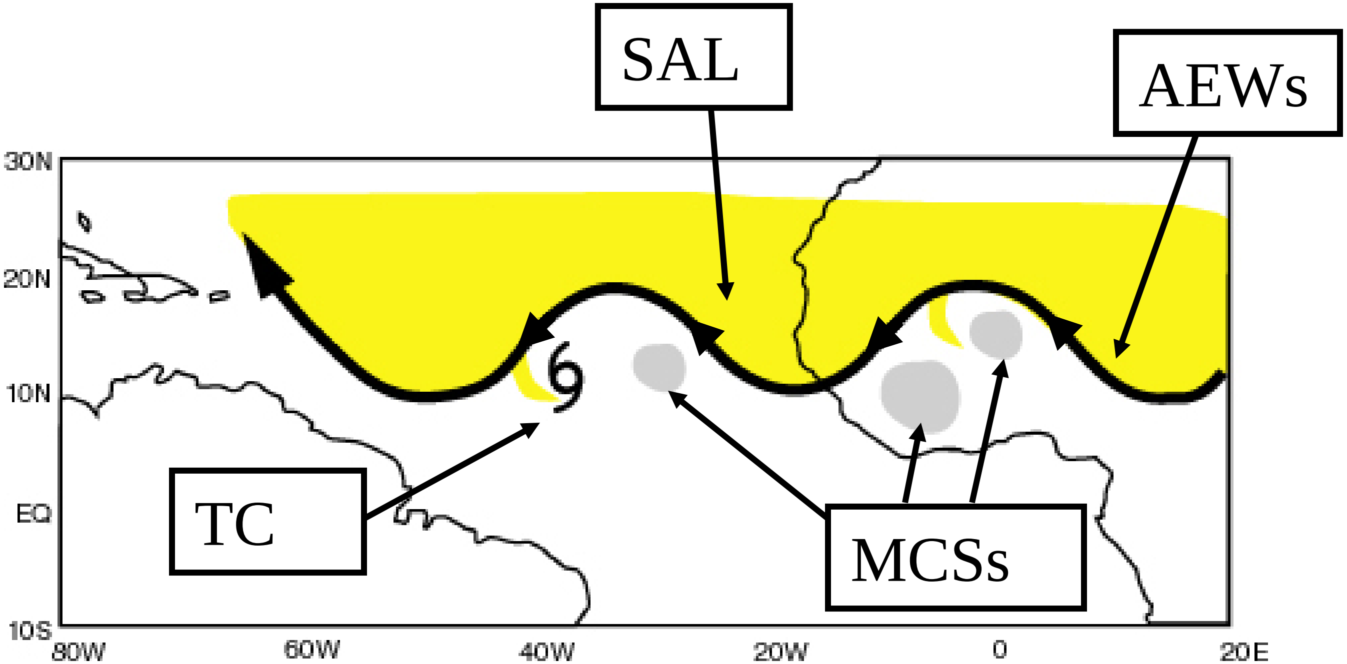
Tropical Cyclogenesis Associated with African Easterly Waves

THIS TALK

1. Multi-Scale Structure of African Easterly Waves
2. Importance of Guinea Highlands Region
3. Future Plans



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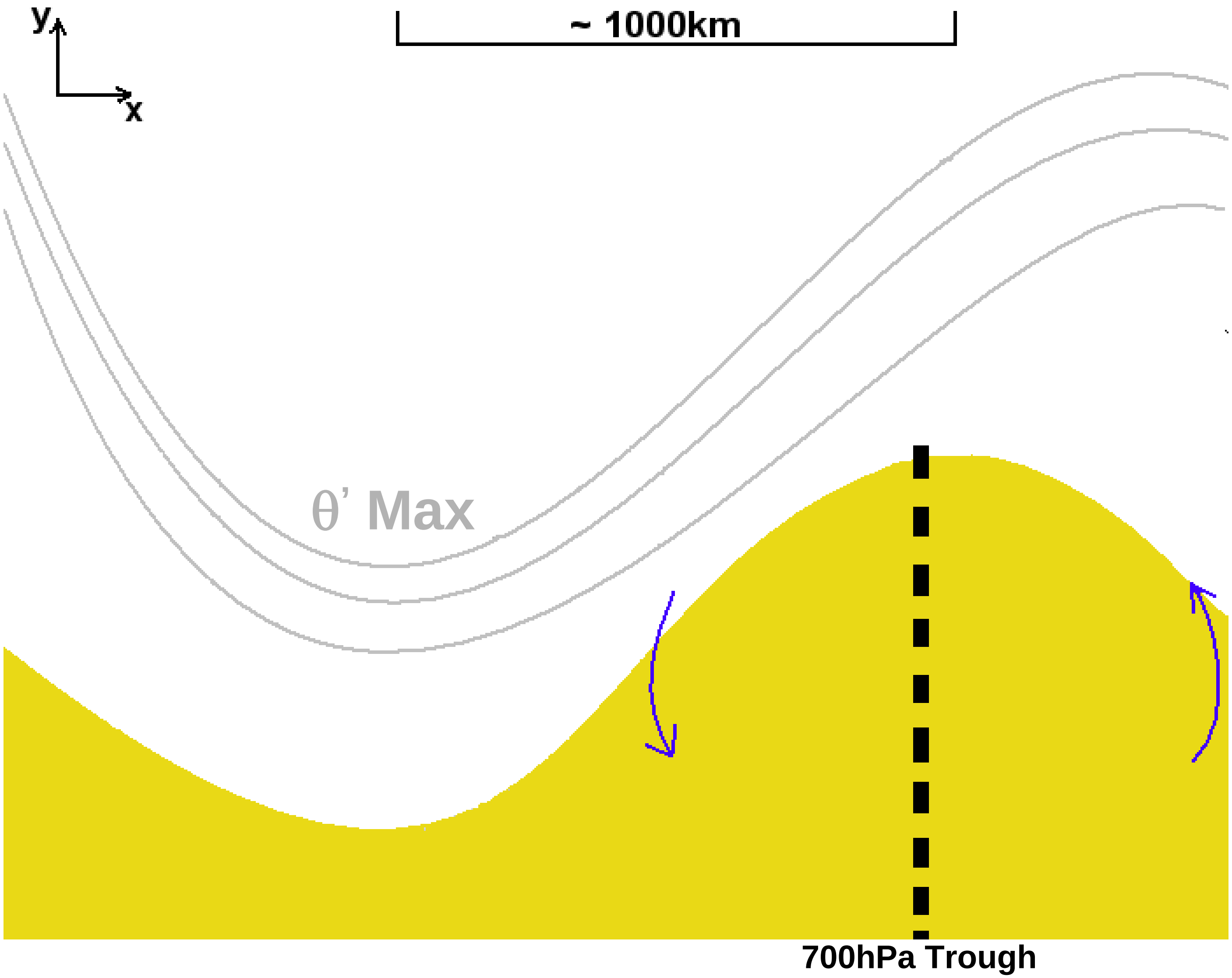

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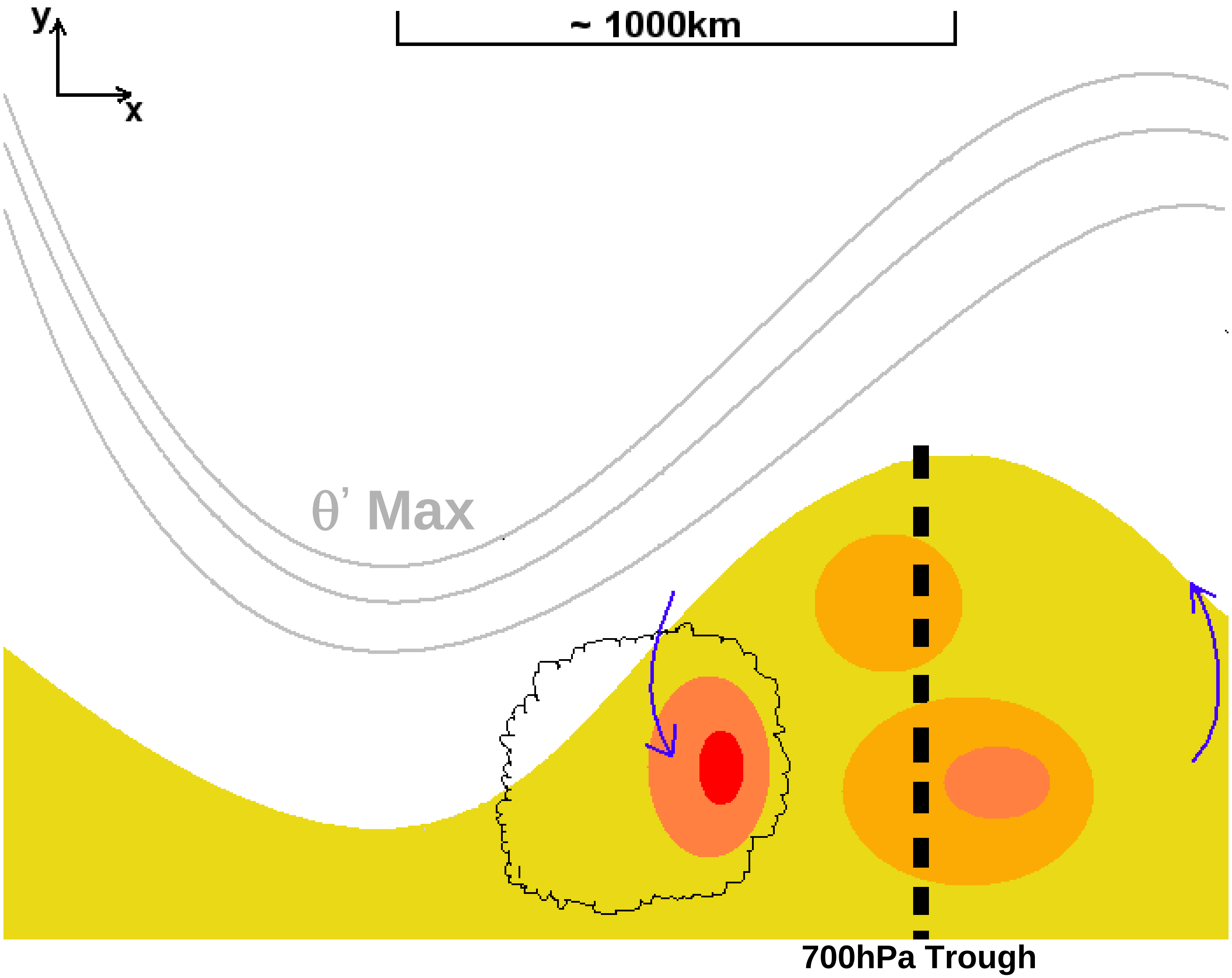

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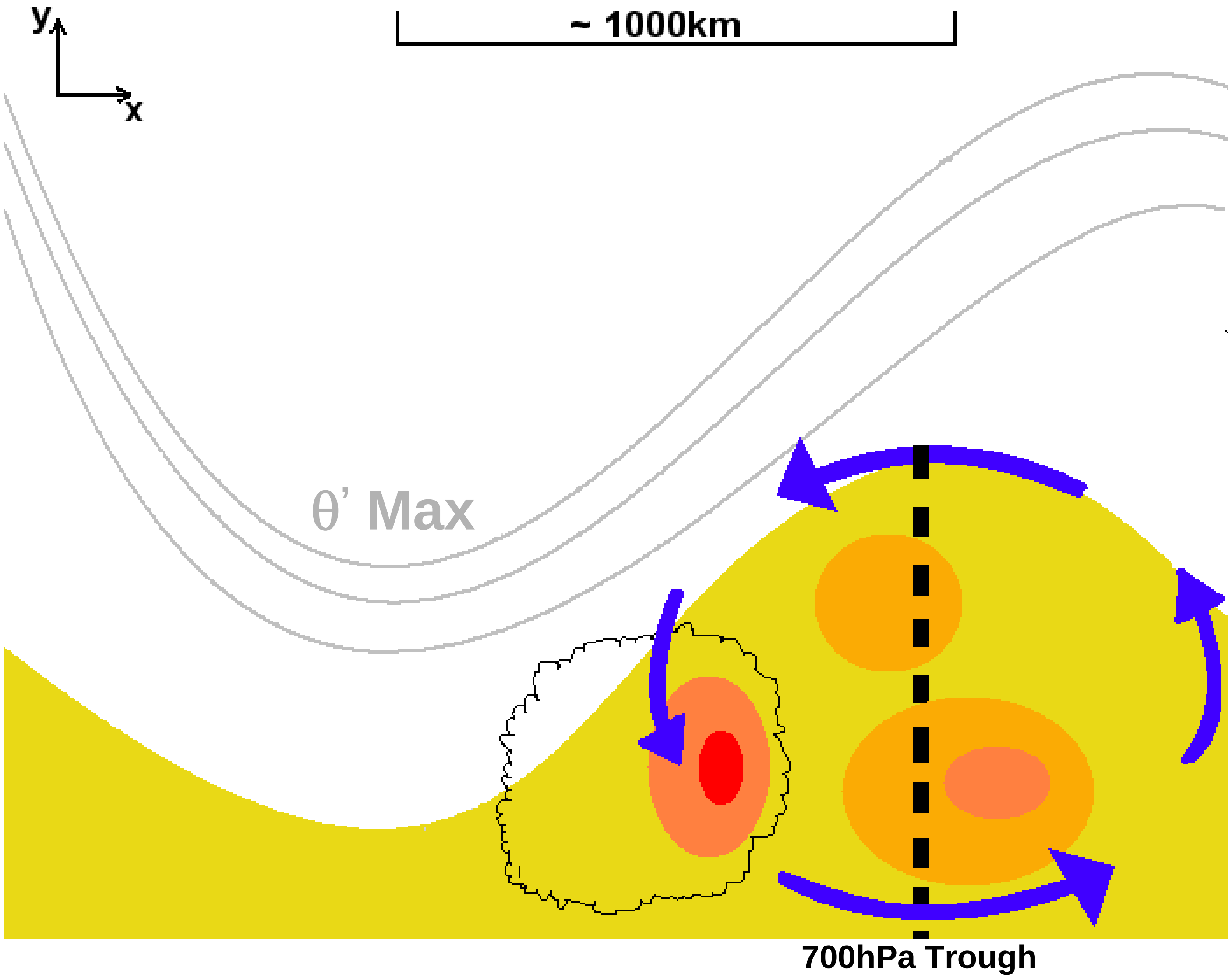

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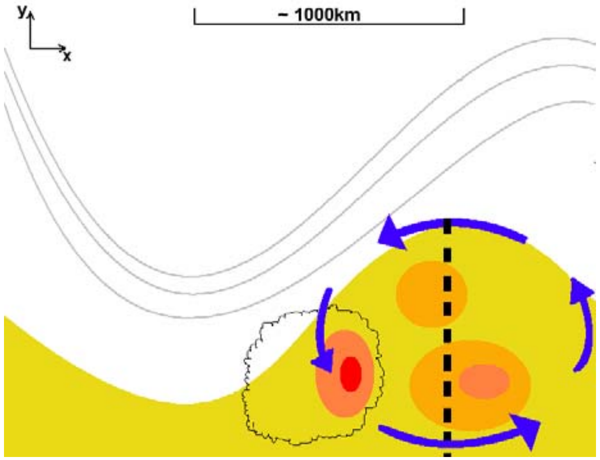

Synoptic-Mesoscale Interactions

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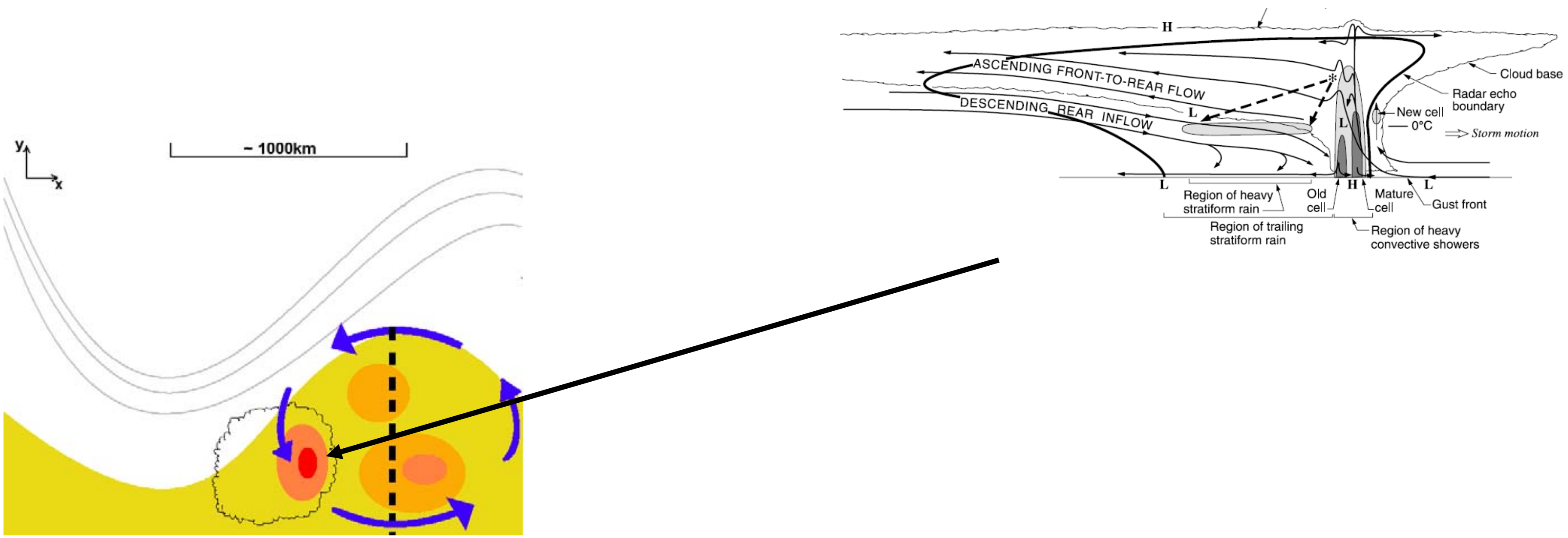

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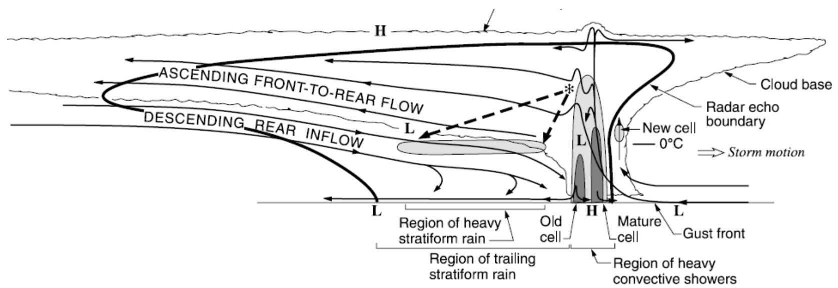

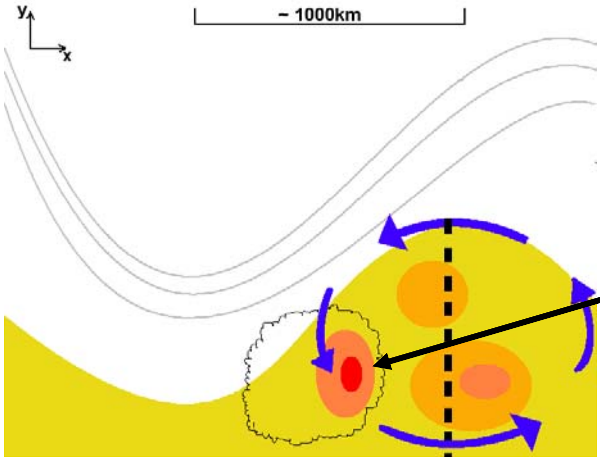

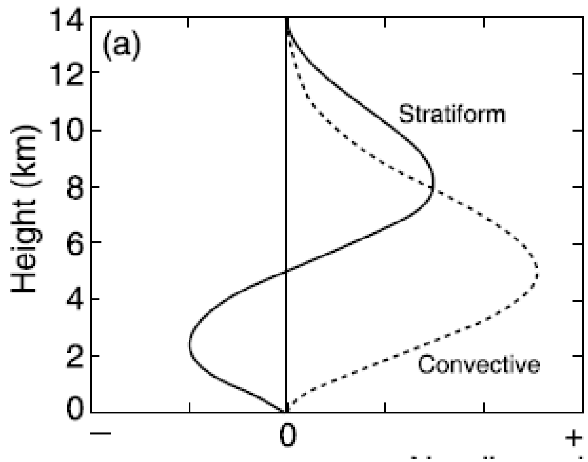

Synoptic-Mesoscale Interactions

From a PV-theta perspective, the heating rate profiles are crucial to know and understand.

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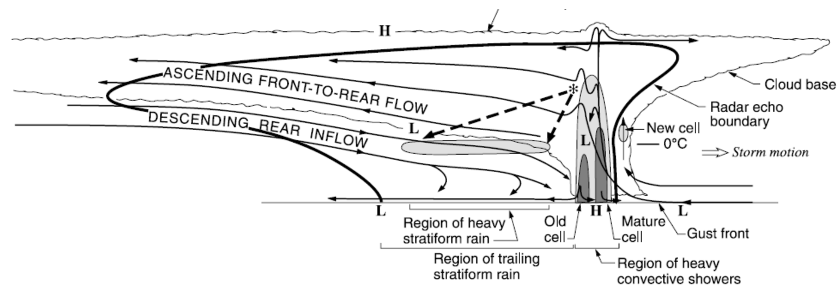

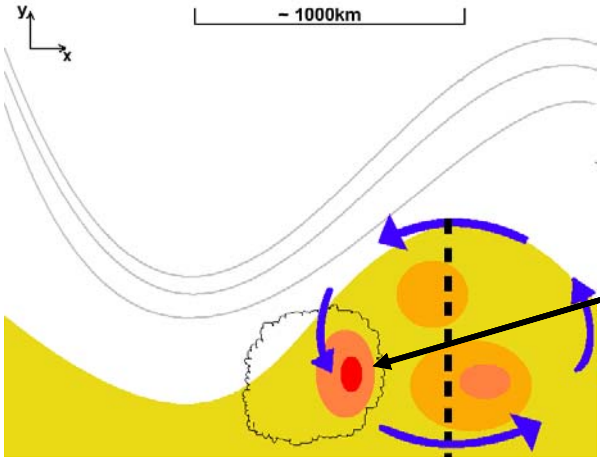

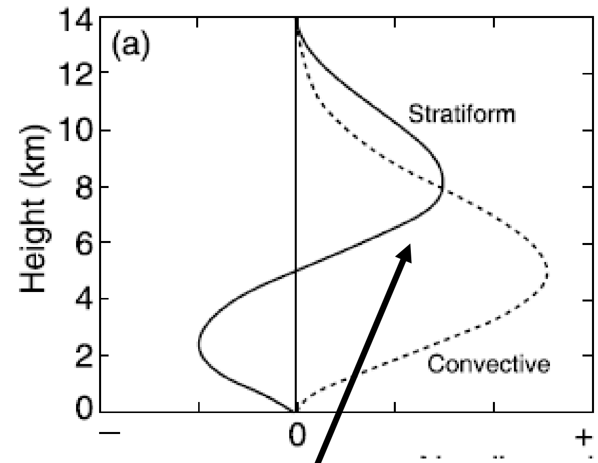

Synoptic-Mesoscale Interactions

From a PV-theta perspective, the heating rate profiles are crucial to know and understand.

Mesoscale-Microscale Interactions

Ultimately these profiles are influenced by the nature of the microphysics!

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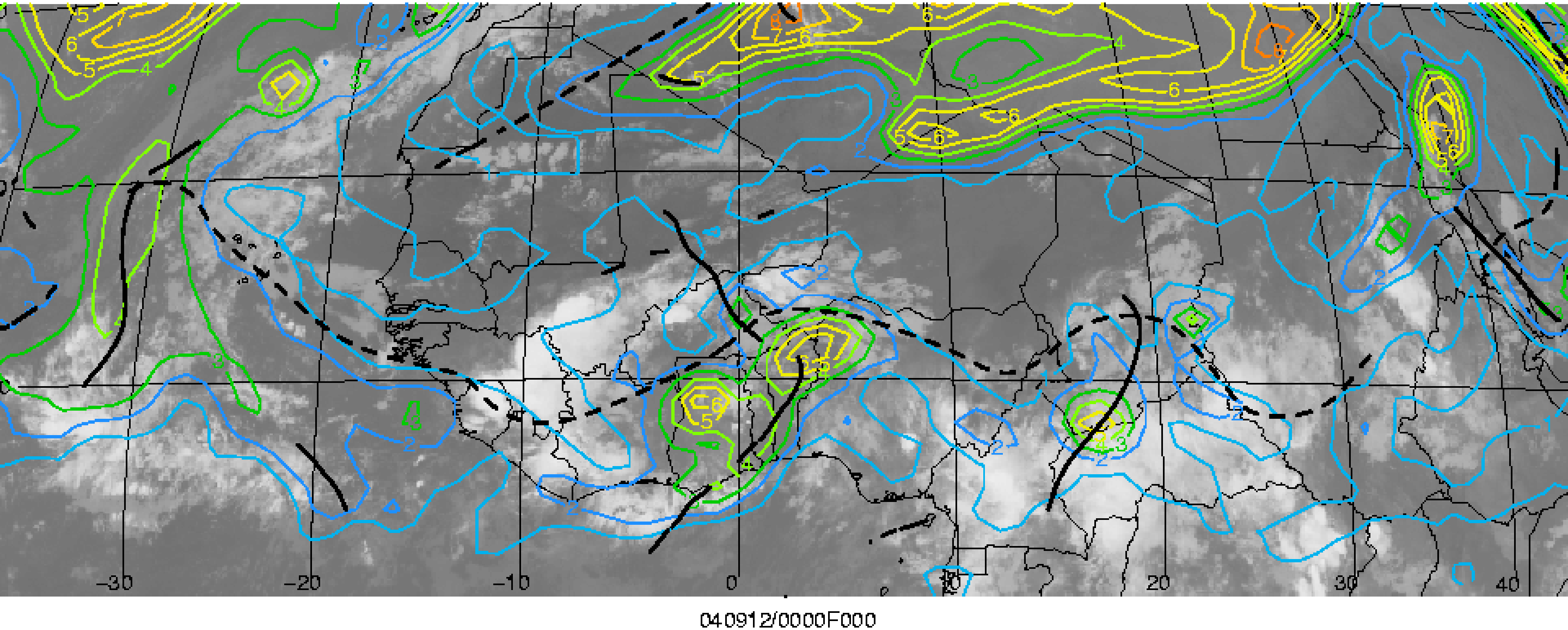

315K Potential Vorticity (Coloured contours every 0.1PVU greater than 0.1 PVU) with 700hPa trough lines and easterly jet axes from the GFS analysis (1 degree resolution), overlaid on METEOSAT-7 IR imagery.

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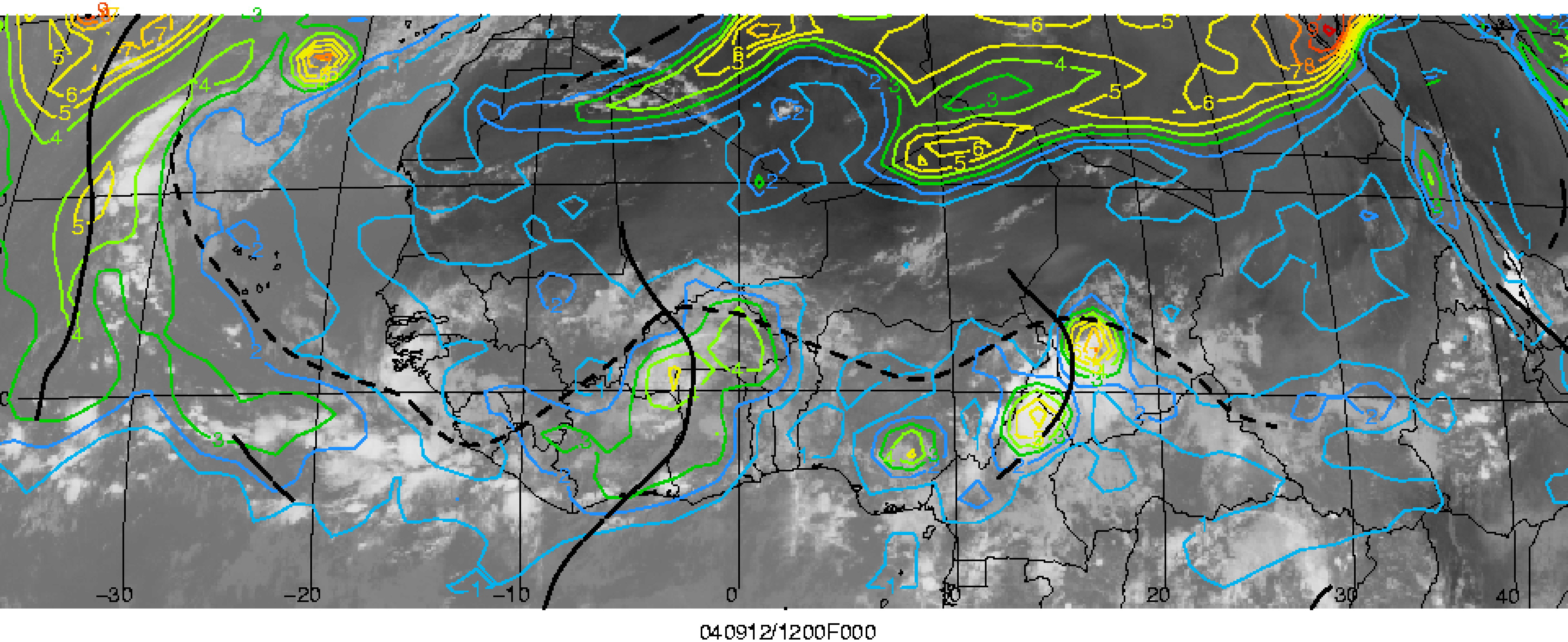

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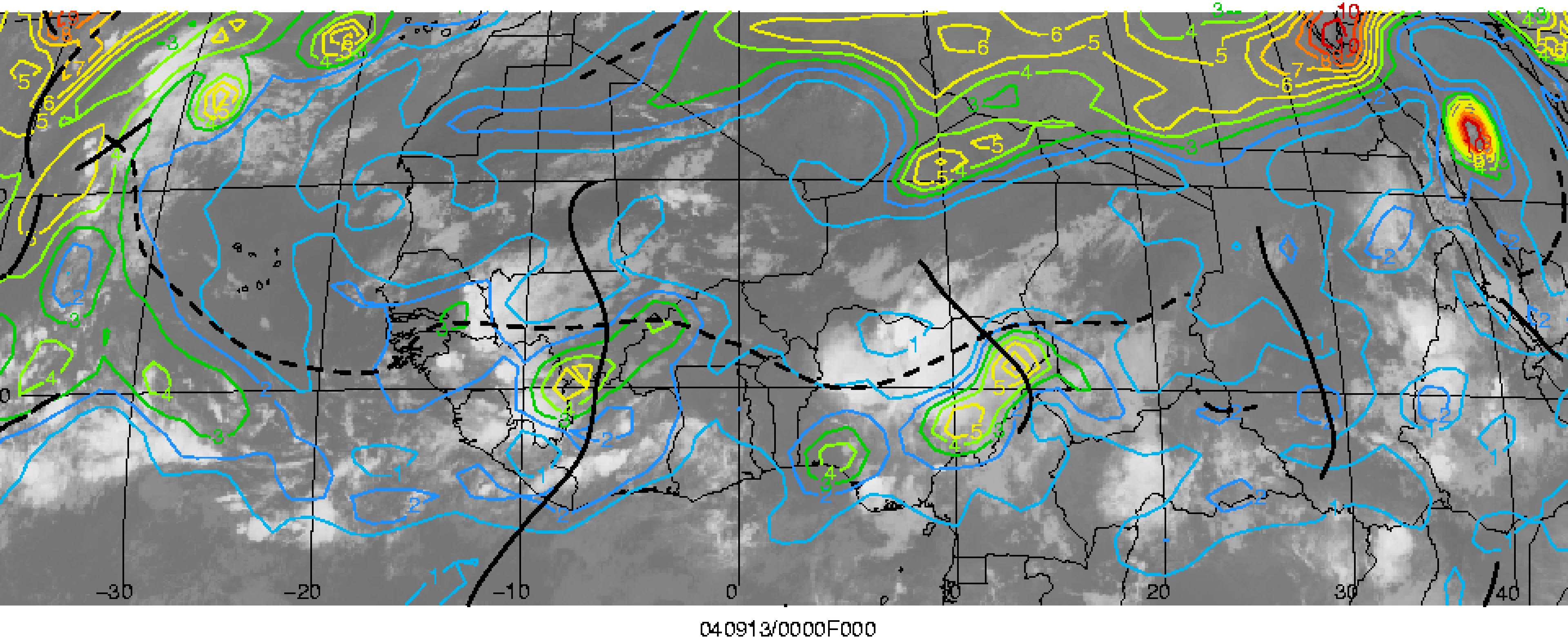

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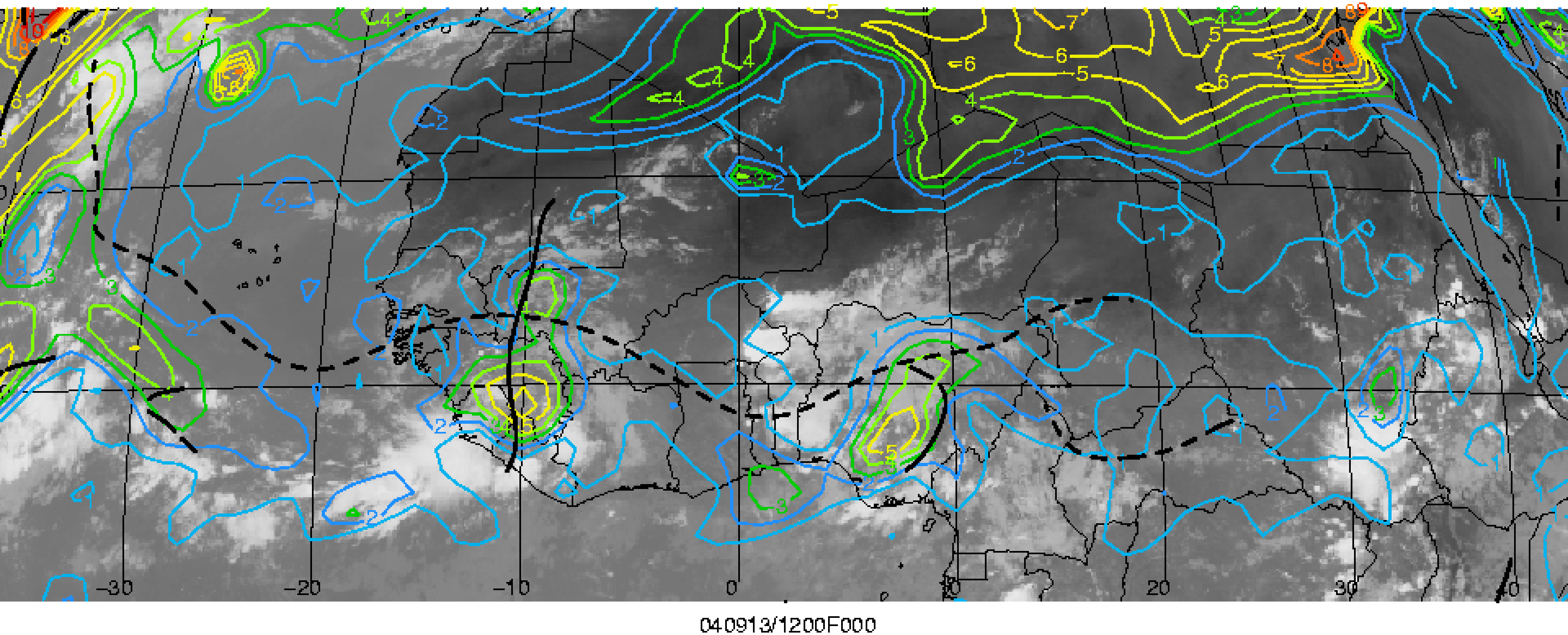

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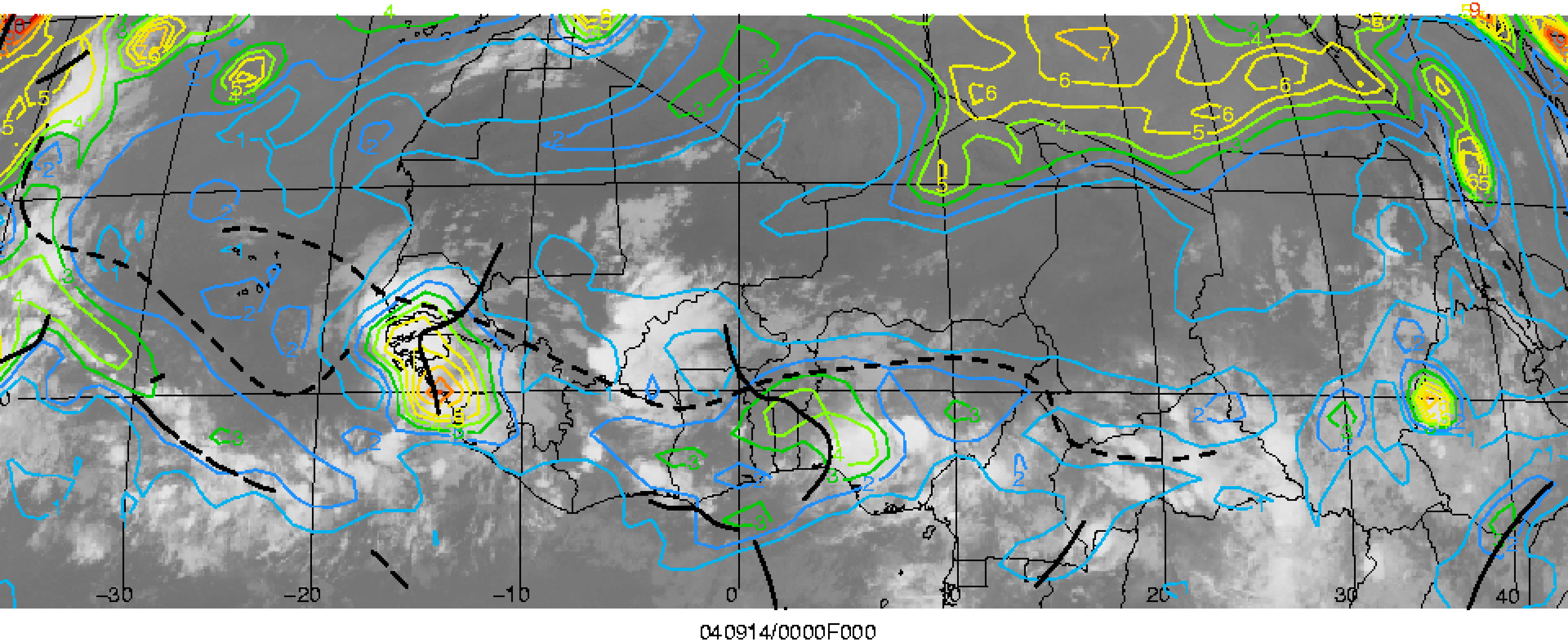

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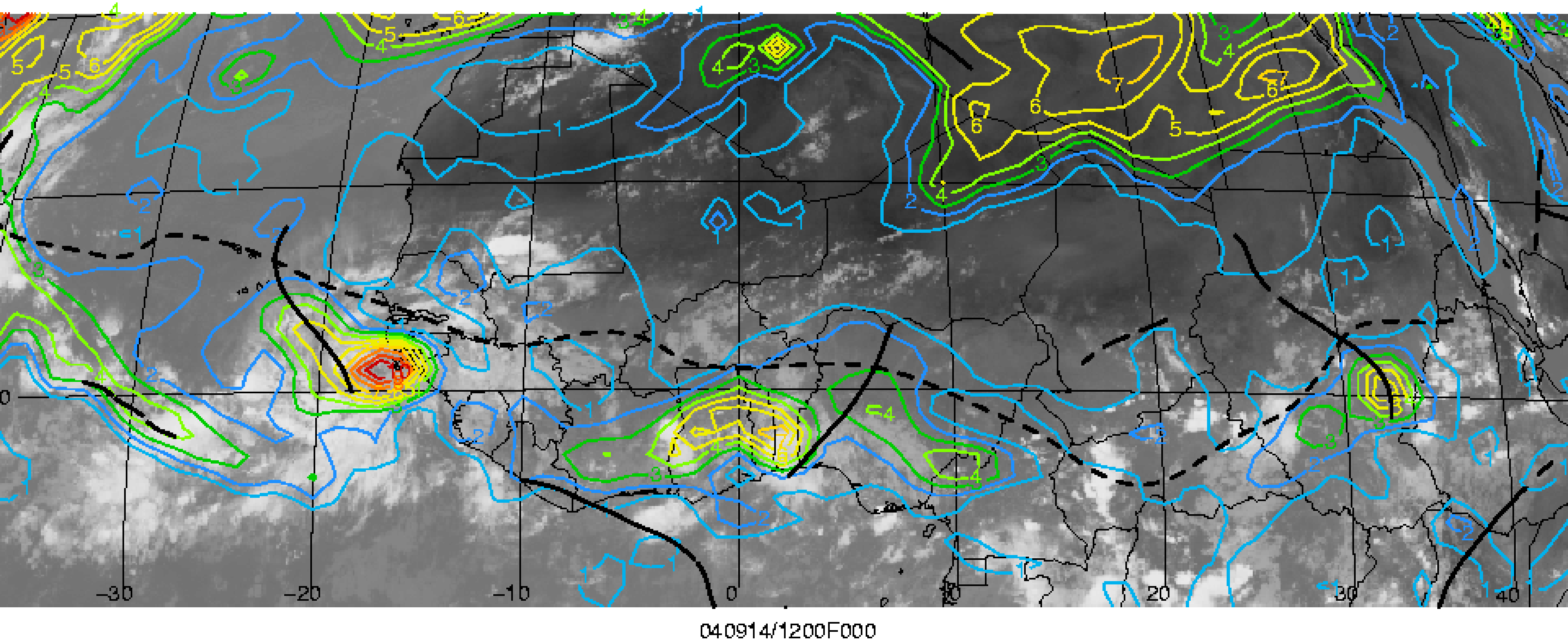

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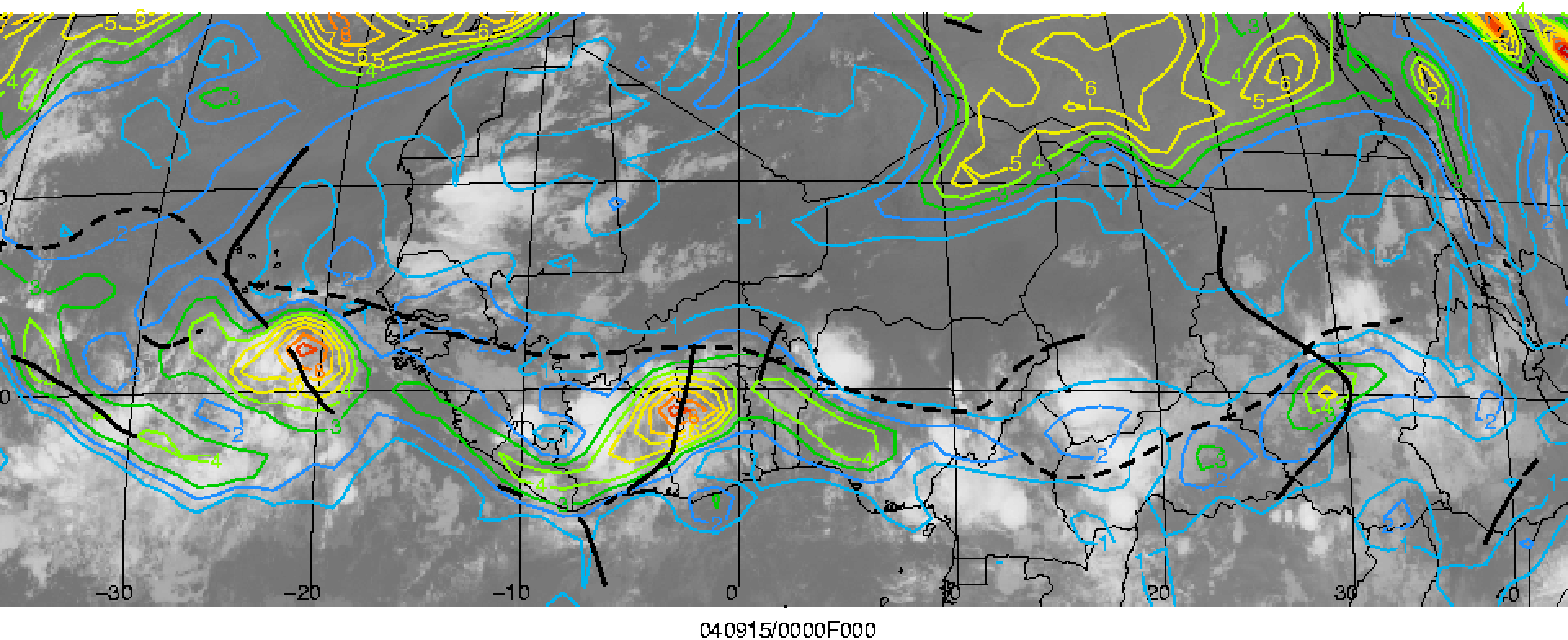

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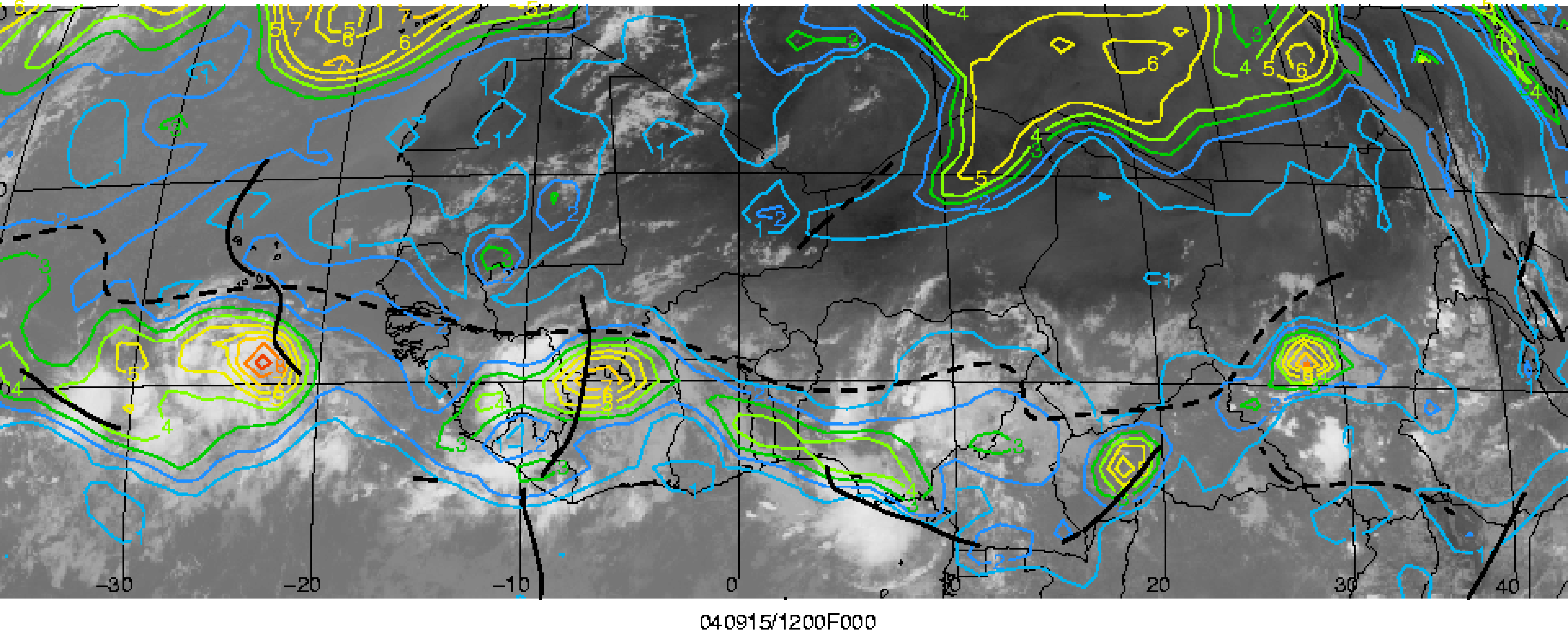

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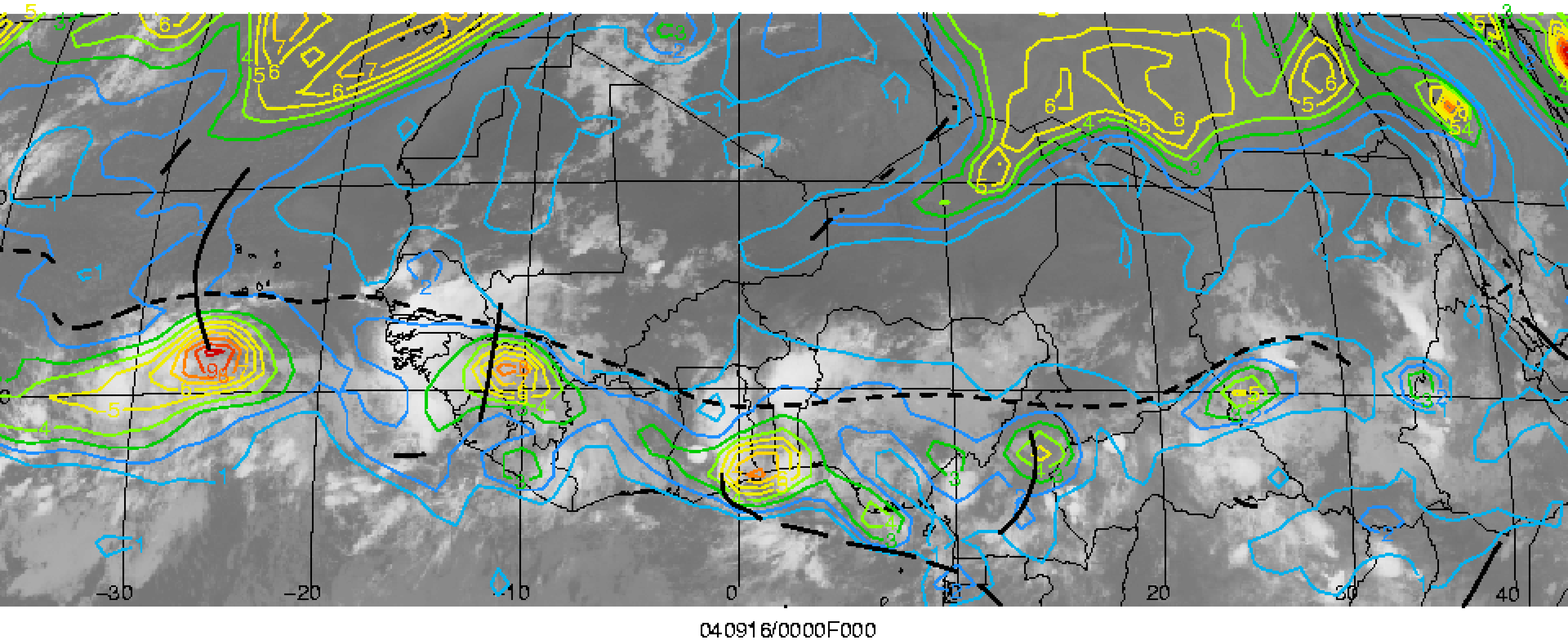

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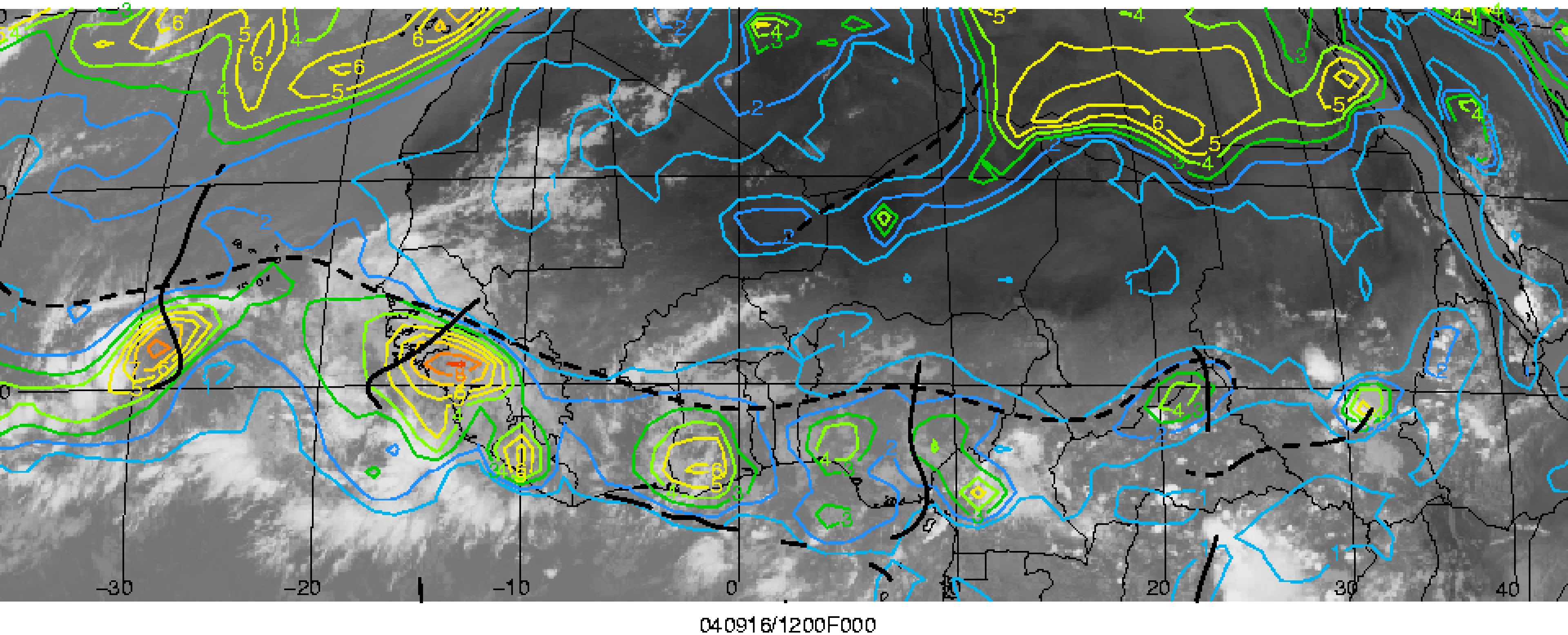

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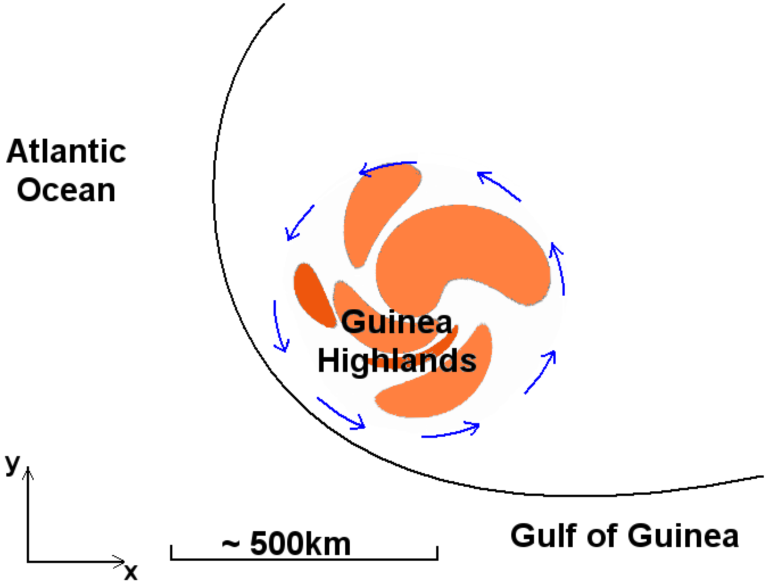
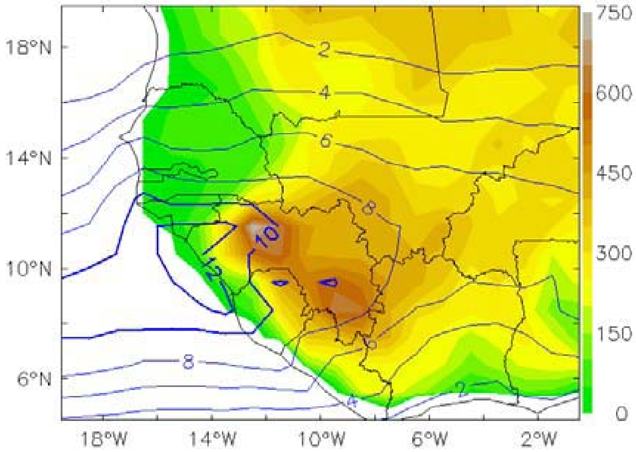
2. Importance of Guinea Highlands Region

AEWs often get a "boost" before they leave Africa; associated with mergers of PV from upstream and in situ generation.



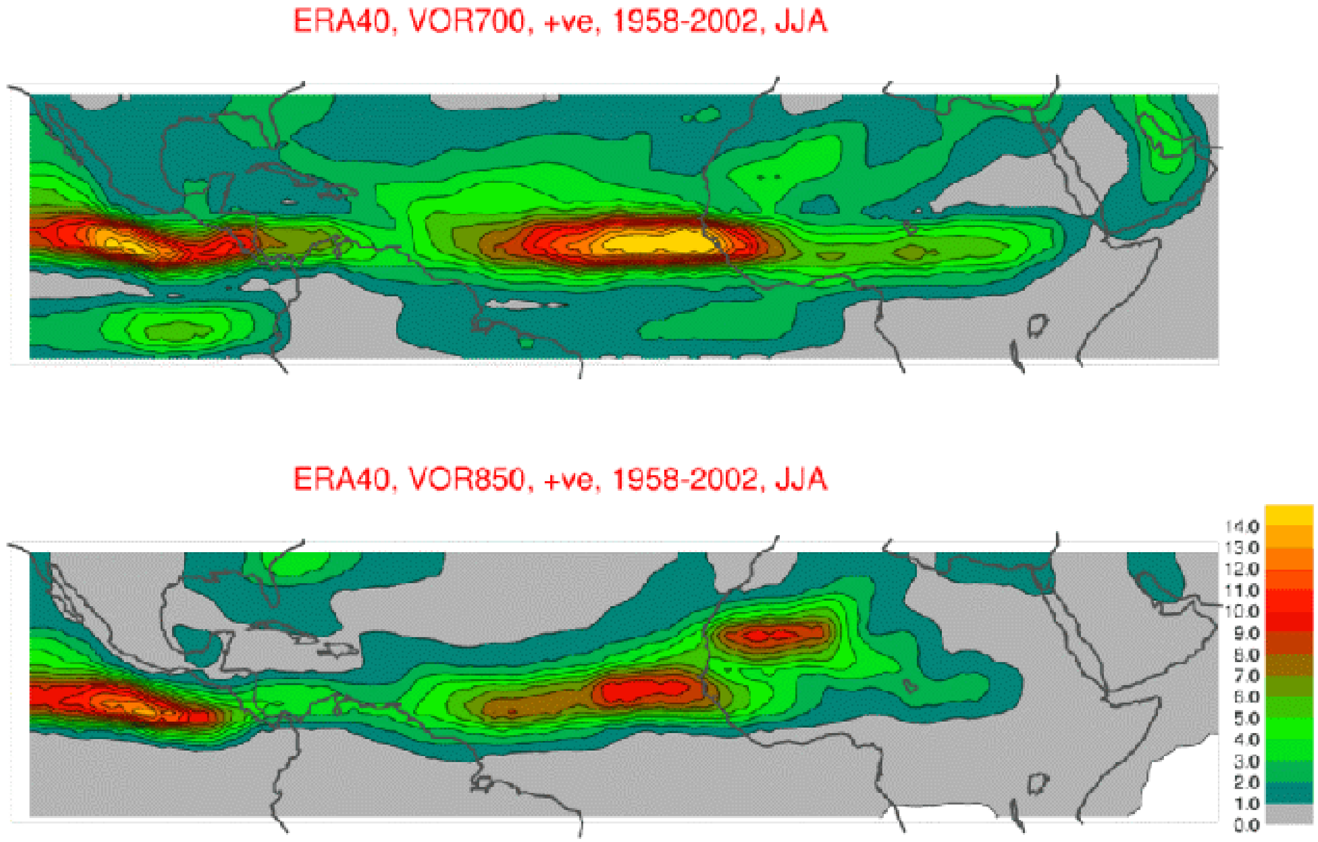
The Guinea Highlands region is one of the wettest regions of tropical North Africa.



GPCP rainfall (mm/day) for Aug-Sep, 1997-2007)

2. Importance of Guinea Highlands Region

Coherent cyclonic centers are tracked within the ITCZ at 700hPa and in the low-level baroclinic zone at 850hPa

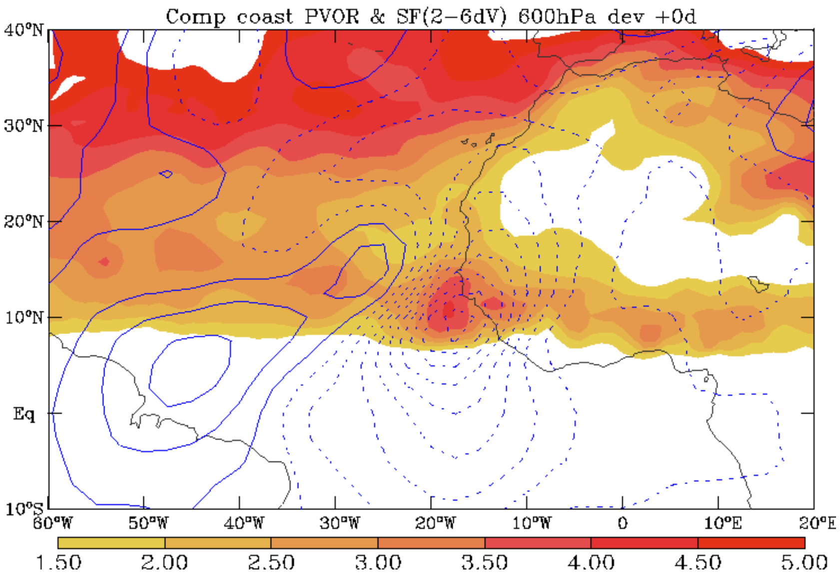


Average vorticity tracking statistics for June-July-August at 700hPa and 850hPa based on ERA40 using methodology of Thorncroft and Hodges (2001).

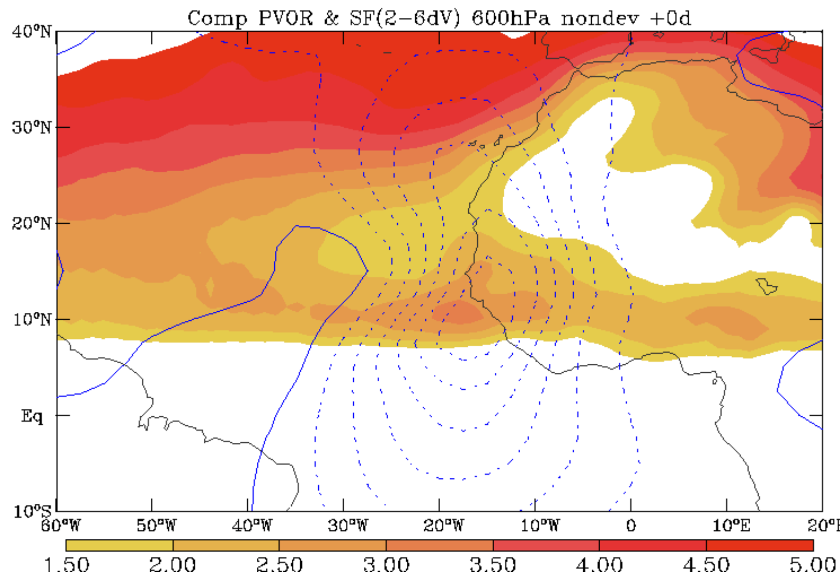
2. Importance of Guinea Highlands Region

Composites of East Atlantic Developing and Non-Developing AEWs (1979-2001)

Developing



Non-Developing

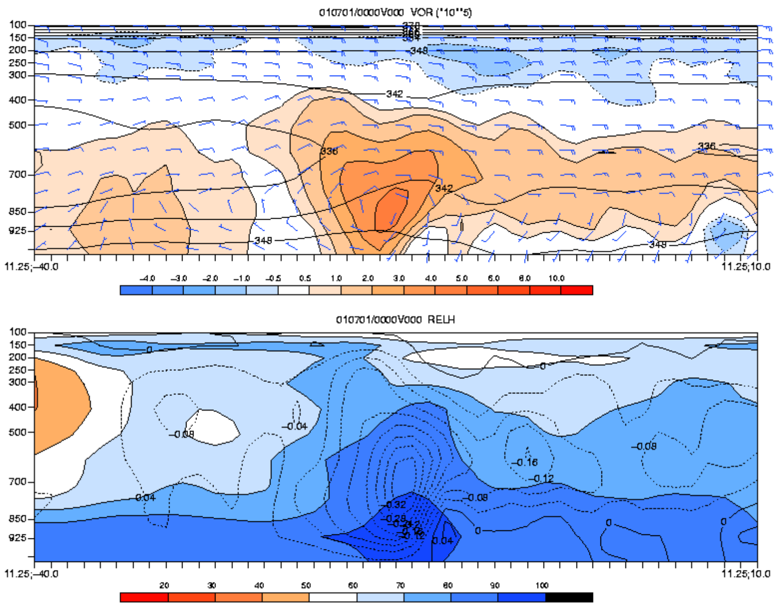


Hopsch , Thorncroft and Tyle 2009

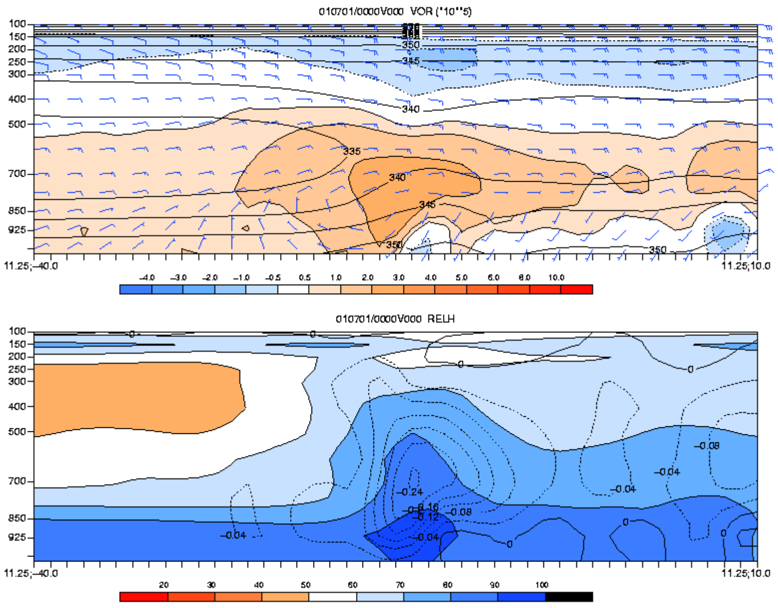
2. Importance of Guinea Highlands Region

Composites of East Atlantic Developing and Non-Developing AEWs (1979-2001)

Developing (33)



Non-Developing (512)



Hopsch , Thorncroft and Tyle 2009

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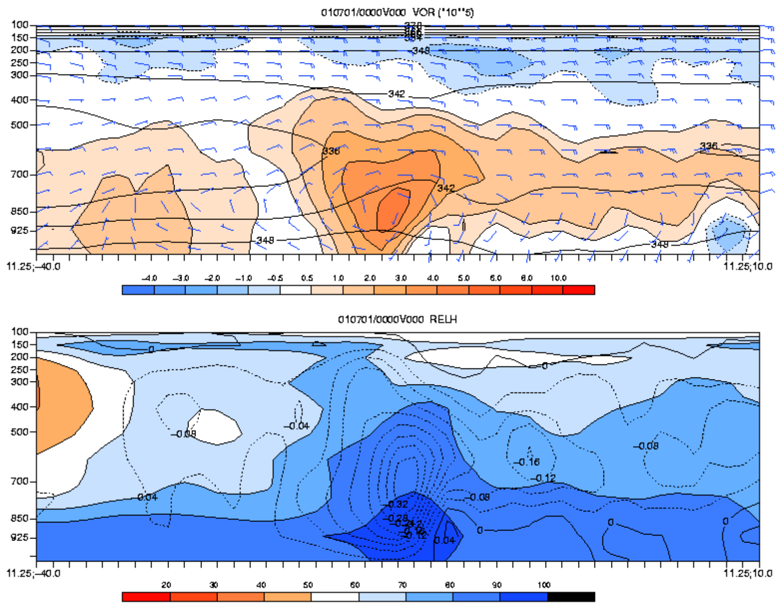
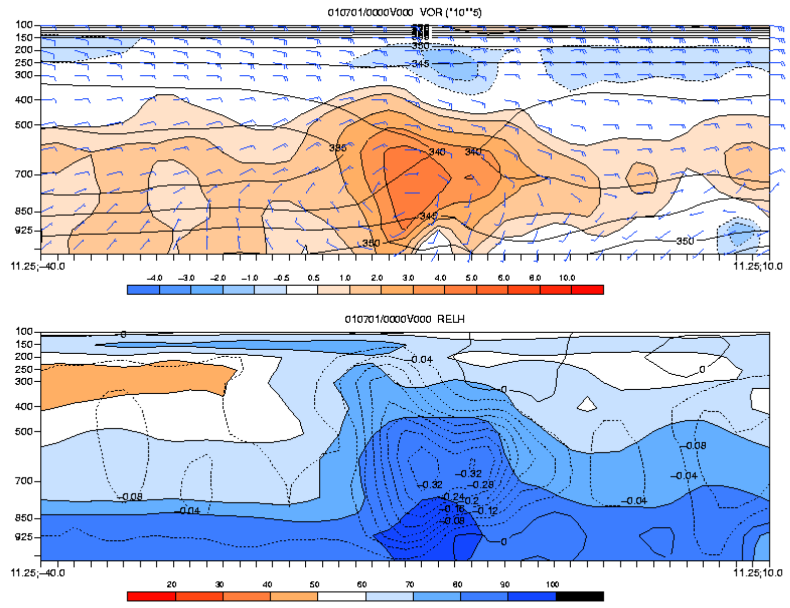


Non-Developing (33 most intense)

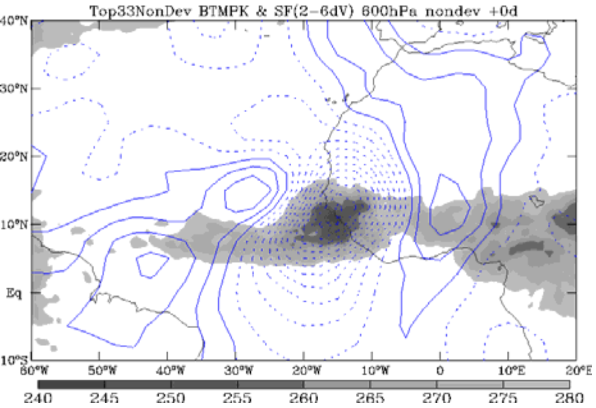


Hopsch , Thorncroft and Tyle 2009

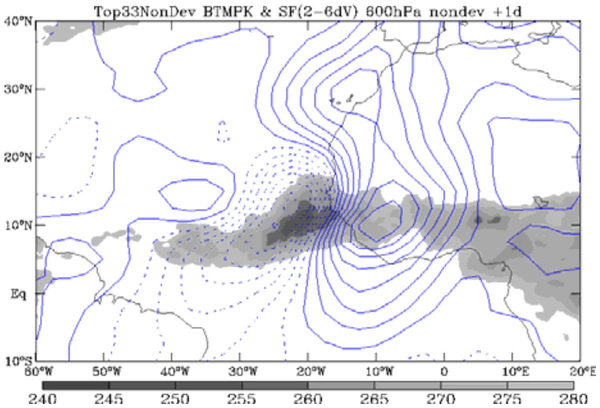
2. Importance of Guinea Highlands Region

Most Intense Non-Developing AEWs

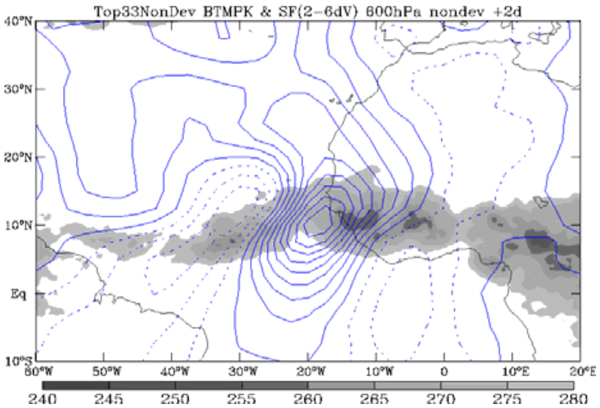
DAY 0



DAY 1



DAY 2



Hopsch , Thorncroft and Tyle 2009

3. Future Plans: Objectives

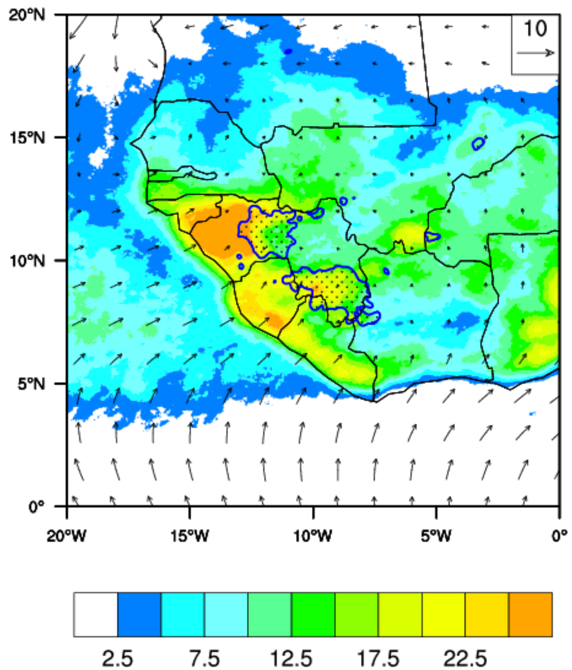
(i) To document and explore the nature of the convection and associated PV structures which develop in the Guinea Highlands region, including the relative roles of in situ generation and advection from upstream.

(ii) To improve our knowledge and understanding of the processes that influence the fate of the PV structures leaving the West African coast, including assessment of the relative roles of the “seedling” and the large-scale environment.

3. Future Plans: Key Scientific Questions

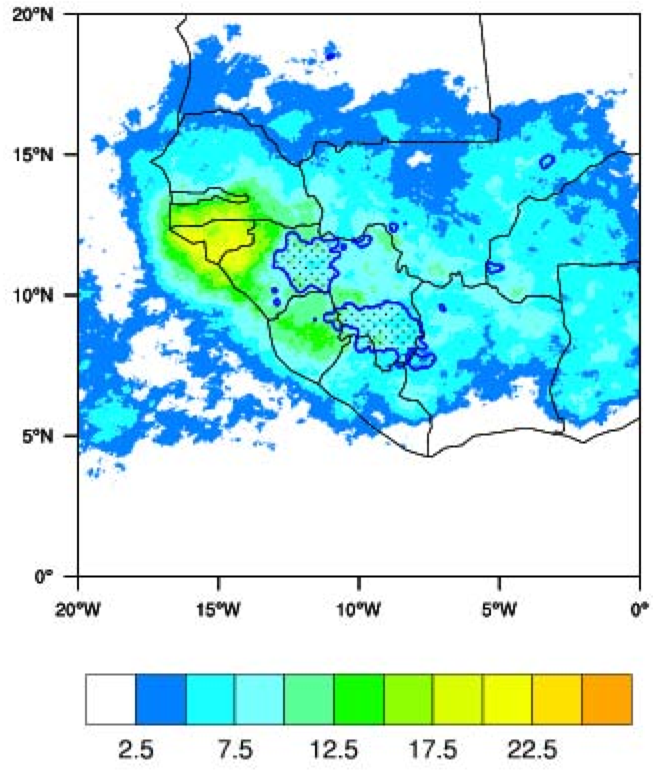
• *What are the convective characteristics in the West African coastal region?*

• *To what extent is convective activity associated with a coherent diurnal cycle linked to variations in daytime heating and/or land-ocean circulations, and how important is the contribution from the AEW and associated embedded MCSs from upstream?*



Sep. 04-07 15-21Z 233K Exceedance Freq. and 18Z 950 hPa Wind (courtesy Matt Janniga)

Sep 2004-2008 00Z 233K Exceedence Freq.



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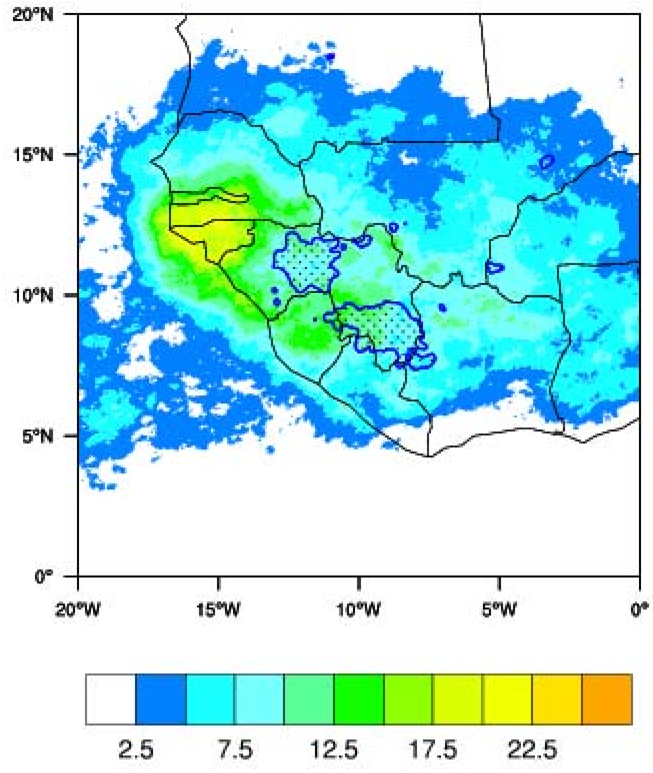

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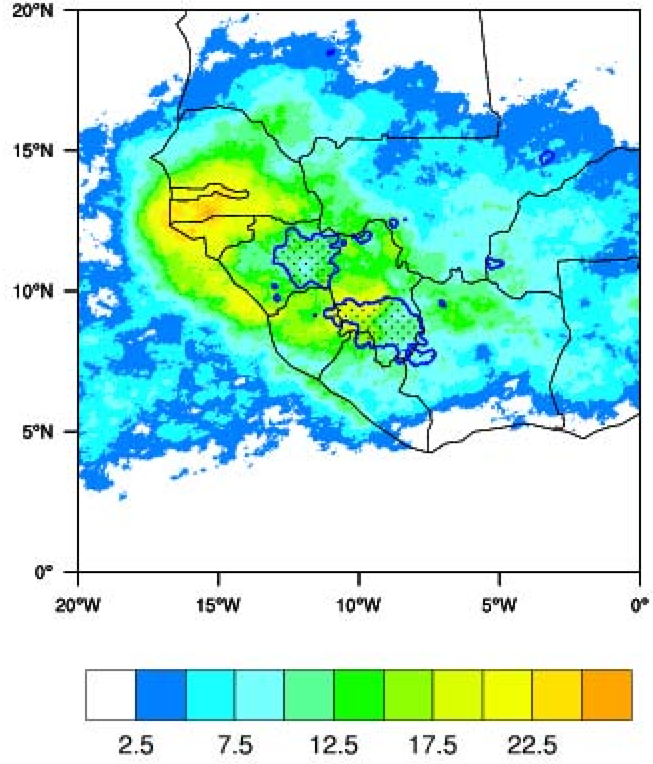

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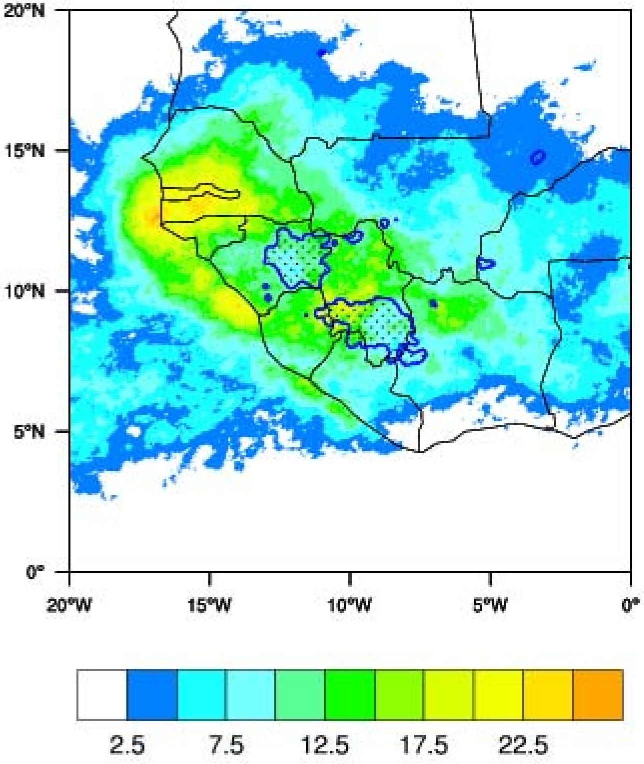

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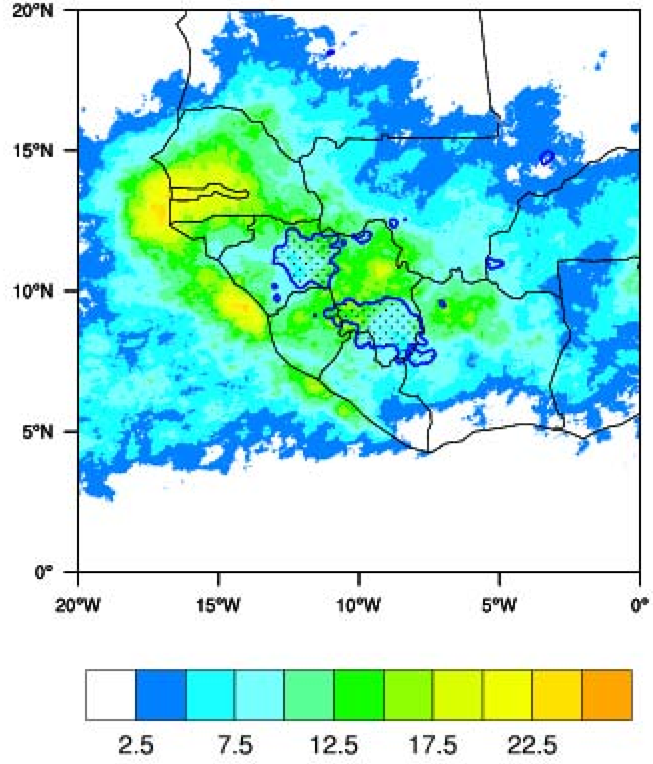

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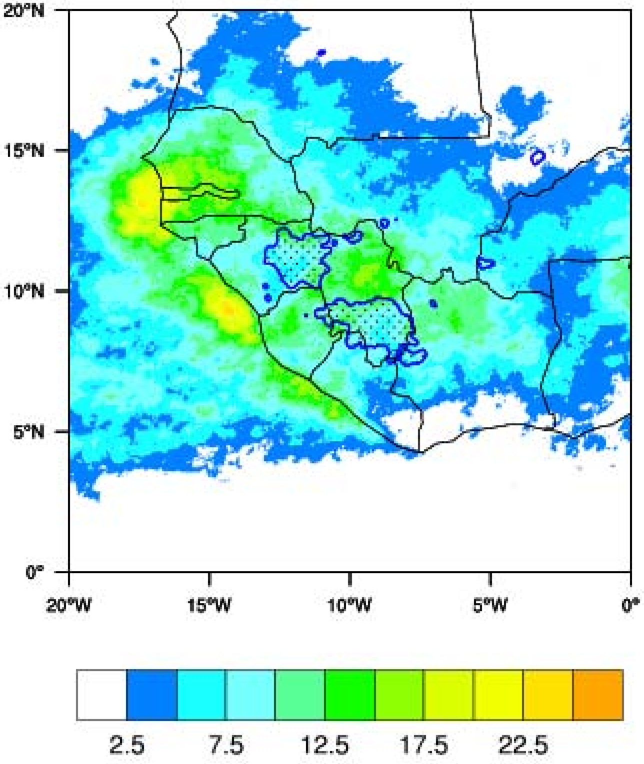

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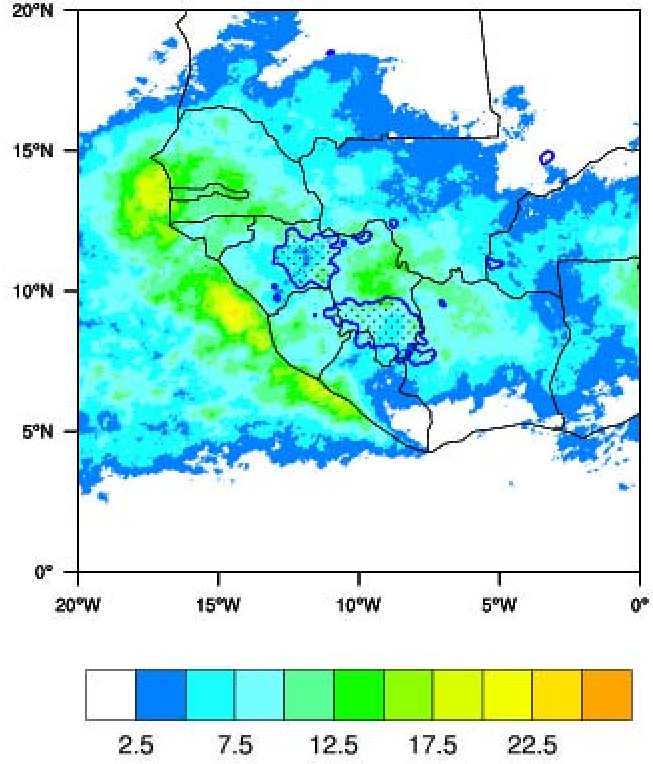

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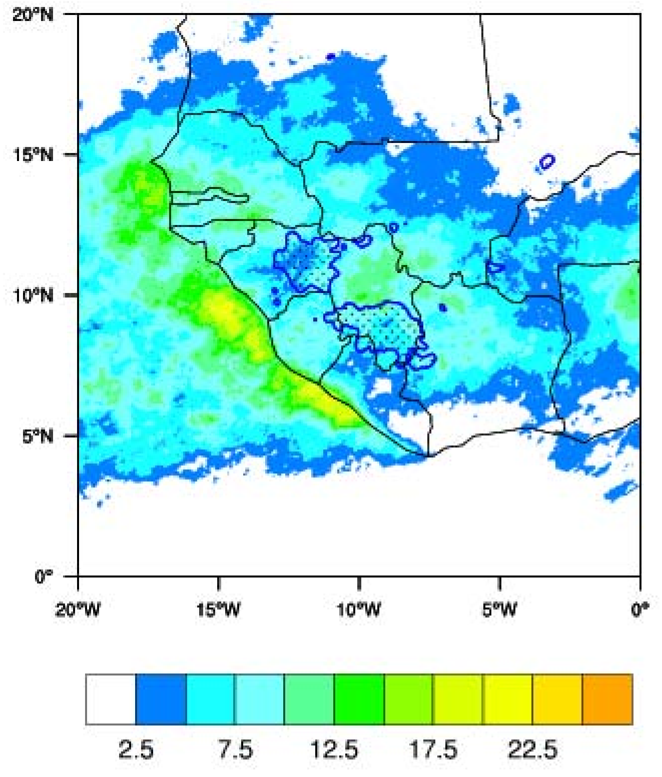

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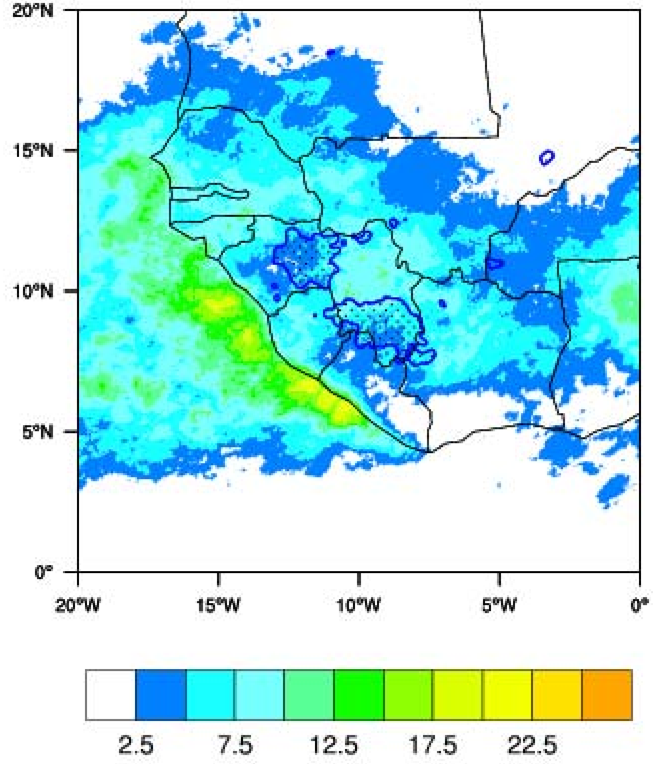

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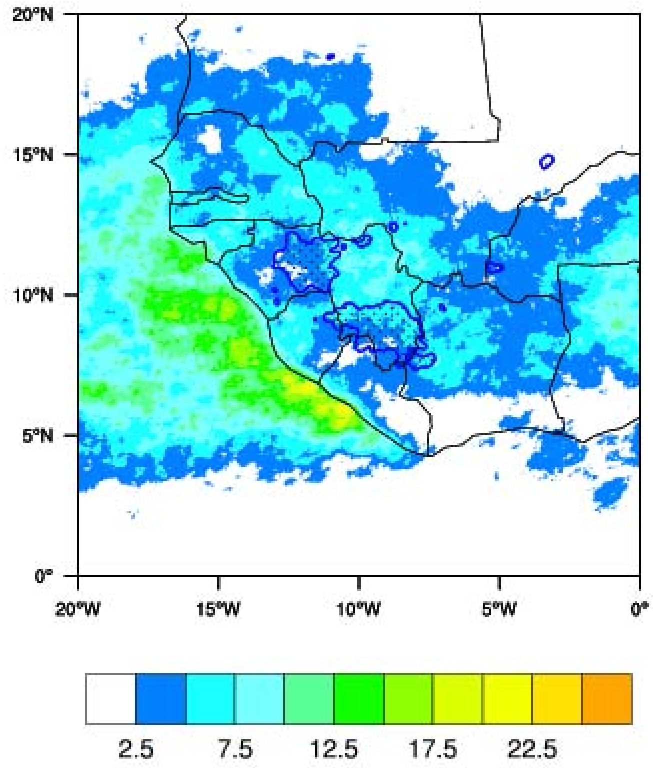

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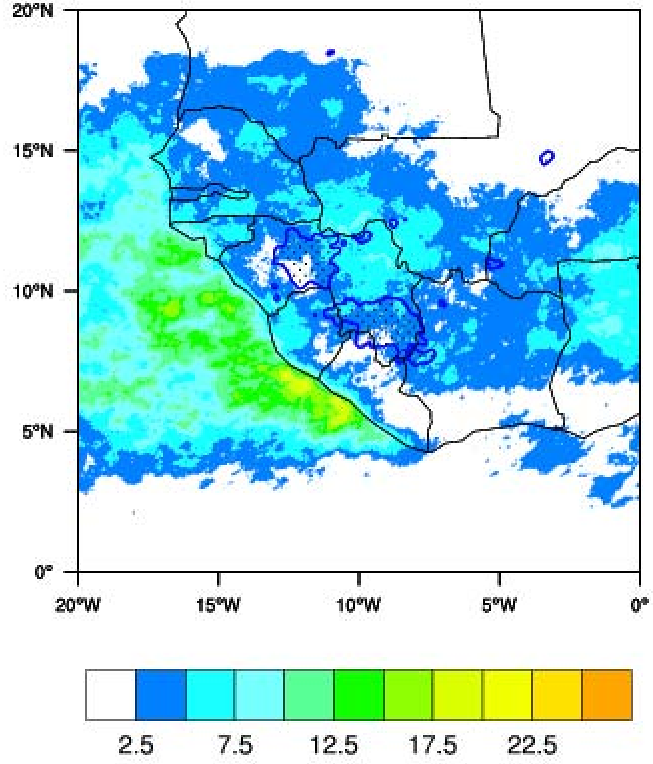

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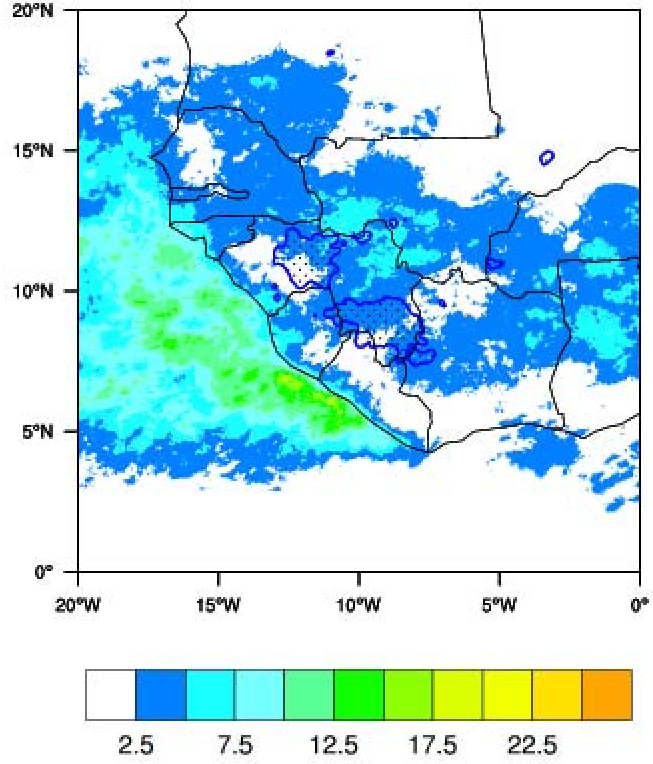

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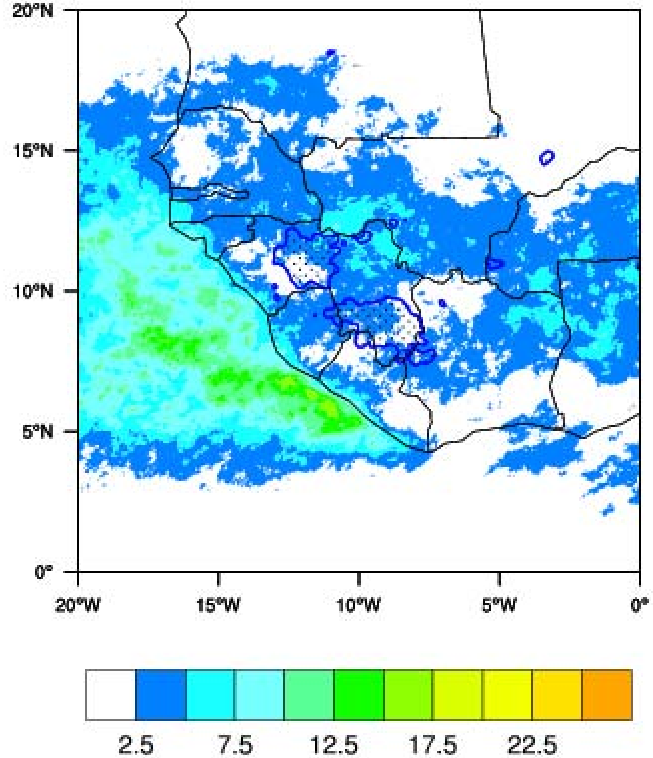

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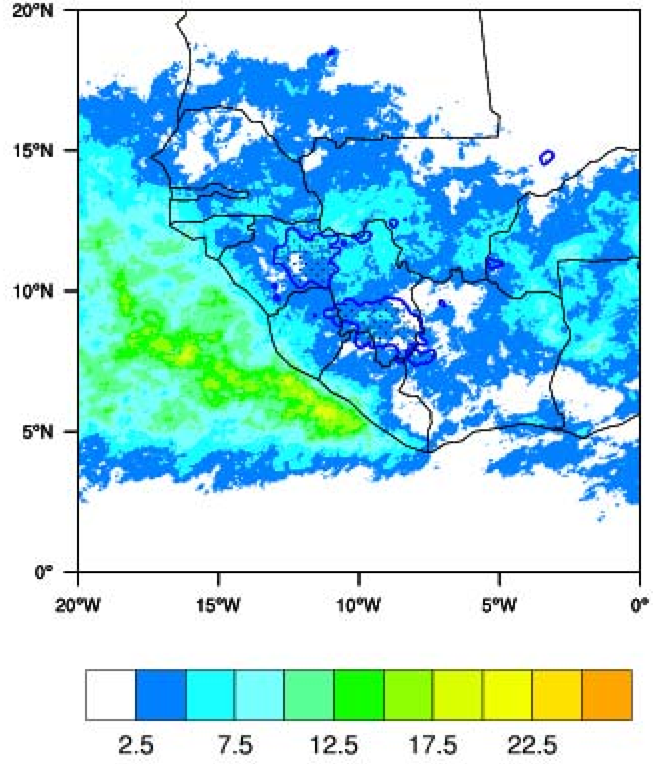

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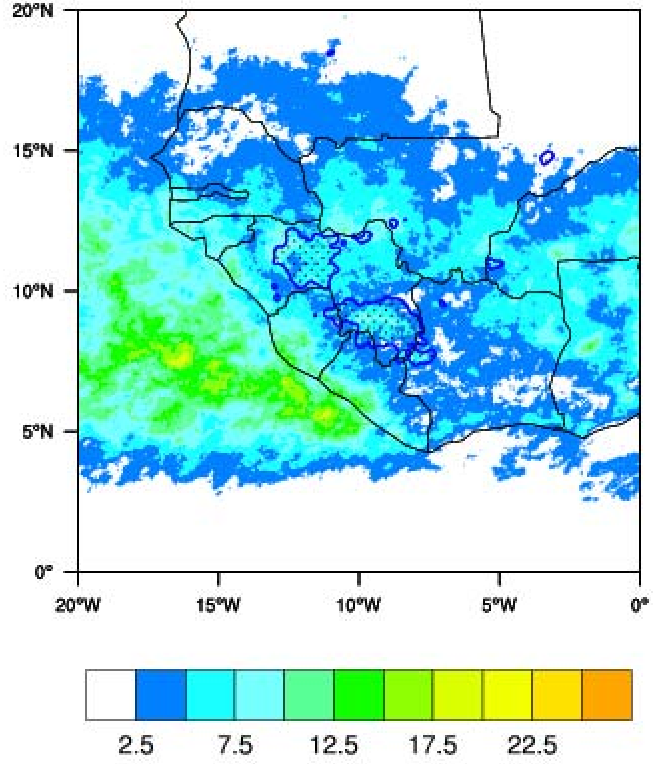

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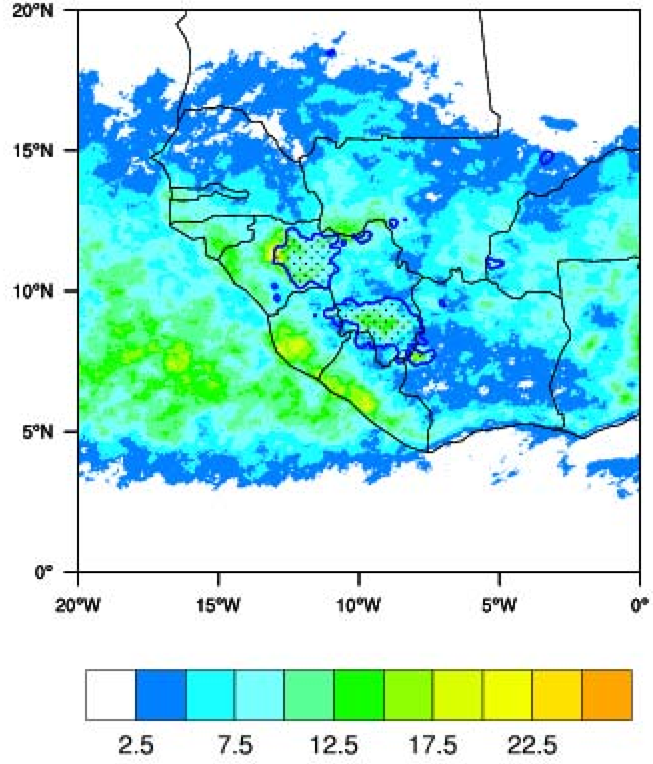

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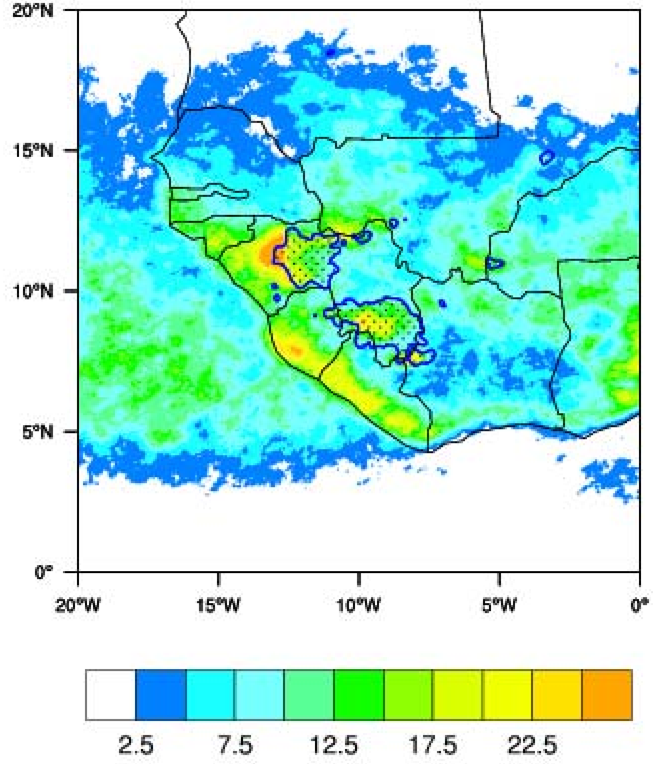

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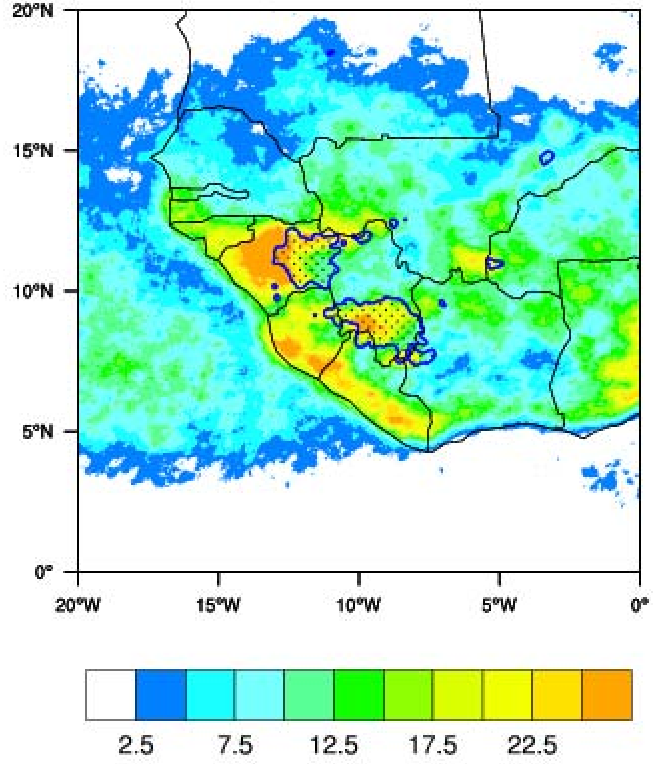

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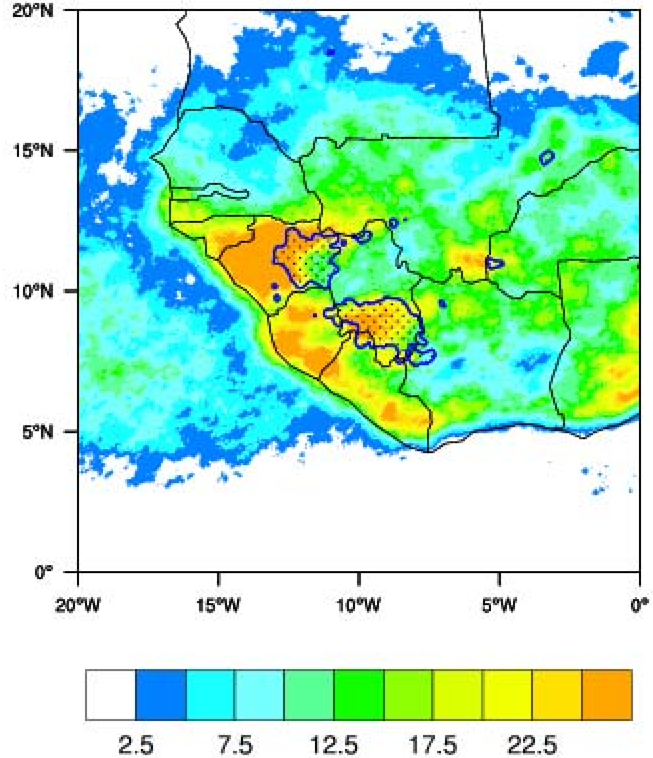

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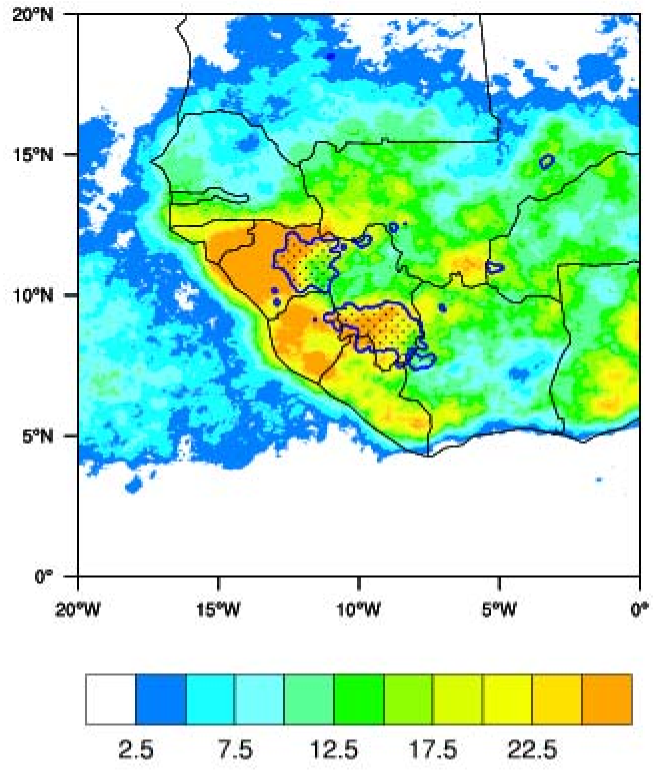

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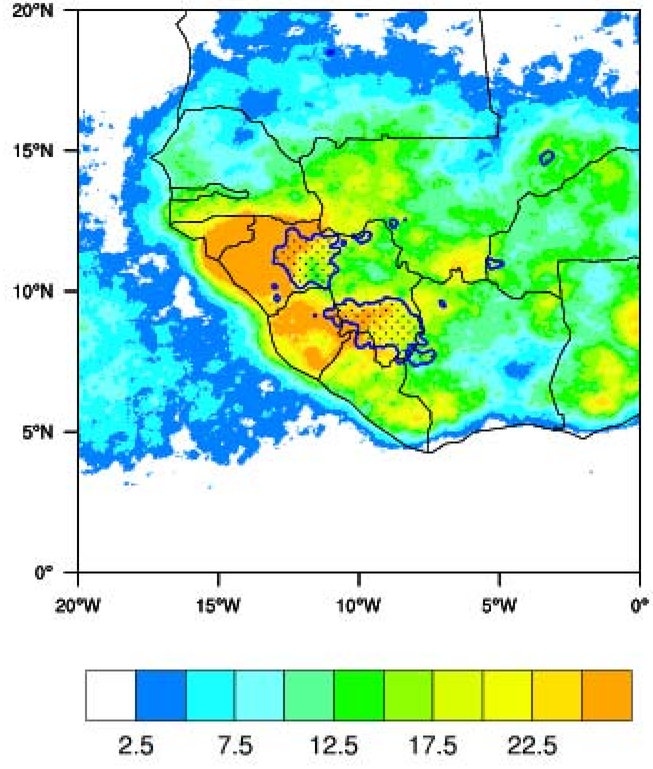

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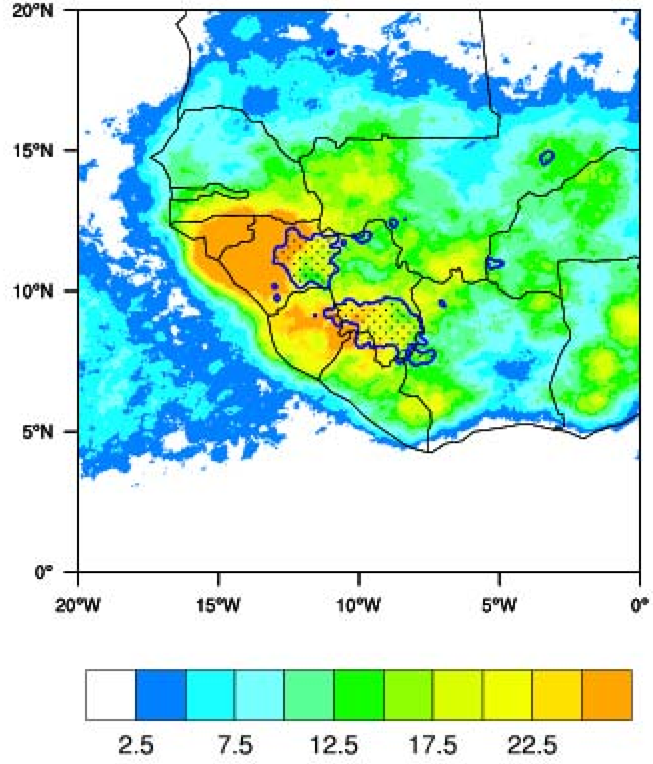

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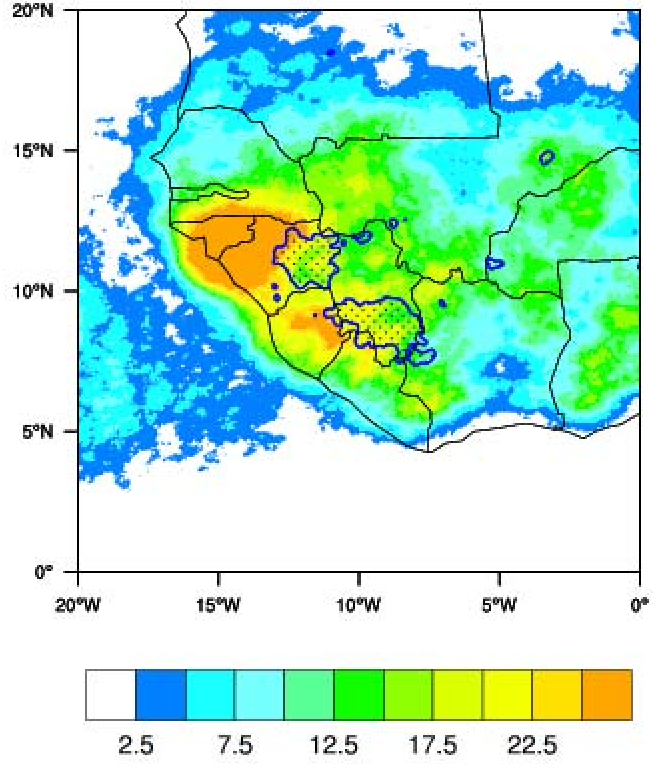

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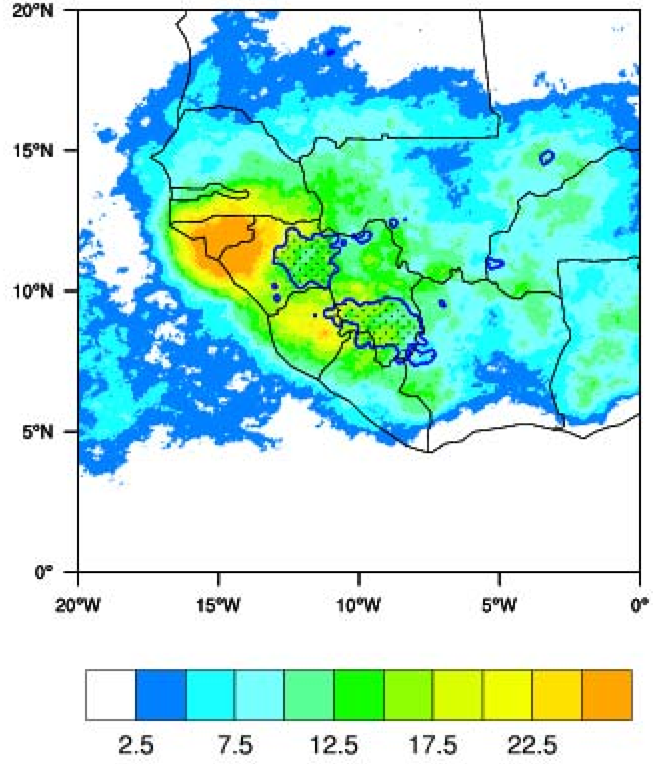
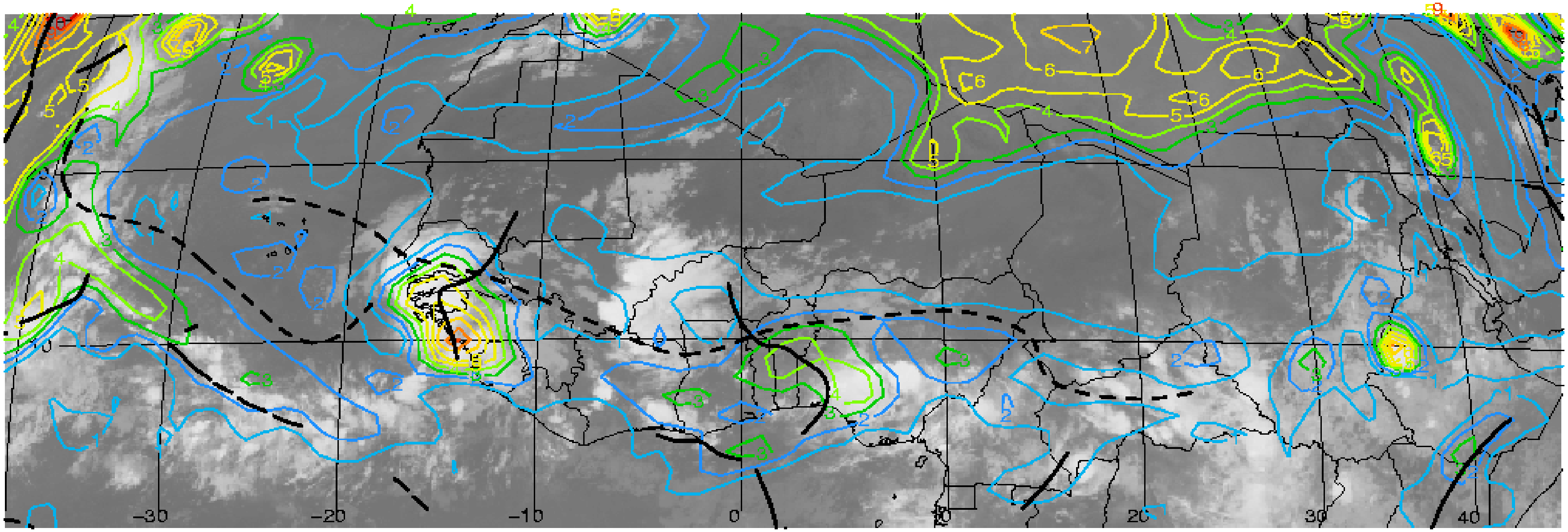


3. Future Plans: Key Scientific Questions

• *What is the PV structure of the AEW close to the West African coast? What are relative contributions from PV generated by in situ convection in the coastal and Guinea Highlands region and that with the incoming AEW and associated embedded MCSs?*



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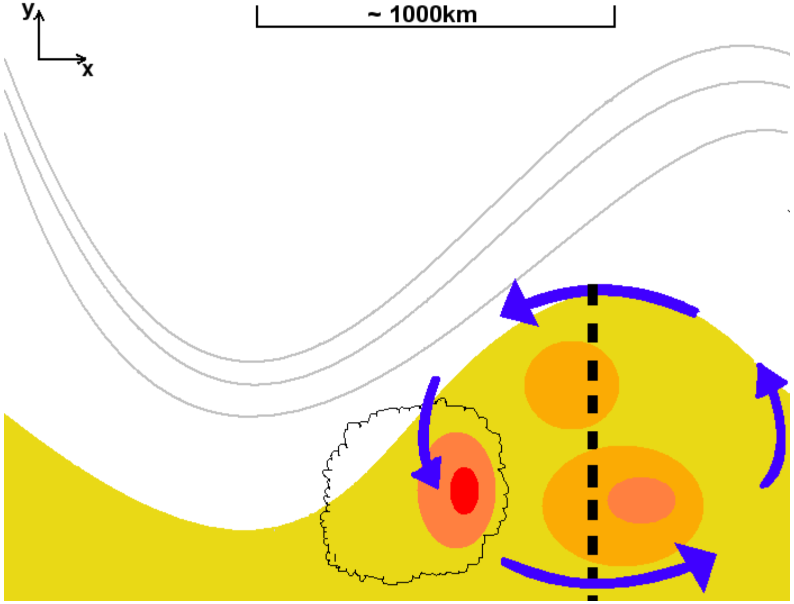
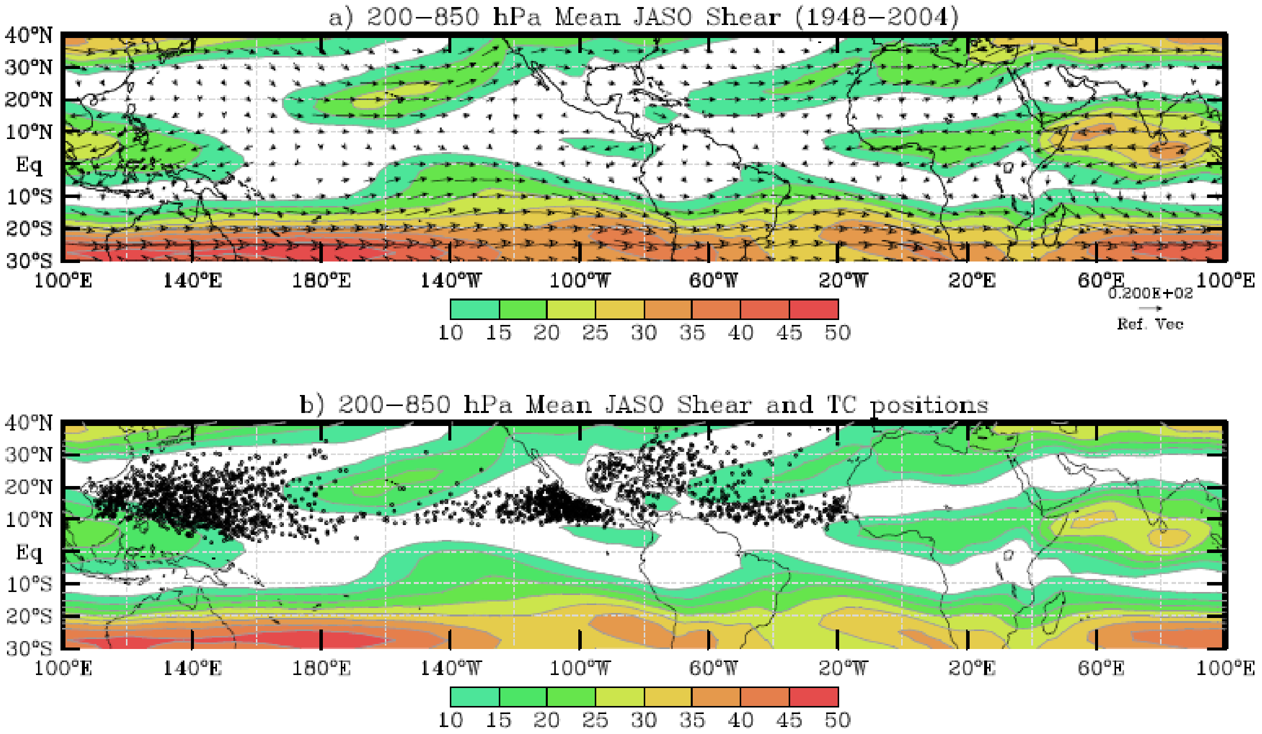
3. Future Plans: Key Scientific Questions

- *To what extent is the "critical-line-theory" of Dunkerton et al (2008) relevant to AEWs in the West African region? Is it more important that the AEW passage be coincident with topographically enhanced convection or that convection is close to the critical line?*



3. Future Plans: Key Scientific Questions

- *Do the AEW characteristics leaving the West coast influence the fate of the AEWs downstream? Or do the large-scale environmental conditions provide the more important influence?*

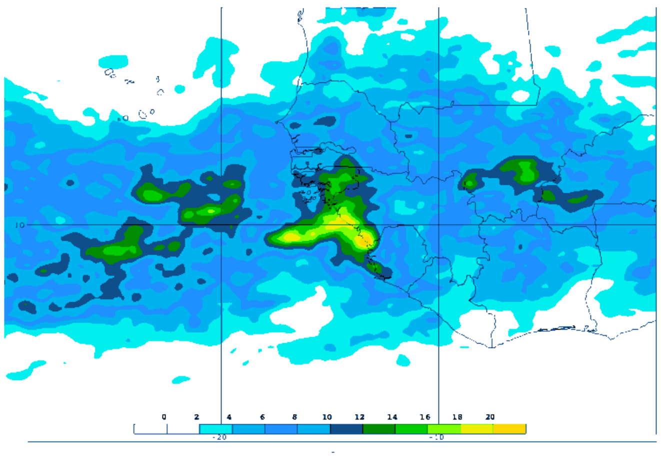


Aiyyer and Thorncroft (2009)

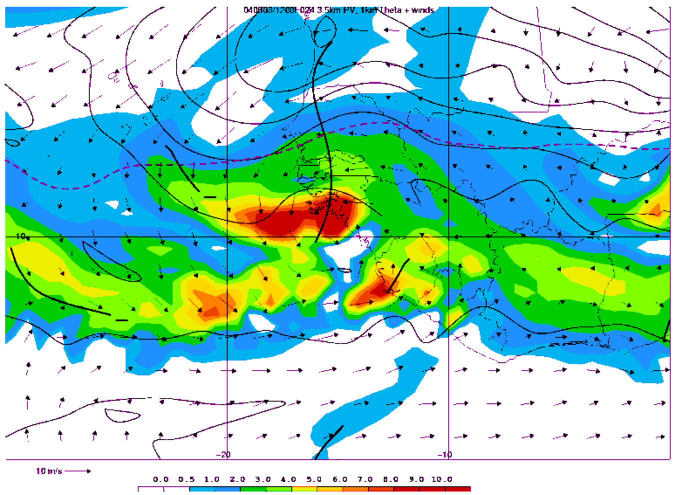
3. Future Plans: Approach

Case studies of AEWs in 2006 exploiting the NAMMA and AMMA special observations, Satellite Datasets and NWP analyses.

High resolution WRF simulations



Rainfall averaged for August 15th to September 15th 2006 based on CMORPH.



PV (shaded) with objective trough lines (black solid) and African easterly jet (black dashed); for a 24 hour forecast made with WRF.