

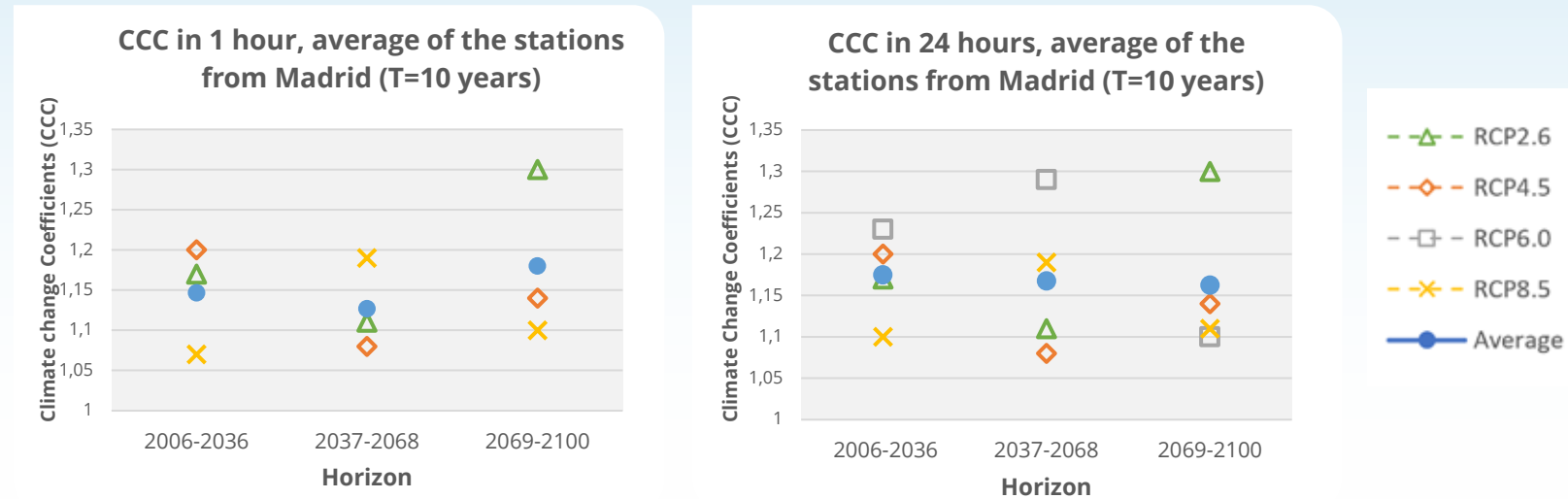
### Madrid Region & Climate Change

- 6.7 million** inhabitants
- 8,028 km<sup>2</sup>**
- 15,000 km** sewer network
- 157 WWTP**



Climate change effects are challenging the current operating system of infrastructures and, more generally, the cities' resilience to climate change.

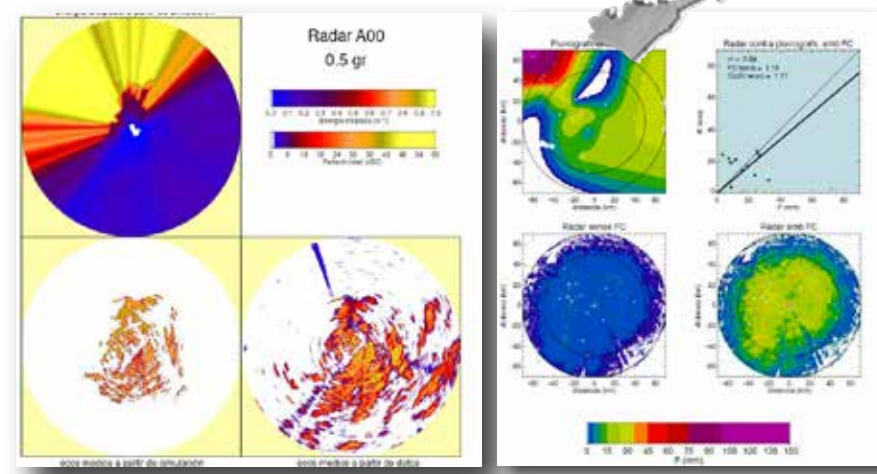
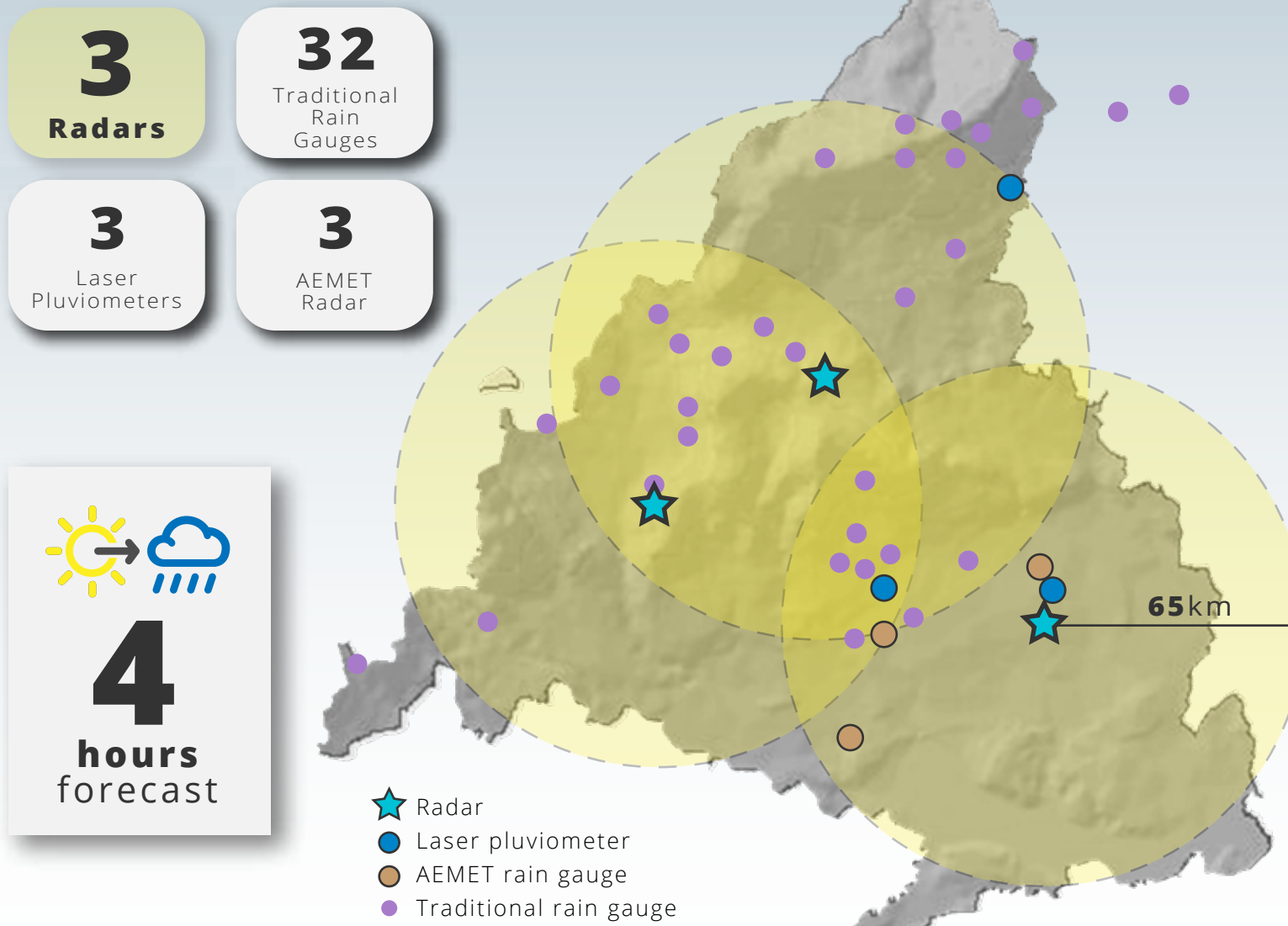
In the case of Madrid, climate change is going to increase the peak of the hyetographs, so that hydrograph peaks will be higher and more often they will belong to longer return periods than those for what the sewer network was designed for (10 years return period traditionally).



This could cause the system malfunctioning. Rainwater exceedance could be uncontrollably discharged into the receiving waterbody or cause problems in the biological treatment process. Urban rainwater is often more polluted than the wastewater itself.

### Early Warning System

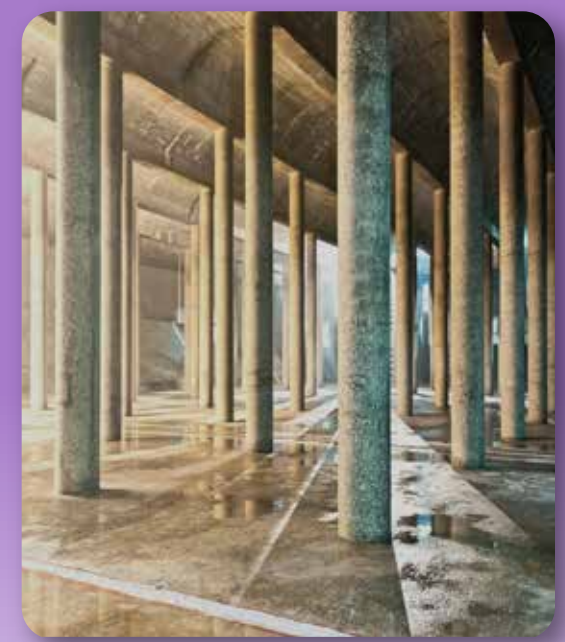
The early warning system owned by Canal de Isabel II, is a real-time monitoring system composed by three radars with range of 65km, some laser pluviometers and several traditional rain gauges that covers the whole watershed.



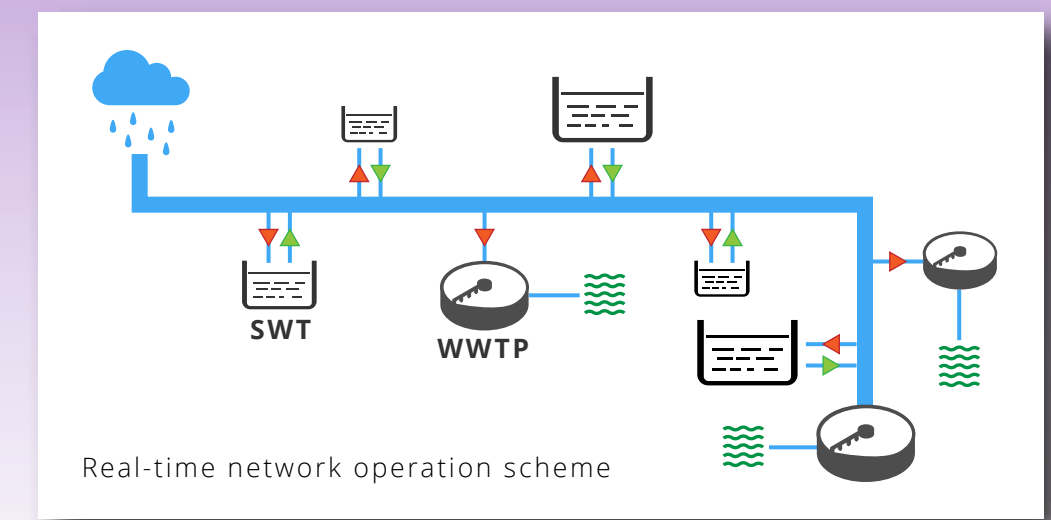
This real-time tool forecasts the short-term precipitation patterns on local level with a time prediction of 4 hours. This is useful to alert the emergency team and serve to take flooding mitigation measures based on the hyetograph shape.

### Real-time sewer network operation

Madrid's sewer network is especially complex and flexible, mainly thanks to a group of **32 stormwater tanks**. They were built with the aim of storing sewage. Hyetograph shape forecasted 4 hours earlier will support early operation decisions.



The main advantage is that sewage can be distributed along different paths, which allows certain level of freedom to redirect sewage between different tanks. In this way overflowing or flooding will not happen.



### Conclusion

Given a forecasted severe precipitation, decision makers will be able to act over the full network for capacity reasons. Hence, while the WWTP operates to full-power, excess sewage will be diverted between the storing facilities or sewer pipes. Sewer management is going to be based on sewage quality and quantity and it will also implement climate change effects. This way uncontrolled discharges will be minimal, and if they happen, they will be originally from the stormwater tank or facility where sewage quality has been already improved (Lastra et al. 2018).

\*AEMET (Environment and the Meteorological State Agency of Spain)

**Uncontrolled discharges**

**WWTPs & sewers malfunction**

**Flooding**