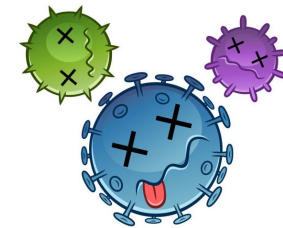
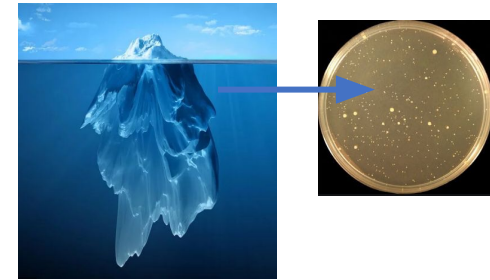


# Control of microbiological sanitary risk in water treatment through real-time analyzers



# Context: Microbiology monitoring barriers

1. Robustness of the analyzers available on the market
2. Costs
3. Data complexity
  - Understanding how to interpret the results.
  - Linking them to parameters defined by legislation.
  - Global indicators vs. pathogens.
4. Chlorine: the major barrier
  - Residual chlorine monitoring.
  - Do we need more in highly chlorinated waters?



# Objectives

Validate and understand online microbiology parameters in DWTP processes in order to have:

- Faster event detection/risks quantification
- Better analytical autonomy
- Better tap water quality



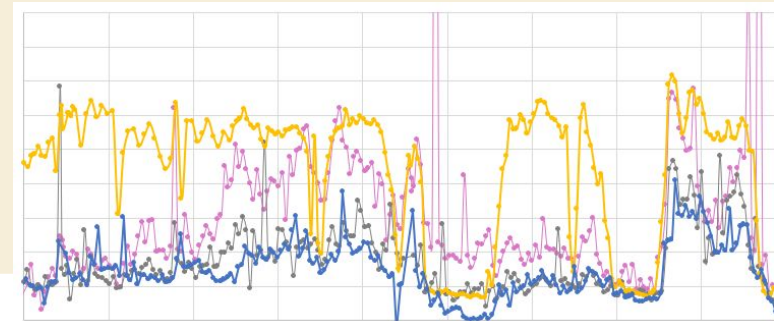
## Online equipment testing

**Assessment of two online global microbiology analyzers** in the Sant Joan Despí DWTP (Barcelona):  
EZ-ATP (Hach) TCC BactoSense (Bnovate)



## Data treatment

Understand the microbiological dynamics in processes





**BactoSense - TCC**  
06/03/20 - 15/12/20

**EZ-ATP**  
28/01/20 - 23/12/20

	EZ-ATP	BactoSense TCC
Detection method	Fluorescence (Chemiluminescence)	Cytometry
Parameters measured	<b>Free ATP, Total ATP</b>	<b>Total Cell Count (TCC) or Intact Cell Count (ICC). % of High Nucleic Acid (HNA)</b>
Time per measurement	7 min	30 min
Number of automatic samples	4	1
Samples tested	Sand Filters, Ozonation, Carbon Filters, Cartridge filters, Reverse Osmosis, Drinking Water	Sand Filters, Ozonation, Carbon Filters, Ultrafiltration, Reverse Osmosis, Drinking Water

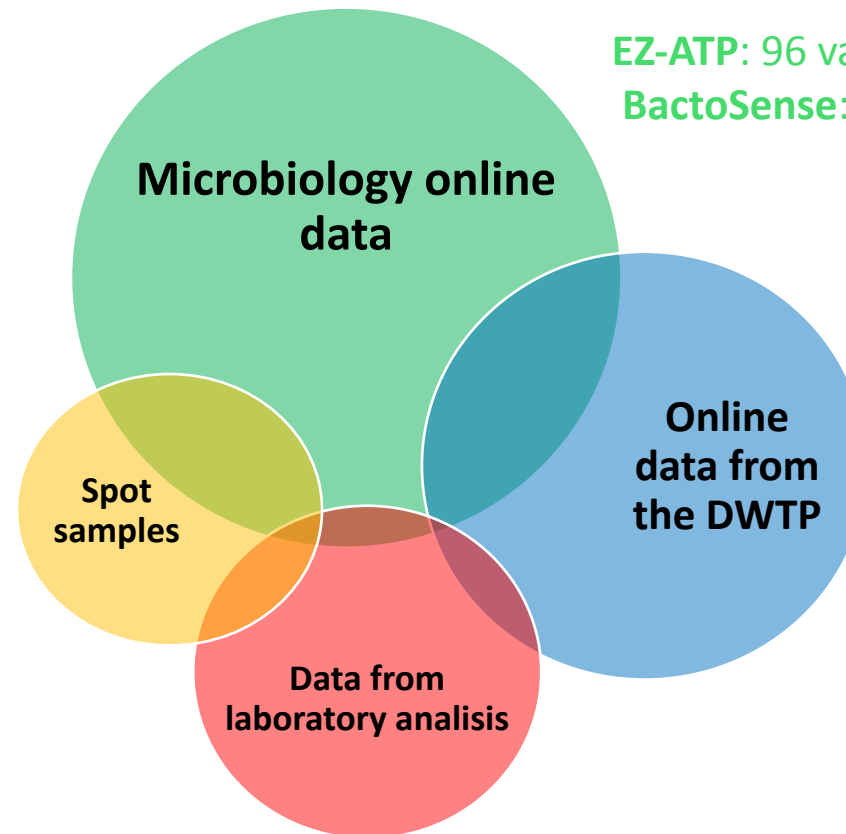


# Methodology: Evaluation strategy

## 1 - Microbiology online data

EZ-ATP: 96 values ATP bact/day

BactoSense: 24 values TCC/day



## 2.- Online data vs physic-chemical an operational information

Online SCADA variables:

- High turbidity in the catchment
- Technical shutdowns
- Ozone dose changes
- Diatom appearance (GAC detection)
- Routine operations (backwashing)
- Advanced treatment maintenance

## 4.- Online data alerts vs laboratory analysis

Sampling and analysis according to online alerts:  
Colierts + Aeromonas 22 °X + Clostridium

## 3.- Online data vs laboratory microbiological assessment

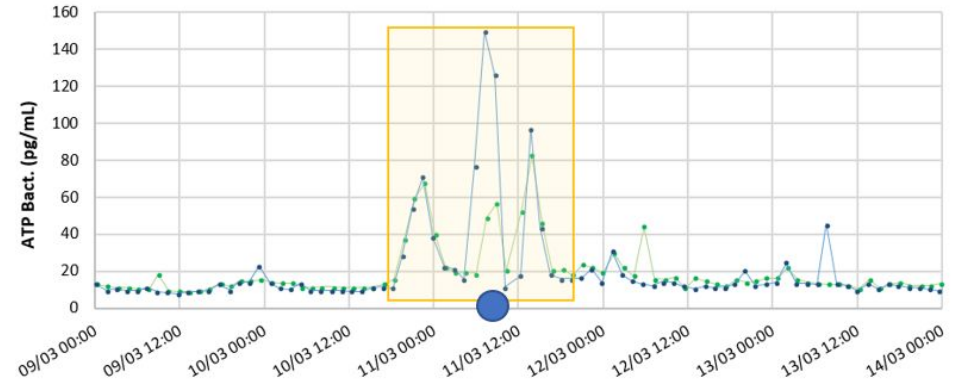
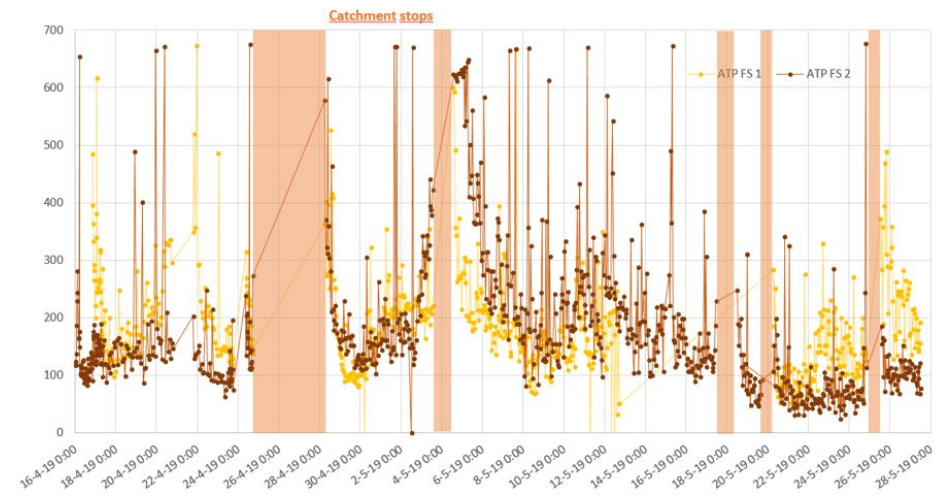
Routine microbiology data at the water treatment plant

# Methodology: Event detection by using online analysers

- Baseline: definition of normality (per process, season, water origin, disinfectants doses...)
- Event: deviation from normality
  - Peak (>2-3h)
  - Baseline increase
- Certainty: operational events or lab values deviation

Last step: validation of events.

- Do these events involve sanitary risks (in treated water)?
- Therefore, are these indicators useful for preventing microbiological issues?



# Results: Events detected

All the events: No impact on daily outlet samples

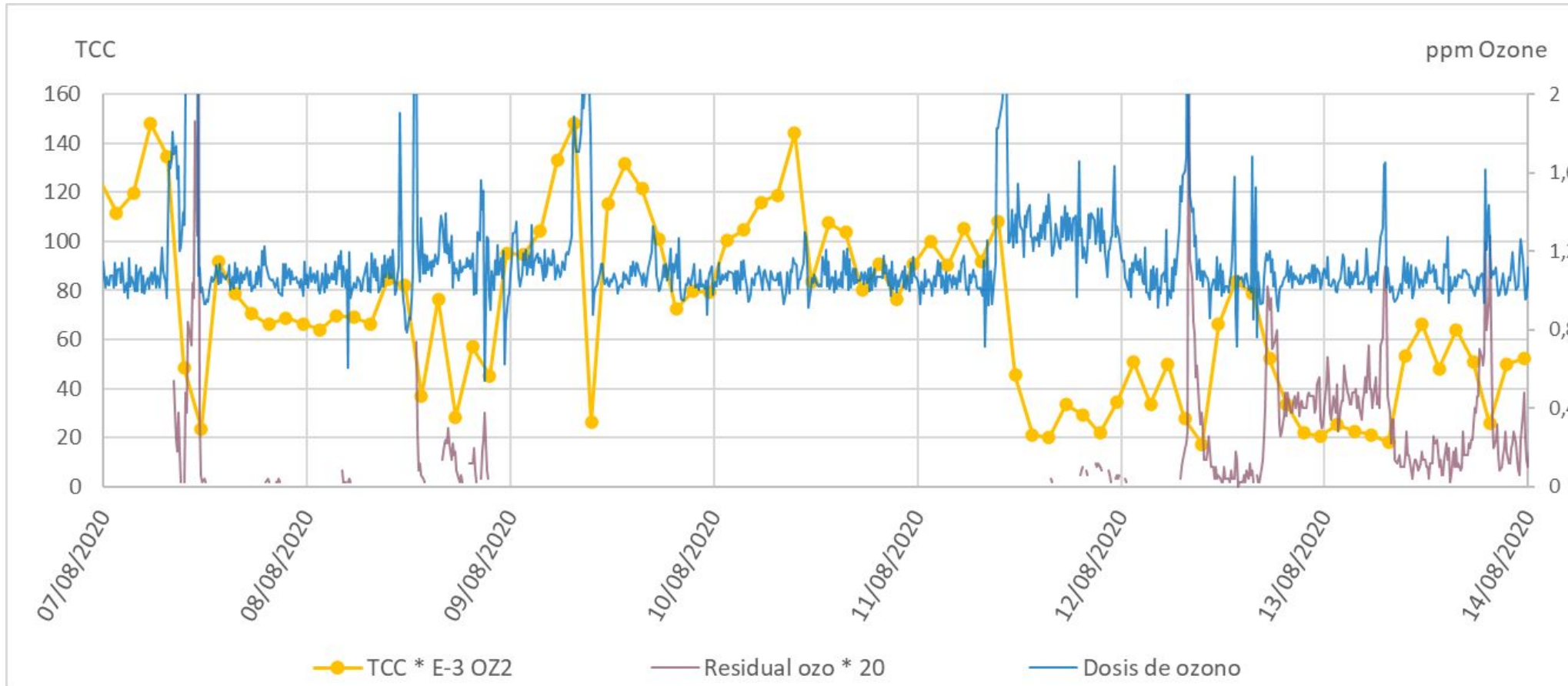
Event type	Number of events (total)	BactoSense TCC (events detected)	EZ - ATP (events detected)	Comments
Events detected by online analyzers and confirmed by conventional laboratory analysis	6	5	5	
Events detected by online analyzers and related to plant operation (no laboratory confirmation available)	11	9	10	
Events detected by online analyzers without confirmation	-	0	10	Potential false positive
Events not detected by online analyzers with plant confirmation	7	0	0	Potential false negatives

**TCC:** All events considered in BactoSense can be justified by operational parameters. Some also coincide with total coliform alerts in GAC.

**EZ - ATP:** 38% of events considered in EZ-ATP (10/26) do not have a relationship with operation or conventional microbiology values.



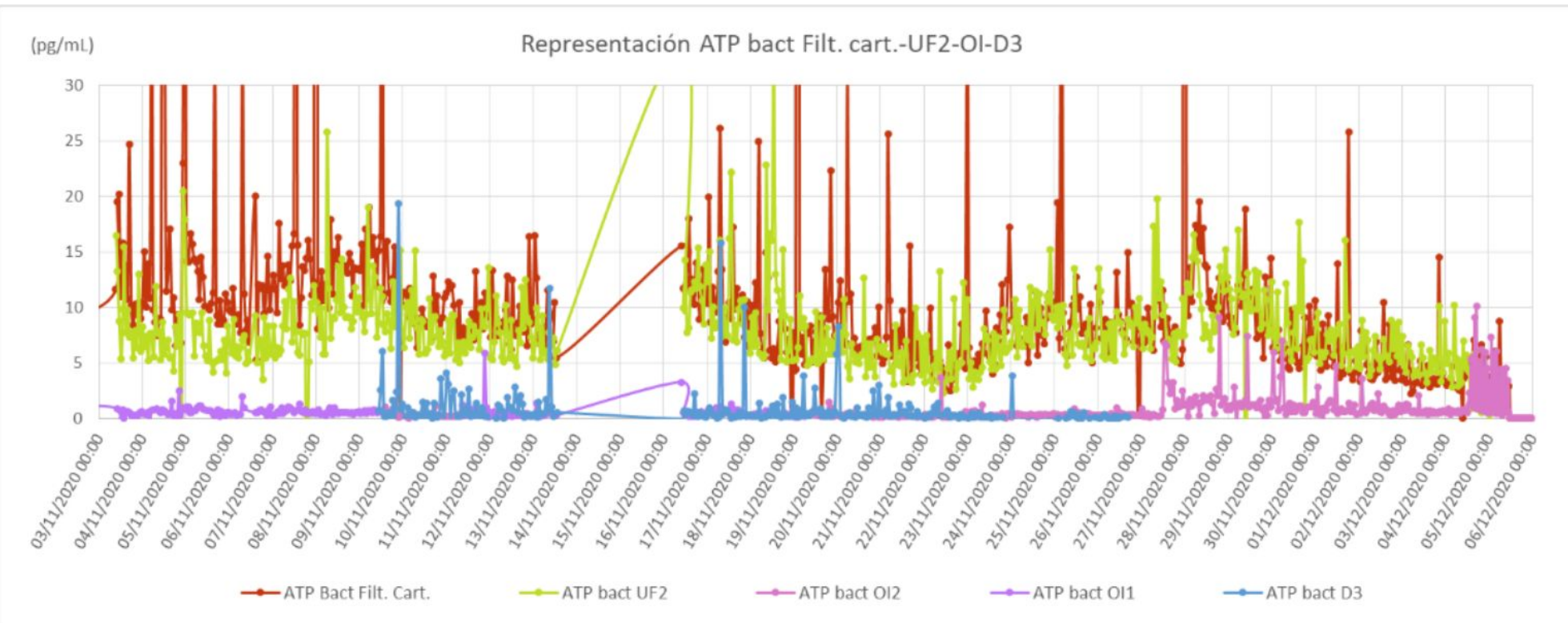
# Results: Correlation between TCC and ozone



When there is high concentration of residual ozone (purple line) the TCC detected (yellow line) decreases



# Results: ATP measurement at different DWT steps



Clear differentiation between points with relatively high microbial concentration outlet of cartridge filters and ultrafiltration (red and green) with low microbial concentration (blue (reverse osmosis and purple treated water))

Slight differentiation between red and green points

No differentiation when there is low microbial concentration (blue and purple)



# Conclusions and recommendations

	Feedback	Recommendation for use in the SJD DWTP
BactoSense - TCC	Easy, and robust performance. Most results are consistent with operation and occasionally with traditional microbiological indicators	<ul style="list-style-type: none"> <li>• <b>Ozone control</b> (choose between ozone input, ozonation output)</li> <li>• <b>Treated water monitoring.</b> Strengthen TCC with HNAC</li> </ul>
EZ-ATP	Good overall performance but delicate maintenance. It provides good trends on microbial concentration but it is not valid for accurately detecting events (specially low microbial concentration)	Multipoint control in ultrafiltration/cartridge filter



**Thank you for your attention**

