Paraná River Delta 2013 flood as seen by AMSR-2, SMOS, Aquarius and and SAR systems

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Over the past decade, several flood monitoring/forecasting methodologies based on remote sensing data have been proposed. Among them, the ones based on microwave observations are the most successful, since large flood events and intense cloud covers are often encountered simultaneously. This is a severe limitation of flood monitoring based on optical instruments. In general, flooding increases the moisture of the soil and decreases its roughness. For higher water levels and in presence of vegetation cover, flooding also reduces the height of the emerged vegetation. In extreme cases, water level submerges vegetation. All these processes produce a decrease of the surface emissivity and an increase of the difference between the emissivity measured in the vertical and horizontal polarizations. Therefore, passive microwave polarization index (PI) has the potential to detect the fraction of inundated area and to monitor the increase of water level. These issues have been discussed in several papers (Prigent et al., 2007, Sippel et al 1994, Salvia et al., 2011). Furthermore, the backscattering coefficient is also sensitive to flooding and vegetation condition. In summary, the combination of microwave remote sensing (active and passive) constitutes a good option, in which the best of both systems (high spatial resolution from SAR and high temporal resolution from passive systems) can be exploited for large river basins monitoring. This led us to the development of a methodology to retrieve flooded area in herbaceous wetlands, based on active/passive microwave data (Salvia et al., 2011).

Currently there are several passive systems available, which present different characteristics (resolutions, frequencies, and incidence angles). In this study, we analyze the multi-frequency temporal trends of available radiometers (Aquarius (L Band), SMOS (L Band) and AMSR2 (C, X, Ka Band)) to estimate the fraction of flooded area inside a wetland floodplain. The influence of resolution, frequency and incidence angles are discussed using model simulations. In this case Cosmo Skymed data acquired once every ~20 days is used to compute high resolution flooding maps that are used to re-calibrate the parameters (mainly the Polarization difference of flooded area) in order to enhance the accuracy of passive data flooded area fraction estimation performed with a temporal resolution of a few days to a week.

The Parana River Delta was selected as test site. In April-June, 2013, strong rains fell over the upper Paraná Basin (South of Brazil and North-East of Argentina), leading to the occurrence of a moderate flood wave that reached the lower Paraná Basin (including Paraná River Delta) on July, 2013. In this context, the objective of this paper is to

estimate flooded area fraction from passive microwave data. The general approach is based on the exploitation of the PI from a complete series of passive data, and the use of high resolution flooding maps based on Cosmo Skymed data in specific dates for parameter calibration (Salvia et al., 2011). We show the feasibility to monitor flood condition with the combination of active and passive microwave data, and the effects of spatial resolution, frequency and incidence angle of passive data in the algorithm performance.

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