

Spire Weather Data Description and Service Level Agreement

This data description (this “**Data Description**”) forms part of a contract between the Spire entity specified in the Order Form (“**Spire**”) and the entity specified in the Order Form as the customer for the Data (“**Customer**”).

The contract between Spire and Customer (this “**Agreement**”) consists of:

- A. The Order Form;
- B. The Spire Data Terms & Conditions (v1.6 dated 1 February 2021) (the “**Terms & Conditions**”); and
- C. This Data Description.

Capitalized terms not defined in this Data Description will have the meaning provided in the Terms & Conditions

1. Current Forecasts - Data

1.1 Spire provides two types of forward-looking weather forecasts (collectively, the “**Current Forecasts**”):

- (a) **Current Global Forecast** – a Data forecast based on Spire’s global forecast model. The Current Global Forecast is available (depending on the terms of the Order Form):
 - (i) for the Data fields described in [Annex 1](#);
 - (ii) for 1 day, 2 days, 5 days, 7 days or 10 days (as further described in [Paragraph 2](#)); and
 - (iii) globally (or for specified areas or locations); and
- (b) **Current Optimized Point Forecast** – a Data forecast optimized for specific coordinates. The Current Optimized Point Forecast is available (depending on the terms of the Order Form):
 - (i) for the Data fields described in [Annex 2](#);
 - (ii) for 1 day, 2 days, or 7 days (as further described in [Paragraph 2](#)); and
 - (iii) for specific coordinates only.

2. Current Forecasts - Period

2.1 Spire provides the Current Forecasts for the following time periods (depending on the terms of the Order Form):

- (a) **1 Day** – a Current Forecast for a rolling 24-hour period:
 - (i) updated every 6 hours; and
 - (ii) providing hourly Data Output for each the variable unless stated otherwise. Minimum and maximum temperatures are currently 6-hourly Data Output;
- (b) **2 Day** – a Current Forecast for a rolling 2-day period:
 - (i) updated every 12 hours; and
 - (ii) providing hourly Data Output for each the variable unless stated otherwise. Minimum and maximum temperatures

- (c) **5 Day** – a Current Forecast for a rolling 5-day period:
 - (i) updated every 12 hours; and
 - (ii) providing 3-hourly Data Output for each the variable unless stated otherwise. Minimum and maximum temperatures are currently 6-hourly Data Output; and
- (d) **7 & 10 Day** – a Current Forecast for a rolling 7- or 10-day period:
 - (i) updated every 12 hours; and
 - (ii) providing 6-hourly hourly Data Output for each variable unless stated otherwise. Minimum and maximum temperatures are currently 6-hourly Data Output.

2.2 “**Data Output**” means the number of forecasts during a particular period for a variable. For example:

- (a) hourly Output means one forecast per variable per hour – e.g. the expected temperature at a location at 0000 hrs UTC, 0100 hrs UTC, etc.
- (b) 6-hourly Output means one forecast per variable per every 6 hours - e.g. the expected temperature at a location at 0000 hrs UTC, 0600 hrs UTC, etc);

3. Current Global Forecast - Updates

3.1 The Current Global Forecast is updated as follows:

Forecast Update	Forecast Generation (Base Time; UTC)	Forecast Period (UTC)	Delivery - API Availability (UTC)
For 1 Day Current Forecasts	0000	0000 (day 1) to 0000 (day 2)	0630 to 0830
	0600	0600 (day 1) to 0600 (day 2)	1230 to 1430
	1200	1200 (day 1) to 1200 (day 2)	1830 to 2030
	1800	1800 (day 1)	1230 (next)

		to 1800 (day 2)	day) to 0230 (next day)
For 2 Day or more Current Forecasts	0000	0000 (day 1) to 0000 (up to day 10)	0700 to 0900
	1200	1200 (day 1) to 1200 (up to day 10)	1900 to 2100

3.2 For example, the 1 Day Current Global Forecast will be updated every 6 hours and delivered to the API with up to 8.5 hours' latency. This means:

- (a) a 1 Day Current Global Forecast will be generated at 1200hrs UTC (day 1) for the period 1200hrs UTC (day 1) to 1200hrs UTC (day 2);
- (b) this will be available on the API by 2030hrs UTC (day 1); and
- (c) up to the first 8.5 hours of the 1 Day Current Global Forecast will be an historical forecast by the time the Data is delivered to the API.

3.3 There shall be no changes to forecasts between updates.

3.4 Spire provides access to Current Forecasts through an API with the following options:

- (a) File: For customers to download global or large area forecast data in GRIB2 format for offline use;
- (b) Point: For customers to retrieve coordinate-by-coordinate forecast data in JSON format;
- (c) Trajectory: For customers to download weather forecast data over a future route/trajectory in JSON format. A trajectory is defined by a set of coordinate/time pairs provided by the customer; or
- (d) WMS: For customer to download map visualization layers using the OGC Web Map Service standard.

4. Current Optimized Point Forecasts – Updates

4.1 Current Optimized Point Forecasts are updated every hour and delivered to the API immediately. For example, a 1 Day Current Optimized Point Forecast generated at 1200hrs UTC (day 1) for the period 1200hrs UTC (day 1) to 1200hrs UTC (day 2) will be available on the API at 1200hrs UTC (day 1).

4.2 There shall be no changes to forecasts between updates.

5. Current Optimized Point Forecasts – Period

- (a) The Wind Power and Solar Power Current Optimized Point Forecasts bundles are available only as 1 Day or 2 Day forecasts with a 15 minute Data Output. For the avoidance of doubt, one forecast will be available per variable per 15-minutes– e.g. the expected 100-m wind speed at a location at 0000 hrs UTC, 0015 hrs UTC, etc;

and

- (b) The Optimized Point Forecasts core bundle is available for only the first 7 days, in the time intervals described at the Current Forecast – Period section.

6. Current Optimized Point Forecasts – Locations

6.1 Current Optimized Point Forecasts are available for:

- (a) **Standard Locations** – locations such as ports, airports, and weather stations where Spire generates Current Optimized Point Forecasts routinely as part of its standard Current Optimized Point Forecasts product; and
- (b) **Custom Locations** - locations specifically requested by Customer.

6.2 Current Optimized Point Forecasts are available for specific coordinates only and not for areas defined by polygons.

7. Nature of Data – Current Forecasts

7.1 The Data in the Current Forecasts consists of the Spire's forecasts for the relevant Data field.

7.2 A forecast is necessarily a prediction based on analysis of several variables and does not guarantee the forecasted weather will match what the weather conditions are when the forecasted time arrives. The Data does not include any verification of the forecast or actual value for the Data field.

7.3 For example, if the Data is a forecast for the expected temperature at 0000hrs on a date, it does not include the actual temperature at 0000hrs on that date.

8. Data Access – Current Forecast

8.1 Spire provides access to Current Forecasts through an API in the following file formats:

- (a) GRIB2;
- (b) JSON; or
- (c) WMS (OGC Web Map Service)

8.2 Customer acknowledges that not all the Data is available in all formats:

- (a) the Current Global Forecast is available in the formats described in [Annex 1](#); and
- (b) the Current Optimized Point Forecast is available in JSON only.

8.3 Customer shall not exceed the number of Permitted API Calls specified in the Order Form.

8.4 In the event Customer exceeds the number of Permitted API Calls specified in the Order Form, Spire may immediately suspend Customer's access to the Data in accordance with Clause 15 of the Terms & Conditions.

8.5 Customer acknowledges that Spire is only providing the Data through its API and is not providing any software or other services for the analysis or visualization of the Data.

9. Historical Data

9.1 Spire's Historical Data product consists of Data

generated by utilizing observed weather data for the applicable period and processing such observed weather data in a weather model to provide estimated Data either globally or for the applicable Coverage Area.

- 9.2 Unless another Data Output is specified on the Order Form, the Historical Data will be available for each hour of the applicable period (for example, the 10m wind speed at a location at 0000 hrs UTC, 0100 hrs UTC, etc).
- 9.3 Historical Data is available for Data fields described in [Annex 3](#) of this Data Description.
- 9.4 Notwithstanding anything to the contrary in Clause 17.5 of the Terms & Conditions requiring the deletion of the Historical Data, Customer may retain and use any Historical Data provided by Spire provided that such retention and use otherwise complies with the terms of this Agreement.
- 9.5 Customer acknowledges that Spire is not providing any software or other services for the analysis or visualization of the Historical Data.

10. Data Access – Historical Data

- 10.1 Spire provides access to Historical Data by making it available for download from a cloud-based internet service (such as AWS S3) in the following file formats:

- (a) GRIB2;
- (b) JSON; or
- (c) CSV.

- 10.2 Other formats may be available on request.
- 10.3 The Historical Data shall be available for download for a period of 60 days.
- 10.4 Customer may download the Historical Data once. Additional charges will be applicable if Customer downloads the Historical Data more than once.

11. Current Conditions Data

- 11.1 Spire's Current Condition Data product consists of Data generated by utilizing observed weather data for the applicable period and processing such observed weather data in a weather model to provide estimated Data either globally or for the applicable Coverage Area.
- 11.2 Unless another Data Output is specified on the Order Form, the Current Conditions Data will be available for the current hour (or the previous hour depending on update schedules).
- 11.3 Current Conditions Data is available for Data fields described in [Annex 4](#) of this Data Description.
- 11.4 Customer acknowledges that Spire is not providing any software or other services for the analysis or visualization of the Current Conditions Data.

12. Current Conditions – Updates

- 12.1 Current Conditions are updated every hour and delivered to the API with a 40-minutes latency. For example, the Current Conditions update for 1200hrs UTC will be available at the API at 1240hrs.
- 12.2 There shall be no changes to current conditions between updates.

13. Data Access – Current Conditions

- 13.1 Spire provides access to Current Conditions through an

API in the following file formats:

- (a) GRIB2;
- (b) JSON; or
- (c) WMS (OGC Web Map Service)

- 13.2 Customer shall not exceed the number of Permitted API Calls specified in the Order Form.

- 13.3 In the event Customer exceeds the number of Permitted API Calls specified in the Order Form, Spire may immediately suspend Customer's access to the Data in accordance with Clause 15 of the Terms & Conditions.

14. Tides Data

- 14.1 The Tides dataset represents the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted by the Moon and the Sun, and the rotation of the Earth.

- 14.2 Tides Data is available for Data fields described in [Annex 5](#) of this Data Description.

- 14.3 Customer acknowledges that Spire is not providing any software or other services for the analysis or visualization of the Tides Data.

- 14.4 Spire provides access to Tides through an API in the JSON file format.

15. Customer Applications

- 15.1 For the purposes of this Agreement, "Customer Applications" shall mean:

- (a) a derivative digital product showing in visual form on a map the latest Data forecast for a location; or
- (b) a written or electronic report produced by Customer that includes the Data as an ancillary part of the report together with other information, data and services provided by Customer.

- 15.2 The definition of "Customer Application" in [Paragraph 9.1](#) supersedes the definition in the Terms & Conditions.

- 15.3 The use of the Data in Customer Applications shall be allowed only to the extent permitted in the Order Form.

16. Service Levels - SLs

- 16.1 Spire will use commercially reasonable efforts to achieve the service levels ("SLs") set out below, as measured by reference to Spire's business records but excluding:

- (a) commercially reasonable planned downtime;
- (b) the failure of equipment, applications, and other systems not under the direct control of Spire or its subcontractors; and
- (c) other circumstances beyond Spire's reasonable control

(collectively, "Excluded Events").

Service Item	Service Level
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System Uptime	Monthly average of more than 99% "Uptime" means the average time that a Weather Forecast was online and available on an API in any given month, as recorded by Spire.
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17. Service Levels - Remedies

- 17.1 In the event that Spire fails to meet the SLs in a given calendar month, but ignoring any failure to the extent attributable to Excluded Events, Customer shall be entitled to receive a number of additional free days access to the Data at the end of the Initial Term or any Renewal Term as applicable (the "Service Level Credit") calculated as follows:

Performance compared to SL (on average during the month).	Service Level Credit days
99% or more	No credit
Between 50% and 98.9%	15 days
Below 50%	1 month

Example for the "API uptime" SL: If the average uptime of the API in a calendar month is equal to 99.93%, the performance against the SL will be calculated as follows:

*$(99.93/99.9) * 100 = 100.03\%$ of the SL*

The customer shall receive no Service Level Credit

- 17.2 In order to obtain a Service Level Credit in any given calendar month, Customer must send Spire a written notice within 30 days following the end of such calendar month specifying:

- (a) the Data in relation to which Customer is claiming the credit;
- (b) the dates and or times in which the Data or availability of the Data failed to achieve the applicable SL; and
- (c) the amount of the Service Level Credit that Customer believes it is owed.

- 17.3 Spire shall check any claim for a Service Level Credit against its business records in order to determine whether:

- (a) the Data has met the SLs; and
- (b) whether Customer is entitled to a Service Level Credit.
- (c) Spire's determination shall be binding in the absence of fraud or manifest error.

- 17.4 The aggregate maximum number of days of additional access to the Data granted as Service Level Credits for any failures in to meet the SLs in a calendar month shall not exceed the number of days in that calendar month. Service Level Credits may not be exchanged for, or converted to, monetary amounts.

- 17.5 In the event that Customer receives the maximum Service Level Credit for any 6 consecutive calendar monthly periods, then Customer shall be entitled to terminate this Agreement.

- 17.6 Customer agrees that (a) the Service Level Credits; and (b) Customer's right to terminate in [Paragraph 10.5](#) are

Customer's sole and exclusive remedy, and Spire's sole and exclusive liability, for:

- (a) downtime in the availability of the Data; and
- (b) failure of the Data to meet any expectations and performance level.

18. Third-Party Data Providers

- 18.1 The Data may contain or be based upon:

- (a) data and products from the European Centre for Medium-Range Weather Forecasts (ECMWF);
- (b) data generated using DICAST® software. DICAST was developed at the Research Application Laboratory (RAL) of the National Center for Atmospheric Research (NCAR), which is operated by the University Corporation for Atmospheric Research (UCAR). Copyright © 2016 UCAR. DICAST is a registered trademark of the University Corporation for Atmospheric Research; and
- (c) data from Copernicus Climate Change Service, Copernicus Atmosphere Monitoring Service, and/or EU Copernicus Marine Service Information.

Annex 1 - Data – Current Global Forecast

The Data provided in the Current Global Forecast and Historical Products may consist of a combination of the following data fields (depending on the terms of the Order Form):

Basic Bundle

Field Name	Vertical Level	Description
Temperature	2 meters Above Ground Level ("AGL")	Air temperature at screen level
Relative humidity	2 meters AGL	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
Dewpoint temperature	2 meters AGL	The screen-level temperature at which a parcel of air cooled at constant pressure and specific humidity reaches saturation
u-wind component	10 meters AGL	The eastward component of the horizontal wind
v-wind component	10 meters AGL	The northward component of the horizontal wind

Mean sea-level pressure	Sea level	Air pressure adjusted to mean sea level
Accumulated precipitation	Surface	The total accumulated (liquid) precipitation occurring since the beginning of the forecast
Wind gust speed	10 meters	Instantaneous wind gust (speed)
Maximum Temperature	2 meters AGL	Maximum air temperature in the previous six hours
Minimum Temperature	2 meters AGL	Minimum air temperature in the previous six hours
Cloud Cover	Whole atmosphere	The percentage of the sky covered by clouds
Visibility	Surface	The horizontal visibility

This bundle is available in WMS, GRIB2, or JSON.

Basic (Ensemble) Bundle

Field Name	Vertical Level	Description
Temperature	2 meters AGL	Air temperature at standard observation height (2 meters above the surface)
Relative humidity	2 meters AGL	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
u-wind component	10 meters AGL	The eastward component of the horizontal wind
v-wind component	10 meters AGL	The northward component of the horizontal wind
Accumulated precipitation	Surface	The total accumulated (liquid) precipitation occurring since the beginning of the forecast

This bundle is available in GRIB2 or JSON.

The Basic (Ensemble) Bundle is produced using a multi-model ensemble forecast system. The output variables represent the statistically most probable weather outcome, calculated for each model grid point individually.

Agricultural Bundle

Field Name	Vertical Level	Description
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Skin (surface) temperature	Surface	Temperature at the interface between the air and the ground
Dewpoint temperature	2 meters AGL	The screen-level temperature at which a parcel of air cooled at constant pressure and specific humidity reaches saturation
Specific humidity	2 meters AGL	The ratio of the mass of water vapor to the total mass of an air parcel in a moist atmosphere taken at screen level
Soil moisture	0-10 cm, 10-40 cm, 40-100 cm, 100-200 cm	Volumetric soil moisture content, expressed as a fraction, for a given depth below the surface
Soil temperature	0-10 cm, 10-40 cm, 40-100 cm, 100-200 cm	The temperature of the soil for a given depth below the surface
Latent heat flux	Surface	The exchange of heat between the surface and the air owing to evaporation (and sublimation)
Sensible heat flux	Surface	The exchange of heat between the surface and the air due to the turbulent motion of air

This bundle is available in GRIB2 or JSON.

Aviation Bundle

Field Name	Vertical Level	Description
Temperature	Flight levels	Air temperature
Relative humidity	Flight levels	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
u-wind component	Flight levels	The eastward-component of the horizontal wind
v-wind component	Flight levels	The northward-component of the horizontal wind
Height	Level of max. winds	The height (above sea level) where the maximum wind speed is found

u-wind component	Level of max. winds	The eastward component of the horizontal wind
v-wind component	Level of max. winds	The northward component of the horizontal wind
Clear-air turbulence	Flight levels	Potential severity of turbulence associated with wind shear (not due to mountain waves or convection), using the EDR (Eddy Dissipation Rate).
Icing severity	Flight levels	Potential for aircraft icing conditions (0-1)

This bundle is available in GRIB2 only.

The flight levels currently available range from FL100 to FL450 (10,000 feet to 45,000 feet mean sea level). The altitudes in the files are shown in meters and correspond to the following values:

3048, 3352, 3657, 3962, 4267, 4572, 4876, 5181, 5486, 5791, 6096, 6400, 6705, 7010, 7315, 7620, 7924, 8229, 8534, 8839, 9144, 9448, 9753, 10058, 10363, 10668, 10972, 11277, 11582, 11887, 12192, 12496, 12801, 13106, 13411, 13716.

Maritime Bundle

Field Name	Vertical Level	Description
Sea Surface Temperature	Sea level	The temperature at the ocean surface
Ocean Currents (eastward component)	Sea level	The eastward component of the ocean current vector
Ocean Currents (northward component)	Sea level	The northward component of the ocean current vector
Significant Wave Height	Sea level	Wave heights of combined swell and wind waves
Mean Wave Direction	Sea level	Mean wave direction of combined swell and wind waves
Mean Wave Period	Sea level	Mean wave period of combined swell and wind waves
u-wind component	50 meters AGL	The eastward component of the horizontal wind
v-wind	50 meters	The northward component

component	AGL	of the horizontal wind
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This bundle is available in WMS, GRIB2 or JSON. At the API, the bundle is split in the maritime and maritime-atmos (due to slightly different publication schedules).

Maritime Wave Bundle

Field Name	Vertical Level	Description
Significant Wind Wave Height	Sea level	Wave heights of waves generated by local winds
Mean Wind Wave Direction	Sea level	Mean wave direction of waves generated by local winds
Mean Wind Wave Period	Sea level	Mean wave period of waves generated by local winds
Significant Total Swell Wave Height	Sea level	Wave heights of combined swell waves
Mean Total Swell Wave Direction	Sea level	Mean wave direction of combined swell waves
Mean Total Swell Wave Period	Sea level	Mean wave period of combined swell waves

This bundle is available in WMS, GRIB2 or JSON.

Precipitation Bundle

Field Name	Vertical Level	Description
Precipitation Type	Surface	The predominant precipitation type. Values are "no_precipitation", "rain", "snow", "freezing_rain", "mixed/ice". Note: At the file API, available as categorical masks for areas of each of the precipitation types
Snowfall Amount	Surface	The total accumulated snowfall occurring since the beginning of the forecast.

This bundle is available in WMS, GRIB2 or JSON.

Wind Power Bundle

Field Name	Vertical Level	Description
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u-wind component	80 meters AGL	The eastward component of the horizontal wind
v-wind component	80 meters AGL	The northward component of the horizontal wind
u-wind component	100 meters AGL	The eastward component of the horizontal wind
v-wind component	100 meters AGL	The northward component of the horizontal wind
u-wind component	120 meters AGL	The eastward component of the horizontal wind
v-wind component	120 meters AGL	The northward component of the horizontal wind
Air Density	80 meters AGL	The air density at 80 m above ground level. Air density is the density of the atmosphere. It is a function of atmospheric pressure, temperature and humidity and decreases with increasing altitude.
Air Density	100 meters AGL	The air density at 100 m above ground level. Air density is the density of the atmosphere. It is a function of atmospheric pressure, temperature and humidity and decreases with increasing altitude.
Air Density	120 meters AGL	The air density at 120 m above ground level. Air density is the density of the atmosphere. It is a function of atmospheric pressure, temperature and humidity and decreases with increasing altitude.

This bundle is available in GRIB2 or JSON.

Solar Power Bundle

Field Name	Vertical Level	Description
Incoming shortwave radiation	Surface	Shortwave radiation directed at the surface from above and includes direct and diffuse components
Incoming longwave radiation	Surface	Longwave radiation directed at the surface from above
Outgoing	Surface	Longwave radiation directed

longwave radiation		(upwards) away from the surface
Outgoing shortwave radiation	Surface	Shortwave radiation directed (upwards) away from the surface
Outgoing longwave radiation	Top of atmosphere	Longwave radiation directed (upwards) away from the top of the atmosphere

This bundle is available in GRIB2 or JSON.

Thunderstorm Bundle

Field Name	Vertical Level	Description
CAPE	Whole atmosphere	Convective Available Potential Energy
CIN	Whole atmosphere	Convective Inhibition
Lifted Index	Whole atmosphere	The temperature difference between the air lifted from the surface to 500 hPa and the environmental temperature at that level
Storm-relative helicity	0-3 km	A measure of the transfer of vorticity from the environment to an air parcel in convective motion from a frame of reference moving with a thunderstorm
Storm motion (eastward component)	0-6 km	The eastward component of the storm-motion vector
Storm motion (northward component)	0-6 km	The northward component of the storm-motion vector
0-6 km shear vector (eastward component)	0-6 km	The eastward component of the deep-layer shear vector
0-6 km shear vector (northward component)	0-6 km	The northward component of the deep-layer shear vector

This bundle is available in GRIB2 only.

Upper Air Bundle

Field Name	Vertical Level	Description
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Geopotential height	Isobaric levels	The approximate height of a given point in the atmosphere above the surface of the earth accounting for variations in gravity
Temperature	Isobaric levels	Air temperature
u-wind component	Isobaric levels	The eastward component of the horizontal wind
v-wind component	Isobaric levels	The northward component of the horizontal wind
Relative humidity	Isobaric levels	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature expressed as a percentage
Vertical velocity	Isobaric levels	The component of the full velocity vector in the vertical direction
Absolute vorticity	Isobaric levels	The vertical component of the absolute vorticity vector measuring the local rotation of the atmosphere
Cloud water mixing ratio	Isobaric levels	The ratio of the mass of non-precipitating liquid water to the mass of dry air in a unit volume of air
Cloud ice mixing ratio	Isobaric levels	The ratio of the mass of non-precipitating frozen water to the mass of dry air in a unit volume of air

This bundle is available in GRIB2 only.

Probabilistic Precipitation Bundle

Field Name	Vertical Level	Description
Probability of Precipitation above 1 mm	Surface	The probability (in %) that total precipitation will be 1 mm or above.
Probability of Precipitation above 5 mm	Surface	The probability (in %) that total precipitation will be 5 mm or above.
Probability of Precipitation above 10 mm	Surface	The probability (in %) that total precipitation will be 10 mm or above.
Probability of	Surface	The probability (in %) that

Precipitation above 15 mm		total precipitation will be 15 mm or above.
Probability of Precipitation above 20 mm	Surface	The probability (in %) that total precipitation will be 20 mm or above.
Probability of Precipitation above 25 mm	Surface	The probability (in %) that total precipitation will be 25 mm or above.
Probability of Precipitation above 50 mm	Surface	The probability (in %) that total precipitation will be 50 mm or above.

This bundle is available in JSON and GRIB2 only.

The Probabilistic Precipitation Bundle is produced using a multi-model ensemble forecast system. The output variables represent the statistical probability of different weather outcomes, calculated for each model grid point individually. The bundle is available at 0.25 degree global resolution, and in 6-hours intervals only.

Probabilistic Temperature Bundle

Field Name	Vertical Level	Description
Probability of Temperature below -15 Celsius	2 meters AGL	The probability (in %) that the temperature will be below -15 degrees Celsius.
Probability of Temperature between -15 and -5 Celsius	2 meters AGL	The probability (in %) that the temperature will be between -15 and -5 degrees Celsius.
Probability of Temperature between -5 and -0 Celsius	2 meters AGL	The probability (in %) that the temperature will be between -5 and 0 degrees Celsius.
Probability of Temperature at or below 0 Celsius	2 meters AGL	The probability (in %) that the temperature will be 0 degrees Celsius or below.
Probability of Temperature between 0 and 5 Celsius	2 meters AGL	The probability (in %) that the temperature will be between 0 and 5 degrees Celsius.
Probability of Temperature between 5 and 15 Celsius	2 meters AGL	The probability (in %) that the temperature will be between 5 and 15 degrees Celsius.
Probability of Temperature between 15 and	2 meters AGL	The probability (in %) that the temperature will be between 15 and 25 degrees

25 Celsius		Celsius.
Probability of Temperature between 25 and 35 Celsius	2 meters AGL	The probability (in %) that the temperature will be between 25 and 35 degrees Celsius.
Probability of Temperature between 35 and 45 Celsius	2 meters AGL	The probability (in %) that the temperature will be between 35 and 45 degrees Celsius.
Probability of Temperature above 45 Celsius	2 meters AGL	The probability (in %) that the temperature will be above 45 degrees Celsius.

This bundle is available in JSON and GRIB2 only.

The Probabilistic Temperature Bundle is produced using a multi-model ensemble forecast system. The output variables represent the statistical probability of different weather outcomes, calculated for each model grid point individually.

Annex 2 - Data – Current Optimized Point Forecast Data

The Data provided in the Current Optimized Point Forecast may consist of a combination of the following data fields (depending on the terms of the Order Form):

Core Bundle

Field Name	Vertical Level	Description
Temperature	2 meters AGL	Air temperature at standard observation height (2 m above the surface)
Dewpoint temperature	2 meters AGL	Temperature at which a parcel of air cooled at constant pressure and specific humidity reaches saturation
Relative humidity	2 meters AGL	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
24-h Maximum temperature UTC	2 meters AGL	Maximum air temperature for the remainder of the current calendar day (day in UTC time – same across all stations) For example, at 18 UTC, the Maximum Temperature is

		predicted for the period between 19:00 and 23:59.
24-h Minimum temperature UTC	2 meters AGL	Minimum air temperature for the remainder of the current calendar day (day in UTC time – same across all stations)
24-h Maximum temperature local	2 meters AGL	Maximum air temperature for the remainder of the current calendar day (day in the station local time zone)
24-h Minimum temperature local	2 meters AGL	Minimum air temperature for the remainder of the current calendar day (day in the station local time zone)
Mean sea-level pressure	Sea level	Air pressure adjusted to mean sea level
Cloud ceiling	Surface	The height above the Earth's surface of the base of the lowest layer of cloud with a coverage of more than 50%. Data is provided in ranges For example, "0 to 800 m" or "No Ceiling"
Total cloud cover	Surface	The percentage of the sky around the location covered by clouds
Visibility	Surface	The horizontal visibility
Probability of fog	Surface	The probability of fog
Probability of thunderstorm	Surface	The probability of thunderstorm
Wind speed	10 meters AGL	The wind speed at standard observation height (10 m above the surface)
Wind direction	10 meters AGL	The meteorological wind direction (90° corresponds to wind from east)
Eastward wind velocity	10 meters AGL	The eastward component of the horizontal wind. It is the horizontal speed of air moving towards the east
Northward wind velocity	10 meters AGL	The northward component of the horizontal wind. It is the horizontal speed of air moving towards the north
1-h	Surface	The probability of (liquid)

Probability of precipitation		precipitation in the next one hour
1-h Accumulated precipitation	Surface	The total accumulated (liquid) precipitation occurring in the next one hour
3-h Probability of precipitation	Surface	The probability of (liquid) precipitation in the next three hours
3-h Accumulated precipitation	Surface	The total accumulated (liquid) precipitation occurring in the next three hours
6-h Probability of precipitation	Surface	The probability of (liquid) precipitation in the next six hours
6-h Accumulated precipitation	Surface	The total accumulated (liquid) precipitation occurring in the next six hours
24-h Probability of precipitation	Surface	The probability of (liquid) precipitation in the next 24 hours
Conditional probability of rain	Surface	Conditional probability of rain. Likelihood of receiving rain if precipitation were actually to occur.
Conditional probability of snow	Surface	Conditional probability of snow. Likelihood of receiving snow if precipitation were actually to occur.
Conditional probability of ice	Surface	Conditional probability of ice (freezing rain or sleet). Likelihood of receiving ice if precipitation were actually to occur.

The Optimized Point Core Bundle is available in JSON only.

Wind Power Bundle

Field Name	Vertical Level	Description
Wind speed	80 meters AGL	Wind speed at 80 m above the surface.
Wind direction	80 meters AGL	Meteorological wind direction at 80 m above the surface (90° corresponds to wind from east).

Wind speed	100 meters AGL	Wind speed at 100 m above the surface.
Wind direction	100 meters AGL	Meteorological wind direction at 100 m above the surface (90° corresponds to wind from east).
Wind speed	120 meters AGL	Wind speed at 120 m above the surface.
Wind direction	120 meters AGL	Meteorological wind direction at 120 m above the surface (90° corresponds to wind from east).

The Optimized Point Wind Power Bundle is available in JSON only.

Solar Power Bundle

Field Name	Vertical Level	Description
Global Horizontal Irradiance	Surface	Total shortwave radiation received by a surface horizontal to the ground. This field is the combination of both the direct normal irradiance (DNI) and the diffuse horizontal irradiance.
Direct Normal Irradiance	Surface	The incoming shortwave radiation per unit area received by a surface which is always normal (perpendicular) to the direction of the sun's incoming rays.
Plane of Array Irradiance	Surface	The irradiance received by a sensor attached directly to a solar array. This field incorporates the tilt of the array, the solar zenith angle, as well as the solar azimuth angle to obtain a best estimate for the amount of radiation received by the array directly.

The Optimized Point Solar Power Bundle is available in JSON only.

Annex 3 - Data – Historical Data

The Data provided in Spire's Historical Data product may consist

of a combination of the following data fields (depending on the terms of the Order Form):

Core Bundle

Field Name	Vertical Level	Description
Temperature	2 meters AGL	Air temperature at standard observation height (2 meters above the surface)
Relative humidity	2 meters AGL	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
Dewpoint temperature	2 meters AGL	Temperature at which a parcel of air cooled at constant pressure and specific humidity reaches saturation
u-wind component	10 meters AGL	The eastward component of the horizontal wind
v-wind component	10 meters AGL	The northward component of the horizontal wind
Wind speed	10 meters AGL	Wind speed
Wind direction	10 meters AGL	Meteorological wind direction (direction from which the wind is blowing) i.e. 90° is wind from the east, 180° from the south, etc.
Mean sea-level pressure	Sea level	Air pressure adjusted to mean sea level
Total precipitation	Surface	The total accumulated (liquid) precipitation that occurred in the last hour
Wind gust	10 meters AGL	Instantaneous wind gust speed
Max wind gust	10 meters AGL	Maximum wind gust speed that occurred in the last hour
Maximum temperature	2 meters AGL	Maximum air temperature in the previous six hours
Minimum temperature	2 meters AGL	Minimum air temperature in the previous six hours
Cloud Cover	Whole atmosphere	The percentage of the sky covered by clouds

Agricultural Bundle

Field Name	Vertical Level	Description
Skin (surface) temperature	Surface	Temperature at the interface between the air and the ground
Specific humidity	2 meters AGL	The ratio of the mass of water vapor to the total mass of an air parcel in a moist atmosphere taken at screen level
Soil moisture	0-7 cm, 7-28 cm 28-100 cm, 100-289 cm	Volumetric soil moisture content, expressed as a fraction, for a given depth below the surface
Soil temperature	0-7 cm, 7-28 cm 28-100 cm, 100-289 cm	The temperature of the soil for a given depth below the surface
Latent heat flux	Surface	The exchange of heat between the surface and the air owing to evaporation (and sublimation)
Sensible heat flux	Surface	The exchange of heat between the surface and the air due to the turbulent motion of air
Incoming shortwave radiation (acc.)	Surface	Hour-accumulated shortwave radiation directed at the surface from above, including direct and diffuse components
Incoming longwave radiation (acc.)	Surface	Hour-accumulated longwave radiation directed at the surface from above
Outgoing longwave radiation (acc.)	Surface	Hour-accumulated longwave radiation directed (upwards) away from the surface
Outgoing shortwave radiation (acc.)	Surface	Hour-accumulated shortwave radiation directed (upwards) away from the surface
Outgoing longwave radiation (acc.)	Top of atmosphere	Hour-accumulated longwave radiation directed (upwards) away from the top of the atmosphere

Invariants Bundle

Field Name	Vertical Level	Description
Terrain height	Surface	The elevation of the surface of the earth in the model environment relative to mean sea level. Also known as orography.
Soil Type	Surface	Index from 1 to 7 indicating the following soil types: <ul style="list-style-type: none"> 1 = Coarse 2 = Medium 3 = Medium fine 4 = Fine 5 = Very fine 6 = Organic 7 = Tropical organic Soil types are derived from the FAO/UNESCO Digital Soil Map of the World.
Low Vegetation Cover	Surface	Fraction of the grid box (0-1) that is covered with vegetation that is classified as 'low'
Type of Low Vegetation	Surface	This parameter indicates the recognised types of low vegetation: <ul style="list-style-type: none"> 1 = Crops, Mixed farming 2 = Grass 7 = Tall grass 9 = Tundra 10 = Irrigated crops 11 = Semidesert 13 = Bogs and marshes 16 = Evergreen shrubs 17 = Deciduous shrubs 20 = Water and land mixtures Other types are high vegetation, or indicate no land surface vegetation (8 = Desert, 12=Ice caps and Glaciers, 14 = Inland water, 15 =Ocean)
High Vegetation Cover	Surface	Fraction of the grid box (0-1) that is covered with vegetation that is classified as 'high'
Type of High Vegetation	Surface	This parameter indicates the recognised types of high vegetation: <ul style="list-style-type: none"> 3 = Evergreen needleleaf trees 4 = Deciduous needleleaf trees

		<ul style="list-style-type: none"> 5 = Deciduous broadleaf trees 6 = Evergreen broadleaf trees 18 = Mixed forest/woodland 19 = Interrupted forest Other types are low vegetation, or indicate no land surface vegetation (8 = Desert, 12=Ice caps and Glaciers, 14 = Inland water, 15 =Ocean)
Land-Sea Mask	Surface	The proportion of land, as opposed to ocean or inland waters (lakes, reservoirs, rivers and coastal waters), in a grid box.
Ocean Depth	Sea Level	The depth of water from the surface to the bottom of the ocean. Also known as bathymetry.

Note: Invariant fields don't change through the historical period.

Maritime Bundle

Field Name	Vertical Level	Description
Sea Surface Temperature	Sea level	The temperature of the ocean surface
Significant Wave Height	Sea level	Wave heights of combined swell and wind waves
Mean Wave Direction	Sea level	Mean wave direction of combined swell and wind waves
Mean Wave Period	Sea level	Mean wave period of combined swell and wind waves
Maximum Wave Height	Sea level	Estimated height of the expected highest individual wave.
Ocean Currents (eastward component)	Sea level	The eastward component of the ocean current vector
Ocean Currents (northward component)	Sea level	The northward component of the ocean current vector
Ocean Salinity	Sea level	The amount of dissolved

		salts that are present in water.
Sea Ice Fraction	Sea level	Fraction of the grid box (0-1) that is covered by sea ice.
Sea Ice Thickness	Meters	Mean thickness of the sea ice layer in the area of the grid cell covered by ice.

Maritime Swell Wave Bundle

Field Name	Vertical Level	Description
Significant Wave Height of 1st Swell Partition	Sea level	Wave heights of first swell partition
Mean Wave Direction of 1st Swell Partition	Sea level	Mean wave direction of first swell partition
Mean Period of 1st Swell Partition	Sea level	Mean wave period of first swell partition
Significant Height of 2nd Swell Partition	Sea level	Wave heights of second swell partition
Mean Wave Direction of 2nd Swell Partition	Sea level	Mean wave direction of second swell partition
Mean Wave Period of 2nd Swell Partition	Sea level	Mean wave period of second swell partition

Maritime Wave Bundle

Field Name	Vertical Level	Description
Significant Wind Wave Height	Sea level	Wave heights of waves generated by local winds
Mean Wind Wave Direction	Sea level	Mean wave direction of waves generated by local winds
Mean Wind Wave Period	Sea level	Mean wave period of waves generated by local winds
Significant Total Swell Wave Height	Sea level	Wave heights of combined swell waves

Mean Total Swell Wave Direction	Sea level	Mean wave direction of combined swell waves
Mean Total Swell Wave Period	Sea level	Mean wave period of combined swell waves

Precipitation Bundle

Field Name	Vertical Level	Description
Precipitation Type	Surface	The type of precipitation at the surface, at the specified time. Types are the following: <ul style="list-style-type: none"> 0 = No precipitation 1 = Rain 3 = Freezing rain 5 = Snow 6 = Wet snow 7 = Mixture of rain and snow 8 = Ice pellets
Total Snowfall	Surface	The total accumulated snow that occurred in the last hour
Snow depth	Surface	The depth of snow from the snow-covered area of a grid box. It represents the depth the water would have if the snow melted and was spread evenly over the whole grid box
Maximum precipitation rate	Surface	Maximum total precipitation rate that occurred in the last hour

Renewable Energy Bundle

Field Name	Vertical Level	Description
u-wind component	100 meters AGL	The eastward component of the horizontal wind
v-wind component	100 meters AGL	The northward component of the horizontal wind
Wind speed	100 meters AGL	Wind speed at 100 meters
Wind direction	100 meters AGL	Meteorological wind direction at 100 meters (direction from which the wind is blowing) i.e. 90° is wind from the east, 180° from the south, etc.

Thunderstorm Bundle

Field Name	Vertical Level	Description
CAPE	Whole atmosphere	Convective Available Potential Energy
CIN	Whole atmosphere	Convective Inhibition

Annex 4 - Data – Current Conditions

The Data provided in the Current Weather Conditions may consist of a combination of the following data fields (depending on the terms of the Order Form):

Field Name	Vertical Level	Description
Temperature	2 meters Above Ground Level ("AGL")	Air temperature at screen level
Relative humidity	2 meters AGL	The fractional ratio of the partial pressure of water vapor to the equilibrium vapor pressure at a given temperature, expressed as a percentage
Dewpoint temperature	2 meters AGL	The screen-level temperature at which a parcel of air cooled at constant pressure and specific humidity reaches saturation
u-wind component	10 meters AGL	The eastward component of the horizontal wind
v-wind component	10 meters AGL	The northward component of the horizontal wind
Mean sea-level pressure	Sea level	Air pressure adjusted to mean sea level
Precipitation Rate	Surface	The rate of liquid precipitation at the specified time.
Wind gust speed	10 meters	Instantaneous wind gust (speed)
Visibility	Surface	The horizontal visibility

Incoming Shortwave Radiation	Surface	Hour-accumulated shortwave radiation directed at the surface from above, including direct and diffuse components
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This bundle is available in WMS, GRIB2, or JSON.

Annex 5 - Data – Tides

Field Name	Vertical Level	Description
Tides	Sea Level	The altered height of the sea above its normal level due to effects of the earth's rotation and gravitational pull of the sun and moon.