Precipitation Potential Estimation

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Introduction

This document outlines the calculation of precipitation potential based on the Lifted Index (LI) and cloud water content. The Lifted Index (LI) is used to assess atmospheric instability, while the cloud water potential normalizes the cloud water content. These factors are combined to estimate the precipitation potential.

Lifted Index (LI) Calculation

The Lifted Index (LI) compares the temperature of a rising air parcel to the temperature of the environment at 500 hPa. The formula for the LI is given by:

$$\text{LI} = T_{\text{env}}(500\,\text{hPa}) - T_{\text{surface}} \tag{1}$$

Where:

- $T_{\text{env}}(500\,\text{hPa})$ is the temperature of the air parcel at 500 hPa.
- T_{surface} is the surface temperature.

A negative LI indicates instability, suggesting a higher potential for precipitation.

Cloud Water Potential Calculation

The cloud water potential is calculated by normalizing the cloud water content (CWC) to a scale of 0 to 1. The formula is:

$$\text{Cloud Water Potential} = \frac{CWC}{CWC_{\text{max}}} \tag{2}$$

Where:

- CWC is the cloud water content (in g/kg).
- CWC_{max} is the maximum realistic cloud water content used for normalization (in this case, 5.0 g/kg).

Precipitation Potential Calculation

The precipitation potential is calculated by combining the Instability Potential (based on the LI) and the Cloud Water Potential. The formula is:

$$\text{Precipitation Potential} = 0.6 \times \text{Instability Potential} + 0.4 \times \text{Cloud Water Potential} \tag{3}$$

Where:

- The Instability Potential is calculated as:

$$\text{Instability Potential} = \max\left(\frac{-\text{LI}}{10}, 0\right)$$

- The Cloud Water Potential is the normalized cloud water content.

Thus, the final equation for Precipitation Potential is:

$$\text{Precipitation Potential} = 0.6 \times \max\left(\frac{-\text{LI}}{10}, 0\right) + 0.4 \times \frac{CWC}{CWC_{\max}} \tag{4}$$

Where:

- LI is the Lifted Index.
- CWC is the cloud water content.
- $CWC_{\max}$ is the maximum cloud water content used for normalization.

The Precipitation Potential score ranges from 0 to 1, where 1 indicates a high potential for precipitation enhancement, and 0 indicates a low potential.