CRISP:
Climate Risk Index from Space Platforms

Telespazio UK & Assimila

Funded by:

Background

- **Telespazio UK** & **Assimila** are part of the **Space4Climate** Climate Risk Disclosure Task Group
- Exploring how the UK space sector can support the **green finance sector** in making climate informed decisions and disclosures.
- Engagement with the finance sector (Chartered Banker Institute, European Actuarial Climate Index working group) has highlighted interest in **climate indicators** that focus on extreme climate conditions.
- Initial funding was secured through the Space4Climate Task Group for development of an initial demonstrator.
- Additional funding from **UKSA** has enabled the prototype development of the **Climate Risk Index from Space Platforms (CRISP).**

CRISP
Climate Risk Indices from Space Platforms

TELESPAZIO
a LEONARDO and THALES company

Assimila

CRISP: Why is it useful?

- Provides access to quality assured, world leading climate data
- Enables analysis of our changing climate and extreme weather events
- Provides data synthesised by climate experts in a form useful to end users

Met Office confirms highest temperature ever recorded in the UK

ENVIRONMENT 30 July 2019 — NewScientist

'It's like a war': Greece battles increase in summer wildfires

Thu 30 Sep 2021 12.18 BST

Prevention and suppression are crucial as climate change creates stronger heatwaves, say experts

The Guardian

NEWS

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Extreme weather is new normal, as 2021 becomes among hottest on record

UN releases figures showing world is 'changing before our eyes'

31 October 2021 • 8:39pm — The Telegraph

Scotland 'breaks temperature record'

2 July 2018 — BBC

United Nations | UN News
Global perspective Human stories

Deadly flooding, heatwaves in Europe, highlight urgency of climate action

16 July 2021 | Climate and Environment

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CRISP: Why is it useful?

- CRISP data can support regulatory compliance for **climate mitigation** & **adaptation**
- Supports companies in making **climate risk disclosures**
- As customers become more '**climate aware**' they demand higher accountability
- Companies reporting on climate risk better enable action to be taken to move towards achieving the **European Green Deal** and **NetZero**

UK's biggest money manager warns on climate catastrophe

Simon Jack
Business editor
@BBCSimonJack

BBC

UK firms will have to disclose climate impact

By Beth Timmins
Business reporter, BBC News

BBC

Greening Finance:
A Roadmap to Sustainable Investing

October 2021

HM Government

FINANCIAL TIMES

Reputations at stake for asset managers as biodiversity concerns mount

Institutions are paying more attention to preserving natural habitats in their investment decisions

TheActuary™
The magazine of the Institute and Faculty of Actuaries

TCFD sees record growth in climate disclosures

Wednesday 20th October 2021

New Zealand becomes first country to force finance companies to act on climate risks

Thu 21 Oct 2021 06.30 BST

Country hopes to ensure effects of climate crisis are always considered in business, investment, lending and insurance decisions

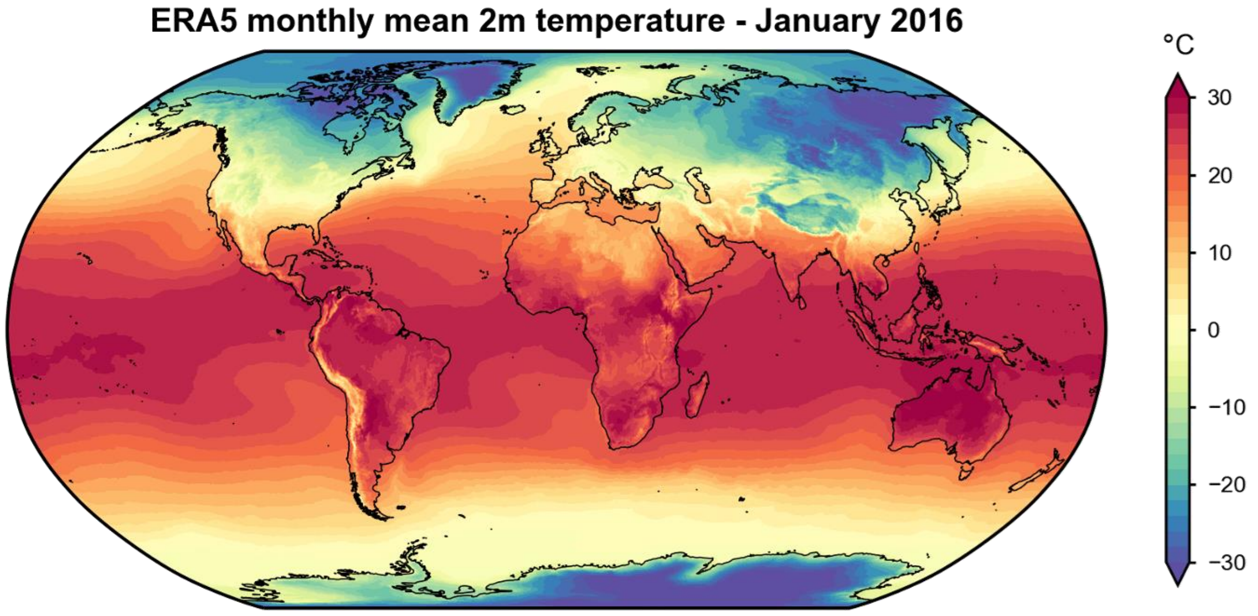
The Guardian

CRISP Tool

- Brings together quality assured **EO-based historical reanalysis** and **climate projection** datasets to generate **climate indices.**
- Aims to provide a **framework** where users can access different indices of interest.
- Enables users to get a **dynamic Climate Risk Index** for their location of interest.
- Will include a number of **use cases** to show companies how they could use the data in their own assessments.
- Flexible interface provides decision-ready information for **non-experts** while being fully customisable for **expert users**.

Input Data

- **Reanalysis data** (produced by combining models with observations)
  - Temperature (daily, 1979 to present)
  - Wind power (daily, 1979 to present)
  - Precipitation (daily, 1979 to present)
- **Satellite Earth Observation data**
  - Sea level (daily, 1993 to present)
- **Climate Projections**
  - Temperature (daily, 2015 to 2100)
  - Wind power (daily, 2015 to 2100)
  - Precipitation (daily, 2015 to 2100)

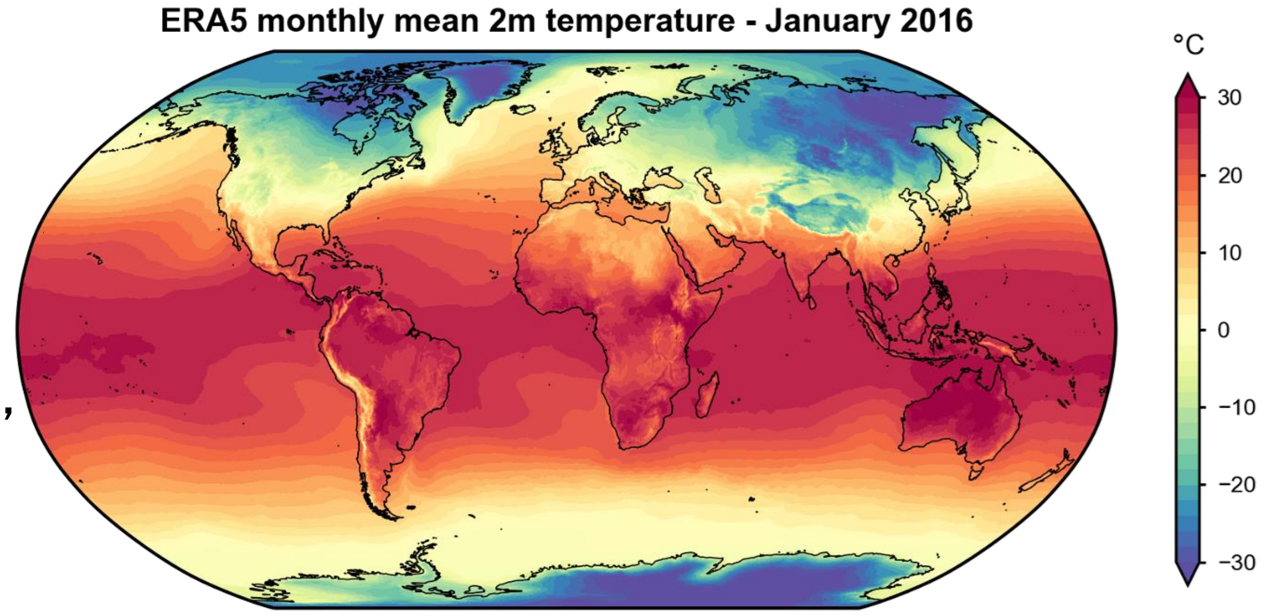


Source: Copernicus Climate Change Service

Input Data

ERA5 Reanalysis

- The 5th generation of ECMWF atmospheric reanalyses (ERA5)
- Combines vast amounts of **EO and in situ observations** into global estimates of climate variables using advanced modelling and data assimilation systems
- Provides **hourly estimates** of many atmospheric, land and oceanic climate variables
- Variables extend **from 1979 to a week from present** (recently extended back to 1950).
- Data cover the Earth on a **~30km grid** and resolve the atmosphere up to a height of 80km.

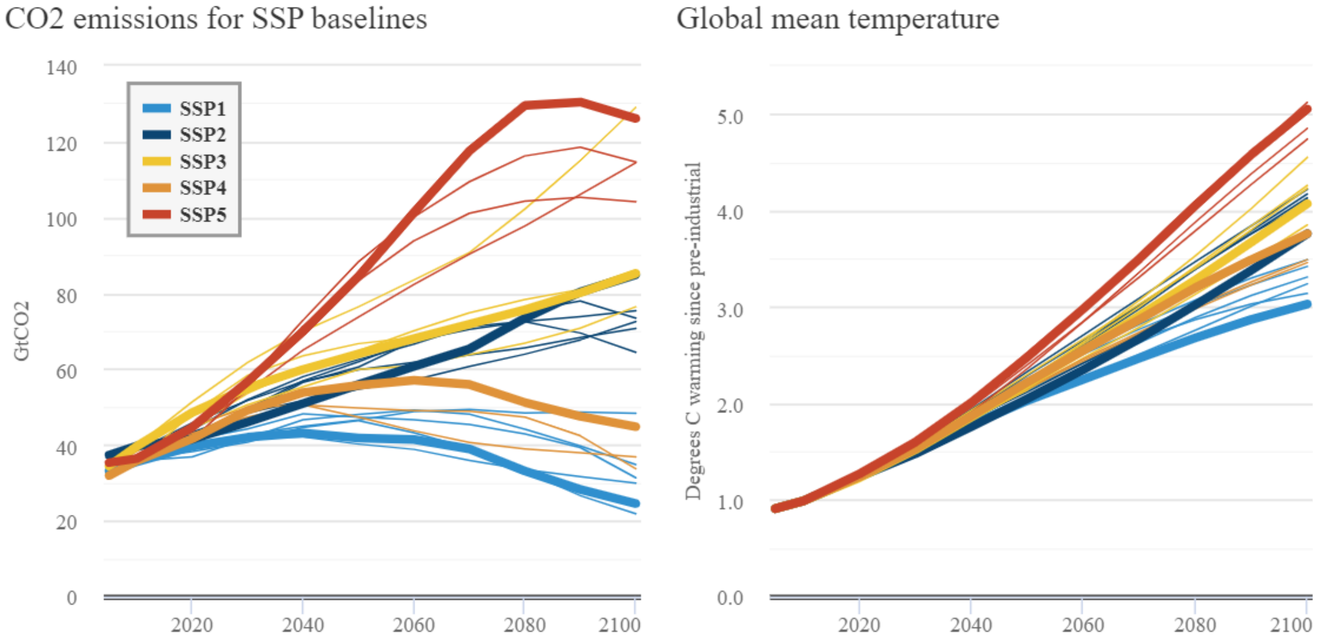


Source: Copernicus Climate Change Service

Input Data

CMIP6 Climate Projection

- The most recent and extensive set of climate projections
- Has a common set of future scenarios comprising land use and emissions as required for the future:
    - **Shared Socio-Economic Pathways (SSPs)**
    - **Representative Concentration Pathways (RCPs)**.
- CMIP6 data underpins the Intergovernmental Panel on Climate Change 6th Assessment Report.



Source: Carbon Brief (https://www.carbonbrief.org/)

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CRISP Climate Indices

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- **High temperatures** – Frequency of high temperature extremes
- **Low temperatures** – Frequency of low temperature extremes
- **Heavy rain** – Maximum 5-day rainfall in the month
- **Drought** – Maximum number of consecutive dry days
- **High wind** – Frequency of high wind speeds
- **Sea level** – Sea level anomalies on a monthly basis time series

These indices are combined to generate an **Actuaries Climate Index (ACI)**

CRISP Interface

CRISP
Climate Risk Indices from Space Platforms

Climate Risk Indices from Space Platforms (CRISP)

CRISP is a demonstrator aimed to determine climate indices, based on consistent identification of extreme climate events derived from different long-term data records of EO-based climate variables. The climate indices are developped based on the definitions provided for Actuaries Climate Index (**ACI**). The Actuaries Climate Index is intended to provide a useful monitoring tool, an objective indicator of the frequency of extreme weather. The CRISP interface provides informational graphics for those who wish to explore the ACI Index and its components.

Several sources of information have been used for generating the ACI. For the historical timescale, the fifth generation of ECMWF ReAnalysis dataset (**ERA5**) has been used. For the future timescale we have used 2 models from the sixth and latest Coupled Model Intercomparison Project (**CMIP6**) under three future scenarios, ranging from optimistic to pessimistic, specified as Shared Socio-economic Pathway (SSP). The indices below capture the changes in frequency of extreme climate events with respect to a reference time period (1981-2010).

All CRISP indices are expressed as standard deviations of anomalies, i.e. how far the monthly mean of the index departs from the reference. CRISP core components are:

- **High Temperatures (T90):** Monthly frequency of daily maximum temperatures above the 90th percentile of the reference time period
- **Low Temperatures (T10):** Monthly frequency of daily minimum temperatures below the 10th percentile of the reference time period
- **High Wind (WP90):** Monthly frequency of daily wind power above the 90th percentile of the reference time period
- **Drought (CDD):** Maximum number of consecutive days in a year with less than 1mm of daily precipitation (interpolated to monthly timesteps)
- **Heavy Rainfall (P):** Monthly maximum consecutive 5-day precipitation

The Actuaries Climate Index is then obtained by combining these components

$$ACI = mean(T90_{std} - T10_{std} + P_{std} + CDD_{std} + WP90_{std})$$

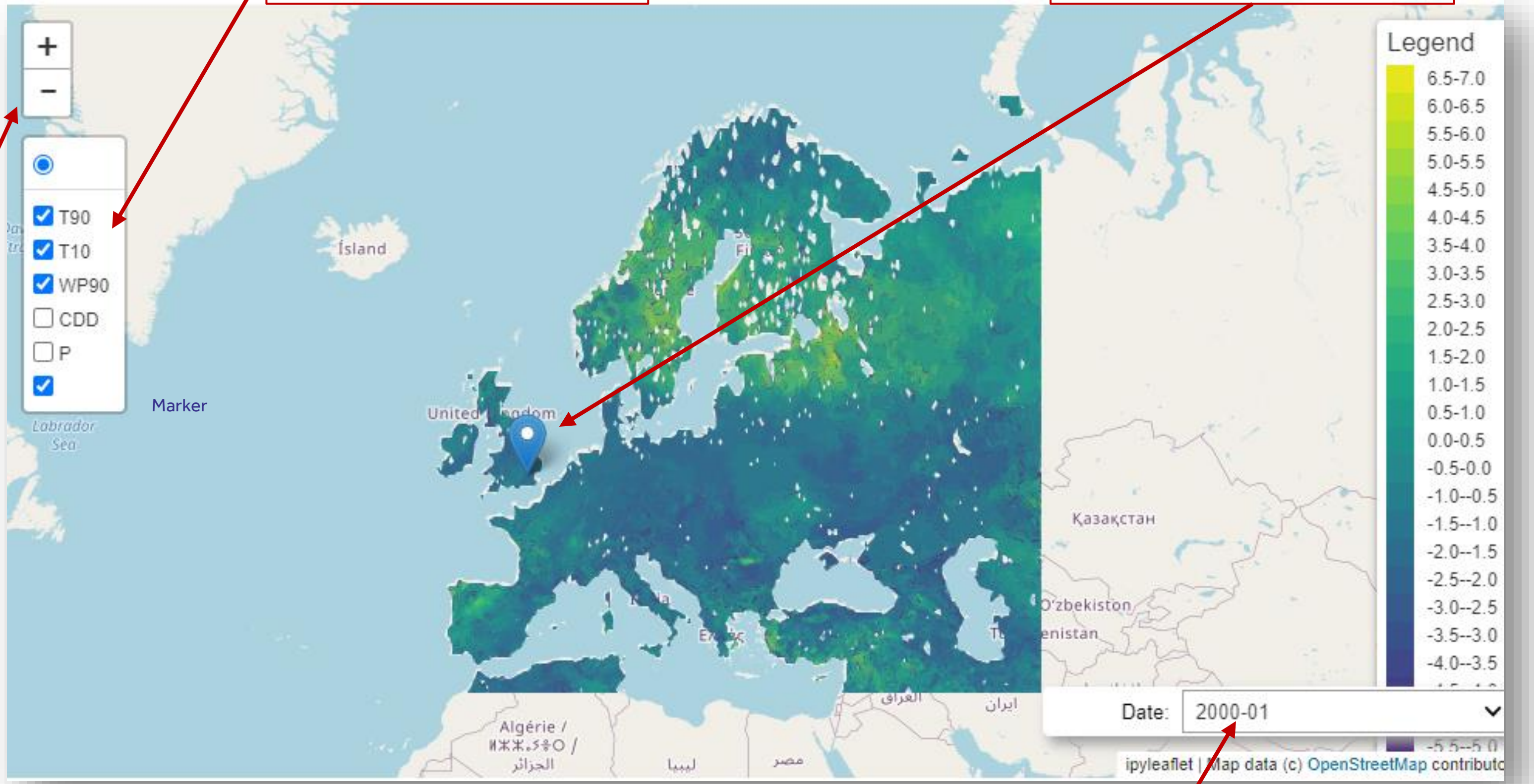
CRISP Interface

Interface Key Features:

- Fully dynamic map
- Integrated Leaflet JavaScript
- Dynamic markers
- Dynamic time series plots for selected markers

Layer Selection

Dynamic Markers



Dynamic Zoom

Month Picker

CRISP Interface

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Indices | ACI

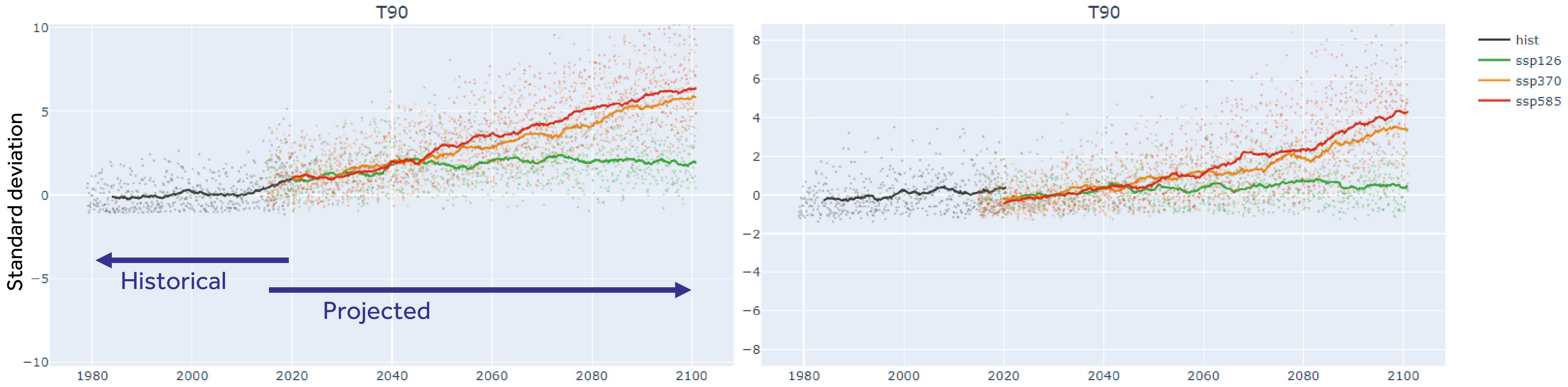
Extreme high temperatures (T90)

Frequency of temperatures above the 90th percentile

Climate indices timeseires for the selected markers

Black – historical data
Red – pessimistic
Orange – moderate
Green - optimistic

Marker 1 **Marker 2**

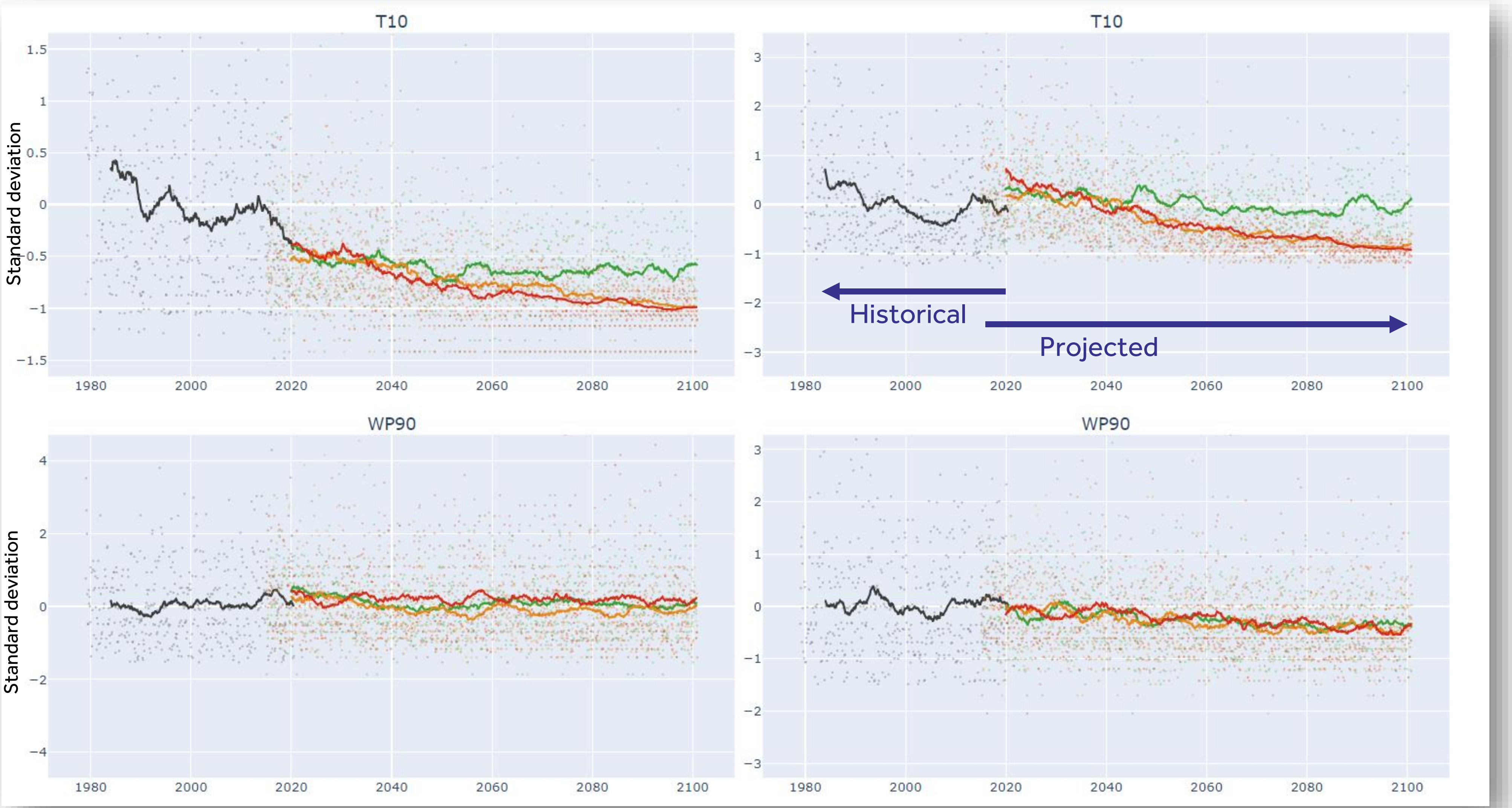


Example of historical and projected indices for Madrid (Marker 1) and Glasgow (Marker 2).

CRISP Interface

Extreme low temperatures (T10)
Frequency of temperatures below the 10th percentile

High wind power (WP90)
Frequency of wind power above the 90th percentile



CRISP Interface

Drought (CDD)
Maximum no. of consecutive dry days (<1 mm rain)

Extreme rainfall (P)
Maximum five-day precipitation in a given month

CRISP Interface

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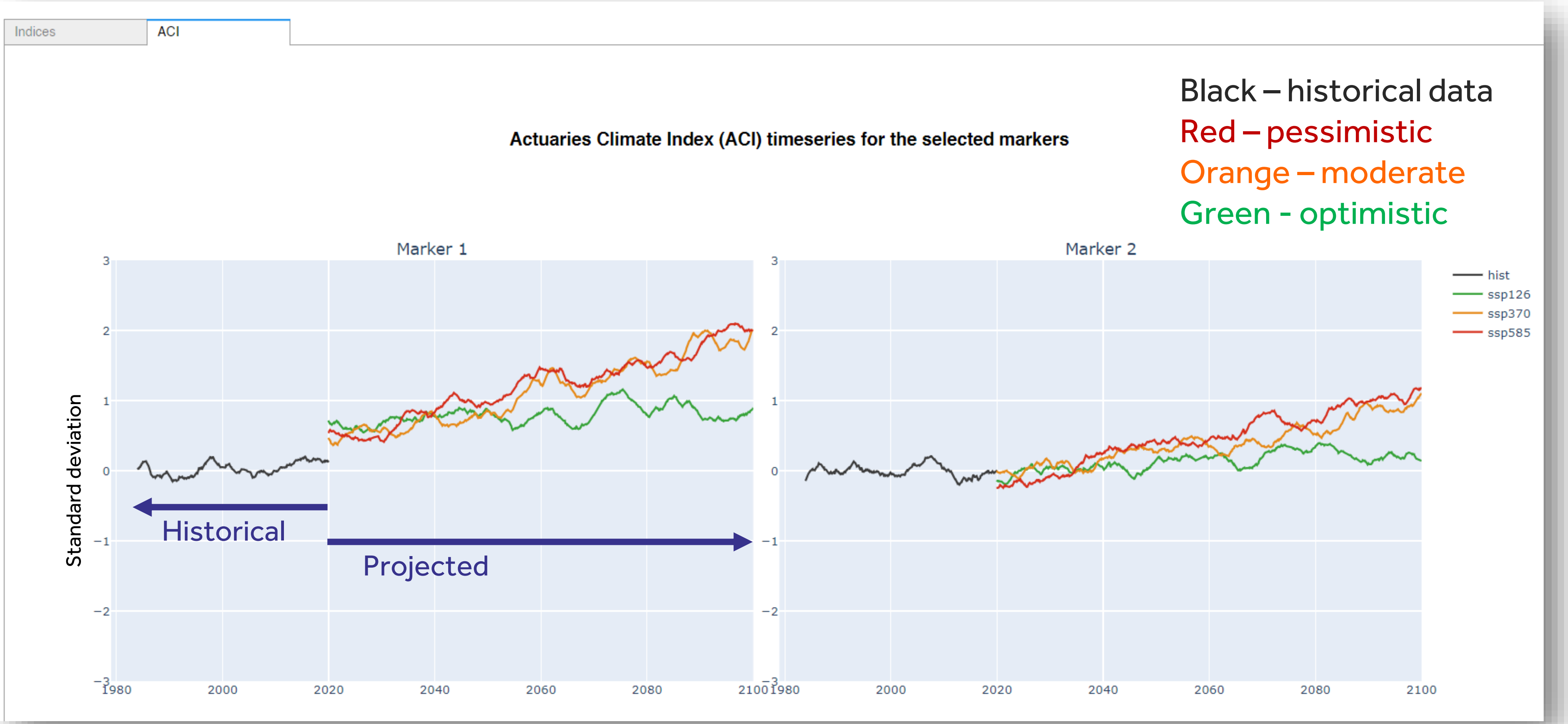
Actuaries Climate Index (ACI)

Which combines:

- Extreme high temperatures
- Extreme low temperatures
- Drought
- Extreme rainfall
- High wind power



Example of historical and projected ACI for Madrid (Marker 1) and Glasgow (Marker 2).

CRISP Interface

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UK heatwave, July 2019

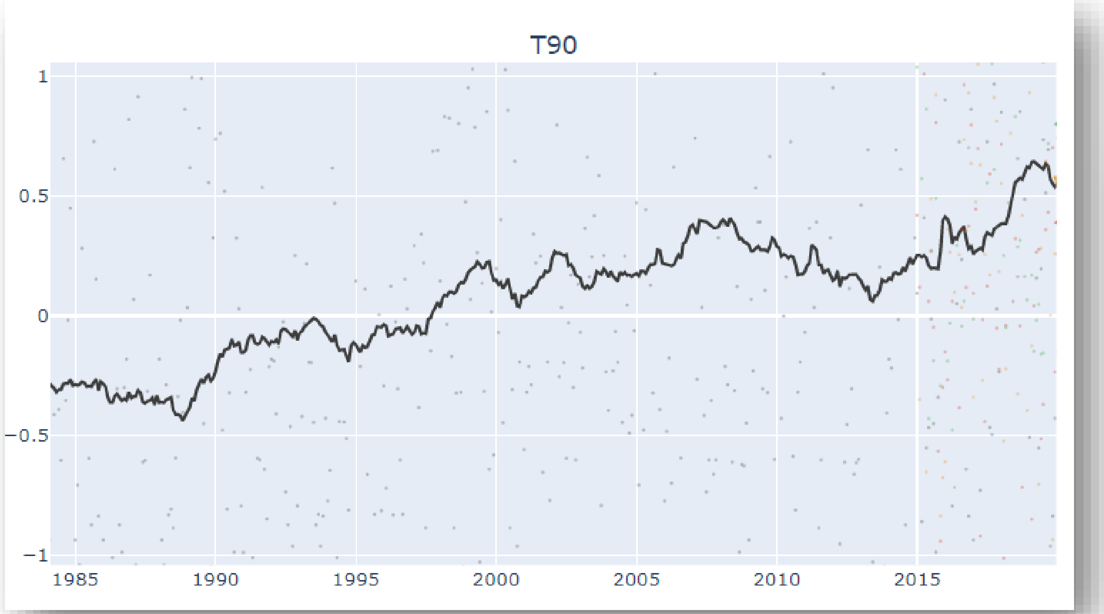
Met Office confirms highest temperature ever recorded in the UK

ENVIRONMENT 30 July 2019

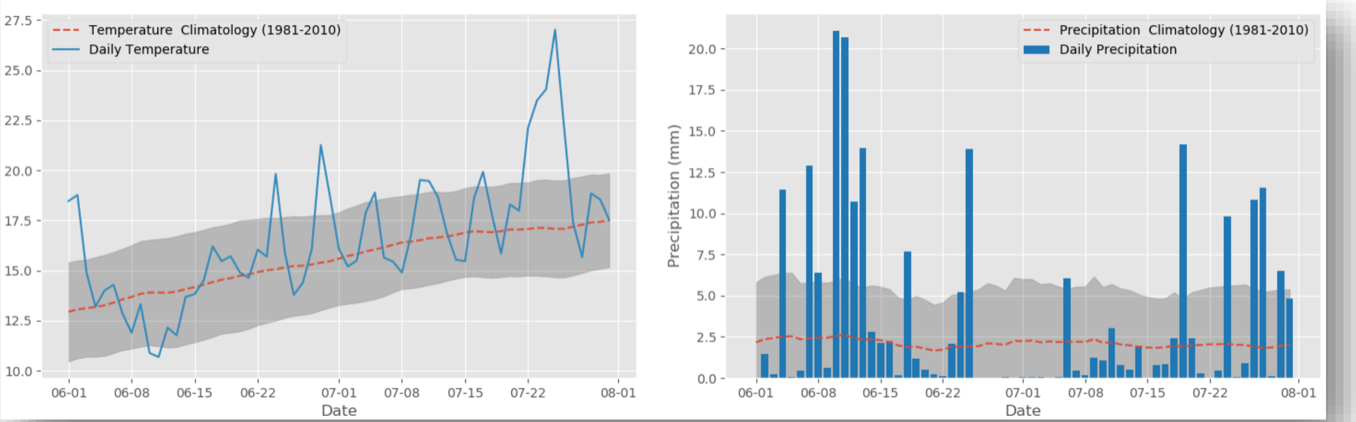
NewScientist

Historical time series of high temperatures (T90)

Frequency of temperatures above the 90th percentile



Daily temperature and precipitation 60 days before the event



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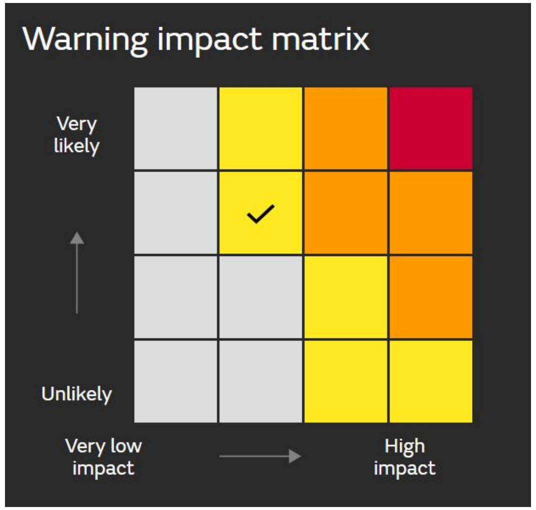
Climate Risk

- Risk can arise from potential **impacts** of climate change as well as human **responses** to climate change
- **Physical climate risk** - risks to a company's own infrastructure/ operations
- **Transitional climate risk -** risks associated with the transition to a decarbonised economy

Risk = (probability of hazard) * (vulnerability) * (exposure)

Derived from Earth Observation & Climate Data

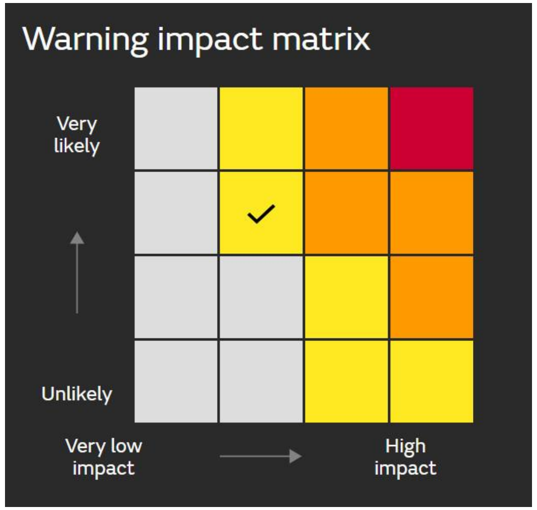
Dynamically derived from use case to use case



Climate Risk Use Cases

Use Case 1: Wildfires

- CRISP probabilistic fire risk model is based on statistical relationship between:
  - CRISP components (extreme temps, precipitation & wind power)
  - EO derived NDVI
  - Historical EO wildfire characteristics (active fires & burned area)



- Six years of CRISP components and fire characteristics used to predict: i) number of fires, ii) average intensity of fire, iii) burned area

- Severity thresholds based on climatological fire characteristics are used to create the risk matrix

Risk level	Risk color	Likelihood and severity of event	Action
1–4	Green	Very low-severity event predicted	No action necessary
5	Green	Very low probability (<25%) of low-severity event	No action necessary
6	Green	Low probability (25%–50%) of low-severity event	No action necessary
7	Yellow	Moderate probability (50%–75%) of low-severity event	Be aware
8	Yellow	High probability (>75%) of low-severity event	Be aware
9	Yellow	Very low probability (<25%) of moderate-severity event	Be aware
10	Yellow	Low probability (25%–50%) of moderate-severity event	Be aware
11	Yellow	Very low probability (<25%) of high-severity event	Be aware
12	Amber	Moderate probability (50%–75%) of moderate-severity event	Action may be necessary
13	Amber	High probability (>75%) of moderate-severity event	Action may be necessary
14	Amber	Low probability (25%–50%) of high-severity event	Action may be necessary
15	Amber	Moderate probability (50%–75%) of high-severity event	Action may be necessary
16	Red	High probability (>75%) of high-severity event	Take action

Dacre, H.F., Crawford B.R., Charlton-Perez, A.J., Lopez-Saldana, G., Griffiths G.H., Vicencio Veloso, J. (2018). Chilean wildfires - Probabilistic Prediction, Emergency Response, and Public Communication. *Bulletin of the American Meteorological Society*, (November), 2259–2274. https://doi.org/10.1175/BAMS-D-17-0111.1

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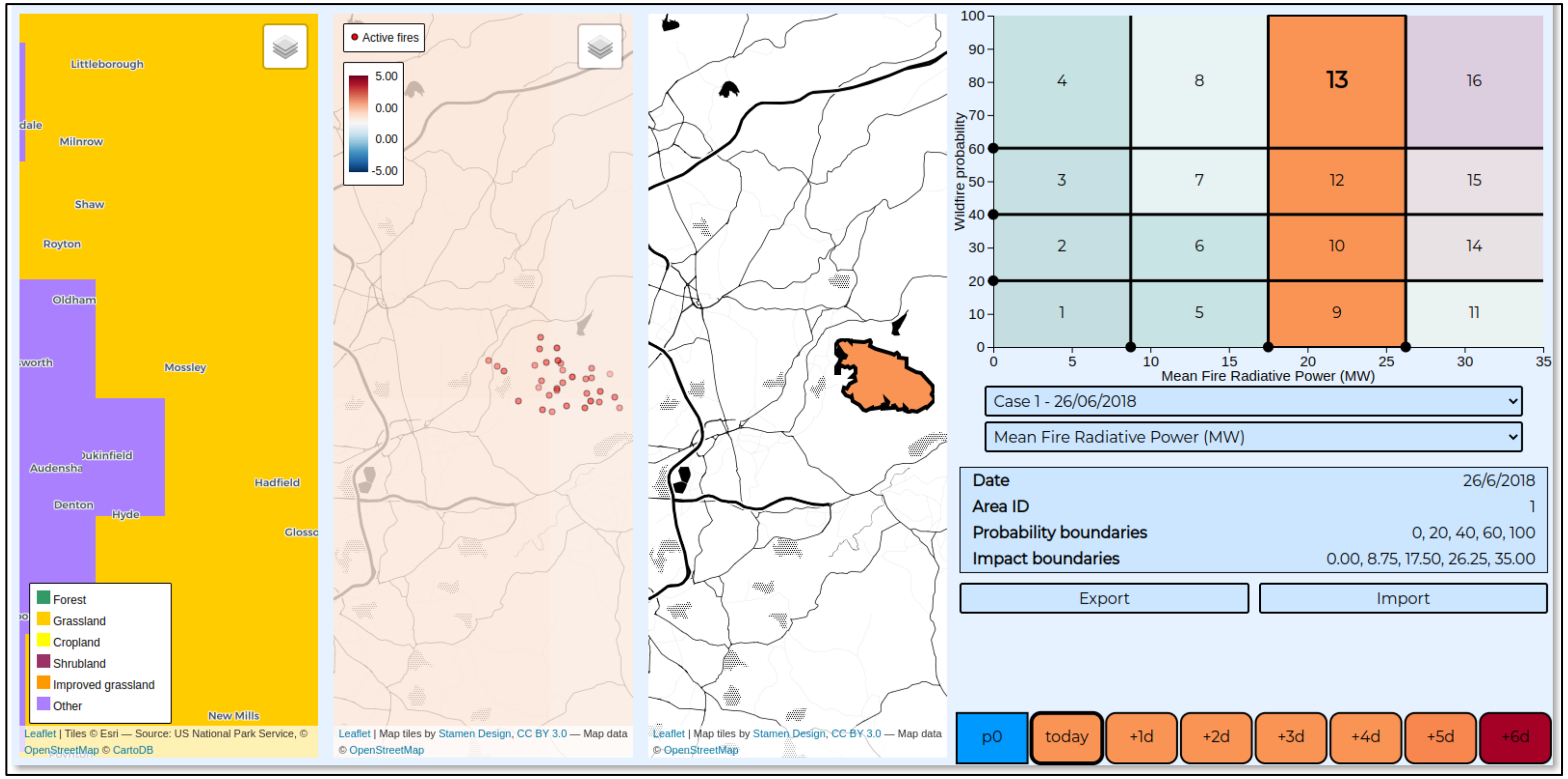
Climate Risk Use Cases

Use Case 1: Wildfires, Saddleworth Moor, UK, 2018

- The CRISP visualisation tool allows users to select specific assets and visualise:
  - Contextual information, e.g. land cover and population density
  - CRISP climate indices and EO derived data
  - The asset or AOI
- For each asset the risk matrix can be adjusted taking into account the contextual information



https://www.bbc.co.uk/news/uk-england-manchester-44626899

Climate Risk Use Cases

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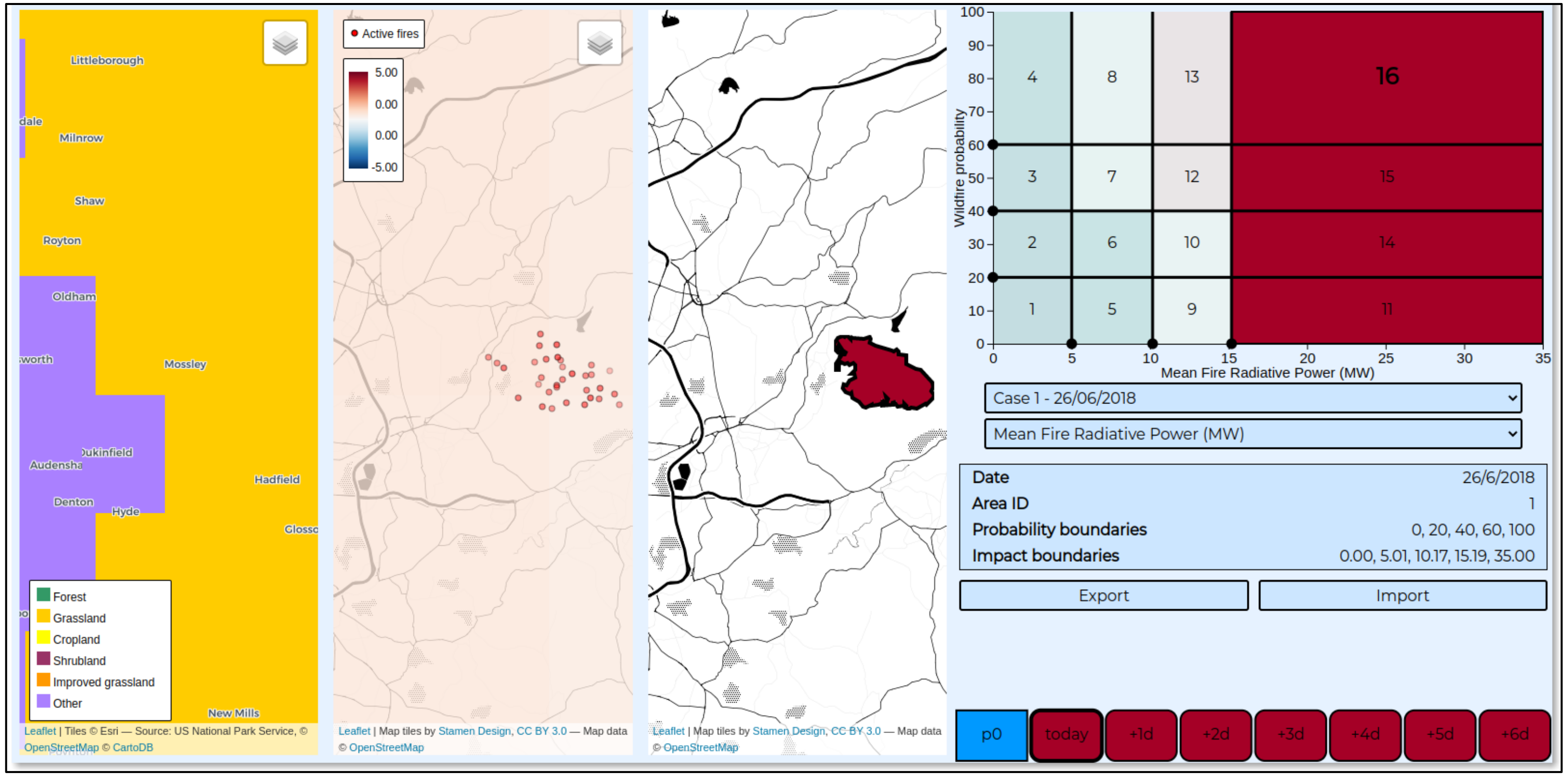

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Climate Risk Use Cases

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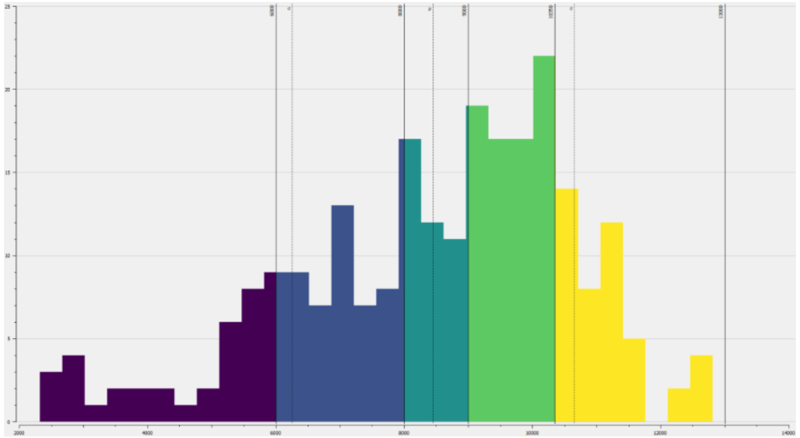
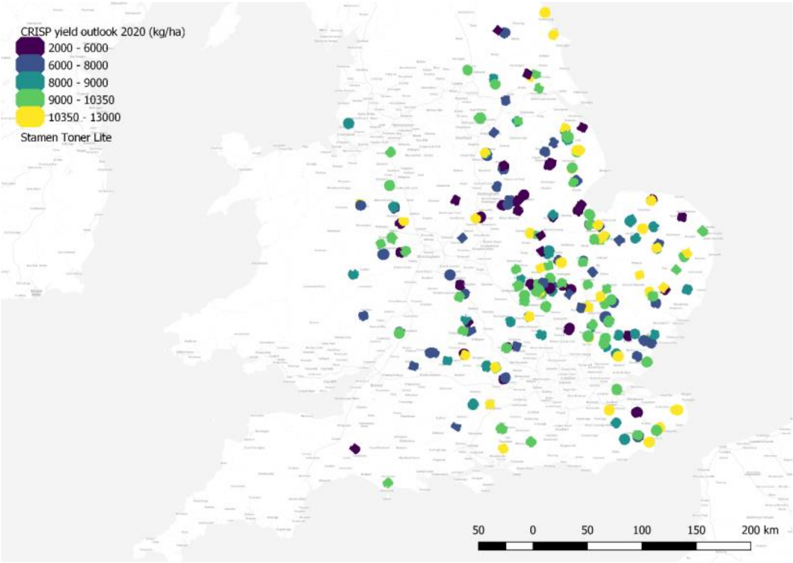
Use Case 2: Agricultural applications

- CRISP climate indices demonstrate extreme climate events and their variability with climate change.
- Heat stress, drought, heavy rain and very strong winds can impact crop yield.
- The probabilistic agriculture risk model is based on statistical relationships between:
  - CRISP components (extreme temp, precipitation & wind power)
  - EO derived data Normalised Difference Vegetation Index (NDVI)
  - Historical in-situ yield measurements for winter wheat in the UK during the 2018-2020 time period.
- A simple regression model was used to derive yield outlook and five categories were created





What Happens Next?

Continue CRISP development

- Improving the spatial resolution of datasets
- Adding more analytical capabilities including indices for user-defined AOI (point, line, polygon)
- Adding more climate models
- Rigorous quality control and uncertainty metrics

Engage with potential stakeholders

- Demonstrate tool capabilities to a wider audience
- Incorporate stakeholder feedback and ideas for tool development
- Develop tailored use cases for specific user needs

For more information please contact CRISP@telespazio.com