Recent Progress in Asian Cryospheric Researches

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In recent decades, cryosphere in high Asia and the northern Eurasia continent has been decaying widely. These changes have exerted important impacts on availability of water resources, ecology, regional climate and environment. The key issues that should be currently addressed are: 1) fluctuation mechanisms of different types of glaciers in responses to climate changes and the scale-conversion in assessments of glacial water resources; 2) observations and modeling of water and heat exchanges within frozen soil and between frozen soil and vegetation; 3) parameterization modifications of physical processes associated with the cryosphere as well as their coupling with climate models. Towards full solution of these key issues, studies in following three aspects should be highlighted, i.e. cyrospheric processes and their responses to climate changes, influences of cryospheric changes, and adaptation strategies for cryospheric changes.

Four major research programs have been launched in China in recent years for understanding the above scientific questions.

1) Cryospheric processes and its mechanisms of influencing climate, ecology and hydrology: adaptation strategy (2007-2011). Seven benchmark glaciers were selected for comprehensive monitoring in order to understand the response of different types of glaciers (maritime, continental and polar) to climate changes. Two supersites, Urumqi River basin and headwater area of Yangtze/ Meikong/Yellow rivers, are selected to study impacts of cryospheric changes to arid lowlands' ecology and plateau ecology, respectively. Hydrological impacts by cryospheric changes from circum-Tarim River basin and Himalayas are specifically focused.

(2) The second phase of glacier inventory on High Asia (2008-2012). Using remote sensing data together with widespread in-situ calibrations, the second inventory of glaciers is expected to be more precise and shorter time-consume than the first inventory which spans the period 1970's-1990's. The recent inventory will produce snapshots of glaciers in recent years, laying a solid base for assessment of their long-term changes (1970s-) and every 5-yearly fluctuations after 2000 AD.

(3) The inventory of frozen ground on Tibetan Plateau (2009-2013). Detection of frozen soil (depth, ice content, soil temperature, vegetation, ground/atmospheric interaction, etc) is performed over Tibetan Plateau. Echo radar sounding, boreholes and some new technologies are used for investigations. The results are expected to assess the water balance of frozen soil, stability of frozen ground under climate warming, carbon pool effects, etc.

(4) Cryospheric roles in East Asian summer monsoon (EASM) (2007-2010). In the Chinese COPES program, it is aimed to detect and diagnose the relationship between Eurasia cryosphere (snow cover and frozen soil) and regional climate

variability, particularly their associations with EASM circulation and rainfall variability.

The programs have some important findings such as regional pattern of glacier changes, total estimation of ice content in frozen ground on Tibetan Plateau, contributions of meltwater to river discharge, mechanisms of cryospheric changes impacting monsoon system, paramerization of vegetation in active layer of permafrost. The updated researches, including data analysis and numerical simulations, showed that snowcover and frozen soil variations may produce impacts on East Asian climate variability, and spring Eurasian continental snow cover along with Arctic sea ice become a complementary precursor for rainfall variability in EASM regions. More scientific results are expected to be shown in recent future years.

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