MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-16 Online Forum

MONITORING SUMMARY MEDCOF-16

for April 2021

First draft

Last update: 19 May 2021

Compiled by

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The following MedCOF monitoring summary is based on

- climate monitoring results from RA VI RCC Node-CM at DWD,
- analysis of the state of the oceans in April 2021 and some drivers for the climate situation of the following summer 2021 from RA VI RCC Node-LRF at Météo France, https://nextcloud.meteo.fr/s/4oJH8kmF7xyLmjB ,
- verification bulletin with information about large-scale circulation for February-April 2021, https://nextcloud.meteo.fr/s/4iyANafsXD3FxyZ .
- Assessments from NOAA CPC and BOM Australia

1. Oceanic Analysis

In the Pacific Ocean: weak "La Niña", almost neutral:

- The La Niña phenomenon is still present according to Mercator Ocean temperatures (Fig. 1.1). The cold anomaly in the central and eastern Pacific persists (equator and southern tropics). The Nino3.4 index for Mercator Ocean data was -0.45°C, just below the La Niña threshold of -0.5°C, therefore entered the neutral range, similar like in March 2021 (Fig. 1.2).
- According to BOM, ENSO is also already in a neutral state because Pacific Ocean temperatures across most of the equatorial region are close to the long-term average both at the surface and subsurface. The warm anomaly in the western part of the equatorial Pacific hast weakened, but expanded further to the east in the subsurface (Fig. 1.3). See http://www.bom.gov.au/climate/enso/index.shtml#tabs=Sea-sub%E2%80%93surface.
- According to NOAA CPC also, the tropical Pacific Ocean returned to ENSO-neutral conditions during April, as the coupling between the atmosphere and ocean weakened. Sea surface temperatures were near-to-below average across most of the equatorial Pacific Ocean in the past month, see https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml

In Indian Ocean:

- Neutral conditions in the tropics. Still warm anomalies in the southern hemisphere, despite a general cooling. No significant west-east gradient, therefore near-neutral Indian Ocean Dipole (IOD).
- Similar assessment by BOM (last update of 11 May 2021): http://www.bom.gov.au/climate/enso/index.shtml#tabs=Indian-Ocean

In the Atlantic Ocean:

- Neutral conditions in the tropics. In the northern hemisphere, a large positive anomaly pattern between 20°N and 45°N. Compared to March 2021, there is a warming tendency close to West Africa and West Iberia.
- According to Duchez et al. 2016 (https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074004/pdf), cold North Atlantic Ocean temperatures are linked to heat waves in Europe. However, the North Atlantic Ocean did not show such a pattern in April 2021 (and neither for May 2021 as simulated by the Météo France model).

In the Mediterranean and Black Sea:

- Sea surface temperature (SST) was slightly above normal in the entire Mediterranean basin except the Adriatic Sea, which had a slightly below-normal temperature. Compared to March 2021, the Mediterranean became cooler due to atmospheric cooling over Europe.

- In the Black Sea, SST was around normal, see e.g. ERSST data, provided by NASA, https://data.giss.nasa.gov/gistemp/maps/

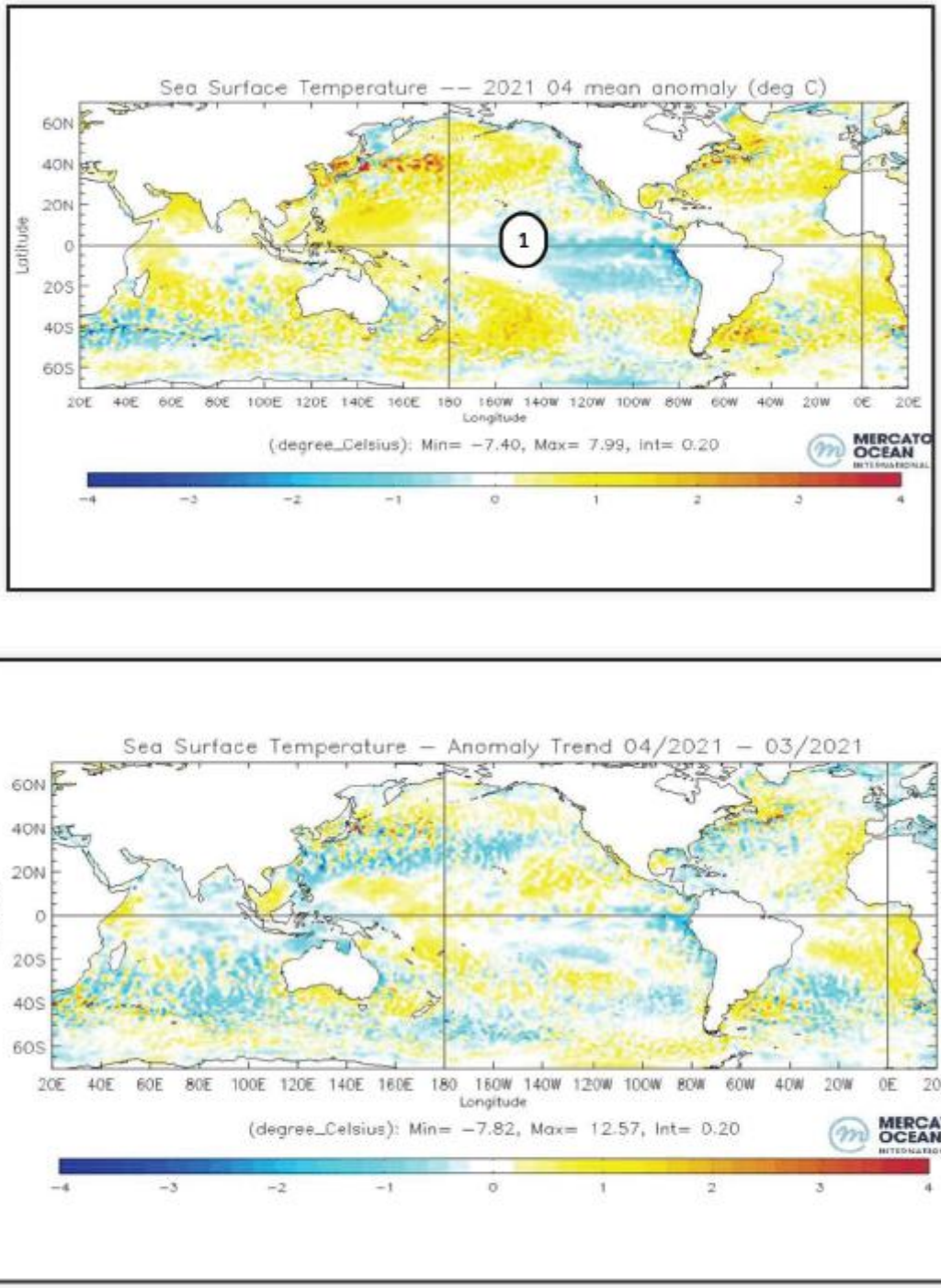

Figure 1.1: Sea surface temperature anomalies for April 2021, 1992-2013 reference (upper map) and anomaly differences April minus March 2021 (anomaly trend). Number: 1 – La Niña cold anomaly. Data from Mercator Ocean, source: Météo France

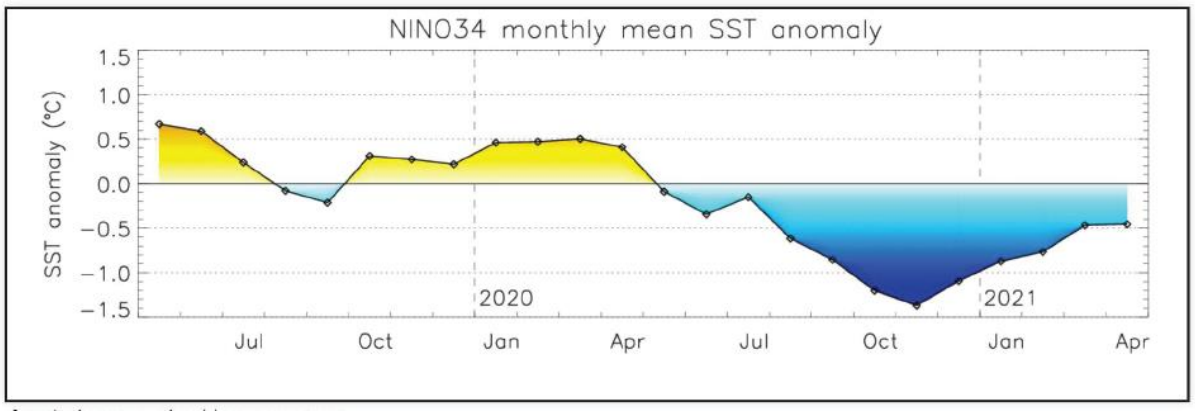

Figure 1.2: Evolution of sea surface temperature anomalies in the Niño3.4 box, 1992-2013 reference. Data from Mercator Ocean, source: Météo France.

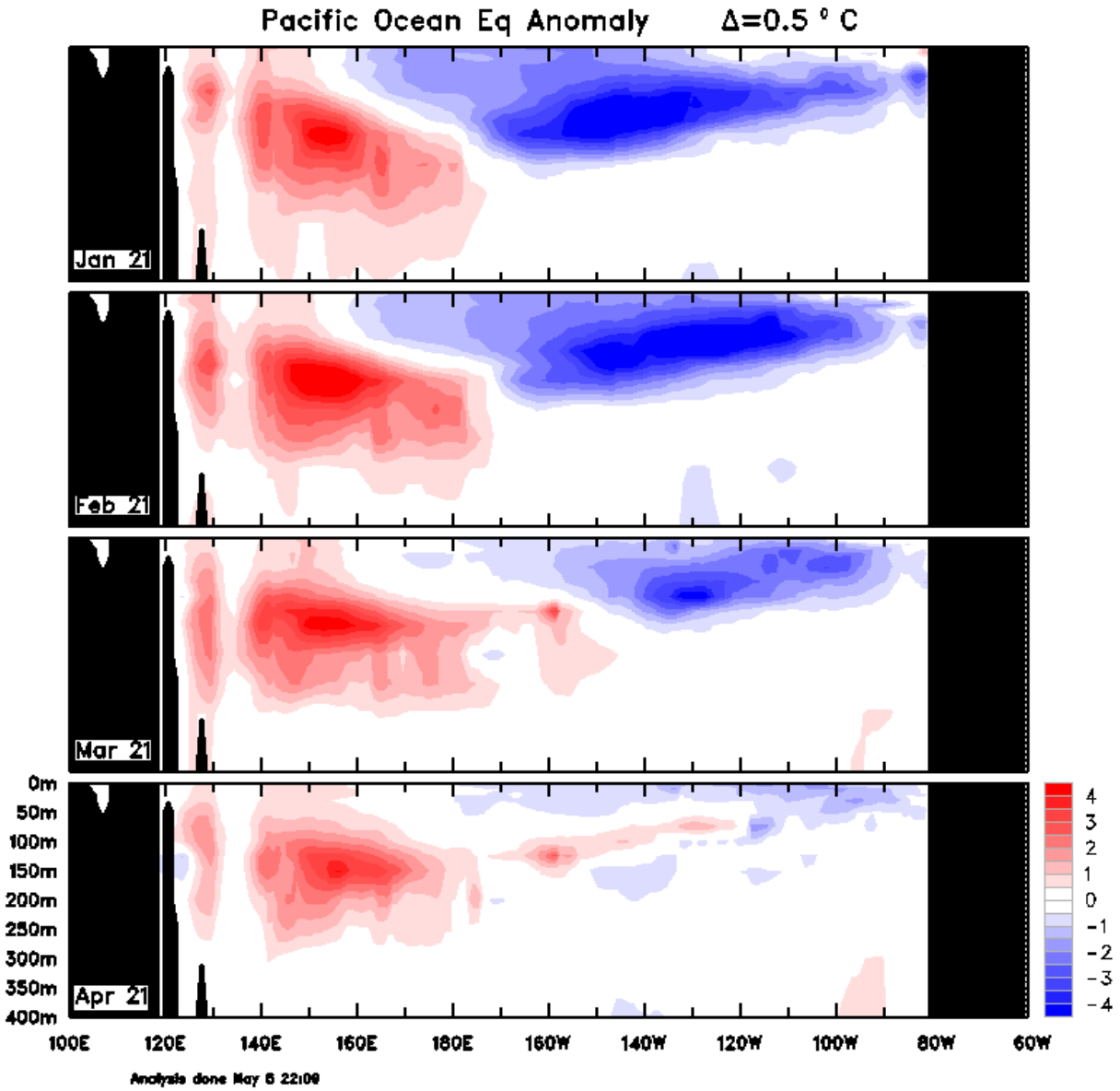

Figure 1.3: Monthly Pacific Ocean temperature anomalies in the sub-surface January-April 2021, 1900-1992 reference (Climatology after Levitus World Ocean Atlas). Source: BOM, http://www.bom.gov.au/climate/enso/index.shtml#tabs=Sea-sub%E2%80%93surface

2. Atmospheric Circulation Analysis

Velocity Potential Anomaly field in the high troposphere (fig. 2.1 – insight into Hadley-Walker circulation anomalies), Madden-Julian Oscillation (MJO) (fig. 2.1.b) and Southern Oscillation Index (SOI):

- Upward motion anomaly over the western Pacific in April 2021 like it was in previous months, still coupled with SST and associated with ENSO (Fig. 2.1a). However, MJO was active as well over the western Pacific in April 2021 (Fig. 2.1b) and has probably also contributed to the upward motion anomaly, which means that the ENSO contribution became probably weaker.
- Monthly SOI for April 2020 was +2.0 for BOM, +0.3 for NOAA, which mean mainly neutral ENSO conditions, see https://www.ncdc.noaa.gov/teleconnections/enso/indicators/soi/ , http://www.bom.gov.au/climate/current/soihtm1.shtml
- At the same time, the strongest downward motion anomaly has been shifted from Africa to the Indian Ocean, which might also have been due to MJO because it intensified over Africa in late April.
- The downward motion anomaly over the Indian Ocean extended quite far to the north over the Arabian Peninsula to the Eastern Mediterranean region.
- Over the North Atlantic, a weak upward motion anomaly close to West Africa might have had weak influence in Iberia, but as it might have been influenced by MJO, it is not expected to remain a longer time there.

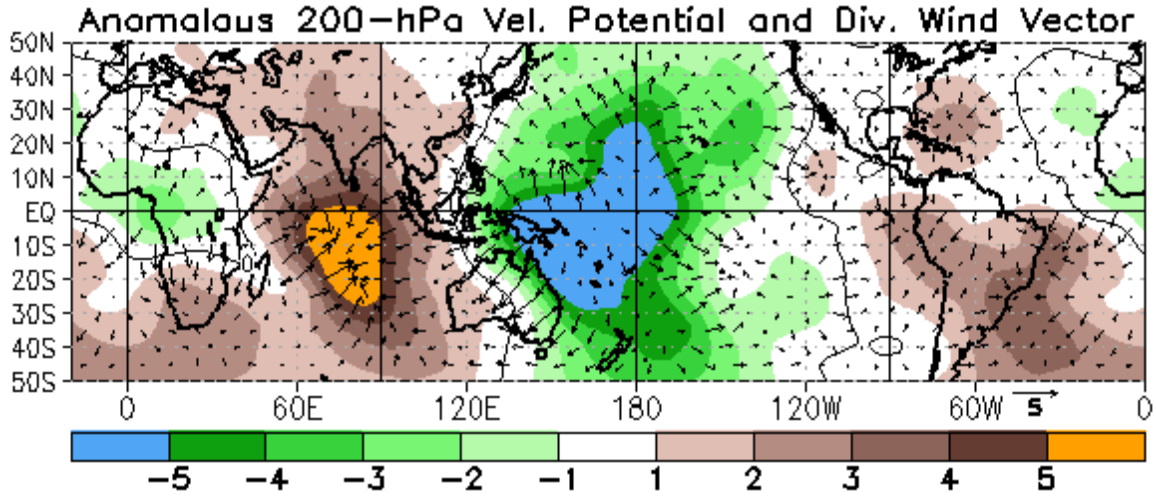

Figure 2.1.a: Velocity Potential anomalies at 200 hPa and associated divergent circulation anomaly for April 2021. Green (brown) indicates a divergence-upward motion anomaly (convergence-downward motion anomaly).
http://www.cpc.ncep.noaa.gov/products/CDB/Tropics/figt24.shtml

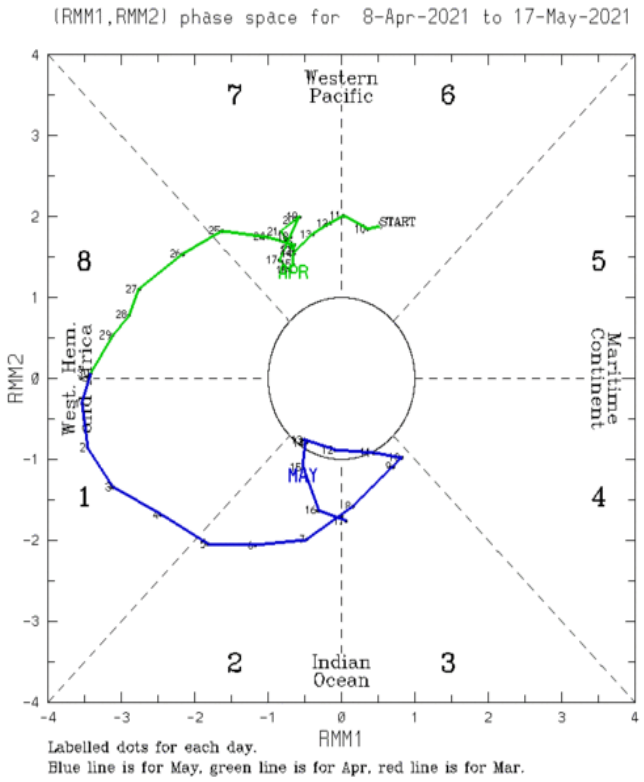

Figure 2.1.b: indices MJO

http://www.bom.gov.au/climate/mjo/

Stream Function anomalies in the high troposphere (fig. 2.2 – insight into teleconnection patterns tropically forced):

Mostly weak anomalies in the tropics and very scattered, hence no significant teleconnections.

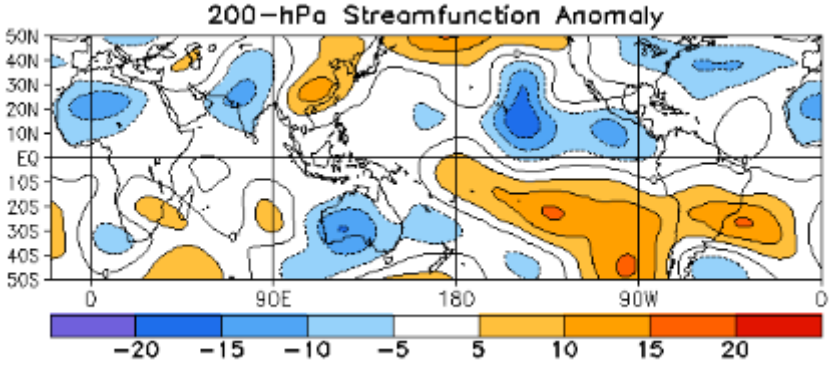

Figure 2.2: Stream Function Anomalies at 200 hPa in April 2021.

http://www.cpc.ncep.noaa.gov/products/CDB/Tropics/figt22.shtml

Geopotential height at 500 hPa (fig. 2.3 – insight into mid-latitude general circulation):

- A strong anticyclonic anomaly from Greenland to Western Europe and a cyclonic anomaly over Northern and parts of Eastern Europe. Anticyclonic conditions also over eastern parts of the MedCOF domain (South Caucasus, eastern Mediterranean) and much of North Africa.

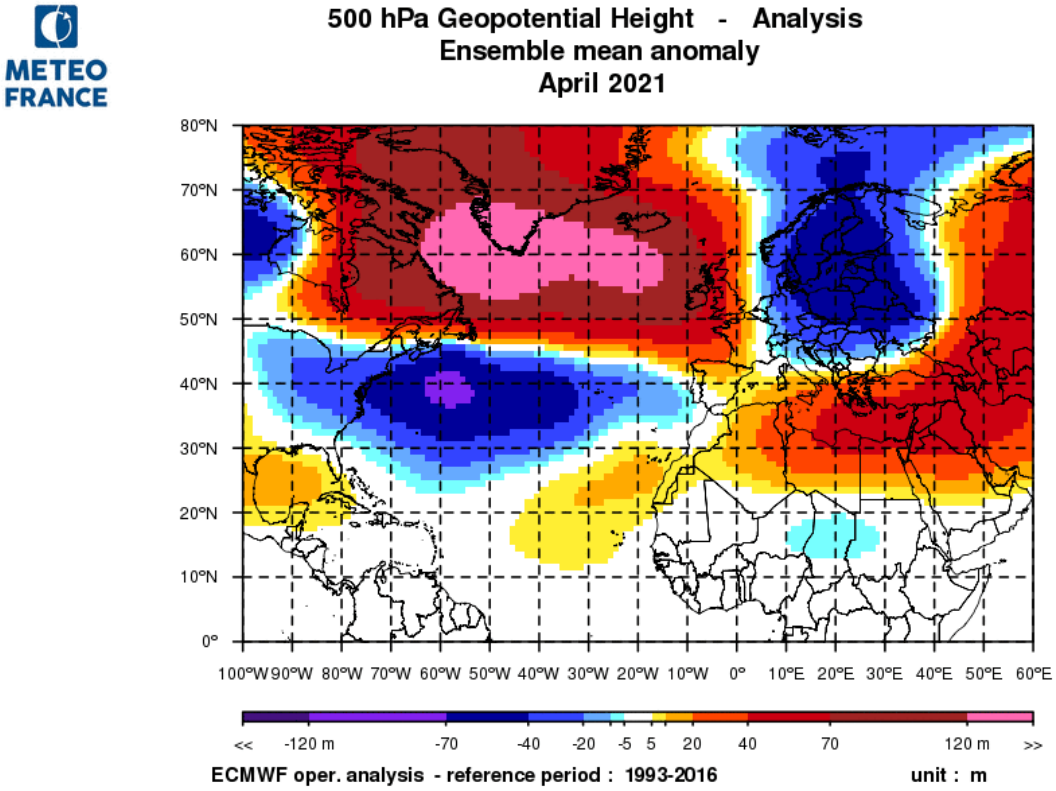

Figure 2.3: Anomalies of Geopotential height at 500hPa (Météo-France)

Sea level pressure and circulation types relevant for the domain

- Very intense high pressure from Greenland to Northwestern Europe and low pressure north of Scandinavia. This caused a strong flow of cold Arctic air into Europe.
- High pressure anomalies even extended to the Mediterranean.
- The Azores high was weak, over Iberia and western parts of North Africa even cyclonic conditions.
- The main circulation types in April 2021 relevant for Europe were the following:
    - NAO-: resulted from high pressure anomaly in the northern parts of the North Atlantic and low pressure anomaly in the south, just the contrary pattern compared to normal conditions.
    - SCAND-: given by the low pressure anomaly with core pressure north of Scandinavia.

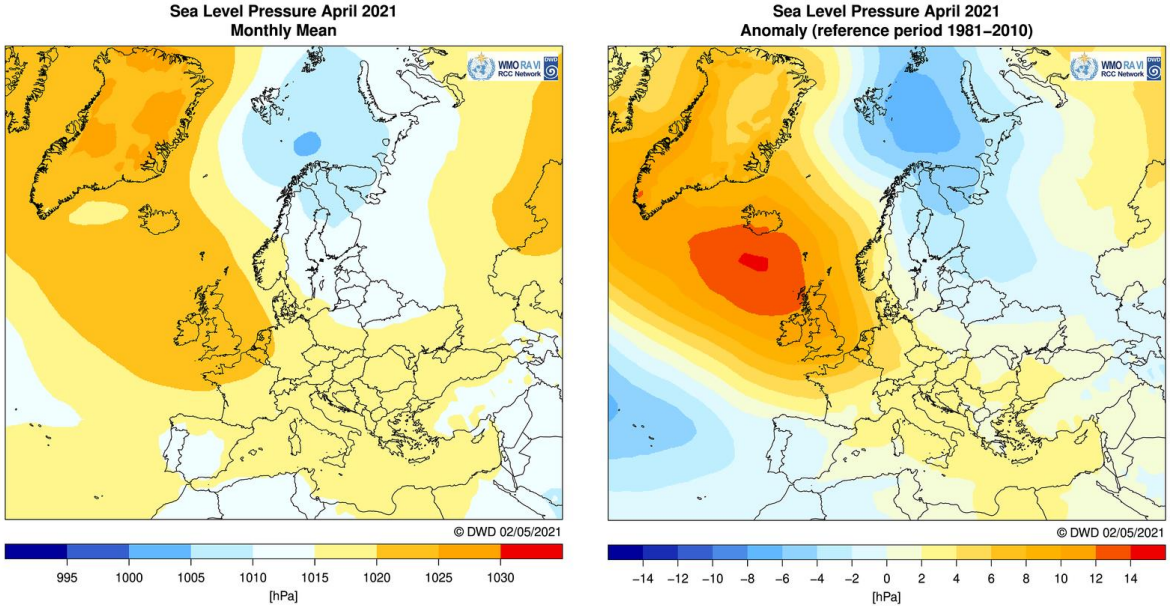

Figure 2.4: Mean sea level pressure over the North Atlantic, Europe and North Africa and 1981-2010 anomalies for April 2021. Source: DWD, https://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_ppp.html?nn=490674

MONTH	NAO	EA	WP	EP-NP	PNA	TNH	EATL/WRUS	SCAND	POLEUR
APR 21	-1.7	0.3	-0.1	0.8	-1.3	---	-0.4	-1.2	-0.2
MAR 21	0.4	-0.2	2.1	-1.3	-1.2	---	3.0	-0.9	0.6
FEB 21	-0.3	1.2	0.8	-0.8	-0.7	1.3	0.8	0.3	-3.2
JAN 21	-1.8	0.0	2.5	-0.7	-0.4	-0.1	-1.3	0.3	-1.6
DEC 20	-0.4	-0.8	1.0	---	1.3	0.2	-1.1	2.3	0.1
NOV 20	2.5	0.0	0.7	-0.7	0.2	---	0.1	-0.1	-0.6
OCT 20	-0.2	-0.2	-1.2	0.6	-1.1	---	-1.8	1.5	-1.0
SEP 20	1.1	1.9	-2.4	0.1	0.6	---	-0.9	-0.5	0.3
AUG 20	0.0	1.6	-0.2	-2.4	1.8	---	0.6	-1.6	-0.5
JUL 20	-1.2	0.5	-0.5	-2.0	1.2	---	-0.7	-2.3	-0.1
JUN 20	0.2	-0.1	-1.2	-0.7	0.9	---	-2.0	0.6	-0.2
MAY 20	-0.3	0.1	0.1	0.0	0.3	---	-0.5	-2.4	-1.1
APR 20	-1.3	0.6	-1.3	1.5	-1.4	---	1.8	-1.5	0.4

Table 1: Evolution of the main atmospheric indices for the Northern Hemisphere for the last months: http://www.cpc.ncep.noaa.gov/products/CDB/Extratropics/table3.shtml

NAO was in a negative phase almost the whole month of April and the first half of May, causing the inflow of cold Arctic air into Europe. For the Arctic Oscillation (AO), which concerned the entire northern hemisphere, the negative phase started much later in April.

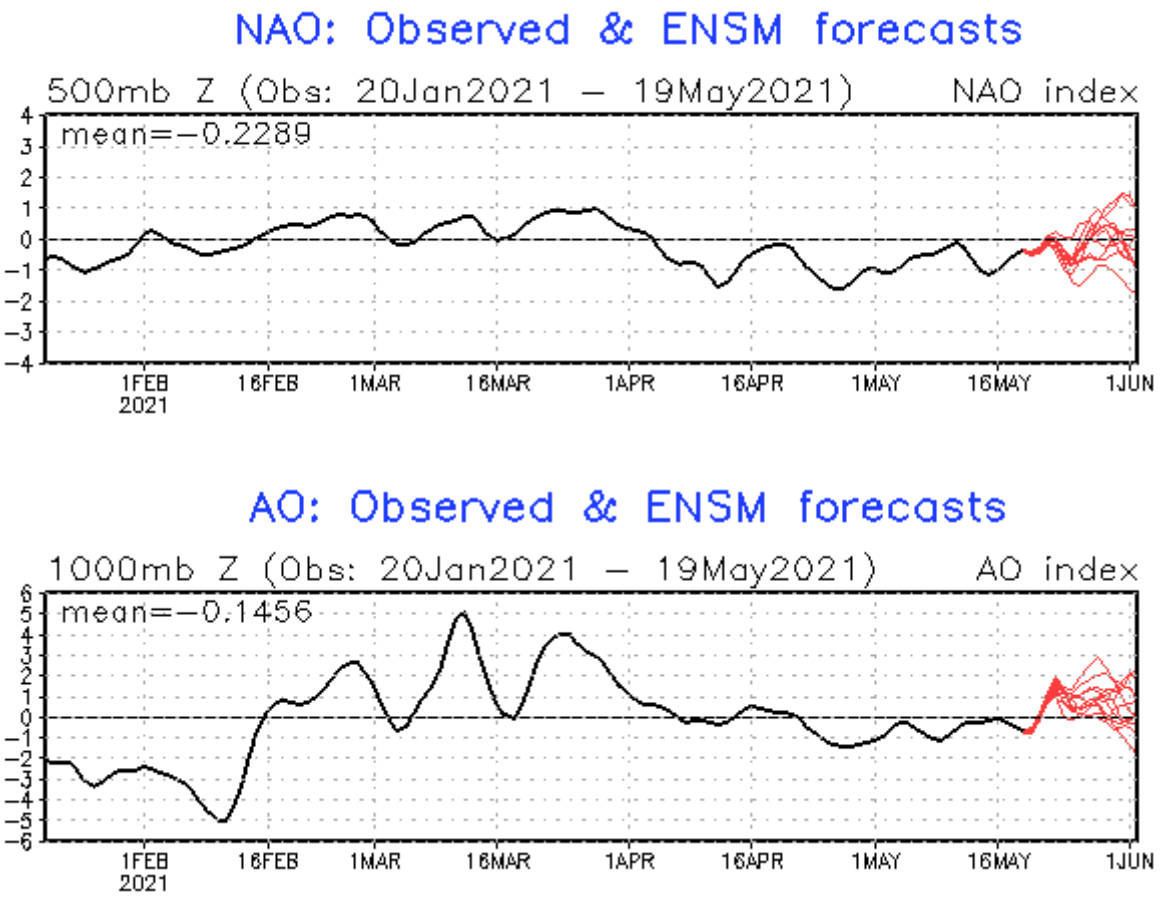

Figure 2.5: North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) indices. Source: NOAA CPC, https://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/nao.shtml

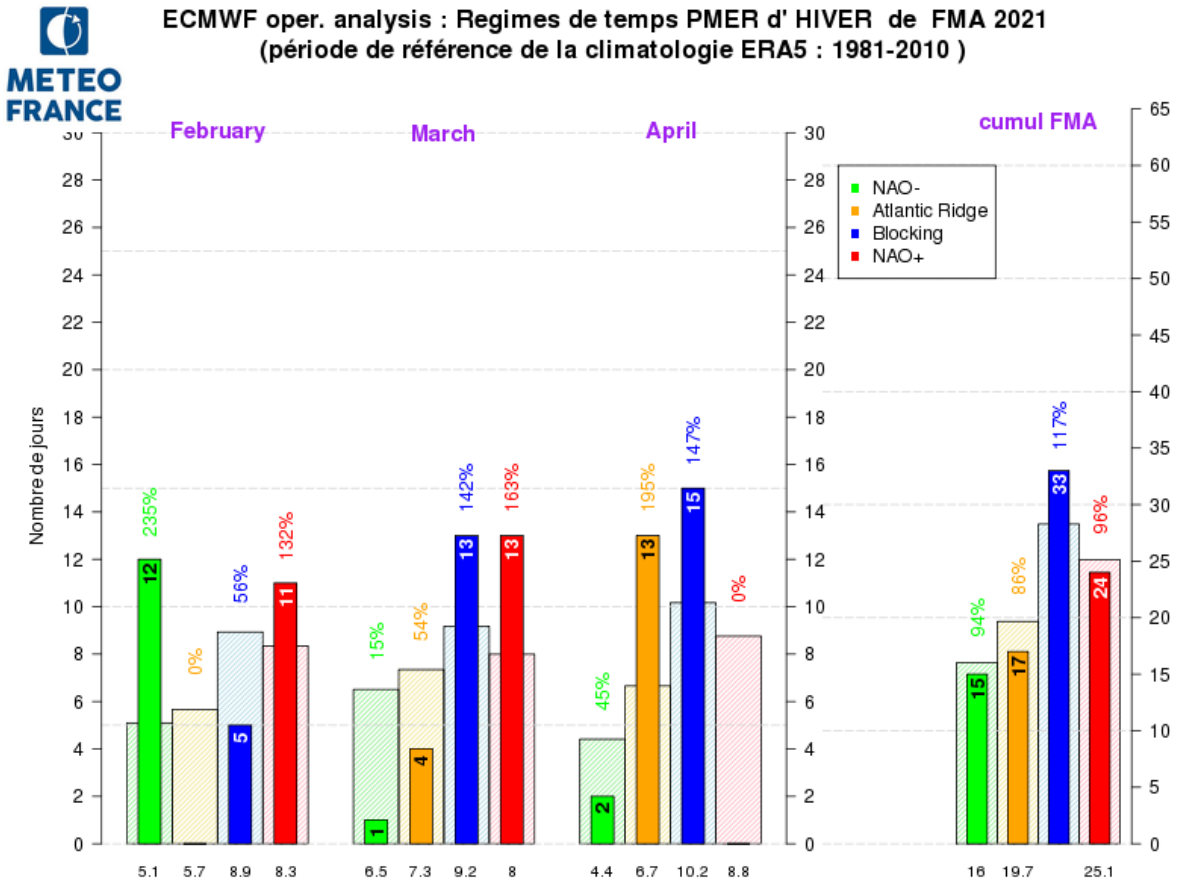

Figure 2.6: Distribution of weather types of Météo France classification (winter regime) for February-April 2021.

Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-regimes-trim

According to the Météo France weather type classification, the two dominating types in April 2021 were Atlantic ridge and blocking. The appearance of NAO+ stopped completely that month.

3. Precipitation

Europe/RA VI domain

Monthly precipitation totals in April 2021 were lower than normal in Western Europe, particularly in France, but also in much of the Eastern Mediterranean region, partly below the 10th percentile. Precipitation was above normal in some places in Iberia and near the western Mediterranean and around the Black Sea.

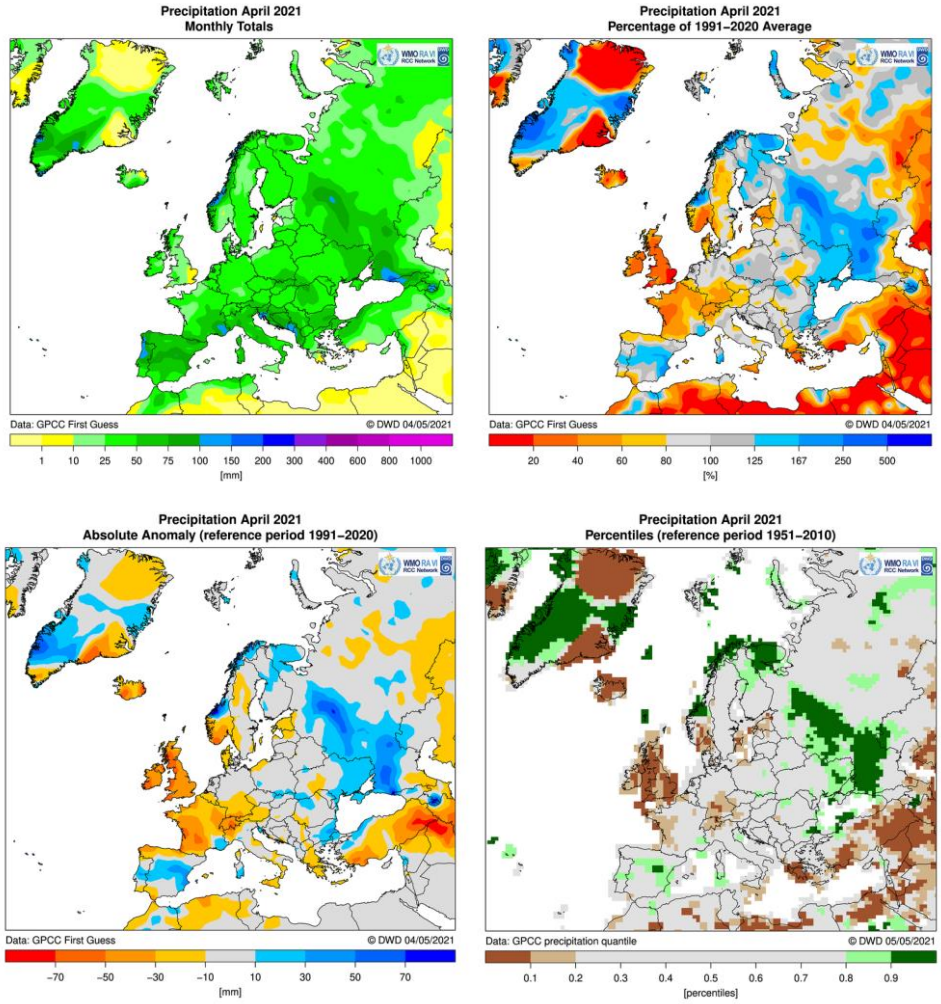

Figure 3.1: Monthly precipitation sum (upper left), percentage of normal (upper right), absolute anomalies (bottom left), and percentiles (bottom right) for April 2020 (1981-2010 reference for percentages and anomalies, 1951-2010 for percentiles) in Europe/RAVI. Data from GPCC (First Guess version). Source: DWD, http://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_rrr.html?nn=16102

Precipitation in North Africa

In North Africa, it was mainly dry in large parts in April 2021 except in Morocco and northern coasts of Algeria and Tunisia. Above-normal precipitation was mostly in places in Morocco.

4. Temperature

Europe/RA VI domain

Due to inflow of cold Arctic air, April 2021 was a cold month in much of Europe. This included also much of the MedCOF domain, particularly the Balkan Peninsula and Eastern Europe up to the Ukraine. Western parts of Iberia and easternmost parts of the domain (South Caucasus, eastern Turkey, Middle East) were influenced by a flow of subtropical air and were warmer than normal.

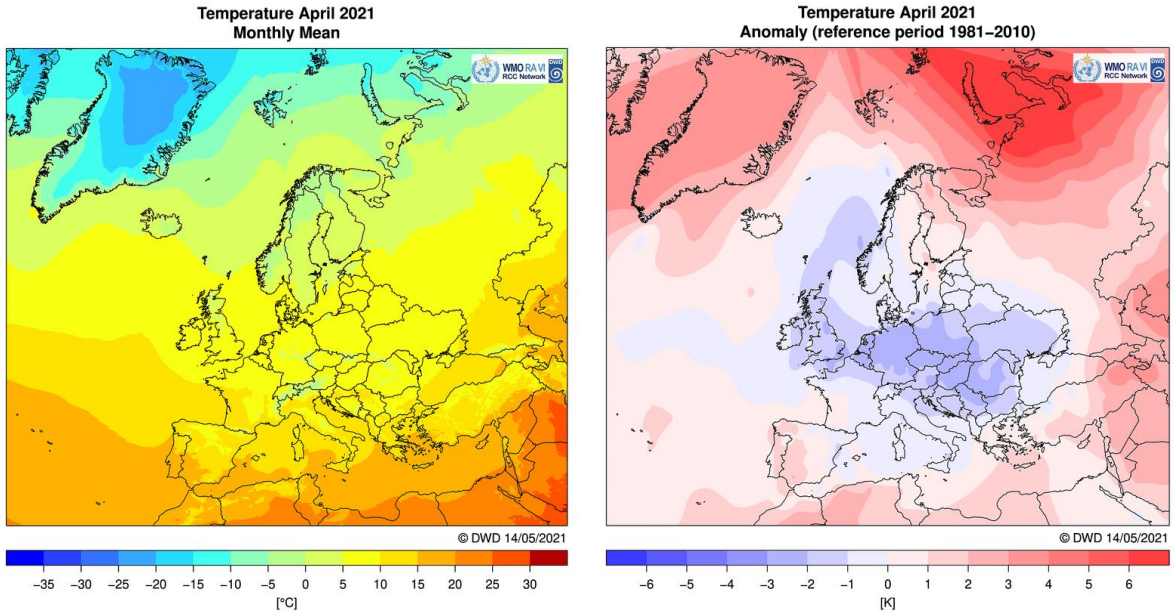

Figure 4.1: Mean temperature (left) and anomalies (1981-2010 reference, right) in °C in the RA VI Region (Europe) interpolated from CLIMAT station data, for April 2021. Source: DWD, http://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_ttt.html?nn=490674.

Temperature in North Africa

North Africa was entirely within the warm subtropical air most of the time and often under high-pressure influence, so the whole domain was warmer than normal.

5. Soil moisture

In late April, soil moisture in Western Europe, especially western France was much lower than normal, and also eastern Turkey had dry conditions. Low soil moisture may amplify positive temperature anomalies and therefore a risk of heat waves. However, due to low temperatures in April 2021 in much of Europe, evaporation was also low, and thus most of Europe had no critical drought situation as it was in previous years.

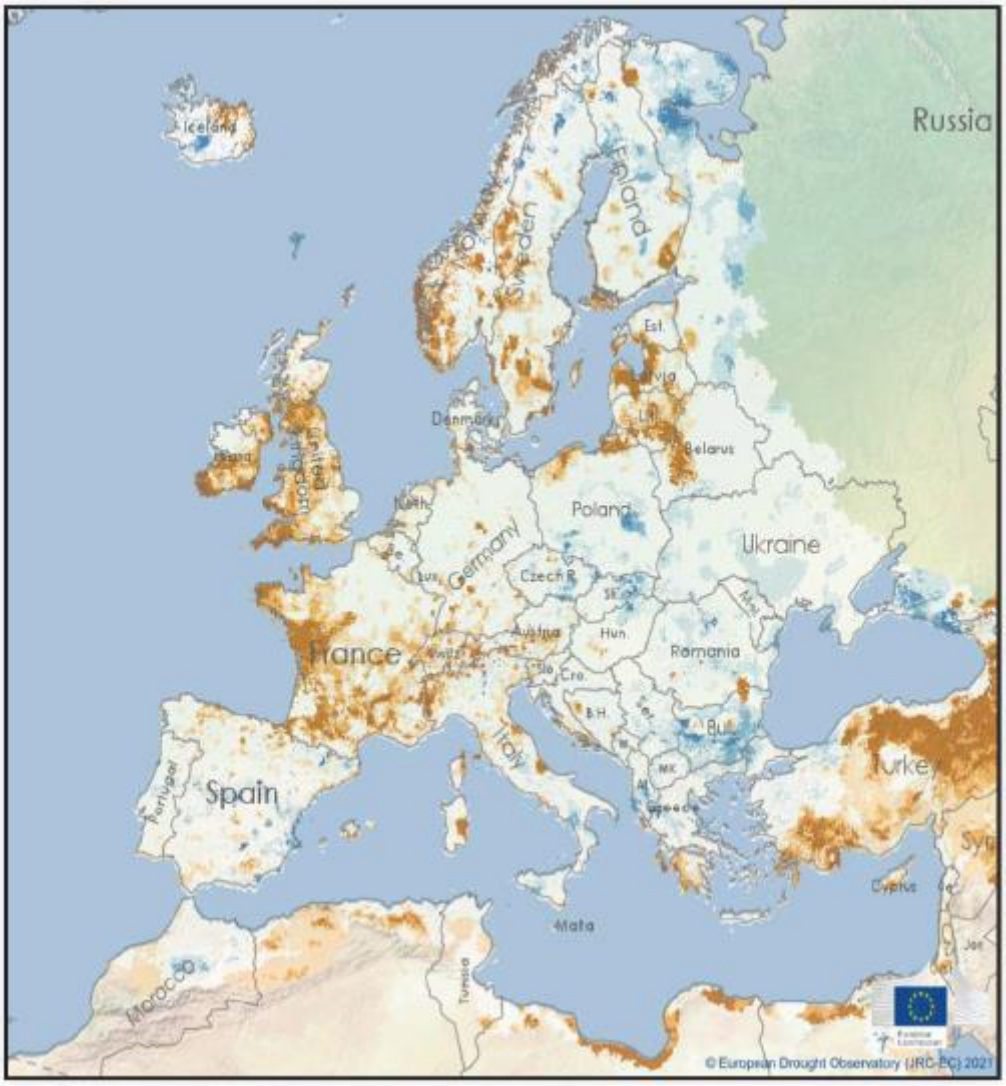

Figure 5: Soil moisture index (SMI) anomaly for the third ten-day period of April 2021. Source: https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1111

References:

Météo France Monthly Seasonal Forecast Bulletin and climate monitoring maps: http://seasonal.meteo.fr (password protected)

WMO RA I RCC Node on Climate Monitoring Website with monitoring results: https://www.meteo.tn/en/climate-monitoring-watch

WMO RA VI RCC Node on Climate Monitoring Website with monitoring results: http://www.dwd.de/rcc-cm

GPCC: http://gpcc.dwd.de

EDO (EU European Drought Observatory): https://edo.jrc.ec.europa.eu

Duchez, A. *et al.,* 2016 : *Environ. Res. Lett.* **11** 074004. https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074004

Guemas, V., Salas-Mélia, D., Kageyama, M. *et al., 2010:* Summer interactions between weather regimes and surface ocean in the North-Atlantic region. *Clim Dyn* **34,** 527–546. https://doi.org/10.1007/s00382-008-0491-6