LS4P-II: Initial results from sensitivity experiments with the ECMWF-IFS forecast model

Retish Senan
Long Range Forecasting Team
Earth System Predictability Section
Research Department

Thanks to Yongkang and Aaron for encouraging my participation, and Yongkang and Hara for interesting discussions!

ECMWF

Experimental Set-up

- ECMWF-IFS CY49R1 Seasonal forecasting suite
- Atmosphere: IFS Tco319 (~36km) + 137 levels
- Ocean: NEMO3.4 ORCA025 (0.25º) + 75 levels

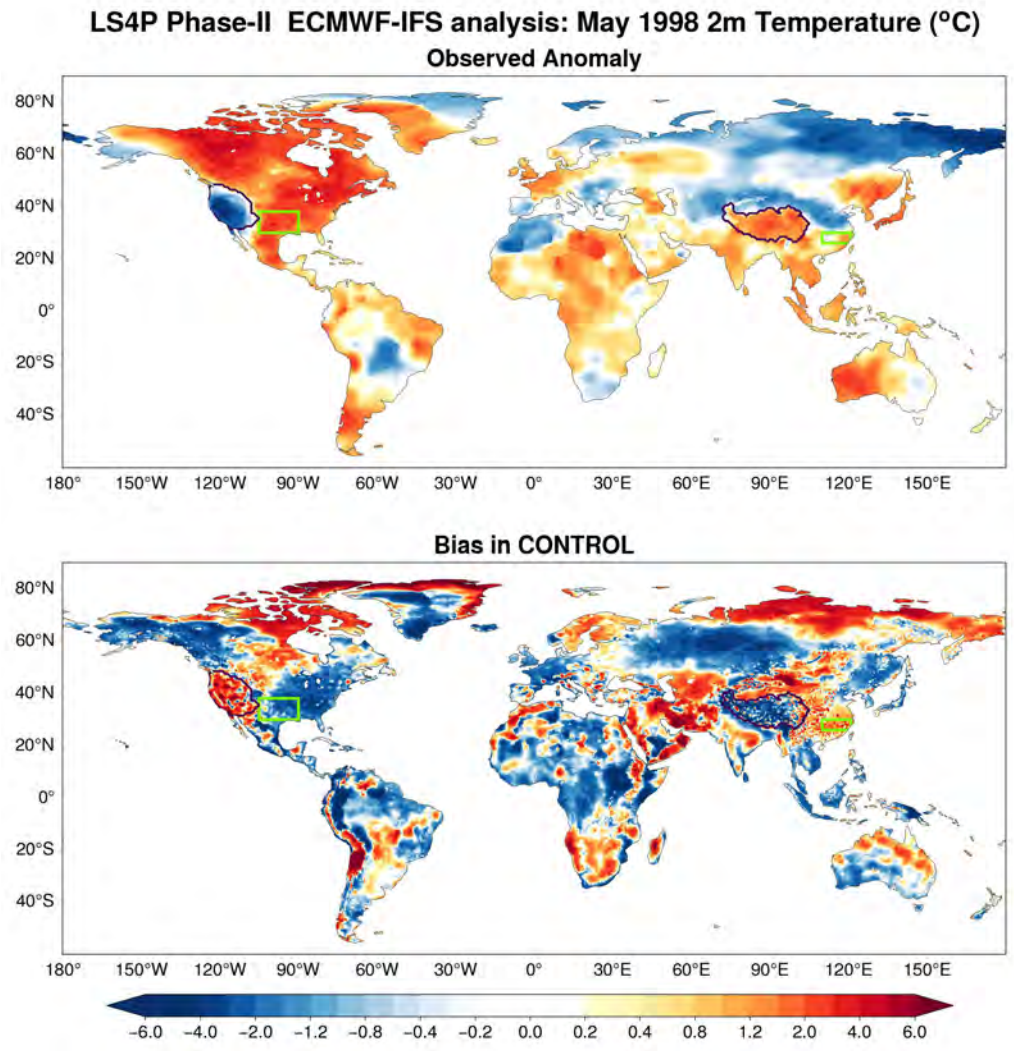
- EC-Land layer LSM embedded into IFS.
- 4 Soil layers

➢ **CONTROL:** Initialized on 01-May-1998 with 10 Ensemble members

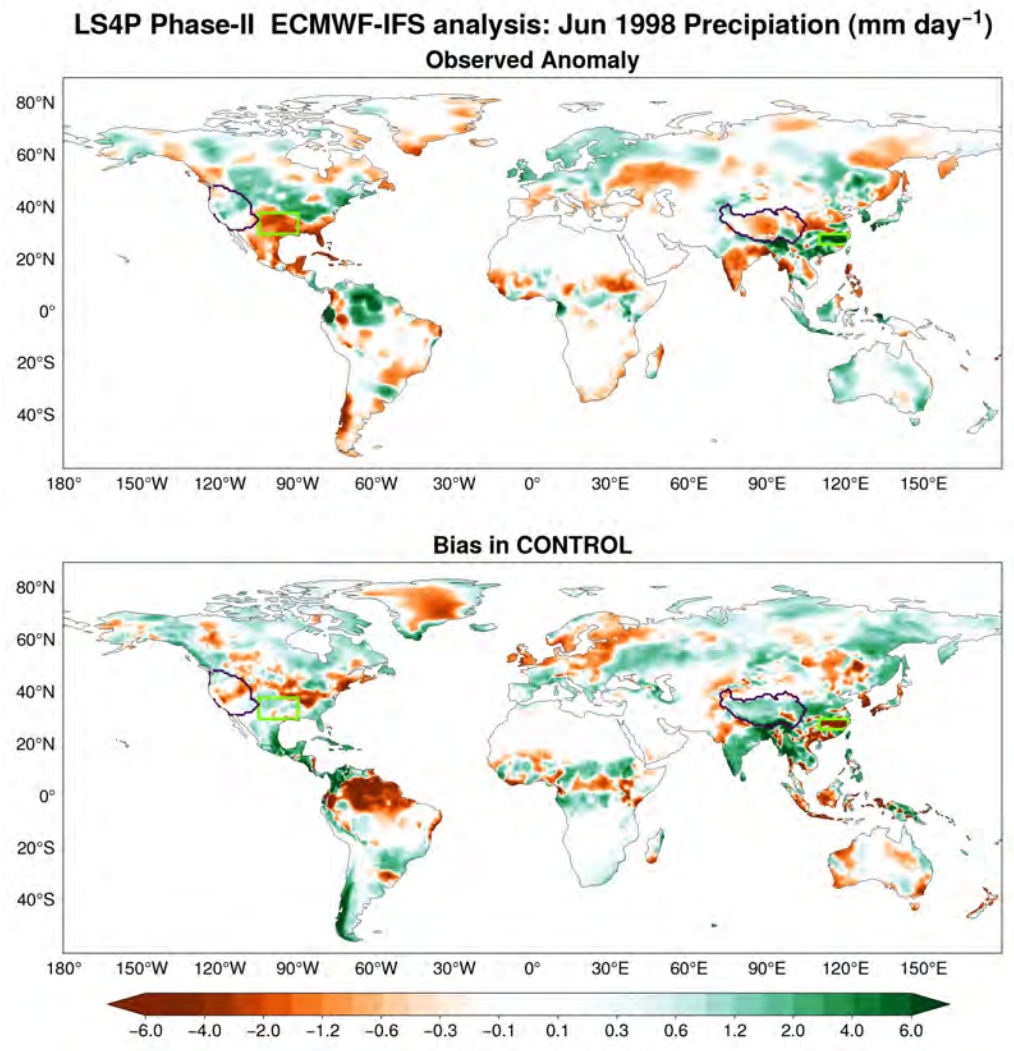
➢ **Sensitivity experiments**:

- Impose ΔT mask over Tibetan Plateau/Rocky Mountains at first time step
- 5 Case TPI + 4 Case RMI

Biases in CONTROL



- Cold bias over TP
- Warm bias over RM



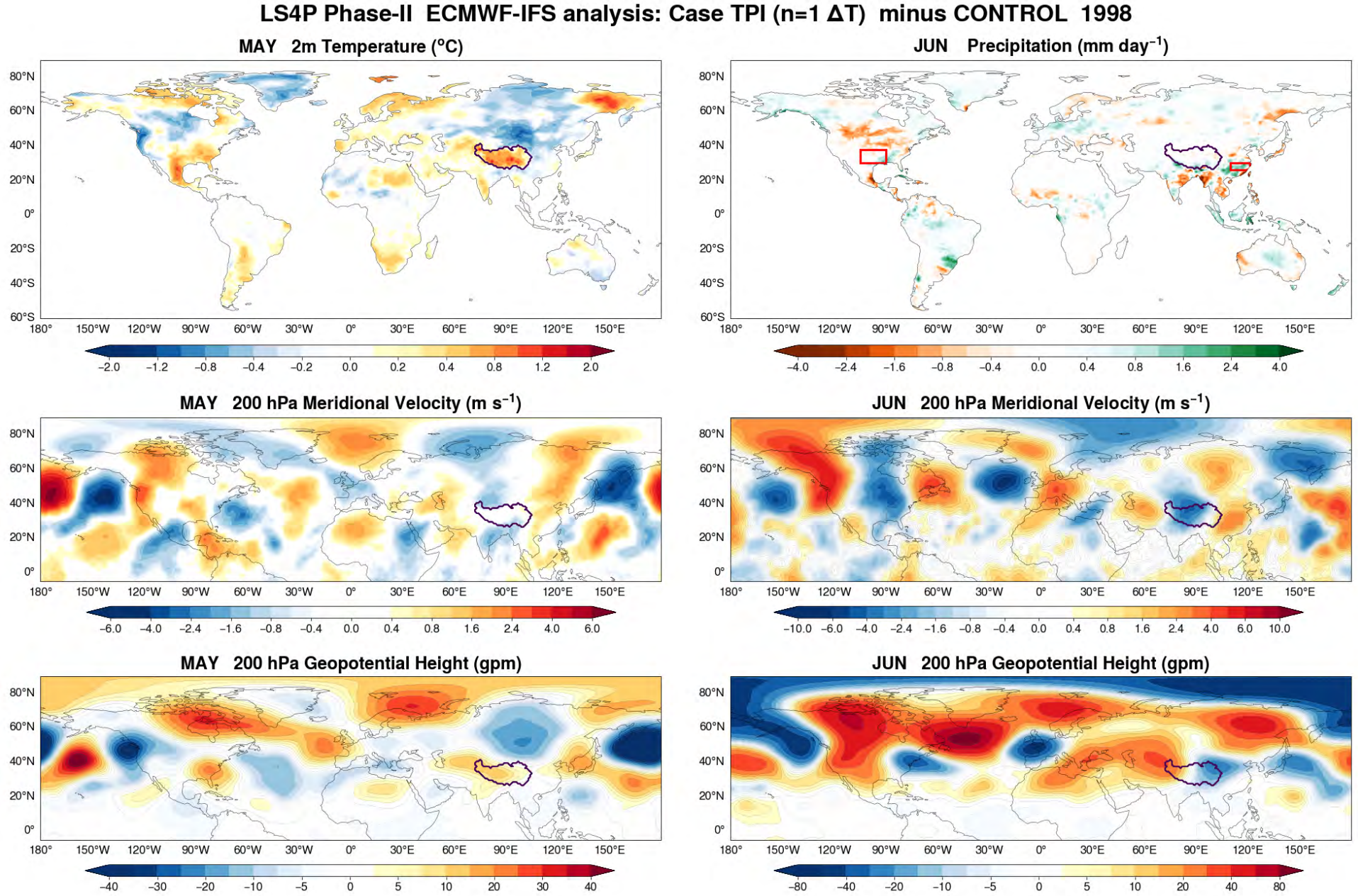
- Dry bias over YRB
- Weak wet bias over SGP

Regional statistics

	May 2m Temperature (ºC)		June Precipitation (mm/day)	
	Tibetan Plateau	Rocky Mountains	Yangtze Basin	S. Great Plains
Obs. Anomaly	1.404	-2.21	5.668	-1.6
Bias in CONTROL	-3.314	2.049	-5.281	0.17
Sensitivity Experiments	Experiment minus CONTROL			
TP △t n=1	0.618	-0.275	0.672	0.115
TP △t n=3	0.717	-0.224	1.759	0.604
TP △t n=4	0.329	0.208	0.867	0.809
TP △t n=-1	-0.107	0.086	0.321	0.507
TP △t n=-2	-0.551	-0.309	1.739	0.562
RM △t n=2	-0.181	-0.652	0.995	0.092
RM △t n=3	0.132	-0.372	1.601	0.231
RM △t n=4	-0.337	-0.557	3.299	0.09
RM △t n=-2	-0.115	-0.111	0.069	0.64

Impact of choice of △T over Tibetan Plateau

n=1

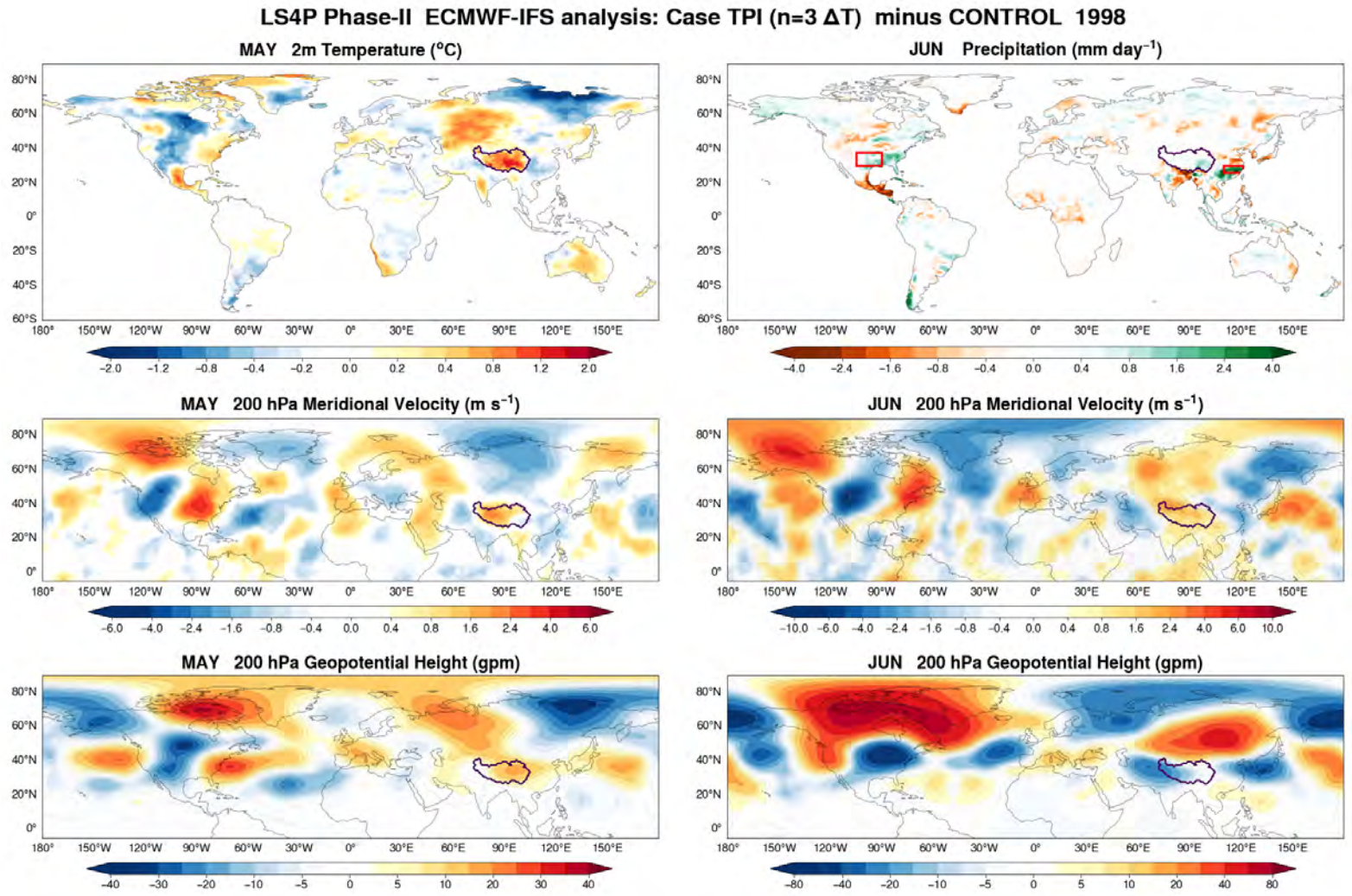


Regional statistics

	May 2m Temperature (ºC)		June Precipitation (mm/day)	
	Tibetan Plateau	Rocky Mountains	Yangtze Basin	S. Great Plains
Obs. Anomaly	1.404	-2.21	5.668	-1.6
Bias in CONTROL	-3.314	2.049	-5.281	0.17
Sensitivity Experiments	Experiment minus CONTROL			
TP △t n=1	0.618	-0.275	0.672	0.115
TP △t n=3	0.717	-0.224	1.759	0.604
TP △t n=4	0.329	0.208	0.867	0.809
TP △t n=-1	-0.107	0.086	0.321	0.507
TP △t n=-2	-0.551	-0.309	1.739	0.562
RM △t n=2	-0.181	-0.652	0.995	0.092
RM △t n=3	0.132	-0.372	1.601	0.231
RM △t n=4	-0.337	-0.557	3.299	0.09
RM △t n=-2	-0.115	-0.111	0.069	0.64

Impact of choice of △T over Tibetan Plateau

n=3

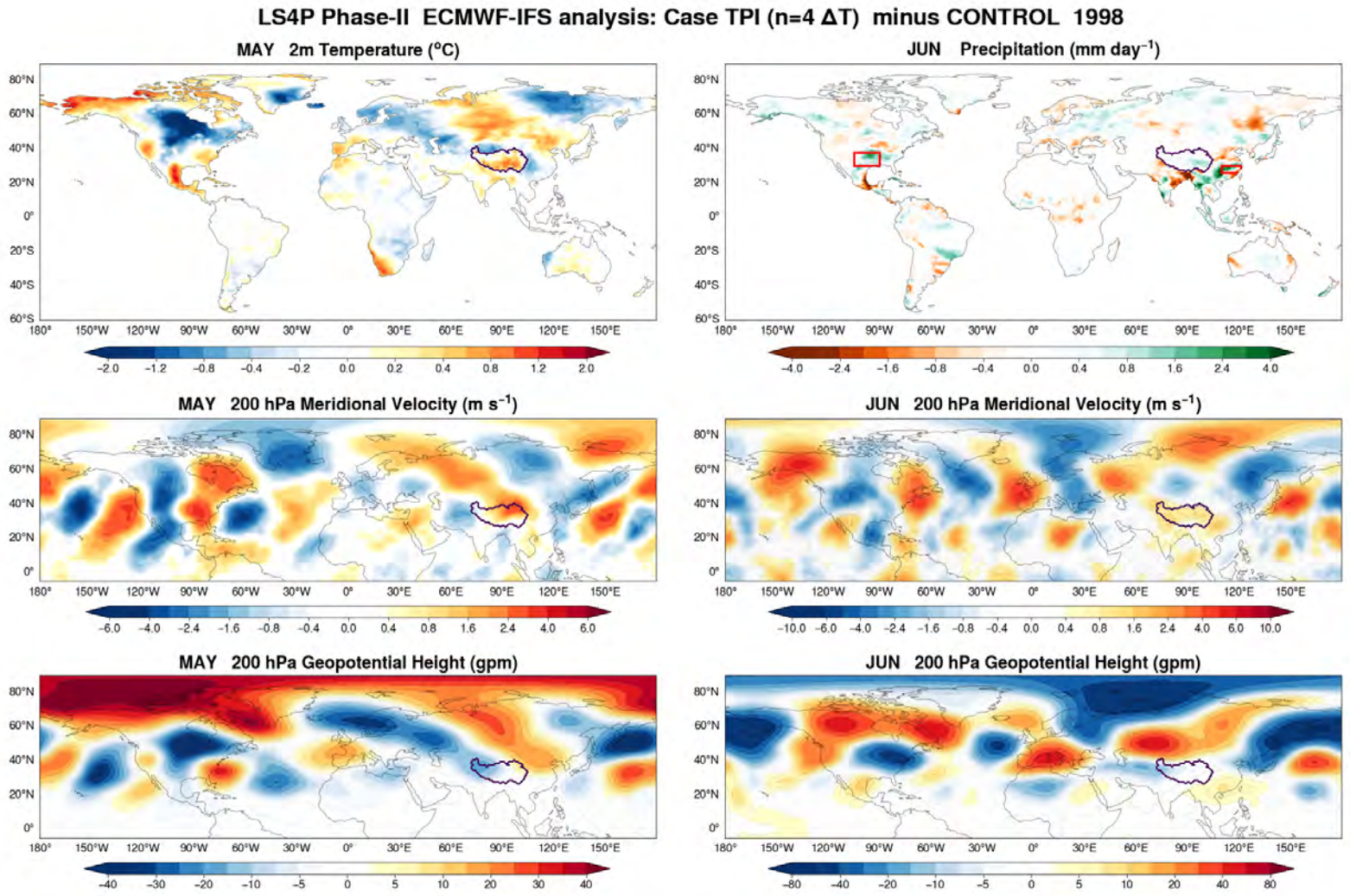


Regional statistics

	May 2m Temperature (ºC)		June Precipitation (mm/day)	
	Tibetan Plateau	Rocky Mountains	Yangtze Basin	S. Great Plains
Obs. Anomaly	1.404	-2.21	5.668	-1.6
Bias in CONTROL	-3.314	2.049	-5.281	0.17
Sensitivity Experiments	Experiment minus CONTROL			
TP △t n=1	0.618	-0.275	0.672	0.115
TP △t n=3	0.717	-0.224	1.759	0.604
TP △t n=4	0.329	0.208	0.867	0.809
TP △t n=-1	-0.107	0.086	0.321	0.507
TP △t n=-2	-0.551	-0.309	1.739	0.562
RM △t n=2	-0.181	-0.652	0.995	0.092
RM △t n=3	0.132	-0.372	1.601	0.231
RM △t n=4	-0.337	-0.557	3.299	0.09
RM △t n=-2	-0.115	-0.111	0.069	0.64

Impact of choice of △T over Tibetan Plateau

n=4

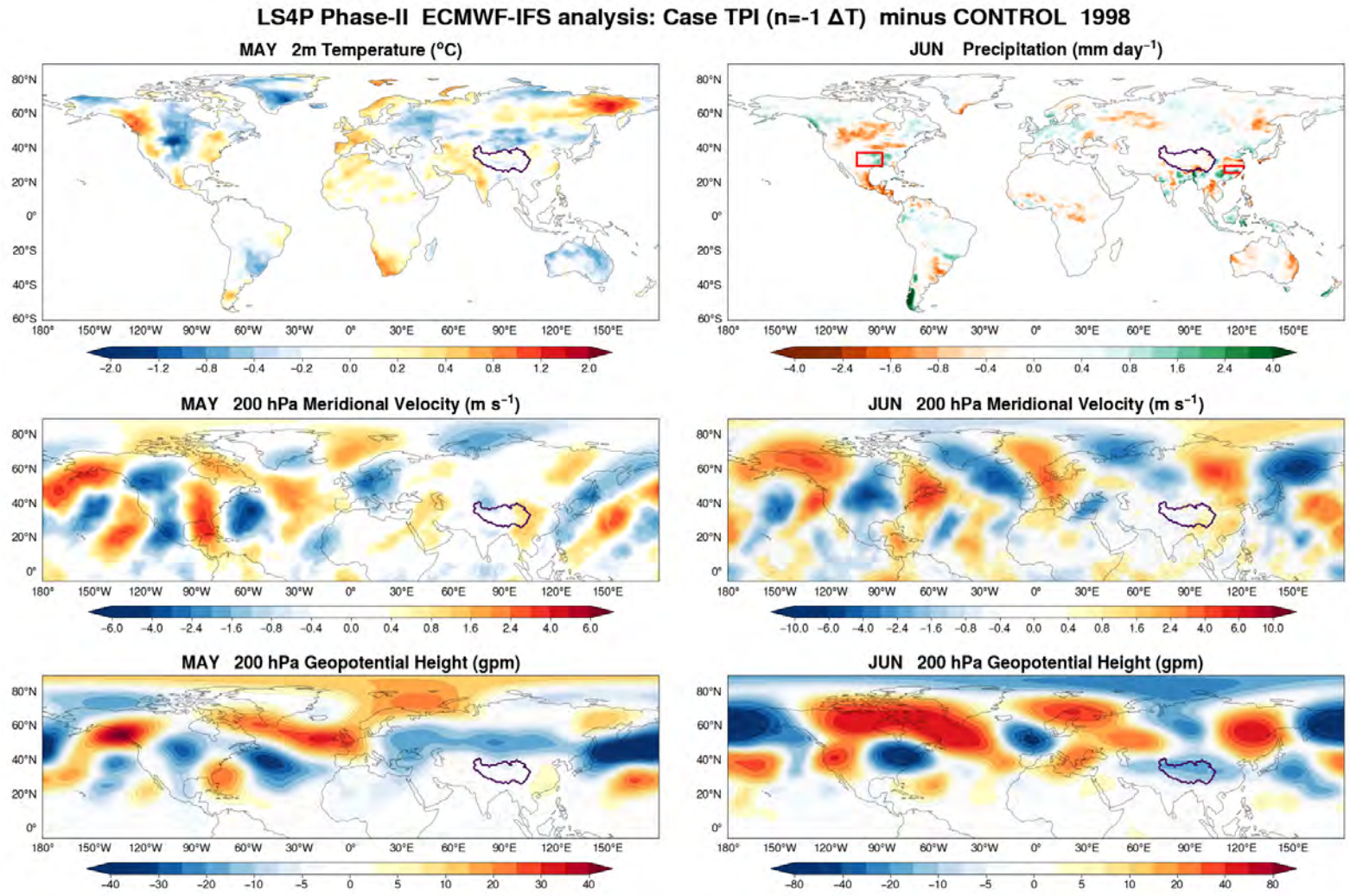


Regional statistics

	May 2m Temperature (ºC)		June Precipitation (mm/day)	
	Tibetan Plateau	Rocky Mountains	Yangtze Basin	S. Great Plains
Obs. Anomaly	1.404	-2.21	5.668	-1.6
Bias in CONTROL	-3.314	2.049	-5.281	0.17
Sensitivity Experiments	Experiment minus CONTROL			
TP △t n=1	0.618	-0.275	0.672	0.115
TP △t n=3	0.717	-0.224	1.759	0.604
TP △t n=4	0.329	0.208	0.867	0.809
TP △t n=-1	-0.107	0.086	0.321	0.507
TP △t n=-2	-0.551	-0.309	1.739	0.562
RM △t n=2	-0.181	-0.652	0.995	0.092
RM △t n=3	0.132	-0.372	1.601	0.231
RM △t n=4	-0.337	-0.557	3.299	0.09
RM △t n=-2	-0.115	-0.111	0.069	0.64

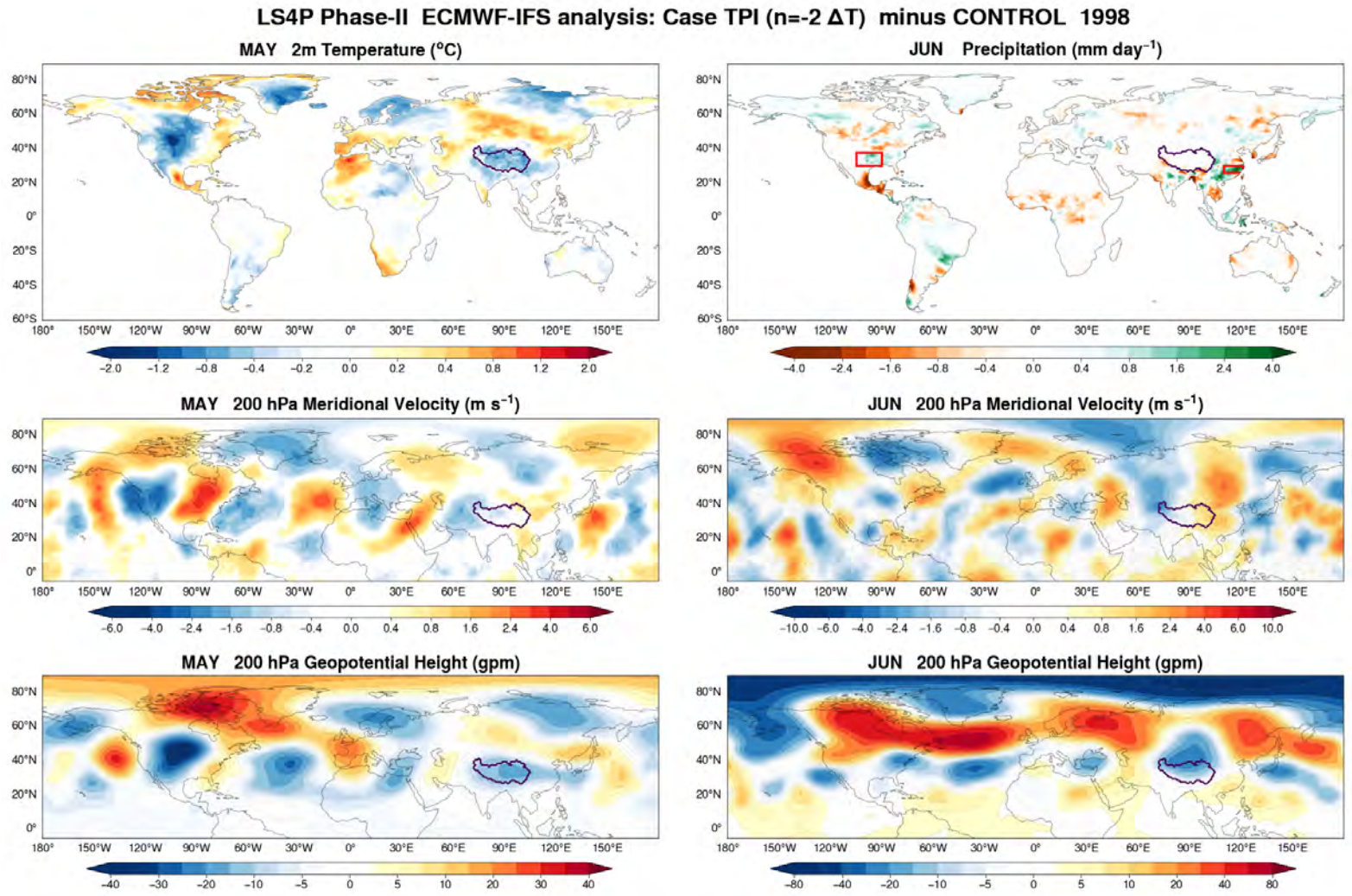
Impact of choice of △T over Tibetan Plateau

n=-1



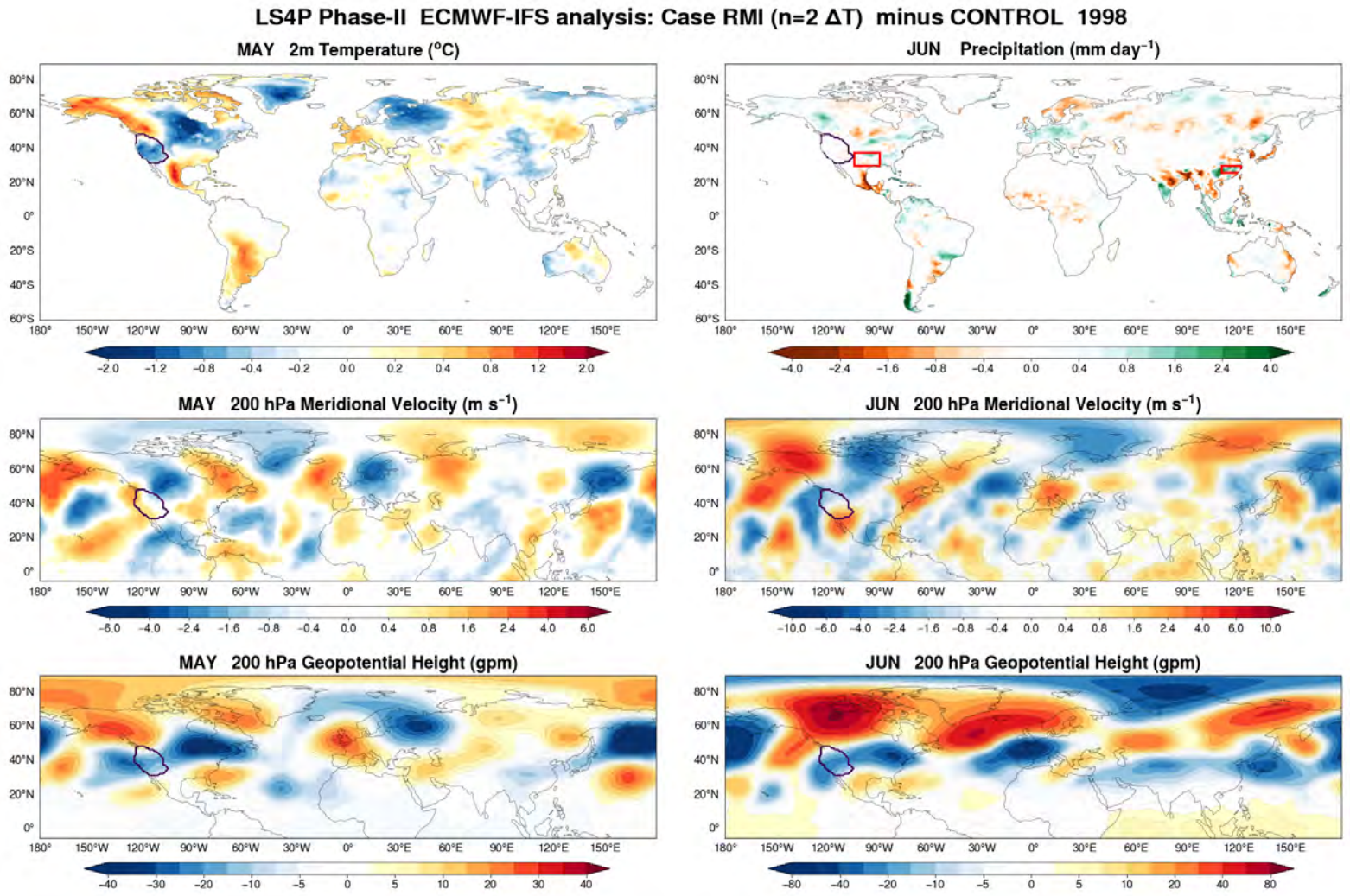
Impact of choice of △T over Tibetan Plateau

n=-2



Impact of choice of △T over Rocky Mountains

n=2

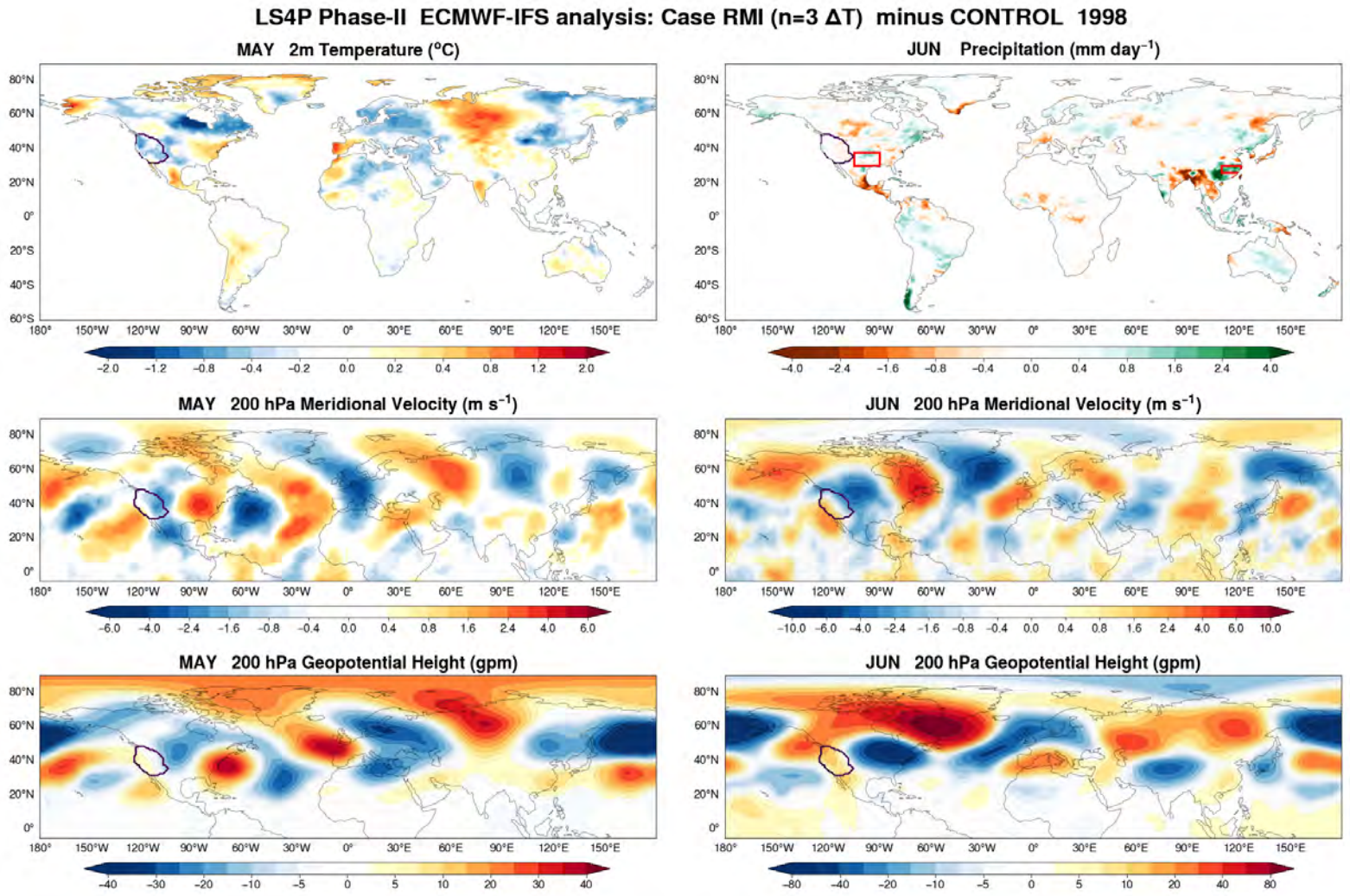


Regional statistics

	May 2m Temperature (ºC)		June Precipitation (mm/day)	
	Tibetan Plateau	Rocky Mountains	Yangtze Basin	S. Great Plains
Obs. Anomaly	1.404	-2.21	5.668	-1.6
Bias in CONTROL	-3.314	2.049	-5.281	0.17
Sensitivity Experiments	Experiment minus CONTROL			
TP △t n=1	0.618	-0.275	0.672	0.115
TP △t n=3	0.717	-0.224	1.759	0.604
TP △t n=4	0.329	0.208	0.867	0.809
TP △t n=-1	-0.107	0.086	0.321	0.507
TP △t n=-2	-0.551	-0.309	1.739	0.562
RM △t n=2	-0.181	-0.652	0.995	0.092
RM △t n=3	0.132	-0.372	1.601	0.231
RM △t n=4	-0.337	-0.557	3.299	0.09
RM △t n=-2	-0.115	-0.111	0.069	0.64

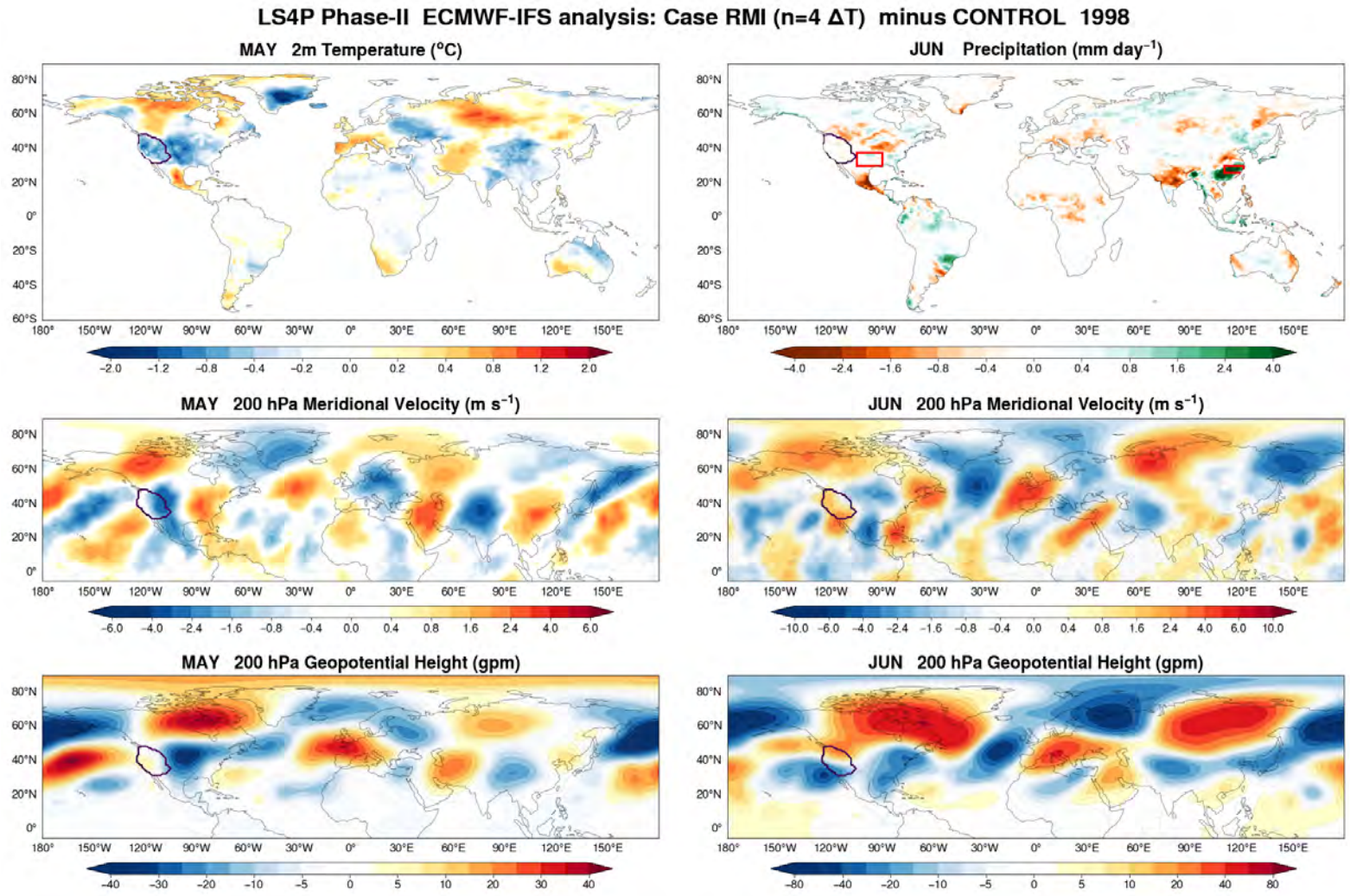
Impact of choice of △T over Rocky Mountains

n=3



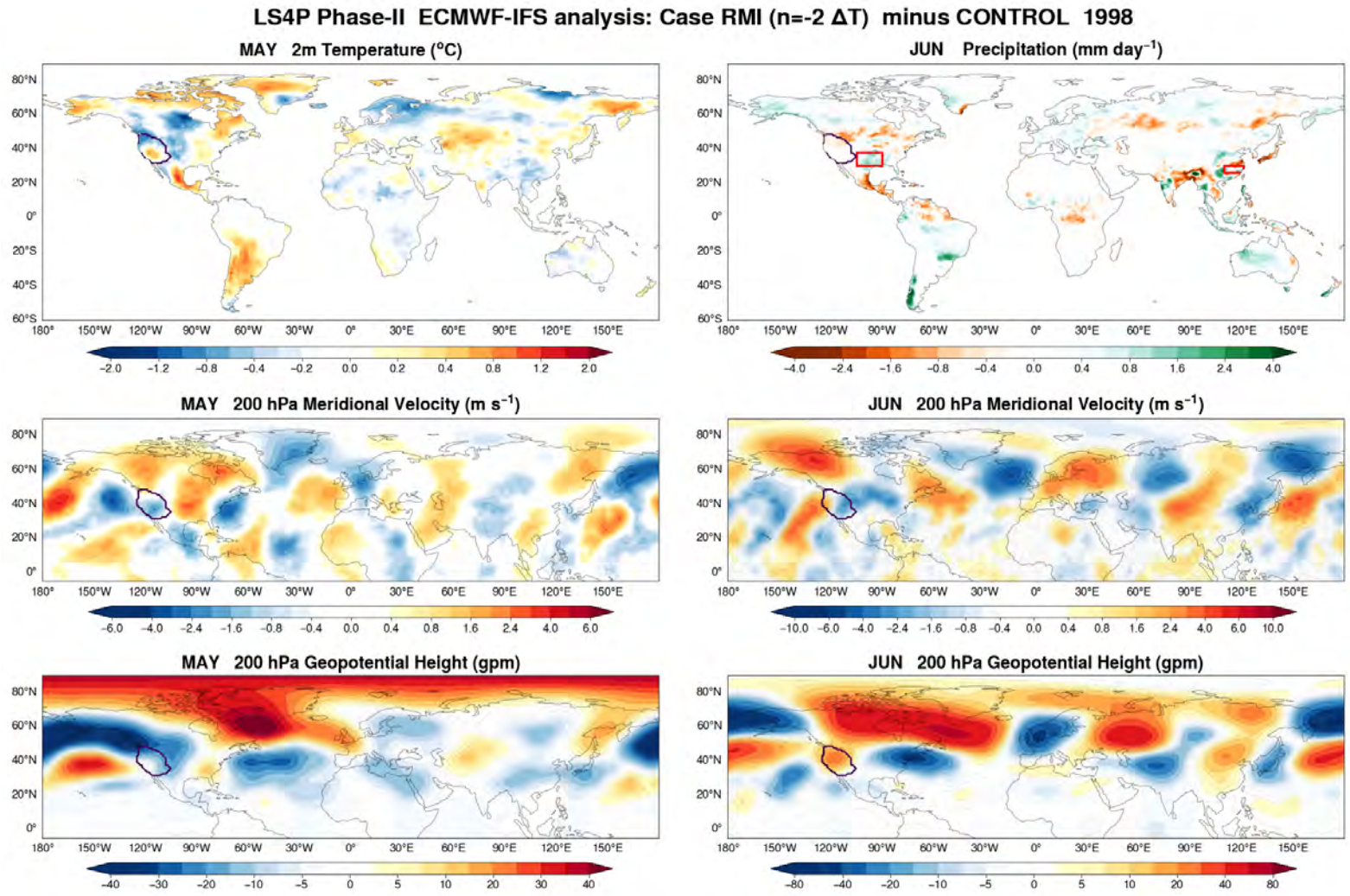
Impact of choice of △T over Rocky Mountains

n=4



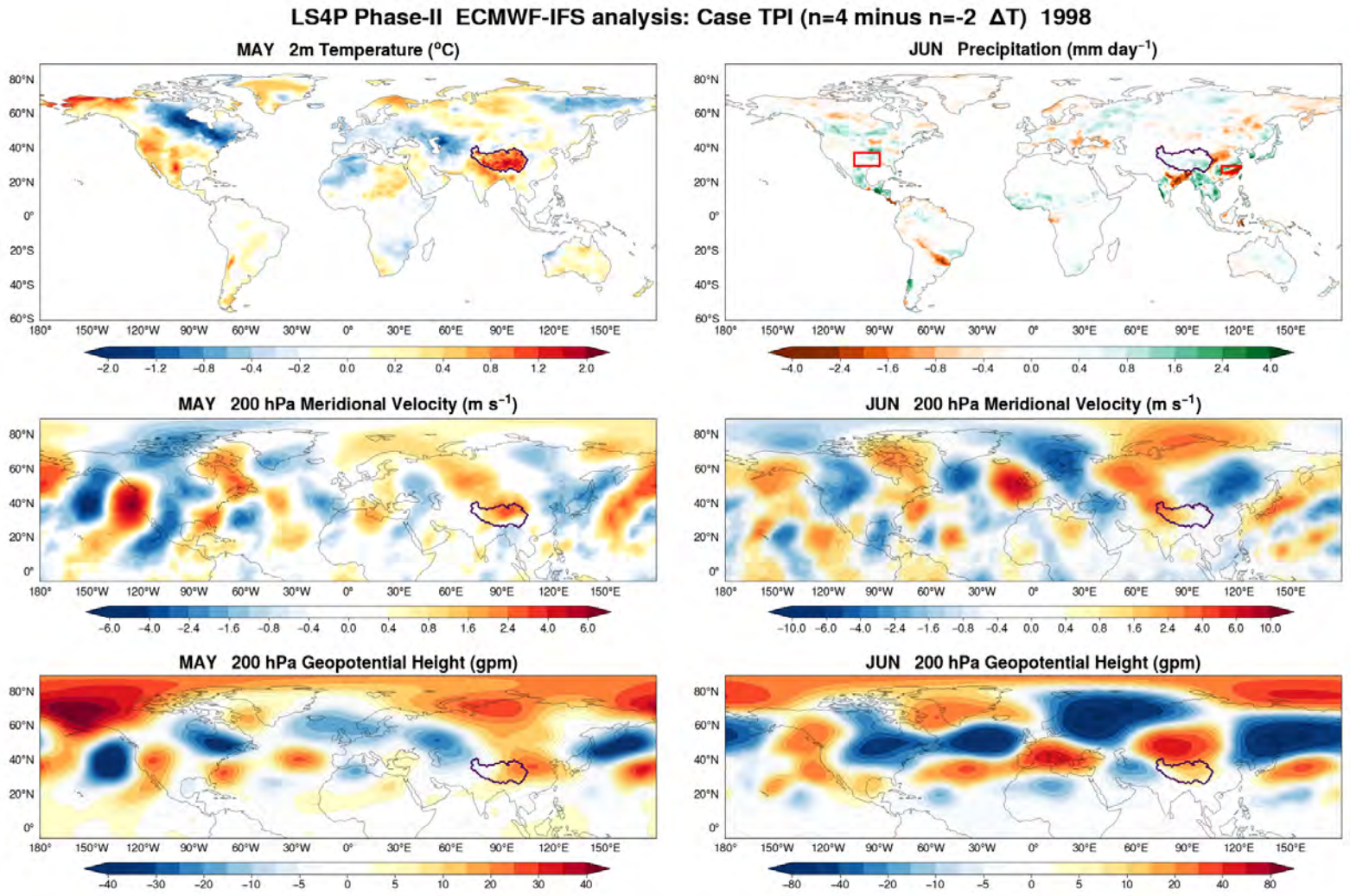
Impact of choice of △T over Rocky Mountains

n=-2



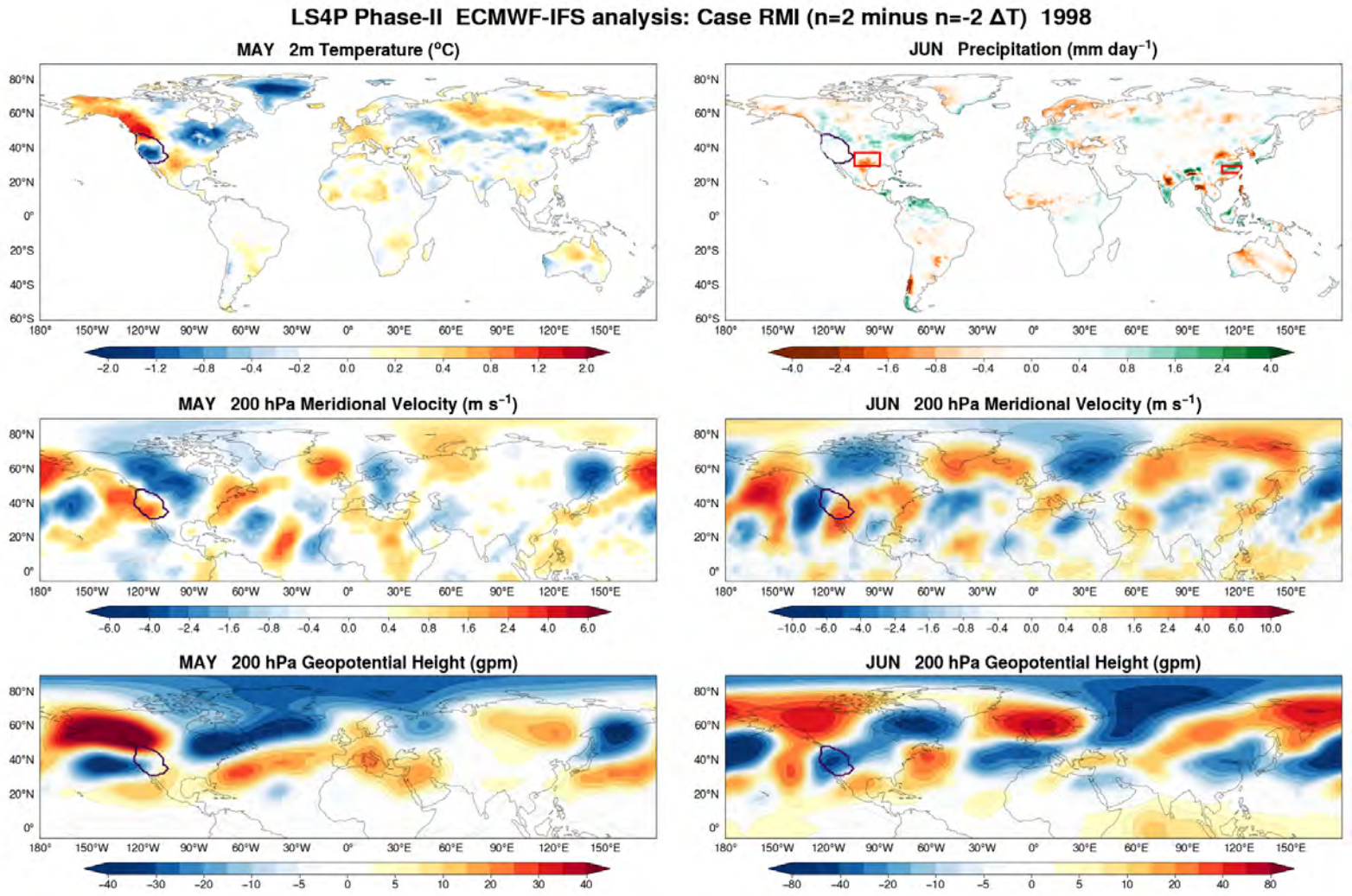
Impact of choice of △T over Tibetan Plateau

n=4 minus n=-2



Impact of choice of △T over Rocky Mountains

n=2 minus n=-2



Summary

- The ECMWF-IFS model has
  - a cold bias over TP and warm bias over RM in May
  - a dry bias over YRB and weak wet bias over SGP.
- The LS4P initialization strategy produces some interesting responses
- Increasing/decreasing mask strength doesn't have a linear impact on the response.
- All sensitivity experiments worsens the (wet) bias over SGP.
- For TPI cases
  - n=3 produces the stronger response than n=4 in local 2m temperature
  - n=4 and n=-2 have similar impact on YRB precipitation
- For RMI cases
  - N=4 has the best response on YRB precipitation
- Linear combinations seems to produce better responses:
  - n=2 minus n=-2 for RM produces the right response on SGP precipitation
  - n=4 minus n=-2 for TP produced better local temperature over TP and precipitation response over SGP.