Re: Adiabatic wet bulb temperature as defined by the AMS

Source: http://sci.tech−archive.net/Archive/sci.geo.meteorology/2008−03/msg00042.html

- *From*: Adam <no@xxxxxxxx>
- *Date*: Thu, 27 Mar 2008 13:30:26 −0400

Thanks for this.

In reading further, it appears that the "lifted condensation level" is the elevation associated with the air parcel being "cooled adiabatically to saturation".

The "moist adiabatic compression" process sounds complicated −− the latent heat of vaporization for water varies with pressure. So the properties of the droplets that are magically injected into the parcel would seem to vary throughout the process of compression.

So I gather that the AMS "adiabatic wet−bulb temperature":
1. Equals the "isobaric wet−bulb temperature" if the ground−level air parcel starts out saturated.
2. Is less than the "isobaric wet−bulb temperature" if the air parcel starts out less than saturated −− with the difference between the two values increasing as the starting ground−level relative humidity of the air parcel decreases.

The discrepancy between the values seems to arise because:
1. For the isobaric wet−bulb temperature, all moisture added to the air has the same latent heat of vaporization −− as determined only by the pressure at ground level.
2. For the adiabatic wet−bulb temperature, the latent heat of vaporization for the moisture added to the air has an "average" value somewhere between the value at ground level (where the latent heat is lowest) and the value at the "lifted condensation level" (where it is highest).

Am I understanding things correctly?

Thanks,
Adam

On Thu, 27 Mar 2008 11:19:10 −0400, Brent Lofgren wrote:

A "moist adiabatic process" is technically not adiabatic. What you are supposed to imagine in this moist adiabatic process is that as the parcel is compressed, enough water comes from somewhere (cloud/fog droplets were magically injected into the parcel) that vaporization occurs, keeping the water vapor at saturation. Thus there is a cooling from vaporization (diabatic) that partially offsets the adiabatic heating from the compression. Terms that are used for the curves on a temperature−pressure graph along which a saturated parcel would travel are "moist adiabats" and "pseudo−adiabats," the latter being more accurate.

Actually, a more real−world thing to visualize would be the reverse process: a saturated parcel starting at the adiabatic wet bulb temperature, being transported up to a specified level (saturation point of the original parcel), leaving behind the water that had condensed out, then warming adiabatically to the temperature and pressure of the original parcel.

Brent

Adam wrote:

> Hello,
>
> Please help me to understand the definition of adiabatic wet bulb temperature, as given here:
>
> http://amsglossary.allenpress.com/glossary/browse?s=w&p=23
>
> "Adiabatic wet−bulb temperature (or pseudo wet−bulb temperature): the temperature an air parcel would have if cooled adiabatically to saturation and then compressed adiabatically to the original pressure in a moist−adiabatic process."
>
> I am an engineer. I was taught to use the term "adiabatic wet bulb temperature" to refer to what is called the "isobaric wet−bulb temperature" by the AMS. It is the isobaric wet−bulb temperature that is shown on psychrometric charts for the air−conditioning industry.
>
> What is accomplished by the process in the AMS definition quoted above?
>
> It sounds like the air cools adiabatically as the pressure reduces (such as when an air parcel moves to a higher elevation), but no condensation happens.
>
> Is some other kind of "adiabatic cooling" possible?
>
> Is the "adiabatic wet−bulb temperature" equal to the dew point at this cooled and saturated condition?
>
> Then the air is re−compressed adiabatically to the original pressure.

What is the point of describing the re−compression in the definition? Wouldn't adiabatic re−compression simply return the air to exactly its original state?

Thanks for any clarity you may bring to the AMS defintion of the adiabatic wet bulb temperature.

Adam

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