WORLD METEOROLOGICAL ORGANIZATION

WMO Global Annual to Decadal Climate Update

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

CCCMA

DWD

Met Office
Hadley Centre

WMO 2026 Calendar Competition - Niurma Sanchez

WORLD METEOROLOGICAL ORGANIZATION

Global Annual to Decadal Climate Update 2026-2035

Key Messages

The Global Annual to Decadal Climate Update is issued annually by the World Meteorological Organization (WMO). It provides a synthesis of the global annual to decadal predictions produced by the WMO designated Global Producing Centres and other contributing centres. The latest predictions show that:

- Global mean temperatures are likely to continue at or near record levels in the five-year period 2026-2030. The annually averaged global mean near-surface temperature for each year between 2026 and 2030 is predicted to be between 1.3°C and 1.9°C higher than the average over the years 1850-1900.
- It is very likely (91% chance) that global mean near-surface temperature will exceed 1.5°C above the 1850-1900 average levels for at least one year between 2026 and 2030. It is also likely (75% chance) that the 2026-2030 five-year mean will exceed 1.5°C above the 1850-1900 average.
- It is likely (86% chance) that at least one year between 2026 and 2030 will set a new annual record (currently 2024). It is exceptionally unlikely (<1%) that any year will exceed 2°C of warming in the next five years.
- The five-year predicted average temperature in the Niño 3.4 region relative to the whole tropics indicates a preference for El Niño conditions, particularly in 2027 and 2028.
- Arctic temperatures over the next five extended winters (November-March) are predicted to be 2.8°C above average temperatures for 1991-2020, an anomaly more than three and half times that of global mean temperature anomaly over the same period.
- Decadal predictions of near-surface temperature for 2026-2035 are similar to those seen in climate projections. However, the predictions show warmer anomalies over the Amazon, North Africa, northern Scandinavia, and the Greenland Sea than projections.
- Predictions of Arctic sea-ice for March 2026-2035 suggest further reductions in sea-ice concentration in the Barents Sea, Bering Sea, and Sea of Okhotsk.
- Predicted precipitation patterns for May-September 2026-2030 suggest wet anomalies in the Sahel, northern Europe, Alaska and Siberia, and dry anomalies over the Amazon, are more likely in this season.
- Regional forecasts are made for all WMO Regions. As an example, recent winters have been anomalously dry in the Southeastern European (SEECOF) region. The regional forecast suggests that the 2026-2030 period is likely to have anomalously high precipitation again.

Observed Climate of the Last Five Years

This section provides a brief summary of the observed climate of the last five years to give context for the predictions shown later in this report. Please refer to the WMO State of the Global Climate report for a more complete discussion. Figure 1 shows the global patterns of surface air temperature, sea-level pressure and precipitation anomalies over the last year (2025) and the last five-year (2021-2025) period with respect to the most recent climatological normal, the average over the years 1991-2020.

Last year, 2025, was one of the three warmest years on record, with the globally averaged near-surface temperature estimated at 1.43 °C ± 0.13 °C above the 1850–1900 baseline. Near-surface temperatures in 2025 were warmer than the long-term average almost everywhere over land with particularly large warm anomalies in North America, North Africa, Europe and parts of Asia.

Over 2021-2025, anomalous warmth was widespread, except over the eastern tropical Pacific and parts of South America, Australia and India. The anomalies were largest at high latitudes in the Northern Hemisphere, especially the Arctic, and generally larger over land than ocean, apart from in the North Pacific. Four out of five years in this period had La Niña conditions.

Sea-level pressure in 2025 and in the last five years was anomalously low over Antarctica. The Aleutian Low for 2021-2025 was anomalously weak and the sea-level pressure was high in the eastern Pacific, consistent with the extended La Niña conditions that prevailed.

Precipitation patterns in 2025 show that parts of central South America had below average rainfall. Southern Africa and the maritime continent had above average rainfall. During 2021-2025, parts of Asia and the African Sahel were wetter than average, and southern Africa, western Australia, central and southern South America, southwestern Europe and parts of North America were drier than average.

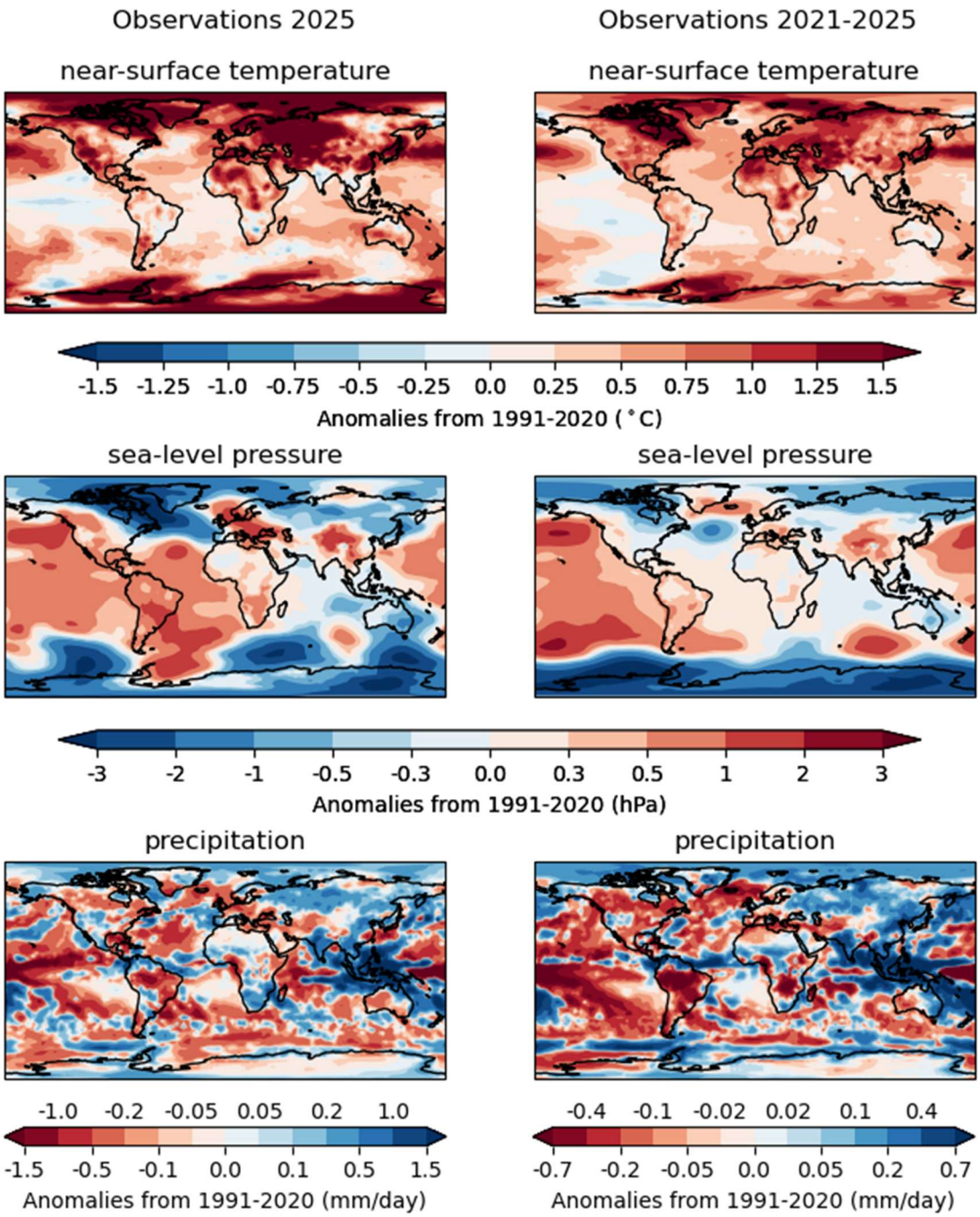

Figure 1: Observed annual mean near-surface temperature (°C, top), pressure (hPa, middle) and precipitation (mm/day, bottom) anomalies relative to 1991-2020. *The left column shows the year 2025, the right column refers to the average of the five-year period 2021-2025. Near-surface temperature is ERA5 2m temperature (Bell et al, 2021). Mean sea-level pressure is also from ERA5. Precipitation is from GPCP (Adler et al, 2003, updated).*

To highlight summer and winter differences, Figure 2 shows average anomalies over the last five years for two extended seasons, May to September and November to March. Both seasons had generally higher temperatures than the 1991-2020 average, apart from the East and South Pacific. Western North America was anomalously warm in May to September and anomalously cold in November to March.

The sea-level pressure anomalies seen in the five-year mean in Figure 1 over Antarctica and the Aleutian Low were largest in November to March. Precipitation patterns show that East Asia and South

Asia were wetter than average in May to September, but this hides large inter-annual variability. The African Sahel also shows wet anomalies for this season. Western Australia and most of South America were drier than average over the five years in both seasons.

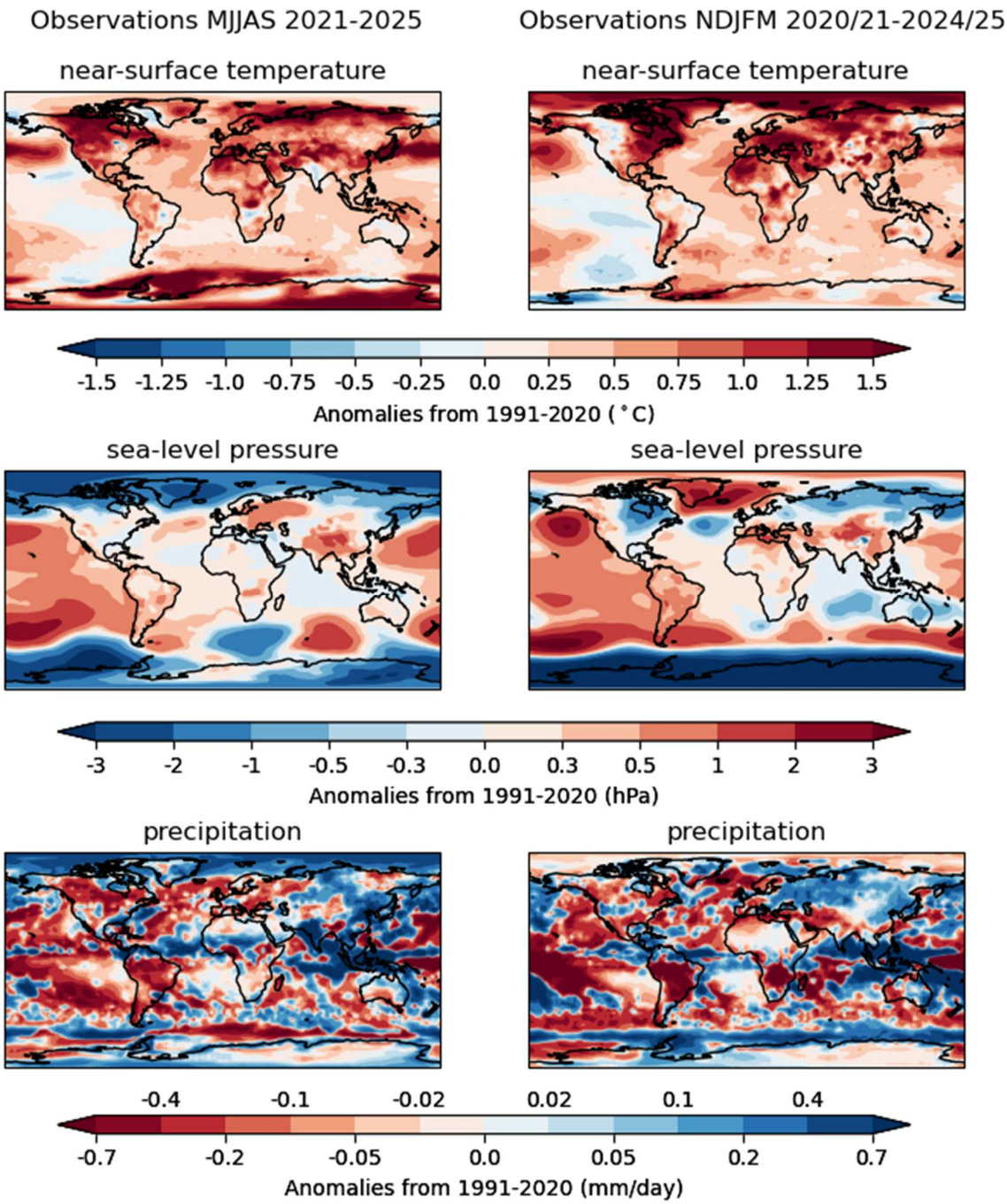

Figure 2: Observed five-year seasonal mean near-surface temperature (°C, top), pressure (hPa, middle) and precipitation (mm/day, bottom) anomalies relative to 1991-2020. *The left column shows anomalies for May to September averaged over 2021-2025, the right column shows anomalies for November to March averaged over 2020/2021-2024/2025. Observational datasets are the same as those in Figure 1.*

Annually averaged global (land and sea) mean near-surface temperature has increased continuously over recent decades (Figure 3). The last three years, 2023-2025, are the warmest years on record. According to the WMO *State of the Global Climate,* the last eleven years are also the hottest on record, primarily due to the rising atmospheric concentration of carbon dioxide. Atlantic Multidecadal Variability (AMV) anomalies in the last five years are positive since near-surface temperatures in the North Atlantic have been warmer than the rest of the oceans. After a string of three negative (La Niña) December to February seasons, the tropical East Pacific had warm anomalies at the beginning of 2024 (El Niño). This was followed by La Niña in the last two December to February seasons.

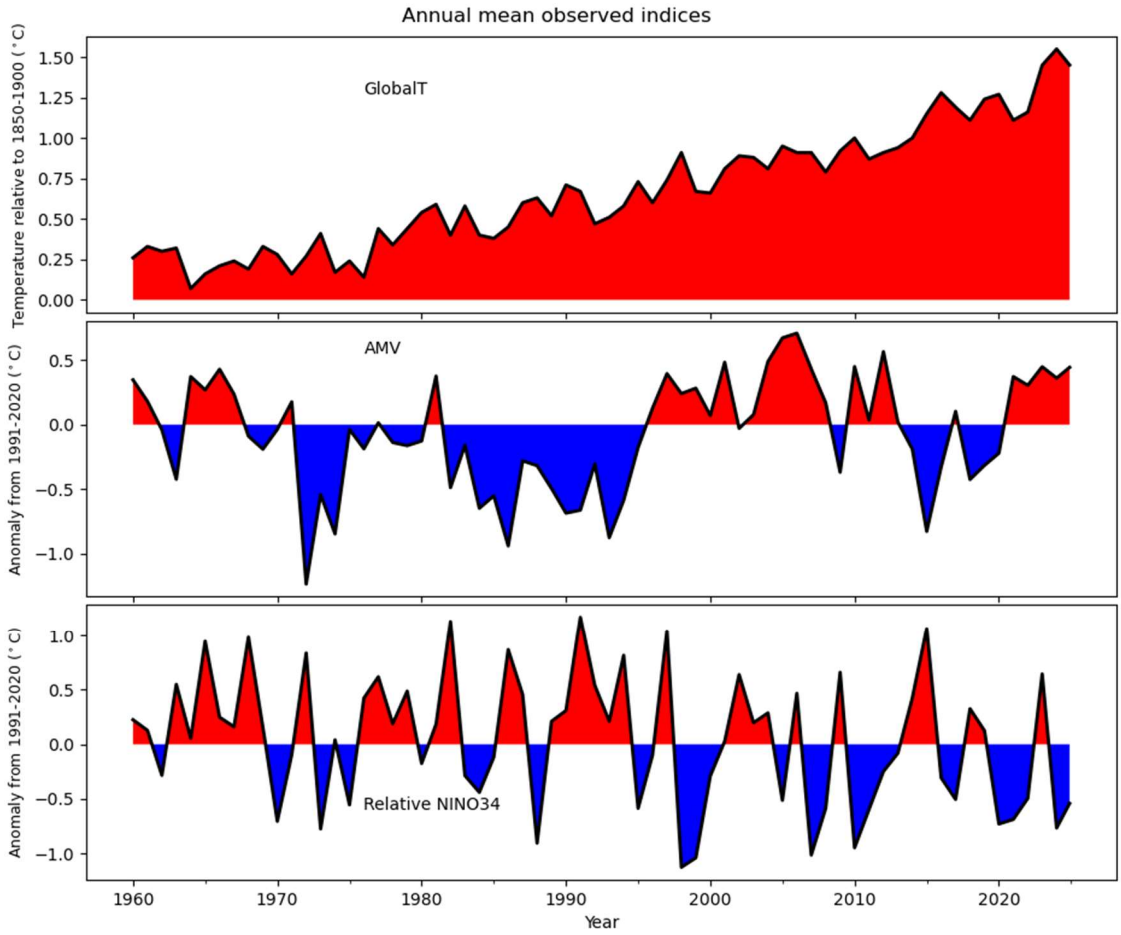

Figure 3: Observed climate indicators. *Global annual mean near-surface temperature anomaly (top), annual mean Atlantic Multidecadal Variability (AMV) defined as the difference between two regions: 45°N-60°N,60°W-0°E minus 45°S-0°S, 30°W-10°E as in Roberts et al, 2013 (middle) and December to February Niño 3.4 defined as the average over 5°S-5°N, 170°W-120°W with the tropical average 20°S-20°N removed as in van Oldenborgh et al, 2021 (bottom). Nine datasets are used in the calculation of global near-surface temperature and are the same as in the WMO State of Global Climate 2025 report. Anomalies are with respect to 1850-1900. The other two indices are based on 2m temperature from ERA5 as in Figure 1 and anomalies are relative to the 1991-2020 reference period.*

Predictions from the WMO Lead Centre

Predictions of climate indices and global fields are obtained from multi-model initialised annual-to-decadal climate predictions contributed to the WMO Lead Centre for Annual to Decadal Climate Prediction. For this year's update there are 250 ensemble members from prediction systems contributed by 13 different institutes, including four Global Producing Centres: Barcelona Supercomputer Centre, Canadian Centre for Climate Modelling and Analysis, Deutscher Wetterdienst, and the Met Office. Predictions are either started from the conditions on 1 November 2024 or 1 January 2025, depending on the decadal prediction system. Retrospective forecasts, or hindcasts, covering the period 1960-2018 are used to estimate forecast skill. Uninitialised historical simulations and projections are from the World Climate Research Programme's Coupled Model Intercomparison Project phase 6 (CMIP6). Please consult the "How to Use the Global Annual to Decadal Climate Update" section of this report for information on forecast confidence and see Hermanson et al (2022) for background information.

Predictions of Global Climate Indicators

Annually averaged global near-surface temperatures are likely to continue at or near record levels in the five-year period 2026-2030 and stay well above annual mean temperatures seen in the last 60 years (Figure 4). Annually averaged global mean near-surface temperature for each year in this five-year period is predicted to be between 1.3°C and 1.9°C (90% confidence interval) higher than the average for the period 1850-1900[1].

The chance of the annually averaged global near-surface temperature exceeding 1.5°C above 1850-1900 levels for at least one of the next five years has been increasing with time. For 2026-2030 it is now very likely (91%, brown histogram and right-hand axis in Figure 4). The five-year mean is predicted to be between 1.4°C and 1.8°C (90% confidence interval) and it is likely (75%) that the five-year mean will also exceed 1.5°C. Note that the 1.5°C level specified in the Paris Agreement refers to long-term level of warming inferred from global temperatures, typically over 20 years. Temporary exceedances of the 1.5°C level are expected to occur with increasing frequency as the underlying rise in global temperature approaches this level. It is exceptionally unlikely (<1%) that at least one year exceeds 2°C in 2026-2030.

The chance of one or more annual global near-surface temperature records in the next five years is 86% (the current record is 1.55°C in 2024). The chance of the five-year mean for 2026-2030 being higher than the last five-year mean is 91%. Confidence in forecasts of annually averaged global mean near-surface temperature is high since hindcasts show very high skill in all measures (right-hand panels of Figure 4).

[1] Forecasts are produced relative to 1991-2020 and then the difference between this period and 1850-1900 derived from observations is added. This difference is most likely 0.88°C, but is uncertain due to the incomplete observational network in the 19th century and could be as low as 0.72°C or as large as 0.99°C.

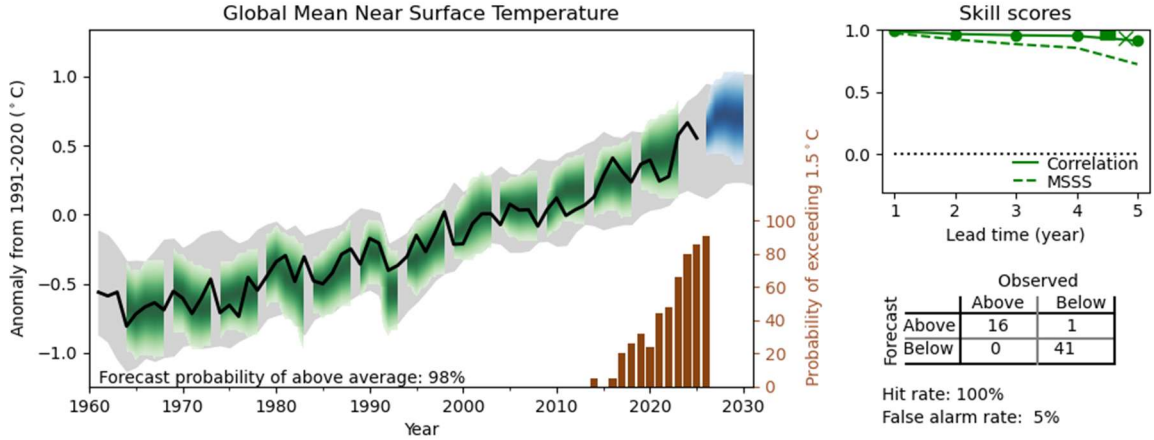

Figure 4: Multi-annual predictions of global mean near-surface temperature relative to 1850-1900. *Annual global mean observations (see Figure 3) in black, forecast in blue, hindcasts in green. Shading indicates the 90% confidence interval. Grey shading shows the 90% confidence interval of uninitialised simulations. The calibrated probability for the five-year-mean forecast to be above the 1991-2020 average is given at the bottom of the main panel. Hindcast skill scores are shown in the upper right panel; the square and the cross show the correlation skill and Mean Square Skill Score (MSSS) for five-year means, respectively. Statistically significant correlation skill (at the 5% confidence level) is indicated by solid circles/square. The contingency table for the prediction of above-average five-year means (compared to 1991-2020) is shown in the bottom right panel. Also inset in the main panel, in brown, referring to the right hand axis, is the probability of global temperature exceeding 1.5°C above 1850-1900 levels for at least one of the five following years, starting with the year indicated. This probability is calculated as in Smith et al (2018) by counting the proportion of ensemble members that predict at least one year above 1.5°C.*

Predictions indicate a 75% calibrated probability (Bett et al, 2022) that Atlantic Multidecadal Variability (AMV) index will be positive on average over the next five years (Figure 5). The hindcasts have medium skill in both measures and a medium hit rate, giving medium confidence in this prediction. The North Atlantic subpolar gyre, the main centre of action of the AMV, has had positive near-surface temperature anomalies in the last five years (Figure 1). Some predictions from the contributing centres indicate a return to cool temperatures in the next five years, but most predict continued warming of the region (individual centre contributions can be seen on the website). Predictions for the Atlantic Meridional Overturning Circulation (AMOC), which is related to AMV and shows a decrease, can be found in the Appendix.

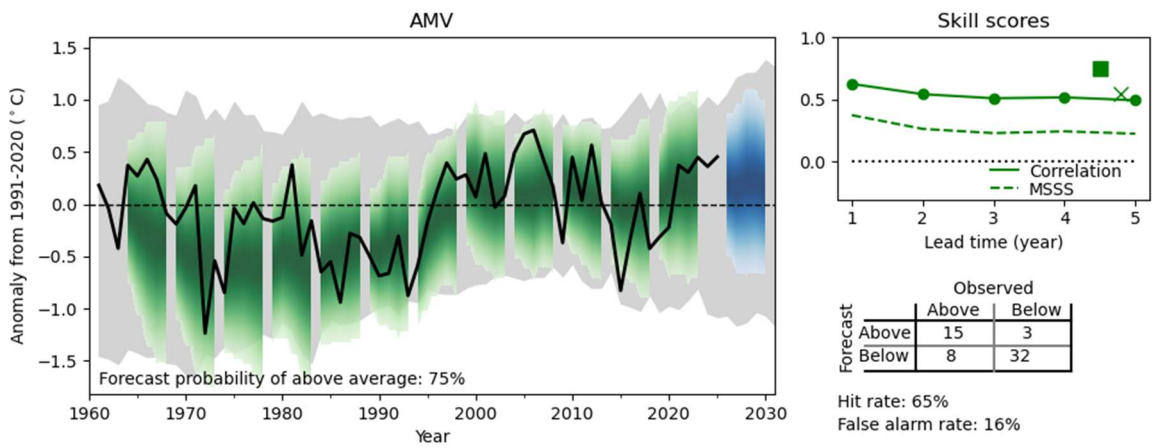

Figure 5: Multi-annual predictions of Atlantic Multidecadal Variability (AMV) relative to its 1991-2020 average, defined as the anomaly difference between two regions: 45°N-60°N, 60°W-0°E minus 45°S-0°S, 30°W-10°E as in Roberts et al (2013). *Annual mean observations in black, forecast in blue, hindcasts in green. Shading indicates the 90% confidence interval. Grey*

shading shows the 90% confidence interval of unininitialised simulations, indicating the degree to which forecasts reduce the uncertainty compared to projections. The calibrated probability (as in Bett et al, 2022) for the most likely category (above or below climatology) of the five-year-mean forecast is given at the bottom of the main panel. Hindcast skill scores are shown in the upper right panel; the square and the cross show the correlation skill and Mean Square Skill Score (MSSS) for five-year means, respectively. Statistically significant correlation skill (at the 5% confidence level) is indicated by solid circles/square. The contingency table for the prediction of above/below average five year means is shown in the bottom right panel.

The year of 2026 started with La Niña conditions in the tropical East Pacific. These anomalies are predicted to decline and the Niño 3.4 region is predicted to show positive anomalies (El Niño) for December 2026 – February 2027. There is a large ensemble spread (±0.5 °C) and skill is medium for 1 year ahead (Figure 6). There are indications that the following December 2027 – February 2028 may also have positive anomalies, but skill for the two years ahead is low. The five-year average temperature in the Niño 3.4 region relative to the whole tropics has a 64% calibrated probability of being above average, indicating a small signal for dominance of El Niño in this period. Skill is medium, giving medium confidence in this forecast.

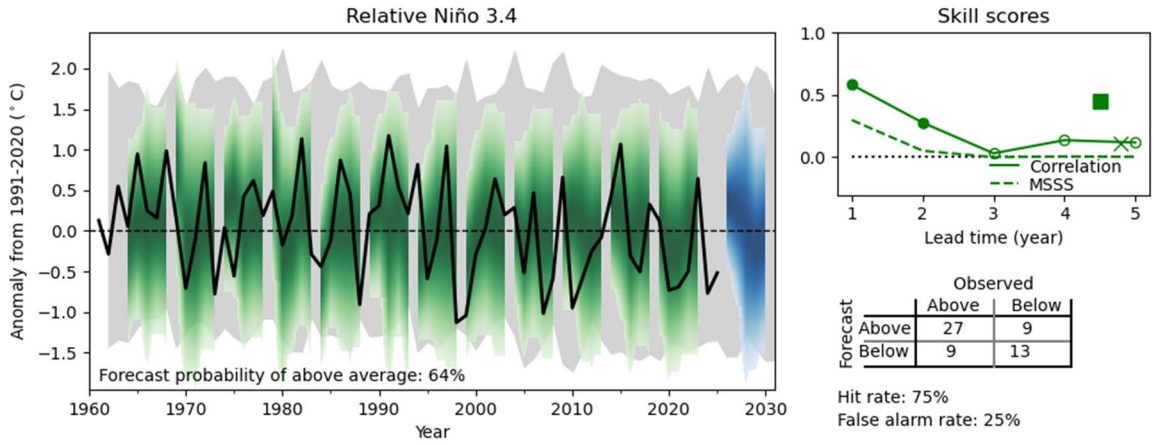

Figure 6: As Figure 5, but for December-February averaged Niño 3.4 relative to the tropical mean defined as the average over 5°S-5°N, 170°W-120°W with average over 20°S-20°N removed*. This index is suitable for a warming climate (van Oldenborgh et al, 2021).*

Regional Predictions for 2026

Near-surface temperatures in 2026 are predicted to be higher than the 1991-2020 average in almost all regions across the globe, except for parts of the South Pacific (Figure 7). The stippled regions in Figure 7 indicate where the different prediction systems disagree on the sign of the anomaly. The regions showing below-average temperatures are stippled, which implies low confidence in whether the forecasts for these regions will be above or below normal. Skill is estimated from hindcasts (Figure 8) giving medium to high confidence in the forecast in most regions.

Sea-level pressure forecasts suggest the Aleutian Low will remain weak and anomalous high pressure is likely over the South Pacific. The skill gives medium confidence in this prediction. The pattern of low pressure over Antarctica and high pressure over the southern hemisphere mid-latitudes is consistent with a positive Antarctic Oscillation index (see also Figure 21). The skill for these regions gives medium to low confidence.

Predicted precipitation patterns show an increased chance of wetter conditions in the African Sahel due to a northward shifted Intertropical Convergence Zone (ITCZ) in the Atlantic, likely due to the relatively warm North Atlantic and positive AMV. Northern high latitudes are likely to have above average precipitation, consistent with climate change projections. Parts of Brazil are likely to be drier

than usual. The correlation skill for precipitation in hindcasts is low (but significant) in these regions, giving low confidence in the forecast.

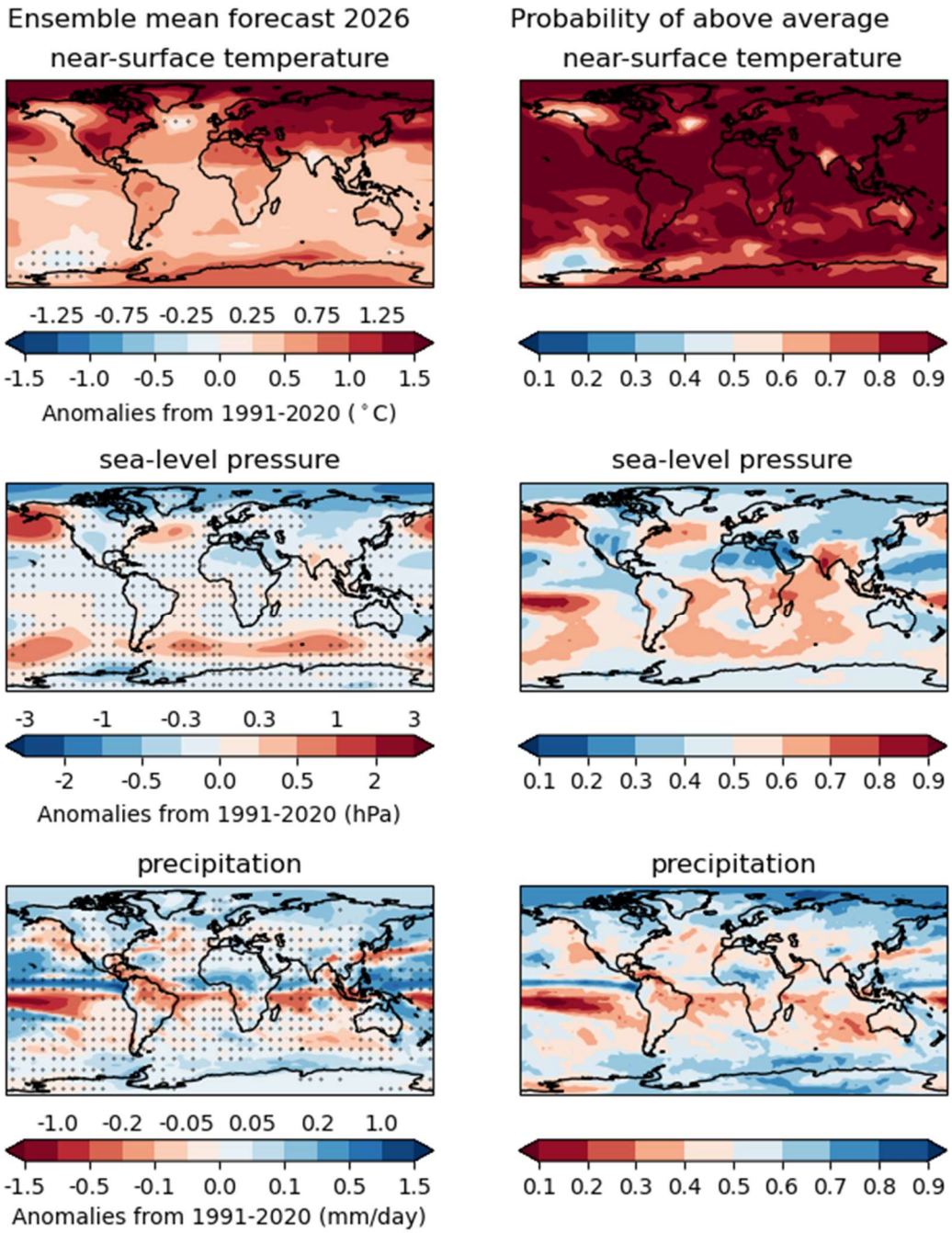

Figure 7: Annual mean anomaly predictions for 2026 relative to 1991-2020. *Ensemble mean (left column) for temperature (top, °C), sea level pressure (middle, hPa), precipitation (bottom, mm/day), stippled where more than 1/3 of prediction systems disagree on the sign of the anomaly, and probability of above average (right column). As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

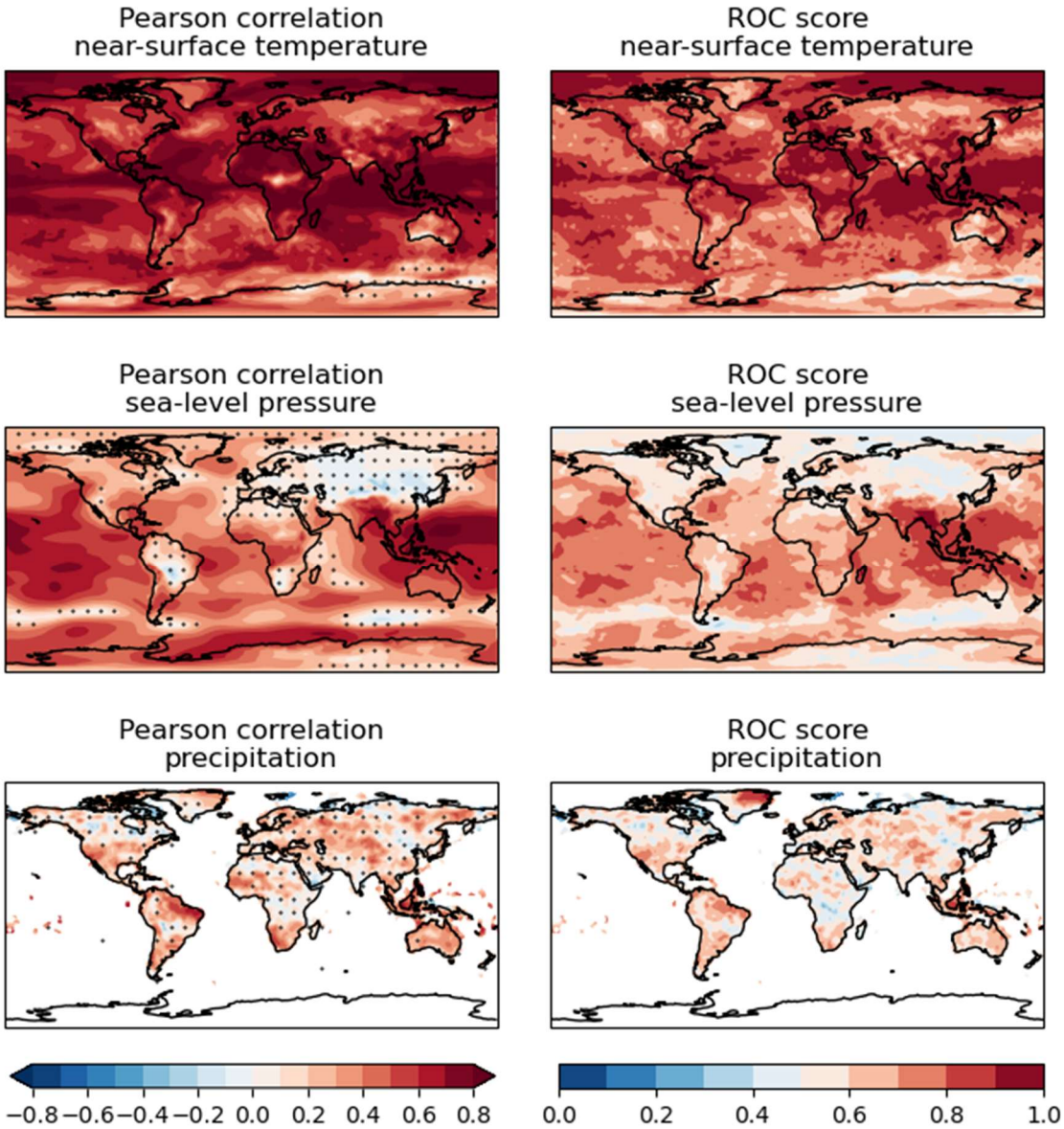

Figure 8: Prediction skill of annual means evaluated using hindcast experiments. *Pearson correlation (left) and ROC score for predictions of above average conditions (right). For correlation stippling shows where skill is insignificant (at the 5% level).*

Regional Predictions for 2026-2030

This section shows predictions for the average of the next five extended seasons for May to September and November to March.

For the May to September average, predicted temperature patterns over the years 2026-2030 show a high probability of temperatures above the 1991-2020 average almost everywhere, with enhanced warming over land in the northern hemisphere (Figure 9). High or very high skill gives high confidence in this prediction (Figure 10).

For the same season, sea-level pressure is predicted to be anomalously low over the Mediterranean and North America. There is some skill in the hindcasts for these regions and these negative anomalies have appeared in forecasts over the last few years, but so far they have not appeared consistently in the observations. Anomalously high pressure is predicted over the South Pacific and the mid-latitudes of the other oceans in the Southern Hemisphere. These anomalies have also appeared in the observations in the last five years (Figure 2). The skill for most of these regions gives low to medium confidence. Predictions of precipitation show wet anomalies in the Sahel, northern Europe, Alaska and Siberia, and dry anomalies for this season over the Amazon. Skill gives low to medium confidence.

For the November to March average over the years 2026/27-2030/31 (Figure 11), the predictions again show that warm anomalies are likely almost everywhere, with land temperatures showing larger anomalies than those over the ocean. The Arctic (north of 60°N) near-surface temperature anomaly for this season is predicted to be 2.8°C above 1991-2020 average, which is more than three and half times larger than the global mean anomaly with respect to the same period. The North Atlantic subpolar gyre, the location of the so-called “warming hole”, has been linked to a reduction in the AMOC and changes to regional winds. This is an area where the prediction systems disagree on the sign of the anomaly, but consistently show colder temperatures than the rest of the North Atlantic. Skill is high in most regions except for parts of the North Pacific, some areas in Asia, Australia, and the Southern Ocean (Figure 12), giving medium to high confidence.

There will likely be a positive pressure anomaly over the tropical west and central Pacific. At high latitudes, there is a negative pressure anomaly predicted and a positive anomaly in the North Atlantic (though prediction systems disagree on the latter) implying increased likelihood of positive North Atlantic Oscillation (NAO) conditions in this period. The skill over the tropical Pacific gives medium confidence for the prediction there, but there is low confidence in the NAO prediction due to lower skill in these regions.

Precipitation predictions favour wetter than average conditions at high latitudes in the northern hemisphere for the next five extended winter seasons (November to March). The pattern of increased precipitation in the tropics and high latitudes compared to the 1991-2020 reference period, and reduced precipitation in the subtropics, particularly in the southern hemisphere, is consistent with expectations of a warming climate. Skill cannot be measured over the oceans due to lack of observations, and is moderate over large parts of northern Eurasia, Greenland, and the Canadian Arctic Archipelago giving low to medium confidence in the forecast for an increased chance of precipitation in these regions.

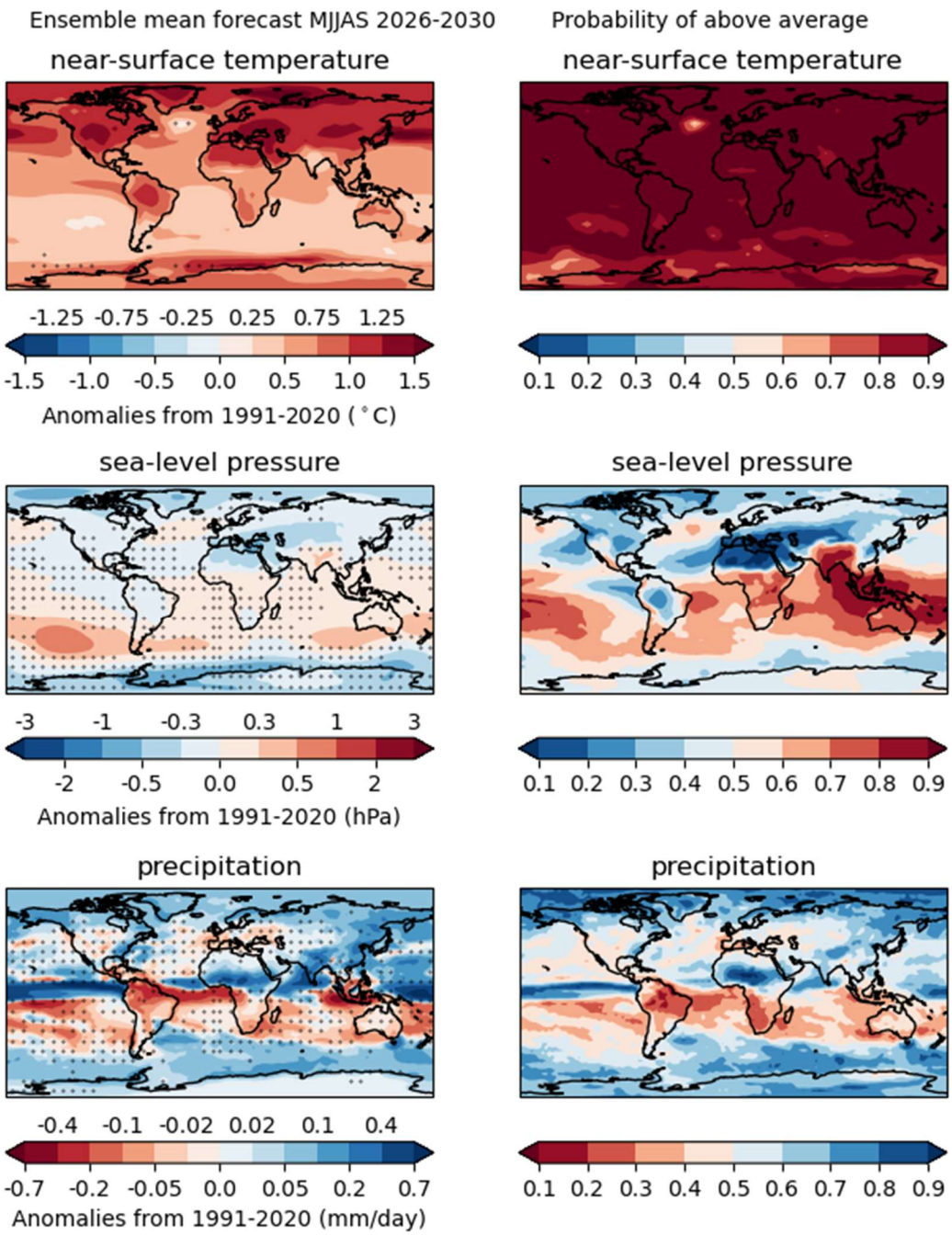

Figure 9: Predictions for 2026-2030 May to September anomalies relative to 1991-2020. *Ensemble mean (left column) for temperature (top, °C), sea level pressure (middle, hPa), precipitation (bottom, mm/day), stippled where more than 1/3 of prediction systems disagree on the sign of the anomaly, and probability of above average (right column). As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

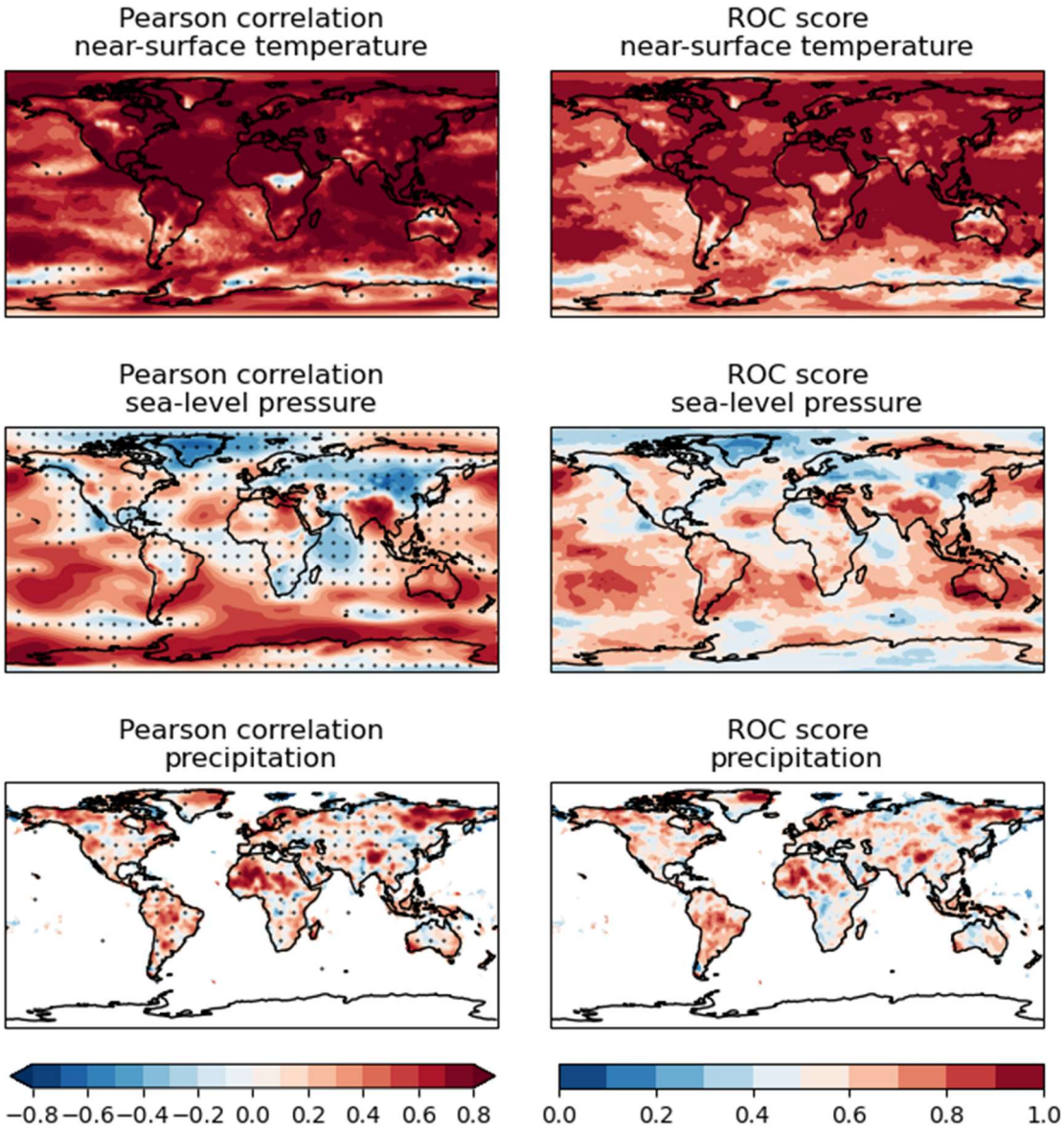

Figure 10: Prediction skill of five-year mean May to September anomalies evaluated using hindcast experiments. *Pearson correlation (left) and ROC score for predictions of above average conditions (right). For correlation stippling shows where skill is not significantly positive (at the 5% level).*

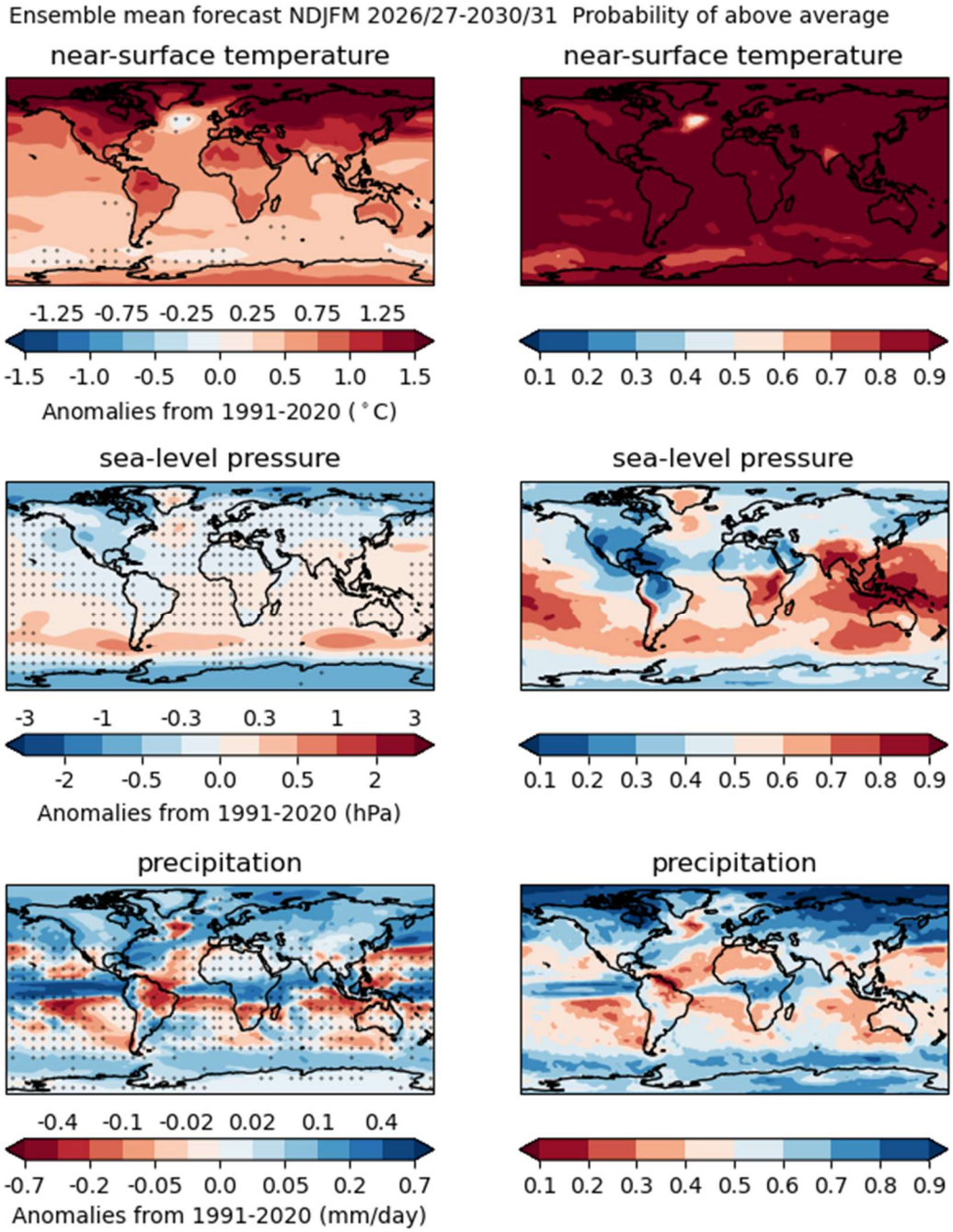

Figure 11: Predictions for 2026/2027-2030/2031 November to March anomalies relative to 1991-2020. *Ensemble mean (left column) for temperature (top, °C), sea level pressure (middle, hPa), precipitation (bottom, mm/day), stippled where more than 1/3 of prediction systems disagree on the sign of the anomaly, and probability of above average (right column). As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

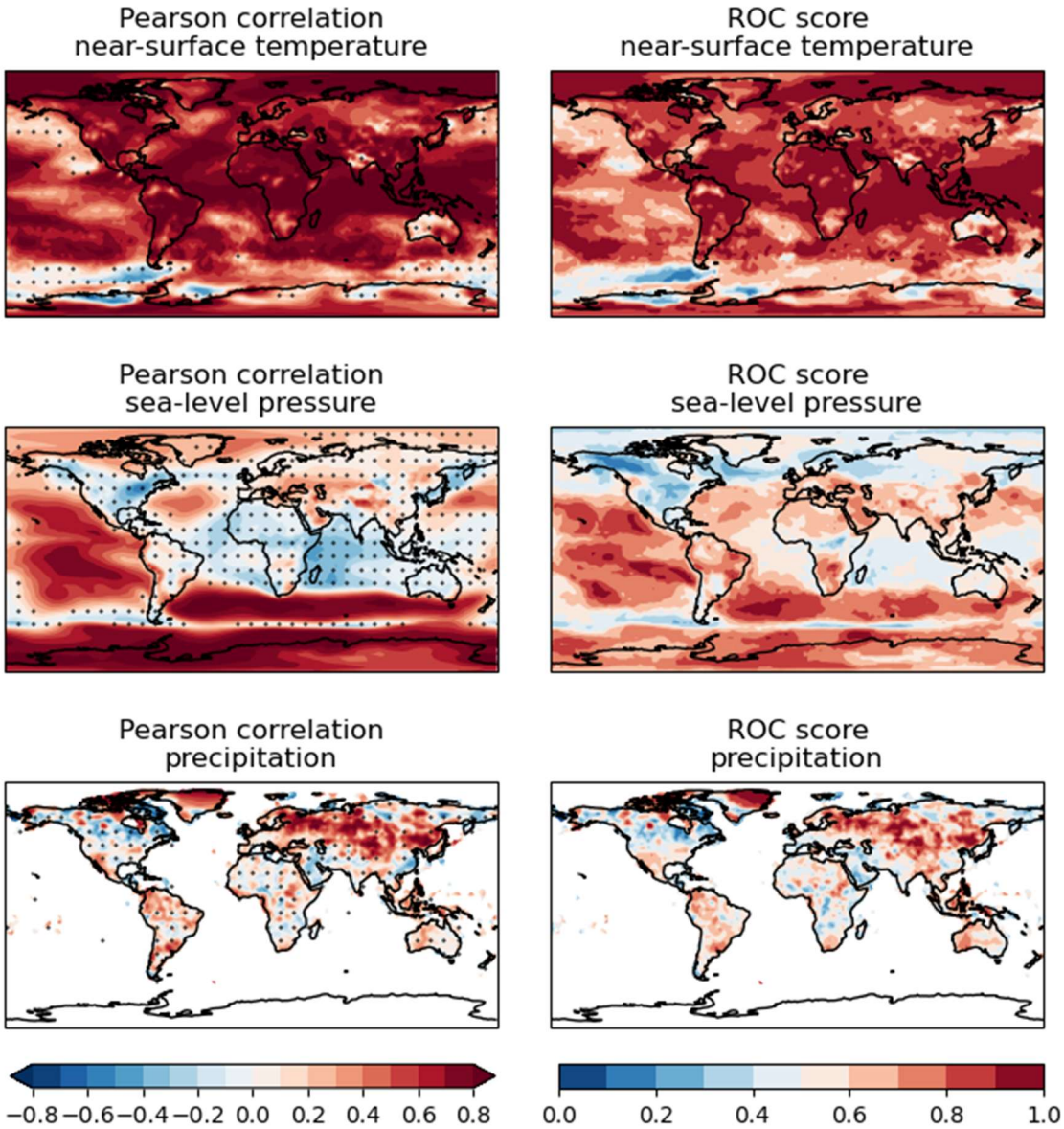

Figure 12: Prediction skill of five-year means November to March anomalies evaluated using hindcast experiments. *Correlation (left) and ROC score for predictions of above average conditions (right). For correlation stippling shows where skill is not significantly positive (at the 5% level).*

Regional Predictions for 2026-2035

This section shows predictions out to ten years into the future. As many readers will be familiar with climate projections, we compare what the initialised predictions show compared with what climate projections show. Note that projections, in contrast to predictions, do not use initial condition information and are therefore not in phase with decadal climate variability. This could therefore be the source of the differences between the two. For comparison with the predictions, we use the IPCC WGI Interactive Atlas using CMIP6 projections for 2021-2040, SSP2-4.5 and the 1995-2014 baseline. The periods and the models are not the same as used for the predictions, but for the multi-model mean there is enough commonality to make a comparison meaningful.

The ensemble mean forecast for 2026-2035 for near-surface temperatures (Figure 13) shows very similar signals, but with warmer anomalies, to the projections over the Amazon, North Africa,

northern Scandinavia, and the Greenland Sea. These regions also have high skill (Figure 14). Anomalies are positive, but weaker than projections, in the seas adjacent to Antarctica, and in the tropical East Pacific (the projections show an El Niño-like pattern).

The precipitation forecast for the next decade, shows compared to the projections, less rainfall over the Amazon and the eastern Indian Ocean and more precipitation over the Barents and Kara Sea and surrounding coastlines. The skill over the oceans for precipitation is not known as precipitation observations over the oceans are not available for the full verification period, which starts in 1960. Sea-level pressure is not available in the interactive atlas. The IPCC Assessment Report 6, Working Group I, Chapter 4, section 4.5.1.6.1 and Figure 4.25, show features for sea-level pressure similar to the predictions in Figure 13.

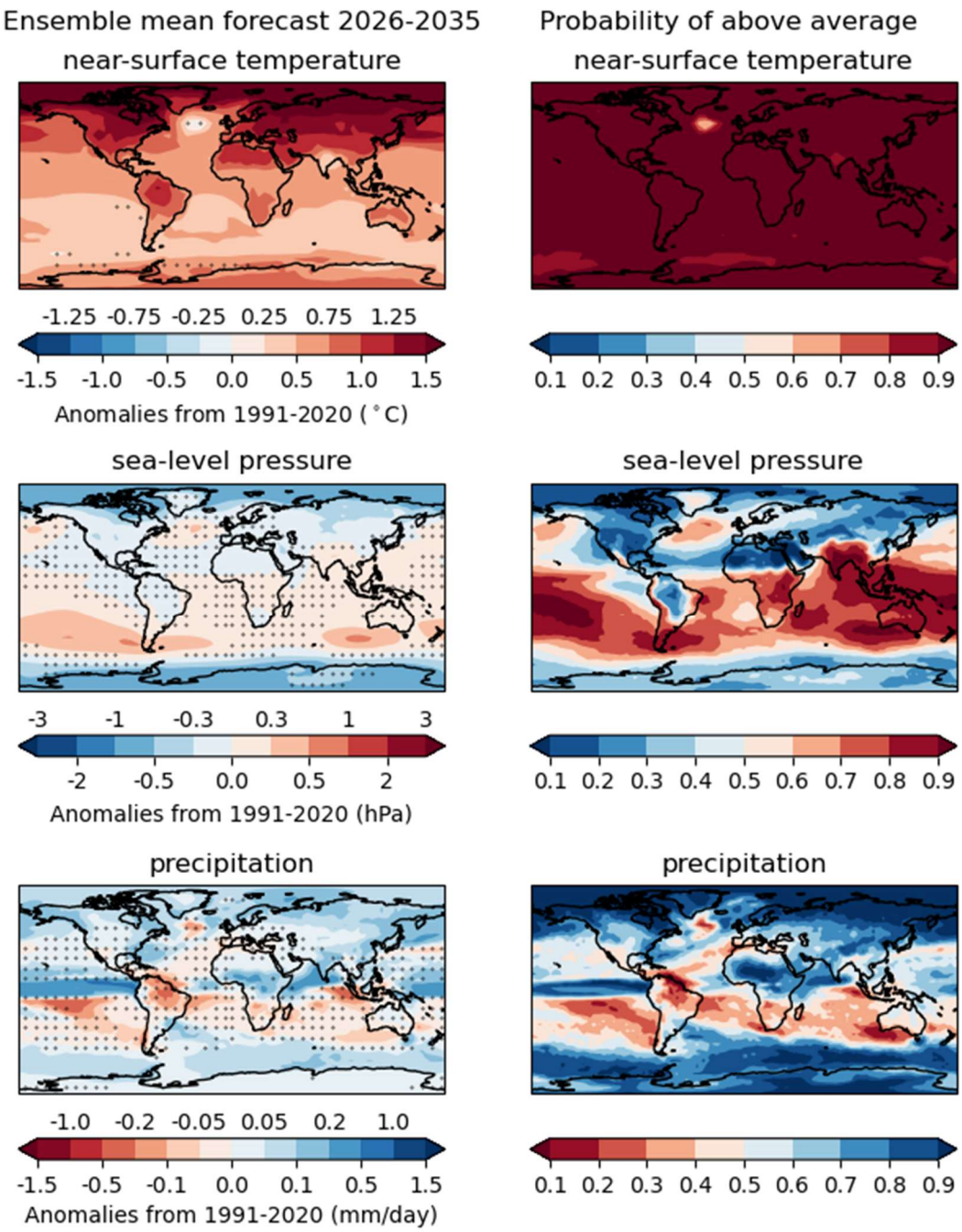

Figure 13: Predictions for 2026-2035 relative to 1991-2020. *Ensemble mean (left column) for temperature (top, °C), sea level pressure (middle, hPa), precipitation (bottom, mm/day), stippled where more than 1/3 of prediction systems disagree on the sign of the anomaly, and probability of above average (right column). As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

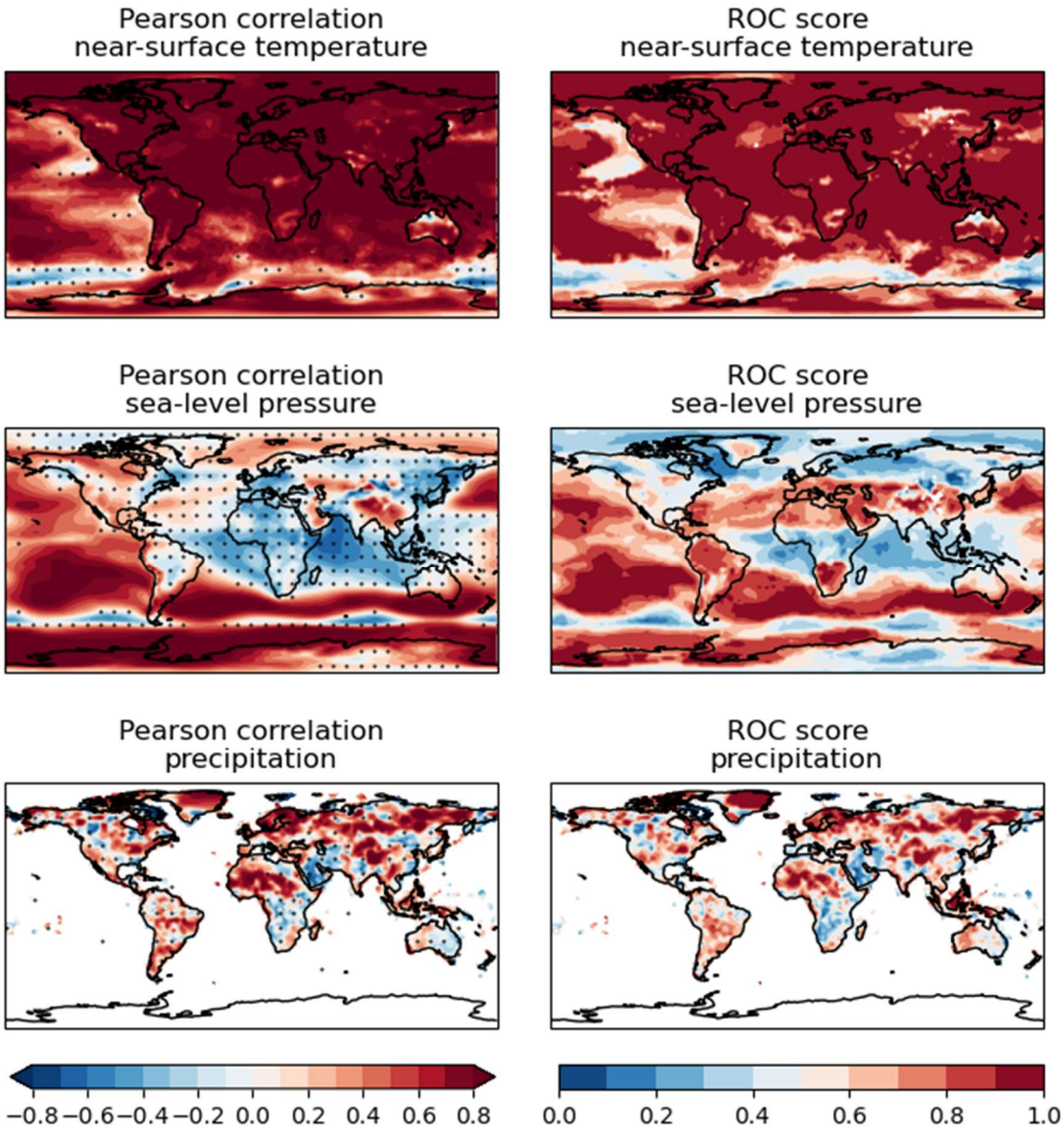

Figure 14: ***Prediction skill of ten-year mean anomalies evaluated using hindcast experiments.*** *Correlation (left) and ROC score for predictions of above average conditions (right). For correlation stippling shows where skill is not significantly positive (at the 5% level).*

Regional Forecast Indices

This section shows an example of a regional forecast index based on notable forecast signals found in the previous section and where there is skill in the multi-model ensemble. The full set of regional forecasts and hindcasts can be found on the website under the "Regional" tab. The regions are based

on the WMO Regional Climate Outlook Forums (RCOFs) and Regional Associations. The season used for the indices is the relevant season for that region, usually the wet season or monsoon season.

The Southeastern European (SEECOF) region, considered here as an example to showcase regional forecast indices, has decadal variability in its December to February precipitation. Recent years have been anomalously dry after many years of high precipitation since 2009. The forecast suggests the 2026-2030 period is likely to have anomalously high precipitation (Figure 15). The calibrated probability of above average is 77%. Predictions for this region have low skill, so confidence is low in this prediction. Note that although the five-year-mean may be positive, this may not be the case for all the individual seasons in this period.

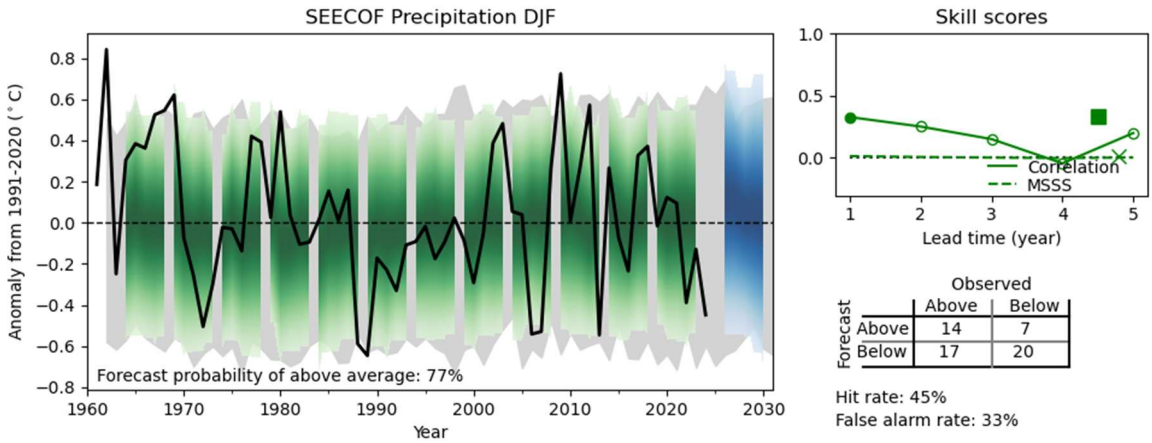

Figure 15: As Figure 5, but for December to February (DJF) averaged precipitation over the Southeastern Europe (SEECOF) region.

Sea ice Forecasts

Sea ice forecasts are challenging for current decadal prediction systems. This can be seen by inspecting the sea-ice concentration maps which are shown (under the "Forecasts" tab) and sea-ice extent timeseries (under the "Timeseries" tab) on the website. Although there is a wide range of mean states and forecast skill, the multi-model ensemble mean is skilful, and these forecasts are issued to stimulate conversations to further improve this aspect of annual-to-decadal predictions.

The sea-ice concentration anomalies (Figure 16) for the Arctic in March (the time of maximum ice extent) show predicted reductions for 2026-2035 in the Barents Sea, Bering Sea, and Sea of Okhotsk. There is also agreement for reductions in the Greenland Sea and Labrador Sea. Skill is high in the North Atlantic and medium in the Pacific for these predictions (Figure 17). For Arctic sea ice in September (minimum extent) 2026-2035, reductions of more than 10% sea ice concentration are predicted for all regions that normally have sea-ice at this time of year. There is high skill in predicting anomalies at the sea-ice edge, so there is high confidence for these reductions, except in parts of the Arctic Archipelago where there is low confidence.

For Antarctic September (maximum extent) the predictions show a high probability of below normal sea ice along the climatological sea-ice edge and an above normal probability for increased sea-ice concentration in the Weddell Sea. Correlation skill gives low-to-medium confidence in this prediction. Many prediction systems have unrealistically low sea ice in Antarctica in March and so there is little

agreement on anomalies (stippling) and skill is low except for near the coast of Ellsworth Land where reductions are predicted.

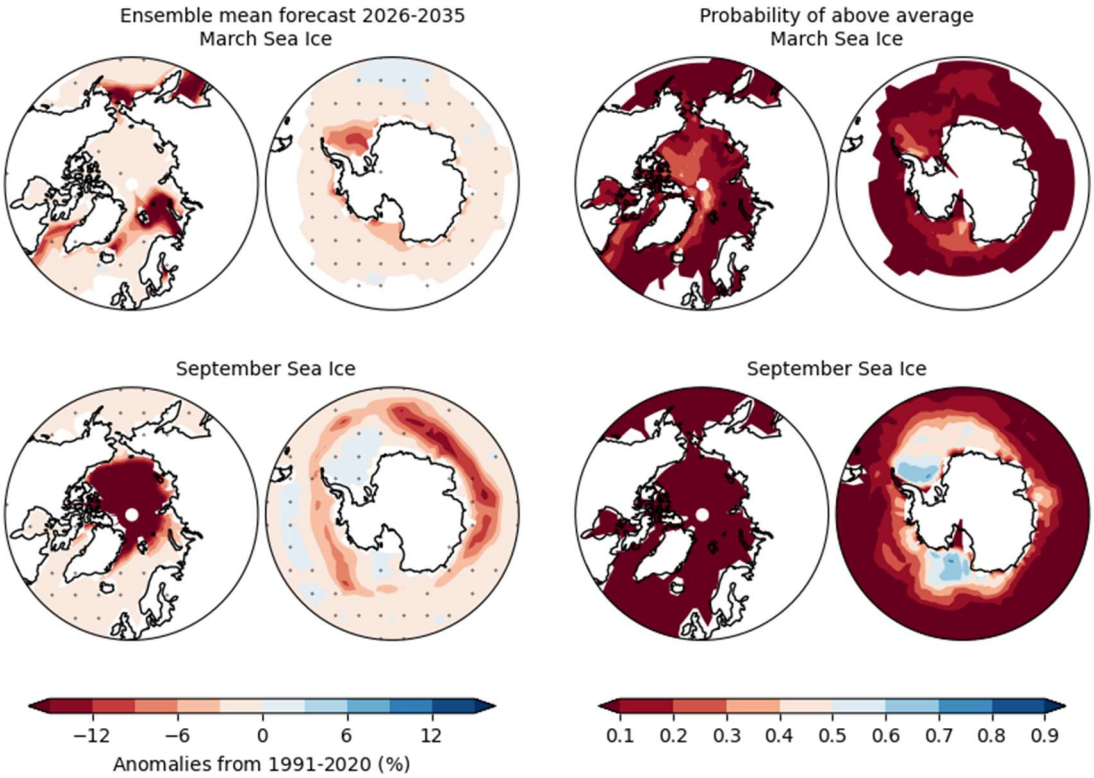

Figure 16: Predictions for 2026-2035 March and September sea-ice concentration anomalies relative to 1991-2020. *Ensemble mean (left column) for March (top, %) and September (bottom, %), stippled where more than 1/3 of prediction systems disagree on the sign of the anomaly, and probability of above average (right column). As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

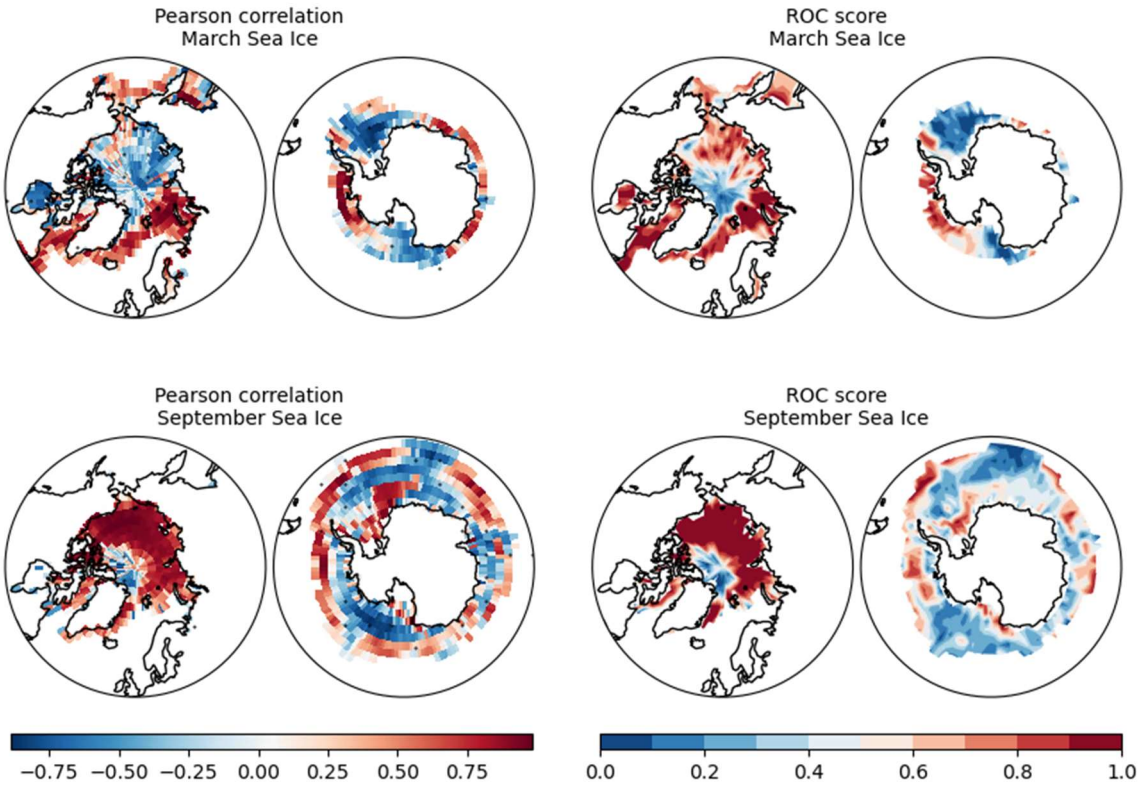

Figure 17: Prediction skill of five-year means of March and September sea-ice anomalies evaluated using hindcast experiments. *Correlation (left) and ROC score for predictions of above average conditions (right). For correlation stippling shows where skill is not significantly positive (at the 5% level).*

Evaluation of Previous Forecasts

This section assesses forecasts that were issued in real time for the most recently completed one- and five-year periods. The forecast for 2025, which was produced using simulations initialised at the end of 2024, is shown in Figure 18. Stippling in the left-hand panels indicates low confidence in the forecast when it was issued. Stippling in the right-hand panels indicates where observations are outside the predicted 90% confidence interval for the multi-model ensemble spread.

For near-surface temperatures, the forecast was good with a spatial correlation (in brackets above the observations) of 0.62. Cold anomalies over India and eastern tropical Pacific were captured by the ensemble spread, though confidence was low for the latter. Cold anomalies over southern Africa and warm anomalies over parts of Antarctica were not captured.

Sea-level pressure patterns agree reasonably well with the observations (spatial correlation of 0.49) where there was confidence in the forecast with anomalously low pressure over the Arctic and Antarctic and anomalously high pressure over much of the Pacific and Southern Ocean. However, many of the predicted anomalies are systematically too small. The ensemble spread does not encompass the largest anomalies in the Southern Ocean.

The multi-model ensemble mean predictions of precipitation captured the correct sign of anomalies in many regions (spatial correlation of 0.50), including wetter conditions in northern Europe, Asia, and the Sahel, as well as the rainfall patterns in the Pacific and Indian Ocean associated with ENSO. The confidence interval does not encompass many of the southern hemisphere high latitude dry anomalies and the dry conditions in the Amazon.

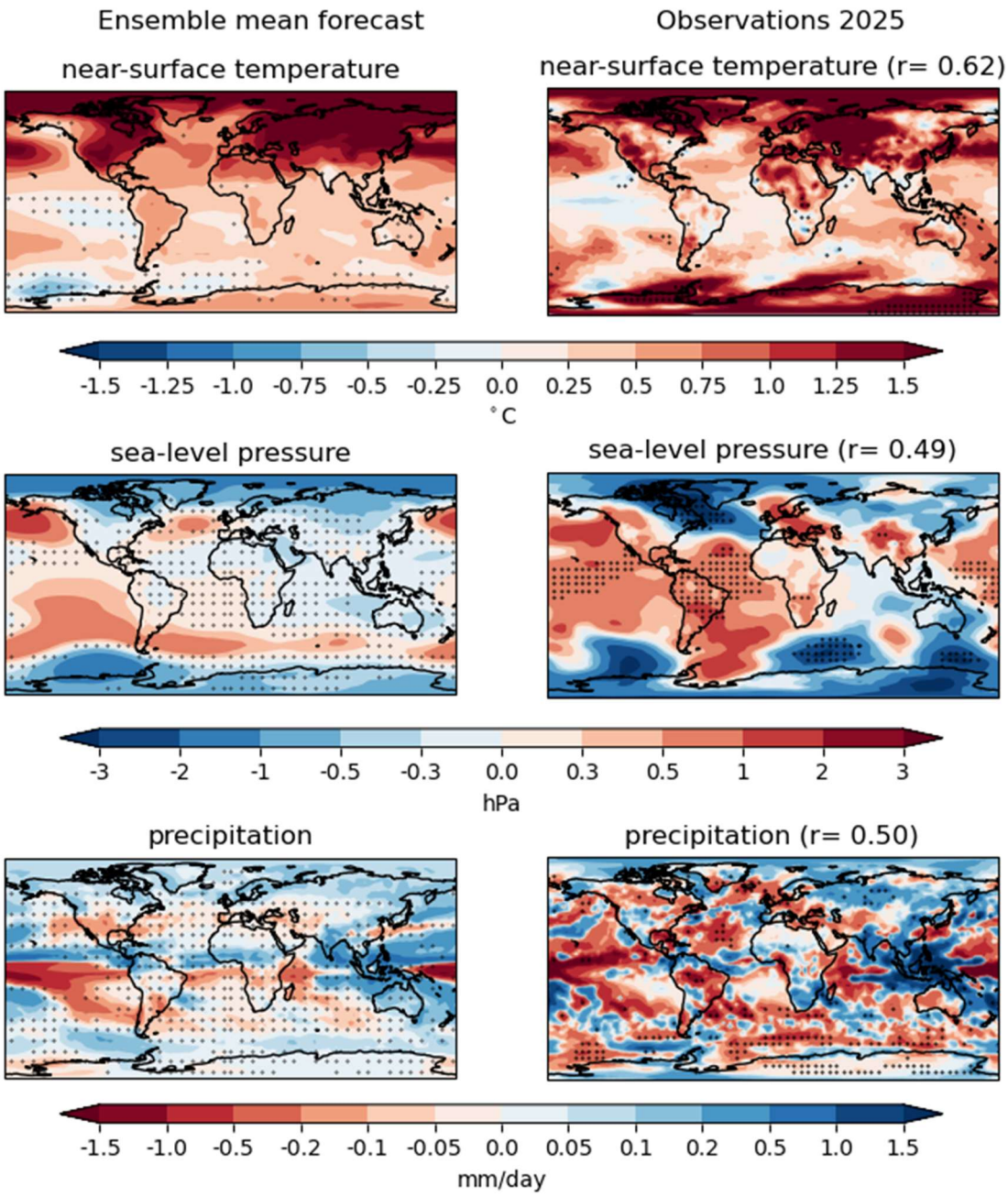

Figure 18: Evaluation of the one-year forecast for 2025 relative to 1991-2020. *Ensemble mean forecast (left) and observed (right) anomalies. Top: temperature (°C); middle: sea level pressure (hPa); bottom: precipitation (mm/day). The spatial Pearson correlation between forecast and observations is shown in brackets above the observations. Stippling on forecasts shows where more than 1/3 of prediction systems disagree on the sign of the anomaly. Stippling on the observations shows where they fall outside of the 90% range of the multi-model ensemble spread. Observations are from the same sources as in Figure 1.*

Average forecast temperature anomalies for the last five years 2021-2025 (from forecasts initialised at the end of 2020 shown relative to 1981-2010, Figure 19), generally agree well with observations (spatial correlation of 0.79) with warm conditions over the Arctic and Eurasia, and enhanced warming over the land compared to the ocean, especially in the northern hemisphere. Relatively cool conditions in the South and tropical Pacific were captured within the confidence interval of the ensemble spread. Relatively cool conditions off the Pacific coast of Mexico were not captured.

Sea-level pressure patterns show reasonable agreement with the observations (spatial correlation of 0.58), with lower-than-average pressure over the Arctic and Antarctic and higher than average pressure over most ocean regions. The low pressure over the North Atlantic was not captured. As with the one-year prediction evaluated above, the forecast anomalies are often too small and the observations are outside the multi-model ensemble spread for regions over the Pacific, Antarctica, and central Asia.

Precipitation patterns show some agreement with observations (spatial correlation of 0.38), including wetter than usual conditions across much of Asia, India and sub-Saharan Africa, and drier than usual conditions in southern Africa and in South America. The wet anomalies in East Asia and drier than normal conditions in North America and South America were not within the ensemble spread.

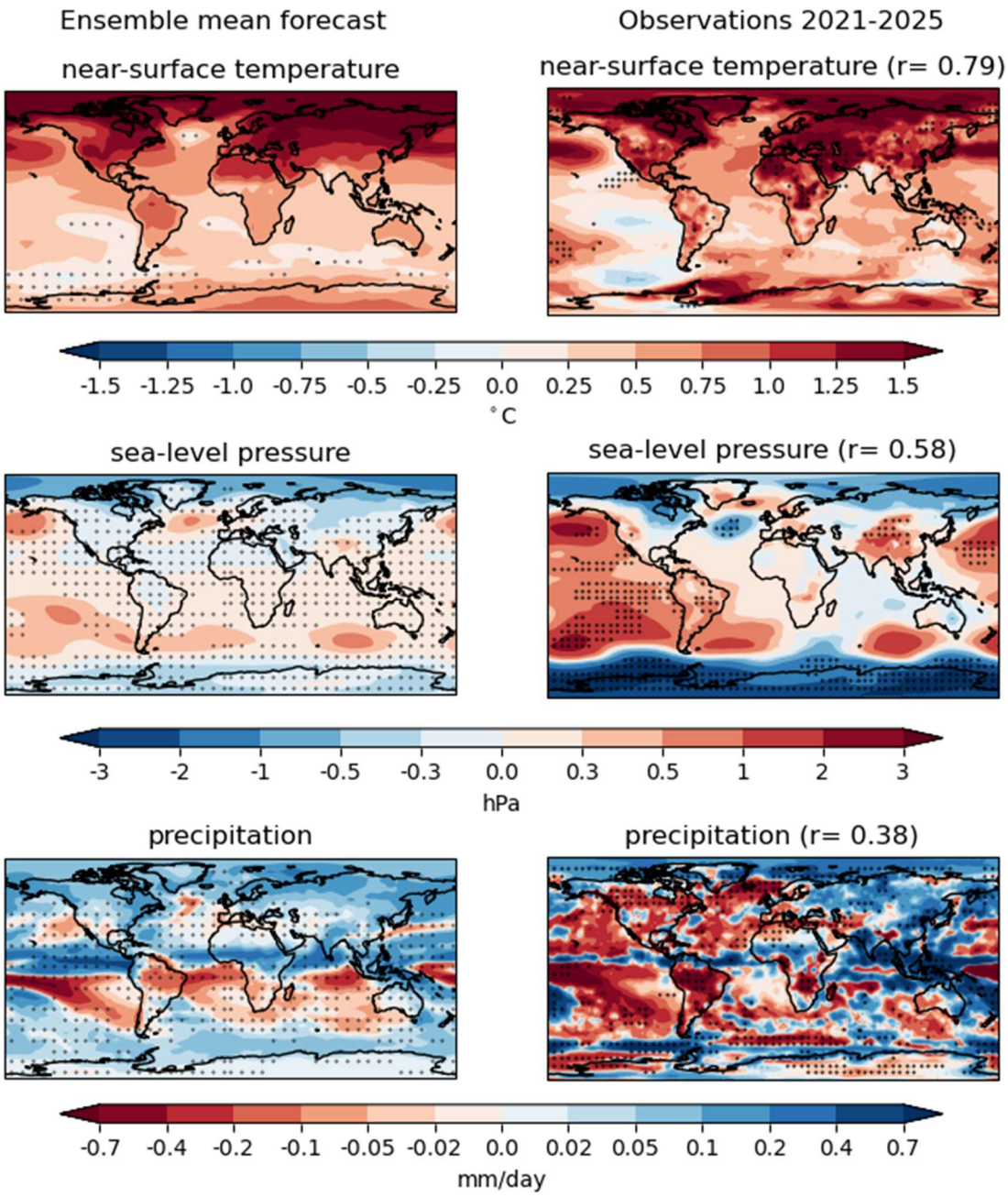

Figure 19: Evaluation of the five-year forecast for 2020-2024 relative to 1981-2010 (this was the forecast climatology at the time of issue). *Ensemble mean forecast (left) and observed (right) anomalies. Top: temperature (°C); middle: sea level pressure (hPa); bottom: precipitation (mm/day). The spatial Pearson correlation between forecast and observations is shown in brackets above the observations. Stippling on forecasts shows where more than 1/3 of prediction systems disagree on the sign of the anomaly. Stippling on the observations shows where they fall outside of the 90% range of the multi-model ensemble spread. Observations are from the same sources as in Figure 1.*

How to Use the Global Annual to Decadal Climate Update

The forecasts shown here are intended as guidance for Regional Climate Centres (RCCs), Regional Climate Outlook Forums (RCOFs) and National Meteorological and Hydrological Services (NMHSs). It does not constitute an official forecast for any region or nation, but RCCs, RCOFs and NMHSs are encouraged to appropriately interpret and develop value-added forecasts from this Climate Update.

Where the ensemble mean is shown, this only indicates the most likely outcome. Other outcomes are possible and may be almost as likely. A major volcanic eruption would change the expected climate, and in this case new forecasts will be made (Sospedra-Alfonso et al, 2024). Signals with small spatial extent are likely unreliable and will likely have lower skill. See Hermanson et al (2022) for more information.

The skill of interannual to decadal forecasts is different to that of weather and seasonal timescales and skill may vary considerably with region and season. It is important to view the forecast maps together with the skill maps provided to evaluate the confidence in a prediction. Skill and therefore the confidence in a forecast is evaluated from hindcasts. Note that skill of predictions from a given initial climate state may differ from average skill estimated over many different cases. Correlation skill is classified into five categories: very low (below 0.2, but still significant), low (between 0.2-0.4), medium (between 0.4-0.6), high (between 0.6-0.8) and very high (0.8 and higher).

Appendix – predictions for other indices

Predictions of Atlantic Meridional Overturning Circulation (AMOC) are important for the climate of countries surrounding the North Atlantic and for global heat transport. The AMOC has been measured at 26°N since 2004. The forecast for 2026-2030 (Figure 20, top row) shows below normal overturning in the subpolar gyre and weaker anomalies further South. The AMOC is usually measured close to 1000m, these negative anomalies peak below that depth. Skill cannot be evaluated due to insufficient observations, which only exist for particular locations.

The AMOC prediction for 2026-2035 (Figure 20, bottom row) shows anomalously low values in the ensemble mean below 1000m throughout the Atlantic basin. Compared to results from projections, these anomalies are deeper and extend further South (Bellomo et al, 2021). The probabilistic forecast shows very low probabilities for above average overturning below 1000m (therefore high probability for below average) in the North Atlantic. There is large variability in the ensemble (individual prediction systems are shown on the WMO Lead Centre for Annual to Decadal Climate Prediction web page, www.wmolc-adcp.org). Confidence is low as there are insufficient observations to evaluate skill.

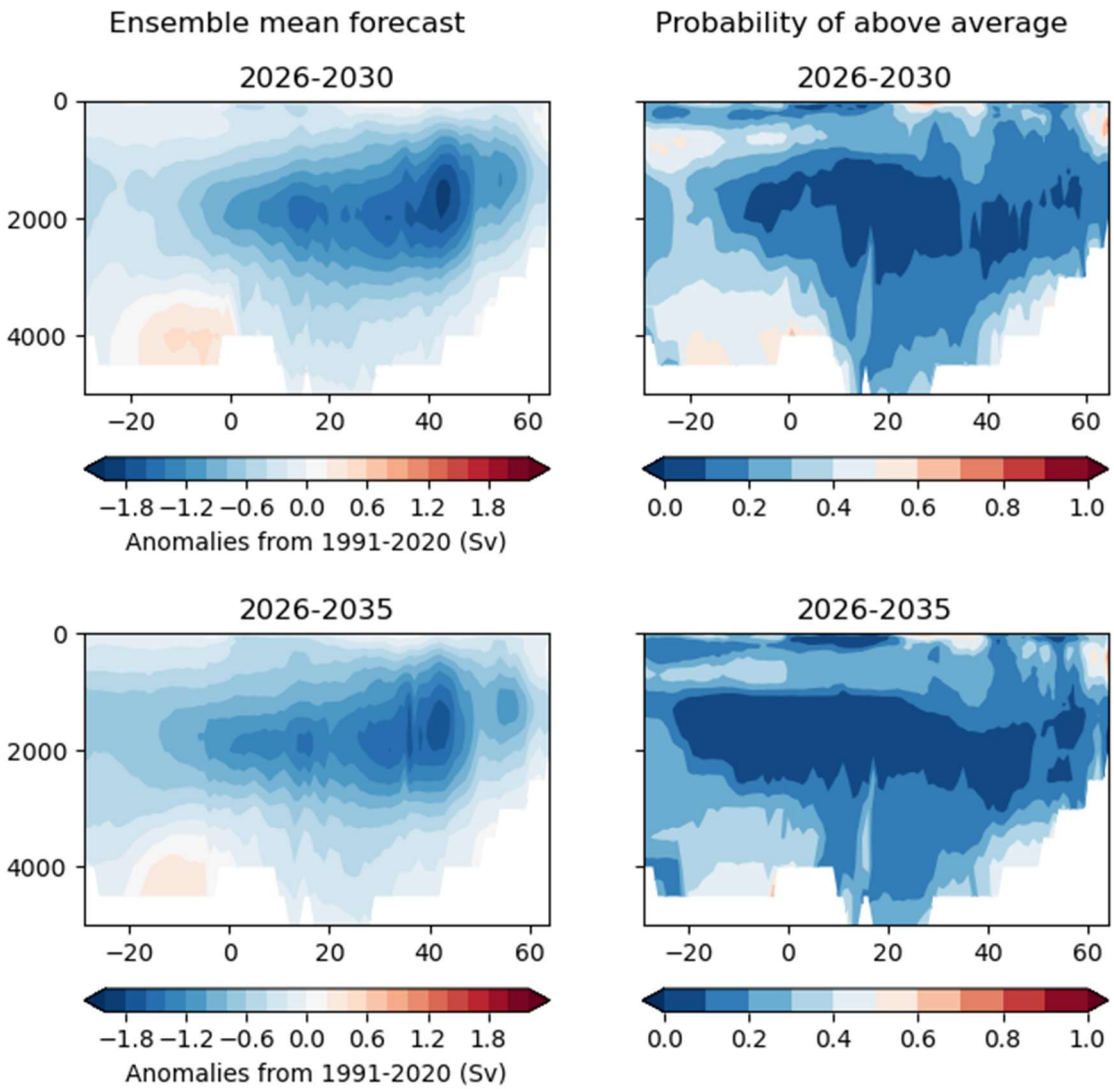

Figure 20: Atlantic Meridional Overturning Circulation (AMOC) forecast for 2026-2030 (first row) and 2026-2035 (second row) relative to 1991-2020. *The left column shows the ensemble mean streamfunction prediction and the right column shows the probability of a stronger than average AMOC. As this is an uncalibrated two-category forecast, the probability for below average is one minus the probability shown in the right column.*

The AMOC close to 30°N is predicted to be near or slightly below recent observed values (Figure 21). After a stable period since the strong decline observed during the 2000s, the AMOC is predicted to decline at a rate similar to climate projections. However, confidence in this forecast is low because there are insufficient past observations to evaluate skill and a recent hindcast (rightmost green plume) predicted a stronger AMOC than was measured. Note that the AMV (Figure 5) is predicted to likely be positive despite the weaker AMOC predicted here.

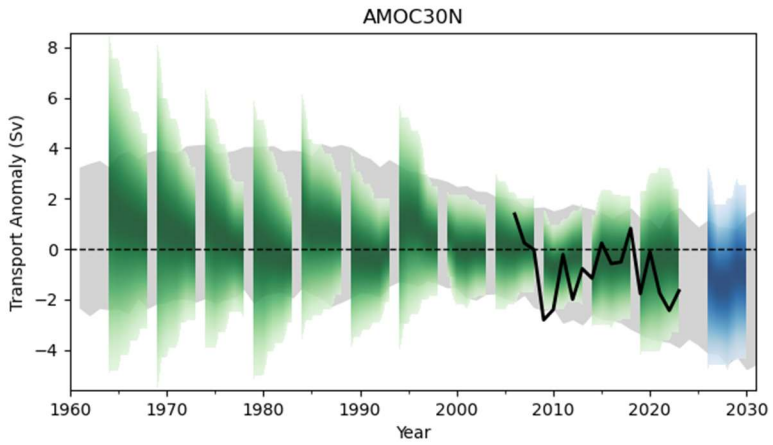

Figure 21: Atlantic Meridional Overturning Circulation close to 30°N and 1100m as in Roberts et al (2013). *RAPID observations (26°N) in black (anomalies relative to its full time series 2005-2021 and then adjusted to 1991-2020 using CMIP6 AMOC) and forecast in blue.*

A positive phase of Pacific Decadal Variability (PDV) is characterised by warm anomalies in the tropical eastern Pacific and cold anomalies in the central North Pacific. Predictions for the next five years show warming in both these regions and therefore do not show a typical PDV pattern. Nevertheless, the PDV index used here is predicted to be negative during 2026-2030 with an 81% calibrated probability (Figure 22). This is consistent with the trend seen since 1990.

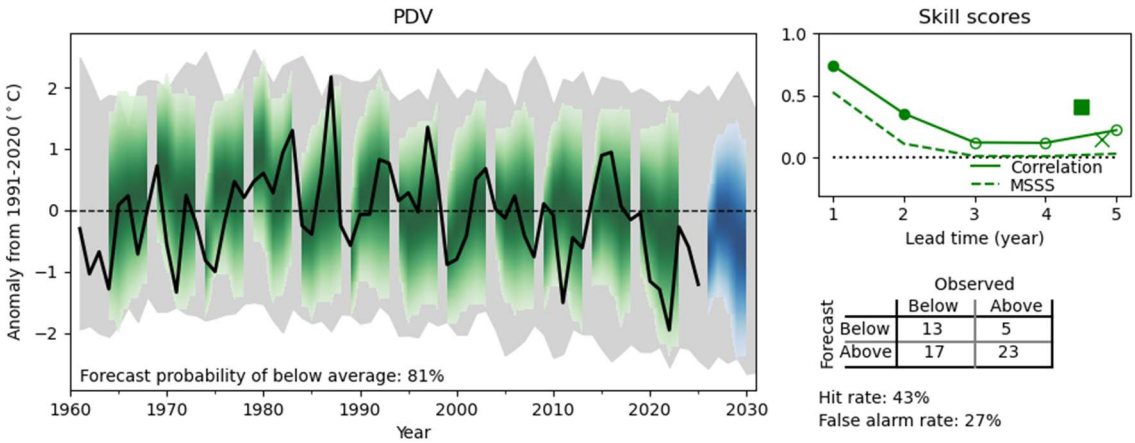

Figure 22: As Figure 5, but for Pacific Decadal Variability (PDV) defined as the difference in SST between the eastern tropical Pacific (10°S-6°N, 110°W-160°W) and the North Pacific (30°N-45°N, 145°W-180°W) as in Dong et al (2014).

The recent strong Antarctic Oscillation (AAO) or Southern Annular Mode (SAM) is predicted to remain above average (Figure 23). The calibrated probability of above average for 2024-2028 is 73%. Although

skill is medium for individual years and high for the next five years, the hindcasts (green) underestimate the strengthening in recent years leading to less confidence in the prediction.

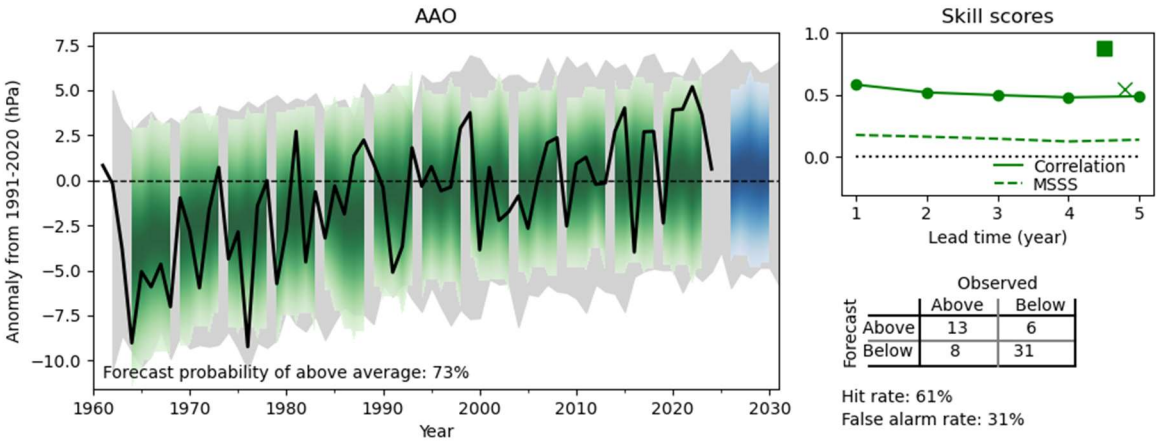

Figure 23: As Figure 5, but for the Antarctic Oscillation (AAO) defined as the difference in November to March mean zonal mean sea-level pressure between 65°S and 40°S as in Gong & Wang (1999).

The Arctic Oscillation has recently been close to neutral due to both high and low pressure in the winter season in the Arctic (Figure 24). The calibrated probability of above average for the next five years is 70%, but skill is very low.

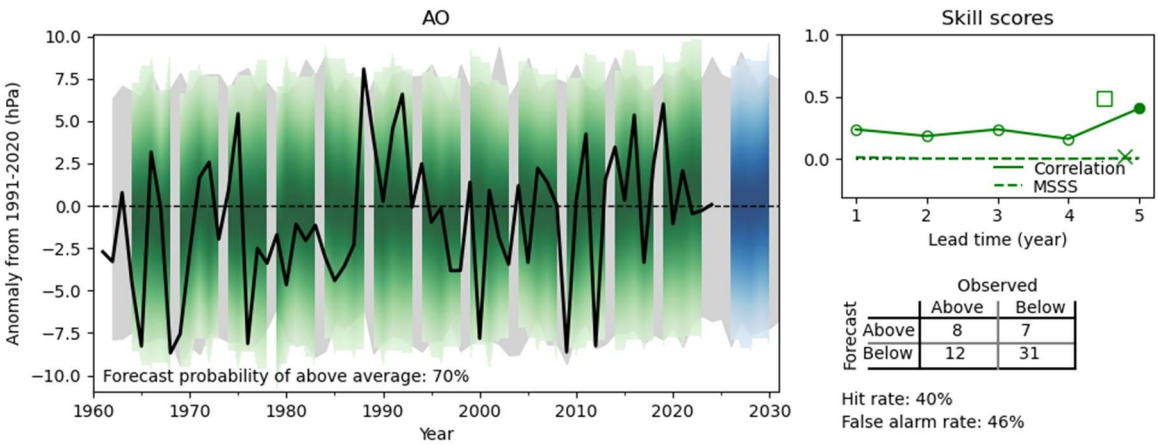

Figure 24: As Figure 5, but for the Arctic Oscillation (AO) defined as the difference in November to March mean zonal mean sea-level pressure between 80°N and 45°N similar to Gong & Wang (1999), but for the Northern Hemisphere.

References

Adler, R.F., G.J. Huffman, A. Chang, R. Ferraro, P. Xie, J. Janowiak, B. Rudolf, U. Schneider, S. Curtis, D. Bolvin, A. Gruber, J. Susskind, and P. Arkin, 2003: The Version 2 Global Precipitation Climatology Project (GPCP) Monthly Precipitation Analysis (1979-Present). *J. Hydrometeor.*, 4,1147-1167. https://doi.org/10.1175/1525-7541(2003)004%3C1147:TVGPCP%3E2.0.CO;2

Bell, B., Hersbach, H., Simmons, A., Berrisford, P., Dahlgren, P., Horányi, A., et al. (2021) The ERA5 global reanalysis: Preliminary extension to 1950. *Q J R Meteorol Soc*, 147 (741, 4186– 4227. Available from: https://doi.org/10.1002/qj.4174

Bellomo, K., Angeloni, M., Corti, S. *et al.* Future climate change shaped by inter-model differences in Atlantic meridional overturning circulation response. *Nat Commun* **12**, 3659 (2021). https://doi.org/10.1038/s41467-021-24015-w

Bett, P.E., H.E. Thornton, A. Troccoli, M. De Felice, E., L. Dubus, Y.-M. Saint-Drenan, D.J. Brayshaw (2022) A simplified seasonal forecasting strategy, applied to wind and solar power in Europe, *Climate Services*, 27 (100318). https://doi.org/10.1016/j.cliser.2022.100318

Dong, L., Zhou, T., and Chen, X. (2014), Changes of Pacific decadal variability in the twentieth century driven by internal variability, greenhouse gases, and aerosols, *Geophys. Res. Lett.*, 41, 8570– 8577 doi:10.1002/2014GL062269.

Gong, D. and Wang, S. (1999) Definition of Antarctic Oscillation index, *Geophys. Res. Lett.*, 26, 459—462, https://doi.org/10.1029/1999GL900003

Hermanson, L., Smith, D., Seabrook, M., Bilbao, R., Doblas-Reyes, F., Tourigny, E., Lapin, V., Kharin, V. V., Merryfield, W. J., Sospedra-Alfonso, R., Athanasiadis, P., Nicoli, D., Gualdi, S., Dunstone, N., Eade, R., Scaife, A., Collier, M., O'Kane, T., Kitsios, V., Sandery, P., Pankatz, K., Früh, B., Pohlmann, H., Müller, W., Kataoka, T., Tatebe, H., Ishii, M., Imada, Y., Kruschke, T., Koenigk, T., Karami, M. P., Yang, S., Tian, T., Zhang, L., Delworth, T., Yang, X., Zeng, F., Wang, Y., Counillon, F., Keenlyside, N., Bethke, I., Lean, J., Luterbacher, J., Kolli, R. K., & Kumar, A. (2022). WMO Global Annual to Decadal Climate Update: A Prediction for 2021–25, *Bulletin of the American Meteorological Society*, *103*(4), E1117-E1129., https://journals.ametsoc.org/view/journals/bams/103/4/BAMS-D-20-0311.1.xml

Roberts, C. D., F. K. Garry, and L. C. Jackson, 2013: A Multimodel Study of Sea Surface Temperature and Subsurface Density Fingerprints of the Atlantic Meridional Overturning Circulation. *J. Climate*, 26, 9155–9174, https://doi.org/10.1175/JCLI-D-12-00762.1

Smith, D. M., Scaife, A. A., Hawkins, E., Bilbao, R., Boer, G. J., Caian, M., et al. (2018). Predicted chance that global warming will temporarily exceed 1.5 °C. *Geophysical Research Letters*, 45, 11,895– 11,903. https://doi.org/10.1029/2018GL079362

Sospedra-Alfonso, R., and Coauthors (2024). Decadal prediction centers prepare for a major volcanic eruption. *Bull. Amer. Meteor. Soc.*, 105, E2496-E2524. https://doi.org/10.1175/BAMS-D-23-0111.1

van Oldenborgh, G. J., H. Hendon, T. Stockdale, M. L'Heureux, E. C. de Perez, R. Singh, and M. van Aalst, 2021: Defining El Niño indices in a warming climate. *Environ. Res. Lett.*, 16, 044003, https://doi.org/10.1088/1748-9326/ABE9ED.