

The use of synoptic cloud band event analysis to identify biases in climate simulations

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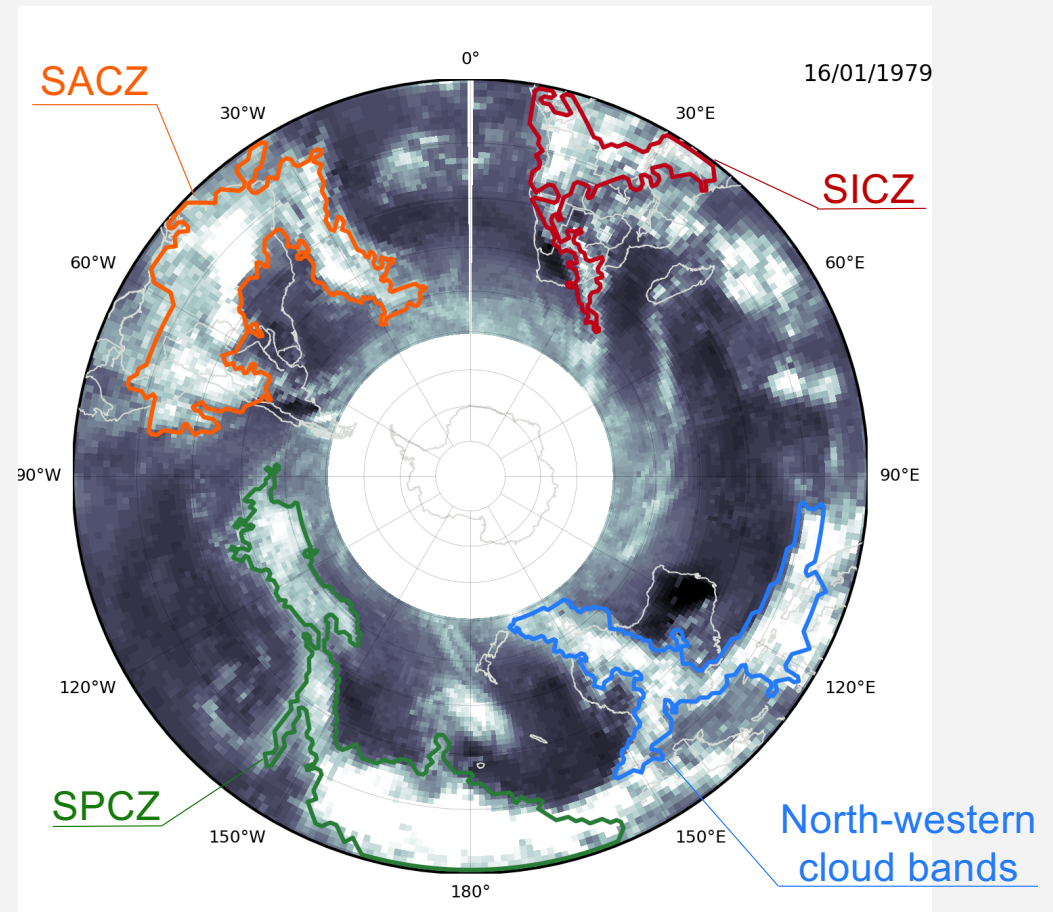
Advancing Subtropical Climate Dynamics: Diagonal
Convergence Zones, Droughts, and Floods in Past, Present
and Future Climates, August 2022

05/08/2022 Marcia Zilli



What are Cloud Bands?

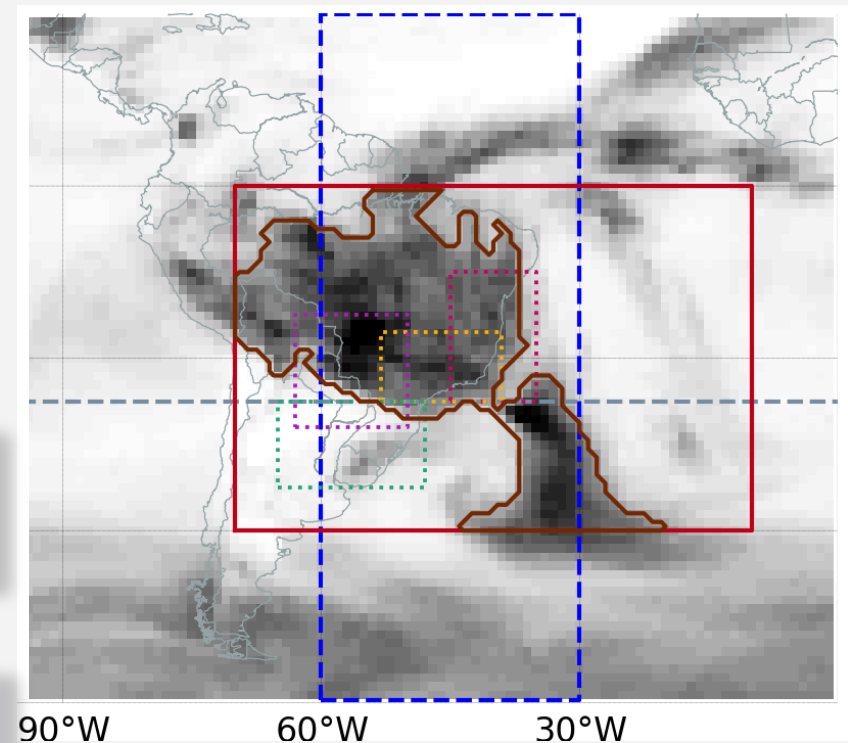
- ☁ Continuous areas of low OLR connecting convective areas from the tropics to the extratropics.
- ☁ Responsible for large fractions of the rainy season precipitation
- ☁ Intense events: floods and landslides
Absence/late onset: dry spells and drought



Identification of Cloud Bands Events

Algorithm developed by Hart et al. (2012, 2013) and adapted to South America [Zilli and Hart 2021]

	OLR	PRECIPITATION	WIND (200hPa)
	NOAA CDR V1.2 [1°lat/lon; 1979-2018]	ERA5 [0.25°lat/lon; 1979-2018]	ERA5 [0.25°lat/lon; 1979-2018]
	Identification of events	Intensity of the events	Circulation features
GCM	BAM v1.2 (TQ0126L042) 0.9735° lat/lon 1981-2010	HadGEM3 n96 1.25° lat/lon 1979-2014 (AMIP and CMIP)	HadGEM3 n216 ~0.55° lat/lon 1979-2014 (AMIP and CMIP)
	Met Office (UK) CPM UM-N512 → CPM control @ 4.5km ERA-I → RCM @ 25km → CPM hindcast @ 4.5km		



[Zilli et al., in preparation]

Identification of Cloud Bands Events

VIEWpoint Cloud Band Explorer

Cloud Band Climatology | All Cloud Band Events | Events per season | Selected Cloud Band

Selected Cloud Band

In this view, you can explore the selected cloud-band event in more detail. The shape of the identified cloud band on the chosen day is plotted on the map. The dashed rhombus-shaped region represents the area over which rainfall is averaged for the season timeline plot.

Individual days can be selected using the time bar at the bottom of the map. It is also possible to see an animation over the cloud band event days by clicking the play button on the right-hand side. The coloured data over the time bar represent days when natural disasters occurred.

Select natural disasters to show

- Floods
- Flash floods
- Hail
- Storms
- Erosion
- Drought
- Landslides

1 Jan 2010

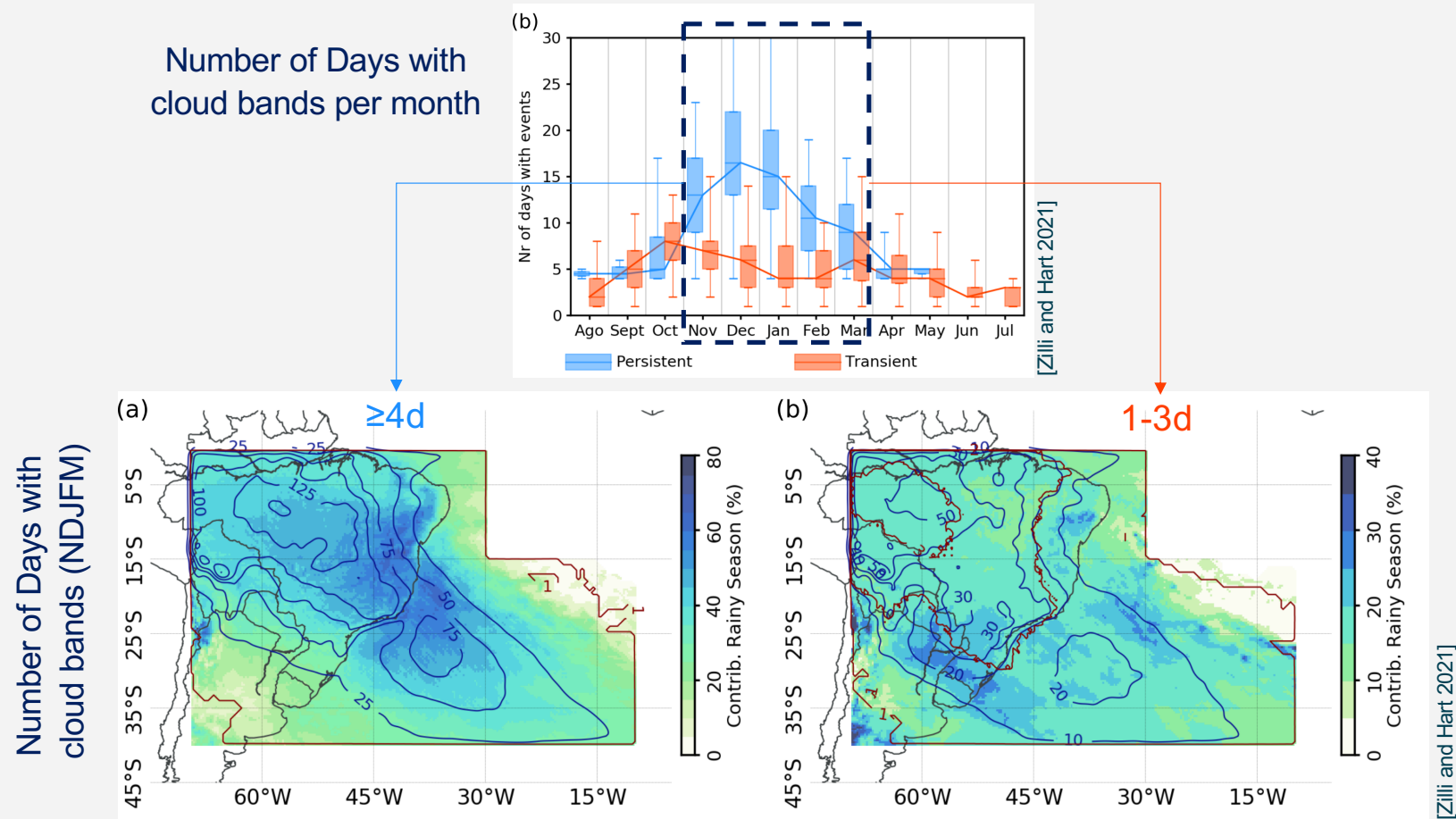
VIEWPoint Cloud Band Explorer

QR CODE

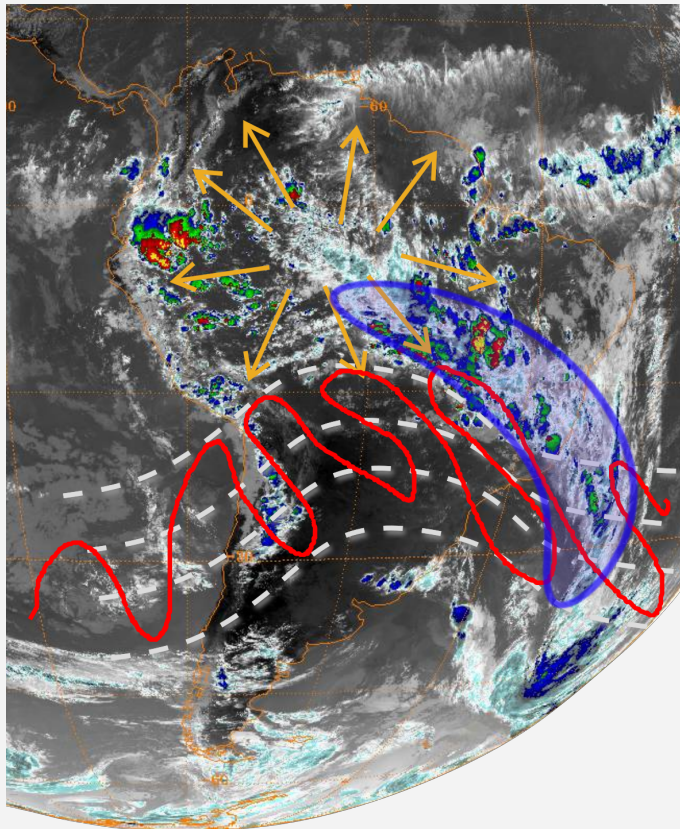
Met Office | SoGE | INPA | Cemaden | Newton Fund

<https://the-iea.github.io/vp-cloud-band-explorer/>

Climatology – Location and Intensity

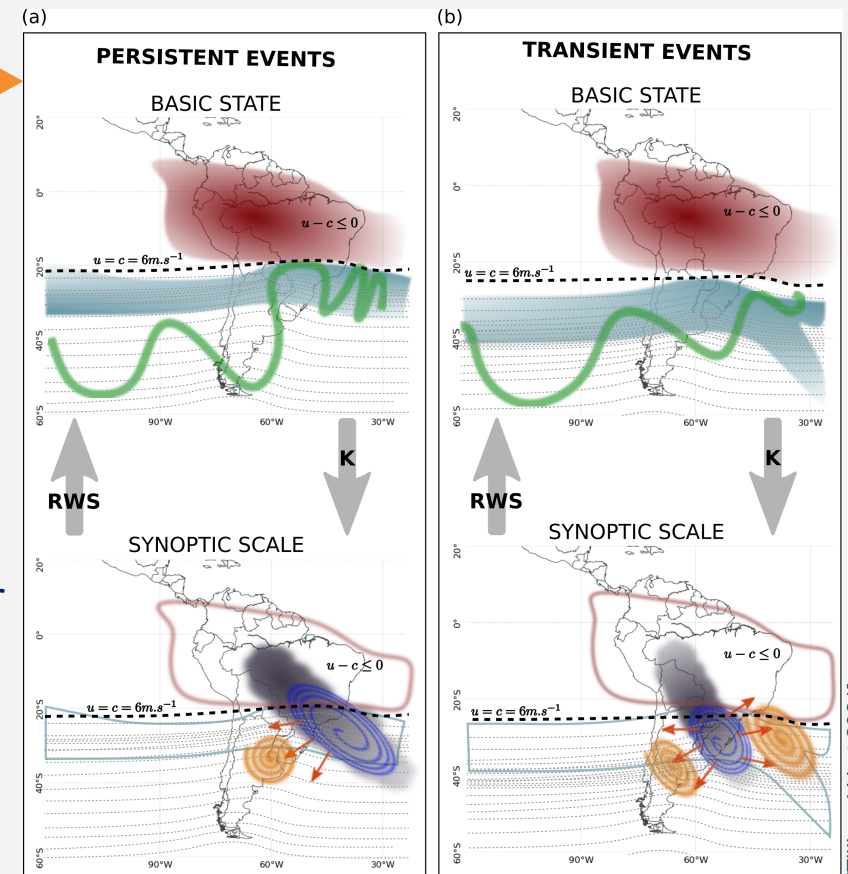


Climatology – Circulation



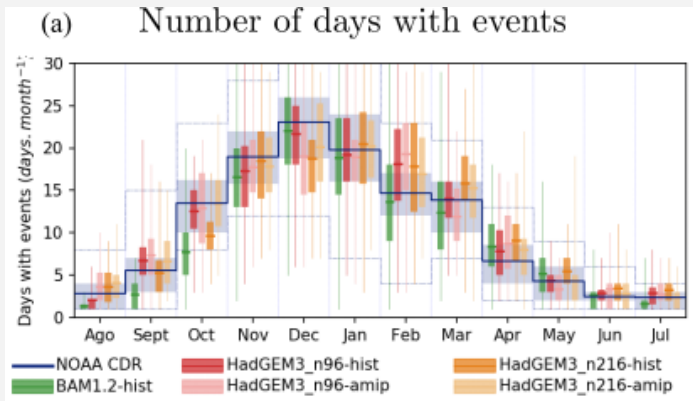
TE Events

- **Extratropical forcing**
Rossby wave propagation
- **Tropical forcing**
diabatic heating from Amazon
- **Local forcing**
land-use change and other regional influence



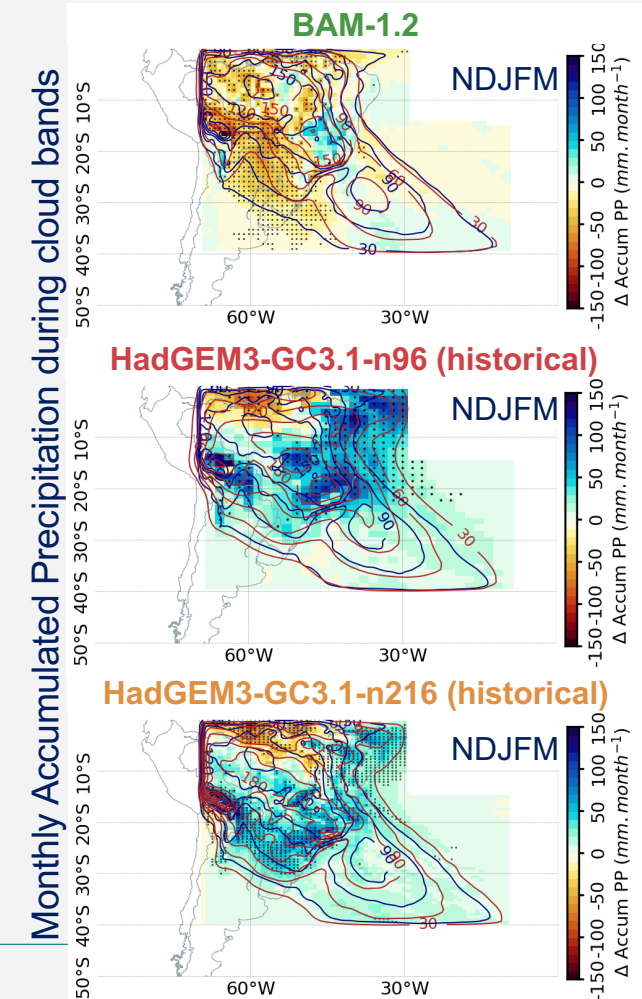
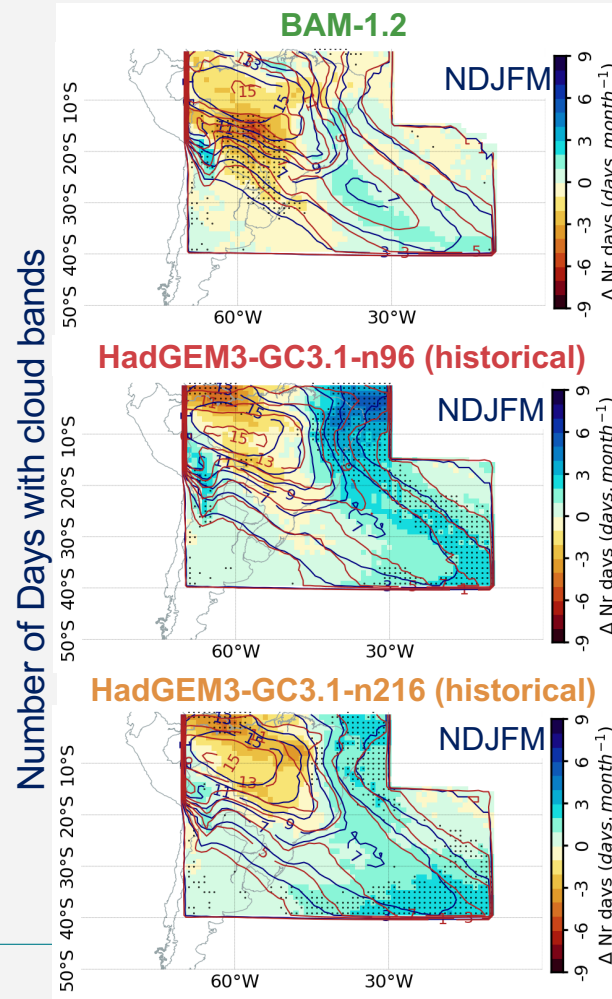
[Zilli and Hart 2021]

GCM Simulations – Location and Intensity



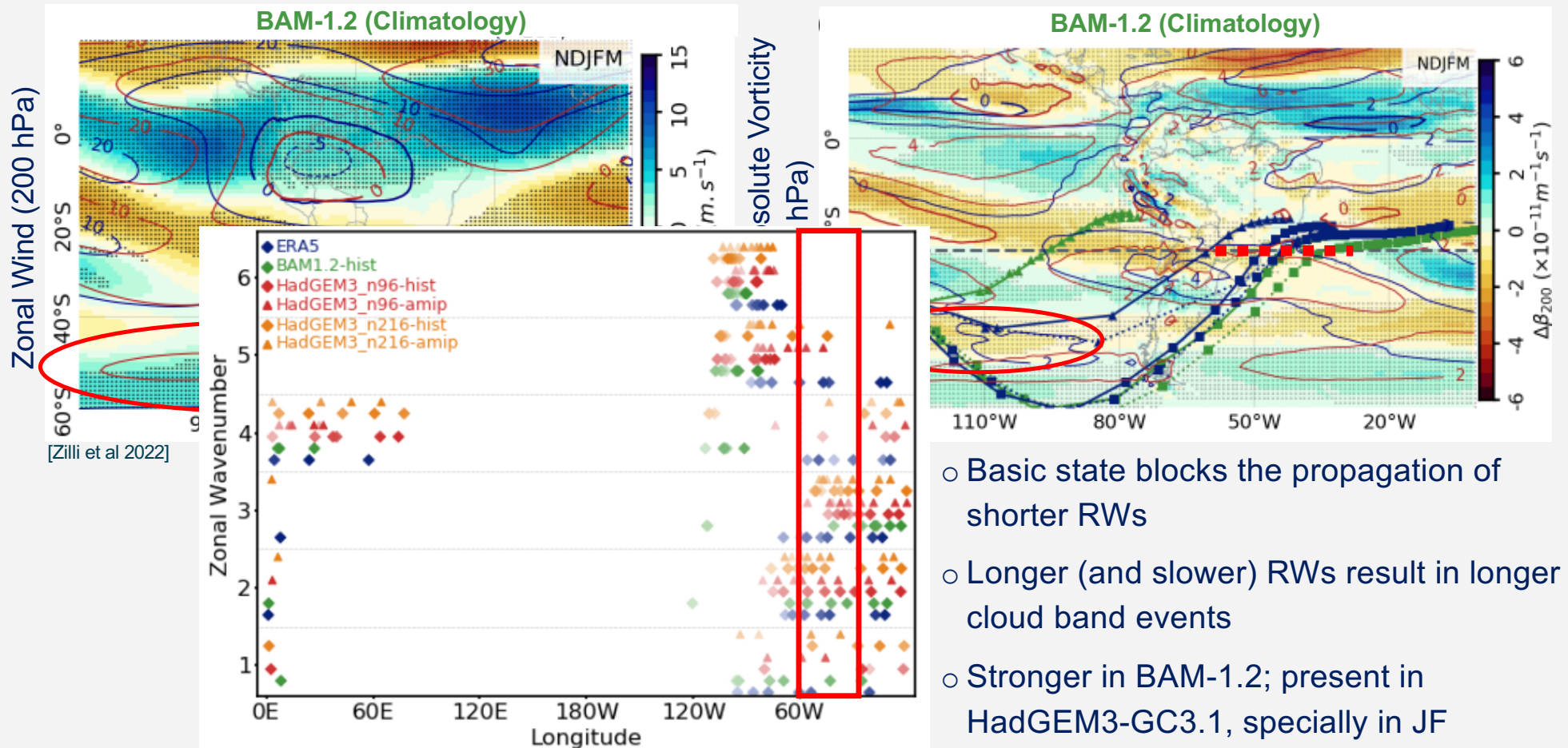
- Delayed onset of the cloud band season (larger in UKMO models)
- Events last longer in BAM-1.2 [fewer transient but more persistent events]
- Wet bias over Eastern Brazil and Southeastern South America

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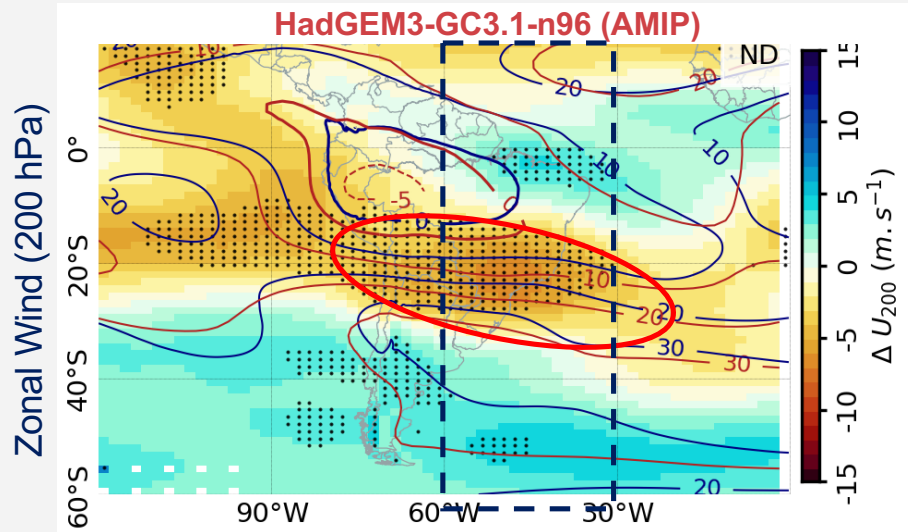
[Zilli et al 2022]

GCM – Bias in the duration of Events

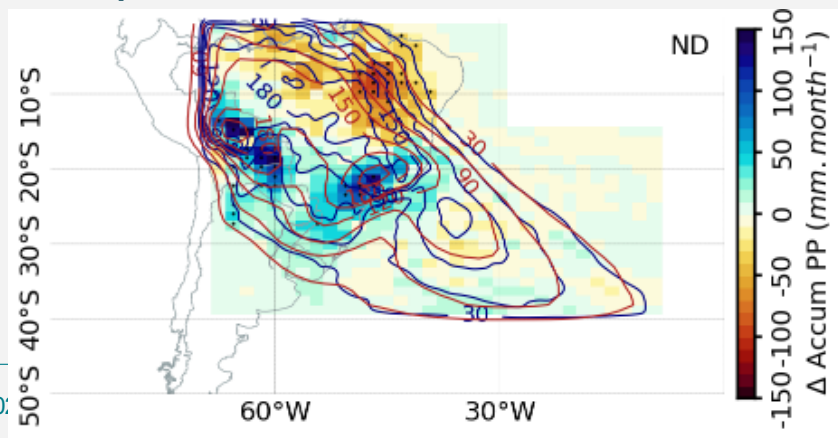


- Basic state blocks the propagation of shorter RWs
- Longer (and slower) RWs result in longer cloud band events
- Stronger in BAM-1.2; present in HadGEM3-GC3.1, specially in JF

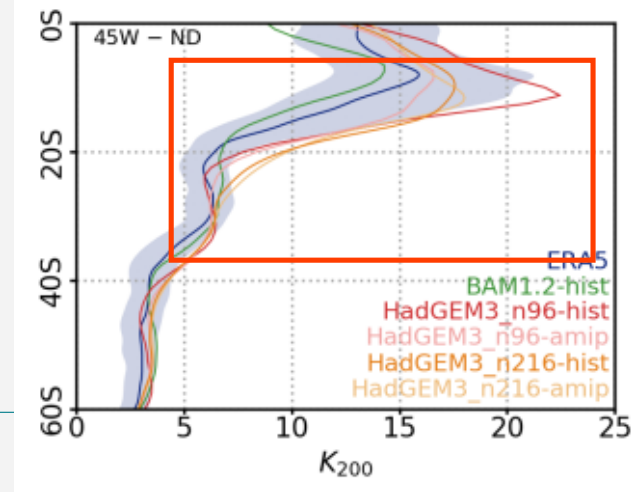
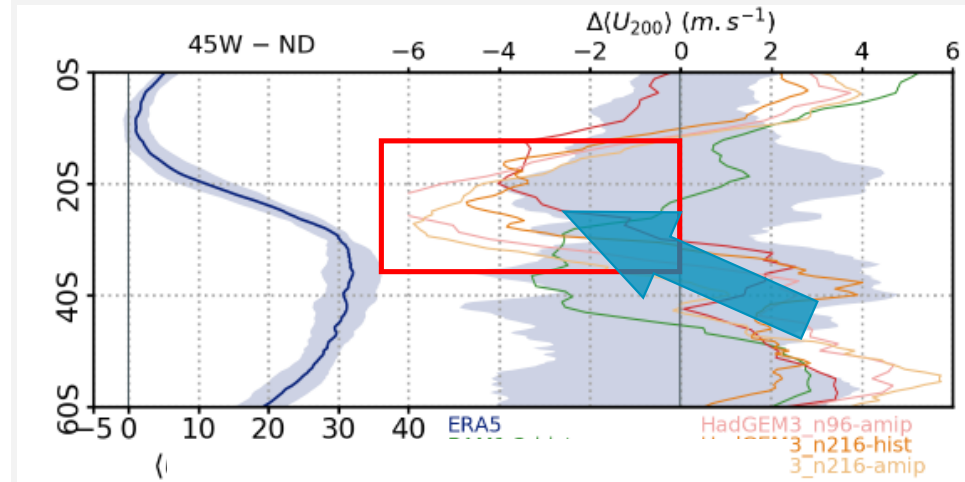
GCM – Wet Bias over Southeastern SAM



[Zilli et al 2022]



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CPM First Results – Cloud Band Events



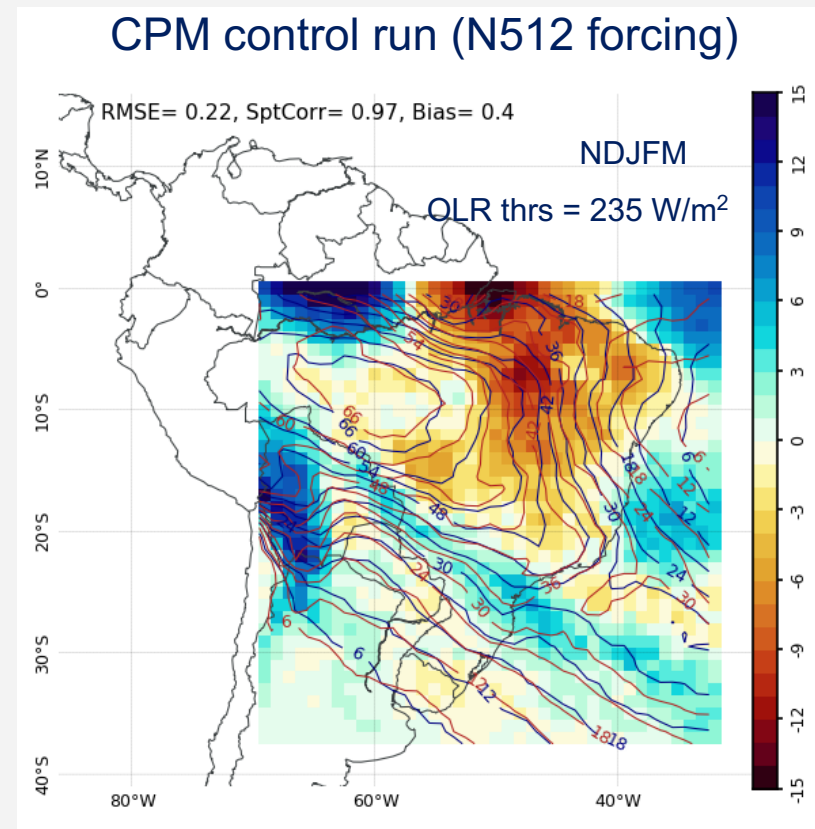
SoGE | School of Geography
and the Environment



Comparison to the number of days with events considering NOAA OLR (blue contour)

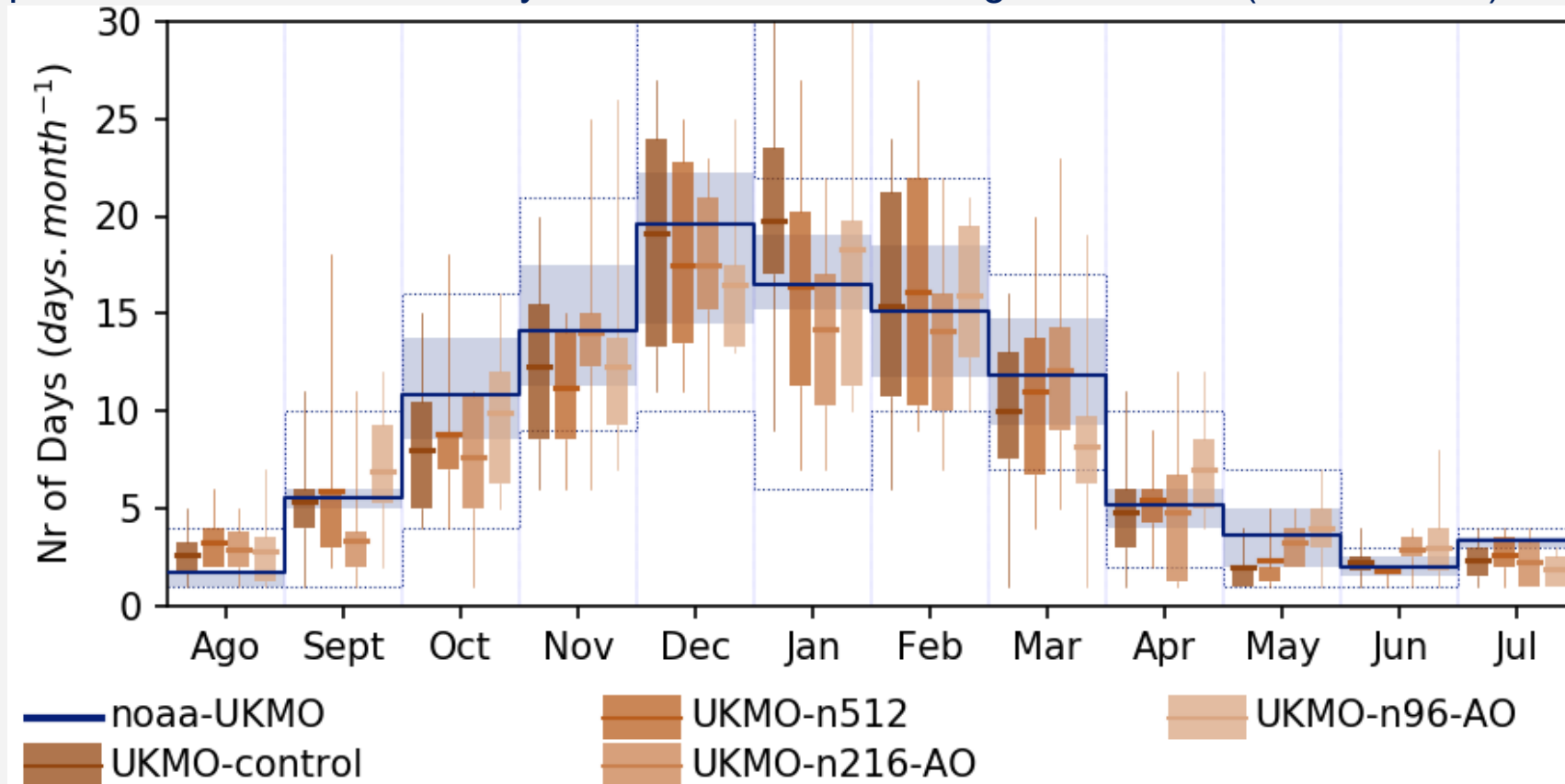
NOAA OLR thrs = 225 W/m²

[1998-2007]



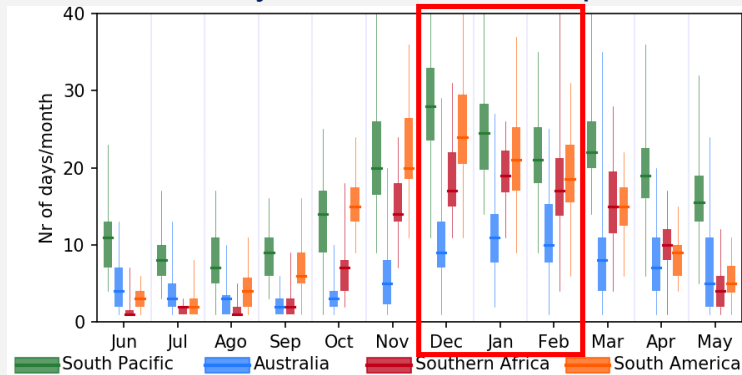
CPM First Results – Cloud Band Events

Comparison to the number of days with events considering NOAA OLR (blue contour)

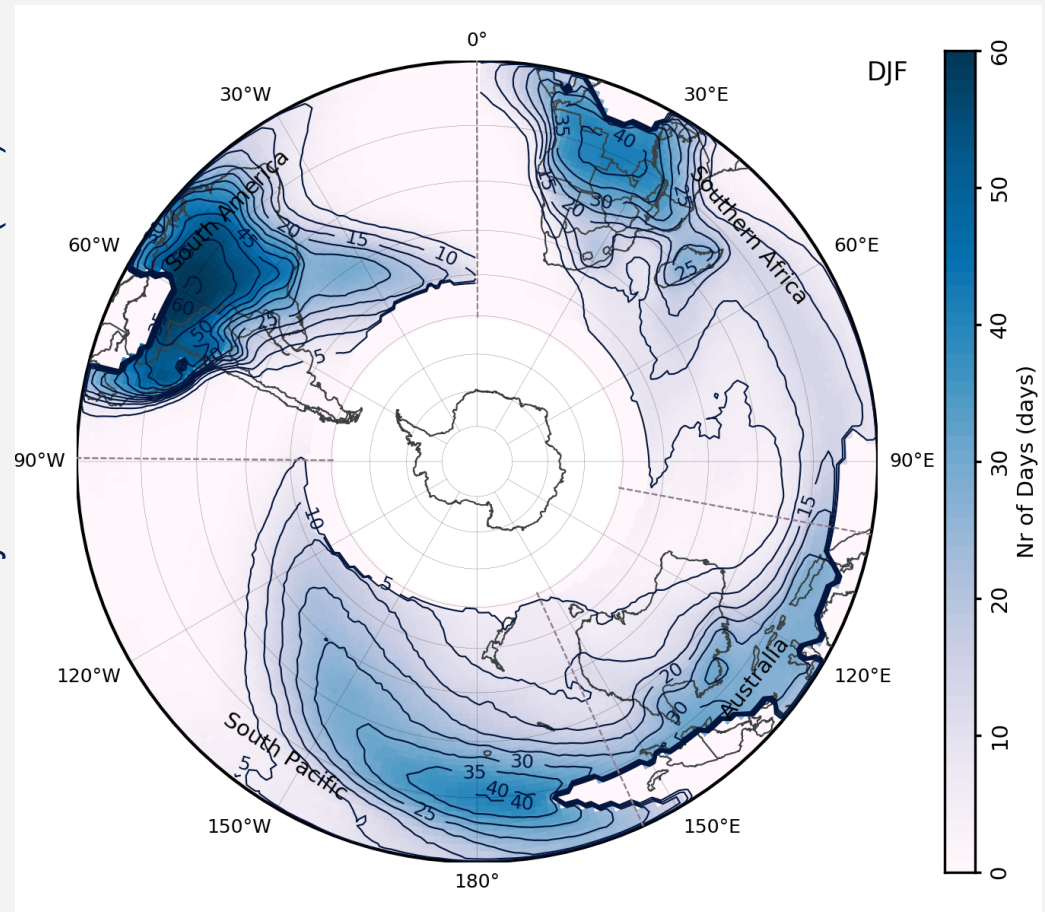


Cloud Bands in a Hemispheric Perspective Climatology

Number of Days with cloud bands per month



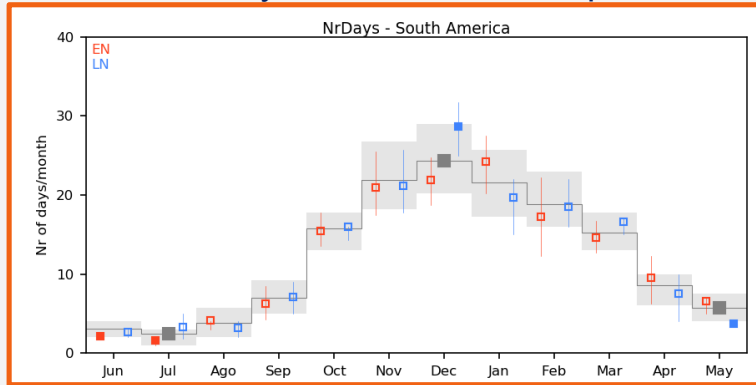
Number of Days with cloud bands (DJF)



Cloud Bands in a Hemispheric Perspective ENSO Anomalies

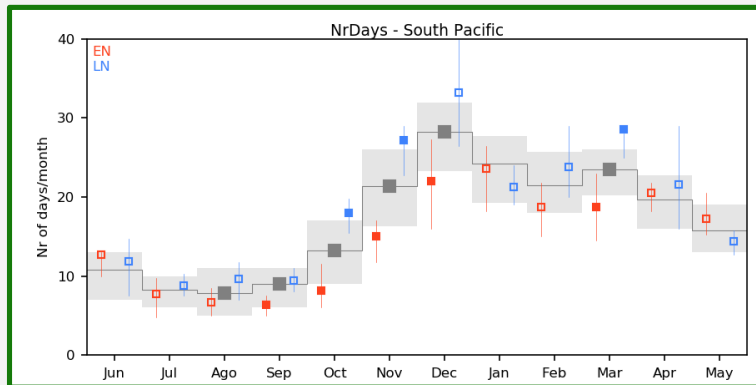
South America

Number of Days with cloud bands per month

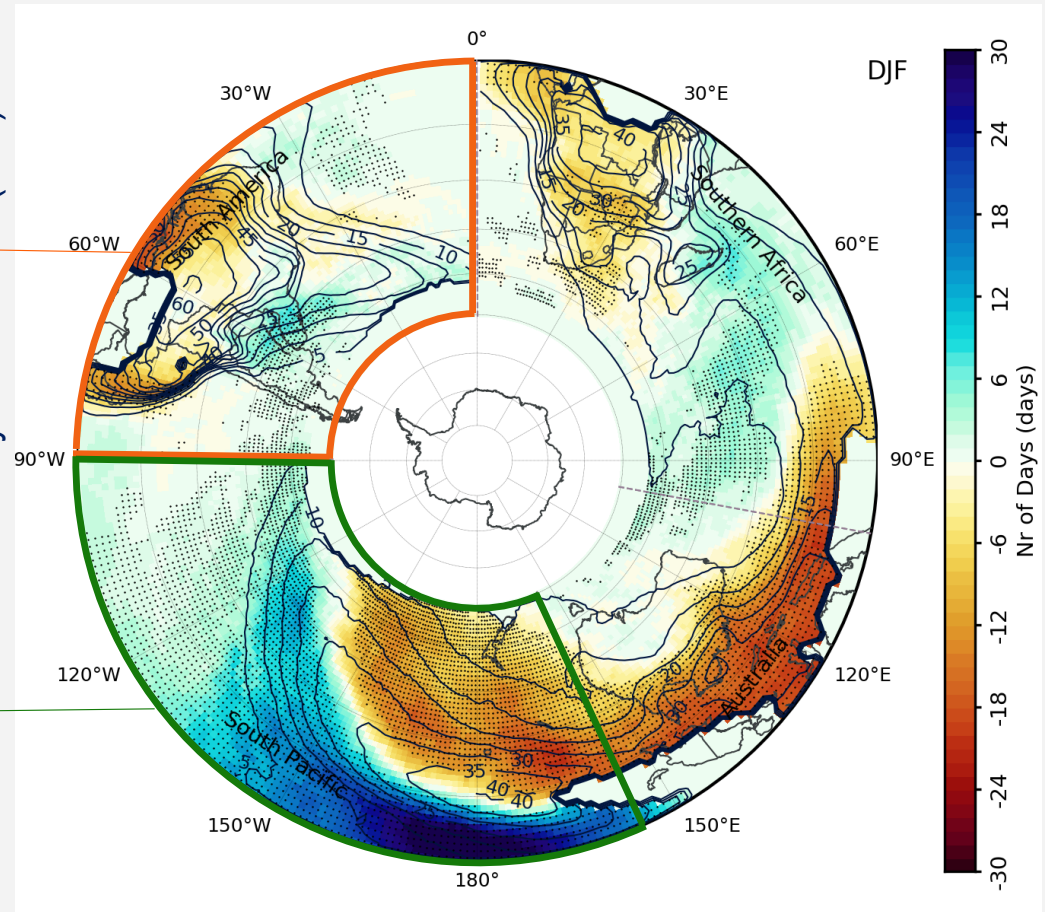


South Pacific

Number of Days with cloud bands per month



EN-LN – Number of Days with Events (DJF)



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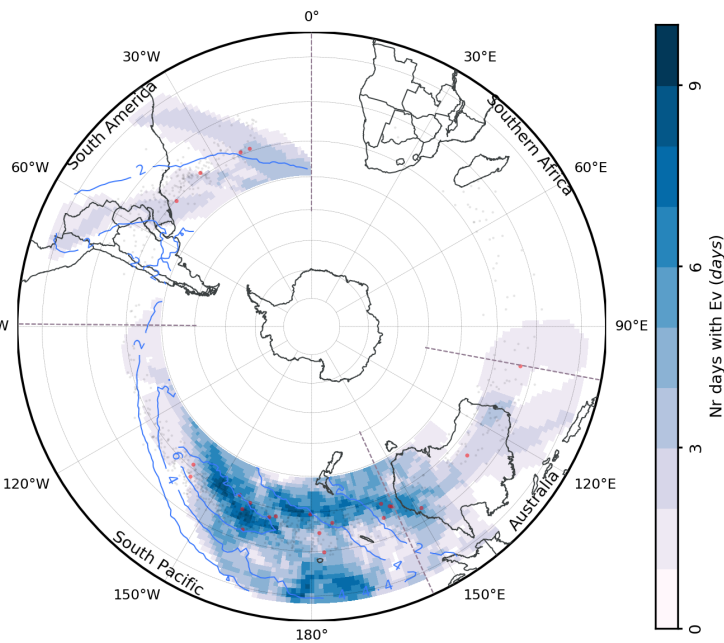
EN	1982	1986	1987	1991	1994	1997	2002	2009	2015
LN	1984	1988	1995	1998	1999	2007	2010	2011	2020

Cloud Bands in a Hemispheric Perspective

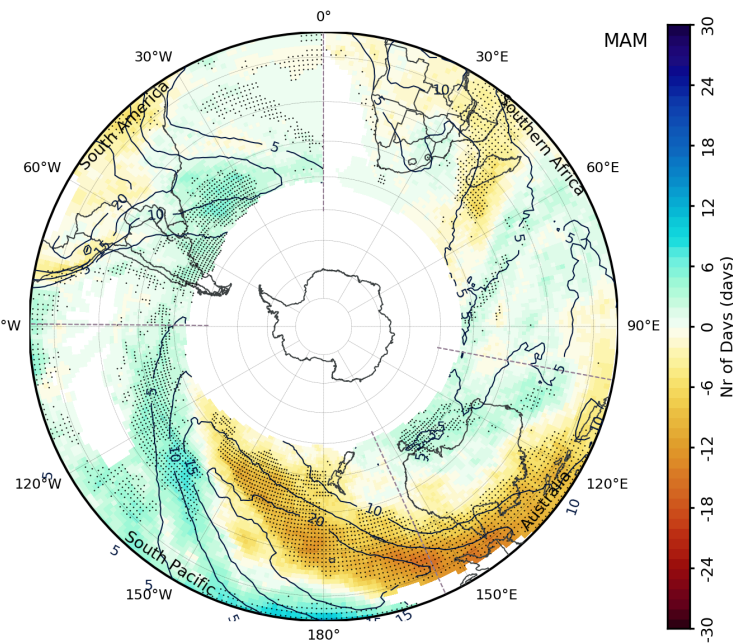
Real-time monitoring over Southern Hemisphere



Number of Days with Events (May 2022)



EN-LN Nr Days with Events (MAM)



Near real-time monitoring webpage



FLOWCODE
PRIVACY.FLOWCODE.COM

Available at
<<https://hart-ncg.github.io/real-time/about.html>>

Discussion Topics

- ☁ Synoptic weather systems to classify different “flavours” of cloud bands (considering a PV and isentropic thinking).
- ☁ Connection with precipitation events over Southern Africa (TTT in the summer, cold fronts and AR in late summer and early fall) and Australia (??).
- ☁ Connections with other diagonal convergence zones over the SH (maybe even NH?)
- ☁ Sources of moisture into the cloudbands
- ☁ Improvements of the identification of cloudbands over Australia (why not over NH?)

Thank you!!

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☁️ Webpages:

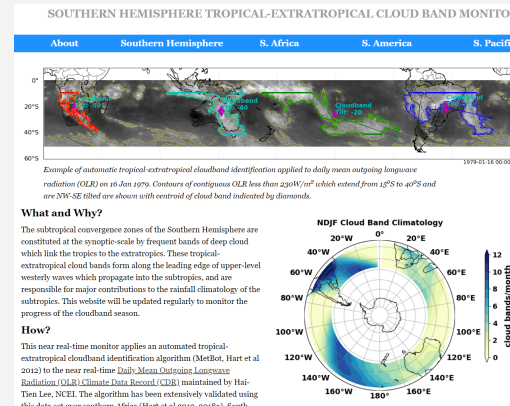
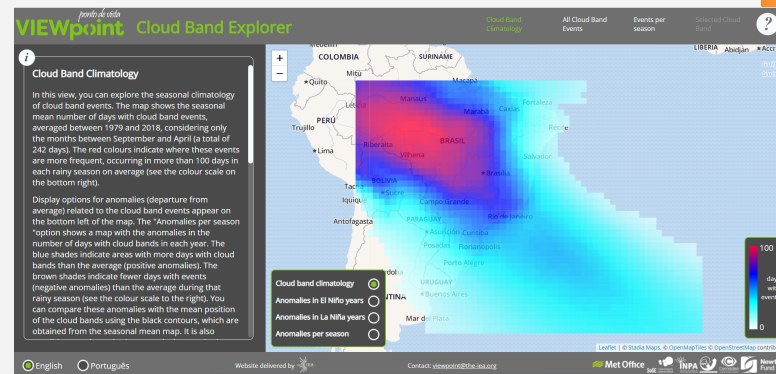


<https://the-iea.github.io/vp-cloud-band-explorer/>
<https://hart-ncg.github.io/real-time/about.html>

☁️ References:



- Hart N et al (2012) Mon Wea Rev 140, 4005-4016, doi: 10.1175/MWR-D-12-00127.1.
- Hart N et al (2018) J Climate 31, 2797-2817, doi: 10.1175/JCLI-D-17-0221.1.
- Zilli MT and Hart N (2021) J Climate 34, 8125-8144, doi: 10.1175/JCLI-D-21-0020.1



VIEWPoint Cloud Band Explorer



Near real-time monitoring webpage

