

Joint Research Centre

The European Commission's
science and knowledge service



Global Surface Water

The where and when of inland and coastal waters

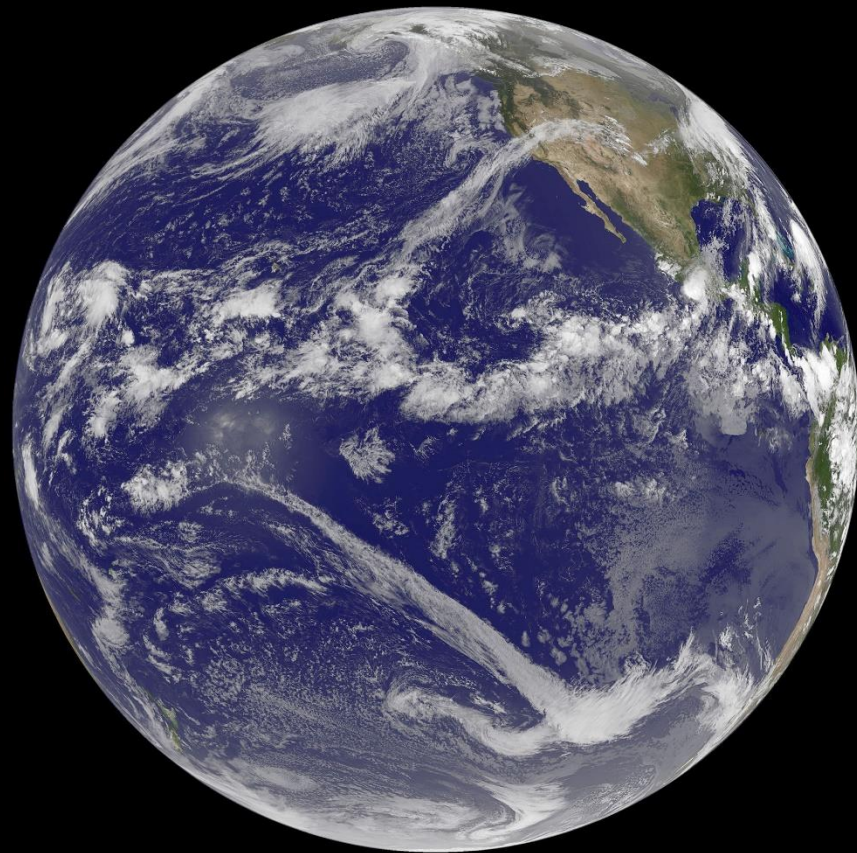
J.-F. Pekel, A. Cottam, N. Gorelick*, A. Belward
and A. Brink

European commission Joint Research Centre

*Google Earth Outreach

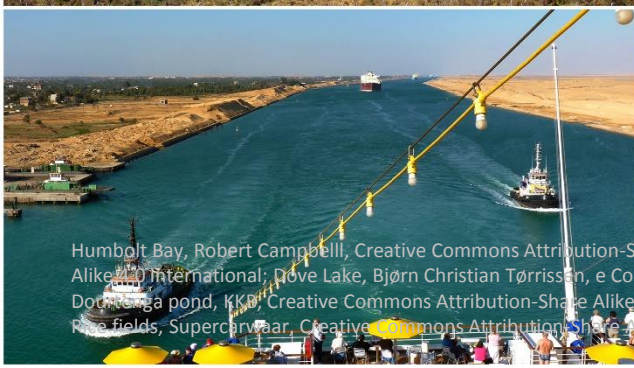


71% >

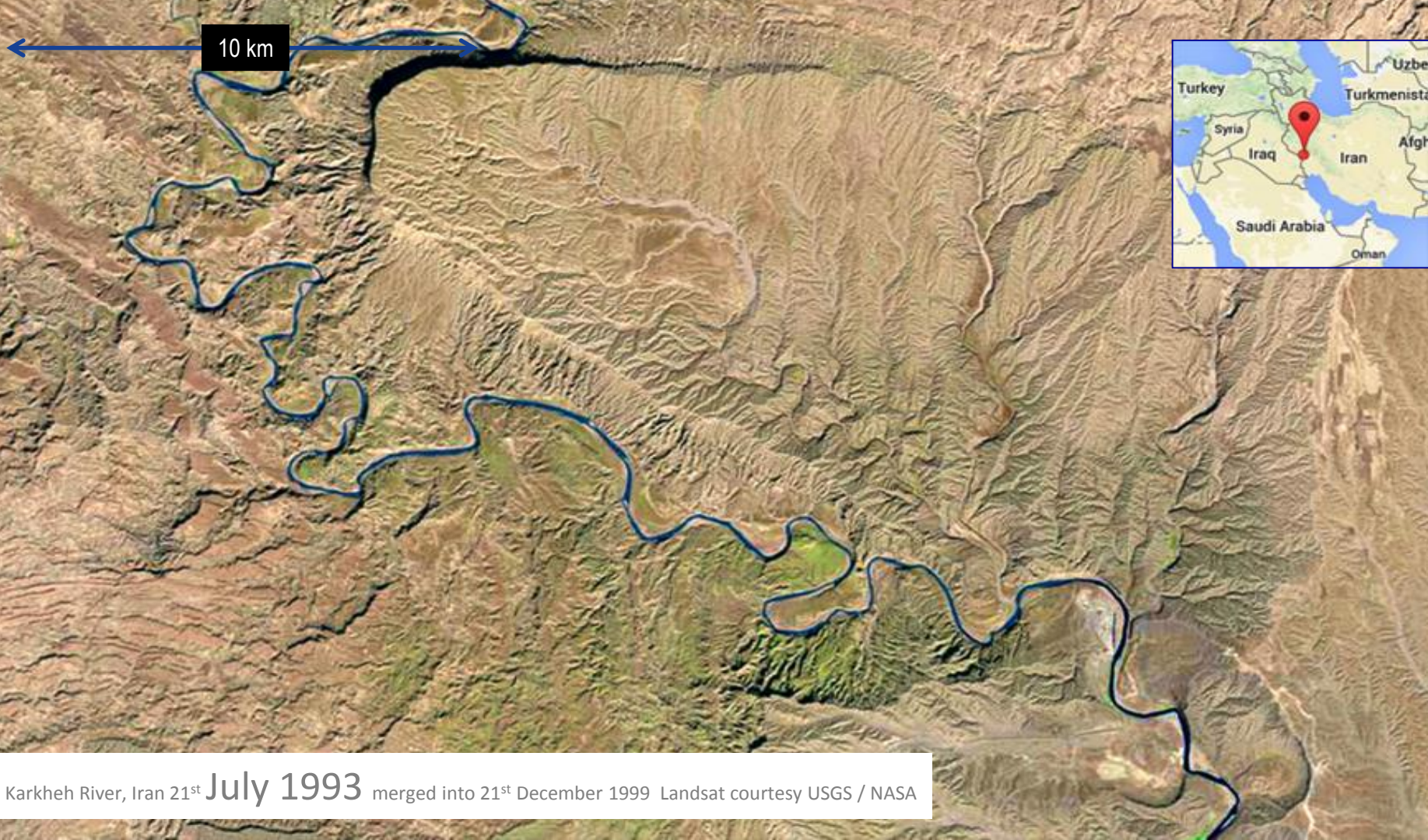


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Humbolt Bay, Robert Campbell, Creative Commons Attribution-Share Alike 3.0; Wetlands in Cape May, U.S. Army Corps of Engineers, public domain; Katse Dam SkyPixels, Creative Commons Attribution-Share Alike 3.0 International; Dove Lake, Bjørn Christian Tørrissen, e Commons Attribution-Share Alike 3.0 Unported; Greenland meltpond, Michael Studinger, Creative Commons Attribution-Share Alike 2.0 Generic; Dokkega pond, KKB, Creative Commons Attribution-Share Alike 4.0 International; Suez Canal, Panoramio user 2433337, Creative Commons Attribution-Share Alike 3.0 Unported; Rice fields, Supercarvear, Creative Commons Attribution-Share Alike 3.0 Unported; Amazon, Neil Palmer, Creative Commons Attribution-Share Alike 2.0 Generic



Karkheh River, Iran 21st July 1993 merged into 21st December 1999 Landsat courtesy USGS / NASA



10 km

Karkheh Dam

Karkheh River, Iran 21st December 1999 Landsat courtesy USGS / NASA

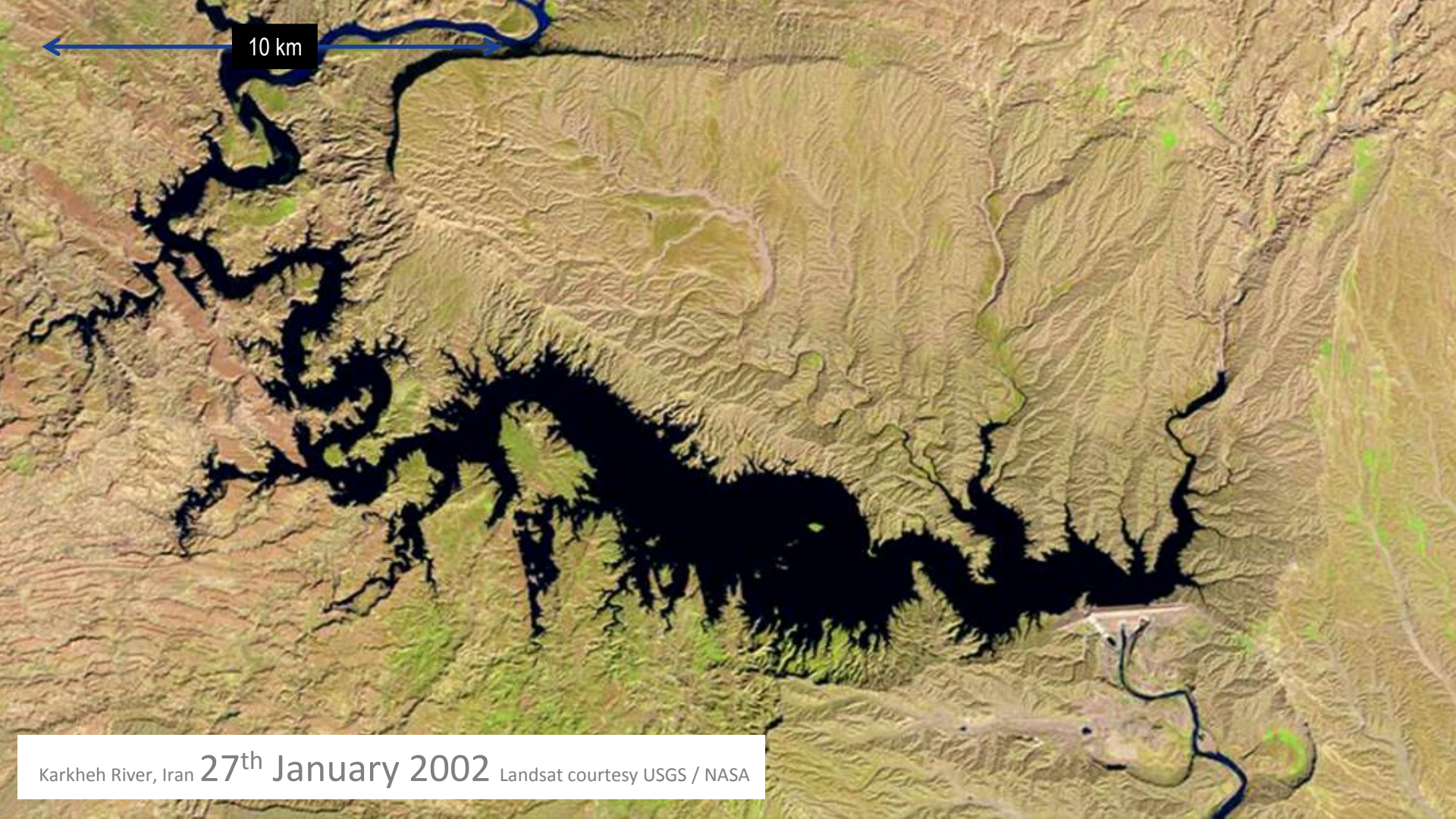


Karkheh River, Iran 23rd February 2000 Landsat courtesy USGS / NASA



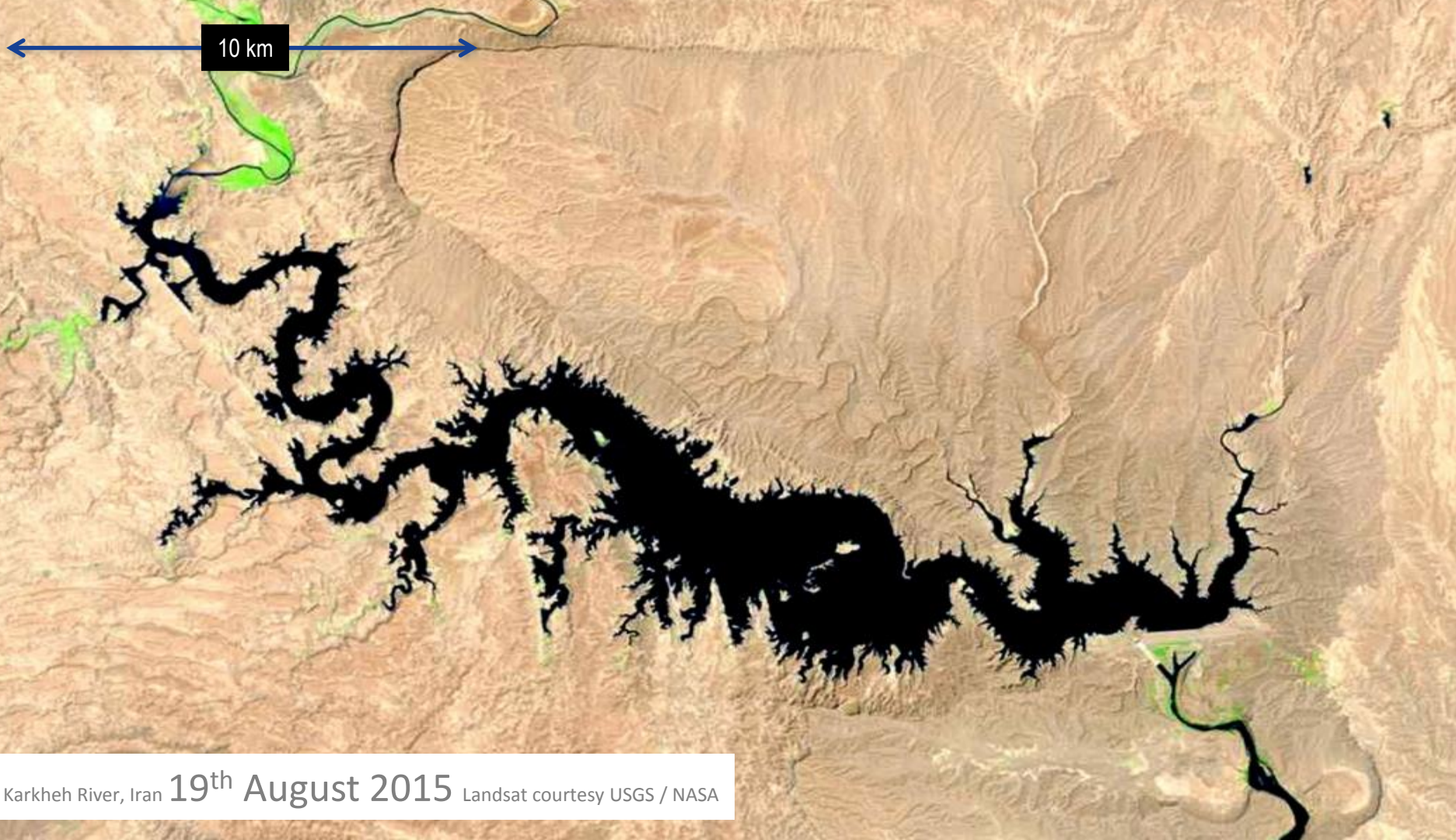
10 km

Karkheh River, Iran 24th January 2001 Landsat courtesy USGS / NASA



10 km

Karkheh River, Iran 27th January 2002 Landsat courtesy USGS / NASA



Karkheh River, Iran 19th August 2015 Landsat courtesy USGS / NASA

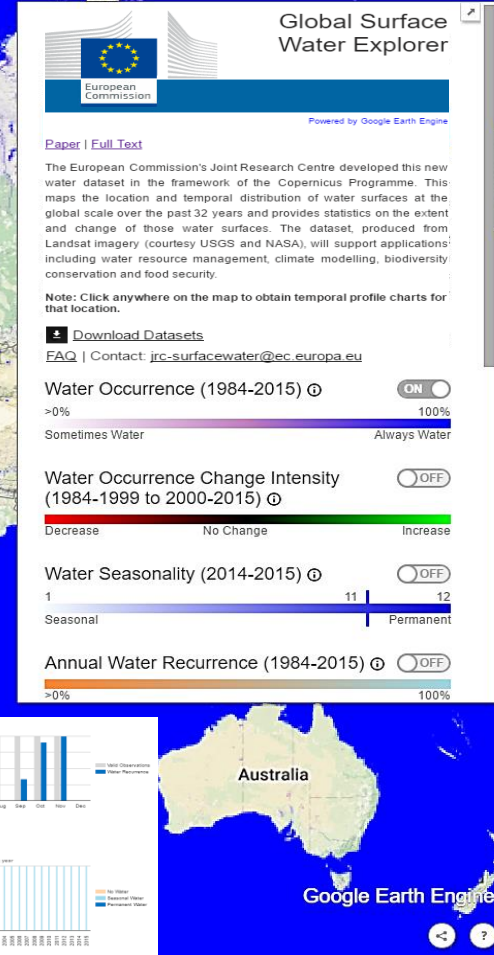
Key question – mapping surface water dynamics

- Where has surface water occurred over the past 3 decades ?
- When do water bodies fill and empty ?
- What about their inter and intra-annual variability ?
- How likely is it to find water in any given place and month ?
- When and where have new/ex water-bodies formed/disappeared ?
- What form did changes take, in terms of seasonality and persistence ?
- What about trends ?

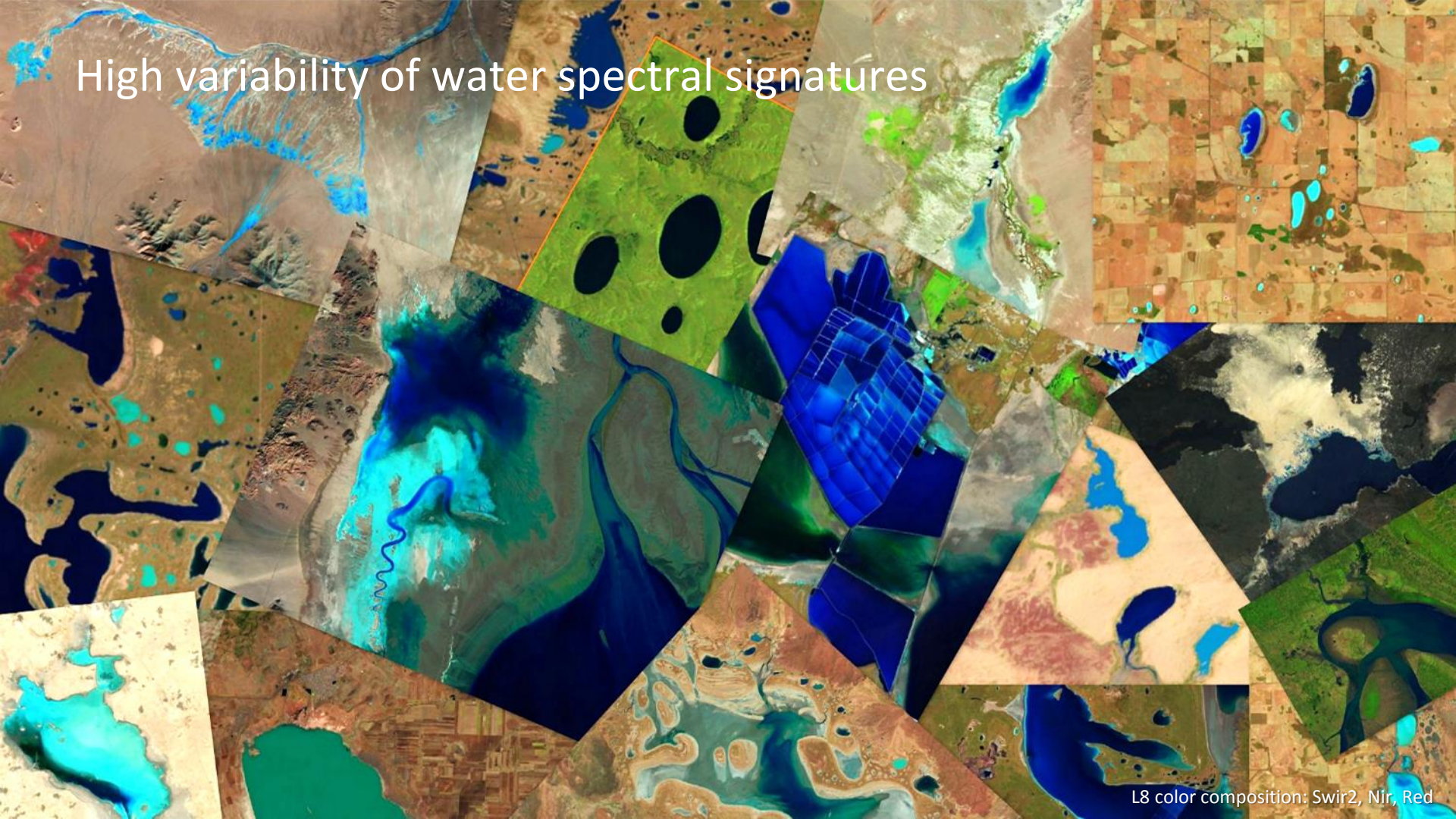
Answer – Global Surface Water Explorer

32 years of 30m resolution Landsat images
maps & temporal Profiles

- Occurrence
- Occurrence Change Intensity
- Seasonality
- Recurrence
- Water Transition
- Max Water Extent
- Full monthly water history



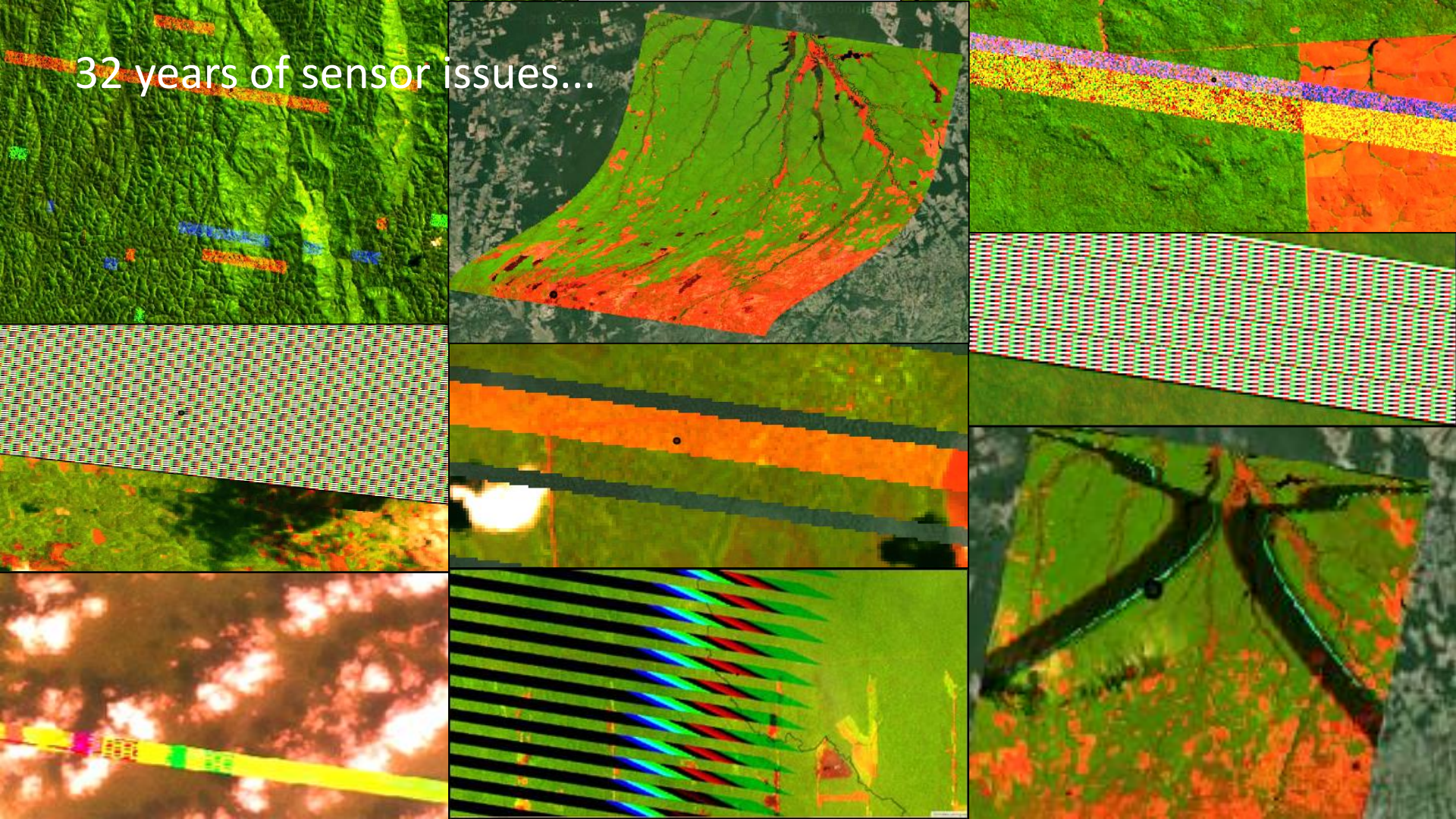
High variability of water spectral signatures



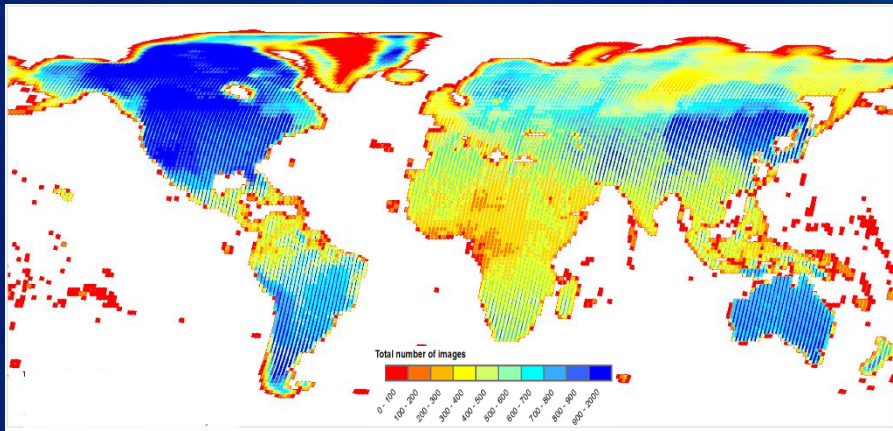
Plenty opportunities for misclassification



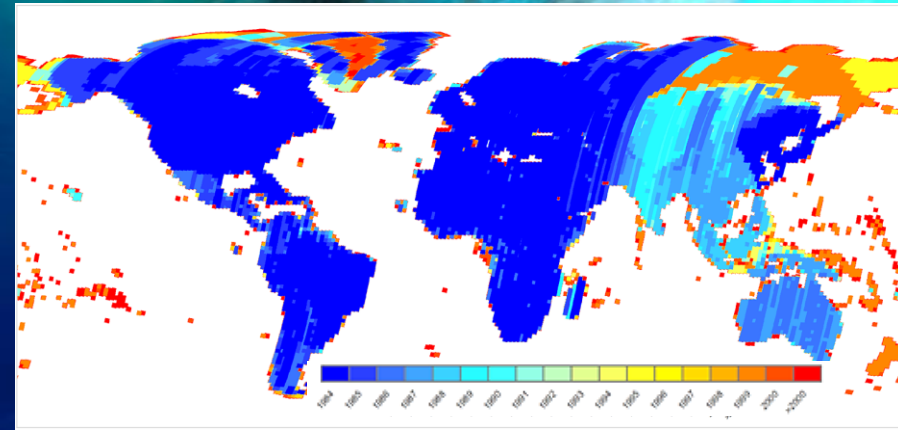
32 years of sensor issues...



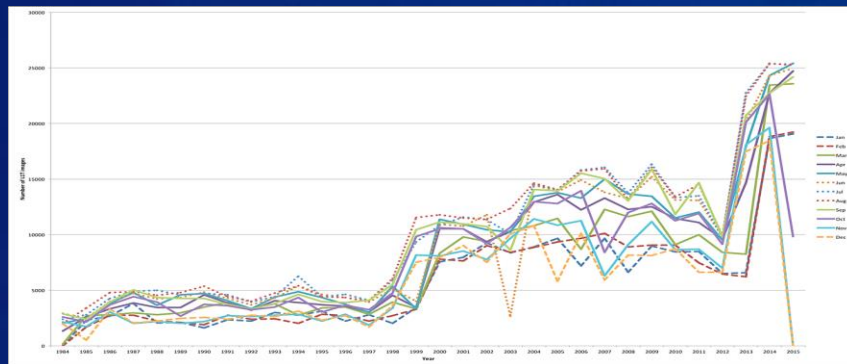
Landsat archive - Geographic and temporal differences



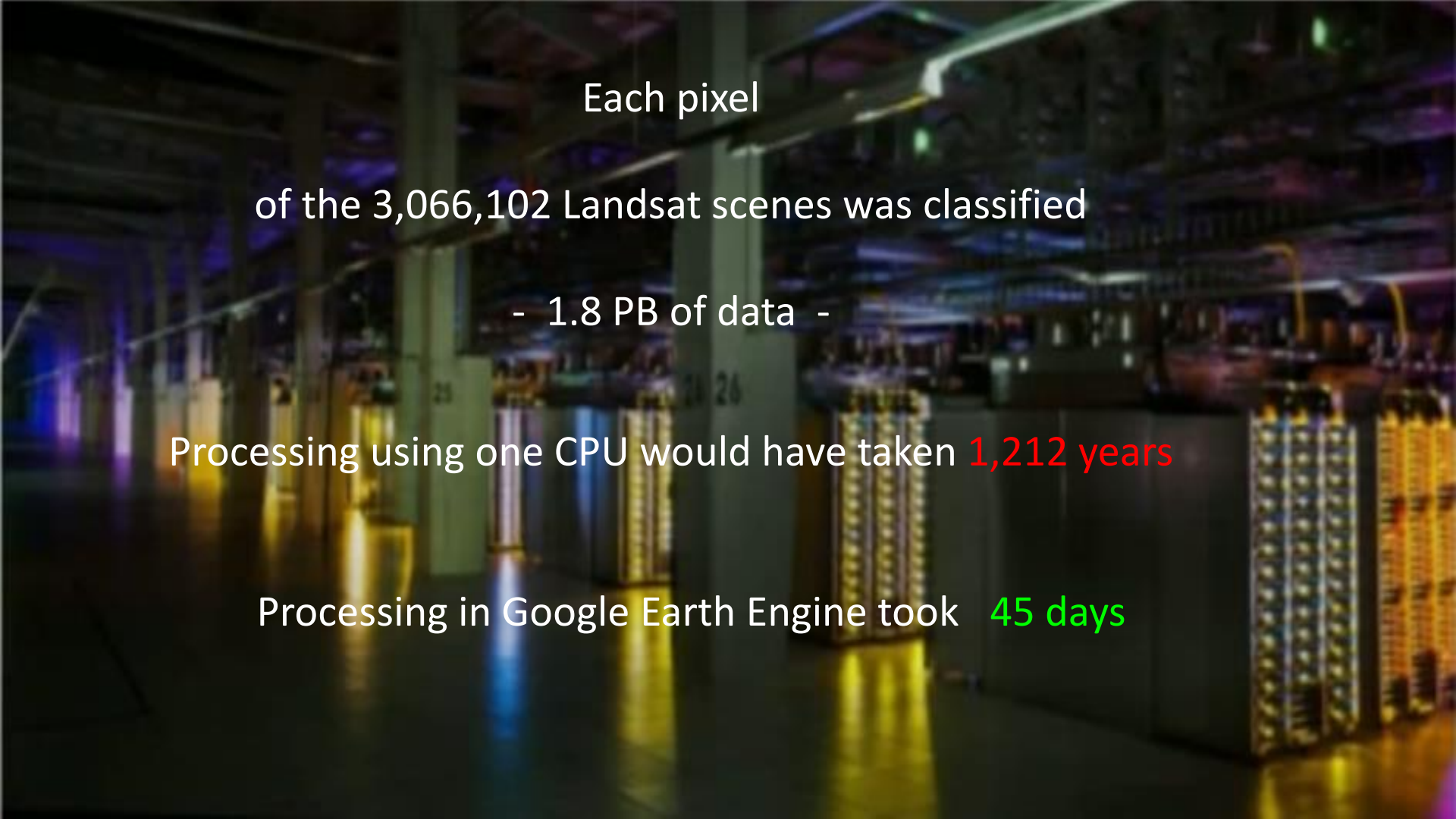
Number of L1T



Year of the first image acquisition



Rate of image acquisition by month (1984 – 2015)



Each pixel
of the 3,066,102 Landsat scenes was classified

- 1.8 PB of data -

Processing using one CPU would have taken 1,212 years

Processing in Google Earth Engine took 45 days



Search for a location...

Water Occurrence

Mangla Dam Lake



Global Surface
Water Explorer

Powered by Google Earth Engine

Water Occurrence (1984-2015) ⓘ



>0%

100%

Sometimes Water

Always Water

Google Earth Engine





Search for a location...

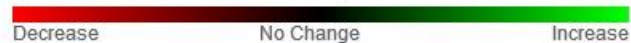
Water Occurrence Change Intensity



Global Surface Water Explorer

Powered by Google Earth Engine

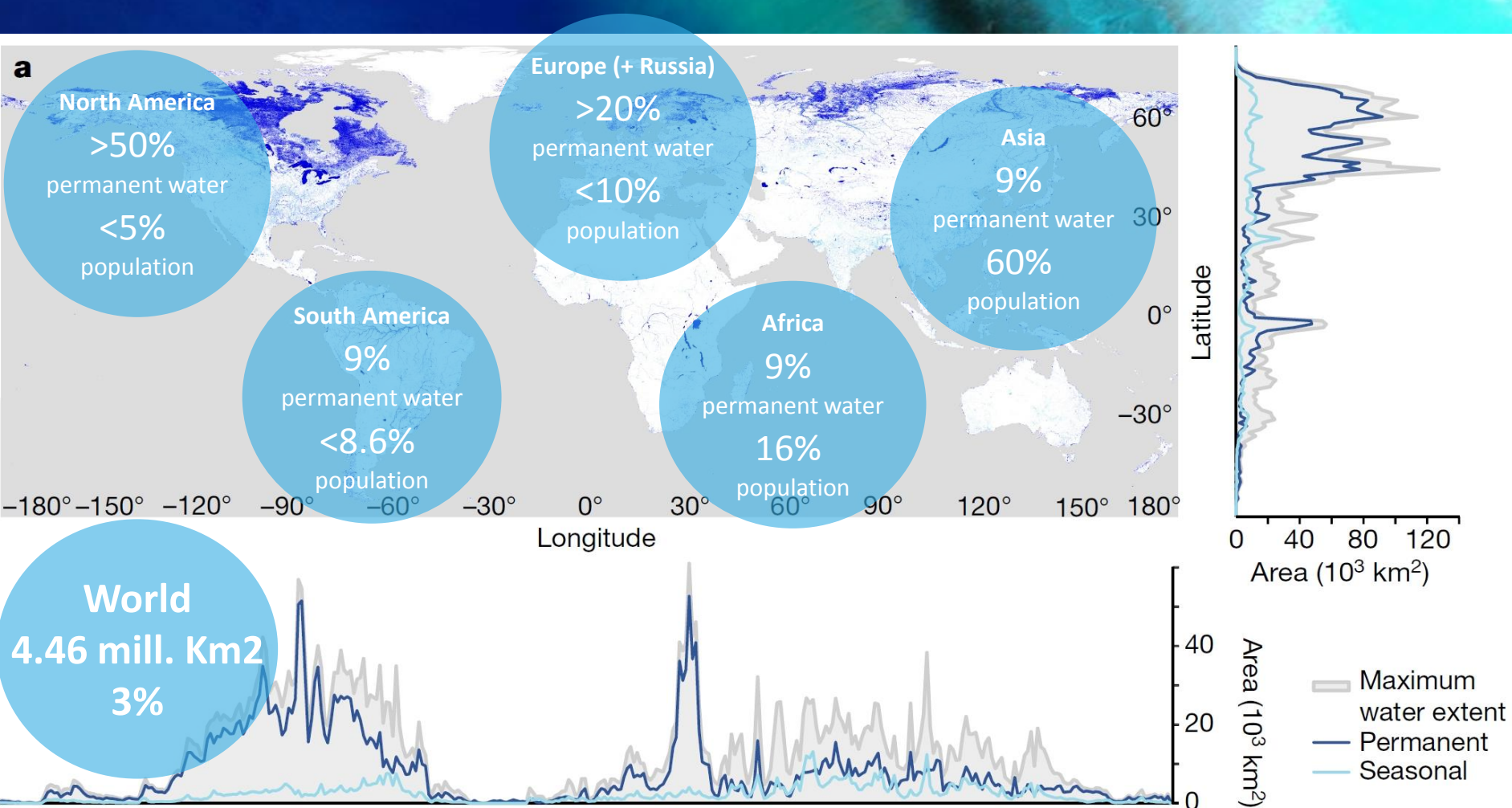
Water Occurrence Change Intensity
(1984-1999 to 2000-2015) ⓘ

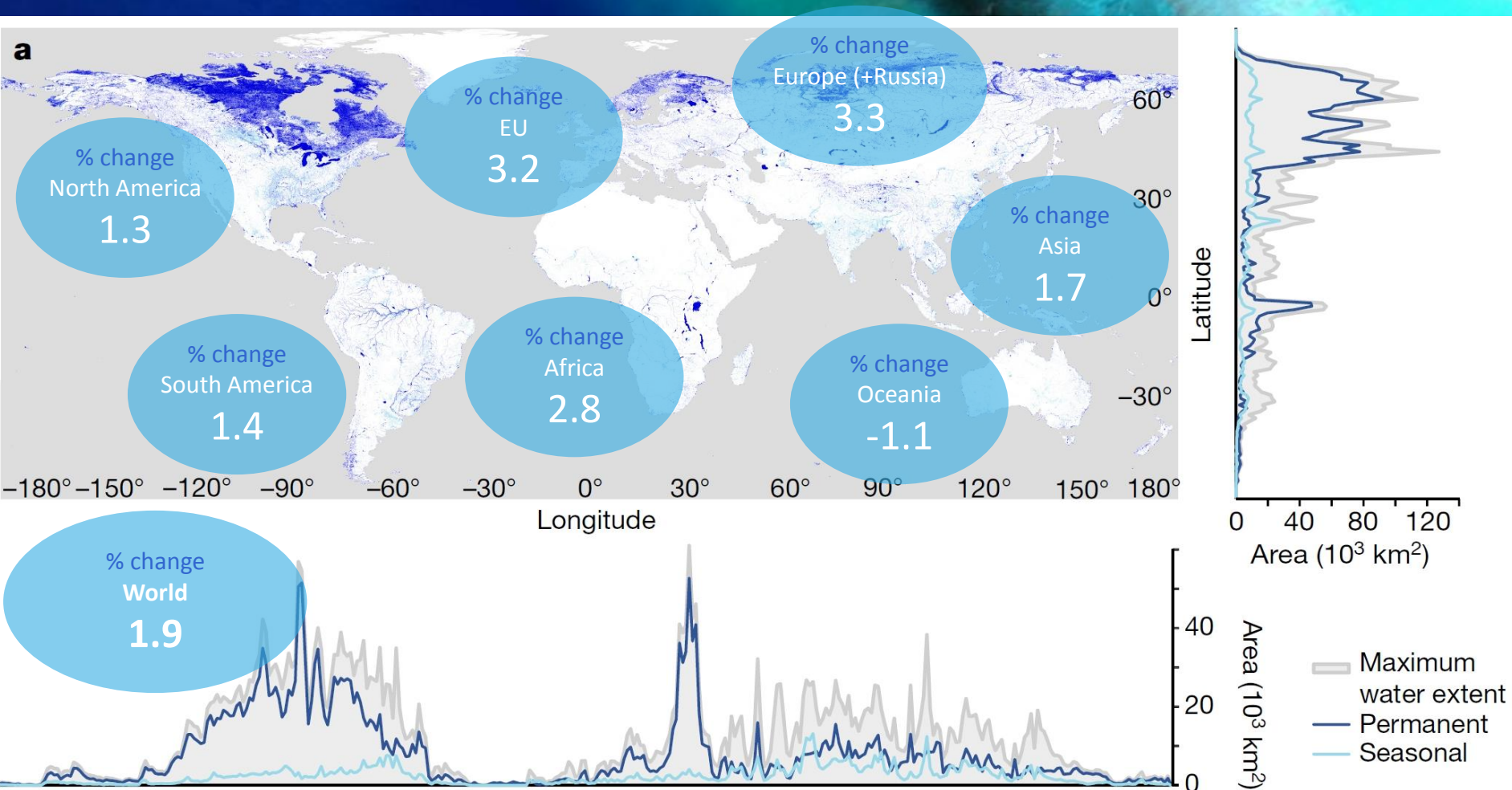


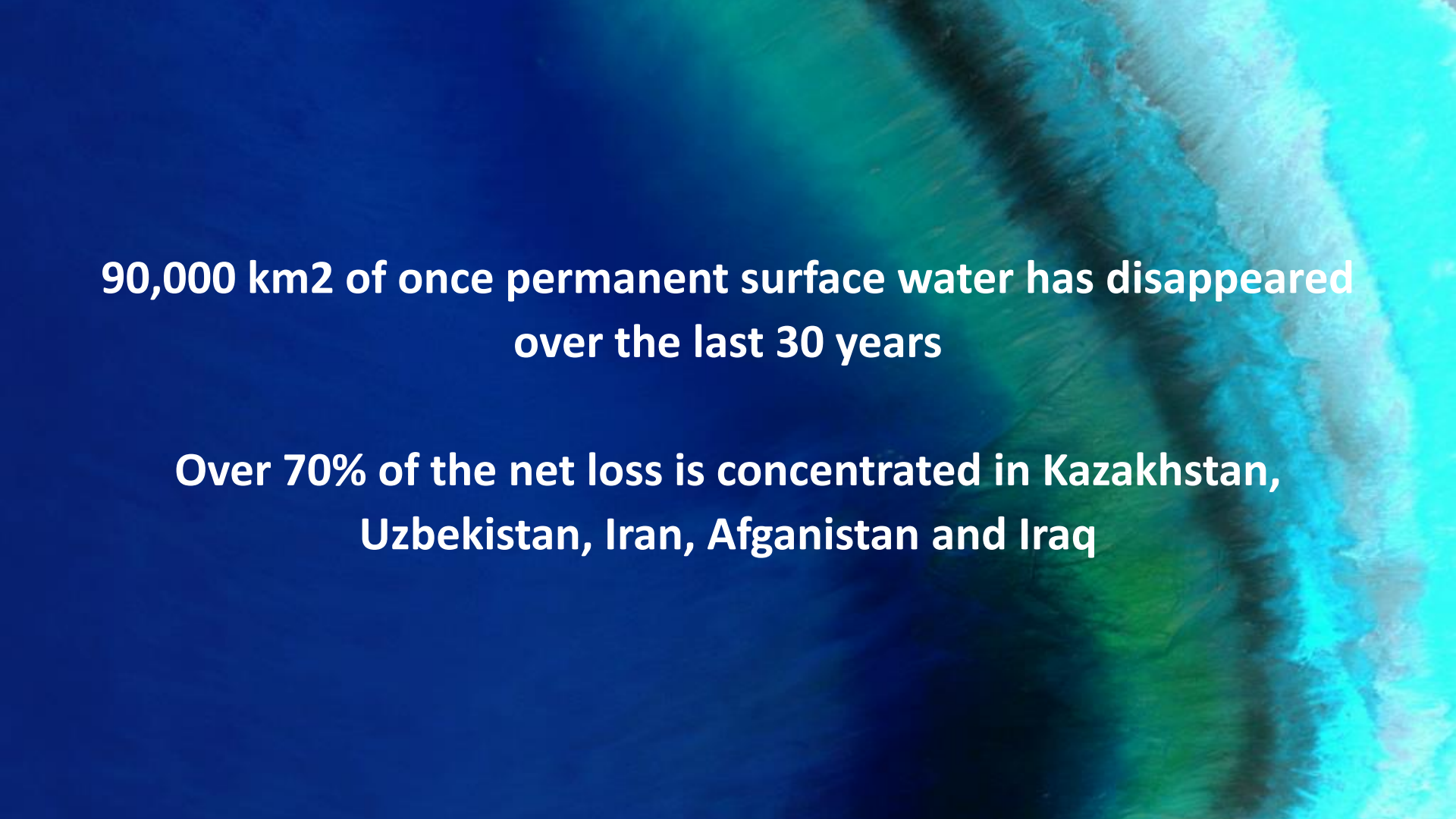
10 km
6 mi

Google Earth Engine



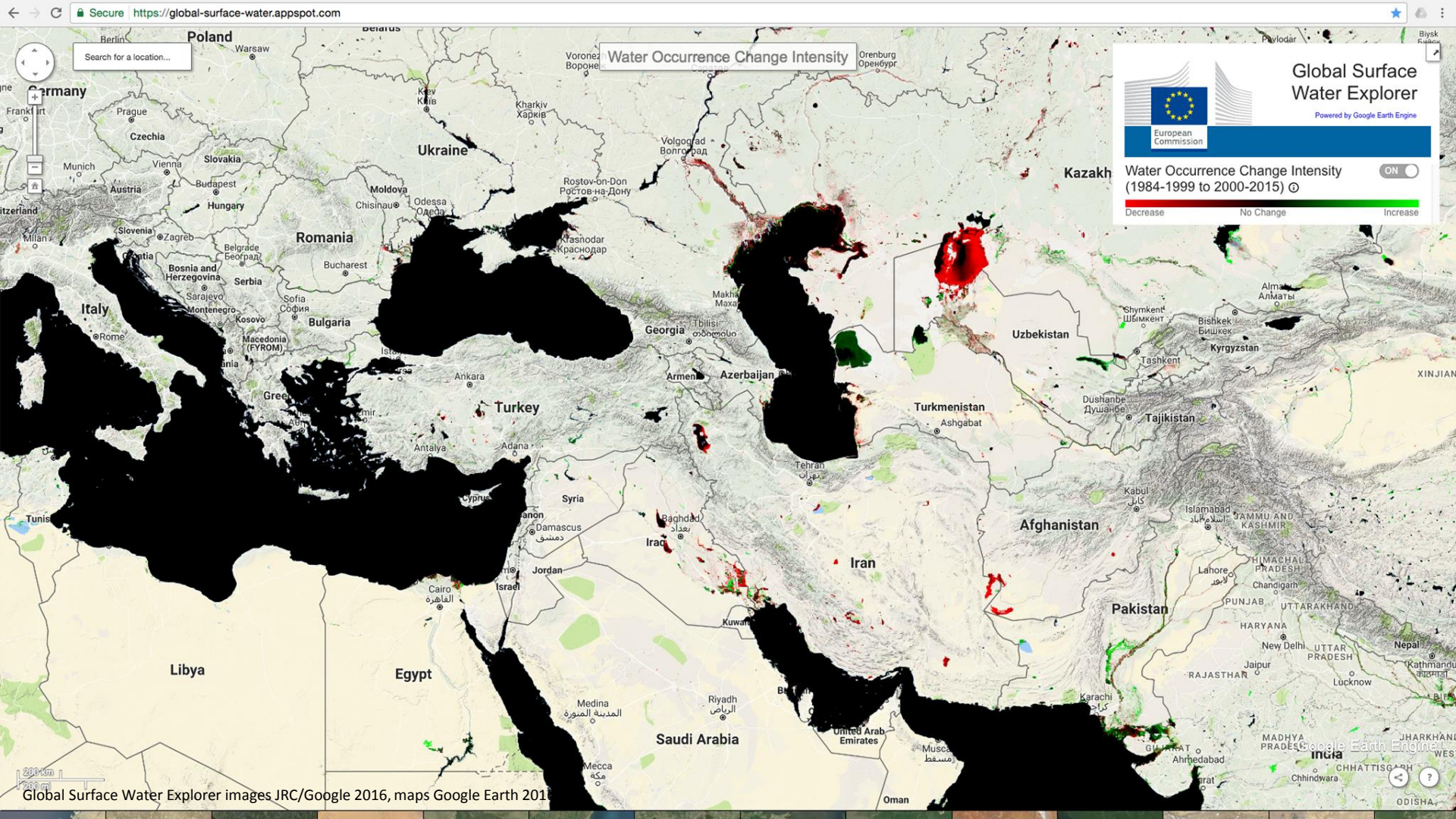


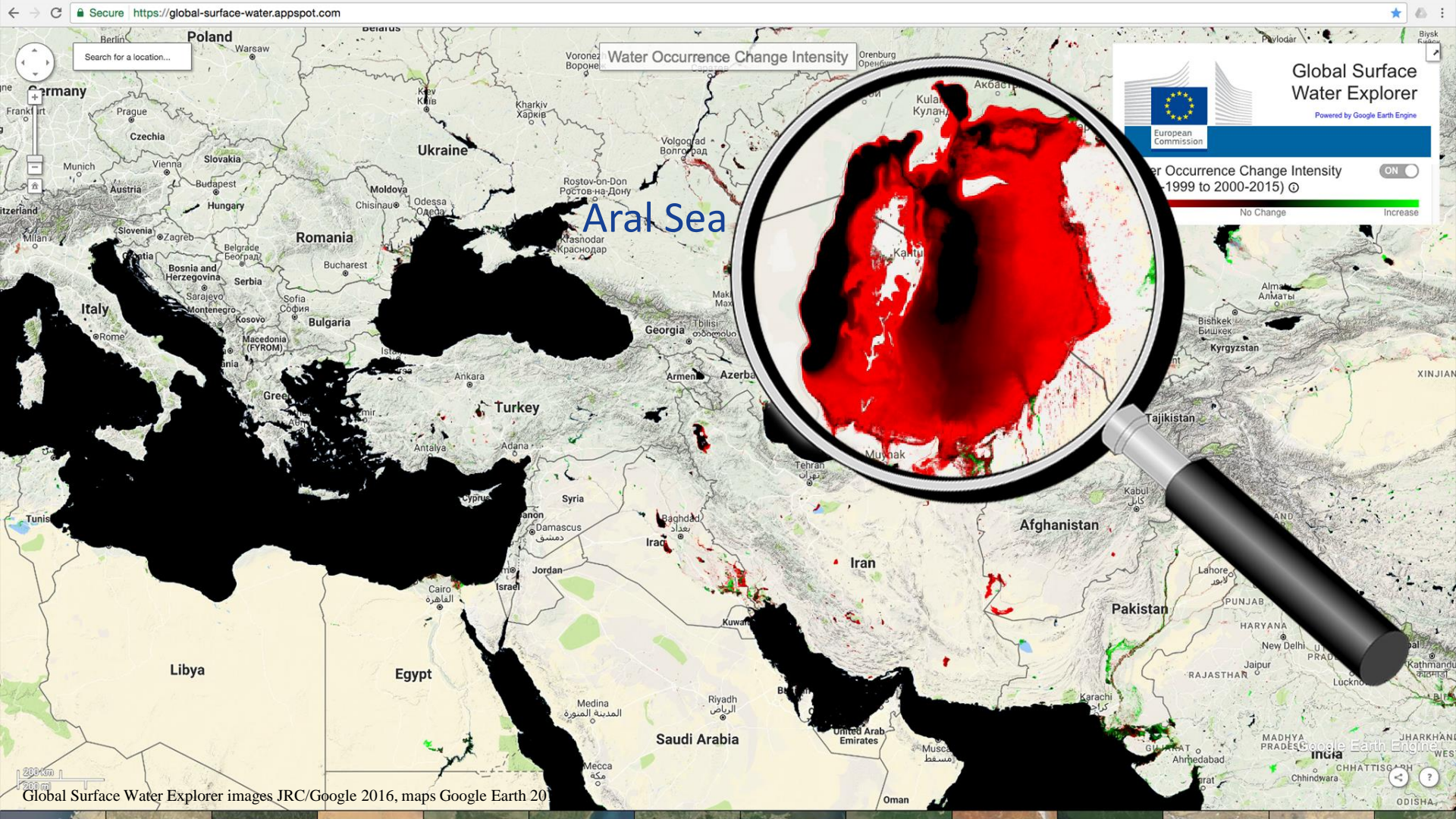


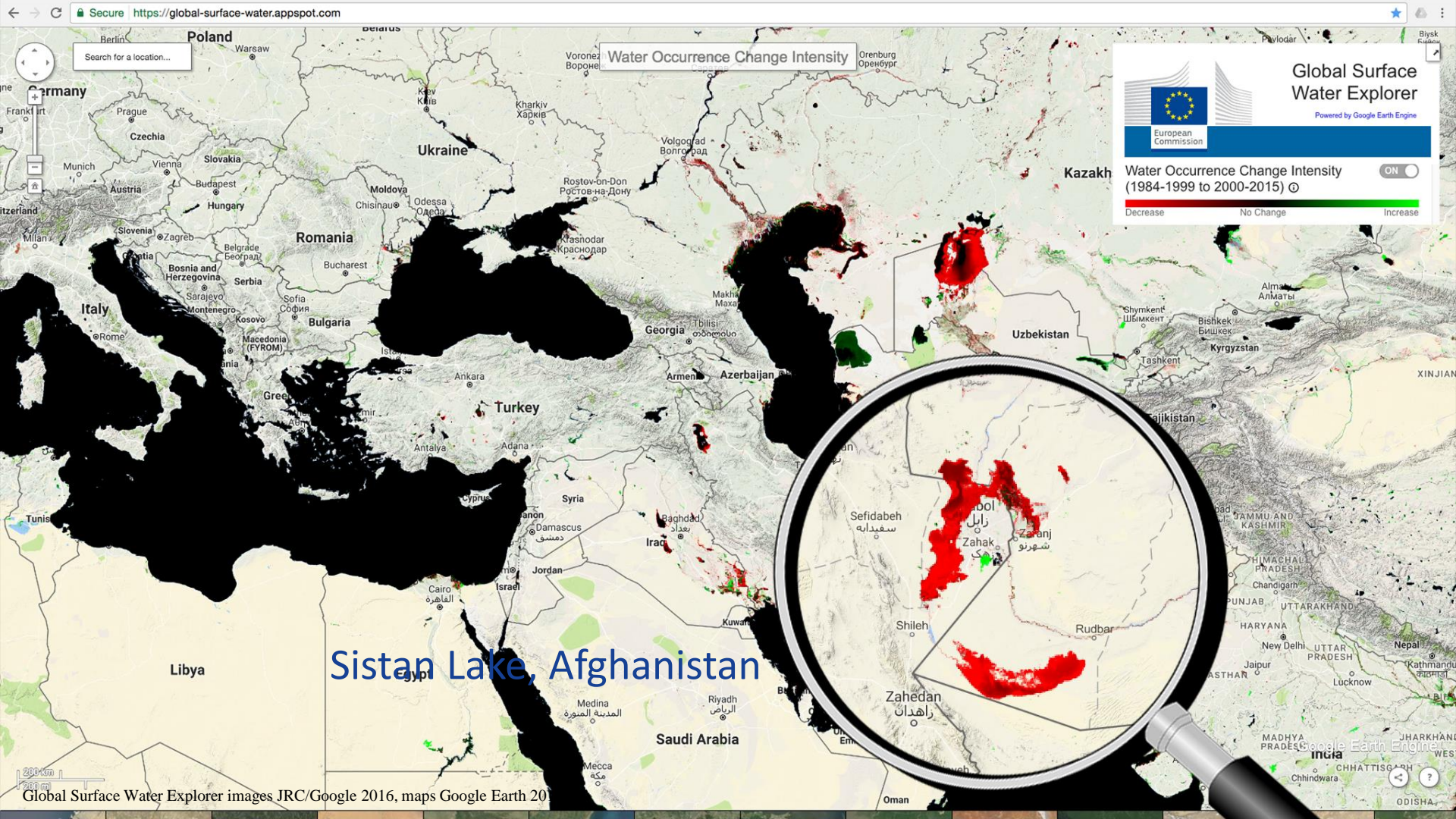


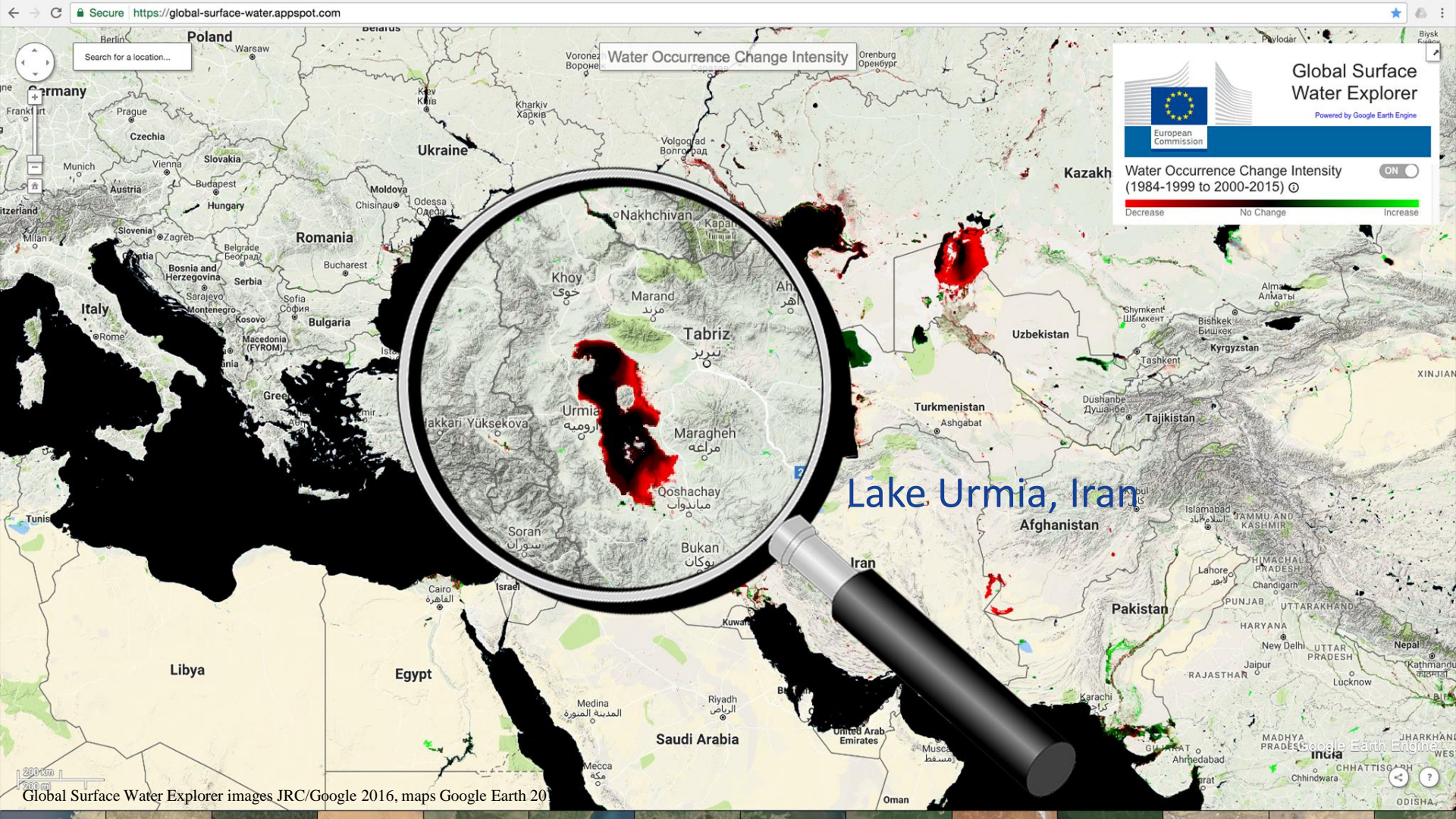
**90,000 km² of once permanent surface water has disappeared
over the last 30 years**

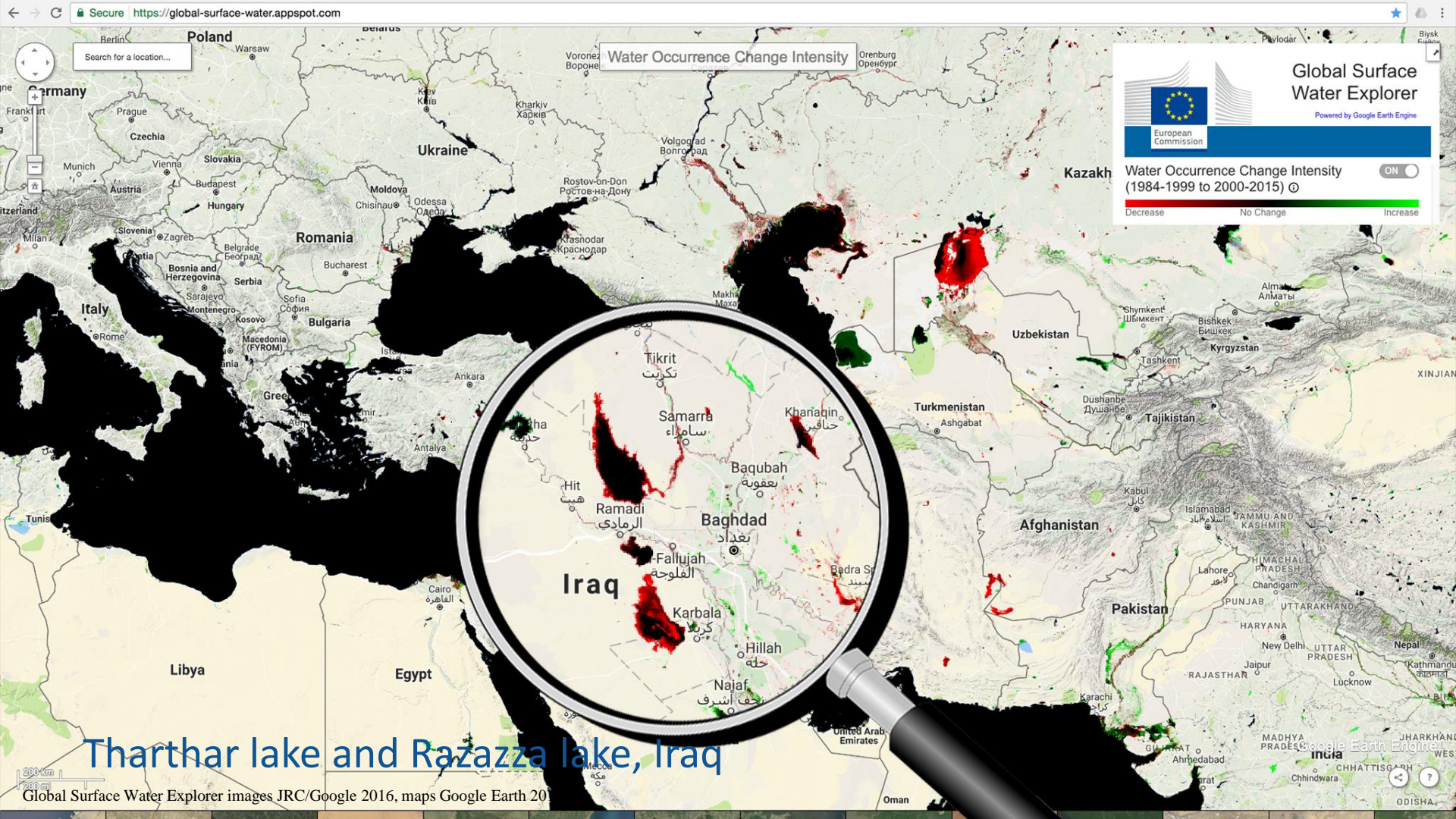
**Over 70% of the net loss is concentrated in Kazakhstan,
Uzbekistan, Iran, Afghanistan and Iraq**

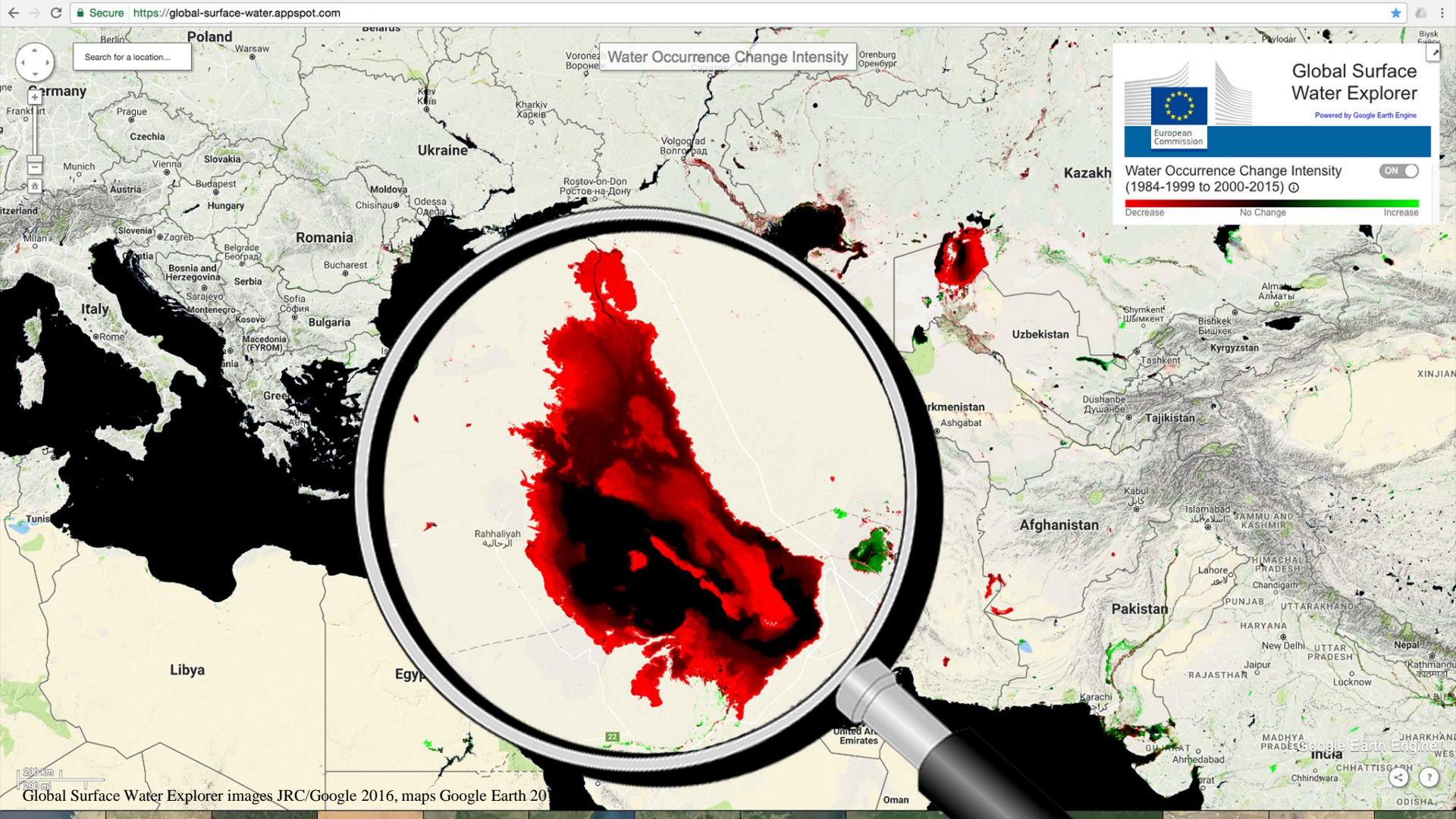


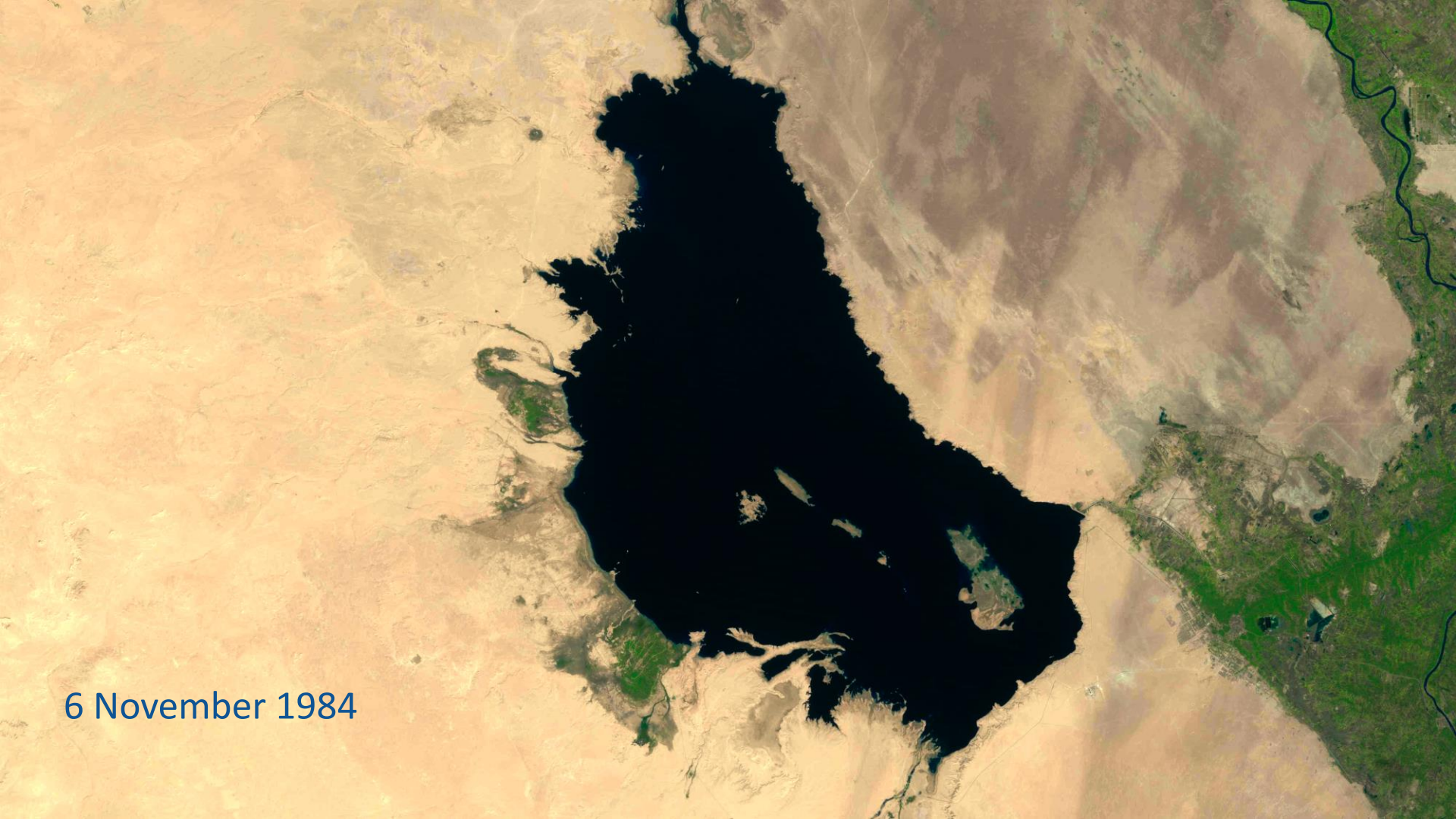










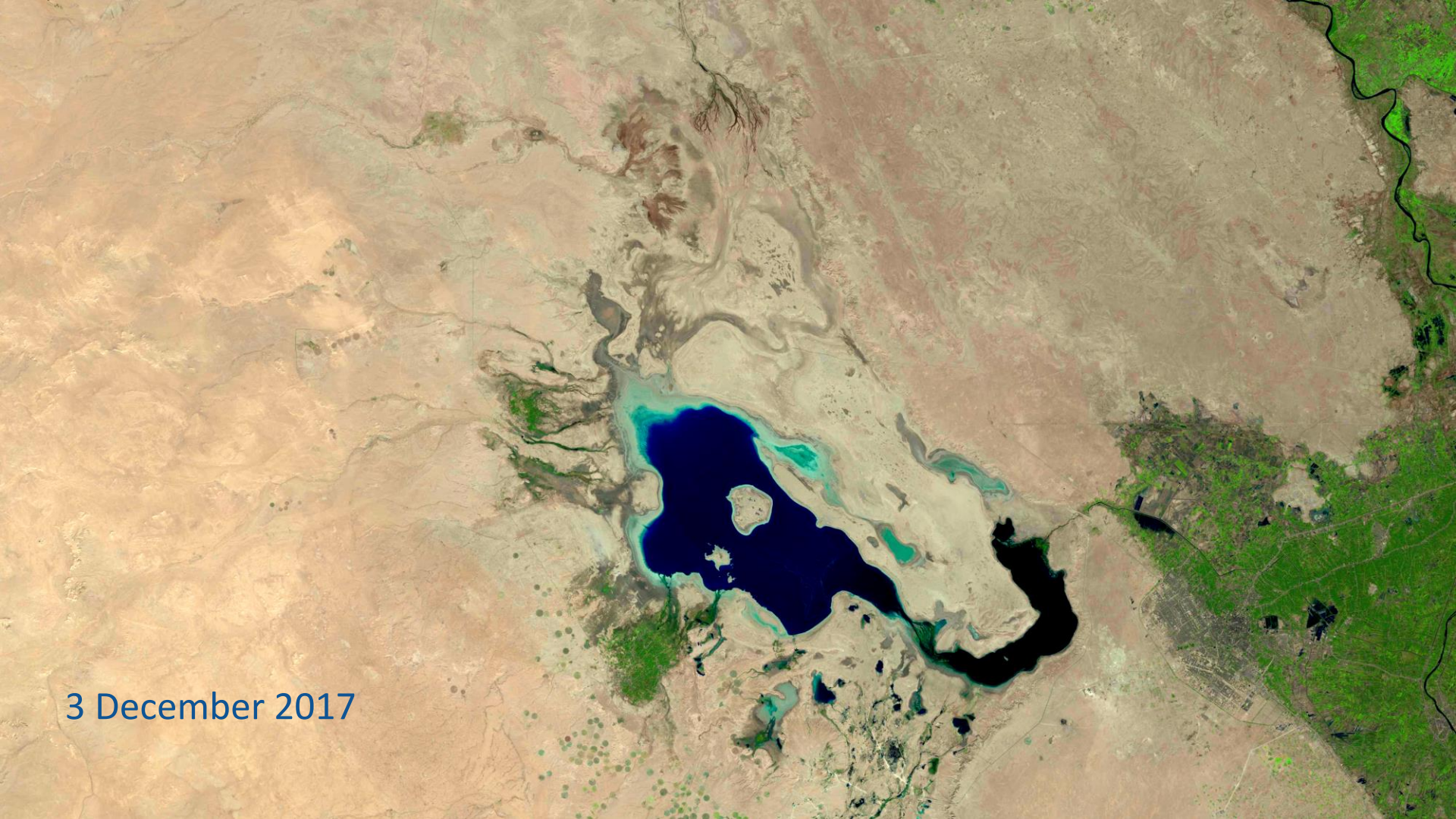


6 November 1984



1 October 2000

3 December 2017



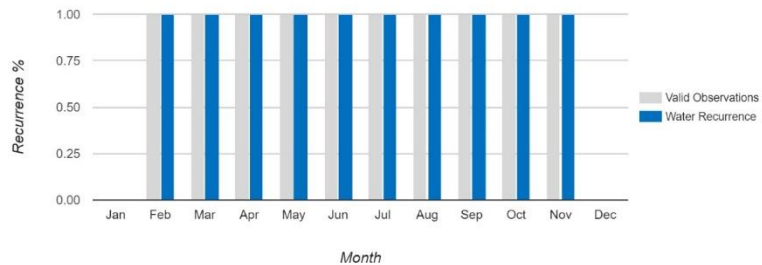


**185,000 km² of new permanent water bodies have formed,
mostly due to dam building and climate change, such as
accelerated glacier-melting**



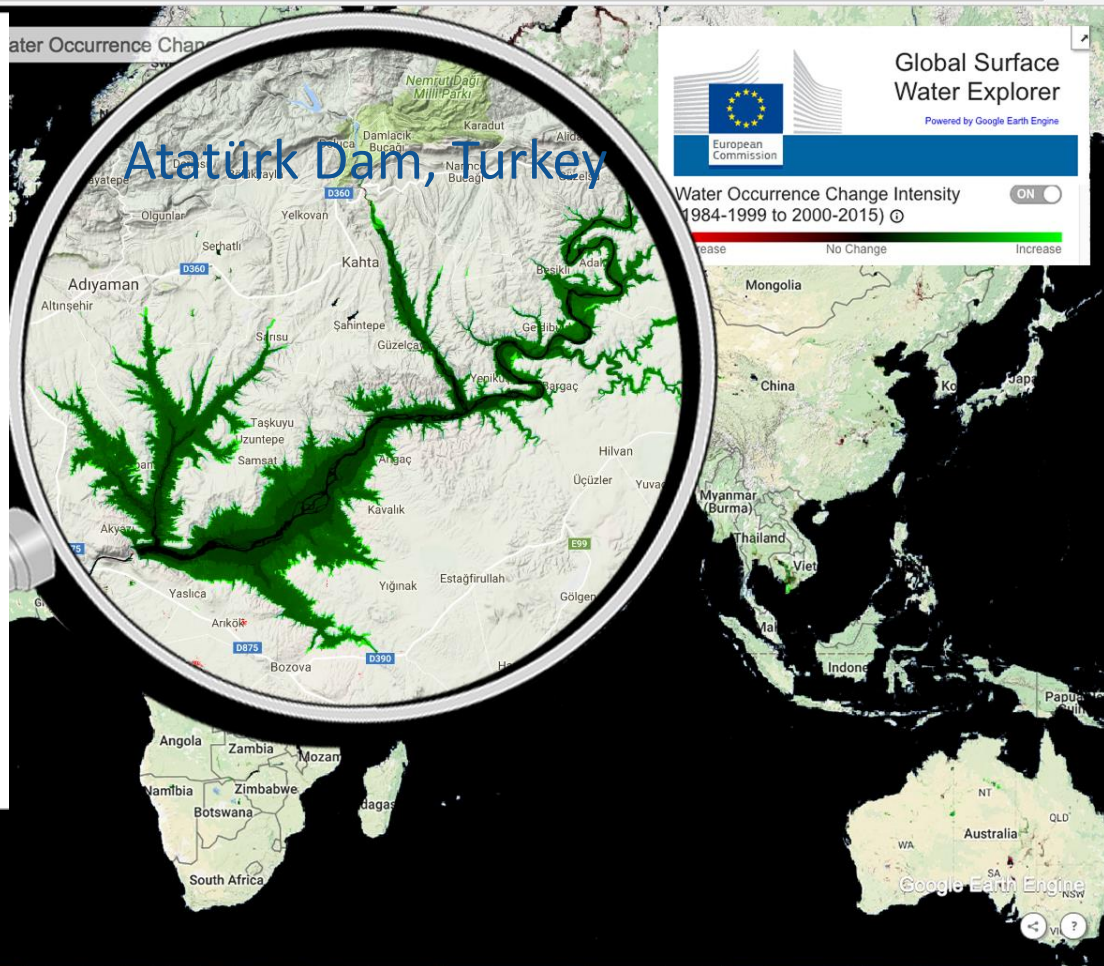
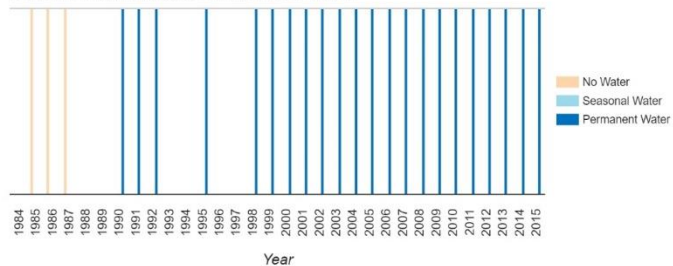
Pixel Coordinates: Lat: 37.477136, Long: 38.430998

Monthly Water Recurrence



Water History

Click a bar on the graph to see full monthly history for that year





Global Surface Water Explorer images JRC/Google 2016, maps Google Earth 2016

- Palm Islands
- Aral Sea
- Manicouagan Crater
- Tahoua
- Okavango Delta
- Ramanathapuram
- Pearl River Delta
- Miss River Delta
- Atchafalaya River
- Lake Gairdner
- Amazon River
- High-Elev Lakes
- Lake Hamoun
- Brahmaputra



Tibet plateau, 29cm, Creative Commons Attribution-ShareAlike 2.0 Generic

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The Global Surface Water Explorer – an Information System for Decision Making and Policy Support



- Contributions to SDGs
 - Indicator 6.6.1 Change in the extent of water-related ecosystems over time
 - Indicator 15.3.1 Proportion of land that is degraded over total land area (indirect)
 - Target 15.5 Take urgent and significant action to reduce the degradation of natural habitats...

The Global Surface Water Explorer – an Information System for Decision Making and Policy Support



- Links to other SBAs or initiatives
 - UNFCCC: Global Climate Observing System (2016 Plan), Lake Area essential climate variable
 - CBD: Ecosystem function (inundation)
 - UNCCD: Part of 14 point land degradation classification (World Atlas of Desertification)

The Global Surface Water Explorer – Future Developments



- Update time series to end of 2017 (currently up to 2015)
- Produce 20m resolution using Sentinel 2 and Landsat
- Move towards operational near real-time product generation

THANK YOU

<https://global-surface-water.appspot.com/>

Jrc-surfacewater@ec.europa.eu

