SATELLITE-BASED PRECIPITATION ESTIMATIONS (PERSIANN); APPLICATIONS

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Regional Centre
on Urban Water Management
(under the auspices of UNESCO)

I.A.U.
N.T.BRANCH

1. Satellite data for precipitation
2. Strengths and weakness
3. Application
4. Case study

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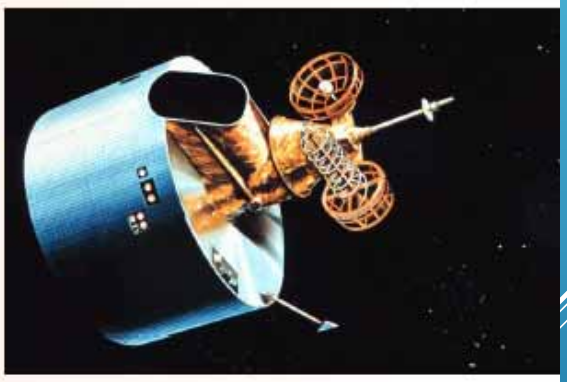
Precipitation Observation

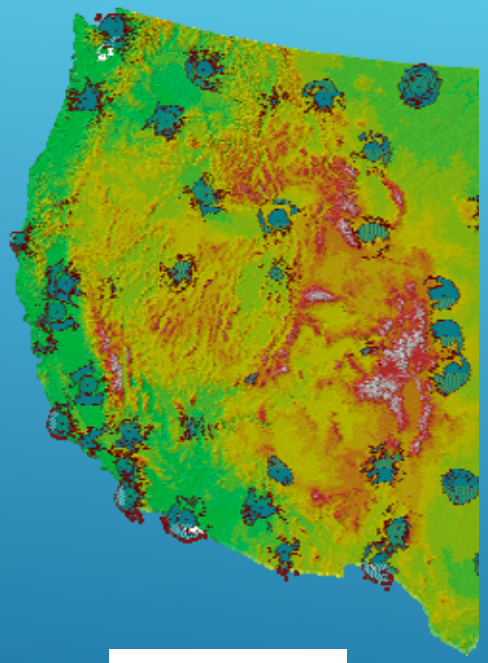
WSR-88D Radar

Rain Gauges

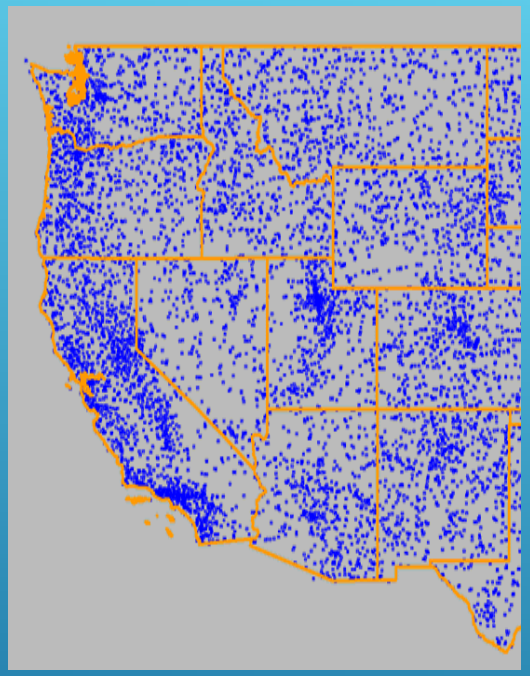


Satellite

Coverage of the radar and gauge networks



1 km AGL



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Global Precipitation Measurement (GPM)

Tanegashima Space Center, Japan

The GPM spacecraft will collect information that unifies data from an international network of existing and future satellites to map global rainfall and snowfall every three hours.

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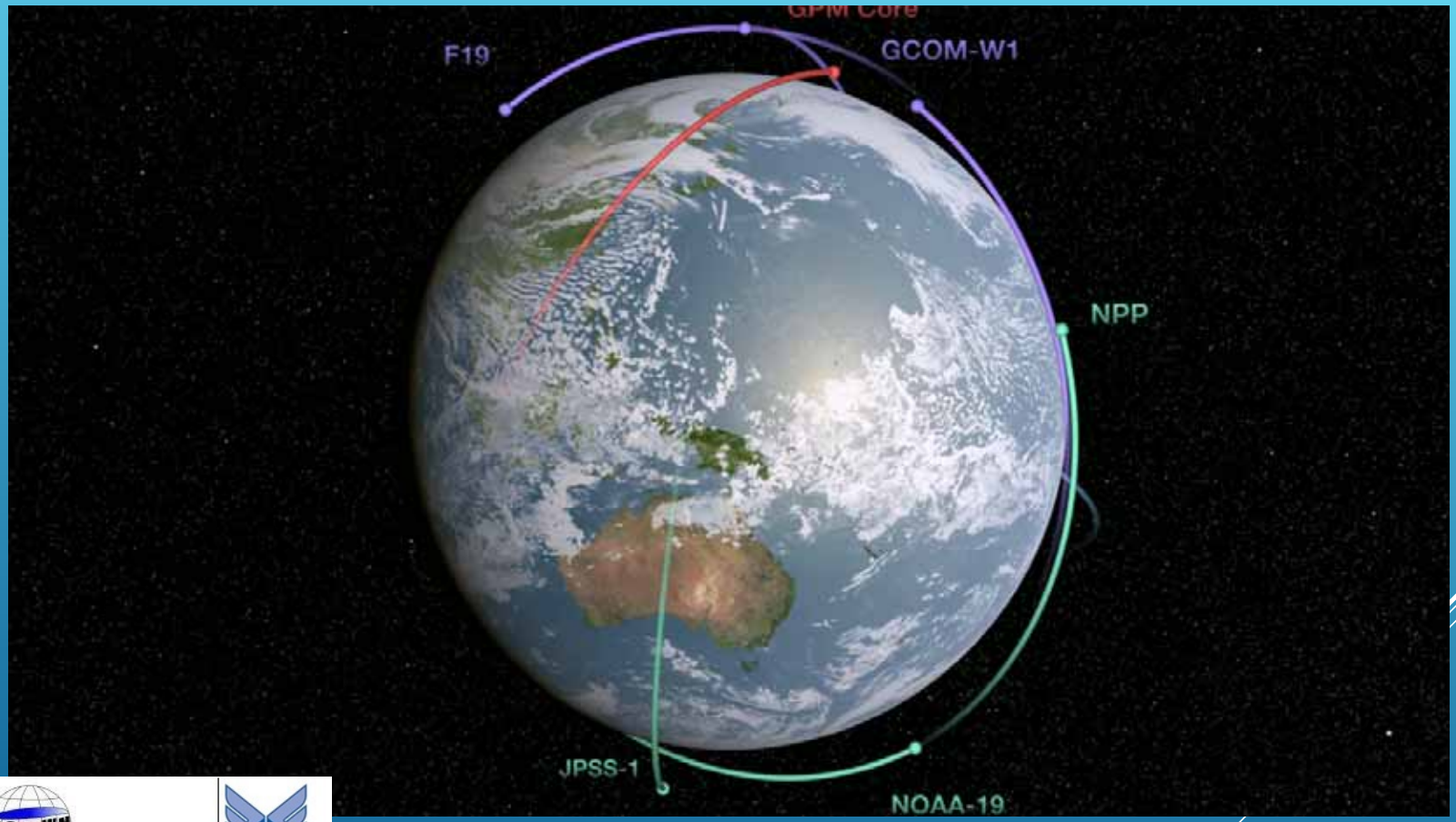
- *GPM Animation* *Courtesy: NASA's ESE*



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Satellite Data for Precipitation

- Geostationary IR • $(0.007 - 1) \times 10^{-4}$ m Cloud top data 15-30 minute resolution

Passive Microwave (SSM/I) $(0.01 - 1) \times 10^{-2}$ m

Some characterization of rainfall

~2 overpasses per day per spacecraft, moving to 3-hour return time (GPM)

The strengths and weakness of satellite-based precipitation data comparing to rain-gauge data:

1. Global coverage (60N-60S), over oceans, high mountains, deserts
2. High spatial (0.04 degree) and temporal (30 min) resolutions
3. Real time available
4. Bias

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APPLICATIONS:

1. THE IMPROVEMENT OF THE NATURAL HAZARDS AND DISASTERS FORECASTING SUCH AS:
   DROUGHT, FLOOD AND LAND SLIDE
2. IMPROVED PREDICTION OF CLIMATE CHANGE AND WATER FUTURES
3. INFORMATION ON HOW, WHERE AND TO WHAT EXTENT THE LAND, OCEANS, ATMOSPHERE AND ICE SHEETS ARE CHANGING
4. ENERGY, WATER RESOURCES, AGRICULTURE, HUMAN HEALTH, NATIONAL SECURITY, COASTAL COMMUNITY AND OTHER INTEREST GROUPS

THE GLOBAL SATELLITE PRECIPITATION PRODUCTS:

- PERSIANN (UCI, USA)
- GPM, TRMM-IMERG (NASA, USA)
- CMORPH (NASA, USA)
- GPCP (Global Precipitation Climatology Center, GERMANY)
- GSMaP (Japan Aerospace Exploration Agency; JAXA, JAPAN)

PRECIPITATION ESTIMATION FROM REMOTELY SENSE INFORMATION USING ARTIFICIAL NEURAL NETWORK (PERSIANN)

product	Temporal Coverage	Spatial resolution	Temporal resolution	latency
PERSIANN	2000-present	0.25°×0.25°	1,3,6 hourly, daily	Real Time
PERSIANN-CCS	2003-present	0.04°×0.04°	1,3,6,hourly, daily	Real Time
PERSIANN-CDR	1983-present	0.25°×0.25°	daily	8 months


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PERSIANN
PERSIANN-CCS
PERSIANN-CDR
The current operational PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks) system developed by the Center for Hydrometeorology and Remote Sensing (CHRS) at the University of California, Irvine (UCI) uses neural network function classification/approximation procedures to compute an estimate of rainfall rate at each 0.25° x 0.25° pixel of the infrared brightness temperature image provided by geostationary satellites. An adaptive training feature facilitates updating of the network parameters whenever independent estimates of rainfall are available. The PERSIANN system was based on geostationary infrared imagery and later extended to include the use of both infrared and daytime visible imagery. The PERSIANN algorithm used here is based on the geostationary longwave infrared imagery to generate global rainfall. Rainfall product covers 60°S to 60°N globally.
Further reading.
Data Period: March 2000 - Present
Coverage: 60°S to 60°N
Resolutions: 0.25° x 0.25°
Timesteps: 1, 3, 6 hourly, daily
FTP Download (full): 1 hourly, 3 hourly, 6 hourly, Daily, Monthly, Yearly
Latest Update: Near real-time with 2 day delay
Selected References:
Satellite
Google
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Map data ©2017 Imagery ©2017 NASA, TerraMetrics
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Dataset PERSIANN
Time Step Daily
Domain Whole Globe
Visualization
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news.xinhuanet.com/english/2017-08/04/c_136500069.htm

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Photo taken on Aug. 4, 2017 shows damaged cars after heavy rain in Shahekou District of Dalian, northeast China's Liaoning Province. Heavy rain hit Dalian from Aug. 2 to Aug. 4. Metrological service of Dalian issued a red alert for flood on Friday. China has a four-tier color-coded weather warning system, with red the most severe, followed by orange, yellow and blue. (Xinhua/Wang Xizeng)

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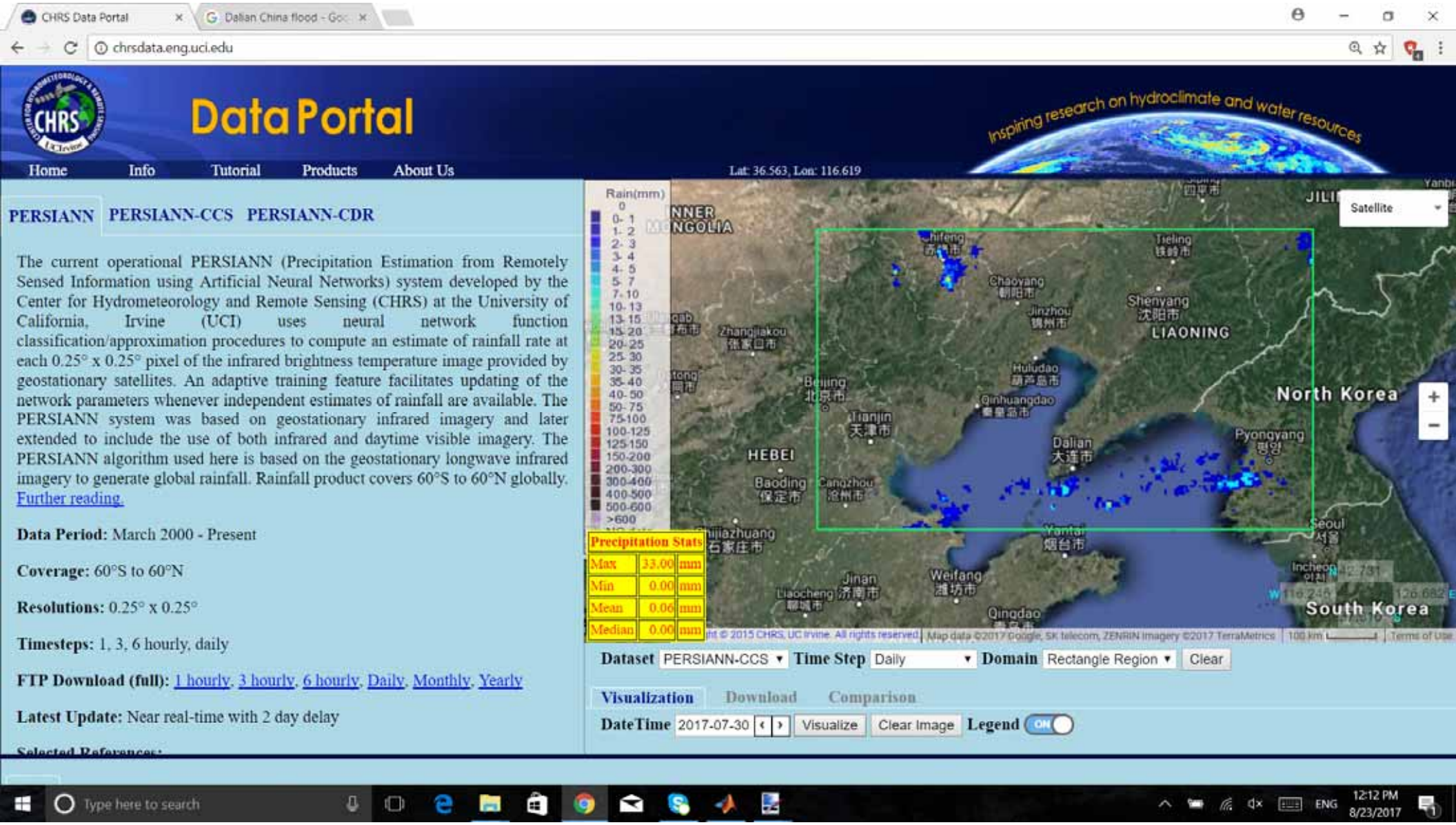
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Latest Update: Near real-time with 2 day delay
Selected References:
Rain(mm)
0
0- 1
1- 2
2- 3
3- 4
4- 5
5- 7
7-10
10-13
13-15
15-20
20-25
25-30
30-35
35-40
40-50
50-75
75-100
100-125
125-150
150-200
200-300
300-400
400-500
500-600
>600
Precipitation Stats
Max 33.00 mm
Min 0.00 mm
Mean 0.06 mm
Median 0.00 mm
Satellite
Beijing
Tianjin
HEBEI
LIAONING
North Korea
South Korea
Pyongyang
Seoul
Dalian
Qinhuangdao
Huludao
Chaoyang
Shenyang
Jinzhou
Tieling
Zhangjiakou
Baoding
Cangzhou
Yantai
Weifang
Jinan
Qingdao
Liaocheng
Dataset PERSIANN-CCS
Time Step Daily
Domain Rectangle Region
Clear
Visualization
Download
Comparison
DateTime 2017-07-30
Visualize
Clear Image
Legend ON
Map data ©2017 Google, SK telecom, ZENRIN Imagery ©2017 TerraMetrics
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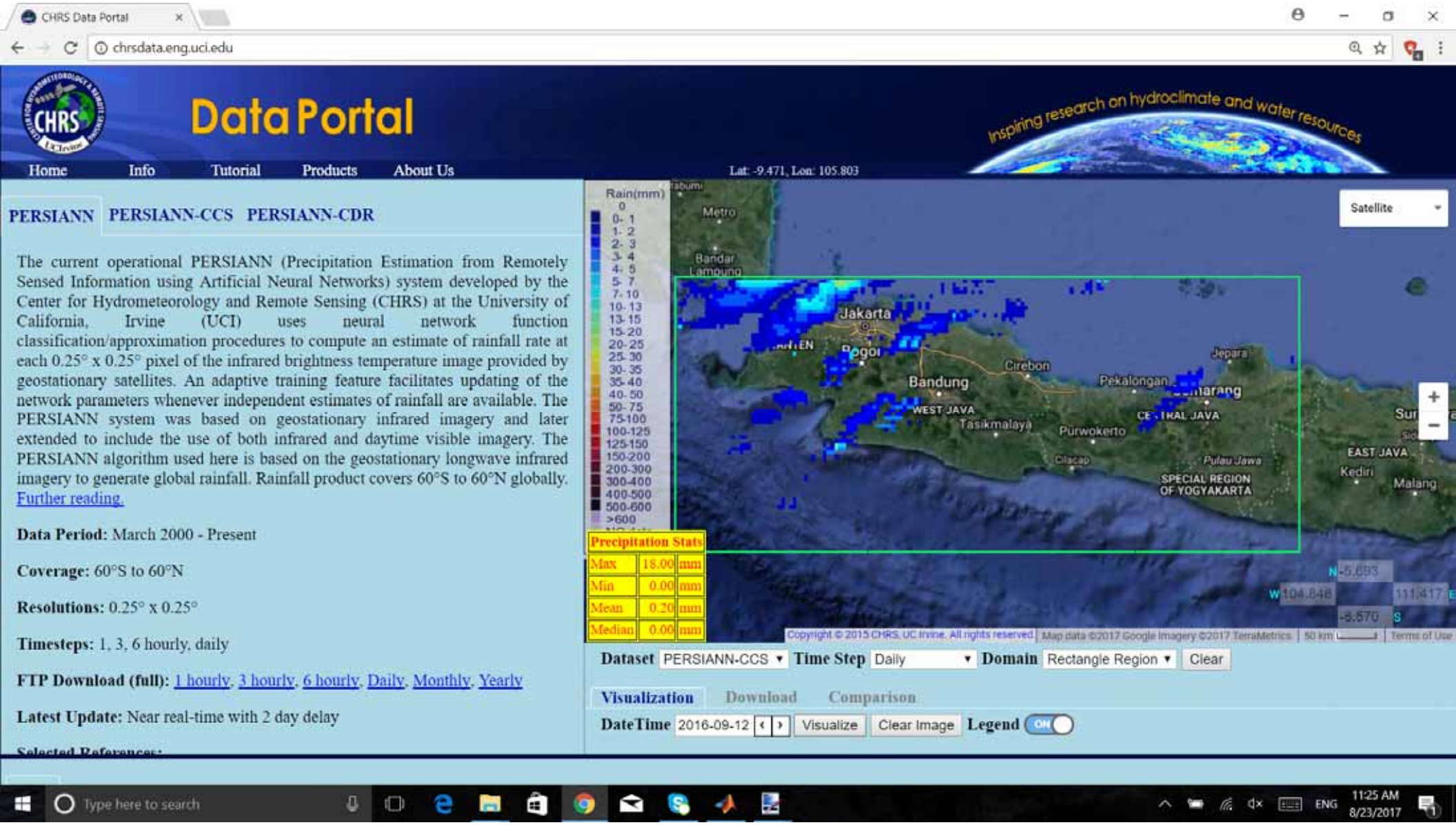
An Indonesian search-and-rescue team along with soldiers use heavy machinery to remove debris from an area hit by a landslide in Sumedang, Indonesia, on Sept. 21, 2016 Timur Matahari—AFP/Getty Images

INDONESIA

Floods and Landslides in Indonesia Kill at Least 19 People

Tekendra Parmar
Sep 20, 2016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5- 7
7- 10
10- 13
13- 15
15- 20
20- 25
25- 30
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35- 40
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50- 75
75-100
100-125
125-150
150-200
200-300
300-400
400-500
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Satellite
Jakarta
Bandung
Cirebon
Pekalongan
Jepara
Purwokerto
Tasikmalaya
Cilacap
Pulau Jawa
WEST JAVA
CENTRAL JAVA
EAST JAVA
SPECIAL REGION OF YOGYAKARTA
Kediri
Malang
Precipitation Stats
Max 18.00 mm
Min 0.00 mm
Mean 0.20 mm
Median 0.00 mm
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Dataset PERSIANN-CCS
Time Step Daily
Domain Rectangle Region
Clear
Visualization
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Comparison
DateTime 2016-09-12
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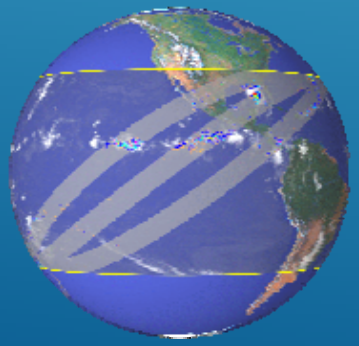
Potential usefulness of PERSIANN-CDR

Reconstruction of more than 30 years of daily precipitation data (1983 ~2016)



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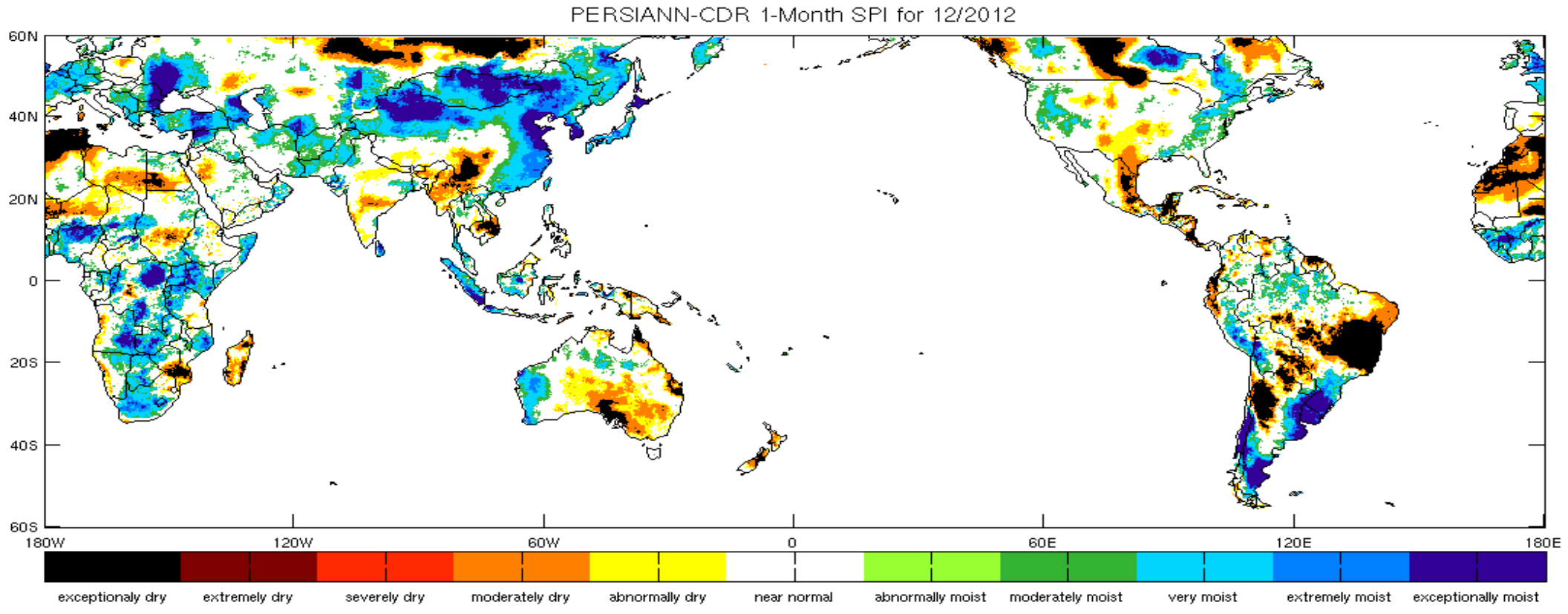
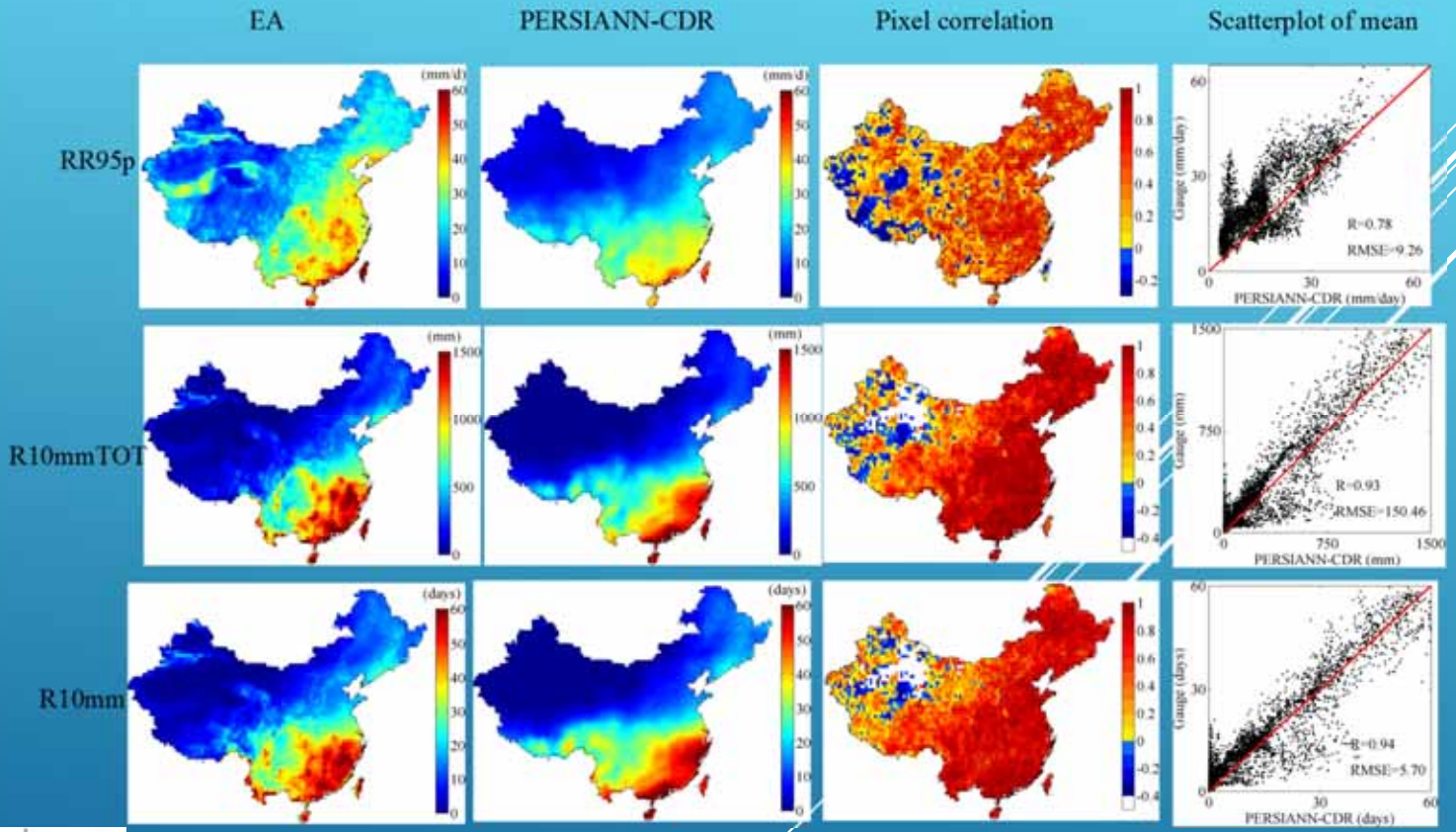
Standard Precipitation Index (SPI) estimated:

- **PERSIANN-CDR 0.25-deg daily**



Results: Entire China



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Miao et al., JHM 2015

IPCC AR5 Scenarios

Time period: 2006-2099

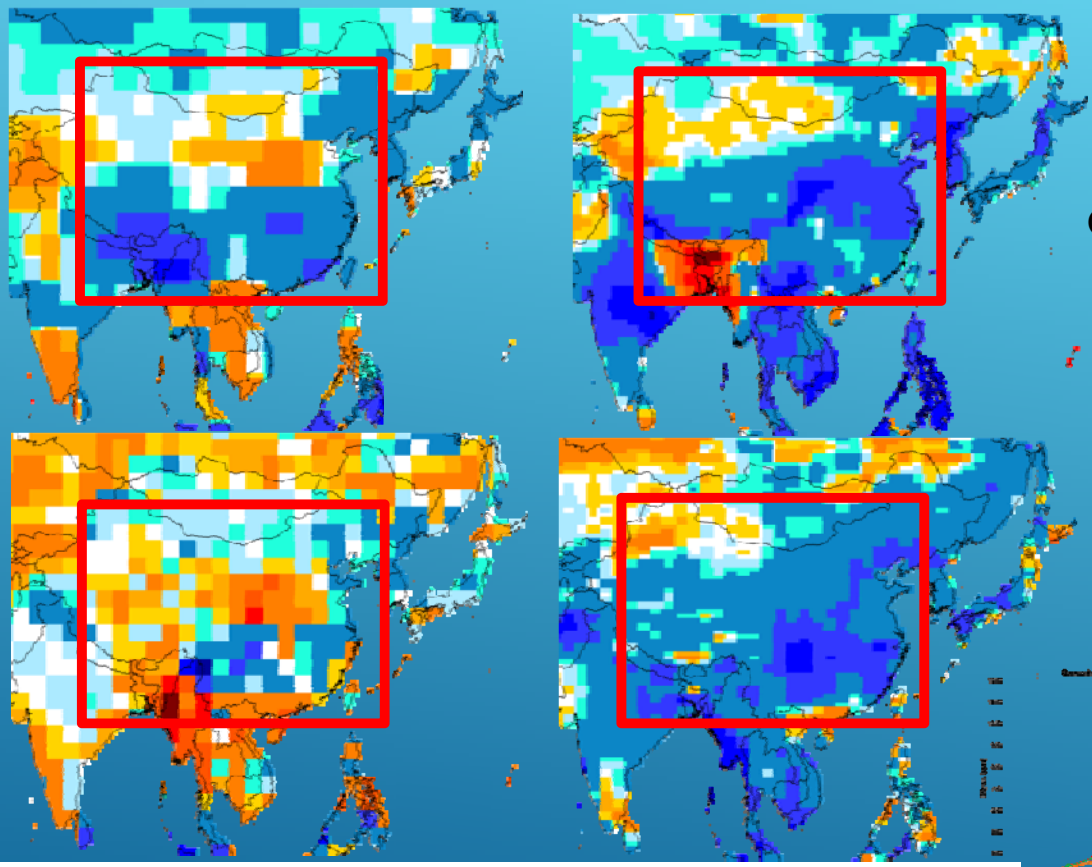
RCP2.6 ("Low": 2.6 W/m^2, Equivalent CO_2 conc. 421 ppm by 2100)

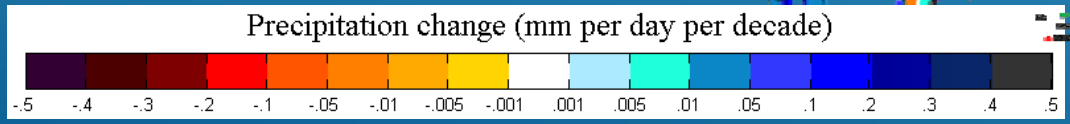
bcc_csm1_1
(Chinese GCM)

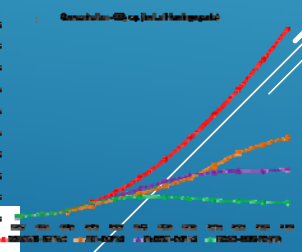
MIROC5
(Japanese GCM)

GISS-E2-R
(U.S. GCM)

HadGEM2-ES
(U.K. GCM)







Resolution: 0.5°x0.5°

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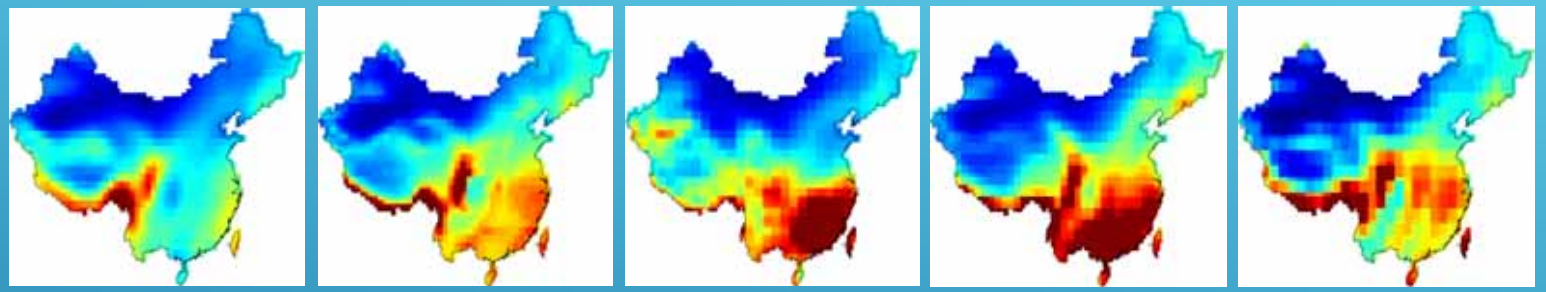
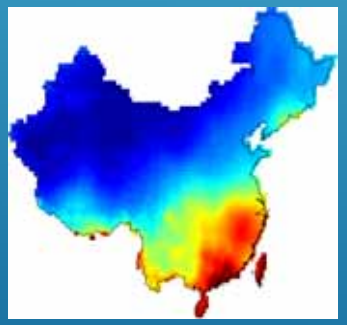
CMIP5 Models' historical simulation (1983-2005): CHINA

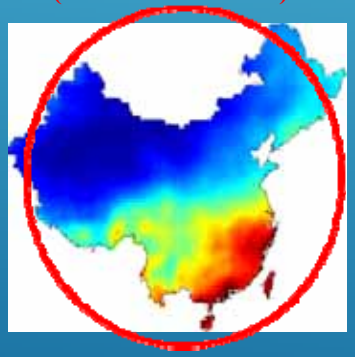
bcc_csm1_1_m (Chinese GCM) | **CCSM4 (NCAR, USA GCM)** | **HadGEM2-ES (U.K GCM)** | **MIROC5 (Japan GCM)** | **MPI-ESM-MR (Germany GCM)**

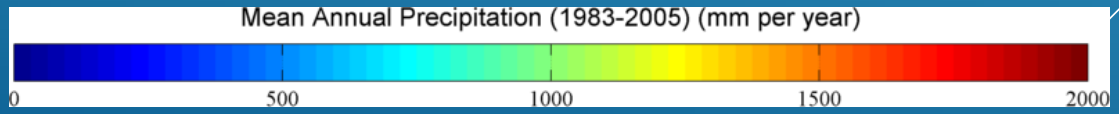


Observation (CRU Dataset)



Observation (PERSIANN-CDR)





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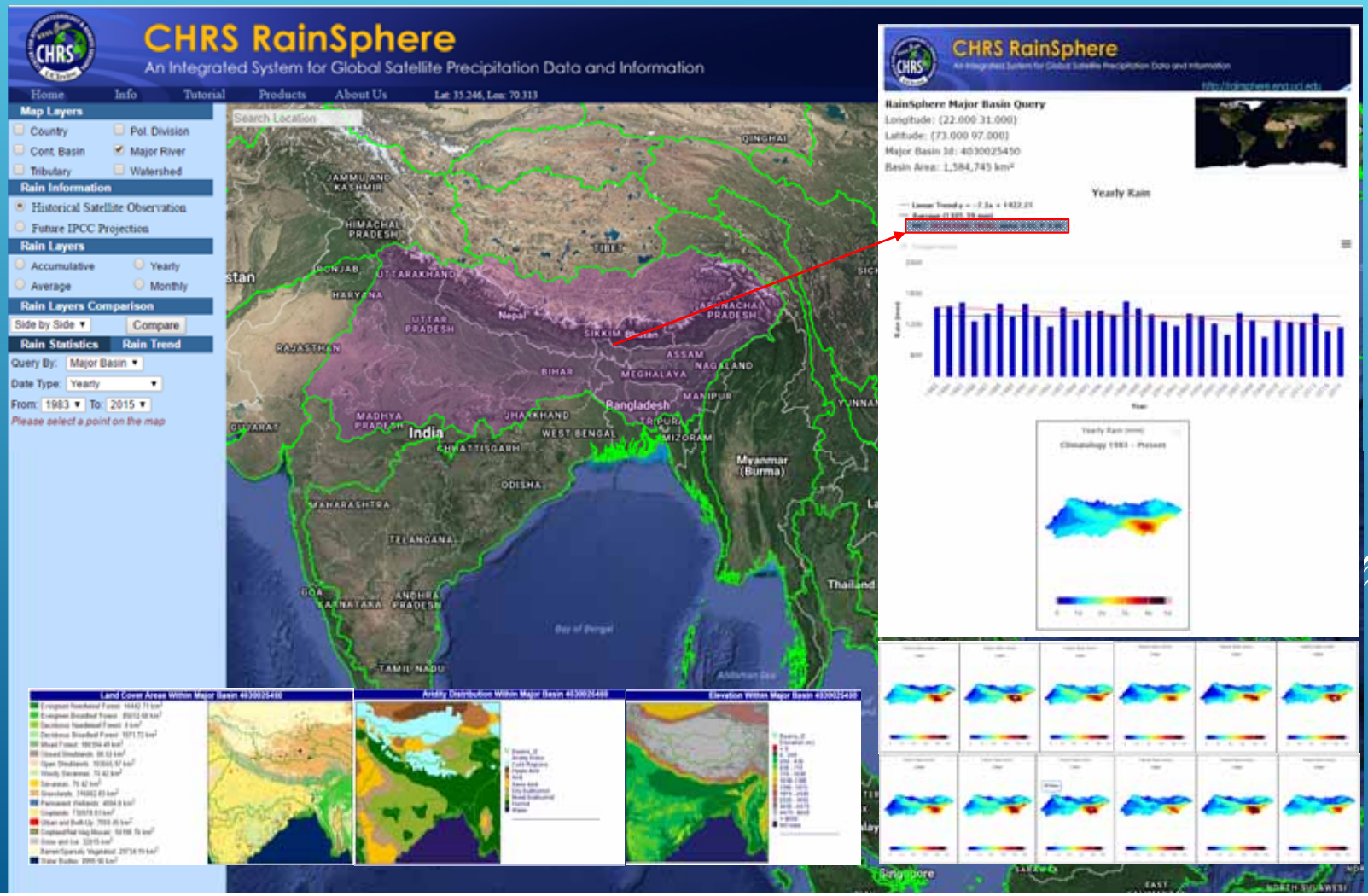
Rainsphere.eng.uci.edu



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CHRS iRain

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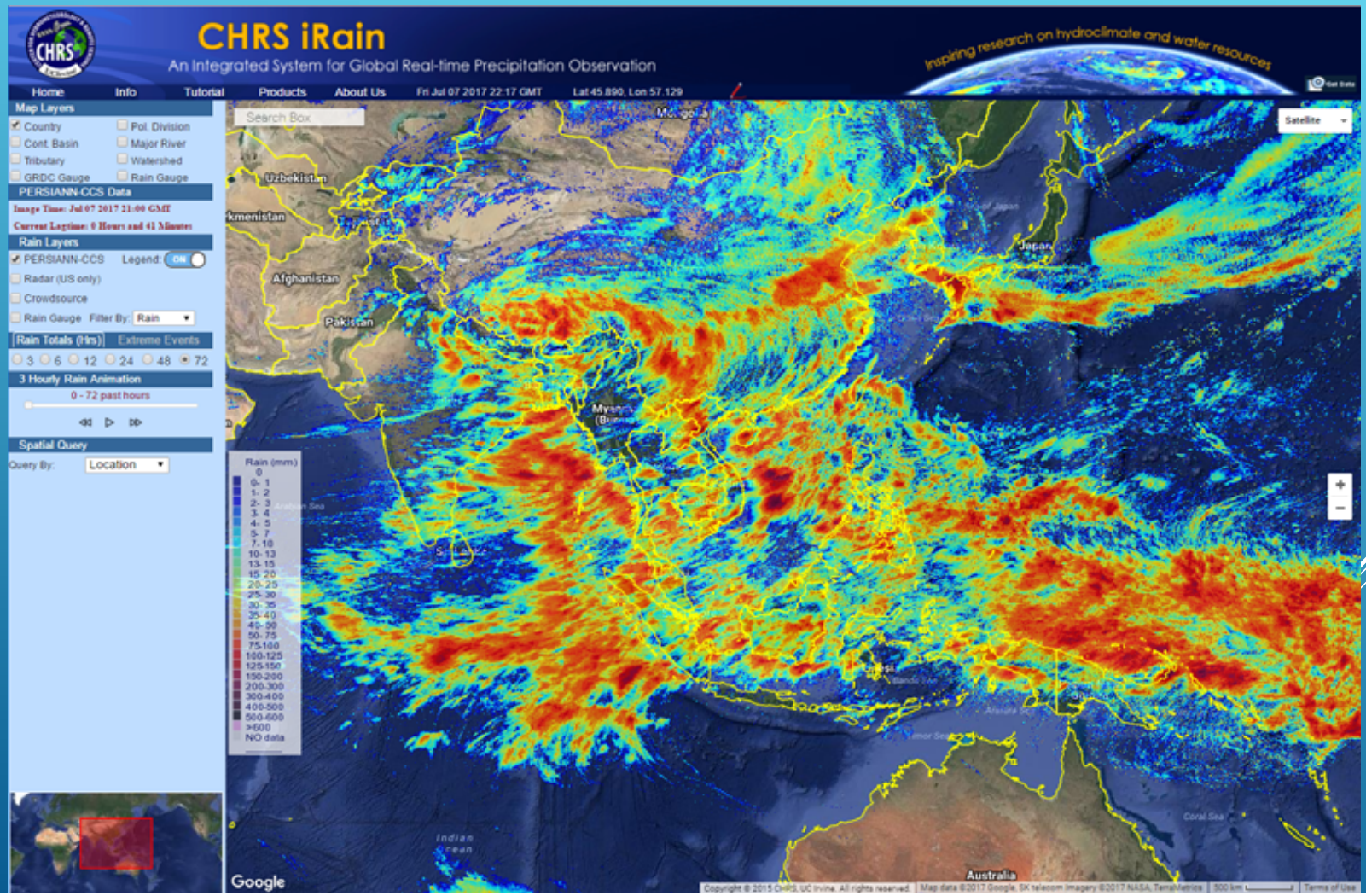
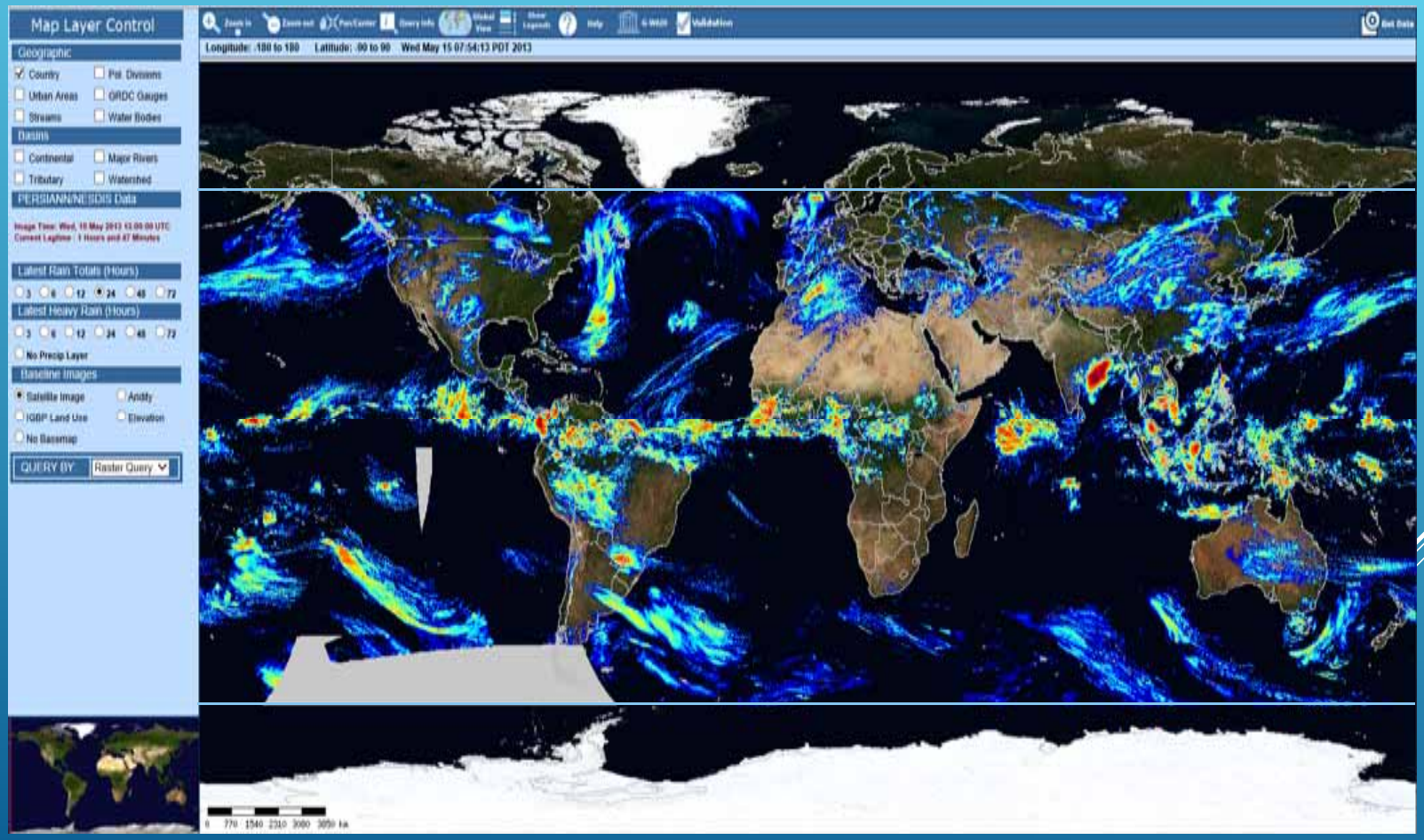


GWADI-GEOSERVER

http://hydis.eng.uci.edu/gwadi/



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Who Uses CHRS Products

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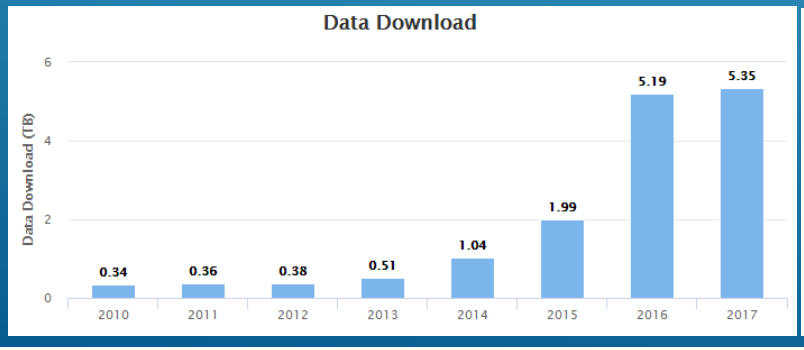
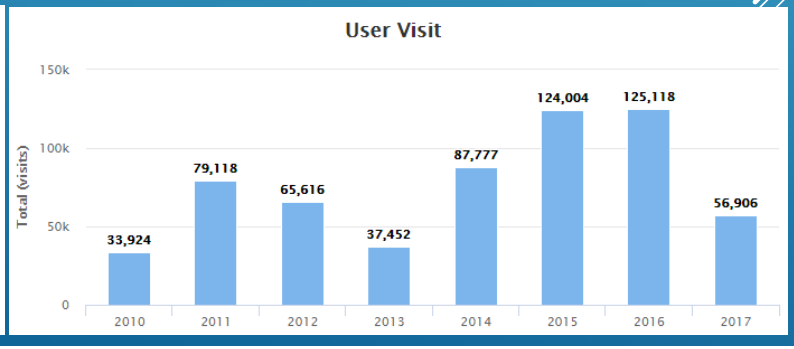
CHRS User Statistics

Overall | CHRS Homepage | G-WADI | iRain | RainSphere | Data Portal | CONNECT

Total Visits: 609,916 since 01-Jan-2010
Countries: 196 countries registered

#	Country	Total Visits
1	United States	390,018
2	China	40,704
3	Thailand	21,901
4	France	20,959
5	Japan	16,004
6	Germany	13,124
7	Iran, Islamic Republic Of	10,804
8	Ukraine	7,746
9	Peru	7,163
10	Canada	6,018





- Thank You