AMUDARIO

"Amudario Research" LLC

Overview of Amudar.IO Projects

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Agenda

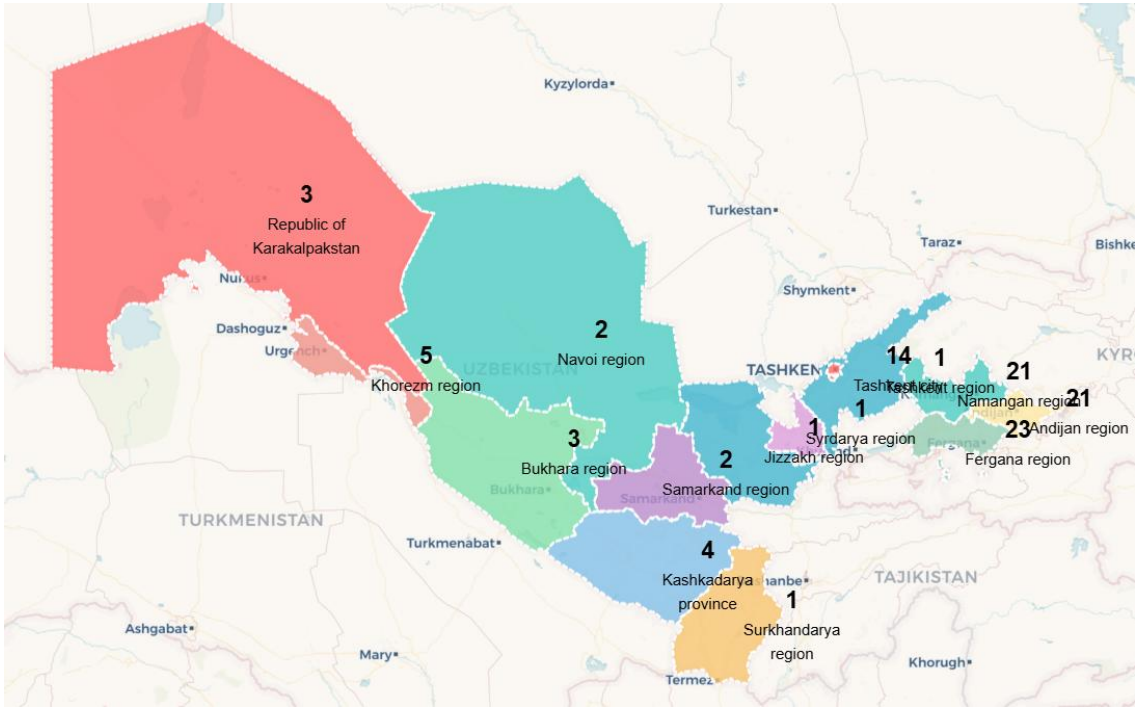
- Our company – Amudar.IO Research
- Our solutions in ecology
- Use of weather stations in agriculture
  - Irrigation and land management
  - Plant protection from pests and diseases
  - Meteograms for tillage, spraying and sowing
  - Weather forecast for agricultural needs
  - Risk assessment based on historical records

What is Amudar.IO?

- Amudar.IO was founded by **three professors from Inha University in 2020** to help farmers in fighting pests using weather stations
- Produced solutions in AgriTech and EcoTech:
  - **Oxus-WS** - agrometeorological stations
  - **JayhunTrap** – smart pheromone trap
  - **GozanLink** – greenhouse monitoring system
  - **AirSense** - air quality monitoring system

110+ weather stations across Uzbekistan

- **Solar powered, autonomous stations deployed** nationwide since 2021 - largest agricultural monitoring network in Uzbekistan
- **Real-time monitoring** of 8+ parameters with AI-powered pest/disease forecasting
- **Training programs** provided to 100+ farmers and agricultural specialists
- **Crop loss prevention** and reduction in pesticide use for farmers
- **Water conservation** up to 30% irrigation water savings through precision scheduling

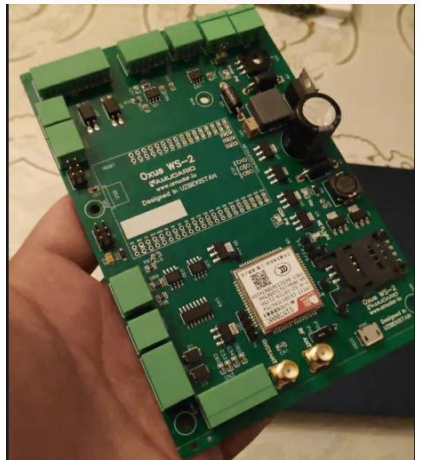


15+ successful joint projects

- **International Development Partners:**
  - **UNDP Projects** - 55 agrometeorological stations + 12 smart pheromone traps deployed across Fergana Valley for climate resilience
  - **IWMI Collaboration** - 3 stations installed in Khorezm, Karakalpakstan, and Kazakhstan for transboundary water management
  - **IFAD Partnership** - 3 stations deployed in Andijan, Namangan, and Fergana for modern irrigation water management on 300 hectares
  - **ICARDA Project** - 4 soil monitoring stations with 48 sensors each for comprehensive soil analysis and research
- **Academic and Community Partners:**
  - **TIIAME University -** 3 stations for soil monitoring in Tashkent, Khorezm, Bukhara, Karakalpakstan
  - **Irrigators School –** 12 stations with farmer training programs for sustainable water management practices
  - **New Uzbekistan University** – A professional weather station for promoting climate change research
  - **Samarkand Marathon -** Portable air quality monitoring for sports events across multiple cities

Designed and serviced in Uzbekistan

- **50% cost reduction** compared to imported alternatives - from $2,300 to $1,300 per station
- **24/7 local technical support** - immediate response and technical maintenance
- **Local pest database** - 30+ diseases and pests specific to Uzbekistan agriculture
- **Uzbek language interface** - accessible to local farmers without language barriers
- **Local job creation** - 8+ skilled positions in engineering, programming, and agronomy enabling technology transfer



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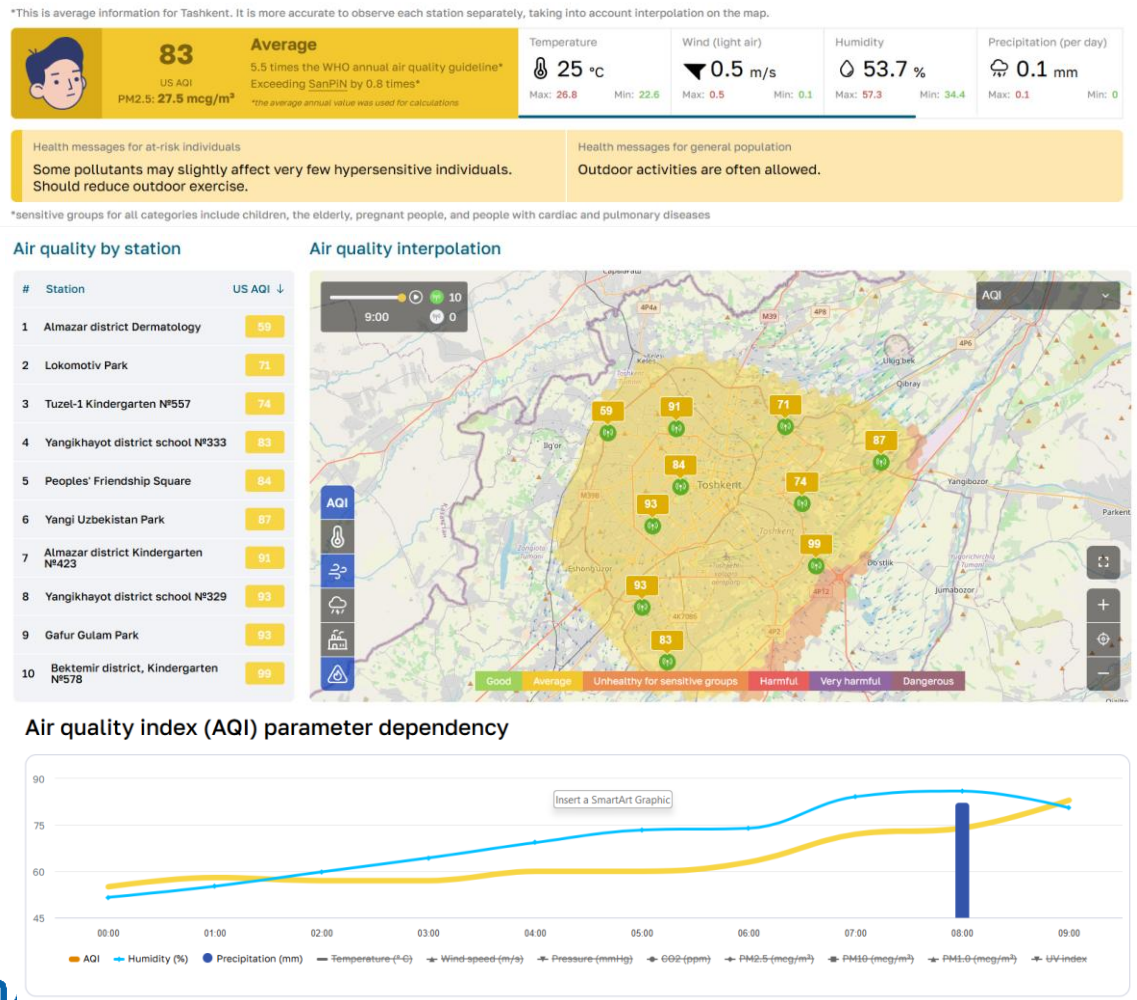
Winner of CGIAR's AgriTech4Uzb

- Selected as winner from **571 international applications spanning 78 countries** competing for agricultural innovation in Central Asia
- **$15K equity-free grant** - Awarded top prize for demonstrating sustainable business model, scaling plan, and strong connection with CGIAR science
- Advanced through **3-month acceleration** program

10 air quality monitoring stations on Air Tashkent Portal

- air.tashkent.uz launched in 2022 by Tashkent Digital Development department providing real-time air quality monitoring for all citizens
- It tracks **PM1, PM2.5, PM10, CO2, meteorological data**, plus registered fires and heating center locations affecting air quality
- Continuously maintained by Amudar.IO for **over 3 years**



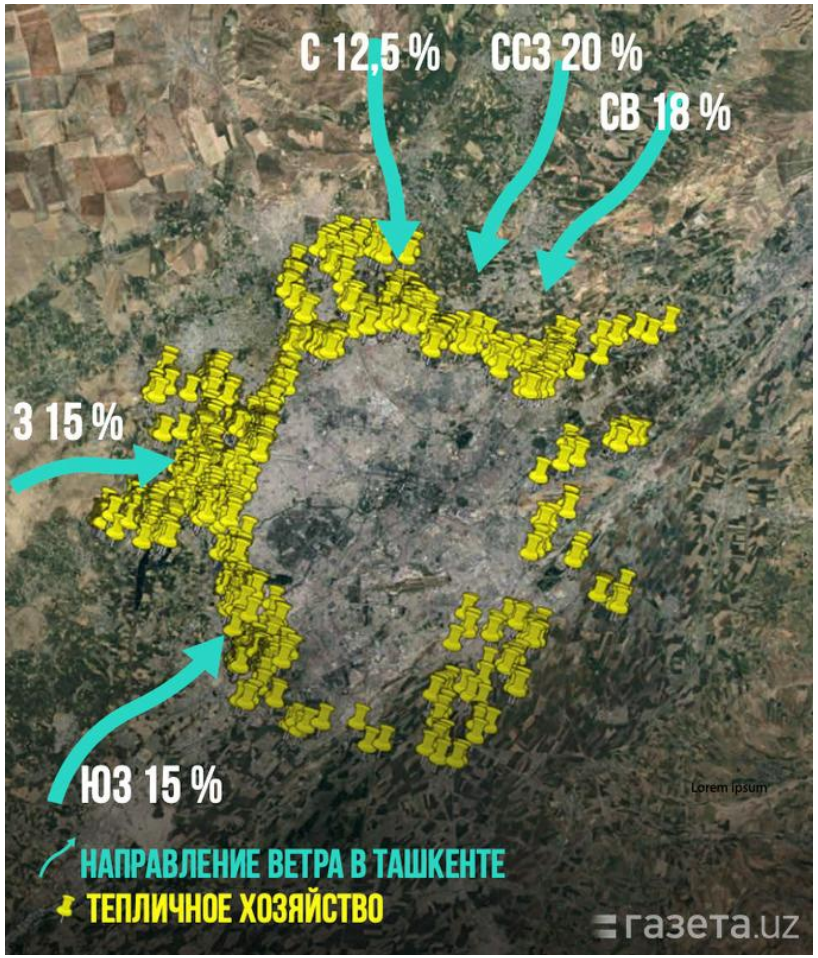
AirSense – air quality monitoring station

Parameter name	Range
Air Temperature	-40°C~+80°C
Air Humidity	0%~100%
Atmospheric pressure	150 — 1100hPa
Precipitation	0 — 200mm/h
Wind direction	0 — 60m/s
Wind speed	0-359°
Nitrogen dioxide NO_2	0-50 ppm
Carbon dioxide CO	0-2000 ppm
Ammonia NH_3	0-200 ppm
Sulfur dioxide SO_2	0-1000 ppm
Hydrogen sulfide H_2S	0-200 ppm
Ozone O_3	0-50 ppm
Dust concentration PM1.0	0.01 µg/m3 — 1500 µg/m3
Dust concentration PM2.5	
Dust concentration PM10	

Coal-burning greenhouses

are major air pollutants around Tashkent

- **631 greenhouses** operating on **1,314 hectares around Tashkent**, with 60% using coal as primary heating source, creating a "**gray ring**" instead of "green ring“
- Greenhouse numbers **increased 2.5x in past 5 years** while coal consumption rose 22%
  - from 6.8 million tons in 2018
  - to 8.3+ million tons in 2022
- Mass transition from gas to coal heating done without installing proper **air filtration or energy saving systems**



GozanLink – greenhouse monitoring system

- **Comprehensive greenhouse climate monitoring system**
  - Combines indoor/outdoor climate sensors, soil monitoring, and energy usage tracking through mobile/web apps and on-site dashboard.
- **Reduces energy consumption by 18-30%** through smart scheduling of the burner
- Continuously informs the owner about **emergency cases**
  - Temperature drops and frosts
  - Humidity spikes
  - Strong winds
  - Power outages
- Provides remote controlled **alarm service** for managing greenhouse personnel

Use of weather stations in agriculture

Key Issues of Agriculture in Uzbekistan

Climate change

Weather data remains largely analog and inaccessible to farmers for decision-making

Unpredictable temperature and precipitation patterns threaten crop planning and yields

Crop yield decline

Inefficient water and fertilizer management leads to 20-30% productivity losses

Outdated farming practices fail to optimize resource allocation across growing seasons

Pests and diseases

Farmers react to outbreaks instead of preventing them through early detection

Lack of real-time monitoring results in 60-80% crop damage before treatment begins

Soil and water management

Salt accumulation and soil degradation go undetected without proper sensors

Irrigation scheduling relies on guesswork rather than actual soil moisture data

Quarantine checks in export

Excessive pesticide use prevents access to premium international markets

Residue testing failures block organic certification and higher-value exports

Why weather stations?

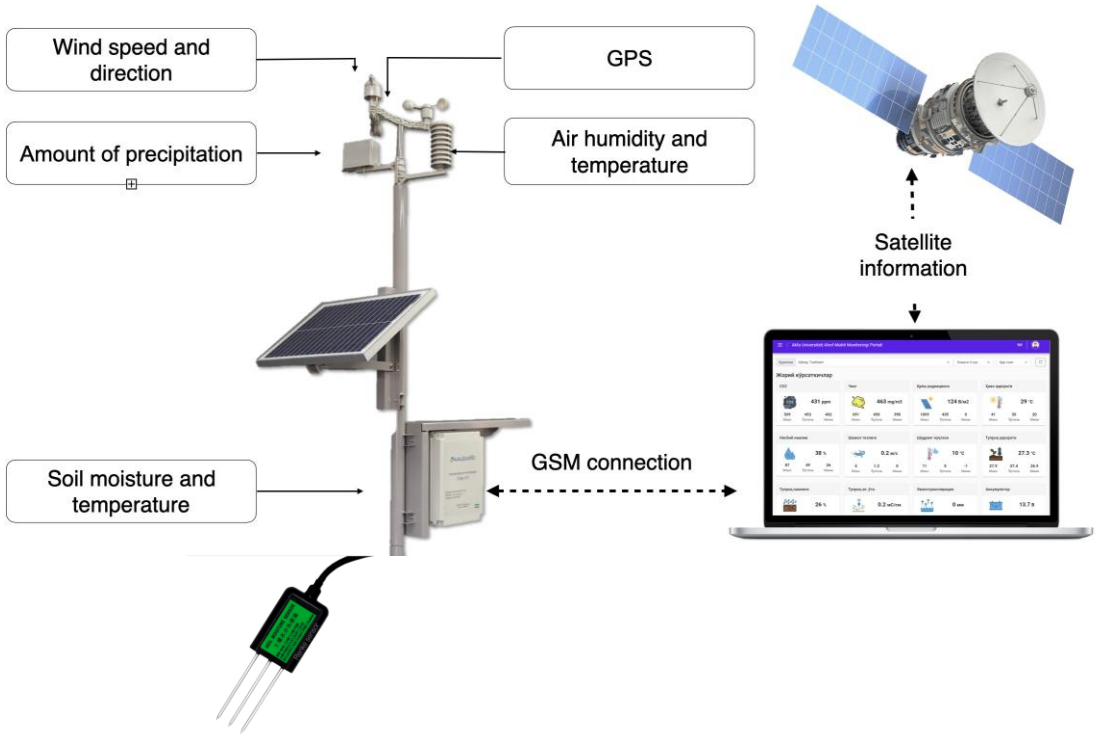
- Irrigation systems
- Greenhouse management
- Prevention of pest spread
- Disease prevention
- Monitoring plant development
- Field work planning
- Farm management
- Agrologistics

Economic benefits of weather stations

- **Impact on productivity**
  - Increase crop yield by 15-30%
  - Reduce crop losses by 20-40%
- **Resource efficiency**
  - Reduce water consumption by 20-30%
  - Increase fertilizer efficiency by 15-25%
  - Reduce labor costs by 10-20%
- **Expected savings per annum per hec:**
  - Water savings: $500-1,500
  - Crop preservation: $2,000-5,000
  - Labor savings: $1,000-2,000
  - ROI – 1-2 years
- **Initial costs**
  - Installation fee: $2,000-5,000
  - Yearly maintenance: $200-500
- **Coverage**
  - Accuracy level: 95-98%
  - Coverage area: 10-50 hectares
  - Battery life: 1-2 years

Oxus-WS Weather Station

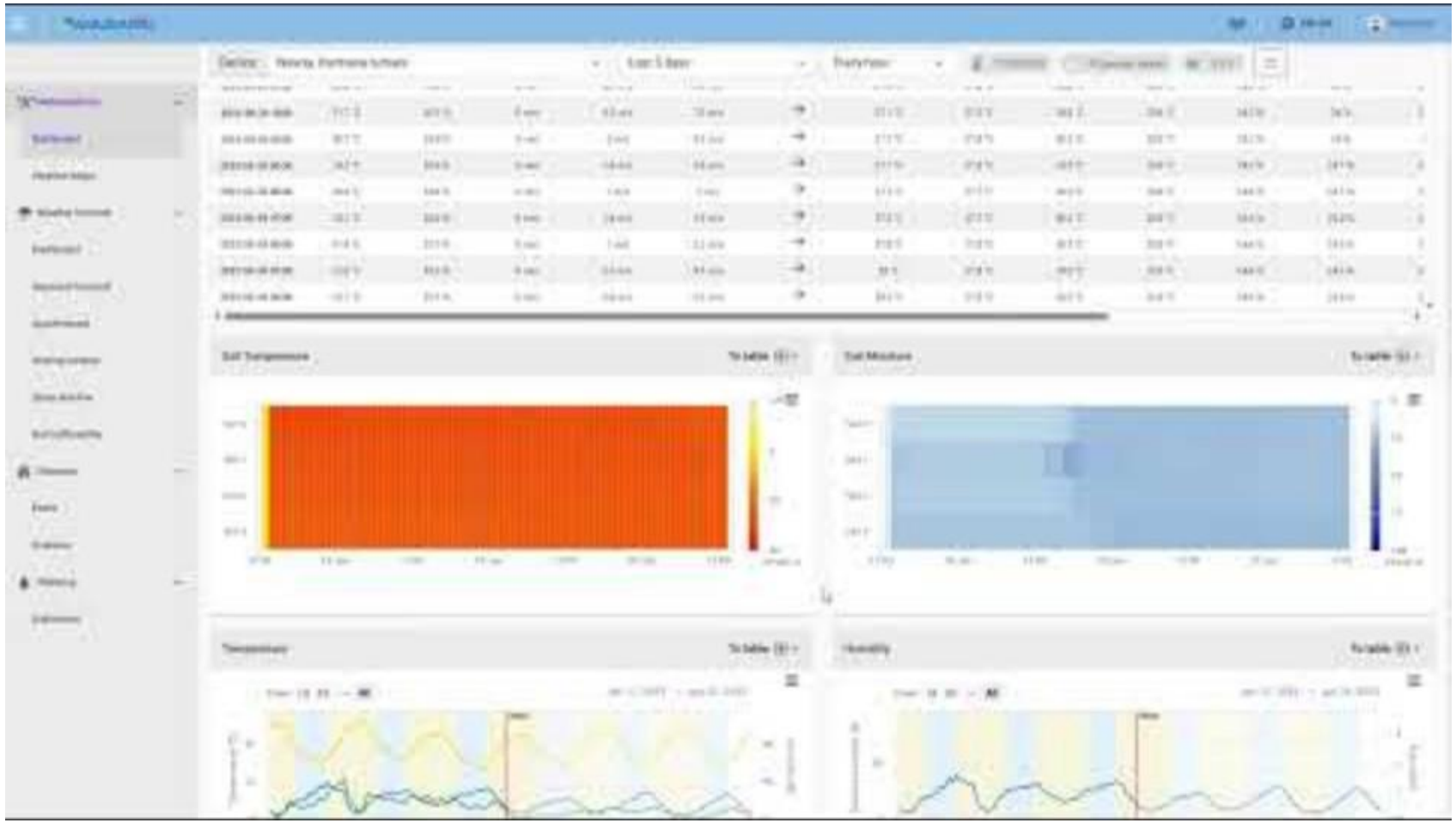
Parameter name	Range
Air temperature	-40°C~+90°C
Air humidity	0%~100%
Wind direction	8 sides, by 45°
Wind speed	0 ~ 40 m/s
Precipitation	0.3 mm
Soil moisture	0%~100%
Soil temperature	-20°C~+80°C
Soil electrical conductivity	0-10'000us/cm
GPS	6~8 mm accurate
GPS Communication Module	2G or higher
Solar panels or battery	12 V (voltage)



Key Features of Oxus-WS

- **Real-time data transmission**
  - Uses GSM/GPRS network to automatically upload data to cloud servers for instant access from any location
- **Web-based monitoring platform**
  - Accessible on any device with historical data, charts, and weather forecasts
- **Agricultural optimization features**
  - 30+ pest/disease risk alerts
  - Irrigation schedule for cotton and wheat
  - Spraying and sowing recommendations
  - Soil trafficability for tillage
  - Historical and forecasted data for risk assessment
- **Autonomous solar-powered operation**
  - Fully self-sufficient with solar panel and battery backup, designed for remote agricultural locations without grid power and harsh climate

Glimpse into main dashboard



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Professional agronomic forecast

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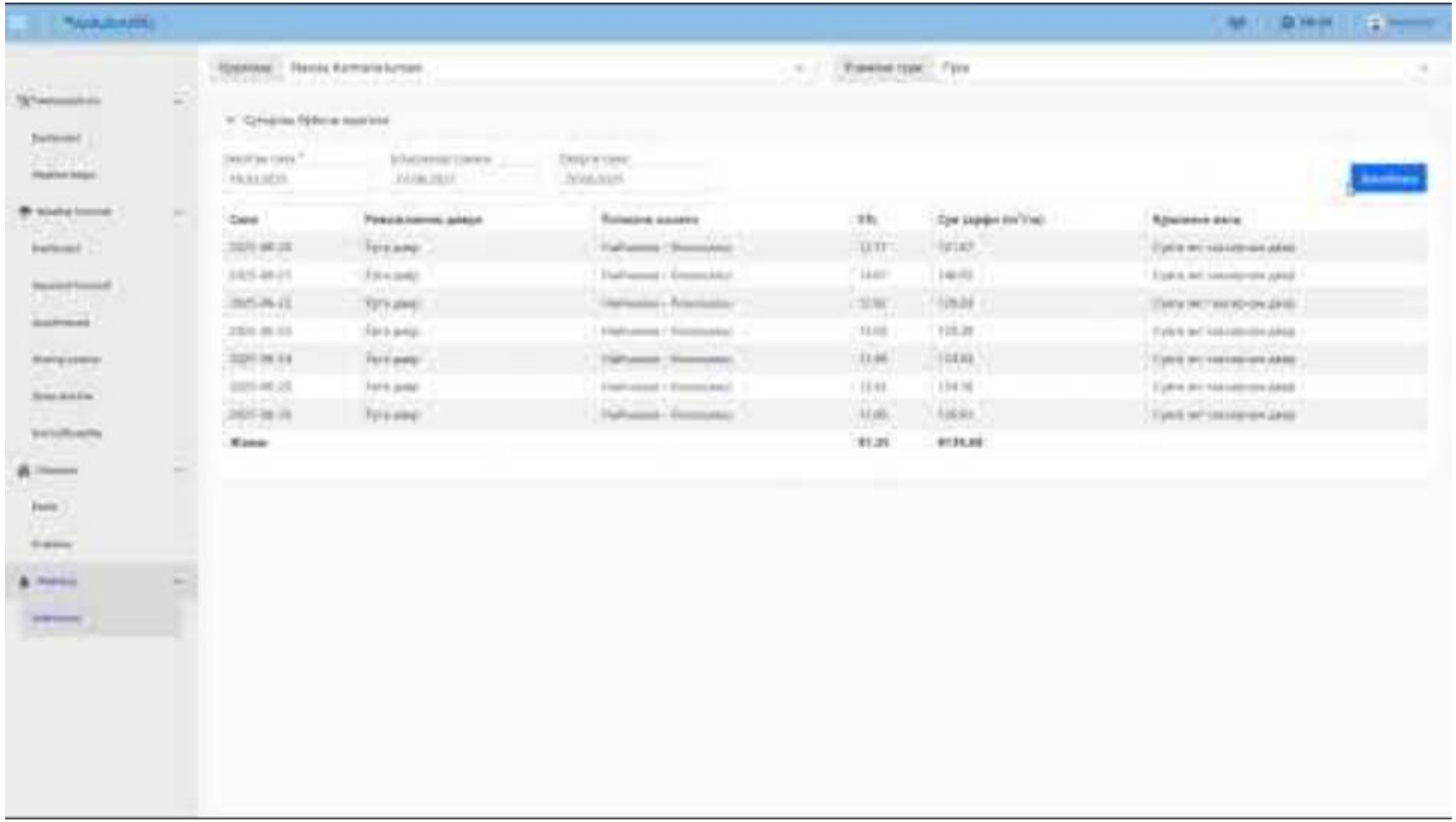
Irrigation Scheduling

- **Multi-depth soil sensors**
  - Continuous monitoring of soil moisture, temperature, and electrical conductivity at various depths for comprehensive root zone analysis
- **Evapotranspiration calculations**
  - Measures actual plant water loss to determine precise irrigation needs rather than guessing
- **Weather-integrated planning**
  - Combines soil data with 7-day weather forecasts to prevent unnecessary watering before expected rainfall
- **Automated scheduling recommendations**
  - System calculates optimal irrigation timing based on soil moisture levels, weather conditions, and crop requirements
  - **20-30% water savings** - Precision scheduling eliminates overwatering and reduces water waste compared to calendar-based irrigation

Irrigation scheduling calendar



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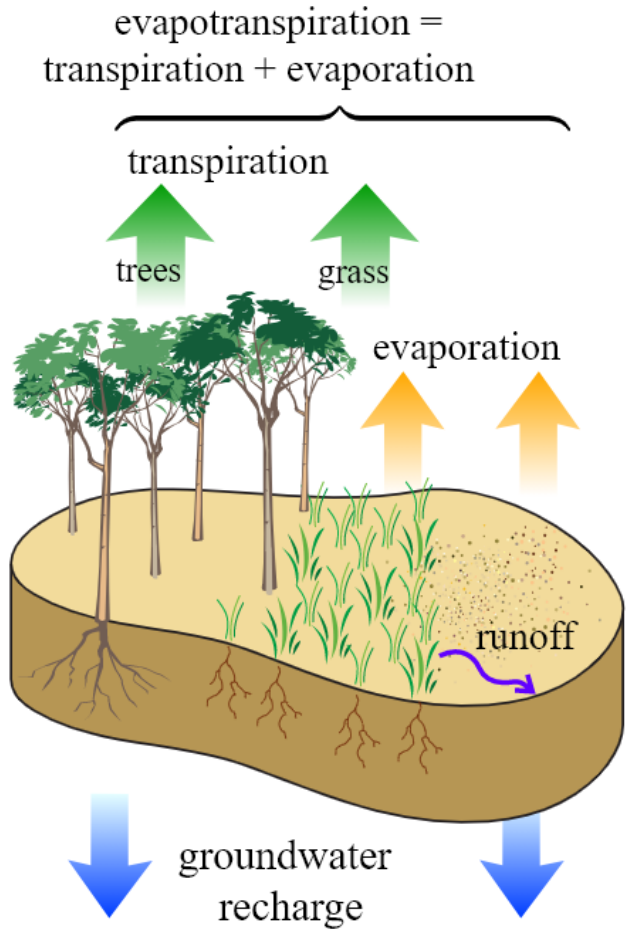
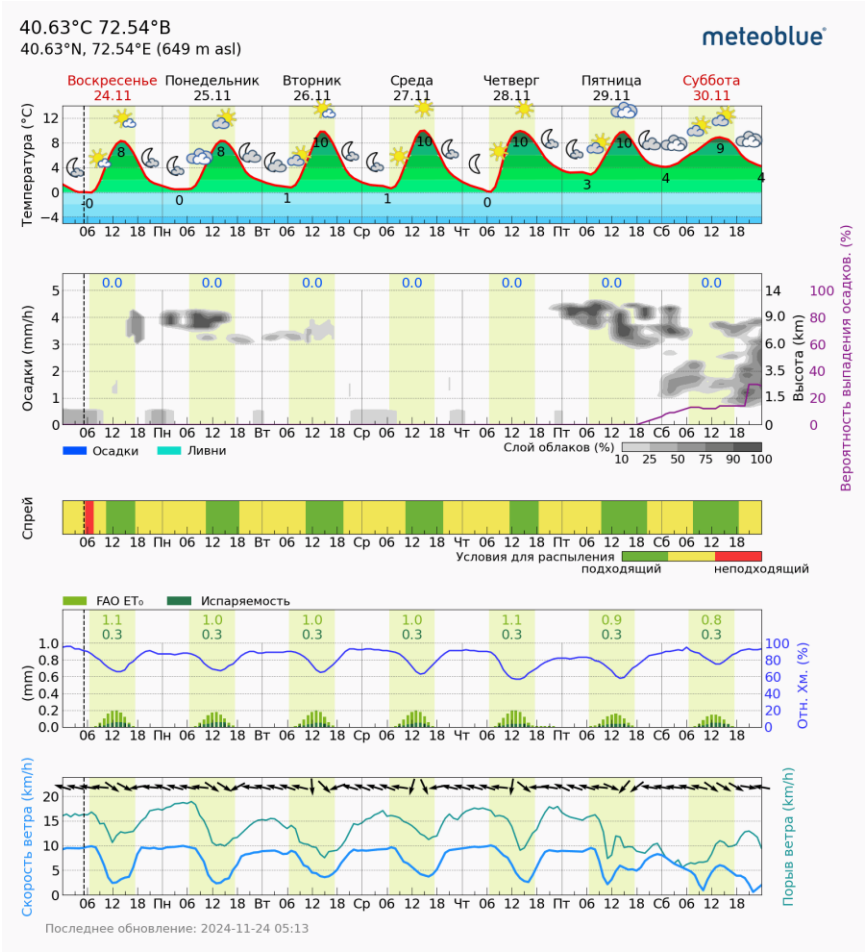
Daily Evapotranspiration

- **Evapotranspiration**
  - The sum of water evaporation from soil surface (evaporation) and water evaporation from plants (transpiration)
  - Measured in mm/day like precipitation
  - In non-irrigated areas, equals precipitation amount
- **Types:**
  - Potential (PET)
    - Maximum evaporation when sufficient water is available
  - Reference (ET_o)
    - Evapotranspiration for 12 cm grass
  - Crop-specific (ETc):
    - $ETc = Kc * ET_o$



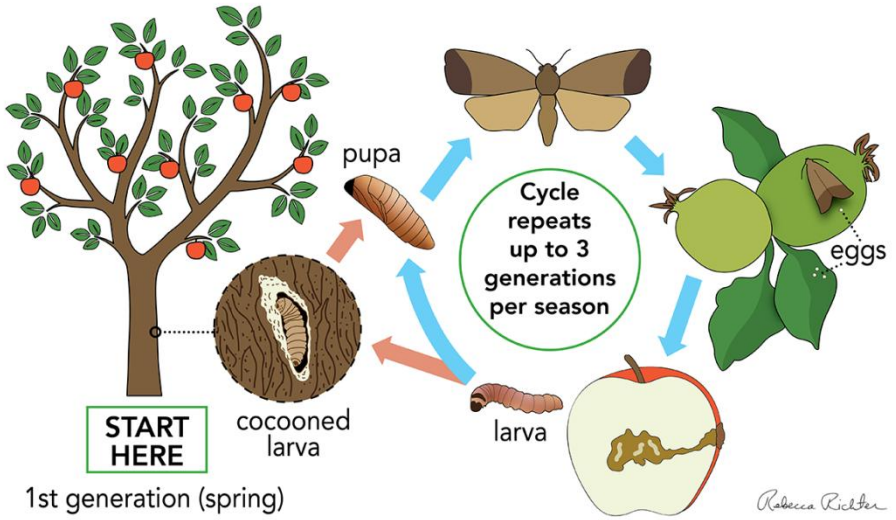
Forecasted Evapotranspiration

- **Precise irrigation scheduling**
  - Daily ET_0 values (0.8-1.1 mm/day shown) combined with crop coefficients calculate exact water requirements, preventing over/under-watering and optimizing plant water stress management
- **Resource conservation**
  - Accurate ET_0 measurements combined with precipitation forecasts can reduce irrigation water use by 25-30% while maintaining optimal crop growth conditions through precision water management



Integrated Pest Management

- **Weather-based prediction models**
  - Agrometeorological stations provide temperature, humidity, and precipitation data to forecast pest development cycles and optimal timing for targeted treatments
- **Reduced chemical dependency**
  - Precision timing and targeted application based on actual pest presence reduces pesticide use by 30-80% while maintaining crop protection effectiveness
- **Multi-modal monitoring approach**
  - Combines automated weather data, pheromone trap monitoring and crop phenology tracking
- **Economic and environmental benefits**
  - Prevents up to 80% of crop losses through early intervention while preserving beneficial insects, reducing chemical residues, and supporting export market requirements for pesticide-free produce



Pest Prediction Models

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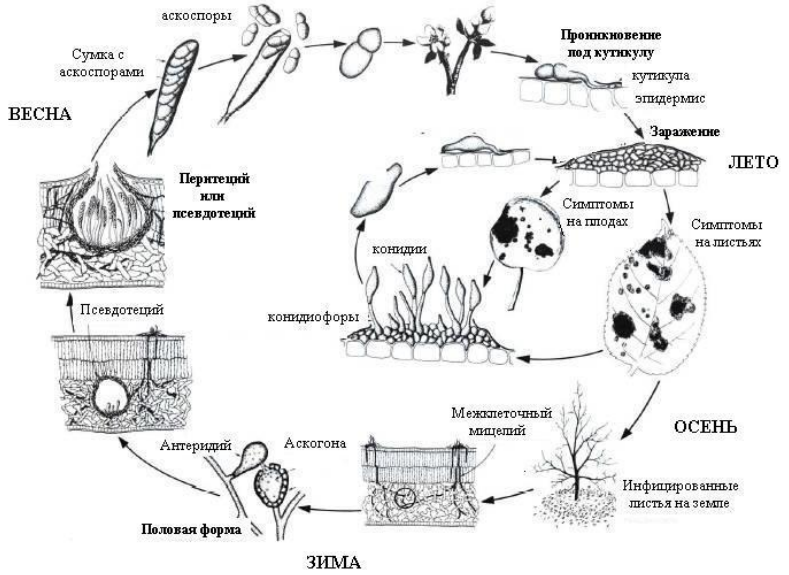
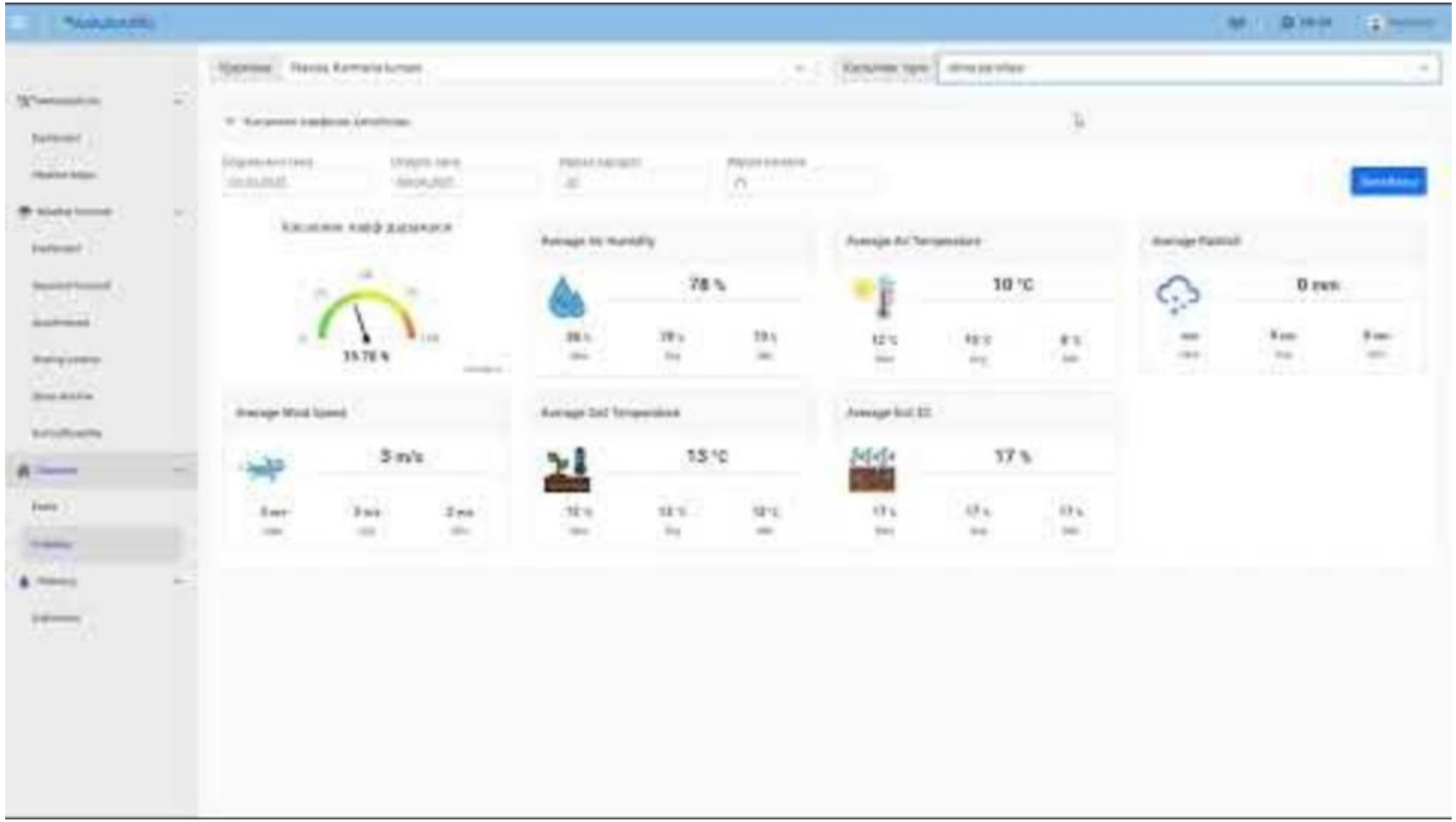
Plant Disease Management

- **Weather-based disease forecasting**
  - Real-time monitoring of temperature, humidity, leaf wetness, and rainfall patterns enables prediction of disease-favorable conditions before symptoms appear
- **AI-powered risk assessment**
  - Models predict the development probability of 30+ common agricultural diseases
- **Preventive intervention timing**
  - Early warning alerts identify critical periods for fungicide application, allowing farmers to protect crops before disease establishment rather than treating existing infections
- **Cost reduction and plant protection**
  - Prevents 60-80% of potential crop losses through early intervention while reducing fungicide costs by 25-40% via targeted applications only when disease conditions are favorable



Plant Disease Models



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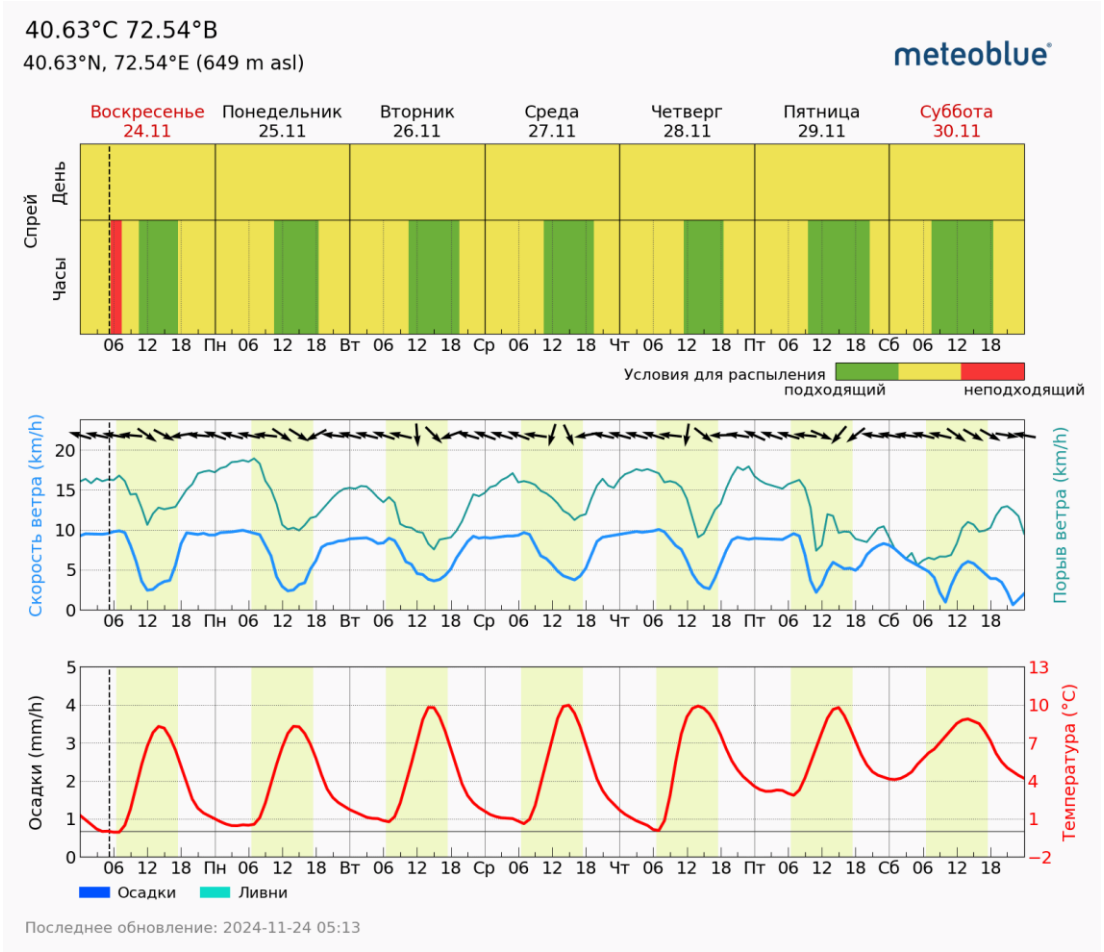
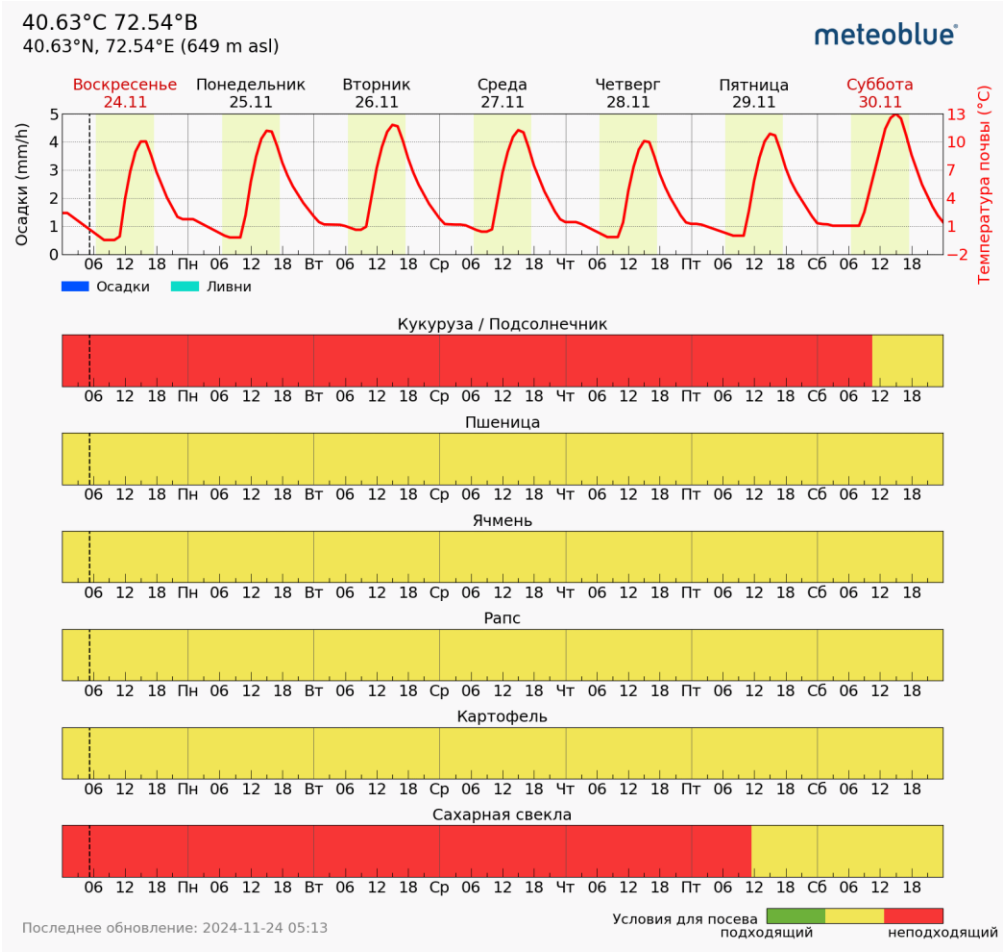
Spraying Windows

- **Optimal application timing**
  - Green windows indicate ideal conditions with low wind speeds (<10 km/h), proper temperature ranges, and no precipitation for maximum pesticide effectiveness
  - Yellow and red periods indicate upcoming rain or adverse conditions that would wash away treatments
- **Chemical efficiency maximization**
  - Spraying during favorable conditions ensures better droplet coverage and penetration, reducing product waste by 20-30%
- **Drift prevention**
  - Real-time wind speed monitoring helps avoid applications during high-wind periods (red zones), preventing chemical drift to non-target areas and neighboring crops



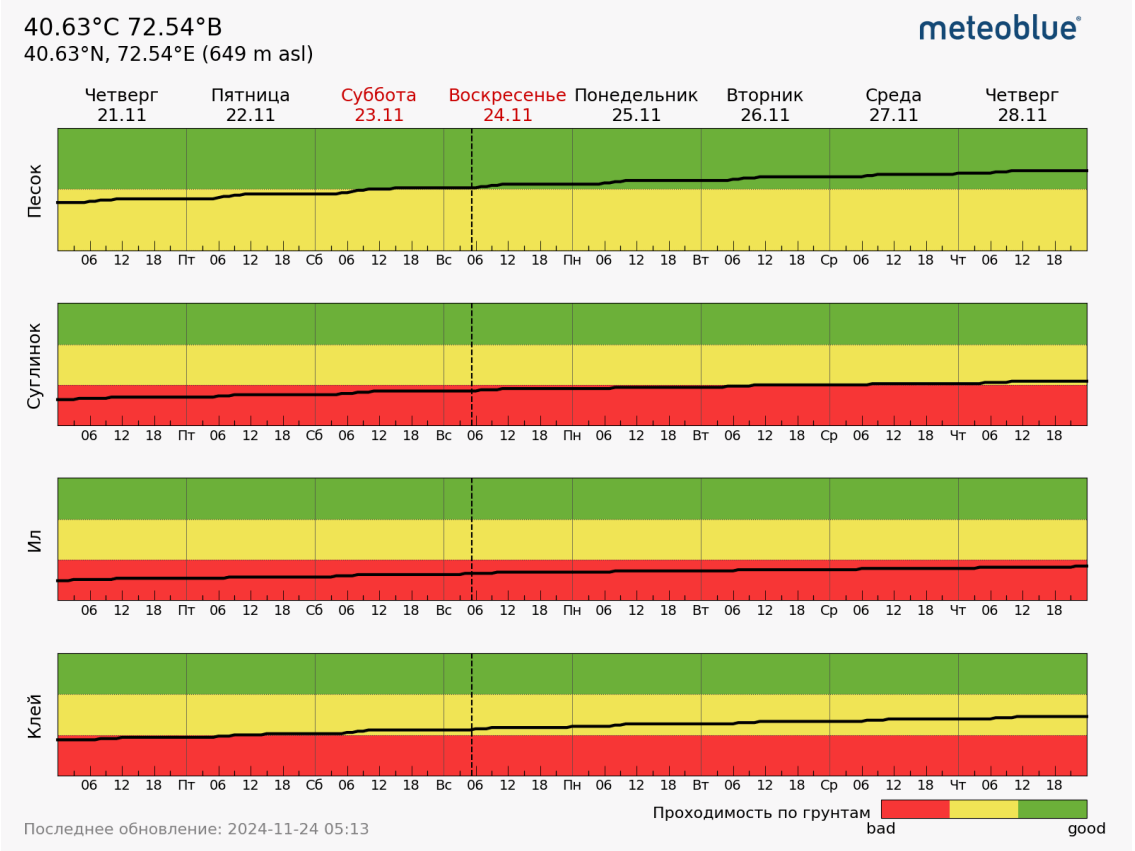
Sowing Windows

- **Crop-specific timing optimization**
  - Color-coded windows show ideal sowing periods for each crop type (corn/sunflower, wheat, barley, rapeseed, potato, sugar beet) based on soil temperature and moisture conditions
  - Avoiding red/yellow periods prevents sowing in overly wet or cold soils that could lead to seed rot, poor emergence, or compaction damage
- **Germination success maximization**
  - Green periods indicate optimal soil conditions for seed germination, reducing replanting costs
  - Proper timing based on weather forecasts can improve emergence rates by 15-25% and establish stronger plant stands that are more resilient to later stress conditions



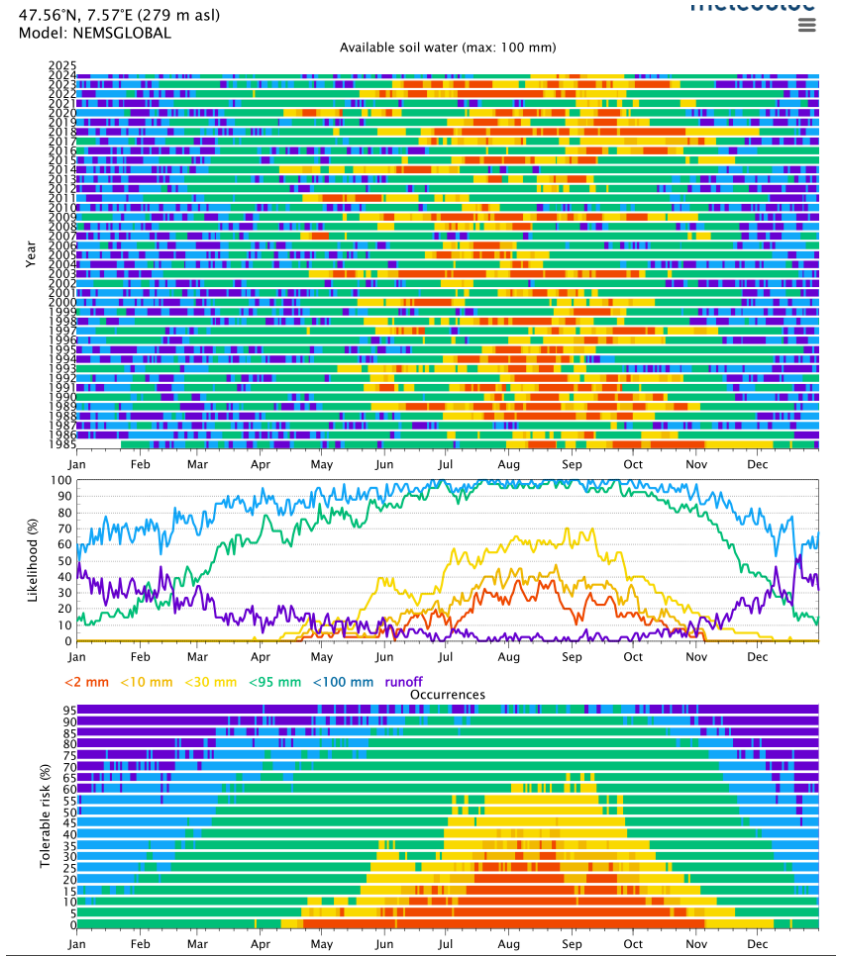
Soil Trafficability

- **Tillage timing**
  - Color-coded conditions show optimal periods for heavy equipment operation on different soil types (sand, loam, silt, clay) to prevent compaction and rutting damage
  - Avoiding red/yellow periods prevents soil compaction damage that can reduce yields by 10-15% and persist for multiple growing seasons
- **Equipment protection and efficiency**
  - Green windows indicate firm soil conditions that allow normal machinery operation without risk of getting stuck or requiring additional traction equipment
  - Proper timing eliminates costs associated with **stuck equipment**, **extra fuel consumption**, and **potential machinery** damage from operating in poor field conditions



Risk assessment based on 40-year historical data

- Extensive historical meteorological records combined with satellite data from meteoblue **for the last 40 years** enable:
  - long-term climate analysis,
  - seasonal pattern identification,
  - baseline establishment for agricultural planning
- **Risk-based insurance**
  - Historical weather data supports crop insurance decisions and helps farmers plan risk mitigation strategies based on documented weather extremes



To summarize, weather stations can…

- **Estimate water consumption** by calculating evapotranspiration
- **Save water** by optimized irrigation scheduling
- **Protect plants from pests and diseases** by modelling their development cycles
- **Save chemicals** by finding optimal spraying windows
- **Maximize seed germination** by choosing optimal sowing window
- **Prevent farm machinery** from getting stuck in mud, or damaging tillers/ploughs
- **Save fuel** by choosing optimal conditions for tillage
- **Assess risk** employing the historical meteorological records of the site

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Questions?

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