Ministry of Earth Sciences
India Meteorological Department
Cyclone Warning Division, New Delhi

FDP (Cyclone) NOC Report Dated 04th December, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Deep Depression over Eastcentral Arabian Sea moved north-northwestwards with a speed of 21 kmph during past 06 hours and lay centred at 1130 hrs IST of today, the 04th December, 2019, over Eastcentral Arabian Sea, near latitude 14.9°N and longitude 69.3°E about 600 km south-southwest of Mumbai and 490 km of west-southwest of Panjim (Goa). It is very likely to intensify into a Cyclonic Storm during next 12 hours. It is very likely to move northwestwards, away from Indian coast during next 48 hours.
- The Deep Depression over southwest Arabian Sea moved northwards with a speed of 04 kmph during past 06 hours and lay centred at 1130 hrs IST of today, the 04th December, 2019 near latitude 7.4°N and longitude 56.6°E over Southwest Arabian Sea, about 650 km south-southeast of Socotra (Yemen) and 920 km east-southeast of Bosaso (Somalia). It is very likely to intensify into a Cyclonic Storm during next 06 hours. It is very likely to move north-northwestwards for some more time and then recurve west-southwestwards towards Somalia coast during next 03 days.
- The trough in easterlies over southwest Bay of Bengal off Sri Lanka-south Tamil Nadu coasts extending upto 1.5 Km above mean sea level now lies over Comorin area and adjoining equatorial Indian Ocean. Under its influence, a Low Pressure Area is likely to form over Maldives-Comorin areas around 6th December, 2019. It is likely to become more marked during subsequent 24 hours.

Dynamical and thermodynamical features

Sea Surface Temperature (SST):

Sea Surface Temperature is around 26-28°C over the system area in westcentral Arabian Sea and along the forecast track. It is around 27-28°C over the system in eastcentral Arabian Sea.

SST is around 26-28ºC over most parts of north BoB and adjoining WC BoB. It is between 28 - 30ºC over rest BoB with higher values over eastcentral and south BoB.

Tropical Cyclone Heat Potential (TCHP):

Tropical Cyclone Heat Potential (TCHP) is 30-40 kJ/cm^2 over the southwest Arabian Sea. It is around 80-90 kJ/cm^2 over southeast Arabian Sea.
There are areas of values more than 100 kJ/cm^2 over southeast Arabian Sea, off Kerala coast & Lakshadweep area and also over equatorial Indian Ocean.

Relative Vorticity:

Cyclonic relative vorticity of value 150x10^{-5} s-1 seen over the area of the Deep Depression over southwest Arabian Sea. Cyclonic relative vorticity of value 50-60x10^{-5} s-1 seen over the area of the WML over southeast Arabian Sea and adjoining Lakshadweep area.

Low level Convergence:

Positive lower level convergence of value 5x10^{-5} s^{-1} is seen over the Deep Depression area; it is around 10x10^{-5} s^{-1} to the south of the centre of the DD over EC Arabian Sea.
An area of positive lower level convergence of value 10-15x10^{-5} s^{-1} is seen over southwest BoB to the south of Sri Lanka.

Upper level Divergence:
Positive upper level divergence of value $30x10^{-5}$ s^{-1} is seen to the north of the centre of Deep Depression over southwest Arabian Sea; $10x10^{-5}$ s^{-1} around the centre of the DD over eastcentral Arabian Sea; $30x10^{-5}$ s^{-1} over Comorin area and adjoining equatorial Indian Ocean.

Wind Shear:
Wind shear is moderate to high over southwest Arabian Sea and low to moderate over southeast Arabian Sea.

Wind Shear Tendency:
The wind shear tendency is negative or neutral over entire BoB.
It is negative or neutral over northeast, eastcentral and southeast Arabian Sea. It is positive over the rest area.

Upper tropospheric ridge:
The upper tropospheric ridge at 200 hPa runs roughly along 13°N over BoB and Arabian Sea.

Satellite observations based on INSAT imagery:

Arabian Sea:-
As per the satellite imagery at 0900 UTC of 4th December, 2019, the intensity of the system over southwest Arabian Sea is T 2.0. Associated broken low to medium clouds with embedded intense to very intense convection lies between latitude 6.0°N to 12.5°N and longitude 54°E to 60.0°E. Minimum Cloud Top Temperature (CTT) is minus 93 deg C.

Intensity of the system over southeast Arabian Sea and adjoining Lakshadweep is T 2.0. Associated broken low/med clouds with embedded intense to very intense convection is seen over area between latitude 12.0°N to 17.0°N long 68.5°E to 72.0°E. Minimum Cloud Top Temperature (CTT) is minus 76 deg C.

scattered low to medium clouds with embedded intense to very intense convection is also seen over Comorin and adjoining southeast Arabian Sea and Maldives area.

Bay of Bengal & Andaman Sea:

According to 0900 UTC satellite imagery, scattered low/medium clouds with embedded moderate to intense convection lies over south BoB to the south of 10°N.

Large scale features

M.J.O. Index:
MJO index is in Phase 1 with amplitude near to 1. It is likely to remain in the same phase for next 3-4 days and move to Phase -2 with increasing amplitude thereafter.

Storms and Depression over South China Sea/ South Indian Ocean: Nil

NWP Input for FDP Cyclone based on 0000 UTC of today

IMD-GFS T-1534:

(i) Indicates a CS over southwest Arabian Sea, which moving in a west-northwest direction weakens and crosses north Somali coast in the morning of 7th December as a depression.

(ii) The Depression over southeast Arabian Sea is seen as a LOPAR on 5th and becomes less marked by 6th December.

(iii) Another LOPAR forms on 7th over central parts of south Arabian Sea which moving in a near westward direction is seen as a depression over southwest Arabian Sea on 8th and 9th and moves towards Gulf of Aden with further weakening.

IMD-GEFS:

(i) Indicates a CS over southwest Arabian Sea (AS) which moving west-northwestwards reaches north Somali coast on 6th as a depression and becomes less marked thereafter.

(ii) Depression over eastcentral Arabian Sea weakens into a LOPAR on 5th December and becomes less marked on 6th.

(iii) Another LOPAR is seen over southeast Arabian Sea on 7th and 8th December which becomes less marked subsequently.

IMD-WRF:

(i) Indicates a CS over southwest Arabian Sea which is seen moving in a west-northwest direction towards Somali coast till 6th with gradual weakening.

(ii) The depression over eastcentral Arabian Sea weakens into a low on 5th and becomes less marked on 6th.

(iii) Another LOPAR is seen to form over equatorial Indian Ocean to the south of southwest BoB on 7th.

NCMRWF-NCUM:

(i) The CS on 03rd December over southwest Arabian Sea is seen moving in NW direction towards Yemen coast with gradual weakening.

(ii) This model is not indicating a second system over SE Arabian Sea.

NCMRWF-UM-Regional Model: Indicates development of no low pressure system for the next 3 days in its domain.

NEPS Model: The deep depression over SW Arabian Sea moving northwestwards further intensifies till 7th and move towards Gulf of Aden with gradual weakening.
This model is not indicating a second system over SE Arabian Sea.

ECMWF:

(i) The depression over southwest Arabian Sea moves nearly westwards intensifies into a CS on 5th and becomes a depression again on 6th and cross Somali coast in the night of 06th December.

(ii) Indicates a LOPAR over eastcentral Arabian Sea on 4th is seen as a depression on 5th and 6th and becomes less marked by 0000 UTC of 7th.

(iii) A third LOPAR forms over Maldives and adjoining southeast Arabian Sea on 6th which moving in westward direction becomes a depression on 7th , a CS on 8th. It further moves towards Gulf of Aden and weakens into a depression on 10th and becomes less marked on 11th.

NCEP-GFS:

(i) The deep depression/ CS on 04th December over southwest Arabian Sea, moves northwestwards weakens into a depression and cross Somali coast by 6th December and weakens thereafter.

(ii) This model indicates D over EC Arabian Sea. It is seen to weaken on 5th and becomes less marked on 6th.

(iii) A third LOPAR is forecast to form over Comorin-Maldives areas on 5th which becomes a depression over southwest Arabian Sea on 9th . Further moving west-northwestwards it weakens and becomes less marked on less marked on 11th.

ARP-Meteo France :.

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

An area of significant zone of GPP is seen over southwest Arabian Sea which is seen to move westwards slowly and crosses Somali coast on 07th December. Another significant GPP zone is seen over southeast Arabian Sea and adjoining Lakshadweep which moves in a north-northwest direction and becomes less marked on 05th December. A third zone Is seen to

develop over southeast Arabian Sea on 6th which moving in a near westward direction becomes insignificant by 10th.

IMD NWP products are available at:
http://nwp.imd.gov.in/bias/gfsproducts.php
http://nwp.imd.gov.in/bias/wrf27pro.php
http://www.rsmcnewdelhi.imd.gov.in/NWP_CYC/Analysis.htm or
http://www.rsmcnewdelhi.imd.gov.in/NWP_CYC/<HH> hrs.htm
<HH> are forecast hours i.e. 24, 48, 72 and etc.

Summary and Conclusion:

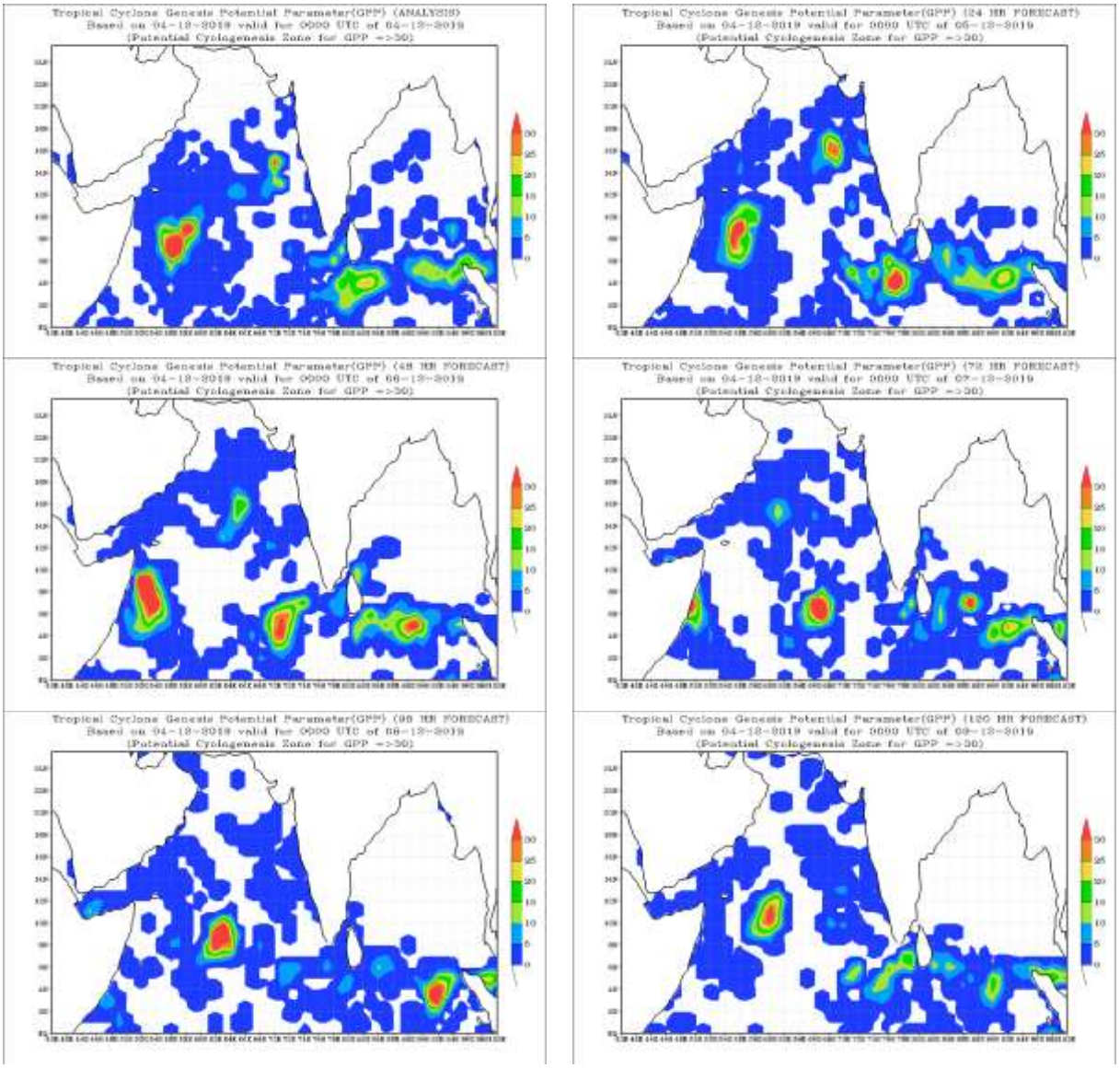
(i) With regard to the DD over southwest Arabian Sea, the low level relative vorticity is about 200 $x10^{-5}sec^{-1}$ to the west of the system centre. Positive vorticity is extending upto 200 hPa level. The lower level convergence is about 20 $x10^{-5}s^{-1}$ to the northwest of the system centre and the upper level divergence is about 40 $x10^{-5}s^{-1}$ the northeast of the system centre. The vertical wind shear is moderate to high (20-25 knots) over the system. The upper tropospheric ridge runs along 13° N. Sea surface temperature is about 26-28°C and tropical cyclone heat potential is 30-40 kJ/cm2 over the region. As the system is lying over a moderately favourable environment tropospheric winds, it is very likely to move west-northwestwards towards Somalia coast and intensify into a cyclonic storm during next 12 hours. As the system lies to the south of upper tropospheric ridge and is being steered by middle and upper coast for the next 03 days. Majority of numerical models agree with the above analysis

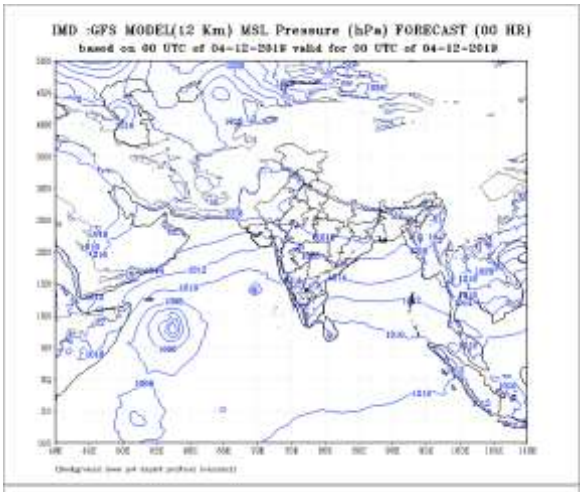
(ii) In respect of the Depression over eastcentral Arabian Sea, total precipitable water vapour imageries indicate warm air advection to the system centre. The low level relative vorticity is about 100 $x10^{-5}sec^{-1}$ to the south of the system centre. Positive vorticity is extending upto 200 hpa level. The lower level convergence is about 10 $x10^{-5}s^{-1}$ to southeast of the system center. The upper level divergence is about 20 $x10^{-5}s^{-1}$ to the northeast of the system center. The vertical wind shear is moderate to high (20-25 knots) over the system area. Sea surface temperature over the system area is 27-28°C and decreases along the forecast track. Tropical cyclone heat potential is 80-90 kJ/cm^2 over the system area and decreases to less than 50 kJ/cm^2 along the forecast track. As the system is lying in a moderately favourable conditions, it is likely to intensify into a marginal cyclonic storm during next 12 hours.

(iii) Possible formation and intensification of the third system over southeast Arabian Sea around 6th December needs to be monitored.

Advisory: No IOP area for the next 5 days

Annexure-1


Tropical Cyclone Genesis Potential Parameter(GPP) (ANALYSIS)
Based on 04-18-8018 valid for 0000 UTC of 04-18-8018
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 04-18-8019 valid for 0000 UTC of 05-18-8019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 04-18-8019 valid for 0000 UTC of 06-18-8019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 04-18-8019 valid for 0000 UTC of 07-18-8019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
Based on 04-18-8019 valid for 0000 UTC of 08-18-8019
(Potential Cyclogenesis Zone for GPP =>30)
Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 04-18-8019 valid for 0000 UTC of 09-18-8019
(Potential Cyclogenesis Zone for GPP =>30)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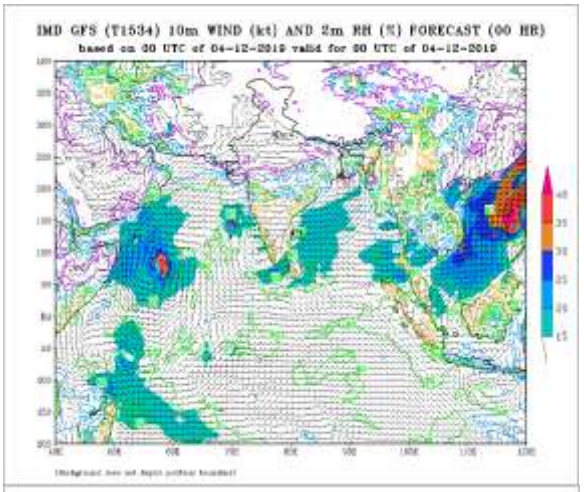
based on 00 UTC of 04-12-2018 valid for 00 UTC of 04-12-2018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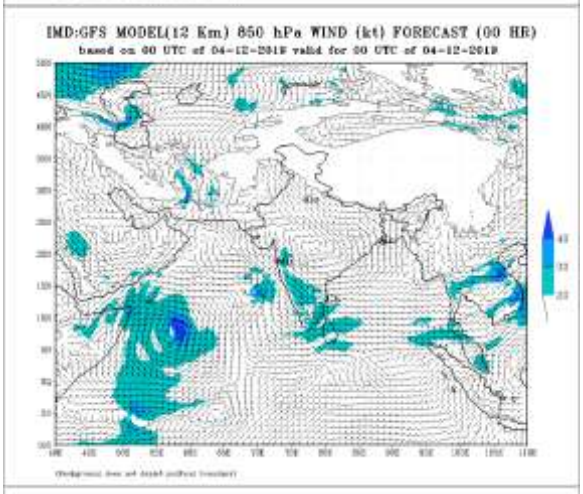
based on 00 UTC of 04-12-2018 valid for 00 UTC of 04-12-2018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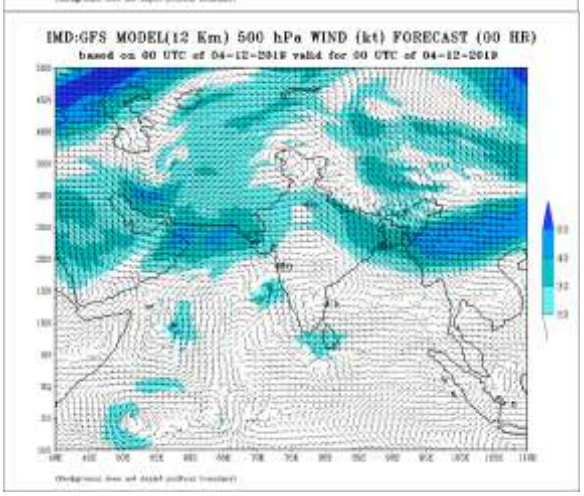
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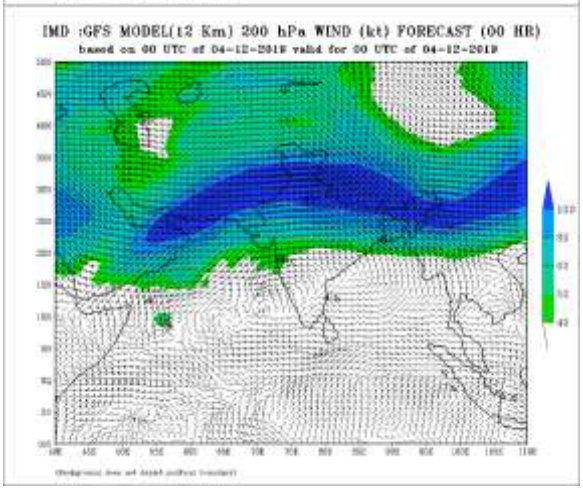
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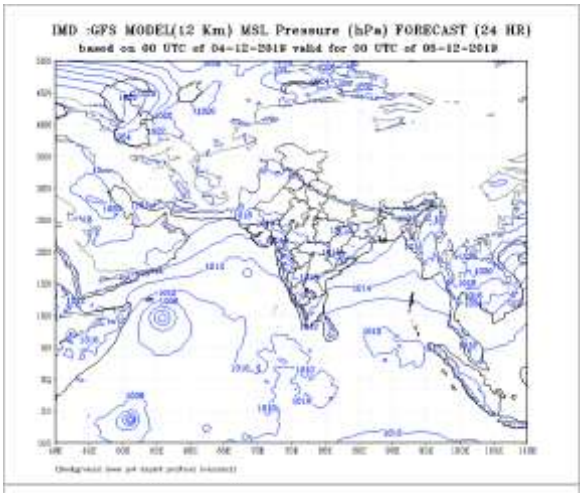
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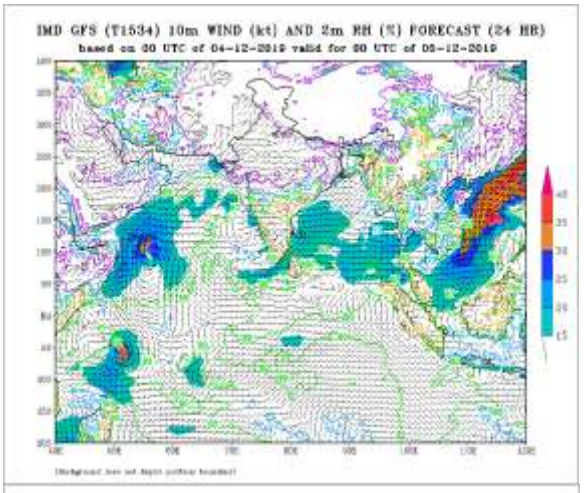
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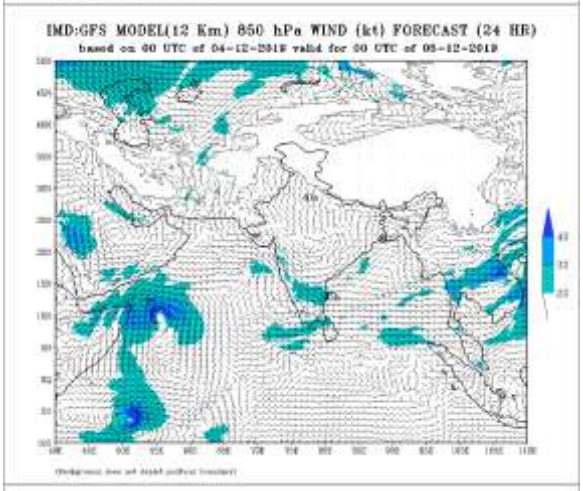
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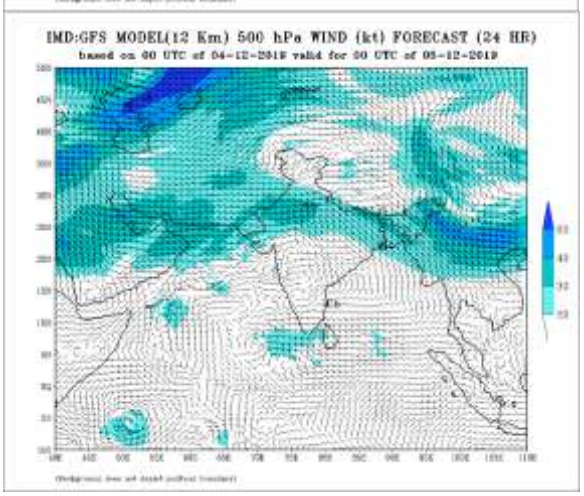
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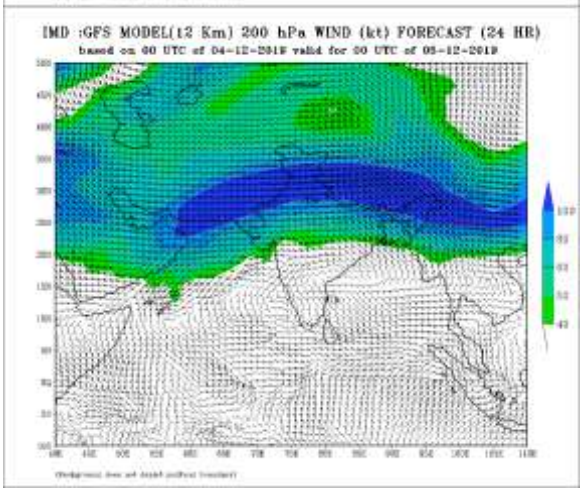
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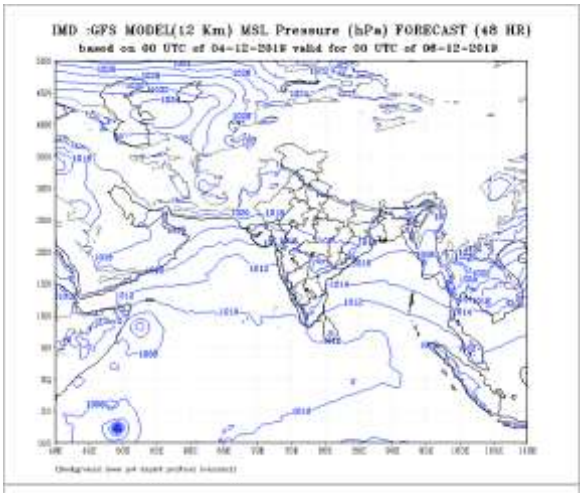
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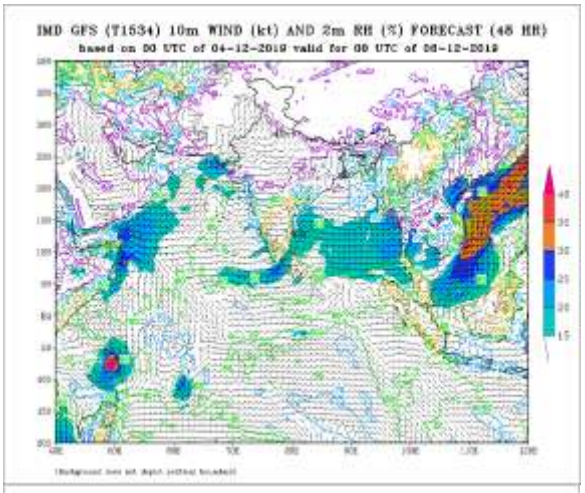
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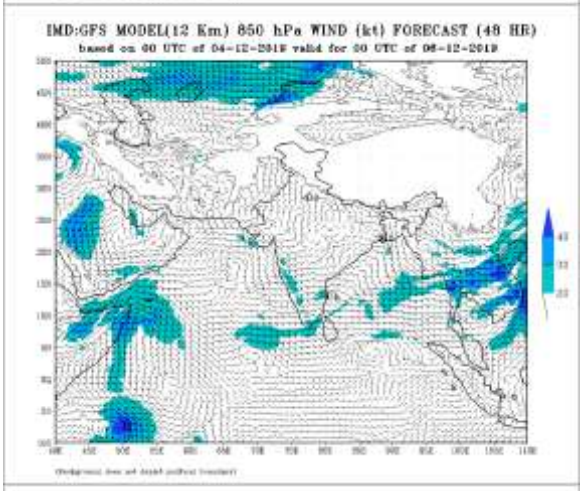
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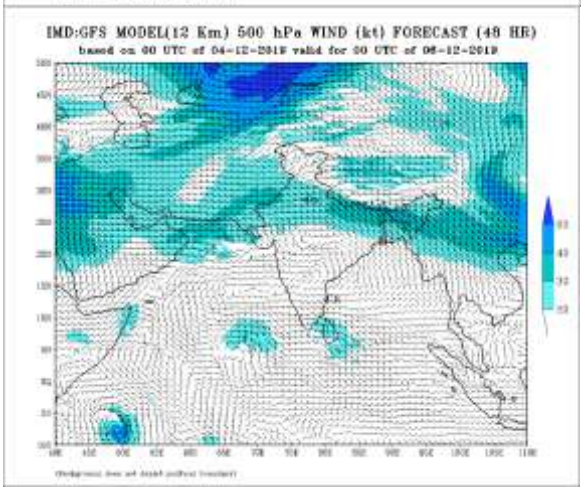
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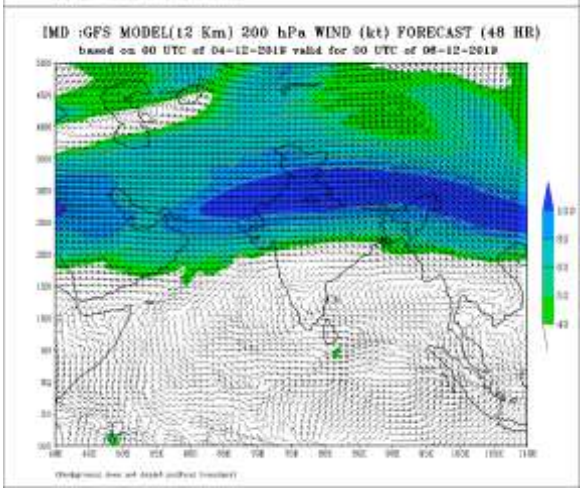
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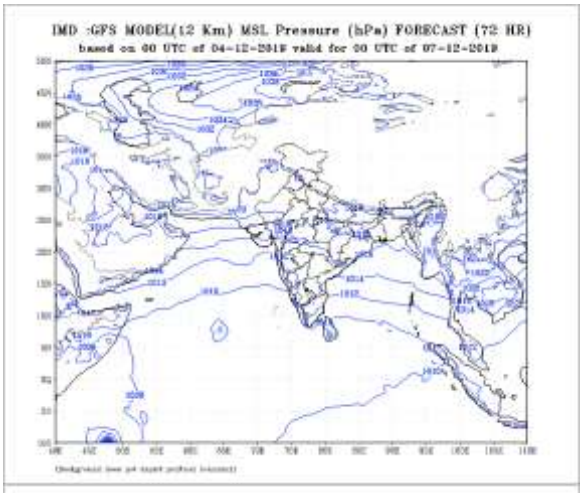
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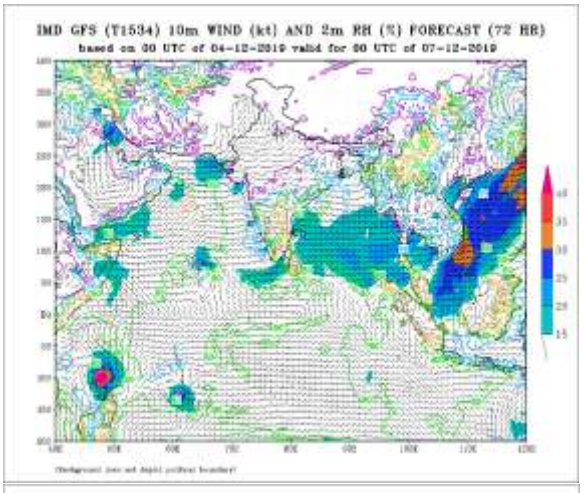
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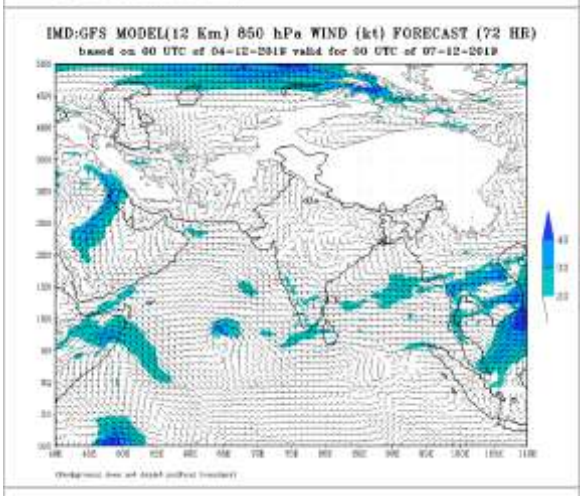
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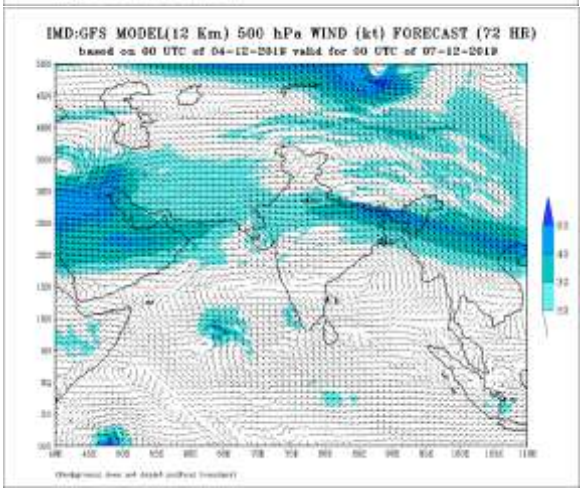
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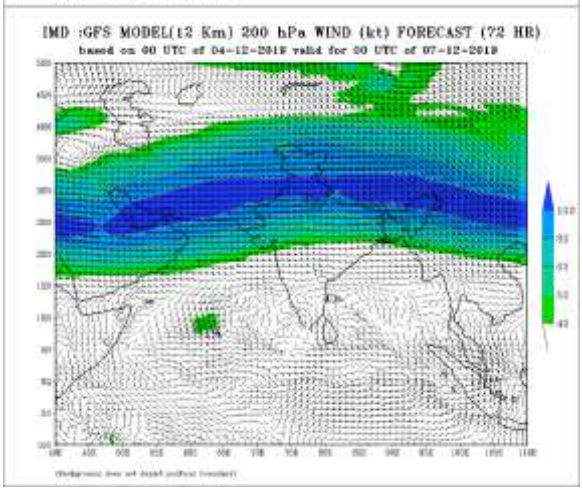
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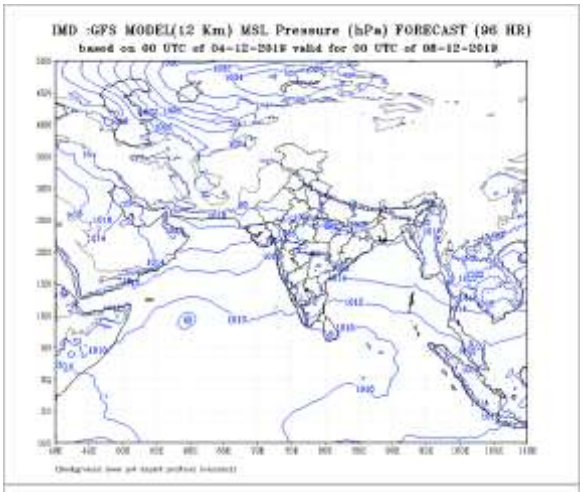
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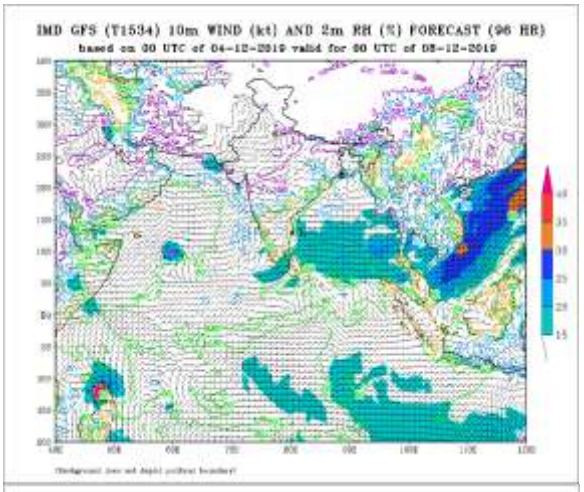
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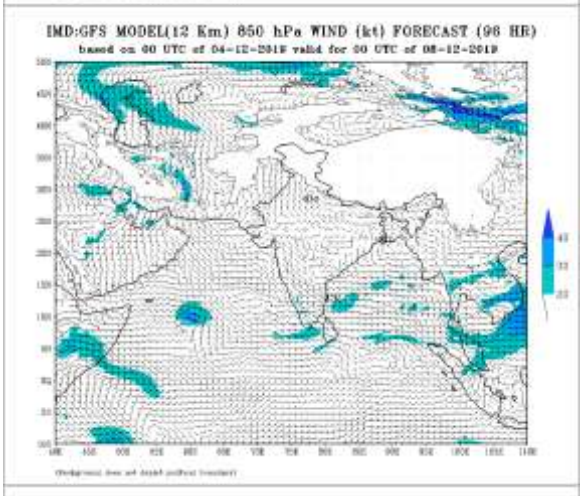
based on 00 UTC of 04-12-2019 valid for 00 UTC of 08-12-2019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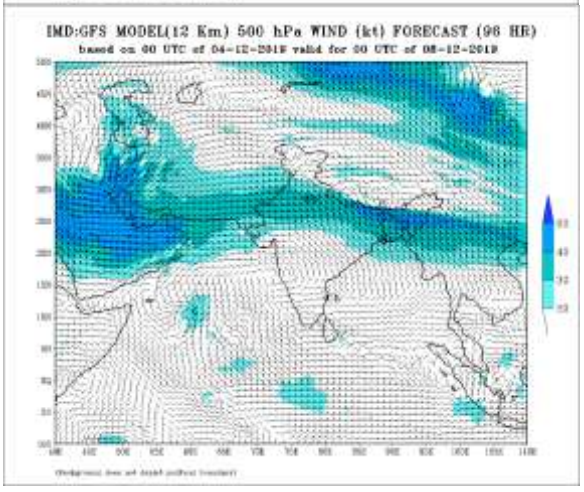
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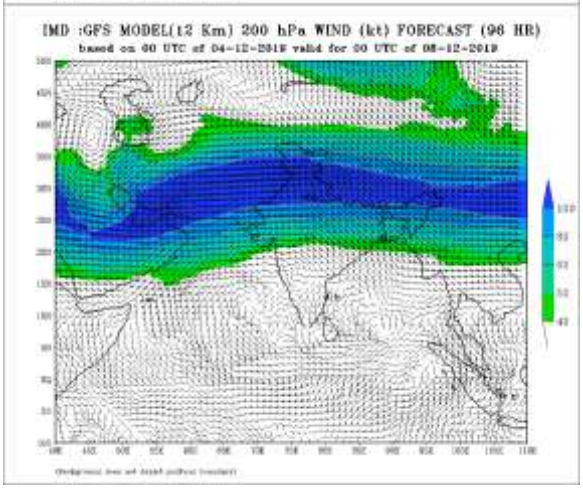
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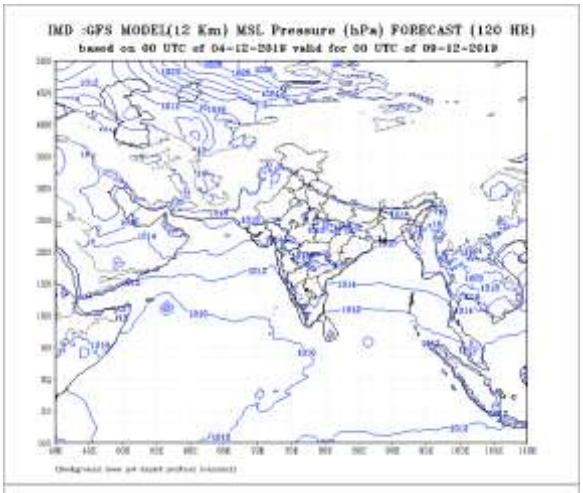
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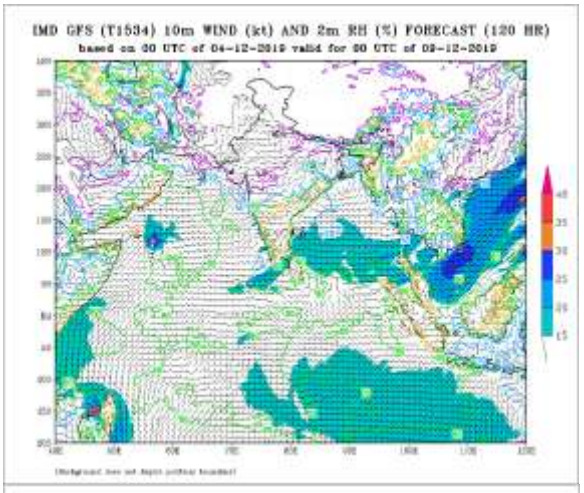
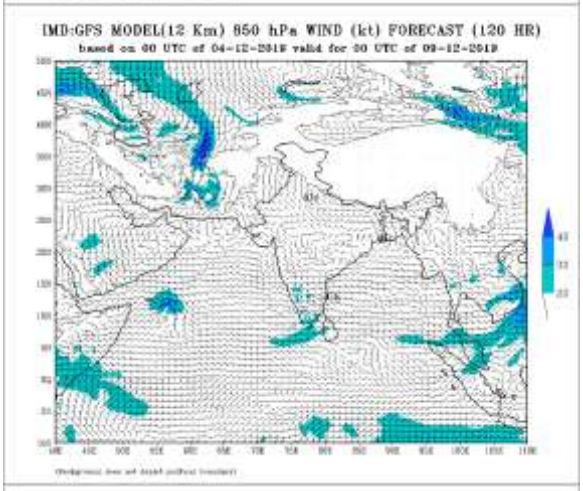
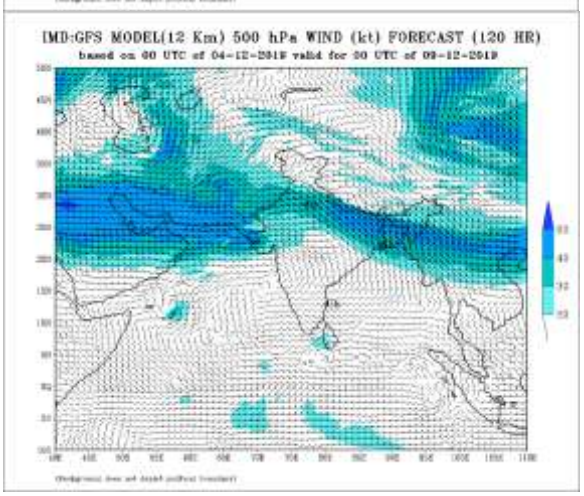
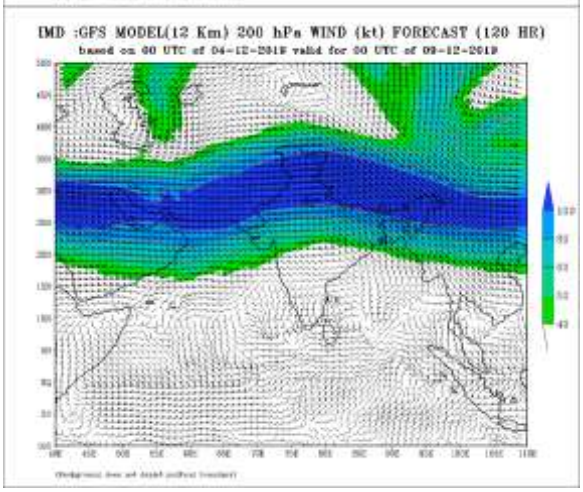
based on 00 UTC of 04-12-2018 valid for 00 UTC of 09-12-2018


IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (120 HR)
based on 00 UTC of 04-12-2018 valid for 00 UTC of 09-12-2018


IMD:GPS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-12-2018 valid for 00 UTC of 09-12-2018


IMD:GPS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-12-2018 valid for 00 UTC of 09-12-2018


IMD :GPS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 04-12-2018 valid for 00 UTC of 09-12-2018