Assessing irrigation performance using open-access FAO WaPOR water productivity data

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D2.07.1 Water Resources Management, LPS22

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Feeding 10 billion people in 2050

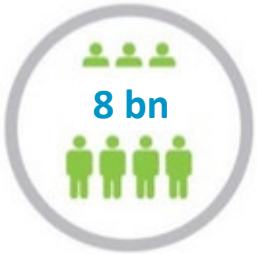
target 2.4
Increasing agricultural productivity

target 15.3
Combat desertification and achieve a land degradation neutral world

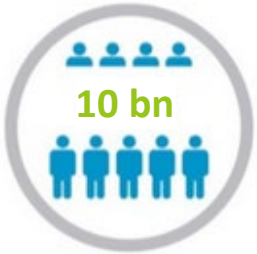
target 6.4
Substantially increase water use efficiency

target 17.18
Increase the availability of high-quality, timely, and reliable data

2022



2050



Farmers will need to produce

40-54 % more food by 2050

Using less water

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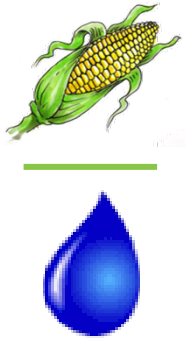
Water productivity

=

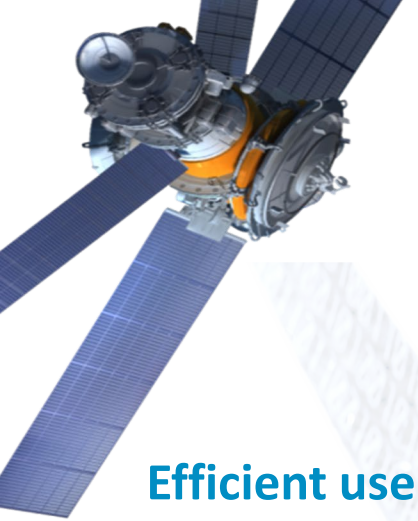
the output in relation to **water** resources

$$WP = \frac{\text{Crop yield (kg)}}{\text{Water consumption } (m^3)} = \frac{\text{yield}}{\text{evapotranspiration}}$$



⇨

Dutch government: 25% water productivity as key policy priority



satellite

weather

other

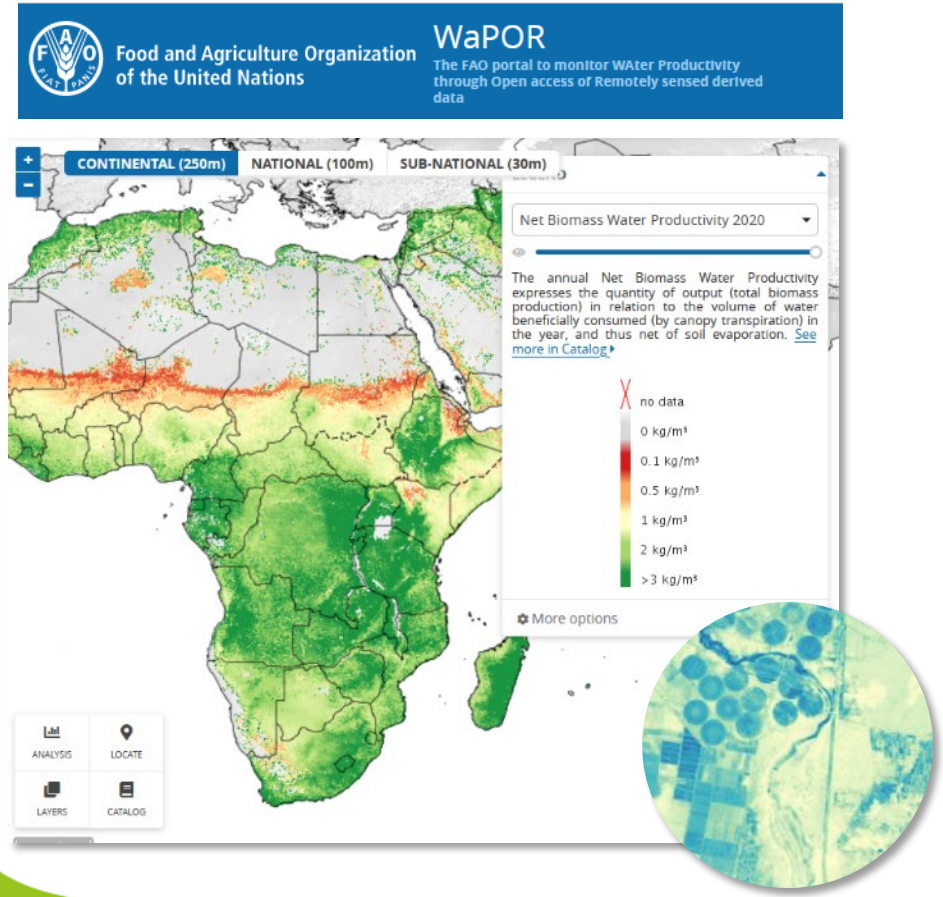
Efficient use of water

Increased productivity

- Agriculture
- Water & Environment
- Climate and agricultural risk

- (Water) authorities
- Farmers & agribusinesses
- Donors (SDGs) and investors
- Banks, NGOs, IGOs

FAO portal to monitor water productivity



Funded by the Netherlands

https://wapor.apps.fao.org

| Open-access data |
| on crop growth and water status |
| for Africa and the Middle East |
| 2009 – present |

Data production & methodology

vito eleaf

Irrigation performance indicators

ELSEVIER

Agricultural Water Management

Volume 261, 1 March 2022, 107373

Translating open-source remote sensing data to crop water productivity improvement actions

Abdur Rahim Safi [a], Poolad Karimi [a], Marloes Mul [a], Abebe Chukalla [a], Charlotte de Fraiture [a, b]

A Framework for Irrigation Performance Assessment Using WaPOR data: The case of a Sugarcane Estate in Mozambique

Abebe Demissie Chukalla[1], Marloes L. Mul[1], Pieter van der Zaag[1,2], Gerardo van Halsema[3], Evaristo Mubaya[4], Esperança Muchanga[5], Nadja den Besten[6,2], and Poolad Karimi[1]

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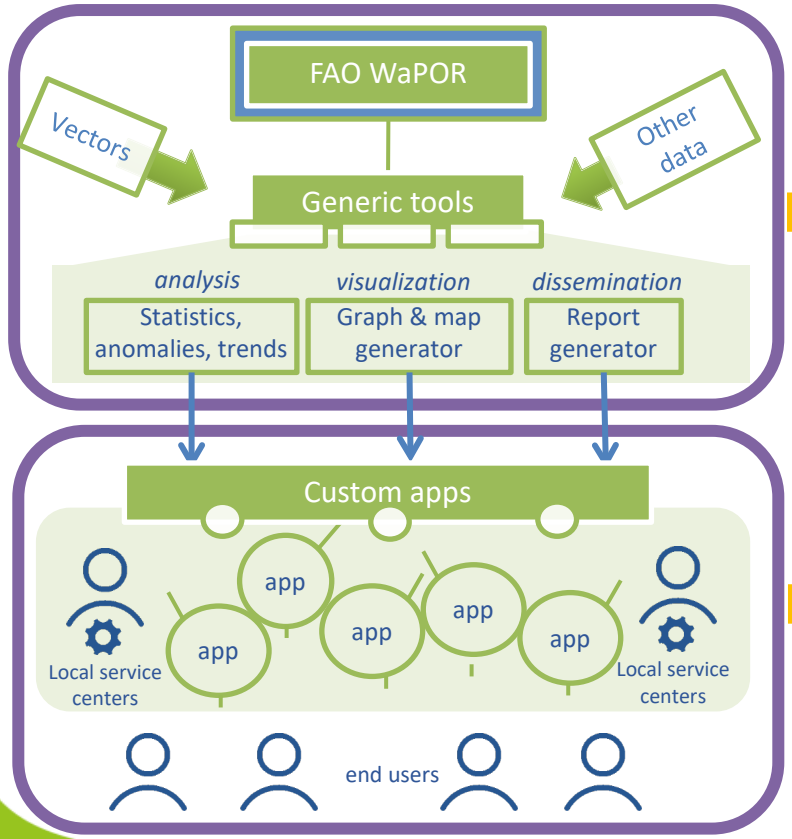
WaPOR Python code

WaterPIP
Water Productivity Improvement in Practice



Existing WaPOR packages for scientific analysis:

- WAPORWA | water accounting analysis
- WAPOROCW | supports open course
- WAPORWP | water productivity analysis

New open-access toolbox :

- WaPORAct package | Supports Service and Pipeline development from WaPOR Data

  https://github.com/eLEAF-Github/WAPORACT

  - Easy to automate
  - Supports customized app development

Custom app development with local partners and MetaMeta

META META

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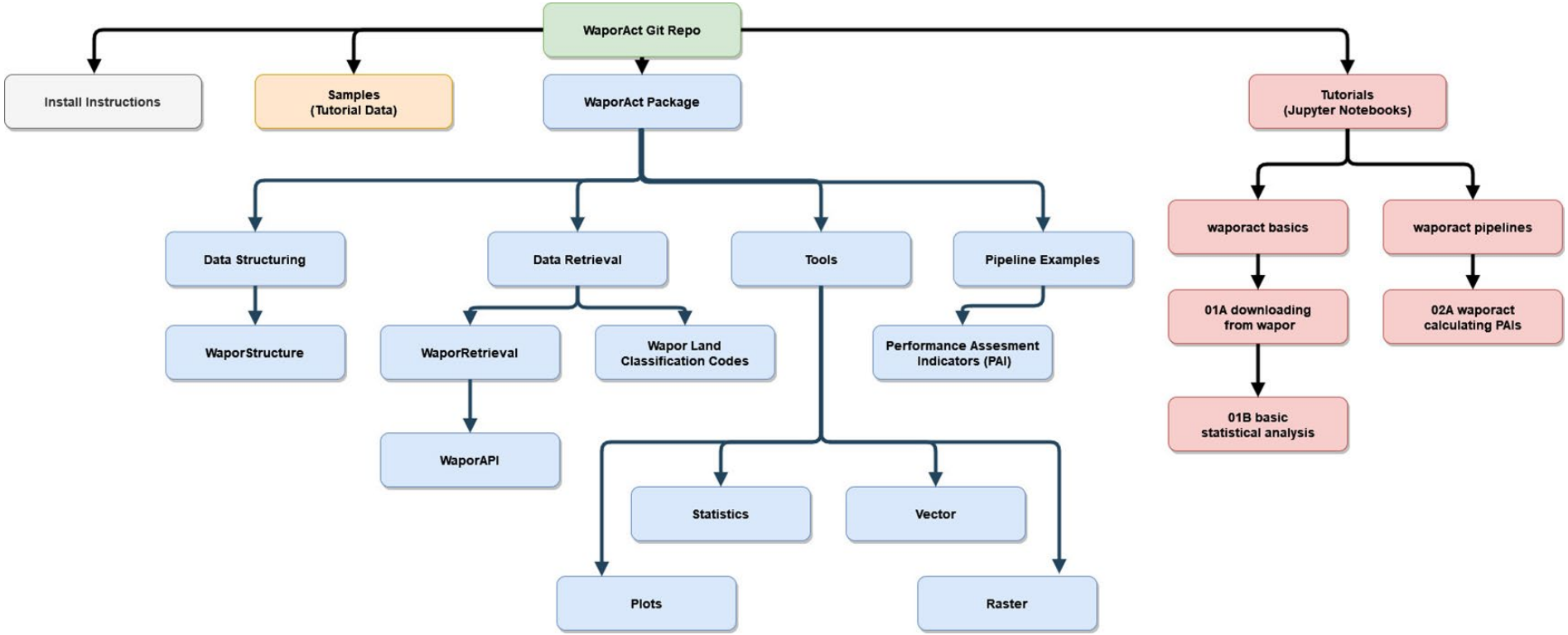
https://github.com/eLEAF-Github/WAPORACT



Example

1. Activate WaPOR analysis class

```
# activation of the wapor analysis class
analysis = WaporPAI(
    waporact_directory=r'C:\Users\roeland\workspace\projects\waporact\testing',
    shapefile_path=r"C:\Users\roeland\workspace\projects\waporact\testing\shapefiles\L3_ODN_LCC_202015.shp",
    wapor_level=3,
    project_name='mali test'.
    api_token='
```

2. Upload your own shapefile **OR** Use WaPOR crop classification

```
# method one using the shapefile (if not using this method skip this cell)
mask_raster_path, mask_shape_path = analysis.create_raster_mask_from_shapef
        mask_name='mali_mask_1')
```

```
# create corp mask using the land classification raster from wapor (if not using t
mask_raster_path2, mask_shape_path2 = analysis.create_raster_mask_from_wapor_lcc(
    lcc_categories=['irrigated sugar cane','sugarcane'],
    mask_name='mali_mask_sugarcane',
    period_start=datetime(2020,3,5),
    period_end=datetime(2020,4,5),
    area_threshold_multiplier=2
```

3. Calculate irrigation performance assessment indicators

```
outputs = analysis.calc_wapor_performance_indicators(
    period_start=datetime(2020,3,5),
    period_end=datetime(2020,4,5),
    fields_shapefile_path=mask_shape_path2,
    mask_raster_path=mask_raster_path2,
    mask_folder='mali_mask_sugarcane',
    output_nodata=-9999,
    )
```

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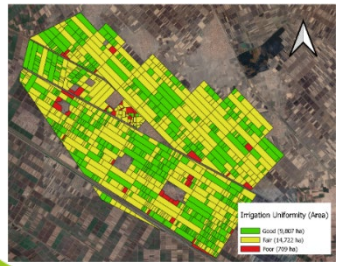
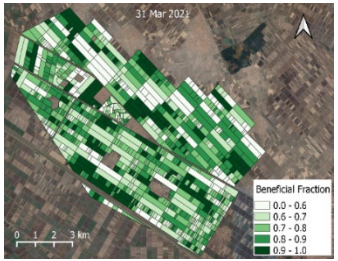
Irrigation performance indicators – Gezira, Sudan

- Uniformity: spatial distribution of water
- Beneficial fraction: performance and losses in field
- Adequacy: quantity of water sufficient for the crop/system
- Reliability: temporal distribution of water
- Water productivity: production per unit of water

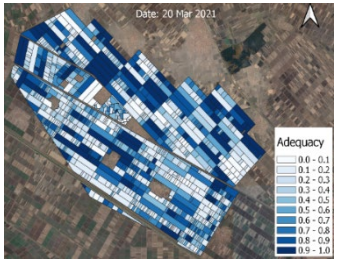
Irrigation uniformity



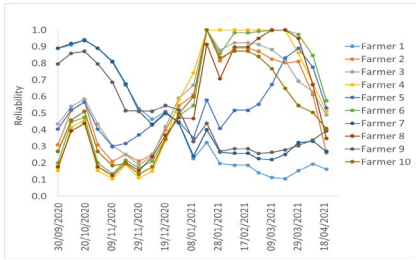
Beneficial fraction



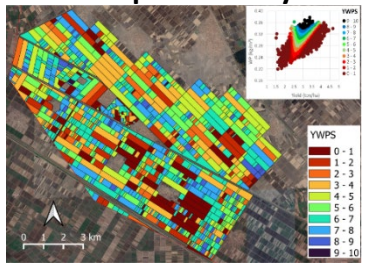
Adequacy



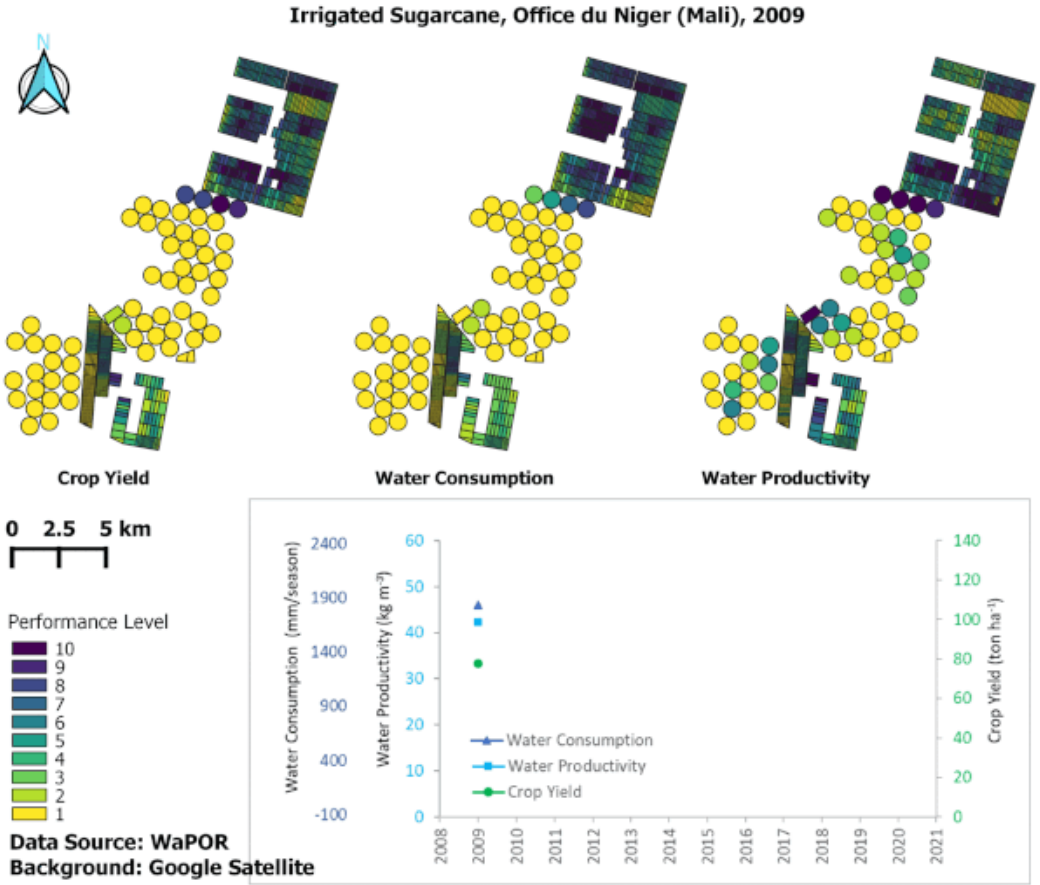
Irrigation reliability



Yield water productivity score



Irrigation performance indicators – ODN, Mali



Long-term assessment

Yield,
water consumption and
water productivity
of sugarcane
in the Office du Niger Irrigation Scheme

2009-2021

Take away message

- ETLook (eLEAF's energy balance model to estimate ET):
  - applicable at field and continental scale
  - at time scales from daily to annual, historical and NRT
  - overall good performance in different ecosystems
- Open-access availability through
  - FAO WaPOR database (DATA)
  - WaPORACT (TOOLS)
- Increasing number of evapotranspiration applications (services developed by scientific community and private sector):
  - WaPOR use cases: http://www.fao.org/in-action/remote-sensing-for-water-productivity/use-casesresources
  - Water auditing (eLEAF|Hydrologic)
  - Crop management portal FruitLook.co.za (eLEAF|DoA)
  - Water accounting (IHE Delft)
  - Irrigation performance indicators (WaterPIP)
- Major challenge is to link data to user needs: (local) service development

WaterPIP

Water Productivity Improvement in Practice

This presentation was developed by the Water Productivity Improvement in Practice (WaterPIP) project, which is supported by the Directorate-General for International Cooperation (DGIS) of the Ministry of Foreign Affairs of the Netherlands under the IHE Delft Partnership Programme for Water and Development (DUPC2).

Project activities are led by:

UNESCO IHE DELFT

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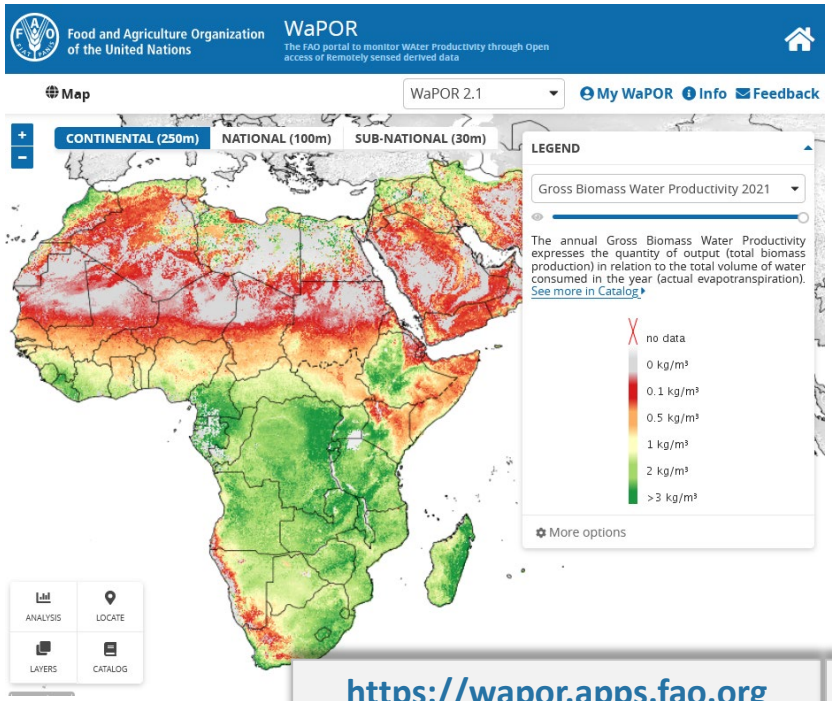
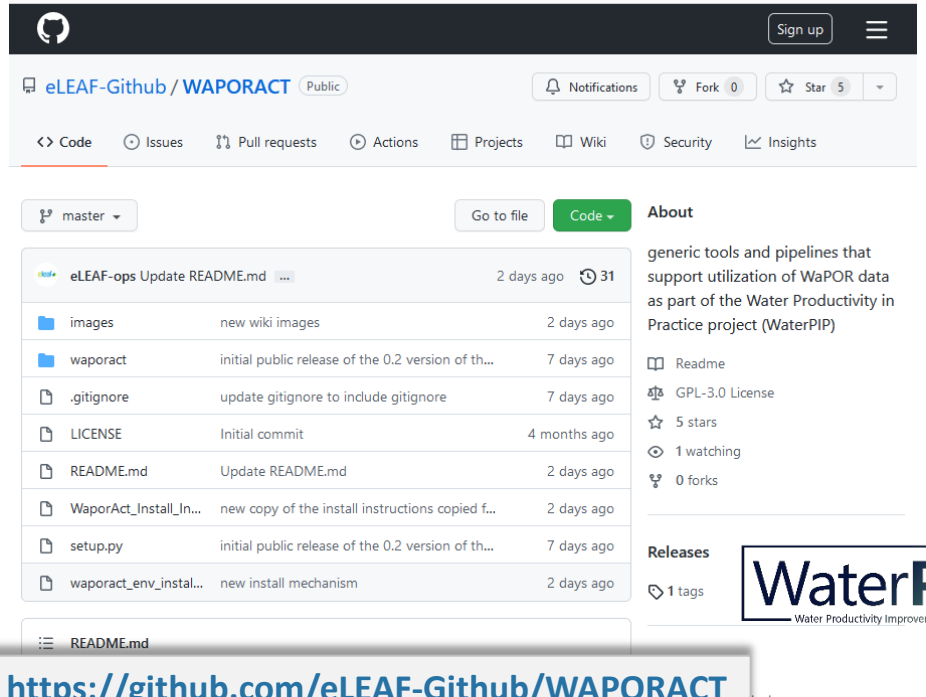
Open-access data and tools





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* Open-access **data** *

* on crop growth and water status *

* for Africa and the Middle East *

* 2009 – present *

https://github.com/eLEAF-Github/WAPORACT

Part of the WaterPIP project

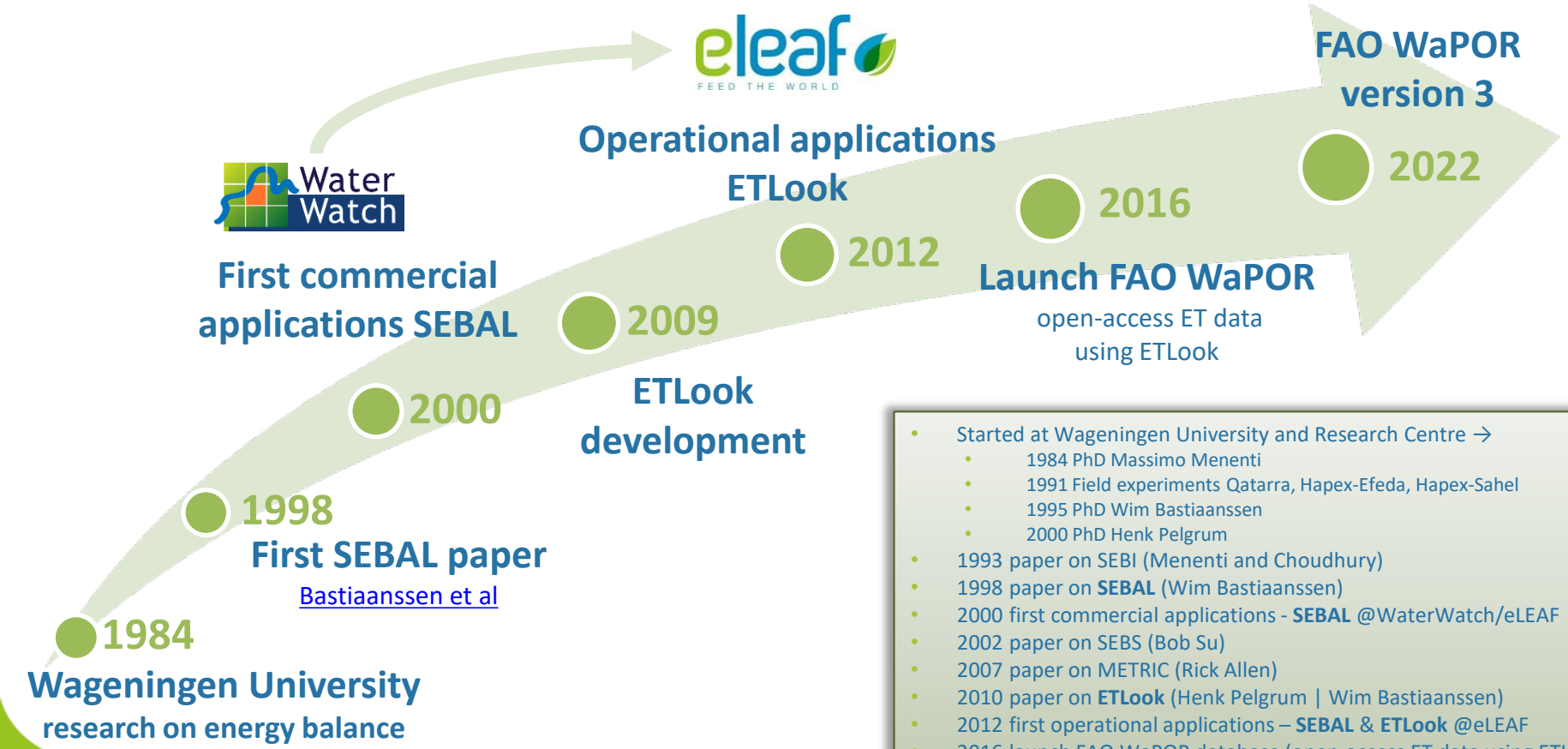
* open-access **tools** *

* to extract, interpret, analyze and visualize geodata *

* building blocks for customized services *

* Uses the FAO WaPOR database *

Evapotranspiration estimates from space



- Started at Wageningen University and Research Centre →
  - 1984 PhD Massimo Menenti
  - 1991 Field experiments Qatarra, Hapex-Efeda, Hapex-Sahel
  - 1995 PhD Wim Bastiaanssen
  - 2000 PhD Henk Pelgrum
- 1993 paper on SEBI (Menenti and Choudhury)
- 1998 paper on **SEBAL** (Wim Bastiaanssen)
- 2000 first commercial applications - **SEBAL** @WaterWatch/eLEAF
- 2002 paper on SEBS (Bob Su)
- 2007 paper on METRIC (Rick Allen)
- 2010 paper on **ETLook** (Henk Pelgrum | Wim Bastiaanssen)
- 2012 first operational applications – **SEBAL** & **ETLook** @eLEAF
- 2016 launch FAO WaPOR database (open-access ET data using ETLook)