Exercise 2. Evaluating a Perturbation in the Trades using WINGRIDDS

1. Open the program WINGRIDDS:

2. Select and open the forecast file.
   a. In the menu, click on the icon to open the file PCG.
   b. Select and open the following file: **OCT090912.AVN003**

3. Inside the command line, we need to specify the analysis area.

AREA 9 80 23 *Esto cambia el área que se va a desplegar, con un punto central en 9N 80W, y una apertura de norte a sur de 23 grados.*

Detection of Waves/Triggers

4. Using winds and vorticity, evaluate the presence of waves in the trade winds.

4a. Wave at 850 hPa.

LAST LT00 CLRN/RVRT WIND DOTS GT00 CLR6/BKNT/STRM WIND 850/ANIM

This sequence of commands plots an animation of the flow at 850 hPa (STRM WIND), winds in barbs in knots (BKNT), y and relative vorticity (cyclonic in red).

- Which type of circulations can we associate with the perturbations in the trades, cyclonic or anticyclonic?
- According to the model, at forecast hour F12, where can the perturbation be found?
- During which period does it enter in Colombia?
- During which period does it exit Colombia?
- What happens when it interacts with the Panamanian Low?

Determine the propagation speed.

- What distance does it travel from F12to F24, in degrees?
- What is the speed of the wave in knots?

To estimate the speed in knots, divide the degrees advanced in 24 hrs by .4 . For example, if the wave covers 4 degrees it is moving at approximately 10 kt.

Please stop the animation.

4b. Wave at 700 hPa.

In the menu, click on "***Command History***" until the previous command appears. Then edit it and change "850" by "700" so it reads::

LAST LT00 CLRN/RVRT WIND DOTS GT00 CLR6/BKNT/STRM WIND 700/ANIM

This sentence provides an animation of the 700 hPa flow (STRM WIND), winds (BKNT) and relative vorticity (cyclonic in red).

- What do we gain by analyzing the mid-level flow?
- What does this tell us about the vertical structure of the perturbation?
- According to the model, where is the perturbation at F12?
- Does this coincide with the observed at 850 hPa?
- At what time does the wave enter in Colombia?
- At what time does the wave exit Colombia?

Please stop the animation.

5. Using winds and equivalent potential temperatures, evaluate the presence of waves in the low-level trades.

THTE CIN3 GRTN 357/THTE CIN3/BKNT 850/ANIM

This command creates an animation of the winds at 850 hPa and the equivalent potential temperatyre (THTE). Values higher than 357K are displayed in color purple.

The equivalent potential temperatura is a scalar with conservative properties. This means that as wave propagates, its equivalent potential temperatura will be nearly constant. Using this variable is an alternative to follow waves in the trades.

- What is the value of THTE once the wave enters the Caribbean by 24 hrs?
- What is the value of THTE once the wave enters the central Caribbean by 42 hrs?
- What is the value of THTE once the wave enters the islands of San Andres by 60 hrs?
- What happens with the values of THTE once the wave propagates away?
- What does this information suggest us?

Please stop the animation.

Convergence and Divergence

6. Evaluation of the convergence and divergence at low levels.

WDVR GT00 CLRN C5-6/WDVR LT00 CLR6 C5-6/BKNT 850/ANIM

This command produces an animation of the 850 hPa winds (BKNT) and wind divergence (negative values in red).

- What does negative divergence imply?
- What types of vertical motions are associated with low-level convergence?
- Where is the convergence in relation to the wave at F24?
- Where is the convergence in relation to the wave during F42-F48?
- Where is the convergence in Colombia at F54?
- What happens to the convergence in Colombia at F72?
- At what local time does F72 corespond to?
- Does this coincide with the period of máximum convective instability?

Please stop the animation.

7. Evaluation of divergence/convergence at upper levels.

7a. 250 hPa Level

WDVR GT00 CLRN C5-6/WDVR LT00 CLR6 C5-6/BKNT 250/ANIM

This command provides an animation of the winds (BKNT) at 250hPa and wind divergence (negative in red).

- What type of motion is associated with upper level convergence?
- What impact might this have on the regions of convection?
- Where is the divergence with respect to the wave in the F30-F54 hrs period, when the wave is in Colombia?
- What happens with the upper divergence in Colombia in hour F72?
- Is 250 hPa divergence representative of the column divergence?

Please stop the animation.

7b. Evaluation of column divergence/convergence.

LD52:ANIM *This command sequence animates the "LD52" macro. This macro can be used to evaluate the divergence/convergence in the column between 500 and 250 hPa. Divergence is plotted in yellow and convergence in purple.*

- Where is the divergence in relation to the wave at F30-F54 hrs, when the wave is in Colombia?
- Which is (or are) the period(s) of stronger divergence between hours F30 and F54?
- What happens with the upper divergence in Colombia during the hours F66-F72?

Please stop the animation.

Computing water content

8. Evaluate dewpoint temperatures at 1000 hPa.

DWPT CIN1 GT15/DWPT CIN1/BKNT 1000/ANIM

This animation shows the total wind (BKNT) and the 100 hPa dewpoints (DWPT) highlighting values larger than 15C.

During the period that corresponds to wave passage, what are the dewpoint temperatures at the following locations,

Central-Eastern Caribbean: _____

Eastern plains of colombia: _____

Colombian Andes: _____

Western plains of Colombia: _____

Please stop the animation.

9. Lets now consider dewpoint temperatures in the boundary-layer.

DWPT CIN1 GT15/DWPT CIN1/BKNT B015/ANIM

This animation shows the total wind (BKNT) and the boundary layer dewpoints (DWPT), highlighting values > 15C.

During the period of time that corresponds to the passage of the wave, which are the dewpoint temperatures at:

Central-Eastern Caribbean: _____

Eastern plains of colombia: _____

Colombian Andes: _____

Western plains of Colombia: _____

●Why are dewpoint values so low in the Andes?

●Why the differences with the previously observed at 1000 hPa?

Please stop the animation before proceeding.

10. Evaluate dewpoint temperature at 2 meters.

DWPT CIN1 GT15/DWPT CIN1 2M/BKNT 10M/ANIM

This animation shows the total wind (BKNT) at 10 meters above ground and dewpoints at 2 meters. Values higher than 15C are highlighted.

●What is the significance of dewpoint temperaturas at 2 m and winds at 10m?

Write down the average dewpoint temperatura at:

Central-Eastern Caribbean: _____

Eastern plains of colombia: _____

Colombian Andes: _____

Western plains of Colombia: _____

●How dows this compare against the previously observed in the boundary-layer?

●How homogeneous is this layer?

Please stop the animation.

11. Generate an animations of winds and mixing ratios:

MIXR C1-3/BKNT B015/ANIM

*Mixing ratio is generated with the command **MIXR**, while winds are plotted using **BKNT,** which outputs the values in knots. To plot winds in meters per second the command to use would be **WIND AROW** for vectors, and **WIND BARB** for barbs.*

Mixing ratio MIXR is plotted using an interval of .001 Kg/Kg using the command C1-3. This is the scientific notation. This reassures that all the mixing ratio contours in the animation have the same interval.

- Why is mixing ratio preferred over relative humidity?
- Do the areas with high/low water content from before coincide?

Please stop the animation before continuing.

12. Quantifying water content in a time section.

12a. Dewpoint temperature.

TSTN SKBQ — *This command allows us to select the station of Barrranquilla in Colombia and to establish a time section.*

DWPT CIN3 — *This plots the dewpoint temperature at an interval of 3C.*

- How much do dewpoint temperatures vary at levels **below** 800 hPa?
- How much do dewpoint temperatures vary at levels **over** 800 hPa?
- What can be attributed to the increase observed by 36-60 hrs?

12b. Mixing ratio.

MIXR C1-3 — *This command plots the mixing ratio **MIXR** at an interval of .001 Kg/Kg. It uses the command **C1-3** to set the contour interval with the scientific notation.*

- How does mixing ratio vary inside the column?
- Does the period with the highest content coincide with the wave passage?
- Is the mixing ratio profile more representative tan the dewpoint temperature one?
- Which other paramters can be considered to quantify water content?

12c. Lets return to the horizontal plane.

PLAN — *The command **PLAN** returns to the horizopntal plane using the area previously defined. Other commands that can be used are **TIME** and **CROS**. **TIME** takes us to timesections and **CROS** to cross sections. Whenever these have not yet been defined during the working sesión.*

13. Total Precipitable Water

13a. Precipitable Water Animation and Winds

BKNT 850 CLR1/PWAT/PWAT CTFC CFCP/ANIM

*This command sequence plits winds at 850 hPa (**BKNT 850**) in barbs and precipitable water (**PWAT**). Wingridds has the capacity of generating color shades via the command **CTFC**. **CFCP** is the color table already defined in the folder "C:/WINGRIDDS/USER".*

- What does Precipitable WATer (PWAT) quantify?
- What does this tell us about rainfall amounts?
- What are PWAT values across the Eastern Caribbean by18 hrs?
- What are PWAT values across the Central Caribbean by 48 hrs?
- What is happening with the water content in Colombia by 18-36 hrs?

- When analyzing the dewpoints, was this tendency observed?
- To what can this difference be attributed?
- During which period do the highest values in Northern Colombia occur?
- Does this coincide with the observed in the time section made in Barranquilla?

Please stop the animation before proceeding.

13b. Animation of low-level flow, upper level flow and precipitable water.

PW25. *This macro creates an animation of precipitable water (colored contours) where red indicates areas with 50mm or more, flow at low levels (streamlines) and winds at 250 hPa.*

- What is the goal of combining these three variables in one plot (low-level winds, upper-level winds and precipitable water)?
- What impact does the upper trough in the Central-Eastern Caribbean have after 42 hrs?

Please stop the animation.

Column Stability

14. Lets evaluate column stability.

14a. K-index

KIMA. *KIMA is a macro that generates an animation of the K index during the available forecast hours.*

- How does the K-index coincide with the areas of higher precipitable water?
- To what can we attribute this?
- How does the K index relate to the distribution and water changes as the wave passes in Northern South America?

Please stop the animation at time F36.

BKNT 700 CLR1 F36/ *This command line overlays the 700 hPa winds at forecast hour F36.*

Note stable conditions before and after wave passage, with largest instability in association with the wave. This also supports the previously suggested by the equivalent potential temperature field in the Caribbean Basin.

15. Using traditional indices, evaluate column stability using four panels.

15a. Changing the display to four panels.

4PNL *This changes the display to four panels when typed in the command line. You can also click the following icon:*

15b. Defining the analysis area.

AREA 9 80 23 *This command changes the area to display. Uses a central point located at 9N 80W and a north-south aperture of 23 degrees.*

Note: This command must be executed every time the window is changed from 4-panels to 1-panel and viceversa.

15c. Creating an animation of the four indices:

SIN4. *The macro **SIN4** is designed to be used in a 4-panel window. It generates an animation of four stability indices. Panel 1 contains the K index (KI). Panel 2 contains the Showalter (SSI). Panel 3 displays the Lifted Index (LI) and panel 4 the Total Totals Index (TTI).*

●Where are the areas of higher instability in Colombia?

●As the wave passes through Colombia, identify and write down the highest values of the four indices displayed:

KI: _____

SSI: _____

LI: _____

TTI: _____

Please stop the animation.

Parameter coupling

16. Upper Divergence Evaluation

DGCO.

> *This macro also works for four panels. In panel 1, the macro animates flow at 250 hPa with the areas of divergence in blue and convergence in red. In panel 2, we have vertical motion and winds at 700 hPa. In panel 3 we have winds and streamlines at 850 hPa as well as convergence. Panel 4 shows the K-index.*

By hour F30, when the wave is located at 71W/72W an entering Colombia:

Panel 1, divergence or convergence? _____

Panel 3, divergence or convergence? _____

Panel 2, positive or negative omegas? _____

Panel 4, K-index values: _____

●Does this favor deep convection?

By hour F36, with the wave located at 74W/75W crossing Colombia:

Panel 1, divergence or convergence? _____

Panel 3, divergence or convergence? _____

Panel 2, positive or negative omegas? _____

Panel 4, K-index values: _____

●Does this favor deep convection?

By hour F42-F54, with wate at 77W/78W exiting Colombia:

Panel 1, divergence or convergence? _____

Panel 3, divergence or convergence? _____

Panel 2, positive or negative omegas? _____

Panel 4, K-index values: _____

●Does this favor deep convection?

●Which is the period with the highest omegas over Colombia?

Please stop the animation.

Vertical Dynamics and Shallow vs Deep Convection Diagnosis

17. Evaluation of dynamics using a cross section.

17a. Change the display to 1 panel:

1PNL *This command changes the display to 1 panel when executed in the command line. The other option is clicking on the icon:*

17b. Cross section along 14N.

XSCT 14 85 14 60 *This command builds a cross section between 14N 85W and 14N 60W.*

17c. Evaluation of Convergence and Divergence in a Cross Section.

DVRH:ANIM *When adding "**:ANIM**" to the "**DVRH**" macro instead of only "**.**", we create an animation instead of one single plot. The macro **DVRH** plots the total wind in the column, relative humidity (green isohumes), conivergence/divergence (red/blue) and ageostrophic circulation (yellow arrows).*

- What are the advantages of evaluating the dynamics in a cross section instread of a time section?

- Where is the wave (latitude/longitude) at F21 hrs?
- Where can we find the ascents and descents in relation to the wave?
- Where will the convection be located in relation to the wave?

- Where is the wave (latitude/longitude) at F42 hrs?
- How strong are the winds in relation to the wave?
- Where can we find the ascents and descents in relation to the wave?

- What happens with the relative humidity at mid/upper levels to the east of 76W by F54?
- What does this suggest?

- Where is the wave (latitude/longitude) at F66 hrs?
- How strong are the winds in relation to the wave?
- Where can we find the ascents and descents in relation to the wave?
- Where would the convection be located in relation to the wave?

Please stop the animation.

17d. Evaluation of convective Instability in a Cross Section

TCBS:ANIM When adding "***:ANIM***" *to the "**TCBS**" macro we can make an animation of the equivalent potential temperature (yellow), mixing ratios (green), temperatures lower than -20C (red) and ageostrophic circulations (arrows).*

- Is the column stable or unstable in relation to the wave at F21?
- If it is unstable, up to what level can the instability be observed?

- Is the column stable or unstable in relation to the wave at F42?
- If it is unstable, up to what level can the instability be observed?

- What happens to the column to the east of 76W at F54?
- If an inversion is present, at what level can it be observed?

Please stop the animation.

17e. Core evaluation and core characteristics.

THTA CIN2/BKNT/RVRT WIND DNEG C5-6 F30

This line of commands plots potential temperature (THTA), total wind (BKNT) and relative vorticity. Negative values are indicated using dashed lines.

- What is the tendency of potential vorticity along 72W?
- Is this characteristic of a cold core or a warm core?

17f. Cross section along 12N.

XSCT 12 85 12 60 *This creates a cross section between 12N 85W and 12N 60W.*

17g. Evaluation of Divergence/Convergence in a cross section.

DVRH:ANIM *Animation of the "DVRH" macro.*

- What happens in the vertical, in relation to the wave, at F36?
- Are areas of low-level convergence in phase with those of upper divergence?
- What impact can this have in convection?

- Where are the ascents in relation to the wave at F48 hrs?
- Under this conditions, does convection precede or follow the wave?

Please stop the animation.

17h. Evaluation of Convective Instability in a Cross Section.

TCBS:ANIM *Animation of the "TCBS" macro.*

- At F36, is the column stable or unstable?
- If it is unstable, up to where can the instability be found?
- What type of convection can be expected under these conditions?

●By F48, is the column stable or unstable?
●If it is unstable, how high does the instability extend?
●What type of convection is expected undern these conditions?

Please stop the animation.

17i. Cross section along 8N.

XSCT 8 85 8 60 *This commands makes a cross section from 8N 85W to 8N 60W.*

17j. Evaluation of Divergence and Convergence in the cross section.

DVRH:ANIM *Animation of the "DVRH" macro.*

●What impact is the wave having in convection across Colombia by F60-F72?
●Are areas of low-level convergence in phase with areas of upper divergence?

Please stop the animation.

17k. Evaluation of Convective Instability in a Cross Section.

TCBS:ANIM *Animation of the "TCBS" macro.*

●What is the impact of the wave in column instability by F60-F72?

●What happens with column instability over Colombia after F78 hrs?

Please stop the animation.

Emagram Evaluation (Thermodynamic Diagram)

18. Evaluation of selected soundings in forecast locations.

18a. Evaluation over Aruba

PLAN *The command "PLAN" returns to the horizontal plane.*

NOTE: Sounding analysis can only be executed when the graphics are set to the horizontal plane. If they are set to cross sections or time sections the command SKEW will not work.

(1) Analysis ahead of the wave.

F12 *Selects forecast hour F12.*

SKEW STIDTNCA *Using the sentence "SKEW STID _ _ _ _" plots en emagram. Here, the four letters that go on "_ _ _ _" represent the OACI code for any station specified in a table available in WINGRIDDS. The graphic shows the temperature (red), dewpoint (blue) and wetblub temperature (dashed blue).*

●How do winds rotate with height?
●How saturated is the column?
●At what level can the inversion be found? K index value:_____
●Is the column stable or unstable?

(2) With the wave:

F21 *Selects forecast hour F21.*

SKEW STIDTNCA *Forecasted sounding for Aruba at F21.*

●How do winds rotate with height?
●How saturated is the column?
●At which level can the inversion be found? K index values:_____
●Is the column stable or unstable?

(3) Wave in the station

F27 *Selects forecast hour F27.*

SKEW STIDTNCA *Forecasted sounding for Aruba at F27.*

●How do winds rotate with height?
●How saturated is the column?
●At which level can the inversion be found? K index values:_____
●Is the column stable or unstable?

(4) After wave passage

F42 *Selects forecast hour F42.*

SKEW STIDTNCA *Sounding forecasted for Aruba at F42.*

●How do winds rotate with height?
●How saturated is the column?
●At which level can the inversion be found? K index values:_____
●Is the column stable or unstable?

18b. Evaluation over Riohacha, Colombia

STRH. *This macro generates an animation of the soundings at Riohacha, Colombia every six hours. Please fill the following table.*

Period	Winds with height	Inversion	K-index	Stability
Day 10/00Z				
Day 10/12Z				
Day 10/18Z				
Day 11/00Z				
Day 11/06Z				
Day 11/18Z				
Day 12/00Z				
Day 12/06Z				
Day 12/12Z				

18c. Evaluation over Barranquilla, Colombia

STBQ. *This macro generates an animation for Barranquilla.*

Period	Winds with height	Inversion	K-index	Stability
Day 10/00Z				
Day 10/12Z				
Day 10/18Z				
Day 11/00Z				
Day 11/06Z				
Day 11/18Z				
Day 12/00Z				
Day 12/06Z				
Day 12/12Z				

18d. Evaluation over Los Cedros, Colombia

STLC. *This macro generates an animation for Los Cedros.*

Period	Winds with height	Inversion	K-index	Stability
Day 10/00Z				
Day 10/12Z				
Day 10/18Z				
Day 11/00Z				
Day 11/06Z				
Day 11/18Z				
Day 12/00Z				
Day 12/06Z				
Day 12/12Z				

e. Evaluation over Quibdó, Colombia.

STUI. *This macro generates an animation for Quibdó.*

Period	Winds with height	Inversion	K-index	Stability
Day 10/00Z				
Day 10/12Z				
Day 10/18Z				
Day 11/00Z				
Day 11/06Z				
Day 11/18Z				
Day 12/00Z				
Day 12/06Z				
Day 12/12Z				

19. Model Rainfall Forecasts.

19a. Evaluation at 24-hour intervals (macro)

PCPA. *The PCPA macro generates an animation of 24-hour rainfall amounts at 12-hr intervals. Aside from coloring the maxima, this command graphs mean sea level pressure and 850 hPa winds through F84.*

- What is the impact over Aruba during the forecast period?
- When is northern Colombia affected?
- What is the impact over the Choco/Eje Cafetero?
- How high are the amounts during the period with the strongest activity?

Please stop the animation.

19b. Evaluation of precipitation over 72 hrs (macro)

PCPT. *The macro PCPT is used to graph, using colored contours, rainfall amounts over a period of 72 hrs. It starts at F12 and ends at F84.*

- What is the use of displaying rainfall over such an extended period of time?

20. Event verification.

a. Water vapor images: WV_zoom_20091009_loop.gif

b. Infrared images: IR_zoom_20091009_loop.gif

c. Visible Images: Vis_zoom_20091009_loop.gif

d. Precipitable Water: TPW_loop.gif