



Accident Reduction Potential Of Advanced Adverse Weather Warning Systems

Dr. José M. Pardillo Mayora

**Universidad Politécnica
de Madrid**

Profesor Titular

jmpardillo@caminos.upm.es



Road safety problems in adverse weather conditions

Spanish National System (1997-2001)

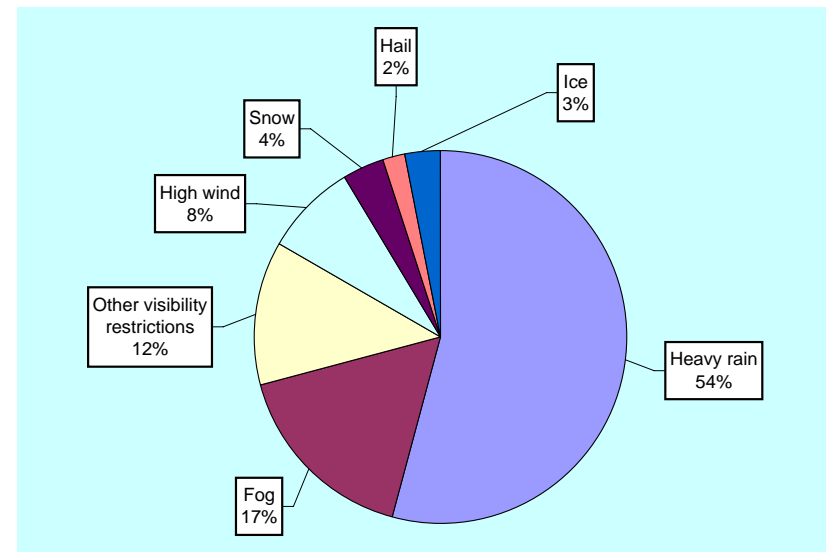
- 8 862 personal injury accidents
 - (9,1 % of National Road System total)
- 955 fatalities
 - (9,7 % of National Road System total)

Prevailing conditions

- Rain 54%
- Fog, visibility restrictions 29%

Main factors

- Inadequate speed 44%
- Driver Distraction 21%



Approaches to road safety improvement in adverse weather

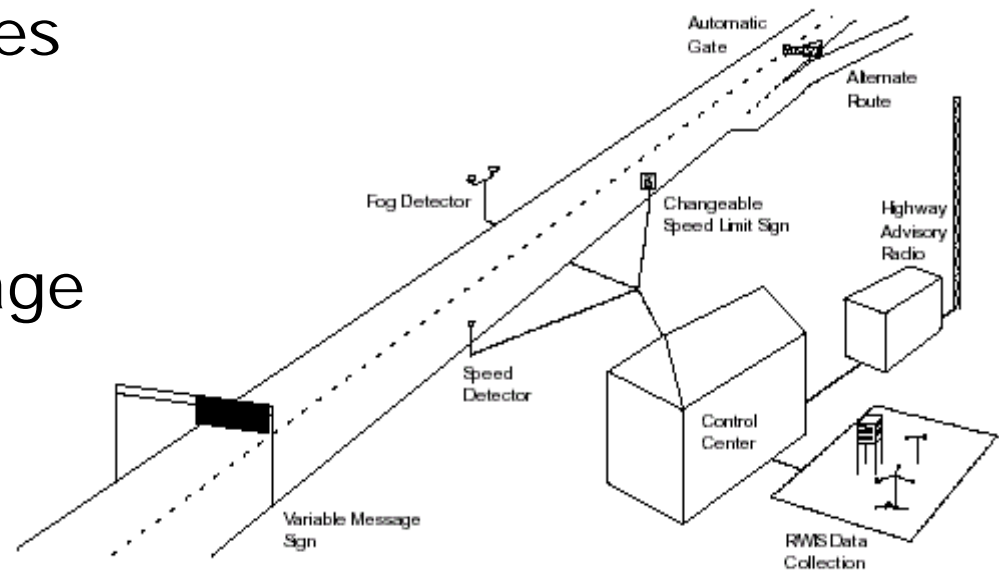
- Increase winter maintenance efficiency to reduce the time of snow or ice accumulation on the roadway
- Reduce speeds and increase headways to compensate for the lower margin of error
- Provide the users with precise and timely information on the state of the roads



Advanced Adverse Weather Warning Systems

Components

- Adverse condition detection devices
- Warning message displays
- System monitoring and activation



Detection devices

**Pavement
condition**



Visibility



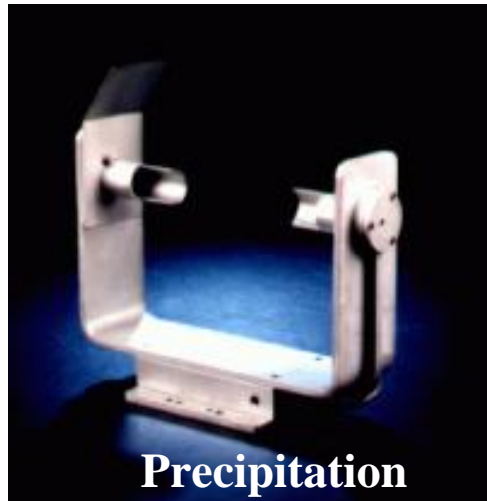
Wind



**Visibility &
precipitation type**



Precipitation



Cameras



Warning message displays



Mobile displays

Flexible

- Sections with occasional weather related hazards

Various applications

- AAWWS
- Road works
- Congestion

Activation

- Manual
- Automated (requires locating problem road segments)



AAWWS operation conditions

- Select the adequate warning message at the right time →
Pre-established operation strategies
- Avoid transmitting inaccurate information or transmitting it too late for the drivers to react upon it →
Precise site location
- Suppress the messages as soon as they cease to correspond with the actual situation →
Accurate detection devices
- Draw drivers' attention and influence their behaviour →
Concise and effective message sequence

Pilot tests

Three pilot tests were carried out to assess the effectiveness of AAWWS

1. Two lane road section of national road N-301 in the province of Toledo
2. Dual carriage road linking Madrid and Seville (N-IV)
3. A Toll motorway in northern Spain (A-1)

Effects on drivers' behaviour

- Mean speed reduction: 20%
- Speed variance reduction: 30%



Test warning messages

Visibility (m)	Pre-warning message	Reinforcement message
>200	Not active	Not active
150-200	Lower your speed Fog 2000 m	Fog Lower your speed
100-150	Recommended speed 80 Thick fog 2000 m	Recommended speed due to fog 80
<100	Recommended speed 60 Very thick fog 2000 m	Recommended speed due to fog 60



Accident reduction potential

214 sections where recurrent adverse weather safety problems occur were identified

- Total length: 744 km (3% of the total network length)
- They account for 25% of the injury accidents recorded with adverse weather

Estimated cost of the implementation

- 20 million €

Safety benefit estimates

- 43,8% reduction of of the 480 annual injury accidents
 - 22 fatalities prevented every year

Accident reduction estimates based on:

- Detailed study of a sample of accidents
- Results of the pilot tests

Conclusions

- AAWWS can provide reductions of up to 40% in personal injury accidents in adverse weather conditions
- The social savings derived from the accident reductions that can be obtained by the deployment of AAWWS in the Spanish system would completely cover the required investment in one year.
- These results support the assumption that ITS can be used to effectively and efficiently improve road safety