GDO Analytical Report

Drought in southern Madagascar – January 2021

Global Drought Observatory (GDO) of the Copernicus Emergency Management Service (CEMS) – 22/01/2021

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Executive summary

- A pronounced rainfall deficit that accumulated throughout 2020, due to scarce precipitation during the first half of 2020 and the beginning of the 2020/2021 rainy season, is exacerbating the exposure to food insecurity of rural communities of southern Madagascar, hampering crop growth, and threatening the water supply for much of 2021.
- After months of poor precipitation, the insufficient coping capacity of the affected communities has exposed them to severe food insecurity. The current conditions may therefore unleash a large-scale crisis, in a region that is already badly hit by the economic impact of the COVID-19 pandemic.
- According to forecasts, average precipitation can be expected up until March 2021, except in the east part of the country, where below average conditions are forecasted. Thus, even in absence of any further worsening of the deficit, the annual rainfall balance will probably not recover, and is likely to remain negative until October 2021.

Risk of drought impact for agriculture (RDrI-Agri)

The GDO indicator Risk of drought impact for agriculture (RDrI-Agri) shows the risk of occurrence of drought impacts, by taking account of the exposure and socio-economic vulnerability of the affected area, with particular focus to the agricultural impacts.

Towards the end of December 2020, dry weather and soil conditions brought a high risk of severe impacts across the south of Madagascar, particularly the regions of Ihorombe, Anôsy, Androy and Atsimo-Andrefana (Figure 1). Most of the rural population in this area is dependent on subsistence agriculture and rain-fed crops, with water resources replenished during the

intense precipitation of the rainy season, from November to March. With its extreme seasonality of precipitation, southern Madagascar is periodically exposed to both droughts and floods, and the annual rainfall balance is determined by the amount of precipitation during the rainy season. A single under-performing wet season entails some risks for food security, while two or more drier than usual wet seasons severely expose entire communities. In addition to the threat to food security, the most likely impacts are insufficient and unsafe water supply and an economic crisis for whole rural communities.

Currently, hundreds of thousands of people are affected directly by drought, while millions are exposed indirectly through food security, prices and economic fallout. In terms of severity, the ongoing drought is comparable with the event of 2016/2017, and is one of the most severe in the last 25 years.

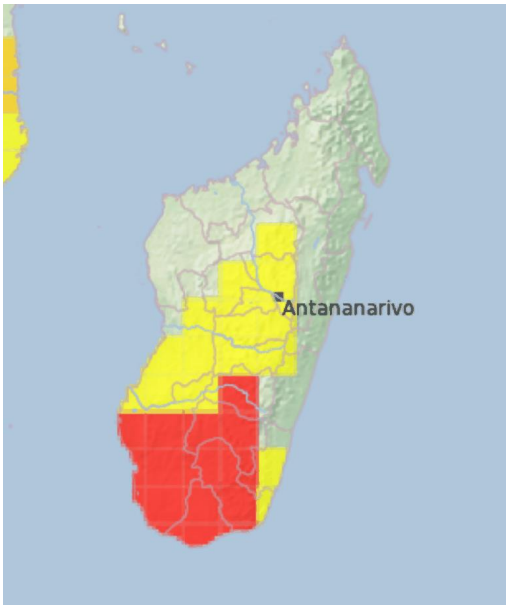


Figure 1: *Risk of drought impact for agriculture (RDrI-Agri) over Madagascar, between 1st and 10th of January 2021 (right).*

Precipitation

Southern Madagascar is characterized by a strong seasonality of precipitation, with the core of the rainy season between December and March, and a dry season between May and October. The four wettest months (December to March) account for over 70% of the total annual rainfall across central and southern Madagascar.

The second half of the 2019/2020 rainy season was below average, followed by a dry season even drier than usual. The first part of the 2020/2021 rainy season has been very poor, with November and December having less than half the expected rainfall, compared with the long-term average for these months, and well below the natural variability (measured by the

standard deviation). Figure 2 shows the pattern of precipitation for different locations in southern Madagascar, highlighting the crucial months responsible for the current deficit.

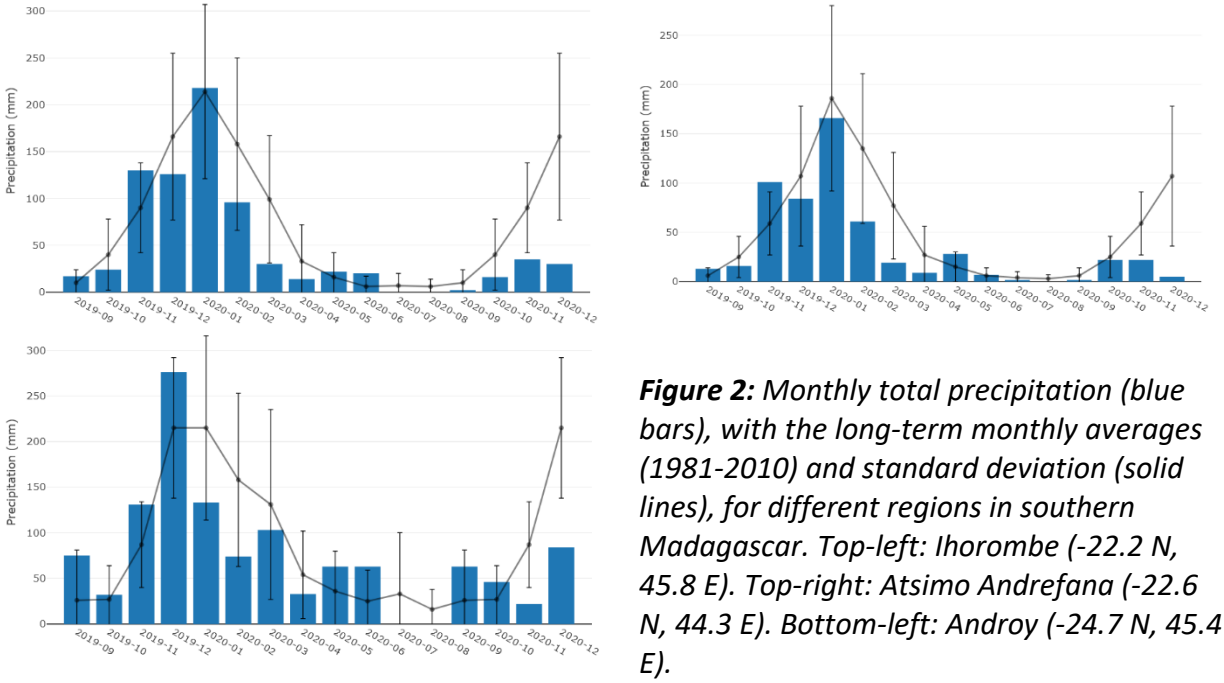


Figure 2: *Monthly total precipitation (blue bars), with the long-term monthly averages (1981-2010) and standard deviation (solid lines), for different regions in southern Madagascar. Top-left: Ihorombe (-22.2 N, 45.8 E). Top-right: Atsimo Andrefana (-22.6 N, 44.3 E). Bottom-left: Androy (-24.7 N, 45.4 E).*

Standardized Precipitation Index (SPI)

GDO's Standardized Precipitation Index (SPI) is used to monitor the occurrence of meteorological drought. The lower (i.e. more negative) the SPI, the more intense is the drought.

The paltry level of precipitation in 2020 produced a significant cumulative deficit, well depicted by SPI at 3 and 12 months respectively. The three-month SPI highlights the rainfall gap in the short term, specifically in the first part of the current rainy season (i.e., October-December 2020). Southern Madagascar, as well as the surroundings of Antananarivo (Madagascar's capital city), show significant negative anomalies of SPI-3 (Figure 3, left). At the annual scale, the twelwe-month SPI, which includes the second half of the 2019/2020 rainy season, highlights the strong negative anomalies of precipitation in the south-west of the country, and north of Antananarivo .

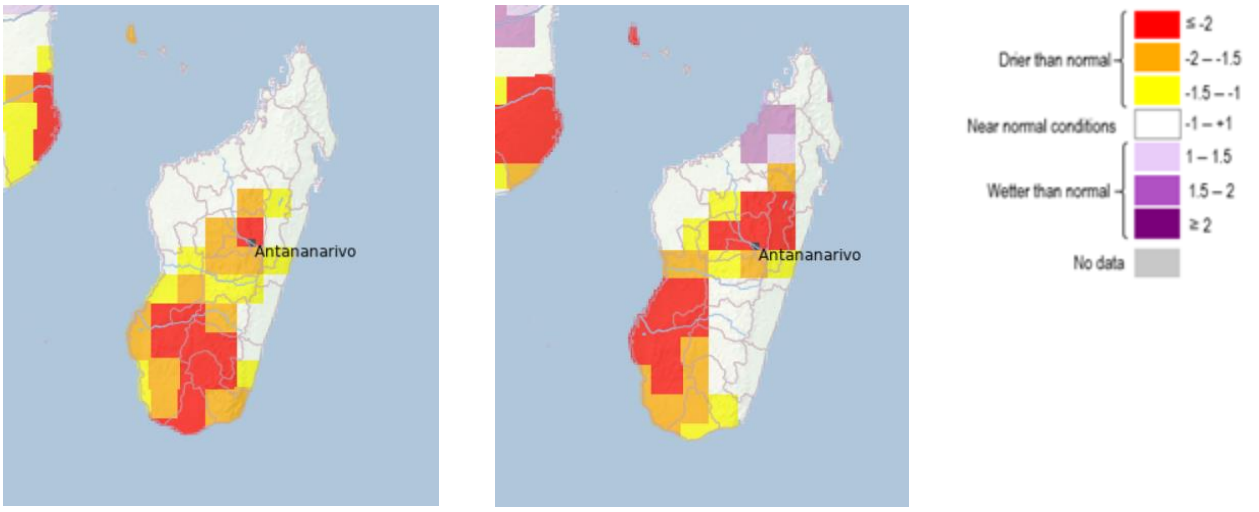
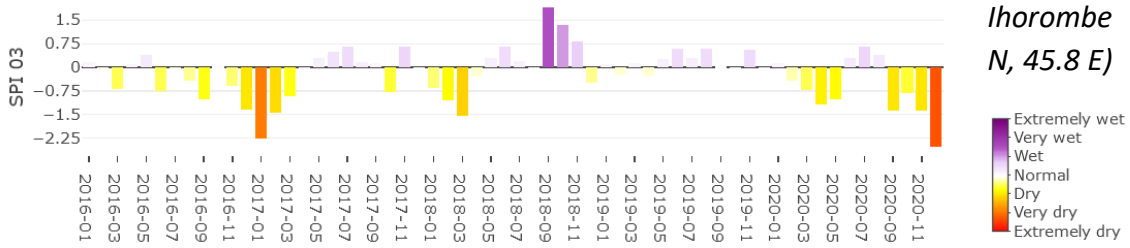


***Figure 3**: SPI values for for October to December 2020 (SPI-3, left) and January to December 2020 (SPI-12, right) in Madagascar.*

The time-series of SPI helps to understand how the meteorological drought has evolved over time and compares with past droughts. In the mid- and short-term, the meteorological drought can be considered very severe, based on both the SPI-3 and SPI-12 absolute values and the crucial timing within the rainy season. As of December 2020, it was already worse than the last significant drought in 2016/2017, albeit shorter so far (e.g., Figure 4, top and middle).

The precipitation anomalies in the long-term are more severe for the south-west. When considering the last four rainy seasons together (i.e. 2016 onwards), some parts of Madagascar have received cumulatively about 25% less rainfall than the average (reference period 1981-2010). Indeed, looking at the 48-month SPI time-series (Figure 4, bottom), which links the 2020/2021 and 2016/2017 droughts, highlights the fact that these events show the biggest negative anomalies for the whole time-series of data available since 1971.



Ihorombe (-22.2 N, 45.8 E)

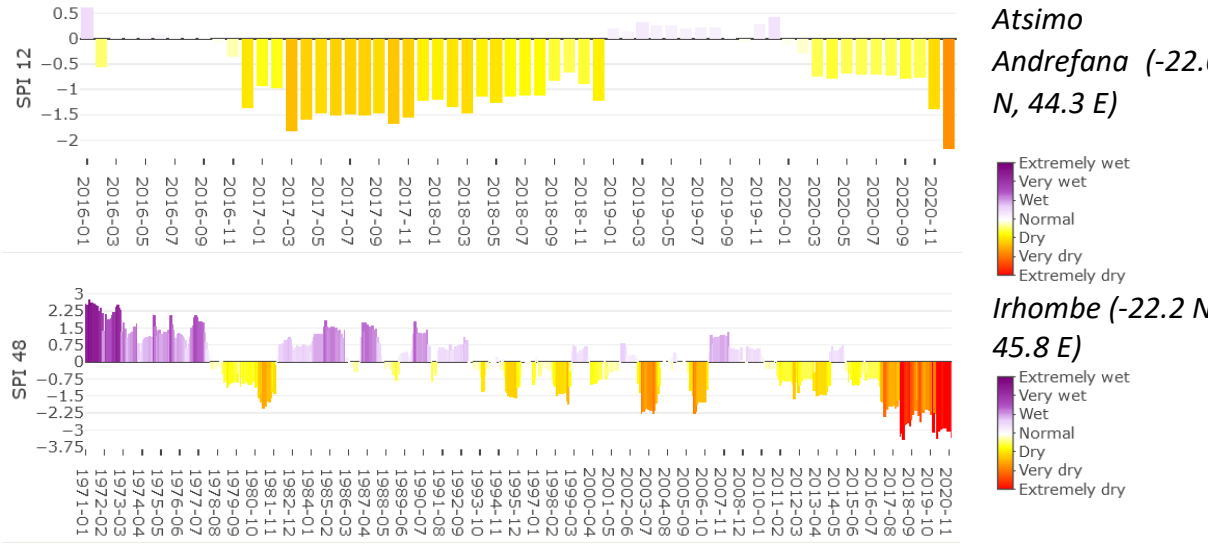


Figure 4: *SPI for a cumulative period of 3, 12 and 48 months in two selected locations.*

fAPAR anomaly

GDO's satellite-derived indicator fraction of Absorbed Photosynthetically Active Radiation (fAPAR) represents the fraction of the solar energy that absorbed by vegetation. fAPAR anomalies, specifically the negative deviations from the long-term average over the same period, are a good indicator of drought impacts on vegetation.

A first widespread and intense vegetation stress was detected back in March 2020, coinciding with the lack of rainfall at the end of the 2019/2020 rainy season (Figure 5, top-left). During the dry season, the fAPAR anomaly receded significantly, with conditions more in line with the normal for the period. However, the cumulative deficit again became evident at the start of the 2020/2021 rainy season, when strong and consistent anomalies appeared throughout the south of Madagascar (Figure 5, top-right and bottom-left). As can be seen in Figure 6, which shows the timeline of the fAPAR anomaly for three selected regions, it is evident that vegetation suffered water stress conditions for a prolonged period.

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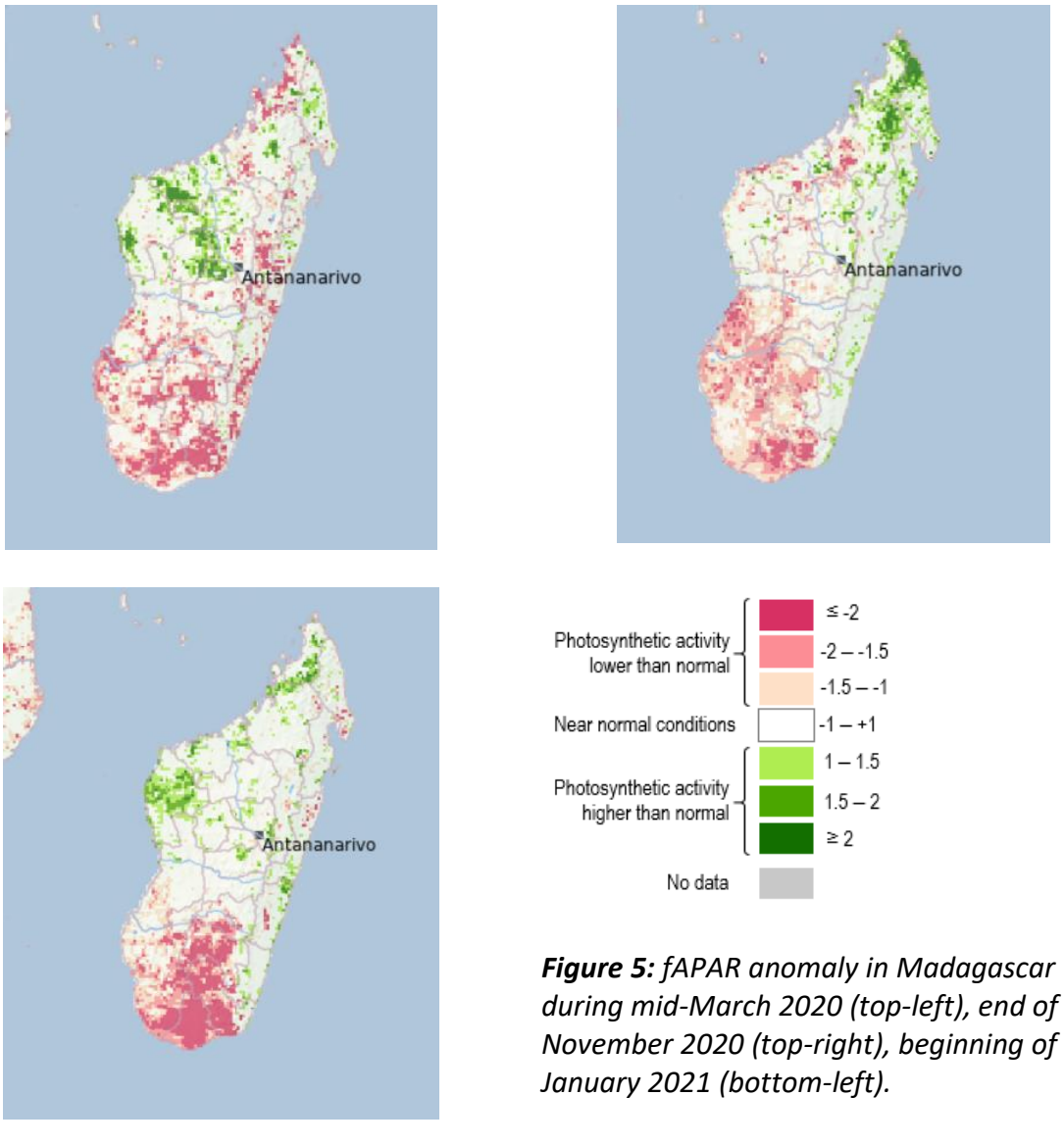
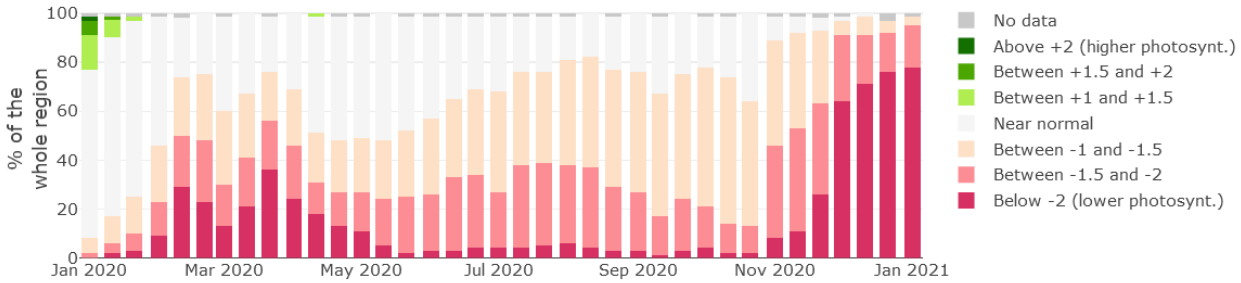


Figure 5: *fAPAR anomaly in Madagascar during mid-March 2020 (top-left), end of November 2020 (top-right), beginning of January 2021 (bottom-left).*



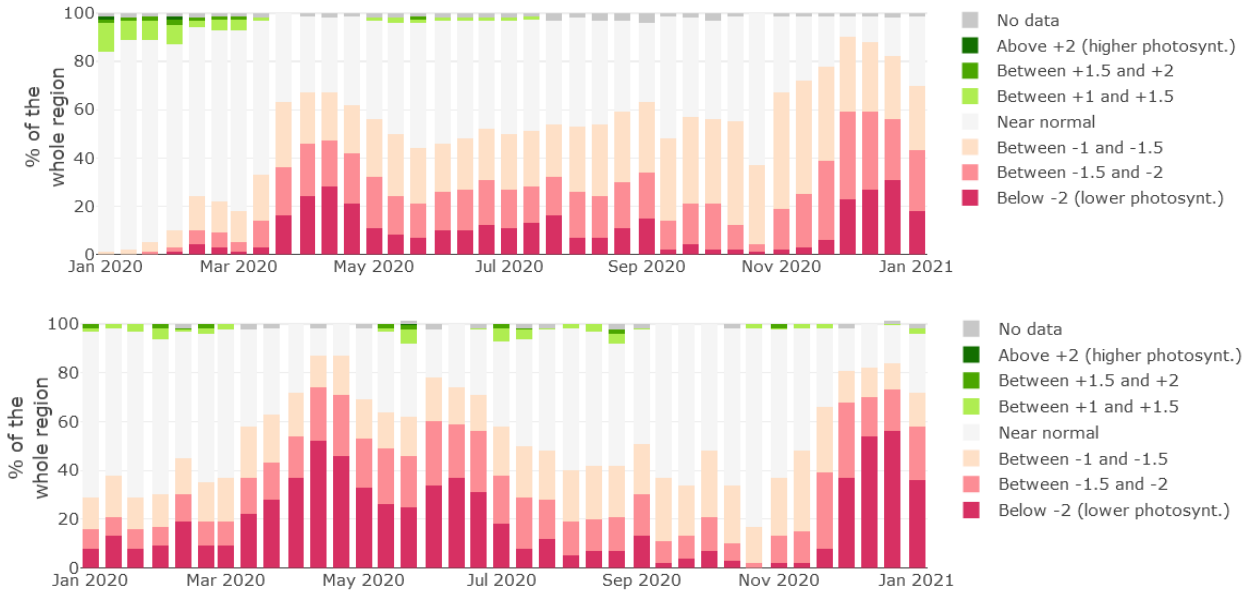


Figure 6: *fAPAR anomaly, evolution over time in Androy (top), Atsimo Andrefana (centre), Ihorombe (bottom).*

Soil moisture anomaly

GDO's soil moisture anomaly indicator provides an assessment of the top-soil water content, which is a direct measure of drought conditions, specifically of the difficulty for plants to extract water from the soil.

Figure 7 shows the soil moisture situation in Madagascar in early and late 2020. As can be seen, dry soil conditions were detected in March (Figure 7, top-left), mostly in the south-west, due to the poor second half of the 2019/2020 rainy season. Subsequently the anomaly decreased, partly due to the normal dryness of soil between July and October. Widespread soil moisture deficits were detected again in November, at the beginning of the 2020/2021 rainy season (Figure 7, top-right). As of January 2021, only the south of Madagascar retained a strong anomaly (Figure 7, bottom left). Figure 8 shows the yearly view of soil moisture anomaly classes for three selected regions, highlighting the recent increase in soil dryness, with a milder and long wave between January and May 2020, and a more intense one from November 2020 onwards.

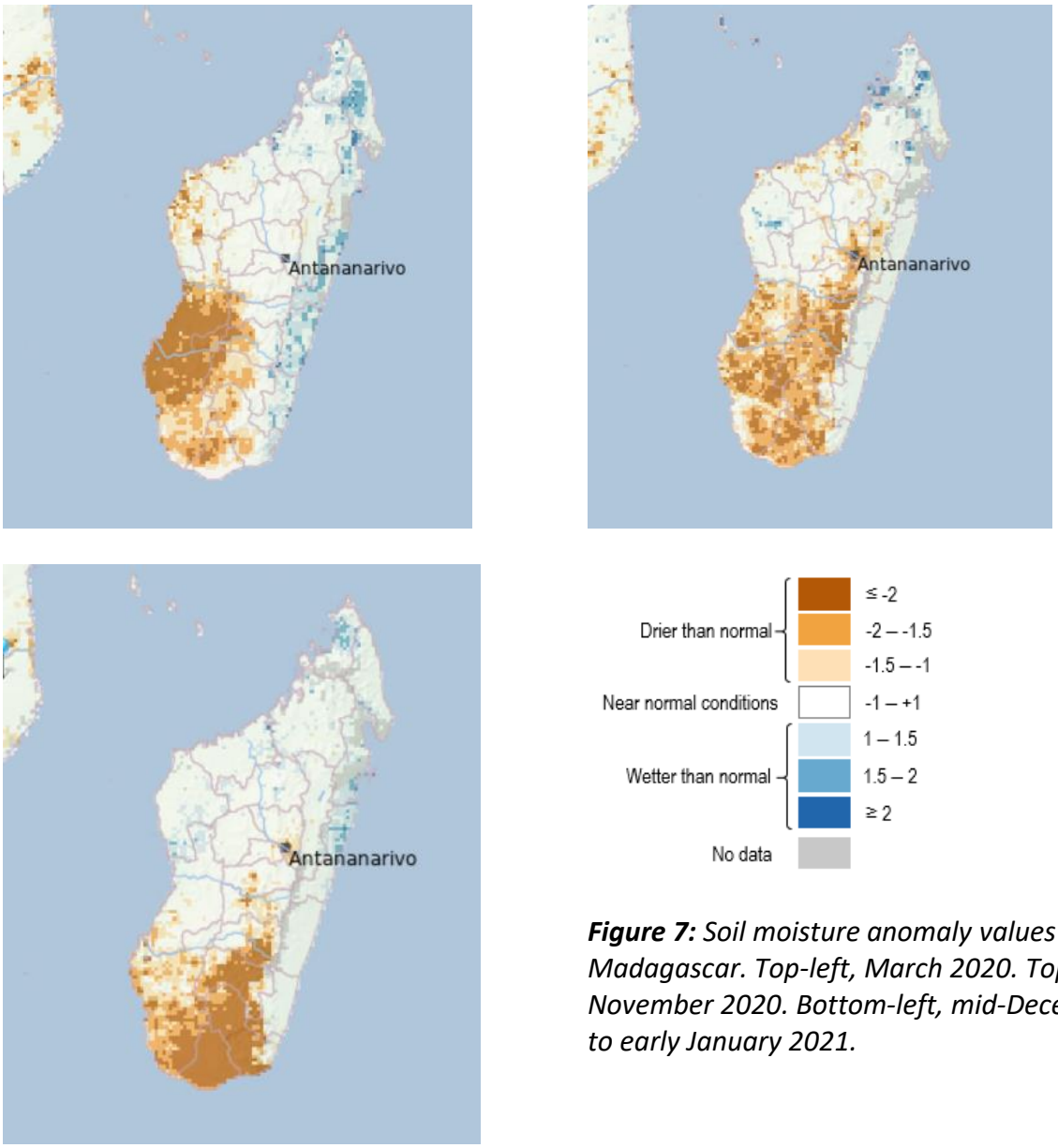


Figure 7: *Soil moisture anomaly values in Madagascar. Top-left, March 2020. Top-right, November 2020. Bottom-left, mid-December to early January 2021.*

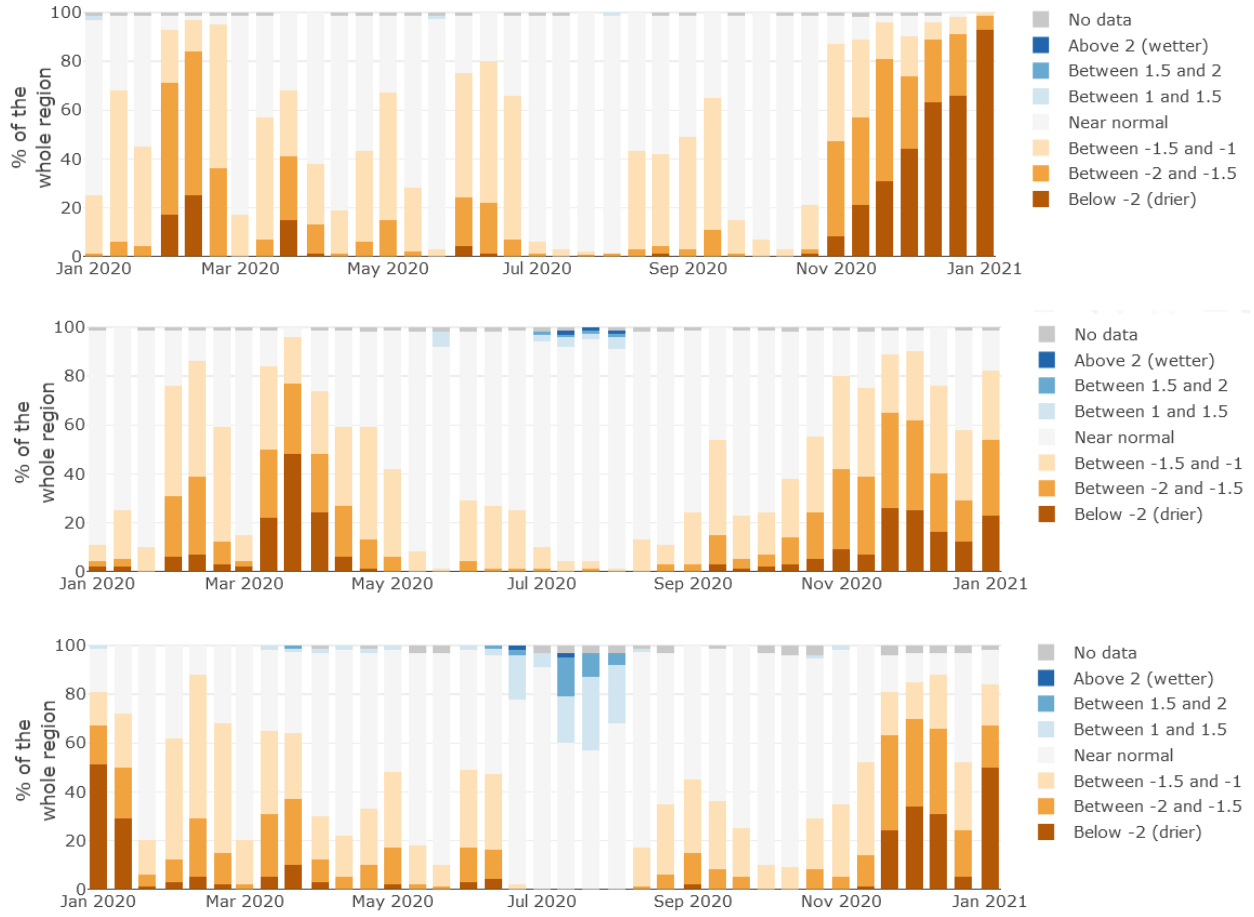


Figure 8: *Evolution over time of soil moisture anomaly in Madagascar, from January 2020, in Androy (top), Atsimo Andrefana (centre), Ihorombe (bottom).*

Outlook for Standardized Precipitation Index (SPI)

As it can be seen in Figure 9, forecasts for SPI over southern Madagascar are neutral for the trimester January-March 2021. Drier than normal conditions are forecast for the central-eastern region, which have been only marginally affected by precipitation deficits so far. However, average precipitation over the south will not compensate for the poor start of the 2020/2021 rainy season, which will likely drag the deficit through 2021 until the next rainy season.

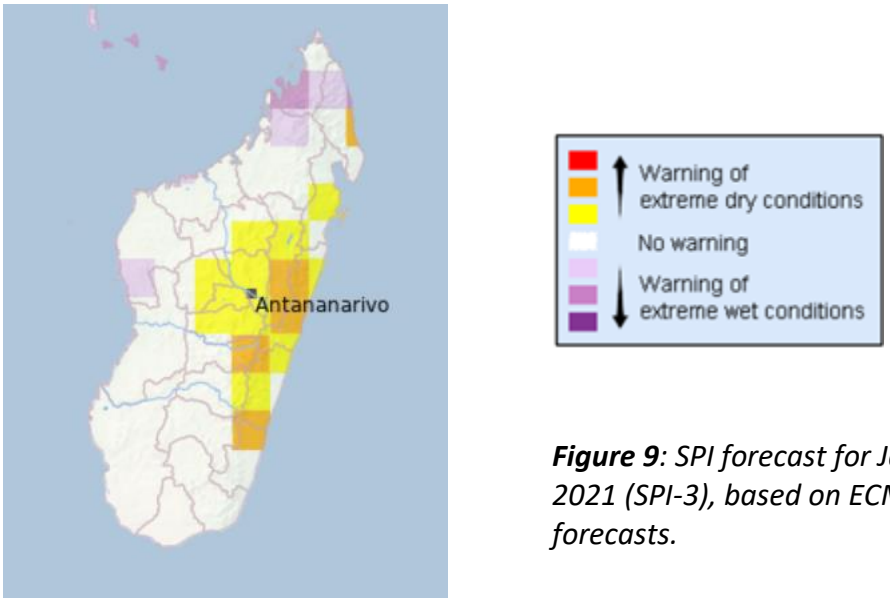


***Figure 9**: SPI forecast for January to March 2021 (SPI-3), based on ECMWF S5 ensemble forecasts.*

Reported impacts

Widespread food security risks and critical conditions are reported for southern Madagascar, where immediate humanitarian aid is required[1] [2]. Estimates of population exposed to some degree of food insecurity vary from one to one and a half million people, with more than 200 thousand under emergency conditions[3]. Food supply was provided by the national government

[1] https://news.un.org/en/story/2021/01/1081892
[2] https://reliefweb.int/sites/reliefweb.int/files/resources/MDG_20201231_FlashAppeal_AbridgedVersion.pdf
[3] http://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/IPC_Madagascar_AFI_AMN_2020Oct2021April_English_summary.pdf

to the affected districts[4] and the African Development Bank (AfDB)[5]. In absence of aid, people are forced to resource from emergency food[6]. The situation was already severe earlier, in relation to the prolonged dry conditions of 2020 and the economic halt due to the global COVID-19 pandemic[7]. The FEWS NET bulletin of December 2020 confirmed impacts on crops and other sectors, and forecasted a food security crisis for February-May 2021[8]. Among other impacts, children are not able to attend school, being committed to help parents in search for food[9]. News reported about internal displacement of affected population towards Antananarivo and the northern part of the island[10].

[4] https://www.madagascar-tribune.com/25-278-tonnes-de-vivres-pour-aider-environ-300-000-personnes.html
[5] http://apanews.net/en/news/afdb-provides-aid-to-drought-stricken-madagascar
[6] https://www.wfp.org/stories/southern-madagascar-africa-climate-change-drought-food-aid-hunger-famine-un-world-food
[7] https://www.wfp.org/news/southern-madagascar-faces-drought-driven-hunger-threatening-millions
[8] https://fews.net/southern-africa/madagascar/food-security-outlook-update/december-2020
[9] https://www.wfp.org/news/humanitarian-crisis-looms-southern-madagascar-drought-and-pandemic-double-number-hungry-people
[10] https://www.linfo.re/ocean-indien/madagascar/famine-a-madagascar-les-victimes-esperent-batir-une-nouvelle-vie

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