CITIZEN SCIENCE SDG CONFERENCE

Knowledge for Change: A decade of Citizen Science (2020–2030) in support of the Sustainable Development Goals

14.–15.10.2020

für Natur
MUSEUM FÜR NATURKUNDE
BERLIN

HITSOFT
R&D CENTER TEAM

CITIZEN SCIENCE SDG CONFERENCE

HI-TERRA | Broaden your insights of drops.

WeObserve Open Data Challenge winner place

Presenter: Gülşen Otçu

MUSEUM FÜR NATURKUNDE BERLIN

Hitsoft R&D Center
What we do

Developing future technologies

›Growing since 2019

›5 completed ML, DL, blockchain projects

›2 on-going ML projects

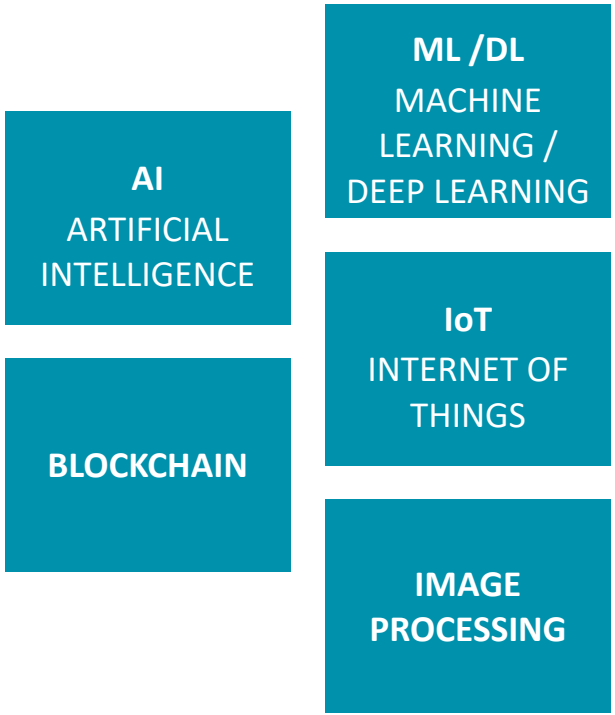
Creating value

›University-industry collaborations

›Qualified human resources

›Growth and expansion on R&D

›Training activities and young talent scouting.



Hitsoft R&D Team
WeObserve ODC Challenge

›We produce technology and do deep learning to create a sustainable future.

›We aim to lead more resource efficient society and businesses.

Bülent BEDİR
Senior Product Manager
Strategy & Artificial Intelligence

Gülşen OTÇU
Analyst, Project Executive
Sustainability & Concept Design

Emre YAZICI
Chief Artificial Intelligence Scientist

Ersin KANAR
R&D Software Developer
Data Science

The project idea
How was Hi-Terra born?

- Sensors
- Soil
- Moisture
- Weather

- **Model and Forecast?**

HI-TERRA: Soil Moisture Forecast Solution
An Intelligent Infrastructure

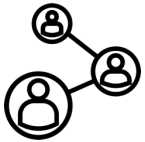
Quick. Easy. Reliable Soil Control System

Hi-Terra transforms GROW field sensor, weather condition and soil characteristics data into meaningful insights about soil moisture

- Helps to minimize artificial watering
- Uses machine learning and deep learning technology in agricultural practices
- Creates dynamic forecasts for 24-hr
- Warning system for critical levels, important weather conditions or anomalies.

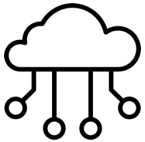
Objectives of HI-TERRA

- Model soil moisture
- Forecast soil moisture



- Create societal and sustainability impact

- Soil, field, crop health
- Optimize water use



- Data-driven agriculture
- Smart resource use

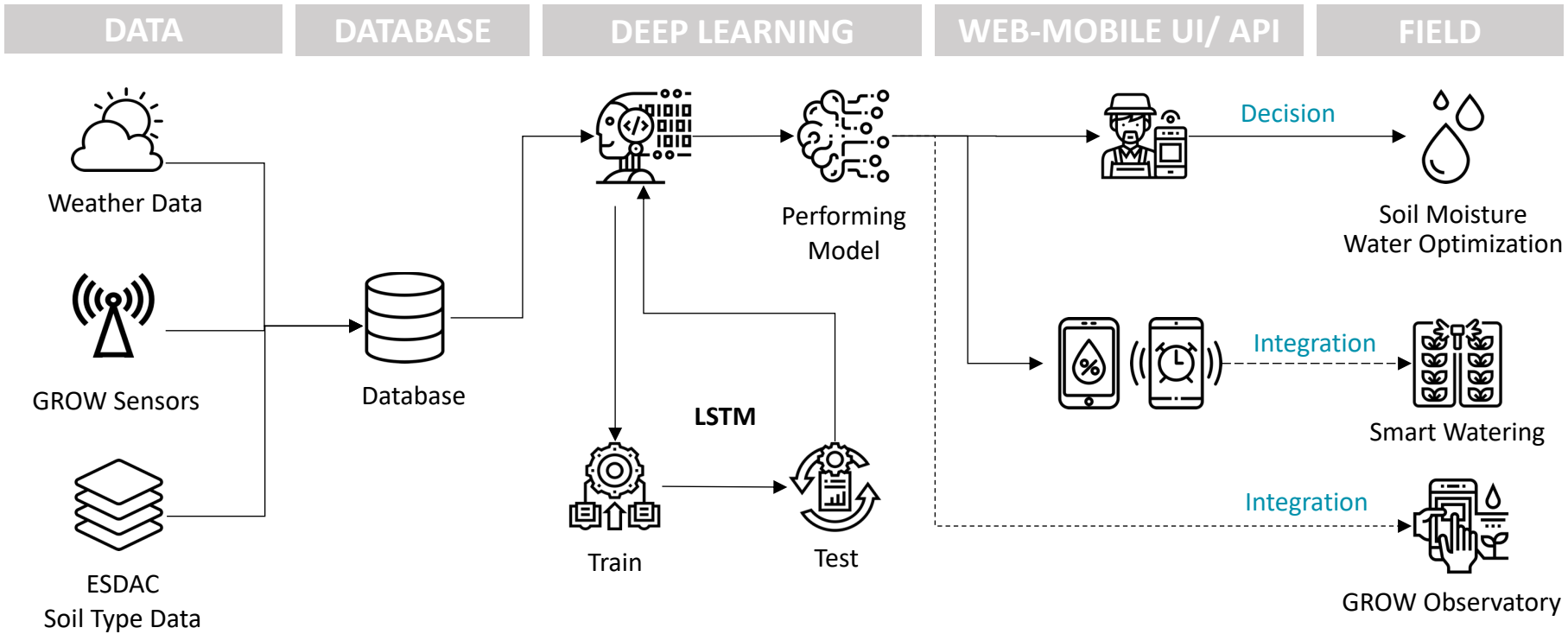
- Dynamic learning -LSTM
- Intelligent infrastructure

- Climate action
- Tackle SDGs

Current Stage of Development
HI-Terra Roadmap

	TRL 1 BASIC PRINCIPLES	TRL 2 CONCEPT	TRL 3 PoC	TRL 4 LAB VALIDATION	TRL 5 VALIDATION
ACTIVITIES	Dataset selection New datasets Feature selection Idea creation Research about soil moisture and related parameters for water use Concept draft	GROW Data normalization Pre-processing Feature extraction Weather data integration Elaboration of use cases and application span User group selection Market analysis	Apply deep learning using LSTM model Train and Test Model soil moisture Improving accuracy Consolidate use-case and user groups Application scenarios Evaluation of potential	Analysis of soil datasets: ESDAC, ISRIC, Copernicus Improve model by using new features of soil type/ characteristics More train and test Improve accuracy Consolidate cases Stakeholder action plans	Apply pilot platform to make a show case Observe real-world condition and get results Develop UI /integrate Improve and consolidate the concept
METHODS	Top-down Bottom-up approach	Deep Learning method	Deep learning LSTM	*On-Going*	Improvement

What is HI-Terra?
The concept and how the system works.



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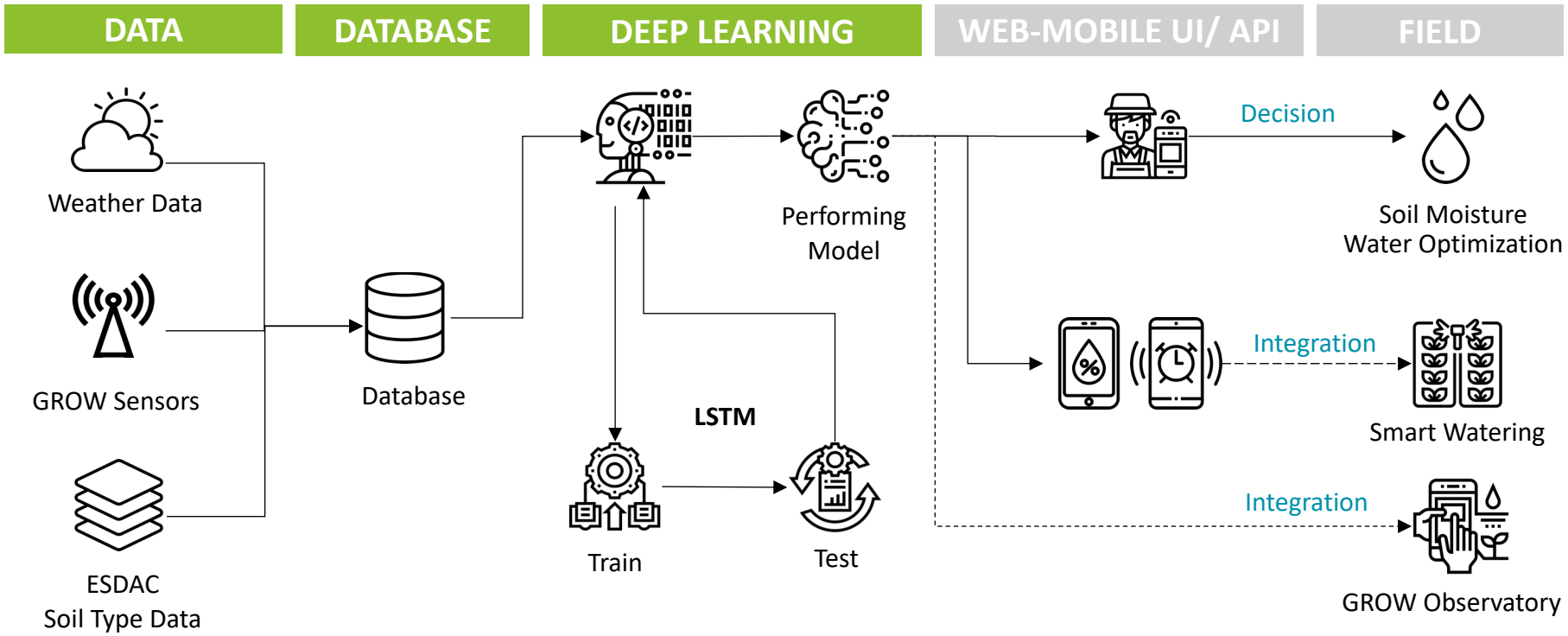
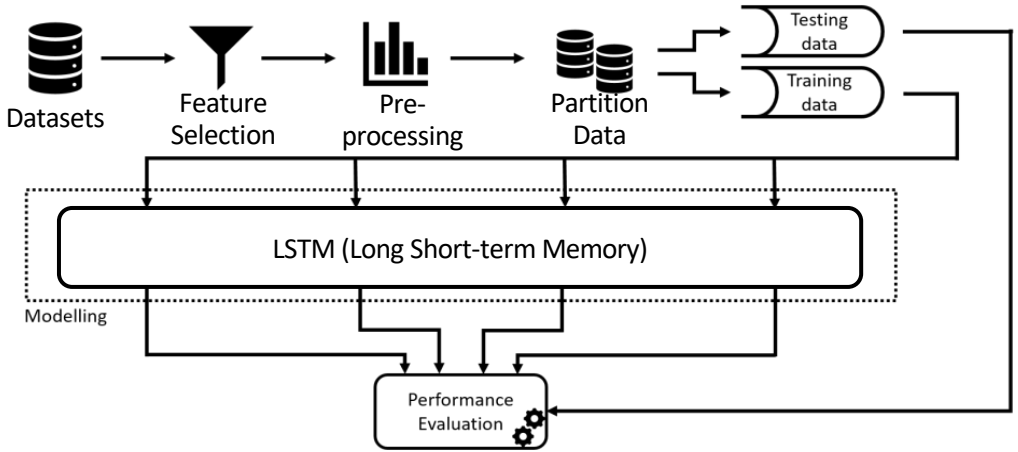


Our Methodology
Deep learning in core

›Deep learning algorithms can reach conclusions as humans would by continually analyzing data with a given logical structure.

›Long short-term memory (LSTM) architecture which is a special kind of artificial recurrent neural networks (RNN) and capable of learning long-term dependencies.



GROW Dataset and LSTM - I
Open-source Data use for HI-TERRA

Datasets

GROW
Soil Condition Dataset

DarkSky
Weather Data

ESDAC Soil Database
Hydrogeological Property of Soil:
Available Water Capacity (AWC)

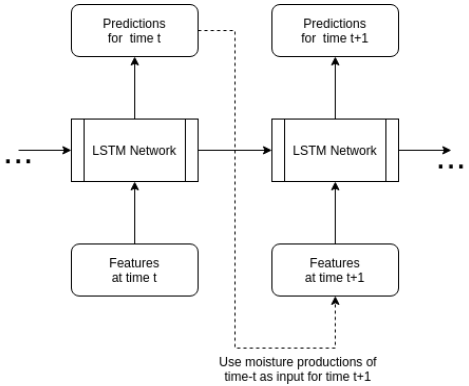
Pre-processing

- Sensors were closed at some intervals
- Split the time-series data into **chunks**; work in chunks

GROW Dataset and LSTM - I
Open-source Data use for HI-TERRA

LSTM Modelling

- LSTM has an internal state that is updated at each time-step with new features



Experiment Setup

- Train and Test

	Train	Test	All
# of Locations	1000	274	1274
# of Chunks	3086	881	3967
# of Hours	1392707	388448	1781155

LSTM Modelling Results: Soil Moisture Forecasts - I

24-hour periodic forecasts
MAPE score: 7.5%

Actual

Forecasts
(each 24-hr)

LSTM Modelling Results: Soil Moisture Forecasts - II

Actual

Forecasts
(each 24-hr)

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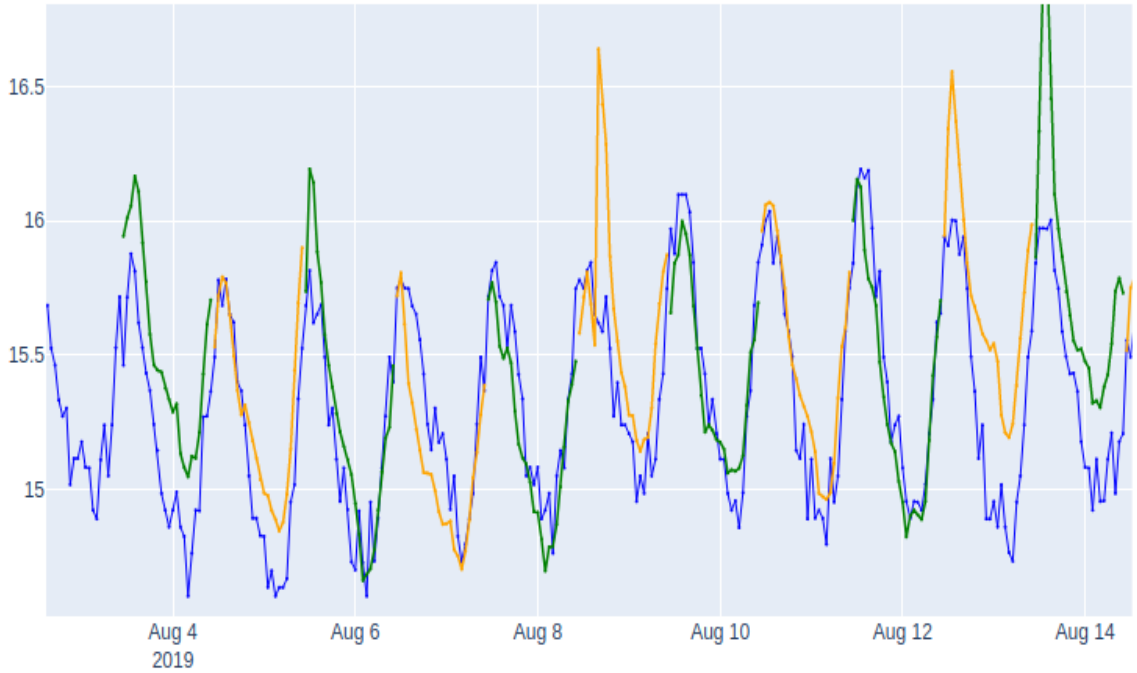
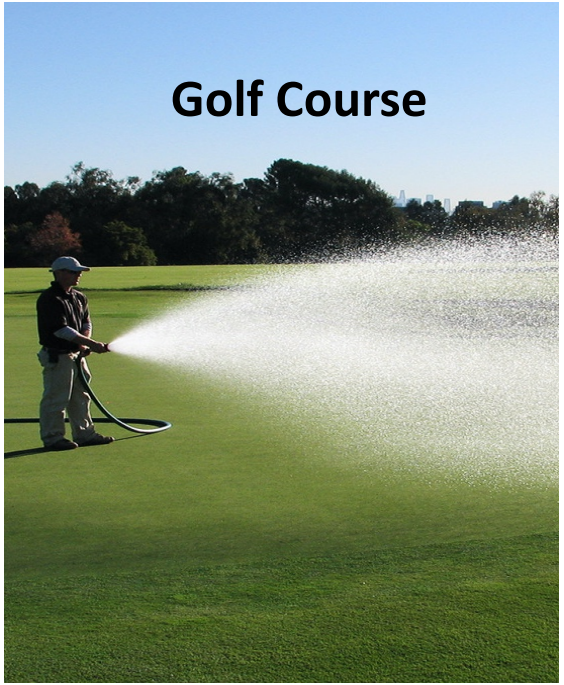
LSTM Modelling Results: Soil Moisture Forecasts - III



Actual

Forecasts
(each 24-hr)

HI-Terra Use Cases



Stakeholders
User Groups, Beneficiaries and Contributors

Beneficiaries	All stakeholders and “Earth”
Contributors	Academicians and Researchers Scientific Organizations Society / Citizens
User Groups	Farmers Land-Owners /Greenhouse Owners Golf course owners Municipalities / Utility Companies Policy Makers

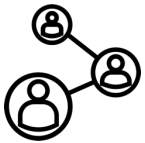
Sustainability of Hi-Terra Solution

Advantages
Benefits of Predictive Soil Moisture Infrastructure

- Tackles societal challenges on climate, food, land and resources, related to SDGs
- Learns from multi-dimensional datasets (sensor, soil, weather data)
- Open to perform better by improving LSTM model and learn iteratively.
- Open to scale up, expand and integrate system to be an infrastructure
- Predictions with high accuracy
- Helps to save water and optimize watering periods
- Sustainable, collaborative and contributing system for our common future

Next Steps to Contribute More
How we will support citizen science

- Land Characteristics Datasets
- More Soil Property Data



- Contribute Citizen Science
- Open source

- Higher Accuracy /MAPE
- Improve model

- Address climate action, food and land use challenges

- Forecast “How much water to be used” for irrigation

- Measure results
- Determine societal impact

Thank You Very Much!

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