Radar Level Measurement

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Goal and Roadmap

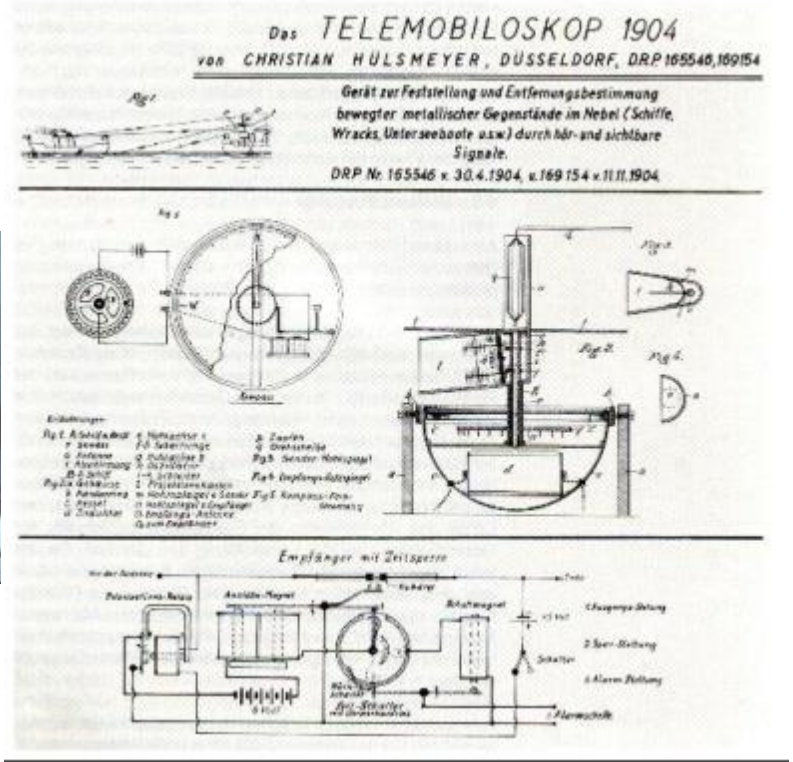
The goal of this presentation is for you to understand the basics of non-contact radar operation and why it is an appealing technology for making many different types of level measurements.

- History
- Types of Radar
  - Antennas
  - Frequency
- Application Advantages
- Summary

History of Radar (Radio Detecting and Ranging)

Heinrich Hertz experiments reflecting radio waves off of metal plates were first manifestation of Radar (1886)

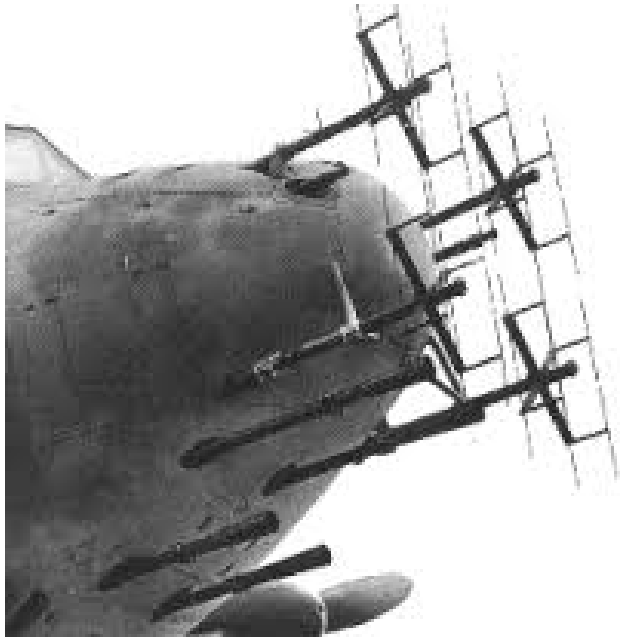
1904 Christian Hülsmeyer patented the Telemobilescope that projected and received Hertzian waves to detect or give warning of the presence of a metallic body such as a ship or train.



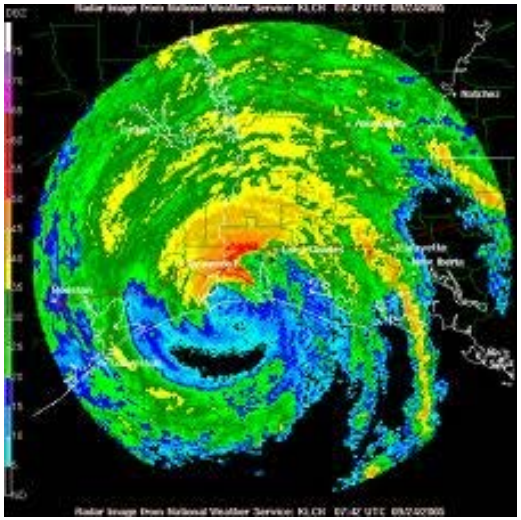
History

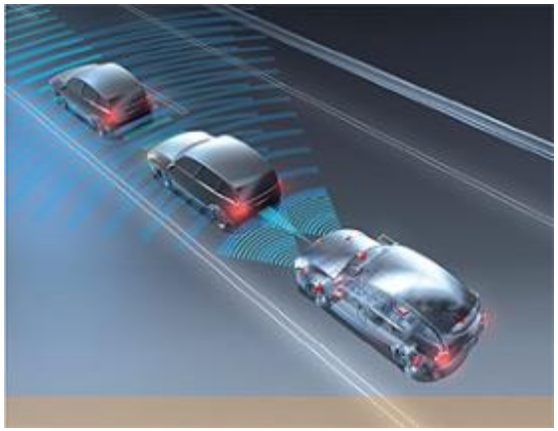
Mid 1930's development continued independently around the world.

WWII saw the first widely used Radar that provided tangible benefits.



Radar Today





Radar for Level Measurement

In the 1970's radar was first used to measure level in large, ocean-going crude oil tankers.

Radar for Level Measurement

Today non contact radar is used for a wide array of measurements. – not just storage

Radar – The Advantages at a Glance

- Little or no maintenance
  - Non-contact
  - No moving parts
  - No recalibration
- Use in many installations
  - Unaffected by the process conditions
  - High accuracy
  - Long measuring range 100 m
  - High pressure (> 2000 psi)
  - High temperatures (>800 °F)
  - High reliability (SIL 2 & 3)

Radar for Level Measurement

There are different techniques (pulse vs FMCW)

Frequencies:

5.925 – 7.250 GHz	C-Band
24.05 – 29.00 GHz	K-Band
75 – 85 GHz	W-Band

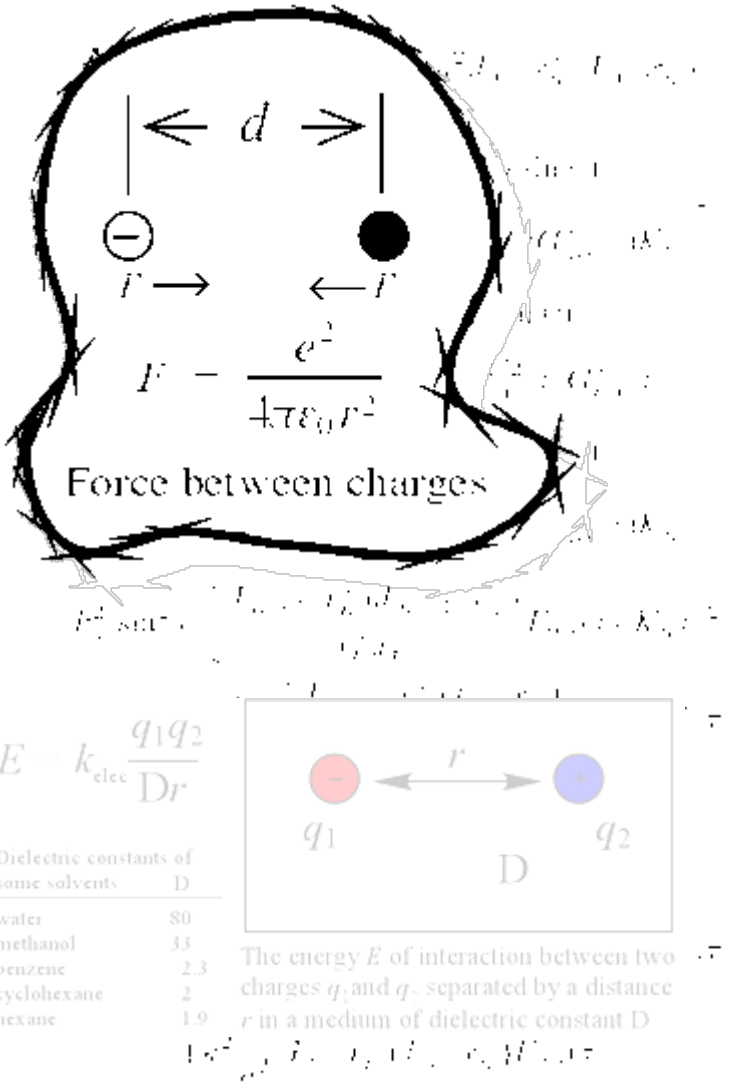
2-wire widely available

Many Antenna styles

No matter how it is done, radar has many advantages that allow for it to be widely used in a reliable manner.

Radar Antennas for All Applications

Process Influences – Dielectric Constant Value/Conductivity



Conductivity and the DK-value influences the amplitude of the product echo!

What is the dK-value?

- The dielectric constant describes how a material behaves in the electromagnetic field.
  - Water has a dK-value of around 80
  - dK-value of oil around 2
  - dK affects sensor selection, mounting possibilities, measurement range, and overall performance

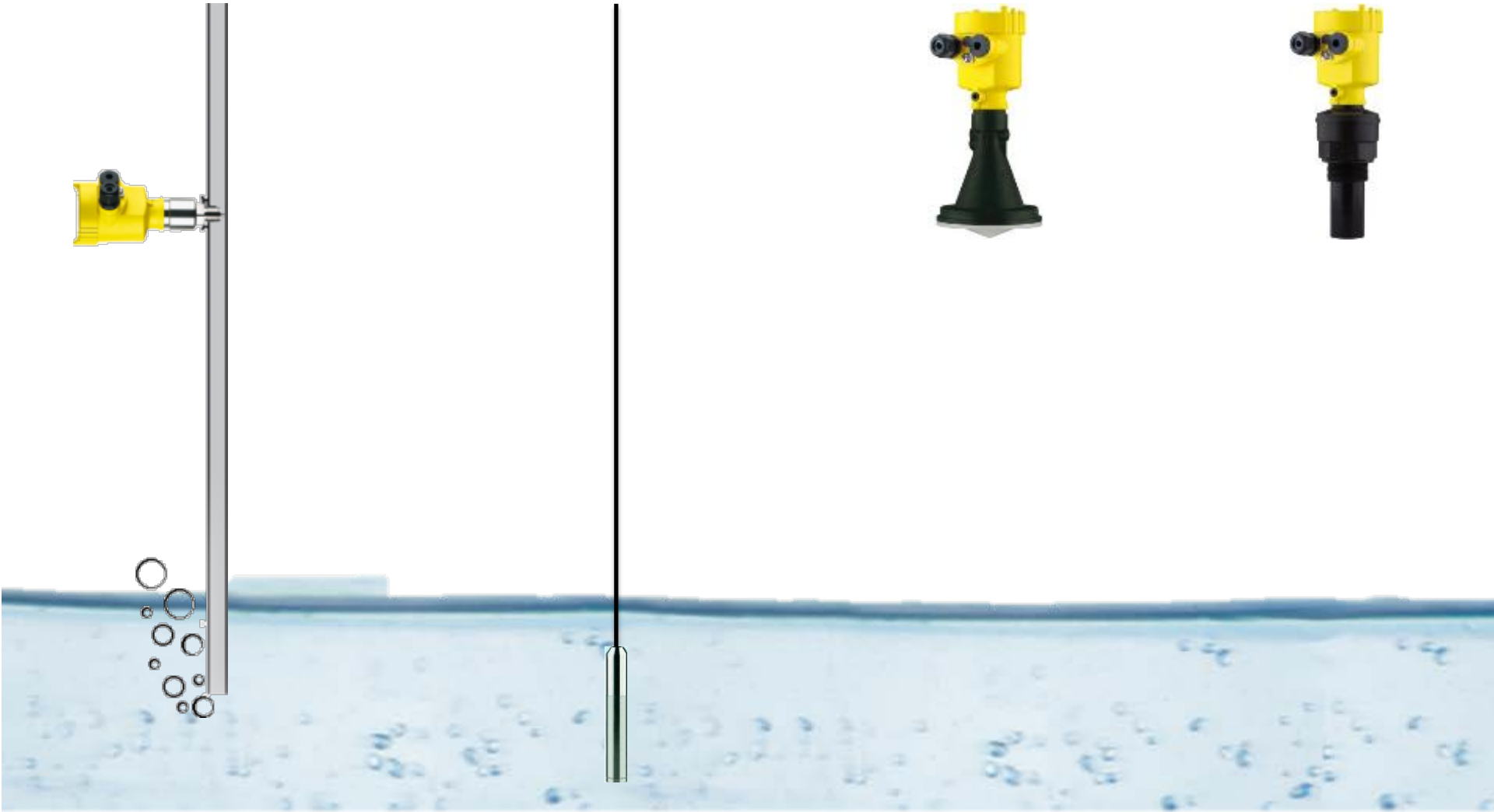
Measuring range

Bubbler system
6, 10, 20, 50, 70 ft ,…

Hydrostatic
6, 10, 20, 50, 70 ft ,…

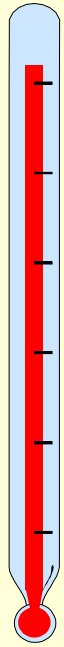
Radar
300+ ft

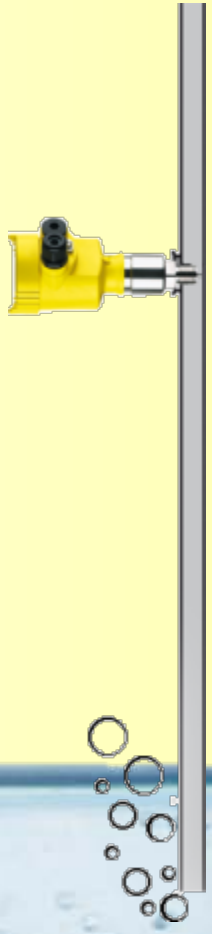
Ultrasonic
200 ft

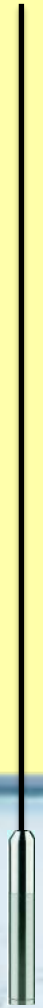


Sun and Temperature Influence

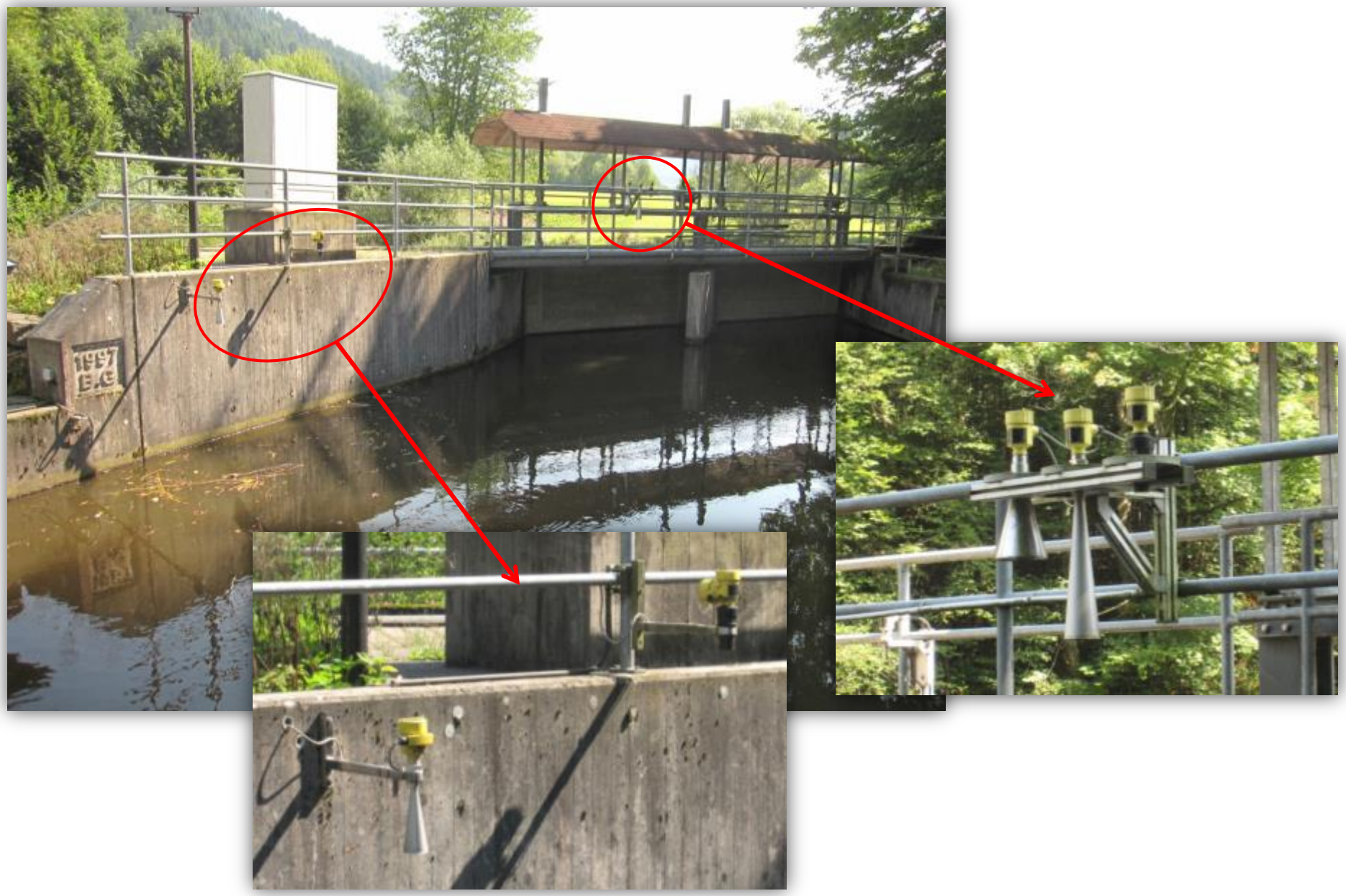
Bubbler system **Hydrostatic** **Radar** **Ultrasonic**



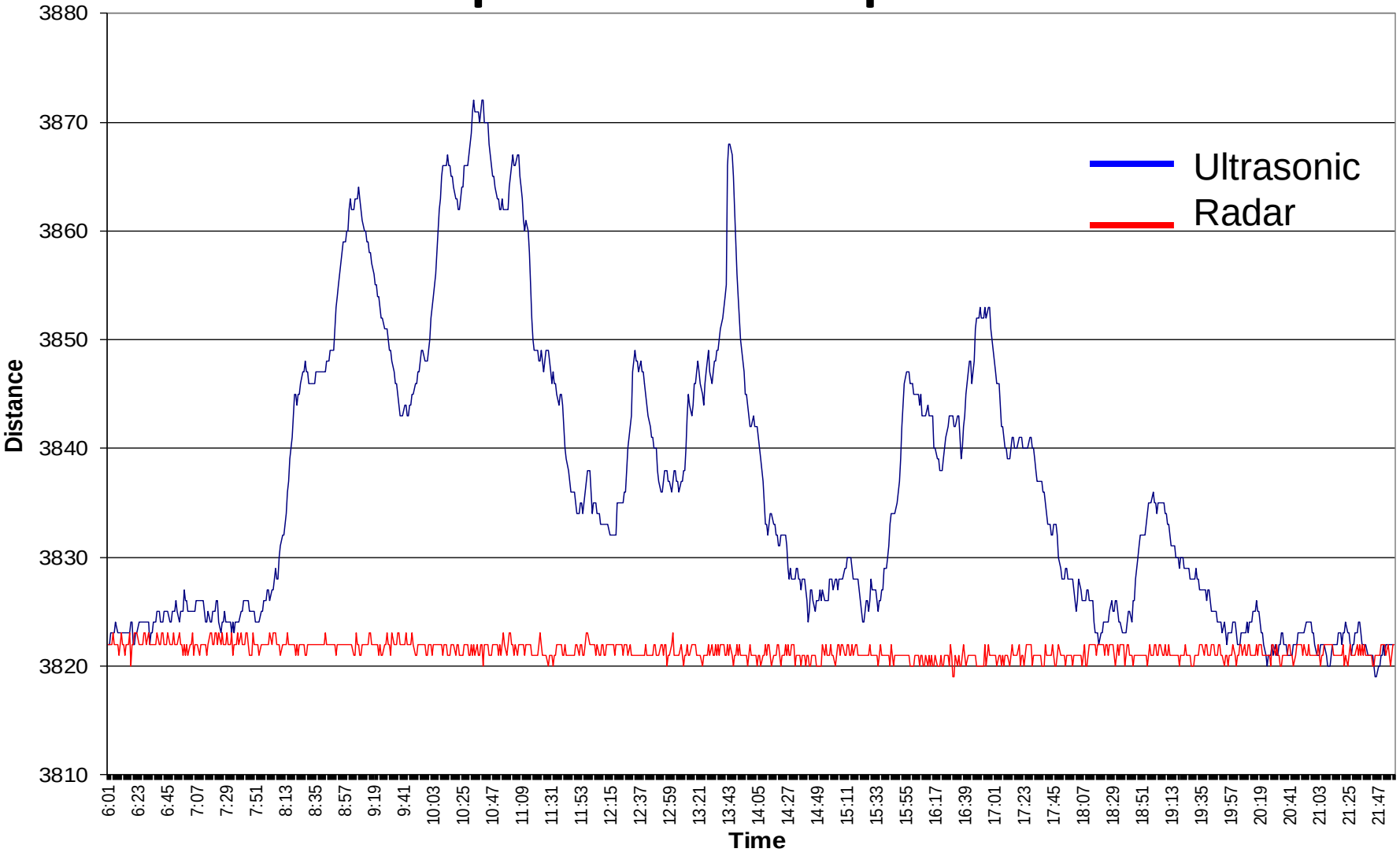




VEGA hydroelectric power station

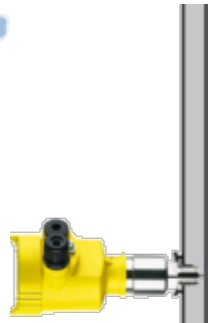


Comparison in practice



Wind or Storm Conditions

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**

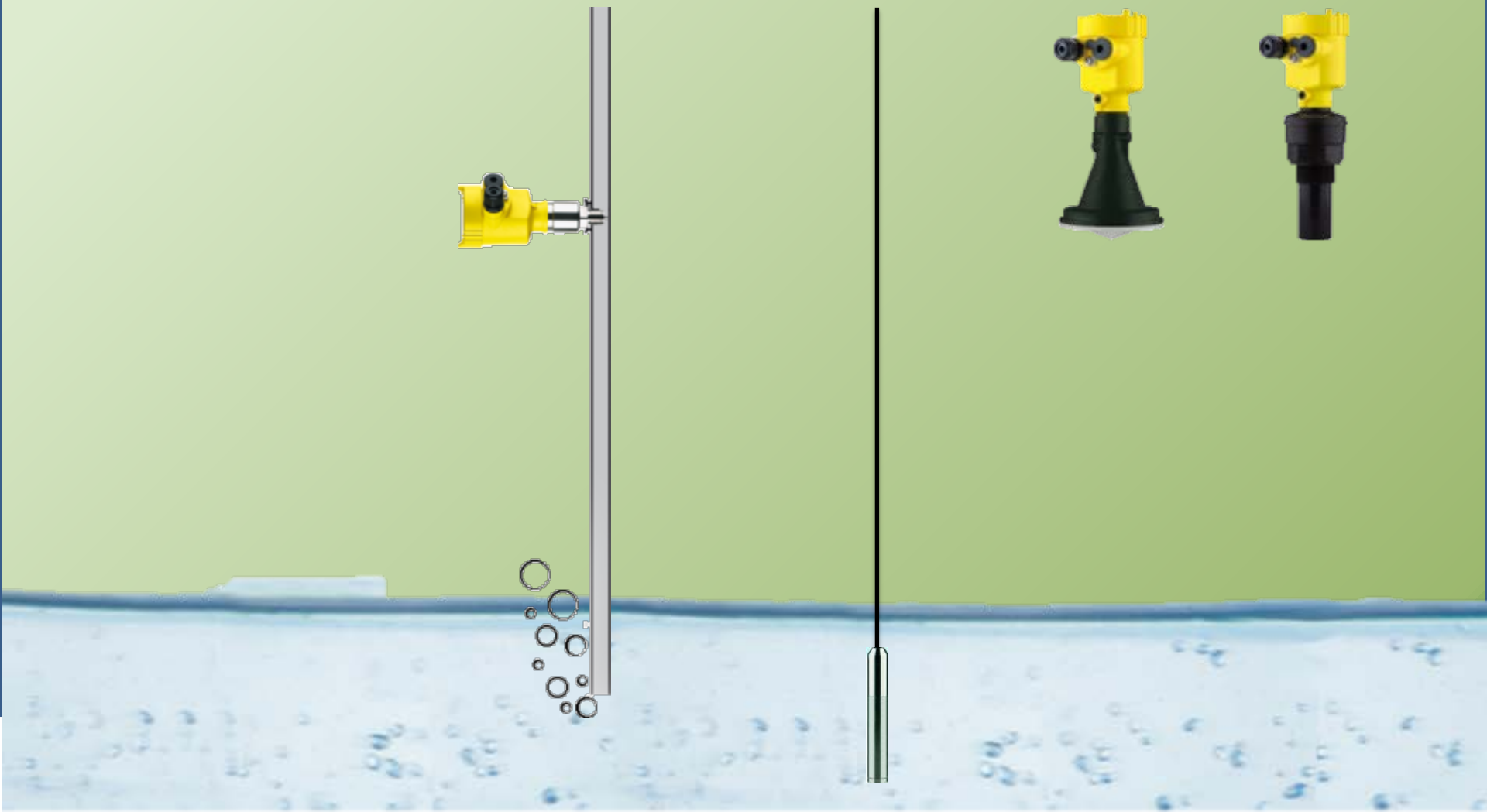


Foam on the Water Surface

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**

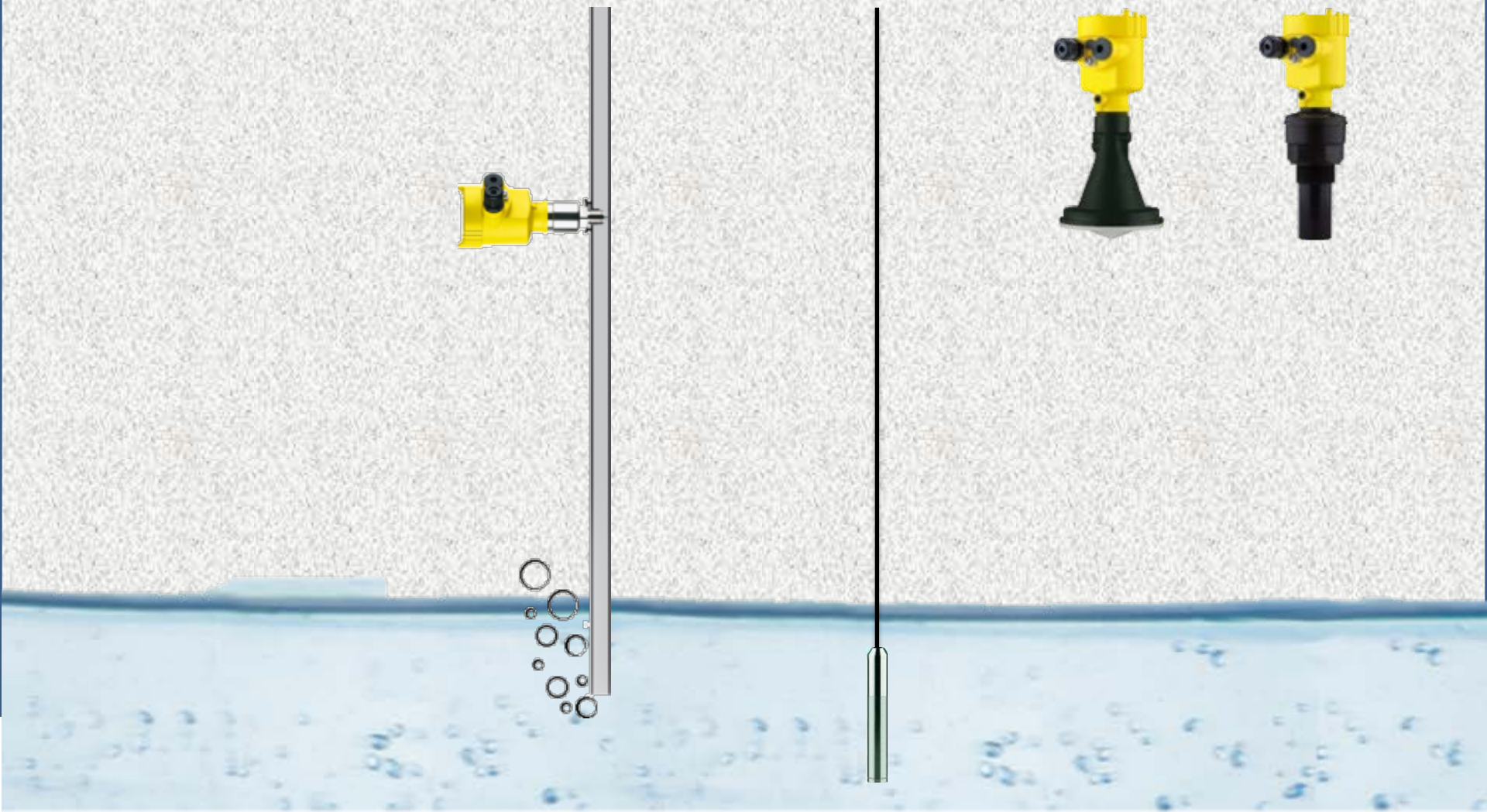
Gases above the Liquid

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**



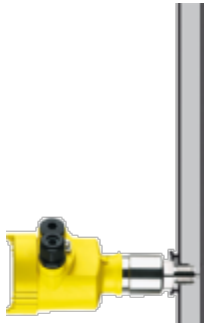
Vapor / Condensation

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**



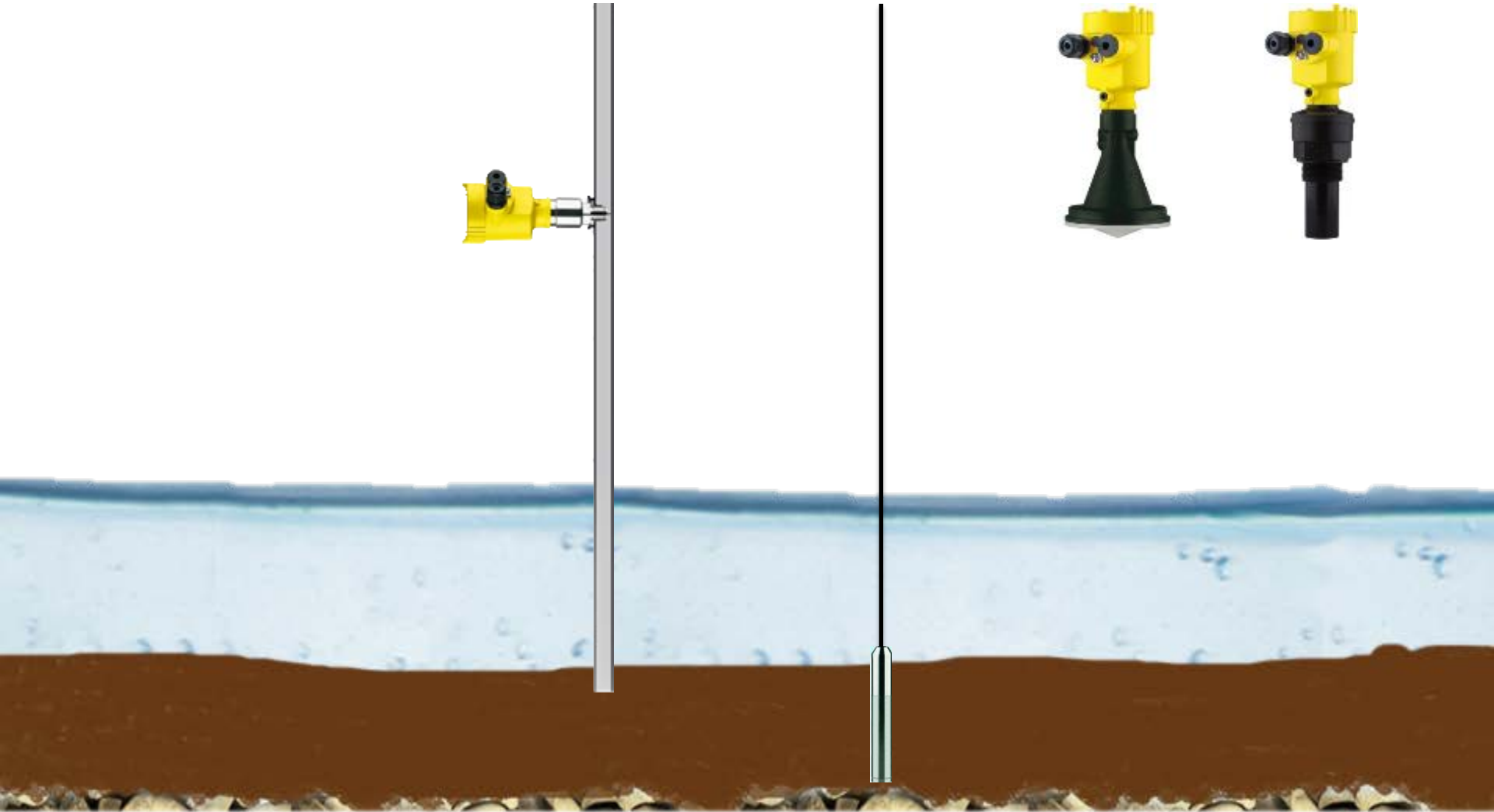
Ice and Frost

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**



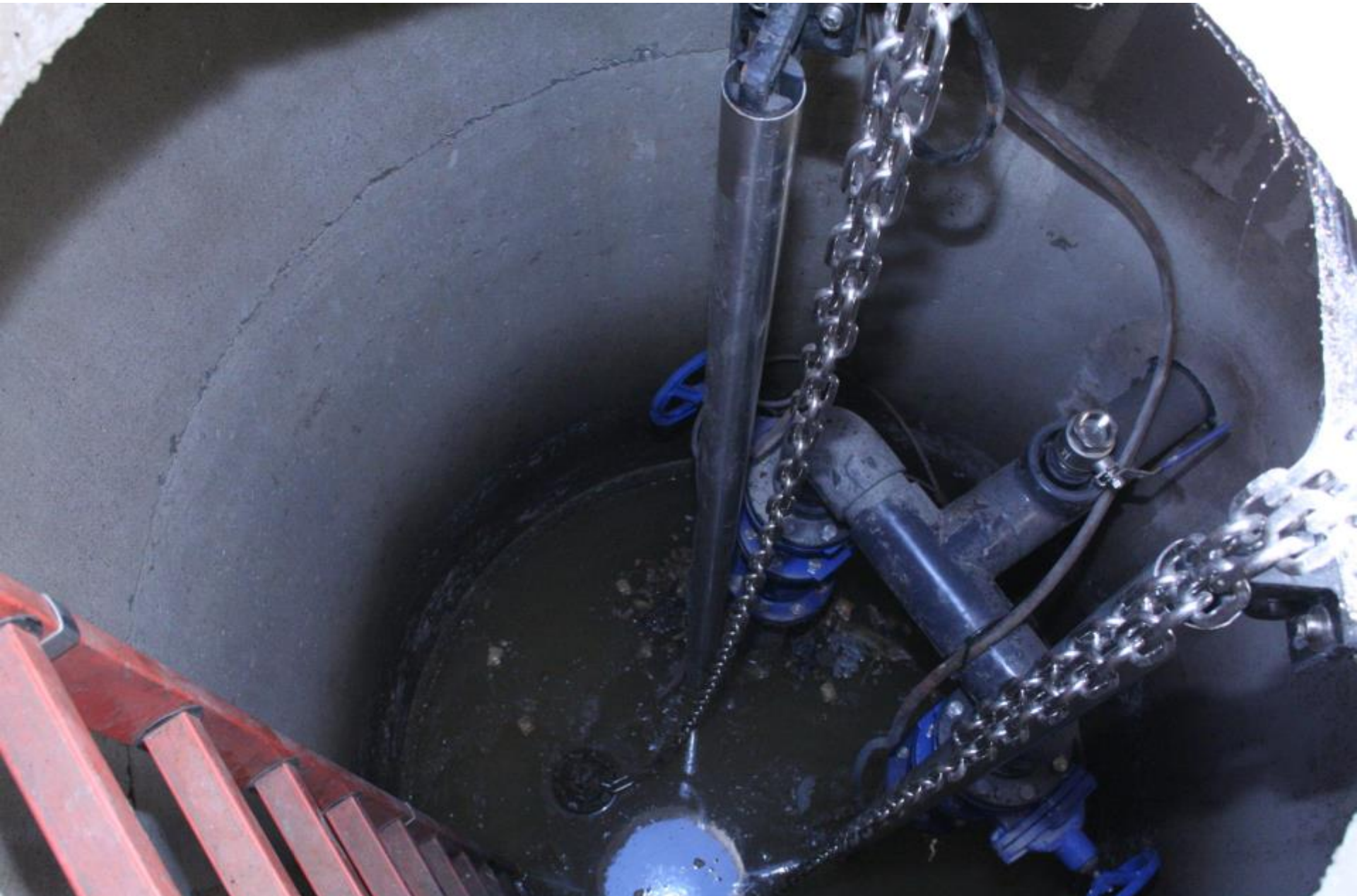
Solids and Build Up

Bubbler system **Hydrostatic** **Radar** **Ultrasonic**



Biological effect of microwaves

Gauge measurement in the sewage network



Gauge measurement in the sewage network

Pump control in a wastewater shaft

- A lot of obstructions in the lower pump shaft
- Very agitated surface
- Different foam generation

Pump control in a wastewater shaft

Level Measurement in Settling

Flow measurement on Weir

Level measurement in chemical tanks

Summary

Radar has advantages over other level measurement technologies:

1. unaffected by changing process conditions
2. no moving parts – no scheduled maintenance or recalibration
3. top mounted, non-contact
4. easy to configure (input distances)