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On the relationship of extremes in cyclones, wind-speed, and precipitation in an ensemble of Maunder Minimum AOGCM Simulations

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Destructive storms, such as Lothar traveling over central Europe in December 1999, have a large impact on society. The observed series of extremes in the last decade must be placed in a long-term perspective. As one example of the past, the coastline of Germany underwent dramatic changes. The first ”Marcellus flood” or ‘‘grosse Manndrenke” (the great man’s drowning) in 1362 caused big land losses and the rich city Rungholt disappeared in the flooding. The second ‘‘grosse Manndrenke” (1634) changed the landscape to the current coastline. Another flooding 1717, known as the ‘‘Christmas flooding”, affected the entire coastline from the Netherlands up to Denmark with a loss of 12,000 human lives.

Therefore, extremes in midlatitude cyclone characteristics, precipitation, wind speed events, their inter-relationships are investigated in simulations of a prolonged cold period, known as the Maunder Minimum from 1640 to 1715 and compared with today. An ensemble of six simulations for the Maunder Minimum as well as a control simulation for perpetual 1990 conditions are carried out with a state-of-the-art coupled atmosphere-ocean general circulation model. The comparison of the simulations shows clear evidence that in a climate state colder than today the occurrence of cyclones, the extreme events of precipitation and wind speed shift southward in all seasons in the North Atlantic and the North Pacific. The extremes of cyclone intensity increases significantly in winter in almost all regions. This is related to a stronger meridional temperature gradient and therefore an increase in lower tropospheric baroclinicity. The extremes of cyclone intensity in subregions of the North Atlantic are related to the extremes in precipitation and in wind speed during winter.