

Volcanic debris flow from Nevado del Ruiz, 1985



Matata, 2005



Matata, 2005



Fergusons Bush, Westland, 2002

**Nice place for a
holiday cottage?**



Fergusons Bush, Westland, 2003

Maybe Not....



Pipson Creek, Makarora, Otago



Pipson Creek, Makarora, Otago



Pipson Creek, Makarora, Otago



Buller



Harihari, West Coast



Rotomanu, West Coast



**A debris-flow fan
in Death Valley**



A "lobate" bouldery debris-flow fan

Boulders

"Lobes"



Debris flows – what are they? What do they do?

They are:

- **A mixture of water, fine sediment and coarse sediment**
- **Sediment grain-size distribution is whatever is available from source material**
- **Sediment concentration is high (> ~ 50% by volume, >> 50% by weight; > 2 tonnes/cubic metre)**

How do they behave? They:

- **Flow as discrete surges, at maximum depths and velocities greater than normal streamflow**
- **Concentrate coarse material at the surge front**
- **Stop *en masse* (all at once)**

They do the following:

- **Cause deep vertical erosion in sediment or rock**
- **Cause massive aggradation**
- **Block channels**
- **Avulse unpredictably on fans**
- **Destroy structures and vegetation**

Debris flow surge at Jiangjia Ravine, China



**Debris-flow
surge in
Indonesia**



Matata, 2005



Matata, 2005





What causes them?

- **Sufficient mixed-grade sediment available to be incorporated in streamflow**
- **Sufficient surface water (rainfall, snowmelt...) and bed slope available to mobilise sediment**

How big are they?

- **Depends on sediment availability; all sediment available above bedrock can be mobilised by an event**
- **In rainstorm situations – surges up to 5 m high, instantaneous discharge up to the order of $50 \text{ m}^3\text{s}^{-1}\text{m}^{-1}$**
- **In landslide situations – several times bigger?**

Where can they occur?

- **Where they have occurred before OR**
 - **Where new sediment sources have become available (e.g. due to land use change, volcanic eruption, ...)**
- and**
- **In steep, erodible catchments < a few km² in area**
 - **Where fan slopes exceed about 5°**

Specific Creek

