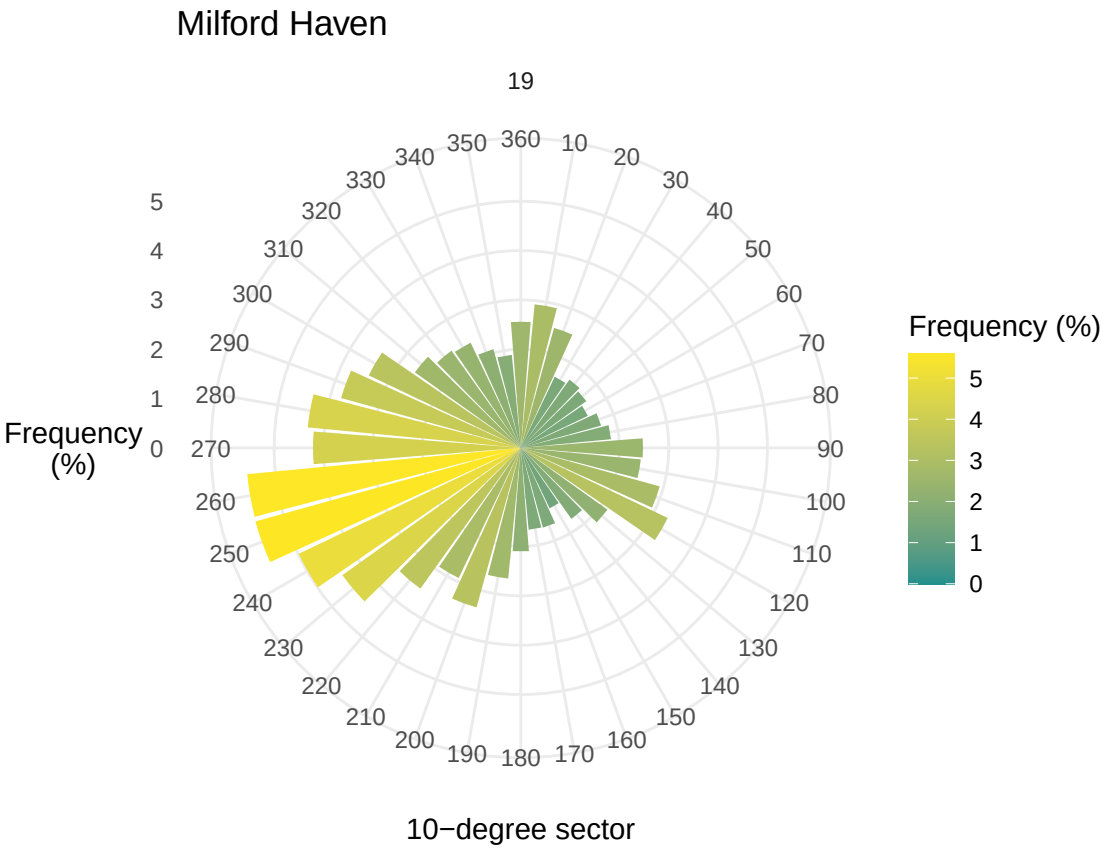
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
8
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
8
6
4
2
0


Milford Haven
19
360
10
20
30
40
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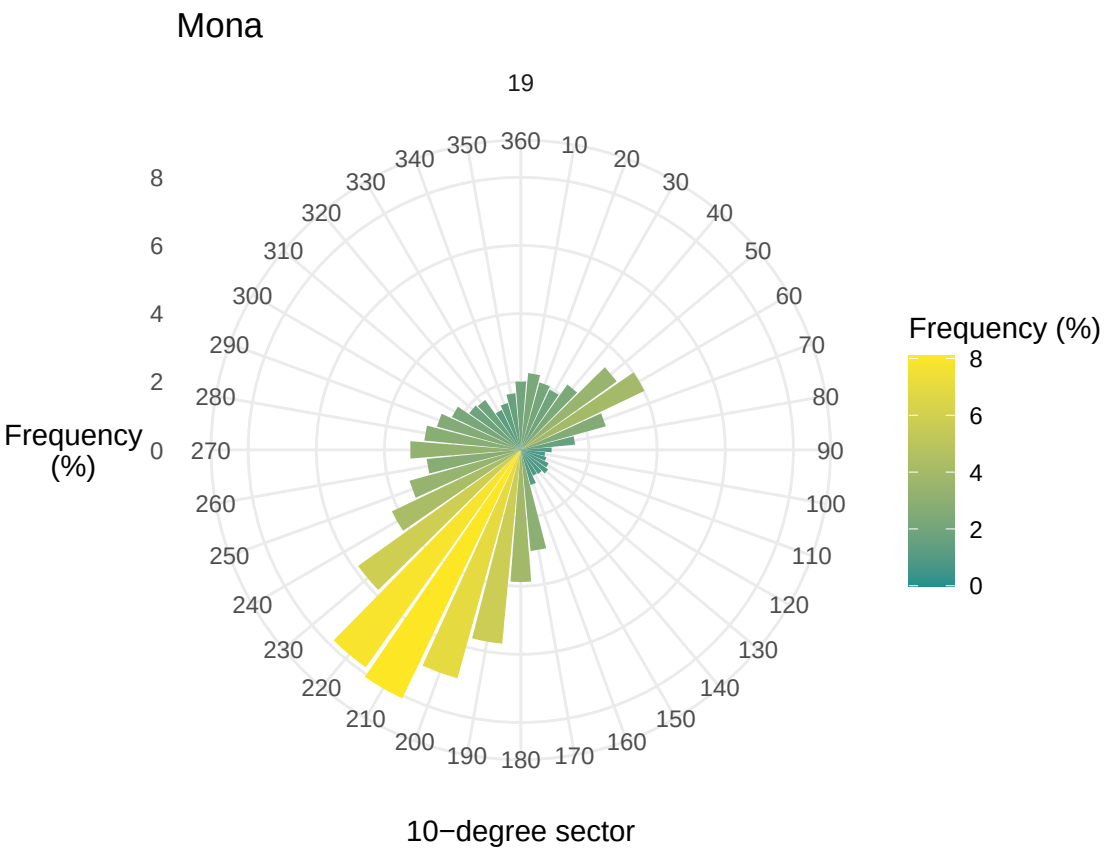
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
0
1
2
3
4
5
Frequency (%)
Frequency (%)
5
4
3
2
1
0
10−degree sector


Mona
19
360
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170
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190
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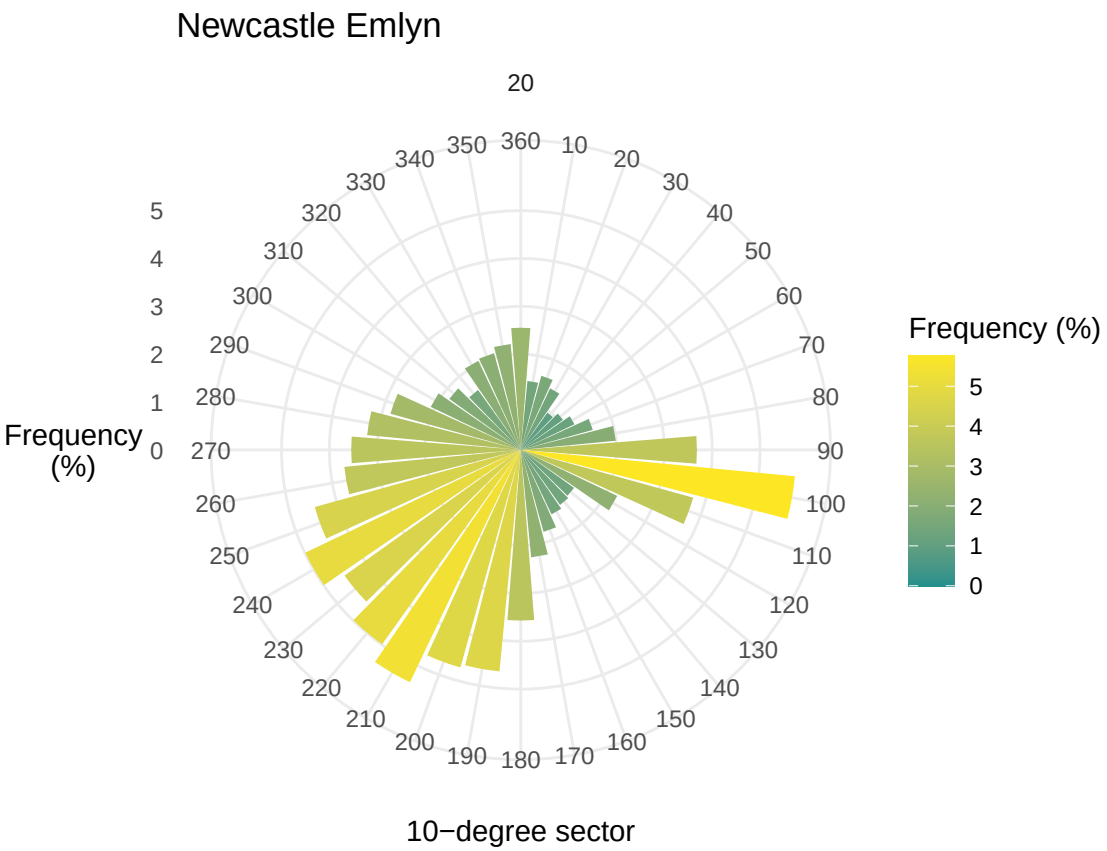
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
0
2
4
6
8
Frequency (%)
10−degree sector
Frequency (%)
8
6
4
2
0


Newcastle Emlyn
20
360
10
20
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80
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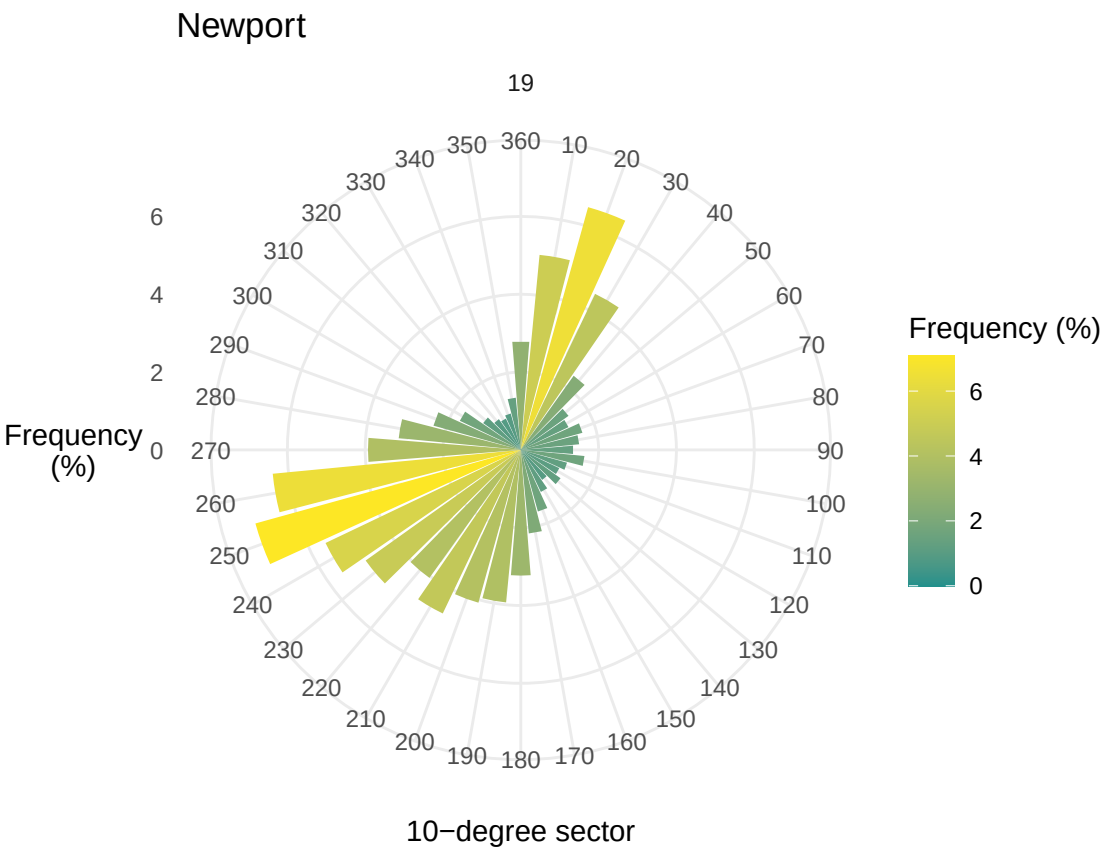
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
0
1
2
3
4
5
Frequency (%)
10−degree sector
Frequency (%)
5
4
3
2
1
0


Newport
19
360
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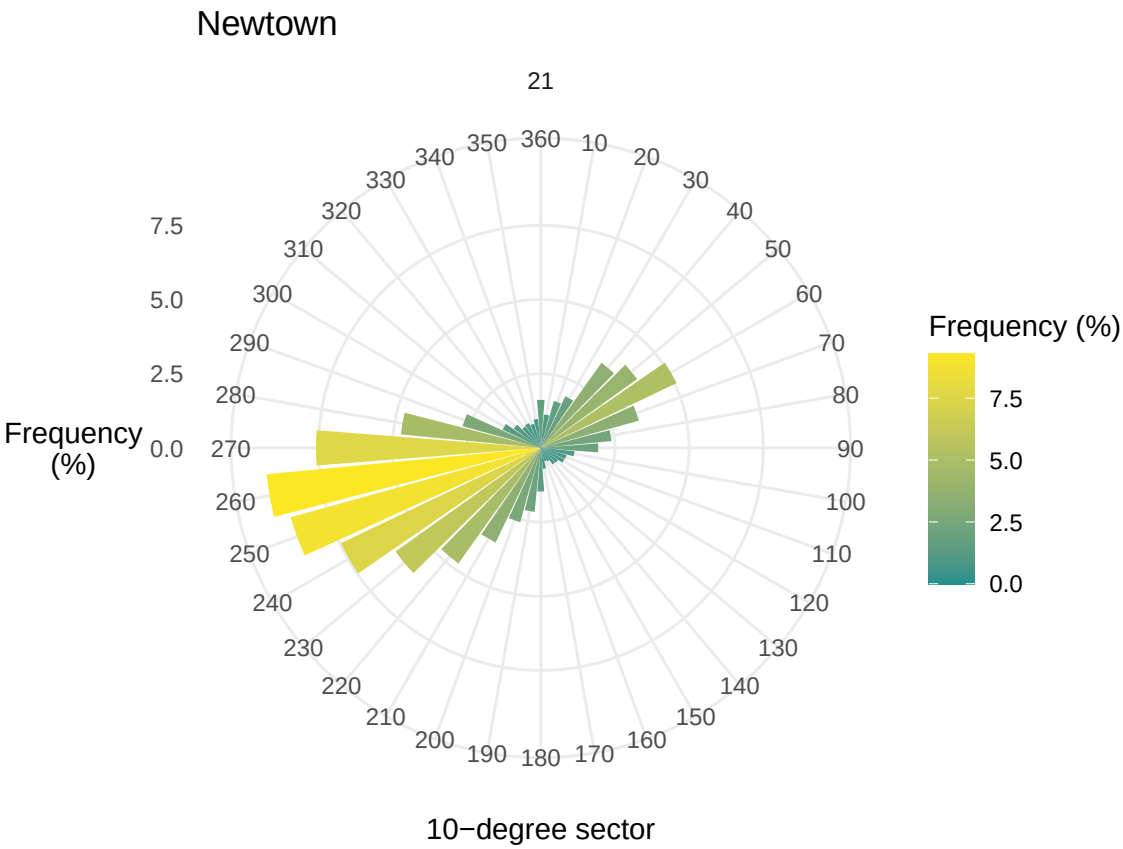
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
6
4
2
0


Newtown
21
360
10
20
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40
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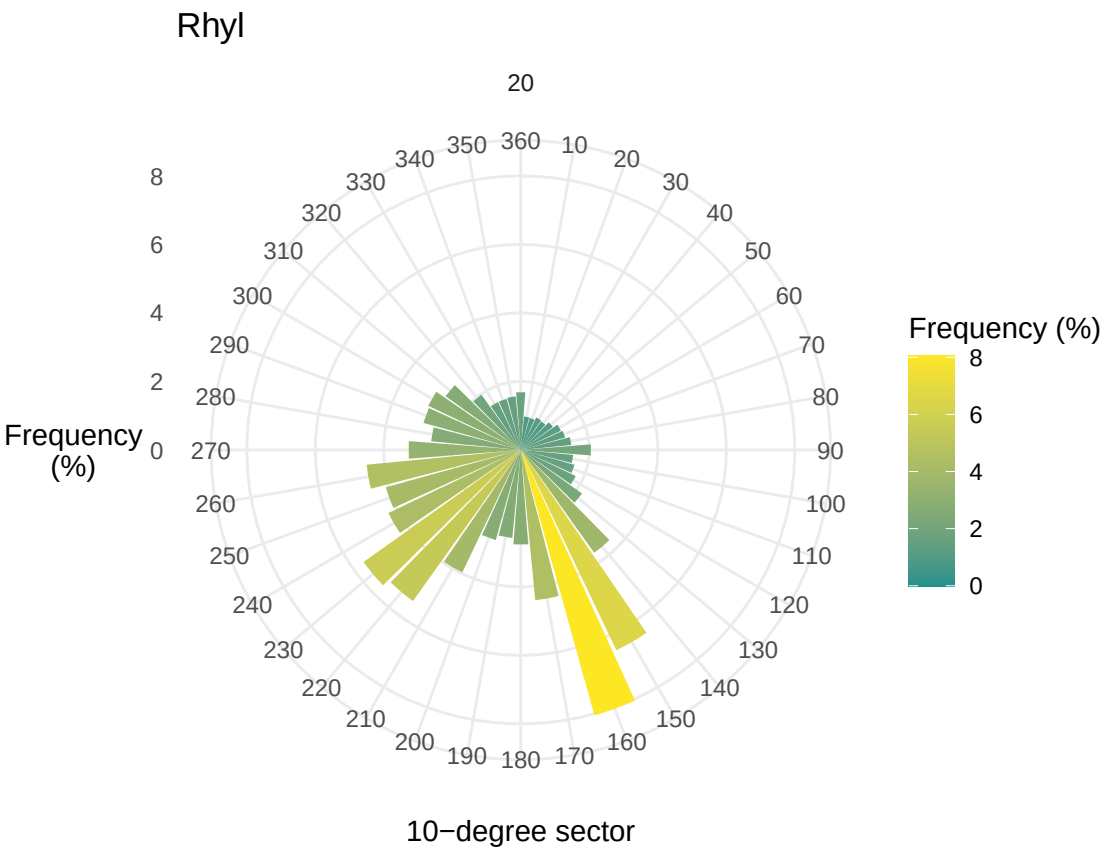
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
7.5
5.0
2.5
0.0
Frequency (%)
10−degree sector
Frequency (%)
7.5
5.0
2.5
0.0


Rhyl
20
360
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170
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260
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280
290
300
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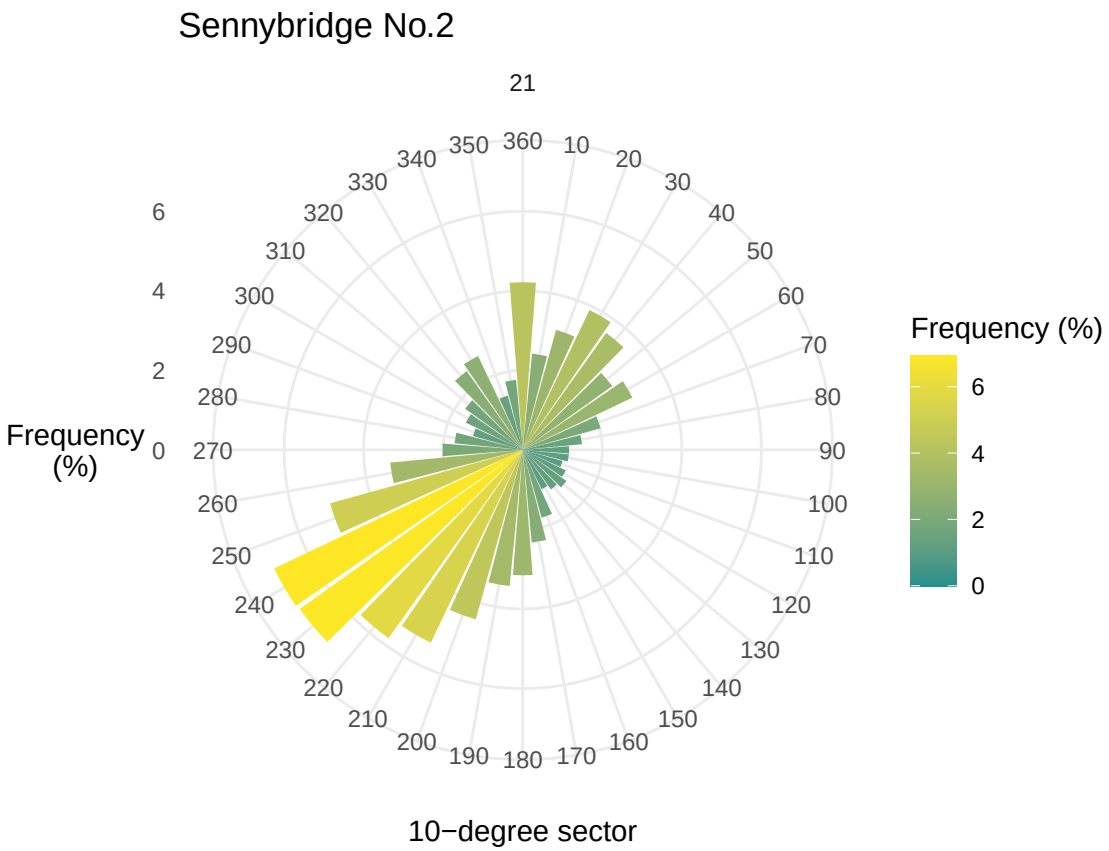
320
330
340
350
8
6
4
2
0
Frequency (%)
Frequency (%)
8
6
4
2
0
10−degree sector


Sennybridge No.2
21
360
10
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110
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130
140
150
160
170
180
190
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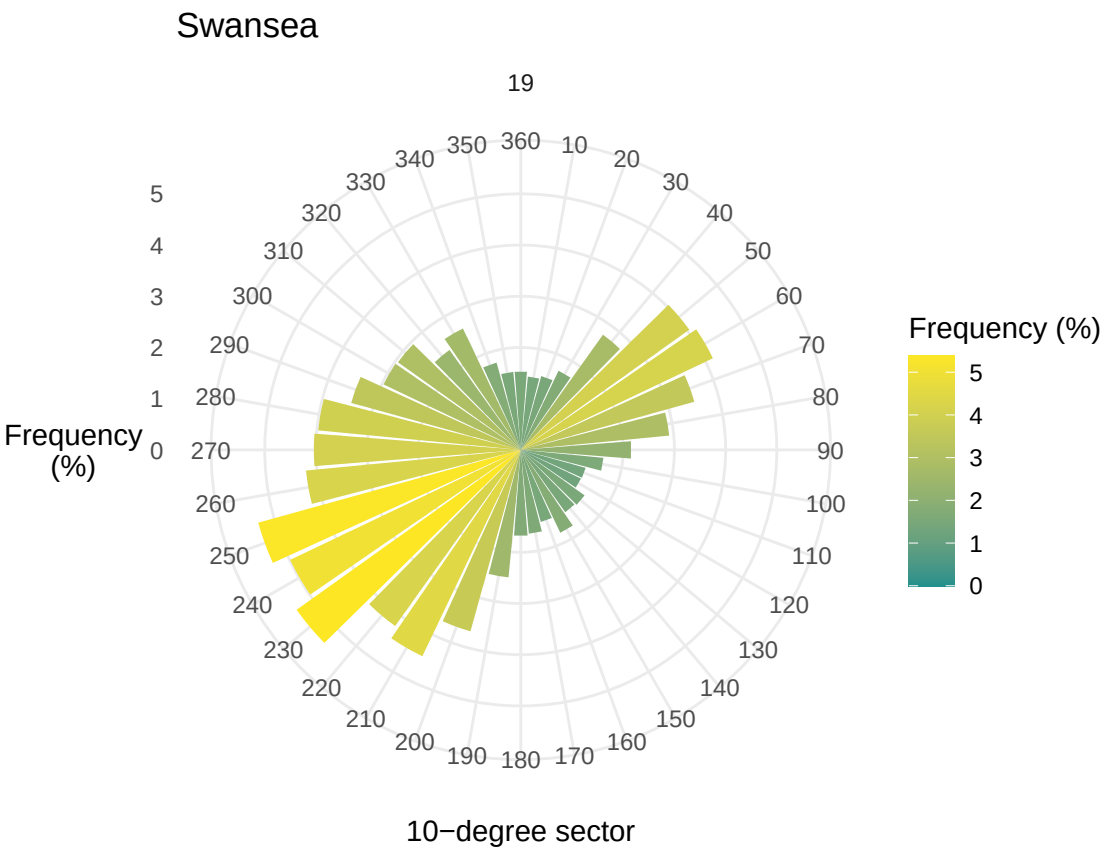
260
270
280
290
300
310
320
330
340
350
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
6
4
2
0


Swansea
19
360
10
20
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100
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120
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140
150
160
170
180
190
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210
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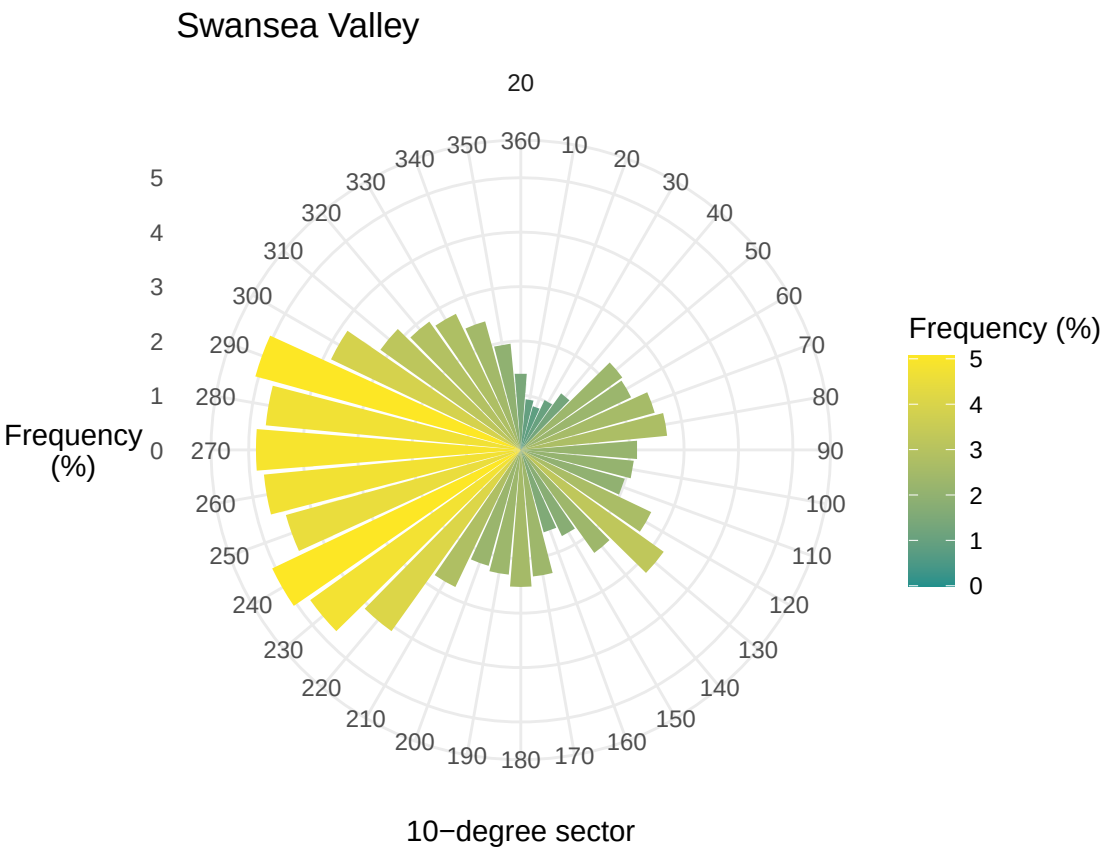
230
240
250
260
270
280
290
300
310
320
330
340
350
0
1
2
3
4
5
Frequency (%)
10−degree sector
Frequency (%)
5
4
3
2
1
0


Swansea Valley
20
360
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20
30
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120
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140
150
160
170
180
190
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230
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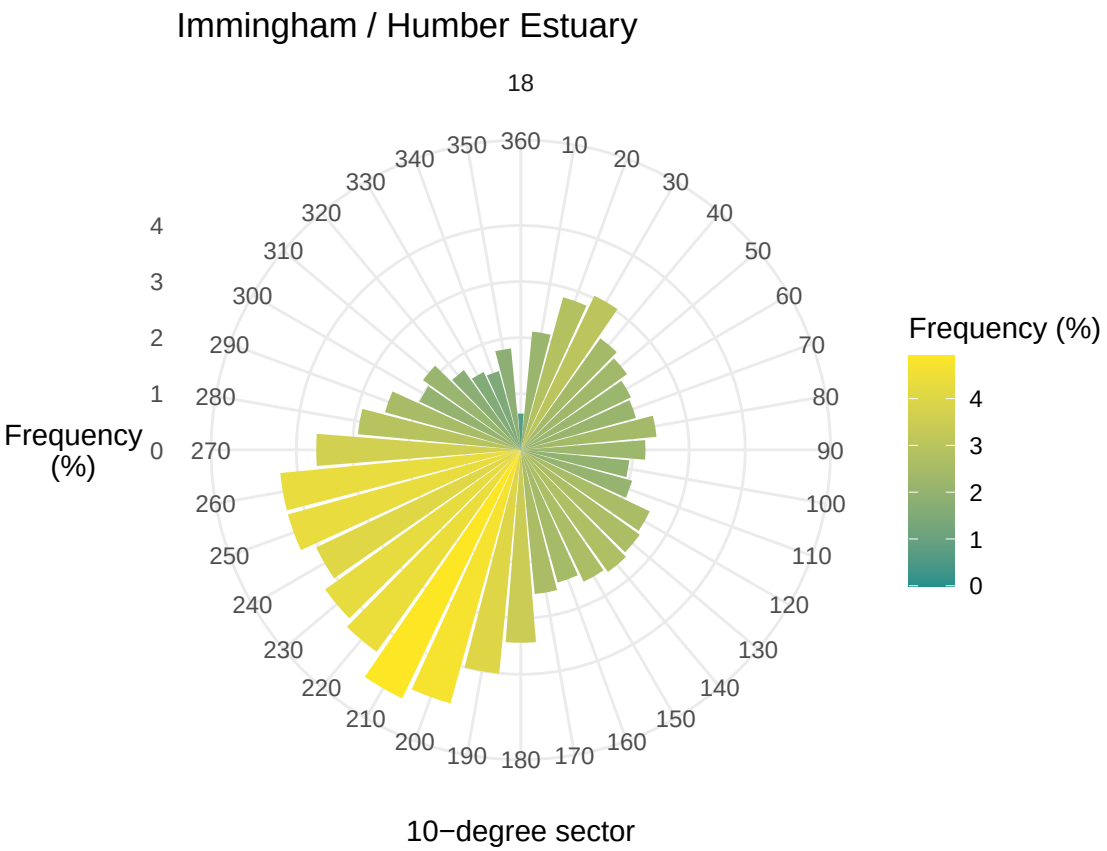
270
280
290
300
310
320
330
340
350
0
1
2
3
4
5
Frequency (%)
10−degree sector
Frequency (%)
5
4
3
2
1
0


Immingham / Humber Estuary
18
360
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170
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240
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260
270
280
290
300
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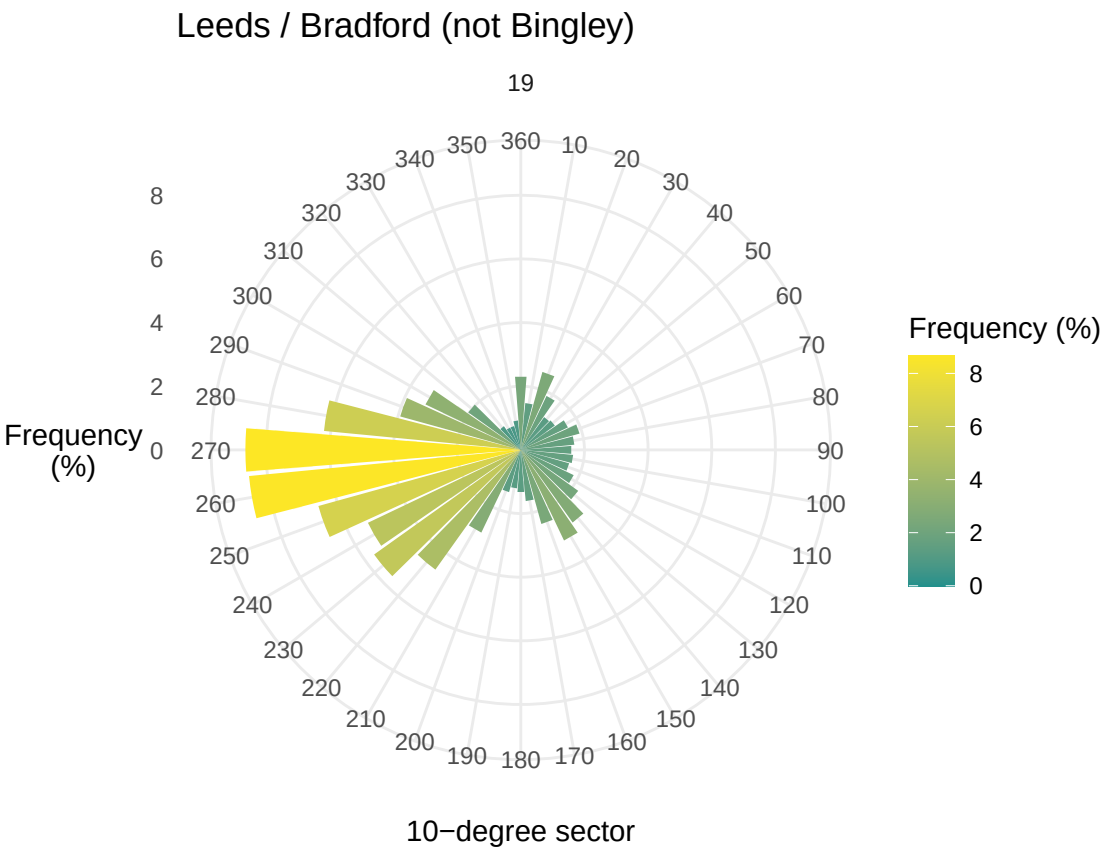
320
330
340
350
4
3
2
1
0
Frequency (%)
10−degree sector
Frequency (%)
4
3
2
1
0


Leeds / Bradford (not Bingley)
19
360
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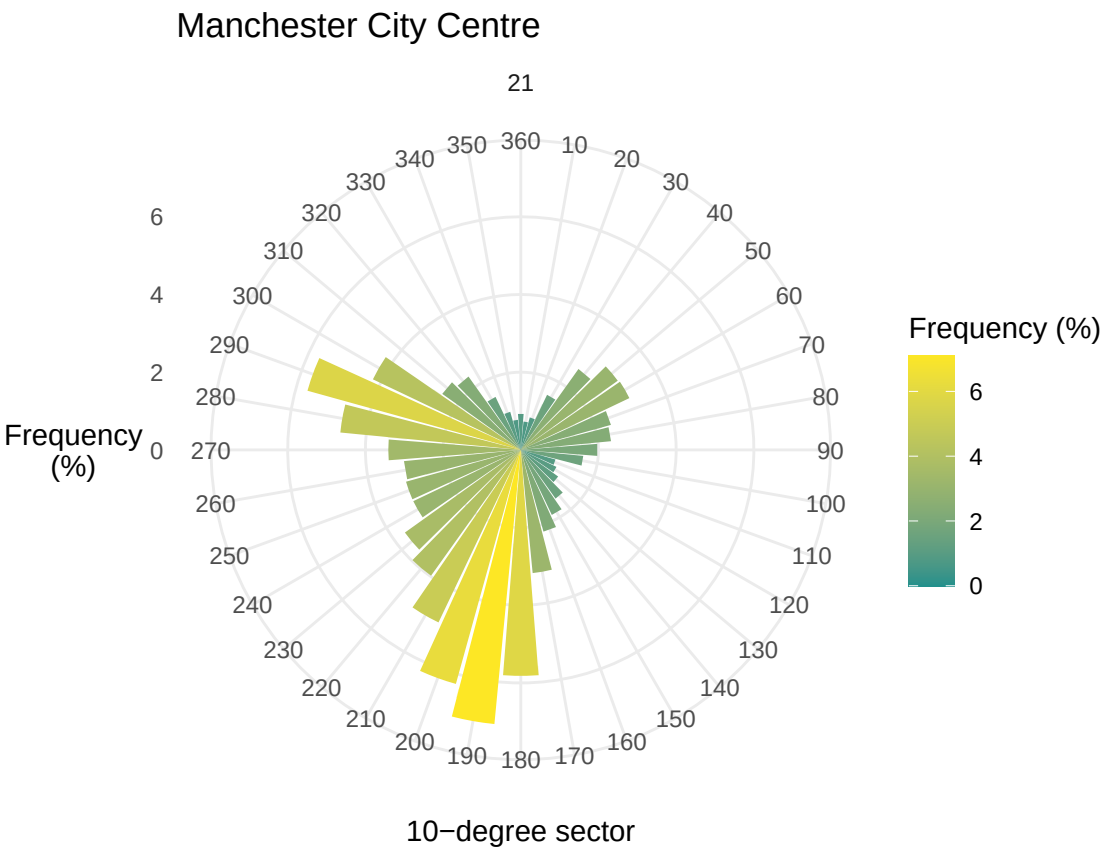
340
350
8
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
8
6
4
2
0


Manchester City Centre
21
360
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160
170
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270
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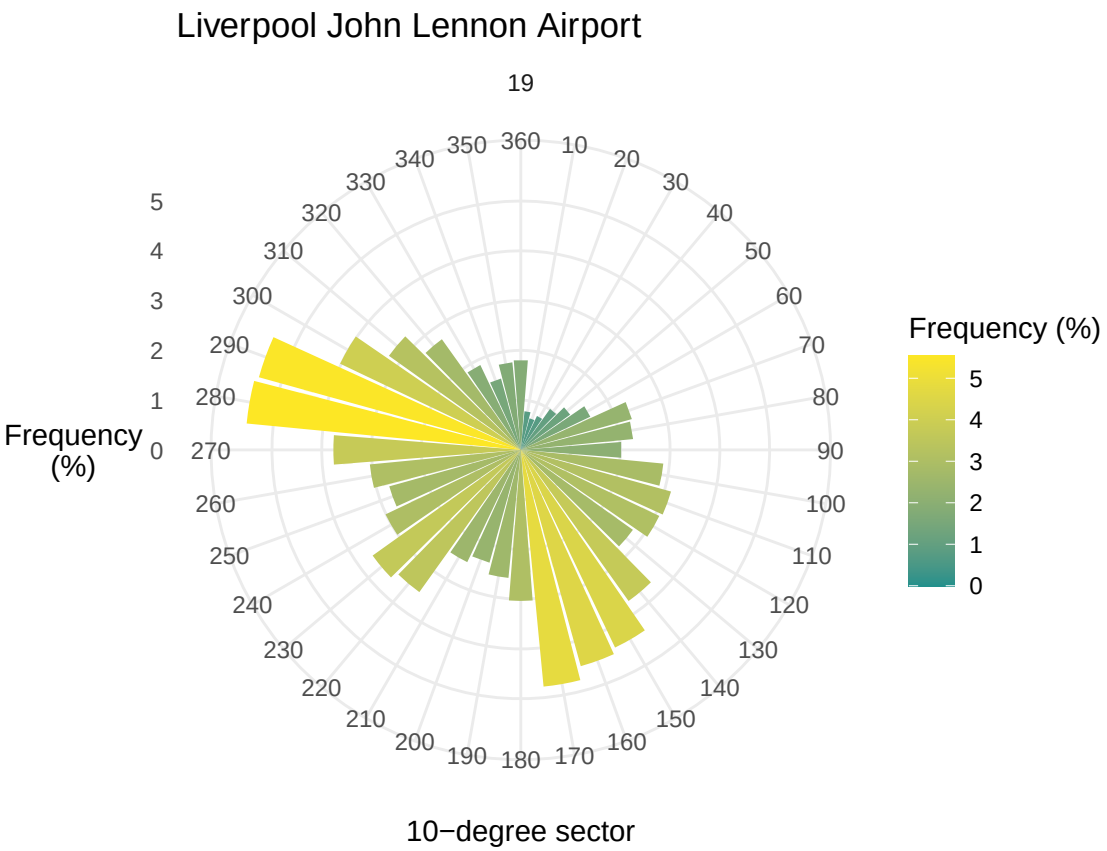
320
330
340
350
6
4
2
0
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Liverpool John Lennon Airport
19
360
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20
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340
350
0
1
2
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4
5
Frequency (%)
10−degree sector
Frequency (%)
5
4
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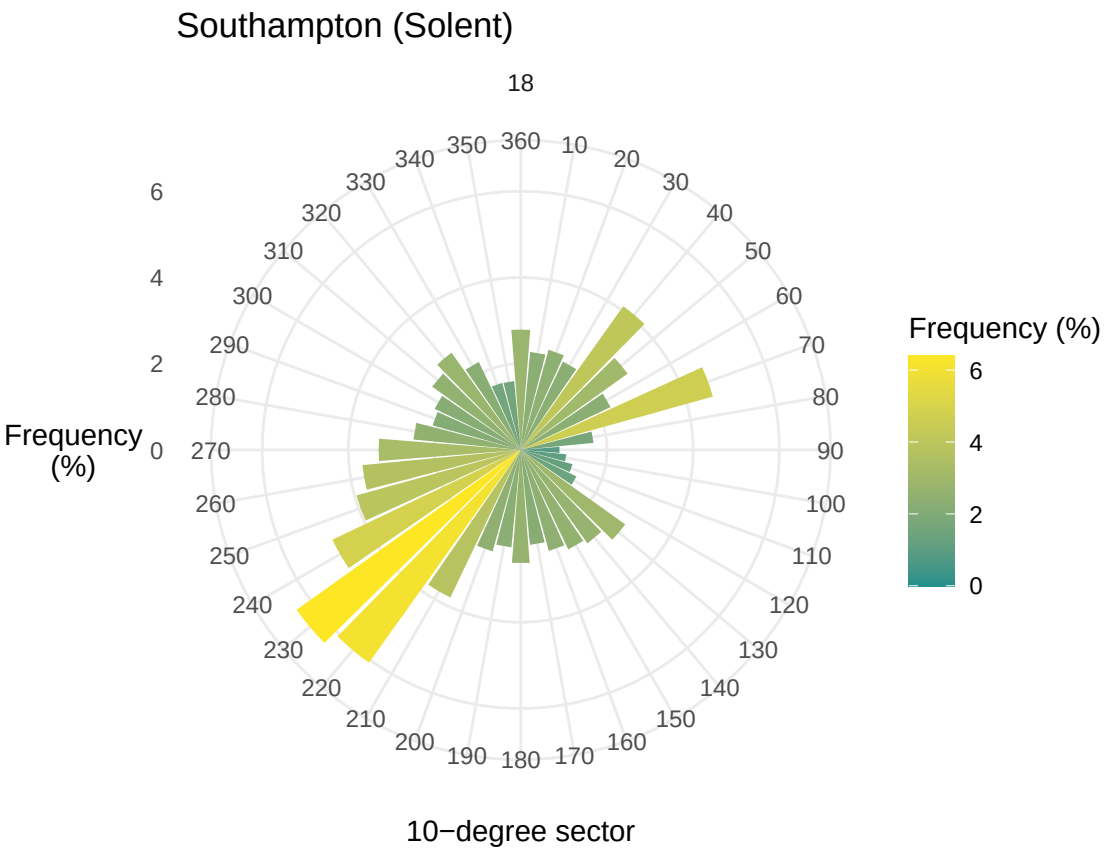
1
0


Southampton (Solent)
18
360
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170
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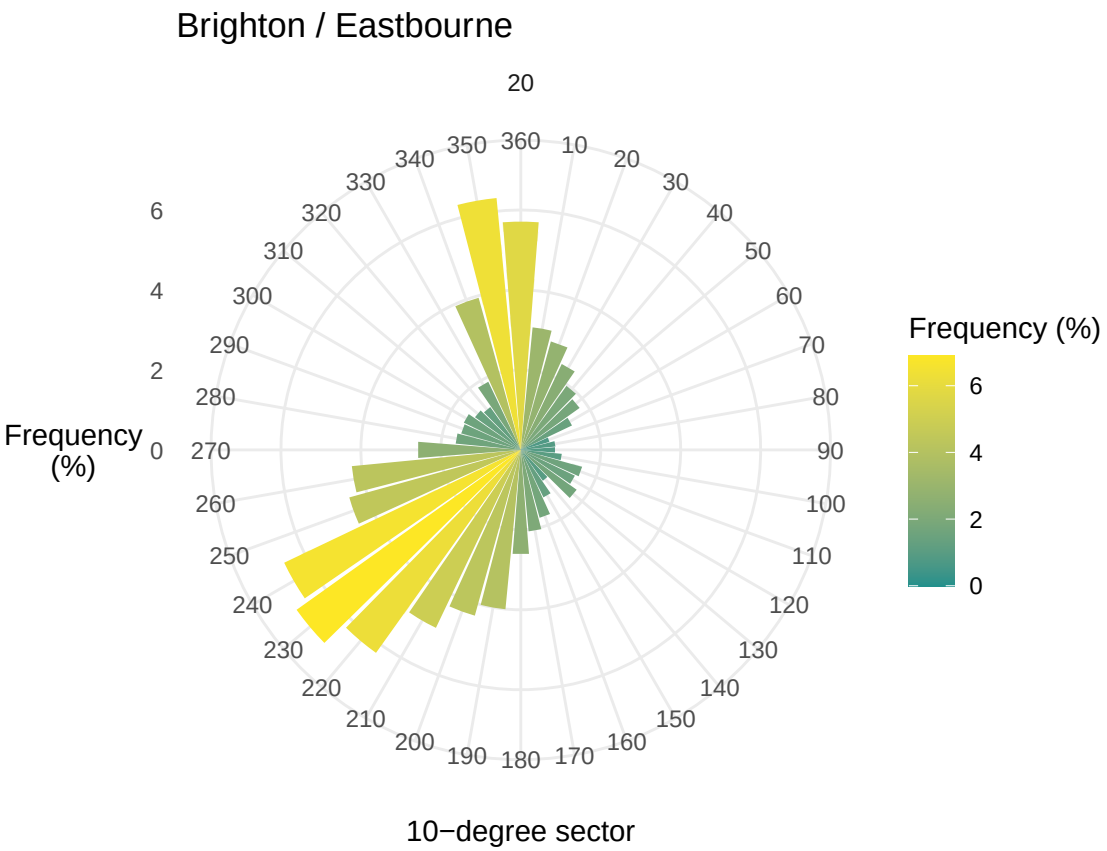
320
330
340
350
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
6
4
2
0


Brighton / Eastbourne
20
360
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170
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190
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300
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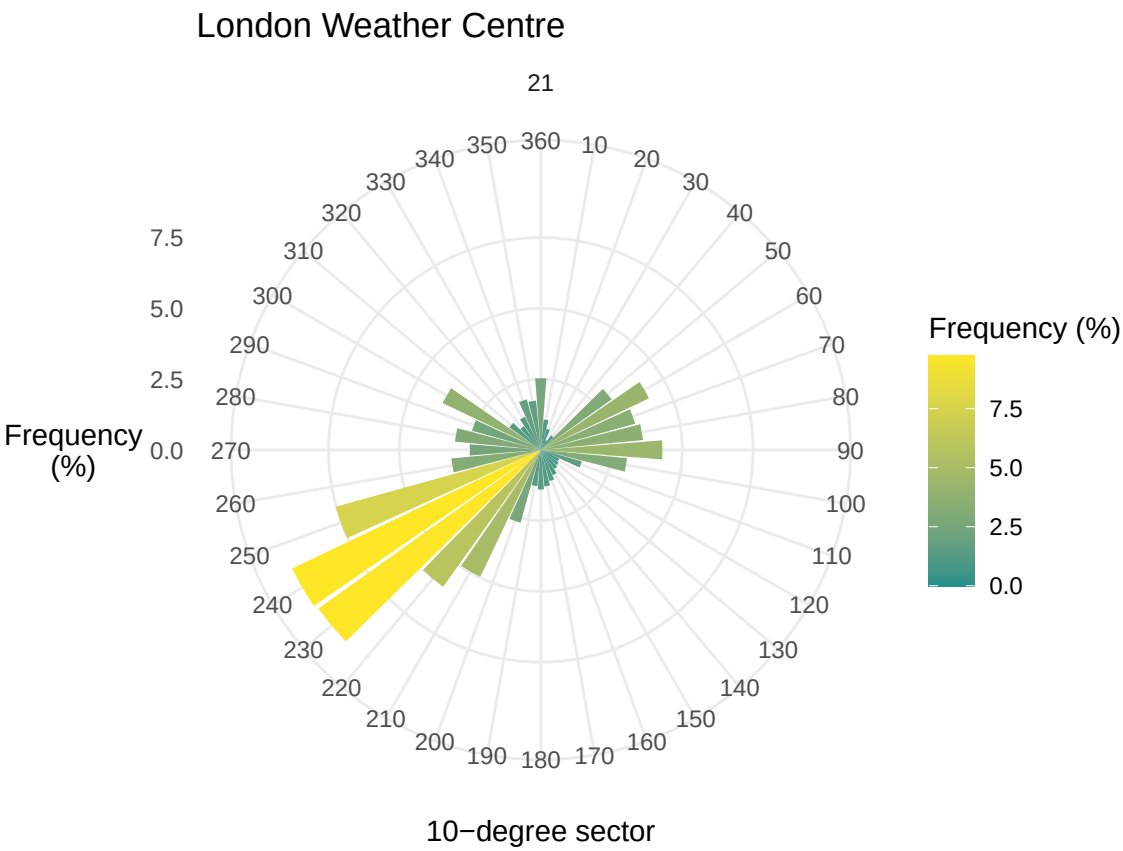
320
330
340
350
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
6
4
2
0


London Weather Centre
21
360
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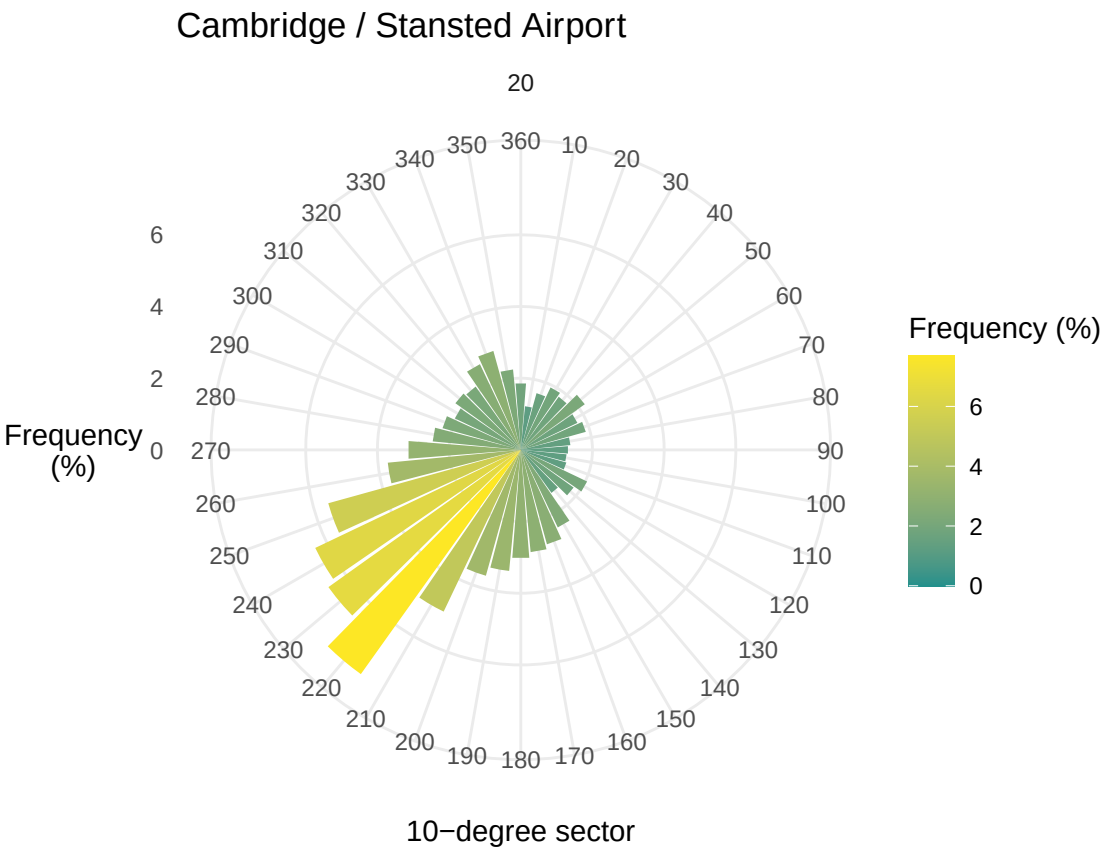
280
290
300
310
320
330
340
350
7.5
5.0
2.5
0.0
Frequency (%)
Frequency (%)
7.5
5.0
2.5
0.0
10−degree sector


Cambridge / Stansted Airport
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360
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100
110
120
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140
150
160
170
180
190
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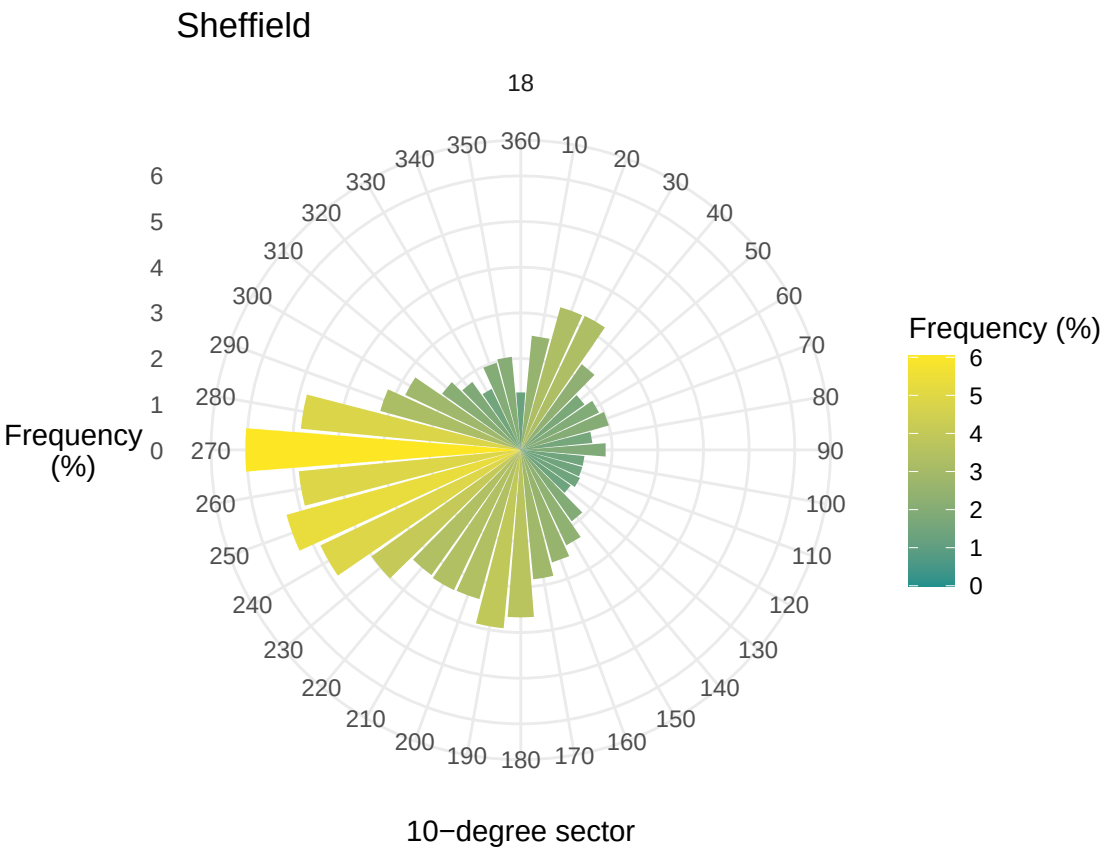
300
310
320
330
340
350
6
4
2
0
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Sheffield
18
360
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240
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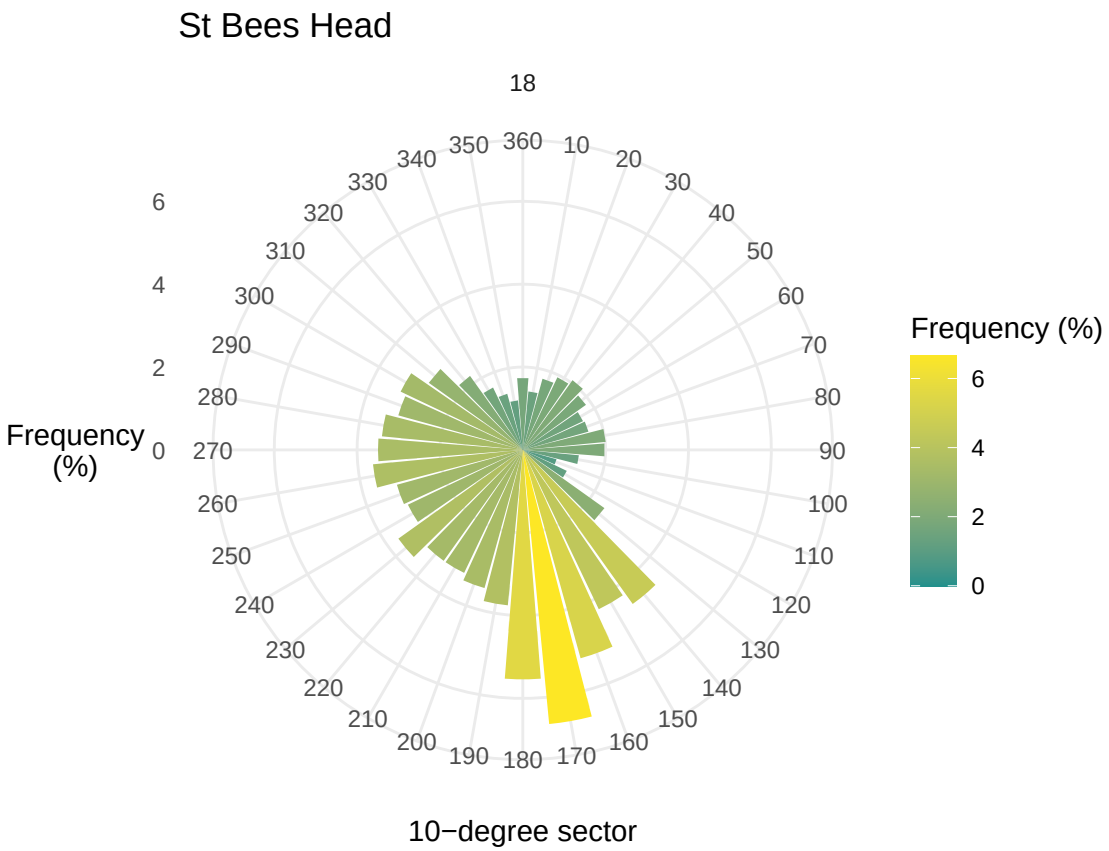
320
330
340
350
0
1
2
3
4
5
6
Frequency (%)
Frequency (%)
6
5
4
3
2
1
0
10−degree sector


St Bees Head
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360
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140
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160
170
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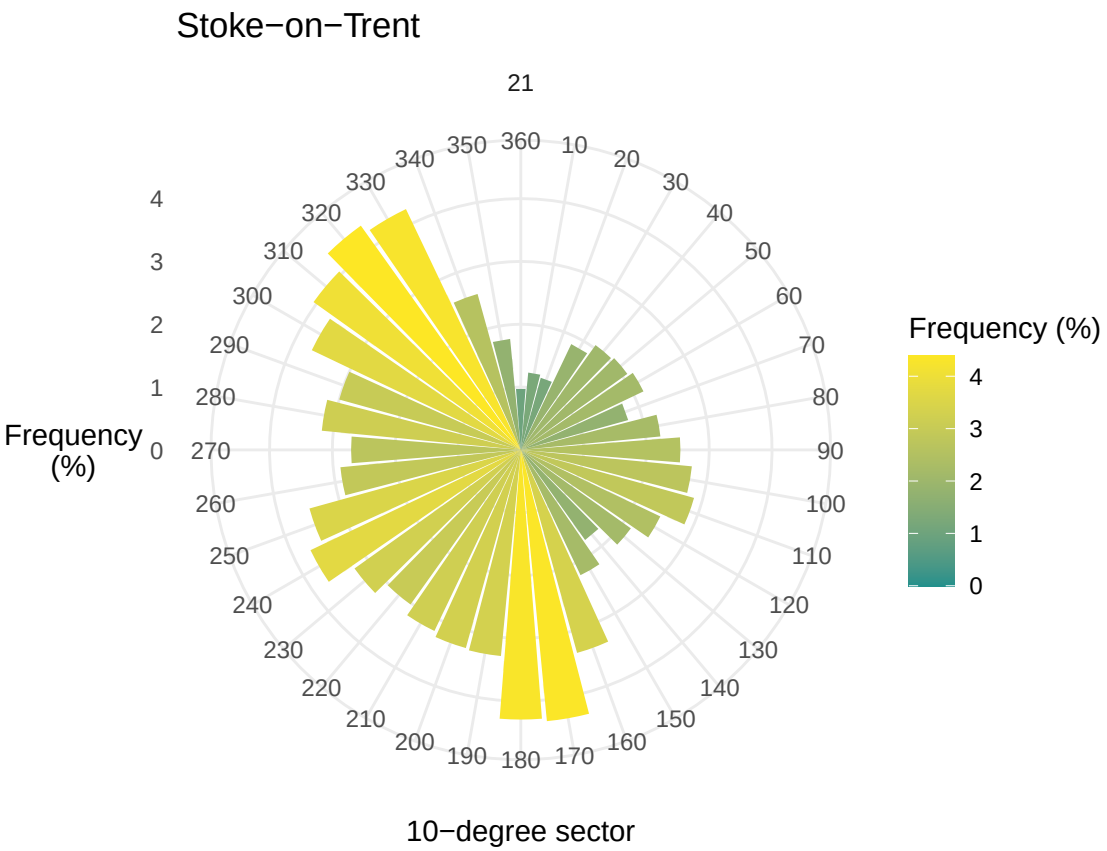
290
300
310
320
330
340
350
6
4
2
0
Frequency (%)
10−degree sector
Frequency (%)
6
4
2
0


Stoke−on−Trent
21
360
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190
200
210
220
230
240
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260
270
280
290
300
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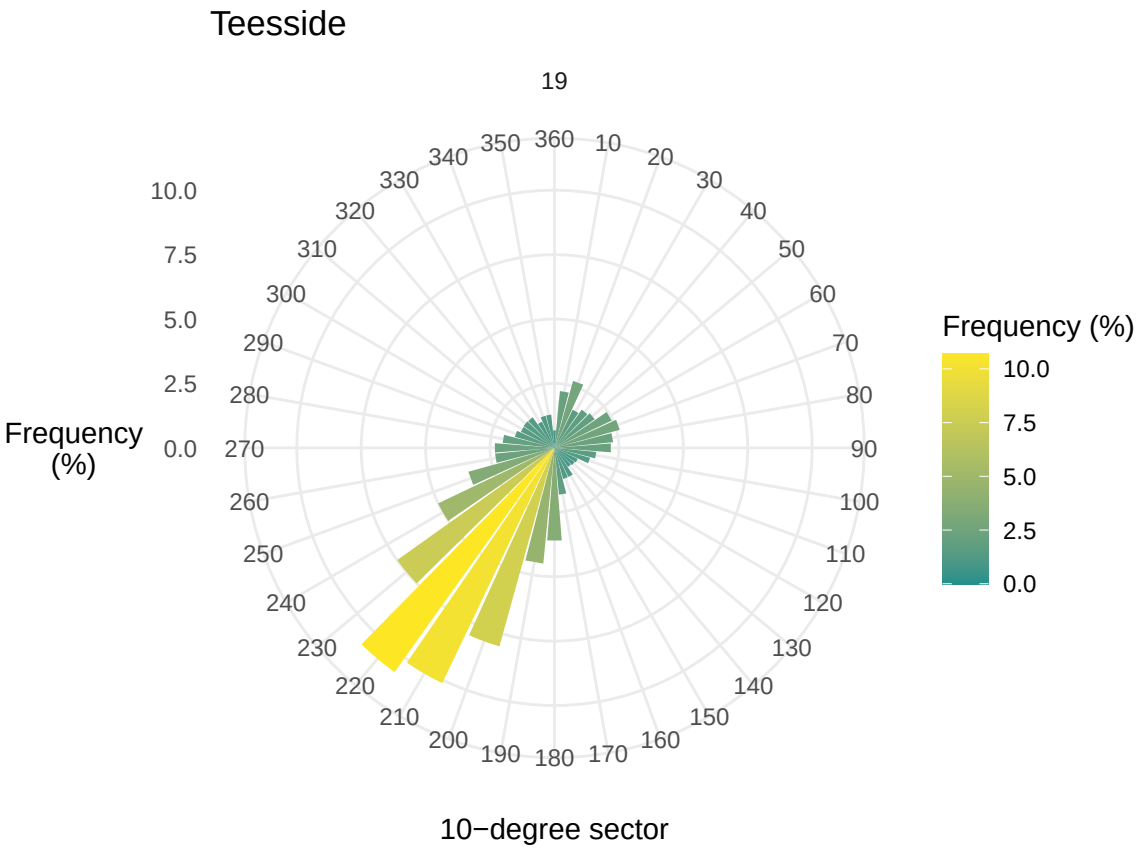
320
330
340
350
4
3
2
1
0
Frequency (%)
10−degree sector
Frequency (%)
4
3
2
1
0


Teesside
19
360
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140
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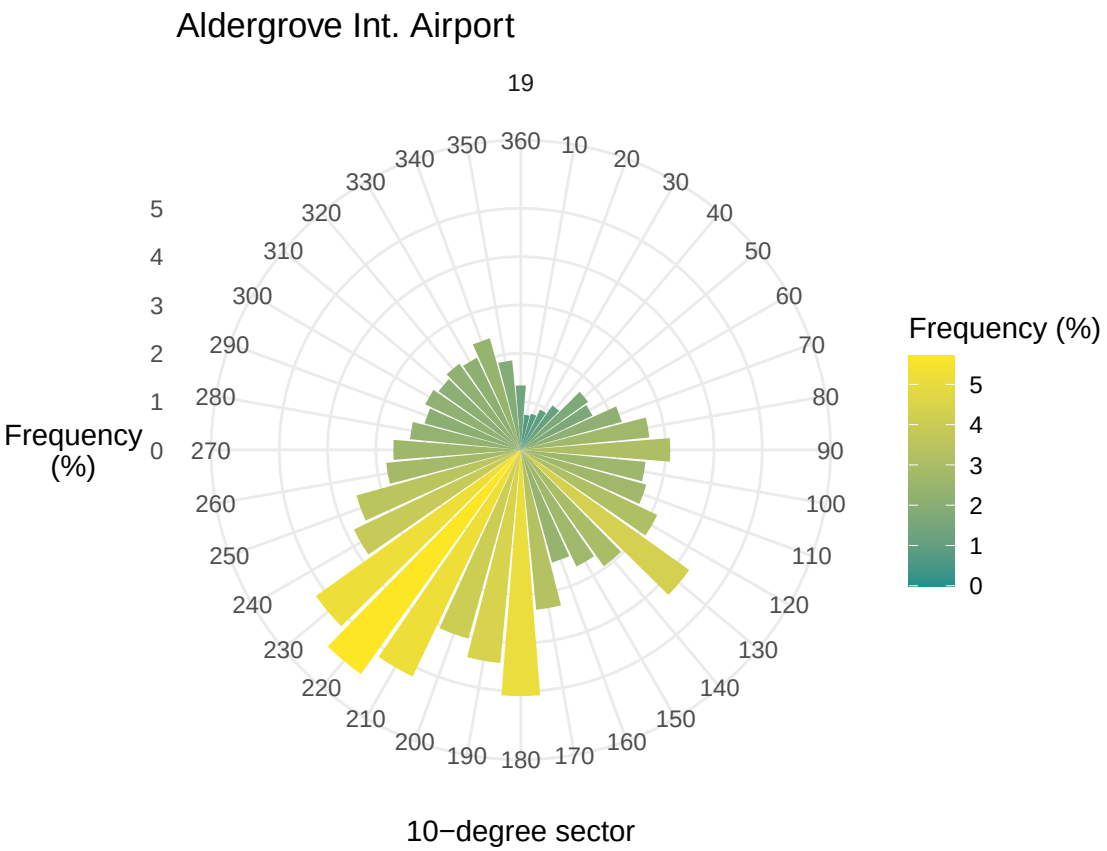
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
10.0
7.5
5.0
2.5
0.0
Frequency (%)
Frequency (%)
10.0
7.5
5.0
2.5
0.0
10−degree sector


Aldergrove Int. Airport
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360
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280
290
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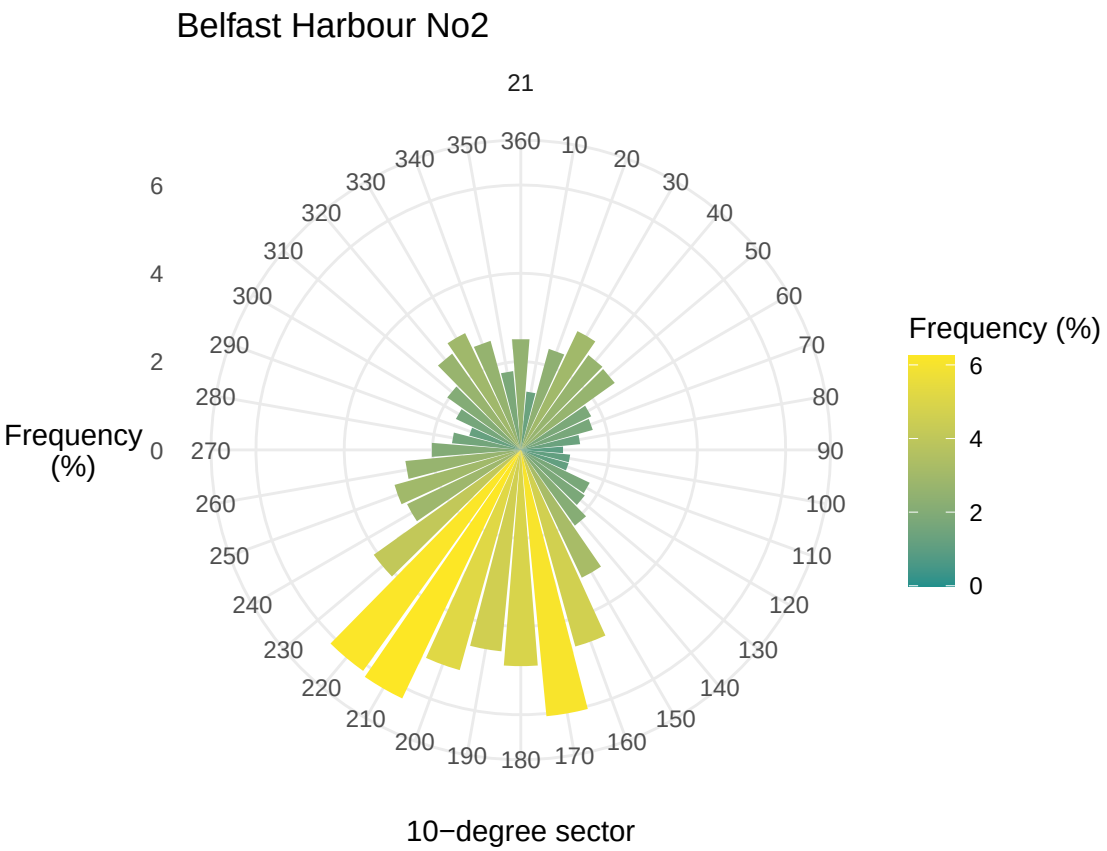
310
320
330
340
350
0
1
2
3
4
5
Frequency (%)
Frequency (%)
5
4
3
2
1
0
10−degree sector


Belfast Harbour No2
21
360
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150
160
170
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190
200
210
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230
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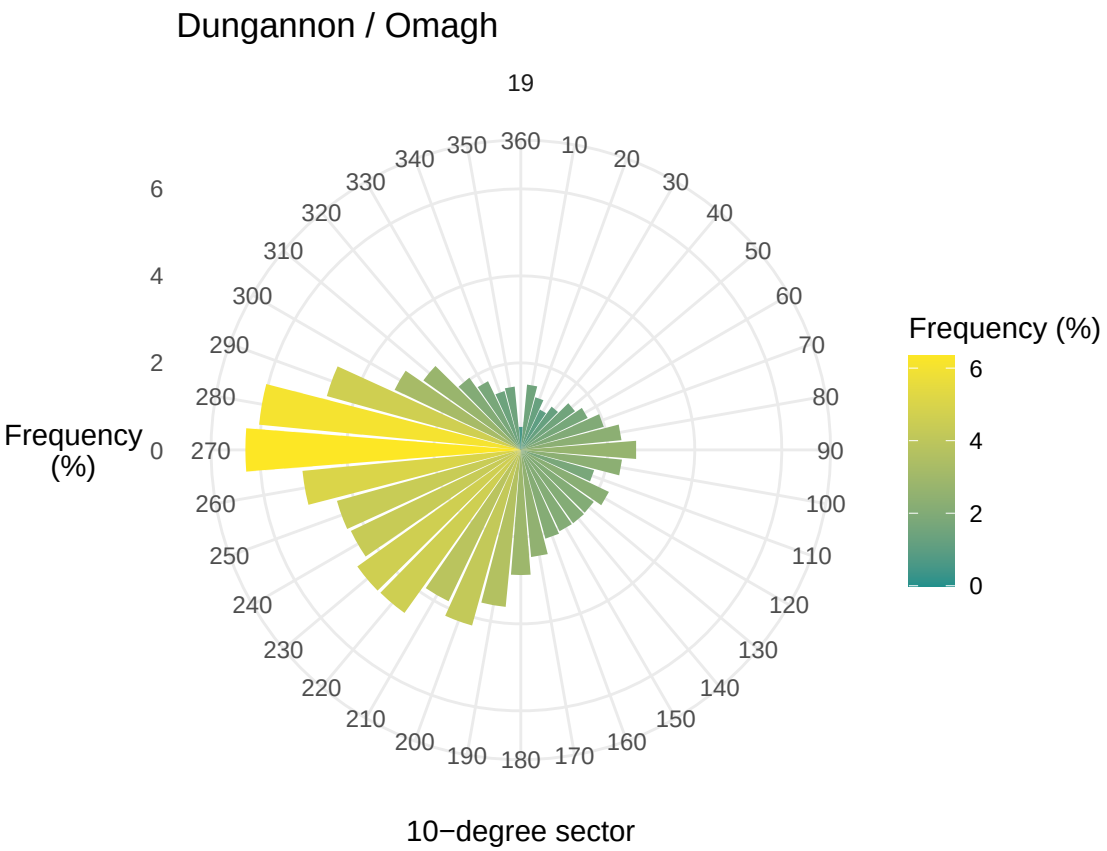
250
260
270
280
290
300
310
320
330
340
350
6
4
2
0
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Dungannon / Omagh
19
360
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170
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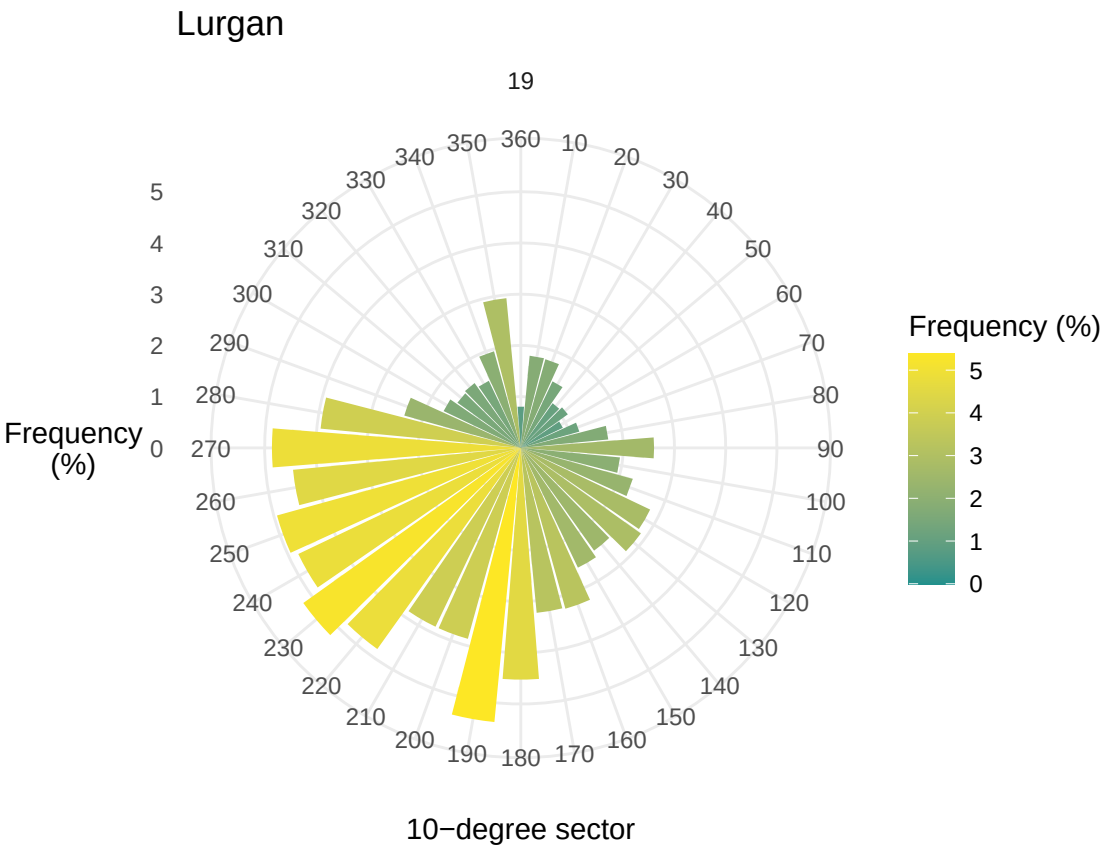
330
340
350
6
4
2
0
Frequency (%)
Frequency (%)
6
4
2
0
10−degree sector


Lurgan
19
360
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350
0
1
2
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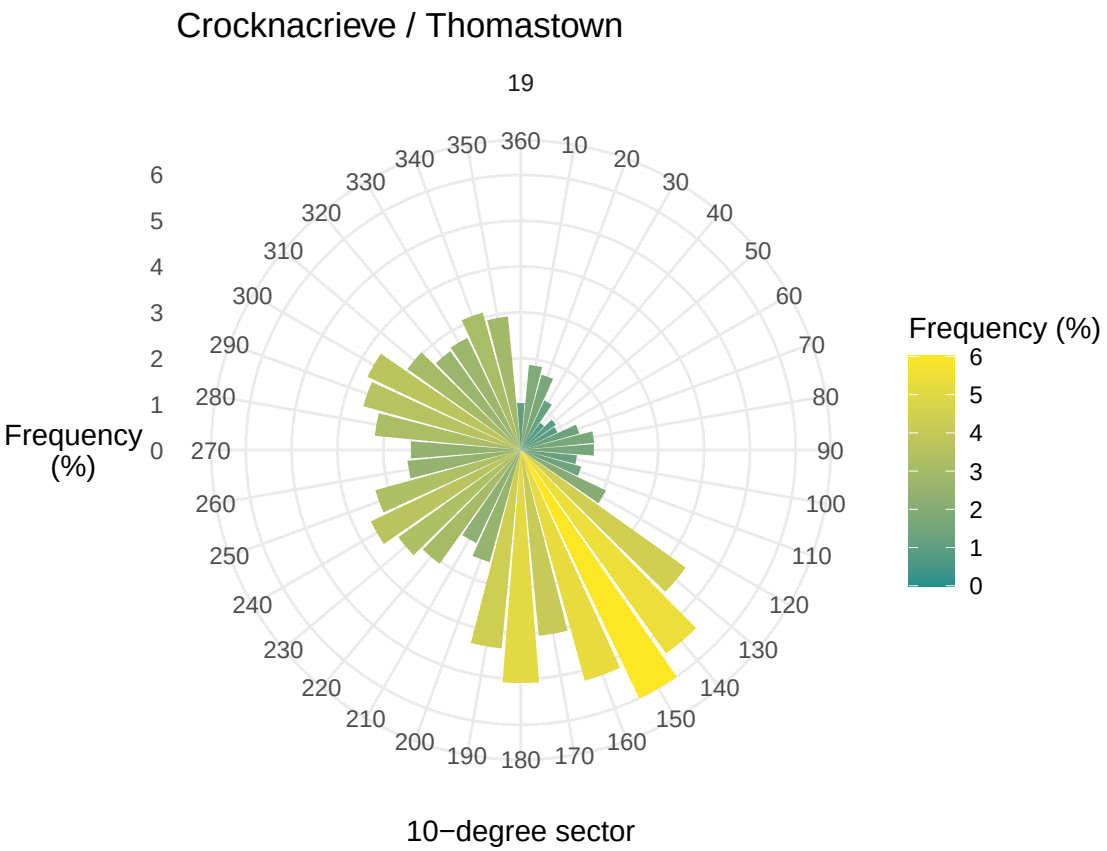
4
5
Frequency (%)
10−degree sector
Frequency (%)
5
4
3
2
1
0


Crocknacrieve / Thomastown
19
360
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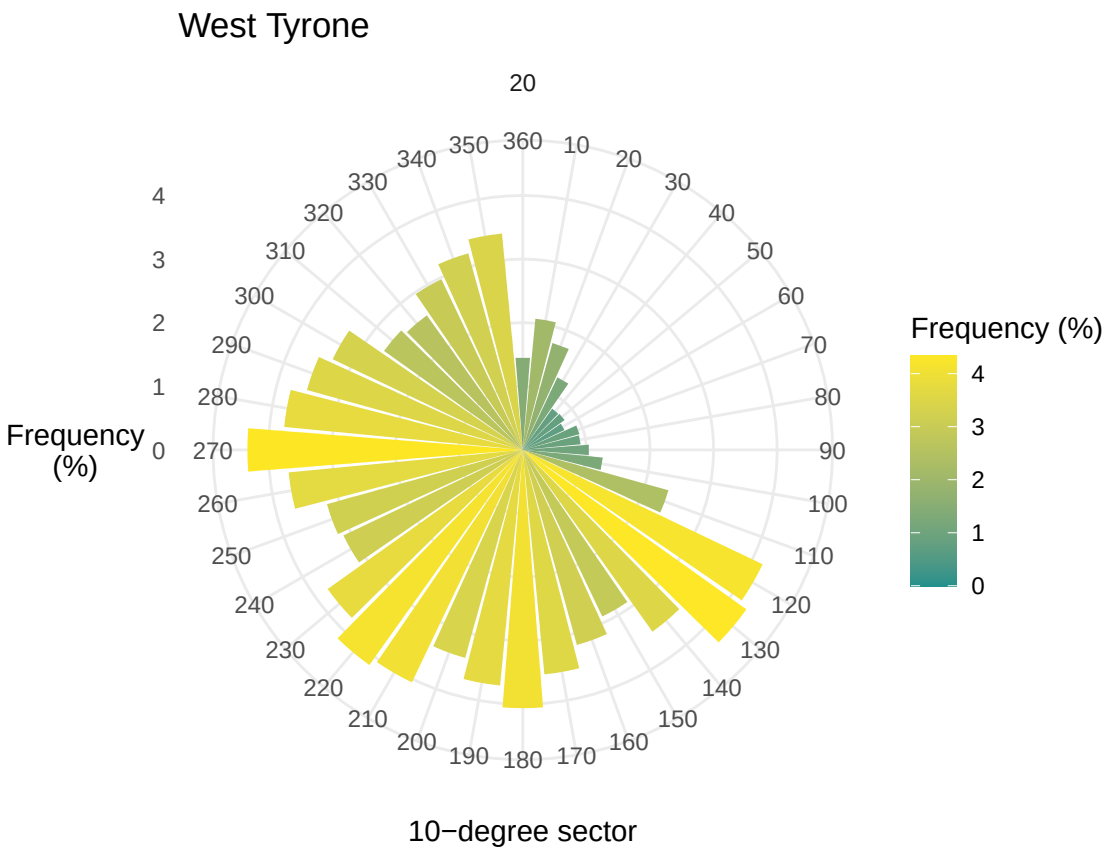
320
330
340
350
0
1
2
3
4
5
6
Frequency (%)
Frequency (%)
6
5
4
3
2
1
0
10−degree sector


West Tyrone
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360
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160
170
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320
330
340
350
4
3
2
1
0
Frequency (%)
10−degree sector
Frequency (%)
4
3
2
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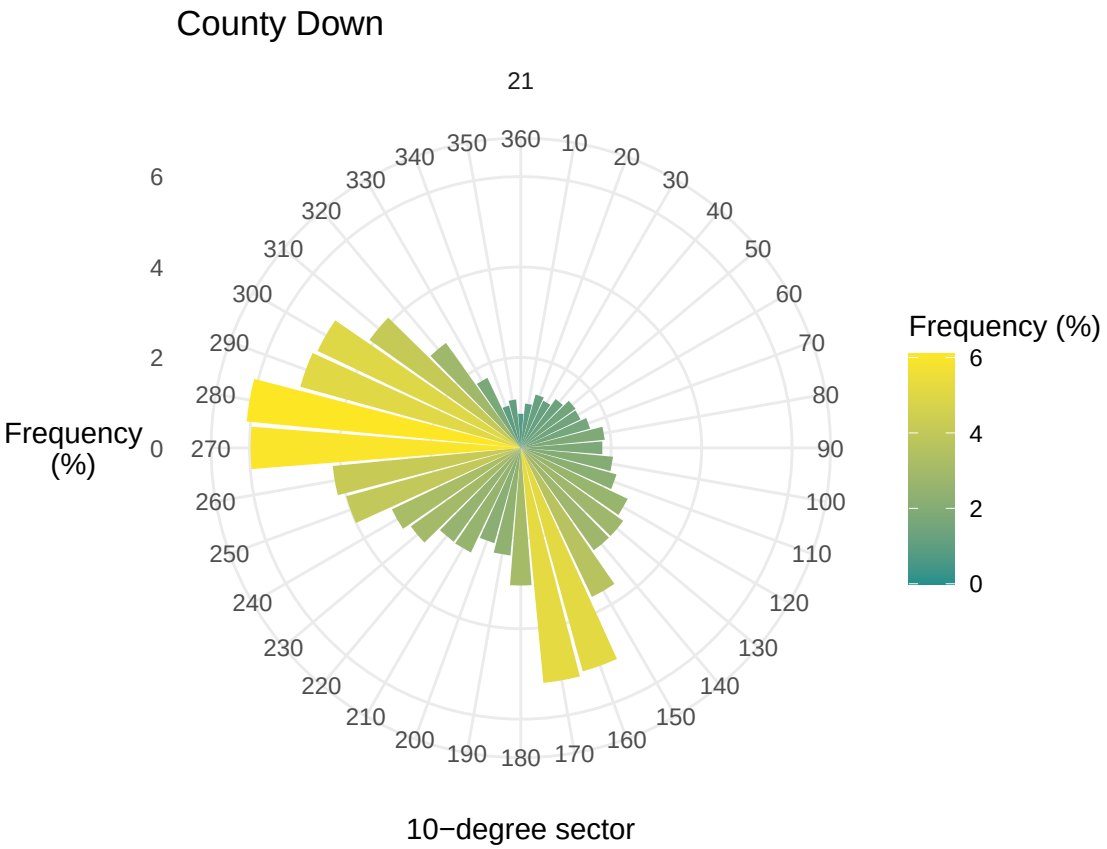
County Down
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Frequency (%)
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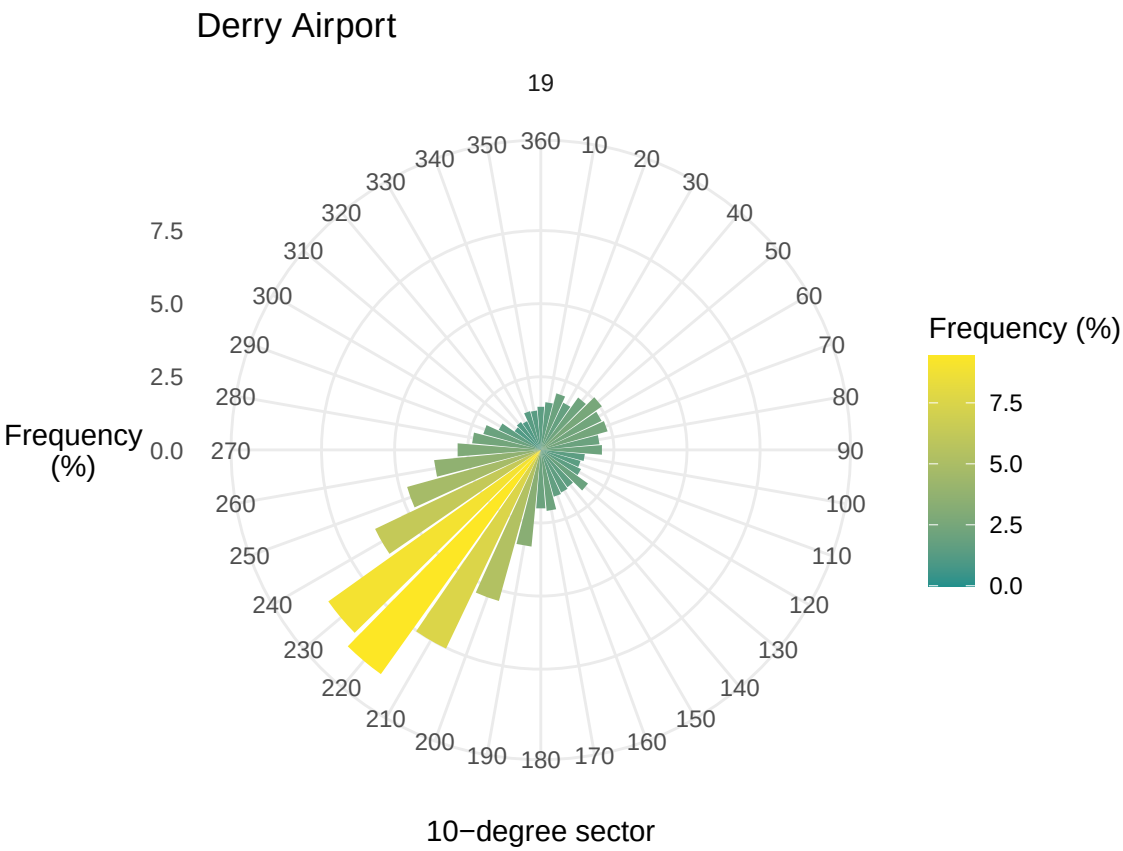
10−degree sector


Derry Airport
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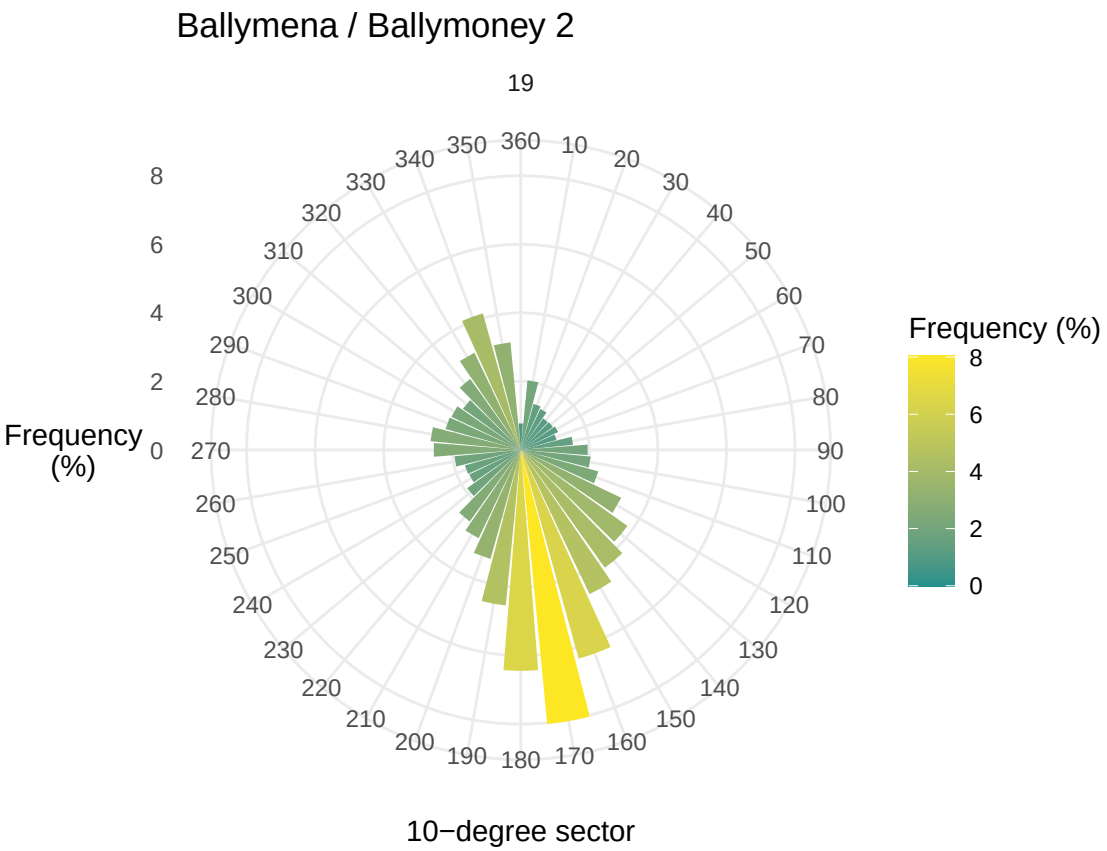
Ballymena / Ballymoney 2
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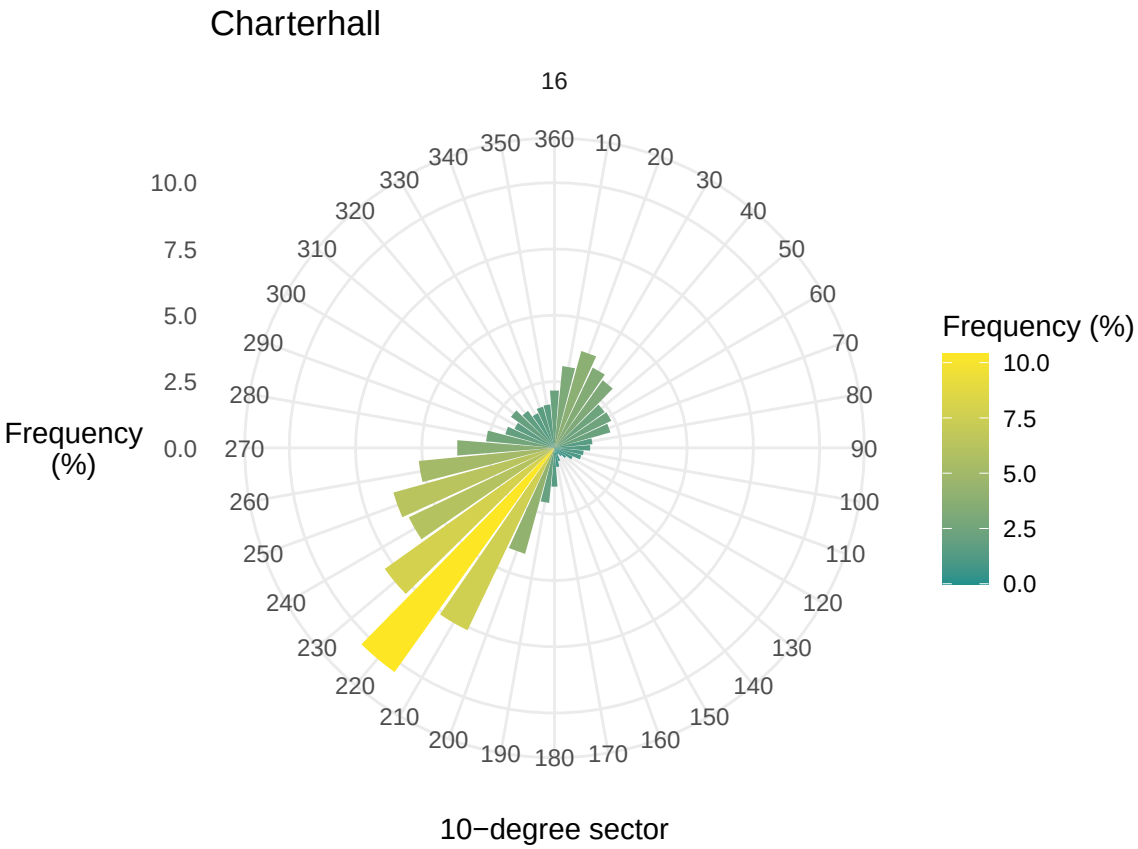
Charterhall
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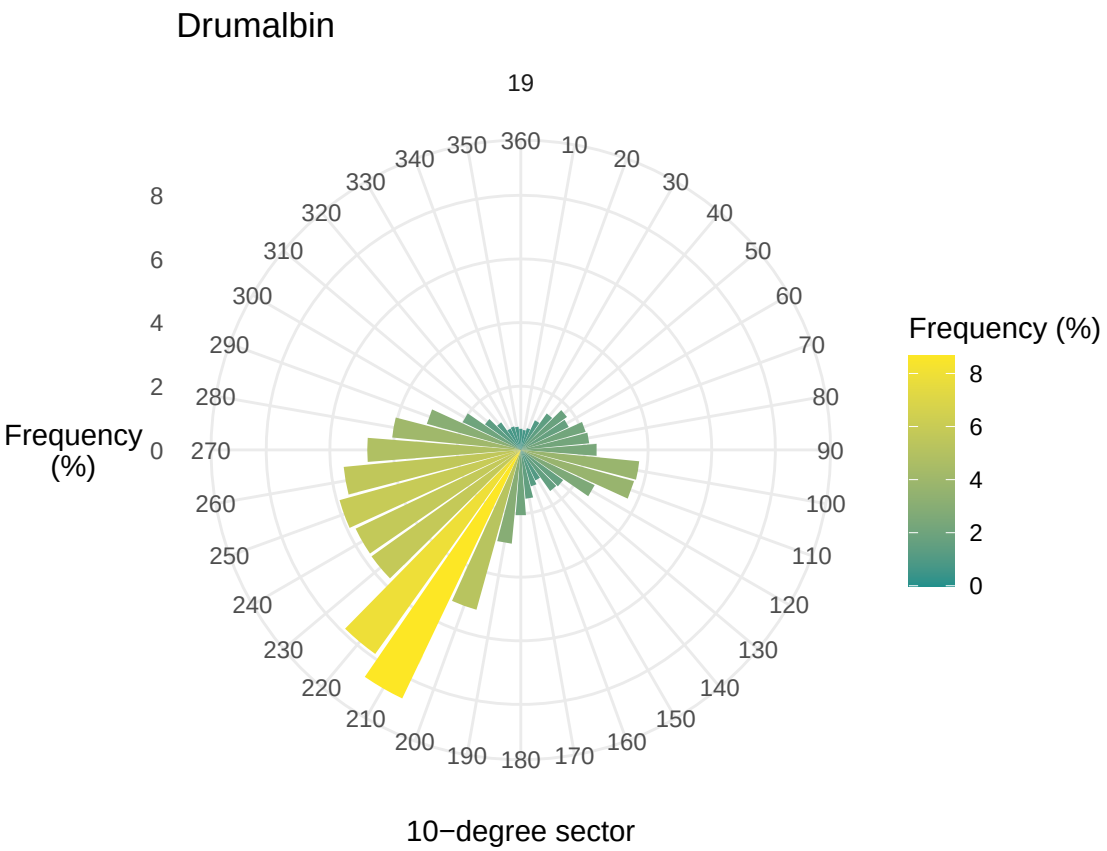
Drumalbin
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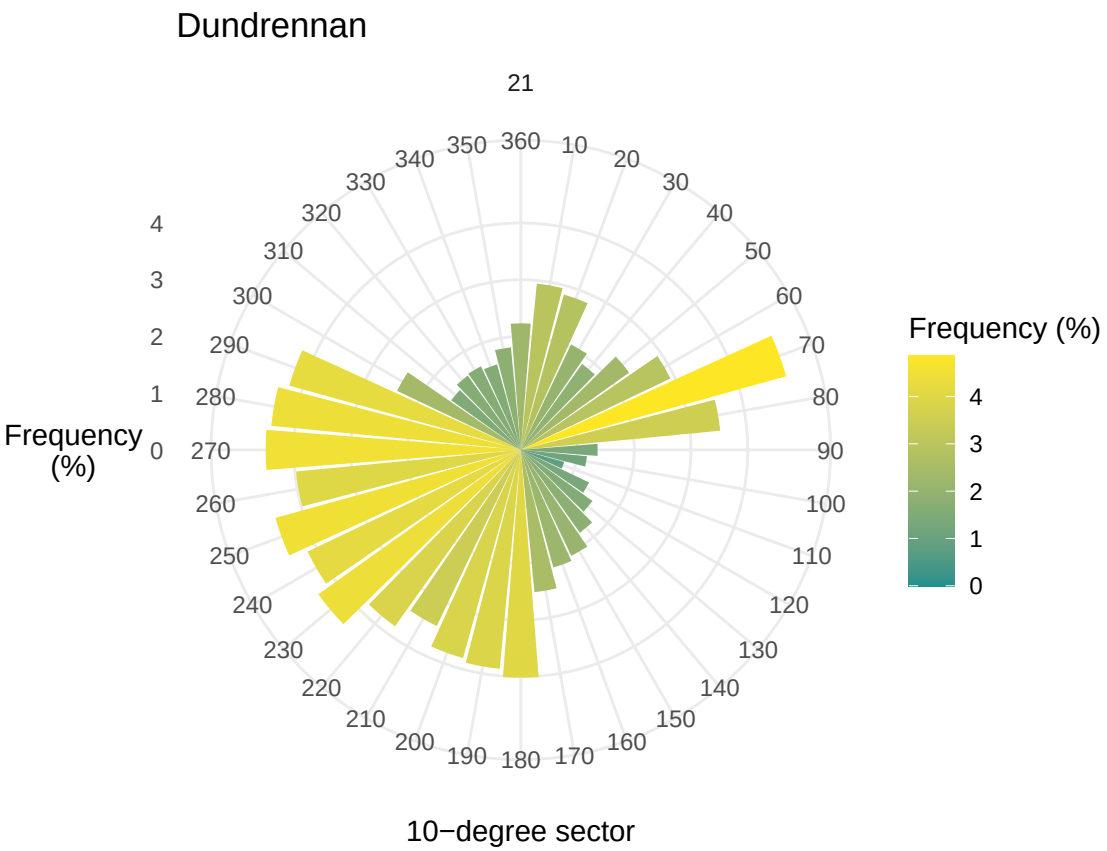
Dundrennan
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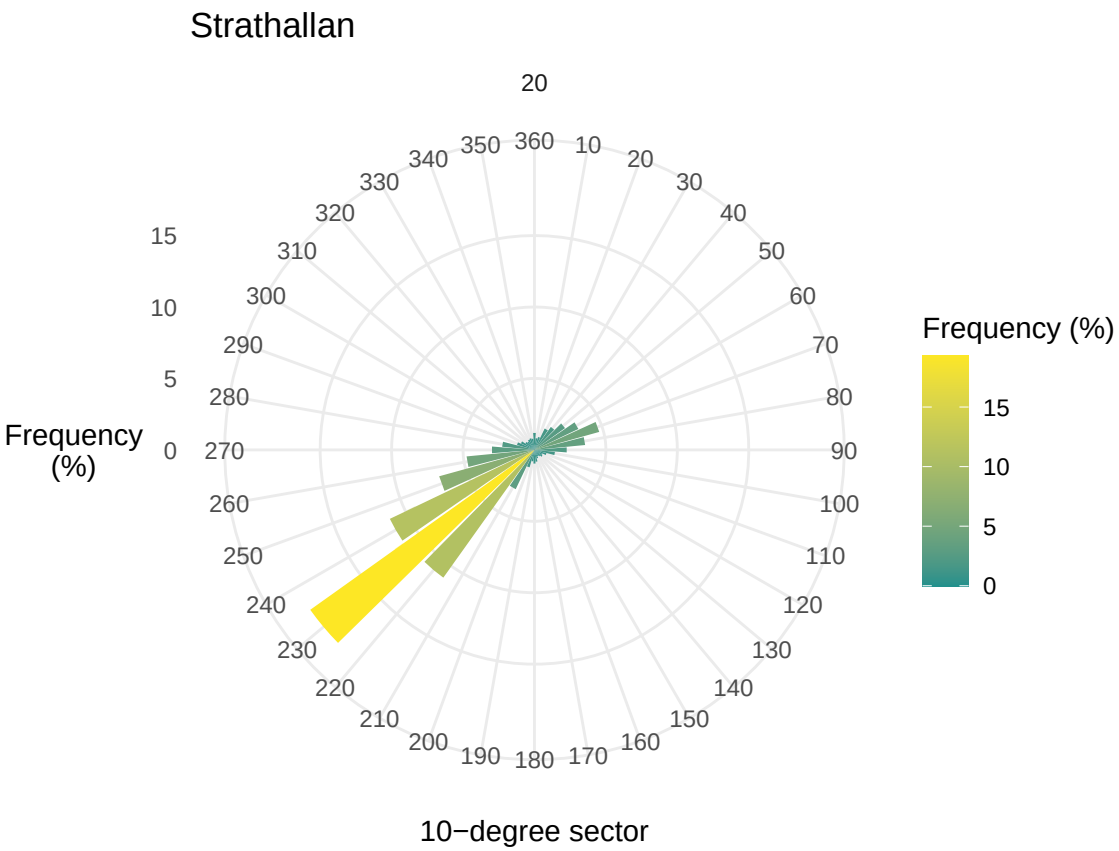
Strathallan
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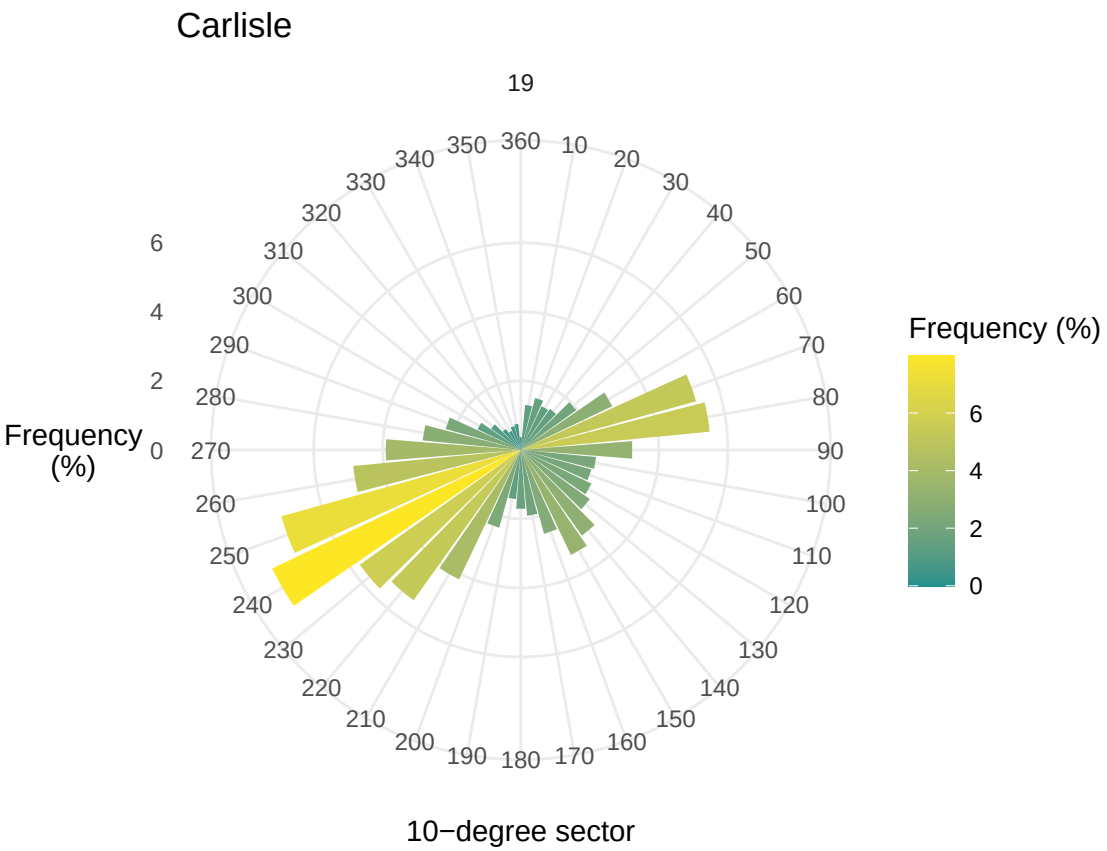
Carlisle
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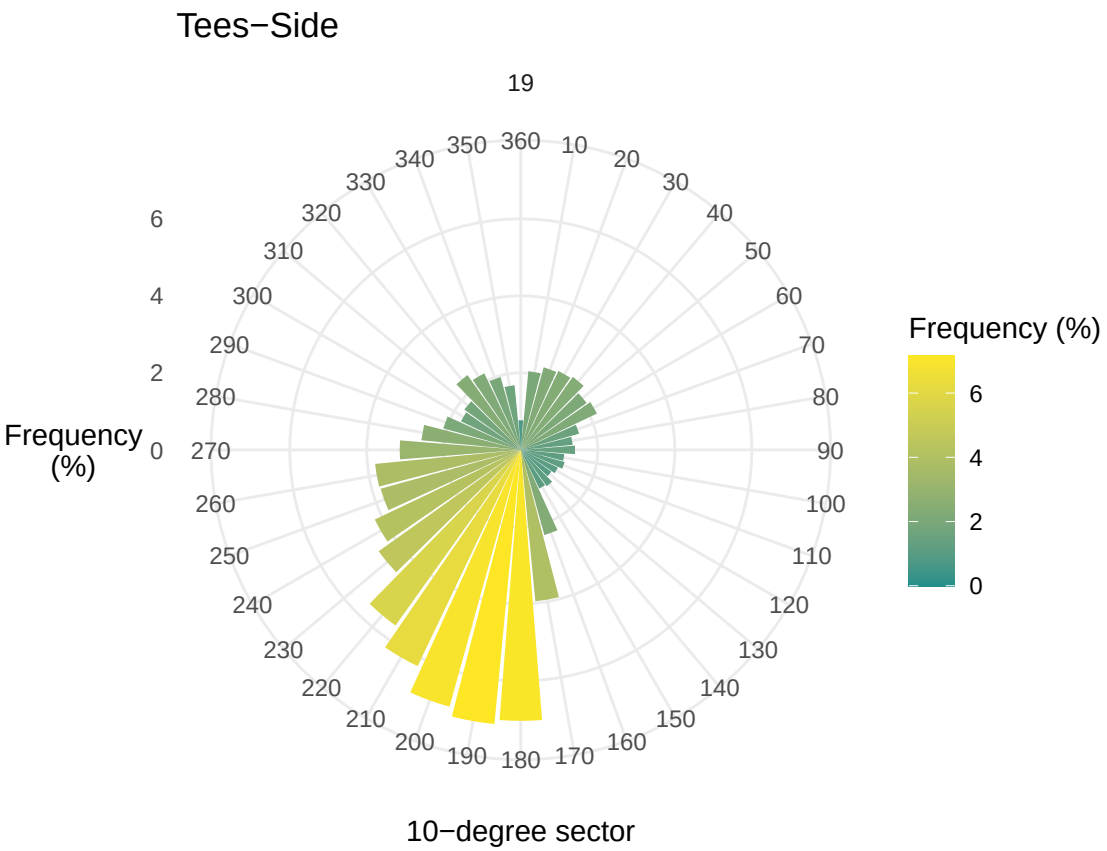
Tees−Side
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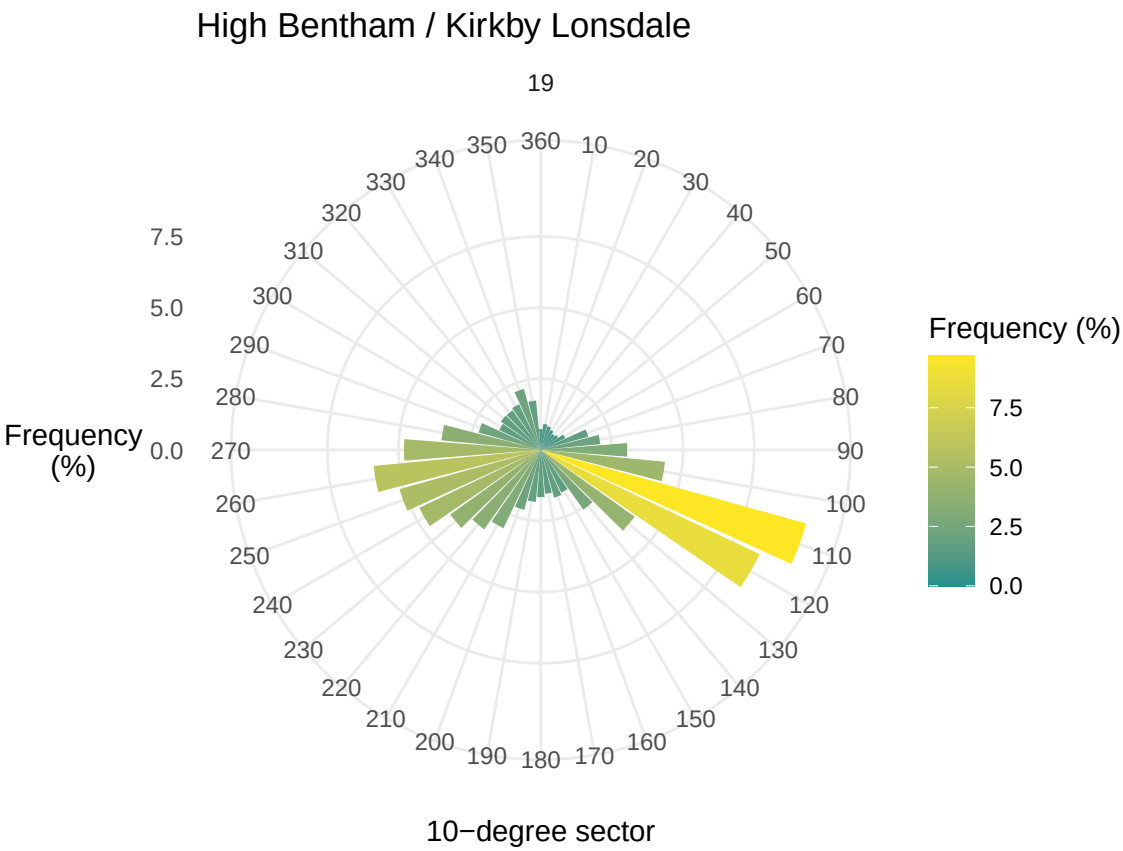
High Bentham / Kirkby Lonsdale
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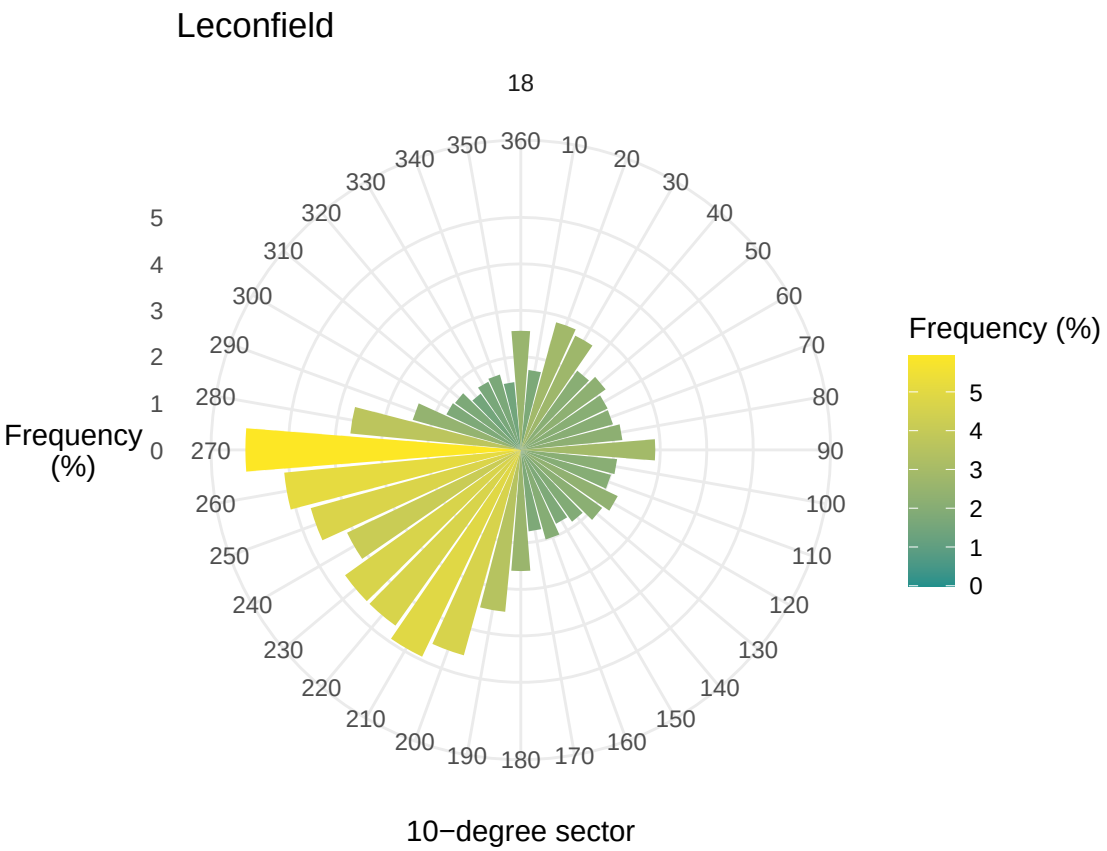
Leconfield
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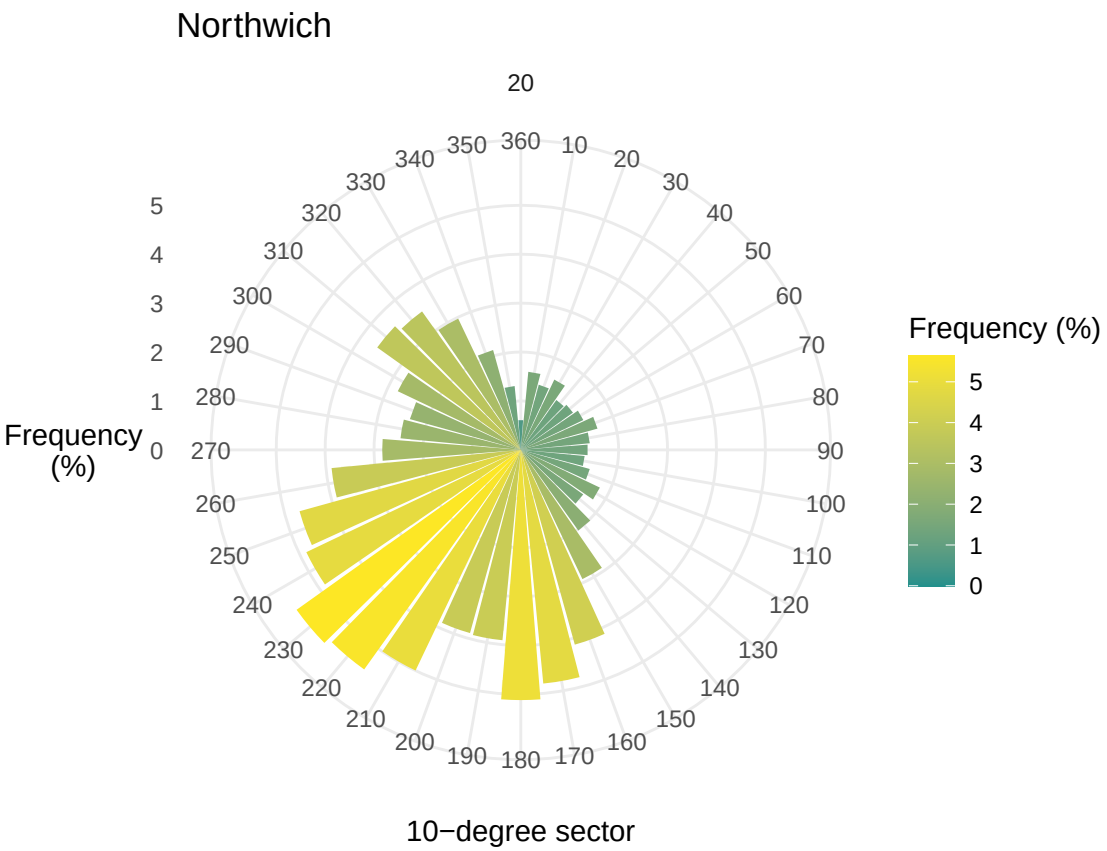
Northwich
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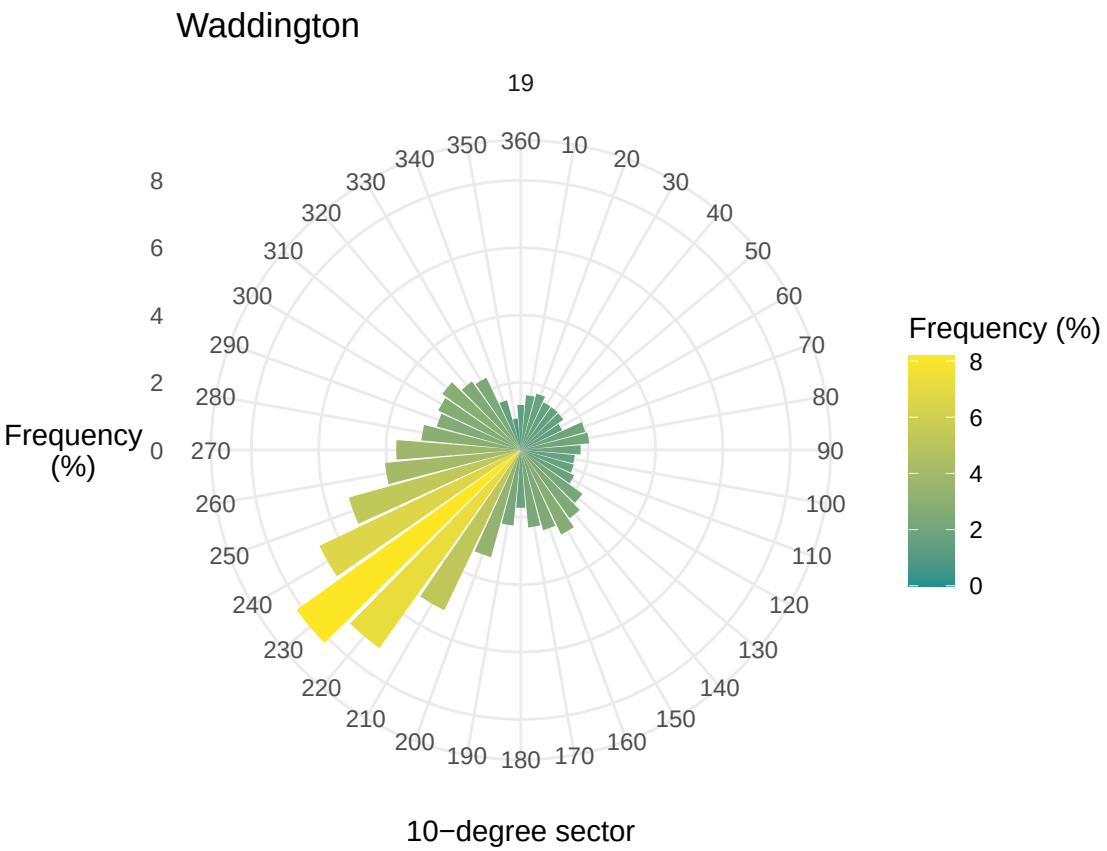
Waddington
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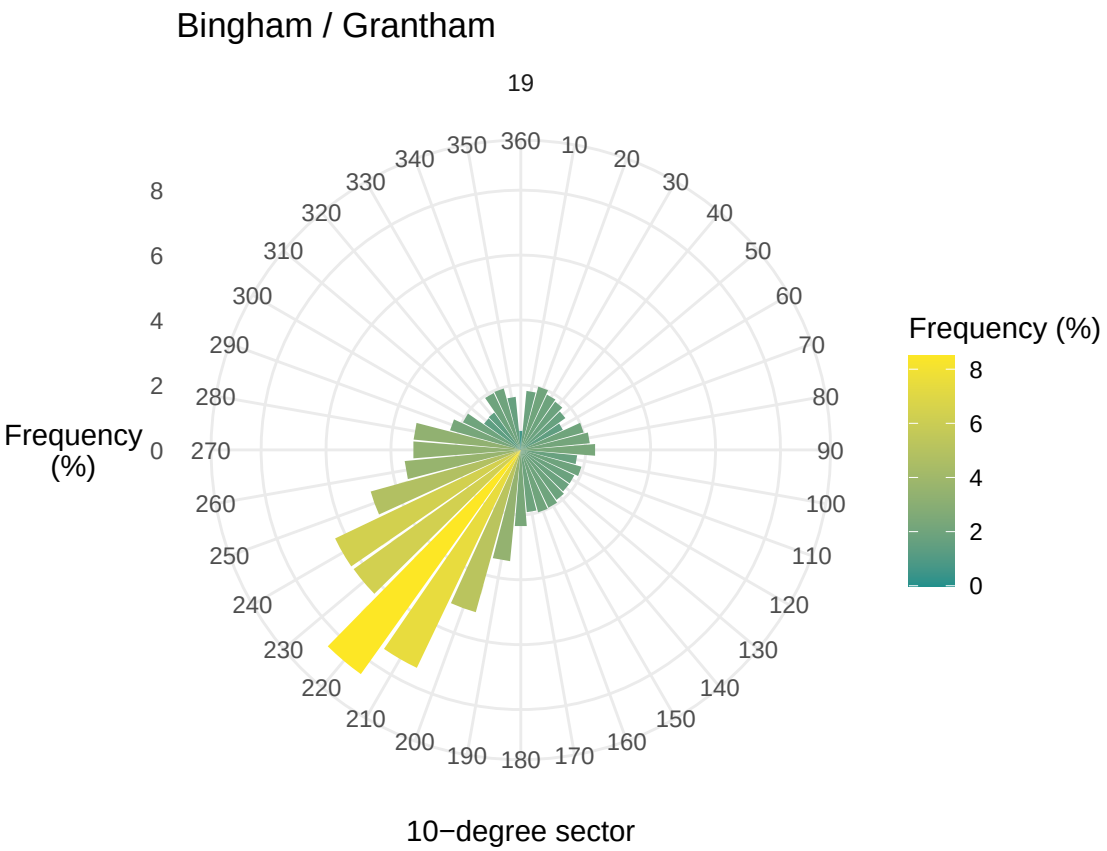
Bingham / Grantham
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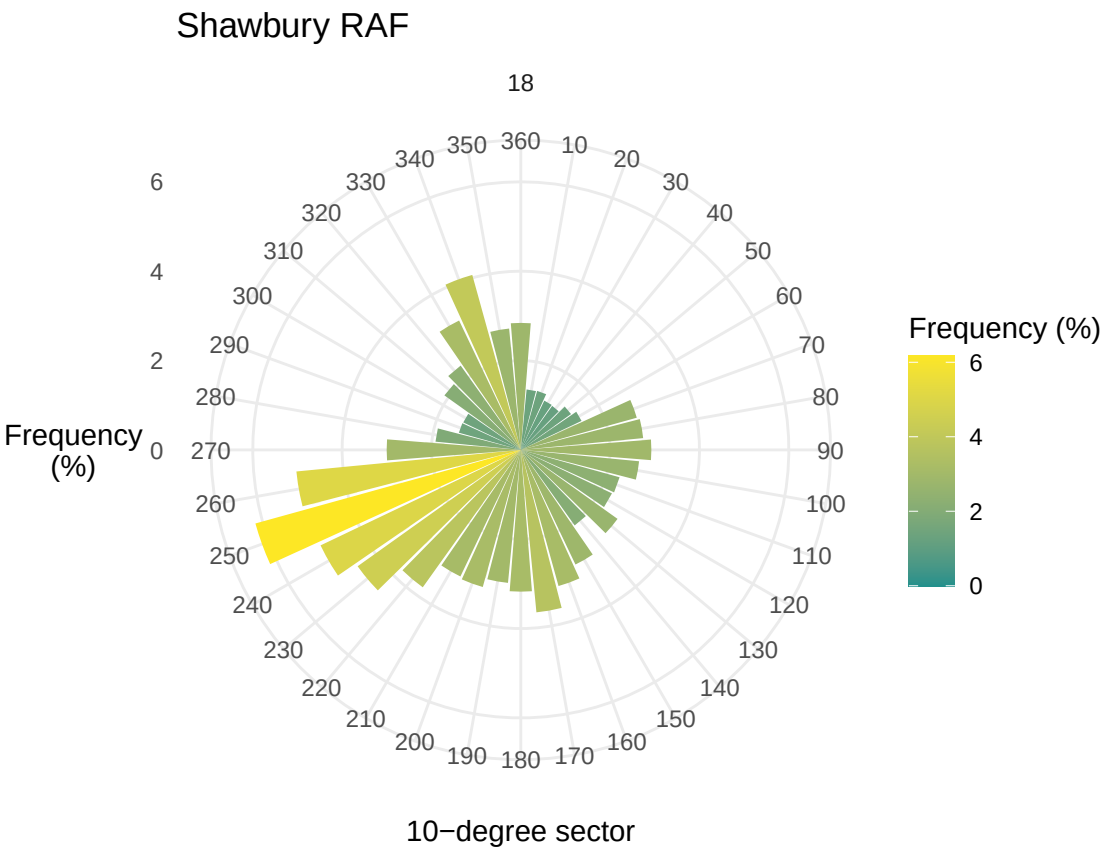
Shawbury RAF
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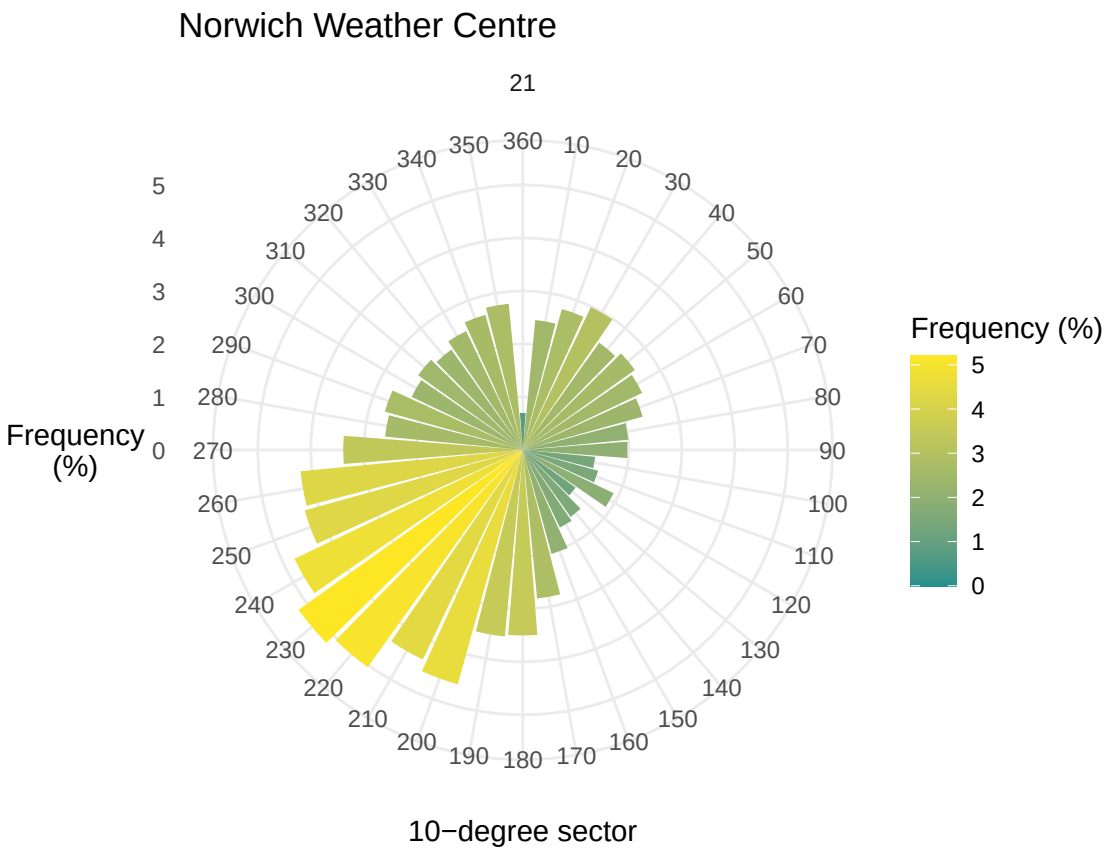
Norwich Weather Centre
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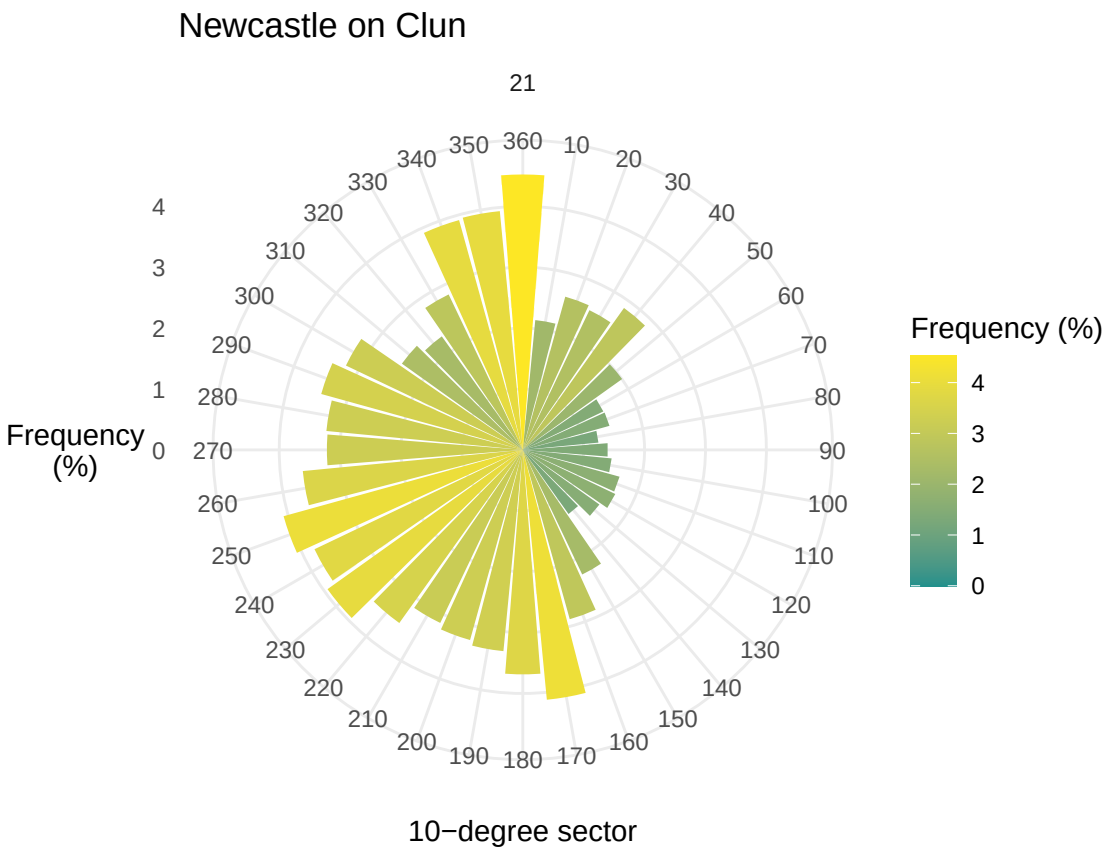
Newcastle on Clun
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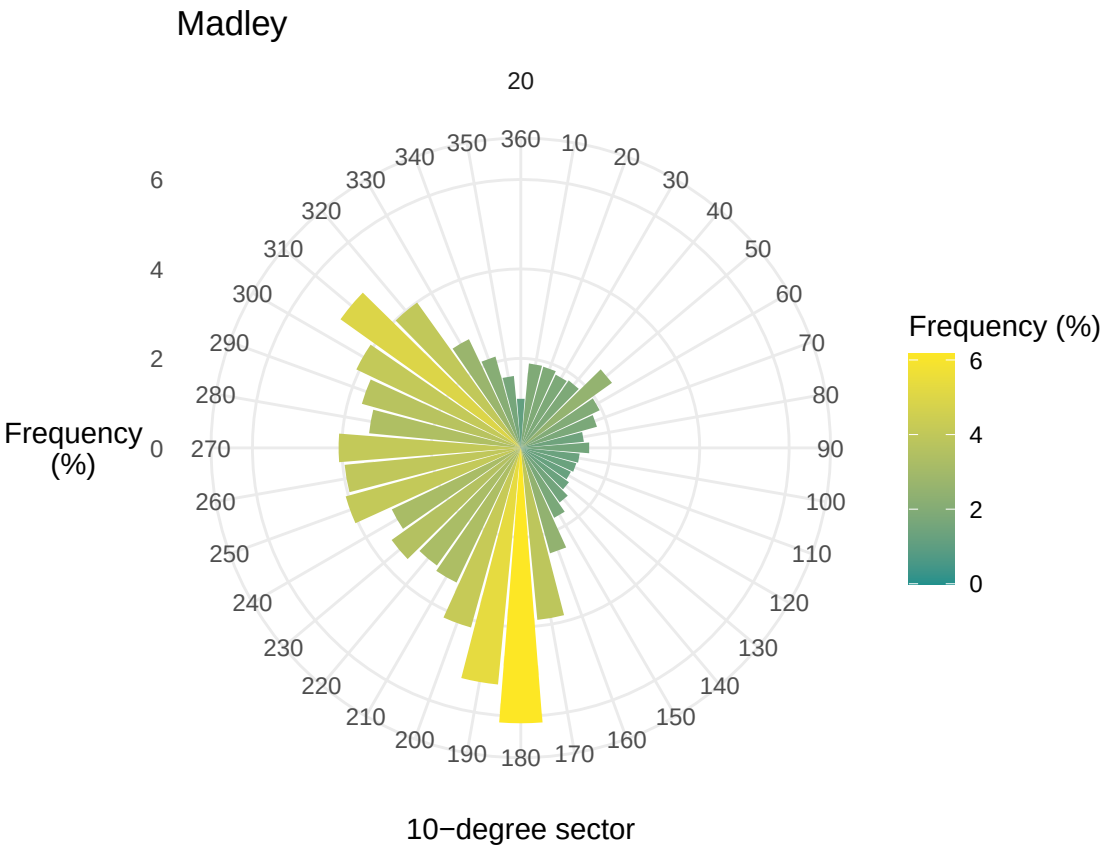
Madley
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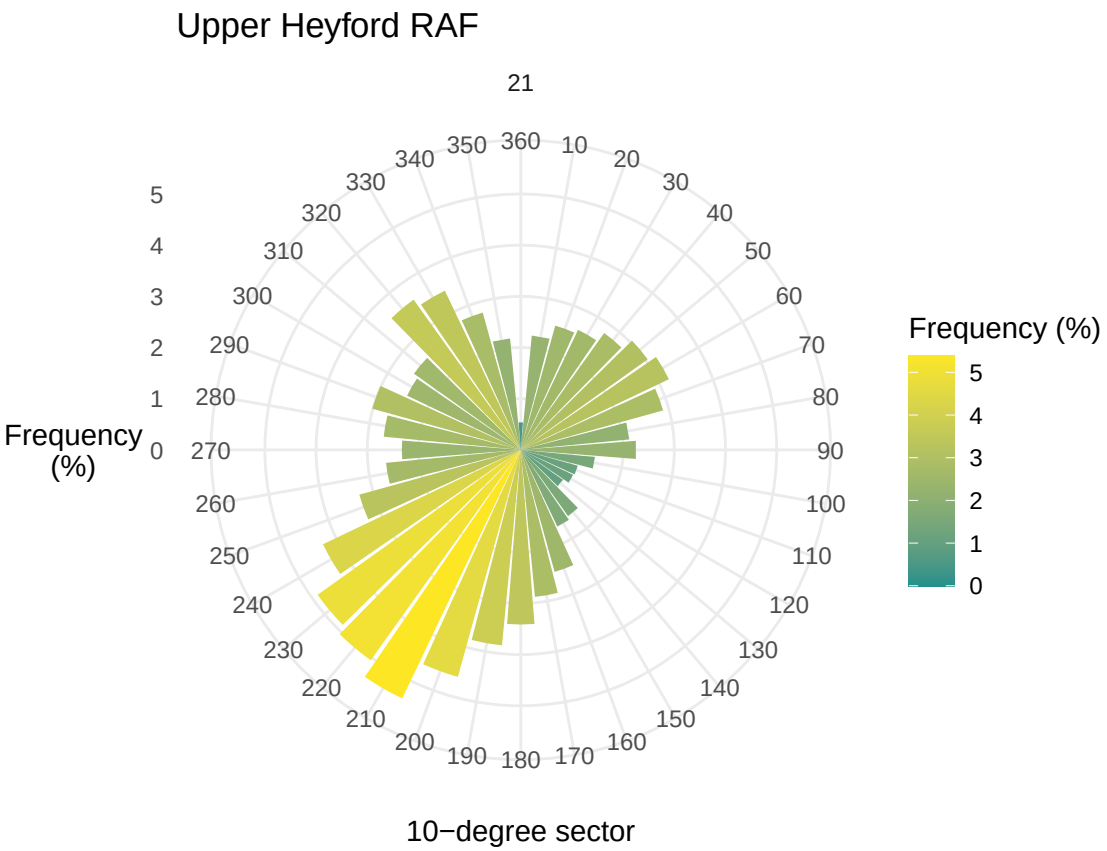
Upper Heyford RAF
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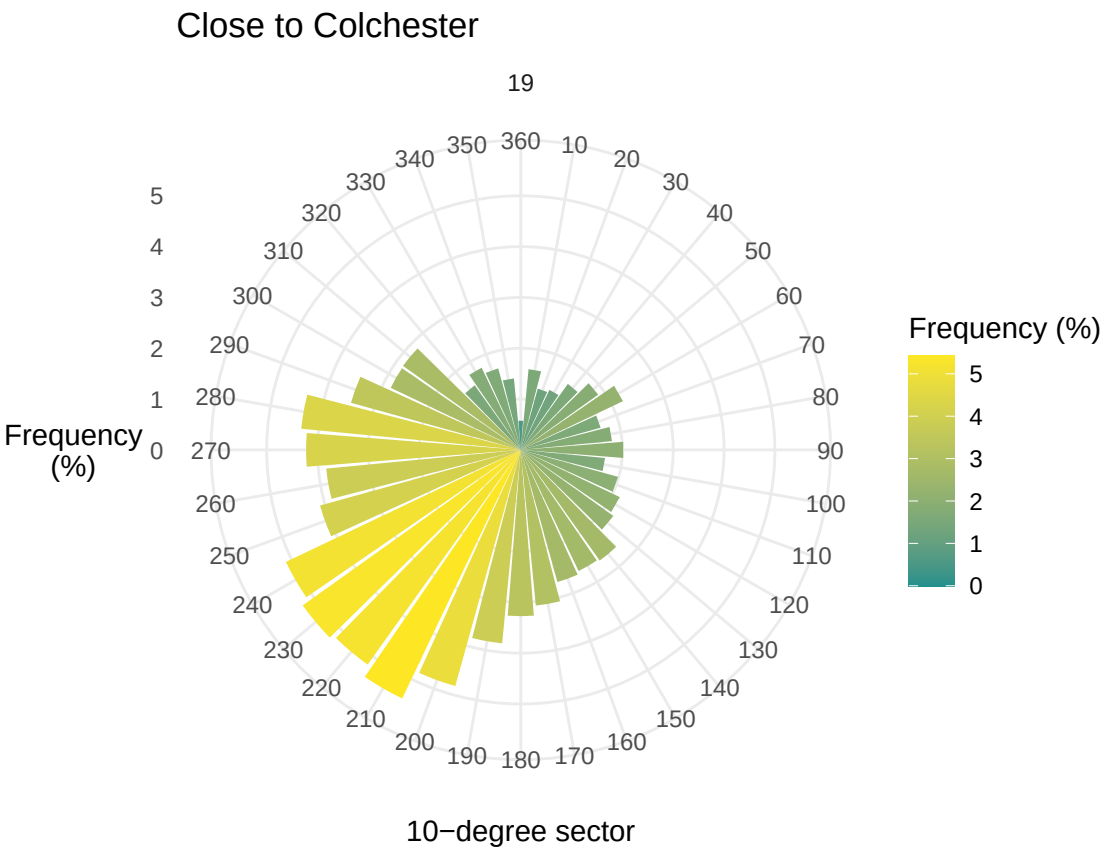
Close to Colchester
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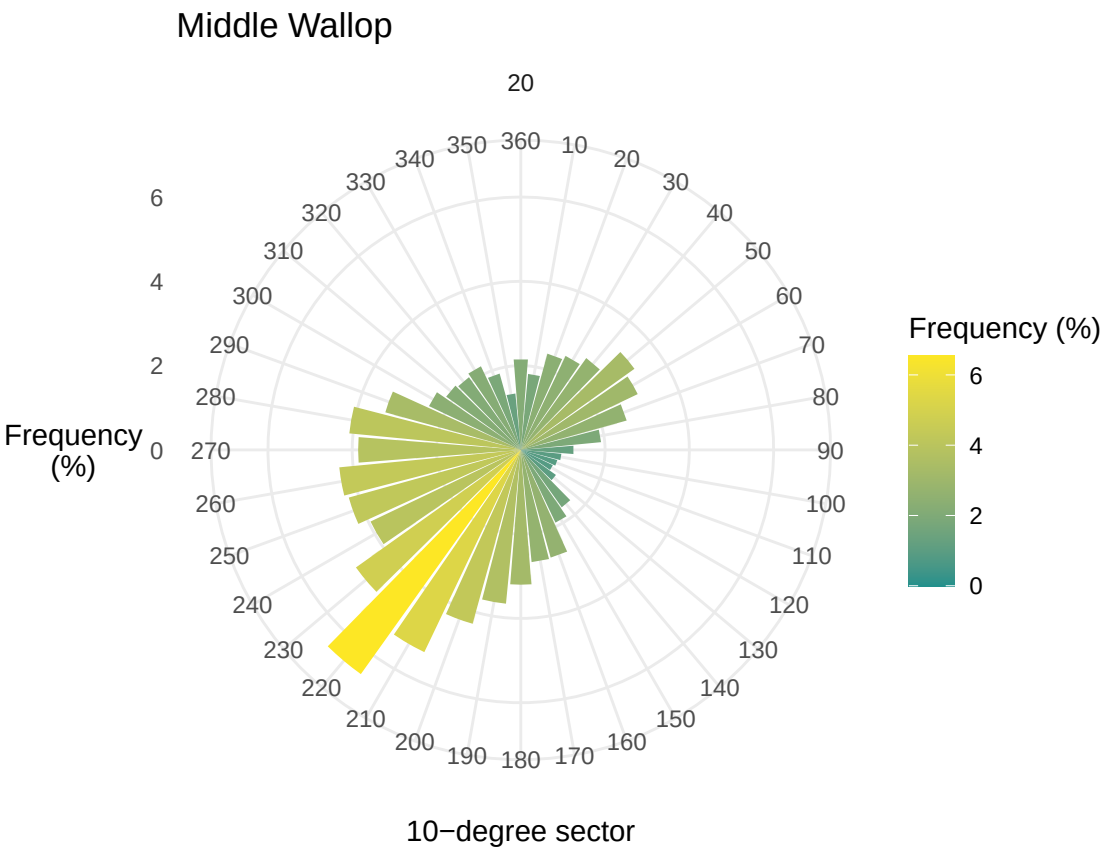
Middle Wallop
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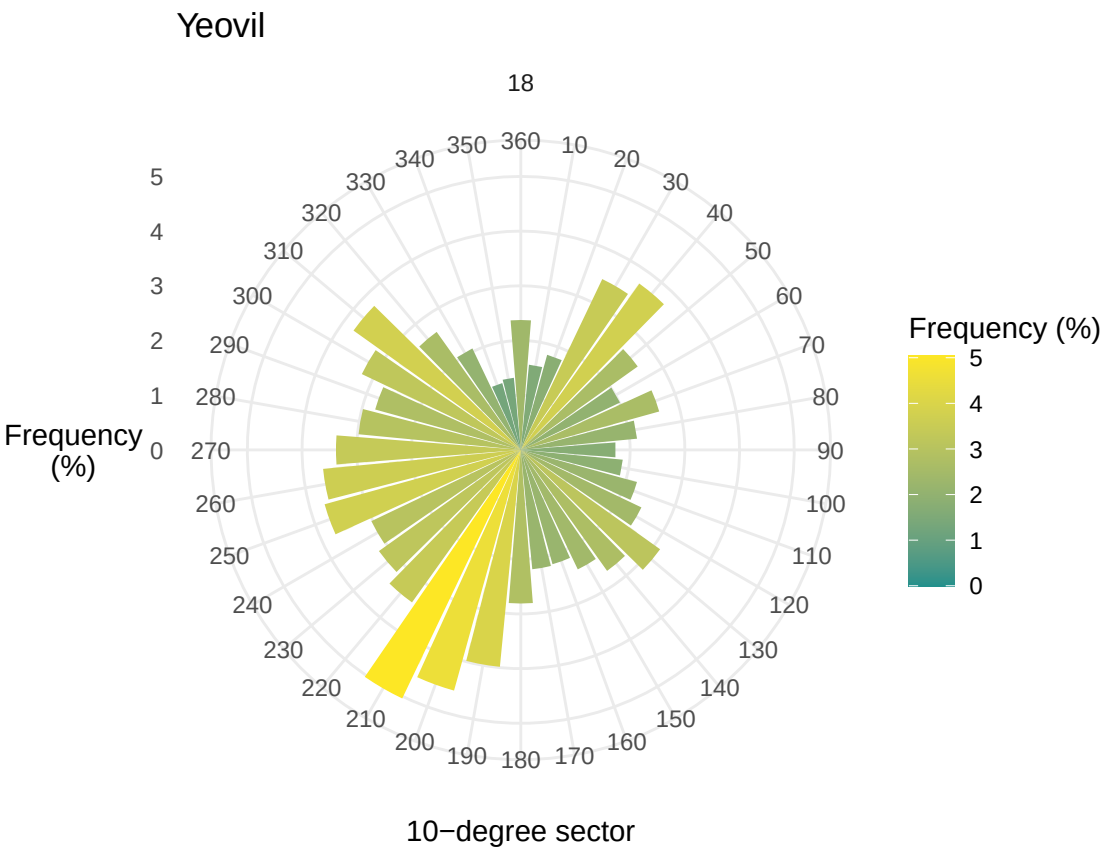
Yeovil
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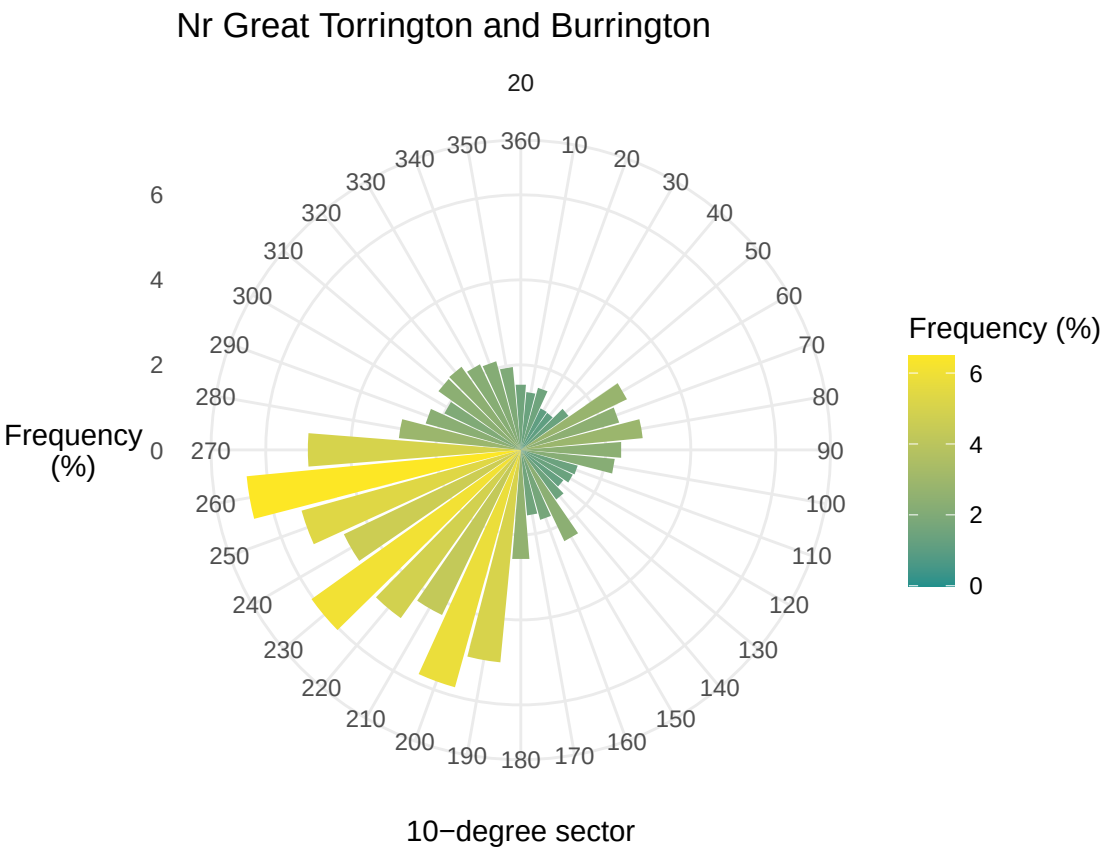
Nr Great Torrington and Burrington
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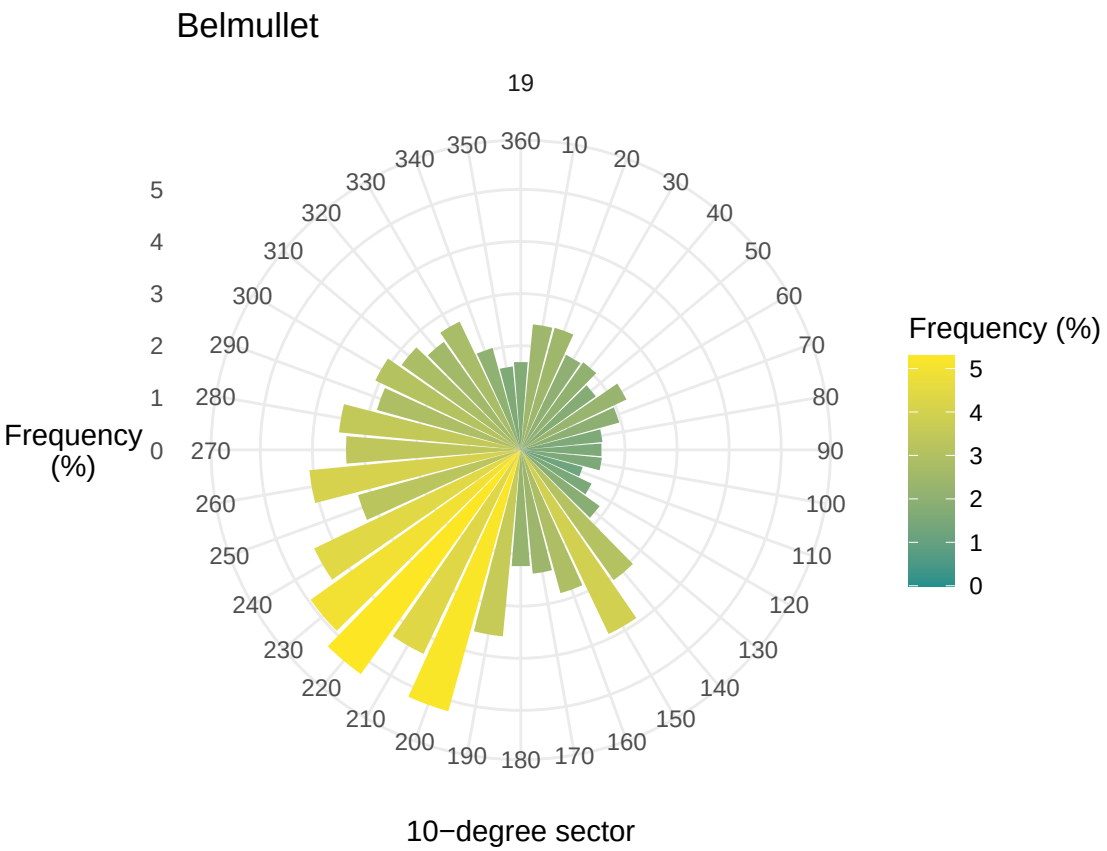
Belmullet
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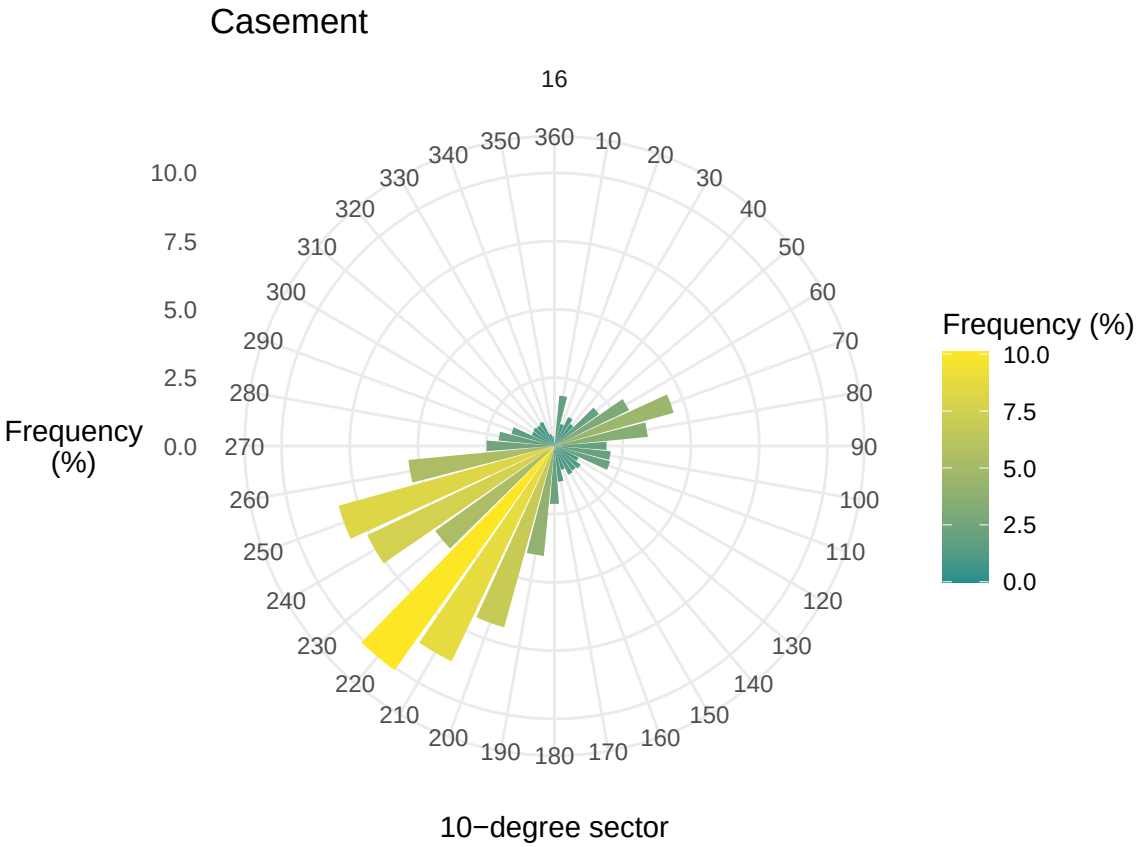
Casement
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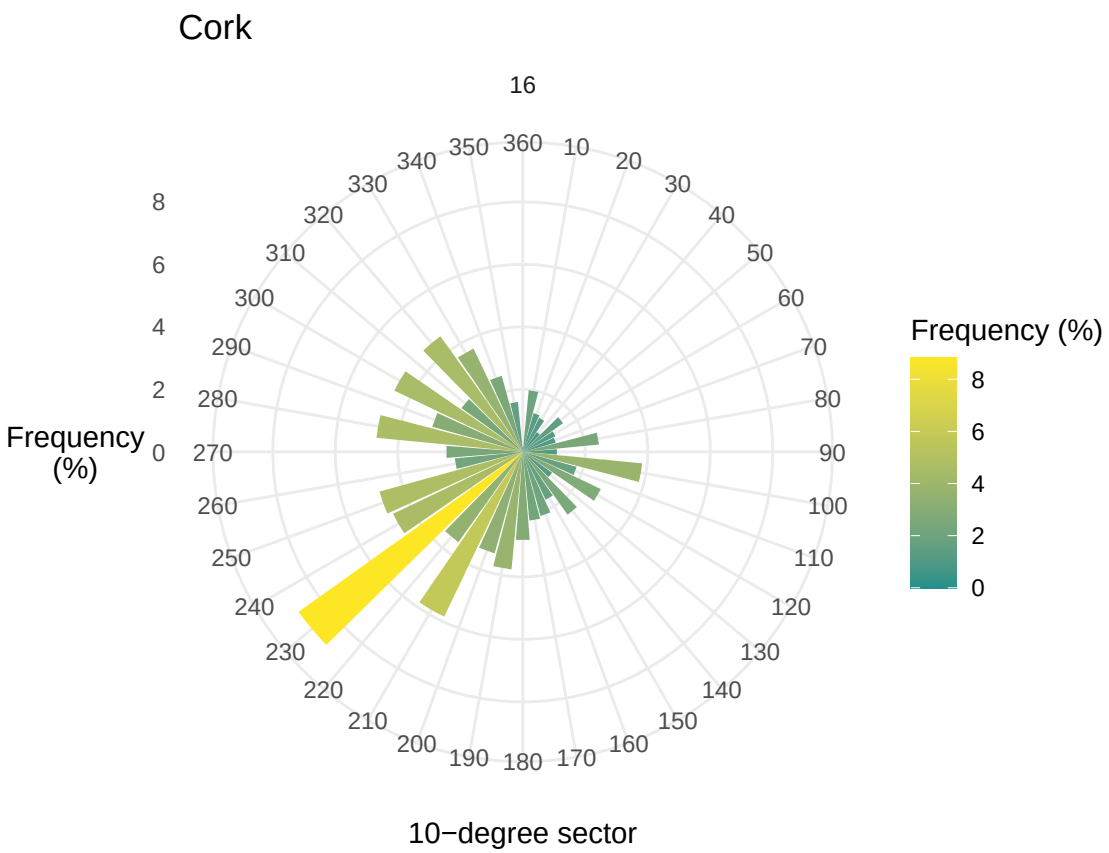
Cork
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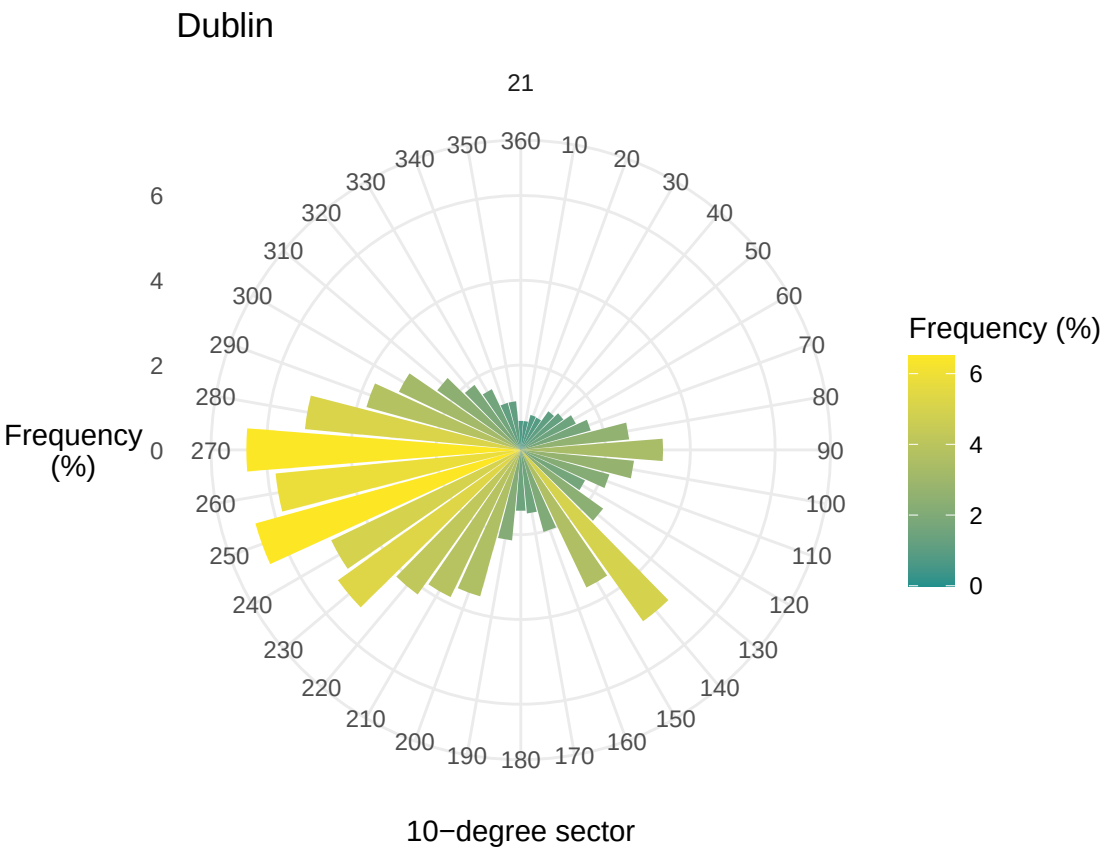
Dublin
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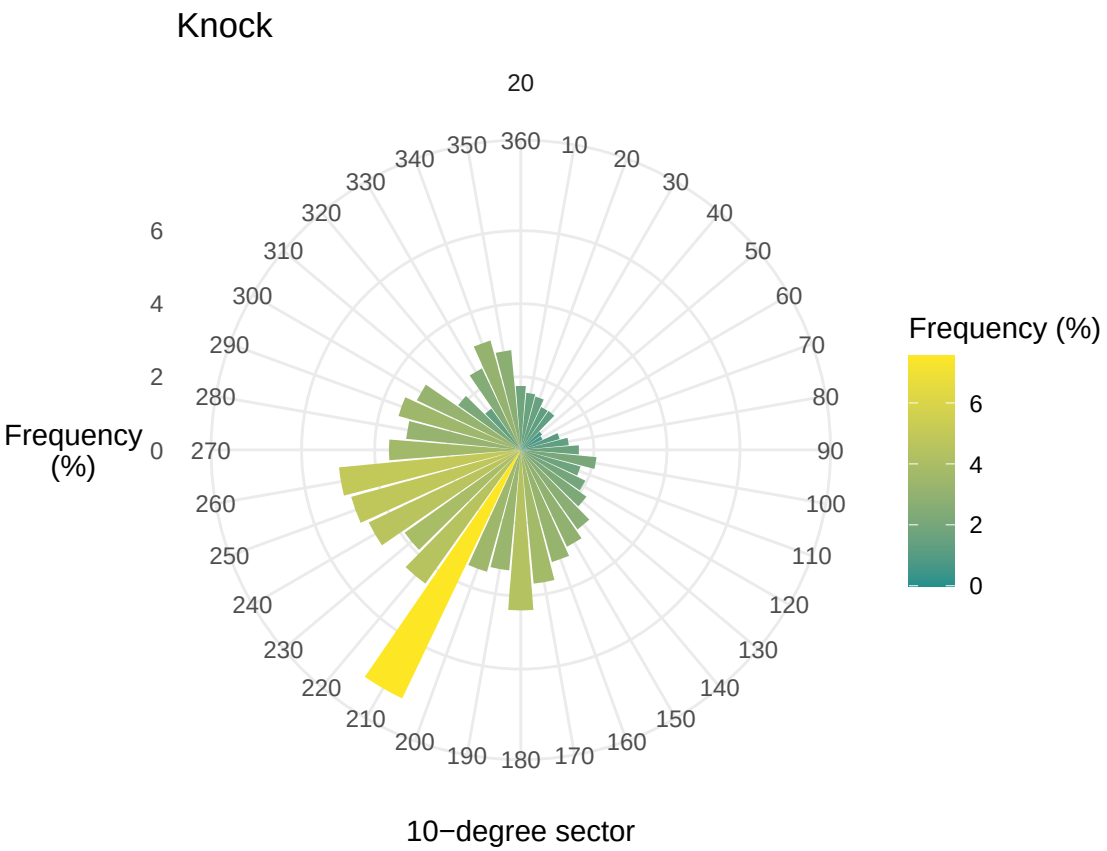
Knock
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Frequency (%)
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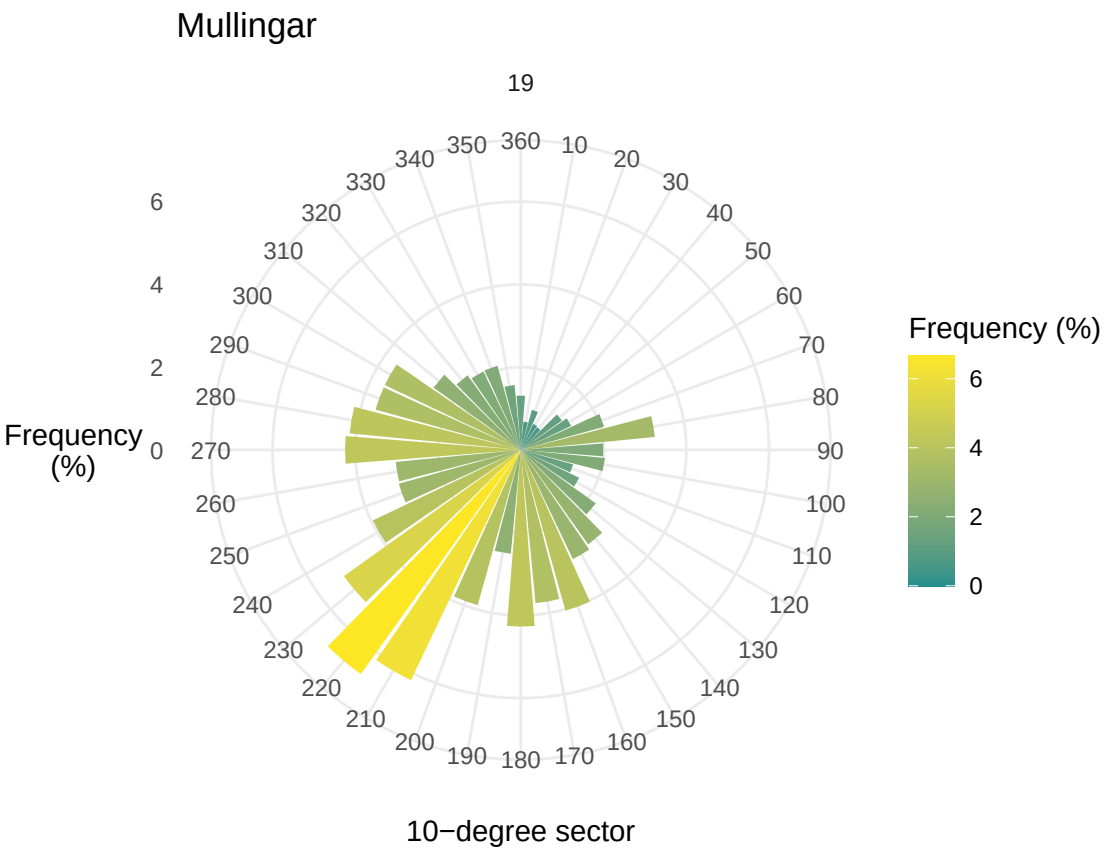
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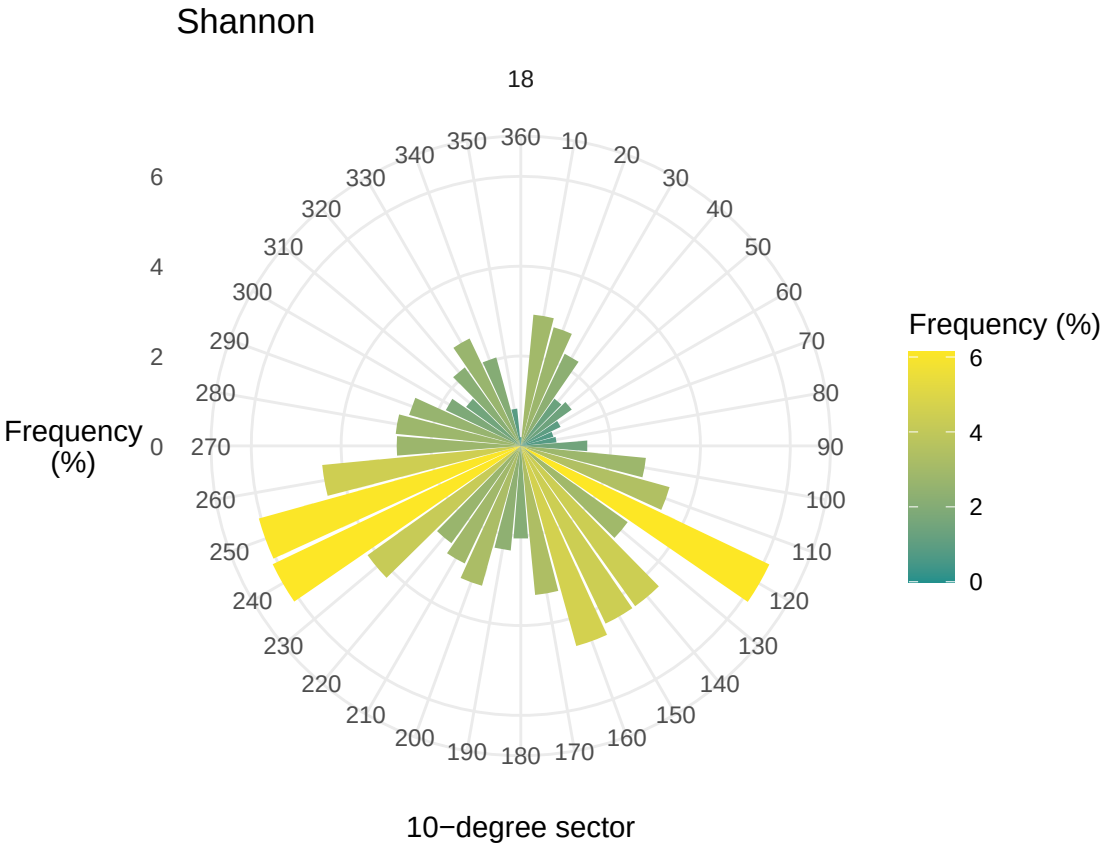
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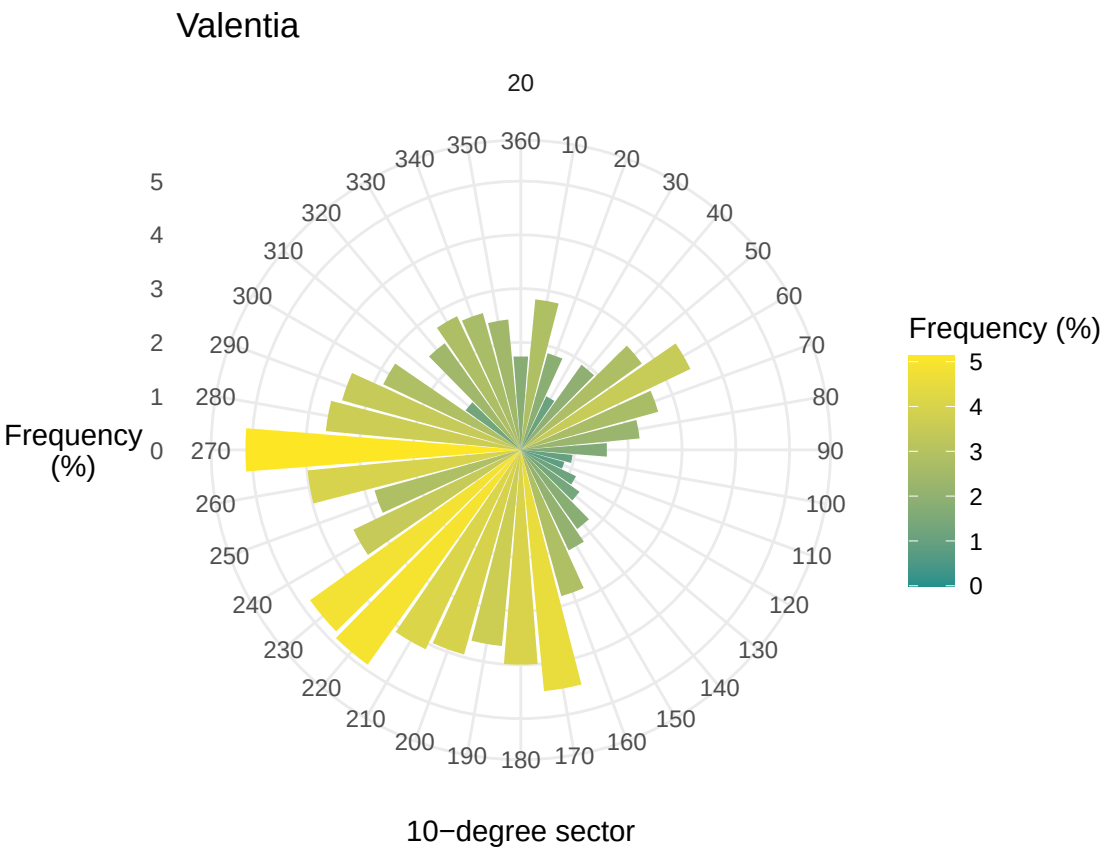
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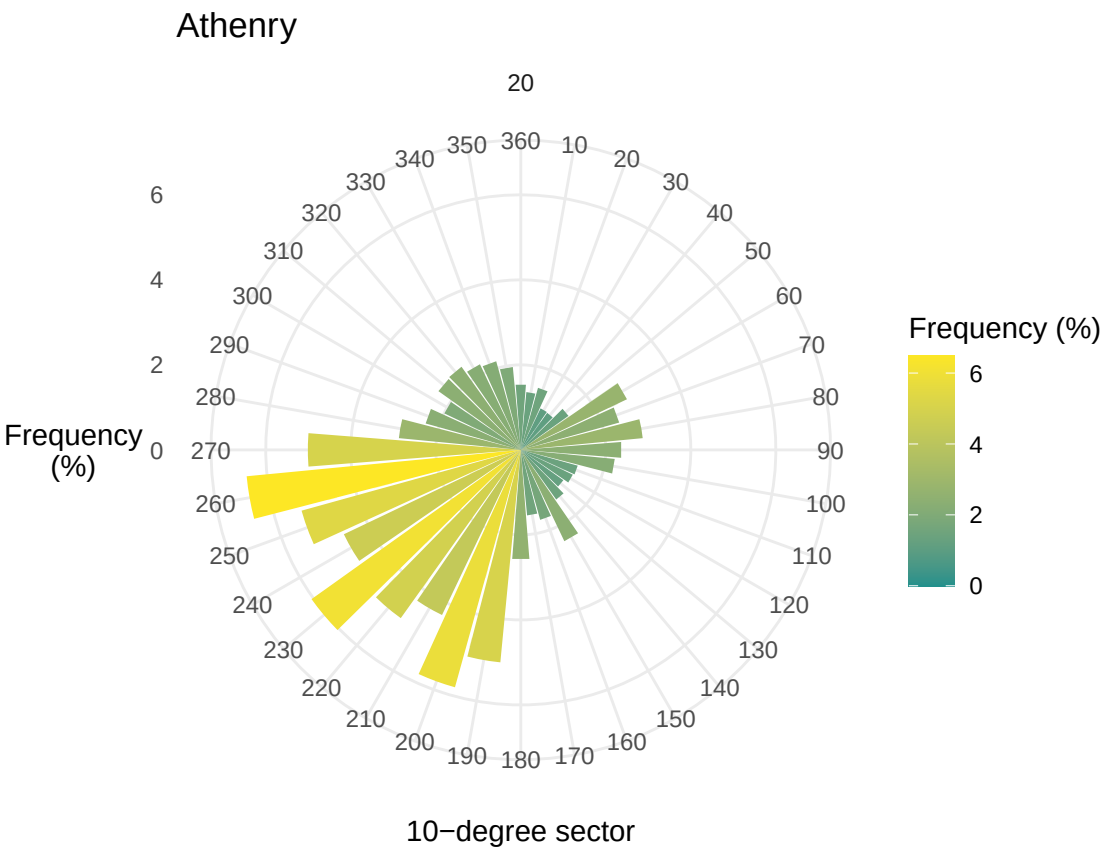
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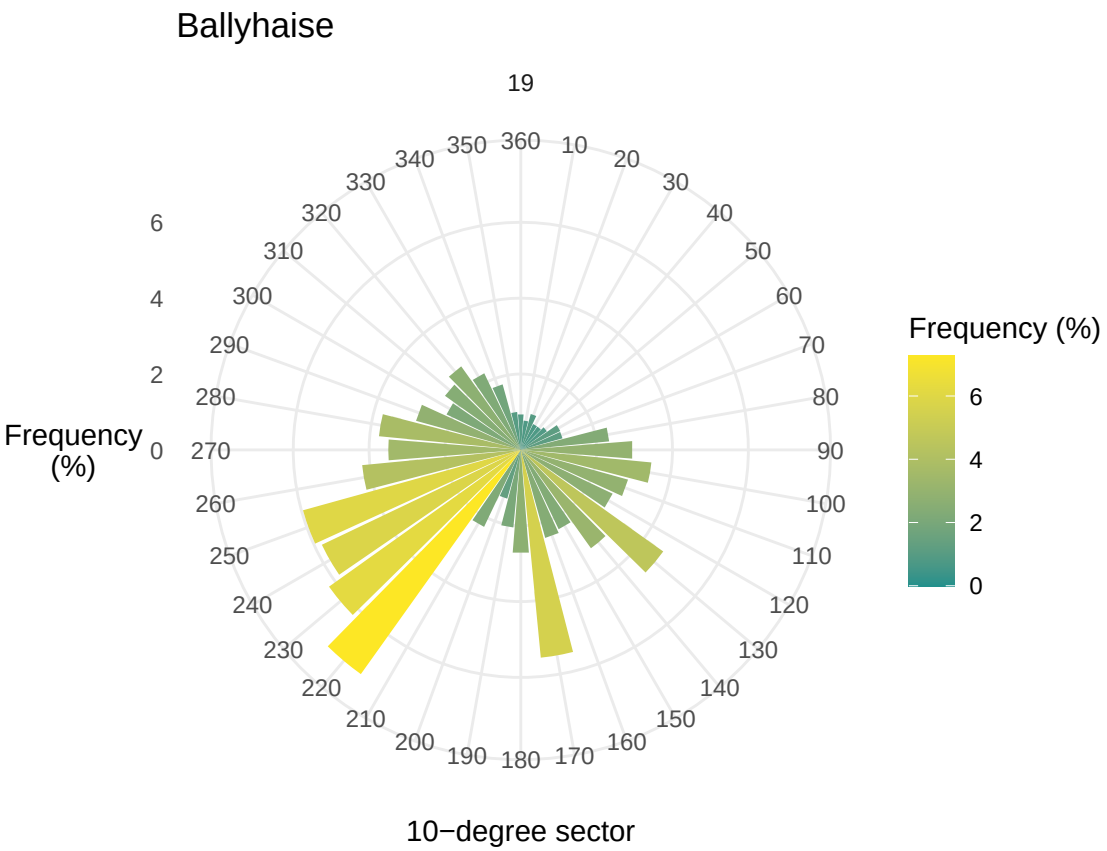
Ballyhaise
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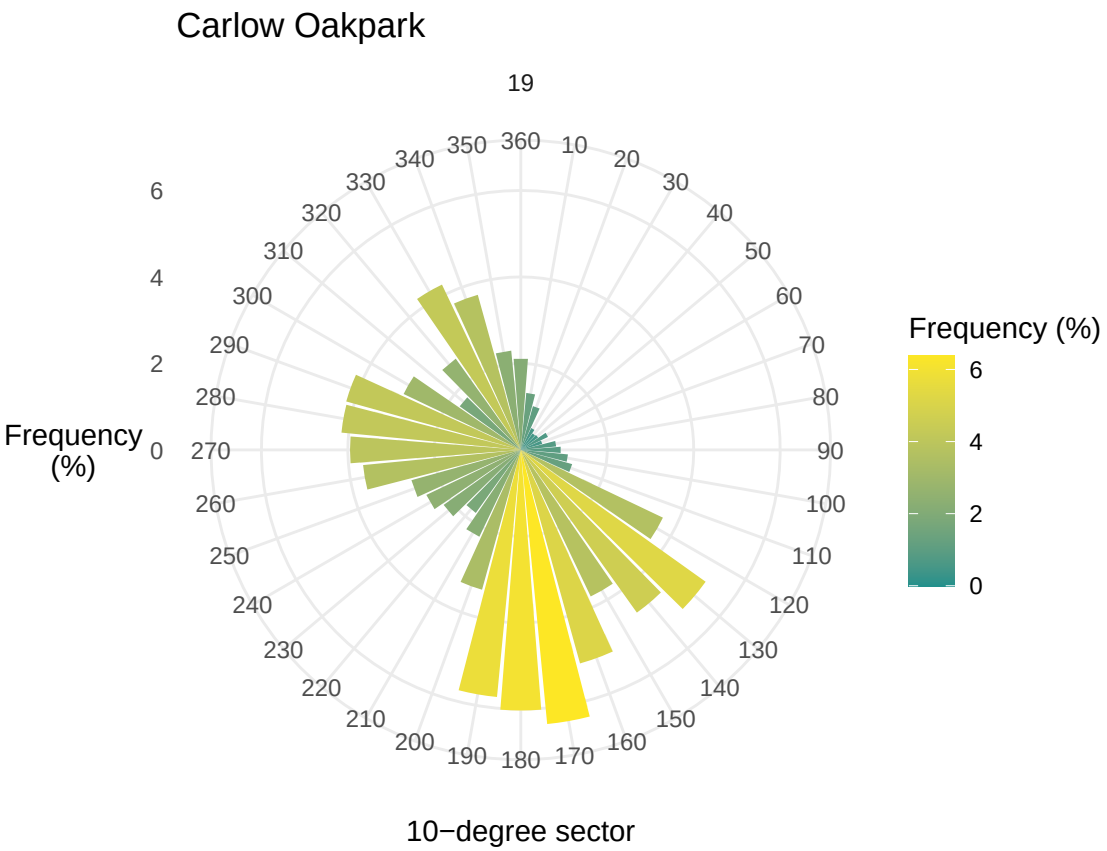
Carlow Oakpark
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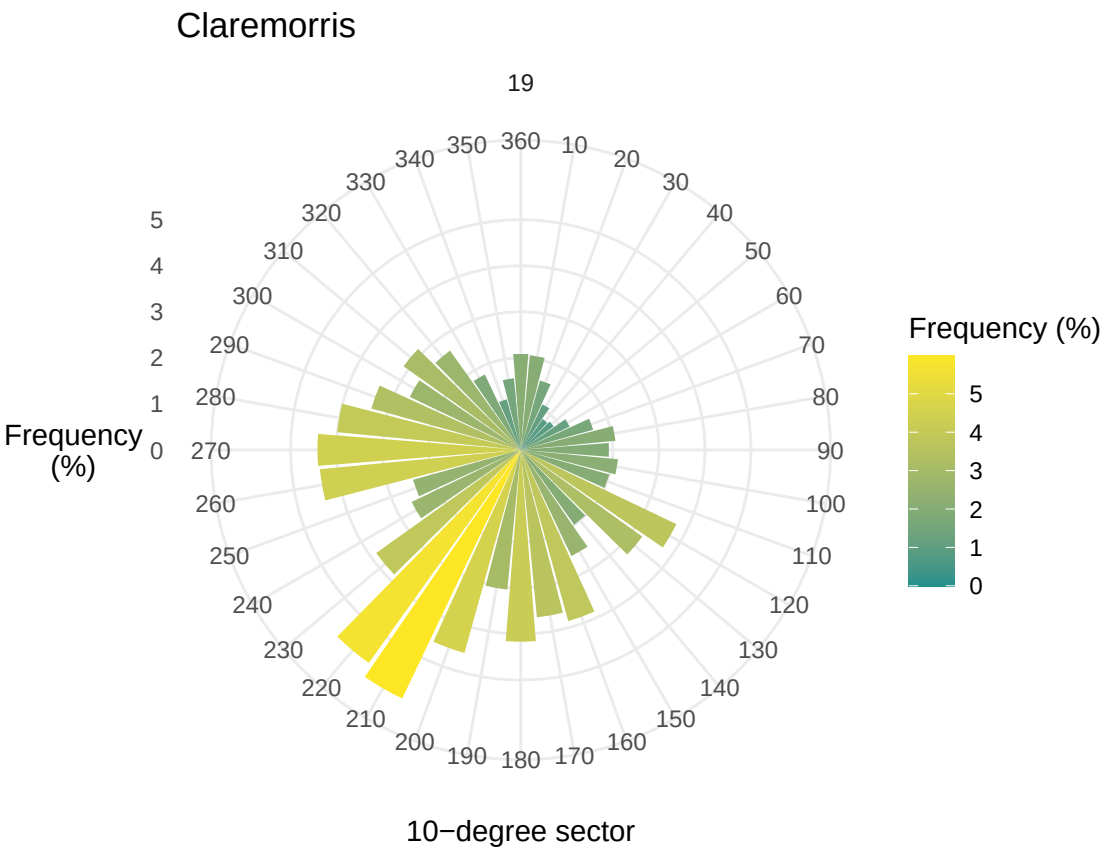
Claremorris
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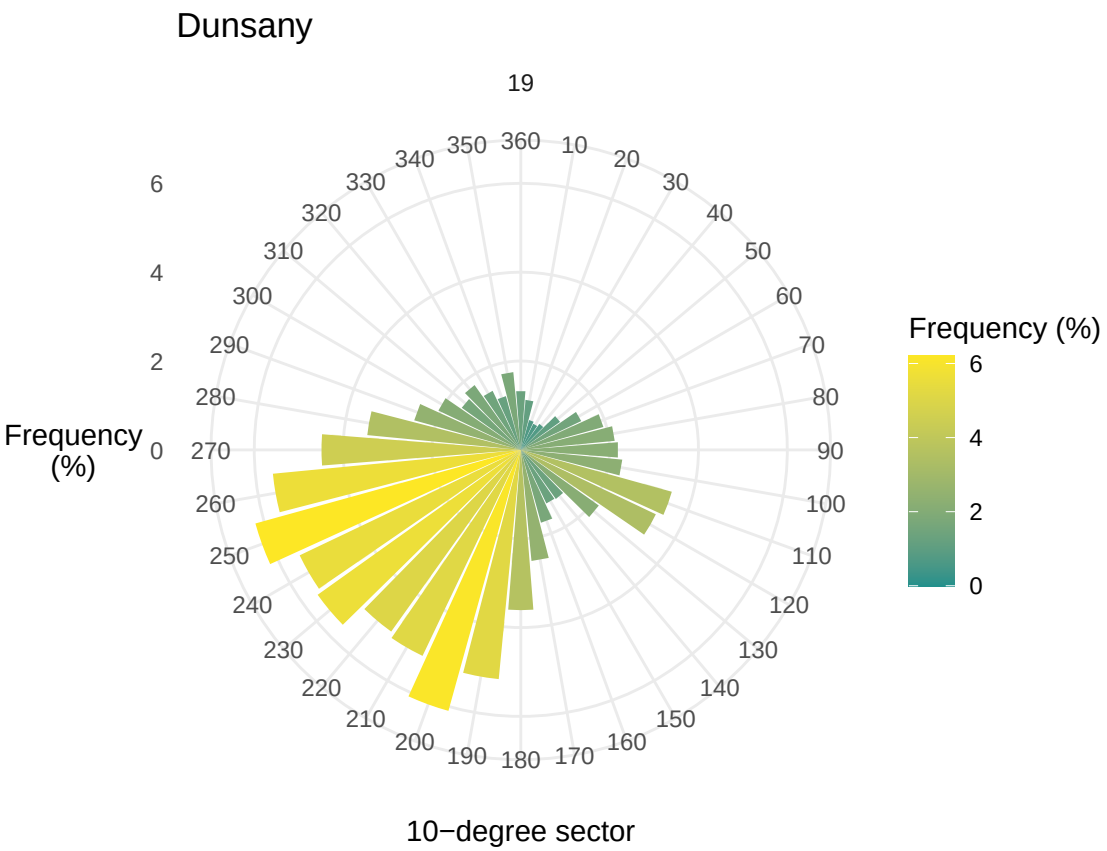
Dunsany
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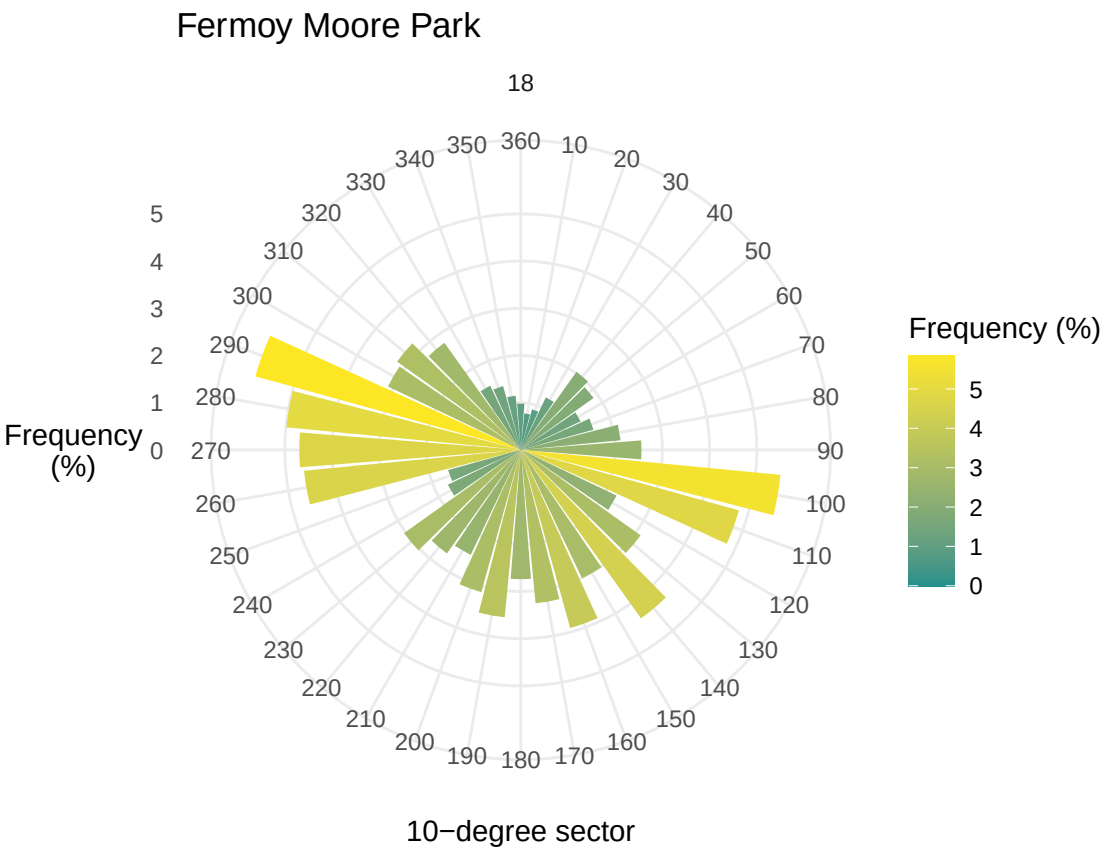
Fermoy Moore Park
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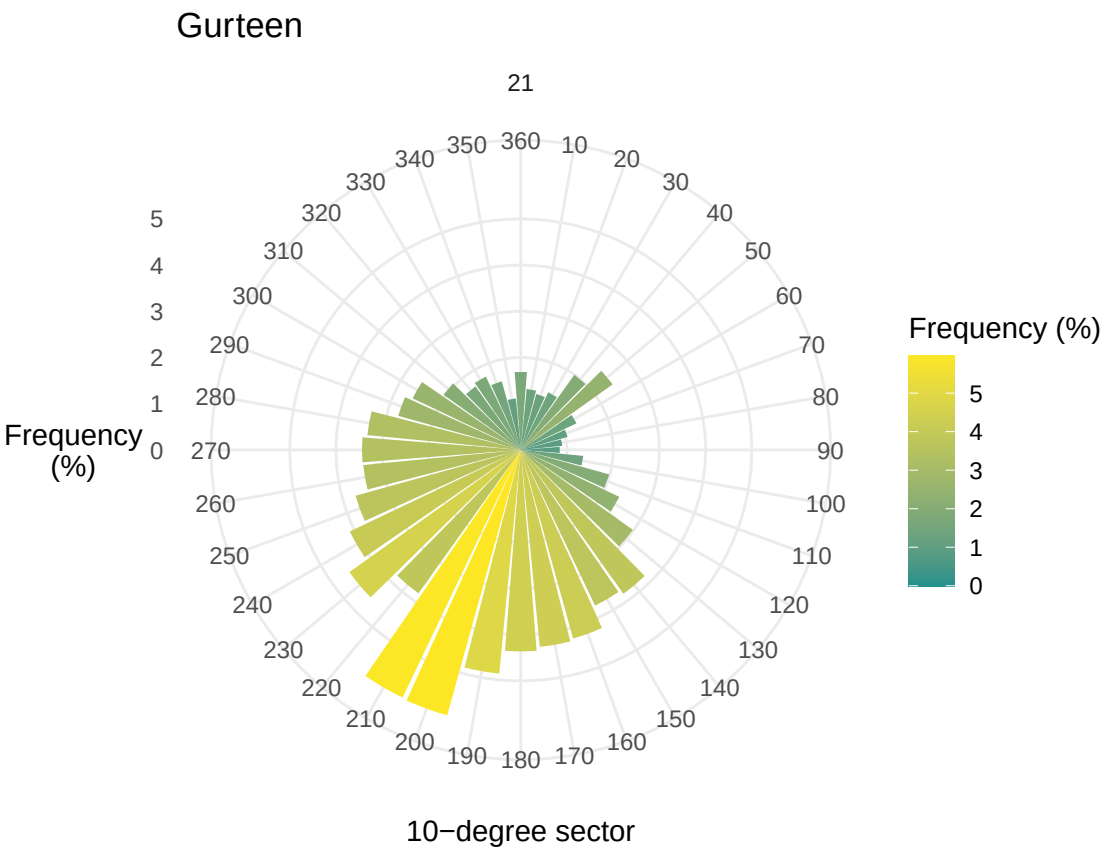
Gurteen
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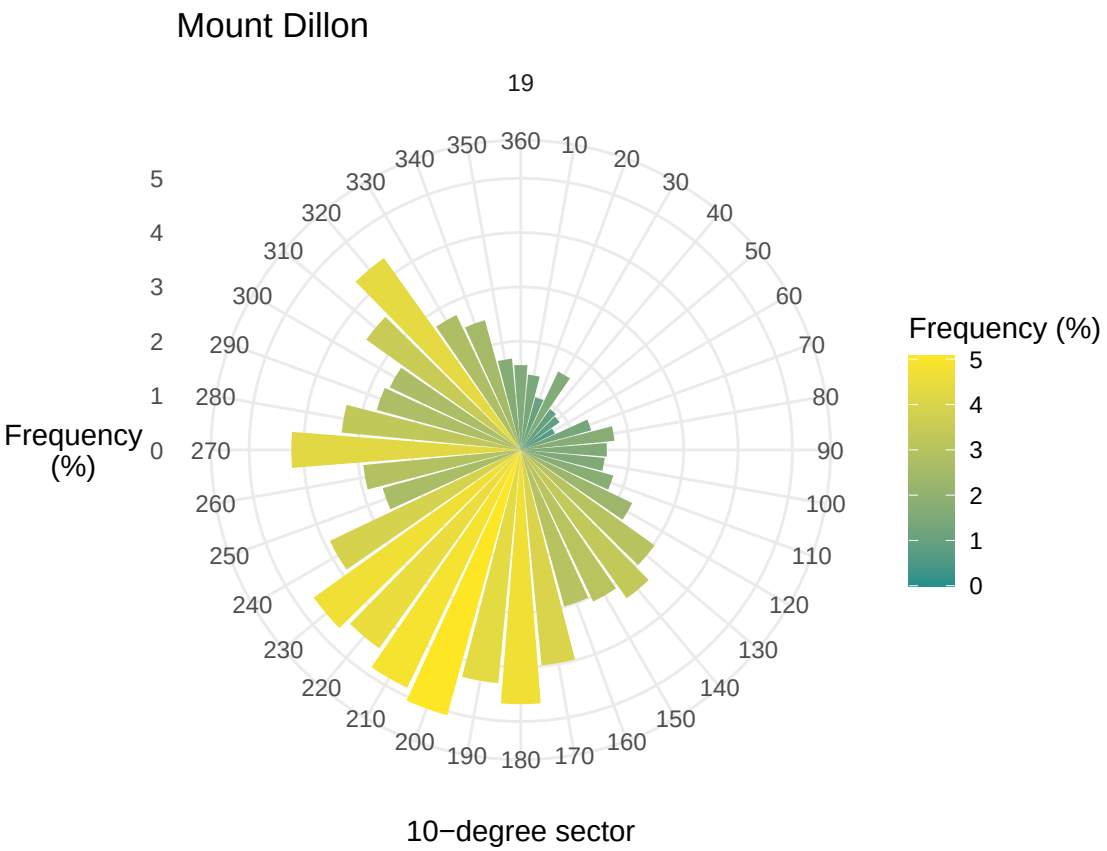
Mount Dillon
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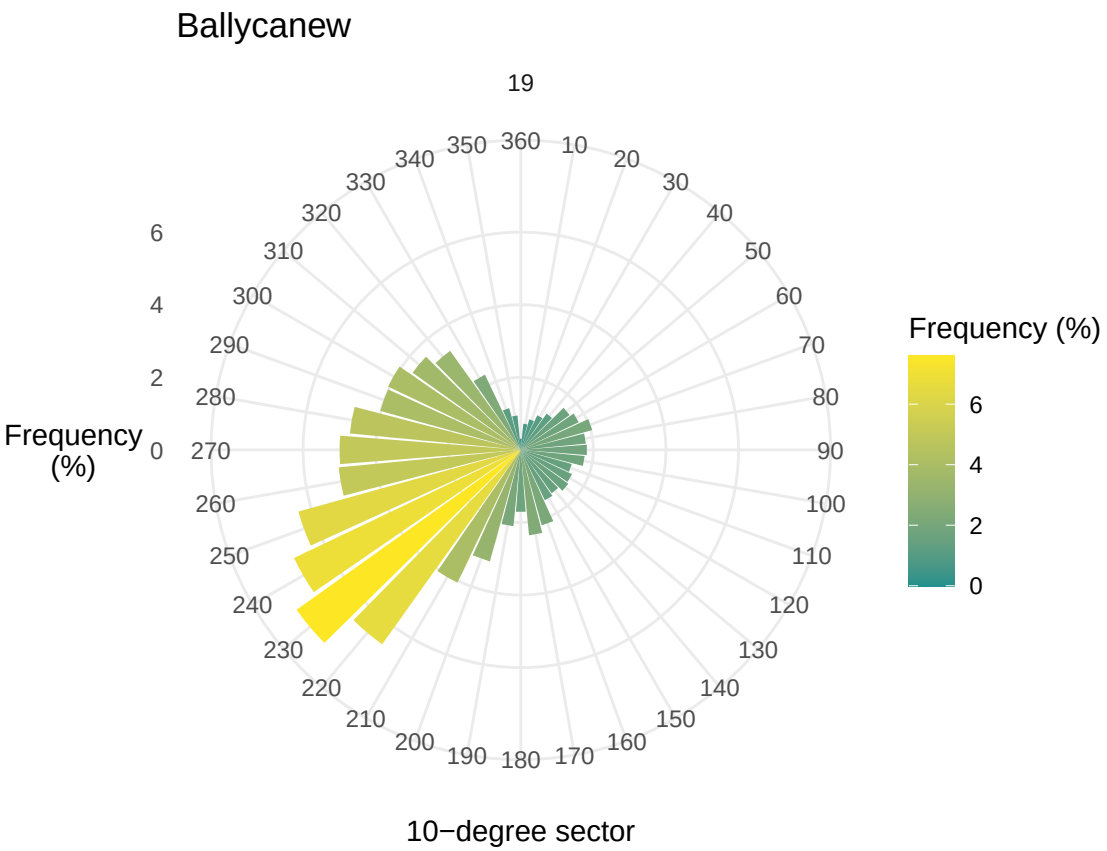
Ballycanew
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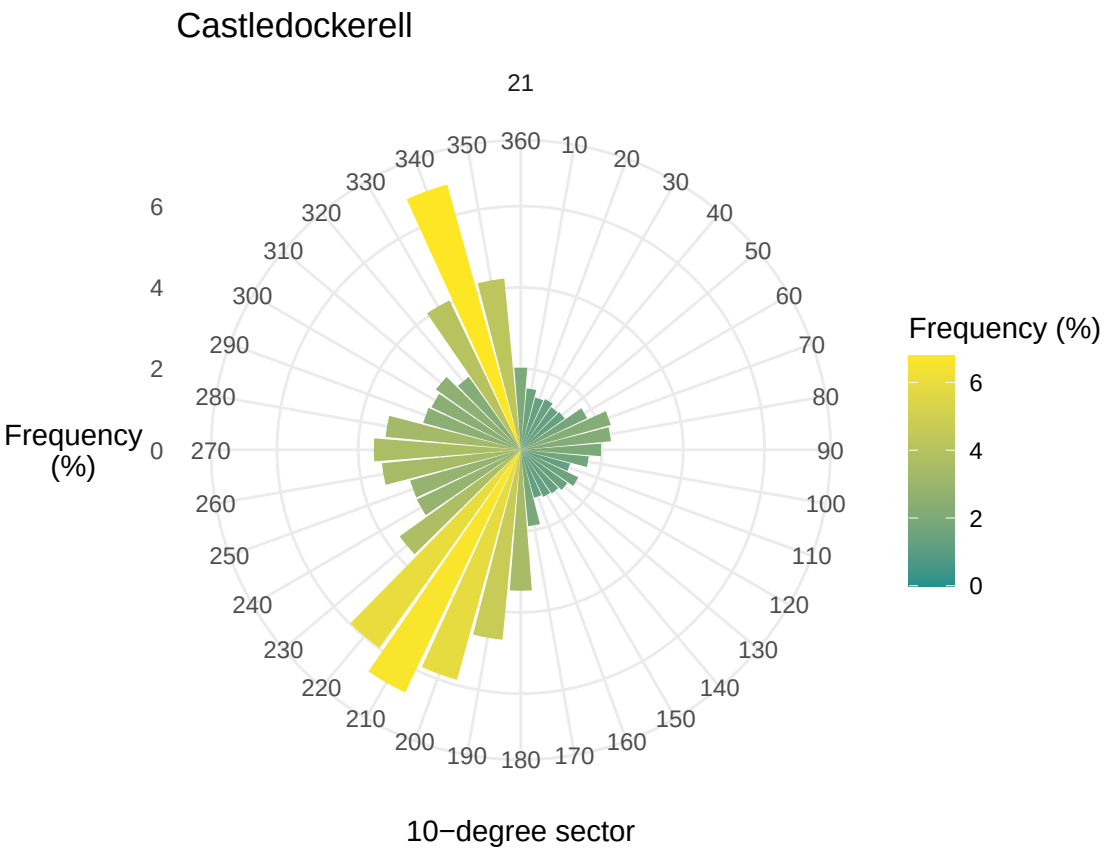
Castledockerell
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Frequency (%)
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