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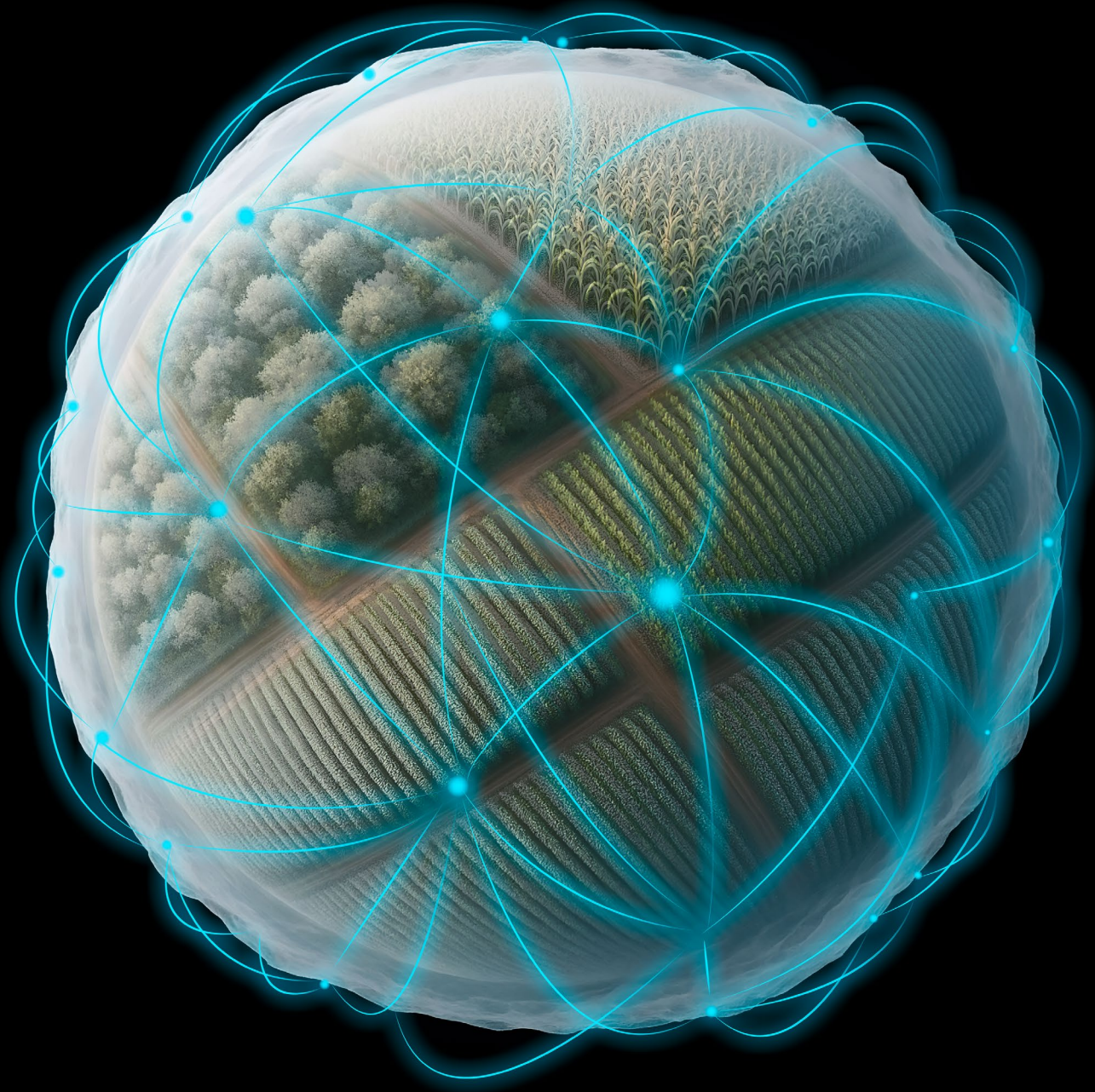

datasphere

Solution Brief: Assessing frost risk based on crop sensitivity and local conditions.

KISTERS

Empowering decisions of tomorrow

Solution Brief:
Assessing frost risk based on crop sensitivity and local conditions.

Why frost matters

Frost is a natural weather phenomenon in temperate and cold climates – and for many crops, a period of cold is even essential to ensure proper development. But not all frost is welcome. In particular, spring frost – especially after a period of warm weather – can be damaging.

These types of events, often called damaging spring frosts, occur when a spell of mild weather triggers early plant development (germination or flowering), followed by a return of night-time freezing temperatures. With climate patterns shifting, these scenarios are becoming more common, as warm spells arrive earlier but cold nights still return.

Risk is not the same everywhere

The impact of frost is not universal.
It depends on:

- The crop type – Some crops (e.g., strawberries) are more sensitive than others (e.g., apples).
- The growth stage – Even within the same crop, frost sensitivity varies. A swelling bud can withstand colder temperatures than a flower in full bloom.
- Local geography – Soil type and terrain shape frost exposure. Cold air accumulates in valleys, and sandy soils cool faster than heavier soils during clear, still nights.

The KISTERS 'Frost Risk' forecast in KISTERS datasphere

The Frost Risk Module in KISTERS datasphere combines these variables – crop, location, growth stage, and weather uncertainty – to help you plan protective actions with confidence.

How it works

1. Local conditions first

You begin by entering the soil type and topographic setting of your field. These parameters help fine-tune the base weather forecast by accounting for microclimatic effects.
For example:

- Valleys trap cold air and cool faster at night.
- Sandy soils radiate heat more quickly than clay or loam.

2. Crop-specific thresholds

Next, you select the crop or cultivar you're monitoring and indicate its phenological stage (growth phase). This information defines the temperature thresholds that matter for that specific crop, at that specific time.

- Default frost sensitivity thresholds are based on reputable sources like FAO.
- You can override them anytime based on your own experience or local benchmarks.

3. Two thresholds, two risk levels

The system calculates the probability that forecast temperatures will fall below:

- 10% damage threshold – minor, but notable crop damage possible.
- 90% damage threshold – severe or widespread crop damage likely.

These calculations use:

- The selected weather model.
- Your local refinement inputs.
- The uncertainty spread in the forecast.

4. Output formats

Choose between:

- Daily reports – Up to 5 days ahead, one value per day.
- 3-hourly detailed reports – More granular planning, same forecast window.

(Note: Some weather models may not provide full 5-day data.)

datasphere

Locations | Dashboards | Alarm Event Status | Alarming | Channels | Account Settings | Time Series

Risk of damaging Frost

Location	Crop	Topography	Soil type	Model	Time of Forecast
Limousin	Berries/Strawberries/None	Cold air collecting valley	Sand	nwp.noaa.gfs	19.12.2023 17:00

	Wednesday	Thursday	Friday	Saturday	Sunday
	20.04.2023	21.04.2023	22.04.2023	23.04.2023	24.04.2023
Risk summary					
Indicator	D+1	D+2	D+3	D+4	D+5
Probability of a 10% crop damage.	0%	69%	56%	100%	73%
Probability of a 90% crop damage	0%	53%	50%	90%	51%
Probability of frost					
Indicator	D+1	D+2	D+3	D+4	D+5
Minimum air temperature	1.8°C	-13 °C	-0.7°C	-4.8°C	-26°C
Minimum soil temperature	1.6 °C	-17 °C	-0.9°C	-5.4 °C	-3.8°C
Probability of frost at this location	0%	69%	56%	100%	80%
Probability of ground frost at this location	0%	77%	59%	100%	92%

Risk of 10% damage by phenological stages

Stage	Start date	Threshold	D+1	D+2	D+3	D+4	D+5
Tight Bud	19.04.2023	-3.3°C	0%	18%	11%	72%	47%
Tight With White Petals	20.04.2023	-04°C	0%	61%	57%	100%	74%
Full Bloom	21.04.2023	-0.0°C	0%	69%	56%	100%	80%
Immature Fruit	23.04.2023	-0.5°C	0%	59%	51%	100%	73%

Risk of 90% damage by phenological stages

Stage	Start date	Threshold	D+1	D+2	D+3	D+4	D+5
Tight Bud	19.04.2023	-6.1°C	0%	0%	0%	3.3%	10%
Tight With White Petals	20.04.2023	-2.1°C	0%	43%	33%	92%	52%
Full Bloom	21.04.2023	-0.9°C	0%	53%	50%	99%	67%

Figure: Frost risk forecast for berries in Limousin, France

This example shows a 5-day forecast using the KISTERS Frost Risk Module, customized for a cold air-collecting valley with sandy soil. The output displays the probability of crop damage (at 10% and 90% levels), alongside forecasted frost and ground frost risk, and temperature thresholds by phenological stage. It enables growers to anticipate risk for tight bud, bloom, and immature fruit stages with both daily probabilities and minimum air/soil temperature forecasts.

Key benefits at a glance:

- Localized forecasts that adjust for soil, slope, and microclimate.
- Tailored to crop and phenological sensitivity.
- Probabilistic outputs for minor and major frost risk.
- Uses trusted thresholds, customizable to local needs.
- Flexible format: daily overview or 3-hour detail.

HydroMet

Make every growing season a success.

With datasphere Frost Risk Module.

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Who are we?

We're KISTERS – and for over 60 years, we've specialised in helping our customers collect, analyse and share the environmental data that will shape the future.

Through innovative, digitally-focused solutions, we develop advanced systems that enable our customers to capture and manage information at a higher quality than ever before. So they can make the solutions our world needs to thrive.

Discover the Frost Risk Module

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