Climate, Sea Ice, and Ocean Precursors to the Larsen Ice Shelf Disintegrations

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Ice shelf/ice tongue disintegrations and break-ups have a major impact on glacier mass balance, and nowhere has this been more evident than in the northern sections of the Larsen Ice Shelf in the Antarctic Peninsula. Ice flux in this region surged 2- to 6-fold after ice shelf disintegration events in 1995 and 2002, and glacier imbalance has remained roughly double the balance ice loss rate (Scambos et al., 2014). The disintegration events are driven by a group of processes based on the presence of extensive surface melt lakes and hydrofracture. However, precursor changes in the ice shelves beginning more than a decade before the disintegration events have been identified in satellite imagery, beginning around 1990. Prior to this time, available satellite data suggests steady-state evolution of the ice shelf areas. The onset of non-steady structural changes appears to coincide with reduced sea ice extent in the northwestern Weddell Sea. This is linked to climate changes based on increased frequency of Chinook / foen events due to changing Southern Annular Mode trends. An examination of satellite imagery spanning 1963 to the present of the Larsen A and B ice shelves, and of the remnant Scar Inlet Ice Shelf of the former Larsen B shelf, shows that shear margins and suture zone features were essentially unchanged through 1986. Following that time, but well prior to the break-up events or significant ice shelf front retreat, ice shelf shear zones show significant evolution including increased and expanded areas of rifting, concentration of shear, and ice flow speed increases. These early changes, occurring prior to shelf area loss, suggest either increased ocean-driven basal melt or effects of increased meltwater are the cause of early shelf weakening that led to disintegration. The reduced sea-ice extent in the 1990s in the region suggests that wind traction on the ocean surface may have influenced sub-shelf ocean circulation.

Either of these foci would be appropriate:

- Changes in WAIS from observations (*The Times They are a-Changin')*
- Ice-ocean interaction *(Surfin' USA)* everywhere else (*Promised Land)*