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Cyclone activity in modern era reanalyses: Comparative assessment

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Cyclone activity represents an important feature of climate dynamics providing insights on the mechanisms of the observed and projected climate variability and change. At the same time, estimates of cyclone activity are highly uncertain, being dependent on the methods of identification and the data sets used to quantify it. In order to establish more truth in understanding characteristics of cyclone activity in the present climate we investigate it in different modern era reanalyses (NCEP1, NCEP2, ERA-40, ERA-Interim, JRA, MERRA, CSFR, 20th Century Reanalysis). These products represent wide spectrum of model formulations, resolution and data assimilation schemes and cover periods from 2-3 decades to a century. Comparison of cyclone activity in all product is performed for the period of overlap (after 1989), although some specific features of different products and variability patterns were compared for longer periods. For tracking cyclones we used a numerical tracking algorithm developed at P.P. Shirshov Institute of Oceanology, RAS. The tracking scheme conventionally provides identification of cyclone tracks and allows for the quantitative estimation of cyclone numbers and cyclone life cycle characteristics (lifetime, migration, intensity, deepening rate, propagation velocity, etc.). Three main questions to be addressed in our analysis are: (i) the extent to that characteristics of cyclone activity are similar in different reanalyses, (ii) which cyclone characteristics represent the largest spread among different reanlayses, and (iii) capability of reanalyses to adequately quantify characteristics of extreme cyclones on which we make a special emphasis in the study. Not surprisingly, cyclone counts are significantly different in different products with likely a resolution being the main factor determining the differences. In particular, MERRA reveals about 25% more cyclones than the other reanalyses. The highest comparability of cyclone counts is observed over oceans with the strongest regional differences being identified over the continents and in the Arctic, where differences between different data sets may amount to 100%. At the same time, many characteristics of cyclone life cycle (e.g. intensity, deepening rates) depend not only on resolution but also on the model formulation used in reanalyses. For instance MERRA being comparable with CSFR in resolution, shows much higher occurrence of extremely deep and rapidly intensifying cyclones. Analyzing consistency of temporal variability of cyclone characteristics, we separately considered linear trends on interdecadal time scales (different in different products) and shorter period interannual variability (likely comparable in most reanalyses). Finally differences in the advanced characteristics of the cyclone life cycle, such as cyclone size and geometry were discussed.