Center for Disaster Management and Risk Reduction Technology

CEDIM Forensic Disaster Analysis Group (FDA)

Earthquake, Doganyol, Turkey, 24 January 2020

Information as of 28 January 2020 – Report No. 1

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SUMMARY

Official Disaster Name	Date	UTC	Local
Elazig Sivrice Earthquake	**24-Jan-2020**	**17:55:14**	**+3**

Preferred Hazard Information:

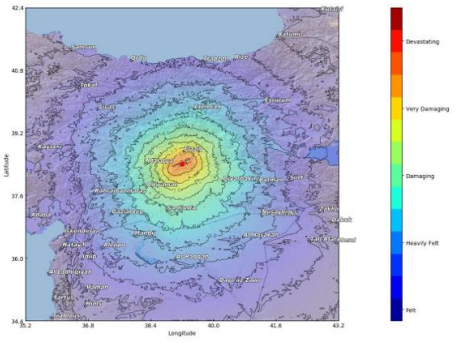
EQ_Latitude	EQ_Longitude	Magnitude	Hyp. Depth(km)	Fault Mech.	Source	Spectra
38.390	**39.081**	**6.7mww**	**11.9**	**Thrust**	**USGS**	**Avail.**

Duration: 80 secs

Location Information:

Country	ISO	Province	Most Impact	Building PF	HDI (2020)	GDP nom. USD	Pop. (2020)
Turkey	**TR**	**Elazig**	**Elazig**	**Average**	**0.761**	**2.45 bill USD**	**607,370**

Preferred Hazard Information:

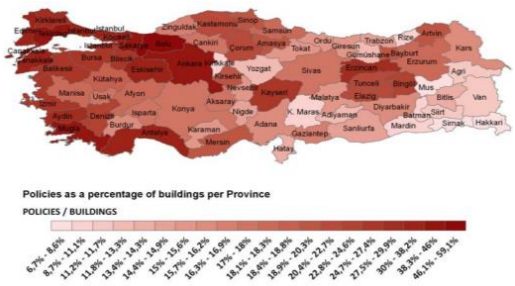
EMS-98	MMI	PGA	**Key Hazard Metrics**
VIII	VIII	0.9g	

Hazard Description (Intensities and Ground Motion)

Intensities reached VIII on the MMI scale – very well built structures received slight damage. Older buildings suffered great damage. There was also limited liquefaction. The damage seen corresponds to VIII and perhaps very isolated VIII-IX locations on the MMI scale.

Elazig (0.69g, VIII), Malatya (0.2g, VII)

Vulnerability and Exposure Metrics (Population, Infrastructure, Economic)



Policies for TCIP as a % of buildings

The epicentral region has an economic capital stock in excess of 30 billion USD with regard to the zone of VI intensity or more. In most cases historically this has been associated with at least 2% loss ratios thus leading to a rule of thumb estimate of at least $600mn.

The population in the exposed zone of intensities VI and above is over 1.6 million people, and this is a strong economic center. Over 35% of houses have insurance protection through the TCIP.

What have been the 2 largest damaging events in the past in the location?

Date - Name	Impact Type	Damage Locations	Social % or Insured %	Economic Loss
1905 Malatya	Earthquake	Malatya, Elazig	500 deaths, 5000 destroyed buildings	$52mn (2020)
2010 Elazig (5.9 Mw)	Earthquake	Elazig	42 deaths, 3500 homeless, 8422 damaged buildings	$11mn (2020)

Preferred Social Impact Information:

Type	Median	Accepted Range	Description	Source
Deaths	**41**	May rise	CATDAT Estimate = 65 (21-133)	News
Injuries	**1607**	May rise	Still counting	News
Homeless/Displaced	10000	May rise	Estimated 500k+ affected	**

Preferred Current Economic Impact Information: $billion int. event-day dollars

Type	Median	Accepted Range	Description	Source
Total Loss	**$1.13bn**	**$0.49bn-1.56bn**	Total Economic Cost including structures, equipment for all types (residential, non-residential, govt.) for Turkey	CATDAT / CEDIM / Daniell
Insured Loss	**$0.1bn**	unknown	Elazig has a 35% penetration rate for TCIP, with 43,317 houses insured out of 123,310 houses (7.15mn TRY premiums)	Industry Estimates

Direct Economic Damage (Total) - Summary

- The rapid loss estimation of CEDIM/CATDAT/Risklayer, gives a total damage value coming out to between 0.49 and 1.56 billion USD with a replacement cost (0.64 to 1.9bn USD) in the order of 30% of the provincial GDP (although damage does occur from outside Elazig)
- The exposed stock with some damage to earthquakes was calculated to be $30bn+.
- Indirect losses and total macroeconomic effects are expected to increase this estimate

1 Earthquake Information

Date and time of earthquake and location of Epicenter:

24 January 2020, 17:55 UTC
9 km NNE of Doganyol, Province of Malatya, Turkey (USGS)

Closest larger cities:

Elazig (40 km NNE, 570.000 inhabitants)
Malatya (60 km W, 790.000 inhabitants)
Diyarbakir (110 km SE, 1.000.000 inhabitants)

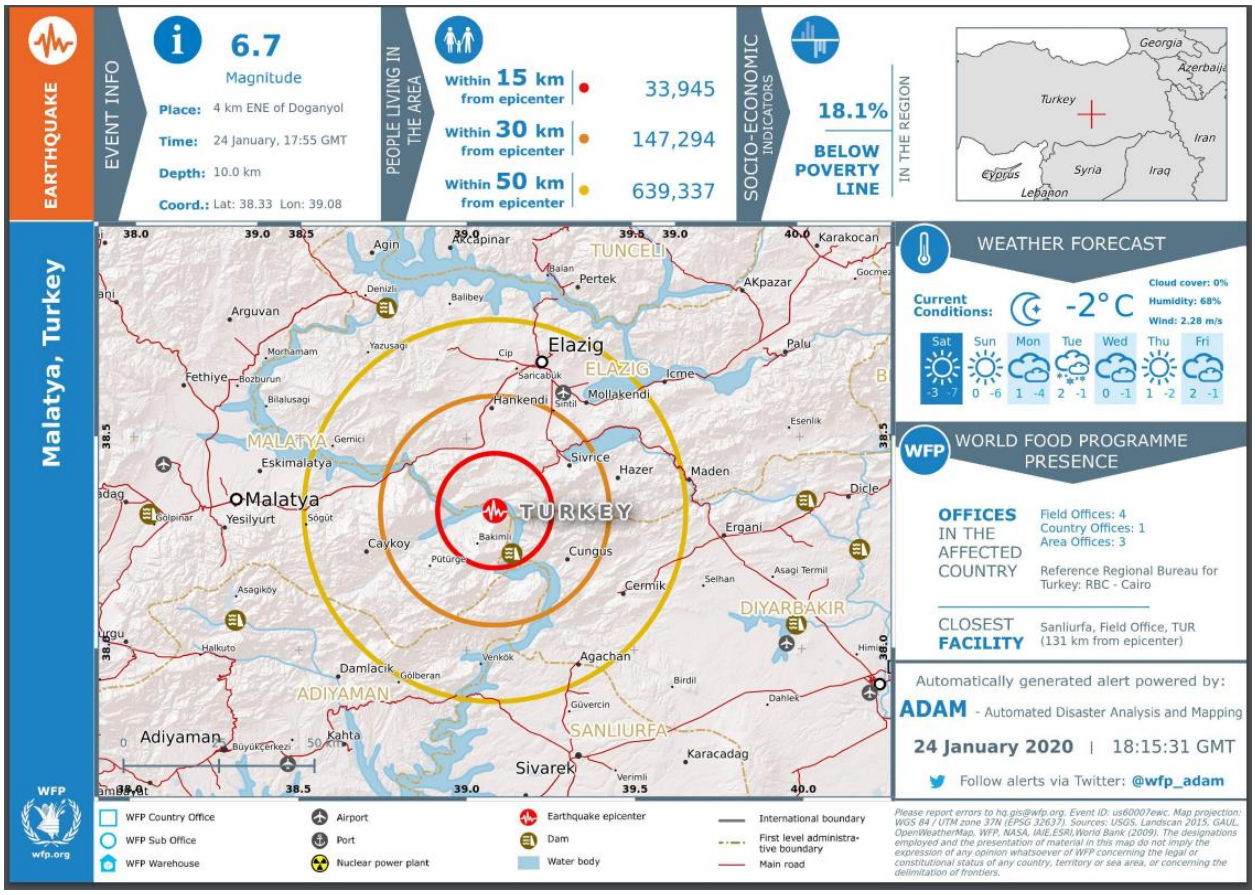
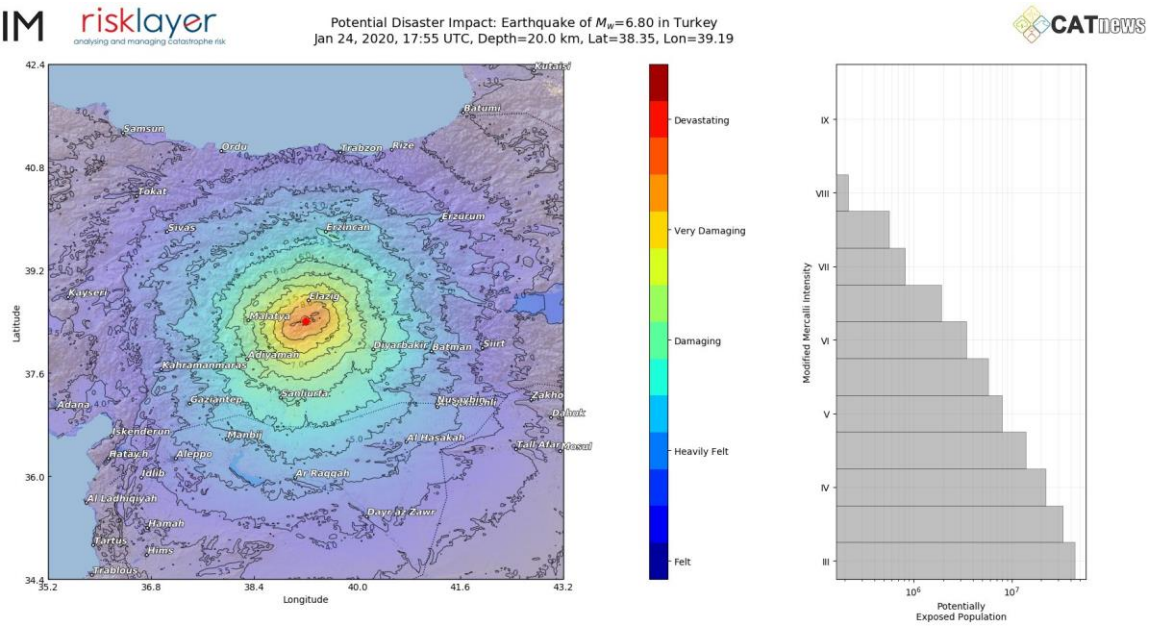


Figure 1: Information about the earthquake event on 24 January 2020, Turkey. Image source: reliefweb.int

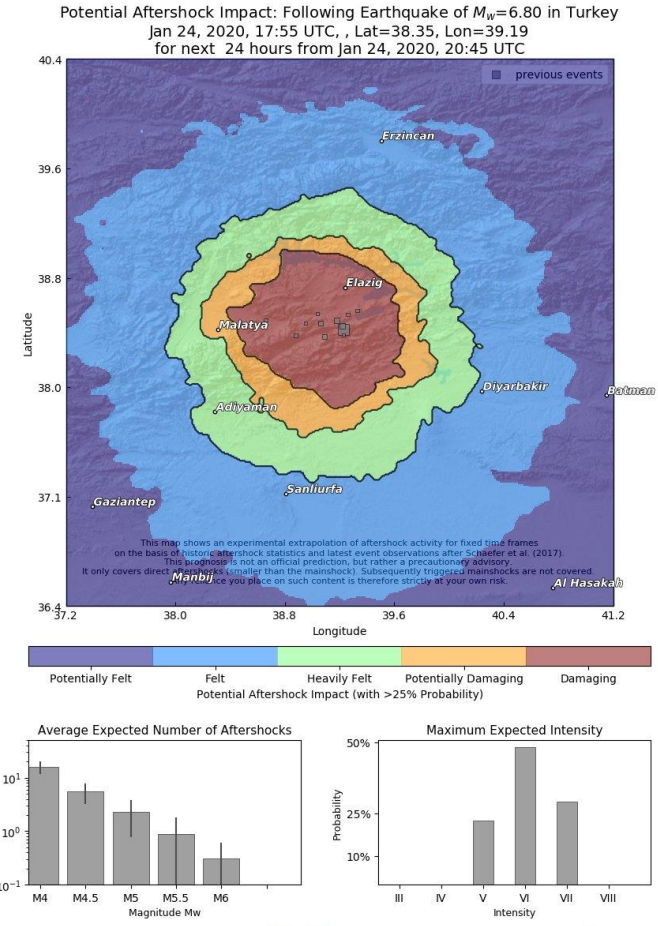
The earthquake intensities were in the order of VIII in the direct epicentral region with recordings of 0.7g present. In terms of the region, a number of historic damaging earthquake have occurred around this location, including the 1905 Malatya earthquake with 500 deaths, and the 2010 Elazig earthquake (Mw5.9) with 42 deaths. The Bingol earthquakes of 1949, 1971 and 2003 earthquakes which killed around 1600 people in total (437, 995 and 177), were in the order of 200km from this epicentre. 71 damaging earthquakes have occurred within 150km of the epicentre since 1900.



The exposed population above intensity VI totalled 1.642 million people, with an associated capital stock of around $30.2 billion. Above intensity VII, 196,000 people and over 4 billion USD in capital can be expected.

Using the casualty and loss ratios within the CATDAT model, an economic loss of $1.13bn USD was expected as a median with a range of between $0.49bn and $1.56bn USD. The number of fatalities expected through the model was 65, however as of the 28th January 2020, 41 people have been reported to be killed.

A significant number of aftershocks were to be expected.



2 Climate Information

2.1 General information

The affected area has a continental location, the Mediterranean Sea is more than 300 kilometres away in the southwest, and the Black Sea is also a good 300 kilometres north of the epicentre. The affected area is characterised by rugged terrain, with mountain ranges, basins, valleys and plateaus. Mountain tops are at a height above 2000 metres. Elazig is situated at an altitude of around 1000 meters.

The climate in the affected area is continental and dry in summer. The temperature differences between summer and winter and also between day and night are usually large due to dry air and solar radiation.

High low-pressure activity during the winter months over the Black Sea, the eastern Mediterranean and the Near East leads to monthly precipitation of 40 to 70 mm in January and February, some of which falls as snow.

2.2 Long term means of temperature and precipitation

Monthly mean temperature in January and February at altitudes between 700 and 1000 meters is around 0°C. In cities and villages which are located at other altitudes in te affected area, the actual values may differ slightly from the values shown in Figure 1. The time course of temperature and precipitation with respect to the 1961-1990 climatology is visible in Figure 1a for the city Malatya and in Figure 1b for Diyarbakir.

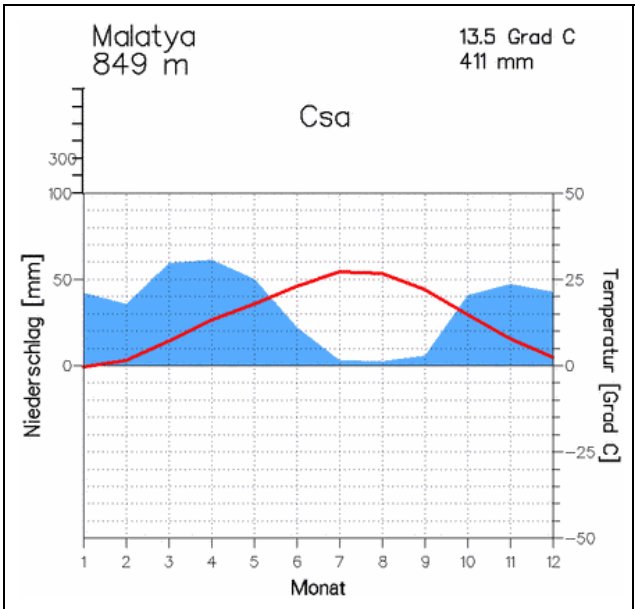


***Figure 2a**: Long term means of temperature and precipitation of Malatya, Turkey. Based on climatology 1961-1990. Image source: www.klimadiagramme.de*

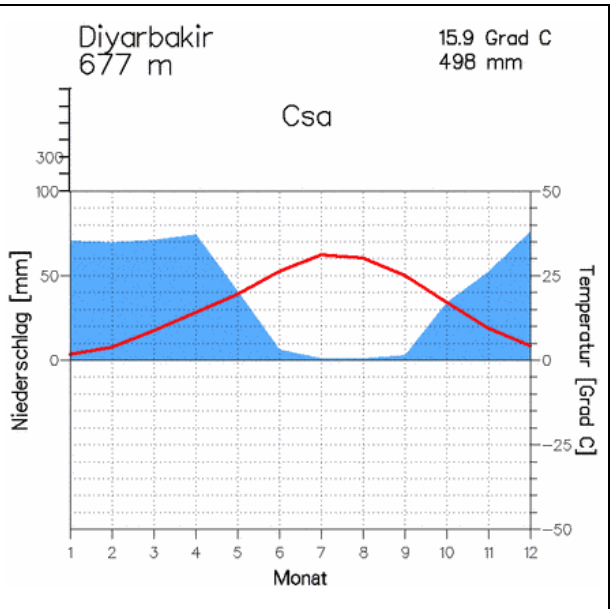


***Figure 2b**: Long term means of temperature and precipitation of Diyarbakir, Turkey. Based on climatology 1961-1990. Image source: www.klimadiagramme.de*

Table 1 gives an overview of the long-term mean values and the extreme values at the two stations Malatya and Diyarbakir. These climatological values can also be used as a first approximation for the affected area.

For the city of Elazig, Table 2 shows the long-term average temperature for the reference period 1981-2010. On average, daytime temperatures are around +3 to +5°C, while slight frost must be expected at night. However, the possible temperature range is enormous: With unfavourable weather conditions, temperatures can drop to even below -20°C.

Table 1: Long-term means (1961-1990) of temperature and precipitation for Malatya (above) and Diyarbakir (below). Data Source: NCDC (Tmean: Monthly mean temperature in°C, Tmx: Mean daily maximum temperature in °C, Max: Absolute maximum temperature (record) in °C, Tmn: Mean daily temperature in °C, Tam: Absolute minimum temperature in °C, RRmean: Monthly mean precipitation in mm, RRmin: Driest monthly precipitation in mm, RRmax: Wettest monthly precipitation in mm, N1mm: Mean number of days with precipitation of 1 mm or above).

	Tmean	Tmx	Tax	Tmn	Tam	RRmean	RRmin	Rrmax	N1mm
Jan	**-0.4**	2.9	14.2	-3.2	-18.3	**41.9**	3.9	139.0	7
Feb	**1.5**	5.3	17.7	-1.7	-18.2	**35.6**	8.9	71.0	7
Mar	**6.9**	11.1	23.3	2.4	-13.9	**59.5**	11.9	131.0	9
Apr	**13.0**	18.2	30.2	7.7	-6.6	**61.3**	2.9	141.0	8
May	**17.8**	23.5	36.0	11.8	2.7	**50.0**	4.9	132.0	8
Jun	**22.9**	29.2	38.2	16.1	4.9	**21.9**	0.0	67.0	3
Jul	**27.0**	33.8	42.2	19.8	10.1	**2.8**	0.0	12.0	1
Aug	**26.5**	33.4	40.8	19.4	12.2	**2.4**	0.0	24.0	1
Sep	**22.0**	28.9	37.0	15.2	6.2	**5.8**	0.0	27.0	1
Oct	**14.8**	20.9	33.1	9.5	-1.1	**40.4**	0.0	130.0	5
Nov	**7.6**	11.8	25.0	3.7	-7.9	**47.0**	0.0	146.0	6
Dec	**2.4**	5.7	18.0	-0.3	-10.4	**42.3**	3.9	93.0	7
Annual	**13.5**	18.7	42.2	8.4	-18.3	**410.9**	0.0	146.0	63

	Tmean	Tmx	Tax	Tmn	Tam	RRmean	RRmin	Rrmax	N1mm
Jan	**1.7**	6.3	16.5	-2.0	-19.7	**70.3**	0.9	189.0	10
Feb	**3.7**	8.7	21.3	-0.6	-19.7	**69.7**	21.9	146.0	10
Mar	**8.6**	14.4	25.5	3.2	-14.2	**70.9**	21.9	141.0	9
Apr	**13.9**	20.1	31.7	7.6	-3.3	**74.1**	1.9	164.0	9
May	**19.4**	26.4	38.1	11.9	0.8	**40.4**	0.0	182.0	6
Jun	**26.2**	33.3	41.2	17.2	6.0	**6.1**	0.0	25.0	1
Jul	**31.1**	38.3	45.0	21.9	14.2	**0.8**	0.0	3.0	0
Aug	**30.2**	37.8	44.4	21.2	14.0	**1.1**	0.0	5.0	0
Sep	**24.9**	33.3	42.0	16.4	5.3	**2.9**	0.0	14.0	1
Oct	**17.0**	24.9	35.7	10.3	-1.2	**34.0**	0.0	148.0	4
Nov	**9.4**	16.0	27.2	4.3	-7.8	**52.2**	1.9	99.0	7
Dec	**4.3**	9.2	19.0	0.8	-17.9	**75.9**	1.9	162.0	9
Annual	**15.9**	22.4	45.0	9.4	-19.7	**498.4**	21.9	189.0	66

In terms of precipitation, usually 7 to 10 days in January and February are associated with significant rain or snow. The winter months can be extremely wet, in Diyarbakir maximum monthly precipitation in January was 189 mm. Such rain amounts, especially when occurring within a few days, would cause severe problems due to flooding or landslides.

Table 2: Long term means (1981-2010) of temperature and precipitation for Elazig. Data Source: Turkish State Meteorological Service, https://mgm.gov.tr

ELAZIG	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ANN
Maximum Temp.	12.4	18.6	26.4	32.2	34.4	38.6	42.2	41.3	37.8	32.1	24.3	24.6	**42.2**
Minimum Temp.	-22.6	-21.4	-17.0	-7.0	0.0	4.0	6.7	10.2	1.0	-2.2	-15.2	-22.6	**-22.6**
Average Temp. (1981-2010)	-0.5	0.7	5.9	12.0	17.1	22.9	27.4	26.8	21.4	14.4	6.8	2.0	**13.1**
Average Max. Temp. (1981-2010)	3.3	5.3	11.3	18.0	23.6	29.8	34.4	34.3	29.4	21.7	12.3	5.7	**19.1**
Average Min. Temp. (1981-2010)	-3.7	-3.1	1.0	6.3	10.2	14.8	19.0	18.7	13.9	8.7	2.6	-1.0	**7.3**

3 Weather forecast

3.1 Temperature

The global weather forecast model GFS provides information about temperature, precipitation and other variables for the next 16 days. Based on the model run, which was issued on 26 January 2020, 00 UTC, 2 meter air temperature is pretty close to long term values until the end January. The different model runs (ensembles) do not differ very much until 31 January, therefore daytime temperatures should be slightly above 0°C, while during the night light frost cannot be excluded (Figure 2). With the beginning of February, colder temperatures become more likely, particularly during night, when temperatures might drop to below -5°C.

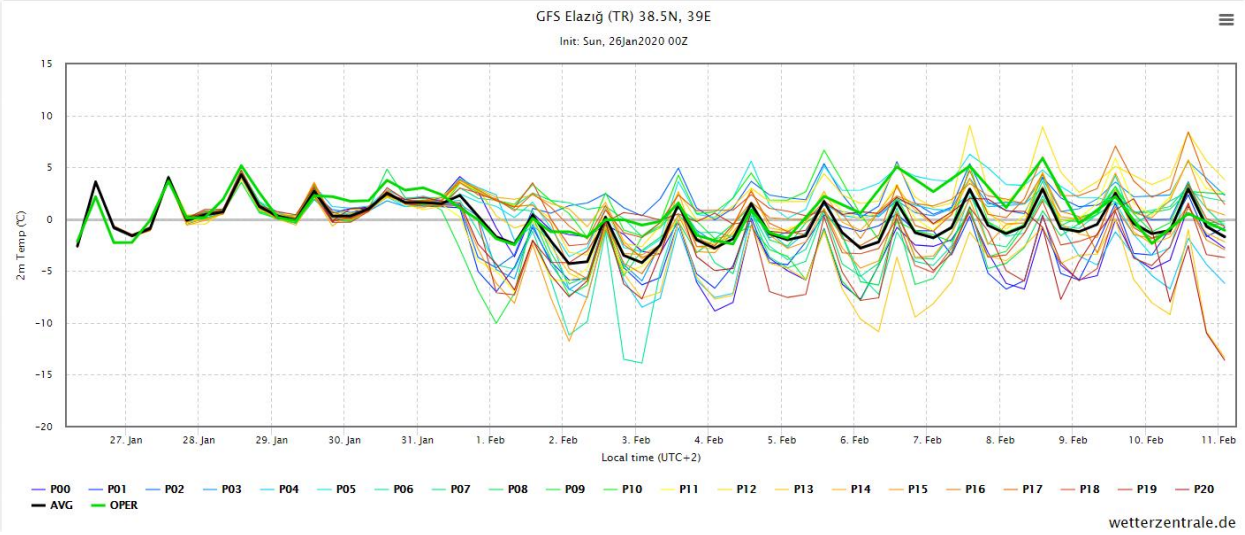


Figure 3: Ensemble forecast (GFS-model) for 2m-air temperature for Elazig (Turkey), 26 January - 11 February 2020. Initialization of model run: 26 January 2020, 00 UTC. Image source: www.wetterzentrale.de

3.2 Precipitation

Small amounts of precipitation are likely on 29 January and there may be some snow with an accumulation of a few centimeters at elevations above 1200 meters. Starting in the course of 30 January 2020, strong precipitation appears to become very likely especially on 31 January 2020. The precipitations should start as rain on 30 January but turning into snow the day after (Figure 2). Total precipiatation accumulation until 02 February 2020, 00 UTC, may be around 20 mm in the vicinity of large lakes, in broad valleys and basins (Figure 3). In mountainous areas however, precipitation accumulation may be as much as 80 mm which correspondents to fresh snow of about 80-100 cm. Some roads and paths may become impassable.

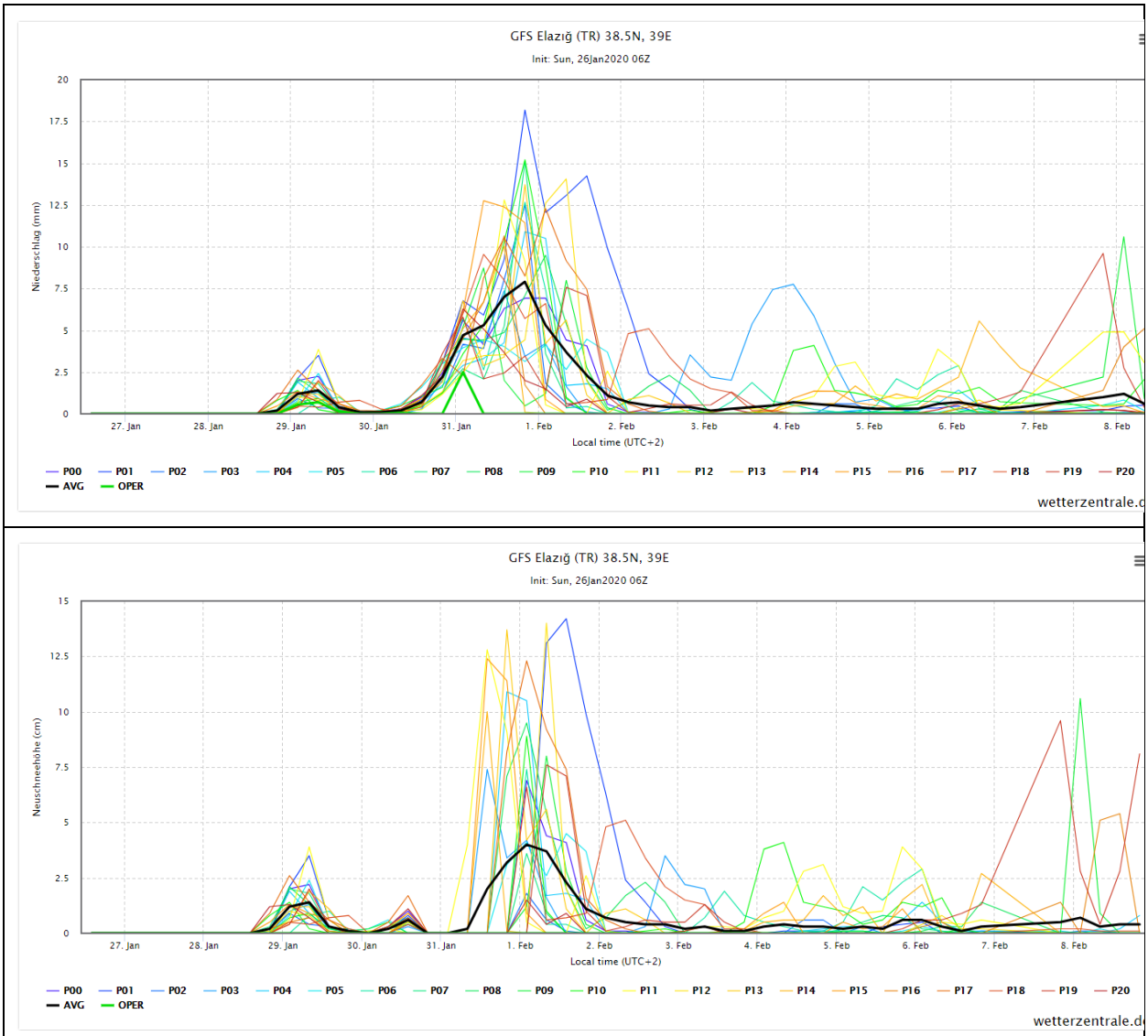


Figure 4: Ensemble forecast (GFS-model) for precipitation (above) and fresh snow (below) for Elazig (Turkey), 26 January - 11 February 2020. Initialization of model run: 26 January 2020, 00 UTC. Image source: www.wetterzentrale.de

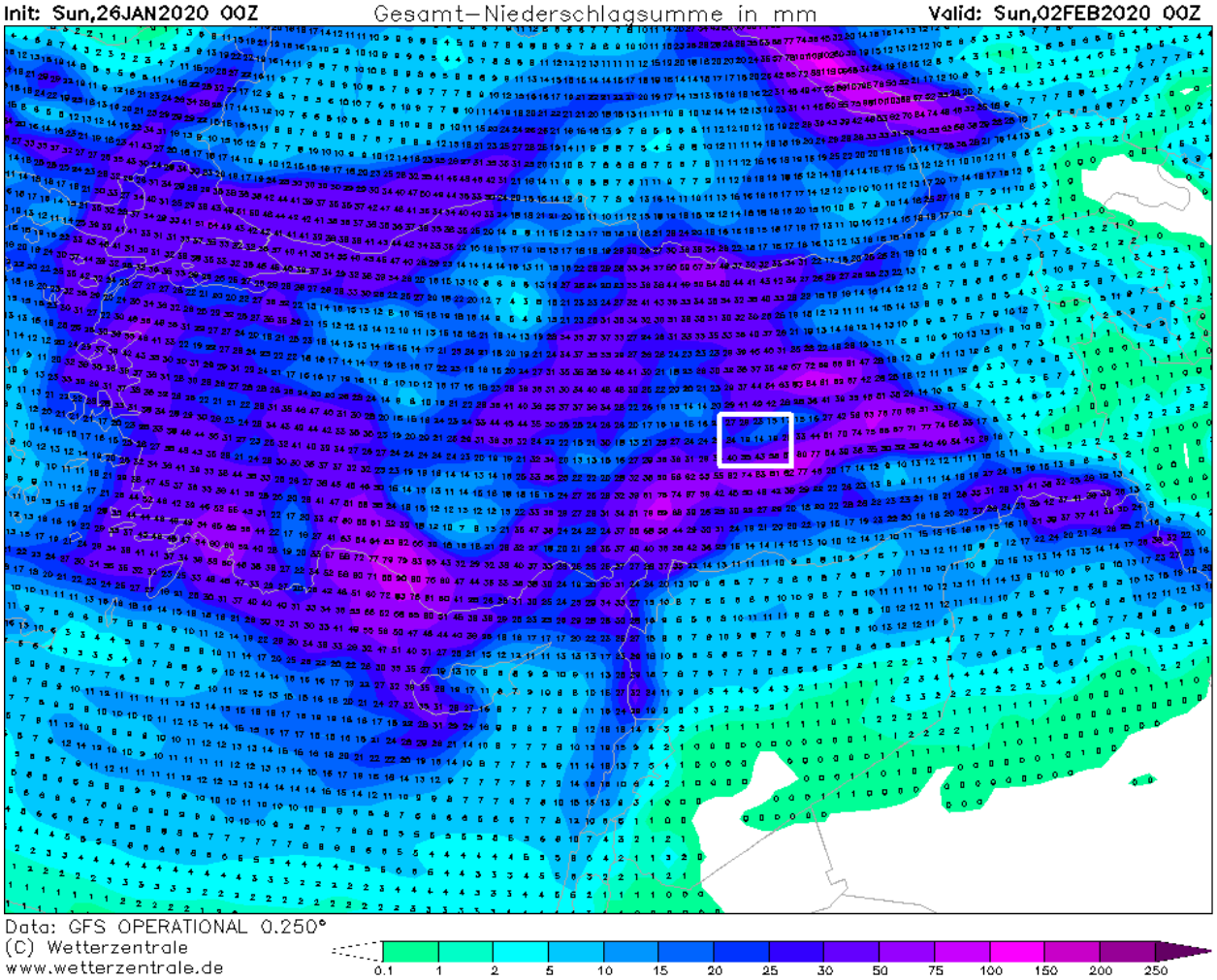


Figure 5: 168 h-accumulated precipitation (26 January 2020, 00 UTC, - 02 February 2020, 00 UTC). Initialization of GFS model run: 26 January 2020, 00 UTC. Image source: www.wetterzentrale.de

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