

Weather vs Climate

What's the Difference?

Climate vs. Weather

"Climate is what you expect ... weather is what you get!"

- Climate is an **"envelope of possibilities"** within which the weather bounces around
- Climate is determined by the properties of the Earth system itself (the **boundary conditions**), whereas weather depends very sensitively on the evolution of the system from one moment to the next

Predictability

"If they can't predict the weather, how can they possibly hope to predict the climate?"

- Weather **forecasts are only useful for a few days**, maybe a week at best
- Forecasting is limited by modeling skill and inadequate observations, but **even if these were perfect, the limit of predictability would be about 2 weeks**
- This limit is a **property of the atmosphere itself**, not a failure of our science!

Limits to Predictability

- Instability and scale interactions make long-range weather forecasting **impossible** (not just hard!)
- This is **not true for climate!**

Airplane analogy

- The flow around an airplane wing is governed by the same strongly nonlinear Navier-Stokes equations that govern the atmosphere
- For the same reasons we will never forecast the weather a month in advance, we can never predict the details of the flow around the wing
- But given boundary values and parameters, we can predict with confidence the statistics of this flow, or flight would be impossible!

Long-term Forecasting

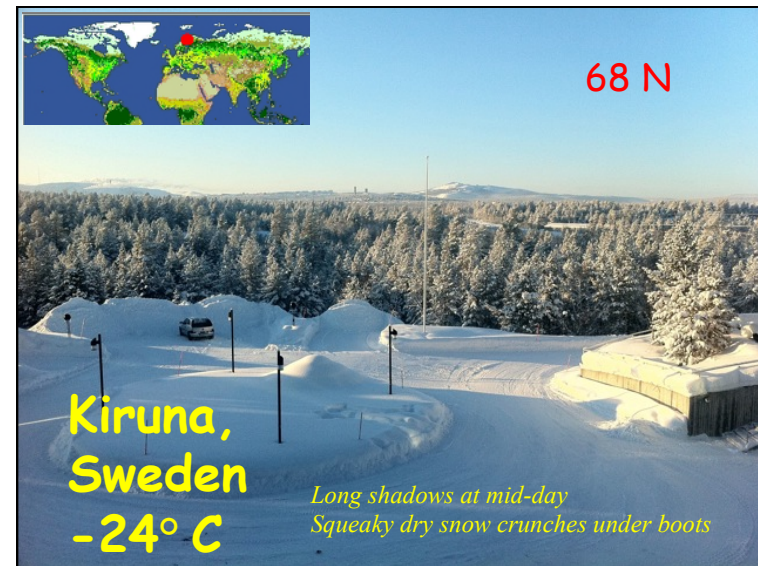
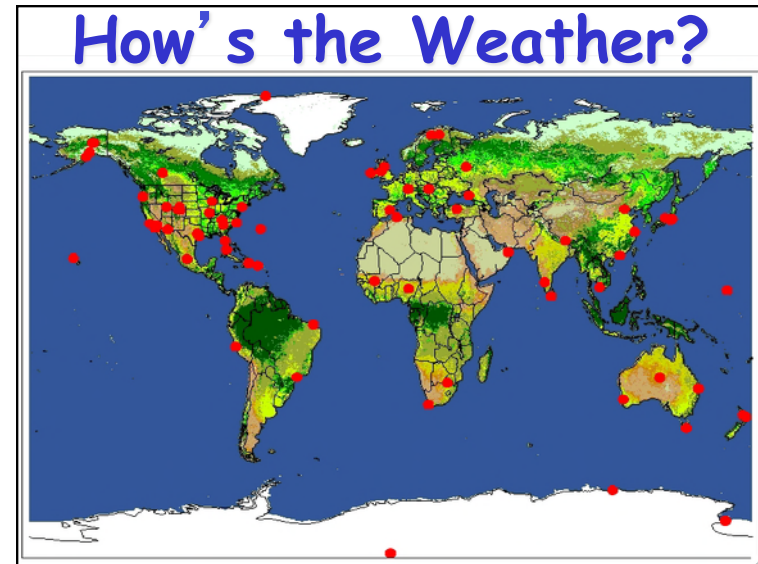
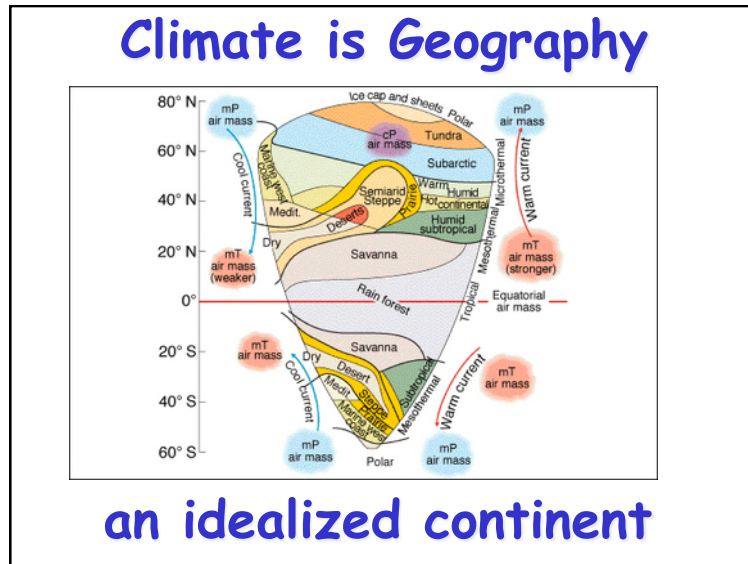
- Can't forecast the weather in Fort Collins on the day of the ATS 150 final exam in May (Snow? Sunshine? 50° F? 90° F?)
- Can "forecast" with complete confidence that $-100\text{ C} < T_{\text{max}} < +100\text{ C}$, or even that May will be warmer than March
- Why?
 - Boundary conditions!
 - Solar constant, position of Earth in orbit
 - Atmospheric composition
 - Tilt of Earth's axis, Fort Collins latitude, etc

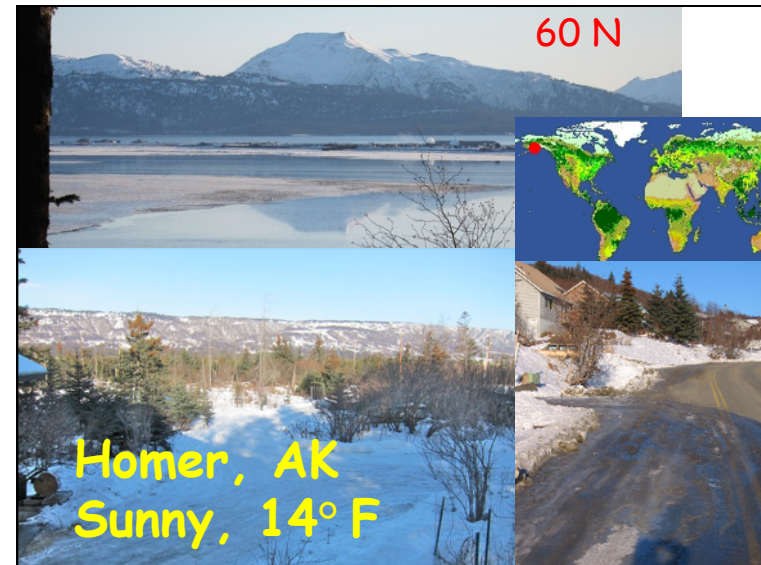
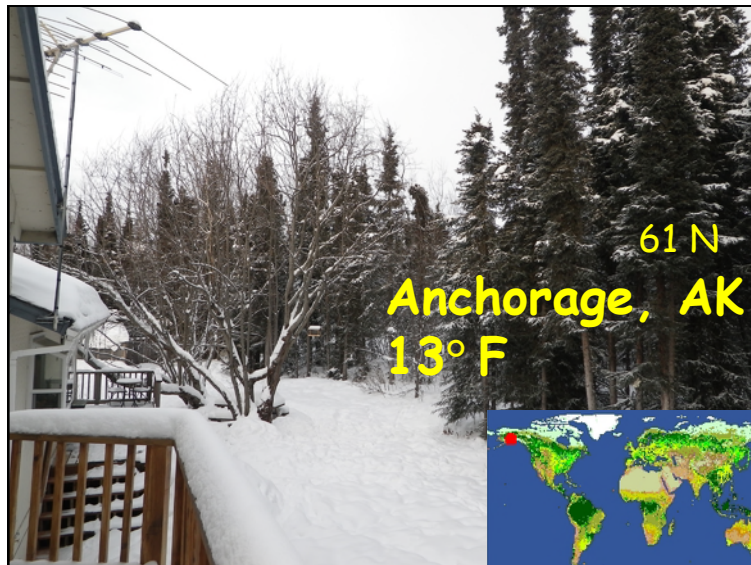
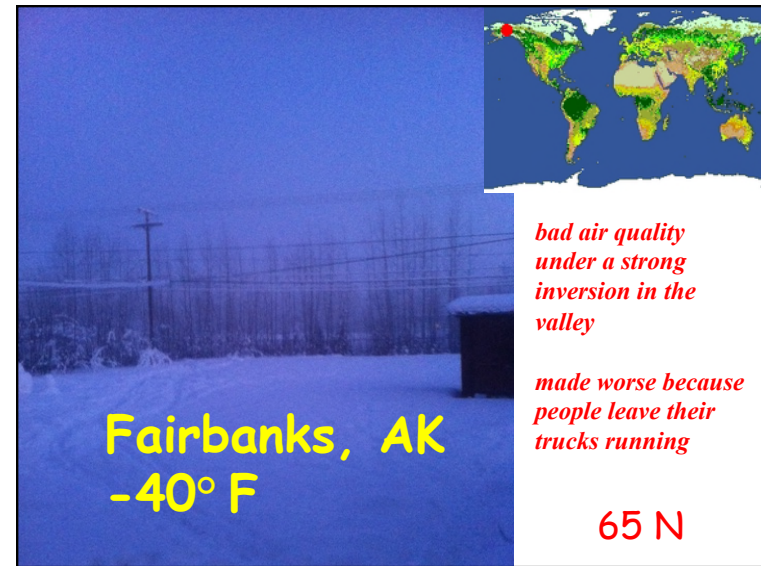
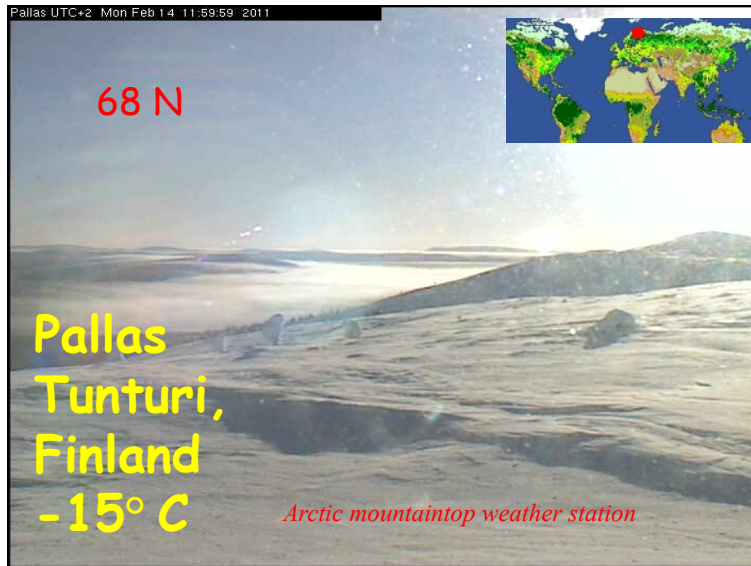
Weather

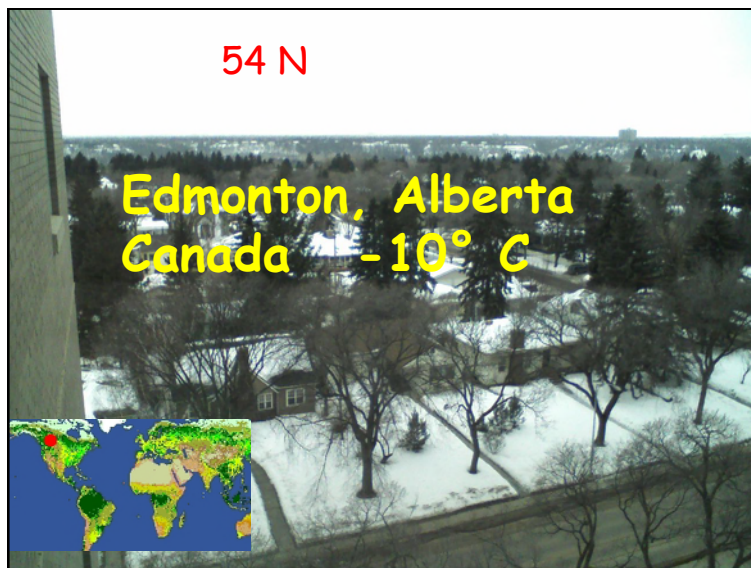
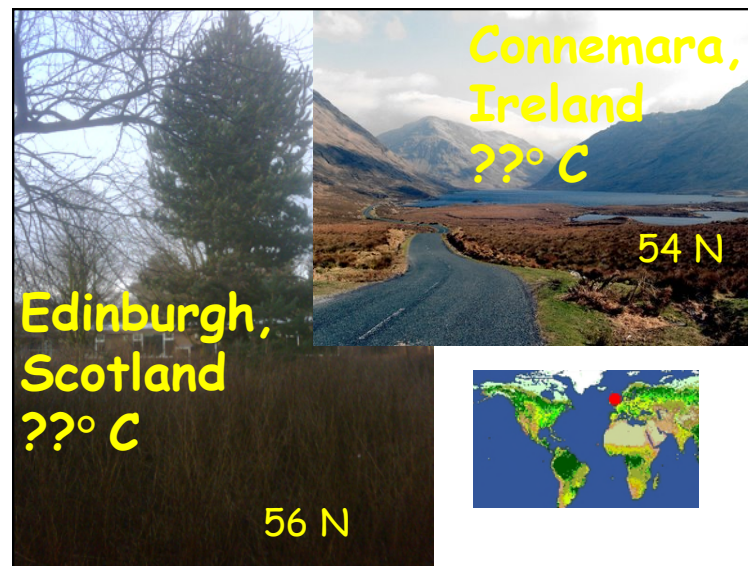
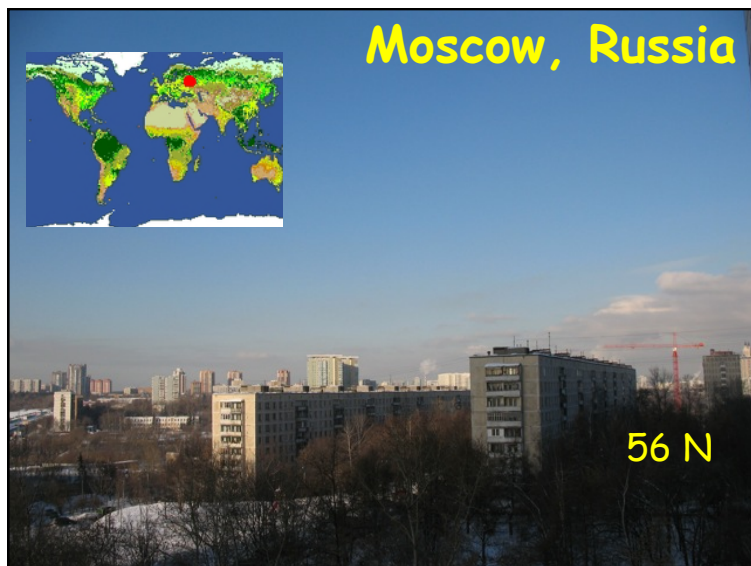
- Depends on time
 - weather nearby (especially upwind!)
 - weather yesterday
 - which way the wind blows
- Changes a lot!
 - from day to day
 - from season to season
 - from place to place on a given day
- Unpredictable more than a few days ahead

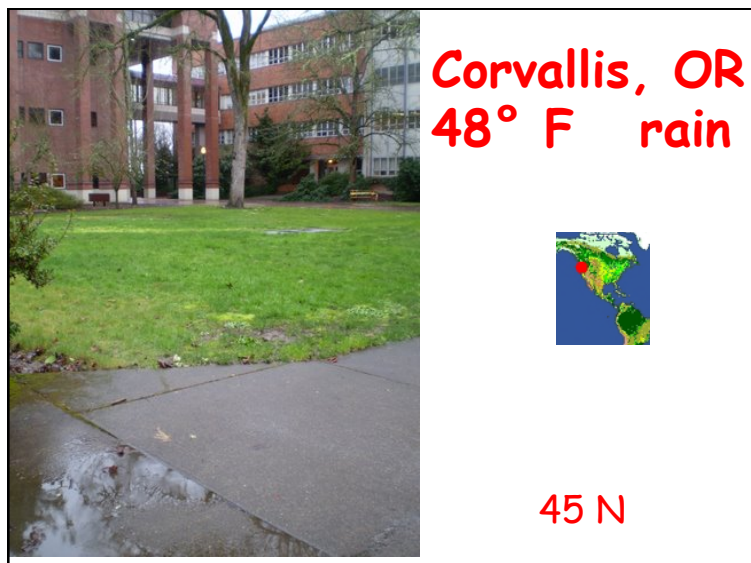
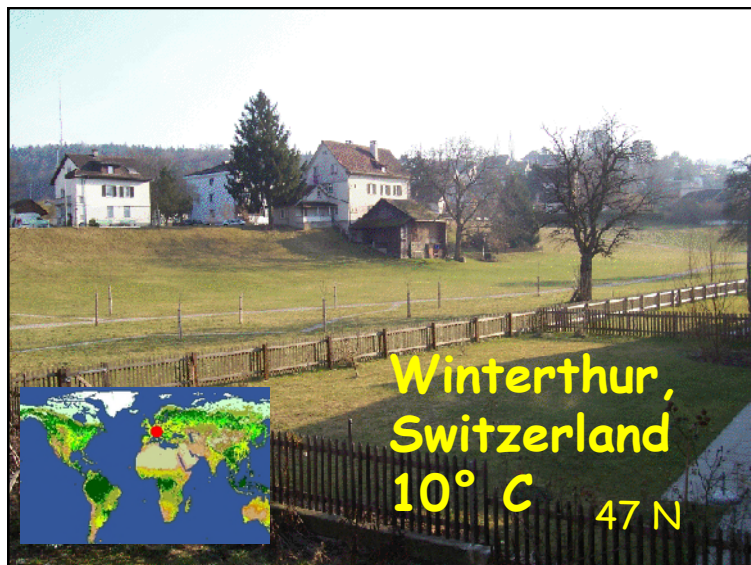
Climate

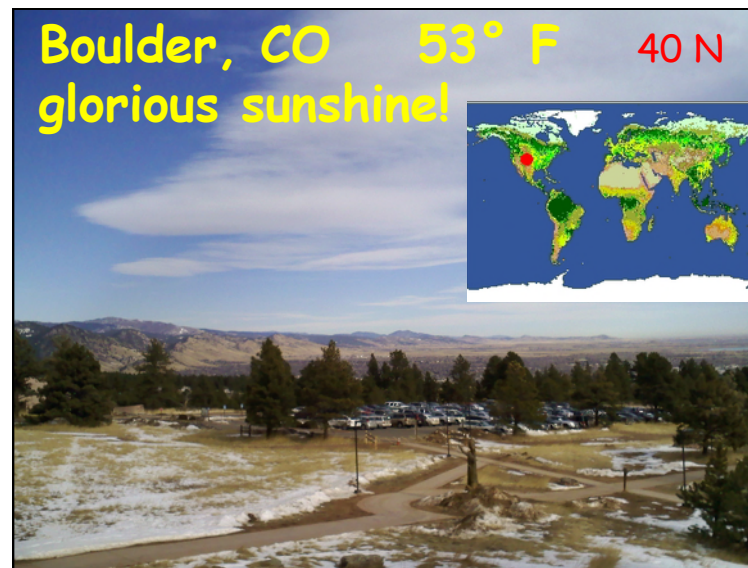
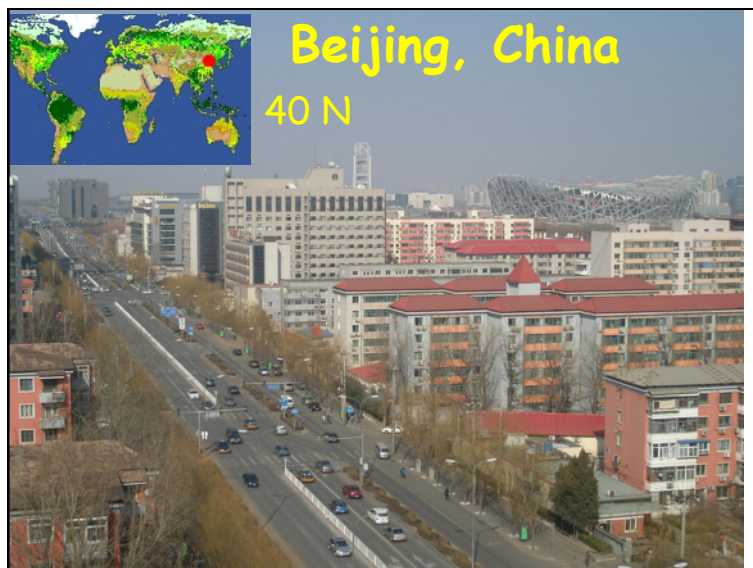
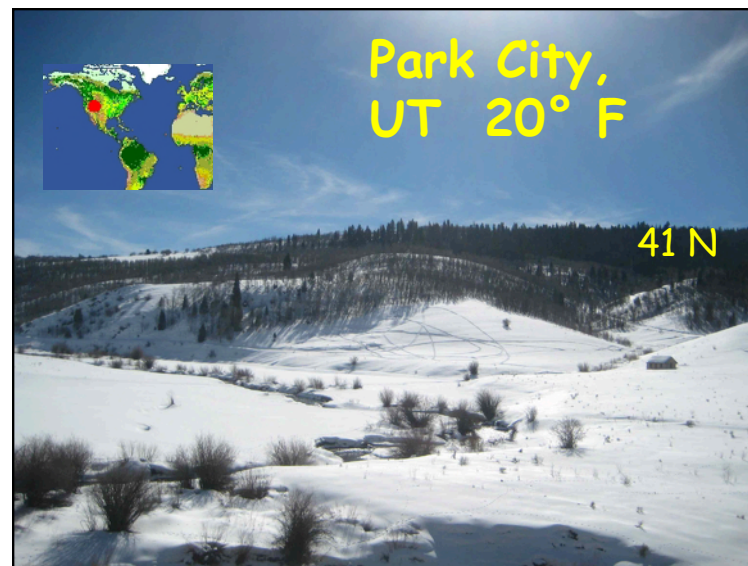
- Depends on where you live:
 - Latitude!
 - Altitude (mountains vs plains)
 - What's upwind (ocean vs land)
- Changes very slowly
- Very predictable
- We can predict that Miami is warmer than Minneapolis for precisely the same reasons that we can predict a warmer future!

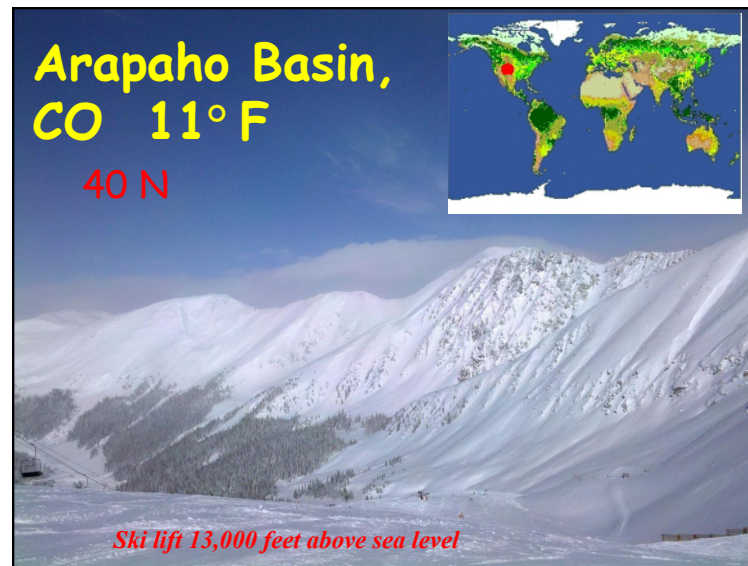
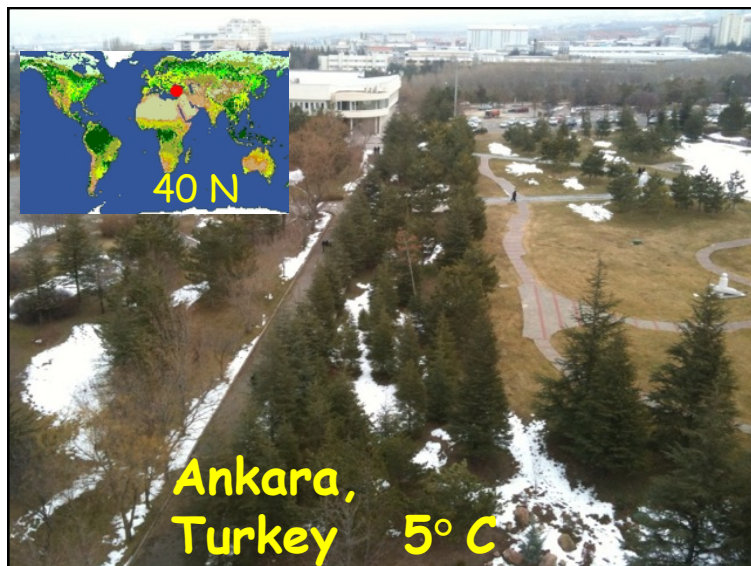


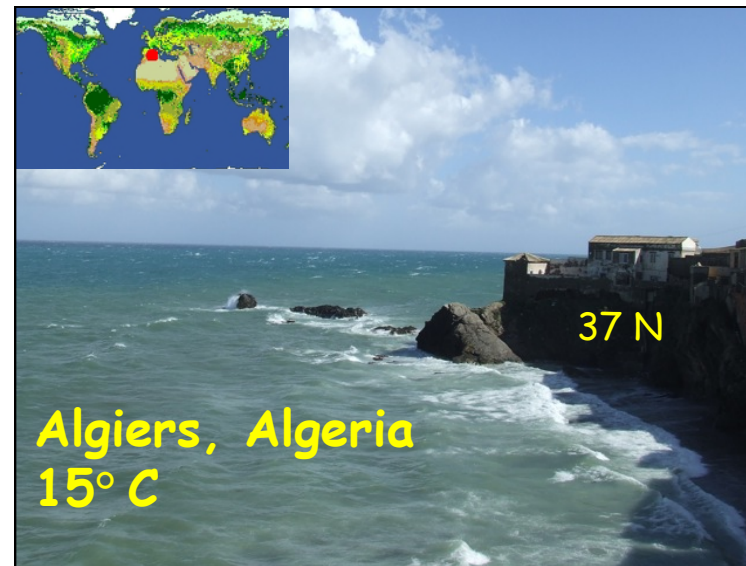
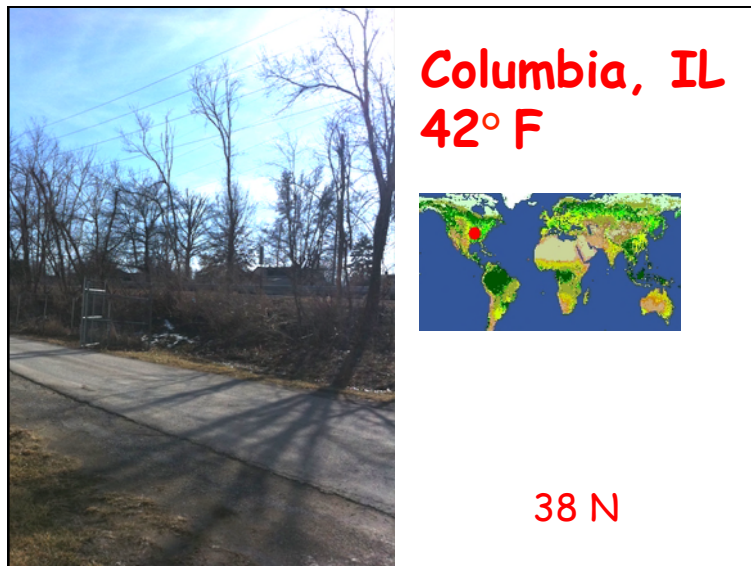
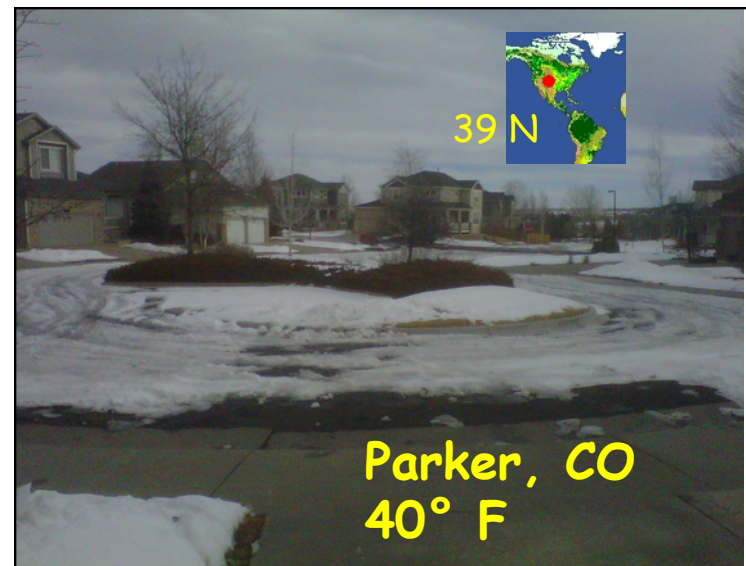


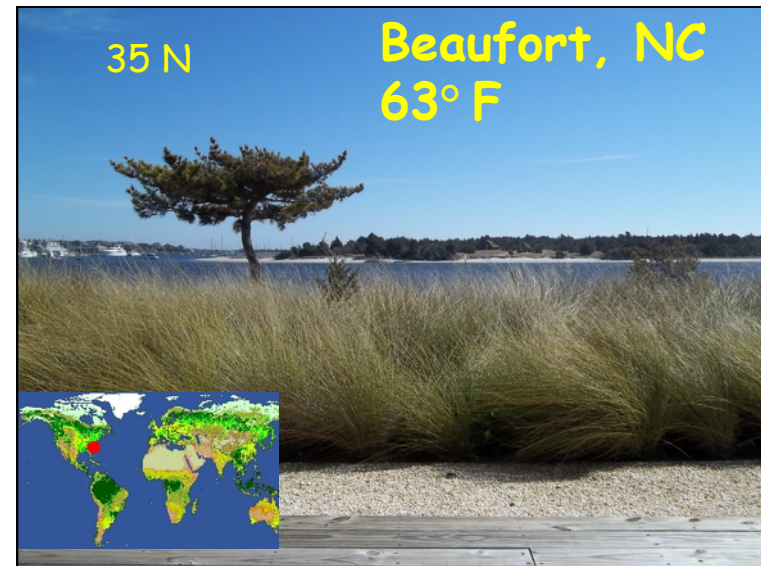


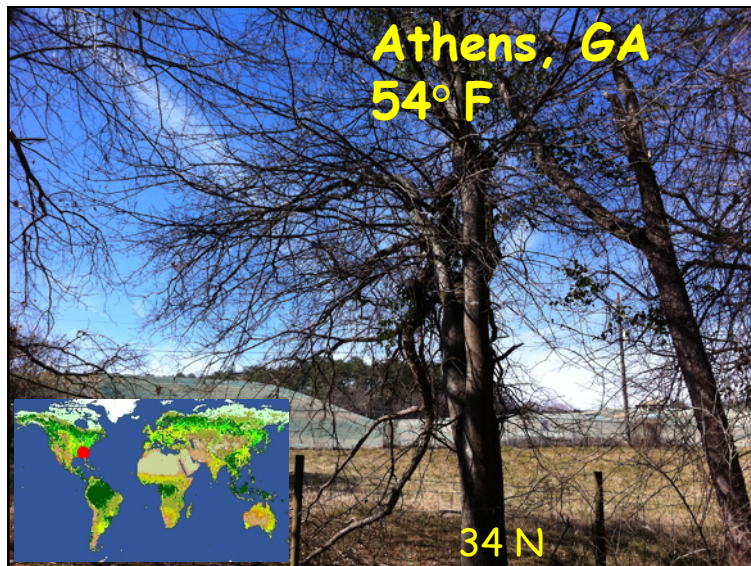


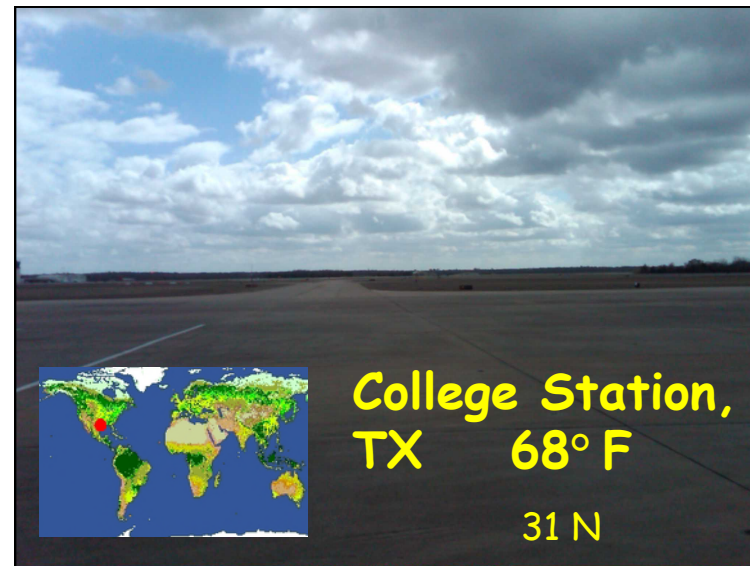
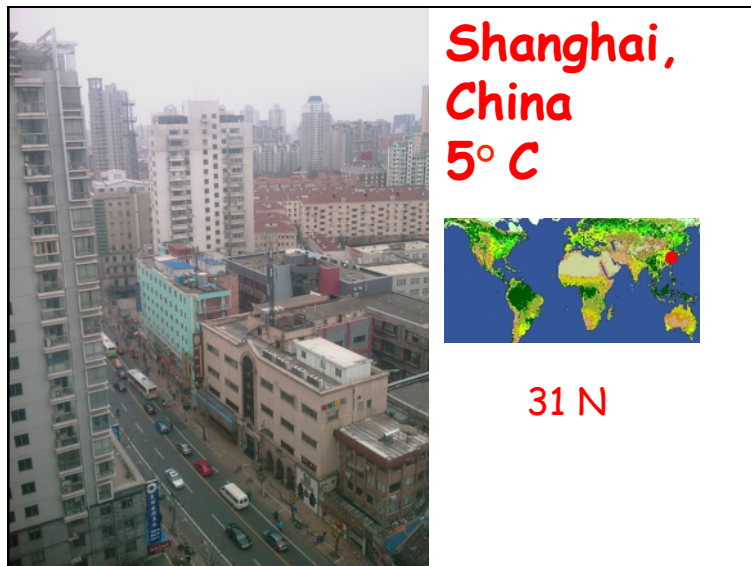
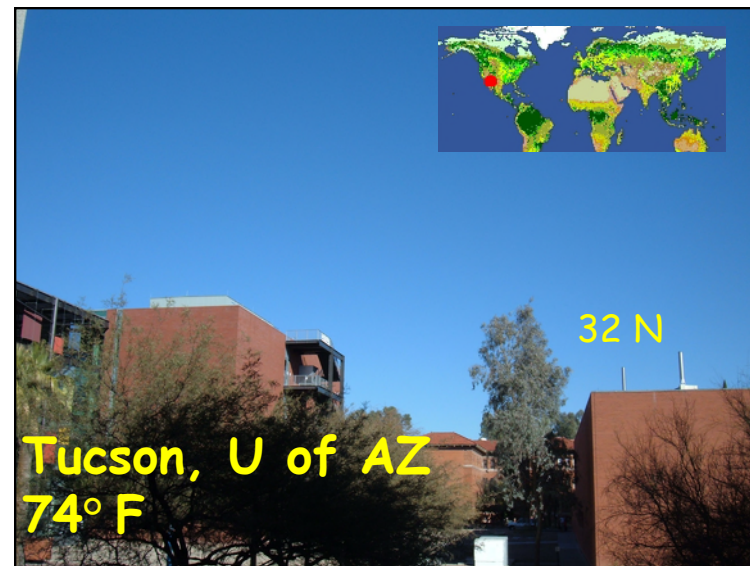


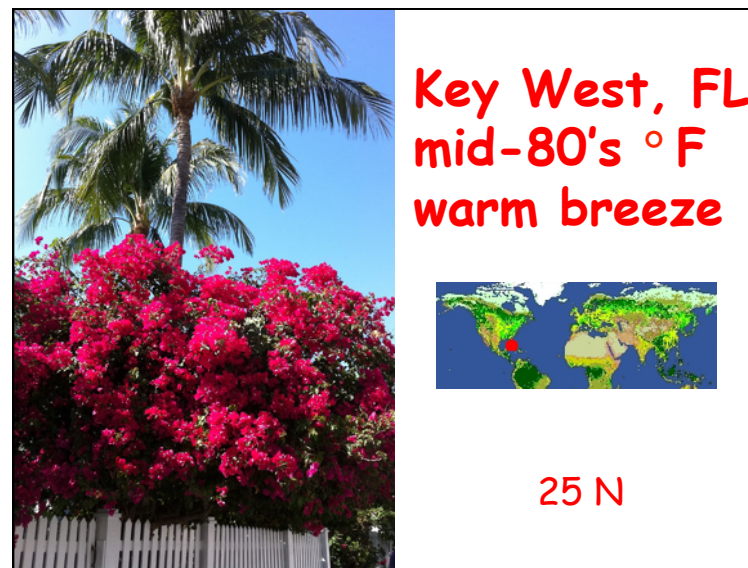
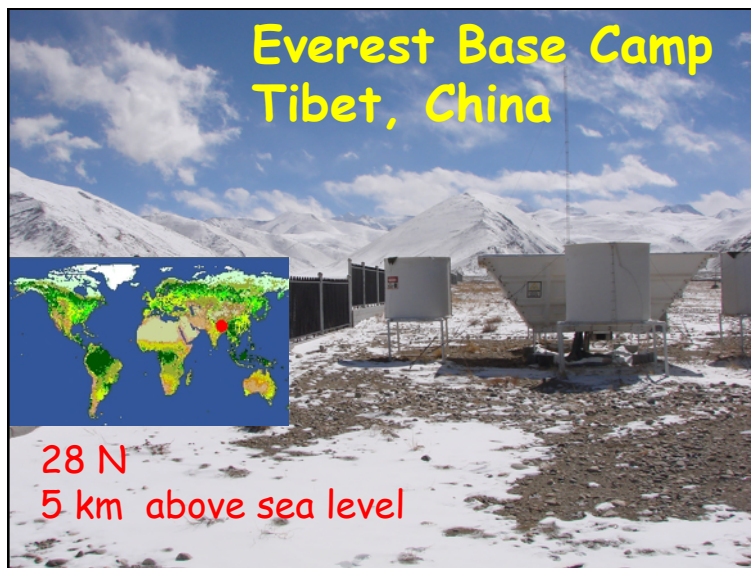


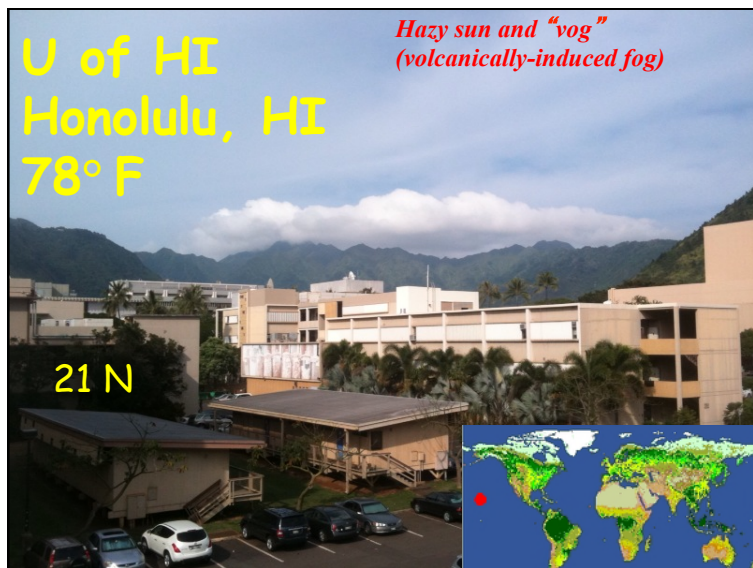
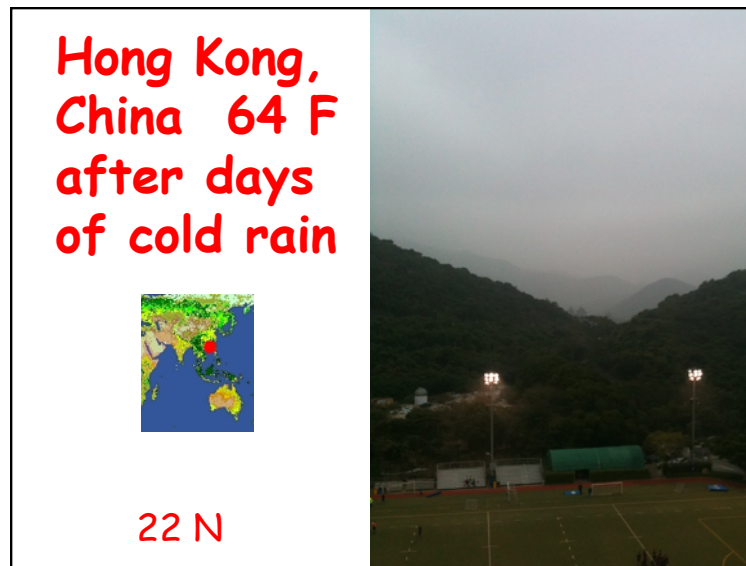
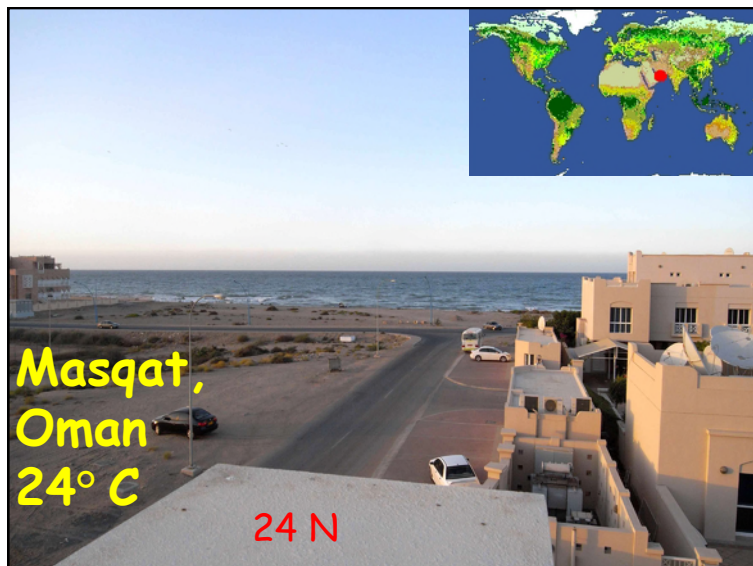










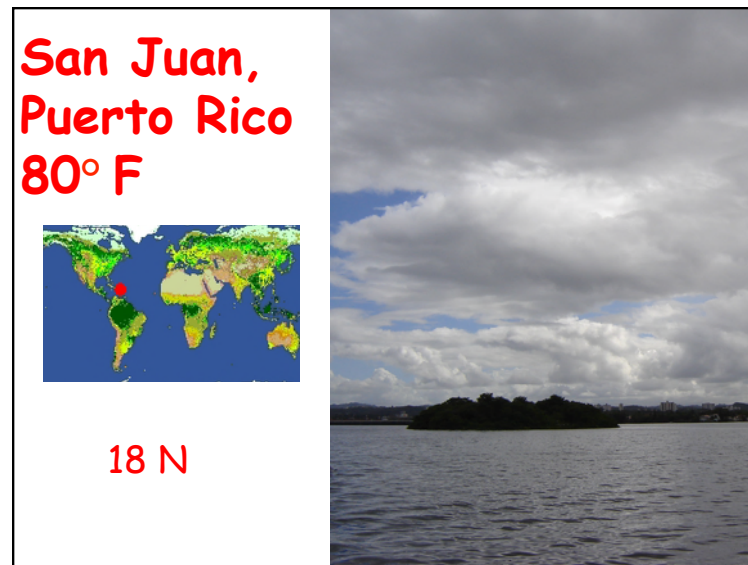


Santiago, Dominican Republic
87° F ... trees are leafing out



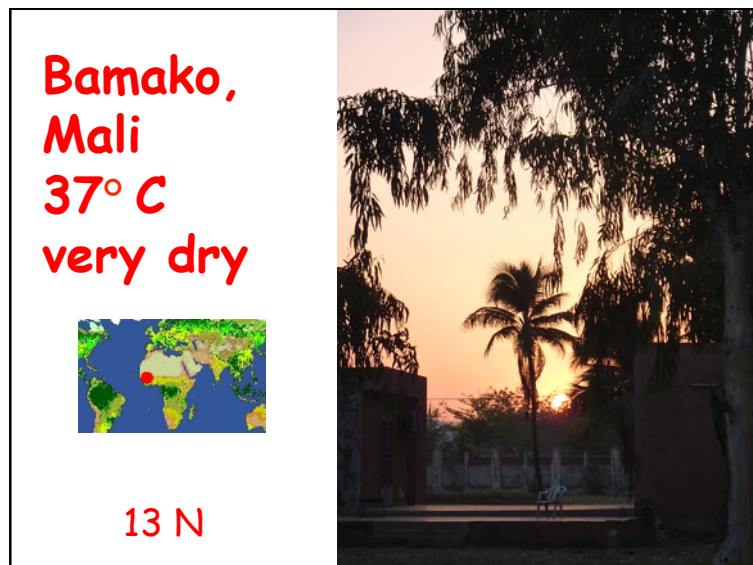
19 N

San Juan, Puerto Rico
80° F



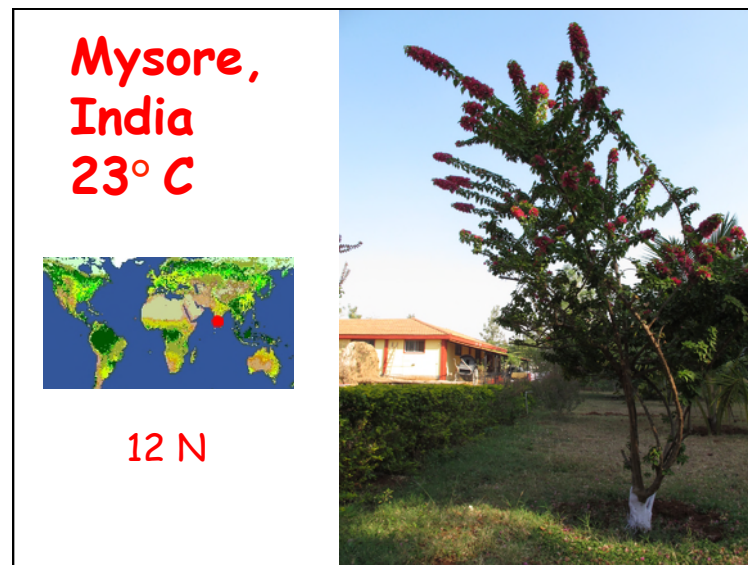
18 N

Bamako, Mali
37° C
very dry



13 N

Mysore, India
23° C



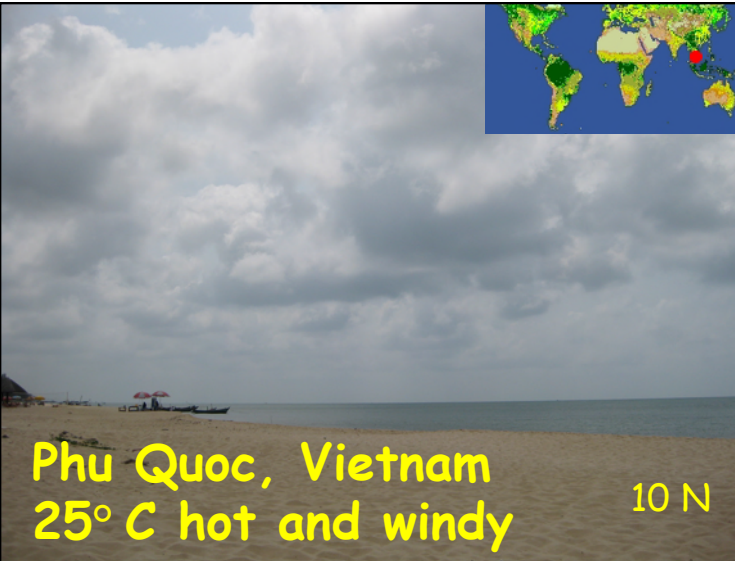

12 N



**Rayfield Jos
Nigeria
25° C
drizzle**



10 N

**Phu Quoc, Vietnam
25° C hot and windy**

10 N



**Kwajalein Atoll,
Marshall Islands
82° F**

9 N



*"heart of the dry season,
trade winds are king ...
hold onto your hat!"*



**Columbo Sri Lanka
27° C**

7 N



