RESEARCH AREA NO.: 1
THEME NO.: 3

TITLE: STORM ACTIVITY AND ATMOSPHERE-SEA ICE-OCEAN INTERACTION

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CO-INVESTIGATOR:

MEMBER’S ROLES:
XIANGDONG ZHANG: Data analysis, model simulations, project coordination.
JUN INOUE: Data analysis, atmosphere observations.
TAKASHI KIKUCHI: Data analysis, ocean observations, project leader.
TAKESHI ENOMOT: Model simulations.
NOBUYUK KOMORI: Model simulations.

A broad collaborations with a number of other scientists
BACKGROUND:

- Storm activity has been intensified in the Arctic Ocean, and storm activities are correlated with ice and ocean regime shift (Zhang et al. 2004).

- Radical spatial shifts of atmospheric circulation enhanced atmosphere-ice-ocean interactions and arctic-global interactions, causing extreme sea ice loss in 2007 and recent severe cold weather in the midlatitude of Eurasia (Zhang et al. 2008).
OBJECTIVES:

(1) To detect the seasonal and regional changes in storm activity during the rapid climate change periods in observations and model projections.

(2) To provide a schematic description of synoptic-scale variations of atmosphere, ocean and sea ice processes under impact of storm process.

(3) To identify underlying physical processes linking to or impact the recently observed and future projected large-scale climate system change.

(4) To quantify atmosphere and ocean heat and freshwater budgets and pathways and sea ice heat and mass balance in the context storm activity.

(5) To create database of heat energy and water mass budgets in Arctic atmosphere, ocean and sea ice at a synoptic-scale resolution.
METHODOLOGY:

(1) To employ and improve the existing storm identification and tracking algorithm for applications to reanalysis data and model simulation and projection output.

(2) To augment storm activity database and detect seasonal and regional changes of storms in the most recent rapid change episode of the Arctic climate.

(3) To compare several model simulation results including AFES and CFES conducted by Earth Simulator Center (JAMSTEC) in terms of change of the Arctic atmospheric condition.
Activity 1: Impacts of storm activity on ocean and sea ice (also collaboration with AWI)

Activity 2: Atmospheric Modeling (CAM3) study of Arctic sea ice on storms and surface climate

Detrended Arctic Sea Ice Extent (1979 – 2008) in millions sq. km in MAM

Basu, S., and X. Zhang, 2014
Activity 2: Atmospheric Modeling (CAM3) study of Arctic sea ice on storms and surface climate

Basu, S., and X. Zhang, 2014
Activity 3: Impacts of Eurasian spring snow cover anomaly on the atmospheric circulation and Arctic sea ice

Eurasian snow cover and Arctic sea ice extent anomalies (1979-2011)

EP-flux and its convergences, and zonal winds regressed on June snow cover anomalies

Activity 3: Impacts of Eurasian spring snow cover anomaly on the atmospheric circulation and Arctic sea ice

Regressions of surface atmosphere onto June Eurasian SCE (1988-2011)

Shadings: p<0.05

Activity 4: Attribution of the recently observed intensification of the Beaufort High and increase in surface winds

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OUTCOMES OF 2013FY:


Major Accomplishments:

(1) Analyzed Arctic regional storm activities in the high resolution fully-coupled Arctic regional climate model simulations through collaboration with the AWI.

(2) Isolated roles of Arctic sea ice and tropical Pacific SST anomalies on storm track dynamics and activities and surface climate.

(3) Detected impacts of Eurasian spring snow cover variability on the atmospheric circulation and its across-season linkage to the accelerated Arctic sea ice reduction.

(4) Evaluated attribution of the recently observed changes in the Beaufort High and surface winds by using the ERA-Interim and CMIP5 model simulations.