CATASTROPHIC GRAVITY FLOW SIMULATION:EROSION, TRANSPORT & DEPOSIT

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We present here a simple mathematicalmodel for the equations of the motion offinite gravity flows. The flow istreated as a deformable geometricalobject, comparable to a semi-lens, wherethe height is small relative to thelength.By rewriting mass, momentum, andparticle concentration conservation lawsin the reference frame linked to thegeometrical barycenter of the object, wemake appear two velocity fields. Thefirst one describing the dynamics of arigid body in translation in the globalreference frame. The second one,symmetrical with respect to theascending axis, describing thedeformation in reference to the localreference frame.Integration of the system over theobject leads to the characterization ofthe temporal evolution of the meanmotion velocity, the spreading velocity,the height and the particleconcentration.Main features of the model include : (1)Turbulence, (2) Spreading due topressure forces, (3) Water incorporationat the suspension-ambient fluidinterface, (4) Particle settling and (5) Particle erosion.The obtained non-linear differentialsystem is solved numerically. Predictions on front velocity anddeposit height are compared toexperimental small-scale model data andshow good agreement. An inversion method is develop in orderto test scenarii. Application to theNice 1979 gravity flow (France),constrain by cable breaks and depositthicknesses, leads, for example, toinitial volume estimation or flowphysical parameters (frictioncoefficient...).Despite some limitations, due to thegeometrical simplification of the flow,this model constitutes a first steptowards quantitative comprehension ofthe impact of external parameters oncatastrophic gravity flow dynamics andon the organization of subsequentdeposit.