7. Discussion

By combining the separate hemispheric sea ice records into a global one, we find that there are statistically significant net decreases in the global sea ice coverage from October 1978 through December 1996. The slope of the global sea ice extent is -0.01 ± 0.003 x 10^6 km² per decade. The decrease in the areal coverage of the sea ice is only slightly smaller, so that the difference in the two, the ice-free areas within the packs, has no statistically significant change.

The annual variation of the global sea ice area is ~39% of the mean, on average, and represents an annual change of ~10^{21} J in the amount of latent heat stored in the global sea ice cover, assuming an average seasonal sea ice cover thickness of 0.5 m [*Gloersen et al.*, 1992]. When spread over the course of a year and over ~10^7 km² of seasonal sea ice zone area, the annual variation of latent heat becomes ~30 Wm^{-2}, an order of magnitude smaller than the annual variation of insolation, but not negligible. When integrated over a year, the heat needed to melt this amount of ice represents ~10% of the annual variation in the global insolation. A more significant effect is the corresponding change in surface albedo, which can result in an order of magnitude decrease in the absorbed solar radiation at the ocean surface in the seasonal sea ice zone. Still more important is the 2 to 3 order of magnitude change in the rate of sensible heat exchange between the surface and the atmosphere when the ocean surface becomes covered with ice [*Badgley*, 1966; *Maykut*, 1978]. This can play a significant role in atmospheric circulation [*Budd*, 1975; *Simmonds and Budd*, 1990].

In comparing the 18.2-year local means of the hemispheric ice cover concentrations with the earlier 8.8-year records, we find that the 18.2-year means in the central Arctic are smaller than the 8.8-year ones, in keeping with the long-term negative trends in those localized areas. Examination of the local trends in the two records reveals smaller trends, or even reversal of the directions of the trends, in the longer one. We interpret these observations as an indication of long-term oscillations in the hemispheric ice packs.

A modeled seasonal cycle has been produced for each of the polar map grid elements for each hemisphere. The coefficients for the model were obtained by multiple ordinary least squares fitting of the data. Comparison of the modeled seasonal cycles in the earlier 8.8- and present 18.2-year time spans of each hemisphere shows them to be largely the same, indicating stability in both the amplitude and phase of their monochromatic components.

A number of authors [*Power and Mysak*, 1992; *Barry et al.*, 1993; *Maslanik et al.*, 1996] have suggested that there is a strong coupling between the atmosphere and the sea ice. One way of substantiating these opinions would be to look for similarities in long-term trends and oscillatory behavior. Investigation of this connection is made difficult by the paucity of atmospheric observations in the polar areas and the subjectivity in producing the atmospheric parameter fields by interpolation and extrapolation, particularly when dealing with small numbers as expressed in decadal trends.

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