China's Deserts

edited by

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Note: In PDF format most of the images in this web paper can be enlarged for greater detail.

Introduction

China, because of its size and unique plate tectonics, has some of the most extreme landforms of any continental land mass. The highest mountain and mountain range, Mount Everest and the Himalayas, are in China. It also has the largest and highest plateau in the world, the Tibetan Plateau, called the "roof of the world". Both the Himalayas and the Tibetan Plateau are still being formed by the collision of the Indian and Eurasian tectonic plates.

These landforms have in turn created some of the largest and most extreme deserts in the world. China has one the worlds largest desert basins, the Tarim Basin and the Taklimakan Desert just north of the Tibetan Plateau. It also has the tallest sand dunes, and the largest desert alluvial fan (playa) in the world. Both are located in the western portion of the Alxa Plateau in the Badain Jaran Desert of north central China.

One goal of this paper, beyond providing basic geographic information on China's deserts, is to show how the landforms of China have determined the location of China's arid lands. This, in turn, shows which areas are most prone to the problems of desertification and dust storms that have increasingly plagued China in recent years.

Web Reference
http://en.wikipedia.org/wiki/Geography_of_China

This web paper is part of a series of papers on global ecology. In addition to this paper the series includes:

Asian Air Pollution
http://fire.biol.wwu.edu/trent/alles/AirPollution.pdf

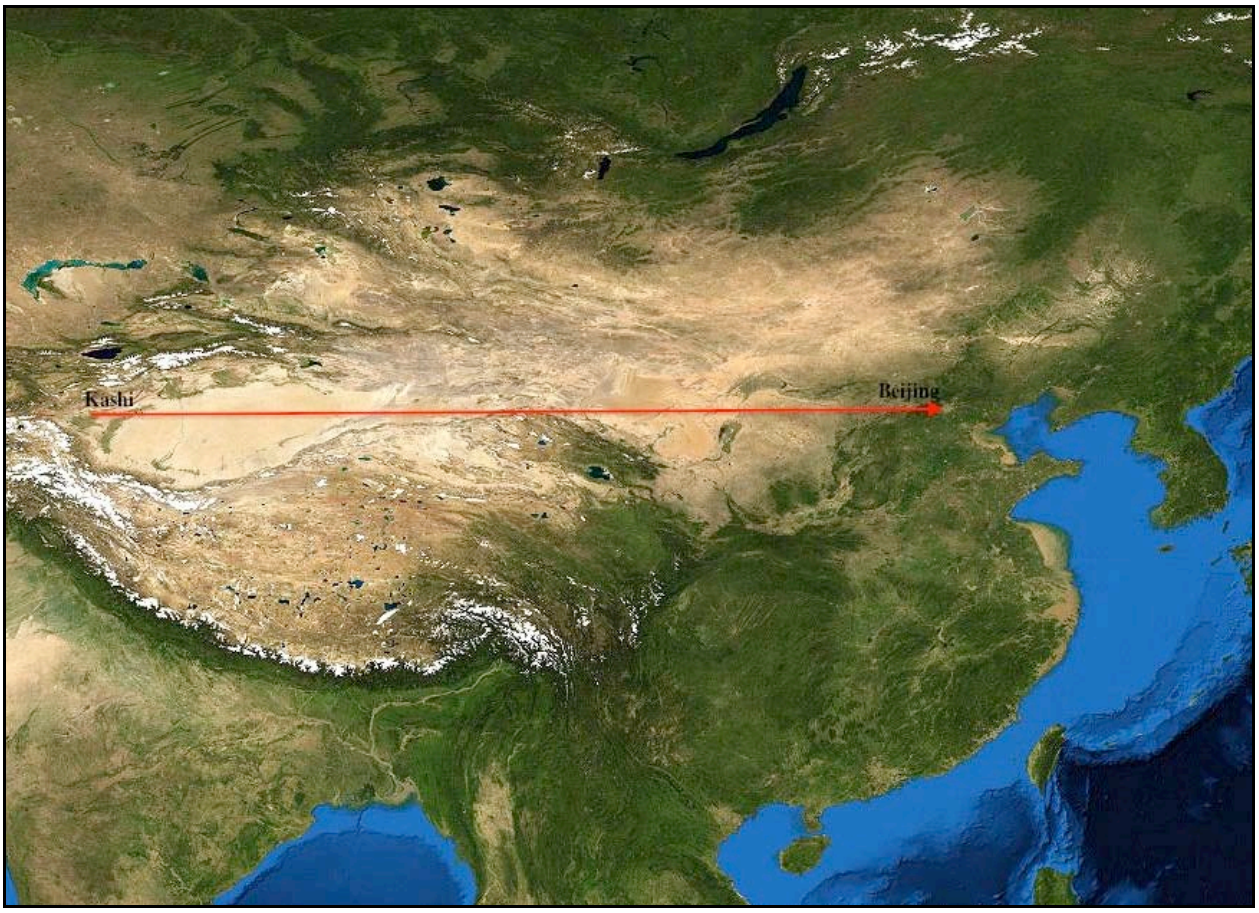
Freshwater Shortage and Desertification
http://fire.biol.wwu.edu/trent/alles/WaterShortage.pdf

Geomorphology and Dust Storms in China
http://fire.biol.wwu.edu/trent/alles/ChinaDust.pdf

The Aral Sea
http://fire.biol.wwu.edu/trent/alles/AralSea.pdf

The Colorado River: An Ecological Case Study
http://fire.biol.wwu.edu/trent/alles/ColoradoRiver.html

The common thread in all these papers is to show how complex coupled natural systems and human interactions have led to the ecological crises of our times.

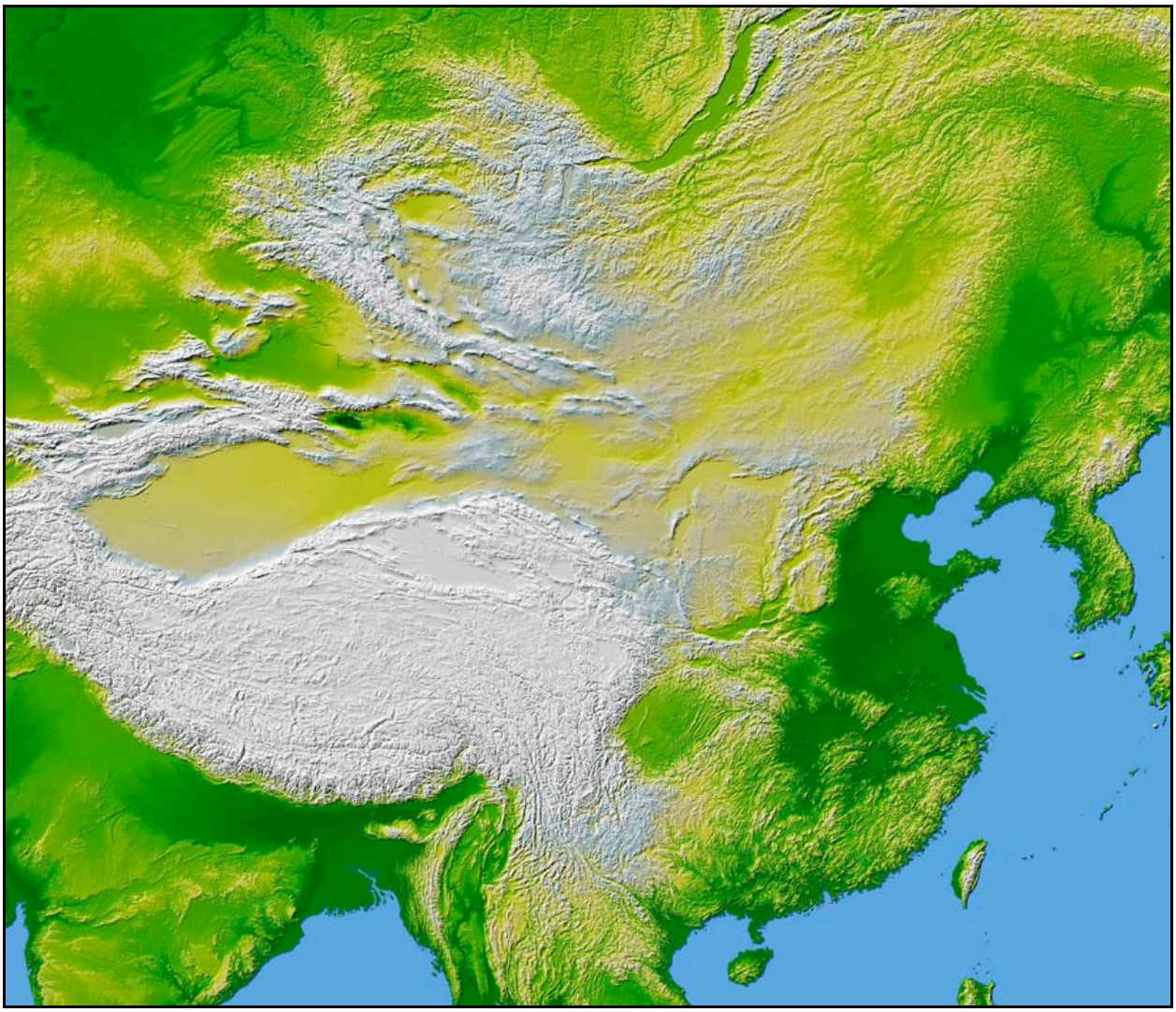


From Kashi to Beijing

Above is a true color satellite image that includes all of China and Mongolia. On a straight line running 40 degrees north latitude from west to east across the center of the image are the Taklimakan, Kumtag, Badain Jaran, Ulan Buh, and Hobq deserts in China (see Appendix One). The city of Kashi (Kashgar) (39.5N, 76E) at the far western end of the Taklimakan Desert sits at ~ 40 degrees north latitude as does the Lop Nur (Lop Nor) region (40N, 90.5E) at the eastern end. Far to the east of both, Beijing (39.9N, 116.4E) sits at the same latitude just east of the Taihang Mountains. As the crow flies the distance between Kashi and Beijing is ~ 3435 km (2135 mi).

(Note in this paper the degree symbol ° has been left out of latitude and longitude coordinates and decimal fractions of a degree used instead of minutes and seconds. And kilometers are abbreviated as km and miles as mi.)

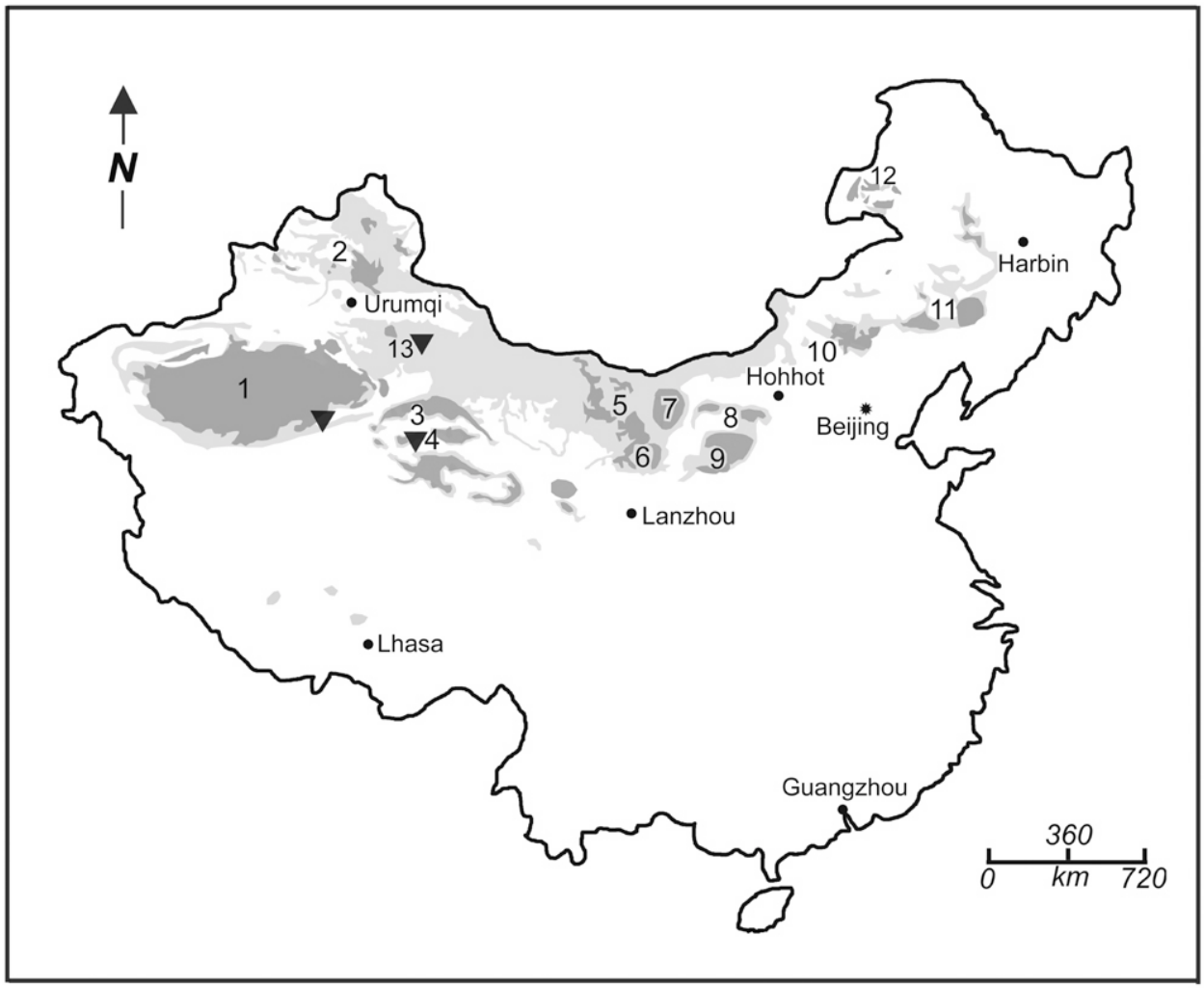
(2004 image courtesy of NASA's Blue Planet)



This topographic image of eastern Asia was generated with a global data set from the Shuttle Radar Topography Mission (SRTM). Color coding is directly related to height, with green at the lower elevations, rising through yellow and tan, to white at the highest elevations.

Note that a straight line from Kashi, at 1310 m (4300 ft) above sea level, east across the Taklimakan, through the Hexi Corridor, across the central deserts of China and the Ordos Plateau is almost flat. A portion of the northern Taihang Mountains comes next, then an abrupt drop in elevation (dark green) to Beijing at 44 m (145 ft) and the North China Plain most of which is less than 50 m (160 ft) above sea level.

Web Reference
http://earthobservatory.nasa.gov/IOTD/view.php?id=3741



Map of Sandy and Gobi Deserts (shamo) and Sandy Lands (shadi) in China

Dark gray — sandy deserts and lands; light gray — gobi deserts

1. Taklimakan Shamo; 2. Gurbantunggut Shamo; 3. Kumtag Shamo; 4. Qaidam Basin Shamo; 5. Badain Jaran Shamo; 6. Tengger Shamo; 7. Ulan Buh Shamo; 8. Hobq Shamo; 9. Mu Us Shadi; 10. Hunshandake Shadi; 11. Horqin Shadi; 12. Hulun Buir Shadi; and 13. Turpan Depression Shamo. (Deserts and sandy lands are numbered roughly according to size. Triangles identify study site locations.)

In China, if greater than 50% of an area is gravel or cobble plains, it is denoted as a gobi desert. All of the light gray areas along China's border with Mongolia can collectively be referred to as the central Gobi Desert in China. (Map and text from Warren-Rhodes, et al., 2007)

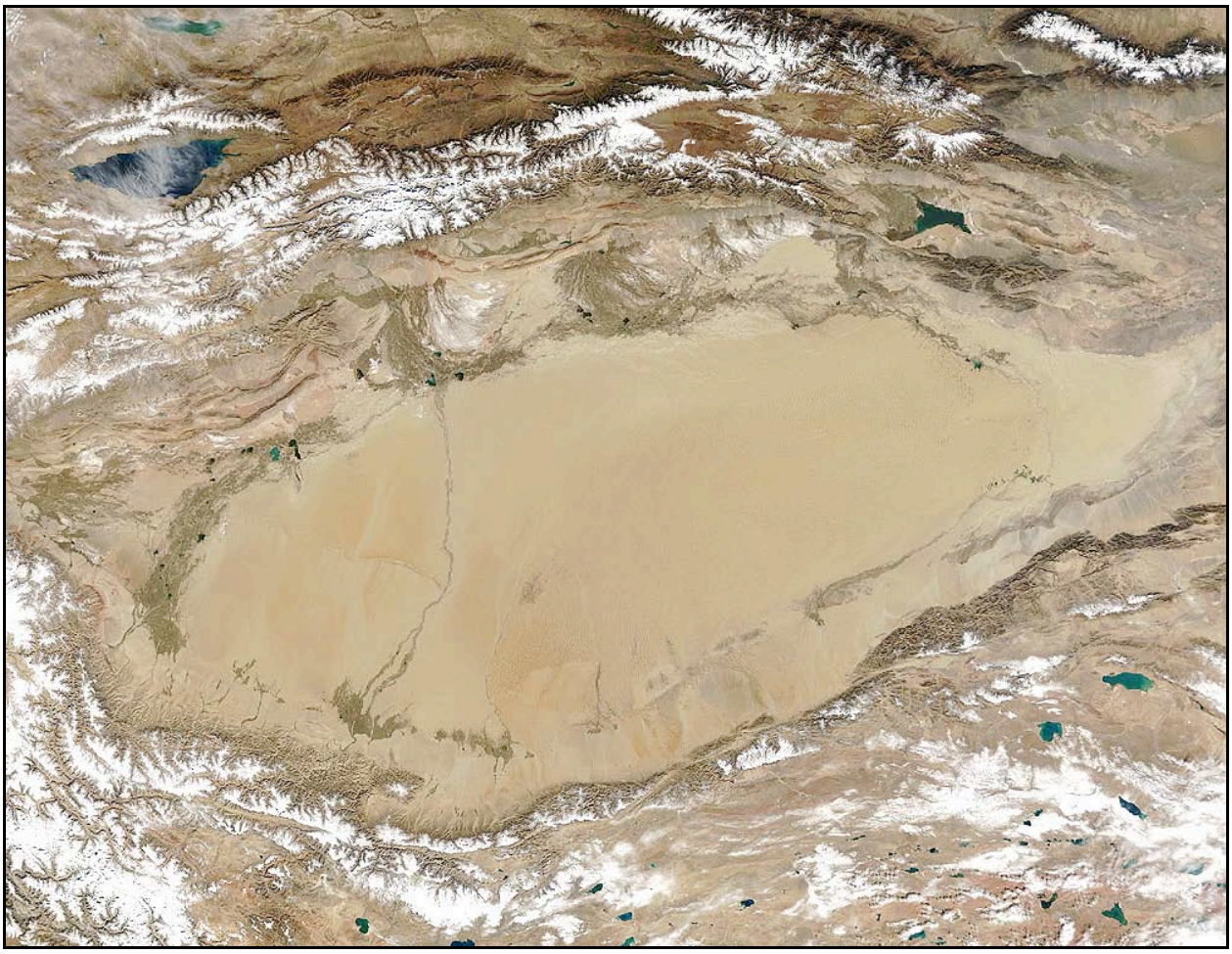
Web Reference

http://www.nasa.gov/centers/ames/multimedia/images/2007/chinadesert_feat.html

Above a NASA scientist collects samples in a gobi type desert in the southeast of the Turpan Depression. Gobi type deserts are erosion landforms. Their characteristics result from wind eroding sand and dust from the surface, leaving only gravel and bedrock. Gravel and cobble plains extend to the horizon in the image. Because it is contiguous with gobi type desert to the east, this area of the Turpan Depression can be categorized as part of the central Gobi Desert in China.

(Photograph courtesy of K. Warren-Rhodes, NASA)

Web Reference
http://www.nasa.gov/centers/ames/news/releases/2007/07_14AR.html

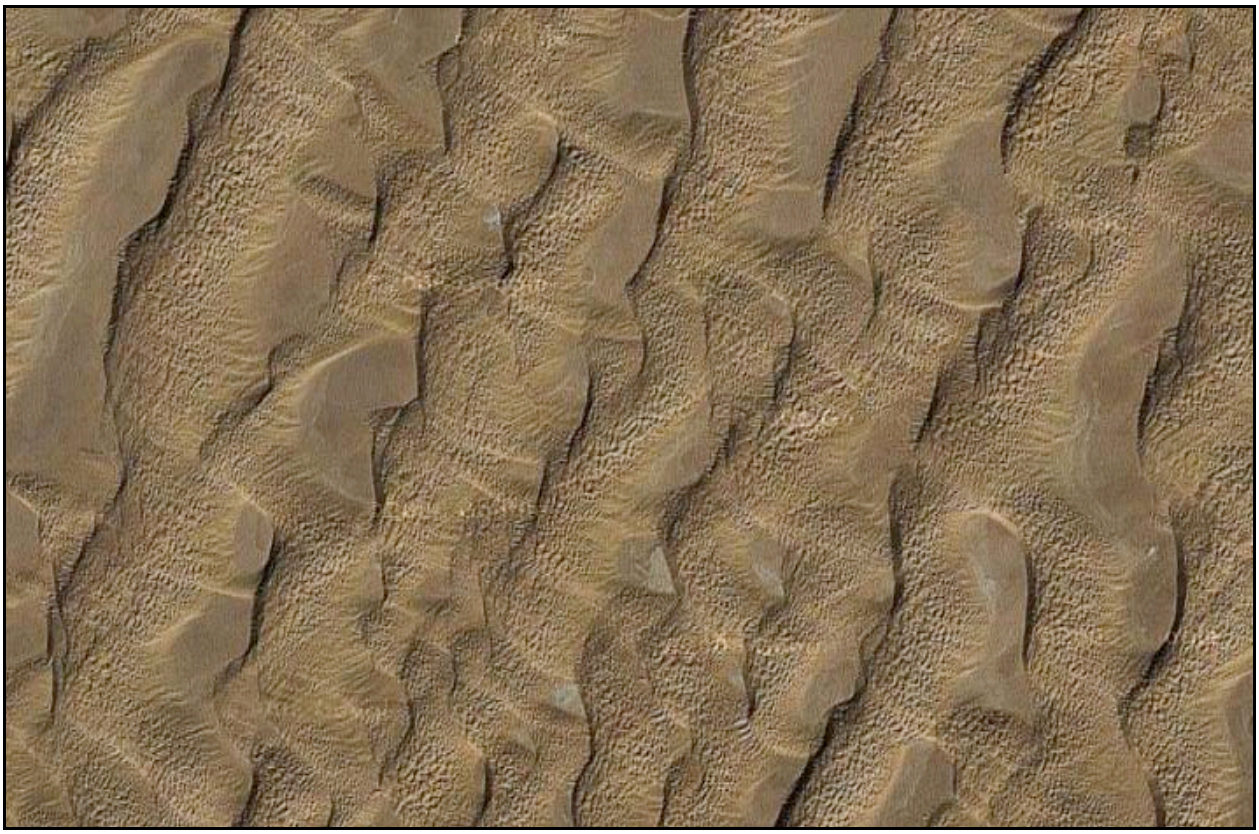


Desert 1 — The Taklimakan Shamo

The Taklimakan (Takla Makan) Desert, shown in this MODIS/Terra image acquired October 22, 2005, is one of the world's largest sandy wastes occupying an area of ~ 337,000 sq km (130,000 sq mi) in the Tarim Basin (Tarim Pendi) of northwest China (Sun & Liu, 2006) (Wang & Dong, 1994). Going straight across the Tarim Basin from the city of Kashi on the west to the Lop Nur region on the east is ~ 1220 km (760 mi). The desert is flanked by high mountain ranges including the Tian Shan (Tien Shan) to the north, the Kunlun and Altun mountains to the south, and the Pamirs to the west. The Turpan Depression is at the east end of the Tian Shan (top right corner).

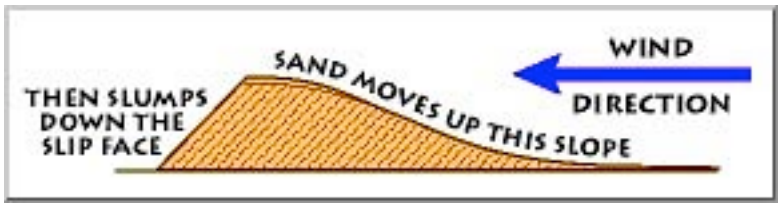
The Taklimakan Desert is a main source of atmospheric dust in Northern China. The next important sources are the central Gobi Desert and the deserts of the Alxa Plateau (Ala Shan) (Xuan & Sokolik, 2002).

Web Reference
http://en.wikipedia.org/wiki/Taklimakan_Desert



Sand Dunes in the Eastern Taklimakan Desert

The image above can only be understood, if you realizes that low angled light is coming from the bottom right, and that flat areas are the low areas between dunes. The dominant winds that formed these dunes are from the southeast. However, there is a strong component of "cross" dunes formed by northeast winds. This area is located at ~39.9N, 86.5E, ~340 km (212 mi) due west of Lop Nur at 40N, 90.5E. The resolution is what you would see if you were ~20 km. above the Earth.



References

Xunming Wang, et. al. (2002).

(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA)

The North-South Tarim Desert Highway S165/G315

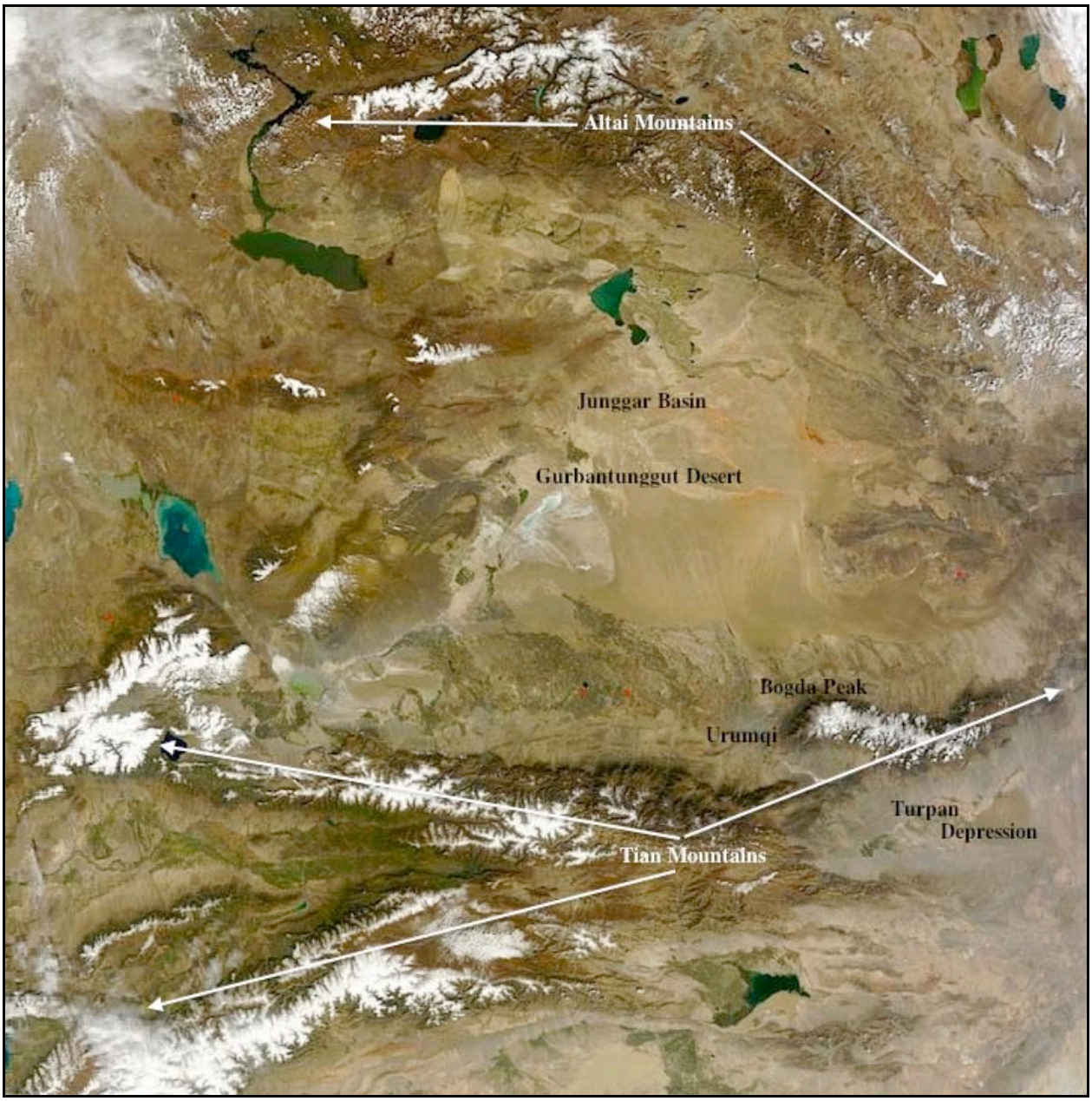
The Tarim Desert Highway, the first built across the Taklimakan, was opened to traffic in 1995. This amazing paved road gives access to the very heart of one of the world's most grueling deserts. At the time it was the longest highway crossing a mobile desert in the world. The ~500 km long highway cuts across the Taklimakan Desert from Luntai (41.78N, 84.24E) in the north to Niya (37.06N, 82.69E) in the south. The roadbed is made in four layers, plastic nets, cobblestone, sand, and asphalt.

In addition, shelterbelts have been built along sections of the highway to prevent shifting sand from burying the road. Started in 2003, the shelter belts are now larger than 3,128 hectares in total size. To water the shelter belts the Tarim Oilfield Company dug 114 wells, equipped them with generators and water pumps, and laid over 20,000 km of water pipes. Oil exploration is why the 500 km Tarim Highway was built.

Since its completion a second North-South Tarim Highway has been build west of S165/G315. Highway G217, starts at Hotan on the south side of the desert and follows the Hotan and Tarim Rivers across the Taklimakan to Kuqa on the north side of the desert.

North-South Tarim Desert Highway S165/G315 at 39.2N 83.7E

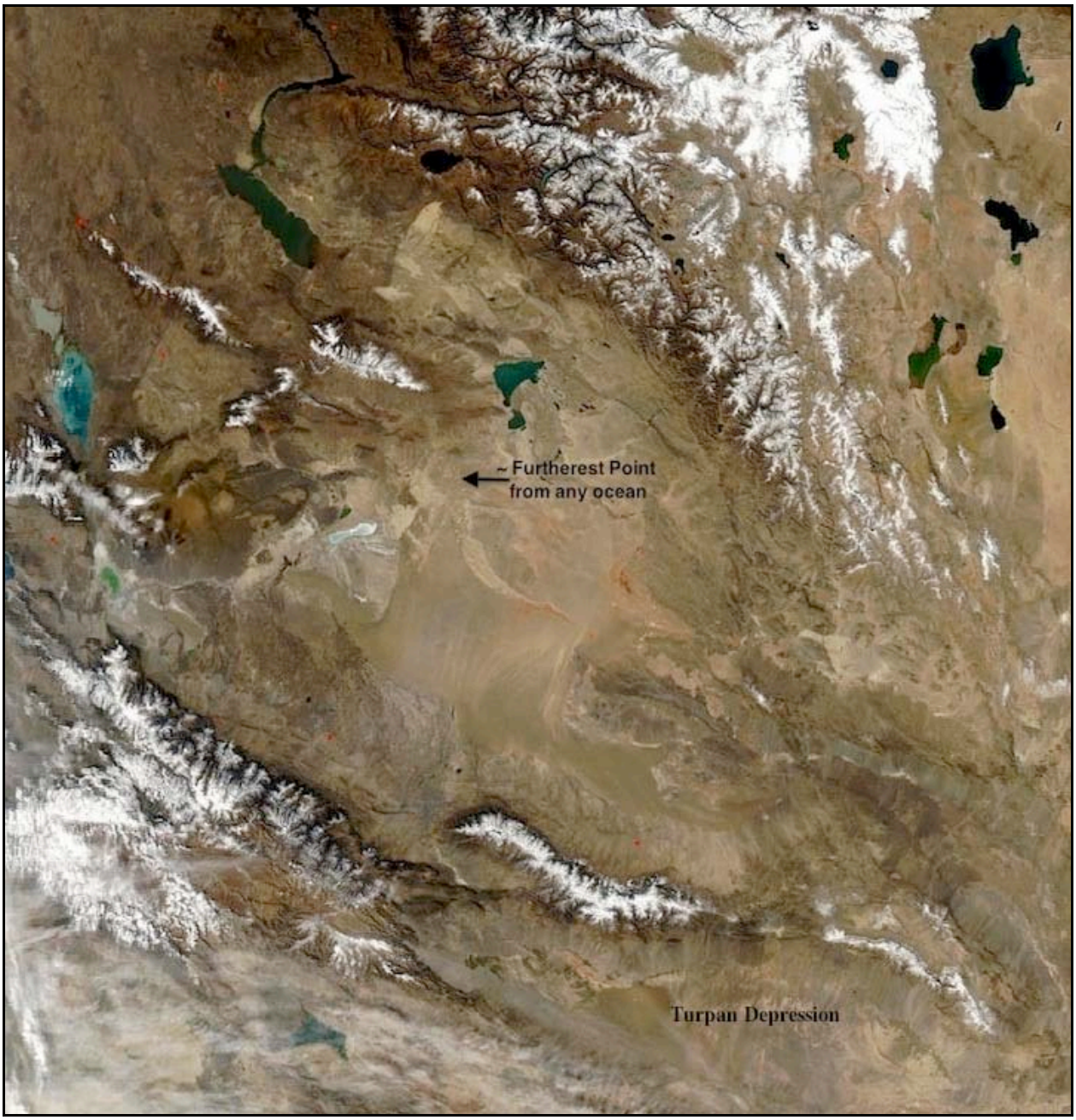
Sand Dunes Image by Carl Parker taken from S165/G315 at 39.2N 83.7E
http://www.panoramio.com/photo/1012738



Desert 2 — The Gurbantunggut Shamo in the Junggar Basin

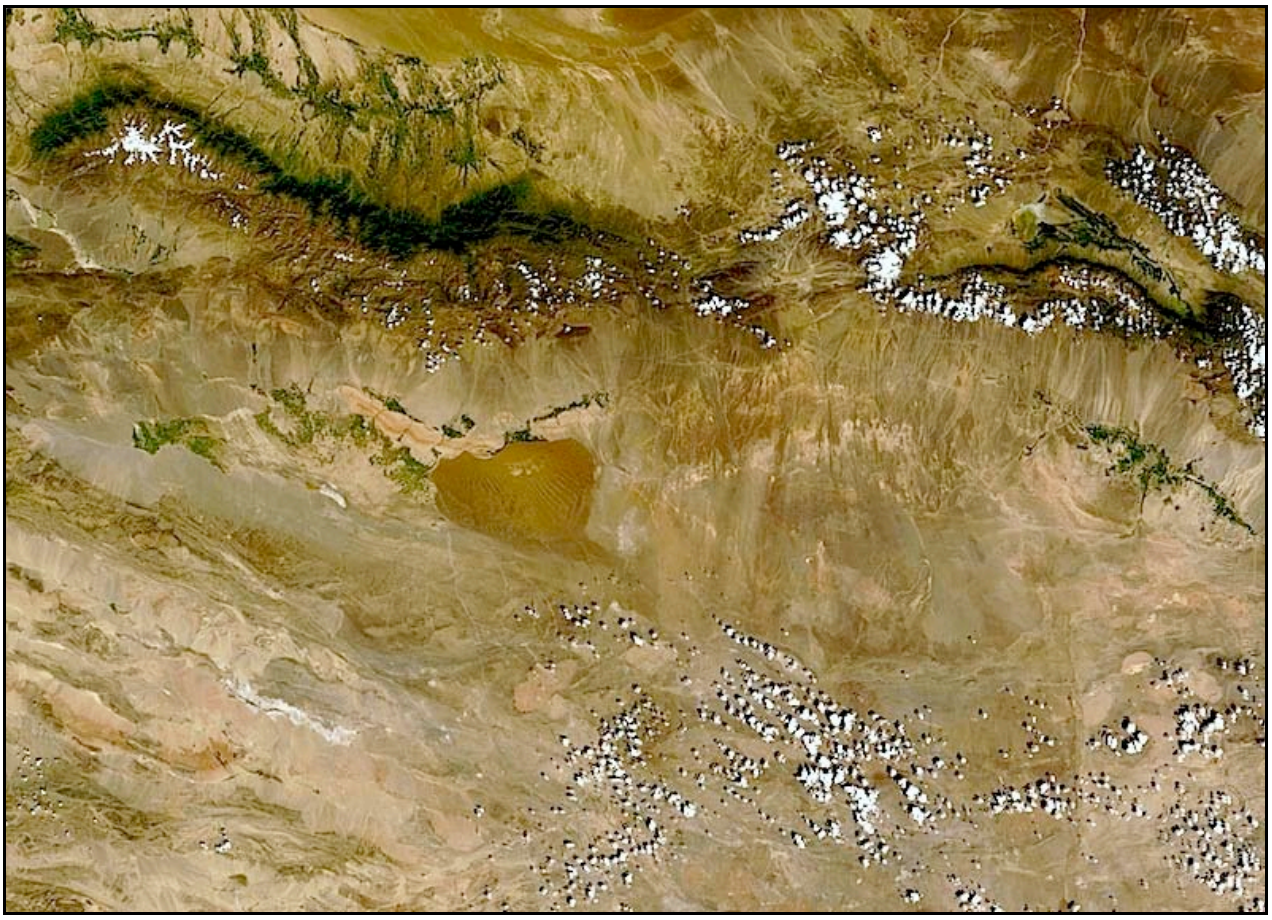
The Junggar Basin in northern Xinjiang is defined by the Tian Mountains on the south that run east-west across the lower portion of this image and the Altai Mountains on the north that run diagonally across the top. The Gurbantunggut Desert occupies a large portion of the Junggar Basin. The desert is approximately 50,000 sq km (19,000 sq mi), and located around 300 to 600 meters above sea level. It is China's second largest desert, after the Taklimakan. The Gurbantunggut Desert also contains the furthest point from any ocean bordering Eurasia.

(Unlabeled 2011-9-23 MODIS/Terra image courtesy of NASA)



The arrow above marks the Eurasian Pole of Inaccessibility or the furthest point from any ocean in Eurasia. The point is just southeast of a line from Karamay to Altay north of Urumqi. Each continent has its own Continental Pole of Inaccessibility, defined as the place on the continent that is farthest from any ocean. Of these continental points, the most remote is the **Eurasian Pole of Inaccessibility (or "EPIA") at 46.17N, 86.40E** in China's Gurbantunggut Desert near the Kazakhstan border. Calculations have commonly suggested that it is 2,645 km (1,644 mi) from the nearest coastline.

Note the Eastern Tian Mountains separate the Junggar Basin from the Turpan Depression seen in the lower right of the image.



Desert 13 — The Turpan Depression Shamo

The Turpan Depression is a fault-bound elongated trough in the Xinjiang Autonomous Region approximately 150 km southeast of the provincial capital Ürumqi. Its main cities are Turpan in the west; Shanshan west of center; and Kumul (Hami) in the east.

The depression includes the fourth lowest exposed point on the Earth's surface and the entire Turpan Depression is below sea level. By some measures, it is also one of the hottest and driest places on Earth.

(2007-7-21 MODIS/Terra image courtesy of NASA)

Web References
http://earthobservatory.nasa.gov/IOTD/view.php?id=77779

The Lowest Point in China

China's Turpan Depression and its lake Aydingkol Hu (red marker) at 154 meters (505 ft) below sea level is considered China's lowest land point, and 4th lowest in the world.

(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA)

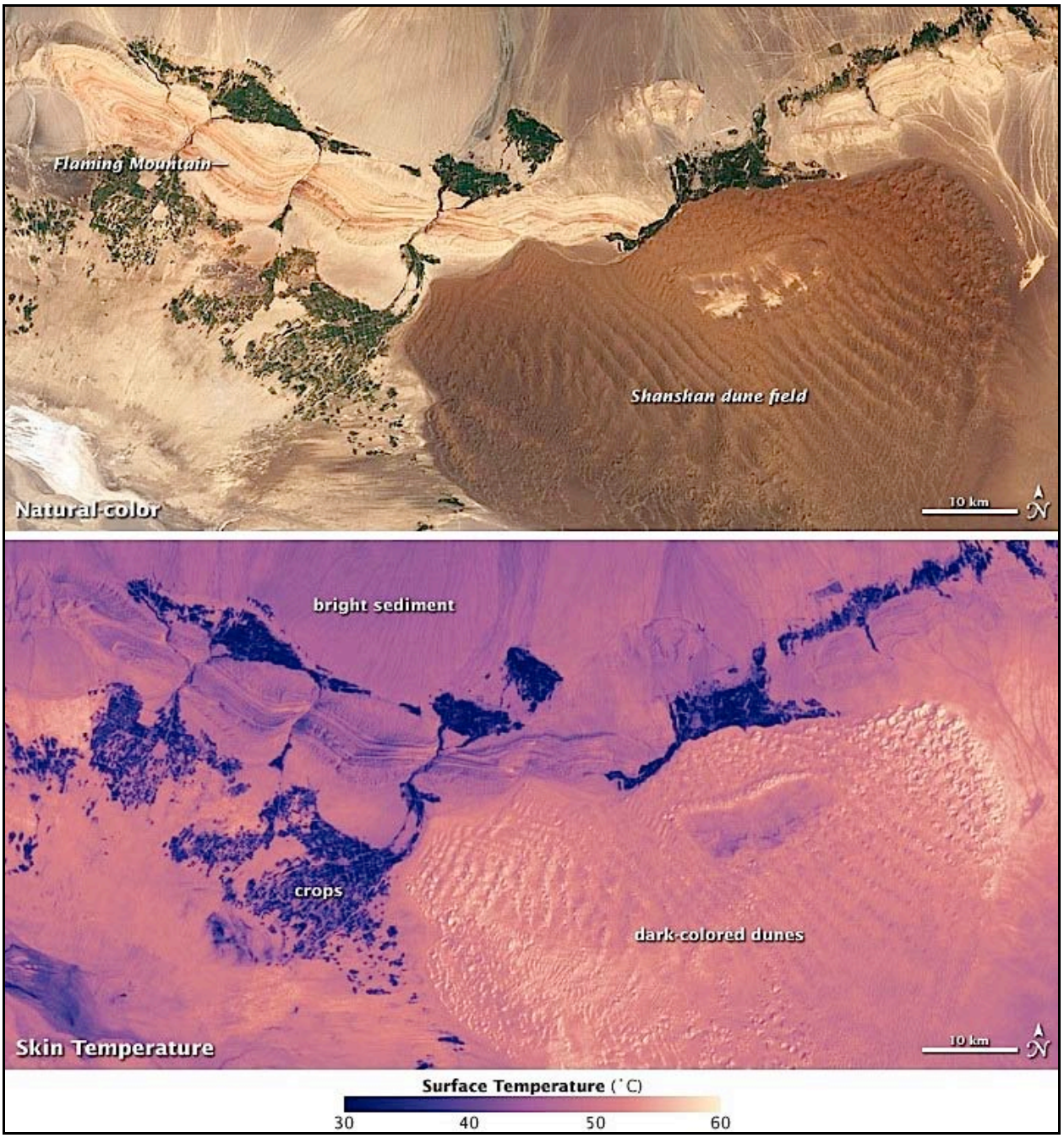
Flaming Mountains in the Turpan Basin, China

The mountains are approximately 100 km (60 mi) long and 5–10 km (3–6 mi) wide, crossing the Turpan Depression from east to west. The average height of the Flaming Mountains is 500 m (1,600 ft), with some peaks reaching over 800 m (2,600 ft). The mountain climate is harsh, and the extremely high summer temperatures make this the hottest spot in China, frequently reaching 50 °C (122 °F) or higher.

Land skin temperatures (LST) reflect the direct heating of a parcel of ground by radiation from the sun, the atmosphere, and other heat flows. Therefore, the hottest LSTs are likely to occur where the skies are clear, the soil is dry, the winds are light, and the ground absorbs the most light and reflects little—that is, it has a low albedo. Rocky deserts such as the Flaming Mountains and Shanshan Dune Field (Turpan Kumtag) offer the perfect combination.

Web Reference

http://earthobservatory.nasa.gov/Features/HottestSpot/?src=features-hp



Flaming Mountains (left) and Shanshan Dune Field (right)

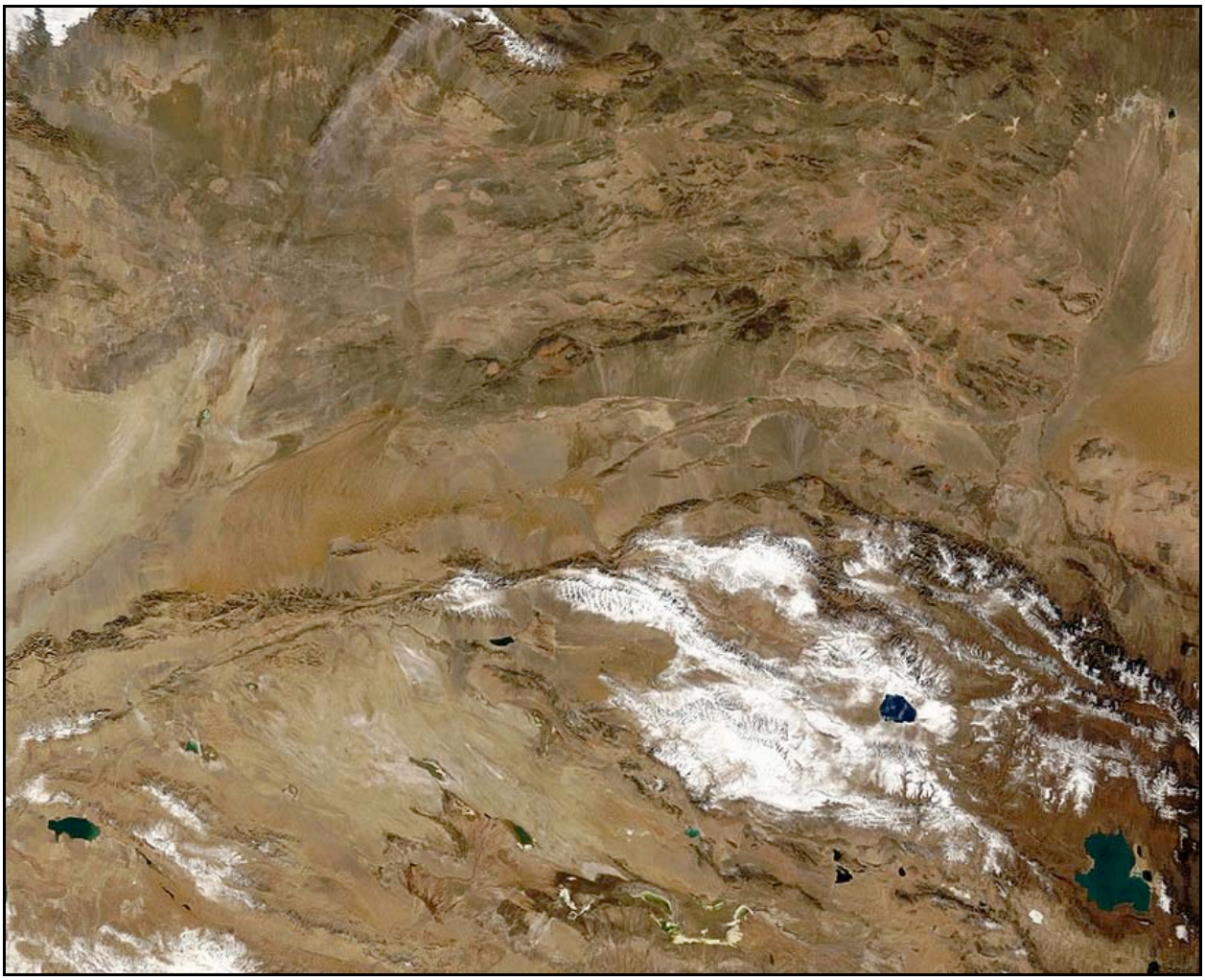
In 2008, the yearly maximum temperature of 66.8°C (152.2°F) was recorded by satellite in the Turpan Depression of the Taklimakan Desert in China.

Web Reference
http://svs.gsfc.nasa.gov/vis/a010000/a010900/a010946/

This image shows the sand dunes in the Turpan Depression. In Uygur "kum tagh" or "kumtag" literally means "sand mountain". The Turpan dune field, or "Turpan Kumtag", is located just south of the town of Shanshan in the central portion of the depression and covers an area ~ 63 km long by 40 km wide (~ 2500 km sq). It is a deposition landform created by deposits of sand that were carried there and shaped by the wind.

Sandy deserts and gobi type deserts are both written as "shamo" when translated from Chinese to the Latin alphabet. It follows then that "Turpan Depression Shamo" refers collectively to the gobi and sandy deserts in the Turpan Depression. The "Turpan Kumtag" is the dark gray spot just above the 13 on the map on page 6. Desert 3, the Kumtag Shamo, is the sandy desert southeast of the Lop Nur region east of the Taklimakan.

Image by uni-corn
http://www.panoramio.com/photo/17978563

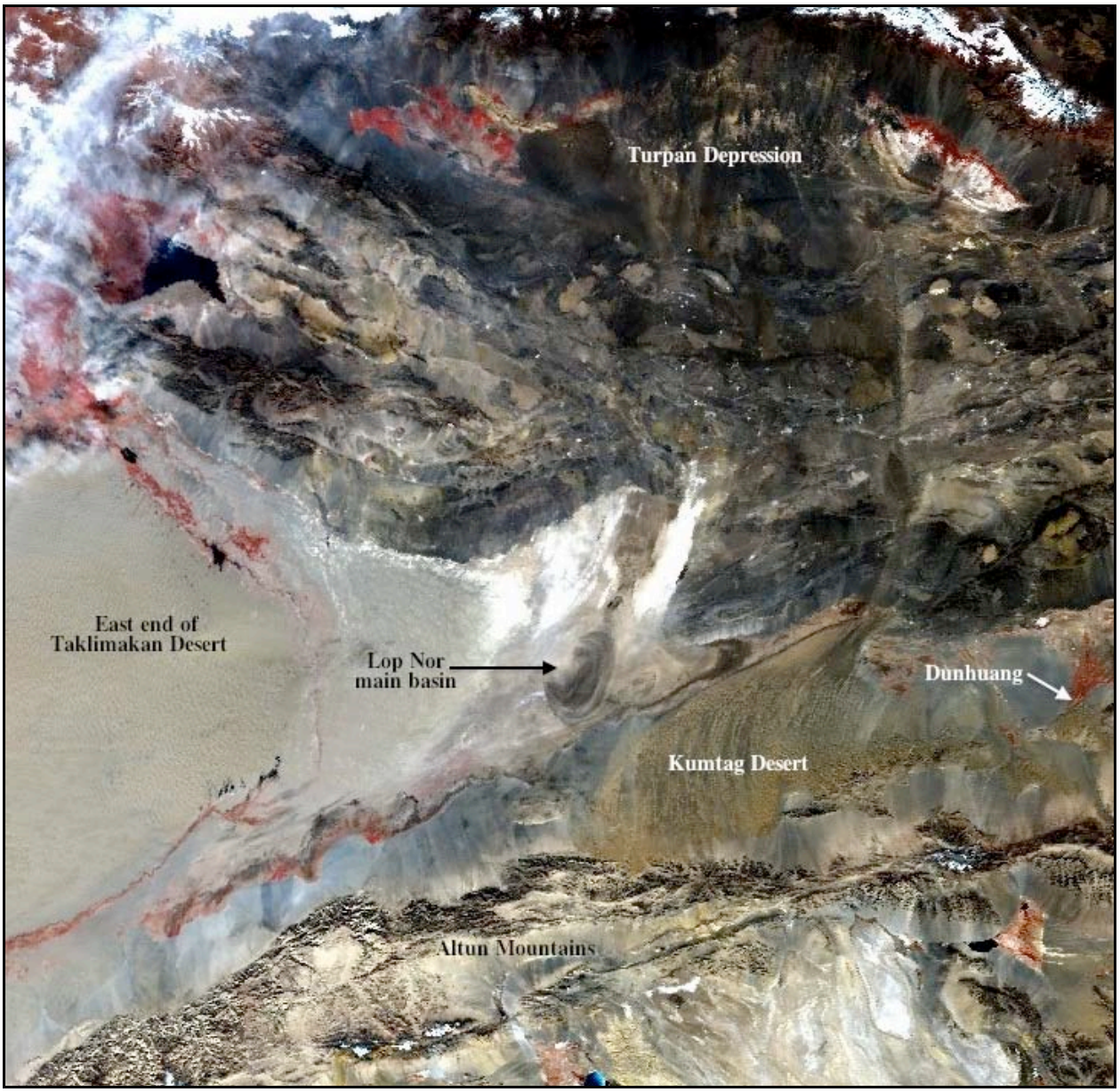


Taklimakan to the Badain Jaran Shamo ~ 765 km (475 miles)

Winds funneled through a gap between mountains can increase their velocity to the point where they can carry grains of sand. This phenomenon is known as the Venturi effect. Once the wind passes through the gap and into the open the wind velocity falls. The sand is then deposited, forming dunes. The Venturi effect occurs between the Taklimakan (far left) and Badain Jaran (far right) deserts.

The Lop Nur region at the eastern end of the Taklimakan Desert is the location of the "gap" through which west winds are funneled. The mountains on the south of the gap are the Altun to the west and the Qilian to the east. On the north of the gap, opposite the Qilians, are the Beishan mountains. The town of Dunhuang is near the center of the image. The Turpan Depression is in the upper left, and the Badain Jaran Playa in the upper right.

(2006-11-11 MODIS/Terra image courtesy of NASA)



Lop Nur (below center) was once a huge lake surrounded by fertile land. Its place in history is the town of Loulan, a communication hub on the ancient Silk Road. But by 1972, the lake was bone dry and swallowed up in the “sea of death”, the Taklimakan (left). The Kumtag Desert is to the southeast of Lop Nur and borders the Altun mountains on the south. (Reference for Loulan: http://en.wikipedia.org/wiki/Loulan_(town)

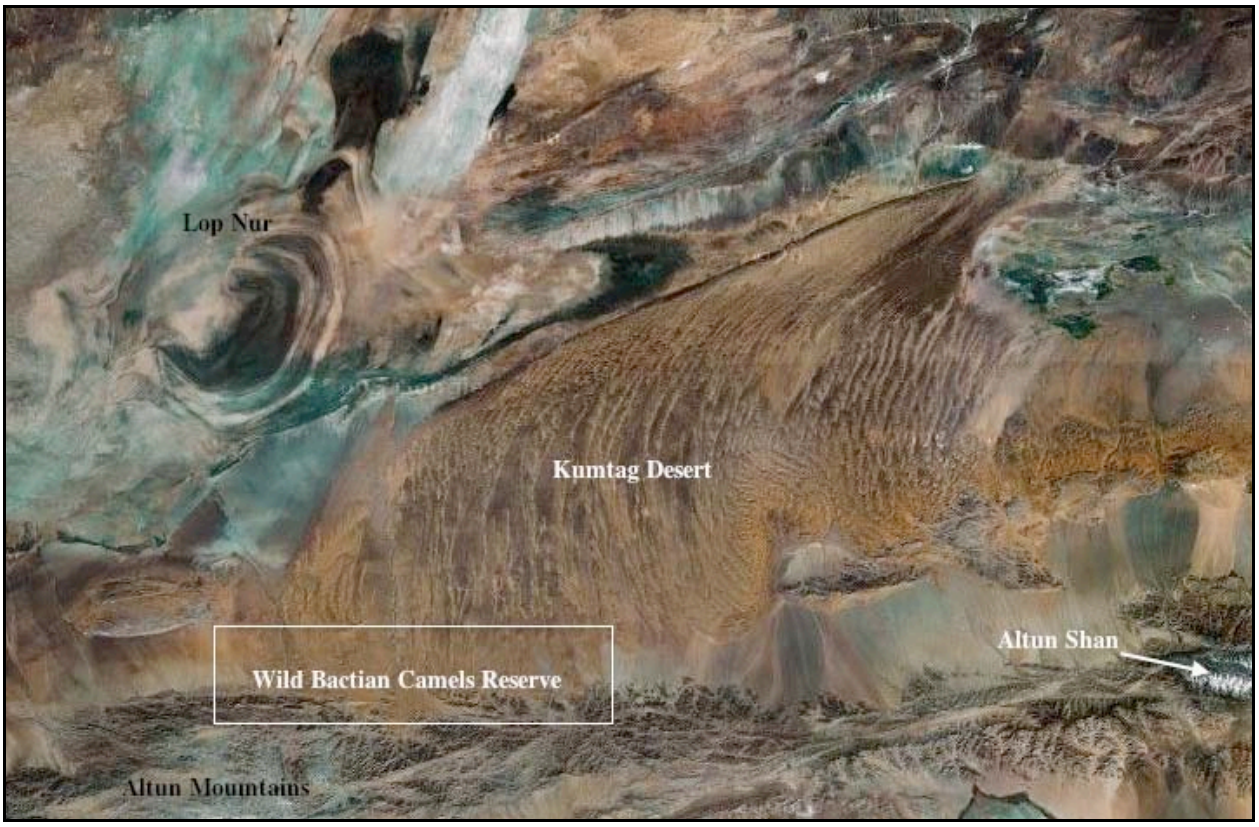
Lop Nur is recorded in ancient Chinese records and maps as a salt lake 150 km (93 miles) in diameter. Today, it is a dry lake bed with a salt crust 30 to 100 cm thick. At it's lowest elevation of 780 m (2560 ft) above sea level, the area is the lowest drainage point of the Tarim Basin.

(2001-10-28 False Color [vegetation is red] MODIS/Terra image courtesy of NASA)

Lop Nur Region 2012-9-29

The ear shaped Lop Nur lower basin at **40.15N, 90.50E** gives new meaning to the word "desert" with an average precipitation of less than 20 mm (0.8 inch) per year, and where, in the summer, humidity drops to zero and temperatures reach 50°C (122°F) in the shade.

For more on the role the Lop Nur region (and the green Potash mine at **40.45N, 90.80E**) plays in modern China go to: http://fire.biol.wwu.edu/trent/alles/PotashMineLopNur.pdf



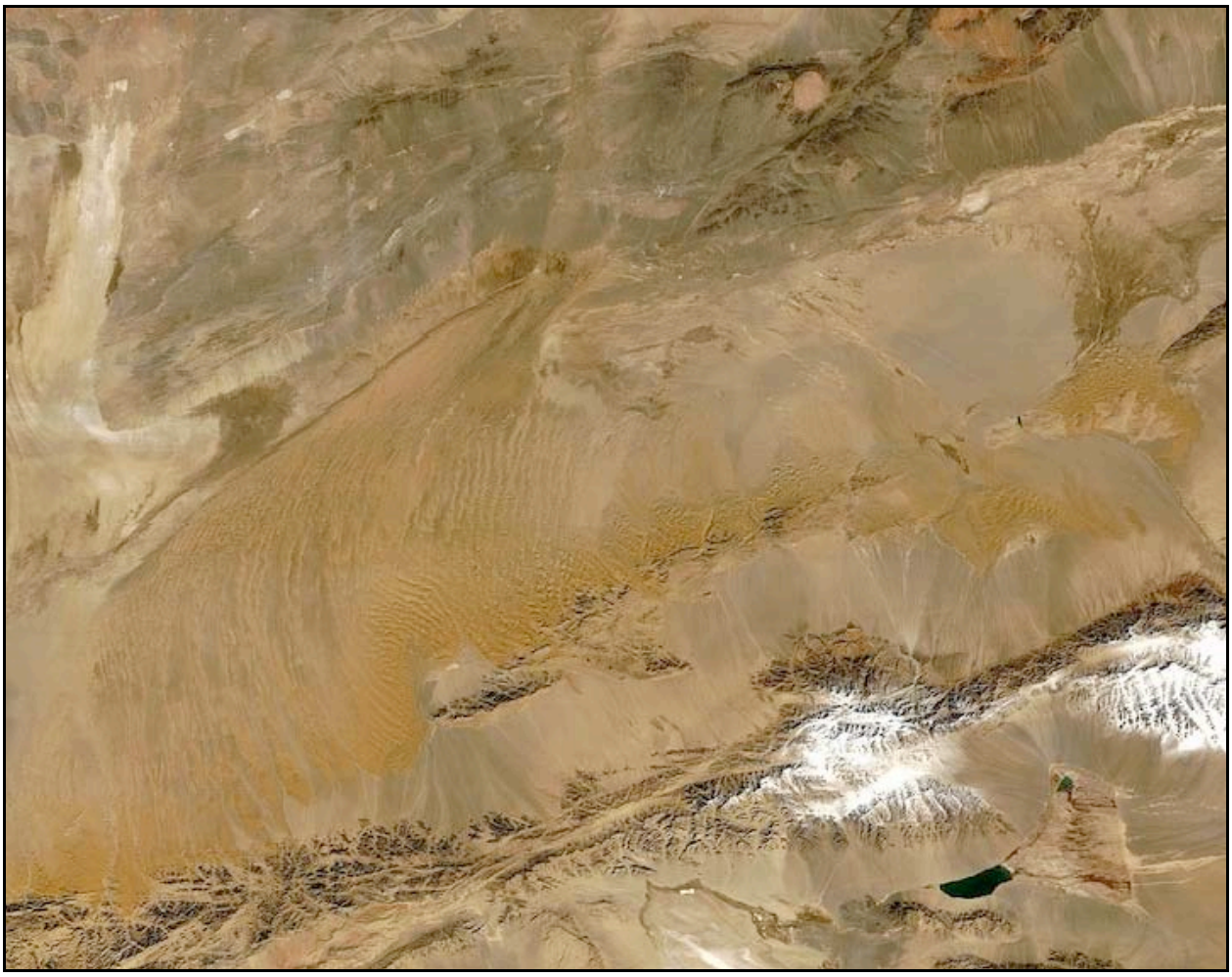
Western Section between the Taklimakan and Badain Jaran Deserts

Lop Nur is left of center above, with Desert 3 the Kumtag Shamo center. The Altun mountain range runs west to east along the bottom of the image. The sandy desert area along the northern base of the Altuns was in the past one of only three areas in the world that supported a population of wild Bactrian camels.

(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA)

Web References
http://en.wikipedia.org/wiki/Lop_Nor

http://en.wikipedia.org/wiki/Bactrian_camel

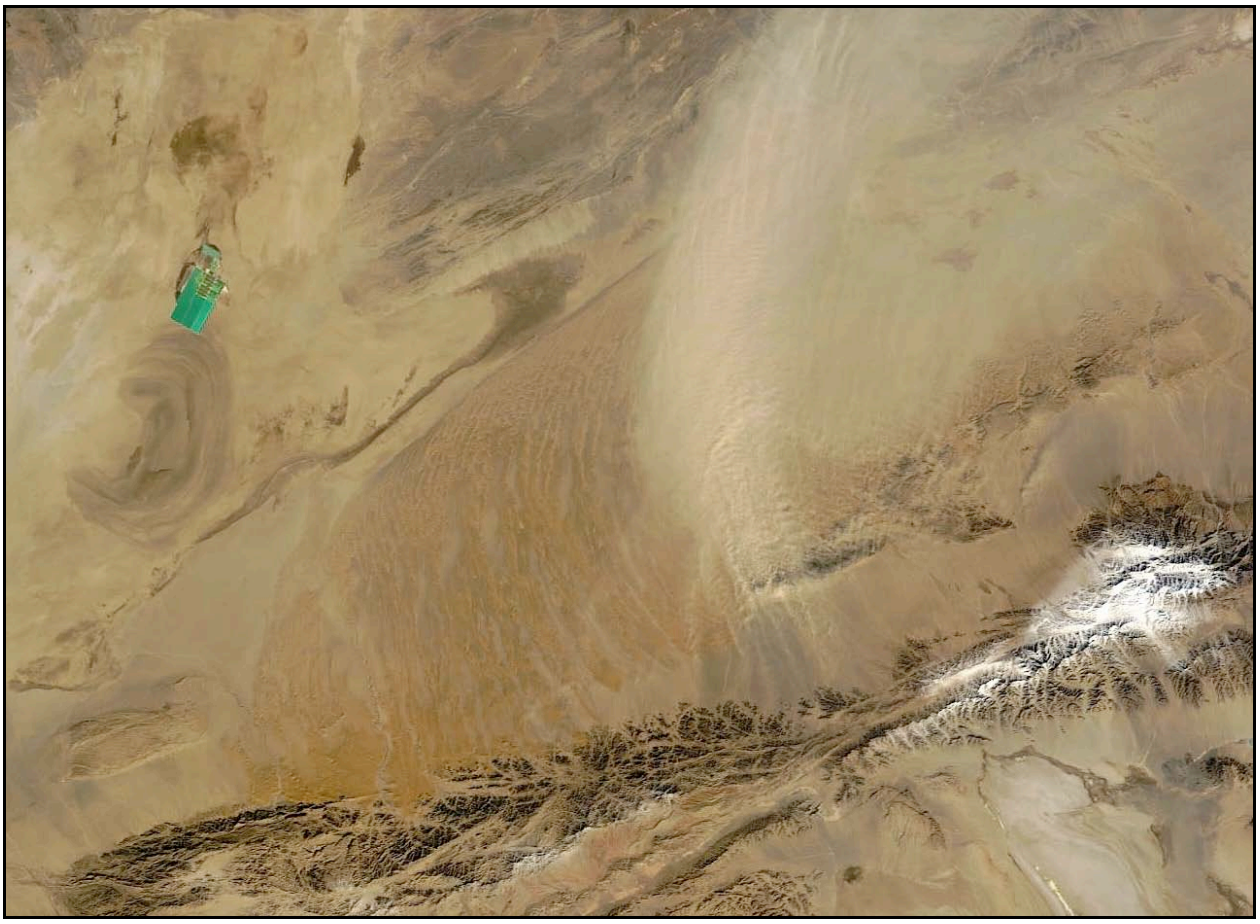


Desert 3 — The Kumtag Shamo

The Kumtag Desert lies east-southeast of Lop Nur. It's bordered by Dunhuang in the east; gobi type desert and the Turpan Depression in the north; and Lop Nur on the west-northwest. With its gobi type desert it has a total area of ~22,900 sq kms (~8,800 sq mi). Its southern rim is marked by a labyrinth of hills, dotted in groups and irregular clusters. Between these and the Altun Mountains, lies a broad latitudinal valley seamed with water-courses that come down from the foothills of the snow covered Altun Shan.

A noticeable feature of the Kumtag is the presence of large accumulations of drift-sand, especially along the foot of the desert mountains, where it rises into dunes sometimes as much as 250 ft (76 m) in height and climbs half-way up the flanks of mountains themselves.

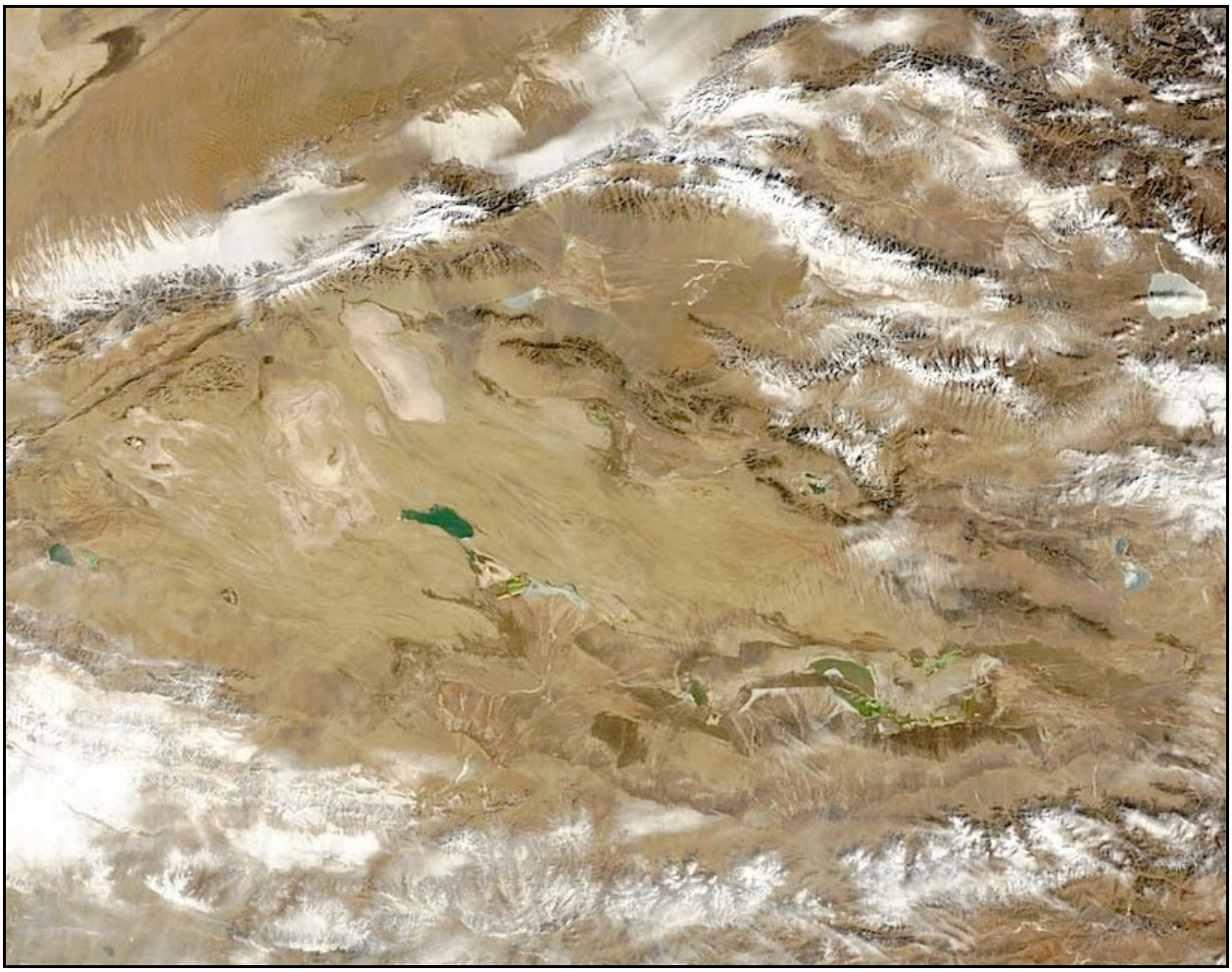
(2006-11-11 MODIS/Terra image courtesy of NASA)



This image shows the proximity of the Kumtag Desert (center); Lop Nur and the Potash Plant (upper left); the eastern Altun Mountains (lower left); the Altun Tagh Fault and Altun Shan with snow; and the northern part of the Qaidam Basin (south below Altun Shan).

The dust storm blowing from the south gives some feeling for the fact that such storms can come from almost any direction in China's western deserts.

(2012-11-16, MODIS/Terra image courtesy of NASA)



Desert 4 — The Qaidam Basin Shamo

The Qaidam Basin covers an area of approximately 120,000 sq km, one fourth of which (35,000 sq km) (13,513 sq mi) is desert covered by dry saline lakes and playas. In this image the Altun Tagh Fault and the snow covered Altun Shan run diagonally across the upper left corner of the basin, with the snow covered strands of the Qilian Mountains running east southeast in the upper right. The southeast extension of the Kunlun Mountains forms the south wall of the basin. In this image mountain snows in effect outline the Qaidam Basin Shamo.

(2013-1-14 Qaidam Basin MODIS/Terra image courtesy of NASA)

Web Reference
http://en.wikipedia.org/wiki/Qaidam_Basin

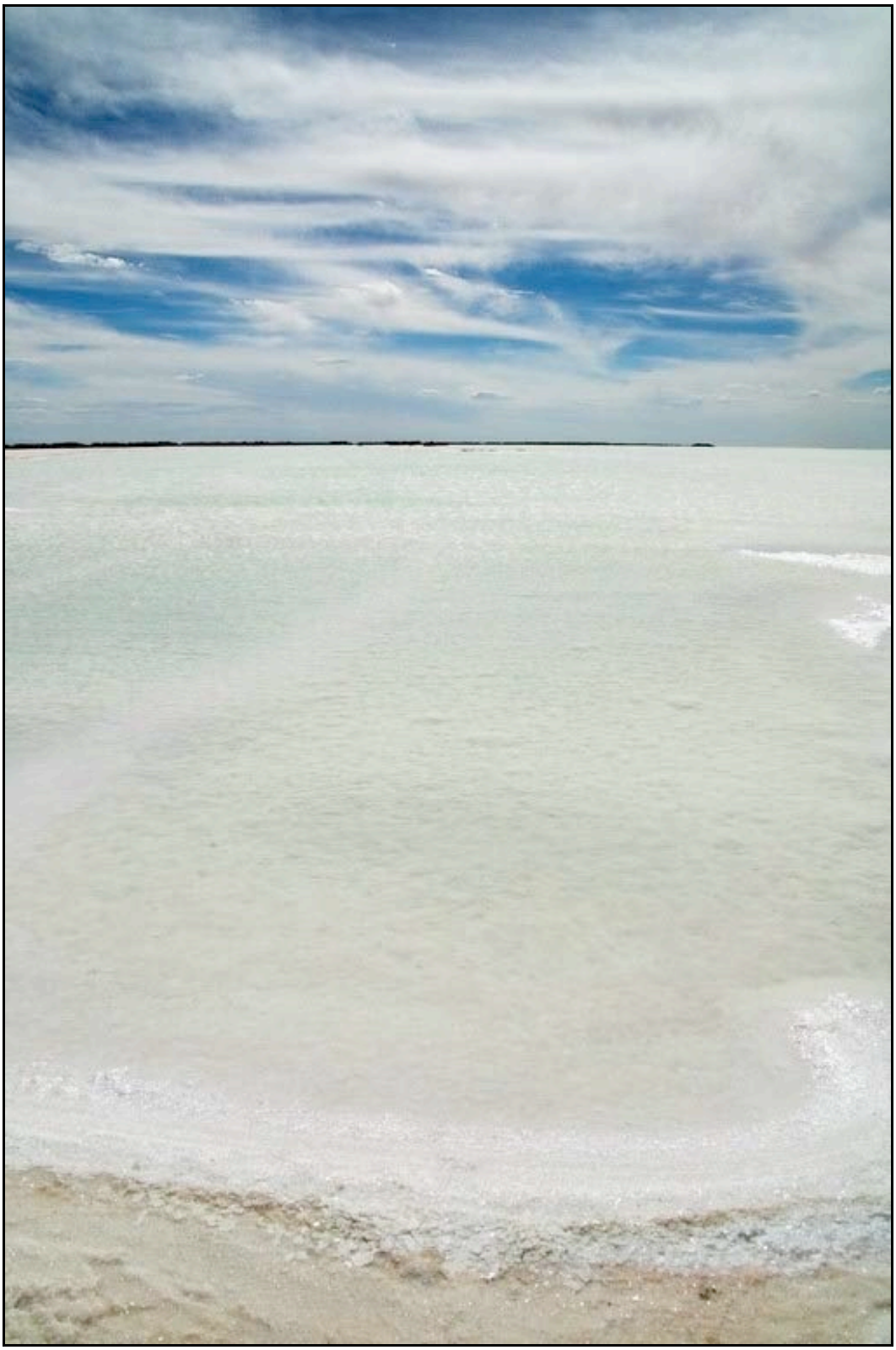
Note the blue line that crosses from Kashi to Beijing is 40 degrees N latitude.

This simplified map makes it easier to picture the "Great Bend" region of the Yellow River as it flows in an upside down "U" shape around the Ordos and Loess Plateaus (see page 46) before turning sharply east to the North China Plain.

The Qaidam Basin Alkalai—Cracked Earth—Salt Flats

The Qaidam Basin Alkalai Salt Flats at **37.35N, 94.28E** lie southeast of the snow covered Altun Shan in approximately the center of the Qaidam Basin along Highway G315 in Qinghai Provence.

This and the following image by Carl Parker
http://www.panoramio.com/user/211654/tags/Desert



Qaidam Basin Salt Flats at 37.35N, 94.6E from Highway G315

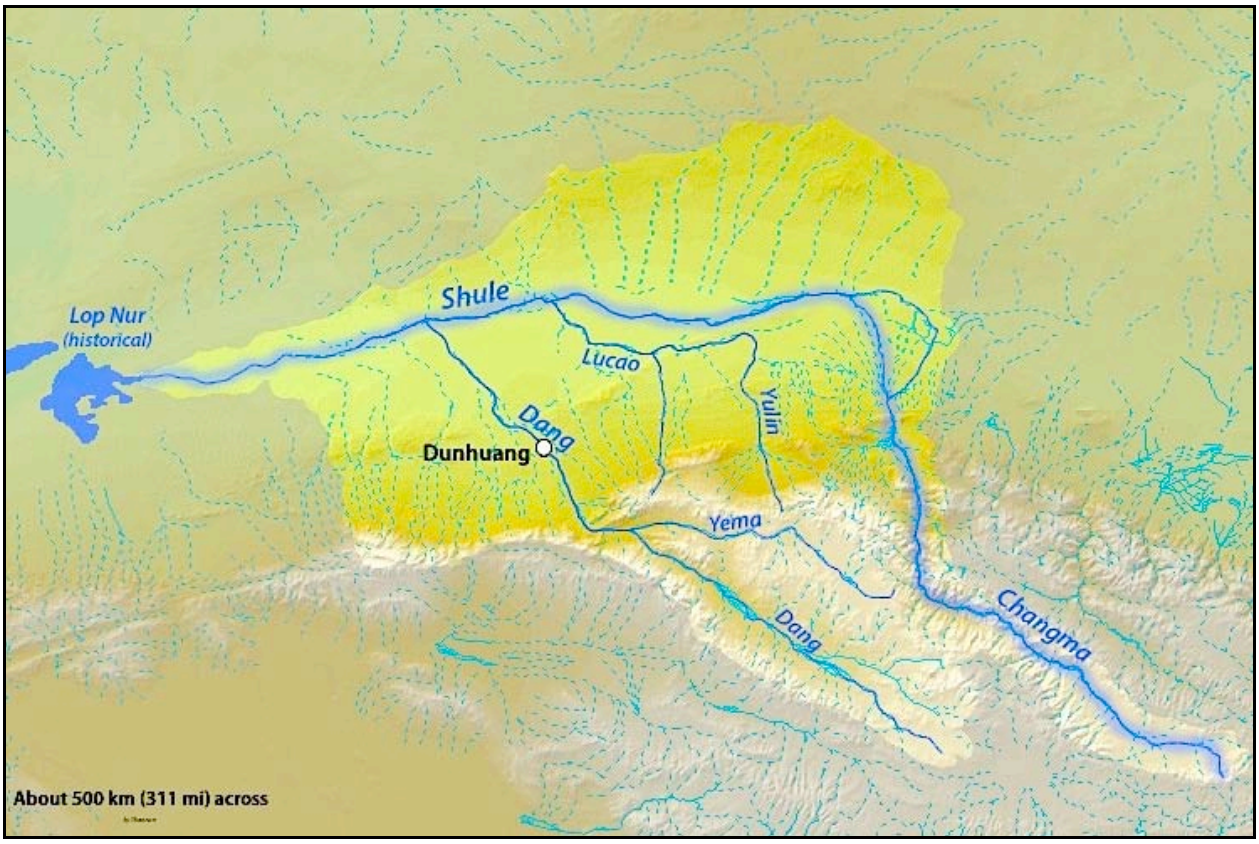
Middle Section between the Taklimakan and Badain Jaran Deserts

Above and left of center is the western most section of the historic Hexi Corridor, route of the ancient Silk Road. This western most section includes the town of Dunhuang at **40.15N, 94.68E** and to the east the ruins of the ancient town of Anxi. The ruins of Anxi are not far from where the modern main highway G30/G312 turns north to Kumul (Hami) just as the ancient Silk Road split north to Hami and the Turpan Depression. Dunhuang is located on the Dang (Tang) River and ancient Anxi on the Shule River, both of which flow northwest from the Qilian mountain range.

The image also shows an alluvial fan or playa on the right above center. The fan at **~ 40.25N, 96.75E** is derived from flows of the Shule River out of the Qilian mountain range at the bottom of the image. The town of Yumen is located on the far east corner of the playa. The fan is approximately 540 km (335 mi) east of Lop Nur.

(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA)

Web Reference
http://en.wikipedia.org/wiki/Dunhuang

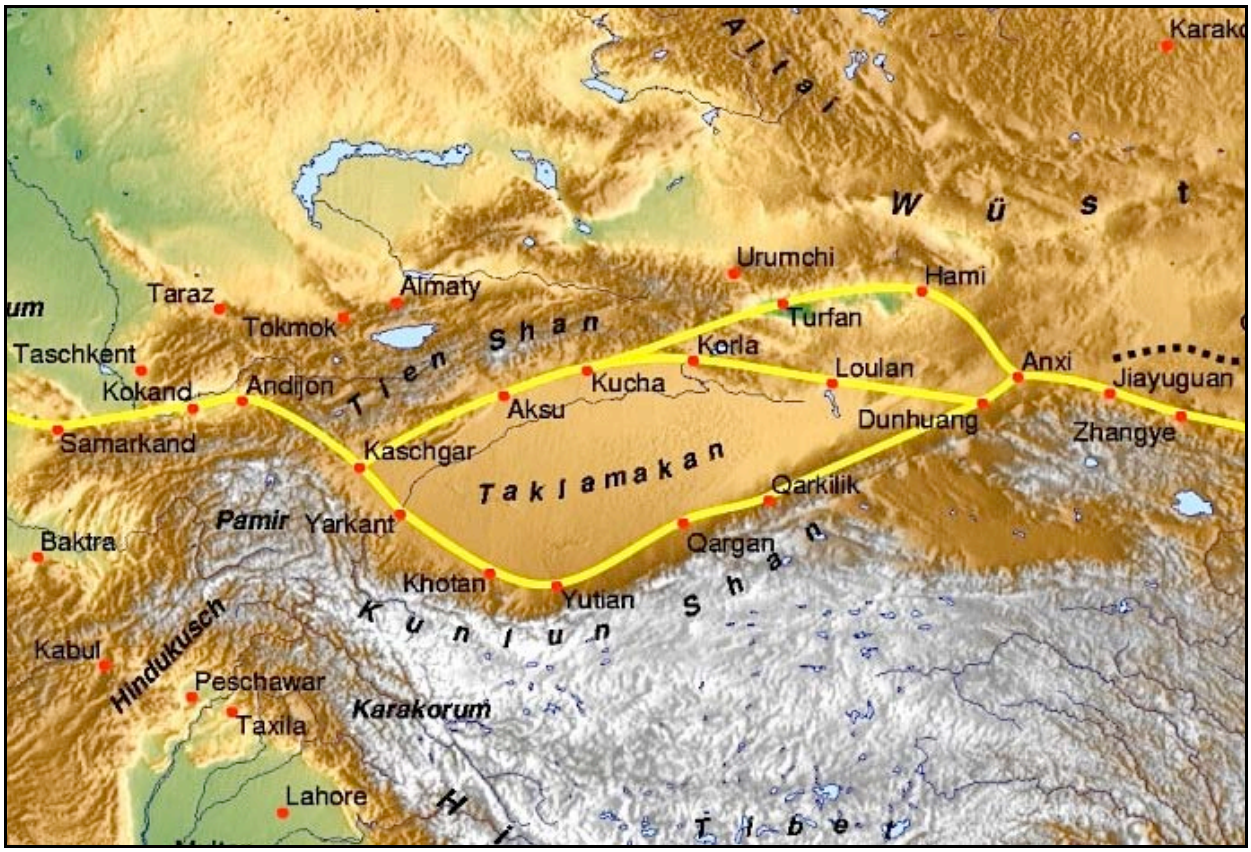


Drainage Basin of the Shule River through the Hexi Corridor

Note the word "historical" under the label for Lop Nur. The Shule River has long ago ceased flowing to what was Lake Lop Nur and now disappears into the desert sands well before reaching the Lop Nur basin.

The eastern section of the Hexi Corridor is defined by the eastern front of the Qilian Mountain Range before it reaches the playa of the Shule River. The Corridor then turns west and follows the Shule to ancient Anxi where the Silk Road split south to Dunhuang and north to Kumul (Hami) the most northern route of the Silk Road. It is also the route, via Turfan and Urumqi, into the Junggar Basin and the steppes of Central Asia. For this reason it was one of the preferred routes in ancient times for people migrating away from Chinese domination or, in the opposite direction, conquest of Chinese territory.

Web Reference
http://en.wikipedia.org/wiki/Shule_River



The Silk Road in Western China

Dunhuang is where the northern and southern routes of the Silk Road split to go around the Taklimakan Desert. The northern route leaves Dunhuang northwest toward the Yumenguan Pass, more famously known as the "Jade Gate", to the ancient town of Loulan. The southern route travels to the Yangguan Pass west-southwest of Dunhuang.

Because of its location Dunhuang was of military importance to ancient China. Rocked by waves of invasion, Dunhuang has been independent, as well as being ruled by both China and Tibet. Dunhuang was first made a prefecture of China in 117 BC, and was a major point of interchange between China and the outside world during the Han and Tang dynasties (206 BC to 907 CE). It is approximately 1600 km (990 mi) as the crow flies from Dunhuang to Kashi, which makes the actual routes of the Silk Road around the Taklimakan Desert somewhat longer.

Web References

http://en.wikipedia.org/wiki/Jade_Gate

http://en.wikipedia.org/wiki/Silk_Road

Jade Gate Garrison Building at Yumenguan (40.35N 93.85E)

Travelers to the Western Regions left China through the famous Yumenguan, or "Jade Gate Frontier-post", named for the many jade caravans that passed through it. The original Jade Gate was erected by Emperor Wudi (Emperor Wu of Han) soon after 121 BCE. Its ruins can still be seen ~ 80 km (50 mi) to the northwest of Dunhuang. Until the 6th century, the gate was the final outpost of Chinese territory for caravans on their long caravan journeys to India, and the Roman Empire.

Web Reference
http://en.wikipedia.org/wiki/Yumen_Pass

Southeast View of Jade Gate Garrison Building at Yumenguan

Although in Chinese *guan* is usually translated simply as "pass", its more specific meaning is a "frontier pass" to distinguish it from an ordinary pass through the mountains.

For more on the recent history of the Jade Pass go to:

The Jade Gate an Oral History
http://fire.biol.wwu.edu/trent/alles/Jade_Gate_Oral_History.pdf

Watchtower and remnants of the Great Wall near Yumenguan

The fortifications wind through the Gobi Desert and were composed of several watch-towers with a continuous wall between them. The walls are made of layers of stamped reed, stone & sand.

Yangguan Beacon Watchtower (39.79N, 94.11E)

Gate to the southern route of the Silk Road out of Dunhuang

Above is all that is left of the Yangguan Gate, walls, and watchtowers of the southern route of the Silk Road out of Dunhuang. In the background is the Mingsha Shan dune field south of Dunhuang. The view is to the east. This ruin of a Han Dynasty (206 BC – 220 AD) Chinese high beacon tower made of rammed earth lies 75 km (47 mi) southwest of Dunhuang.

Web References

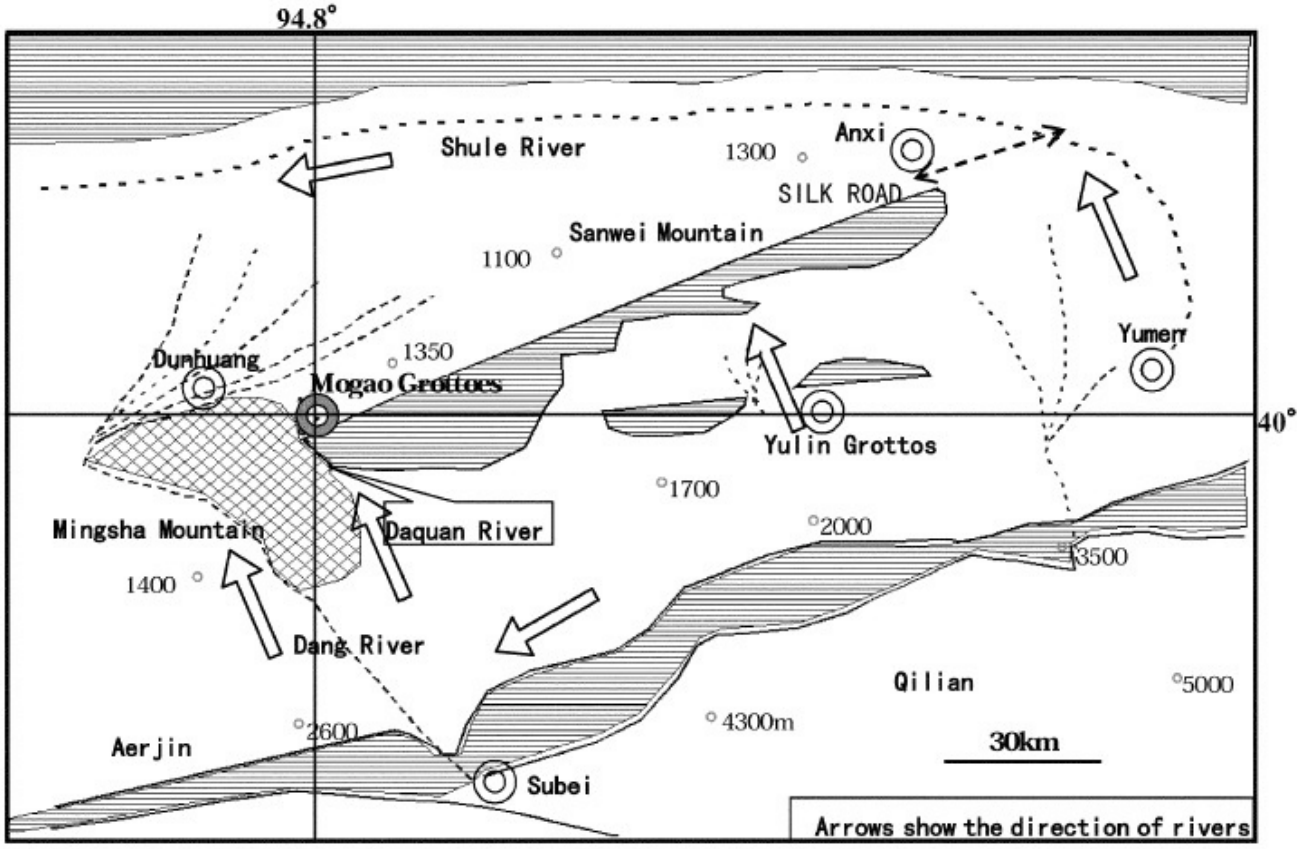
http://en.wikipedia.org/wiki/Yangguan

http://en.wikipedia.org/wiki/Rammed_earth

Road from Dunhuang south to Mingsha Shan Sand Dunes

(40.095N 94.675E)

Web Reference
http://en.wikipedia.org/wiki/Dunhuang



Geological Map of the Middle Section between the Taklimakan and Badain Jaran Deserts

Reference: Chunze Piao, et al. (2003)

Above is the view looking east from the Mogao Grottoes south of the Mingsha Shan Sand Dunes and Dunhuang. In the foreground are the Sanwei mountains and the Daquan River. In the background are the Qilian Mountains, which form the west wall of the Hexi Corridor along the southeast section of the corridors length, but form the south wall of the corridor after it turns west at Yumen.

It is along the base of the Qilian Mountains from Yumen west that the Altyn Tagh Fault one of the major geological faults in northern China runs.

(Photograph by Patrick Jennings)

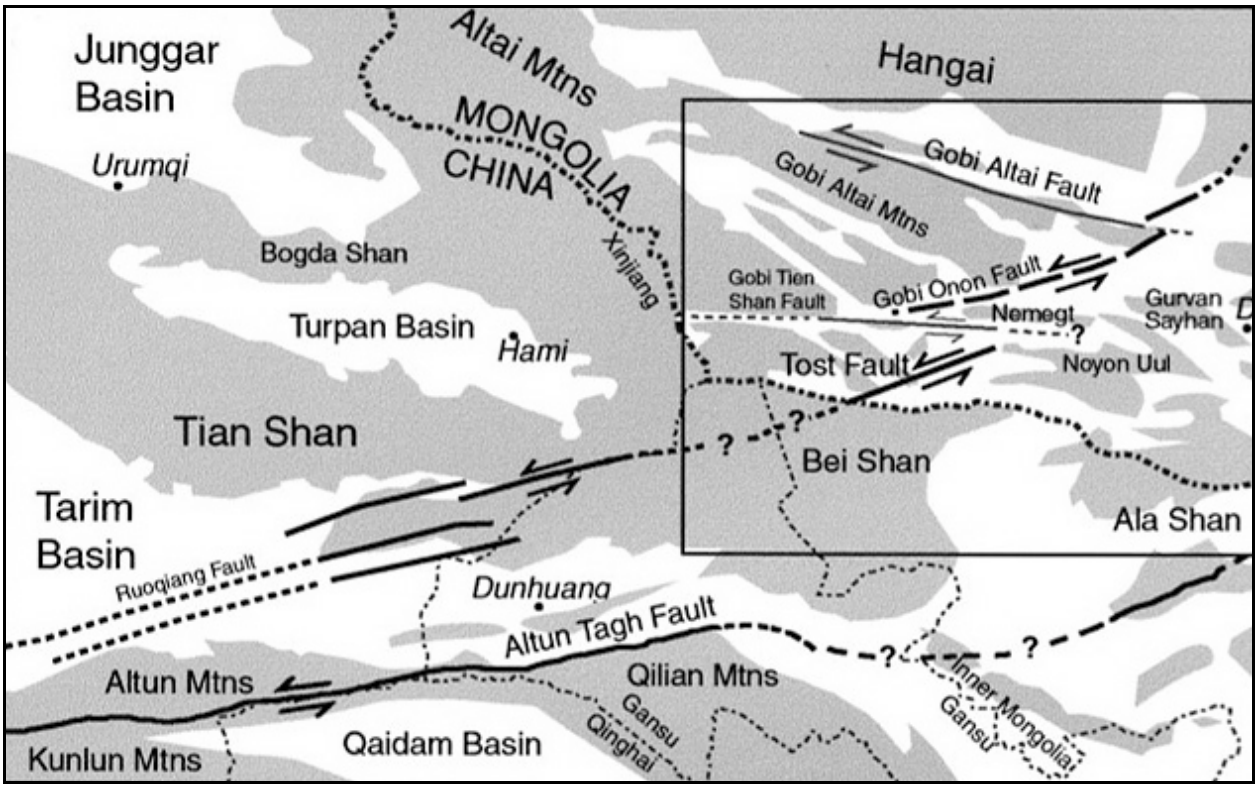
The Altyn Tagh Fault

The Altyn Tagh fault basin is a giant scar that can readily be seen from space. This section of the fault centers on **39.15N, 92.65E**, and runs just west of where the Qilian mountain range (to the right of this image) ends and the Altun mountain range begins. The Qaidam Basin lies directly to the south of this section and the Kumtag Desert directly to the north. The area is approximately 263 km (164 mi) southwest of Dunhuang.

The section of the fault in this image is 44 km (27 mi) long. The total length of the Altyn Tagh fault is more than 1500 km (932 mi) long and runs the length of the northern edge of the Tibetan Plateau from the Pamir mountains on the west to the Qilian mountains on the east.

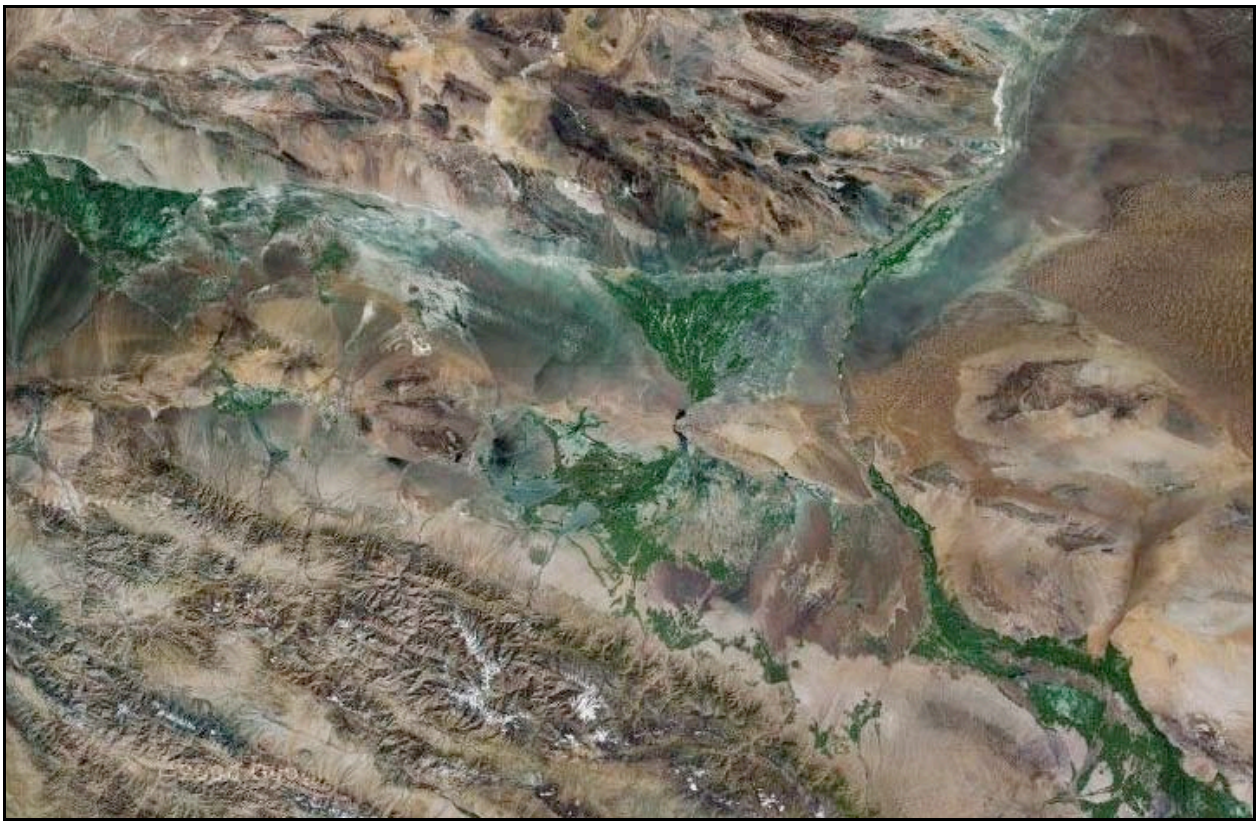
(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA)

For more on the Altyn Tagh Fault go to:
http://fire.biol.wwu.edu/trent/alles/AltynTagh.pdf



Above is a geological map (Figure 1, Lamb, M., et al.,1999) that includes the western Hexi Corridor just north of the Qilian Mountains. Dunhuang is below center, and to the left. Note the Altun (Altyn) Tagh left-lateral strike-slip fault which runs west to east across the lower portion of the map and defines the northern end of the Qilian Mountains. The Ala Shan (lower right), also called the Alxa Plateau, contains the Badain Jaran, Tengger, and Ulan Buh deserts.

Web Reference
http://en.wikipedia.org/wiki/Geologic_fault

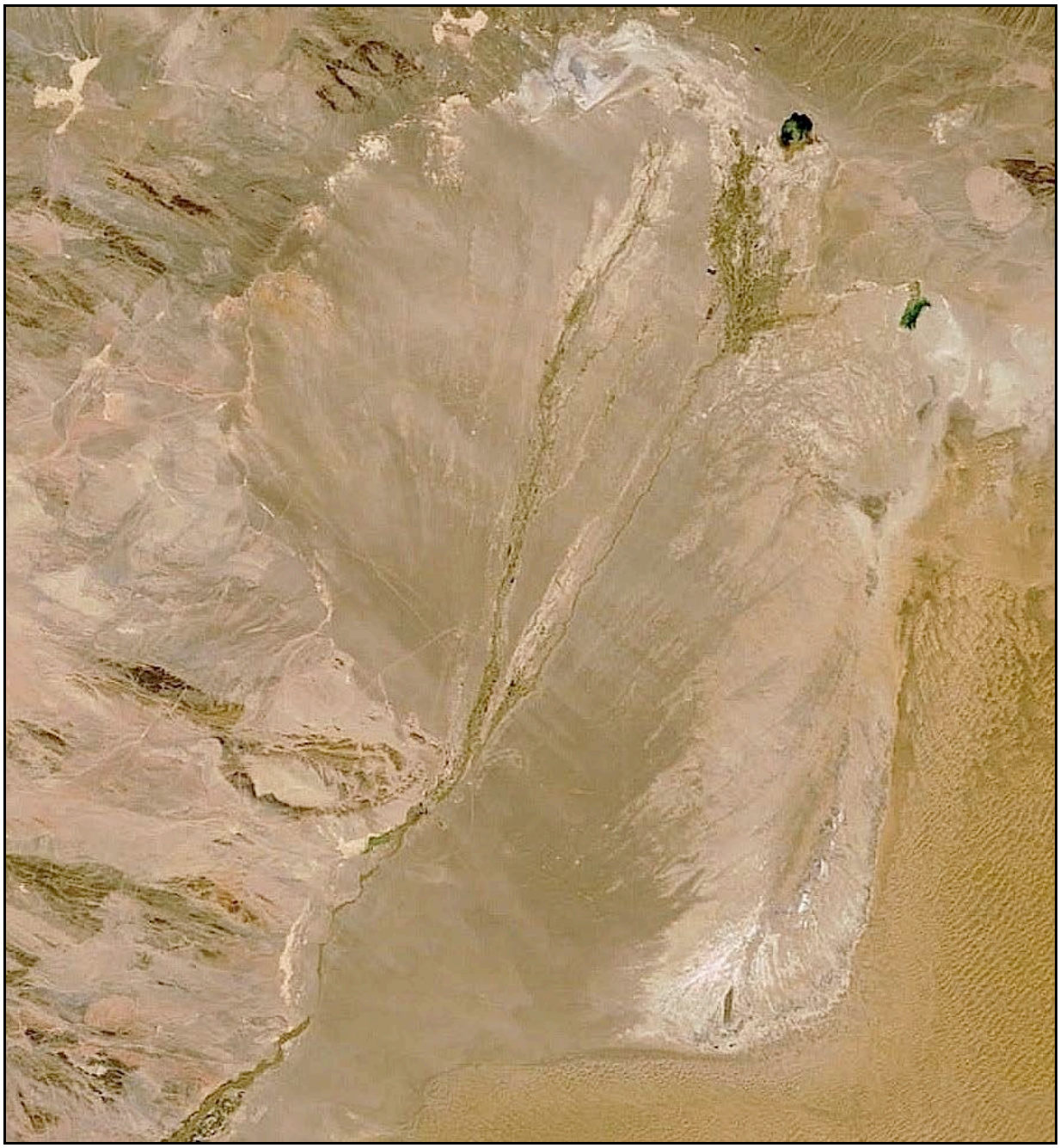


Eastern Section between the Taklimakan and Alxa Plateau Deserts

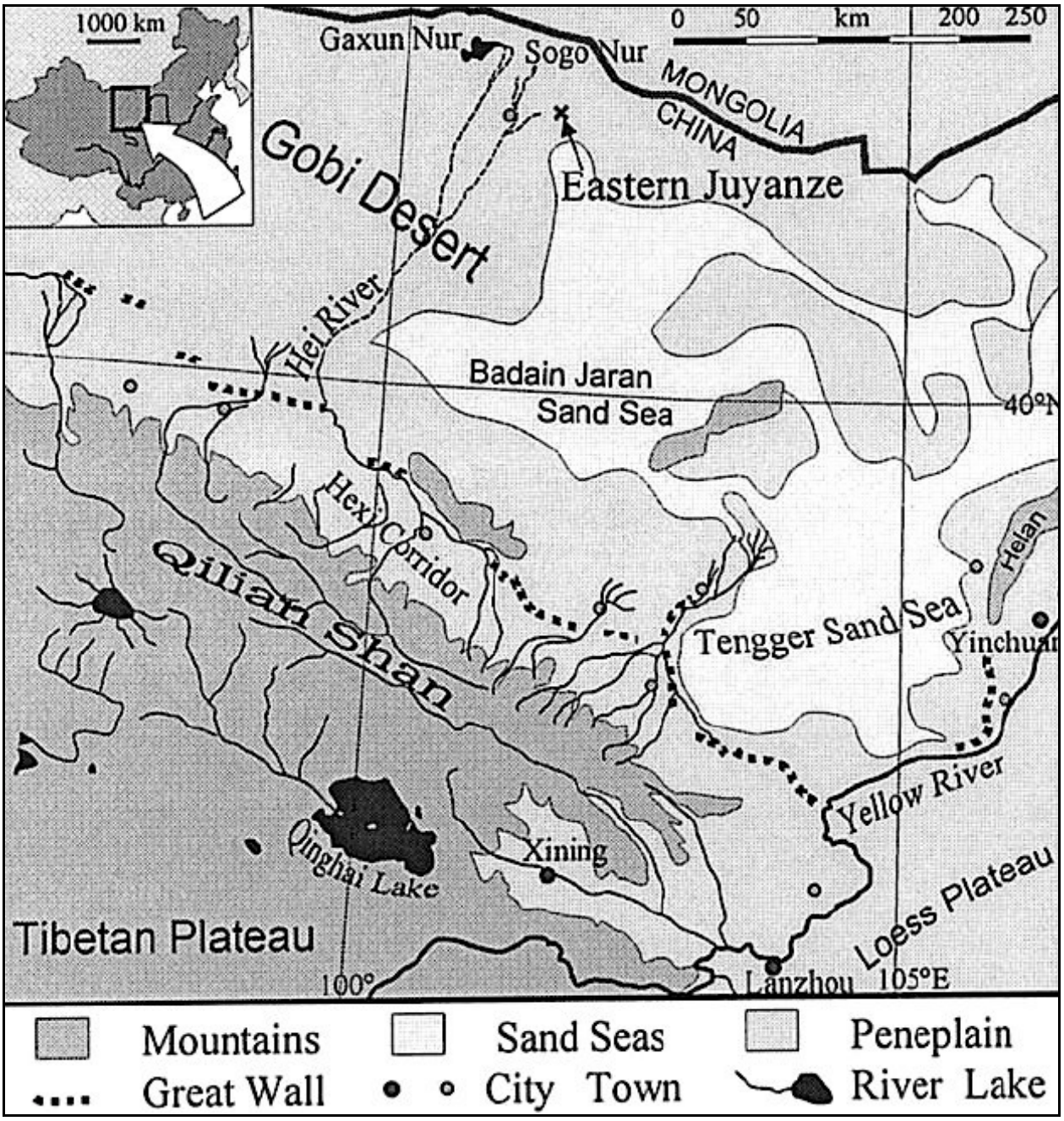
This image shows the Ruo Shui River running from bottom to top of the image, right of center. The Ruo Shui or "weak river" is the name sometimes used for the lower reaches of the river because it is intermittent. The river sits on the western edge of the Badain Jaran Desert and feeds one of the largest known alluvial fans in the world, the Badain Jaran Playa (the southern portion is upper left). The river originates in the Qilian mountain range to the south and drains north into the desert. The linear area of green in the bottom right is called the Hei He or "black river", the name used for the upper reaches of the Ruo Shui River that lie in the historic Hexi Corridor at the base of the Qilian range.

Note the Shule River Playa on the left edge of this image and the Shule River flowing out of the Qilian mountains.

(Satellite False Color Imagery from Google Maps, TerraMetrics, NASA, 2006)

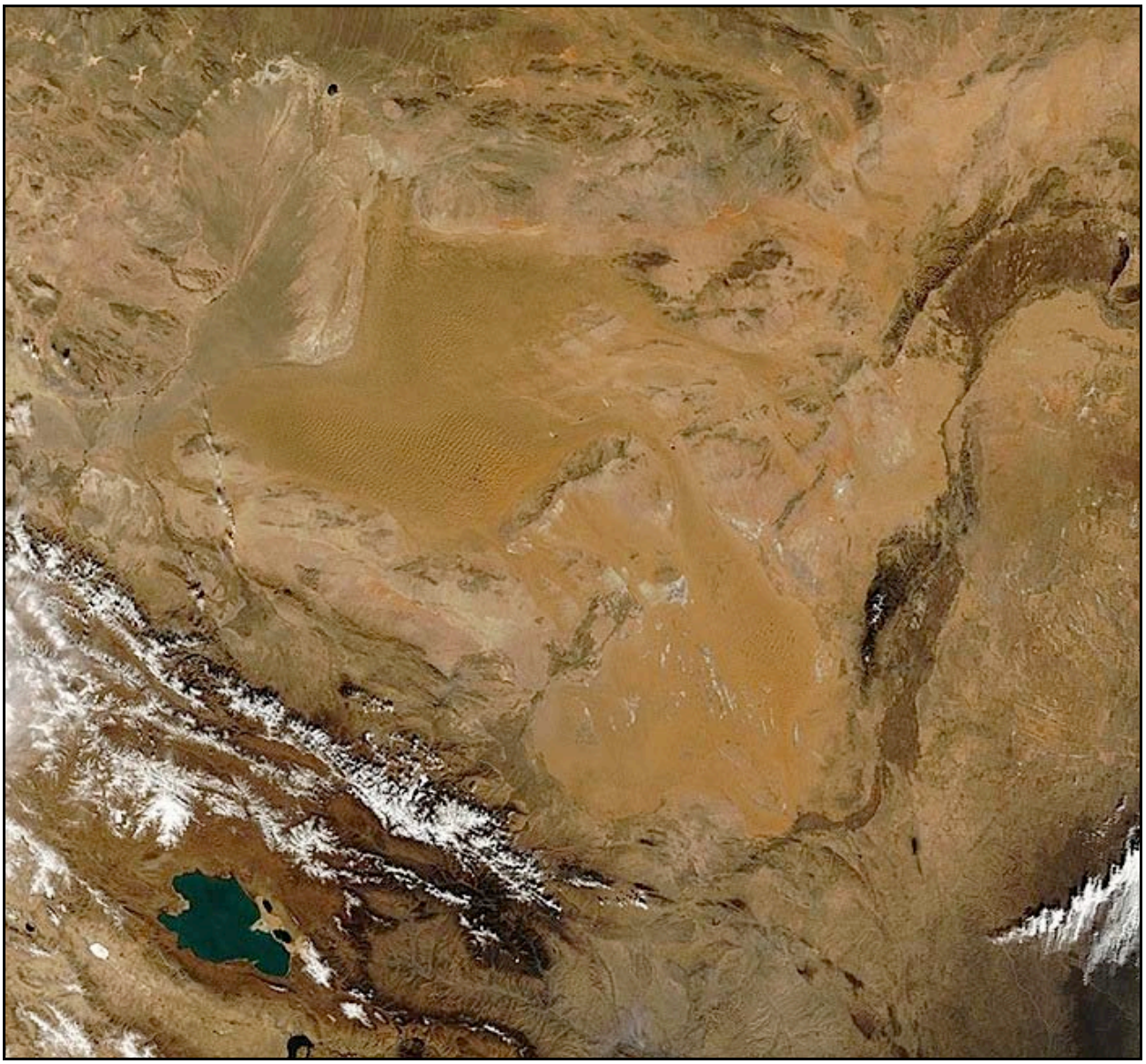


This image shows the Ruo Shui (Hexi He) flowing onto the Badain Jaran Playa on the northwest edge of **Desert 5—the Badain Jaran Shamo**. The alluvial fan has an area of ~ 26,000 km sq (~ 10,000 mi sq) and is roughly 130 km east-west by 200 km north-south (80 x 125 mi). The Ruo Shui splits further north into the Xi He (west river) and the Dong He (east river). The Xi He ends in the intermittent lake Gaxun Nur, and the Dong He ends at Lake Sogo Nur. Gaxun Nur sits at **42.4N, 100.6E**, at ~1000 m above sea level. Sogo Nur is at **42.29N, 101.25E**. Because of its size and location, the playa is a major source area for wind blown dust and sand in China.



Map of the Eastern Hexi Corridor and the Alxa Plateau

In this map what is labeled as "Gobi Desert" is the Badain Jaran Playa with the Ruo Shui labeled as the "Hei River". The light gray areas are coded as "Peneplain" and correspond to gobi type desert lands (Mischke, S., et al. (2003).

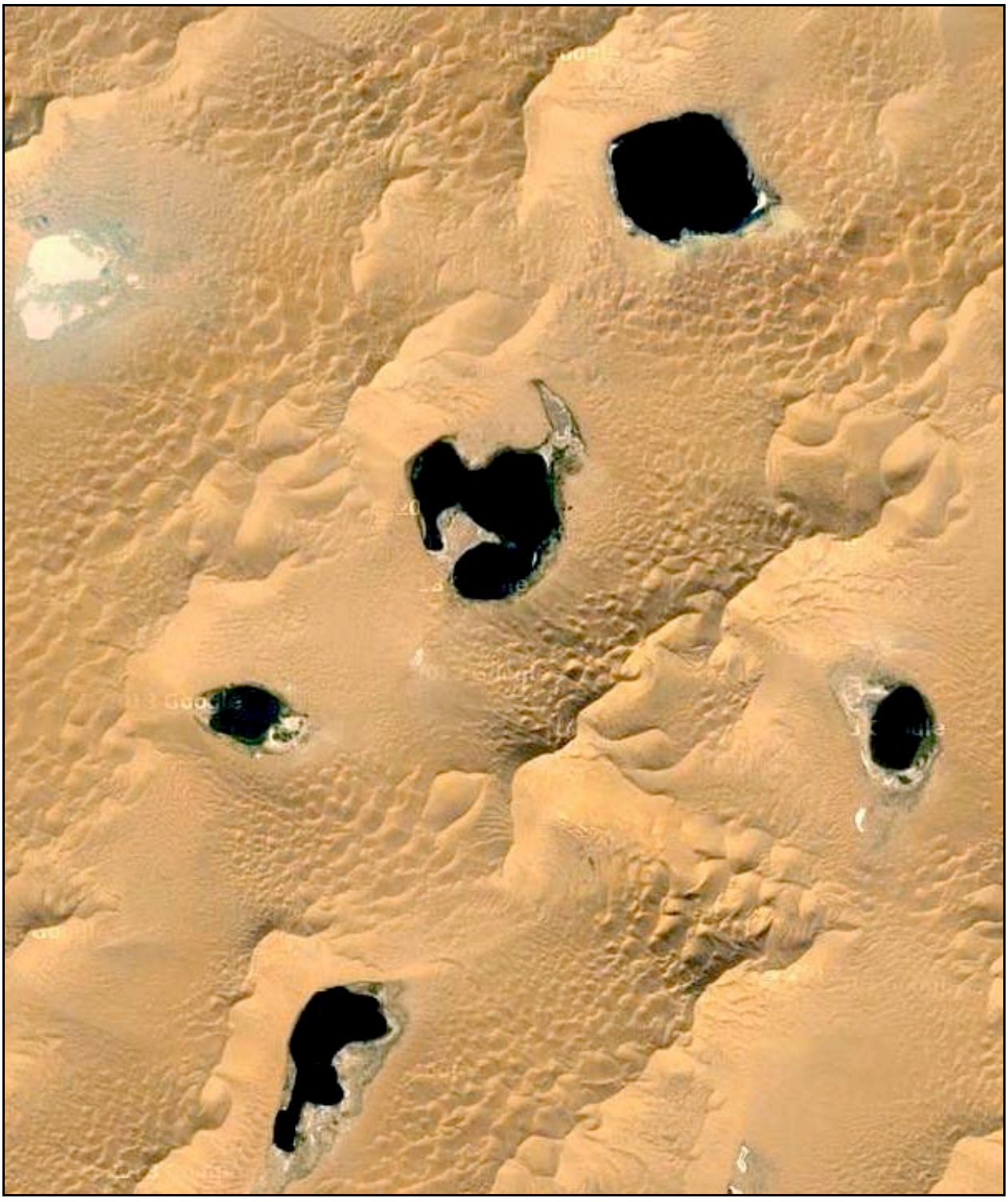


China's Central Deserts

In China the Badain Jaran Shamo (upper left); **Desert 7—the Ulan Buh Shamo** (right of center); and **Desert 6—the Tengger Shamo** (below center) are known as the Central Deserts. All three deserts lie on the Alxa Plateau located northeast of the Hexi Corridor. The plateau has an elevation of 1000 to 1400 m (3300 to 4600 ft), and an area of 100,000 sq km (38,600 sq mi), with an annual rainfall of ~100 millimeters. There are two main dune deserts on the plateau, the Badain Jaran (45,000 sq km) (18,000 sq mi) in the northwest and the Tengger Desert (42,700 sq km) (16,500 sq mi) in the southeast. The smaller Ulan Buh Desert (10,000 sq km) (3,800 sq mi) is in the northeast of the plateau on the west side of the Yellow River between the Helan and Yinshan Mountains on the north. The central Gobi Desert runs along the top of the image. Altogether the distance from the Ruo Shui River on the west of the Badain Jaran Desert at **40N, 99.4E**, directly east to the Yellow River at **40N, 106.7E**, is ~ 620 km (385 mi).

Sand Dunes in the Eastern Badain Jaran Desert

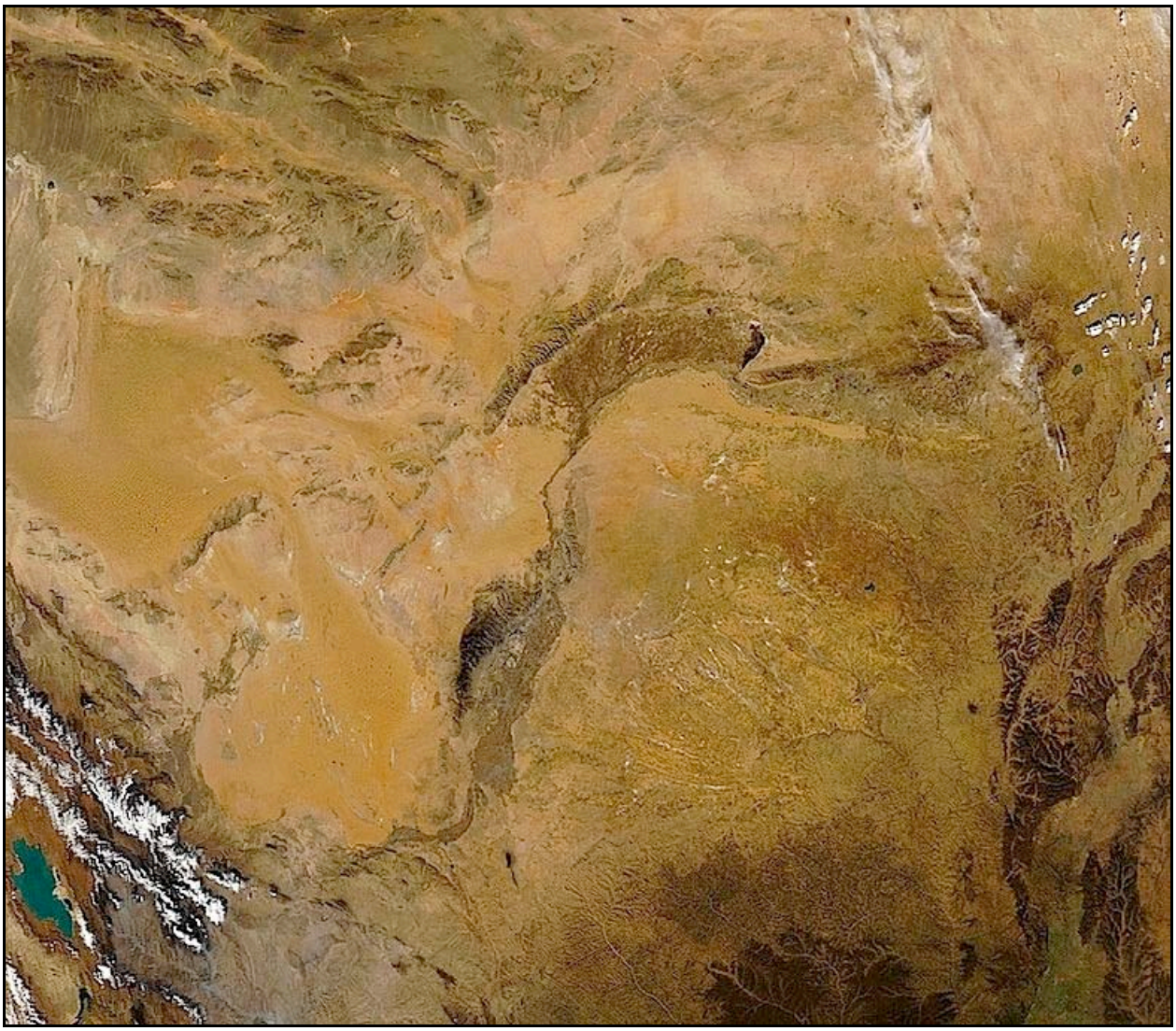
This image can only be viewed correctly if you understand that low angled light is coming from the bottom right and that the flat areas are the low interdunal areas or lakes. The prevailing winds in this case are from the northwest with the slip face on the southeast. This area is located at **39.85N, 102.44E**, approximately 222 km (138 miles) due east of the Ruo Shui River.



Above are some of the largest dunes and lakes in the Eastern Badain Jaran Desert.

In the central and eastern Badain Jaran Desert sand dunes average 200-300 meters in height, and occasionally 500 m (1640 ft) high. Which means these dunes, like the one shown above, may be the tallest sand dunes on Earth (Walker, et al., 1987). Their height may be explained by the presence of groundwater (Chen, et al., 2004). This dune, which is above center in the previous image, sits at 39° 50' 38.63" N 102° 26' 37.13" E. This view is to the west.

Web Reference: http://www.newscientist.com/article.ns?id=dn6712



The Hetao Plain shown above center is an intensely irrigated agricultural region, that sits between the Yinshan Mountains on the north and the Yellow River on the south. To the right of the plain is Ulansuhai Lake at the east end of the irrigated region.

In the image the Ulan Buh Desert is left of center west of the Yellow River and south of the Hetao Plain. The northern portion of the Great Bend region of the Yellow River, also called the Ordos Plateau (90,650 sq km) (35,000 sq mi), is right of center, east, south, and west of the Yellow River (see page 26).

Desert 8—the Hobq (Kubuqi) Sandy Desert lies on the Ordos Plateau to the south of the Yellow River is a long band of sand extending about 400 km (250 mi) from west to east. The desert is 50 kilometers wide in the west, 15-20 kilometers wide in the east and covers an area of 16,756 sq km (6,469 sq mi).

Web Reference
http://en.wikipedia.org/wiki/Ordos_Desert

Southeast of the Ordos Plateau the Loess Plateau has an elevation of ~1200 m (746 ft), and an area of 640,000 sq km (247,100 sq mi), also with an annual rainfall of ~100 millimeters. The Loess Plateau's area is spread widely south, west, and east opposite of the Yellow River.

At the far lower right edge of the image are the Taihang Mountains that sit between the Loess Plateau on the west and the North China Plain on the east. The Fen River Valley can be seen winding its way south through the Taihang Mountains.

Note that from the western edge of the Badain Jaran there is an unbroken path to the wind gap between the Yinshan Mountains on the north and the Helan Mountains on the south, and across the Ordos Plateau to the Taihang Mountains just west of Beijing. The distance from the Yellow River at 40° north latitude, north of the Helan Mountains, east to the Beijing is ~ 830 km (515 mi).

Web Reference
http://en.wikipedia.org/wiki/Loess_Plateau

China's Shadi Deserts

The Sandy Lands of the Loess Plateau & Inner Mongolia

9. Mu Us Shadi; central-southern Ordos Plateau, Inner Mongolia, northern Shaanxi—32,100 sq km

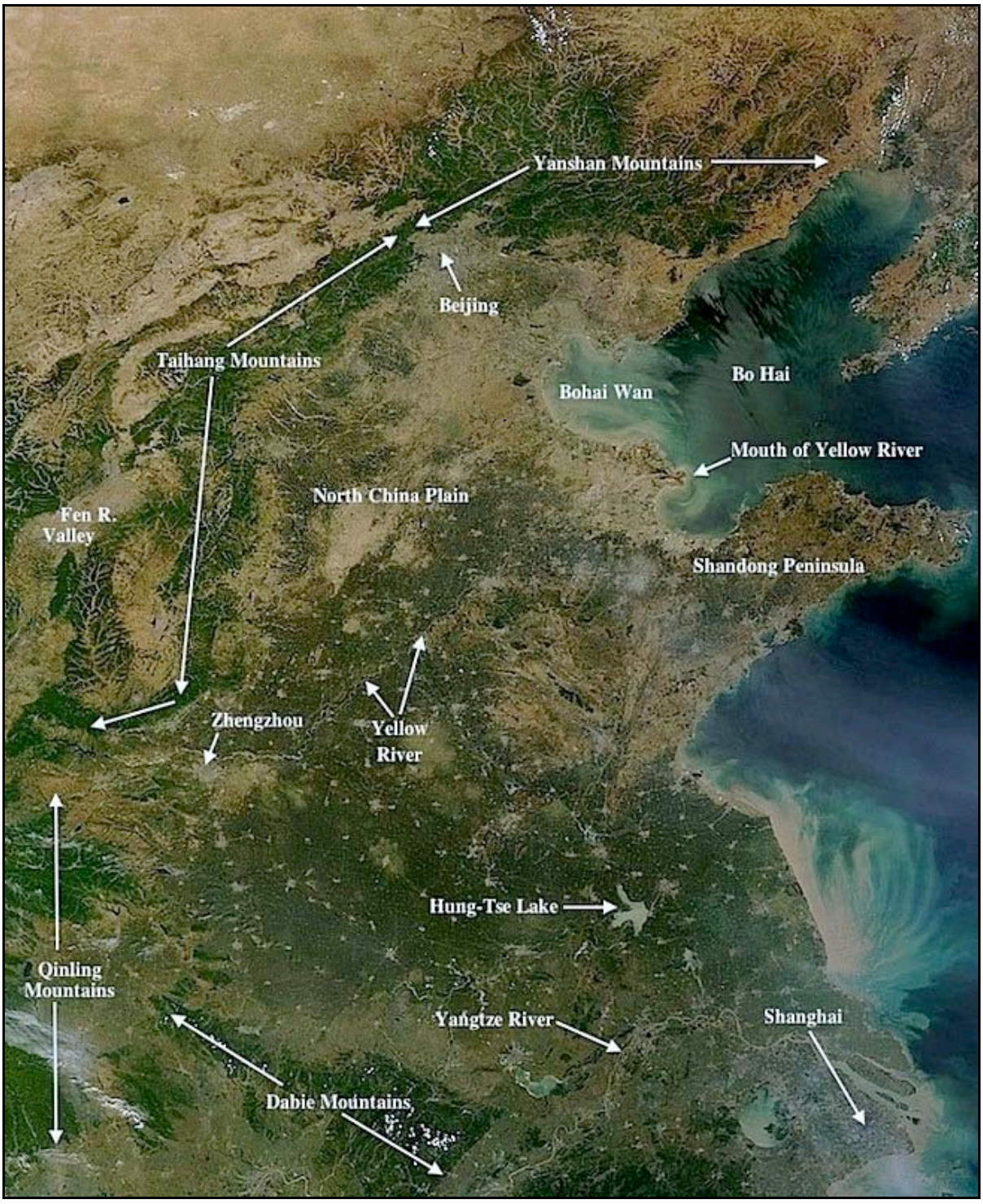
10. Hunshandake Shadi; eastern Inner Mongolia Plateau—21,400 sq km

11. Horqin Shadi; western Liaohe River in eastern Inner Mongolia Plateau and western Northeastern Plains—42,300 sq km

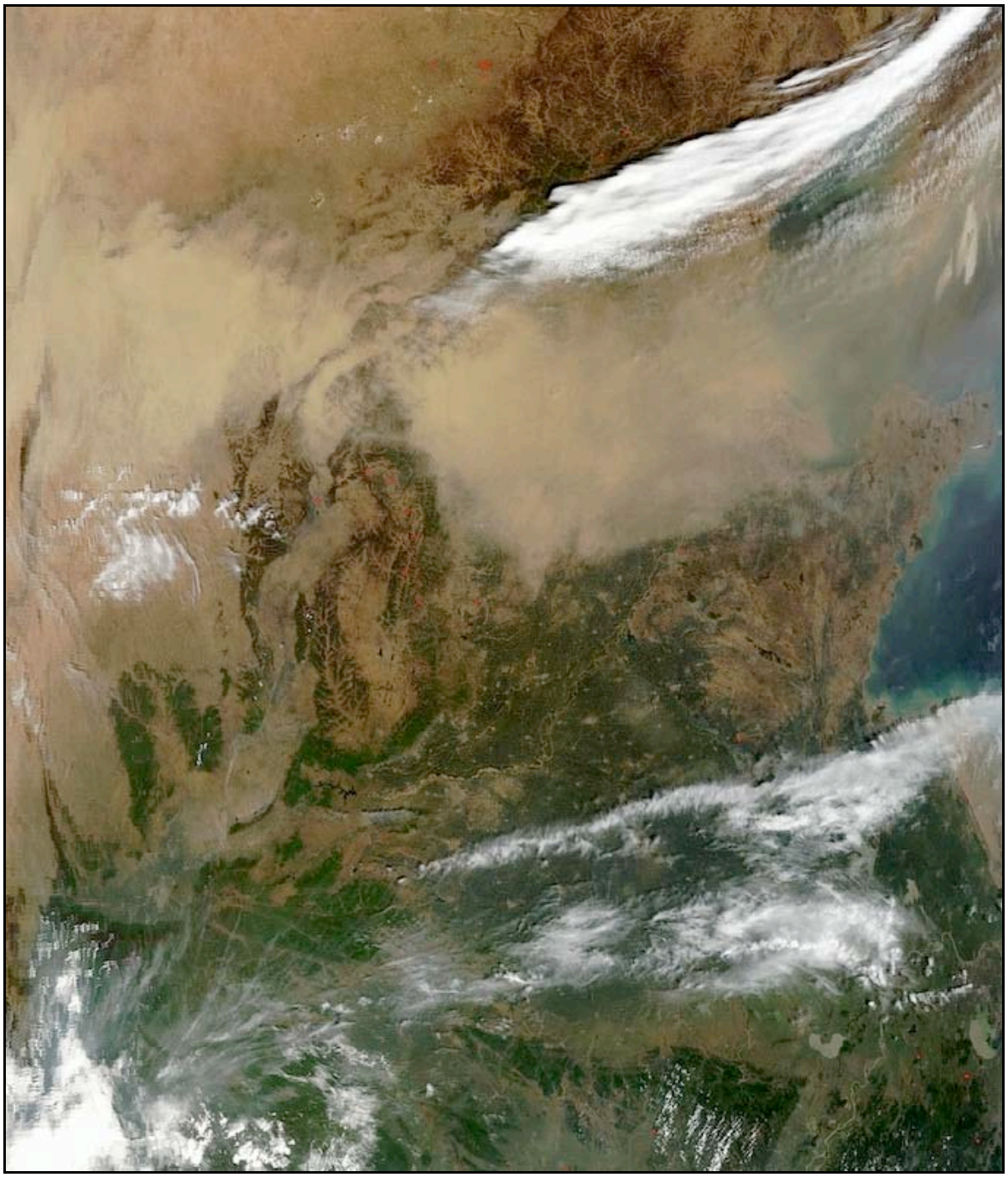
12. Hulun Buir Shadi; Hulun Buir High Plain in northeastern Inner Mongolia—7,200 sq km

Its clear that by looking at the map on page 6, that the sandy lands of China, with the possible exception of the lands called the Mu Us Shadi of the Loess Plateau, contribute little to the problem of dust storms in China. However they play a significant part in the continuing problem of desertification in China which is symptomatic of over-farming, and over-grazing in semi-arid regions.

Web Reference
Freshwater Shortage and Desertification
http://fire.biol.wwu.edu/trent/alles/WaterShortage.pdf

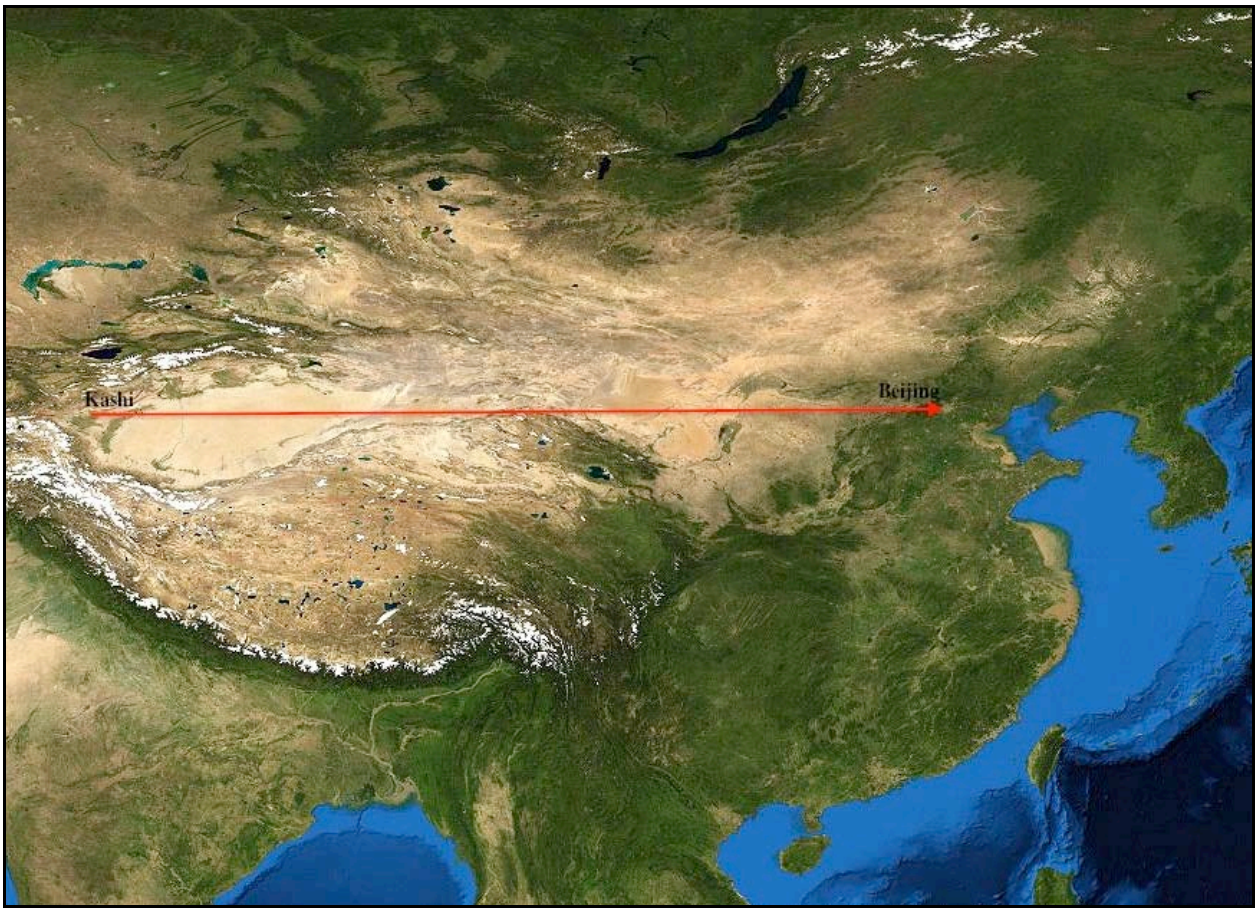


Beijing is near top center in this labeled image of eastern China. The city is surrounded by the Yanshan Mountains to the north and the Taihang Mountains to the west. The north wind gap that lies west of Beijing is centered approximately on 40° north latitude where the Taihang and Yanshan mountains meet. (MODIS/Terra image from May 17, 2012, courtesy of NASA)



Why is all this important?

Above is a dust storm that struck eastern China on April 28, 2005. Also in 2005, a paper in the journal *Nature* (Liu & Diamond, 2005) examined China's changing environment. Between AD 300 and 1949, northeastern China saw a dust storm on average every 31 years. After 1990, the average jumped to one such storm per year. According to news reports at the time this storm hit, the average rate of dust storms for the Beijing region in northeastern China was five to six a year.



To understand the varying effects of the dust storms that form in China's deserts, it's necessary to distinguish between their extent, as measured by area affected, and their severity, as measured by wind speed and particulate load. Most dust storms in China are local or regional in extent. The regions of the Tarim Basin, the Alxa Plateau, and the central Mongolia Plateau all experience storms of varying severity that are localized because of wind direction and topography. In contrast, major dust storms are those that cross multiple regions. Dust from major storms has reached east to Korea, Japan, even across the Pacific to North America.

For further information on both regional and multiple regional dust storms in China go to **Geomorphology and Dust Storms in China at:**

http://fire.biol.wwu.edu/trent/alles/ChinaDust.pdf

Appendix One: Major Deserts and Sandy Lands of China

1. Taklimakan **Shamo**, Tarim Basin, Xinjiang—337,600 sq km

2. Gurbantunggut **Shamo**, Jungger Basin, Xinjiang—48,800 sq km

3. Kumtag **Shamo**, eastern Xinjiang, western Gansu, southern Lop Nur region, northern Altun mountain range—22,900 sq km

4. Qaidam **Shamo**, Qaidam Basin, Qinghai—34,900 sq km

5. Badain Jaran **Shamo**, western Alxa Plateau, Inner Mongolia—44,300 sq km

6. Tengger **Shamo**, southeastern Alxa Plateau, Inner Mongolia—42,700 sq km

7. Ulan Buh (Wulanbuhe) **Sandy Desert**, northeastern Alxa Plateau, north of the Helan Mountains, Inner Mongolia—9,900 sq km

8. Hobq (Kubuqi) **Sandy Desert**, northern Ordos Plateau, south of the Yellow River, Inner Mongolia—16,700 sq km

9. Mu Us (Maowusu) **Shadi** (sandy lands), central-southern Ordos Plateau, Inner Mongolia, northern Shaanxi—32,100 sq km

10. Hunshandake **Shadi** (sandy lands), eastern Inner Mongolia Plateau—21,400 sq km

11. Horqin **Shadi** (sandy lands), western Liaohe River in eastern Inner Mongolia Plateau and western Northeastern Plains—42,300 sq km

12. Hulun Buir **Shadi** (sandy lands), Hulun Buir High Plain in northeastern Inner Mongolia—7,200 sq km

13. Turpan Kumtag **Sandy desert**, Turpan Basin, Xinjiang—2,500 sq km

("**Shamo**" as used above describes an area of both sandy and gobi type deserts. The term "**Sandy Desert**" is used to denote a desert of sand alone. The term "**sandy lands**" (**Shadi**) are semi-arid grasslands that may have pockets of sandy ground.)

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