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Assessment of the impact of the Cordón Caulle 2011 tephra fall on vegetation: an NDVI analysis

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On June 4, 2011, the Cordón Caulle volcano (Chile) erupted after decades of repose, generating a 10 to 14 km high – plume, which, due to the prevailing westerly winds, dispersed about 1 km3 of tephra mostly over Argentina. The impact assessment of the 2011 tephra fallout on Patagonian vegetation was carried out through the analysis of the Normalized Difference Vegetation Index (NDVI). For a preliminary stage, a regional study was carried out using the MOD13Q1 product with a 250 m spatial resolution. This data was acquired by the Moderate Resolution Image Spectro-radiometer (MODIS). The NDVI data products used in this study have been acquired during the month of January, as the photosynthetic activity and growth rates of the studied vegetation reach maximum values during this month of the summer season. The evaluation was done over a time series that encompasses eight years, from 2009 to 2016. Bi-temporal analyses of the NDVI were carried out, comparing year-to-year changes on NDVI indices of the selected area, which has about 100,000 km2. While small changes in the index are observed for the first two inter-annual periods, a significant decrease can be identified for the 2011 – 2012 interlude, forming a NW – SE trending broad strip. When compared with the isopach maps of the tephra deposit and the prevailing orientation of the plume during the eruptive event, it can be seen that this abrupt change in the index clearly reflects a decay on the vegetation activity due to the primary tephra fallout. Since then, vegetation does not show a constant recovery rate. Secondary processes, such as ash re-mobilization and re-deposition, especially important in the windy semi arid steppe, also affected vegetation. In addition, a strong drought period has been affecting the Patagonian steppe for over 15 years.