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 (v1.5 dated 1 January 2020) (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 Paragraph 12;

(ii)   for 24 hours, 7 days, or 10 days (as further described in Paragraph 2); and

(iii)   globally (or for specified areas or locations); or

(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 Paragraph 13;

(ii)   for 24 hours 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)   **Analysis** – The Data forecast for a Data field at the time the forecast is generated (for example, the expected temperature at a location at 0000 hrs UTC for a Forecast generated at 0000 hrs UTC);

(b)   **Short-Range Forecast** – a Current Forecast for a rolling 24-hour period, with hourly output (one forecast per variable per hour – for example, the expected temperature at a location at 0000 hrs UTC, 0100 hrs UTC, etc); and

(c)   **Medium-Range Forecast** - a Current Forecast for a rolling period of either 7 days or 10 days, with 6-hourly output (i.e. one forecast per variable every 6 hours – for example, 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	Forecast Generation (Base Time; UTC)	Forecast Period (UTC)	Delivery - API Availability (UTC)
Analysis	0000	0000 (day 1)	0700 to 0800
	0600	0600 (day 1)	1300 to 1400
	1200	1200 (day 1)	1900 to 2000
	1800	1800 (day 1)	0100 (next day) to 0200 (next day)
Short-Range	0000	0000 (day 1) to 0000 (day 2)	0700 to 0800
	0600	0600 (day 1) to 0600 (day 2)	1300 to 1400
	1200	1200 (day 1) to 1200 (day 2)	1900 to 2000
	1800	1800 (day 1) to 1800 (day 2)	0100 (next day) to 0200 (next day)
Medium-Range 7-Day	0000	0000 (day 1) to 0000 (day 7)	0700 to 0800
	1200	1200 (day 1) to 1200 (day 7)	1900 to 2000
Medium-Range 10-Day	0000	0000 (day 1) to 0000 (day 10)	0700 to 0800
	1200	1200 (day 1) to 1200 (day 10)	1900 to 2000

3.2   For example, the Short-Range Forecast for the Current Global Forecast will be updated every 6 hours and delivered to the API with up to 8 hours' latency. This means:

(a) a Short-Range Forecast for the Current Global 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 2000hrs UTC (day 1); and

(b) the first 8 hours of a Short-Range Forecast for the 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.

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 Short-Range Forecast for an 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. Historical Global Forecasts

5.1 Spire provides the Data forecast by Spire's global forecast model for the creation of the Current Global Forecast for four historical time periods, depending on the terms of the Order Form (collectively, "**Historical Global Forecasts**"):

(a) **Analysis** – The Data forecast for a Data field at the time the forecast is generated (i.e. for example, the expected temperature at a location at 0000 hrs UTC for a Forecast generated at 0000 hrs UTC);

(b) **Hourly** – The forecast for a Data field for each hour during a specified period on the Order Form from the closest preceding Short-Range Forecast (for example, the expected temperature at a location at (a) 0500 hrs UTC, etc will be from the Short-Range Forecast generated at 0000 hrs UTC; and (b) 1300 hrs will be taken from the Short-Range Forecast generated at 1200 hrs UTC);

(c) **Short-Range** – The Data generated as Short Range Forecasts during the period specified on the Order Form. For the avoidance of doubt, the Data is comprised of the forecasts generated during the specified period, not the Short Range forecasts generated (at any time) relating to the specified period; and

(d) **Medium-Range 7-day** – The Data generated as Medium Range 7-day Forecasts during the period specified on the Order Form. For the avoidance of doubt, the Data is comprised of the forecasts generated during the specified period, not the Medium Range 7-day Forecasts generated (at any time) relating to the specified period.

5.2 The Historical Global Forecasts are available for Data fields described in Paragraph 12 of this Data Description. Please note that the Data fields in the Data

bundles have varied over time and:

(a) not all Data fields are available for all time periods; and

(b) the horizontal resolution of the Data varies according to the time period.

5.3 If a specific Data field or resolution are required for a particular time period, it must be specified on the Order Form.

6. Nature of Data

6.1 For the avoidance of doubt:

(a) the Data (including the Data used in the Historical Global Forecasts) consists of the Spire's Data forecasts for the applicable period; and

(b) the Data does not include any verification of the forecast or actual value for the Data field.

6.2 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 (including if the Data is provided as part of an Historical Global Forecast).

7. Data Access

7.1 Spire provides access to the Data through an API in the following file formats:

(a) GRIB2;

(b) JSON; or

(c) WMS (OGC Web Map Service)

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

(a) the Current Global Forecast is available in the formats described in Paragraph 12;

(b) the Current Optimized Point Forecast is available in JSON only; and

(c) the Historical Global Forecasts are available in GRIB2 only.

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

7.4 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.

7.5 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.

8. Customer Applications

8.1 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; and

(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.

8.2 The definition of "Customer Application" in Paragraph 8.1 supersedes the definition in the Terms & Conditions.

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

9. Service Levels - SLs

9.1 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

(d) (collectively, "**Excluded Events**").

Service Item	Service Level
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.

10. Service Levels - Remedies

10.1 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

10.2 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.

10.3 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.

10.4 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.

10.5 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.

10.6 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.

11. Third-Party Data Providers

11.1 The Data may contain or be based upon:

(a) data and products from the European Centre for Medium-Range Weather Forecasts (ECMWF); and

(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.

12. Data – Current Global Forecast & Historical Global Forecasts

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

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

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
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

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. The bundle is available at 0.25 degree global resolution.

Agricultural Bundle

Field Name	Vertical Level	Description
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
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 longwave radiation	Surface	Longwave radiation directed (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.

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
Visibility	Surface	The horizontal visibility
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

This bundle is available in WMS, GRIB2 or JSON.

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.

Renewable Energy Bundle

Field Name	Vertical Level	Description
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
Incoming shortwave radiation	Surface	Shortwave radiation directed at the surface from above and includes direct and diffuse components
Temperature	2 meters AGL	Air temperature at screen level

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
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

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		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.

13.   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):

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.

Field Name	Vertical Level	Description
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 Probability of precipitation	Surface	The probability of (liquid) 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 Current Optimized Point Forecast is available in JSON only.