



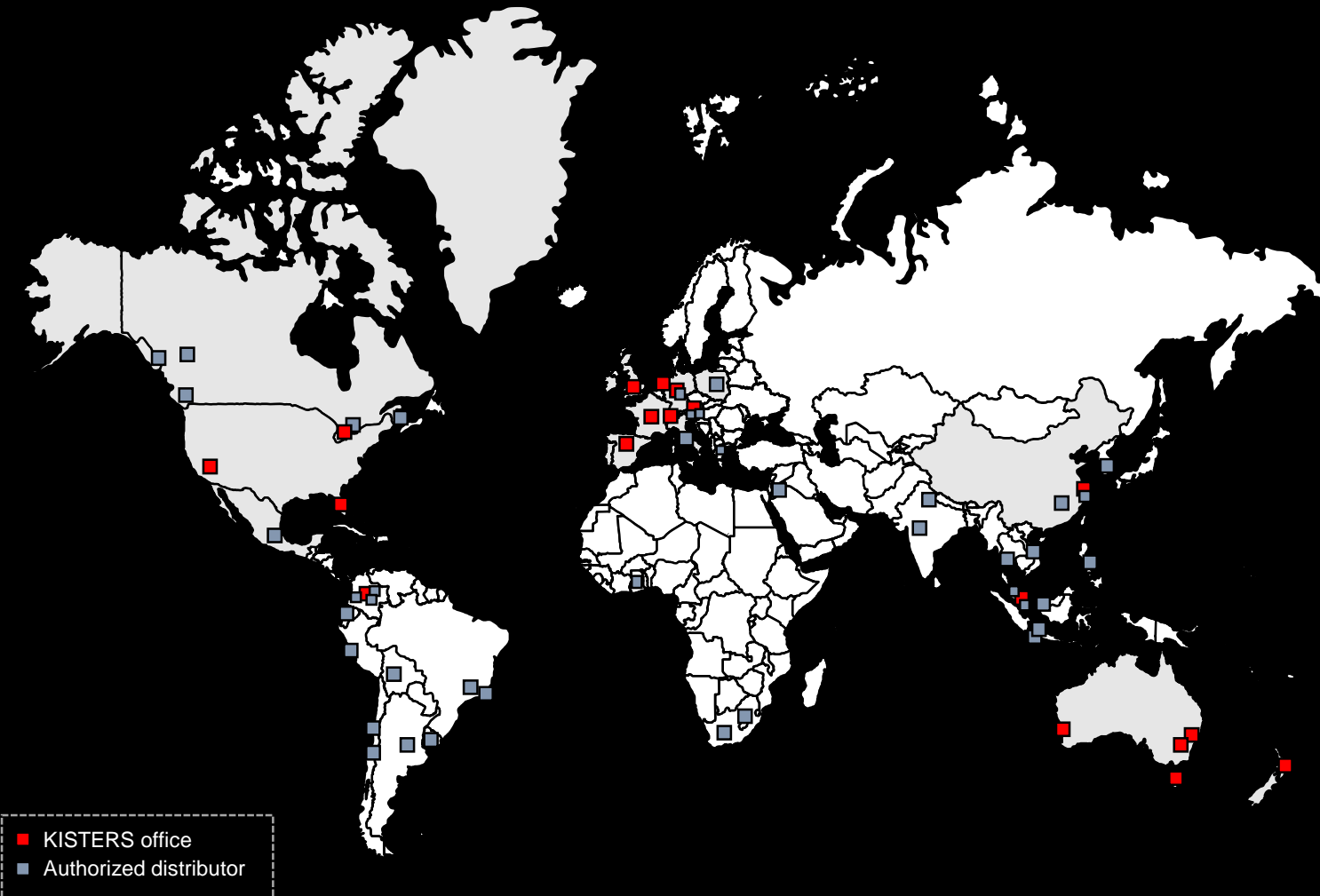
Empowering decisions of tomorrow



HailSens360

Utility Scale Solar Asset Protection

Hello! We're KISTERS.



- International, environmental data and insights organisation founded 60 years ago.
- Specialize in water, weather, energy-renewables and IT sectors.
- Collect, process and report environmental data from all over the world.
- Provide customers with truly reliable data driven insights and technology they can trust.
- One global team, over 800 experts/ engineers/scientists/inventors/developers from 30 nations, 5 continents.

What we do.

Energy renewables



Virtual Power Plant



Smart meter



Generation
optimisation



Smart grids

Water, weather & environment



Meteorology



Urban water



Hydrology



Water quality

A few of the sectors and industries we play in.



**INTERGOVERNMENTAL
ORGANISATIONS**



**NATIONAL, FEDERAL,
STATE AND REGIONAL
AGENCIES**



**CITIES,
MUNICIPALITIES,
LOCAL GOVERNMENT**



WATER UTILITIES



MINING INDUSTRY



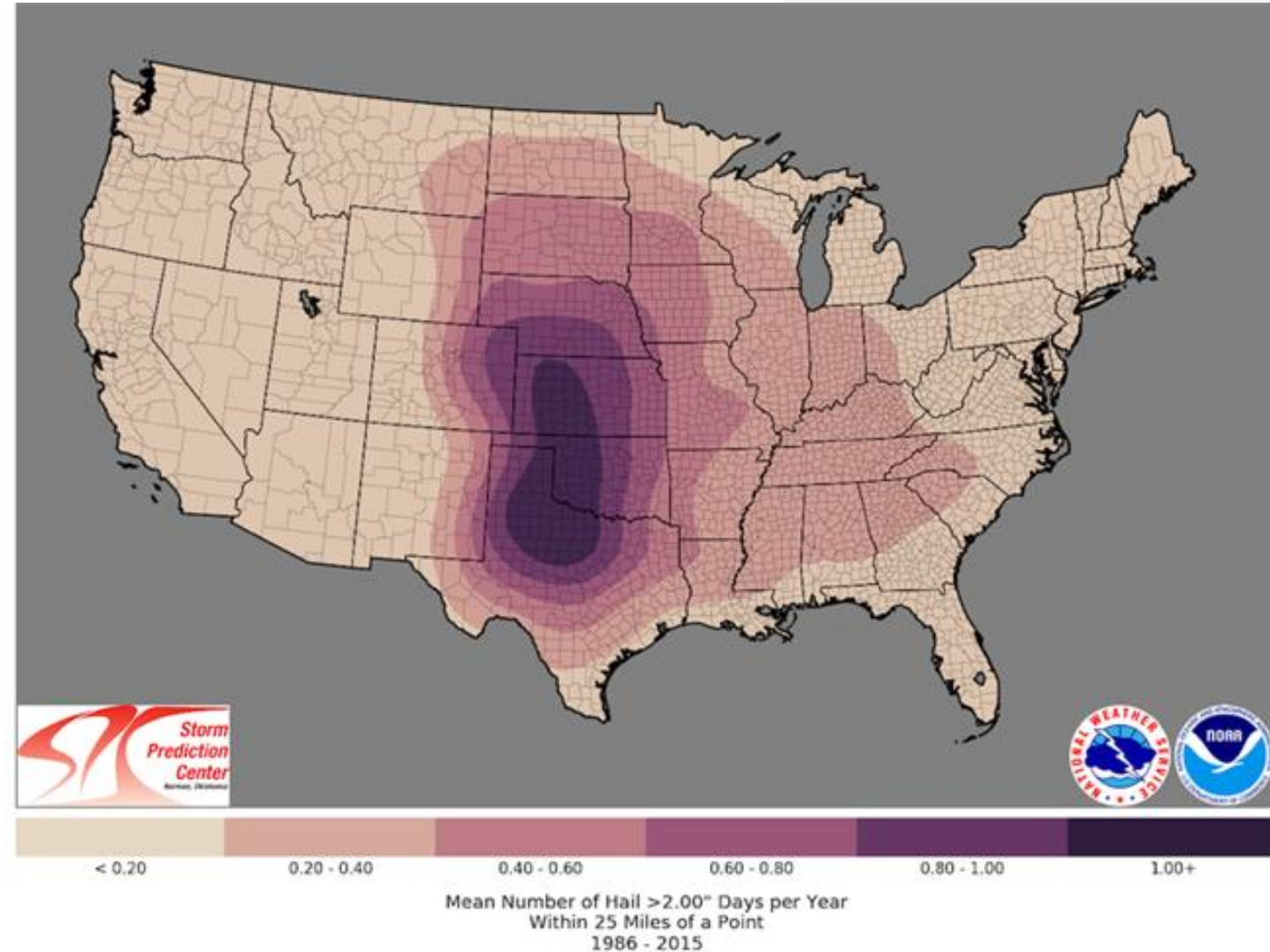
AGRICULTURE



WATER POWER

Challenges.

- Fast growth of Solar Farm utilities in the US
- “Solar belt” overlaps with “large hail risk belt”
- Following a number of severe weather events (incl. hail) insurance policies have become increasingly expensive with less coverage since 2020
- Increased demand for:
 - Capability to prove occurrence of large hail event, including hail sizing statistics – parametric insurance
 - Timely and reliable forecasts of hail, enabling protective measures.



Introducing HailSens360.

A complete end-to-end early warning hail monitoring system that can help you better protect your solar assets.

- All key information on a single platform – end-to-end solution
- Early warnings based on forecasts and nowcasts, enable timely protective measures to be taken against upcoming hail.
- ‘Next generation’ hail sensor and powerful post event analysis tools, empowering the handling of insurance claims

An all-in-one hail monitoring system.



- End-to-end solution integrated into a single platform (datasphere)
 - Forecasts for relevant parameters based on HRRR and NAM model
 - Nowcasts based on volumetric radar/echo top (VR/ET) ratio, proper nowcast algorithms and strong correlation between hail size and VR/ET ratio
 - Observation -similar as nowcast + Hail sensors
 - Post Event Analysis via fixed reporting views
- Hail relevant data available as:
 - raster data
 - timeseries data on solar farm locations
- Extensive alarming functionality

Awareness.

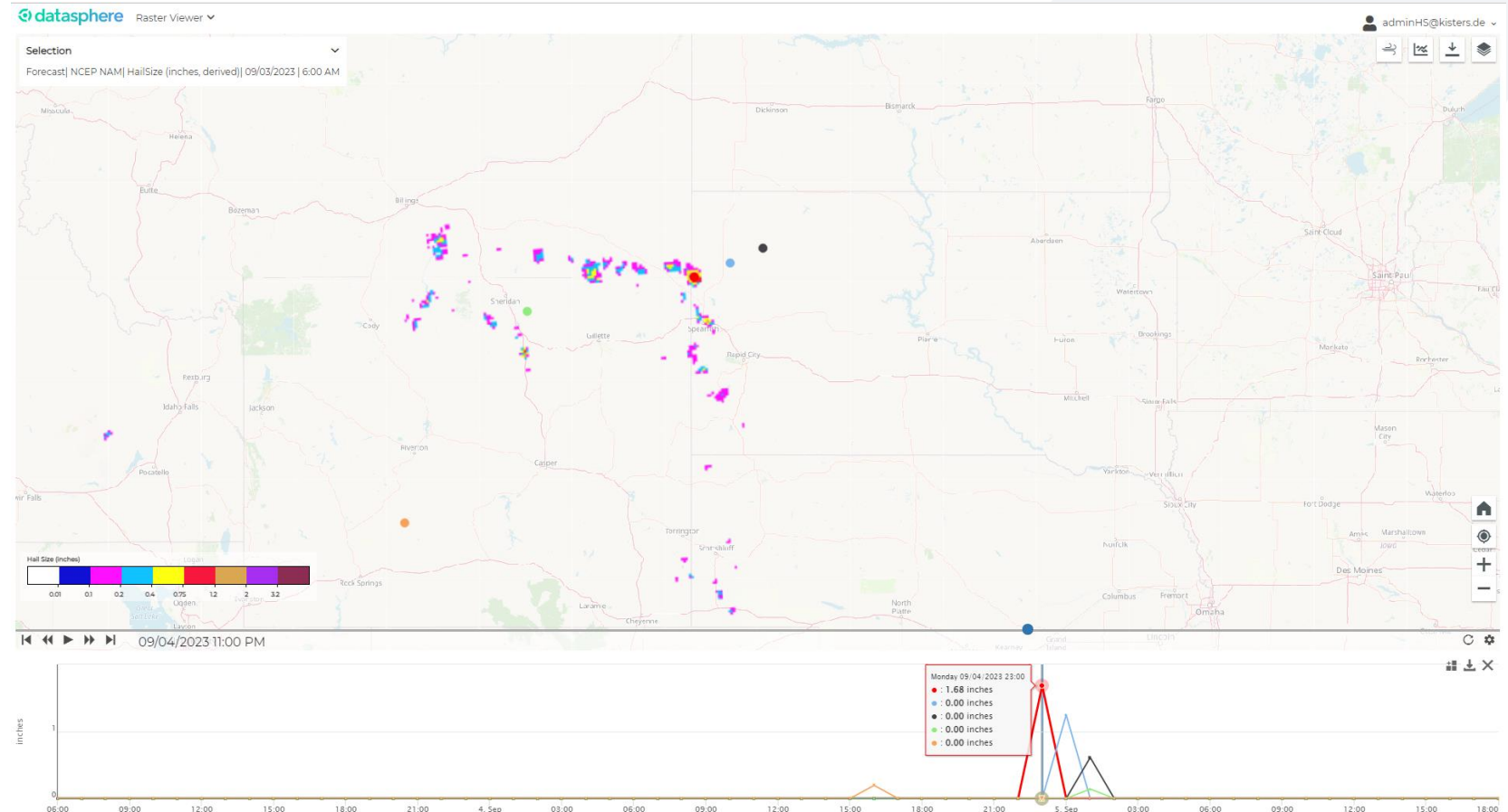
Forecast

Nowcast

Observation

Post-event analysis

- NAM (North American Mesoscale Forecast System)
- Relevant parameters like hailsize, CAPE, etc.
- Updated 6-hourly, hourly timesteps, T+48h horizon
- Download any location via 'raster to point functionality'
- Also available for hail size as timeseries data on assets locations



Awareness.

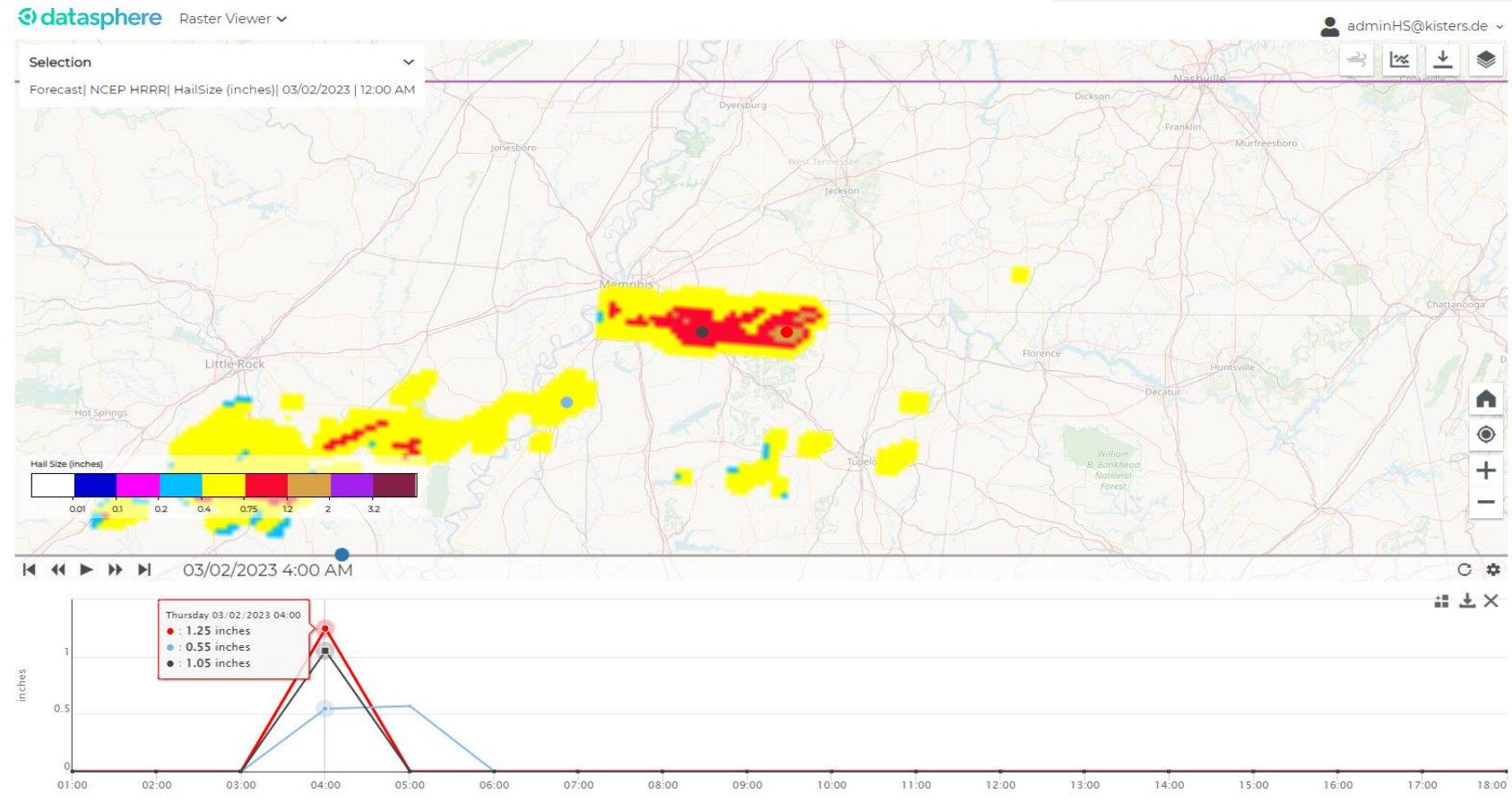
Forecast

Nowcast

Observation

Post-event analysis

- HRRR (High Resolution Rapid Recycling model)
- Relevant parameters like hailsize, CAPE, etc.
- Updated hourly, hourly timesteps, T+18h horizon
- Download any location via 'raster to point functionality'
- Also available for hail size as timeseries data on assets locations



Awareness.

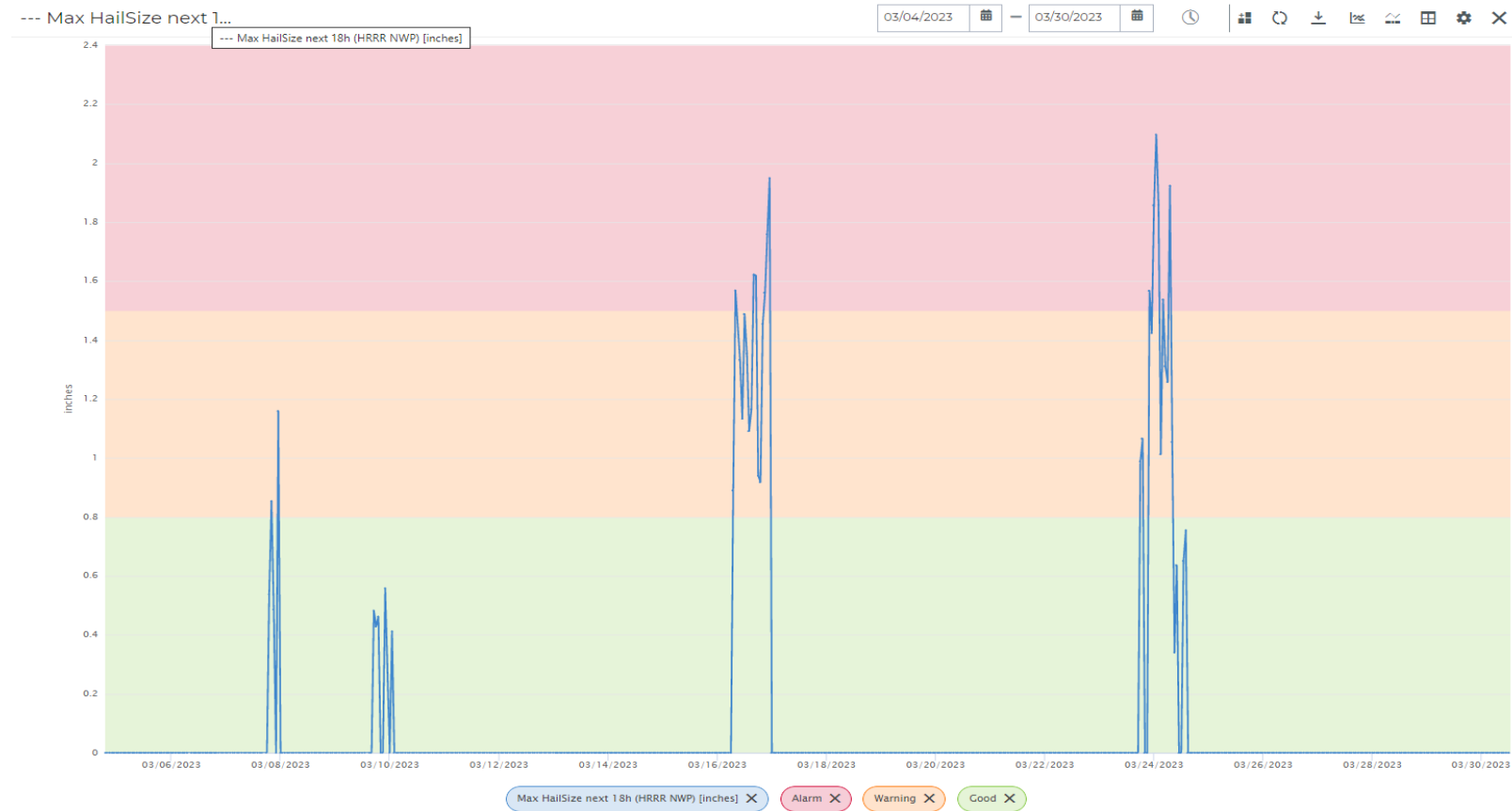
Forecast

Nowcast

Observation

Post-event analysis

- Timeseries showing max hailsize next 18h for your Solar Farm location
- Freely configurable alarm thresholds (color bands)
- Based on HRRR3, hence hourly updated
- Alarming via mail or SMS.



Alarming.

Forecast

Nowcast

Observation

Post-event analysis

- Alarms for any location/timeseries
- Total freedom of recipients and recipient groups allocation to specific alarms
- Several types of thresholds (Above, below, deviation from normal, outdated values)

Add Threshold Configuration

Location
Dallas-East

Time Series
HailSize (inches)

Configuration Active
Yes No

Threshold Type
Above Threshold

	From	To
Out-of-bounds		∞
Alarm		
Warning		
Good		
Out-of-bounds	∞	

Recipient Group
None

New Recipient

Name

Description

Email

SMS

New Group

Name

HailSens Group

Description

Recipients

Name

Channel



Dave Procyk

Email



Elizabeth Mcgoldrick

Email



Johan Jaques

Email



Johan Jaques

SMS



adminHS@kisters.de

Email



dave.procyk@kisters.net

Email



@kisters.de

Email

Alarming.



- Example of e-mail alarm
- Threshold validation for your location of interest 'Dallas East' over max value of 18 forecast steps.

Hi Johan Jaques,

datasphere wants to make you aware that there are changes in your alarm status.

The location Dallas-East has changed status to Warning (07/03/2023 17:00).

For more information, please log in to <https://na.datasphere.online/>

Time Series

Max HailSize next 18h (HRRR NWP)

Alarm status



Alarm Level

Warning

Value

1.2 inches

Location

Dallas-East

Tendency

↑ Ascending

Timestamp

07/03/2023 17:00

Threshold max

2 inches

See Alarm

Operations.

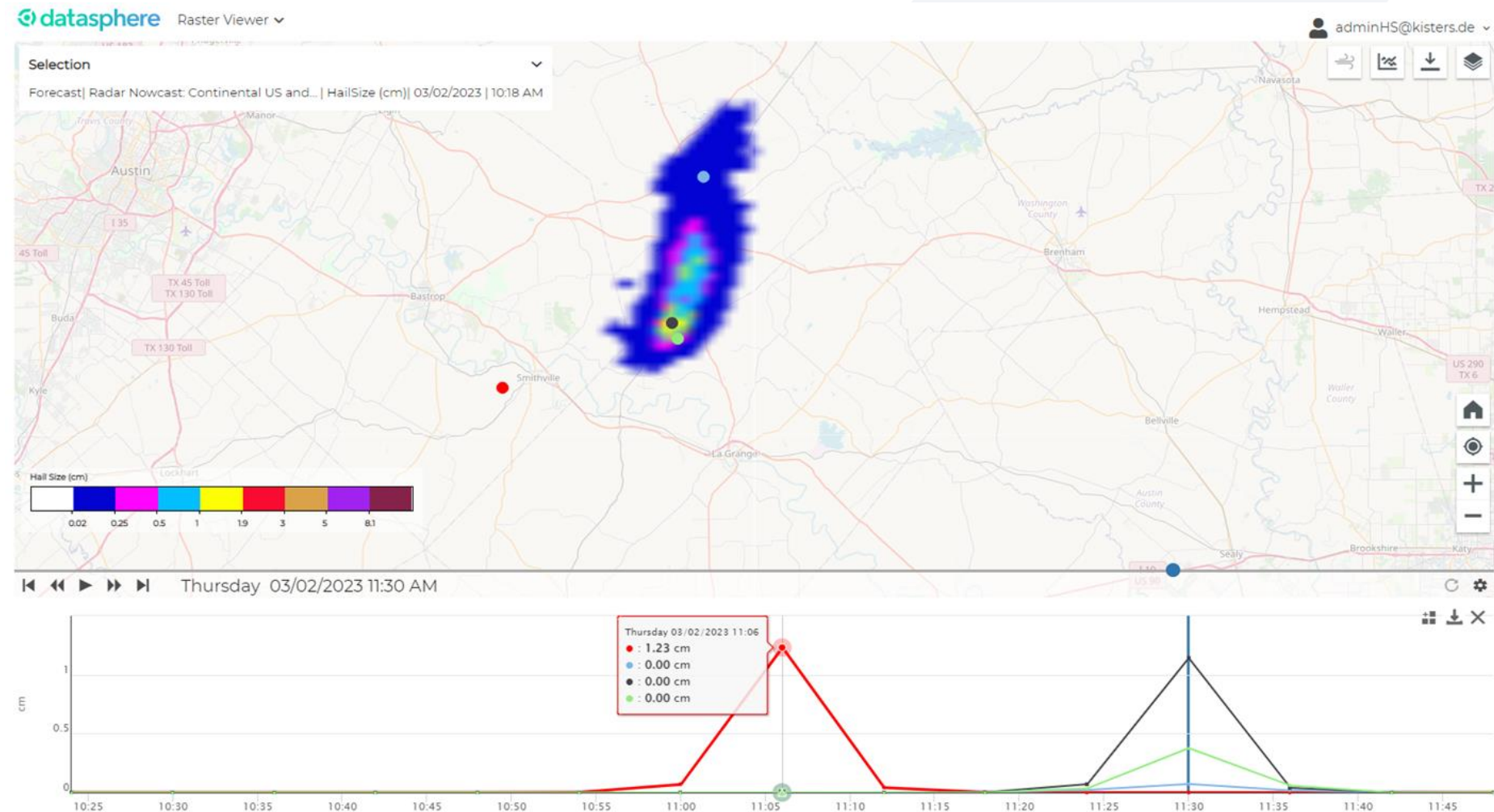
Forecast

Nowcast

Observation

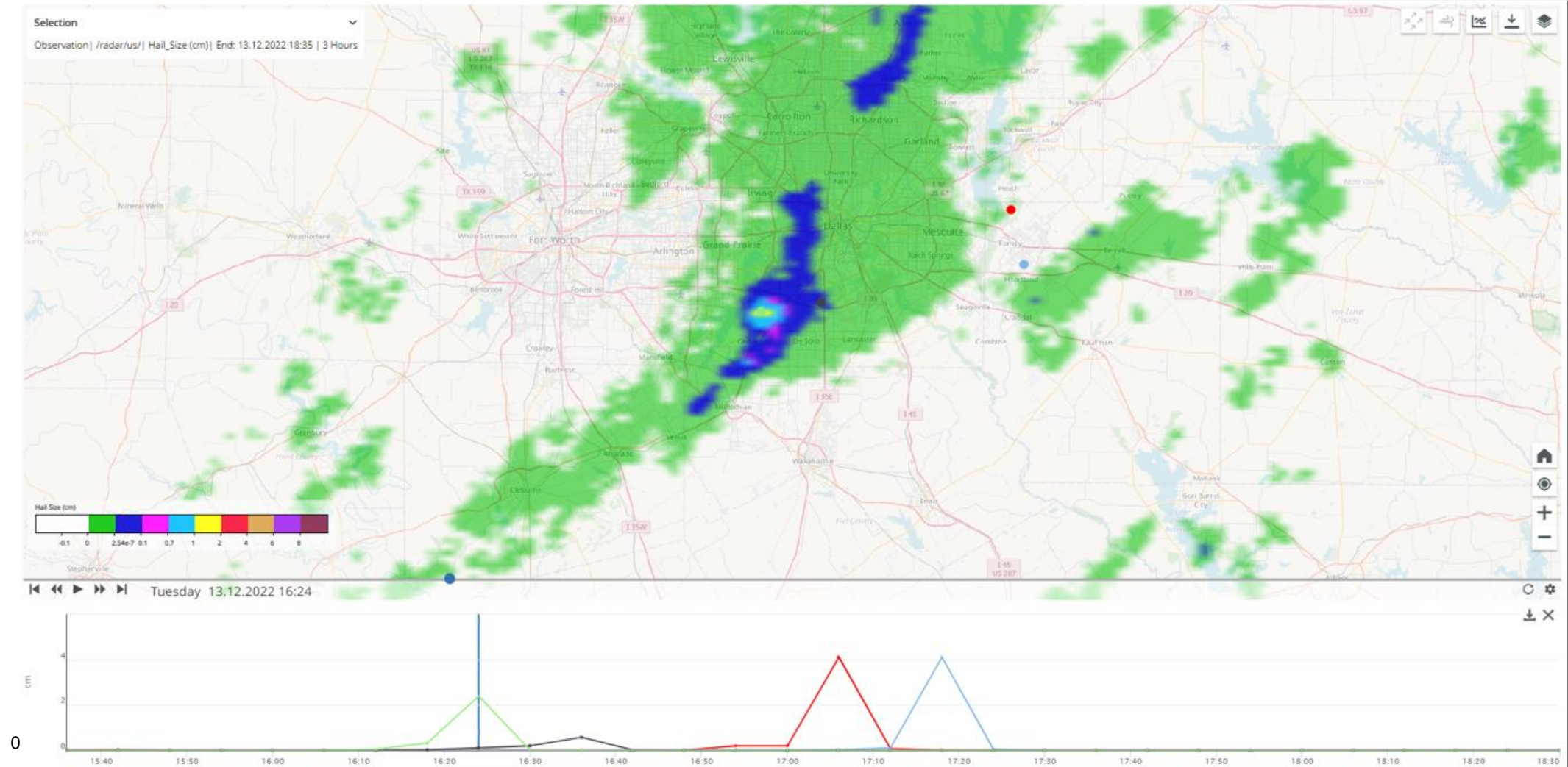
Post-event analysis

- Based on VR/ET and its strong correlation with hail size
- Updated every 6 minutes, 6 min timesteps
- Nowcast depth of 90 minutes



Is the integrated volumetric radar/echo top vs hailsize correlation any good in practice?

VR/ET terrain validation – North Texas, East of Dallas, 13 Dec 2022

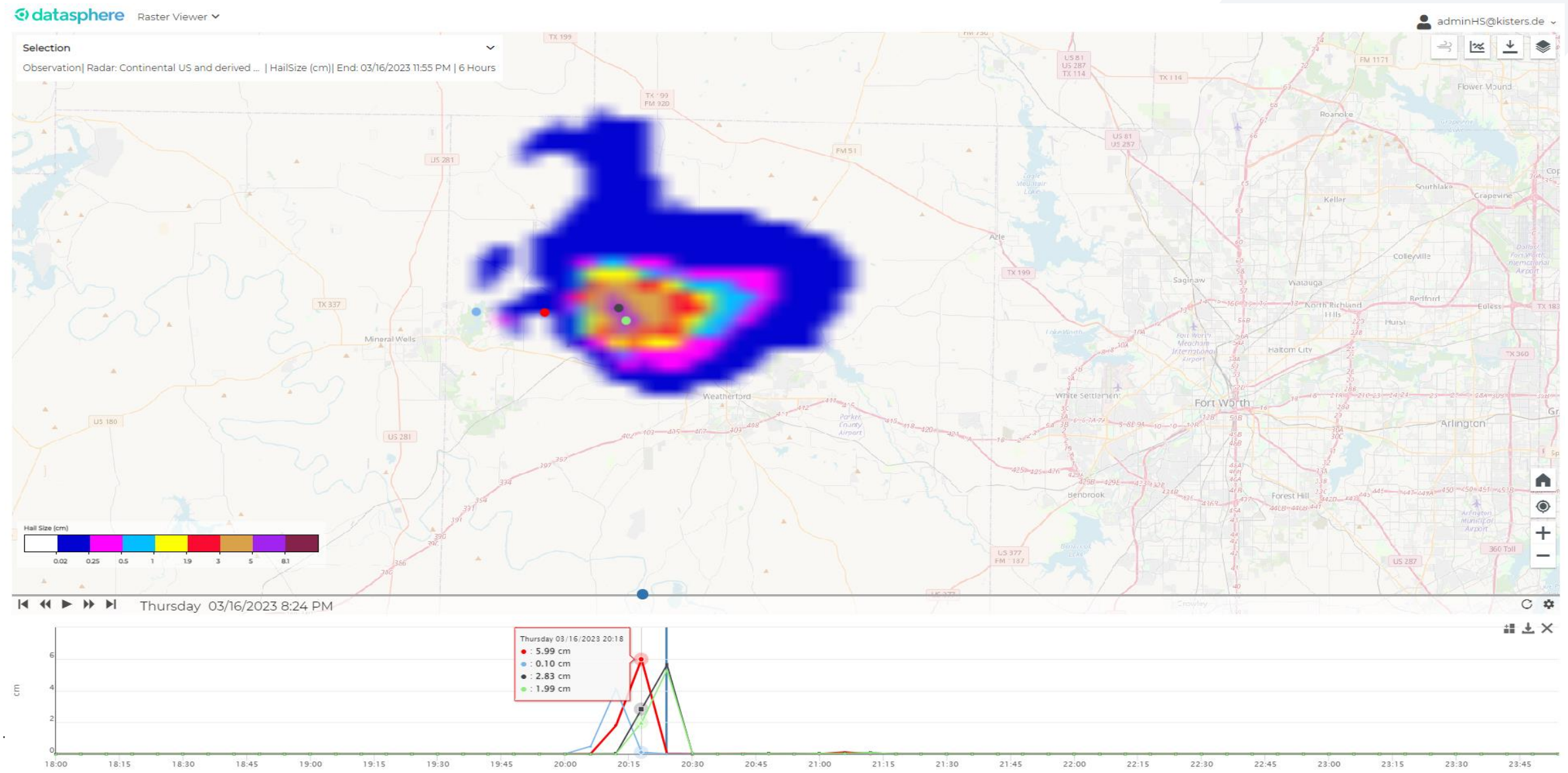


VR/ET terrain validation – North Texas, East of Dallas, 13 Dec 2022



Photos of North Texas Hail on Dec. 13, 2022 – NBC 5 Dallas-Fort Worth ([nbcdfw.com](https://www.nbcdfw.com))

VR/ET terrain validation – Texas, Mineral Wells, 16 Mar 2023



VR/ET terrain validation – Texas, Mineral Wells, 16 Mar 2023



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Nowcast

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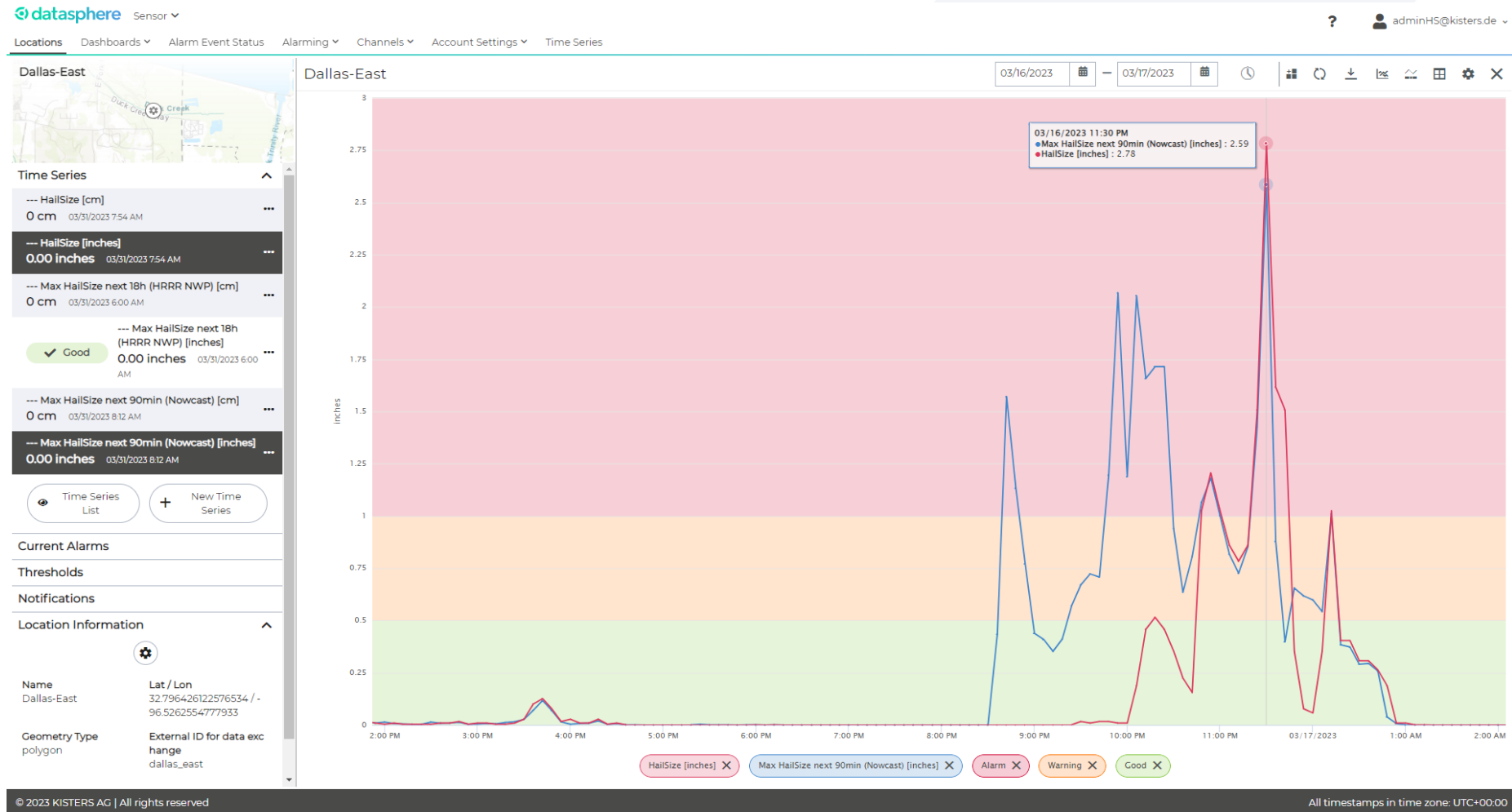
Forecast

Nowcast

Observation

Post-event analysis

- Nowcast captured well: potentially devastating hail size > 2.5 inches
- Focus on early warning and pessimistic view in terms of potential damage to solar panels
- False alarms rather than misses



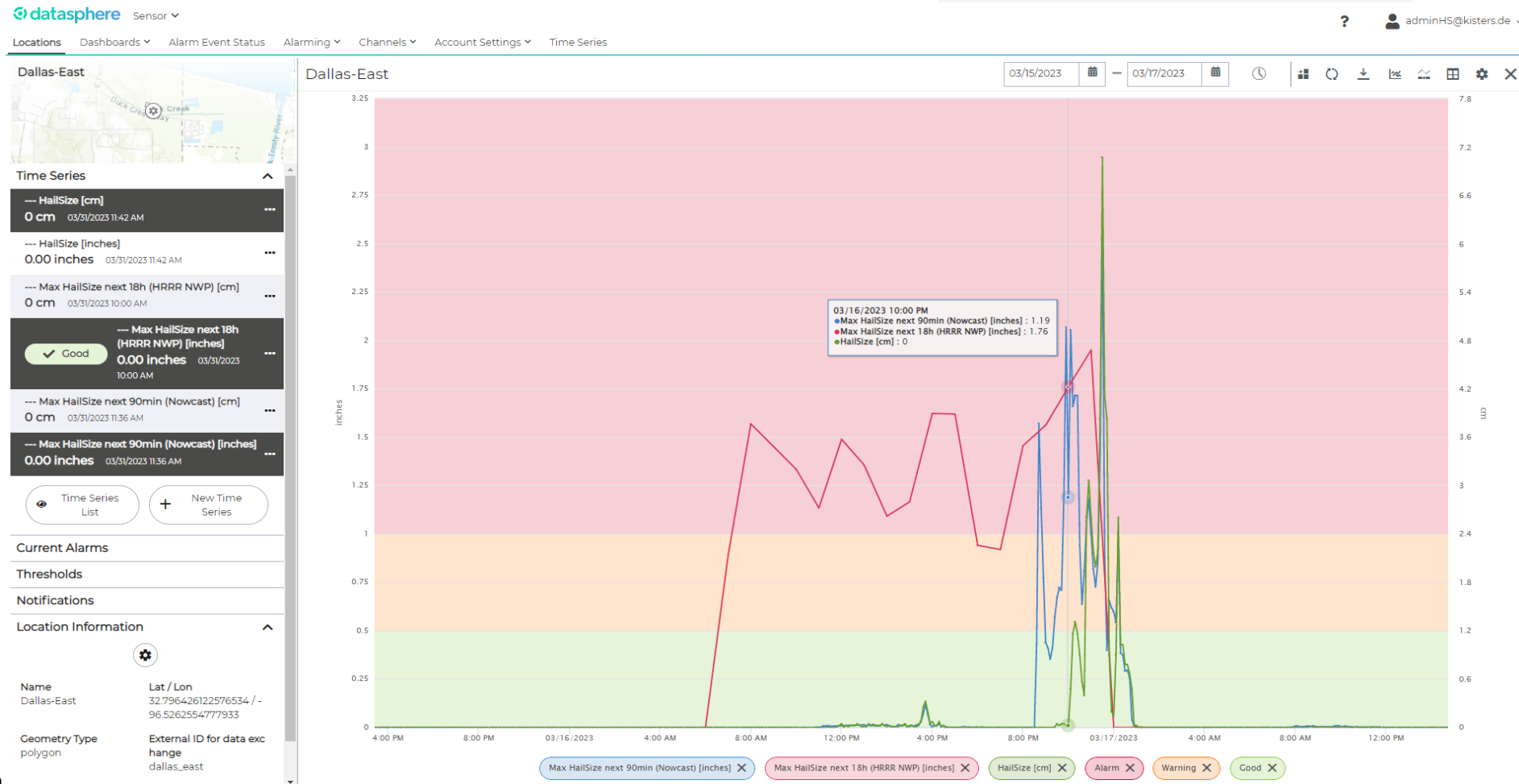
Forecast

Nowcast

Observation

Post-event analysis

- Strength of the datasphere platform to show all at the same time if desired
- Forecast risk of large hail kicks in well ahead of the events.
- HRRR captures order of magnitude (2 inches) quite well



Forecast

Nowcast

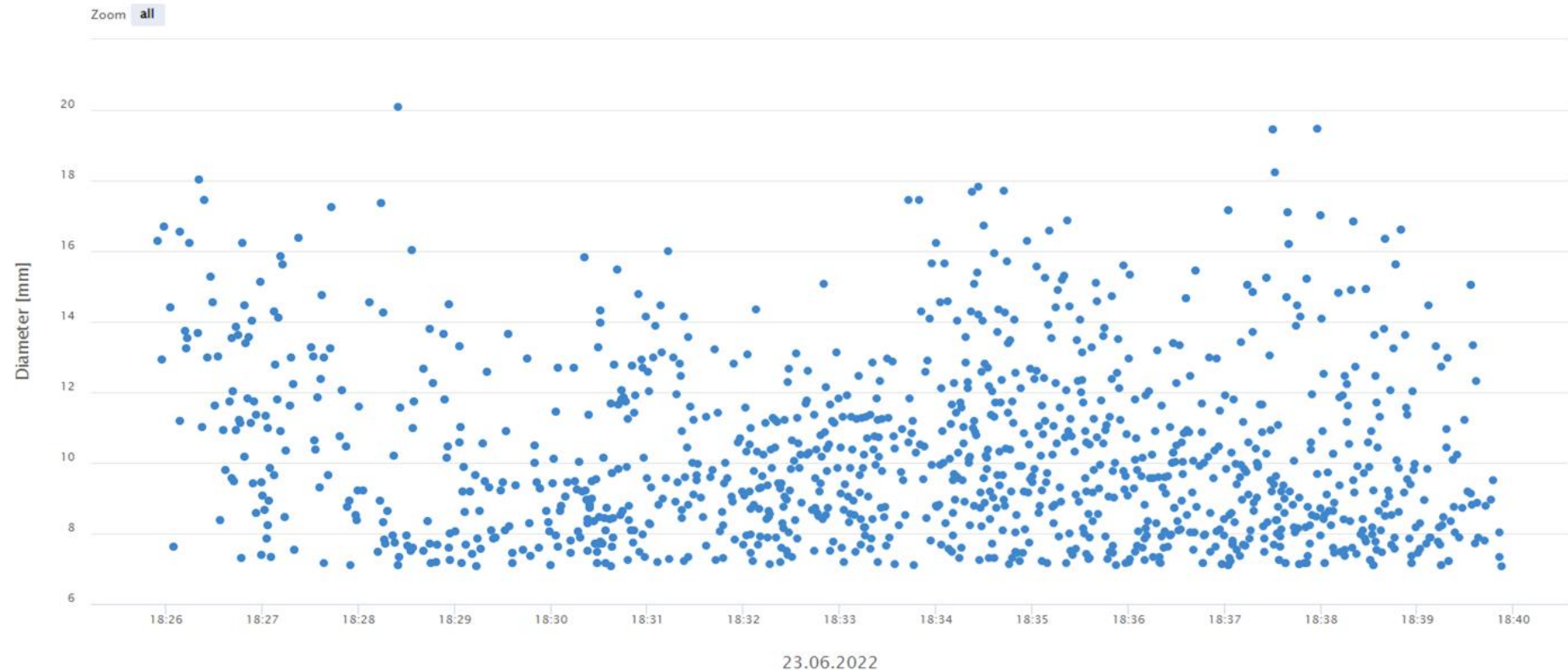
Observation

Post-event analysis

HailSensor 1, 2. Hail Event: 06/23/2022 2:25:00 PM to 06/23/2022 4:40:00 PM

Hail Event Profile

Hailstone Size Distribution in Time



- Very detailed observations are also provided by our HailSens IoT sensor
- Hail Event Profile as one of the fixed outputs of a hail sensor
- Individual impacts with size and timetags are displayed

Forecast

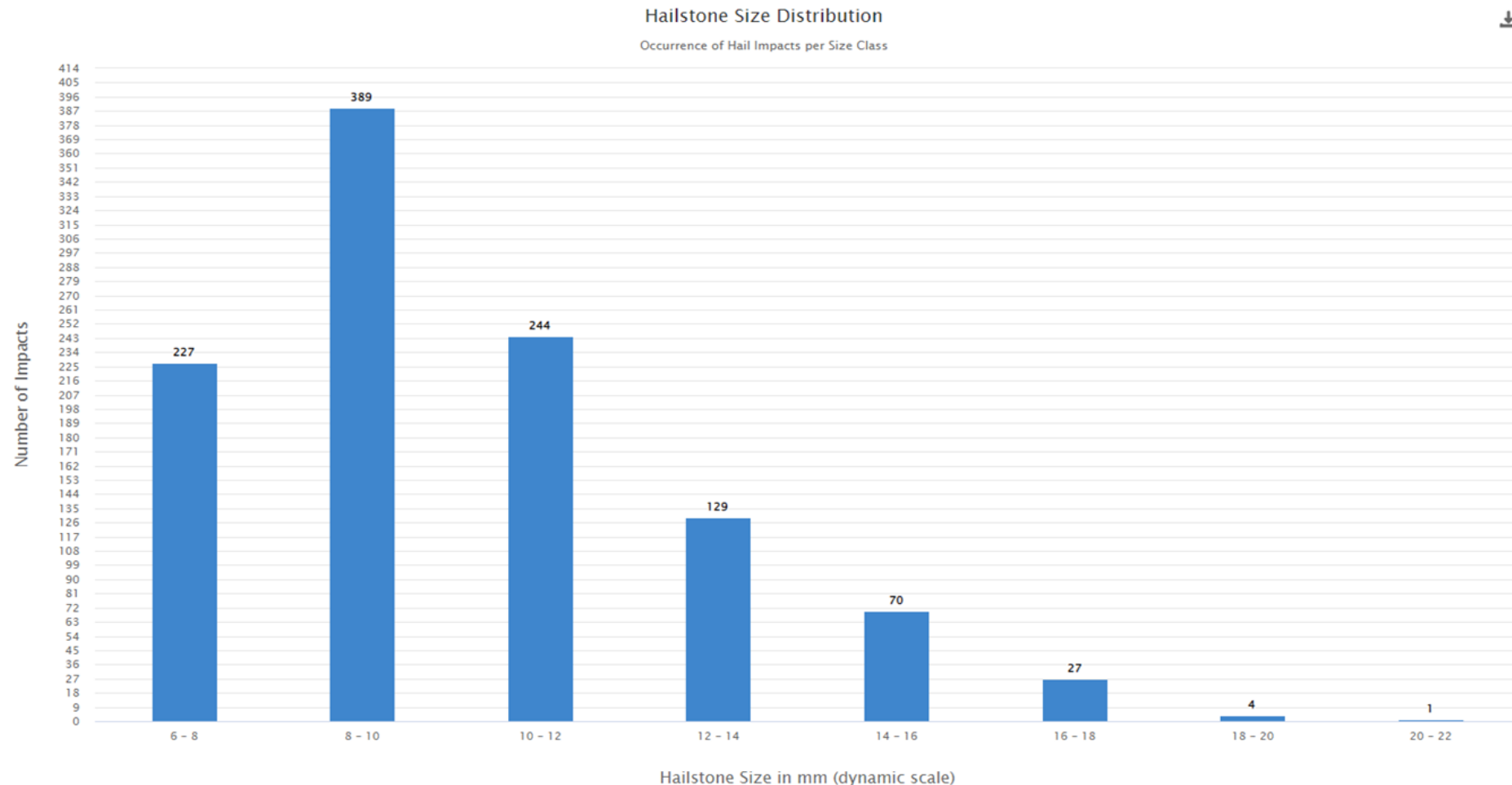
Nowcast

Observation

Post-event analysis

HailSensor 1, 2. Hail Event: 06/23/2022 2:25:00 PM to 06/23/2022 4:40:00 PM

- All individual hail stone impacts (manual downloads/API)
- Class size distribution
- Impact size distribution by international Torro Scale



Forecast

Nowcast

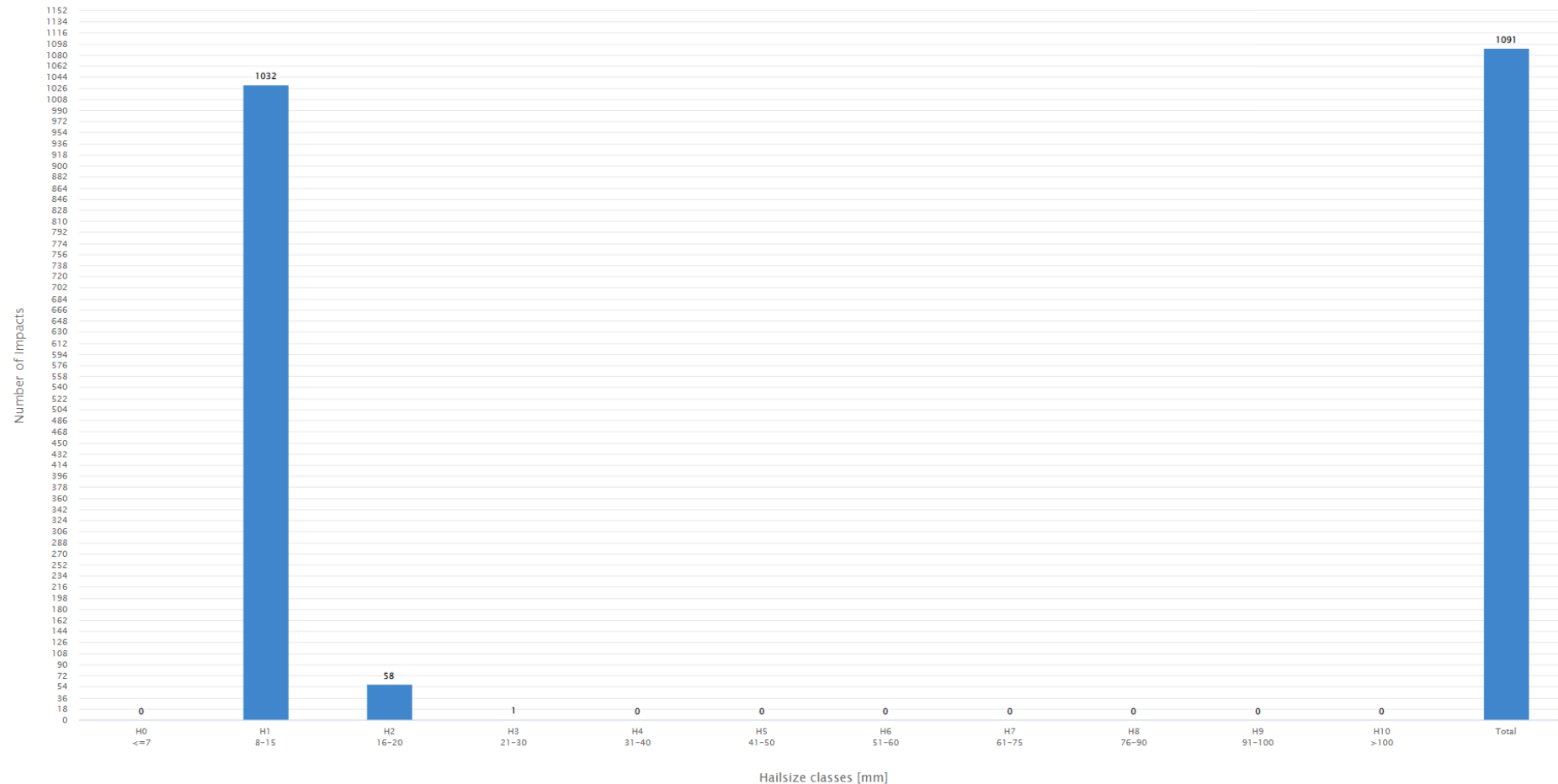
Observation

Post-event analysis

HailSensor 1, 2. Hail Event: 06/23/2022 2:25:00 PM to 06/23/2022 4:40:00 PM

Hail Intensity Class Distribution – Torro scale

Number of impacts in each hail class



- All individual hail stone impacts (manual downloads/API)
- Class size distribution
- Impact size distribution by international Torro Scale

HailSens.

Hail detection and reporting
from the ground.





Moving forward:

- Introduction to our hail instrument; background and value
- Notable - Hail instrumentation:
 - Relatively young tech for analytical sensing especially for practical application
- KISTERS - Global group looking at global issues as a partner



Weather is continually evolving which means needs are growing.



Kinetic Energy of hailstones increasing:

FR 1989-2009: +70% (Berthet et al., 2011)

IT 1975-2009: +60% (Eccel et al., 2012)

Need for damage assessment growing

Masses are proving to be larger over time

Midwest and South experiencing “move severe” hailstorms (44mm-51mm, or 1.75” to 2” (FM Global Research)

Hail defined by WMO as 5-50 mm == kinetic energy range: 0,005 J .. 28 J~30 J

Kinetic Energy

Kinetic energy is the energy that objects possess due to their motion.

$$KE = \frac{1}{2}mv^2$$

m = mass (kg)

v = velocity (m/s)

KE = Kinetic energy (J)



Forecast

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Observation

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Forecast

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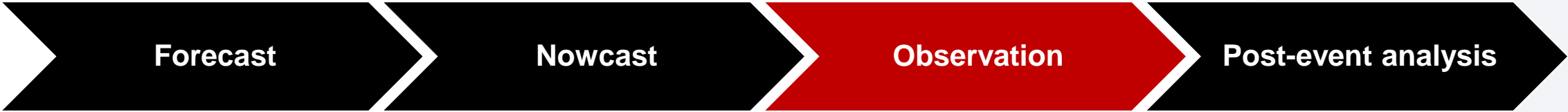
Observation

Post-event analysis

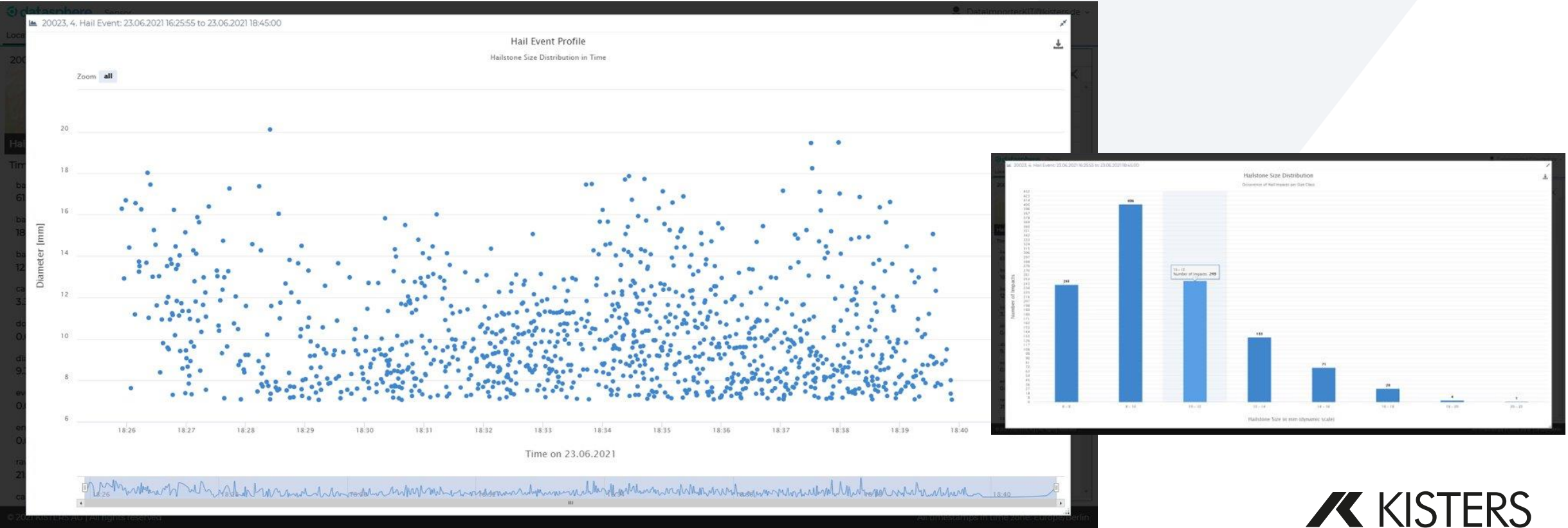
HailSens: Mechanics

- Finely calibrated polycarbonate "drum" or plate recording individual hail impacts and the kinetic energy of each impact with timestamp.
- Self-contained logger and transmitter with simple mount allowing for data to be forwarded in real-time with redundant logging
- Wireless 3G/4G LTE data transmission
 - Heartbeat incl. sensor status every 6 h
 - JSON to IP endpoint (HTTP communication)
 - Ethernet out is option





HailSens, hail event
Graphical + tabular data with metadata



Scientific challenges.



Forecast

Nowcast

Observation

Post-event analysis



We optimized the size of plate

The larger the hailstones/the larger the distance between hailstones
HailSens Sensing Plate - 19.7 in

Wind

Accuracy takes into account variability of wind

Factory calibrated

Edge to edge tuning with an advanced and repeatable process
taking into account sizes and velocities

We are offering precise yet understandable science.

HailSens – the instrument for hail detection and reporting.



Forecast

Nowcast

Observation

Post-event analysis



For?

- Insurance and the insured
- Real-time hazard protection or reporting
- Meteorology studies

Desiring?

- Objective truth to what is falling from the sky and hitting panels or assets at the ***time of impact***
- Immediate Information on time, size of stones, kinetic energy hitting the plate in milliseconds (up to 15Hz)

HailSens concept for renewables and insurance – An excellent companion.



- **General Insurance**
pay out on risks that have an objective truth behind them, such as
 - Hailstorms
 - Rainstorms
 - Other Natural Risks
- **Reasoning**
The increasing frequency of high-risk weather events is leading industries to adopt a scientific approach towards risk.
- HailSens provides objective truth about hail events in terms of characterizing each individual impact by its timestamp, kinetic energy and pellet size.
- HailSens is the result of long-term scientific research, based on a patented method. It will continue to evolve using understandable science that allows for meaningful conversations around assets and protection, whether large or small

Conclusion.

HailSens360 is a complete solution: forecasts, nowcasts, ground observations, alarming and post event analysis tools/auto archiving all brought together on a single platform

Aggregate all your assets in one place and save time, money and frustration

Not limited to hail – we work with most types of weather hazards and models

Get in touch.

USA



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Thank you

