

# Impacts to Agriculture following the 1991 Eruption of Vulcan Hudson, Chile: Lessons for recovery

**Tom Wilson and  
Jim Cole**

(University of Canterbury,  
Christchurch, New Zealand)

**David Johnston**

(GNS Science/Massey  
University, Wellington, New  
Zealand)





Vulcan Hudson 

Image NASA  
Image ©2008 TerraMetrics

© 2007 Google™

Pointer 48°07'05.03" S 70°28'56.95" W

Streaming  100%

Eye alt 1475.22 km

## 1991 Eruption of Vulcan Hudson

- **Eruption began on 8 August 1991**
- **Basaltic fissure eruption (small ash plumes and lava flows)**
- **Then phreatoplinian eruption which rose 12km, depositing ash to north**
- **Second plinian eruption began on 12 August**
  - Eruption column reached 18km
  - Deposited 7.6 km<sup>3</sup> ash in 100km wide band to SE over Chile and Argentina
  - 150,000 km<sup>2</sup> experienced ash fall

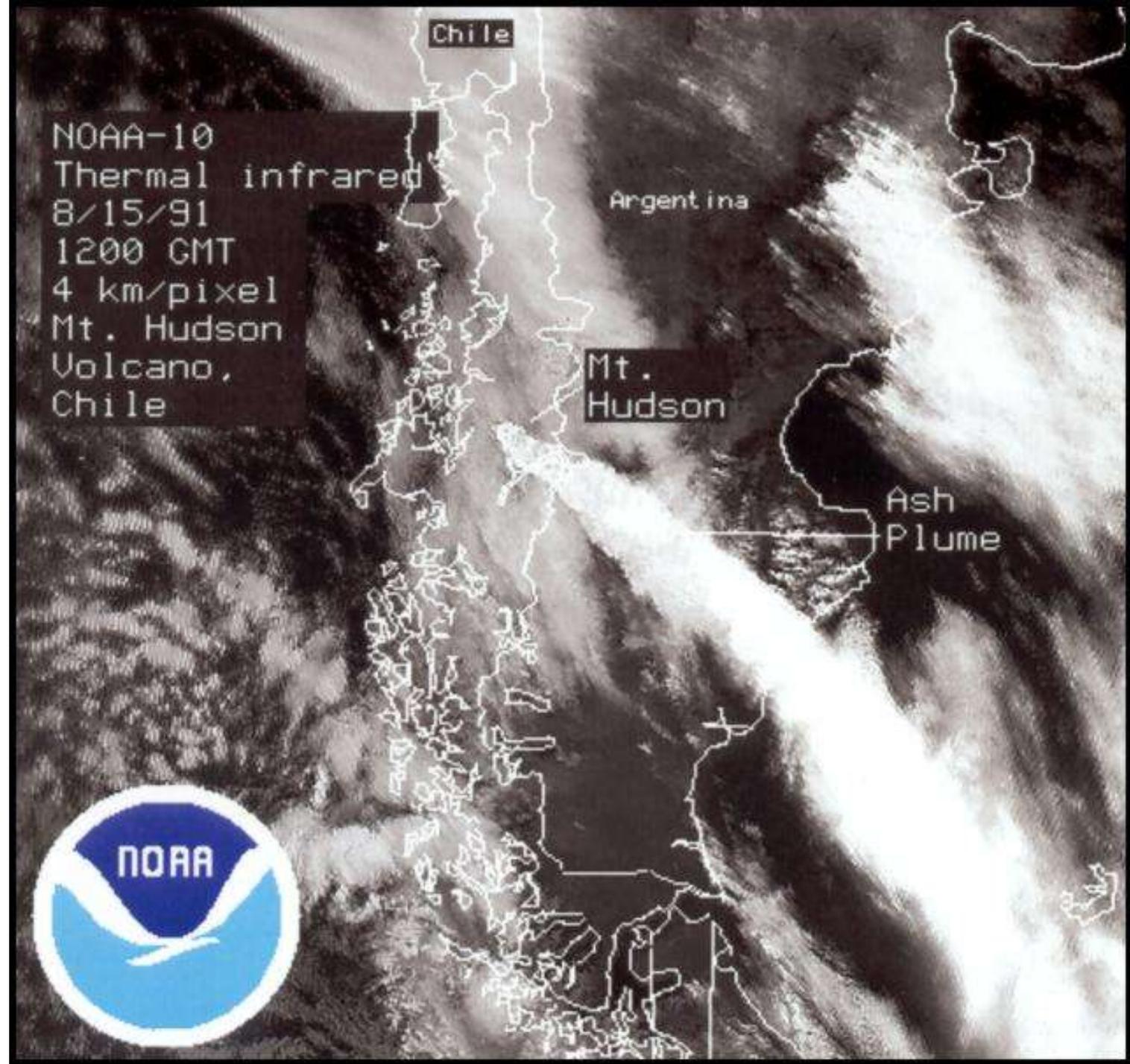
NOAA-10  
Thermal infrared  
8/15/91  
1200 GMT  
4 km/pixel  
Mt. Hudson  
Volcano,  
Chile

Chile

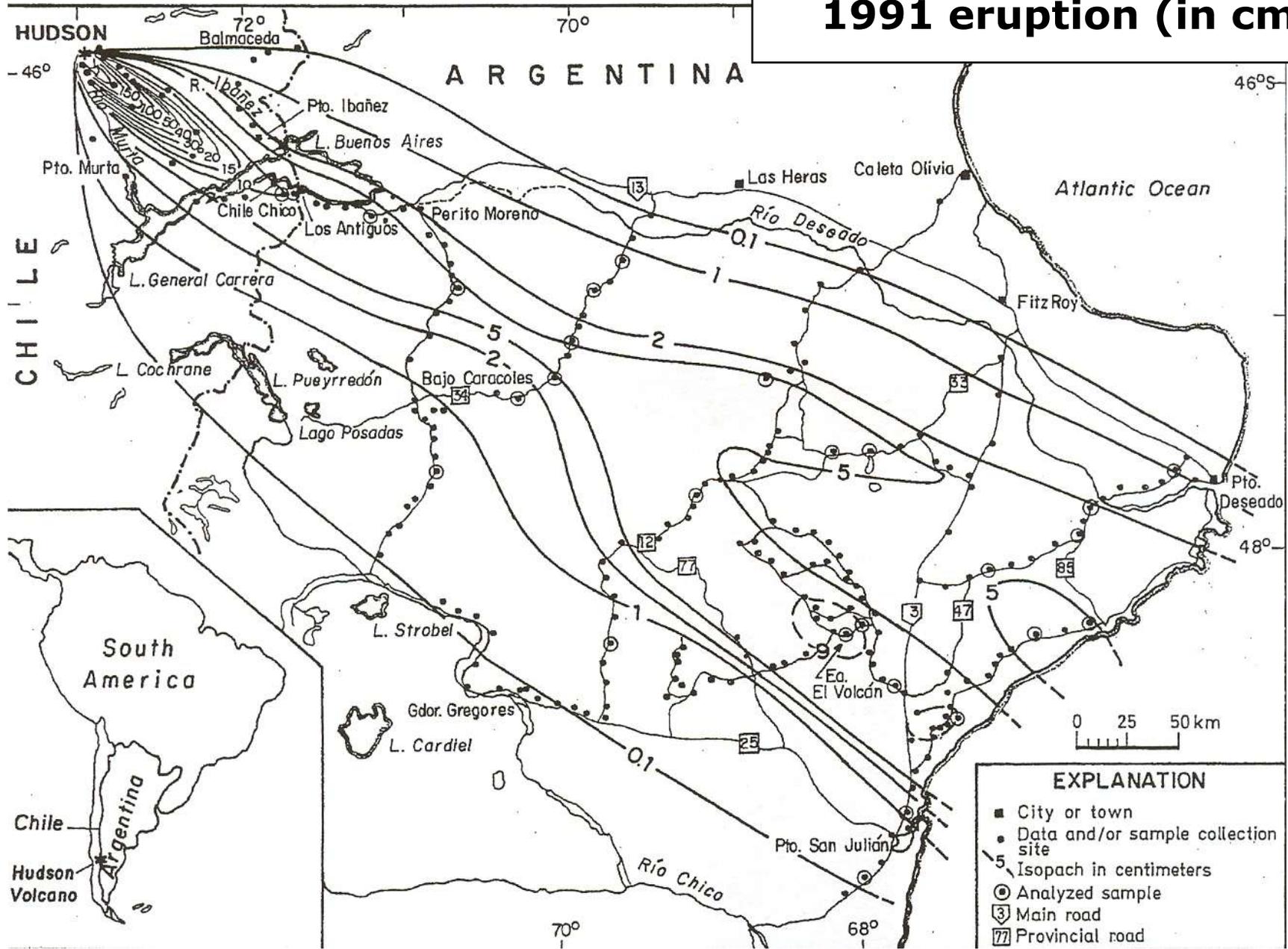
Argentina

Mt.  
Hudson

Ash  
Plume



# Isopach map 15-16 August 1991 eruption (in cms)



Chile Chico

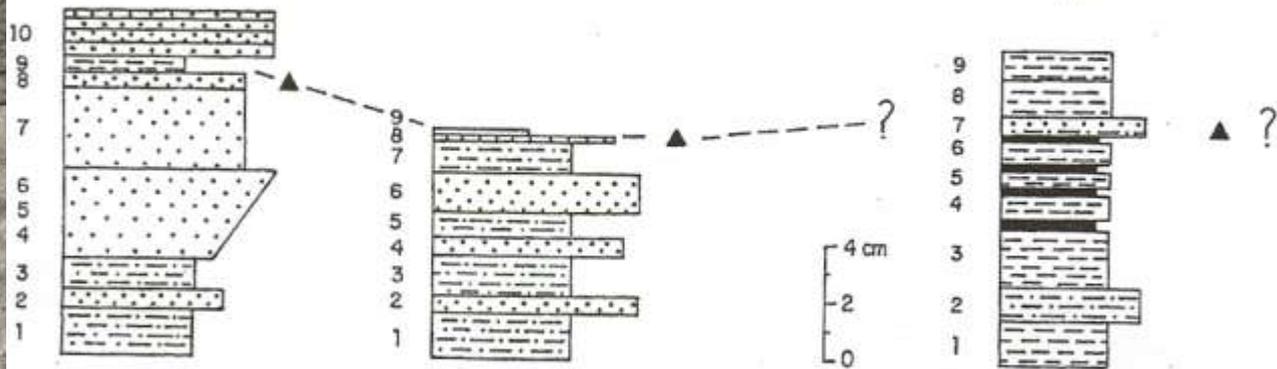
Los Antiguos

Ea. El Volcán

108 km

120 km

461 km



 Coarse ash and fine lapilli (0.062-3 mm)

 Fine ash (<0.062 mm)

 Coarse ash (<0.5 mm) with subordinated fine ash

 Fine ash (<0.0156 mm)



Vulcan Hudson



Puerto Ibanez

Chile Chico

Pertio Merano

Comodoro Rivadavia

Tres Cerros

San Julian

Image © 2008 TerraMetrics  
Image NASA

©2007 Google™

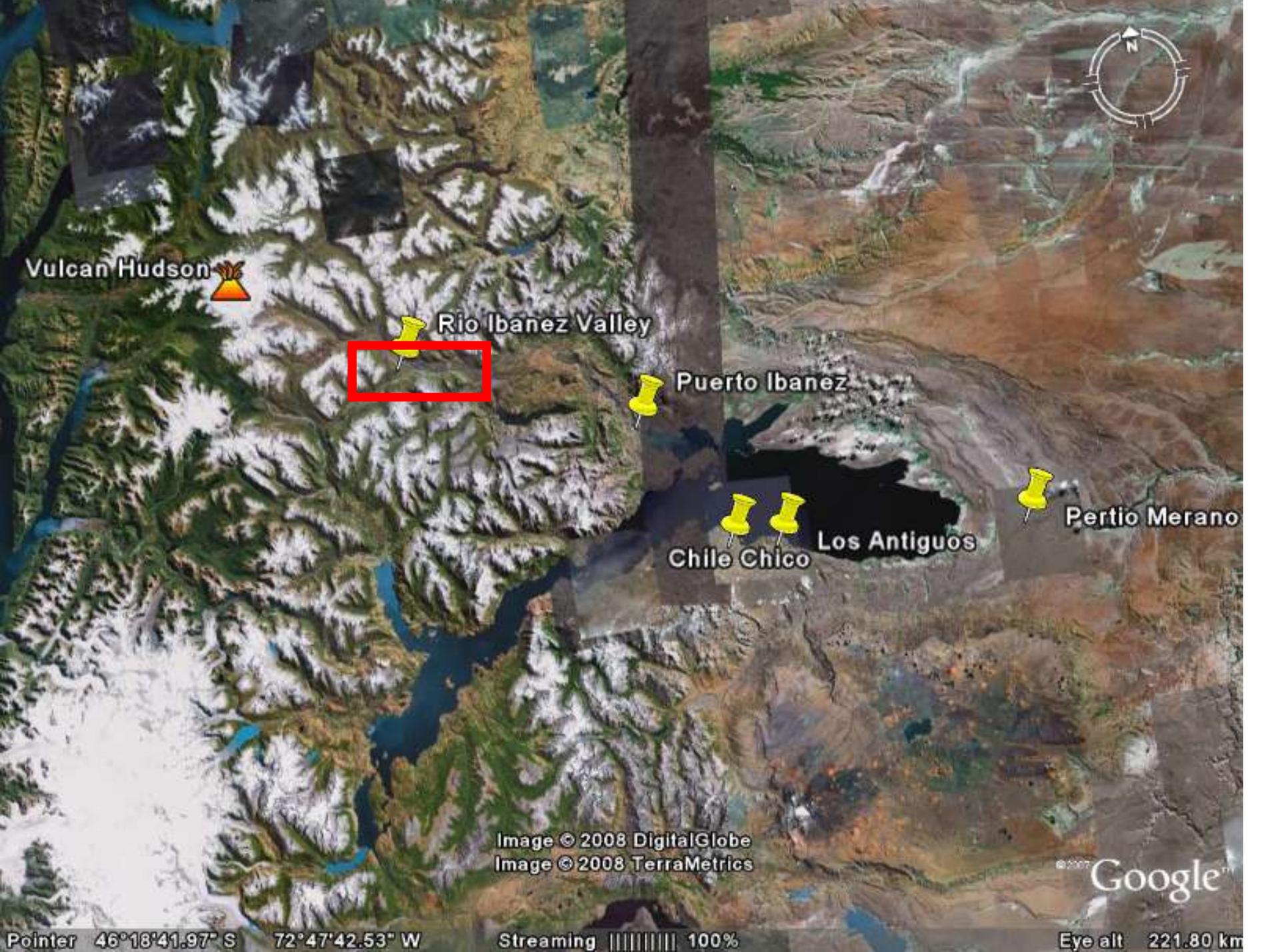
Pointer 47°26'55.31" S 69°39'59.98" W

Streaming ||||| 100%

Eye alt 653.15 km

## Effects of the 1991 Eruption

- **150,000 km<sup>2</sup> impacted by ash fall**
- **Mostly pastoral farms (sheep and beef) with some horticulture in irrigated regions**
- **Significant impact to pastoral farming**
  - Major economic activity in affected area
  - Major livestock losses...30-50% of all herds in some areas
  - Several million livestock perished
- **Horticulture also significantly affected**
  - Loss of crop for several years



Vulcan Hudson 

Rio Ibanez Valley



Puerto Ibanez 

Chile Chico  

Los Antiguos

Puerto Merano 

Image © 2008 DigitalGlobe  
Image © 2008 TerraMetrics

©2007 Google™

Pointer 46°18'41.97" S 72°47'42.53" W

Streaming  100%

Eye alt 221.80 km

## **Study Area 1 – Ibanez Valley, Chile**

- Significant ashfalls (500->1000 mm)
  - **Total burial of pasture and water supplies**
  - **Roof collapse of homesteads**
  - **Most people evacuated within several days - weeks (issue with returning)**
  - **Heavy losses of livestock**
  - **Livestock evacuation attempted for remainder (~20,000 head)**

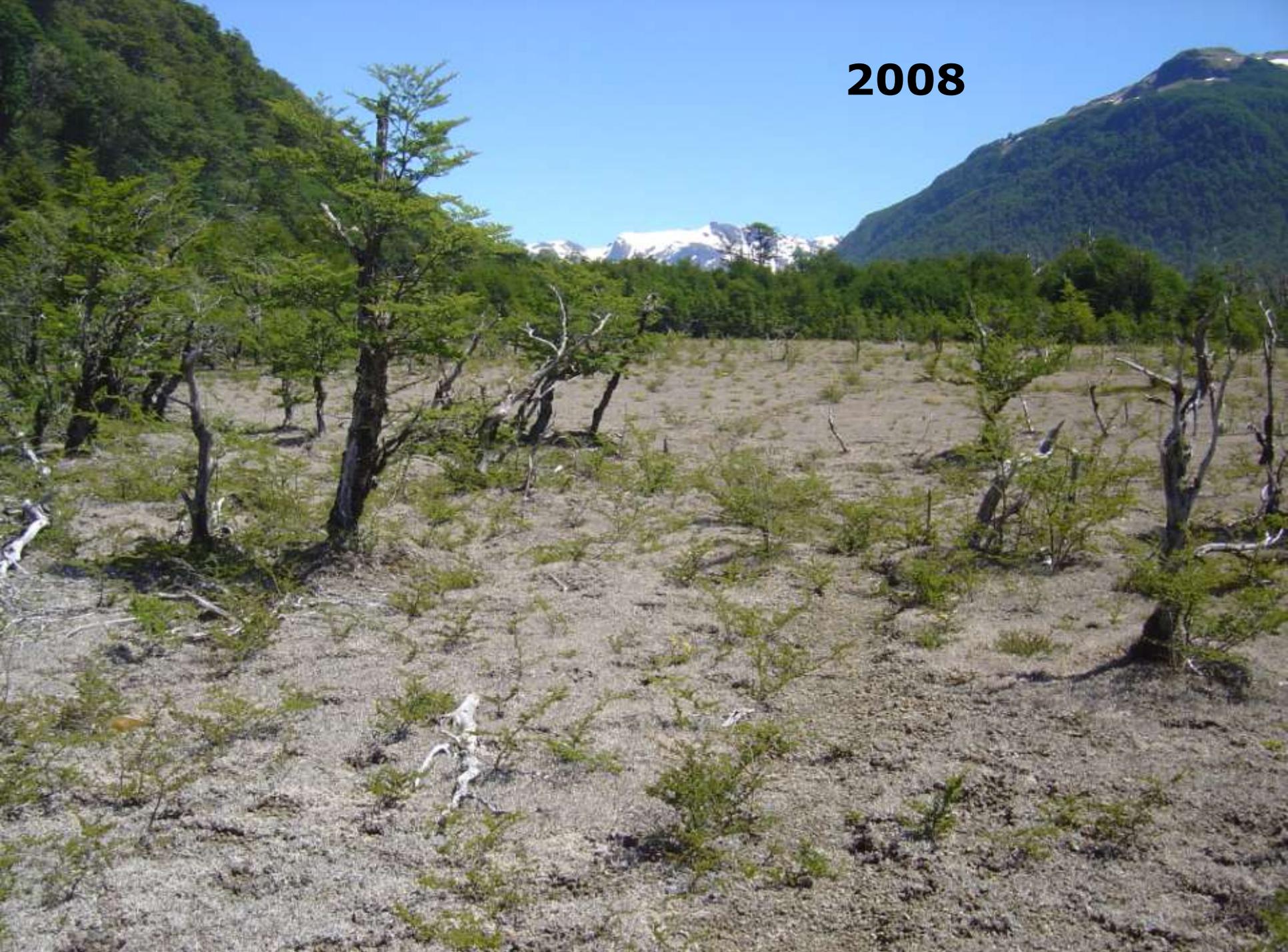
## **Study Area 1 – Ibanez Valley, Chile**

- **Areas in the centre of the plume had over 1 metre of tephra deposit**
- **Little recovery/regeneration useful to agriculture had occurred, although farmers have recently begun returning**
- **Many were still displaced**



1993 – Photo: S. Weaver

**2008**





Vulcan Hudson 

 Rio Ibanez Valley

 Puerto Ibanez

 Chile Chico

 Los Antiguos

 Puerto Merano

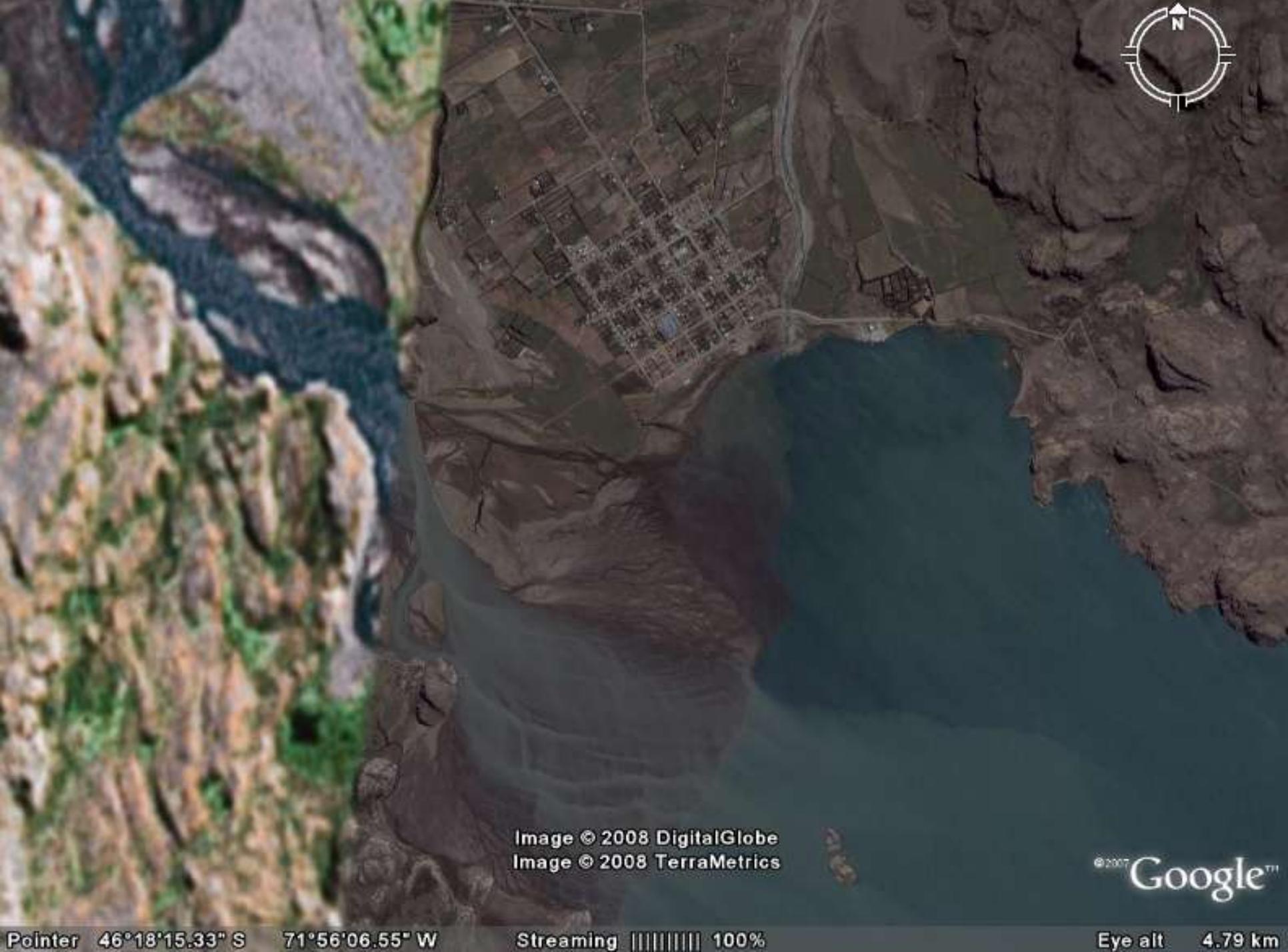


Image © 2008 DigitalGlobe  
Image © 2008 TerraMetrics

©2007 Google™

Pointer 46°18'15.33" S 71°56'06.55" W

Streaming ||||| 100%

Eye alt 4.79 km







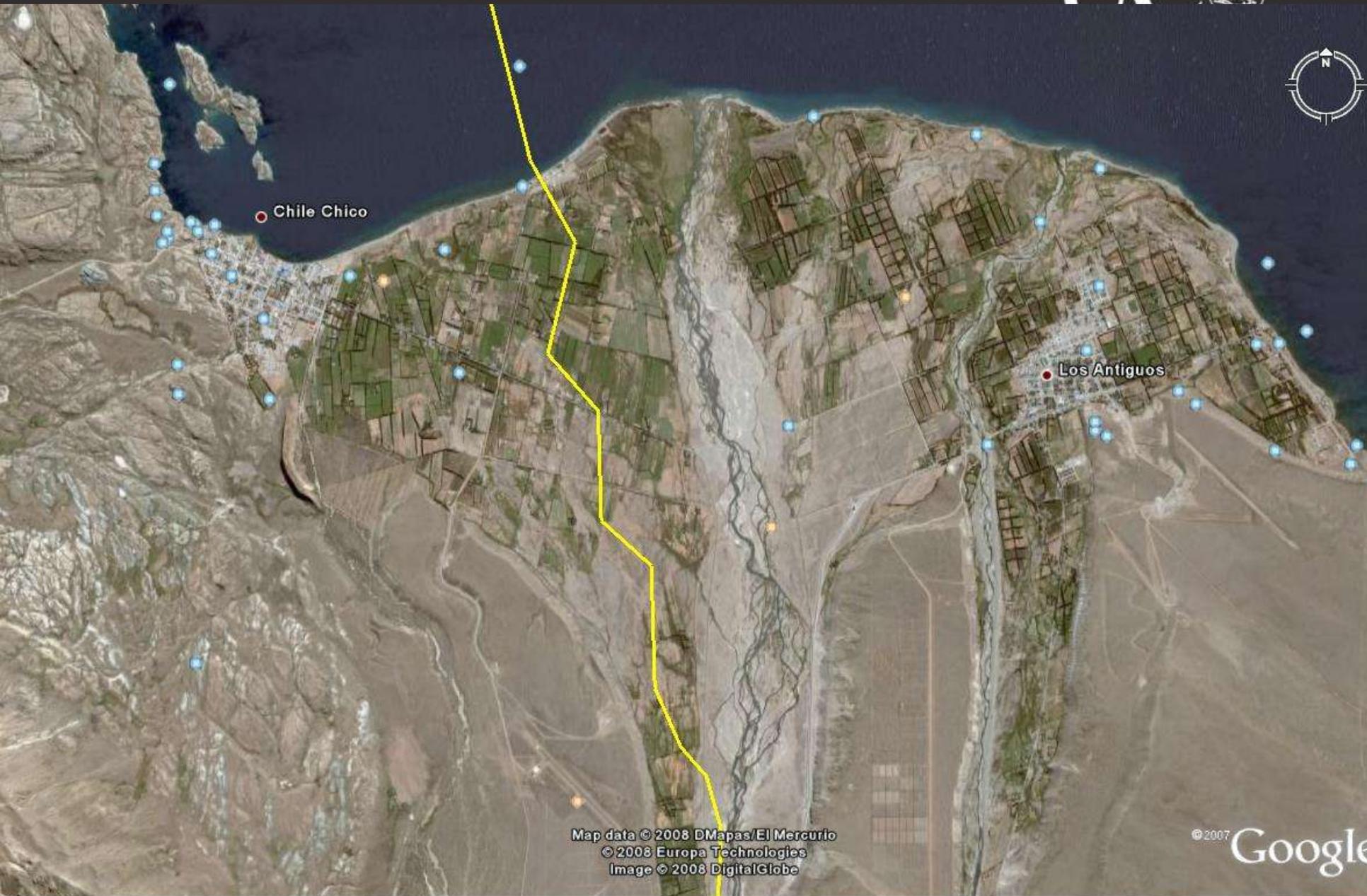
Vulcan Hudson 

 Rio Ibanez Valley

 Puerto Ibanez

  Chile Chico  Los Antiguos

 Puerto Merano



Chile Chico

Los Antiguos

Map data © 2008 DMapas/El Mercurio  
© 2008 Europa Technologies  
Image © 2008 DigitalGlobe

© 2007 Google

## Study Area 3 – Chile Chico (Chile) & Los Antiguos (Argentina)

- Again, heavy losses of livestock.
- Evacuation of livestock and people for several months
- Cherry orchardists were badly hit (short term), with no income for several years as blossom and fruit was destroyed by wind remobilised ash
- However, they appear to have recovered more successfully (long term) with yields back to 1991 levels by 2000.
- Livestock farmers still really struggling with poor soil fertility resulting in low stocking rates

## Study Area 3 – Chile Chico (Chile) & Los Antiguos (Argentina)

- Community spirit was high and reported to have significant influence on recovery
- Highly organised and motivated Los Antiguos municipality led the response and recovery
- Tourism is thriving and population has increased from 700 (1991) to ~4000 now.
- Few border issues...Chile Chico isolated so received Argentine assistance



Vulcan Hudson



Puerto Ibanez

Chile Chico

Pertio Merano

Comodoro Rivadavia



Tres Cerros



San Julian

Image © 2008 TerraMetrics  
Image NASA

© 2007 Google™

Pointer 47°26'55.31" S 69°39'59.98" W

Streaming ||||| 100%

Eye alt 653.15 km

## Study Area 4

- Large scale, extensive pastoral farming
- Significant impact, with many farms simply abandoned in this region, causing economic and social decline in many service towns. Mining, forestry and tourism has offered some diversification
- Very fine ash (1-50 mm) caused significant effects to:
  - animal health (teeth, respiratory, digestive tract, eyes, watering holes)
  - human health (respiratory)
  - machinery (windmills and motors)
- Continual and devastating wind/ash storms...greatly compounded the effects of the eruption



## Discussion of Study Areas 1

In general, long term soil fertility decline and continued remobilisation of ash by strong winds has inhibited recovery in areas impacted by the 1991 eruption of Vulcan Hudson

Physical impacts of the ashfall almost exclusively caused the problems, not chemical impacts

Difficult winter meant livestock were in very poor condition. Highlights the importance of seasonal vulnerability to adverse events

Selling off livestock created a huge glut in the market, dramatically reducing the relative wealth of livestock

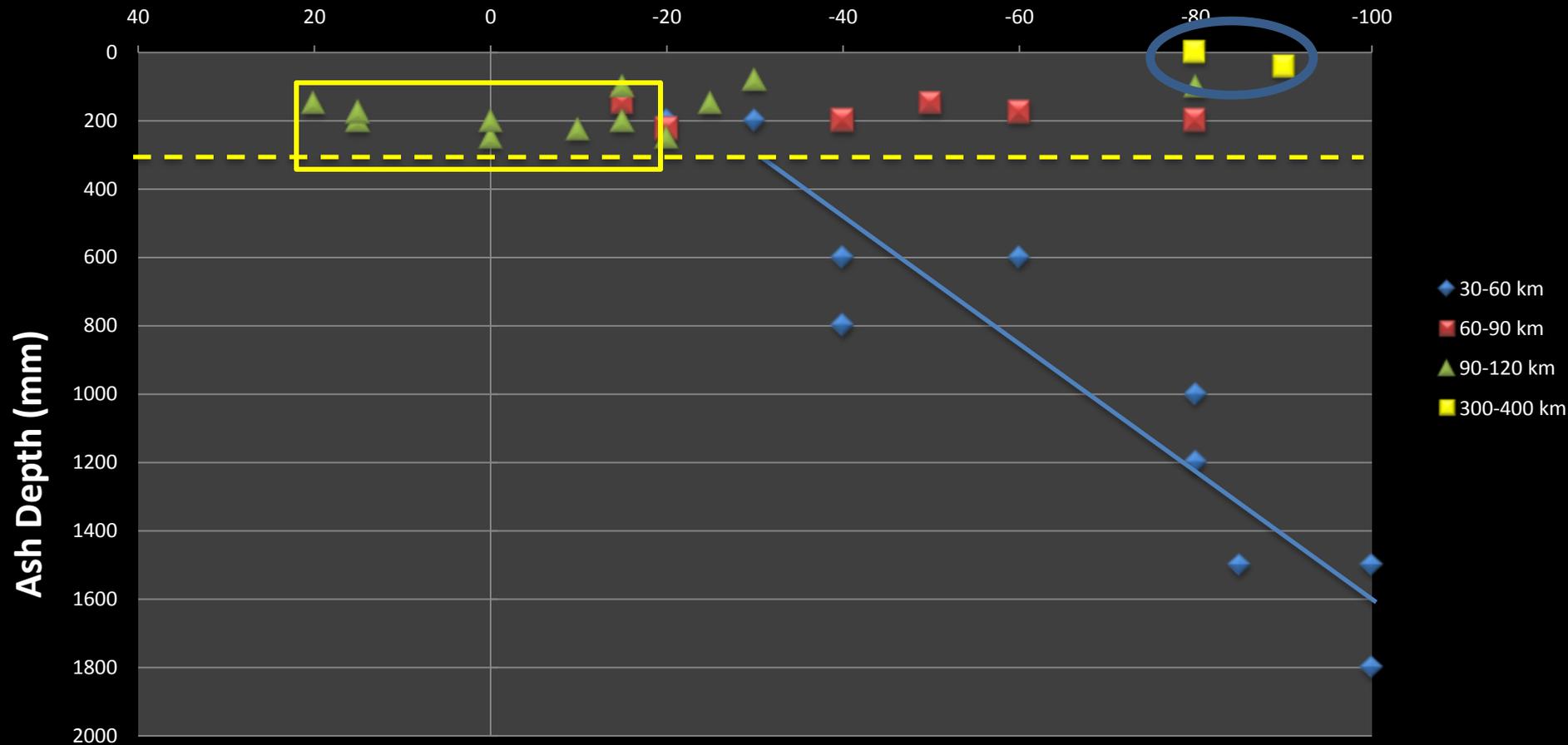
## Discussion of Study Areas 2

Long term climate change (reducing rainfall) and long term reduction in world wool prices make it difficult to determine whether the dramatic impacts and decline are entirely caused by the eruption or by other factors.

Our feeling is that most likely the eruption has had a “shock effect” and greatly accelerated the decline

Significant emotional attachment to land!

## Farmer Perception of Productivity Change between 1991-2008



# Summary of Impacts – Livestock

- **Main impacts:**

- coverage of feed by ashfall
- soil fertility decline
- remobilised ash extended impacts

- **Significant death rates**

- Heavy ashfall areas (>75mm) = 30-50% losses to sheep herds
- Tough winter (**seasonal vulnerability**)
- Ash in fleece...collapse
- "Brick" in first stomach...ash ingestion
- Diarrhoea, abortions, respiratory
- Teeth wear...severe problem
- Hoof wear

- **Water access ok, ash ingestion from feed main problem**

# Agriculture Recommendations

- Recovery will be dependent on depth of ashfall
  - Ashfall >500 mm will be unmanageable and unproductive for several decades following a large eruption
  - However intermediate thicknesses (50-300 mm) are manageable
- Don't expect a fast recovery (following a big ashfall)...but remember that recovery WILL occur
- Yields are likely to be reduced for years to decades...long term adjustment
- What is best management course post eruption? Consider:
  - land use change,
  - livestock issues
  - potentially huge social problem of ruined rural communities

## **Key Findings (Conclusions)**

- **In general, long term soil fertility decline and continued remobilisation of ash by strong winds has inhibited recovery in areas impacted by the 1991 eruption of Vulcan Hudson**
- **This has led to significant social and agronomic decline in affected areas**
- **The time of year the eruption occurred had a significant influence on severity of impacts (seasonal vulnerability)**
- **Climate change (decreasing rainfall) and agricultural commodity prices have exacerbated the impacts**