



ATMO 102 Pacific Climates and Cultures

Lecture 10: Local Winds

Large and Small Scale Winds



- **Macroscale Winds**

- Planetary: Westerlies, trade winds
- Synoptic: Cyclones and anti-cyclones, Hurricanes (weather map size)



- **Mesoscale Winds**

- Thunder storms, tornadoes, etc
- Part of larger macroscale wind systems.



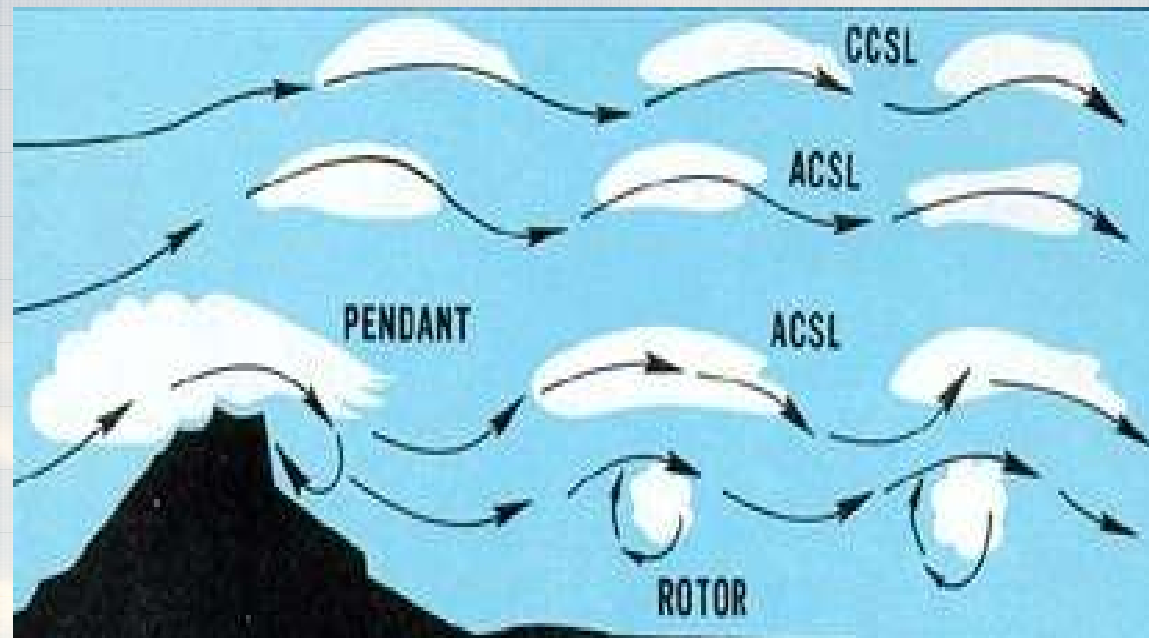
- **Microscale Winds**

- Chaotic motions including gusts and dust devils
- Small, very localized breezes

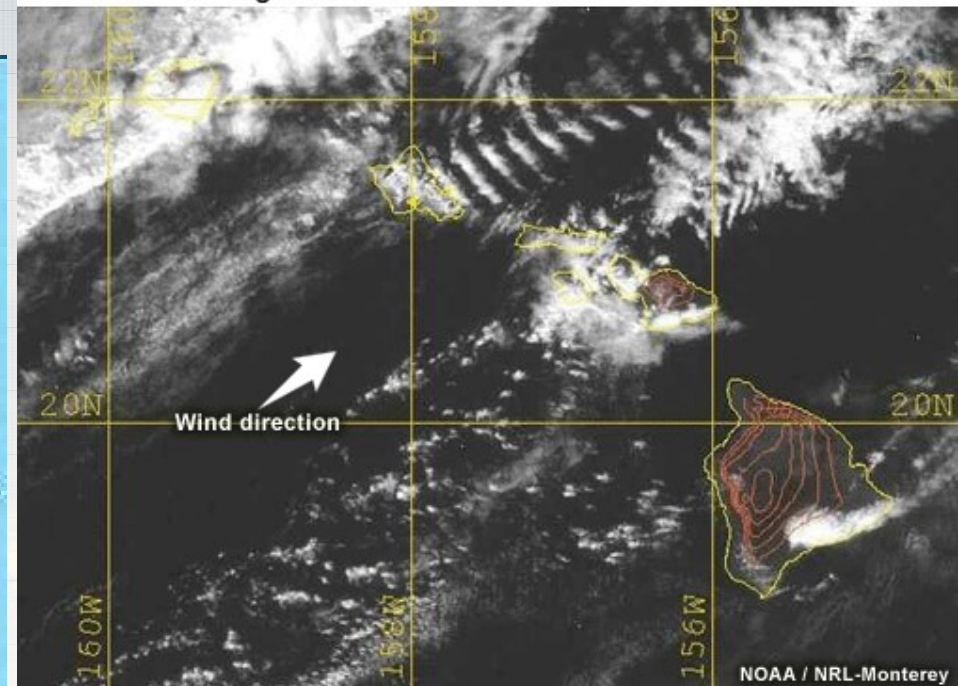
• Eddy

- Whirl of air
- Come in different sizes
- Small volume of air that behaves differently from the large flow in which it resides.
- Caused by encountering an obstacle
- Eddies are down wind from the obstacle

What is an Eddy?



GOES-10 VIS Image 2000 UTC 24 Jan 2003

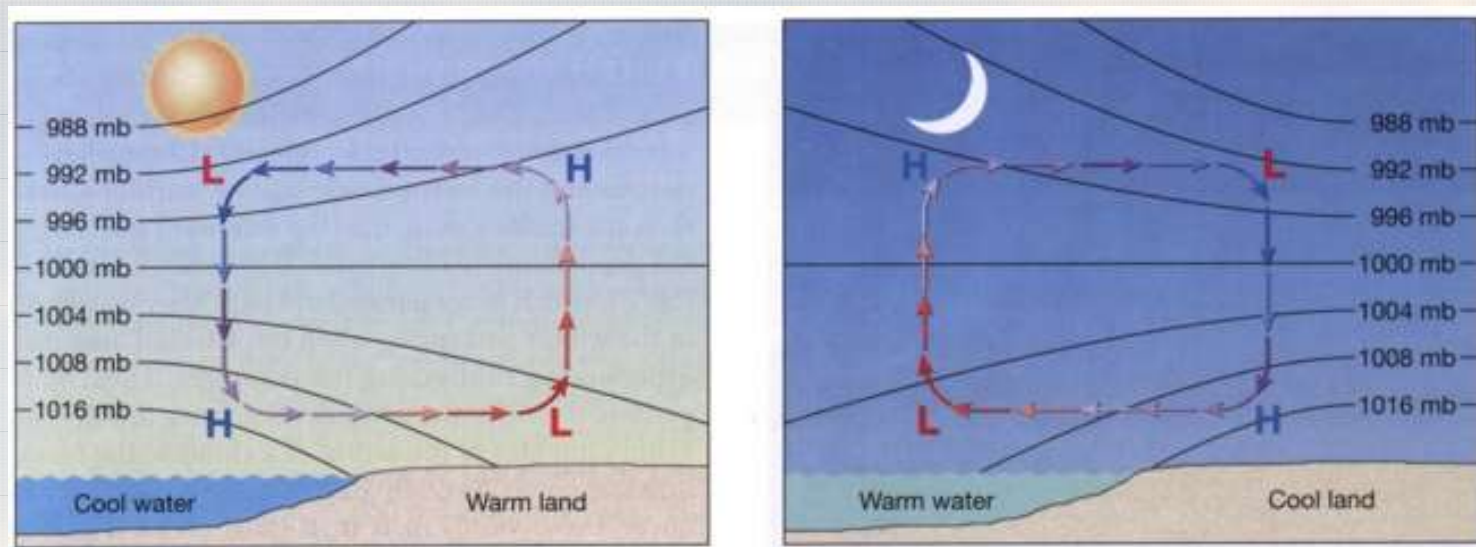


Local Winds

- True **local winds** are caused by **topographic effects** or **variations in local surface composition**
- **Local Winds found in Polynesian Islands (including New Zealand)**
 - Land and Sea Breezes
 - Mountain and Valley Breezes
 - Country Breezes
- **Local Winds typically not found in Polynesia**
 - Chinook (Foehn Winds)
 - Katabatic (Fall winds)
 - Santa Ana Winds
 - Haboobs

Land and Sea Breezes

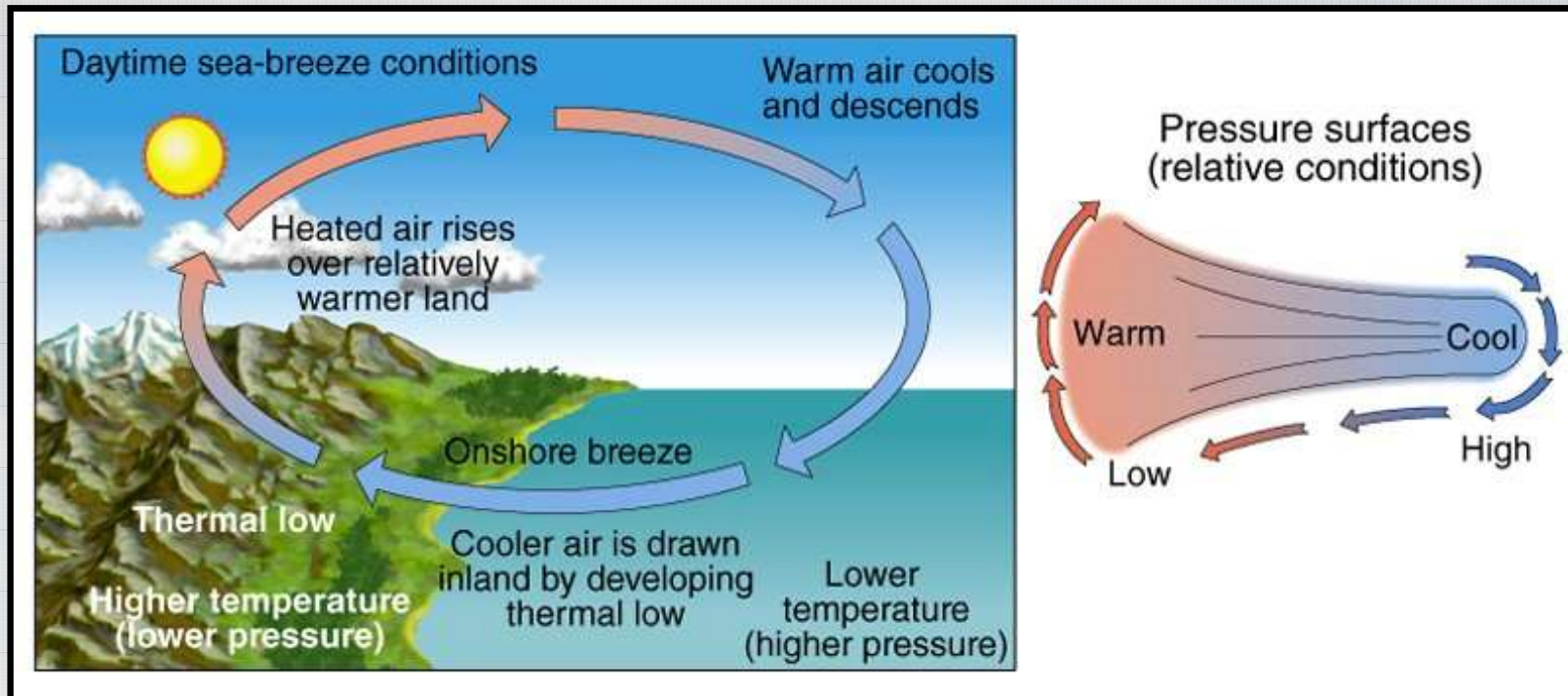
- Most intense Land and Sea Breezes form along tropical coastlines adjacent to cool ocean currents.
 - Hawaii (including Oahu) experiences these every day.



Nice Animation:

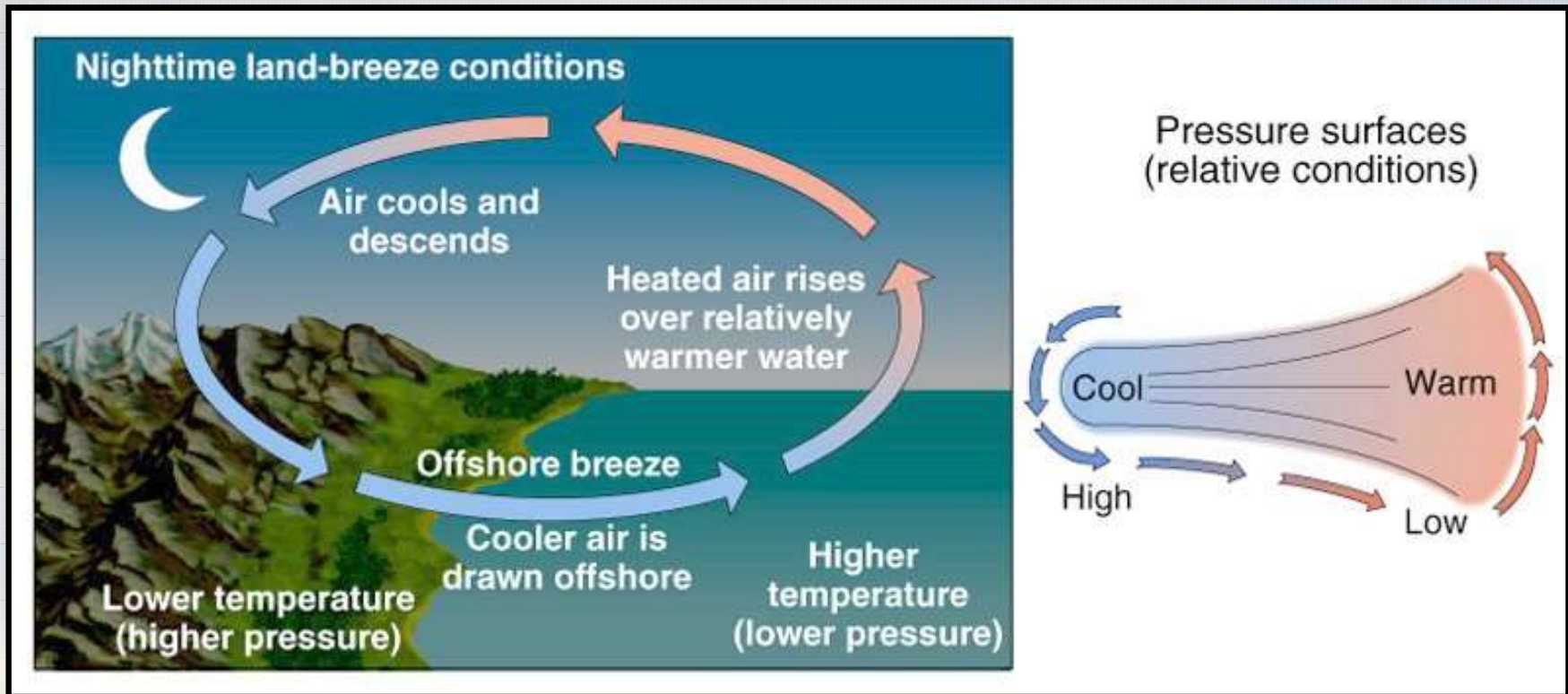
http://www.classzone.com/books/earth_science/terc/content/visualizations/es1903/es1903page01.cfm

Daytime - Sea Breeze Conditions



- The **land heats more quickly** than the water.
- **Higher pressure** is then located over the **ocean**.

Nighttime – Land Breeze Conditions

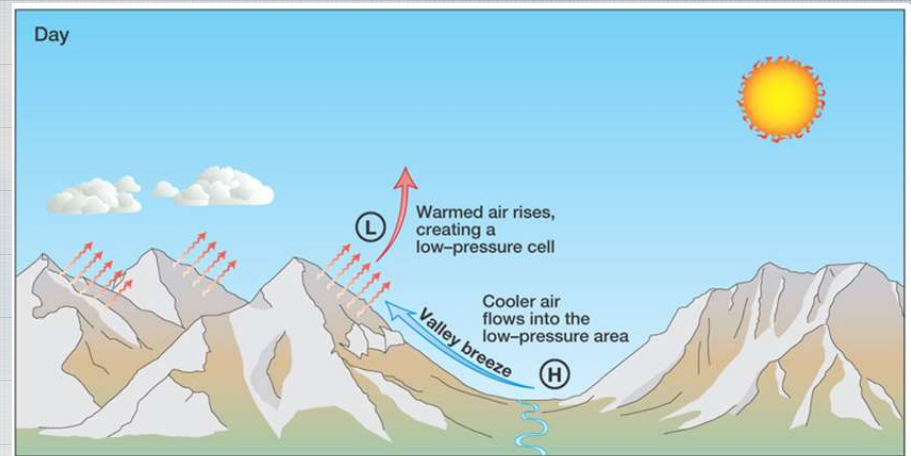


- The **land cools** more quickly than the water.
- **Higher pressure** is then located over **land**.

Mountain and Valley Breezes

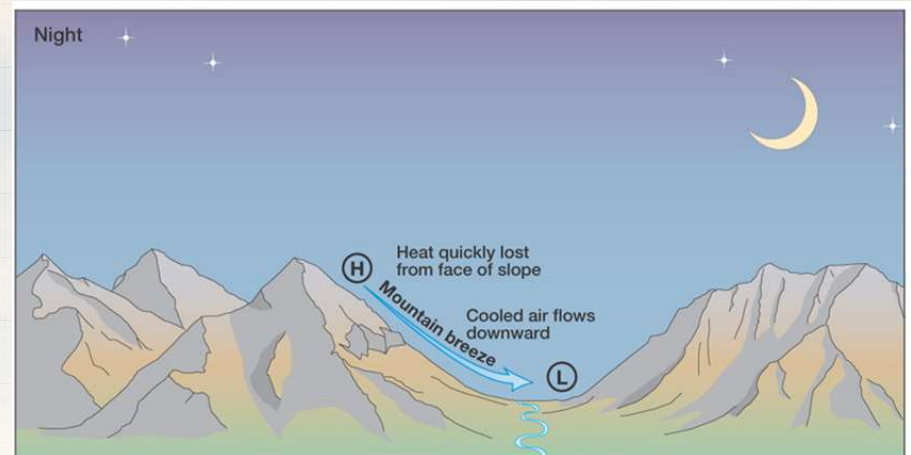
- **Valley Breeze**

- Daytime
- Sun warms valley walls
- Max at afternoon, cloudiness and T-storms likely

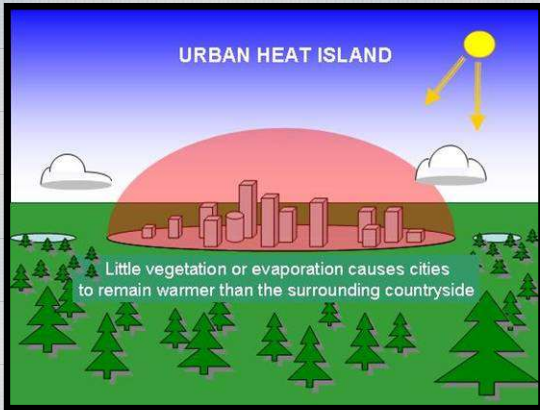


- **Mountain Breeze**

- Nighttime
- Rapid cooling of valley walls

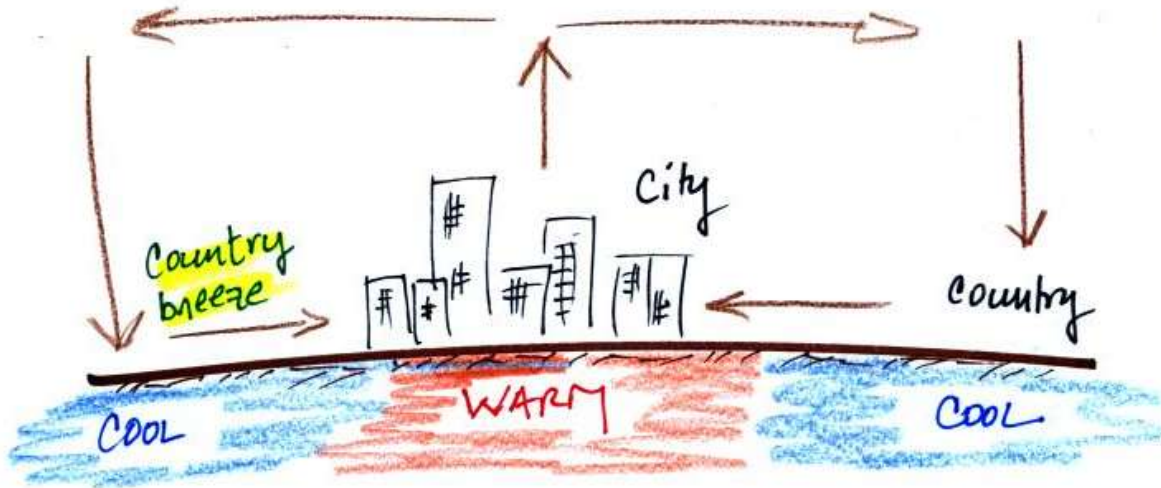


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Country Breezes

- Associated with **large urban areas**. On crowded islands, these regions will be warmer than the rural areas.



- **Light wind** blowing in from rural areas
- Clear, calm nights
- City is warmer (**urban heat island**)

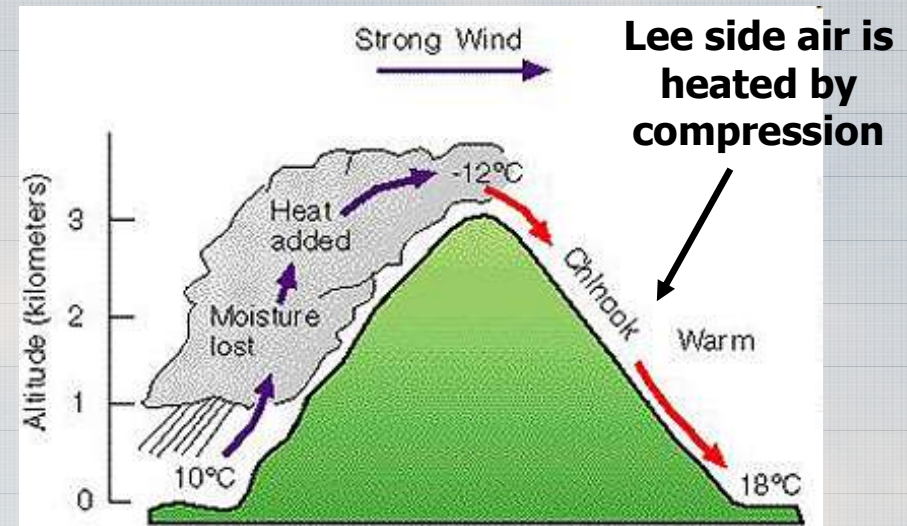
Local Winds not Found in Polynesia

• Chinook (Foehn) Winds

- Warm Dry air moving down the east slopes of the **Rockies (Chinook)** or **Alps (Foehn)**.

• Katabatic (Fall) Winds

- Originate when **cold air**, situated over a highland area (like an ice sheet) is **set in motion**. **Gravity** carries the cold air over the rim like a waterfall.
- The air is **heated like a Chinook**, but because it starts **so cold it stays cold**.
- Same as **Mountain Breeze but STRONGER**



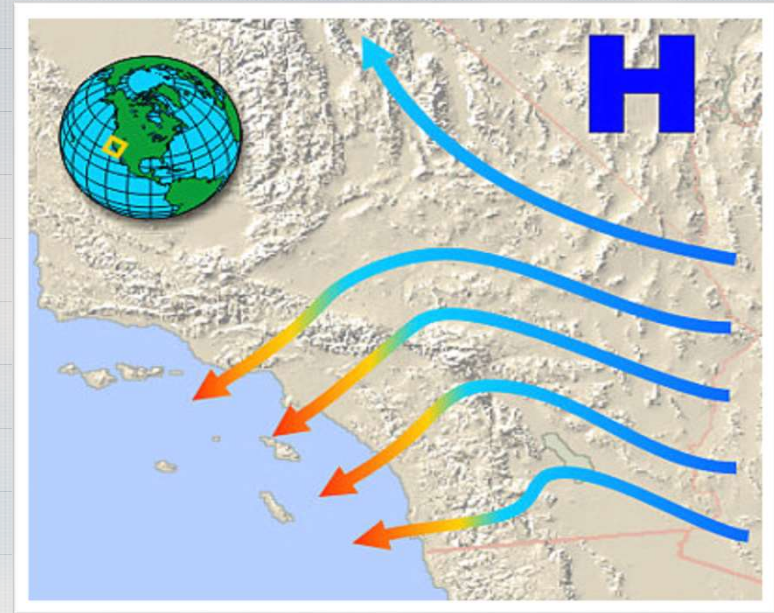
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Local Winds not Found in Polynesia

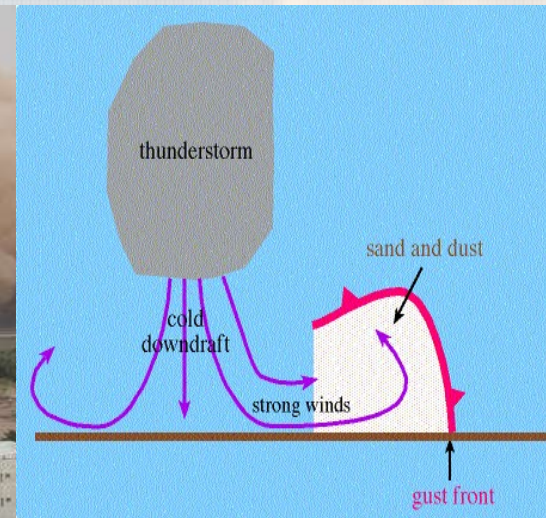
• Santa Ana Winds

- Typically occurs in September-March but can happen at any time the desert is cooler than SoCal.
- **Compressional Heating makes it warm**



• Haboob

- **Associated with Dust Storms in dry regions**
- Examples: Dustbowl storms in the 1930s. Giant dust storms common in the African Sudan
- Caused by out flowing air from **Thunderstorms**.



Cultural Connection to Winds in Hawaii

- **Localized Winds Depend on Local Topography**

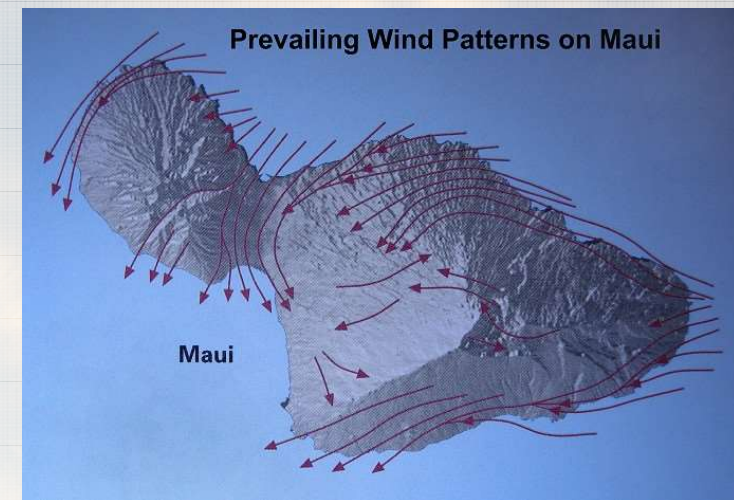
- Local winds and the formation of clouds are related to the diurnal (daily) heating cycle (land vs. ocean)
- Winds and clouds depend on the height of the mountains and the size of the individual Islands

- **Mountains as a blocking and triggering force**

- Winds can go up and over or around the mountains
- When winds go up slope they can form Orographic Clouds and rain
- Are responsible for localized climates like “wet windward” and “dry leeward” slopes
- Can trigger and anchor thunderstorms

- **Predictability → Stories and Myths**

- Mountains are fixed, climate regimes occur
- If you know the topography you can predict the general direction of the winds



Cultural Connection to Winds in Hawaii

• Unique Features

- Each island has its own unique combination of mountains, valleys, sea, land, and windward and leeward features.
- This causes each island, and different parts of each island, to have localized winds that differ from the general large-scale (trade wind) flow

• Cultural Importance as seen in Oral and Written Literature

- Important to maintain knowledge of the weather – needed for sailing and farming
- To be considered local or *kama'āina* (Child of the Land), you may be called upon to recite the winds or rains of that place.
- If you can't recite these you may be labeled a *malihini* (a stranger)
- Chants listing the winds were often published in **newspapers or as part of stories**
 - To inform the public about the nature of the winds in a certain place

• Drama

- People would fight about who was more *kama'āina* and write critiques back and forth about wind names and descriptions in the newspapers.
- ***"I'm right, you're wrong, I'm more local than you!"***