

Quantifying Flood Events using Acoustic Data

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Environmental
Monitoring
Workshop '22



Agenda

How Climate change is making record breaking floods

Flooding-specific features of continuous and instantaneous acoustic data

How to use Acoustics for heavy flooding events

Examples-Hurricane Irma in Kissimmee and Tampa area, FL, USA

Storm Desmond UK flooding, Northumberland, UK

Bathymetry survey – Understanding barrage-Dam management



About SonTek –A Xylem Brand

- Founded 1992 in San Diego, CA
- Specialize in acoustic technology designed to measure the speed of water in natural environments
 - Operating as a brand of Xylem since 2012
 - Presently employs 60 at San Diego Facility. Includes manufacturing; research and development, marketing and support.



How climate change is making record-breaking floods



2015 South- India

How climate change is making record-breaking floods



2005 Mumbai-India

How climate change is making record-breaking floods



2022-UAE

The Recent floods in Pakistan



WHY?



Poor Storm Water Drains



No Storm Water drain data



Encroachments-No Data



No data for river carrying capacity



No data for Weirs/barrage Dam capacity



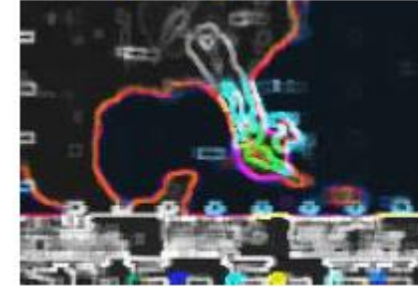
To progress along with line requires

DATA

Analysis Tools

Planning- Action

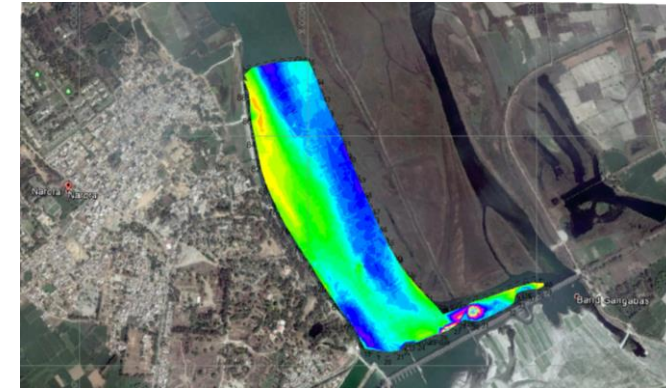
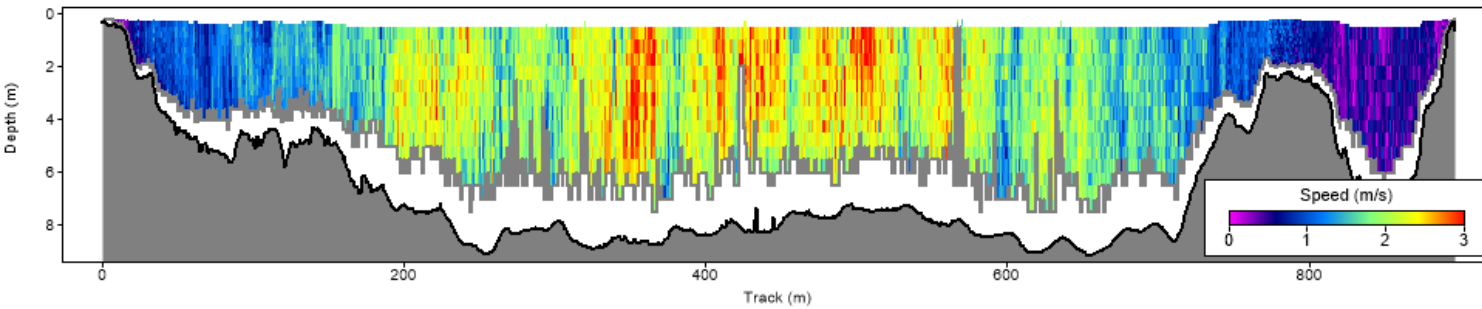
Data



Weather and rainfall forecast
Historical Hydrograph

Real-Time Water Level and
Rainfall Data

Storm Water Data



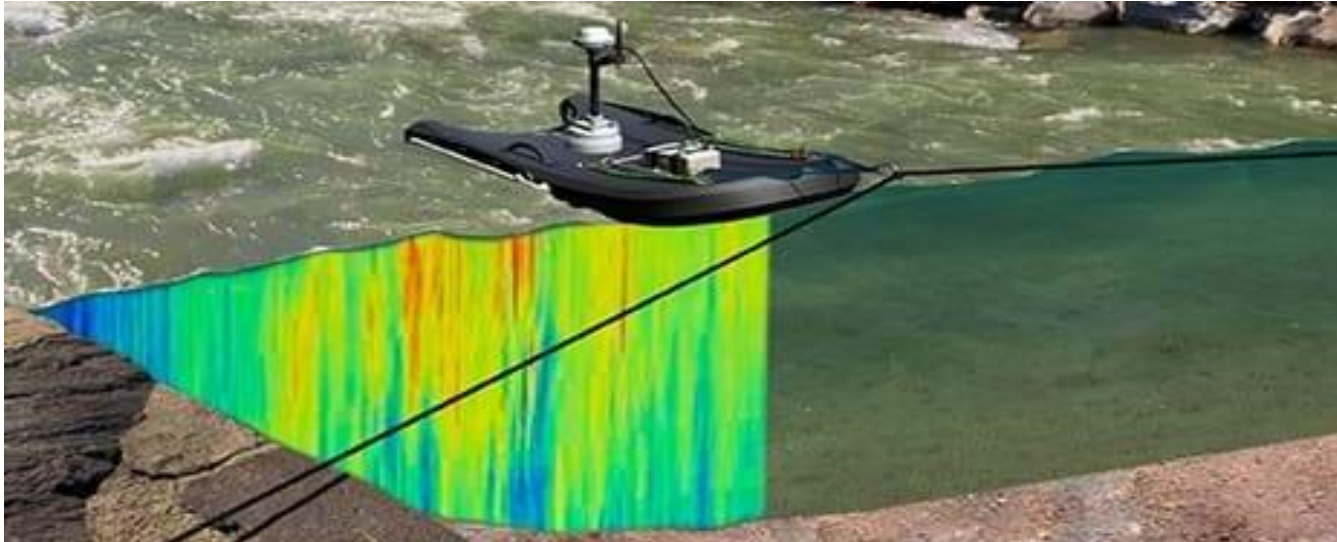
Water Velocity and Cross Section Area Data

Bathymetry for carrying capacity

No Data

Actionable
Information

Acoustics review for flood measurements

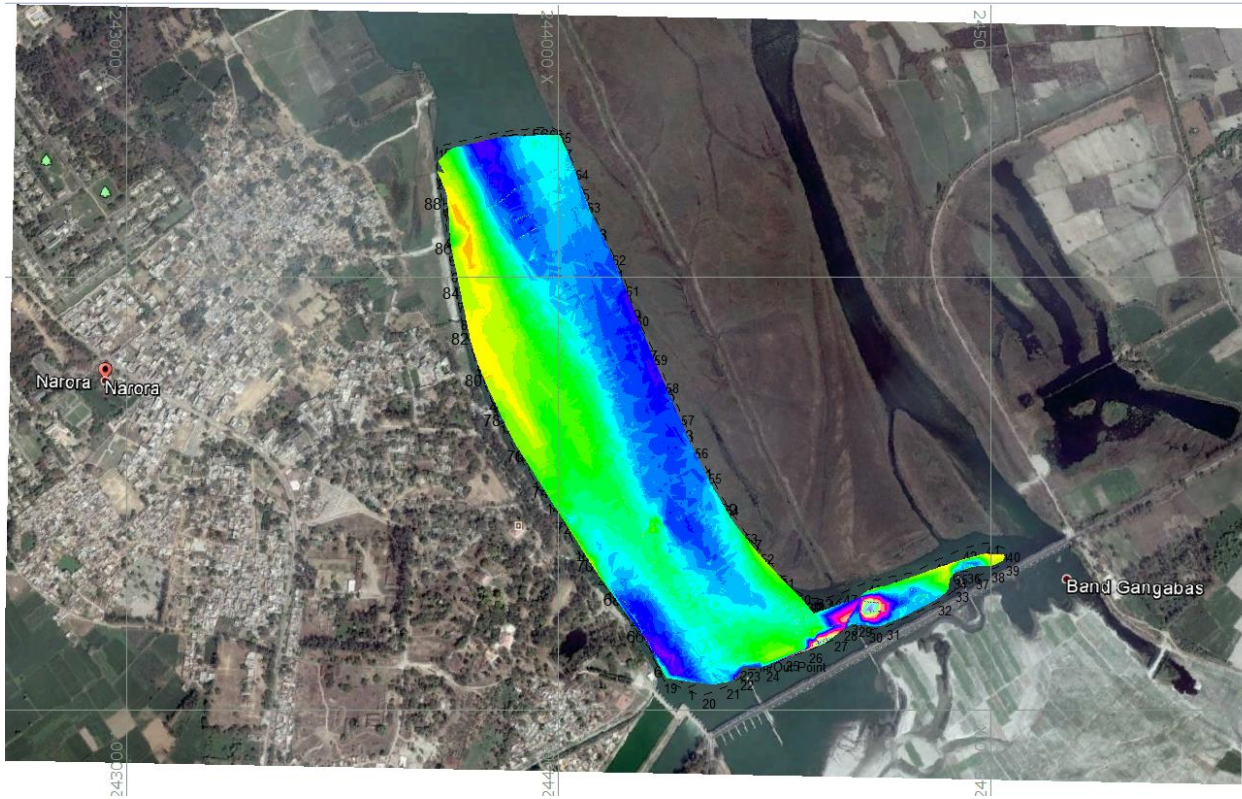


Instantaneous
Discharge measurement

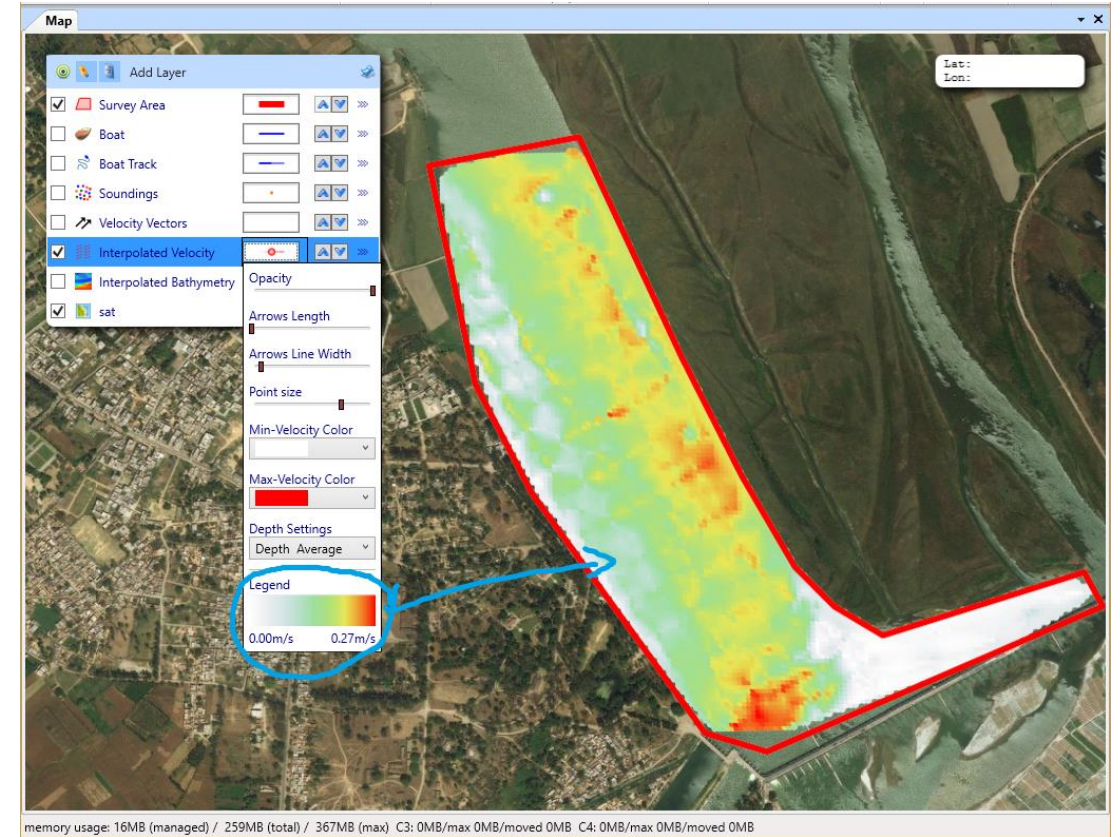
Continuous
measurement



Acoustics review for flood monitoring

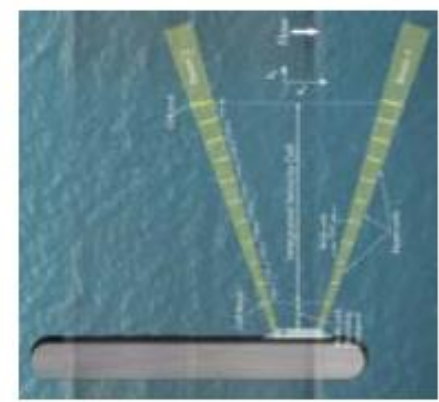


Bathymetry data- carrying capacity



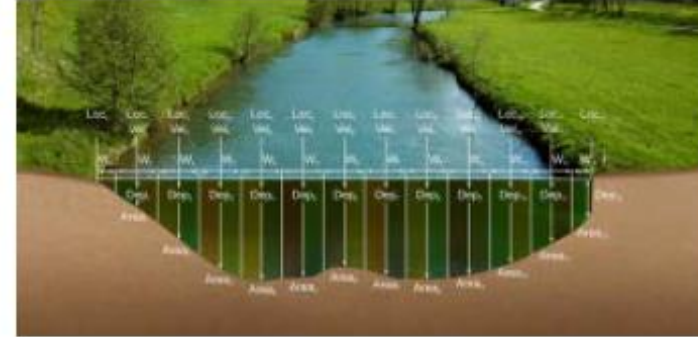
Velocity maps

Acoustics review – Continuous monitoring



Acoustics review – Instantaneous monitoring

ADV: Acoustic Doppler Velocimeter
FlowTracker



ADCP: Acoustic Doppler Current Profiler
RiverSurveyor M9/S5

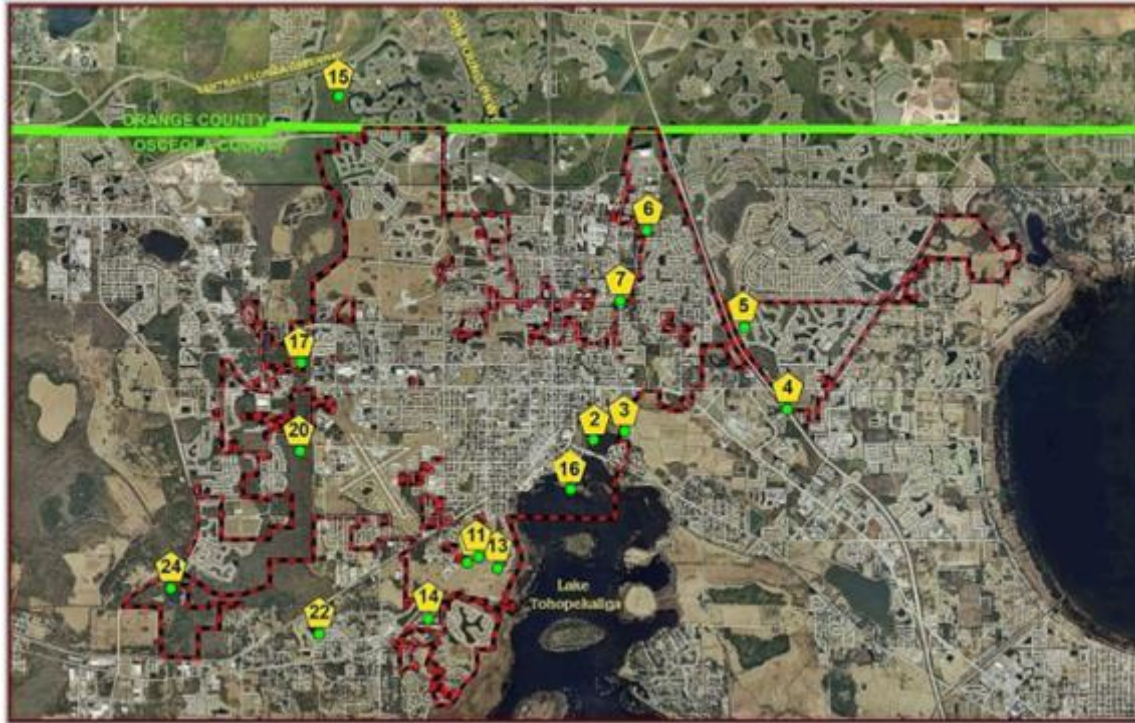


Measuring Instantaneous discharge in flood events



Examples-Hurricane Irma in Kissimmee, FL

Monitoring network in Kissimmee



- Continuous monitoring sites
 - SonTek-SL
 - SonTek-IQ
- Instantaneous measurements
 - RiverSurveyor M9

Also provides data for stormwater reporting

Shingle Creek site Irma in Kissimmee, FL

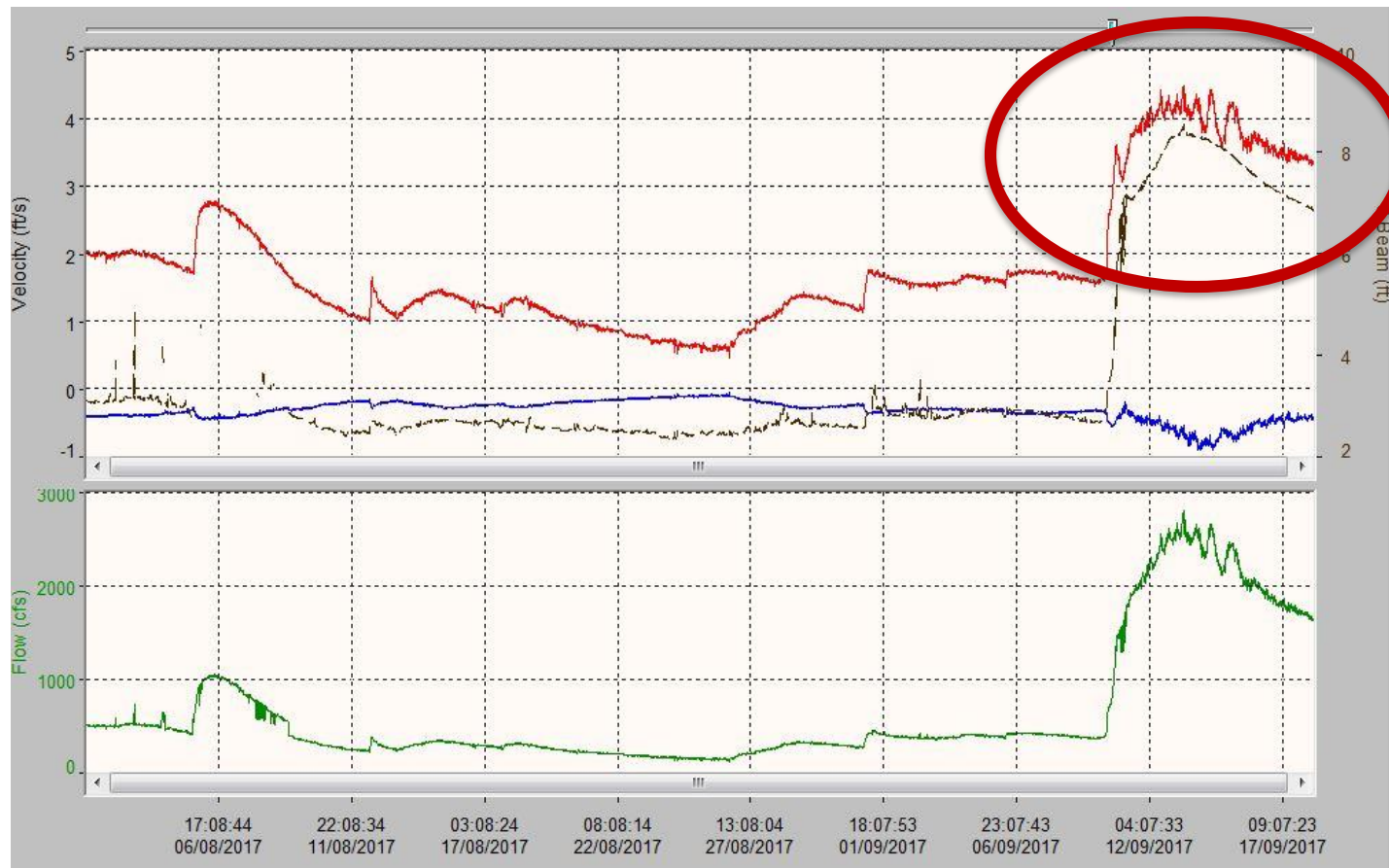
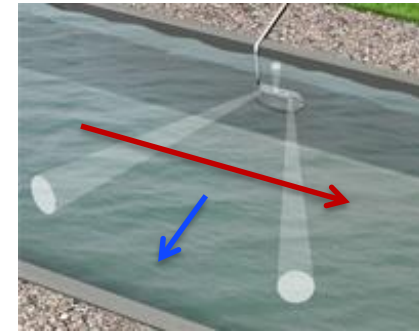


During flooding

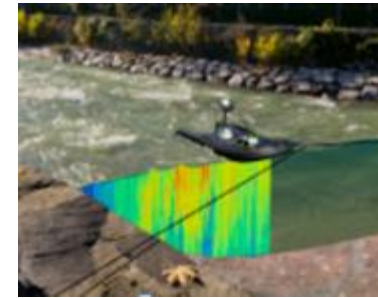
Normal (before flooding)

Irma Data in Kissimmee, FL

Instrument: SonTek-SL 1500 (3G)

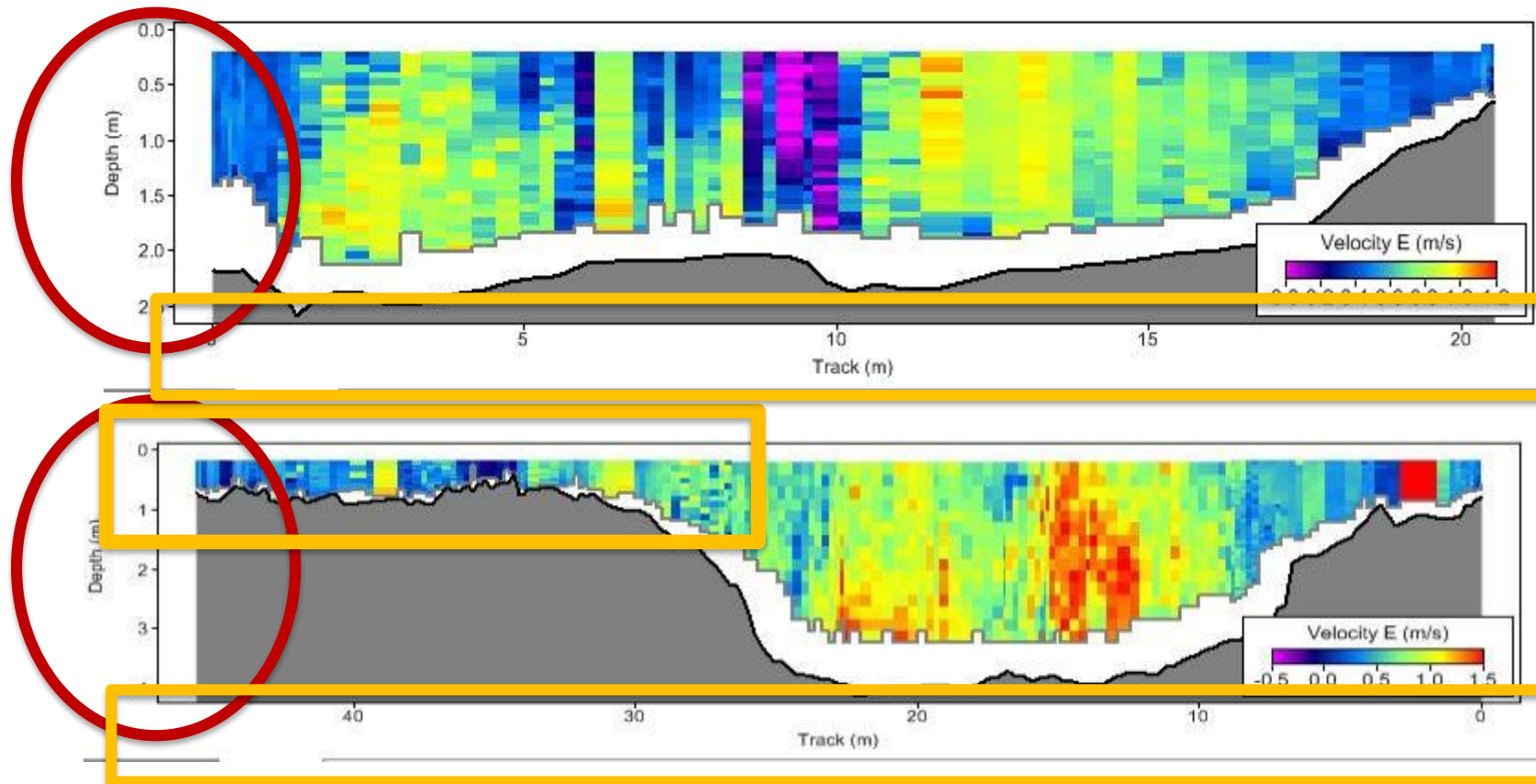


Example Data- Before floods and during floods Irma Data in Kissimmee, FL

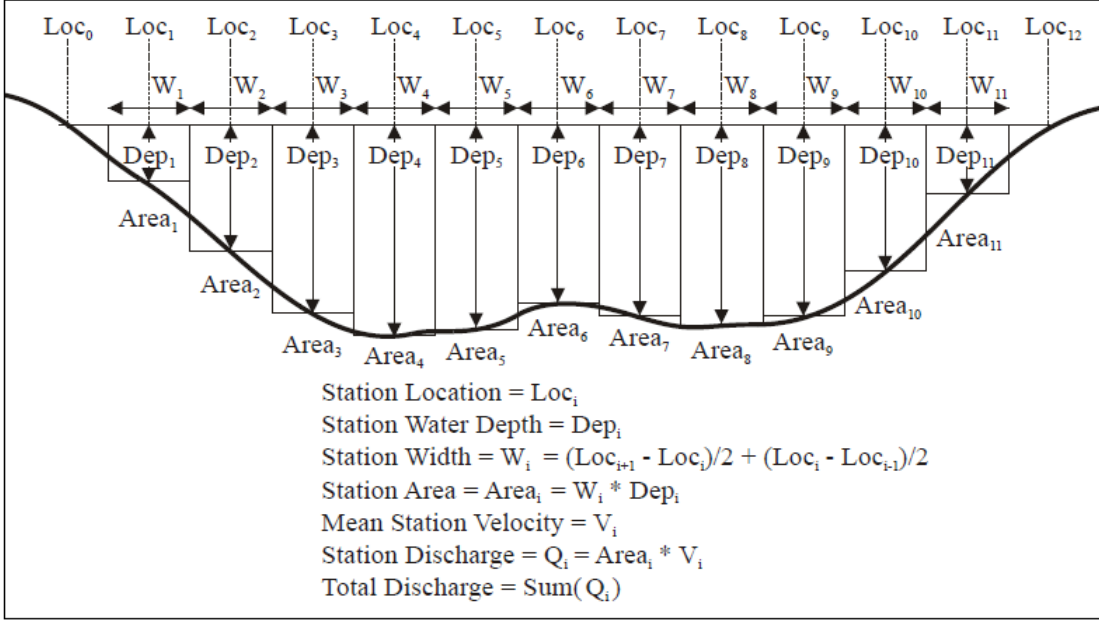
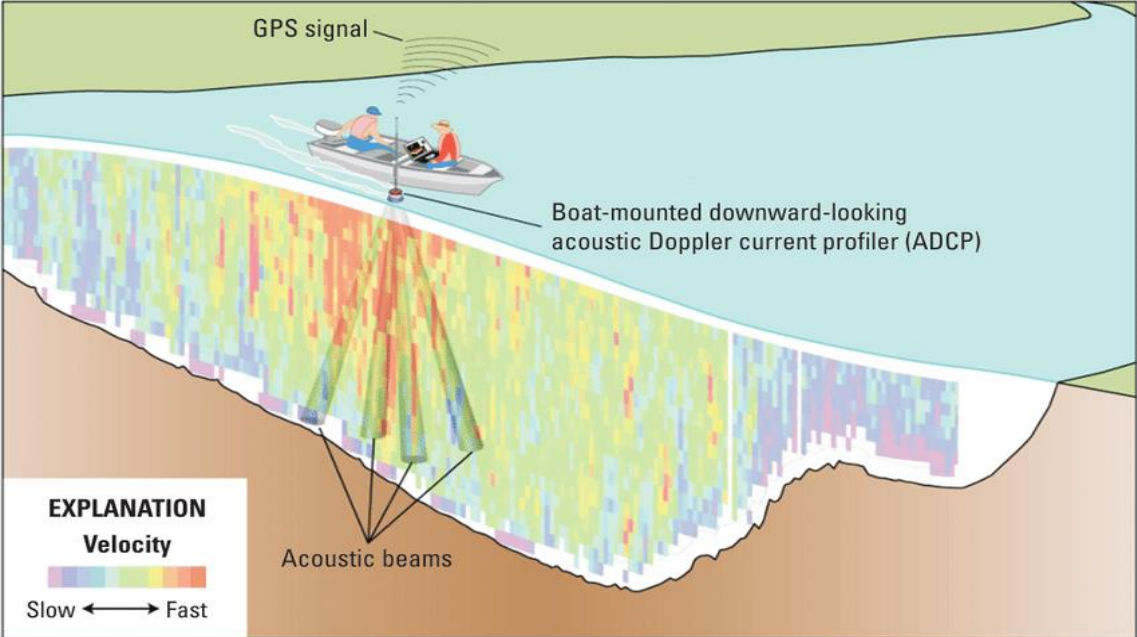


Instrument: RiverSurveyor M9

Same site, before and after Hurricane Irma



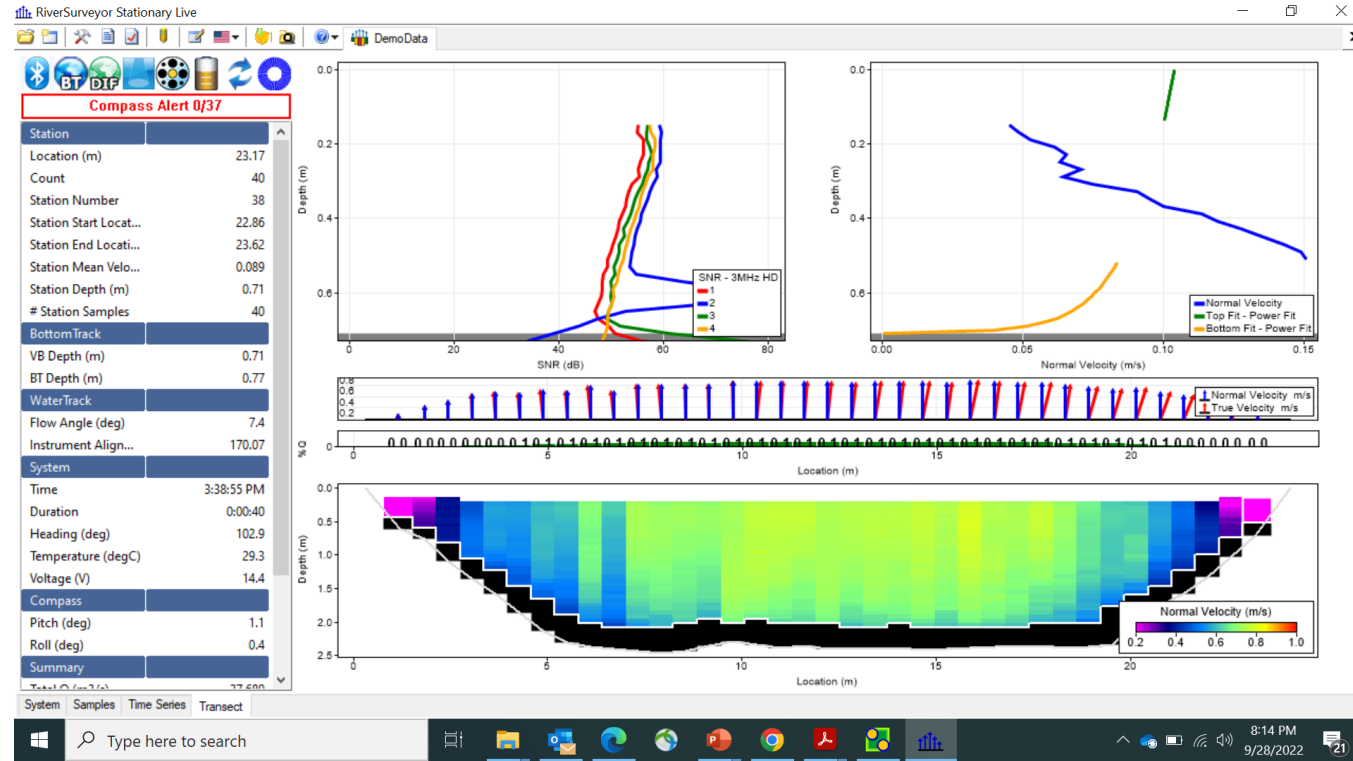
Methods for measurements with the ADCP



Moving Boat Measurements

Conventional method- Stationary measurement- also called as the mid-section method or the basic river discharge measurement method

Stationary Method

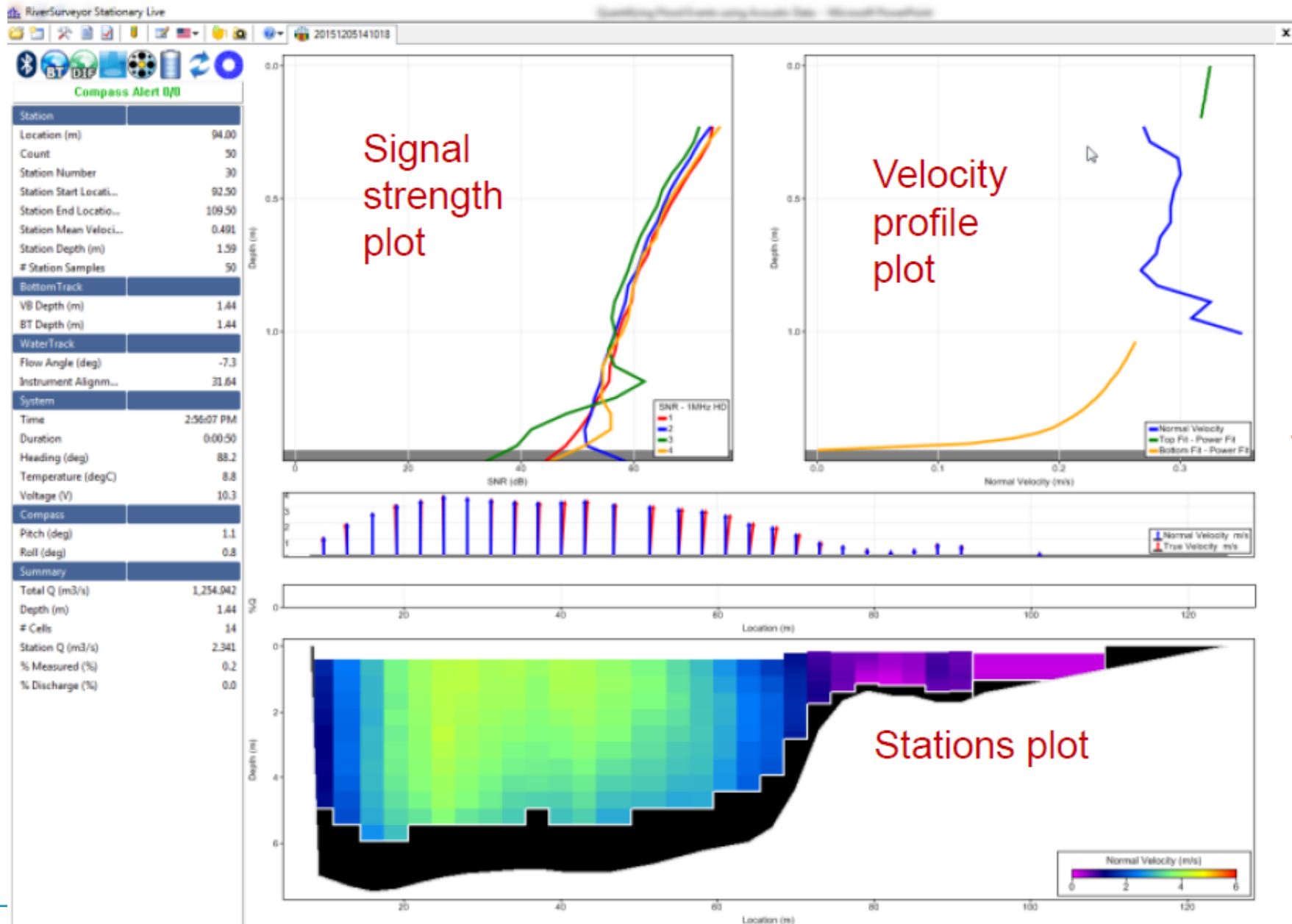


“Stationary” measurement method might be better than “moving boat” method: Possible moving bed
Higher velocities and boat motion—want to eliminate variables
Detect cavitation and some additional control over measurement stop/start
Easy from a bridge site

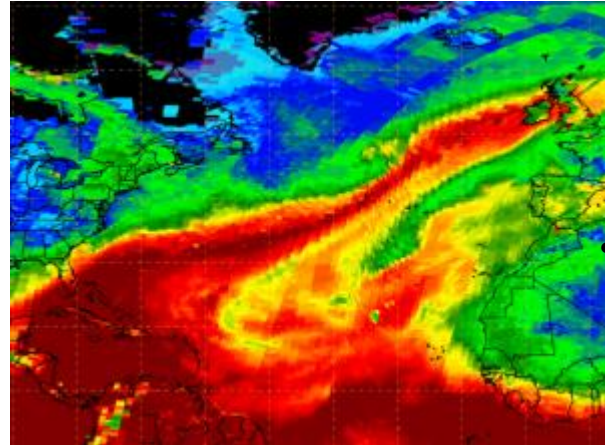
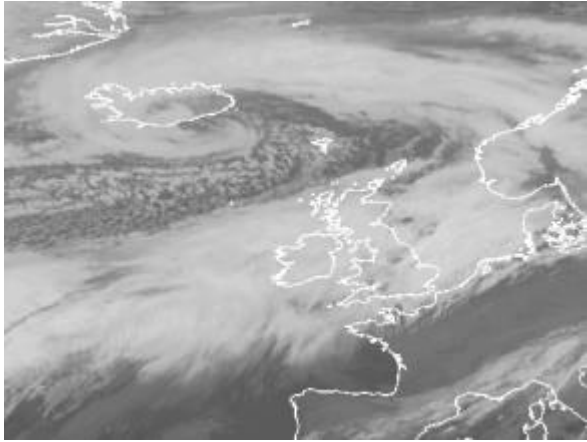
Also consider:

“No tagline” GPS positioning
Manual configuration mode

Stationary Measurement



Storm Desmond



Tied to atmospheric river phenomena

NOAA - <http://www.nvpl.noaa.gov/view/#GOES>

NWS OPC - <https://twitter.com/nwsopc>

- Broke records for UK rainfall
- Evacuations and significant infrastructure losses



UK Mirror- <https://www.mirror.co.uk/news/uk-news/storm-desmond-pooley-bridge-washed-6975427>

Desmond at Tyne River

Highest ADCP gauging in UK history



Torrent Board carrying M9 RiverSurveyor on River Tyne

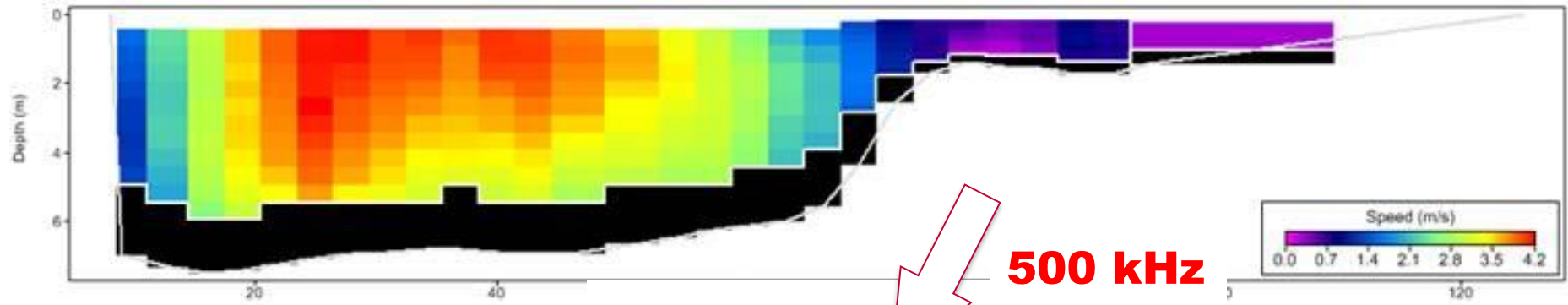


Hydroboard II carrying M9 RiverSurveyor at Rede Bridge on River Rede



Example- Desmond Data at Tyne River

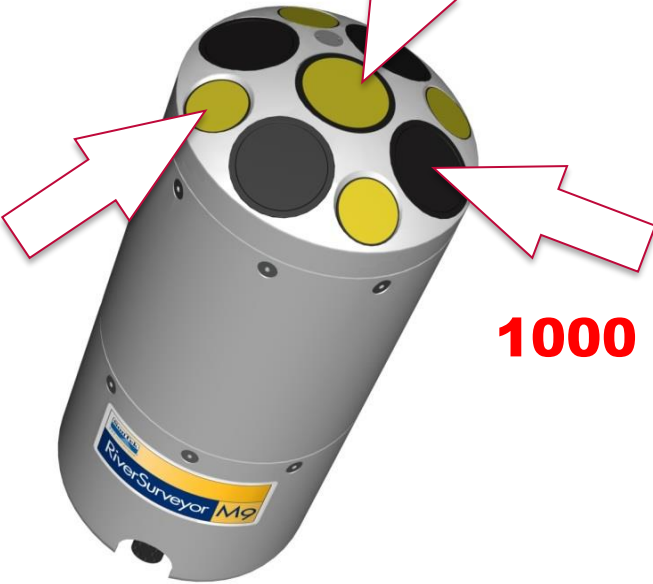
Highest ADCP gauging in UK history



3000 kHz

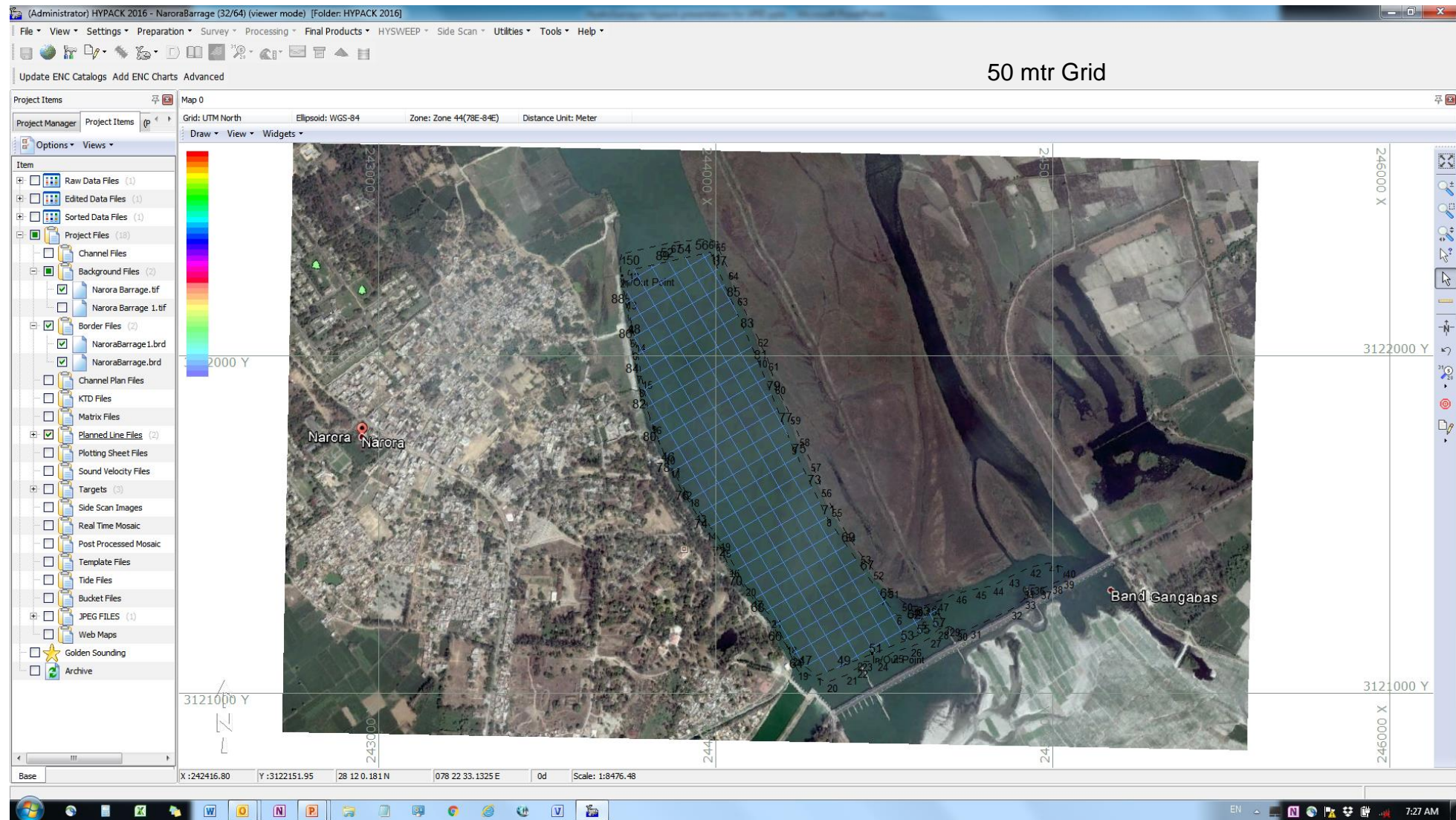
500 kHz

1000 kHz

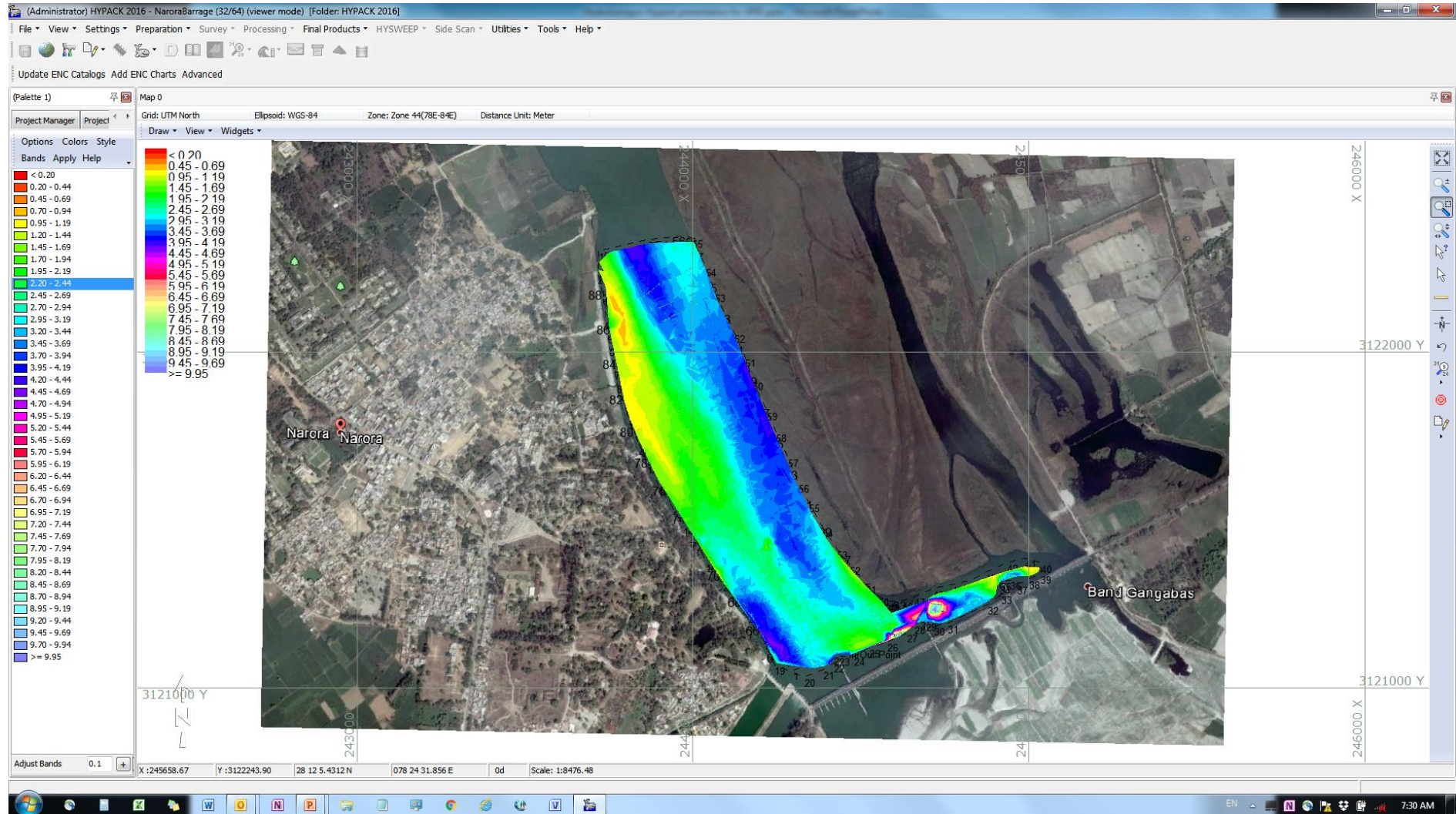


Notice max velocities 4.2 m/s but also near zero velocities. Notice the instrument handles velocity and depth changes. Because of SmartPulseHD and multiple frequency transducers, the M9 can adapt on the fly.

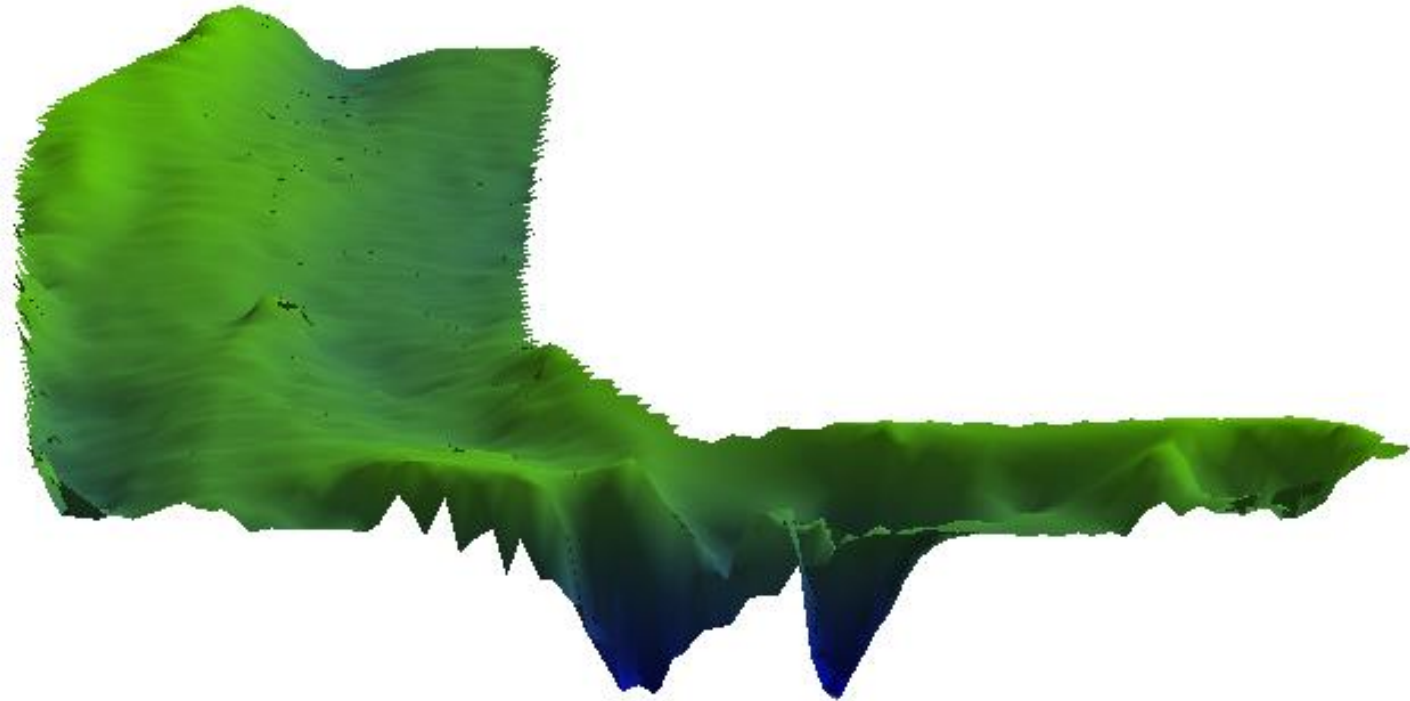
Understanding example of barrage management



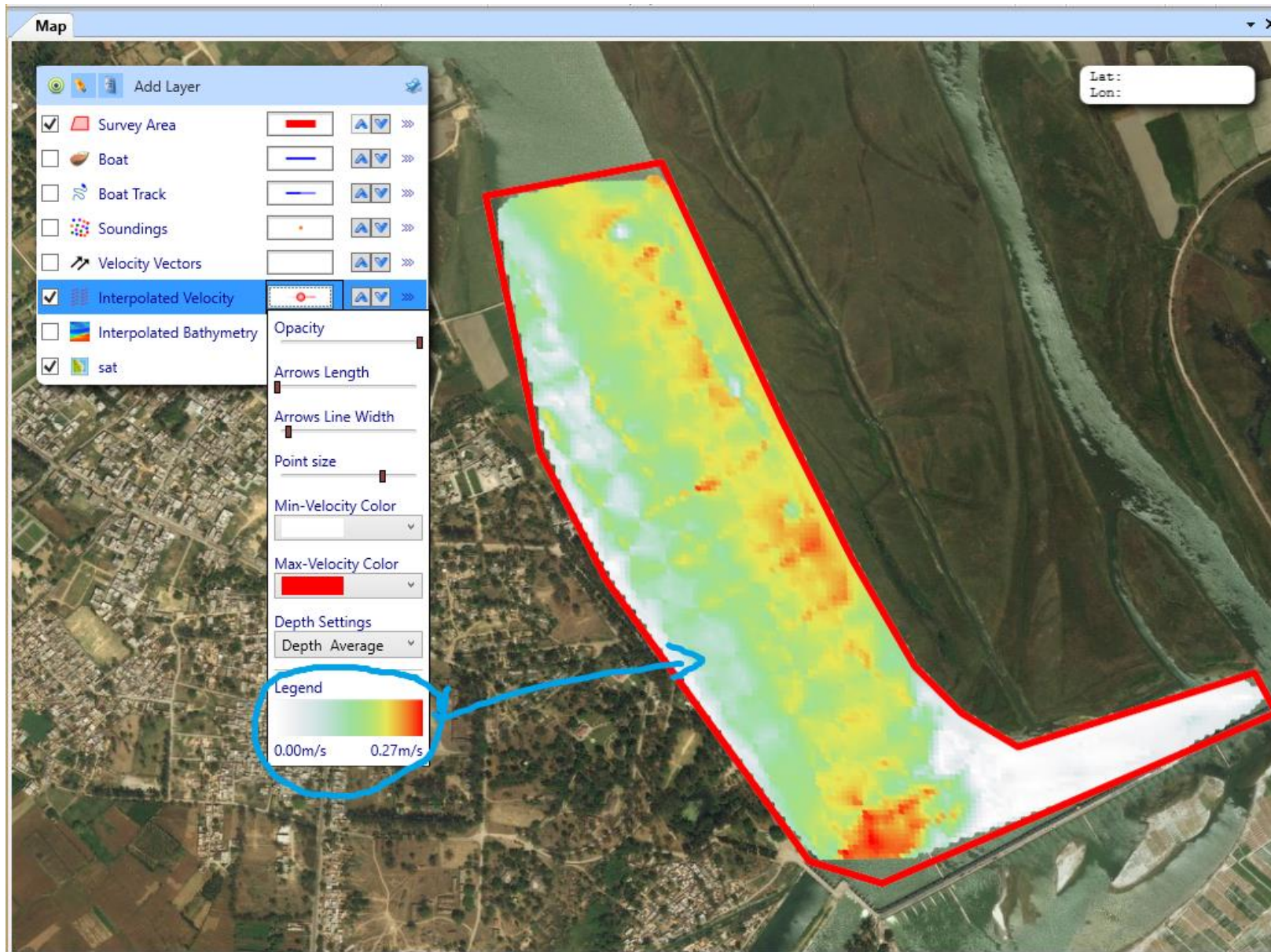
2D Map



3D View



Velocity Map



Questions?

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