



Impact of Intra-seasonal Oscillations on Meiyu

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Background

Meiyu is very important for people's livelihood water. The tropical intra-seasonal oscillation (ISO) is one of the most important changes in the tropical atmosphere. 鄒等(2003) shows that the 30-60-day intra-seasonal oscillation phenomenon has an impact on the rainfall in Taiwan. As for the summer ISO, that is, the boreal summer intra-seasonal oscillation (BSISO) is another dominant factor modulating Meiyu. Therefore, this study hopes to understand the influence of BSISO1 (period 30-60 days) and BSISO2 (period 10-30 days) on Meiyu through the analysis of rainfall fields.

Data & Method

Initial Condition

Control Run (CE)

CFSv2

Sensitivity Run (SE1)
No_BSISO1

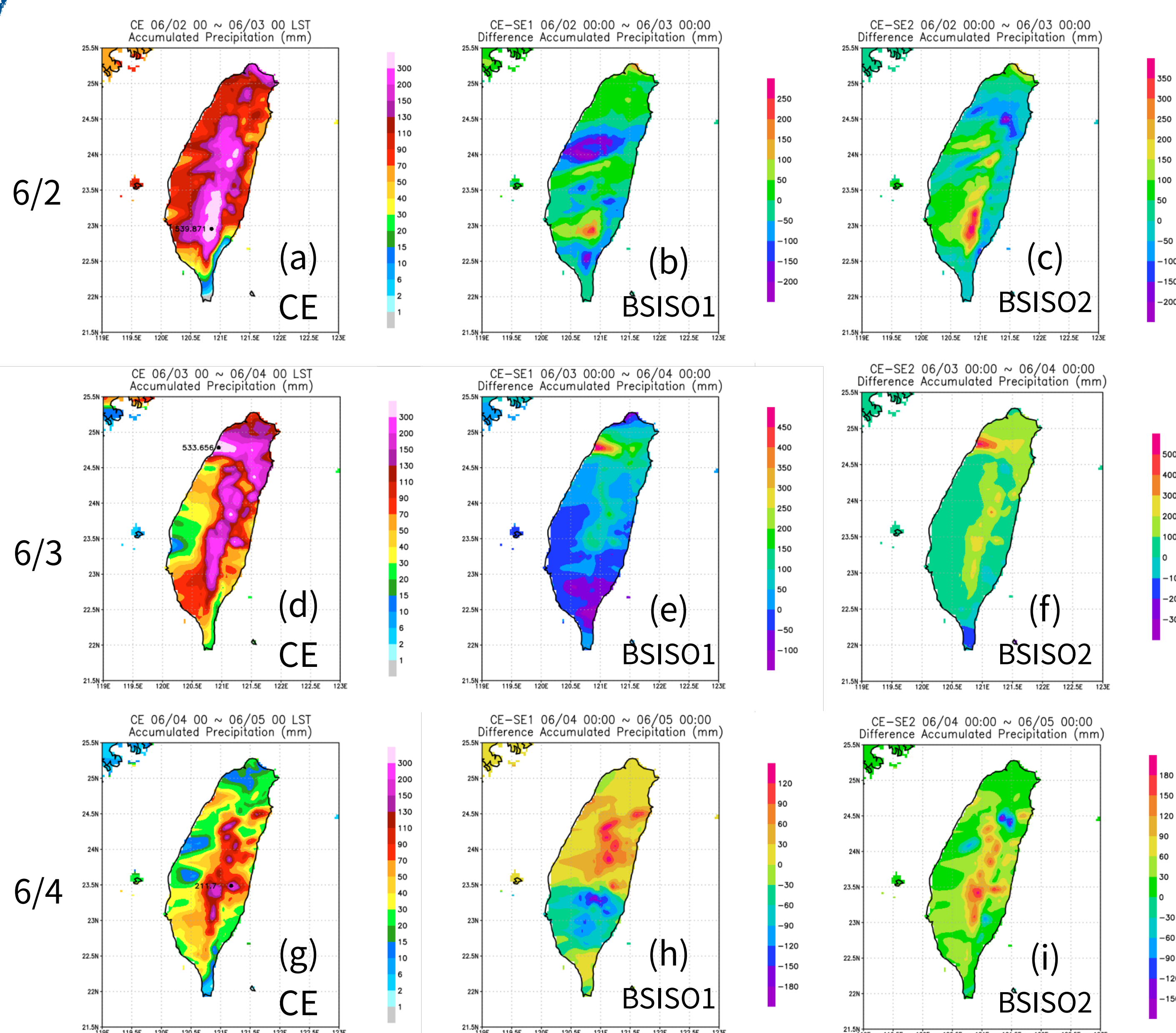
CE - BSISO1

Sensitivity Run (SE2)
No_BSISO2

CE - BSISO2

- Data accessed from :
 - a) NCEP coupled forecast system model version 2 (CFSv2), $0.5^\circ \times 0.5^\circ$, 6 hourly, 25 vertical layers, 95-145°E, 0-50°N.
 - b) Optimum Interpolation SST, $0.25^\circ \times 0.25^\circ$, daily.
- We use Cloud-Resolving Storm Simulator (CRSS) model and NCEP CFSv2 data to reconstruct the case (i.e., CE).
- Then, use the bandpass to filter out the BSISO1 and BSISO2 separately. After subtracting SE from CE, we can finally get the effects of BSISO1 and BSISO2 on the Meiyu front.

The impact of BSISO on rainfall

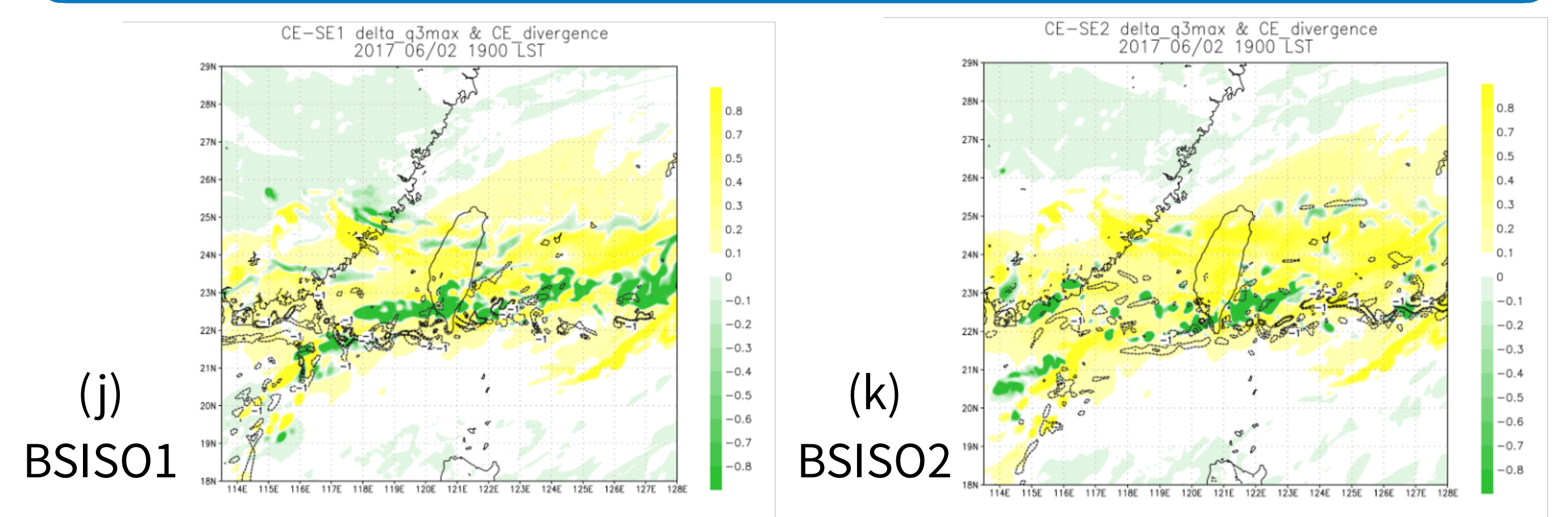


- The above 9 pictures are the accumulative rainfall in one day, the six pictures on the right are the results of CE minus SE, analyzing the impact of BSISO on the whole Taiwan rainfall.
- In 3 pictures of SE1, figure (b) on 6/2, there were obvious negative values in the central region, while most of the other regions showed positive values. figure (e), (h) on 6/3, 6/4, there are negative values in the southern region, and positive values in other regions, especially on 6/4.
- In 3 pictures of SE2, figure (c), (f), (i), most of the Taiwan region showed positive values.

Result

- BSISO1 weakens the rainfall intensity, while BSISO2 mainly affects the rainfall range, making rain all over Taiwan.

The impact of BSISO on the Meiyu front



- Figures (j), (k), shading in yellow means BSISO increases rainfall, while shading in green does the opposite. Contour line represents the convergence of CE, which is the position of the CE front.
- In (j), (k), as the front moves south, the shading area follows the front and spreads roughly according to the shape of the front.
- Green and yellow in (j) appear to be half and half, as the result of the Accumulated Precipitation, BSISO2 reduces rainfall intensity in certain areas and increases rainfall in other areas.
- Most of the colors in (k) are yellow, which means that BSISO2 expands the range of radar echo rainfall, making Taiwan all rainy.
- This result makes us strongly suspect that BSISO directly affects the rainfall intensity of the front, but because this figures cannot be a strong evidence, so it still not so sure that BSISO had direct impact on the Meiyu front.

Water budget

$$p + \frac{\partial}{\partial t}(w_v) = - \int \nabla \cdot (\rho_v V) dz + E + R \quad (1) \quad w_v = \int (\rho_v) dz$$
$$- \int \nabla \cdot (\rho_v V) dz = - \int \rho_v (\nabla \cdot V) dz - \int (V \cdot \nabla) \rho_v dz \quad (3)$$

Trenberth and Guillemot (1995)

- P : precipitation ; TDC : tendency of total water content
- CVF : convergence of vapour flux ; E : evaporation ; R : residual
- CVF is separated into convergence (CONV) and advection (ADV).

6/2-4 data	P	TDC	CVF	CONV	ADV	E	R
CE	2.893	-0.020	2.489	2.105	0.385	0.094	0.325
SE1	2.891	-0.034	2.644	2.301	0.343	0.077	0.201
CE-SE1	0.002	0.014	-0.155	-0.196	0.042	0.017	0.124
CE-SE1/CE	0.07%	70%	-6%	-9%	11%	18%	38%
SE2	1.493	-0.062	1.379	0.360	1.019	0.078	0.004
CE-SE2	1.400	0.042	1.11	1.745	-0.634	0.016	0.321
CE-SE2/CE	48%	210%	45%	83%	-165%	17%	90%

Conclusions

- BSISO1 weaken rainfall intensity, BSISO2 makes rain all over Taiwan.
- From the water budget analysis, BSISO1 mainly reduces the occurrence of convergence, which may reduce the rainfall intensity.
- BSISO2 increases a lot of precipitation, and its CVF contributes about 80% of the precipitation (P).

References

- 鄒治華, 柯文雄, 徐邦琪, 潘淑鈴, 2003: 東亞夏季季風期間季內振盪的年際變化。大氣科學, 31, 239-259。
- Trenberth, K.E. and Guillemot, C.J. (1995) Evaluation of the global atmospheric moisture budget as seen from analyses. Journal of Climate, 8, 2255-2272.