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## INTRODUCTION

- The CLEAN-ROADS project addresses the problem of the **environmental pollution caused by de-icing salts** during winter road maintenance activities.
- A demonstrative Maintenance Decision Support System (MDSS) has been developed in order to **improve the intervention procedures** of the road management service.

The **Ambient Air Quality and Cleaner Air for Europe Directive** (2008/50/EC) states that contributions to exceedances of particulate matter PM10 limit values that are attributable to road winter salting may be subtracted when assessing compliance with air quality limit values, once provided that **reasonable measures have been taken to lower concentrations**.

## STUDY AREA AND EQUIPMENT

**CLEAN-ROADS** project was carried out in **Trentino Region**, a mountainous area in the Northeast Alps of Italy characterized by severe winter weather.

### Test site

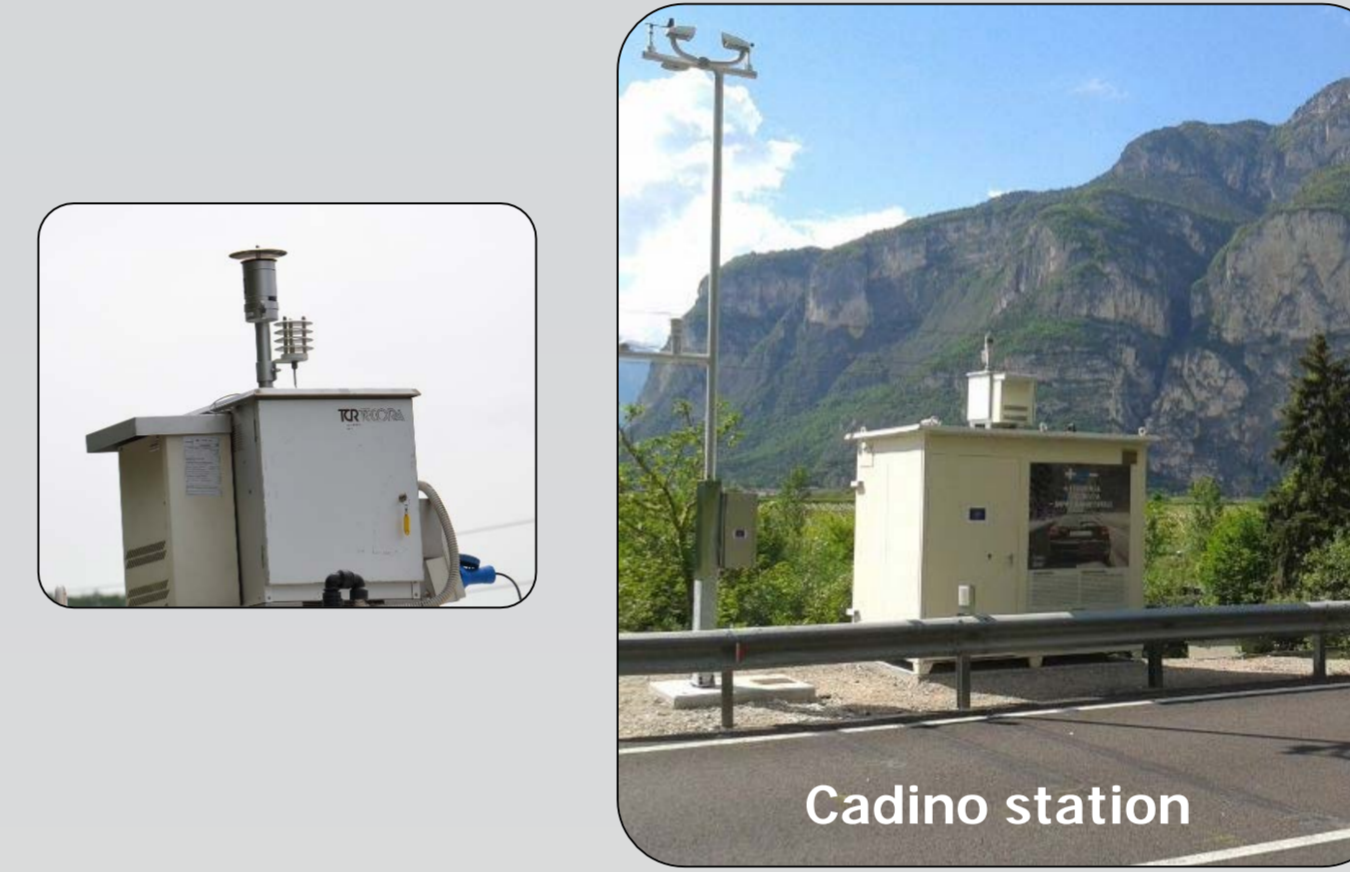
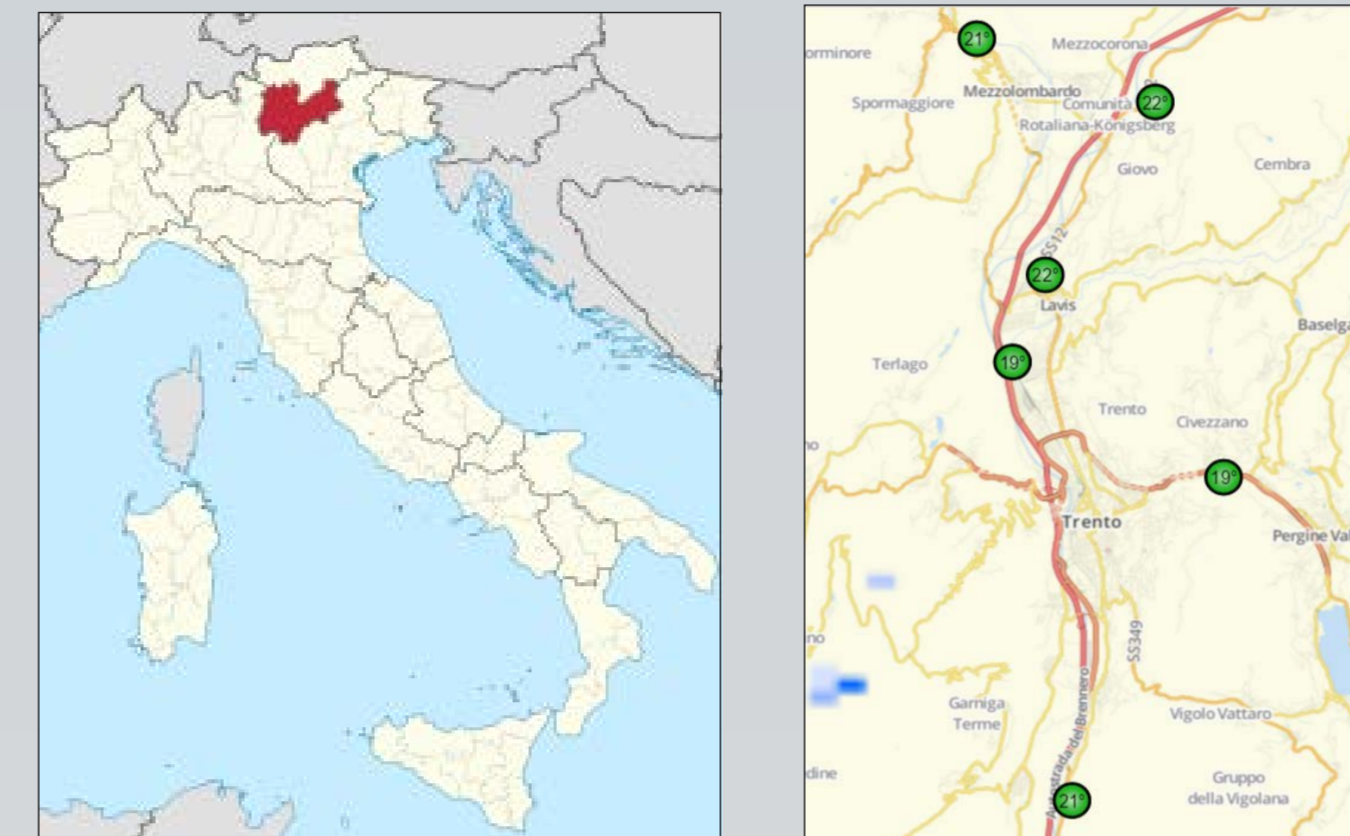
- SS 12, Cadino environmental monitoring station

### Equipment

- 6 RWIS stations
- an automatic outdoor **station for continuous atmospheric particulate monitoring** (Tecora Skypost PM HV)
- a **climate-controlled facility** used for conditioning and weighing the filters

### Dataset - winters 2013/14, 2014/15, 2015/16

- PM, elements, organic markers, ions (including Na<sup>+</sup>, Cl<sup>-</sup>), carbonaceous fraction concentrations in air
- samples collected: 522



## METHODOLOGY

The MDSS is based on a network of **road weather stations** (road weather information system, RWIS) which are capable to collect **real-time data** about the road conditions and to **perform short-term and now-cast road weather forecasts**, which integrate weather data and bulletins covering the target area.



### PM10 – in winter seasons daily samples were collected

- daily average concentration according to EN 12341 norm (gravimetric method)
- compared with daily limit value (50 µg/m<sup>3</sup>)

### Chemical analyses

- elements, organic markers, ions (including Na<sup>+</sup>, Cl<sup>-</sup>) and carbonaceous fraction concentrations in PM10 samples

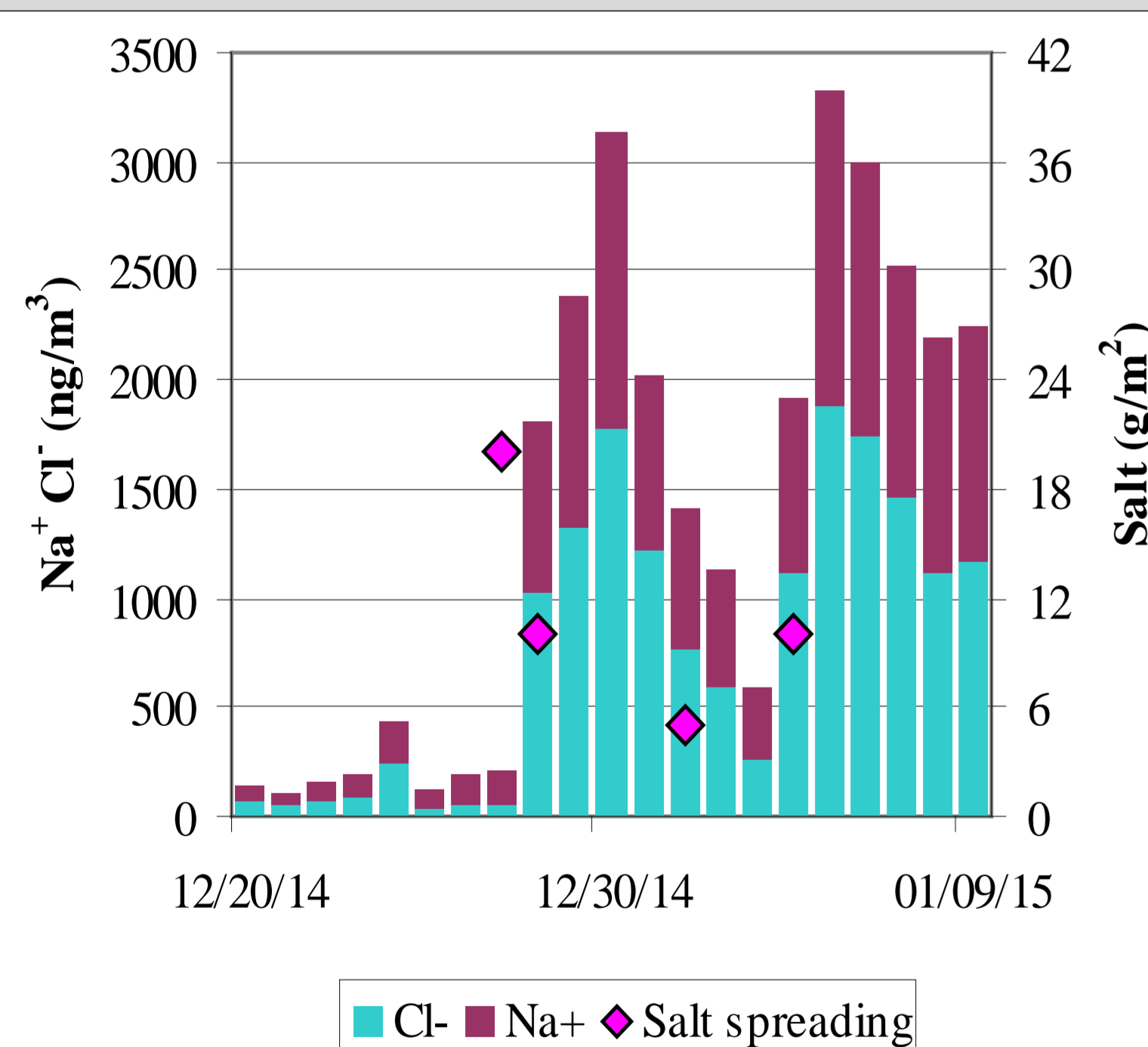
### Na<sup>+</sup> and Cl<sup>-</sup>

- road treatment (salt spreading)
- weather condition
- correlation Na<sup>+</sup>/Cl<sup>-</sup>

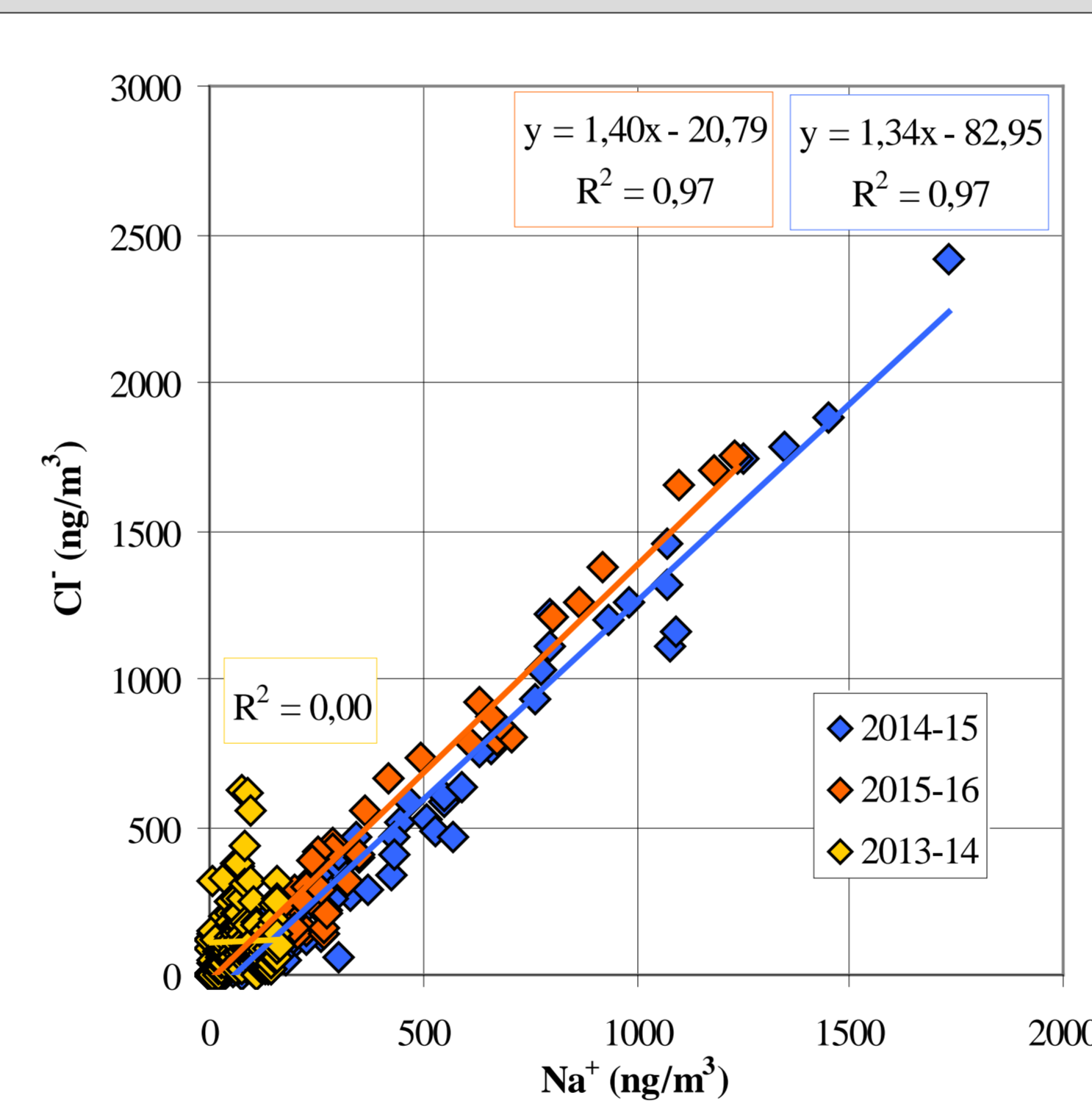
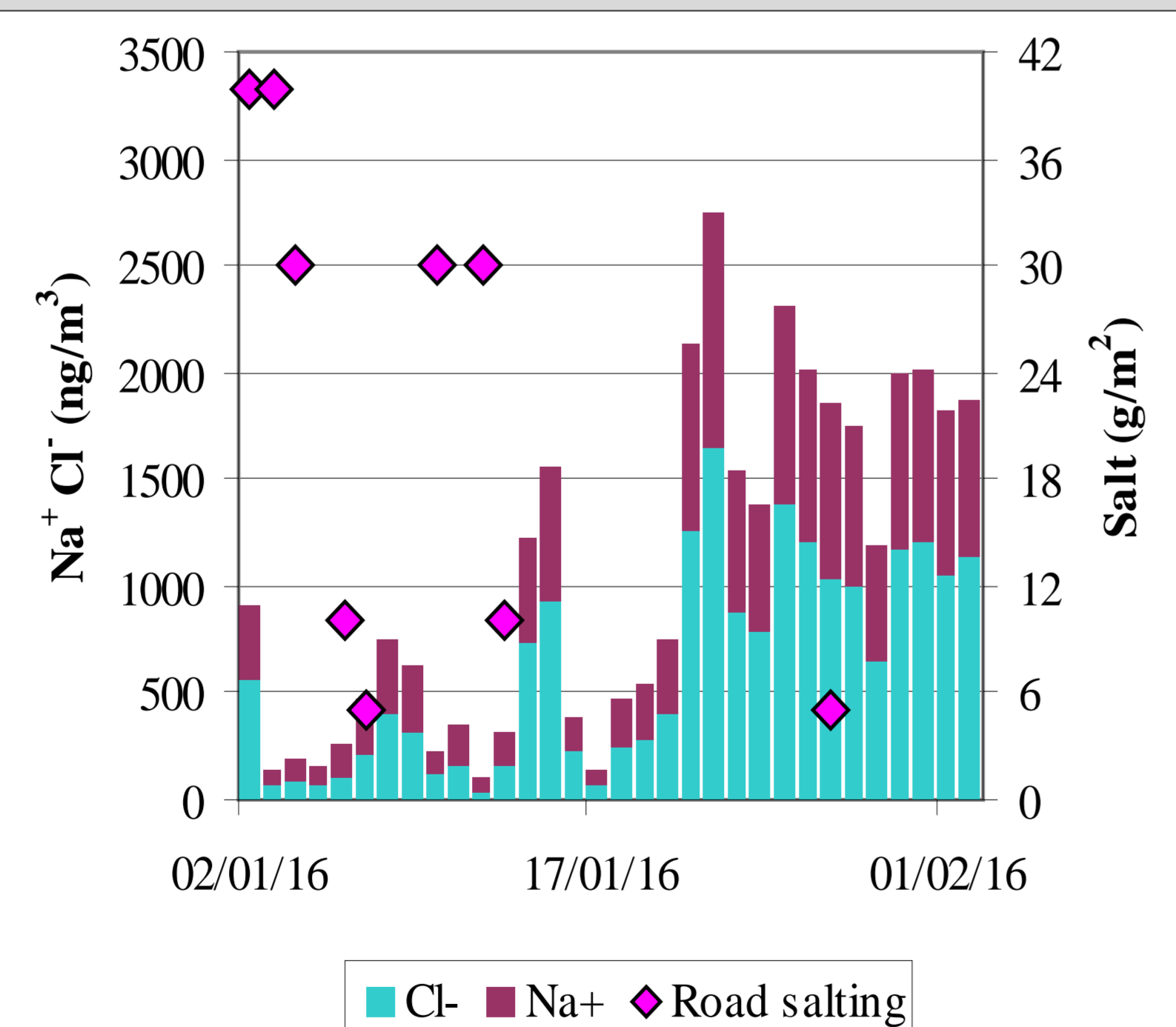
## RESULTS

NaCl concentrations in air is highly linked to weather conditions as, after a road-treatment:

**Without rainfall** NaCl concentrations in air increases immediately



**After light rain** NaCl concentrations in air increases some days after the treatment



**Winter 2013/14**  
Very small concentrations  
No correlation (R<sup>2</sup>=0)

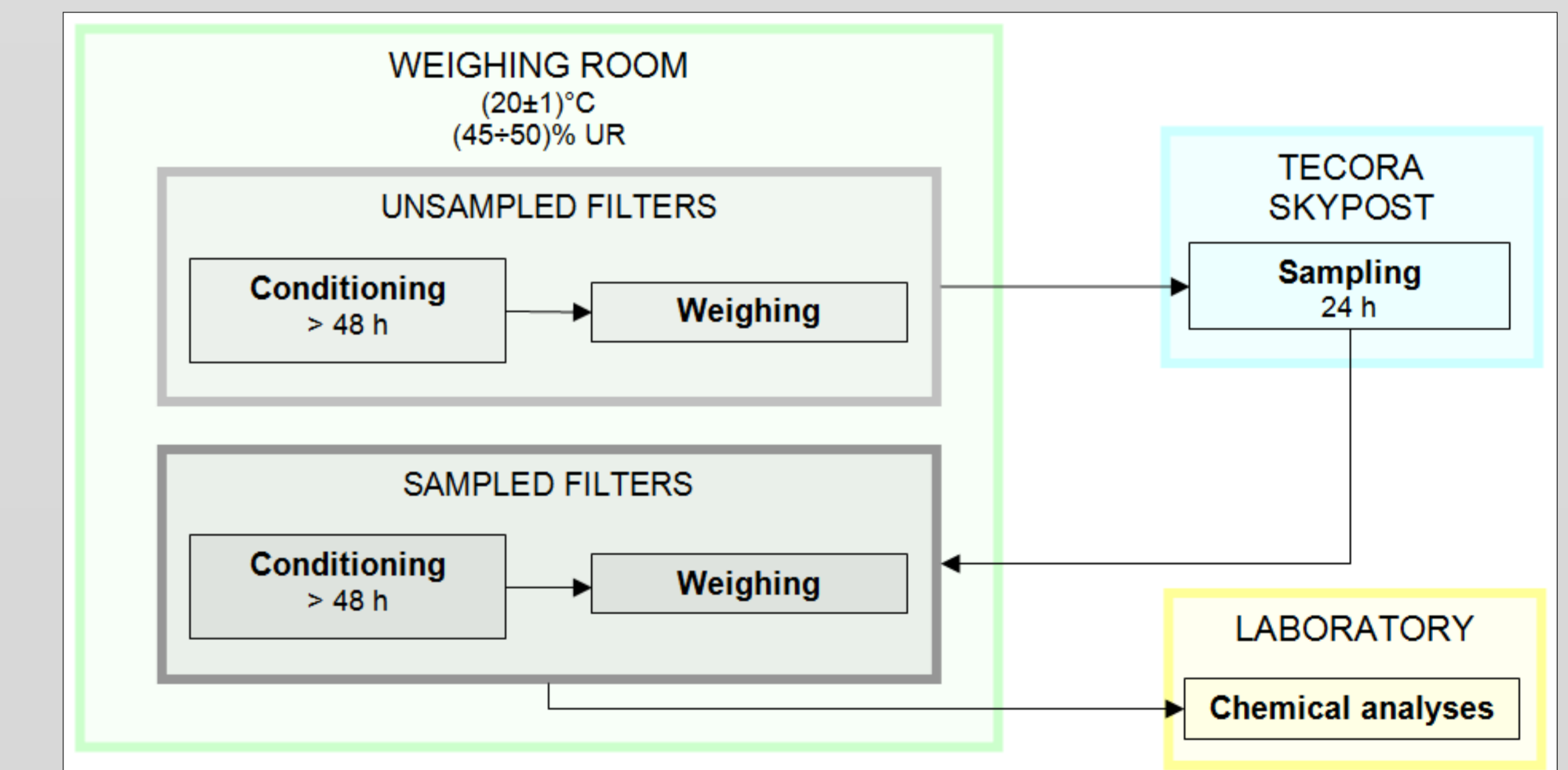
**Winter 2014/15 e 2015/16**  
Small concentrations & peaks  
R<sup>2</sup>=0,97

**Difference due to weather conditions!**

Na<sup>+</sup> and Cl<sup>-</sup> concentration in ambient air is not sufficient to calculate the contribution of salt spreading to PM concentration as:

- Na<sup>+</sup> is also emitted by traffic and is present in secondary particulate
- Cl<sup>-</sup> is emitted by biomass burning (domestic heating)

The CLEAN-ROADS project will provide results on sources identification (e.g. salt spreading, other sources) by using a receptor model as EPA Positive Matrix Factorization



### References

- Pretto, I., et al., SIRWEC 2014 conference proceedings, ID:0019 (2014)
- Ambient Air Quality and Cleaner Air for Europe Directive (2008/50/EC)
- <http://www.epa.gov/air-research/positive-matrix-factorization-model-environmental-data-analyses>

## CONCLUSIONS

**Environmental gain** associated to winter road treatment reduction is a **key factor of the maintenance decision support system** that can help road engineers and maintenance authorities in deciding whether, where and when to spread anti-icing salt.

Analysing the NaCl concentrations in air we demonstrate that:

- NaCl in air strongly depends on weather conditions
- Not all Na<sup>+</sup> and Cl<sup>-</sup> in air is due to road salting

