5th Meeting of Coordinating Group
of RA II WIGOS Satellite Project
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Far Eastern Federal University

New Zealand Country Report

Meteorological Service of New Zealand (MetService)
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Outline

I. Introduction
II. Short description of NMHS activity
III. Current observational system overview
IV. Collection, processing and utilization of satellite data and products
V. Satellite data to address regional challenges

Introduction

I. Country overview
   I. *Geography*
   II. *Population*
   III. *Climate*

II. Major historical hydrometeorological disasters
   I. *Disaster type and distribution*
   II. *Life and economic loss*

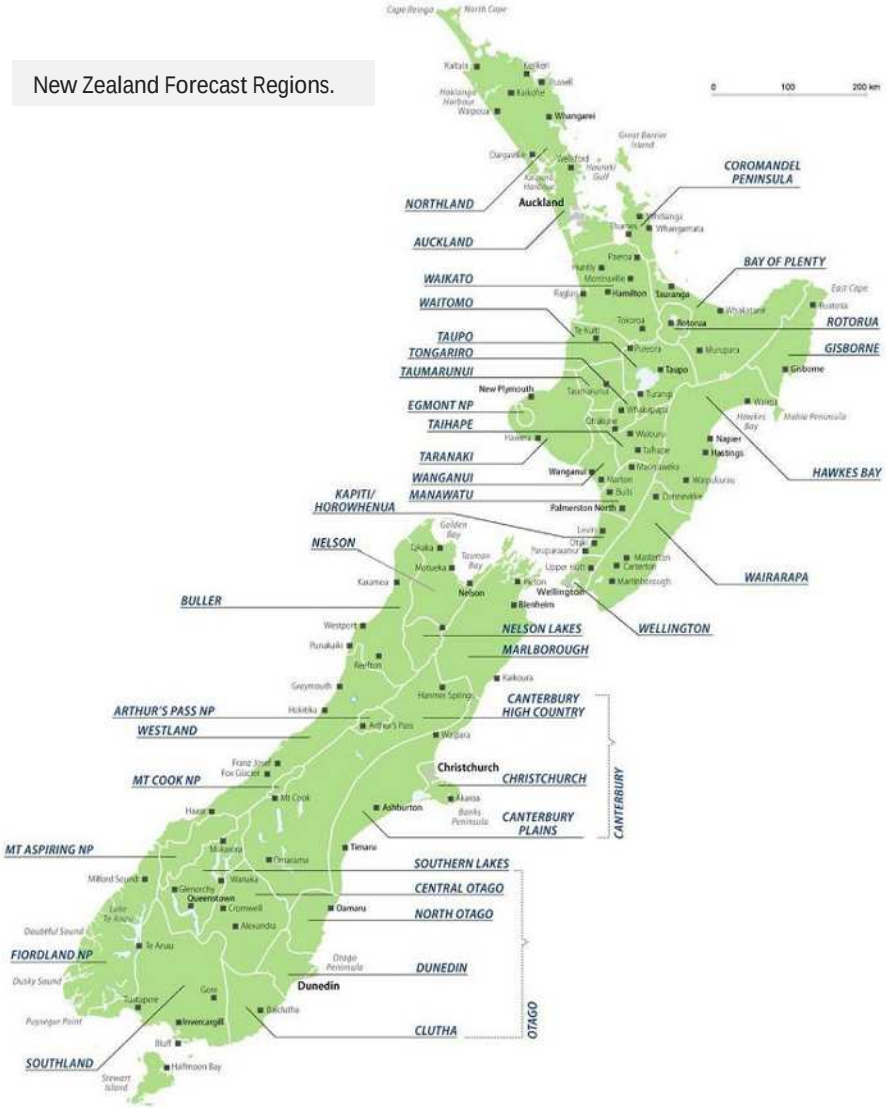
III. Major national economic sectors relying on NMHSs
   I. *Agriculture*
   II. *Transportation*
   III. *Aviation*

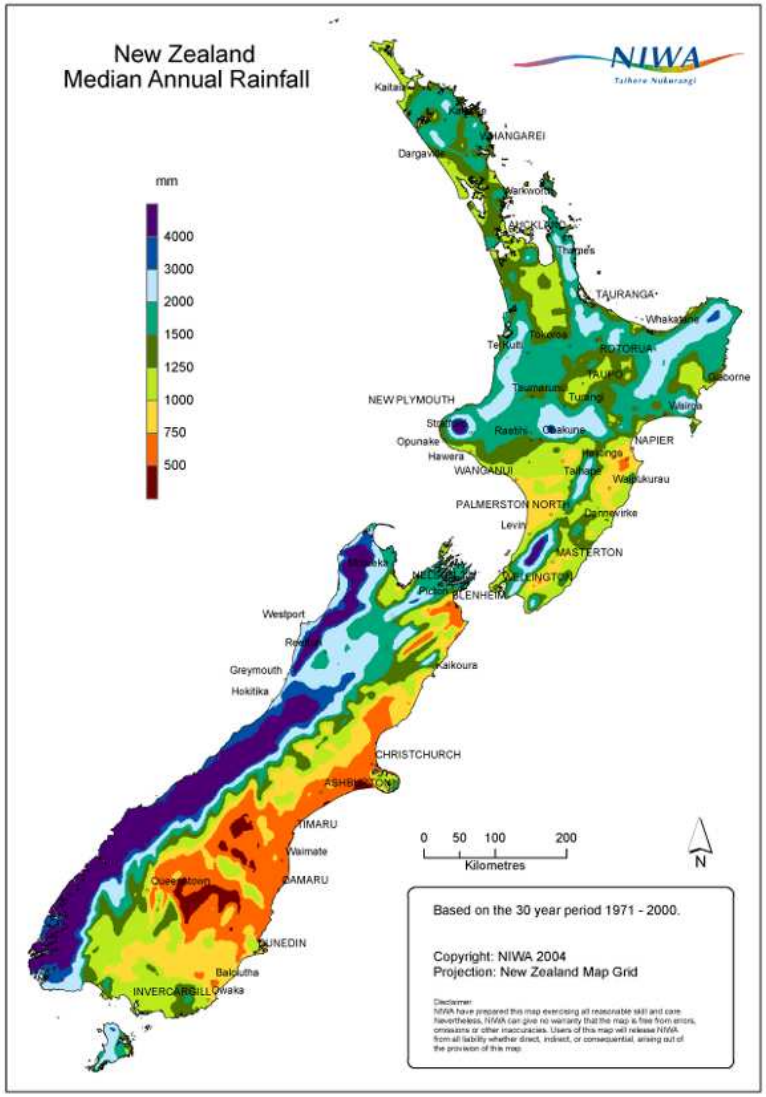
Country Overview

- New Zealand lies in the mid-latitude zone of westerly winds.
- Population 4.7 million.
  - ➢ One-third of the total population in Auckland Region.
- The climate is complex and varies from warm subtropical in the far north (34S) to cool temperate climates in the far south (47S), with severe alpine conditions in the mountainous areas (Aoraki/Mt Cook 3724m).
- The near continuous mountain chains that extend the length of the country create sharp climate contrasts between west and east.
  - ➢ Mean annual rainfall varies from 300mm in Central Otago to over 8000mm in the Southern Alps.

Country Overview

New Zealand Forecast Regions.



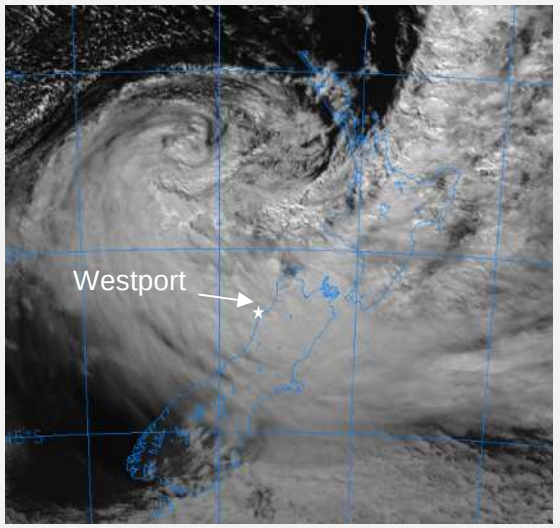


Major historical hydrometeorological disasters

- Ex-Tropical Cyclone Ita.
  - 17-19th April 2014.
  - Strong winds caused lots of damage throughout the country, pulling roofs off houses, bringing down power lines cutting the power supply to thousands.
    - » Highest wind gust recorded Westport 130 km/h.
  - Heavy rain caused significant flooding and slips.
  - Insurance claims totaled $NZ 55.3 million (USD 39.7 million).

Track and intensity of TC ITA April 2014

Greymouth Municipal Band hall in Blaketown

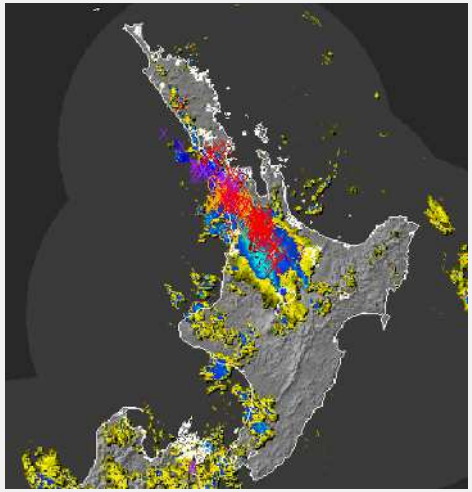


Visible Image from MTSAT, 00Z 17 April 2014

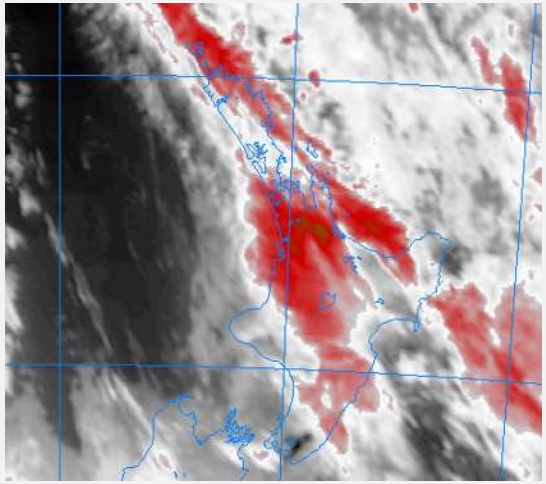
Major historical hydrometeorological disasters

- Severe Thunderstorms- Auckland December 2012
  - On 6th December an active trough passed through Auckland, producing a tornado which touched down just north of the CBD.
  - Ripped roofs from houses, toppled trees and power lines and sent debris flying.
  - 3 construction workers were killed when crushed by falling concrete panels. 8 cows killed by lightning.
  - Costs of clean-up $NZ 13 million (USD 9 million)
  - 22 houses demolished

Tornado damage at Hobsonpoint Secondary School Construction site



Radar image with lightning strikes valid 00Z 06 December.



Infrared Image from MTSAT Valid 00Z 06 December

Major national economic sectors relying on NMHSs

- Transport
  - Road weather - road users can be impacted in severe weather. We provide enhanced forecast services, including severe weather threat matrices about the risks of ice, snow, strong winds, heavy rain and avalanches.

  - Aviation- along with fulfilling ICAO and CAA requirements, we have an Airport Weather Matrix which provides a shared, single airport weather point-of-view. It offers user-defined thresholds about forecast conditions for airlines, airport operations, air traffic controllers, emergency services and air force & military aviation.

Major national economic sectors relying on NMHSs

- Agriculture

  Actively working with partners, BloomSky and Agrigate, to build a country-wide weather network that will support New Zealand's agribusiness sector and new technologies and devices that integrate vital weather services to provide deeper insights of the farm environment.


- Offshore oil and gas

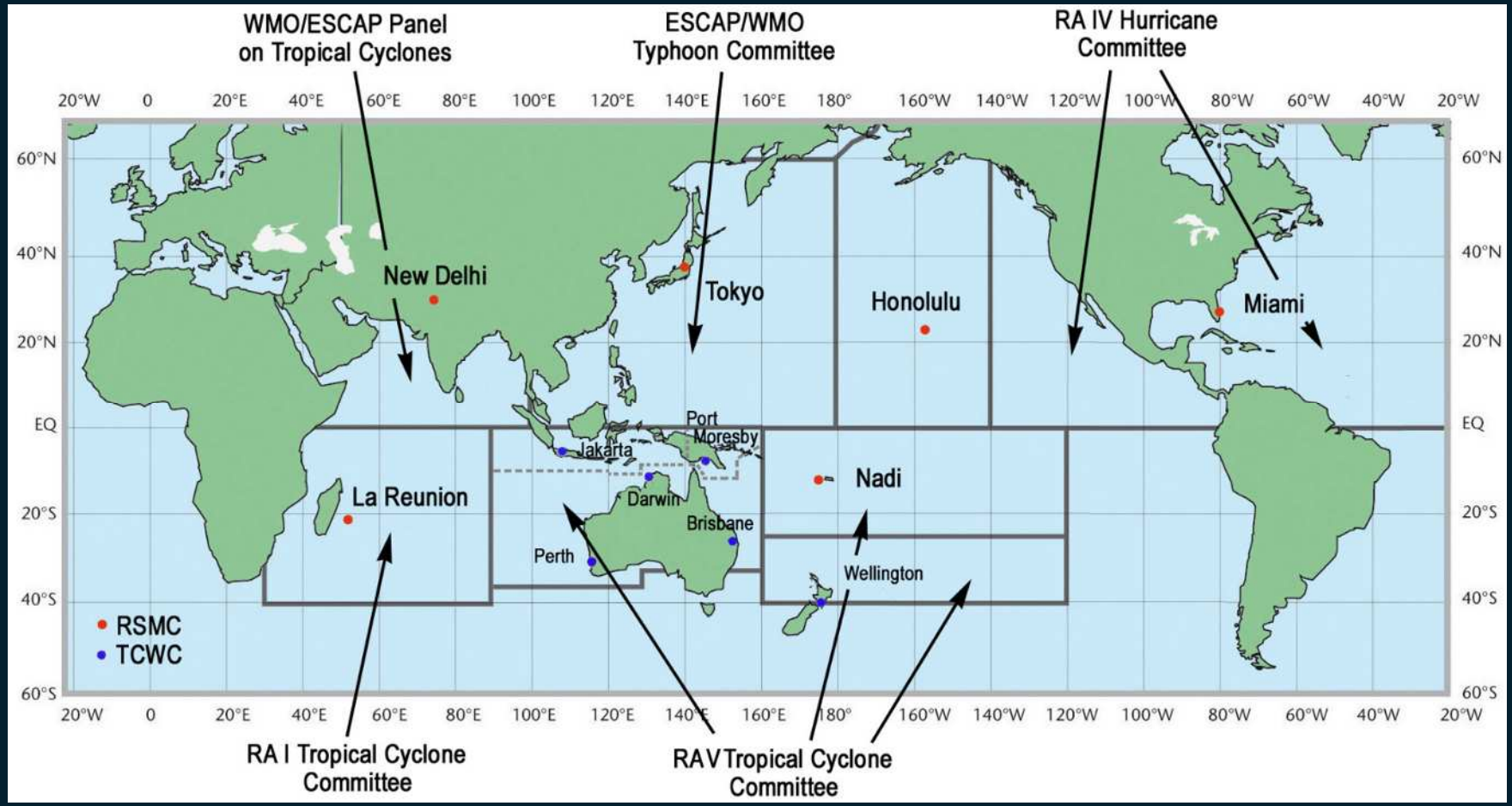
  Weather has been a factor in 7 of the world's 10 worst offshore oil & gas disasters. Tropical cyclones and lightning present significant engineering and safety challenges offshore in South-east Asia and Australia. With our oceanographic partner, MetOcean Solutions, we provide vital offshore decision support.

NMHS Activity- Local Severe Weather

Meteorological Services Act 1990- The objective in respect of potential or actual threats is to issue national warnings and advisories in a timely manner so that agencies, CDEM groups, local authorities, and people can take action to reduce loss of life, injury, and damage.

MetService fulfils requirements of Meteorological Services Act and as Responsible Agency under National CDEM Plan. Image of warnings on metservice.com

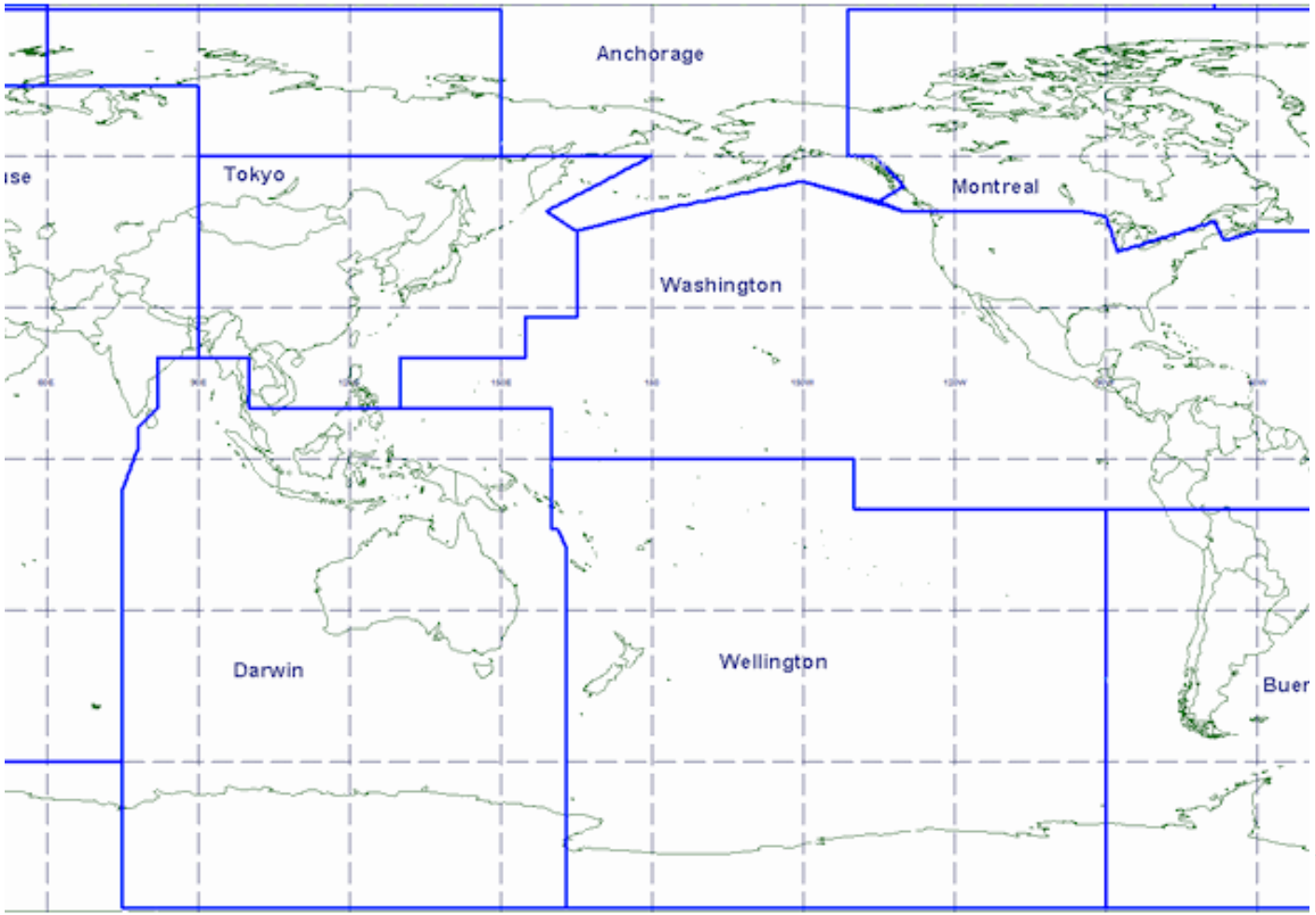
NMHS Activity- Tropical Cyclones



Wellington Tropical Cyclone Warning Centre ("TCWC Wellington")

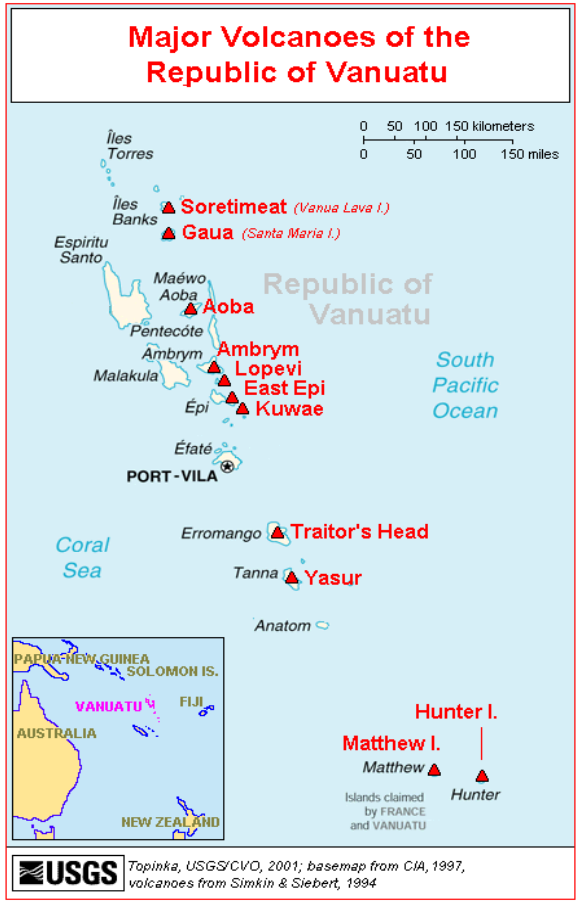
Responsible for issuing tropical cyclone warnings south of 25S, between 160E and 120W.

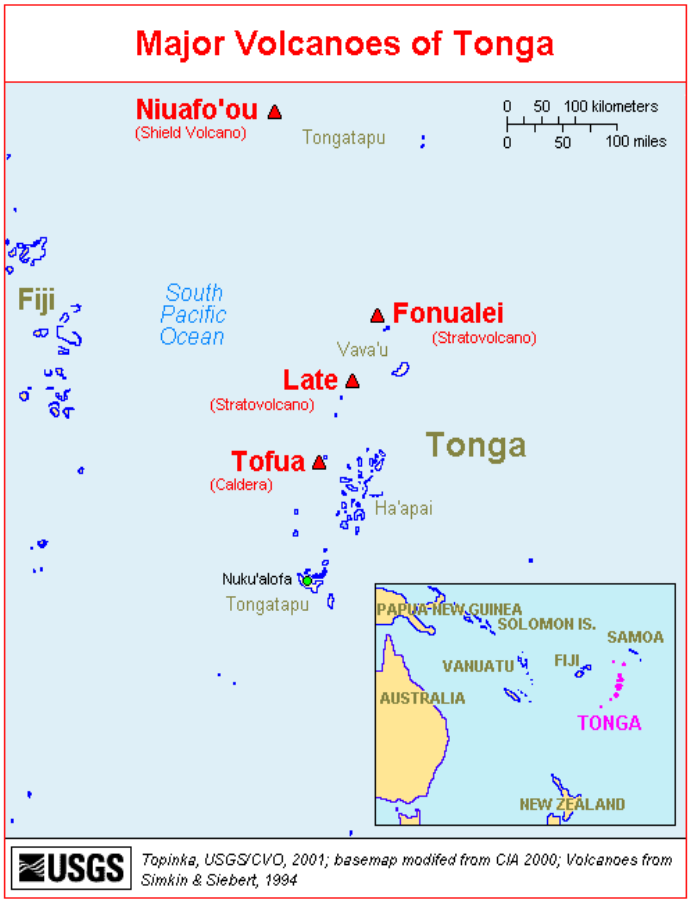
NMHS Activity- Volcanic Ash



Wellington Volcanic Ash Advisory Centre ("Wellington VAAC")

NMHS Activity- Volcanic Ash



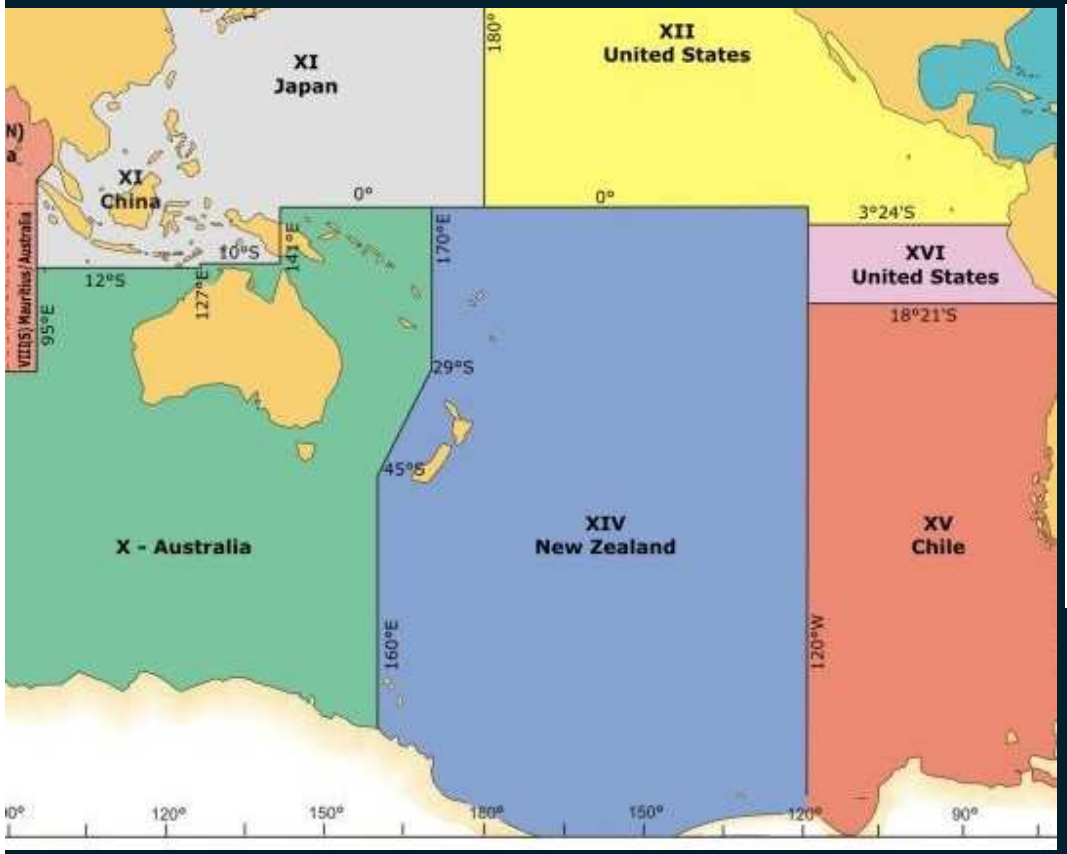


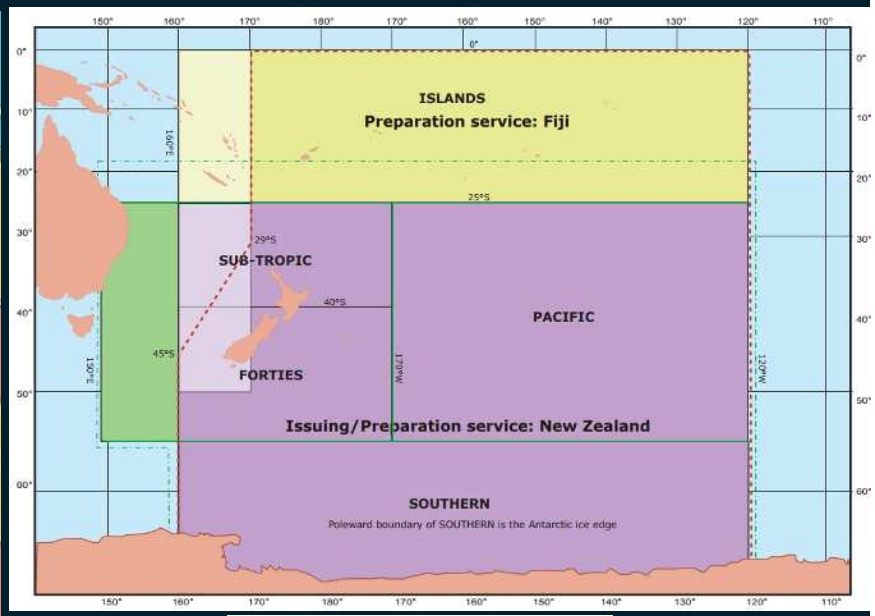
Major volcanoes in the Wellington VAAC AOR

NMHS Activity- Sigmets

Wellington Meteorological Watch Office (“Wellington MWO”)
Responsible for two SIGMET areas: NZZC and NZZO.

NMHS Activity- High Seas





Key/Légende

- Limit of METAREA XIV
- Limits of forecast areas
- Coverage area for Coastal Navigational warnings and Weather bulletins
- Fiji's 'Islands' forecast area and their warning area extend 10° further west into METAREA X
- Australia's forecast area, 'South Eastern' extends into METAREA XIV.
- New Zealand's forecast areas, 'Subtropic' and 'Forties' extend into METAREA X to the eastern Australia coastline and the warning area to 160° East.

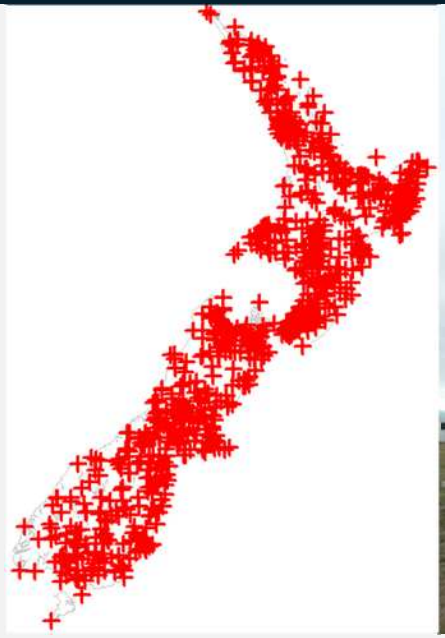
New Zealand as Preparing and Issuing Service.

Current Observational System Overview

I. Surface observations
II. Upper-air observations
III. Marine observations
IV. Aircraft-based observations
V. Satellite observations
VI. Weather Radar Observations
VII. Other observation platforms

Surface Observations

- New Zealand operates a fully automated surface observing network for weather forecasting purposes.
- 230 AWS provide data every minute to forecasters in Auckland and Wellington.
- 34 AWS at airports provide ICAO-compliant AUTO METAR reports every 30 minutes



- 23 Webcams provide 24/7 imagery to forecasters every 4 minutes.
- Lightning detection network of 10 sensors provides a detection efficiency of > 90% over North and South Islands.
- Operate three remote island stations; two in the sub-Antarctic and one in the subtropics.

Upper Air Observations

- Operate four upper air stations: Auckland, Paraparaumu, Invercargill and Raoul Island.
- Three mainland sites perform two observations a day, while Raoul Island in the subtropics undertakes one observation a day.
- All stations use GPS radiosondes and produce BUFR data for global distribution on GTS

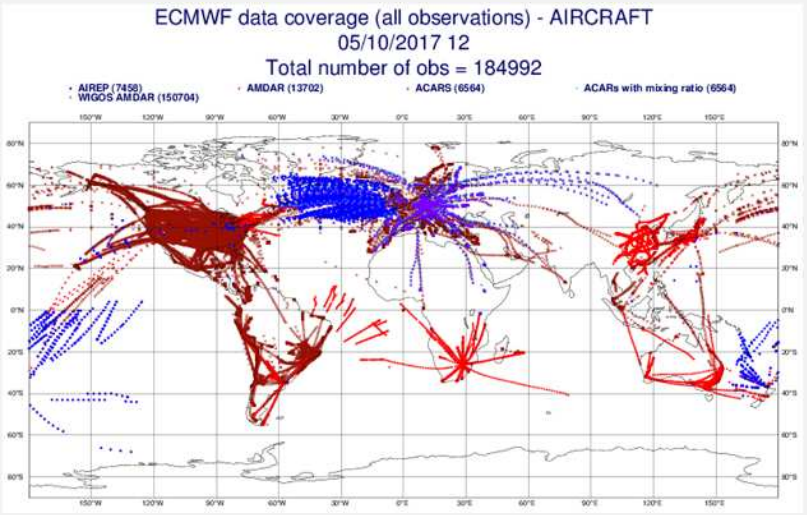
- All stations except Auckland are part of the GCOS Upper Air Network (GUAN) programme.
- Invercargill (93844) has recently joined the GCOS Reference Upper Air Network (GRUAN) programme.

Marine Observations

- Maintain a fleet of about 30 VOS reporting ships and about 20 drifting buoys
- Receive observations from two moored offshore gas production platforms and three coastal moored buoys
- Operate a network of 15 coastal AWS for the New Zealand Coastguard Federation

Aircraft-based Observations

- Aircraft operating on domestic and regional routes provide approx 85,000 AMDAR observations a month.
- Data are provided to forecasters and sent on the GTS for use by global modelling centres.
- Currently investigating the use of other reporting mechanisms (ABS-B, ADS-C) to increase coverage across the South Pacific Ocean



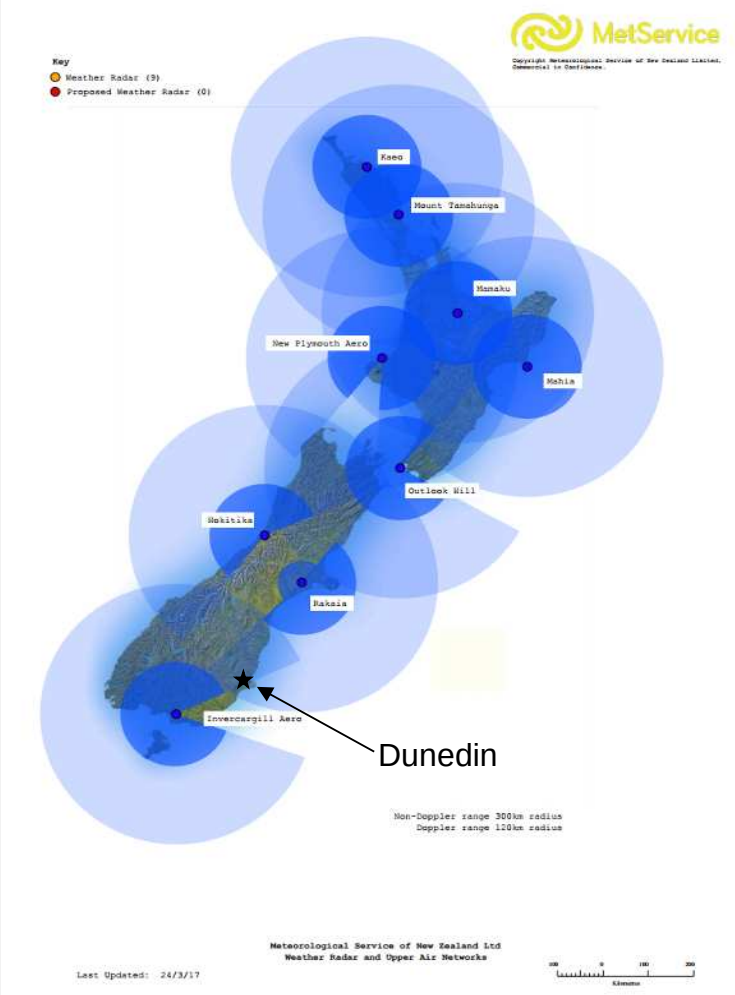
Satellite Observations

- Satellite Reception Facility is at Wellington Headquarters.
- Primary geostationary feed is Himawari-Cloud, where we process the imagery using a cloud computing service in US.
- A Himawari-Cast reception and processing system is used as a backup should the Cloud service fail.

- Data from polar orbiting satellites received and processed locally (NOAA, NPP, METOP, TERRA, AQUA).

Weather Radar

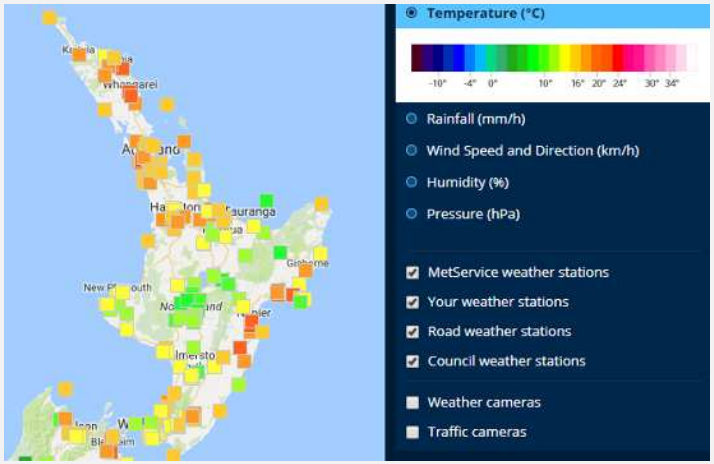
- Operate a network of nine Doppler Weather Radars
- Good coverage of New Zealand's North Island
- Coverage of the South Island limited due to mountainous terrain.
- Tenth radar planned for installation near the southern city of Dunedin in 2019.



Other Observation Platforms

New areas of interest for Observation platforms include:

- Cooperative Weather Observer Networks, such as the UKMO World of Weather (WoW) service.
- Mobile Road Weather Sensors to enhance winter road maintenance forecast services.
- Internet of Things (IOT) sensors within ‘Smart Cities’ being investigated.



Collection, Processing and Utilization of Satellite Data and Products

I. List of satellites/instruments currently used operationally for NWP, nowcasting and other applications

II. Current capabilities of collection, processing and archiving of satellite data and products

III. Current satellite data applications

   I. Key application areas

   II. Satellite-based products

IV. Satellite data and product needs and gaps

Satellites/instruments currently used operationally for NWP, nowcasting and other applications

Geostationary

- Himawari
  - *AHI imager – now-casting, VAAC operations*
  - *AMV – nudging in Limited Area Model*
- GOES-15
  - *IMAGER - 3 hourly for marine forecasting over Eastern Pacific*
- Meteosat9, Meteosat11
  - *SEVIRI – 3 hourly for media products*

Polar Orbiter

Satellite	Instrument
NOAA18	AVHRR
NOAA19	AVHRR
METOP-B	
TERRA	MODIS
AQUA	MODIS
NPP (SUOMI)	VIIRS

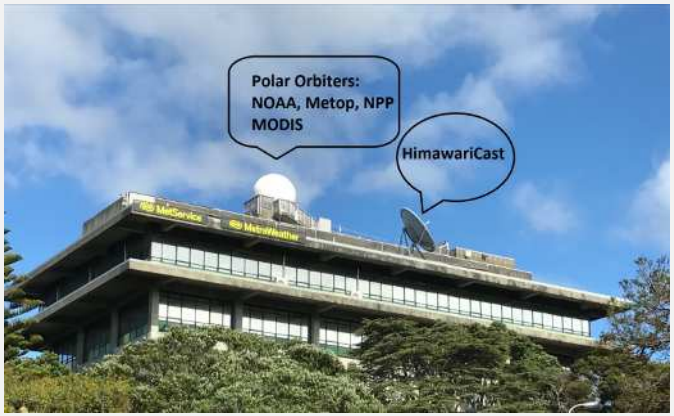
Used for general and VAAC forecasting

Current capabilities of collection, processing and archiving of satellite data and products

Due to the size and frequency of data being generated by newer geostationary satellites, we have moved towards using Amazon Web Services (AWS) to collect, process and archive satellite data.

- Saves considerable amount of bandwidth and local storage.

Some geostationary data is still collected and processed in our two data centres but as newer generation satellites go up we expect the amount of data we process locally to reduce significantly.



We receive

- Himawari HSD files from Himawari-Cloud
- Himawari HRIT data from Himawari-Cast (as a backup to Himawari-Cloud)

And decode using in-house software.

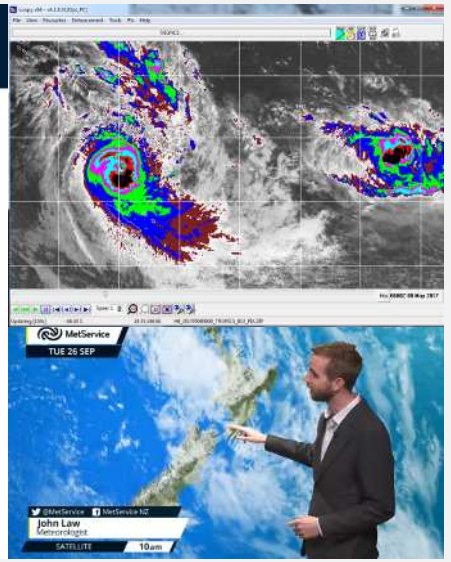
Polar orbiter data is still received locally in our Wellington office by L / X band receivers using a 2.4m antenna and is processed locally.

Do limited archiving of imagery products for specific satellites, bands and projections. Raw data not kept at all.

Current satellite data applications and Satellite data and product needs and gaps.

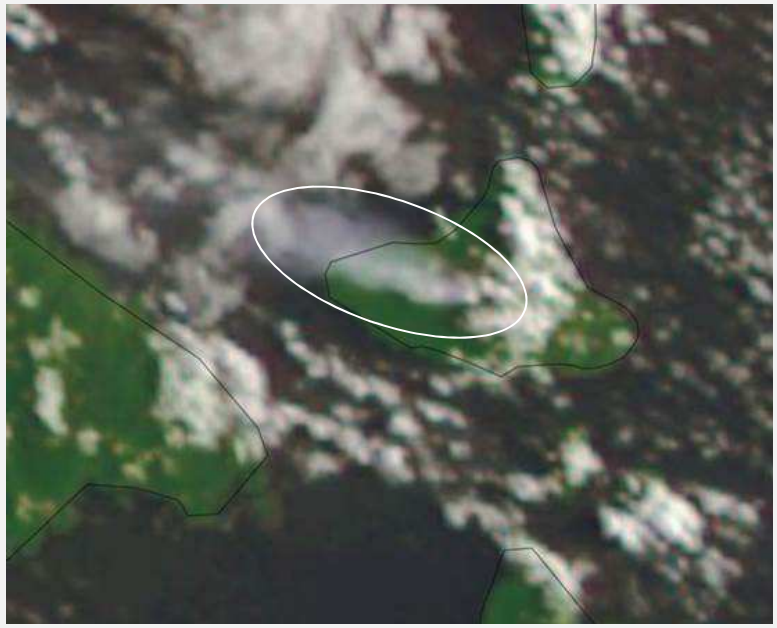
- Key Application Areas
  - now-casting for aviation, including volcanic ash detection
  - now-casting for general forecasting, and severe weather
    - » includes tropical cyclone detection and tracking
  - Aviation portals for private pilots, regional carriers and international airlines.
  - public web site www.metservice.com
  - media displays: TV , web sites.
  - model ingest (AMV only)

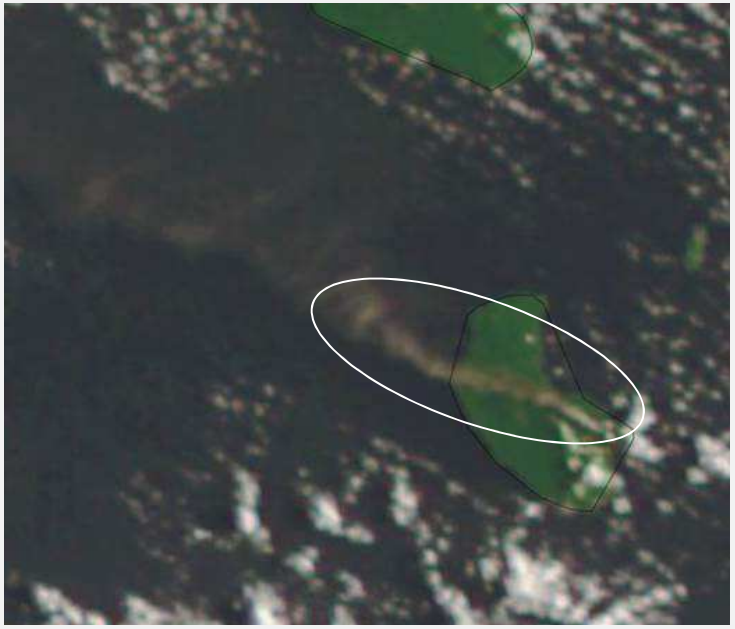
- Satellite-based products
  - Level1b imagery
  - ‘standard’ RGB composites
  - Cloud top height for aviation



- Needs and gaps
  - High temporal, spatial and spectral resolution imagery during severe weather events such as very active fronts
  - Level 2 products for aviation and VAAC forecasting. A project has been scoped to implement Geocat software to make such products, but project has not started.
  - For NWP Data assimilation the following are needed.
    - » Himawari cloud top pressure
    - » Himawari Rainfall Rate QPE/Probability of Rainfall

Satellite Data to address Regional Challenges - Volcanic Ash

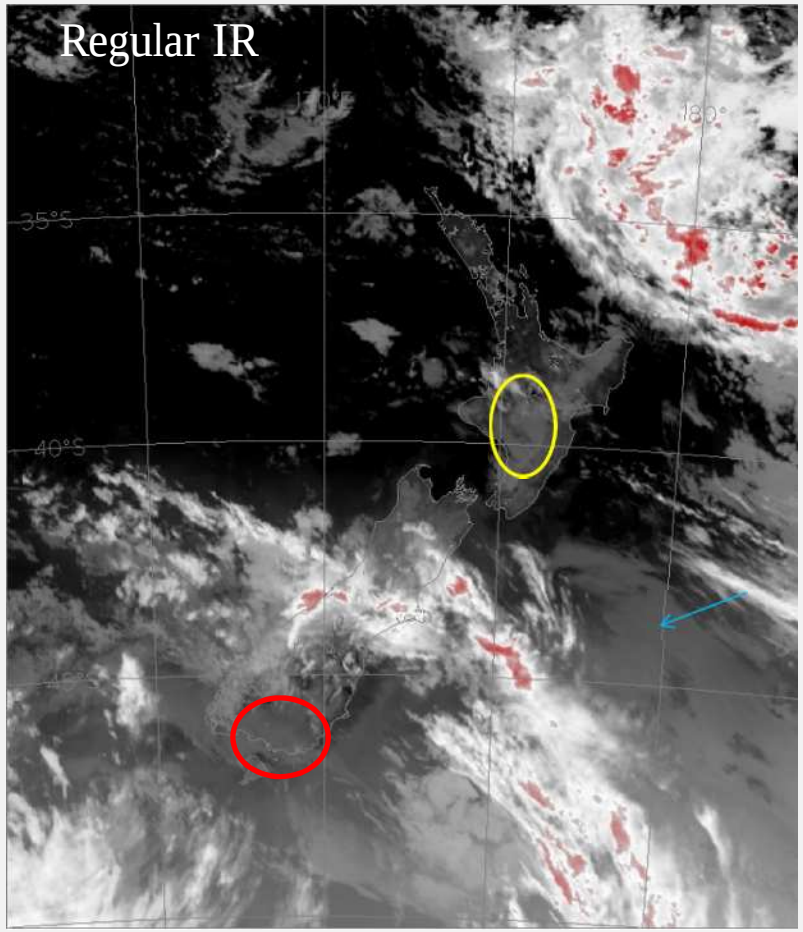


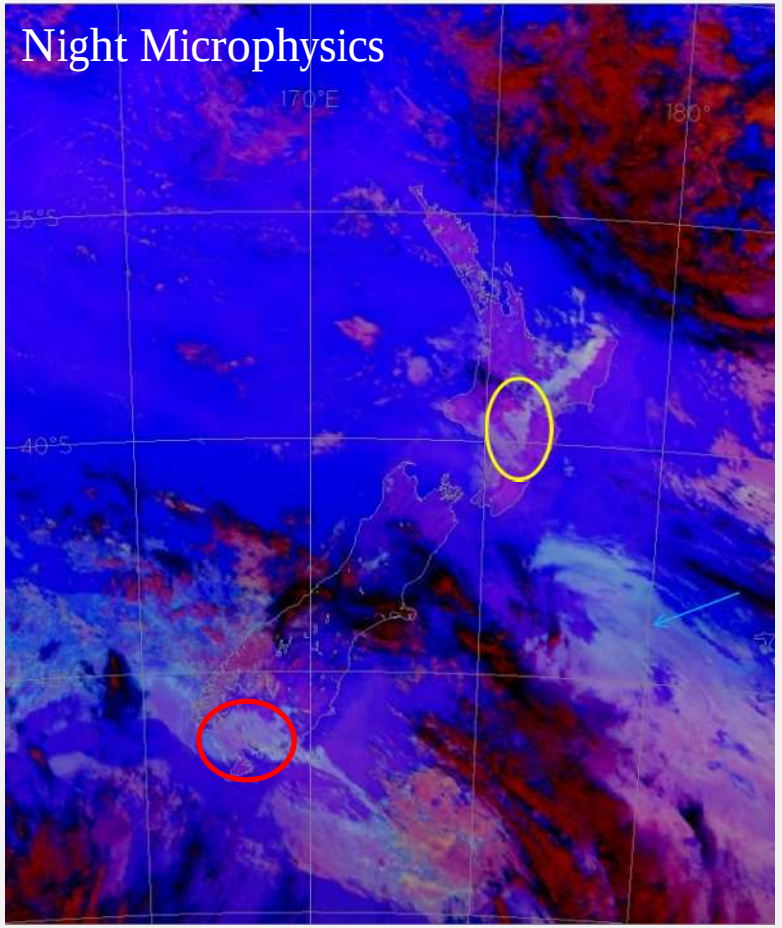


Visible True Colour images from Himawari-8 March 22nd 2017 of two volcanoes in the Wellington VAACs AOR: Ambrym (left) and Yasur (right), both in Vanuatu.

Now able to more easily identify volcanic emissions on satellite imagery, and differentiate steam (left) from volcanic ash (right).

Satellite Data to address Regional Challenges - Fog/ Low stratus Detection





Himawari 8 “Night Microphysics RGB” March 4th 2016
Useful for low-level cloud detection: possible stratus and fog