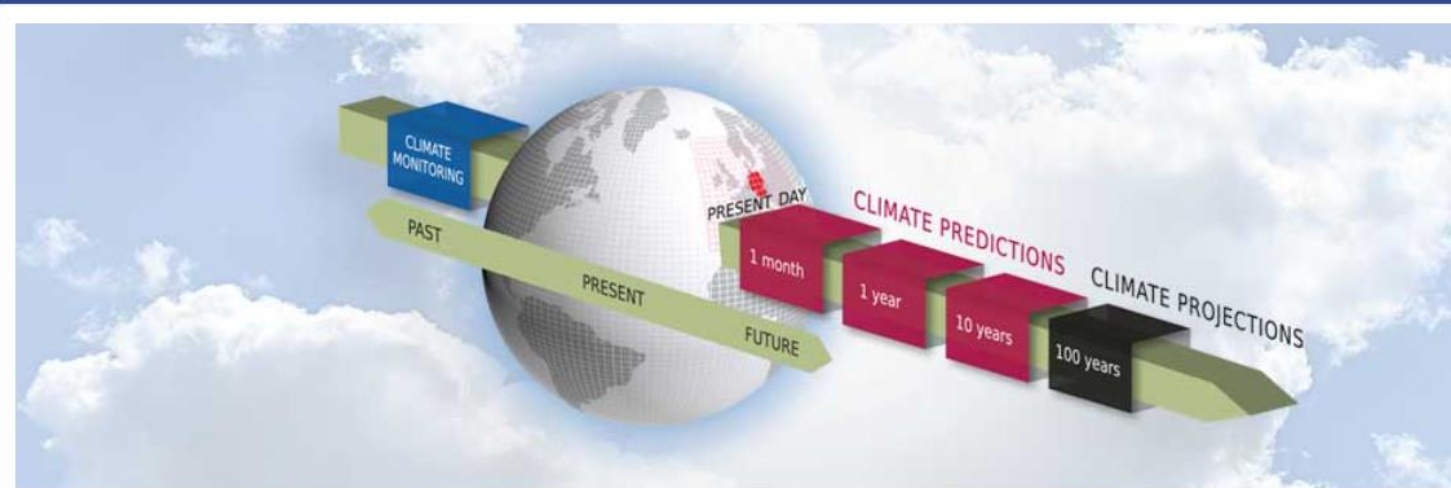


## Climate Predictions for the Next Weeks to Years DE



# User-oriented verification of the DWD climate prediction website

International Verification Method Workshop Online, 19.11.2020

**A. Paxian, K. Reinhardt, K. Pankatz, K. Isensee, K. Fröhlich, B. Früh**

Deutscher Wetterdienst



## Overview

**1**

**Concept, data and evaluation**

**2**

Content and presentation

**3**

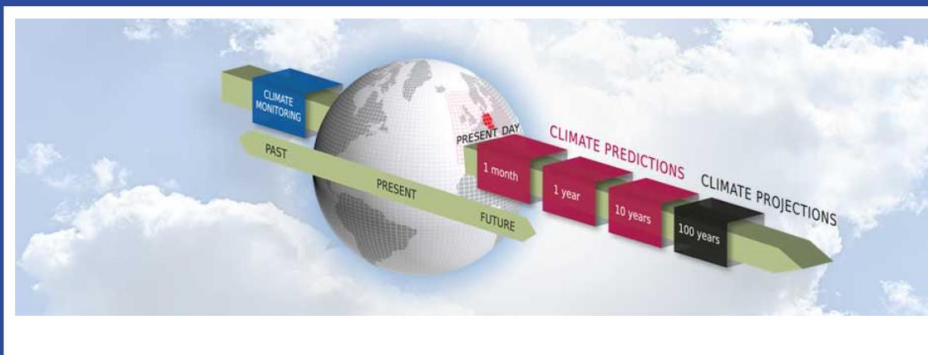
Outlook

Link: [www.dwd.de/climatepredictions](http://www.dwd.de/climatepredictions)

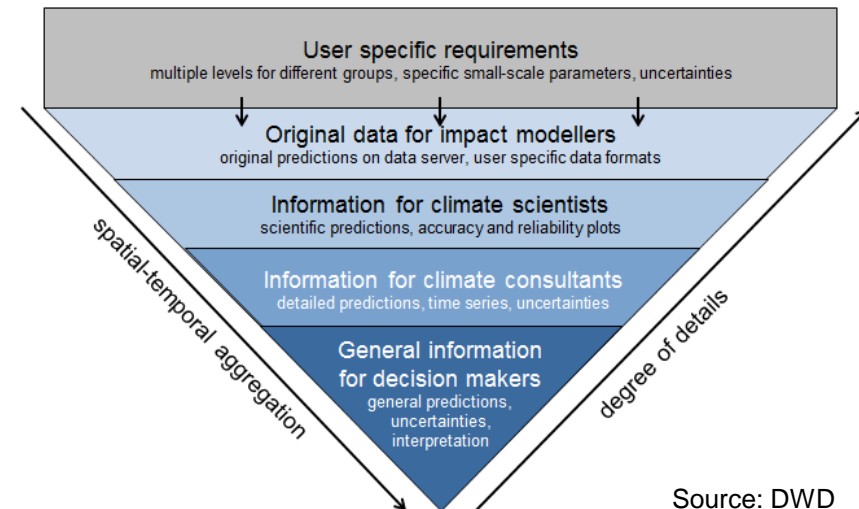
## Concept of DWD climate predictions website

- Consistent evaluation and presentation of **climate predictions across all time scales** (months, seasons, decades)
- Information layers for **different user groups** (public, climate consultants, scientists, WMO)
- Development in **cooperation with users** (workshops, surveys)

Climate Predictions for the Next Weeks to Years DE



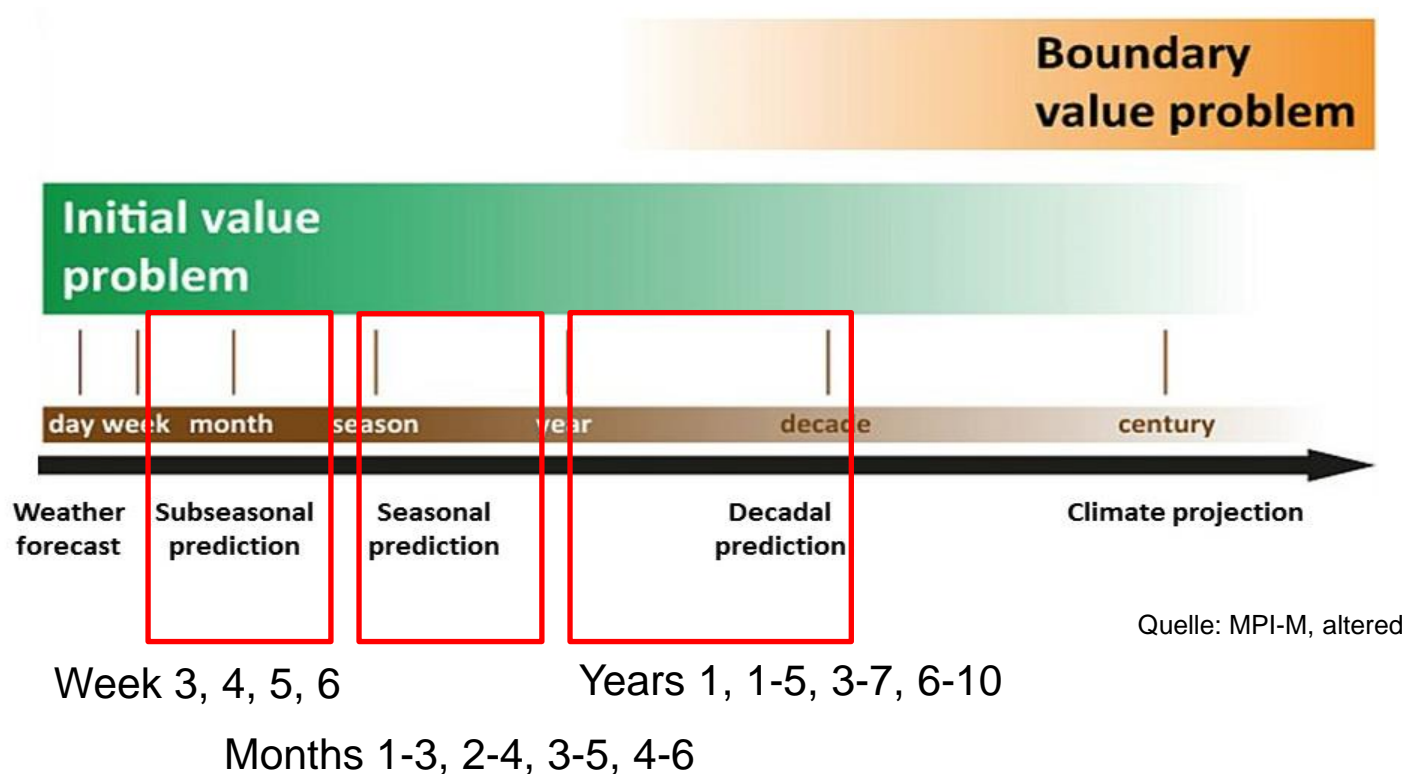
Source: DWD



Source: DWD

## Classification and purpose

- **Climate predictions** range between short-term weather predictions (up to 14 days) and long-term climate projections (30-100 years)



## Climate prediction model configuration

	Subseasonal climate prediction	Seasonal climate prediction	Decadal climate prediction
Climate model	IFS (ECMWF)	GCFS2 (DWD)	MPI-ESM (DWD)
Spatial coverage	global → Germany	global → also Europe, Germany	global → also Europe, Germany
Spatial resolution	36 km	100 km	100-200 km

## Climate prediction model configuration

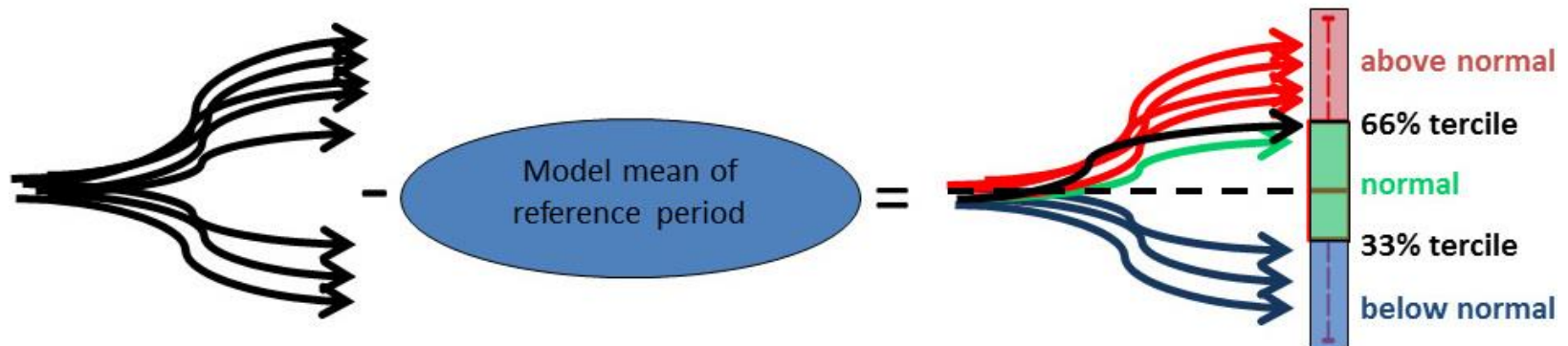
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Spatial resolution	36 km	100 km	100-200 km
Starting point	weekly (Mon./ Thu.)	monthly (1st)	yearly (Nov)
Temporal coverage	46 days	6 months	10 years
Temporal resolution	6h → week	6h → 1-3 months	6h → 1-5 years

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Temporal coverage	46 days	6 months	10 years
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Prediction ensemble	51 simulations	50 simulations	10 simulations
Hindcast ensemble	11 simulations	30 simulations	10 simulations
Hindcast period	last 20 years-present	1990-present	1961-present

## Ensemble mean and probabilistic climate prediction

- **Climate prediction types** for current starting time:
  - **Ensemble mean climate prediction:** anomaly of the ensemble mean
  - **Probabilistic climate prediction:** tercile probability (ensemble distribution)
- **Statistical recalibration** (adjustment of biases, drifts, standard deviations and ensemble spread)



Climate simulations =  
Prediction ensemble

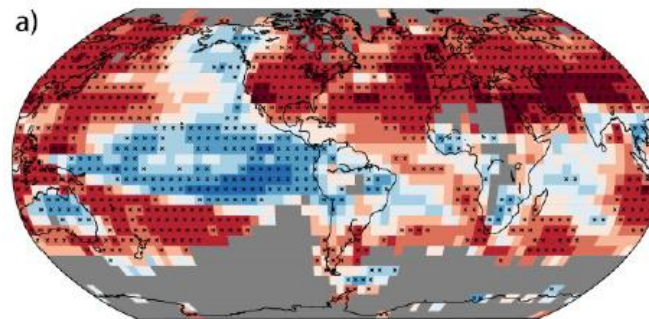
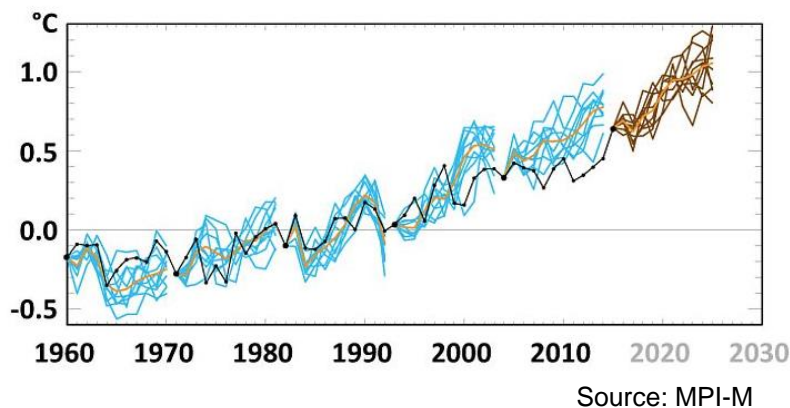
Calculation of the  
deviation

Ensemble mean of all simulations (black),  
climate simulations in the categories „above  
normal“ (red), „normal“ (green) and „below  
normal“ (blue)

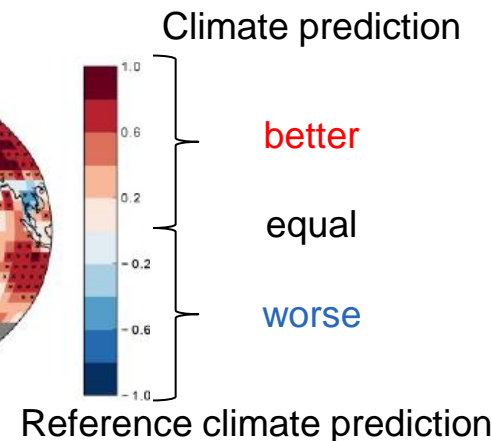


# Climate prediction skill analysis

- ➔ Comparison of hindcasts with observed variability in the past
- ➔ Prediction skill score of **ensemble mean climate prediction**, e.g. MS(E)SS
- ➔ Prediction skill score of **probabilistic climate prediction**, e.g. (Fair)RPSS
- ➔ Comparison of skill of climate prediction in reproducing observed variability with skill of alternative **reference climate predictions (observed climatology, „uninitialized“ climate simulation)**
- ➔ **Significance** level of 95% based on 500 bootstraps

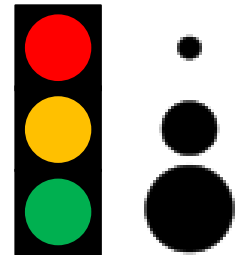


Source: Marotzke et al. 2016



## Climate prediction and skill

- Common presentation of **climate prediction** (colours of areas or dots) and **climate prediction skill** (traffic light or dot size):
  - Climate prediction significantly worse than reference prediction
  - Climate prediction comparable to reference prediction
  - Climate prediction significantly better than reference prediction
- **Basic climate predictions, expert climate predictions and prediction skill**
- **Ensemble mean and probabilistic climate predictions**
- **Time series/ tables** (e.g. year 1, 1-5, 3-7, 6-10), **maps** (Germany, Europe, world)
- **2m temperature and precipitation sum**, further variables later





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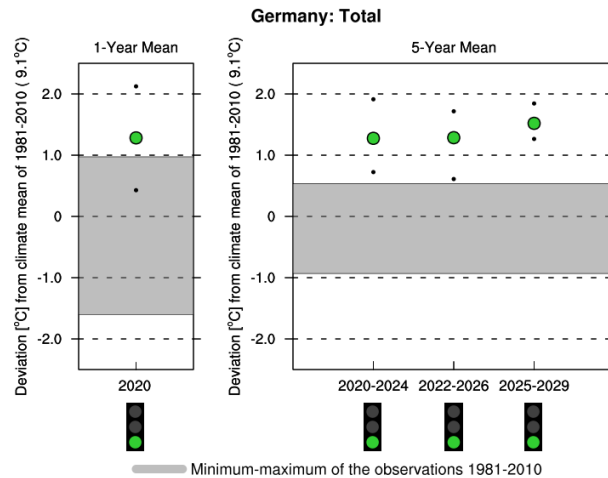
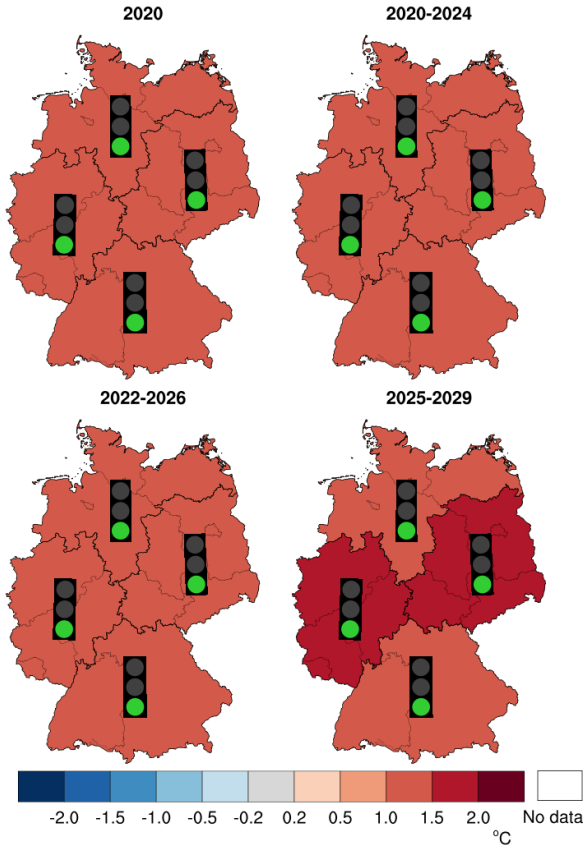
3

Outlook

Link: [www.dwd.de/climatepredictions](http://www.dwd.de/climatepredictions)

# Basic predictions: Ensemble mean predictions of temperature

Germany: Total



Germany: Total Ensemble Mean Prediction in Comparison to the Climate Mean of the Time Period 1981-2010		
Time Period	Climate Mean	Prediction
2020	9.1°C	+1.3°C (+0.4°C - +2.1°C)
2020-2024	9.1°C	+1.3°C (+0.7°C - +1.9°C)
2022-2026	9.1°C	+1.3°C (+0.6°C - +1.7°C)
2025-2029	9.1°C	+1.5°C (+1.3°C - +1.8°C)

**Ensemble mean prediction for temperature:**

The coloured dots represent the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010. The black dots represent maximum and minimum of the ensemble. The area in gray shows the spread of the observations in the time period 1981-2010.

**Prediction skill:**

The traffic light shows the prediction skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

© DWD: generated on 2020-03-11

**Ensemble mean prediction for temperature:**

The table represents the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010. Maximum and minimum of the ensemble are given in brackets.

**Prediction skill:**

The traffic light shows the prediction skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
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© DWD: generated on 2020-03-11

**Ensemble mean prediction for temperature:**

The colour represents the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010.

**Prediction skill:**

The traffic light shows the prediction skill in the evaluation period 1966-2017:

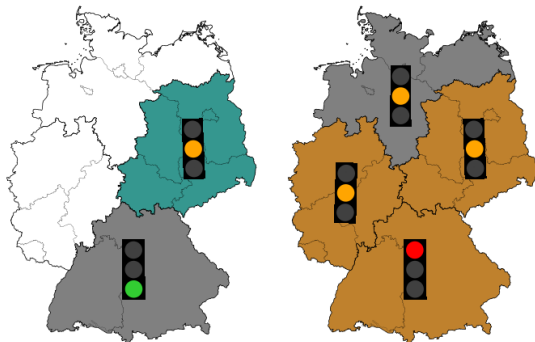
- significantly worse than the observed climate mean
- comparable to the observed climate mean
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© DWD: generated on 2020-03-11

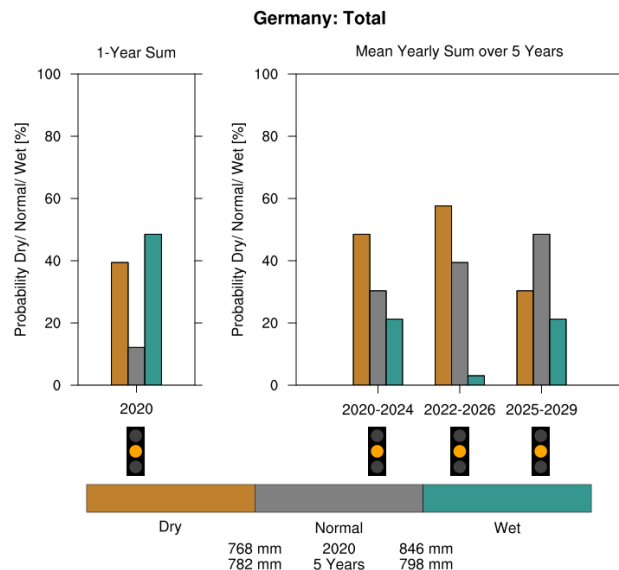
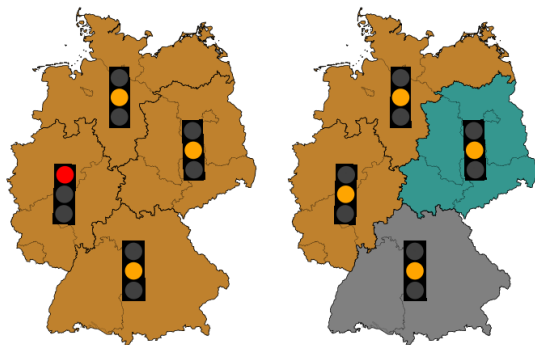
# Basic predictions: Probabilistic predictions of precipitation

Germany: Total

2020 2020-2024



2022-2026 2025-2029



Germany: Total Probability of the Categories Dry/ Normal/ Wet in Comparison to the Climate Characteristics for 1981-2010				
Time Period	Category Normal	Dry	Normal	Wet
2020	768 - 846 mm	39%	12%	48%
2020-2024	782 - 798 mm	48%	30%	21%
2022-2026	782 - 798 mm	58%	39%	3%
2025-2029	782 - 798 mm	30%	48%	21%

**Probabilistic prediction for precipitation:**

The bars represent the probabilities of the three categories dry/ normal/ wet of the climate prediction (mean yearly sum) in comparison to the climate characteristics for the time period 1981-2010.

**Prediction skill:**

The traffic light shows the prediction skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

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**Probabilistic prediction for precipitation:**

The table represents the probabilities of the three categories dry/ normal/ wet of the climate prediction (mean yearly sum) in comparison to the climate characteristics for the time period 1981-2010.

**Prediction skill:**

The traffic light shows the prediction skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
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**Probabilistic prediction for precipitation:**

The colour represents the most probable of the three categories dry/ normal/ wet of the climate prediction (mean yearly sum) in comparison to the climate characteristics for the time period 1981-2010.

**Prediction skill:**

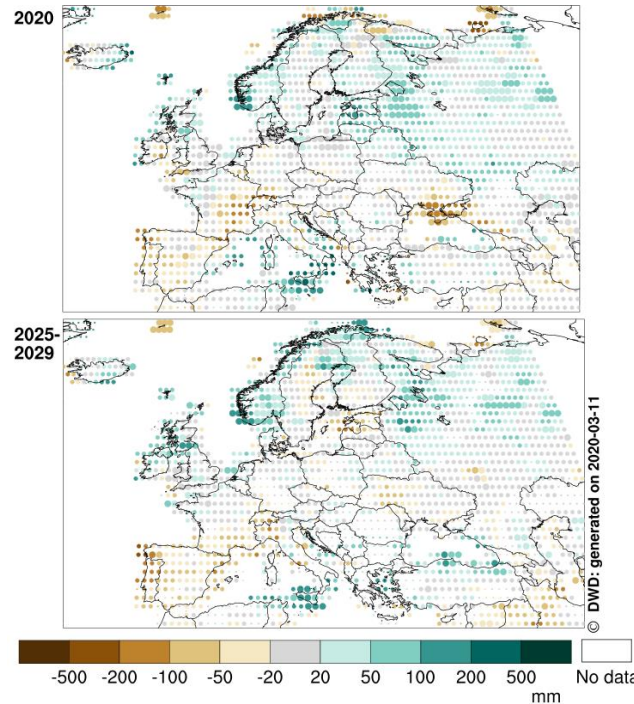
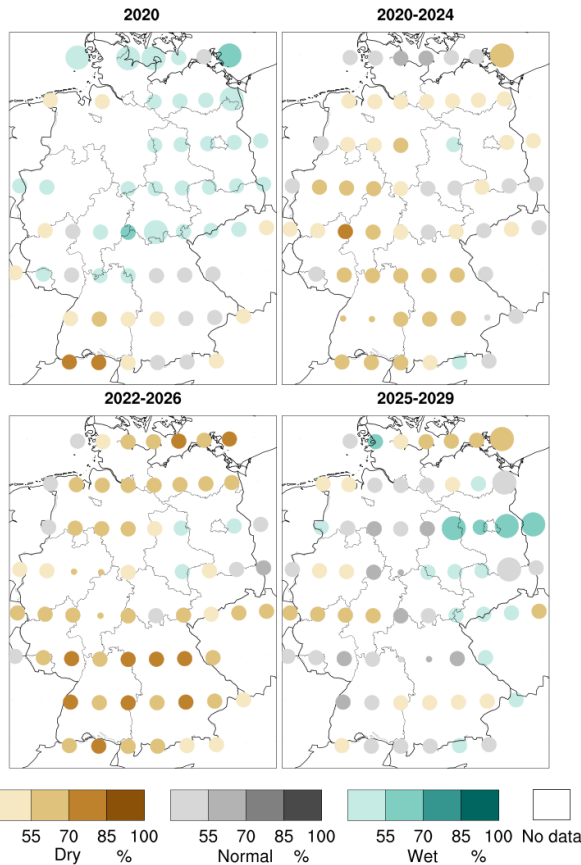
The traffic light shows the prediction skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

© DWD: generated on 2020-03-11



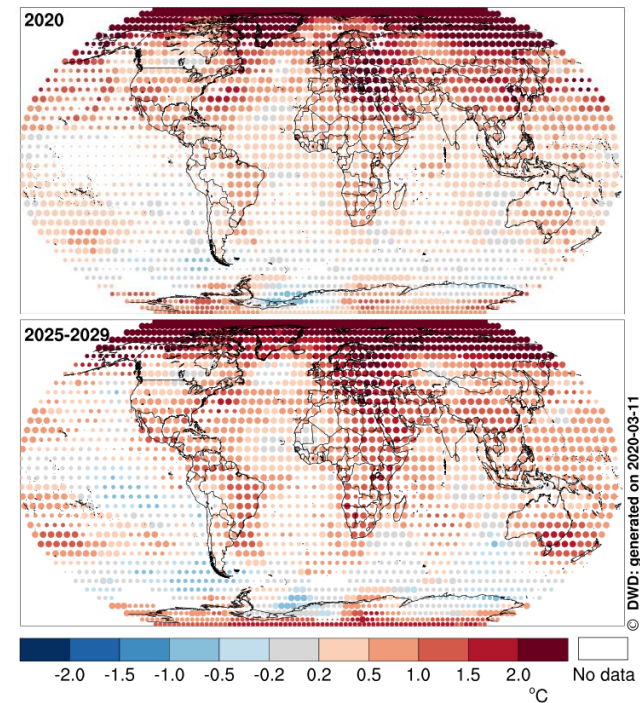
# Expert predictions: Ensemble mean/ Probabilistic predictions of precipitation/ temperature



**Ensemble mean prediction for precipitation:**  
The colour represents the deviation of the ensemble mean prediction (mean yearly sum) from the climate mean of the time period 1981-2010.

**Prediction skill:**  
The size of the dots shows the skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean



**Ensemble mean prediction for temperature:**  
The colour represents the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010.

**Prediction skill:**  
The size of the dots shows the skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

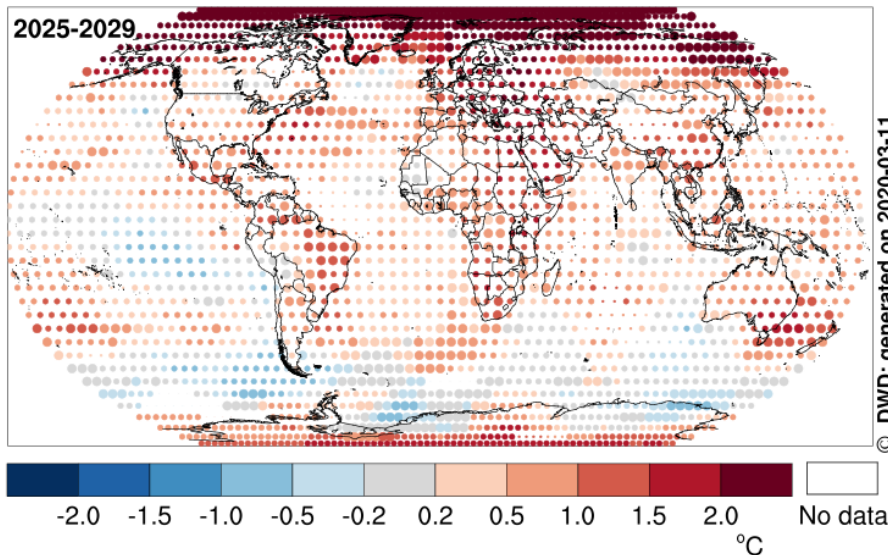
**Probabilistic prediction for precipitation:**  
The colour represents the most probable category (dry/ normal/ wet) of the climate prediction (mean yearly sum) in comparison to the climate characteristics for 1981-2010. The brightness describes the probability of this category.

**Prediction skill:**  
The size of the dots shows the skill in the evaluation period 1966-2017:

- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean

# Expert predictions: Ensemble mean predictions of temperature

Reference prediction climate projection



**Ensemble mean prediction for temperature:**

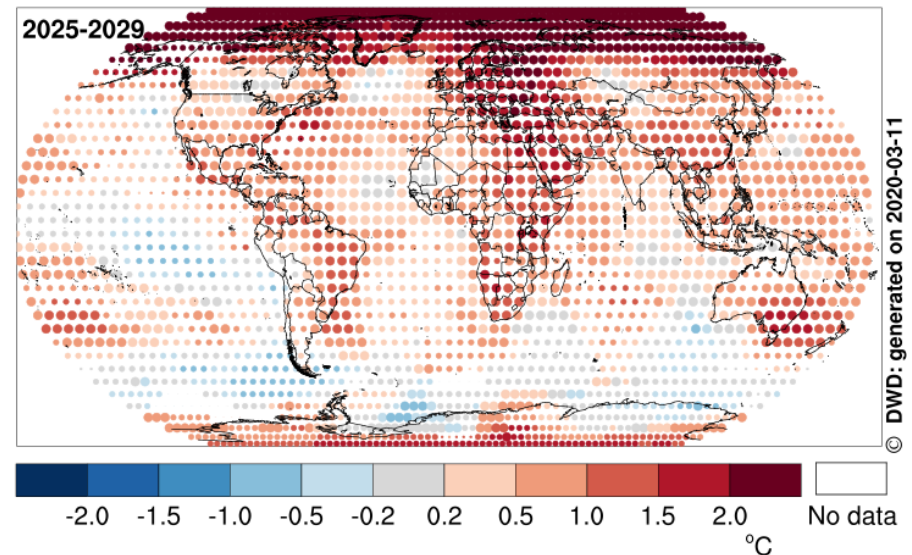
The colour represents the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010.

**Prediction skill:**

The size of the dots shows the skill in the evaluation period 1966-2017:

- significantly worse than the climate projection
- comparable to the climate projection
- significantly better than the climate projection

Reference prediction observed climatology



**Ensemble mean prediction for temperature:**

The colour represents the deviation of the ensemble mean prediction (1-/5-year mean) from the climate mean of the time period 1981-2010.

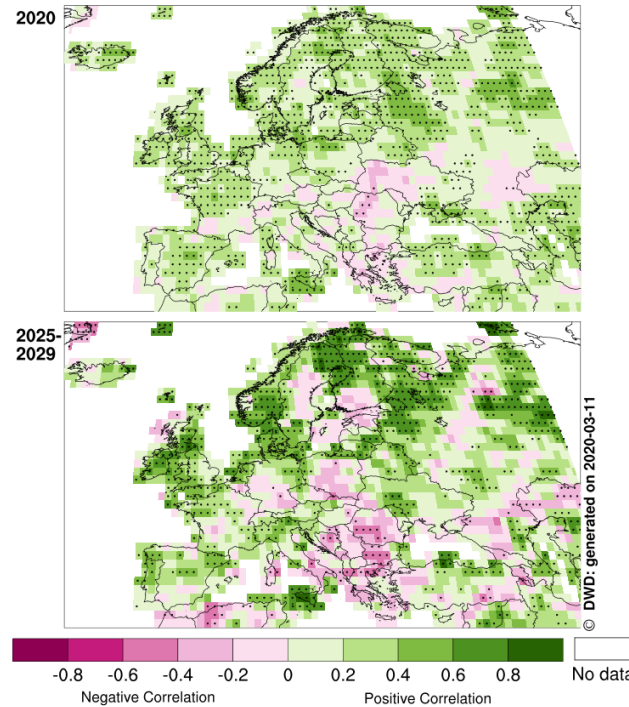
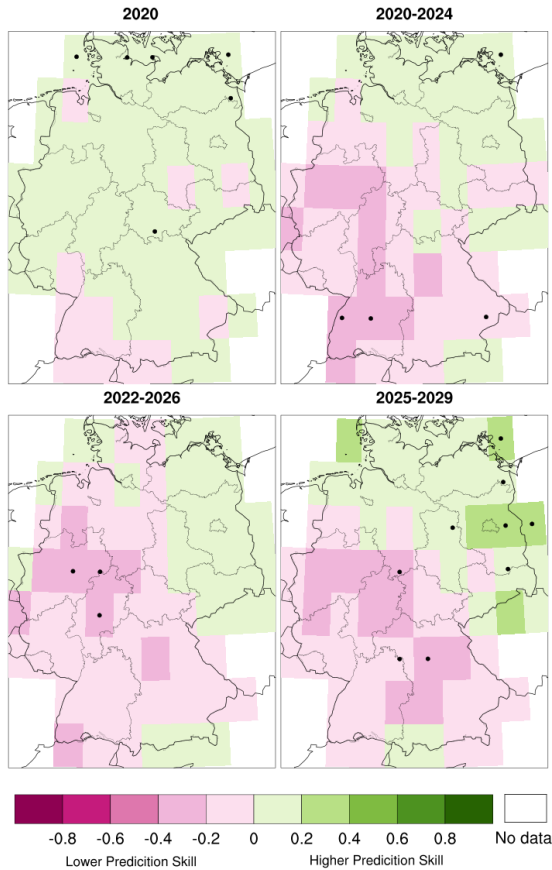
**Prediction skill:**

The size of the dots shows the skill in the evaluation period 1966-2017:

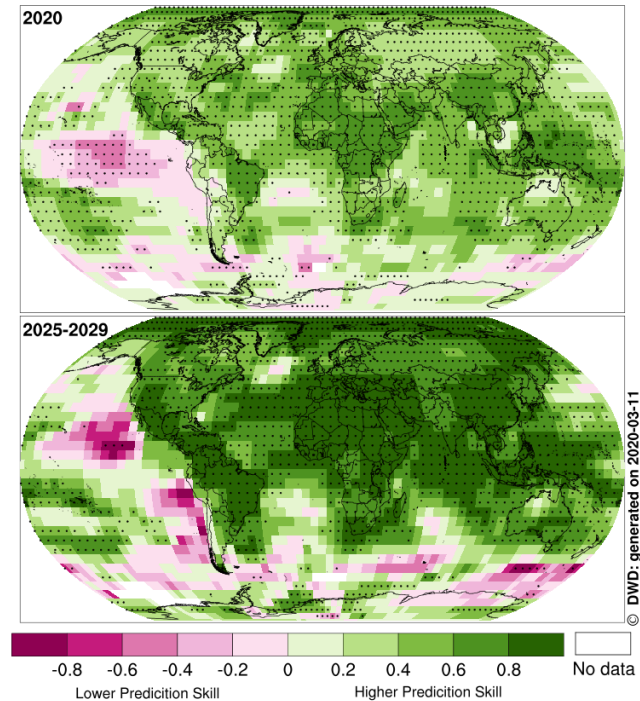
- significantly worse than the observed climate mean
- comparable to the observed climate mean
- significantly better than the observed climate mean



# Expert prediction skill: Ensemble mean/ Probabilistic prediction skill of precipitation/ temperature



**Prediction skill for precipitation (correlation):**  
The colour represents the skill of the climate prediction (mean yearly sum) in the evaluation period 1966-2017 as correlation between climate prediction and observation. Dots indicate significant skill (significance level of 95%).



**Prediction skill for temperature (MSESS):**  
The colour represents the skill of the climate prediction (1-/5-year mean) in the evaluation period 1966-2017 compared to the observed climate mean as reference prediction. Dots indicate significant skill (significance level of 95%).

**Prediction skill for precipitation (RPSS):**  
The colour represents the skill of the climate prediction (mean yearly sum) in the evaluation period 1966-2017 compared to the observed climate mean as reference prediction. Dots indicate significant skill (significance level of 95%).  
© DWD: generated on 2020-03-11





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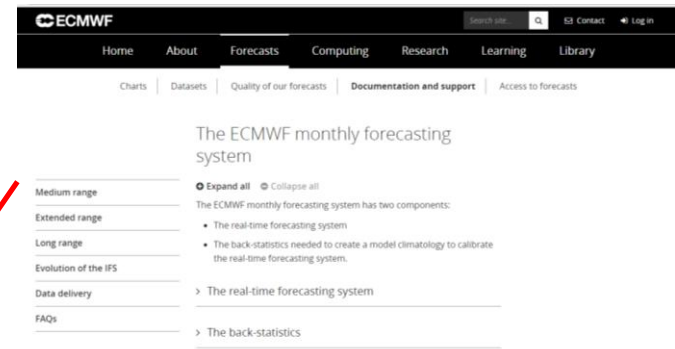
3

**Outlook**

Link: [www.dwd.de/climatepredictions](http://www.dwd.de/climatepredictions)

# Outlook to extensions of the Climate Predictions Website

- ➔ Subseasonal climate predictions (Week 3, 4, 5, 6), seasonal climate predictions (months 1-3, 2-4, 3-5, 4-6), multi-year seasonal predictions
- ➔ Interactive elements in navigation, selection menu and plots

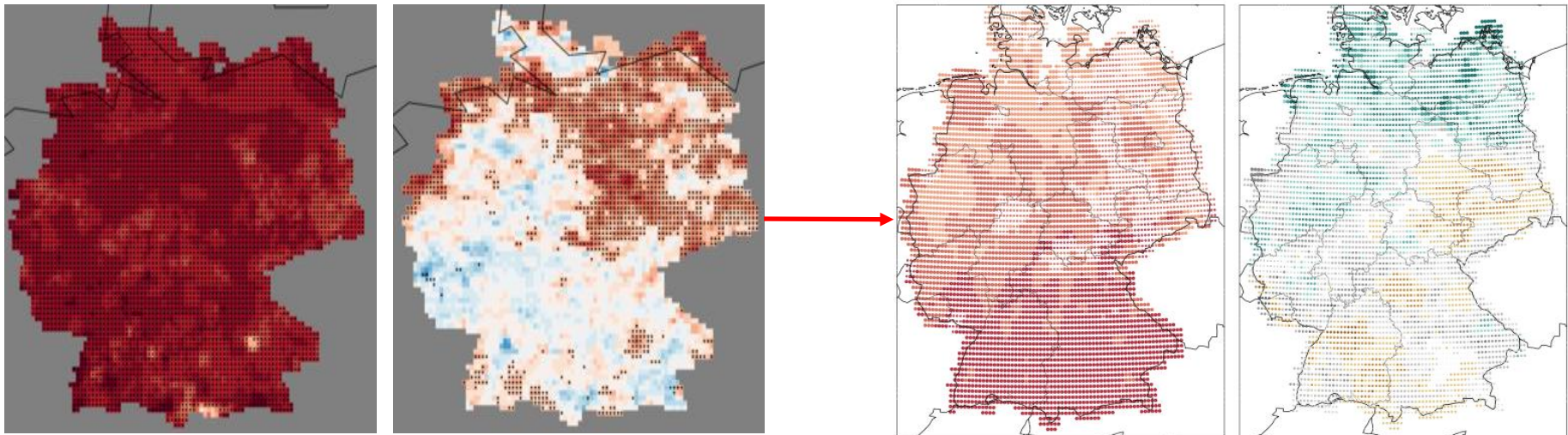


Source: DWD, ECMWF



## Outlook to extensions of the Climate Predictions Website

- **Statistical downscaling (EPISODES)** to 10-20 km in Germany
- Further **user-oriented products** (e.g. wind, drought, extremes, NAO, ENSO)
- **Access to climate prediction data** via ESGF node



Source: DWD

**Thank you very much  
for your attention !**





## Reference prediction

- ➔ „Skill“ (purple) of **hindcasts** (light blue) and **hindcast ensemble mean** (orange) in reproducing the observed variability (black)
- ➔ „Skill“ (red) of **reference prediction long-term observed climatology** (grey) in reproducing the observed variability (black)

