Reporting on the deliverables announced at ASM1 from China

Among the technical outcome documents issued by the first Arctic Science Ministerial (ASM 1), China involved itself in 4 deliverables: "Greenland Glaciers", "Drifting Observatory", "Year of Polar Prediction", and "The Arctic and Education". The following are China's developments in the four areas.

Research by Chinese scientists on Greenland glaciers

As the second largest continental ice sheet in the world, the Greenland ice sheet has experienced an accelerated mass loss in the last decades, making it the single ice body that has contributed most to global sea level rise. The Greenland ice sheet is now a hot spot of Arctic research.

Using panoramic remote sensing images from Landsat 8 over the 2014-2015 period, the team led by Professor Cheng Xiao from Beijing Normal University overcame many technical difficulties and completed the latest high-resolution (30m) Greenland remote sensing image map (2014-2015). On this basis, experts from Beijing Normal University closely worked with their counterparts at the Greenland Institute of Natural Resources and the Board on Geographical Names to mark the names of the main places of the Island based on the map. The results have been presented to the Greenland government as a gift, and will be used in for local resource management, climate change research, marine development and improvement of welfare of the Greenland people.

With continuous warming of the Arctic, the Greenland ice sheet is experiencing an accelerated mass loss, mainly manifested by surface mass loss and sheet bottom ablation. Using multi-source remote sensing and reanalysis data, Professor Cheng Xiao and his team analyzed and examined changes in instantaneous summer snowline and surface ablation in Greenland. The research results revealed the status quo of glacier and snowline retreat in Greenland and offer important implications for global climate change research. The research team selected Jakobshavn, a typical glacier of the Arctic, to study its front collapse positions in the past 30 years, looked into its retreat-driven mechanisms from an energy balance perspective, and explicitly confirmed bottom energy as the main contributor to glacier melting. Based on field observations, the team explained the interrelationship between glacier movement, thinning and disintegration, thus putting forward possible mechanisms of the front edge retreat of Jakobshavn.

Associate Professor Yang Kang from Nanjing University and his international collaborators used high spatial resolution satellite remote sensing and UAV image data to propose a new method for measurement of meltwater runoff on the Greenland ice sheet surface. The results showed that the regional climate model commonly used today not only overestimated the actual runoff on the ice surface, but also overlooked the delay effect of meltwater conveyance on the ice surface. The huge complicated structure of drainage on the ice surface actually controls the mode and efficiency of meltwater conveyance on the ice surface, which has an important

influence on the mass balance of the ice sheet. The research result was published as a cover article in the Proceedings of the National Academy of Sciences (PNAS) on December 12, 2017. This research is the outcome of international collaboration in science and technology among researchers from more than 10 internationally well-known research institutes. After its publication, the research result has been reported by New York Times, Xinhua News Agency and other news media.

The Greenland ice sheet as a whole is in a state of accelerated ablation, which will accelerate the rise of sea level and have an important impact on global climate change. The research work undertaken by Chinese scientists on the Greenland ice sheet has significantly improved the influence of China's Arctic research and laid the foundation for China's active and in-depth participation in international research on Greenland ice sheet.

Status of Chinese Scientists' Participation in MOSAiC

Multidisciplinary drifting Observatory for the Study of Arctic Climate ("MOSAiC") is a one-year (2019-2020) manned multidisciplinary comprehensive observation program with German icebreaker "Polarstern" as the main platform. It aims to deepen our understanding of the coupling processes of atmosphere-sea ice-ecosystems in the central region of the Arctic, and improve the capabilities of Arctic weather, sea ice and climate forecasting. Mainly initiated by Germany, MOSAiC is hitherto the most comprehensive multidisciplinary comprehensive observation program for the Arctic Ocean.

At the invitation of the German side and with the approval of relevant Chinese authorities, China will actively participate in the program. Specifically, China will provide fuel and other logistical support for the "Polarstern" icebreaker, while the German side will provide Chinese scientists with some beds and on-site support for their participation in the multidisciplinary expeditions of the MOSAiC program. Since the second half of 2017, Chinese scientists have communicated with German scientists through e-mail and international conferences over their collaborative participation in the scientific expeditions of the MOSAiC program.

From November 13 to 16, 2017, a MOSAiC Implementation Workshop was held in St. Petersburg, Russia. More than 100 representatives attended the conference, and China sent a 10-member delegation to it. The meeting specified the organizational format of the MOSAiC observation program, and field work was divided into working groups on the atmosphere, sea ice, oceans, biogeochemistry, and ecology. Preliminary arrangements were made for the layout of on-site observation points, observation parameters, content and frequency of sampling, on-site experimental items, items for laboratory analysis, number of personnel of each working group and their basic division of work. CAS Member Chen Dake of the Second Institute of Oceanography of the State Oceanic Administration delivered a plenary report entitled "China's Contribution to MOSAiC" at the workshop and put forward a tentative plan for China's participation in the MOSAiC program, drawing enthusiastic responses from participants. Subsequently, participating Chinese scientists were fully involved in the discussions of various working groups, and made preliminary communications with fellow participants on the content and mode of field observations to be participated in by experts of sea ice, atmosphere,

oceanography and ecology. From May to July 2018, a 4-day fieldwork plan workshop will be held in Potsdam, Germany to specifically discuss and finalize the field work of the various working groups and the specific observation work in which Chinese scientists will partake.

China's Arctic scientific expedition has long been an important platform for international cooperation in the polar research field. Since 1999, China has invited dozens of scientists from the United States, France, Finland, Germany and South Korea to participate in all its Arctic scientific expedition. The current joint expedition can not only make up China's insufficient long-term and continuous observation data on the Arctic and enrich the means of expedition, but also significantly enhance the influence of China's Arctic scientific expeditions and lay a foundation for China's launch of its leading Arctic exploration programs in the future.

Status of Chinese Scientists' Participation in YOPP

The Year of Polar Prediction ("YOPP") is a core action of the World Meteorological Organization's Polar Prediction Project ("PPP"). YOPP aims to organize and coordinate a long period of intensive observation and simulation to improve Arctic and Antarctic forecasting capabilities over a wide range of time scales from several hours to seasons, so as to improve weather and climate services. YOPP is particularly concerned about improving the capability of forecasting sea ice and visibility, wind, precipitation and other key elements. Research Professor Yang Qinghua at the National Marine Environment Forecasting Center of China is currently a member of the PPP Steering Group.

YOPP is to be implemented in 3 stages: preparation stage (2013 to mid-2017), YOPP implementation stage (mid-2017 to mid-2019), and YOPP consolidation stage (mid-2019 to 2023). WMO has identified 3 Special Observing Periods (SOPs) for YOPP, which aim to promote international collaborative observations on sounding and buoys and to share data real time. The specific time schedule of SOP is as follows:

SOP-1: February 1 - March 31, 2018, focusing on the Arctic region;

SOP-2: July 1 - September 30, 2018, focusing on the Arctic region;

SOP-3: November 16, 2018 - February 15, 2019, focused on the Antarctic region.

In February 2017, upon receipt of WMO's consultation letter on China's active participation in YOPP's observation programs, the State Oceanic Administration and the China Meteorological Administration respectively replies to WMO, stating a position of active participation in the international collaborative observation program of YOPP on behalf of the Chinese government. In 2018, China's Ninth Arctic Scientific Expedition happens to coincide with SOP-2, and China will actively participate in collaborative observations of atmospheric sounding and buoys, and transmit its atmospheric sounding data to WMO in real time through GTS.

Other YOPP-related activities which China has participated in include: From February to March 2017, Research Professor Yang Qinghua attended the PPP Steering Group Meeting #8 (SG-8) at NCEP, the United States; in March 2017, Research Professor Yang Qinghua, Research Professor Li Chunhua and Dr. Liang Xi attended the Fourth International Polar Prediction Workshop at AWI, Germany; and in June 2017, Dr. Sun Qizhen attended YOPP's Antarctic Observation and Forecasting

Planning Meeting at the National Center for Atmospheric Research of the United States. In addition, China has also been actively involved in the writing and review work of YOPP-related materials.

Besides, China has made remarkable progress in the research and development of polar numerical forecasting technology. It has developed EnKF-based sea ice data assimilation technology, established an Arctic ice-ocean prediction system (ArcIOPS) and put it into trial operations in early August. For the first time, China has released its sea ice thickness forecast product. The country has developed atmospheric sounding and satellite remote sensing data assimilation technology and successfully applied it in its Antarctic numerical weather forecast system. China has established a fixed ice forecast system for Prydz Bay of the Antarctic and provided its Antarctic expedition team with fixed ice forecast product for the first time. China will actively participate in the international comparison program for polar numerical forecast products during the period of YOPP.

Status of Chinese Scientists' Arctic Policy Research

In recent years, Arctic shipping, fishing, scientific research, maritime search and rescue, and oil and gas development have continued to develop. Centering on these continuously booming Arctic affairs, the international community has gradually formed a community of shared future over Arctic affairs. China as a "Near-Arctic State" and an important stakeholder of the Arctic has solidly implemented the requirement for "Strengthening China's polar governance capacity and international cooperation" in its 13th Five-Year Plan, made corresponding adjustments and released a white paper entitled *China's Arctic Policy*. This policy is also an embodiment in the Arctic context of the idea of "a community of shared future for mankind" proposed by General Secretary Xi Jinping.

As for Arctic governance, China has adapted to the trend of "the Arctic governance center shifting from land to sea and topics shifting from environmental protection to comprehensive sustainable development". Under the "Belt and Road" Initiative, China has actively promoted the co-building of a blue economic corridor connecting with Europe via the Arctic Ocean, and worked with countries in the Arctic to pursue collaborative governance and development of the Arctic Region and build "Polar Silk Road".

As for the issue of indigenous peoples, China has seen the challenges posed by sea ice melting to the traditional lifestyle, cultural identity and political participation of the Arctic indigenous community. The actual life of Inuit has been affected by global warming, and their rights and lives have been attracting wider attention.

China as a Near-Arctic State should build on its newly released Arctic policy, step up efforts and further put forward its own plans for institutional arrangement, mechanism construction and other core issues, contribute Chinese wisdom, while promoting peace and sustainable development in the Arctic.