Knowledge Discovery of Influencing the Movement of Mesoscale Convective System (MCS) Over the Tibetan Plateau

影響青藏高原上中尺度對流系統移動的知識發現

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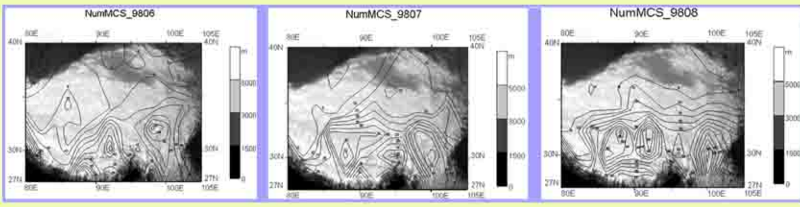
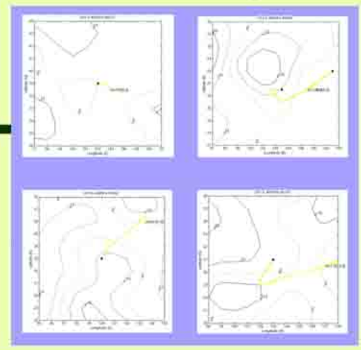
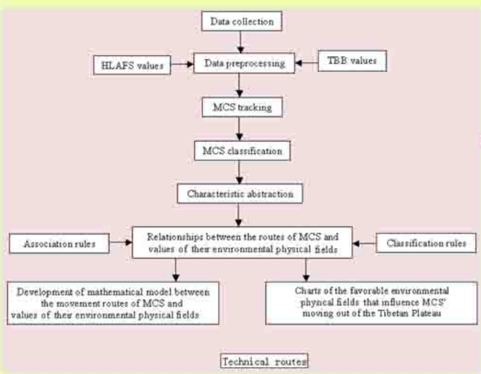
Project Summary:
In this project, Geostationary Meteorological Satellite (GMS) infrared black-body temperature (Tbb) data from June to August 1998 are used to automatically track the activity of Mesoscale Convective Systems (MCSs) over the Tibetan Plateau in China and to obtain the features of MCSs. Furthermore, High Resolution Limited Area Analysis and Forecasting System (HLAFS) values are used to study the relationships between the routes of MCS movement and the values of their environmental physical fields. Based on these, the charts of favorable environmental physical fields that influence MCS movement out of the Tibetan Plateau in different UTC are developed using spatial data mining techniques at levels of 400hPa and 500hPa respectively.



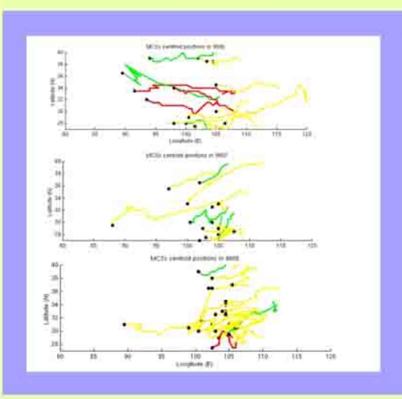
MCS frequency and geographic distribution over the Tibetan Plateau from June to August 1998.



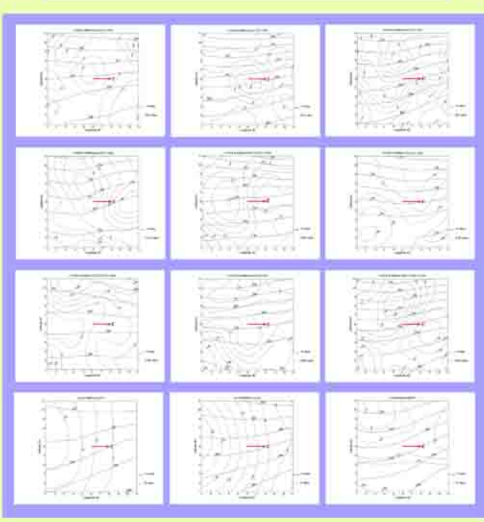
The relationship between moving MCSs and their peripheral divergent values.



Technical routes.



The moving routes of MCSs over the Tibetan Plateau from June to August 1998.



Features of the environmental physical fields of MCSs that moved out of the Tibetan Plateau at the 400hPa and 500hPa levels.

The charts of favorable environmental physical fields of MCSs that moved out of the Tibetan Plateau.

Table 1. Features of the environmental physical fields of MCSs that moved out of the Tibetan Plateau at the 400hPa level (Association Rules).

Index	Rules
1	H_{bs}=28~35.8∧RH_{bs}=22.92~32.38∧ DIV_{bc}=-10.5~-2.8→E(4,1.0,0.018)
2	H_{bs}=12.4~20.2∧H_{bc}=-11.6~-5.7∧DIV_{bs}=0.5~7.0∧DIV_{bc}=-2.8~4.9→E(4,1.0,0.018)
3	H_{bc}=-29.3~-23.4∧VOR_{bc}=-13.6~-1.5∧ω_{bs}=-138~-37.4→E(3,1.0,0.013)
4	RH_{bc}=-23.4—13.8∧VOR_{bs}=3.6~15.7∧DIV_{bc}=-2.8~4.9→E(3,1.0,0.013)
5	VOR_{bs}=3.6~15.7∧DIV_{bc}=-2.8~4.9∧K_{bs}=6~12.5→E(3,1.0,0.013)
6	DIV_{bc}=-10.5~-2.8∧ω_{bc}=-117.6~-9.0∧$IFVQ_{bc}$=-58.8~-30.5→E(4,0.8,0.018)
7	RH_{bc}=-4.2~5.4∧VOR_{bs}=-8.5~3.6∧DIV_{bc}=-10.5~-2.8∧θSE_{bc}=0.4~2.3∧K_{bc}=1~15→E(3,0.75,0.013)
8	DIV_{bc}=-6~0.5∧ω_{bc}=-117.6~-9∧Shape is others→ E(5,0.71,0.022)
9	H_{bc}=-11.6—5.7∧DIV_{bs}=0.5~7.0∧DIV_{bc}=-2.8∧4.9→ E(5,0.71,0.022)

Table 2. Features of the environmental physical fields of MCSs that moved out of the Tibetan Plateau at the 500hPa level (Association Rules)

Index	Rules
1	RH_{bs}=-9.66—1.39∧VOR_{bs} =-5~10.8∧ ω_{bs} =27.8~130.1→E(4,1.0,0.018)
2	H_{bs}=13~19∧RH_{bs}=-5~10.8∧ω_{bs} =27.8~130.1→E(4,1.0, 0.018)
3	H_{bs}=13~19∧T_{bc}=5.6~12.3∧RH_{bs}=-9.66~-1.39∧K_{bc} =1~15→E(3,1.0,0.013)
4	H_{bs}=13~19∧RH_{bc}=-0.02~7.36∧ω_{bc} =-110.9~4.8∧K_{bc}=1~15∧ Shape is others→E(3,1.0, 0.013)
5	T_{bs}=34.3~40∧ω_{bs} =-176.8~-74.5∧K_{bc}=-13~-1→E(3,1.0, 0.013)
6	RH_{bc}=15.15~23.42∧The lowest Tbb=-48.8—44.2→E(4,0.8, 0.018)
7	H_{bs}=13~19∧RH_{bs}=-9.66~-13.9∧DIV_{bc}=-4~2.8→E(3,0.75, 0.013)
8	H_{bs}=13~19∧T_{bc}=-27.9~-21.2∧K_{bs}=-0.5~6→E(3,0.75, 0.013)
9	RH_{bs}=15.15~23.42∧VOR_{bc}=-42~-30.9→E(3,0.75, 0.013)

Table 3. Features of the environmental physical fields of MCSs that moved out of the Tibetan Plateau at the 400hPa level (Decision Tree).

Index	Rules
1	H_{bc}≤-1∧100°E <Longitude≤102°E ∧ Latitude≤37.5°N∧Area≤233750 ∧ K_{bc} ≤-6 ∧Shape is others→E(2)
2	H_{bc}≤-1∧Longitude≤102°E ∧ Area>233750 ∧ θSE_{bc}≤-3 →NE(3/1)
3	H_{bc}≤-1∧Longitude≤102°E ∧ Area>233750 ∧θSE_{bc}>-3 ∧θSE_{bc}≤2∧Shape is circular→E(3/1)
4	H_{bc}≤-1∧Longitude≤102°E ∧ Area>233750 ∧θSE_{bc}>-3 ∧ VOR_{bc} ≤22 ∧ Shape is others →E(7/1)
5	H_{bc}≤-1∧102°E <Longitude≤104°E ∧Area≤41250 ∧ VOR_{bc} >15∧ Shape is others →E(2)
6	H_{bc}≤-1∧102°E <Longitude≤104°E ∧Area>41250 ∧ VOR_{bc} >-28∧ T_{bc}>-1 →E(12/1)
7	H_{bc}≤-1∧Longitude>104°E ∧DIV_{bc} ≤6 →E(16/2)
8	H_{bc}>-1∧T_{bc}≤6 ∧Shape is others→SE(3/1)

Table 4. The results of MCSs knowledge at the 400hPa level (Decision Tree).

Index	Rules
1	H_{bc}≤-1 ∧104°E <Longitude<105°E ∧ DIV_{bc}≤6 →E(16/3.7)
2	H_{bc}≤-1 ∧ 102°E<Longitude≤104°E ∧ Area>41250 ∧ T_{bc}>-1 ∧ VOR_{bc}>-28 →E(12/2.5)
3	H_{bc}≤-1∧ Longitude≤102°E ∧ Area>233750 ∧Shape is others ∧ VOR_{bc}≤22 →E(7/2.4)
4	H_{bc}≤-1 ∧ Longitude≤102°E ∧ Area>233750 ∧ θSE_{bc}>-3 ∧ θSE_{bc}≤2 ∧ Shape is circle →E(3/2.1)
5	H_{bc}≤-1 ∧ Longitude≤ 102°E ∧Area>233750 ∧ θSE_{bc}≤-3 →NE(3/2.1)

Table 5. The results of MCSs knowledge at the 500hPa level (Decision Tree).

Index	Rules
1	101.5°E <Longitude≤104°E ∧ Area≤233750 ∧ $IFVQ_{bc}$ ≤-74 →NE(2/1)
2	101.5°E <Longitude≤104°E ∧ Area≤233750 ∧ H_{bc}≤17 ∧ K_{bc}≤12 ∧ T_{bc}>9 ∧ $IFVQ_{bc}$>-74 ∧ DIV_{bc}≤6 →E(10)
3	101.5°E <Longitude≤104°E ∧ Area≤233750 ∧ H_{bc}>17 ∧ K_{bc}≤12 ∧ T_{bc}>9∧ $IFVQ_{bc}$>-74∧ $IFVQ_{bc}$ >2∧DIV_{bc}≤6→ E(3)
4	Longitude≤104°E ∧Area>233750∧ K_{bc} ≤0 →NE(3/1)
5	Longitude≤104°E ∧Area>233750∧ H_{bc}≤9 ∧θSE_{bc}≤0 →SE(2/1)
6	Longitude≤104°E∧Area>233750∧ω_{bc}≤138∧H_{bc}>9∧K_{bc}>0∧θSE_{bc}≤0 →E(8)
7	Longitude≤104°E∧Area>233750∧ω_{bc}>138∧H_{bc}>9∧K_{bc}>0∧θSE_{bc}≤0 →SE(3/1)
8	Longitude≤104°E∧Area>521250∧θSE_{bc}>0∧DIV_{bc}>-10 →E(2)
9	104°E <Longitude<105°E ∧Area>26250→E(14)
10	104°E <Longitude<105°E ∧Latitude>30.5∧Area≤26250→E(2)

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