In the middle and upper troposphere (500 hPa and 200 hPa), easterlies prevail over the south Peninsula and adjoining seas. The sub-tropical ridge at these levels also shifts southwards from October to December. The sub-tropical ridge in the upper levels is an area of divergence and contributes to the intensification of low pressure systems over the region. The Tropical Easterly Jet (TEJ), which is one of the semi-permanent systems during the southwest monsoon totally disintegrates once the southwest monsoon is withdrawn from the country. From October to December, the sub-tropical westerlies over the northern parts of the country also get strengthened and start moving to lower latitudes. An upper tropospheric ridge gets established over the southern parts of India by October and November at the 200 hPa level.

2.3. **Mean Precipitable Water Content (PWC)**

Spatial distribution of mean precipitable water content provides useful information on moisture sources and sinks over the region during the NE monsoon season. Mean precipitable water content is calculated as the weighted average of moisture from surface to upper troposphere (normally up to 300 hPa). It provides information of moisture content in the whole atmospheric layer. Higher values suggest moisture sources.

The PWC is a measure of available moisture for precipitation in the atmosphere. It measures the maximum possible precipitation of water, which may precipitate out from a given atmospheric column, if nothing else (e.g., surface evaporation, moisture advection) happens over a given time span. Of course, this is rather an oversimplified picture, because it is hard to imagine that all PWC would condensate within a given column under any conceivable process. Nevertheless, it would be good enough to interpret PWC as an upper bound for a possible precipitation at a given moment with a given atmospheric column.

Fig. 2.10 a, b and c show the spatial distribution of precipitable water content during October, November and December respectively. During October, the maximum

PWC is observed over the Southeast Bay of Bengal (east of Andamans) with values of 50 kg/m^2. The PWC reduces sharply westwards. Over the Bay of Bengal, PWAT values are more than 45 kg/m^2. Over south Peninsula, PWC varies between 40 to 45 kg/m^2. During November, the maximum zone of PWC slightly shifts southwards towards the equator. Over the south Peninsula, however, the PWC values are between 40 to 45 kg/m^2. During December, PWC maximum again shifts southwards and lies close to the equator. Over the south Peninsula, PWC values sharply reduce, ranging from 34 to 40 kg/m^2. During November and December, PWC decreases from south to north and isolines are almost parallel to the equator. Over the south Peninsula, PWC values are higher over the east coast as it reduces sharply towards interior parts.

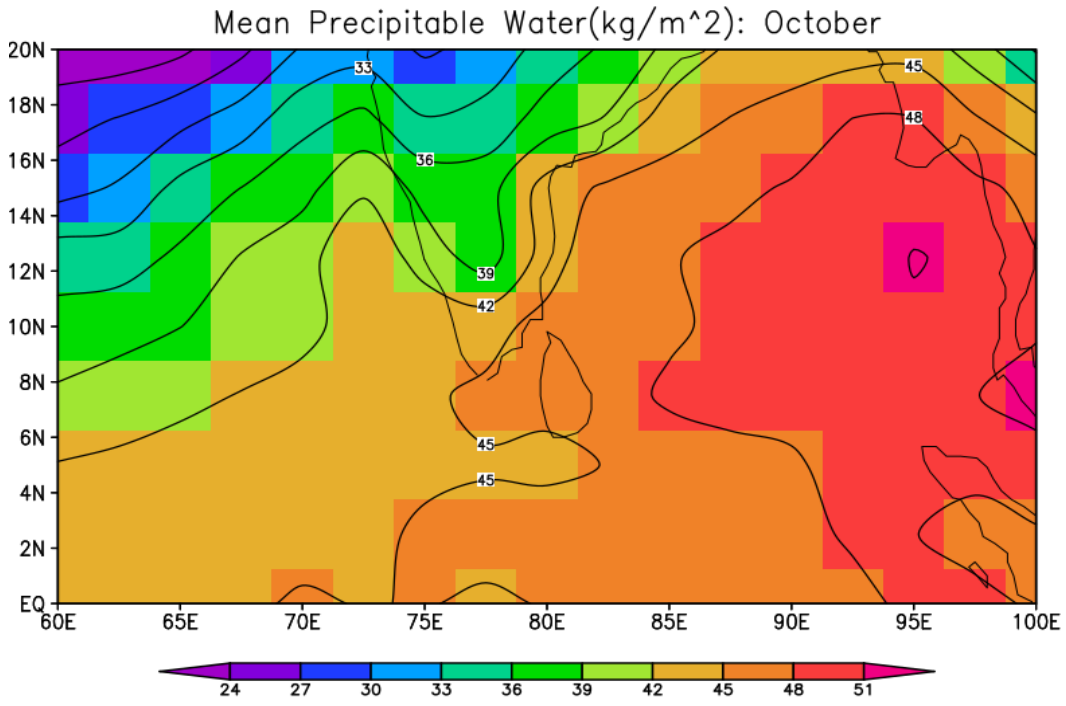

Fig. 2.10 a. Mean precipitable water content (mm) during October (1979-2021). Data source: NCEP/NCAR reanalysis.

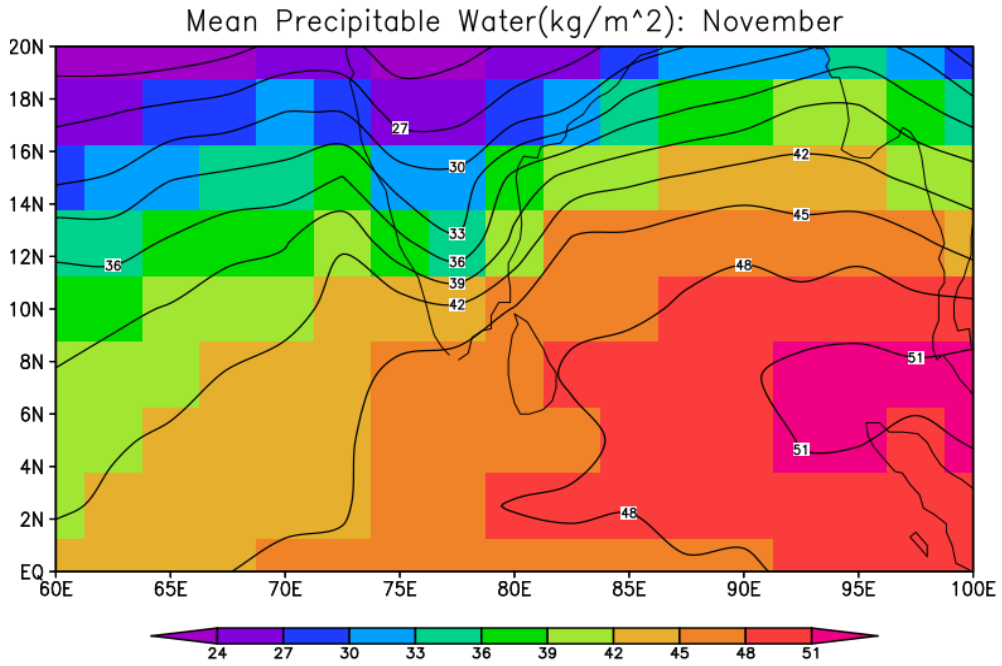

Fig. 2.10 b. Same as Fig 2.10 a but for November.

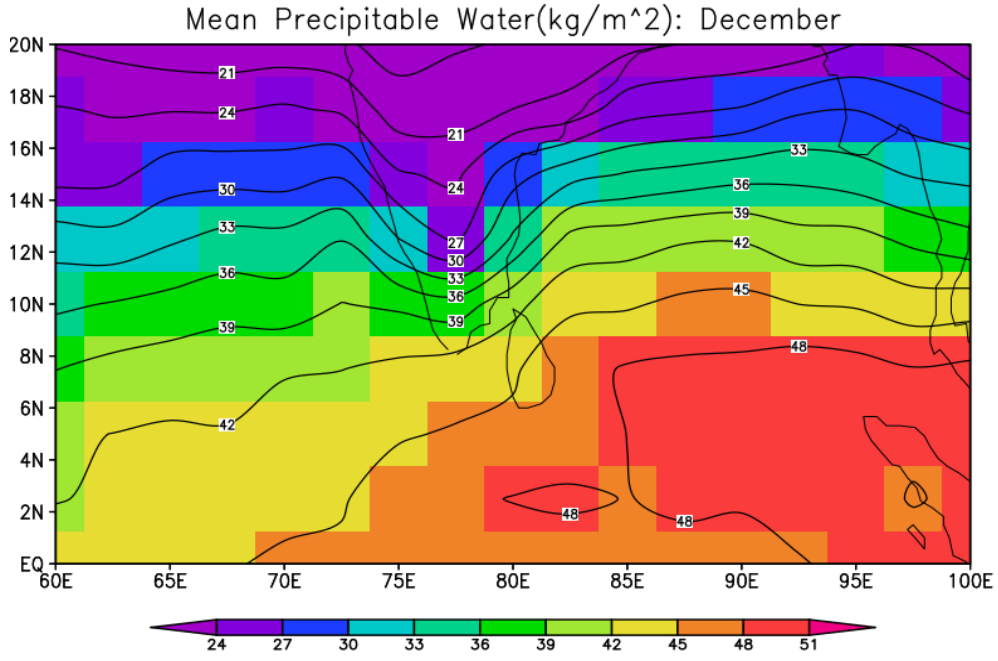

Fig. 2.10 c. Same as Fig 2.10 a but for December.

These are monthly mean patterns, calculated using long term climatological data. However, on a typical day, PWC values can either increase or decrease, depending upon the prevailing synoptic conditions. For example, low pressure weather systems transport more moisture and PWC values can increase sharply in a day or two. To see the variation of moisture content in the atmospheric column, it is better to monitor the PWC changes in addition to low-level humidity. PWC can be easily calculated using radiosonde profiles of moisture.

2.4. **Mean Air Temperatures**

Seasonal (October-December) mean minimum, maximum and mean temperatures over South Peninsula are shown in Fig. 2.11 a, b and c respectively. This analysis was made using the IMD's 1 × 1 degree gridded daily temperature data (Srivastava et al., 2009). Seasonal mean minimum temperatures are the highest along the coasts and they decrease towards the interior parts. Over the east coast, seasonal mean minimum temperatures are of the order of 22-23^{0}C. Over the eastern parts of the south peninsula, the isotherms run parallel to the coast. Over the interior parts, minimum temperatures are below 20^{0}C. Seasonal maximum temperature over the south peninsula varies between 28^0 – 31^{0}C, except over the interior parts of Karnataka where maximum temperatures are below 28^{o}C. Mean temperatures (Fig. 2.11 c) over the coastal Andhra Pradesh are more than 26^{o}C, while over the extreme south peninsula (Tamil Nadu and Kerala), the mean temperatures exceed 27^{0}C.

2.5. **Sea Surface Temperatures (SST)**

During the NE monsoon season, synoptic systems like tropical cyclones, lows and depressions and easterly waves, the presence of east-west trough contribute to rainfall over the South Peninsula. As these weather systems form over the Bay of Bengal and the Arabian Sea, oceanic conditions like Sea Surface Temperature (SST) play an important role. However, higher SSTs lead to more convection only if atmospheric