

CEE 690-02

ENVIRONMENTAL SPATIAL
DATA ANALYSIS

Lecture I2

What we are going (to try) to cover

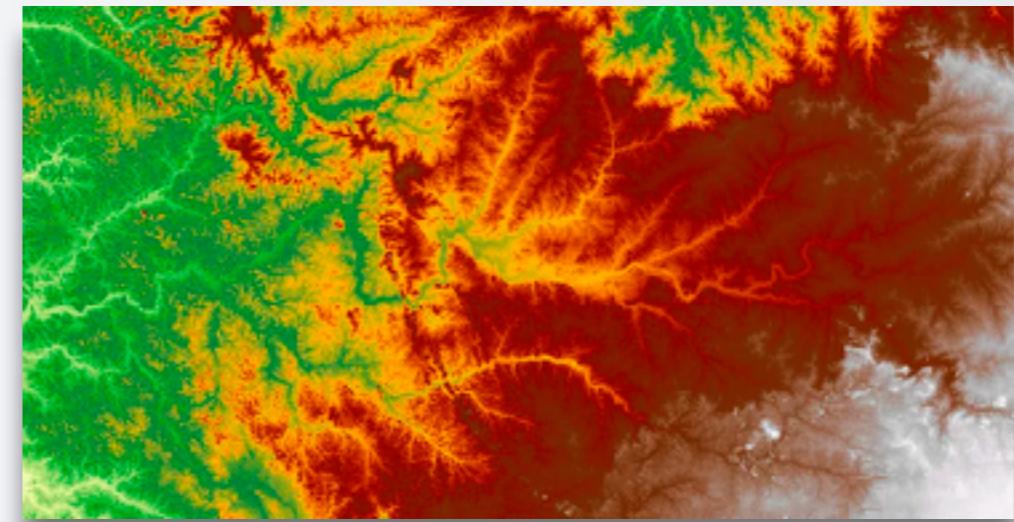
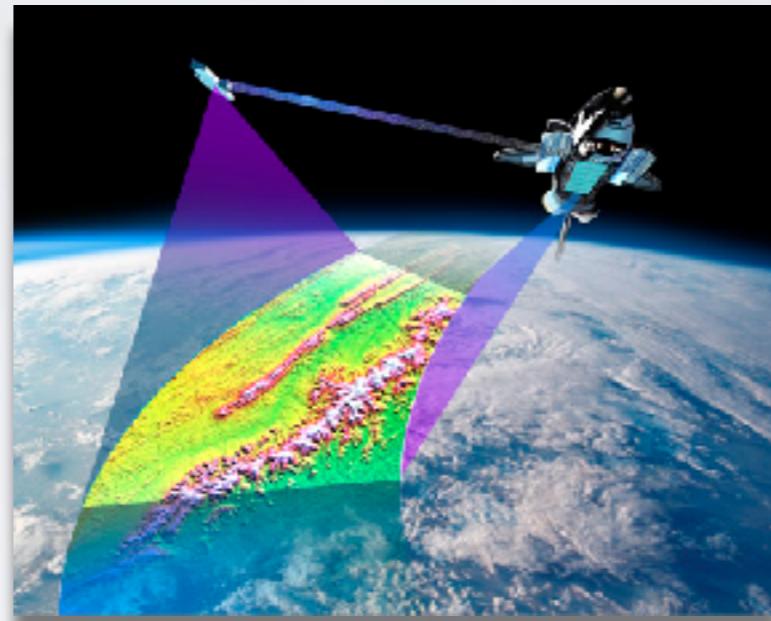
- Elevation data
- Land use/vegetation phenology
- Soil
- River networks
- Water bodies
- Land surface water/energy cycle
- Meteorological observations
- Biogeochemistry
- Climate models
- Weather models

Not exhaustive! Just a
taste of what is out there.

Elevation data

SRTM DEM

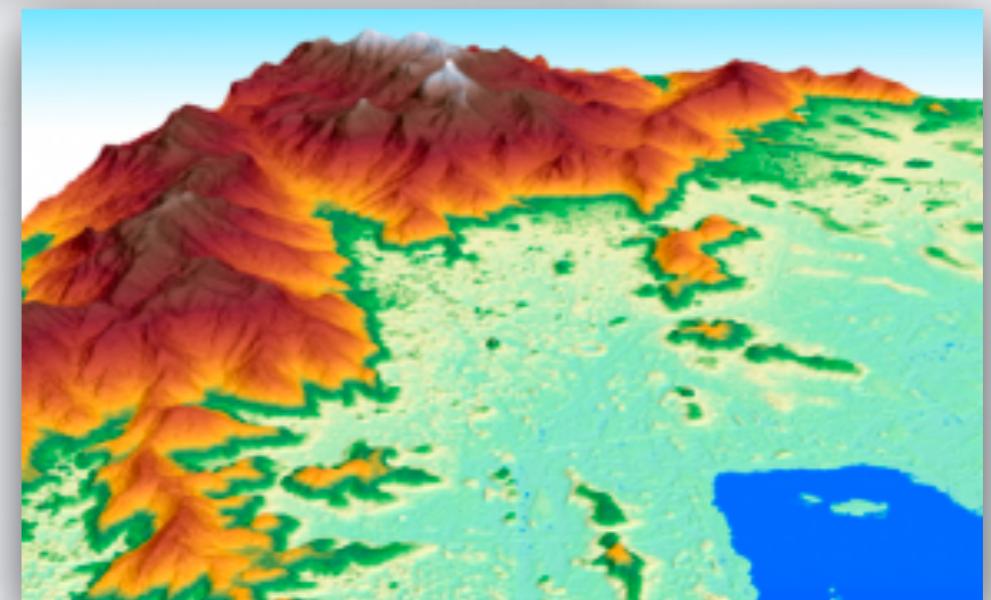
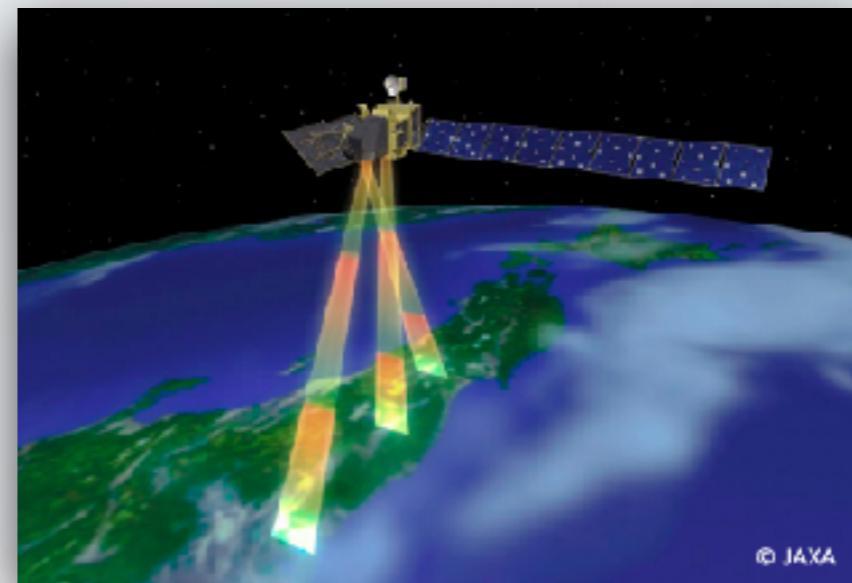
Spatial Cov.	55S-60N
Time Cov.	2000 (once)
Δx	1 arcsec (~30 m)
Δt	N/A



<http://opentopo.sdsc.edu/raster?opentopoID=OTSRTM.082015.4326.1>

ALOS World 3D

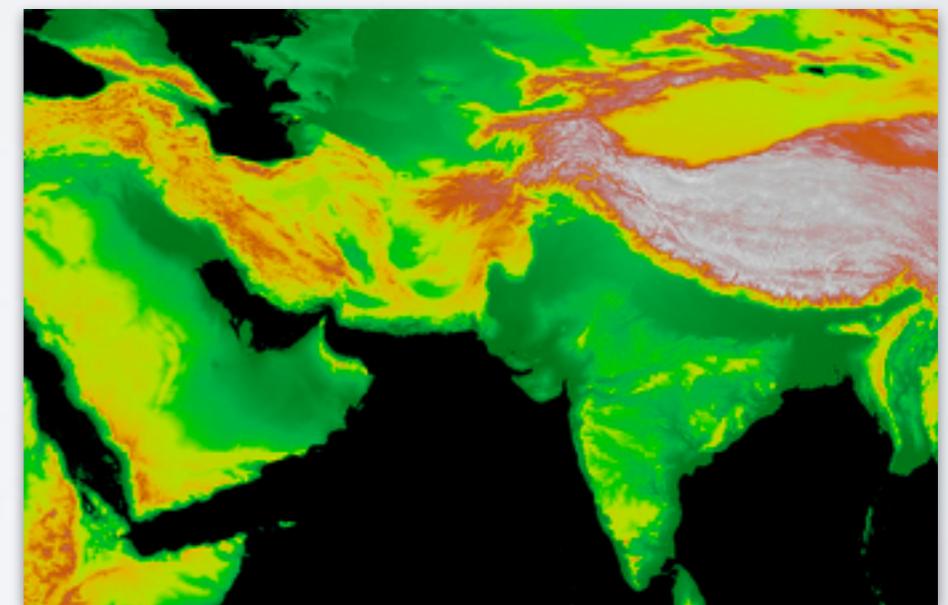
Spatial Cov.	Global
Time Cov.	2006-2011
Δx	1 arcsec* (~30 m)
Δt	N/A



<http://opentopo.sdsc.edu/raster?opentopoID=OTALOS.112016.4326.2>

ASTER GDEM

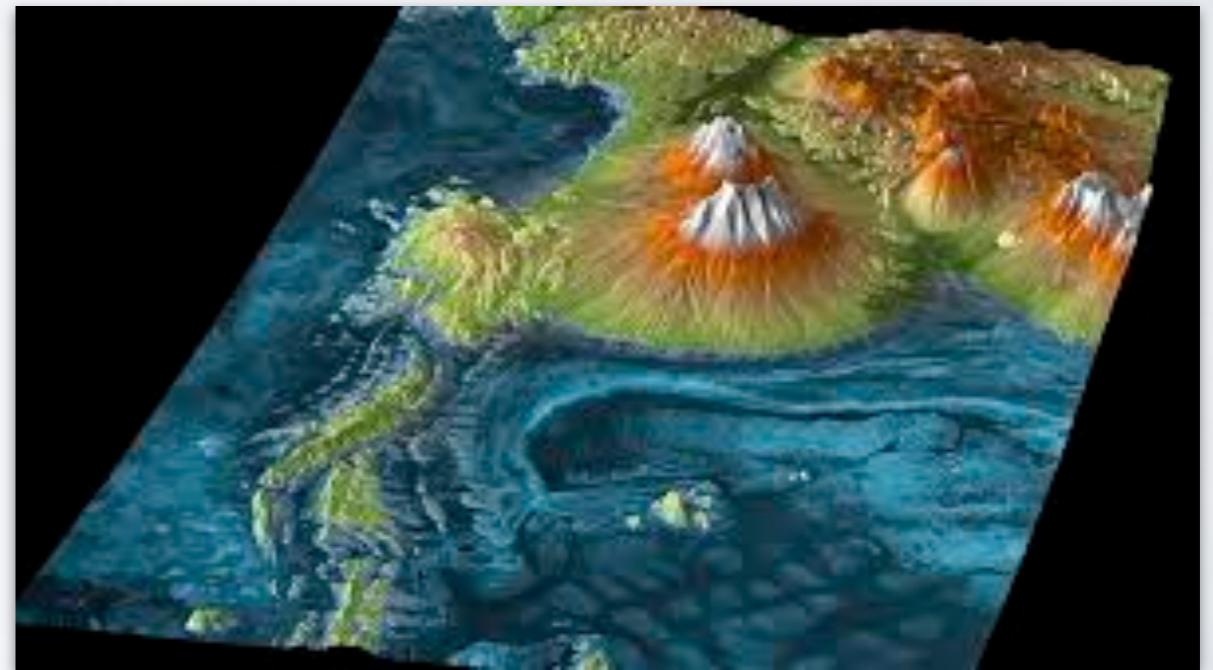
Spatial Cov.	Global*
Time Cov.	2000
Δx	1 arcsec* (~30 m)
Δt	N/A



<https://asterweb.jpl.nasa.gov/gdem.asp>

TanDEM-X 90 m

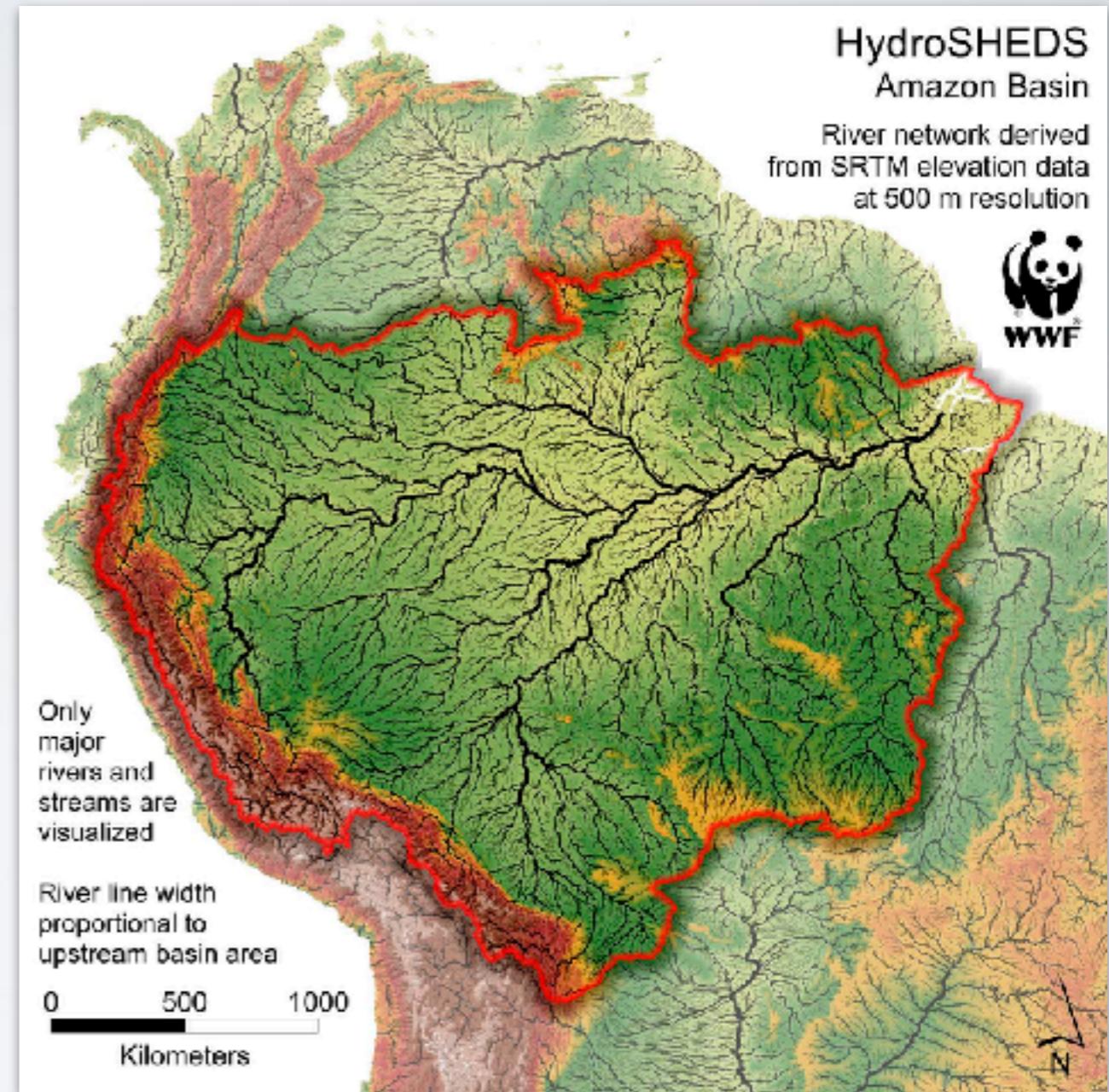
Spatial Cov.	Global*
Time Cov.	2010-
Δx	3 arcsec* (~90 m)
Δt	N/A



<https://tandemx-science.dlr.de/>

HydroSheds (SRTM derived)

Spatial Cov.	55S-60N
Time Cov.	N/A
Δx	3 arcsec (~90 m)
Δt	N/A

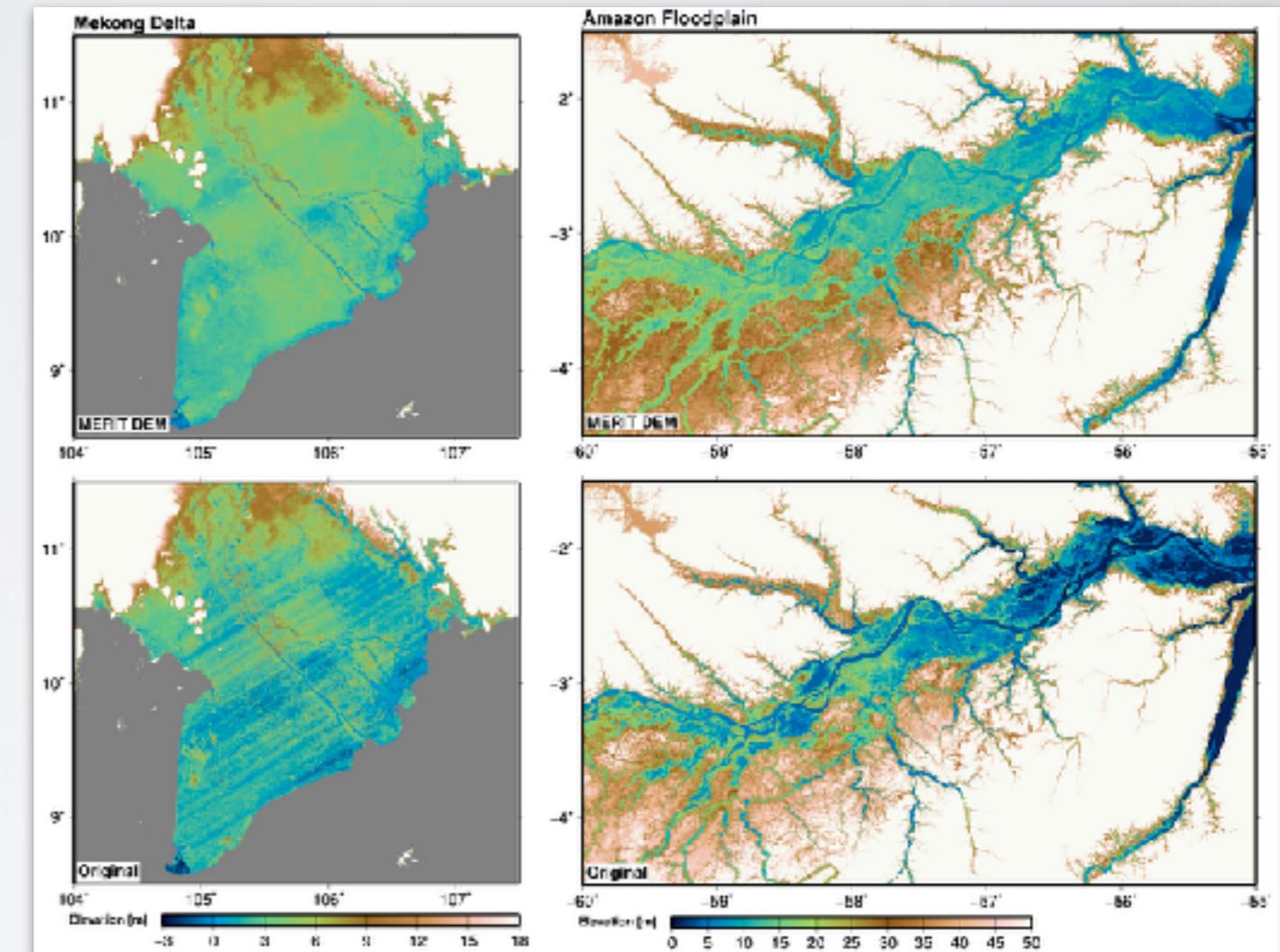


Hydrologically conditioned

<https://www.hydroshe ds.org/>

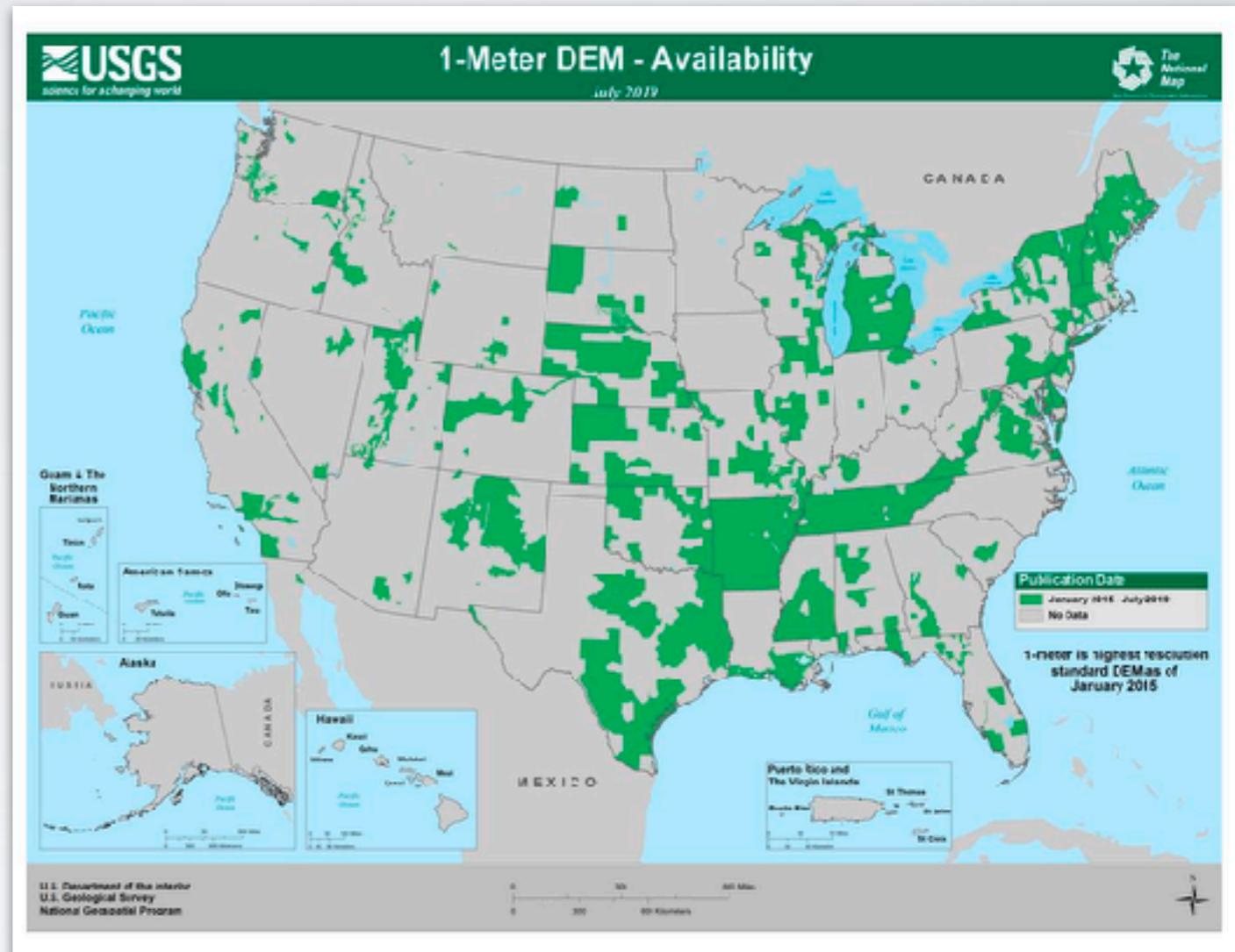
MERIT DEM

Spatial Cov.	Global*
Time Cov.	N/A
Δx	3 arcsec (~90 m)
Δt	N/A



3DEP (Formerly NED)

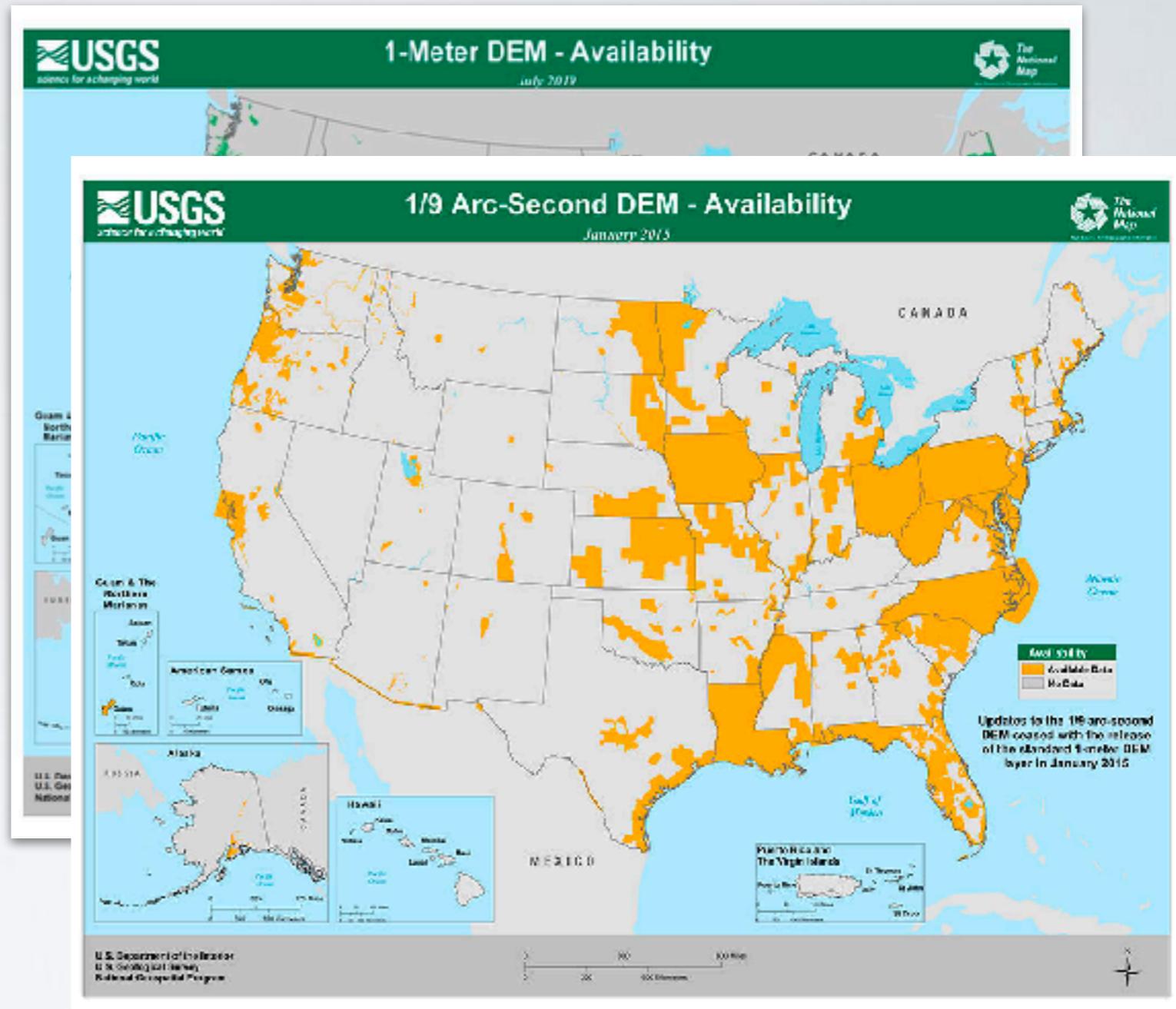
Spatial Cov.	United States
Time Cov.	N/A
Δx	Multiple
Δt	N/A



<https://www.usgs.gov/core-science-systems/ngp/3dep>

3DEP (Formerly NED)

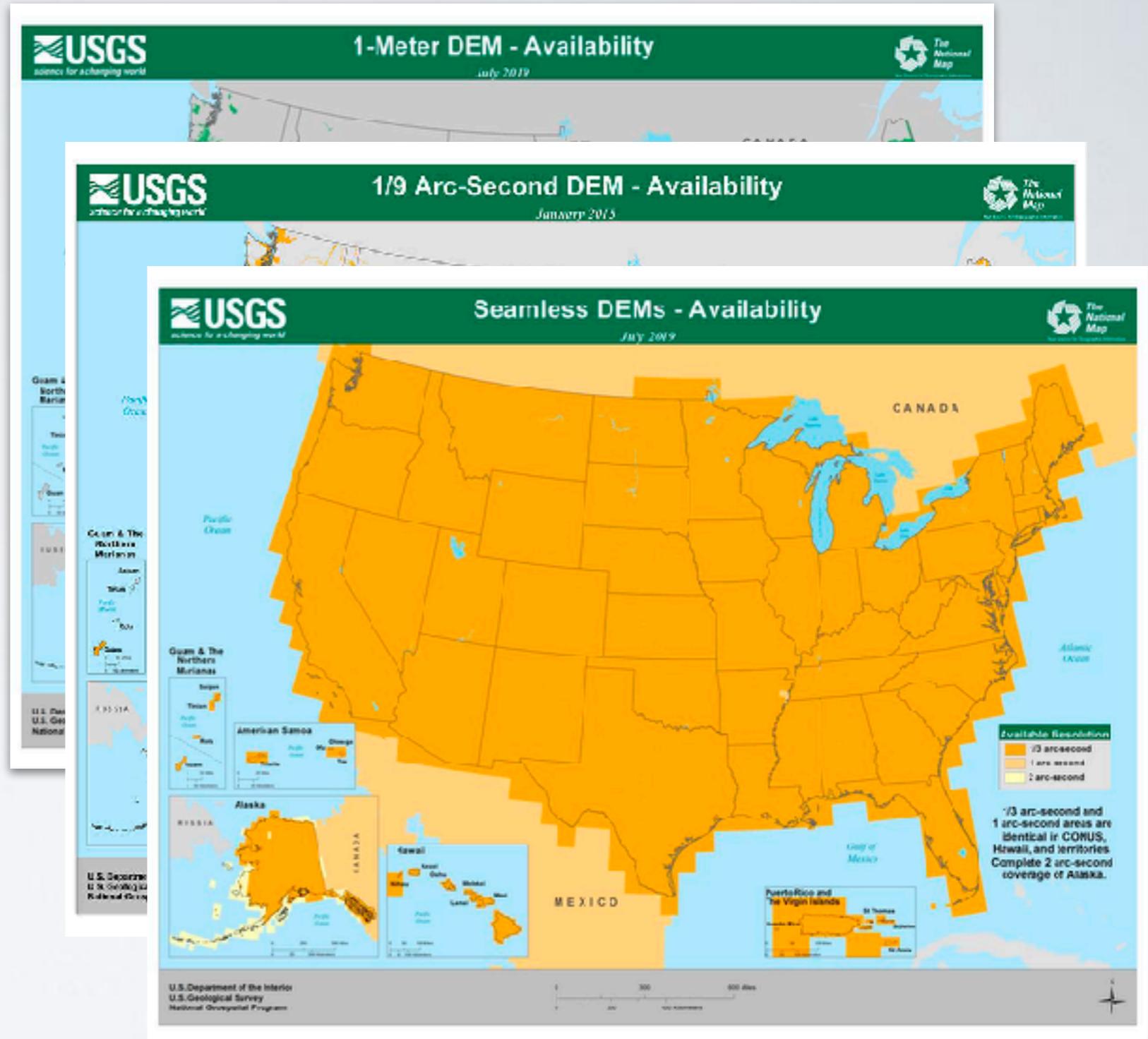
Spatial Cov.	United States
Time Cov.	N/A
Δx	Multiple
Δt	N/A



<https://www.usgs.gov/core-science-systems/ngp/3dep>

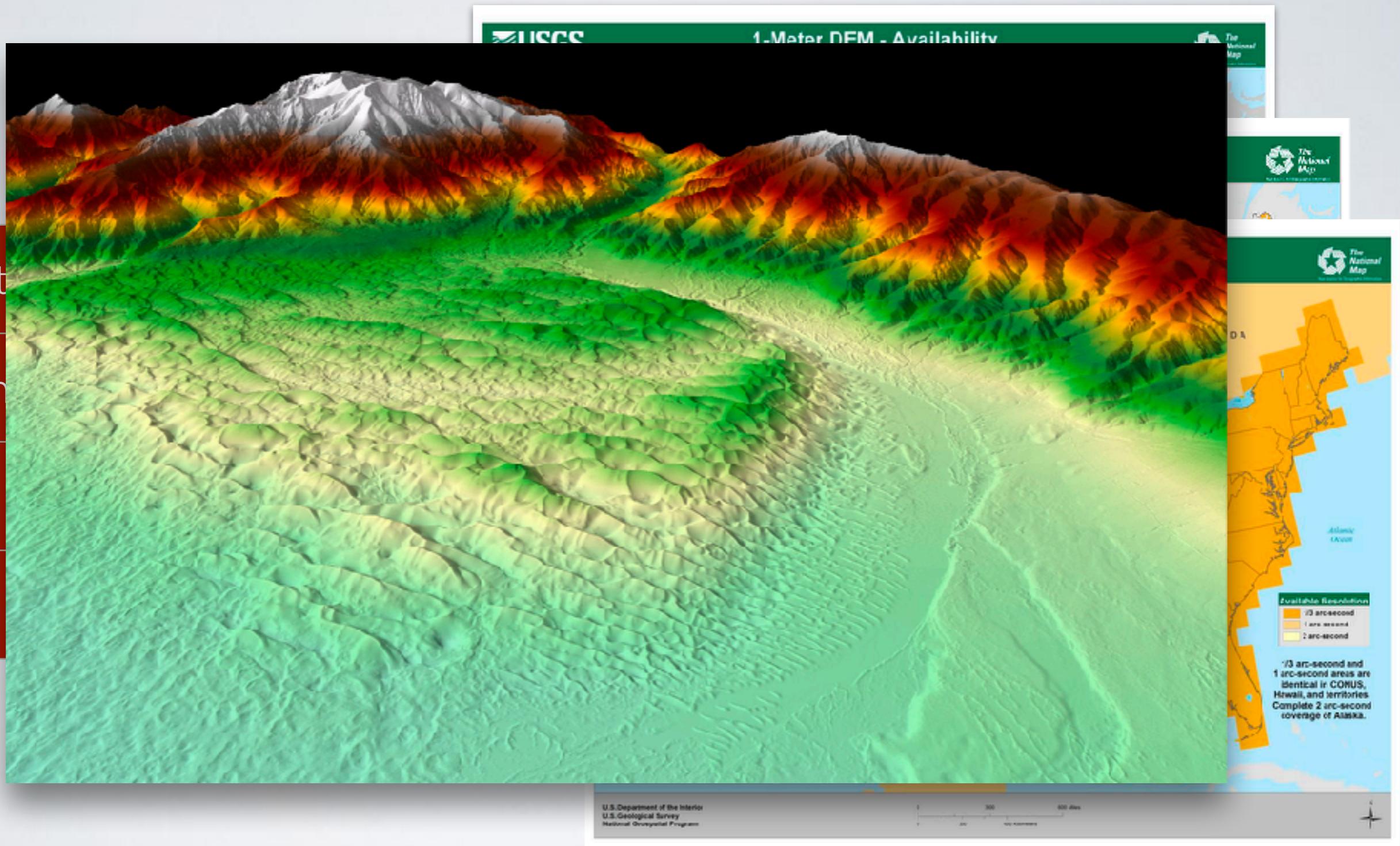
3DEP (Formerly NED)

Spatial Cov.	United States
Time Cov.	N/A
Δx	Multiple
Δt	N/A



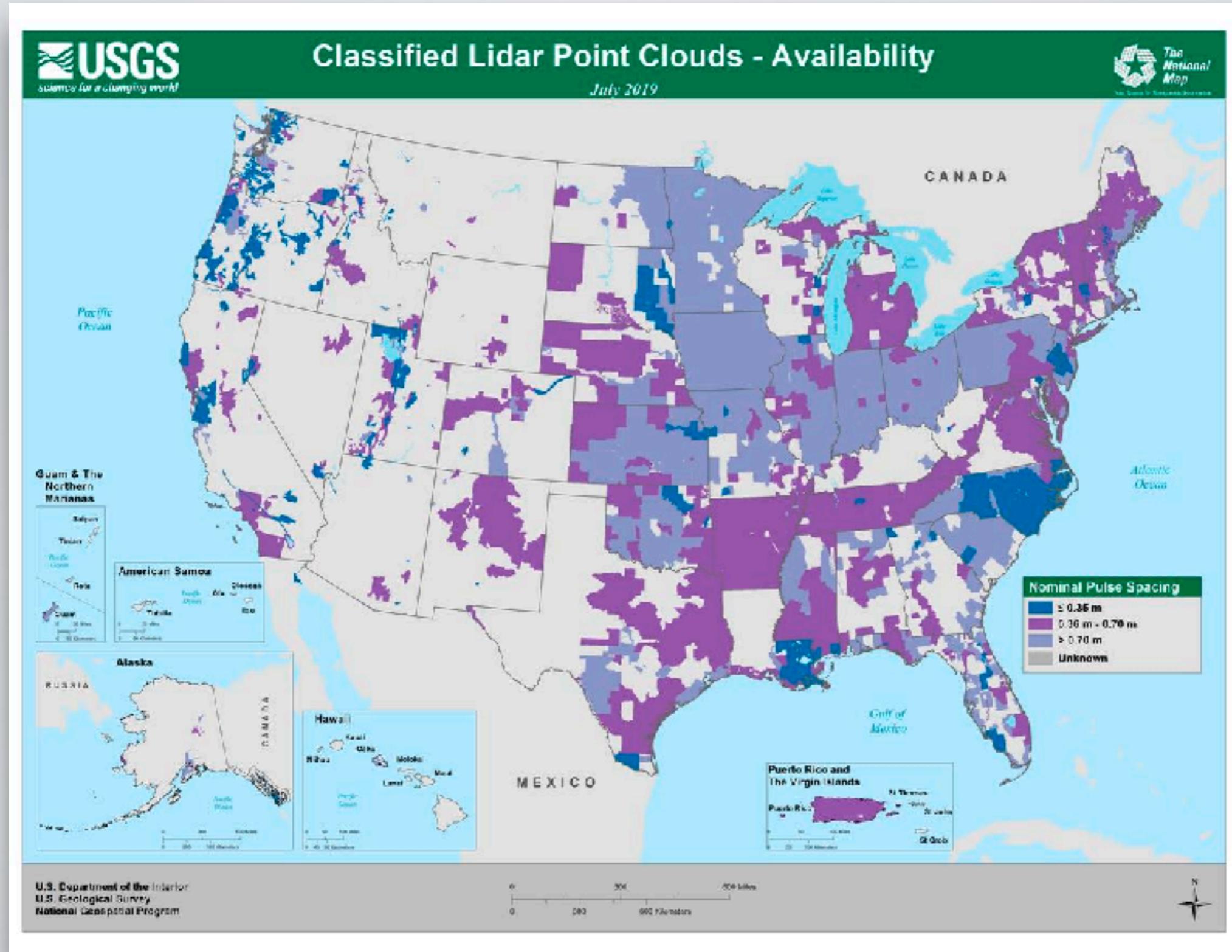
<https://www.usgs.gov/core-science-systems/ngp/3dep>

3DEP (Formerly NED)



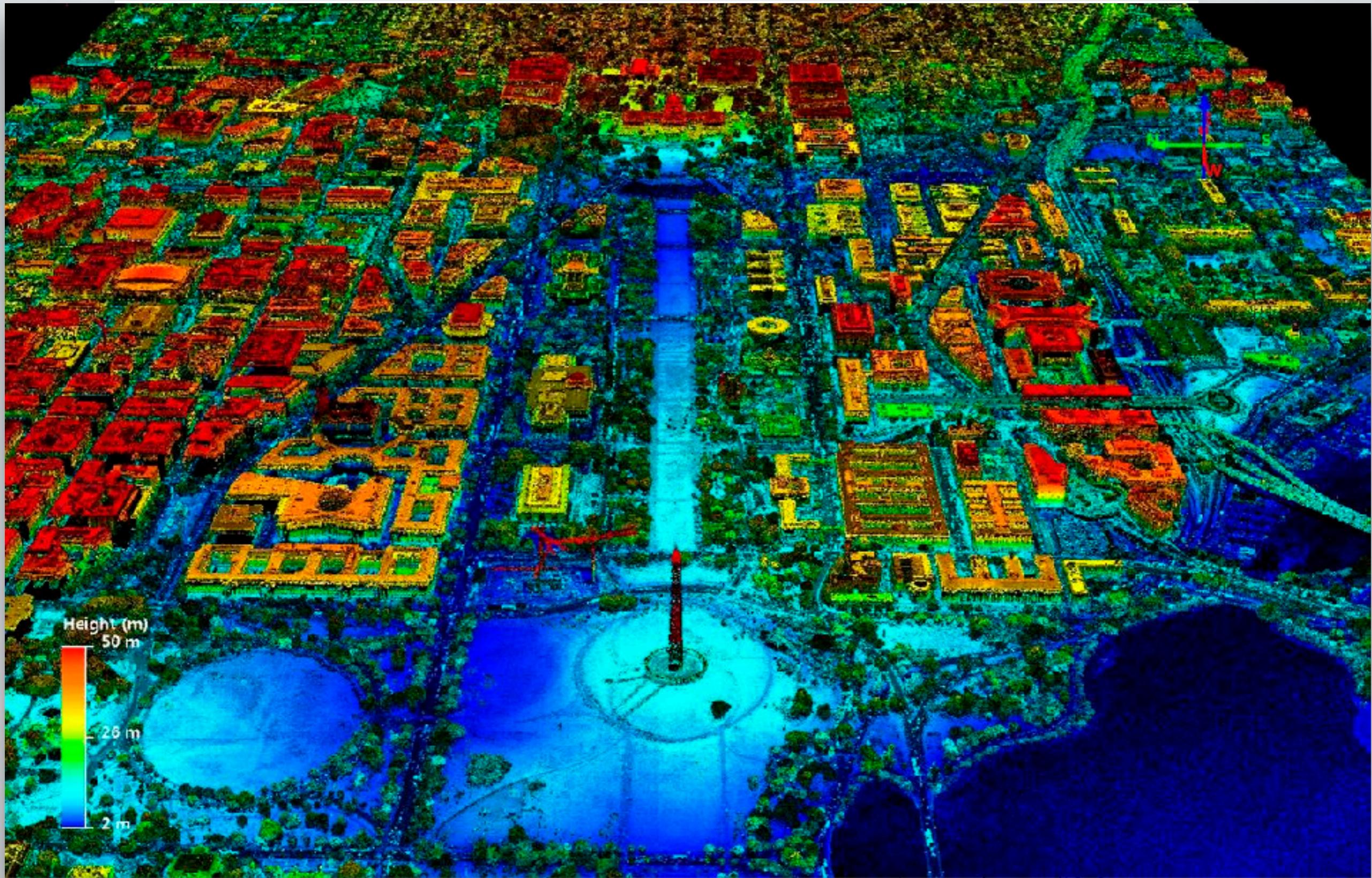
<https://www.usgs.gov/core-science-systems/ngp/3dep>

3DEP LIDAR point cloud



<https://www.usgs.gov/core-science-systems/ngp/3dep>

3DEP LIDAR point cloud



<https://www.usgs.gov/core-science-systems/ngp/3dep>

More elevation data resources?

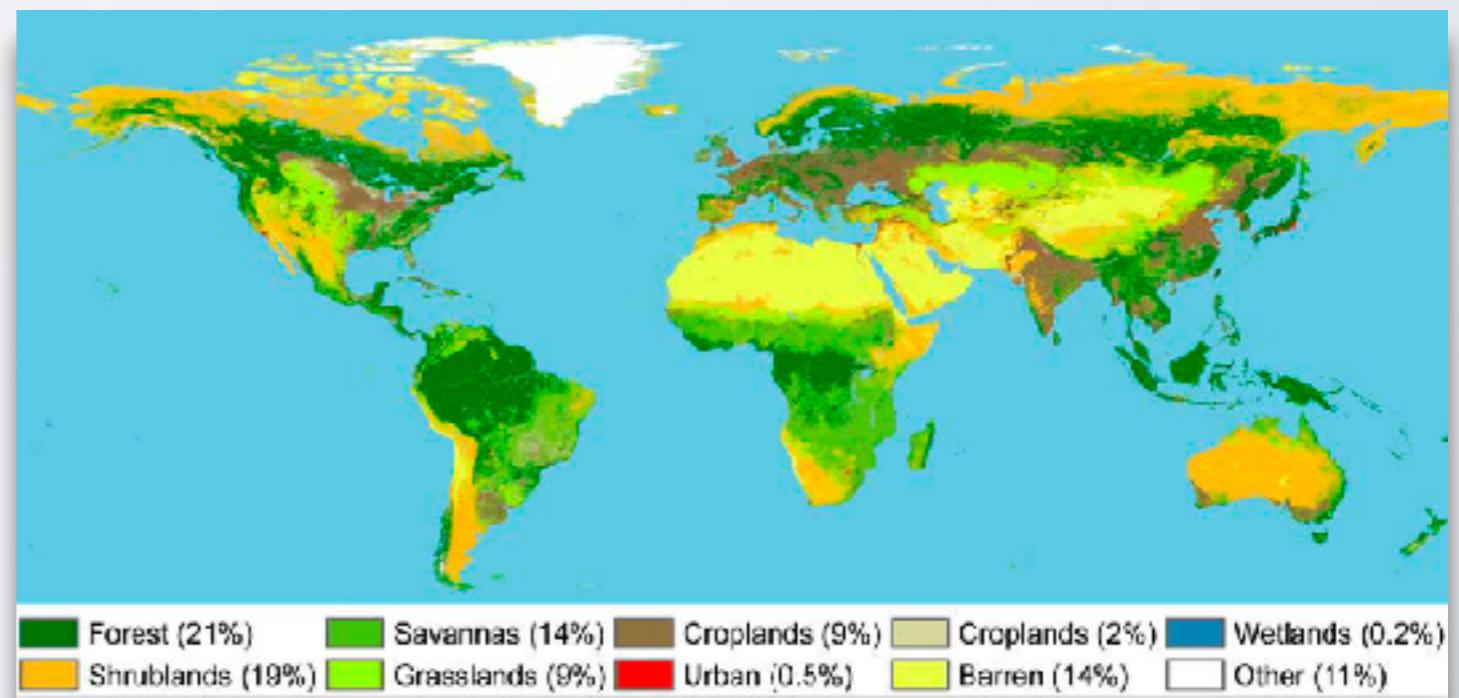
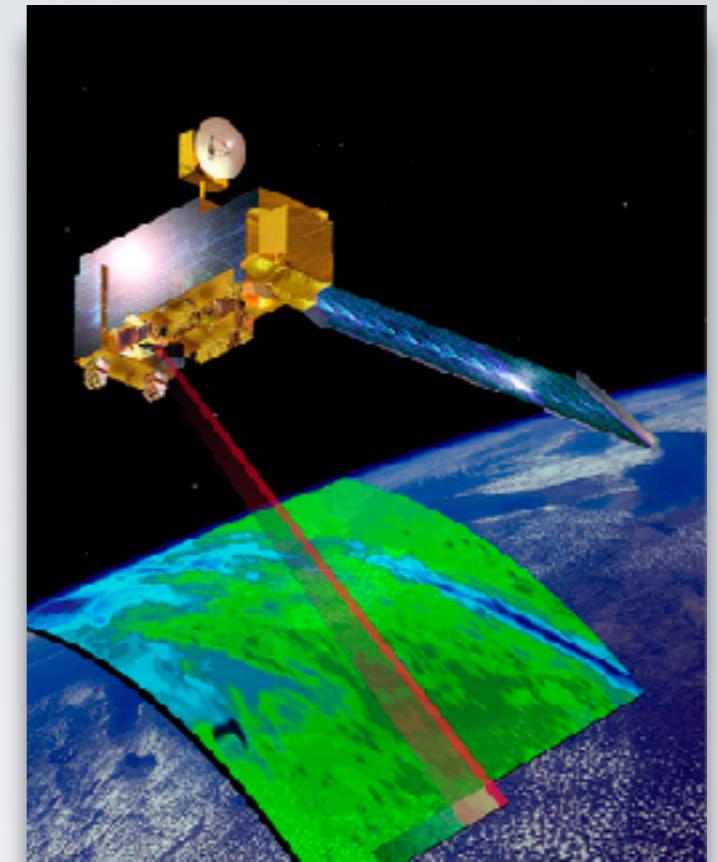


<https://opentopography.org/>

Land use/vegetation
phenology data

MODIS land cover

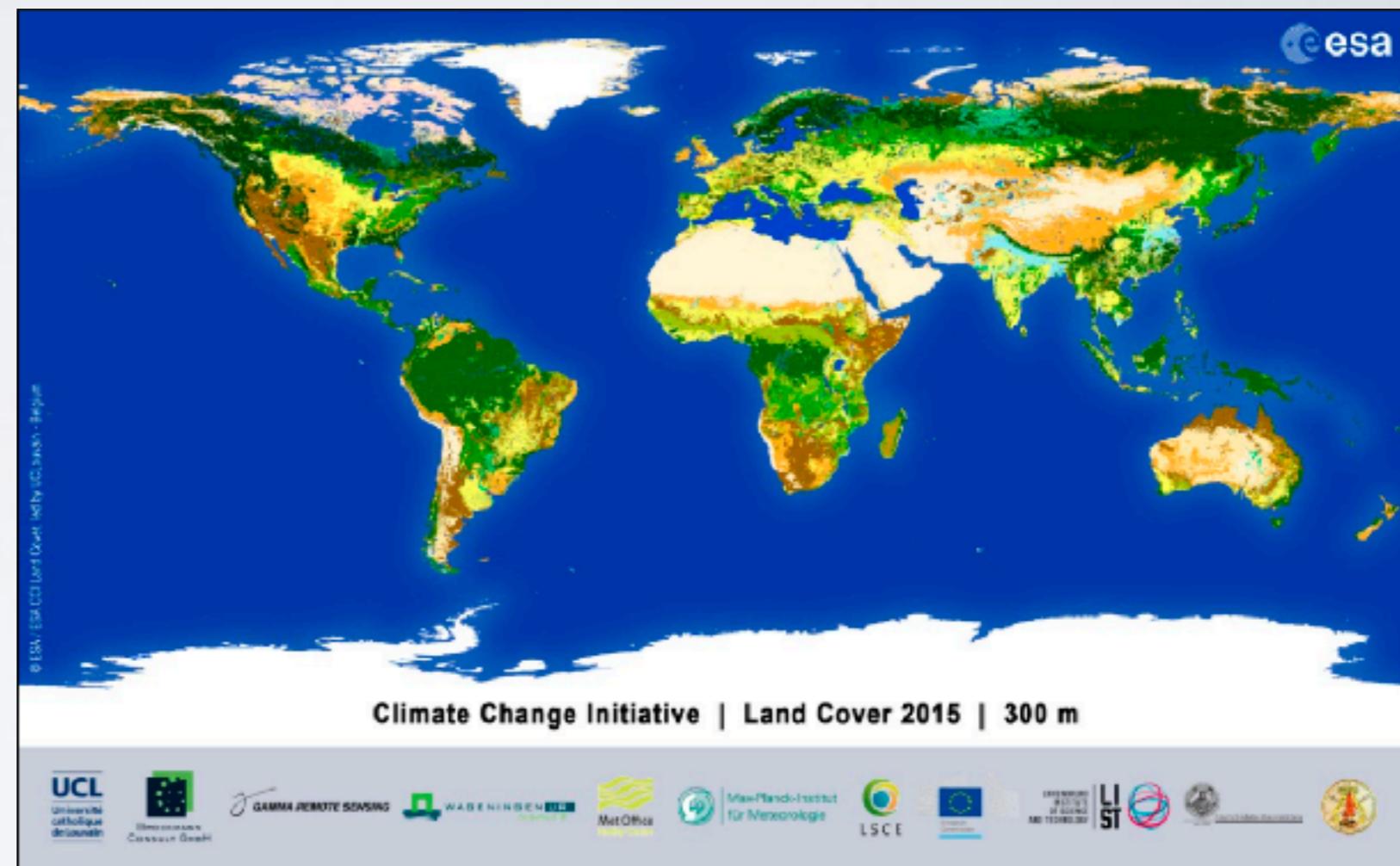
Spatial Cov.	Global
Time Cov.	2001 +
Δx	500 m
Δt	Annual



[https://modis.gsfc.nasa.gov/data/dataproduct/mod12.php](https://modis.gsfc.nasa.gov/data/dataproducts/mod12.php)

Climate Change Initiative (CCI) land cover

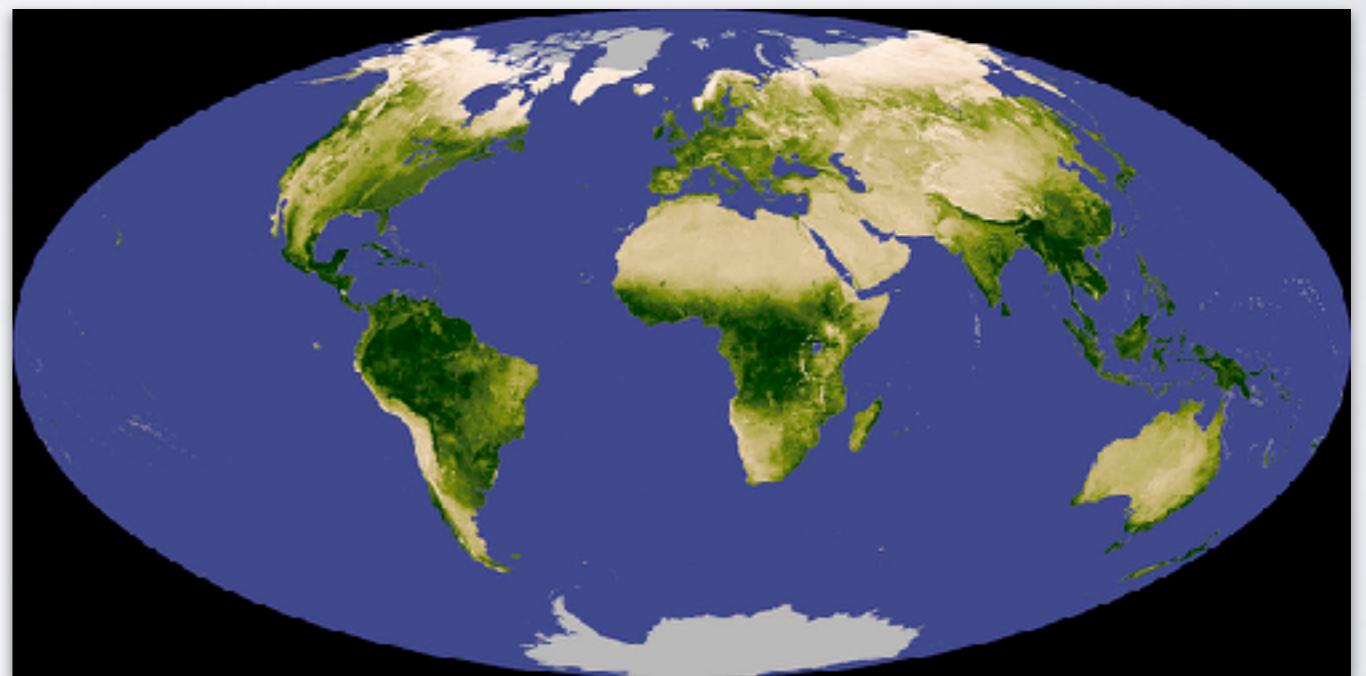
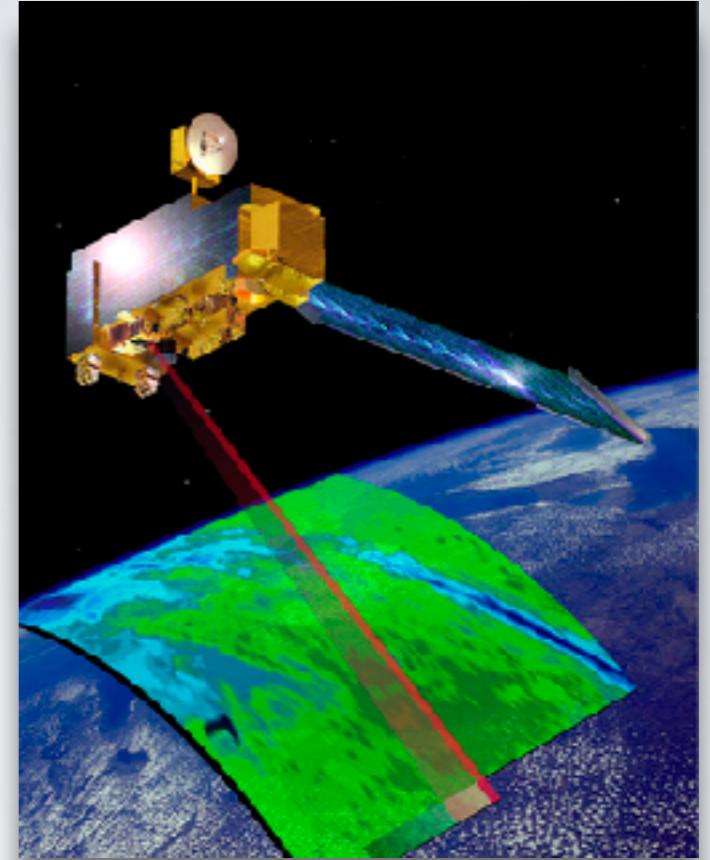
Spatial Cov.	Global
Time Cov.	1998-2008
Δx	300 m
Δt	5 years



<https://www.esa-landcover-cci.org/?q=node/1>

MODIS NDVI/EVI

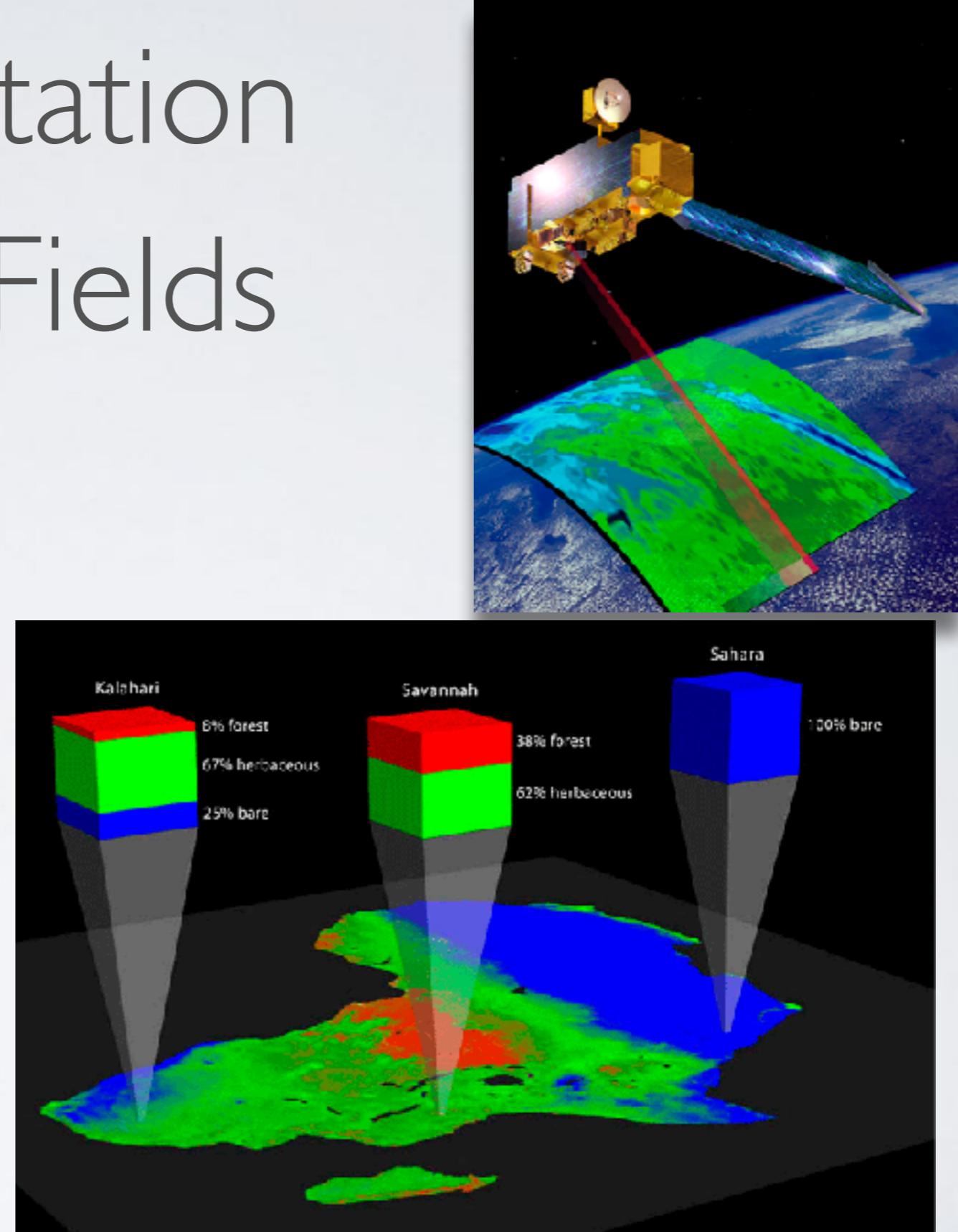
Spatial Cov.	Global
Time Cov.	2001+
Δx	250 m*
Δt	16 days*



<https://modis.gsfc.nasa.gov/data/dataproducts/mod13.php>

MODIS Vegetation Continuous Fields

Spatial Cov.	Global
Time Cov.	2000-2017
Δx	250 m*
Δt	Annual

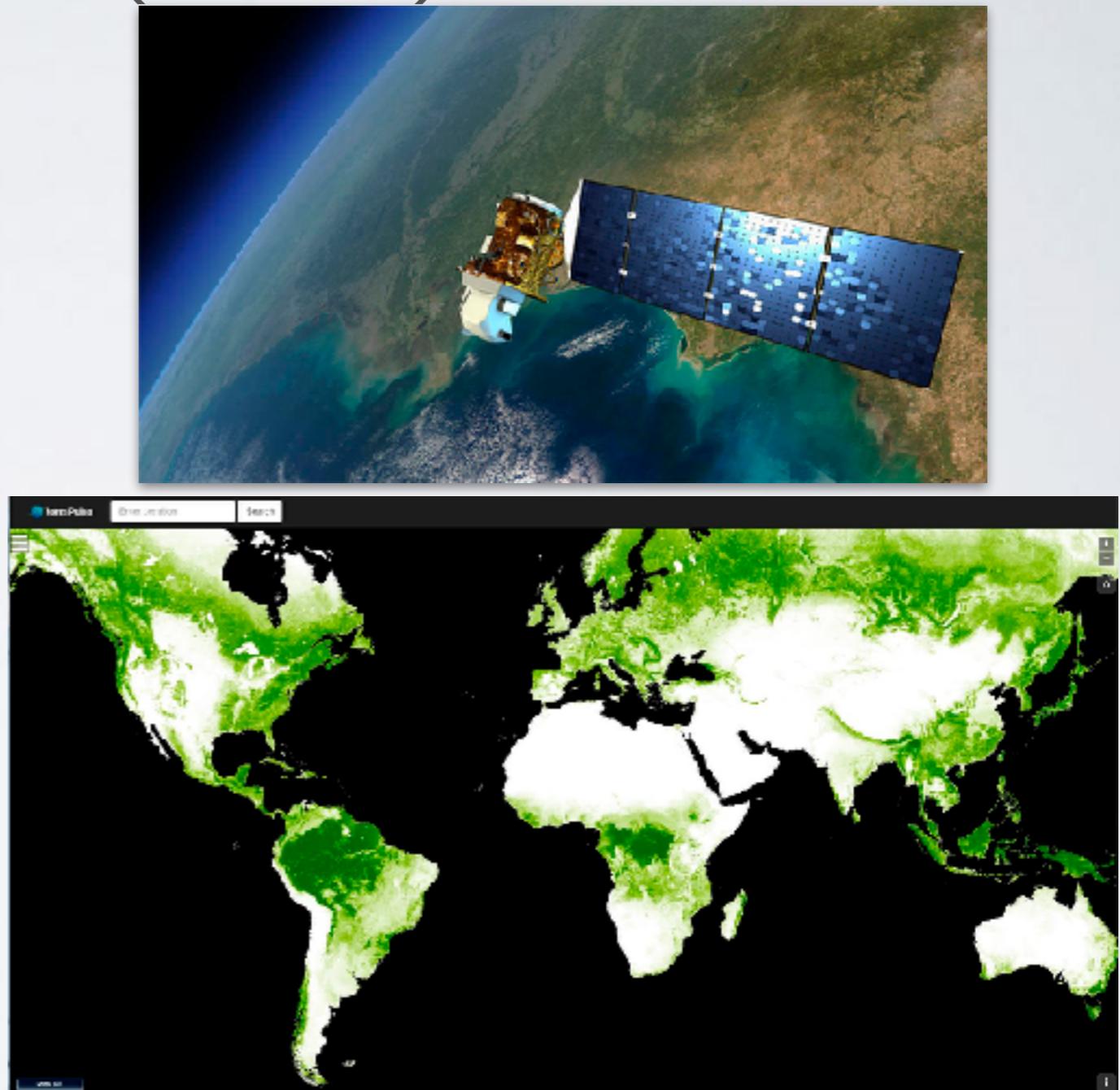


<https://lpdaac.usgs.gov/products/mod44bv006/>

Landsat: Vegetation Continuous Fields (VCF)

Spatial Cov.	Global
Time Cov.	2000-2015
Δx	30 m
Δt	5 year

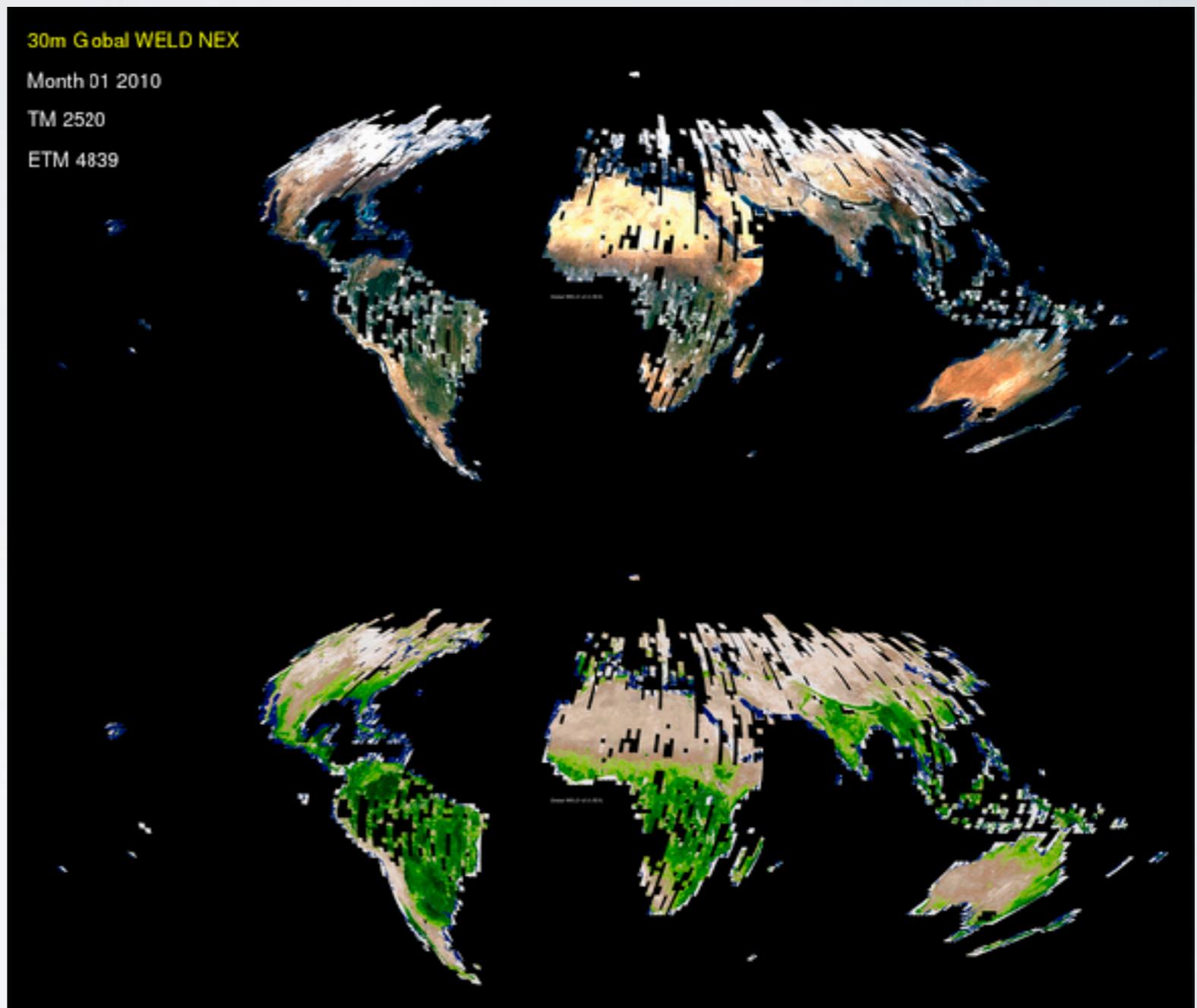
*Rescaled MODIS



<http://lcluc.umd.edu/metadata/global-30m-landsat-tree-canopy-version-4>

WELD (Web enabled Landsat)

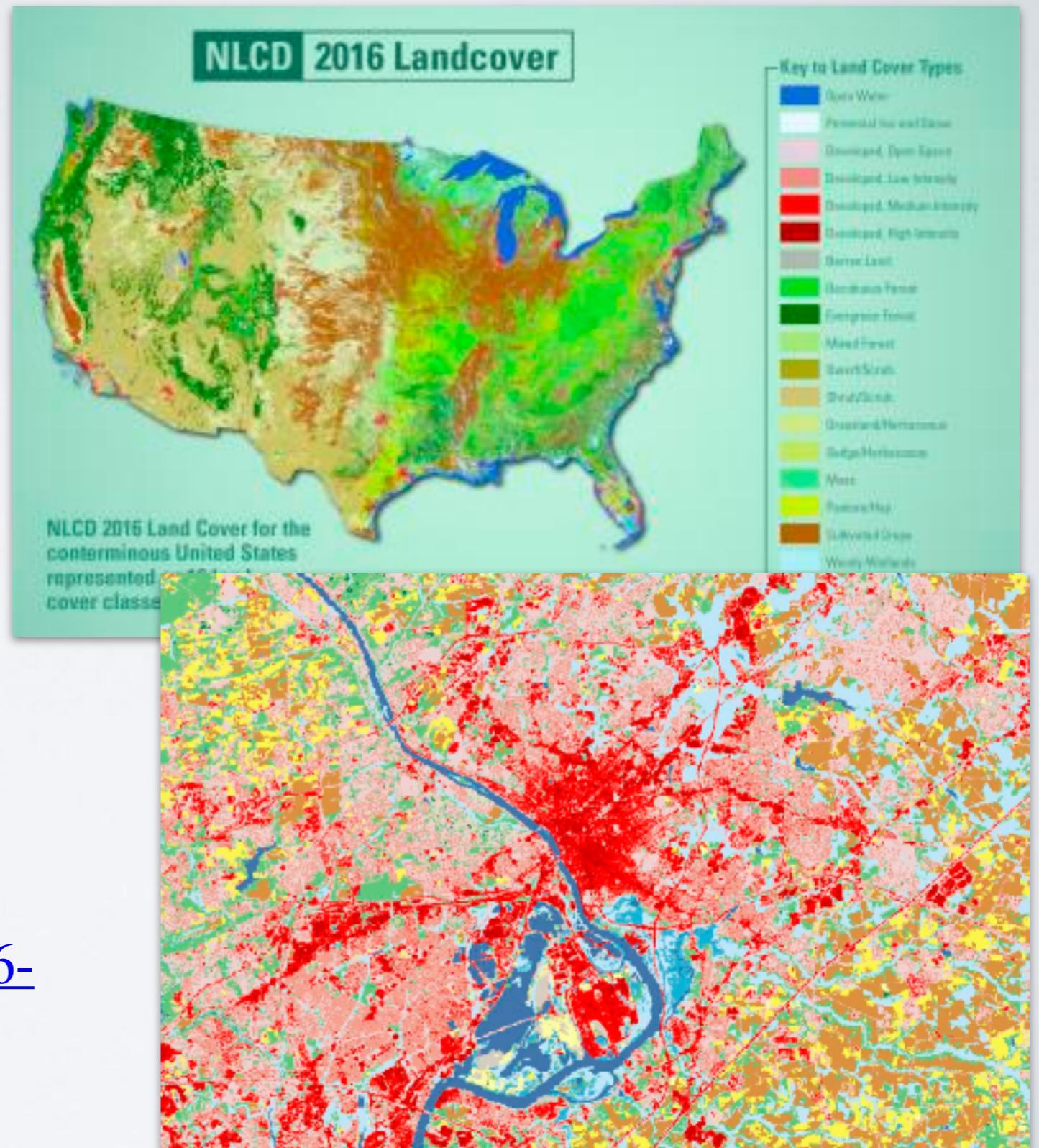
Spatial Cov.	Global
Time Cov.	1982-2012
Δx	30 m
Δt	Weekly*



<http://globalweld.cr.usgs.gov/>

NLCD (National Land Cover Database)

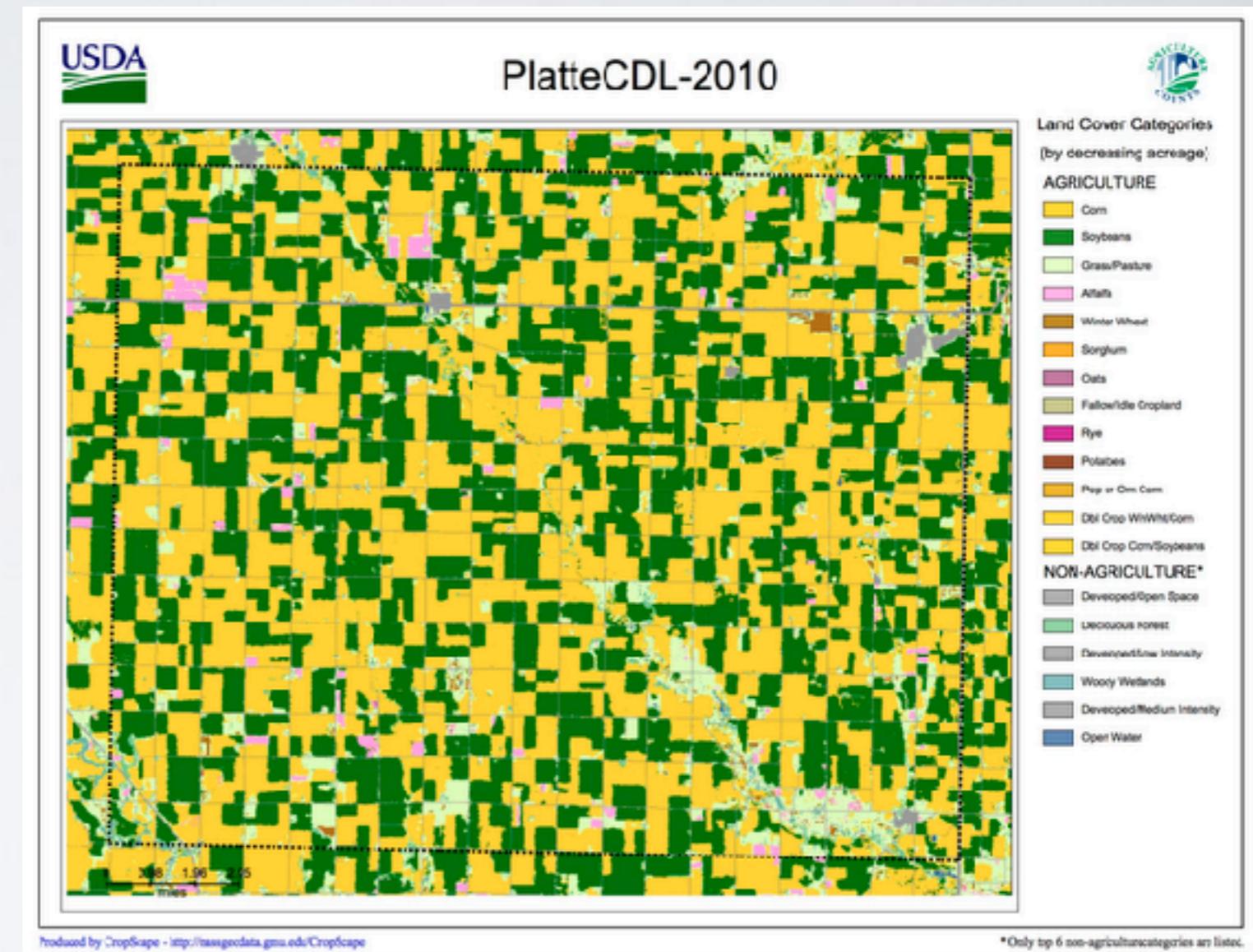
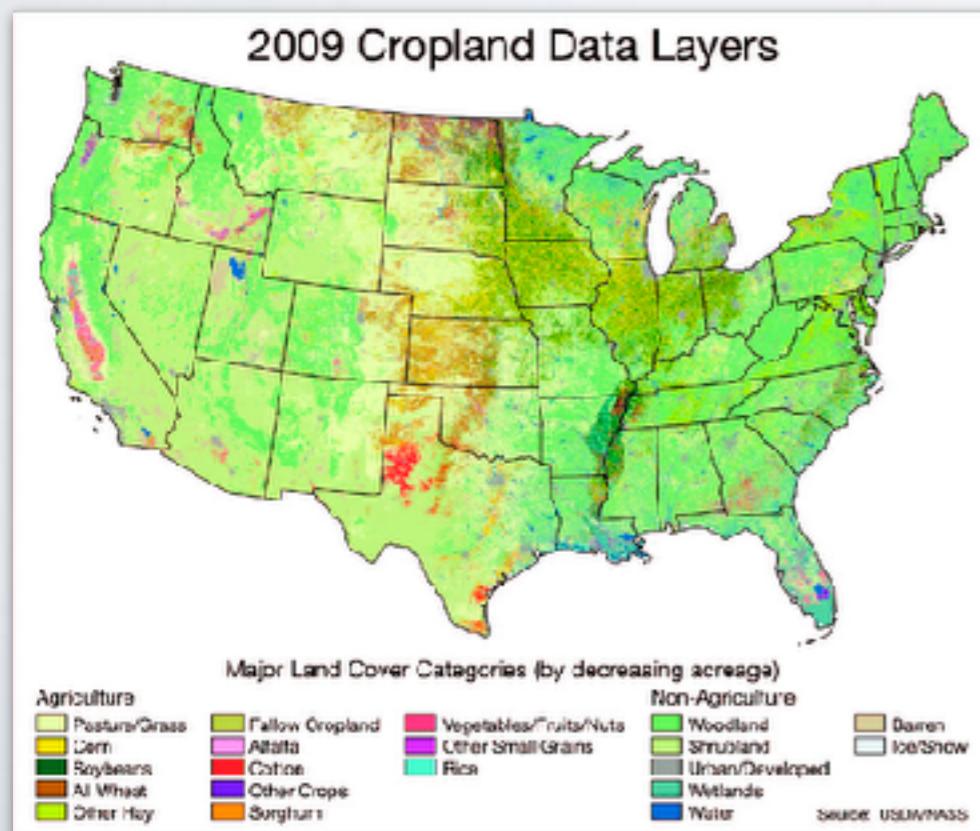
Spatial Cov.	CONUS
Time Cov.	2001-2016
Δx	30 m
Δt	~3 years



<https://www.mrlc.gov/nlcd-2016-science-research-products>

Cropland Data Layer

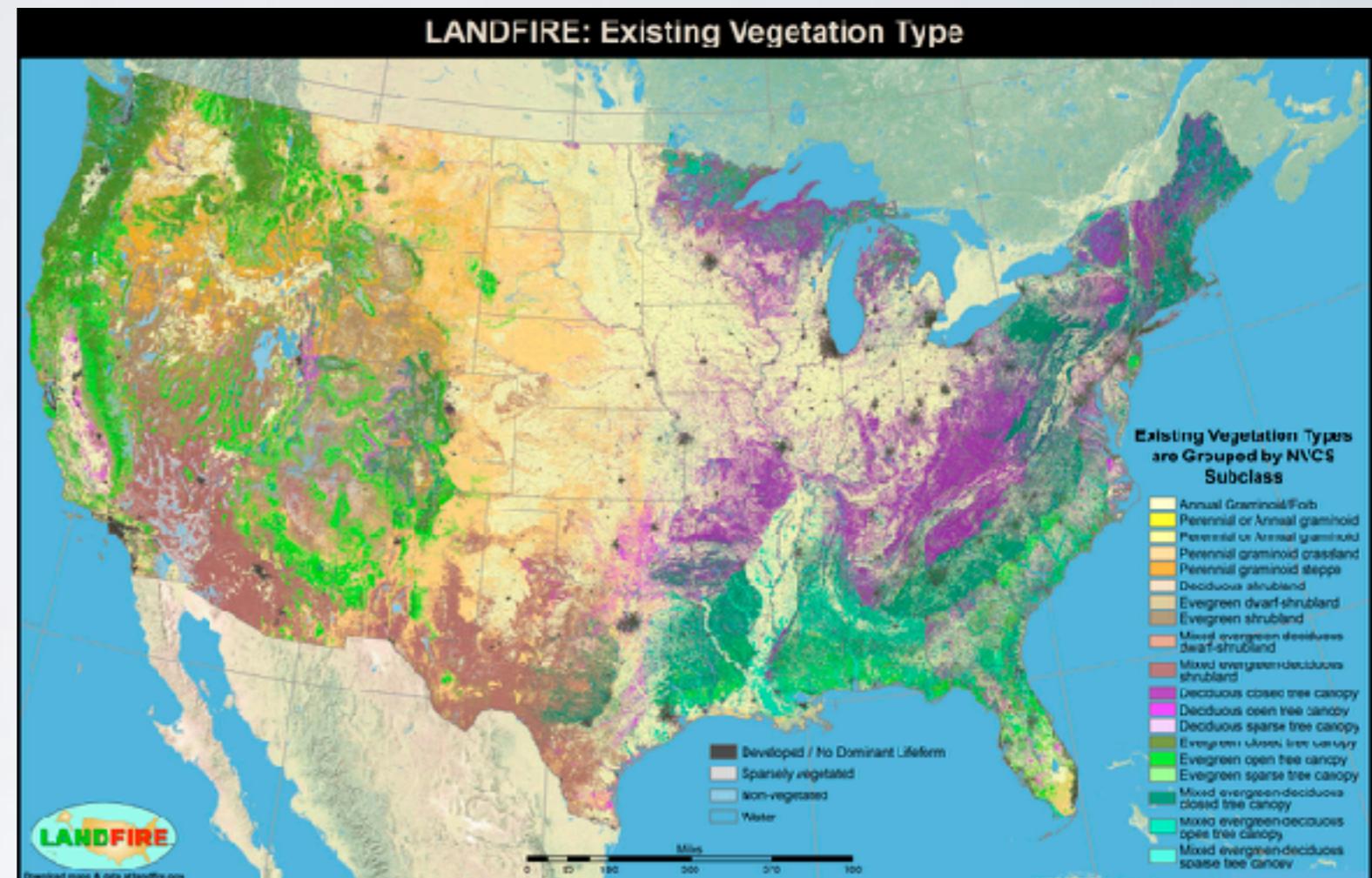
Spatial Cov.	CONUS
Time Cov.	2008-2018
Δx	30 m
Δt	1 year



<https://nassgeodata.gmu.edu/CropScape/>

LANDFIRE

Spatial Cov.	CONUS
Time Cov.	N/A
Δx	30 m
Δt	N/A

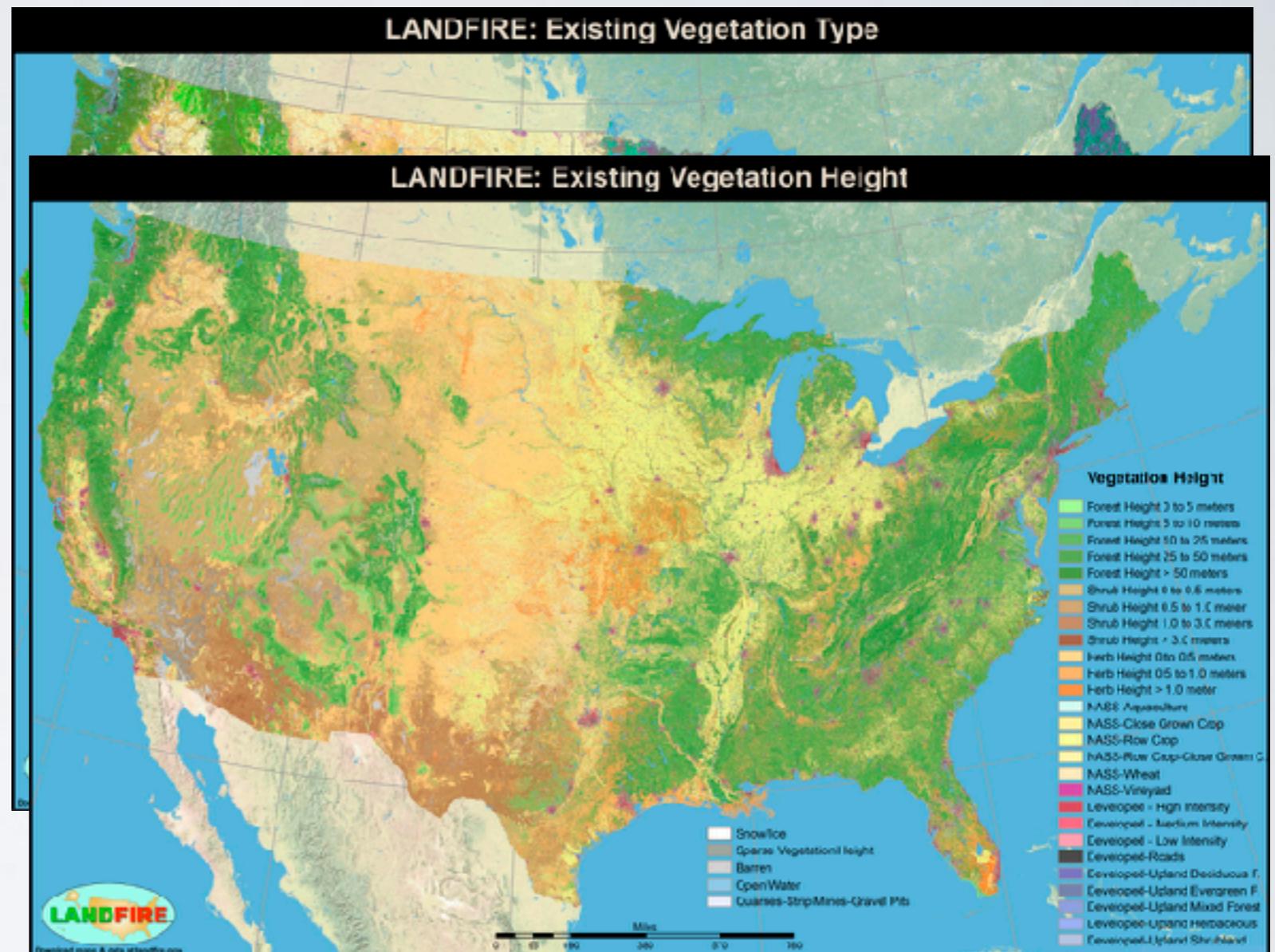


Primarily Landsat derived

https://www.landfire.gov/lf_applications.php#maps

LANDFIRE

Spatial Cov.	CONUS
Time Cov.	N/A
Δx	30 m
Δt	N/A



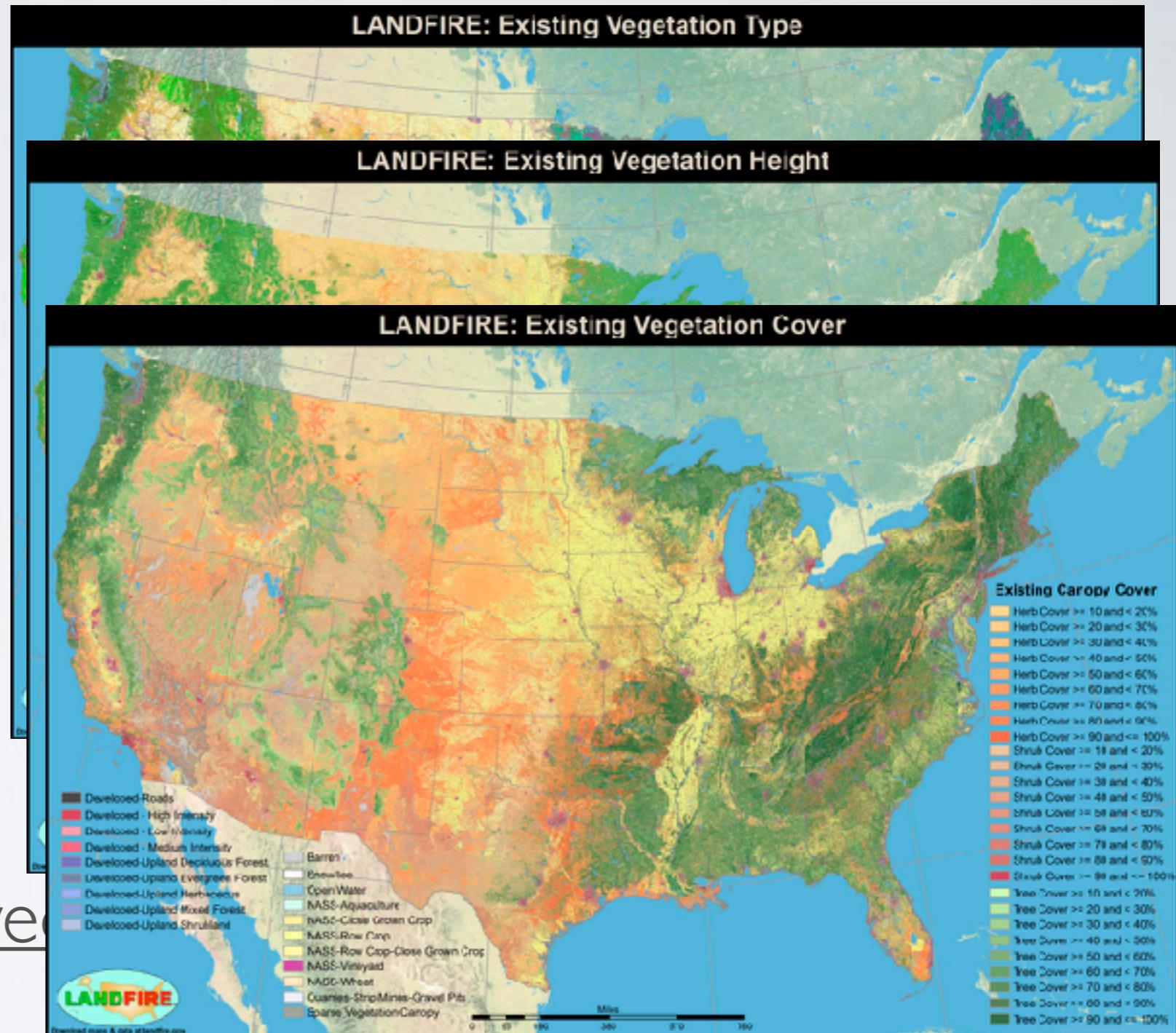
Primarily Landsat derived

https://www.landfire.gov/lf_applications.php#maps

LANDFIRE

Spatial Cov.	CONUS
Time Cov.	N/A
Δx	30 m
Δt	N/A

Primarily Landsat derived

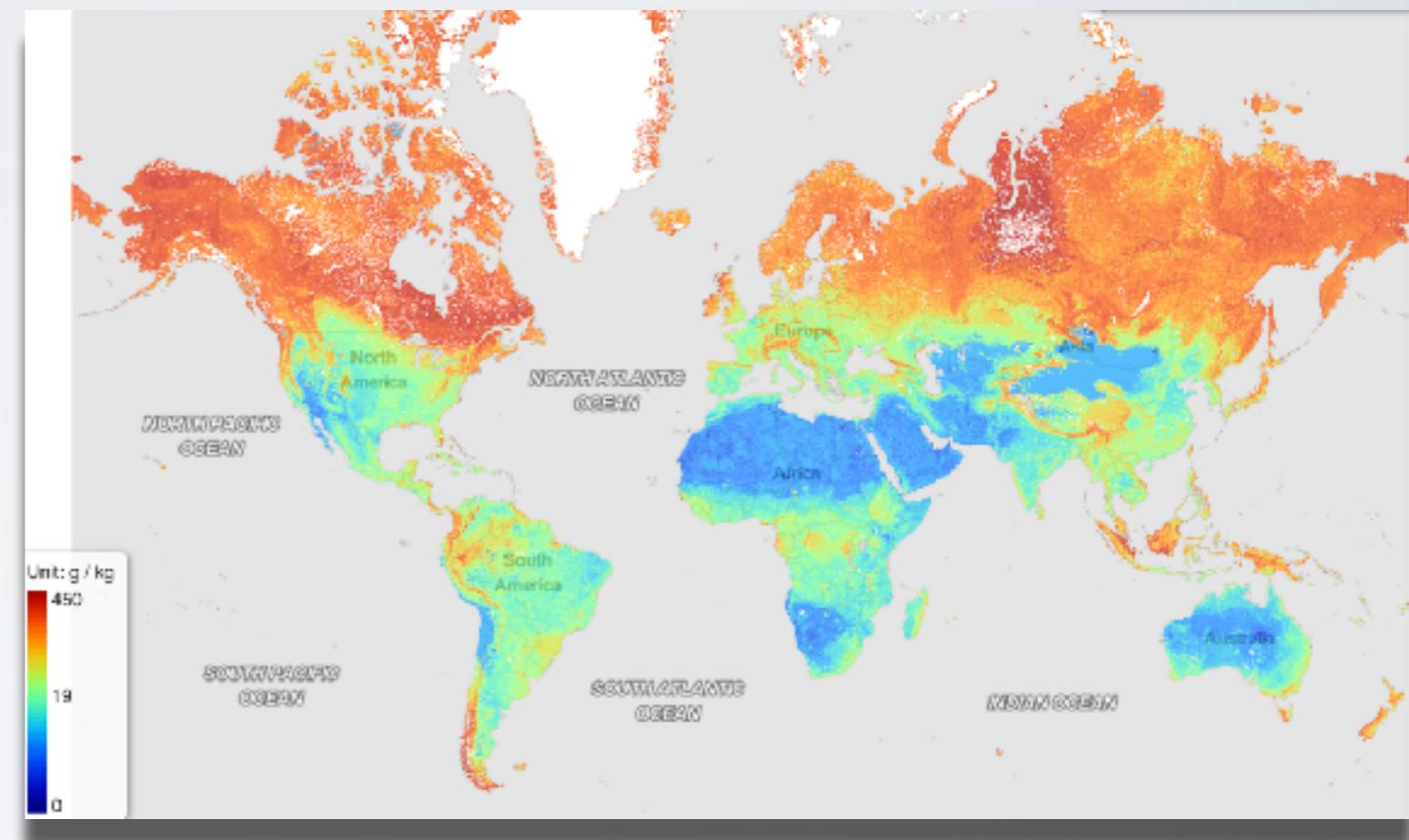


https://www.landfire.gov/lf_applications.php#maps

Soil data

Soilgrids

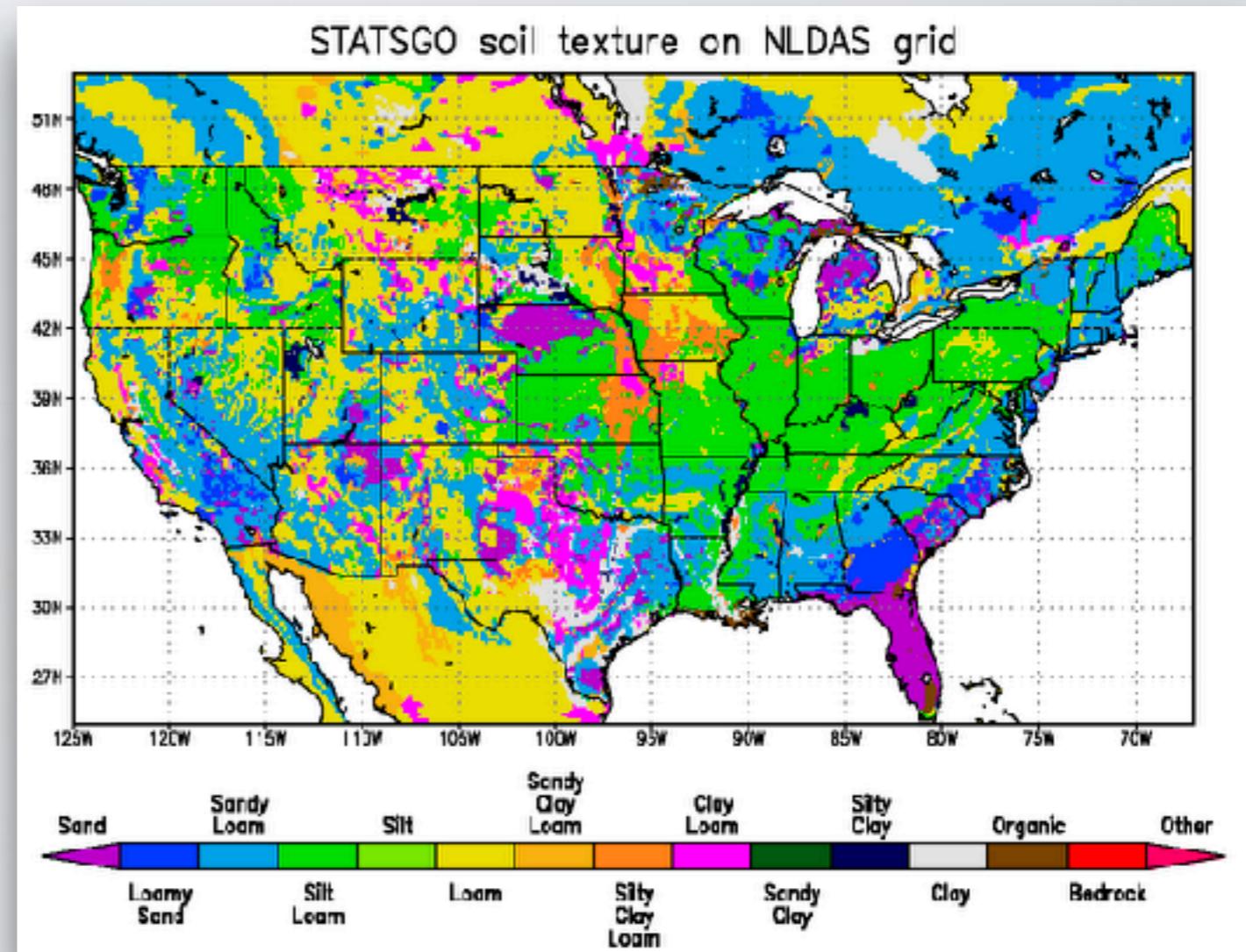
Spatial Cov.	Global
Time Cov.	N/A
Δx	250 m
Δt	N/A



<https://soilgrids.org/>

CONUS-Soil

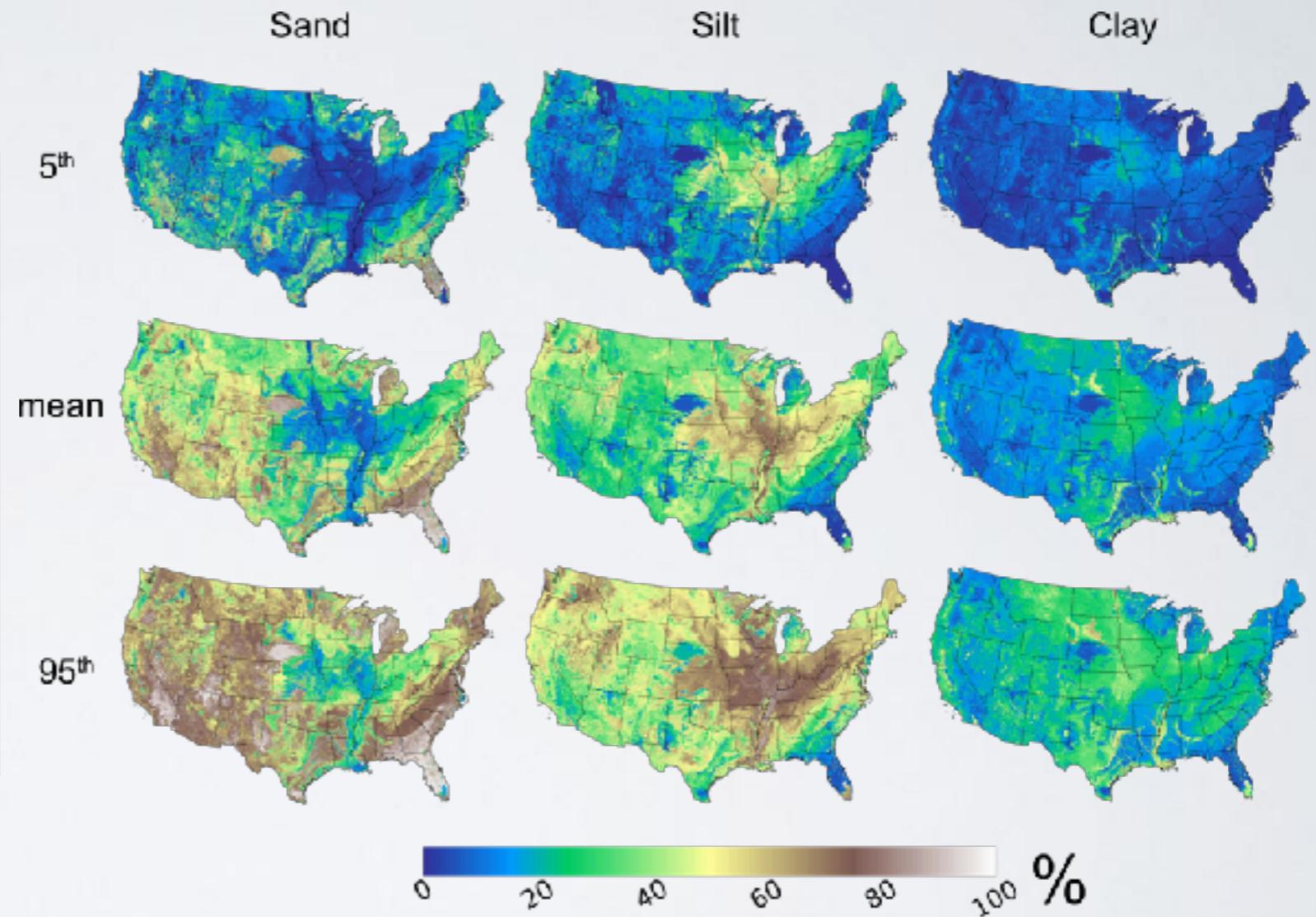
Spatial Cov.	United States*
Time Cov.	N/A
Δx	~25 km
Δt	N/A



http://www.soilinfo.psu.edu/index.cgi?soil_data&conus

POLARIS

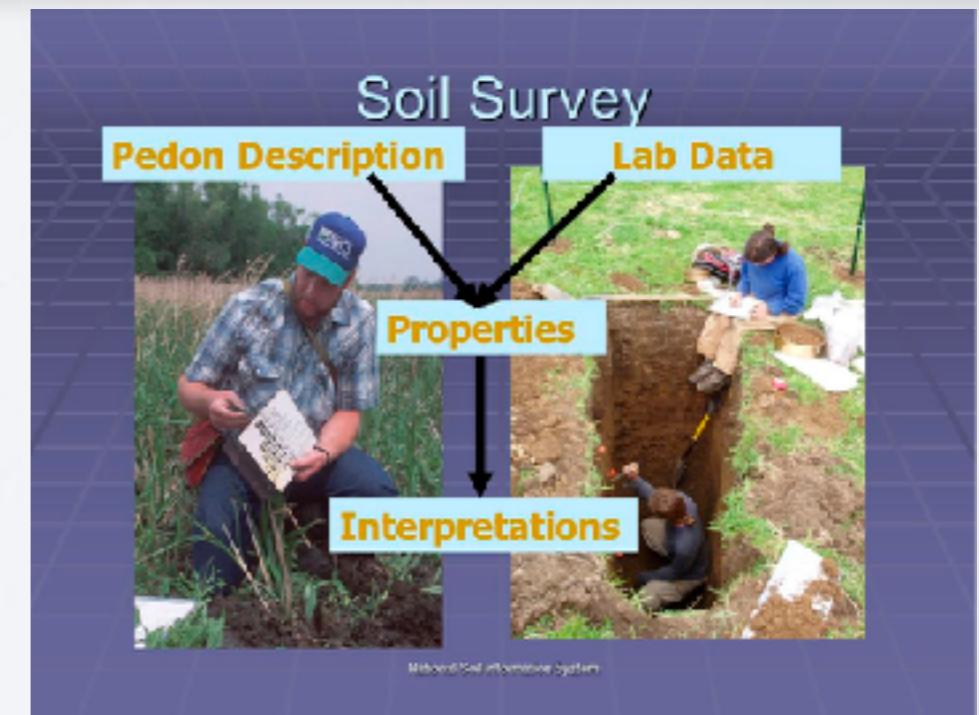
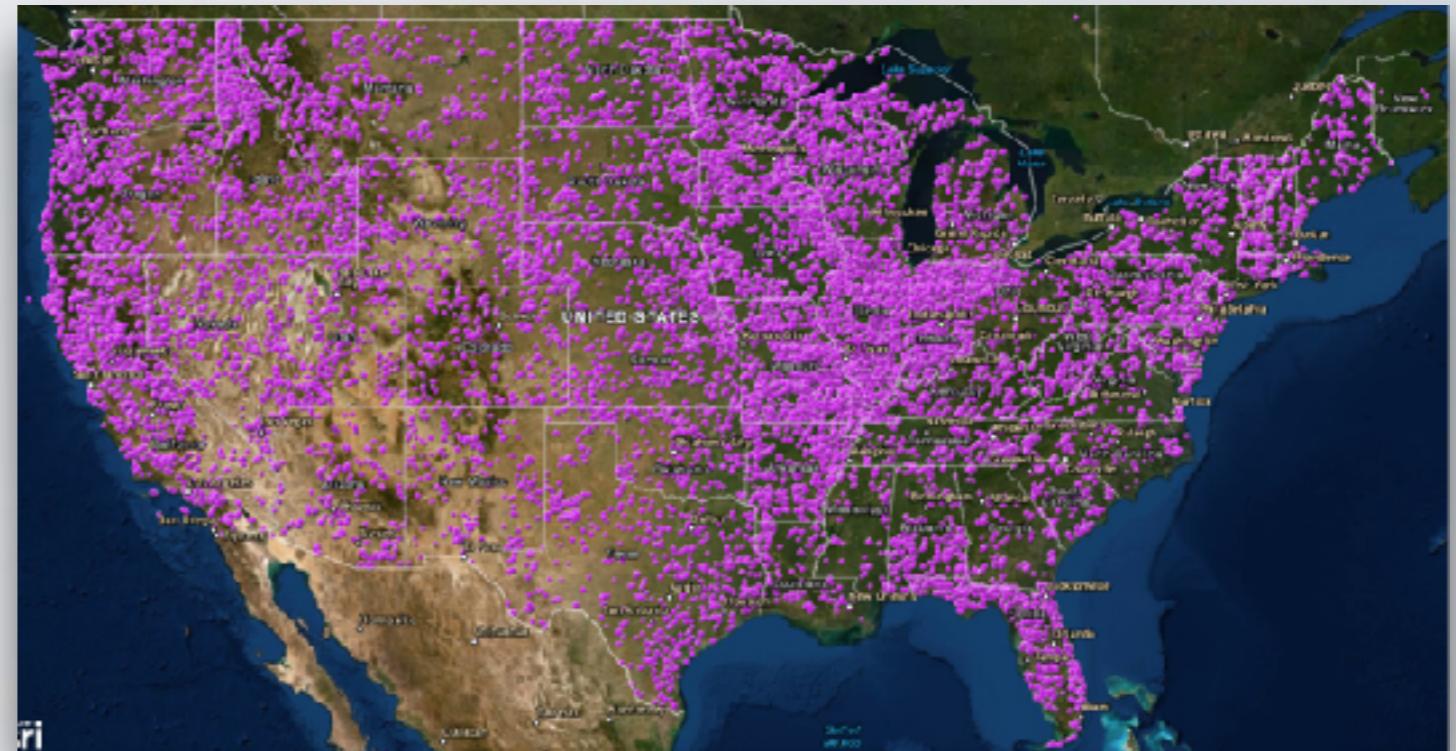
Spatial Cov.	United States*
Time Cov.	N/A
Δx	1 arcsec (~30 m)
Δt	N/A



<https://polaris.earth>

NCSS Soil Characterization Database (SCD)

Spatial Cov.	United States
Time Cov.	N/A
Δx	Point data
Δt	N/A

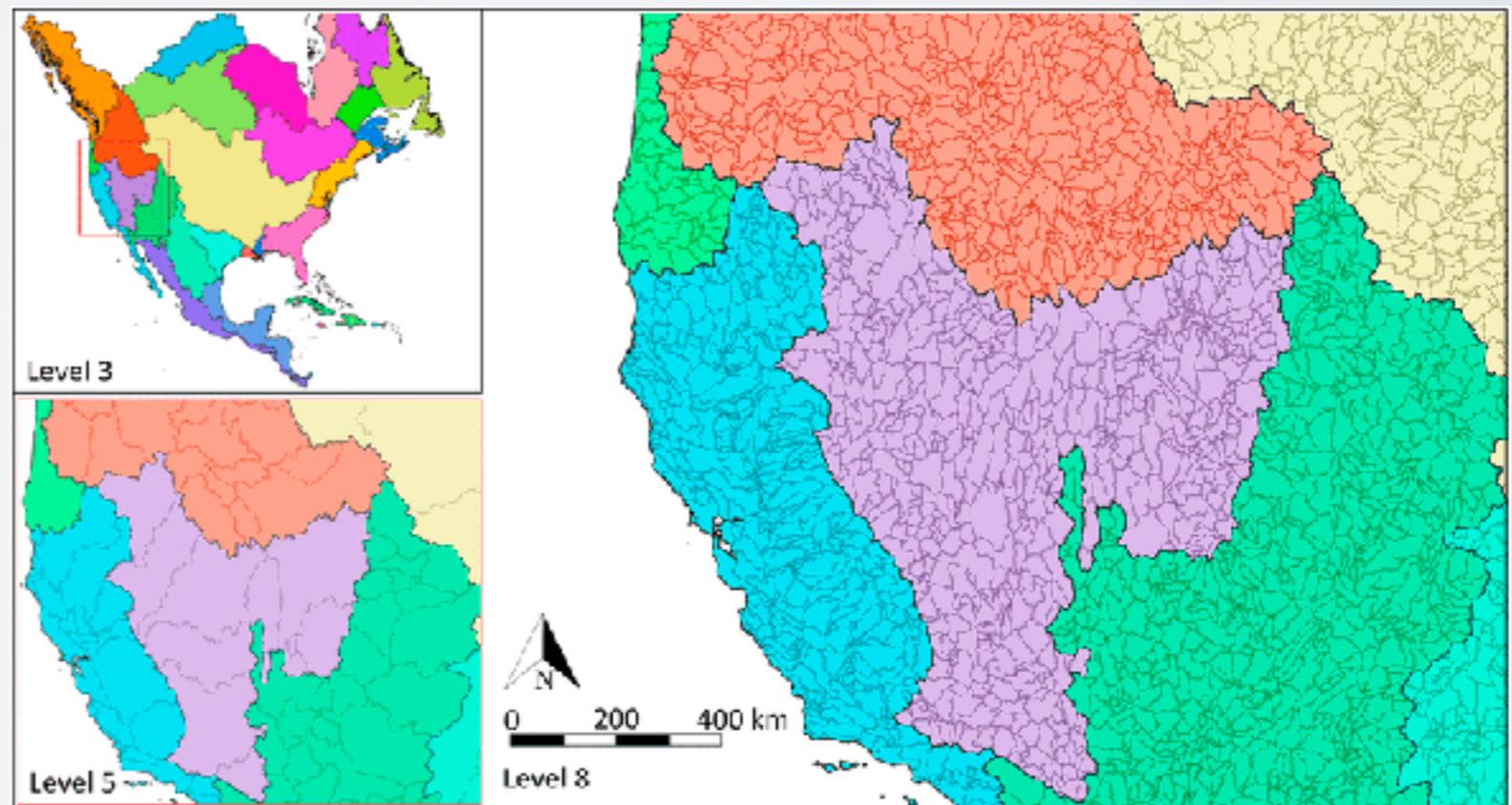
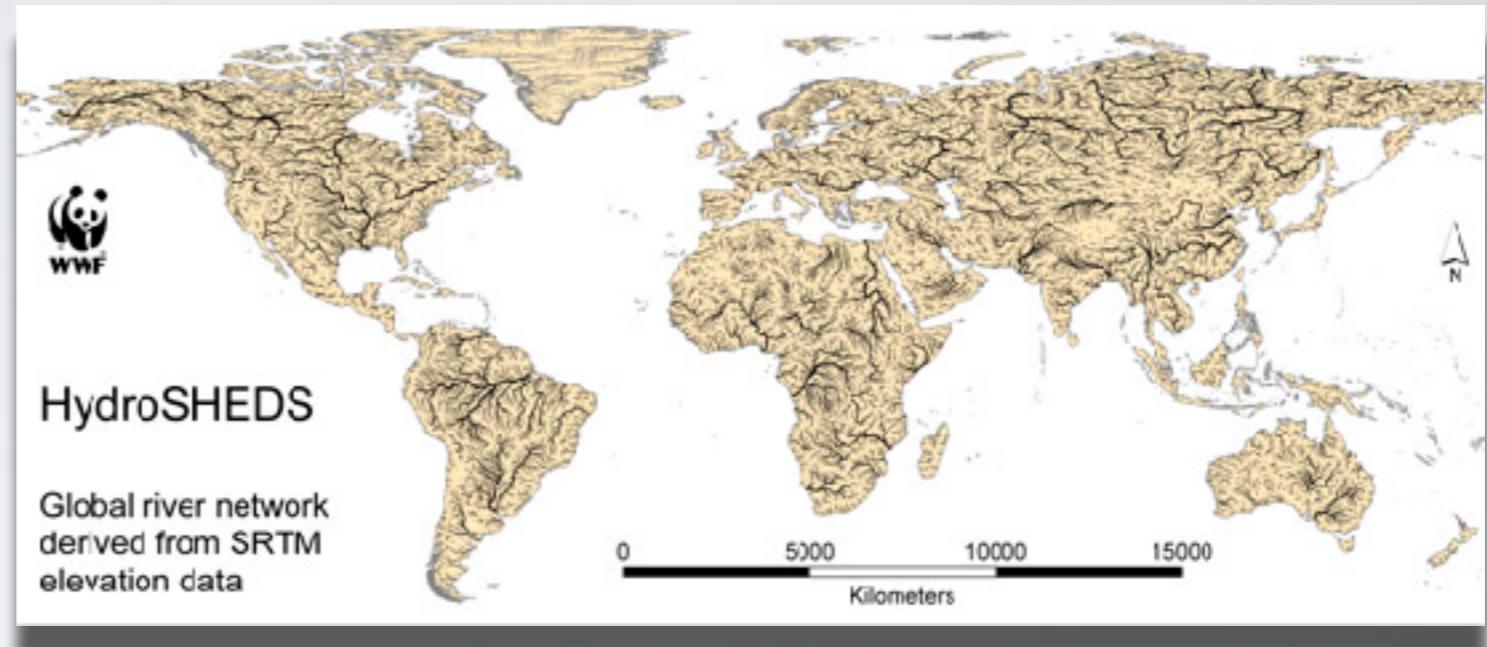


<https://ncsslabdatamart.sc.egov.usda.gov/>

River networks

HydroBasins/HydroSheds

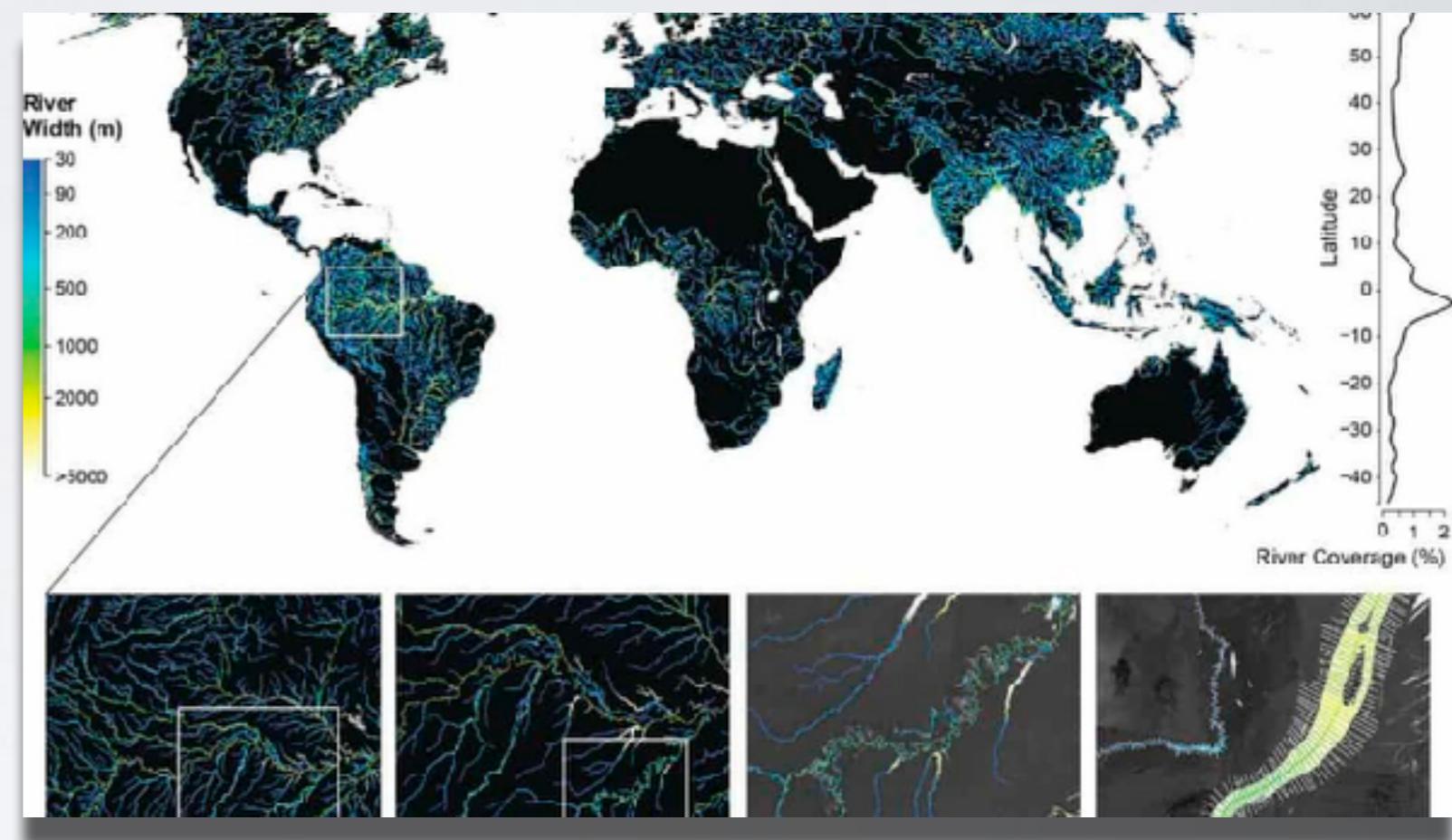
Spatial Cov.	Global*
Time Cov.	N/A
Δx	Vector data
Δt	N/A



<https://www.hydrosheds.org/>

Global Data of River Widths

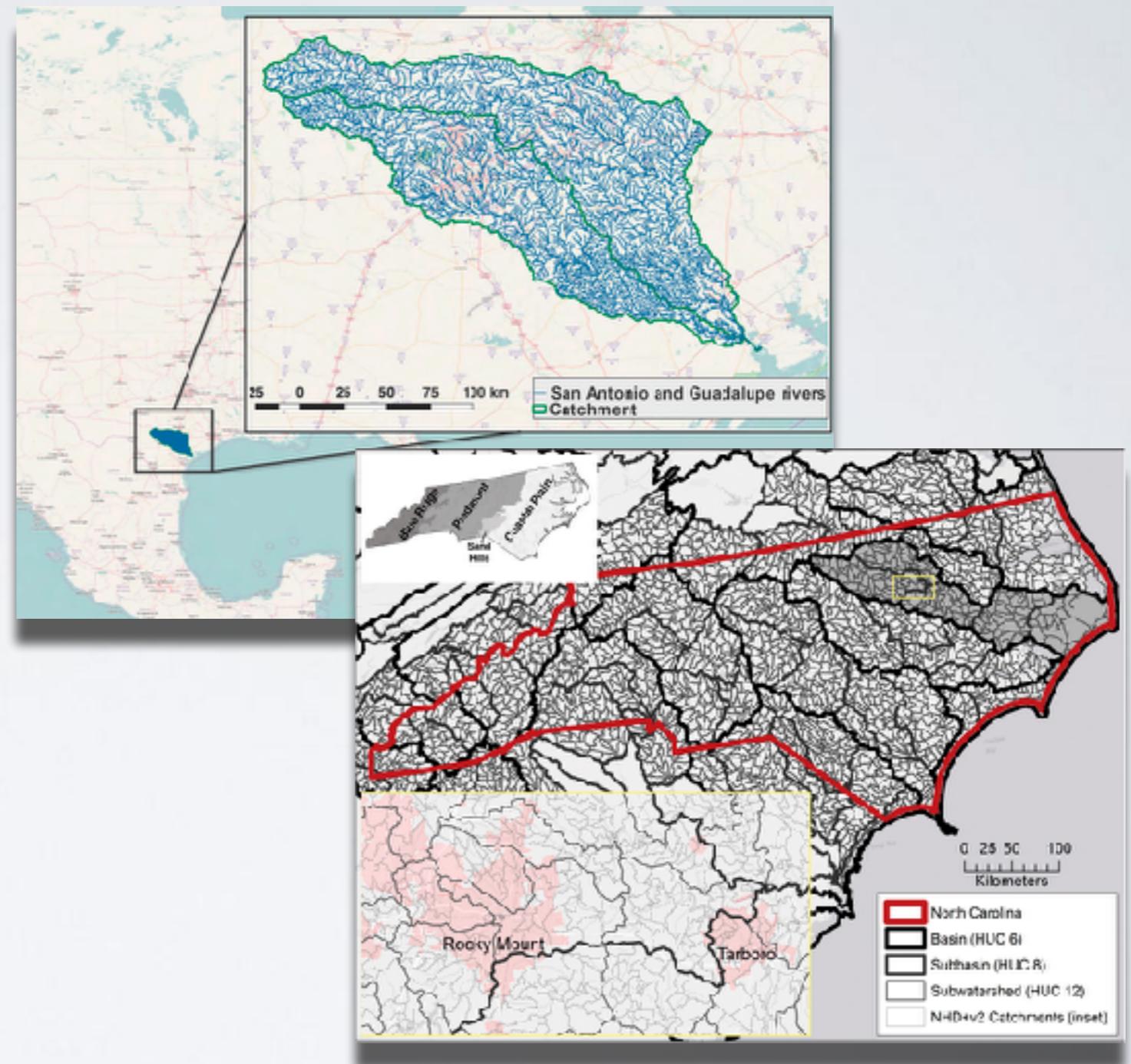
Spatial Cov.	Global*
Time Cov.	N/A
Δx	Vector data
Δt	N/A



<https://zenodo.org/record/1297434#.XZVQNOdKg1I>

NHDPlus Version 2

Spatial Cov.	United States
Time Cov.	N/A
Δx	Vector data
Δt	N/A

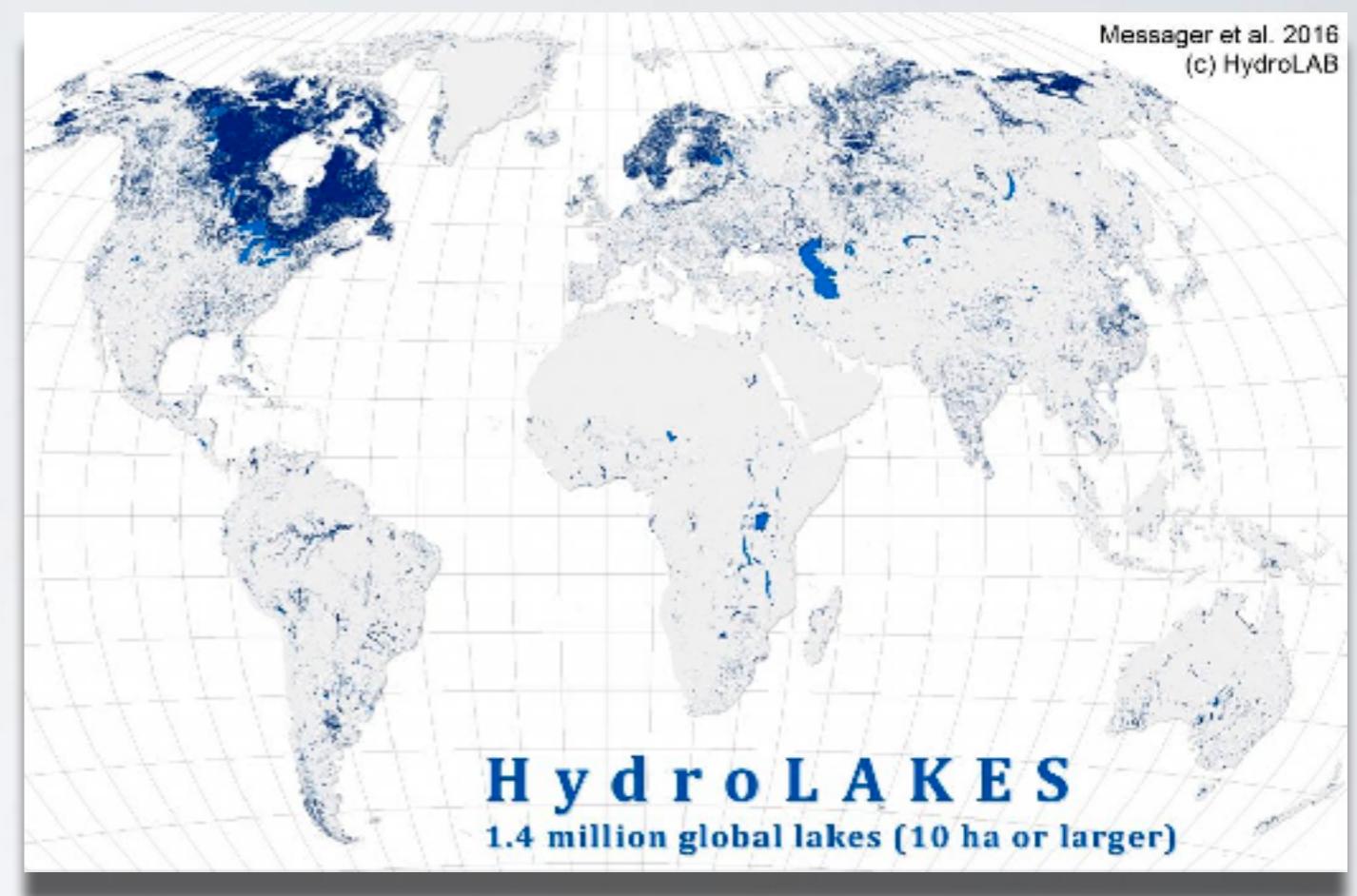


http://www.horizon-systems.com/NHDPlus/NHDPlusV2_documentation.php

Water bodies

HydroLakes

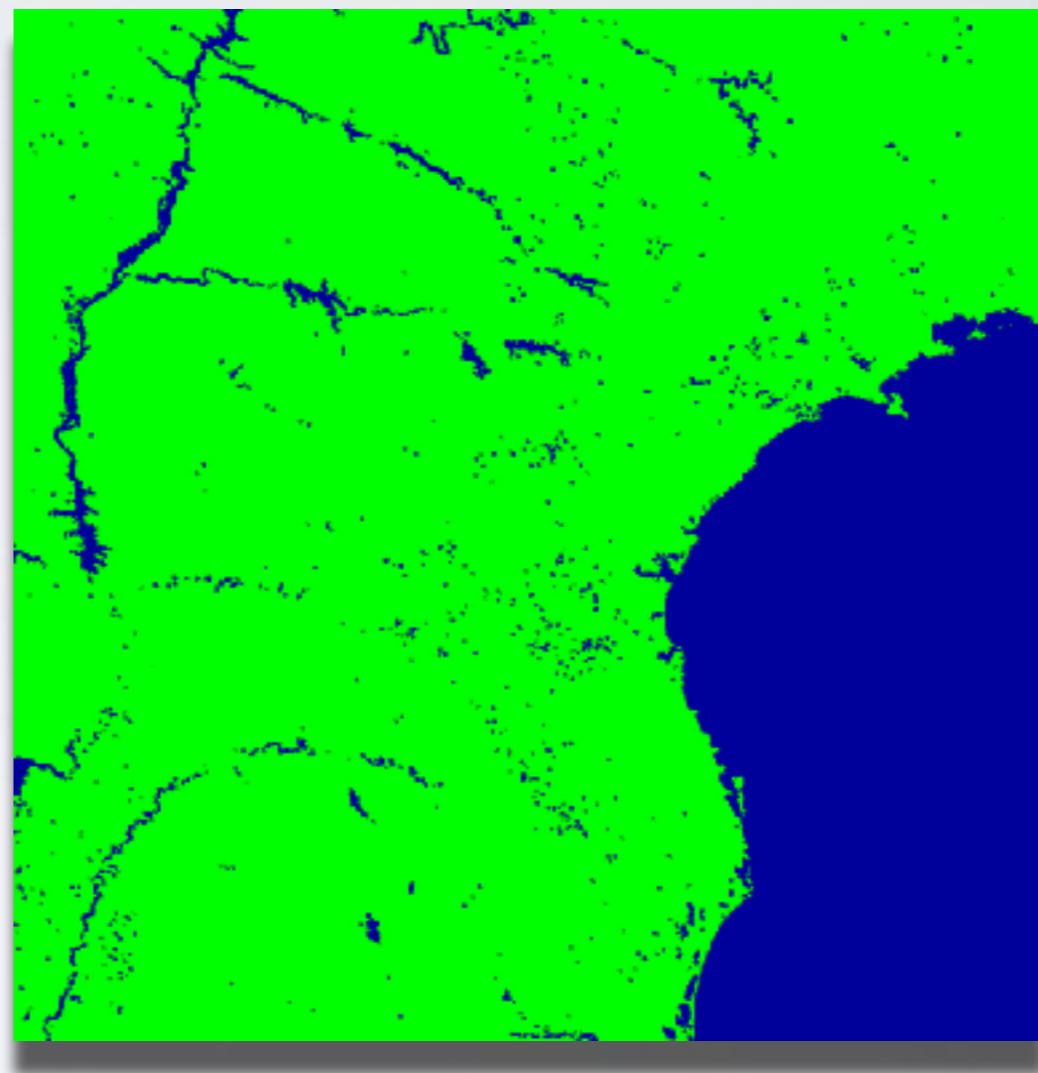
Spatial Cov.	Global*
Time Cov.	N/A
Δx	Vector data
Δt	N/A



<https://www.hydrosheds.org/page/hydrolakes>

MODIS water mask

Spatial Cov.	Global*
Time Cov.	2000-2015
Δx	250 m
Δt	Annual



<https://lpdaac.usgs.gov/products/mod44wv006/>

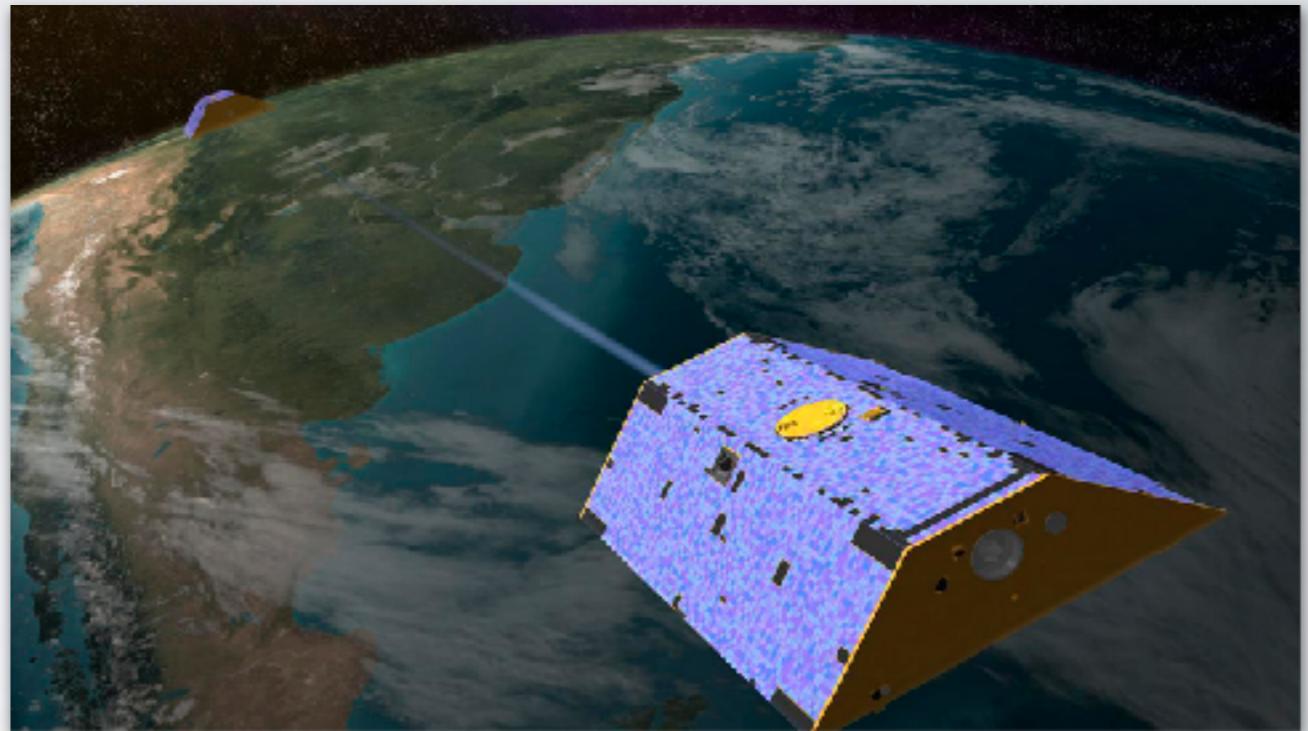
Land surface water/
energy cycle data

GRACE and GRACE-FO

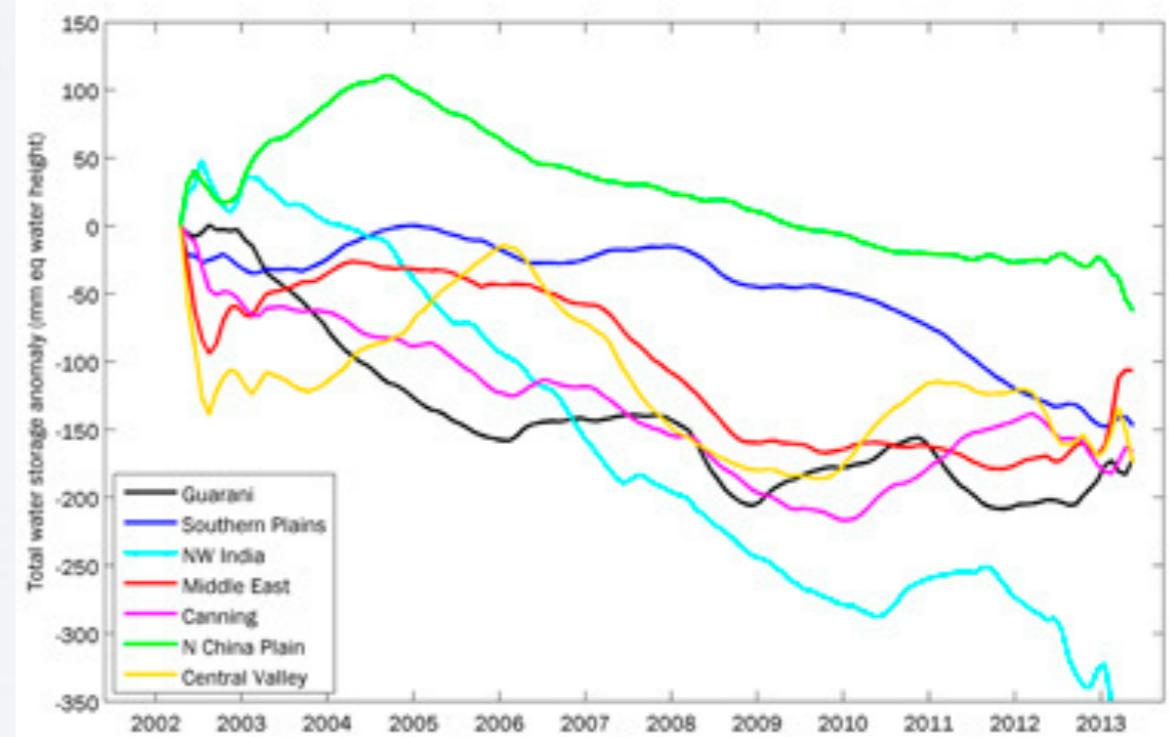
Spatial Cov.	Global
Time Cov.	2002-
Δx	300-400 km
Δt	10+ days

Groundwater

[https://grace.jpl.nasa.gov/
applications/groundwater/](https://grace.jpl.nasa.gov/applications/groundwater/)



Declining storage in major global aquifers (2002-2013)

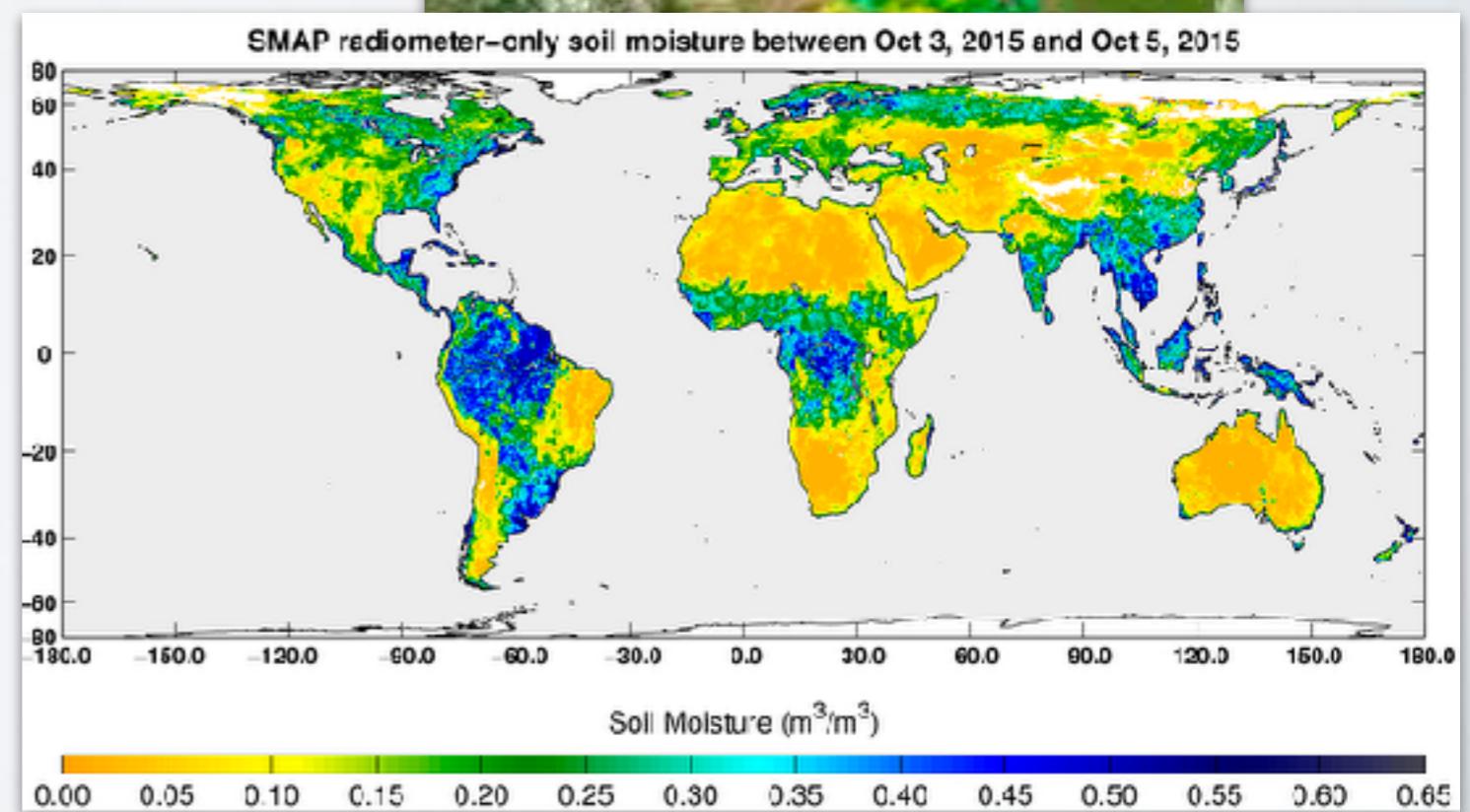
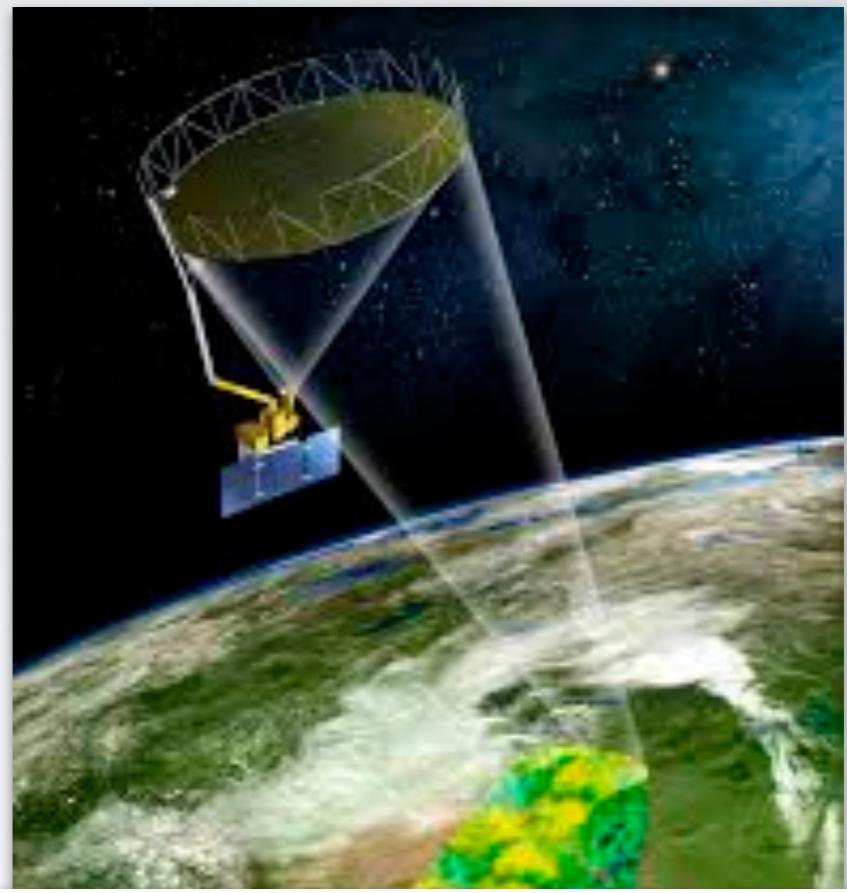


SMAP (Soil Moisture Active Passive)

Spatial Cov.	Global*
Time Cov.	2000-2015
Δx	36 km
Δt	2-3 days

Soil moisture

<https://smap.jpl.nasa.gov/data/>

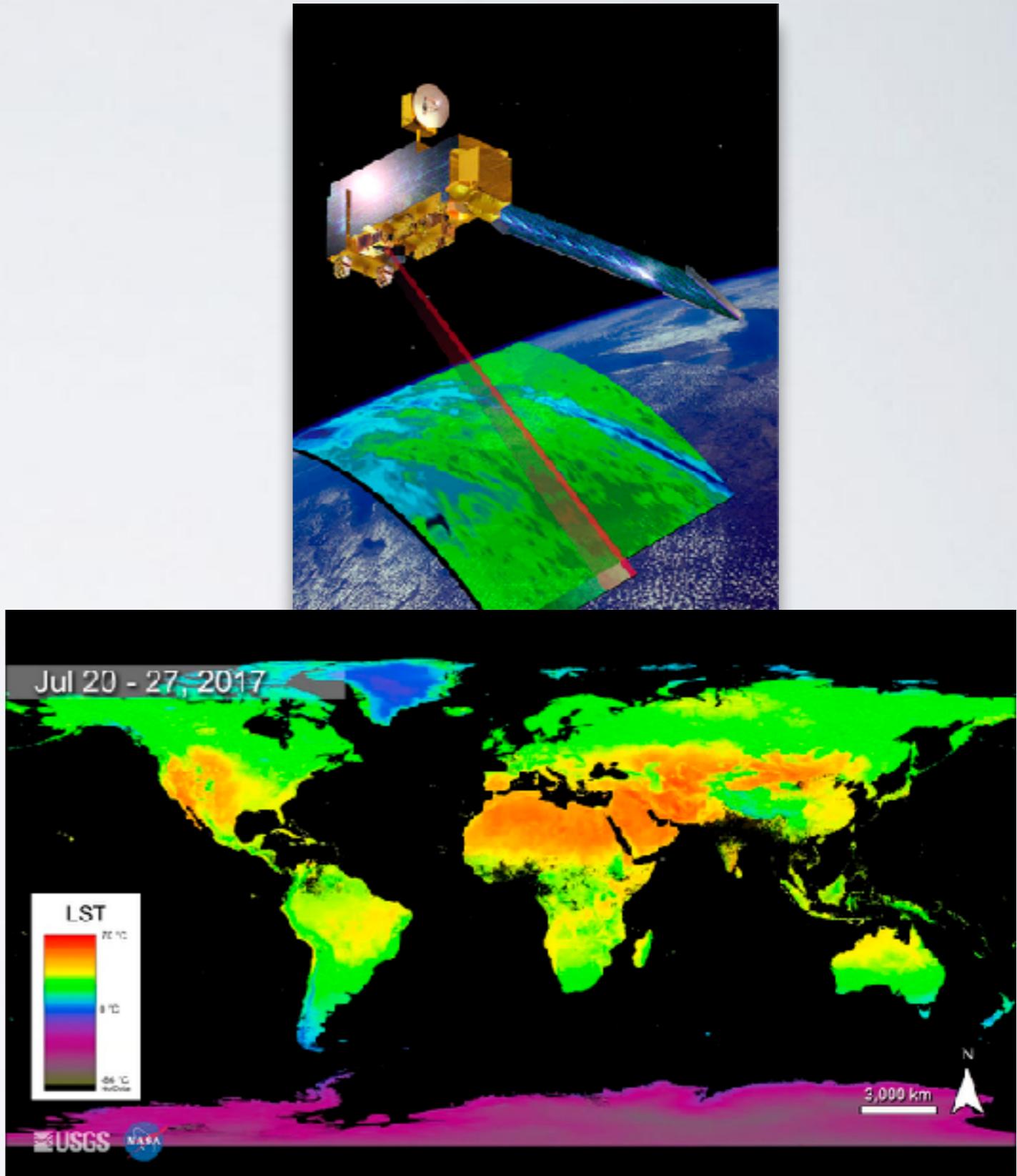


MODIS LST

Spatial Cov.	Global*
Time Cov.	2000-
Δx	1 km
Δt	Daily

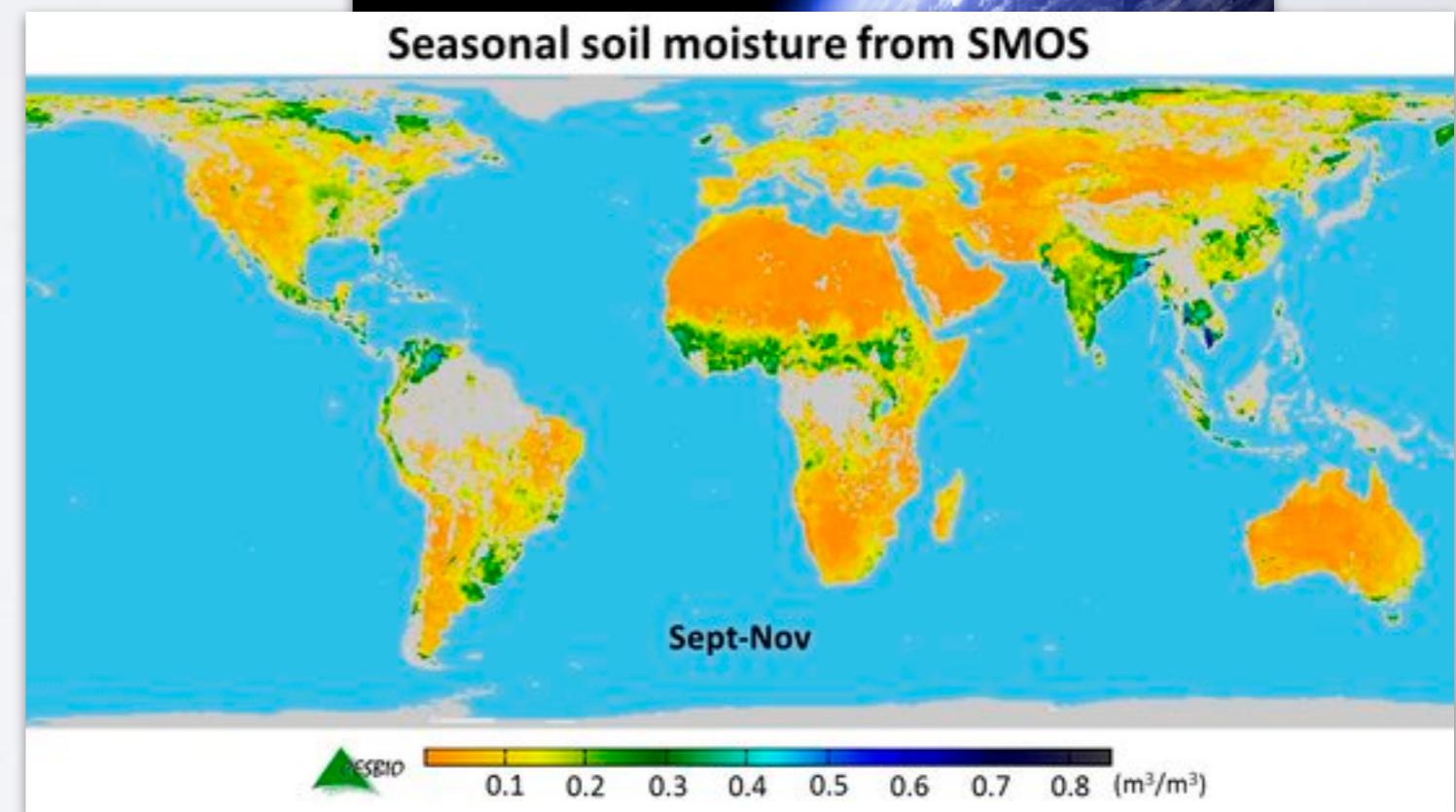
Land surface temperature

[https://modis.gsfc.nasa.gov/
data/dataproducts/mod11.php](https://modis.gsfc.nasa.gov/data/dataproducts/mod11.php)



SMOS (Soil moisture and ocean salinity)

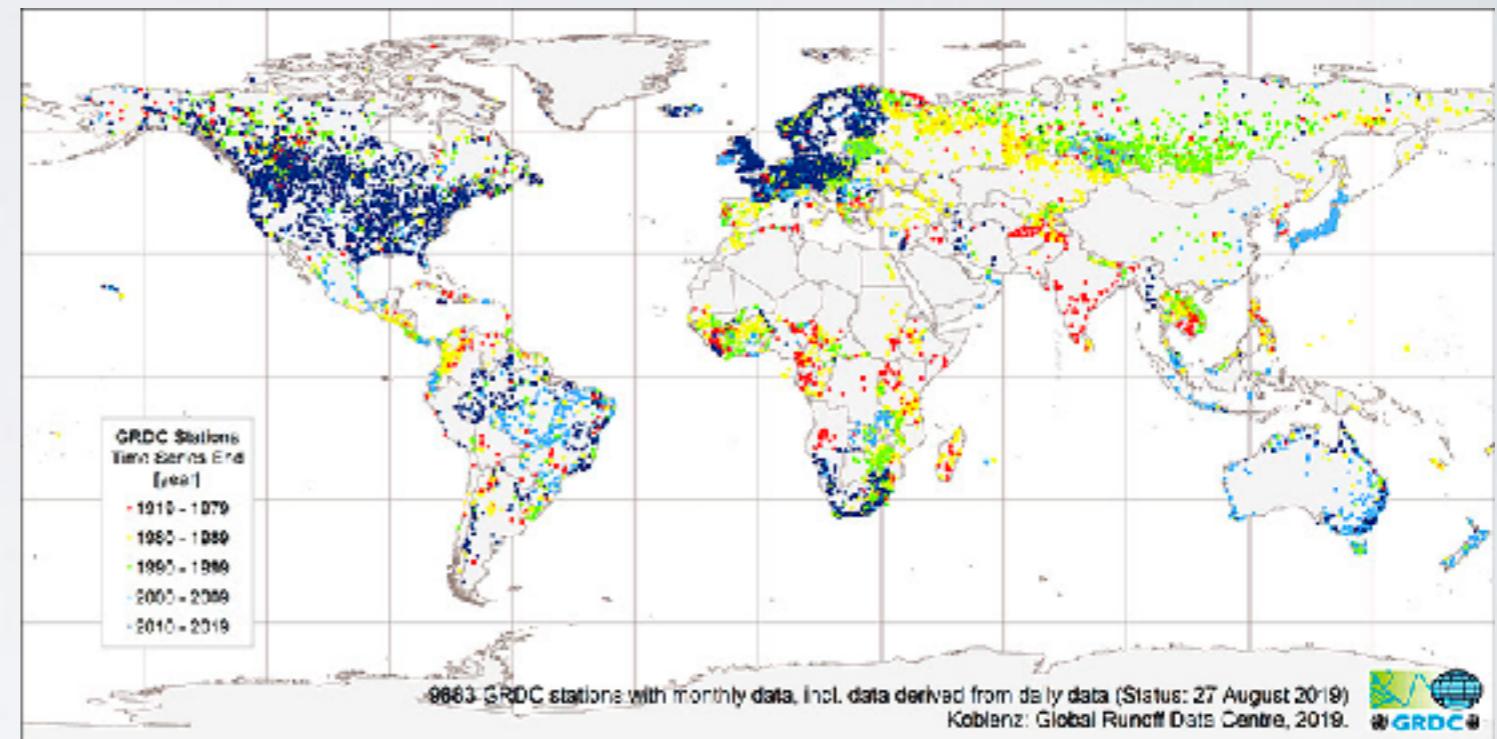
Spatial Cov.	Global*
Time Cov.	2009-
Δx	50 km
Δt	~3 days



https://earth.esa.int/web/guest/missions/esa-operational-eo-missions/smos/content/-/asset_publisher/t5Py/content/how-to-obtain-data-7329

GRDC (Global Runoff Data Centre)

Spatial Cov.	Global*
Time Cov.	1910*-
Δx	N/A
Δt	D/M/A

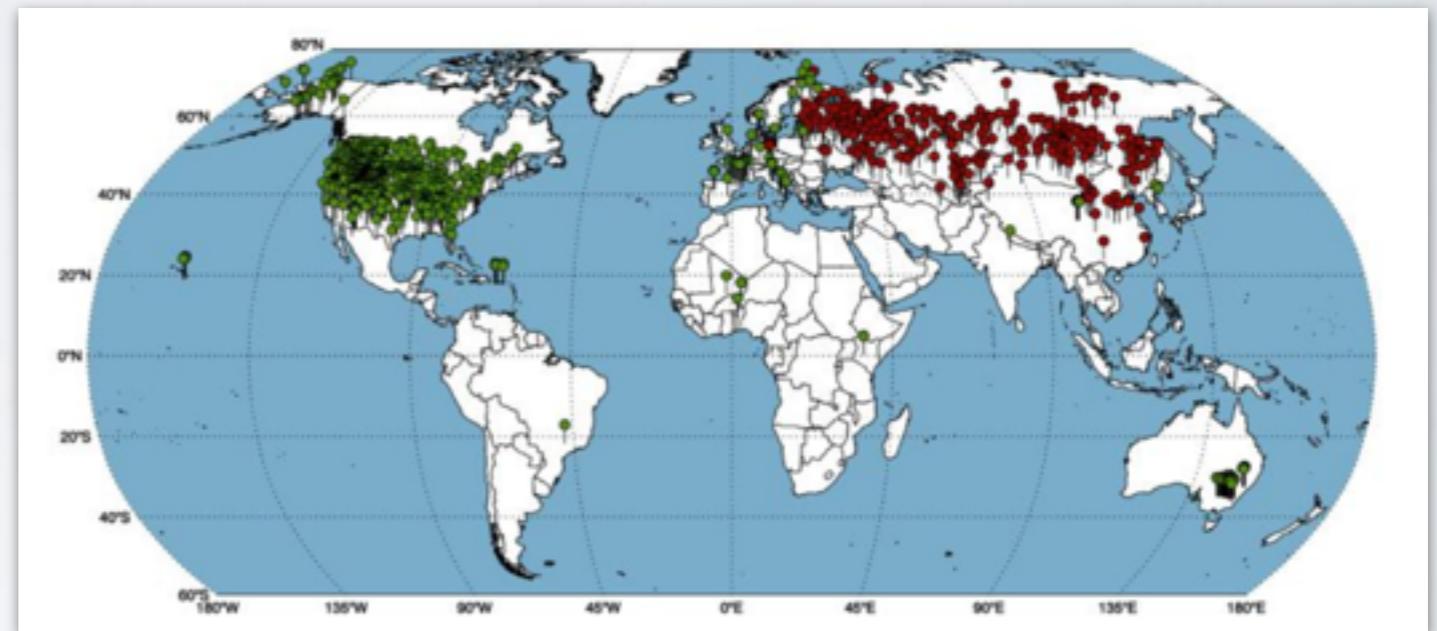


Global stream gauge data

https://www.bafg.de/GRDC/EN/Home/homepage_node.html

ISMN (International Soil Moisture Network)

Spatial Cov.	Global*
Time Cov.	1950*-
Δx	N/A
Δt	Variable



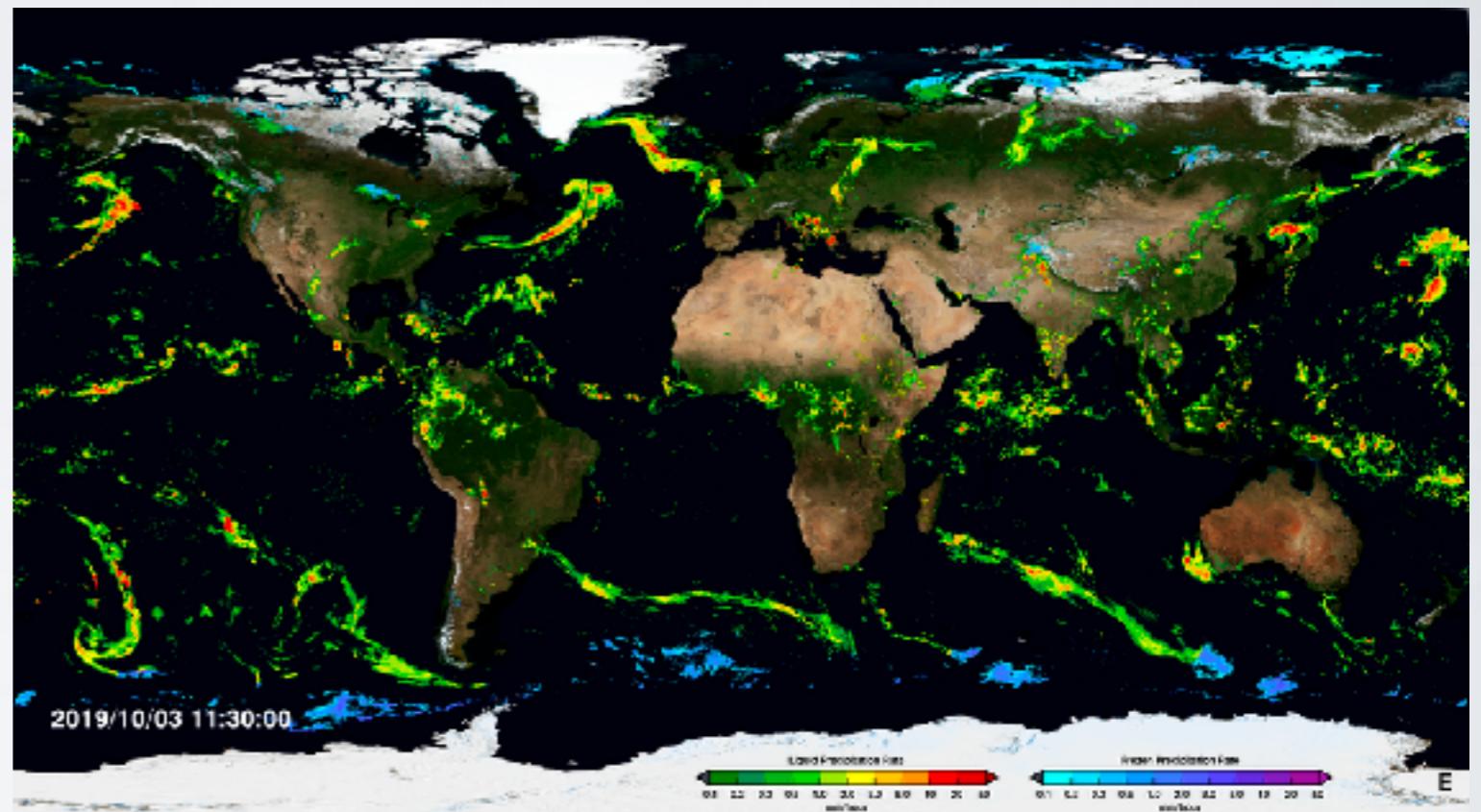
In-situ soil moisture

<https://ismn.geo.tuwien.ac.at/en/>

Precipitation and other
meteorological variables

IMERG (GPM + TRMM)

Spatial Cov.	Global*
Time Cov.	2000+
Δx	0.1 arc degree
Δt	30 min

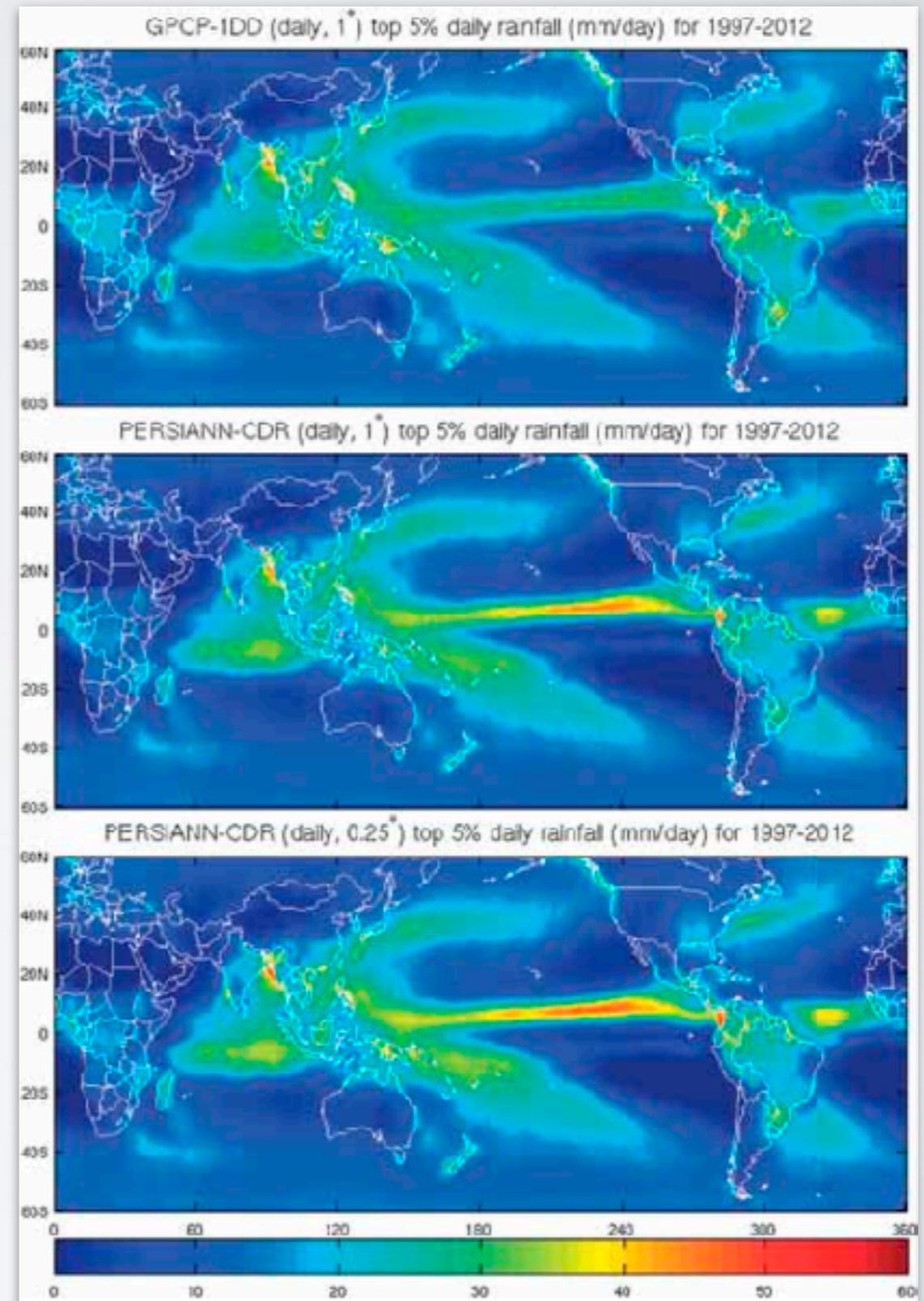


<https://pmm.nasa.gov/data-access/downloads/gpm>

PERSIANN-CDR

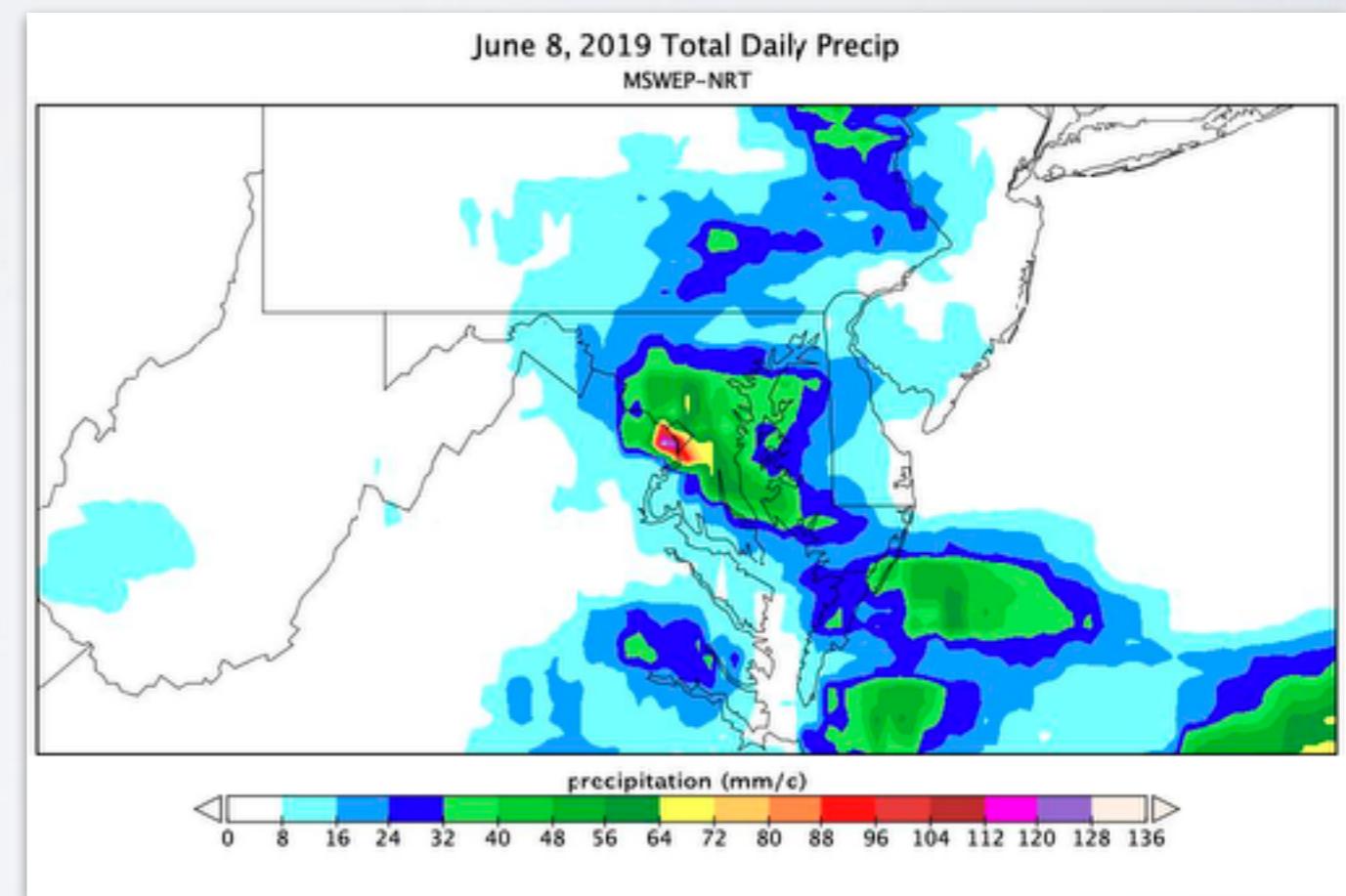
Spatial Cov.	60S-60N
Time Cov.	1983-
Δx	0.25 arcdegree
Δt	Daily

[https://climatedataguide.ucar.edu/
climate-data/persiann-cdr-
precipitation-estimation-remotely-
sensed-information-using-artificial](https://climatedataguide.ucar.edu/climate-data/persiann-cdr-precipitation-estimation-remotely-sensed-information-using-artificial)



MSWEP

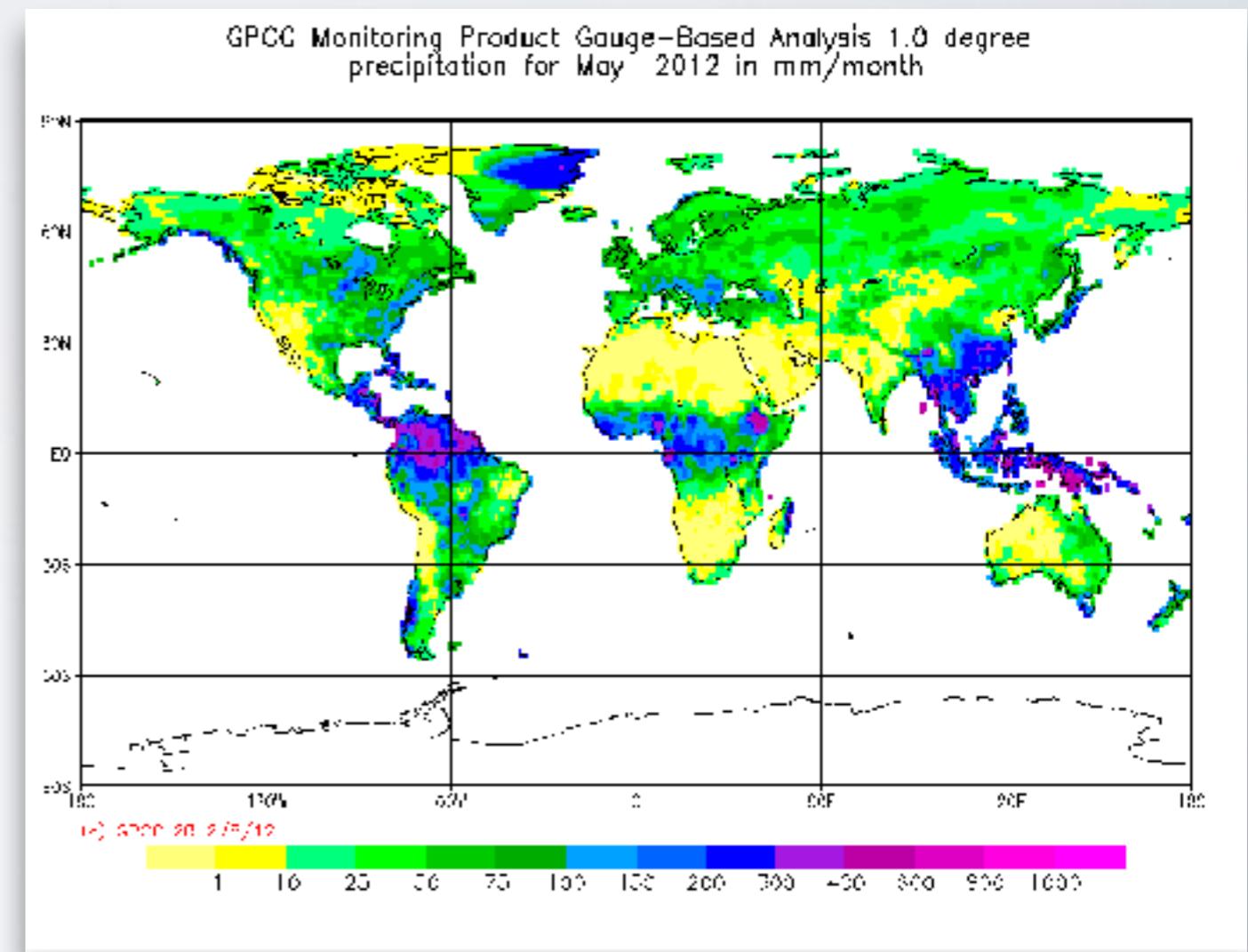
Spatial Cov.	Global
Time Cov.	1979-
Δx	0.1 arcdegree
Δt	3 hours



<http://www.gloh2o.org/>

GPCC (Global Precipitation Climatology Centre)

Spatial Cov.	Global Land
Time Cov.	1901-
Δx	0.5 arc degree
Δt	Monthly

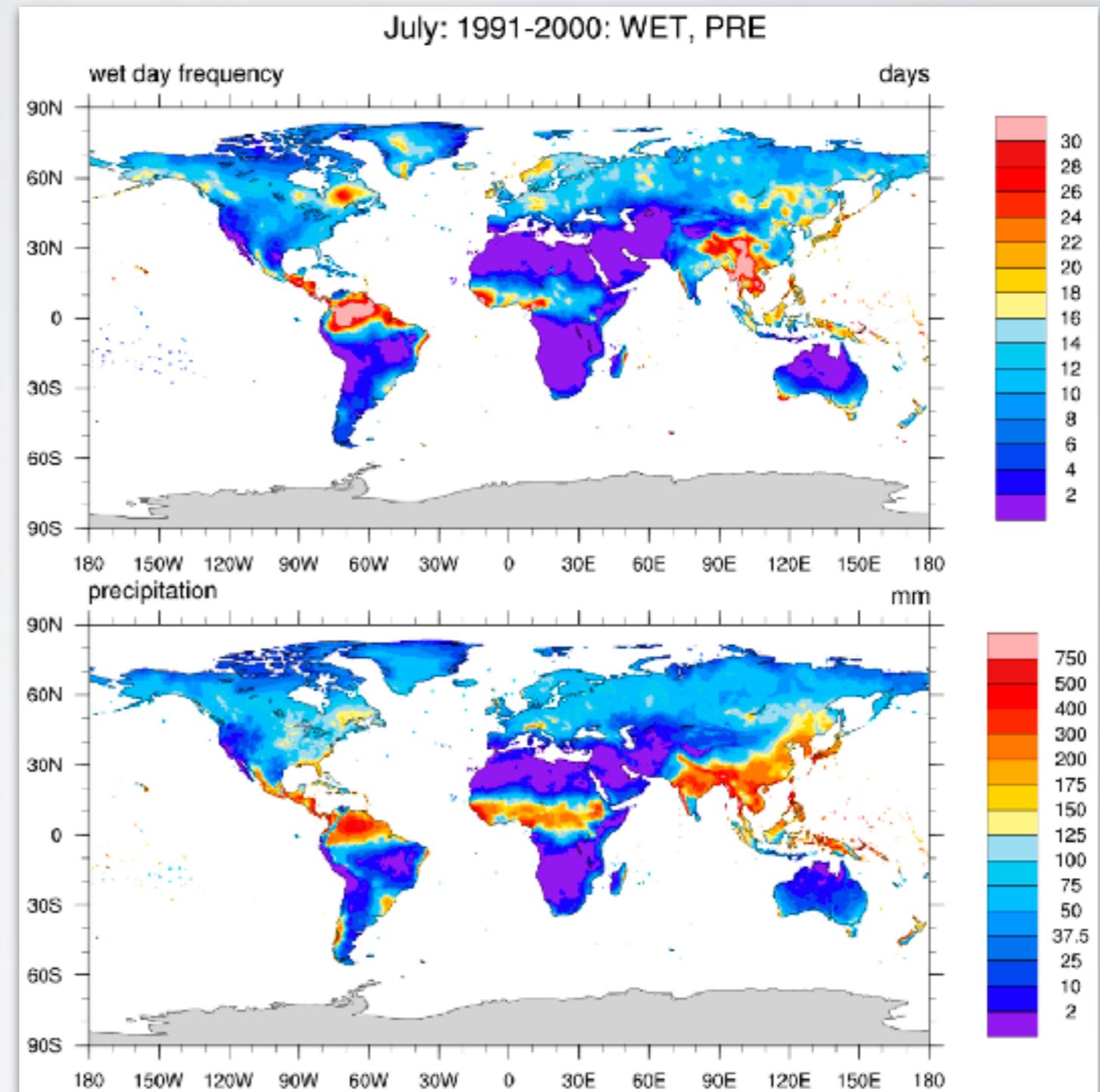


<https://www.esrl.noaa.gov/psd/data/gridded/data.gpcc.html>

CRU

Spatial Cov.	Global Land*
Time Cov.	1901-2018
Δx	0.5 arcdegree
Δt	Monthly

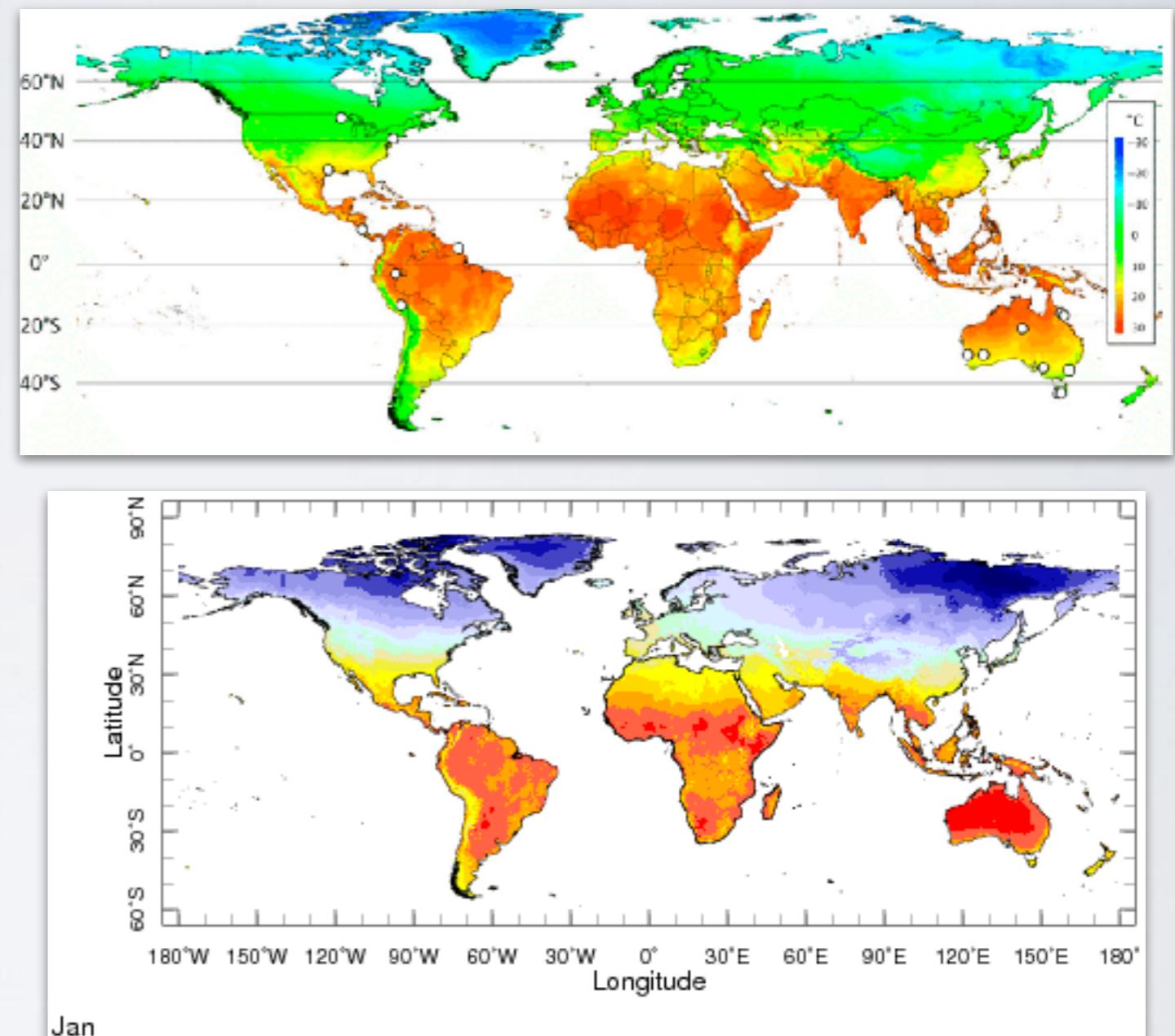
[https://crudata.uea.ac.uk/
cru/data/hrg/](https://crudata.uea.ac.uk/cru/data/hrg/)



*Also includes other meteorological variables

WorldClim

Spatial Cov.	Global Land
Time Cov.	N/A
Δx	30 arcsec (~1 km)
Δt	Monthly climatology



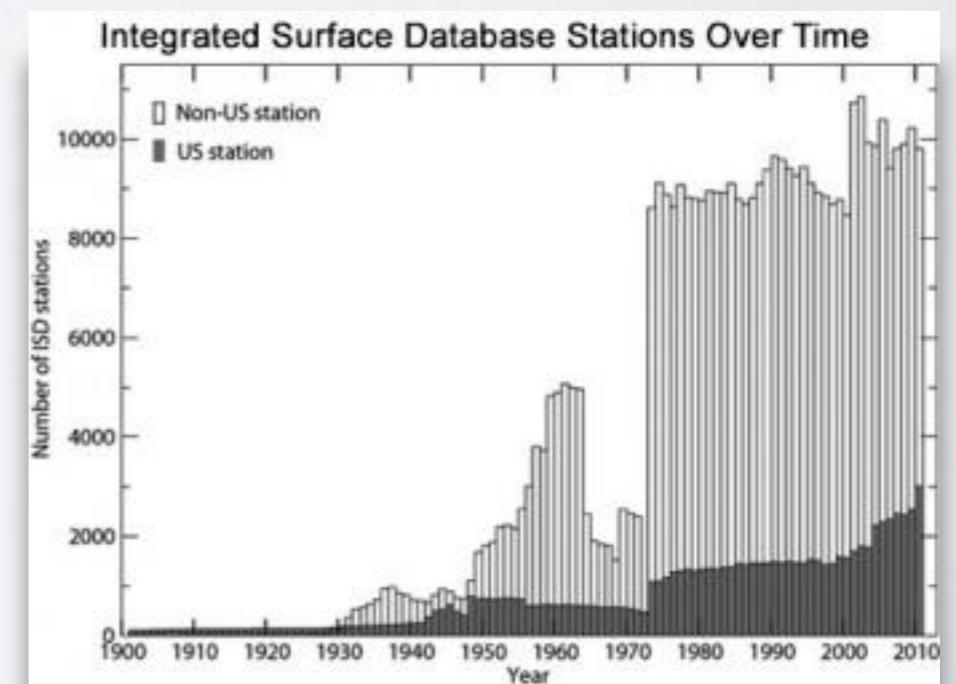
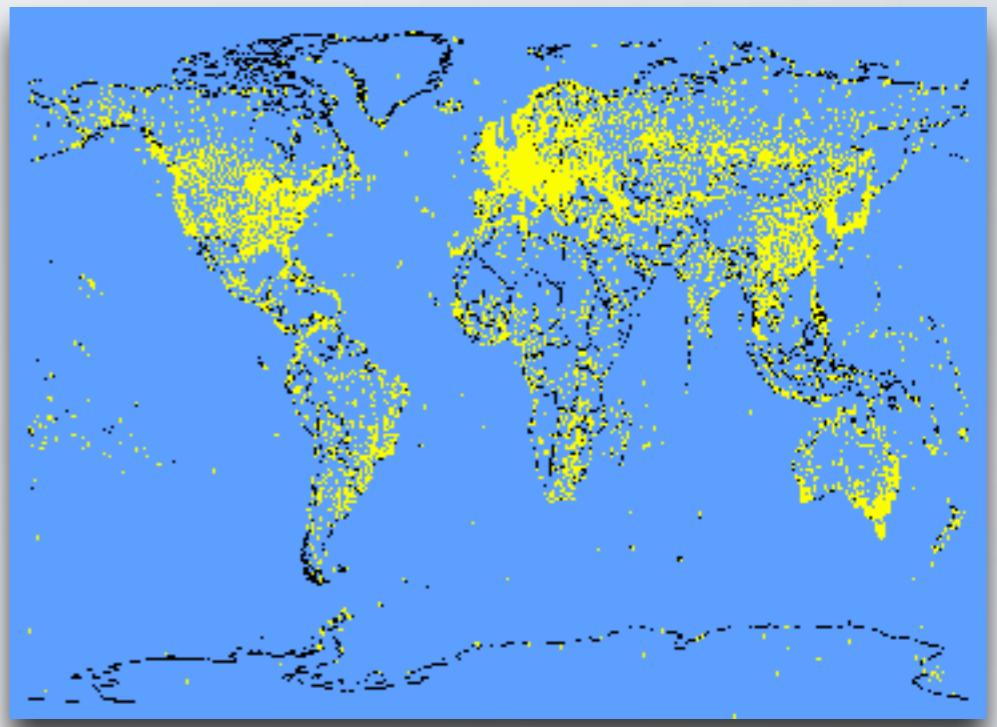
<https://www.worldclim.org/>

*Also includes other meteorological variables

ISD (Integrated Surface Database)

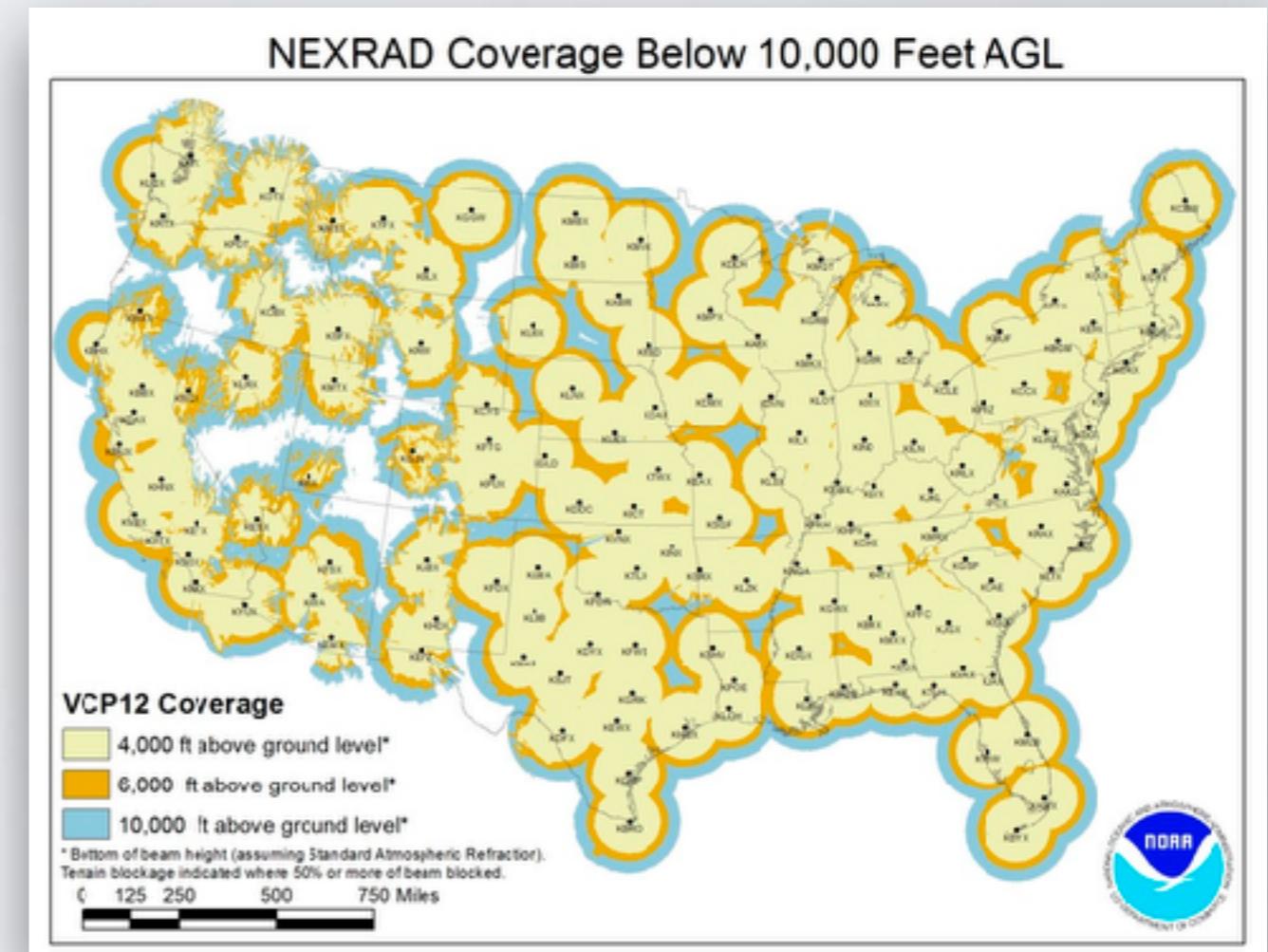
Spatial Cov.	Global
Time Cov.	1901*-
Δx	35,000 stations
Δt	Hourly*

<https://www.ncdc.noaa.gov/isd>



NEXRAD - WSR-88D

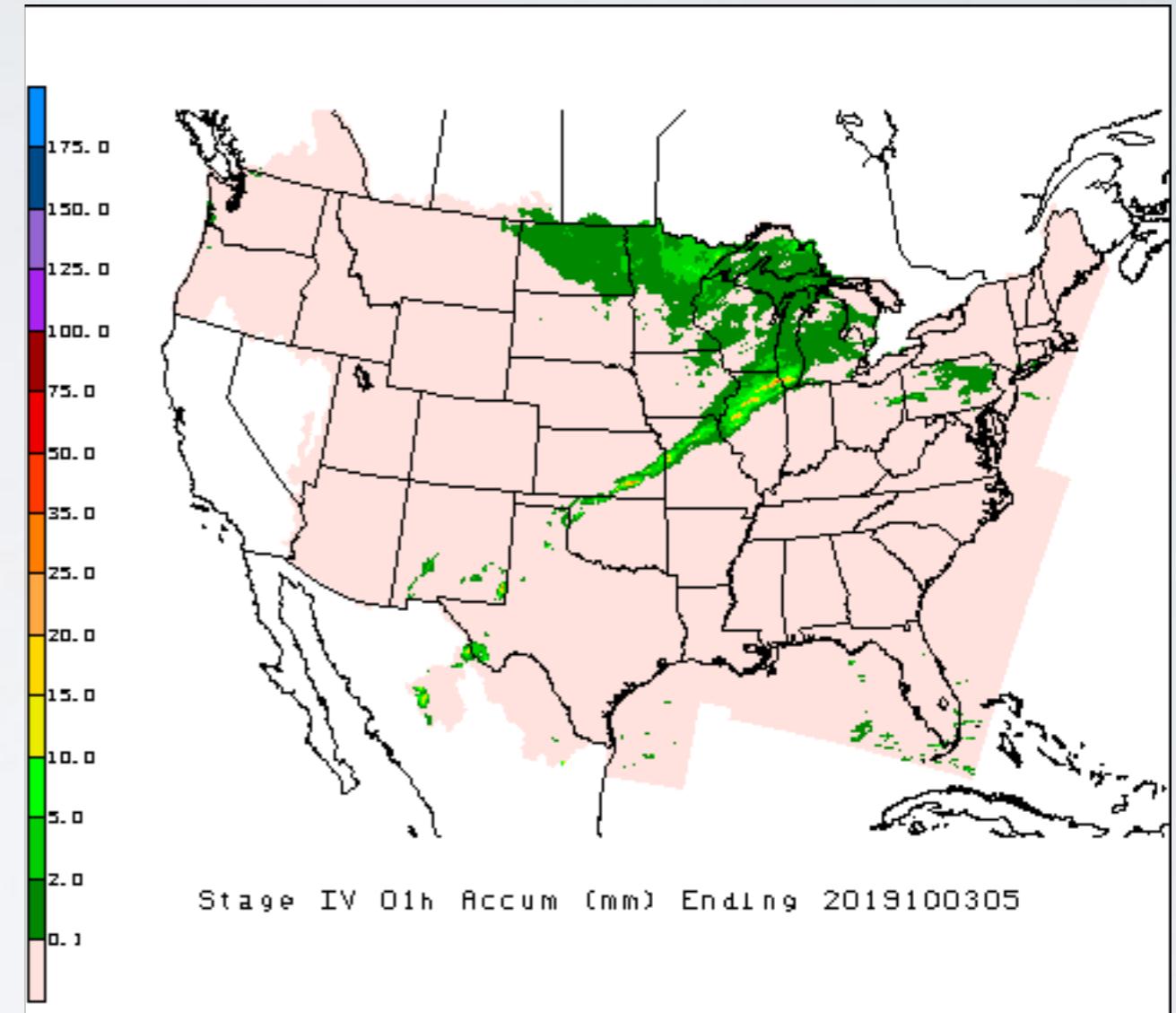
Spatial Cov.	United States
Time Cov.	1979-
Δx	Variable
Δt	Minutes



<https://www.ncdc.noaa.gov/data-access/radar-data/nexrad>

Stage IV Precipitation

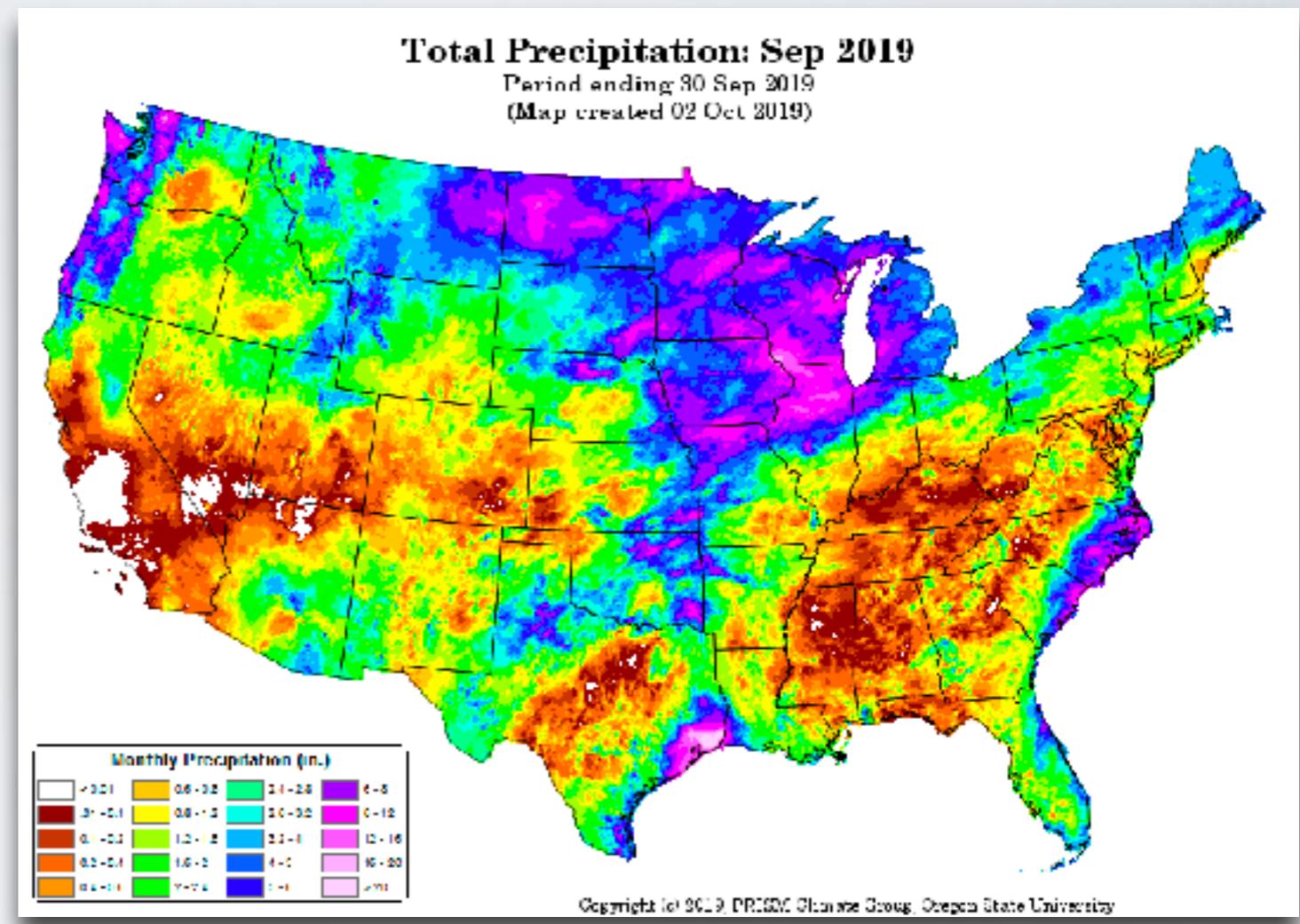
Spatial Cov.	United States
Time Cov.	2002-
Δx	4 km
Δt	1 hour



<https://www.emc.ncep.noaa.gov/mmb/ylin/pcpanl/stage4/>

PRISM

Spatial Cov.	United States
Time Cov.	1981-
Δx	4 km
Δt	Daily



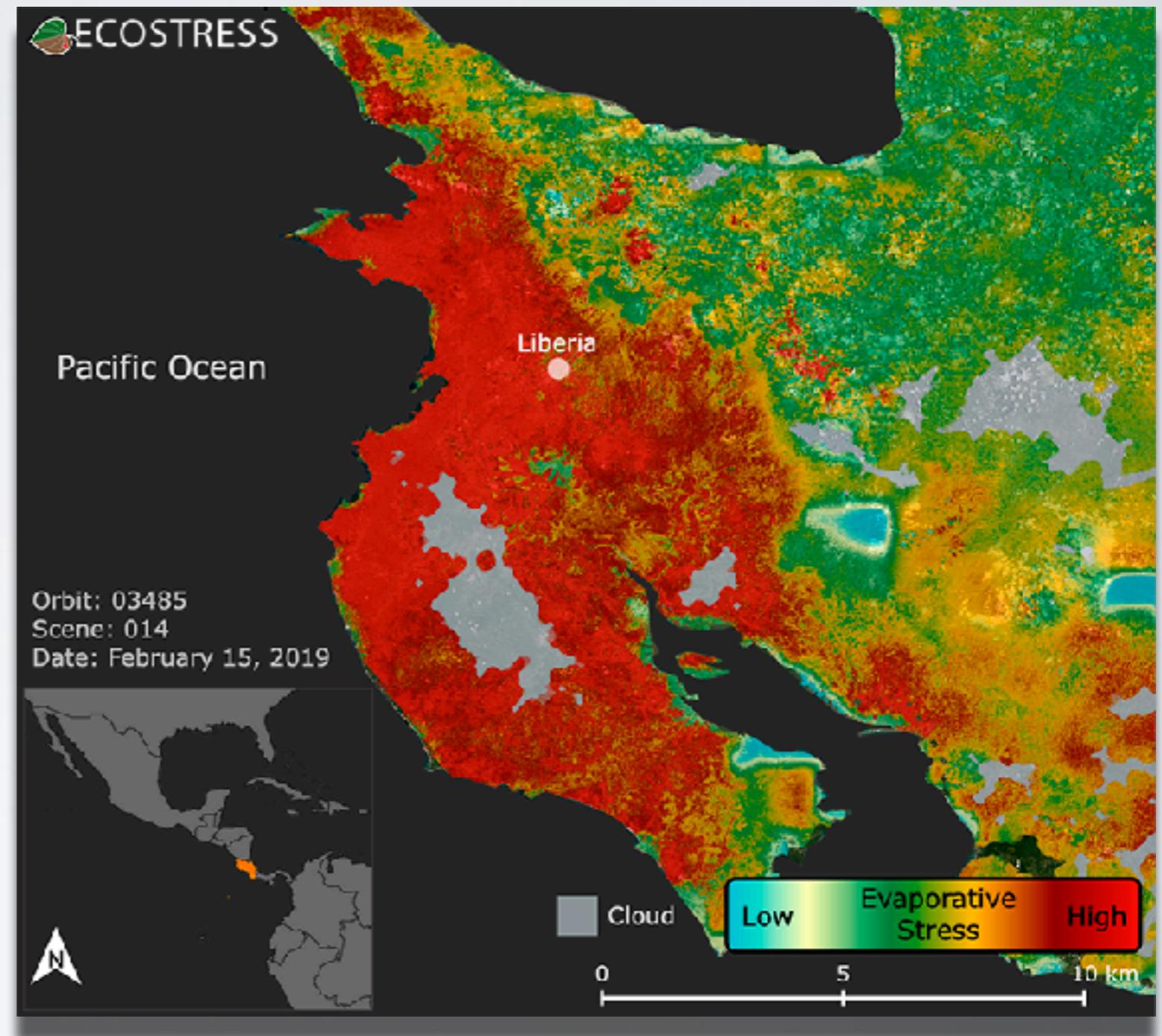
<http://www.prism.oregonstate.edu>

*Also includes other meteorological variables

Biogeochemistry data

Ecostress

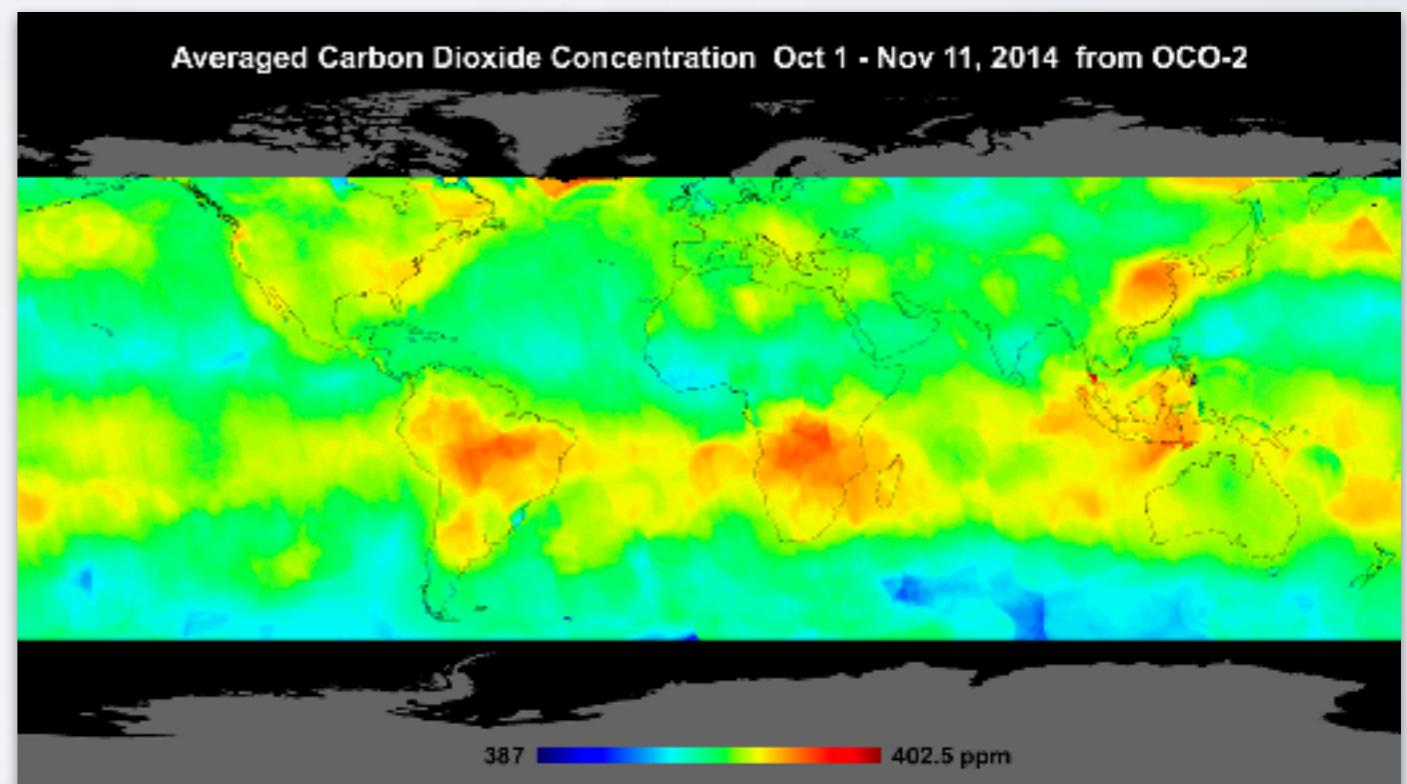
Spatial Cov.	CONUS+
Time Cov.	2018-
Δx	40-70 m
Δt	days?



<https://ecostress.jpl.nasa.gov/>

OCO-2

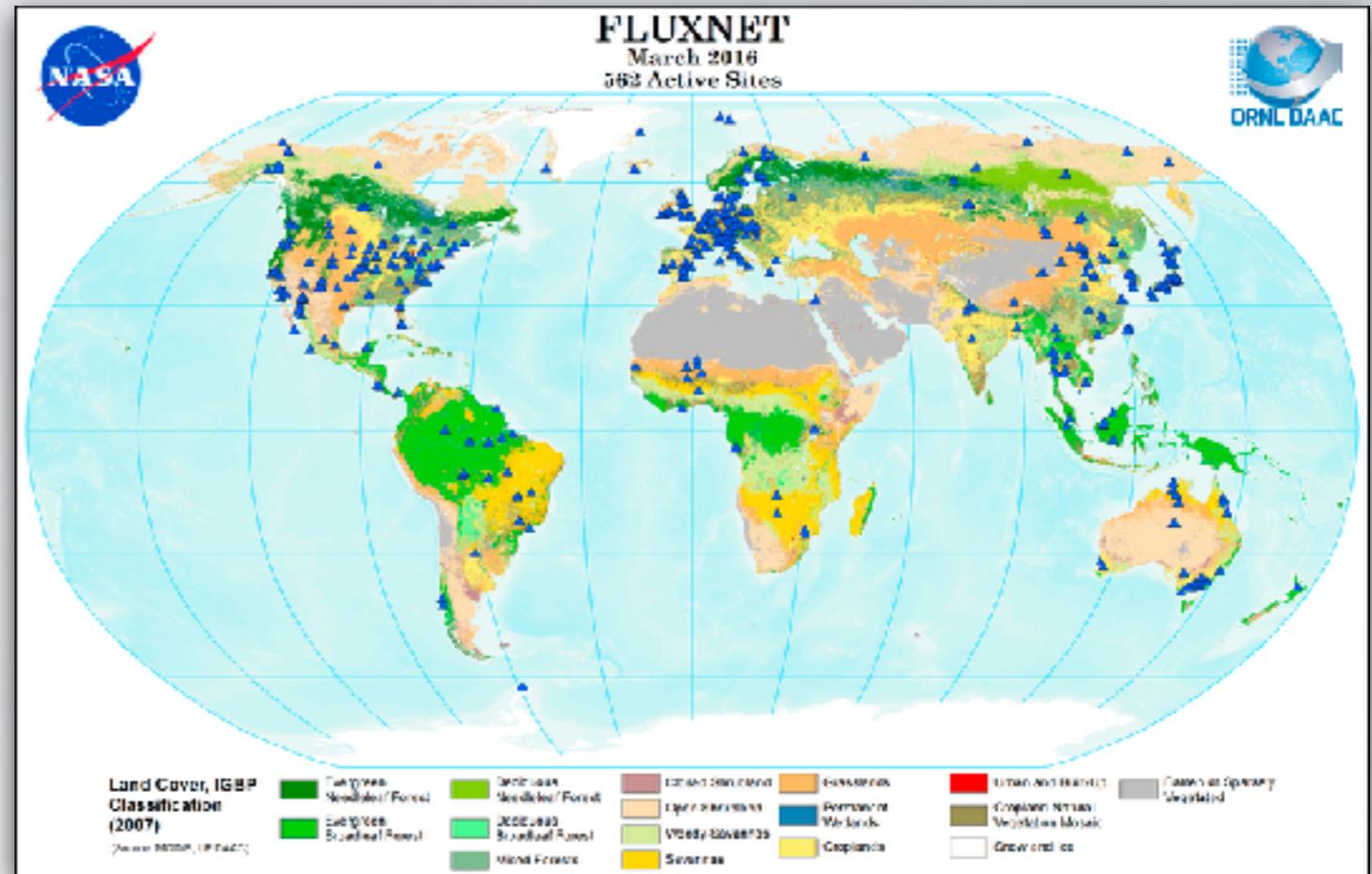
Spatial Cov.	Global
Time Cov.	2014-
Δx	~2 km
Δt	16 days



<https://ocov2.jpl.nasa.gov/>

Fluxnet

Spatial Cov.	Global
Time Cov.	1989-2014*
Δx	Point data
Δt	30 min



<https://fluxnet.fluxdata.org/data/fluxnet2015-dataset/>

*Also includes meteorological data as well as surface water and energy states and fluxes



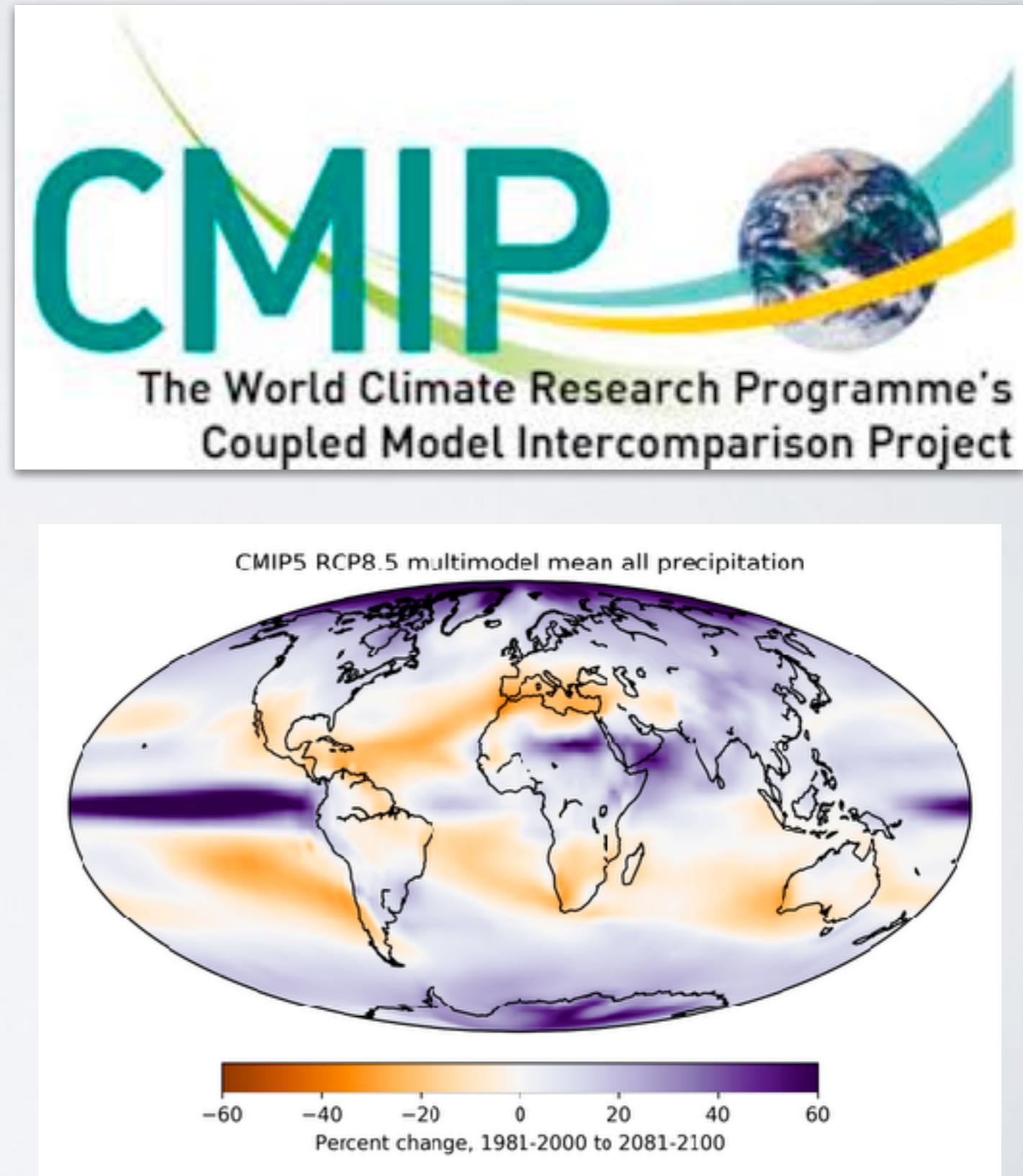
Climate models

CMIP

Spatial Cov.	Global
Time Cov.	1800-2100*
Δx	1-2 arc degree*
Δt	Monthly

*Many different climate models

<https://portal.enes.org/data/enes-model-data/cmip5/resolution>



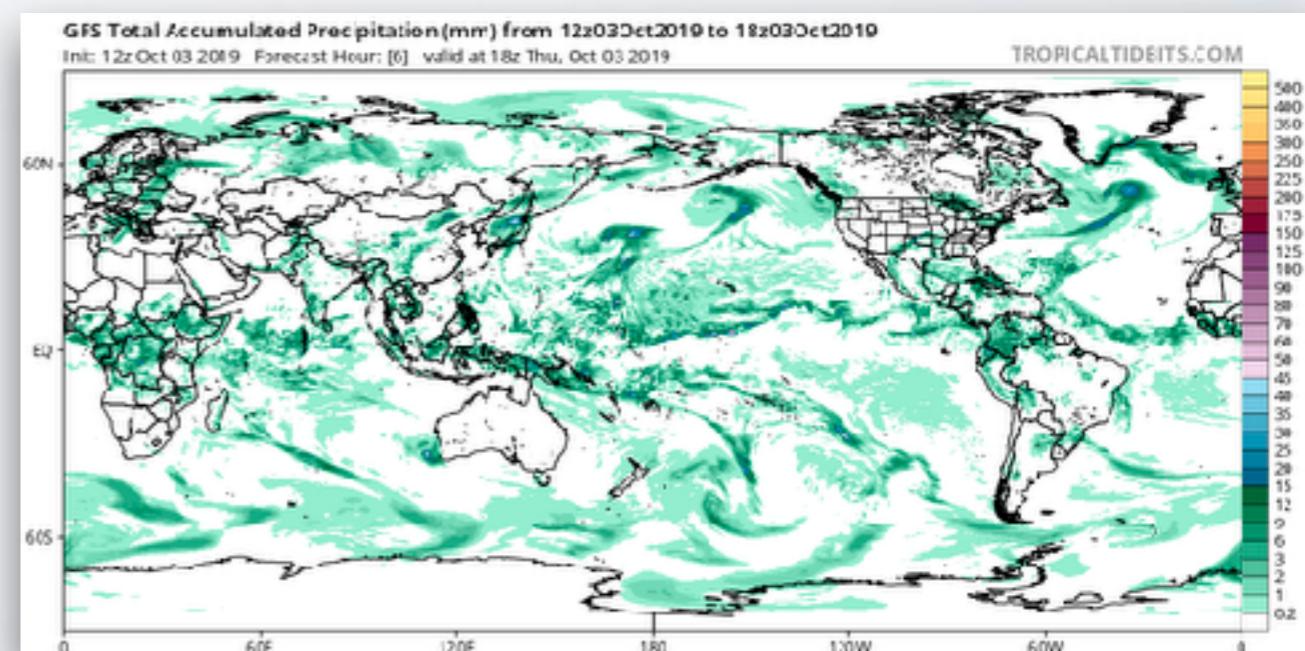
Weather models

GFS (Global Forecasting System)

Spatial Cov.	Global
Time Cov.	16 days initialized every 6 hours
Δx	~25 km
Δt	3 hours



<https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/global-forecast-system-gfs>

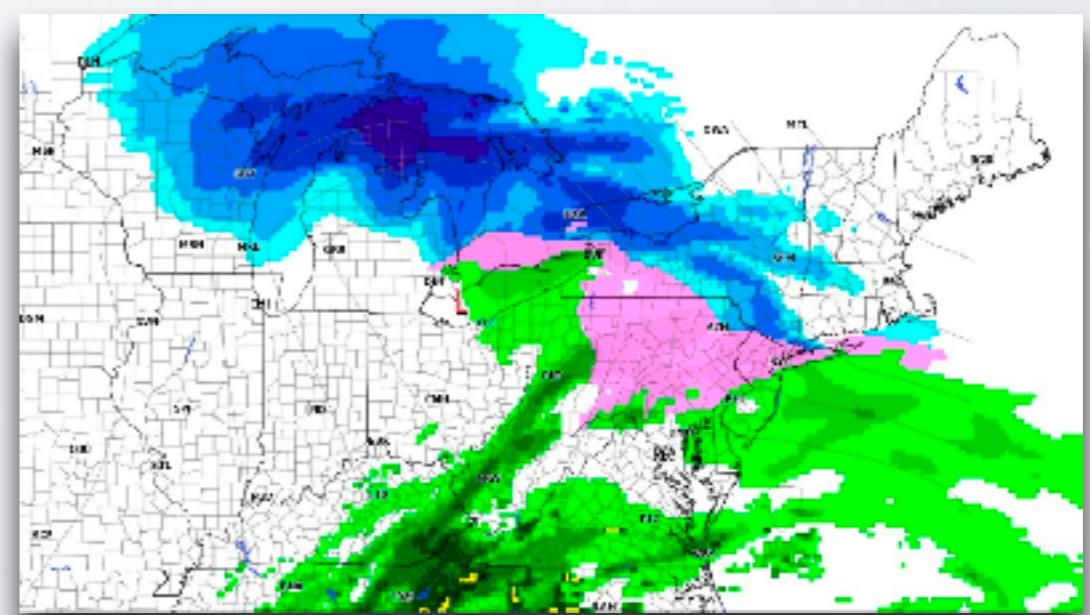


ECMWF

Spatial Cov.	Global
Time Cov.	14 days initialized every 6 hours
Δx	$\sim 10 \text{ km}$
Δt	3 hours

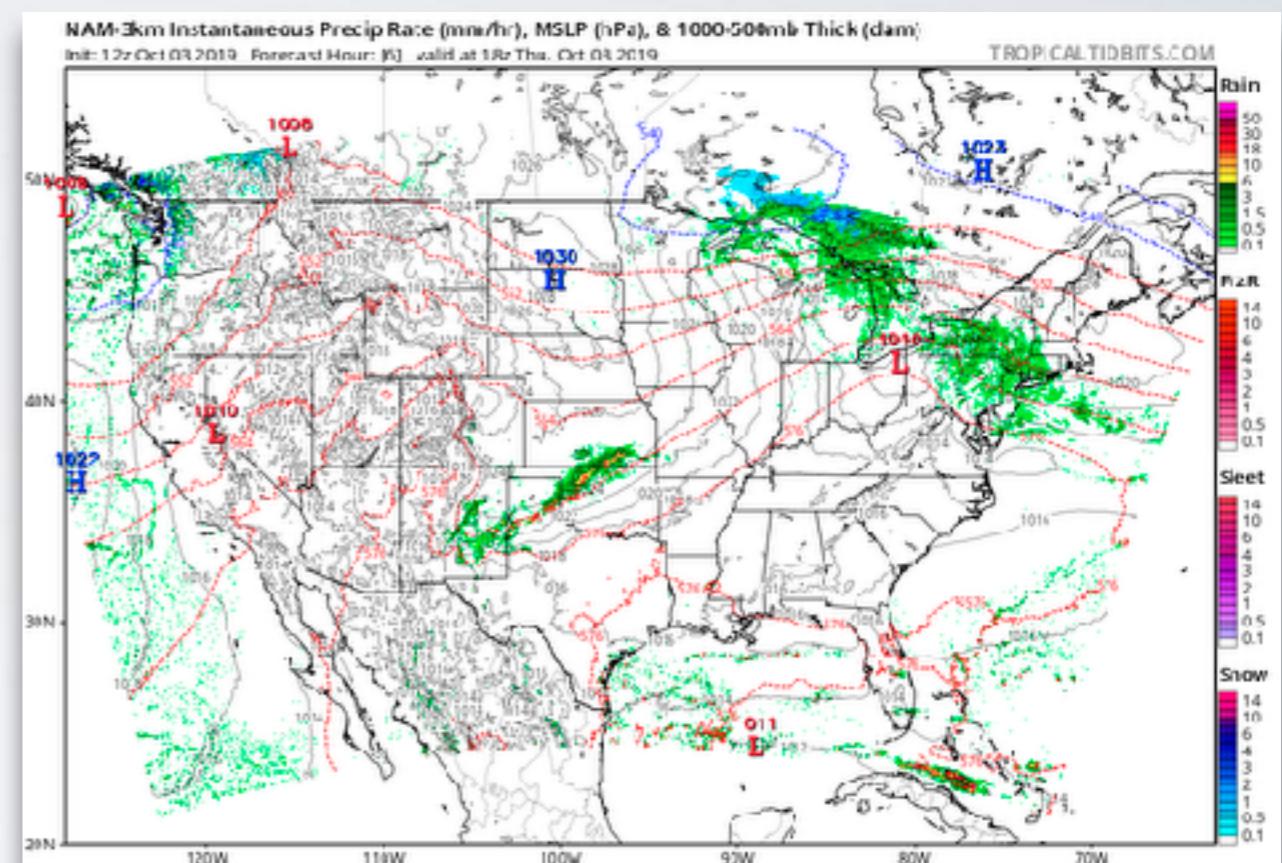


<https://www.ecmwf.int/>



NAM 3km (~WRF)

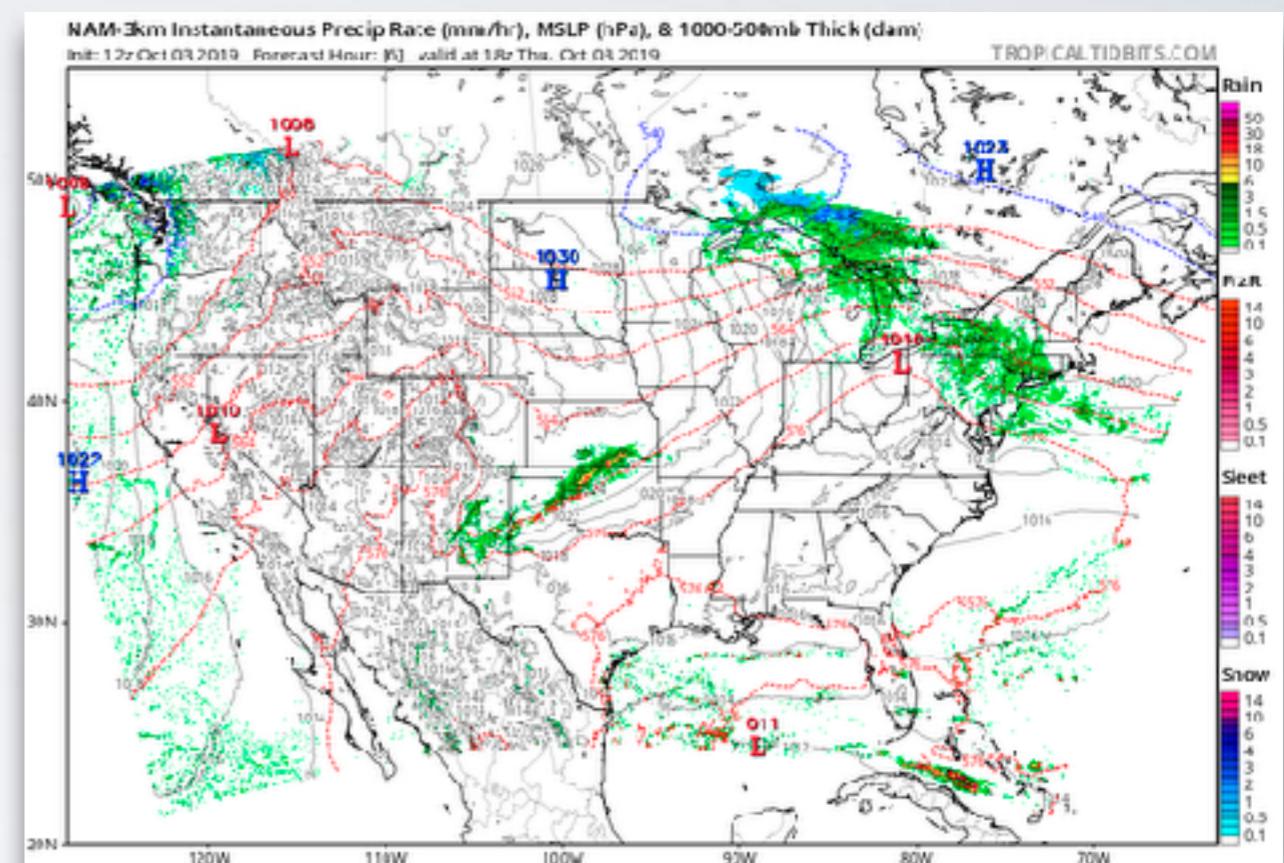
Spatial Cov.	United States
Time Cov.	60 hours initialized every 6
Δx	~ 3 km
Δt	1 hour



<https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/north-american-mesoscale-forecast-system-nam>

HRRR (High Resolution Rapid Refresh)

Spatial Cov.	United States
Time Cov.	18 hrs. initialized every hour
Δx	~3 km
Δt	1 hour

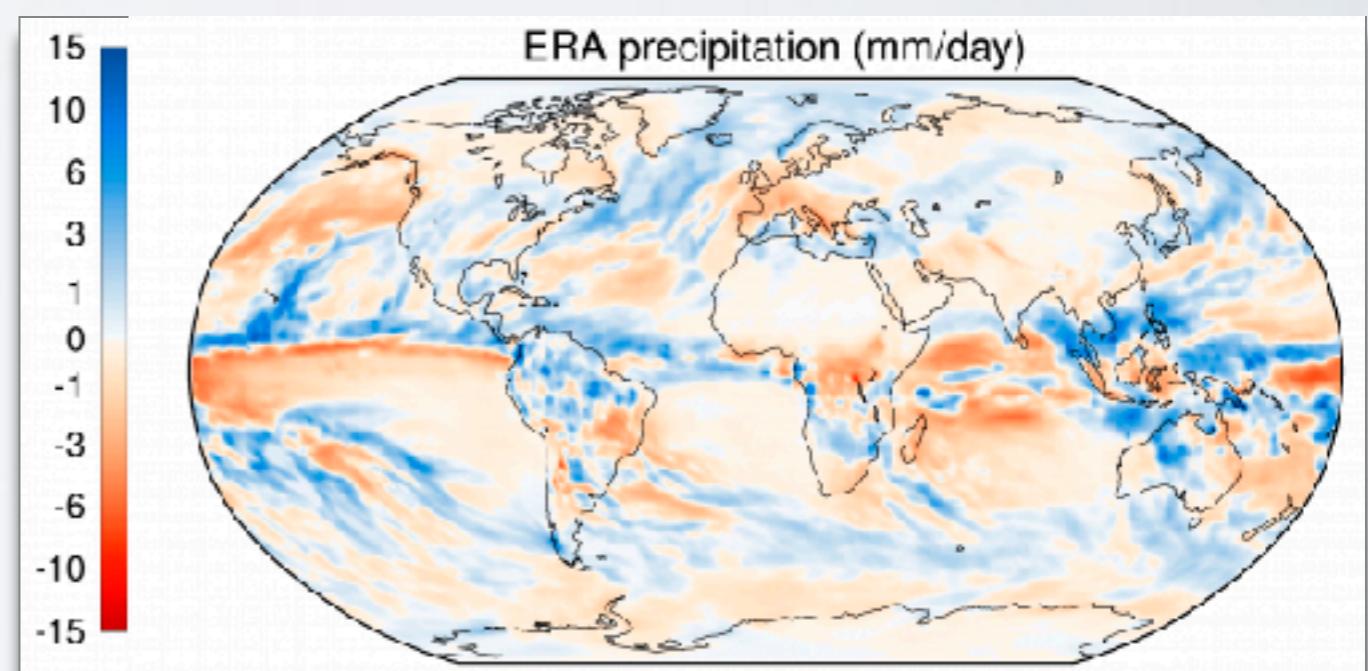
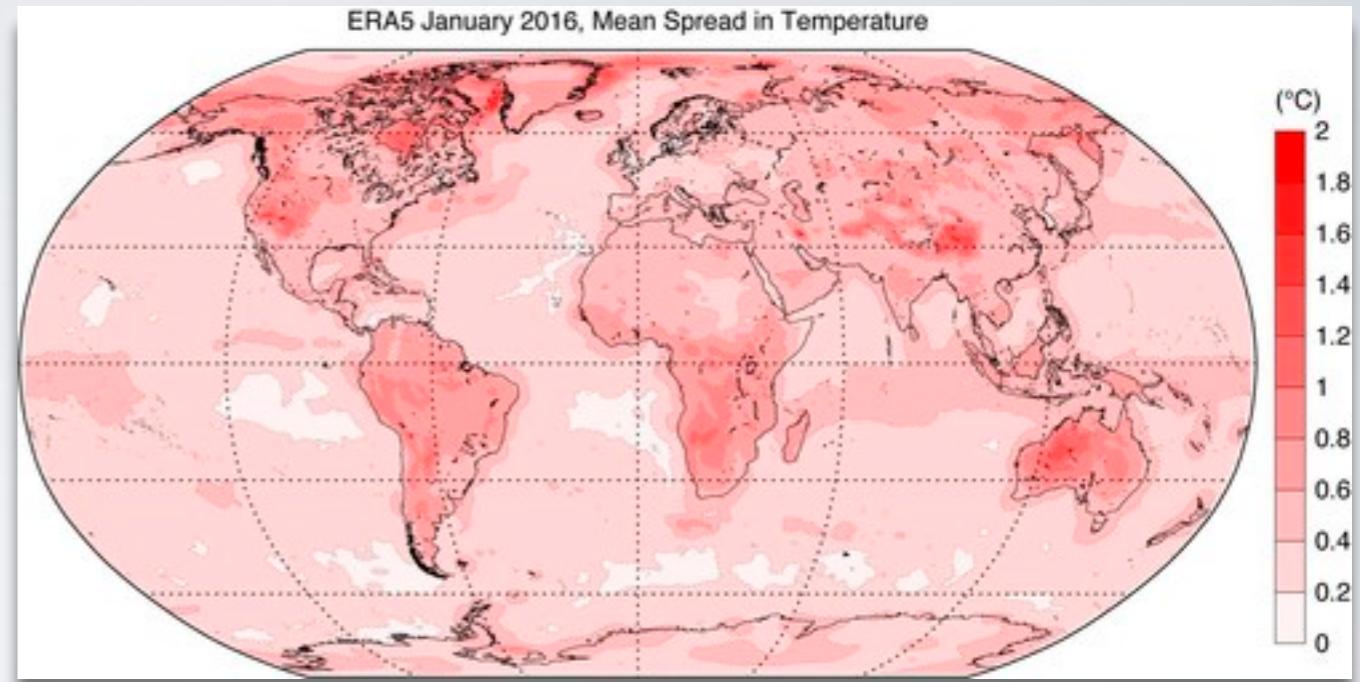


<https://rapidrefresh.noaa.gov/hrrr/>

Reanalysis data

ERA5

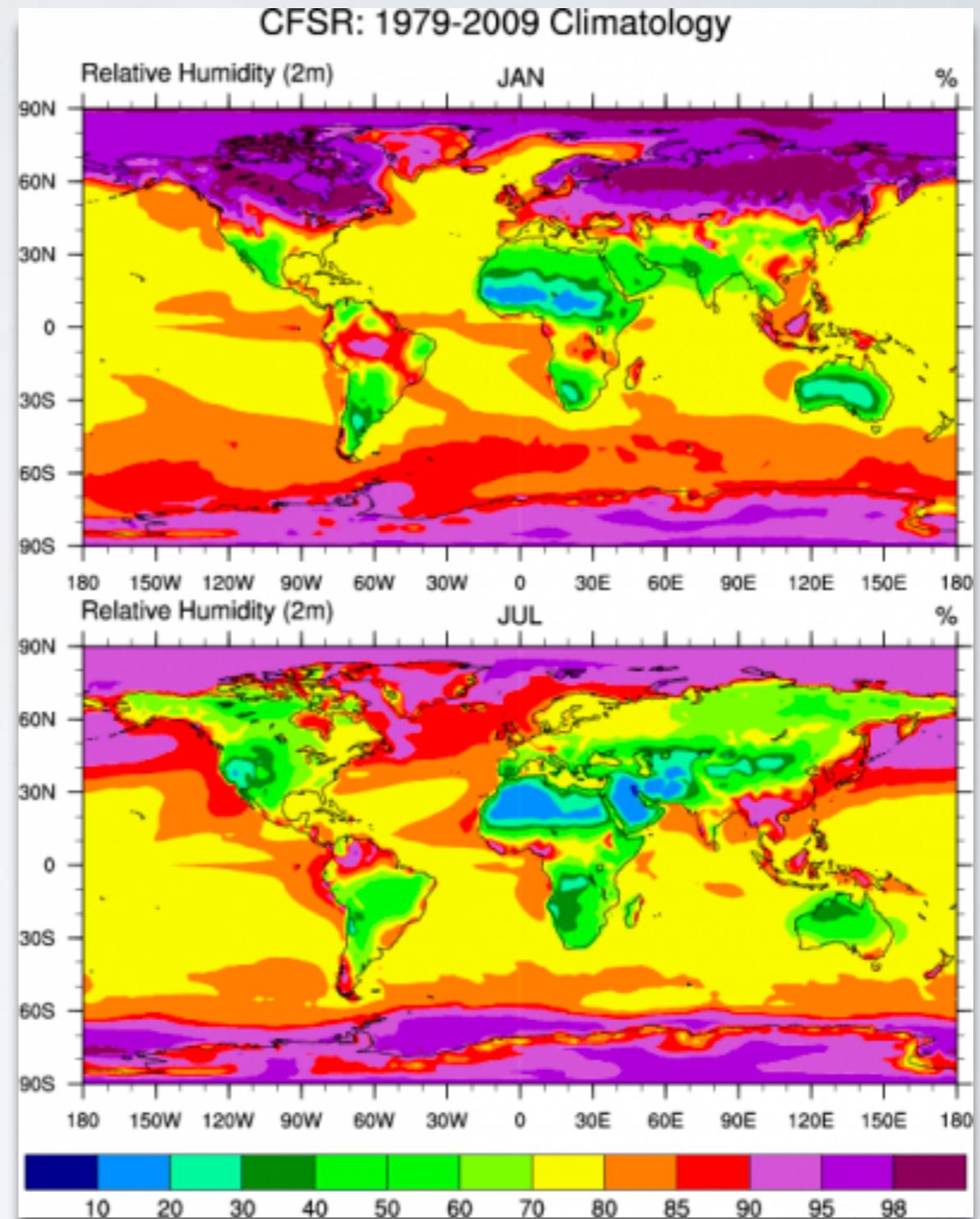
Spatial Cov.	Global
Time Cov.	1979-
Δx	30 km
Δt	1 hour



[https://www.ecmwf.int/en/forecasts/
datasets/reanalysis-datasets/era5](https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5)

CFSR (Climate Forecast System Reanalysis)

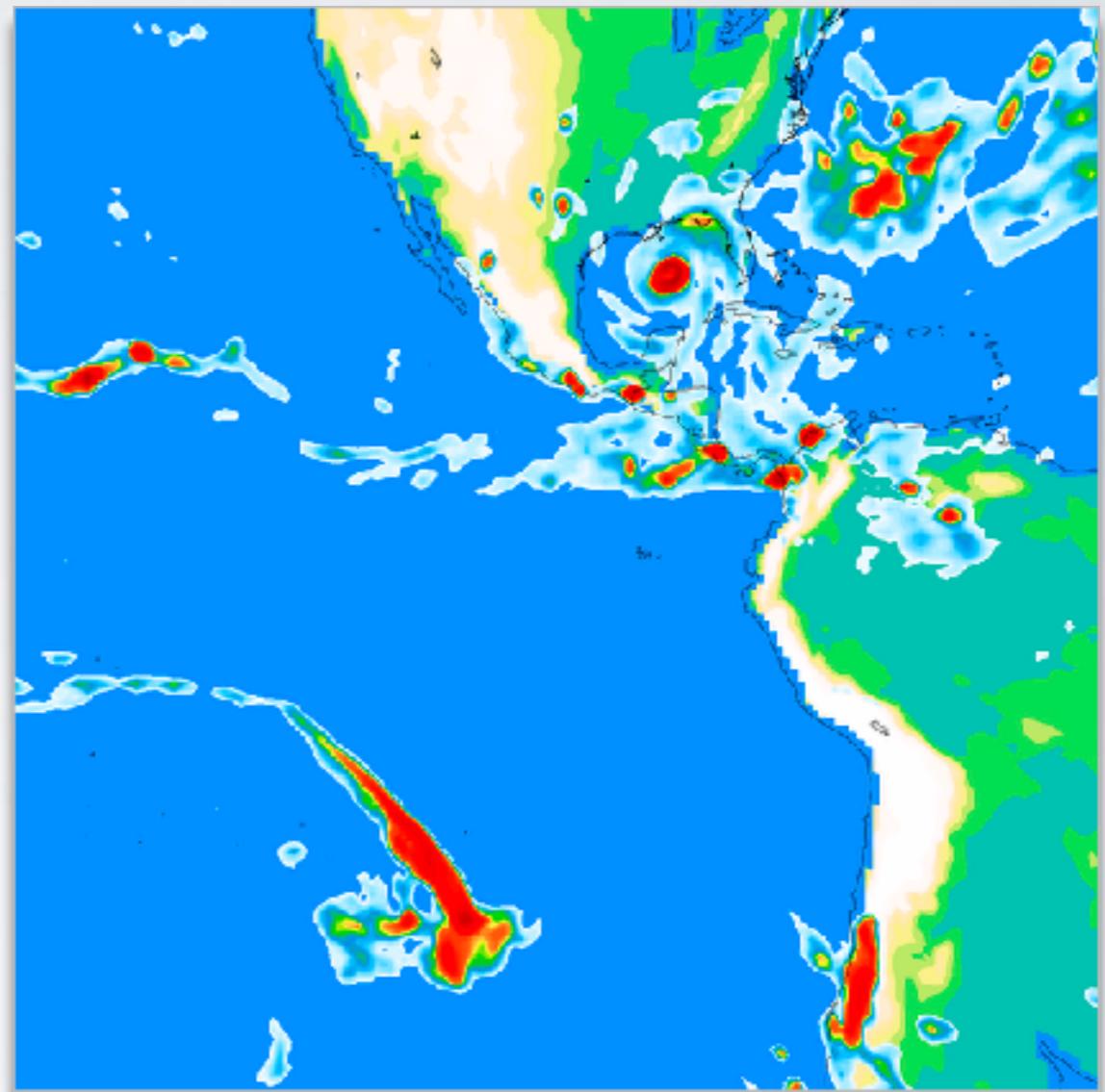
Spatial Cov.	Global
Time Cov.	1979-2010
Δx	~35 km
Δt	6 hours



[https://climatedataguide.ucar.edu/
climate-data/climate-forecast-system-
reanalysis-cfsr](https://climatedataguide.ucar.edu/climate-data/climate-forecast-system-reanalysis-cfsr)

MERRA2

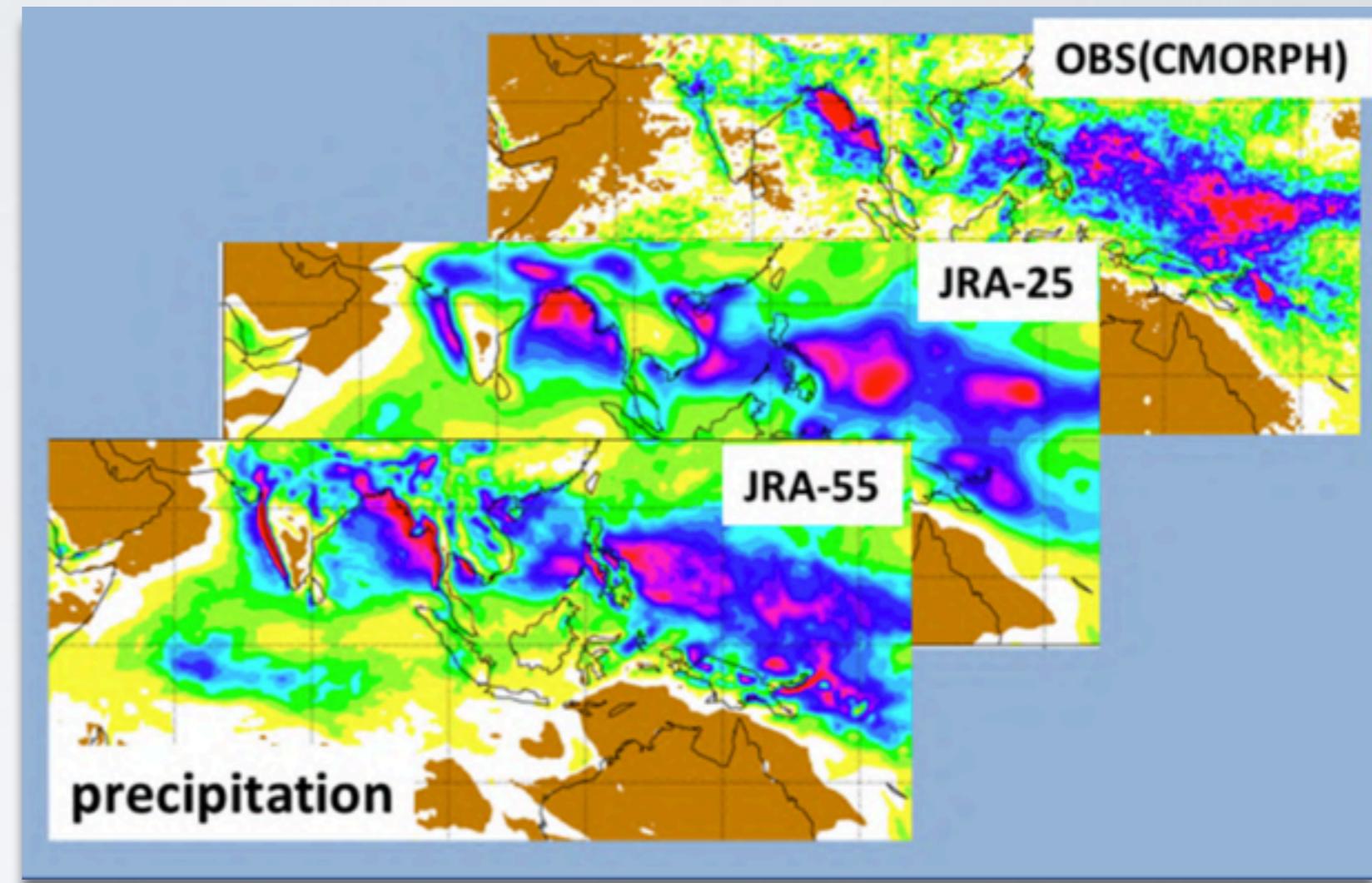
Spatial Cov.	Global
Time Cov.	1980-
Δx	~1/2 arc degree
Δt	1 hour



<https://climatedataguide.ucar.edu/climate-data/nasas-merra2-reanalysis>

JRA55

Spatial Cov.	Global
Time Cov.	1958-
Δx	~55km
Δt	3 hourly

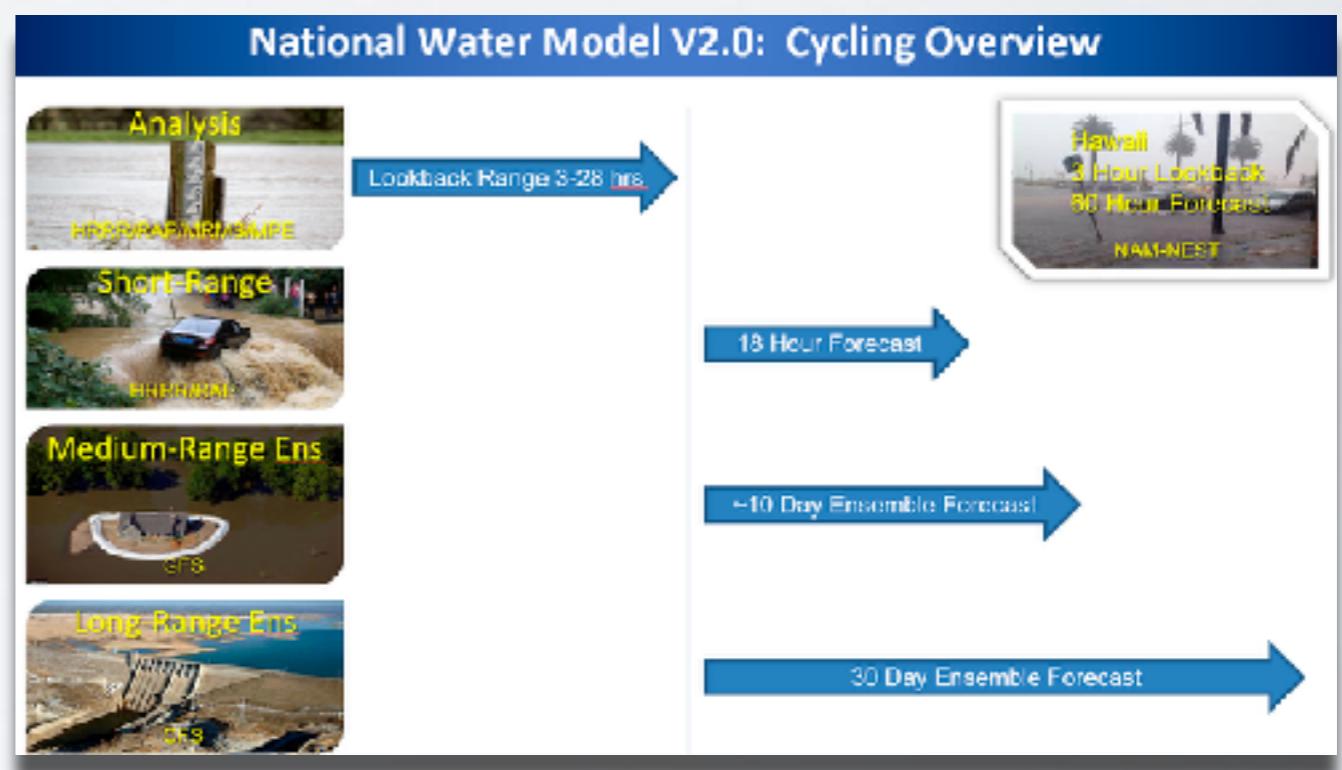


<https://rda.ucar.edu/datasets/ds628.0/>

Hydrologic/Land surface models

NWM (National Water Model)

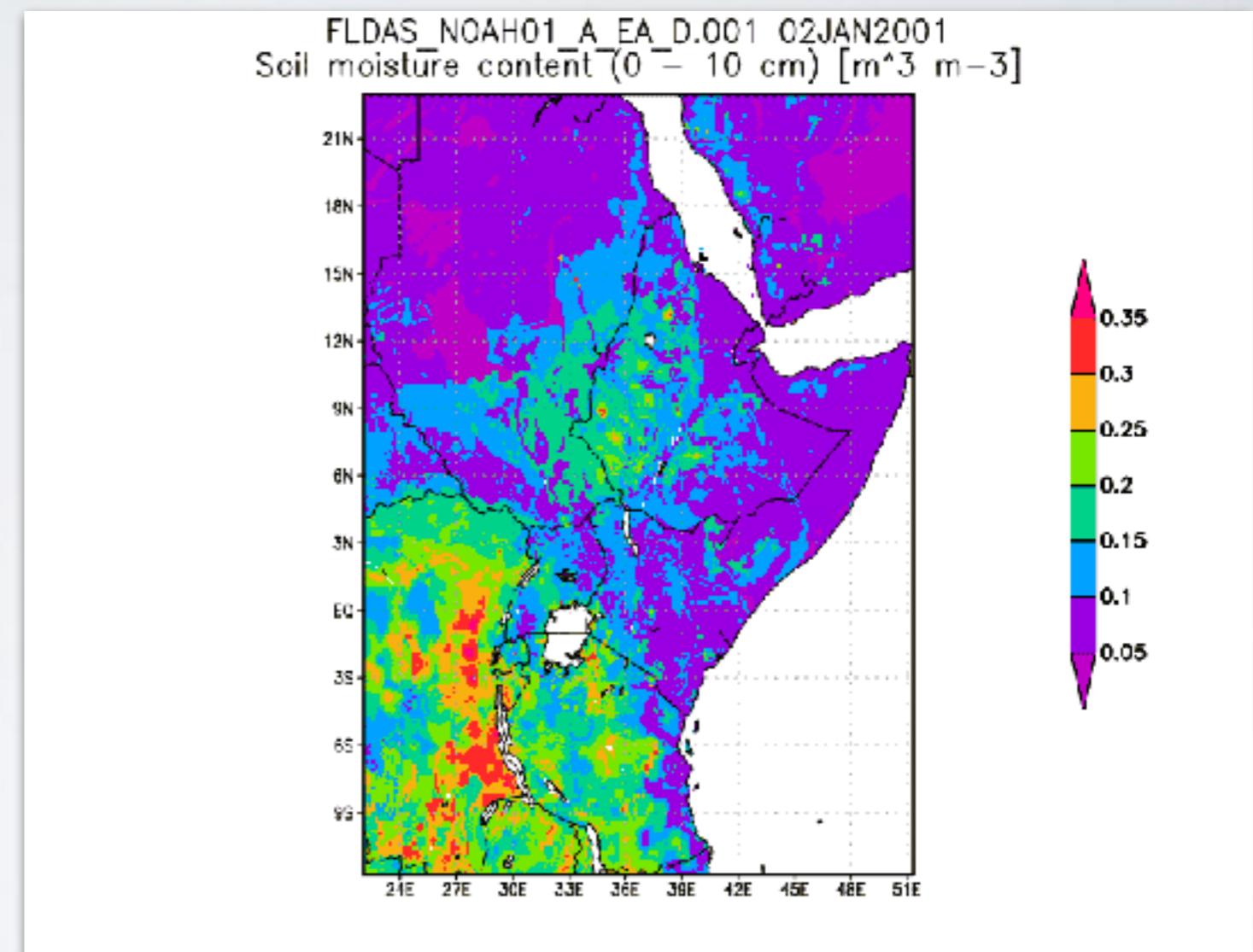
Spatial Cov.	CONUS
Time Cov.	Forecast
Δx	250-1000 m
Δt	Variable



<https://water.noaa.gov/about/nwm>

LDAS (Land Data Assimilation System)

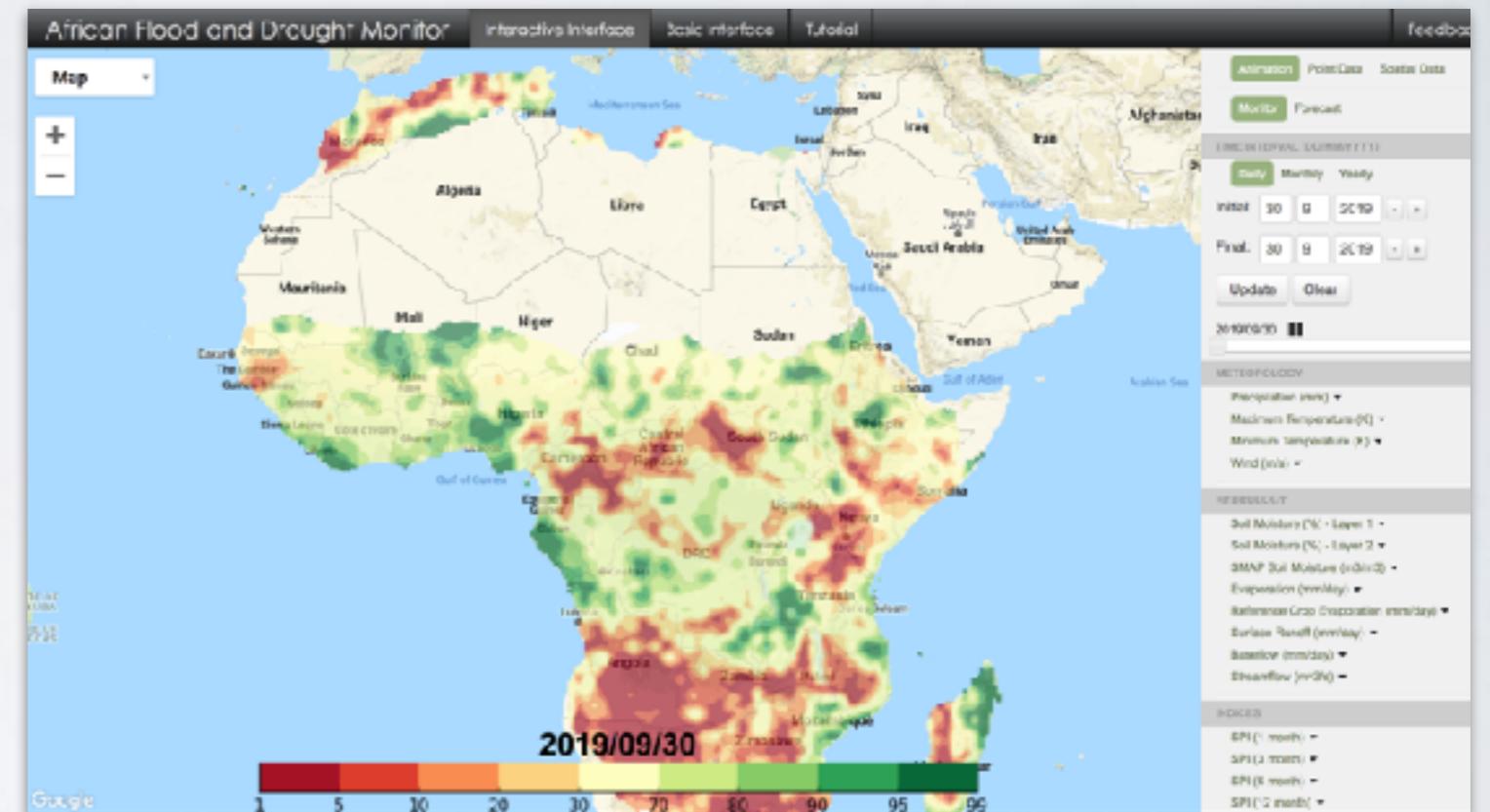
Spatial Cov.	Multiple regions
Time Cov.	Multiple
Δx	0.25-l arcdegree
Δt	Variable



<https://ldas.gsfc.nasa.gov/ldas/land-data-assimilation-system>

African Food and Drought Monitor

Spatial Cov.	Africa
Time Cov.	1950-
Δx	0.25 arc degree
Δt	Daily



<https://platform.princetonclimate.com/AFDM/interface.php?locale=en>

We only scratched the surface
(if that)

A lot, lot more out there