

New road surface maintenance of expressway using an On-Vehicle Salinity Sensor System which measures the salinity continuously

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1. INTRODUCTION

For NEXCO East Tohoku, maintaining expressways in the northeast area of Japan, snow-ice maintenance operations are especially important.

One of them is **Salt-spreading operations**. Close attention is required to this operations.

On-vehicle Salinity Sensor System was introduced 6 years ago for assistance in operations of road-surface maintenance.

- Clarify the outline of the system and the purpose of the introduction
- Report the actual management condition



2. Background :Development of On-Vehicle Salinity Sensor System

Salt-spreading operations

Control of salinity is required to keep the proper saline level.

How to measure the salinity?



Before:

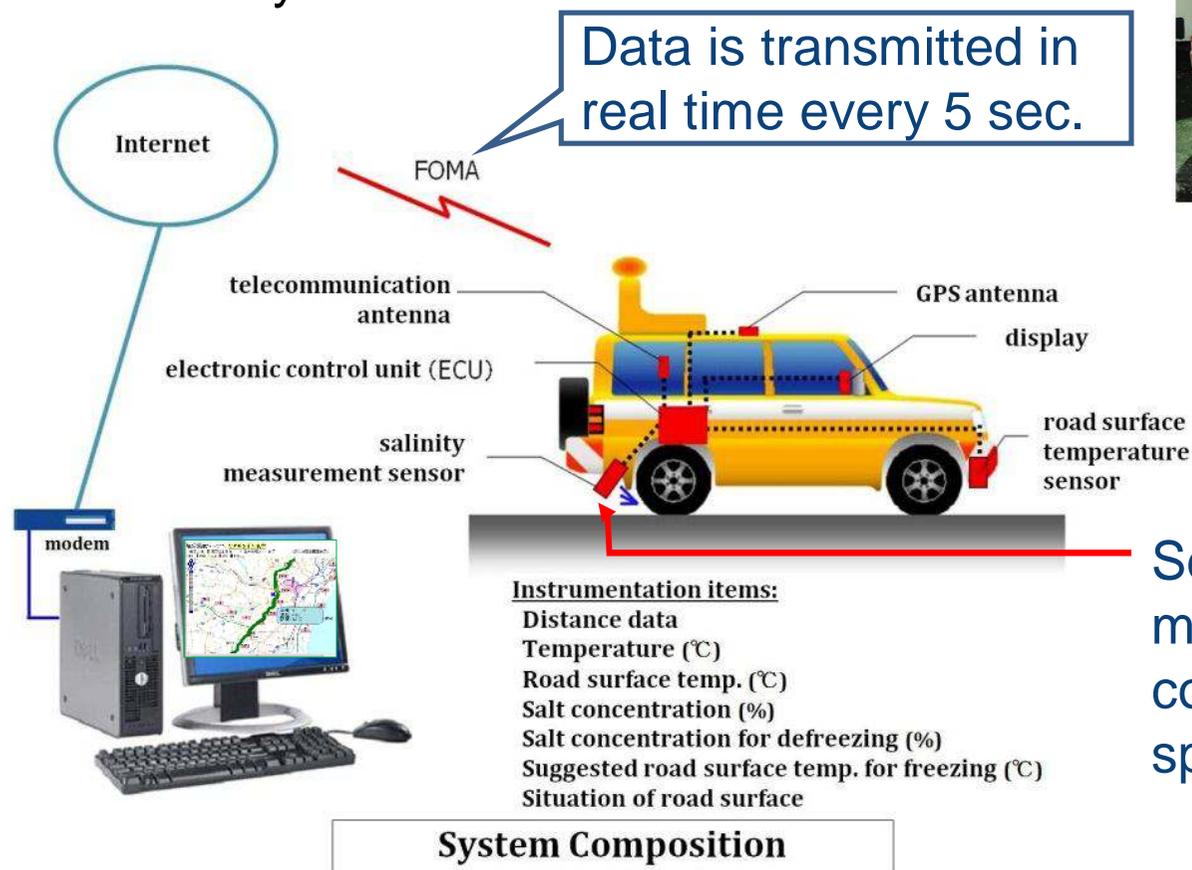
Getting out of the car, using the hand salinity-measurement device, taking the solution one point only



On-vehicle type, automatically, continuously, linearly

3. Outline of system and method of information display

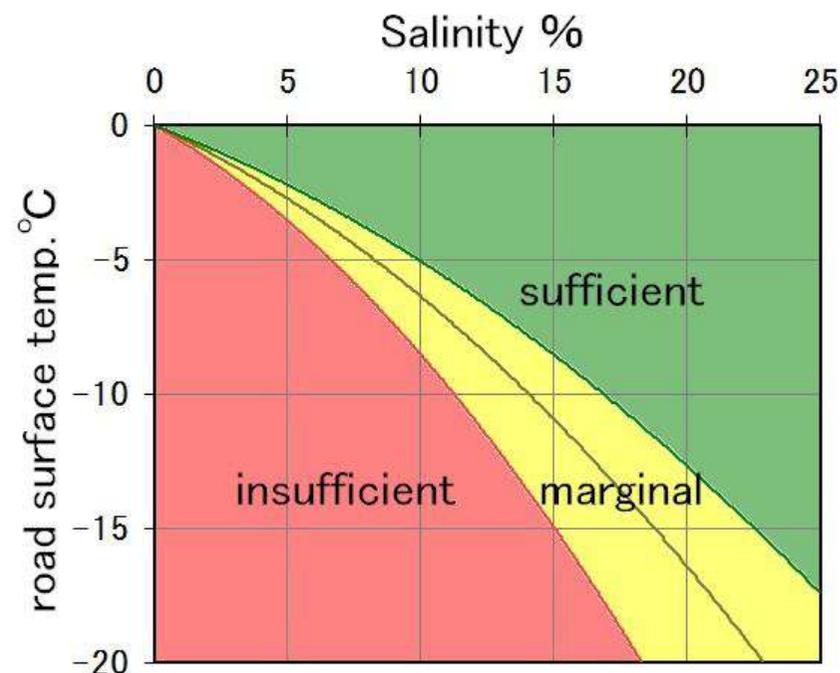
3.1. Outline of On-Vehicle Salinity Sensor System



Sensor optically measures the salinity contained in the water splashed by the tire.

3.2. Principle of use of salinity data

- To optimize the application amount of the anti-freezing agent, it is necessary to calculate the salinity depending on road-surface condition.
- The concept is based on NaCl solution state diagram using NaCl freezing point graph.
- **Note :** It is necessary that the road-surface is in a solution state for applying this figure.



NaCl solution state diagram

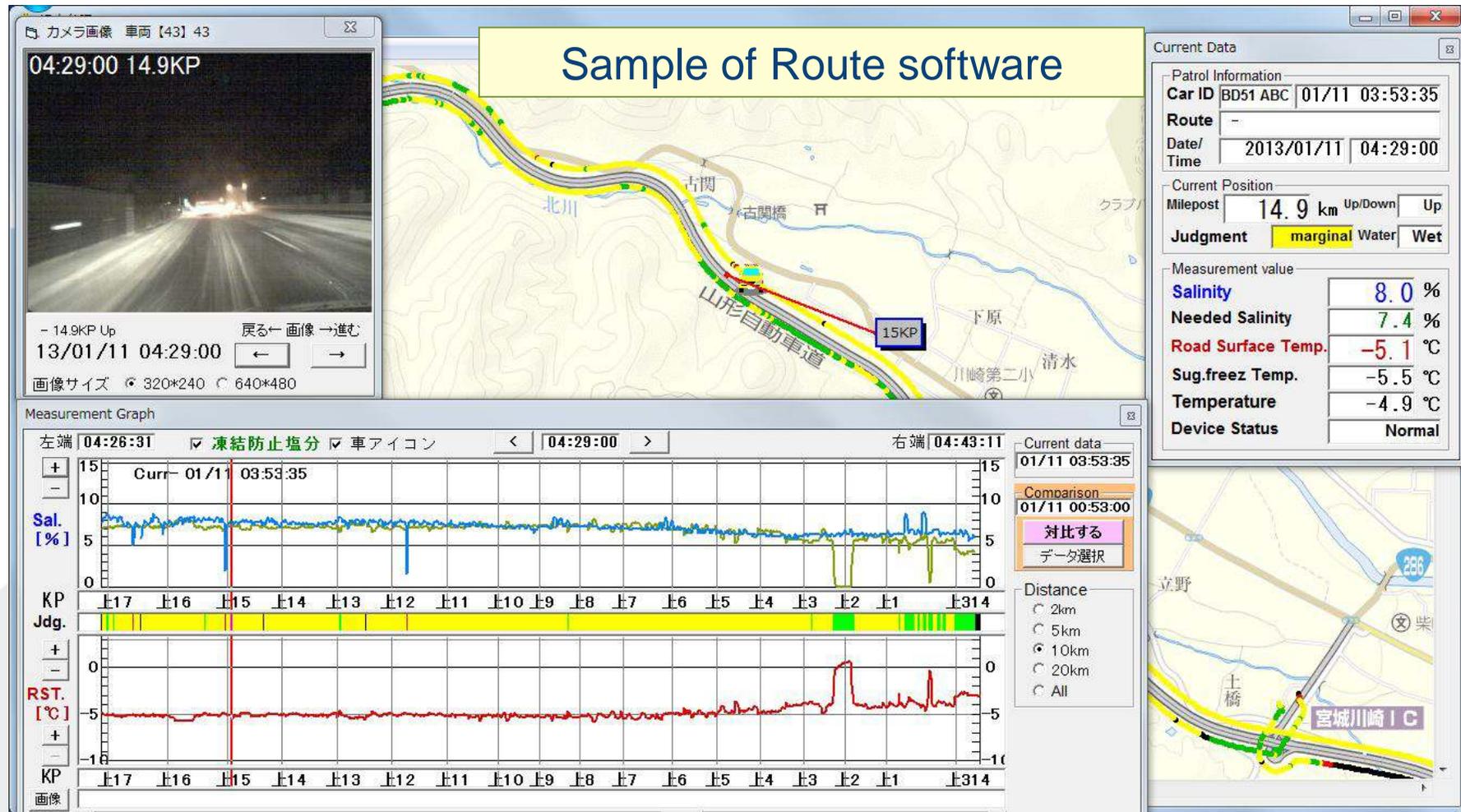
[This diagram shows theoretical road-surface condition by the correlation between the salinity (%) and road-surface temp. (°C)]

3.3. Representation of measurement data

Real-time communication & data analyzing



In-vehicle display

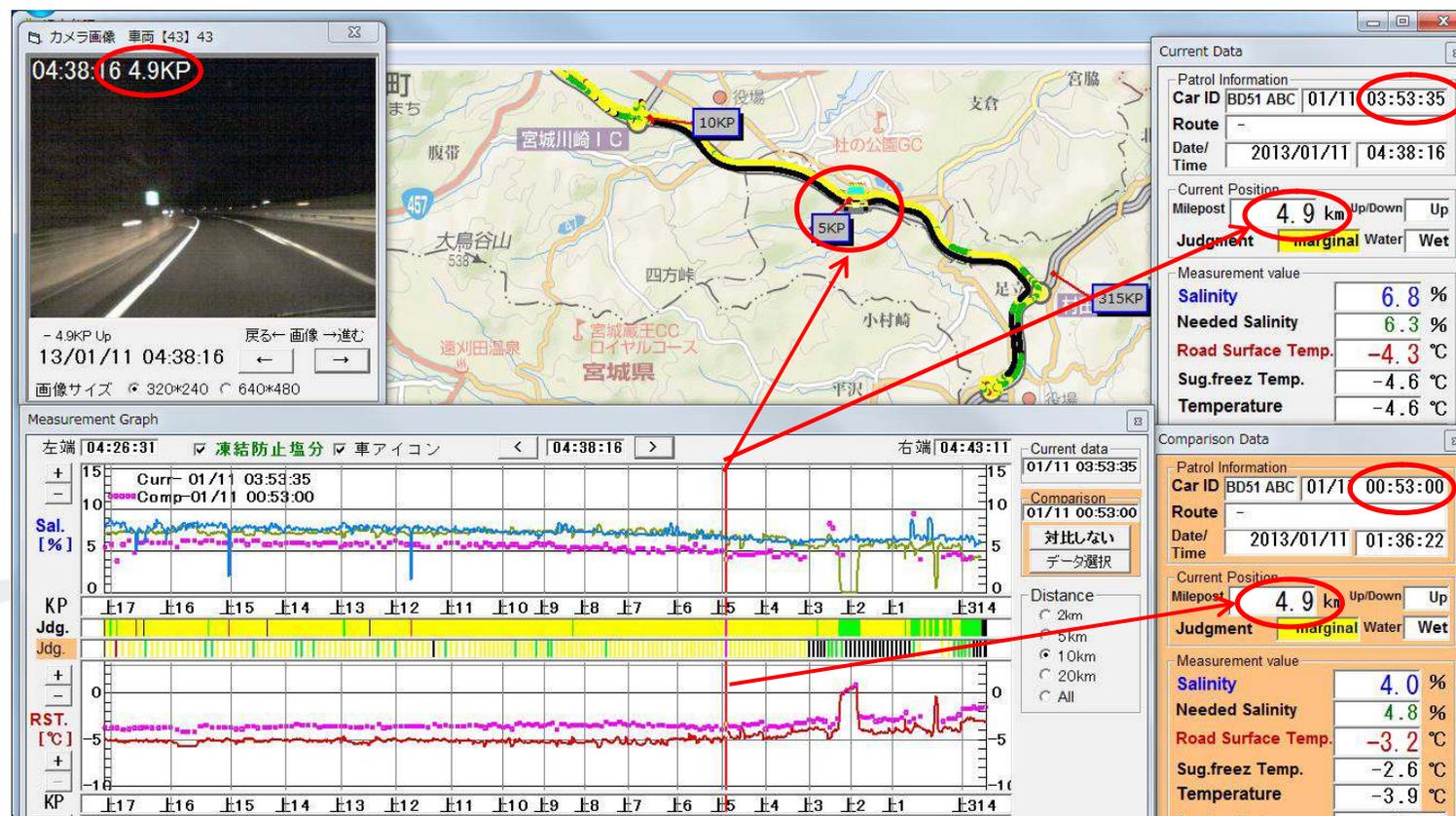


4. Example of management using On-Vehicle Sensor

4.1. Case example of additional application based on data measured by patrol car

Weather forecast :
Snow

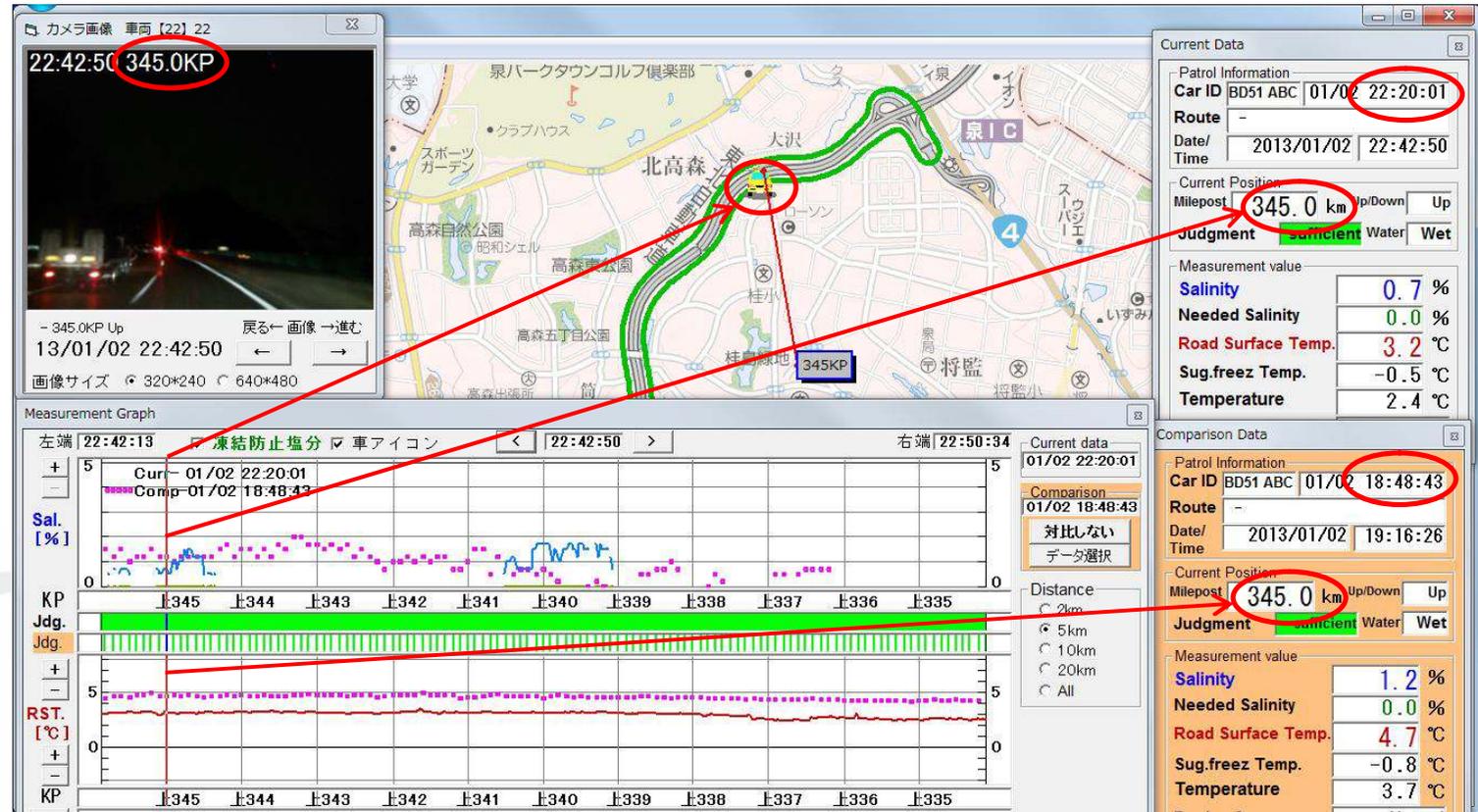
At 2:30
additional
application



Route software displaying measurement data on Jan 11

4.2. Case example of deferring of additional spray based on data measured by patrol car

At 23:40 additional application



Route software displaying measurement data on Jan 2

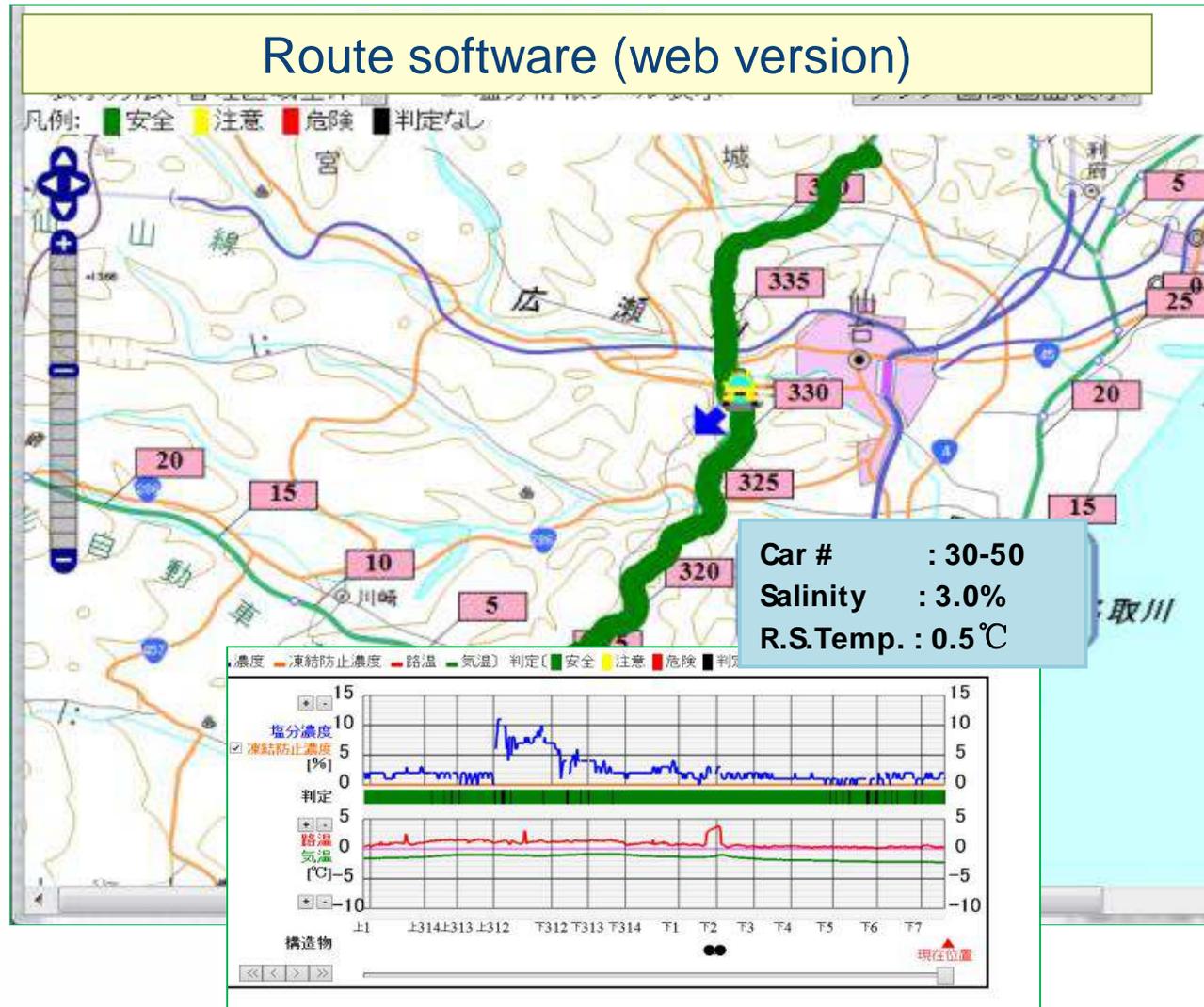
4.3. Visualization of route

By visualization,

1. The safe condition of the route can be confirmed,
2. Partial-route application only on dangerous points is possible.



The amount of application can be reduced, leading to reduction of cost and environmental load.



5. Securing operators' safety

The problem of Hand salinity-measurement device

- Very dangerous to get out of the car on the road
- The measured data is not on the road, but on its shoulder
- The measurement points varied depending on operators.



Measurement after getting out of car

furthermore,

By introducing the on-vehicle salinity sensor system, these problems can be solved.

Because of no need to pull over the car, operation time can be reduced, improving the operation efficiency and accuracy.

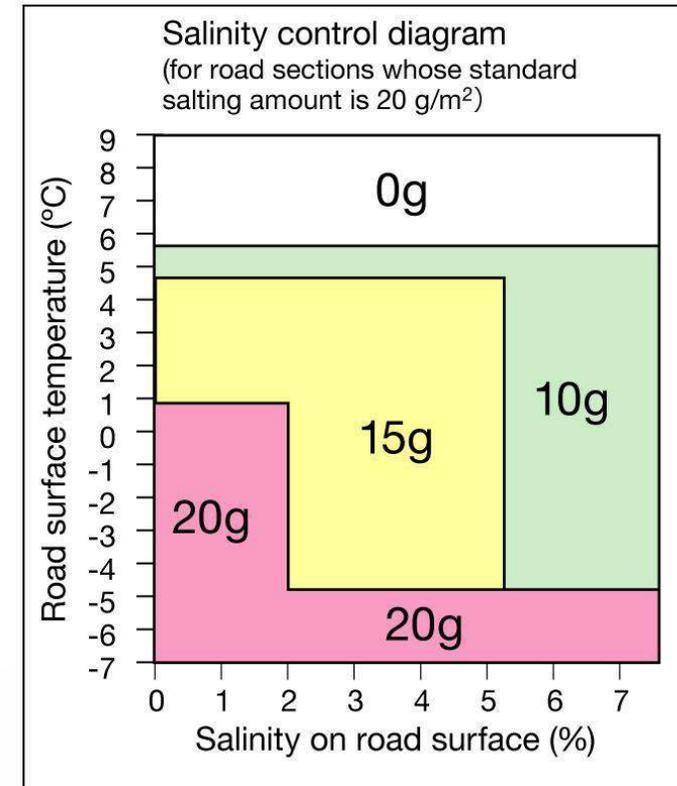
6. Future vision of continuous measurement system

Automatic spraying by utilizing the “Salinity Control diagram”

The purpose of measuring the residual salinity is to examine the additional salt application timing, sections and amount.



An effective method of utilizing this diagram that considers the measurement data and regional features is currently considered for trial calculation of the additional salt application



Salinity Control Diagram

7. Conclusion

- By utilizing the continuous salinity measurement device, road-surface condition can be monitored linearly in real time.
- By utilizing the measurement data, a new approach to the optimum spraying operation considering safety and efficiency has become possible.
- To assist in this operation, it is necessary to improve the device, for example, data can be measured at the areas where there is little water splashed by tires, the sensor should be downsized, other functions should be added, and so on.
- Establish the new scientific road-surface maintenance method of expressways for the support of winter road management.

