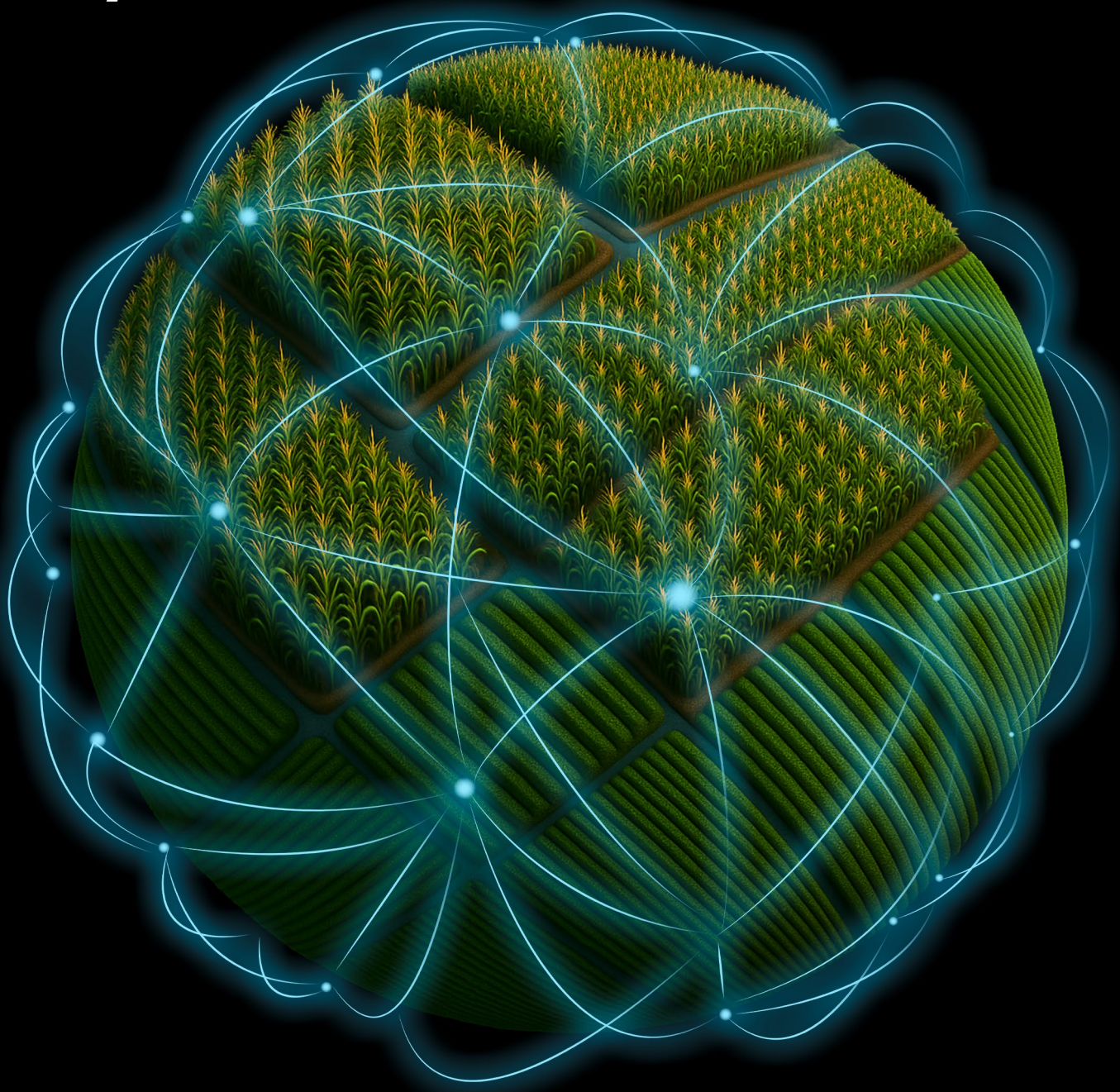
HydroMet



datasphere

Solution Brief: Irrigation Recommendation using an Actual Evapotranspiration (ETa) sensor.

KISTERS

Empowering decisions of tomorrow

Solution Brief:
Irrigation Recommendation using an Actual Evapotranspiration (ETa) sensor.

Introduction

Water is one of the most precious natural resources, and all life depends on it to thrive. However, one of the key consequences of climate change is that water availability in many agricultural areas has become increasingly unpredictable. Drought periods are lasting longer, and when rain does occur, it tends to be more intense – leading to higher runoff and reduced soil infiltration.

In this climate of growing scarcity and uncertainty, agriculture must rely on accurate, real-time insight into crop water stress and irrigation needs. KISTERS addresses this challenge with an advanced irrigation recommendation system built on actual evapotranspiration (ETa) measurements.

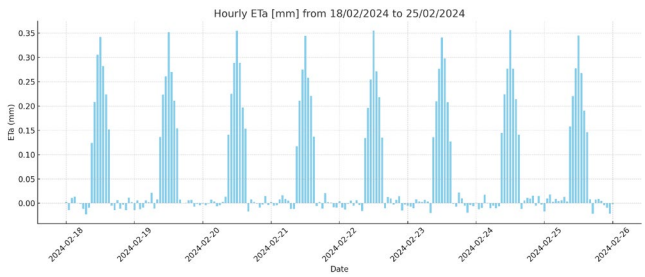


Figure: Hourly ETa measurements from 18 to 25 February 2024.

This chart displays actual evapotranspiration (ETa) measured hourly in millimeters. It provides insight into crop water use throughout each day – supporting more precise, real-time irrigation recommendations.

Why ETa matters

While calculating potential evapotranspiration (ETc) using the FAO56 Penman-Monteith equation has been a long-standing standard, it only estimates how much water a crop could use under ideal conditions. Measuring actual evapotranspiration (ETa), on the other hand, provides direct insight into how much water a crop is actually using in the field.

This enables users to:

- Quantify real-time drought stress.
- Compare ETa vs. ETc to detect water deficits.
- Generate precise, sensor-based irrigation guidance.

Figure: FieldRay station measuring environmental parameters for crop water balance analysis

This KISTERS monitoring station collects real-time data on solar radiation, temperature, humidity, wind, and rainfall – enabling accurate calculation of potential evapotranspiration (ETc) and supporting ETa modeling when direct sensors are not available.

From ETa to Forecast-based irrigation planning

The process begins by comparing ETa (from field sensors) with ETc (from local weather stations or forecast models). From this comparison, the system estimates:

- Future evapotranspiration demand.
- Forecasted rainfall, converted into effective rainfall based on slope, canopy, and growth stage.
- Soil drying patterns depending on soil type, water-holding capacity, and weather conditions.

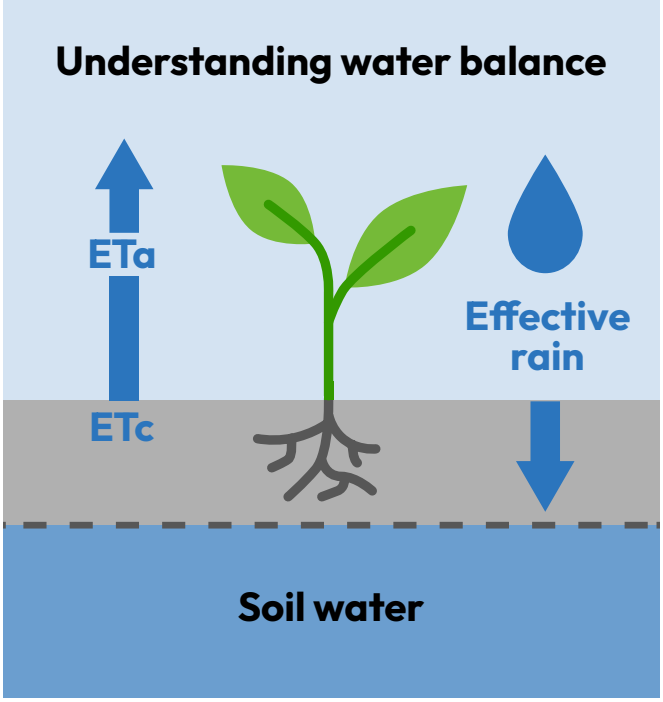


Figure: Understanding water balance

Irrigation recommendations are based on how ETa, ETc, and effective rainfall interact with soil water availability over time.

Forecasting with flexibility

Since weather forecasts come with uncertainty, KISTERS allows users to choose from multiple forecast models to simulate different scenarios. The system calculates:

- ETo – reference evapotranspiration
- ETc – crop-specific potential evapotranspiration.
- ETa – actual crop water use.

These values form the basis of an initial irrigation recommendation.

Refinements for real-world accuracy

The model then refines this baseline by factoring in:

- **Crop phenological stage (Kc values)**
  → Example: Corn at emergence needs much less water than at maturity.
- **Irrigation method efficiency**
  → Example: Drip irrigation is more efficient than sprinklers or gravity-fed systems.

The final recommendation is tailored to crop type, growth stage, and irrigation infrastructure.

Scenario testing for local decision-making
The system also supports "what if" simulations that allow users to model common routines and constraints. For instance:

- A farmer might typically irrigate every 5th day.
- Water extraction might only be allowed on specific days due to local water rights.

These custom simulations show how such routines affect the irrigation recommendation. The model considers:

- Local irrigation efficiency.
- Forecasted rainfall.
- Crop water stress over time.

This allows farmers and planners to compare default practice with data-informed strategy to optimize their outcomes.

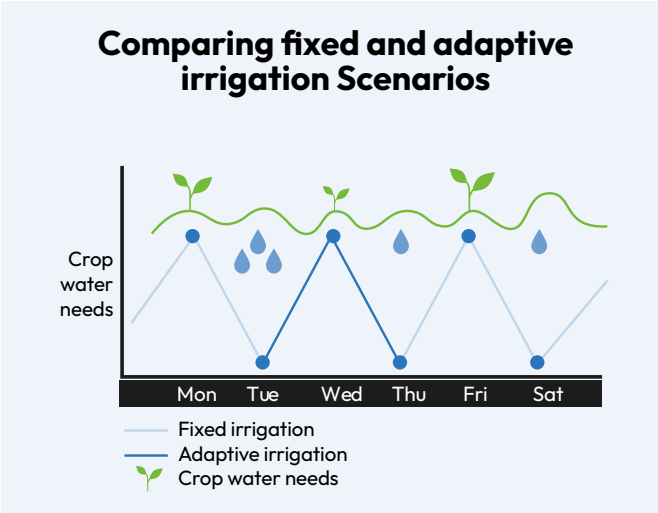


Figure: Fixed vs. Adaptive Scenario comparison chart

Simulations show how static schedules differ from adaptive ones that respond to rain forecasts and crop water status. This helps optimize efficiency and reduce waste.

Figure: Crop Growth vs. Water Demand

Crop water needs vary significantly depending on phenological stage. The system adjusts recommendations using Kc values to avoid over- or under-irrigation.

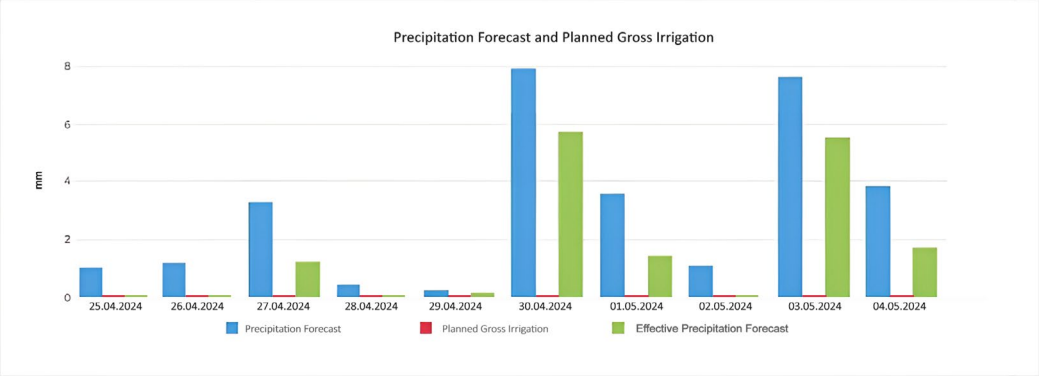
Example output

This output demonstrates how measured ETa values – combined with localized forecasts – translate into actionable recommendations per day.

Irrigation Recommendation

Location	Crop	Date of Emergence	Forecast Model	Time of forecast
Irrigation Location	Carrot	05.02.2024	NCEP GFS	05.04.2024 02:00

	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	25.04.2024	26.04.2024	27.04.2024	28.04.2024	29.04.2024	30.04.2024	01.05.2024	02.05.2024	03.05.2024	04.05.2024
	Today	D+1	D+2	D+3	D+4	D+5	D+6	D+7	D+8	D+9
Precipitation Forecast (mm)	1.0	1.1	3.3	0.4	0.2	7.9	3.5	1.1	7.6	3.9
Planned Gross Irrigation (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Effective precipitation forecast (mm)	0.0	0.0	12	0.0	0.0	5.7	14	0.0	5.5	1.7
ETo forecast (mm)	1.8	2.1	2.4	2.7	2.1	3.5	1.7	0.9	1.8	1.8
ETa forecast (mm)	1.7	1.8	2.4	2.3	1.6	3.5	1.7	0.9	1.8	1.8
Specific Crop Irrigation recommendation (mm)	1.5	1.7	0.1	2.8	3.0	0.0	0.0	0.0	0.0	0.0



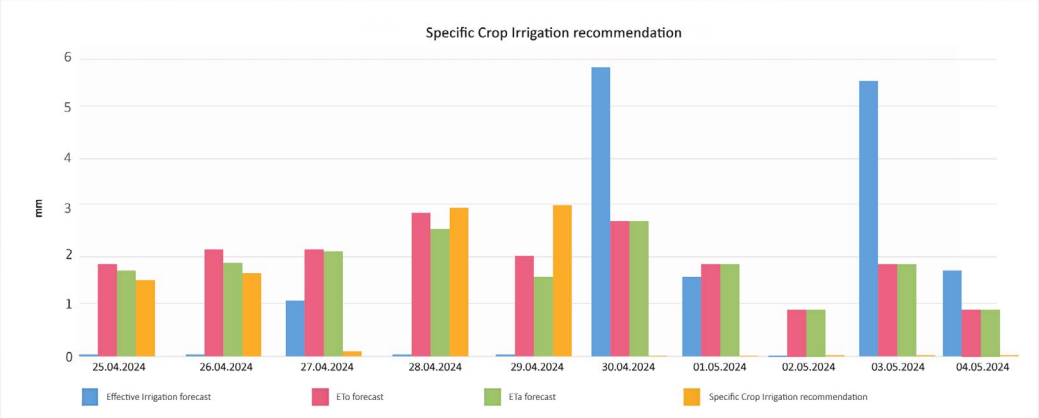


Figure: Daily Irrigation Forecast and Recommendation overview

Top: Precipitation forecast, planned gross irrigation, and effective rainfall.

Bottom: ETo, ETa, effective precipitation, and the final irrigation recommendation. This visual helps compare water demand vs. availability, supporting better irrigation planning.

Key Benefits of ETa-based irrigation recommendation – Available in the KISTERS datasphere Irrigation Recommendation Module:

- Measure actual crop water use to assess drought stress instantly.
- Adapt irrigation plans to crop type, growth stage, and method used.
- Easily simulate “what if” irrigation scenarios to plan under constraints or uncertainty.
- Save water, reduce waste, and improve yields with precision-informed decisions.

HydroMet

Irrigate smarter.
Save water.
Grow better.

With datasphere Irrigation Recommendation Module.

© KISTERS AG | 07.2025

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 Irrigation module

Contact Us

KISTERS Europe | hydromet.sales@kisters.eu | kisters.eu
KISTERS Australia | sales@kisters.com.au | kisters.com.au
KISTERS Latin America | sales@kisters-latam.com | kisters-latam.com
KISTERS New Zealand | sales@kisters.co.nz | kisters.co.nz
KISTERS North America | kna@kisters.net | kisters.net

KISTERS
Empowering decisions of tomorrow