Contemporary changes of climatic and environmental conditions occurring in the last decades have a crucial impact on the dynamics of forest growth and stability. The global warming has increased the frequency and intensity of extreme weather events such as droughts that, in turn lead to severe and permanent damages in forest ecosystems. The risk of forest die-off and an increased forest sensitivity to natural and anthropogenic factors renders the need for continuous monitoring of forest conditions. Understanding of forest ecosystem processes is crucial for forest sustainable management under the changing climate. Due to the great diversity of the forest disturbing factors, their analysis has to be preceded by a detailed and comprehensive examination of forest stand parameters, site characteristics, nutritional status and their link with the weather conditions. The field measurements performed over the large geographical extent are very costly and not feasible to undertake in a relatively short time. In addition, there is no homogeneous ground measurement record that allows to track forest disturbances and mortality through space and time. Therefore, monitoring and analysis of observed changes in forest ecosystems based solely on the field measurements is insufficient. The advanced satellite remote sensing techniques provides datasets allow for detection and monitoring of forest changes in time and for monitoring forest condition over a large geographical extent, at regional and national scale. There is a need for the cost-effective system to monitor the forest condition over the large areas that would improve understanding of reduced stability of forest ecosystems, explain the interactions between drought and deterioration of forest conditions, and identify the primary drivers of the forest die-off. In the proposed project the research will focus on most important forest forming tree species in Poland, i.e., Scots pine, oak, Norway spruce, silver birch, silver fir, and European beech. There are of great environmental and economic importance, and at the same time, that are the most susceptible to disturbances and die-off. The novel aspect of the proposed project is related to a comprehensive and multi-dimensional spatio-temporal approach towards understanding of the forest responses to climate change by means of a new generation of satellite sensors such as Sentinel-2, and Planet. The high spatial and temporal resolution of satellite images is the basic advantage when examining the forest health condition using remote sensing techniques on a local and regional scale. The detailed analysis of the forest stand characteristics, forest disturbances, site parameters, forest site productivity, and soil condition in respect to weather conditions will allow for better understanding the complex effect of multiple factors on forest health condition. The data on the amount of wood removed in sanitary cuts will be used as the primary data source for the forest disturbances. By integrating the spatio-temporal satellite data, with the forest stand characteristics and weather conditions, the magnitude of the relationship between forest status and weather condition for each individual forest stand will be determined. In order to predict large-scale deterioration of forest habitats, various machine learning approaches and empirical models will be employed. This innovative approach will allow the use of various machine learning methods in detecting and predicting areas affected or at risk of drought and damage to stands. Furthermore, a dense time series of Sentinel-2 in combination with daily coverage of the very high resolution PlanetScope and Dove images will be studied to find out if multi-sensor approach will allow to track changes related to the causes of the sanitary cuts in particularly the life-cycle of bark beetles and droughts. The advantage of satellite remote sensing is also the possibility of going back in time. The project will include long-term analyses of trends and anomalies in the vegetation index calculated based on the data from low-resolution MODIS satellites in the period 2000-2020. Comparing the data on the variability of vegetation indices with climatic parameters and information on the forest disturbances will make it possible to understand to what extent the changes occurring in the stands registered in different spectral ranges are related to climate change. This analysis will be performed at the regional and country scale. The results of the project are essential for progressing the knowledge on the effective measures of the forest ecosystem resilience and vulnerability to global warming, a long-term climate mitigation action and biodiversity conservation. The results of the research will lead to the development of indicators and methods which could be used in the future to estimate quantitative and qualitative changes in the health condition of forests on a local, regional and national scale.