

# MeteoVIAS: Web Application for winter road weather forecasting



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# Motivation

- Severe **winter** weather conditions such as ice or snow on the road are potential **risks to the safety and operation** of national transport systems.
- Keeping **roads clear and open** can be a challenge in certain places, especially in winter.
- The region of **Castilla y Leon** is **greatly affected** by winter weather since its main road network has sections over 1000 m of altitude.
- The optimization of human and material resources for this purpose requires **specific and updated meteorological information**.



Source: pittsburgh.cbslocal.com



Source: bbc.com



# Objectives of MeteoVIAS

- Oriented to **traffic/road maintenance managers**:
  - Decision-making tool for winter road operations: **Short** and **very short range**



Source: elconfidencial.com

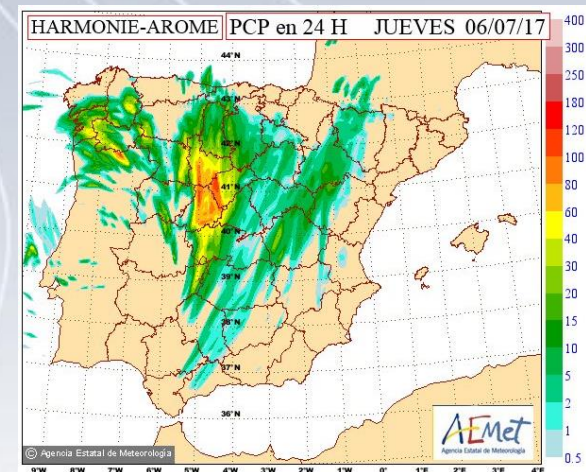


Source: elespanol.com

- Application desired characteristics:
  - Provide a **specific** road forecast.
  - Allow **visual identification** of severe weather forecasted and its **location**.
  - Show an **overall view** of the weather forecasted for the country.
  - Include a **time evolution chart** of variables like temperature, rain or snow.
  - Possibility of **filtering** the information to visualize.

# Specific road forecast

- Model chosen: **METRo** (Model of the Environment and Temperature of Roads)
  - **0D** model (predictions in **points**)
  - Relatively **easy to implement**
  - **Few configuration options**
  - Requires as **inputs**:
    - Atmospheric forecast → **HARMONIE-AROME**
    - Observation data } **DGT road weather station network**
    - Location characteristics }



DGT RWIS network

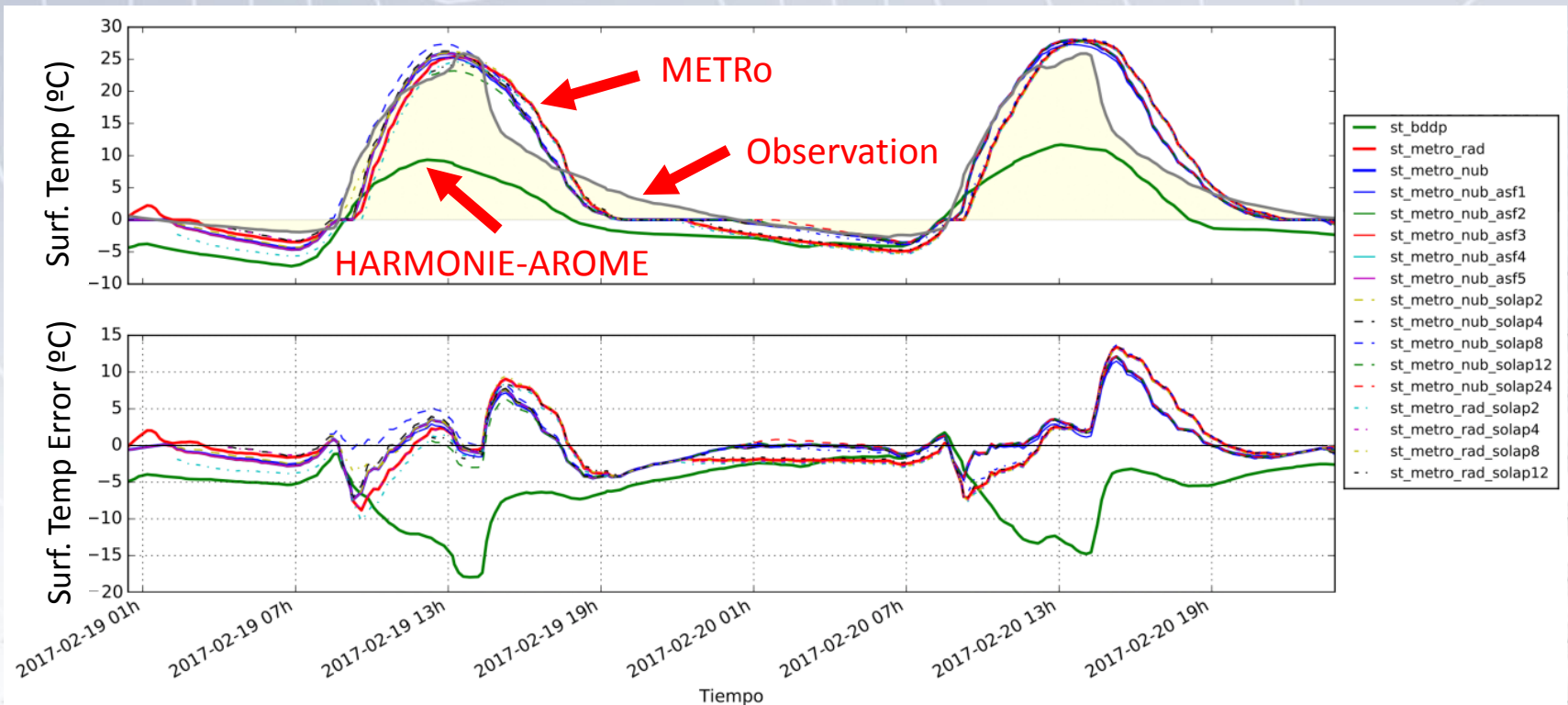


Source: [www.vaisala.com](http://www.vaisala.com)



# METRo verification: Surface Temperature

- A **test campaign** was performed, with **>12000 cases**, aimed to:
  - Find METRo **configuration** that results in best skill
  - Evaluate skill **improvement with respect to HARMONIE-AROME**

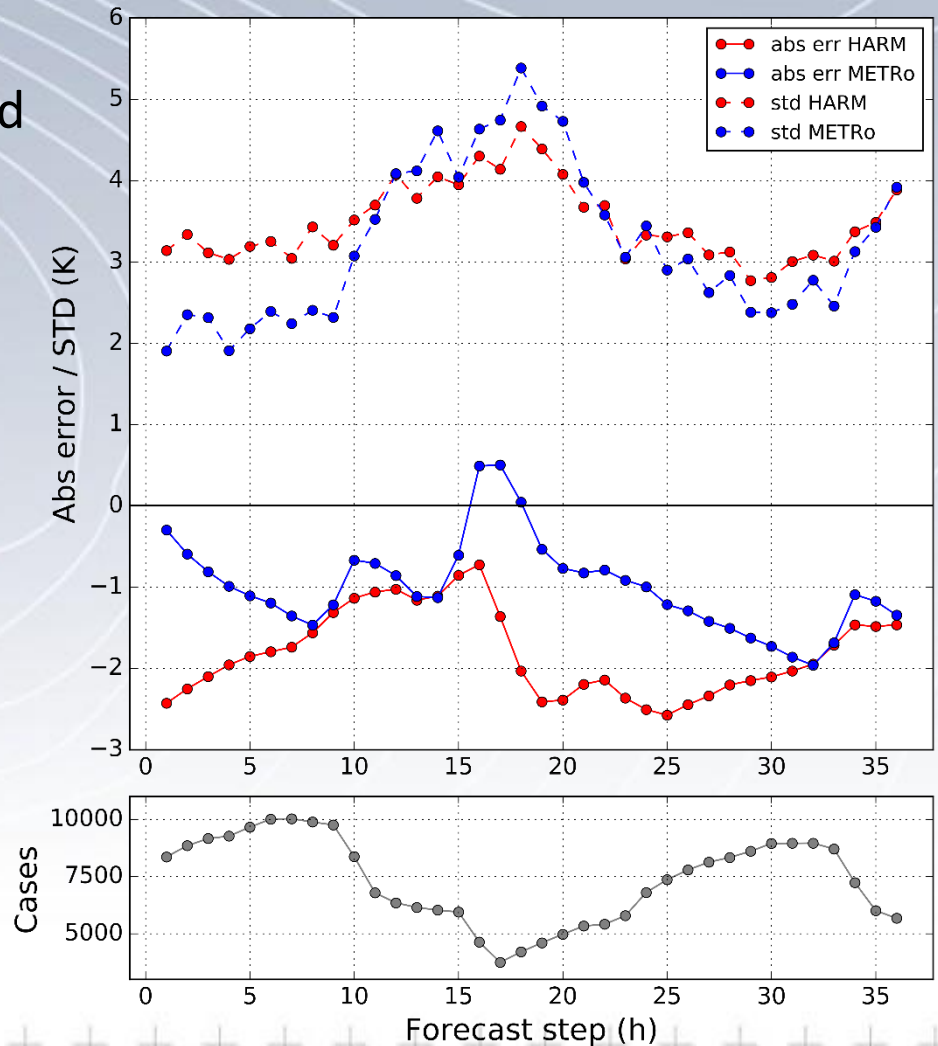


# METRo verification: Surface Temperature

- **Abs. error and STD** compared to HARMONIE-AROME

**Lower Abs. error and STD**  
for **shorter ranges (<6h)**

Average abs. error is **~-1°C**  
(HARM ~-2°C)

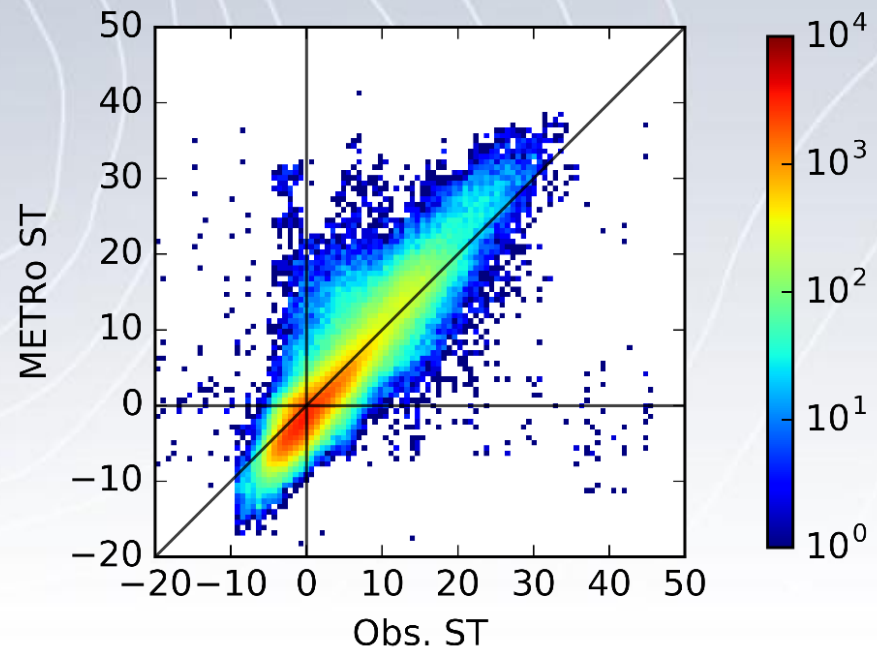
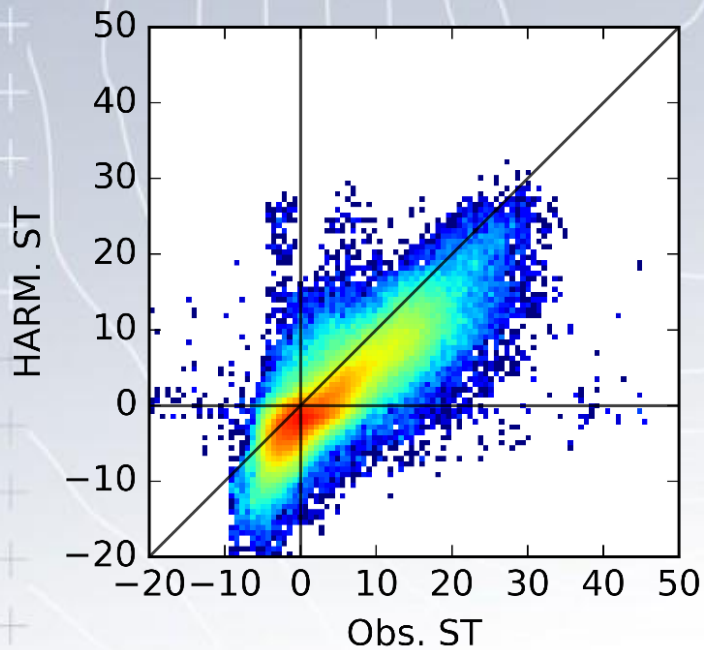


# METRo verification: Surface Temperature

- Forecast-Obs. dispersion

METRo improves skill (**reduces BIAS**)

**Narrower spread** for lower temperatures





# METRo verification: Surface Temperature

- Dichotomous verification

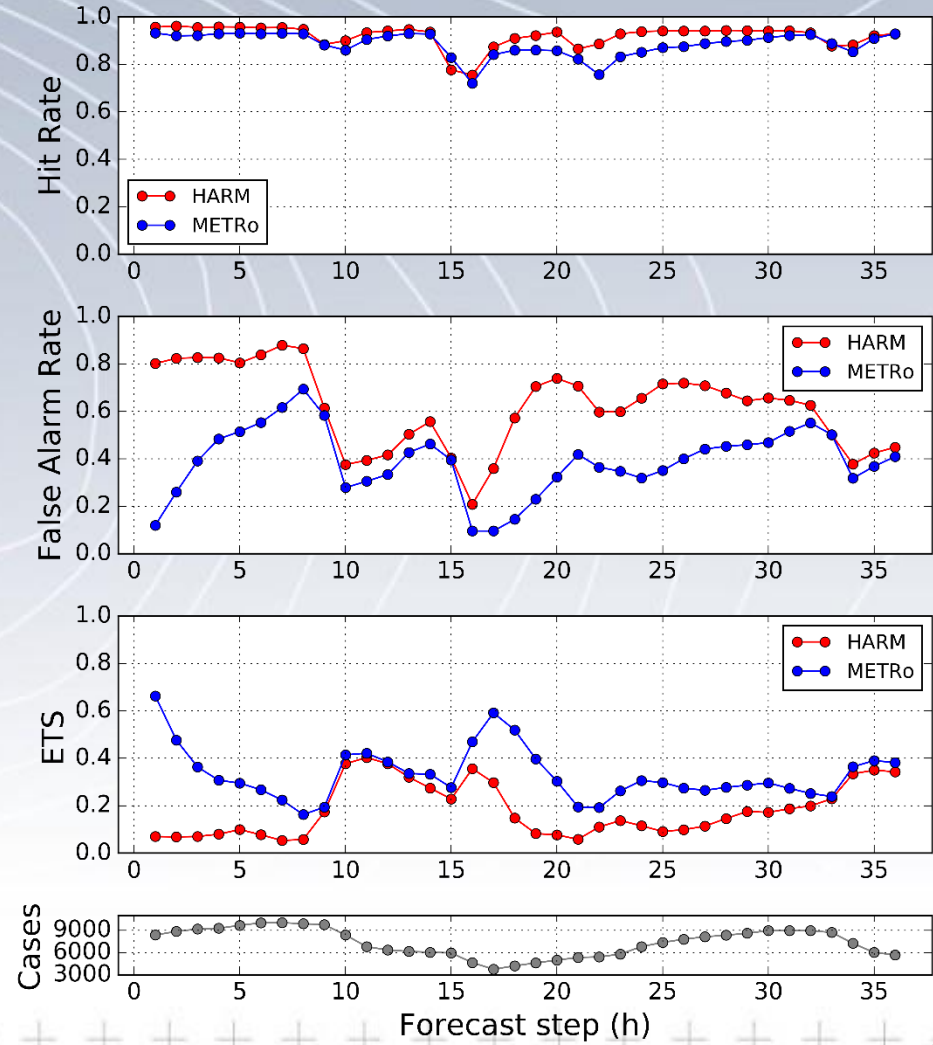
### Hit Rate:

- **similar** to HARMONIE-AROME

### False Alarm Rate and Equitable Threat Score:

- **better** for METRo, specially for shorter ranges

METRo improves skill for road weather forecast,  
compared to HARMONIE





# MeteoVIAS: Features



- Forecast **range: 36 hours**
- **Automatic update every 6 hours**
- Provides information about:
  - **Specific** road forecast (METRo)
  - **Atmospheric** forecast (HARMONIE-AROME)
- Allows to visualize severe weather, intensity and location:
  - **Snow** accumulation
  - **Ice** presence
  - **Water film** on road
  - **Surface temperature** below certain value
- Includes a **time evolution chart** and **most characteristic values** for each point
- Possibility of **filtering** the information to visualize
- **Multi-device** access.



# MeteoVIAS

**Rango temporal**

Total

Rango 1 Rango 2 Rango 3

0:59 27/02 11:58 27/02 12:01 28/02

**Estaciones DGT**

Nieve Ver todo Ocultar todo

Hielo

Agua

Frío

Añadir límites:

Temp. mínima < - 2.0 °C +

Película de agua > - 0.5 mm +

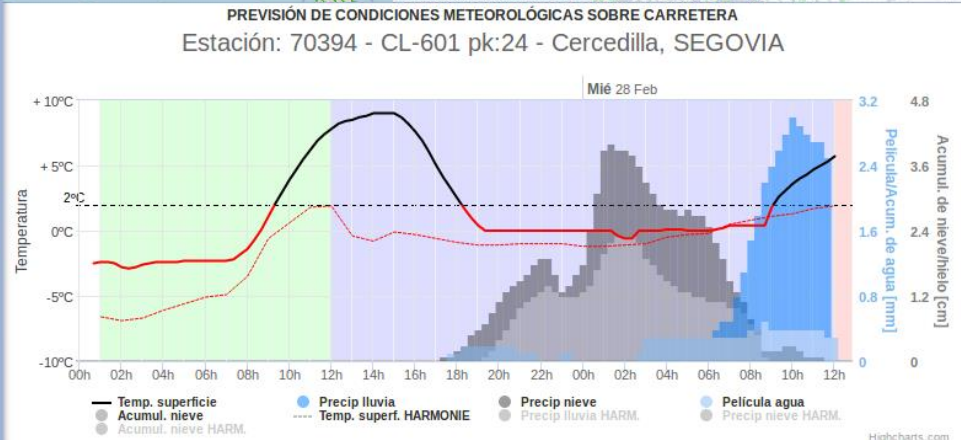
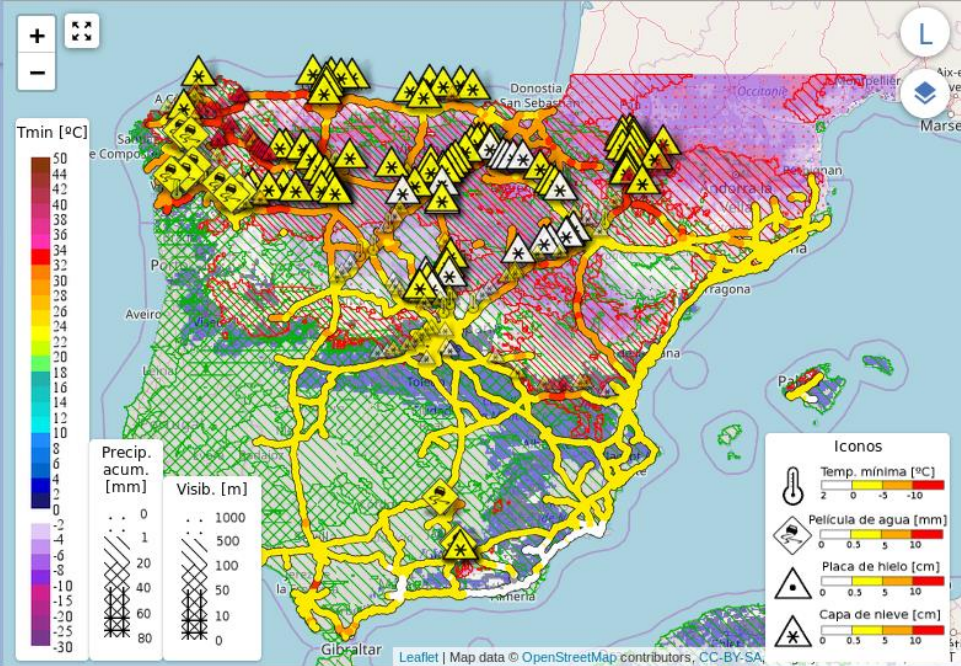
Acum. de nieve > - 0.1 cm +

Reset

**Previsión en carretera para la estación**

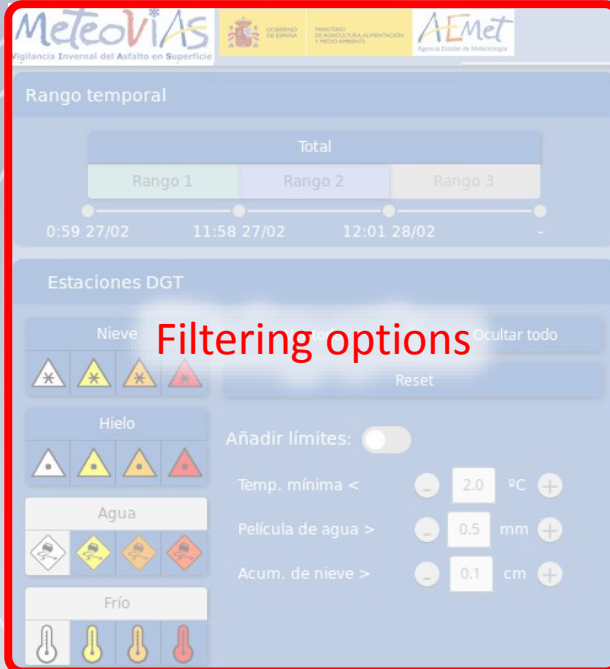
Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-





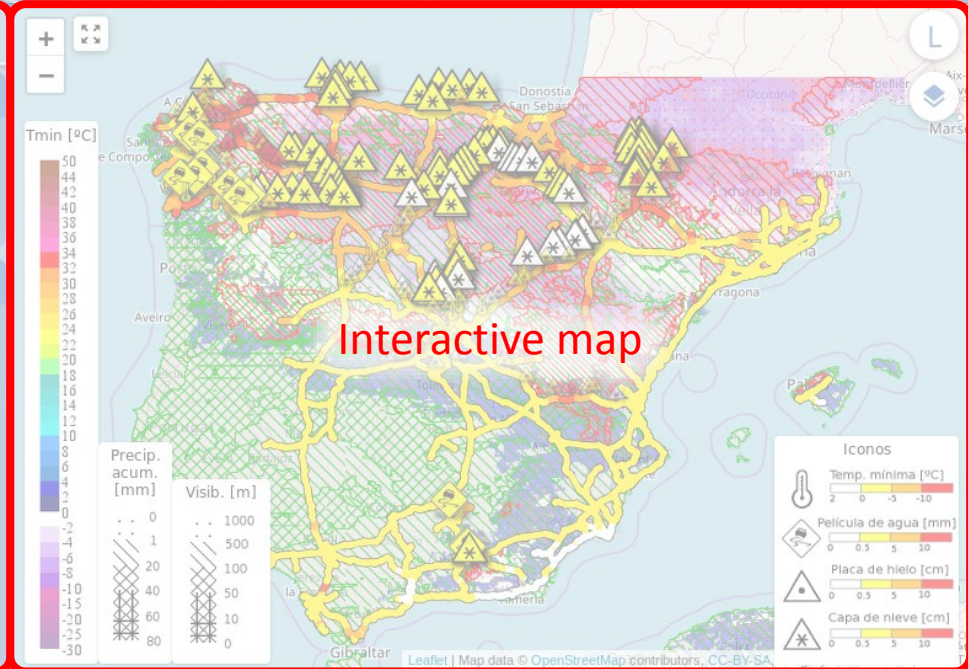
# Web App structure



**Filtering options**

Rango temporal: Total, Rango 1, Rango 2, Rango 3. Time range: 0:59 27/02 to 12:01 28/02.

Estaciones DGT: Nieve, Hielo, Agua, Frío. Añadir límites: . Temp. mínima: 2.0 °C. Película de agua: 0.5 mm. Acum. de nieve: 0.1 cm.

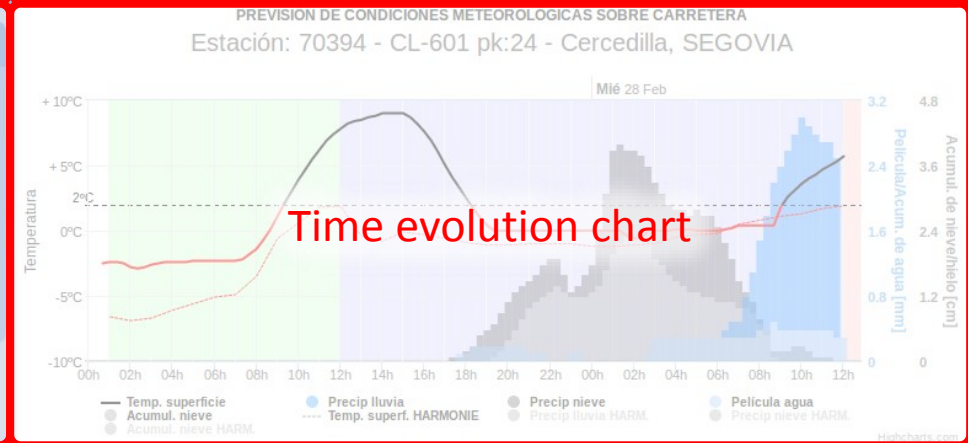


Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02				
De: 11:58 27/02	2:20 28/02	9.59 28/02	8.40 28/02	9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02				
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-

**Summary table**





# Interactive map

MeteoVias Vigilancia Integral del Asfalto en Superficie

Rango temporal

Total

Rango 1 Rango 2 Rango 3

0:59 27/02 11:58 27/02 12:01 28/02

Information shown:

- METRo forecast (icons)
- HARMONIE (other)

Hielo

Agua

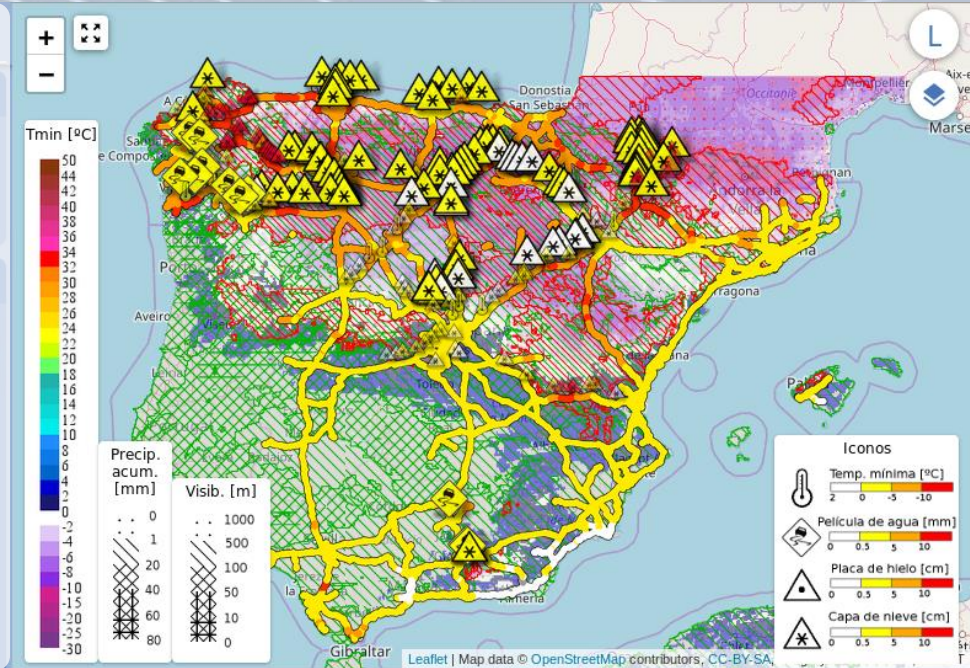
Frío

Añadir límites:

Temp. mínima < 2.0 °C

Película de agua > 0.5 mm

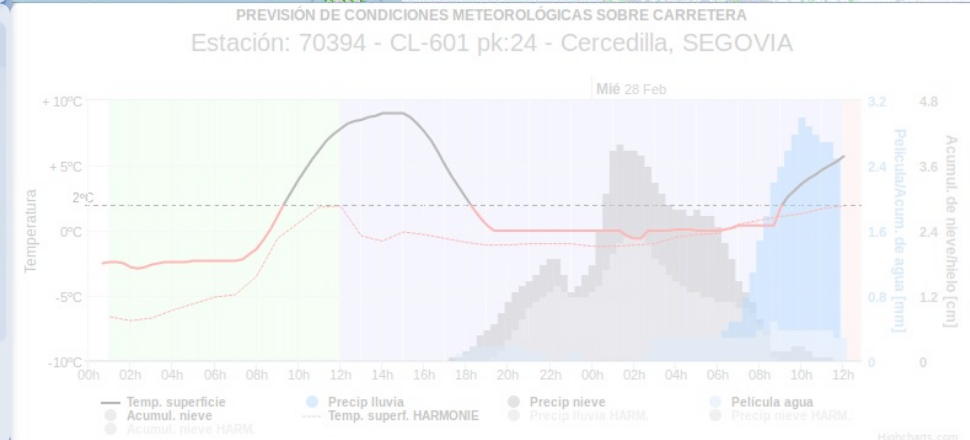
Acum. de nieve > 0.1 cm



Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-



# Interactive map

**MeteoVias** Vigilancia Integral del Asfalto en Superficie

Rango temporal

Total

Rango 1 Rango 2 Rango 3

0:59 27/02 11:58 27/02 12:01 28/02

Estaciones DGT

Nieve

Hielo

Agua

Frío

Añadir límites:

Temp. mínima < 2.0 °C +

Película de agua > 0.5 mm +

Acum. de nieve > 0.1 cm +

Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

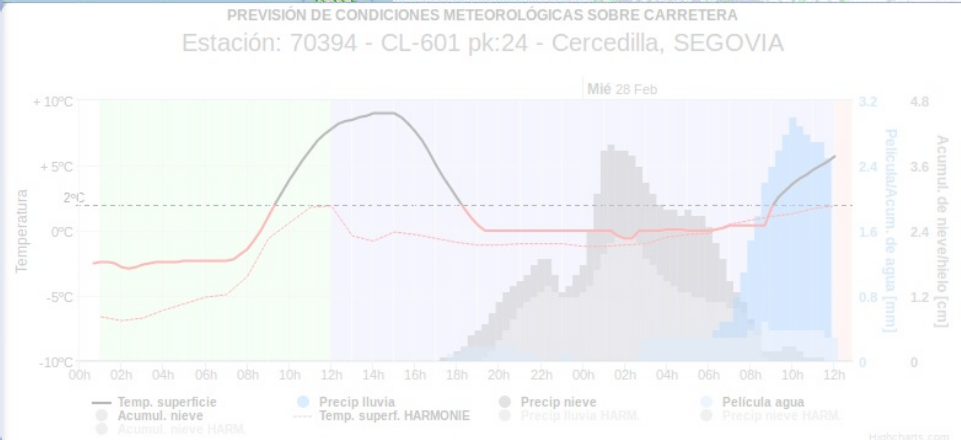
Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-

Layer selector

Capas

Mapas

- Temp. sup. HARMONIE
- Rango temperaturas: < 4°C Completo
- Precip. total acum. HARM
- Tipo precipitación: Global Nieve Lluvia
- Estaciones DGT
- Estaciones DGC
- Mapa carreteras
- Meteoro representado: Más defav. Nieve acum. Lluvia horar. Temp. mín.
- Visibilidad



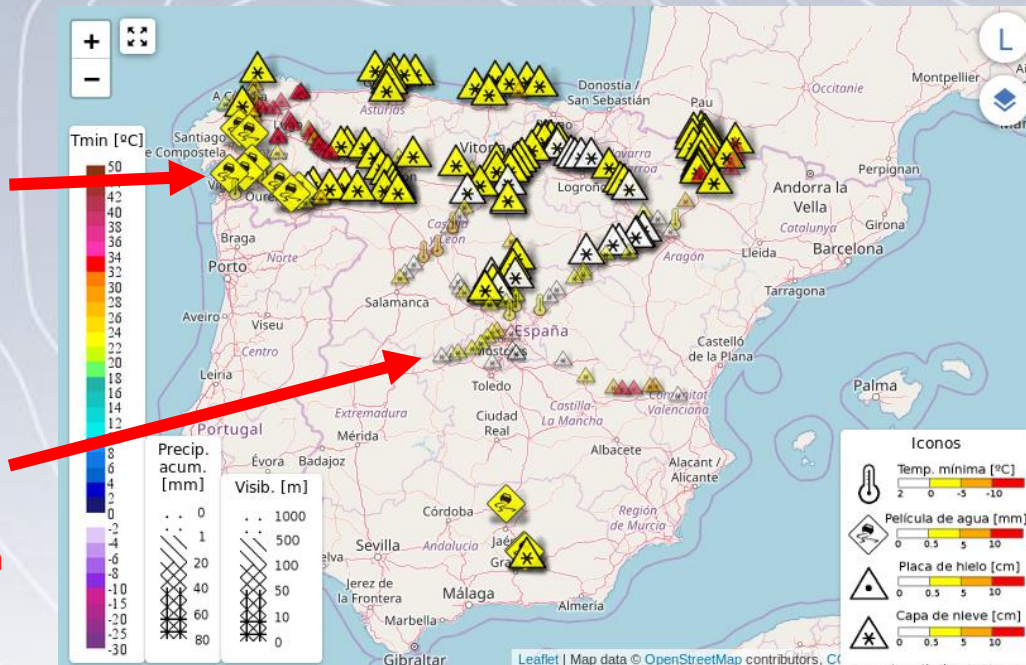


# Interactive map

## Severe winter weather conditions according to METRo

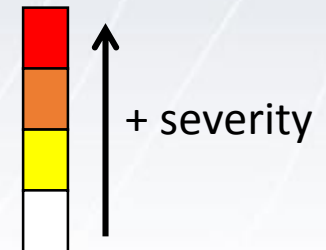
Point with METRo forecast

Point with HARMONIE forecast (no observation available)



Severe weather:

- ⚠️ Accum. snow
- ⚠️ Ice presence
- ⚠️ Water film on road
- ⚠️ Min. surf. temp. <2°C



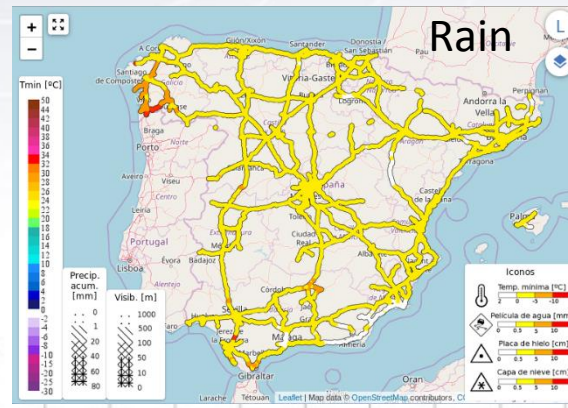
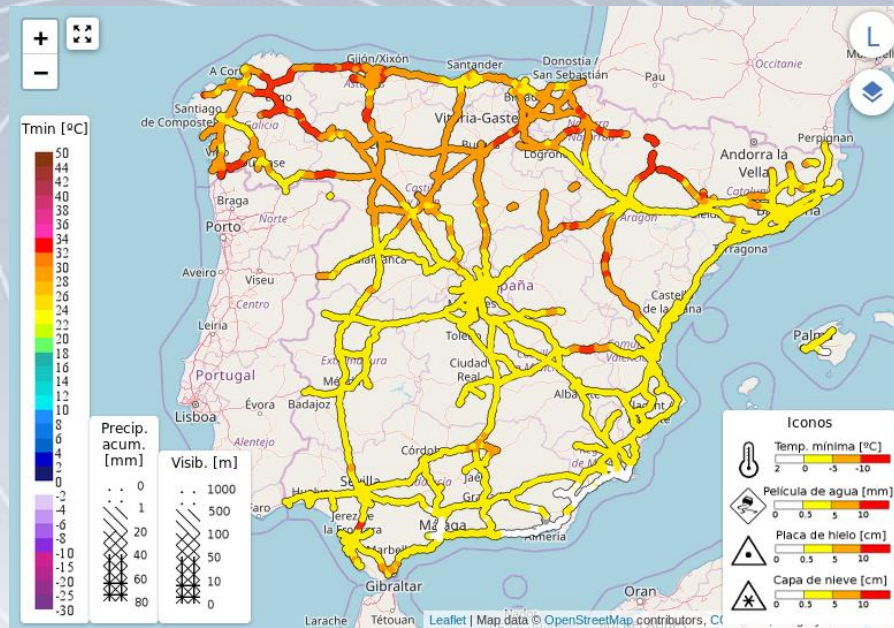
Locations: Points with observation (weather stations)



# Interactive map

## Severe weather condition on road according to **HARMONIE-AROME**

Most severe, no matter which



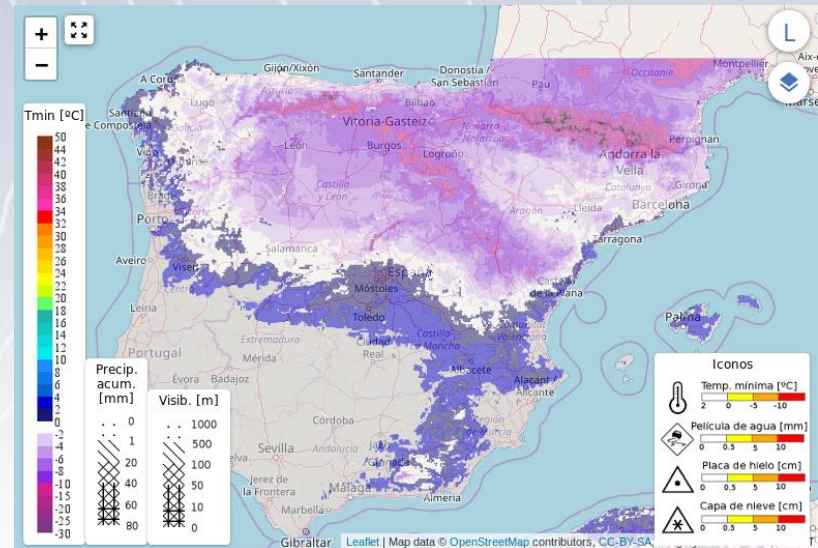
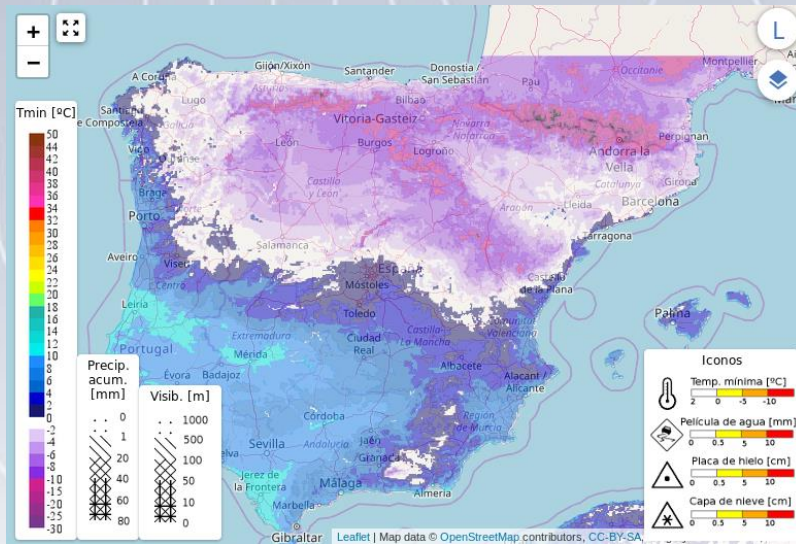


# Interactive map

## Minimum surface temperature according to **HARMONIE-AROME**

Full temp. range

Only for ST < 4°C



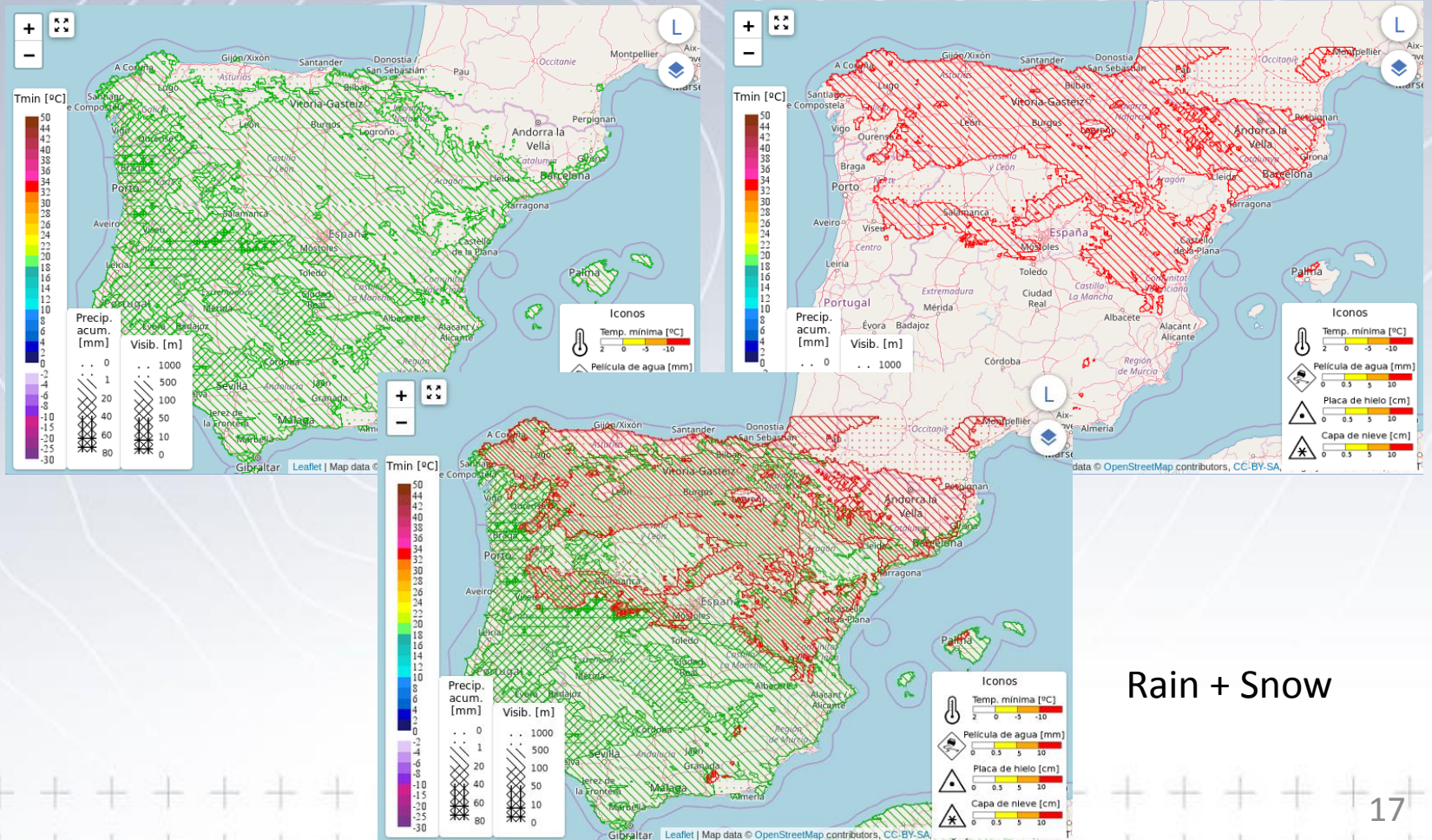


# Interactive map

Total accumulated precipitation according to **HARMONIE-AROME**

Rain

Snow

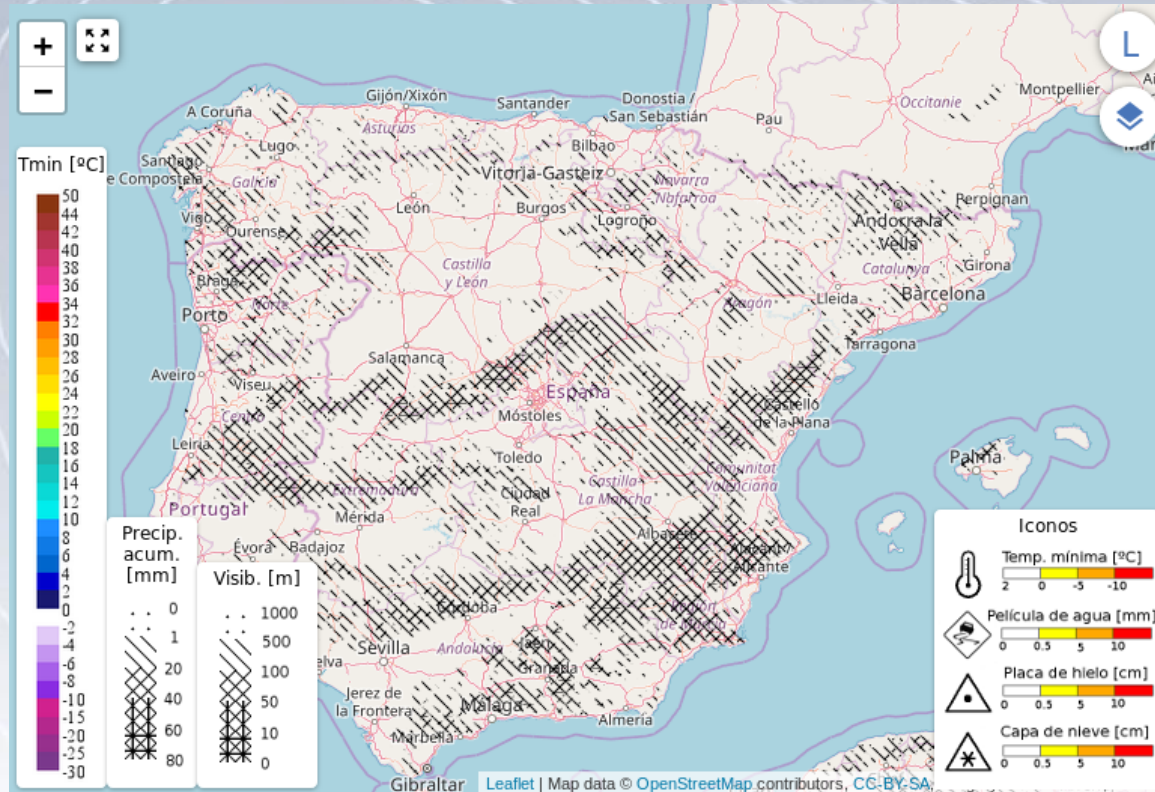


Rain + Snow



# Interactive map

Visibility < 1km according to **HARMONIE-AROME**



# Filtering options



**Rango temporal**

Total

Rango 1 Rango 2 Rango 3

0:59 27/02 11:58 27/02 12:01 28/02

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**Estaciones DGT**

Nieve Ver todo Ocultar todo

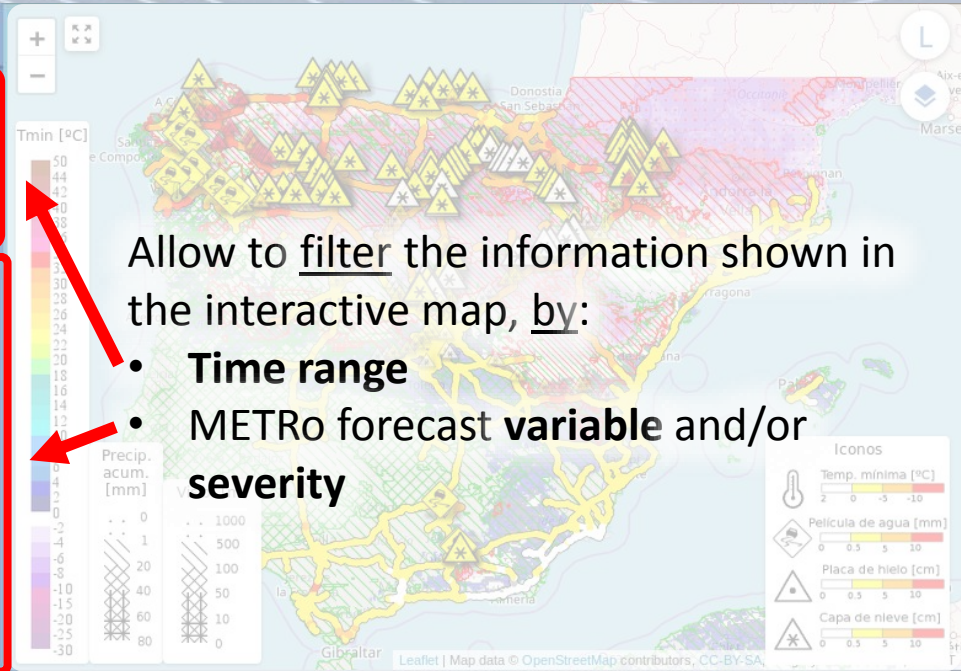
Hielo Añadir límites:

Temp. mínima < - 2.0 °C +

Agua Película de agua > - 0.5 mm +

Acum. de nieve > - 0.1 cm +

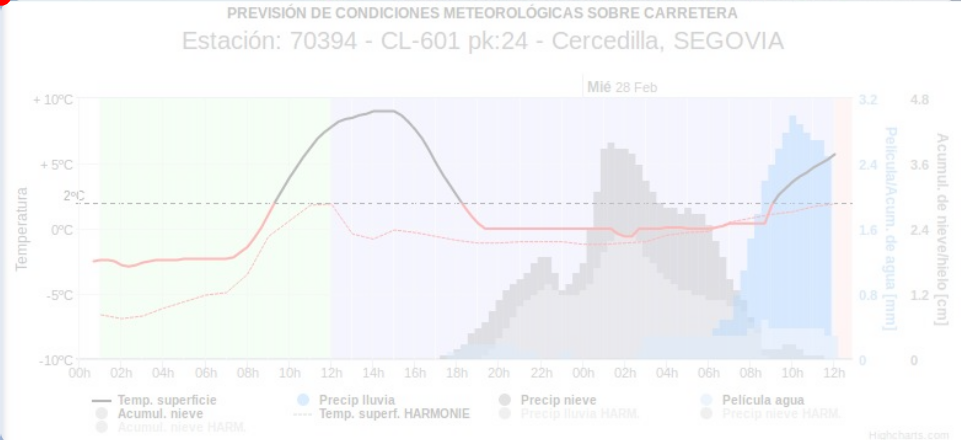
Frío



Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-





# Time evolution chart

Meteovías  
Vigilancia Inversal del Asfalto en Superficie

For each point selected on map, it shows time evolution of:

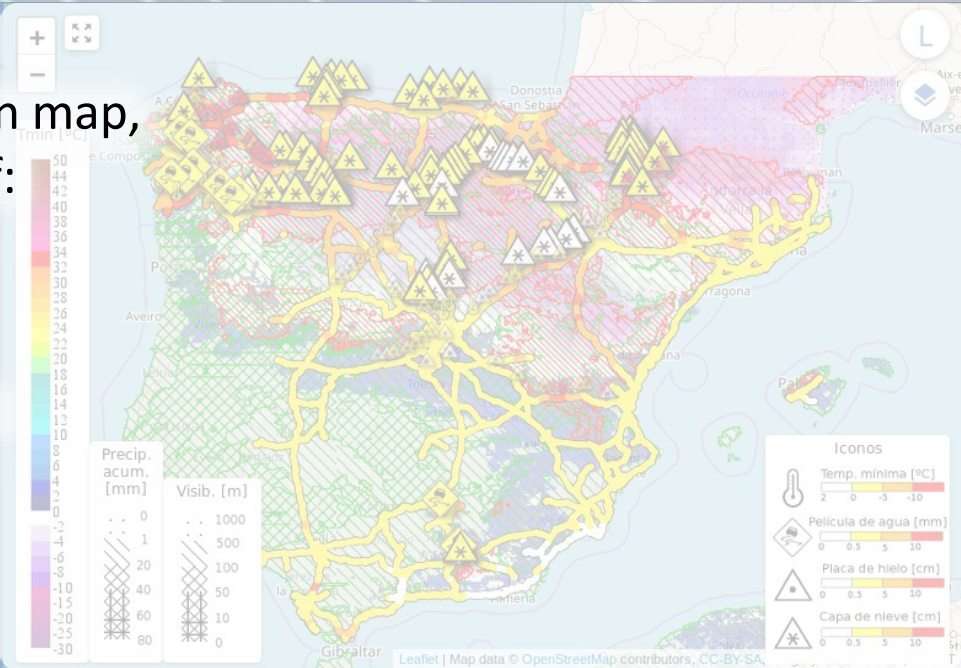
- Surface temperature
- Water film thickness
- Accumulation of snow
- 1 hour snow precipitation
- 1 hour rain precipitation

Agua

Película de agua > 0.5 mm

Acum. de nieve > 0.1 cm

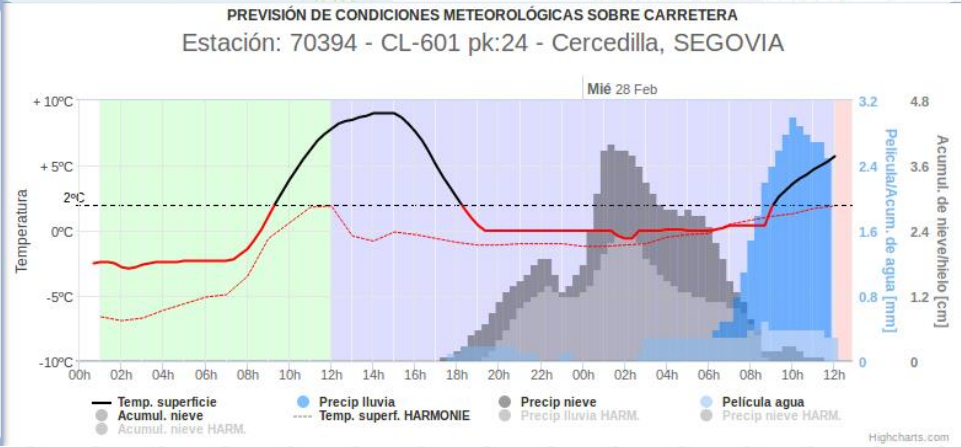
Frío



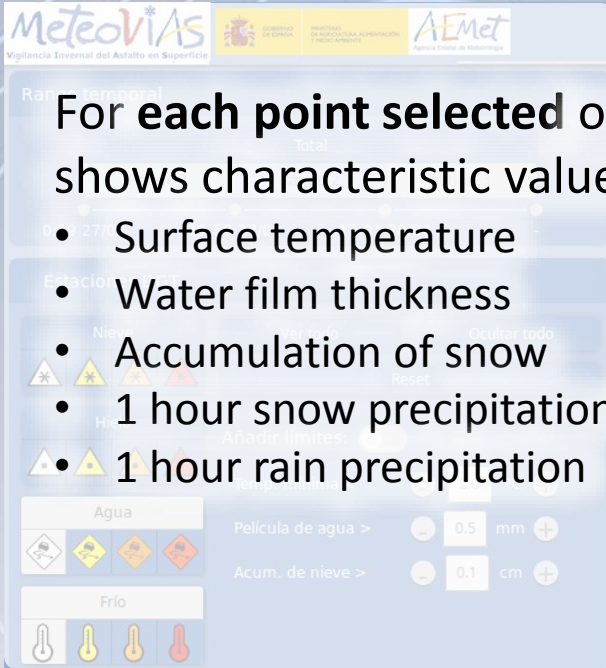
Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-

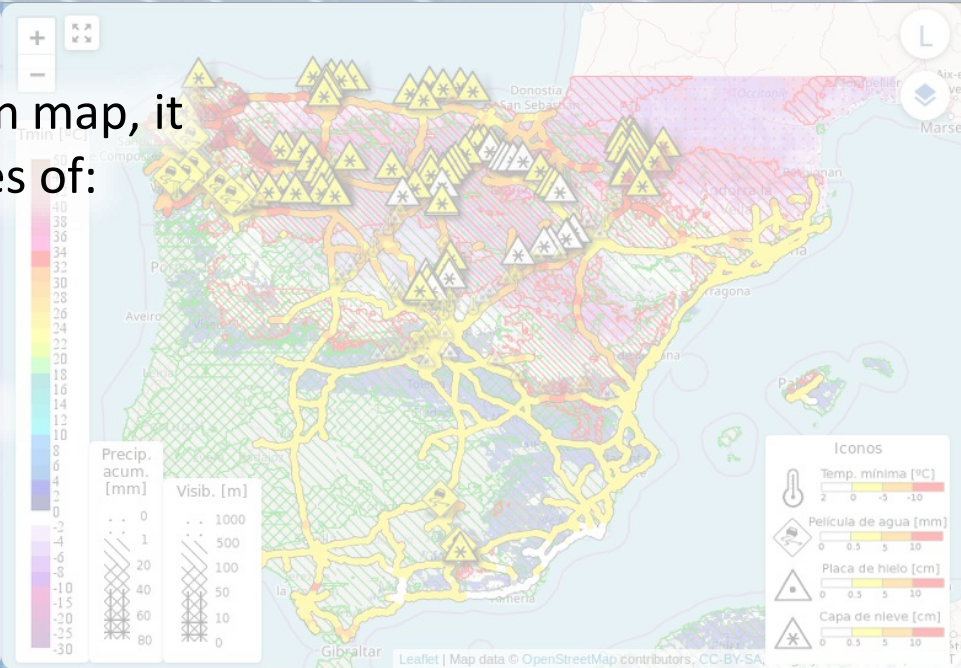


# Summary table



For each point selected on map, it shows characteristic values of:

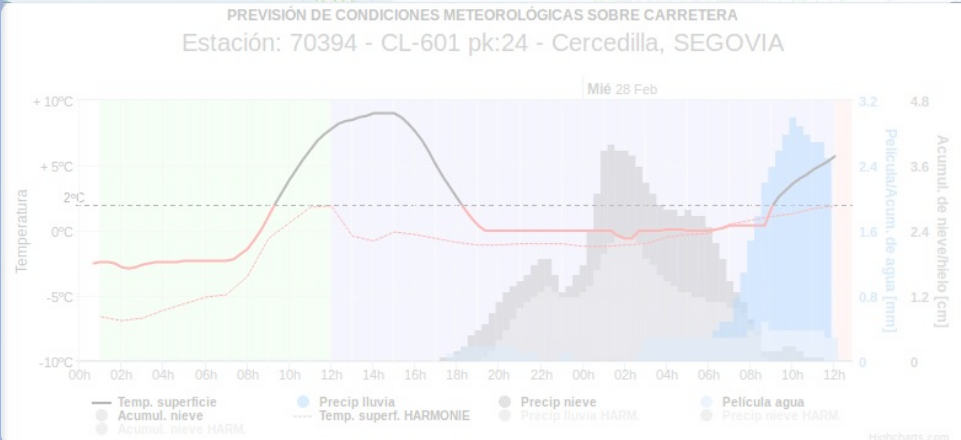
- Surface temperature
- Water film thickness
- Accumulation of snow
- 1 hour snow precipitation
- 1 hour rain precipitation



Previsión en carretera para la estación

Estación: 70394 - CL-601 pk:24 - Cercedilla, SEGOVIA

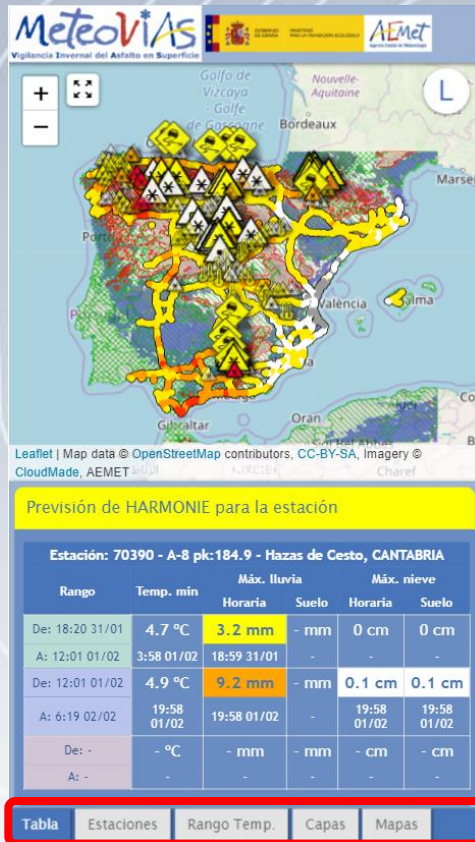
Rango	Temp. min	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 0:59 27/02	-2.8 °C	0 mm	0 mm	0 cm	0 cm
A: 11:58 27/02	2:20 27/02	-	-	-	-
De: 11:58 27/02	-0.6 °C	2.6 mm	0.5 mm	1.9 cm	2.3 cm
A: 12:01 28/02	2:20 28/02	9:59 28/02	8:40 28/02	0:59 28/02	1:59 28/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-





# Responsive Web design

Same features, different structure when accessing from smartphone



Previsión de HARMONIE para la estación

Estación: 70390 - A-8 pk:184.9 - Hazas de Cesto, CANTABRIA

Rango	Temp. mín	Máx. lluvia		Máx. nieve	
		Horaria	Suelo	Horaria	Suelo
De: 18:20 31/01	4.7 °C	3.2 mm	- mm	0 cm	0 cm
A: 12:01 01/02	3:58 01/02	18:59 31/01	-	-	-
De: 12:01 01/02	4.9 °C	9.2 mm	- mm	0.1 cm	0.1 cm
A: 6:19 02/02	19:58 01/02	19:58 01/02	-	19:58 01/02	19:58 01/02
De: -	- °C	- mm	- mm	- cm	- cm
A: -	-	-	-	-	-

Tabla Estaciones Rango Temp. Capas Mapas



Option selector



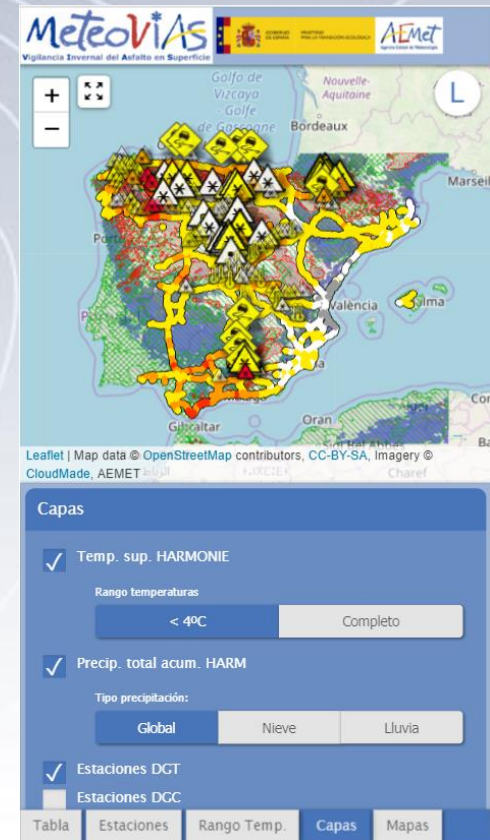
Estaciones DGT

Nieve

Hielo

Agua

Tabla Estaciones Rango Temp. Capas Mapas



Capas

Temp. sup. HARMONIE

Rango temperaturas: < 4°C Completo

Precip. total acum. HARM

Tipo precipitación: Global Nieve Lluvia

Estaciones DGT

Estaciones DGC

Tabla Estaciones Rango Temp. Capas Mapas

# Future work

- Structure and content **modifications** according to **feedback** from test users.
- Increase number of METRo forecast points, **adding other road weather station networks.**
- **Increase** METRo forecast **updating frequency.**
- Include an **observation verification** system for data from road weather stations



Thank you for your attention