Land Surface-Precipitation Feedback Analysis for a Landfalling Monsoon Depression in the Indian Region

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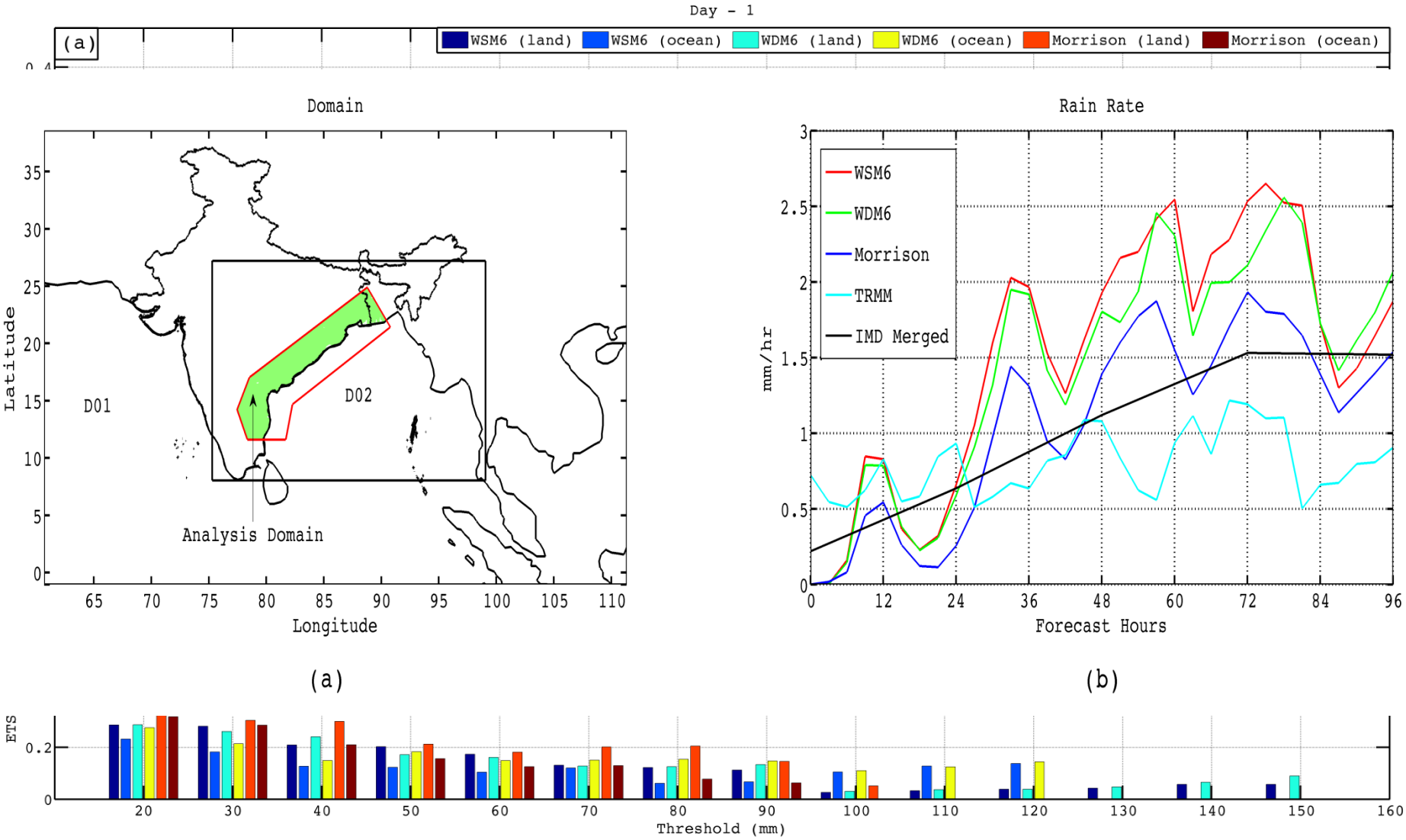
Outline

- Objectives
- Microphysical Sensitivity
- Experiment Setup
- Diagnosis and Analysis
- Conclusions

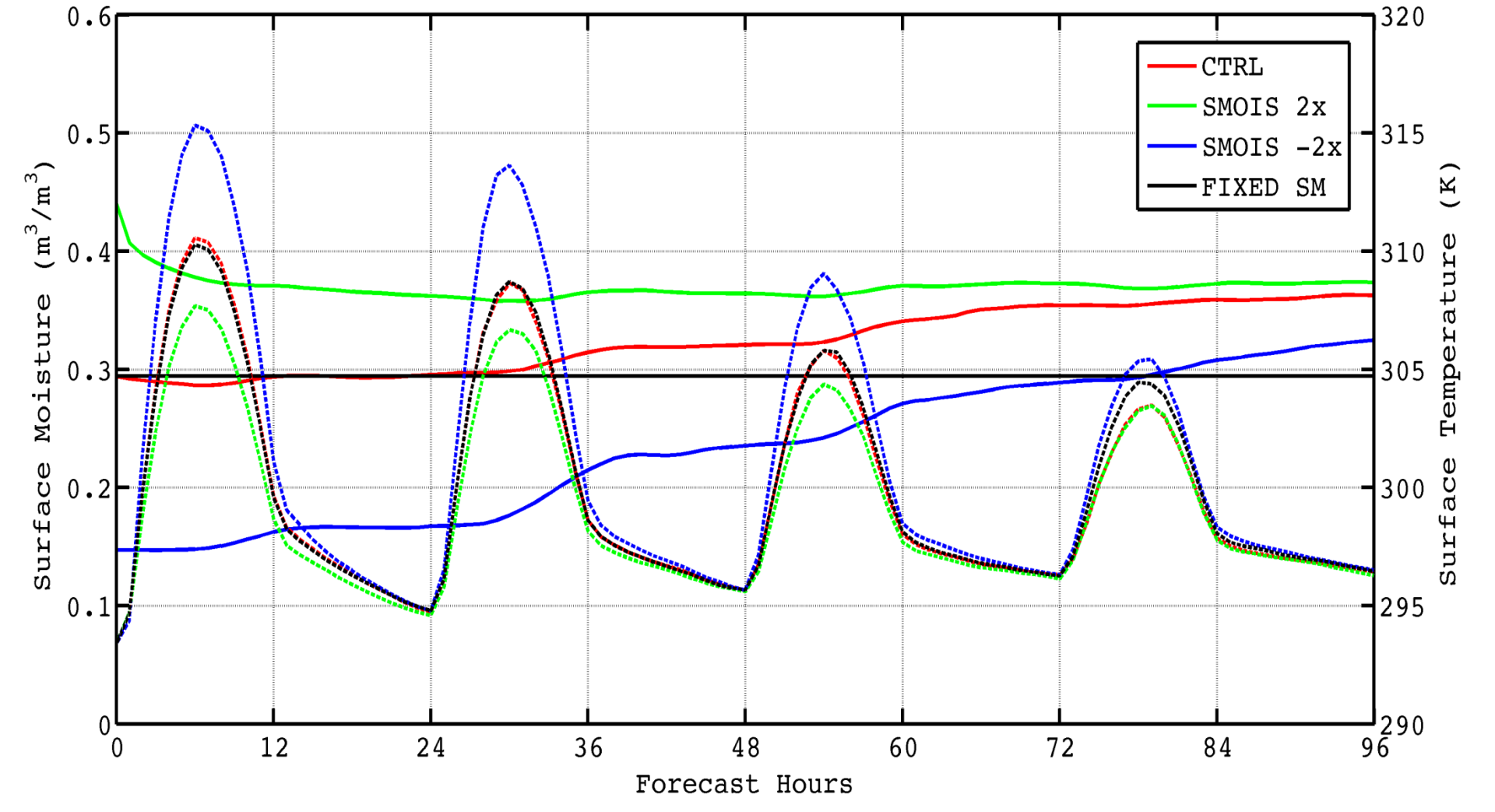
Objectives

- Understanding the feedback mechanisms between soil moisture and precipitation.
- Investigate direct and indirect effects on precipitation.
- Analyze the importance of Moisture Flux Convergence (MFC) as a precursor of heavy precipitation.

Microphysical Sensitivity



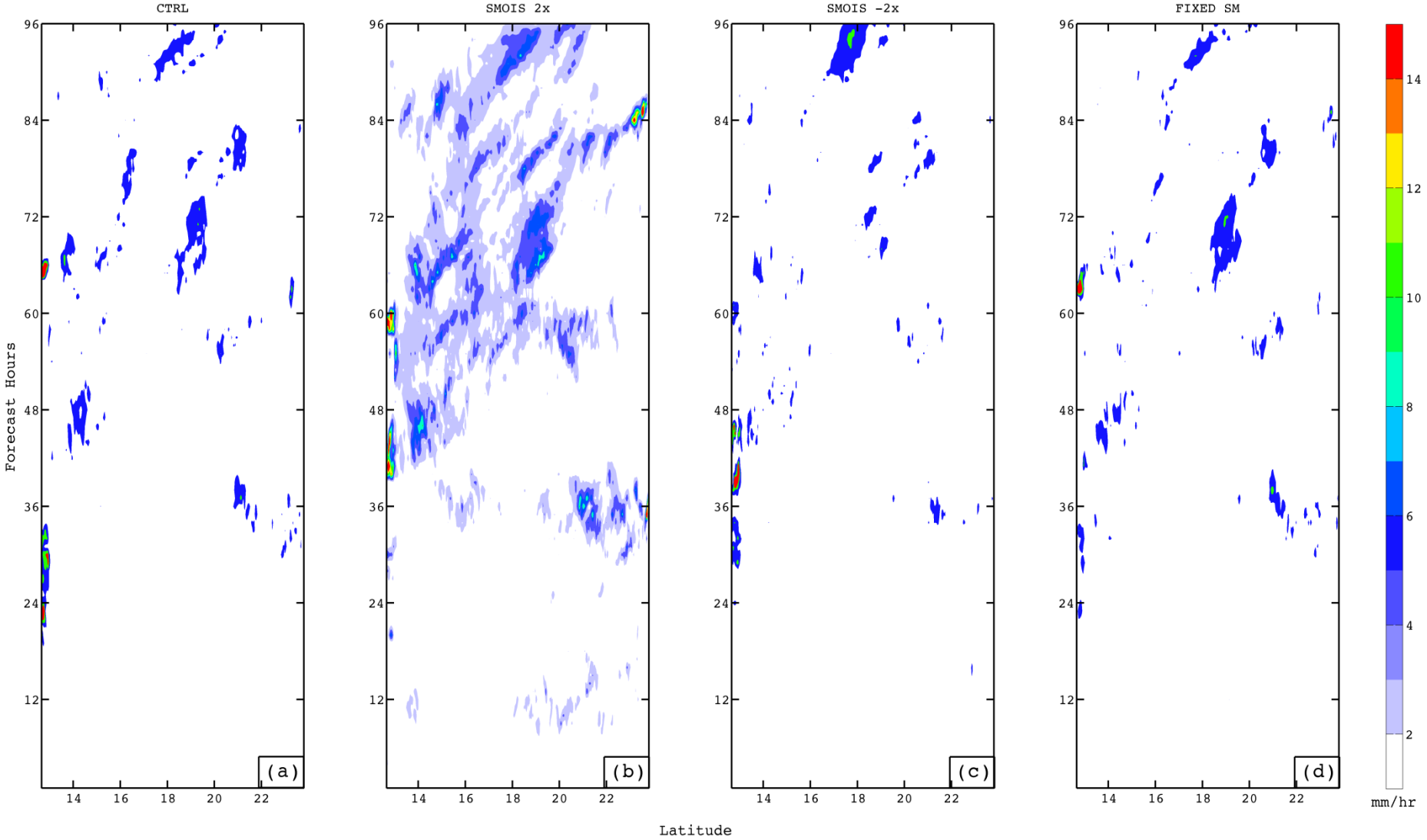
Experiment Setup



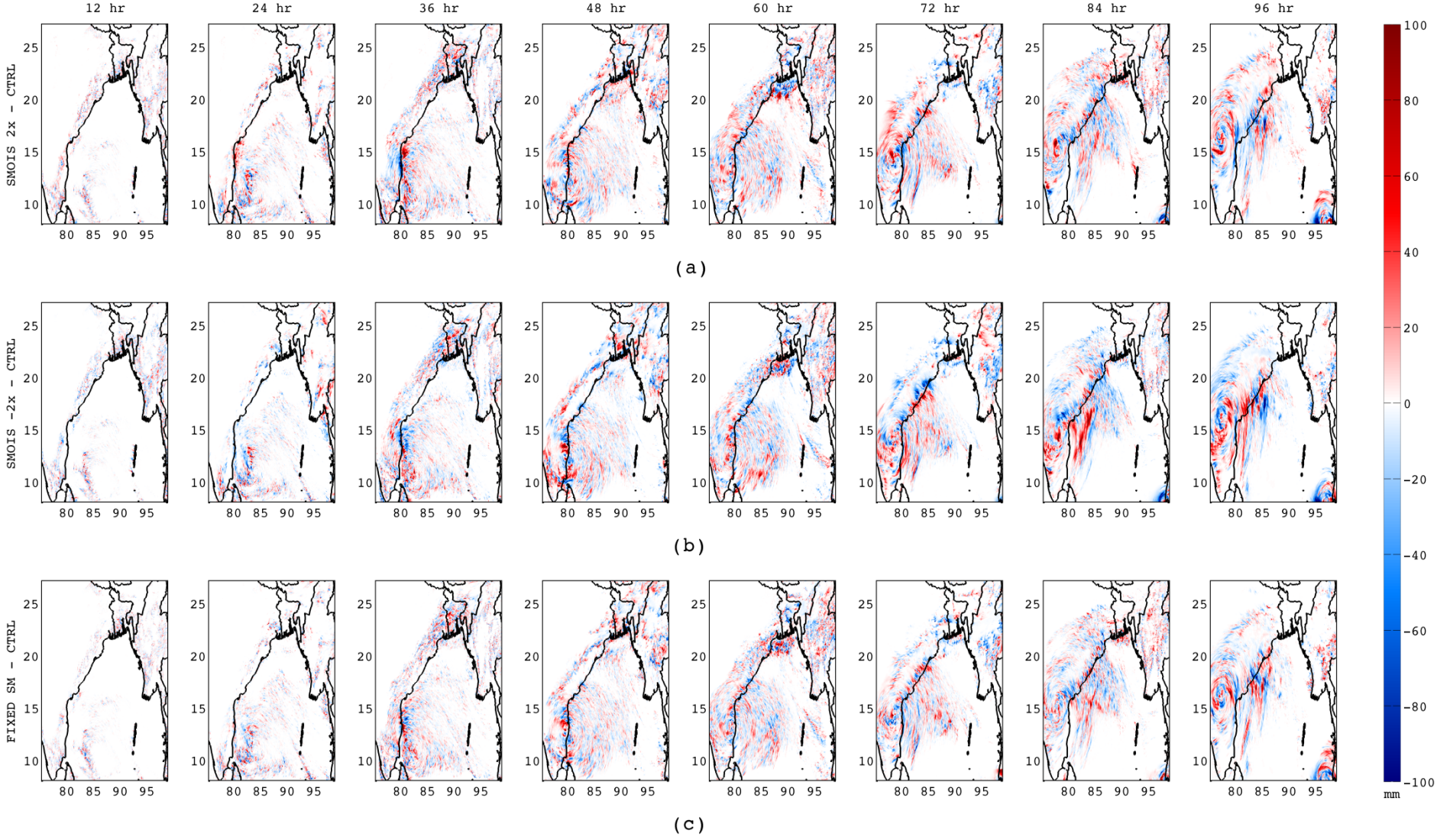
Diagnosis and Analysis

- Hovmöller Plot (Precipitation)
- Precipitation Difference
- Moisture Transport
- Pressure
- CAPE / CIN
- Moist Static Energy (MSE)
- Bowen Ratio
- Moisture Flux Convergence (MFC)
- Feedback Processes

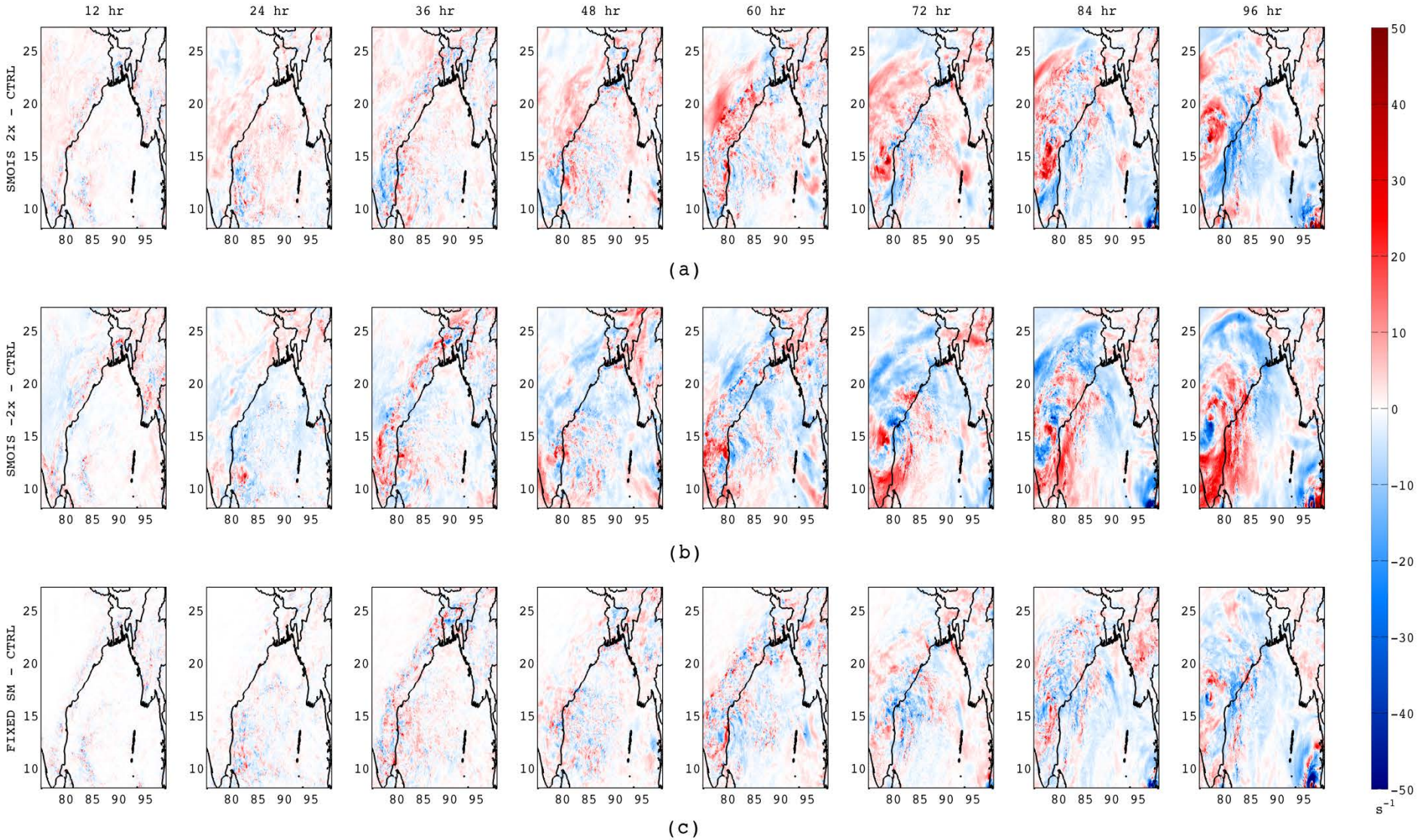
Hovmöller Plot



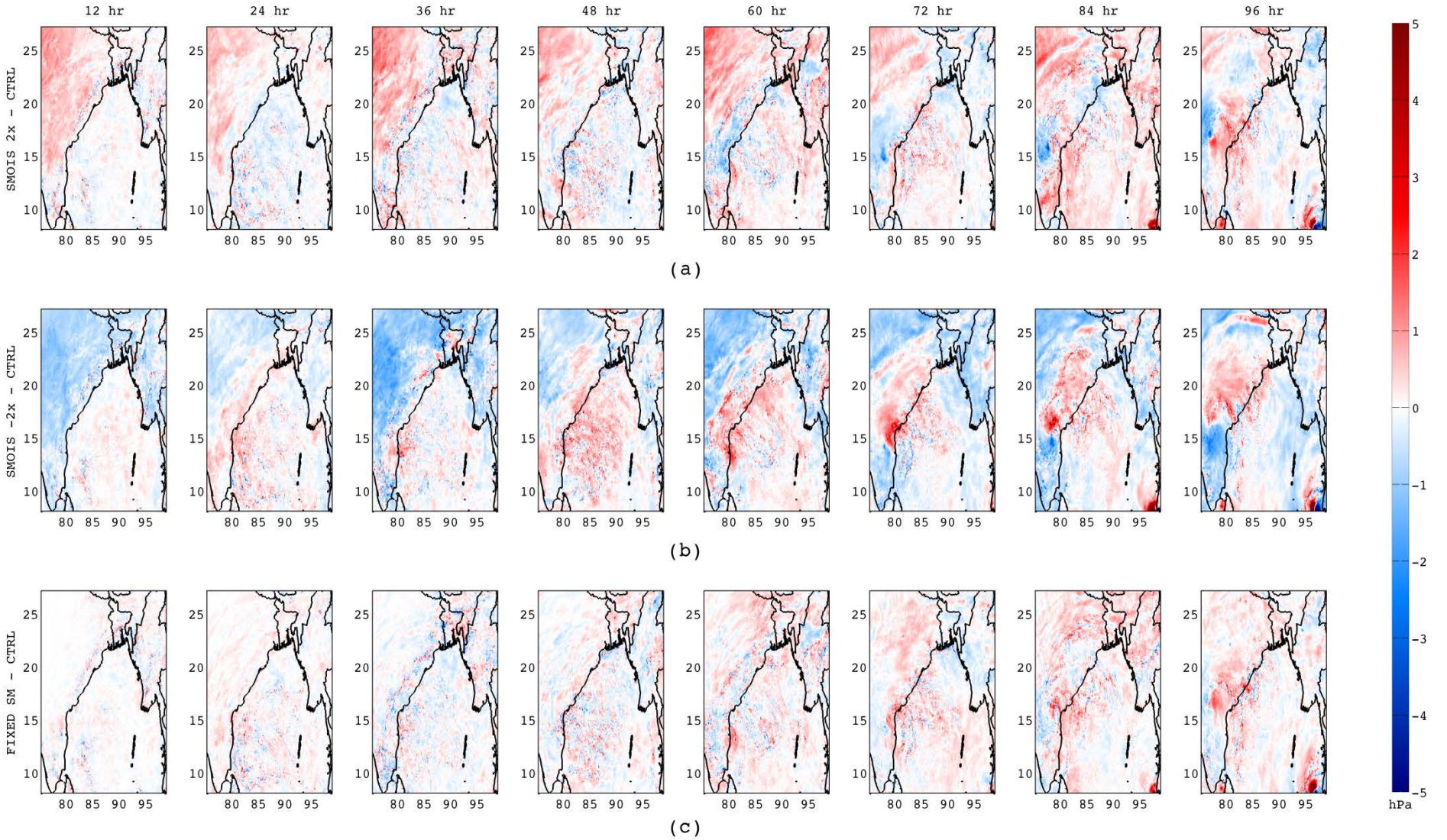
Precipitation Difference



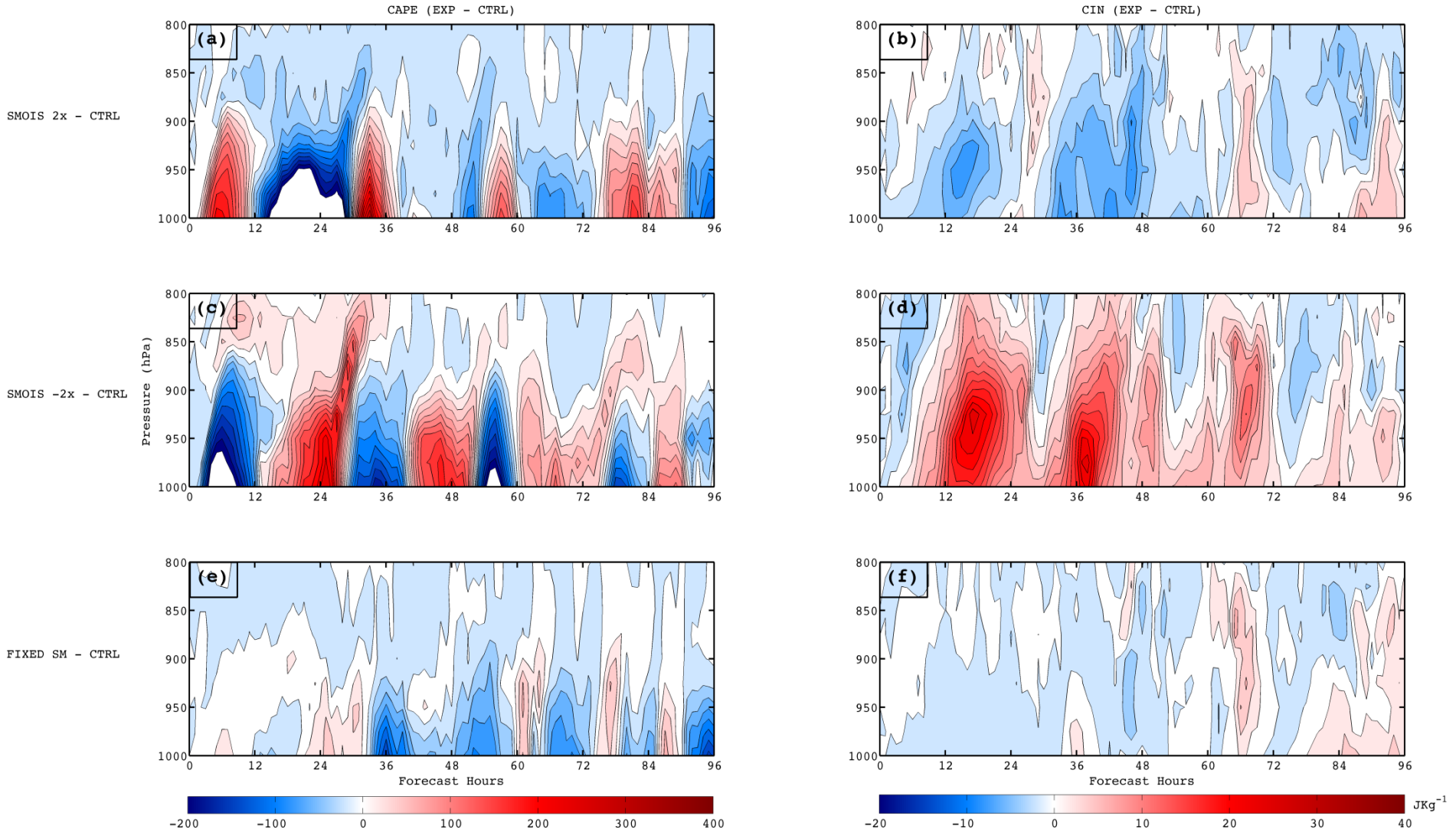
Moisture Transport



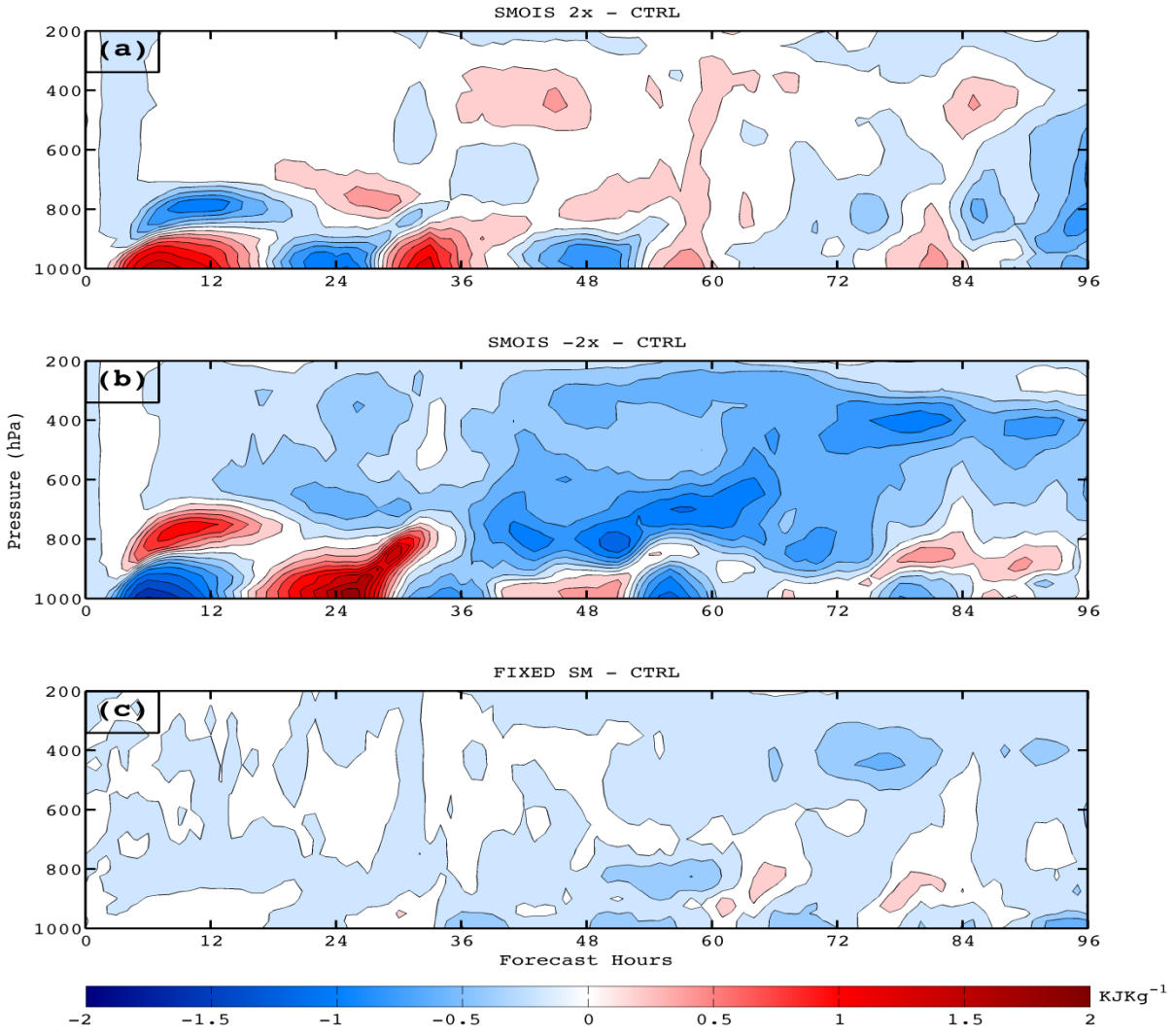
Pressure


12 hr
24 hr
36 hr
48 hr
60 hr
72 hr
84 hr
96 hr
SMOIS 2x - CTRL
(a)
SMOIS -2x - CTRL
(b)
FIXED SM - CTRL
(c)
hPa

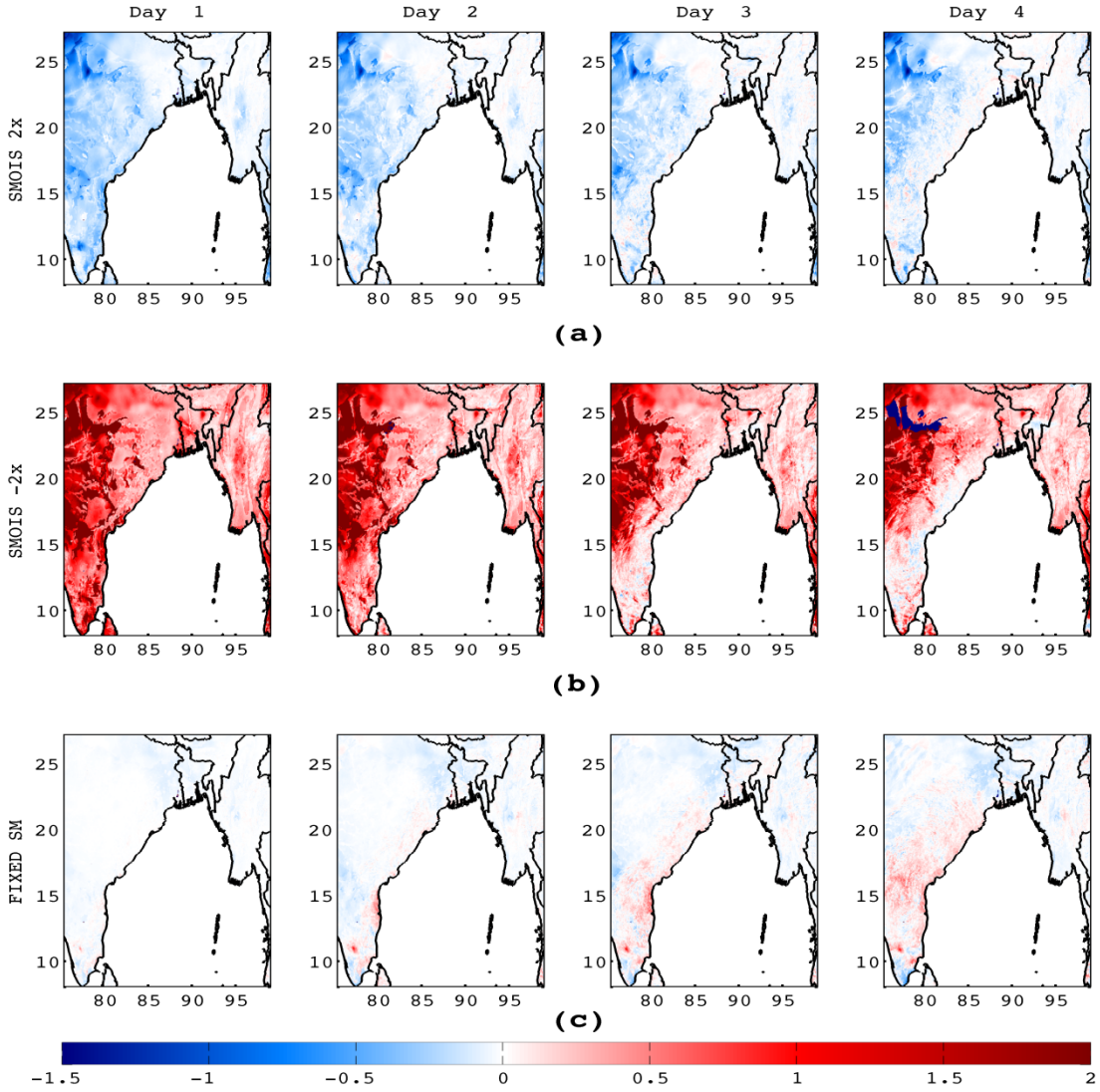
CAPE / CIN


CAPE (EXP - CTRL)
CIN (EXP - CTRL)
SMOIS 2x - CTRL
SMOIS -2x - CTRL
FIXED SM - CTRL
(a)
(b)
(c)
(d)
(e)
(f)
Pressure (hPa)
Forecast Hours
Forecast Hours
JKg-1

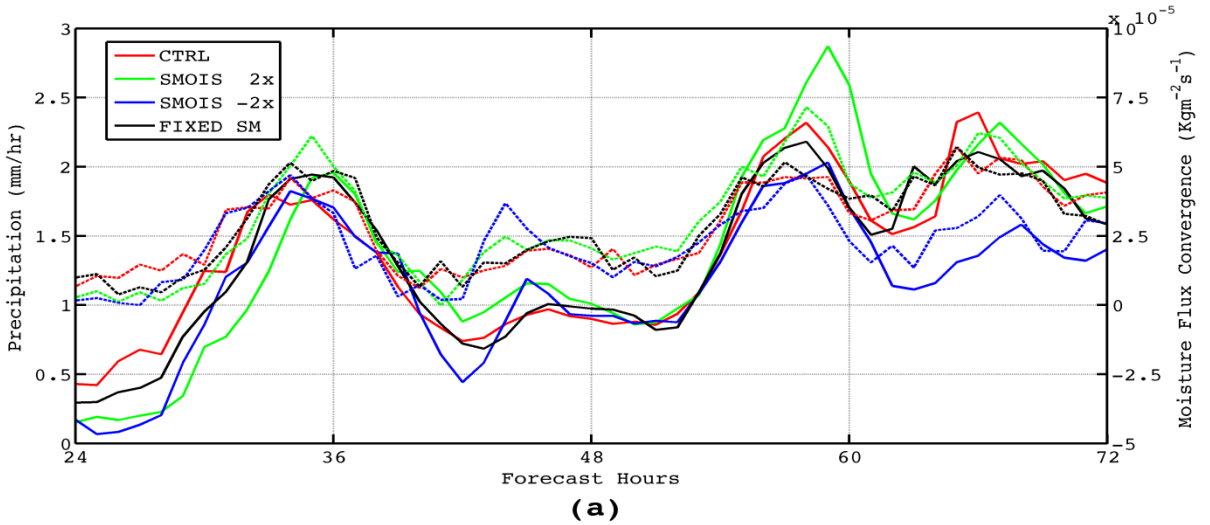
MSE

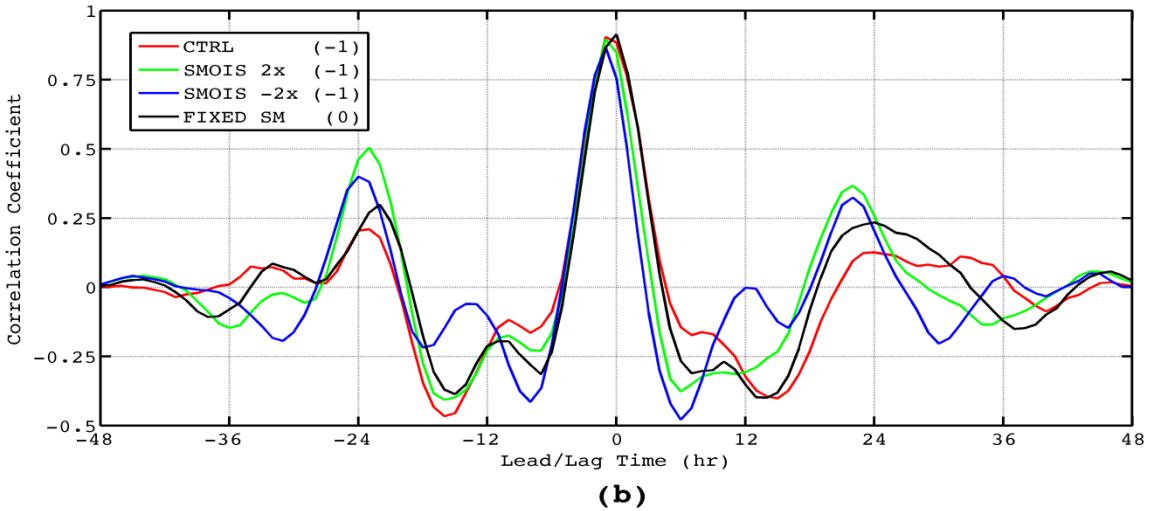

SMOIS 2x - CTRL
(a)
SMOIS -2x - CTRL
(b)
FIXED SM - CTRL
(c)
Pressure (hPa)
200
400
600
800
1000
0
12
24
36
48
60
72
84
96
Forecast Hours
−2
−1.5
−1
−0.5
0
0.5
1
1.5
2
KJKg^{-1}

Bowen Ratio (EXP – CTRL)



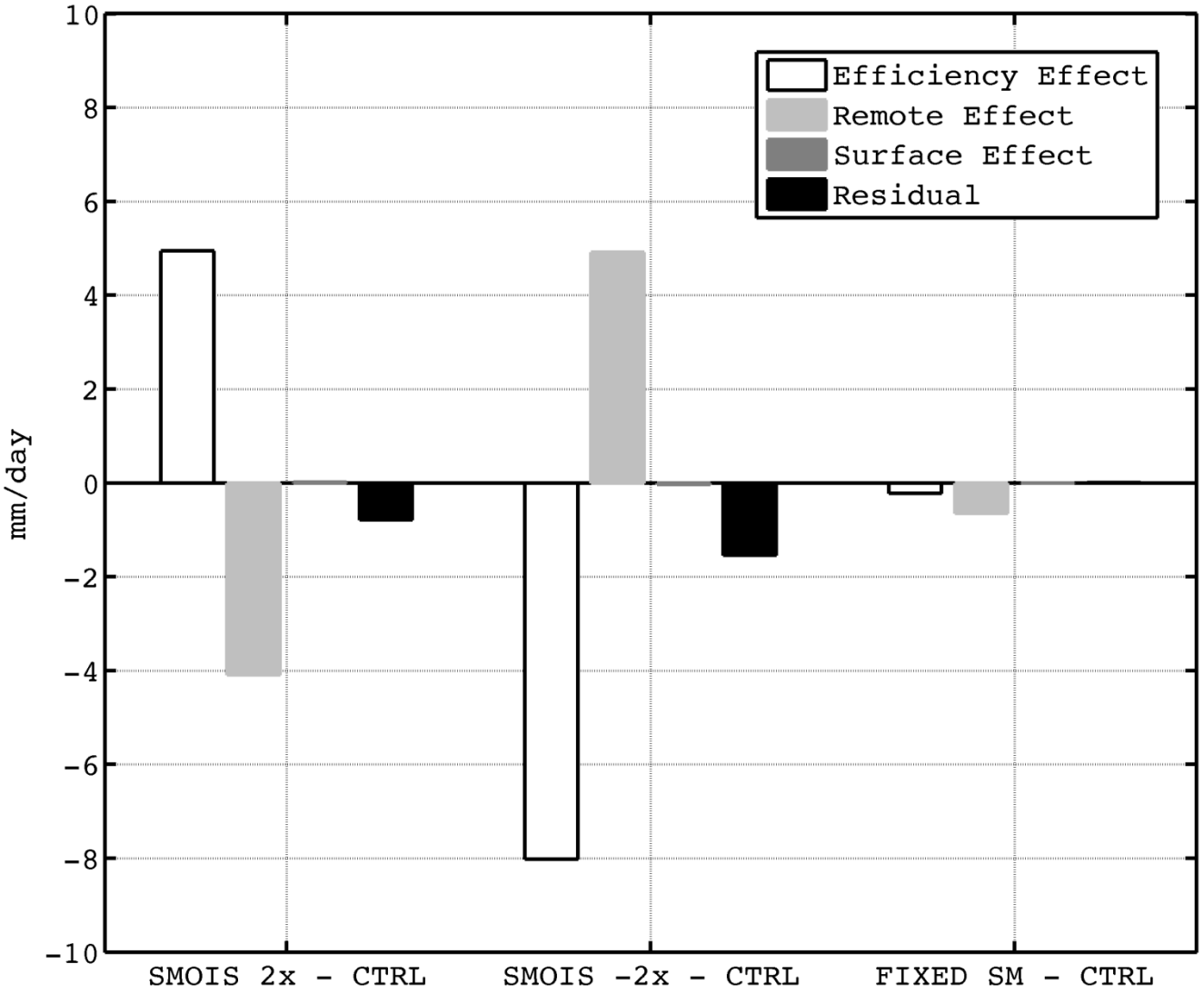
MFC


CTRL
SMOIS 2x
SMOIS -2x
FIXED SM
Precipitation (mm/hr)
Moisture Flux Convergence (Kgm^{-2}s^{-1})
x 10^{-5}
Forecast Hours
(a)


CTRL (-1)
SMOIS 2x (-1)
SMOIS -2x (-1)
FIXED SM (0)
Correlation Coefficient
Lead/Lag Time (hr)
(b)

Feedback Processes

Experimen	β $(\times 10^{-2})$
CTRL	0.45
SMOIS 2x	0.62
SMOIS -2x	0.27
FIXED SM	0.46



Conclusion

- Increased Soil Moisture increases spatial coverage of rainfall but intensity decreases.
- MFC affects precipitation both directly and indirectly, and acts an excellent predictor for subsequent precipitation. MFC increases for SMOIS 2x and decreases for SMOIS -2x.
- Moisture influx decreases in case of SMOIS 2x, whereas increases a lot in case of SMOIS -2x (due to land-sea contrast).
- Efficiency effect is the dominant factor for change in precipitation for SMOIS 2x, as opposed to remote effect that acts as a major contributor for SMOIS -2x.

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