Appendix 2: Explanation of the Model Total Score Calculation Process

This appendix explains the principles and methods used to calculate the comprehensive scores for each model, aiming to demonstrate how the final model performance scores are obtained through standardization and weighted averaging based on the original evaluation indicators. This method references common practices in multi-indicator integrated evaluation, offering good versatility and transparency, and can scientifically reflect the overall performance level of the model under multi-variable and multi-indicator conditions.

Scoring Design Method

This scoring method is based on three commonly used metrics: root mean square error (RMSE), mean absolute error (MAE), and Pearson correlation coefficient (R), and calculates weighted averages for the training set, validation set, and test set. The specific scoring process is as follows:

1. Metric Normalization

For RMSE and MAE: Use maximum value inverse normalization (lower values result in higher scores):

$$N_{RMSE/MAE} = 1 - \frac{x}{x_{max}} \quad (A1)$$

For R values: Use maximum positive normalization (the higher the value, the higher the score):

$$N_R = \frac{x}{x_{max}} \quad (A2)$$

2. Single variable indicator scoring

For each indicator (RMSE, MAE, R) of each model, calculate the weighted average separately for the training set, validation set, and test set (the same applies to MAE and R):

$$S_{RMSE} = \frac{1}{3}\left(N_{Train\_RMSE} + N_{Val\_RMSE} + N_{Test\_RMSE}\right) \quad (A3)$$

3. Single variable scoring

For each meteorological variable (temperature, precipitation, relative humidity),

scores are calculated separately under three evaluation indicators:

$$S_{T/P/H} = \frac{1}{3}(S_{RMSE} + S_{MAE} + S_R) \quad (A4)$$

4. Calculation of total score

The final total score is the weighted average of the three scores for temperature, precipitation, and humidity:

$$S_{total} = \frac{1}{3}(S_T + S_P + S_H) \quad (A5)$$

Variable Scoring Table

Table A1 Temperature (T) Variable Scoring Details

Model	T_RMSE score	T_MAE score	T_R score	T_Total score
RegCM	0.0000	0.0000	0.8541	0.2847
CNN	0.3911	0.3407	0.9516	0.5611
LSTM	0.7123	0.6572	0.9939	0.7878
Transformer	0.4904	0.4164	0.9668	0.6245
CNN-LSTM	0.7713	0.7229	0.9987	0.8309
LSTM-Transformer	0.7913	0.7497	1.0000	0.8470

Table A2: Detailed evaluation of precipitation (P) variables

Model	T_RMSE score	T_MAE score	T_R score	P_Total score
RegCM	0.3387	0.2290	0.5170	0.3616
CNN	0.3541	0.2639	0.9660	0.5280
LSTM	0.3022	0.2792	0.8853	0.4889
Transformer	0.0000	0.0000	0.5237	0.1746
CNN-LSTM	0.4118	0.4126	1.0000	0.6081
LSTM-Transformer	0.3996	0.3636	0.9782	0.5805

Table A3 Relative Humidity (H) Variable Evaluation Details

Model	T_RMSE score	T_MAE score	T_R score	H_Total score
RegCM	0.3819	0.4761	0.8710	0.5763
CNN	0.4082	0.3599	0.9557	0.5746
LSTM	0.3879	0.3790	0.9745	0.5805
Transformer	0.0000	0.0000	0.8754	0.2918
CNN-LSTM	0.5099	0.4985	0.9947	0.6677
LSTM-Transformer	0.5322	0.5238	1.0000	0.6853

Table A4 Summary of Model Total Scores

Model	T_Total score	P_Total score	H_Total score	S_Overall score
RegCM	0.2847	0.3616	0.5763	0.4075
CNN	0.5611	0.5280	0.5746	0.5546
LSTM	0.7878	0.4889	0.5805	0.6191
Transformer	0.6245	0.1746	0.2918	0.3636
CNN-LSTM	0.8309	0.6081	0.6677	0.7022
LSTM-Transformer	0.8470	0.5805	0.6853	0.7043