New Space Observation of the Global Cryosphere

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Quantifying changes in Earth’s ice sheets and identifying the climate drivers are central to improving sea level projections. But it is a pity that the future sea level is difficult to predicted. Space observation can provide global multiscale long-term continuous monitoring data. And it is very important for understanding intrinsic mechanisms, improve models and projections and analyze the impacts on human civilization.

Several satellites are applied for Global Cryosphere Watch, including sea ice extent and concentration, ice sheet elevation, glacier area and velocity. Although there are many variable can be measured by satellite sensors. But several variables need to improve the observing capability and developing new methods. Such as snow depth on ice, ice sheets thickness, and permafrost parameters. China has established high-resolution earth observation system to realize stereopsis and dynamic monitoring of the lands, the oceans and the atmosphere.

Currently, Qian Xuesen Laboratory working together with Sun Yat-sen University, is trying to design a new space observation system to support Three Poles Environment and Climate Changes project. We are conceptualizing two series satellites including FluxSats and BingSats for carbon/water cycle and cryosphere observations, respectively. To clarify the mechanism of the cryosphere carbon release and carbon sink effects of the oceans and ecosystems. We are developing a new lidar system for detecting the concentration and wind speed, and then atmospheric boundary layer flux exchange can be estimated. To understand the rapid change of the sea ice, such as drift, fragmentation and freeze. We need a short revisit and wide swath system capabilities. InSAR technology gives the digitial elevation of the ice surface. And temporal difference InSAR (DInSAR) shows the changes of elevation. BingSAT-Tomographic Observation of Polar Ice Sheets (TOPIS) achieves the tomographic observation of polar ice sheets with a wide swath and short revisit time. Over the polar regions, the CubeSats form a large cross-track baseline with the master satellite to realize the high two-dimensional spatial resolution with the along-track synthetic aperture. The MirrorSAR technology is utilized in BingSat-TOPIS to achieve time and phase synchronization more economically than the traditional bistatic radar. Sparse array and digital beamforming are also considered to significantly reduce the number of microsatellites, and achieve tomographic images of polar ice sheets.