ASIA NORTHERN CHINA

INDEX PRECIPITATION
YEAR 2080-2099 RELATIVE TO 1980-1999
SCENARIO A1B

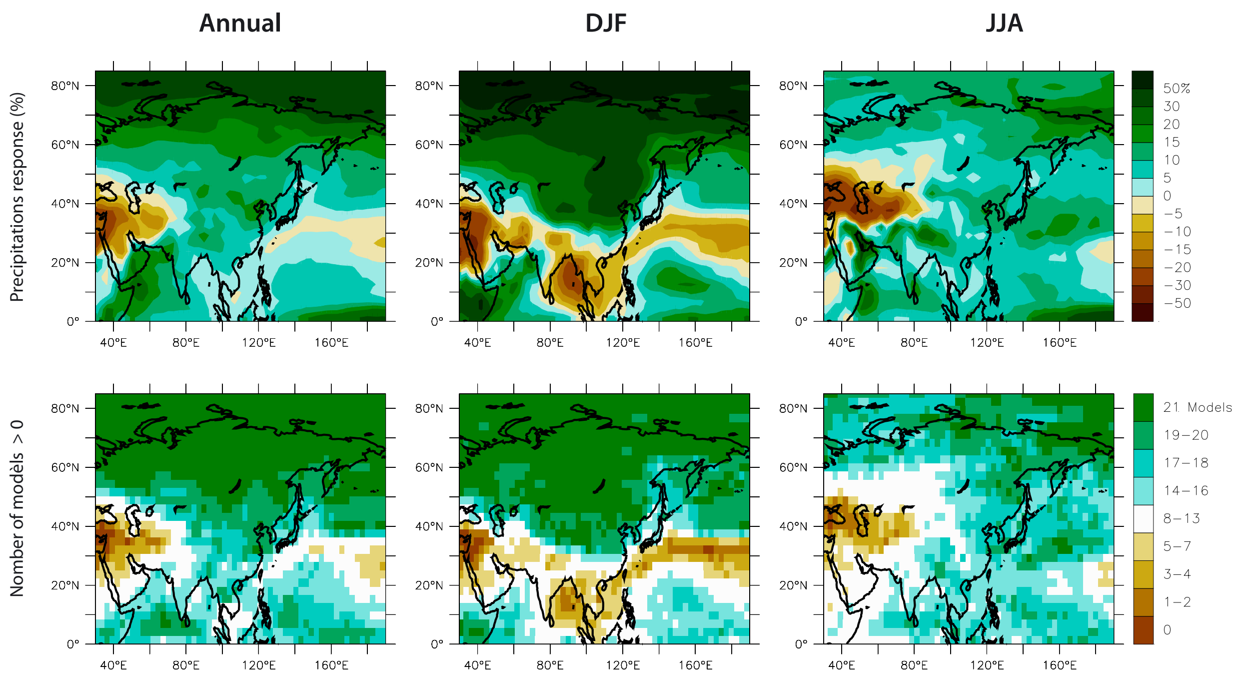
Reference: WG1 2007, Tebaldi et al. (2006), Kitoh and Uchiyama (2006)

1 The major monsoon[1] trends

Over the 21st century, winter precipitation in boreal regions increases (with a 90-99% probability) in northern Asia and the Tibetan Plateau; it also increases (66-90% probability) in East Asia and in the southern most regions of Southeast Asia. Projections for annual mean precipitation in China are similar across the different climate models, except for the east coast of China (see FIGURE 1 of the global precipitation fact sheet). As regards summer precipitation, the results of the different models are consistent for the north-eastern region of China, where precipitation increases (see FIGURE 2 of the global precipitation fact sheet). In winter, the increase in precipitation is simulated for the whole of the northern region of China. However, the projections diverge for summer precipitation, in both the interior and the south of the country. The projections are not enough to indicate a potential change in precipitation in the southern part of China. Projections for monsoon regions are in fact very uncertain, whatever the model used.

Precipitation in China increases by 10 to 20% on average. Winter precipitation is also more marked (15 to 30%) than summer precipitation (5 to 15%)

1. See the global precipitation fact sheet for a more detailed explanation of the monsoon.

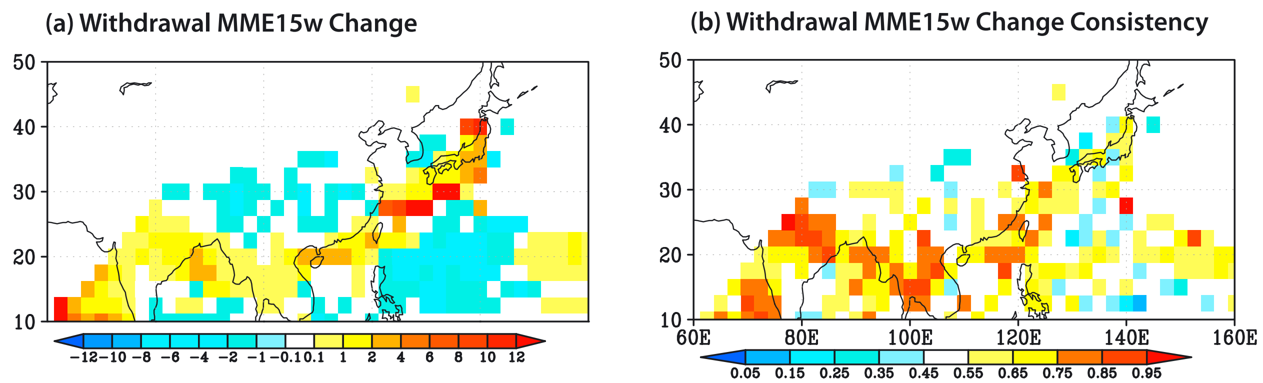


MODIFIED AND BASED ON WORKING GROUP I CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. FIGURE 11.9. CAMBRIDGE UNIVERSITY PRESS.

FIGURE 1 Precipitation changes over Asia from the multi-model data set-A1B simulations. Top row: Annual mean, DJF and JJA precipitation change between 1980 to 1999 and 2080 to 2099, averaged over 21 models. Top: Fractional change in precipitation. Bottom: Number of models out of 21 that project increases in precipitation.

(see FIGURE 1). Summer precipitation increases (66-90% probability) in northern, East and South Asia as well as in most southeast regions, whereas it decreases (66-90% probability) in central Asia. The frequency of torrential rain events increases (90-99% probability) in South and East Asian regions. Extreme rainfall and winds associated with tropical cyclones increase (66-90% probability) in East, Southeast and South Asia. Moreover, summer precipitation produces increased in flooding in areas affected by the Asian monsoon. Climate warming appears to be associated with a change in the characteristics of the monsoon season. Thus, the monsoon in central China advances by about 5 days under the A1B scenario projections for 2081-2100 relative to 1981-2000. Within the same time period, the monsoon in southern China is delayed by 5 to 10 days with a 55 to 95% probability (see FIGURE 2).

The atmosphere is warmer, which implies an increase in water vapour content and precipitation, particularly in the winter season (in line with the temperature increase). However, in the tropics, the models tend to project a slight decrease in precipitation due to a change in the atmospheric Hadley cell.



KITOH AND UCHIYAMA (2006) TAKEN FROM WORKING GROUP I CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. FIGURE 11.10. CAMBRIDGE UNIVERSITY PRESS.

FIGURE 2 (a) The ensemble mean change in withdrawal date of the summer rainy season between the multi-model data set-A1B projections in 2081 to 2100 as compared with the 1981 to 2000 period in the 20C3M simulations. A positive value indicates a later withdrawal date in the A1B scenario. Units are in multiple of 5 days. (b) Fraction of the models projecting a positive difference in other words, a delay in the arrival of the monsoon.

2 Percentiles of precipitation distribution

TABLE 1 shows changes in precipitation (in percent) projected by the A1B scenario and between 2080-2099 and 1980-1999, for several percentiles[1] of the probability distribution. Winter and summer trends are represented over two regions of Asia: Tibet and eastern China.

TABLE 1

		Percentiles				
Region	seasons	5	25	50	75	95
Tibet	DJF	-4	11	21	30	45
	JJA	-8	-2	2	6	13
Eastern China	DJF	-11	-1	6	12	24
	JJA	1	5	7	10	14

In Tibet, the different percentiles show that precipitation increases only in winter above the 25th percentile and in summer above the median value (see FIGURE 1). The median value for precipitation increases 21% in winter and 2% in summer. The difference between the 5th and 95th percentiles is larger in winter (49%) than in summer (21%). The 5th and 95th percentiles show that in winter the high precipitation values increase (45% for the 95th percentile) while the low values decrease (4% for the 5th percentile). In summer, the low values decrease by around 8% (5th percentile), while the high values (95th percentile) increase by over 13%.

In eastern China, the percentiles show that precipitation decreases below the median value in winter and increases in summer (see FIGURE 1). The median value for precipitation increase is 6% in winter and 7% in summer; their values are identical whatever the season. The difference between the 5th and 95th percentiles is larger in winter (35%) than in summer (13%). The lower values decrease by over 11% (5th percentile) and the higher values increase by over 24% in winter (95th percentile). In summer, the lower values increase by over 1% (5th percentile) while the higher values increase by 14% (95th percentile).

In this example, the precipitation extremes show that the regions studied in winter will be the most affected by changes in the hydrological regime.

1. See paragraphs 1.1 and 1.2 of the technical sheet for further information.

3 Climate indices for precipitation

The nine models used agree on a decrease in the number of dry days in northern Siberia, and in north-eastern China in particular. The number of extreme rainfall days increases across the whole country, with agreement between the different models: this increase is all the more pronounced in eastern China and over the Tibetan plateau (see FIGURE 3).

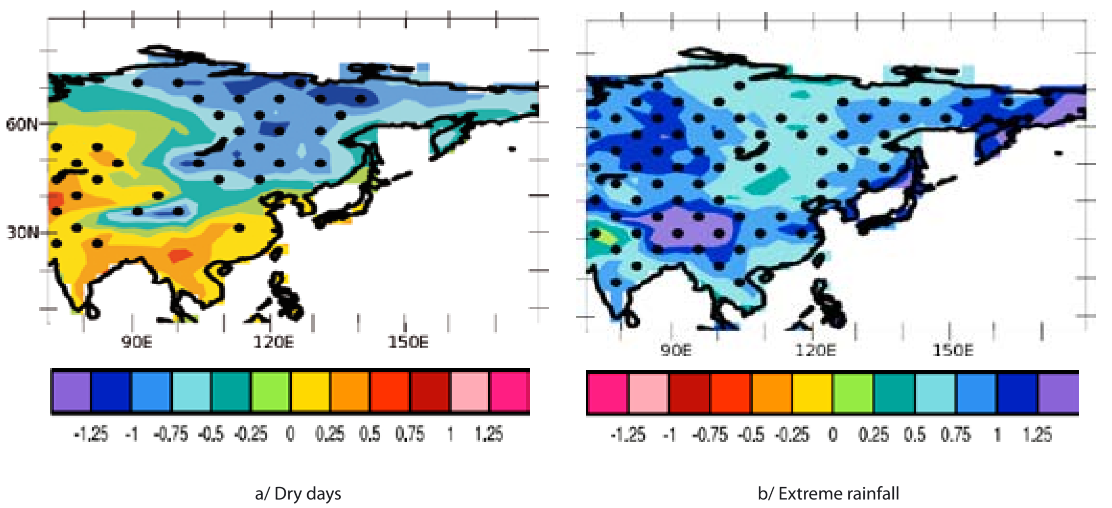


FIGURE 3 Changes in extremes based on multi-model simulations from nine global coupled climate models, adapted from Tebaldi et al. (2006). Changes in spatial patterns of simulated (a) dry days and in (b) 95th percentile of precipitation between two 20-year means (2080–2099 minus 1980–1999) for the A1B scenario. Stippling denotes areas where at least five of the nine models concur in determining that the change is statistically significant. Extreme indices are calculated only over land, according Frich *et al.* (2002). Each model's time series was centred on its 1980 to 1999 average and normalised (rescaled) by its standard deviation computed (after de-trending) over the period 1960 to 2099. The models were then aggregated into an ensemble average, both at the global and at the grid-box level. Changes are thus given in units of standard deviations (see paragraph 1.3 of the technical fact sheet for further information).