# Using soundings to trace the trade wind inversion height across the tropical oceans

In support of Unit 1 Topics:

6. General Circulation of the Tropics

8. Spatial and temporal climatology of tropical circulation features

## Objectives

At the end of this exercise students should be able to

* Understand the relationship between the semi-permanent surface pressure systems and the trade wind inversion
* Understand how that relationship influences the east-west variation in the cloud layer height across the tropical oceans.

## Tools

1. World Map covering 45S – 45N

* With markers and station id labels with regularly reported soundings
* Choose stations to allow plotting of transects that are roughly east to west across the tropical oceans

1. Soundings from online archives:

University of Wyoming, <http://weather.uwyo.edu/upperair/sounding.html>

NOAA ESRL, <http://esrl.noaa.gov/raobs/>

1. Graph or a Spreadsheet program

* For plotting the height of the trade wind inversion versus longitude

## Submission Method

Students will submit powerpoint presentations with the relevant images and explanations.

## Instructions

The following are to be completed for both July and January periods, in order to explore summer and winter conditions. The sounding examples shown are for January only.

1. The trade wind inversion east-west profile

To be done for the North and South Atlantic Ocean and North and South Pacific Ocean

* 1. Choose a set of stations that traverse the tropical ocean basin roughly from east to west

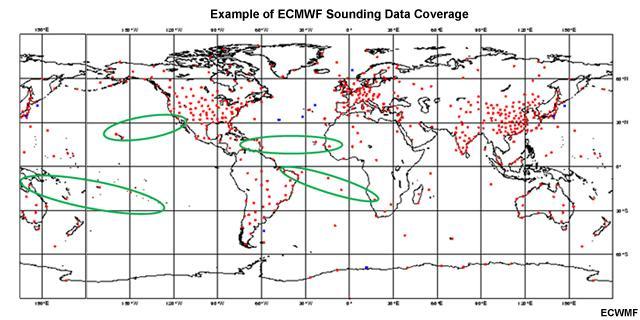


Fig. 1. Example of stations that could be used in transects across the tropical oceans

* 1. Examine temperature profile plots for each station

Two options

* + 1. Find SkewT/Tephigram plots online

University of Wyoming, <http://weather.uwyo.edu/upperair/sounding.html>

NOAA ESRL, <http://esrl.noaa.gov/raobs/>

* + 1. Plot the profile in a spreadsheet program from sounding data to create the temperature profile for the stations marked on the map

University of Wyoming, <http://weather.uwyo.edu/upperair/sounding.html>

NOAA ESRL, <http://esrl.noaa.gov/raobs/>

* 1. Identify the bottom of the trade wind inversion

The example below shows a profile from St. Helena Island in the South Atlantic where the trade wind inversion begins at about 880 hPa.

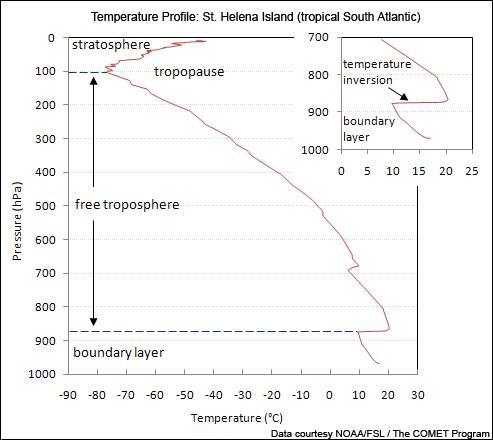


Fig. 2. Example of a temperature profile in the trade wind regime; the inset highlights the trade wind inversion.

1. Estimate the height of the bottom of the inversion

The following graphs are examples for how to identify the trade wind inversion from soundings obtained from the NOAA ESRL website, <http://esrl.noaa.gov/raobs/>

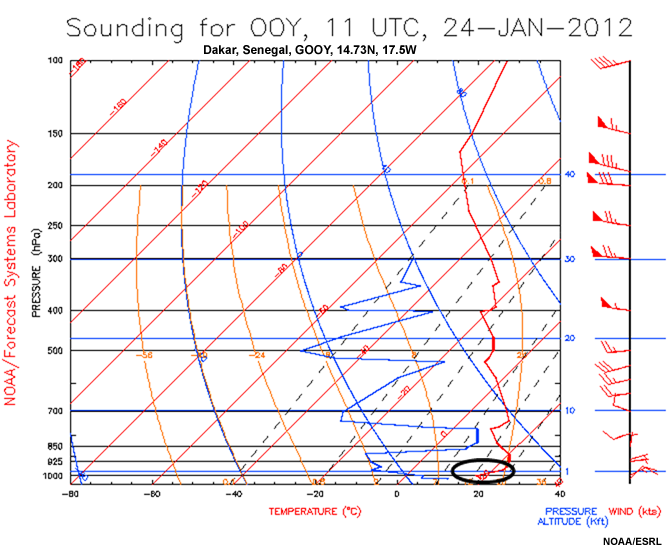


Fig. 3. Sounding for Dakar, Senegal, 61641, GOOY, 14.73, -17.5. The left Y-axis shows pressure in hPa (black numerals) and the right Y-axis has pressure altitude in Kft (blue numerals) on the right. The black oval marks the inversion layer and its base is approximately 1000ft or 304.8 m.

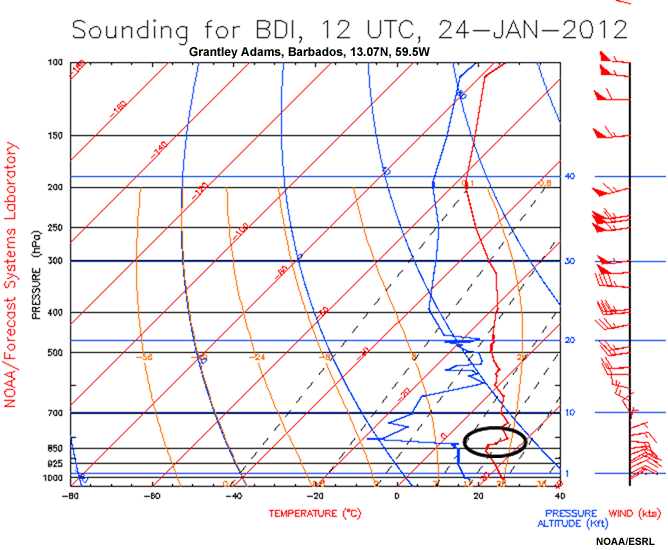


Fig. 4. Same as Fig. 3 except for Grantley Adams Airport, Barbados (78954, TBPB, 13.07, -59.5) and a different inversion height.

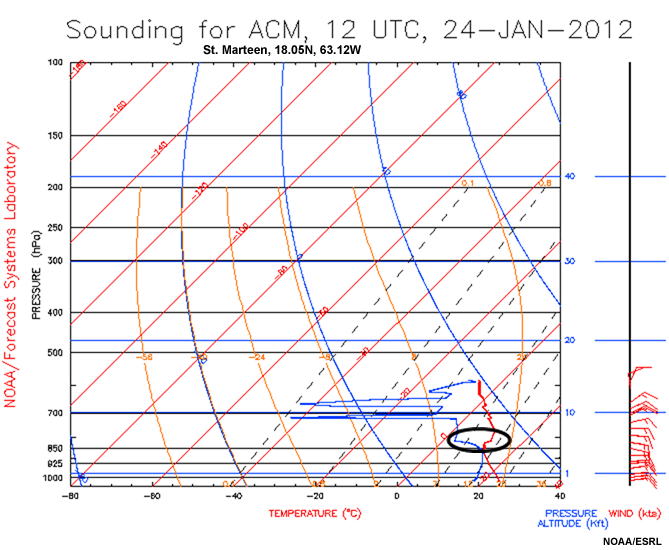


Fig. 5. Same as Fig. 3 except for St. Martin, NE Caribbean, 18.05, -63.12 and a different inversion height.

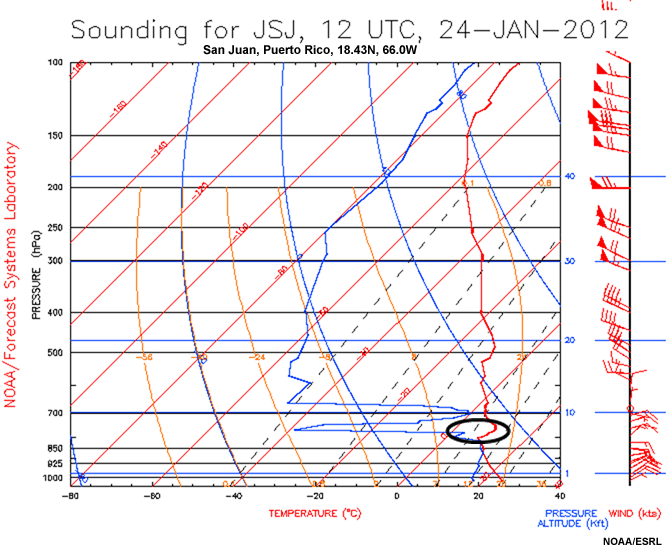


Fig. 6. Same as Fig. 3 except for San Juan, Puerto Rico (18.43, -66) and a different inversion height.

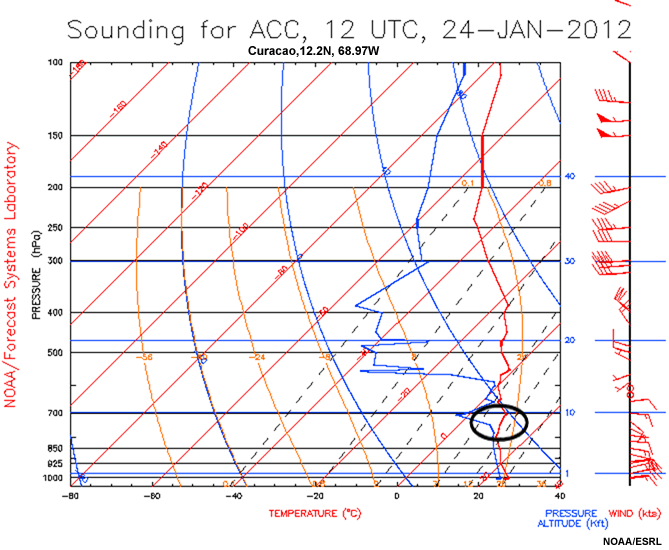


Fig. 7. Same as Fig. 3 except for Curacao, Netherland Antilles (12.20, -68.97) and a different inversion height.

1. Plot the station inversion heights on the Height / Longitude graph

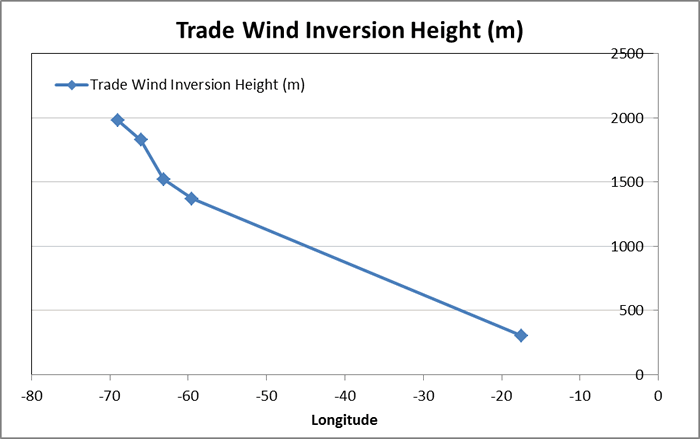
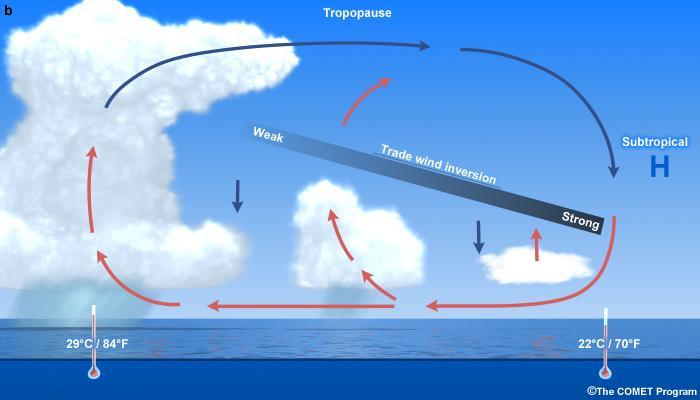
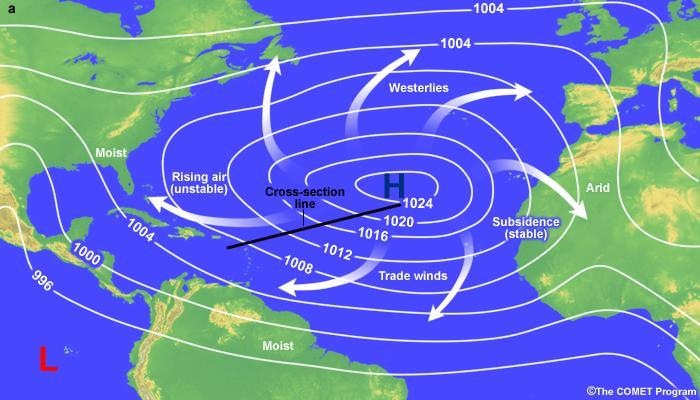


Fig. 8. Example of trade wind inversion height across the tropical north Atlantic, 12 UTC 24 Jan 2012.

1. How does the actual trade wind inversion height/longitude plot compare with the conceptual model of the trade wind inversion?

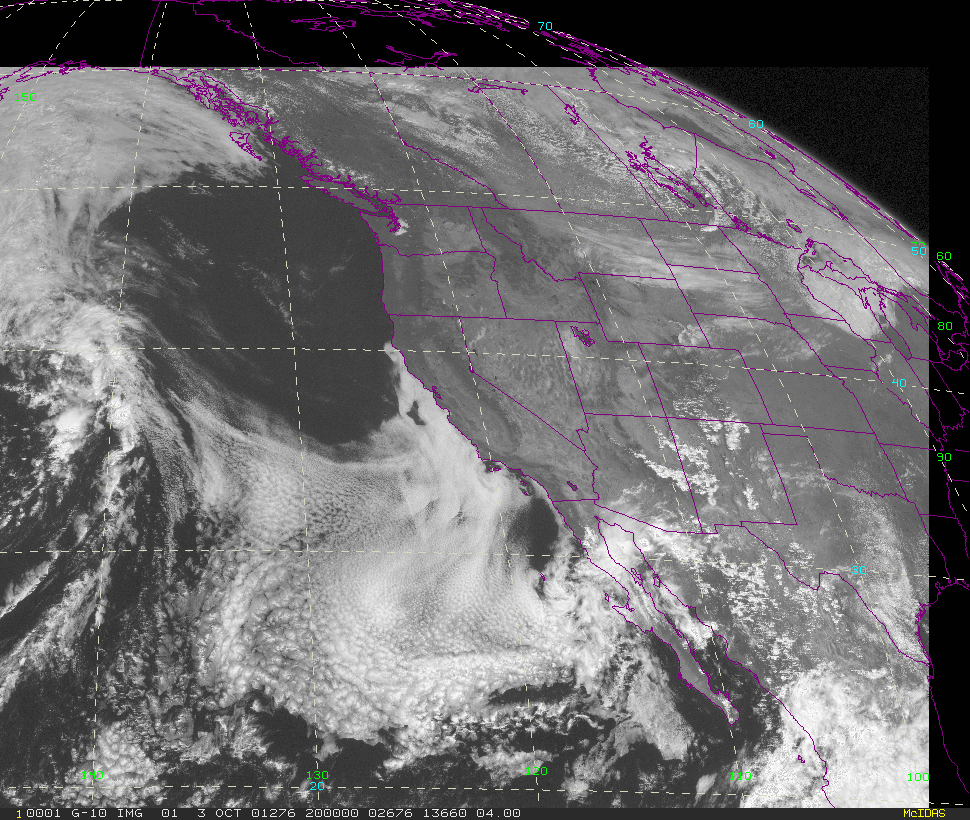
Students will describe how the height/longitude plot from real data compares with the conceptual model of the trade wind inversion. Note where it is similar or different and provide an explanation for the differences or similarities.



(a) Schematic of mean sea level pressure and air flow and its relationship to stability in the troposphere for the tropical north Atlantic and (b) conceptual model of the vertical profile of the trade wind inversion, from west to east across the equatorial oceans.

## Bonus critical thinking questions

1.



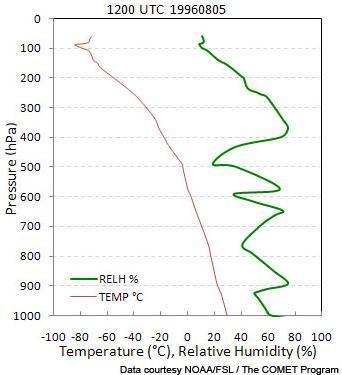
Note the large area of clouds west of southern California and the Baja peninsula.

How high would you expect the tops of these clouds to reach?

* 1. Middle troposphere
  2. Lower troposphere
  3. Upper troposphere

[**Answer**](https://docs.google.com/a/comet.ucar.edu/document/d/12I0rrxhTtojrBe5gZzHaafXUzmTpoBCbyMHoVQp-7q0/edit#)

2. Where in the Pacific is the following profile likely to be found?



1. Central
2. Western
3. Eastern

[**Answer**](https://docs.google.com/a/comet.ucar.edu/document/d/1u-7VFTBndqYagjG5DqPa3wXIpPdxrO3aTDyMDFHTMYw/edit#)

3. What weather systems or synoptic patterns might cause a different height/longitude profile than shown in the example, to occur between West Africa and the Caribbean?

Ask students to describe the weather scenarios that would create a markedly different height/longitude plot than the conceptual model. They should submit a document with their explanation and illustrations of the synoptic conditions that would create a contrasting pattern.