Chapter – 5
CONCLUSIONS AND FUTURE WORK

The present thesis is a unique study about FLJ or Somali jet in detailed. FLJ plays a very important and crucial role in moisture, momentum flux transfer from the Indian Ocean to Arabian Sea and thus plays an important role in SWM onset, progress and withdrawal. To study the climatology of FLJ, intensities of FLJ are observed daily for a period of 14 years (1997-2010) for summer monsoon months (JJAS). The FLJ climatology reveals that, it plays a significant role in monsoon dynamics and also interesting facts in intra seasonal and inter seasonal, and also in inter annual variations of SWM. FLJ turns eastward which is crucial and act as feeder mechanism to monsoon. The turning of FLJ towards west coast of India is observed for entire period of study. The FLJ and its role on monsoon onset is observed during study period with 5 days prior and 5 days after the declared IMD onset dates, reveals that the FLJ is very important and shows a significant strengthening with the advent of monsoon. The FLJ intensities increase substantially on the day of onset and thereafter. In fact, FLJ can be taken as an important factor in determining the onset of monsoon.

The 14 year monthly average picture of FLJ shows the following interesting variations in it. During the month of June the variations in FLJ intensities are maximum or minimum. The intensities are high in July and August and a decrease in intensities is found in the month of September. Out of 14 years of study of the daily FLJ intensities, the maximum and minimum FLJ intensities in June are 30 m/s (1998, 2008) and 6 m/s (1997, 2003). Similarly, July has a maximum intensity of 33 m/s (1998) and a minimum intensity of 10 m/s (2000), August has a maximum intensity of 30 m/s (2005) and a minimum intensity of 10 m/s (1998, 1999) and September has a maximum intensity of 24 m/s (2003, 2007) and a minimum intensity of 8 m/s (1997, 2001, 2004, 2009). The FLJ also shows a variation depending on the activity of monsoon. The intensities of FLJ are also examined in this thesis for both active and break spells of monsoon for a period of 11 years i.e. from 1997-2007. The intensities are higher in active spells and lower in break spells. Thus, FLJ plays a crucial role in determining the activity of southwest or
summer monsoon. If the feeder mechanism by FLJ is more, monsoon is active and FLJ intensities are low during break monsoon. Variations of important parameters like Rainfall, SST, OLR, LHF and SHF with FLJ intensities are also examined and show that these parameters are related to FLJ and show a fair degree of association.

5.1 Rainfall:

The FLJ intensities are indicating the extent of moisture transport from Arabian Sea. This moisture transport reaches Indian subcontinent and results in rainfall. In the present thesis, for comparison, the rainfall is classified into 3 categories 1) All India rainfall 2) South India rainfall 3) Rainfall over Kerala, and the relation with FLJ intensities are examined separately. In order to examine the association of FLJ with monsoon onset, the rainfall over Kerala coast 5 days before and 5 days after the onset is taken and related to FLJ intensities. The possible mechanism explaining the association of rainfall over Kerala with FLJ intensities is the momentum transfer by FLJ after the onset hits directly the Kerala coast. The large momentum coupled with copious amounts of moisture results in large amounts of precipitation. That is why, the correlation coefficient is positive after the onset of monsoon. However, there is equal number of cases in which the correlation coefficient is negative, even after the onset of monsoon when the pentad rainfall is taken. This underlines the wide variations of FLJ and rainfall in the month of June.

It should be mentioned here that FLJ is influential in moisture transport. However, this may not be directed always towards Kerala coast or Southern India. That is why; the rainfall over Kerala is sometimes negatively correlated with FLJ intensities. The correlations may be weak over Kerala and southern India. However, the correlation coefficient for the entire monsoon period (i.e. JJAS) shows a positive correlation with FLJ intensity over India. The important conclusion about the FLJ intensities and how they are related to the important parameter like rainfall during SWM season is the intensity of FLJ is directly proportional to rainfall over all India, southern India and Kerala. The correlation coefficients are negative before the onset of monsoon and turned to be not only positive but also good after the onset of monsoon.
5.2 **Sea Surface Temperature:**

The SST is influenced by the moisture flux and the cloud cover over the Arabian Sea. So, naturally the SSTs are less under active monsoon with large cloud clusters. SSTs are inversely proportional with FLJ intensities as is evident from the graphs during JJAS months. There are wide variations in the month of June and mean monthly averages of SST has also shown the variation of one degree with monsoon activity. So when ever SST decreases the FLJ intensities increases. Same is evident in the months of July, August and September. For the El Nino years the cloud cover is less and the SST is more and there is slight decrease in FLJ intensities. For the La Nina years the SST is less and FLJ intensities are relatively high.

The SSTs along with FLJ throw further light on the monsoon activity in month wise. In 2002 a typical El Nino year of moderate intensity but in phase with IOD results in very much deficit rainfall show the SSTs for JJAS as 28.50°C, 27.21°C, 26.45°C and 27.57°C respectively. This means the monsoon is not active in all the 3 months except August. Another El Nino year 1997 shows the following values of SSTs for JJAS as 29.16°C, 27.35°C, 26.79°C, and 27.43°C respectively. This also shows the monsoon activity gradually improved up to August as evident from the decrease in SST and increase in FLJ. Similarly in 1998, a La Nina year the SSTs for JJAS is 29.13°C, 27.29°C, 27.07°C, and 27.27°C respectively. In the year 2007 the SSTs for JJAS are 29.00°C, 27.21°C, 26.85°C, and 27.15°C respectively. There is no reduction in temperature as expected in the La Nina years. It is rather uniform with slight variations which are due to constant clouding in all the months resulting in uniform reduction and as a consequence, the SST is reduced uniformly and there is no much variation.

5.3 **Outgoing Longwave Radiation:**

OLR is not only an indication of radiation intensity going out but also indicates whether there is clouding or bright sunshine. The OLR is maximum in clear skies and under overcast conditions; there is a marked decrease in OLR intensity. OLR intensities
are higher during El Nino conditions and lower in La Nina conditions. These features are discussed in detail in chapter 4. Surprisingly, 1997 though strong El Nino year which is resulted in near normal rainfall and 2002 a moderate El Nino year as it is in phase with IOD results in very much deficit rainfall, the same features also reflect to the OLR values. In 2002 OLR is above normal which reflects less clouding and less rainfall. This important conclusion not only underlines the importance of OLR but also indicates that IOD also be considered along with El Nino, when Indian monsoon rainfall is concerned.

5.4 Latent Heat and Sensible Heat Fluxes:

LHF and SHF are the vertical fluxes of moisture and heat respectively in Indian Ocean. In chapter 4 the sensible heat and latent heat fluxes are discussed along with FLJ intensities in monsoon season. The sensible heat flux variations naturally reflect the temperature variations in vertical and are more in clear sky conditions. Under cloudy conditions LHF increases and are clearly shown in the present thesis. SHF is high in June and relatively low in July and August. Similarly SHF is high under El Nino conditions and LHF is high under La Nina conditions or cloudy conditions. Thus it can be concluded that SHF and LHF reflect the monsoon activity.

5.5 Future work:

It should be pointed out here that the future research should be directed to get a better understanding of FLJ in the following manner. The study can be extended to more years, so that the variations of FLJ in intra-seasonal and inter-seasonal can be obtained. The study can also be extended to gain insight into the variations of FLJ in good and bad monsoon years especially El Nino and La Nina years. It is desirable that monsoon indices should be developed giving proper weightage to FLJ besides other associated factors.
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