A significant amount of the East Antarctic Ice Sheet’s mass is transported into the Ross Embayment through the Transantarctic Mountains (TAM). The TAM outlet glaciers have large catchments in the Antarctic Plateau and flow through narrow fjords into the Ross Ice Shelf. They are characterized by large basal drag, minimal side drag and large driving stresses. Their dynamic behaviour is also sensitive to the presence of subglacial water. Most of these glaciers are situated at latitudes above 80°S where a limited amount of high resolution satellite data is available. During the International Polar Year acquisition of TerraSAR-X data in left looking mode was initiated in these areas close to the South Pole as collaboration between the German Aerospace Center and other space agencies and the scientific community. Our results are based on this data set and aim at a better understanding of the ice dynamics and mass balance of TAM glaciers. The velocity fields of major TAM glaciers located south of 80°S are derived with speckle tracking applied to pairs of repeat pass TerraSAR-X. The algorithm gives robust results in these areas with rare melting and snow fall. The main glaciers covered by our acquisitions start with Byrd glacier and continue along the TAM up to the Southern end of the Ross Ice Shelf, including Whillans and Van der Veen ice streams. Although the Ross Ice Shelf is buttressing all investigated TAM outlet glaciers the velocity patterns reveal major differences in their flow characteristics. These are due to various factors like the topography of the fjords and upstream presence of subglacial lakes. As complement to the surface velocity field the position of the grounding line of the TAM glaciers is derived by differential InSAR applied to TerraSAR-X. After processing three consecutive repeat pass TerraSAR-X acquisitions the distinct signature of the grounding line due to elastic bending is used to map the position of the grounding line. For some specific data acquisitions vertical tidal effects in the grounding zone could be observed in the range component of the TerraSAR-X velocity fields. The possibilities to identify the position of the grounding line using the speckle tracking derived velocities instead of high coherent InSAR are investigated. The recently published grounding line of Antarctica compiled with various SAR data extends over the entire coastline of Antarctica but gaps are present in the Ross Ice Shelf sector. The TerraSAR-X data can thus complement Radarsat-2 based grounding lines and velocity fields through narrow glaciers at high latitudes.