Effective Use of PUMA station in Nowcasting Process

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FORUM DES USAGERS D'EUMETSAT EN AFRIQUE

13th ème

EUMETSAT USER FORUM IN AFRICA

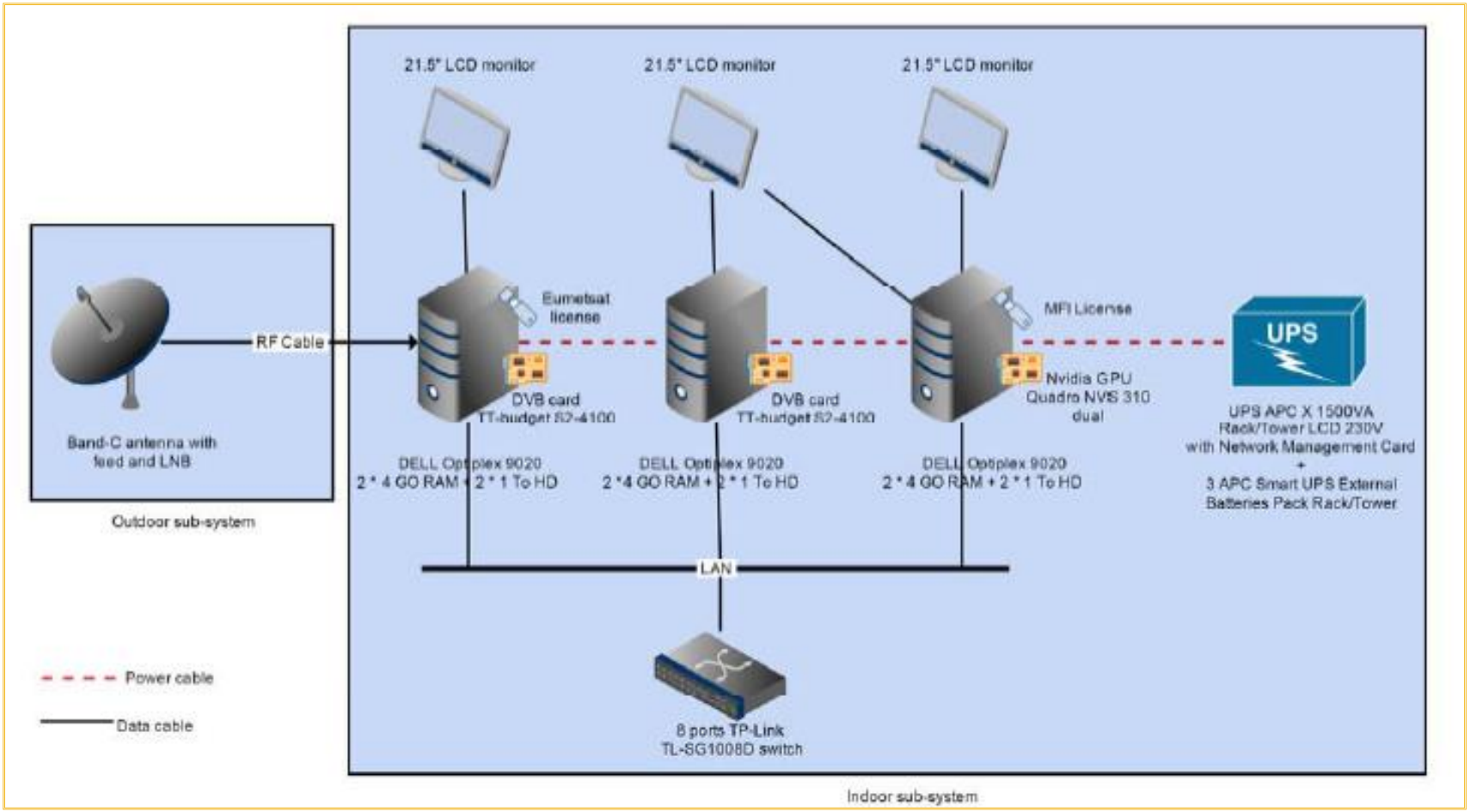
24-28 Septembre 2018 - Abidjan

24-28 September 2018 - Abidjan

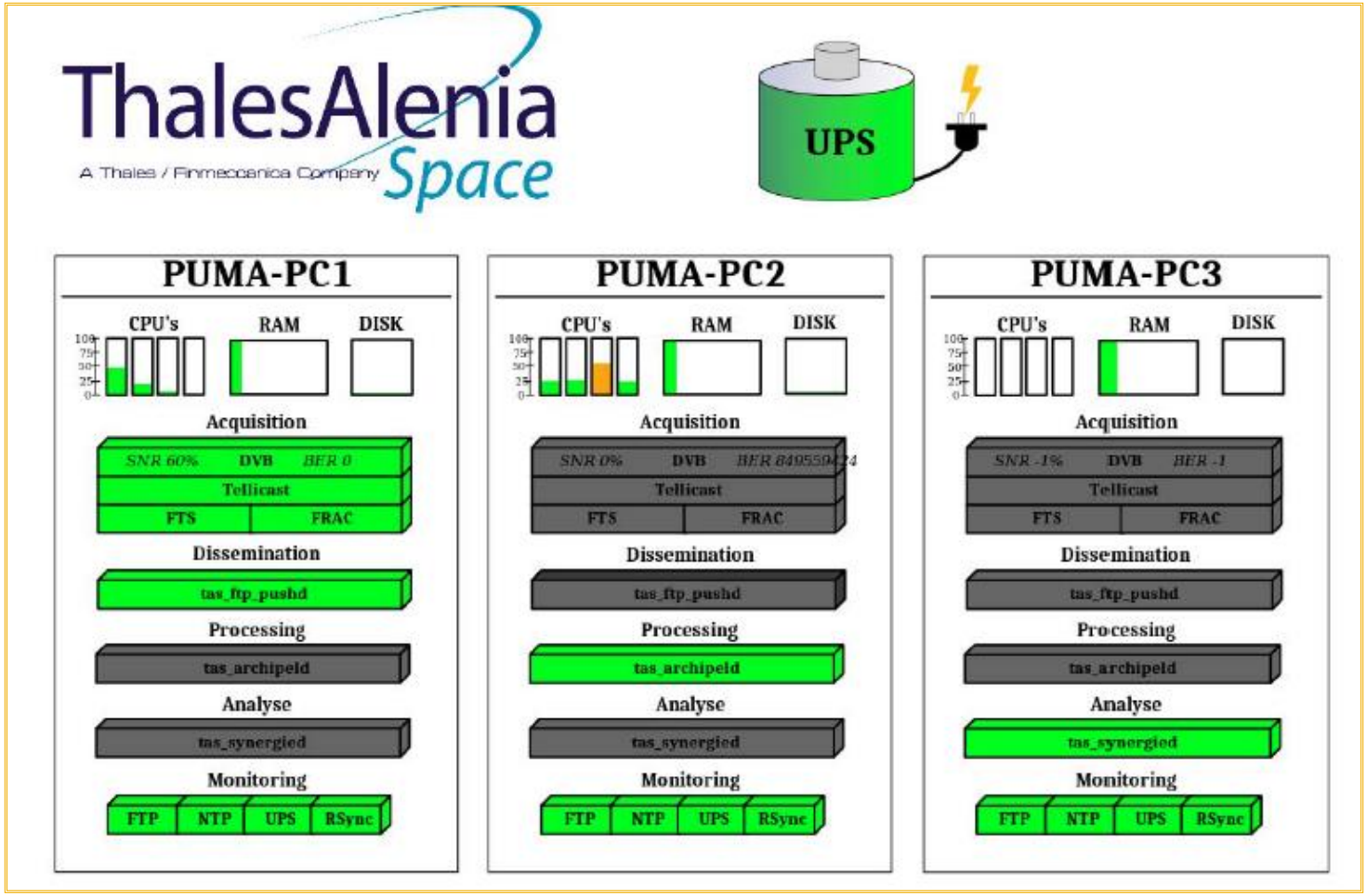
Overview

1. PUMA WorkStation structure
2. Data Available on PUMA Station
3. PUMA Nowcasting Applications
4. Forecasting Problem approach
5. Steps in Forecasting Using Synergie system
6. Forecast for Kenya based on this analysis
7. Summary

PUMA 2015 station



PUMA-2015 Monitoring dashboard



Starting:

Login : synergie
Password: synergie

Displays this MMI for you on PC3 only

Data sets

Data available On PUMA Synergie

- Satellite (MSG , RGB products) MPEF, LSAF,GOES E/W,FY2G/D Products e.g. MODIS ,SARAL,Jason products, Jason etc), Wave Models, radiosonde data, Alpha data,
- NWP models
  - Different spatial and temporal resolutions (UK Models Res. 0.5 deg, Arpege (FR)), ECMWF models, Local models (LAM, regional models), and many more
  - Diagnostic models (300 hPa geopotental and analyses, development/steering and forecast)
- Synoptic data (Meteorological Data Dissemination on GTS)
- Lightning data
- FAX Images or Significant Weather charts
- NCEP data

PUMA Synergie System is designed to:

- Integrate all data in a workstation
- Equip the weather person with power of data and information
- Provide capacity to selectively utilize the relevant data for specific scenario for your forecasting skills development
- Obtain optimum information from ALL the available data to make Reliable Forecasts!

Applications in Nowcasting

- Forecast for Public-transport, sporting
- Required data
  - 24 hours MSLP
  - RGB Night micro-physics (10-9,9-4,9)
  - Airmass RGB (5-6,8-9,5i)
  - SURFACE WIND
  - 925 (WEST Africa) ,850 hPa wind, Div, streamlines
  - Instability Indices (CAPE, GII, TPWC, Li..), Lightning
  - SST. (Moisture fetch)
  - Temperature data (land and Sea)
  - Lightening data

Application in Nowcsting-Aviation

- Forecast for AVIATION
- Required data
  - NWP-> MSLP and Vertical wind profiles
  - RGB Night Micro-physics (10-9,9-4,9) ->Icing and Turbulence
  - Day Microphysics RGB 1,4,9 – super cooled clouds (Yellow zones)
  - Fog RGB (5-6,8-9,9) and Dust RGB(10-9,7-9,9)
  - Winds at 300-250 hPa: -> CAT areas
  - 925 (W. Africa) ,850, 700, 500 hPa: wind, Div, streamlines
  - Instability Indices (CAPE, GII, TPWC,li..), Lightning data
  - SST (moisture fetch)
  - Temperature data (land)
  - PNG data -> SigWX charts

Application s in Nowcasting :Marine

- Forecast for Marine Industry
- Required data
  - Wind Model (sea height, Swell, wave speed)
  - NWP-> MSLP Low pressure features
  - RGB Night Micro-physics (10-9,9-4,9) TCs
  - Fog RGB (5-6,8-9,9) and Dust RIB (10-9,7-9,9)
  - 925 (W. Africa) ,850, 700, 500 hPa: wind, Div, streamlines
  - CAPE, TPWC, and Lightning data
  - SST

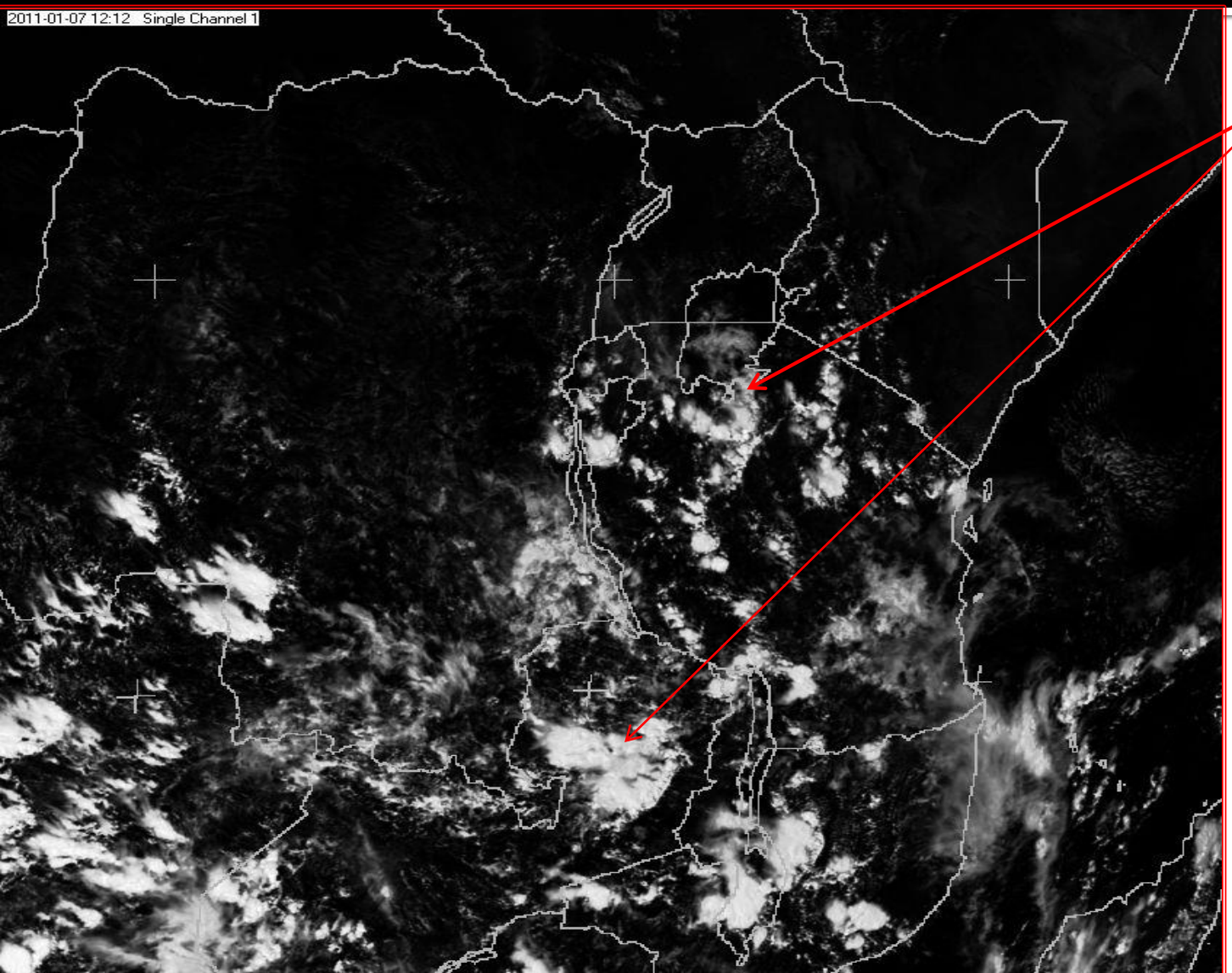
Forecasting Problem approach

- How do I make a good forecast?
- Three fundamental steps
  1. Analysis
  2. Diagnosis
  3. Prognosis
- Analysis: understanding what is happening
- Diagnosis: understanding why it is happening
- Prognosis: understanding what's going to happen next

Steps in Forecasting Using Synergie system:

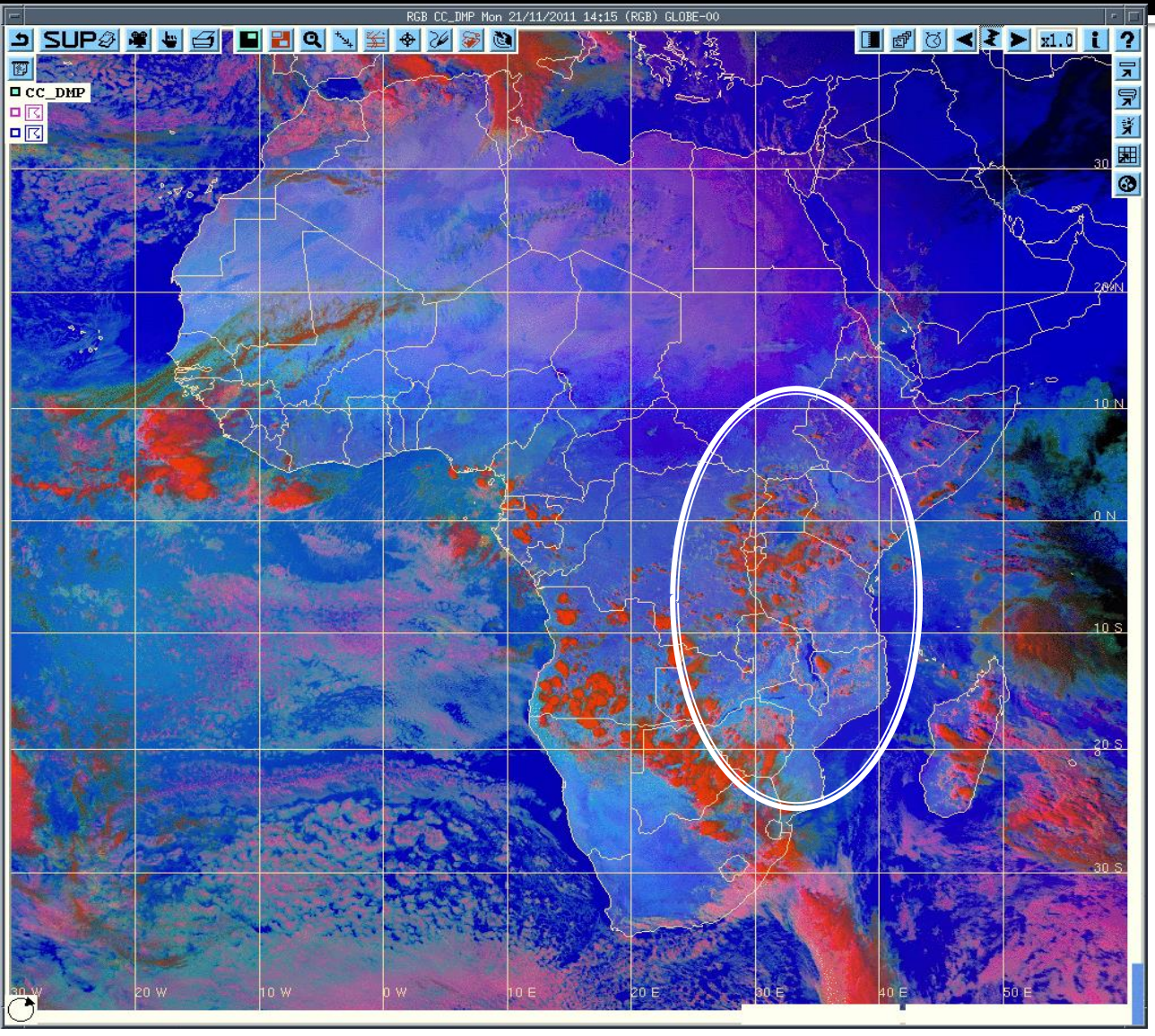
- Step 1. What season are we? What is happening to the Weather?
- Step 2. Display a VIS Image if daytime or Natural color rgb but for the night use Night Microphysics RGB (10-9,9-4,9-0), to identify location of any deep convection by presence of water and ice clouds

Step 2: Display VIS (day)



Several convective cells at different stages of development

Tep 2.1. Day Microphysics RGB 149

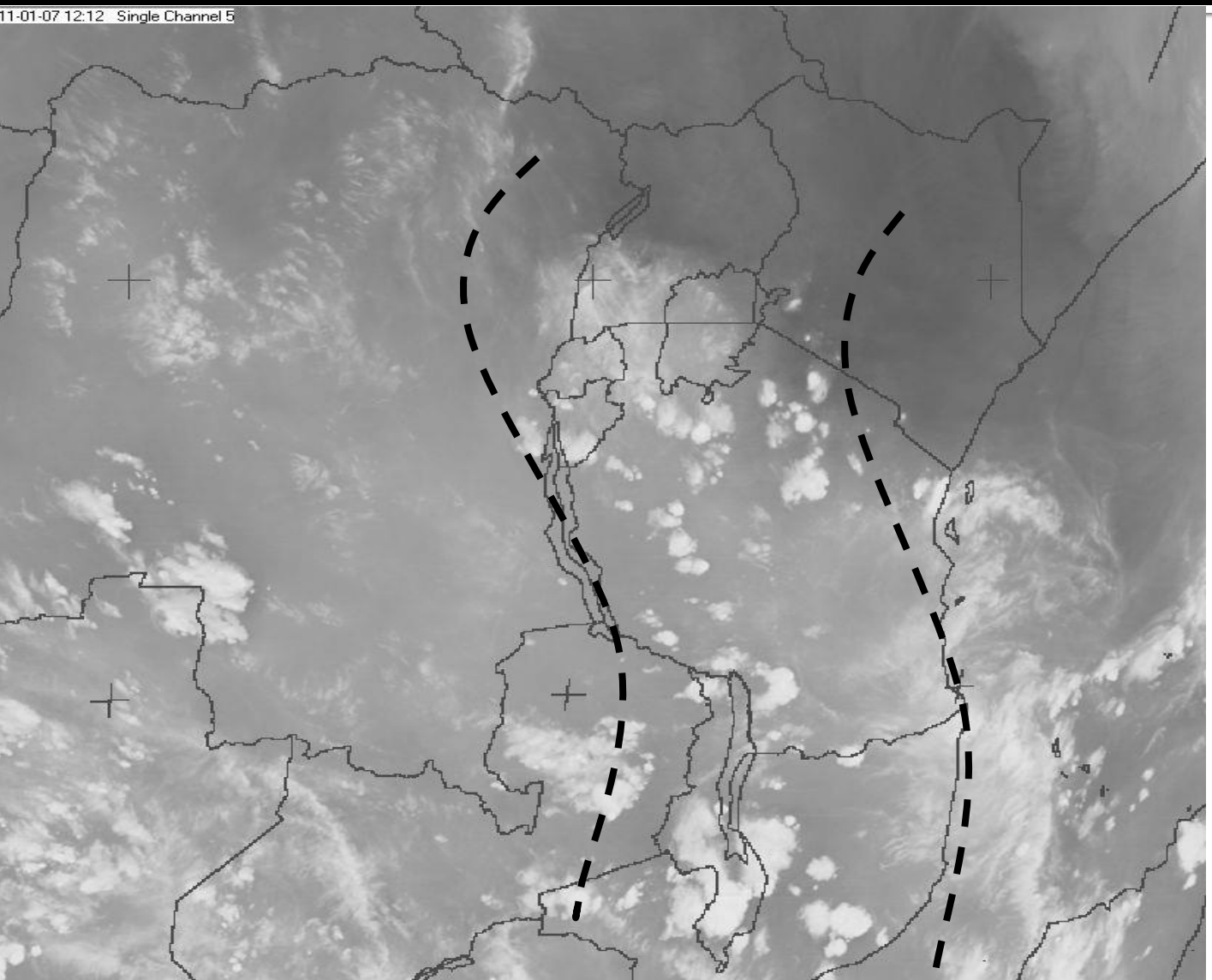


1. Look for Deep convection areas depicted by deep red
2. You may Animate to monitor translation of developments

Step3.0: Use WV5 and WV6

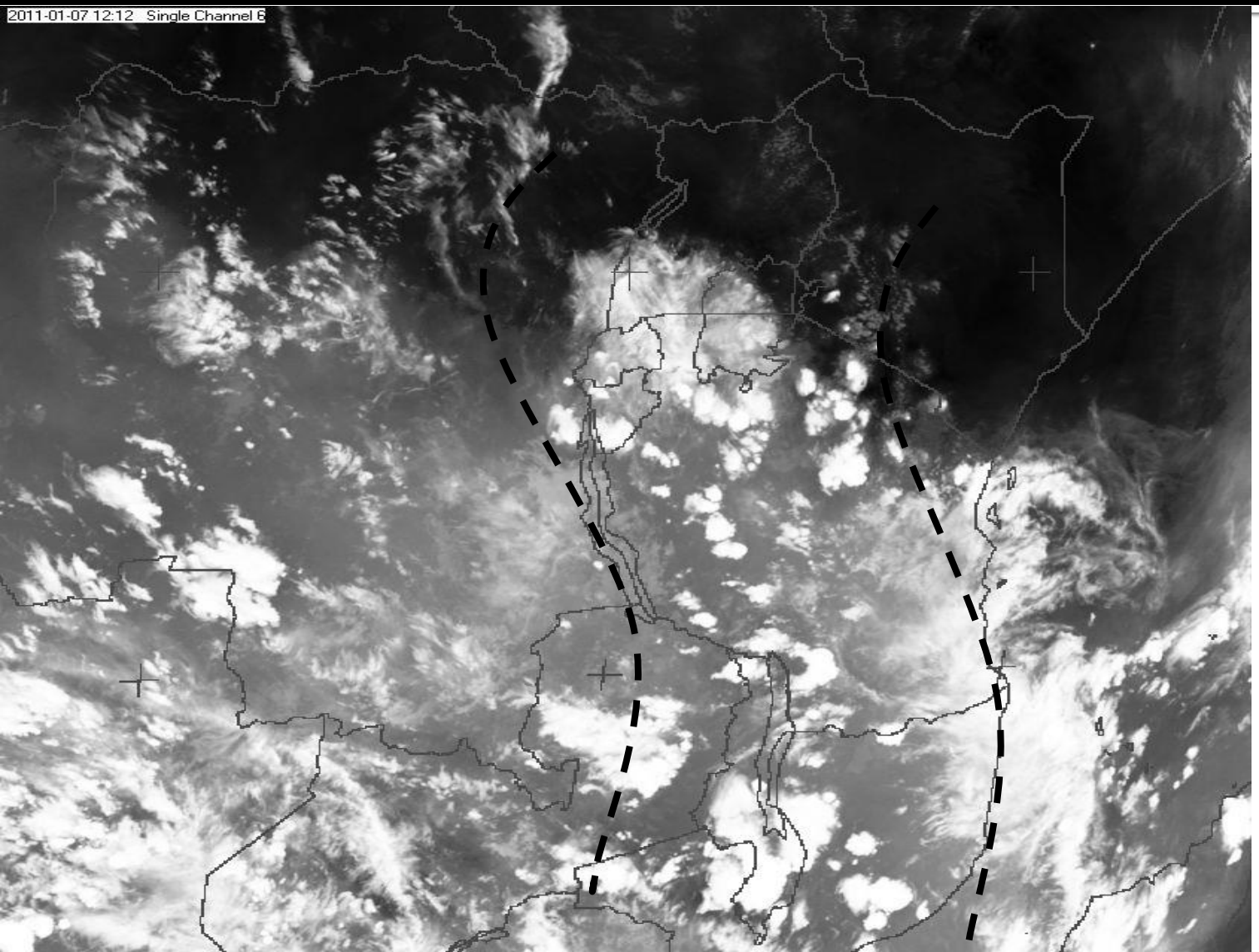
- Use WV 6.2 and 7.3 microns to identify **potential areas with sufficient moisture to support further development (Deep moisture columns)**
- White areas are moist and cold, dark or grey areas are dry on WV and warmer.
- *For Enhanced WV5 (reddish brown is dry and warm, blue is Moist and very cold)*
- Assessment of Upper level moisture from WV5 (6.2)
- Assessment of Medium Level moisture from WV6 (7.3)

Step 3.1 Display WV5 data for Moisture assessment



1. Convective cells are within the high density water vapour.
2. They exist in convergence zone
3. Moisture supply is high
4. Time is 12:12 pm
5. Further development possible likely

Step 3.2 Display WV-6 for Mid Level Moisture



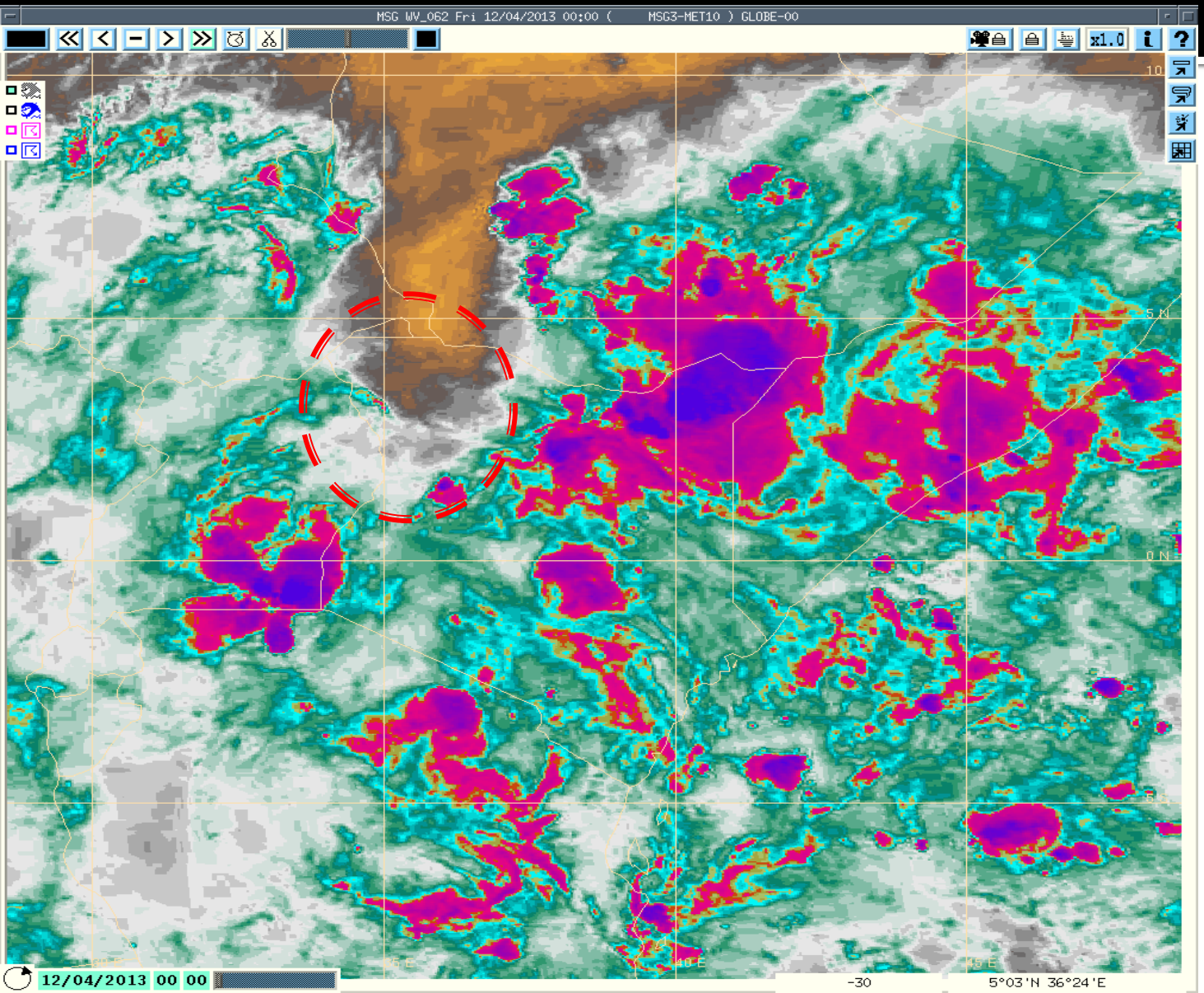
Sufficient moisture at mid levels

Question Is there enough Thermodynamic (Pressure Field) convergence at lower levels and Upper air diffluence (wind data or Animations) to generate deep convection?

Step 4: Animate to Identify trend on convective areas

- You may animate VIS or IR, RGB consecutive images for the last 6, 9,12, 18 hours
- This will answer the two questions:
  - Is convection increasing or decreasing?
  - What direction are pressure systems leading?
  - If there is a system How fast is the system developing?
- Channel 3(1.6): good for daytime as reflectance reduces for developing severe storms and brightness increases for decaying storms
- At night use night time microphysics RGB (10-9,9-4,9-0) or 5-6,8-9,5i air-mass)

What happened on 12/04/2013 animation: from 00:00-09:00; enhanced WV5

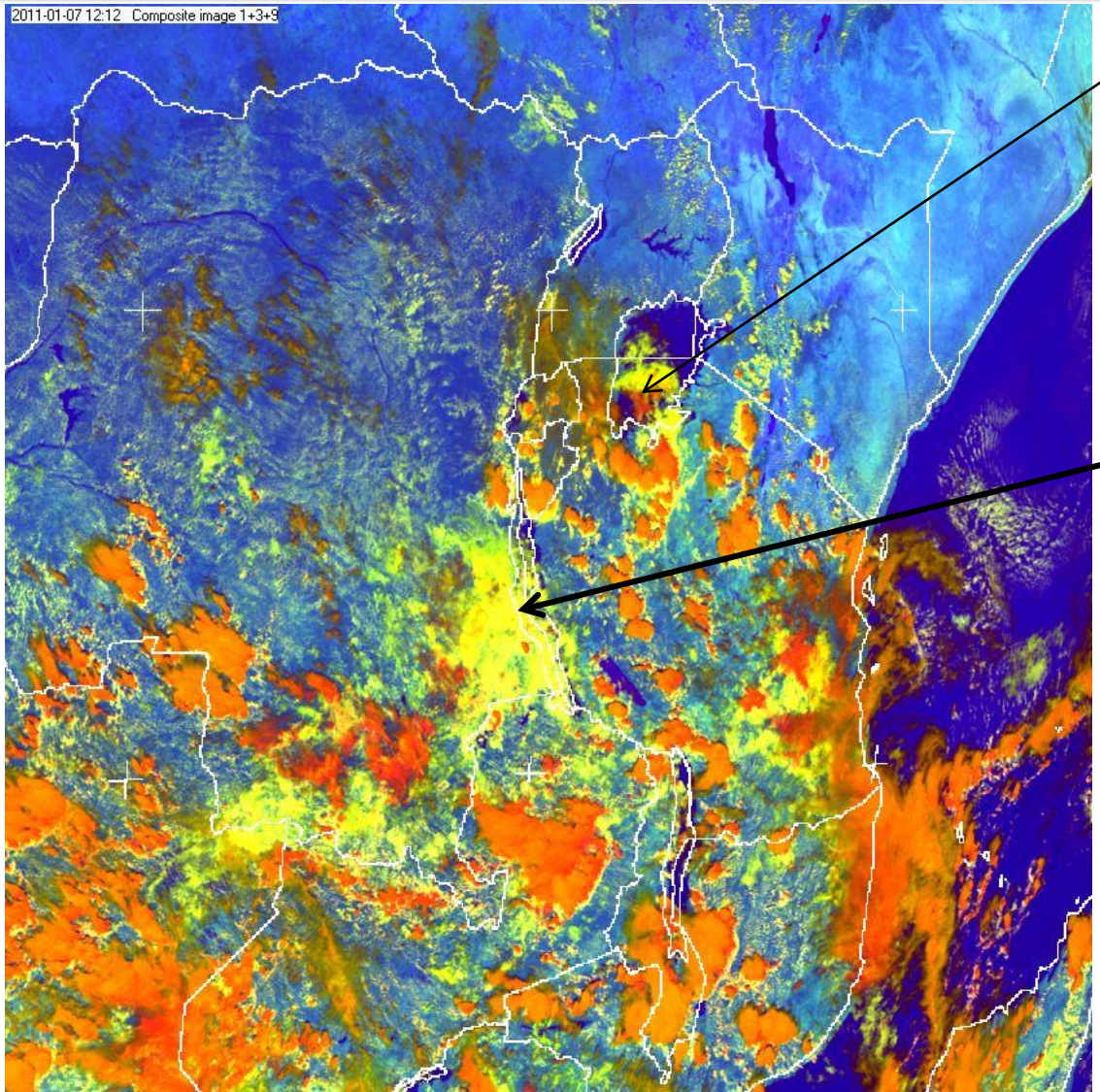


WX OVER L. Victoria
NE and NW Kenya and Somali Coast very violent

NW Kenya at 7:30 Heavy Rains Causing flooding and death

Very Dangerous stom. Cpud temp, -81C

Step 5:Confirm microphysics or stages of convection by RGB139



Deep dirty brown indicates very cold large ice clouds.

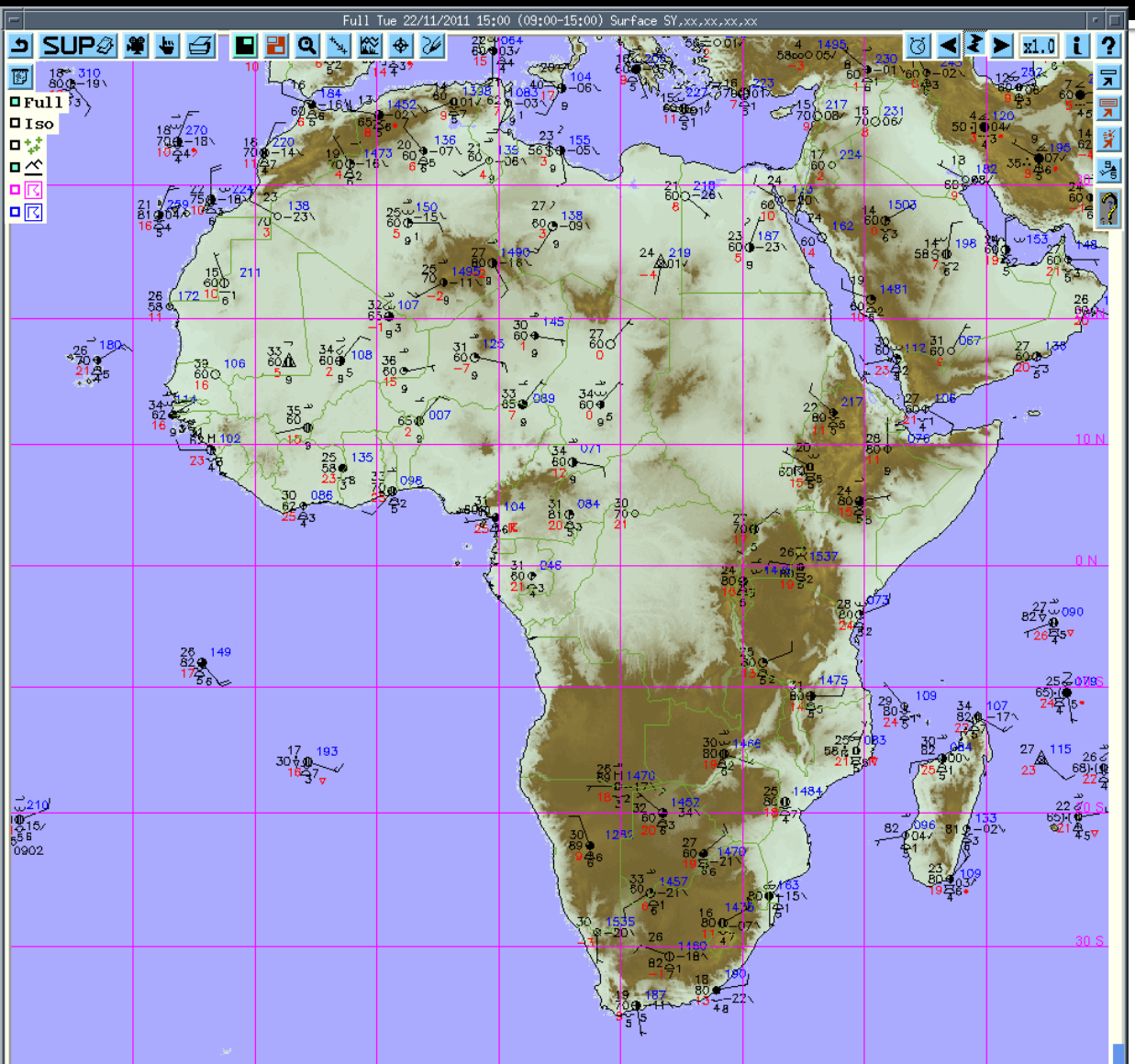
The yellow areas are clouds with small ice and water clouds at stage of development- Super-cooled (-33 deg) clouds, see over lake Tanganyika.

•Cyan is cloud free and warm
•Deep Blue is warm water body.
•Thin Cirrus clouds appear dark brown

Step 6.0: Get synoptic data 6-24 hours

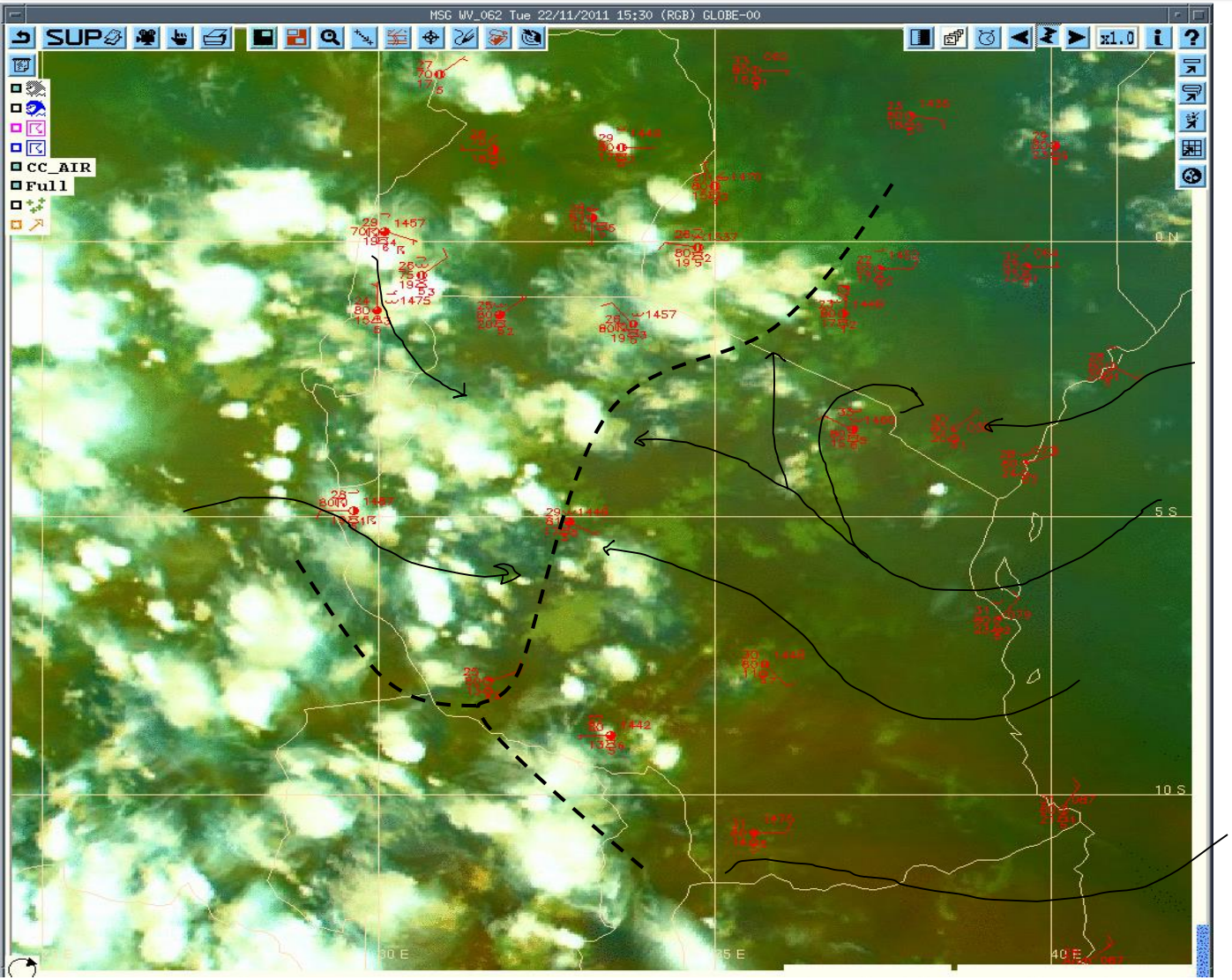
- View reported synoptic data for synoptic hours.
- Confirm from dry bulb and web bulb data for drying or increase in moisture from depression values (T_a-T_d)
- You may use **conditional plotting** of Synergie tools.
  - Area whose(T_a-T_d) <=1 Moist or cloudy
  - Areas whose (T_a-T_d)=>8 dry air conditions

6.1. Full Synoptic chart at 15:00 utc



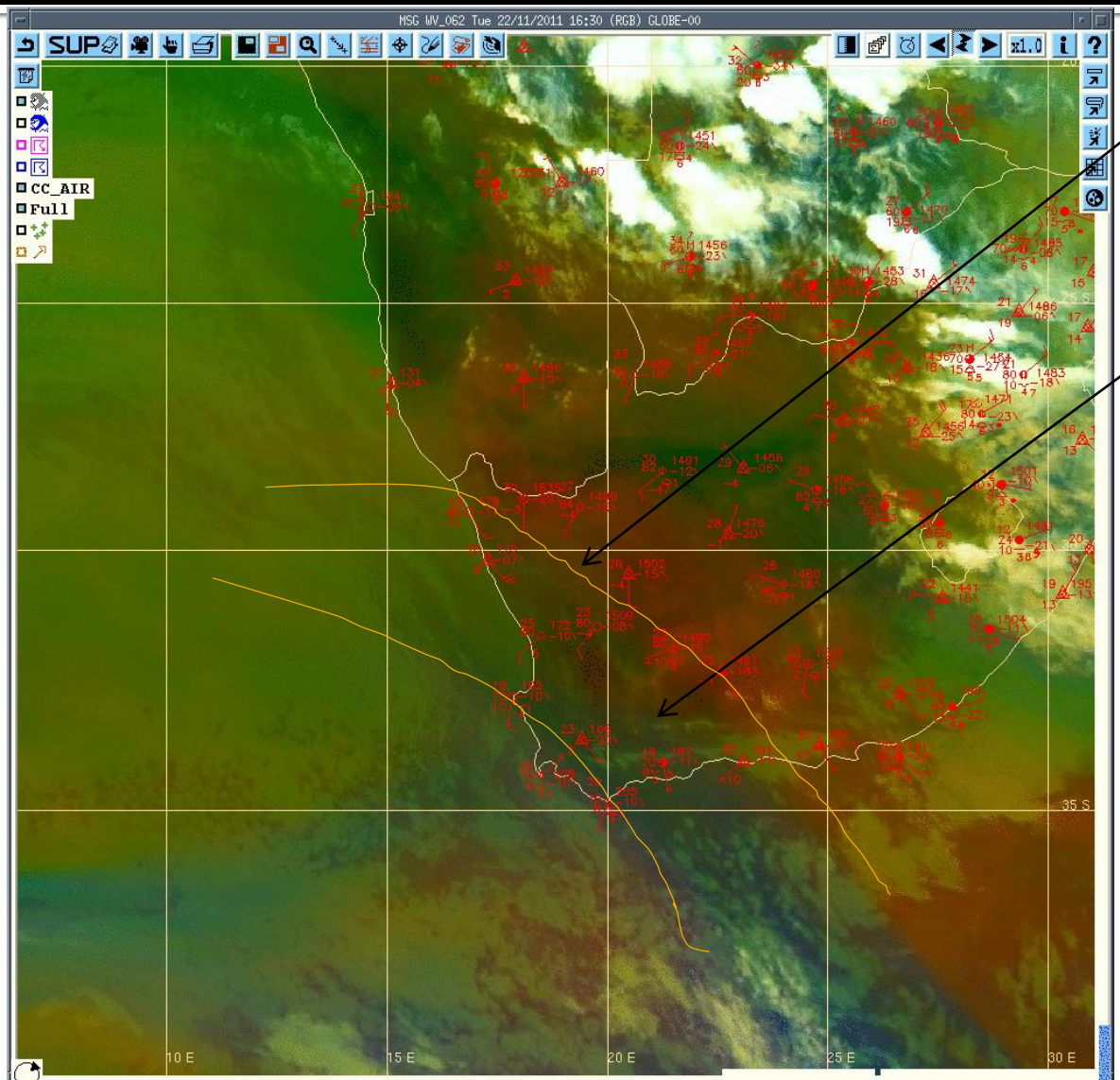
You need confirmation of some reports on the ground. Scarce data stations requires to be complemented with Satellite data

6.2: Overlay Display: Airmass rgb , Synoptic chart Surface obs on eg 22/11/11



1. Current Wind analysis suggests a convergence zone as shown
2. Position of deep convection is supported by convergence of the winds
3. Moist Easterly winds supply moisture

6.3 Synoptic chart: with Overlay Airmass (e.g. SA -22/11/11)

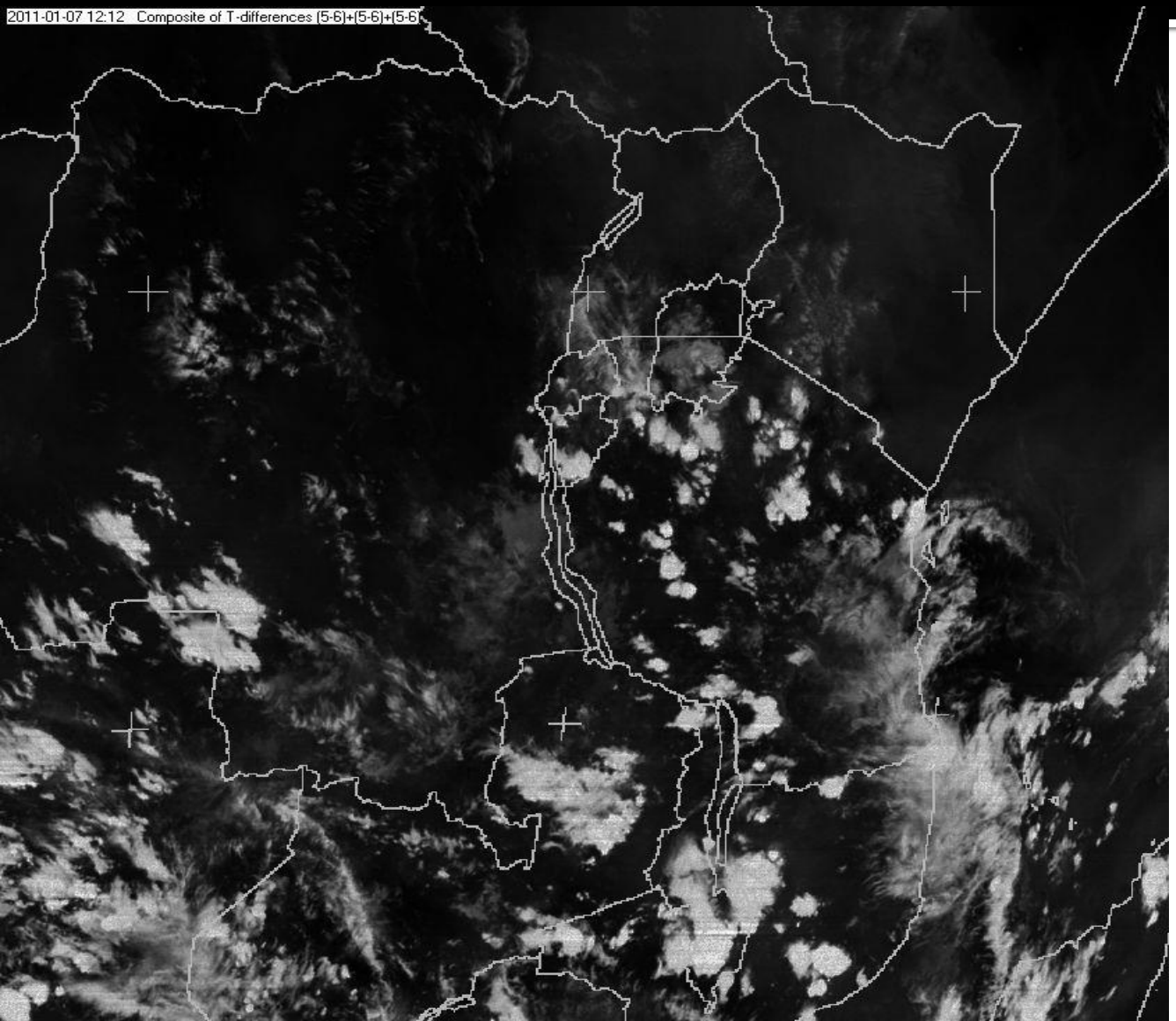


1. Dry cold air-mass from Southern Tip of Africa.
2. This appears to be under St Hellena high pressure ridge (descending air). supports synoptic p/gradient
3. Moisture: dry bulb 30°C wet bulb -4°C. (Dry air)

Step 7. Severe Weather arises from deep convection (WV 5 and WV 6)

- Deep convection goes beyond medium (WV6) and upper tropopause(WV5) hence
- Solar radiation and Thermodynamic processes that cause the: BT Diff (WV5-WV6) >0 generates TS and Heavy Showers/ rain
- Mechanical lifting (convergence zone or orographic lifting) contribute to development of severe weather.
- Global Instability Index (GII), K>40 means 100% possibility of severe thunderstorms & s showers

Step 7: Analysis WV5-WV6 product



Interpretation:

>Dark is negative

>White is positive or greater than or equal to zero

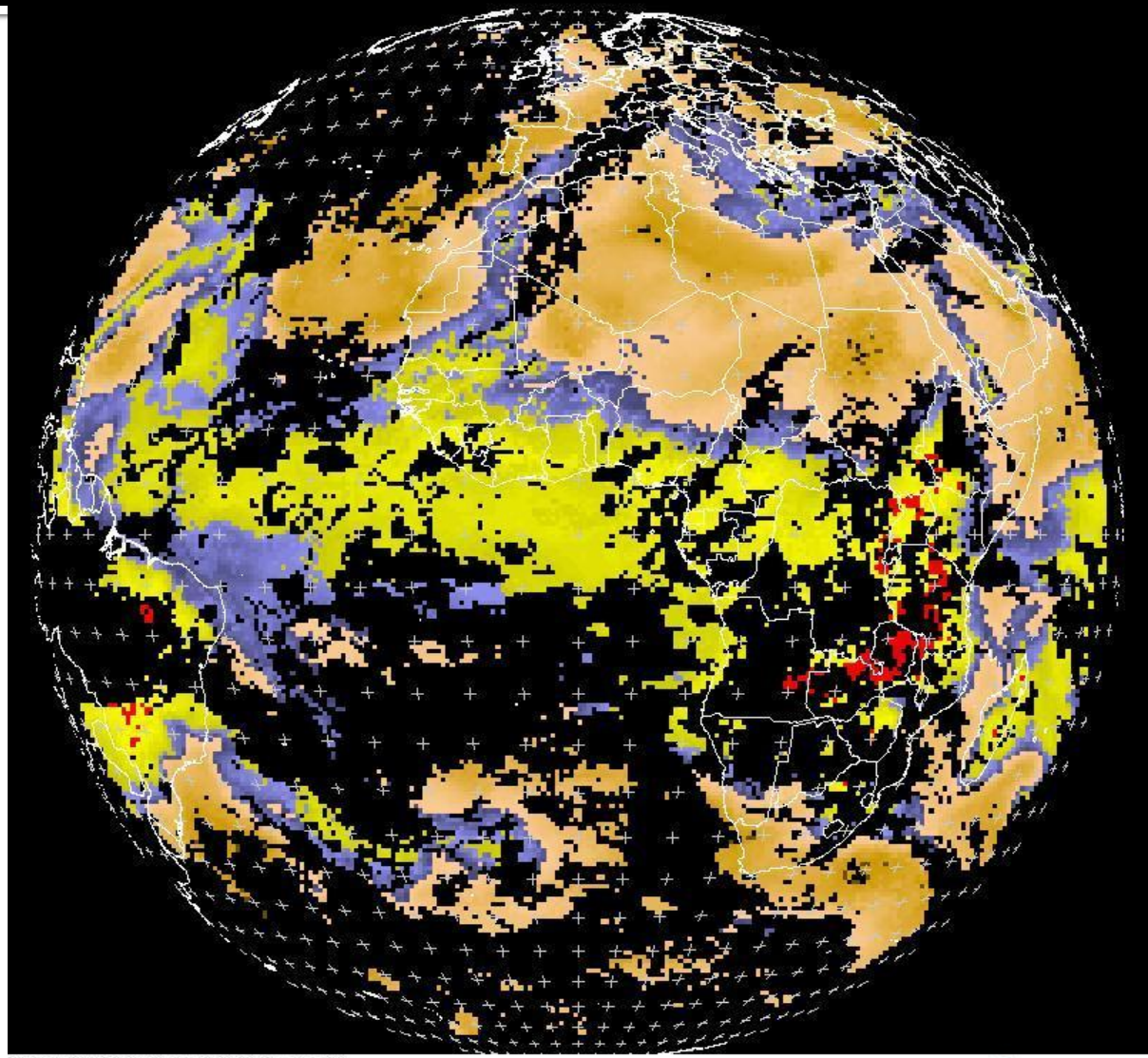
Use storm RGB (5-6,9-4,3-1)

8.0 Analyze Global Instability Index (GII) Hail Storm (K Index)

K –Values legends
Cyan
K>20 showers possible

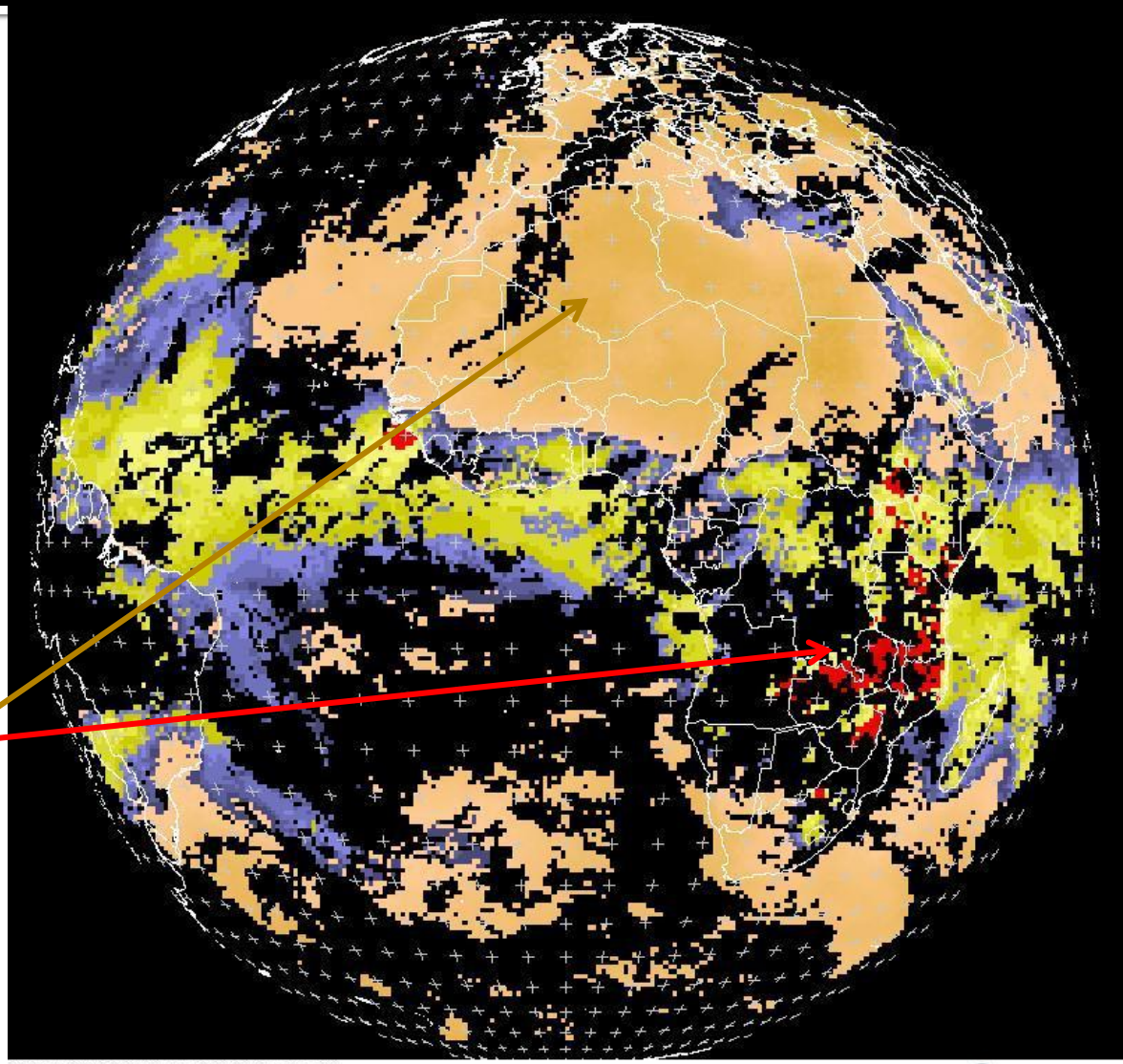
Yellow
K>30 -- 60-80% chance of TS

Red
K>40 100% chance of Showers and Thunderstorm
Black= cloud mask
Brown Desert,



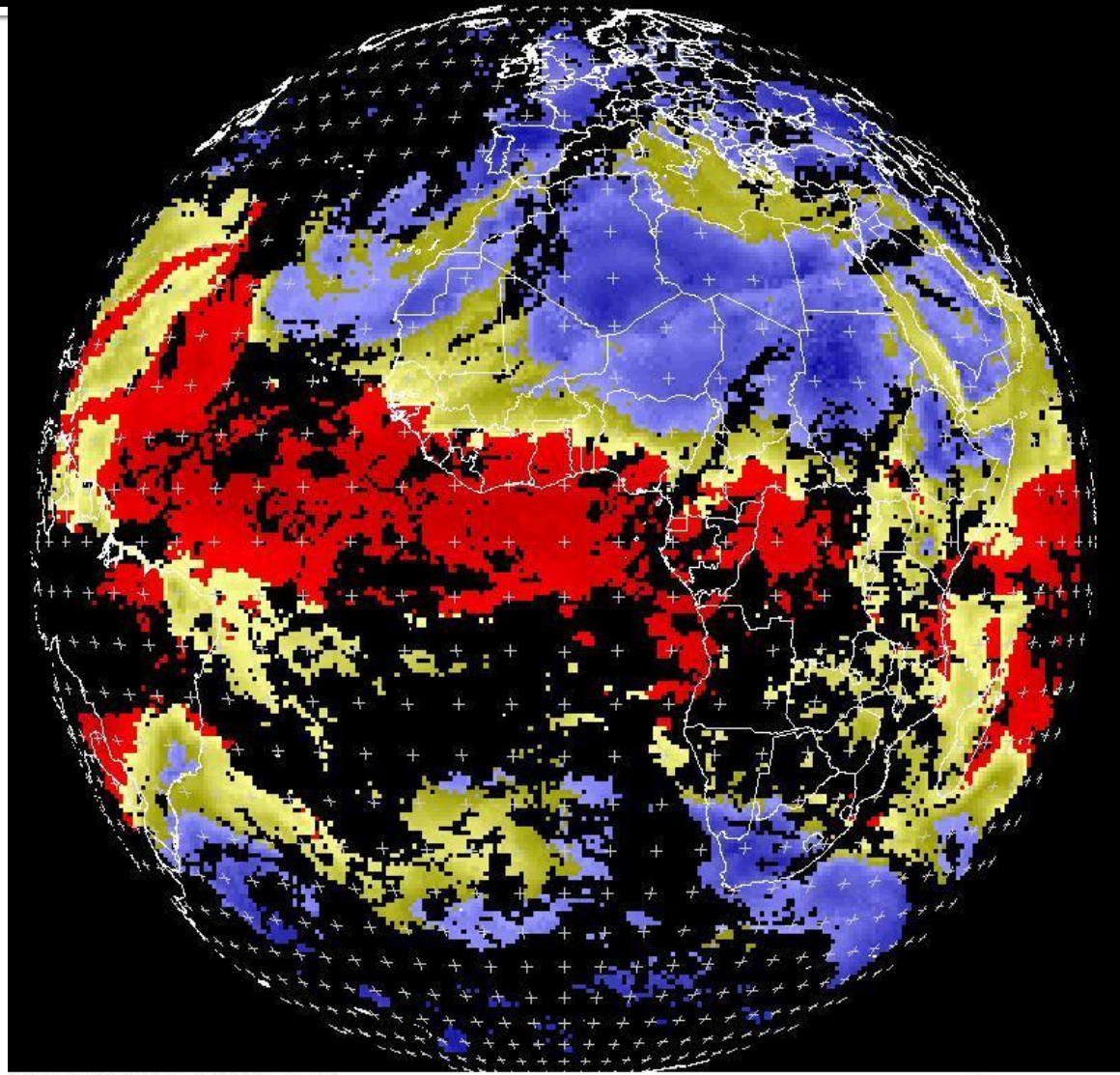
8.1 Global Instability Index (GII) Hail Storm (lifting Index) 3-6 hrs

- Negative values mean Buoyant atmosphere
- -10<Li<-5
- Thunderstorms likely
- Red
- Brown stable



8.2 GII -Total Precipitable Water (TPW)

- Color code
- Black=Cloud Masked
- Red=High precipitable water
- Yellow= less 60 % partially
- Blue= Dry

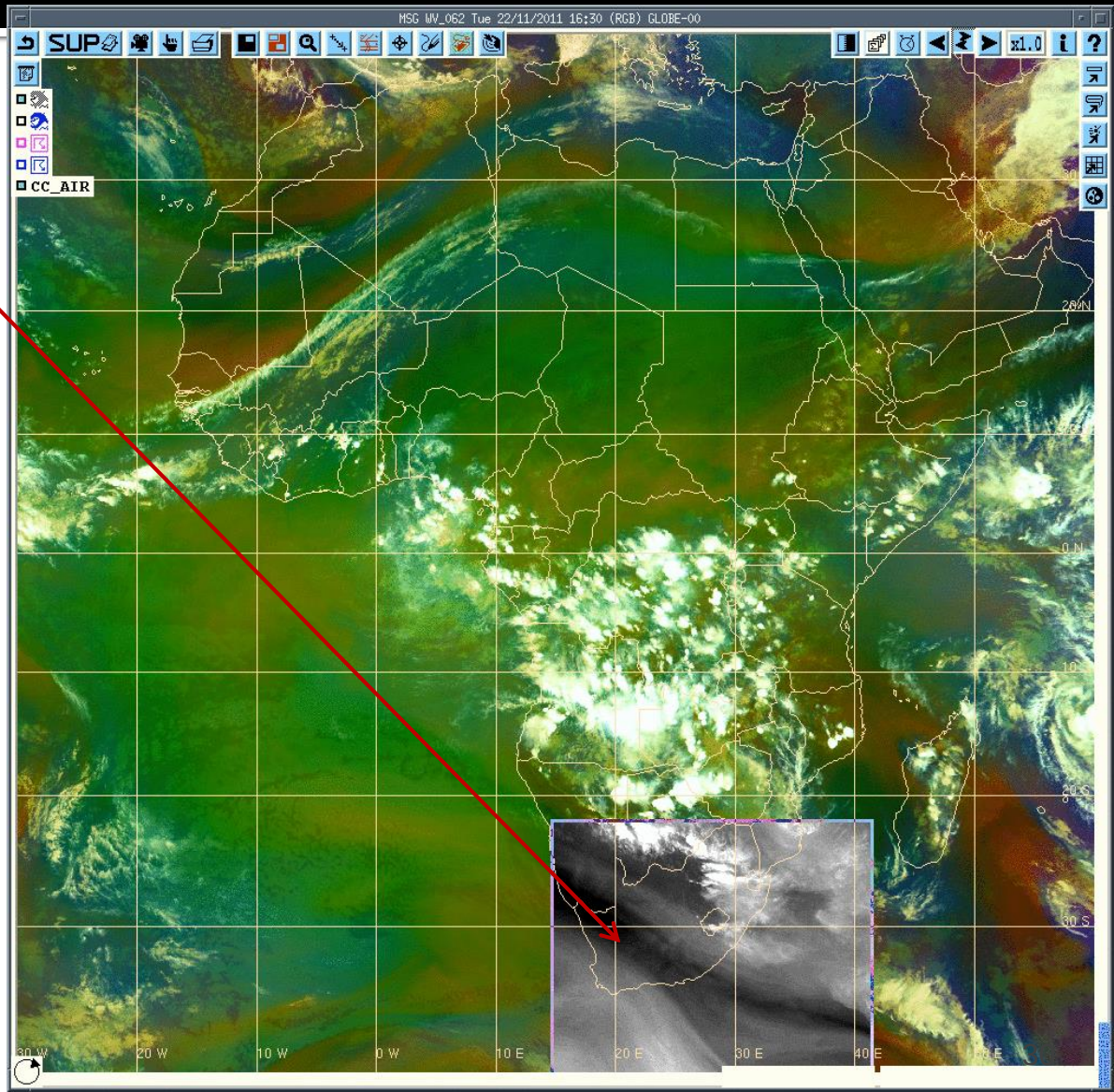


Step9: identify deep moisture in WV5 from AIRMASS RGB

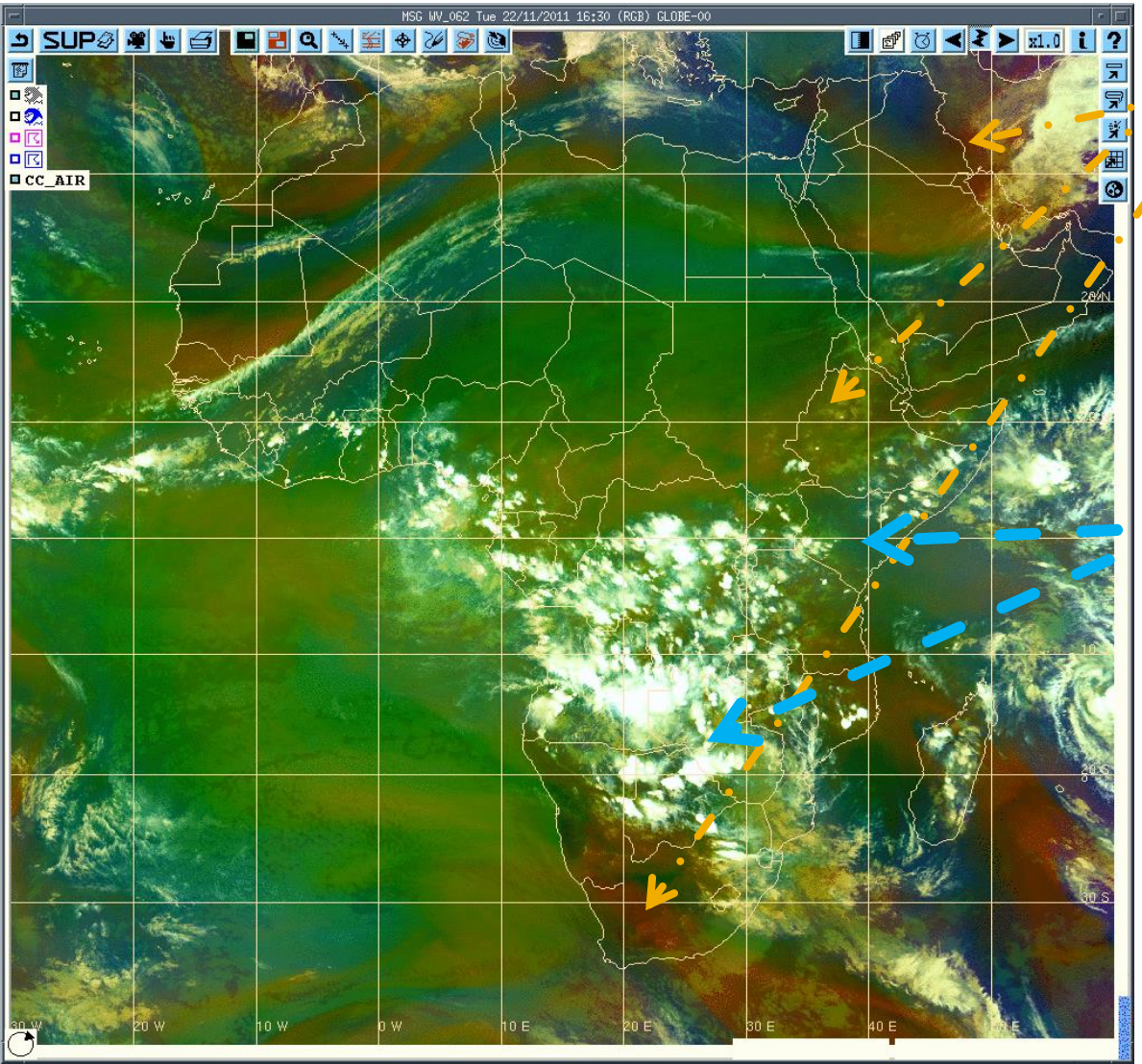
Synergie Under tool important for comparison

WV5 under Airmass RGB

Interpretation:
Dry airmass is brown color



Step 10: AIRMASS RGB (5-6,8-9, 5i)



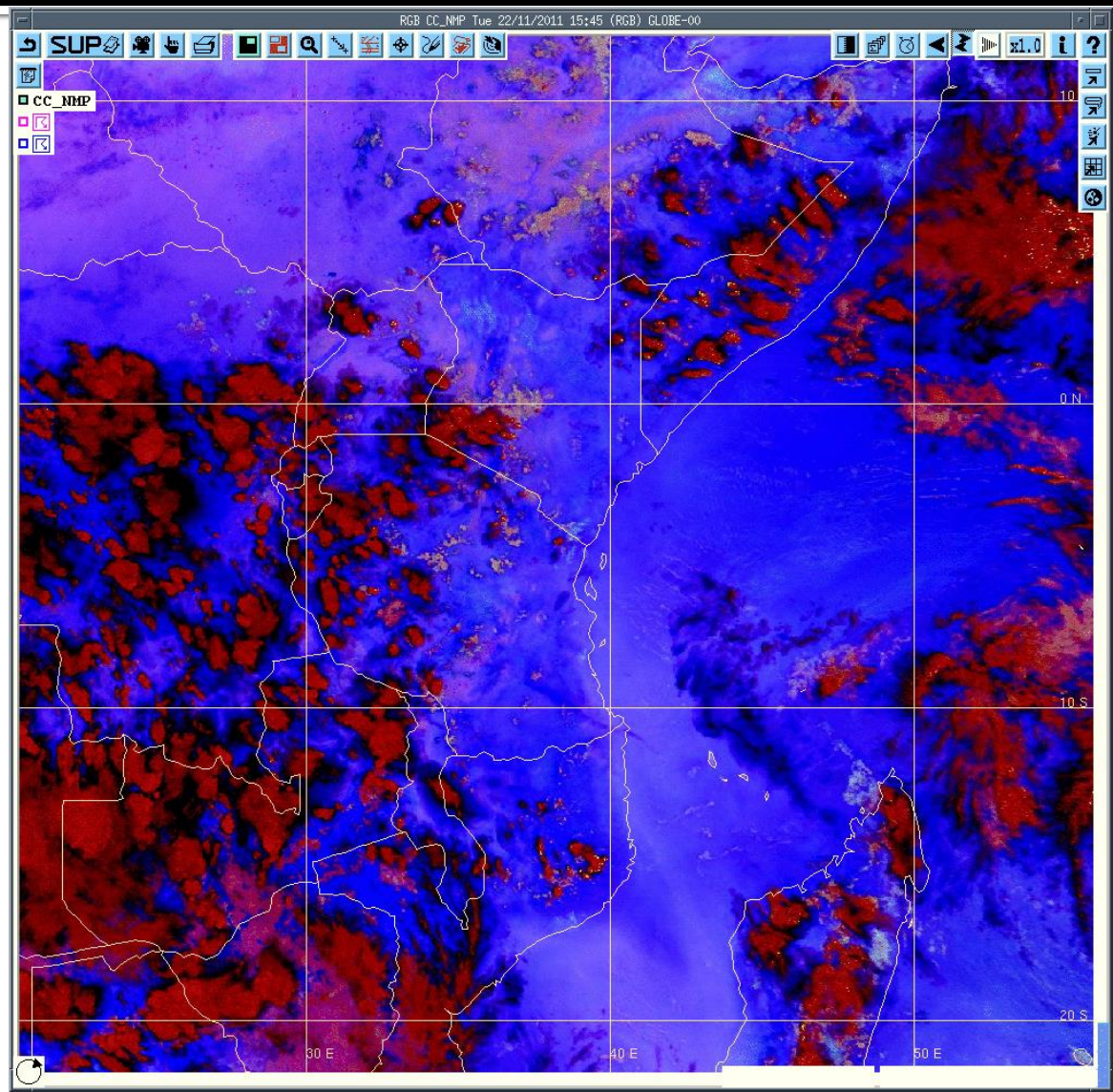
identifies dry air associated with ridges

high cold clouds above moist air mass

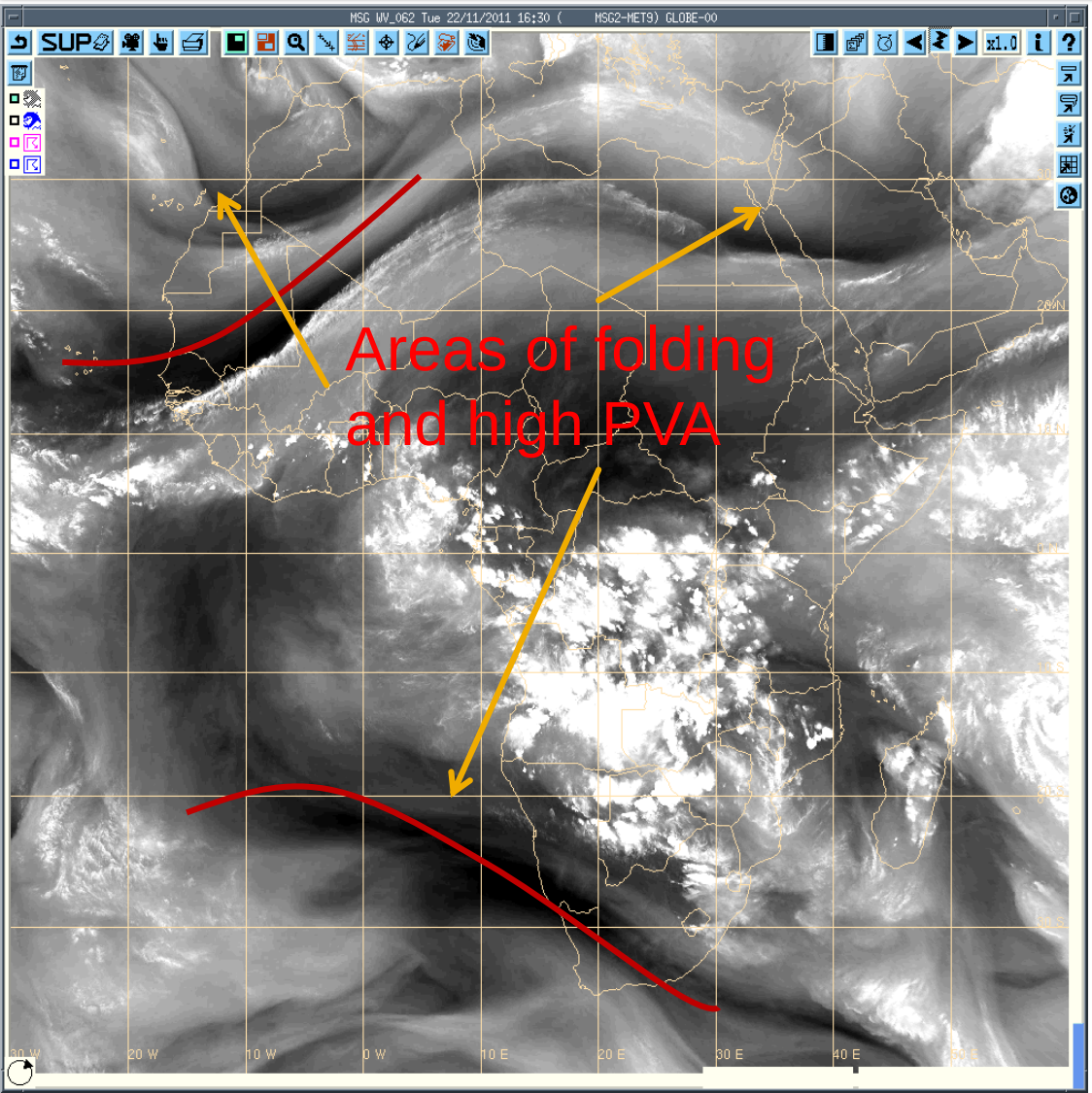
Green are areas with Relatively low moisture/ at medium layers

Step 11.Identify Areas of deep convection on NMPRGB(10-9,4-9,9)

- Night microphysics RGB
- Areas of deep convection in Red
- Blue=open land or Sea surface
- Pink=low level water clouds



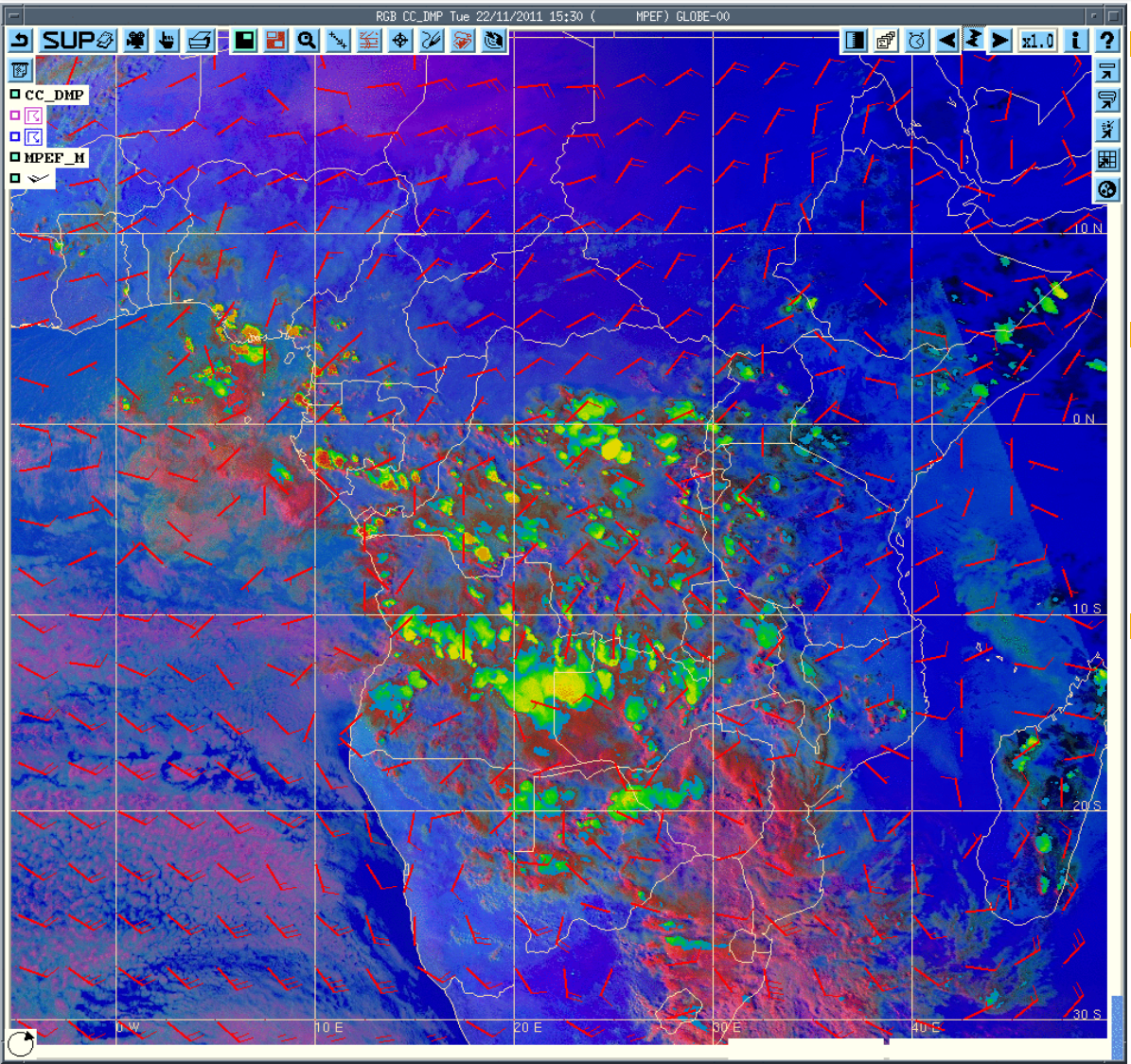
Step 12: Identify positions of Jetstreams, strong PVA on WV5 and Moisture field



Positions of Jet streams affects:

1. Weather in their region of Influence by by creation of strong outflows at the troop-pause level .
2. The Onset of a season and its performance;
3. PVA +ve areas causes atmospheric Instability such as folding that initiates pressure falls (deepening of troughs)

Step13: Overlay NWP wind at 850 hPa and MPE

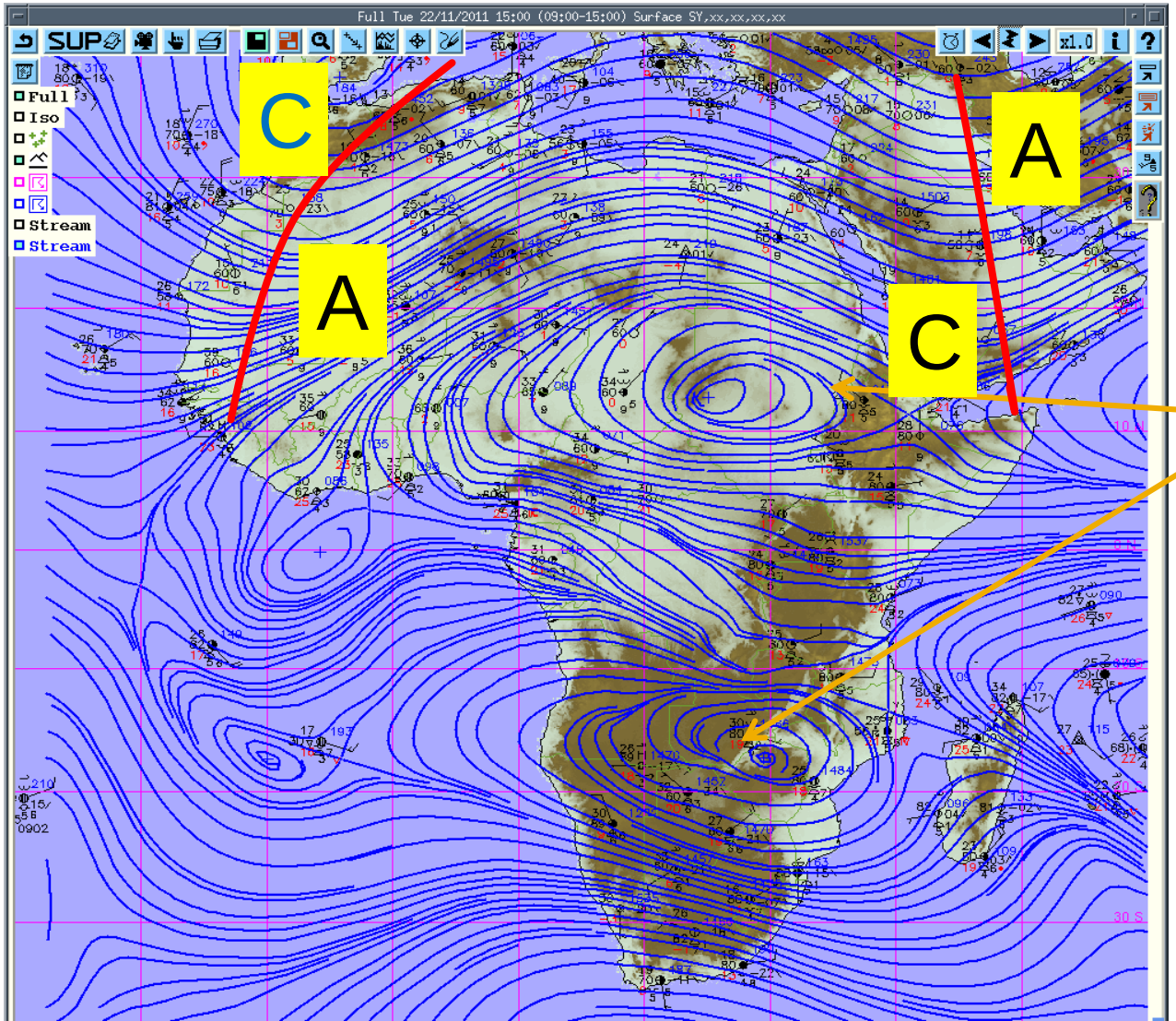


- Areas of low level convergence
- Corresponds with areas of deep clouds
- Producing MPE rates /values

Step 14: How will upper levels contribute to surface weather?

- Dines compensation law stated that if we have pressure rises (Falls) at upper levels this will cause pressure falls (Rises) at lower levels to compensate for the mass
- In meteorology, *Dines' compensation* states that net mass convergence into a given column of air must be balanced by a net mass divergence from the same column of air

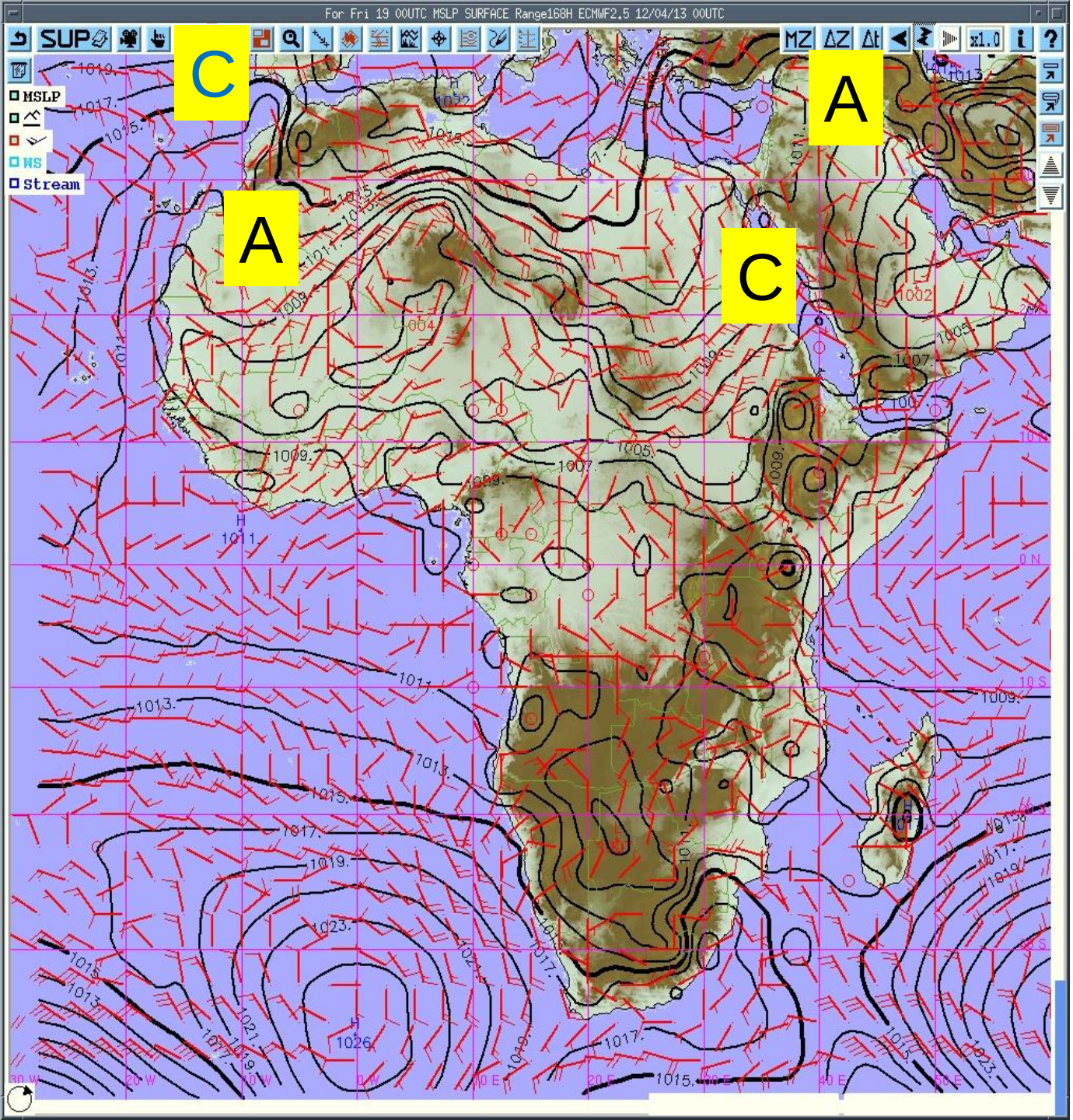
Step 14.1 Dev .Term: A and C areas (Synoptic Surface and 200 hPa stream lines)



Streamlines on 200 hPa BLUE

Notice the position of Outflow on 200 hPa areas

Development term along trough axis or ridge lines at 200 hPa may initiate changes on **surface pressure**

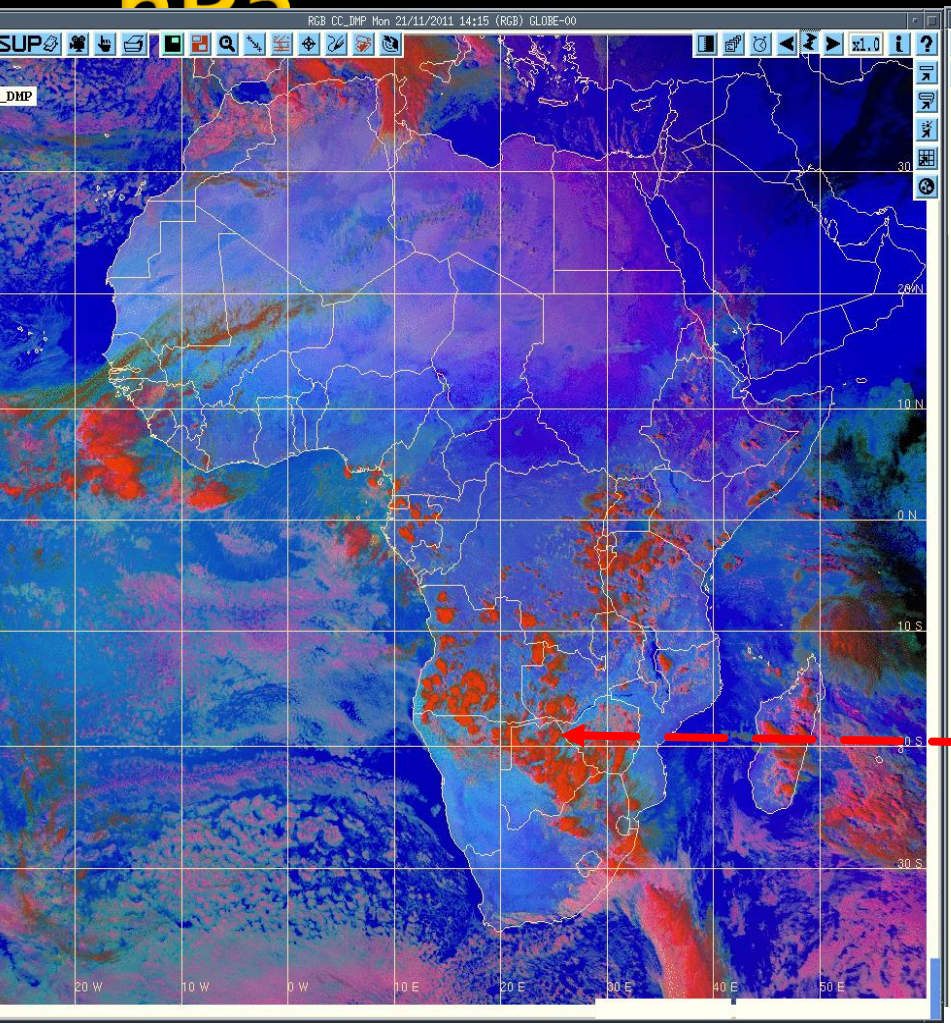


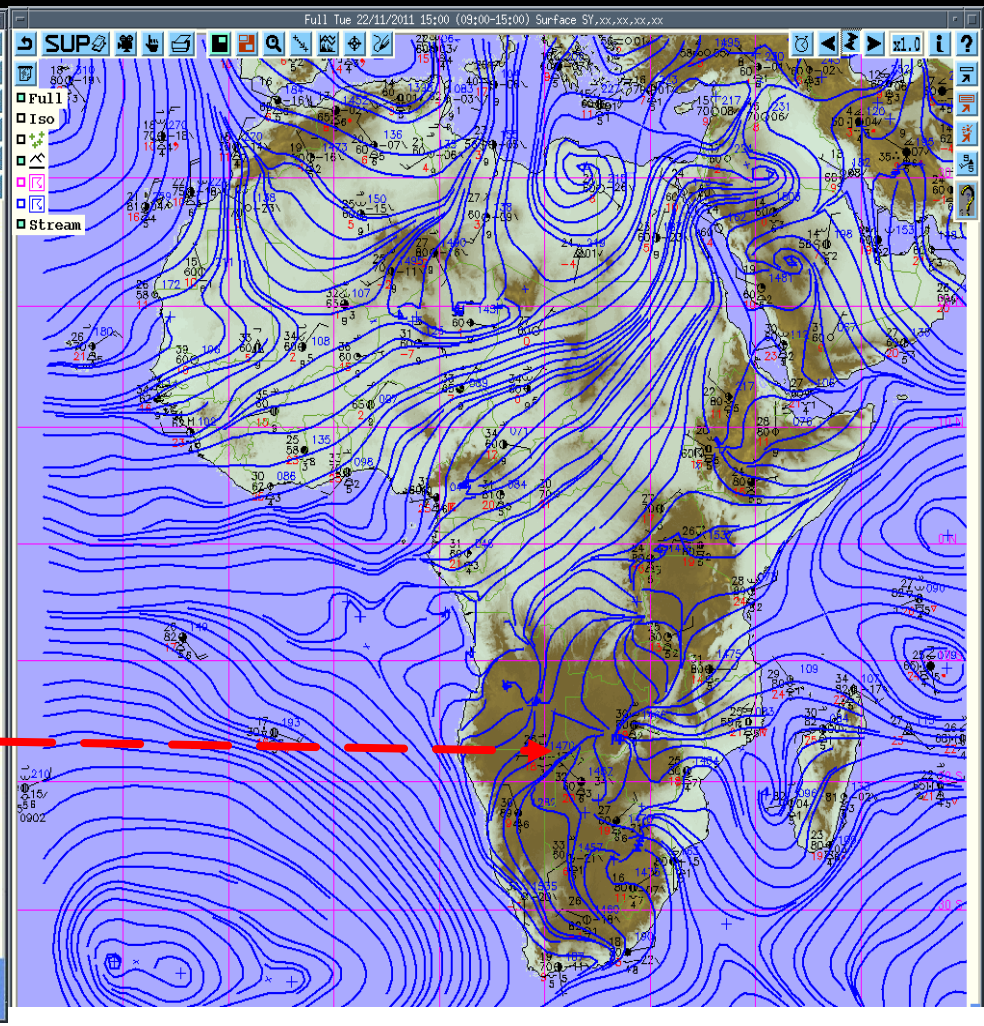
Surface Pressure and Wind patterns

C – pressure falls) weakenig Libyan ridge

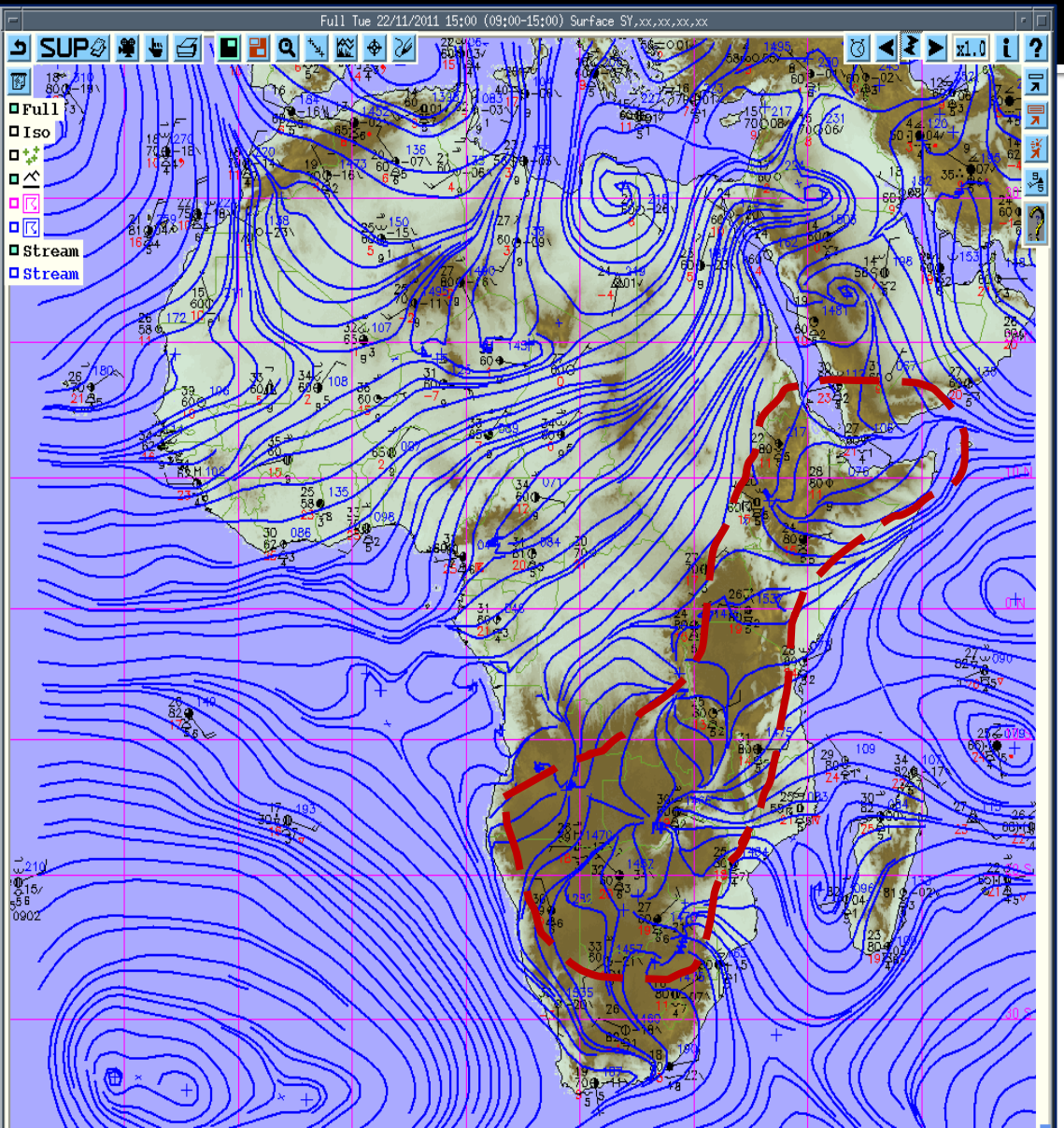
A- Pressure rises- Enhancing Azores High

Step 15. Compare deep clouds on RGB and NWP streamlines at 850 hPa



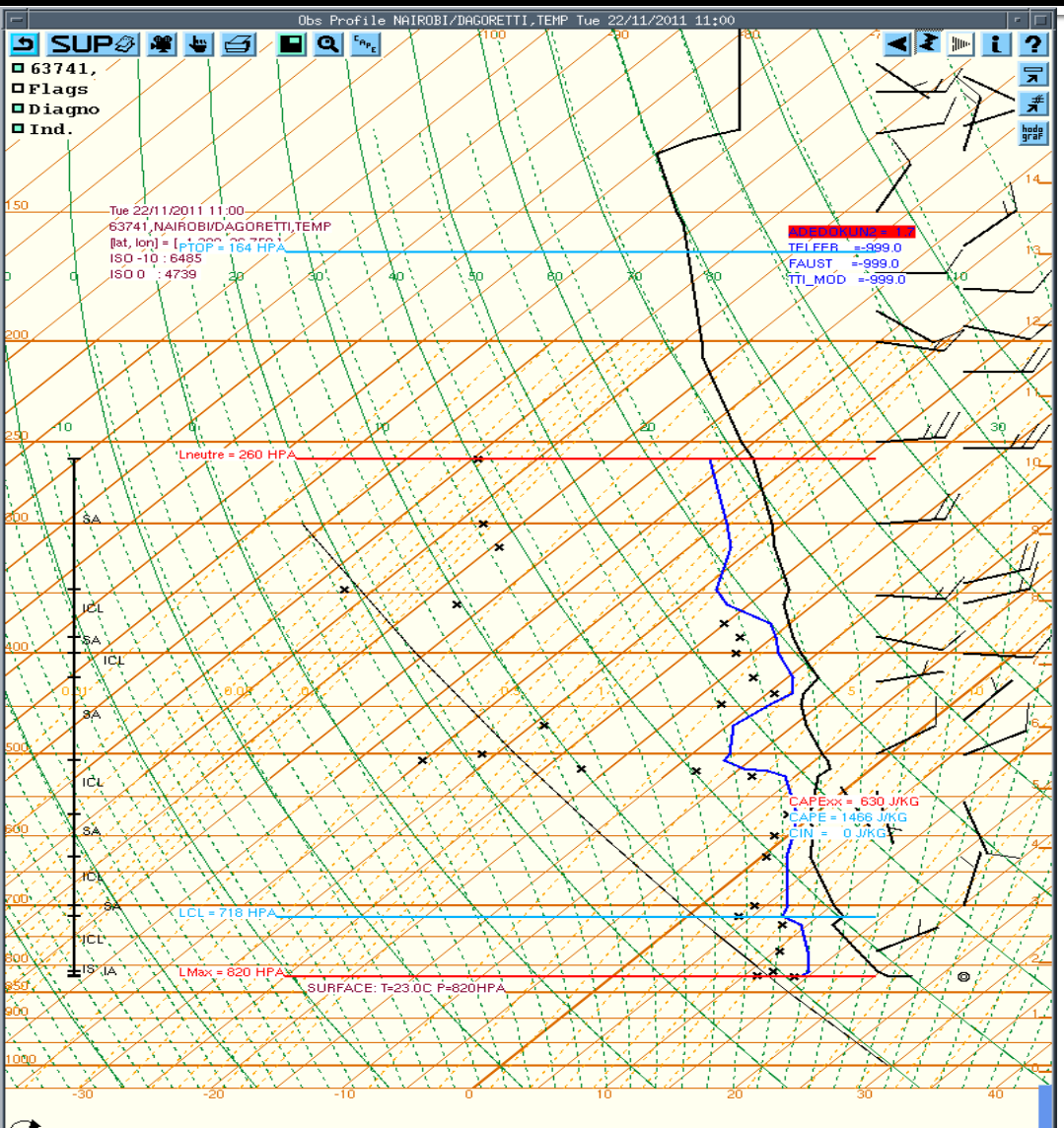


NWP in Severe WX FCASTING



1. Since NWP data ,Synoptic data And satellite data are in agreement :
2. The Belt of convergence on NWP wind analysis on 850 hPa identifies areas of expected Severe Weather.
3. **On the Meridional** arm of the ITCZ
4. I have confidence in the NWP products

Step 16. How unstable is the atmosphere : Vertical profile for Nowcasting.

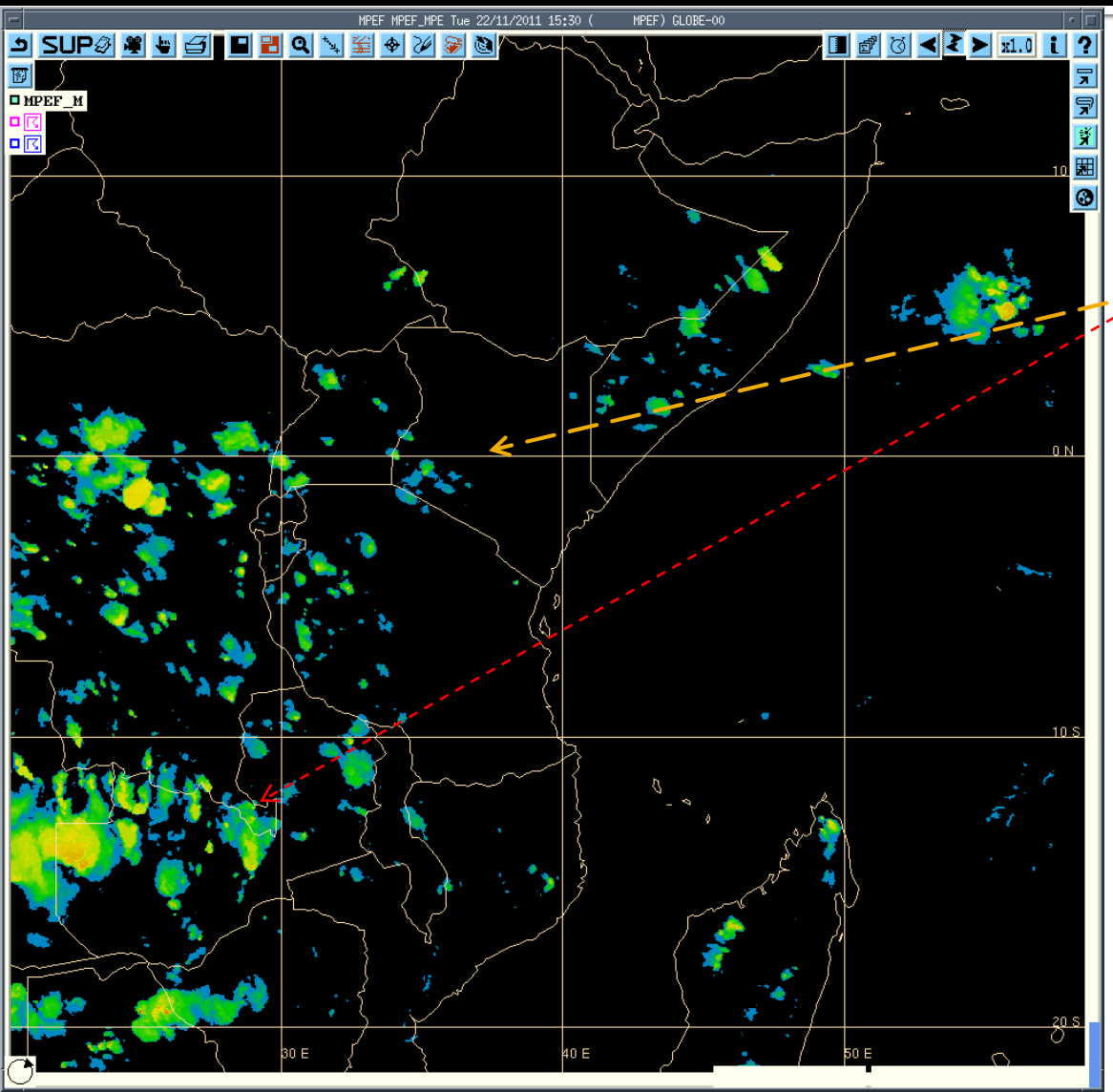


Ascent analysis:

1. Very Unstable at lower levels.
2. Generally moist atmosphere but dry at 450 hpa
3. Easterly Wind pattern conducive for afternoon WX activities

Index: possibility of Showers and T/S over several places over Nairobi and Highlands East

Starting point MPE Rain estimate



1. Will the forecast Sustain the weather Or Reduce or provide more weather **than has been observed**?
2. Solution:

   It depends on the evolution on pressure patterns with time.

Step 17: Based on the Analysis, Diagnosis , and prognosis

Prognosis: slight Pressure build in over Azores activiting the ITCZ , Unstable atmosphere, Supply of Moisture::
The 24 Forecast for Kenya is expected as follows:

- HE/NA : PTCN-> followed by SIM leading to Scattered SWs and T/S in afternoon
- HW/LB Isol SWS TN, SIM, Isol SWS &TS in Afternoon.
- COAST& SE: PCTN, ISOL SWS Morning,Sunny rest of Day.
- NE& NW PTCN , Isol rains in Morning, SIM rest of Day. (Moist Eastery flow identified over Kenyan coastal rising from Indian Ocean)

Macro management: Synergie and Macros

- Save all steps as Macro for future use.

Summary

- Use Yesterday and current Satellite data for assessment (Analysis)
- Look at all data: NWP to find agreement with your assessment (Diagnostic/ Analysis)
- Make your Forecast based on all available information impacts of possible changes in Pressure fields (Prognostic)
- Validate your forecast by other reports (Satellite Imagery and ground report)
- Rectify your forecast failure → Improve