Flood Hazard

Scale of 1:1,500,000 on an A0 page

0 50 100 200 km
0 20 40 80 miles

Synthetic description of the flood modeling of Afghanistan (from Hagen, E., Shroder, J.F.Jr., Lu, X.X., and Teufert, J.F. (2010). Reverse engineered flood hazard mapping in Afghanistan: A parsimonious flood map model for developing countries. Quaternary International, 226: 82-91).

Most flood models are based on advanced algorithmic and multiple data requirements that are sometimes difficult to apply in developing countries. These feed-forward models cannot be applied to large areas and can lead to extreme over/under estimations in some developing countries due to extrapolation from inadequate datasets where each additional parameter adds further uncertainty. This study proposes to employ a parsimonious model that only relies on adequate available data reducing forward-uncertainty- propagation. A "reverse engineering" approach that relies on past inundation depths does provide a solution for flood hazard mapping where extracting the flood extent of extreme floods is the primary goal and where only inadequate hydrological input data are available. The feedback method was successfully deployed to create the nationwide Afghanistan Flood Hazard Map (AFG-FHM) at a scale of 1:100,000 using a high-resolution digital elevation model, sample measurements and Dartmouth Flood Observatory past flood data. This paper describes the parsimonious flood map model and general methodology employed to create the AFG-FHM, as it is a robust method to generate extreme inundation outlines, which can be utilised in other developing nations as well.

Conclusion
A parsimonious flood hazard map model based on past inundation extents can successfully be applied in developing countries provided that a DEM with a minimum resolution of 90 m is available and sufficient past flood observation or if the flood depth can be extracted from high-resolution satellite imagery. A few years of flood observations will suffice to create a rudimentary flood maps: the data sets used for the creation of the Afghanistan Flood Hazard Map spanned 5 years. The Dartmouth Flood Observatory has collected global past flood events over the past 10 years and keeps expanding this data set, which will enable improvements of future of flood maps based on past flood extents.
The inundation model based on past floods is stable and it is not essential to include variable Manning's n values. Although inclusion of variable Manning's n values might yield better results in theory, tests revealed that these improvements are hardly noticeable for a medium-scale flood map. The reason for this is not straightforward. This could be the result of either that in the attempt to capture extreme flood events the medium map scale could be a factor, or because the past flood method already stabilises the underlying hydraulic model. Wilson and Atkinson (2003, p. 1581) have also made similar observations stating "spatially distributed friction has a small effect on the flood wave when compared to the underlying elevation data".
The model accuracy is primarily dependent on DEM resolution and not on the inflow rate. For extreme flood extent, mapping the inflow data has limited influence at a mapping scale of 1:100,000. The correct regression method and basin adjustment factor influences the outcome of the model more profoundly; validating and adjusting these data are an essential step, especially when working with different types of DEM and topographical areas. For large-area flood mapping, computational resources play an important role in making modelling decisions. The Afghanistan Flood Hazard Map needed 2.5 months of pure hydraulic processing time on multiple high-end workstations. Additional processing time is needed to correct the DEM, and extract rivers and additional parameters.
By utilising a parsimonious model there will be limitations on the output accuracy, yet the Afghanistan Flood Hazard Map highlighted that such simplified models are a valuable alternative for developing countries where no accurate input data are available.

Date Created: Jan 09, 2011
Map Num: iMMAP_AFG_FLOOD-HAZARD_A0_20110109
Datum/Projection: WGS84/Geographic
For copies or questions contact: afghanistan@immap.org

Data Source:
Flood data: NATO (Hagen et al., 2010)
Rivers: USGS Afghanistan Project
Digital Elevation Modle (DEM), Slope, Hillshade: Shuttle Radar Topographic Mission (SRTM) & United States Geological Survey (USGS)
Adminstrative layers: Afghan Geodesy and Cartography Head Office (AGCHO)
Roads: United States Agency for International Development (USAID)
Lakes, Drainage Basins, & Rainfall: Food and Agriculture Organization of the U.N. (FAO) & Environmental System Research Institute (ESRI)

iMMAP in Afghanistan is funded by The United States Departmentof State/Office for Weapons Removal and Abatement (WRA) and The United States Agency for International Development (USAID)/ Office of U.S. Foreign Disaster Assistance (OFDA)

The boundaries and names and the designations used on this map do not imply official endorsement or acceptance by iMMAP, WRA or USAID/OFDA. All information is the best available at the time this map was produced.

Flood Hazard created with hydraulic modeling from high Resolution Digital Elevation Model (DEM) data by NATO C3 Agency. Layer shows potential inundation extent.

Reference: Emlyn Hagen, NC3A (2008). Afghanistan Flood Hazard Map v.2. 1:100 000. From NATO Consultation, Command and Control Agency, CAT-6, Geo Team. NATO C3 Agency, The Hague, November 2008

Map Disclaimer
The Afghanistan Flood Hazard were created by the NATO Consultation, Command and Control Agency ("NC3A"), Geo-Team. Some flaws and limitations of the data are described below. However, a degree of error is inherent in all maps, especially modeled maps and maps of dynamic events such as floods. Accordingly, the maps are distributed "AS-IS" without warranties of any kind, either express or implied. NC3A shall not accept any liability or warranties for damages incurring from the use of these maps, including but not limited to warranties of suitability to a particular purpose or use. No attempt has been made in either the design or production of the maps to define the limits or jurisdiction of any federal, state, or local government. The map is intended for use only at the published scale.