

# Initial preliminary analysis of Vanuatu and Pacific stockpiles

February 7, 2017

Vanuatu

# Overview

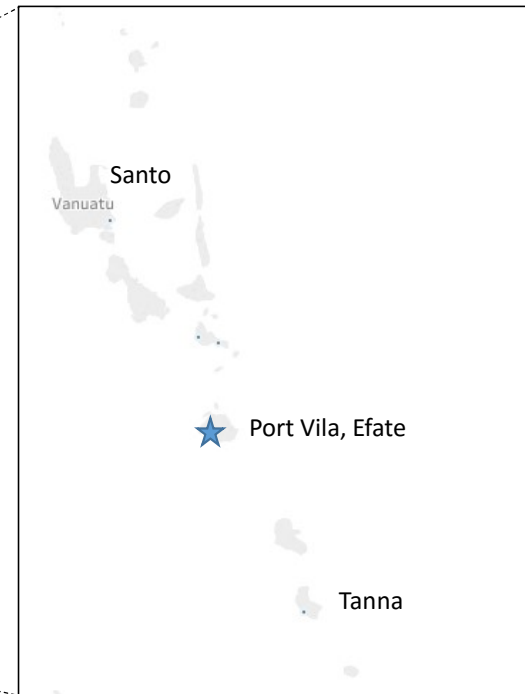
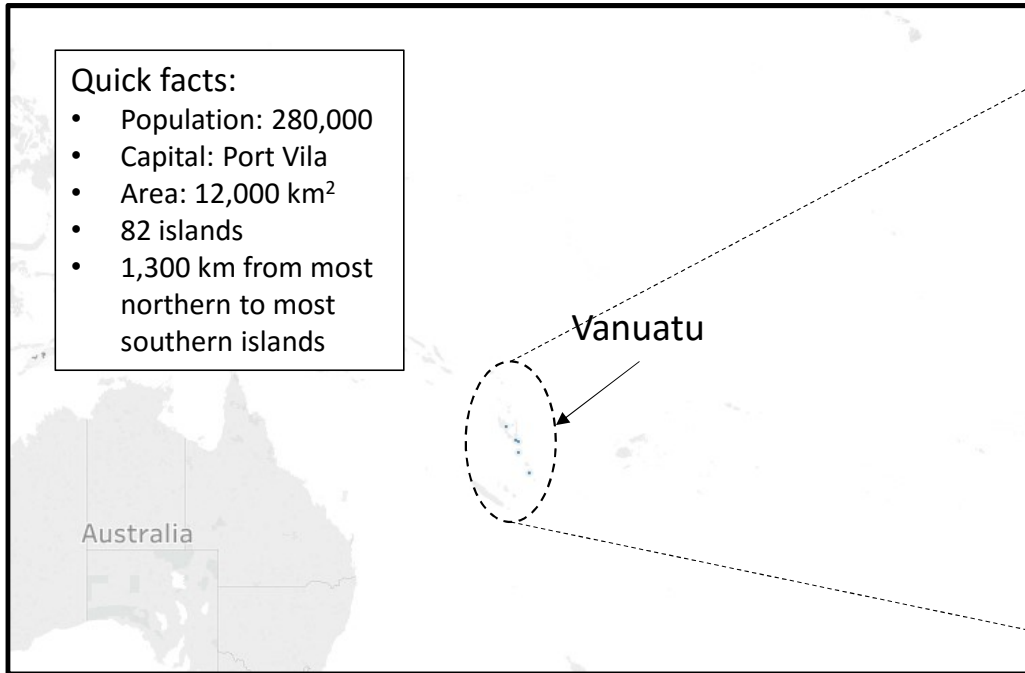
- Goal: Allocate inventory in Vanuatu to minimize average response time
  1. Examine current inventory in a country.
  2. Examine current warehouses operated by all organizations in a country
  3. Allocate that inventory to those warehouses.
- Method: Optimization models
- Data: Pacific Stockpile Mapping compiled by WFP (Florent)

## Assumptions

- Averages are taken over 22 historical disasters in Vanuatu
- We assume everyone affected in a disaster needs the item of interest

**Quick facts:**

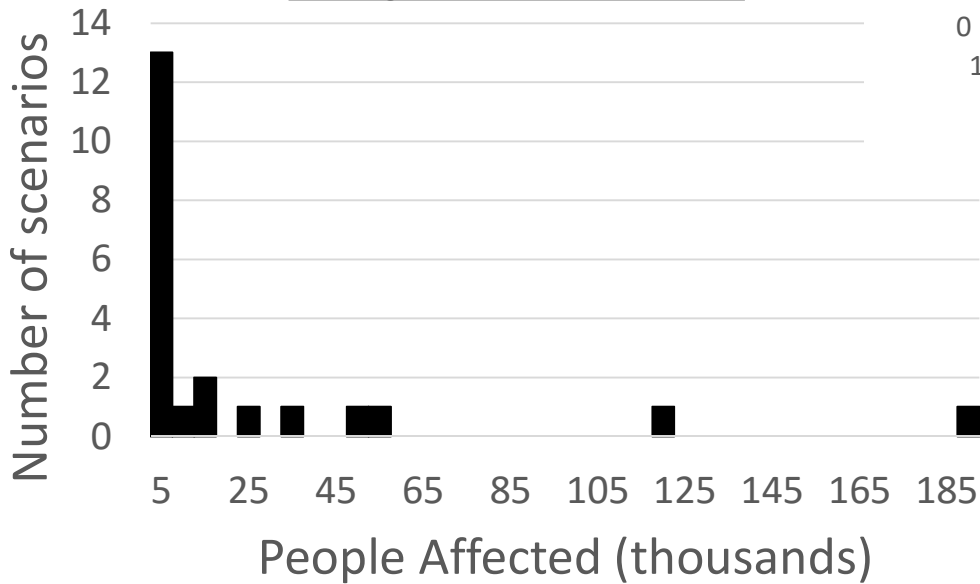
- Population: 280,000
- Capital: Port Vila
- Area: 12,000 km<sup>2</sup>
- 82 islands
- 1,300 km from most northern to most southern islands



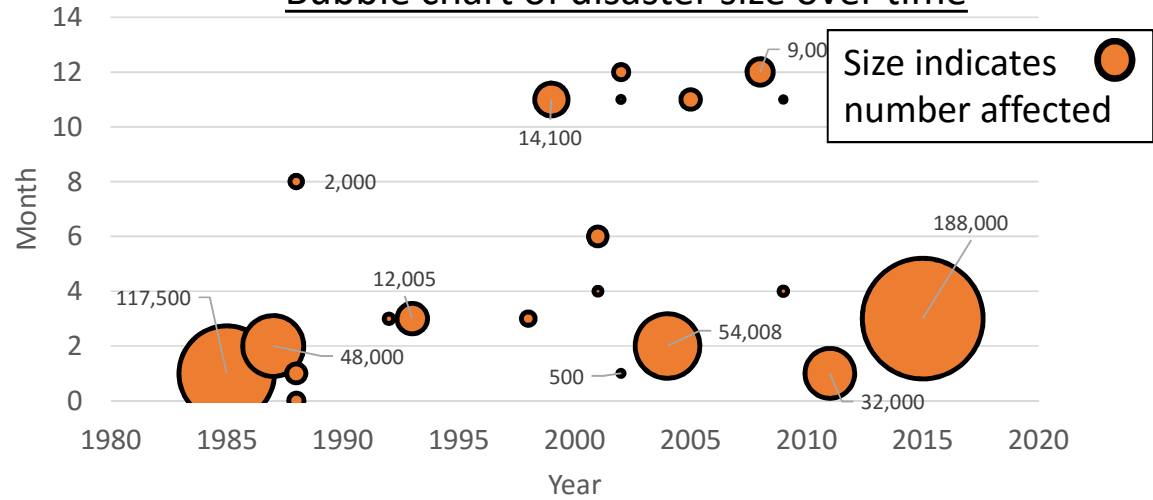
# Historical disasters in Vanuatu

Over the past 35 years, disasters have affected many of the inhabitants (we have 22 disasters on record)

Histogram of disaster size



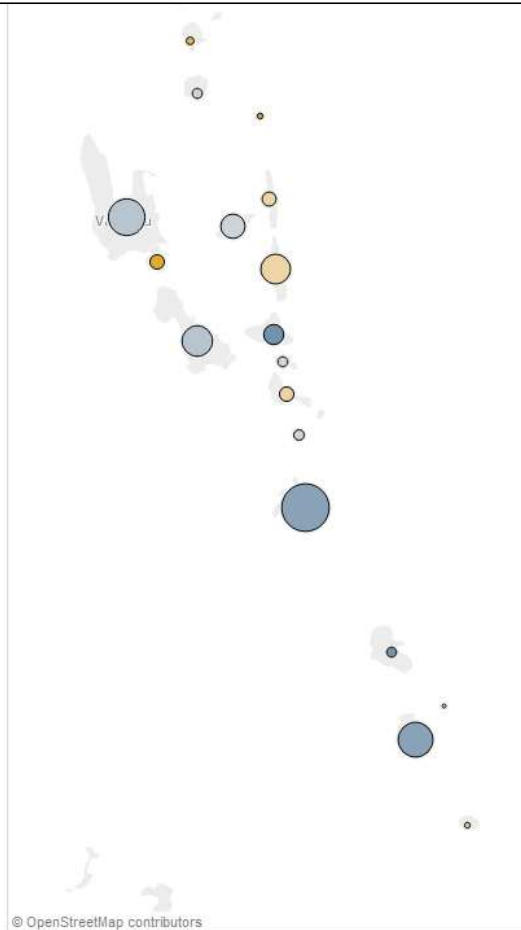
Bubble chart of disaster size over time



Average disaster size:	23,739
Median disaster size (50 <sup>th</sup> percentile):	4,600

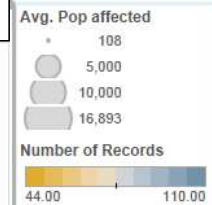
## Disaster locations

(bigger dot means more people affected on average per disaster. Color means how many records we have of past disasters, with blue being a lot and orange being a little.)



## Warehouse locations

(bigger dot means more organizations have a warehouse in that exact location)



# Different storms affect different islands

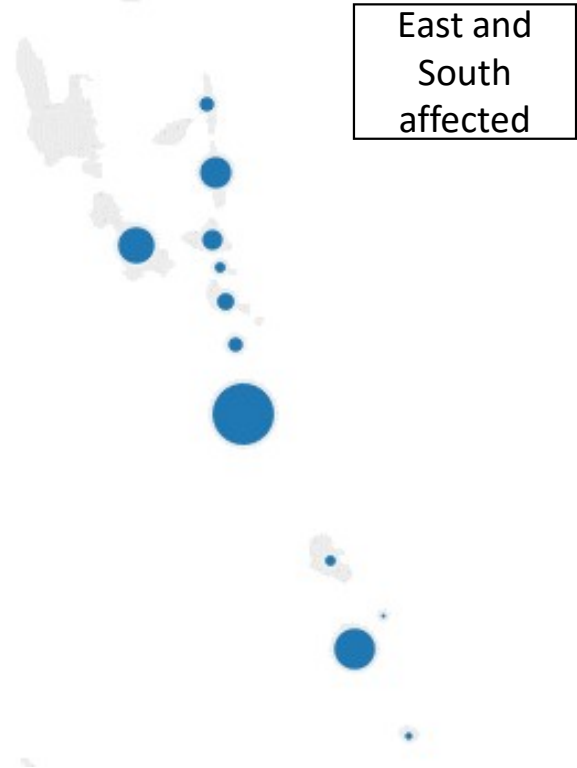
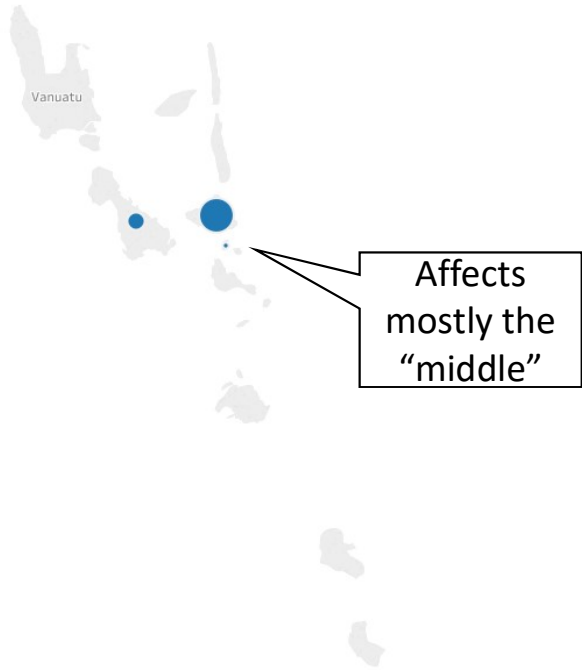
In March, 2015, Cyclone Pam hit Vanuatu, affecting 188,000 people

Size indicates ●  
number affected

**2002 storm**  
3,000 people affected

**2008 storm**  
9,000 people affected

**Cyclone Pam**  
In March, 2015, Cyclone Pam hit Vanuatu, affecting 188,000 people





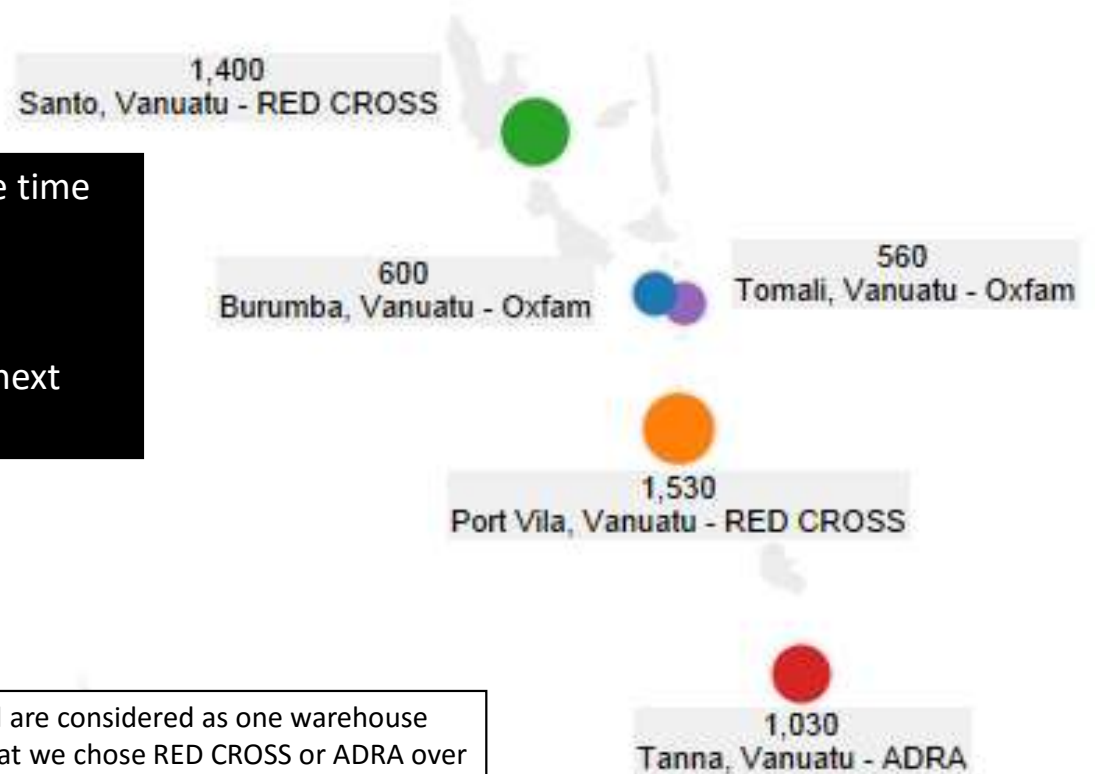
# Optimal allocation of 5116 tarps in Vanuatu

In order to minimize average time-to-respond to the average beneficiary for the average disaster, how should tarps be allocated?

This warehouse allocation allows total average time to be minimized across scenarios.

These warehouses will serve different islands depending on where the disaster strikes (see next slide)

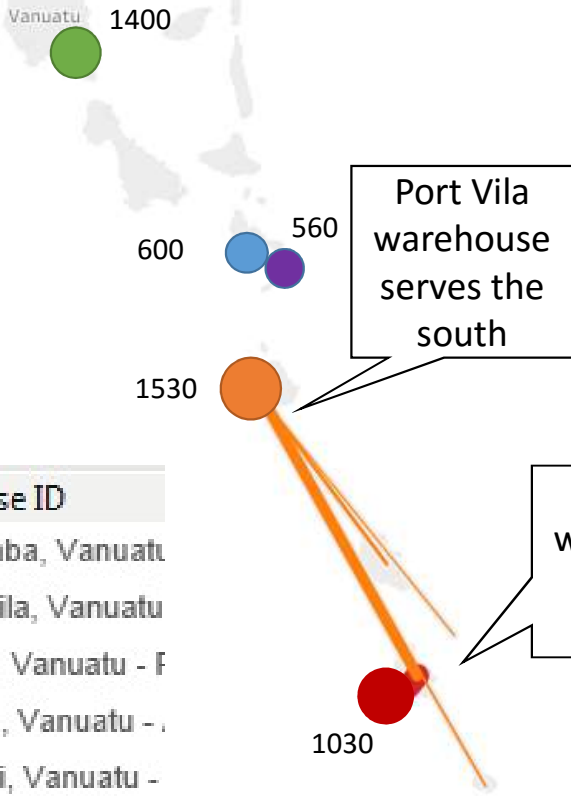
Warehouses on the same island are considered as one warehouse for this analysis (It is random that we chose RED CROSS or ADRA over other organizations)



In order to be able to respond to any scenario (these 3 plus 19 other ones), it is recommended that Vanuatu has 4 main storage hubs. Santo serves the north, Burumba serves the mid-northern, Port Vila is central, serving Efate, the north, or the south, and Tanna serves the south.

**Response for 2002 storm**

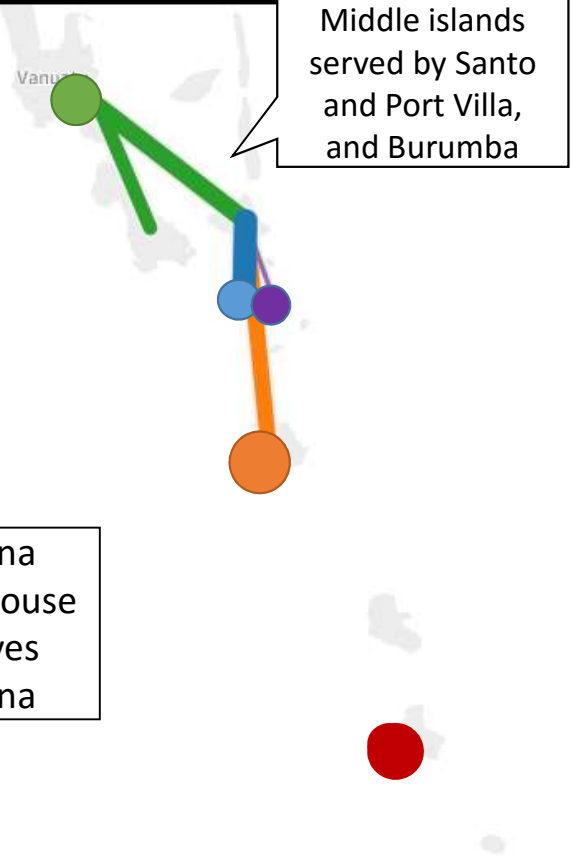
3,000 people affected



Warehouse ID	
Blue	Burumba, Vanuatu
Orange	Port Vila, Vanuatu
Green	Santo, Vanuatu - F
Red	Tanna, Vanuatu - .
Purple	Tomali, Vanuatu -

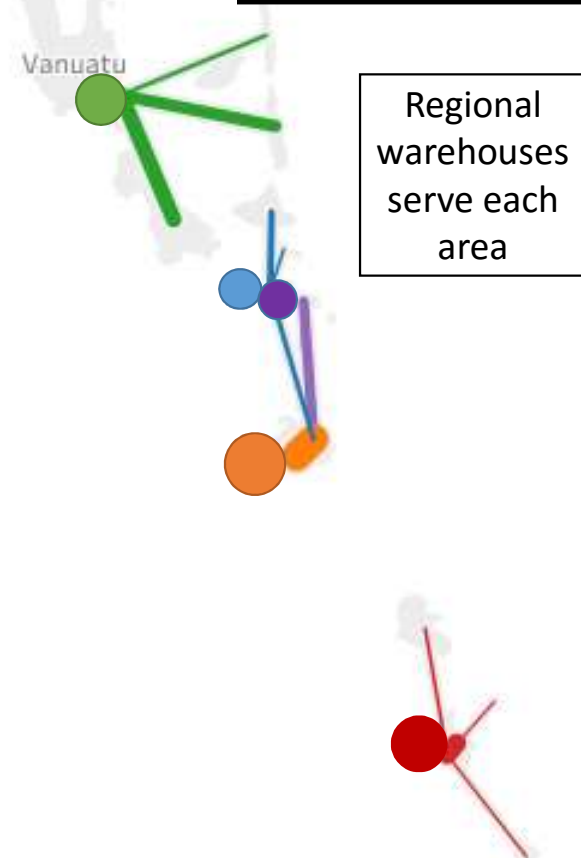
**Response for 2008 storm**

9,000 people affected



**Response for Pam**

188,000 people affected



# Summary statistics for 7 items

Statistics regarding current inventory levels' abilities to meet needs

Based on goal of serving **80%** of disasters without outside assistance

Item name	Inventory	People served per item	People able to be served with total inventory (per capita inventory)	Fraction of disasters can be served with on-hand inventory	Size of 80% percentile disaster (people affected)	Can current inventory serve 80% percent of disasters?	Recommended stocks to serve 80% of disasters	Increase stocks by a factor of:
Blanket	11,006	12.6	139,725	95%	38,400	Y	3,048	OK
JerryCan	5,722	2.5	14,305	71%	38,400	N	15,360	2.7
KitchenSet	3,020	5	15,100	71%	38,400	N	7,680	2.5
MosquitoNet	3,536	2.5	8,840	61%	38,400	N	15,360	4.3
ShelterKit	3,003	5	15,015	71%	38,400	N	7,680	2.6
SleepingMats	1,234	1	1,234	25%	38,400	N	38,400	31.1
Tarpaulin4x6	5,116	2.5	12,790	68%	38,400	N	15,360	3.0

Insight: There seem to be enough blankets.  
Sleeping mats seem understocked.

# Summary statistics for 7 items

Statistics regarding current inventory levels' abilities to meet needs

Based on goal of serving **70%** of disasters without outside assistance

Item name	Inventory	People served per item	People able to be served with total inventory (per capita inventory)	Fraction of disasters can be served with on-hand inventory	Size of 70% percentile disaster (people affected)	Can current inventory serve 70% percent of disasters?	Recommended stocks to serve 70% of disasters	Increase stocks by a factor of:
Blanket	11,006	12.6	139,725	95%	14,691	Y	1,166	OK
JerryCan	5,722	2.5	14,305	71%	14,691	N	5,876	1.0
KitchenSet	3,020	5	15,100	71%	14,691	Y	2,938	OK
MosquitoNet	3,536	2.5	8,840	61%	14,691	N	5,876	1.7
ShelterKit	3,003	5	15,015	71%	14,691	Y	2,938	OK
SleepingMats	1,234	1	1,234	25%	14,691	N	14,691	11.9
Tarpaulin4x6	5,116	2.5	12,790	68%	14,691	N	5,876	1.1

# Optimal location of items to satisfy 80% of disasters

Including only main warehouses

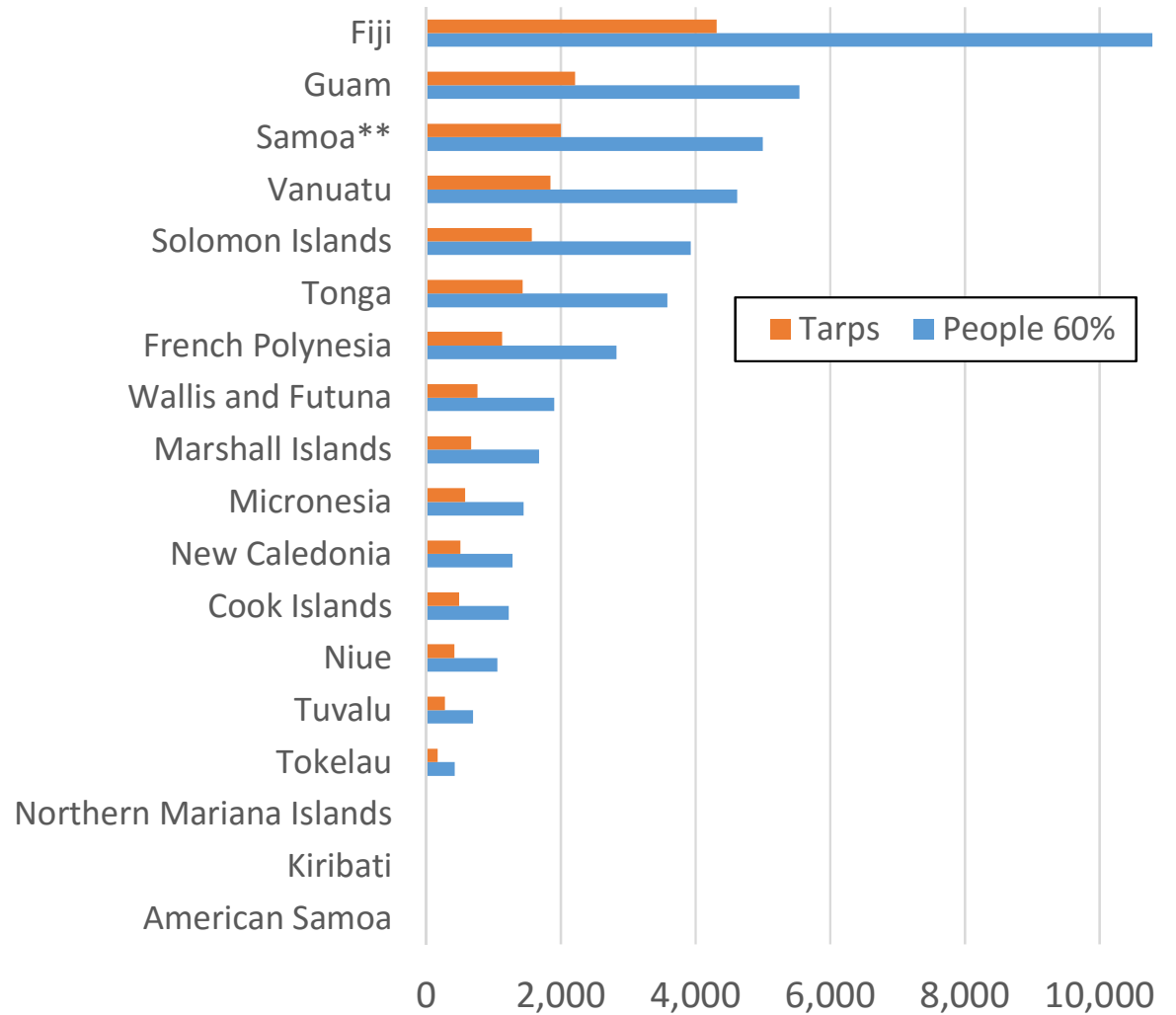
<b>Item</b>	<b>Port Vila</b>	<b>Santo</b>	<b>Tanna</b>	<b>Total</b>
Blanket	4,780	3,980	2,240	<b>11,010</b>
JerryCan	6,280	4,140	4,950	<b>15,360</b>
KitchenSet	3,140	2,070	2,470	<b>7,680</b>
MosquitoNet	6,280	4,140	4,950	<b>15,360</b>
ShelterKit	3,140	2,070	2,470	<b>7,680</b>
SleepingMats	15,700	10,340	12,360	<b>38,400</b>
Tarpaulin4x6	6,280	4,140	4,950	<b>15,360</b>

Pacific

# Pacific region

- Optimally allocate stock across:
  - Countries in the Pacific
  - Depot hubs in Australia, New Zealand, Malaysia
- Ensure that countries store enough stock to cover at least 60% of disasters
  - Even though putting inventory in (say) Vanuatu means that this inventory is not available to respond to a disaster in Samoa, there are other advantages to having inventory in each country

Minimum stock required per country to satisfy 60% of disasters without external assistance



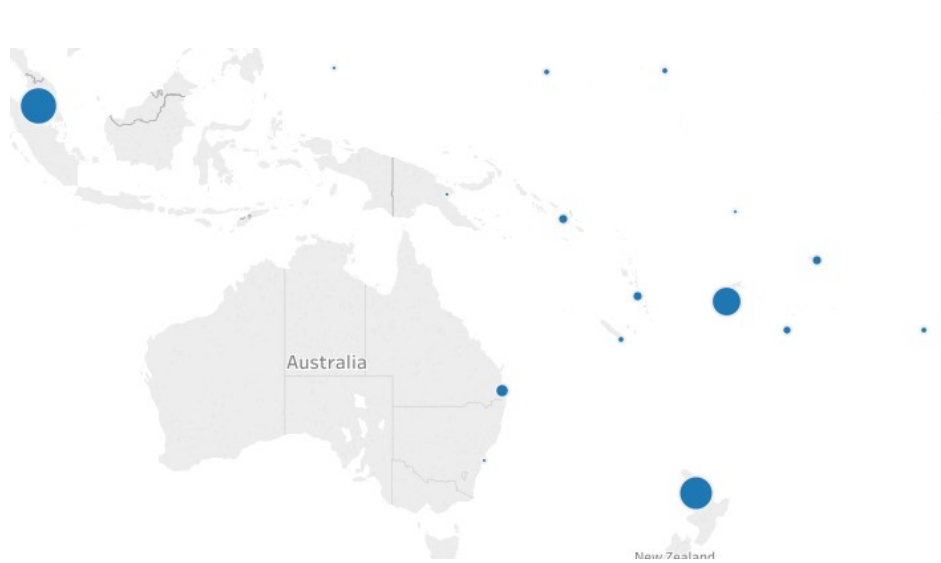


# Tarp allocation across the pacific

## Actual



## Optimal

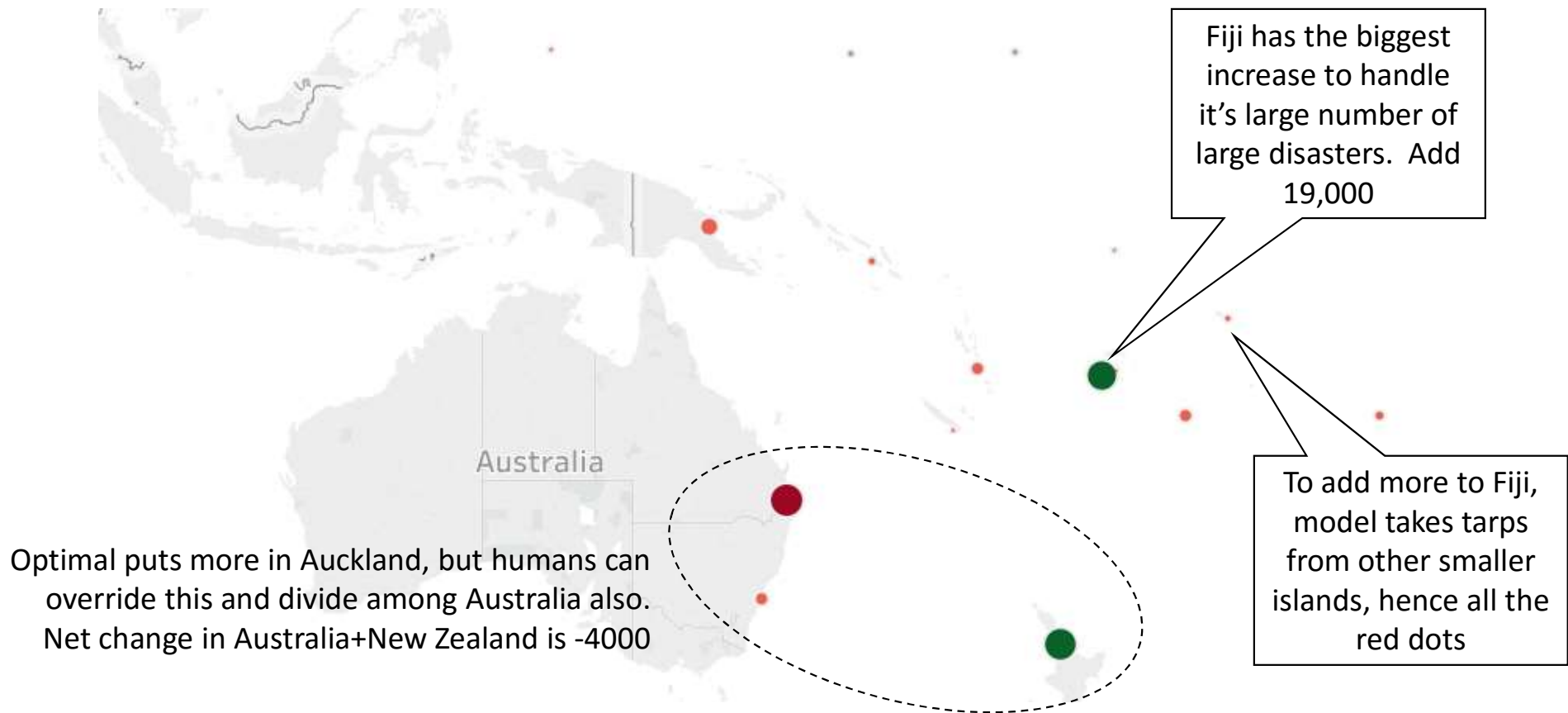


(Assume Subang is fixed inventory and can't be changed)

# Changes between “optimal” and “actual”

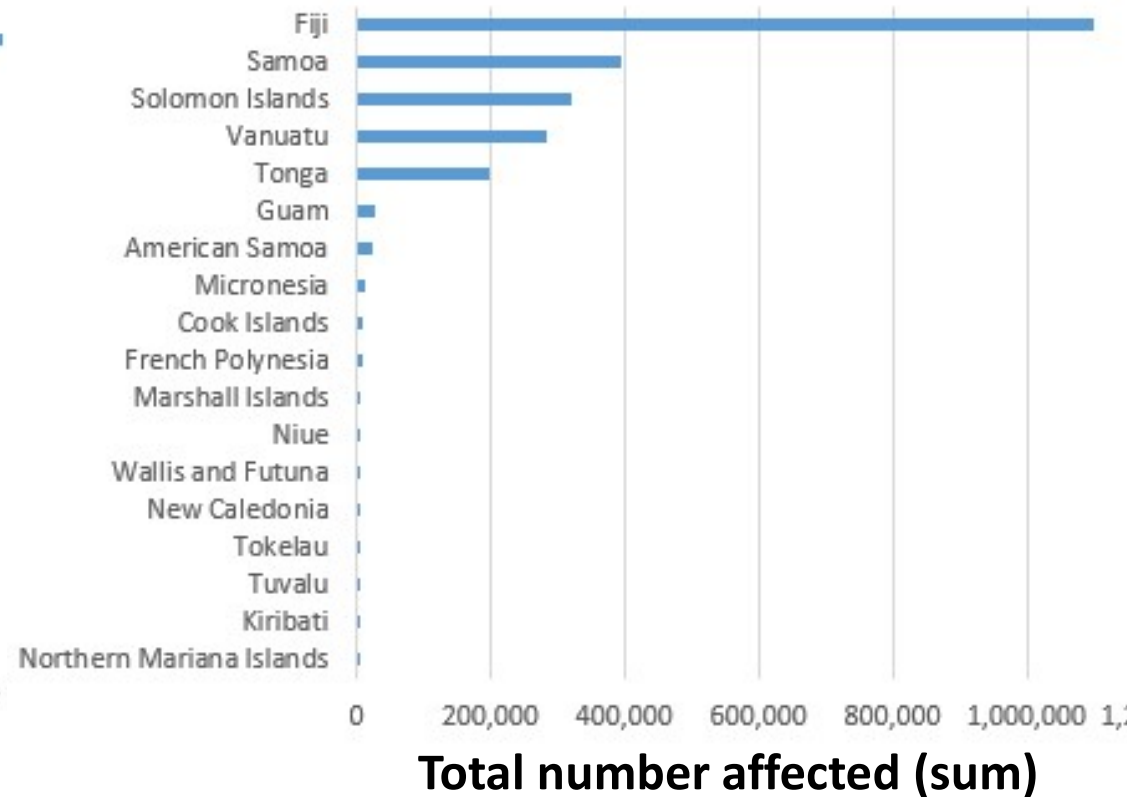
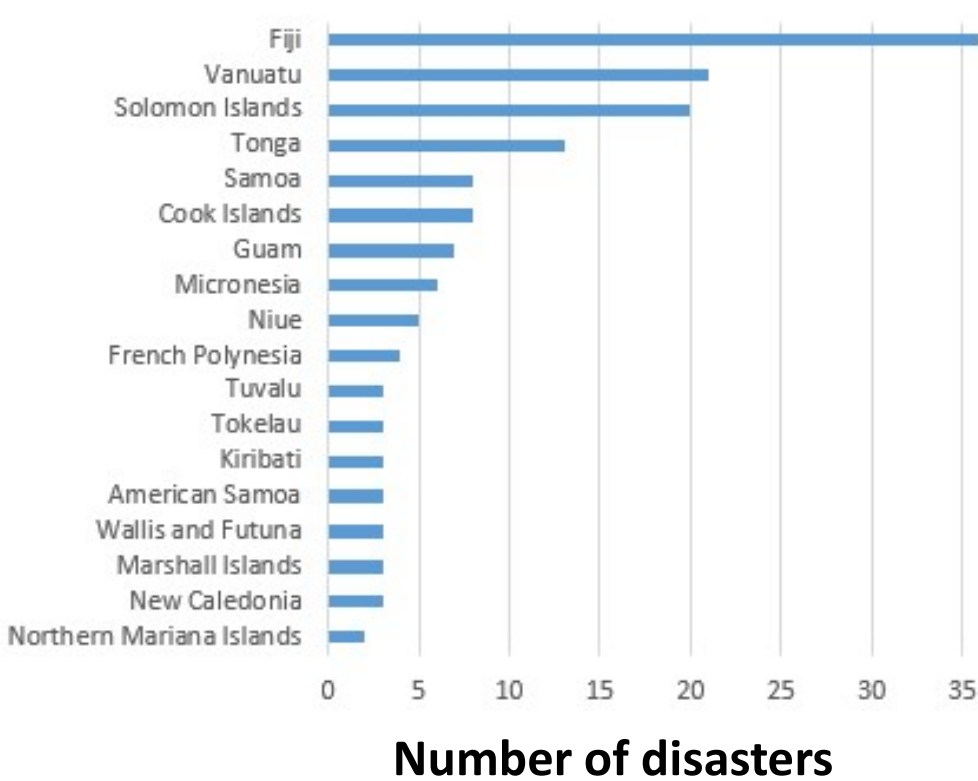
Size is absolute value in change between optimal and actual.

Color is **green** if optimal > actual and **red** if optimal < actual



# Why does Fiji get so much inventory?

It has a lot of large disasters



# Analysis of Pacific inventory

Item	Demand covered				Inventory				
	Fraction of demand served		Fraction of disasters covered		Actual		Optimal		Total
	Actual	Optimal	Actual	Optimal	Aus/NZ/Sub	Islands	Aus/NZ/S	Islands	
Blanket	100%	100%	100%	100%	85,674	39,867	25,314	100,227	125,541
JerryCan	99%	100%	99%	100%	68,927	74,649	62,751	80,825	143,576
KitchenSet	83%	95%	94%	98%	19,726	18,155	31,052	6,829	37,881
MosquitoNet	100%	100%	100%	100%	72,722	33,544	49,800	56,466	106,266
ShelterKit	66%	68%	91%	91%	13,255	7,640	14,066	6,829	20,895
SleepingMats*	54%	38%	91%	86%	50,022	2,563	18,428	34,157	52,585
Tarpaulin4x6	100%	100%	99%	100%	80,262	30,384	76,000	34,646	110,646

(To make specific recommendations, need to know role of Subang: we assume all of its inventory is available for use in the Pacific. Indeed, it plays a large role as a hub for Mosquito nets (47% of total inventory in Subang) and Jerry Cans (32% of total inventory in Subang).)

# Conclusion

- The model can be adapted to account for features specific to a region
- Back and forth dialogue was necessary to understand the limitations of the real world as well as the model