

User Guide

Irish Pest Emergence Maps

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Introduction

The Irish Pest Emergence Maps (IPEM) webtool was designed for users to generate risk prediction maps of potential pests that may arrive on the island of Ireland using past climate data from 1991:present, the most recent thirty-year climate normal (1991:2020) and future climate scenarios. Users may view the predicted emergence date and the number of generations predicted to emerge for 12 developmental starting dates within a year.

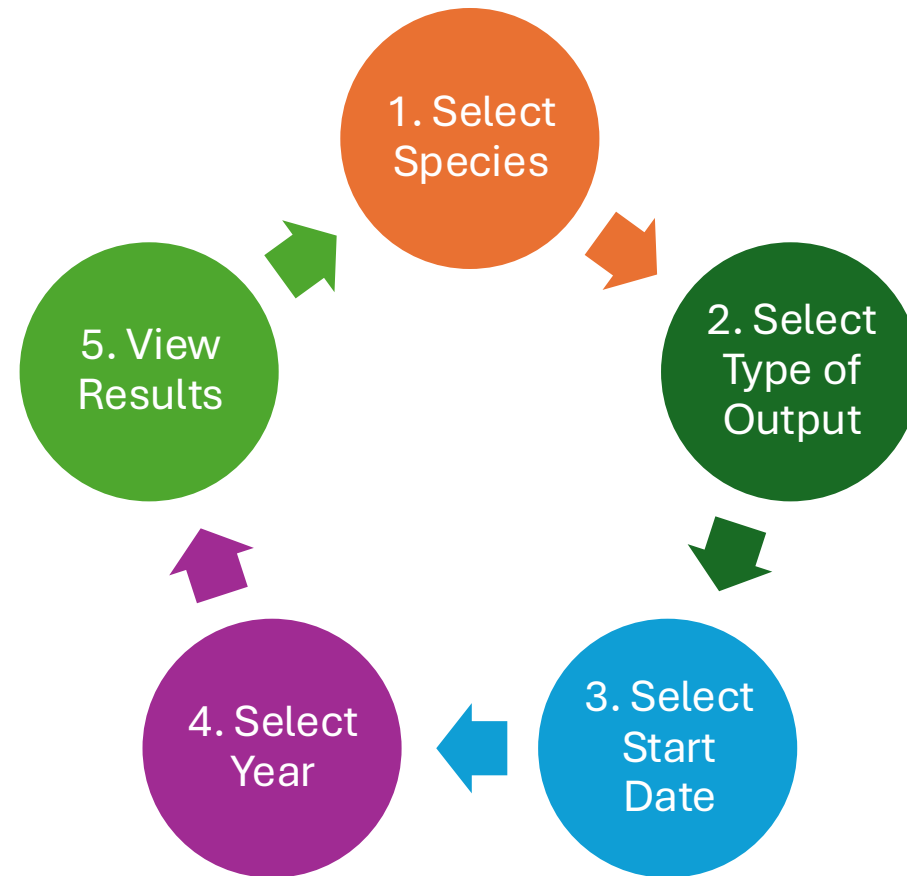
Climate data for these maps is from [Met Éireann's 1km gridded climate data](https://www.met.ie/science/translate), the future climate scenarios are provided by the [TRANSLATE project](https://www.met.ie/science/translate). Further details may be found via <https://www.met.ie/science/translate> & <https://www.met.ie/daily-rainfall-and-temperature-grids>

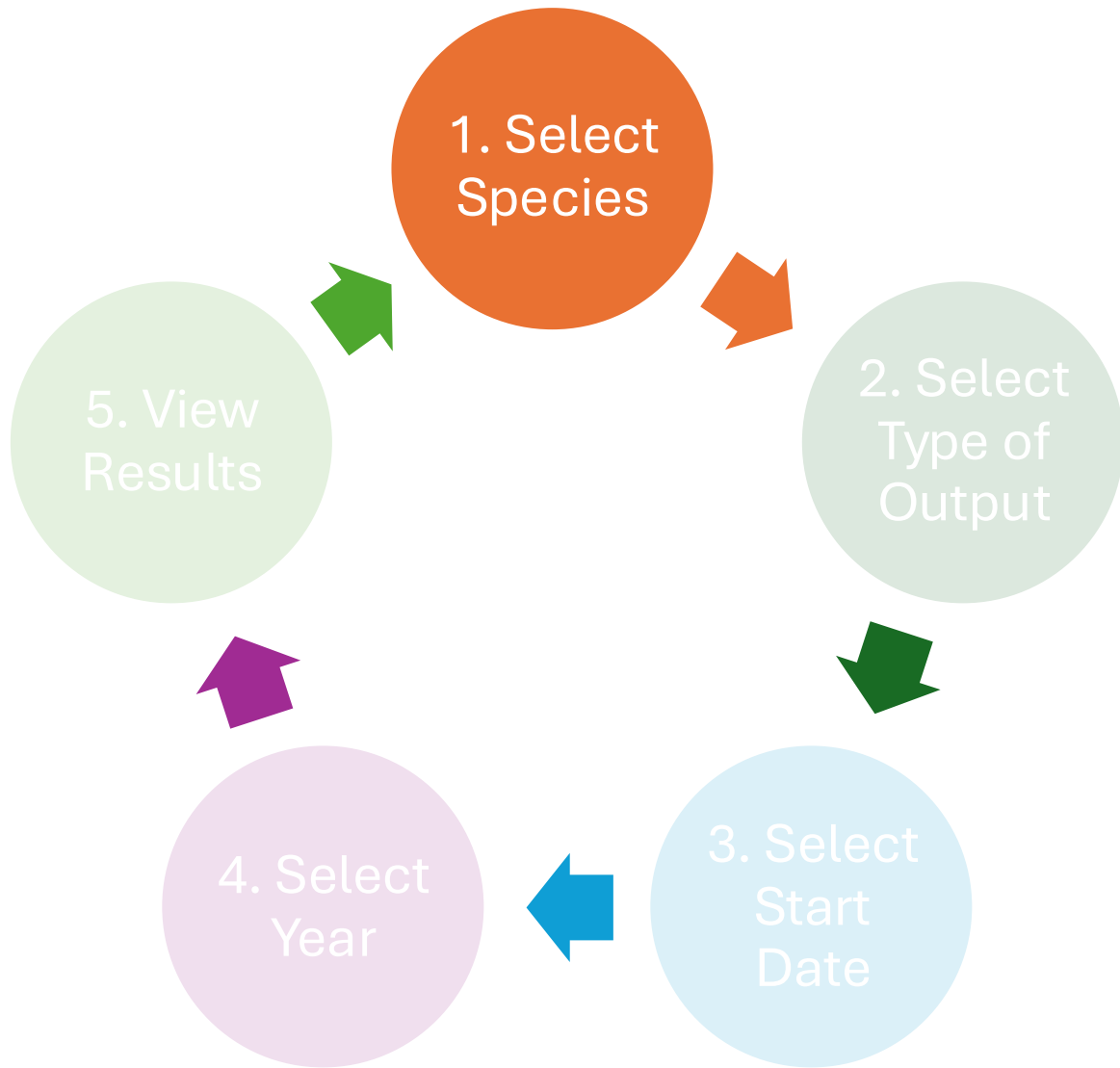


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Example of a typical workflow





1. Select Species

Select species from the dropdown menu on the left hand side

The species are ordered alphabetically

Species User Defined

Species ⓘ

Halyomorpha halys ▾

Halyomorpha halys

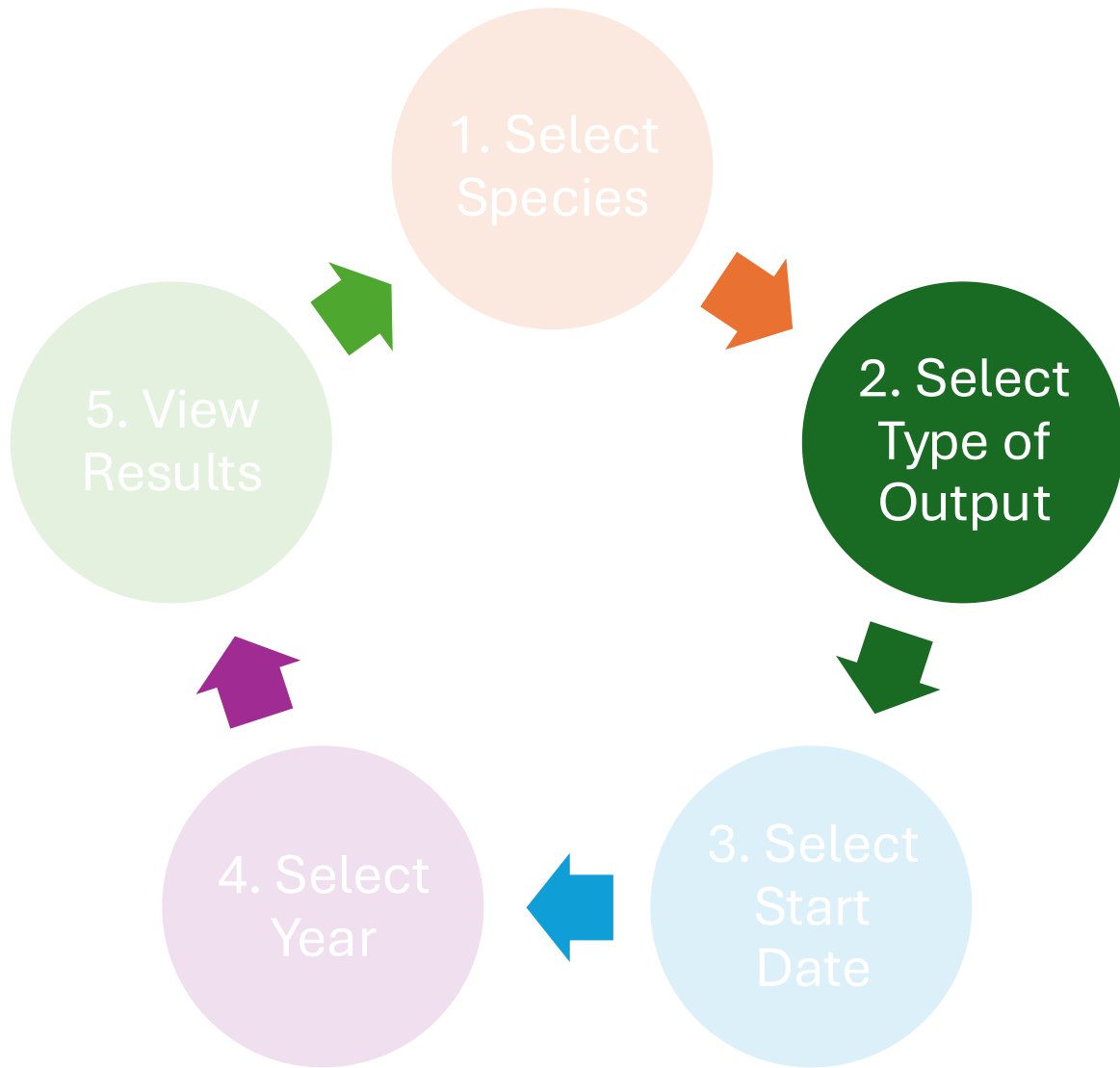
Ips cembrae

Ips duplicatus

Ips sexdentatus

Ips typographus

Leptinotarsa decemlineata

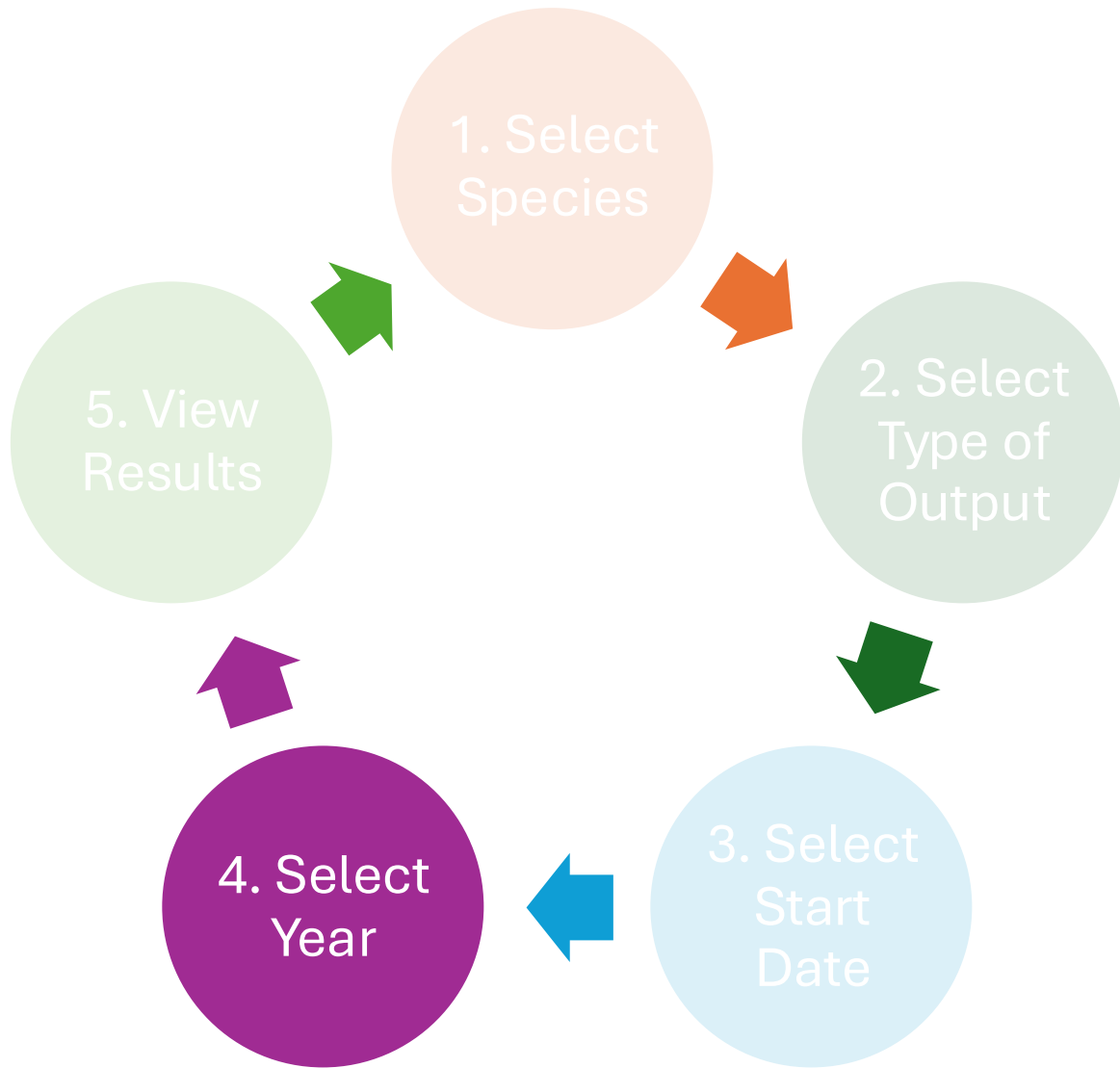


2. Select Type of Output

There are three choices of output:

- Yearly
- 30 Year Average
- Future Climate Projections





4. Select Year

Select year from the slider
The most recent year is the default

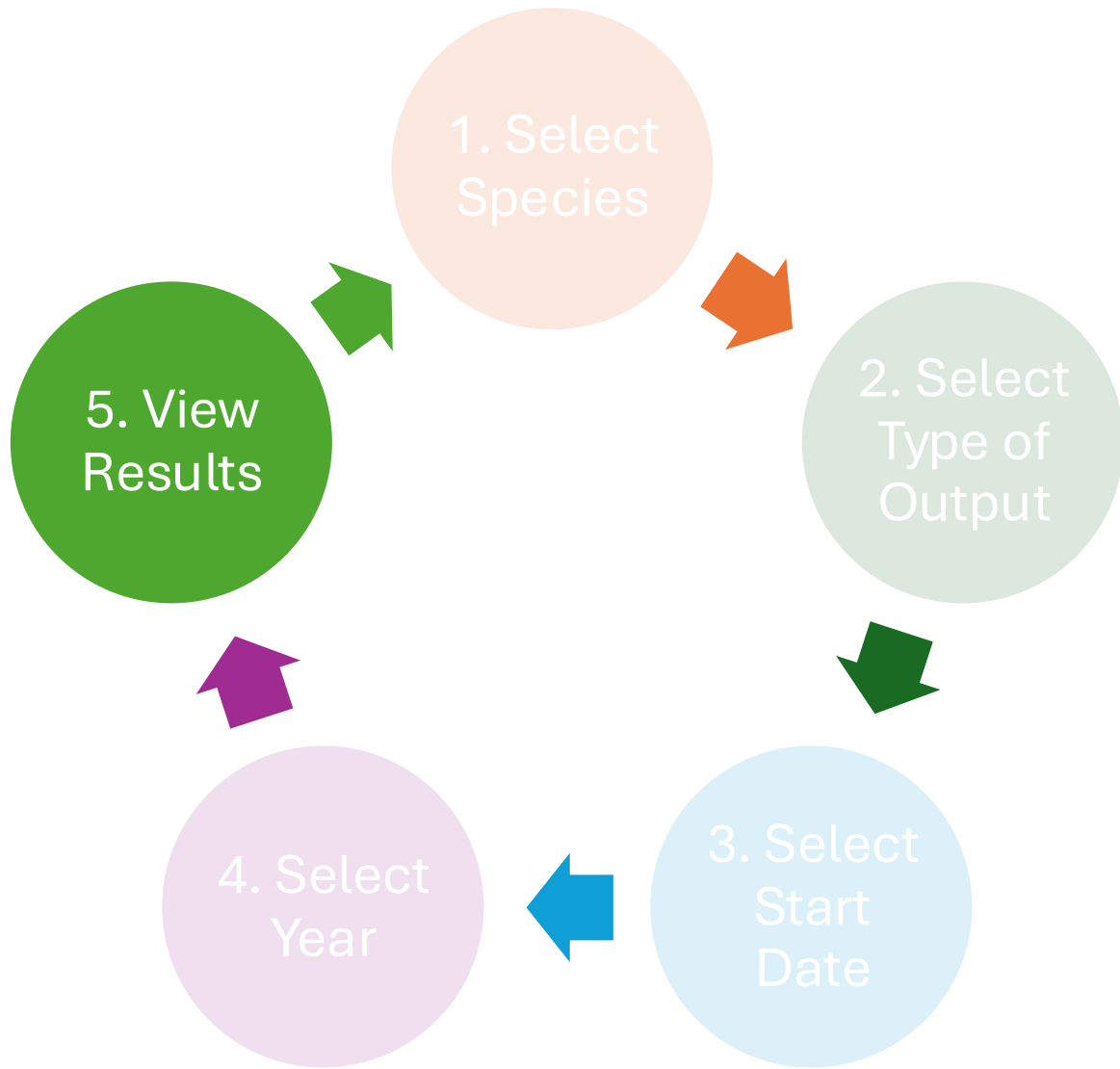
Yearly 30 Year Average (1991 - 2020) Future Climate Projections

Start Date ⓘ
1st of Jan

○ —————
Jan Apr Jul Oct Dec

Year ⓘ
2024

—————○
1991 2024

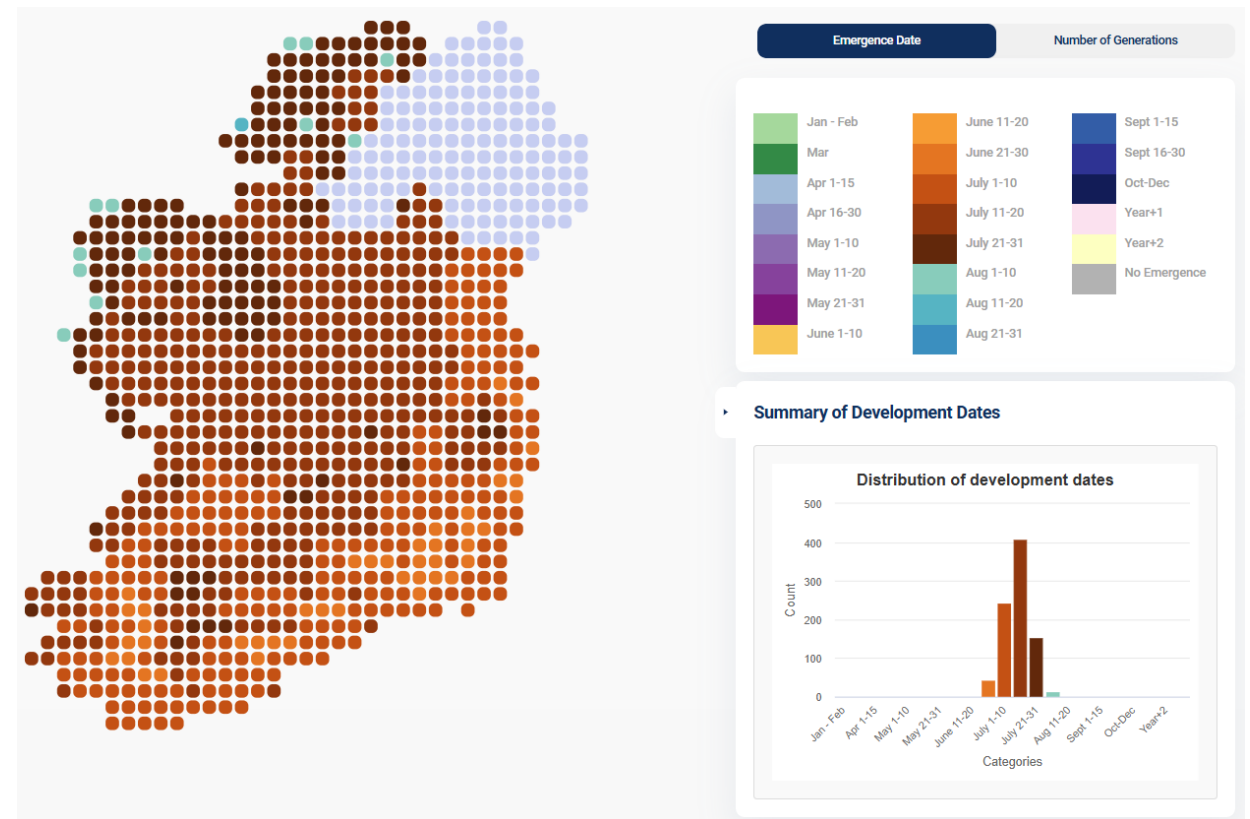


5. View Results

From here one may view the following:

- The emergence date (pictured below)
- The number of generations
- The anomaly for each of these

These results may also be exported



Using the Pest Risk Tool

Sections

1. Home Page Guide
2. Selecting Model Output
3. Yearly Historical Climates
4. 30 year Climate Normals
5. Future Climates
6. User Defined Species
7. Data Export

1. Home Page Guide

The image shows a screenshot of the MET eReconn website interface with several callout boxes pointing to specific features. The interface includes a top navigation bar with links for Forecasts, Latest Reports, Climate, Education, Science, Podcasts, and About. The main content area is divided into a left sidebar with controls, a central map, and a right sidebar with data visualizations.

Left Sidebar Controls:

- User Guide:** A button labeled "View Instructions".
- To select a species:** A "Species" dropdown menu currently showing "Agnilus anxius".
- Variables used in each model:** "Temperature Baseline" set to 1.7°C and "Degree day threshold" set to 1004.0.
- To change the climate data:** A "Yearly" tab selected, with "30 Year Average" and "Future Climate Projections" options.
- Sliders to change the start date of the model & the year:** "Start Date" set to "1st of Jan" and "Year" set to "2024".
- To view each year as an anomaly:** A "View as an anomaly" checkbox.
- Export data section:** An "Export Data" button with a "Graph.csv" link.

Central Map:

- 10 KM gridded map:** A map of the United Kingdom overlaid with a 10 km grid. The grid cells are colored based on emergence dates, with a color gradient from purple (earlier) to yellow (later).

Right Sidebar Visualizations:

- To select the Emergence Date Summary & the Number of Generations:** A section with tabs for "Emergence Date" and "Number of Generations".
- Legend shows the 10 day appearance of a species:** A color-coded legend for 10-day intervals. The legend includes categories for months (Jan-Feb, Mar, Apr 1-15, Apr 16-30, May 1-10, May 11-20, May 21-31, June 1-10, June 11-20, June 21-30, July 1-10, July 11-20, July 21-31, Aug 1-10, Aug 11-20, Aug 21-31) and "Number of Generations" (Sept 1-15, Sept 16-30, Oct-Dec, Year+1, Year+2, No Emergence).
- Histogram shows the count of emergence data that appear on this in 10 day intervals:** A bar chart titled "Distribution of development dates" showing the count of emergence events for each 10-day interval. The x-axis categories are the same as the legend, and the y-axis is labeled "Count".

Quiescence example

2. Selecting Model Output

The parameters for each of the species models differ depending on the overwintering cycles:

- Quiescence (Temperature Baseline & Degree Day Threshold)
- Obligative Diapause (Temperature Baseline, Degree Day Threshold & Photoperiod)
- Facultative Diapause (Temperature Baseline, Degree Day Threshold, Photoperiod & Temperature Threshold)

This differs from species to species

Links to the reference publications, DAFM fact sheet and EPPO fact sheet (if available) are in the info box for the species (click on the “Species **i**” icon).

The screenshot shows the MET eReconn interface for the Quiescence model. The interface includes a 'View Instructions' button, a 'Species' dropdown menu (currently set to 'Agrilus anxius'), and a 'User Defined' button. Below the species selection, there are two input fields: 'Temperature Baseline' (1.7°C) and 'Degree day threshold' (1004.0). The 'Temperature Baseline' field has an information icon (i) next to it. Below these fields, there are tabs for 'Yearly', '30 Year Average', and 'Future Climate Projections'. The 'Yearly' tab is selected, showing a 'Start Date' of '1st of Jan' and a 'Year' of '2024'. There is also a 'View as an anomaly' checkbox. At the bottom, there is an 'Export Data' section with a 'Graph.csv' button. Three annotations are present: one pointing to the 'Species' dropdown menu, one pointing to the 'Temperature Baseline' and 'Degree day threshold' fields, and one pointing to the 'Species i' icon.

To select a species

Parameters used in each template model differ depending on the overwintering cycle

The i icon gives the publication references used for the variables in the model & links to information sheets from DAFM & EPPO

2. Selecting Model Output Overview

Growing degree day models are used in the IPEM tool to predict developmental timings from Egg to Adult. The tool uses the triangle method to calculate growing degree days from daily maximum and minimum temperatures.

The IPEM tool also includes three models for overwintering.

- **Quiescence (no overwintering).**
 - Development continues throughout the year if temperatures are high enough
- **Obligate (overwintering determined by daylength)**
 - Development stops when daylength drops below a critical threshold
- **Facultative (overwintering determined by day length and daily temperature)**
 - Development stops when daylength drops below a critical threshold and daily mean temperature drops below a critical threshold

3. Yearly Historical Climates

The ability to change the yearly climate data from 1991:2024 for each 1km grid location.

The start date for each model is the 1st day of each month and the model will extend for up to 4 years. This was done as some species may not appear within a single season and could appear the subsequent year.

View as anomaly; will show the difference in the individual years to the most recent climate normal (1991:2020 climate normal).

The screenshot shows the MET Éireann web interface for configuring climate data. The interface includes a header with the MET Éireann logo and the text 'The MET Meteorological Service'. Below the header, there is a 'View Instructions' button. The main configuration area is divided into several sections: 'Species' (set to 'User Defined' and 'Agrilus anxius'), 'Temperature Baseline' (set to 1.7°C), 'Degree day threshold' (set to 1004.0), 'Yearly' (selected), '30 Year Average (1981-2010)', and 'Future Climate Projections'. The 'Start Date' is set to '1st of Jan' with a slider for months (Jan, Jul, Dec). The 'Year' is set to '2024' with a slider from 1991 to 2024. There is a checkbox for 'View as an anomaly' which is currently unchecked. At the bottom, there is an 'Export Data' section with a 'Graph.csv' button. Four callout boxes with arrows point to specific elements: 'To change the climate data' points to the 'Species' section, 'Slider to change the start date of the model' points to the 'Start Date' slider, 'Slider to change year of the model' points to the 'Year' slider, and 'To select View as Anomaly' points to the 'View as an anomaly' checkbox.

3. Yearly Historical Climates

The output for the Republic of Ireland is visualised on a 10km grid. The results shown for each 10km square is a “worst case” for all the 1km grids within the 10km square (i.e the earliest emergence date and the highest number of generations).

The output on a 1km grid is available by clicking on the respective circle for county.

Results are visualised using a colour scale, and a histogram showing the number of grid squares with different emergence dates/number of generations

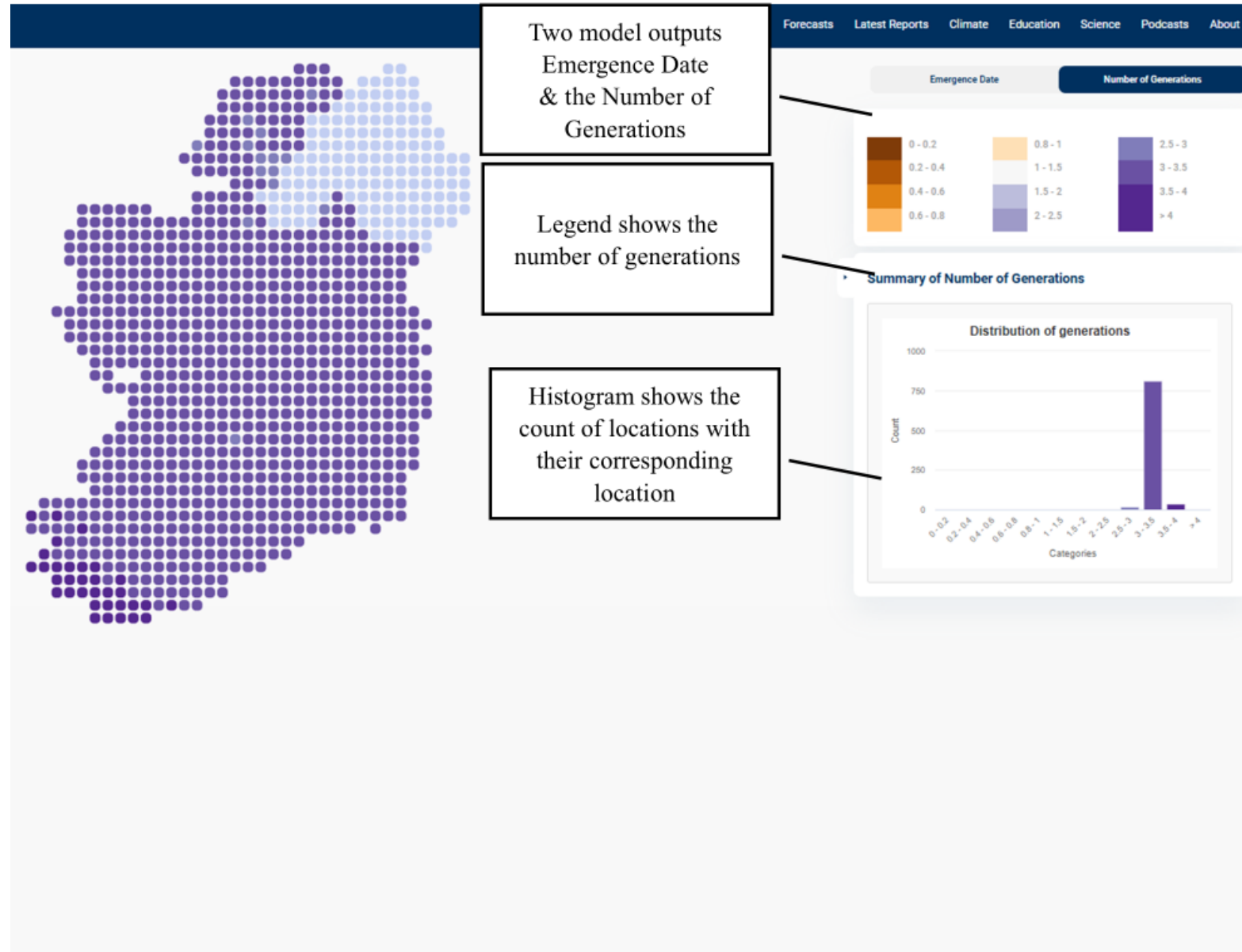


3. Yearly Historical Climates

The Number of Generations gives the number of completed generations that are predicted to emerge in the first year.

The histogram shows the count of locations with the respective number of generations.

The output on a 1km grid is available by clicking on the respective circle for county



3. Yearly Historical Climates

The Number of Generations states the number of completed generations that are predicted to emerge that year in total. The histogram below shows the count of locations with the respective number of generations.

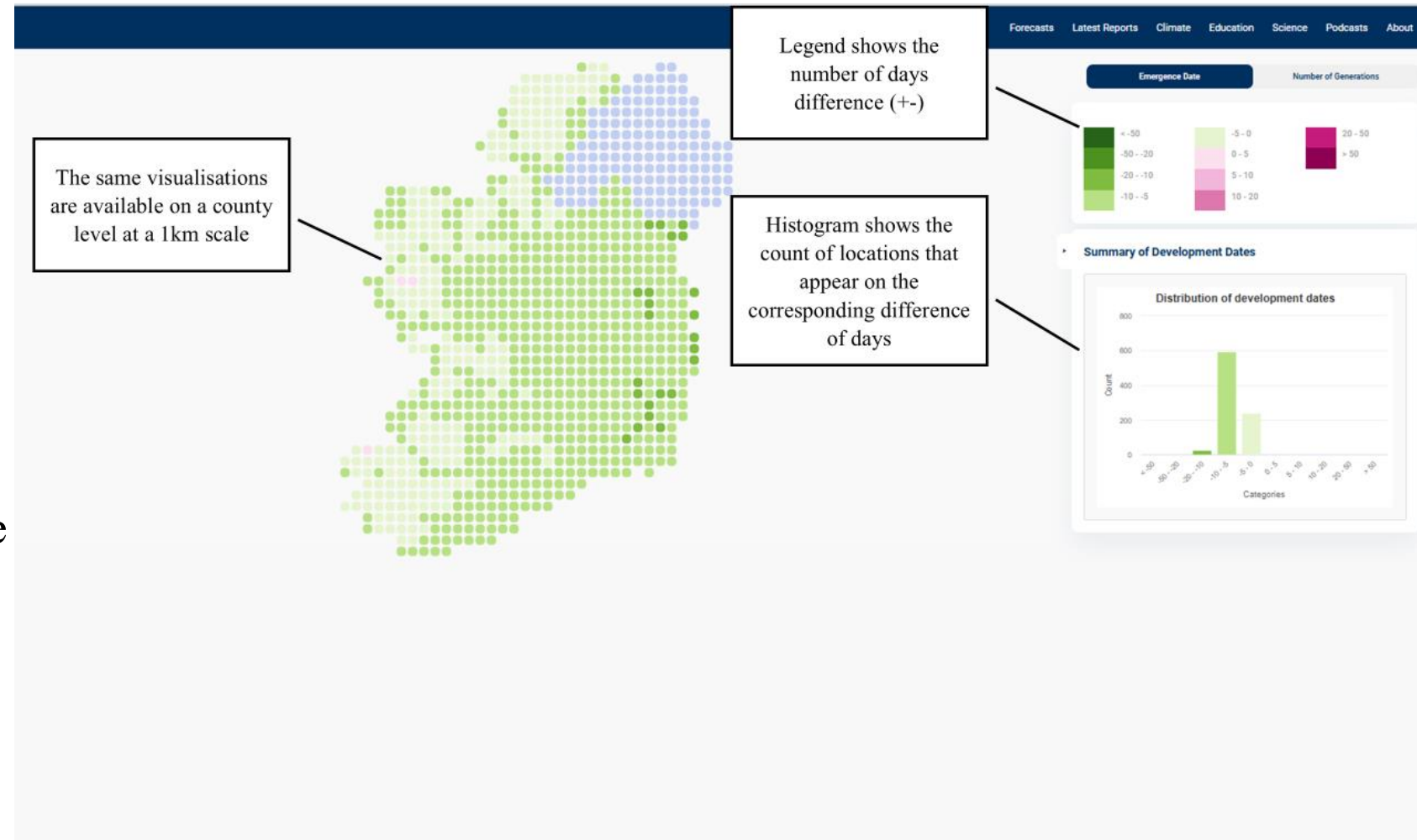
The output on a 1km grid is available by clicking on the respective circle for county



3. Yearly Historical Climates

View as anomaly; will show the difference in the individual years to the most recent 30 year climate average (1991-2020).

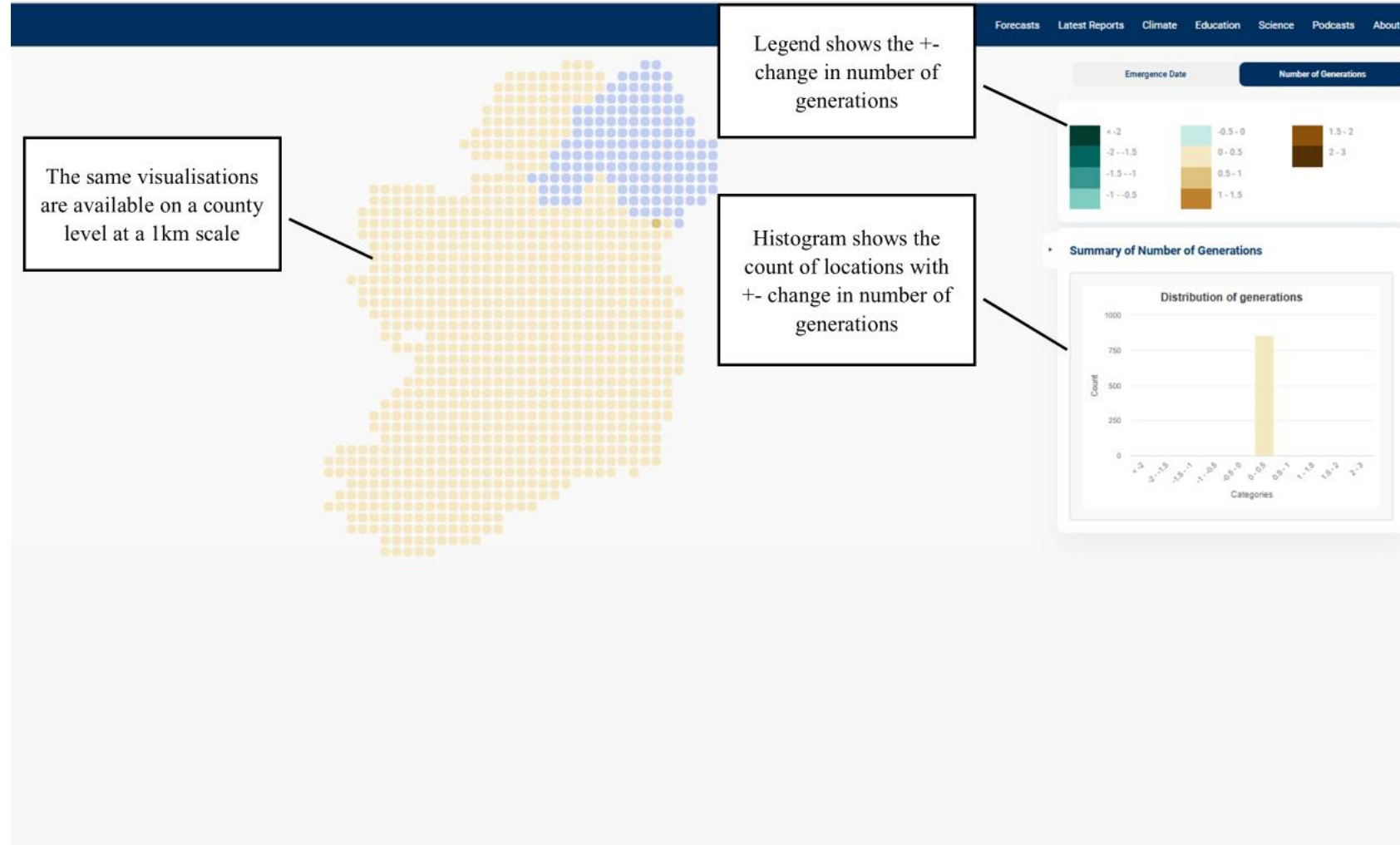
The output on a 1km grid is available by clicking on the respective circle for county



3. Yearly Historical Climates

View as anomaly; will show the difference in the individual years to the most recent 30 year climate average (1991-2020).

The output on a 1km grid is available by clicking on the respective circle for county



3. Selecting Model outputs – 30 year climate normal

4. 30 year Climate Normals

The 30 year climate average is the mean emergence date and mean number of generations for each 1 km across 1991 - 2020.

The start date can be changed in this instance.

The screenshot displays the MET Eriocann web application interface. The left sidebar contains configuration options: 'Species' (Agrilus anxius), 'Temperature Baseline' (1.7°C), 'Degree day threshold' (1004.0), 'Start Date' (1st of Jan), and 'Export Data' (Sash.csv). The main area features a map of the UK with a 1km grid of colored dots representing model outputs. A callout box points to the map with the text: 'The same visualisations are available on a county level at a 1km scale'. Another callout box points to the 'Start Date' field with the text: 'Change the start date'. On the right, a 'Number of Generations' legend shows color-coded ranges from 0-0.2 to >4. Below the legend is a bar chart titled 'Distribution of generations' showing the count of locations for each generation category. A callout box points to the legend with the text: 'The same visualisations are available as the past climate data'. The top navigation bar includes links for 'Forecasts', 'Latest Reports', 'Climate', 'Education', 'Science', 'Podcasts', and 'About'.

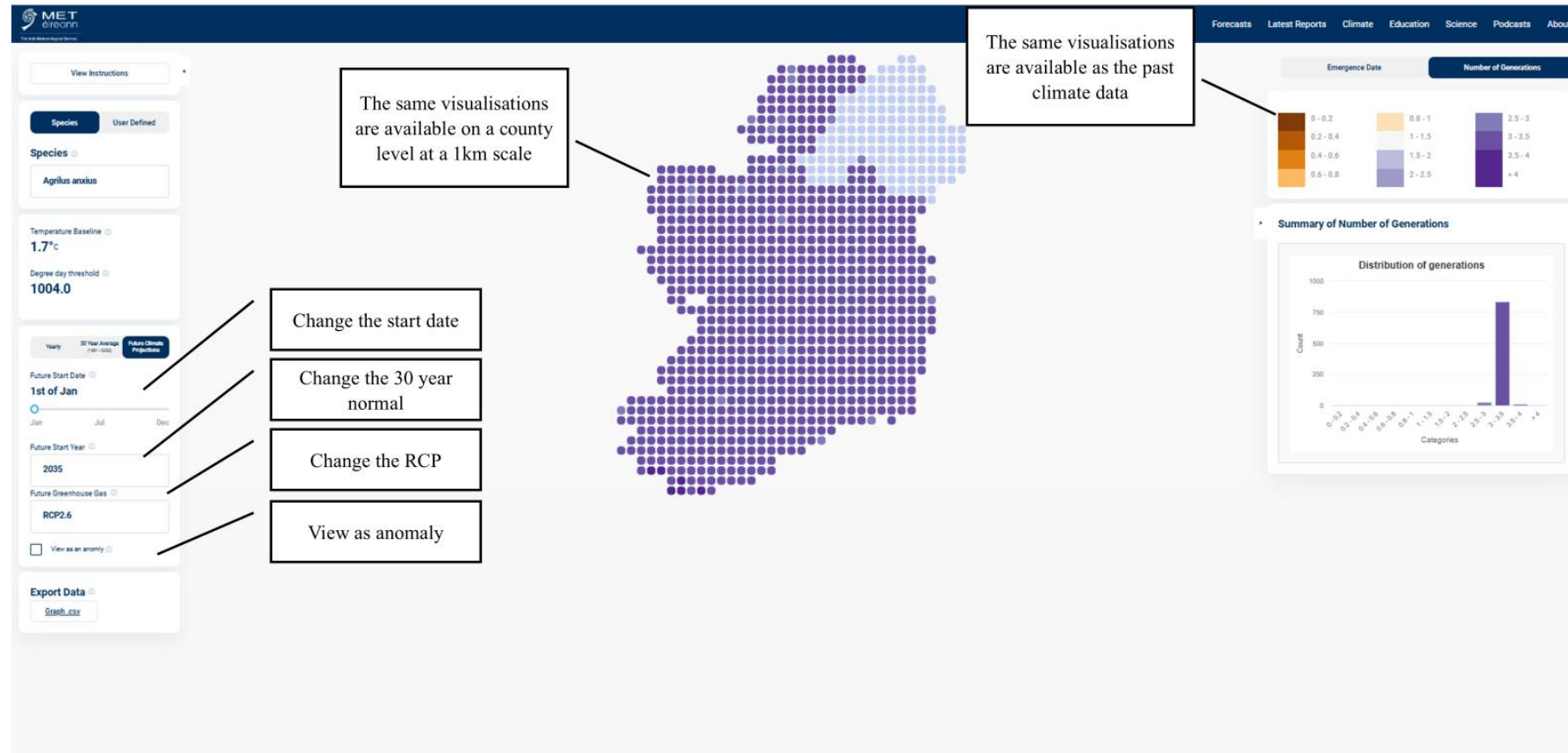
5. Future Climates

Within this section, one can select two thirty-year future climate projections 2020:2050 & 2040:2070.

For each future climate projections, one can select the Representative Concentration Pathway (RCP) 2.6, 4.5 and 8.5.

The start date can be changed

The anomaly in this instance is the difference to the 1991-2020 30 year climate average.



6. User Defined Species

Within this tab: you can adjust

- Temperature Baseline in 1-degree increments from 0 to 12°C
- degree day threshold in 50 degree increments from 0 to 1000 degree days.

This may be used to define stages of development and/or species not defined within the models

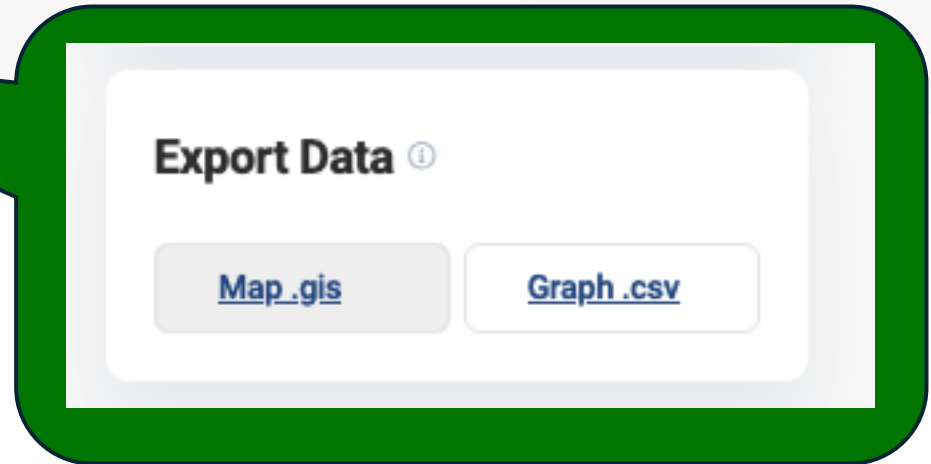
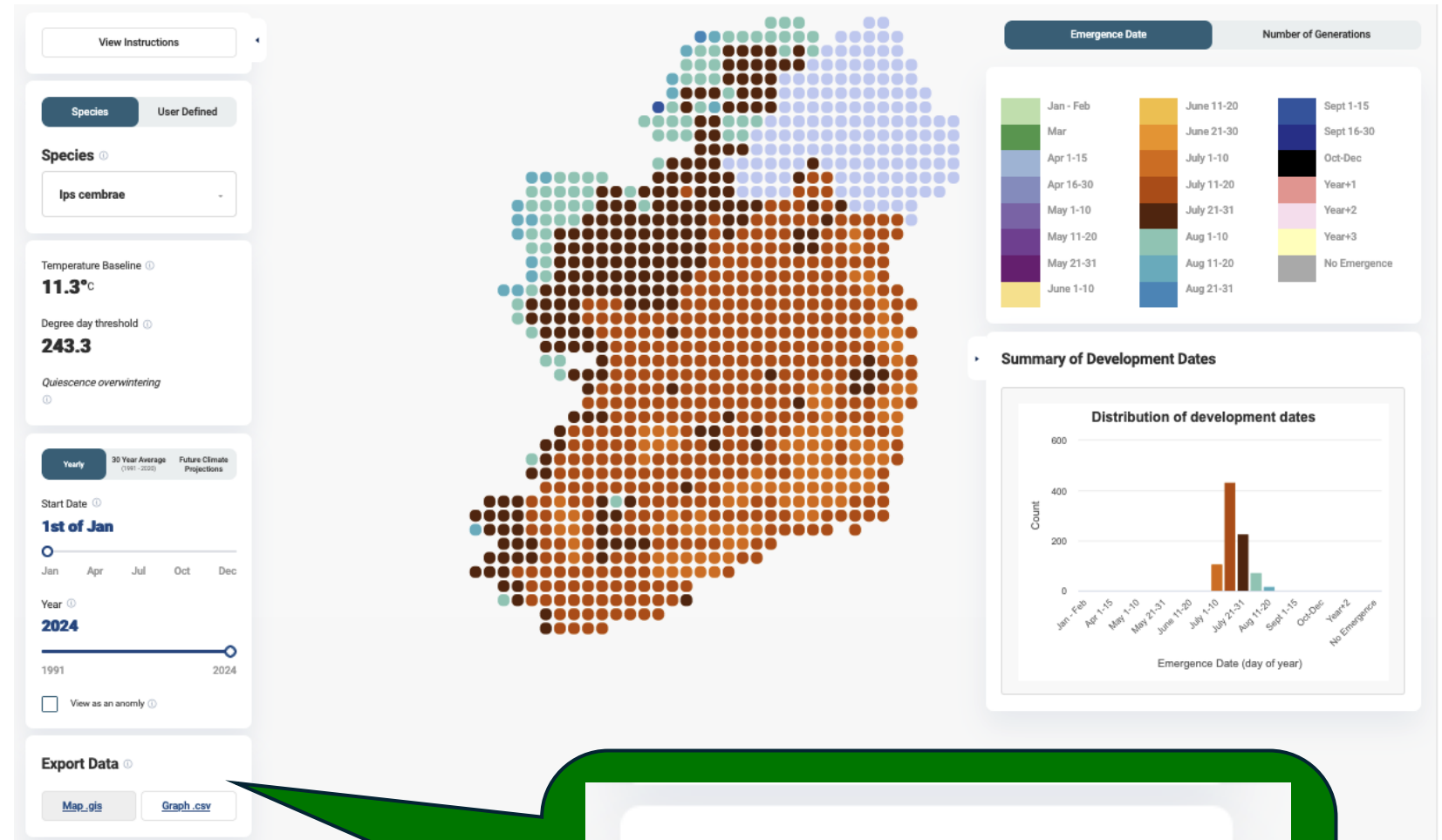
All these used-defined models use a quiescent overwintering model

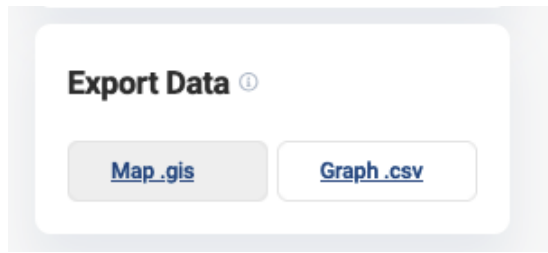
The screenshot displays the MET ecoin interface. On the left, the 'User Defined' tab is active, showing settings for Temperature Baseline (0°C), Degree day threshold (600), Start Date (1st of Jan), and Year (2024). Callout boxes point to these settings with labels: 'Adjust the Baseline Temperature', 'Adjust the Threshold', 'Change the start date', 'Slider to change year of the model', and 'To view as an anomaly'. The 'Export Data' section shows a 'Download CSV' button. In the center, a map of Ireland is shown with a grid of colored dots representing data points. A callout box points to the map with the text: 'The same visualisations are available on a county level at a 1km scale'. On the right, a 'Summary of Number of Generations' section features a bar chart titled 'Distribution of generations' showing the count of generations for various categories. A legend above the chart shows color-coded ranges for Emergence Date and Number of Generations.

7. Data Export

The IPEM data can be downloaded in two formats:

1. **Map.gis**: a geoTIFF file. This file can be imported into any GIS software (Click on “Map.gis” button)
2. **Graph.csv**: a comma separated variable (CSV) file. This file can be imported into any spreadsheet or statistical software package.





7. Data Export (Map.gis)

The geoTIFF file can be downloaded by clicking on the Map.gis button.

The file contains a GIS raster data with 7 bands.

- Band 1, 3, 5: Day of year of pest emergence (band 1: specific year, band 3: 30 year average, band 5: anomaly)
- Band 2, 4, 6: Number of pest generations (band 1: specific year, band 3: 30 year average, band 5: anomaly)
- Band 7: County boundaries

The file uses the [TM75 / Irish Grid \(EPSG:29903\)](#) coordinate reference system.

All data are at a 1km spatial resolution

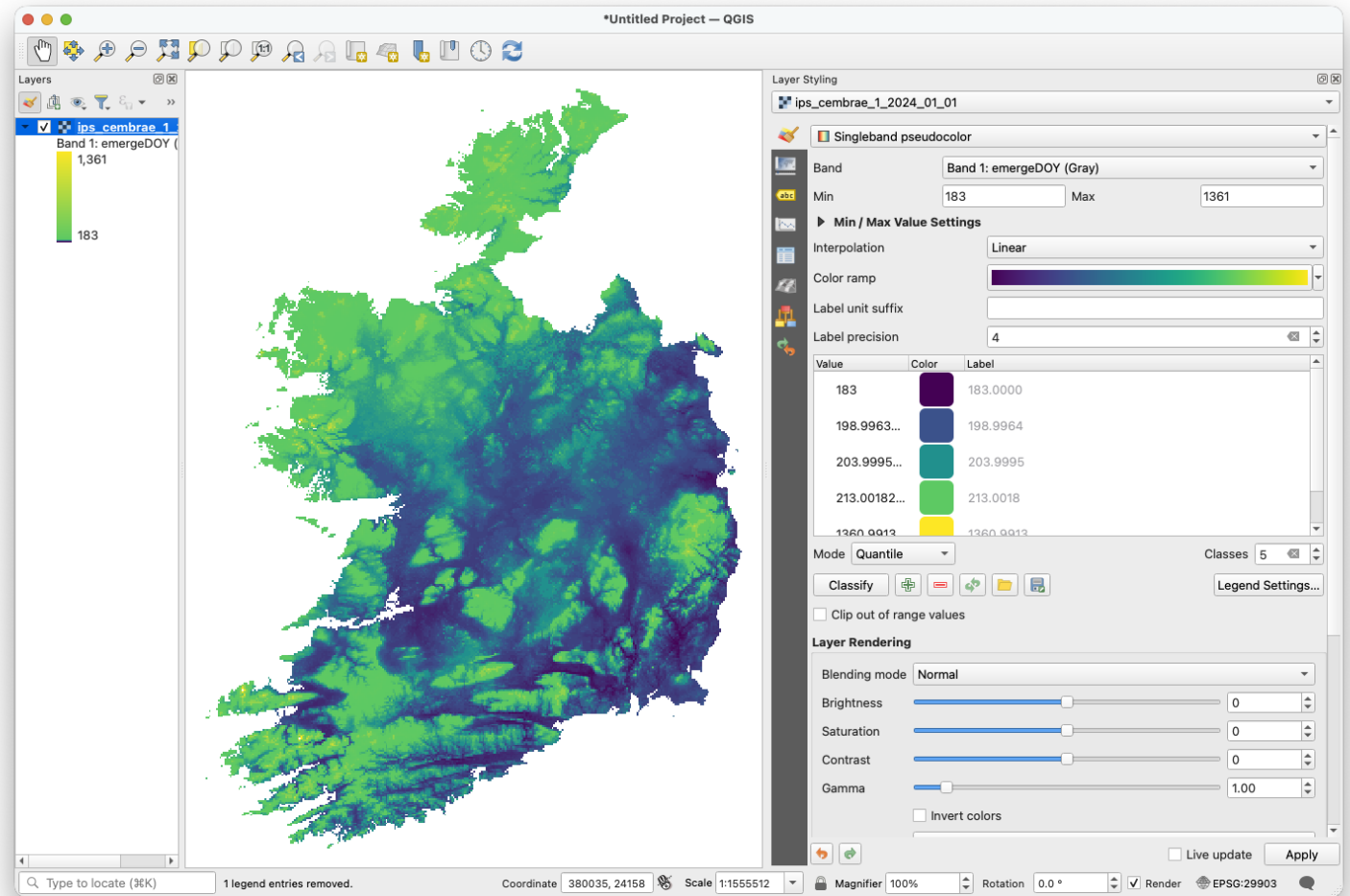
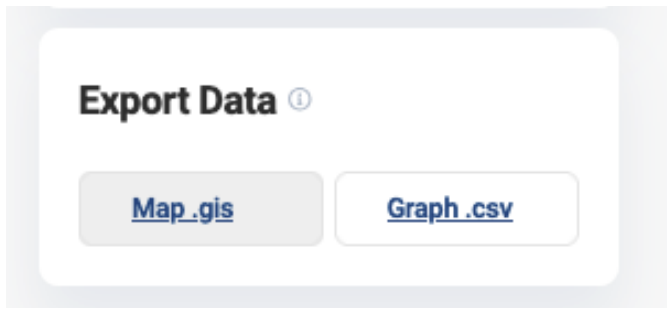


Figure: A geoTIFF file being visualised in QGIS software. The data being visualised is the emergence day of year for *Ips cembrae* for with a start date of 1st Jan 2024



7. Data Export (Graph.csv)

The CSV file can be downloaded by clicking on the Graph.csv button. The CSV file will contain the data being visualised by the IPEM webtool.

10km scale data:

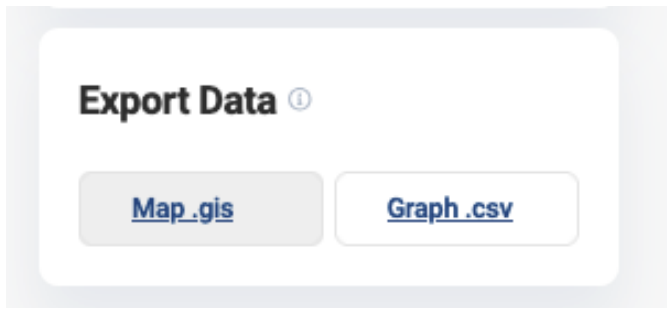
If the Republic of Ireland is being viewed, the CSV file will contain data at a 10km spatial scale.

The file has 10 variables (10 columns). An example is shown in the figure.

Spatial coordinates use [the Irish Grid Reference \(TM75, EPSG 29903\)](#)

	A	B	C	D	E	F	G	H	I	J
1	hectad	startDate	emergeDOY	emergeDOY_30yr	emergeDOY_anomaly	emergeDate	emergeDate_30yr	nGen	nGen_30yr	nGen_anomaly
2	V26	01/01/2024	219	210	9	06/08/2024	28/07/2024	2.27	2.32	-0.05
3	V29	01/01/2024	232	219.5	12.5	19/08/2024	07/08/2024	1.45	1.48	-0.03
4	Q20	01/01/2024	221	209	12	08/08/2024	27/07/2024	2.24	2.31	-0.07
5	Q30	01/01/2024	218	207	11	05/08/2024	25/07/2024	2.24	2.34	-0.04
6	V39	01/01/2024	219	207	12	06/08/2024	25/07/2024	2.25	2.33	-0.03
7	V37	01/01/2024	218	207.5	10.5	05/08/2024	26/07/2024	2.25	2.33	-0.02
8	V36	01/01/2024	218	207.5	10.5	05/08/2024	26/07/2024	2.25	2.32	-0.04
9	Q31	01/01/2024	219	206.5	12.5	06/08/2024	24/07/2024	2.23	2.34	-0.06
10	V46	01/01/2024	214	204	10	01/08/2024	22/07/2024	2.27	2.36	-0.04
11	V47	01/01/2024	217	205.5	10	04/08/2024	24/07/2024	2.24	2.34	-0.03
12	Q40	01/01/2024	216	204	11.5	03/08/2024	22/07/2024	2.26	2.35	-0.04
13	Q41	01/01/2024	221	208	12	08/08/2024	26/07/2024	2.19	2.32	-0.04
14	V49	01/01/2024	217	205.5	11.5	04/08/2024	24/07/2024	2.25	2.34	-0.09
15	V48	01/01/2024	215	204	10.5	02/08/2024	22/07/2024	2.27	2.36	-0.05

Figure: CSV file for IPEM data at 10km spatial scale with 10 variables, being viewed in Excel. Variables are: [hectad grid reference](#), start date, emergence day of year (specific year, 30 year average, anomaly), emergence date (specific year, 30 year average), number of generations (specific year, 30 year average, anomaly).



7. Data Export (Graph.csv)

The CSV file can be downloaded by clicking on the Graph.csv button. The CSV file will contain the data being visualised by the IPEM webtool.

1km scale data:

If a county in Ireland is being viewed, the CSV file will contain data at a 1km spatial scale.

The file has 10 variables (10 columns). An example is shown in the figure.

Spatial coordinates use the [Irish Grid Reference \(TM75, EPSG 29903\)](#)

	A	B	C	D	E	F	G	H	I	J
1	ID	eastings	northings	startDate	emergeDOY	emergeDOY_30yr	emergeDOY_anomaly	nGen	nGen_30yr	nGen_anomaly
2	21244	48000	264000	01/01/2024	233	221	12	1.44	1.49	-0.06
3	22245	49000	265000	01/01/2024	232	221	11	1.44	1.5	-0.05
4	24246	51000	266000	01/01/2024	225	213	12	1.51	1.62	-0.11
5	25245	52000	265000	01/01/2024	225	213	12	1.51	1.91	-0.4
6	26221	53000	241000	01/01/2024	220	208.5	11.5	2.19	2.27	-0.08
7	26235	53000	255000	01/01/2024	225	213	12	1.51	1.63	-0.12
8	26245	53000	265000	01/01/2024	224	213	11	1.53	2.05	-0.52
9	26246	53000	266000	01/01/2024	232	220.5	11.5	1.44	1.5	-0.06
10	27245	54000	265000	01/01/2024	225	213	12	1.51	1.63	-0.11
11	27246	54000	266000	01/01/2024	227	215	12	1.5	1.57	-0.07
12	28237	55000	257000	01/01/2024	220	208	12	2.12	2.28	-0.16
13	28238	55000	258000	01/01/2024	221	209.5	11.5	1.83	2.27	-0.43
14	28245	55000	265000	01/01/2024	224	213	11	1.51	1.69	-0.18
15	28246	55000	266000	01/01/2024	223	211	12	1.58	2.22	-0.65
16	28247	55000	267000	01/01/2024	225	213	12	1.51	1.6	-0.09
17	29223	56000	243000	01/01/2024	222	210	12	1.55	2.21	-0.66
18	29233	56000	253000	01/01/2024	219	208.5	10.5	2	2.27	-0.27
19	29235	56000	255000	01/01/2024	220	208.5	11.5	2.1	2.28	-0.18

Figure: CSV file for IPEM data at 1km spatial scale with 10 variables, being viewed in Excel. Variables are: unique ID for each 1km square, eastings and northing of the 1km square (bottom-right corner), start date, emergence day of year (specific year, 30 year average, anomaly), number of generations (specific year, 30 year average, anomaly).