



Digital Diagnostic Atlas: MURGAB RIVER BASIN

Zafar Gafurov and Sarvarbek Eltazarov



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International Water Management Institute (IWMI)



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/ river basins / digital technology / maps / simulation models / satellite imagery / climate change / irrigation / soils / vegetation / Central Asia /

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Project



The geodatabase and digital diagnostic atlas were generated within the framework of the “Transboundary Water Management in Central Asia” project being implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with the International Water Management Institute (IWMI) and the Ministry of Agriculture and Water Resources of Turkmenistan. Since 2009, the project has been supporting the five Central Asian states (Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan and Tajikistan) in strengthening regional water cooperation, application of Integrated Water Resources Management (IWRM), and river basin planning.

For further details about the project, visit:

<https://www.giz.de/en/worldwide/15176.html>

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Federal Foreign Office

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Introduction

"Transboundary Water Management in Central Asia" project, funded by the German Federal Foreign Office since 2009, supports the five Central Asian states in strengthening regional water cooperation, IWRM application and basin planning. An essential prerequisite for basin planning is sound data and information on actual water and land resources and their use within the basin. The primary goal of the program is to move forward a process of political rapprochement in Central Asia that leads to closer cooperation in the use of the scarce water resources and may result in joint water management in the long term. The program aims to foster regional institutional cooperation, especially among institutions that regulate matters of water distribution in Central Asia such as the Interstate Commission for Water Coordination (ICWC) and the International Fund for Saving the Aral Sea (IFAS), so that these institutions have stronger positions in the political system to make tangible impacts. Principles of river basin management are being introduced and applied in selected transboundary river basins in Central Asia to strengthen transboundary management practices. To this end, capacity of water management organizations is being improved both on institutional and individual levels.

A strong and permanent element of the project is data generation in water-related state aspects, with a view to specifically developing a geodatabase and digital diagnostic atlas using open source data.

Data Accuracy and Reliability

The Digital Diagnostic Atlas of Murgab River Basin was created using open source GIS, Remote Sensing and analogue information which was already published by world renowned organizations and used in public projects and scientific research certified by international agencies.

Availability and Accessibility

The Digital Diagnostic Atlas of Murgab River Basin can be obtained in digital form for use by external parties with the approval of the Ministry of Agriculture and Water Resources of Turkmenistan and GIZ.

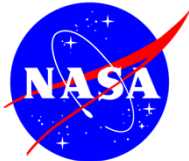
Software Employed

This geodatabase and the associated maps were created on a computer machine running Windows 10 Professional and using QGIS 2.17, Google Earth Engine. End users should download the package that is most appropriate for the version of QGIS software that they are using. It is important to note that QGIS is not only required to make use of the map package and the associated geodatabase.

Data Sources



International Water Management Institute (IWMI)



National Aeronautics and Space Administration - Land Data Products and Services (NASA LP DAAC)



International Center for Agricultural Research in the Dry Areas (ICARDA)



Central Asian Countries Initiative for Land Management (CACILM)



European Space Agency (ESA)



World Climate Research Programme (WCRP),
Coupled Model Intercomparison Project (CMIP)

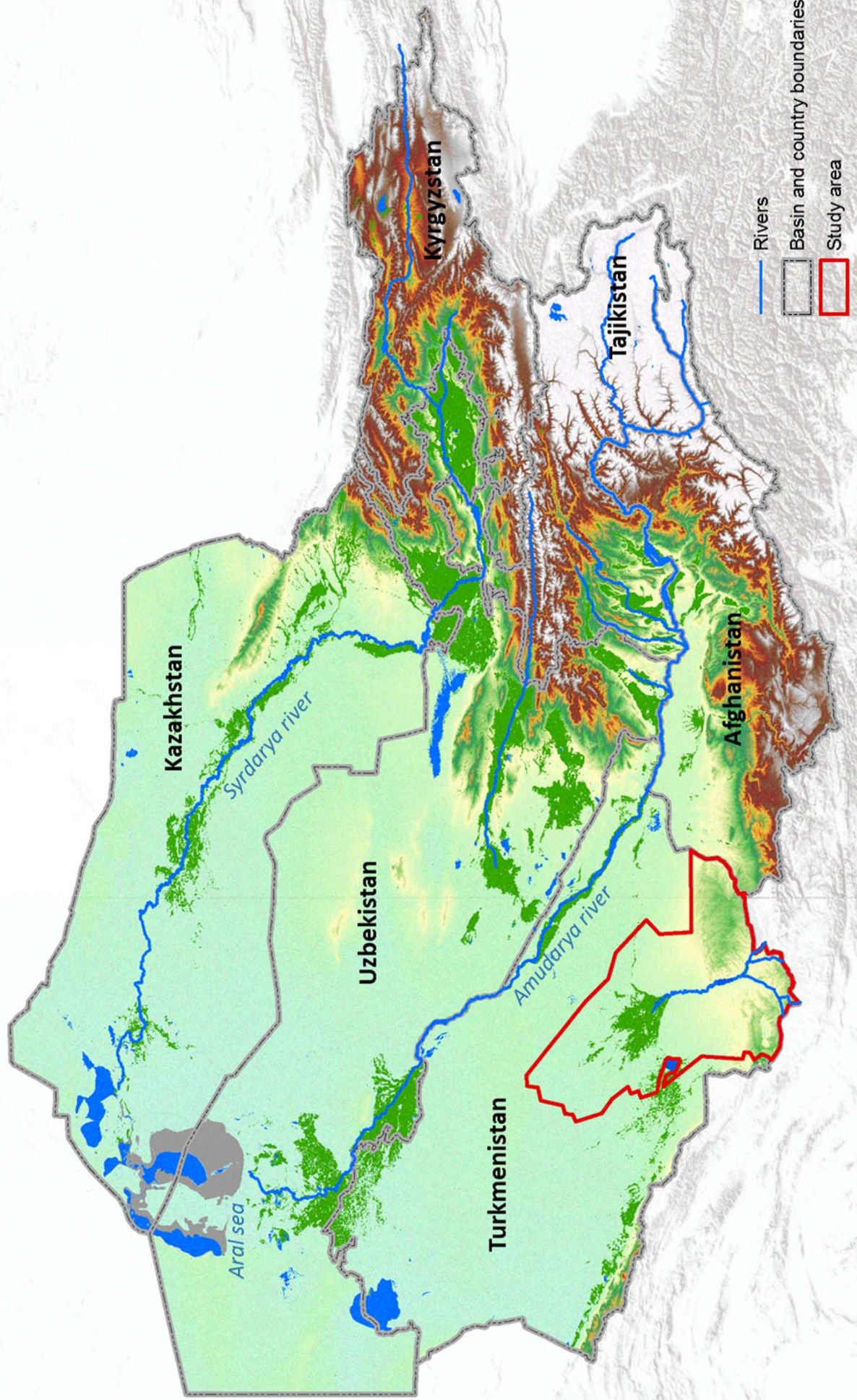
Map Projection and Coordinate System

Map projections describe the techniques that represent the Earth's curved surface on a flat map. Coordinate systems describe the grid referenced and measurement units, effectively translating the map projection. In order to overlay the GIS layers on each other, a single data frame is required. In the geodatabase, the layers are projected into a common coordinate system World Geodetic System 1984.

Objective and Recommendation for Use

The main objective of the Digital Diagnostic Atlas of Murgab River Basin is to provide data, maps, charts, and infographics on water and land resources of the region in a consolidated form. The authors hope that it can be used as a tool to inform management practices and support decision making at the local, national, and regional levels.

Aral Sea Basin



Satellite view

Mary province is one of the five provinces of Turkmenistan. It is located in the south-eastern part of the country, bordering Afghanistan. Its capital is the city of Mary. With an area of 87,150 km² (33,650 sq. mi) and a population of about 1.5 million, the province has an average population density of about 15 persons per square kilometer but reaches 150-200 per square kilometer in the most developed oases. Mary province's agriculture is irrigated by the Karakum Canal, which flows east to west through the heart of the province, and by the Murgab River, which flows south to north, entering the province from Afghanistan. While the northern portion of the province is within the Central Asian southern desert ecoregion, the southern portion of the province is characterized by a savanna of pistachio and desert sedges, known as the Badkhez-Karabil semi-desert.

Lebap province

Ahal province

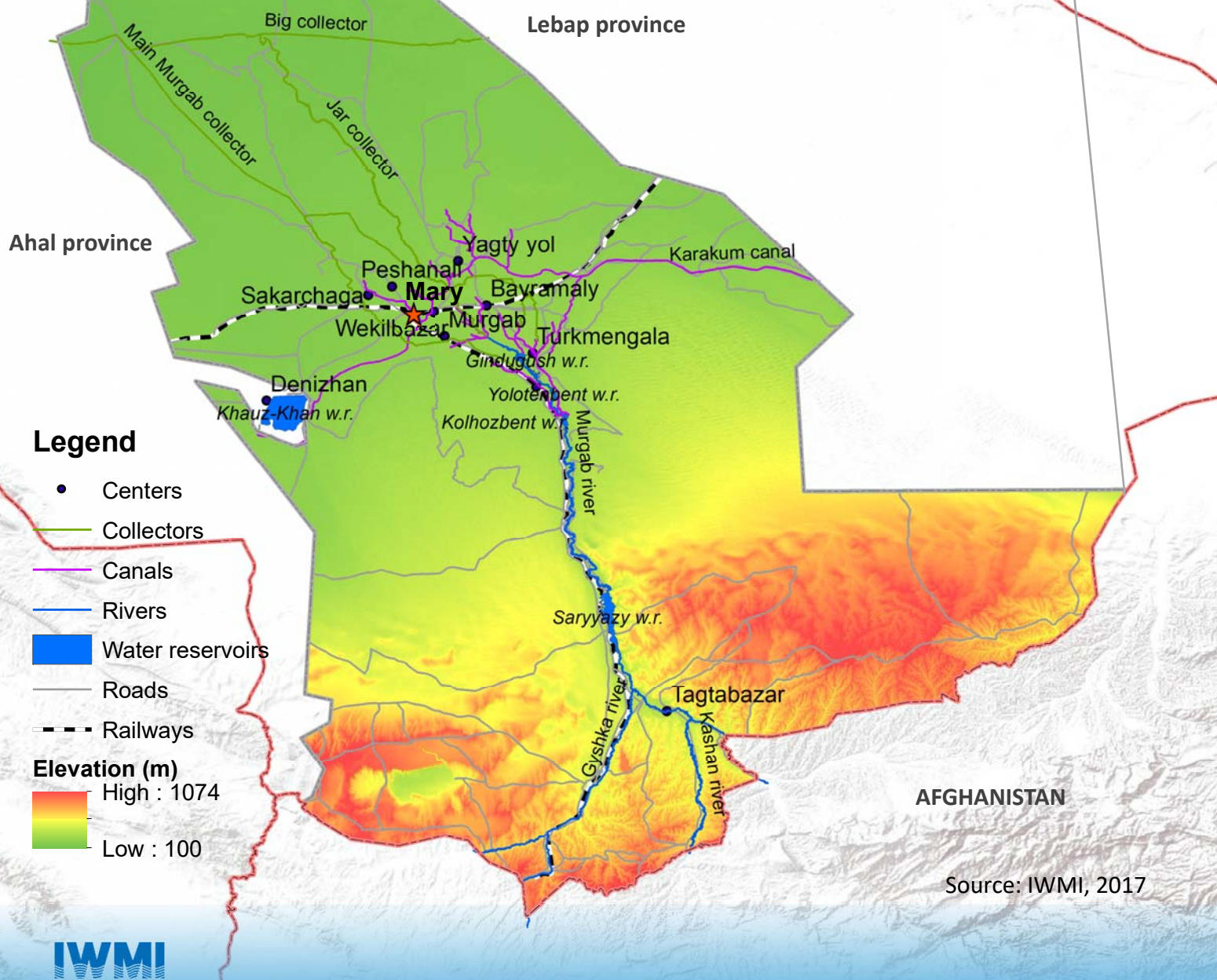
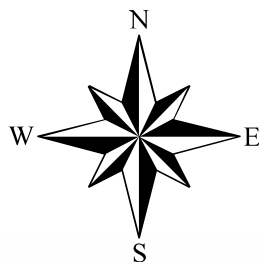
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AFGHANISTAN

Source: IWMI, 2017

UZBEKISTAN

Location map (Mary, Turkmenistan)



AFGHANISTAN

Source: IWMI, 2017

UZBEKISTAN

Administrative map

Lebap province

Legend

- ★ Capital city
- District centers
- Roads
- - - Railways

Ahal province

PAKISTAN

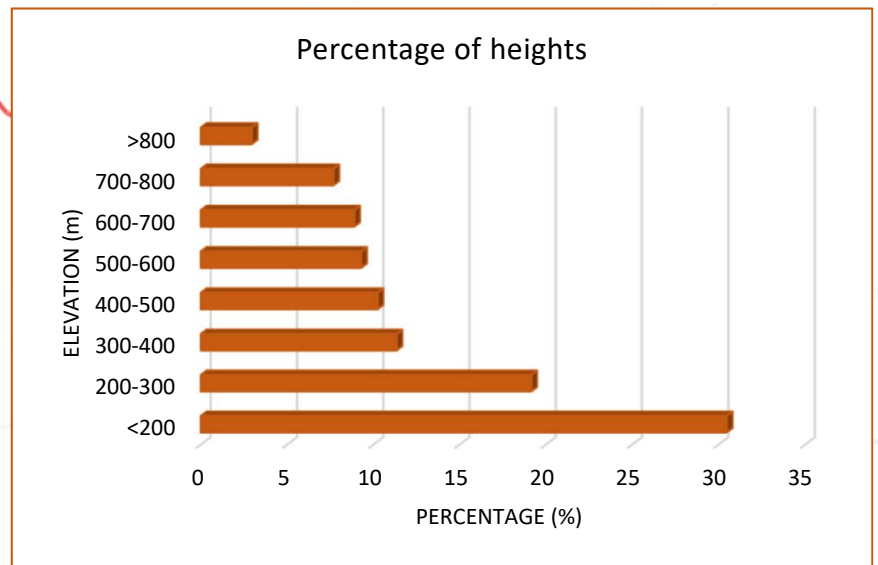


AFGHANISTAN

Source: IWMI, 2017

UZBEKISTAN

Digital Elevation Model



Lebap province

Legend

Elevation (m)
High : 1074
Low : 100

Ahal province

PAKISTAN

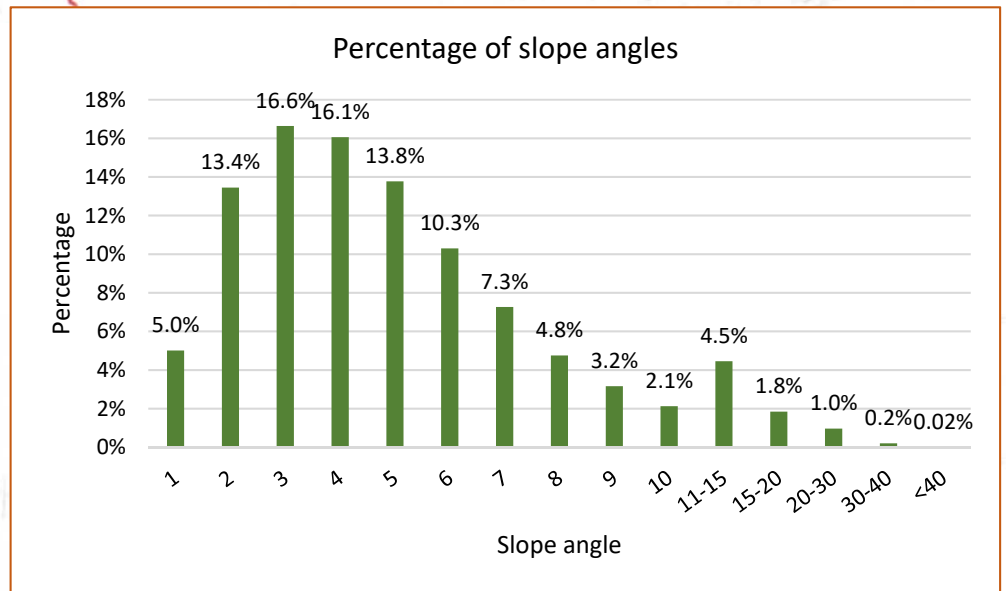


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Source: NASA LP DAAC, 2015

UZBEKISTAN

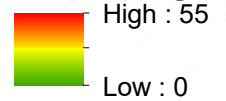
Slope map



Lebap province

Legend

Slope (degree)



Ahal province

PAKISTAN



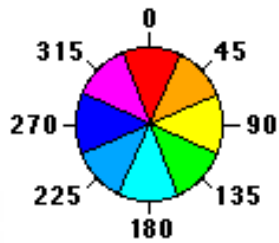
AFGHANISTAN

Source: IWMI, 2017

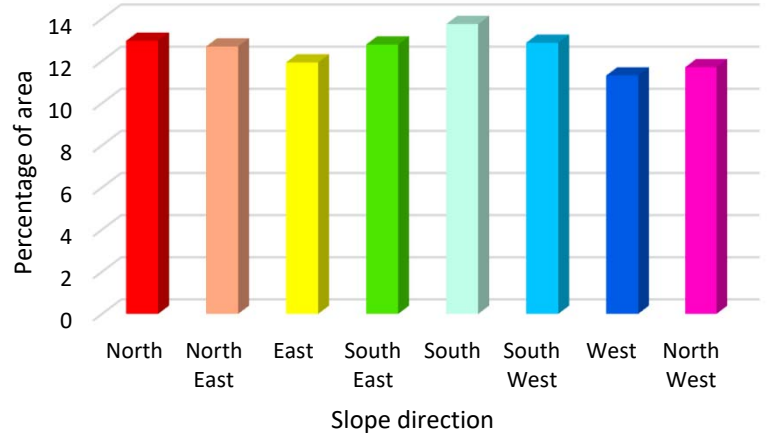
UZBEKISTAN

Aspect map

Hue indicates direction of aspect



Percentage of areas, by slope direction



Lebap province

Ahal province

Legend

Slope direction



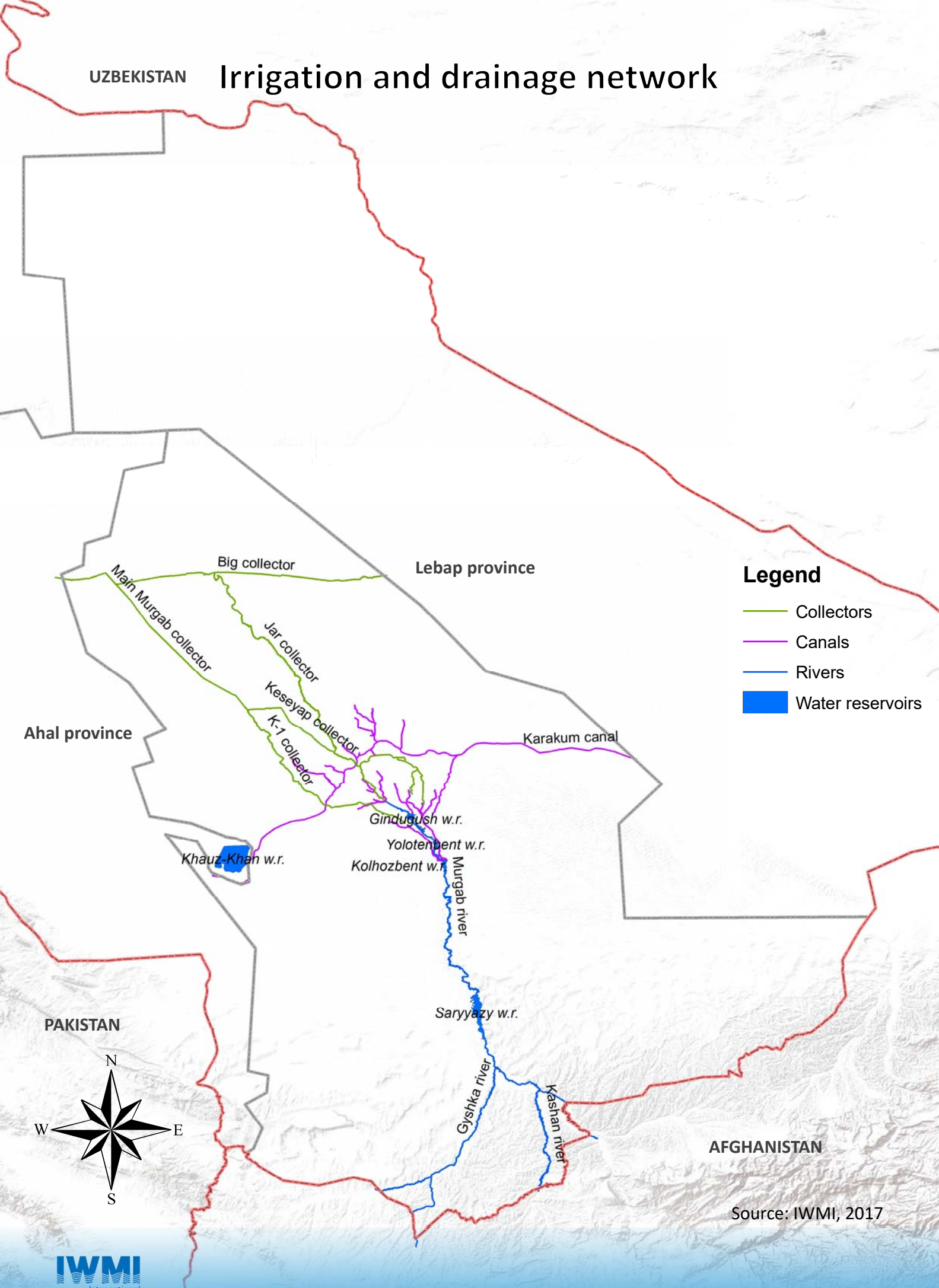
PAKISTAN



AFGHANISTAN

Source: IWMI, 2017

Irrigation and drainage network



Legend

- Collectors
- Canals
- Rivers
- Water reservoirs

PAKISTAN



AFGHANISTAN

Source: IWMI, 2017

Watershed map



Source: IWMI, 2017

Soil types

UZBEKISTAN**Lebap province**

Ahal province

PAKISTAN

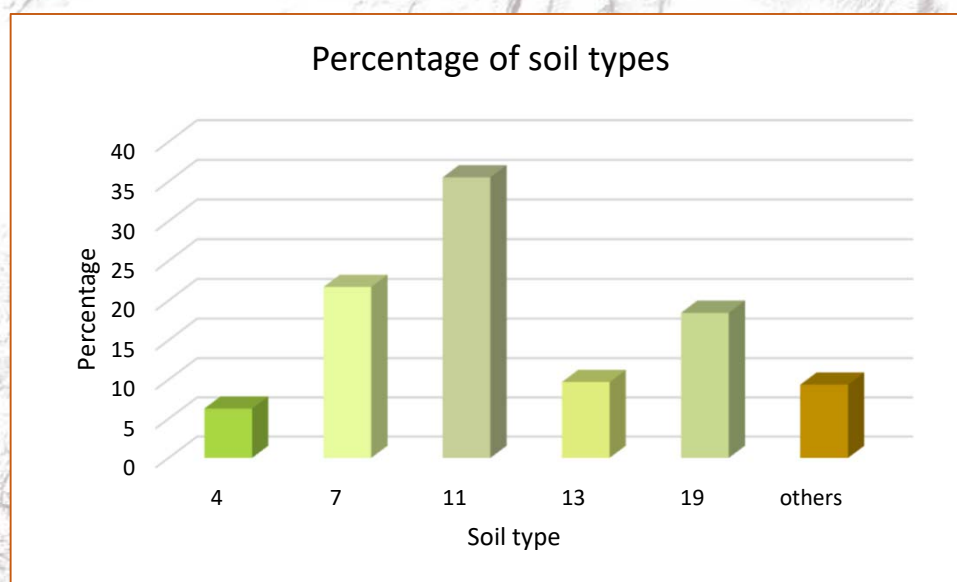


AFGHANISTAN

Source: CACILM, 2009

Legend

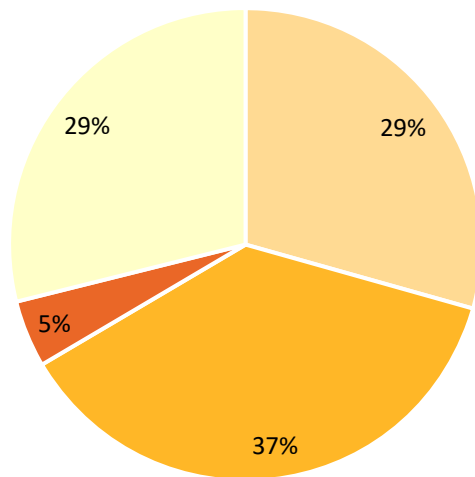
- 1. Blown and poor fixed sands
- 2. Desert sandy solonchak-like on wind deposits, proluvium and aluvium
- 3. Desert solonchaks
- 4. Irrigated meadow
- 5. Irrigated meadow-desert sandy
- 6. Light sierozem subtropic hot unfreeze through
- 7. Light-brown desert subtropic unfreeze through
- 8. Meadow desert (takir-like) soils
- 9. Meadow desert sandy
- 10. Meadow-oasis saline and irrigated meadow-desert (takir-like)
- 11. Sand (50%) and sandy desert (50%)
- 12. Sand (60%) solonchak (40%)
- 13. Sand (70%) takir-like (15%) and takir (15%)
- 14. Sandy desert (60%) and light-brown (40%)
- 15. Takir (50%) and takir-like (50%)
- 16. Takir-like desert subtropic unfreeze through
- 17. Takirs and meadow takirs
- 18. Terrace, screes and rock yield
- 19. Typical sierozem subtropic hot unfreeze through



UZBEKISTAN

Soil salinity

Percentage of areas, by salinity levels



Lebap province

Legend

Soil salinity level

- Non saline
- Slightly saline
- Moderately saline
- Strongly saline

Ahal province

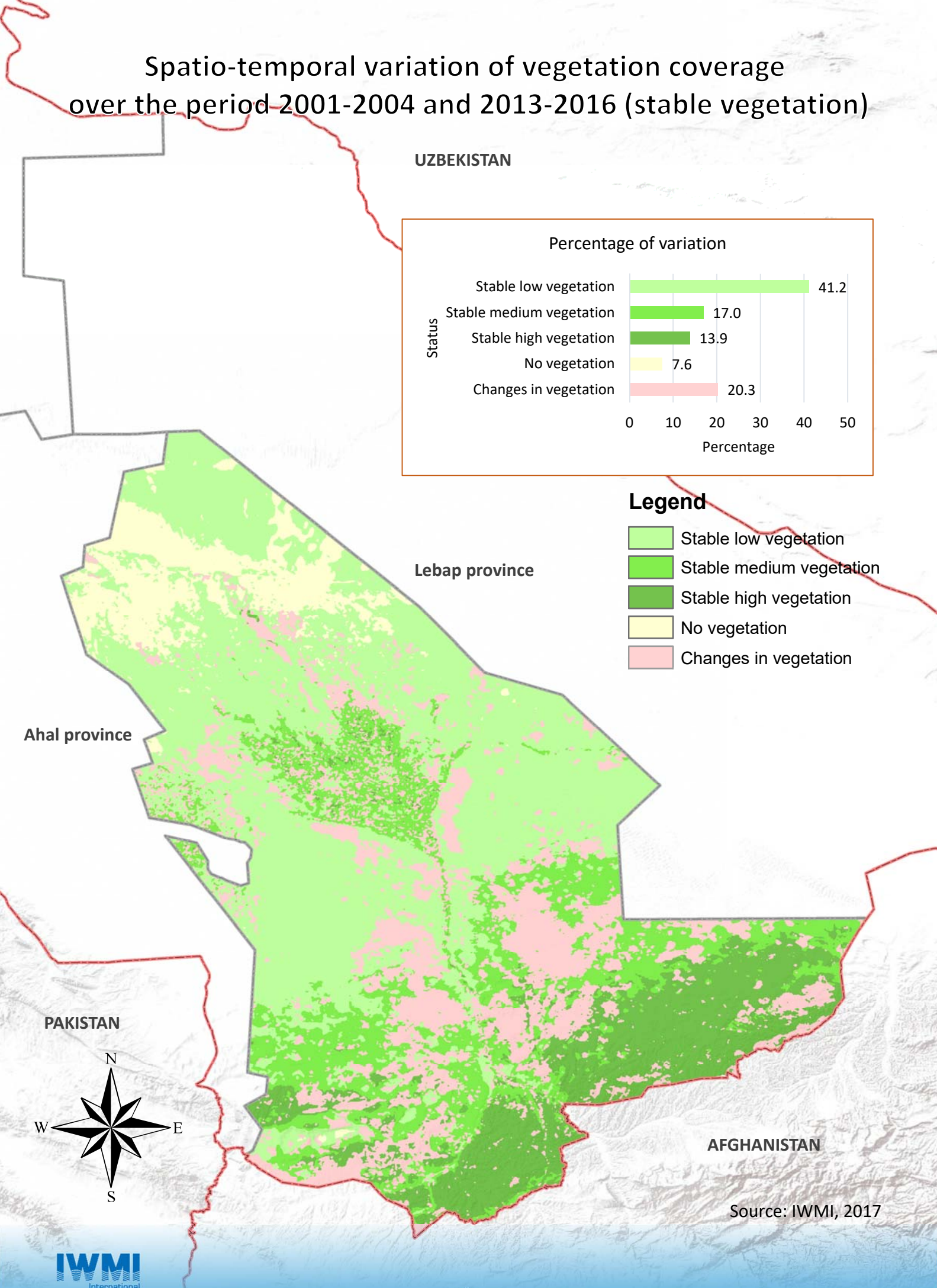
PAKISTAN



AFGHANISTAN

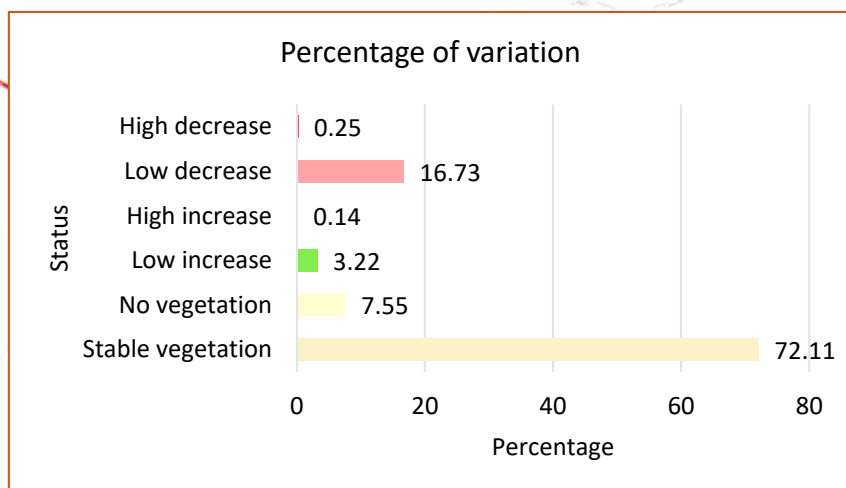
Source: ECO Geoscience Database 2016

Spatio-temporal variation of vegetation coverage over the period 2001-2004 and 2013-2016 (stable vegetation)



Spatio-temporal variation of vegetation coverage over the period 2001-2004 and 2013-2016 (changes in vegetation)

UZBEKISTAN



Legend

- High decrease
- Low decrease
- High increase
- Low increase
- No vegetation
- Stable vegetation

Lebap province

Ahal province

PAKISTAN



AFGHANISTAN

Source: IWMI, 2017

Land use / Land cover in 2015

Legend

- Bare areas
- Cropland, irrigated or post-flooding
- Cropland, rainfed
- Grassland
- Herbaceous cover
- Mosaic cropland (>50%) / natural vegetation (tree, shrub, herbaceous cover) (<50%)
- Mosaic natural vegetation (tree, shrub, herbaceous cover) (>50%) / cropland (<50%)
- Mosaic tree and shrub (>50%) / herbaceous cover (<50%)
- Shrubland
- Sparse vegetation (tree, shrub, herbaceous cover) (<15%)
- Urban areas
- Water bodies

Lebap province

Ahal province

PAKISTAN

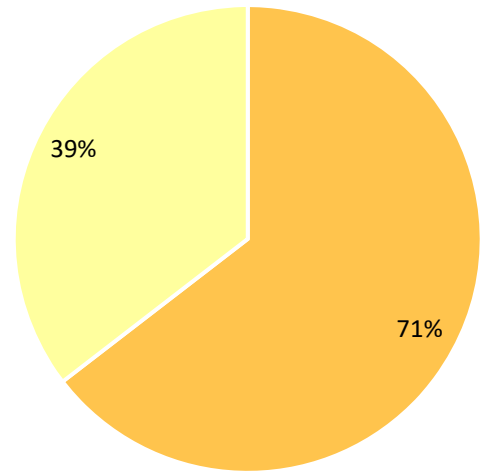


AFGHANISTAN

Source: ESA, 2015

Climate zones

Percentage of climate zones



Legend

- Cold desert climate (BWk)
- Cold semi-arid climate (BSk)

Ahal province

Lebap province

PAKISTAN

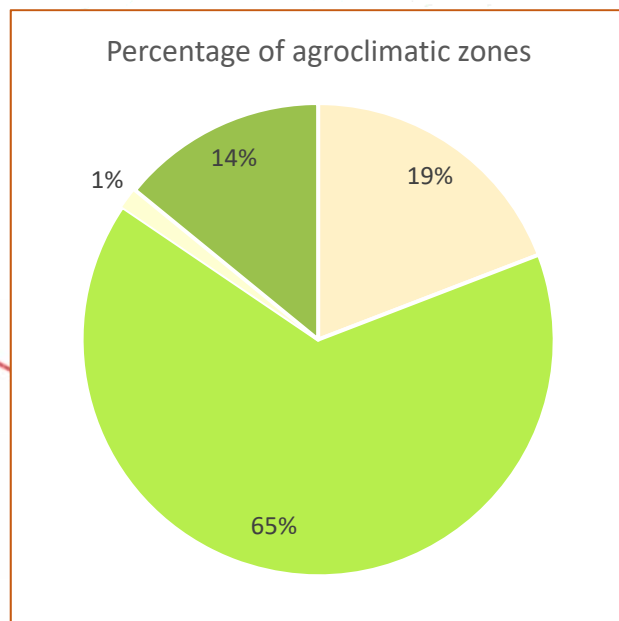


AFGHANISTAN

Source: Kottek et al., 2006

UZBEKISTAN

Agroclimatic zones



Lebap province

Legend

- Arid, cold winter, cool summer
- Arid, cool winter, very warm summer
- Arid, cool winter, warm summer
- Semi-arid, cold winter, warm summer

Ahal province

PAKISTAN



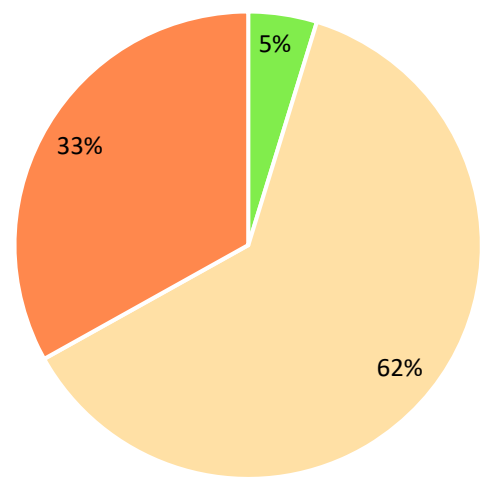
AFGHANISTAN

Source: De Pauw, 2008

UZBEKISTAN

Potential EvapoTranspiration Zones

Percentage of EvapoTranspiration zones



Legend

PET(mm)

- 1200-1400
- 1400-1600
- 1600-1800

Ahal province

Lebap province

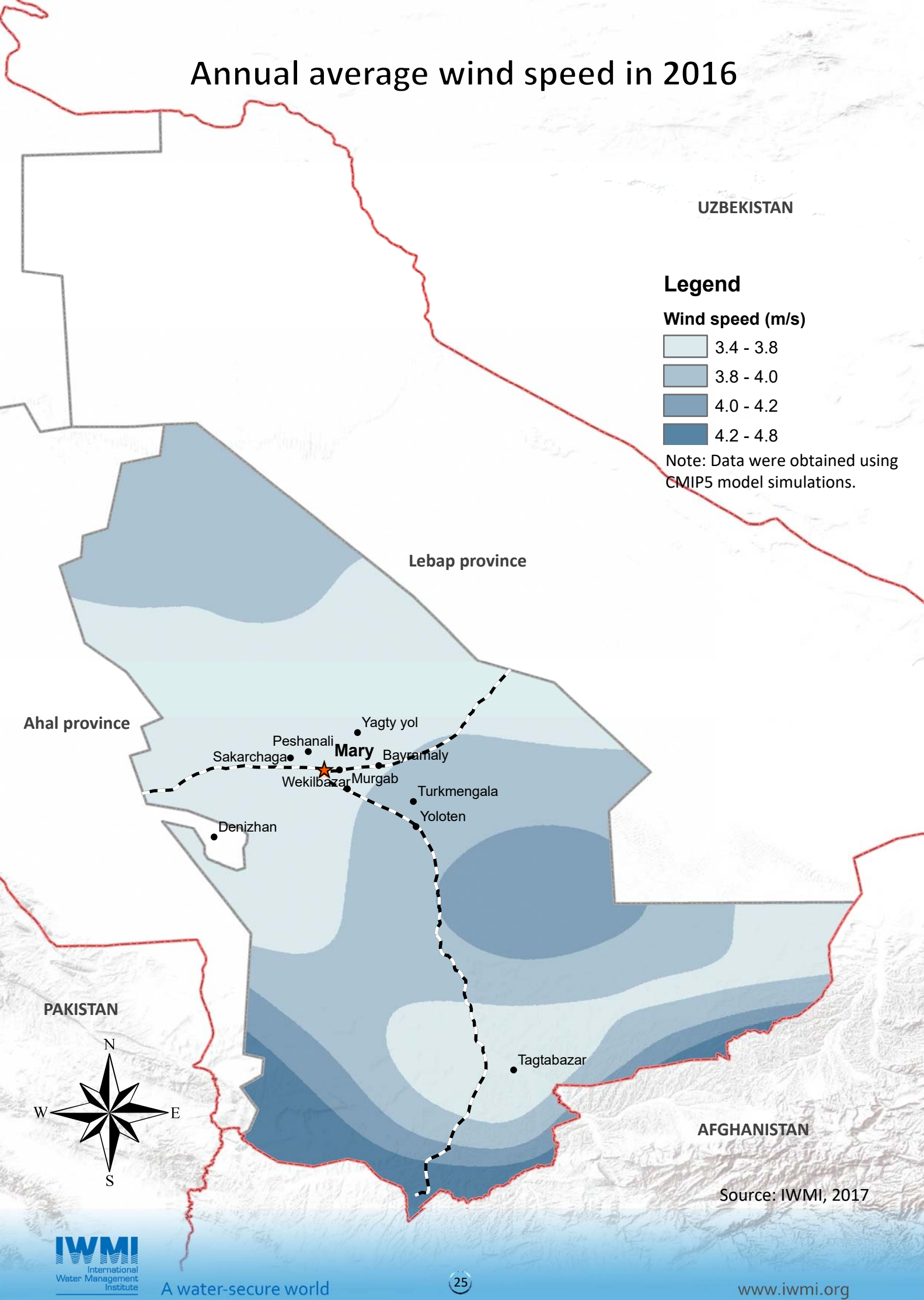
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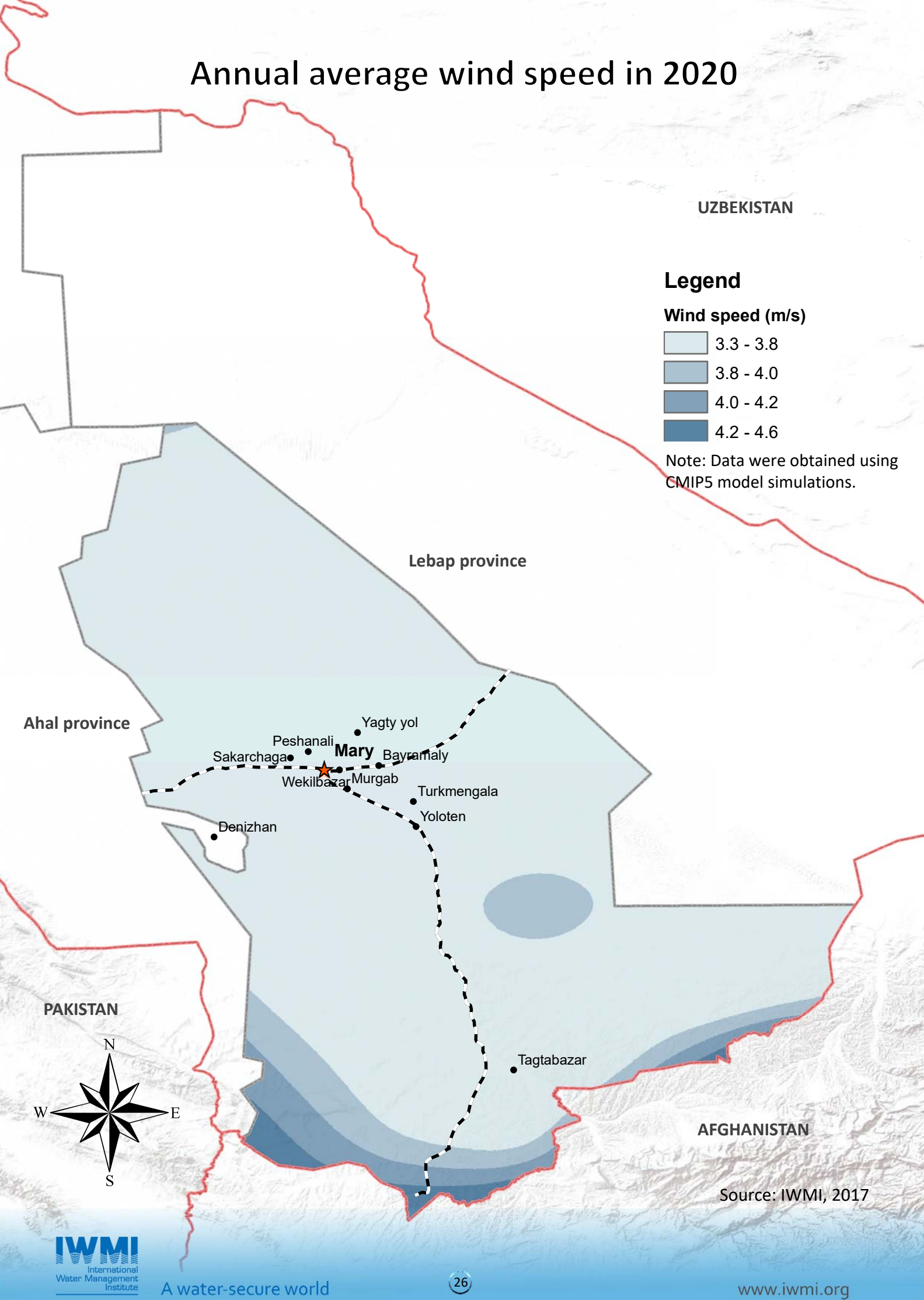
AFGHANISTAN

Source: De Pauw, 2008

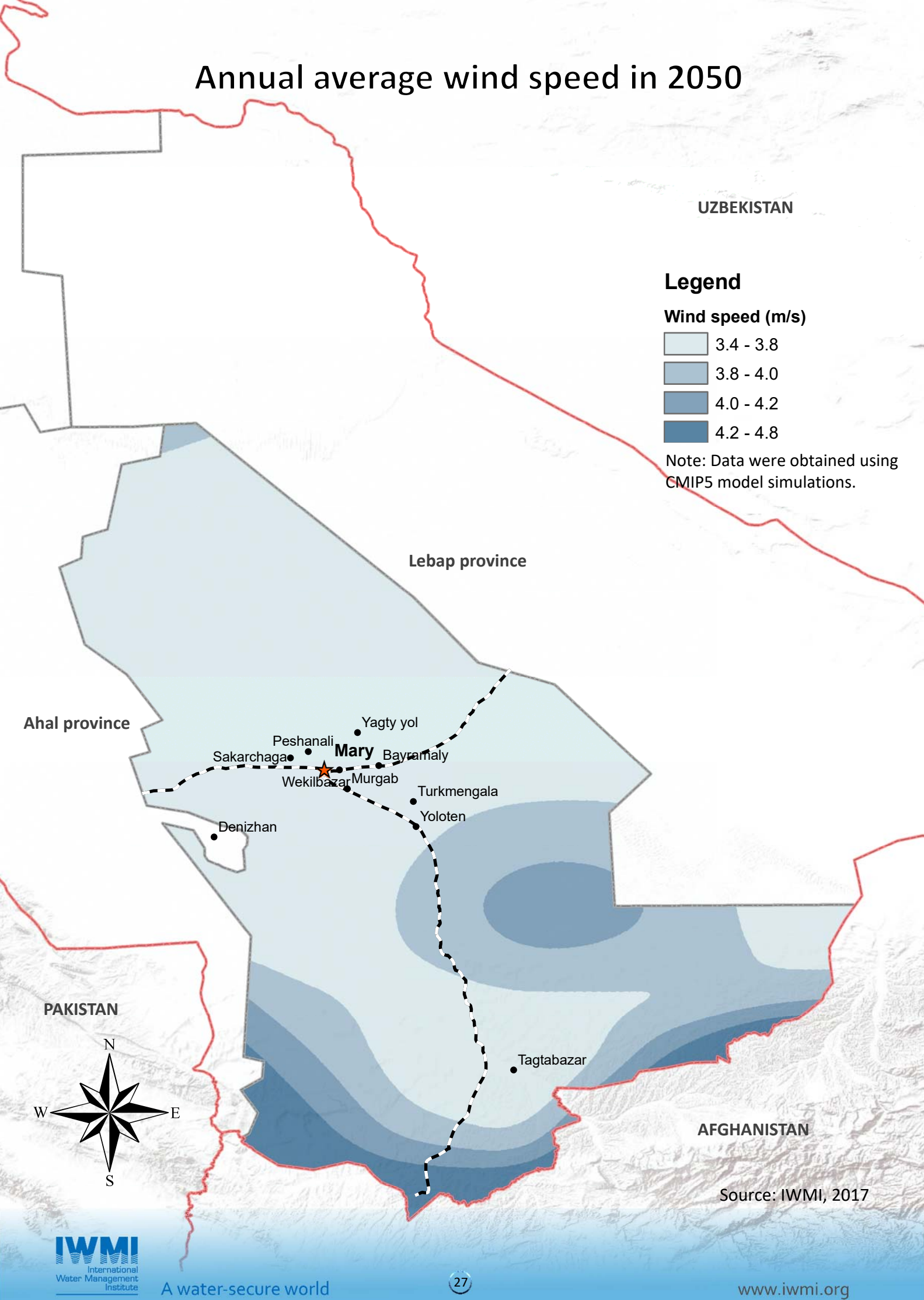
Annual average wind speed in 2016



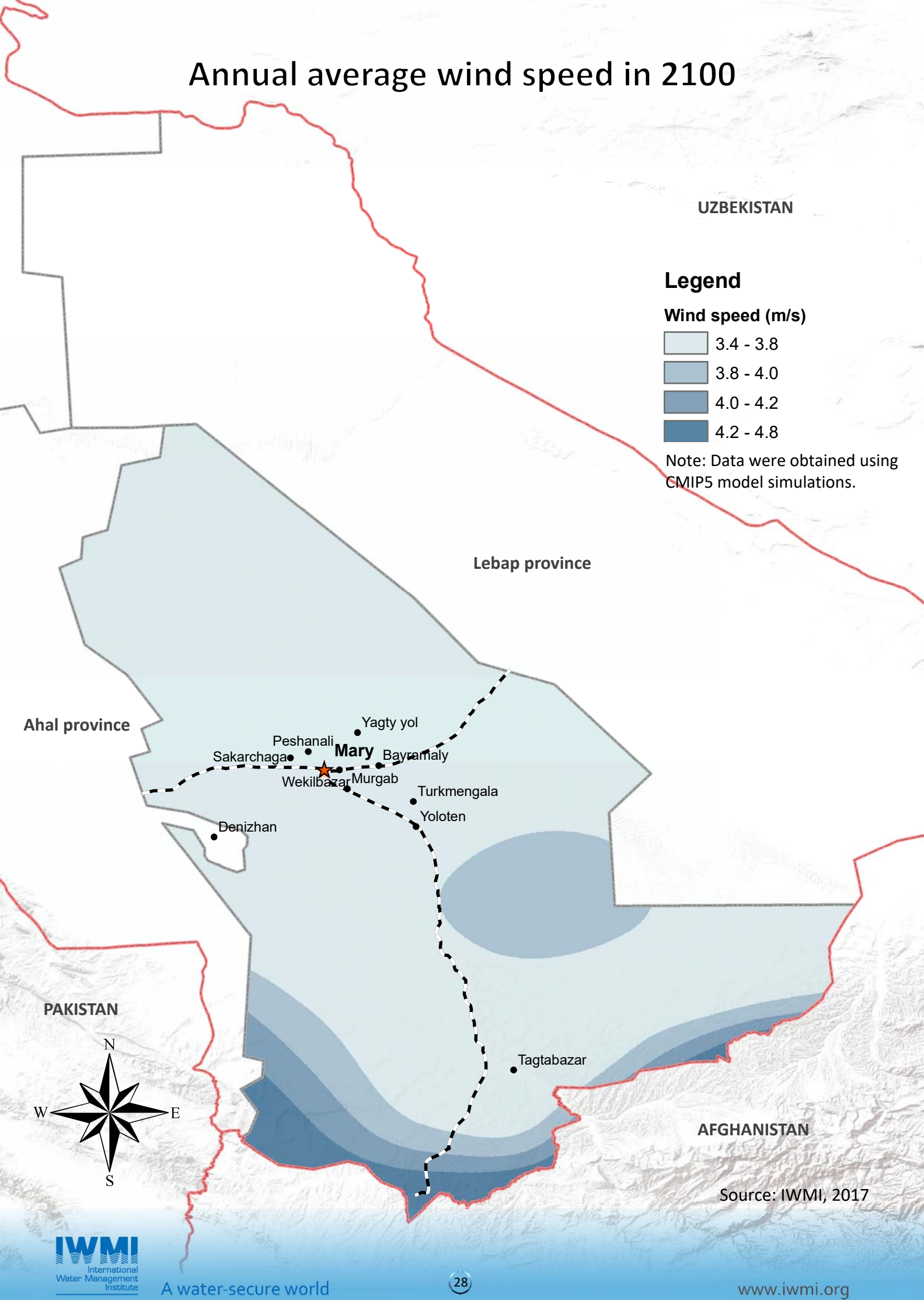
Annual average wind speed in 2020



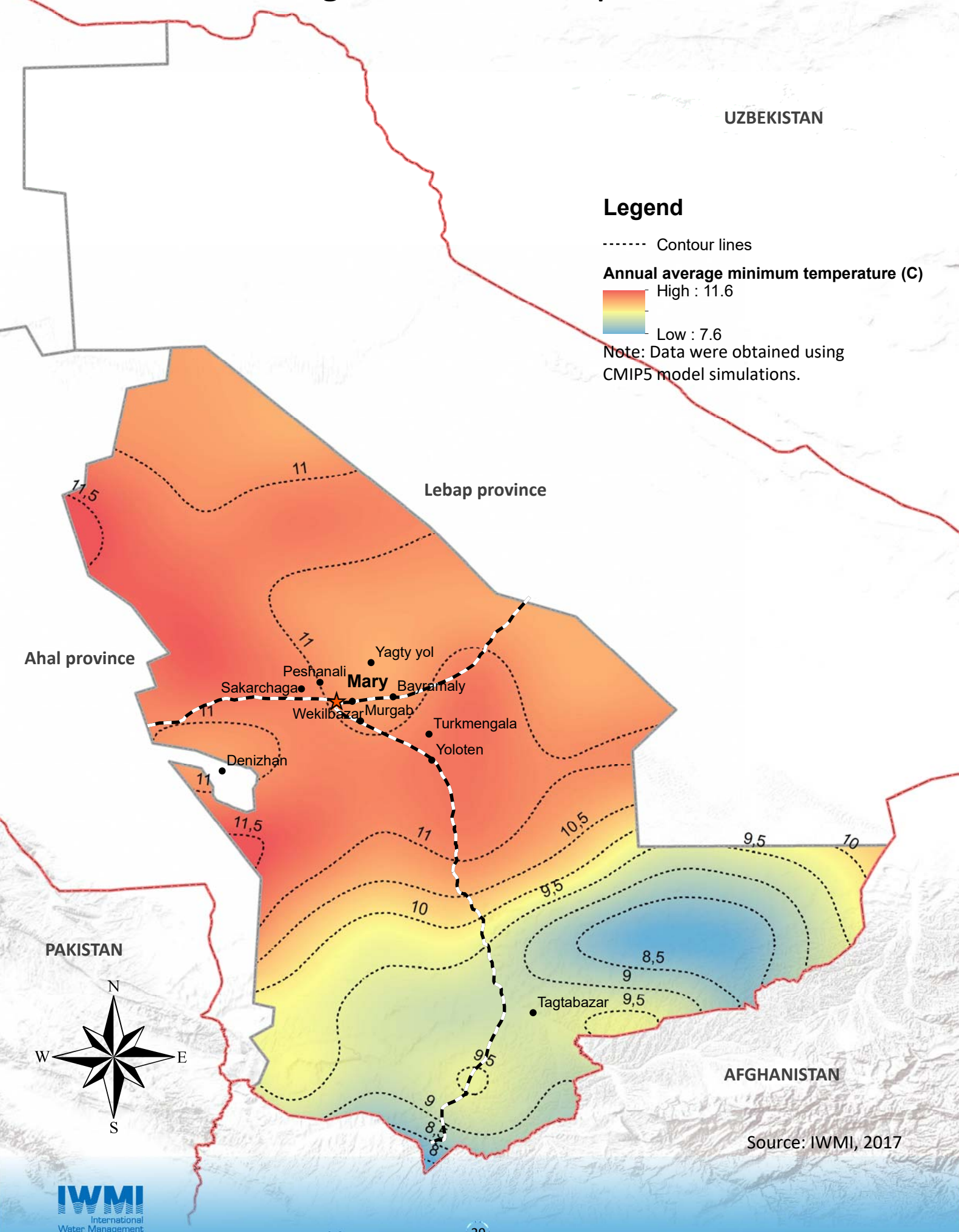
Annual average wind speed in 2050



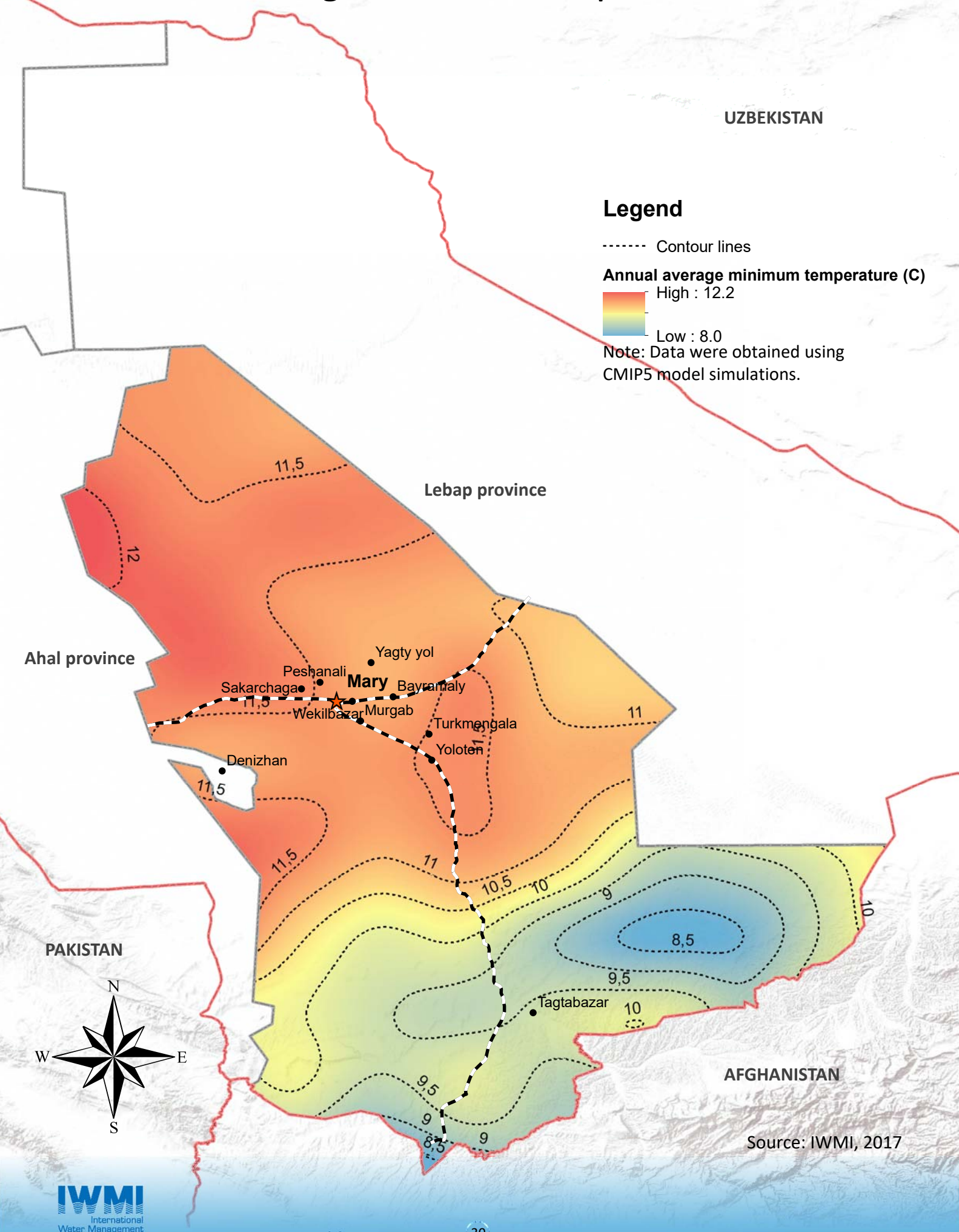
Annual average wind speed in 2100



Annual average minimum temperature in 2016

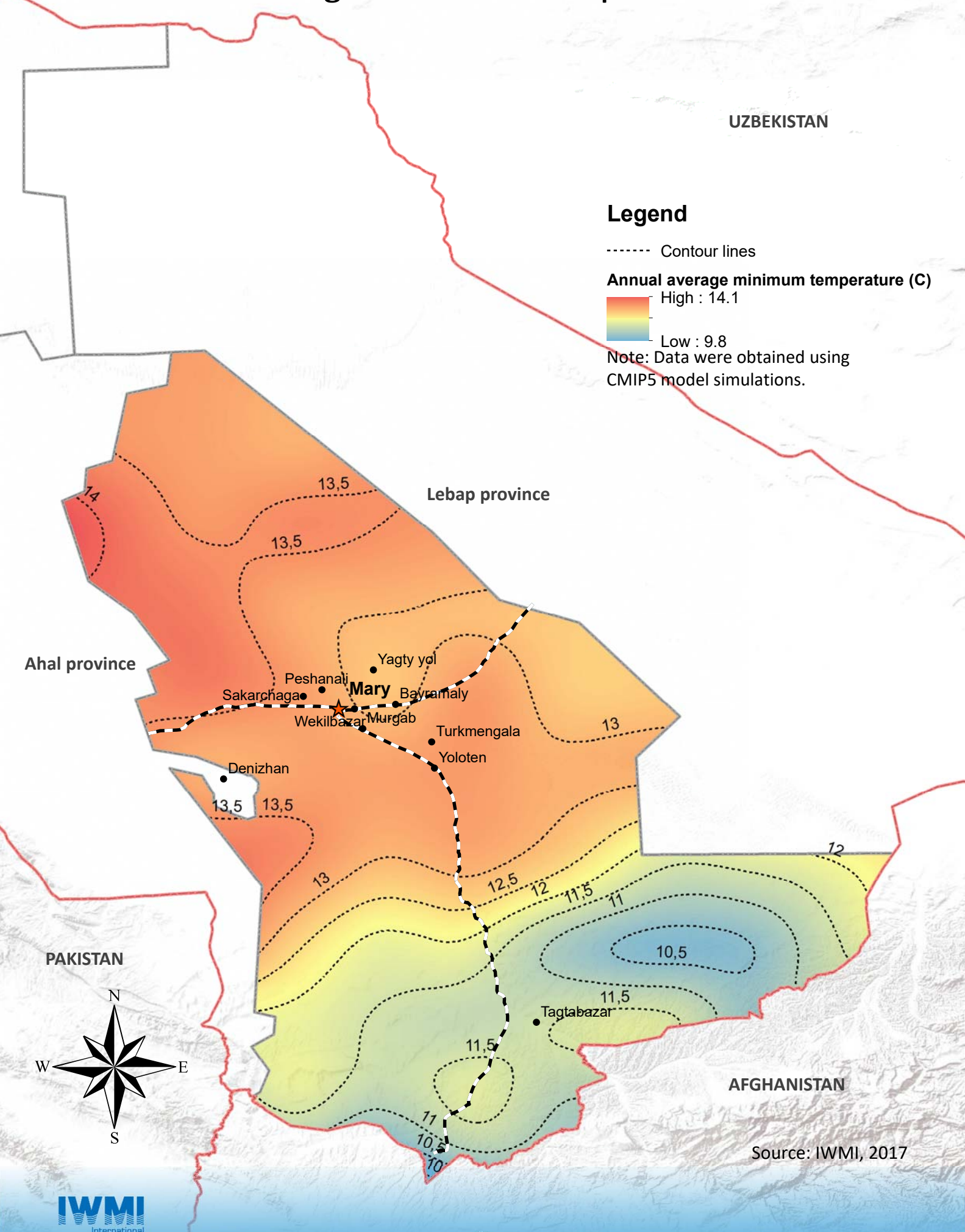


Annual average minimum temperature in 2020



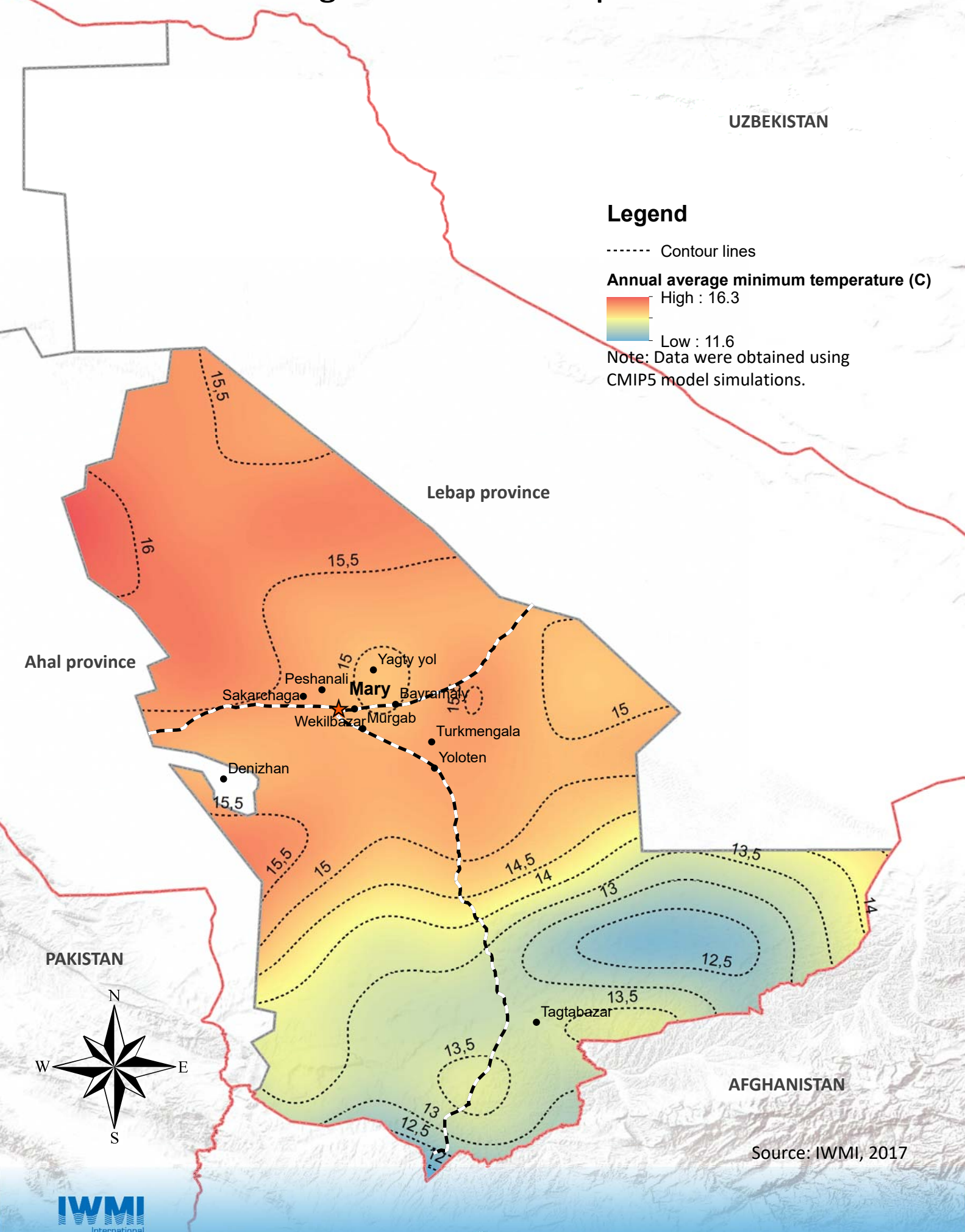
Source: IWMI, 2017

Annual average minimum temperature in 2050



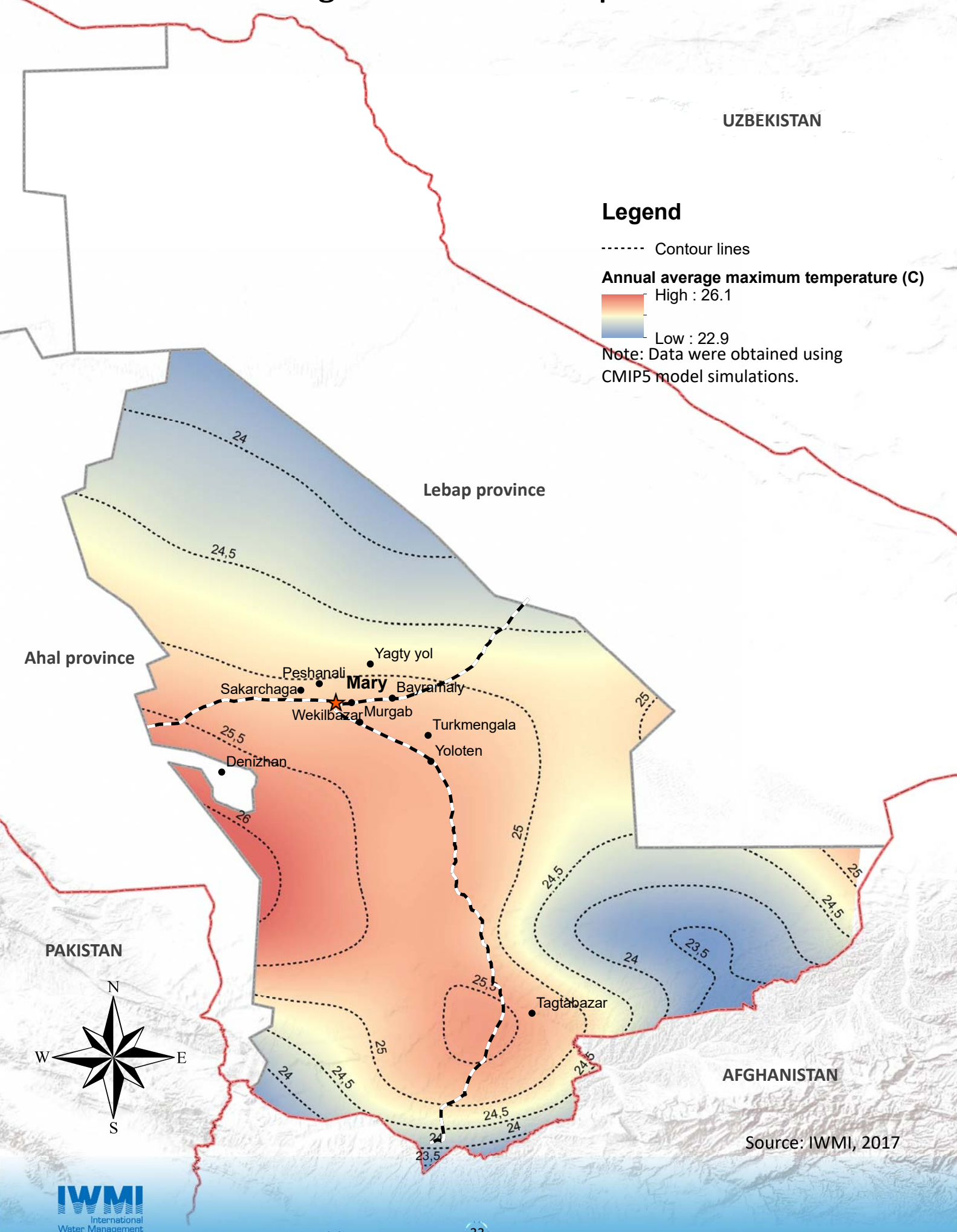
Source: IWMI, 2017

Annual average minimum temperature in 2100

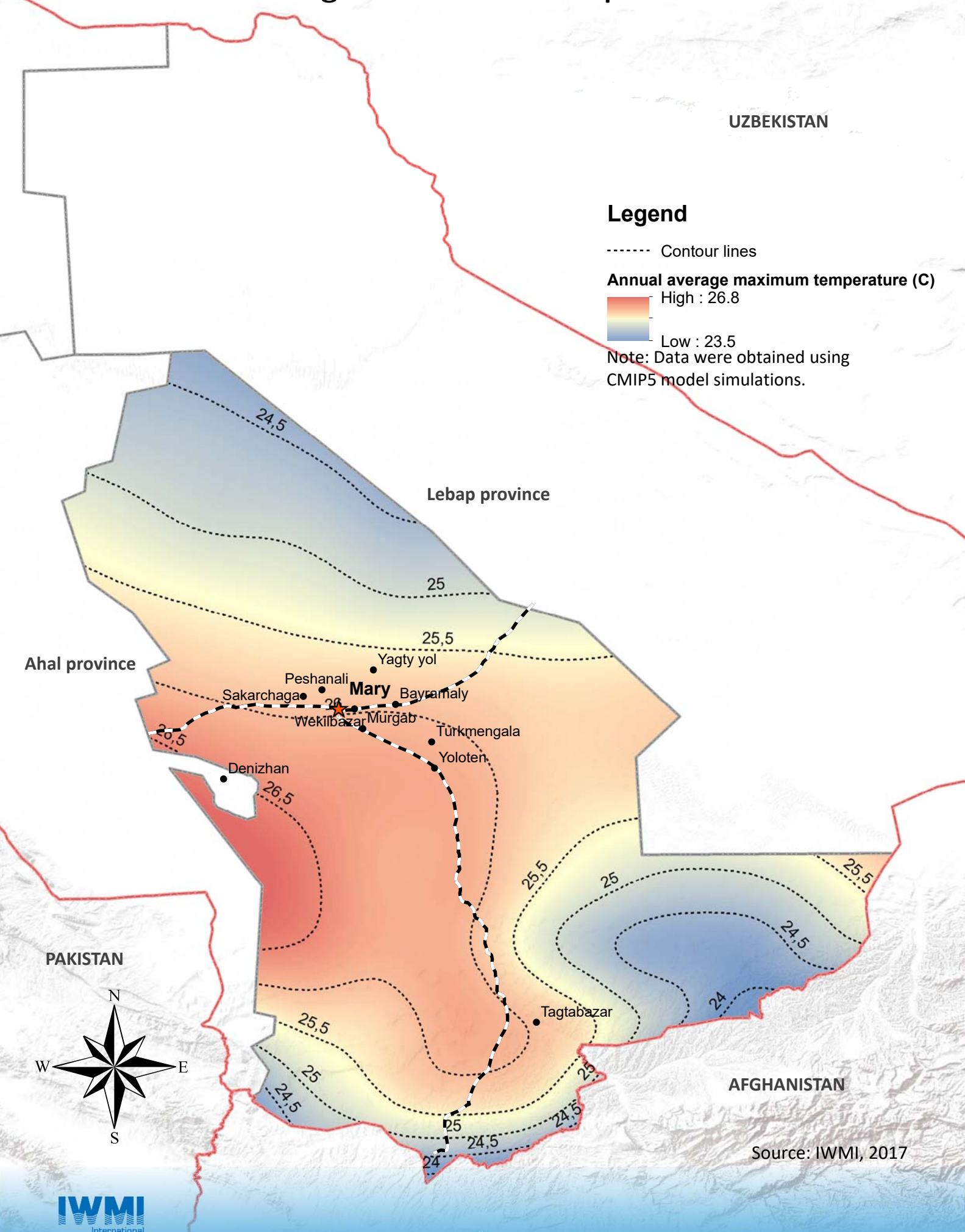


Source: IWMI, 2017

Annual average maximum temperature in 2016

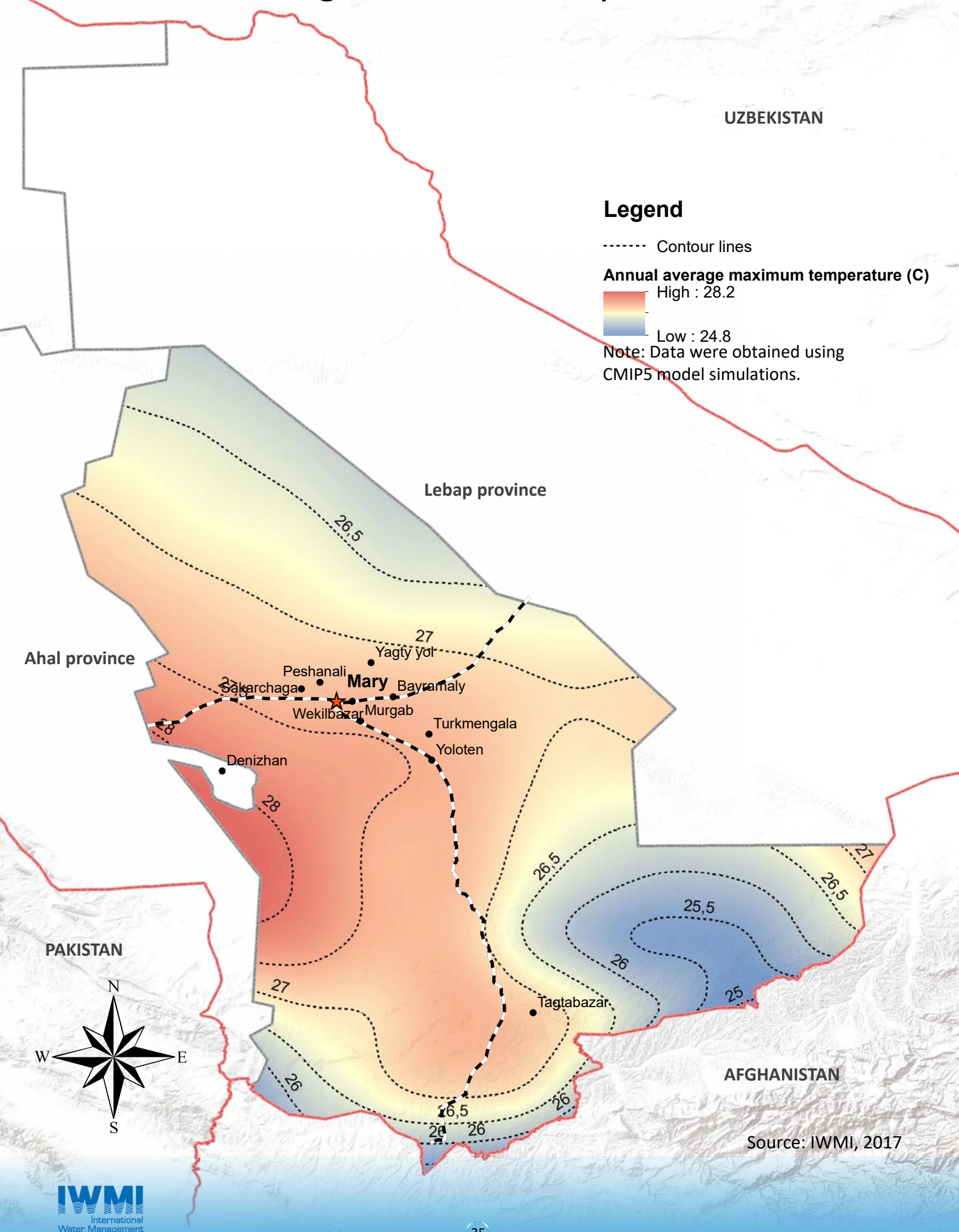


Annual average maximum temperature in 2020



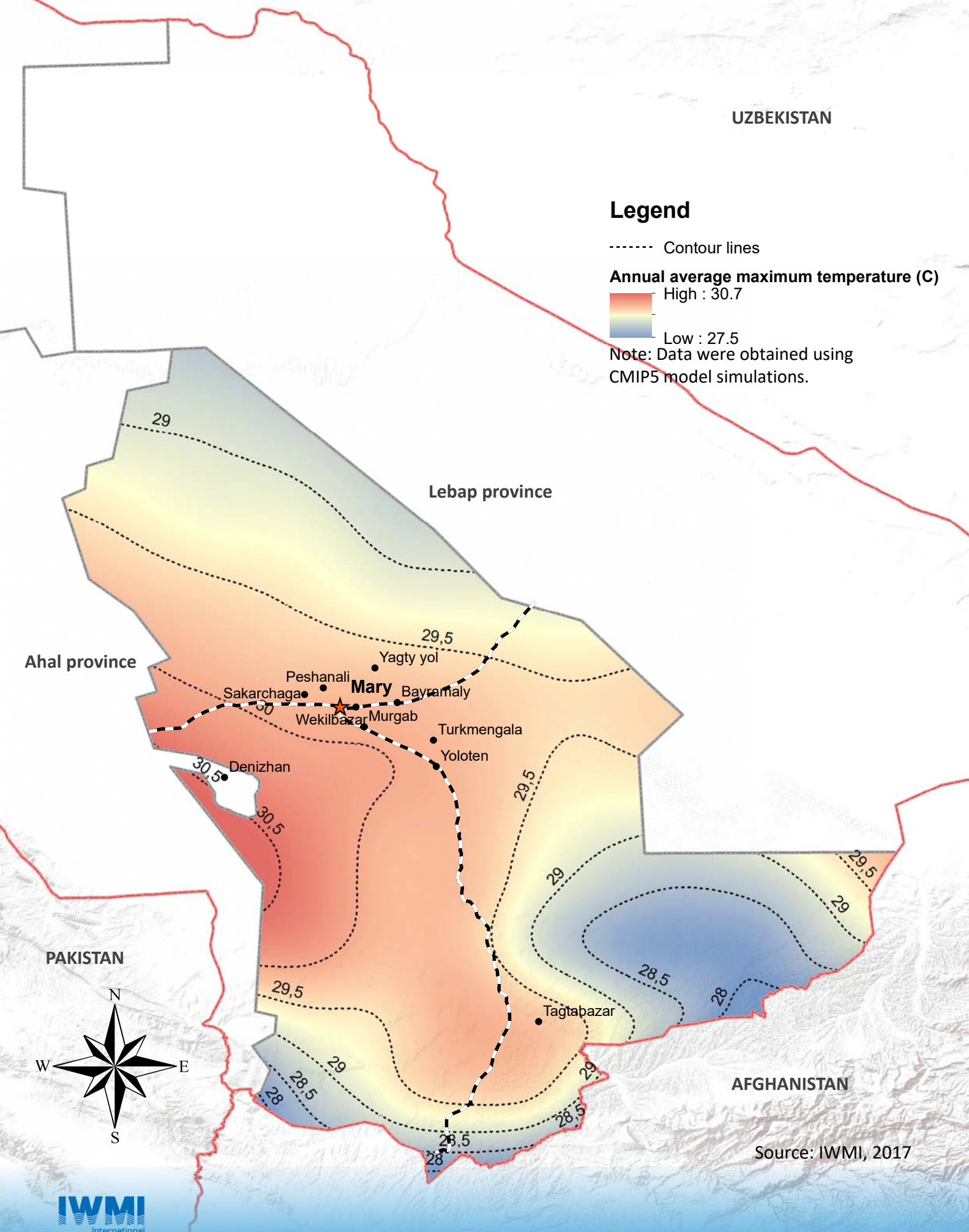
Source: IWMI, 2017

Annual average maximum temperature in 2050



Source: IWMI, 2017

Annual average maximum temperature in 2100



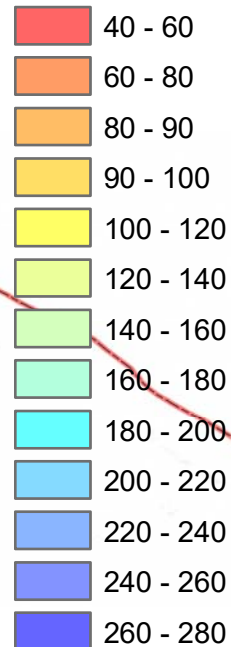
Source: IWMI, 2017

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Annual precipitation in 2016

Legend

Annual precipitation (mm)



Note: Data were obtained using CMIP5 model simulations.

Ahal province

Lebap province

PAKISTAN



AFGHANISTAN

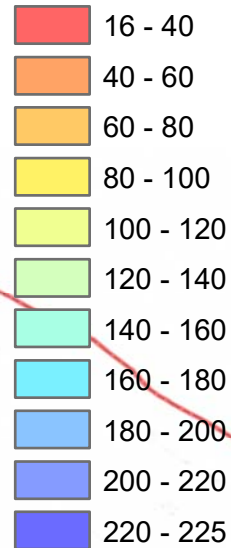
Source: IWMI, 2017

UZBEKISTAN

Annual precipitation in 2020

Legend

Annual precipitation (mm)



Note: Data were obtained using CMIP5 model simulations.

Lebap province

Ahal province

PAKISTAN



AFGHANISTAN

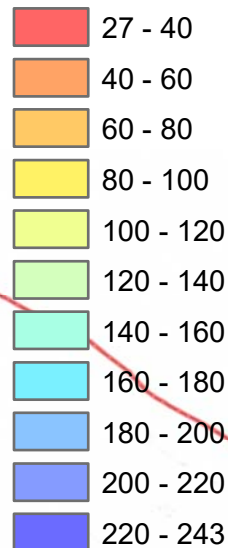
Source: IWMI, 2017

UZBEKISTAN

Annual precipitation in 2050

Legend

Annual precipitation (mm)

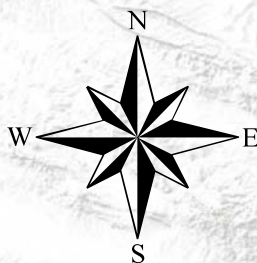


Note: Data were obtained using CMIP5 model simulations.

Ahal province

Lebap province

PAKISTAN



AFGHANISTAN

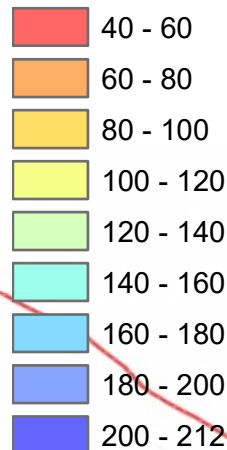
Source: IWMI, 2017

UZBEKISTAN

Annual precipitation in 2100

Legend

Annual precipitation (mm)



Note: Data were obtained using CMIP5 model simulations.

Lebap province

Ahal province

PAKISTAN



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Source: IWMI, 2017



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