Biermanns, Ludwig

Adiabatic winds, put into mathematical formulas

Universität Tübingen, Deutschland;
biermanns@yahoo.com

The development of the air temperature under foehn winds can be put into the following formulas:
On the windward side, under dry adiabatic conditions, there is a fall in air temperature of 1.0°C per 100 m in the air parcel. From the condensation level, there is a change into wet adiabatic conditions, with a fall in air temperature of 0.6 °C per 100 m: we have cloud formation wind with subsequent precipitations. With the arrival of the air masses on top of the mountain crest, the lowest possible temperature is reached:
$\theta_{h\,min} = \theta_{st\,sl} + [(- 1.0\ °C) / 100\ m] \cdot 400\ m + [(- 0.6\ °C) / 100\ m] \cdot (h_{top} - 400\ m)$; **(1)**
If the observation locality for the initial temperature takes a height above sea level, the section from it to sea level is subtracted from the height above sea level:
$\theta_{h\,min} = \theta_{st\,ab\,sl} + [(- 1.0\ °C) / 100\ m] \cdot 400\ m + [(- 0.6\ °C) / 100\ m]$
$\cdot (h_{top} - \Delta_{st\,sl} - 400\ m)$; **(2)**
$\theta_{h\,min}$ = temperature on top of mountain range [°C];
$\theta_{st\,sl}$ = temperature from starting point, on sea level [°C];
400 m = condensation level on windward side, normally, ca. 400 m above observation point, range of condensation level down to sea level and up to more than 400 m possible;
h_{top} = height of air parcel on top of mountain chain [m];
$\theta_{st\,ab\,sl}$ = temperature from starting point, above sea level [m];
$\Delta_{st\,sl}$ = difference in height on sea level from starting point above sea level.
When, from the height, the air parcel, on the opposite side of the mountain range, moves downward, again, from the topmost 500 m, the temperature rises by ca. 0.6 °C per 100 m. Afterward, from the dissipation level of the atmospheric humidity, with a continuous descending motion of the air, from the height downward, there is a rise in temperature of 1.0 °C per 100 m, down to sea level.
$\theta_{dest\,sl} = \theta_{h\,min} + [(+ 0.6\ °C) / 100\ m] \cdot 500\ m_{top} + [(+ 1.0\ °C) / 100\ m] \cdot (h_{top} - 500\ m_{top})$; **(3)**
If the destiation point takes a height above sea level, the difference from it to sea level, again, is subtracted:
$\theta_{dest\,ab\,sl} = \theta_{h\,min} + [(+ 0.6\ °C) / 100\ m] \cdot 500\ m_{top} + [(+ 1.0\ °C) / 100\ m] \cdot (h_{top} - 500\ m_{top} - \Delta h_{dest})$; **(4)**
$\theta_{dest\,sl}$ = air temperature on destination point in wind shade, on sea level [°C];
500 m_{top} = uppermost 500 m of mountain range, surpassed by air parcel, in wind shade;
$\theta_{dest\,ab\,sl}$ = air temperature on destination point in wind shade, above sea level [°C];
Δh_{dest} = difference in height on sea level from destination point above sea level [m].
Differences in temperature of 20 °C can be reached by adiabatic winds.

Session: *DEUQUA Session: Terrestrial records of paleoenvironments and – climates*
Keywords: *air parcel, condensation, dissipation, formulas, adiabatic conditions.*