

The Need for Data and Technology Integration to Observe Tundra Wildfires at Multiple Scales

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Arctic systems are changing more rapidly than any other systems around the planet as a result of changing climate (IPCC 2007). As the Arctic plays major role in global climate feedback, any changes in the Arctic affects other parts of the world. The indispensability for observing changes in the Arctic brought people and institutions on a common platform for data acquisition and research. There are various networks and groups are already in place, formed by both Arctic and non-Arctic nations. Numerous studies have been carried out in different spatial and temporal scales on various dimensions of Arctic human and physical systems. Both field measurements and remotely sensed data have demonstrated their strength in identifying complex patterns of environmental changes. However, over the past decade there has been a growing need for circumpolar observation as a result of heterogeneous nature of challenges faced across the Arctic. Studies have shown that the nature and dynamics of wildfires in the North American Arctic and European Arctic tend to be different as a result of contrasting biophysical and bioclimatic factors (Rogers et al. 2015). To better understand the variations, patterns and processes of these phenomena, integrating regional dataset into a comprehensive global dataset has its merit in conducting circumpolar observation.

Existing satellite observing systems collect global datasets that is very useful as they provide necessary spectral bands to capture phenomena such as wildfires. A wide variety of global-scale satellite observations are currently available to monitor these events worldwide, however, only some of them have been engaged in conducting observation of polar environments. For instance, Fire Information for Resource Management System (FIRMS) delivers global fire locations (with fire intensity measures) in easy to use formats captured by MODerate Resolution Imaging Spectroradiometer on board NASA's Earth Observing System (EOS) Terra (EOS AM) and Aqua (EOS PM) satellites. These are near real-time observations (available for the last 24 hours) of active fire hotspots that are useful for observing both global and regional changes in wildfire events. Temporal and spatial dimensions of these datasets facilitate tracking fire progression both spatially and temporally. That is, we can identify spatial and seasonal patterns of Arctic wildfires in relation to changing climatic parameters. We have been using these MODIS datasets to study the spatio-temporal dynamics of Arctic tundra wildfire on a circumpolar basis. However, the observations of these wildfires are only available since 2000 and onward. Another opportunity is to broadly and jointly use hyperspectral and moderate to high resolution imagery collected by early sensors and systems (e.g., Landsat, EO-1 Hyperion, SPOT) that also provide useful data to study wildfire events, but with limitations (Zhang et al. 2003). These observing systems were not developed in sole purpose to collect information from the Arctic. Moreover, there are disturbances involved (e.g., cloud cover) and also, they don't provide finer-scale detail essential to make ground-to-satellite comparisons to study region-wide change (LaRue et al. 2013).

Although previous reports of the Arctic Observing Summit (AOS) have already discussed the need for 'accurate and continuous' data record, it is time to develop multiscale systems for simultaneous observations involving satellite, airborne and ground components. The wider use of low-altitude remote sensing instruments (UAVs) and methods could be effective in monitoring wildfire events in the Arctic at regional scales. However, not only high cost and technical difficulties are involved with these novel

approaches, but also these applications are limited to small geographic area. In this perspective our suggestions are:

- 1) Create tundra wildfire knowledge hubs in key regions that will ultimately be integrated into circumpolar observation network;
- 2) Within these knowledge hubs, initiate simultaneous deployment of multiple sensors (both satellite, airborne/UAVs) and ground-based observation systems at regional scales to better understand the relationship between tundra's insitu bio-geo-physical characteristics (e.g. moisture stress, evapotranspiration, biomass, etc.) and remotely sensed data (hyperspectral, high-resolution, thermal, etc.);
- 3) Intensify data sharing and knowledge exchange that help various stakeholders in terms of cost-effectiveness, easy accessibility, reusability and efficiency;
- 4) Engage already existing global fire data more effectively in studying local/regional wildfire events in the circumpolar Arctic.

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