

La predicción meteorológica

Benito Elvira
belviram@aemet.es

La predicción meteorológica

1. Rangos o alcances de la predicción meteorológica

Predicción climática, estacional, mensual, medio plazo, corto plazo, vigilancia

Papel del predictor en cada alcance de predicción

2. Productos disponibles en Aemet para cada rango de predicción

Escenarios meteorológicos

Mapas de anomalías de temperatura y precipitación

Mapas de probabilidad de superación de umbrales

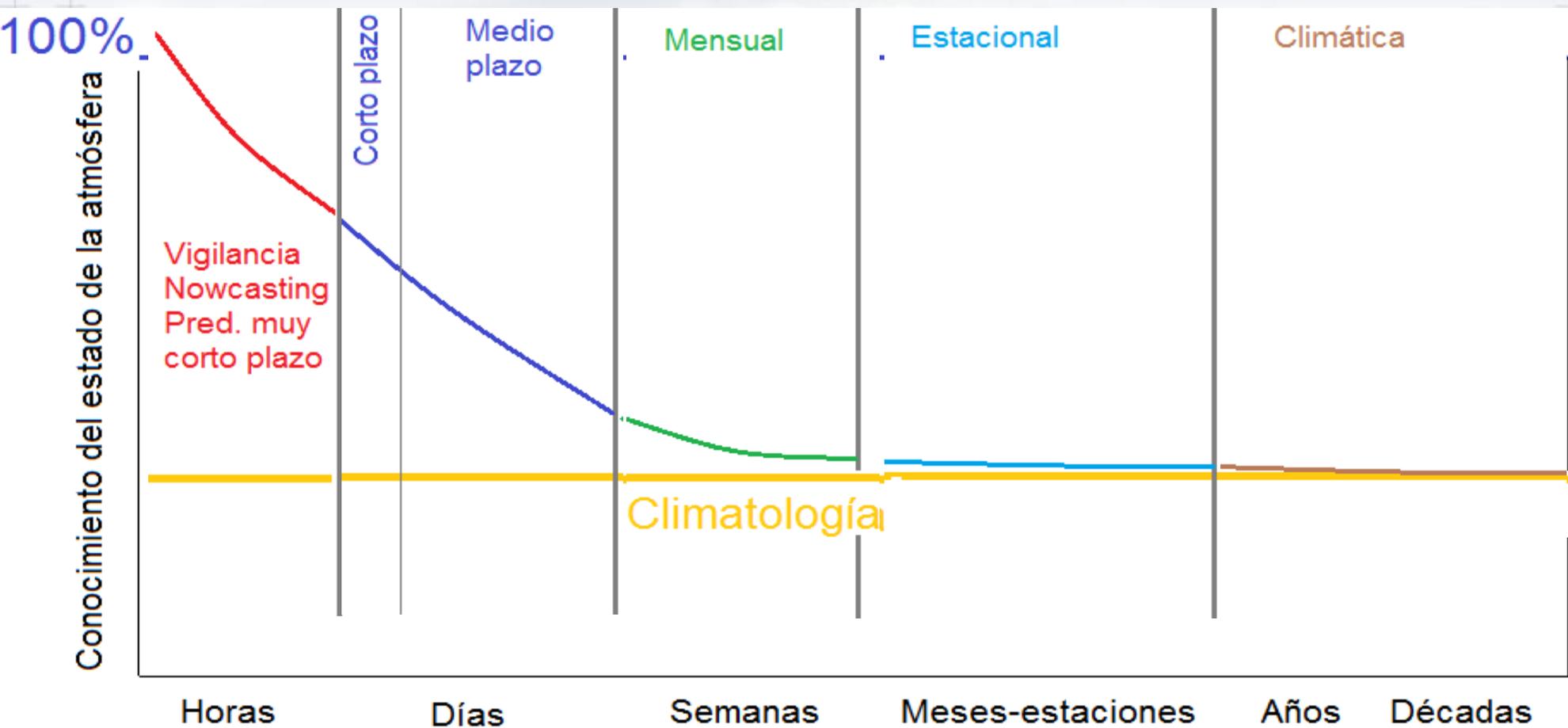
Índice de fenómenos extremos

3. Importancia y ventajas de la predicción probabilística

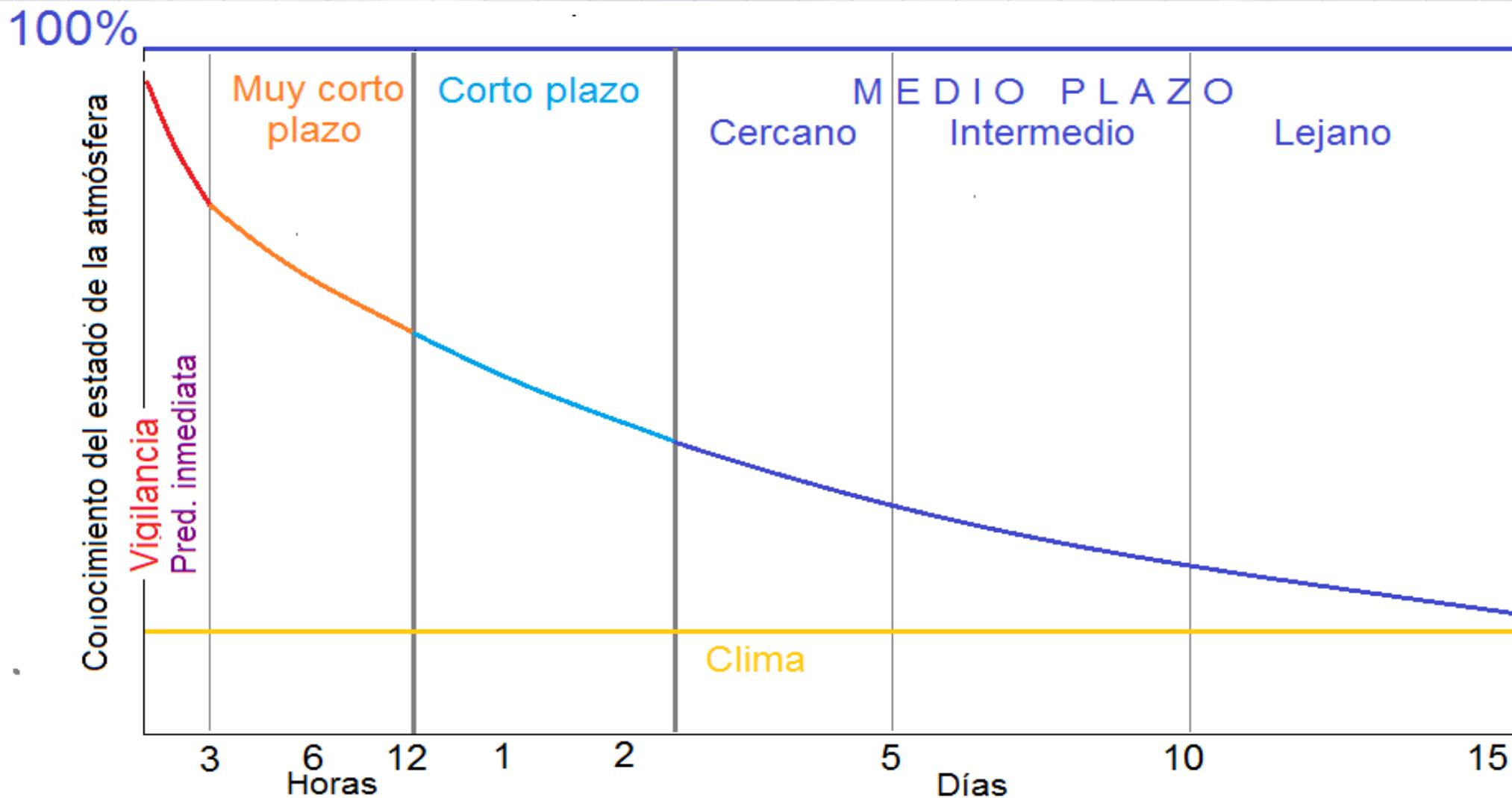
Por qué la predicción probabilística?

Valor económico de una predicción. Aplicación a la viticultura

Rangos de la predicción: horas → décadas

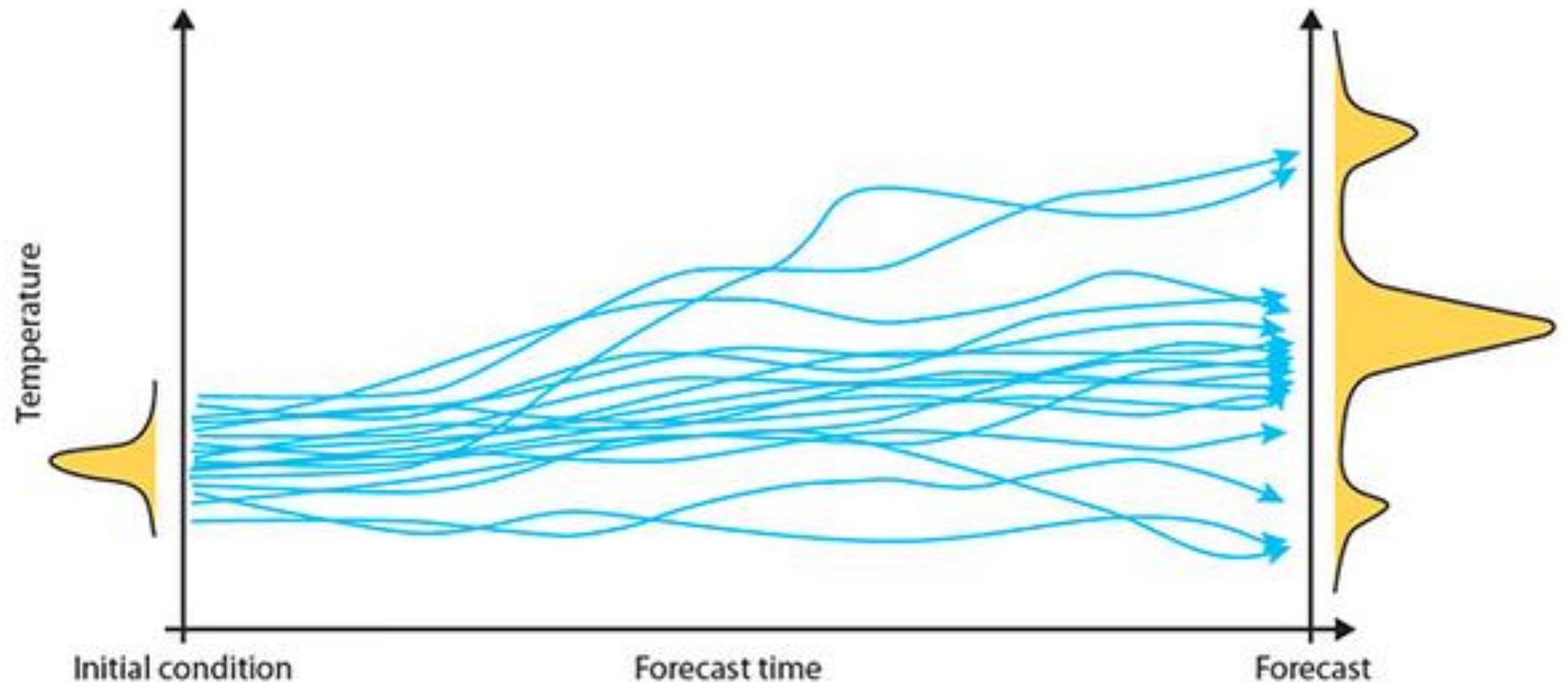


Rangos de la predicción: vigilancia → medio plazo

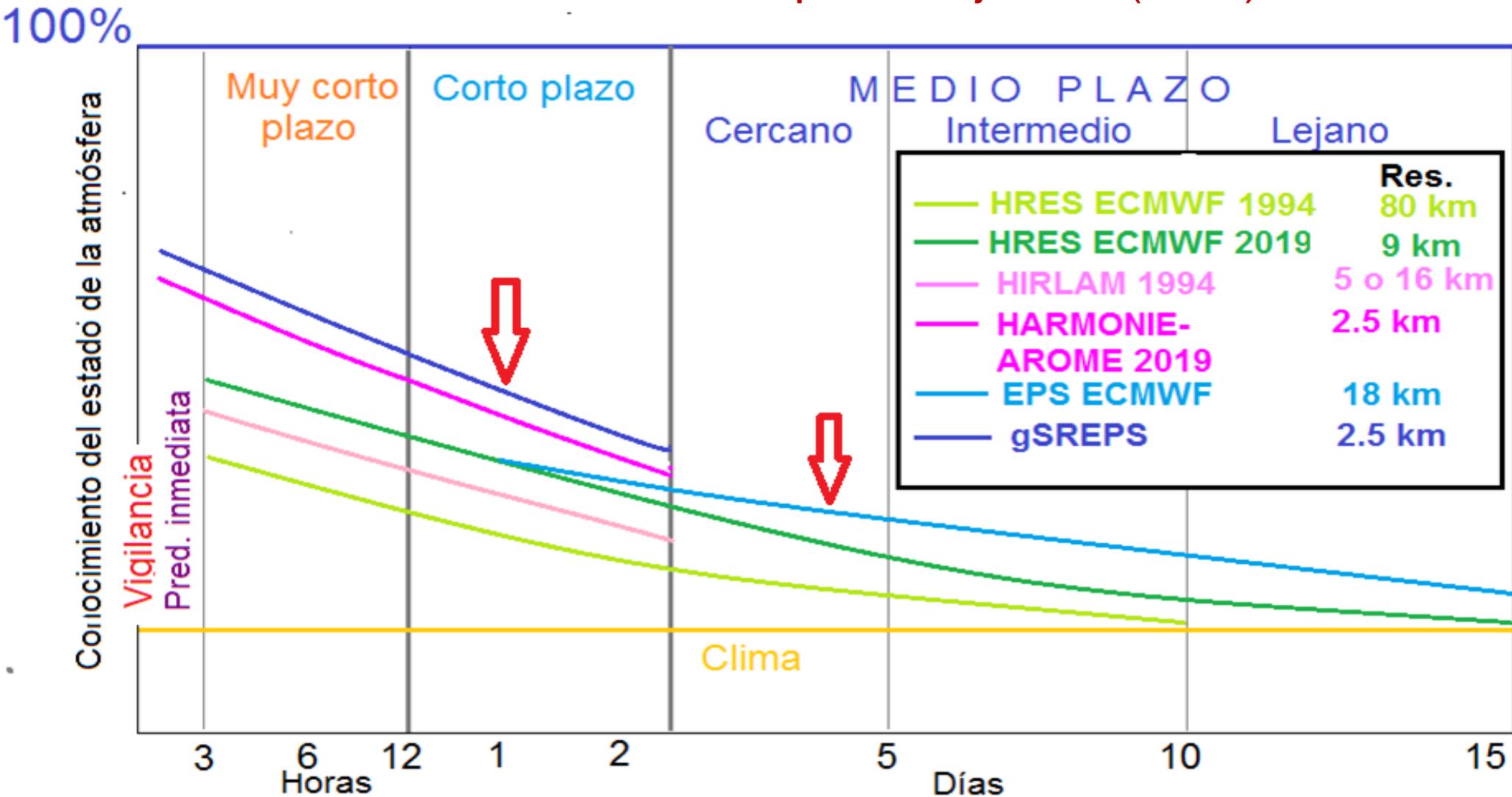


Modelos meteorológicos

Sistemas de Predicción por Conjuntos (EPS).



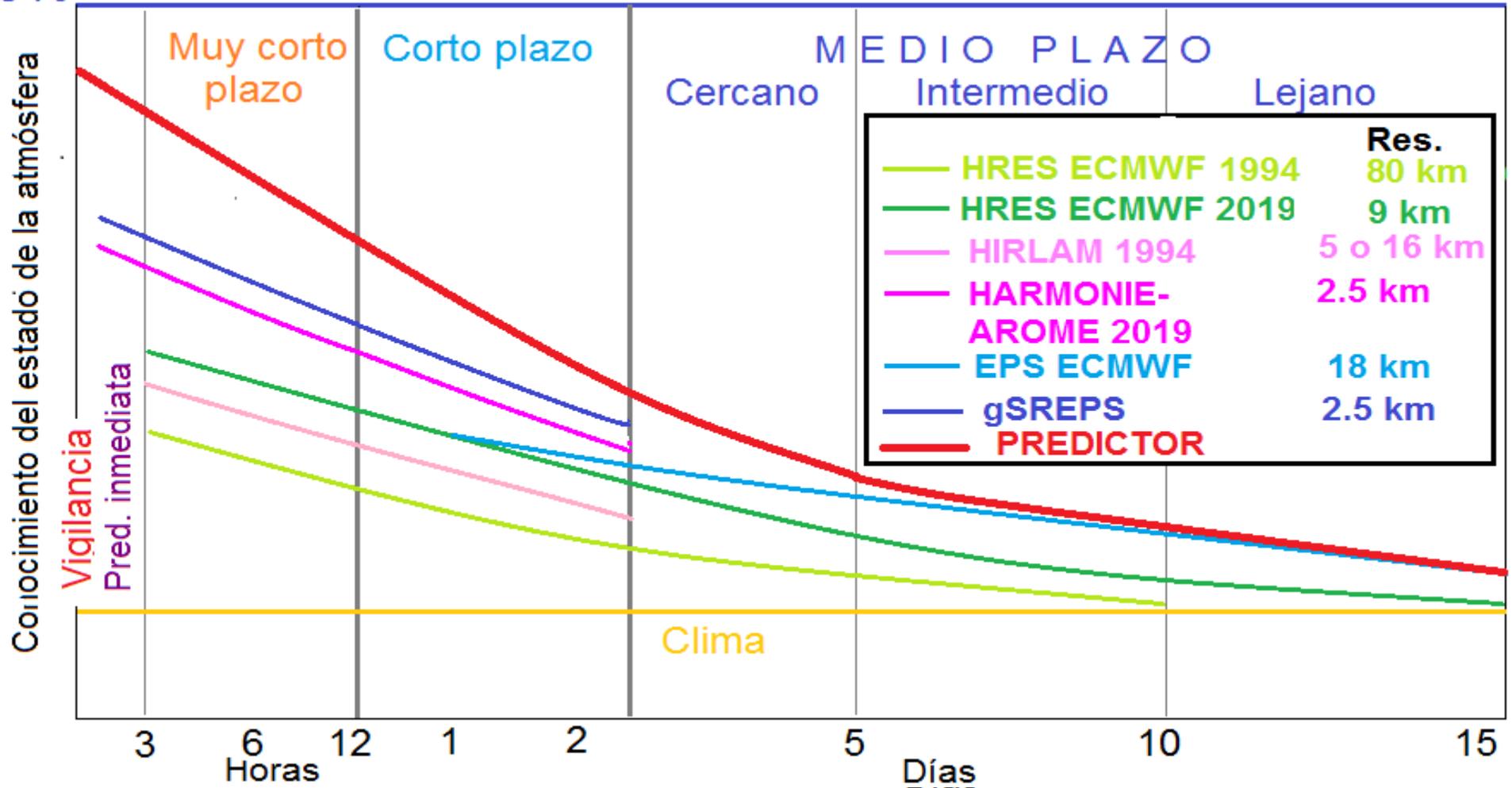
Modelos meteorológicos para cada rango de predicción. Sistemas de Predicción por Conjuntos (EPS).



Papel del predictor en la predicción operativa

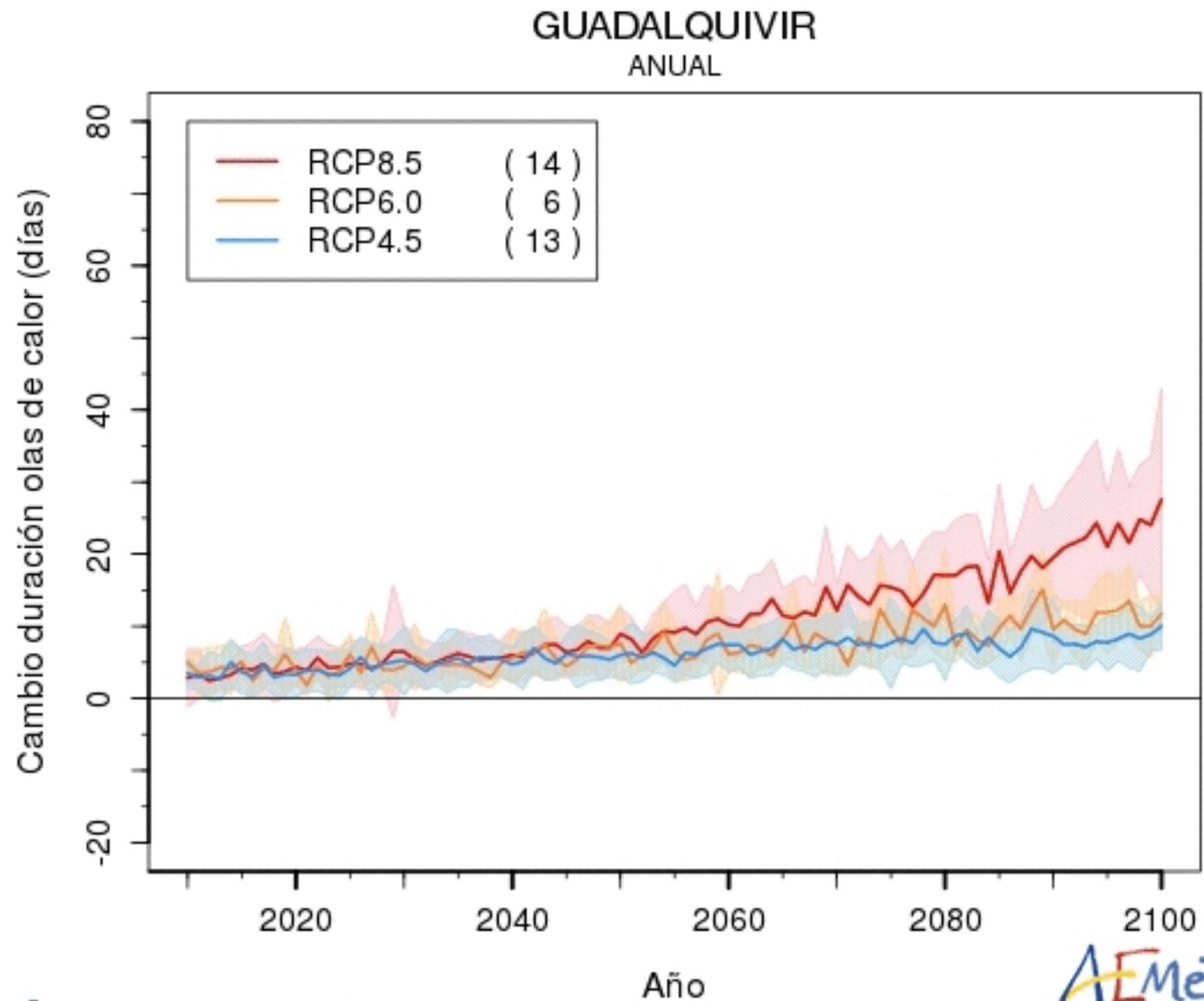
El valor añadido del predictor

100%



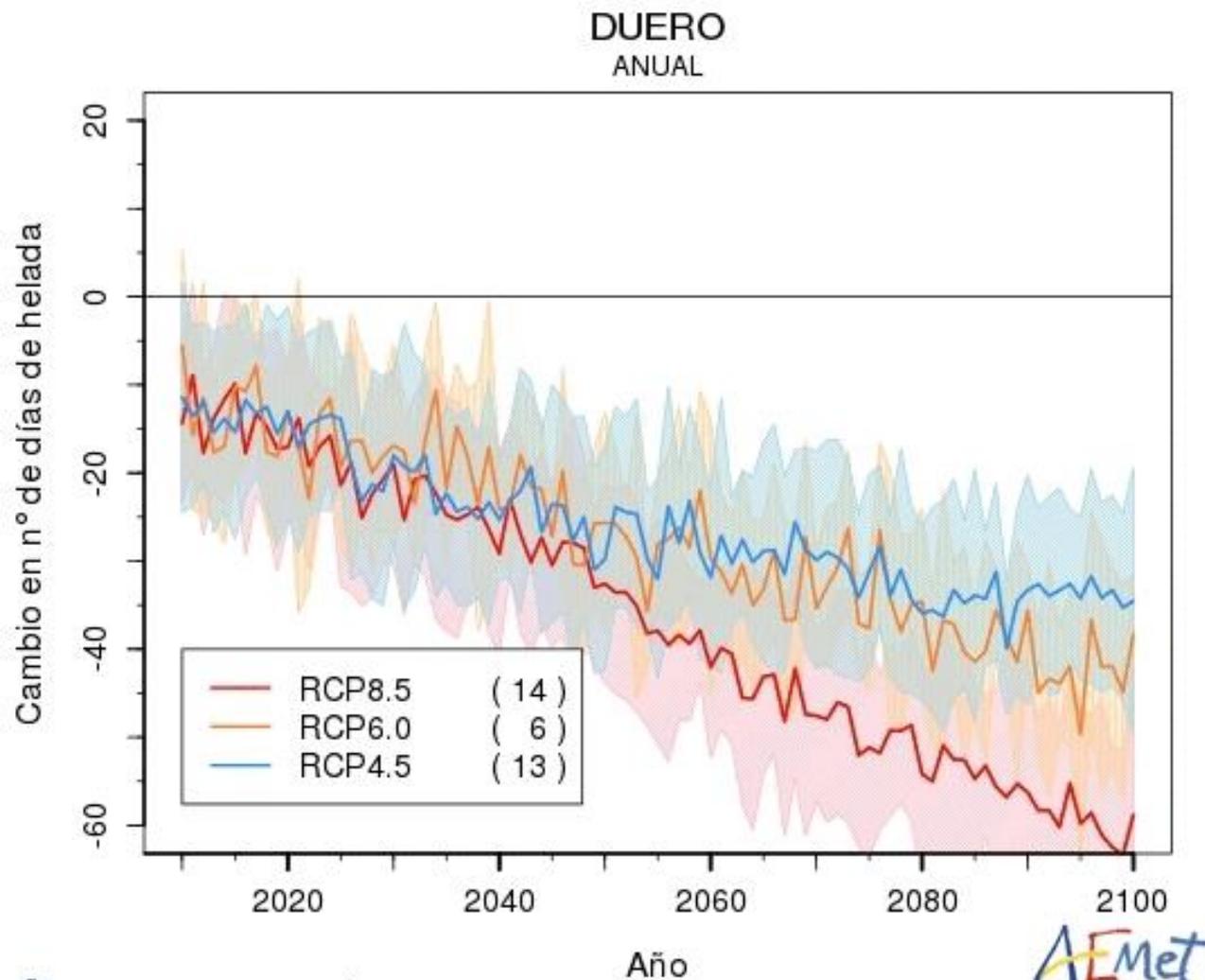
1. Predicción CLIMÁTICA. AEMET. Tmáx: olas de calor

http://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?



1. Predicción CLIMÁTICA. AEMET. Tmín: heladas

http://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?

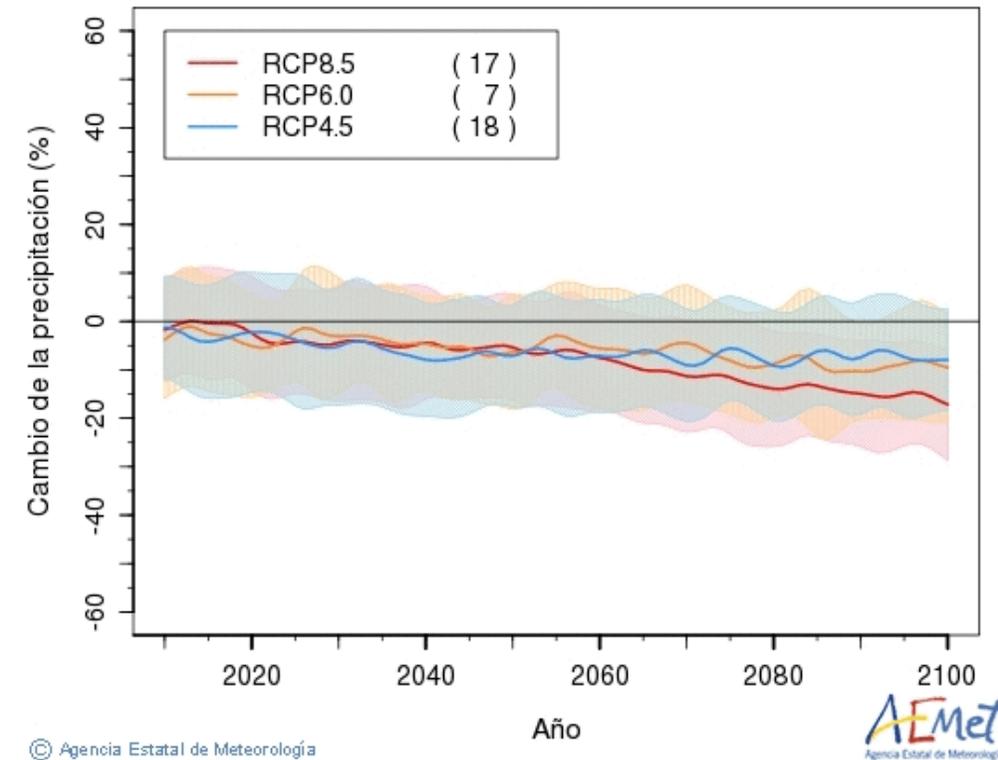


© Agencia Estatal de Meteorología

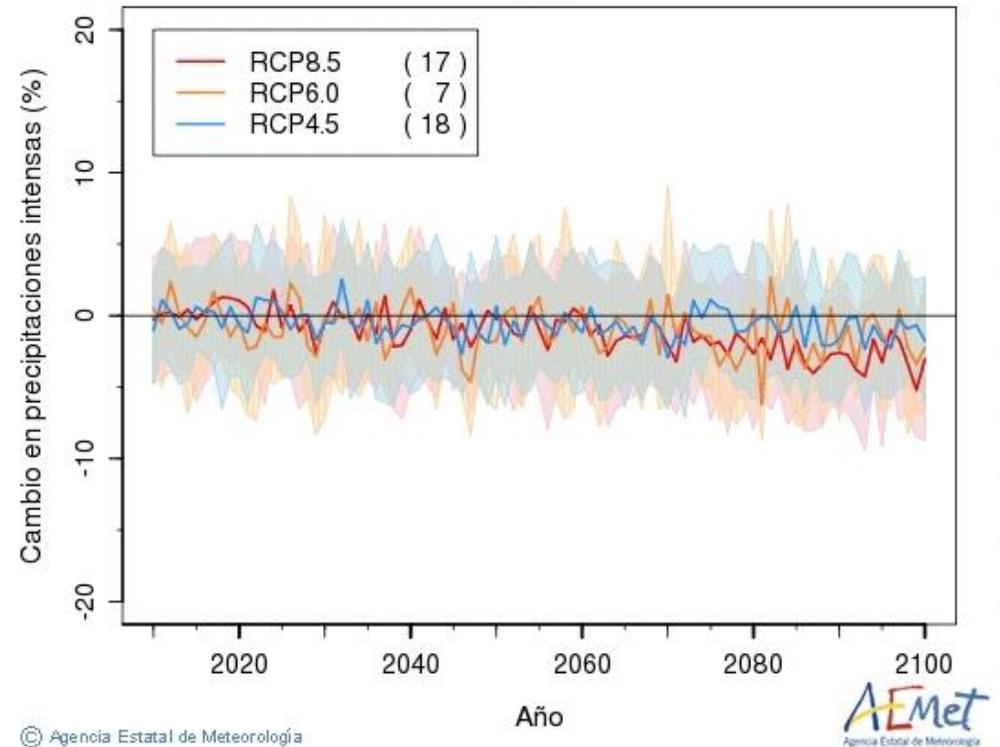
1. Predicción CLIMÁTICA. AEMET. Precipitaciones

http://www.aemet.es/es/serviciosclimaticos/cambio_climat/result_graficos?

COMUNIDAD FORAL DE NAVARRA
ANUAL



COMUNIDAD FORAL DE NAVARRA
ANUAL



2. Predicción ESTACIONAL: Temperatura

ECMWF Seasonal Forecast

Mean 2m temperature anomaly

Forecast start is 01/03/21, climate period is 1993-2016

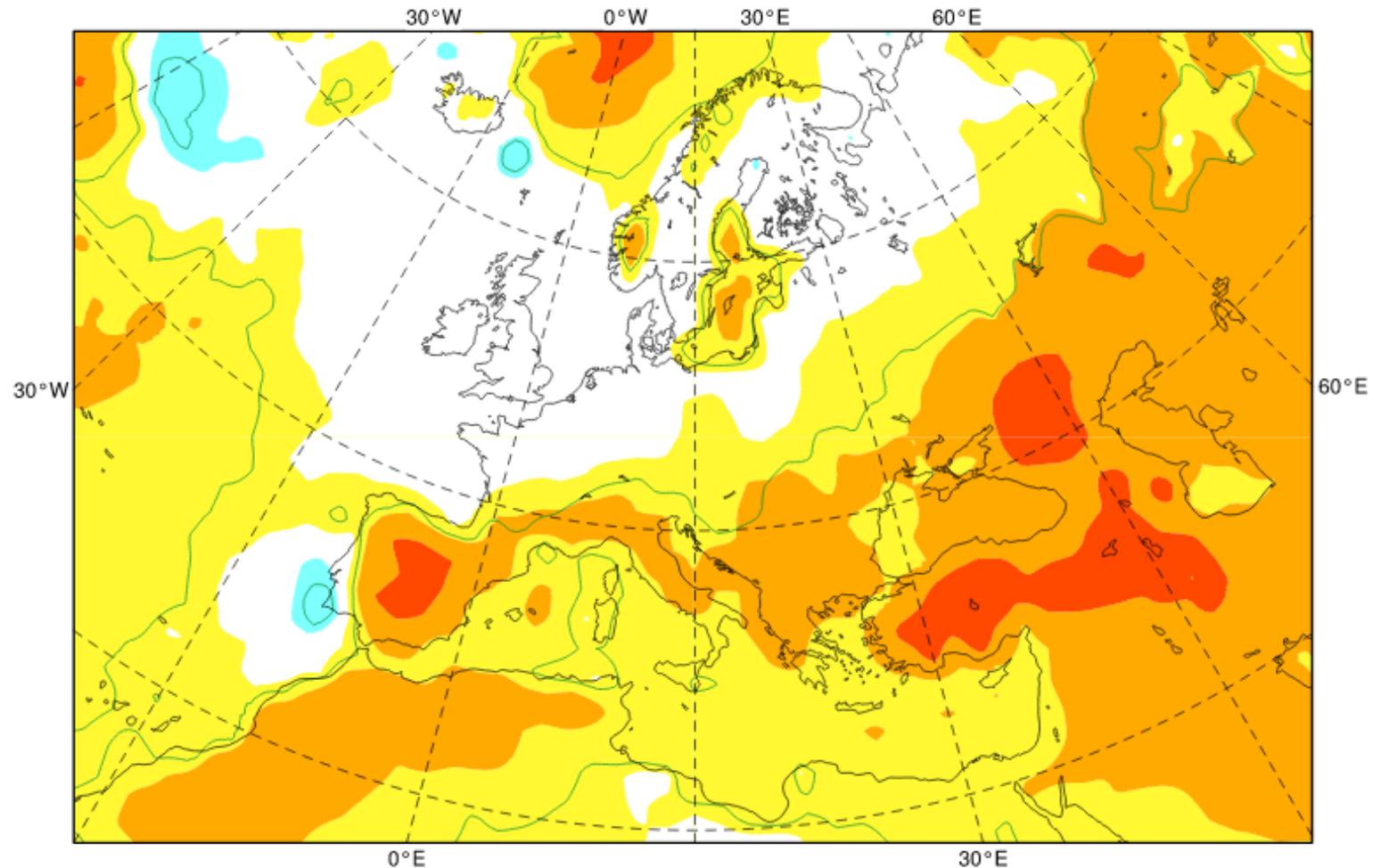
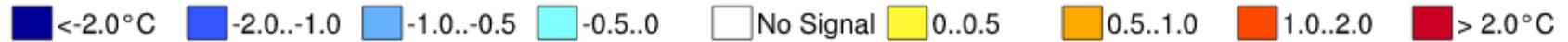
Ensemble size = 51, climate size = 600

System 5

JJA 2021

Shaded areas significant at 10% level

Solid contour at 1% level



2. Predicción ESTACIONAL: Precipitación

ECMWF Seasonal Forecast

Mean precipitation anomaly

Forecast start is 01/03/21, climate period is 1993-2016

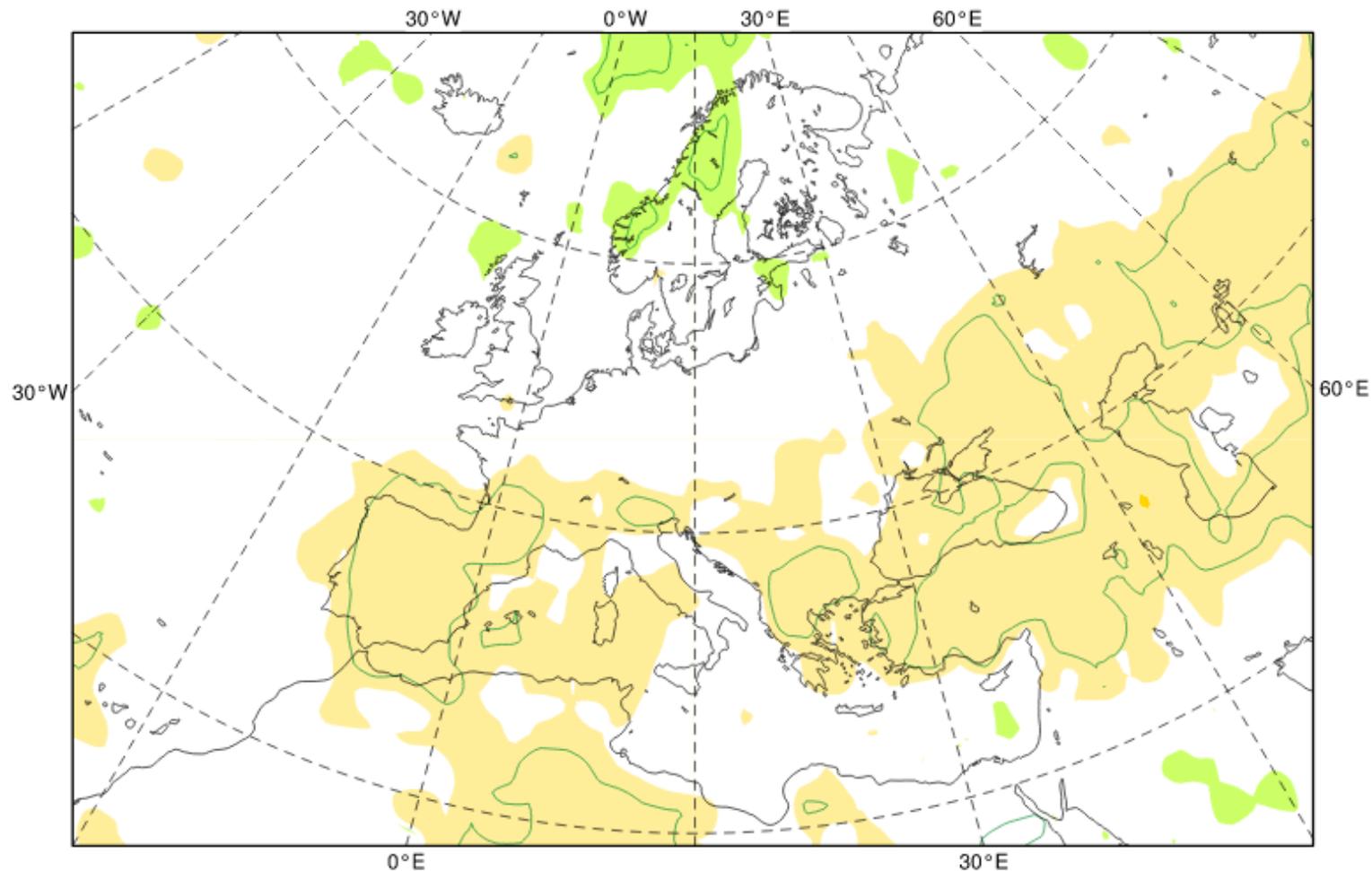
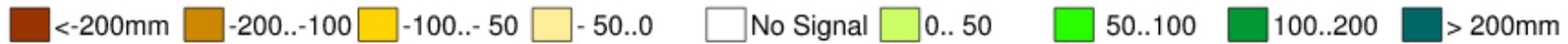
Ensemble size = 51, climate size = 600

System 5

JJA 2021

Shaded areas significant at 10% level

Solid contour at 1% level



2. Predicción ESTACIONAL: Precipitación

ECMWF Seasonal Forecast

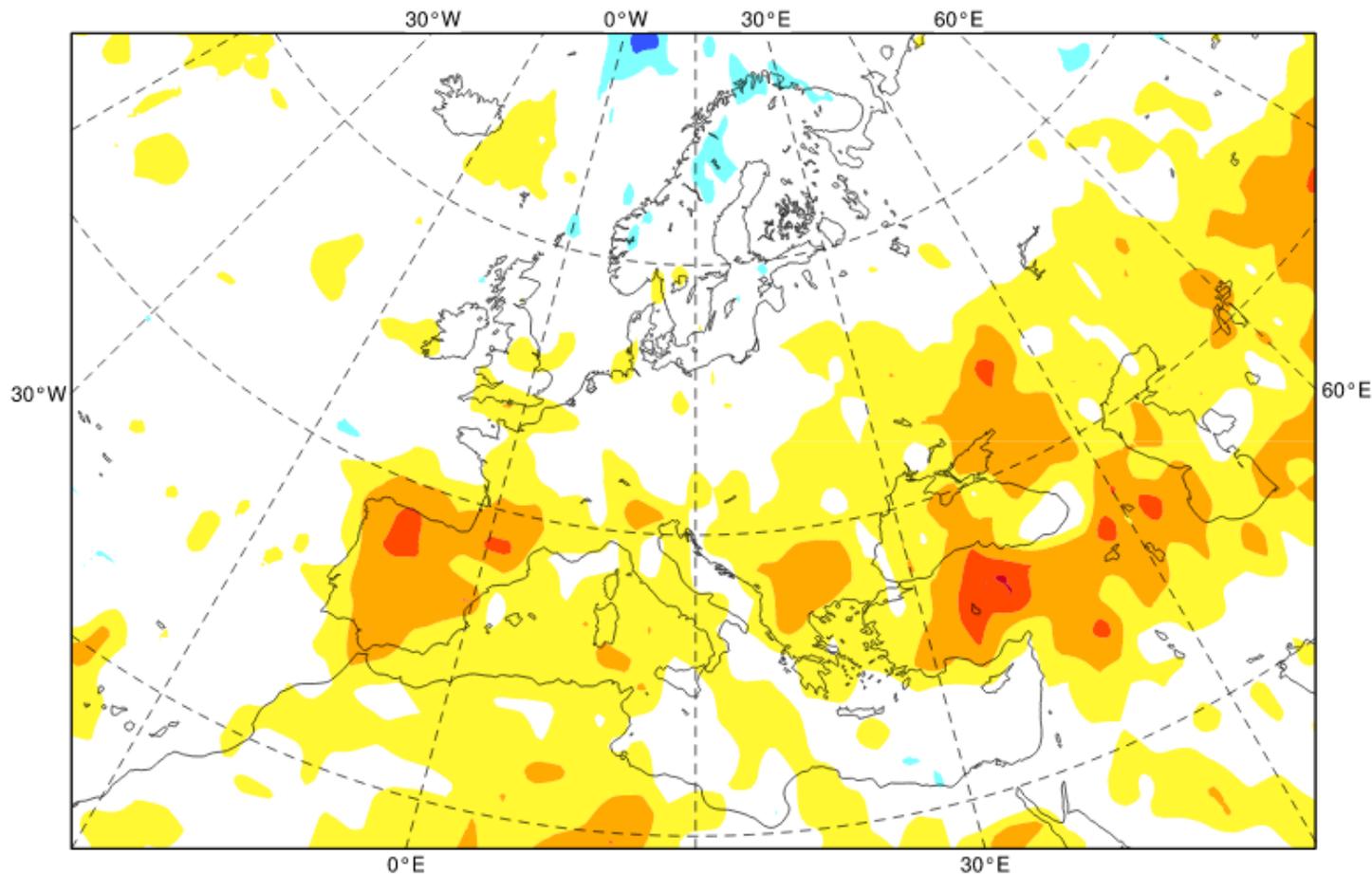
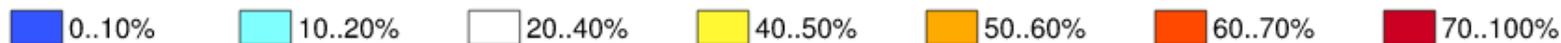
Prob(precipitation < lower tercile)

Forecast start is 01/03/21, climate period is 1993-2016

Ensemble size = 51, climate size = 600

System 5

JJA 2021

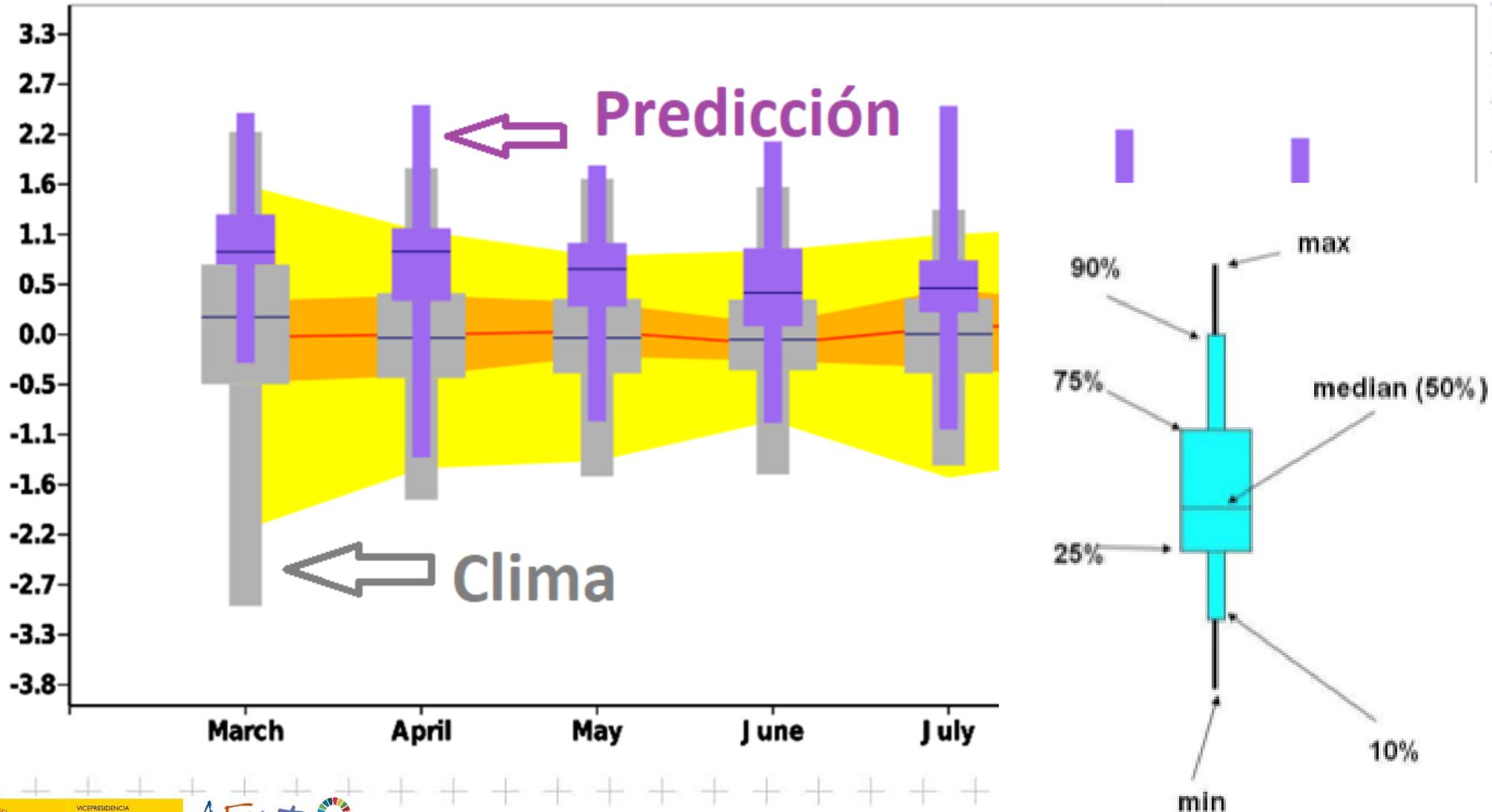


2. Predicción ESTACIONAL: Temperatura. Sur de Europa

2m temp. anomalies (K) latitude= 50.0 to 35.0 longitude= -10.0 to 30.0

Forecast initial date: 20210301

Ensemble size: Forecast=51 Model climate=600 Analysis climate=24 Climate period: 1993-2016



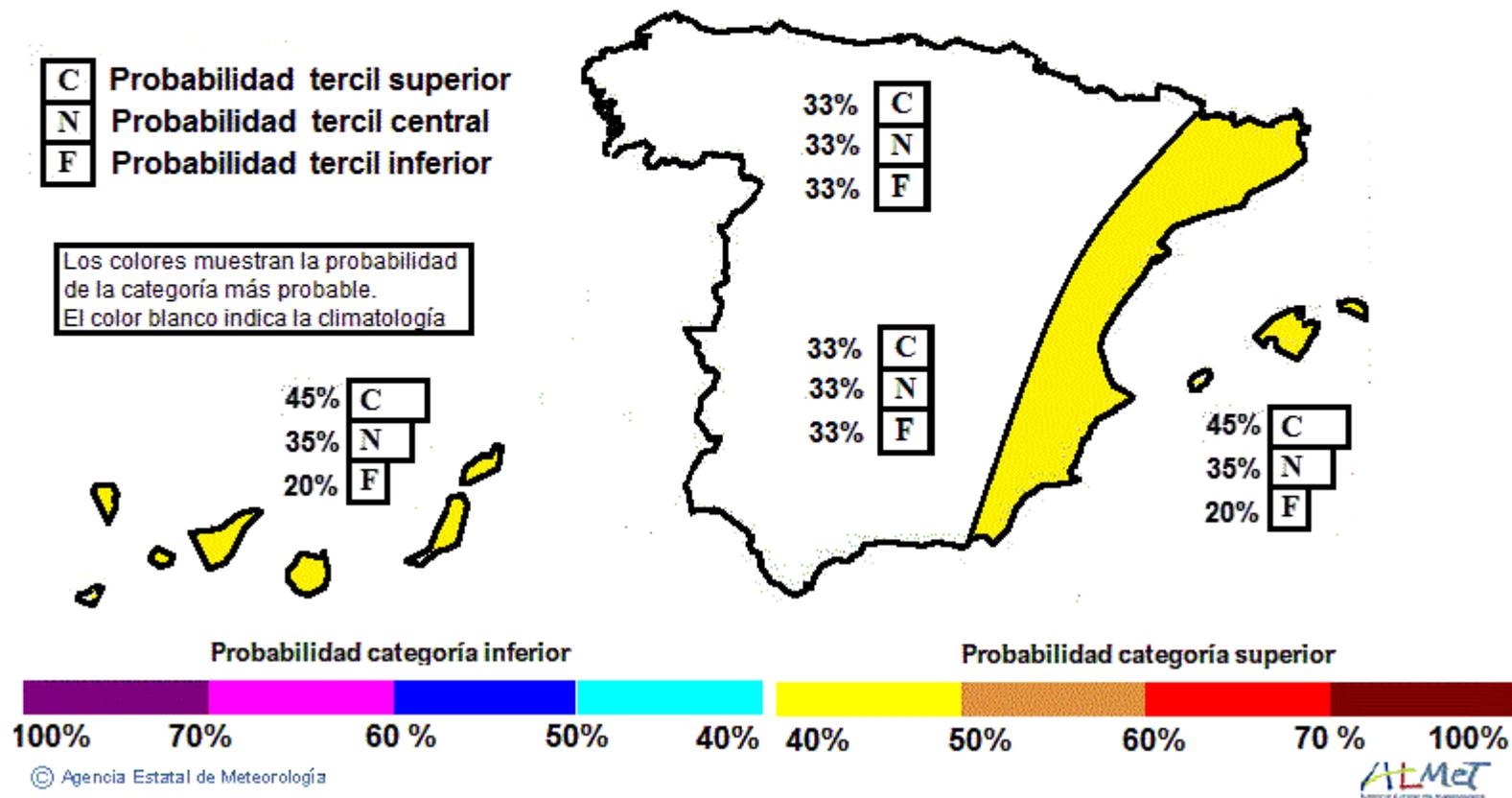
2. Predicción ESTACIONAL. AEMET

http://www.aemet.es/es/serviciosclimaticos/prediccion_estacional

TEMPERATURA

Para MARZO-ABRIL-MAYO de 2021 hay una mayor probabilidad de que la temperatura se encuentre en el tercil superior en la vertiente mediterránea, Canarias y Baleares. En el resto de España la probabilidad de los terciles es la climatológica (periodo de referencia 1981-2010).

PROBABILIDAD DE LA CATEGORÍA MÁS PROBABLE DE TEMPERATURA MARZO - ABRIL - MAYO 2021



Probabilidad de la categoría más probable de temperatura

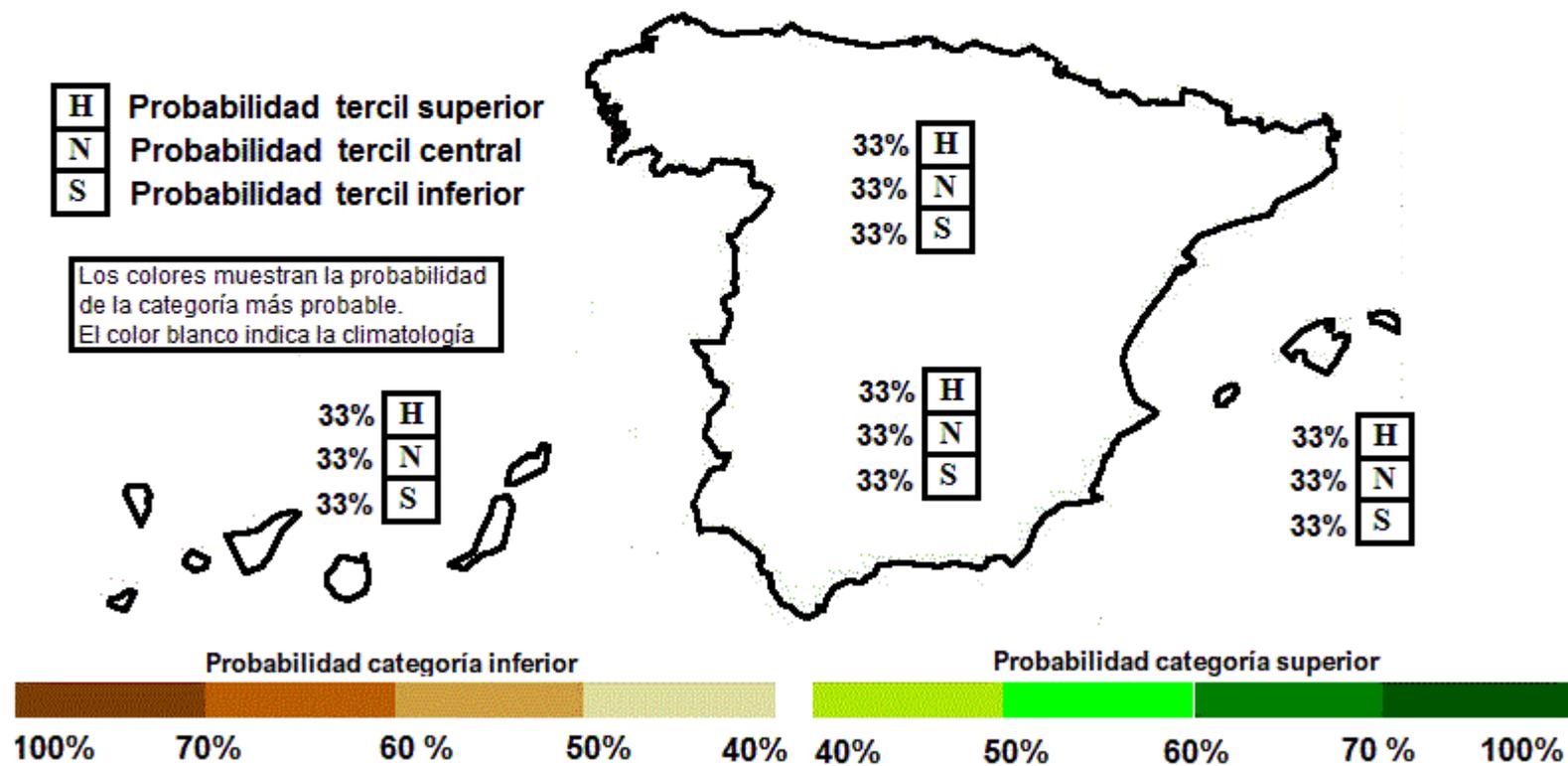
2. Predicción ESTACIONAL. AEMET

http://www.aemet.es/es/serviciosclimaticos/prediccion_estacional

PRECIPITACIÓN

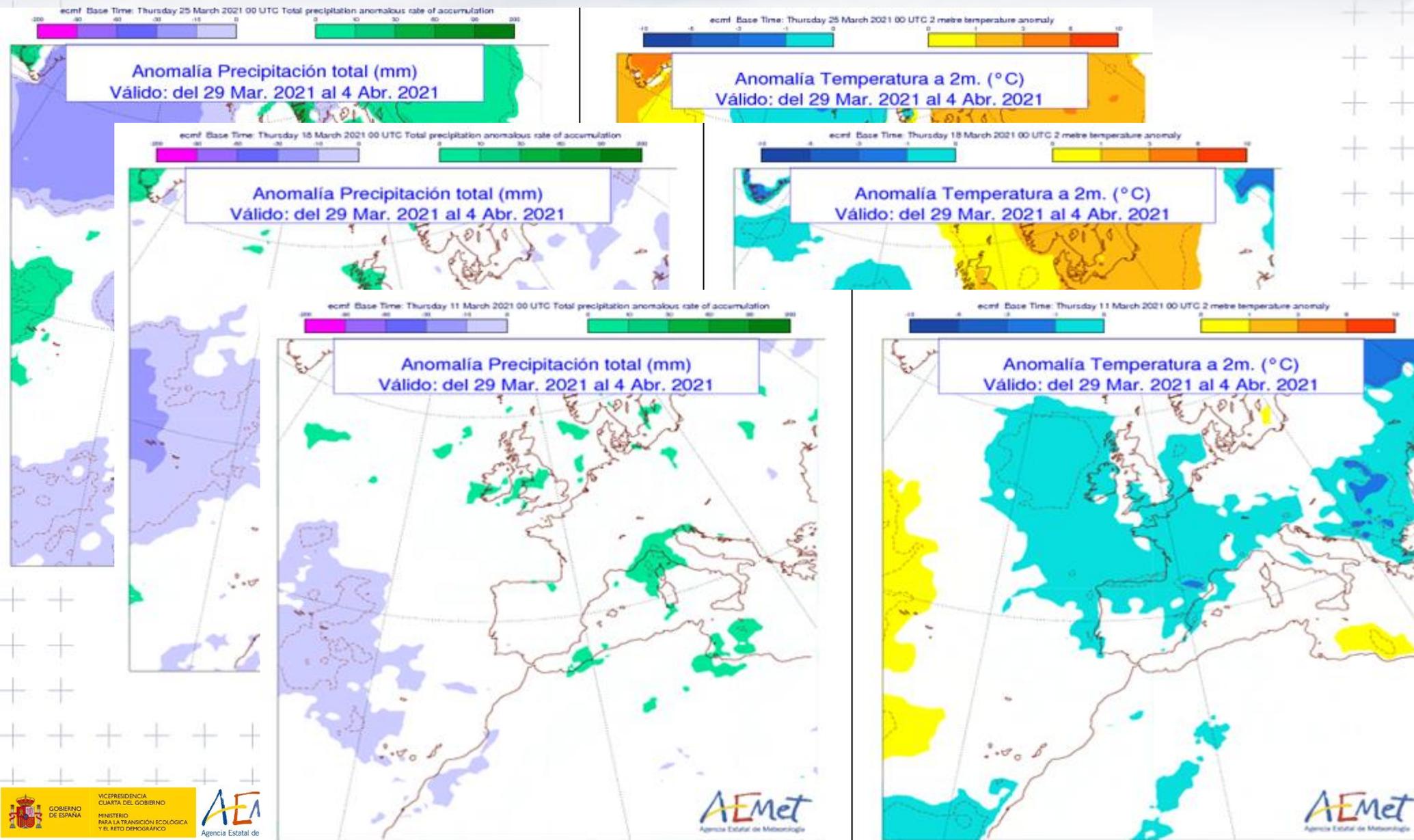
Para MARZO-ABRIL-MAYO de 2021 la probabilidad de los terciles es la climatológica en toda España (periodo de referencia 1981-2010).

PROBABILIDAD DE LA CATEGORÍA MÁS PROBABLE DE PRECIPITACIÓN MARZO - ABRIL - MAYO 2021



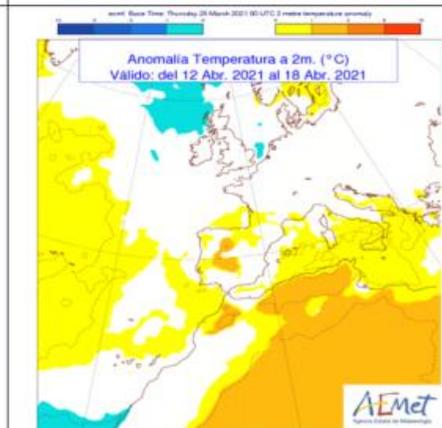
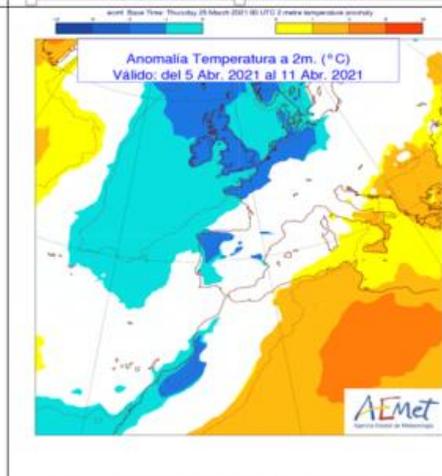
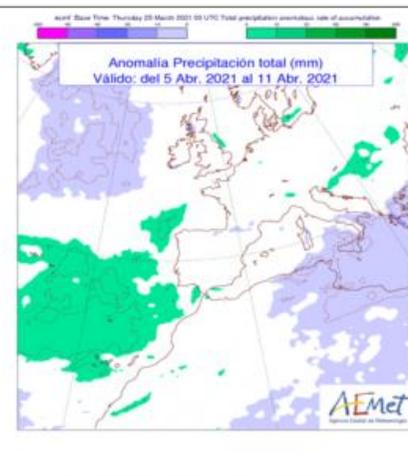
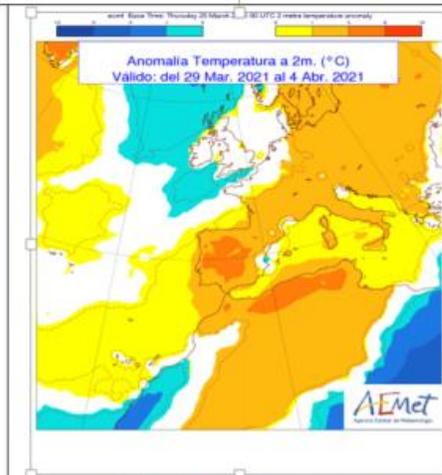
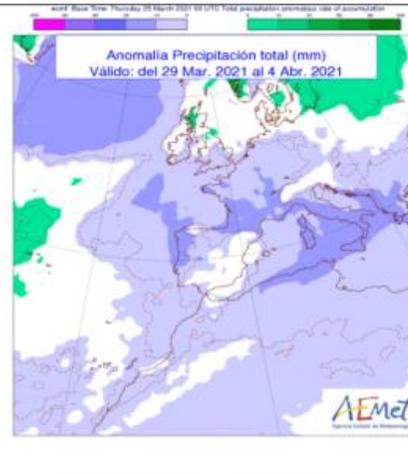
3. Predicción MENSUAL

http://www.aemet.es/documentos_d/enportada/20210326080702_p54tesp1.pdf



3. Predicción MENSUAL

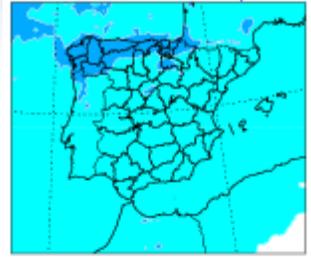
http://www.aemet.es/documentos_d/enportada/20210326080702_p54tesp1.pdf



4. Predicción de MEDIO PLAZO. Escenarios. D+14

H + 348 (Lunes)

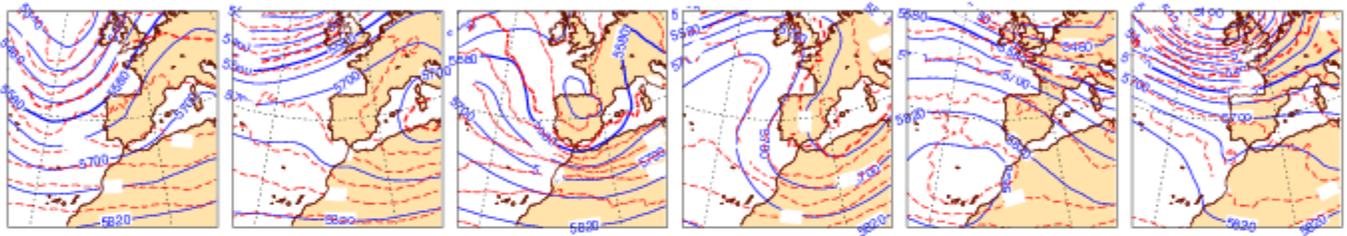
as: 10, 40, 70, 90%)



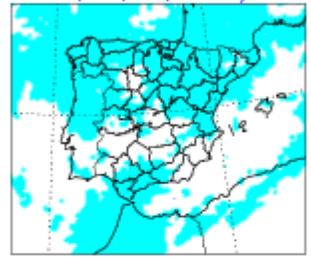
GRUPOS (Z-500) / 15 Mar. 00 UTC / H + 348 / válido para: 29 Mar. 2021, Lunes, a 12 Z

Grupo 1: 12 m.	Grupo 2: 12 m.	Grupo 3: 9 m.	Grupo 4: 8 m.	Grupo 5: 5 m.	Grupo 6: 5 m.
15, 46, 16, 8, 24, 7, 48, 21, 19, 43, 42, 4,	17, 37, 1, 38, 14, 33, 35, 45, 9, 32, 31, 41,	13, 18, 0, 34, 28, 25, 30, 12, 2,	3, 29, 44, 26, 40, 39, 23, 49, 2,	22, 50, 20, 11, 27,	5, 6, 36, 10, 47,
Control					

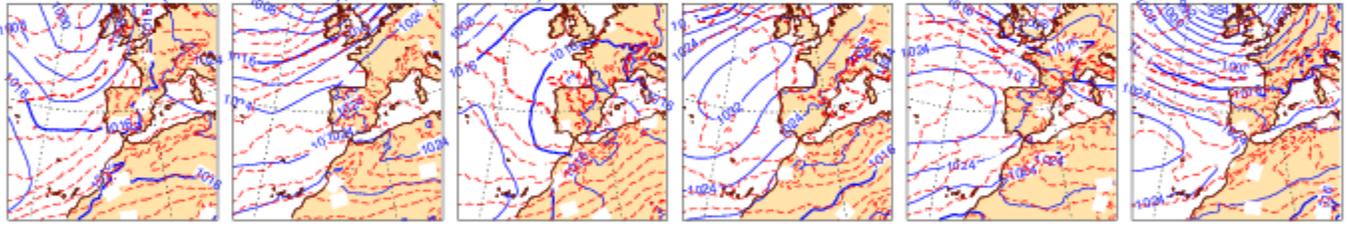
500 hPa: Z (5580 +/- 60 m), T (-22 +/- 2 C)



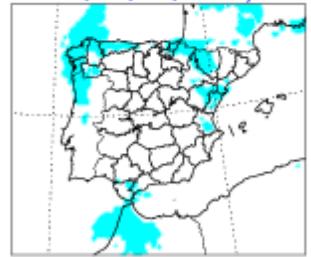
as: 10, 40, 70, 90%)



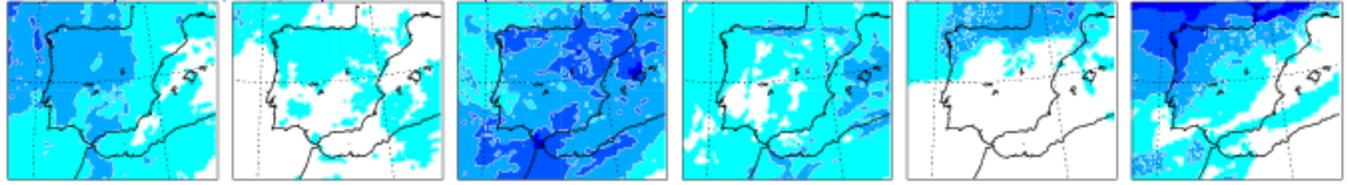
Presión SFC (1016 +/- 4 hPa), T 850 (2 +/- 2 C)



as: 10, 40, 70, 90%)



Prob. de prec. tot. (0-24) superior a 1 mm para cada grupo; (int= 10, 40, 70, 90%)

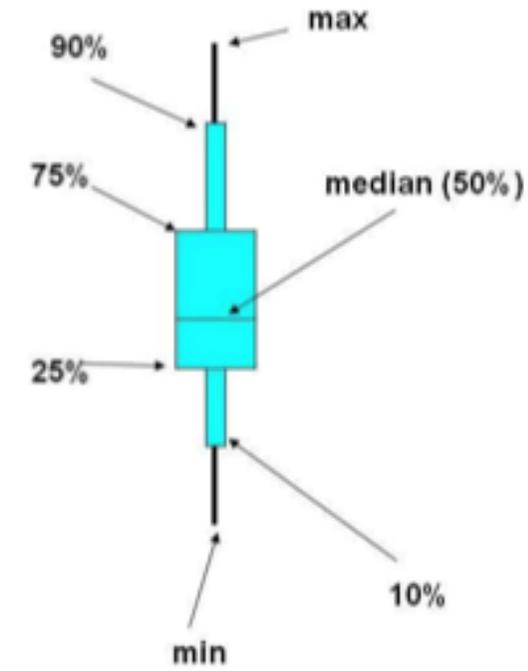
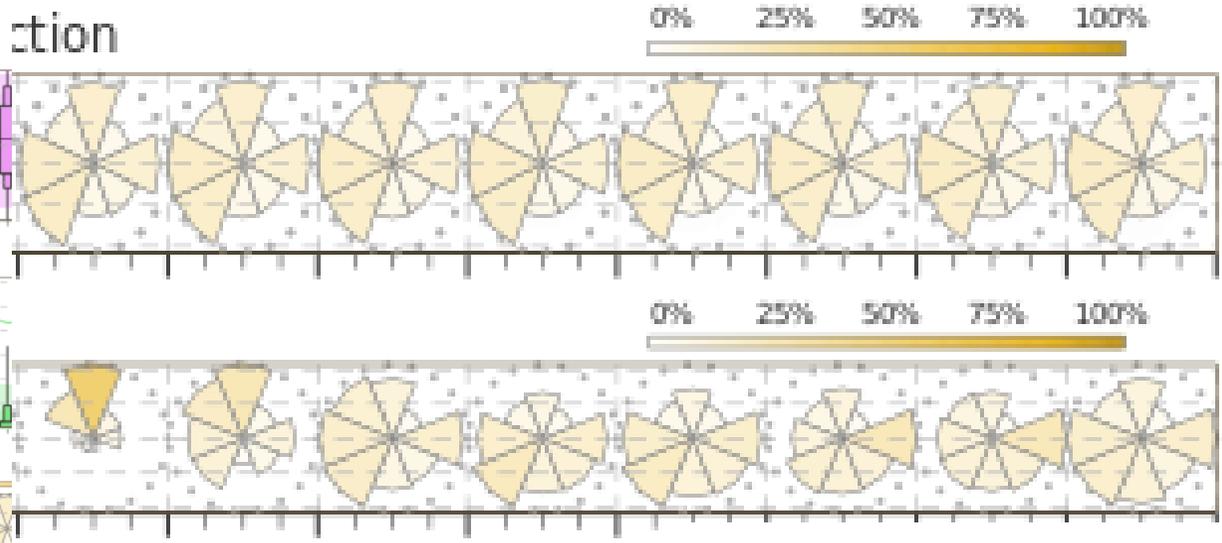
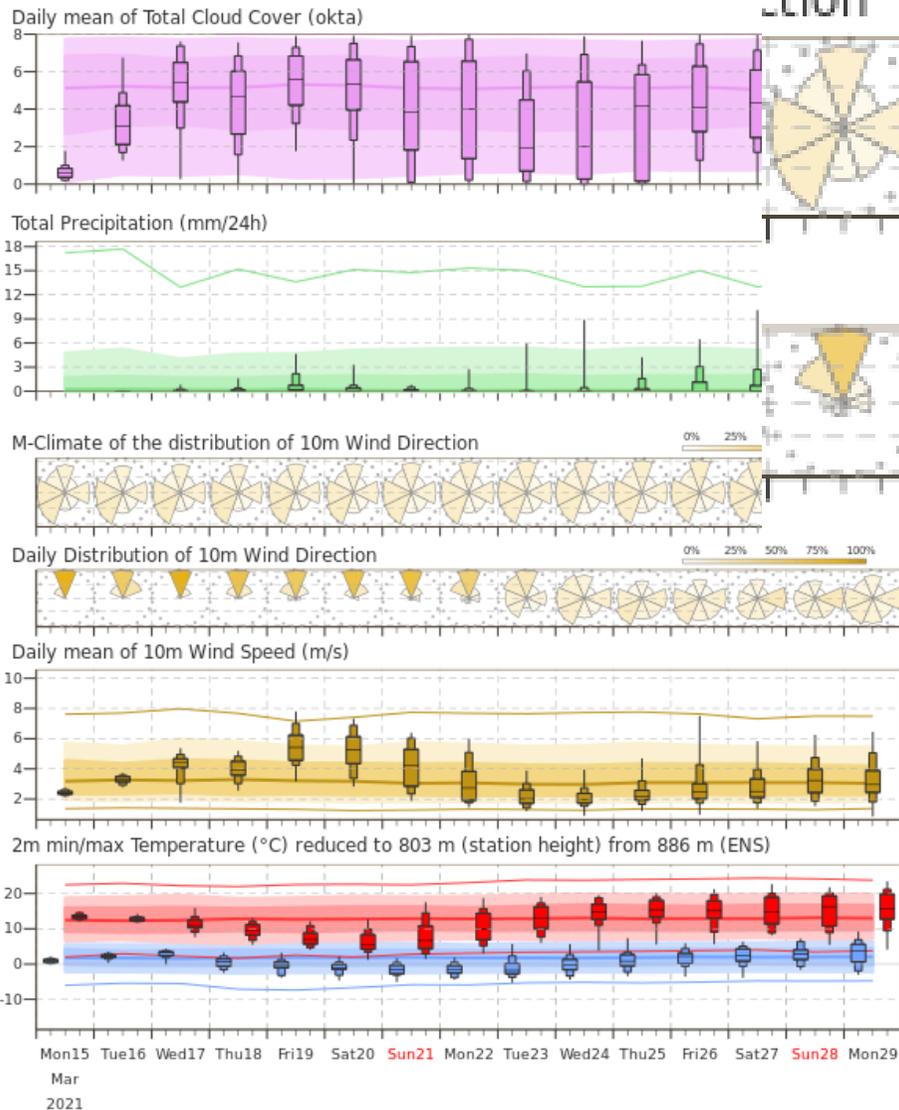


as: 5, 10, 40, 70%)



4. Predicción de MEDIO PLAZO. Meteogramas

Aranda de Duero, Spain 41.68°N 3.62°W (ENS land point) 803 m
 Forecast based on ENS distribution Monday 15 March 2021 00 UTC



M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning a 11 member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data.

ca del Vino. 29/03/2021

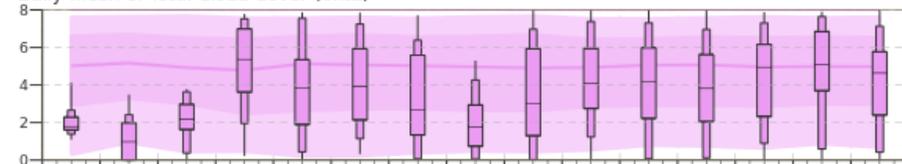
3. Predicción MEDIO PLAZO. I

ENS Meteorogram

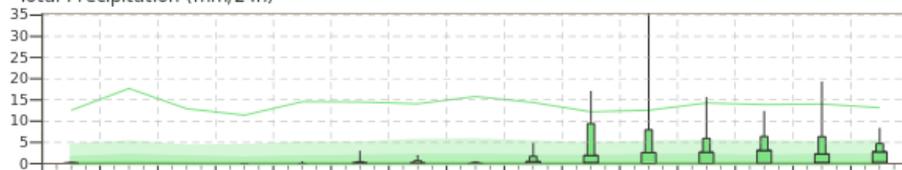
Aranda de Duero, Spain 41.68°N 3.62°W (ENS land point) 803 m

Forecast based on ENS distribution Monday 22 March 2021 00 UTC

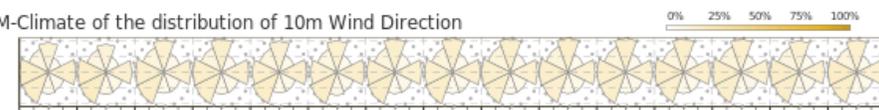
Daily mean of Total Cloud Cover (okta)



Total Precipitation (mm/24h)



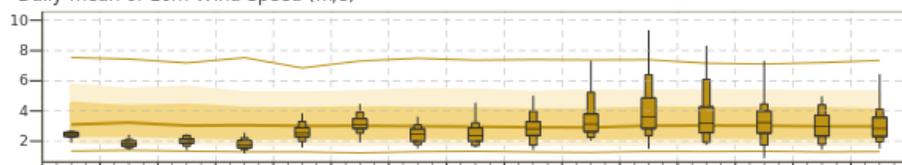
M-Climate of the distribution of 10m Wind Direction



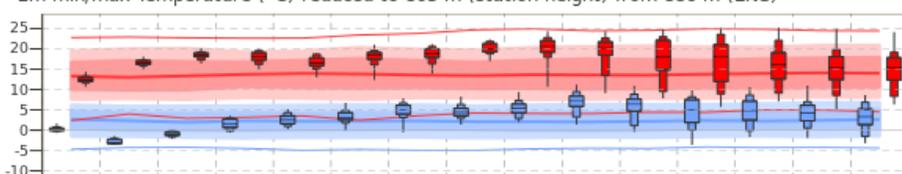
Daily Distribution of 10m Wind Direction



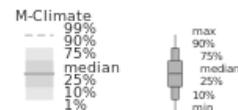
Daily mean of 10m Wind Speed (m/s)



2m min/max Temperature (°C) reduced to 803 m (station height) from 886 m (ENS)



Mon22 Tue23 Wed24 Thu25 Fri26 Sat27 Sun28 Mon29 Tue30 Wed31 Thu 1 Fri 2 Sat 3 Sun 4 Mon 5
Mar Apr 2021



M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning a 11 member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data.

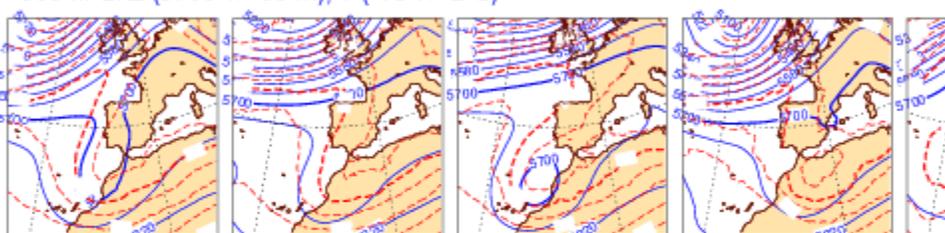
GRUPOS (Z-500) / 22 Mar. 00 UTC / H + 180 / válido para: 29 Mar

Grupo 1: 18 m. Grupo 2: 12 m. Grupo 3: 7 m. Grupo 4: 6 m. G

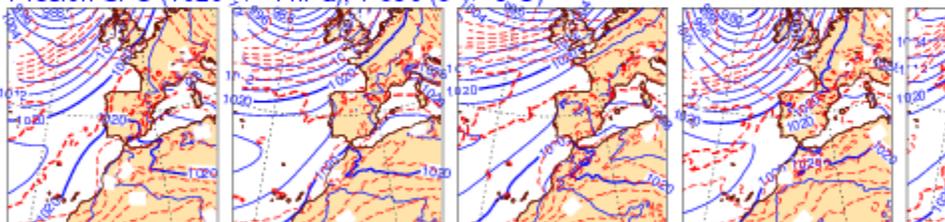
7, 38, 47, 30, 45, 5, 18, 40, 17, 29, 33, 31, 49, 13, 43, 12, 10, 42, 24, 25, 41, 6, 34, ... 2, 37, 16, 46, 27, 35, ... 22, 3
1, 8, 11, 3, 19, 30, 26, 48, 23, 36, ... 21, 0, 14, 9,

Control

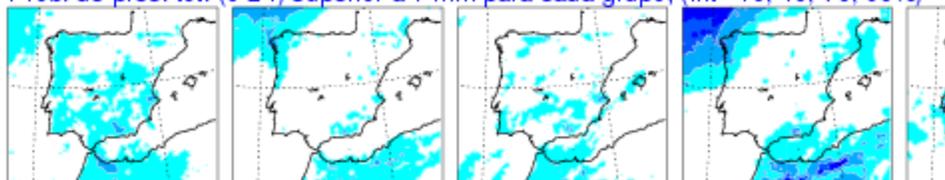
500 hPa: Z (5700 +/- 60 m), T (-18 +/- 2 C)



Presión SFC (1020 +/- 4 hPa), T 850 (8 +/- 2 C)



Prob. de prec. tot. (0-24) superior a 1 mm para cada grupo; (int= 10, 40, 70, 90%)



3. Predicción de MEDIO PLAZO. T mínimas. EFI

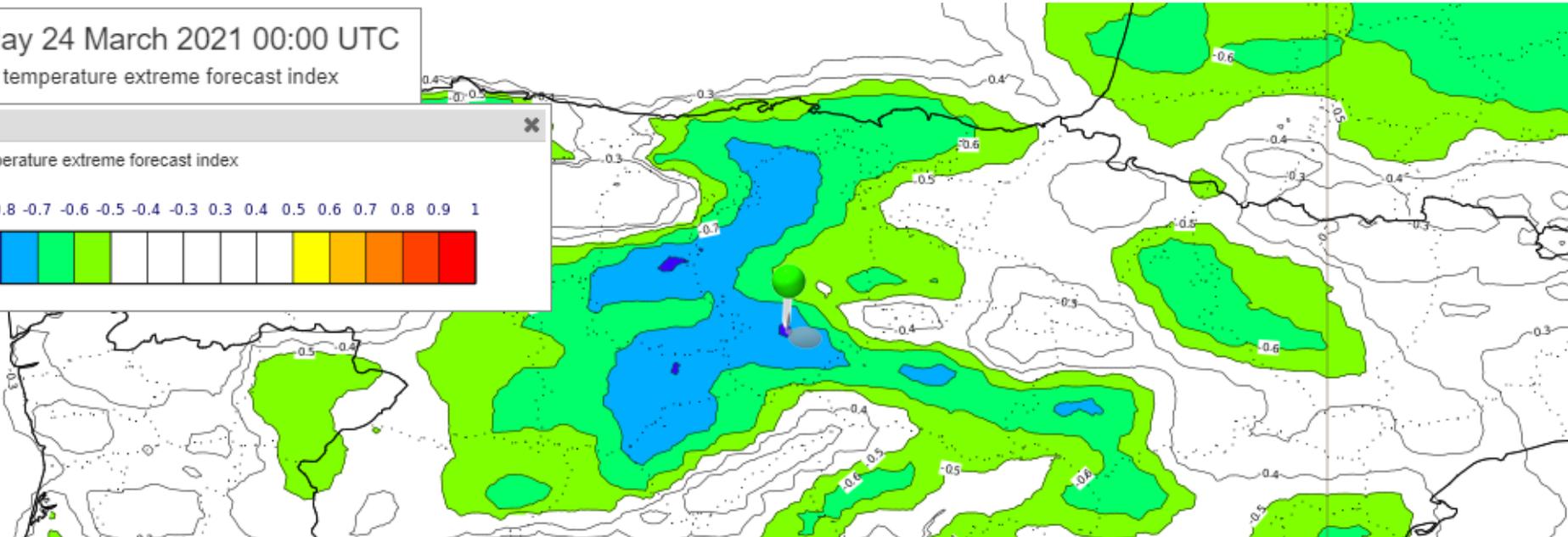
Wednesday 24 March 2021 00:00 UTC

2m minimum temperature extreme forecast index



2m minimum temperature extreme forecast index

-1 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1



Meteograms

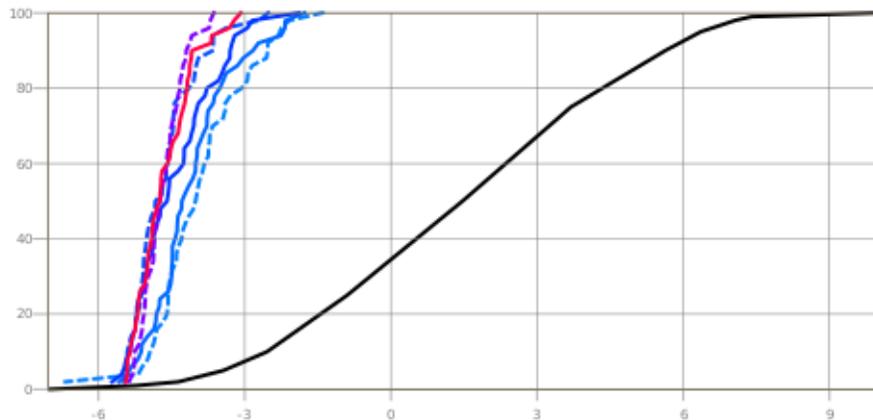
Location: 41.93°N 3.66°W

Help + More ... + Load ...

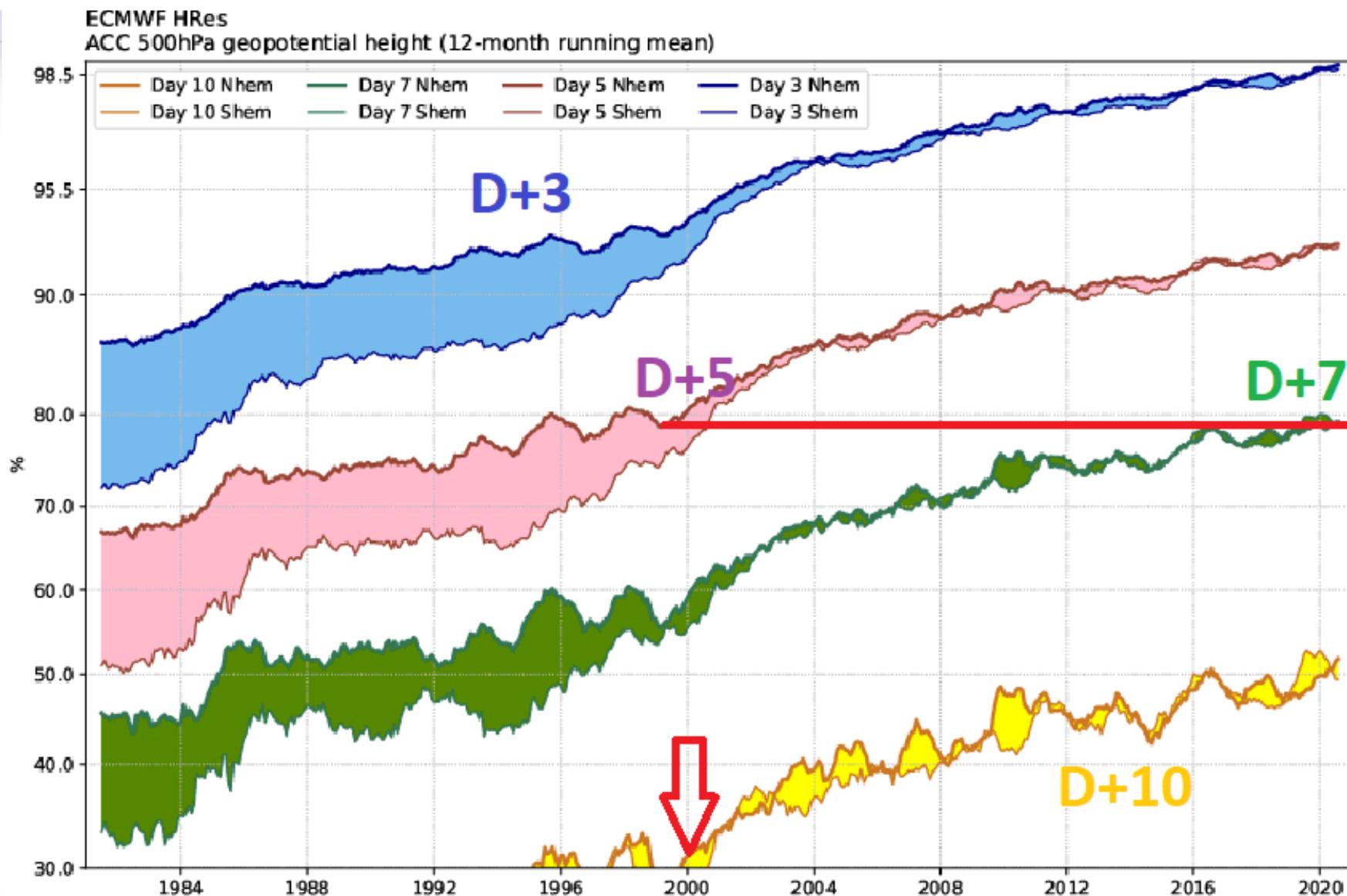
ENS cumulative distribution function (CDF) for 24hr minimum 2m temperature

Base date: Sunday 21 Mar, 00 UTC

Valid for 24 hours from Tuesday 23 Mar, 00 UTC to Wednesday 24 Mar, 00 UTC, adjusted to 976m height



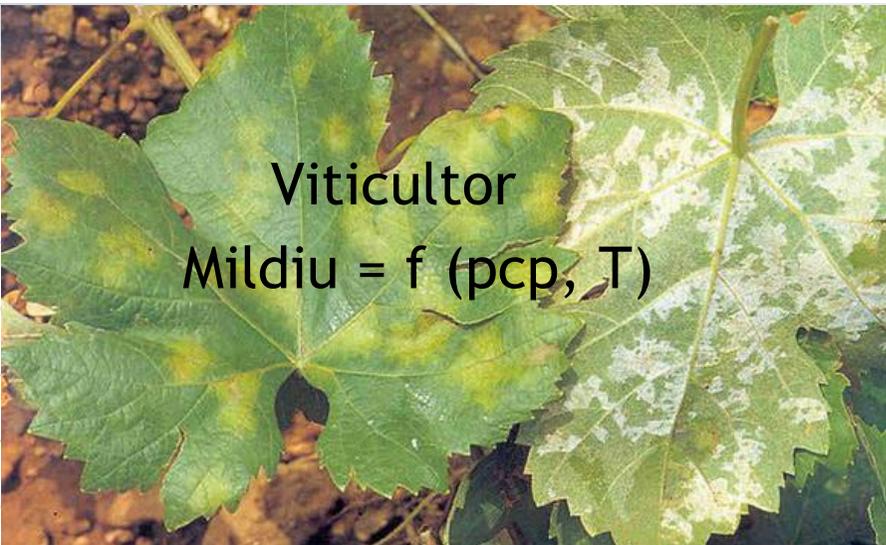
3. Predicción de MEDIO PLAZO. Evolución de los modelos



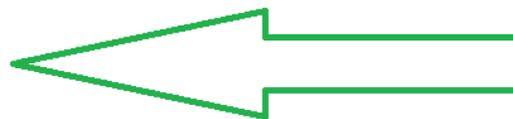
Año 2000: 4DVar

Incremento de la resolución: de 80 km a 9 km

4. La predicción probabilística



AEMET
Servicio Meteorológico



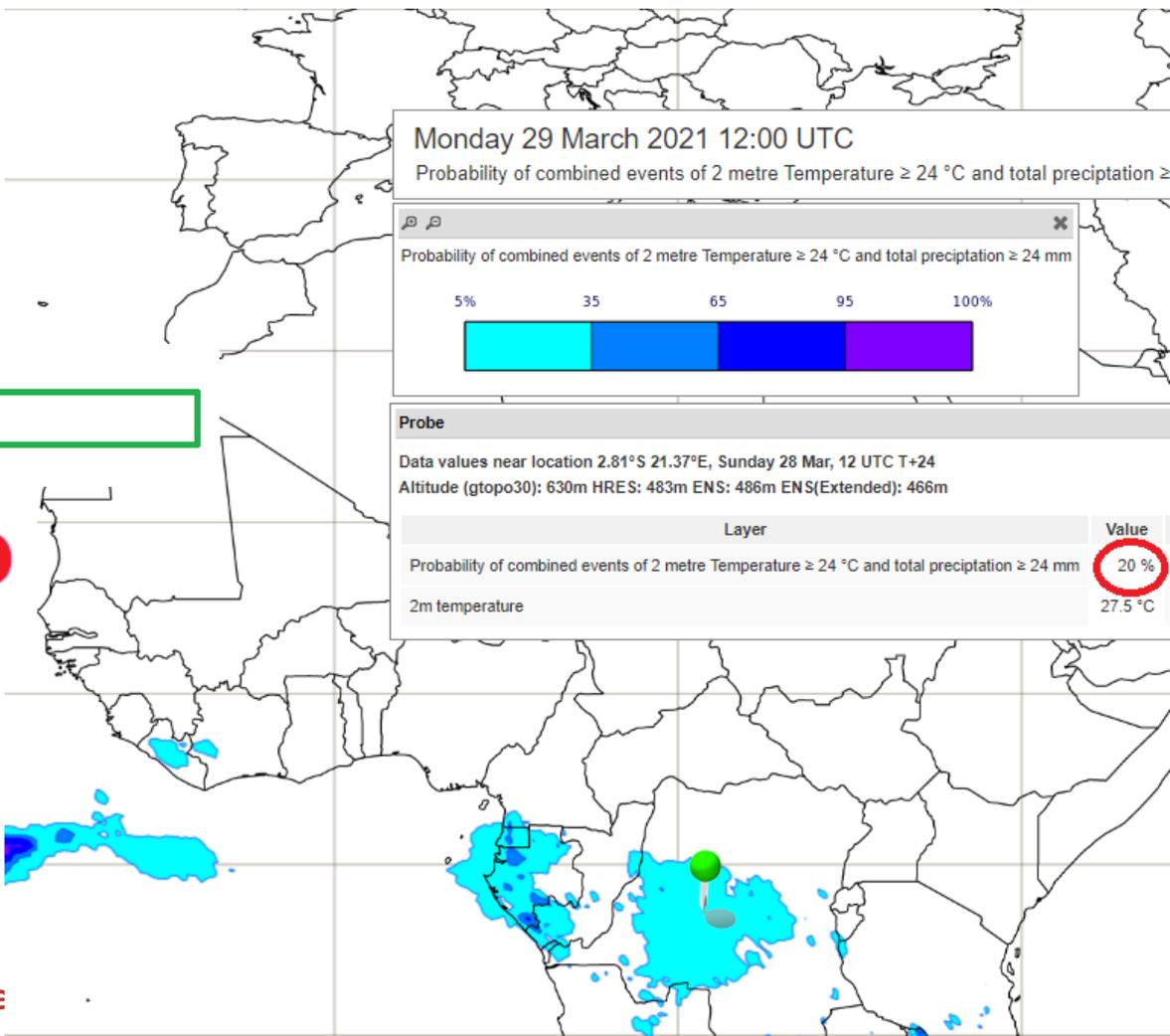
a) Determinista

- No

b) Probabilística

- 20%

???



Qué prefiere el usuario, a ó b?

3. La predicción probabilística. Por qué?

1) Ética profesional

Richard Feynman:

“it is better not to know than to be told something that is wrong o misleading”.

Reformulación:

“it is better to know that we do not know than to believe that we know when we don´t”.

Lorenz

“What the critics of probability forecasting fail to recognize or else are reluctant to acknowledge is that a forecaster is paid not for exhibiting his skill but for providing information to the public, and that a probability forecast conveys more information, as opposed to guesswork, than a simple [deterministic] forecast of rain or no rain.” (Lorenz, 1970)

3. La predicción probabilística. Por qué?

b) Más útil: mayor beneficio económico usuarios

Objetivo del viticultor: minimizar gastos por el Mildiu

¿Cómo? Tratando con fungicida, cuando se prevean condiciones meteorológicas favorables

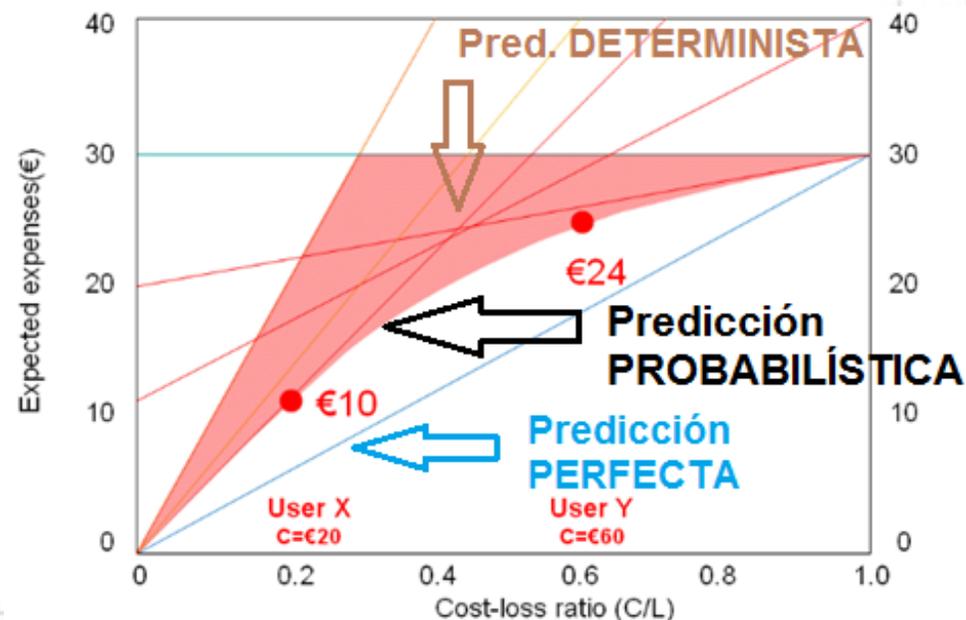
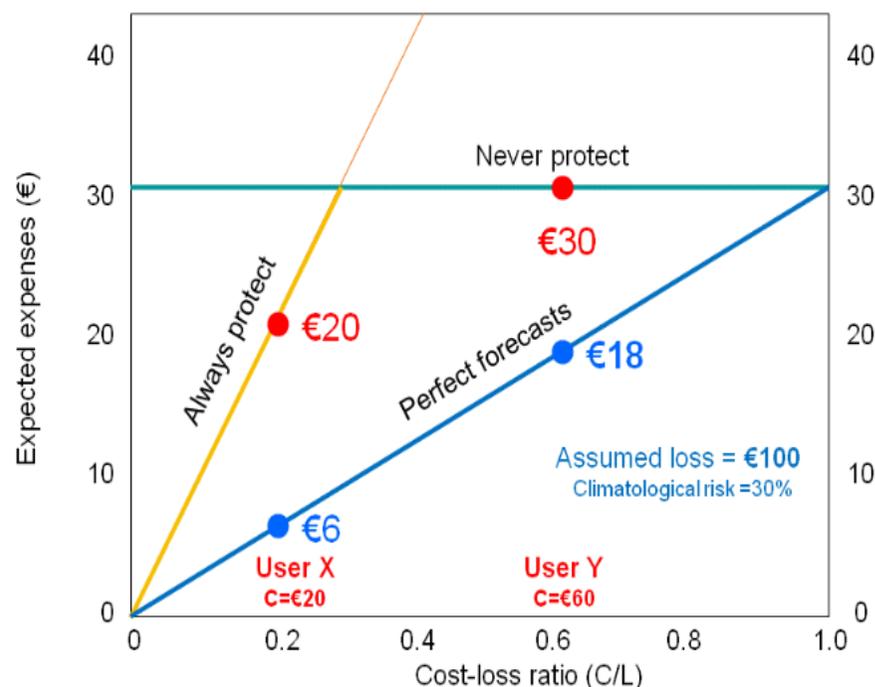
Variables económicas:

Coste de la protección: 500 €/Ha

Pérdidas potenciales: 5.000 €/Ha

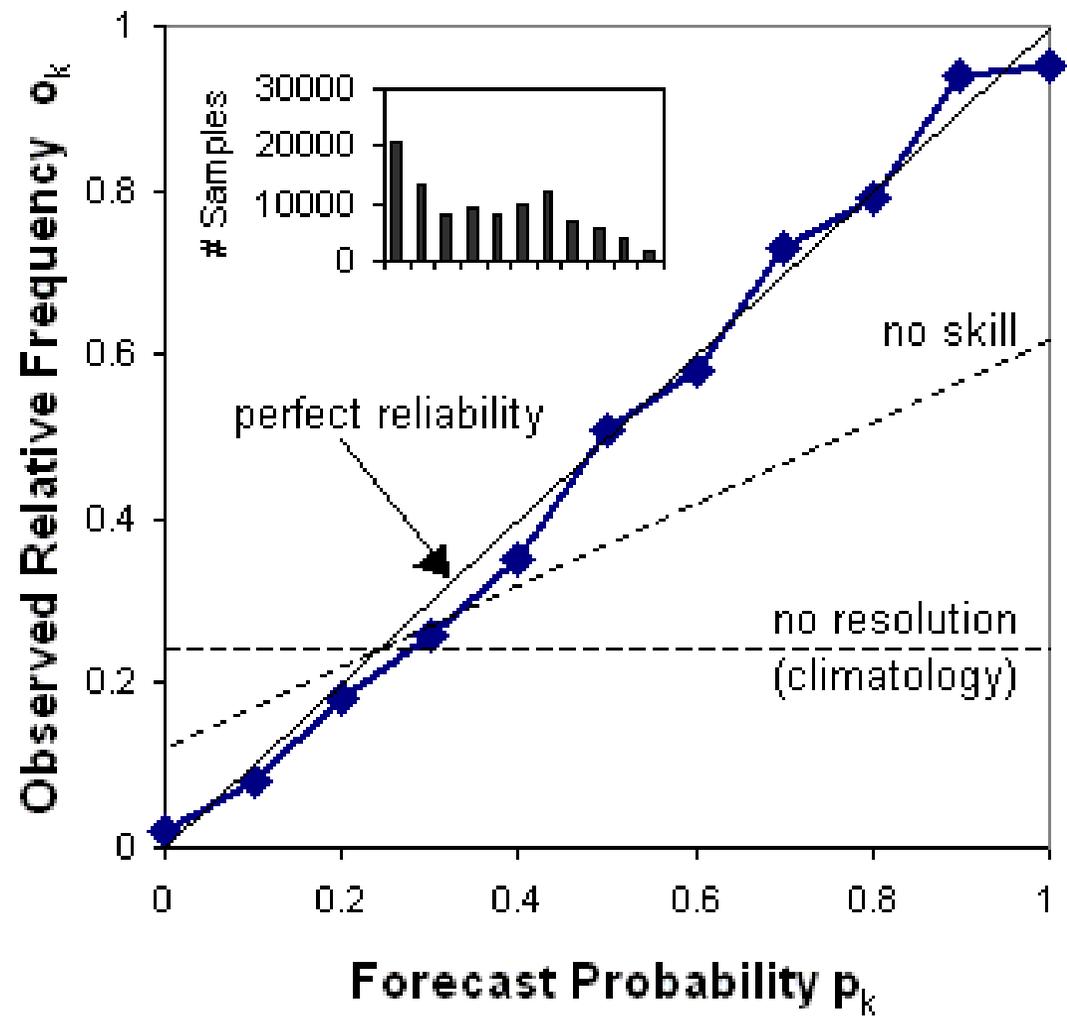
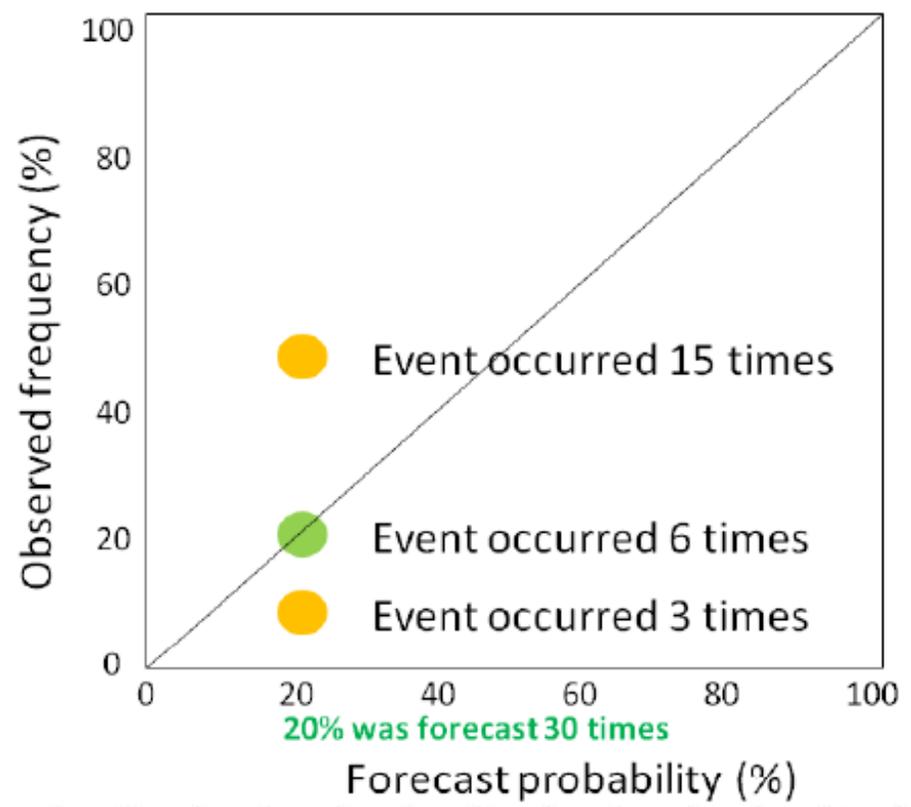
Relación coste/pérdida. $C/L = 0.1$

Quando actuar? $P \geq C/L$



3. La predicción probabilística. Verificación

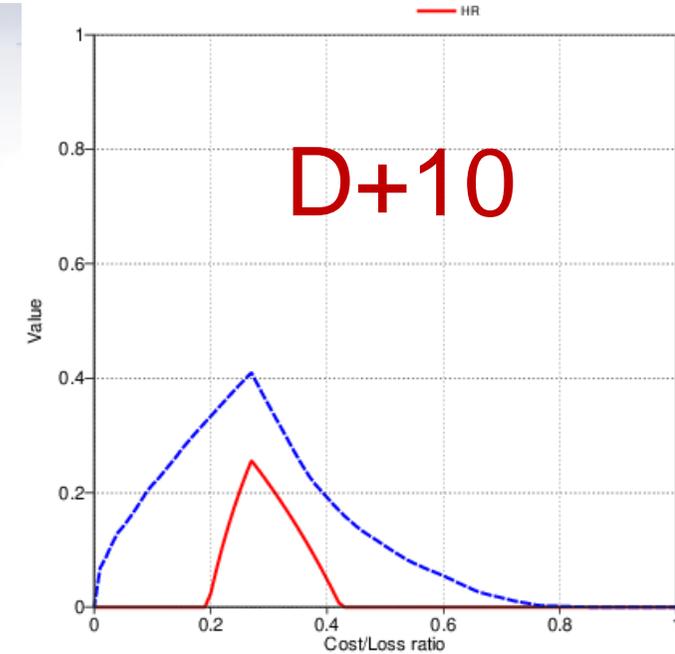
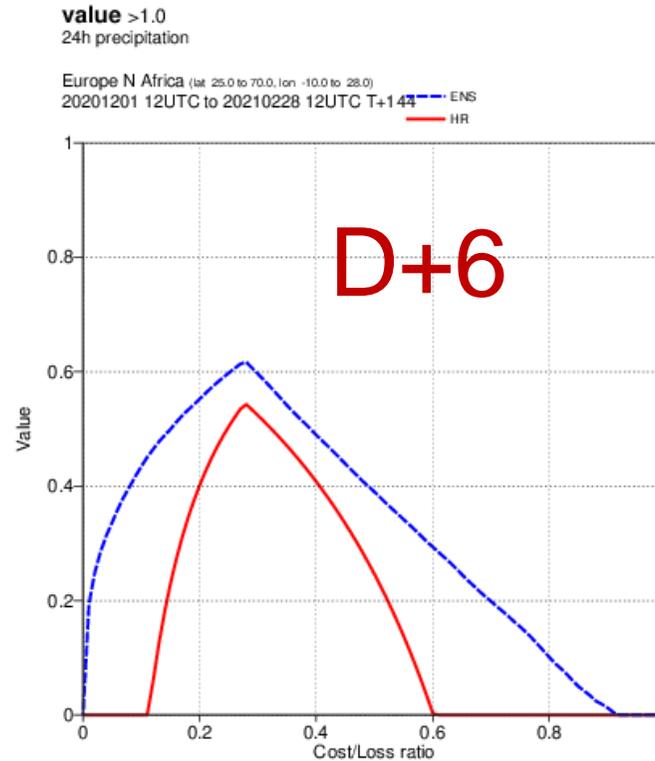
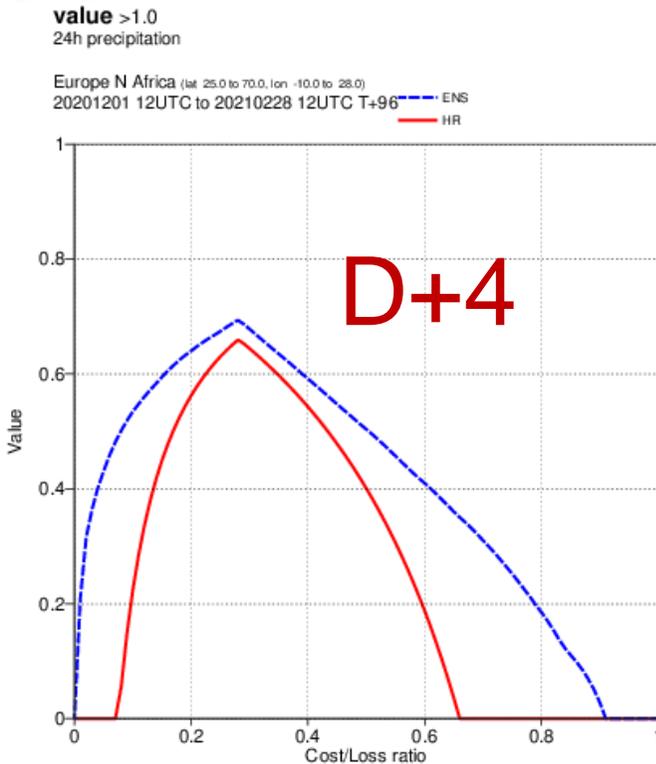
Diagramas de fiabilidad



3. La predicción probabilística. Verificación

Diagramas coste-pérdida: Valor económico

$$V = \frac{E_c - E_f}{E_c - E_p}$$



Gracias!!