Hellenic National Meteorological Service Climatology-Applications Division

2016 SIGNIFICANT WEATHER and CLIMATIC EVENTS in GREECE



Paraskevi - Vivianna FRAGKOULI

Front Page Photograph

ThunderStorm 7 AUGUST 2016, Kerkira

Courtesy of Stathis Koutsiaftis

1^{rst} award, 2016 Photography Contest, Hellenic Meteorological Society

SIGNIFICANT WEATHER and CLIMATIC EVENTS in GREECE during 2016

The definition of the weather categories and the selection of the cases of each category was done according to the instructions and recommendations of the World Meteorological Organization.

For the chosen cases the geographical extent, duration, severity, casualties and impacts of the event were taken into account.

ANALYTICALLY:

FLOOD (2 episodes)

EXTREME PRECIPITATION EPISODE

HAIL

AFRICAN DUST TRANSPORT

HEAT WAVE

TEMPERATURE CLIMATOLOGY: HOT month FEBRUARY 2016

RAINFALL CLIMATOLOGY: WET month JUNE 2016

RAINFALL CLIMATOLOGY: WET month SEPTEMBER 2016

RAINFALL CLIMATOLOGY: DRY month APRIL 2016

RAINFALL CLIMATOLOGY: DRY month DECEMBER 2016

This report was conducted by Paraskevi - Vivianna FRAGKOULI,

Head of Climate and Research Section of Climatology-Applications Division,

Hellenic National Meteorological Service

Email: frag@hnms.gr

WMO: World Meteorological Organization

HNMS: Hellenic National Meteorological Service
NOA: National Observatory of Athens

WS: Weather Station

AWS: Automatic Weather Station

WMO-ID: World Meteorological Organization-IDentification Number

R: Rainfall or Precipitation Height (in mm)

R12: 12-hour Rainfall Height
R24: 24-hour Rainfall Height
R36: 36-hour Rainfall Height
R48: 48-hour Rainfall Height

R-*-monthly-average: monthly average Rainfall Height of a specific (*) month

Tmean:mean Temperature (in $^{\circ}$ C)Tmax:maximum Temperature (in $^{\circ}$ C)Tmin:minimum Temperature (in $^{\circ}$ C)

Tmax-*-monthly-average: monthly average Tmax of a specific (*) month

FLOOD

The MOST SIGNIFICANT EVENT of the year 2016 for Greece

DESCRIPTION

During **6-9 SEPTEMBER 2016** a cut-off upper level low located southwest of the country affected mainly its west part and caused severe thunderstorms with heavy rainfalls, floods, landslides, and locally tornadoes.

SEVERITY

RAINFALL HEIGHT (R)

Not recorded any new absolute records, but many WSs reported 12-hour precipitation height > 50 mm. Especially:

on 6 SEPT 2016

at the HNMS-WS of **Kerkira** (WMO-ID: 16641):

R24 = 113.3 mm

historical reference

(R-SEPT-monthly-average = 71.8 mm, reference period: 1971-2000).

at the HNMS-WS of **Andravida** (WMO-ID: 16682):

R12 = 54.0 mm

historical reference

(R-SEPT-monthly-average = 28.7 mm, reference period: 1971-2000).

at the HNMS-WS of **Araxos** (WMO-ID: 16687):

R12 = 66.1 mm

historical reference

(R-SEPT-monthly-average = 29.5 mm, reference period: 1971-2000).

at the HNMS-WS of **Kalamata** (WMO-ID: 16726):

R24 = 132.6 mm

historical reference

(R-SEPT-monthly-average = 27.2 mm, reference period: 1971-2000).

at the NOA-AWS of **Karavostasi** (Thesprotia):

R24 = 156.0 mm

on 7 SEPT 2016

at the HNMS-WS of **Thessaloniki** (WMO-ID: 16622):

R12 = 51.1 mm

<u>historical reference</u>

(R-SEPT-monthly-average = 25.4 mm, reference period: 1971-2000).

at the NOA-AWS of **Geraki** (Lakonia):

R24 = 200.2 mm

at the NOA-AWS of **Nea Mihaniona** (Thessaloniki):

R24 = 198.2 mm

It is worth mentioning that the **SEPTEMBER's 2016 monthly rainfall height** of some WSs is set as the **new UPPER record** or as the second in rank of **SEPT's rainfall**.

More details at the category of the climate event: **Wet month SEPTEMBER 2016** (page: 14).

CASUALTIES

6 people.

Specifically: 5 people at Peloponnese (3 at Messinia, 1 at Lakonia, 1 at Korinthia) and 1 woman at Nea Mixaniona (Thessaloniki/Macedonia).

IMPACTS

Continuous heavy rainfalls affected several areas of the country causing power outages, large damage to networks, crops, infrastructure, roads and public and private property due to flash floods.

Also, some regions at the western and northern part of the country were declared in states of emergency.

The Fire Brigade received hundreds of distress calls to rescued people in difficulty, but in some places the flood water was up to 2 meters deep, causing problems for emergency services to reach the affected communities.

There are many images showed cars washed out to sea or piled up from torrential rain.





http://www.newsit.gr/ellada/THeominia-kai-eikones-vivlikis-katastrofis-stin-Kalamata-apo-tin-kakokairia-Plirofories-gia-enan-nekro/647312



http://www.bbc.com/news/world-europe-37295180

FLOOD

DESCRIPTION

During **26-30 NOVEMBER 2016** a 5-day severe weather event affected mainly the west and eastern part of the country, including Attica the capital of Greece, and caused extended floods due to continuous rainfalls.

SEVERITY

RAINFALL HEIGHT (R)

Many WSs recorded a 12-hour precipitation height > 50 mm and some **new UPPER records** were set. Especially:

on 26-27 NOV 2016

at the HNMS-WS of **Zakinthos** (WMO-ID: 16719):

R48 = 183.4 mm

historical reference

(R-NOV-monthly-average=158.3 mm, reference period: 20-year long term statistics).

on 28-29 NOV 2016

at the HNMS-WS of Mitilini (WMO-ID: 16667):

R36 = 177.2 mm

historical reference

(R-NOV-monthly-average = 101.3 mm, reference period: 1971-2000).

at the HNMS-WS of **Skiros** (WMO-ID: 16684):

R36 = 120.2 mm

(analytically: R36 = 17.5 + 100.0 + 2.7 = 120.2 mm)

historical reference

The R12 = 100.0 mm on 29 NOV 2016 is set as its R12's new UPPER record.

Moreover, the R24 = 117.5 mm (17.5 +100.0) is set as its R24's new UPPER record (period: 28 NOV 2016/06 UTC-29 NOV 2016/06 UTC).

(2nd in rank R12 = 69.6 mm on 5 JAN 1973 and 2nd in rank R24 = 98.9 mm on 2 DEC 2002) (reference period: 1955-2016).

(R-NOV-monthly-average = 51.8 mm, reference period: 1971-2000).

on 29 NOV 2016

at the HNMS-WS of **Kos** (WMO-ID: 16742):

R12 = 86.2 mm

historical reference

The R12 = 86.2 mm on 29 NOV 2016 is set as R12's second in rank.

(R12-UPPER-record = 133.1 mm on 13 JAN 1984) (reference period: 1982-2016).

 $(R-NOV-monthly-average = 83.9 \text{ mm}, 20-year long term statistics}).$

on 30 NOV 2016

at the HNMS-WS of **Souda** (WMO-ID: 16746):

R12 = 70.8 mm

historical reference

(R-NOV-monthly-average = 86.7 mm, reference period: 1971-2000).

CASUALTIES

1 man was swept away in the flash floods (in Zakinthos island).

IMPACTS

Large damage occurred to infrastructure, crops, roads and public and private property.

Fire Service received a large number of calls with requests for pumping flood water, rescuing stranded drivers and evacuating people to safer locations.

Flooding also affected Athens the capital city of Greece, where several Metro-underground stations and roads had been closed.

EXTREME PRECIPITATION EPISODE

DESCRIPTION

During **25-26 JUNE 2016** a barometric low moved from northern part of Africa towards Greece, and affected the south Ionian Sea and Peloponnese prefecture causing severe thunderstorms with heavy rainfalls.

SEVERITY

RAINFALL HEIGHT (R)

on 25-26 JUN 2016

at the HNMS-WS of **Tripoli** (WMO-ID: 16710):

R24 = 157.7 mm

(analytically: R24 = 86.5 + 71.2 = 157.7 mm)

historical reference

The R12 = 86.5 mm on 25 JUN 2016 is set as its R12's new UPPER record,

while the R12 = 71.2 mm precipitation height of the next 12-hours (on 26 JUN 2016) is the 5th in its rank.

Moreover, the R24 = 157.7 mm is set as its R24's new UPPER record.

(2nd in rank R12 = 76.0 mm on 18 AUG 1997 and

2nd in rank R24 = 110.7 mm on 30 DEC 1984) (reference period: 1957-2016).

 $(R-JUN-monthly-average = 17.2 \text{ mm}, reference period: } 1971-2000).$

on 25 JUN 2016

at the HNMS-WS of Kalamata (WMO-ID: 16726):

R12 = 64.1 mm

historical reference

(R-JUN-monthly-average = 6.3 mm, reference period: 1971-2000).

at the NOA-AWS of **Megalopoli** (Arkadia):

R24 = 213.0 mm

at the NOA-AWS of Kalamata (Messinia):

R24 = 129.0 mm

It is worth mentioning that for the WS-Tripoli the JUNE's-2016 monthly precipitation height (R-JUN-2016 = 163.4 mm) is its JUNE's new UPPER record.

More details at the category of the climate event: Wet month JUNE 2016 (page: 13).

IMPACTS

The heavy rainfalls caused extensive damage to infrastructure and to the public and private property at Peloponnese prefecture, while Megalopolis (central Peloponnese) was declared in state of emergency. In Tripoli (central Peloponnese) there was a power outage for several hours.

HAIL

DESCRIPTION

Severe thunderstorms occurred on **28 JUNE 2016** over the central mainland of Greece, including Attica prefecture, due to favorable weather conditions produced intense electrical activity, gale force downdrusts, floods and many cases of hailfalls large hailstones (upto walnut sized).

SEVERITY

RAINFALL HEIGHT (R)

Locally, some WSs recorded **precipitation height > 15 mm in less than 2-hour period**.

on 28 JUN 2016

at the HNMS-WS of **Hellinikon** (WMO-ID: 16716): $\mathbf{R} = 18.0 \text{ mm}$, in 30-minutes period

historical reference

 $(R-JUN-monthly-average = 5.7 \text{ mm}, reference period: }1971-2000).$

at the HNMS-WS of **Tatoi** (WMO-ID: 16715): $\mathbf{R} = 13.8 \text{ mm}$, in 80-minutes period

historical reference

(R-JUN-monthly-average = 8.8 mm, reference period: 1971-2000).

at the NOA-AWS of **Drosia** (Attica):

R24 = 46.6 mm

at the NOA-AWS of **Penteli** (Attica):

R24 = 23.6 mm

IMPACTS

The hailfalls caused extensive catastrophes to the crops in Trikala and Karditsa (Thessalia prefecture).

Also, the big hailstones combined with the strong winds resulted in large damage to public and private property.

Moreover, only for the area of Attica, the Hellenic National Meteorological Service was asked to certify more than 3000 cases of hail occurrence.



http://www.newsit.gr/topikes-eidhseis/Mpoyrini-sarose-ta-Trikala-Epese-xalazi-se-megethos-koromiloy-VINTEO/631519



http://static.larissanet.gr/wp-content/uploads/2016/06/201606281321535792.jpg

AFRICAN DUST TRANSPORT

DESCRIPTION

During 22-23 MARCH 2016 an episode of Sahara dust transport affected the whole country.

SEVERITY

On 23 MARCH 2016, the recorded PM-10 dust concentration of 2190 mg/m³ was one the most severe dust episodes of the last years (allowable limit: 50 mg/m³).

IMPACTS

The transport of Sahara dust combined with the weather conditions (gale force south winds, high values of both ambient temperature and relative humidity) produced a bad air quality that influenced the human health adversely.

Furthermore, in Athens locally the visibility was lower than 1 km, a very rare event in the area concerned.

PM-10: Particulate Matter up to 10 micrometers in diameter size

(PM-10 measurements from NOA's station)

HEAT WAVE

DESCRIPTION

During **18-21 JUNE 2016**, a 4-day Heat Wave event (Tmax \geq 40 °C) affected the eastern part of the Greek mainland.

SEVERITY

MAXIMUM TEMPERATURE (Tmax)

Not being any record, but many WSs recorded Tmax >39 °C. Some examples:

on 18 JUN 2016

at the HNMS-AWS of **Tithorea** (WMO-ID: 16649):

 $Tmax = 42.9 \, ^{\circ}C$

historical reference

The Tmax = 42.9 °C on 18 JUN 2016 is its **Tmax's new absolute UPPER record** since its operational use from autumn 2012.

at the HNMS-AWS of **Argos** (WMO-ID: 16724):

 $Tmax = 41.7 \, ^{\circ}C$

historical reference

 $(Tmax-UPPER-record = 46.4 \degree C \text{ on } 27 \text{ JUL } 2007).$

(Tmax-JUN-monthly-average = 31.7 °C, reference period: long term statistics).

at the HNMS-WS of **Tripoli** (WMO-ID: 16710):

 $Tmax = 40.3 \, ^{\circ}C$

historical reference

(*Tmax-UPPER-record* = 43.0 °C on 12 AUG 1994).

(Tmax-JUN-monthly-average = 28.3 °C, reference period: 1971-2000).

at the HNMS-WS of Larissa (WMO-ID: 16648):

 $Tmax = 40.1 \, ^{\circ}C$

historical reference

 $(Tmax-UPPER-record = 45.4 \degree C \text{ on } 5 \text{ JUL } 2000).$

(*Tmax-JUN-monthly-average* = 31.4 °C, reference period: 1971-2000).

at the NOA-AWS of **Sparti** (Lakonia)

 $Tmax = 43.4 \, ^{\circ}C$

at the NOA-AWS of Mires (Iraklio)

 $Tmax = 43.2 \, ^{\circ}C$

at the NOA-AWS of **Thiva** (Viotia)

 $Tmax = 42.9 \, ^{\circ}C$

TEMPERATURE CLIMATOLOGY HOT month FEBRUARY 2016

DESCRIPTION

i) The **mean monthly mean Temperature of FEBRUARY 2016** was above the 1971-2000 climatology for all over the country (estimated by the tercile method from representative HNMS-WSs).

The positive anomalies were varying from 3.3 °C for mean Tmin up to 4.4 °C for mean Tmax, while locally the deviations for the Tmax exceed the 5 °C.

ii) Also, at many WSs during FEBRUARY 2016 were set the Tmax's new UPPER record.

And it is worth mentioning that in several cases this record was broken more than once during this month.

iii) Moreover, ranking the FEBRUARY's mean monthly Tmax of various WSs, the **FEBRUARY's 2016 mean Tmax is mainly ranked in the first place** and at the rest of the WSs in the second or third.

SEVERITY

MAXIMUM TEMPERATURE (Tmax)

(examples of the larger difference from the previous record)

on 23 FEB 2016 at the HNMS-WS of **Kastoria** (WMO-ID: 16614): Tmax = 24.7 °C

historical reference

The Tmax = 24.7 °C on 23 FEB 2016 is **FEBRUARY's Tmax new UPPER record**.

(2nd in rank: 23.3 °C on 18 FEB 2014) (reference period: 1981-2016).

(Tmax-FEB-monthly-average = 8.0 °C, reference period: long term statistics).

on 16 FEB 2016 at the HNMS-WS of **Mitilini** (WMO-ID: 16667): Tmax = 26.2 °C

historical reference

The Tmax = 26.2 °C on 16 FEB 2016 is **FEBRUARY's Tmax new UPPER record**.

(2nd in rank: 22.0 °C on 27 FEB 1958, reference period: 1955-2016).

(Tmax-FEB-monthly-average = 12.3 °C, reference period: 1971-2000).

on **16 FEB 2016** at the HNMS-WS of **Zakinthos** (WMO-ID: 16726): **Tmax = 22.8** °C

historical reference

The Tmax = 22.8 °C on 16 FEB 2016 is **FEBRUARY's Tmax new UPPER record**.

(2nd in rank: 20.6 °C on 14 FEB 1998, reference period: 1983-2016).

(Tmax-FEB-monthly-average = 14.3 °C, reference period: long term statistics).

on **17 FEB2016** at the HNMS-WS of Kalamata (WMO-ID: 16726): **Tmax = 26.0 °C**

historical reference

The Tmax = 26.0 °C on 17 FEB 2016 is FEBRUARY'S Tmax new UPPER record.

(2nd in rank: 23.8 °C on 19 FEB 1960, reference period: 1956-2016).

(Tmax-FEB-monthly-average = 14.9 °C, $reference\ period$: 1971-2000).

on **16 FEB 2016** at the HNMS-WS of **Kos** (WMO-ID: 16742):

 $Tmax = 24.6 \, ^{\circ}C$

historical reference

The Tmax = 24.6 °C on 16 FEB 2016 is **FEBRUARY's Tmax new UPPER record**. (2nd in rank: 20.8 °C on 19 FEB 2010, reference period: 1982-2016).

 $(Tmax\text{-}FEB\text{-}monthly\text{-}average = 13.4 \, ^{\circ}C, reference period: long term statistics).$

RAINFALL CLIMATOLOGY WET month JUNE 2016

DESCRIPTION

The **monthly precipitation amount of JUNE 2016** was about equal or above the 1971-2000 climatology (estimated by the tercile method from representative HNMS-WSs), while locally at the Peloponnese prefecture the precipitation height was 5 times higher than the normal values.

Moreover, the JUNE's 2016 monthly rainfall height of WS of Tripoli was set as its JUNE's new UPPER record.

SEVERITY

MONTHLY RAINFALL HEIGHT (R)

at the HNMS-WS of **Tripoli** (WMO-ID: 16710):

R-JUN-2016 = 163.4 mm

<u>historical reference</u>

The R-JUN-2016 = 163.4 mm is its JUNE's new UPPER record of the rainfall height. (2nd in rank: 127.5 mm, JUN 1986) (reference period: 1957-2016).

 $(R-JUN-monthly-average = 17.2 \text{ mm}, reference period: } 1971-2000).$

RAINFALL CLIMATOLOGY

WET month SEPTEMBER 2016

DESCRIPTION

The **monthly precipitation amount of SEPTEMBER 2016** accounts for the 168% of the 1971-2000 climatology, that is approximately 1.5 times higher than the normal values (estimated by the tercile method from representative HNMS-WSs), while locally the precipitation height was 3 times higher than the normals.

Moreover, the **SEPTEMBER's 2016 monthly rainfall height** of some WSs was set as the **SEPTEMBER's new UPPER record** or as the second in rank.

SEVERITY

MONTHLY RAINFALL HEIGHT (R)

at the HNMS-WS of **Araxos** (WMO-ID: 16687):

R-SEPT-2016 = 139.3 mm

historical reference

The R-SEPT-2016 = 139.3 mm is the new UPPER record for its SEPTEMBER's precipitation height.

(2nd in rank: 117.0 mm, SEPT 1959) (reference period: 1955-2016).

(R-SEPT-monthly-average = 29.5 mm, reference period: 1971-2000).

at the HNMS-WS of **Kozani** (WMO-ID: 16632)

R-SEPT-2016 = 129.2 mm

historical reference

The R-SEPT-2016 = 129.2 mm is the new UPPER record for its SEPTEMBER's precipitation height.

(2nd in rank: 118.4 mm, SEPT 2014) (reference period: 1955-2016).

(R-SEPT-monthly-average = 28.1 mm, reference period: 1971-2000).

at the HNMS-WS of **Kastoria** (WMO-ID: 16614):

R-SEPT-2016 = 161.1 mm

historical reference

The R-SEPT-2016 = 161.1 mm is the 2nd in rank UPPER record for its SEPTEMBER's precipitation height.

(1rst in rank: 177.7 mm, SEPT 2002) (reference period: 1955-2016).

 $(R-SEPT-monthly-average = 45.5 \text{ mm}, reference period: long term statistics}).$

at the HNMS-WS of **Kalamata** (WMO-ID: 16726):

R-SEPT-2016 = 158.3 mm

historical reference

The R-SEPT-2016 = 158.3 mm is the 2nd in rank UPPER record for its SEPTEMBER's precipitation height.

(1rst in rank: 174 mm, SEPT 2009) (reference period: 1956-2016).

(R-SEPT-monthly-average = 27.2 mm, reference period: 1971-2000).

RAINFALL CLIMATOLOGY DRY month APRIL 2016

DESCRIPTION

The **monthly precipitation amount of APRIL 2016** accounts for the 18% of the 1971-2000 climatology (estimated by the tercile method from representative HNMS-WSs), while in many places the precipitation anomalies were lower than 10% of the 1971-2000 climatology.

It is worth mentioning that at Attica area, the capital city of Greece, the monthly rainfall height was about zero.

Moreover, the **APRIL's 2016 monthly rainfall height** of some WSs was set as the **APRIL's new LOWER record** or as the second in rank.

SEVERITY

MONTHLY RAINFALL HEIGHT (R)

at the HNMS-WS of **Hellinikon** (WMO-ID: 16716):

R-APR-2016 = 0.0 mm

historical reference

The R-APR-2016 = 0.0 mm is the new LOWER record for its APRIL's precipitation height.

(2nd in rank: 0.6 mm, APR 2010) (reference period: 1955-2016).

(R-APR-monthly-average = 29.3 mm, reference period: 1971-2000).

at the HNMS-WS of **Tatoi** (WMO-ID: 16715):

R-ARP-2016 = 0.0 mm

historical reference

The R-APR-2016 = 0.0 mm is equal with the previous LOWER record for its APRIL's precipitation height.

(equal driest as APR 2010 and APR 1970) (reference period: 1956-2016).

(R-APR-monthly-average = 26.4 mm, reference period: 1971-2000).

at the HNMS-WS of **Mitilini** (WMO-ID: 16667):

R-ARP-2016 = 0.4 mm

<u>historical reference</u>

The R-APR-2016 = 0.4 mm is the 2nd in rank LOWER record for its APRIL's precipitation height.

(lower in rank: 0.4 mm, APR 1964) (reference period: 1955-2016).

(R-APR-monthly-average = 49.4 mm, reference period: 1971-2000).

RAINFALL CLIMATOLOGY DRY month DECEMBER 2016

DESCRIPTION

The **monthly precipitation amount of DECEMBER 2016** accounts for the 14% of the 1971-2000 climatology (estimated by the tercile method from representative HNMS-WSs), while in many places the precipitation anomalies were lower than 10% of the 1971-2000 climatology. Only at Crete island the precipitation amount was above average.

Compared to the corresponding precipitation amount of DECEMBER 2015, the latter was drier about 10%.

Moreover, the **DECEMBER's 2016 monthly rainfall height** of some WSs was set as **DECEMBER's new LOWER record** or as the second in rank.

SEVERITY

MONTHLY RAINFALL HEIGHT (R)

at the HNMS-WS of **Preveza** (WMO-ID: 16643):

R-DEC-2016 = 0.6 mm

<u>historical reference</u>

The R-DEC-2016 = 0.6 mm is its DECEMBER's new LOWER record for the precipitation height.

(2nd in rank: 4.9 mm, DEC 2015) (reference period: 1971-2016).

(R-DEC-monthly-average = 128.9 mm, reference period: 1971-2000).

at the HNMS-WS of **Kalamata** (WMO-ID: 16726):

R-DEC-2016 = 8.9 mm

historical reference

The R-DEC-2016 = 8.9 mm is its DECEMBER's new LOWER record for the precipitation height.

(2nd in rank: 19.8 mm, DEC 1972) (reference period: 1956-2016).

(R-DEC-monthly-average = 141.0 mm, reference period: 1971-2000).

at the HNMS-WS of **Kerkira** (WMO-ID: 16641):

R-DEC-2016 = 5.9 mm

historical reference

The R-DEC-2016 = 5.9 mm is the 2nd in rank LOWER record for its DECEMBER's precipitation height.

(lower in rank: 5.7 mm, DEC 2015) (reference period: 1955-2016).

(R-DEC-monthly-average = 163.6 mm, reference period: 1971-2000).

at the HNMS-WS of **Thessaloniki** (WMO-ID: 16622):

R-DEC-2016 = 0.9 mm

historical reference

The R-DEC-2016 = 5.9 mm is the 2nd in rank LOWER record for its DECEMBER's precipitation height.

(lower in rank: 0.2 mm, DEC 2015) (reference period: 1955-2016).

(R-DEC-monthly-average = 46.5 mm, reference period: 1971-2000).

Selected Significant Climate Anomalies and Events in 2016

CANADA

A wildfire destroyed large parts of Fort McMurray (Alberta) in early May and became the costliest natural disaster in Canada's history.

ALASKA

2016 was the warmest year for the state since records began in 1925.



CONTIGUOUS UNITED STATES

2016 was the 2nd warmest year on record for the contiguous U.S. Every state was warmer than average.



EASTERN NORTH PACIFIC HURRICANE SEASON

Above-average activity, 144% of normal ACE, 21 storms, 11 hurricanes.

TROPICAL STORM DARBY (Jul 11th-26th)

Tropical Storm Darby was the second tropical cyclone in the past three years to make landfall in Hawaii, and only the fifth landfalling cyclone there since records began in 1949.

SOUTH AMERICA

Large areas of record warmth, particularly in the north, and much-warmer-than average temperatures resulted in the 2nd warmest year, behind only 2015, since continental records began in 1910. Jan, Feb, and Apr were each record warm.



ARCTIC SEA ICE EXTENT

During its growth season, the Arctic had its smallest annual maximum extent for the second year in a row. During its melt season, the Arctic reached its 2nd smallest minimum extent on record (tied with 2007).



2016 was the warmest year for North America since continental records began in 1910, surpassing the previous record set in 1998.

ATLANTIC HURRICANE SEASON Above-average activity, 140% of normal ACE.

15 storms, 7 hurricanes.

HURRICANE MATTHEW (Sep 28th - Oct 9th

Matthew was the first Category 5 hurricane in the North Atlantic since Felix in 2007. The storm majorly impacted Haiti, Cuba, the Bahamas, and parts of the southeastern U.S. More than 1.000 fatalities were reported and thousands of homes and buildings were destroyed.

AFRICA

Southern Africa experienced two consecutive poor rainy seasons, with rainfall well below average in both 2014-15 and 2015-16, leading to serious drought and substantial agricultural losses.

reports, a temperature of 54.0°C was recorded at Mitribah, Kuwait, Upon verification, this will be the highest temperature on record for Asia. On Jul 22nd, Basra, Iraq, reached 53.9°C and Delhoran, Iran reached 53.0°C, a new national record.



On Jul 21st, according to preliminary

Europe experienced its 3rd warmest year, behind only

2014 (record warm) and 2015 (2nd warmest), making

the past three years the three warmest in the 107-year

continental record. The average winter (Dec 2015-Feb

Asia observed its 3rd warmest year on record,

behind 2015 (record warmest) and 2007 (2nd

warm, while Oct and Nov were both cooler

than their long-term averages.

warmest). Apr, Aug, and Sep were each record

2016) temperature was record high.

On May 19th, Phalodi, India reached a temperature of 51.0°C, becoming the highest temperature on record for the country.

NORTH INDIAN OCEAN CYCLONE SEASON

Near-average activity. 5 storms, 1 cyclone.

SOUTH INDIAN OCEAN CYCLONE SEASON

Below-average activity. 8 storms, 3 cyclones.

AUSTRALIAN CYCLONE SEASON

Below-average activity. Lowest number of named storms since reliable records began in 1969. 7 storms, 3 cyclones.

ANTARCTIC SEA ICE EXTENT

During its growth season, the Antarctic had its 10th smallest annual maximum. During its melt season, the Arctic reached its 9th smallest minimum extent on record (tied with 2007).

TYPHOON LIONROCK

(Aua 16th-31st)

Lionrock impacted northeastern areas of the Democratic People's Republic of Korea (DPRK), where rainfall of up to 320 mm in four days led to catastrophic flooding and 133 fatalities.

EAST ASIA

A cold wave in late Jan impacted parts of East Asia. In southern China, Guangzhou recorded its first snow since 1967 and Nanning its first since 1983. A low temperature of 3.1°C was observed at the Hong Kong Observatory, the 6th lowest temperature on record at that location.

WESTERN PACIFIC OCEAN TYPHOON SEASON

Average activity. 26 storms, 13 typhoons.

SOUTH WEST PACIFIC OCEAN CYCLONE SEASON

Average activity. 11 storms, 6 cyclones.



AUSTRALIA

Australia observed its 4th warmest year in its 107-year national record. Tasmania was record warm. Nine of the past 10 years (excepting 2010) have been warmer than average and 7 of the 10 warmest years have occurred since 2005.



Please Note: Material provided in this map was compiled from NOAA's State of the Climate Reports and international partners. For more information please visit: http://www.ncdc.noaa.gov/sotc