Season of the non-developer?

A review of tropical lows: 08, 10, 11 and 12U

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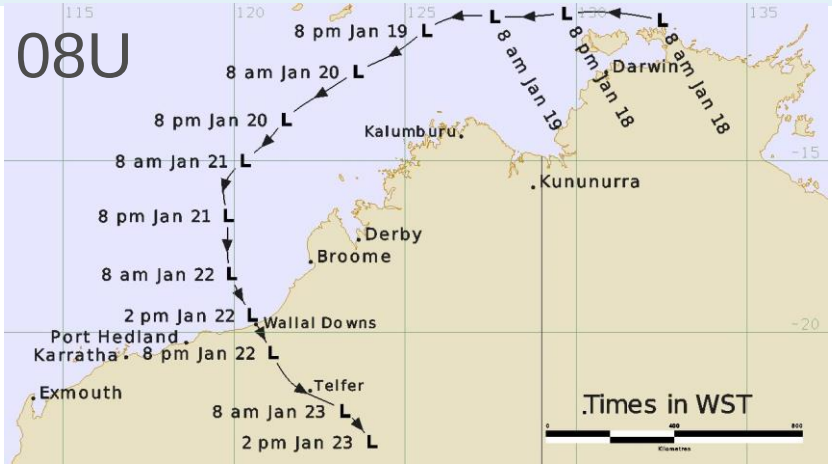
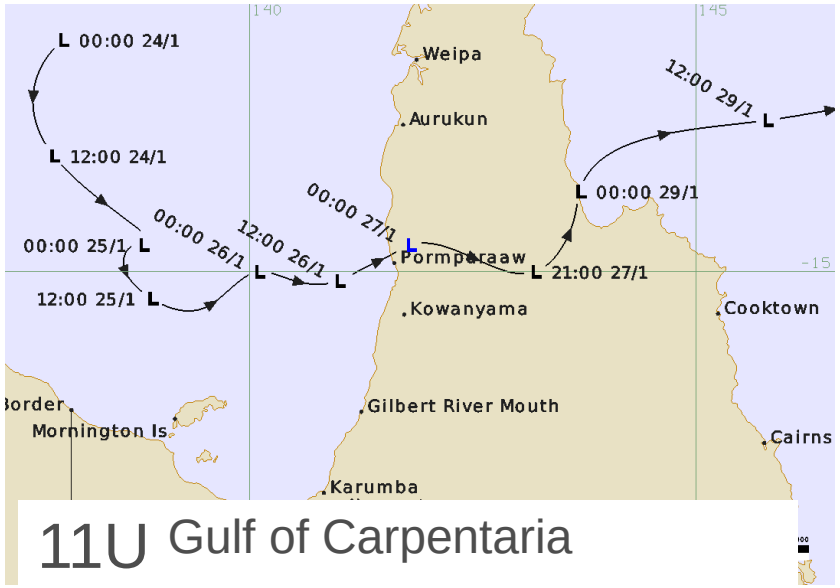
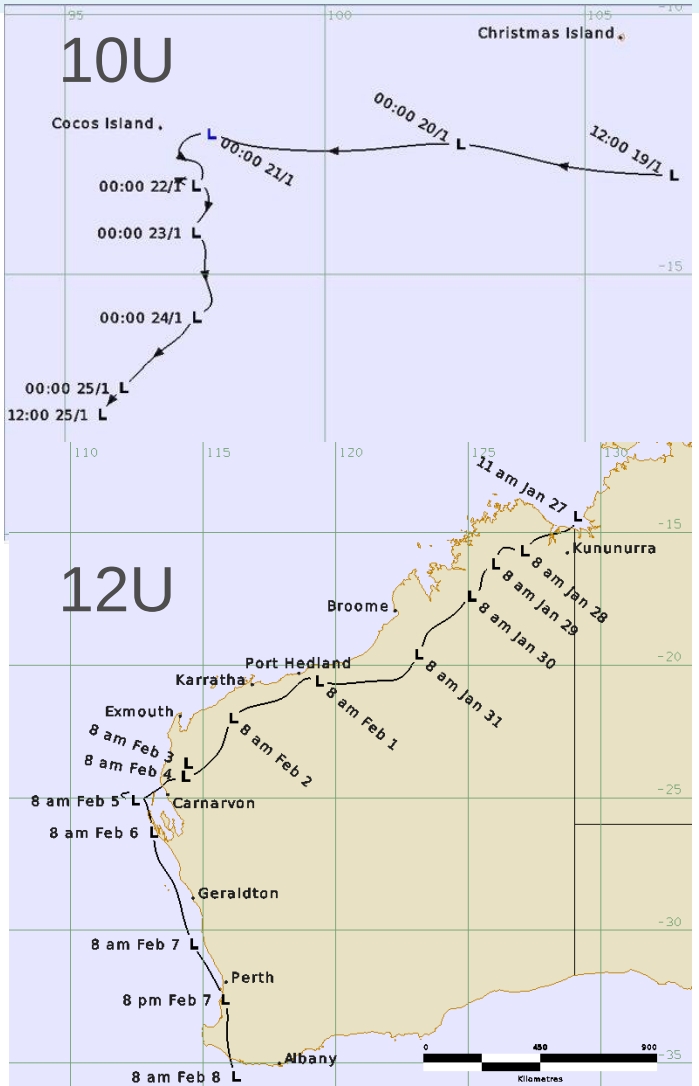
All were forecast to be TCs but didn't develop?





11U Gulf of Carpentaria



Australian TC season thus far

Very low Accumulated Cyclone Energy ACE

Australian Government
Bureau of Meteorology

Australian region: 4 named TCs: Imogen, Joshua, Kimi, Lucas.
No severe TCs. Onl[illegible] TC days But 13 tracked lows

Note: JTWC has mo[illegible]

SPac: dominated by[illegible]

SIO: dominated by I[illegible]

Basin	Named Storms	Na Da
South Indian (West of 135°E)	11 (10.1)	44
South Pacific (East of 135°E)	9 (5.5)	26
Southern Hemisphere	20 (15.6)	70

Source: http://tropical.atmos.colosta[illegible]

Real-Time Southern Hemisphere Statistics by Storm for 2020/2021

Year	Basin	Storm#	Name	Dates TC Active	Max Wind (kts)	MSLP (mb)	Cyclone (>=34 kt) Days	Cyclone (>=64 kt) Days	Major (>=96 kt) Cyclone Days	Accumulated Cyclone Energy
2021	South Indian	9	FOURTEEN	1/21-1/22	40	997	1.00	0.00	0.00	0.6
2021	South Pacific	4	IMOGEN	1/3-1/4	45	995	1.00	0.00	0.00	0.6
2020	South Pacific	1	FOUR	12/11-12/12	40	997	1.50	0.00	0.00	0.9
2021	South Pacific	7	BINA	1/30-2/1	45	991	1.50	0.00	0.00	1.0
2021	South Pacific	9	TWENTY	2/10-2/12	45	991	1.75	0.00	0.00	1.0
2021	South Indian	10	EIGHTEEN	2/4-2/6	35	991	2.25	0.00	0.00	1.1
2020	South Indian	3	THREE	12/8-12/11	45	992	3.00	0.00	0.00	1.8
2021	South Pacific	5	KIMI	1/17-1/18	55	990	2.00	0.00	0.00	1.8
2021	South Indian	6	JOSHUA	1/15-1/18	45	998	3.25	0.00	0.00	1.9
2021	South Indian	8	THIRTEEN	1/21-1/26	35	999	4.00	0.00	0.00	2.0
2021	South Indian	7	ELOISE	1/17-1/20	50	994	3.50	0.00	0.00	2.5
2020	South Indian	4	CHALANE	12/25-12/30	60	990	4.00	0.00	0.00	2.9
2020	South Pacific	3	ZAZU	12/13-12/16	55	985	3.50	0.00	0.00	3.2
2020	South Indian	2	BONGOYO	12/7-12/11	55	992	4.25	0.00	0.00	3.4
2021	South Pacific	6	ANA	1/30-2/2	65	976	3.50	0.50	0.00	3.6
2021	South Pacific	8	LUCAS	1/31-2/3	65	980	3.75	0.25	0.00	3.7
2020	South Indian	1	ALICIA	11/14-11/17	65	983	3.75	0.75	0.00	4.2
2021	South Indian	5	DANILO	1/1-1/8	70	979	6.50	0.75	0.00	6.2
2020	South Pacific	2	YASA	12/12-12/19	140	914	7.50	4.75	2.50	23.8
2021	South Indian	11	FARAJI	2/5-2/14	140	920	9.00	6.00	3.00	28.7

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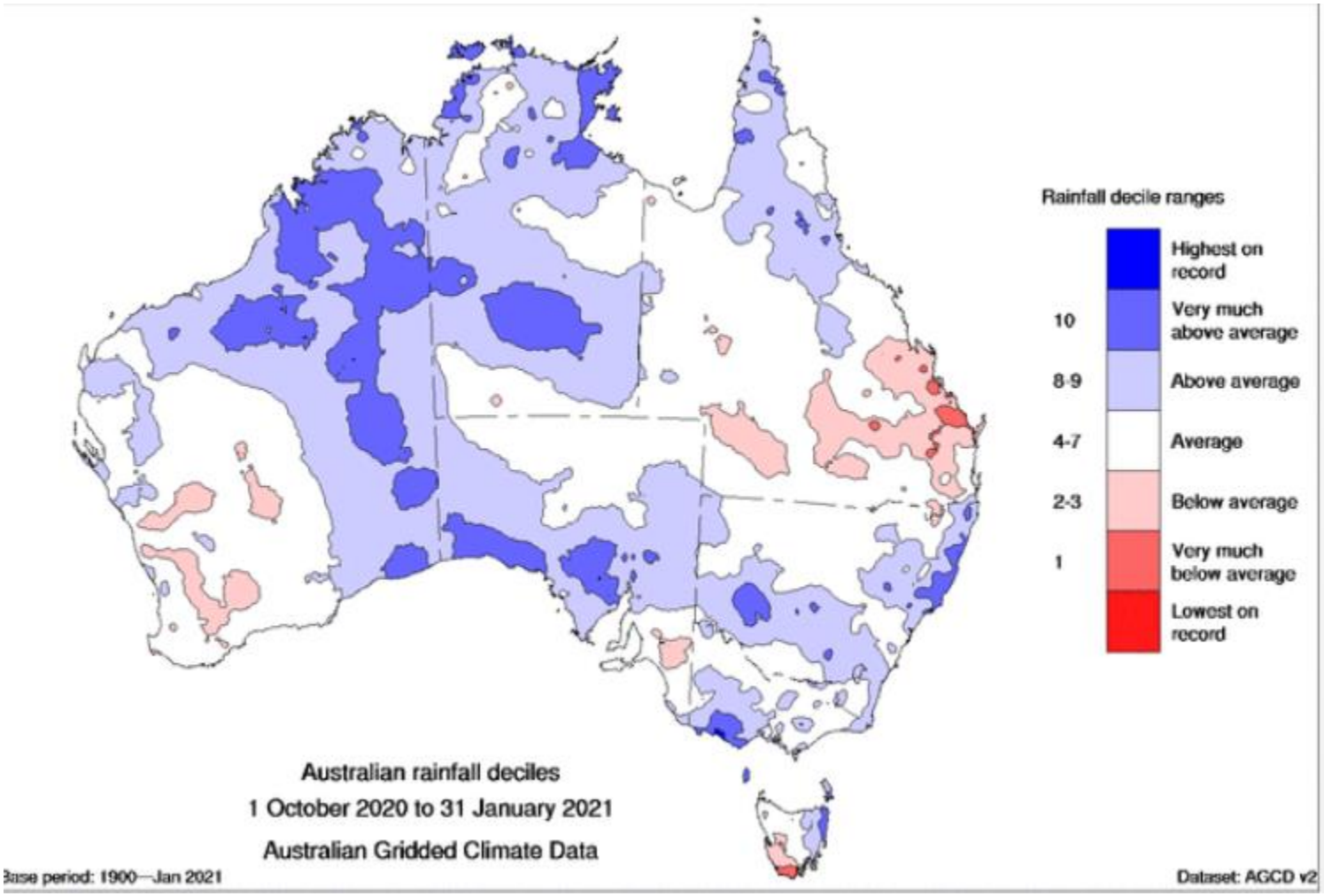
Less TCs but more rain!



Source:
http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=decile&period=cnws&region=nat&year=2021&month=02&day=10

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Review of genesis influences

- Coriolis
- Moist unstable air mass
- Warm SST
- Deep Convection
- Weak vertical wind shear
- Low-level vorticity

1. Coriolis and Low-level vorticity
2. Moist unstable air mass
3. Warm SST
4. Deep Convection
5. Weak vertical wind shear

Quiz: which one is NOT that important in the Australian region?

Answer in chat or type any questions there too!

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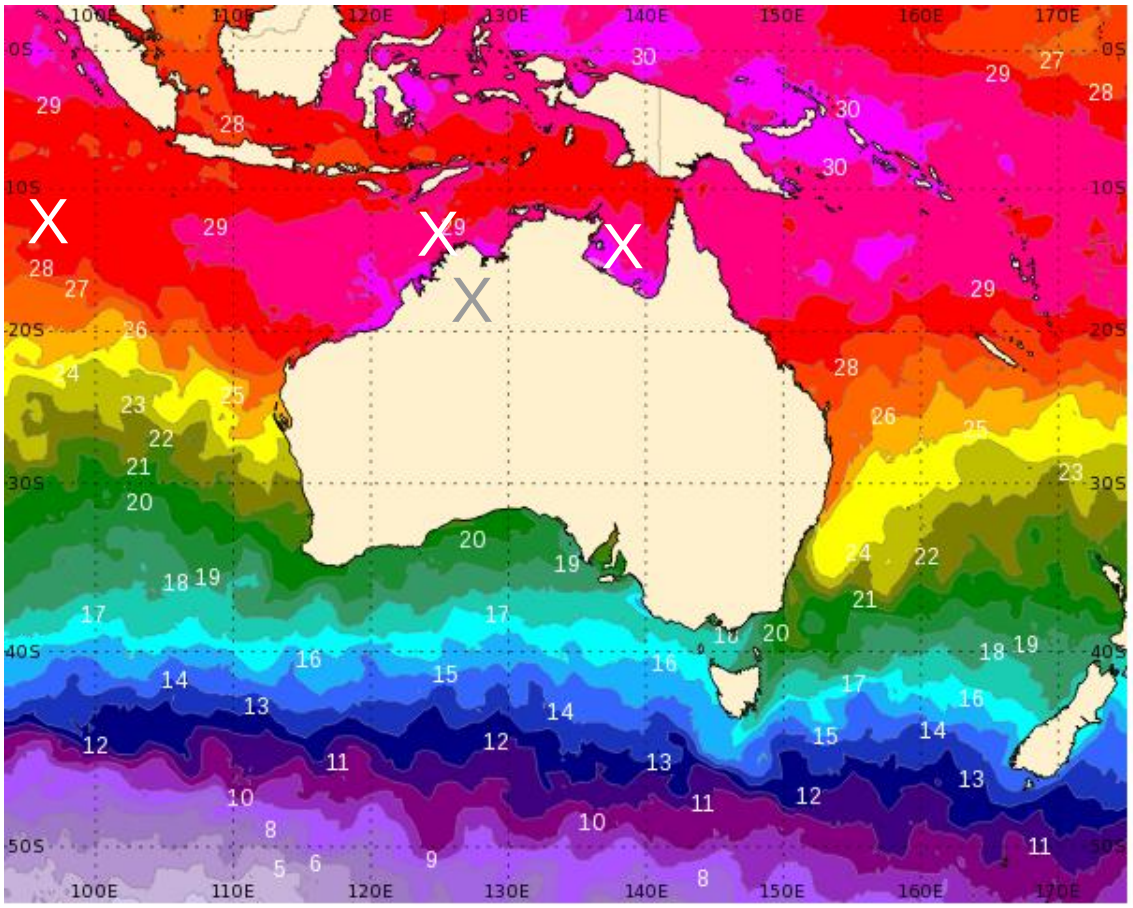
Review of genesis influences

Quiz: which one is NOT that important in the Australian region?

SSTs* (still need ocean)



Sea surface temperature (deg C): Daily analysis for **Tue 9 Feb 2021**
(c) Copyright Australian Bureau of Meteorology | **RAMSSA**

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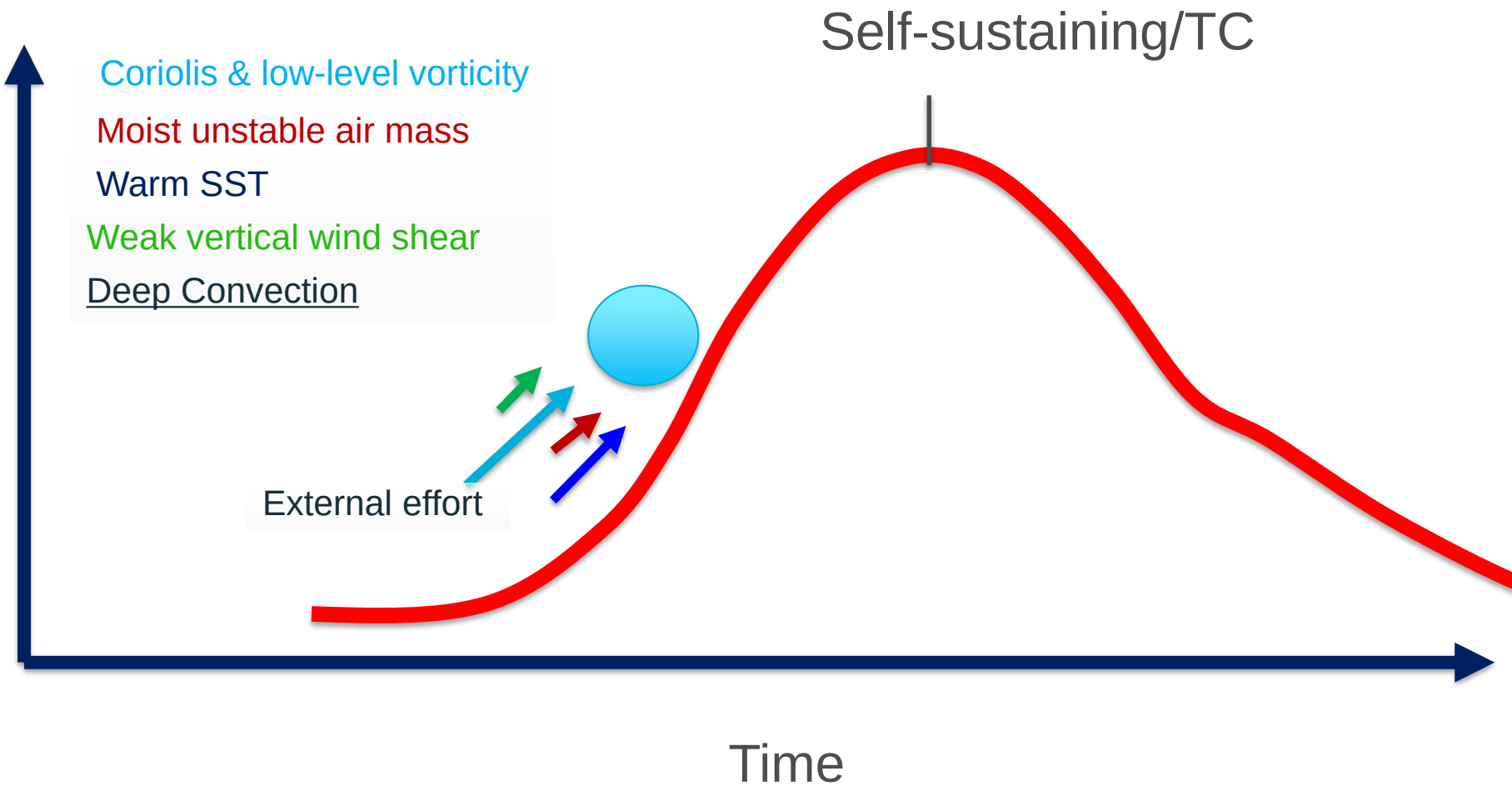
Bureau of Meteorology

(Courtney) Conceptual Model



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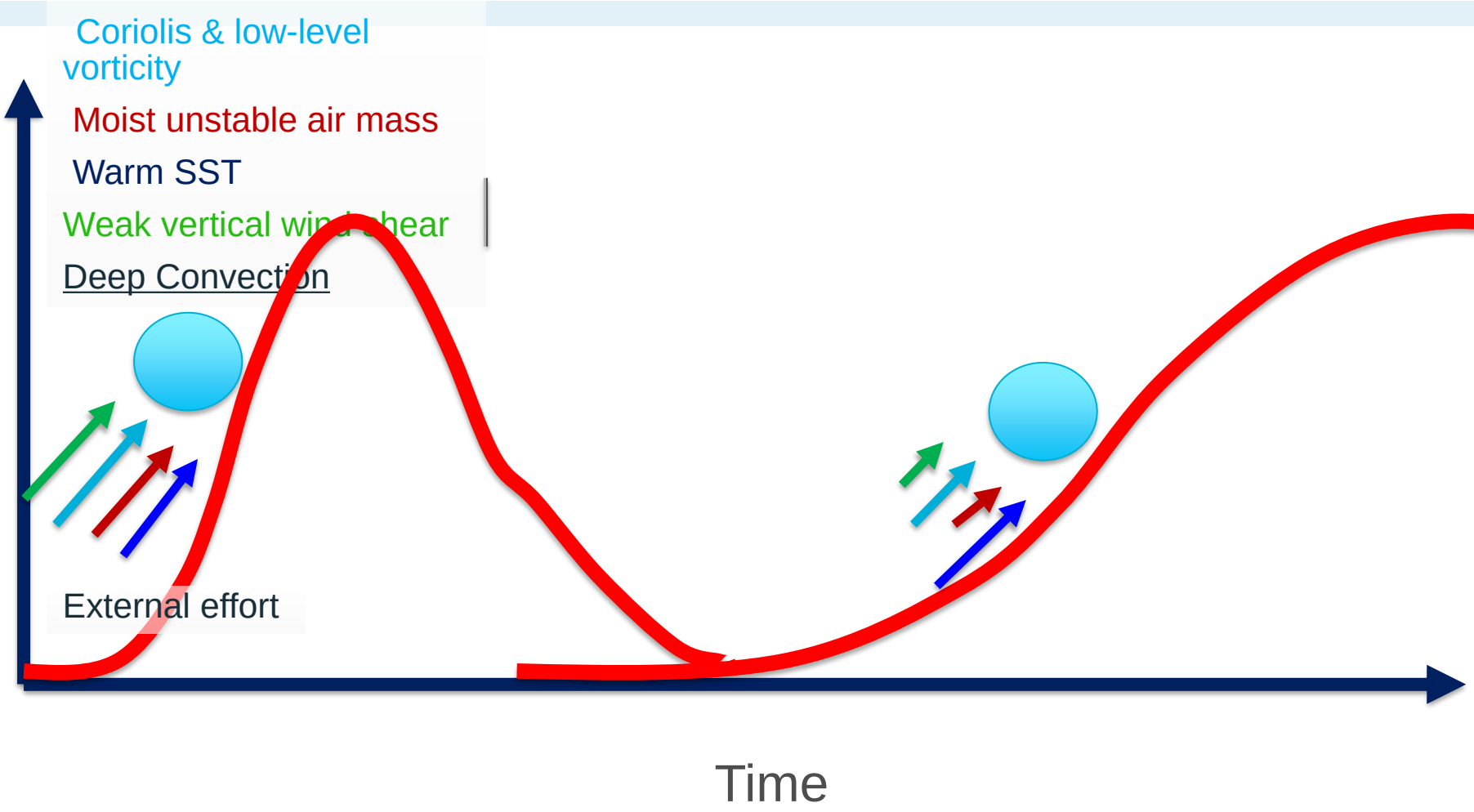
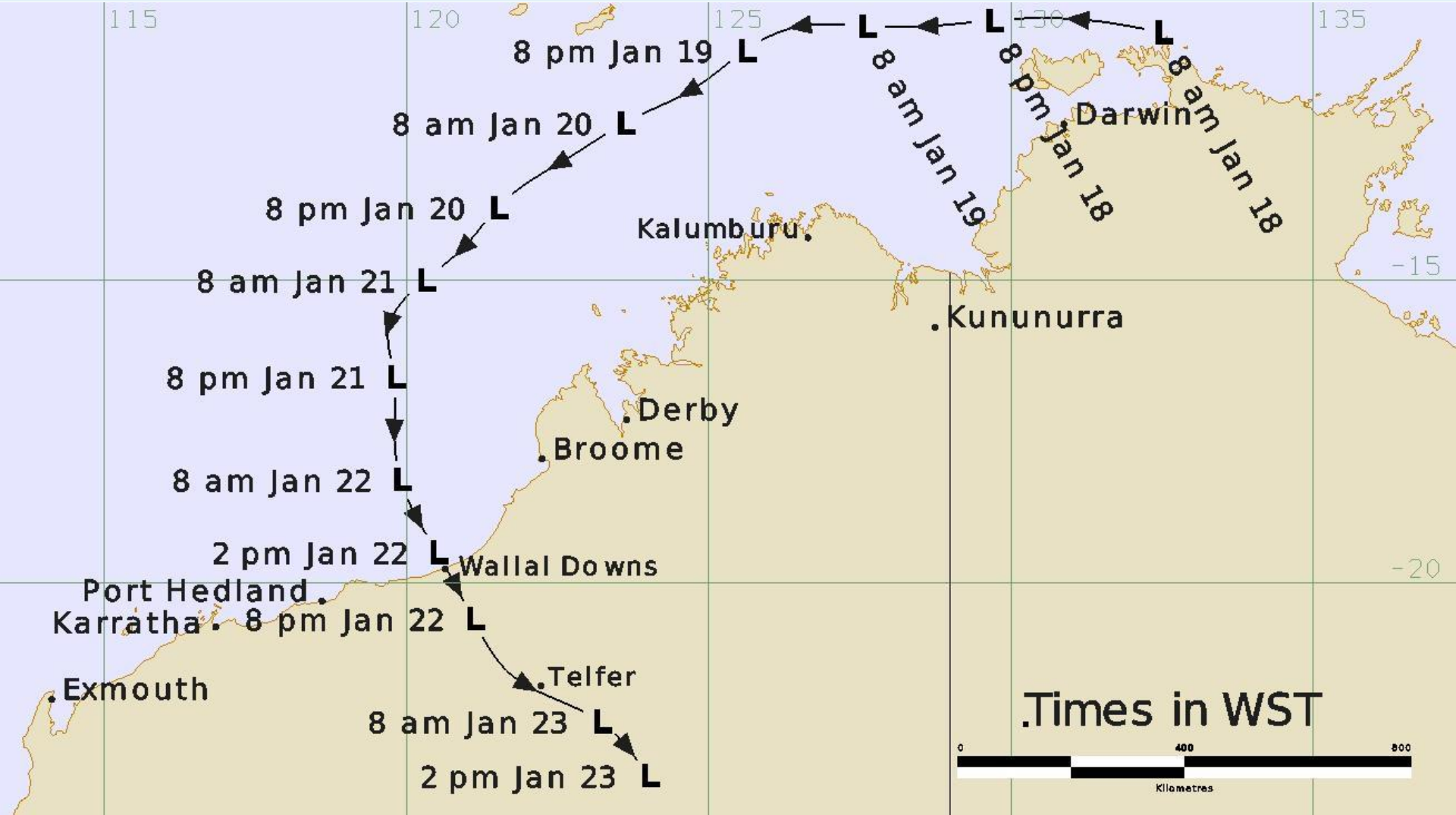
(Courtney) Conceptual Model Fast Vs Slow development



08U 18-23 Jan 2021

Standard Pilbara recurver BUT a non-developer!

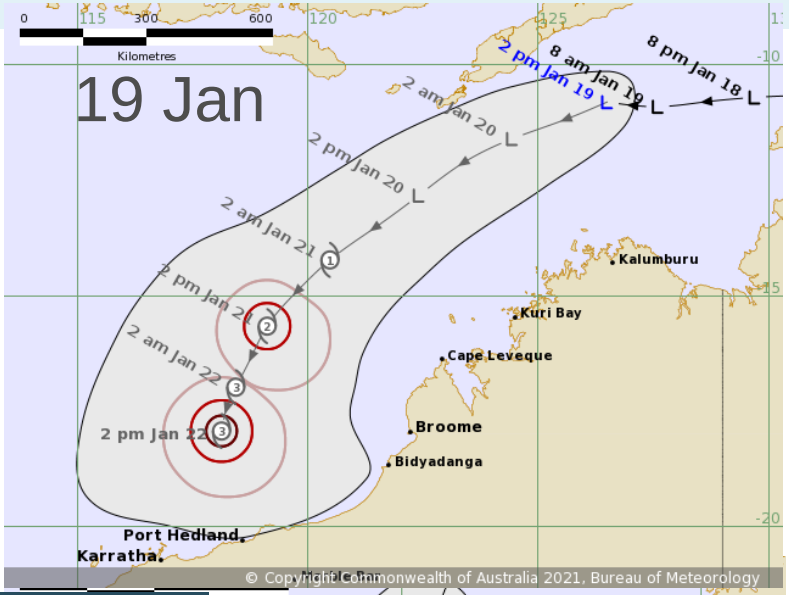


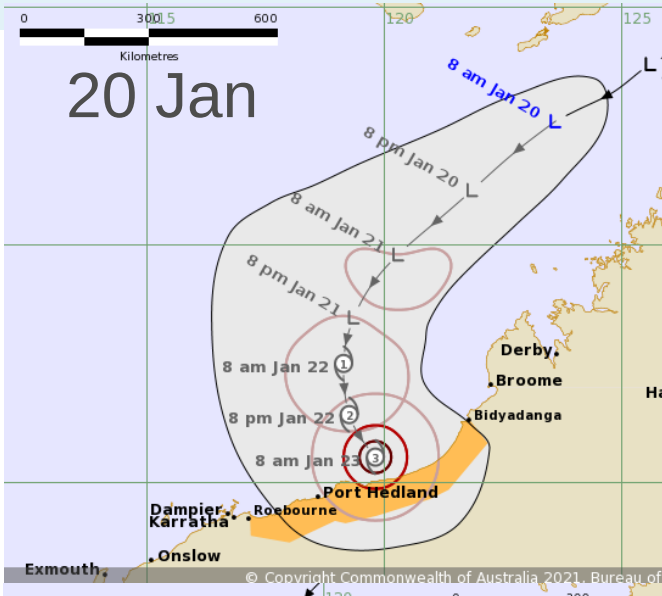
08U Forecast Track Maps
19-22 Jan

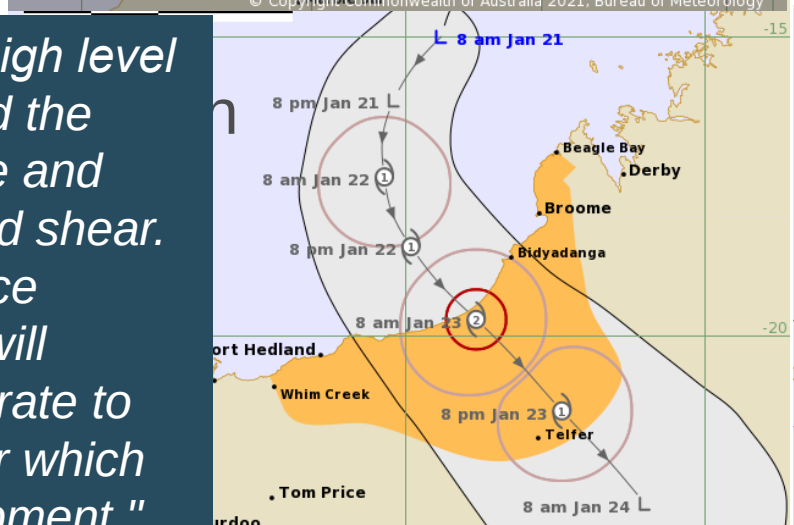
Australian Government
Bureau of Meteorology

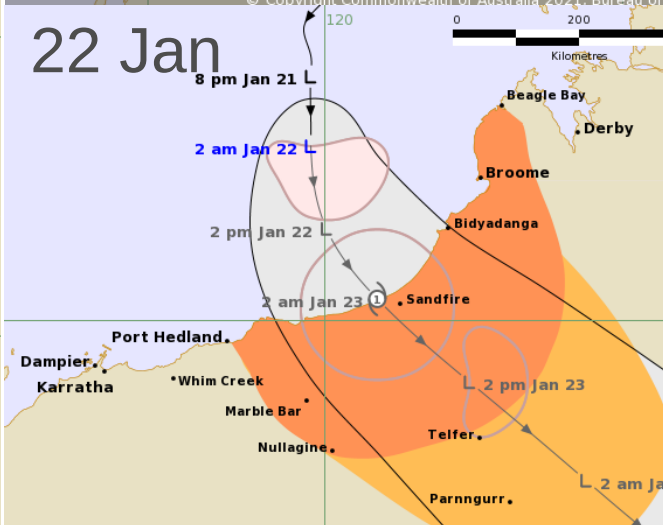
Good track forecast

Early forecast cat three for landfall!









"…there remains a high level of uncertainty around the mid-level wind profile and resultant vertical wind shear. Some model guidance indicates that there will continue to be moderate to strong easterly shear which would inhibit development."

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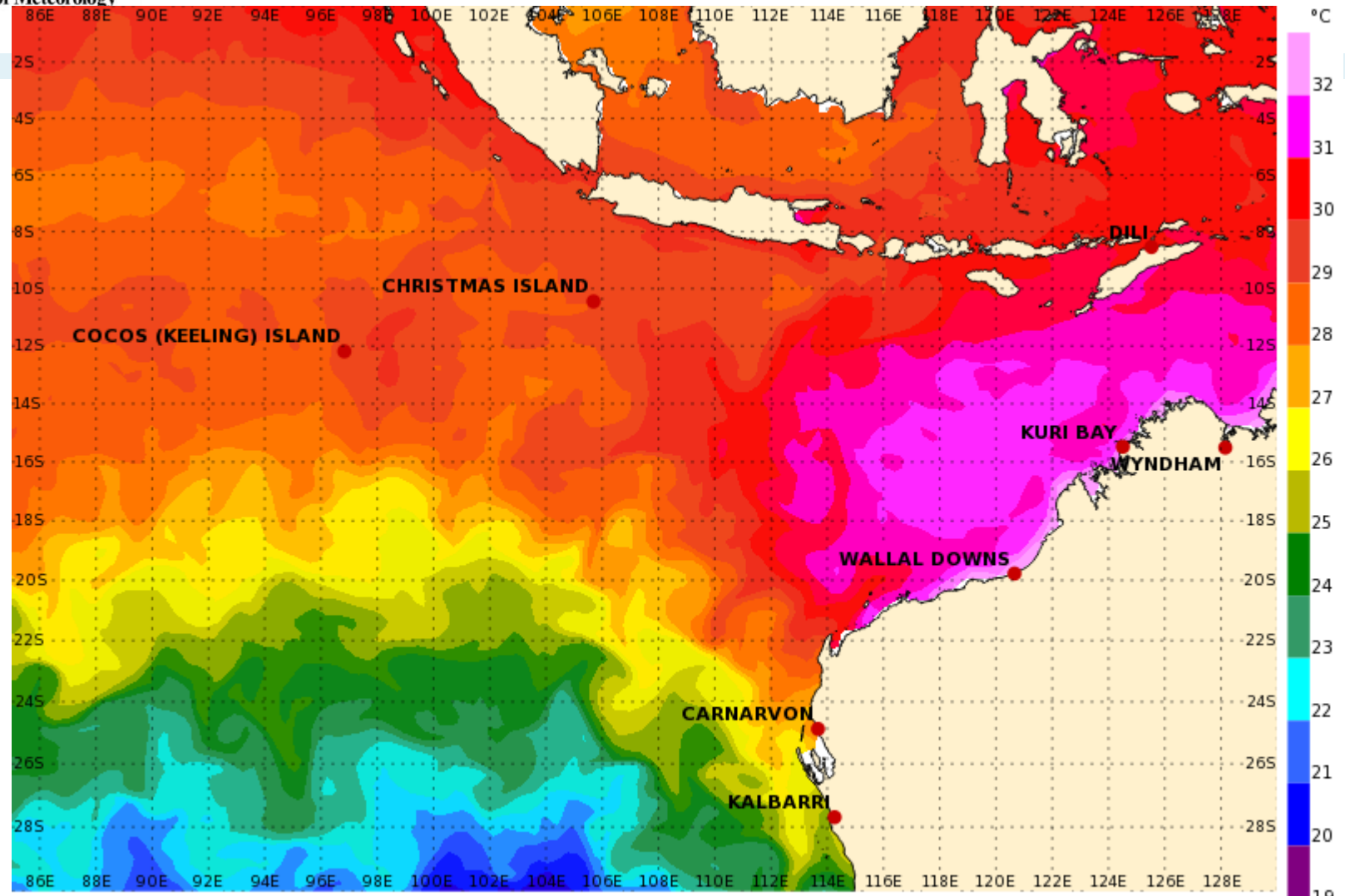
SST 19 Jan >31C



Sea Surface Temperature (deg C): 6 hr Average for **Mon 18 Jan 2021 18 UTC**
Model Base Time: Mon 18 Jan 2021 12UTC

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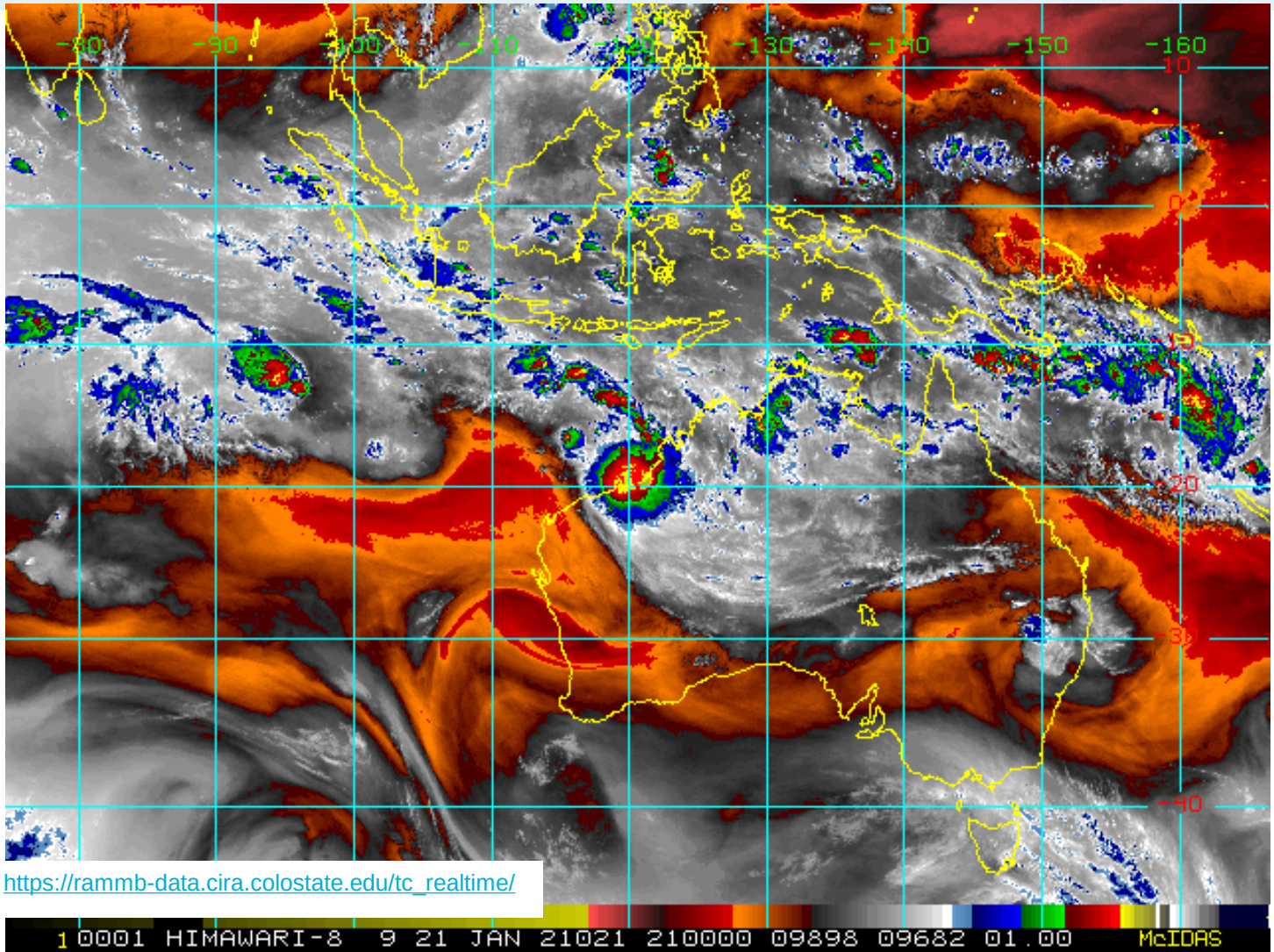
Deep moisture 21 Jan



Credit: CIRA https://rammb-data.cira.colostate.edu/tc_realtime/

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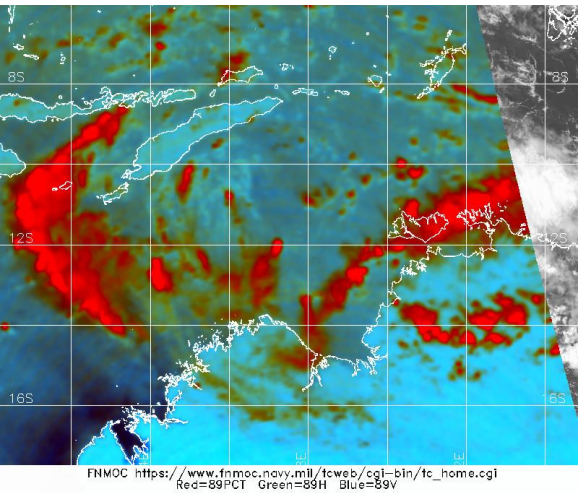
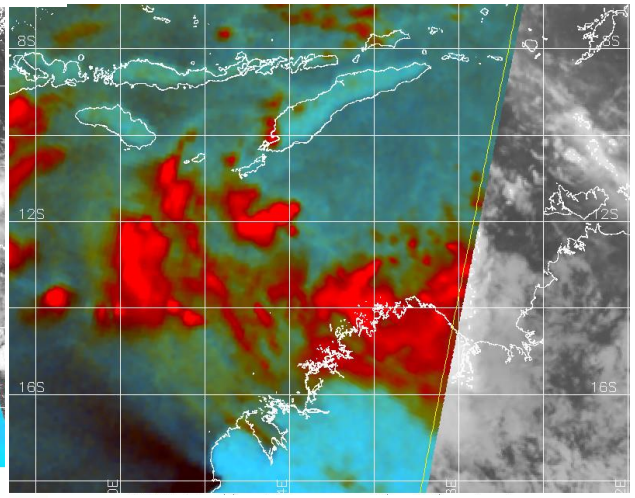
Microwave series

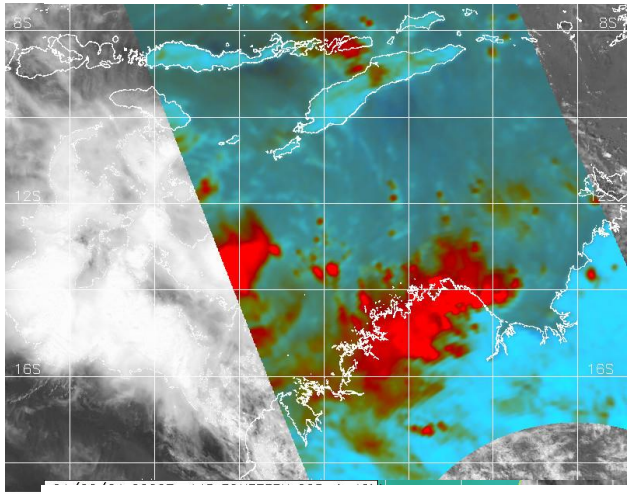
AMSR2 19/0514UTC



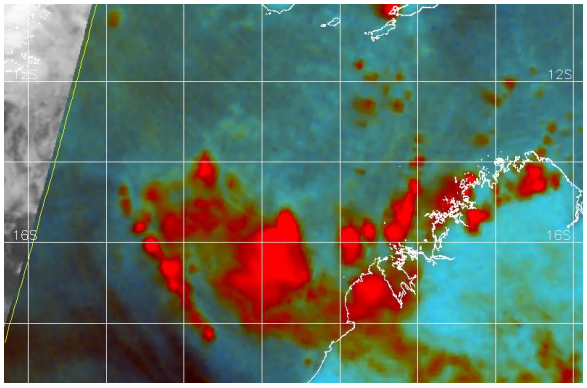
SSMIS 19/2009UTC



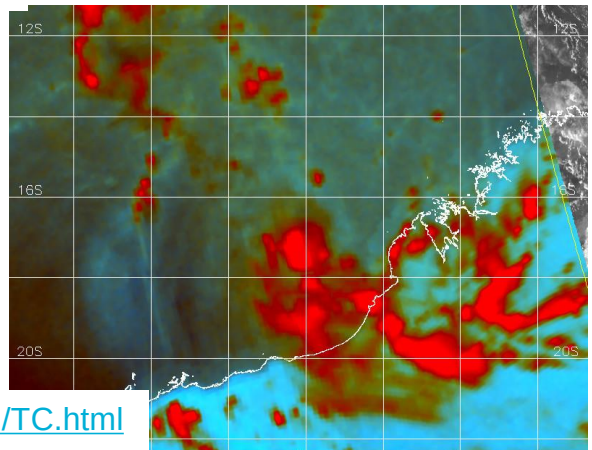
GMI 20/0455UTC



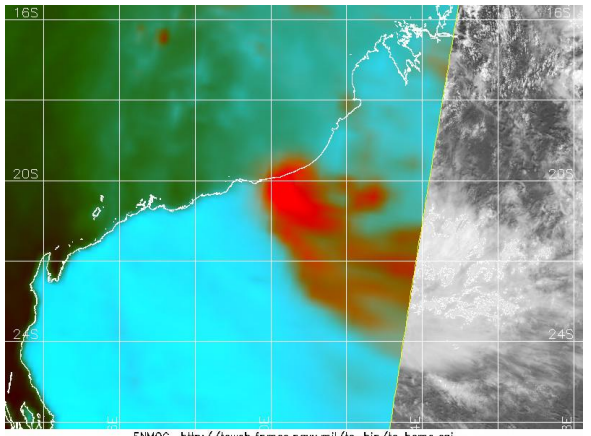
SSMIS 20/1957UTC



SSMIS 21/0852UTC



MHS 22/0142UTC



Credit: NRL: https://www.nrlmry.navy.mil/TC.html

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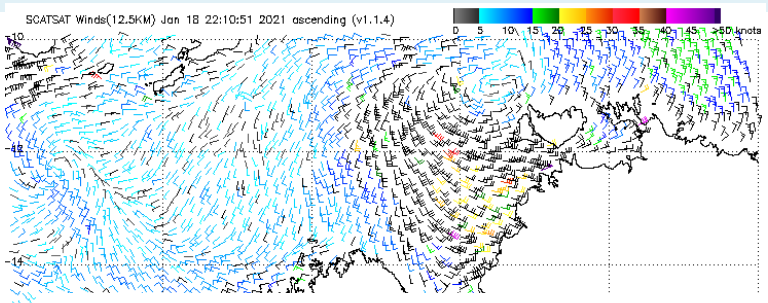
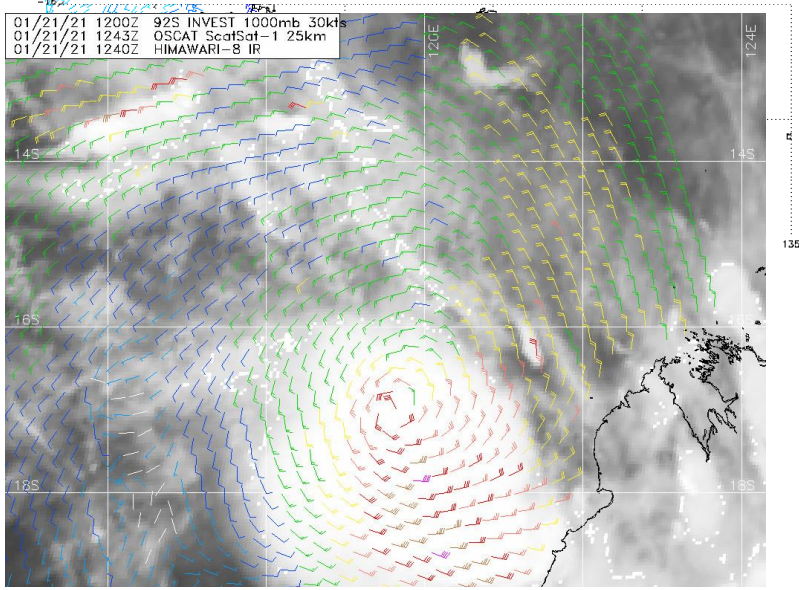
Scatterometry series



SCATSAT 19/1153UTC



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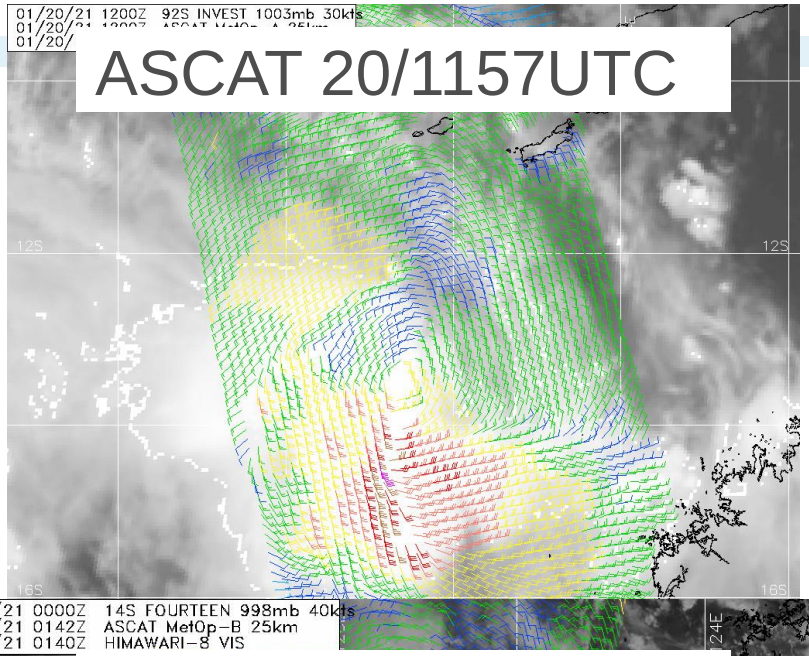
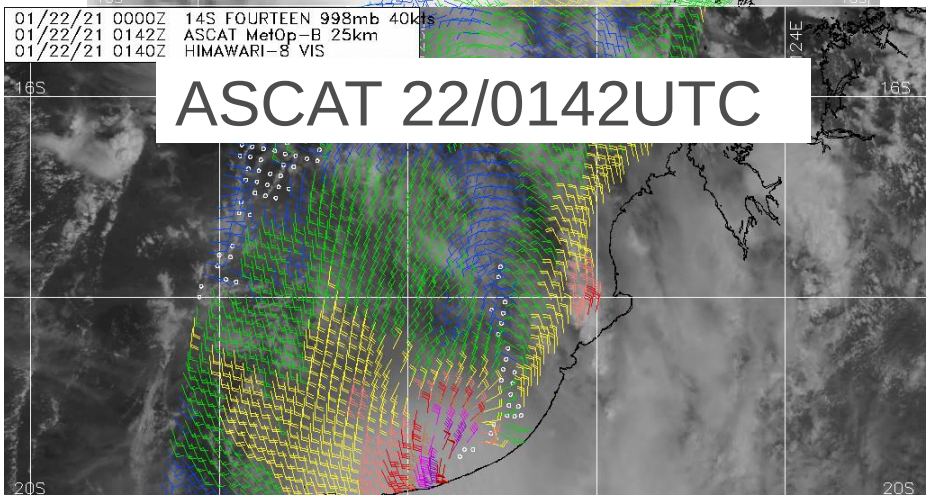


ASCAT 20/1157UTC



ASCAT 22/0142UTC

Credits: NOAA: https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php and NRL: https://www.nrlmry.navy.mil/TC.html

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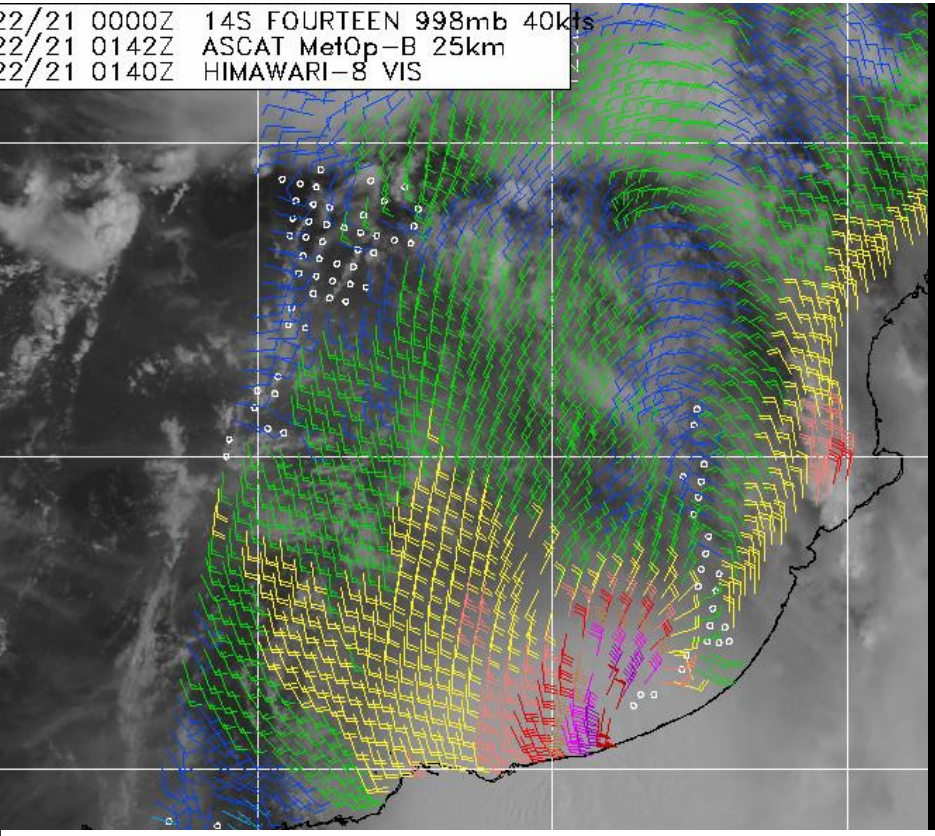
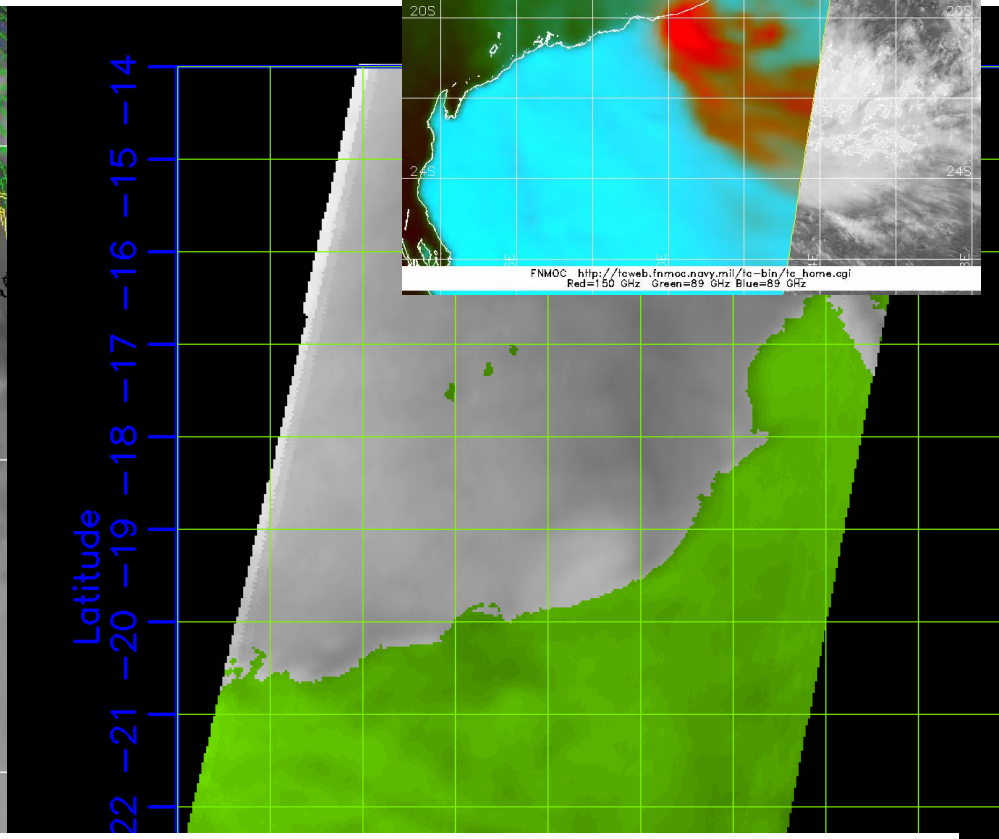
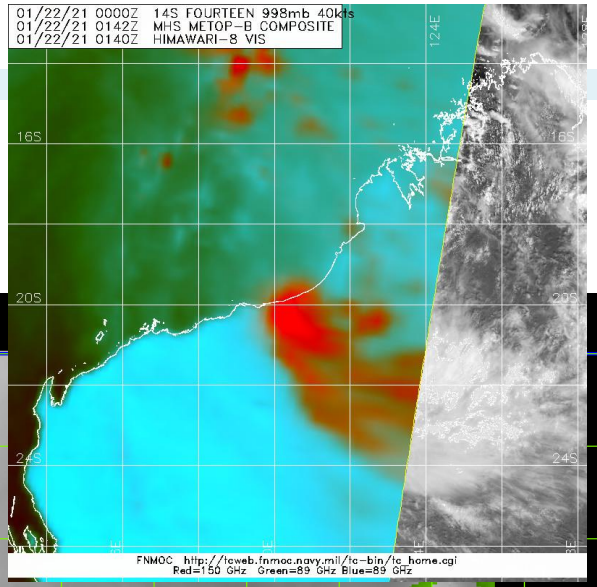
Scat near landfall indicates development 22/0142UTC

ASCAT wrong wind direction solution but scalar winds indicate gales







Credits: NOAA: https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php and NRL: https://www.nrlmry.navy.mil/TC.html

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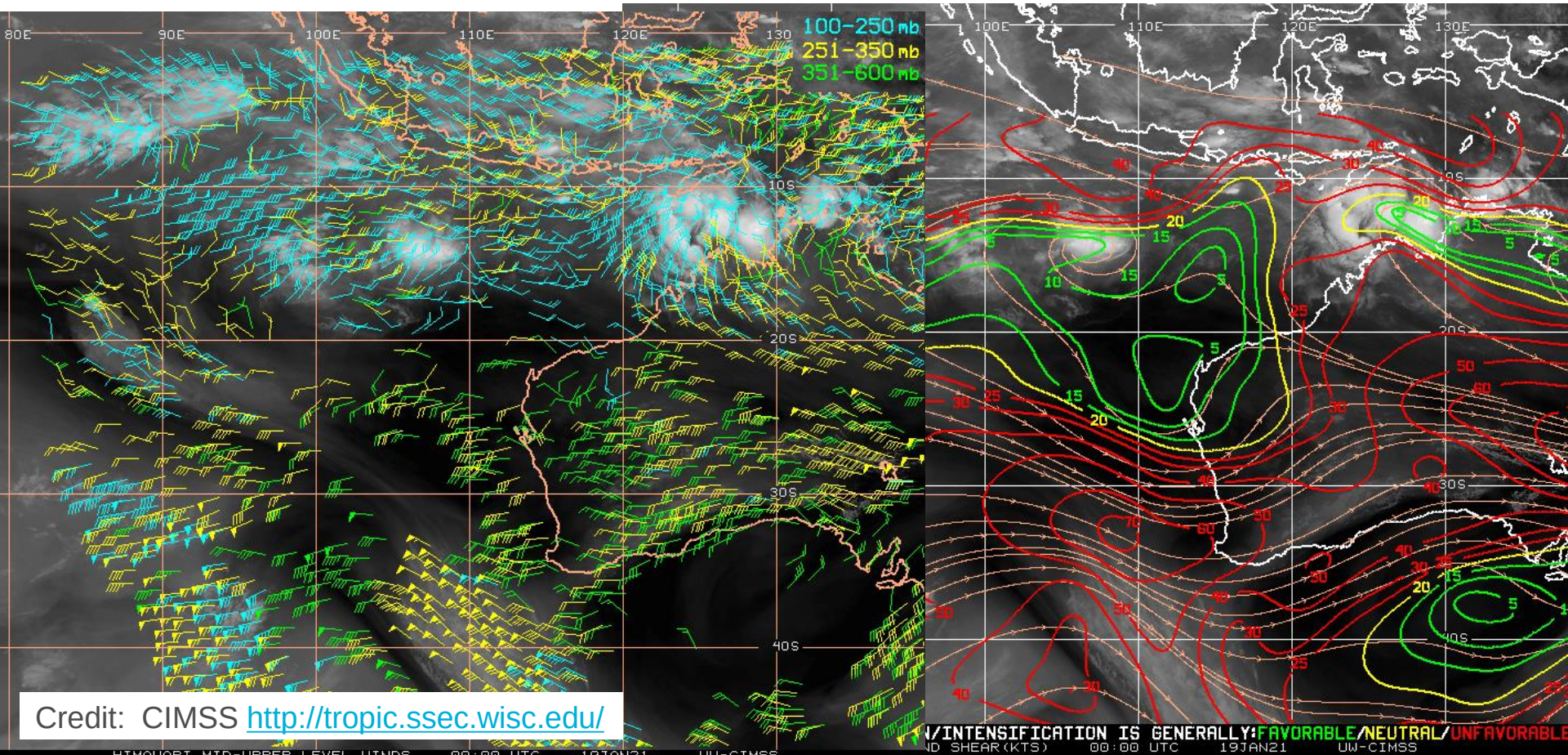
Shear and Upper winds 19/00UTC
Easterly shear strong poleward outflow



Credit: CIMSS http://tropic.ssec.wisc.edu/

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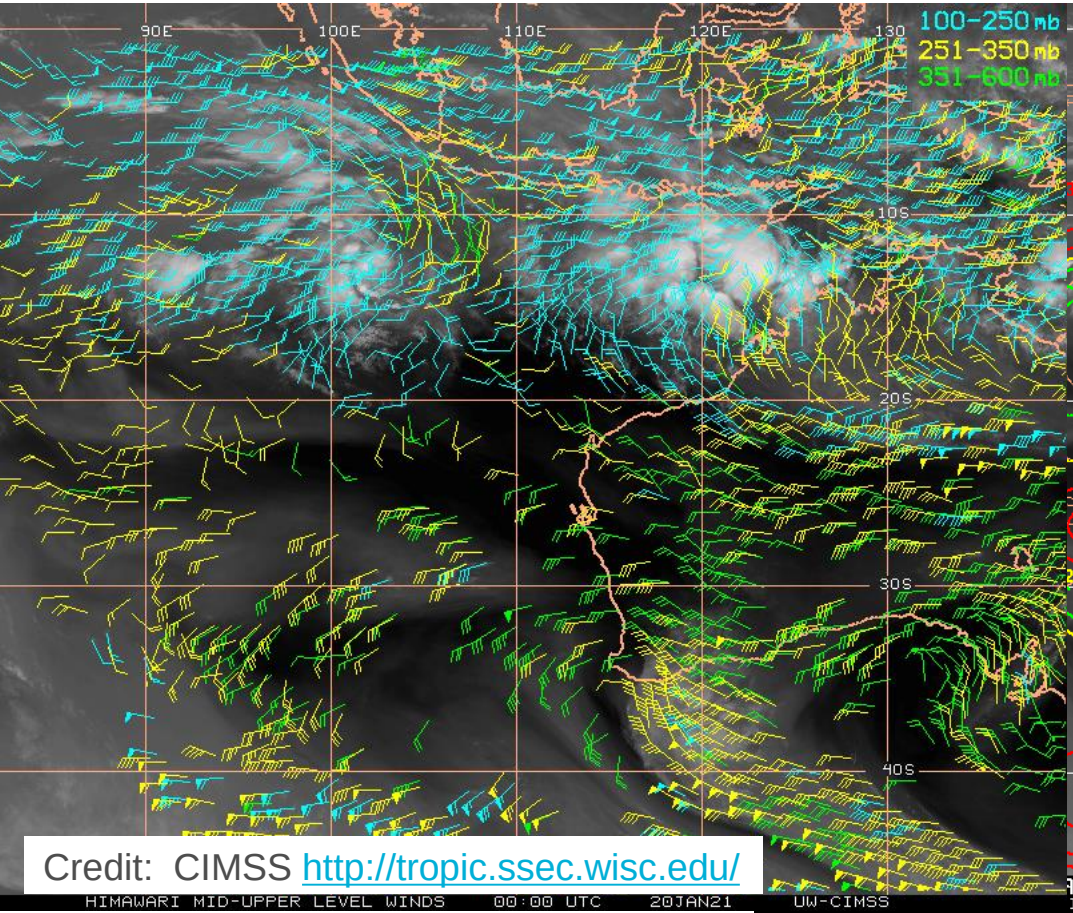
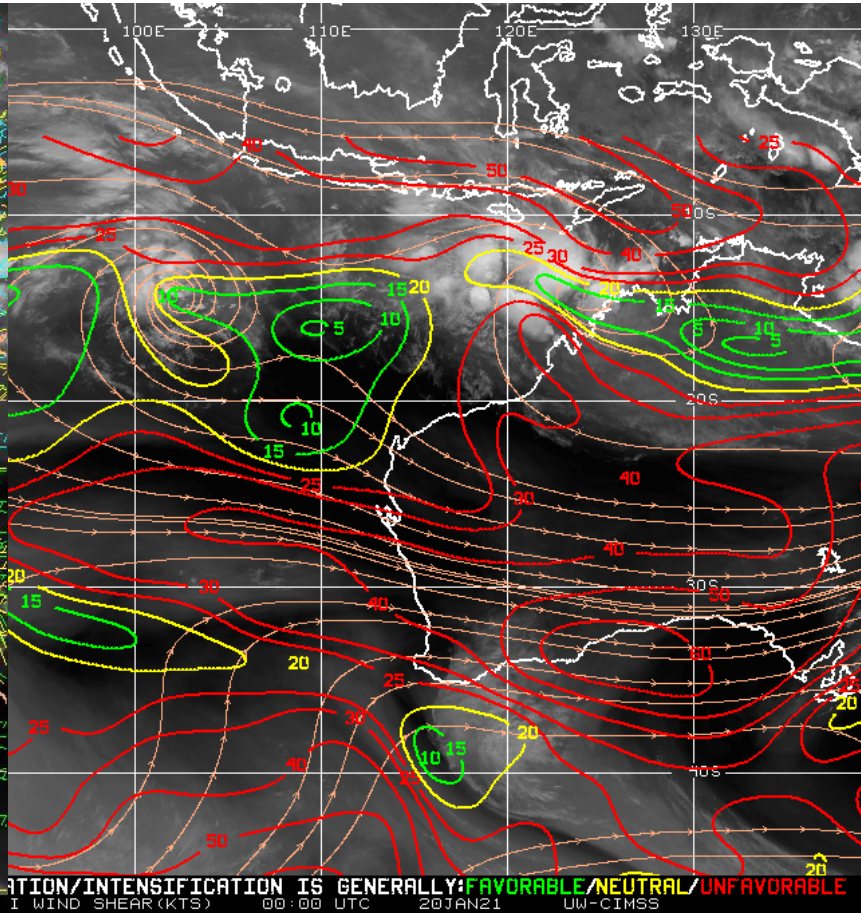
Shear and Upper winds 20/00UTC
Same: Easterly shear & strong poleward outflow





Credit: CIMSS http://tropic.ssec.wisc.edu/

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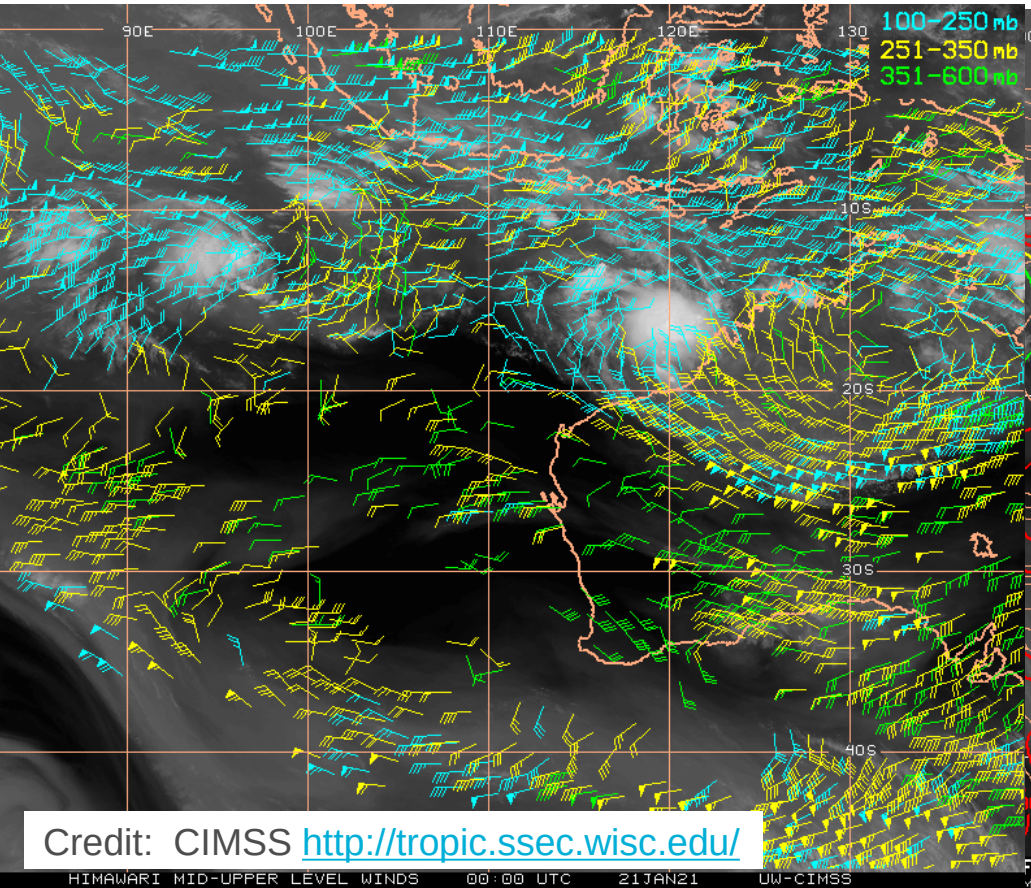
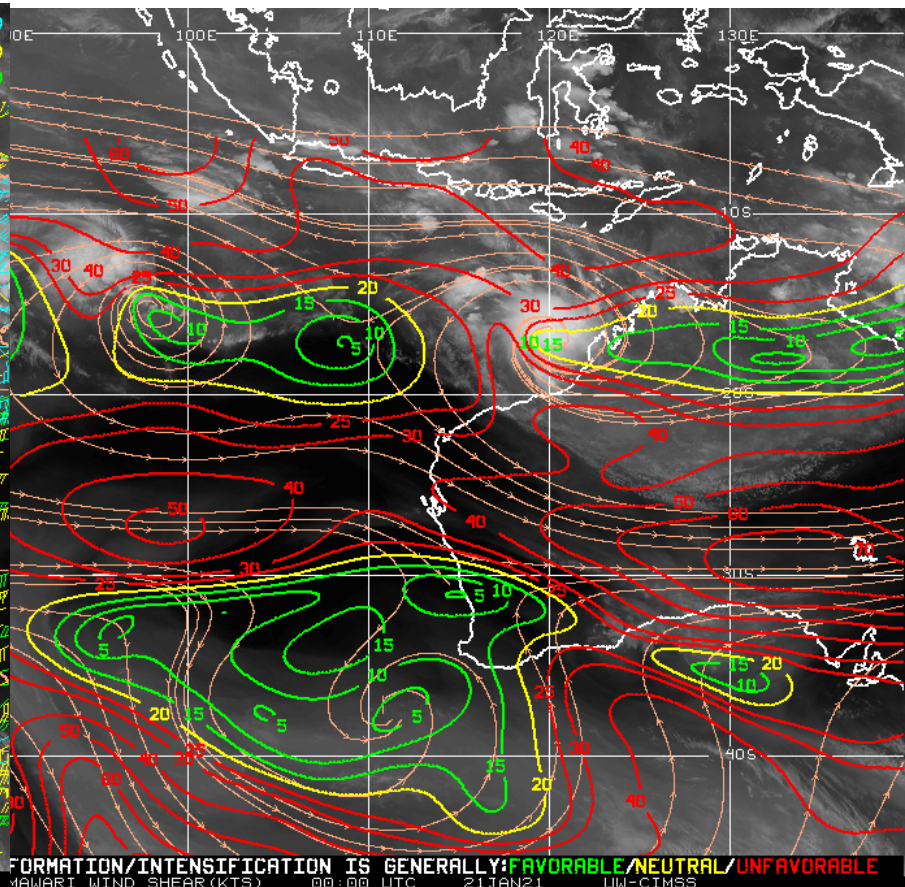
Shear and Upper winds 21/00UTC
Easterly shear





Credit: CIMSS http://tropic.ssec.wisc.edu/

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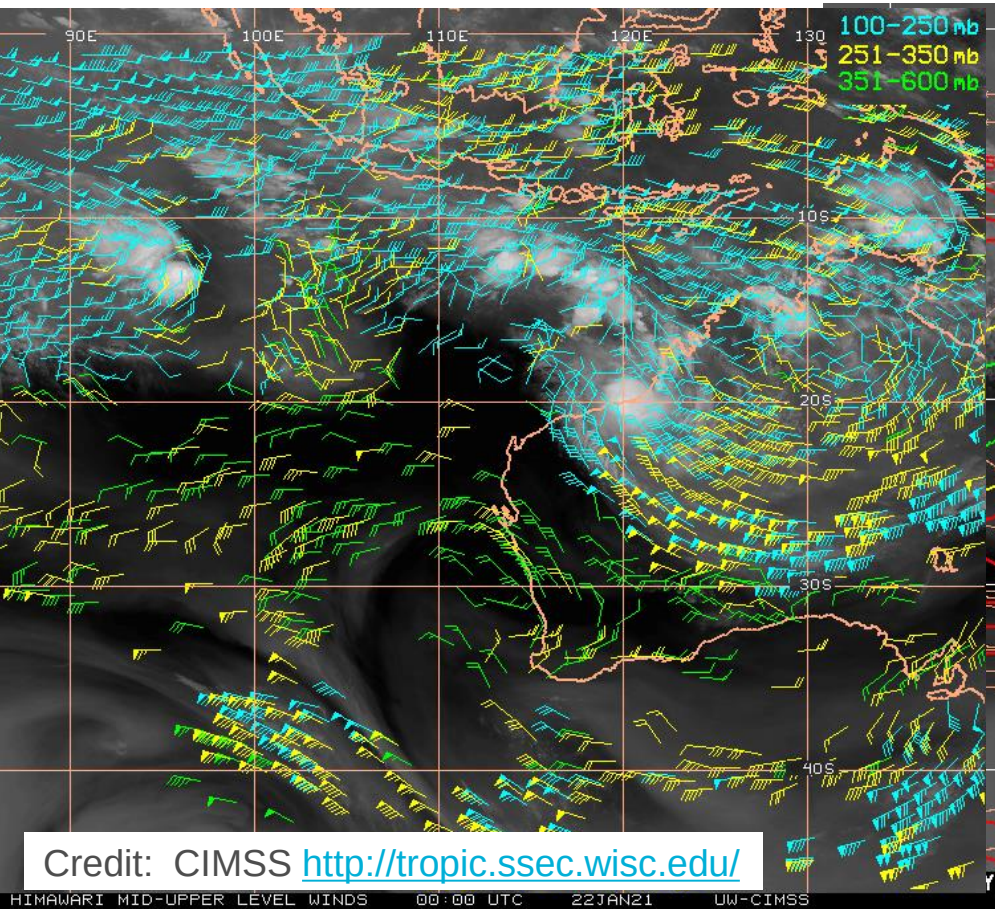
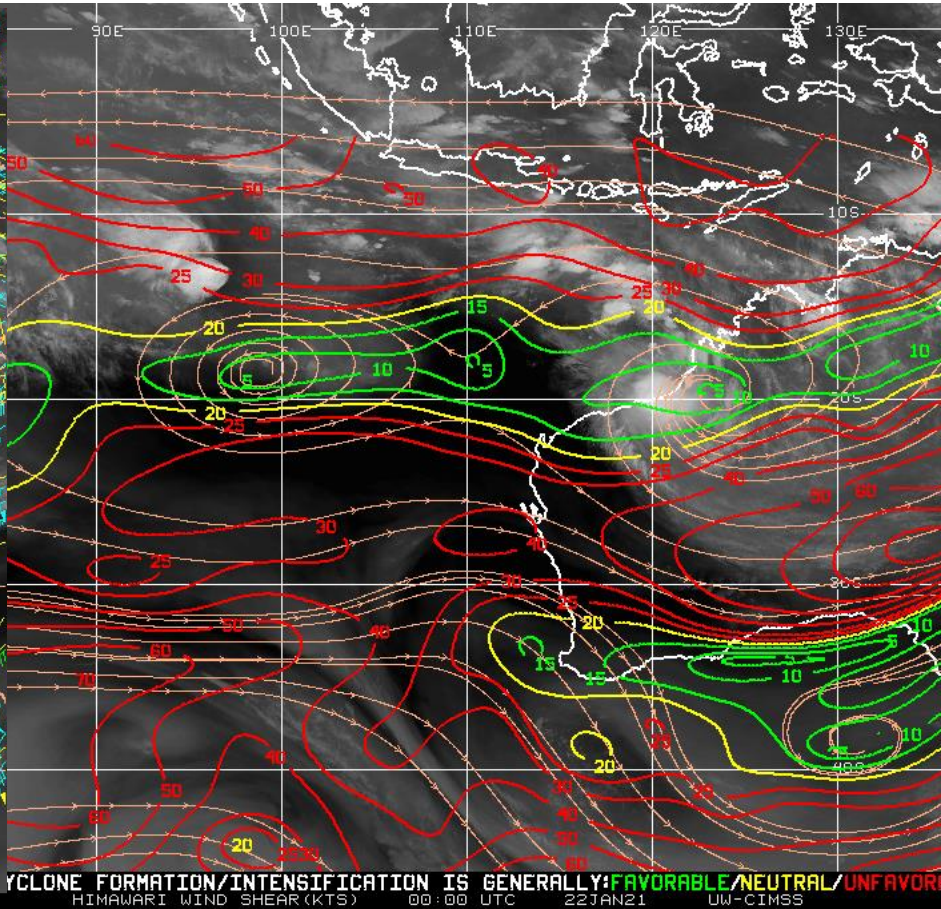
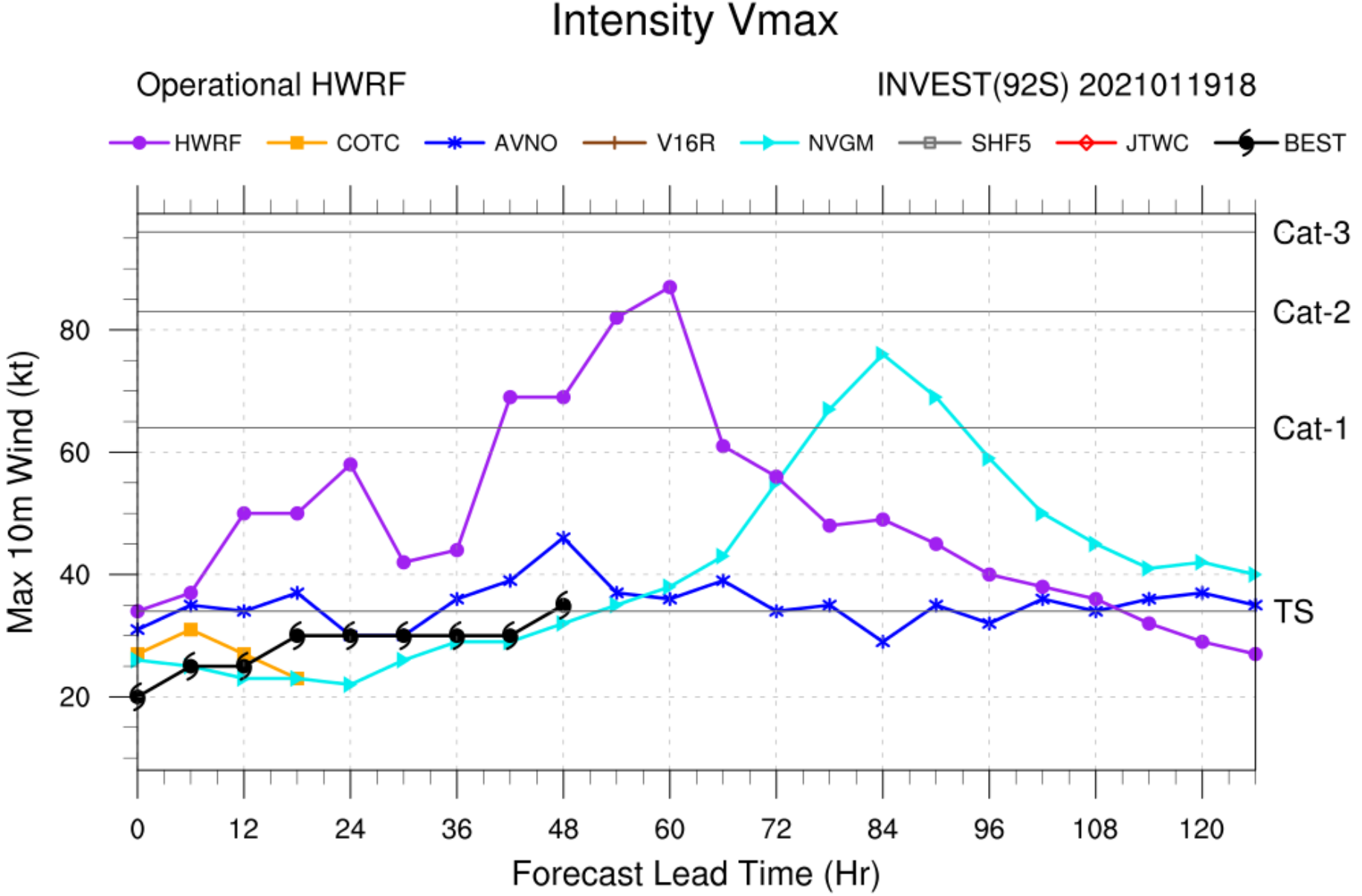
Shear and Upper winds 22/00UTC
Easterly shear





Credit: CIMSS http://tropic.ssec.wisc.edu/


Intensity Vmax
Operational HWRF
INVEST(92S) 2021011918
HWRF
COTC
AVNO
V16R
NVGM
SHF5
JTWC
BEST
Cat-3
Cat-2
Cat-1
TS
Max 10m Wind (kt)
80
60
40
20
0
12
24
36
48
60
72
84
96
108
120
Forecast Lead Time (Hr)

Australian Government
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08U summary: finely balanced genesis mix

SST: YES

Deep moisture: YES

Upper-level outflow: Strong poleward

Circulation: Yes but weak and weak low-level inflow from north

Low Vertical Wind Shear: Not quite low enough! Models?

Persistent deep convection: downshear and unorganized

If it had become self-sustaining it could have intensified rapidly

Shear diagnostic???

10U Cocos Low 19-26 Jan 2020/21

Microwave, scatterometry and Vis 20 Jan

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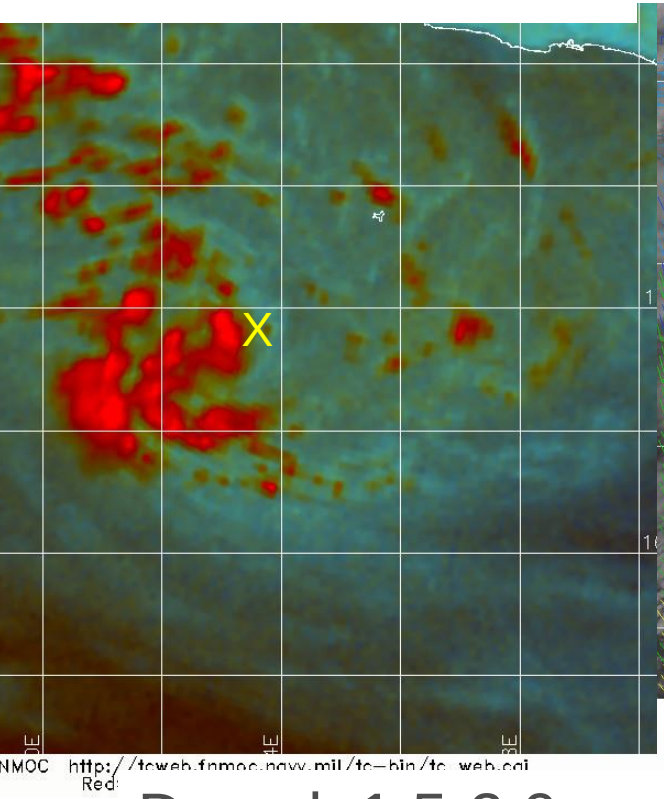
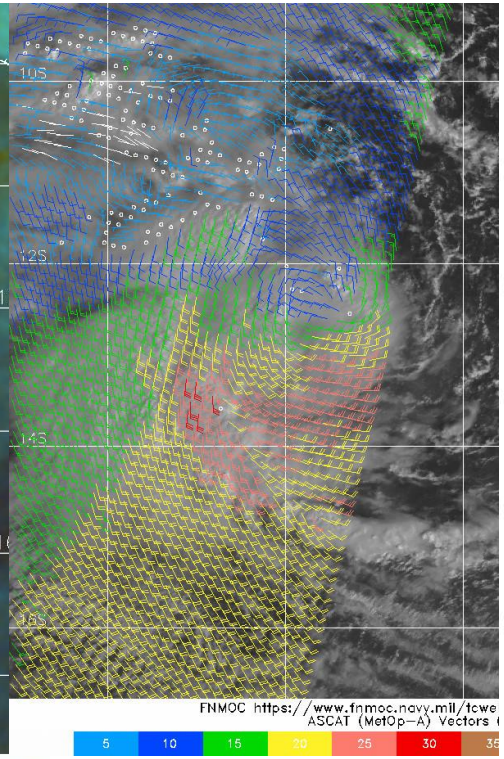
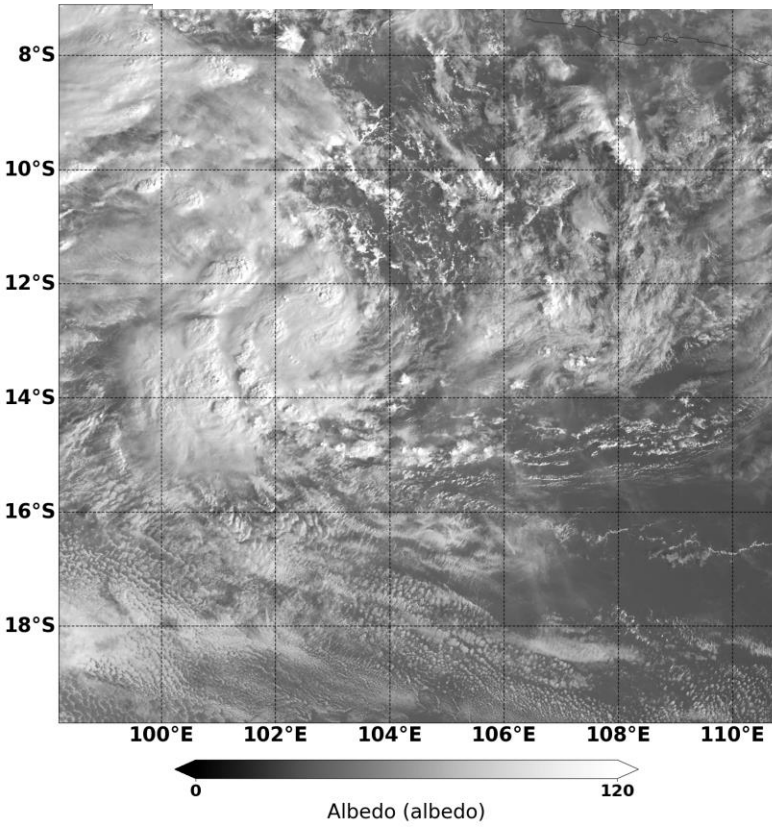
SSMIS 19/2325UTC



ASCATA 20/0109UTC



Vis 20/0000UTC



Dvorak 1.5-2.0

Credit: NRL: https://www.nrlmry.navy.mil/TC.html

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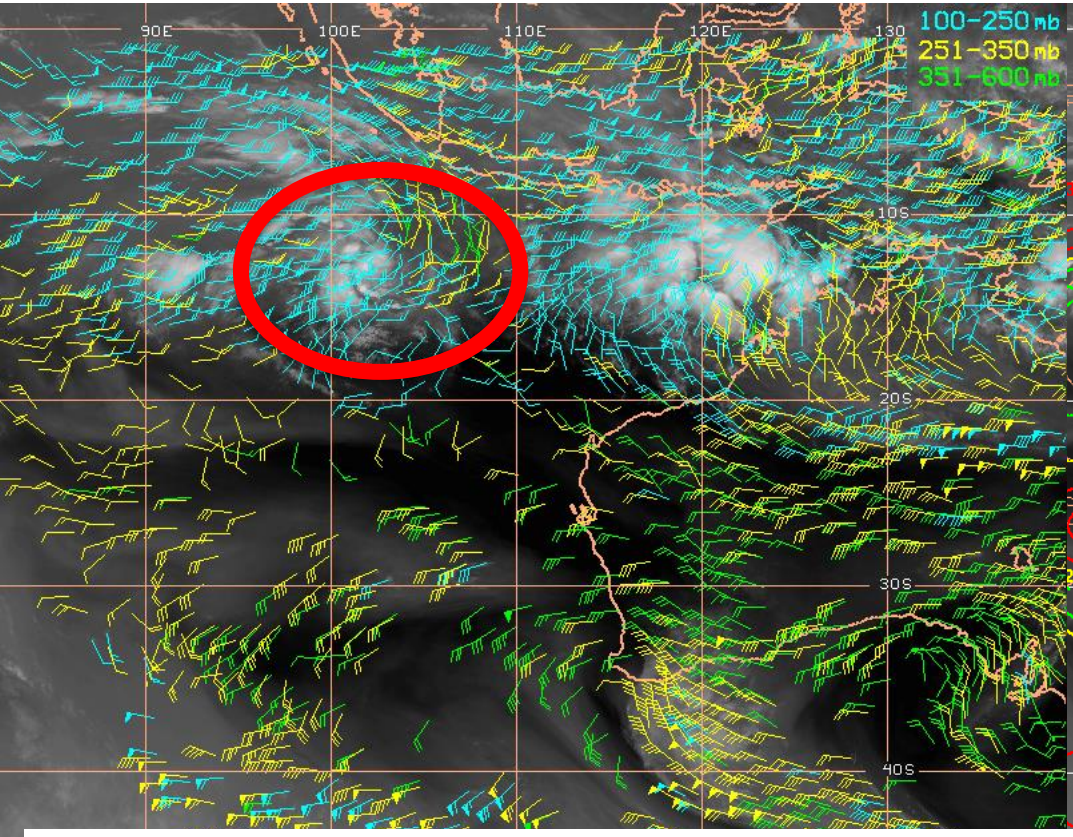
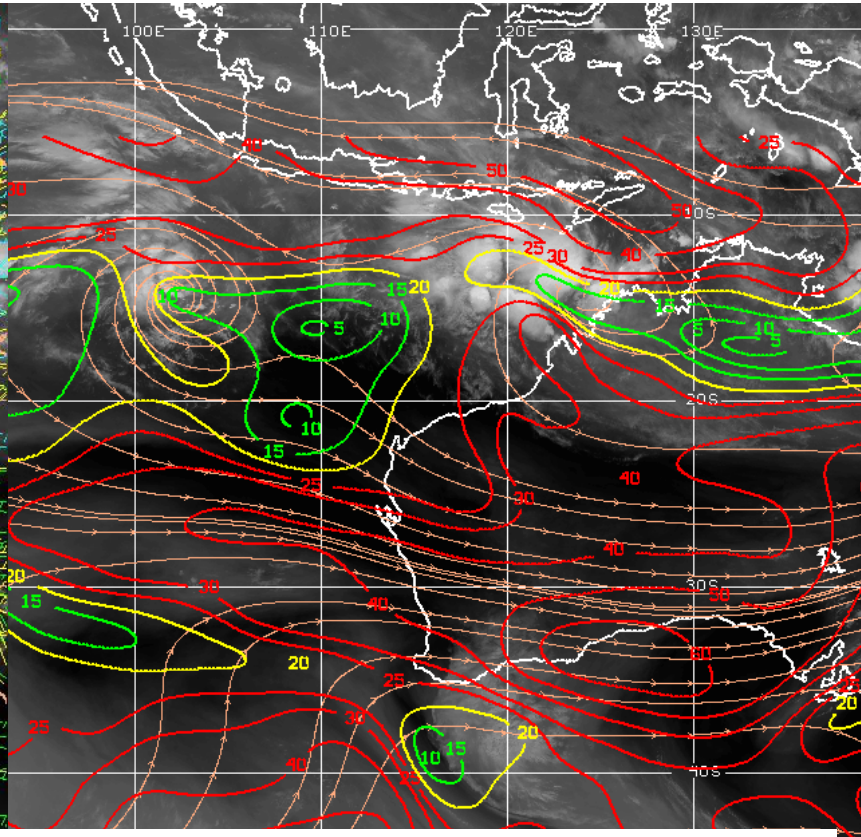
Shear and Upper winds 20/00UTC
Mod/strong easterly shear





22/00UTC Credit: CIMSS http://tropic.ssec.wisc.edu/

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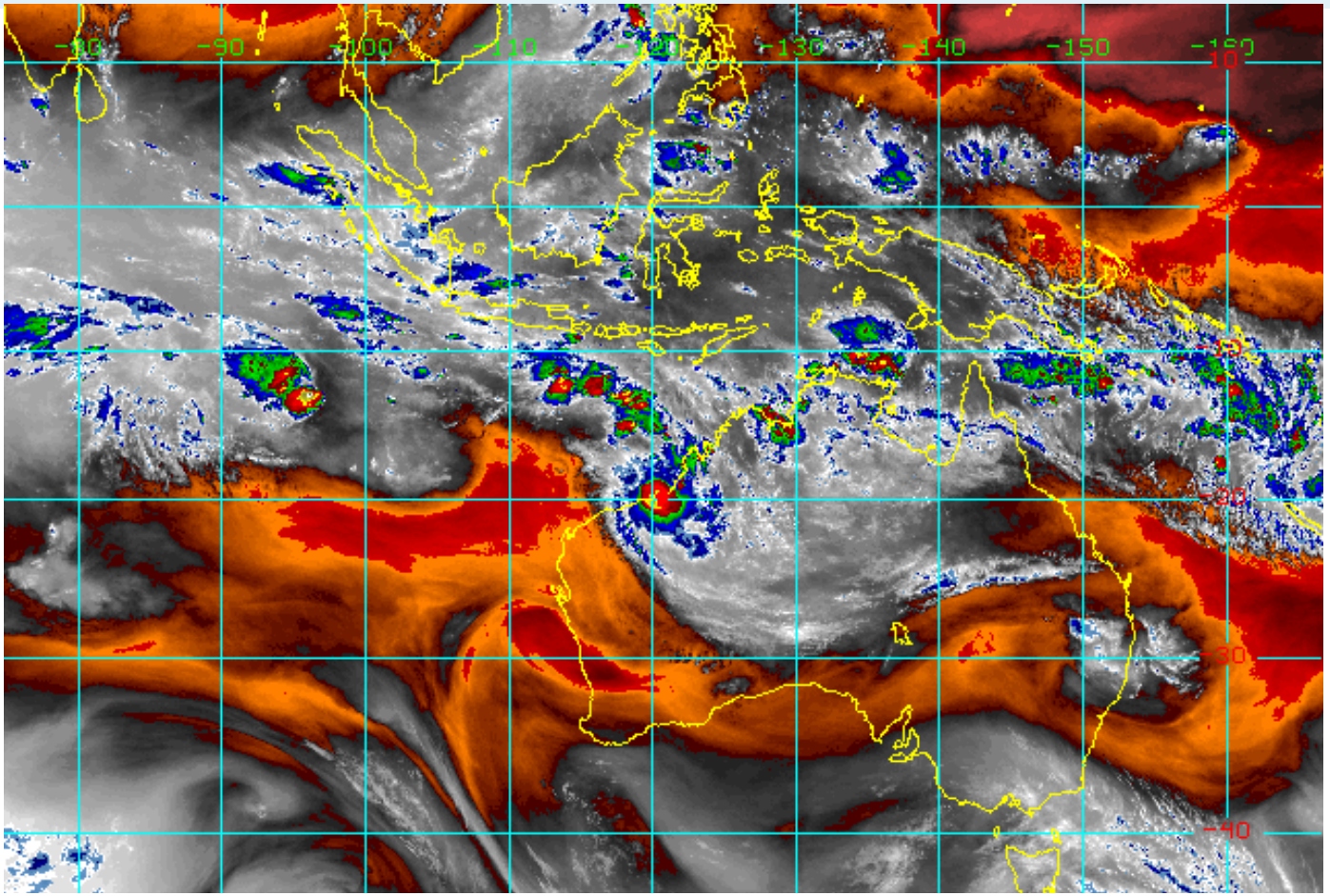
10U WV:
ok moist environment but not great

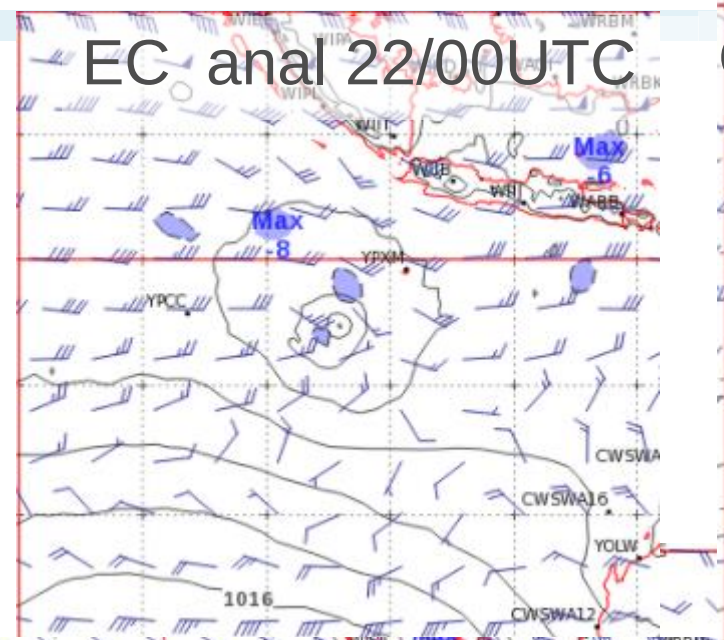


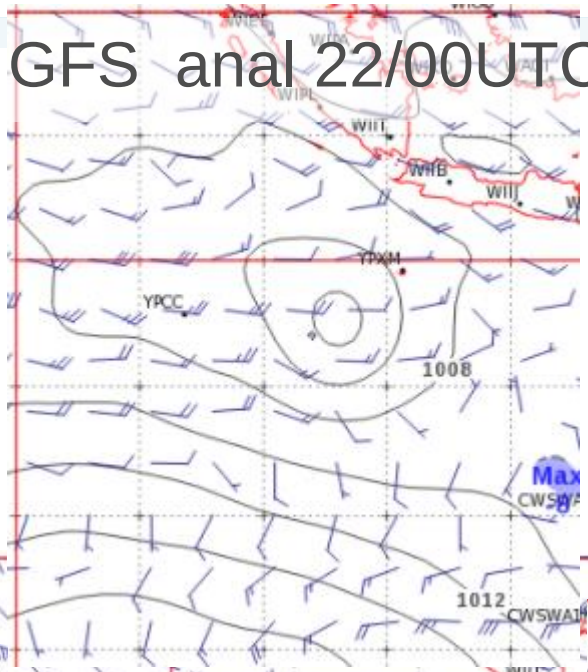
WV at 22/00UTC Credit: CIRA

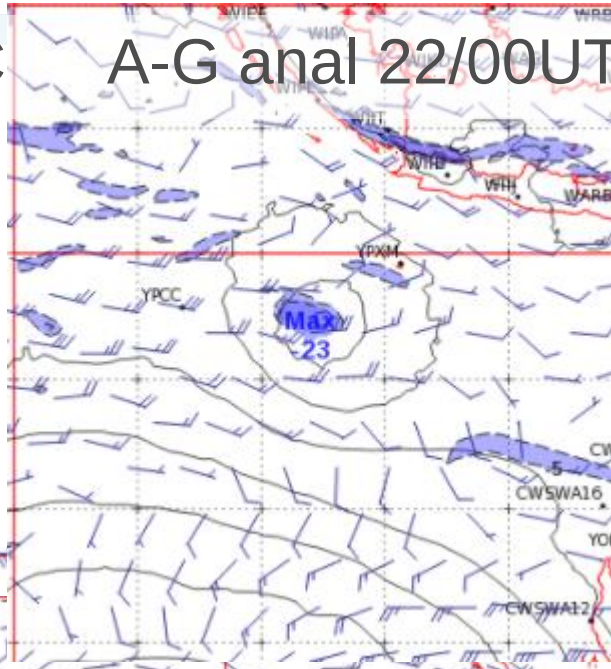
https://rammb-data.cira.colostate.edu/tc_realtime/products/storms/2021sh14/16kmgwvp/2021sh14_16kmgwvp_202101220000.gif

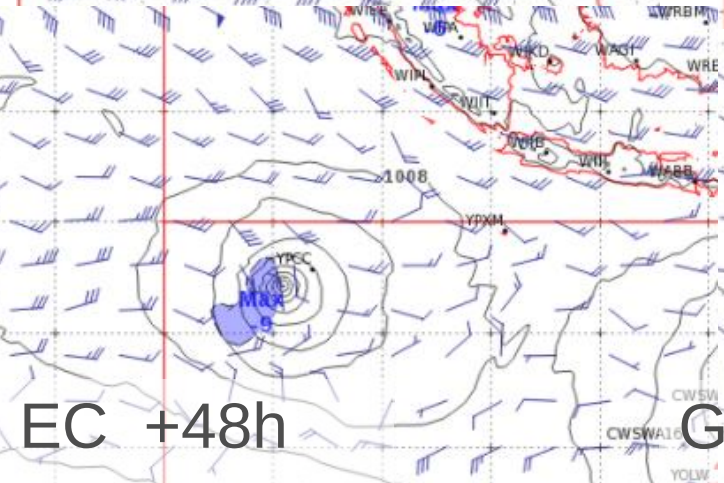
Australian Government
Bureau of Meteorology

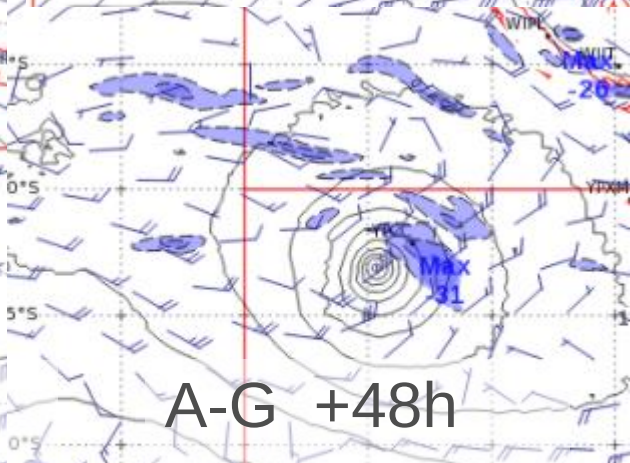
NWP forecast for 22/00UTC +48h
MSLP, 300hPa winds and vorticity







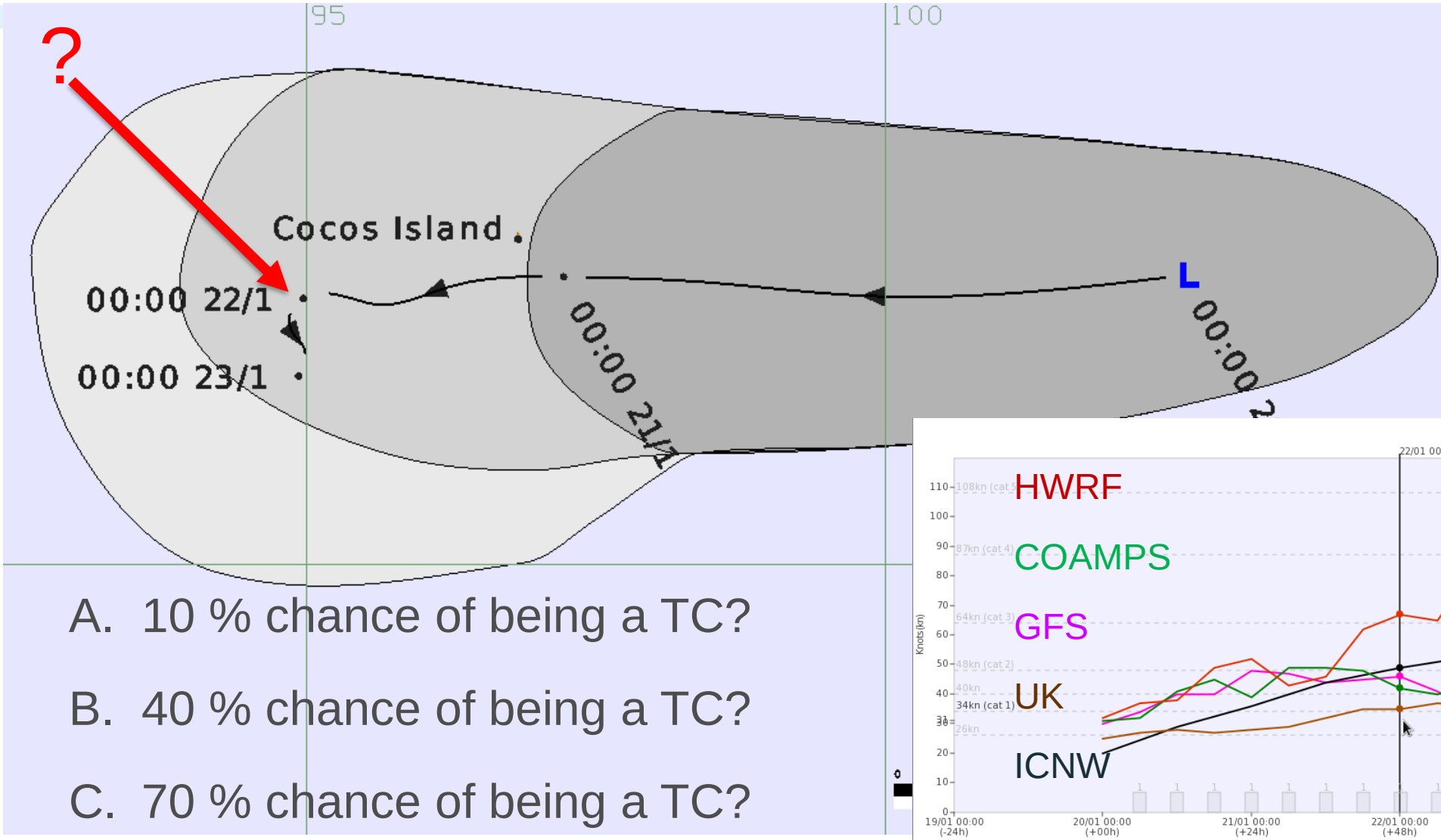




What is your forecast for 22/00UTC?

Australian Government
Bureau of Meteorology

What other influences should you be considering?



A. 10 % chance of being a TC?

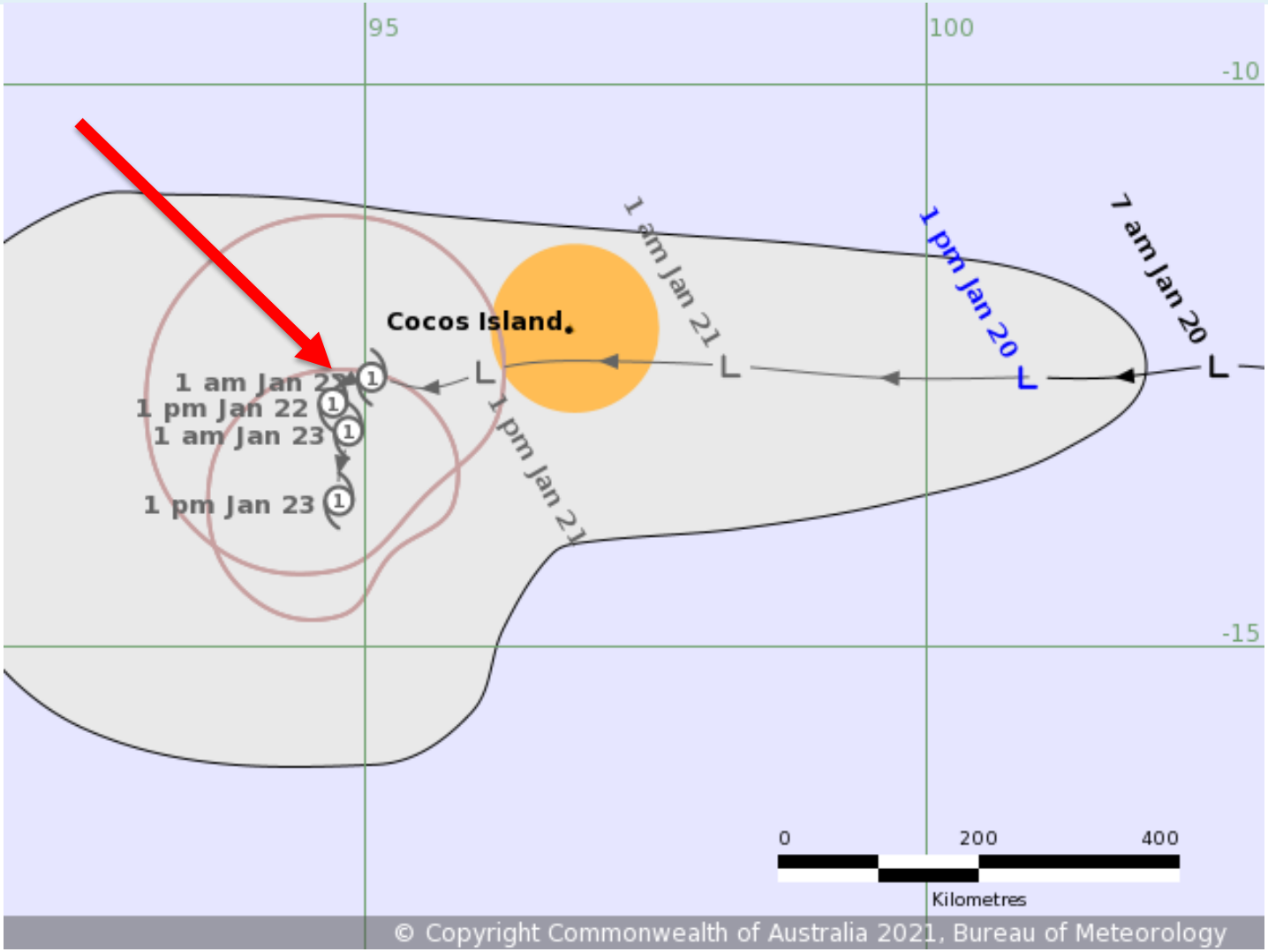
B. 40 % chance of being a TC?

C. 70 % chance of being a TC?

Australian Government
Bureau of Meteorology

10U Cocos Low 19-26 Jan 2020/21

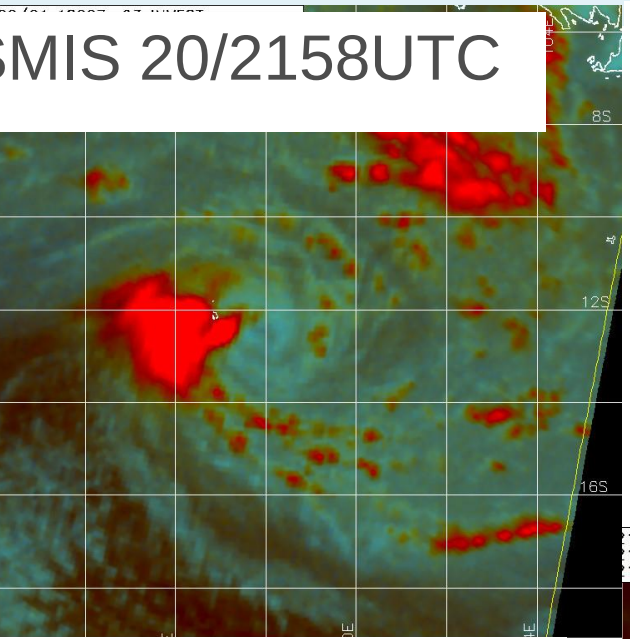
Forecast cat 1 00UTC 22 January?



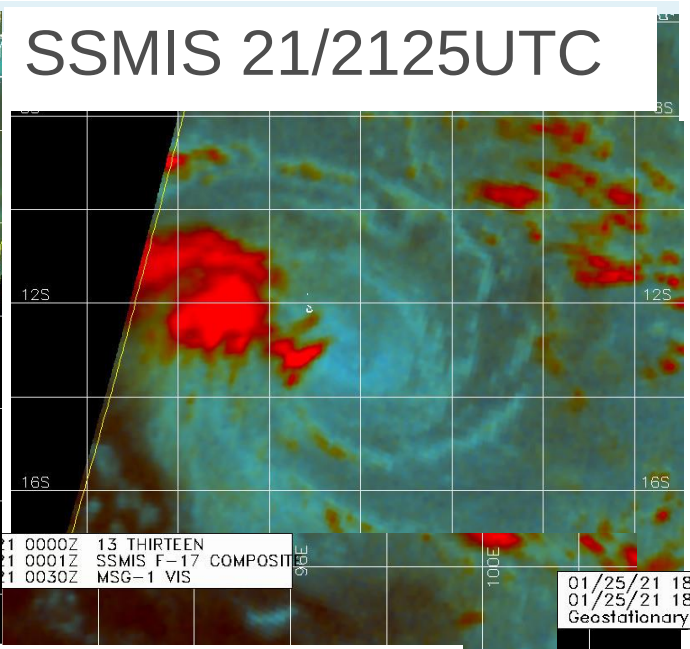
Australian Government
Bureau of Meteorology

But what happened?
Microwave series

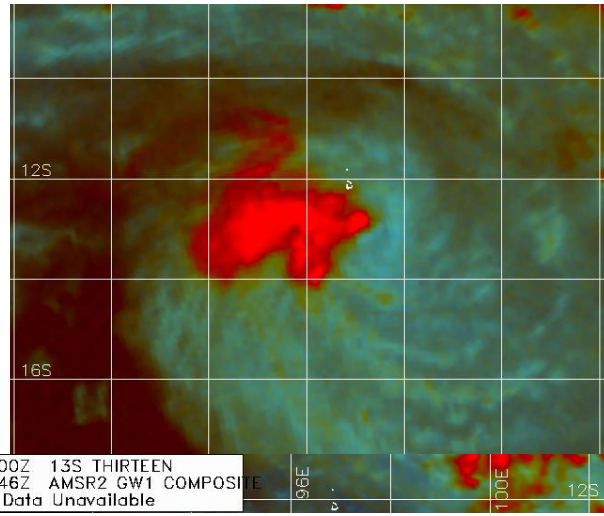
SMIS 20/2158UTC



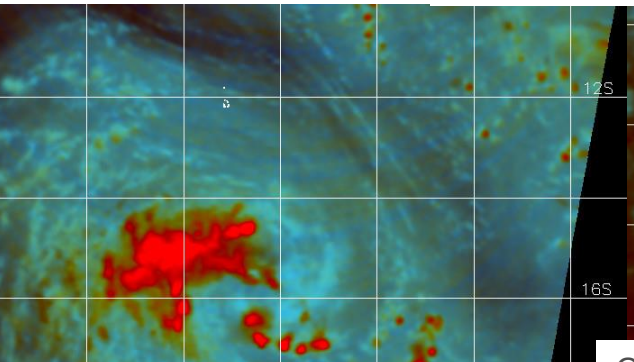
SSMIS 21/2125UTC



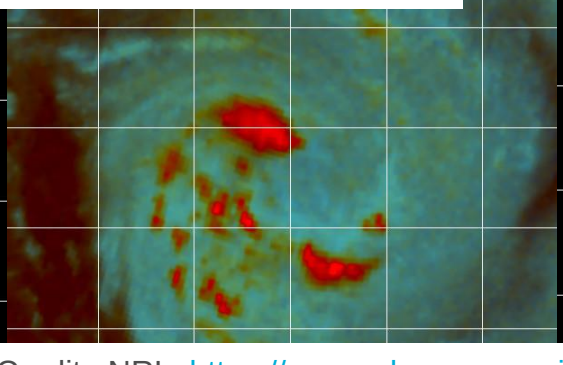
SSMIS 22/1022UTC



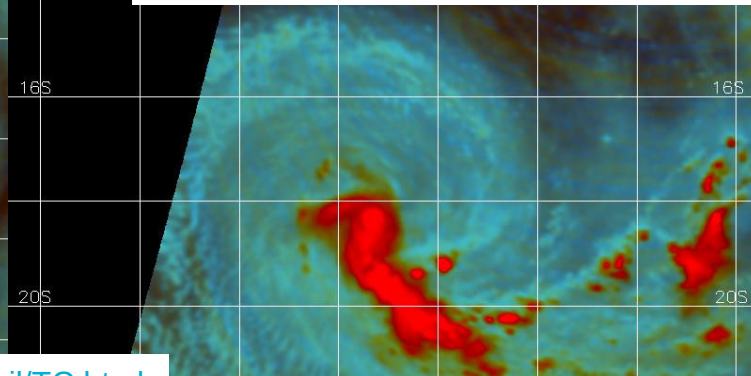
MSR2 23/1857UTC



IS 25/0001UTC



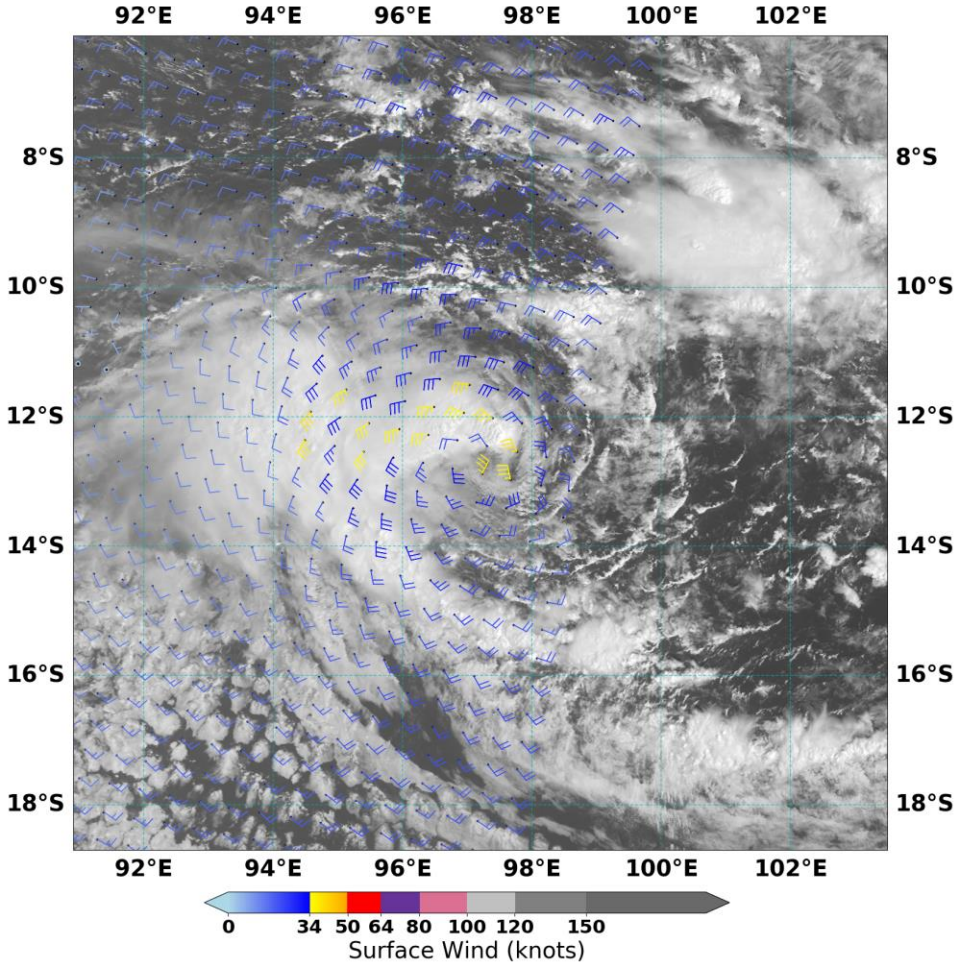
AMSR2 25/1846UTC



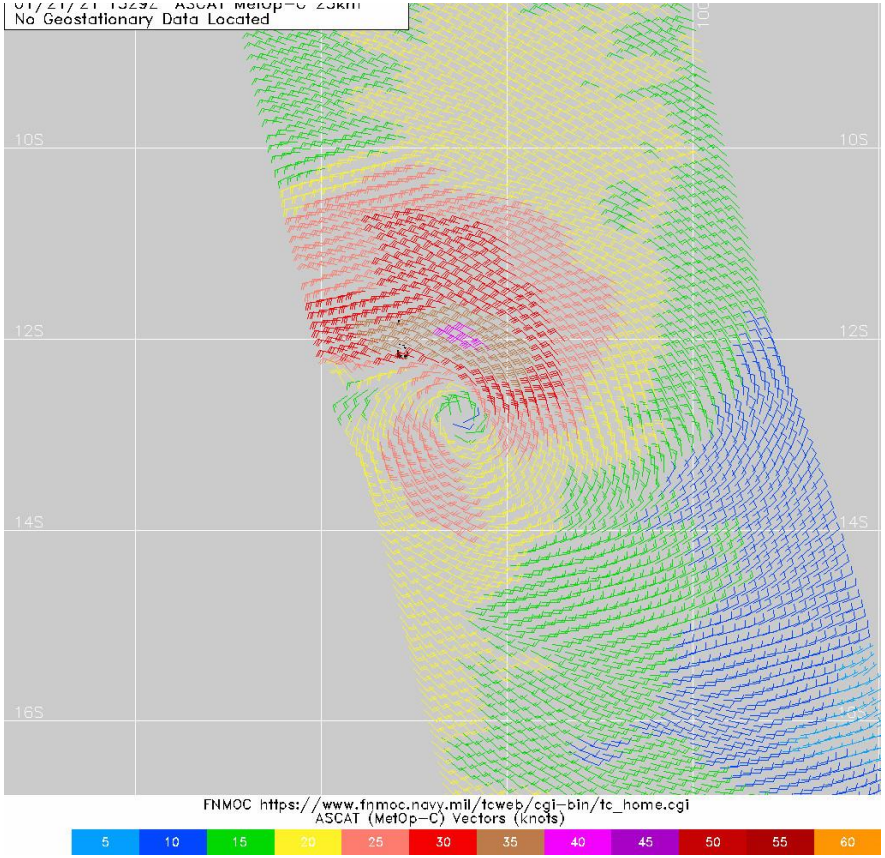
Australian Government
Bureau of Meteorology

Scatterometry 21 Jan

SCATSAT 21/0202UTC



ASCATC 21/1529UTC



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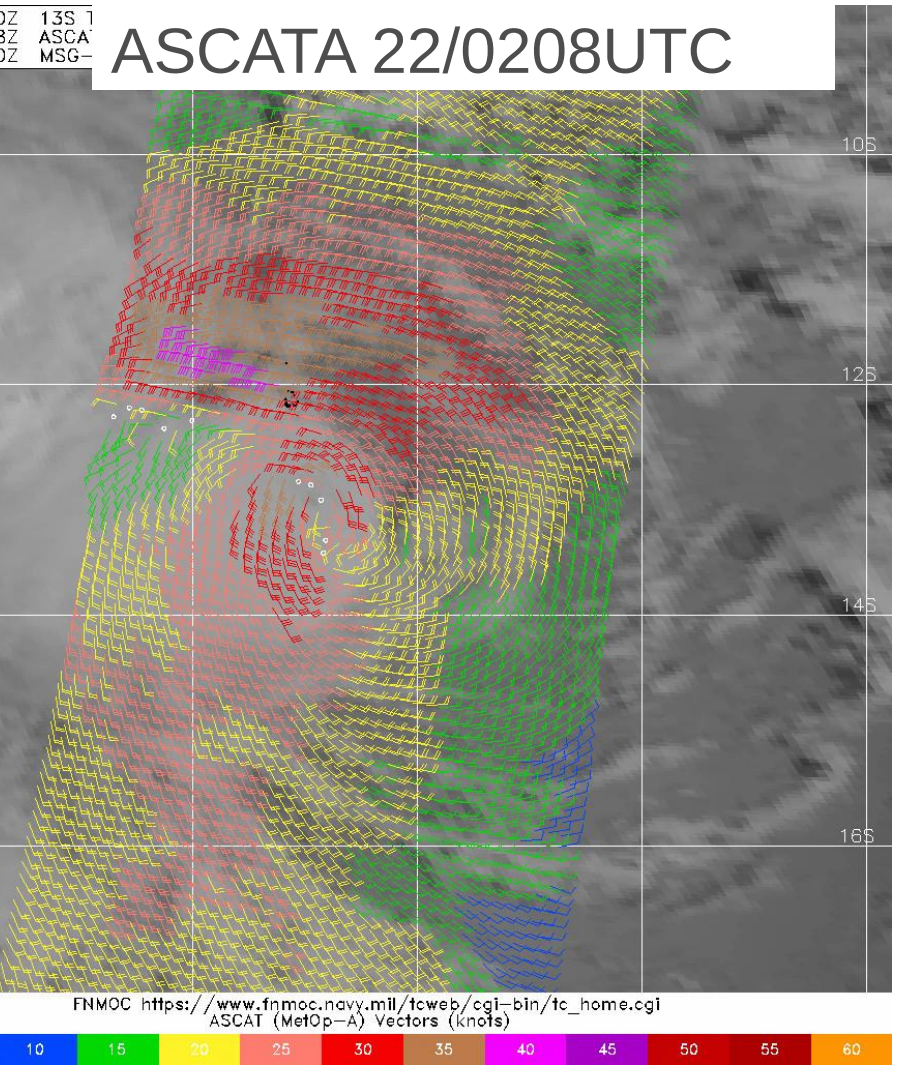
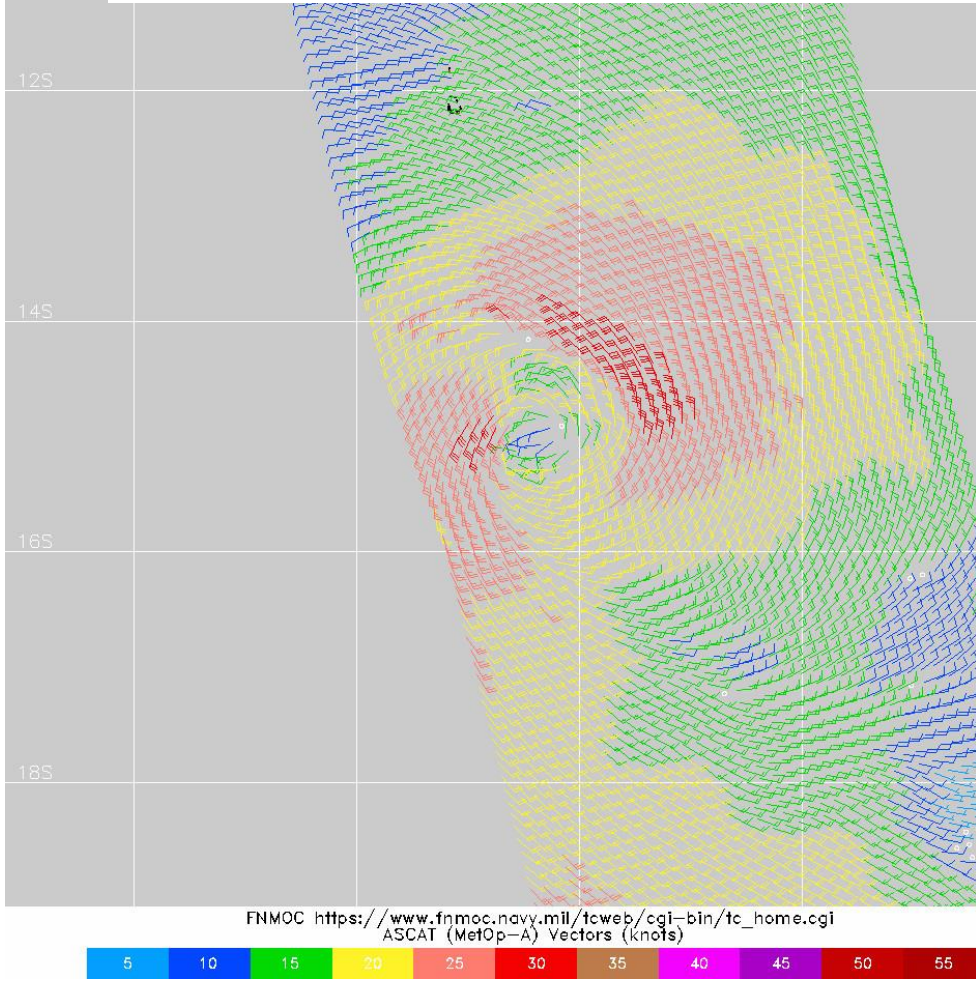
Bureau of Meteorology

Scatterometry 22-23 Jan

ASCATA 22/0208UTC



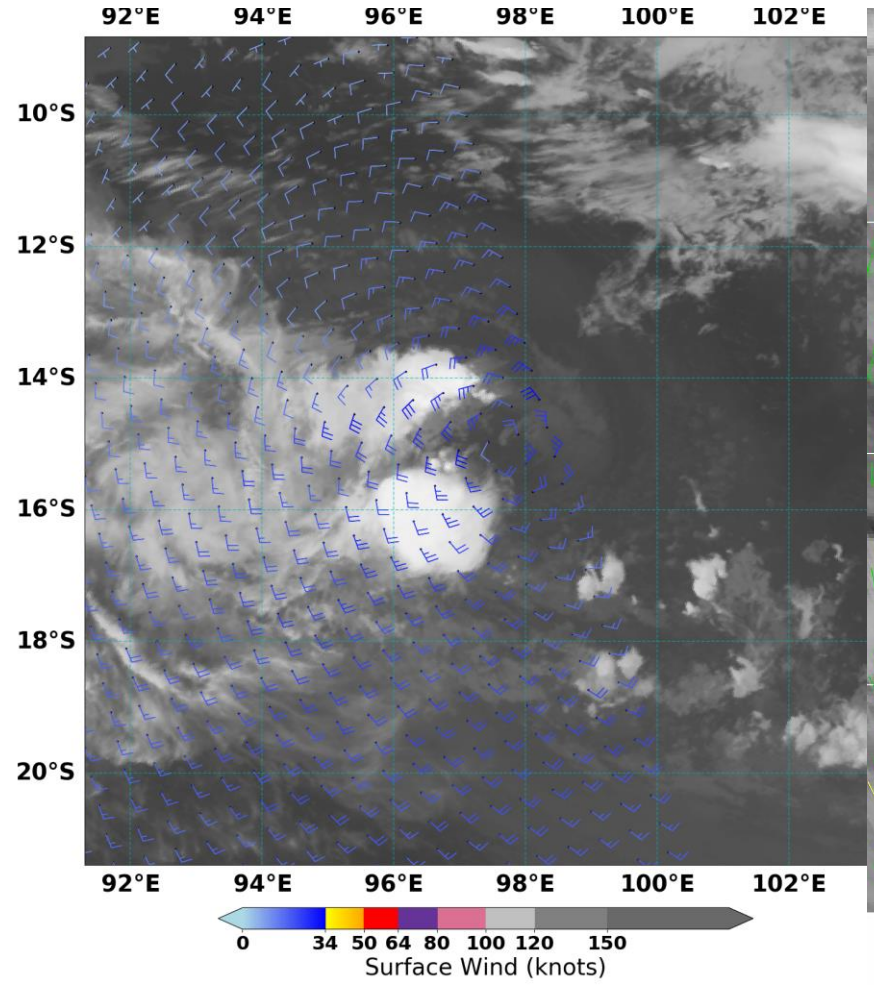
ASCATA 23/1419UTC



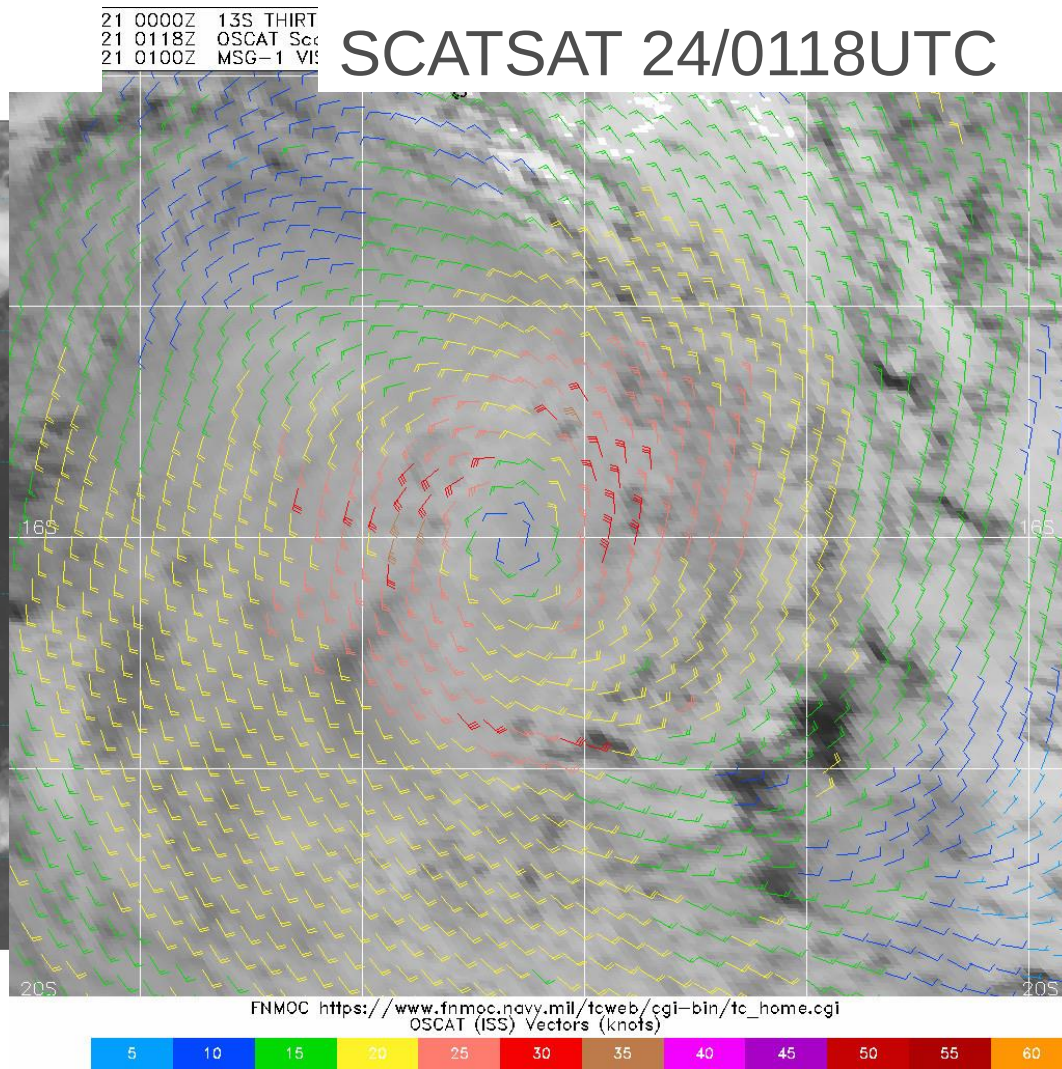
Australian Government
Bureau of Meteorology

Scatterometry 23-24 Jan

SCATSAT 23/1419UTC



SCATSAT 24/0118UTC

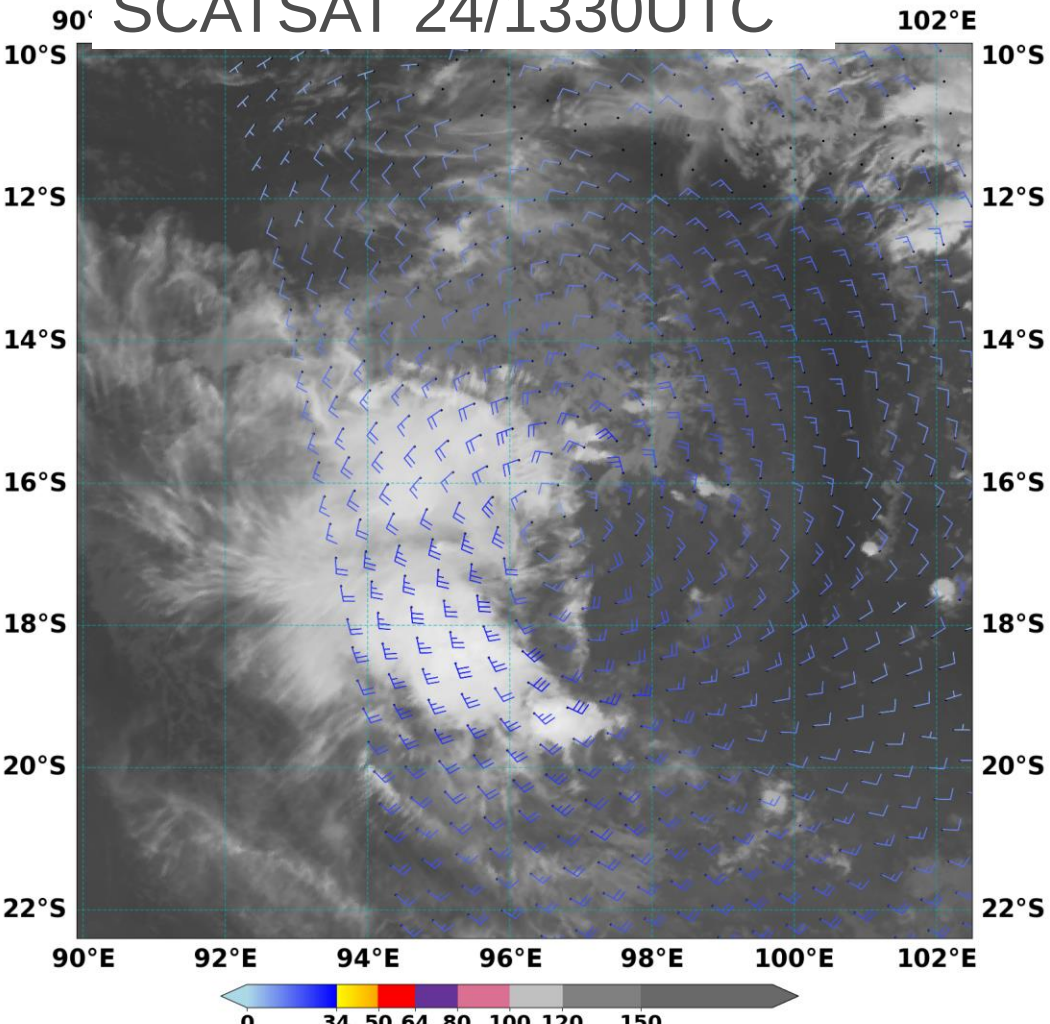


Australian Government
Bureau of Meteorology

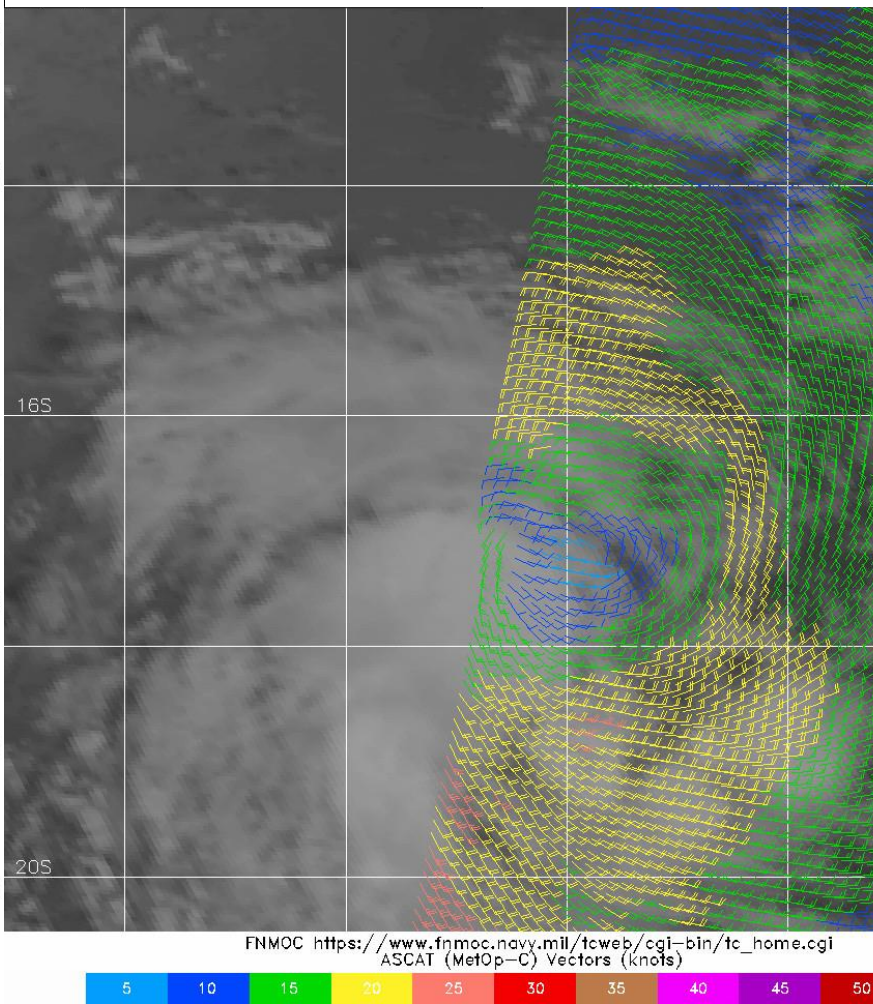
Scatterometry 24-25 Jan

SH13 THIRTEEN at 2021-01-24 12:00:00, NRL-Monterey

SCATSAT 24/1330UTC



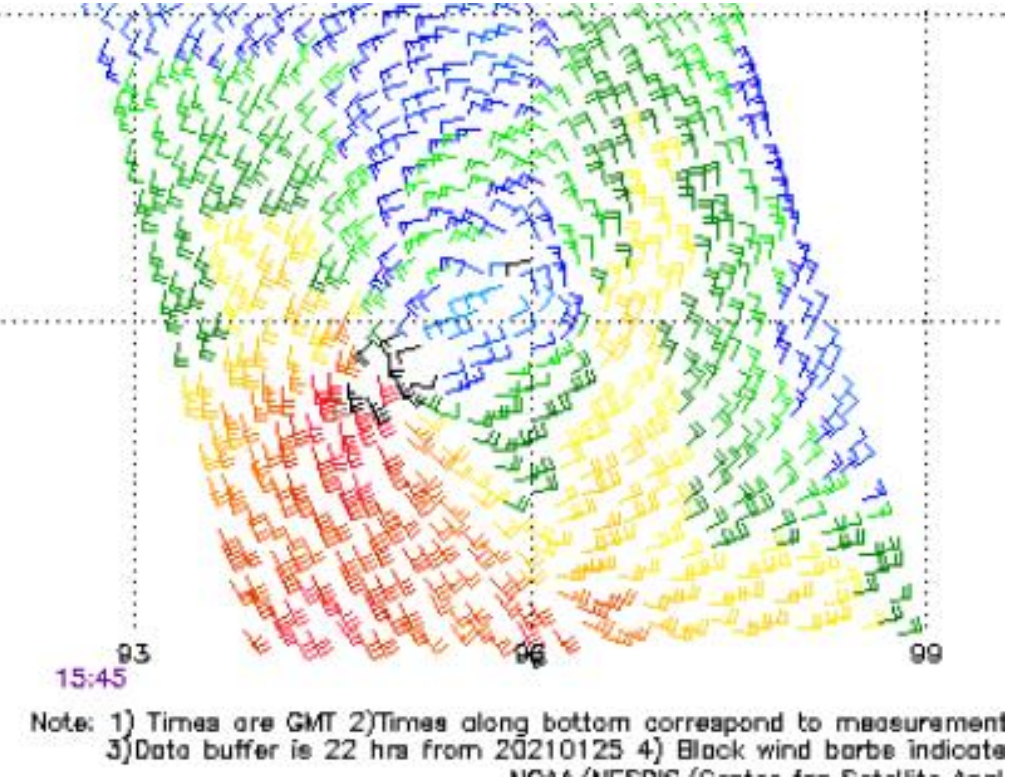
ASCATC 25/0315UTC



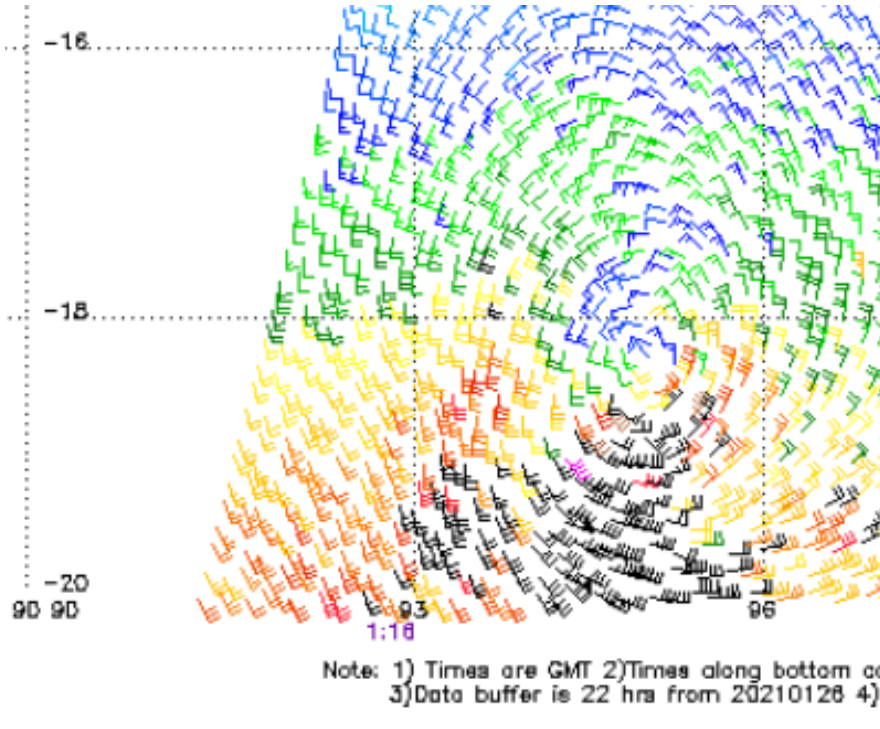
Australian Government
Bureau of Meteorology

Scatterometry 25-26 Jan

ASCAT 25/1545UTC

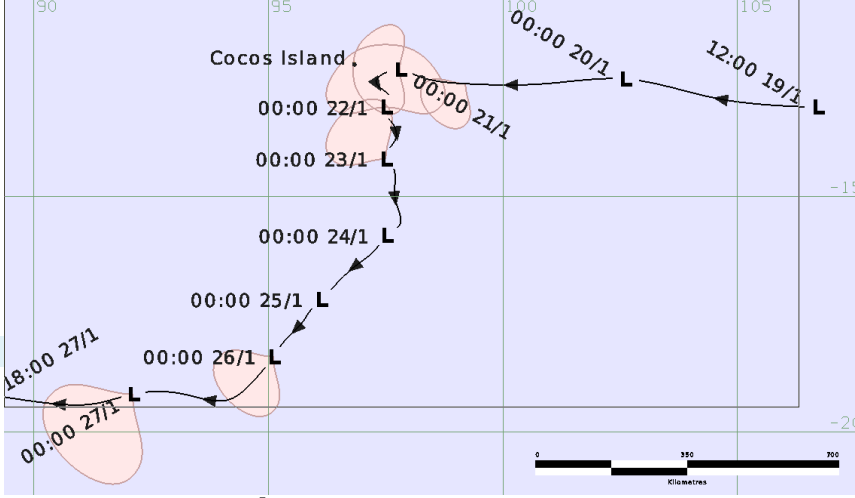


SCATSAT 26/0116UTC



Australian Government
Bureau of Meteorology

10U summary: timing is everything



SST: OK 28C initially then ~27C later on track

Deep moisture: OK initially then moderated from 25 Jan

Upper-level outflow: on western side, then southern side from 24

Circulation: improved on 21-23 Jan then weakened on 24 Jan

Low Vertical Wind Shear: No but eventually low from 26 Jan

Persistent deep convection: downshear mostly then a period of near the centre 24-25 Jan

<u>Ingredients not quite right at the same time!!</u>

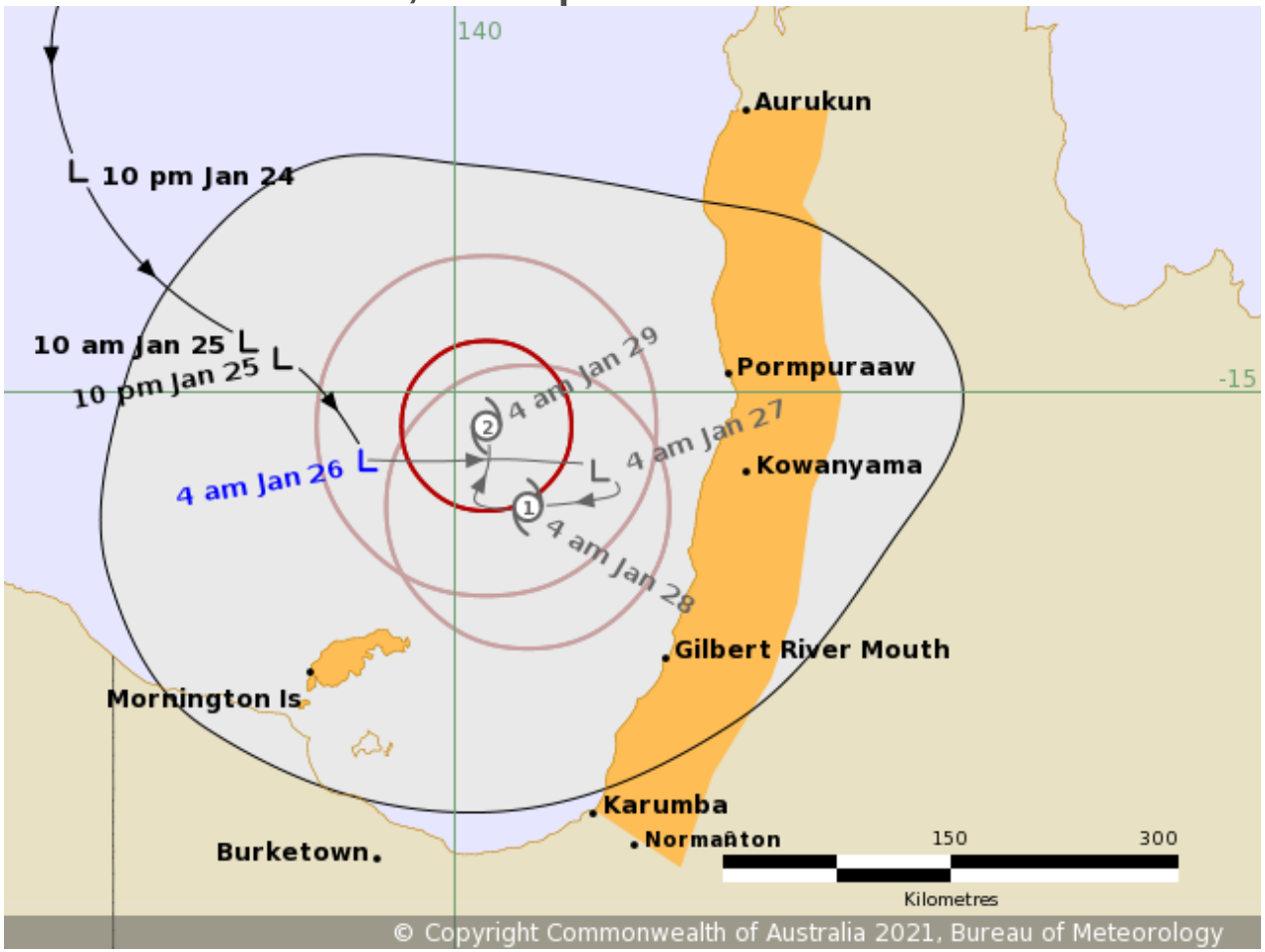
Australian Government
Bureau of Meteorology

11U pre-Lucas 24-27 Jan 2020/21

Slow moving Gulf system

Forecast 25/18 UTC TC in +48h

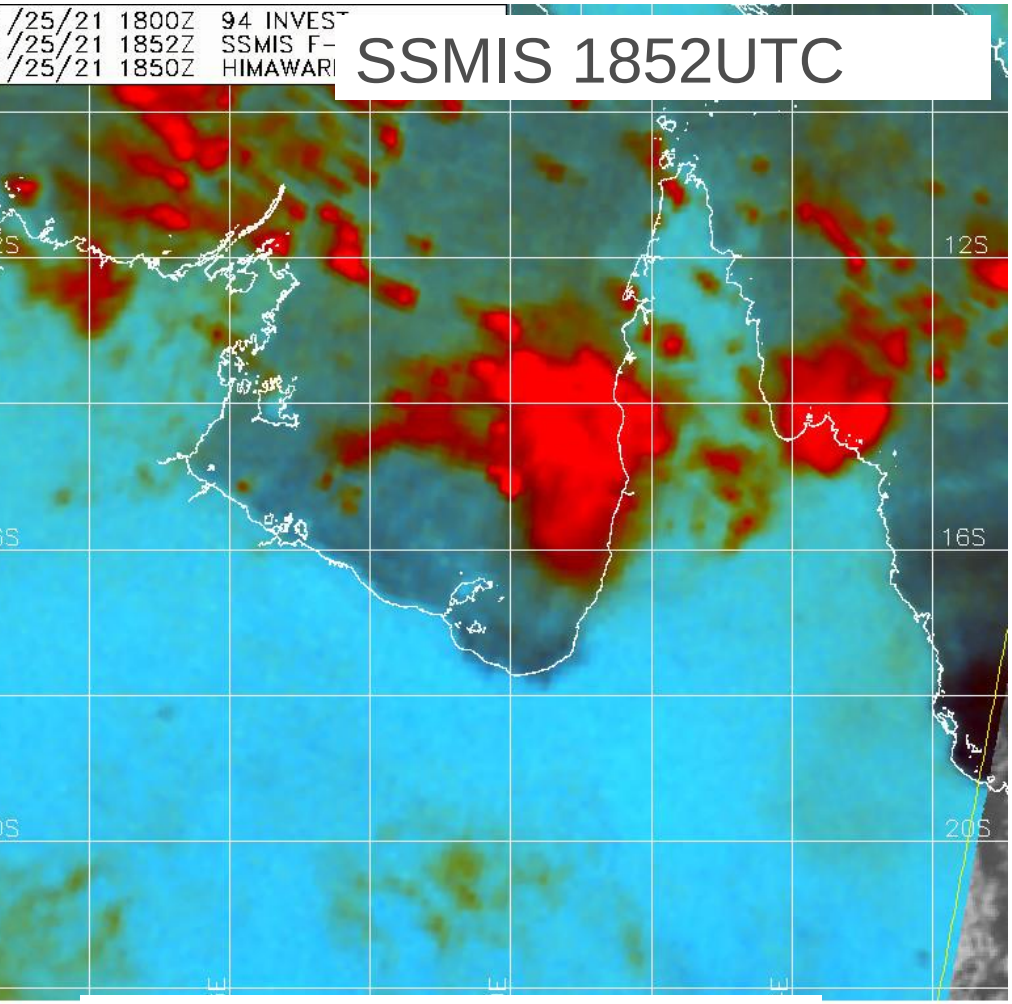
SST: >30C; Deep moisture

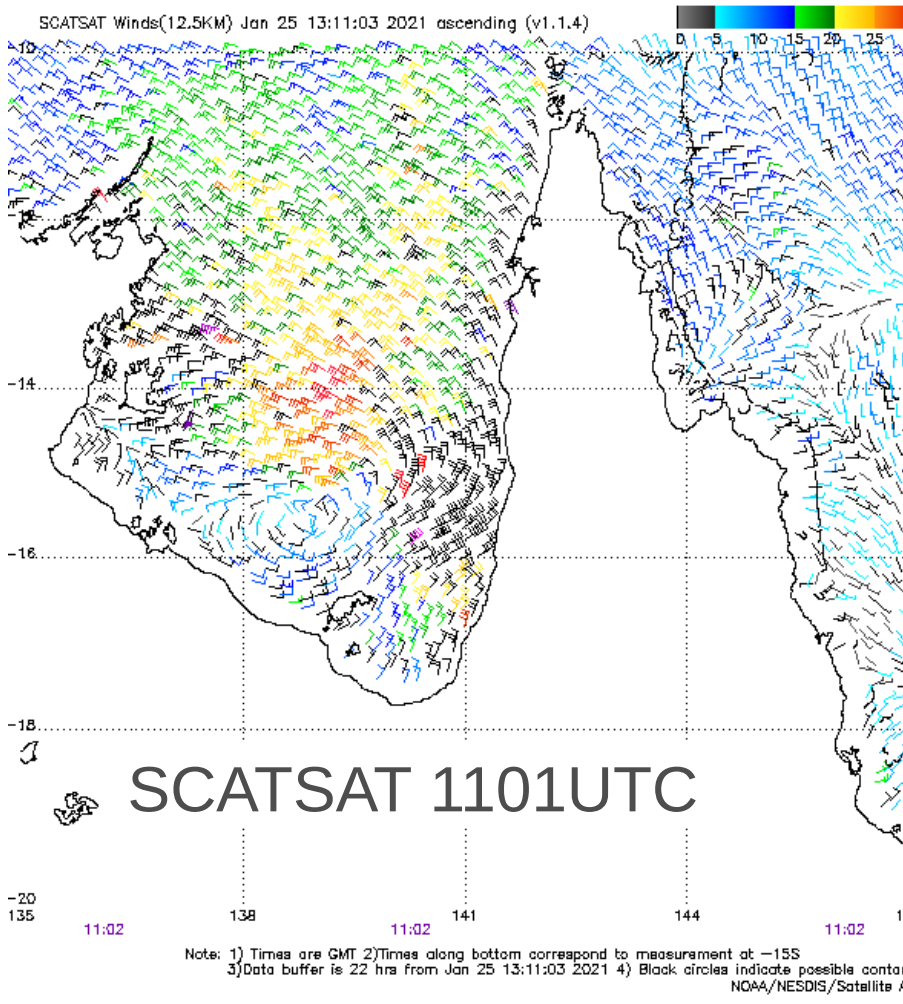


Australian Government
Bureau of Meteorology

Analysis 25 Jan

Strong inflow on northern side;
Deep convection on eastern side



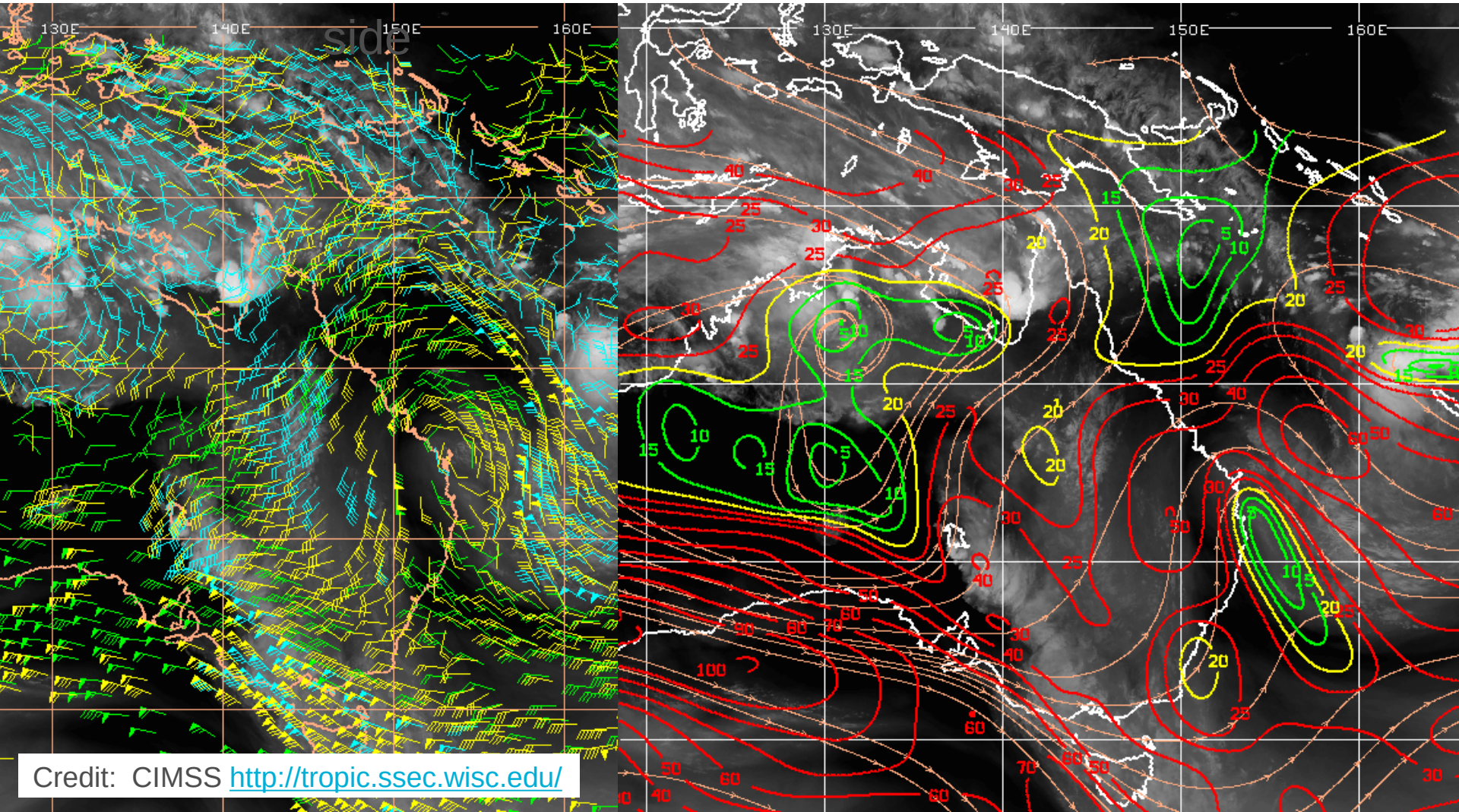


Credit: NRL: https://www.nrlmry.navy.mil/TC.html

Upper levels CIMSS 25/12UTC

Australian Government
Bureau of Meteorology

Upper-level SE flow currently so not favourable but expected to change?



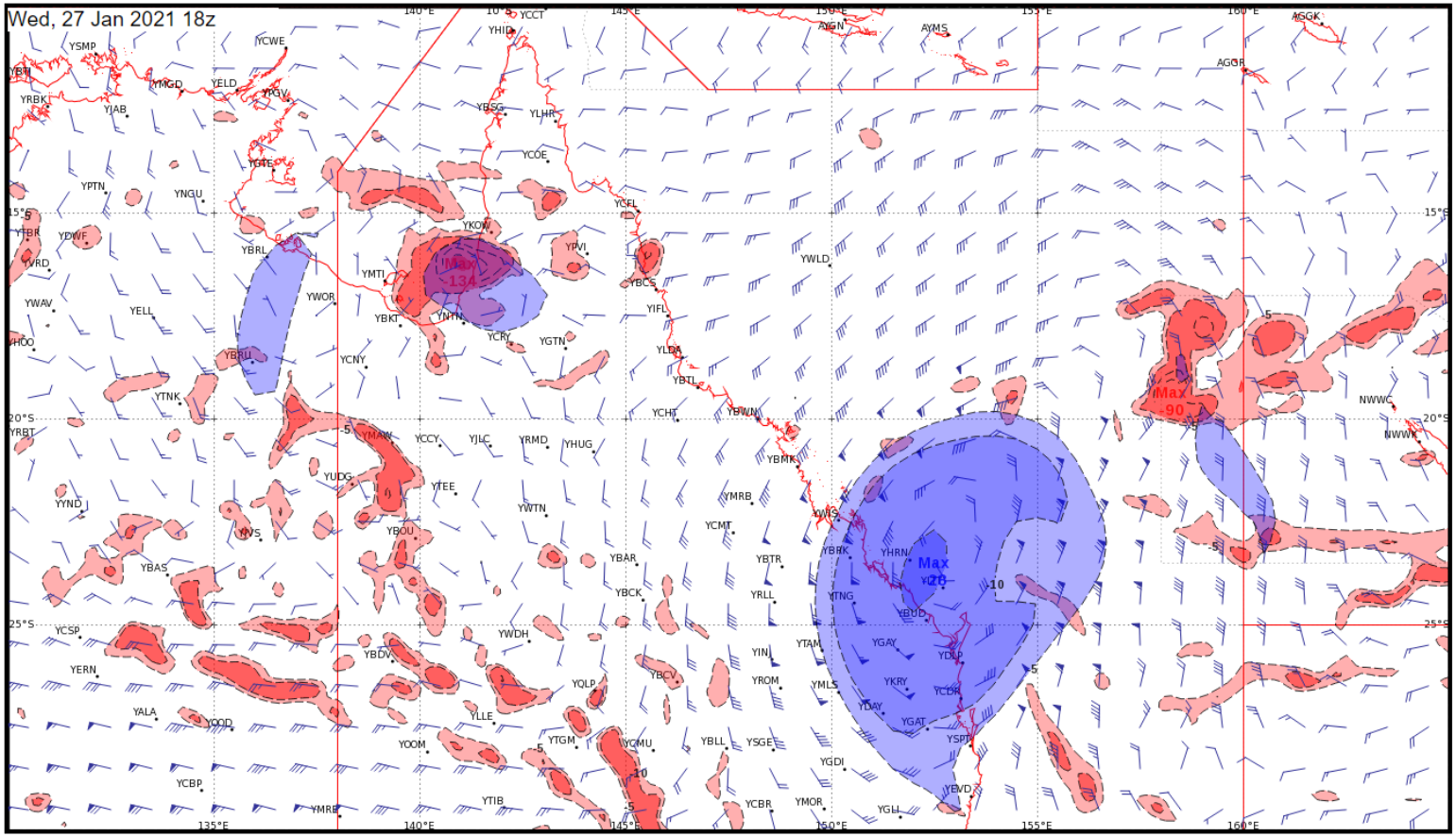
Credit: CIMSS http://tropic.ssec.wisc.edu/

Australian Government
Bureau of Meteorology

Upper level pattern EC for 27/18UTC

Weak flow; low shear;

upper-level circulation (blue) developing



Region
Eastern Australia NorthwestW

Models
AGX USGFS UKHR EC
ACCESS-G

Runs
2021-01-24 12Z
2021-01-25 00Z
2021-01-24 00Z
2021-01-23 12Z

MSLP	WindSFC
Vort850	Wind850
Vort700	Wind700
Vort500	Wind500
Vort300	Wind300
RH600	Wind200
DLM850_300	DLM850_50
GeoPot500	Shear850_2

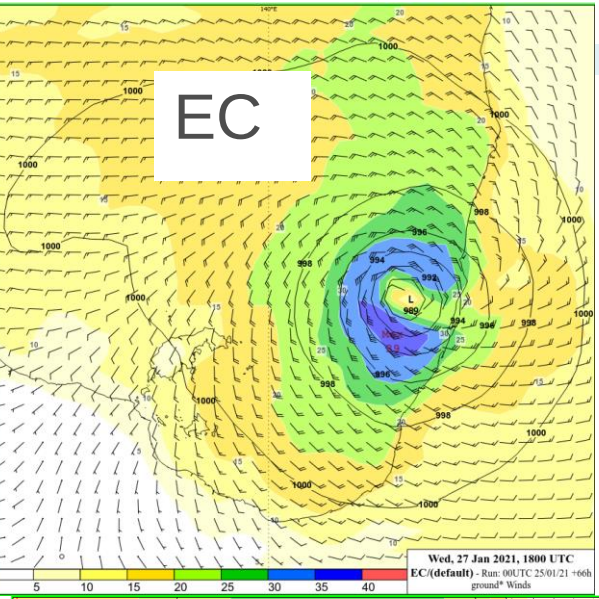
TCBrowser Archive
TCBrowser Wiki

Q - region	W +24 hrs	E + region
A - timestep	S -24 hrs	D + timestep

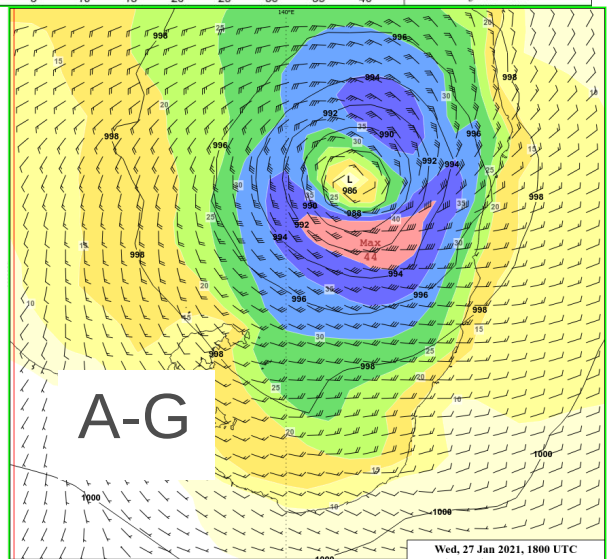
Australian Government
Bureau of Meteorology

NWP 25/00 to 06UTC for 27/18UTC
Models indicating TC

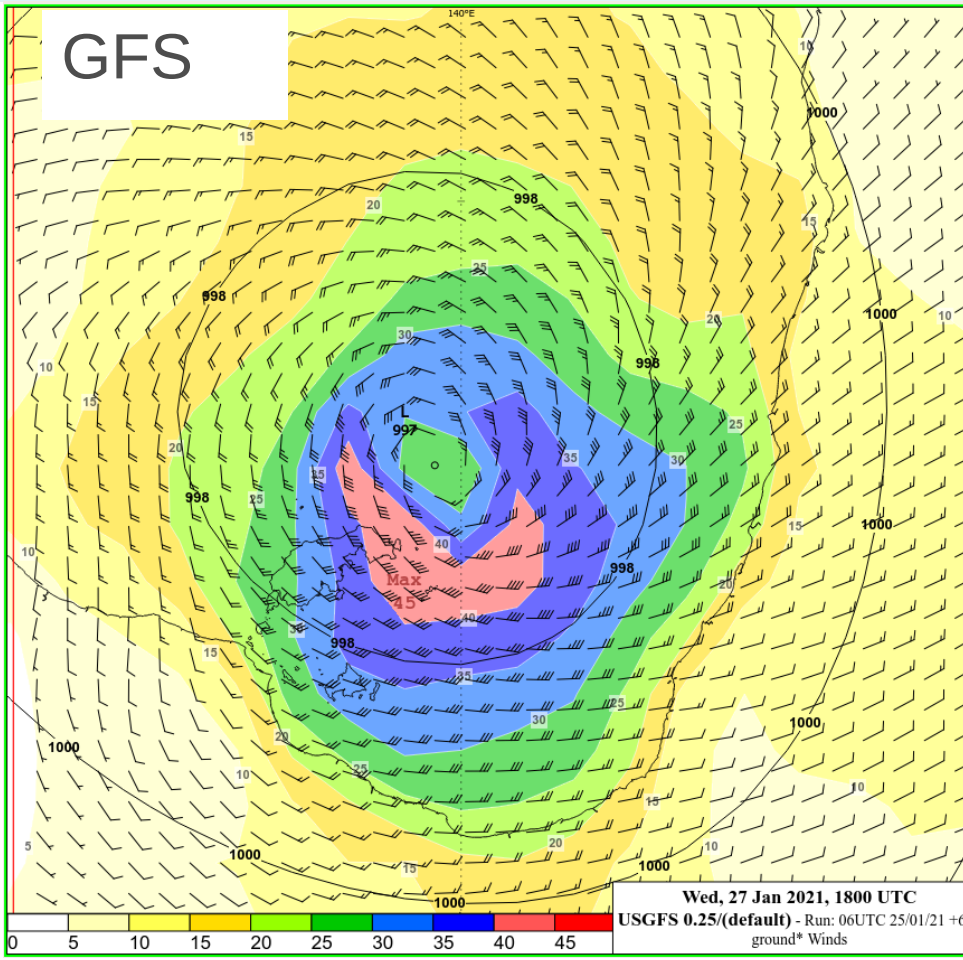
EC



A-G

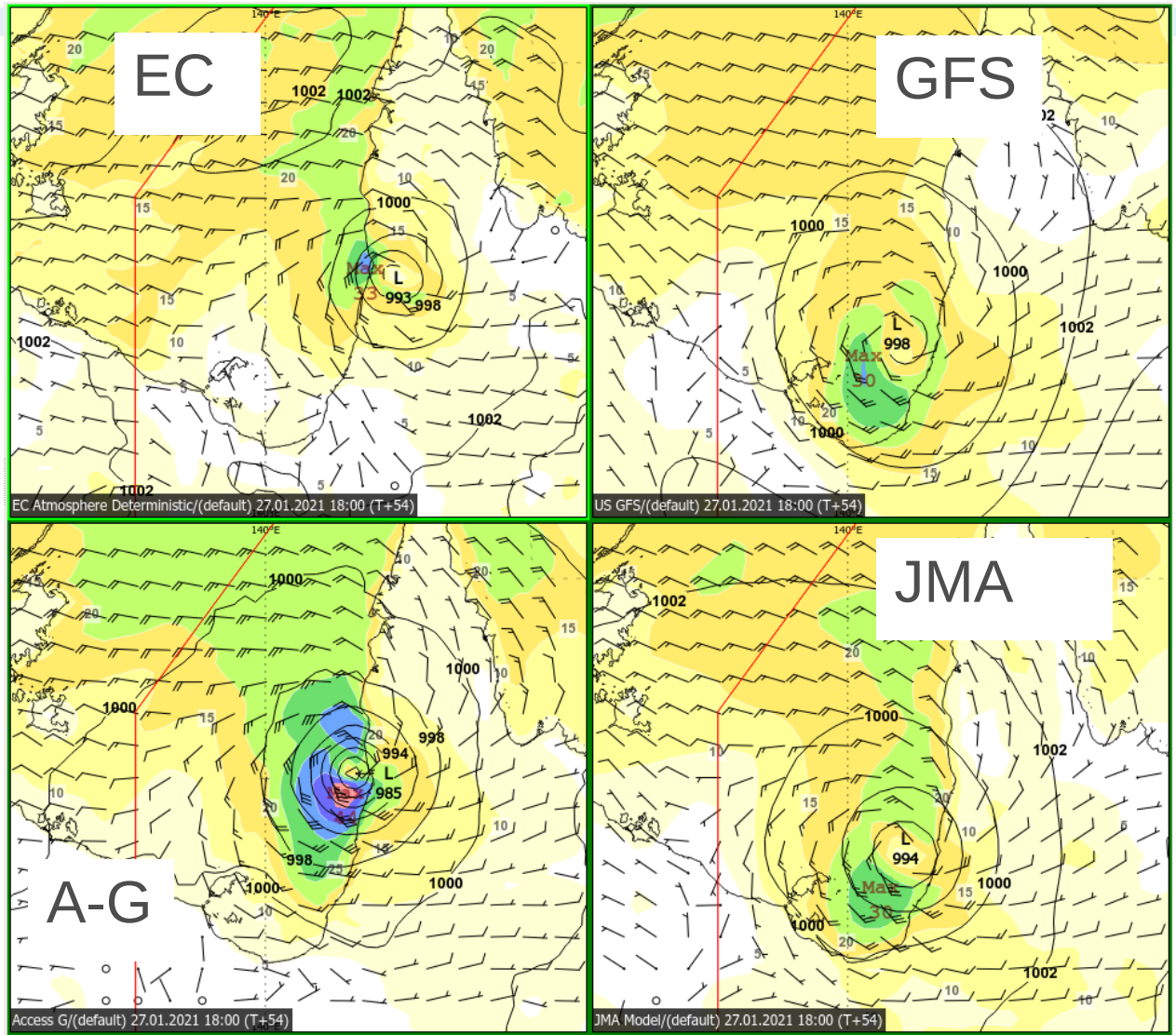


GFS



Australian Government
Bureau of Meteorology

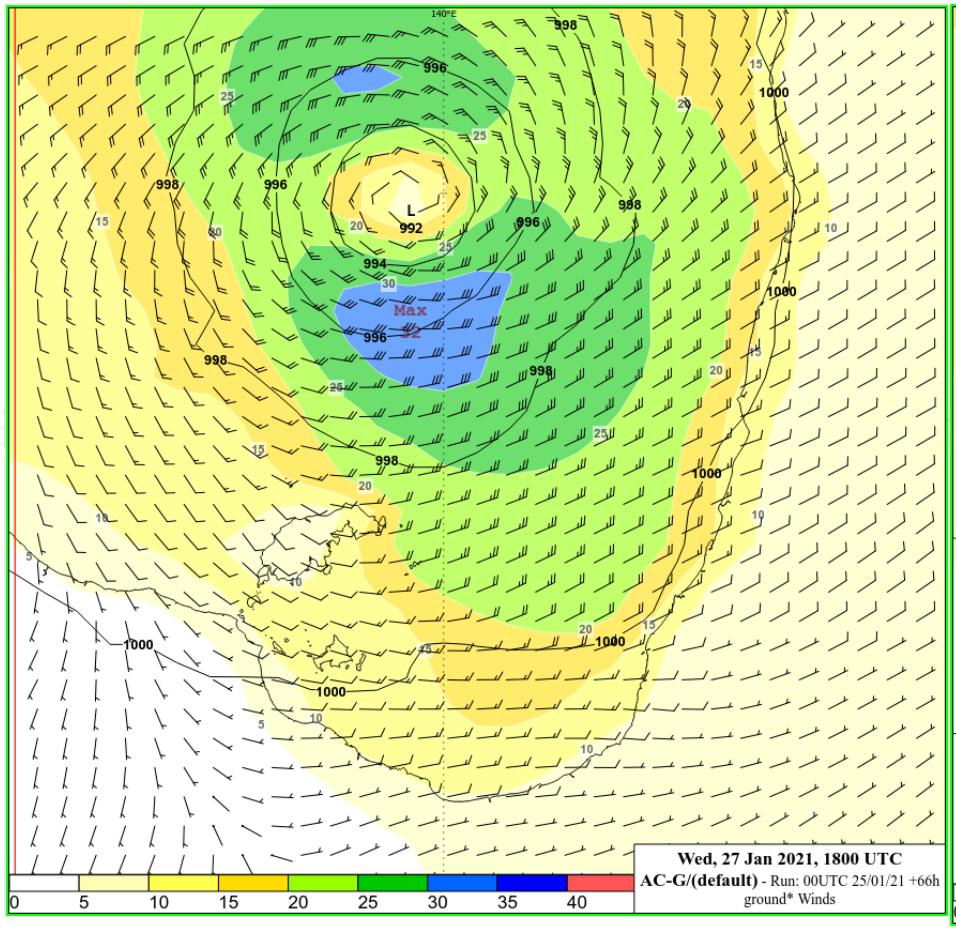
NWP 25/12UTC for 27/18UTC over land or offshore? Weaker?



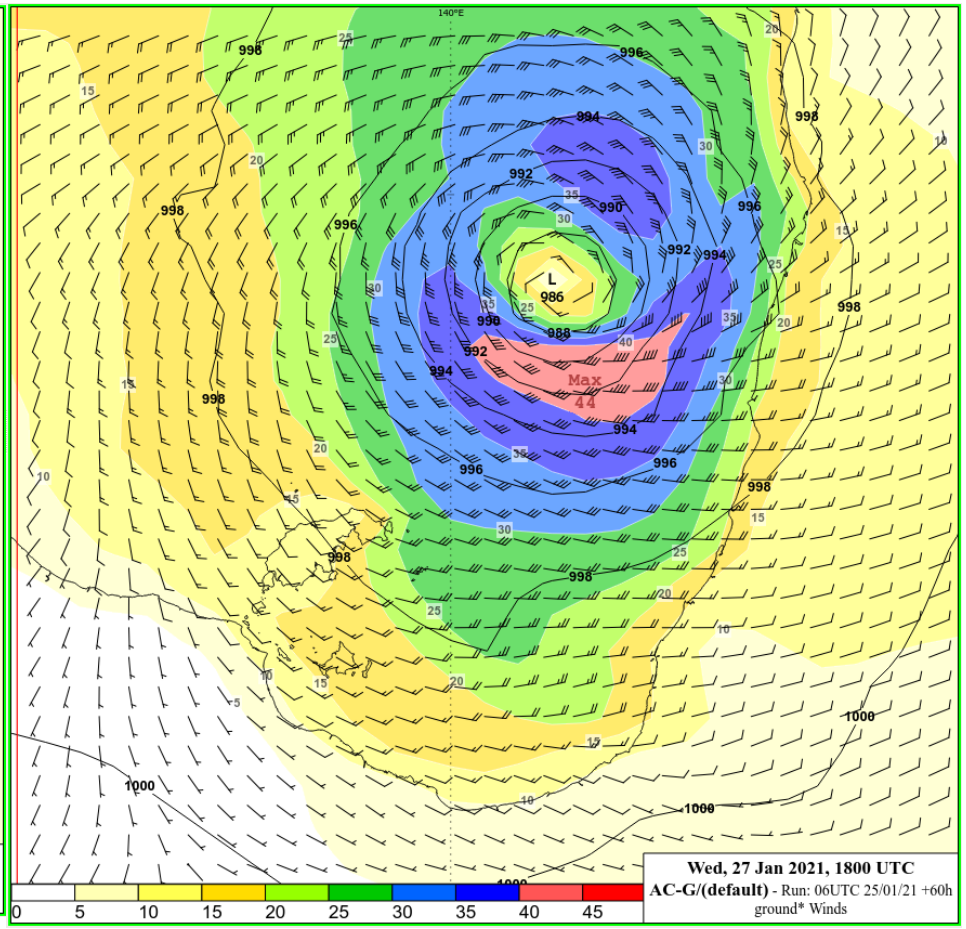
Australian Government
Bureau of Meteorology

NWP for 27/18UTC
ACCESS and GFS much stronger on 25/06UTC runs

A-G 25/00UTC run



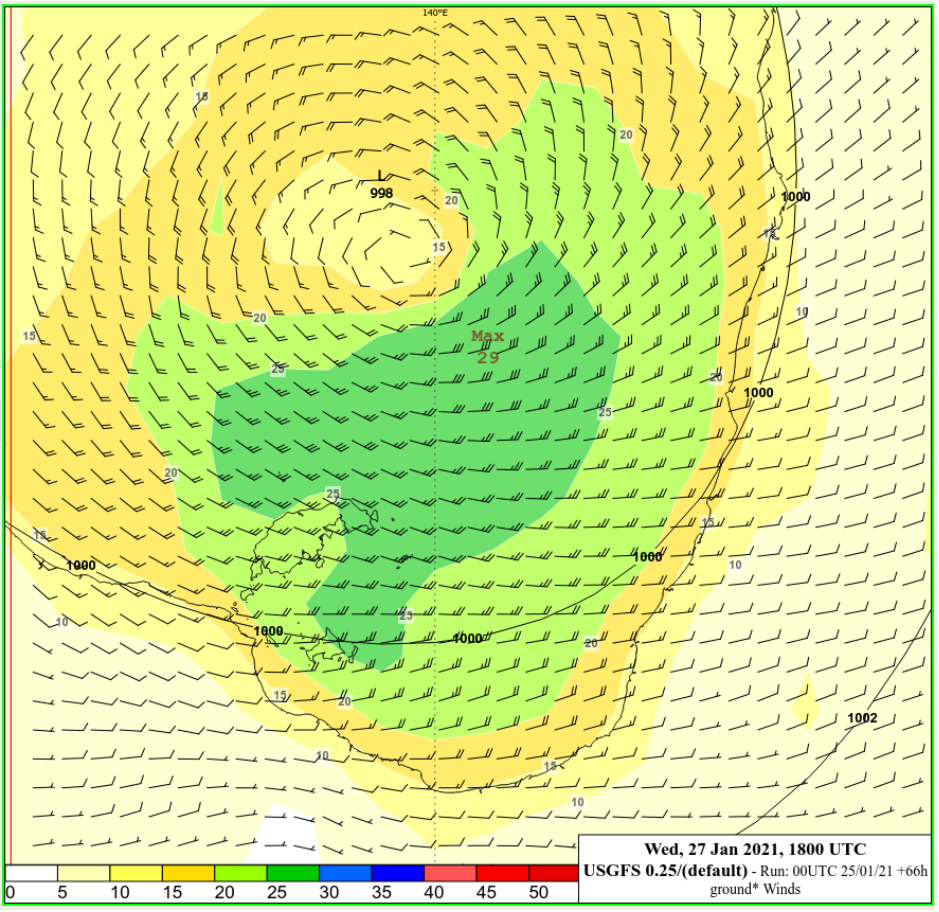
A-G 25/06UTC run



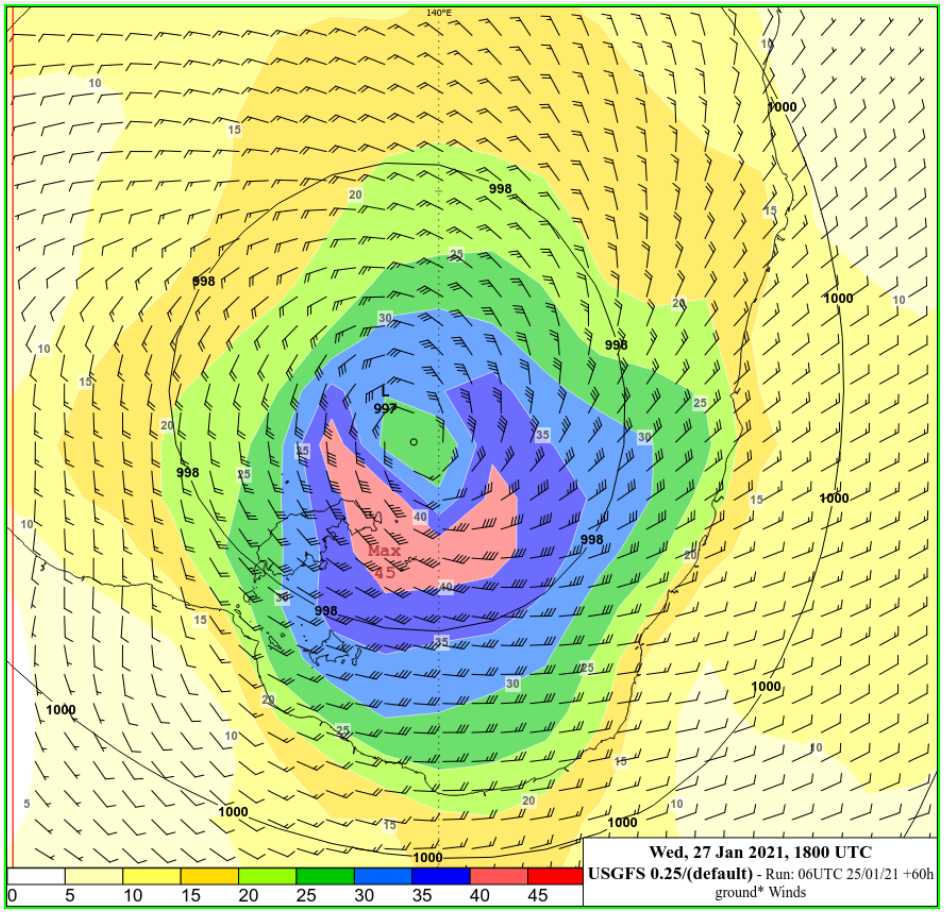
Australian Government
Bureau of Meteorology

NWP for 27/18UTC
ACCESS and GFS much stronger on 25/06UTC runs

GFS 25/00UTC run



GFS 25/06UTC run



Australian Government
Bureau of Meteorology

11U summary: mostly good but for land!

SST: YES

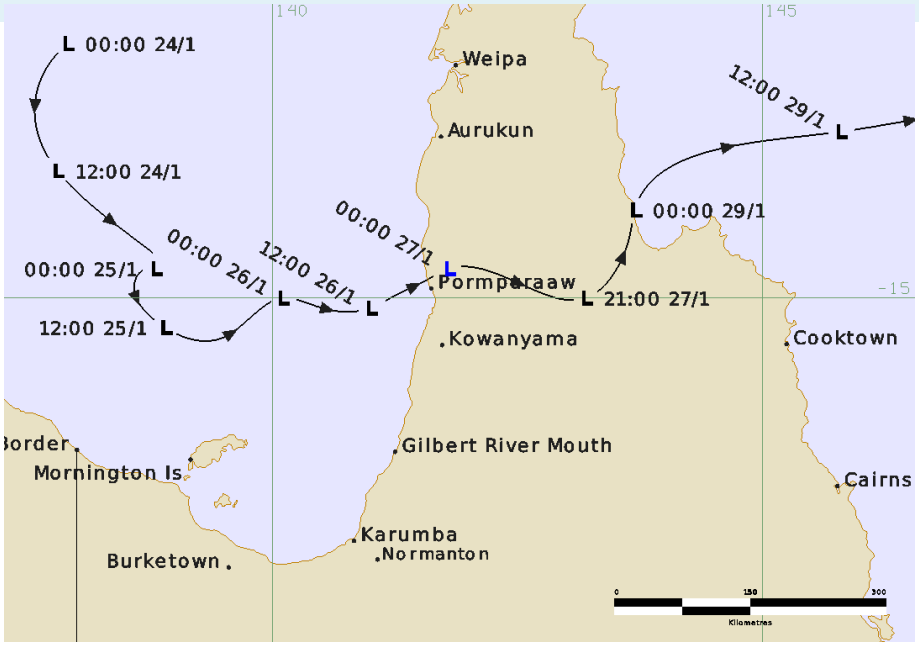
Deep moisture: YES

Upper-levels : weak outflow but becoming low shear

Circulation: Yes

Persistent deep convection: eastern side

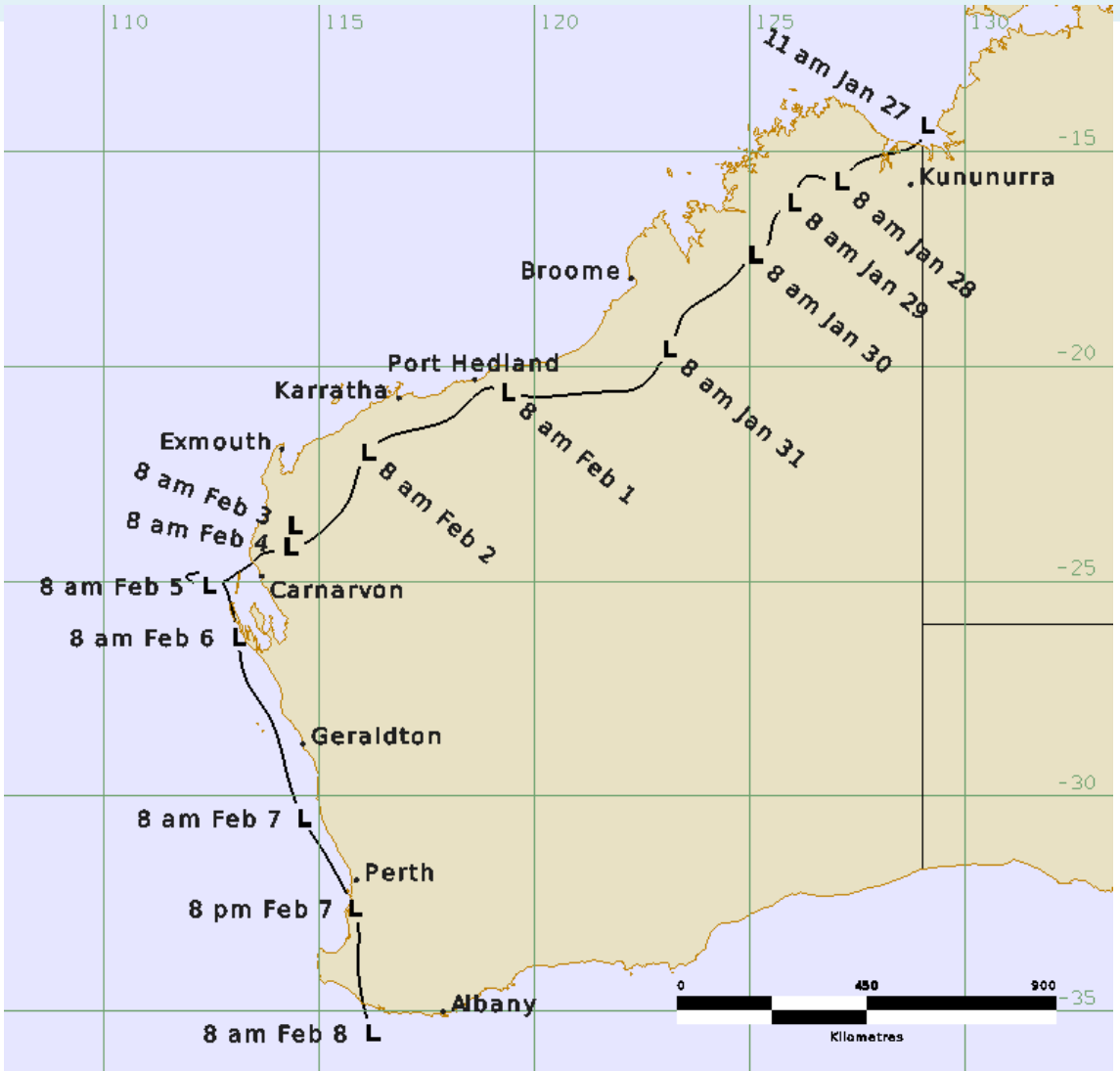
BUT LAND got in the way!



Australian Government
Bureau of Meteorology

12U 27 Jan – 9 Feb 2021

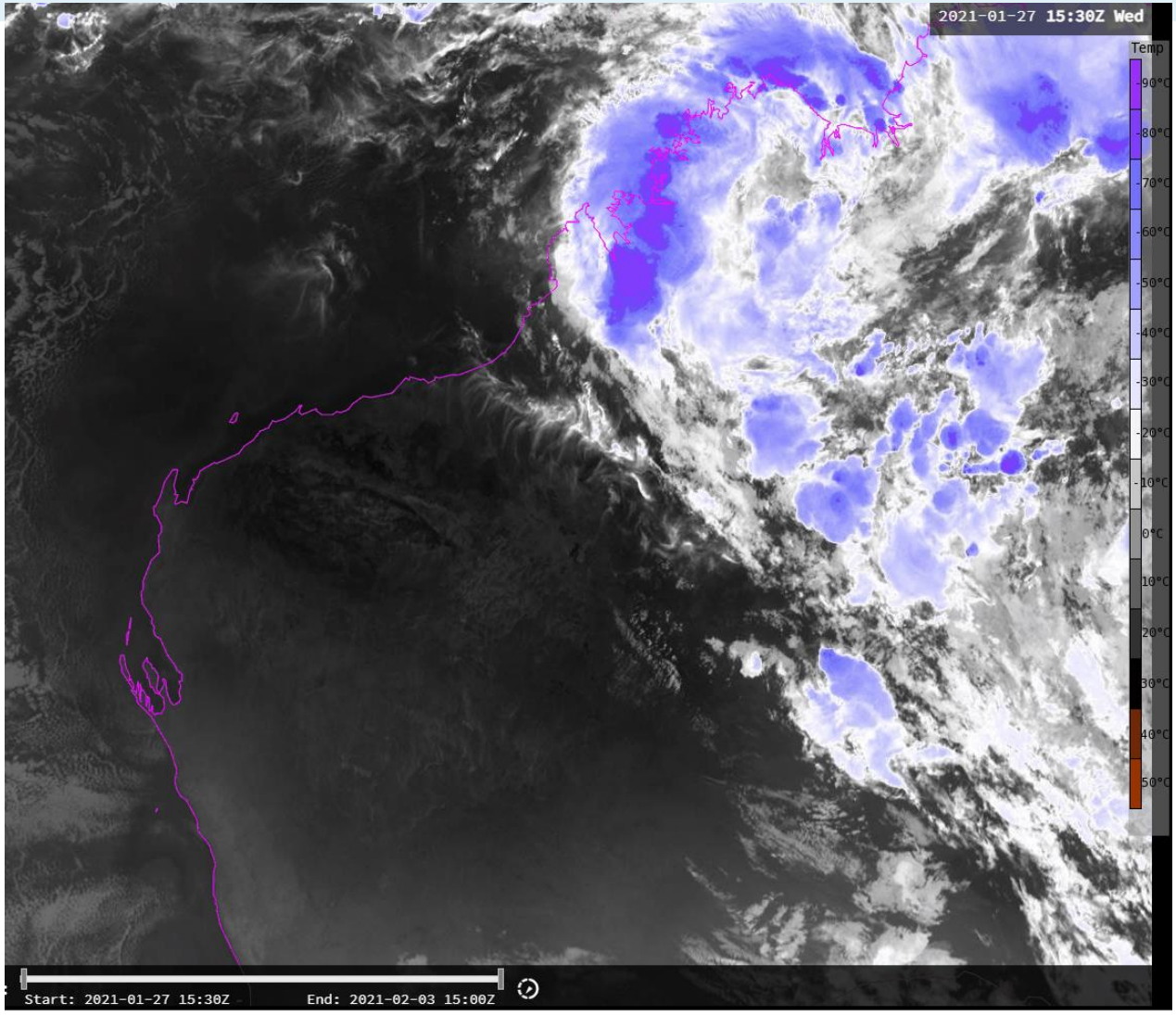
Over land coastal hugger all rain and not much wind



Australian Government
Bureau of Meteorology

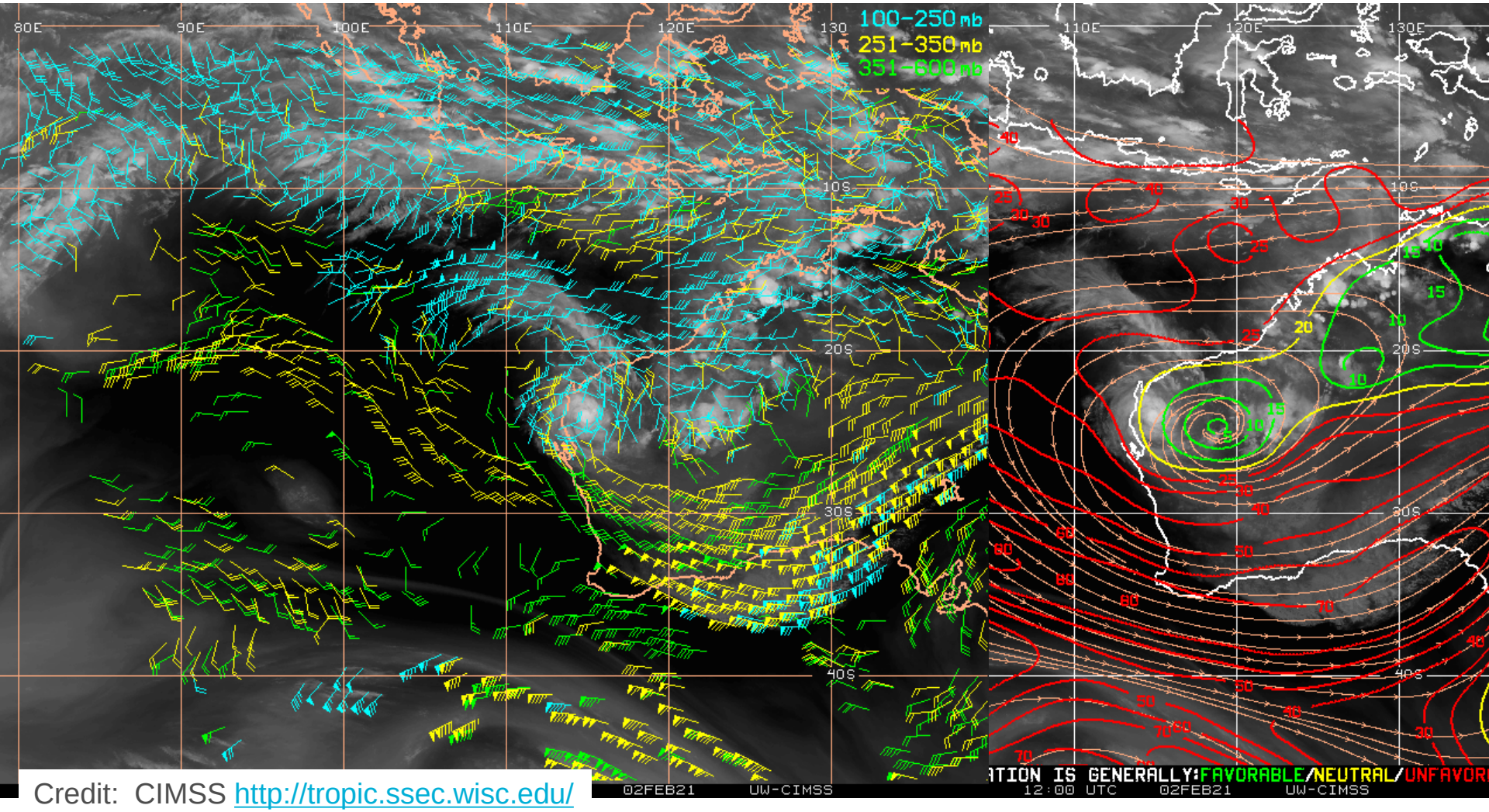
IR loop 12U

3-hourly 27 Jan – 3 Feb 2021



Australian Government
Bureau of Meteorology

Upper levels CIMSS 02/12UTC

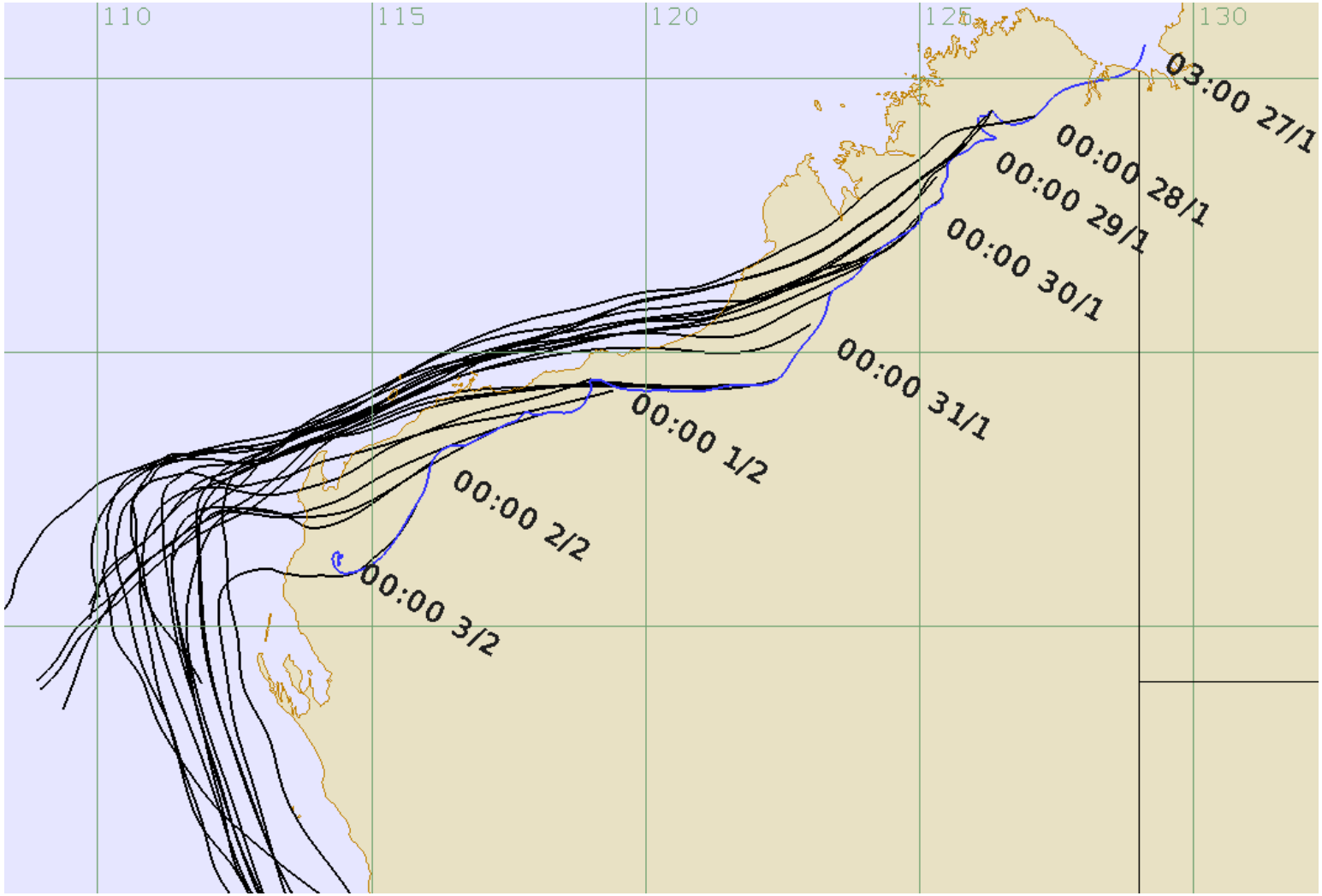


Credit: CIMSS http://tropic.ssec.wisc.edu/

Australian Government
Bureau of Meteorology

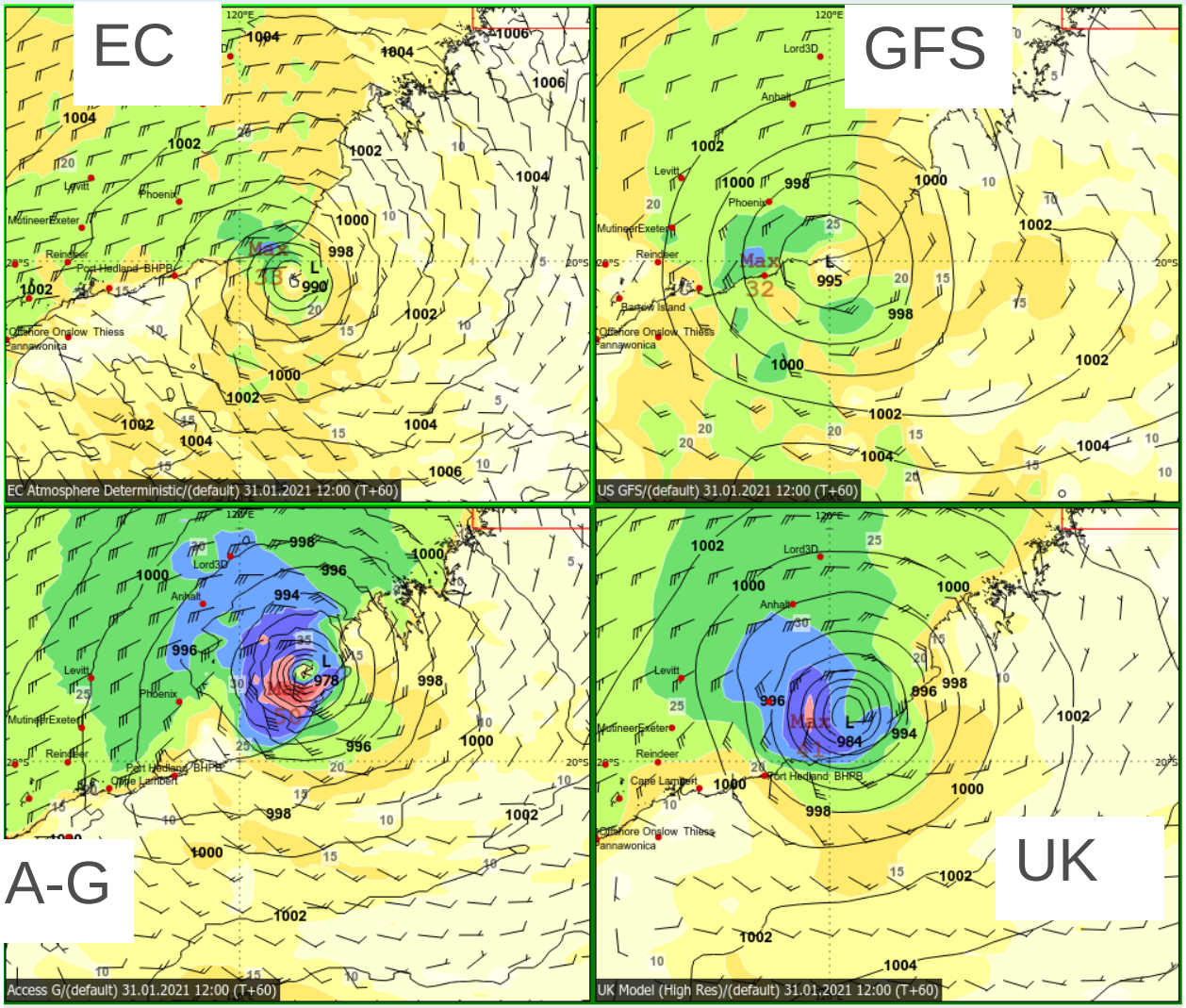
Official Forecast Track 12U

OFT to 3 Feb bias north of analysis track



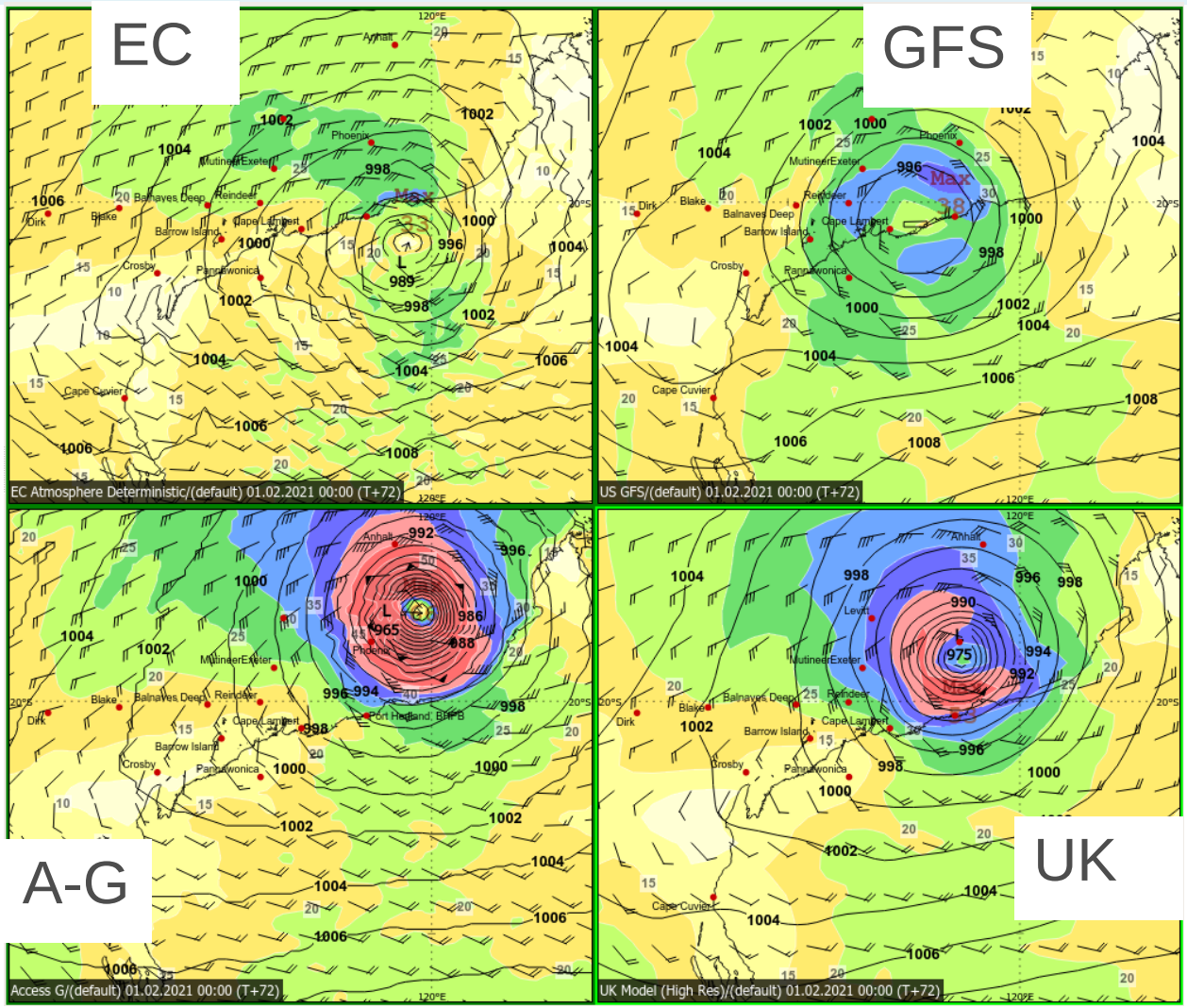
Australian Government
Bureau of Meteorology

NWP 29/00UTC run for 31/12UTC



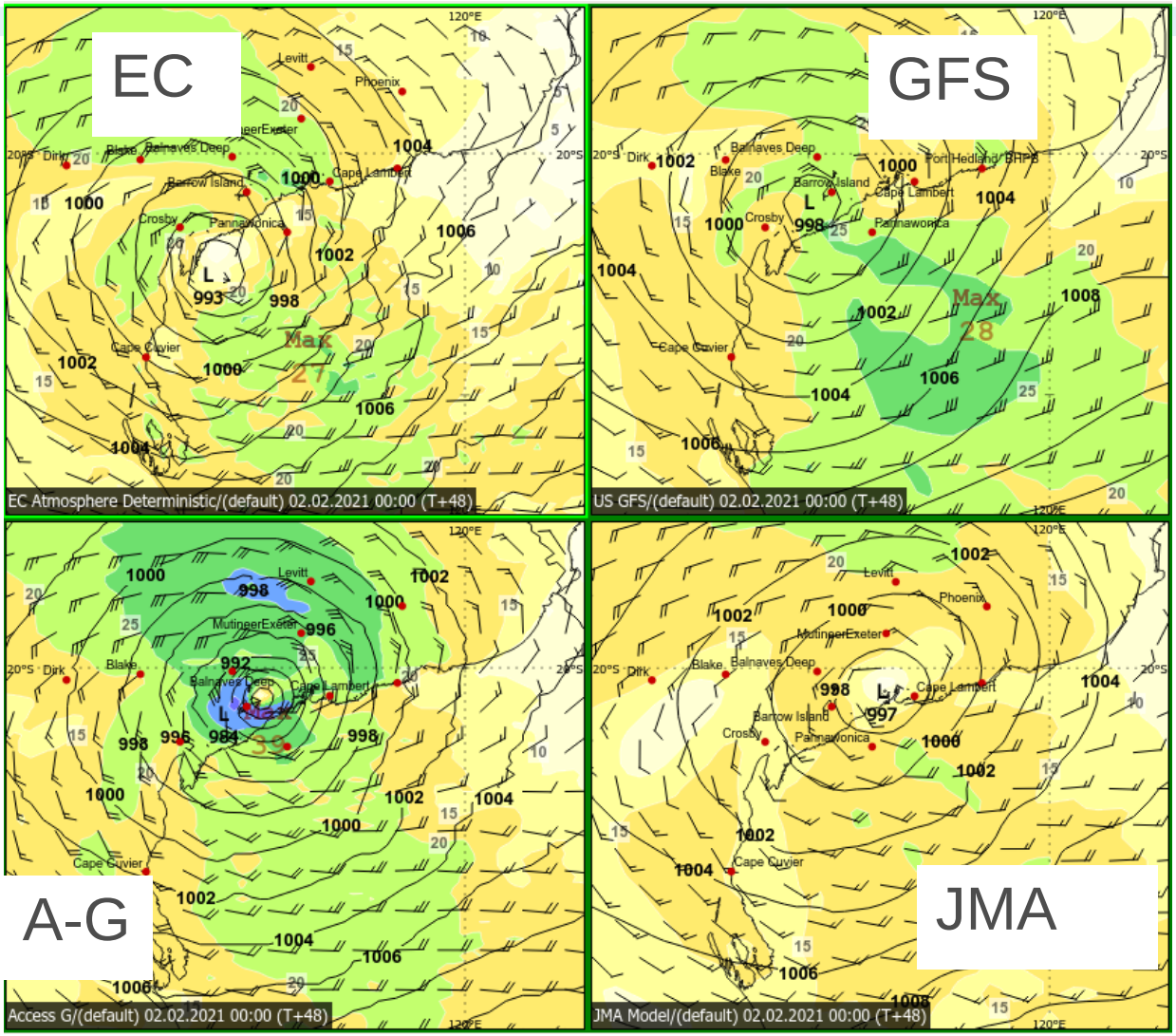
Australian Government
Bureau of Meteorology

NWP 29/00UTC run for 01/00UTC



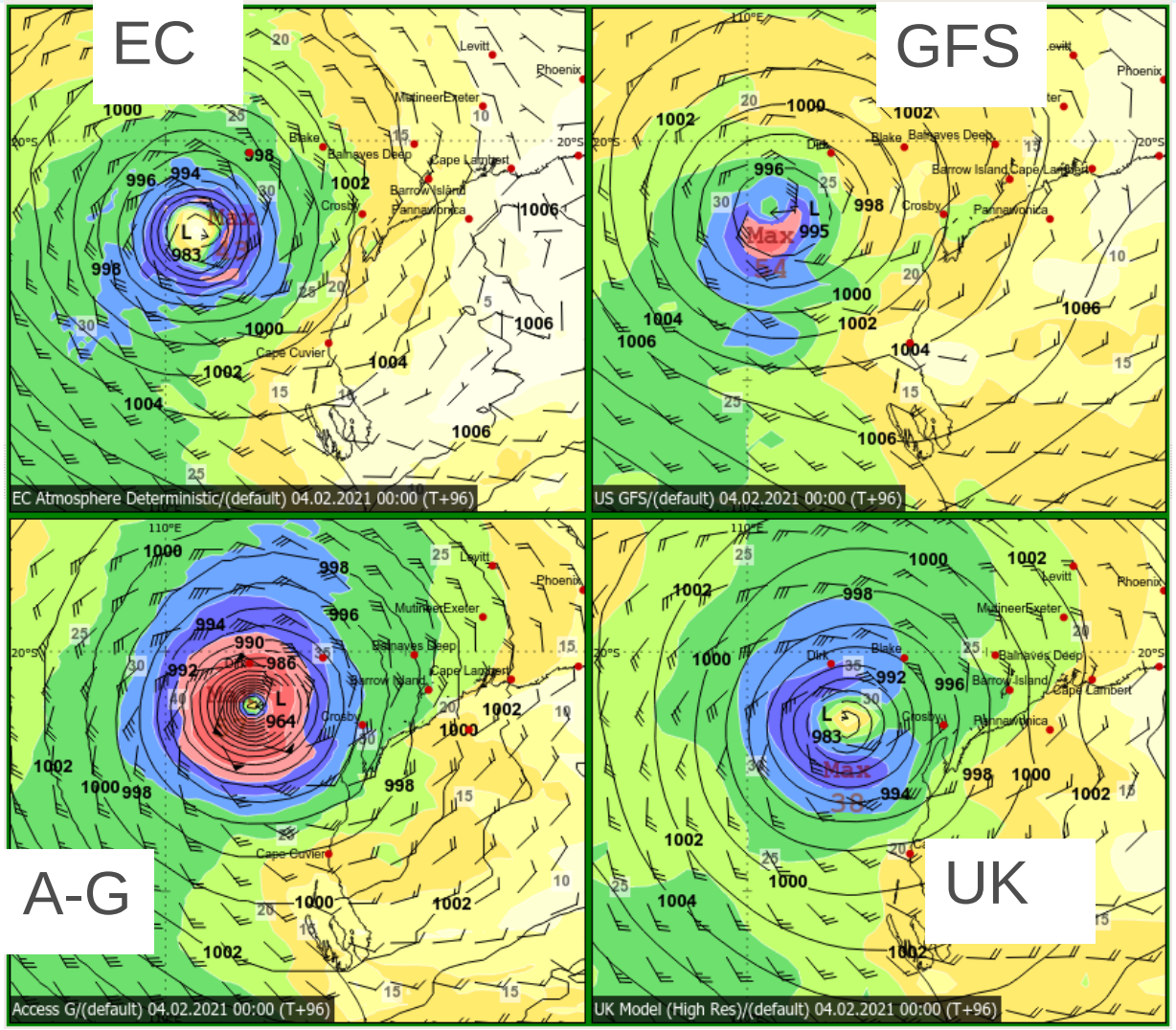
Australian Government
Bureau of Meteorology

NWP 31/00UTC run for 02/00UTC



Australian Government
Bureau of Meteorology

NWP 31/00UTC run for 04/00UTC

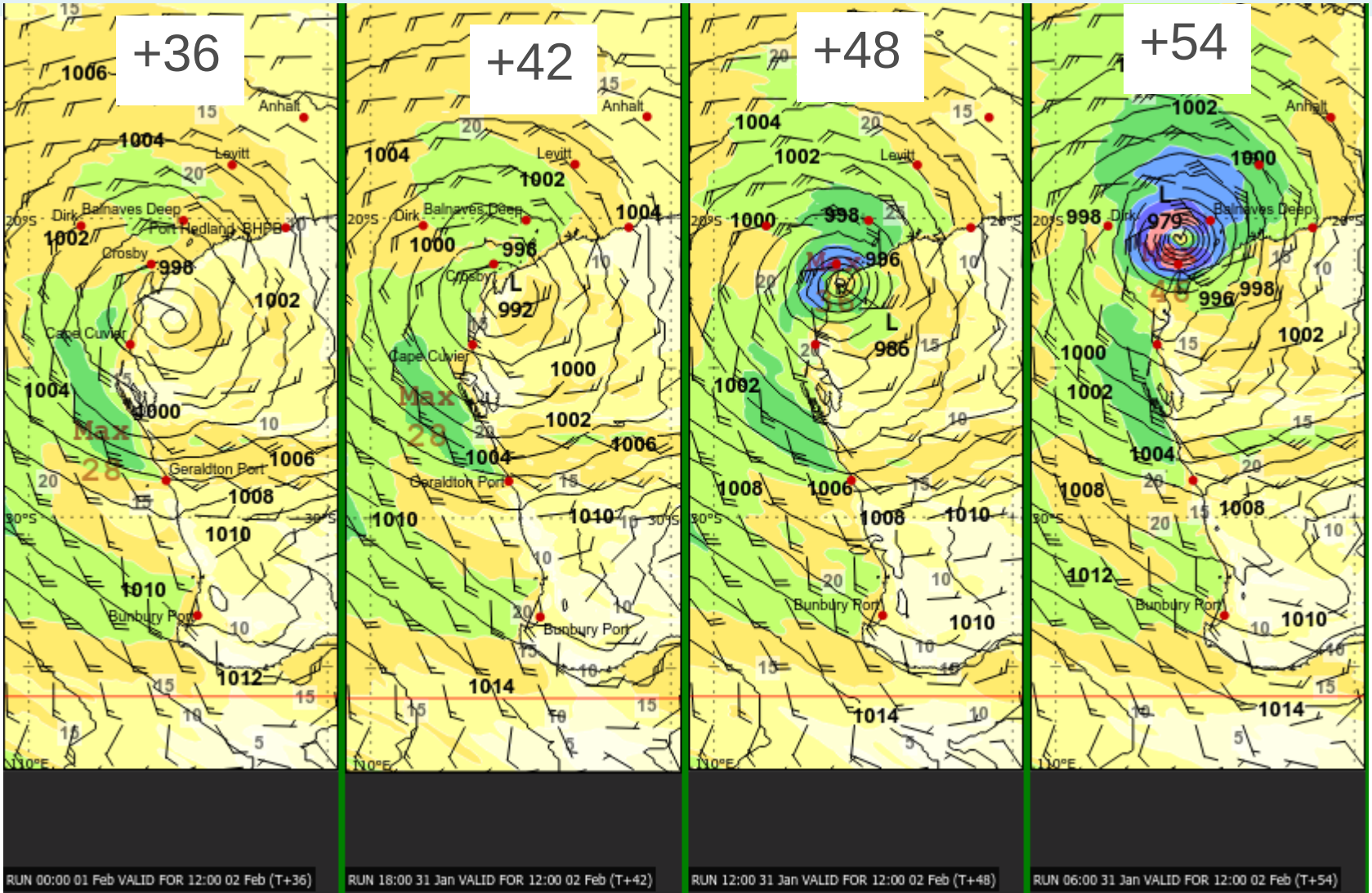


Australian Government
Bureau of Meteorology

NWP AG hot over water early but improved

Different runs for 02/12UTC (right to left)

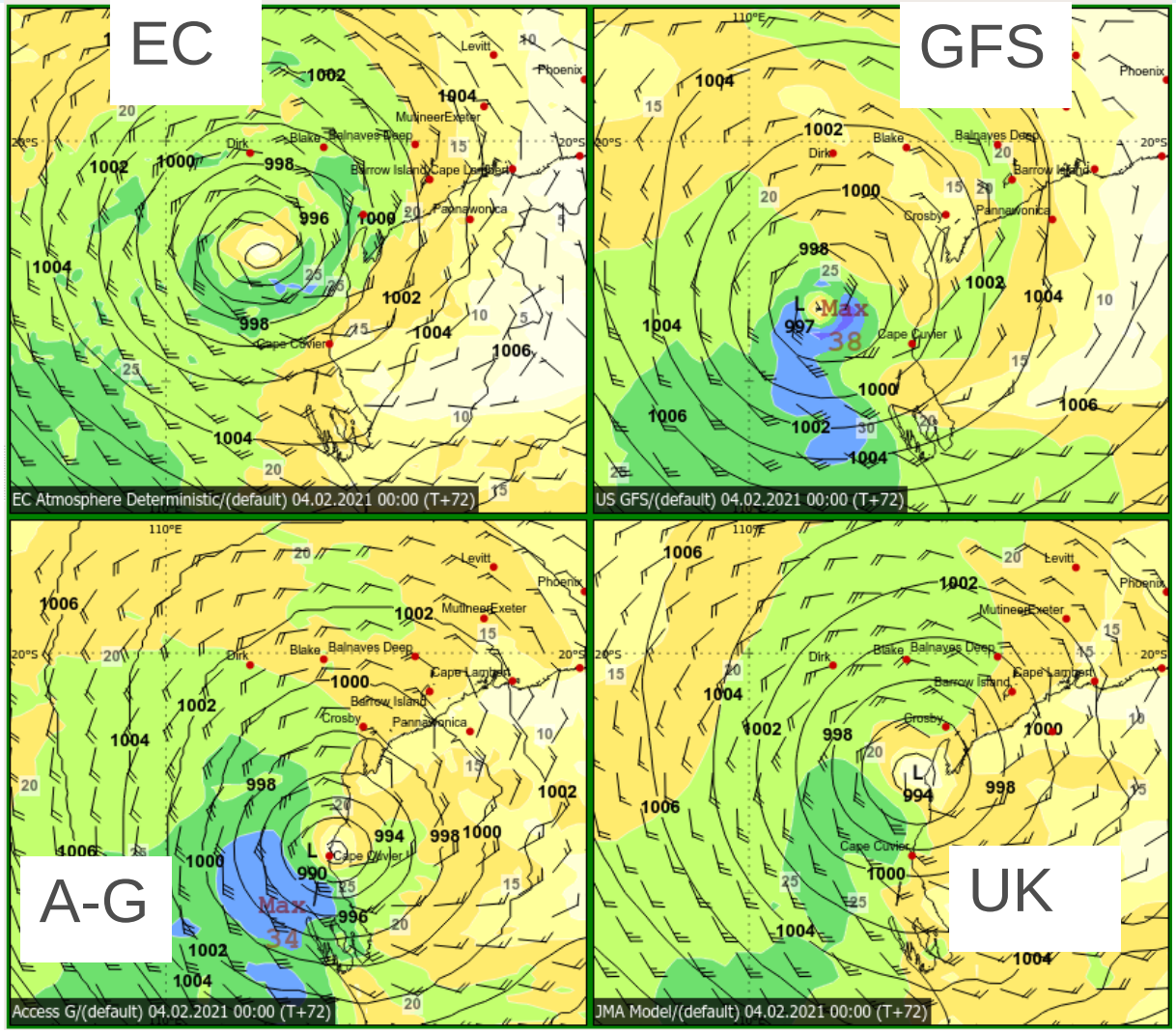
A-G



Australian Government
Bureau of Meteorology

NWP 01/00UTC run for 04/00UTC

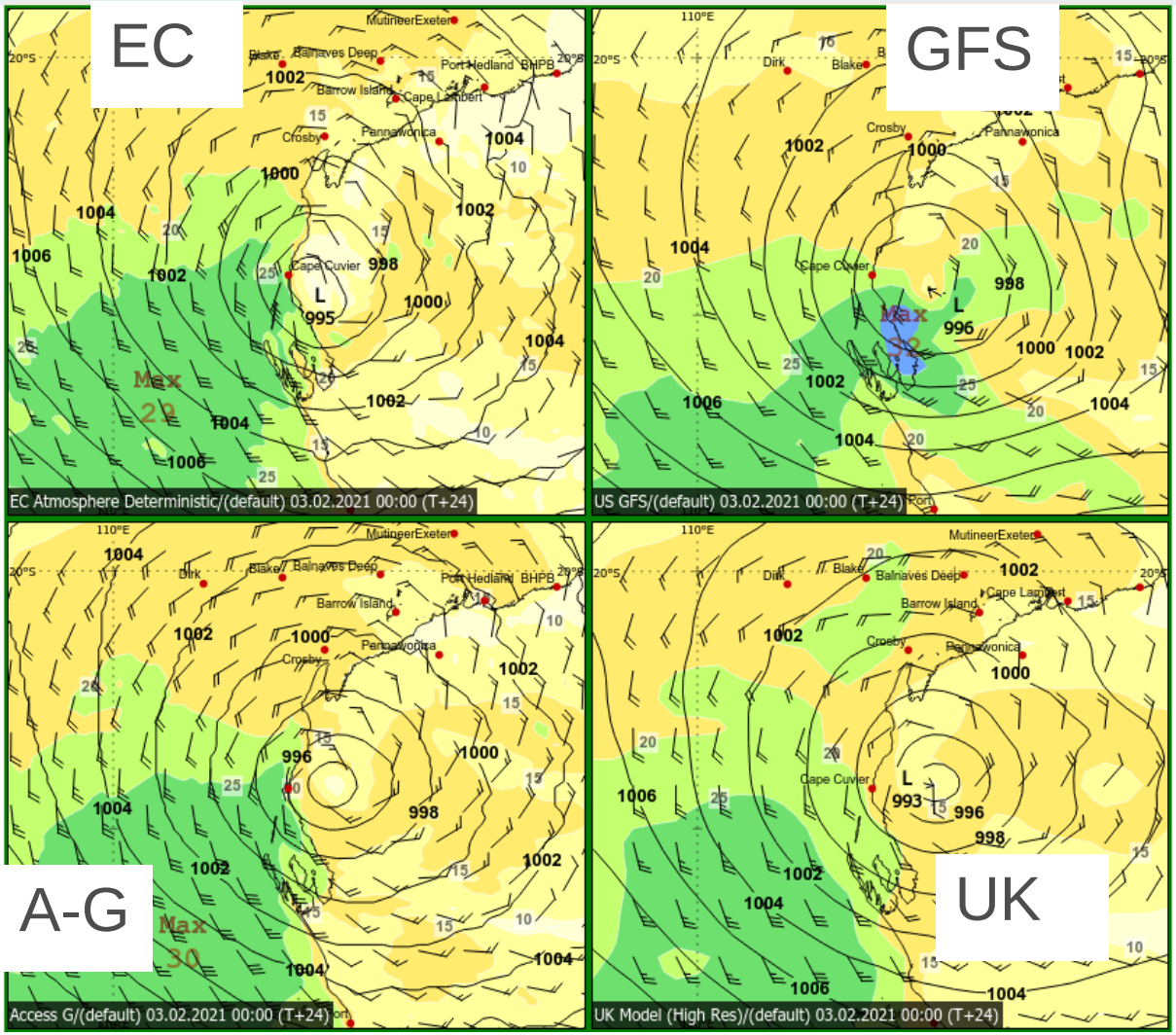
A-G best others offshore



Australian Government
Bureau of Meteorology

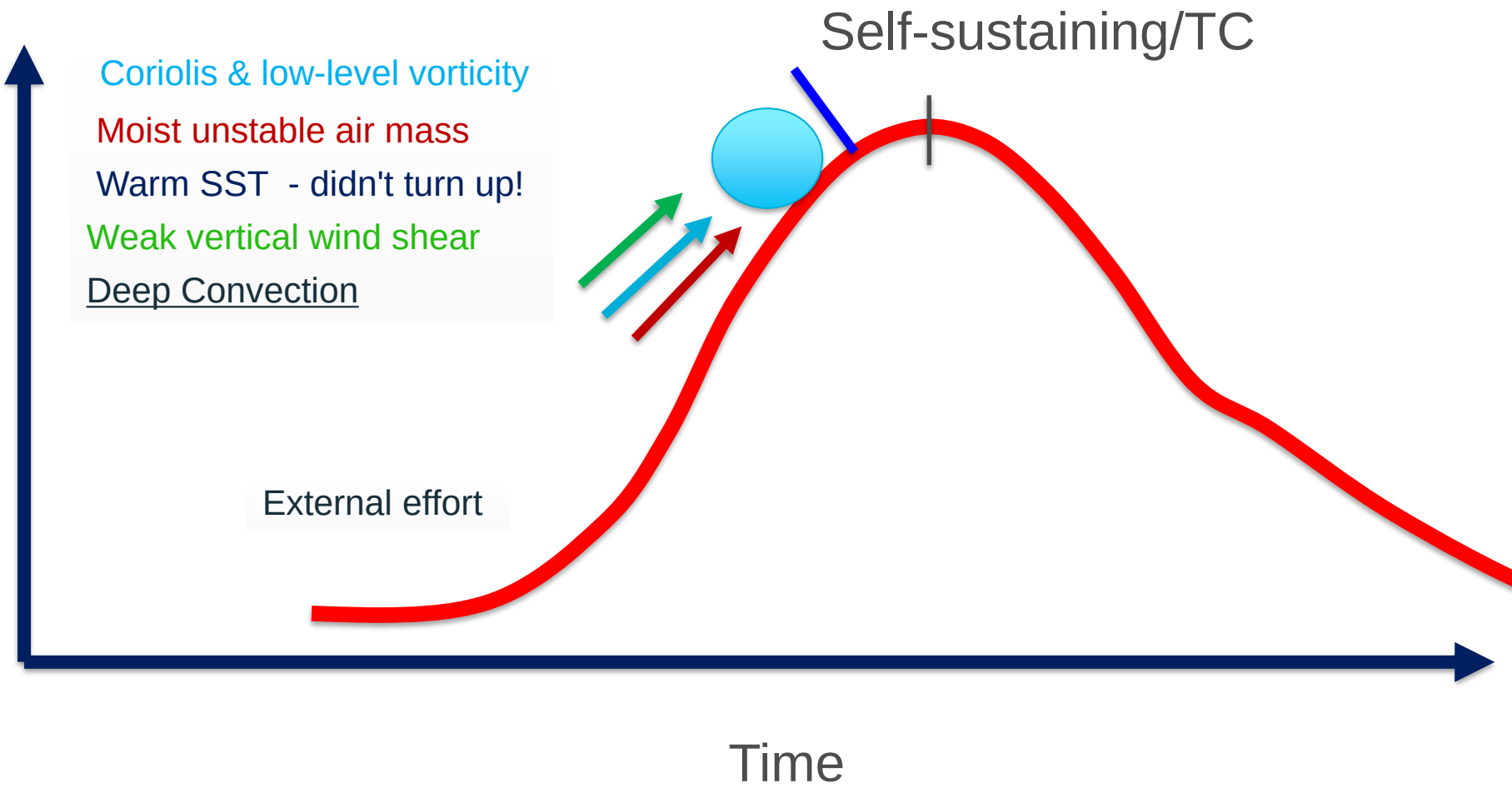
NWP 02/00UTC run for 03/00UTC

All inland at last; warnings cancelled



Australian Government
Bureau of Meteorology

12U
(Courtney) Conceptual Model



Australian Government
Bureau of Meteorology

Summary: mostly good but for land!

Coincidence that in a short period of time four circulations developed but did not reach TC intensity!

11U and 12U constrained by land

08U: balanced between circulation strength and wind shear

10U: very close to TC; gales impact at Cocos Is.

Lessons to be learned: following process and acting on best information at the time still remains.

Do anything differently next time??

What next for the rest of the season?

MJO dominated – quiet now but active March?

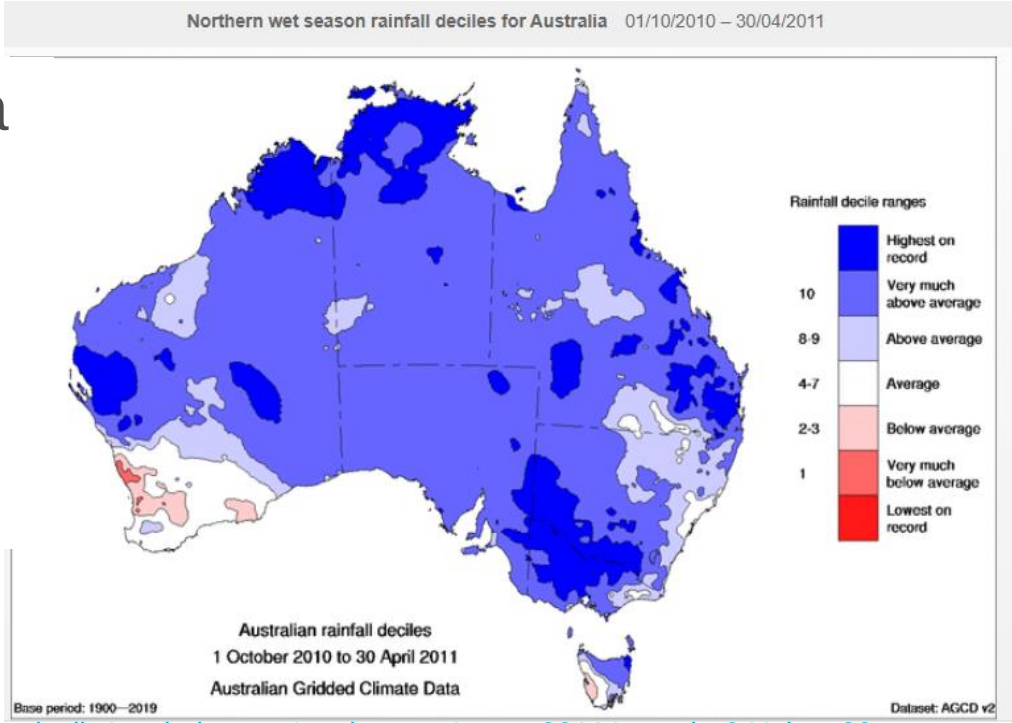
As season gets later formation area further north and less likely to be land affected – more likely to get severe TCs

What happened in late Jan won't be remembered by March!

Comparison with 2011 La Nina

Wet but fewer TCs

7 TCs 3 Severe



Source:
http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=decile&period=cnws&region=nat&year=2011&month=04&day=30