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Hydraulic description of a flood event with optical remote sensors: a constructive constraint on modelling uncertainties

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The exceptional characteristics of the December 2003 Rhône flood event (particularly high water flows, extent of the affected area, important damages especially in the region of Arles) make it be considered as a reference flood episode of this French river and a very well-known event.
During the crisis, the International Charter "Space and Major Disasters" was triggered by the French Civil Protection for the rapid mapping of the flooding using Earth Observation imagery in order to facilitate crisis operations. As a result, more than 60 satellite images covering the flood were acquired over a 10 days period following the peak flow. Using the opportunity provided by this incomparable data coverage, the French Ministry of the Environment ordered a study on the evaluation of remote sensing's potential benefits for flood management. One of the questions asked by the risk managers was: what type of flood information can be provided by the different remote sensing platforms?

Elements of response were delivered mainly in the form of a comprehensive compilation of maps and illustrations, displaying the main hydraulic elements (static ones as well as dynamic ones), initially listed and requested by hydrologists (more precisely, by a regional engineering society specialised in hydraulics and hydrology and in charge of a field campaign during the event), observed on different optical images of the flood event having affected the plain between Tarascon (upstream) and Arles (downstream).
It is seen that a careful mapping of all flood traces visible on remote sensing event imagery – apparent water, moisture traces, breaches, overflows, stream directions, impermeable boundaries … – delivers a valuable vision of the flood's occurrence combining accuracy and comprehensiveness.
In fact, optical imagery offers a detailed vision of the event : moisture traces complete flood traces extent; the observation of draw-off directions through waterproof barriers reveals hydraulic compartments; high resolution optical imagery allow the exhaustive inventory of breaches and overflows; turbidity variations and draw-off give information on stream directions.
These facts are of primary interest to help in deriving a firm understanding of the flooding processes, but also comprise a powerful source for the necessary parameterization and/or calibration of hydraulic models. Thus the accuracy of flood extents derived from remote sensing data could, on the one hand, be valuable inputs to historical flood info-bases within overall risk-linked databases, and on the other hand, test the validity of hydrological modelling, while helping to lift equifinality uncertainties.

These first investigations highlight that space imagery of events constitutes an unrivalled tool for flood disaster observation. This 2D record is complementary to all field measurements and the integration of "space derived flood products" is valuable for all stages of risk management. This potential of EO optical sensors for flood monitoring is also confirmed in a detailed analysis making a qualitative and quantitative evaluation of the results, confronting ten optical and radar remote sensing platforms with field observations.