Photo: Andrei Stepanov/Shutterstock.com

3.6 LAND COVER CHANGE

Data collection in the Arctic is logistically challenging and very resource intensive, and as a result, data are sparse and disparate (Jenkins et al. 2020). Remote sensing data have frequently been used for specific studies at focused locations across the Arctic. However, few large-scale studies, at the landscape or pan-Arctic scale, have been conducted. Recognising these challenges and the need for a more comprehensive understanding of change across the Arctic, CAFF, through its Land Cover Change Initiative (CAFF 2020), developed a set of physical and ecological parameters) that represent key elements dictating seasonal processes in Arctic terrestrial ecosystems. (Box 3-5). These were analysed between 2001 and 2017 using a standard remote sensing platform (MODIS) to help understand changes occurring and evaluate remote sensing for use in Arctic biodiversity monitoring and assessment. A key challenge is to translate what these mean on the ground for Arctic terrestrial biodiversity and how this assessment coupled with the CBMP Terrestrial Biodiversity Monitoring Plan (Christensen et al 2013) can help improve our understanding of biotic responses to these broad-scale drivers.

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The Land Cover Change Initiative analysis showed that significant change is occurring in the Arctic's terrestrial ecosystem and identified statistically significant temporal rates of change across several parameters. The results (Figure 2-5) corroborate past findings indicating strong signals of ecosystem change in the Arctic terrestrial environments, for example, regarding vegetation greening. An important outcome of this work is helping to develop an understanding of the status of spatial and temporal trends across multiple parameters simultaneously and serving as potential explanatory variables for in situ changes observed across FECs.

The aggregated average annual pan-Arctic data showed significant temporal trends in land surface temperature and NDVI with both significantly increasing in CAVM (Fig 1-2) subzones A, B, D and E, and displaying a north–south variability in the seasonality of temperature change. The northernmost CAVM subzone experienced significant increasing temperatures in the autumn, winter, and spring, while the southernmost CAVM subzone showed a significant increase in temperature in late spring to early summer.

Three parameters for phenology were analysed: green-up date, senescence date and growing season length. Results indicated an earlier green-up by approximately six days and a growing season length extended by approximately four days, from 2001 to 2014. Subzones C and E showed a significant decrease for green-up date (by 4.5 days) and a shift to an earlier start to the growing season (by four days) over the 14 years. Subzones B and E showed a significant increase in growing season length (5 and 3.5 days respectively). No significant trends were observed in senescence date. There is a greater year-to-year variability in the date of senescence than green up, with results showing a somewhat cyclical trend.

No significant trends were observed in the average annual percent snow covered areas, although time series for individual months revealed significant trends—for example, significant declining trends were observed in subzones C and D for June, in subzone E for July and in subzones A and B for October. Observations of the seasonal data indicate a significant declining trend from 2000 to 2011, followed by a significant increasing trend from 2011 to 2014 in subzone B. No other significant seasonal trends were identified. No trends were found in the average annual burned area across the pan-Arctic with no burned areas found in subzones A and B.

A set of five parameters were also analysed for the Arctic's marine ecosystem—marine chlorophyll, coloured dissolved organic material, sea surface temperature, marine primary productivity, and sea ice extent. Both the terrestrial and marine environments experienced similar amounts of change with more statistically significant trends being observed in seasonal data. The rates of change of NDVI and sea ice were approximately the same.

The Land Cover Change analysis shows that significant change is occurring in the Arctic. We need to determine how resilient the Arctic is to these changes and where there may be certain thresholds, '"tipping points',' beyond which an abrupt shift of physical or ecological states occur. Only with a combination of in situ data, remote sensing data, and an understanding of the processes occurring at different scales can we begin to understand change in the Arctic Therefore the analyses developed in the Land Cover Change initiative should be repeated regularly to support CBMP efforts to improve our understanding of status and trends in the Arctic biodiversity.

Greenland willows. Photo: Skip Walker

BOX 3-5. PARAMETERS ANALYSED IN THE LAND COVER CHANGE INITIATIVE

- Land Surface Temperature
- Percentage of snow-covered area
- Normalised Difference Vegetation Index (NDVI)
- Enhanced vegetation index
- Green-up date
- Senescence date
- Growing season length

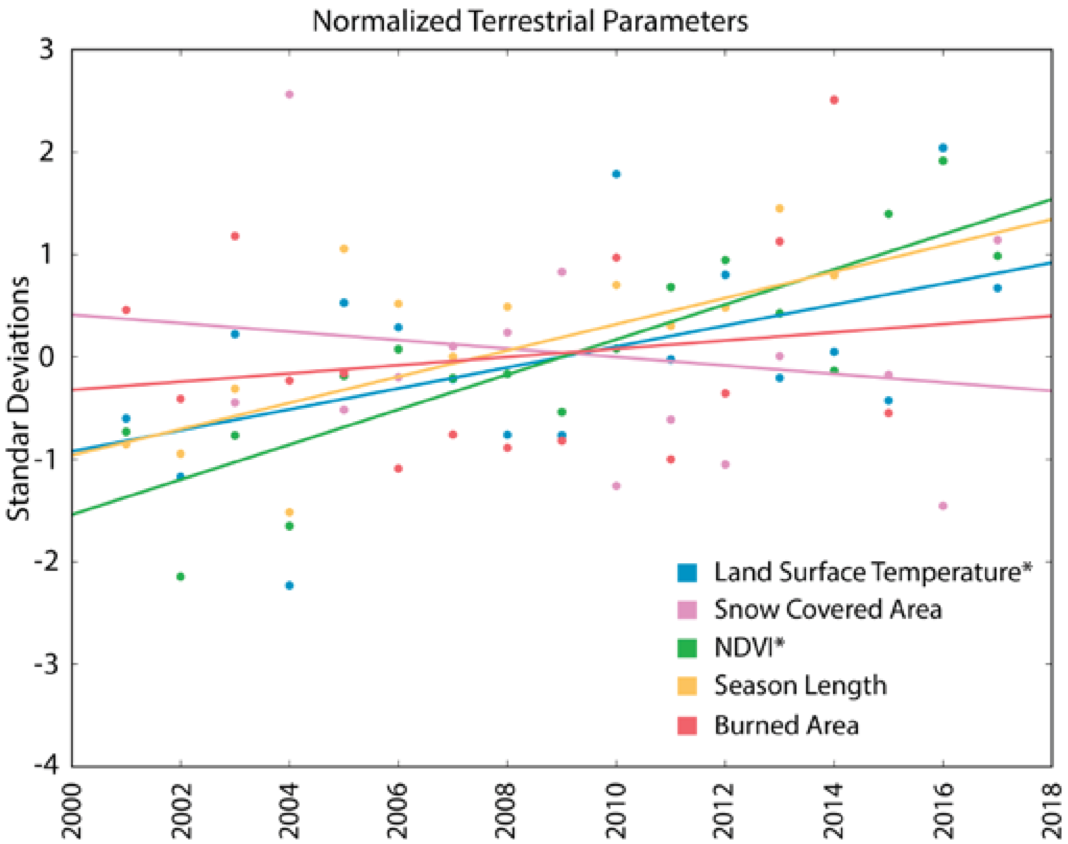

*Figure 3-33. Rates of change among different terrestrial parameters, using average annual standardised data for the pan-Arctic. *identifies parameters with statistically significant trends*