

# **Mean Sea Level Pressure and Wind Climatology over the North Indian Ocean: Quality control, Validation and Biases**

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# Introduction

- India is a WMO responsible country for the Marine Climatological work.
- So far, IMD had published:
  - annual summaries for the period 1961-1970
  - decadal summaries for the period 1971-1980.
- Recently, IMD completed a Marine Climatological Atlas of Indian Ocean using marine data of 1961-1900.



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GOVERNMENT OF INDIA  
भारत मौसम विज्ञान विभाग  
INDIA METEOROLOGICAL DEPARTMENT

# MARINE CLIMATOLOGICAL ATLAS

1961 - 1990

# List of parameters

- Air Temperature
- Sea surface temperature
- Air-Sea surface temp difference
- Dew Point Temperature
- MSL Pressure
- Wind Direction
- Wind Speed
- Gale Wind
- Low Cloud amount
- Total Cloud amount
- Mean Wave Height
- Wave Height > 4.0 m
- Maximum Wave Height
- Mean Wave Period
- Visibility

# Data Sources

- The data used to prepare the Atlas were obtained from two sources:
  - Observations recorded in the meteorological log books by Indian Voluntary Observing Fleet.
  - Observations made by other ships in the Indian area of responsibility and sent to IMD by other WMO members in the IMMPC/IMMT formats.
- All the observations available with IMD for the period 1961-1990 have been used for the preparation.

# Quality Control

- Data were scrutinized to eliminate instrumental, positional and coding errors.
- Data were further subjected to quality control as per the WMO guidelines
  - Duplicate observations were eliminated.
  - Internal consistency checks were done.
  - Extreme value checks were done.

# Analysis Methods

- The area of responsibility is divided into boxes with constant grid spacing of 2.5 degree in latitude and longitude.
- All available quality controlled observations were averaged in each boxes for each month during the 30 year period.
- The raw monthly mean fields were then objectively analyzed to filter out spatial noise.

# Analysis Methods

- The objective analysis scheme is an iterative difference-correction scheme with a weight function. The Barnes weight function is defined as

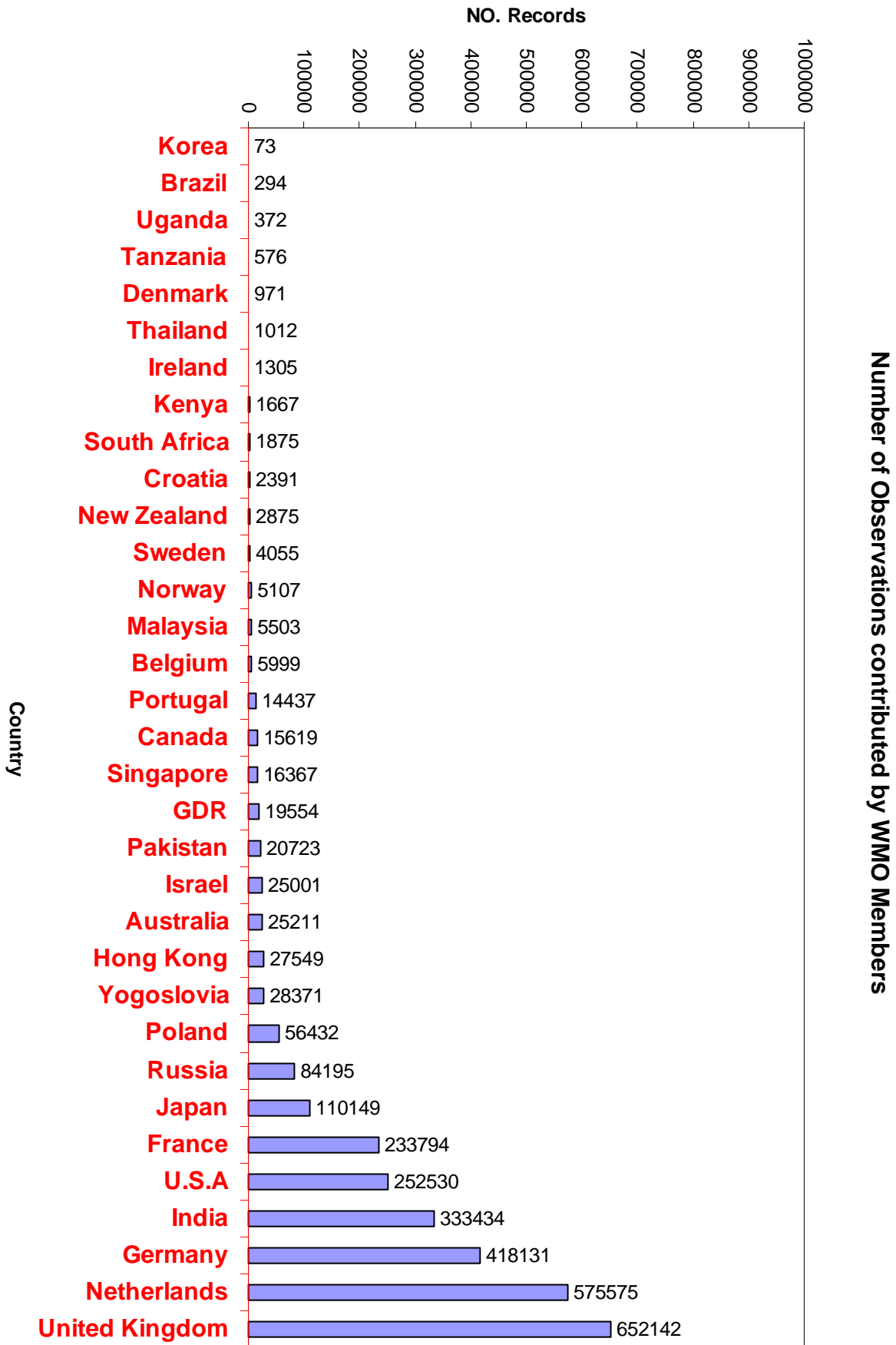
$$W = \exp(-4 r^2 R^{-2}) \text{ for } r < R$$

Where  $r$  is the distance between the grid point and analysis grid point.  $R$  is the radius of influence. It was decreased with each pass in order to analyze smaller scale features with each successive iteration.

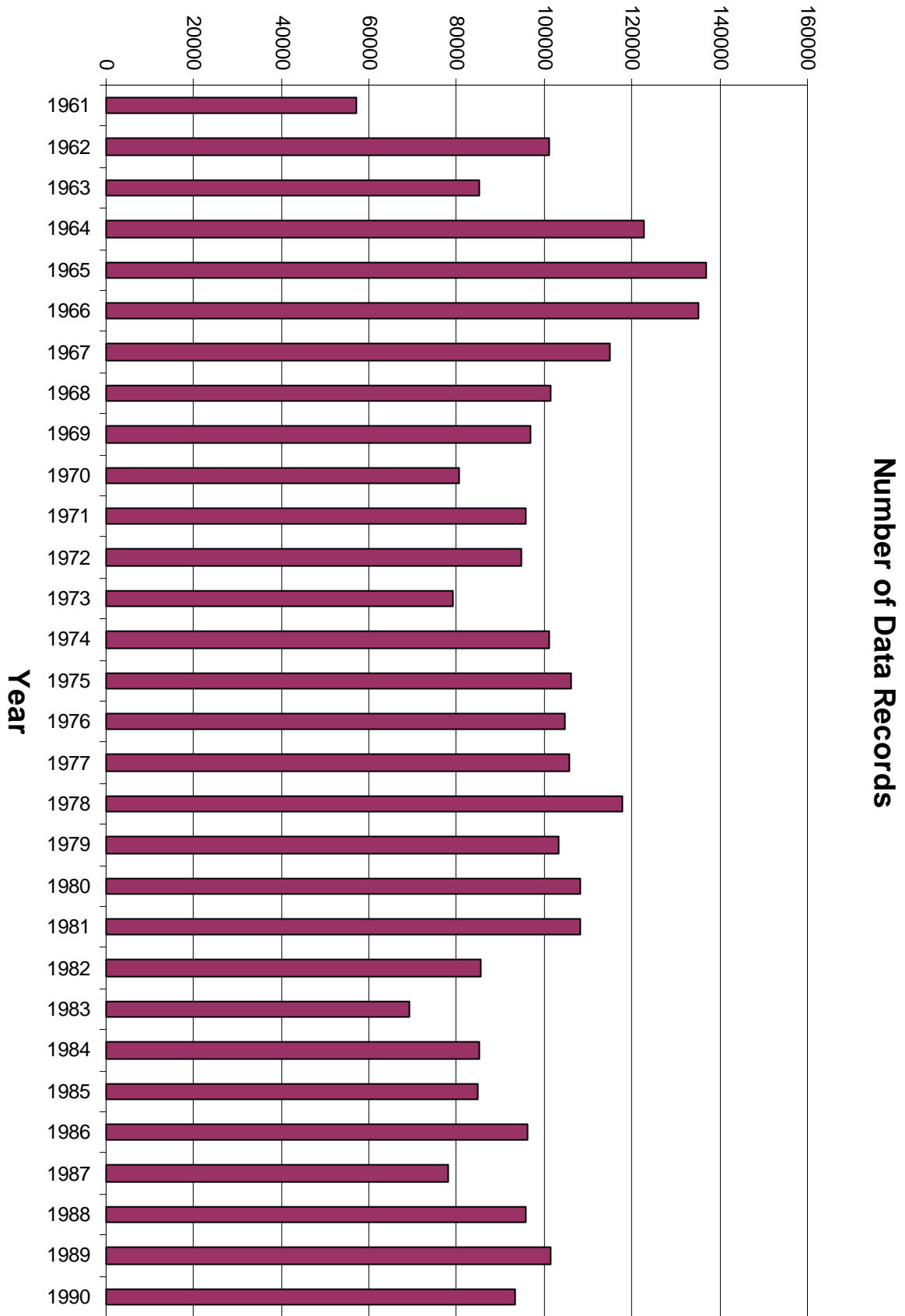


# Analysis Method

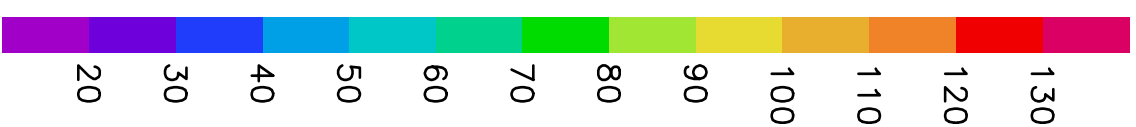
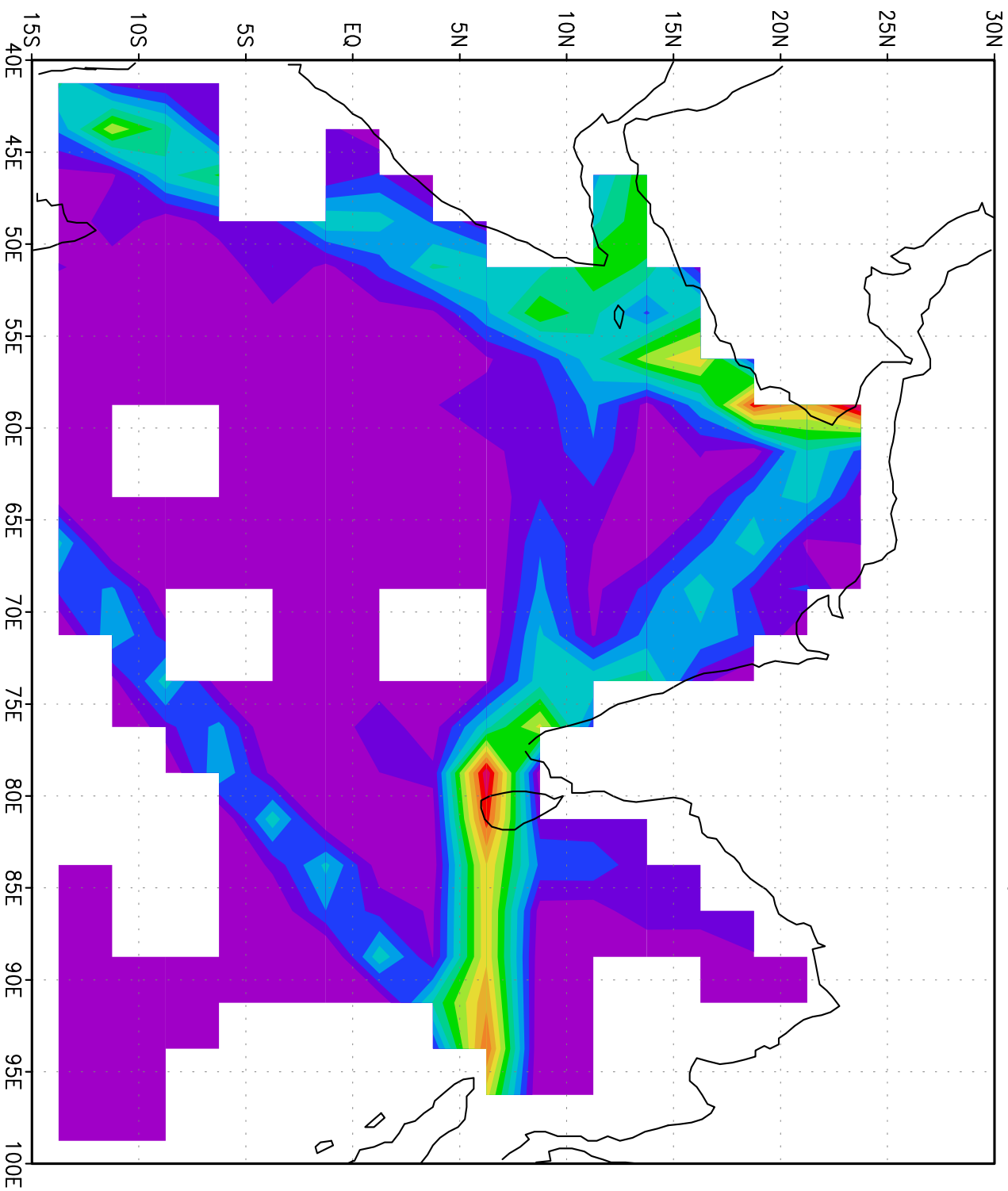
- Resultant Climatology of MSL Pressure and winds was compared with other data sets.
- The data sets considered for comparison are:
  - NCEP/NCAR reanalysis
  - UK Met office GMSLP
  - SSMI wind speed



# Data Records



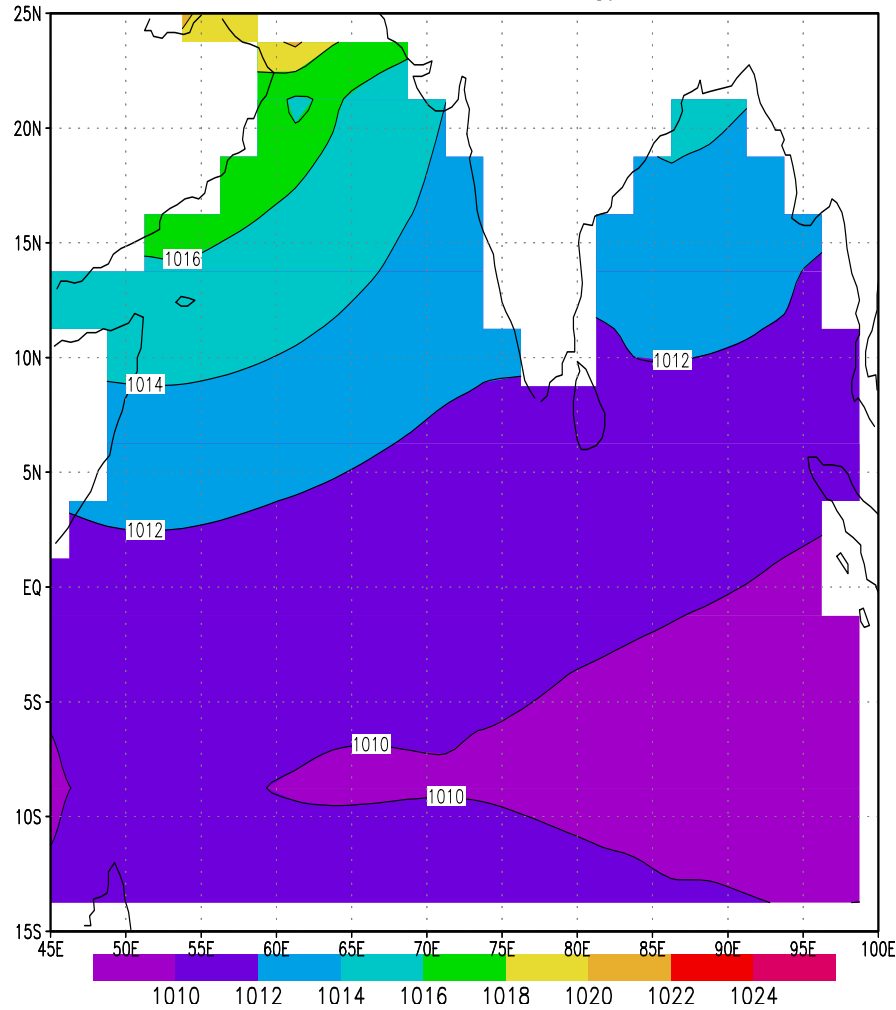
# Number of Records : July



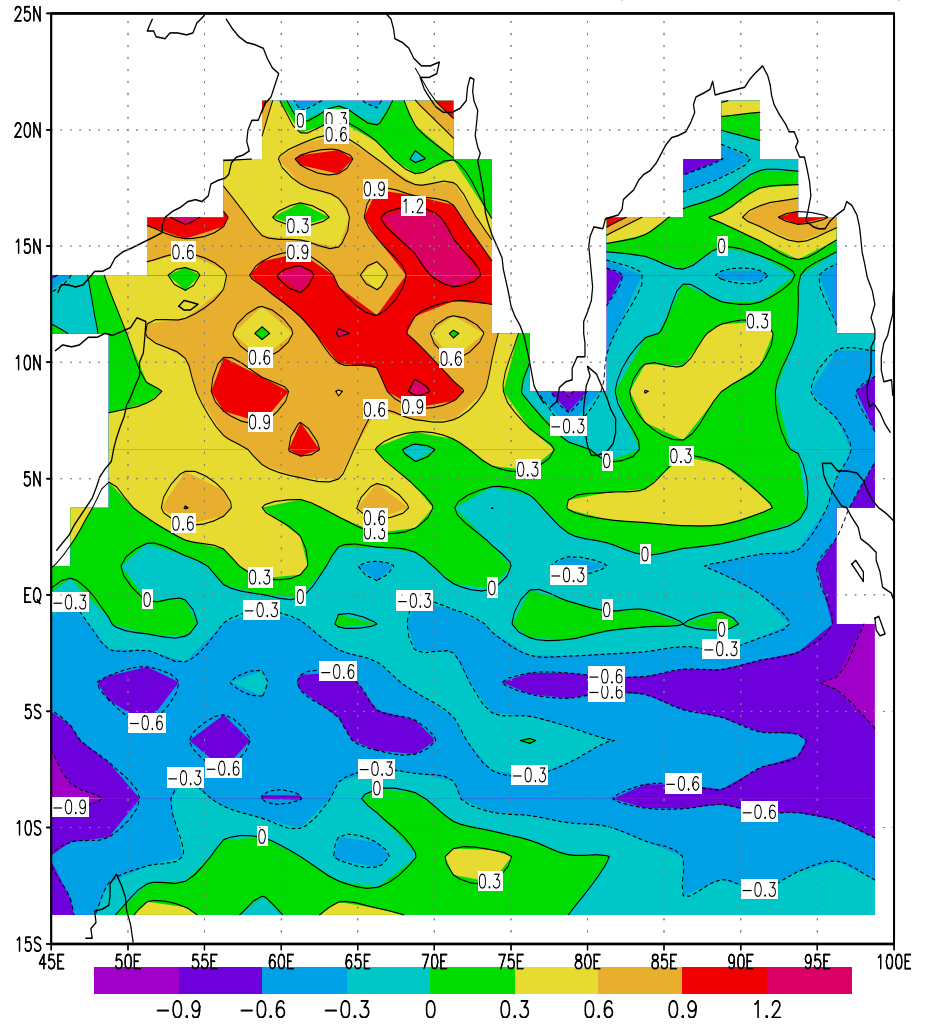
# MSL Pressure

# MSL Pressure : Winter

MSL Pressure Climatology : DJF

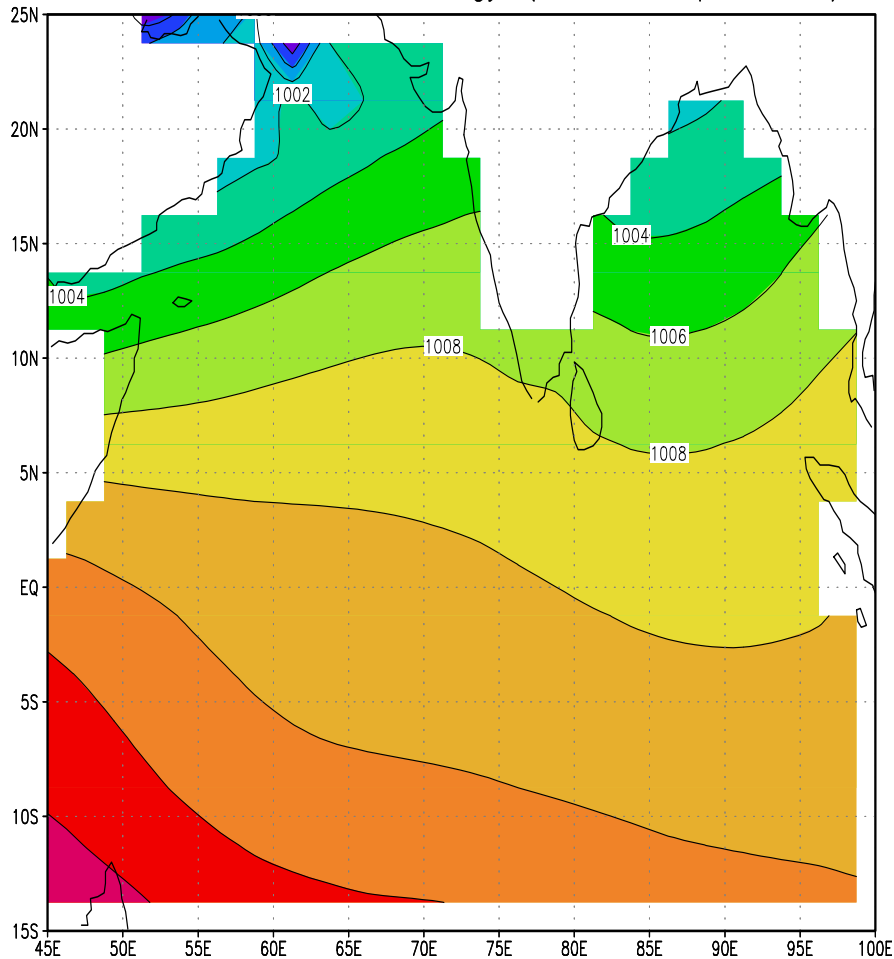


MSL Pressure Difference : Winter ( MCLIM - NCEP )

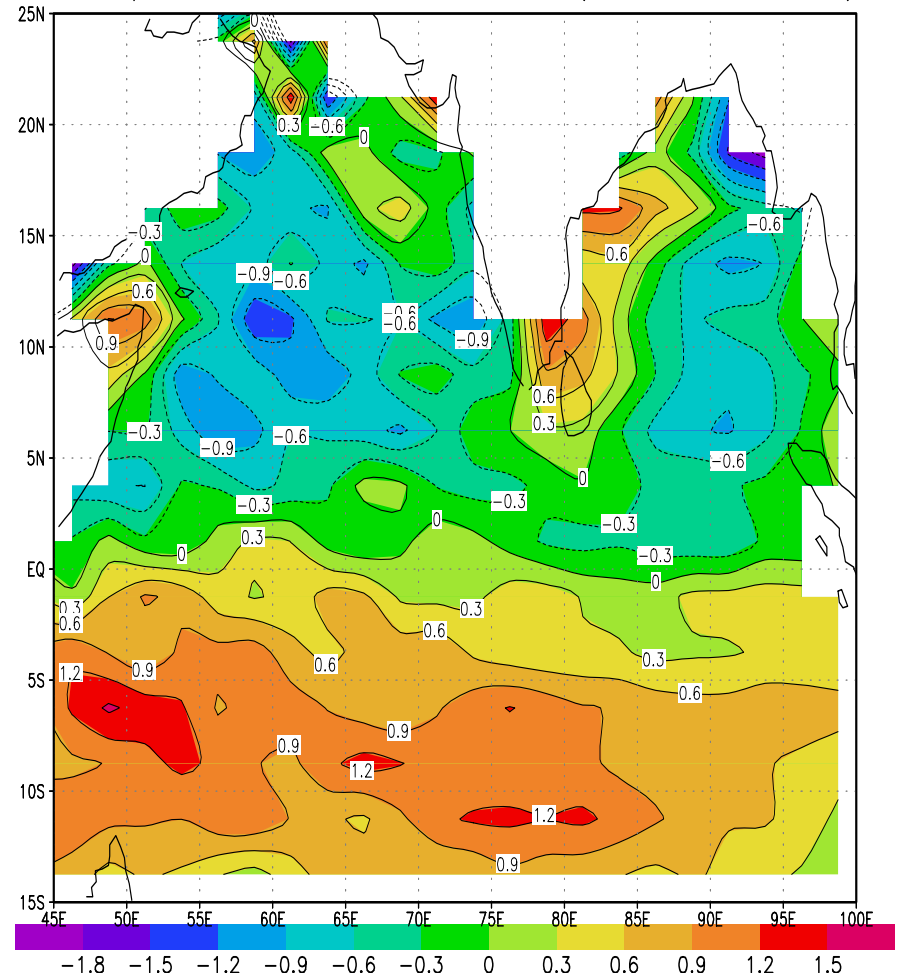


# MSL Pressure : Monsoon Season

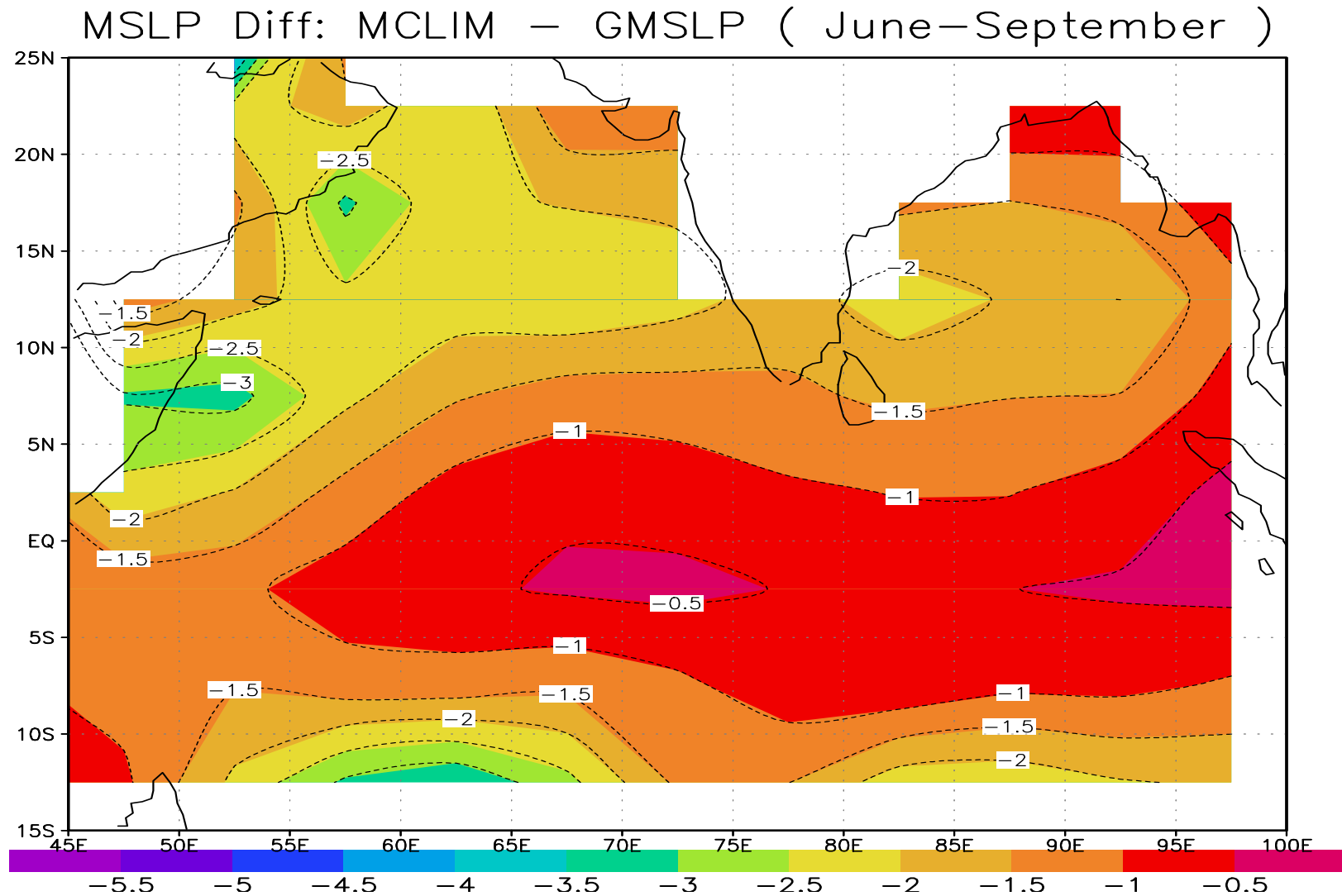
MSL Pressure Climatology ( June–September)



MSL pressure Difference : JJAS ( MCLIM – NCEP)

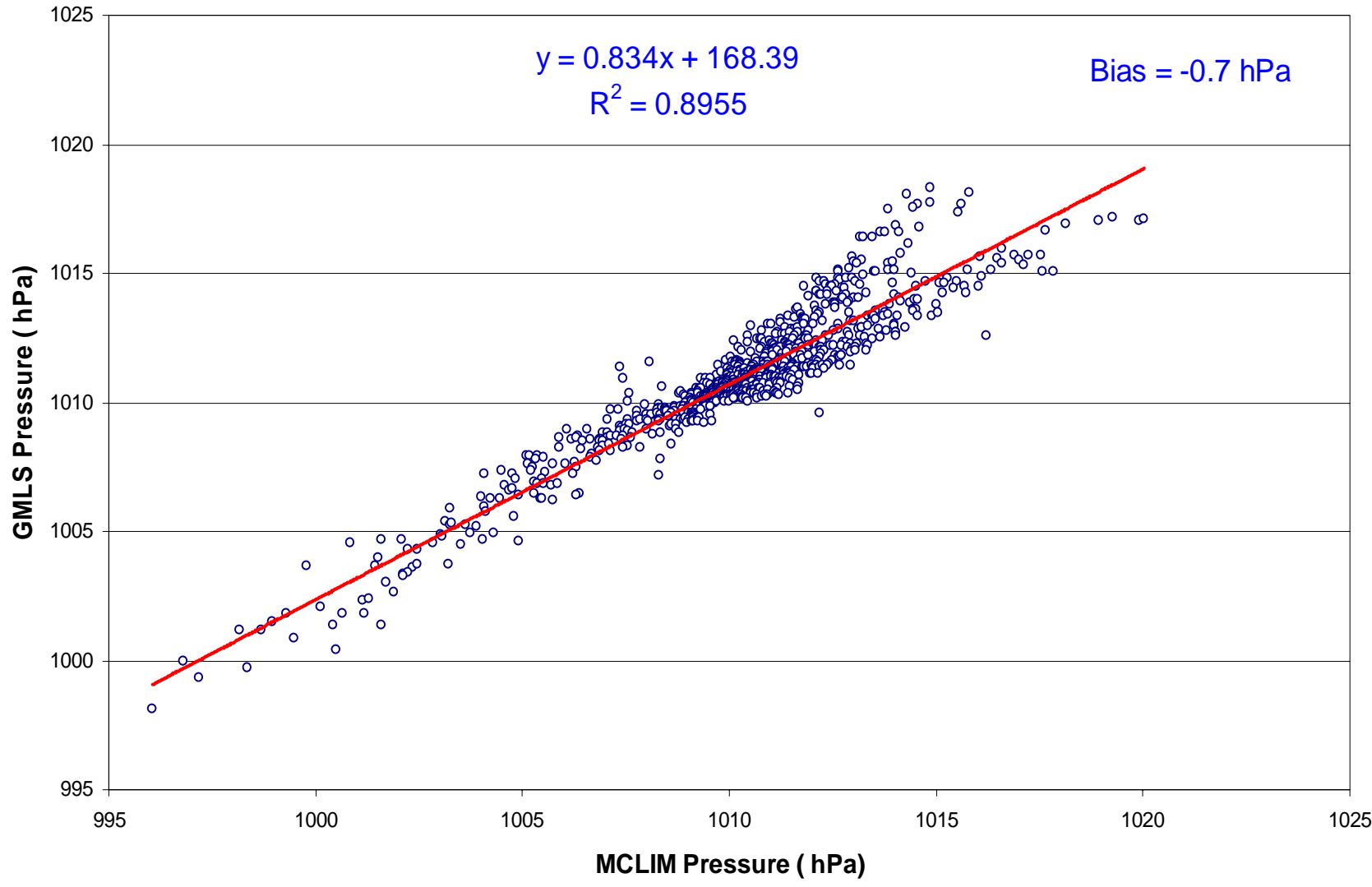


# MSL Pressure : Monsoon Season





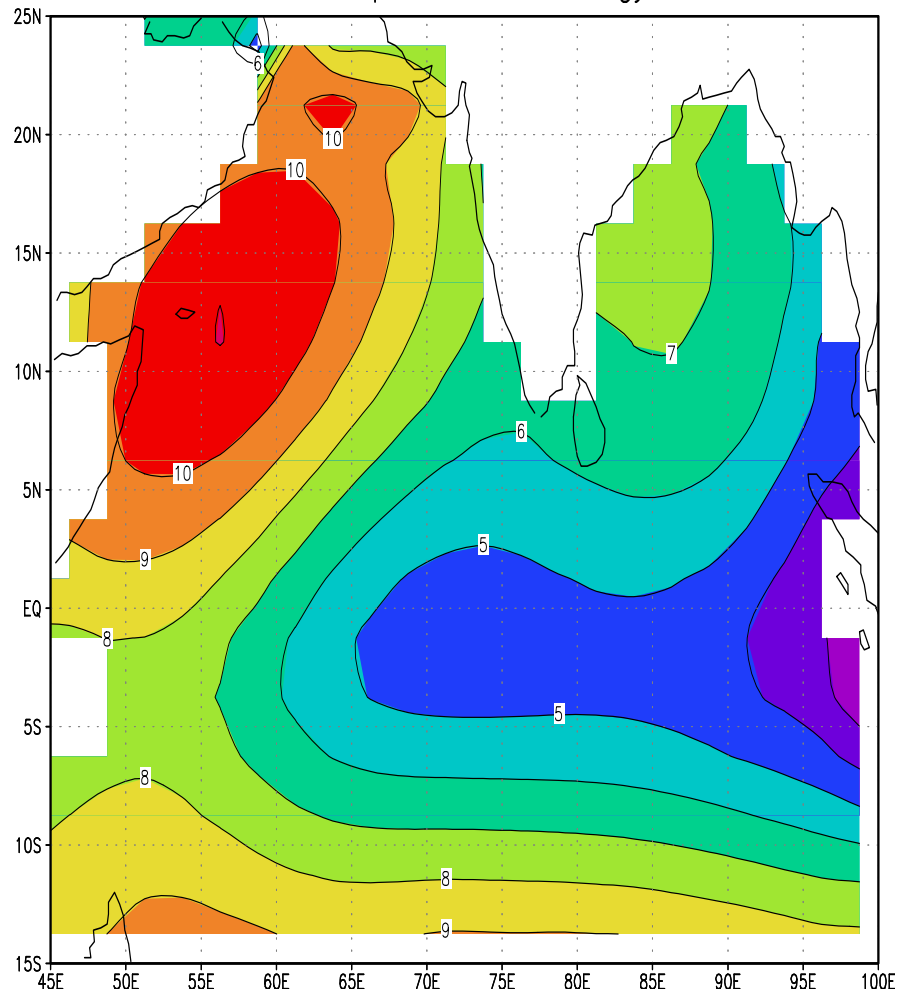
**Comparison of MCLIM and GMSLP DATA**



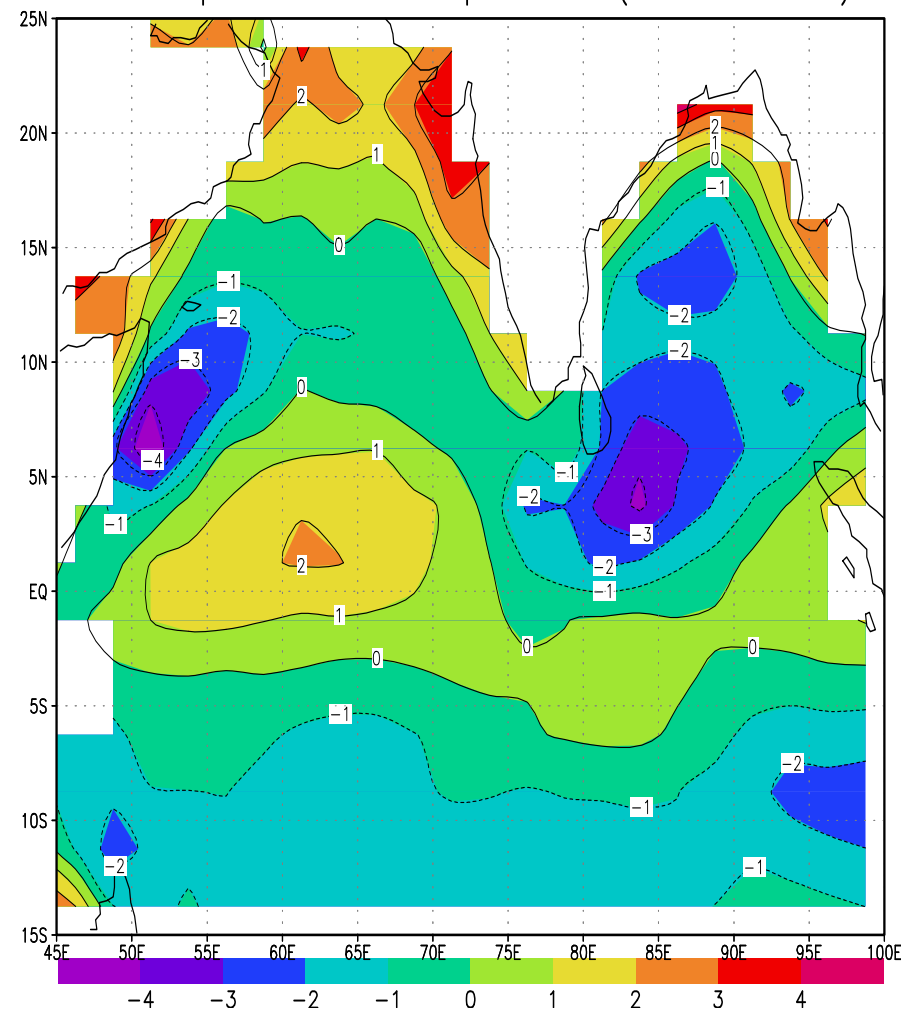
Wind

# Wind Speed : Monsoon Season

Mean Wind Speed Climatology : JJAS

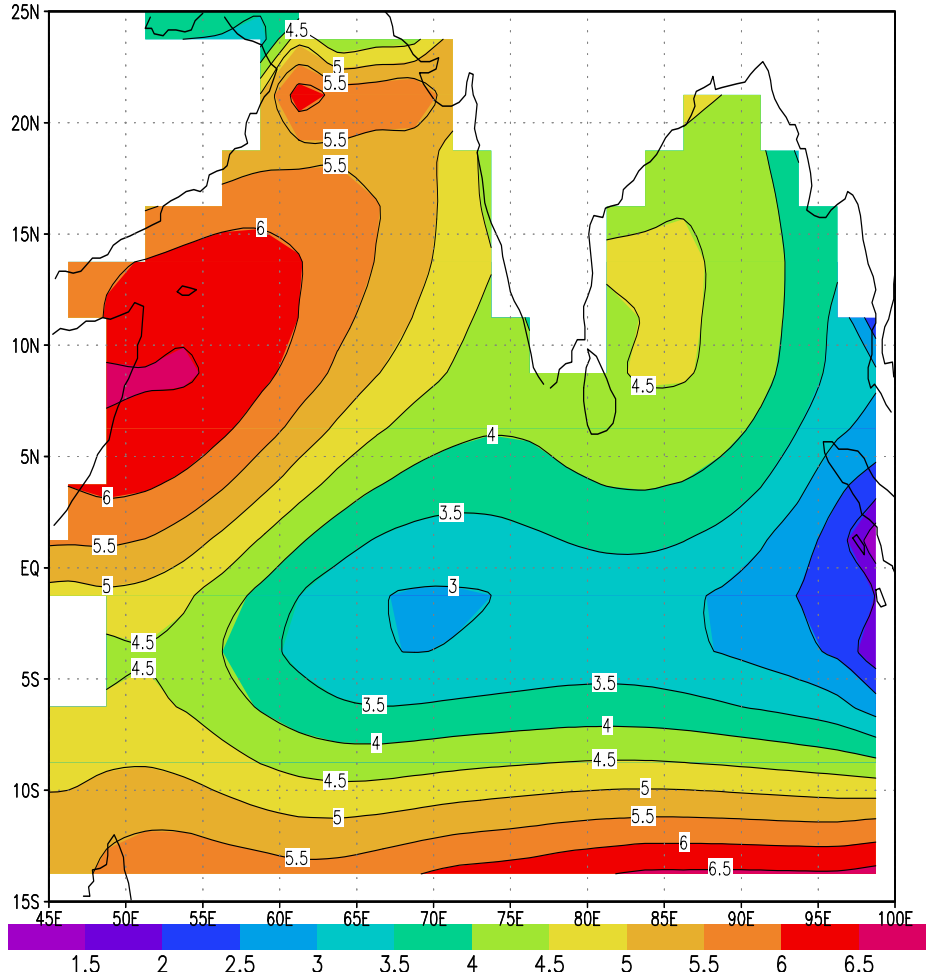


Wind Speed : June–September (MCLIM–NCEP)

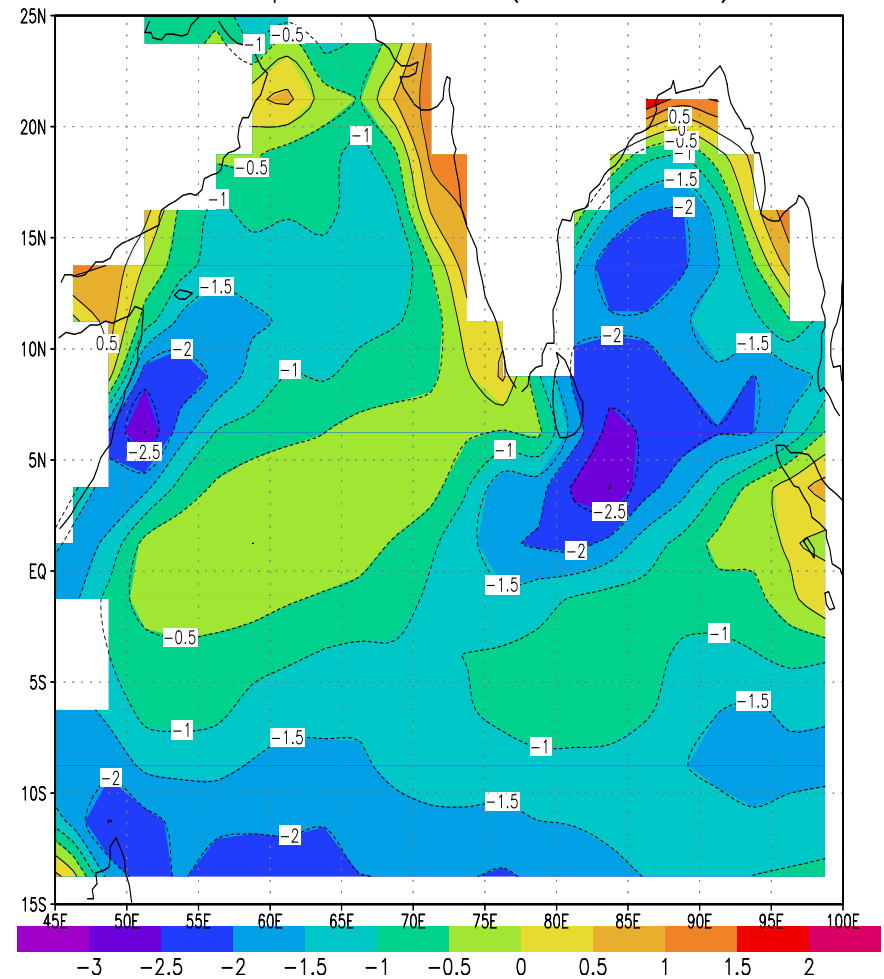


# Wind Speed : Annual

Mean Wind Speed Climatology : Annual

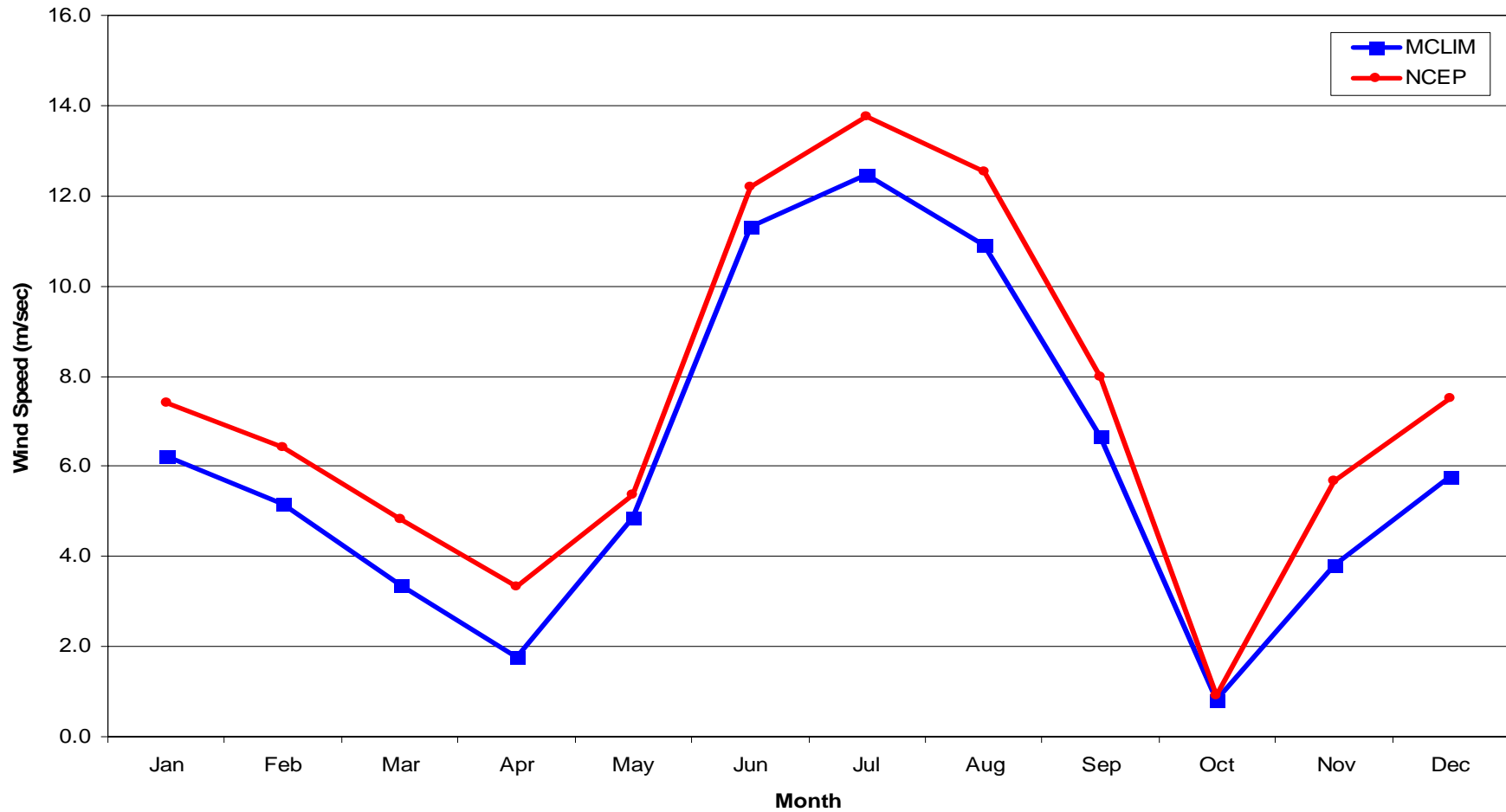


Wind Speed : Annual (MCLIM-NCEP)



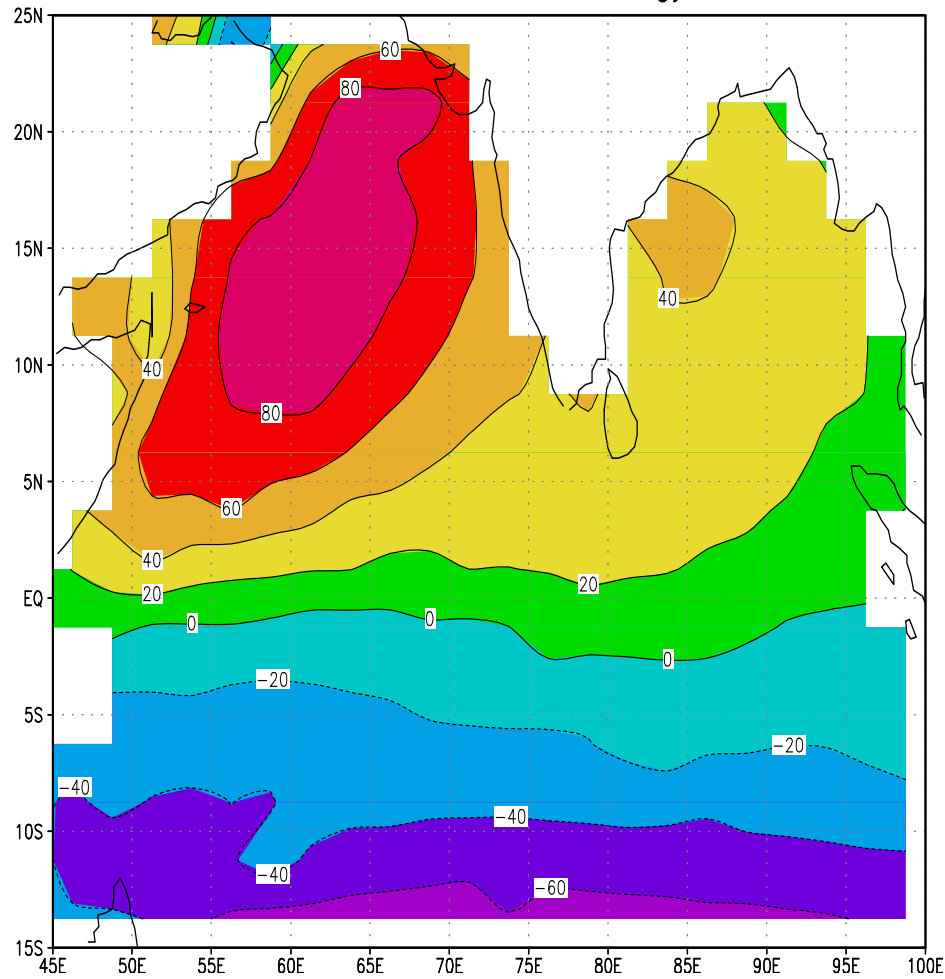
# Wind Speed: MCLIM VS NCEP

West Arabian Sea Wind Speed (50-60E, 5-12.5N) MCLIM Vs NCEP

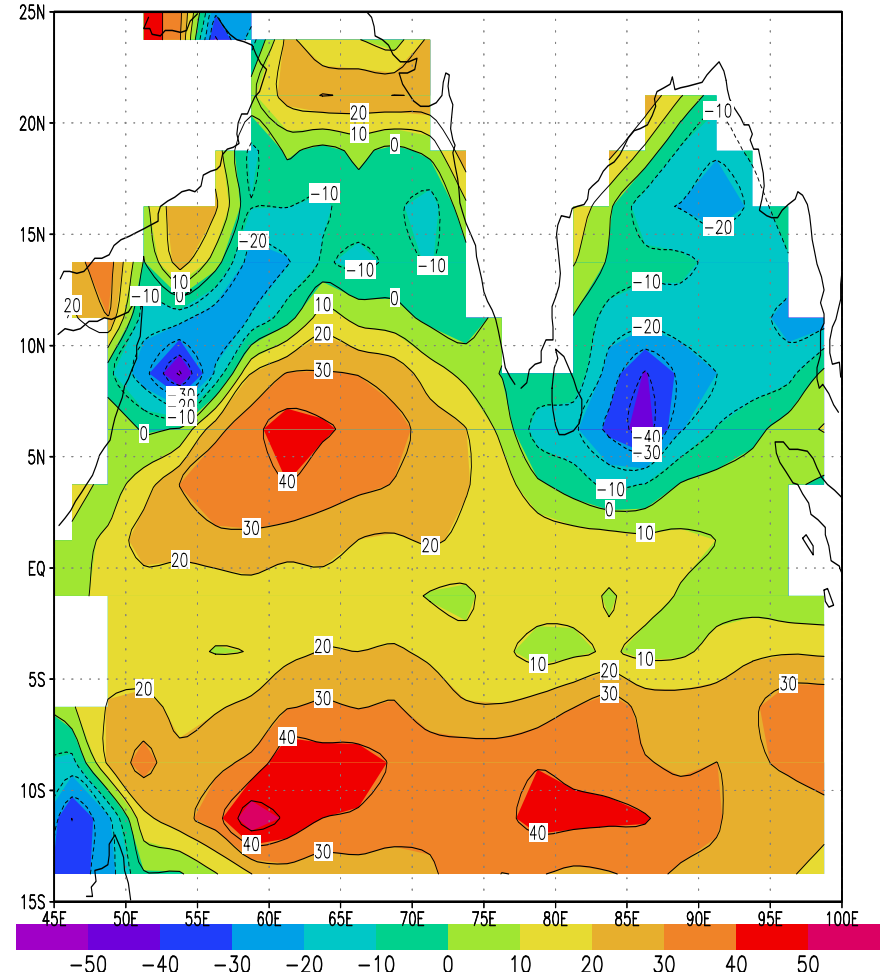


# Zonal Wind Stress : Monsoon Season

Zonal Wind Stress Climatology : JJAS

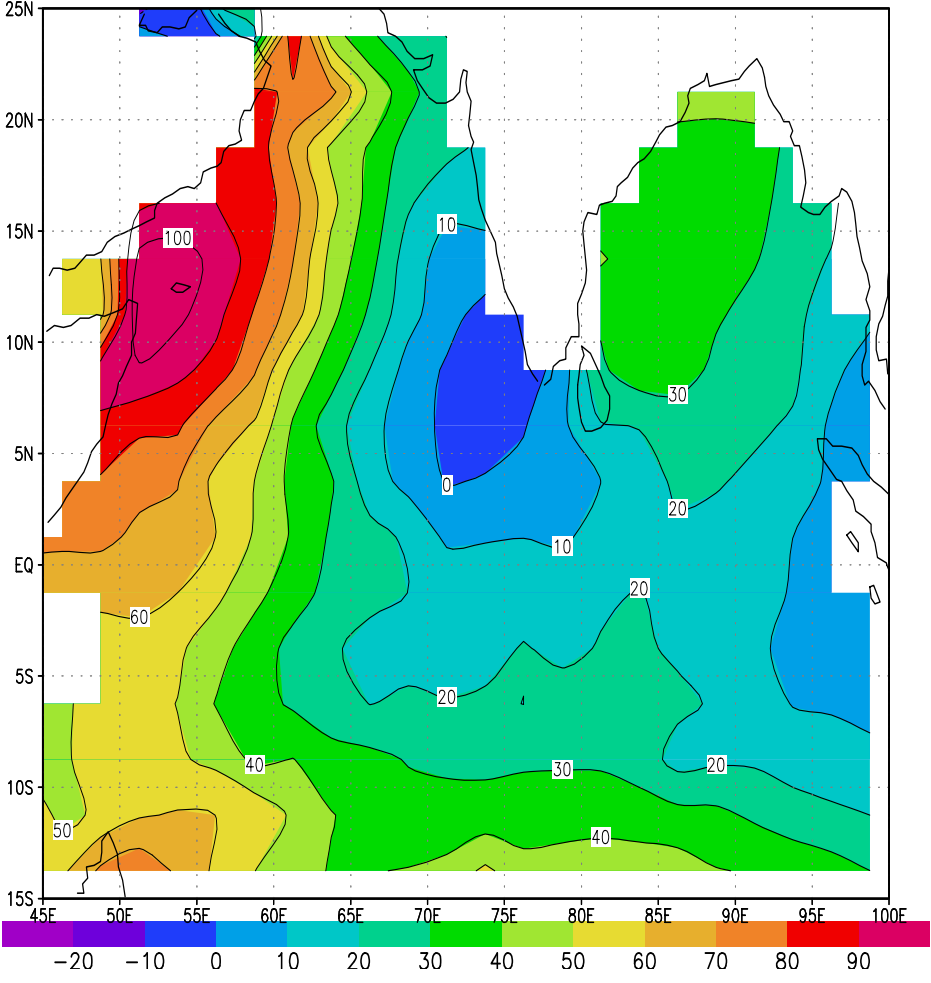


Zonal Wind Stress Diff: JJAS (MCLIM-NCEP)

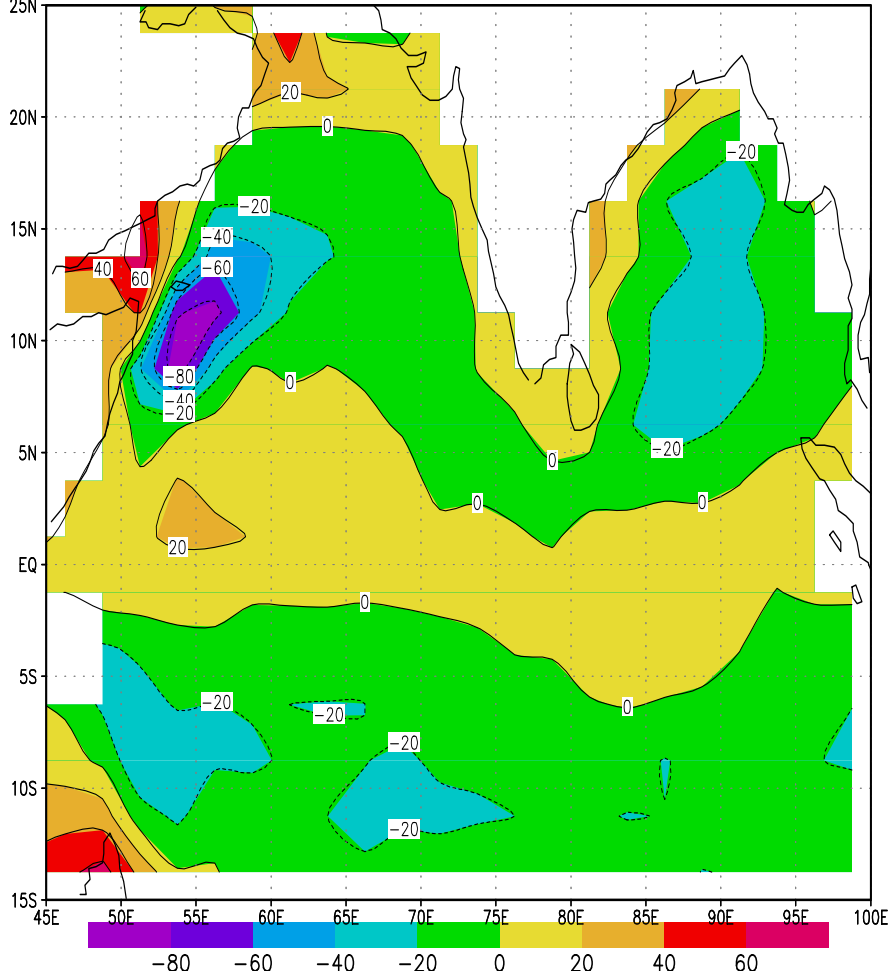


# Meridional Wind Stress : Monsoon Season

Meridional Wind Stress Climatology: JJAS

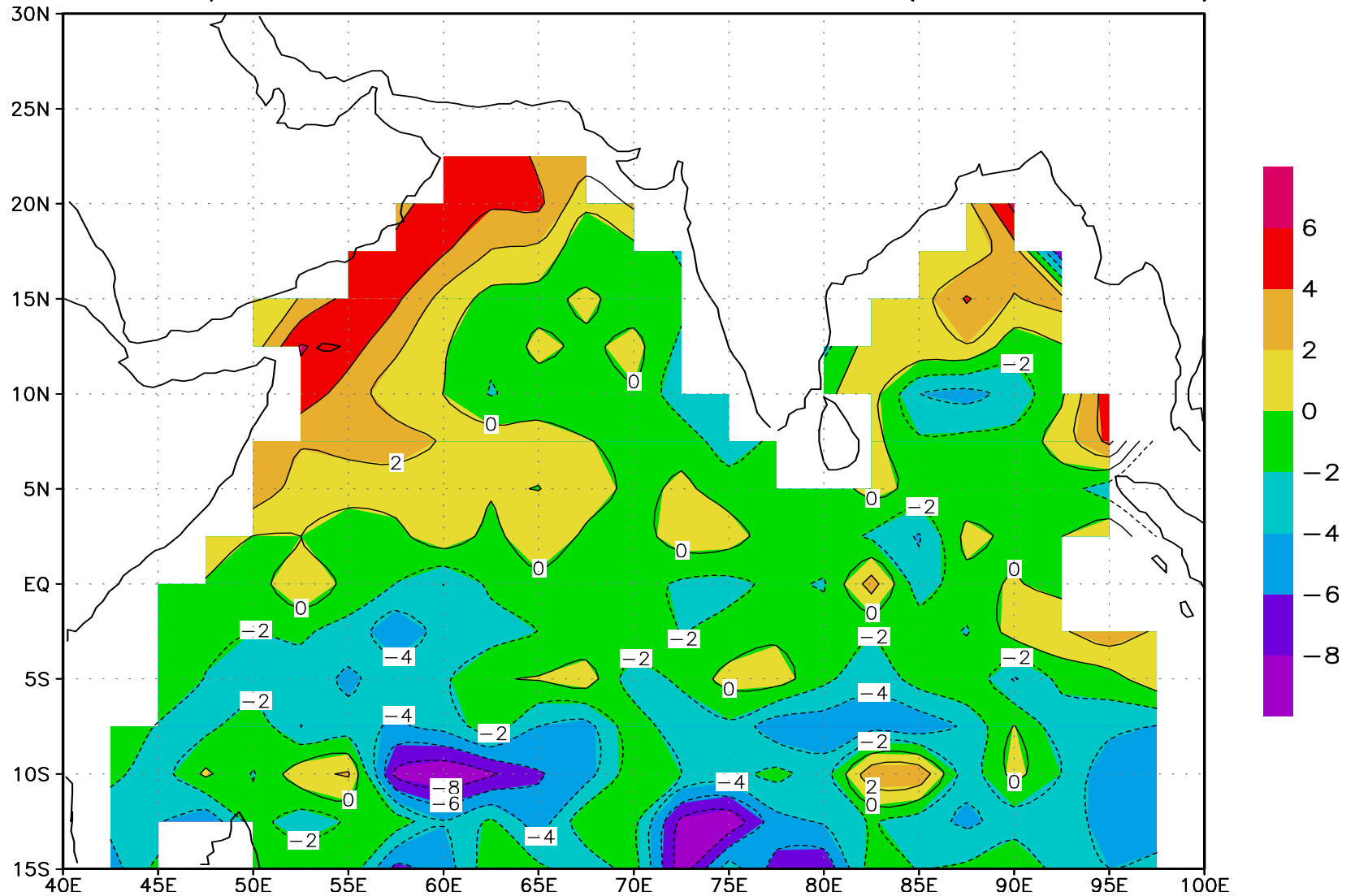


Meridional Wind Stress Difference : JJAS (MCLIM\_NCEP)



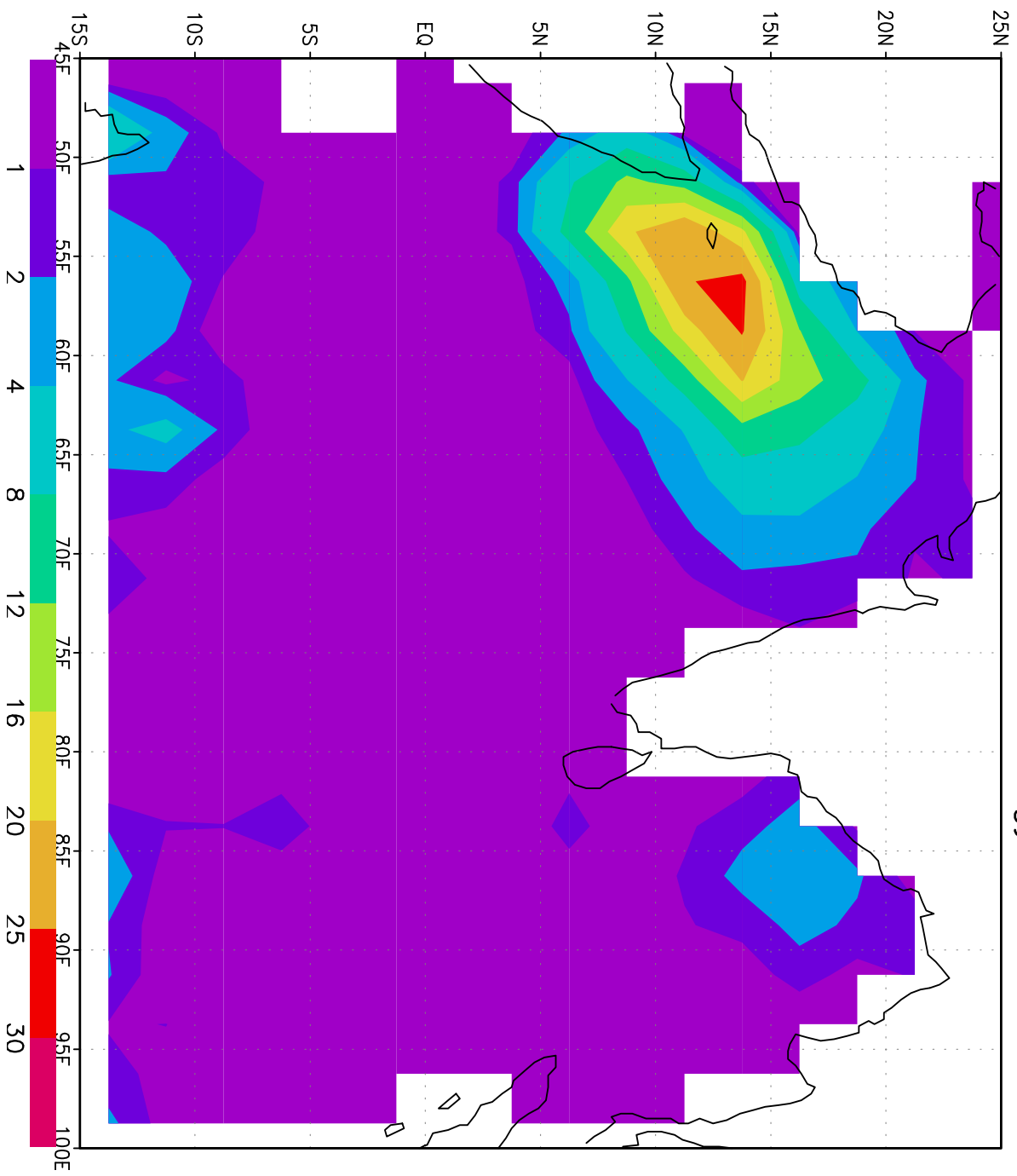
# Wind Speed : MCLIM Vs SSMI

Wind Speed Difference 1987–1988 (MCLIM–SSMI)



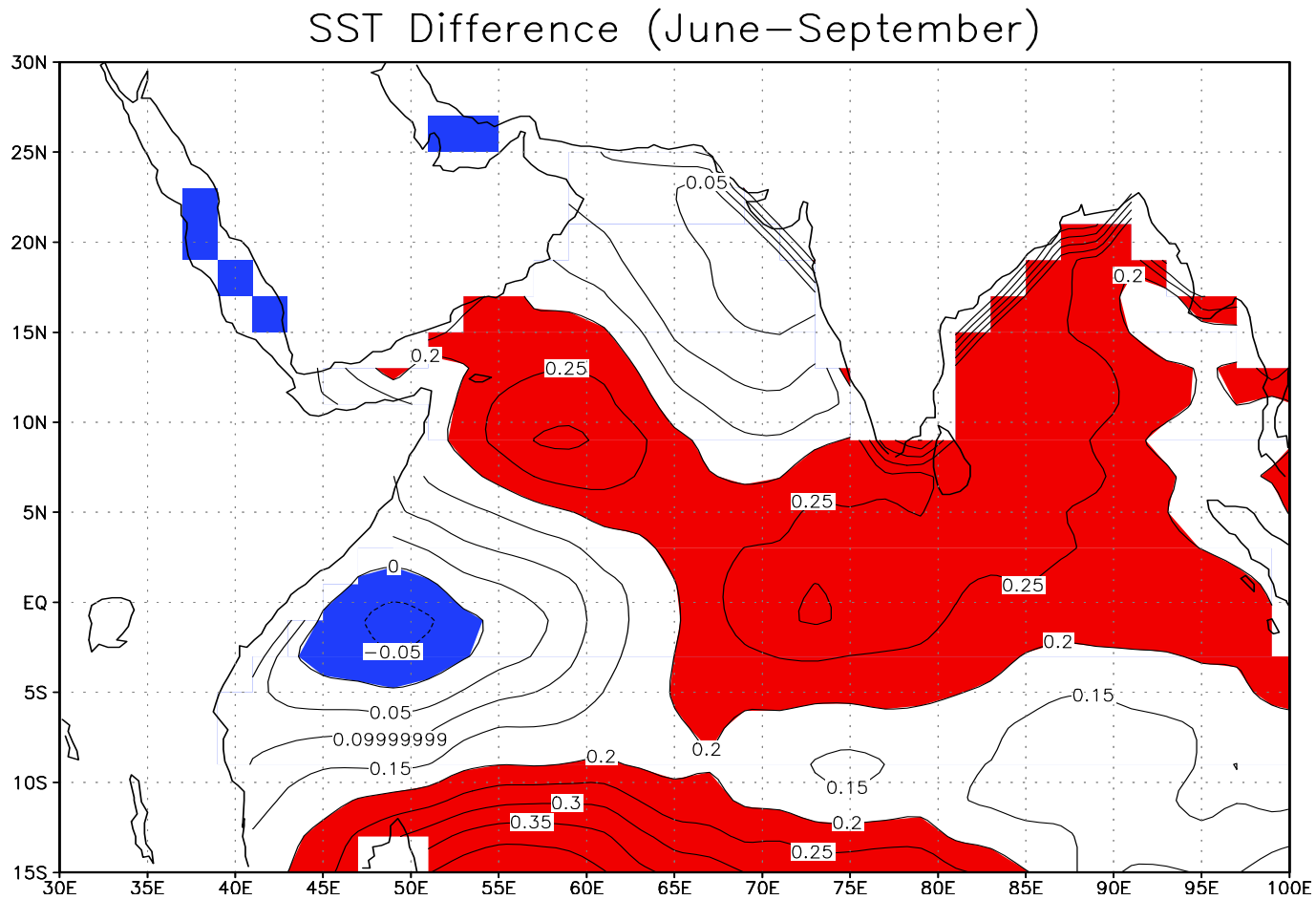


# % of Gale Winds Climatology : JJA

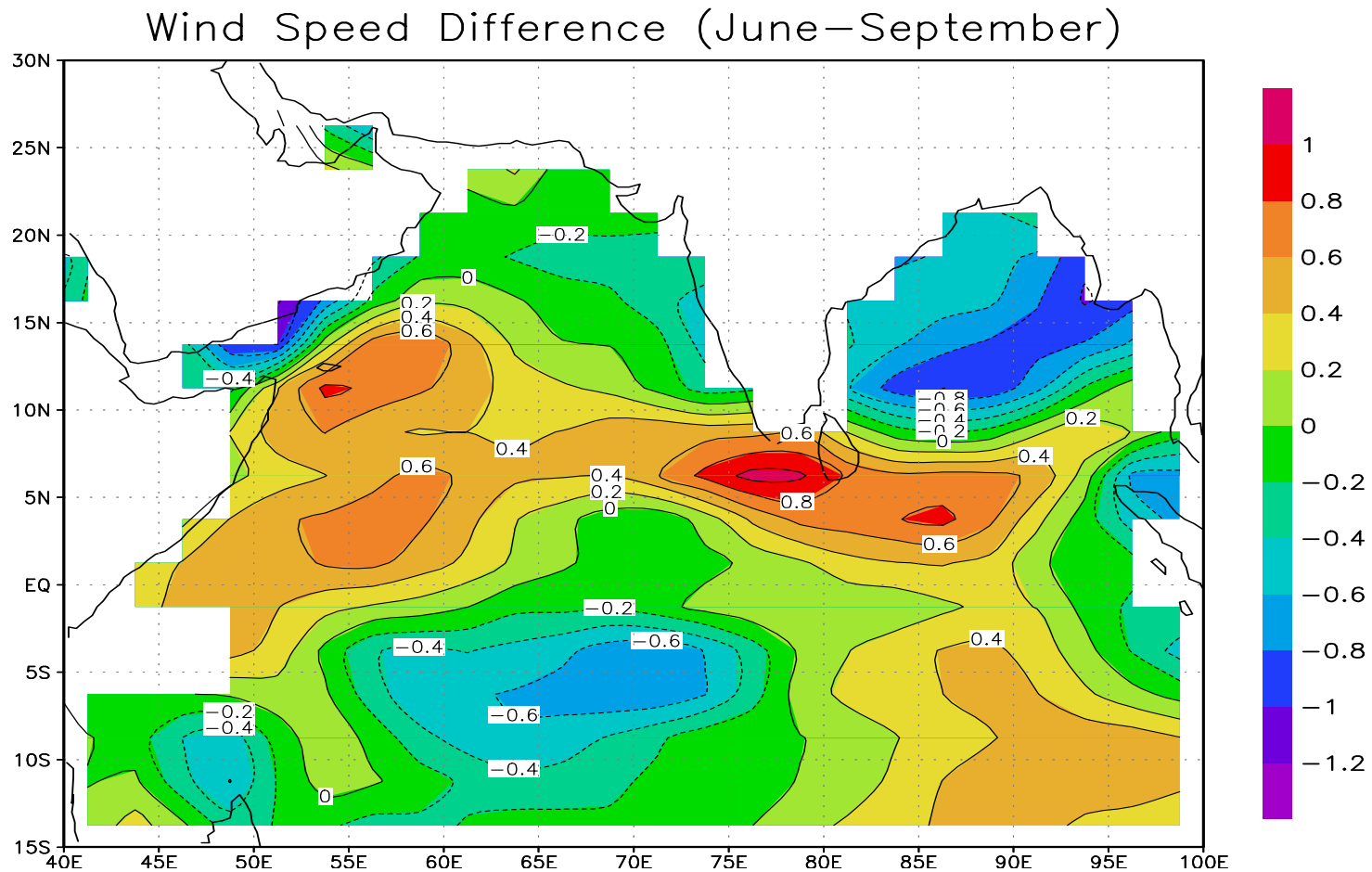


# Indian Ocean Warming and Associated Changes

# SST Difference : 1961/75 – 1976/90

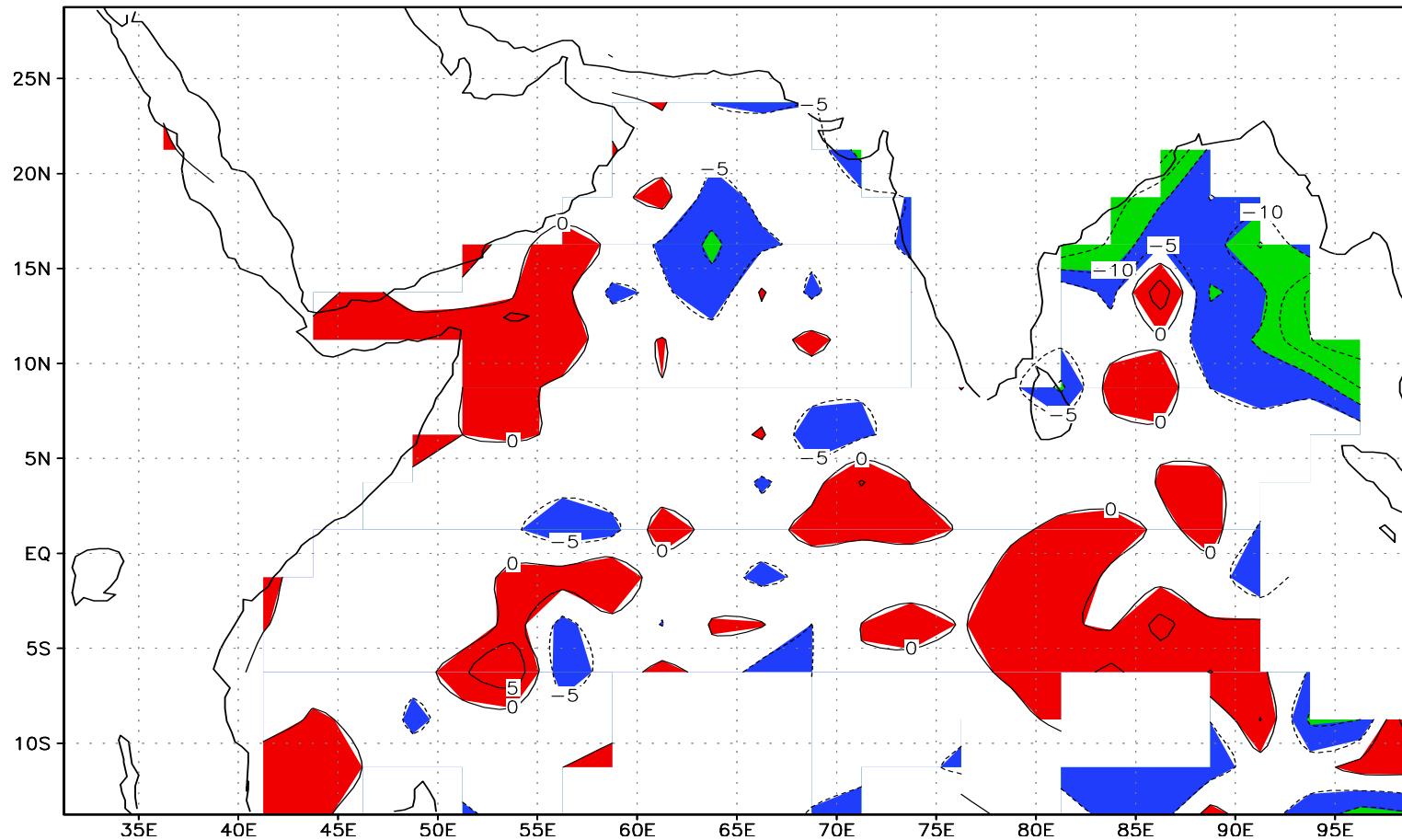


# Wind Speed Difference : 1961/75 – 1976/90



# Total Cloud Difference : 1961/75 – 1976/90

Total Cloud Difference (JJAS) (1976/90 1961/75)



# Conclusions

- MCLIM Pressure Gradient was stronger than the pressure gradient in NCEP reanalysis. Absolute differences are of the order of 0.5 to 1 hPa.
- MCLIM pressures are systematically smaller than the GMSL pressure by about 1 hPa.
- Differences in wind speed are consistent with the pressure differences. Somali Jet is stronger in NCEP data compared to MCLIM data.
- Somali Jet is stronger in SSMI data compared to MCLIM data.
- Interesting and physically consistent changes have been observed in wind speed and cloud associated with the Indian Ocean warming in Mid 70s.