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Variability of Intertropical Convergence Zone (ITCZ) and Extreme Weather Events

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1. Introduction

For case one, the UK severed from abnormal severs cold winter season on 2009. The mean temperature for that winter was 3.2 °C, which was 0.5 °C below average of (1971-2000), provisionally making it the coldest winter since 1996/97. Whereas, Mean temperatures over the UK were 1.1 °C below the average during December 2008, 0.6 °C below average during January and 0.2 °C above average during February during that season. A generally cold first half to December was followed by a milder period, before turning very cold by the first of January see Figure (1). This very cold spell persisted for the first 10 days of January, with some severe frosts, followed by alternating milder and colder periods. Despite a cold (and snowy) first half of February, milder conditions later resulted in near-normal temperatures overall. Rainfall amounts over the UK were below the 1971-2000 average during December with 70%, January was close to average with 98% and February was drier than average with 63%. In December, parts of south-east England, East Anglia and Wales had less than 50% of the average rainfall and in February much of Wales, north-west England and western Scotland recorded less than 50% of average. Significant snowfalls occurred in the first half of February, particularly over England and Wales during the first week, when depths greater than 15 cm were recorded quite widely. The last time of that winter season a comparable snowy spell occurred was in February 1991 (MetOffice., UK, 2009). However, there are several scientific literatures challenge the abnormal weather conditions [e.g. (Cohen et al., 2001; Hafez 2007, 2008; and Rosting & Kristjansson 2008)]. In addition to that identification, oscillations, and influence of the ITCZ (Intertropical Convergence Zone) in the atmospheric cooling weather conditions had studied by (Bates 1970; Pike 1972; Citeau 1988b; Gadgil & Guruprasad 1990; Waliser 1992, 1994; Hess et al., 1993; Philander et al., 1996; Kraus 1997; Sultan & Janicot 2000; Hafez 2003a; Broccoli et al., 2006; and Raymond 2006). However, climate simulations, using models with different levels of complexity, indicated that the north-south position of the intertropical convergence zone (ITCZ) responds to changes in interhemispheric temperature contrast. The present work aims to investigate the relationship between the Atlantic Western Africa ITCZ variability and the surface air temperature over UK through months of the winter 2009. For case two, the intertropical convergence zone (ITCZ) is one of the most recognizable aspects of the global circulation that influence in the atmospheric weather. The ITCZ forms as a zonally elongated band of cloud at low latitudes nearness of the equator where the northeasterly and southeasterly

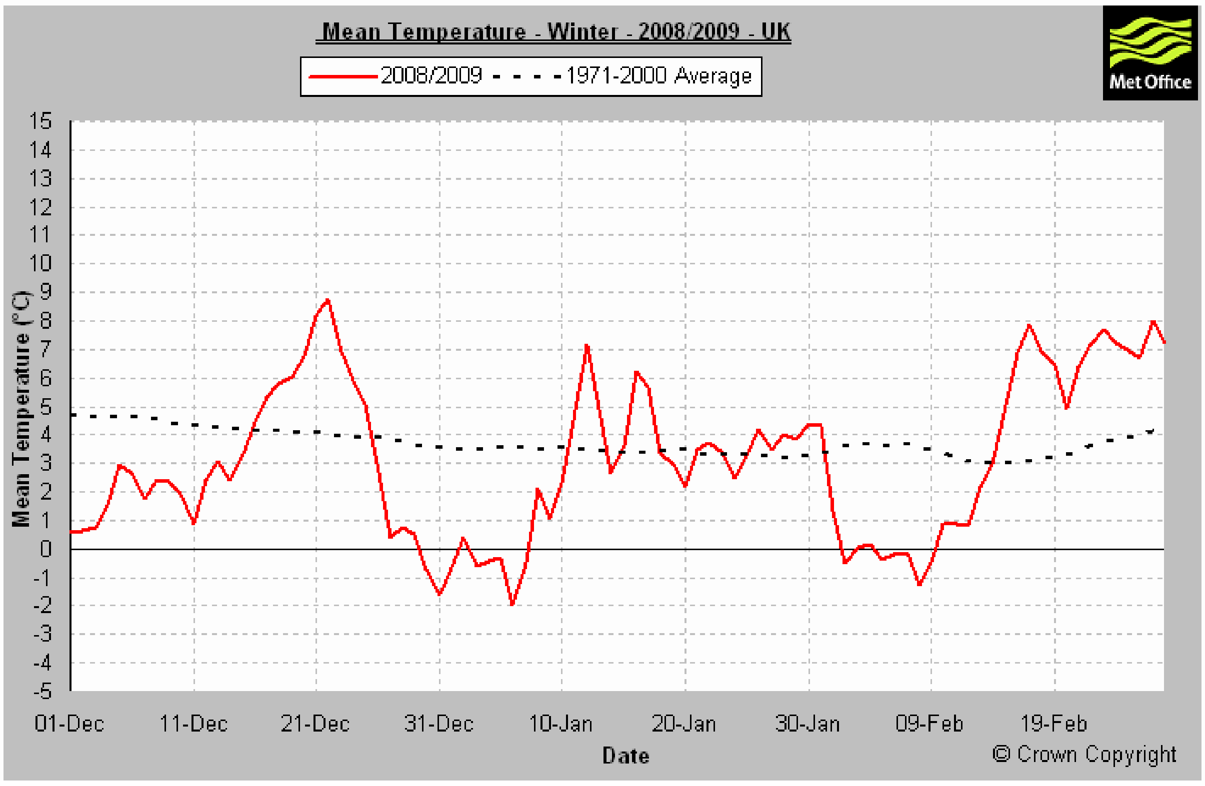


Fig. 1. Variation of UK daily mean temperature for Winter 2008/2009 [Source: MetOffice., UK, 2009: Winter Summary, 2009, ©Crow copyright]

trade winds converge. The focus of this study is to introduce the rule of ITCZ variability on the occurrence of unseasonably heavy rains, widespread flash floods, over Eastern Mediterranean (EM) in the period (17- 20) on January 2010. In fact, the topography in the EM such as high mountains, is essential factor for huge disasters of flash floods (Llasat, 2009). The flood disasters in EM through this period had been recorded and reported. Whereas, in Egypt, in the southern city of Aswan, floods and strong winds disrupted power in several neighborhoods. The floods were a surprise as North Sinai had not seen floods in 30 years. Sinai Peninsular was flash floods damage left more than 1000 homes totally destroyed, 1,076 submerged and the area suffered material losses of over US$25.3 million. The floods ruined 59km of roads, killed 1,838 animals and felled 27,820 (mostly olive) trees. Five Egyptians died in flooding in the southern Sinai desert. All 75 patients at the El-Arish general hospital in the Sinai had to be evacuated when the first floor was flooded. Flooding wiped out large sections of a major road in Egypt's south Sinai and destroyed two dozen homes in Ras Sudr. In Palestine, Heavy rain and flooding has forced hundreds of people from their homes in Khan Younis in the south of the Gaza Strip. Over 100 families had been made homeless.. Some 300 families were also displaced. The flooding along Egypt's Red Sea coast, the border with Israel and in the south left six people dead. It also damaged the roads leading to the resorts in the Sinai desert and brought down telephone and power lines. Israel temporarily closed its southern border crossings with Egypt and Jordan. Jordanians were warned off the streets after nearly a dozen accidents in one area. Rains of this magnitude, rains reached to 90 mm/day, which are rare in this largely arid region and where heavy precipitation can result in sudden and deadly flash floods. In Israel, a woman drowned when her car was caught in a flash flood in the south, where stormy weather also blocked the main road to the Red Sea resort of Eilat. A bridge also collapsed near a cargo crossing between Egypt and Israel. In addition to that, heavy rainfall recorded over south Turkey, Syria and Lebanon. One positive aspect of the flooding is that it helped replenish groundwater reserves. Whereas, the floods boosted groundwater reserves which are the main source of freshwater in this region. It also brought silt, which is very good for crops. Silt also reduces erosion of the coast when flood water reached the sea. The disasters information getting from Dartmouth Flood Observatory. Historical records of flash flood episodes over EM show that it was existed in autumn season of months (September, October and November) not in January. So that the present case study is outstanding extreme case. However, the flash floods problem in the EM was challenged several times in scientific literatures (e.g, Hafez, 2003b; Barnolas et al., 2007&2008, Papadopoulos & Katsafados, 2009; Houssos et al. 2009; Hatzaki et al., 2010;Michaelides et al., 2010 and Llasat et al., 2010). The previous studies referred the occurrence of these floods to deep of upper air trough of low pressure system with cold advection over the EM region. The present paper aims to uncover the rule played by ITCZ variability in the occurrence of extreme flash floods in EM in January 2010.

2. Data and methodology

For the first case, the daily NCEP/NCAR reanalysis data composites for mean surface air temperature, over the UK, [(49° N- 61° N) latitudes and (11° W- 2° E) longitudes] , for the period from 1 December 2008 to 28 February 2009 (Kalnay et al., 1996) are used in this study. The available meteorological data obtained from UK meteorological office are also used in the present study. In addition to that, the Atlantic – Western Africa [15° W – 10° E] ITCZ mean position data for summer months June, July and august of 2008 are used. The movement of the ITCZ over Atlantic-Western Africa has been monitored by plotting the daily location of the surface 15-degree C dew point temperature at 1200 UTC for every 5 degrees of longitude, (Ilesanmi, 1971). Over Atlantic-Western Africa, a mean position for each 10-day period is calculated for the area from 15 degrees west longitude to 10 degrees east longitude. However, the ITCZ data series begin in 1979 for Atlantic - Western Africa and the long-term means use 1979-2001 data. These data were obtained from website through the internet of the Climate Prediction Centre at http://www.cpc.ncep.noaa.gov/products/monitoring_data/. In the present work, these datasets are analyzed using the anomalies methodology and correlation coefficient technique. The formula for calculating the correlation coefficient was taken from (Spiegel, 1961). For the second case; The 6-hour and daily NCEP/NCAR reanalysis data composites for precipitation MSL pressure, gepotential height at 500 hpa level, surface vector and meridonal winds over the eastern Mediterranean region [(22° N- 40° N) latitudes and (24° E- 42° E) longitudes] , for the period (17 - 20) January 2010 (Kalnay et al., 1996) are used in the present study. The available floods disaster data obtained from dartmouth flood observatory are also used. In addition to that, 6-hour infrared (IR) satellite images are obtained to identify the ITCZ position by using of cloud clusters through the same period. In the present work, datasets are analyzed using the anomalies methodology. These data were obtained from websites through the internet of the Climatic centers, Climate Diagnostics Centre for supporting the data used throughout this study. Plots and images were provided by the NOAA-CIRES Climate Diagnostics Centre, Boulder, Colorado, USA from their Web site at http://www.cdc.noaa.gov. Available data of flash floods disasters obtained from dartmouth flood observatory through its website http://www.dartmouth.edu.

3. Results

3.1 For the first case

3.1.1 Analysis of the surface temperature anomalies over UK in winter 2009

In the present work, daily data for surface air temperature in UK through the period (1 December 2008 – 28 February 2009) are analyzed using of statistical anomalies methodology. Table (1) shows the anomalies in the 10-day mean of surface temperature (°C) over UK in winter 2008/2009. The results revealed that almost of UK severed from abnormal cooling whereas there are negative anomalies in the surface air temperature during December 2008. However, surface air temperature was less than its normal values by -0.5 °C. However, the normal value taken as average of the period of years 1968-1996. As shown in Figure 2a and Table 1. Meanwhile, for the month of January 2009 the temperature becomes around its normal values. Whereas, the anomalies in temperature values alternative around its normal between positive at the north of the UK, and negative values at the south of the UK, (Figure 2b and Table 1). For the month of February, the first half had a cooling and the last half had a warming rather than its normal values. In general the temperature remands around its normal values for that month (Figure 2c, and Table 1). In general, winter 2008/2009, from 1 December 2008 to 28 February 2009, had recorded a negative anomalies in surface air temperature with -0.5 °C. This cooling during that winter season occurred mainly at the central and southern parts of UK (Figure 2d).

Duration time (10-day interval)	Anomalies in the 10- day Mean surface air temperature (°C) over UK
1-10 Dec. 2008	-2.2
11-20 Dec. 2008	0.0
21-31 Dec. 2008	-0.5
1-10 Jan. 2009	-5.0
11-20 Jan. 2009	+1.2
21-31 Jan. 2009	+1.0
1-10 Feb. 2009	-3.5
11-20 Feb. 2009	+2.0
21-28 Feb. 2009	+3.5

Table 1. Anomalies in the 10-day mean of surface temperature (°C) over UK in winter 2008/2009.

3.1.2 Study variability of the Atlantic-Western Africa ITCZ during summer 2008

The movement of the ITCZ over Atlantic-Western Africa had been monitored by plotting the daily location of the surface 15-degree C dew point temperature at 1200 UTC for every 5 degrees of longitude, (Ilesanmi, 1971). Over Atlantic-Western Africa, a mean position for each 10-day period is calculated for the area from 15 degrees west longitude to 10 degrees east longitude. The data series begin in 1979 for Atlantic-Western Africa and the long-term means use 1979-2001 data. In the present study the changes of Atlantic-Western Africa ITCZ

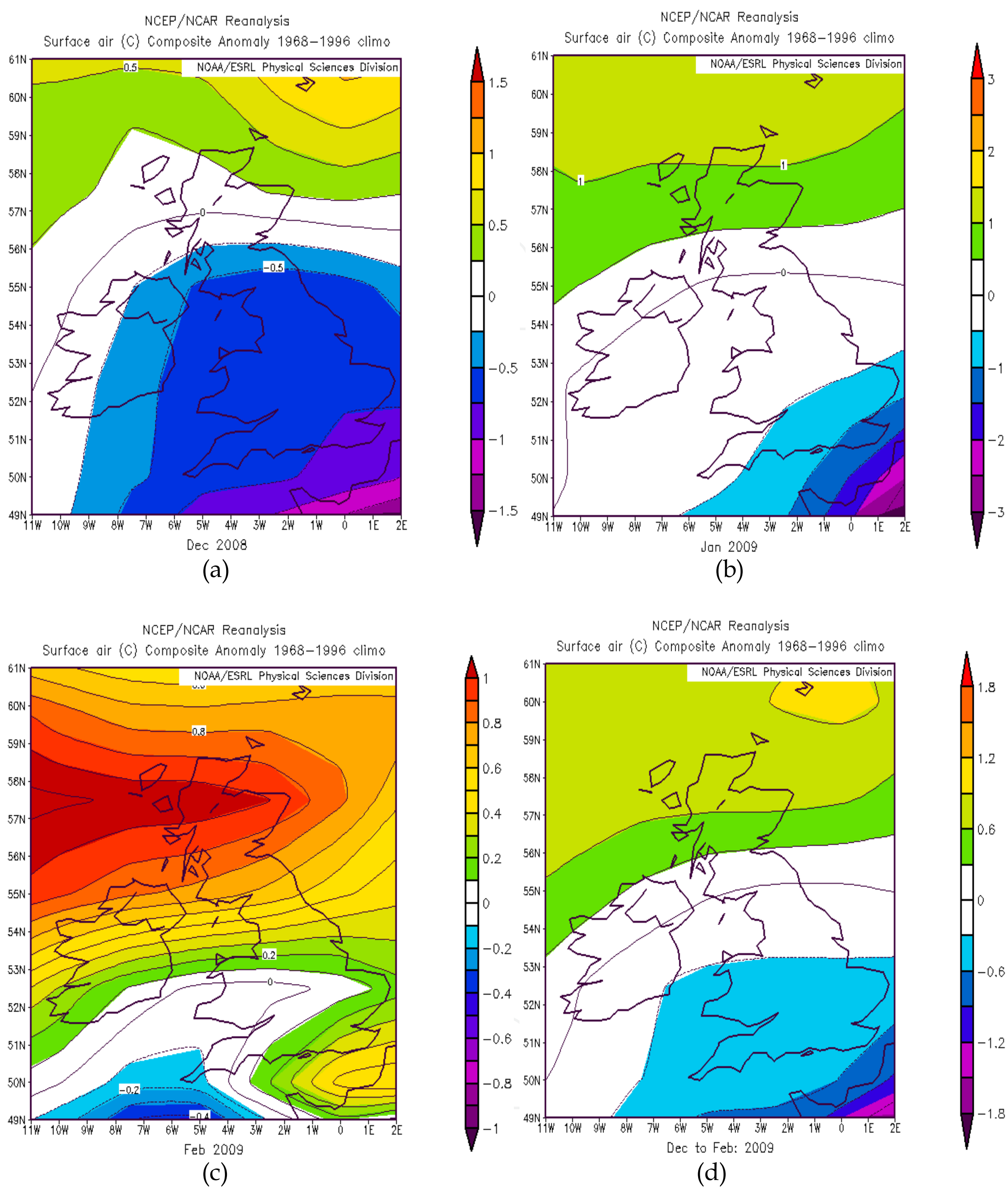


Fig. 2. The distribution of mean surface air temperature anomalies (°C) over UK for winter 2008/2009, (a) For month of December 2008, (b) For month of January 2009, (c) For month of February 2009 and (d) For months of winter season 2008/2009 (December, January and February).

variability through the period (1 June 2008 – 31 August 2008) are analyzed using of anomalies methodology. The result shows that the Atlantic-Western Africa ITCZ moved southward direction south of its average position from 1 June to 20 July with negative anomalies of its values. The maximum negative anomaly is recorded -2.351 latitudinal degrees at 15 W of ITCZ position through the 10 day interval (11-20 June 2008). In general, the outstanding southward changes of ITCZ variability existed over western part of the Greenwich longitude. Whereas, the significant negative anomalies occurred at the western part of the ITCZ through the period of study (Table 2 and Figure 3).

Duration time (10-day interval)	Anomalies in 10- day mean position of Atlantic-Western Africa ITCZ (Longitude degree)					
	15W	10W	5W	0	5E	10E
1-10 June 2008	-1.716	-1.719	-1.347	-0.625	-0.840	-0.488
11-20 June 2008	-2.351	-1.757	-1.250	-0.718	-0.892	-0.427
21-30 June 2008	-0.291	-0.481	-0.048	-0.090	0.059	0.071
1-10 July 2008	-1.374	-1.104	-1.565	-0.737	-0.295	-0.555
11-20 July 2008	-1.757	-2.058	-1.133	-0.808	-0.596	-0.374
21-31 July 2008	0.091	0.136	-0.213	-0.039	0.379	0.604
1-10 August 2008	-0.075	-0.846	-0.661	0.103	0.142	0.518
11-20 August 2008	0.033	0.371	0.759	1.023	1.194	1.379
21-31August 2008	0.200	0.433	0.562	0.954	0.571	0.035

Table 2. Anomalies in 10-day mean position of Atlantic-Western Africa ITCZ during summer 2008.

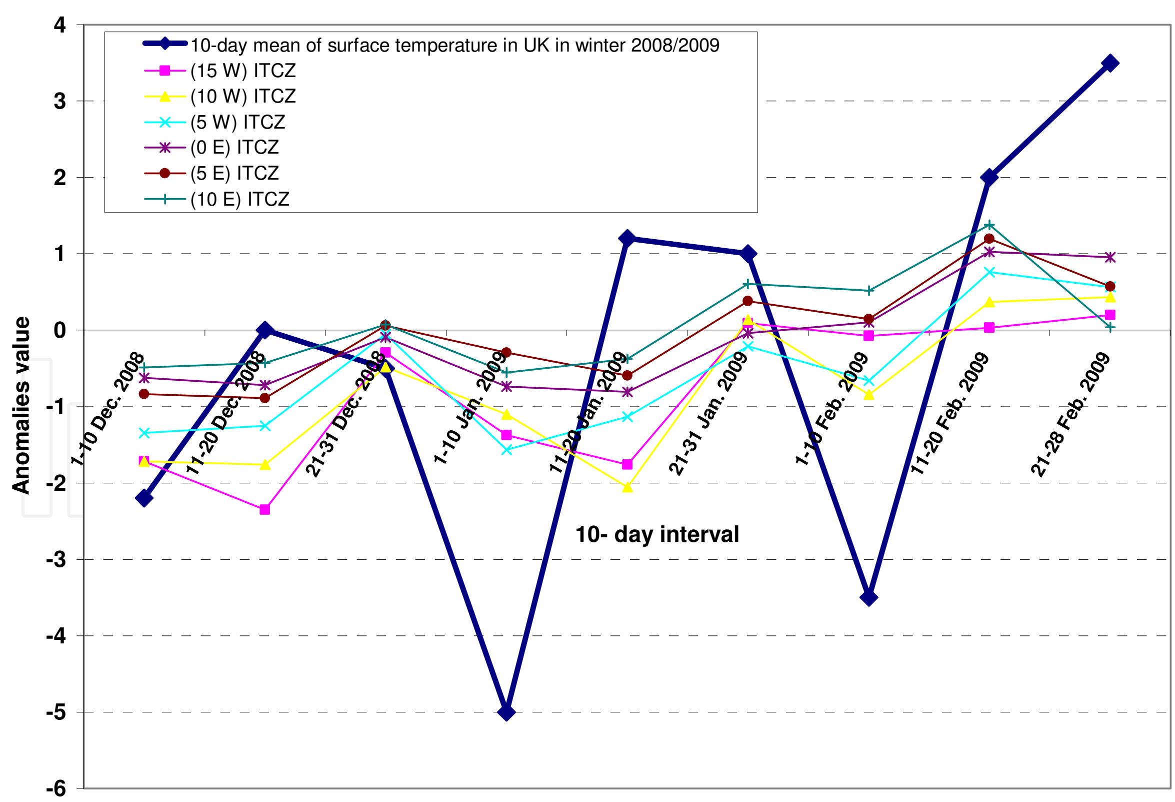


Fig. 3. The variation of 10-day Atlantic-Western Africa ITCZ mean position anomalies during summer 2008 and the variation of 10-day mean surface temperature anomalies over UK through winter 2008/2009.

3.1.3 Relationship between the Atlantic-Western Africa ITCZ and abnormal cold winter 2009 over UK

The relationship between the Atlantic-Western Africa ITCZ variability and abnormal cold winter 2009 over UK are studied in this section. Whereas, a 10-day time series analysis of anomalies in both of the variation of Atlantic-Western Africa ITCZ mean position during summer 2008 and the variation of mean surface temperature anomalies over UK through winter 2008/2009 are analyzed. The results revealed that there are outstanding relationship between the southward variations of Atlantic-Western Africa ITCZ and the occurrence of negative anomalies in surface air temperature over UK through winter 2009 (Figure 3). In addition to that a correlation coefficient technique analysis has been made to study this relationship. There are significant positive correlation coefficients between the southward variability of summer Atlantic-Western Africa ITCZ and the abnormal cooling weather that existed in UK through winter 2009. The highest correlation coefficient value is +0.7 at 5° W longitude of ITCZ (Figure 4).

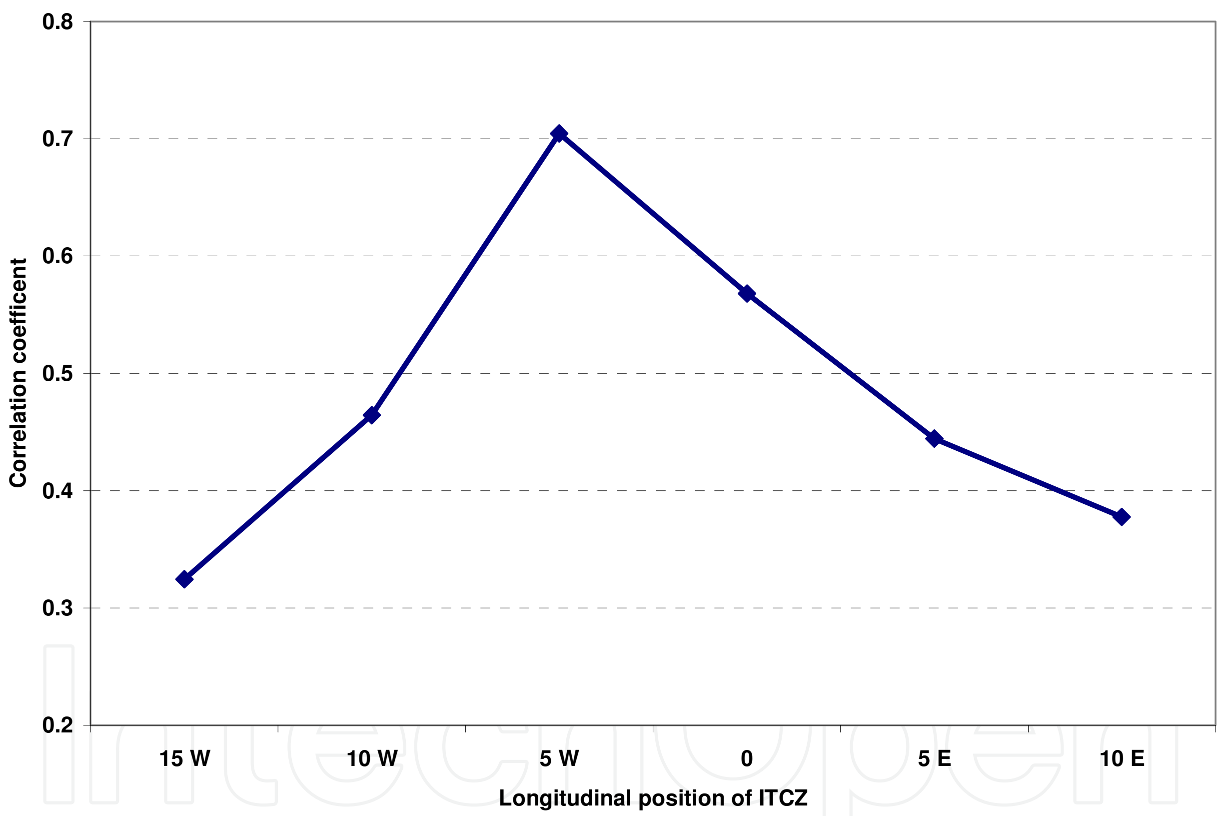


Fig. 4. The variation of correlation coefficient values between 10-day Atlantic-Western Africa ITCZ mean position anomalies during summer 2008 and 10-day mean surface temperature anomalies over UK through winter 2008/2009.

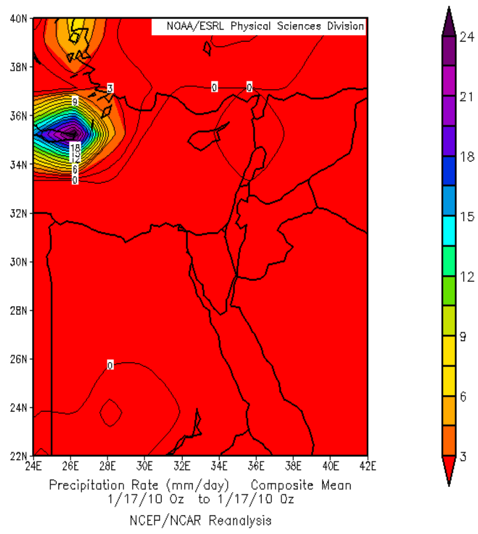
3.2 For the second case

3.2.1 Distribution of precipitation values in EM during (17-20) january 2010

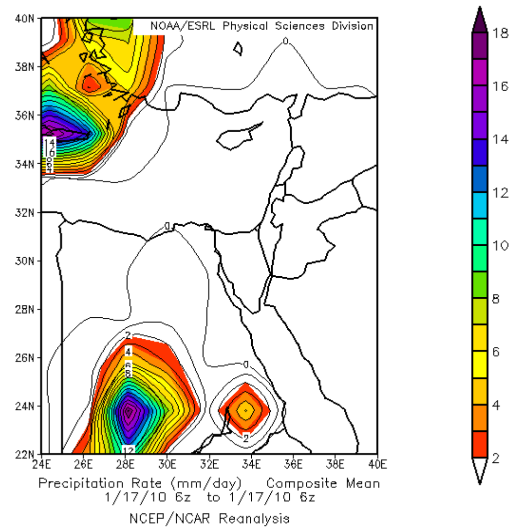
Through the present work, the 6-hour NCEP/NCAR reanalysis data composites for precipitation rates over the EM region [(22° N- 40° N) latitudes and (24° E- 42° E) longitudes during the period (17 -20) January 2010 has been analyzed. Analysis of this data shows that on the first day, 17 January, the precipitation existed over the north western part of EM (Malta) and also over the south western part of EM(south west of Egypt) and Sinai and reached to its maximum value (90 mm) over South Sinai (see Table 3 and Figure 5a,b,c and d respectively). On next day, the precipitation hold eastward of EM to cover several countries include of (East Sinai, (Palestine &Israel), Jordon, North Syria and south Turkey) with maximum value of precipitation rate 90 mm/day as its clear in Table 3 and Figure 5e,f,g and h respectively. On 19 and 20 January precipitation widespread to cover all the EM region but with maximum values, 24 mm/day that less than the first two days. See Table 3 and Figure 5 (from i to p). This precipitation causing huge damages in several areas in EM and mainly lee the mountain regions. In particular, Sinai Peninsular was flash floods damage left more than 1000 homes totally destroyed, 1,076 submerged and the area suffered material losses of over US$25.3 million. Five Egyptians died in flooding in the southern Sinai desert.

Precipitation amount (mm)	Maximum amount of precipitation in (mm) over Eastern Mediterranean	
(6-hour) Time	Maximum value	Location
17 January 2010 (0000UTC)	21 mm	Malta
17 January 2010 (0600UTC)	16	Malta and south west of Egypt
17 January 2010 (1200UTC)	27	south west of Egypt
17 January 2010 (1800UTC)	90	South Sinai
18 January 2010 (0000UTC)	90	East Sinai, (Palestine &Israel) and Jordon
18 January 2010 (0600UTC)	65	Jordon, Lebanon and south Syria
18 January 2010 (1200UTC)	55	North Syria and south Turkey
18 January 2010 (1800UTC)	50	North Syria
19 January 2010 (0000UTC)	12	Cyprus and Lebanon
19 January 2010 (0600UTC)	14	Eastern Mediterranean sea region
19 January 2010 (1200UTC)	16	Cyprus
19 January 2010 (1800UTC)	20	Eastern Mediterranean sea region
20 January 2010 (0000UTC)	22	Eastern Mediterranean region
20 January 2010 (0600UTC)	21	Eastern Mediterranean sea region
20 January 2010 (1200UTC)	24	Cyprus, west Syria and Lebanon
20 January 2010 (1800UTC)	24	Cyprus, west Syria and Lebanon

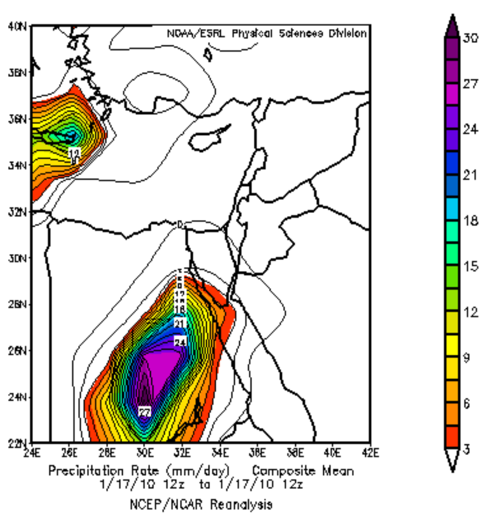
Table 3. 6-hour maximum amount of precipitation in (mm) over Eastern Mediterranean during the period of 17-20 January 2010.


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/17/10 0z to 1/17/10 0z
NCEP/NCAR Reanalysis

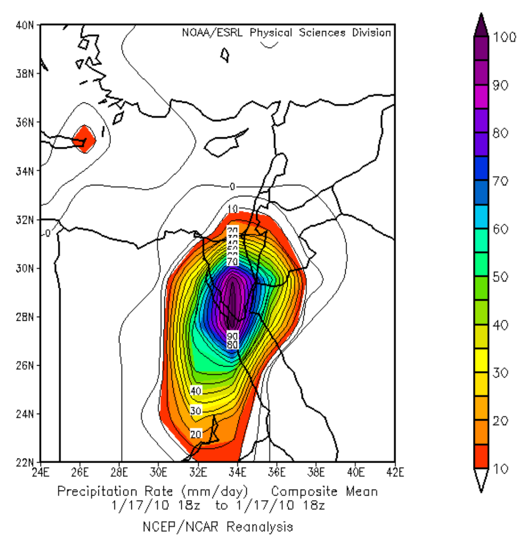
(a)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/17/10 6z to 1/17/10 6z
NCEP/NCAR Reanalysis

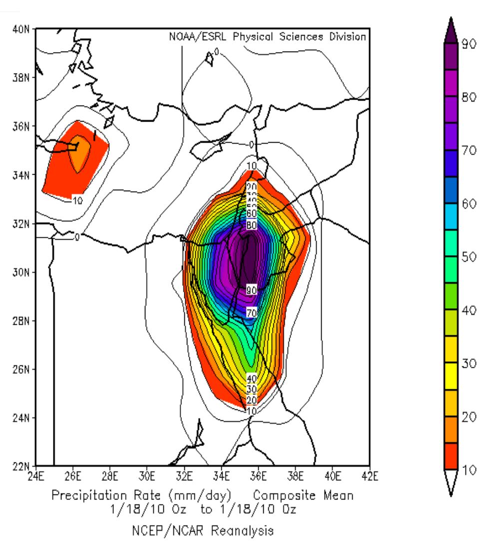
(b)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/17/10 12z to 1/17/10 12z
NCEP/NCAR Reanalysis

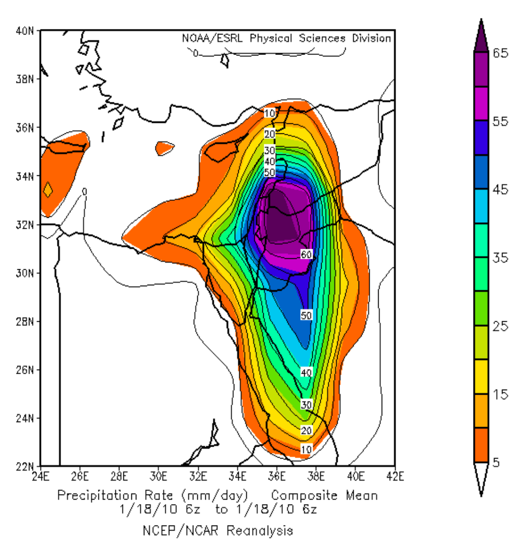
(c)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/17/10 18z to 1/17/10 18z
NCEP/NCAR Reanalysis

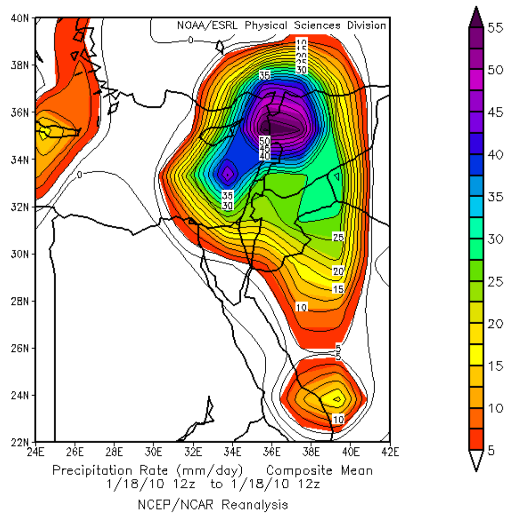
(d)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/18/10 0z to 1/18/10 0z
NCEP/NCAR Reanalysis

(e)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/18/10 6z to 1/18/10 6z
NCEP/NCAR Reanalysis

(f)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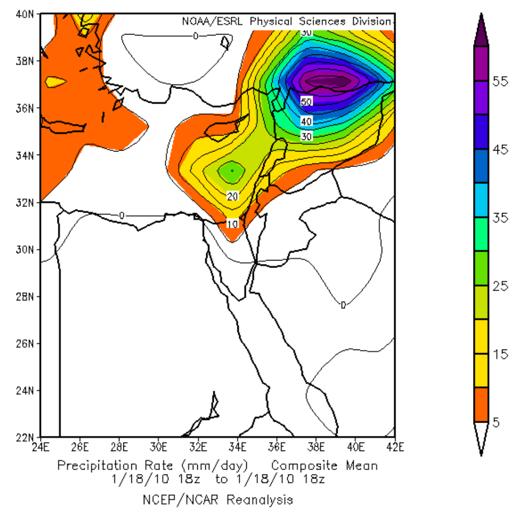
Precipitation Rate (mm/day) Composite Mean
1/18/10 12z to 1/18/10 12z
NCEP/NCAR Reanalysis

(g)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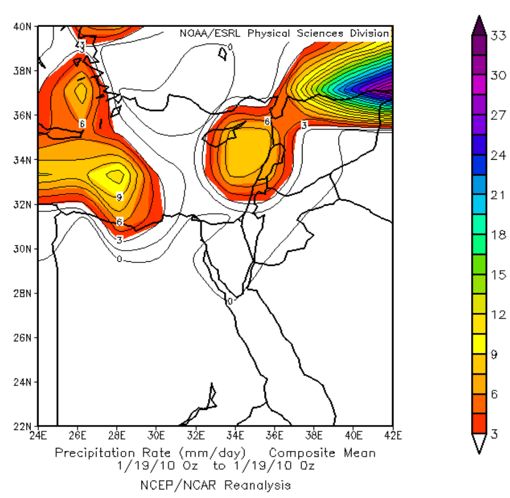
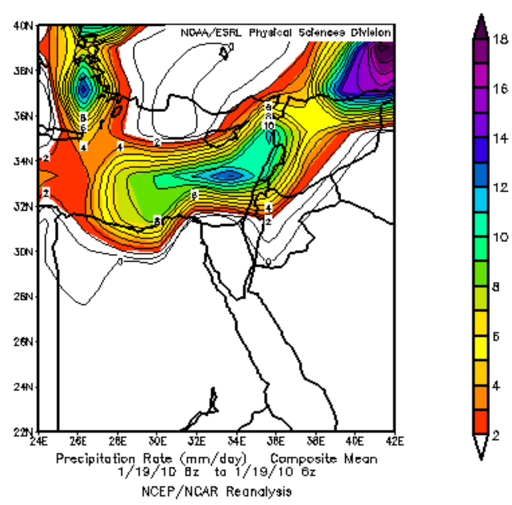
Precipitation Rate (mm/day) Composite Mean
1/18/10 18z to 1/18/10 18z
NCEP/NCAR Reanalysis

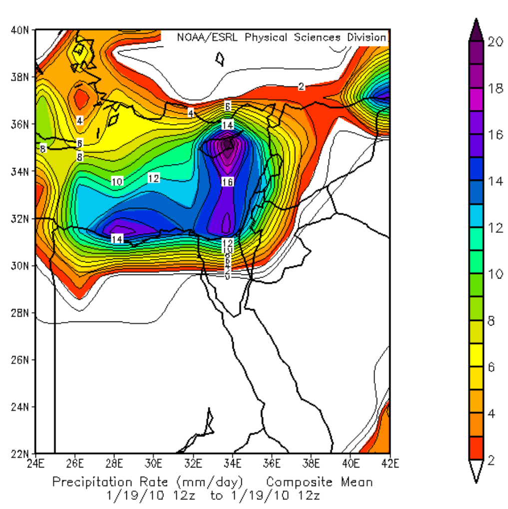
(h)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/19/10 0z to 1/19/10 0z
NCEP/NCAR Reanalysis

(i)


NOAA/ESRL Physical Sciences Division
Precipitation Rate (mm/day) Composite Mean
1/19/10 6z to 1/19/10 6z
NCEP/NCAR Reanalysis

(j)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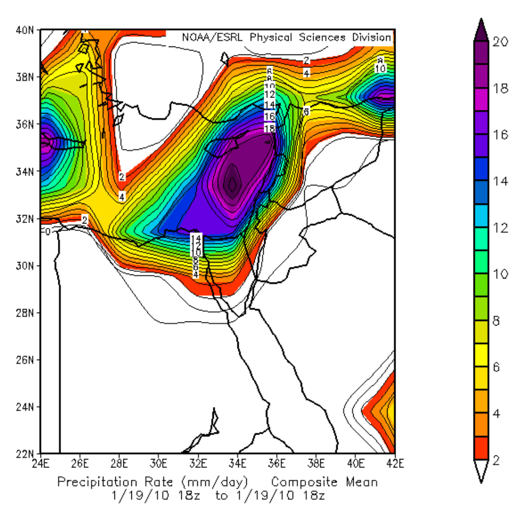
Precipitation Rate (mm/day) Composite Mean
1/19/10 12z to 1/19/10 12z
NCEP/NCAR Reanalysis

(k)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Precipitation Rate (mm/day) Composite Mean
1/19/10 18z to 1/19/10 18z
NCEP/NCAR Reanalysis

(l)

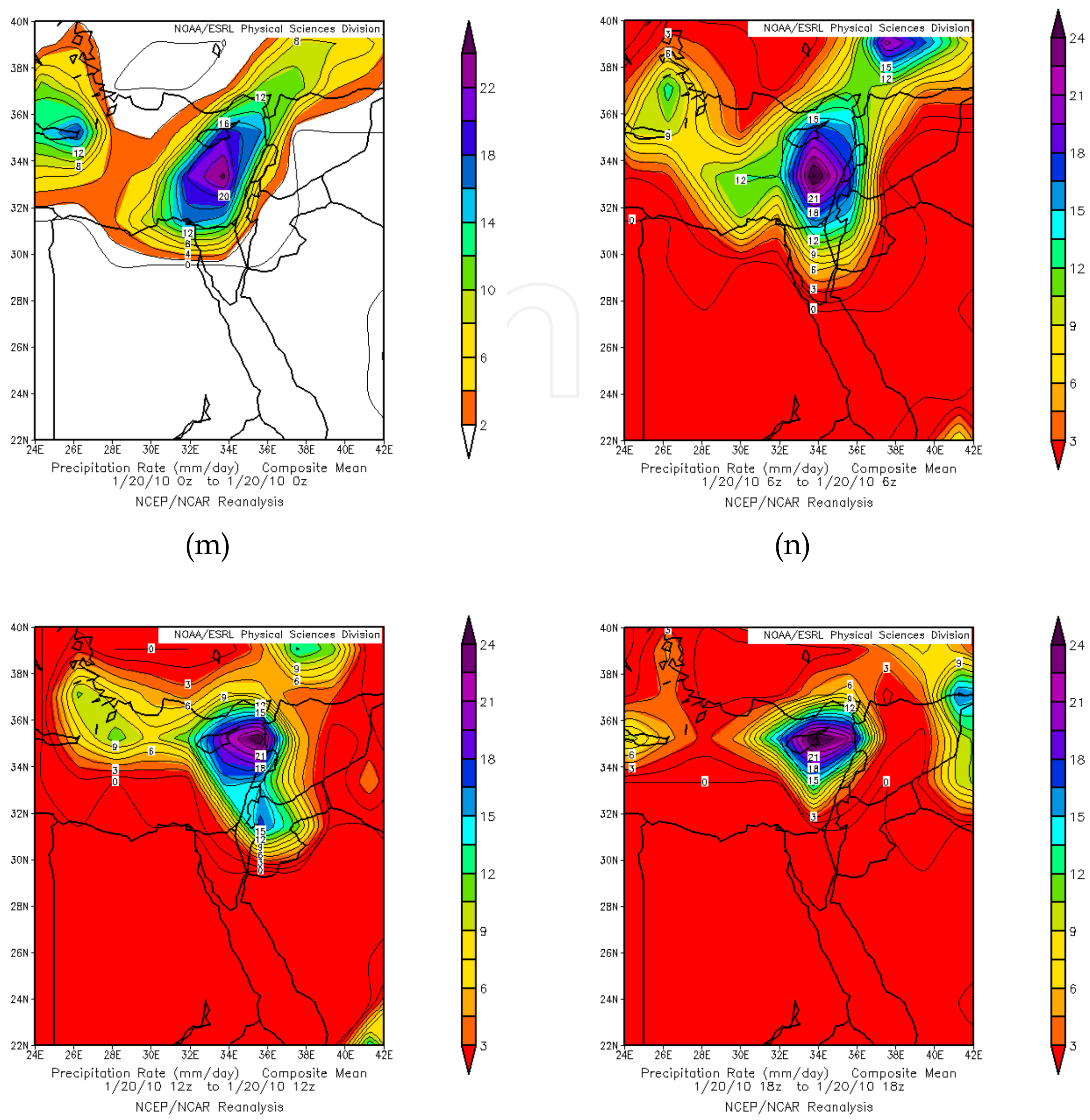


Fig. 5. The 6-hour precipitation values (mm) distribution over the Eastern Mediterranean

3.2.2 Study the ITCZ variability over eastern Africa on (17-20) january 2010

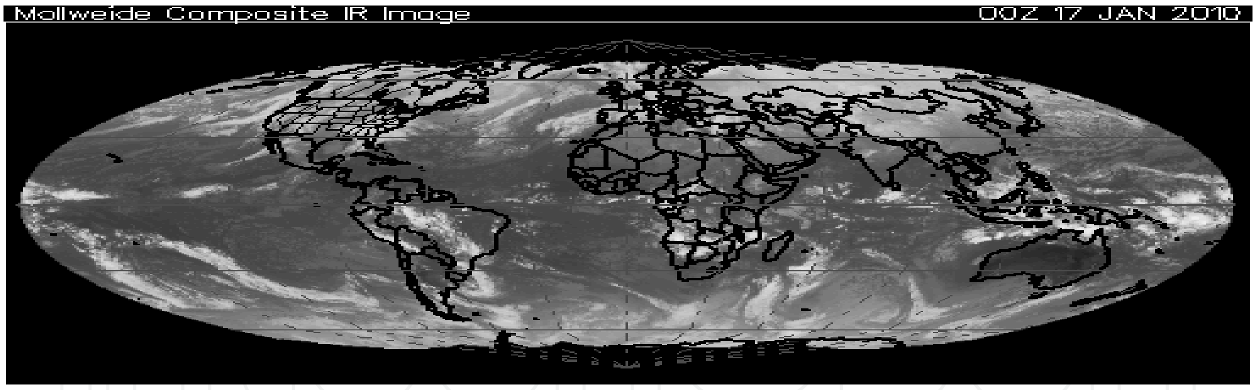
Traditionally, the ITCZ has been identified in terms of time-averaged fields, either in terms of the seasonal mean outgoing longwave radiation (OLR) or, in more recent years, in terms of the seasonal mean precipitation. For example, (Waliser et al., 1993) used thresholding of mean OLR in combination with mean high reflectivity to identify the ITCZ. Previous observational studies of the global climatological ITCZ (e.g., Mitchell & Wallace 1992; Waliser et al., 1993) focused on the annual cycle in different regions. They found very distinct longitudinal variations in the ITCZ. In the western Pacific region the summer ITCZ is broad in latitude and ill-defined due to the extensive warm pool in the ocean and monsoonal circulations. However, in the east Pacific the mean summer ITCZ is narrow and long, generally located at the southern boundary of the east Pacific warm pool, north of the strongest meridional gradient of sea surface temperature (Raymond et al., 2006). During the summer the east Pacific ITCZ is particularly visible in instantaneous satellite fields. During

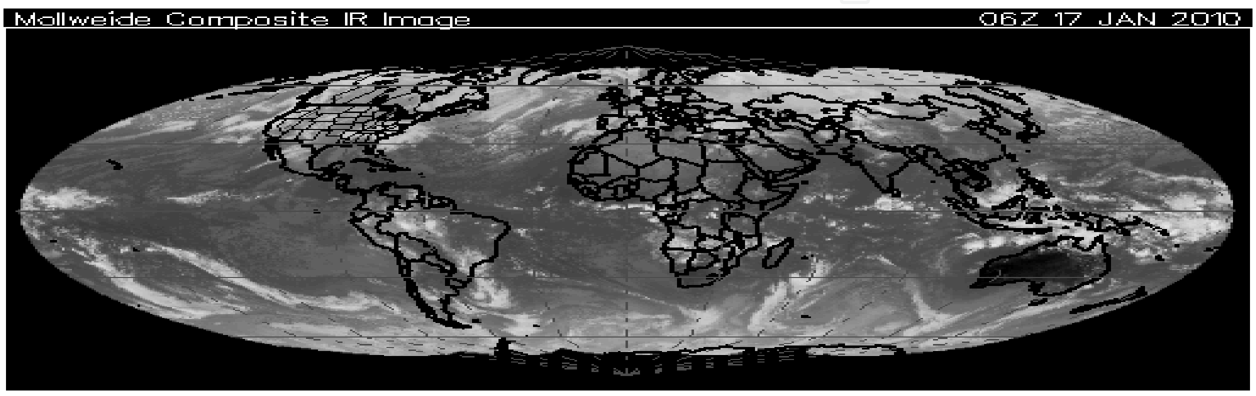
Northern Hemisphere winter the ITCZ remains in the Northern Hemisphere, but its signature is considerably weaker and gets mixed in with signatures of extratropical frontal systems owing to cold air outbreaks (Wang & Magnusdottir 2006). The variability of the ITCZ presents a serious challenge to its automatic detection in instantaneous data. Here we want to focus on the ITCZ as a weather feature that has long been recognized by satellite meteorologists who analyze instantaneous fields. In the present study, 6-hour infrared (IR) satellite images for the period (17-20) January are obtained to identify the ITCZ position by using of cloud clusters. The following criteria to define the ITCZ (Bain et al.,2011).

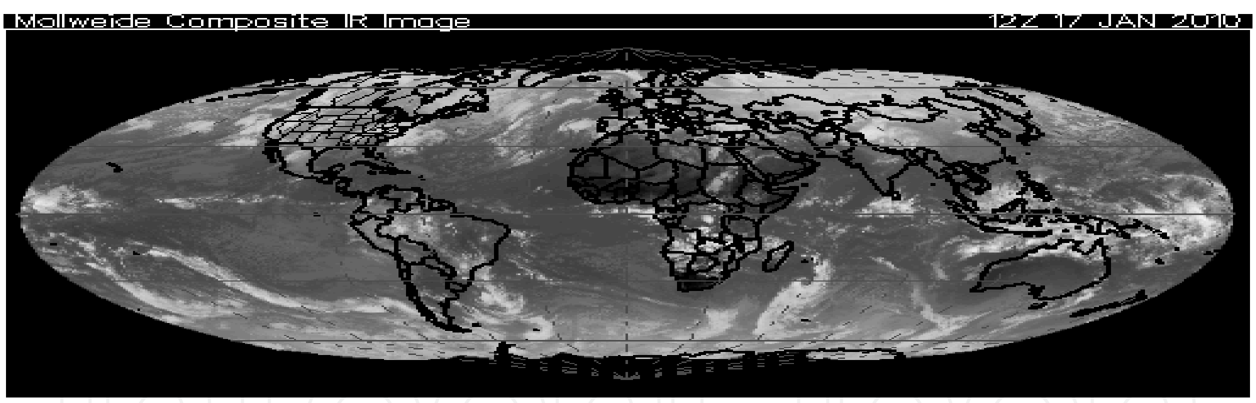
i. The ITCZ is a predominantly zonal feature.
ii. It is cloudy but there may be cloud-free regions within the envelope of convection and the convection may be shallow (as represented by rather warm cloud-top temperatures).
iii. The ITCZ is a large-scale feature and isolated tropical disturbances, unconnected to larger cloudy regions, are not part of the ITCZ.

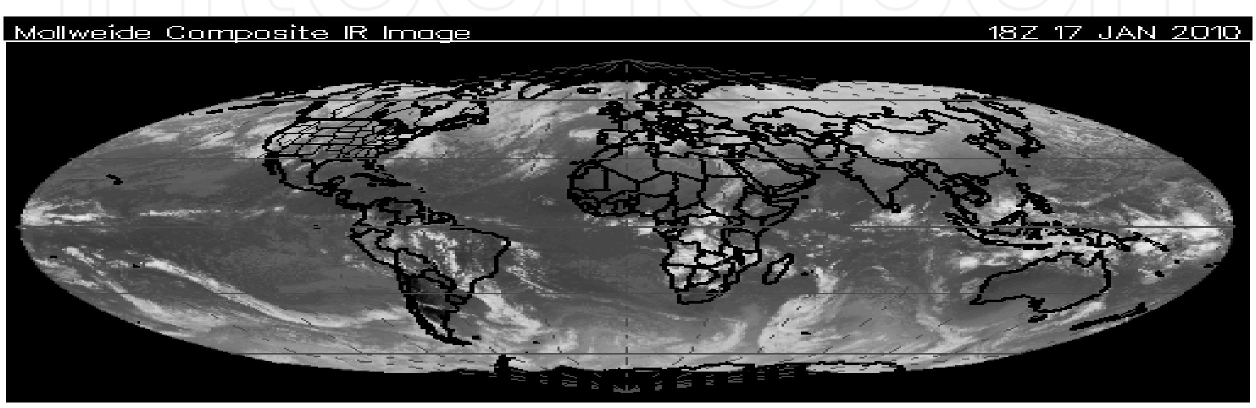
Variability of ITCZ (6-hour) Time	Location of Intertropical conversion zone (ITCZ)
17 January 2010 (0000UTC)	Shift to north west Sudan and north east Ethiopia
17 January 2010 (0600UTC)	South west Sudan and north east Ethiopia
17 January 2010 (1200UTC)	Sudan and extends towards north Red Sea over South east of Egypt
17 January 2010 (1800UTC)	Sudan, north Red Sea and eastern part of Egypt
18 January 2010 (0000UTC)	North Sudan and Sinai
18 January 2010 (0600UTC)	North Sudan and Sinai
18 January 2010 (1200UTC)	South Sudan
18 January 2010 (1800UTC)	South Sudan
19 January 2010 (0000UTC)	South Sudan
19 January 2010 (0600UTC)	South Sudan
19 January 2010 (1200UTC)	Extended to north Sudan
19 January 2010 (1800UTC)	Extended to Sudan, Ethiopia and Red Sea
20 January 2010 (0000UTC)	Extended eastward over south Red Sea
20 January 2010 (0600UTC)	Shift widespread eastward to Saudi Arabia
20 January 2010 (1200UTC)	Saudi Arabia
20 January 2010 (1800UTC)	Ethiopia

Table 4. The 6-hour locations of ITCZ over Eastern Africa during the period 17-20 January 2010.


Mollweide Composite IR Image
00Z 17 JAN 2010
(a)


Mollweide Composite IR Image
06Z 17 JAN 2010
(b)


Mollweide Composite IR Image
12Z 17 JAN 2010
(c)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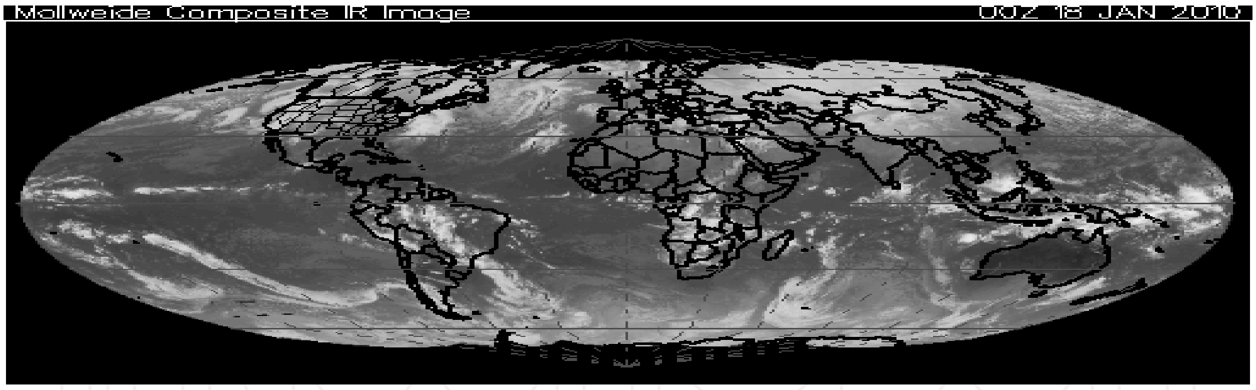
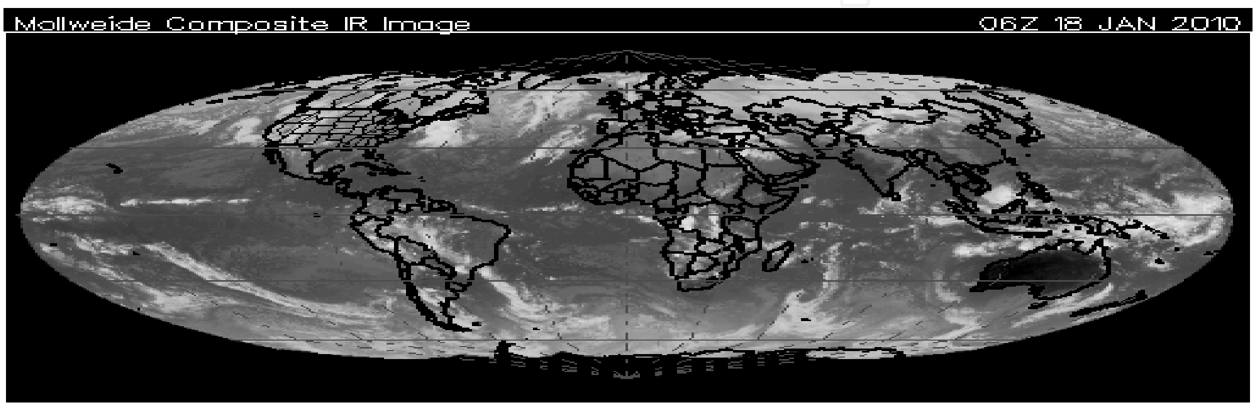
18Z 17 JAN 2010
(d)


Mollweide Composite IR Image
00Z 18 JAN 2010

(e)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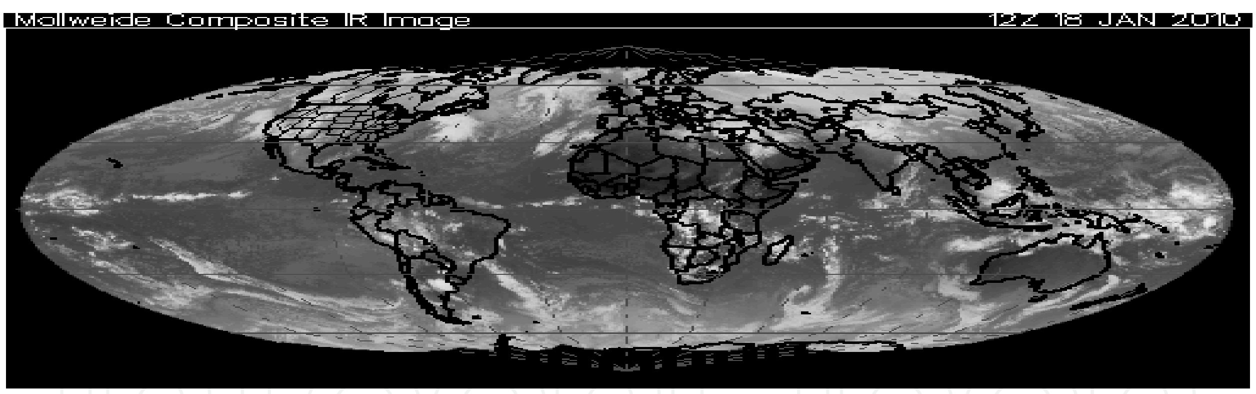
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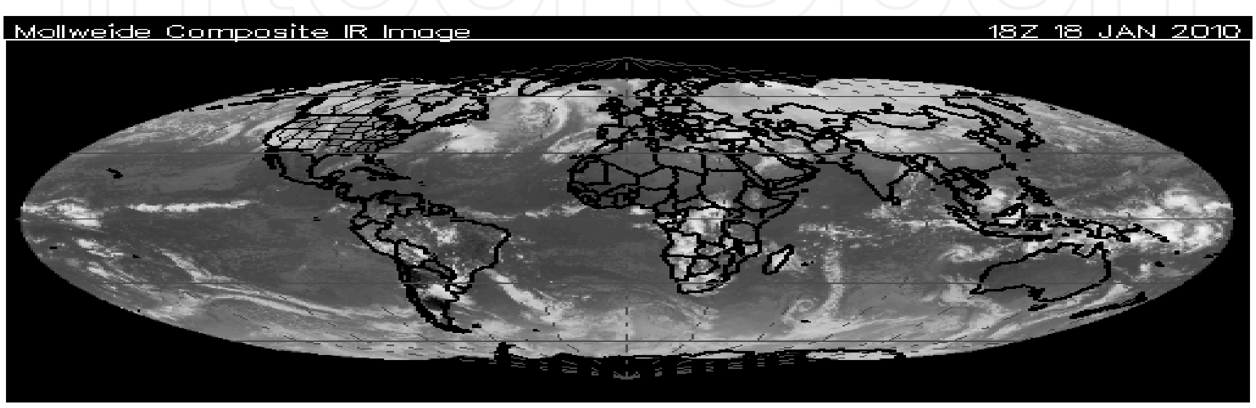
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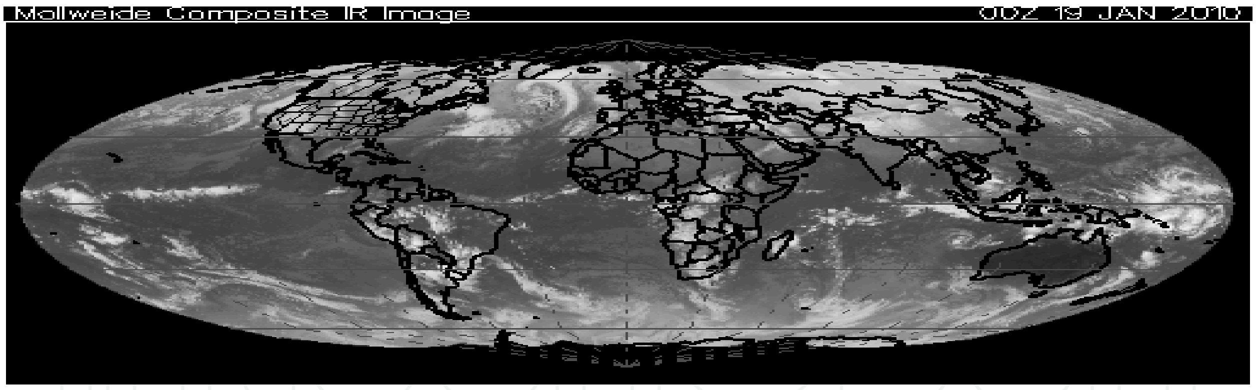
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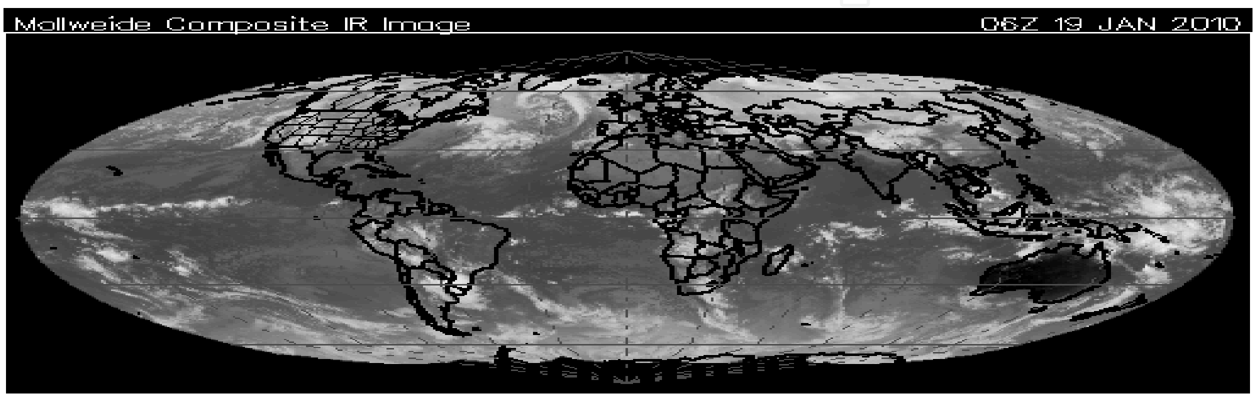
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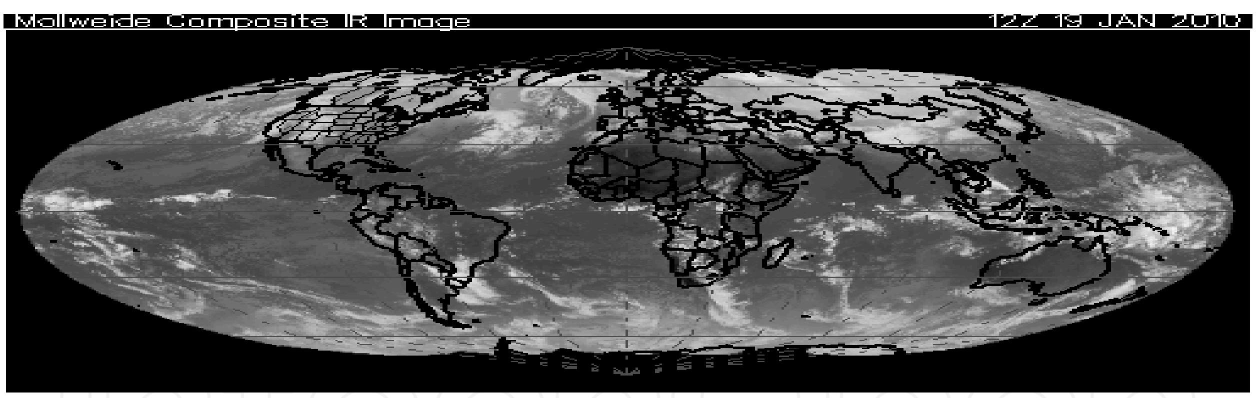
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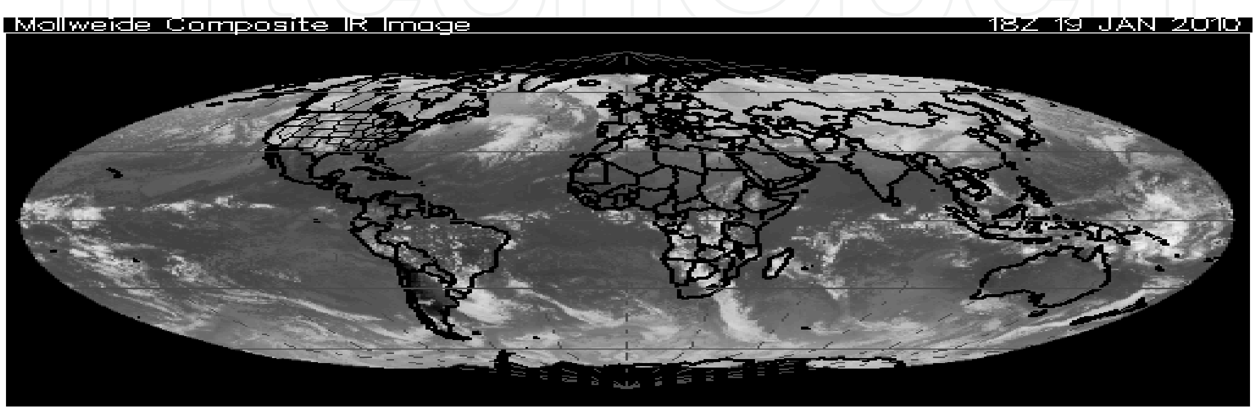
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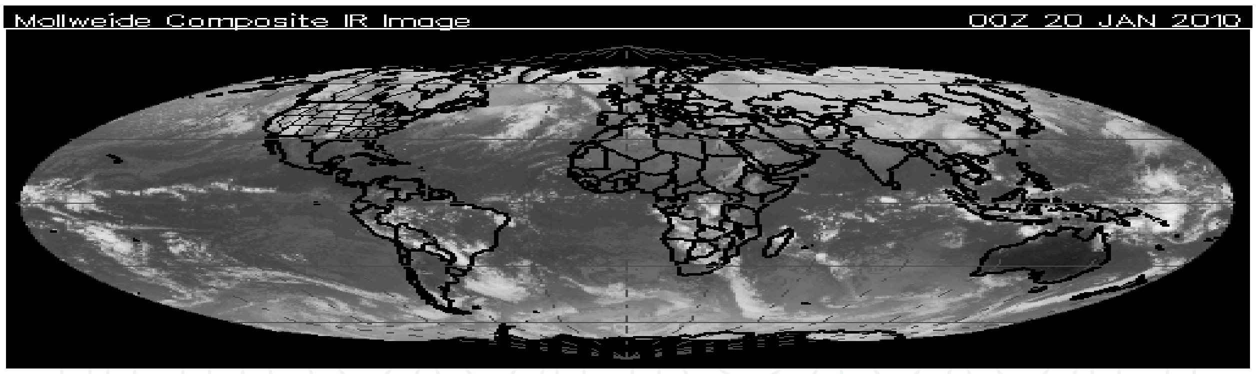

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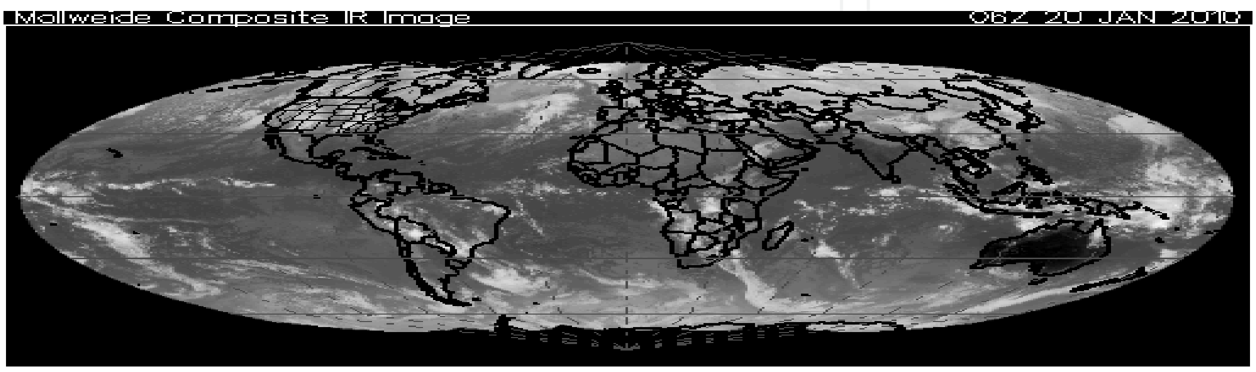

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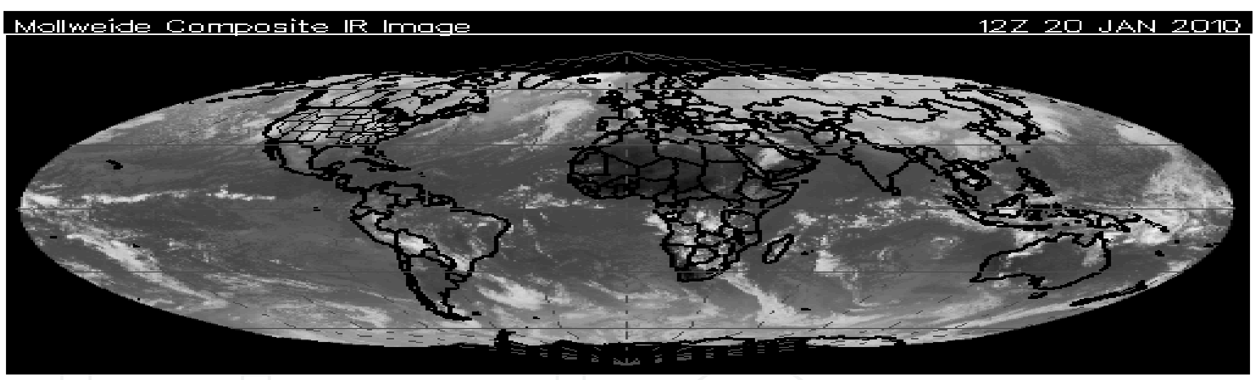

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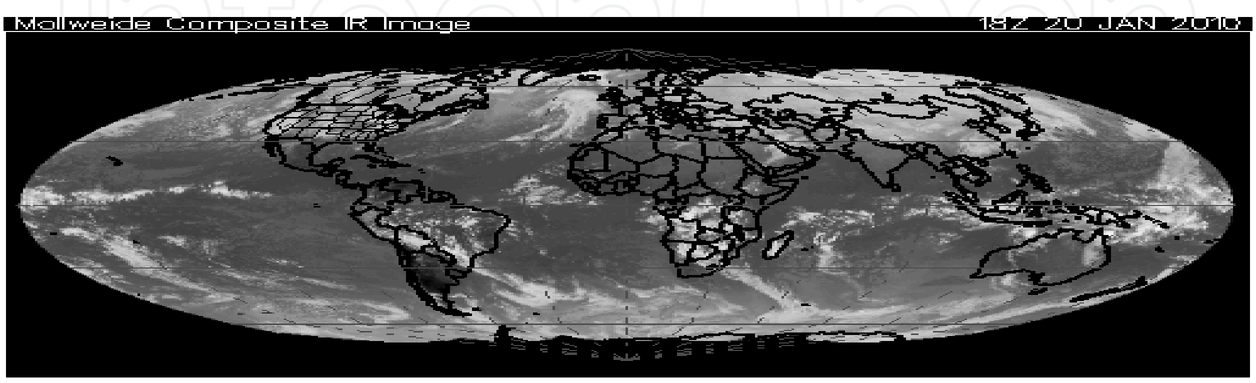


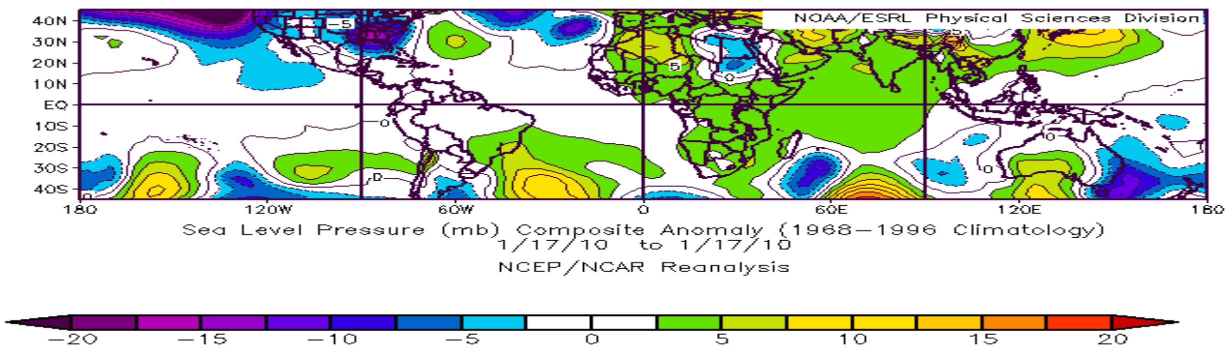
(p)

Fig. 6. The 6-hour Mollweide composite IR satellite images through the period 17-20 January 2010

We use satellite fields of infrared IR to find large-scale zonally connected regions of convection. Table 2 shows the 6 –hour location of ITCZ over eastern Africa during the period of the present case study according to the interpretation of Mollweide composite IR satellite images. From day to day it is clear that there is a shift of ITCZ over eastern Africa toward north east direction mainly over north Sudan, Ethiopia and Red Sea and reached to Sinai during the period of study. Whereas, on the first day, 17 January, ITCZ Shift to north west Sudan and north east Ethiopia and extends towards north Red Sea over South east of Egypt(see Table 4 and Figure 6a, b, c and d). During 18 January ITCZ its maximum northward extension reached to Sinai as it is clear from Table 4 and Figure 6e,f,g and h). In fact, it is abnormal that ITCZ reach to Sinai in month of January or in winter season. On 19 January, ITCZ oscillates over Sudan and extended to north Sudan, Ethiopia and Red Sea. See Table 4 and Figure 6i, j, k, and l. The eastward extension of ITCZ reach its maximum widespread eastward to reach Saudi Arabia as it is clear from Table 4 and Figure 6m, n, o, and p.

3.2.3 Relationship between variability of ITCZ over eastern Africa and occurrence of flash floods over EM on January 2010

Other studies (e.g., Serra & Houze, 2002) have referred to the ITCZ as a geographical region along which westward propagating disturbances (WPDs) tend to propagate zonally. Weak WPDs (or easterly waves) have been observed to propagate through the ITCZ cloud envelope (e.g., Scharenbroich et al., 2010) and, in general, it is impractical to attempt to separate the easterly wave signal out of the ITCZ signal. (Magnusdottir & Wang, 2008) reached the same conclusion when using spectral analysis on 40-yr European Centre for Medium-Range Weather Forecasts Re-Analysis (ERA-40) 850-hPa relative vorticity. The line of thinking that easterly waves or WPDs are inseparable from the ITCZ accommodates the idea that the ITCZ is composed of WPDs. Through the present work, in the pervious section 3.2.2, analysis of cloud clusters using of satellite images show that from day to day the location of the ITCZ is highly dynamic and changeable during the period of study. The ITCZ can form as a narrow band of convection stretched over an extensive longitudinal distance. From analysis of mean sea level pressure using of method of anomaly, it is clear there are negative anomalies (-5hpa) over EM during the period of study. As it is shown from Figure 7a, b, c and d and Table 5. In addition to that in the upper air at 500 hpa level there upper air trough of low pressure system over EM with negative anomalies less than (-75 m) of geopotential height. These anomalies persisted all the time of flash floods that existed. See Figure 8a, b, c, and d and Table 5. Also, analysis of vector wind in the tropical region revealed that there are positive anomalies more than +7 m/sec over all EM region and Red Sea through the period of study. Which mean that there was a strong westerly air current flow in EM as it is clear from Figure 9a, b, c, and d and Table 5. Meridonal wind component analysis shows that there existed a positive anomalies more than + 4 m/s over EM during the time of existing of flash floods over this region. It is clear in Figure 10a,b,c, and d and illustrated in Table 5. These results means that the south wind component is the common component in the vector wind field in EM through the period from 17-20 January 2010.The south wind component comes from the northward shift of ITCZ as unusual to exist in January month. So that, the variability of ITCZ to north and north east toward several countries in the EM region across Red Sea and Sinai carry out the convective cloud systems from tropics to EM and cause of flash floods.



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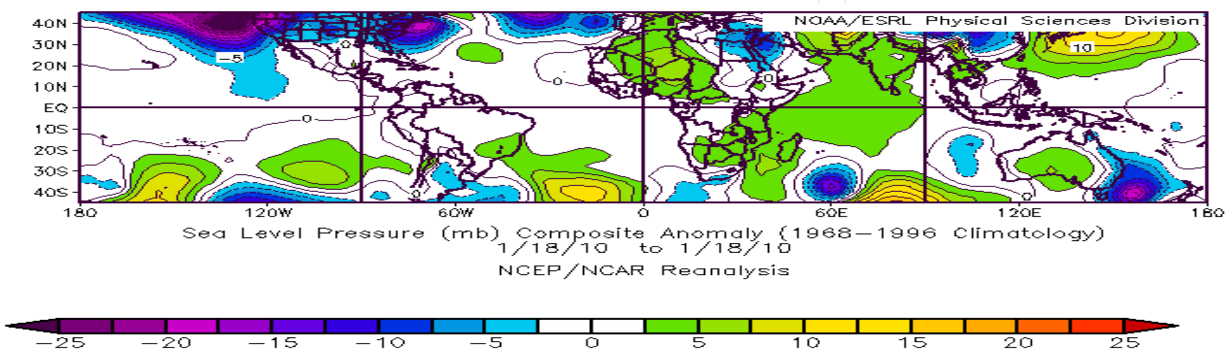

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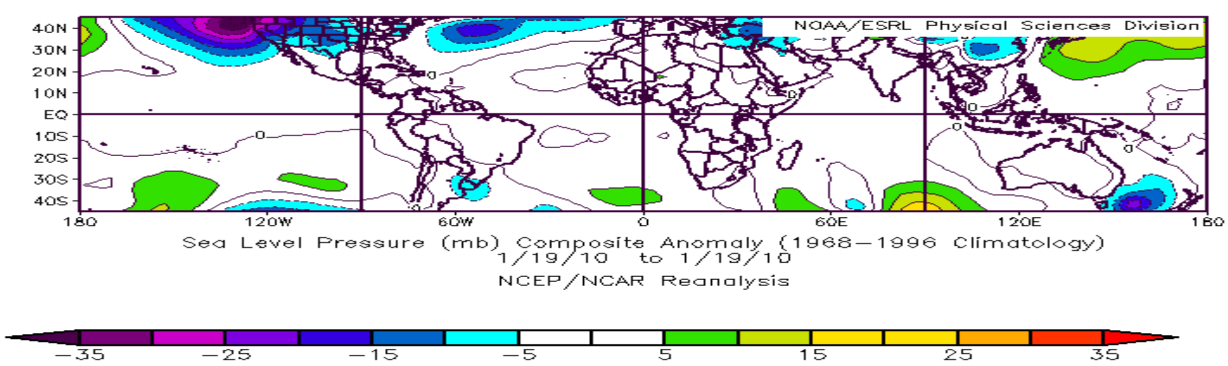

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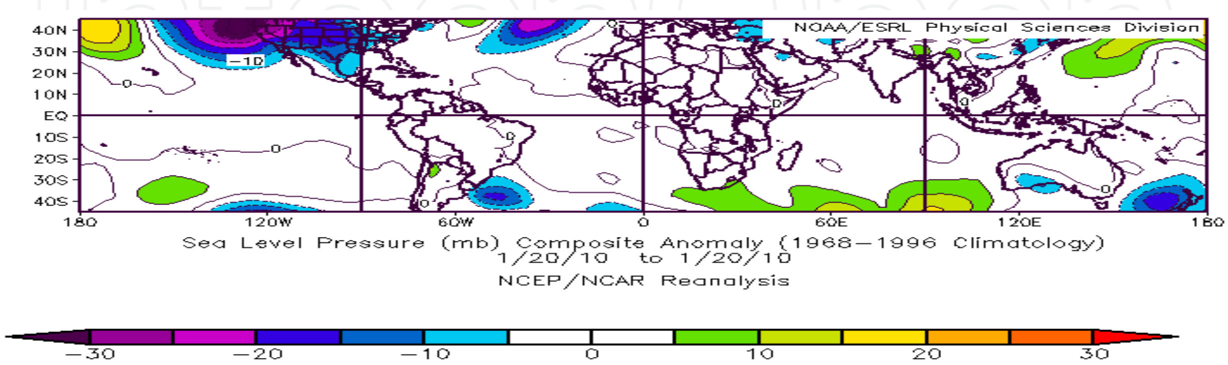
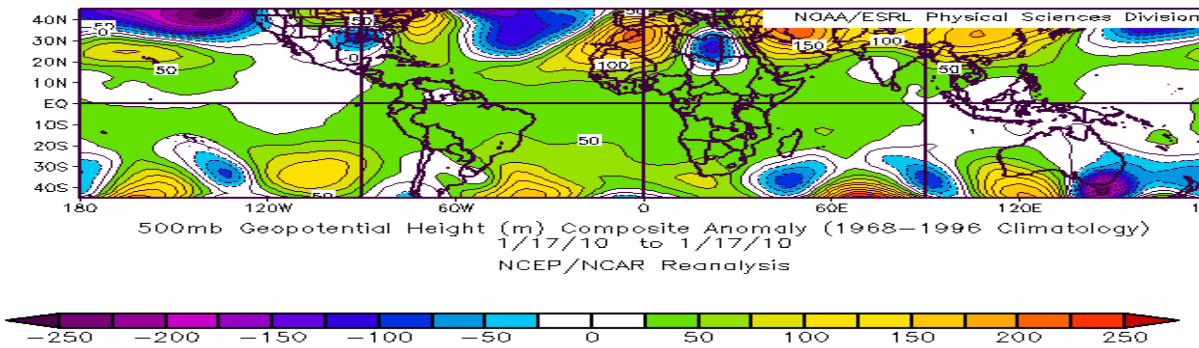


(d)

Fig. 7. The daily sea level pressure (mb) composite anomaly distribution for the period 17-20 January 2010



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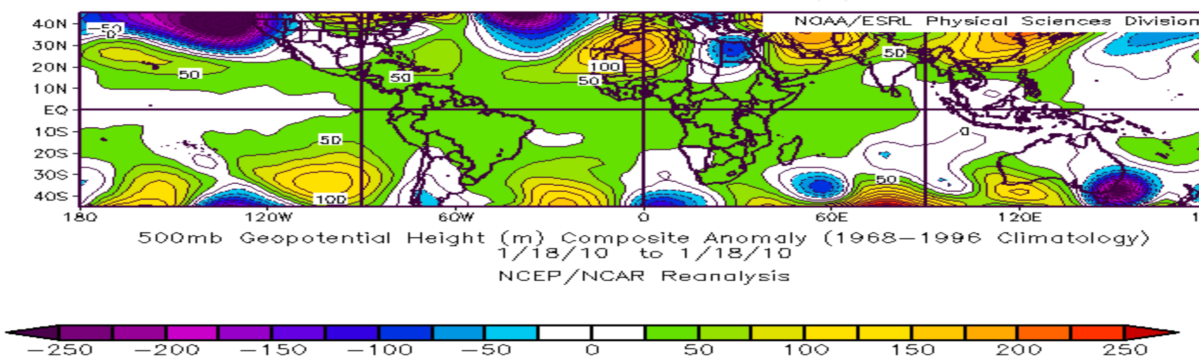

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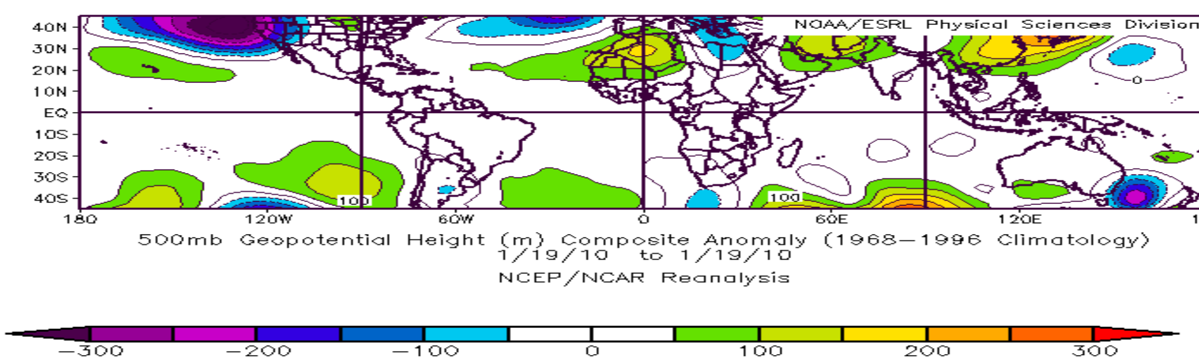

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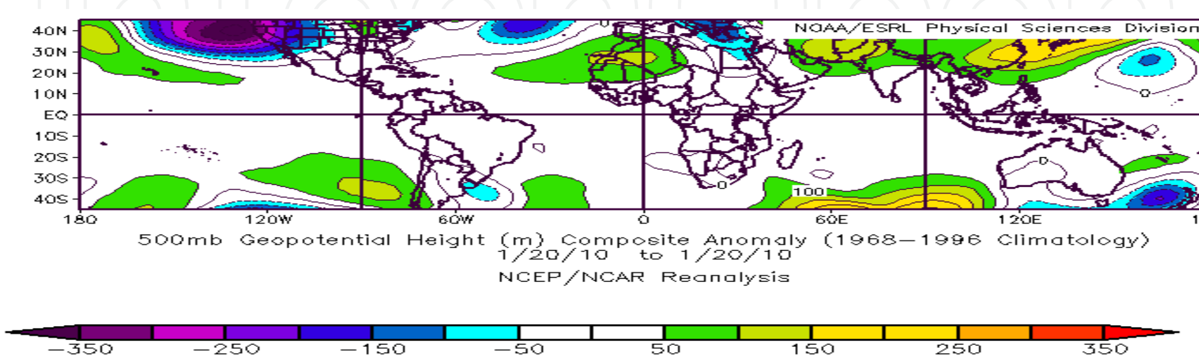
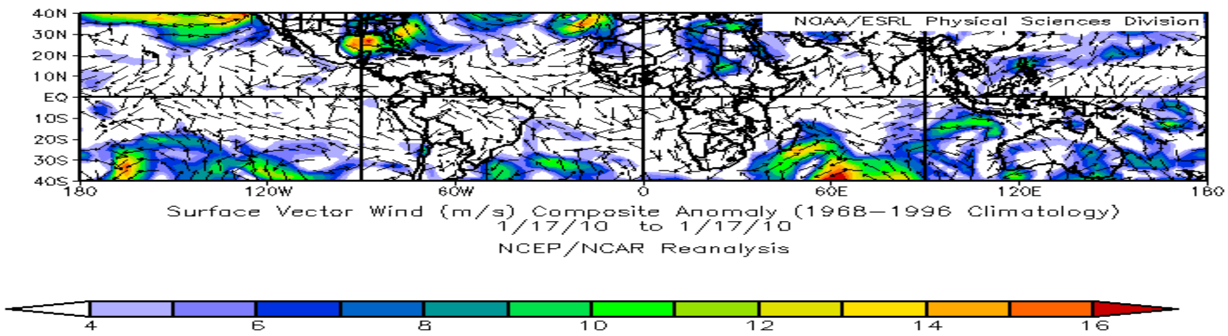


(d)

Fig. 8. The daily geopotential height (m) composite anomaly distribution for the period 17-20 January 2010



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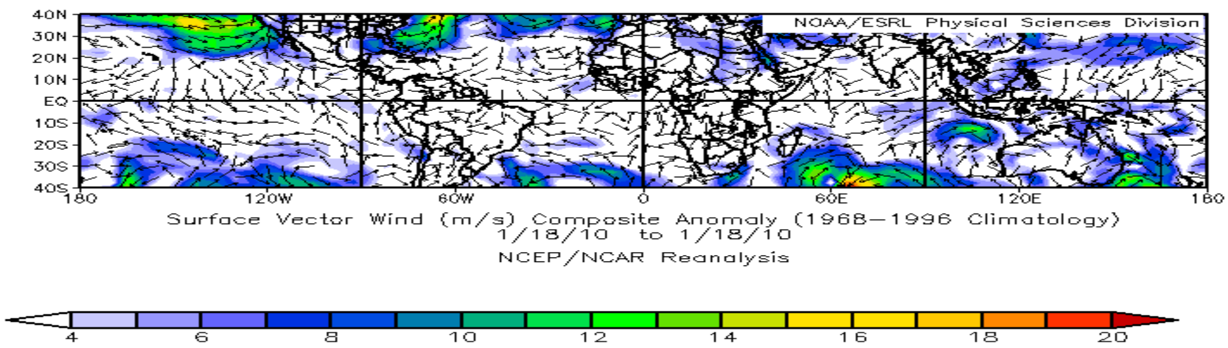

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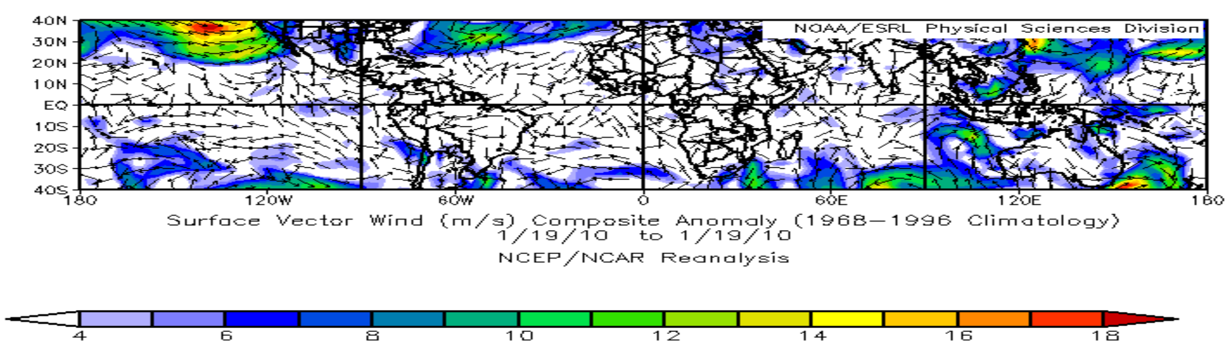

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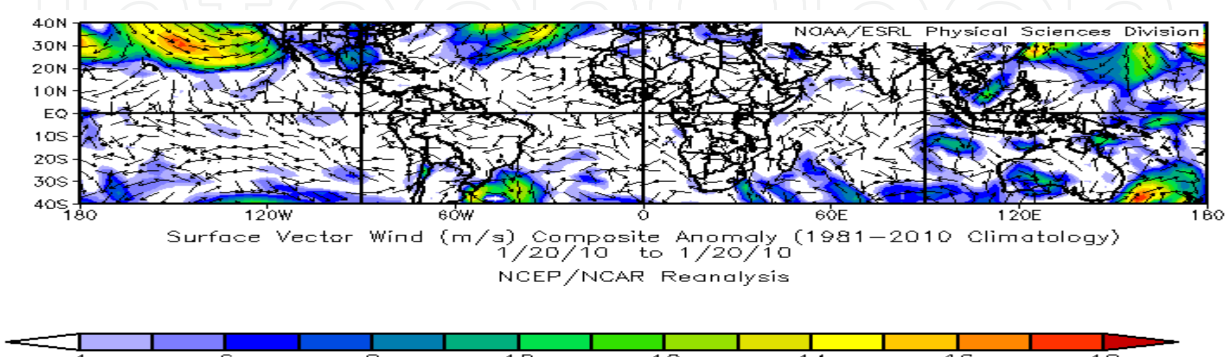
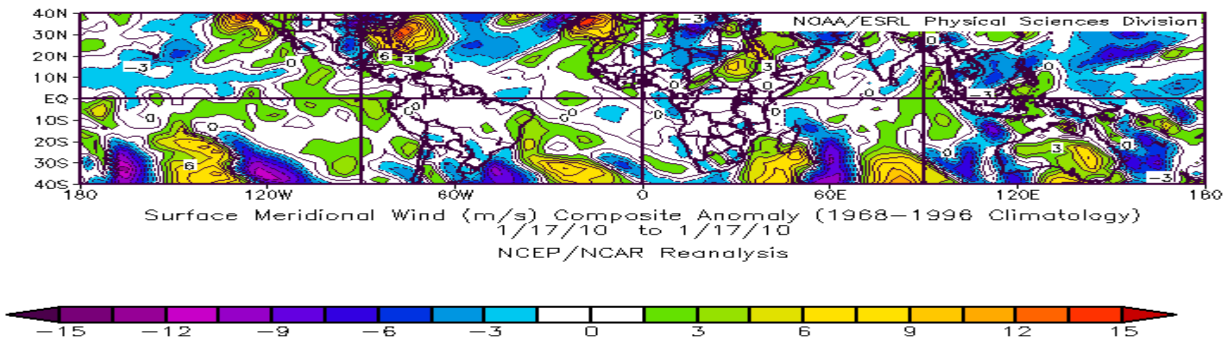


(d)

Fig. 9. The daily surface vector wind (m/s) composite anomaly distribution for the period 17-20 January 2010



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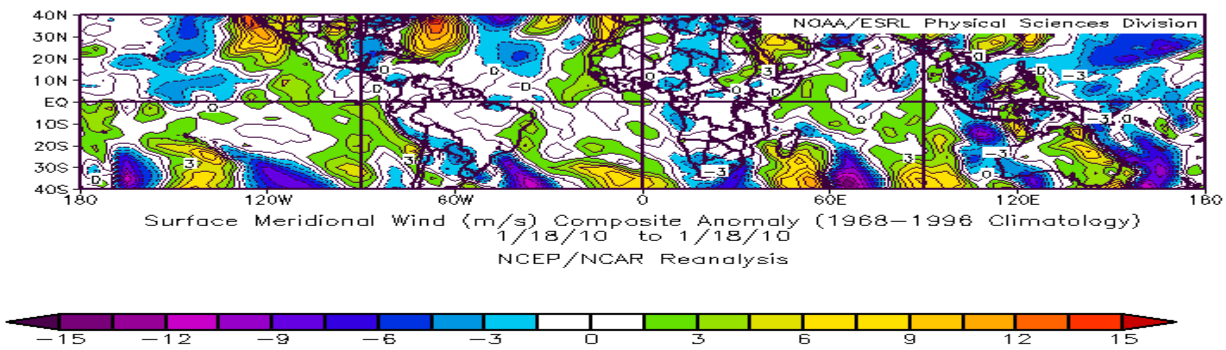

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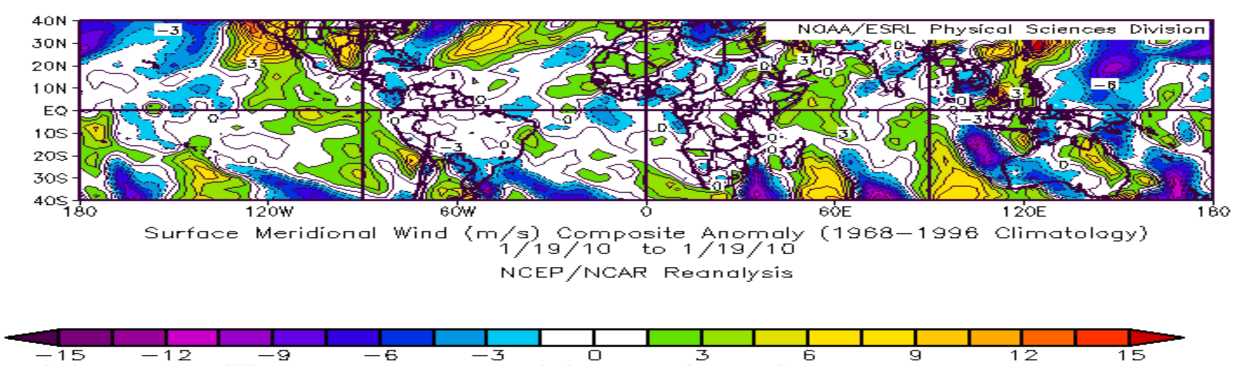

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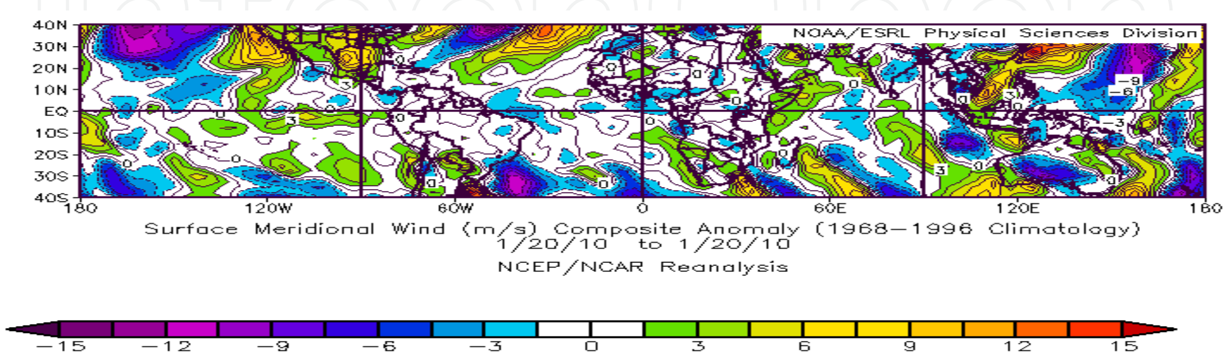

(d)

Fig. 10. The daily surface meridional wind (m/s) composite anomaly distribution for the period 17-20 January 2010

Anomalies in meteorological element Date time	Anomalies in the following meteorological elements and its location in the eastern Mediterranean region							
	Geopotential height In (m) Value Location		MSL pressure in (hpa) Value Location		Vector wind in (m/s) Value Location		Meridional wind in (m/s) Value Location	
17 January 2010	-75	Libya and Egypt	-5	Egypt	+10	SW Sudan and medial of Red Sea	+6	Sudan, Red Sea and north of Egypt
18 January 2010	-75	Egypt	-10	Eastern Mediterranean region	+7	Libya , Sudan and central of Red Sea	+6	Red Sea and Saudi Arabia
19 January 2010	-100	North coast of Egypt	-15	Eastern Turkey	+7	Over eastern Mediterranean region	+4	Eastern Mediterranean, Red Sea and north Sudan
20 January 2010	-100	North coast of Egypt	0	Over all eastern Mediterranean region	+7	Over eastern Mediterranean region	+4	South Red Sea and eastern Mediterranean region

Table 5. Daily Anomalies amount in the meteorological elements and its location in the eastern Mediterranean region through the period 17-20 January

4. Discussion and conclusion

It is clear from the above studies that ITCZ controlling on the extreme weather events. For first case study, the UK severed from abnormal cooling through the winter season on 2009. The mean temperature for that winter was 0.5 °C below average of (1971-2000), making it the coldest winter since 1997. However, the ITCZ is an important parameter for climatic studies in the northern hemispheric circulation. Through the present work relationship between the movement of the Atlantic-Western Africa ITCZ in summer 2008 and the cooling occurred over UK in winter 2009 has been studied. The results revealed that cooling in that winter was correlated to the southward variability that existed Atlantic -Western Africa ITCZ in summer 2008. However, there is mainly a significant positive correlation coefficient value +0.7 at 5° W longitude of ITCZ. In addition to that, for second case, the results of the present study uncover that the unusual north eastward shift of ITCZ over the north Sudan, Ethiopia and Red Sea on the period of 17-20 January 2010 leads to push the tropical weather regime northward towards eastern Mediterranean. One can concluding that the extreme shift of ITCZ to north eastward over eastern Africa is causing of occurrence widespread flash floods over EM on abnormal period. So in the future works the teleconnection of interaction between tropical and midlatitude weather regimes must take in consideration to forecasting of flash floods in EM region. In fact, during winter Northern Hemisphere, winter the ITCZ lies almost in the southern Hemisphere mainly over eastern Africa and Indian ocean. Meanwhile, during Summer Northern Hemisphere summer the ITCZ lies in the

Northern Hemisphere. However, Figure 11 shows the longitudinal variations band in the ITCZ over the globe through January and July months. Satellite images show that from day to day the ITCZ is highly dynamic and changeable. This dynamic ITCZ has been the subject of dynamical modeling studies (Ferreira and Schubert 1997; Wang et al. 2010) . In a northern summer monsoon, the prevailing winds at the low levels are from the southeast. At high levels, the wind direction reverses. This configuration produces a large vertical wind shear not occur elsewhere in the tropics. In the monsoon onset process, the ITCZ shifts from near the equator to more than 10 degrees away in days. Compared with the movement of the Earth's tilt toward the Sun, this change is rapid. The shifts and preferred latitudes of the ITCZ observations and theory were investigated in several scientific studies (Bates,1970; Philander et al., 1996 and Hafez ,2003c).

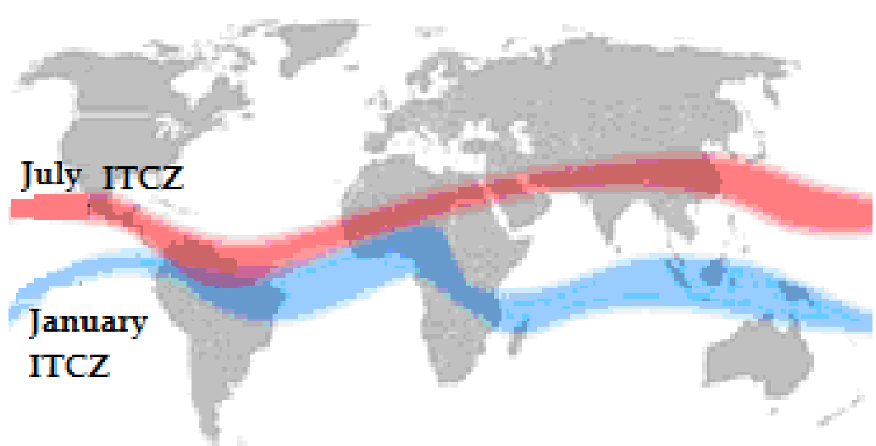

Fig. 11. The longitudinal distribution of ITCZ in winter season represents by January and in summer season represents by July.[source: Wikipedia, the free encyclopedia.mht]

5. Acknowledgments

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observatory for obtained dataset of flash floods through the website http://www.dartmouth.edu.

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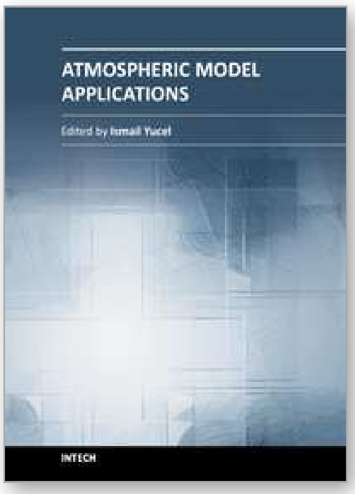

Atmospheric Model Applications

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