



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



FDP (Cyclone) NOC Report Dated 21st October, 2019

Time of Issue: 1200 UTC

Synoptic features:

- The Low Pressure Area over east central Arabian Sea persists over the same region at 0300 UTC of today. Associated cyclonic circulation extends upto 4.5 km above mean sea level. It is very likely to become a Well Marked Low Pressure Area over the same region during next 24 hours and is likely to concentrate into a Depression during subsequent 24 hours. It is likely to move initially north-northeastwards over eastcentral Arabian Sea till 24th October and then west-northwestwards with gradual intensification.
- Another Low Pressure Area is likely to form over southwest & adjoining westcentral Bay of Bengal off north Tamilnadu and south Andhra Pradesh coasts during next 36 hours.

Dynamical and thermodynamical features

Surface Temperature (SST):

SST is > 30°C over eastern Bay of Bengal (BOB) along Myanmar coast; 29-30°C over east central and northeast Bay of Bengal & Andaman Sea; 28-30°C over rest of BOB and southeast, east central and northwest Arabian Sea.

SST is the least (26-27 °C) over west central and adjoining southwest Arabian Sea (AS) and along Oman – Yemen coasts.

Tropical Cyclone Heat Potential (TCHP):

TCHP is > 50 kJ/cm² over most parts of BOB and southeast & east central AS. There are pockets in southwest and adjoining west central BOB and over equatorial Indian Ocean (IO) and adjoining south AS, where it is 100 -120 kJ/ cm².

Over parts of the AS comprising north & west central AS, it is < 50 kJ/cm².

Relative Vorticity (at 850 hPa):

An area of cyclonic relative vorticity at 850 hPa of > 50X10⁻⁶s⁻¹ is seen over southern parts of central AS. And also over southwest BOB off Sri Lanka –South Tamil Nadu coasts.

Low level Convergence:

Lower level convergence of about 5 - 10 x 10⁻⁵s⁻¹ is seen over central AS

Lower level convergence of about 10 - 15 x 10⁻⁵s⁻¹ is seen also over south and adjoining west central BOB.

Upper level Divergence:

A zone of upper level divergence of 20x10⁻⁵ s⁻¹ is seen over Lakshadweep-Maldives area and 5-10x10⁻⁵ s⁻¹ over east central and southern parts of west central AS.

A zone of upper level divergence of 10-20x10⁻⁵ s⁻¹ is seen over south west and adjoining west central BOB and 5x10⁻⁵ s⁻¹ is seen over the rest of BOB.

Wind Shear:

Wind shear is 10-15 knots over central and adjoining south AS and increases to the north. Wind shear is 20 knots over south Andaman Sea and 10-15 knots over rest of BOB.

Wind Shear Tendency:

The wind shear is in increasing tendency over south and adjoining central AS and decreasing over north AS.

It is increasing over south BOB and neutral elsewhere.

Upper tropospheric ridge:

The upper tropospheric ridge at 200 hPa runs roughly along 16°N over the north Indian Ocean region.

Satellite observations based on INSAT imagery:

Arabian Sea:-

According to 0600 UTC satellite imagery, scattered to broken low/medium clouds with embedded intense to very intense convection is seen over central AS in association with the Low pressure area (Lopar) and over south AS and Maldives.

Bay of Bengal & Andaman Sea:-

According to 0600 UTC satellite imagery, scattered low/medium clouds with embedded intense to very intense convection is seen over west central and south BOB and Andaman Sea.

Large scale features

M.J.O. Index:

MJO index is in Phase 2 (western Indian Ocean) with amplitude more than 1. It will continue in same phase with gradual reduction in amplitude for next 6 days.

Storms and Depression over South China Sea/ South Indian Ocean: Two tropical cyclones, viz., Tropical Storm 21W "Neoguri" and Typhoon 22W "Bualoi" are located over Pacific Ocean.

NWP Input for FDP Cyclone based on 0000 UTC of today

IMD-GFS T-1534

- (i) Indicates : Well marked Low pressure area (WML) over west central AS on 21st, extended low over central AS on 22nd & 23rd, extended low over east central AS off south Maharashtra-Goa-Karnataka coasts on 24th, WML over east central AS off south Maharashtra-Goa coasts on 25th, Depression (D) over east central AS off south Maharashtra-Goa coasts on 26th, Cyclonic Storm (CS) over east central AS off (away from) south Maharashtra coast on 27th, Severe CS (SCS) / Very SCS (VSCS) over east central AS (west north westward movement) on 28th, VSCS over east central AS on 29th, VSCS over west central AS on 30th and 31st October.
- (ii) Indicates : An extended low over south west and adjoining west central BOB off Tamil Nadu-south Andhra Pradesh coast on 22nd, Deep Depression (DD) over west central BOB off Andhra Pradesh coast on 23rd, CS over north coastal Andhra Pradesh on 24th, Lopar over south Odisha on 25th and less marked on 26th October.

IMD-GEFS

- (i) Indicates : WML over central AS on 21st, Lopar over central AS on 22nd, extended low over east central AS off Maharashtra coast on 23rd, Lopar over east central AS off Maharashtra-Goa coast on 24th & 25th, WML over east central AS off south Maharashtra-Goa-Karnataka coasts on 26th, WML over east central and adjoining south east AS on 27th, west north westward movement and D over east central AS on 28th, west north westward movement and DD over central AS on 29th October.

(ii) Indicates : An extended low over south west and adjoining west central BOB off north Tamil Nadu -south Andhra Pradesh coasts on 22nd, Lopar over west central BOB off Andhra Pradesh coast on 23rd, WML over coastal Andhra Pradesh and adjoining west central BOB on 24th, Lopar over south Odisha on 25th, a fresh Lopar over coastal Andhra Pradesh and adjoining BOB on 26th and less marked on 27th October.

IMD-WRF

- (i) Indicates : A trough of low over central and south AS on 21st, Lopar over central AS on 21st to 24th October.
- (ii) Indicates : An extended low over southwest and adjoining west central BOB on 21st, Lopar over west central BOB on 22nd and 23rd, WML over west central BOB off north Andhra Pradesh coast on 24th October.

NCMRWF-NCUM:

- (i) Indicates : A Lopar over central AS on 21st, WML over central AS on 22nd, D over east central AS on 23rd, CS over east central AS off south Maharashtra-Goa coasts on 24th, SCS over the same region on 25th, VSCS or extremely SCS (ESCS) over the same region on 26th, ESCS over the same region on 27th, moving west north westwards over east central AS as ESCS on 28th, ESCS over north AS on 29th, cross Pakistan coast on weakens on 30th and over Pakistan and adjoining west Rajasthan as a DD on 31st October.
- (ii) Indicates : Lopar over west central and adjoining south west BOB off north Tamil Nadu-south Andhra Pradesh coast on 22nd, WML over west central BOB off south Andhra Pradesh coast on 23rd, D over west central BOB Andhra Pradesh coast on 24th, CS over west central BOB off north Andhra Pradesh coast on 25th, CS over West Bengal coast on 26th and weakens in to Lopar over Bangladesh on 27th October.

NCMRWF-UM-Regional Model:

- (i) Indicates : Lopar over central AS on 21st and 22nd, WML over east central AS off south Maharashtra coast on 23rd, D over the same region on 24th October.
- (ii) Indicates : Lopar over west central BOB on 23rd, WML over west central BOB off south Andhra Pradesh coast on 24th October.

NEPS Model:

- (i) Indicates : Lopar over central AS on 21st, WML over central AS on 22nd, D over east central AS on 23rd, CS over east central AS off south Maharashtra coast on 24th SCS over east central AS off south Maharashtra-Goa-Karnataka coasts on 25th, VSCS/ESCS over the same region on 26th, ESCS (westward movement) over east central AS on 27th, further west north westward movement as ESCS up to 29th and over Pakistan coast on 30th October.
- (ii) Indicates : Lopar over west central and adjoining south west BOB off south Andhra Pradesh -north Tamil Nadu coasts on 22nd, WML over west central and adjoining south west BOB off south Andhra Pradesh-north Tamil Nadu coasts on 23rd, D over west central BOB off Andhra Pradesh coast on 24th, CS over west central BOB off north Andhra Pradesh coast on 25th, SCS over Gangetic West Bengal on 26th, and Lopar over Bangladesh on 27th October.

ECMWF:

- (i) Indicates : A trough of low over central AS on 21st, Lopar over central AS on 22nd, D over central AS on 23rd and 24th, DD over central AS on 25th, 26th and 27th, CS/SCS over west central AS on 28th, VSCS over west central AS (west north westward movement) on 29th, VSCS close to south Oman coast over west central AS on 30th, weakens in to DD close to south Oman coast on 31st October.

- (ii) Indicates : A trough of low over west central and south west BOB off south Andhra Pradesh-Tamil Nadu coasts on 21st, less marked on 22nd, trough of low over south west BOB and adjoining Sri Lanka on 26th and 27th and less marked on 28th October.

NCEP-GFS :

- (i) Indicates : A Lobar over central AS on 22nd, Lobar over east central and adjoining west central AS on 23rd, WML over east central AS on 24th, WML over east central AS close to south Maharashtra coast on 25th, Lobar over east central AS off south Maharashtra coast on 26th, fresh Lobar over east central and adjoining south AS on 27th and 28th, WML over central and south AS on 29th, D over east central AS on 30th, persists there upto 2nd November with gradual intensification and slow movement towards south Gujarat coast during 3rd -5th November.
- (ii) Indicates : An extended low over west central and adjoining south west BOB off south Andhra Pradesh-north Tamil Nadu coasts on 22nd, extended low over west central BOB off Andhra Pradesh coast on 23rd, extended low over coastal Andhra Pradesh and a trough of low over central parts of south BOB on 24th, Lobar over interior Odisha and adjoining Chhattisgarh on 25th, a fresh Lobar over Lobar over east equatorial IO and adjoining south west BOB off Sri Lanka coast on 26th, trough of low over south west BOB off Sri Lanka-Tamil Nadu coasts on 27th and 28th, Lobar over north Tamil Nadu coast on 29th, and less marked on 30th October.

ARP-Meteo France :

- (i) Lobar over central AS on 21st, WML over central 22nd and 23rd, extended low over central AS on 24th October.
- (ii) Lobar over west central BOB on 22nd, WML over west central BOB and adjoining coastal Andhra Pradesh on 23rd, WML over north coastal Andhra Pradesh-south Odisha on 24th October.

Dynamical statistical models

IMD Genesis Potential Parameter (GPP):

- (i) Significant zone of GPP seen over central AS on 21st, disorganized on 22nd and 23rd, and extended zone over east central AS on 24th, a compact zone over east central AS to the west of Goa-Karnataka coasts on 25th, persists more close to Go-south Maharashtra coasts on 26th, over east central AS but away from the coast on 27th and 28th October.
- (ii) A circular but less potential zone over west central BOB off Andhra Pradesh coast on 24th, nil on 25th, a fresh zone appears over east equatorial IO off south Sri Lanka coast on 26th, weakens on 27th and seen over south west BOB off Tamil Nadu coast on 28th October.

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:

Arabian sea:

ECMWF, NEPS and NCUM are showing formation of a depression by 23rd and its intensification in to cyclonic storm by 25th and further intensification thereafter. IMDGFS also is showing depression on 25th and cyclonic storm and further intensification thereafter. NCEP GFS & GFS forecast is only up to depression stage. Hence, majority of models suggest that a depression will form around 23rd oct over eastcentral Arabian Sea. Given the

climatology and dynamical parameters such as poleward out flow, anticyclonic shear suggest that it may intensify into a cyclone. Further, 29-30°C sea surface temperature over most parts of eastcentral Arabian Sea and >80 kJ/cm² tropical cyclone heat potential over eastcentral Arabian Sea area are favorable for cyclogenesis and its further intensification. Most of the models agree for northeast ward movement initially towards Maharashtra coast till 24th and then west northwestward movement.

The MJO lies in the phase 2 with amplitude >1. It will remain in the same phase during next 6 days. It is favorable for genesis and intensification of the system over the Arabian Sea.

Bay of Bengal:

A majority of the models are also indicating genesis of low around 23rd. Oct. A few models like IMDGFS and NCUM suggest further intensification. However all the models suggest the movement of this low pressure system from southwest and adjoining westcentral Bay of Bengal north-northwestwards towards Andhra Pradesh coast.

Probability of cyclogenesis over Bay of Bengal and Andaman Sea during next 120 hours:

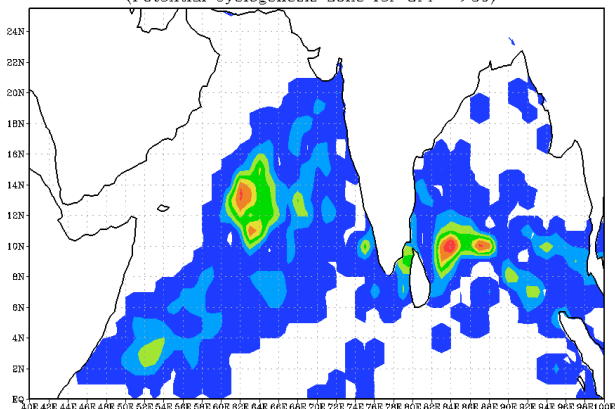
24 HOURS	24-48 HOURS	48-72 HOURS	72-96 HOURS	96-120 HOURS
Nil	Nil	Nil	Low	Low

Probability of cyclogenesis over Arabian Sea during next 120 hours:

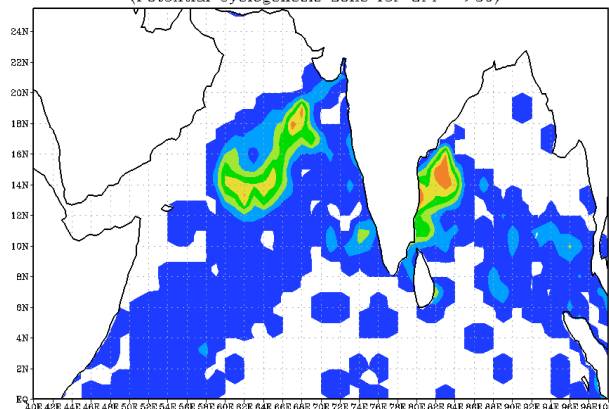
24 HOURS	24-48 HOURS	48-72 HOURS	72-96 HOURS	96-120 HOURS
Nil	Low	Moderate	High	High

Advisory: No IOP area for the next 5 days.

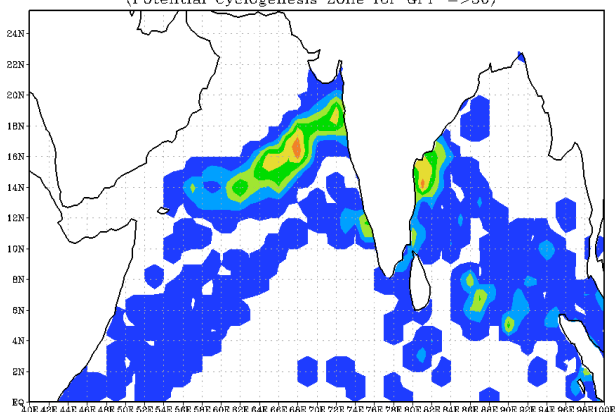
Tropical Cyclone Genesis Potential Parameter(GPP) (ANALYSIS)
Based on 21-10-2019 valid for 0000 UTC of 21-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



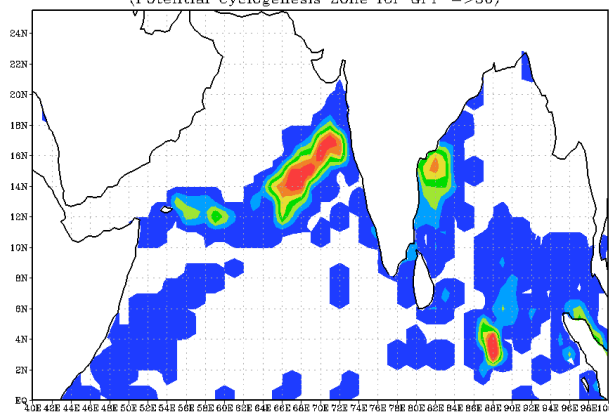
Tropical Cyclone Genesis Potential Parameter(GPP) (24 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 22-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



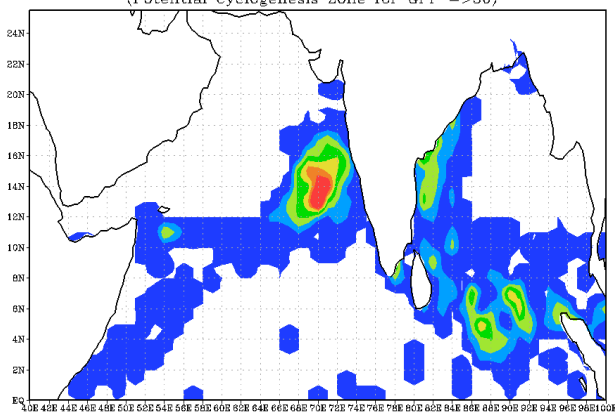
Tropical Cyclone Genesis Potential Parameter(GPP) (48 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 23-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



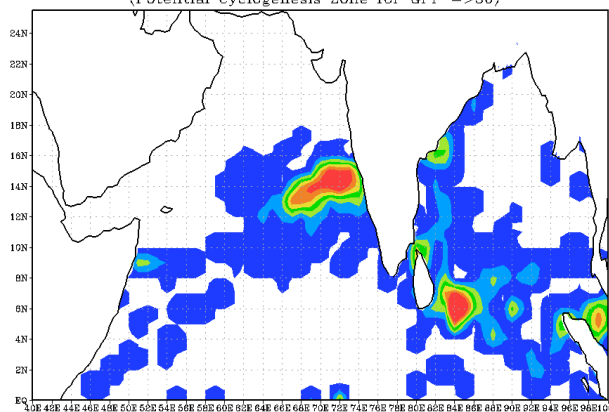
Tropical Cyclone Genesis Potential Parameter(GPP) (72 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 24-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



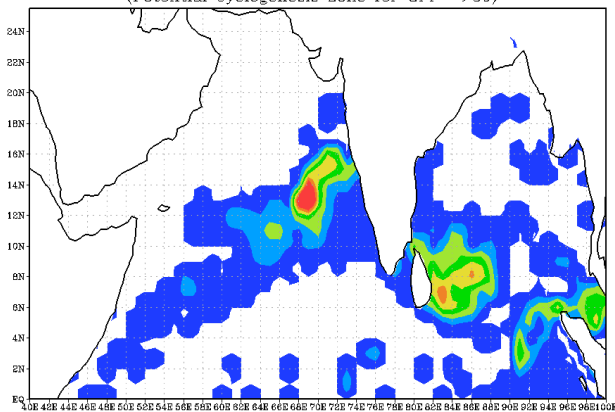
Tropical Cyclone Genesis Potential Parameter(GPP) (96 HR FORECAST)
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(Potential Cyclogenesis Zone for GPP =>30)



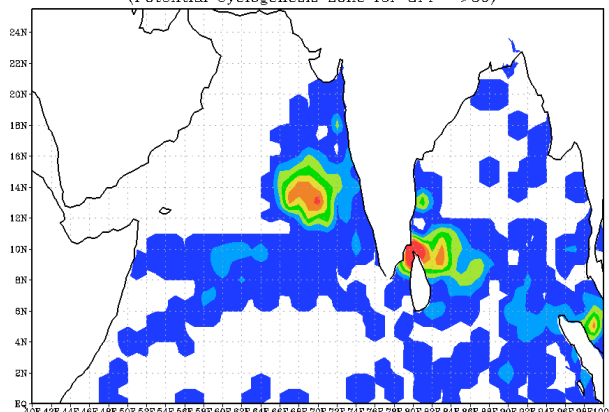
Tropical Cyclone Genesis Potential Parameter(GPP) (120 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 26-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



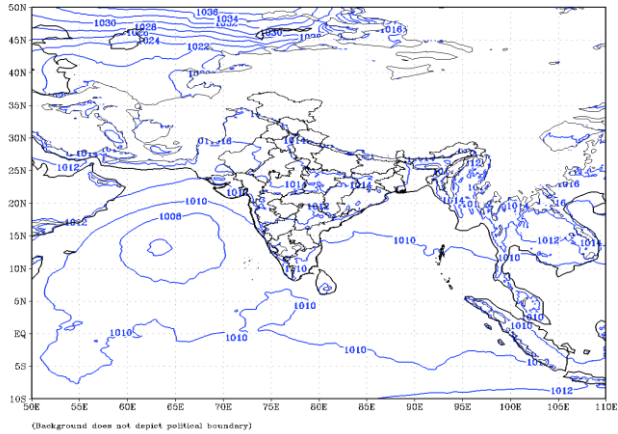
Tropical Cyclone Genesis Potential Parameter(GPP) (144 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 27-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



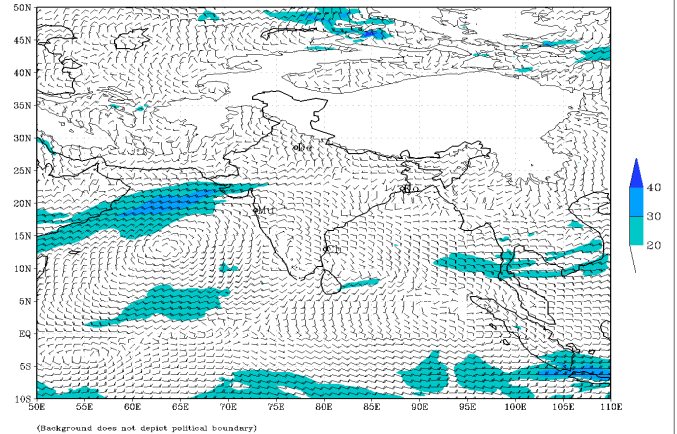
Tropical Cyclone Genesis Potential Parameter(GPP) (168 HR FORECAST)
Based on 21-10-2019 valid for 0000 UTC of 28-10-2019
(Potential Cyclogenesis Zone for GPP =>30)



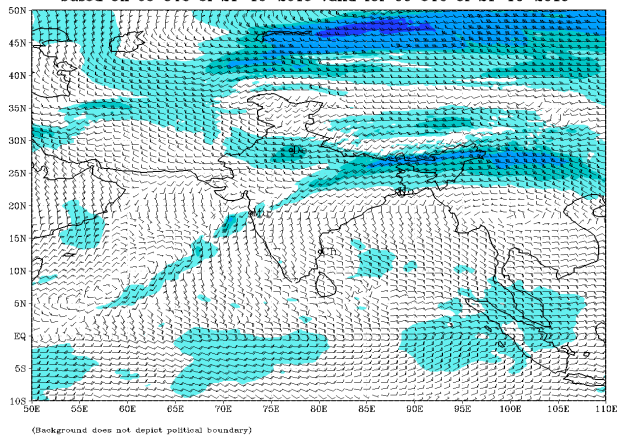
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 21-10-2019



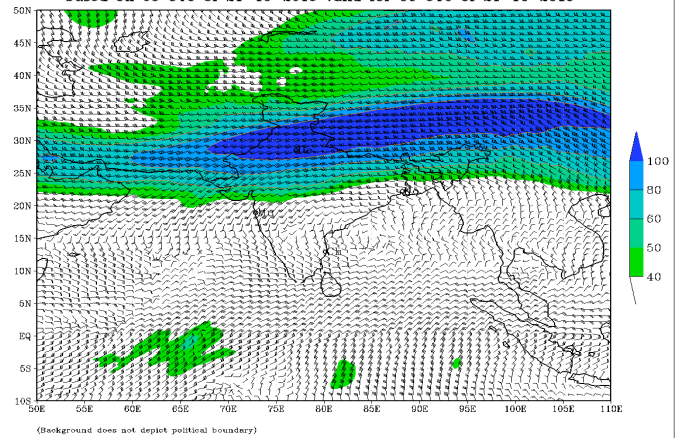
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 21-10-2019



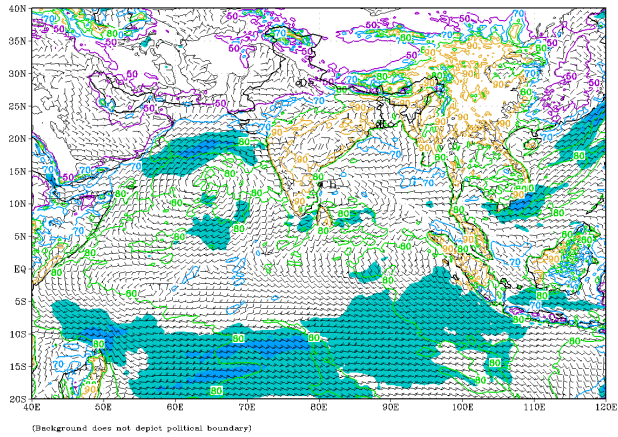
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 21-10-2019



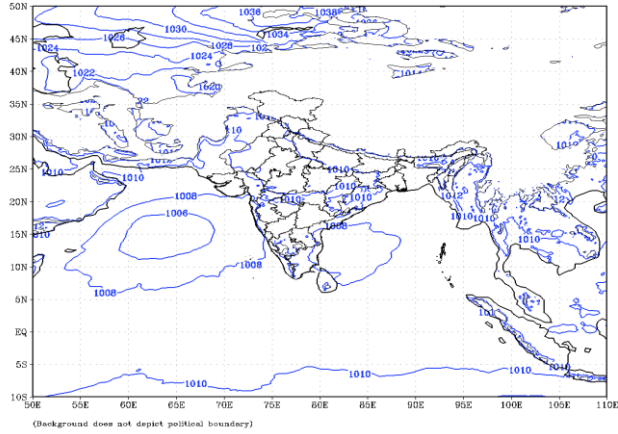
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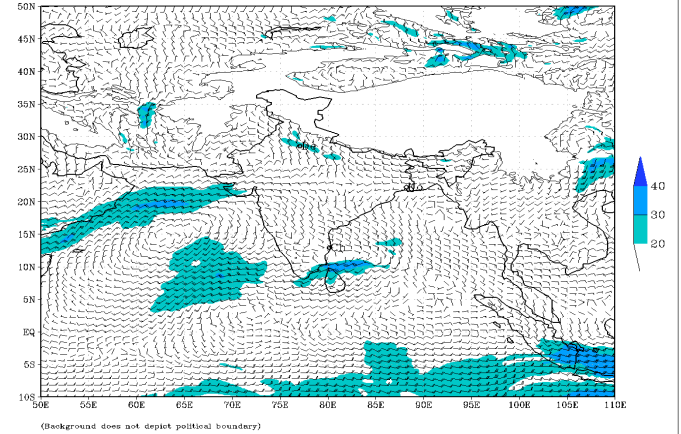
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (00 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 21-10-2019



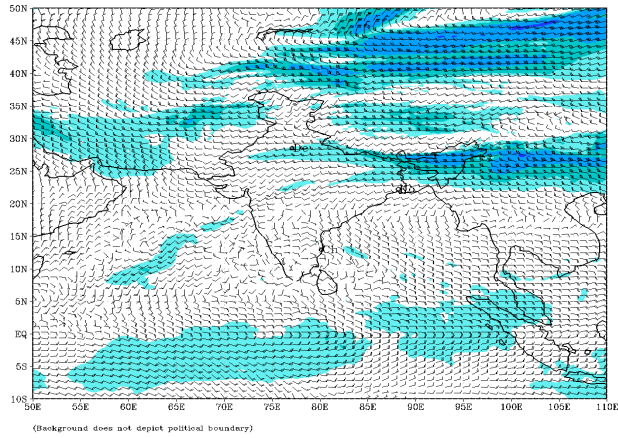
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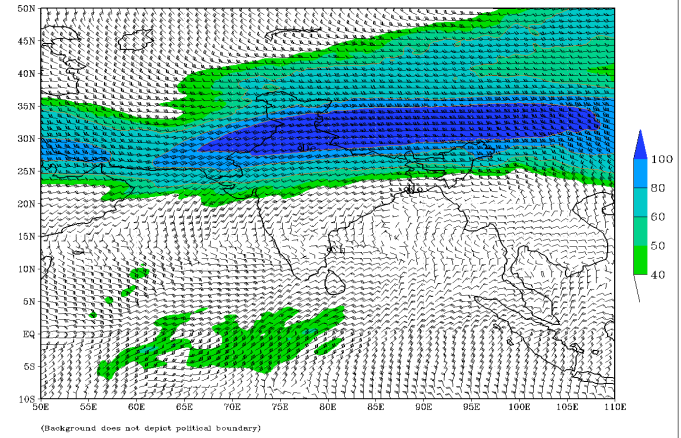
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 22-10-2019



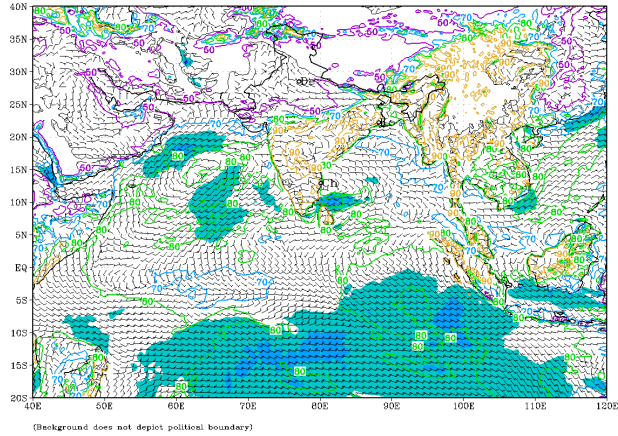
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 22-10-2019



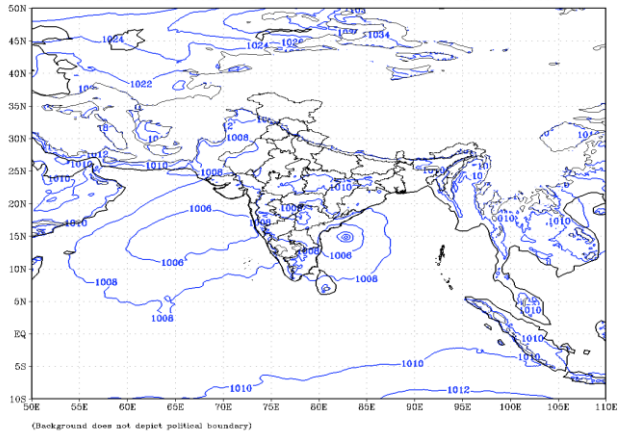
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 22-10-2019



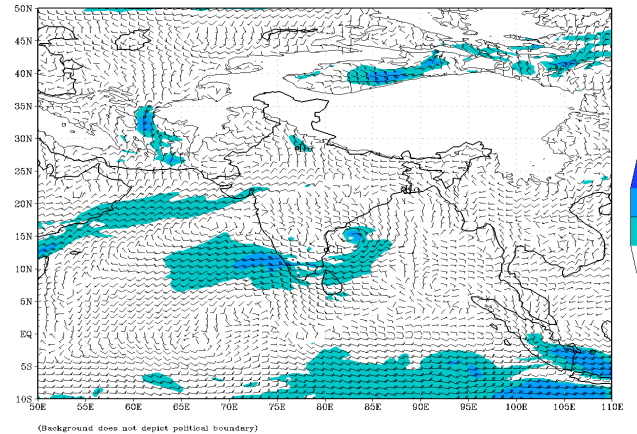
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (24 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 22-10-2019



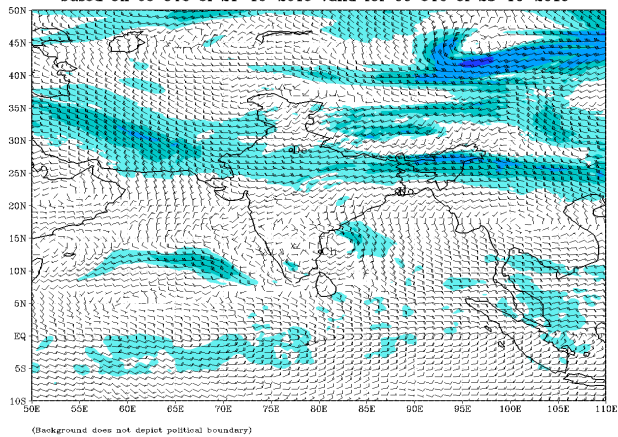
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 23-10-2019



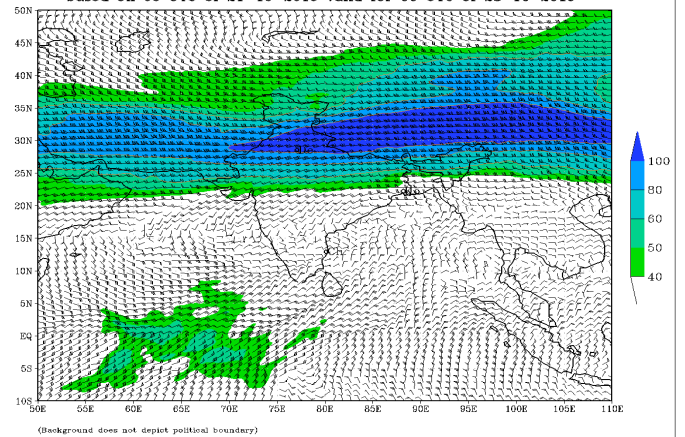
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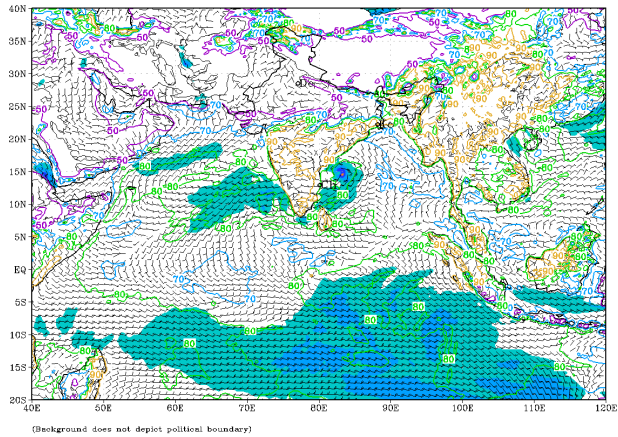
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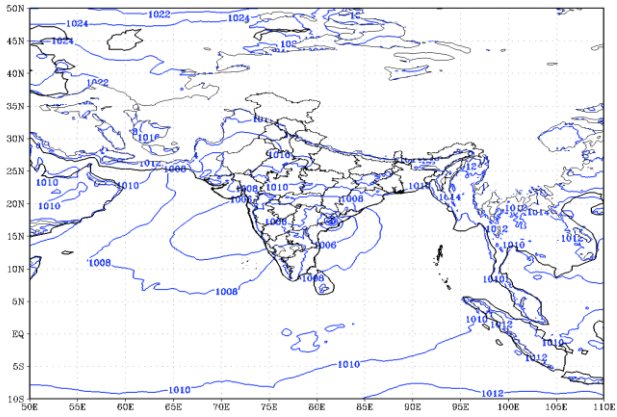
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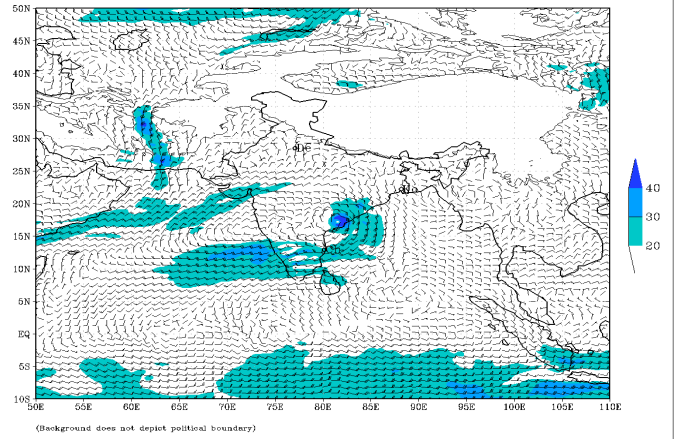
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (48 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 23-10-2019



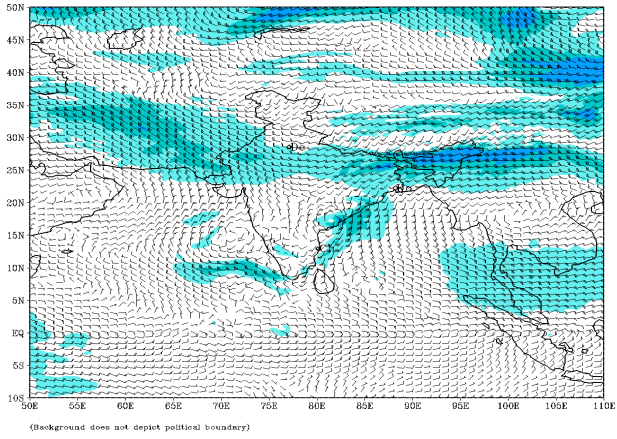
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 24-10-2019



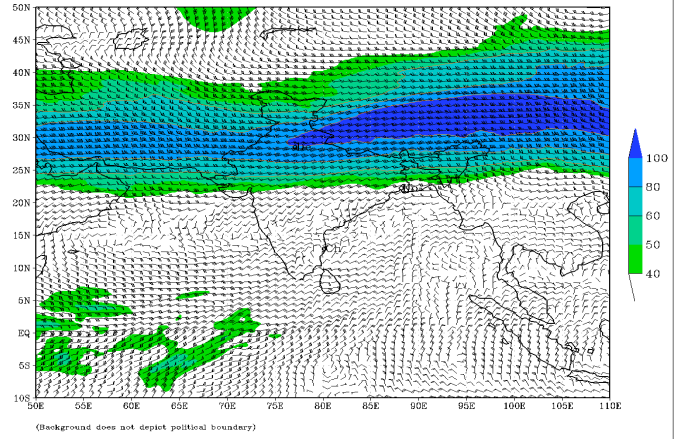
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 24-10-2019



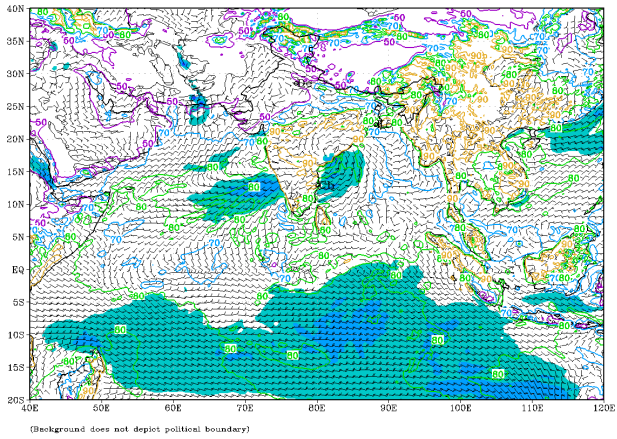
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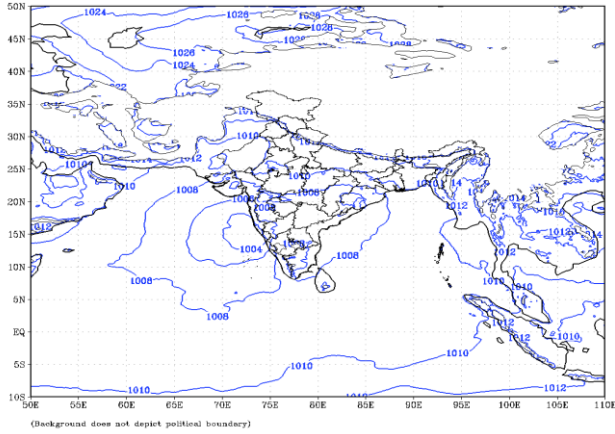
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based on 00 UTC of 21-10-2019 valid for 00 UTC of 24-10-2019



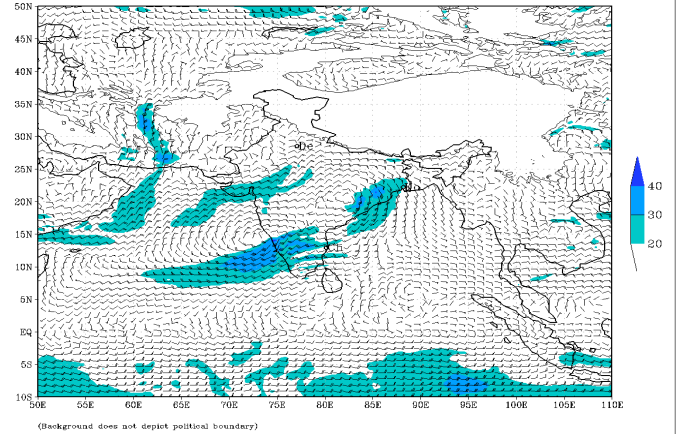
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (72 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 24-10-2019



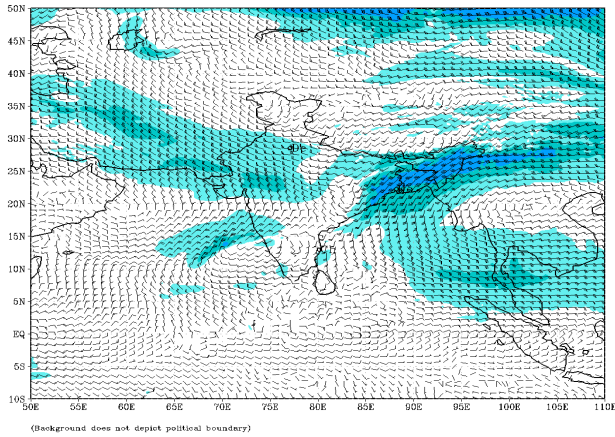
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (96 HR)
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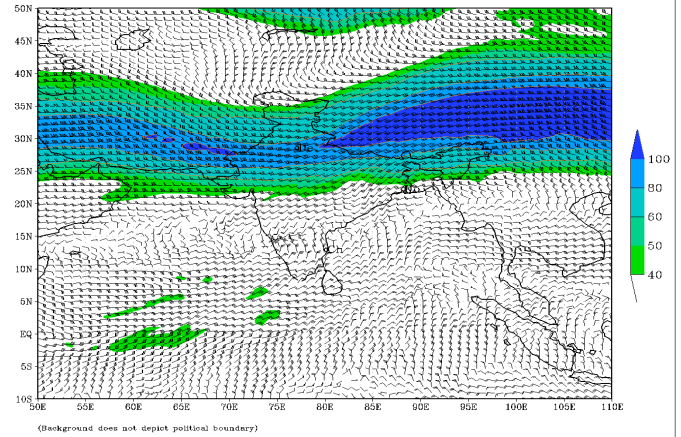
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 based on 00 UTC of 21-10-2019 valid for 00 UTC of 25-10-2019



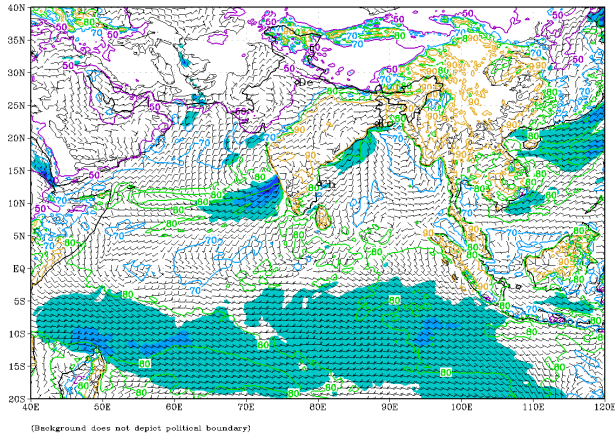
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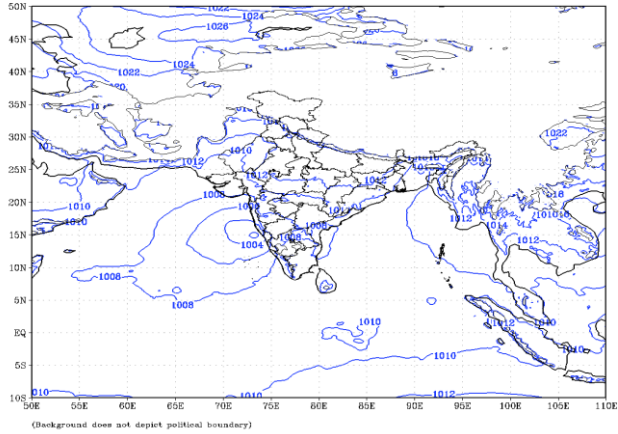
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 based on 00 UTC of 21-10-2019 valid for 00 UTC of 25-10-2019



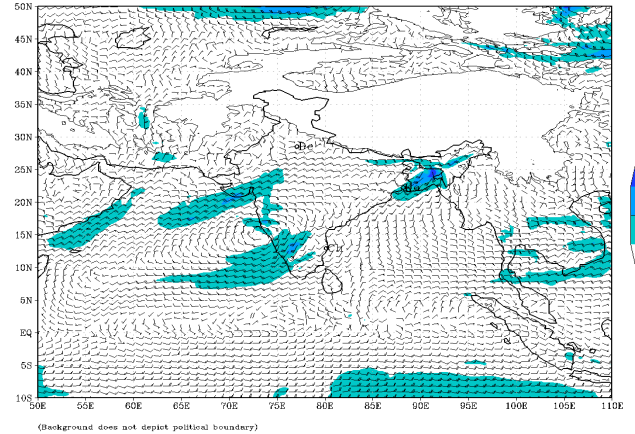
IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (96 HR)
 based on 00 UTC of 21-10-2019 valid for 00 UTC of 25-10-2019



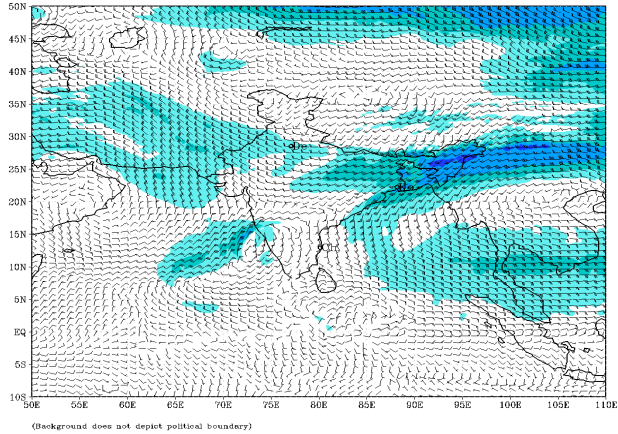
IMD :GFS MODEL(12 Km) MSL Pressure (hPa) FORECAST (120 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 26-10-2019



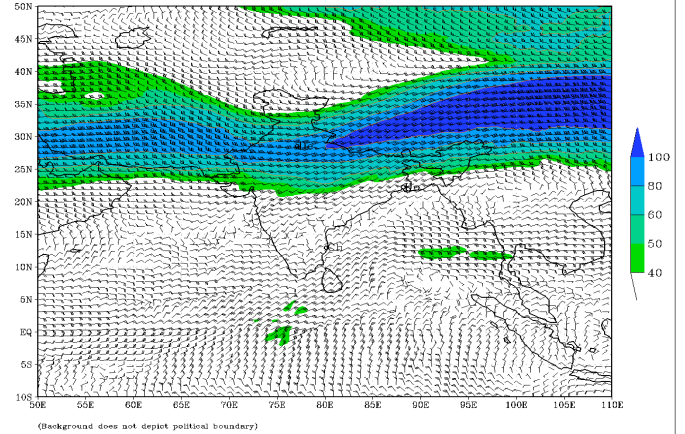
IMD:GFS MODEL(12 Km) 850 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 26-10-2019



IMD:GFS MODEL(12 Km) 500 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 26-10-2019



IMD :GFS MODEL(12 Km) 200 hPa WIND (kt) FORECAST (120 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 26-10-2019



IMD GFS (T1534) 10m WIND (kt) AND 2m RH (%) FORECAST (120 HR)
based on 00 UTC of 21-10-2019 valid for 00 UTC of 26-10-2019

