The Bureau of Meteorology

Sunglint around New Georgia (S.I) and Bougainville(PNG) on 15 September 2025

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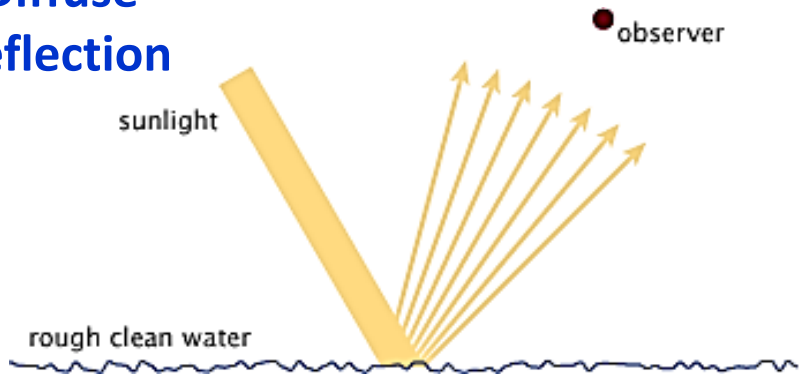
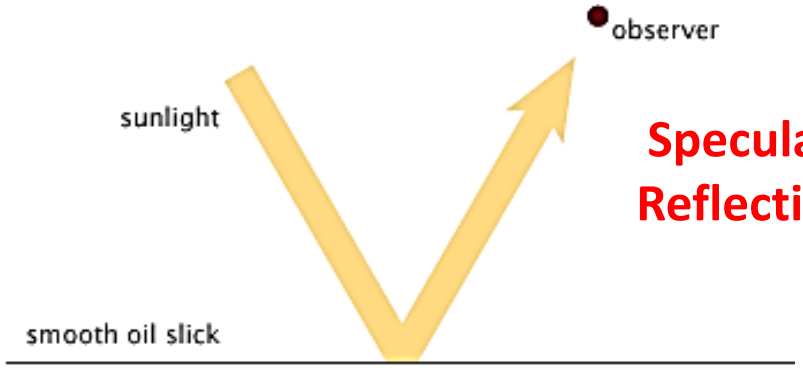
What is Sunglint?

Diffuse Reflection





Specular Reflection

Images courtesy Robert Simmon NASA

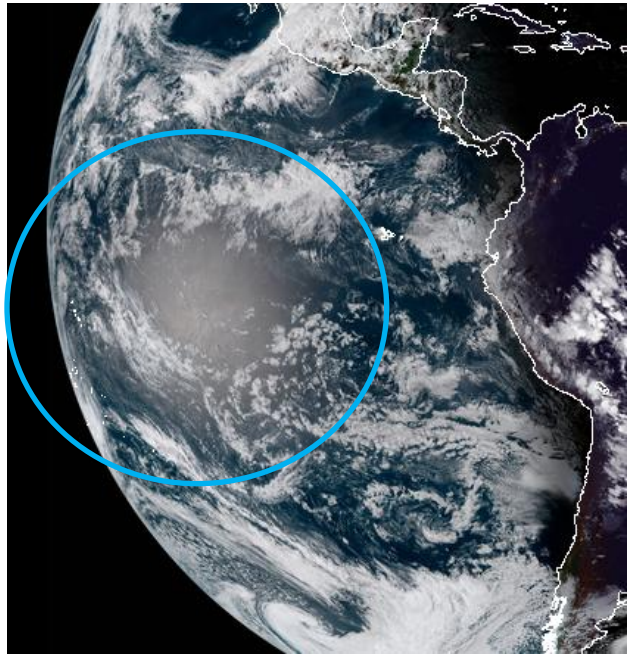
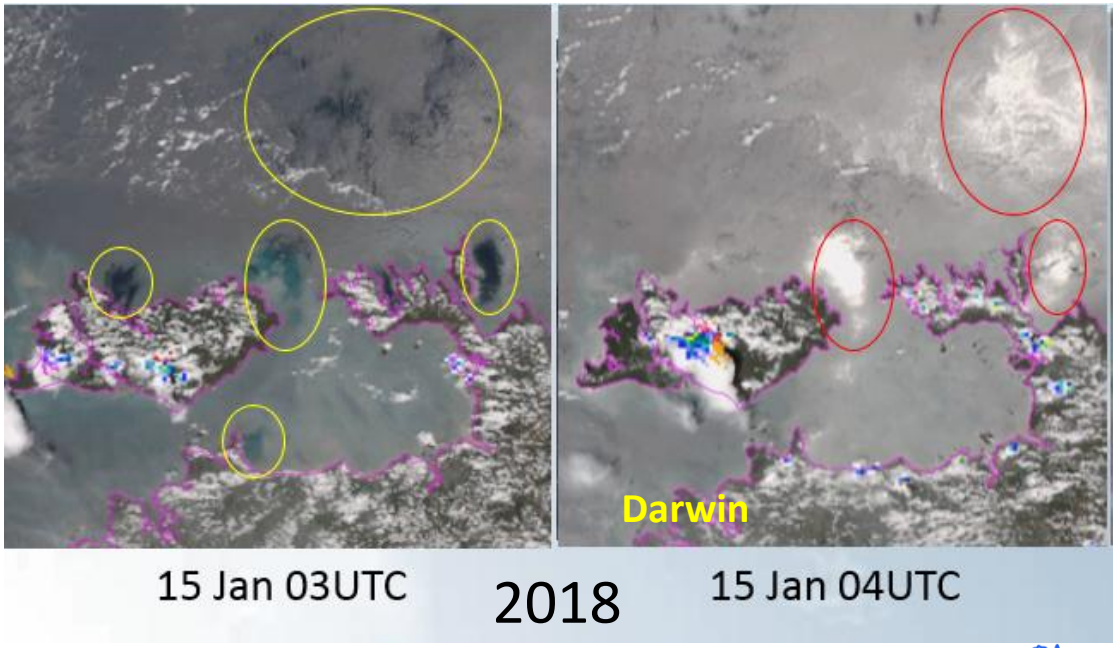


image courtesy CIRA/RAMMB



images courtesy JMA/Bureau of Meteorology

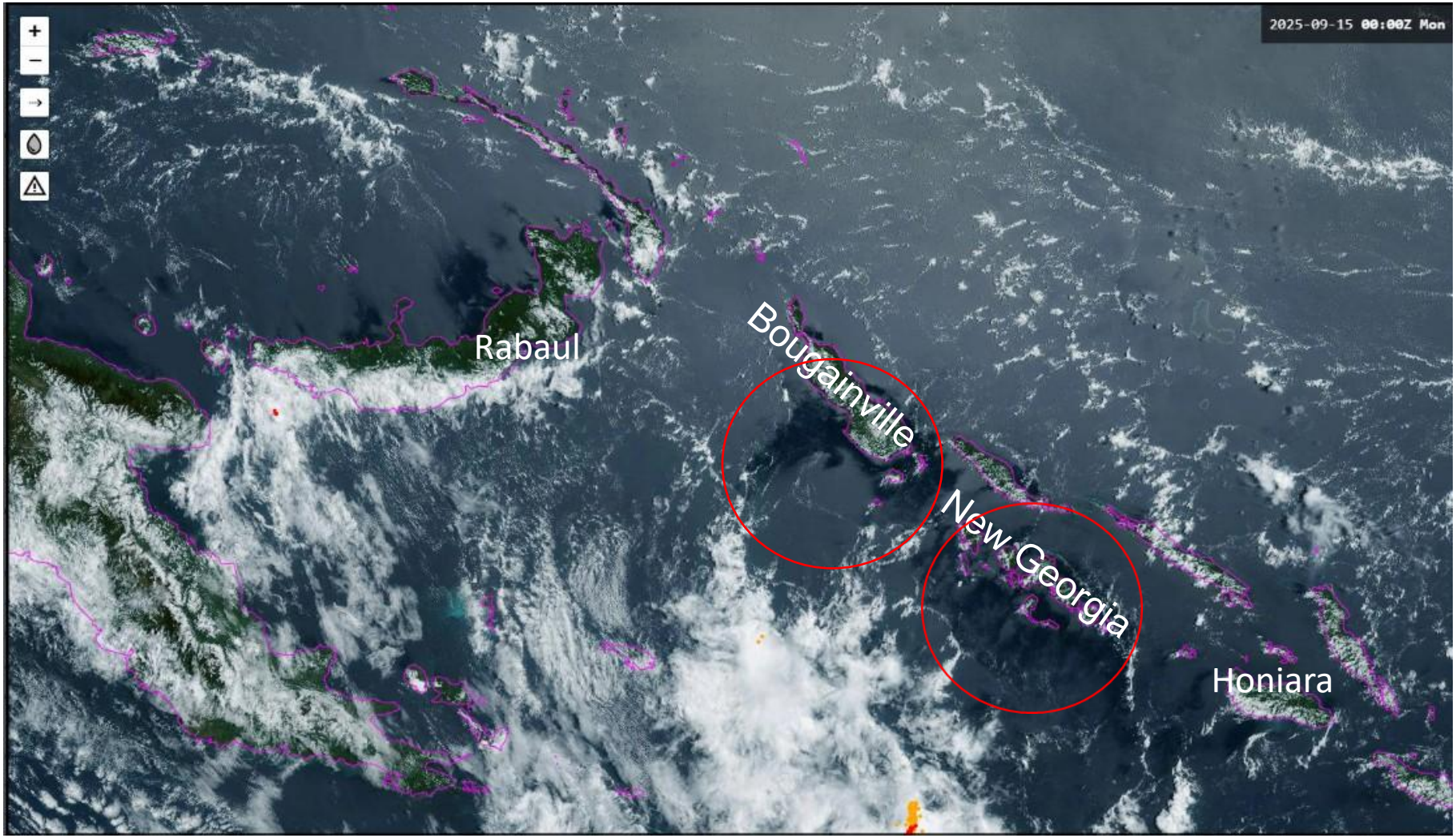
What is Sunglint?

Sunglint is the portion of shortwave radiation, including the visible radiation illuminating a water surface that is reflected back to space.

There are two types of Sunglint.

- The first is diffuse reflection, shown on the left-hand side. This is where visible sunlight is reflected off a rough ocean surface.
- The second is specular reflection, where visible sunlight is reflected off a smooth surface. This is like a mirror.
    - For specular reflection, if the reflected beam aligns with the satellite sensor, then the area is a brilliant white as shown on the RHS.
    - If the reflected beam does not align with the satellite sensor, then the area is very dark as shown in the centre image.

Sunglint as revealed in the satellite imagery: broad overview



Papua New Guinea and Solomon Island regions, True Colour RGB, 00UTC 15 September 2025

image courtesy JMA / Bureau of Meteorology

Sunglint as revealed in the satellite imagery: broad overview

This is the area of the case study, including the Papua New Guinea and Solomon Island regions, as rendered in the Himawari-9 True Colour RGB, and dated 00UTC 15 September 2025.

The areas of specular sunglint corresponding to calm sea surfaces are shown within the circled areas, over Bougainville island of Papua New Guinea and over New Georgia island of the Solomon Islands.

The areas corresponding to calm sea surfaces are a dark colour because most of the reflected light is not aligned with the satellite sensor. This is shown in the schematic below.

RHS image courtesy JMA/Bureau of Meteorology

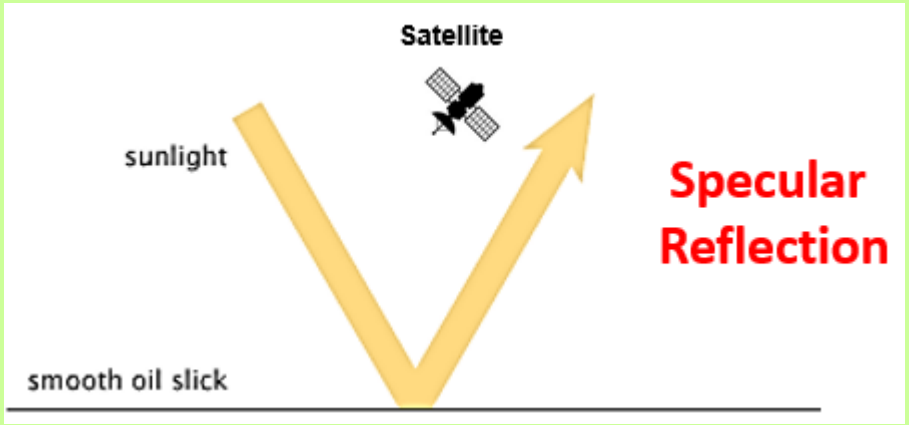
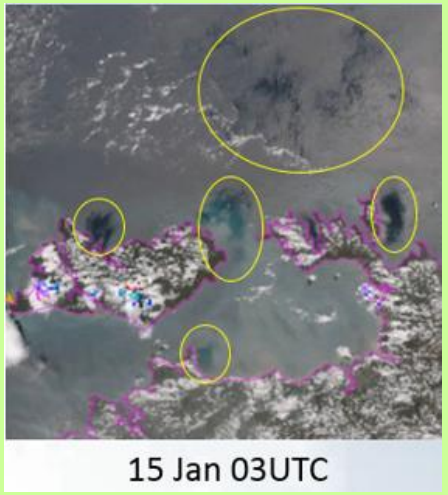
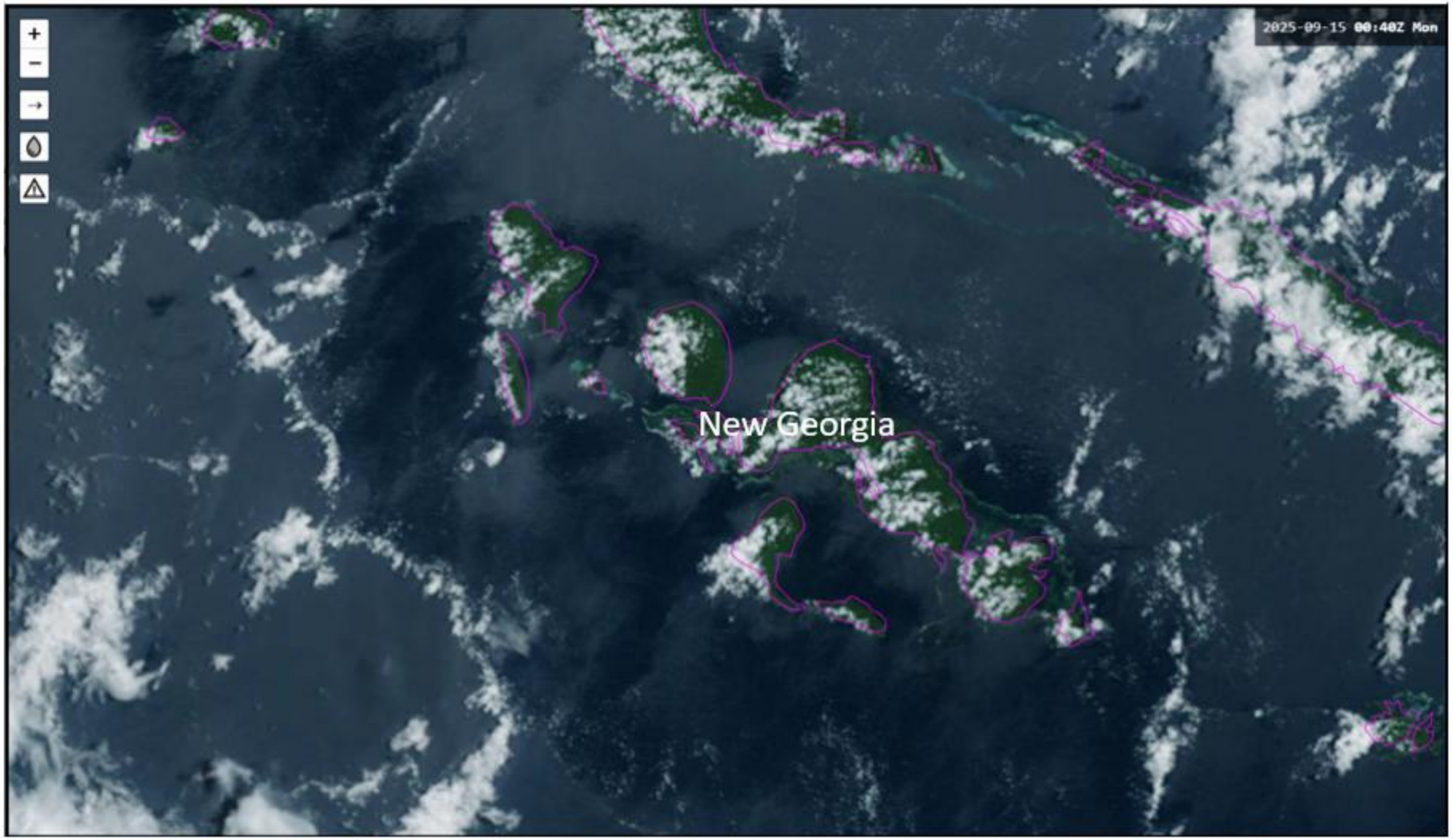


image courtesy Robert Simmon NASA. Image modified to include the satellite in a position not aligned with the reflected light



Animation: Sunglint over New Georgia (S.I)



True colour RGB 00UTC 15th Sept 2025 (animation)
image courtesy JMA / Bureau of Meteorology

Sunglint over New Georgia (S.I)

Let's have a look over the New Georgia Island region.

The movement of low-level clouds indicate an easterly flow. This can also be seen when inspecting the cloud developing around the ranges of New Georgia.

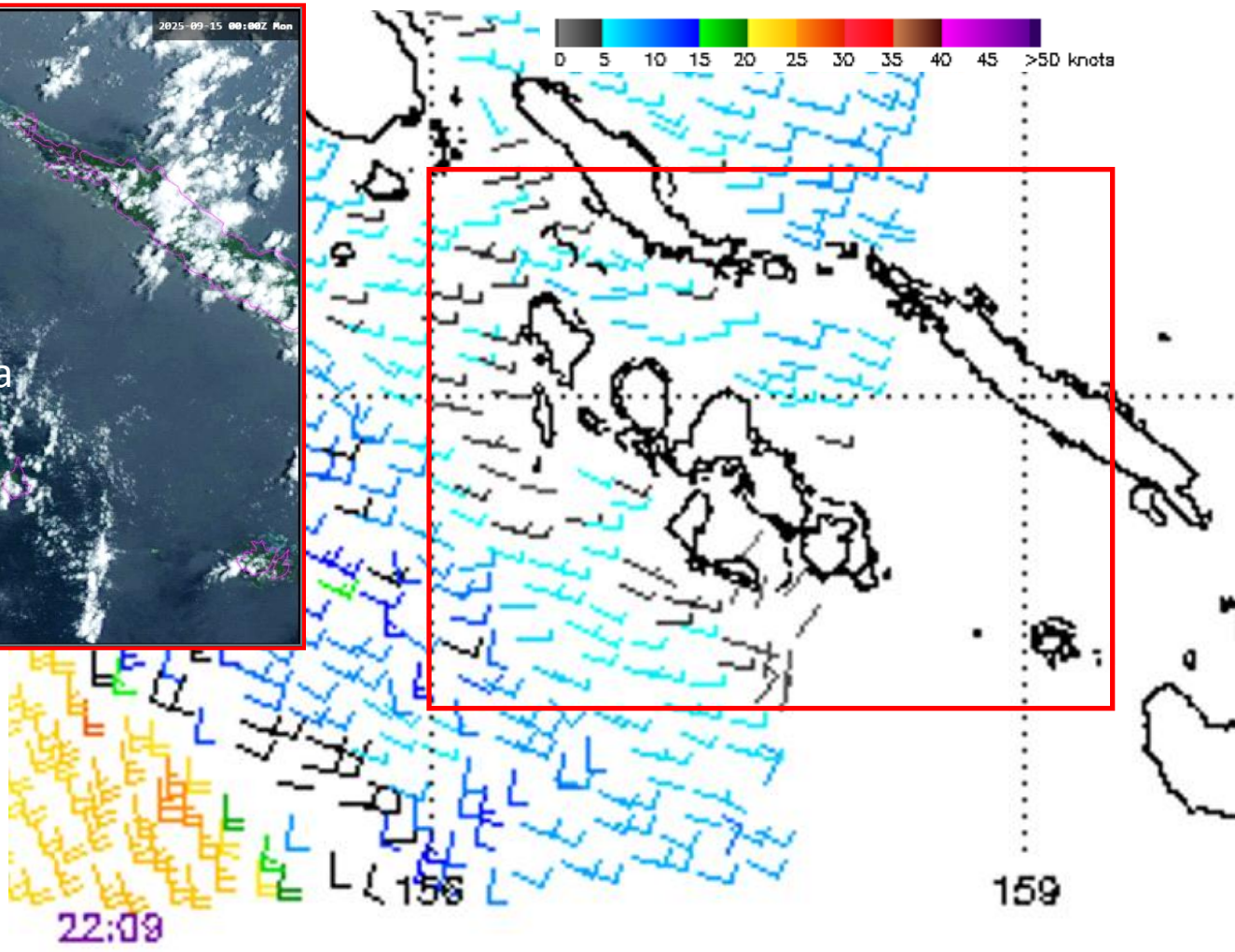
Areas of specular sunglint are quite complicated, due to the interaction of this flow with the complicated topography and coastlines of the islands.

The areas of specular sunglint are generally located on the lee side of the islands.

Note: one of the attendees at the RFG meeting cautioned that cloud shadows can sometimes masquerade as these "dark areas". This is not an issue for this case study as there are few clouds over maritime areas where these specular sunglint areas are revealed.

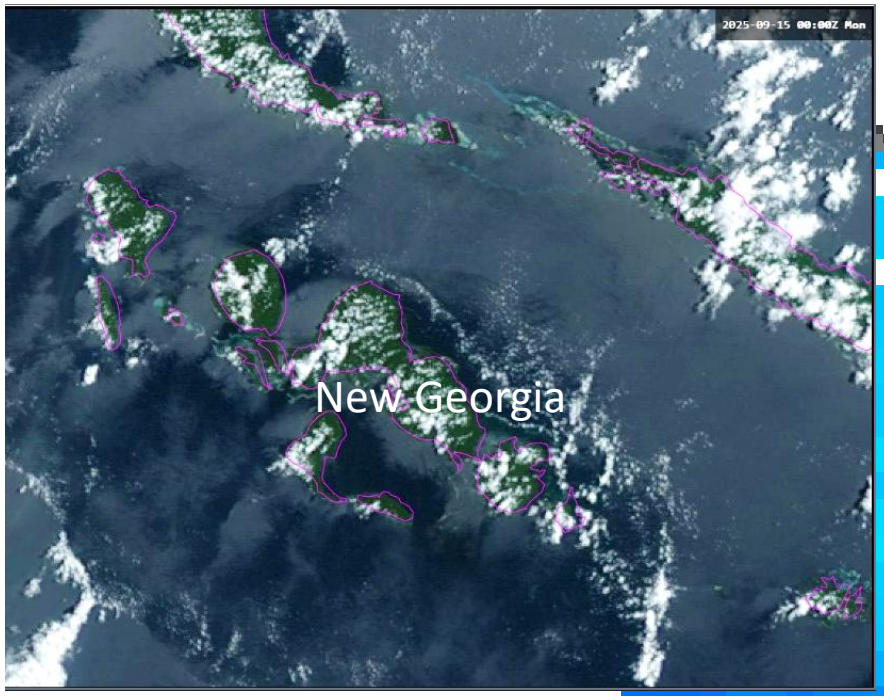
Sunglint over New Georgia (S.I) and ASCAT winds

True colour RGB 00UTC 15th Sept 2025 *image courtesy JMA / Bureau of Meteorology*

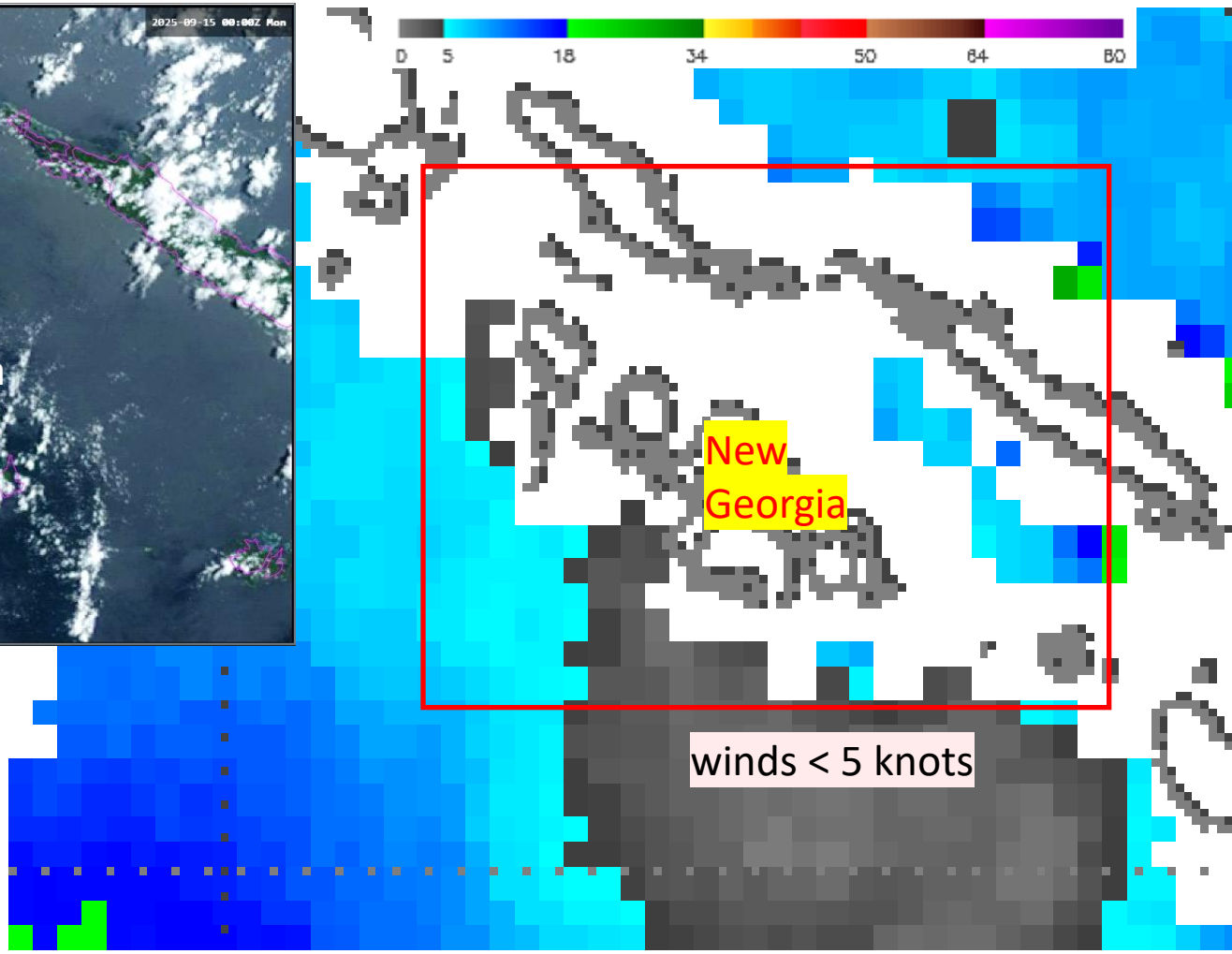


ASCAT-B 22:09UTC 14th Sept 2025
image courtesy NOAA NESDIS STAR

Sunglint over New Georgia (S.I) and AMSR2 NRT winds



True colour RGB 00UTC 15th Sept 2025 *image courtesy JMA / Bureau of Meteorology*



AMSR2 NRT Winds 08:17UTC 15th Sept 2025
image courtesy NOAA NESDIS STAR

Sunglint over New Georgia (S.I) and ASCAT / AMSR2 winds

Now let's compare the dark areas of specular sunglint (smooth sea and light wind) as revealed in the True Colour RGB with the sea surface winds from the ASCAT-B microwave scatterometer.
The ASCAT-B data clearly shows the easterly surface winds and the lighter winds to the lee of the islands. However, these areas are not as well resolved as in the True Colour RGB.

Let's compare the True Colour RGB rendering of the sunglint areas with the AMSR-2 surface winds. The areas of light winds are defined, but once again the lack of spatial resolution is noted.
Also, as the presence of the islands contaminates the microwave signal for this sensor, so no information is shown in close proximity and between the islands. This is another limitation. This is also true for OSCAT-3 scatterometer data.

Animation: Sun glint over Bougainville (PNG)

True colour RGB 0000UTC 15th Sept 2025 (animation)

image courtesy JMA / Bureau of Meteorology

Sun glint over Bougainville (PNG)

Now let's look at the sunglint areas around the island of Bougainville.

Here we see the low-level wind flow funnelled into the straits to the south of Bougainville. The specular sunglint helps us to identify calm seas in the lee of the topography. The sunglint also helps us to identify a vortex that is spinning clockwise over waters to the southwest of Bougainville.

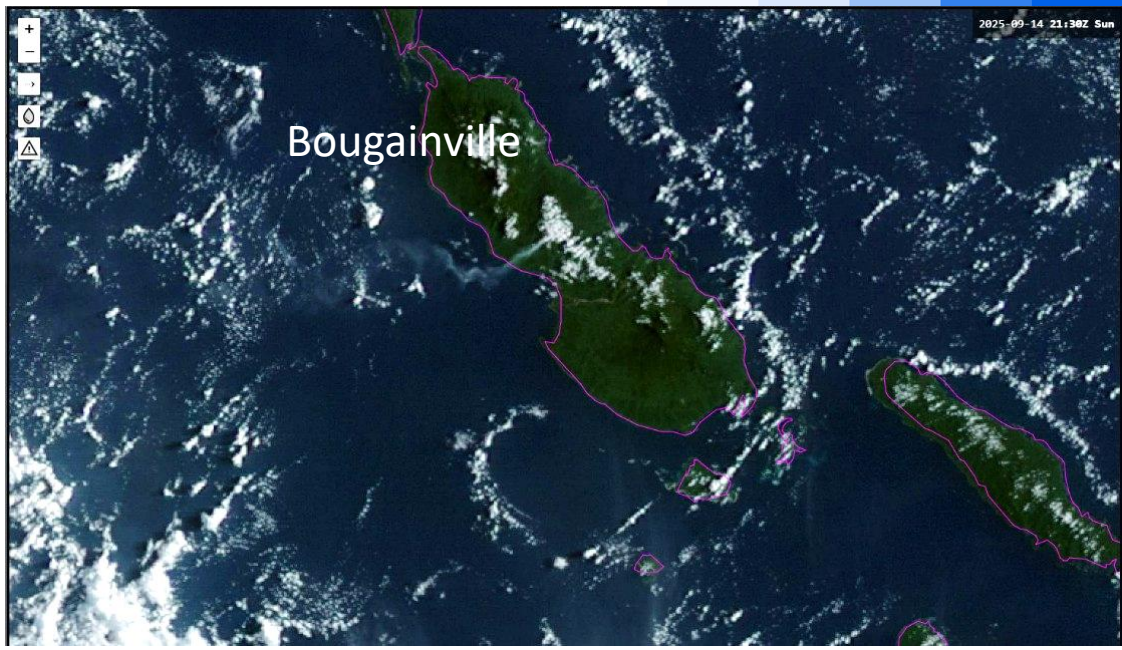
Low level cloud lines indicate that the flow to the south of Bougainville is a northeasterly.

The cloudlines also help to identify the flow within the vortex, possibly due to local convergence within the moist maritime flow.

Again, you can see the clouds forming on top of the mountains of Bougainville, and this helps to identify the direction of the low-level flow.

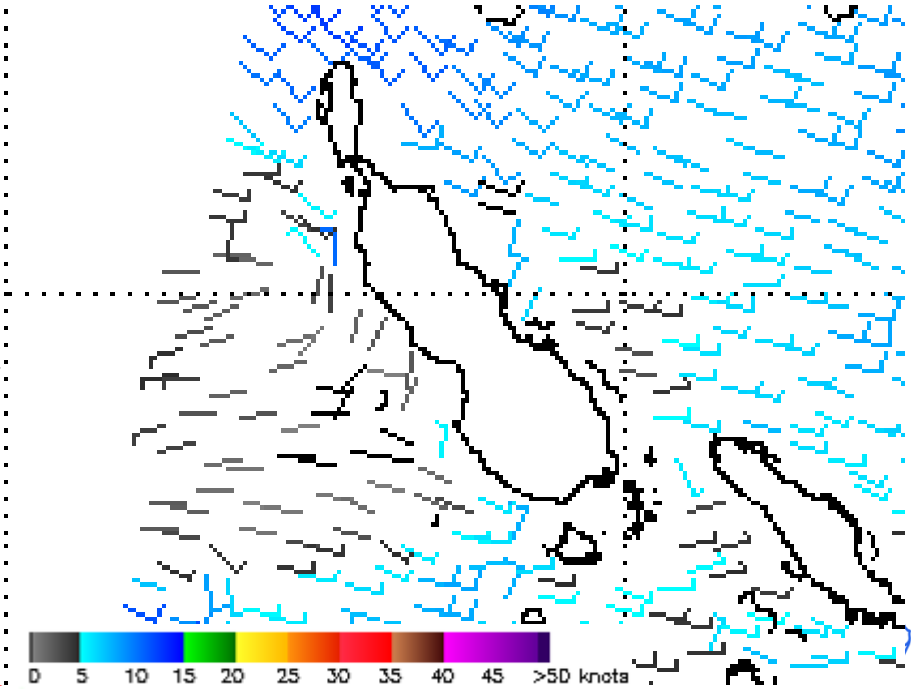
Note too the volcanic plume emitting from Bagana volcano, also indicating that the low-level flow is from the northeast.

Bougainville lee vortex. Himawari RGB data compared to ASCAT data



Enhanced True Colour
RGB 2140UTC 14th Sept

image courtesy JMA / Bureau of Meteorology



ASCAT-B winds
2209UTC 14th September

image courtesy NOAA NESDIS STAR

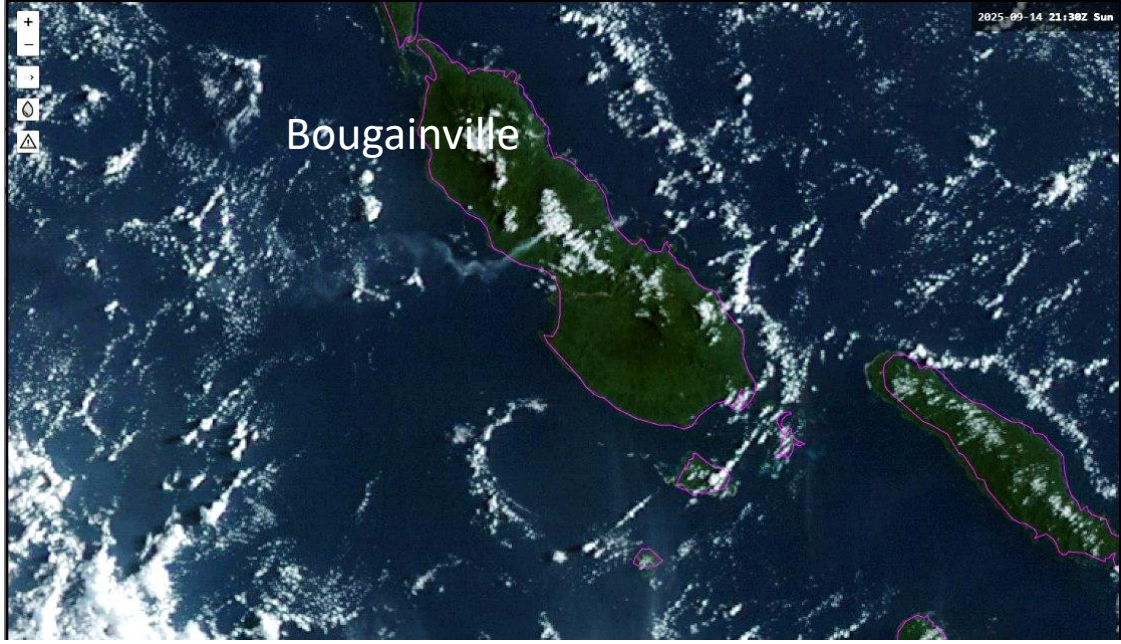
Bougainville lee vortex. Himawari RGB data compared to ASCAT data

Comparing the sunglint features and the low-level clouds in the True Colour RGB with the ASCAT-B surface winds:

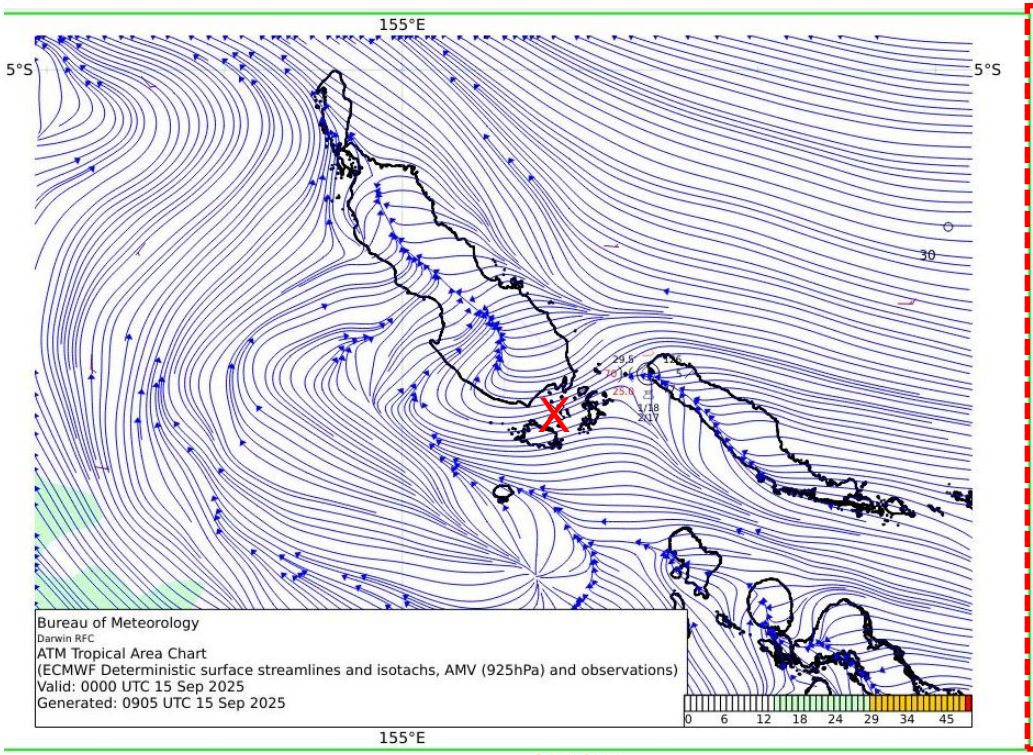
- The ASCAT data shows light low-level winds (less than 5 knots) over the region of the vortex, however, the coarse resolution of the ASCAT data does not pick up the vortex as well as is revealed in the True Colour RGB.
- In addition, the curved low level cloud lines over waters to the southwest of Bougainville in the Himawari-9 True Colour RGB defines the vortex very well.

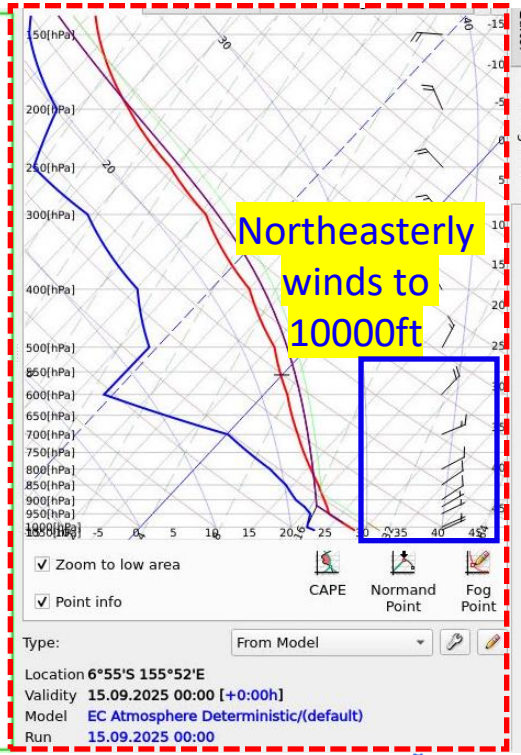
Bougainville lee vortex. Satellite data compared to NWP data

Enhanced True Colour RGB
2140UTC 14th Sept
image courtesy JMA / Bureau of Meteorology



ECMWF surface winds 00UTC 15th September. Also, sounding in the straight to the south of Bougainville
image courtesy Bureau of Meteorology





Bougainville lee vortex. Satellite data compared to NWP data.

Let's see how the NWP models have captured these low-level marine and atmospheric features.

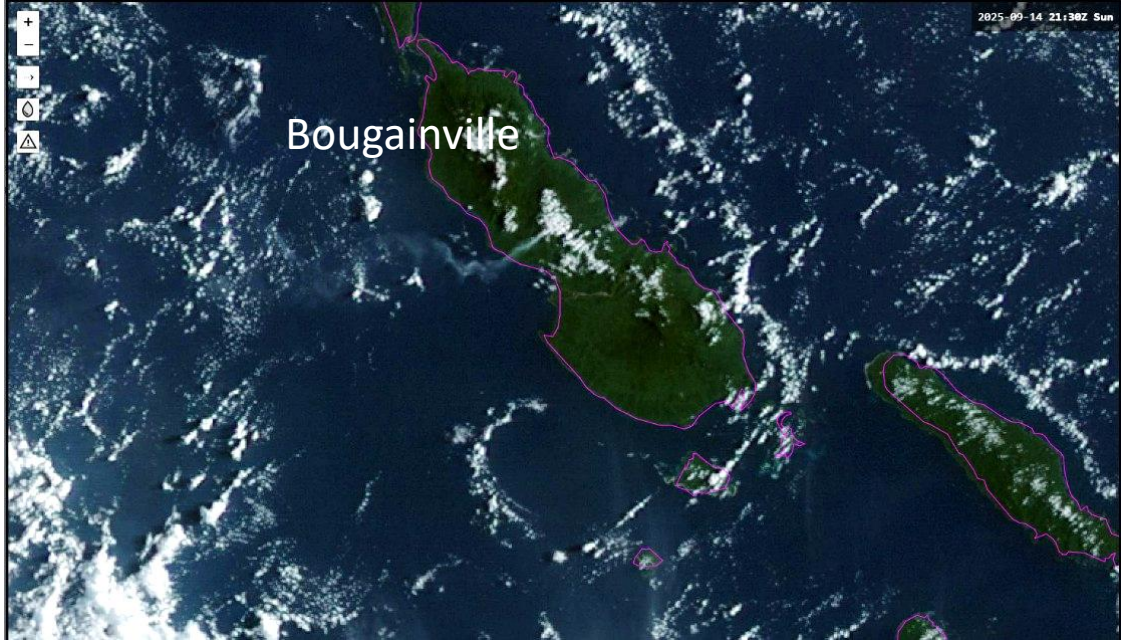
The ECMWF surface wind streamline analysis is shown here and this reveals the circulation of the winds to the southwest of Bougainville.

Inspection of the ECMWF sounding within the straits to the south of Bougainville is also instructive. This shows northeasterly winds to 10000ft.

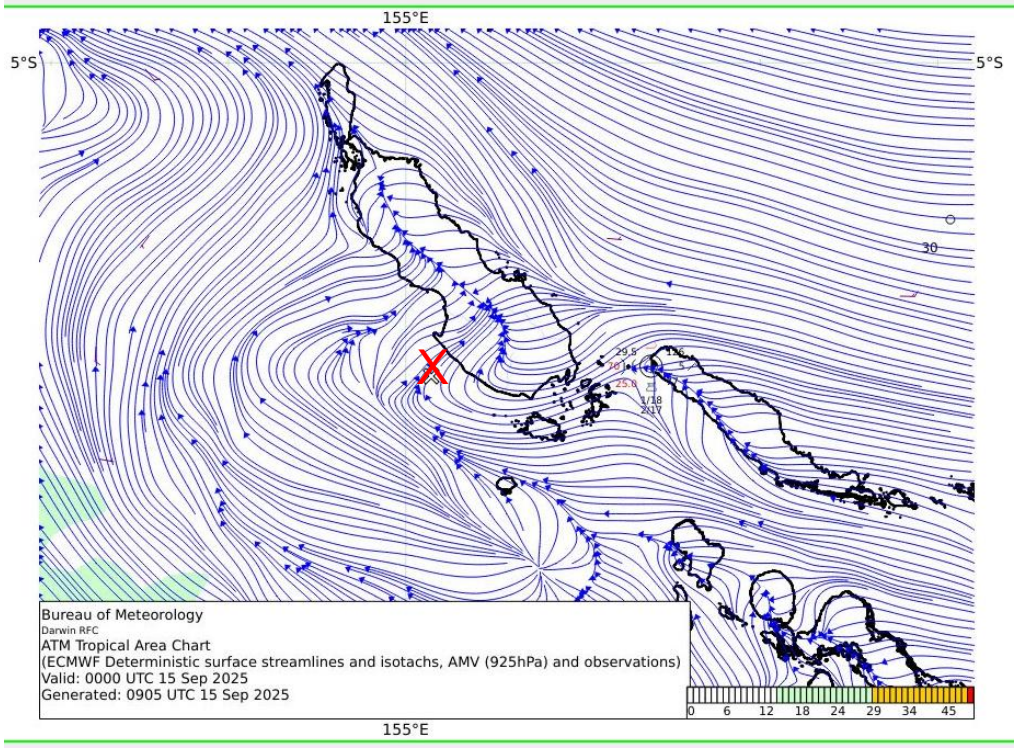
Note too that the sounding is fairly moist below 5000ft but becomes a lot drier above this. This explains the predominantly low cloud observed in the True Colour RGB images.

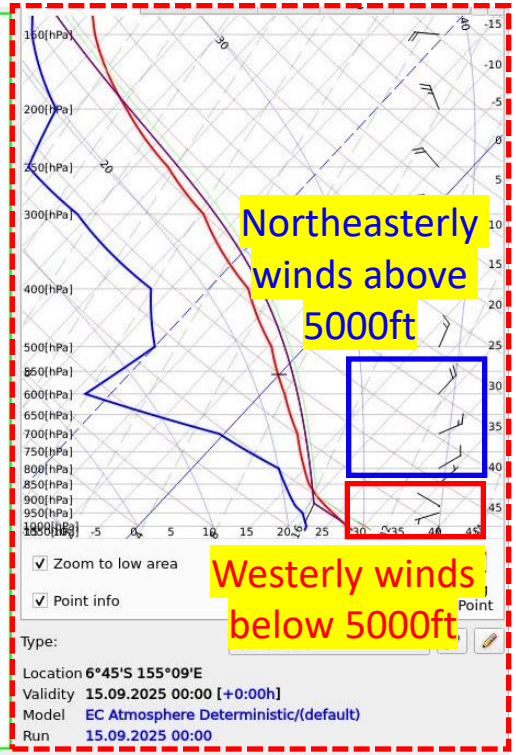
Bougainville lee vortex. Satellite data compared to NWP data

Enhanced True Colour RGB
2140UTC 14th Sept
image courtesy JMA / Bureau of Meteorology



ECMWF surface winds 0000UTC 15th September. Also, sounding in the lee of Bougainville
image courtesy Bureau of Meteorology





Bougainville lee vortex. Satellite data compared to NWP data

Inspection of the ECMWF sounding located in the lee and to the west of Bougainville Island shows westerly winds below 5000ft.

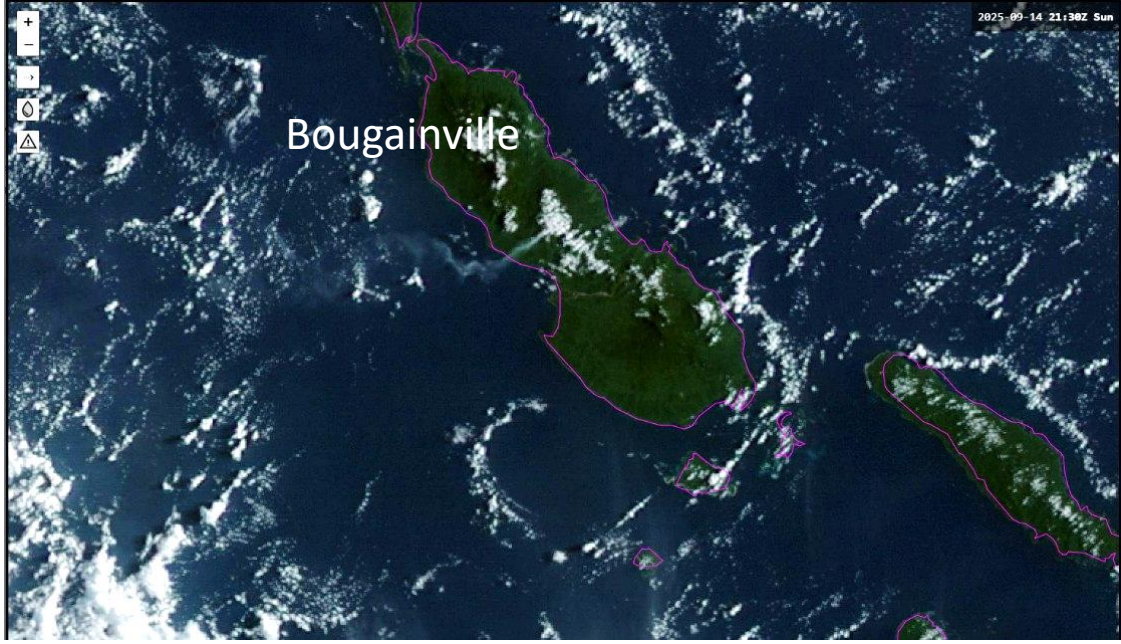
Above that the winds are northeasterly from 5000-10000ft.

The soundings indicate that the circulation associated with the vortex is quite shallow, below 850hPa (5000').

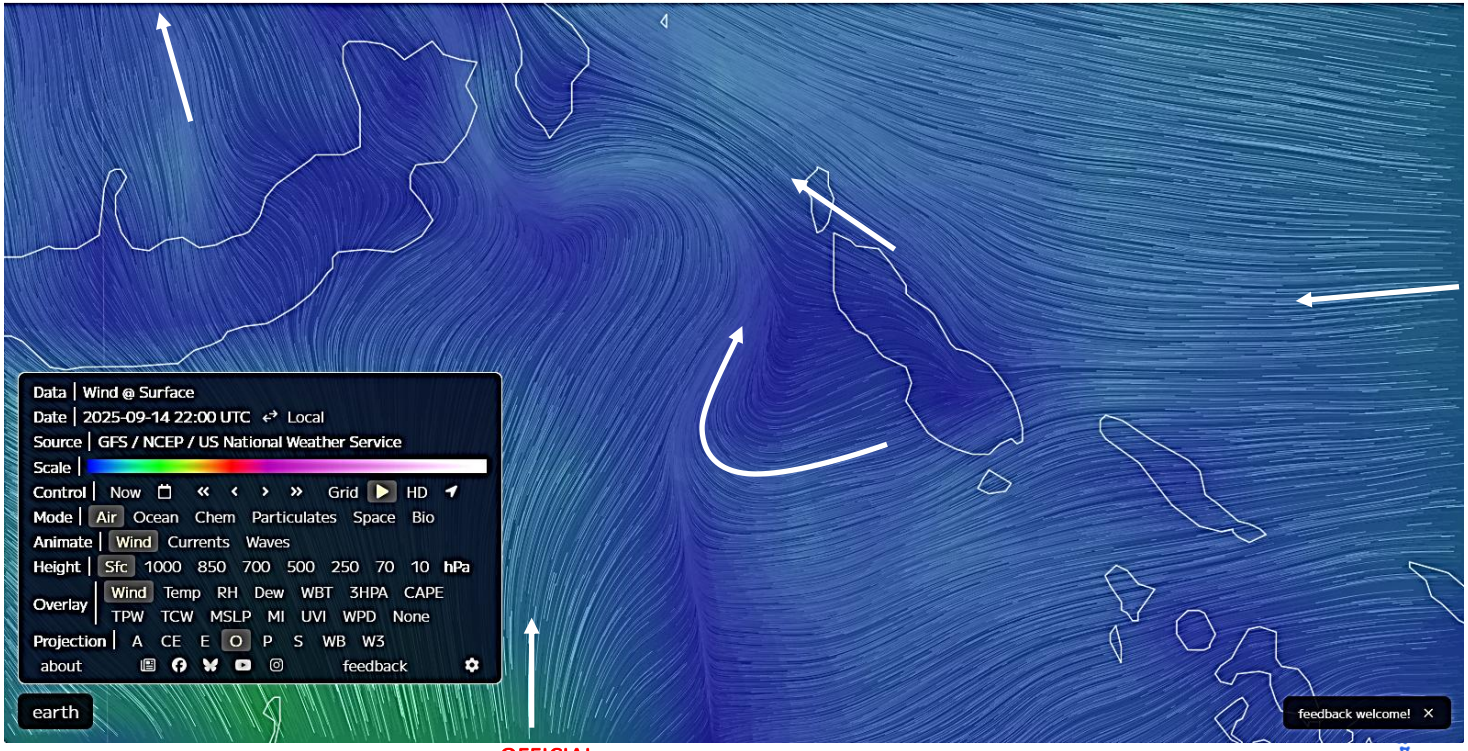
This indicates that the circulation is strongly affected by the interaction between the low level wind flow and the topography of Bougainville.

Bougainville lee vortex. Satellite data compared to NWP data

Enhanced True Colour RGB
2140UTC 14th Sept
image courtesy JMA / Bureau of Meteorology



GFS surface winds 2200UTC 14th September. Wind direction at selected locations shown
image courtesy Earth Nullschool Cameron Beccario



Bougainville lee vortex. Satellite data compared to NWP data

Finally, it is always important to compare across at least two NWP models when you are forecasting.

Here we are looking at the GFS surface winds rendered as streamlines and obtained from the Earth Nullschool website at https://earth.nullschool.net/ .

White arrows show the direction of the surface winds. Again, it is clear that the GFS model has captured the circulation located to the southwest of Bougainville island.

So, in summary, both the ECMWF and the GFS model have captured the circulation associated with the vortex. On the other hand, only the Himawari-9 True Colour RGB truly shows the complete closed circulation associated with the vortex, when this image is animated.

Animation: Implication /Useful to the Mariners

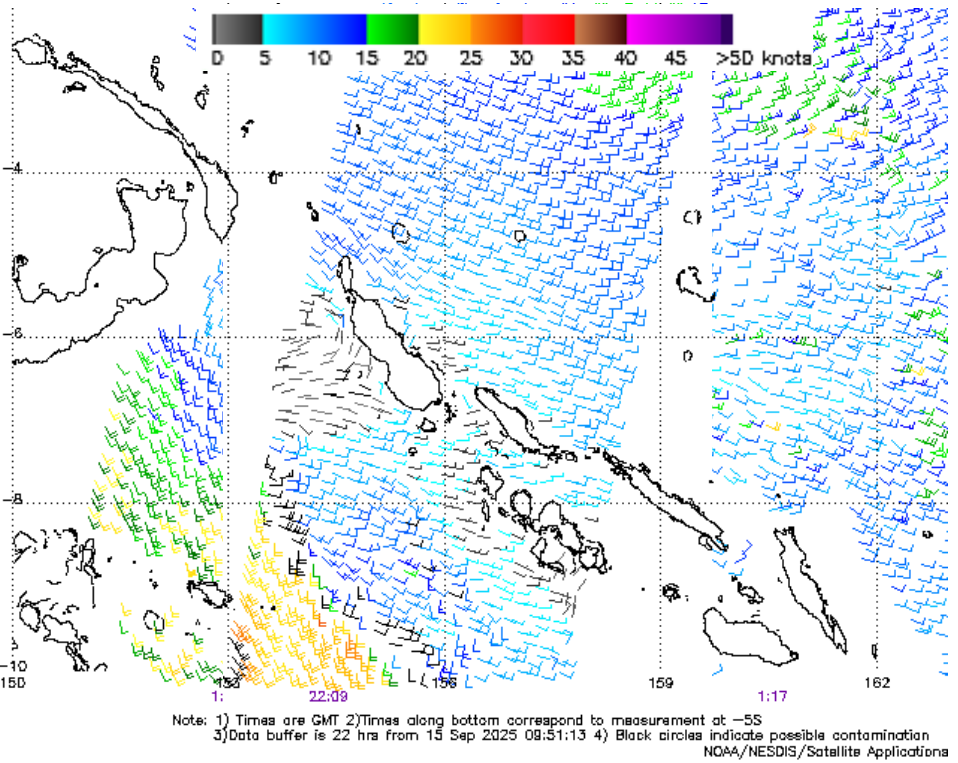
Small boats

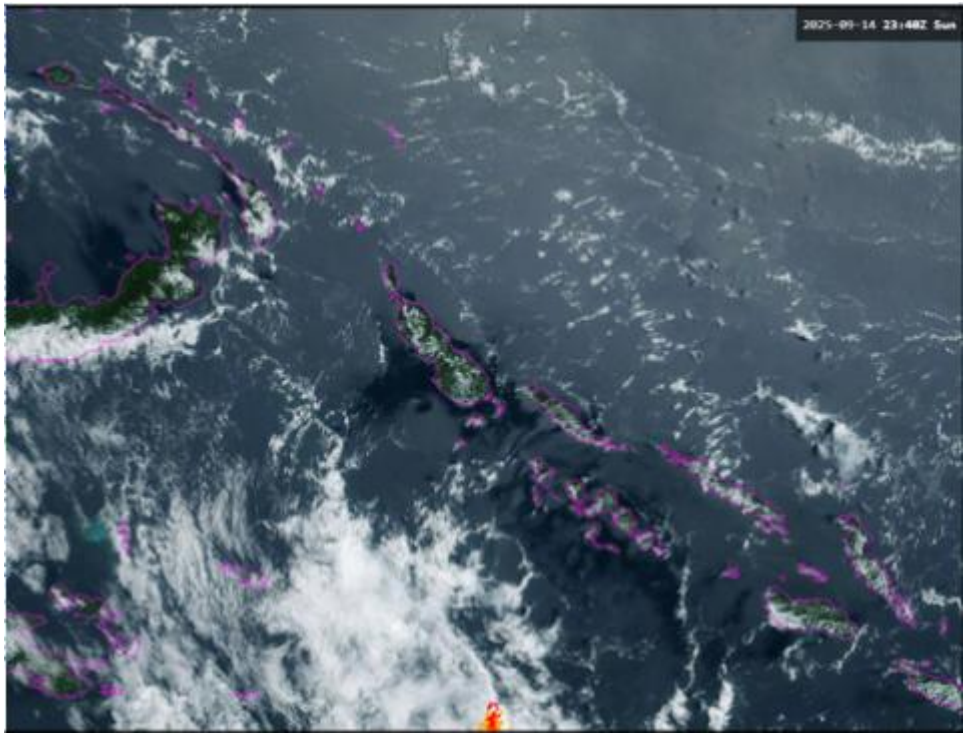
- Smooth to slight seas state

good for travel between the inter Islands (<15kts)

Sailing

Not a good time for sail as winds are light near the coast.





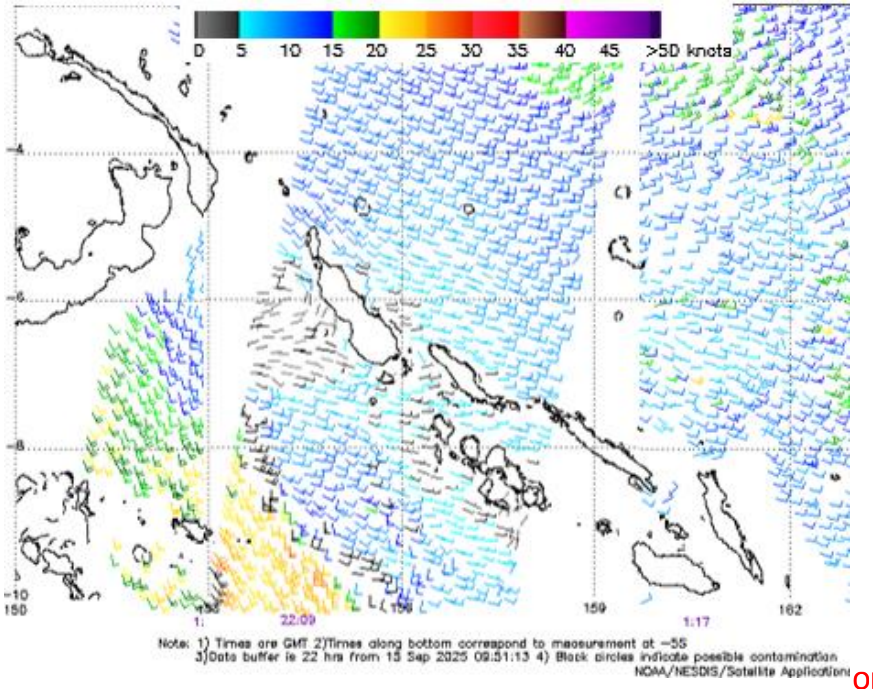
OSCAT winds 0117UTC 15th Sept 2025, overlaid with ASCAT winds 2209UTC 14 Sept image courtesy; NOAA NESDIS STAR

Enhanced True Colour RGB 21UTC 14th to 0500UTC 15th Sept (animation) image courtesy JMA / Bureau of Meteorology

Implication/Useful to the Mariners

Fishing condition

- **In terms of sea nutrients lack of distribution of phytoplankton in that region. Phytoplankton production increases for higher wind speeds,**
- **Wind- driven nutrient upwelling supports the ecosystem functioning around larger tropical reef islands** (The island mass effect: a study of wind-driven nutrient upwelling around reef islands | Journal of Oceanography)



OSCAT winds 0117UTC 15th Sept 2025, overlaid with ASCAT winds 2209UTC 14 Sept image courtesy; NOAA NESDIS STAR

Implication/Useful to the Mariners

This study of sun glint has also encouraged Frank and Richard to think about the impact of local conditions on sailors, mariners and fishermen.

For small crafts powered by fuel, the calm seas indicated by the specular sunglint would be favourable conditions for inter-island travel.

On the other hand, for a sailing boat these would not be good conditions, as these craft rely on wind for propulsion.

Implication and usefulness of sun glint to the fishing industry: Read from the Slide!!! Note though that strong surface winds can also have an adverse impact on phytoplankton, as the resultant vertical movement of the submarine waters can transport phytoplankton to greater depths in the ocean and away from the sunlight that these need.

Note here that I have superimposed the ASCAT-B scatterometer winds over the OSCAT scatterometer winds of a similar time. This shows that the ASCAT data resolves winds closer to the island shores compared to the OSCAT data.

Lessoned learned (includes my input as well)

1. Weather related in the Sunglint area (regions)

2. Using satellite data

3. How to apply in regular forecasting

4. Useful to regular users (Boat travellers/sailors/fishermen)

Lessons learned (includes my input as well)

Lessons learned included:

- Practical application of what was learned about the sunglint effect during lectures in constructing the case study.
- Using of satellite data is vital and very useful. In particular the True Colour RGB was very useful in resolving the areas of calm seas in great detail.
- Additional useful information was obtained by examining the movement of low-level clouds in identifying the low-level wind flow, including the vortex to the southwest of Bougainville island and the effect of topography on the flow.
- Himawari-9 satellite data has been compared to satellite microwave data, NWP low level winds and soundings to give better insight to the situations around Bougainville and New Georgia. This is good practise for operational forecasting work, where a range of data is used to assist understanding of the meteorology.
- The impact of the sunglint effect on motor-boat traffic, sailing ships and fishing activities was also investigated and this is important knowledge to ensure that the forecaster can communicate the forecasts to the people who use these.

The Bureau of Meteorology

Thank You

Richard Huka

Frank Bale