



# From IPY4 to IPY5: China's Contributions and Perspective

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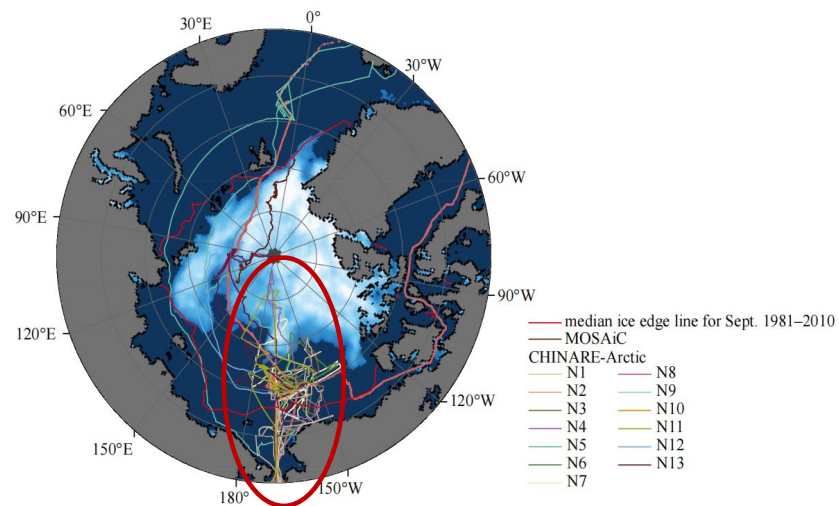
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Polar Research Institute of China



# IPY4 Arctic Ocean-Chinese contributions

- ❑ Observation capability improvement: Xuelong renovation, Arctic exploration every 2 years since 2008, Xuelong 2 Project
- ❑ International cooperation: PAG, DBO, DAMOCLES
- ❑ Ice based buoy, underwater machine
- ❑ Ocean acidification, shelf-basin material and energy exchange, sea ice retreat, and their ecological and climatic effects



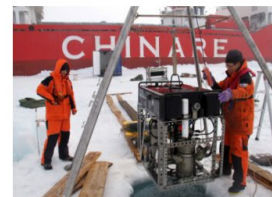
polar ARV in the 3rd CHINARE



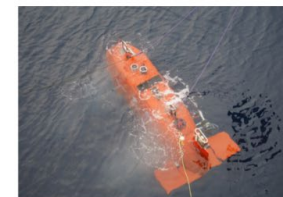
TS 4500 in the 12th CHINARE



ITP in the 6th CHINARE



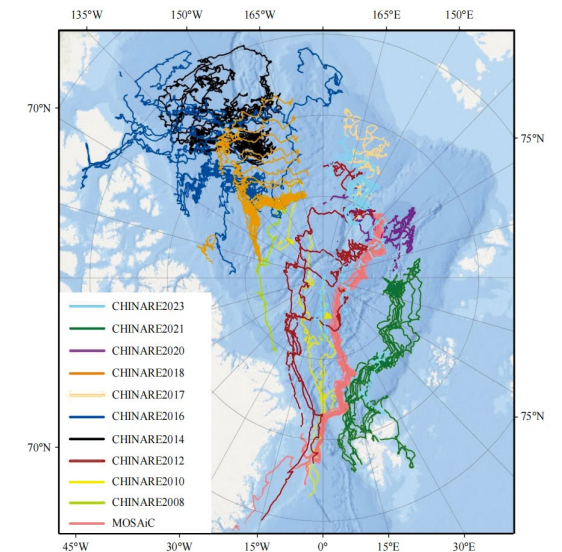
polar ARV in the 6th CHINARE



Xinghai 1000 in the 13rd CHNARE



Unmanned Ice Station:  
in the 11th CHINARE



# ▶ Knowledge contribution

## ▶ Breakthroughs have been made in Arctic research



**Decrease in the CO<sub>2</sub> Uptake Capacity in an Ice-Free Arctic Ocean Basin**  
Wei-Jun Cai, *et al.*  
*Science* 329, 556 (2010);  
DOI: 10.1126/science.1189338

### Decrease in the CO<sub>2</sub> Uptake Capacity in an Ice-Free Arctic Ocean Basin

Wei-Jun Cai,<sup>1\*</sup> Liqi Chen,<sup>2</sup> Baoshan Chen,<sup>1</sup> Zhongyong Gao,<sup>2</sup> Sang H. Lee,<sup>3</sup> Jianfang Chen,<sup>4</sup> Denis Pierrot,<sup>5,6</sup> Kevin Sullivan,<sup>5,6</sup> Yongchen Wang,<sup>1</sup> Xinping Hu,<sup>1</sup> Wei-jen Huang,<sup>1</sup> Yuanhui Zhang,<sup>2</sup> Suqing Xu,<sup>2</sup> Akihiko Murata,<sup>7</sup> Jacqueline M. Grebmeier,<sup>8</sup> E. Peter Jones,<sup>9</sup> Haisheng Zhang<sup>1</sup>

In the summer of 2008, we conducted a high-resolution underway survey of partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) across the Canada Basin in the western Arctic Ocean where substantial melting of ice had occurred (Fig. 1 and fig. S1). Surface-water temperatures were as high as 10°C to 15°C in the

1 August 11, 2010



**Direct Observations of the Evolution of Polar Cap Ionization Patches**  
Qing-He Zhang *et al.*  
*Science* 339, 1597 (2013);  
DOI: 10.1126/science.1231487

### Direct Observations of the Evolution of Polar Cap Ionization Patches

Qing-He Zhang,<sup>1\*</sup> Bei-Chen Zhang,<sup>1</sup> Michael Lockwood,<sup>2</sup> Hong-Qiao Hu,<sup>1</sup> J. Michael Ruohoniemi,<sup>4</sup> Evan G. Thomas,<sup>4</sup> Shun-Rong Zhang,<sup>5</sup> Hui-Gen Rui-Yuan Liu,<sup>1</sup> Kathryn A. McWilliams,<sup>6,2</sup> Joseph B. H. Baker<sup>4</sup>



nature  
climate change

LETTERS

PUBLISHED ONLINE: 27 FEBRUARY 2017 | DOI: 10.1038/NCLIMATE3228

### Increase in acidifying water in the western Arctic Ocean

Di Qi<sup>1,2</sup>, Liqi Chen<sup>1\*</sup>, Baoshan Chen<sup>3,4</sup>, Zhongyong Gao<sup>2</sup>, Leif G. Anderson<sup>7</sup>, Heng Sun<sup>1</sup>, Jianfang Chen<sup>4</sup>, Jun Cai<sup>3,4\*</sup>

nature  
climate change

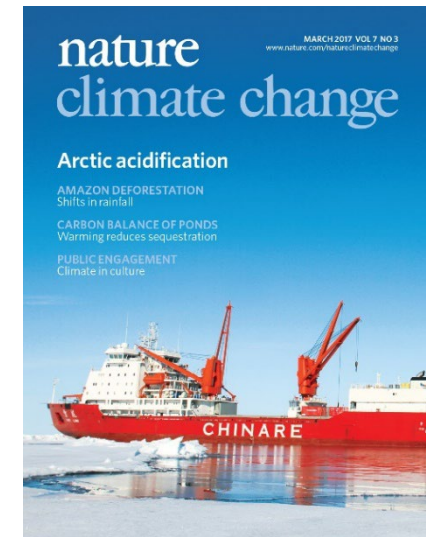
LETTERS

PUBLISHED ONLINE: 24 OCTOBER 2016 | DOI: 10.1038/NCLIMATE3136

### Persistent shift of the Arctic polar vortex towards the Eurasian continent in recent decades

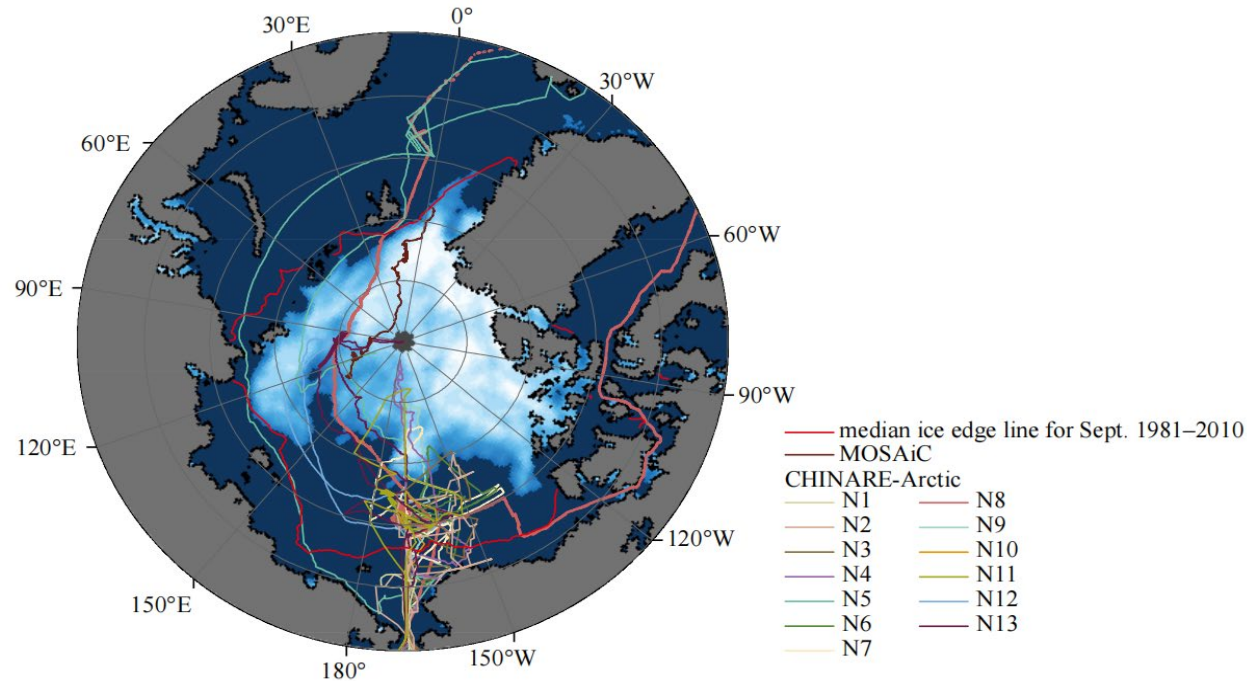
Jiankai Zhang<sup>1</sup>, Wenshou Tian<sup>1\*</sup>, Martyn P. Chipperfield<sup>2</sup>, Fei Xie<sup>3</sup> and Jinlong Huang<sup>1</sup>

A comprehensive understanding of the climate and environment changes have been made, including acidification in Arctic, Arctic vortex shift and evolution of polar cap ionization patches.



# ▶ CHINARE: International Science Platform

## CHINARE(Chinese Arctic Research Expedition)



Nation	USA	Russia	French	Korea	Japan	Iceland	Thailand	Canada	Singapore	Columbia	German	Estonia
Number	13	16	14	5	4	2	2	2	1	1	1	1

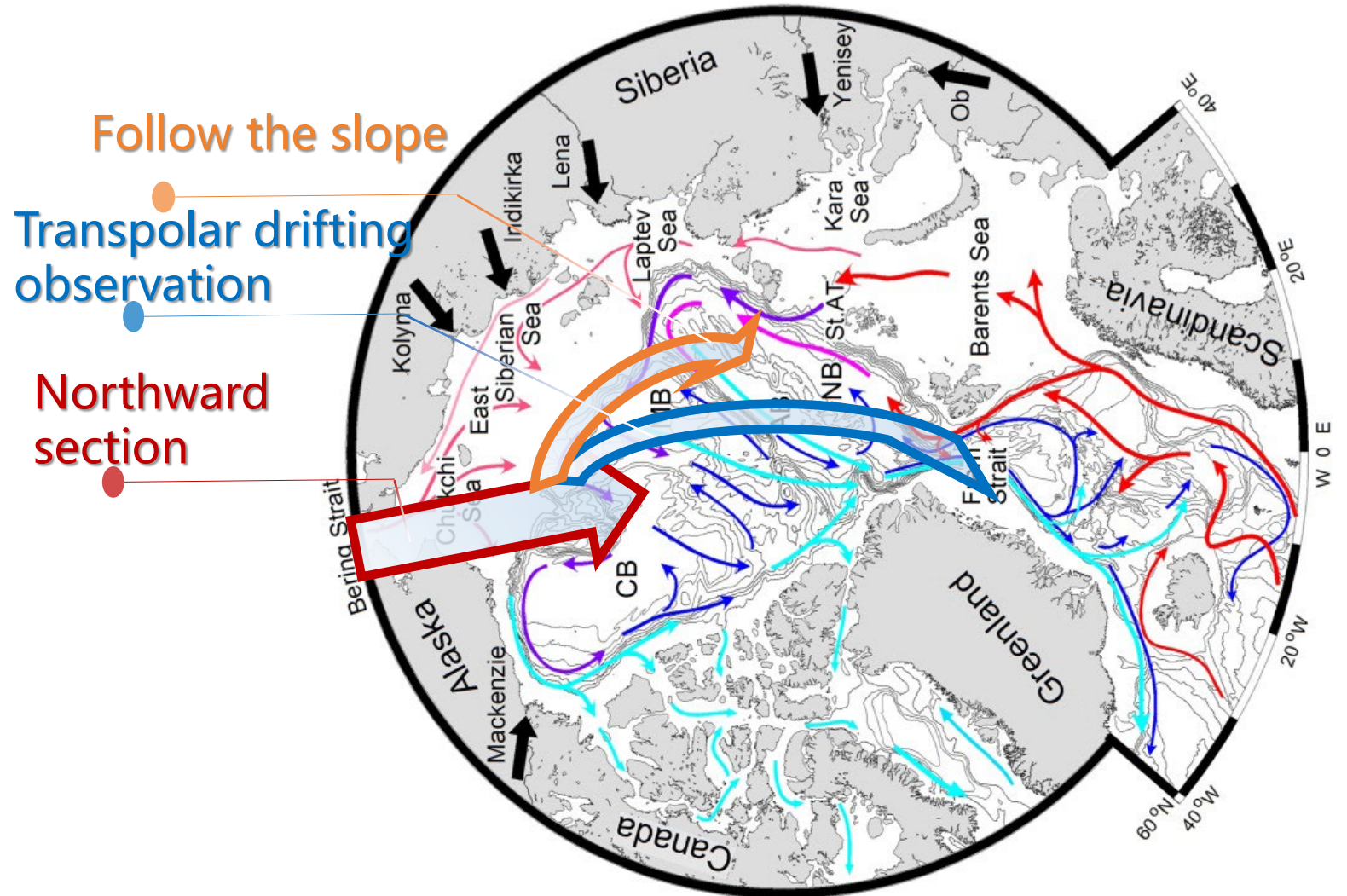
Since China organized its first Arctic Science Expedition in 1999, a total of 72 foreign scientists from over 15 countries and regions have participated in its scientific research expeditions. China has always been committed to making CHINARE a model for international cooperation in the Arctic.

# IPY-5 National Vision in Arctic

## Material and Energy Exchanges crossing the Arctic Shelf and Basin and Its Climate and Ecological Effects/MEE-CEE

### Task

- Cross shelf material and energy transport
- Ecosystems and biodiversity
- Carbon budget
- Pacific and Atlantic inflow water and their range of influence
- Changes in sea ice volume and freshwater budget
- Key Arctic regions affecting weather and climate in Asia



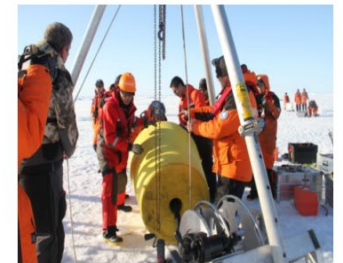
# ▶ CHINARE: Infrastructure improvement in IPY5



Manned submersible



12th CHINARE



ITP in the 6th CHINARE



polar ARV in the 6th CHINARE



Xinghai 1000 in the 13th CHNARE



Unmanned Ice Station:  
in the 11th CHINARE

# ▶ Xuelong 2: Adaptive from summer to winter



- Upgrade: Air-condition, Heating system, CTD.....make Xuelong 2 adaptive to -25°C
- Successfully conduct Ross Sea Cruise in April 2005
- Gathering Operation experience in winter

# Recording the Environment and Ecosystem Changes in the Central Arctic Ocean (RecCAO)



## Project objectives:

Focusing on the key scientific issue of “Rapid environmental change and ecosystem response in the CAO”, carry out the atmosphere-ice-water multi-sphere observations and research, obtain data on the atmosphere-ice-water ecosystems in the CAO, reveal the structure and the regulation mechanism of ecosystems, predict future developing trends of the ecosystem under the rapid changes in the Arctic Ocean and jointly respond to the challenges of global climate change, provide scientific bases for the assessment of the Arctic ecosystem and the conservation of biodiversity, and contribute to other international collaborative projects .

## Research topics:

1. Physical properties and interactions of atmosphere-ice-water interfaces
2. Dynamic processes of the upper ocean in the rapidly melting ice zone
3. Spatio-temporal changes in sea ice biota and biodiversity
4. Response of Arctic Ocean ecosystem to rapid ice decreasing
5. Ecological effects and trends under rapid Arctic changes