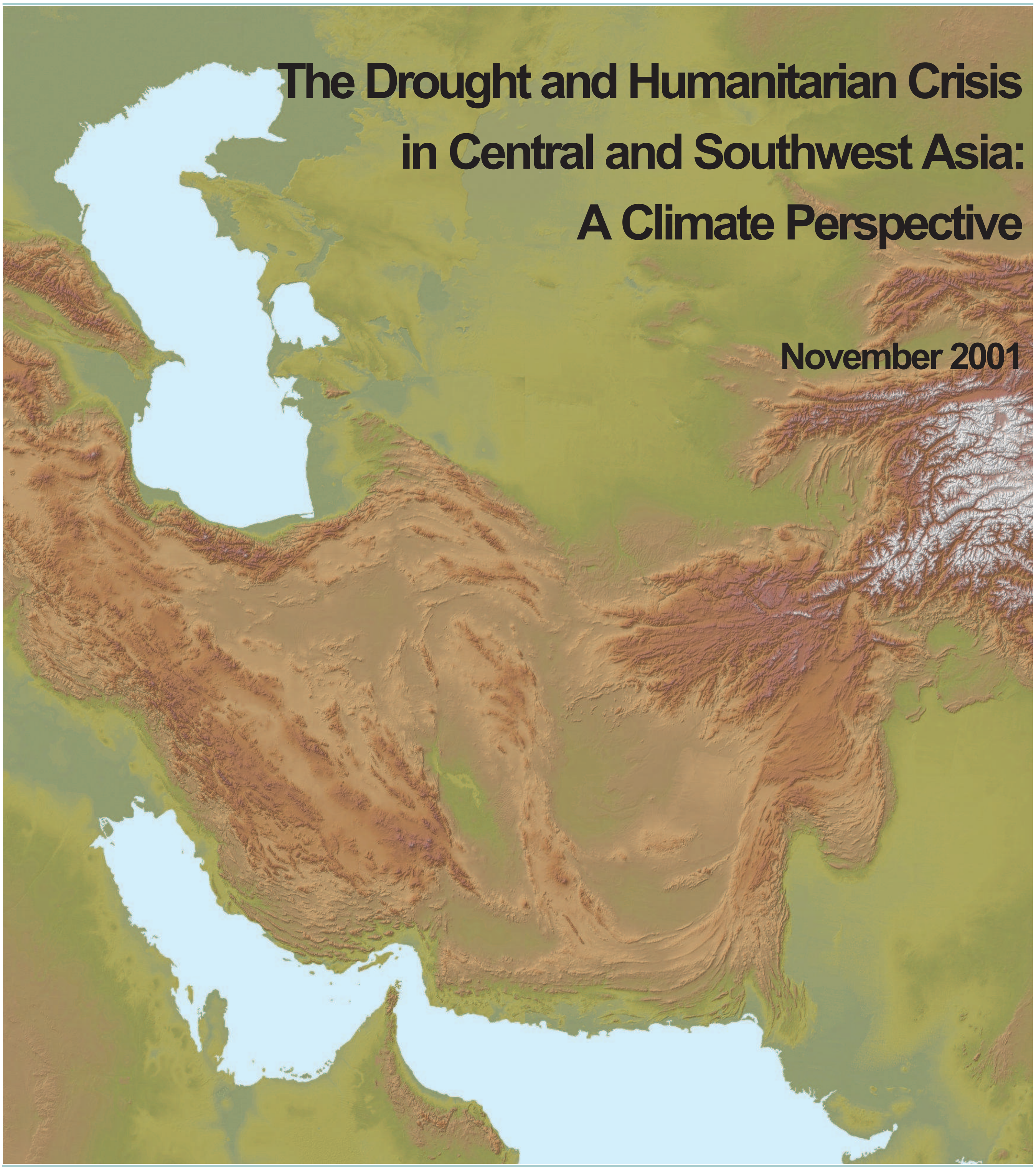
THE INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE PREDICTION

LINKING SCIENCE TO SOCIETY

IRI SPECIAL REPORT NO. 01-11

The Drought and Humanitarian Crisis in Central and Southwest Asia: A Climate Perspective

November 2001



COLUMBIA EARTH INSTITUTE

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

ACKNOWLEDGMENTS

Review comments and other input from Michael Bell, Maxx Dilley, Roberto Lenton, Antonio Moura, Carolyn Mutter, Chet Ropelewski, Antionette Wannebo and Neil Ward are gratefully acknowledged.

The Drought and Humanitarian Crisis in Central and Southwest Asia: A Climate Perspective

Authors: Shardul Agrawala, Mathew Barlow, Heidi Cullen and Bradfield Lyon

Contributors: Anthony Barnston, Reid Basher, Rachel Cardone, Simon Mason, Tricia Ramsey, Michael Tippett and Steve Zebiak

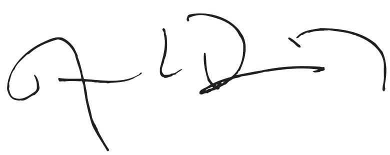
The International Research Institute for Climate Prediction (IRI) was established as a cooperative agreement between U.S. NOAA Office of Global Programs and Columbia University. IRI is a unit of the Columbia Earth Institute located at Lamont-Doherty Earth Observatory.

Published by the International Research Institute for Climate Prediction (IRI),
Lamont-Doherty Earth Observatory of Columbia University
Palisades, New York, 10964, USA
IRI Special Report 01-11

FOREWORD

The vision for the IRI is that of a lively innovative science institution working to accelerate the abilities of societies worldwide to deal with climate fluctuations, especially those that cause devastating impacts on humans and the environment, and thereby reaping the benefit of decades of research on the El Niño Southern Oscillation phenomenon and other variations. IRI experts routinely provide guidance and leadership in training, regional climate outlook forums and numerous other outreach activities around the world to explore how specific regions or sectors might better understand and utilize climate prediction information.

Research on the severity of the drought in Central and Southwest Asia and possible mechanisms for it began at IRI in spring 2000. This Special Report is the product of collaboration between climate modeling, monitoring and impacts experts at the IRI. The target audience for this report includes national, regional and international policymakers, humanitarian relief agencies, members of the research community as well as others with a general interest in Central and Southwest Asia and the causes and consequences of the persistent drought in the region.



Antonio Divino Moura
Director General

Palisades, New York
November 2001

TABLE OF CONTENTS

EXECUTIVE SUMMARY

A persistent multi-year drought in Central and Southwest Asia has affected close to 60 million people as of November 2001. Chronic political instability in many parts of this region and the recent military action in Afghanistan have further complicated the situation. This report provides a climatic perspective on the severity and spatial extent of the ongoing drought and its social and economic impacts. The target audience for this report includes national, regional and international policymakers, humanitarian relief agencies, members of the research community as well as others with a general interest in Central and Southwest Asia and the causes and consequences of the persistent drought in the region. The report discusses underlying climatic mechanisms that might explain the causes for the persistent drought, and presents seasonal climate forecasts and their implications for the region.

The principal conclusions of this report are as follows:

- Central and Southwest Asia represents the largest region of persistent drought over the past three years anywhere in the world.

- From a regional perspective, the ongoing drought is the most severe in the past several decades. Significant shortfalls in precipitation have led to widespread social and economic impacts, particularly in Iran, Afghanistan, Western Pakistan, Tajikistan, Uzbekistan and Turkmenistan. Agriculture, animal husbandry, water resources, and public health have been particularly stressed throughout the region.

- Preliminary analysis suggests that the drought is related to large-scale variations in the climate across the Indian and Pacific Oceans, including the recent "La Niña" in the eastern Pacific.

- Current seasonal climate forecasting skill in Central and Southwest Asia is modest. IRI seasonal forecasts for the period November 2001-April 2002 are consequently for climatology or equal likelihood of above-, near-, or below-normal precipitation in the region. While not indicative of any pronounced trends, a climatology forecast is less dire than one indicating enhanced probabilities for below normal precipitation. IRI forecasts are produced monthly and are available at: http://iri.columbia.edu/climate/forecast/net_asmt/.

1. OVERVIEW AND SOCIETAL IMPACTS OF THE DROUGHT

As of November 2001 Central and Southwest Asia has been affected by a persistent multi-year drought. From a global perspective this drought represents the largest region of persistent precipitation deficits over the past three years (Figure 1). Up to 60 million people have been affected throughout the region, with Iran, Afghanistan, Western Pakistan, Tajikistan, Uzbekistan and Turkmenistan experiencing the most severe impacts (Figure 2). The effects of the drought are further exacerbated by political instability and economic isolation. Afghanistan is particularly vulnerable, having witnessed over two decades of civil strife that has been further complicated in recent weeks by the US-led military action against the Taliban.

The severity and persistence of the drought has led to a wide range of impacts across the region. In many areas there is widespread scarcity of potable water as well as depleted supplies for irrigation and sanitation. Agricultural production has been severely impacted, and there has been a significant reduction in livestock populations that are key to subsistence livelihoods. There has also been a rise in respiratory and sanitation-related diseases. Large population movements due to the combination of drought and civil instability have aggravated all these problems. The following summary of impacts in Iran, Afghanistan, Pakistan and Tajikistan is based on reports from national agencies and several international humanitarian and relief

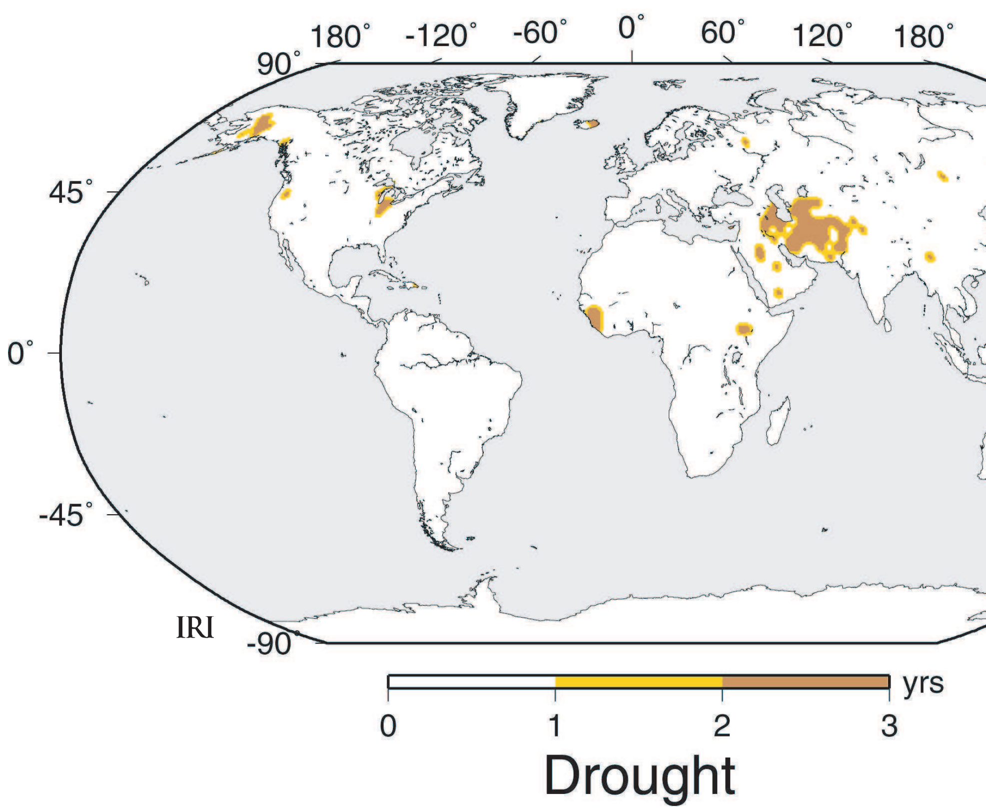


Figure 1. *Prolonged Drought: A global perspective of the number of consecutive years (ending in 2001) with precipitation deficits in the lowest fifth of the historical record.*

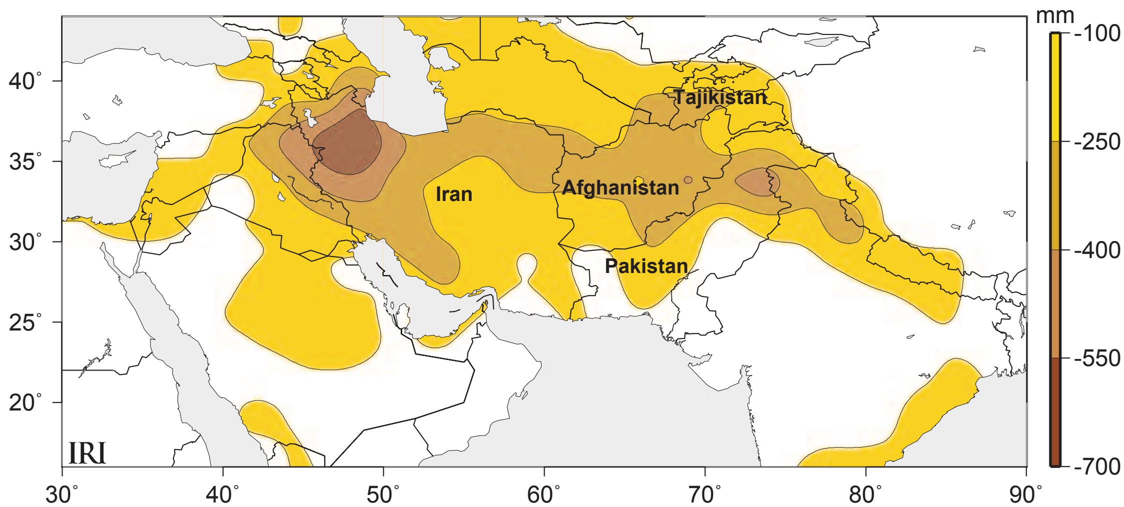


Figure 2. *Regional Drought Situation: Deficit in precipitation totaled over 1998-2001.*

organizations including Reliefweb/United Nations Office for Coordination of Human Affairs (OCHA), Food and Agricultural Organization (FAO), World Food Program (WFP), Department for International Development (DFID), and the United States Agency for International Development (USAID).

1.1 Iran

In Iran, the three-year drought has severely affected 10 of the country's 28 provinces, leaving an estimated 37 million (over half the country's population) vulnerable to food and water insecurity.[1] Twenty provinces have experienced precipitation shortfalls during winter and spring 2001. The most affected provinces are Fars, Keran, Khorasan and Sistan-va-Baluchistan in the southeast. According to the Ministry of the Interior, water reserves in the country were down by 45% in July 2001.[2]

In the agricultural sector, Iranian farmers have sold roughly 80% of their livestock, and an estimated 800,000 livestock were lost in 2000 as a result of the drought.[3] An estimated 2.6 million hectares of irrigated lands and 4 million hectares of rain-fed agriculture have experienced the drought's impact, along with 1.1 million hectares of orchards growing almonds, apricots, mangoes, and other fruits. Farmers are expecting 35-75% reductions in wheat and barley produce in 2001. The United Nations estimates the damages to agriculture and livestock at $2.5 billion in 2001, up from $1.7 billion in 2000.[4]

The extreme drought conditions have led to widespread migration. Iran must also contend with the swelling number of Afghan refugees who are seeking to escape drought and political instability. The lack of proper sanitation and clean water has contributed to the increased incidence of polio, along with cholera, diphtheria and typhoid. Among the refugee population, tuberculosis is prevalent.

1.2 Afghanistan

Roughly 12 million Afghans are affected by the ongoing drought, of which an estimated five million lack access to food and water.[5] In particular, the northern provinces of Takplar, Balkh, Jowzjan, Faryab, and Badghis face extreme conditions, along with the western half of the country, including the provinces of Ghowr, Oruzgan, Farah, Nimruz, Ghazni, Paktika, Zabol, and Quandahar. Afghanistan also has close to one million internally displaced persons (IDPs) and several million more refugees (Figure 3).[6]

Adding to the humanitarian crisis, fewer than 25% of Afghans have access to clean water, and only 12% have access to sanitation.[7] Rain-fed crops failed in 2001, and irrigated agricultural output was reduced due to lack of water and failure of infrastructure.[8] In 2000, the cereal deficit exceeded 2.3 million tons, doubling the shortfall from previous years. Livestock heads have also been depleted by 40% since 1998[9] and reports suggest that distress sales of livestock have increased. As of September 25, 2001, World Food Program food reserves were estimated to last just three weeks for the estimated 3.8 million in dire need of food aid.[10] Drought conditions, coupled with the ongoing civil conflict and the US-led military action have driven hundreds of thousands of Afghans towards the borders with Iran, and particularly Pakistan.

1.3 Pakistan

Pakistan's four provinces - Baluchistan, Sindh, Punjab, and the North West Frontier Province - have all been affected by the drought. An estimated 349,000 people, mostly farmers, pastoralists, and landless rural households have been impacted, mostly in Baluchistan.[11] Food insecurity threatens farmers both from shortfalls in agricultural production and from the loss of livestock. Numbers of affected livestock (through barrenness or loss) ranging from 40% to over 60% have been reported in Pakistan's four provinces. Plummeting prices and the need to use remaining livestock for food have all contributed to a bleak situation in parts of the provinces, most significantly in Punjab, where losses are estimated at 5.5 billion rupees[12] (approximately US $90 million).

The drought situation in Pakistan has been further complicated by the significant influx of Afghan refugees over the last 5 years. Between September 2000 and January 2001 alone, an estimated 68,000 Afghan refugees crossed the border into the Northwest Frontier Province and Baluchistan.[13] The refugee situation has created

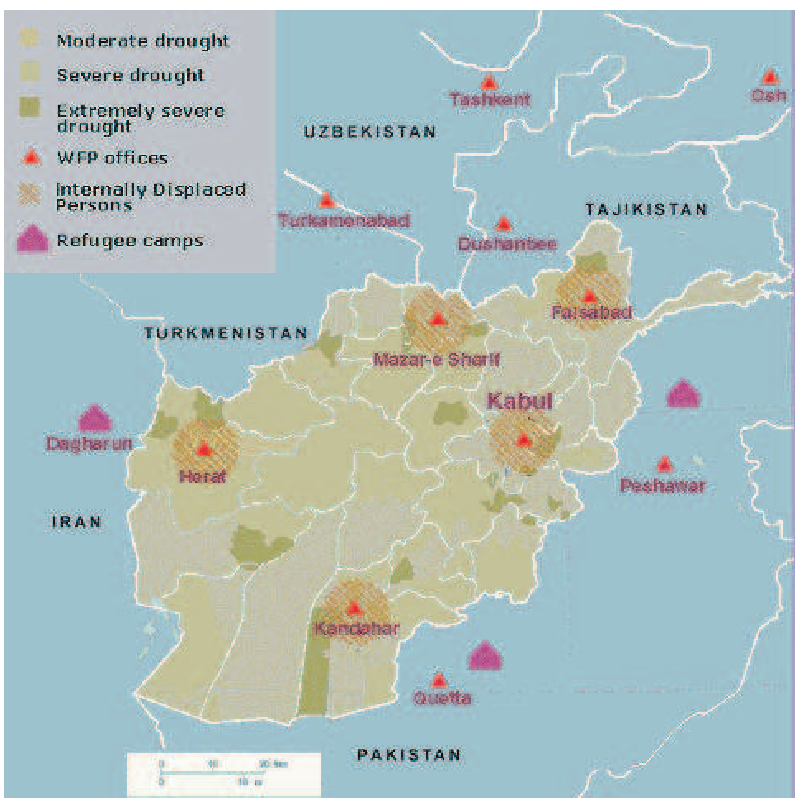


Figure 3. *Afghanistan: Drought and Internally Displaced Persons (Source: World Food Program, October 2001).*

a delicate problem for the Pakistan government, both politically and economically, particularly in the wake of ongoing political instability.

1.4 Tajikistan

As of spring 2001, 1.2 million people were at risk of famine in Tajikistan, which is suffering the worst drought in 74 years.[14] The country has suffered two successive years of drought and a failed harvest in 2000 and 2001. This has impacted an estimated 3 million people, or half the country's population.

Tajikistan is a land-locked country, and only 7% of its land is arable, but agriculture sustains over 60% of the population. In 2001, approximately half of Tajikistan's grain crops failed.[15] Cereal production dropped to 15% below 2000 levels, threatening the country's food security. The drought has also impacted the already stressed public health infrastructure. Only 35% of the rural population has access to safe drinking water. Deaths resulting from diarrhea are the largest cause of both infant and adult morbidity in Tajikistan.[16] With roughly 80% of the population living below the poverty line, the food shortages, loss of livestock, and diseases resulting from the drought have resulted in a national crisis.

CENTRAL AND SOUTHWEST ASIA DROUGHT
Answers to Key Questions

How severe is the drought?
Central and Southwest Asia represent the largest region of persistent and severe drought around the globe over the past three years. In parts of Iran, Afghanistan, Pakistan and Tajikistan, the ongoing drought is the worst to hit the region over the past 50-100 years.

What is causing the drought?
Has El Niño played a role?
There is some evidence that the current drought is related to the combination of prolonged La Niña conditions in the eastern and central equatorial Pacific and unusually warm water in the western Pacific Ocean.

Is the drought related to global climate change?
Globally, increased surface temperatures were observed during the drought period, although it is not clear whether this is a result of natural climate variability or related to anthropogenic causes. Increased surface temperature causes increased evaporation, thereby exacerbating drought. According to the 1998 assessment of The Regional Impacts of Climate Change by the Intergovernmental Panel on Climate Change (IPCC) higher temperatures can also affect the amount and timing of snowmelt and river flow in this region. In addition, global warming could affect the role the tropical oceans play in the climate of Central and Southwest Asia as well as the character of winter storms that currently supply the majority of cold season precipitation in the region.

How long will the drought continue?
With the continued weakening of the La Niña during 2001, conditions may be favorable for a return towards normal precipitation in Central and Southwest Asia. The IRI seasonal climate forecast produced in October 2001 indicates an equal likelihood of above-, near-, or below-average precipitation for the region during winter 2001-2002.

Effects of the drought will likely persist for several years, even if precipitation returns to normal levels. Severely depleted soil moisture and water supplies will take time to recover. In addition, extremely dry soil is also prone to flash-flooding with the return of rainfall. Ongoing issues of population increase and movement, as well as land-use change will likely continue to affect the region.

2. THE CLIMATE PERSPECTIVE

The climate of Central and Southwest Asia ranges from steppe to desert, with large areas of the region receiving little to no precipitation. The spatial distribution of annual precipitation is shown in Figure 4, with monthly totals provided for representative stations. In Iran and Afghanistan, the precipitation primarily falls as winter storms moving eastward from the Mediterranean, with the high mountains of the region intercepting most of the water and the interior high plains left with large stretches of barren desert. This wintertime precipitation generally occurs between the months of November and April. Much of the precipitation falls as snow in the higher elevations and the timing and amount of snowmelt is an important factor in the irrigated agriculture prevalent in the region. In eastern Pakistan, the primary rainfall season is summer, associated with the northernmost advance of the Asian monsoon.

The monsoonal system results in a summertime maximum in precipitation in the northern mountain regions of Pakistan but generally suppresses rainfall over Iran and Afghanistan. In summer, dust storms are prevalent through much of the region and are often associated with the “wind of 120 days”, the highly persistent winds of the warm season which blow from north to south. These storms occur throughout the year in the desert high plains.

The land cover and land use patterns in the region are shown in Figure 5. With the exception of the irrigated Indus Valley in Pakistan, the cropland/pasture and forest areas correspond roughly with regions that receive the most rainfall: the west side of the Zagros mountains in western Iran, the north side of the Albroz mountains in northern Iran, and the slopes of the Hindu Kush in Afghanistan.

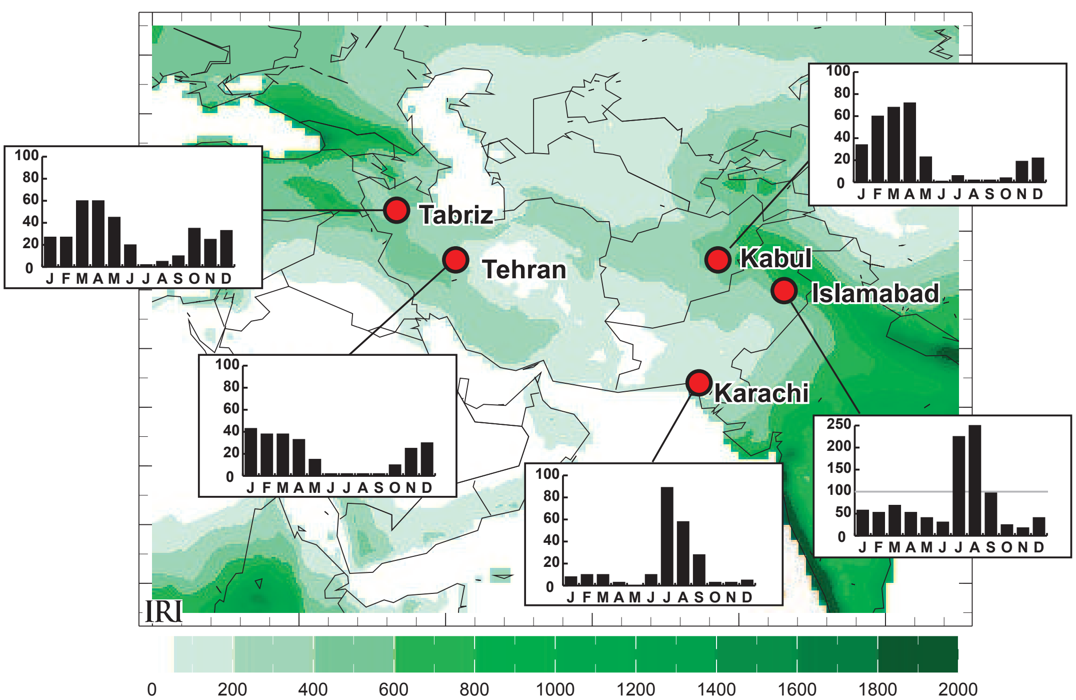


Figure 4. *Annual precipitation (mm) in Central and Southwest Asia.*

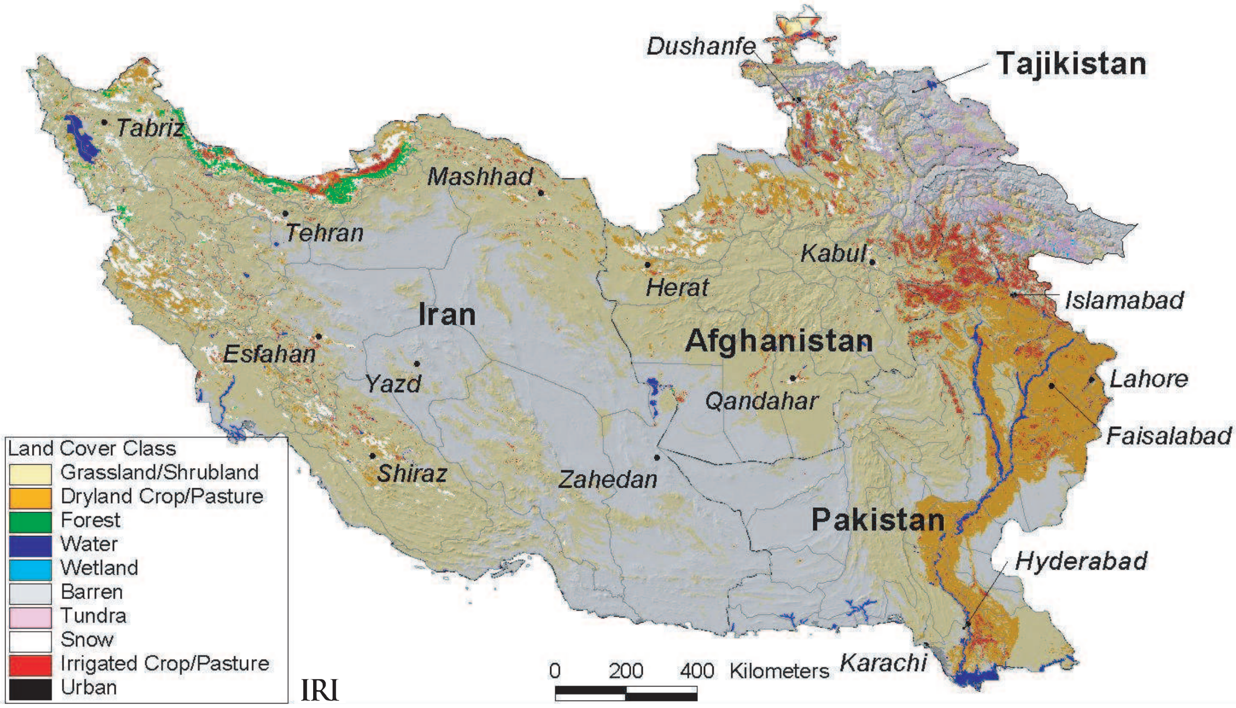


Figure 5. *Land cover and topography map of Central and Southwest Asia.*

2.1. Precipitation Deficits

The intensity of the drought in Central and South West Asia has varied across the region. However, the overall drought pattern has been remarkably persistent over the past three years, as shown earlier in Figure 1.

Both the historical perspective and the small-scale structure of the drought are difficult to confidently assess, as precipitation data for the region is meager and difficult to obtain. There were two types of precipitation data available for this study: a long-term (50+ years), gridded dataset[17] based on land station observations that ends in 1996 before the drought onset; and a shorter (22 years) but current dataset[18] based on a blend of station observations and remotely sensed data that is continuously updated. Given these data concerns, this analysis should only be considered at the country level and larger. Both collection of historical data and improvements to the real-time observing network in this region would greatly aid efforts to understand and mitigate the effects of the drought.

To place the current drought in historical context we take a regional view by considering precipitation departures from the long-term average for the entire drought region (25-42N, 42-70E). Figure 6 indicates the departure of monthly precipitation from the long-term average for the period 1950-2001. In terms of both its duration and magnitude, this figure indicates that the drought which started in 1999 is the most severe for the region in the past fifty years.

In addition to the precipitation deficits for a given month, the recent history of deficits is important, as the accumulation of water maintains river flows, lakes, and moisture in the soils. Figure 7 displays the accumulated rainfall surplus or deficit averaged over the entire region for the period January 1998-August 2001. As seen in the figure, regionally averaged moisture deficits first began to emerge during late 1998. These deficits have continued to increase through the period covered in this figure, and have had a profound impact on the local

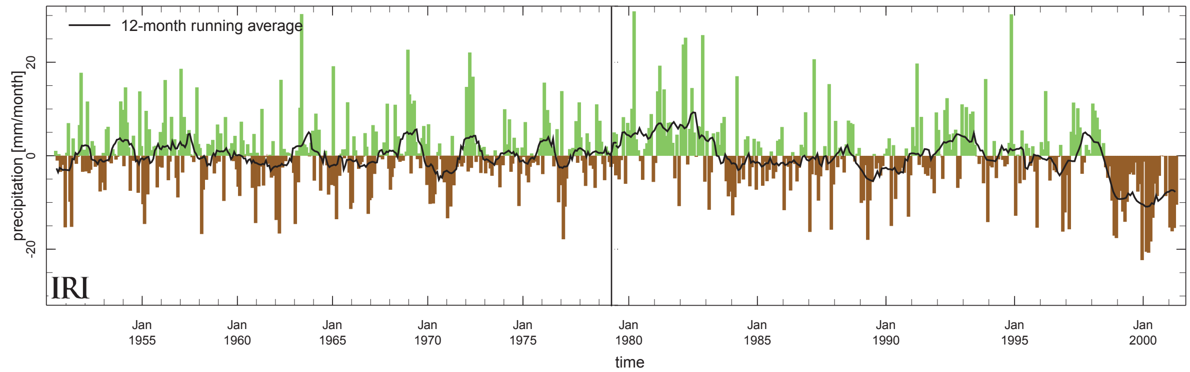


Figure 6. *Precipitation Anomalies: Monthly precipitation departures from the historical average over Central and Southwest Asia (over 25N-42N; 42E-70E), from Jan.1950 - Sep. 2001.*

hydrology resulting in acute water shortages in many areas.

2.2 Relationship with Large Scale Climate Anomalies

The onset and evolution of the drought has occurred in association with changes in rainfall, temperature, and winds across large areas of the Indian and Pacific Oceans. Additionally, long-term warming trends in global temperatures have been prominent during the drought period and may have played a contributing role. Some of the recent climate anomalies, such as those in the central Pacific, are consistent with well-known natural variations of the climate. Other aspects, however, such as the warmer-than-average surface temperatures over the continents and much of the global ocean, are not as well understood and may be either natural decadal-scale fluctuations or related to anthropogenic greenhouse warming.

The El Niño phenomenon is a well-known source of seasonal climate variability. Characterized by anomalously warm waters in the tropical Pacific, El Niño, and its cold-water counterpart La Niña alter ocean currents, winds, temperature and rainfall patterns, and are second only to the seasons themselves in terms of their influence on global climate patterns. The period 1998-2001 has been characterized by prolonged La Niña conditions and, while drought in Central and Southwest Asia is not typically associated with La Niña, other factors may have modified the usual pattern of La Niña climate impacts in this region. Figure 8 shows

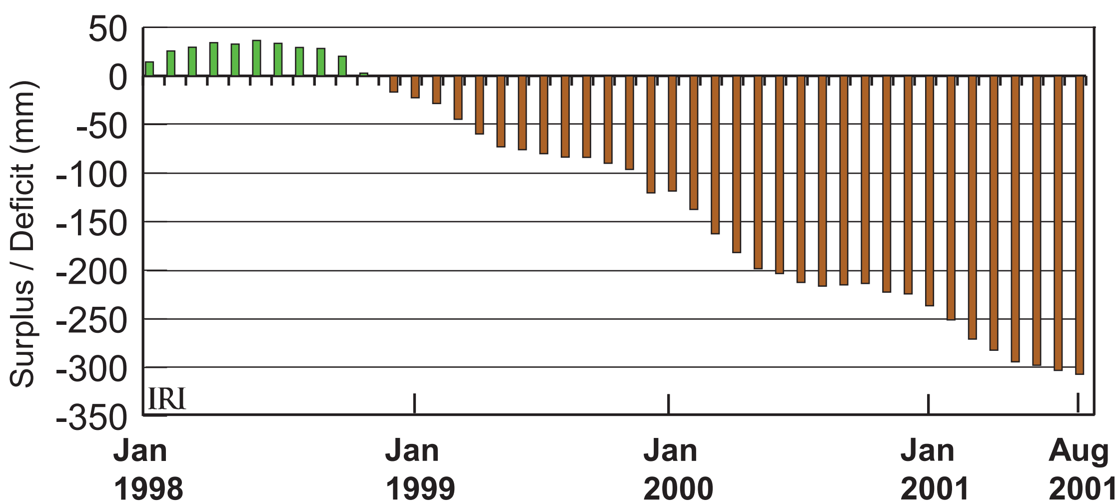


Figure 7. *Accumulated area averaged precipitation surplus (green) or deficit (brown) for Central and Southwest Asia (25N-42N; 42E-70E) from January 1998-August 2001.*

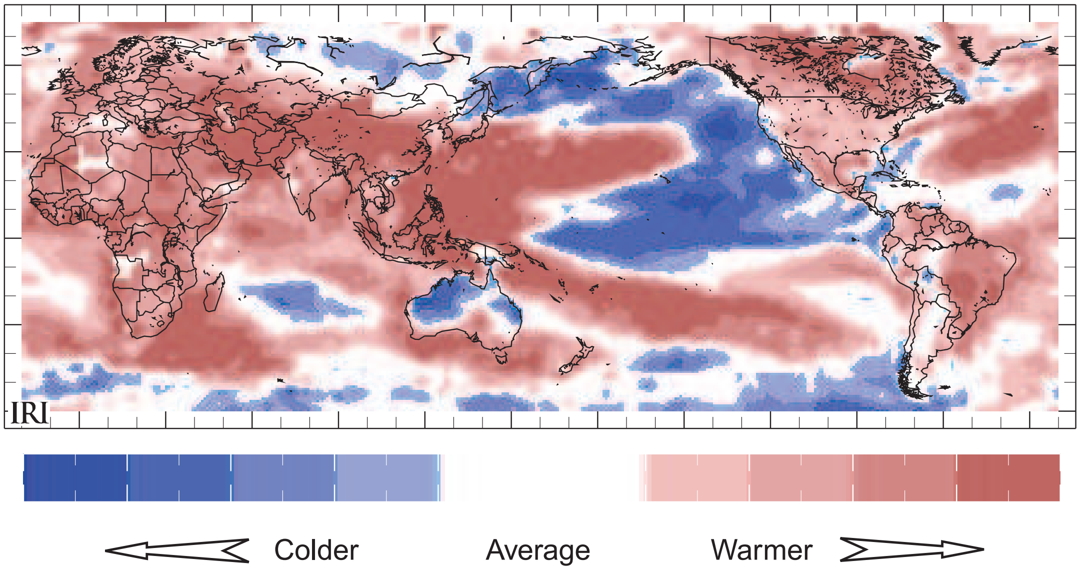


Figure 8. *Average November-April land and ocean temperature anomalies for years 1998-99, 1999-00, and 2000-01.*[19]

the surface temperature anomalies during the drought period: the colder-than-average temperatures in the central Pacific and, to some degree, the warmer-than-average temperatures in the western Pacific are associated with the La Niña. However, the areal extent of unusually high temperatures is generally not associated with La Niña. Warmer than normal temperatures in an arid region such as Central and Southwest Asia can exacerbate drought by increasing evaporation at the surface and thereby reducing soil moisture and water levels in lakes and reservoirs. The relationship between the drought and the regional and large-scale climate is the focus of current research efforts at IRI.

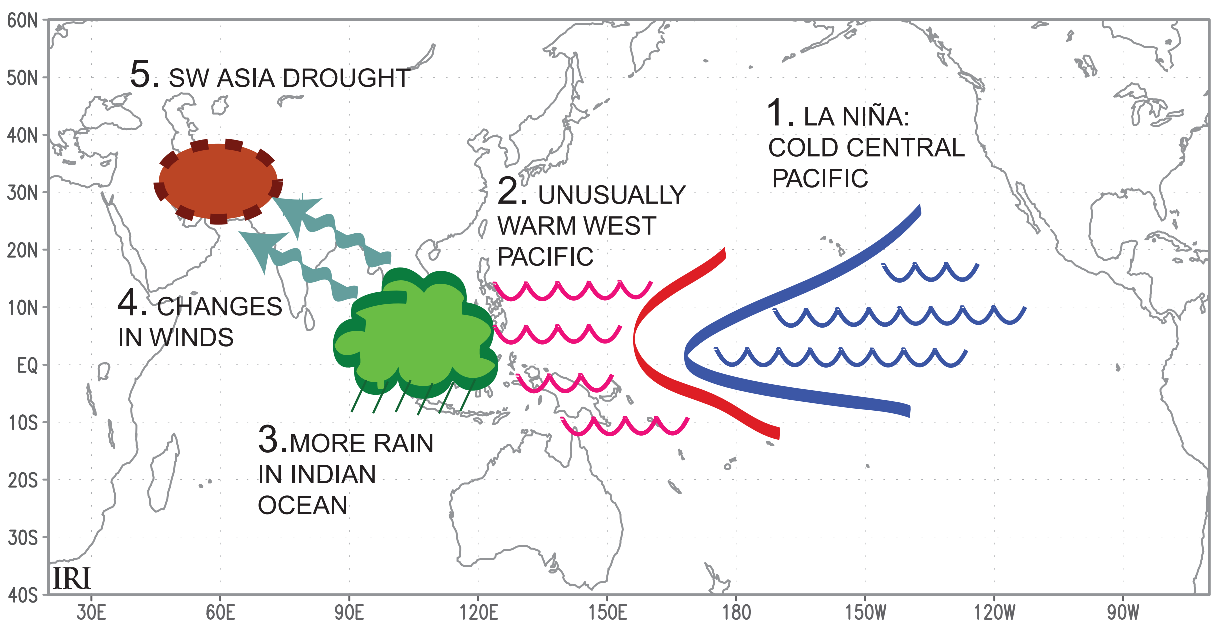


Figure 9. *Proposed mechanism for drought in Central and Southwest Asia.*

2.3 Ongoing Research on Drought Mechanism

As part of IRI's response to the severe drought in Central and Southwest Asia, a research effort was begun in spring of 2001. An analysis of the drought and potential causes of it will appear shortly in a peer reviewed scientific journal.[20] These findings should be interpreted with caution given their preliminary nature.

La Niña conditions prevailed from 1998-2001, in close correspondence with the onset and persistence of the drought. In addition, there were unusually warm waters in the western Pacific. It appears that the combination of these warm waters with the cold La Niña waters in the central Pacific can result in rainfall increases over the Indian ocean, changes in the Asia jet stream, and precipitation deficits over Central and Southwest Asia (Figure 9).

While the underlying dynamics of this relationship require further investigation, the proposed link between the drought in Central and Southwest Asia and ocean temperatures suggests a measure of predictability. As of November 2001, the majority of ocean forecasts do not call for La Niña conditions for the upcoming winter; if La Niña is a critical link in the drought mechanism, the absence of La Niña conditions may allow a return toward more normal conditions in the region. Over the next several years, if warm temperatures persist in the western Pacific, as part of a trend or slow natural fluctuation, these could work in synergy with future La Niña events to result in drought conditions in Central and Southwest Asia.

Due to the chaotic nature of the atmosphere, detailed forecasts of weather sequences are not possible for longer than about 10 days. Despite this, there can be a source of predictability for seasonal climate arising from interactions between the atmosphere and more slowly evolving components of the earth's climate system - the land surface, and especially the ocean surface conditions. These more slowly evolving "boundary conditions" can affect the atmosphere in the sense of shifting the likelihood of particular patterns of precipitation and temperature for certain regions and seasons. Seasonal forecasts should be considered as probabilistic forecasts; generally they are presented as such. Because land and ocean conditions themselves have variable predictability in many regions and scenarios, the potential predictability of seasonal climate also varies. The area of interest here - Central and Southwest Asia, appears to have very modest predictability in general.

IRI seasonal climate forecasts are based upon models and outputs produced locally and at collaborating centers worldwide. A two-tiered approach is followed in making these forecasts. First, mathematical models use observational data on ocean temperatures and atmospheric conditions to forecast surface temperatures in the tropical oceans. Next, this information serves as input to other models to predict regional temperature and precipitation patterns worldwide for the upcoming three-month season. The seasonal climate forecasts of the IRI are presented in terms of probabilities that the total precipitation (or average temperature) for three-month seasons over a particular region will fall into three tercile categories: the wettest or warmest third of years (above-normal), the middle third of years (normal), and the driest or coolest third (below-normal), as defined from the thirty year historical climate record for that region. The most recent IRI forecasts for Central and Southwest Asia were issued in October 2001, and are for four overlapping three month seasons: November 2001- January 2002; December 2001-February 2002; January 2002-March 2002; and February 2002-April 2002.

3.1 Precipitation Forecast

The IRI precipitation forecast for the period November 2001-January 2002 is for equal likelihood of experiencing above-, near-, or below- normal seasonal precipitation for much of Central and Southwest Asia, as depicted by the absence of color on the maps shown in Figures 10a, 10b and 10c.There are however slightly enhanced probabilities for above normal rainfall in southwestern Iran, southeast Iraq, and the northern part of Saudi Arabia (Figure 10a). This region of enhanced probabilities for above normal precipitation becomes somewhat more pronounced for the periods December 2001-February 2002 (Figure 10b), and January 2002-March 2002 (Figure 10c).

The skill of the IRI's precipitation forecasts for Central and Southwest Asia over the last three winters has been slightly above the chance level. In winter 1997- 98, the forecast was quite skillful due to the presence of a strong El Niño and knowledge of its likely climate impacts. In the following two winters skill was only marginally better than chance and the multi-winter drought was under-forecast. Although current forecasting skill for the region is modest, additional forecasting tools are under development that may improve forecast quality.

Equal likelihood or "climatology" forecasts for Central and Southwest Asia for winter 2001-2002 are less dire than forecasts indicating enhanced probabilities for below normal precipitation. These precipitation forecasts however are critically dependent on the evolution of temperatures in the tropical oceans during winter 2001-2002. Although both the

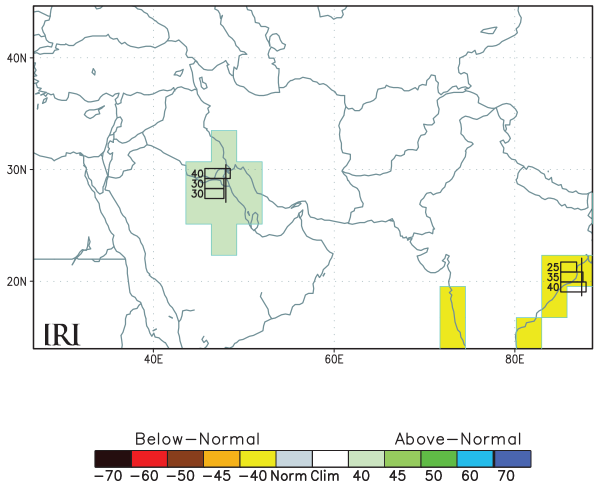


Figure 10a. *IRI seasonal precipitation forecasts November 2001- January 2002*

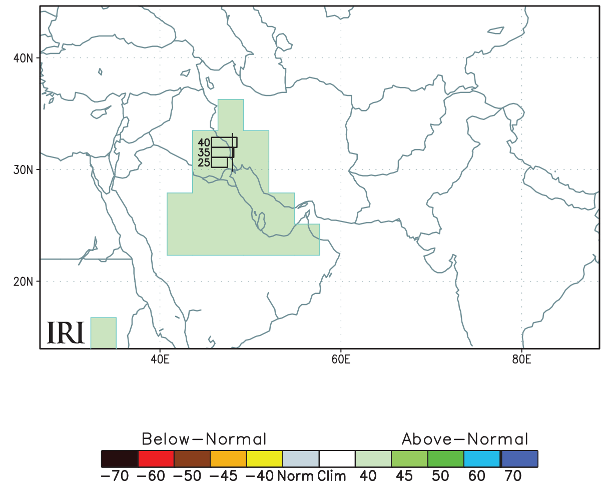


Figure 10b. *IRI seasonal precipitation forecasts December 2001-February 2002*

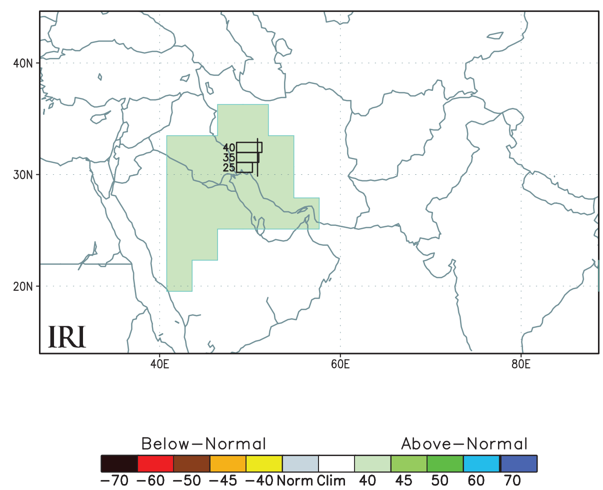


Figure 10c. *IRI seasonal precipitation forecasts January 2002-March 2002.*

western Pacific and the far eastern Indian Ocean have warmer than normal surface temperatures as of November 2001, mathematical models are currently forecasting approximately near-normal surface temperatures in the coming winter months. This is the most important reason why the forecasts for precipitation in much of Central and Southwest Asia are for equal likelihood of above-, near-, or below normal precipitation. However, skill in forecasting ocean surface temperatures is very limited under prevailing conditions, which include the absence of a pronounced El Niño or La Niña signal. In fact, if far-west Pacific and eastern Indian Ocean surface temperatures ocean temperatures do not cool as predicted and continue to remain warm in the coming months, then there is a possibility for continued dry conditions in Central and Southwest Asia.

3.2 Temperature Forecast

The temperature forecasts for Central and Southwest Asia show a more pronounced and widespread signal. The November 2001-January 2002 forecast indicates slightly enhanced probabilities for above normal temperatures throughout Pakistan and parts of western and southeastern Iran (Figure 11a). The December 2001-February 2002 (Figure 11b) and January 2002-March 2002 (Figure 11c) forecasts indicate enhanced probabilities for above normal temperatures through much of the drought affected region, including Pakistan, southern Afghanistan, and most of Iran. Therefore, there is an increased likelihood for a milder than normal winter. Above average winter temperatures might also result in increased snowmelt and may contribute to higher river flows. However, it should be noted that there has been a trend toward warmer winter temperatures in southwestern Asia over recent years, and the last several years have all been warmer than normal. Such a warming trend is not limited to southwestern Asia but has been seen in large portions of the globe and may be related to global climate change.

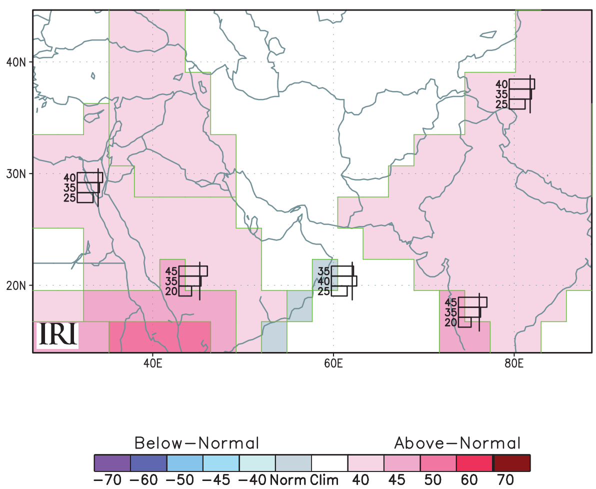


Figure 11a. *IRI seasonal temperature forecasts November 2001- January 2002*

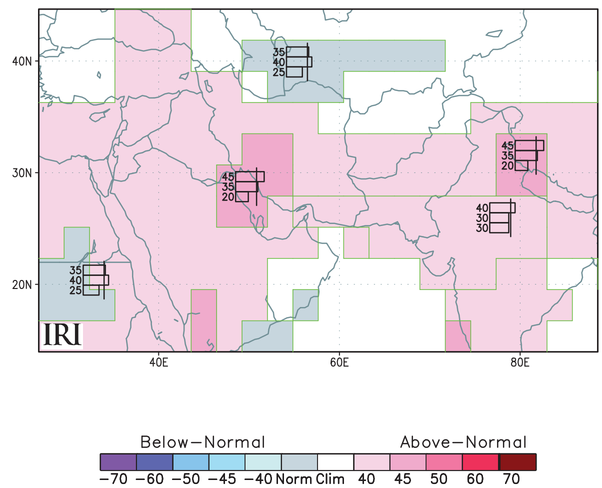


Figure 11b. *IRI seasonal temperature forecasts December 2001-February 2002*

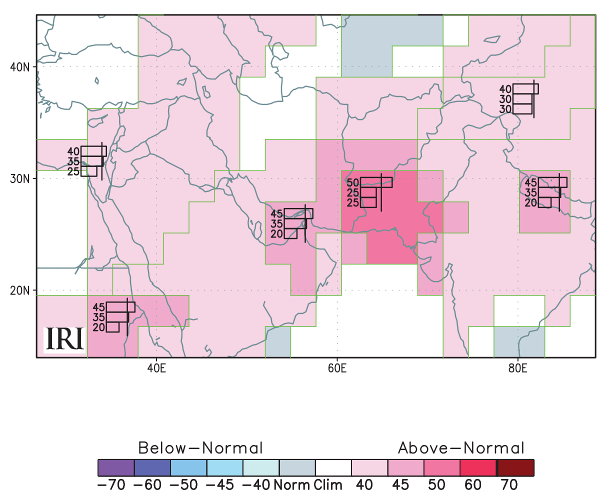


Figure 11c. *IRI seasonal temperature forecasts January 2002-March 2002.*

LOOKING FORWARD

This report has provided an assessment of the severity and potential causes of the drought in Central and Southwest Asia. Precipitation and temperature forecasts for winter 2001-2002 based upon an assessment of state-of-the-art climate models and available observational data are provided for potential use in drought mitigation strategies and the allocation of humanitarian aid. All aspects of climate information presented in this report - historical analysis, real time monitoring, and seasonal forecasts - bear upon the situation in Central and Southwest Asia.

Seasonal climate forecasts for this region (and the rest of the world) are produced by the IRI at the end of each month throughout the year and can be accessed over the internet for up to date information.[21] This report points to the potential climatic influence of the far west Pacific and eastern Indian Oceans that have received considerably less attention than the central Pacific where the El Niño phenomenon originates. Further research and the development of better models to forecast the evolution of sea surface temperatures in these oceans will be critical in improving our ability to forecast seasonal climate patterns in Central and Southwest Asia.

Given the magnitude and persistence of this drought, severe impacts such as degradation of soil and vegetation, increased vulnerability to flooding (as evidenced in northeastern Iran in May 2001), and depletion in ground water stocks will likely persist even after a return to normal precipitation. The political instability in the region and social and economic pressures may exacerbate these impacts.

Effective use of climate information in drought management and response for Central and Southwest Asia will require a sustained interaction between climate analysts, impacts specialists, local planners and humanitarian relief agencies. There is also an urgent need to improve the climate observational network in the region, as well as mechanisms for the timely availability of such data for input into climate forecasting.

References

[1]"Iran - Drought OCHA Situation Report No. 5." Ref: OCHA/GVA - 2000/0227. 15 December 2000.
[2] "Despair on Iran's dusty plains, International Federation of Red Cross and Red Crescent Societies. 19 July 2001.
[3] "United Nations Inter-agency Assessment Report on the Extreme Drought in the Islamic Republic of Iran," UN Country Team in Iran. July 2001.
[4]op cit.
[5]"Drought in central, southern Asia affects 60 million people: WFP," Agence France-Presse, 19 Jul 2000.
[6]"Afghanistan - Complex Emergency Situation Report #1 (FY2001). September 6, 2001. U.S. AID; Bureau for Humanitarian Response; Office of U.S. Foreign Disaster Assistance.
[7]C. Lazaroff "Drought in Afghanistan Threatens Millions". Environment News Service, June 6, 2000.
[8]Joint WPM/FAO Press Release #01/37: "Millions of Afghans Face Starvation as Crops Fail." June 8, 2001.
[9]FAO/WFP Crop and Food Supply Assessment Mission, May 2001.
[10]"WFP to resume food aid shipments to Afghanistan," WFP Press Release, September 25, 2001.
[11]2001 Drought Assessment Report on Pakistan, 23 May-18 June 2001, FAO and WFP with UNDP.
[12] Resident Coordinator of the United Nations System's Operational Activities for Development in Pakistan. Drought - Pakistan. Update No. 12. 8 June 2001.
[13]"Urgent funding needed for large scale displacement in Afghanistan," UN OCHA Press Release. July 12, 2001
[14]"Warning of famine in Tajikistan, UN appeals for some $77 million for drought aid." 19 September 2000.
[15]"Millions of people in East Asia hit by heavy monsoon rains as Central Asia is gripped by drought; Near East reels from three consecutive years of drought," FAO Press Release 01/63. 28 September 2001.
[16] "Tajikistan: One million people face starvation." UN OCHA Regional Information Network for Central Asia. 29 August 2001.
[17] Data from the Climate Research Unit, University of East Anglia.
[18] Data from the US Climate Prediction Center of the National Centers for Environmental Prediction.
[19] Data from the Climate Anomaly Monitoring System (CAMS), US Climate Prediction Center.
[20] M. Barlow, H. Cullen, and B. Lyon: "Drought in Central and Southwest Asia: La Niña, the warm pool, and Indian Ocean precipitation", IRI contribution IRI-PP/01/22. Accepted as a Journal of Climate Letter, November 2001.
[21]http://iri.columbia.edu/climate/forecast/net_asmt/

INTERNATIONAL RESEARCH INSTITUTE
FOR CLIMATE PREDICTION
Lamont-Doherty Earth Observatory of Columbia University
61 Route 9W
Palisades, NY 10964-8000 USA
Phone: 845-680-4468
Fax: 845-680-4866
http://iri.columbia.edu
E-mail: swasia@iri.columbia.edu