Sensitivity Study of Land Use Change over South Asia using RegCM3

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Introduction

- South east part of Pakistan,
  deserts: Thar and Cholistan
- Less summer rain in this region
- Motivation: to see the effect of land use change on precipitation/temperature patterns
- Three different land use categories:
  - Grass
  - Crop
  - Woodland

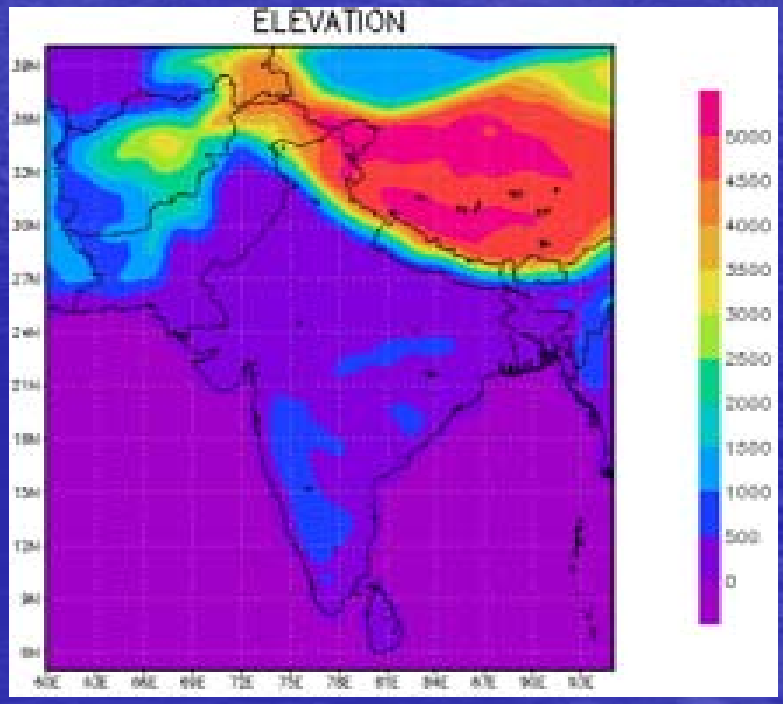
South Asia


Dushanbe
Tajikistan
Kabol
Peshawar
Afghanistan
Islamabad
Gujranwala
Amritsar
Faisalabad
Pakistan
Lhasa
New Delhi
Nepal
Agra
Bhutan
Jodhpur
Jaipur
Kanpur
Patna
Karachi
Varanasi
Bangladesh
Ahmadabad
Bhopal
India
Kolkata
Vadodara
Indore
Nagpur
Chittagong
Surat
Mumbai
Pune
Hyderabad
Chennai
Bengaluru
Sri Lanka

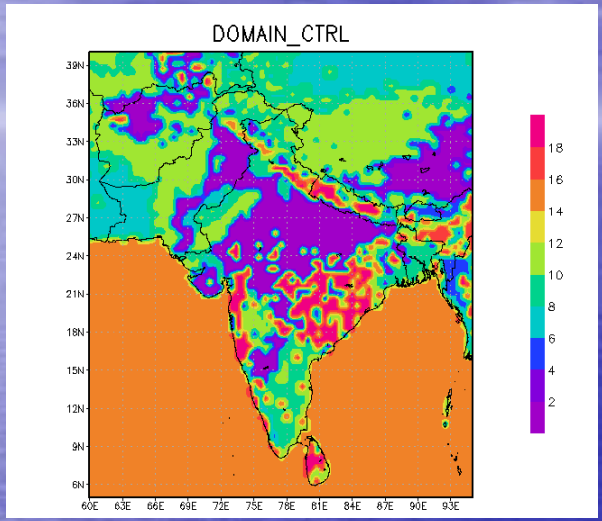

Dera Ismail Khan
Chiniot
Gujranwala
Himachal Pradesh
Amritsar
Lahore
Faisalabad
Kasur
Shimla
Ludhiana
Shorkot
Kamalia
Okara
Chandigarh
Punjab
Quetta
Dera Ghazi Khan
Khanewal
Sahiwal
Patiala
Pakistan
Multan
Ganganagar
Karnal
Bahawalpur
Panipat
Haryana
Ahmadpur east
Khanpur
New Delhi
Jacobabad
New Delhi
Rahimyar Khan
Bikaner
Sadiquabad
Shikarpur
Sikar
Alwar
Mathura
Sukkur
Larkana
Bharatpur
Jaipur
Rajasthan
Nawabshah
Ajmer
Jodhpur
Tando Adam
Pali
Mirpur Khas
Bhilwara
Kota
Hyderabad
Karachi
Udaipur

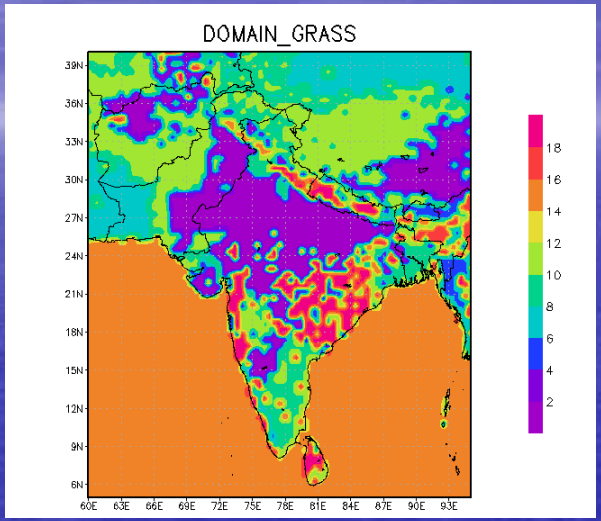
Experiment Design

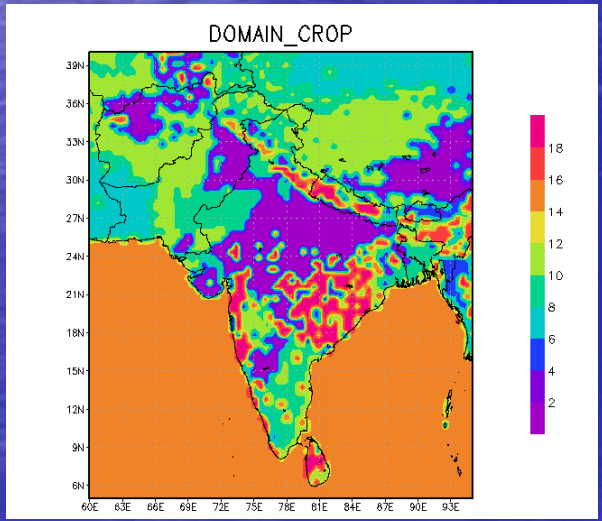
- Domain: South Asia
  - Lat: 5 – 40
  - Lon: 60 – 95
- Resolution: 50KM
- Time period: May 1997 – Sep 1997 (summer)
- Data set: ERA40
- SST: OI_WK
- Land Surface: BATS
- Land Use Categories Used:
  - Control (Desert)
  - Grass
  - Crop
  - Woodland
- Projection: LAMCON
- Convective Scheme: Grell-fc
- Compiler: PGI

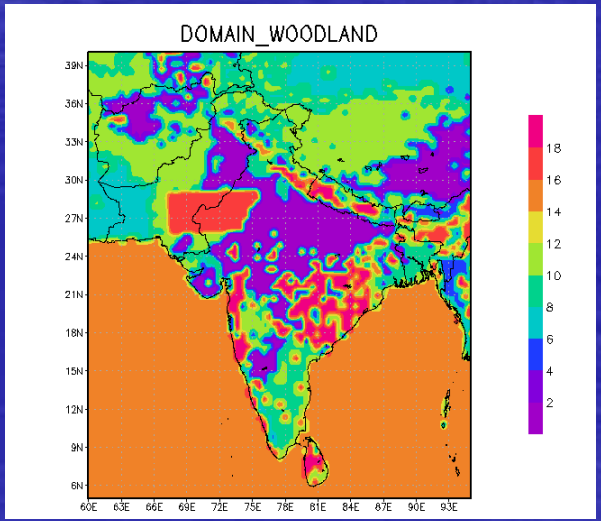


Land Use Categories





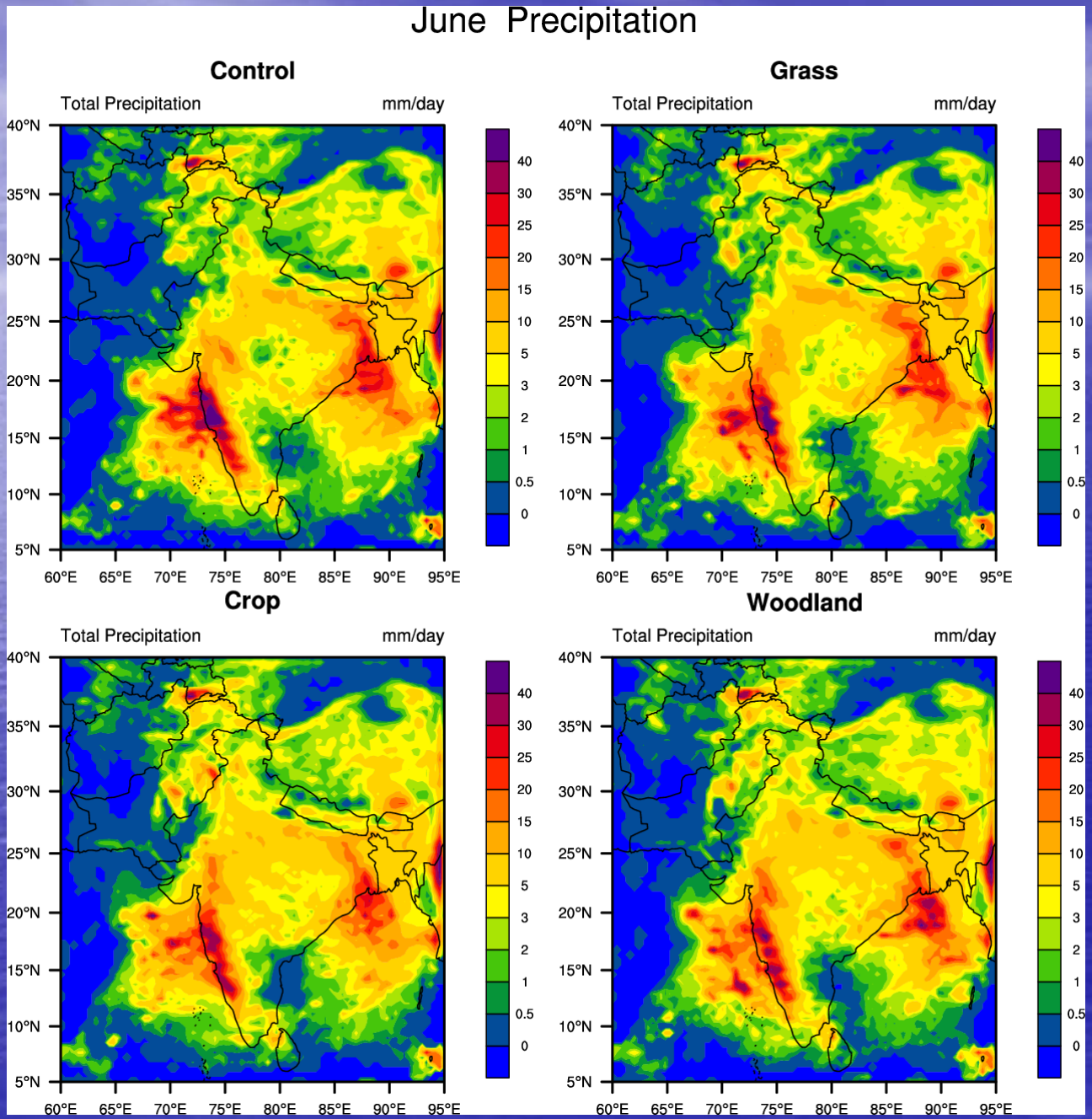




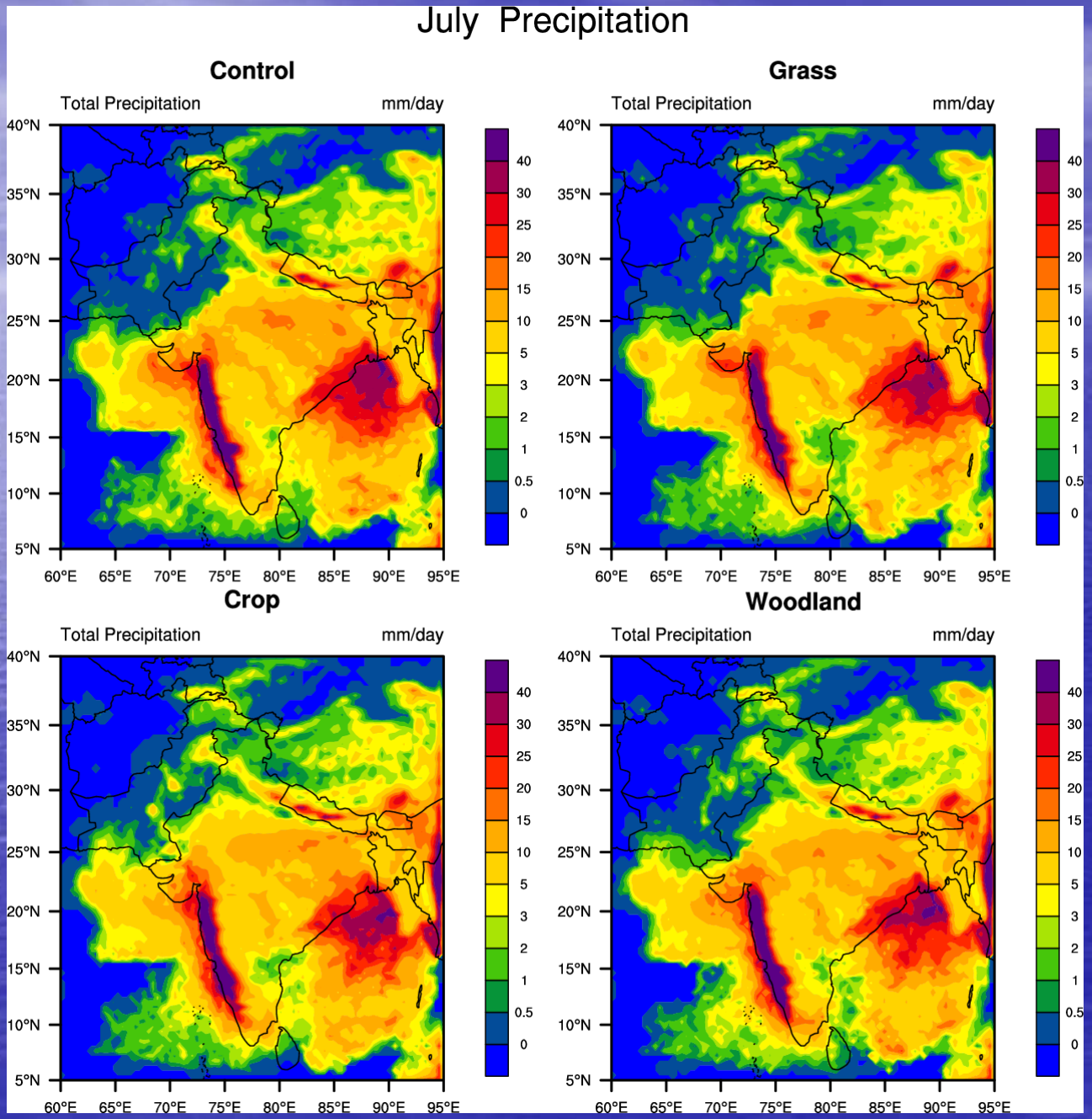
Results

- Precipitation
- Temperature
- Evapotranspiration
- Sensible heat flux
- Relative humidity

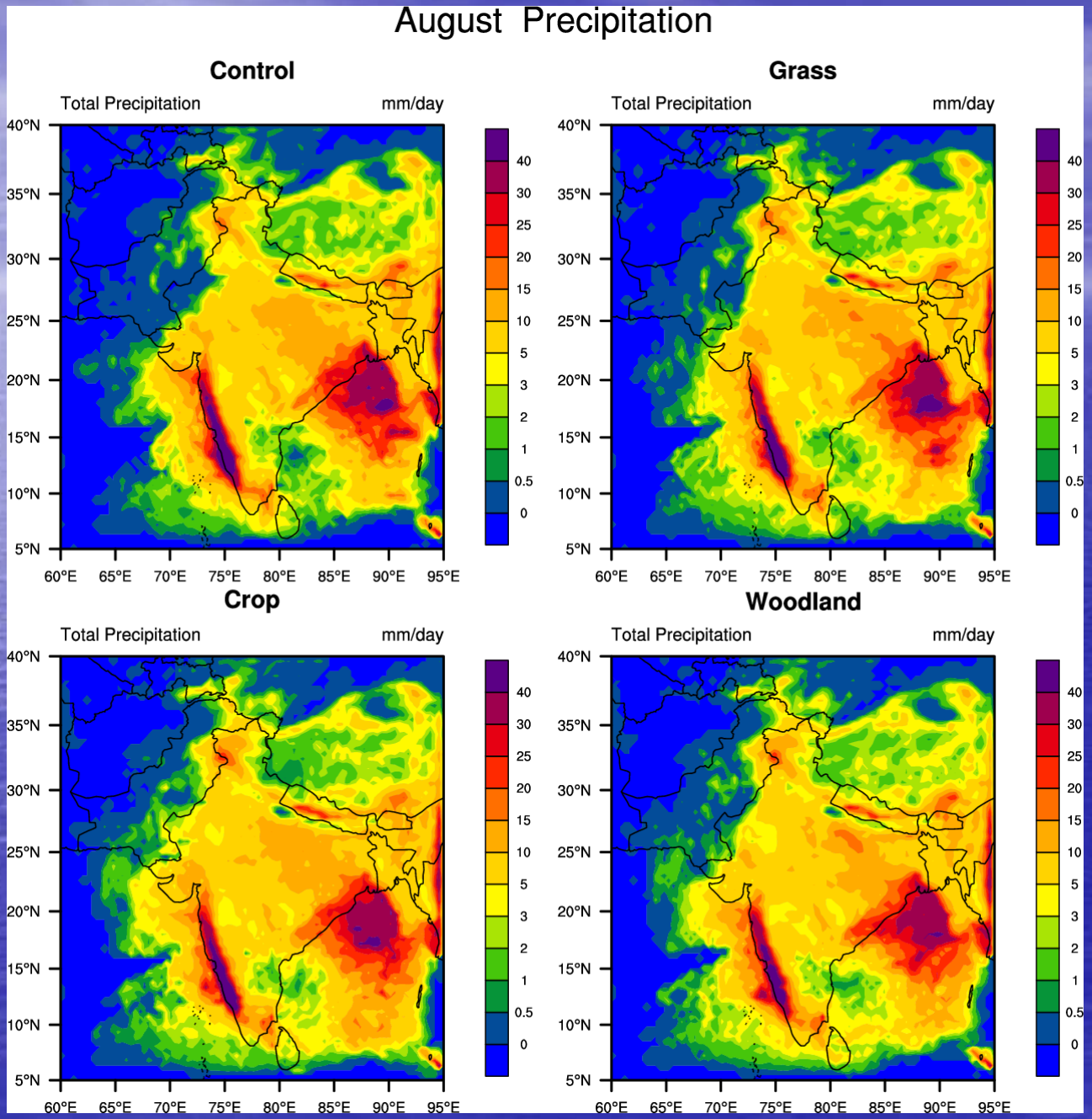
June Precipitation

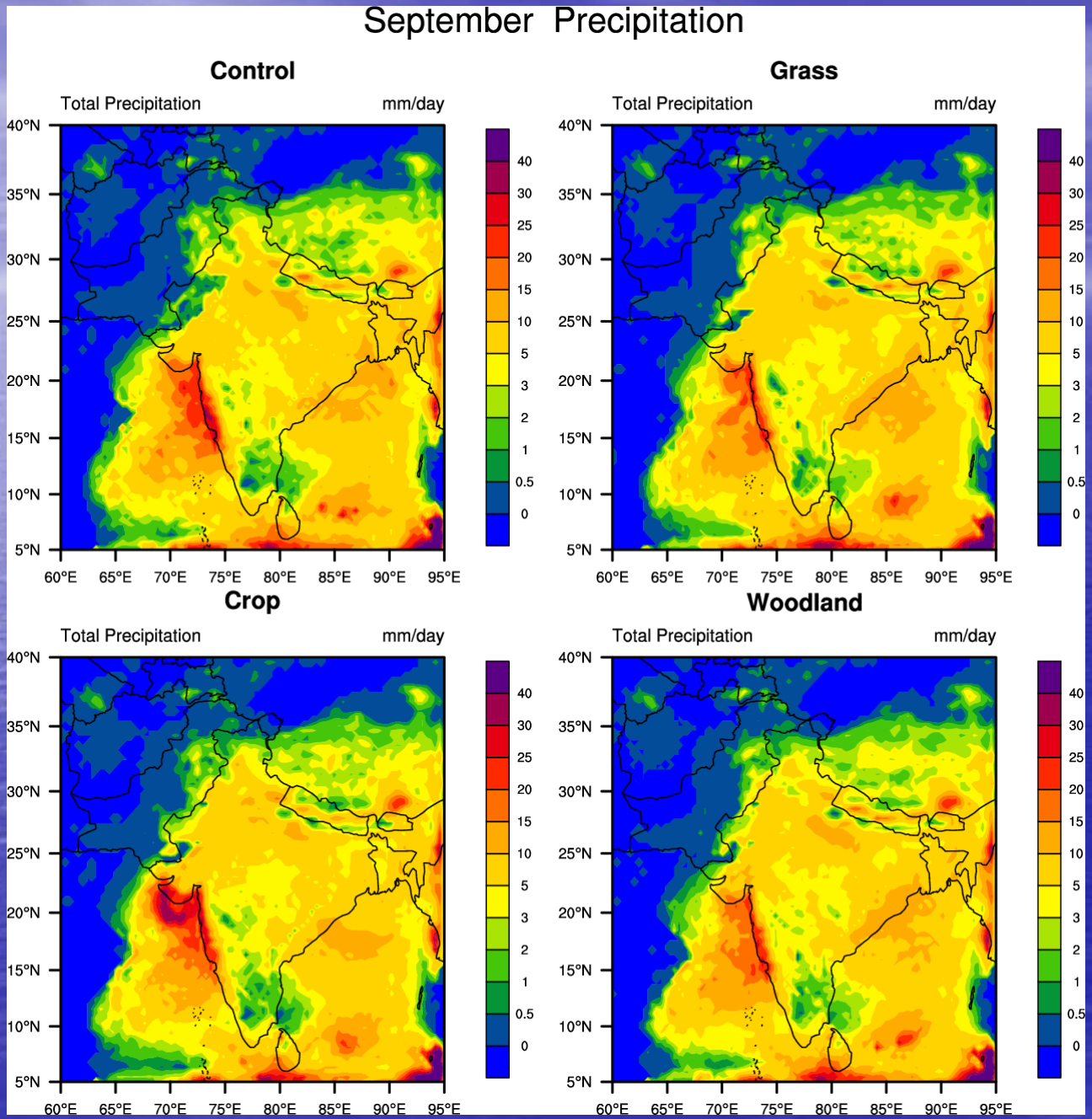


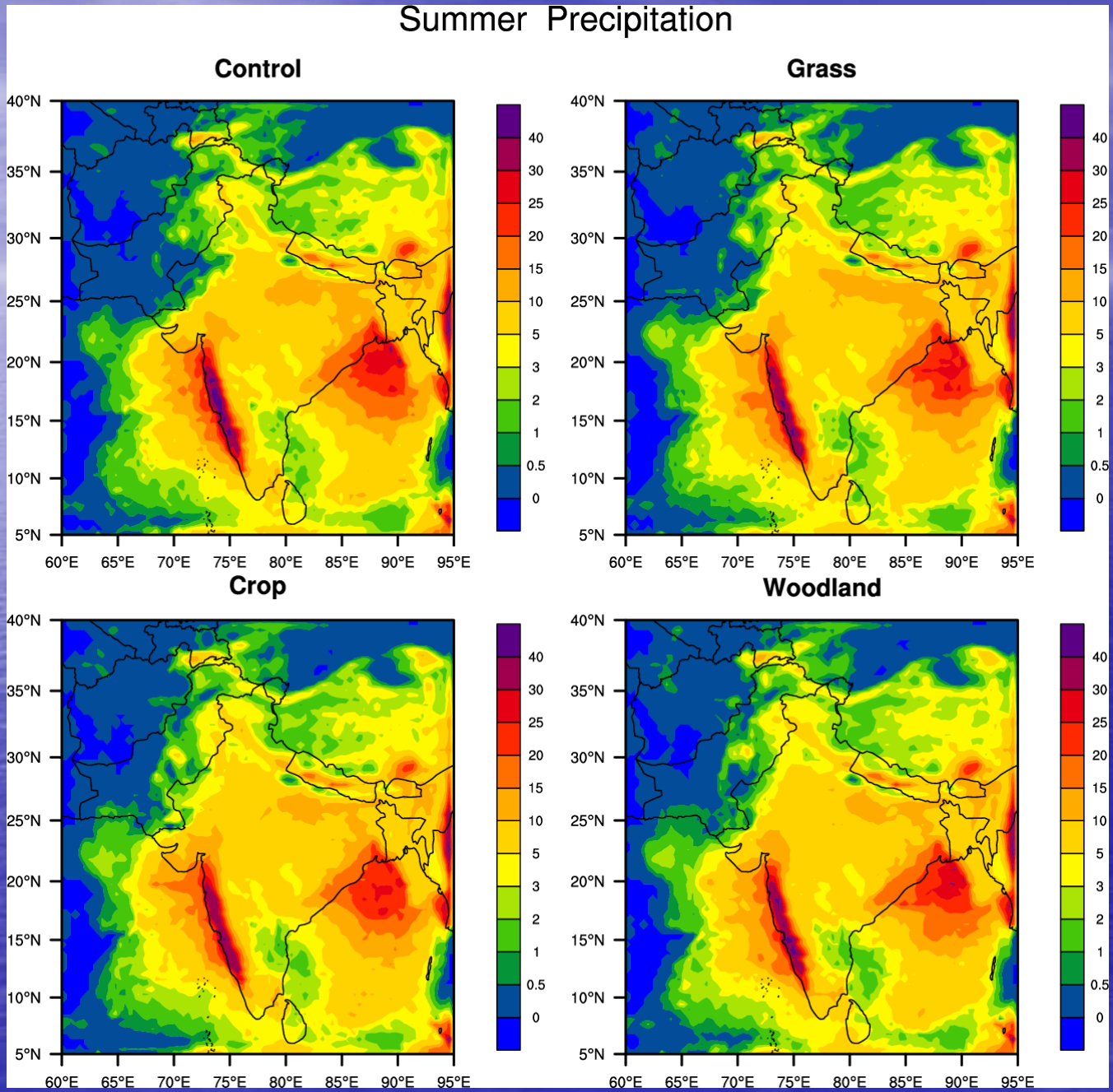
July Precipitation

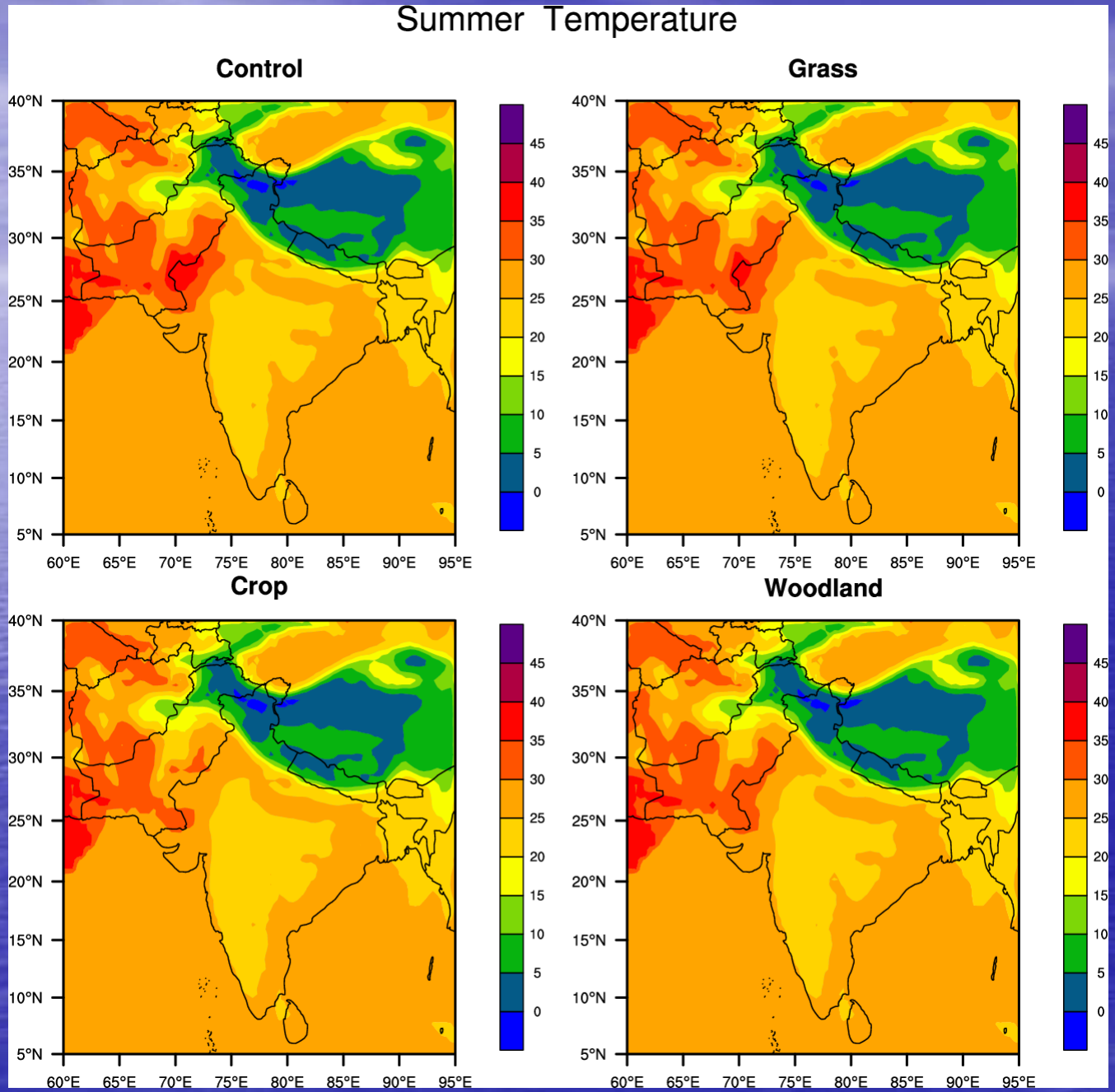


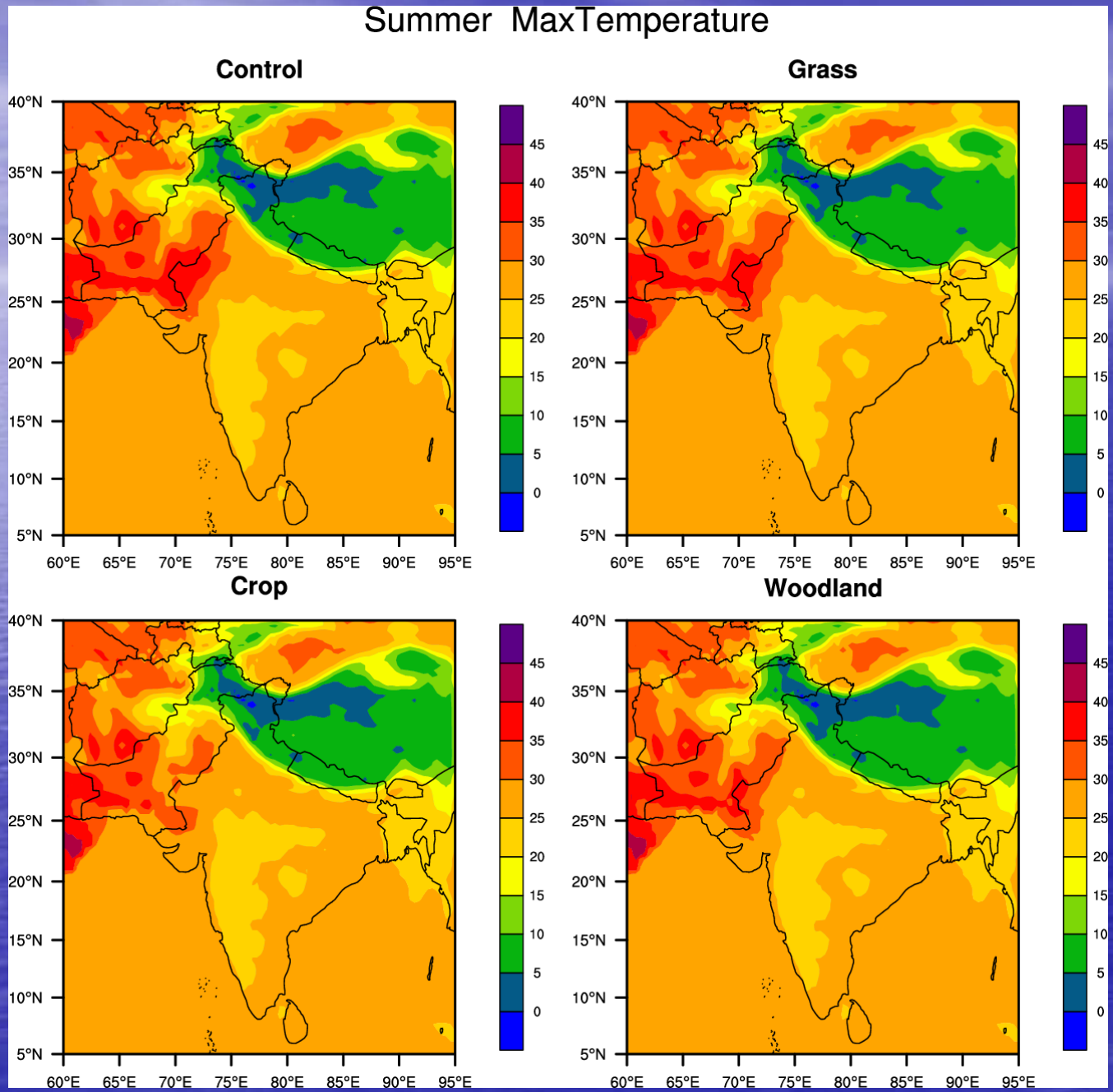
August Precipitation

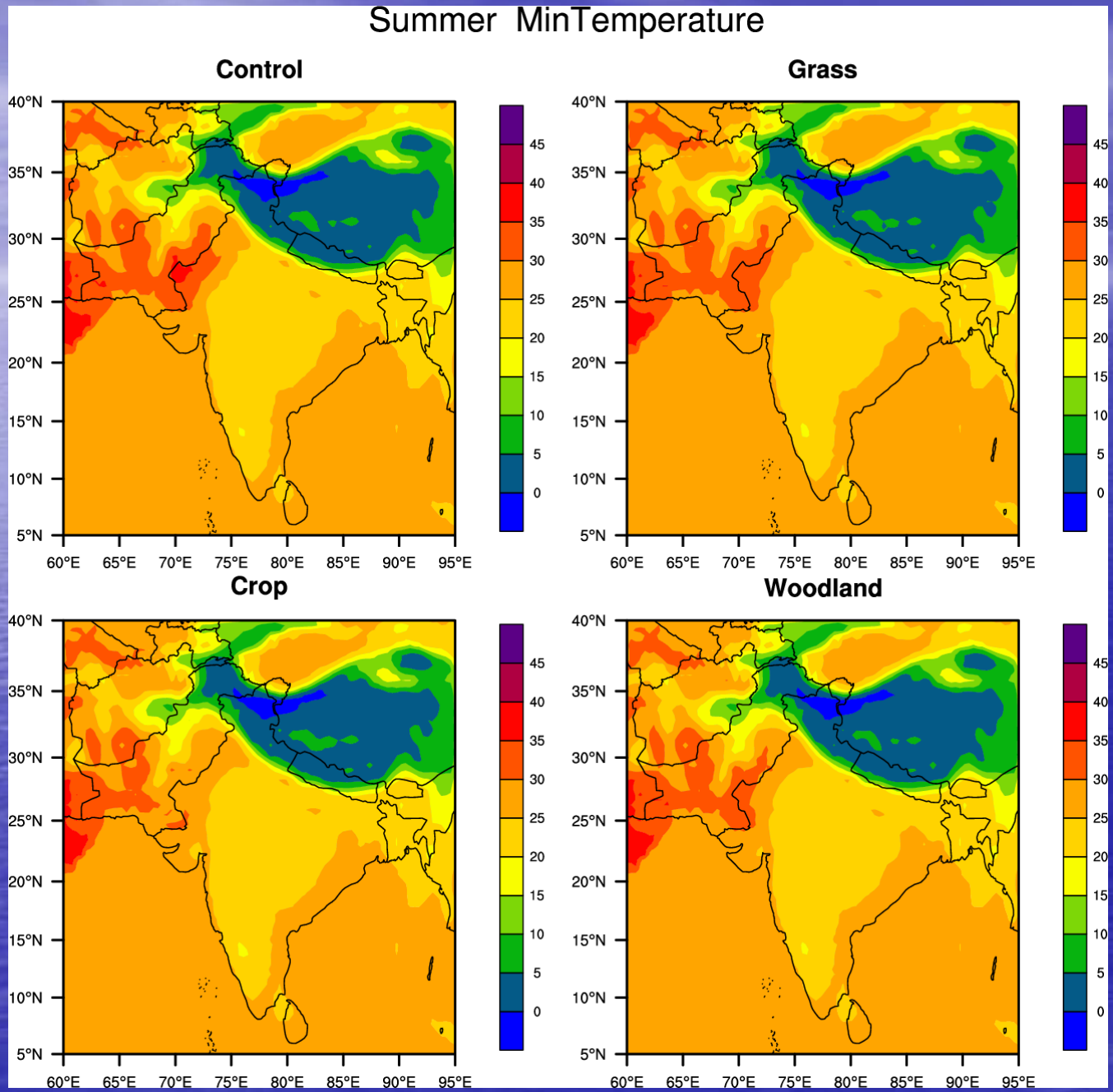


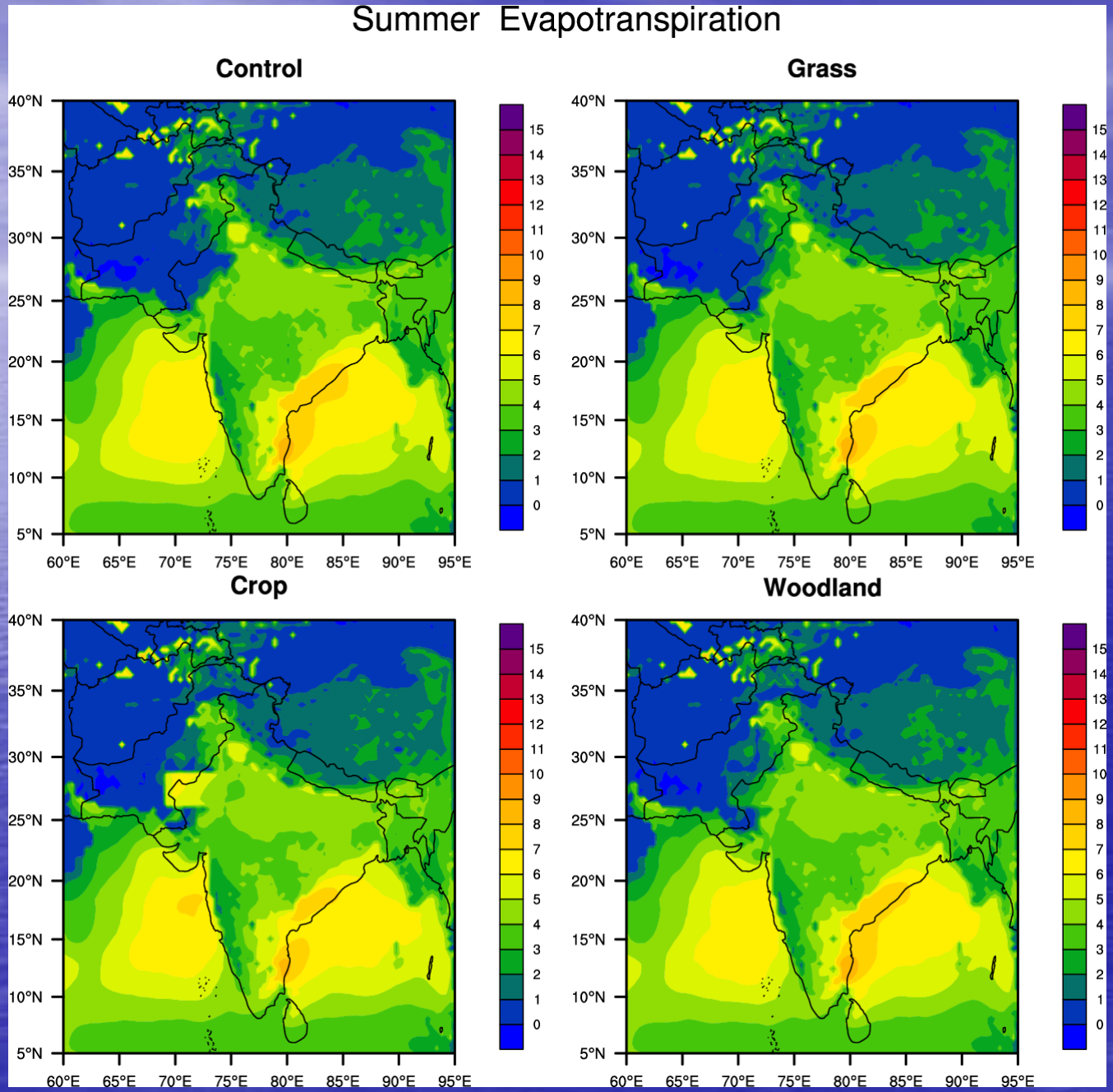

September Precipitation
Control
Grass
Crop
Woodland
Total Precipitation
mm/day
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
40
30
25
20
15
10
5
3
2
1
0.5
0

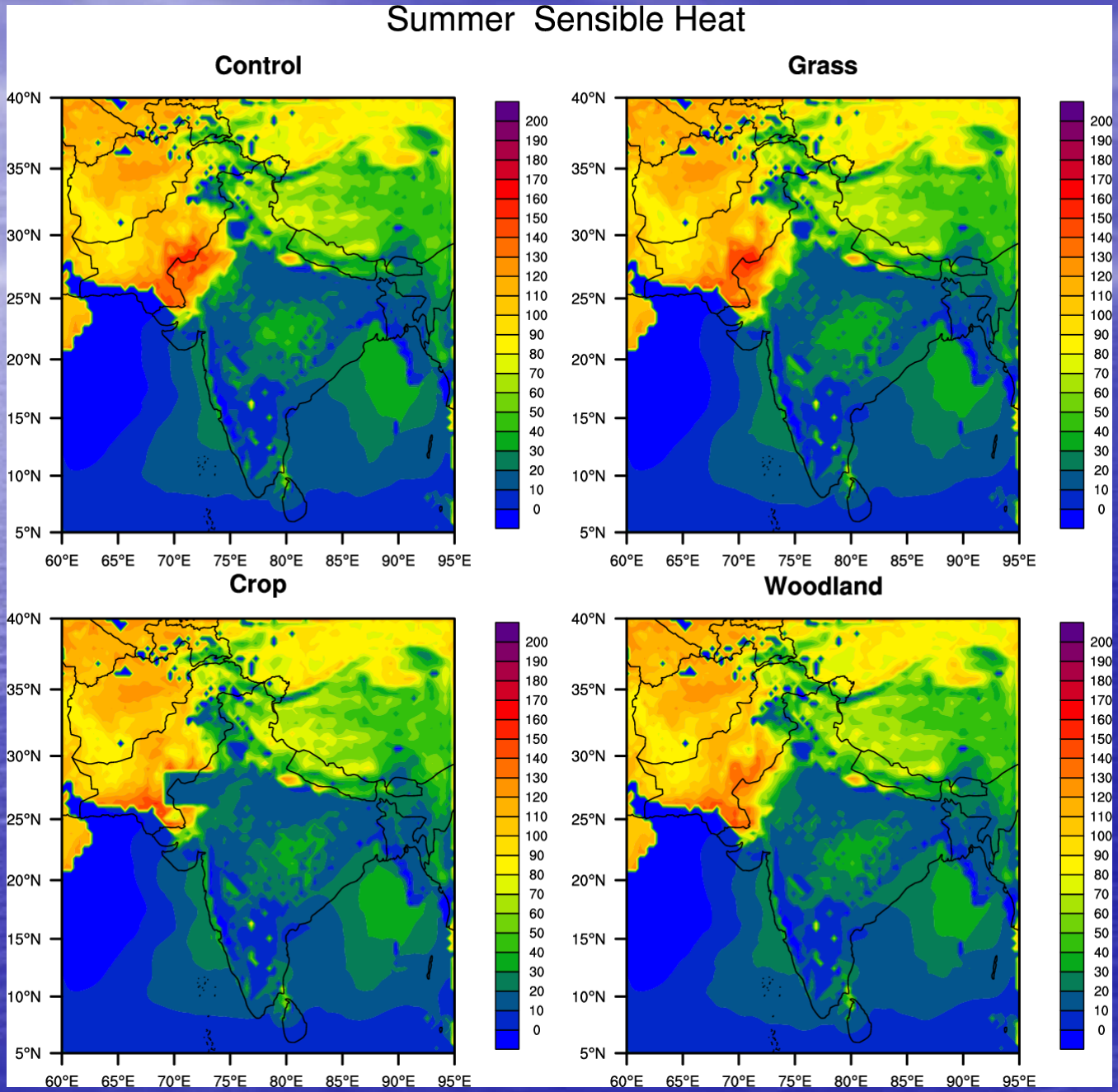

Summer Precipitation
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
40
30
25
20
15
10
5
3
2
1
0.5
0

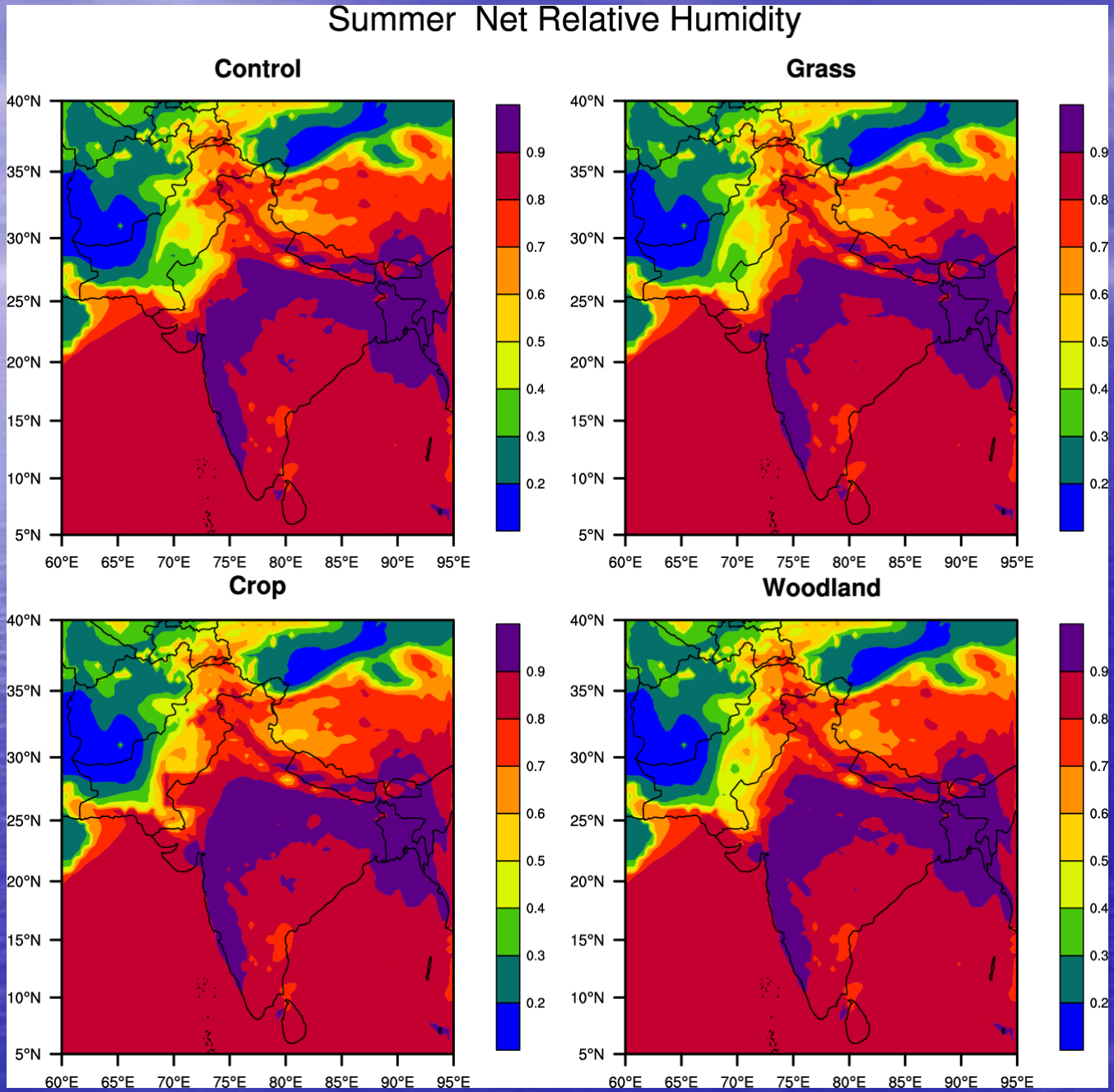

Summer Temperature
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
45
40
35
30
25
20
15
10
5
0

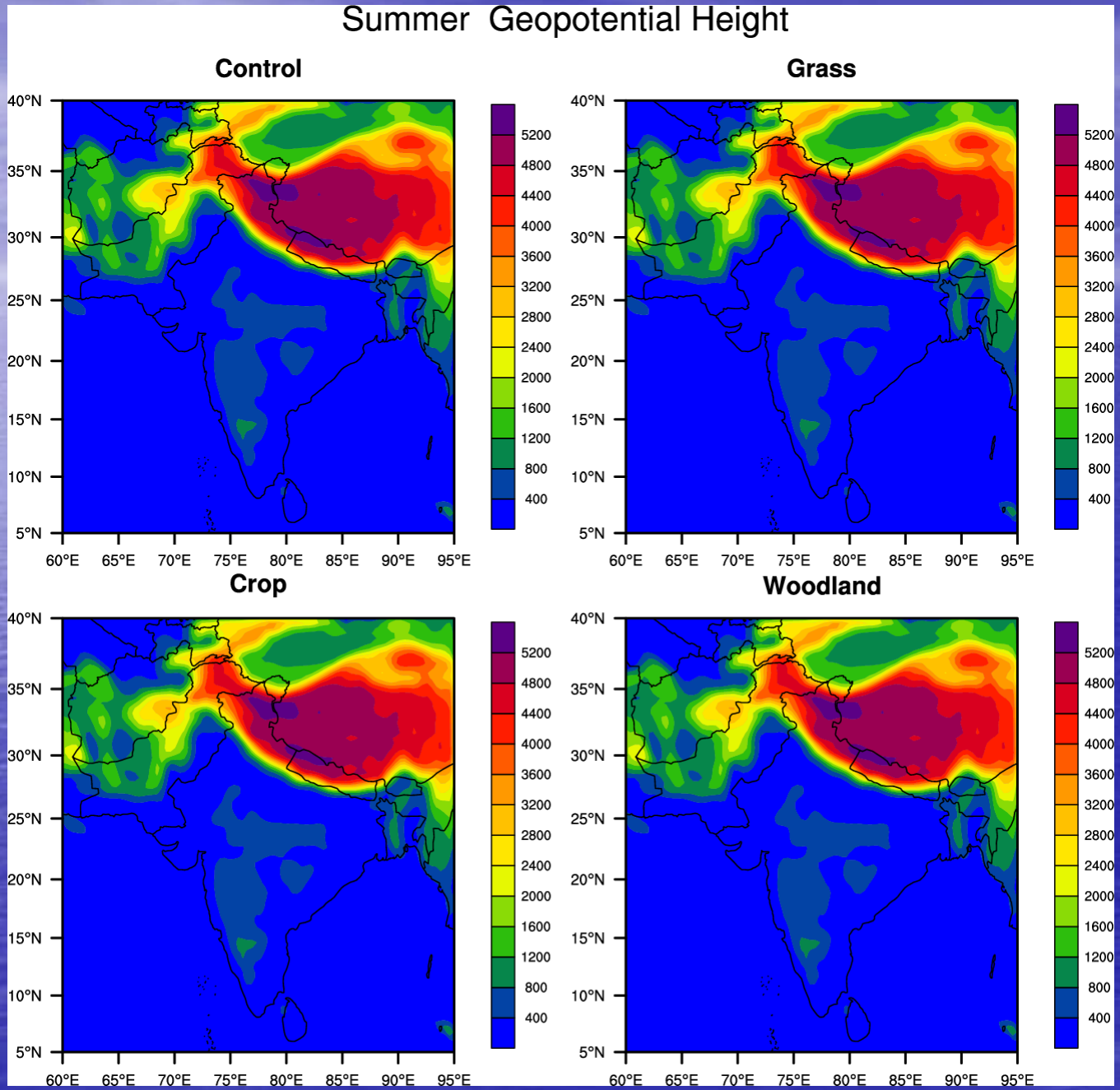

Summer MaxTemperature
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
45
40
35
30
25
20
15
10
5
0

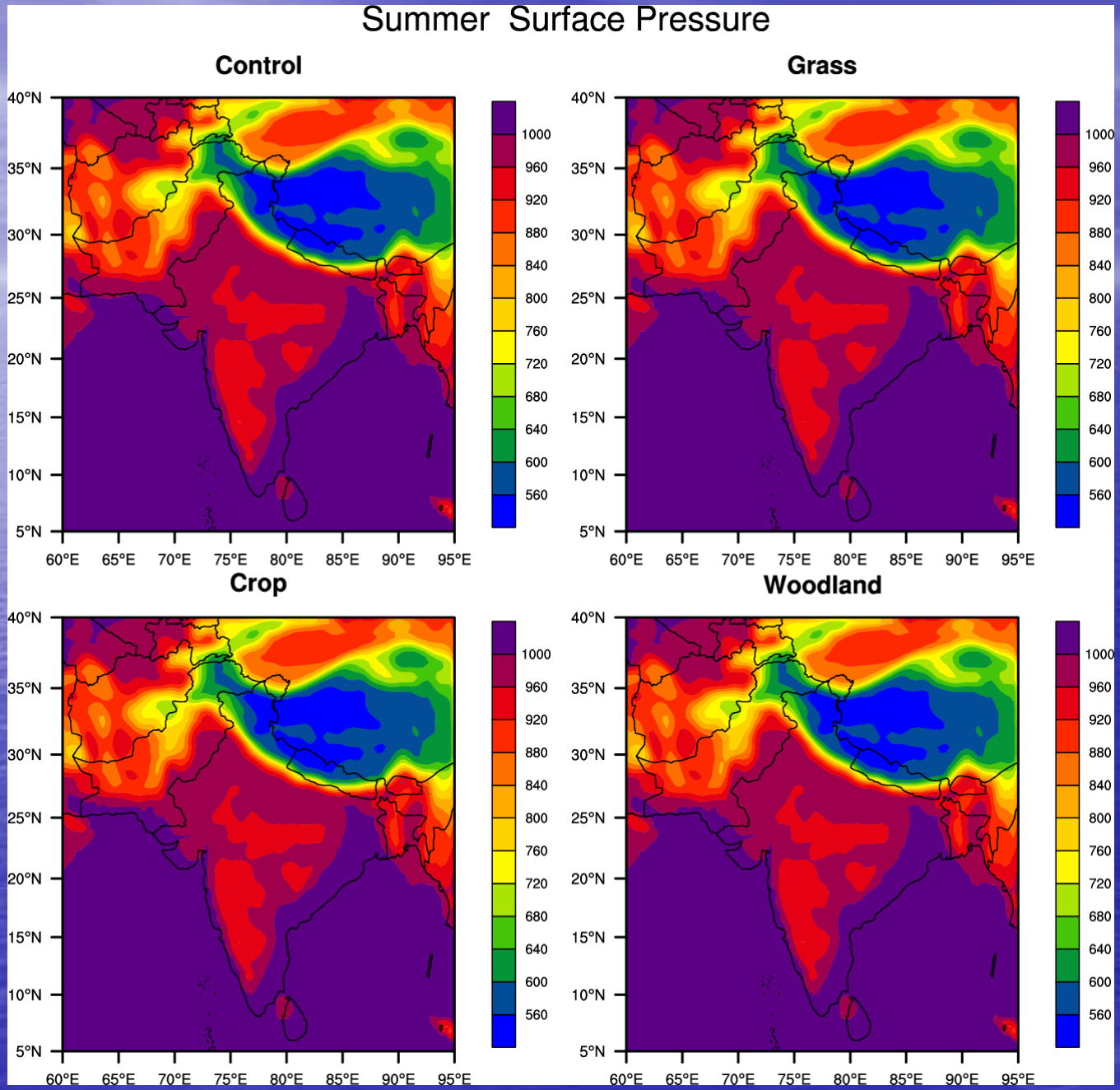

Summer MinTemperature
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
45
40
35
30
25
20
15
10
5
0


Summer Evapotranspiration
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0


Summer Sensible Heat
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


Summer Net Relative Humidity
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2


Summer Geopotential Height
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
5200
4800
4400
4000
3600
3200
2800
2400
2000
1600
1200
800
400


Summer Surface Pressure
Control
Grass
Crop
Woodland
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
60°E
65°E
70°E
75°E
80°E
85°E
90°E
95°E
1000
960
920
880
840
800
760
720
680
640
600
560

Summary

- Among different categories of land use changes, crop has more significant effects on precipitation, temperature, evapotranspiration and relative humidity as compared to grass and woodland.
- By changing the land use type from desert to irrigated crop, the summer moonson penetrates more into the southern Pakistan
- However there is no significant change in variables like surface pressure or geopotential height