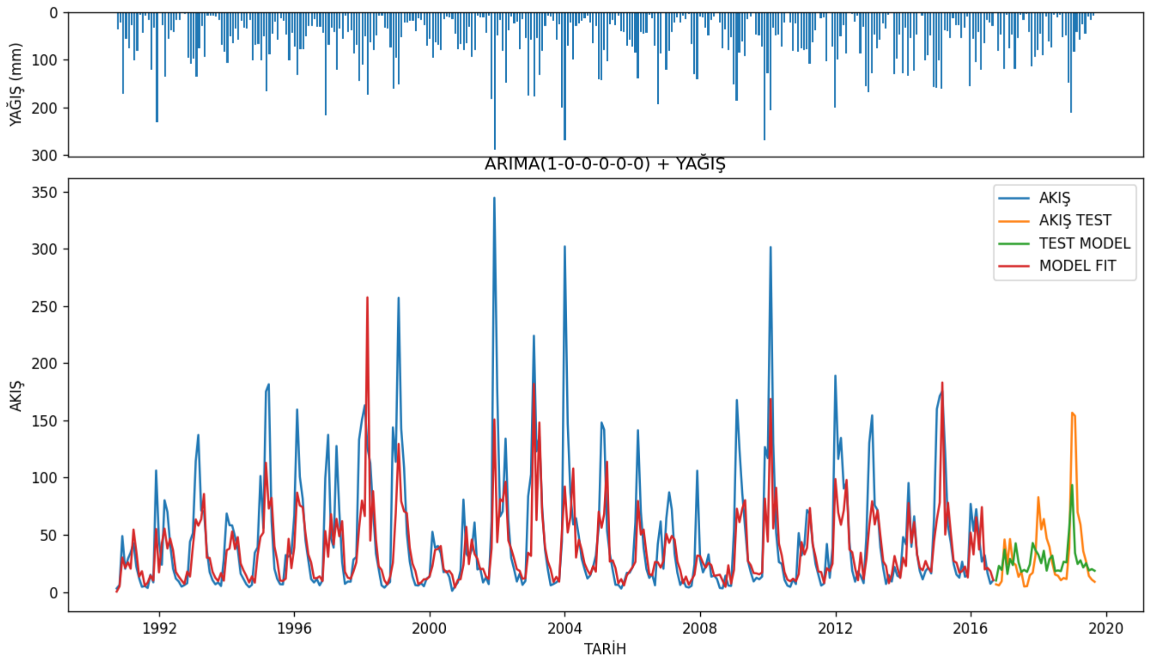
WATER INTELLIGENCE DIVISION

INTEGRATED CAPABILITIES PRESENTATION

Water Systems Smart Agriculture Modelling & DSS

From specialist components to integrated master plans



EKOFLY Tech • METU Technopolis • 2026

Decision risk begins when systems are built in isolation

01 **Fragmented data**

Station, satellite, meter and field data are not converted into a common quality and time standard.

02 **Isolated analyses**

Water, agriculture and model outputs do not meet in the same budget; results cannot cross-check each other.

03 **The decision trail is lost**

The data and models behind scenarios, priorities and investment decisions cannot be traced.

The EKOFLY approach

We run all three systems on one data backbone and pass their results through common quality gates.

- **One data and version record**
  Raw data, processed data, model runs and decision outputs remain distinct.
- **Independent validation**
  Model selection is based on calibration, validation and a locked test period.

We operate three systems as one decision chain

WATER AGRICULTURE MODEL + DSS

Hydrometeorological data, groundwater, satellite observations, agricultural indicators and operating data meet on one project backbone.

Data backbone

Gauges • satellites • meters • wells • GIS

System models

Hydrology • hydrogeology • agriculture • operations

Validation gates

QA • calibration • validation • locked test

Decision and delivery

Scenarios • KPIs • investment • GIS • reports

Core value proposition

Not a single software package: an integrated system where data sources, model selection, uncertainty and delivery remain traceable.

Our portfolio combines three systems with one delivery architecture

Water Management
Hydrology • groundwater • karst • natural flow • reservoirs • risk

Smart Agriculture
Crops • ETa • irrigation • stress • moisture • efficiency

Modelling & DSS
Model Hub • validation • uncertainty • AI • scenarios

Master Plans & Handover
Investment programme • GIS • reporting • training • institutional handover

Integrated client outputs

Shared water budget
Surface water, groundwater and agricultural demand in one balance.

Scenarios and investment
Climate, allocation, operations and prioritisation in one chain.

Traceable delivery
An auditable package from data source to management decision.

Each system can be deployed independently; the greatest value is created when they share one data backbone and decision framework.

The water system is delivered through six end-to-end work packages

01 Data and observation infrastructure

QA and inventory of gauges, wells, dams, satellites, climate and GIS data

02 Hydrological modelling

Rainfall–runoff, natural flow, water balance, forecasting and multi-model comparison

03 Hydrogeology and karst

Conceptual model, groundwater potential, baseflow, allogenic recharge and numerical modelling

04 Naturalisation and forecasting

Separation of regulation effects; reliable inputs and flow scenarios

05 Reservoirs, energy and allocation

Rule curves, hydropower, demand coverage, environmental flows and optimisation

06 Risk, climate and investment

Floods, drought, sediment, CMIP6, water deficits and investment priorities

The agriculture system advances from parcel observation to irrigation decisions

01 Land and parcel base

Active agricultural land, parcels/AOIs, crop patterns and cultivated-area change

02 Crop mapping and phenology

Crop class, growth stage, NDVI/LAI and seasonal behaviour

03 ETa and crop water use

High-resolution ETa, ensemble comparison and water consumption

04 Irrigation demand and scheduling

Timing and volume from effective rainfall, soil water and crop demand

05 Stress, health and soil moisture

Thermal/CWSI and spectral indicators, moisture anomalies and field priorities

06 Efficiency, climate and reporting

Water productivity, loss areas, drought scenarios and GIS dashboards

The modelling system manages performance, uncertainty and decisions together

01 Data quality and run records

Source, unit, period, geometry, missing data and version records

02 Model Hub and model selection

Alternative models compared with the same data and objective functions

03 Calibration and validation

Multi-objective metrics, period separation, cross-checks and locked testing

04 Uncertainty and ensembles

Parameter, data and structural uncertainty carried into decision ranges

05 AI and hybrid correction

Volume-bias-controlled residual correction of process-based models

06 Scenarios and interoperability

WEAP, HAPP, HEC-ResSim, MODSIM, GIS, reports and institutional handover

Each system plays the right role; results converge in one decision

Shared data and QA
Gauges • wells • satellites • meters • climate • GIS

Water Management
Hydrology • groundwater • karst • natural flow • reservoirs

Smart Agriculture
Crops • ETa • irrigation demand • stress • efficiency

Decisions and investment
Water balance • allocation • risk • KPIs • action programme

Independent control and support layers

Model Hub
Candidate model screening and comparative experiments

Groundwater / karst
MODFLOW • FEFLOW • baseflow • allogenic recharge

HAPP / HEC-ResSim
Reservoir operations, energy and rule-curve control

QA / versions / reports
Uncertainty, provenance and reproducible delivery

Outcome: water supply, agricultural demand and operating decisions are compared under the same scenario.

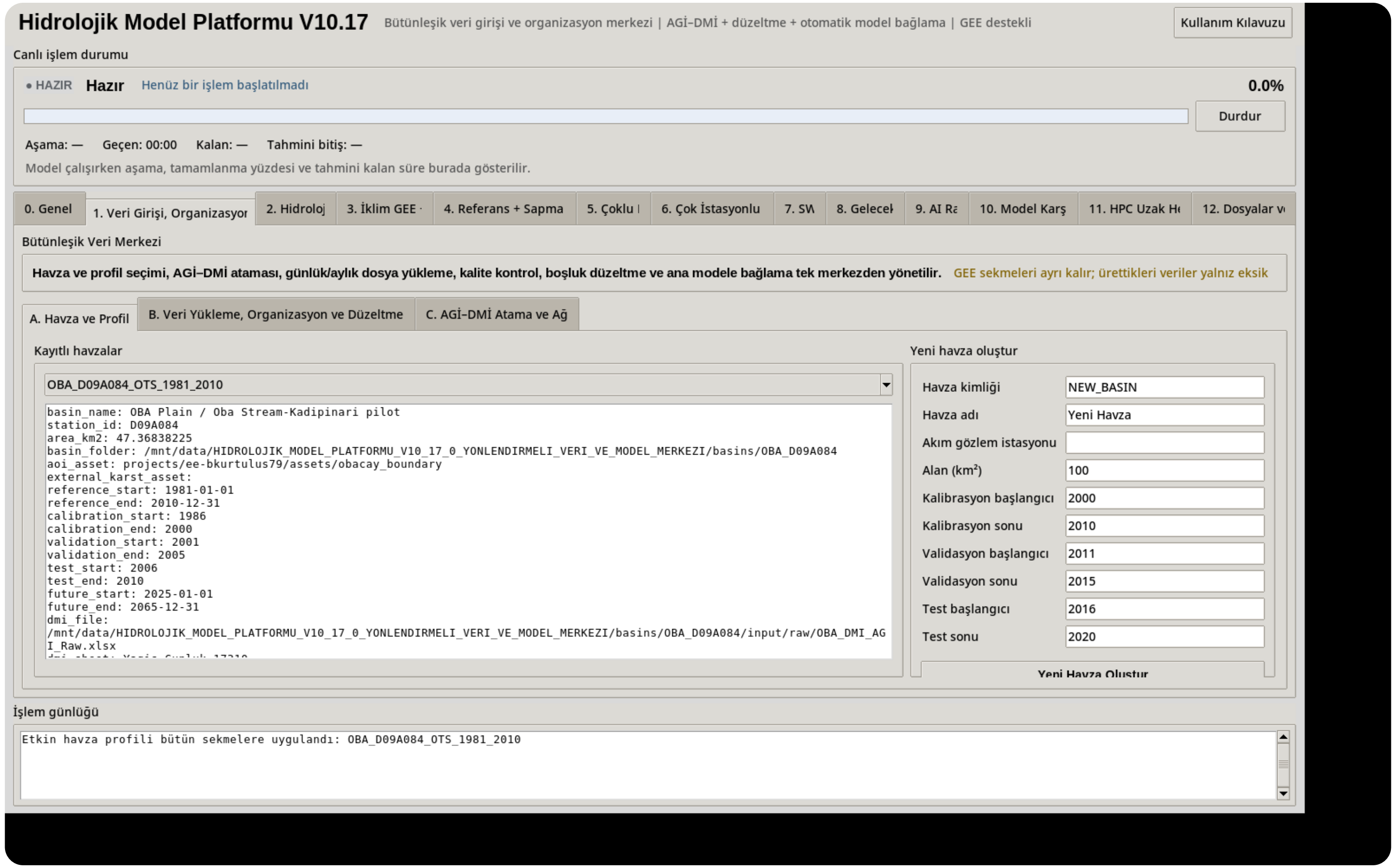
Reliable data first, defensible hydrological results next

1. Data and observation infrastructure	Gauges • wells/dams • CHIRPS • ERA5-Land • Sentinel • quality flags	**Approved model inputs**
2. Basin and drainage system	DEM • sub-basins • drainage network • gauge–outlet matching • area consistency	**Correct spatial model structure**
3. Rainfall–runoff modelling	HBV/TUW • GR4J • HEC-HMS • SWAT+ • DynWBM • multi-model experiments	**Flow, water balance and forecasts**
4. Hydrological naturalisation	Separation of regulation • abstraction • returns • pumping • transfers	**Planning-ready natural flow series**
5. Calibration and flow scenarios	Multi-objective metrics • validation • locked test • uncertainty • climate inputs	**Defensible performance range**

Resource potential becomes operating, risk and investment decisions

6. Hydrogeological model	Conceptual model • aquifers • recharge–discharge • wells • SW–GW interaction	**Groundwater potential**
7. Karst and fractured media	Allogenic recharge • conduit–matrix • spring hydrographs • baseflow • vulnerability	**Karst contribution and protection risk**
8. Reservoirs and allocation	WEAP • HAPP • HEC-ResSim • MODSIM • rule curves • energy • demands	**Operations and supply security**
9. Floods, drought and sediment	Extreme analysis • hydrographs • low flows • sediment risk • early warning	**Risk and action maps**
10. Climate, water balance and investment	CMIP6 • supply–demand • environmental flows • deficits • scenarios • prioritisation	**Master-plan decision base**

The multi-model platform selects the right model through evidence



- **Shared daily/monthly core**
  TUW-HBV, GR4J, HYMOD, DynWBM and abcde use the same data and experiment logic.
- **Snow, karst and multiple stations**
  Snowmelt, periodic/dynamic karst and multi-gauge configurations.
- **Comparative experiment design**
  Rainfall sources, model structures and component ablation runs in one interface.
- **Reproducible delivery**
  Sources, periods, parameters, metrics, charts and reports recorded by run ID.

Naturalisation prepares observed flow for planning

Observed flow cannot represent the natural regime until regulation, abstraction, returns, pumping and transfers are separated.

1. Import
CSV/Excel • units • frequency • QA

2. Manage gaps
AUTO • RF • KNN • donor • trace flag

3. Naturalise
Run alternative methods on the same series

4. Compare
Hydrograph • ΔQ • volume • score

5. Transfer to models
HBV • HEC-HMS • WEAP

21/21
Core and workflow tests

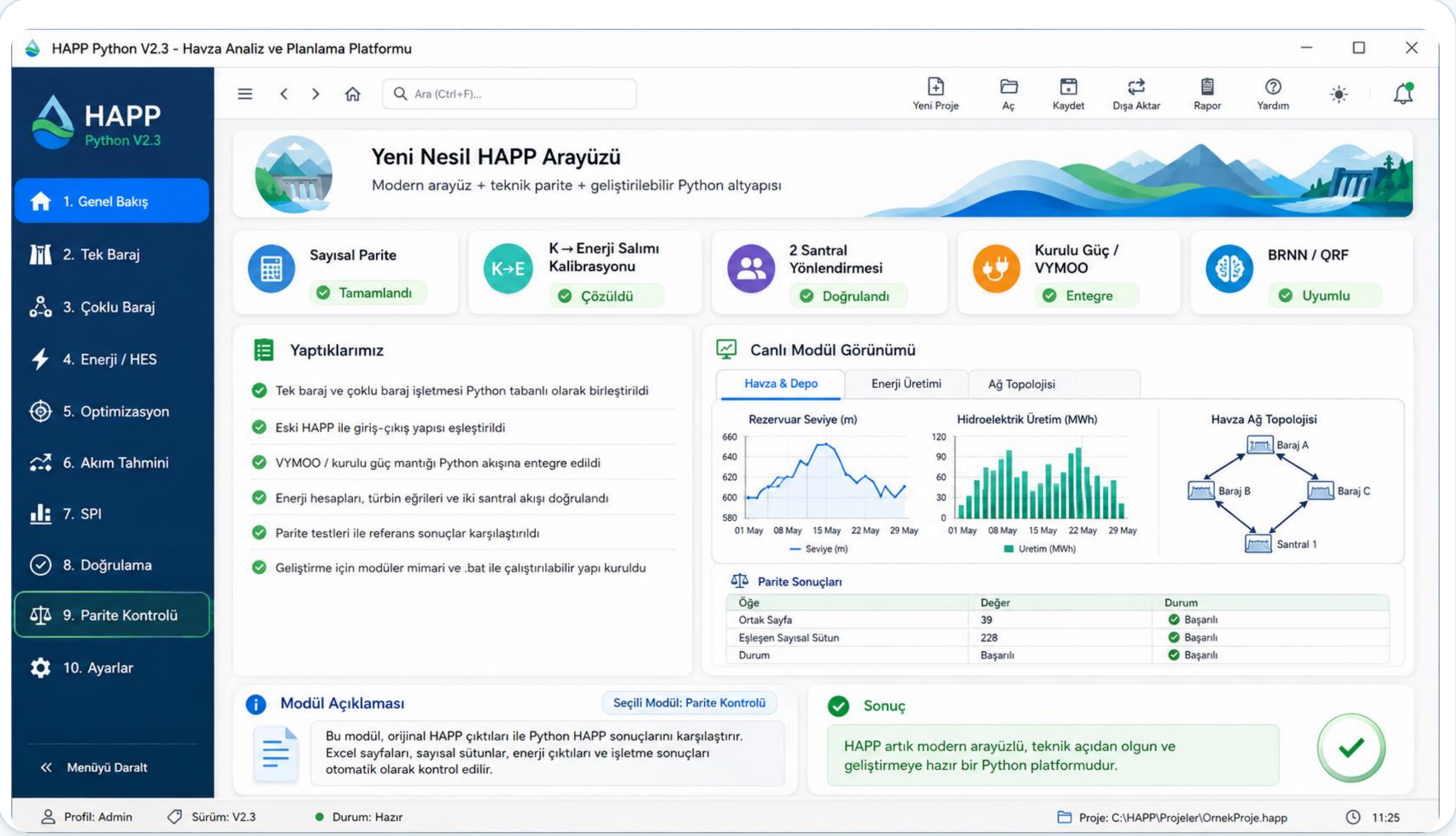
480 months
WY1986–WY2025 tutorial series

30 months
Controlled missing-data scenario

0 missing
AUTO gap-fill regression result

Filled or corrected values are never labelled as observations; method, quality and provenance remain traceable.

HAPP Python makes reservoir, energy and allocation decisions visible



- **Single/multi-reservoir**
  Irrigation, water supply, environmental flows, energy and other demands.
- **Hydropower operations**
  Turbine curves, installed capacity, rule curves and optimisation.
- **Scenario and KPI management**
  Comparison of drought, demand, priority, storage and operating scenarios.
- **Model Hub connection**
  Role-based real-engine and mapping gates with WEAP, HEC-ResSim and MODSIM.

Tutorial runs • provenance gates • local engine self-tests • editable reports

We turn groundwater potential into operating scenarios

01 Hydrogeological conceptual model

Aquifers, boundaries, recharge–discharge, springs and SW–GW interaction

02 Groundwater potential

Water table, well yield, dynamic reserves, abstraction balance and safe operation

03 Recharge and baseflow

WTF, MRC, water balance, isotopes/hydrochemistry and spring hydrographs

04 Numerical groundwater model

MODFLOW/FEFLOW: calibration, abstraction, drought, protection and forecasting scenarios

05 Karst and fractured aquifers

Allogenic recharge, conduit–matrix behaviour, spring response, vulnerability and contamination risk

06 Protection and management plan

Protection zones, monitoring networks, managed aquifer recharge and sustainable operation

The observation layer reads parcels, crops and water use together

1. Agricultural land inventory	Parcels/AOIs • active land • cultivated-area change • field-control sampling	**Current land and parcel base**
2. Crop class and phenology	Sentinel/Landsat • time series • NDVI/LAI • crop patterns • growth stages	**Crop and seasonal maps**
3. Actual evapotranspiration	SEBAL/TSEB approach • MOD16 • ERA5-Land • ensembles • field validation	**Parcel/sub-basin ETa series**
4. Effective rainfall and soil water	Rainfall partitioning • soil moisture • root zone • storage and anomalies	**Available-water indicator**
5. Crop health and stress	NDVI/EVI/NDMI • thermal/CWSI • stress classes • hotspots • field priorities	**Early-intervention map**

Agricultural indicators become irrigation programmes and investment decisions

6. Irrigation demand	ETa • effective rainfall • soil water • crop stage • gross and net demand	**Parcel and scheme demand**
7. Irrigation scheduling	When • how much • priority • water source and system constraints	**Operating schedule**
8. Irrigation efficiency	Applied water–demand gap • conveyance losses • over/under-irrigated areas	**Improvement priority**
9. Water productivity	Crop/biomass indicator • consumed water • area and period comparisons	**Production value per unit resource**
10. Forecasts, GIS and reporting	Drought/climate scenarios • seasonal outlook • dashboard • GIS • management report	**Planning and investment base**

ETa ensembles prevent irrigation demand from relying on one data product

Climate and EO inputs
ERA5-Land • MODIS • Landsat • Sentinel-2 • rainfall • field data

ETa method family
SEBAL/TSEB approach • MOD16 • ERA5-Land • external METRIC/EEFlux

Demand calculation
ETa ensemble • effective rainfall • active agricultural land • crop stage

Management output
Parcel/sub-basin maps • seasonal series • GIS • editable reports

3–30 m

Spatial resolution by sensor and product source

ETa ensemble

Inter-method spread, consistency and field controls

Irrigation demand

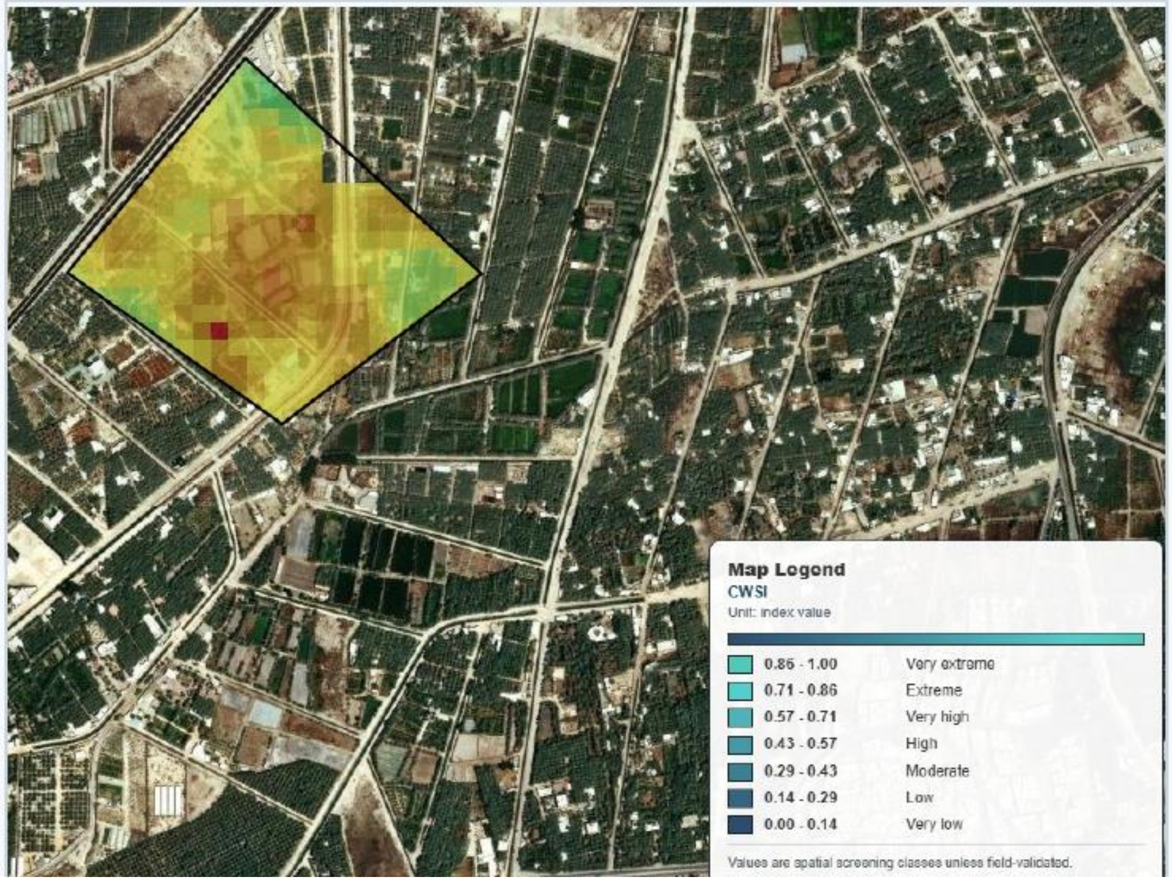
Crop water use, effective rainfall and area calculated together

GIS + reports

Maps, time series, provenance and decision summaries

ETa is not a meter reading; operational decisions are validated with irrigation records and field data.

Parcel indicators target field inspections



- **Crop area and pattern**
  Active agricultural land, crop type and seasonal change
- **Crop health and stress**
  NDVI/EVI, CWSI, LAI, LST and anomaly screening
- **Soil moisture and irrigation**
  Moisture indicators, water-deficit signals and irrigation demand
- **Yield and field priority**
  Risk classes, hotspots, validation samples and intervention plans

Output: parcel/sub-basin maps • time series • GIS layers • management report

Field demand feeds back into the basin water balance

Satellite + climate + field
Sentinel • Landsat • ERA5-Land • rainfall • meters • DEM

Agricultural indicators
Crops • ETa • stress • moisture • effective rainfall • irrigation demand

Water-system models
Rainfall–runoff • groundwater • natural flow • reservoirs • water balance

Allocation and decisions
WEAP • HAPP • irrigation scheduling • constraints • risk • investment

Integrated decision outputs

Irrigation programme
Where, when and how much water should be applied?

Basin water allocation
How should agricultural demand be balanced with other sectors and environmental flows?

Efficiency and investment
Which schemes/parcels require field control and modernisation first?

ETa and irrigation demand are validated with meters, scheme records and field data before entering basin scenarios.

Model selection uses the same data, period and metrics

1. Data quality and input records
Source • version • unit • period • geometry • missing data • transformations
Reproducible inputs

2. Model Hub
Role base for hydrology • groundwater • agriculture • reservoir • allocation engines
One project framework

3. Candidate model selection
Physical suitability • data needs • scale • operating purpose • licences
Defensible shortlist

4. Calibration
NSE/KGE • RMSE • volume bias • high/low flows • multi-start optimisation
Balanced objective function

5. Validation and locked testing
Separate period • untouched test • comparison • acceptance/rejection thresholds
Generalisable performance

Uncertainty and interoperability are part of decision design

6. Sensitivity and ablation	Rainfall source • karst/snow component • parameters • model-structure experiments	**Which component adds value?**
7. Ensembles and uncertainty	Model/data/parameter spread • probability • confidence ranges • decision thresholds	**Results expressed with risk**
8. AI-assisted correction	XGBoost/ML residual model • cross-validation • volume gate • accept/reject	**Controlled hybrid performance**
9. Scenarios and integration	WEAP • HAPP • HEC-ResSim • MODSIM • SWAT+ • MODFLOW • GIS	**Real engines and field mapping**
10. Reports, versions and handover	Run ID • source report • editable outputs • guides • training	**Auditable delivery**

Quality gates screen model performance before decisions

32/32 + 4/4
Model Platform regression and headless tests

21/21
Naturalisation core and workflow tests

12/12
OBA V6.3 daily/monthly model tests

35/35
HAPP tutorial operational validation

Quality gates monitored in every run

- **Source, version and input records**
- **Calibration / validation / locked-test separation**
- **Uncertainty, sensitivity and model comparison**
- **Unit, period, area and geometry controls**
- **Mass balance, volume bias and extreme flows**
- **Independent acceptance/rejection gate for AI outputs**

Test counts validate software packages; each new basin is calibrated and validated separately with project data.

Main planning, reference control and optimisation roles are separated

Hydrological and agricultural inputs

Rainfall–runoff • natural flow • groundwater • ETa • irrigation demand

HAPP Python

Independent DSI-compatible reservoir and energy control layer

WEAP

Main basin-planning engine

Water balance • demand • sectors • climate • scenarios

HEC-ResSim

Reservoir operations and alternative DSS comparison

MODSIM / Python

Allocation, optimisation and custom-algorithm comparison

External software is not imitated: no ‘complete’ status is issued without licences, local projects and direct field mapping.

A pilot reduces risk and accelerates basin-wide scaling

1. Data diagnosis

Data inventory
Critical gaps
AOI–gauge–well checks

2. Representative pilot

Sub-basin selection
Candidate models
Field/institution agreement

3. Evidence and selection

Calibration
Validation/locked test
Uncertainty and decisions

4. Scale-up

Sub-basins
Operations/allocation
Training and handover

Decision gate at every stage

Are data sufficient? → Is the pilot defensible? → Can parameters/workflows transfer? → Can the institution operate it?

Entry options: technical diagnosis • pilot deployment • master-plan integration • full-scale institutional handover

Three systems become one basin investment programme

1. Diagnosis and GIS
Sub-basins
Data inventory
Quality and gaps

2. Integrated system
Water + GW/karst
Agriculture + ETa
Models + QA

3. Scenarios and allocation
Climate
Water balance
Operations and risk

4. Decisions and investment
Prioritisation
Action programme
Institutional handover

Four decision levels in one chain

Sub-basin/data approval → Model consistency → Climate, allocation and operating scenarios → Investment programme

EKOFLY role: water management • smart agriculture • modelling/DSS • GIS, reporting, training and institutional handover

We work end to end from models to operations in hydrology master plans

01 Basin and sub-basin system

DEM, drainage network, gauge matching, hydrological regionalisation and pilot selection

02 Data and climate chain

MGM/DSI, CHIRPS, ERA5-Land, quality control, bias correction and CMIP6

03 Rainfall–runoff models

HBV/TUW, GR4J, HEC-HMS, SWAT+; multiple models, validation and uncertainty

04 Floods, drought and sediment

Extreme flows, hydrographs, low flows, sediment risk and action maps

05 Reservoirs and allocation

WEAP, HAPP, HEC-ResSim, MODSIM; rule curves, energy and demand scenarios

06 Water balance and investment

Supply–demand, environmental flows, deficits, prioritisation and implementation programme

We make groundwater manageable through hydrogeology master plans

01 Hydrogeological conceptual model

Aquifers, boundaries, recharge–discharge, springs and SW–GW interaction

02 Groundwater potential

Water table, well yield, reserve–abstraction balance and safe operation

03 Recharge and baseflow

WTF, MRC, water balance, isotopes/hydrochemistry and spring hydrographs

04 Numerical groundwater model

MODFLOW/FEFLOW: calibration, forecasts, abstraction, drought and protection scenarios

05 Karst and fractured aquifers

Allogenic recharge, conduit–matrix behaviour, spring response, vulnerability and contamination risk

06 Protection and management plan

Protection zones, monitoring networks, managed aquifer recharge and sustainable operation

The agriculture master plan links water resources to parcel and scheme decisions

01 Agricultural land and crop patterns

Active land, parcels, crop classes, phenology and cultivated-area change

02 Water budget and demand

Surface/groundwater, scheme capacity, ETa, effective rainfall and crop demand

03 Irrigation demand and scheduling

Parcel/scheme demand, timing, priorities, dry periods and allocation constraints

04 Efficiency and modernisation

Over/under-irrigation, conveyance loss, water productivity and investment priorities

05 Climate and drought scenarios

CMIP6, crop patterns, ETa/demand change, supply security and adaptation options

06 GIS monitoring and action

Indicators, dashboards, field validation, investment schedule and institutional handover

We structure our systems around six core application areas

01 Basin master plans

Water potential, demand, scenarios, deficits, risk and investment programmes

02 Irrigation master plans

ETa, crops, irrigation demand, efficiency, schemes and modernisation

03 Dams, reservoirs and energy

Rule curves, hydropower, operations, allocation, environmental flows and drought

04 Floods, drought and sediment

Extreme analysis, hydrographs, low flows, sediment risk and action plans

05 Groundwater, karst and protection

Recharge, baseflow, numerical models, vulnerability and protection zones

06 Climate resilience and digital DSS

CMIP6, water balance, risk indicators, dashboards and institutional decision support

Our capabilities were proven in field and international projects from 2016 to 2026

01 EU groundwater resilience

2016–2020 • Integrated water management, climate change and groundwater resilience

02 Liwa strategic water storage

2016–2020 • UAE • Strategic storage and recovery • Zetaş–GIZ

03 Agricultural-area mapping

2023–2025 • Saudi Irrigation Organization • Remote sensing and spatial analysis

04 National model prototype

2024–2026 • MEWA • Data, hydrogeological models and institutional roadmap integration

05 Water supply for agricultural land

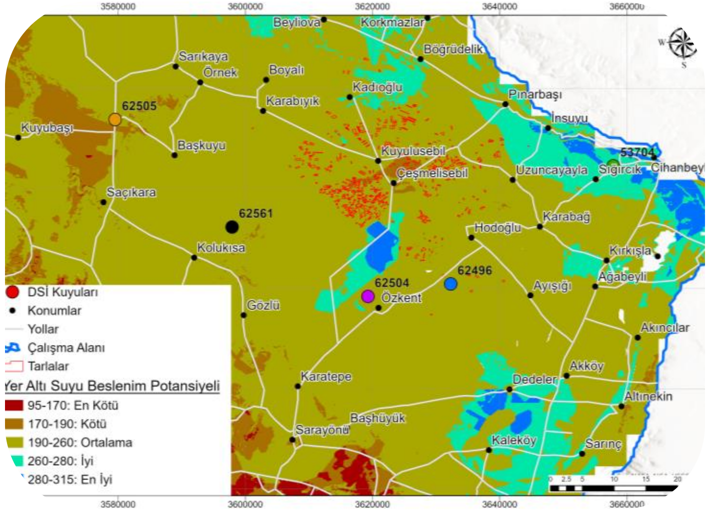
2025 • Geological–hydrogeological–geophysical assessment and groundwater-potential maps

06 Proven delivery chain

Field and satellite data • GIS • hydrology/GW • agriculture • model integration • decision support

Water and groundwater capability proven through three distinct applications

2025 water-supply study: integrated geology, hydrogeology and geophysics for groundwater-potential maps and field–GIS delivery



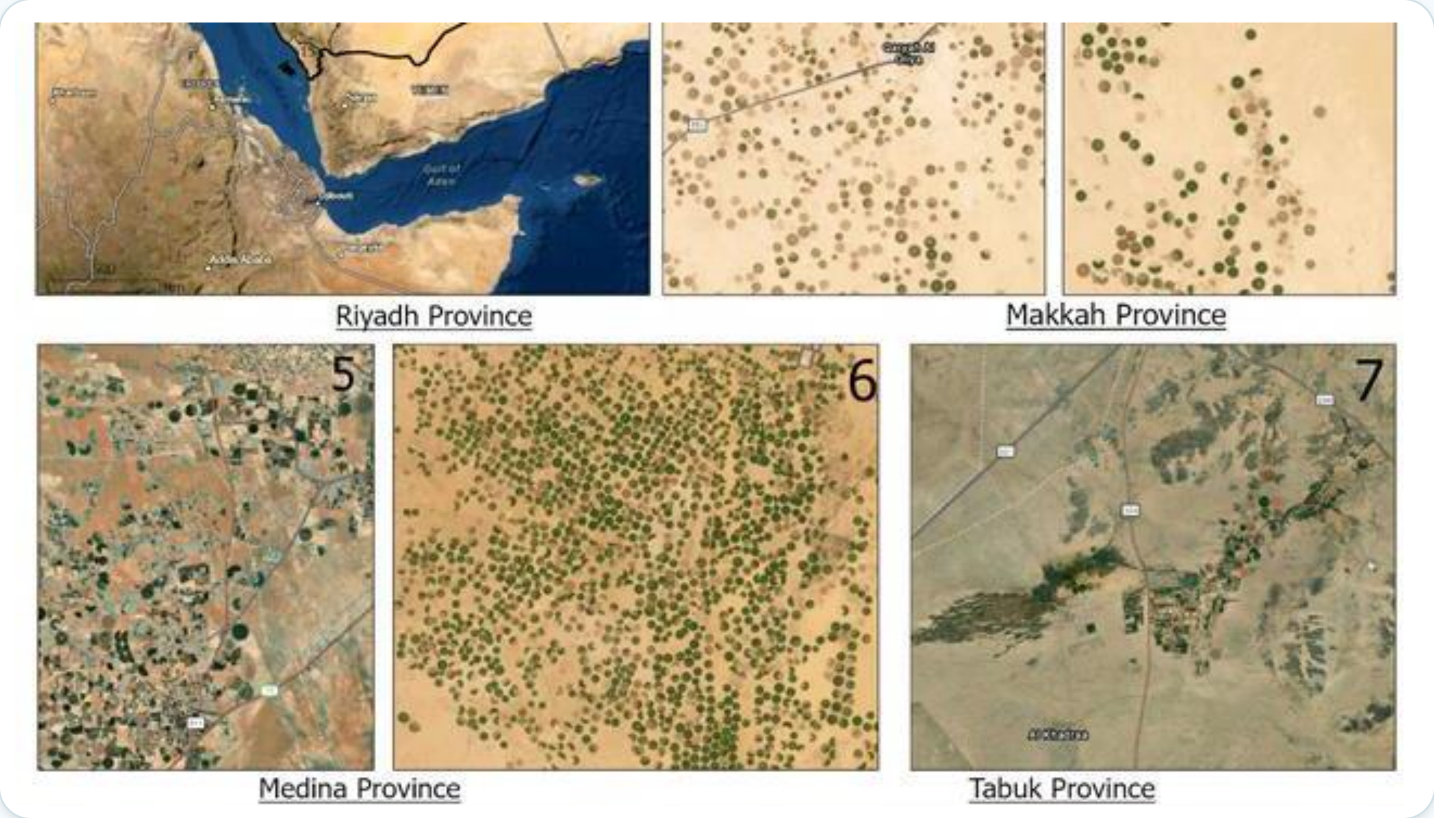
- **EU groundwater | 2016–2020**

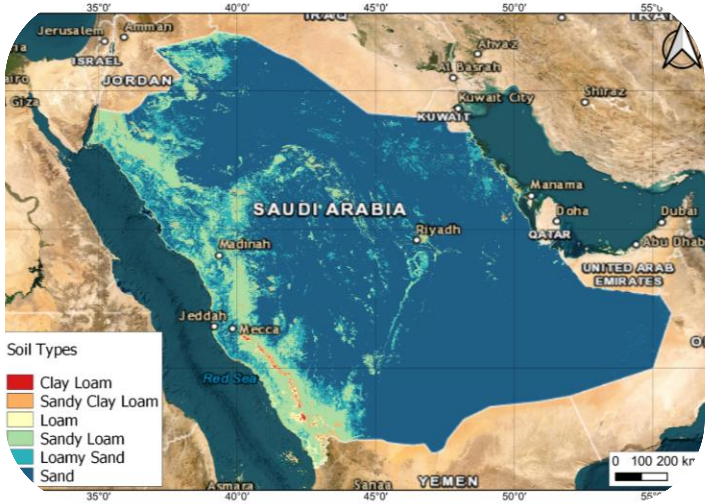
  Groundwater resilience under climate change and intensive abstraction pressure.

- **Liwa water storage | 2016–2020**

  UAE • Strategic storage and recovery • Zetaş–GIZ

Agricultural monitoring and model integration delivered at international scale





Shared value: remote sensing → data standards → model integration → institutional decision support

- **Agricultural areas | 2023–2025**
  Saudi Irrigation Organization • Satellite-based active agricultural-area analysis.
- **Model prototype | 2024–2026**
  MEWA • GSI • USGS • KFUPM • Data/model integration and national roadmap.

Clients receive an auditable system, not only results

Delivery principles

Editable
Reproducible
Traceable sources
Version controlled
Training and guides

Code, data, third-party software and licence scope are explicitly defined in the contract.

- **Data inventory and quality report**
  Sources, periods, units, missing data, transformations and responsibility matrix
- **Calibrated / validated model packages**
  Parameters, experiments, comparisons, locked testing and uncertainty results
- **GIS and remote-sensing outputs**
  Maps, rasters, vectors, time series, metadata and project geodatabases
- **Scenario and decision tables**
  Water balance, demand coverage, risk, environmental flows, KPIs and investment
- **Technical report and management summary**
  Editable report, methods, charts, sources and scientific limitations
- **Installation, training and commissioning**
  User/technical guides, user training, acceptance testing and institutional handover

Project credentials grow through clear roles and the right partnerships

Qualification evidence

Verified evidence structure for every tender

- Contract, scope and role definition
- Acceptance, payment and completion certificates
- Comparable projects, experts and field references
- Model, software and validation records
- Delivery, training and commissioning evidence

Documents, values, duration and reference use follow the current approved file.

STRATEGIC PARTNERSHIP

H3GEN

Basin master plans and integrated modelling

Water • agriculture • hydrology/hydrogeology • scenarios • decision support • institutional alignment

Project-based collaboration network

BARSU

Engineering and project-based collaboration

ESPROJE

Technical and project-based collaboration

EXPERTS

Universities • consultants • field teams • software teams

Roles, responsibilities, IP/licences and reference use are defined in writing for every project.

Every accepted package strengthens the qualification file

Documentation standard

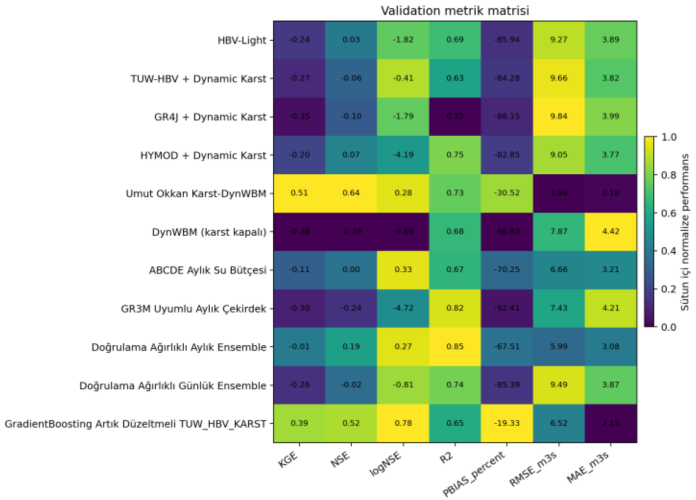
Defined role
Quantified scope
Signed deliverables
Acceptance record
Reference consent

Project experience is used only with contracts, payments, delivery and acceptance documents.

- **Basin hydrology and modelling**
  Sub-basins, data, rainfall–runoff, natural flow, validation and scenarios
- **Hydrogeology and groundwater models**
  Conceptual model, potential, MODFLOW/FEFLOW, karst and protection plans
- **Flood–drought–sediment package**
  Extreme analysis, hydrographs, risk maps, early warning and action plans
- **Reservoir operations, energy and allocation**
  HAPP/WEAP/HEC-ResSim/MODSIM; rule curves and water distribution
- **ETa, agriculture and irrigation package**
  Crops, ETa, stress, demand, efficiency, schemes and water balance
- **GIS–DSS and institutional handover**
  Databases, decision screens, reports, training, guides and commissioning

Our ultimate goal: Türkiye Intelligence System

Goal: one scalable platform managing the data → model → scenario → decision → report chain



- ### One integrated final asset

  Water, agriculture, groundwater, reservoirs, climate and reporting will converge in one interface.

- ### Phased development

  Existing specialist systems will connect gradually to a shared data and quality core.

WATER INTELLIGENCE DIVISION

Let us integrate water, agriculture and models into one decision chain

A traceable solution from data diagnosis and system selection to ETa, water budgets, scenarios, investment and institutional handover.

Technical lead: Assoc. Prof. Dr. Bedri Kurtuluş
bedri.kurtulus@ekoflytech.com

THANK YOU

EKOFLY Tech
METU Technopolis • Ankara
ekoflytech.com