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Modeling Sea-Ice Mechanics.

Sea ice regulates heat, moisture and salinity in the polar oceans. In the winter, sea-ice insulates relatively warm ocean water from colder air, except where cracks, or leads, allow heat and water vapor to escape from the ocean to the atmosphere. This exchange affects cloud cover and precipitation. Freezing of water exposed in leads also causes brine to be ejected into the ocean. These factors impact worldwide ocean currents, weather patterns and ecosystems.

Motion of the ice pack is driven by the atmosphere and ocean. The ice pack is able to move and deform because of concentrated deformation at leads. An elastic-decohesive constitutive model for pack ice has been developed that explicitly accounts for leads. The constitutive model is based on elasticity combined with a cohesive crack law that predicts the initiation, orientation and opening of leads, and also has a simple closing model. Example calculations using the Material-Point Method and the elastic-decohesive constitutive model are performed for rectangular regions of Arctic ice near a coastline. Simulations will also be presented for an area of the Beaufort Sea, where predictions can be validated against satellite observations of the Arctic. (Received September 12, 2008)