



## Division of Climatology – Applications

### **Analysis of Winter2016/17 and verification of SEECOF-16 Winter2016/17 outlook (Consensus seasonal forecast for Winter2016/2017) compared to base period 1971-2000, regarding mean temperature and precipitation for Greece**

#### **Introduction**

This report consists of two parts. In part A, an analysis of observed mean temperature and precipitation for Winter 2016/17 was performed, first on monthly basis and then for the whole Winter 2016/17 season (DJF). The reference period for comparison was the base period of 1971-2000.

In part B, an assessment - verification of SEECOF-16 Winter 2016 outlook (Consensus seasonal forecast for Winter 2016/2017, issued in November 2016) was carried out in comparison with the observed weather of Winter 2016/17.

In part A also are included indicative *extremes - weather/climate events in Winter 2016/2017*.

#### **A. Analysis of Winter 2016 weather compared to base period 1971-2000, regarding mean temperature and precipitation.**

First the analysis was carried out on a monthly basis and then for the whole Winter 2016 (DJF) season. The reference is made first for temperature and then for precipitation.

##### Temperature

*December 2016* was in general a cooler than average month and the departures of mean monthly temperature from normals (climatological averages) ranged from nearly 1.0 to 3.0 or more degrees below the climatology of base period 1971-2000.

The largest anomalies (near or more than three) were observed over south mainland (including Attica), locally in Aegean and Crete.

*January 2017* was a very cold month for almost the entire country, particularly in the north and central parts. The weather was relatively milder in southeast island areas, Cyclades, Crete and Dodecanese. The departures of mean monthly temperature from normals (climatological averages) ranged from nearly 2.0 to 3.0 or more degrees below the climatology of the base period 1971-2000. The largest negative anomalies (more than three to four) were observed over north and central mainland, while lower values (near normal to 1.7 degrees) were recorded in Cyclades, Crete and Dodecanese. In January 2016 there was observed a very extreme event of total frost of 3 to 5 consecutive days locally in the mainland.

*February 2017* was a warmer than average month for the whole country, since the departures of mean monthly temperature from normals (climatological averages) ranged from 0.7 to 2.7 degrees above the climatology of the base period 1971-2000. The largest positive anomalies were observed in northern parts (Kozani 2.7, Macedonia 2.1), while the smallest ones (0.7-0.9) were recorded locally in eastern islands (Cyclades, Crete and Aegean). Note: there were gaps in the available data for this month and hence the analysis on monthly basis was difficult which created some problems for the analysis on seasonal Winter basis, which followed.

*For the whole Winter 2016/17 (DJF) season*, taking into account the previous analysis on monthly basis and performing a respective similar analysis on seasonal Winter basis, the conclusions drawn for Greece are the following for the *seasonal Winter temperature*:

Regarding seasonal mean temperature for Winter 2016/2017, Winter of 2016/17 was, in general, colder than normal, since the seasonal mean temperature was below average values and particularly its negative departures from normals ranged from near 1 °C to locally - slightly above this level.

### Precipitation

*December 2016* was a very dry month for almost the entire country, since the accumulated monthly precipitation accounted for less than 10 % up to 85 % of average values for the largest part, while in some places (north) the precipitation was zero. However, there were some exceptions of high precipitation (near normals and locally up to twice the mean values) only in the island of Crete.

*In contrast to December 2016, January 2017 was in general a wet month for several parts of the country, since the accumulated monthly precipitation ranged from 120 % to up to 200 % (in some places), while only in few locations (in western, northern and central parts, Dodecanese and Crete) the recorded monthly precipitation accounted for less than normals (62 to 87 %).*

*February 2017 was a relatively dry month for most areas of the country, since the accumulated monthly precipitation was well below the normal values. The accumulated monthly precipitation accounted for less than 10 % to 70 % of average values for the largest part of Greece. However, there were few exceptions (locally in northwest mainland, west Crete and north Aegean), where the monthly precipitation was near or above average values (Kozani 95 %, Souda 131 %, Limnos 143 %).*

*For the whole Winter 2016 (DJF) season, taking into account the previous analysis on monthly basis and performing a respective similar analysis on seasonal Winter basis, the conclusions drawn for Greece for the seasonal Winter precipitation are the following:*

With respect to seasonal accumulated precipitation for Winter 2016/2017, Winter of 2016/17 was dryer than average, since the accumulated seasonal precipitation was below normal and ranged from near 50 % to 85 % of climatological values (for mean winter precipitation). There were few exceptions and especially for the island of Crete, where the corresponding percentages were above 100 % (up to 150 %). That means, the winter only in Crete was wetter than normal.

#### *Extremes - weather/climate events in Winter 2016/2017 (indicative)*

In January 2017, an extreme weather/climate event, relative to total frost, was observed particularly in the first half this month in Greek mainland (mainly north and central). A total frost event was recorded with its duration of five or more consecutive days. A representative case of this event is the meteorological station of Macedonia (Figure 1.), where the minimum and maximum temperature remained always below zero for five consecutive days during the period of 7-11 January 2017. Similarly, in the station of Larisa there was observed a similar phenomenon with greater severity. The duration was bigger, from 7 to 14 January 2017 (eight days) and larger magnitude of total frost was observed (highest minimum temperatures: - 18 °C in Larisa as opposed to -9.6 °C in Macedonia). Both phenomena had never been observed before in these areas and generally in Greece. Figure 1 follows, depicting this previously mentioned extreme event (for Macedonia).

Division of Climatology - Applications





**Figure 1. Extreme total frost event(s)** (including winter 2016/2017/Jan.17)

Met. Station : Macedonia (airport)

Longitude                      Latitude                      Station altitude  
22.97                              40.53                              2 meters

Parameter: Events of total frost 1959-2017

<u>WMO No</u>	<u>Year of Observation</u>	<u>Month of observation</u>	<u>Day of observation (date)</u>	<u>Min Temp. (oC)</u>	<u>Max Temp. (oC)</u>
-	-	-	-	-	-
16622	1985	2	19	-5.4	-0.2
16622	1987	1	9	-6.0	-1.8
16622	1987	1	10	-9.4	-0.6
16622	1991	2	1	-6.0	-1.8
16622	2001	12	17	-3.6	-1.6
16622	2001	12	18	-4.0	-1.6
16622	2001	12	19	-5.2	0.0
16622	2001	12	21	-7.6	-0.4
16622	2002	1	4	-4.2	-0.4
16622	2002	1	5	-5.0	-0.6
16622	2004	1	24	-3.8	0.0
16622	2004	2	13	-5.8	-1.2
16622	2006	1	25	-4.6	-1.4
16622	2017	1	7	-6.0	-3.2
16622	2017	1	8	-8.4	-3.4
16622	2017	1	9	-5.5	-3.5
16622	2017	1	10	-4.6	-3.1
16622	2017	1	11	-9.6	-2.0

	One isolated day
	Two consecutive days
	Three consecutive days
	Five consecutive days

Furthermore, in February 2017, high precipitation heights were locally recorded in western Crete, above the corresponding normal values. It is indicative that, the monthly accumulated precipitation for February 2017 was 148 mm from Met. Station Souda /HNMS (Hellenic National meteorological Service – HNMS, [www.hnms.gr](http://www.hnms.gr)) and 133.0 mm from W.S Vryssai /NOA (W.S: weather station, National Observatory of Athens, [www.noa.gr](http://www.noa.gr)). The corresponding mean value for monthly precipitation for Souda (HNMS) in February is 112.8 mm. Thus, February 2017 was a wet month for western Crete, since the monthly precipitation of this particular month accounted for 131% of normal values.

From climatological view point, December 2017 was a very dry month, since the accumulated monthly precipitation for this particular month accounted for less than 10% to 85% of average values, for the largest part, while in some places (north) the precipitation was zero, as mentioned earlier in Part A. Precipitation. Figure 2 which follows, includes the monthly precipitation heights for December 2017 and the corresponding percentages of mean values (the smaller the percentages, the dryer the month).

Division of Climatology - Applications

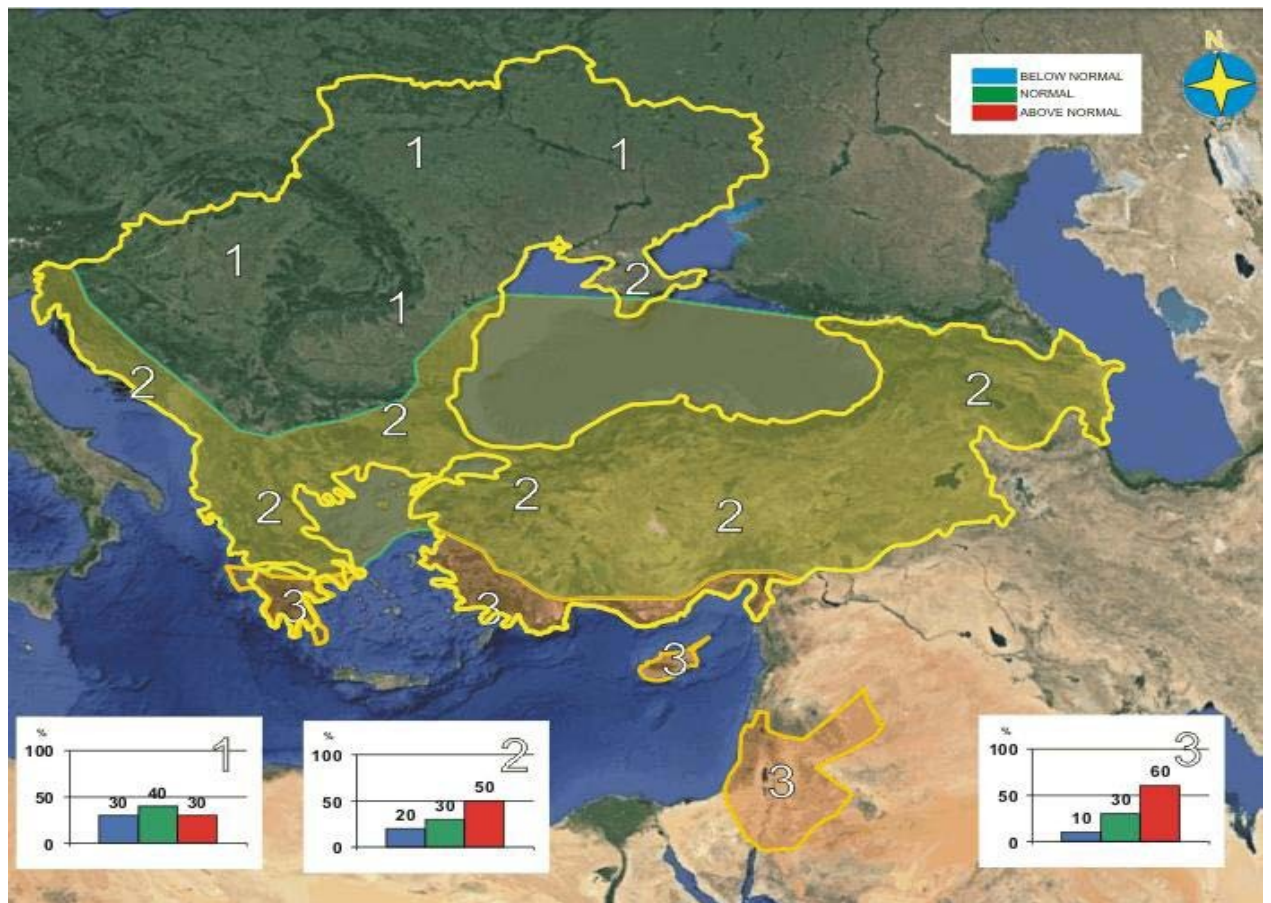
**Figure 2. Dry December 2016: Low monthly precipitation heights,  
Percentages (%) Dec. 16 preci. Heights / mean values of Dec. preci.**

Parameter : precipitation height in mm

WMO code No	Met. Station	Longitude	Latitude	December 2016 (preci. Height)	Percentage (%) Dec. 16 preci. Heights /Mean values of Dec. preci.
16 627	Alexandroupoli	25.95	40.85	6	6.9%
16 632	Kozani	21.83	40.28	9	16.5%
16 641	Kerkyra	19.92	39.62	6	3.3%
16 648	Larisa	22.45	39.65	5	9.6%
16 685	Argostoli	20.5	38.12	26	20.7%
16 716	Hellinikon	23.73	38.33	23	34.7%
16 710	Tripoli	22.4	37.52	9	6.1%
16 726	Kalamata	22.02	37.07	9	5.9%
16 667	Mytilini	26.6	39.05	16	11.0%
16 744	Santorini	25.41	36.41	52	85.7%
16 754	Iraklion	25.18	35.33	164	212.7%
16 746	Souda	24.12	35.55	203	216.2%
16 757	Sitia	26.1	35.21	69	77.8%
16 749	Rodos	28.08	36.4	68	46.8%

**B. Assessment / verification of SEECOF-16 Winter 2016 outlook (Consensus seasonal forecast for Winter 2016/2017 regarding mean temperature and precipitation. Averaging period 1971-2000.**

**B1. Temperature**



**Figure 3.** Graphical presentation of the 2016-2017 Winter temperature outlook.

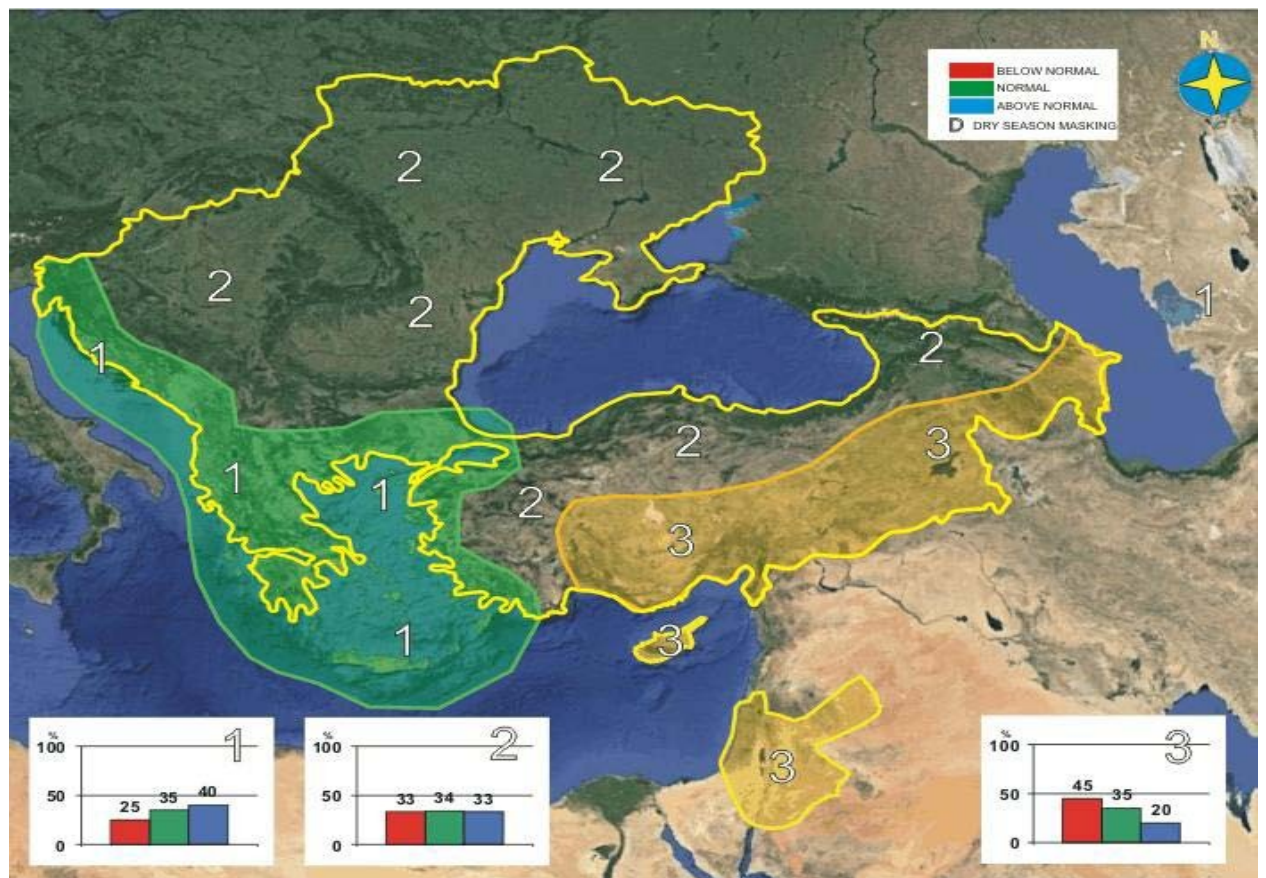
According to the SEECOF's outlook for the 2016-2017 Winter mean Temperature (Figure 3): the biggest part of Greek territory (north and central mainland and north Aegean sea) is in the SEECOF's zone 2, where the above normal mean temperature is the dominant figure (50%), while the probability for below normal temperatures is low (20%). The rest part of Greek mainland (Peloponnese) is in zone 3, where also the mean temperature follows the same regime of zone 2, since the mean temperature was likely to be above normal with a probability of 60%, near normal with a probability of 30% and below normal with a probability of only 10%.

Verifying the SEECOF's temperature outlook (although this is relative to the 1981-2010 normals), it was found that this SEECOF - 16's Winter 2016/17 temperature outlook was not successful, since it predicted that seasonal



temperatures below normals would had probability of 10 to 20 % only, while the corresponding probability of seasonal temperatures above normals were 50 to 60 %. This verification is based on the reality that, according to previous climatological analysis (observed data) Winter 2016/17 seasonal temperature was below normal.

## B2. Precipitation



**Figure 4.** Graphical presentation of the 2015-2016 Winter precipitation outlook.

According to the SEECOF-16 outlook for the 2015-2016 Winter precipitation (Figure 4): the whole Greece belongs to zone 1, which meant that, the probabilities for the accumulated precipitation were 25%, 35% and 40 % for below normal, normal and above normal respectively. There was no dominant figure, since the probabilities for near, below and above normal situations are relatively close.

Verifying the SEECOF-16 precipitation outlook (although this is relative to the 1981- 2010 normals), it was found that this SEECOF-16 accumulated Winter 2016/17 precipitation outlook failed, since this outlook did not forecast the dryer than climate averages season. Although this consensus forecast



did not give a clear signal (25 % below, 35 % normal, 40 % above), the probability of above normal accumulated precipitation was the largest:40 %. However, the observed data showed that Winter 2016/17 was not wetter than normals but in contrast it was dryer. Consequently, the SEECOF - 16 outlook for precipitation was unsuccessful for most parts of the country.

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