Optimizing Ukrainian Water Resources to Revive Irrigated Agricultural Land, Improve Productivity, and Build Soil Health While Mitigating and Adapting to Climate Change

Terry Nipp, Anthony Aufdenkampe, Jaehak Jeong, and Raghavan Srinivasan

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Interconnected Puzzle Pieces
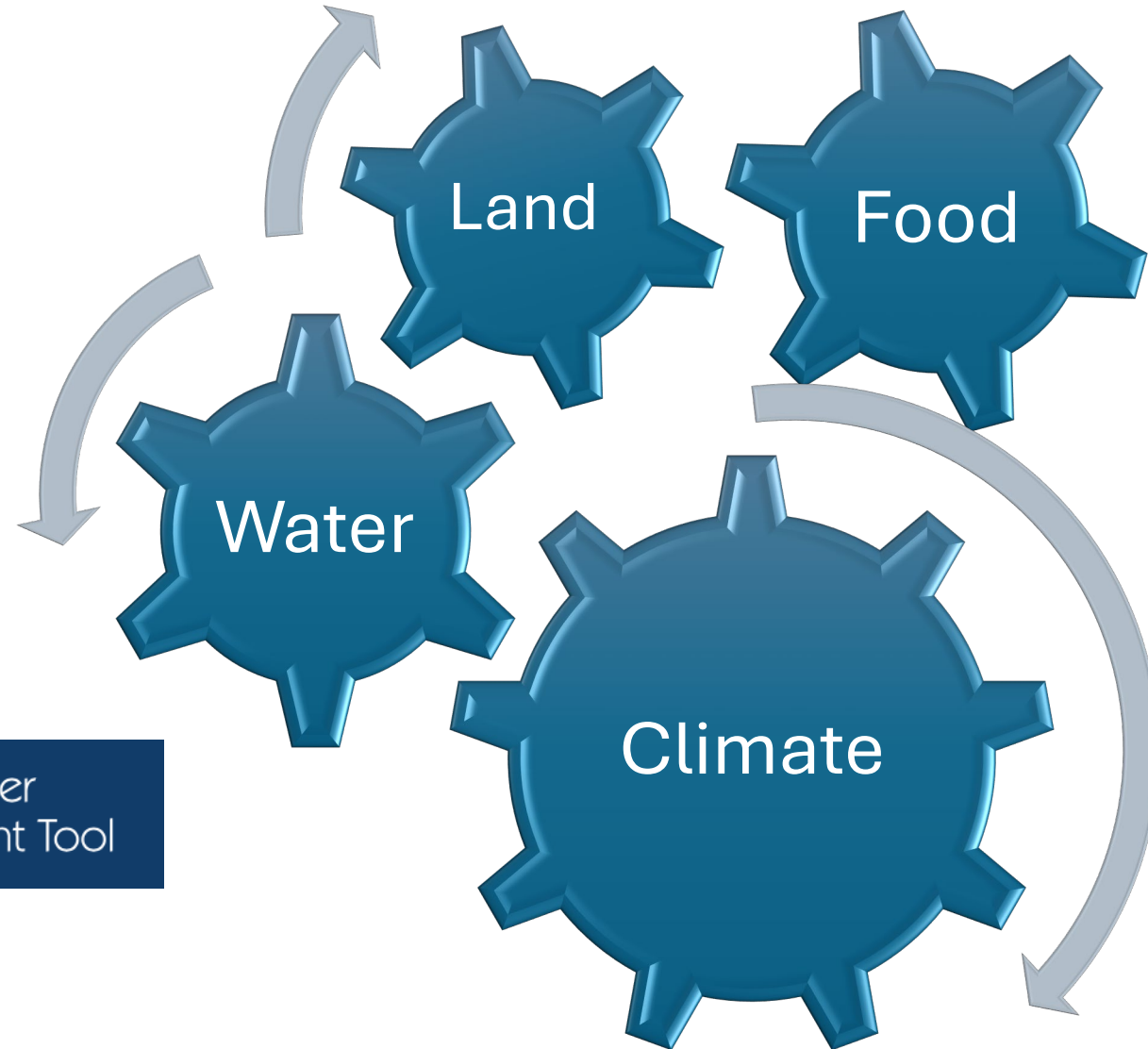
Coupling SWAT and CE-QUAL-W2

- Watersheds and landscapes

- Farm and land management practices

- Movement of sediments, nutrients, chemicals, biologicals

- Upstream land management

- Downstream water management

- Integrative modeling framework

- Climate

- Texas A&M – SWAT

- LimnoTech

- USACE

- USDA

SWAT Soil & Water Assessment Tool

Ukraine:
Optimizing Rebuilding Water and Food Production

- Choices
  - Nature Based Solutions
  - Built infrastructure
  - Use of SWAT to optimize / site
- Simultaneously optimize
  - Water
  - Farmlands / Food production
  - Mitigation and adaption to climate change
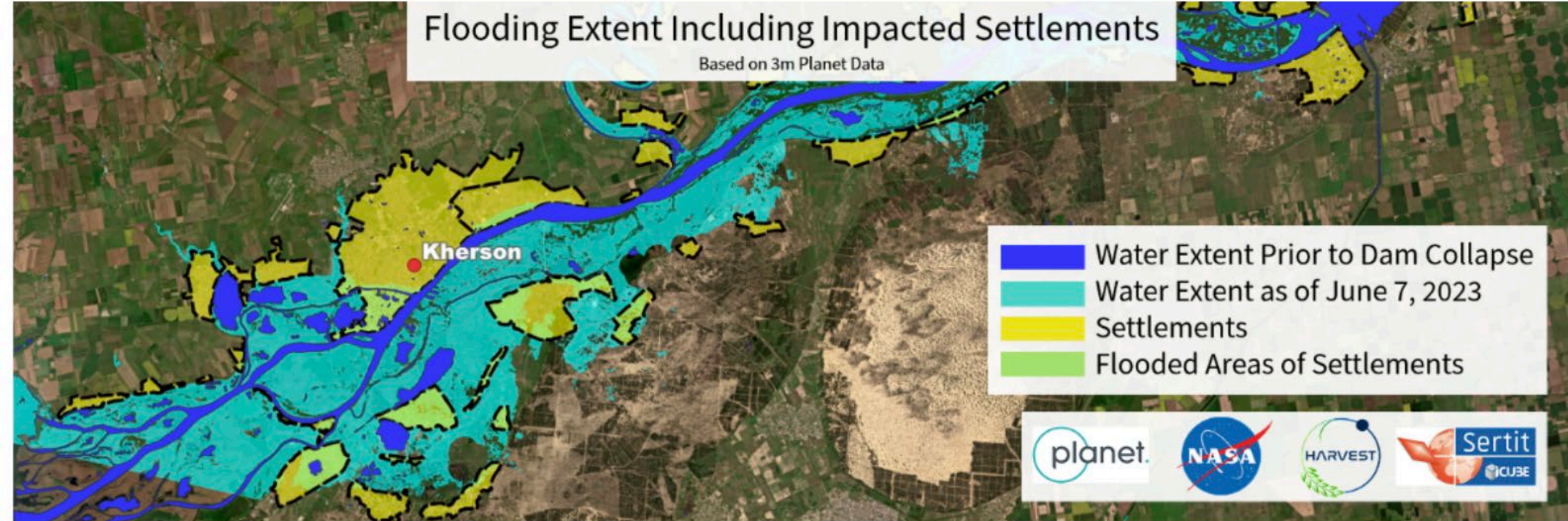- Build new partnerships
  - Satellite data

- Texas A&M – SWAT
- LimnoTech
- USACE
- USDA

NAVIGATING THE KAKHOVKA DAM COLLAPSE: NASA HARVEST CONSORTIUM ASSESSES AGRICULTURE IMPACTS WITH SATELLITE IMAGERY

Flooding Extent Including Impacted Settlements
Based on 3m Planet Data

Kherson

Water Extent Prior to Dam Collapse
Water Extent as of June 7, 2023
Settlements
Flooded Areas of Settlements

https://www.planet.com/pulse/kakhovka-dam-collapse-nasa/

Major Canal Inlets

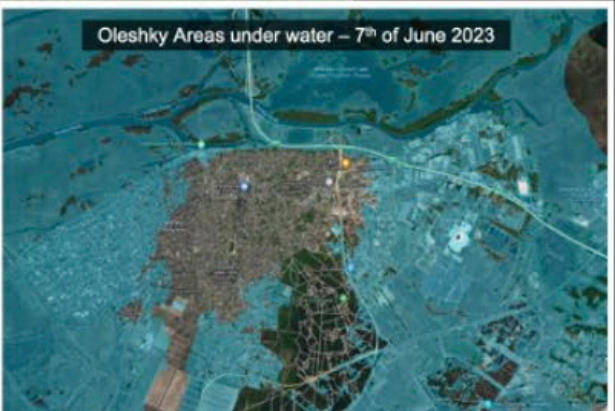Canal near Maryanske
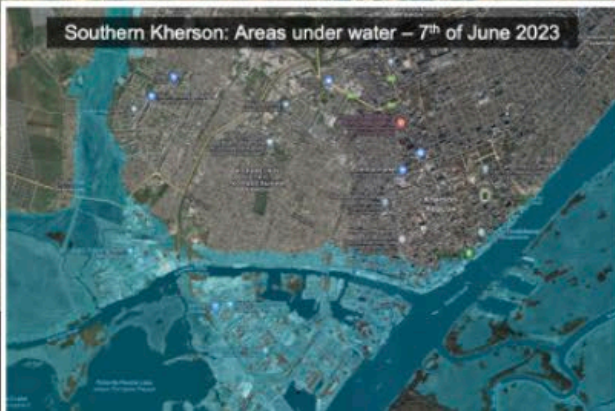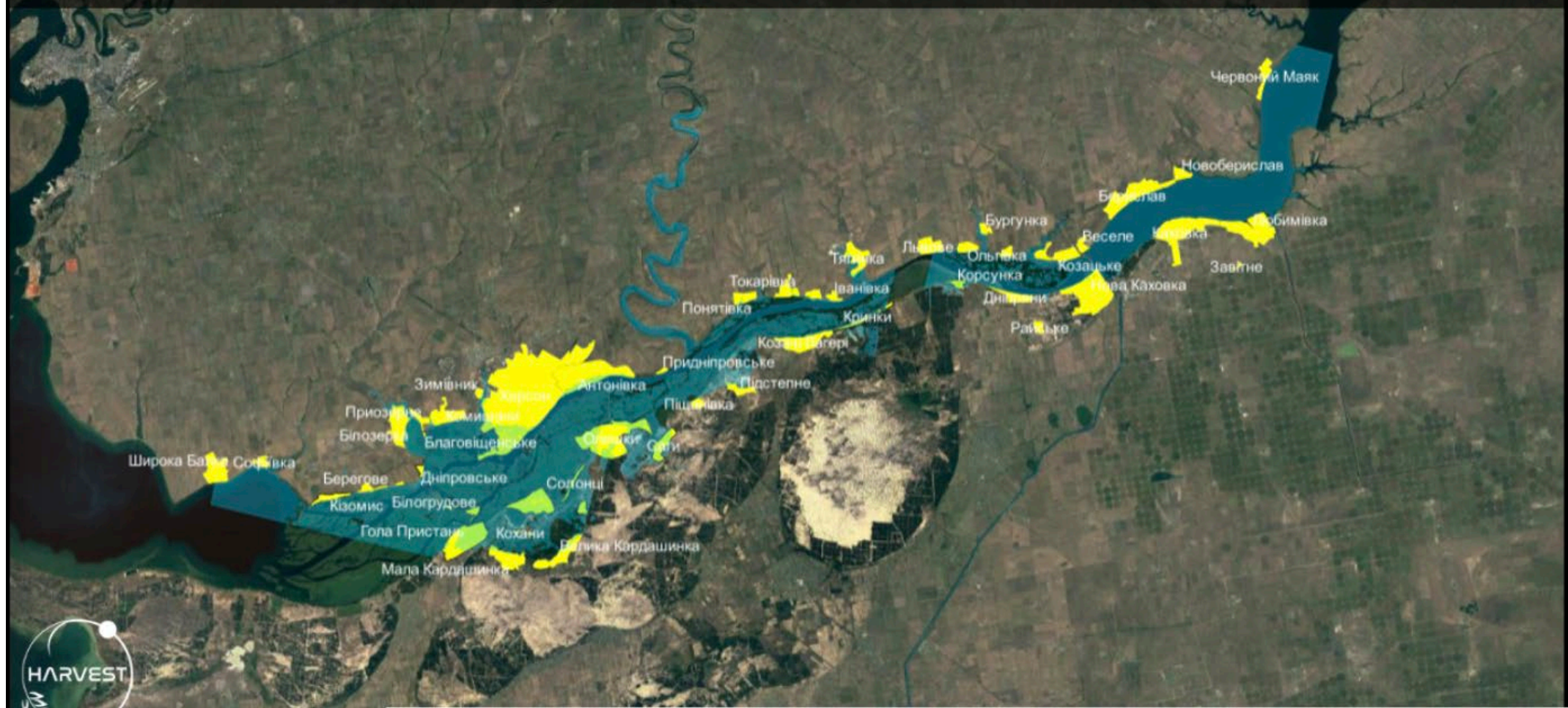
Canal near Balky
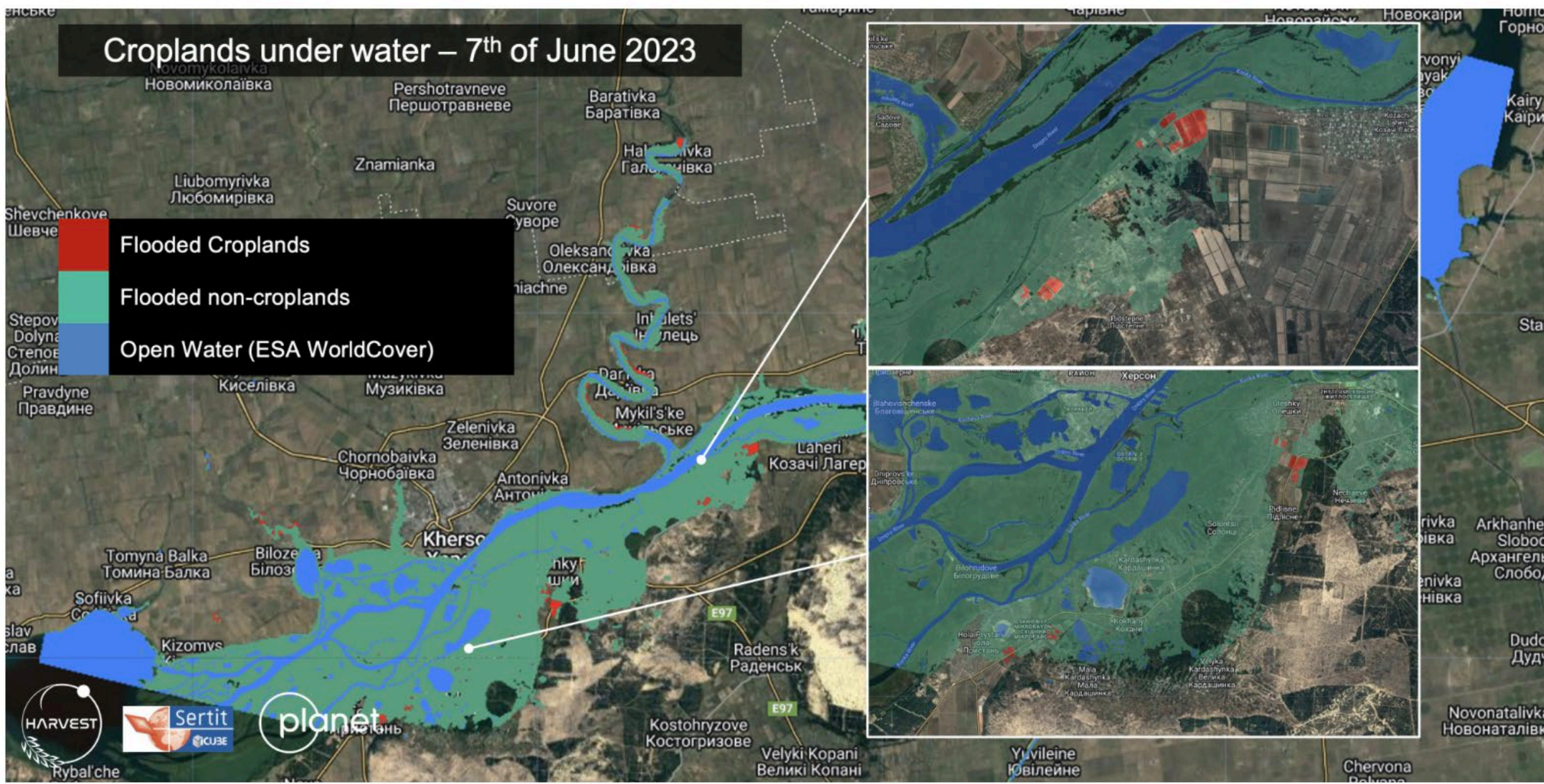
Kakhovsky Canal

North Crimean Canal

- NASA Harvest
- Planet Labs

100 km

Source Canals Netwo

Cities/Villages Flooded as 7ᵗʰ of June 2023

In partnership with Planet and SERTIT, NASA Harvest was able to produce a comprehensive map of flooded croplands, flooded villages, and open water, providing critical information for the Ukrainian Ministry of Agriculture and humanitarian response.

Water line receding at eastern end of the reservoir – 9th of June 2023

Nikopol
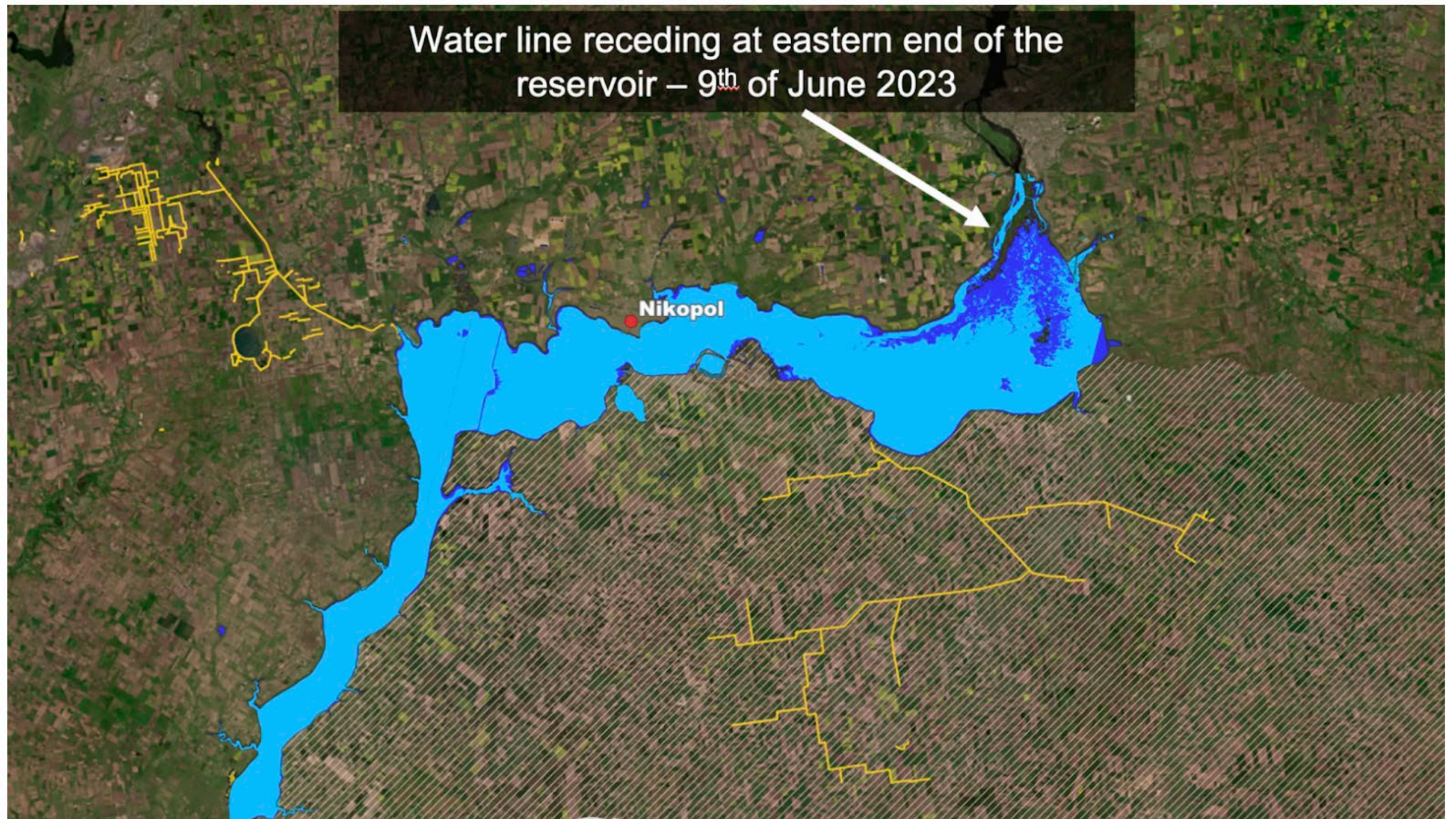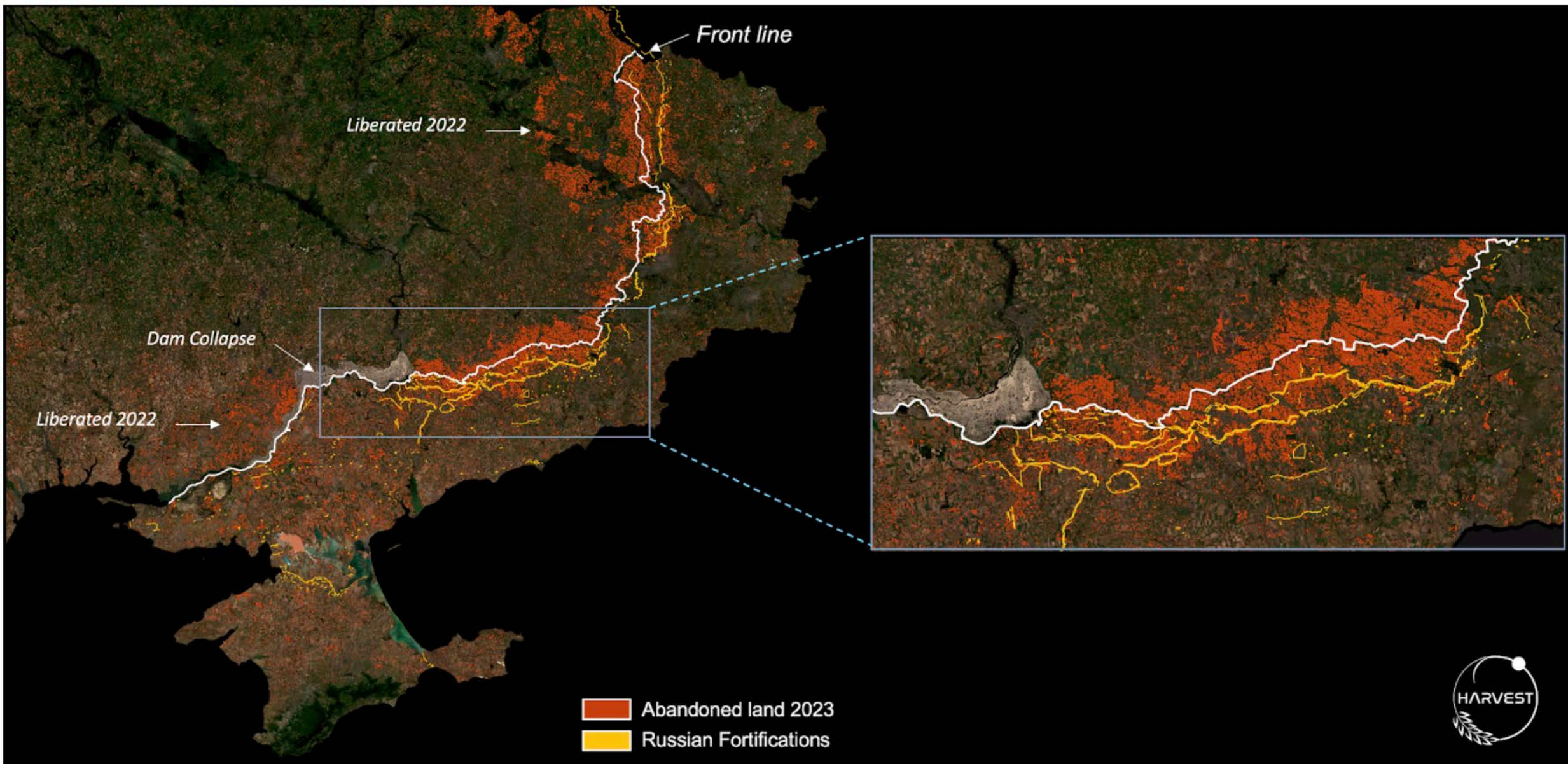
Satellite imagery reveals that approximately 7% of Ukraine's total cropland has been abandoned in 2023 due to the war, translating to $2 billion in lost harvest and a quantity of grains and oilseeds that could have fed over 25 million people for a year. [Source: NASA Harvest (J. Wagner, S. Nair, J. Becker-Reshef), Satellite Data Source: PlanetScope, Russian fortifications source: Brady Africk.]
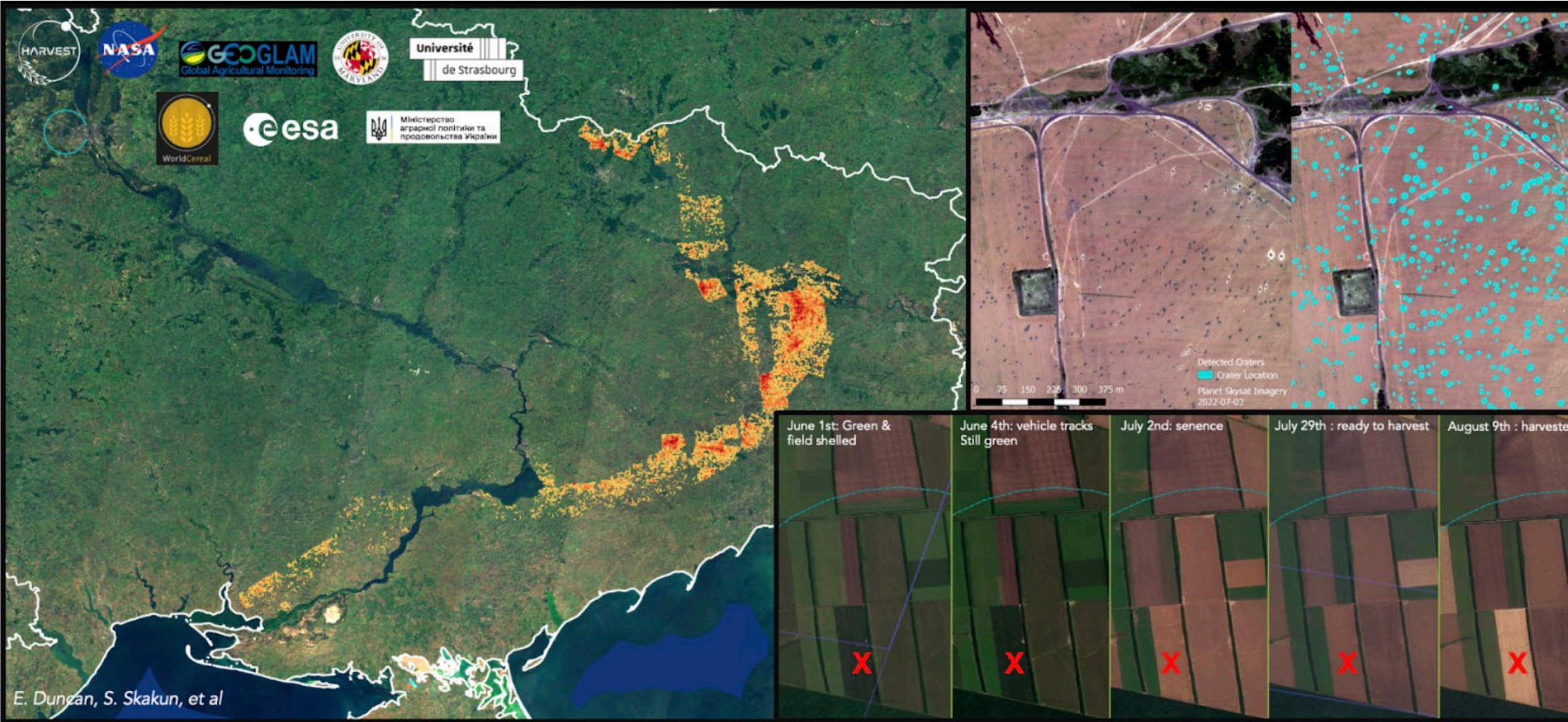
NASA Harvest maps showing 2.5 million artillery and rocket impacts mapped across the 2022 front lines (left), crater detection in agricultural fields using Planet Skysat Imagery (top right), and shelled fields that were still harvested by resilient farmers in 2022 (bottom right).

Climate: SWAT-C

Terrestrial Carbon Cycle

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Coastal Region
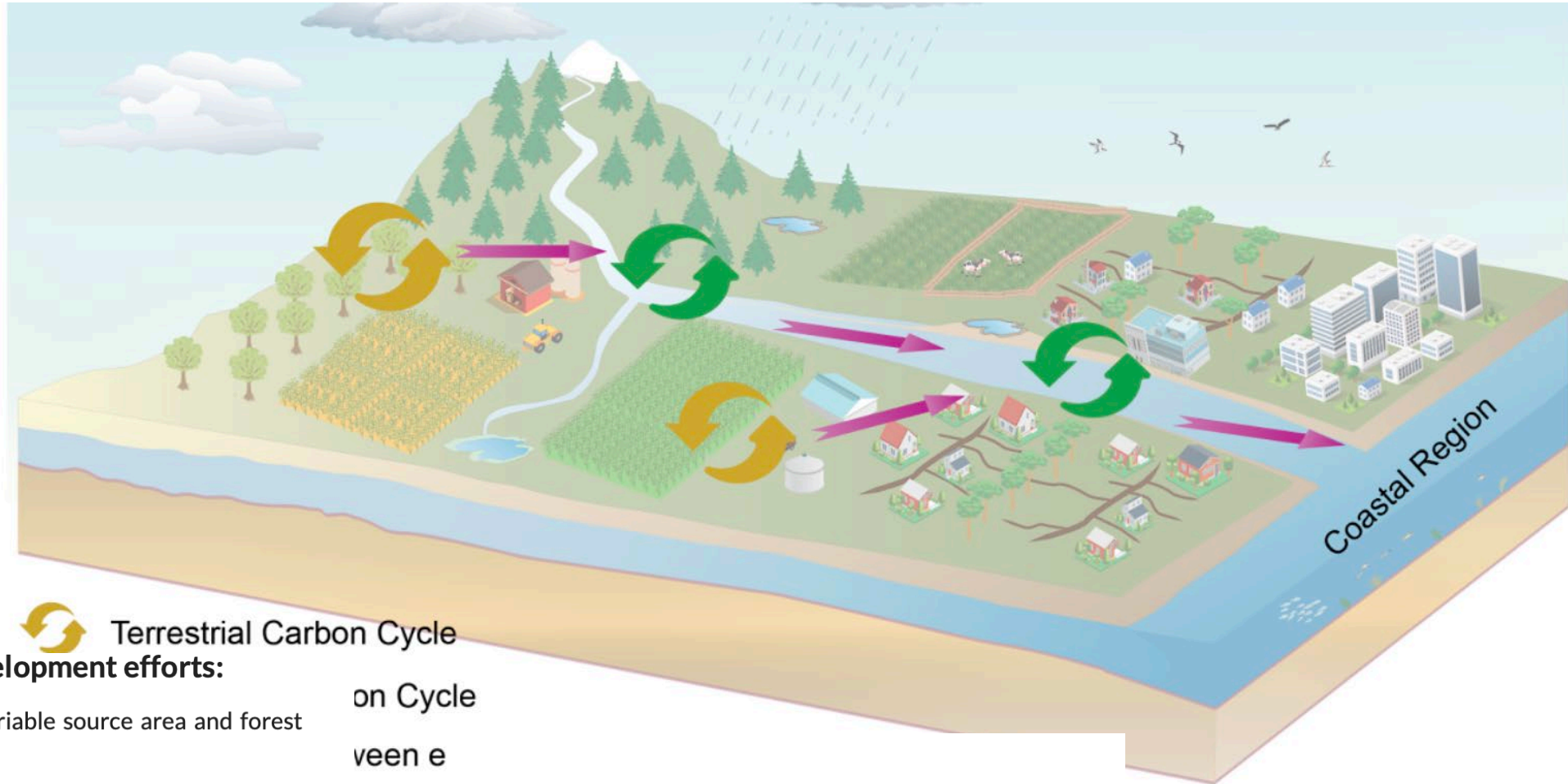
Current model development efforts:

- **Rajith Mukundan**: Variable source area and forest modeling

- **Sijal Dangol**: Root and shoot development of crop, grass and forest

- **Kaiguang Zhao**: Energy balance and photosynthesis
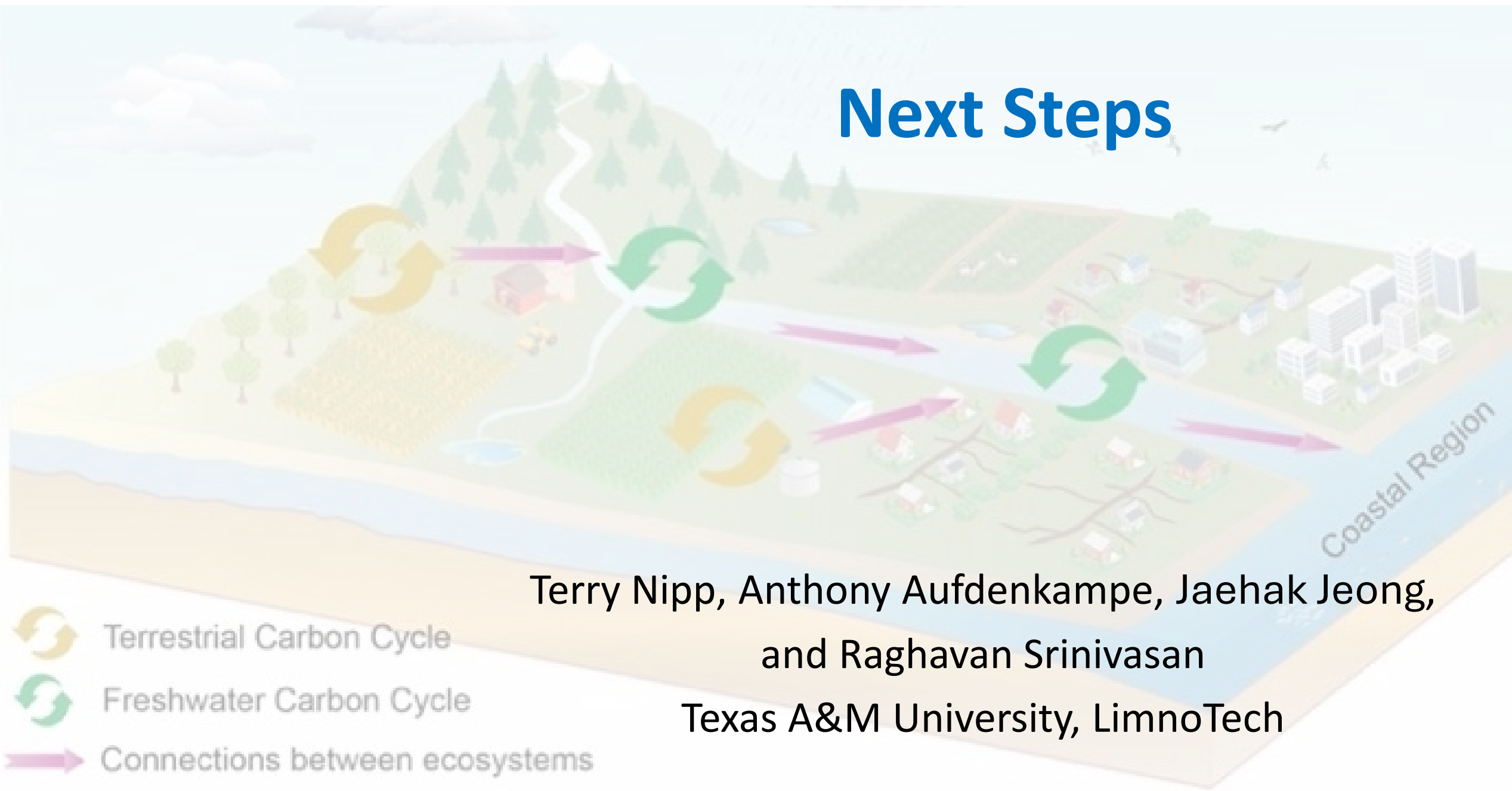
- **Xuesong Zhang**: River routing and coupled

Converging Terrestrial and Aquatic Sciences: the Soil and Water Assessment Tool – Carbon (SWAT-Carbon)

- Key improvements:
  - Terrestrial carbon algorithms from CENTURY, DNDC, DSSAT, EPIC, and recent literature
  - Riverine carbon algorithms from QUAL2K and CE-QUAL-W2
  - Coupled heat balance across terrestrial and aquatic ecosystems
  - N_2O emissions from nitrification and denitrification processes
  - Ongoing development/improvements regarding soil moisture, river routing, sediment diagenesis, photosynthesis, root development, and evapotranspiration.
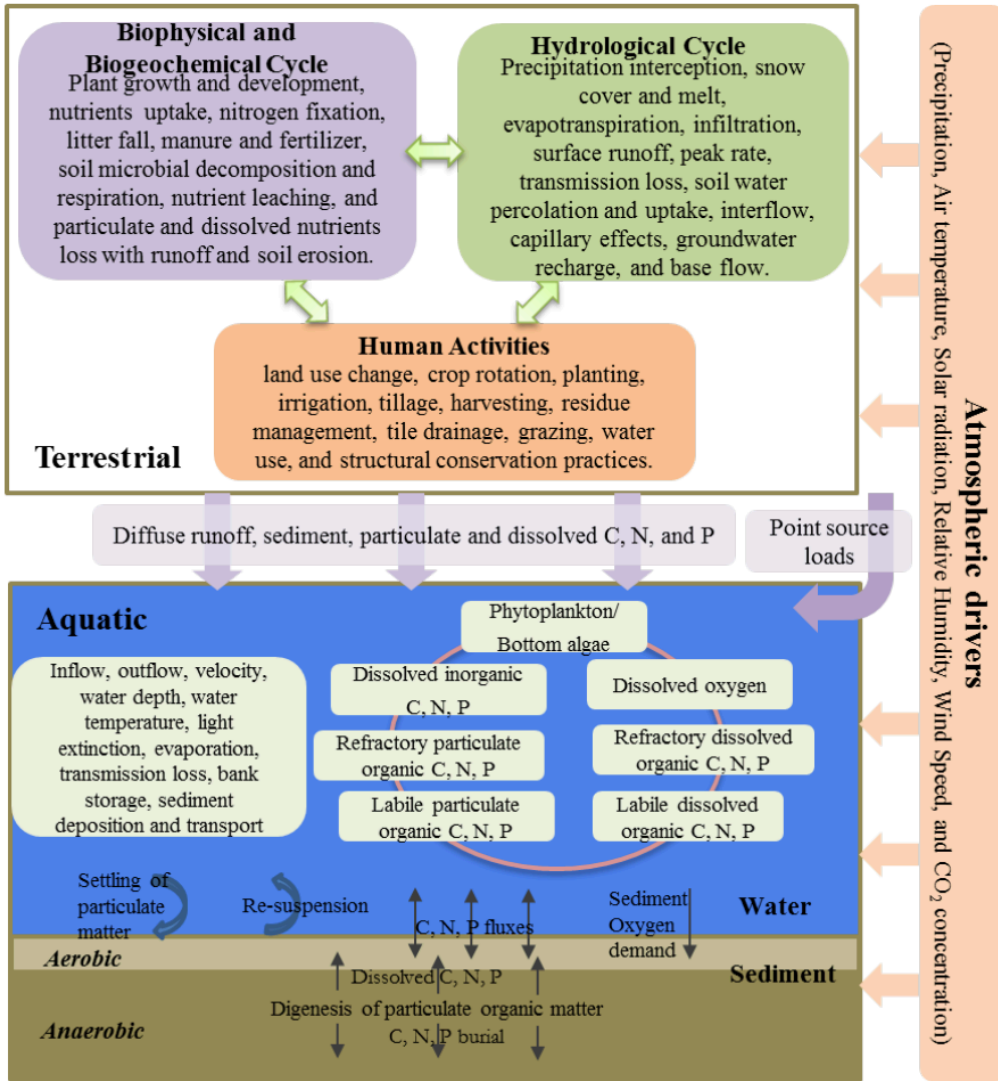
Xuesong Zhang
USDA ARS

Next Steps

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Terrestrial Carbon Cycle

Freshwater Carbon Cycle

Connections between ecosystems

Coastal Region