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Linkages between Low Pressure Systems over the Northwestern Pacific and Arctic Regions during Winter T-PARC

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For the purpose of improvement of 1-14 day high impact weather forecast, the wintertime THORPEX Pacific-Asia Regional Campaign (Winter T-PARC) was carried out by the lead organization of National Oceanic and Atmospheric Administration (NOAA) in the United States from the middle of January to the end of February 2009. And further it continued until the end of March as Winter Storm Reconnaissance Program (WSR-09). This campaign includes the upper air sounding enhancement in Eastern Siberia, Russia and two aircrafts drop-sonde soundings. As the rapidly deepening low pressure systems in the Northwestern Pacific region strongly affect downstream regions, such as Alaska, Arctic and entire North-American continent, they have a great contribution to the improvement of the forecasting in the Unite Sates and Canada. Therefore, they were one of the main targets of the campaign. As the low pressure system in the Northwestern Pacific region affects to Alaska and Arctic region, winter T-PARC is assigned as a part of International Polar Year (IPY) program in the Unites States. National Institute of Polar Research in Japan supports the Winter T-PARC as a part of Japanese IPY activity. In this poster we will discuss about storm behaviors over the North Pacific Ocean and their linkages to the Arctic Region.

Using NCEPFNL analysis dataset, the tracking of low pressure system center was analyzed over the North Pacific and Arctic Regions in February and March. The low pressure activity was dominate in Northwestern Pacific Region and moved into the Arctic Region through the East of Kamchatka Peninsula and Bering Straight in February. Low pressure systems moved towards Alaska and they stagnated over the Gulf of Alaska in March. Low pressure systems were not identified over the Beaufort Sea due to high pressure systems. Hovmoller Diagram of 300hPa meridional winds (v component winds) averaged between 35N and 45N shows several Rossby wave energy propagation paths (wave trains). We can identify upper-level short wave troughs and ridges propagating to the East around the globe. Signals amplified at Northwestern Pacific Ocean in February and at the center of the North Pacific Ocean in March and then propagate to the East.

In total, 5 cyclones entered into the Arctic region from the Northwestern Pacific Region in February. All of these 5 cyclones were bomb type cyclones. And also each cyclone associated with a distinct "Atmospheric River (moisture river in the air)" at their minimum central SLP. To develop a bomb type cyclone, it needs an upper-level short wave trough approaching and lower-level moisture supply into the cyclone center are necessary for the rapidly development. Therefore, it may be reasonable to observe the "Atmospheric River" after the cyclone's rapidly development.

Low pressure systems stagnated over the Gulf of Alaska in March. This condition looks connected to a developed low over the Sea of Okhotsk. This low brought warm air into the Arctic region (over the Beaufort Sea) through the Eastern Siberia. As polar cold airs existed over Siberia and Central Canadian Arctic, upper level jet made anti-cyclonic circulation around the warm air over the Beauport Sea. The air descended due to this anti-cyclonic circulation and flow out to the south (Bering Sea, across Aleutian Islands and off-shore of Gulf of Alaska) through the Bering Straight.

Combined with anti-cyclonic circulation in the North Pacific Ocean, "Atmospheric River" in precipitable water became clear. A low formed in the North of "Atmospheric River" near the Aleutian Islands. This low moved towards East and stagnated over the Gulf of Alaska. At this time, "Atmospheric River" distinguished again. And next generation low pressure systems formed again almost the same scenario.

Keywords: Low Pressure Systems, North Pacific Region, Arctic Region, Winter T-PARC