I. SUMMARY

Using data from the 2010 Schultz Fire near Flagstaff, Arizona, and the 2011 Monument and Horseshoe 2 Fires in southeastern Arizona (Figure 1), we tested 3 models developed by the USGS to predict the probability of postwildfire debris-flow occurrence (Cannon and others, 2010, GSA Bull, 122(1-2), 127-144).

II. MOTIVATION

Following the 2011 Wallow, Monument, and Horseshoe 2 Fires one of the models tested here (Model A) was used to identify burned basins with a high probability for post-fire debris-flows (Ruddy, 2011, OFR 2011-1181, OFR 2011-1197, OFR 2011-1214). Neither Model A, nor the other 2 Intermountain West USGS models (Models B and C), however, have been tested for the varied physiographic provinces of Arizona.

III. POST-FIRE DEBRIS FLOW MODELS

The models use a combination of basin morphometric data, derived using GIS, STATSGO soils data and rainfall to predict the probability of post-fire debris-flow occurrence (Cannon and others, 2010). The probability of debris-flow occurrence is calculated by: 

\[ P = \frac{1}{1 + e^{-(a + bX)}} \]

Three models calculate the variable ‘P’.

- **Model A** uses basin data (SGE30%), (R), and (% AB), soils data (C) and (LL) and rainfall intensity (I).
- **Model B** uses basin data (R) and (% AB), soils data (C) and (OM) and rainfall intensity (I).
- **Model C** uses basin data (%AB), soils data (C), (LL) and (HG) and rainfall intensity (I).

**Model Parameters**

- **SGE30%** = %basin area w/slopes ≥ 30%
- **R** = ruggedness (elev range/basin area\(1/2\))
- **% AB** = % basin area burned at high and moderate severity
- **C** = %average clay content
- **LL** = liquid limit
- **OM** = % organic matter
- **HG** = hydrologic group
- **I** = average storm intensity (mm/hr)
- **GIS Data**
- **STATSGO Soils Data**
- **Rainfall Data**

**Field Data**

During the first summer after each fire, test basins were monitored to document debris-flow occurrence (yes/no) after significant rainfall.

**Rainfall Data**

Rainfall data from tipping-bucket rain gauges were analyzed for the significant rainfall events to calculate total storm precipitation and average rainfall intensity.

**IV. METHODS**

**Average Storm Intensity for 3 Arizona and 2 Colorado Fires**

<table>
<thead>
<tr>
<th>Fire</th>
<th>Average Storm Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schultz</td>
<td>0.10</td>
</tr>
<tr>
<td>Monument</td>
<td>1.00</td>
</tr>
<tr>
<td>Horseshoe 2</td>
<td>0.00</td>
</tr>
<tr>
<td>Flagstaff</td>
<td>0.00</td>
</tr>
<tr>
<td>Phoenix</td>
<td>0.10</td>
</tr>
<tr>
<td>Tucson</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**V. RESULTS**

**Success/ Failure Matrix**

<table>
<thead>
<tr>
<th>Hi P w/DFs</th>
<th>Lo P w/oDFs</th>
<th>Sum (#DFs)</th>
<th>Sum (#no DFs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Pos</td>
<td>False Neg</td>
<td>True Neg</td>
<td>False Pos</td>
</tr>
<tr>
<td>19 Basins, 5 Storms</td>
<td>8 Basins, 3 Storms</td>
<td>6 Basins, 3 Storms</td>
<td>18 Basins, 6 Storms</td>
</tr>
</tbody>
</table>

**VI. CONCLUSIONS AND ONGOING WORK**

- Model A generally performed better than Model B in northern AZ, but not as well in SE AZ. Model C did not work in any of the environments.
- Results from both Model A and Model B plot above and to the left of the 1:1 line on the success/failure graphs, with the exception of the July 20th results from the Schultz Fire.
- Average Storm Intensity was higher for the more poorly performing models.