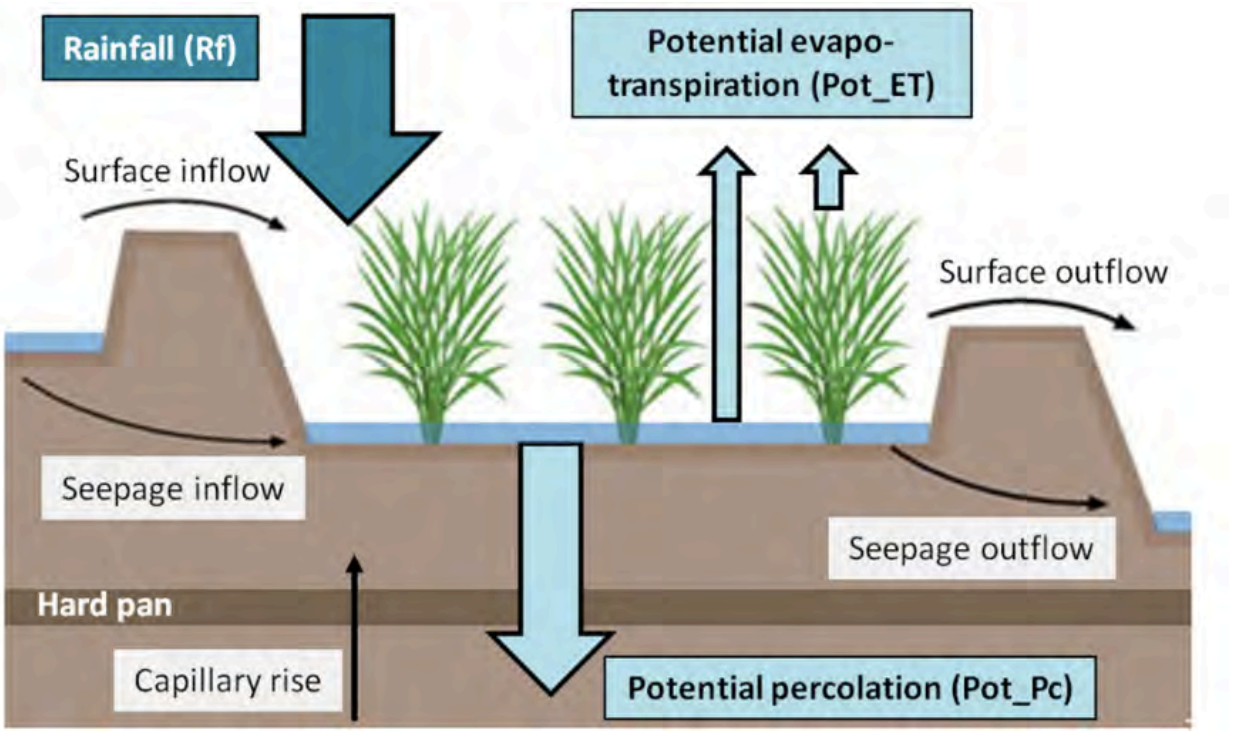
Remote Sensing and Geospatial Innovations for Rice Based Agri-Food Systems

Thomas Gumbricht
May 2019

Components that will be covered



Nelson, A., Wassmann, R, Sander, B.O., Palao, L.K., 2015. Climate-Determined Suitability of the Water Saving Technology "Alternate Wetting and Drying" in Rice Systems: A Scalable Methodology demonstrated for a Province in the Philippines. https://doi.org/10.1371/journal.pone.0145268

Remote Sensing and Geospatial Innovations for Rice Based Agri-Food Systems

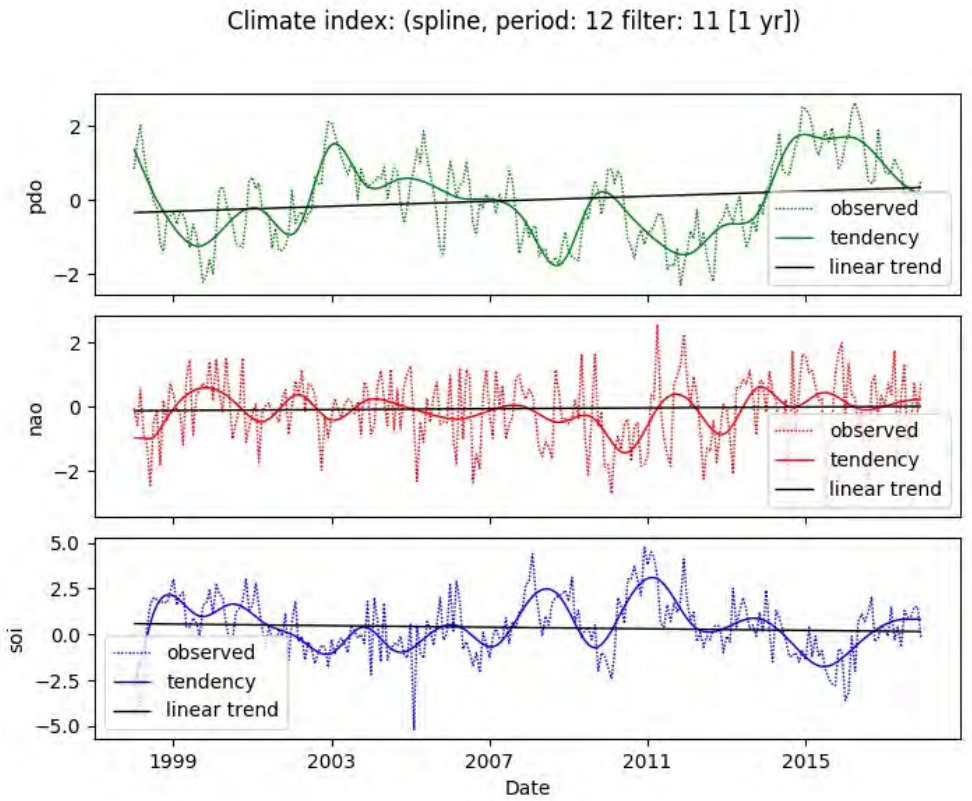
Data and models

Global
Continental
Basin
Landscape
Phenotype

Impacts and drivers

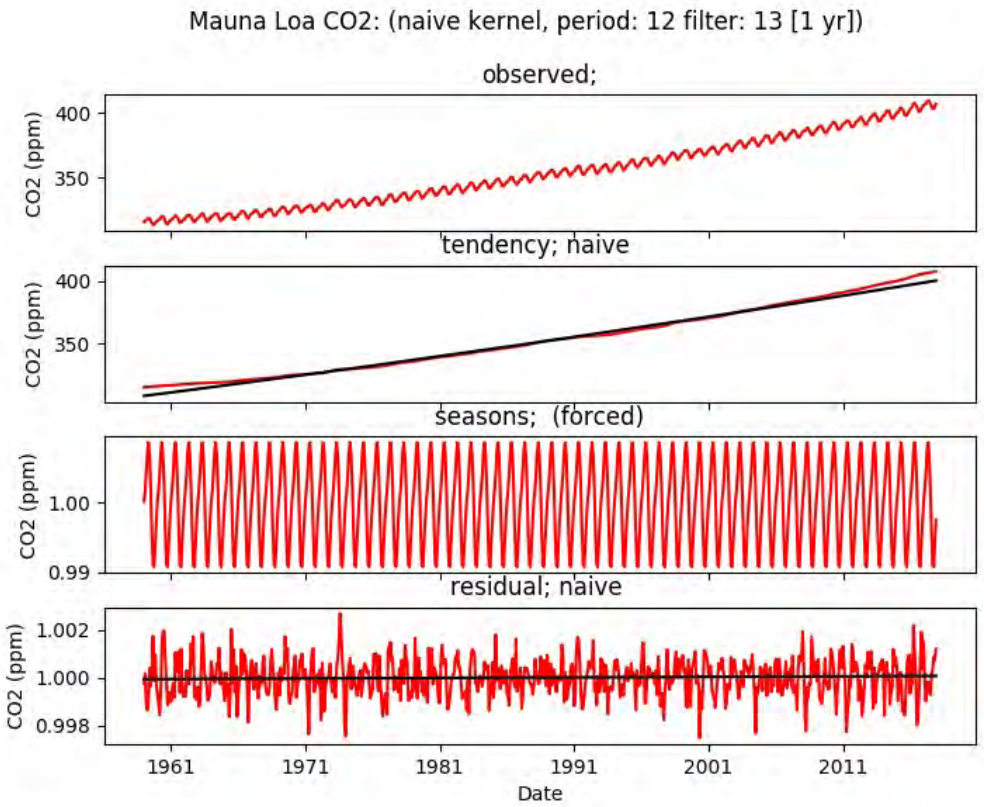
Transforming lives
Climate change
Water Use Efficiency
Precision farming
Livelihood

Climate indexes



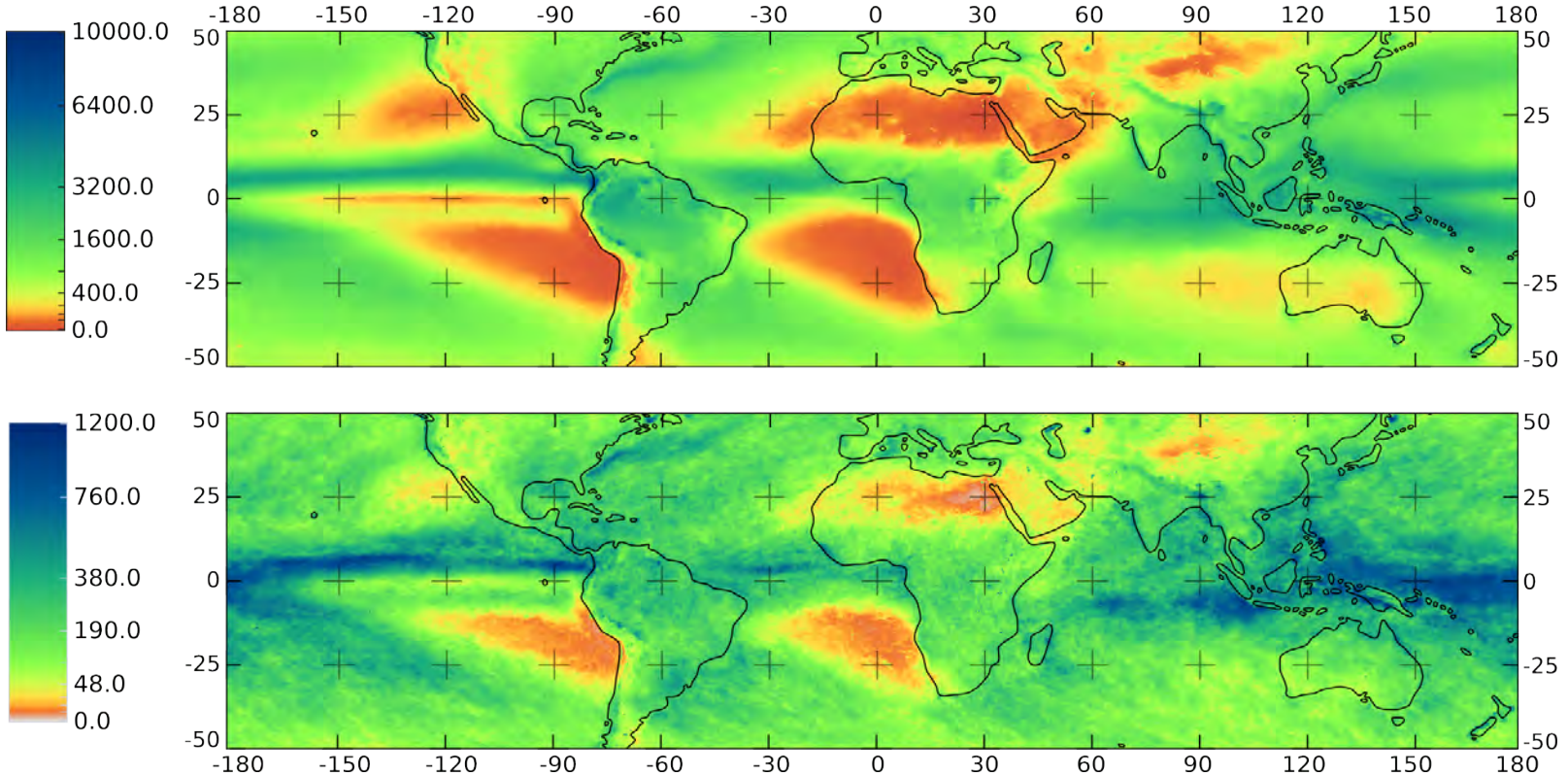
Climate index smoothing and trends

Climate indexes



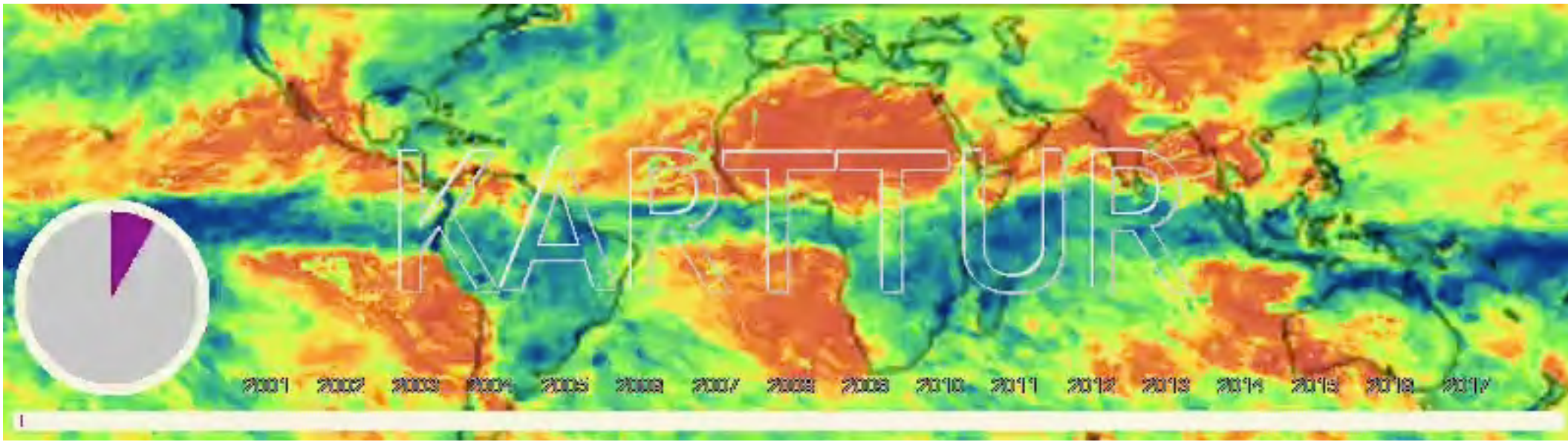
Multiplicative decomposition of the Mauna Loa CO_2 observation

Tropical precipitation (TRMM)



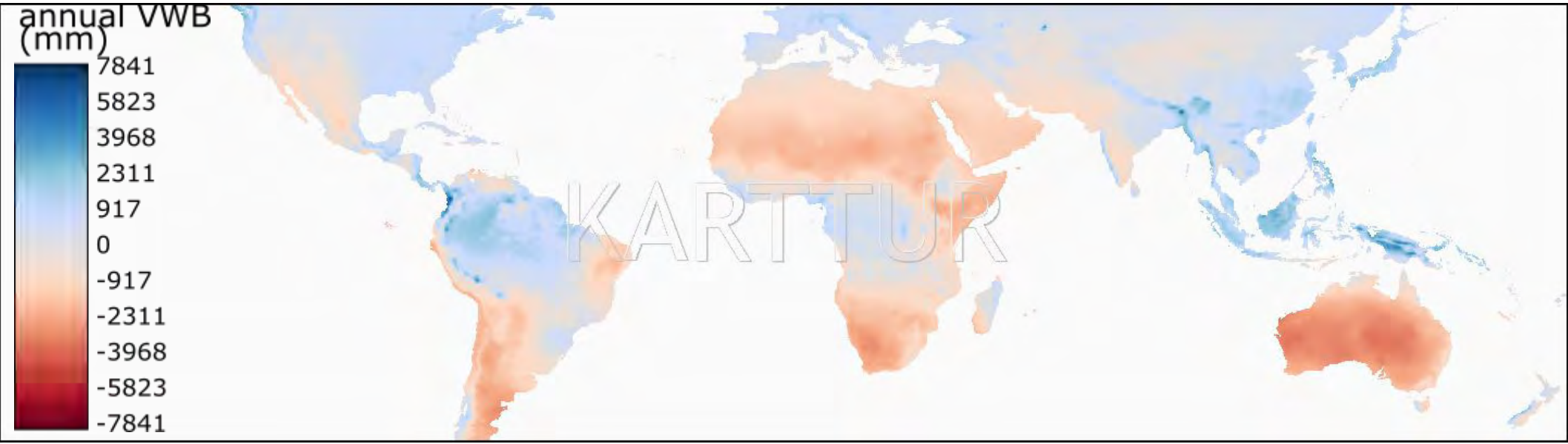
Tropical Rainfall Measurement Mission (TRMM) rainfall
1998-2016 (mean and standard deviation)

Tropical precipitation (TRMM)



https://karttur.github.io/common/movies/rainfall_3b43_trmm_199801-201807_v7-f.mp4

Tropical Vertical Water Balance (VWB)



VWB is calculated as the annual accumulated monthly difference between rainfall and evapotranspiration.

Tropical Vertical Water Balance (VWB)

https://karttur.github.io/common/movies/trmm-fao-vwb_3b43_trmm_199801-201807_v7-f-m.mp4

Significant trends in tropical VWB

Regions with significant trends in VWB 1998-2016.

Significant trends in tropical VWB

Humid region.

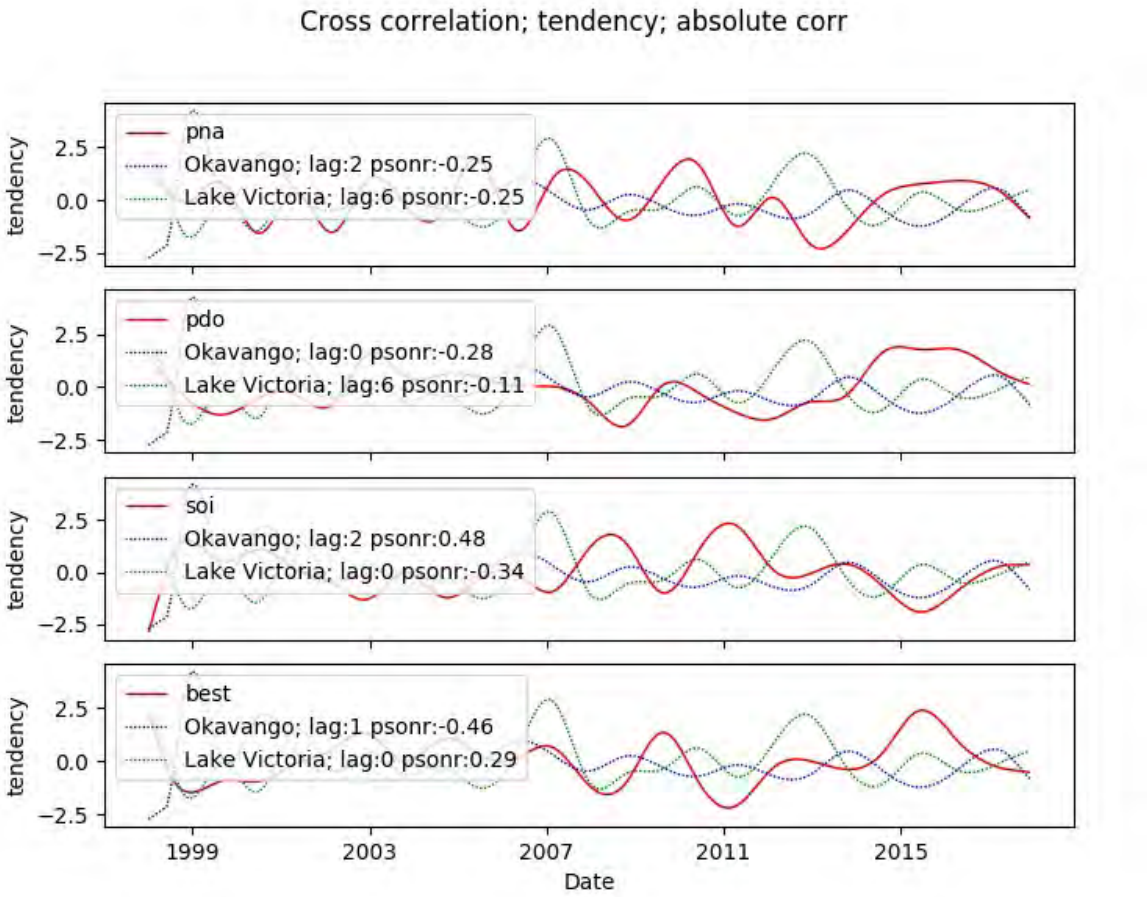
Regions with significant trends in surplus VWB 1998-2016.

Significant trends in tropical VWB

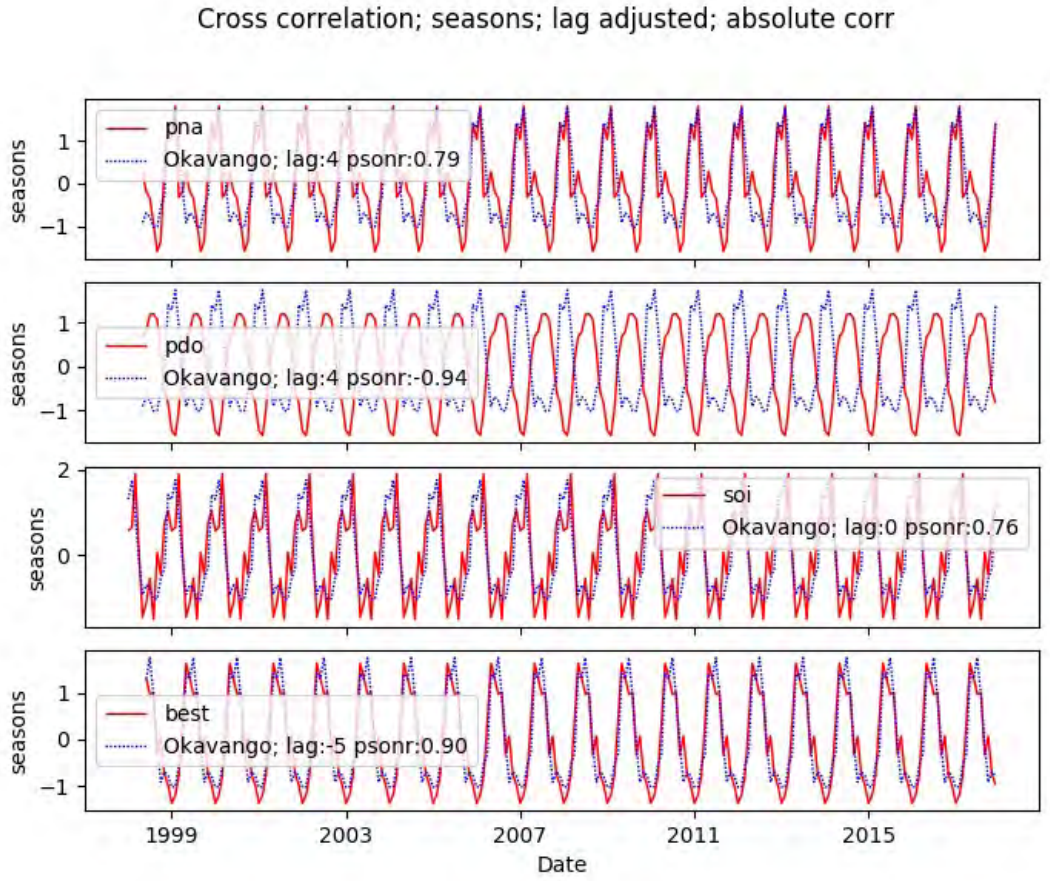
Arid region.

Regions with significant trends deficit VWB 1998-2016.

Cross correlation: climate vs rainfall



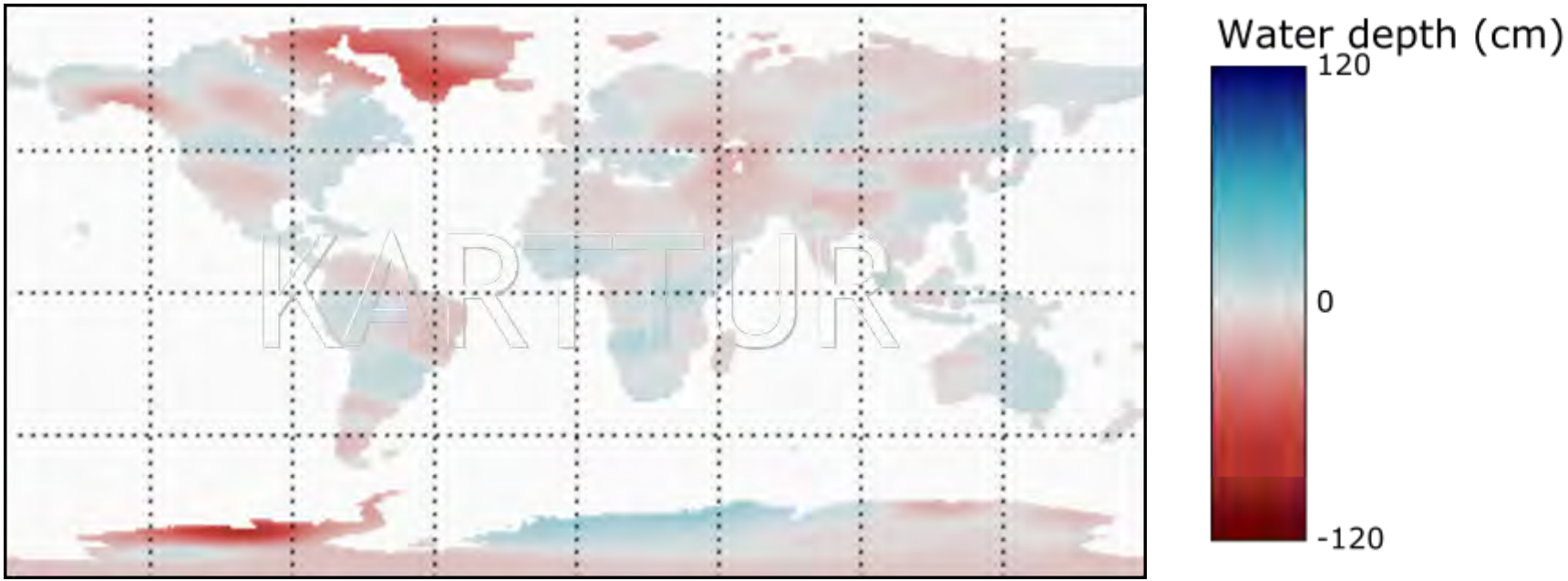
Cross correlation: climate vs rainfall



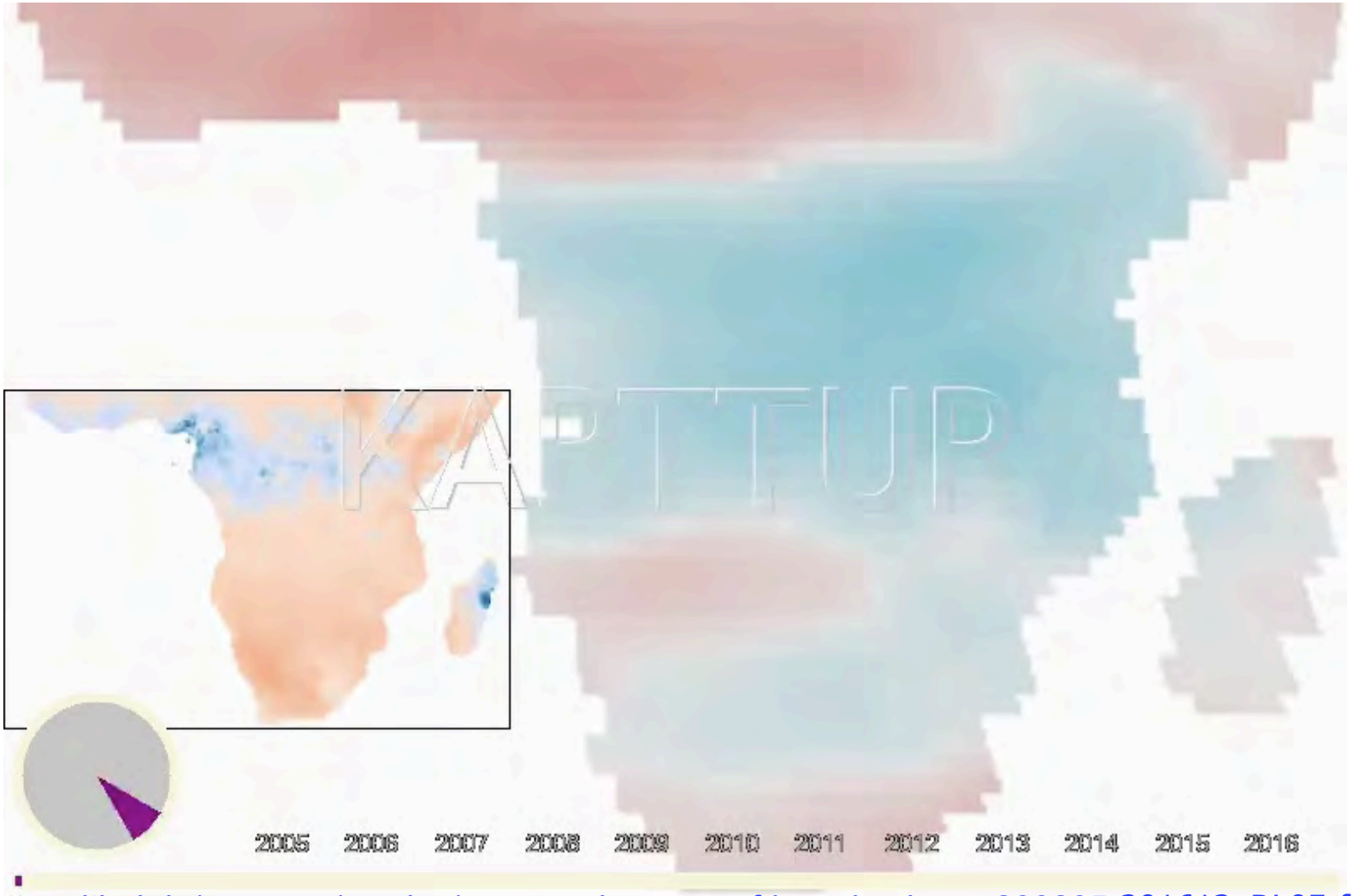
Cross correlation: climate vs rainfall

Southern Oscillation index vs TRMM rainfall (1998 to 2017)
Seasonal cross correlation

GRACE global variation in water content

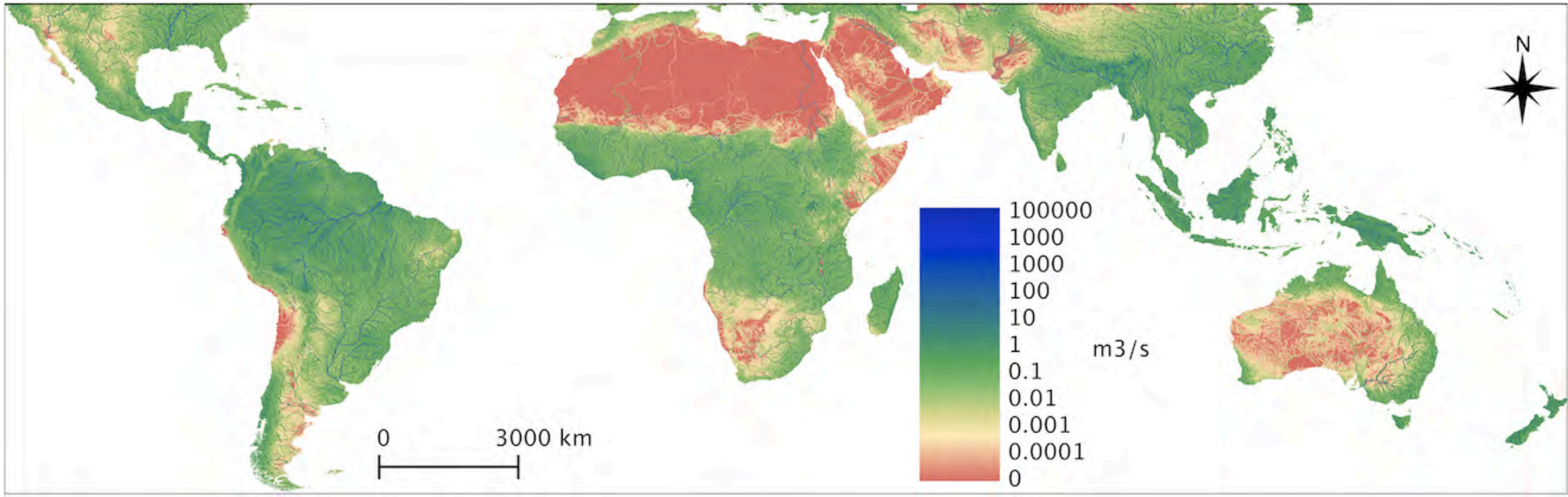


Gravity Recovery And Climate Experiment (GRACE)
average water depth 2003-2016



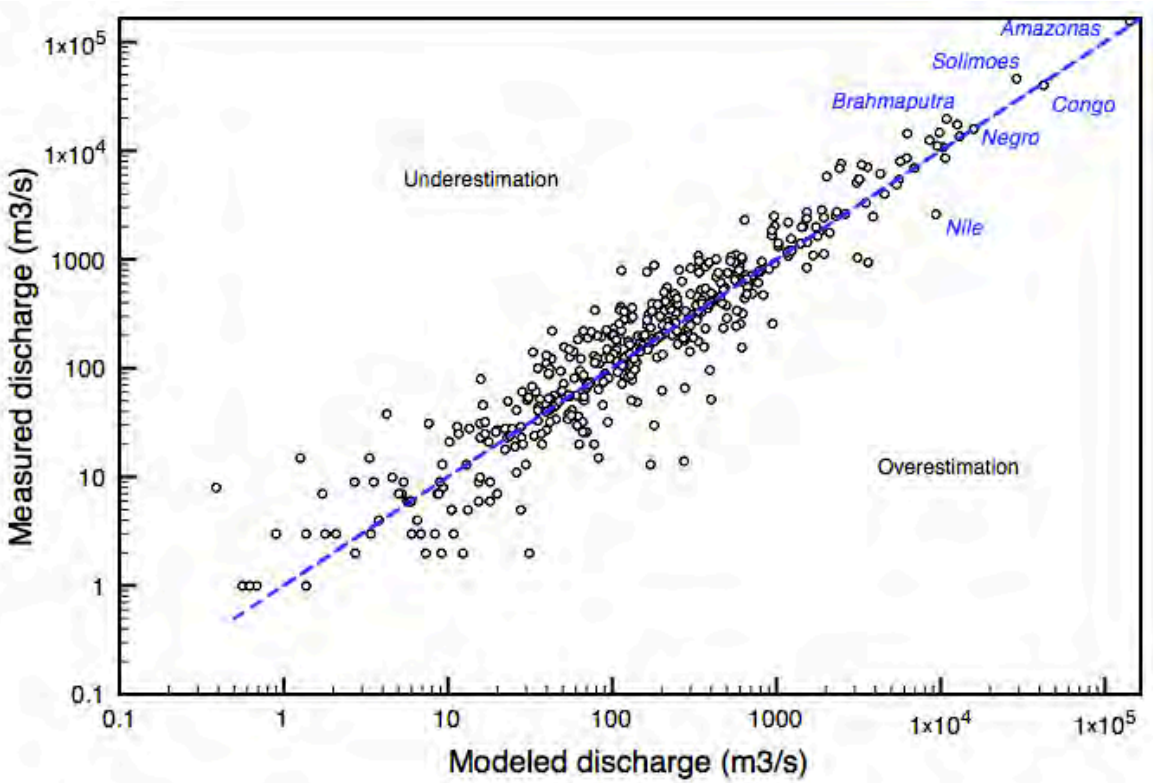
https://karttur.github.io/common/movies/grace-vwb_xcorr_africasubsahara_200205-201612_RL05-f-1deg.mp4

Topographic water flow



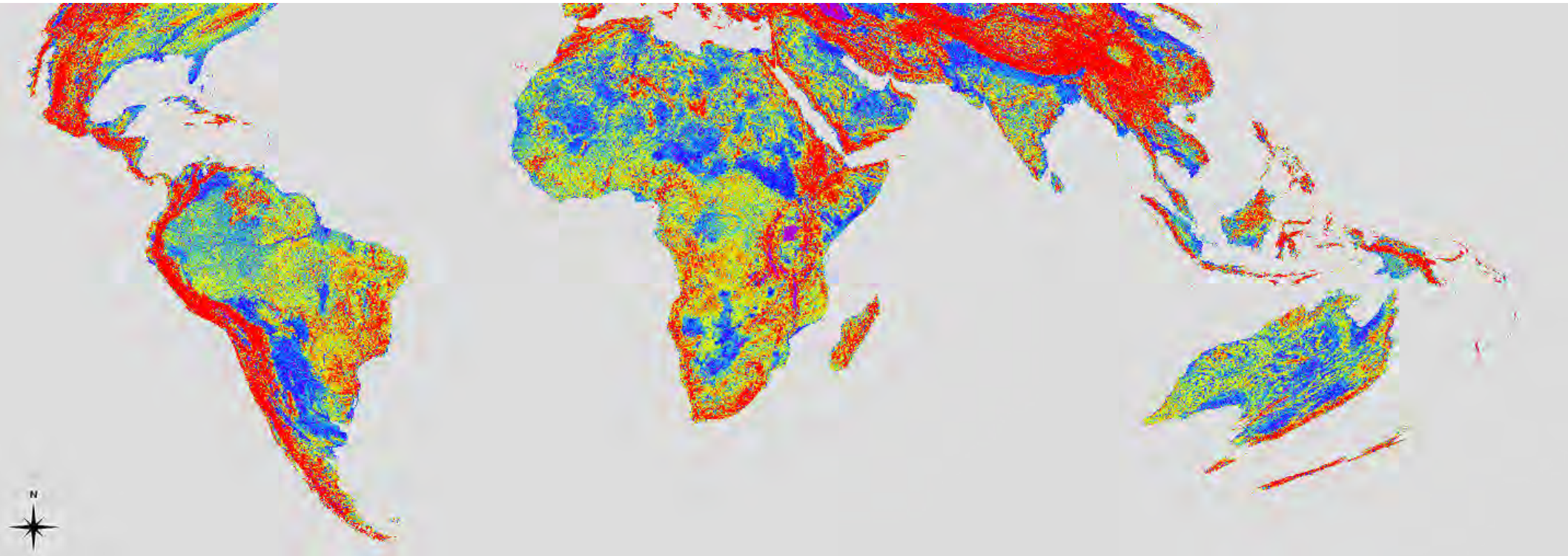
Modeled annual average water flow

Topographic water flow



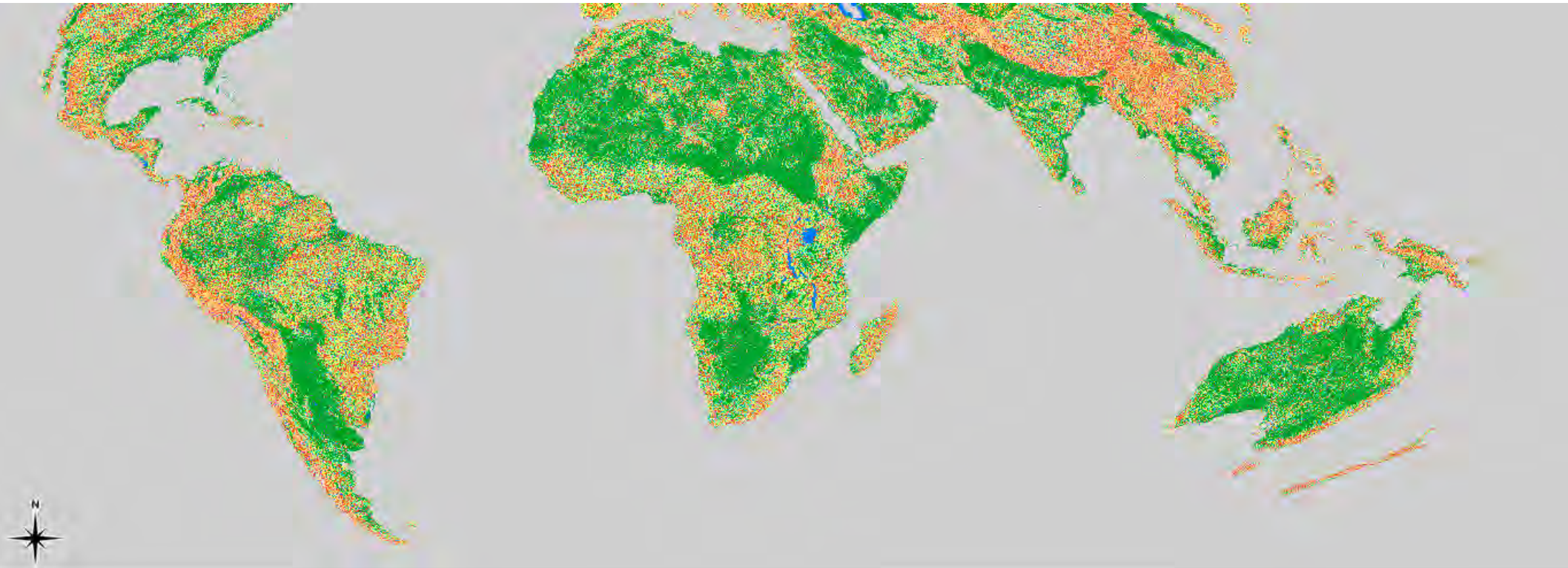
Accuracy assessment of global hydrological model

Hydraulic head



The hydraulic head is the vertical elevation difference between the land surface and its permanent drainage point.

Landform



The landform map is created from multiscale topography combined with hydrological data.

Optical Sensor Data

Office Du Niger, irrigated rice paddies along the Niger River

Microwave Sensor Data

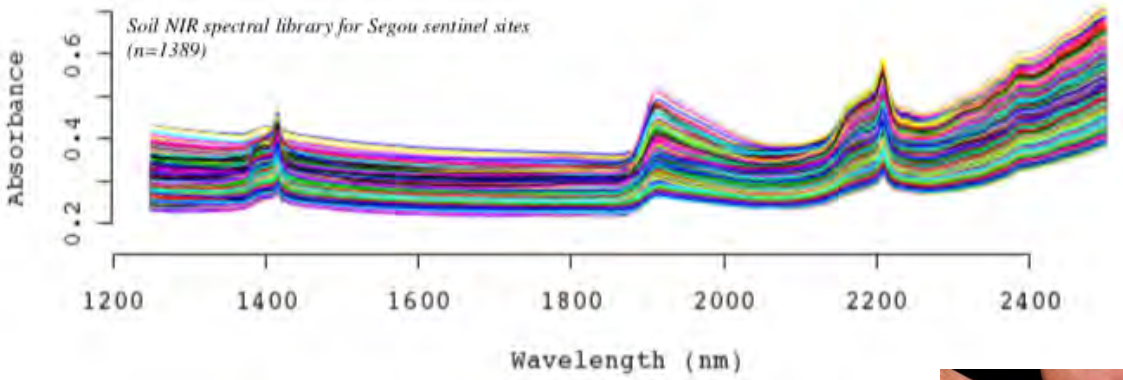
SMAP (Soil Moisture Active Passive) Mission

Landscape

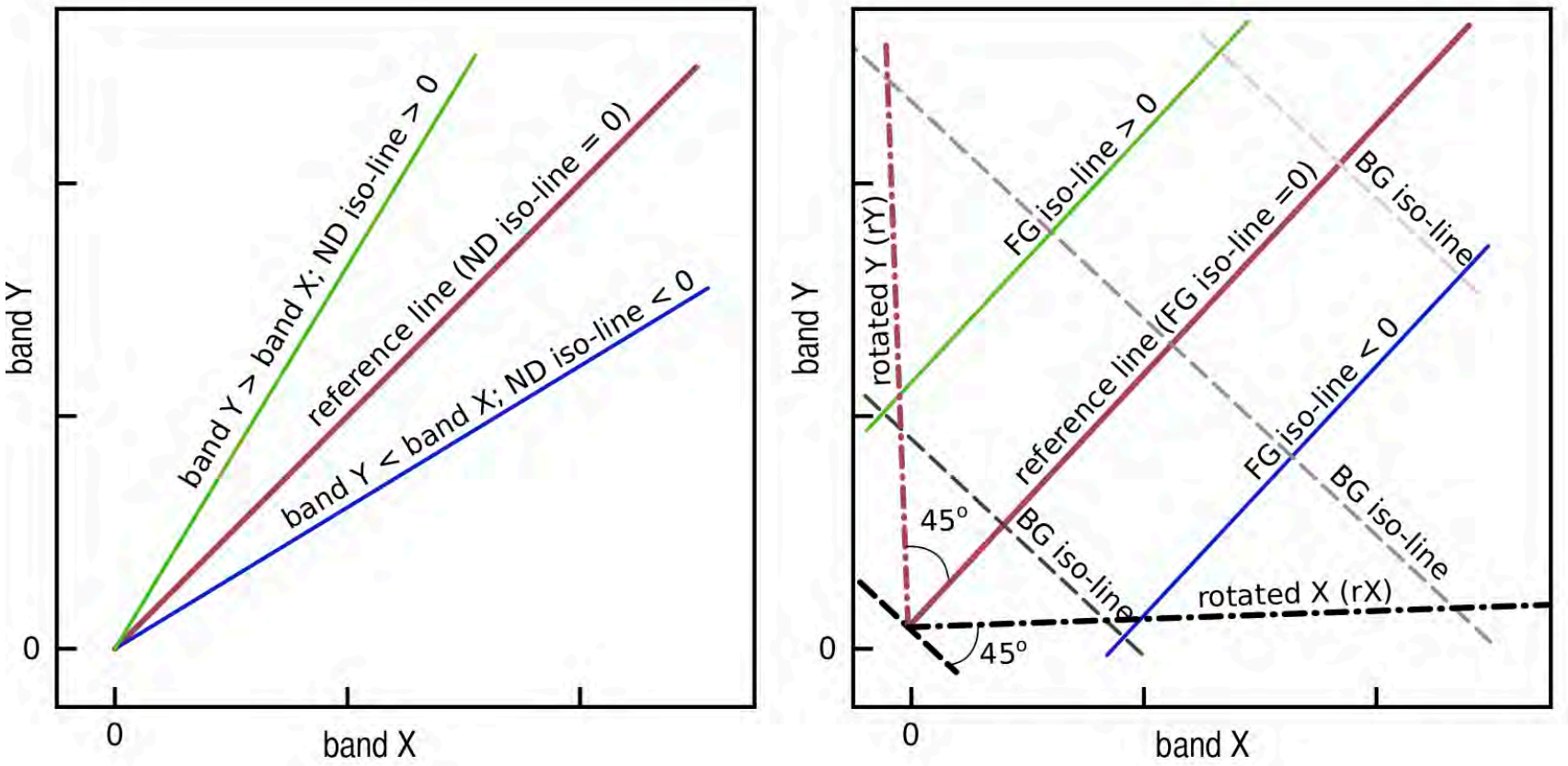
https://karttur.github.io/common/movies/soil-moisture-avg_SPL3SMP_global_2015121-2018345_005.mp4

Field and laboratory spectroscopy

(soon in the smart phone)

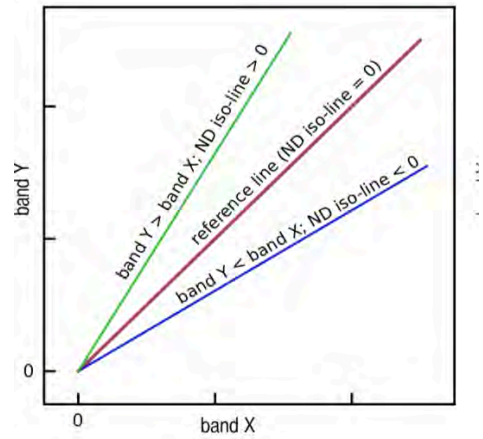


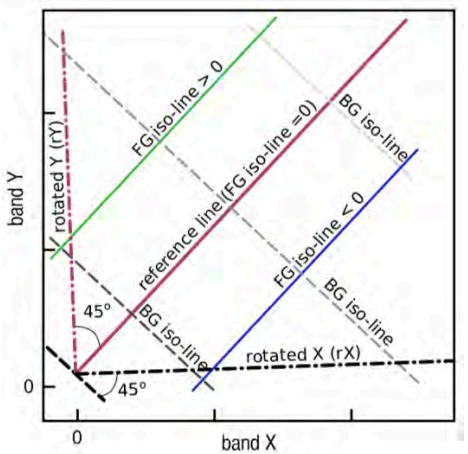
Traditional and customized models for biomass

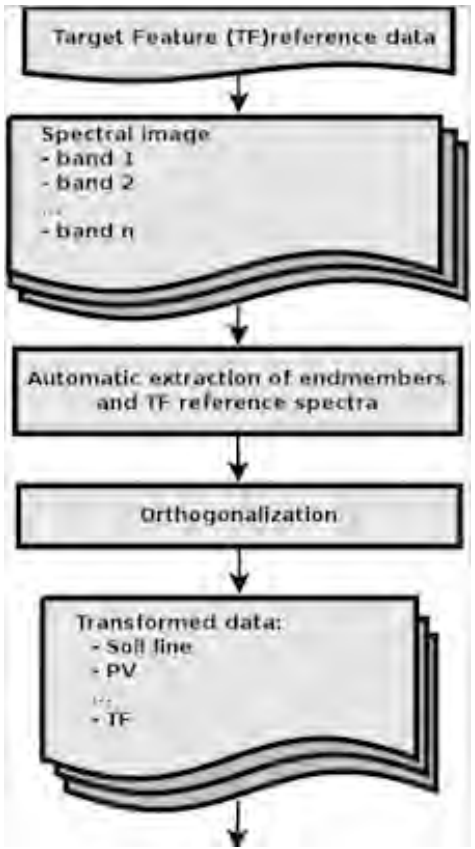


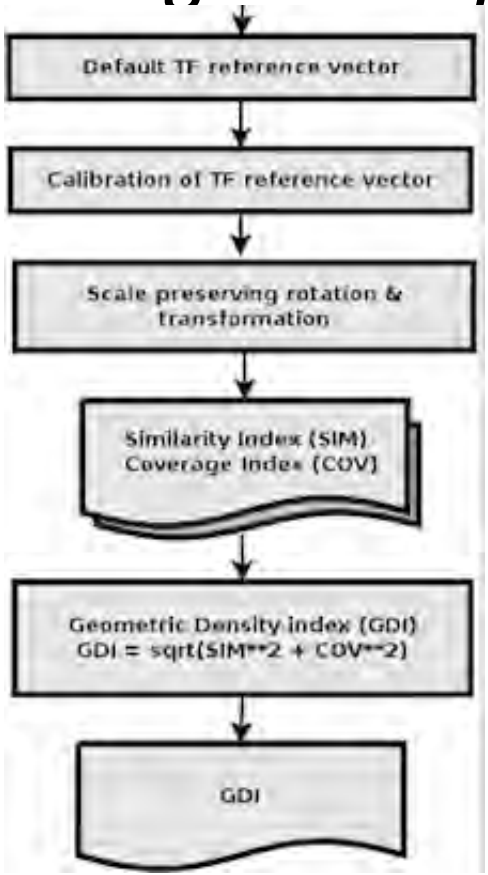
Transformed and Rotated Indexing of Density

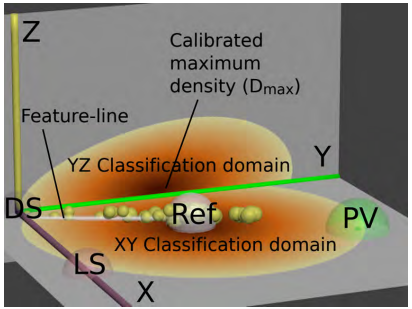
Deterministic biomass modeling from optical data



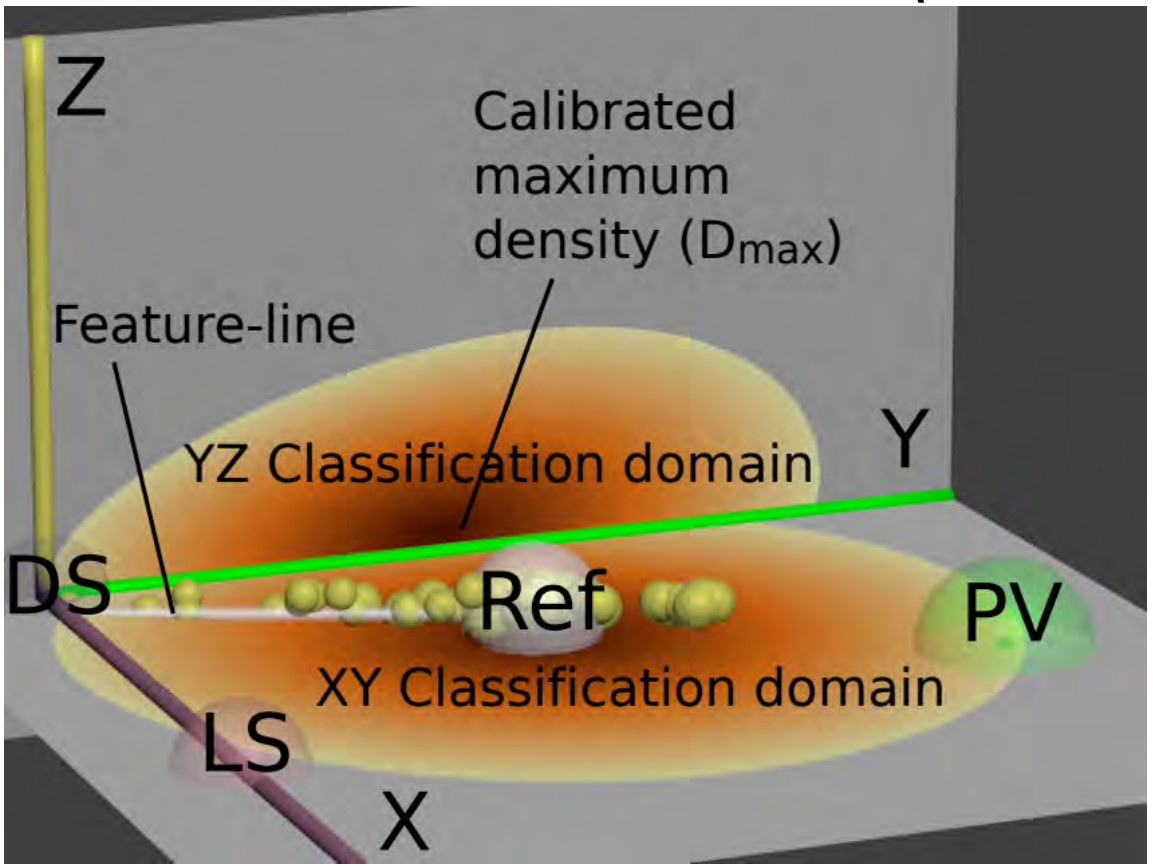


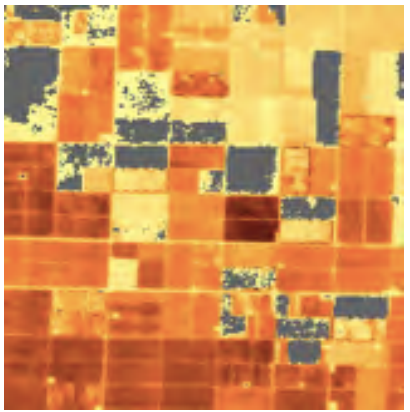






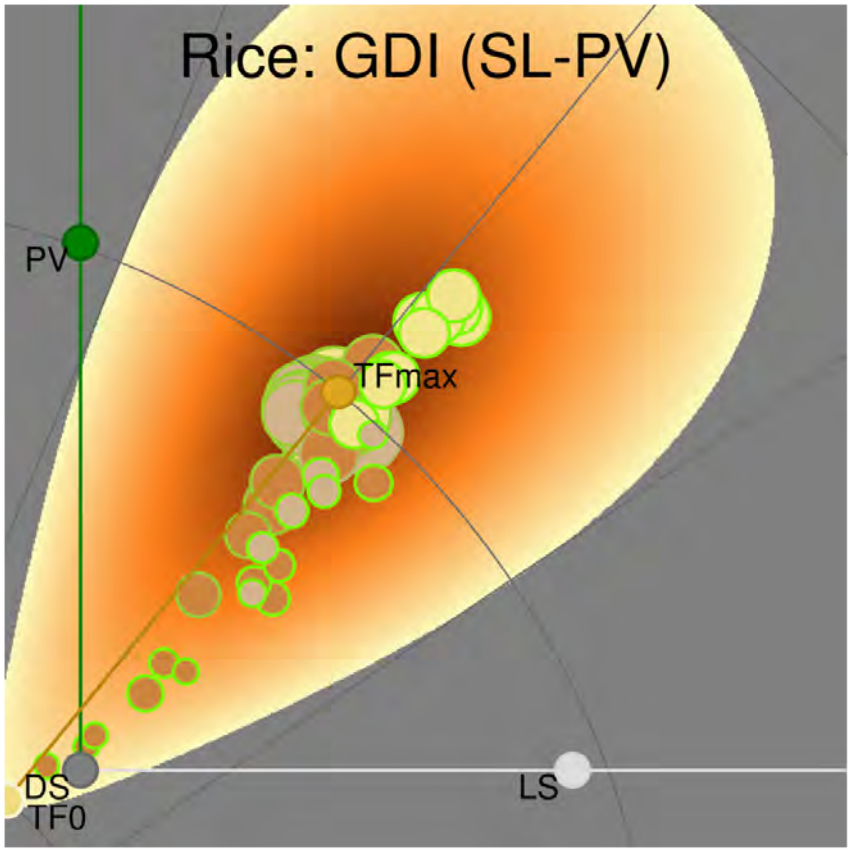
Model for rice biomass (flooded conditions)

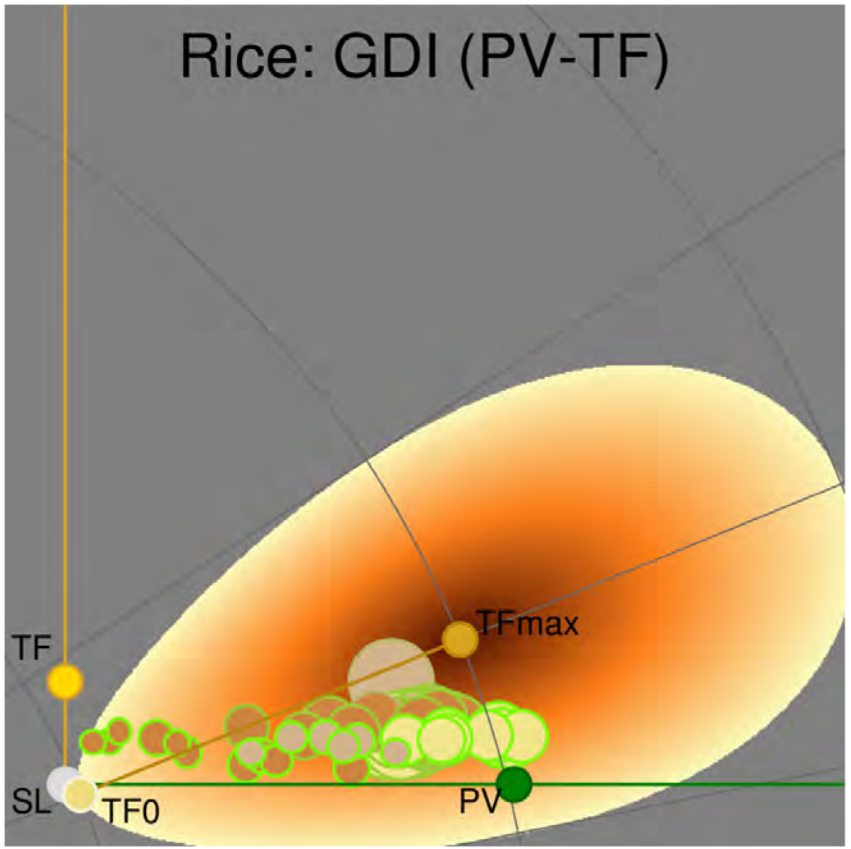




Transformed and Rotated Indexing of Density

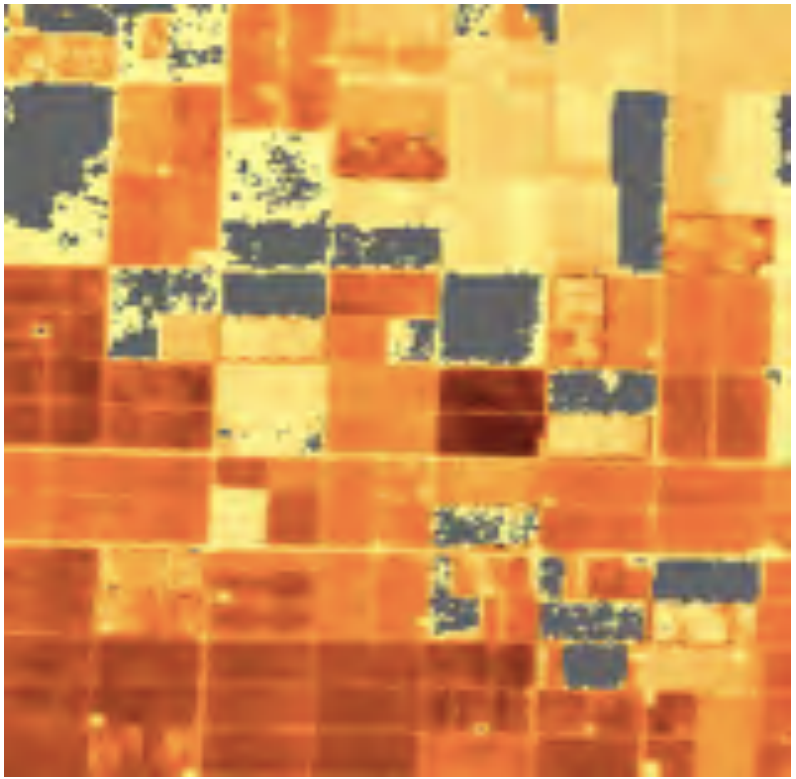
Model for rice biomass (flooded conditions)





Modeling of rice biomass for 3 fields in California

Biomass map for rice fields in California (single date)

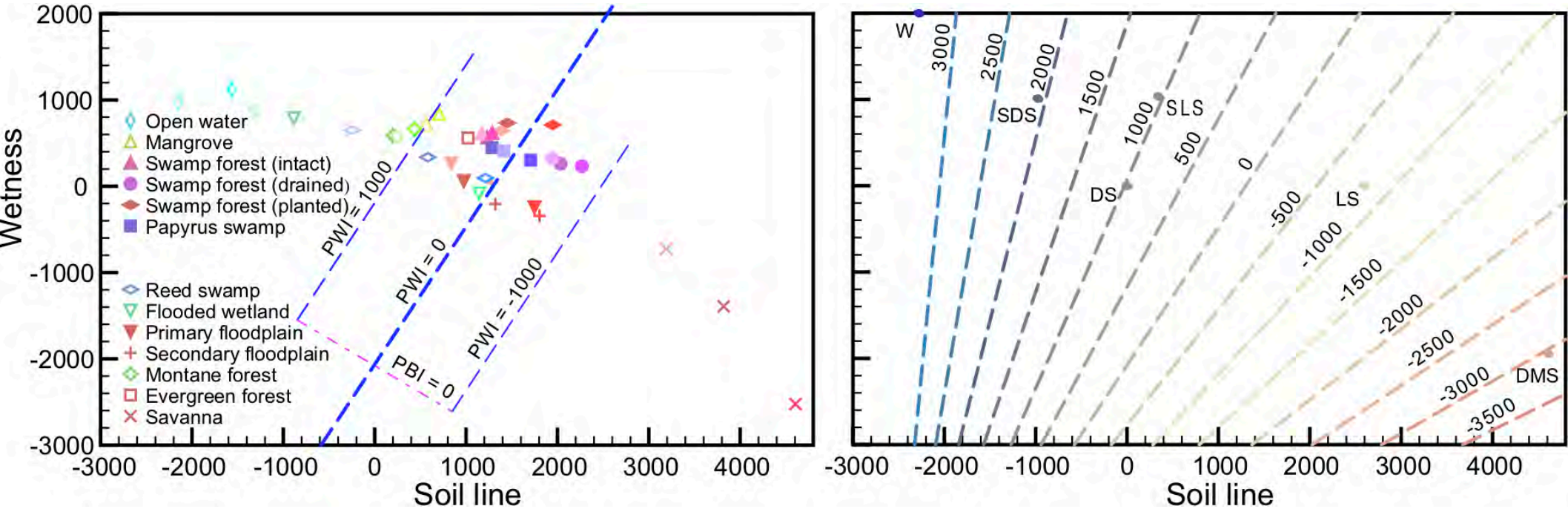


California Rice fields:

- Areas
- boundaries
- biomass

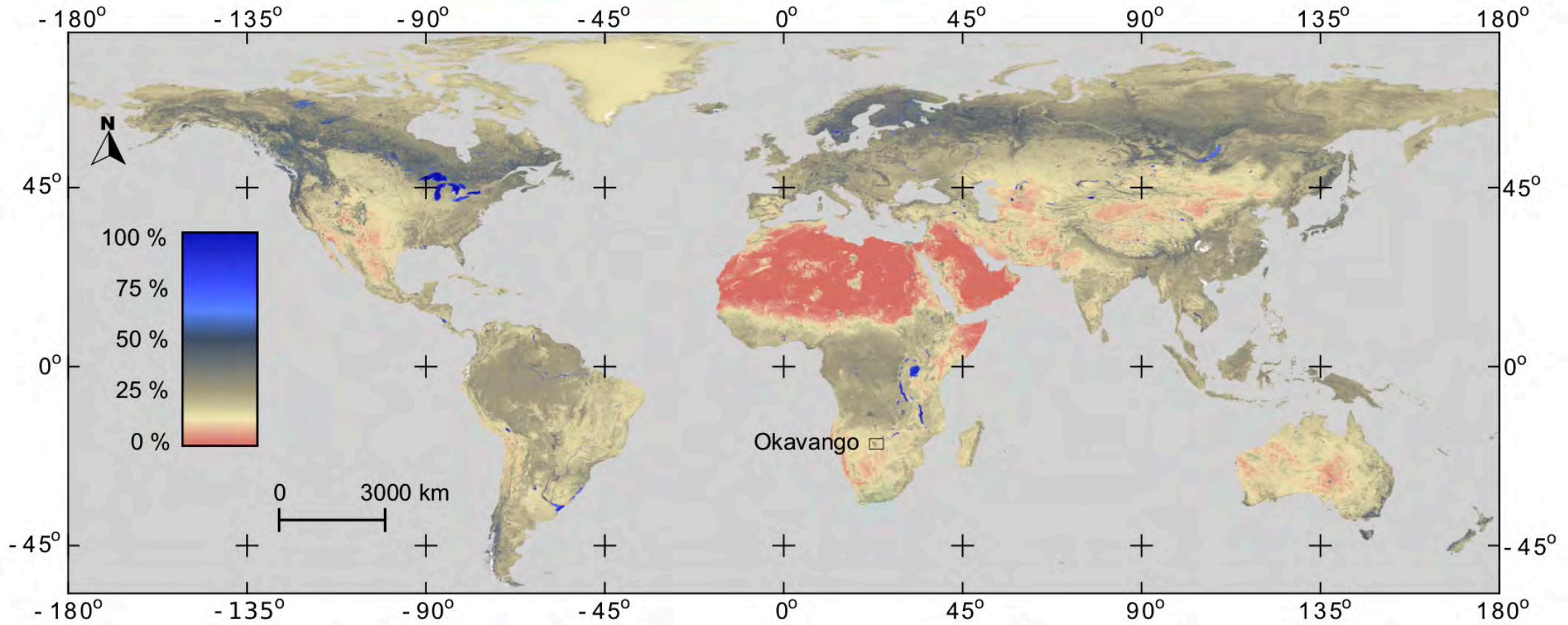
Transformed and Rotated Indexing of Density

Model for soil moisture conditions for MODIS

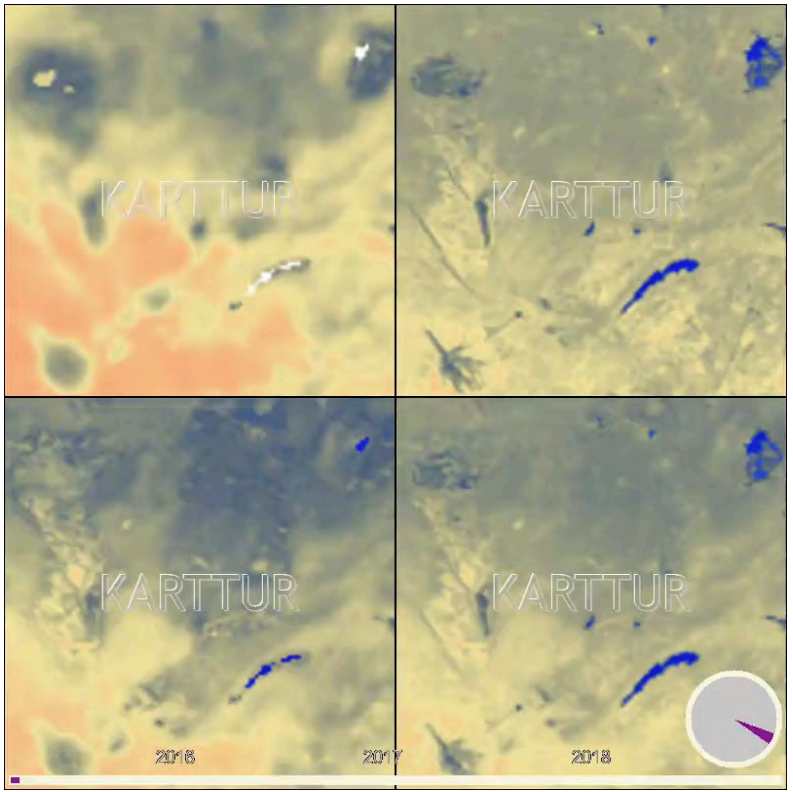


Transformed Wetness Index (TWI)

Transformed Wetness Index (TWI)

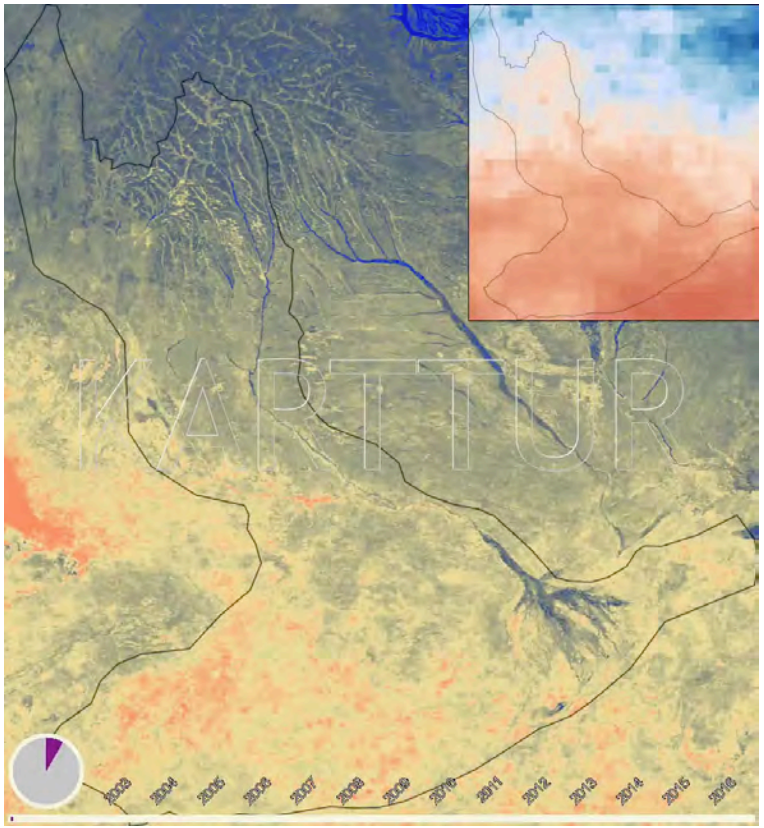


Adjusting TWI bias using SMAP



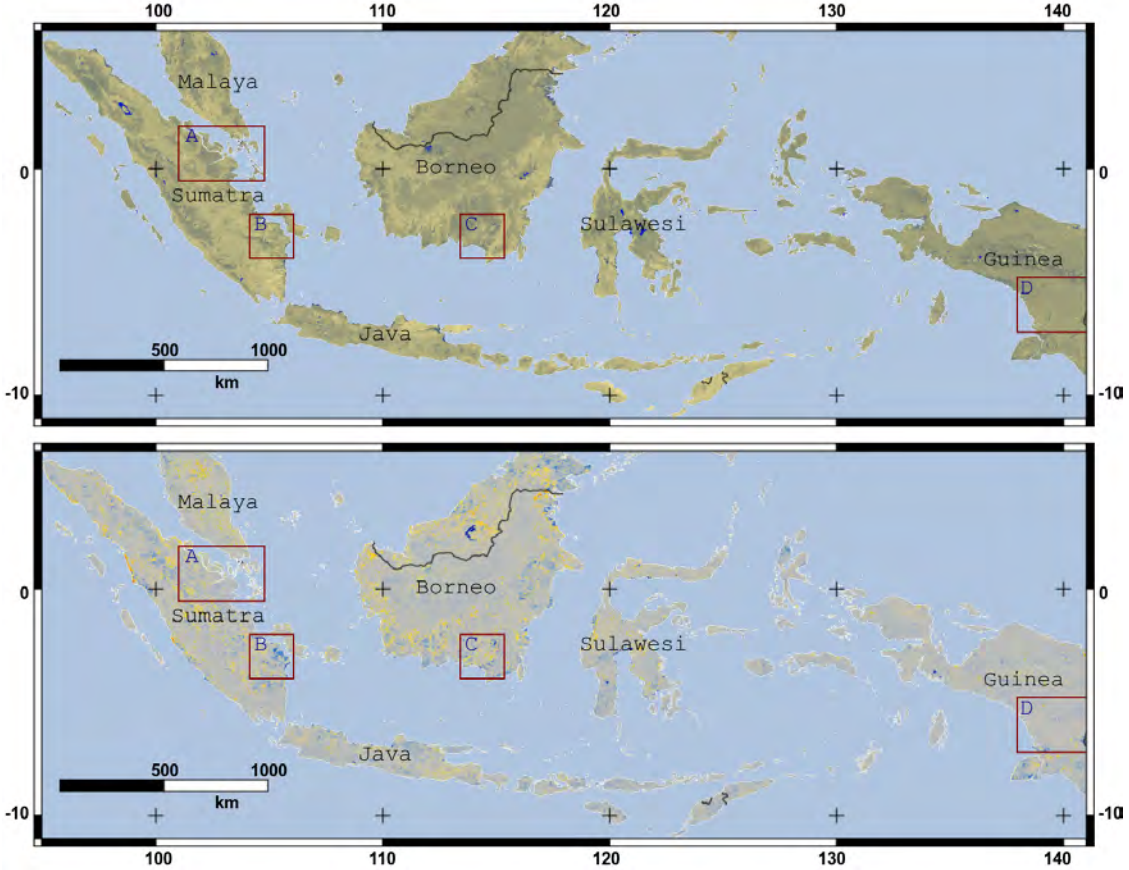
https://karttur.github.io/common/movies/SMAPvsTWIx4_h20v10_2015121-2018361_002-modfit-9km.mp4

Soil moisture dynamics at 500 m spatial scale



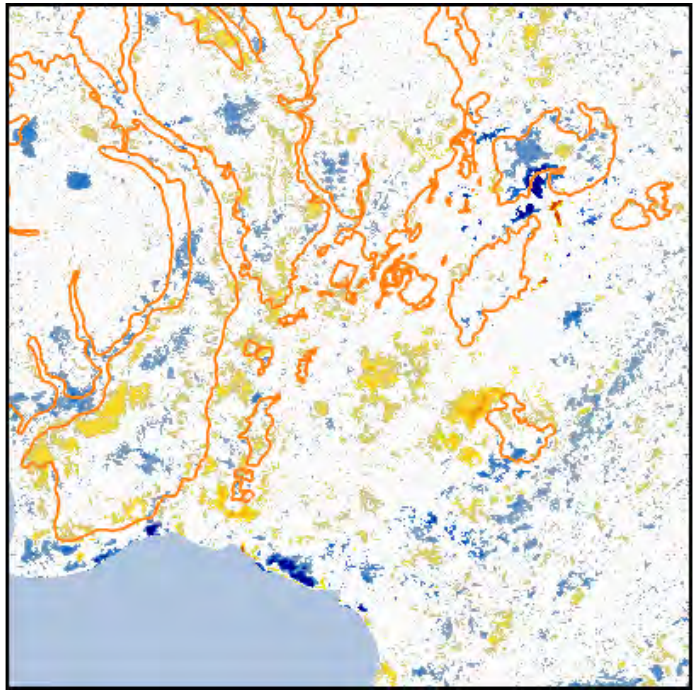
https://karttur.github.io/common/movies/twi-vwb-clock-basin_mp4_oka-basin_2001-2016_MS.mp4

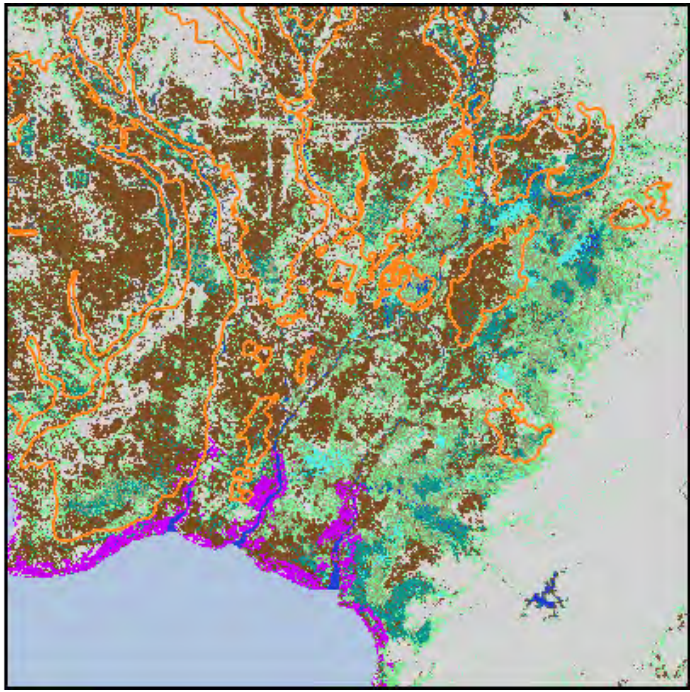
Soil moisture map over Indonesia



TWI and TWI change for Indonesia 2001 - 2016

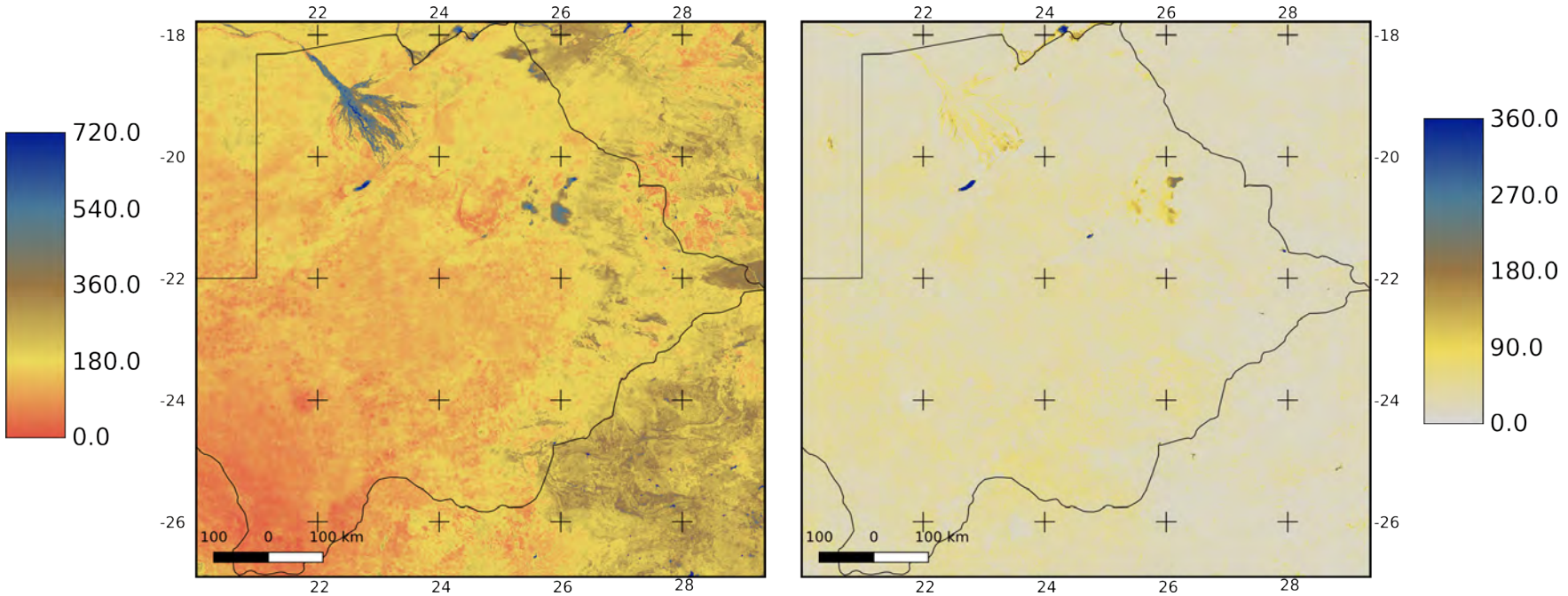
Soil moisture and wetland maps: Mega Rice Project





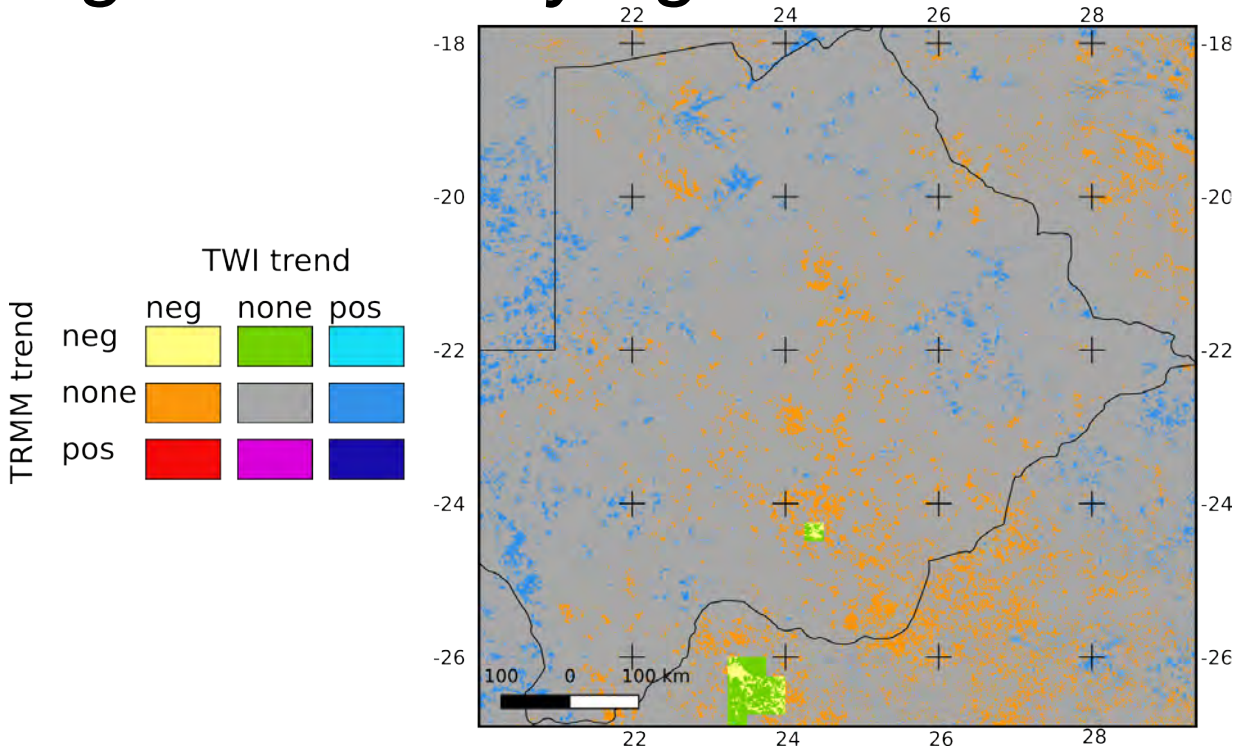
The Mega Rice Project in Indonesia (Borneo)

Rain Normalized Transformed Wetness Index



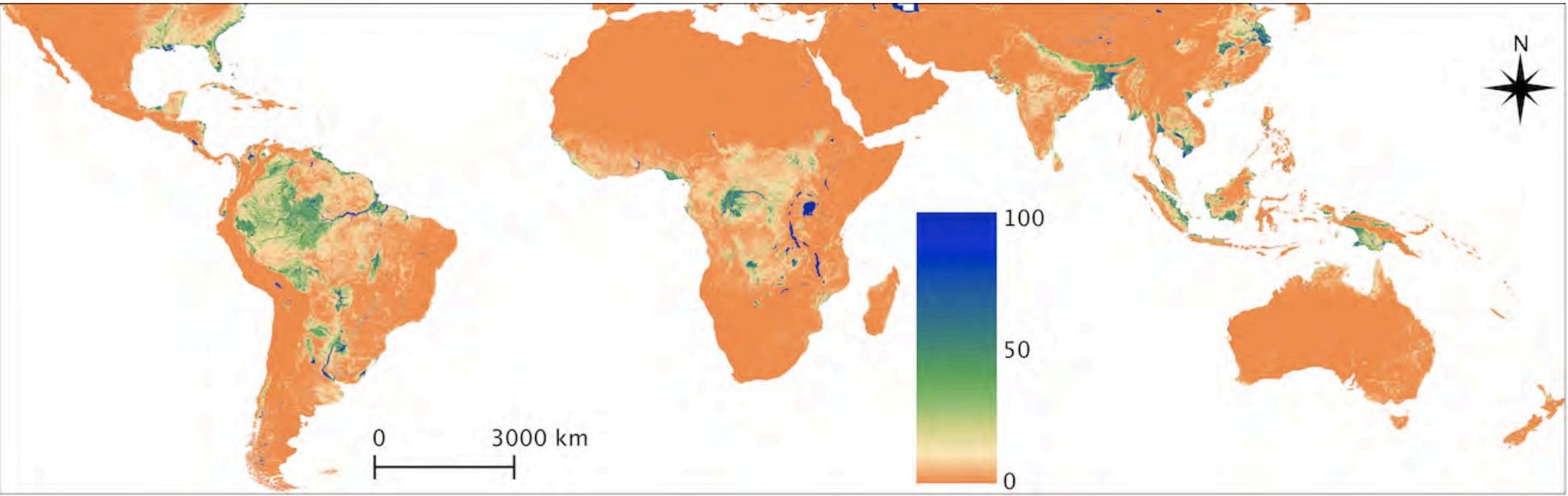
RNTWI for Botswana 2001 to 2016 (mean and standard deviation)

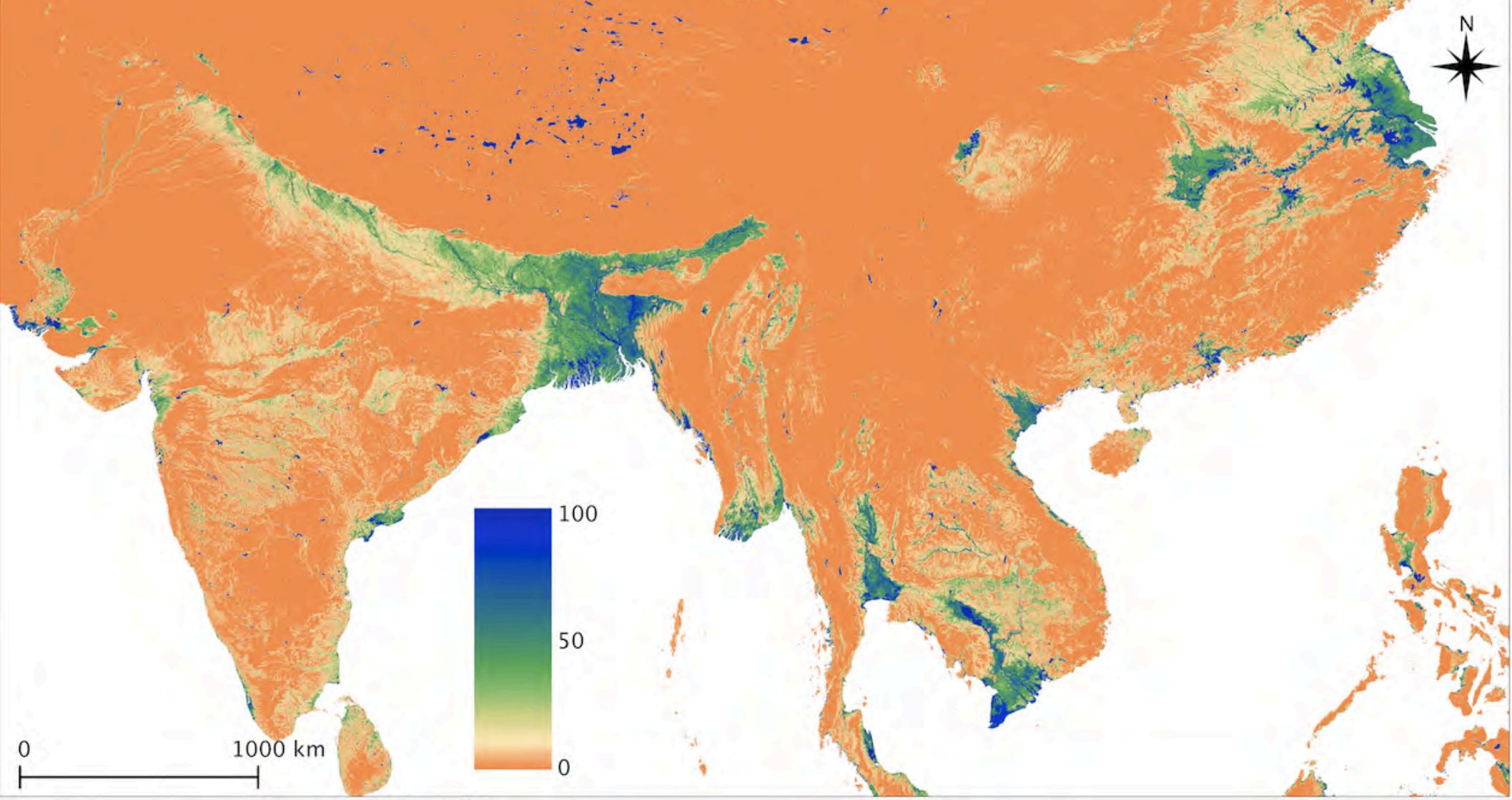
Comparing and identifying drivers of moisture change



Comparison of trends in soil moisture (TWI) and rainfall (TRMM) 2001 to 2016 for Botswana.

Expert model of global tropical wetlands

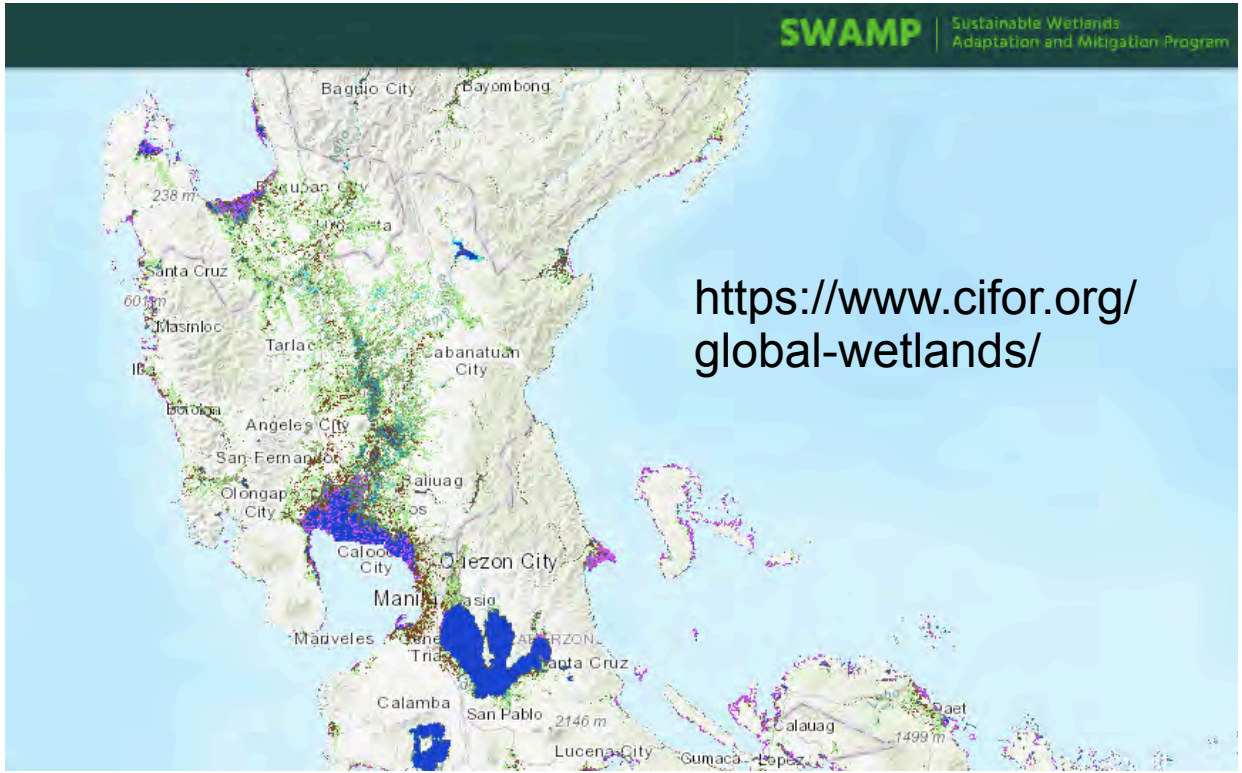




Thomas Gumbricht, May 2019

Remote Sensing and Geospatial Innovations for Rice Based Agri-Food Systems

The online version of the Global wetlands map



Remote Sensing and Geospatial Innovations for Transforming Lives in Rice Based Agri-Food Systems

Genotype selection for local conditions (physical, medical and cultural)
Real time monitoring for precision farming (mobile phones!, even as spectrometers?)
Soil health and nutrient mapping and assessment (mitigating As content in rice?)
Management for water conservation (considering CH_4?)
Identify landscape suitability and cultural/economic markets
Adapting to climate change effects, including sea level rise and salinization, and changes in water regimes.

Remote Sensing and Geospatial Innovations for Rice Based Agri-Food Systems

Almost all maps and models, and how to make them, are available on my blog:

Anchor aweigh