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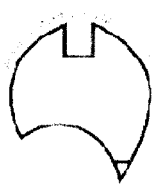

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Inundation patterns and vegetation responses in the Paroo and Warrego catchments using multi-temporal Radar remote sensing

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Keywords: Paroo; remote sensing; wetlands

Abstract

Freshwater is a vital resource in Australia, and its availability is highly variable in semi-arid and arid. Rapidly expanding water resource development in the Murray Darling Basin (MDB) has impacted natural flow regimes and the ecological integrity of many dryland rivers and their large floodplain wetlands. Efforts to manage and conserve the surface waters of rivers in the MDB are hampered by limited scientific data regarding historical and contemporary flow and inundation patterns and of responses of flora and fauna to the high natural variability of flow regimes that typify the lowland-dryland rivers.

Introduction

Remote sensing is a powerful tool for investigating floodplain inundation patterns and vegetation responses in river and wetland systems, particularly for monitoring at a catchment scale. Synthetic Aperture Radar (SAR) microwave satellite imagery has great potential for these uses since it can be used to characterize flooding and vegetation communities independent from cloud cover or daylight, and is available at any time of the day or year (Milne et al. 2007). SAR is particularly well suited to wetland studies because of the ability to detect flooding beneath vegetation canopies, where optical imagery cannot, and because it is sensitive to the di-electric constant which is an indicator for soil moisture (Finlayson & Spiers, 1999; Milne et al.

2008). These qualities make it a valuable data source when regular temporal data acquisition is necessary for wetland monitoring purposes. Airborne scanning laser altimetry (Lidar) imagery compliments SAR data when used to define floodplain channel structure, surface hydrology and vegetation structure and will be used in this research at selected floodplain sites.

Aims

For this PhD research I will use multi-temporal SAR imagery to map floodplain wetland inundation and vegetation responses across the Paroo and Warrego River catchments and to investigate the linkages between flow, inundation and vegetation responses at specific sites by integrating Lidar and optical data. Specific objectives include:

1. Identifying the size of flows in the Warrego and Paroo Rivers required for different extents of inundation events.
2. The application of different remote sensing techniques at selected floodplain sites to determine their ability to provide critical information on wetland landform and vegetation characteristics.
3. Identification of the distribution, size and perennial nature of waterholes in the catchments.
4. Quantification of changes in biomass after flooding using SAR and Landsat and evaluation of their interoperability.

Proposed study area

The study sites will be located in key inland floodplain wetland systems along the Paroo and Warrego Rivers. The Paroo River carries floodwaters through a reticulate system of broad, shallow channels that distribute water into overflow swamps, waterholes, and terminal playa lakes (Goodrick, 1984; Maher & Braithwaite, 1992; Kingsford & Porter,1999) and contains two Ramsar sites. The dominant vegetation within the channels and swamps are Lignum (Muehlenbeckia cunninghamii), River Red Gum (Eucalyptus camuldulensis), Coolibah (Eucalyptus coolabah) and River Cooba (Acacia stenophylla). The wetlands support a wide range of feeding and nesting water birds (Maher & Braithwaite,1992; Kingsford & Porter,1999). The

Paroo has several wetland types that could be investigated including claypans, floodplains, billabongs, swamps and saline and freshwater lake assemblages with lunettes and associated vegetation. Some of these fill from local rainfall so imagery from non-flooded times will also be utilised to characterise the lakes, especially for investigating their changing water chemistry and turbidity.

The Warrego River is the northernmost tributary of the Darling River, and is a variable system, with some sections of stream-bed well defined and other sections comprised of complex braided channels with highly mobile sand beds. The Warrego River supplies water to a number of areas listed on the Directory of Important Wetlands, including floodplains along Cuttaburra Creek, which connects the Warrego to the Paroo River through a system of channels. These two systems have a range of important ecological and social values that must be carefully managed to protect and preserve them into the future.

Field Work

Trips to the selected study sites will be conducted throughout different wet and dry times of the year to measure (ground validate) the flood waterline, water chemistry and turbidity, and vegetation types and condition; all coincident with SAR image acquisition.

Methods

Data sources

- Phase Arrayed L-band (15 – 30 cm wavelength) SAR (PALSAR). Dual polarisation (HH and HV) multi-temporal data (UNSW) through agreement with the Japanese Space Agency (JAXA).
- Landsat TM and MSS (5-band) optical satellite data (UNSW)
- Lidar data in LAS (point cloud) format through MDBA and DECCW

Image classification and processing

SAR data will be used to detect water and flooded vegetation by examination of the backscatter properties of the surface features. Statistical techniques will be applied to SAR data to determine the value of different polarisation combinations for improved classification (Milne et al, 2007).

Field data

Water chemistry data from arid lake sites and vegetation survey data from floodplain sites will be used to develop remote sensing methods to monitor change of state in lake water chemistry and vegetation biomass responses to flooding.

Project outcomes and relevance to the Western CMA Catchment Action Plan (CAP)

The mapping of floods will provide important information on the downstream transference of water from high flow events to the Darling River, and from lateral flow that spreads out across the floodplains; that will provide baseline data for monitoring wetland health. Outputs relevant to the Western CMA will include fact sheets designed to inform managers and landholders on the extent of flooding, potential structures that might intercept flows, and suitability of water sources for people and livestock; as well as providing guidance on the appropriate timing for grazing of wetland water sources in relation to flooding, recommendations on fencing, identification of high conservation value areas for protection of critical habitats, and the importance of riparian and wetland fringing zone vegetation. This innovative, and new research using SAR remote sensing, has the potential to improve our ability to monitor flooding and wetland dynamics, and provide cost effective solutions to broad scale catchment assessment.

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Melrose, R. (2010). Inundation patterns and vegetation responses in the Paroo and Warrego catchments using multi-temporal Radar remote sensing. In: *Proceedings of the 16th Biennial Conference of the Australian Rangeland Society*, Bourke (Eds D.J. Eldridge and C. Waters) (Australian Rangeland Society: Perth).