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RESPONSE OF RIPARIAN VEGETATION ACROSS AUSTRALIA'S LARGEST RIVER BASIN TO INTER AND INTRA-ANNUAL FLOODING: DYNAMICS QUANTIFIED FROM TIME SERIES OF LANDSAT AND MODIS DATA

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ABSTRACT:

Australia is a continent subject to high rainfall variability, which has major influences on vegetation greening. However, the resulting spatial-temporal pattern of flooding and its influence on riparian vegetation has not been quantified.
Here we focused on the floodplains of the entire Murray-Darling Basin (MDB; 72 Landsat path-rows) of Australia as a case study. The MDB is the country's primary agricultural area with scarce water resources impacted by climate change and extensive zones with degrading riparian vegetation.
We advance our understanding of the relationship between climate-driven flooding dynamics and vegetation response at the sub-continental to local scales and across inter to intra-annual time scales based on almost three decades of Landsat and one decade of MODIS imagery.
We use Landsat TM and ETM+ data to synoptically map spatially detailed dynamics of flooding with an internally consistent machine learning algorithm. We derived riparian phenology (Fig below) from MODIS data and attributed differences in vegetation response to flooding dynamics, vegetation types and sub-basin land use.
Vegetation community response to flooding varied in space and time and with vegetation types, densities and location relative to areas frequently flooded. Phenological degradation trends were observed over riparian forests and woodlands in the center and southern parts of the basin that are primarily farmed. These are also areas where flooding regimes have changed the most to less frequent and smaller inundation extents. Conversely, herbaceous vegetation phenology followed primarily a boom and bust cycle related to less extensive flooding dynamics. This pattern was found across different areas of the basin. As expected, flooding regimes and vegetation response patterns were fine grained, confirming the choice of a spatially explicit, internally consistent analysis leading the path for ongoing analysis.
Remote sensing-based monitoring of the response of riparian vegetation to flooding can be used to quantify spatially explicit changes in vegetation community response as the result of climate variability and change and outcomes of land and water management decisions with applicability to other areas globally such as the Nile river basin and Okavango River delta in Africa or the Mekong River Basin in Southeast Asia.

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Riparian vegetation phenological response to flooding: EVI of the first phenological peak in the 2009 dry and the 2010 wet year (A & B), EVI of the second phenological peak in the 2009 dry and the 2010 wet year (C & D), Floodplain and wetland areas in blue (E), and Google Earth view of sample area (F).