The role of low- and high centered polygons on arctic wetland water balance

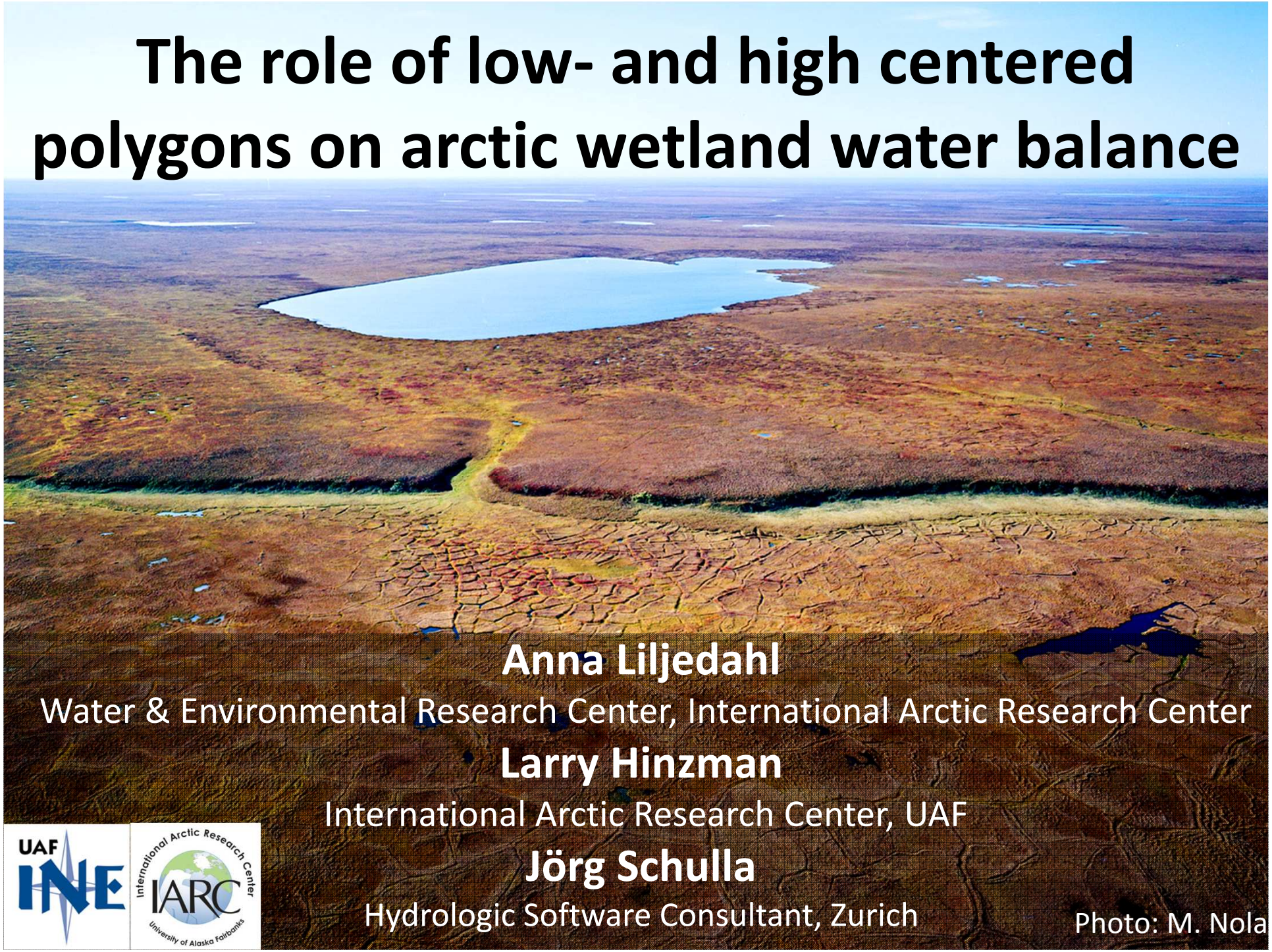

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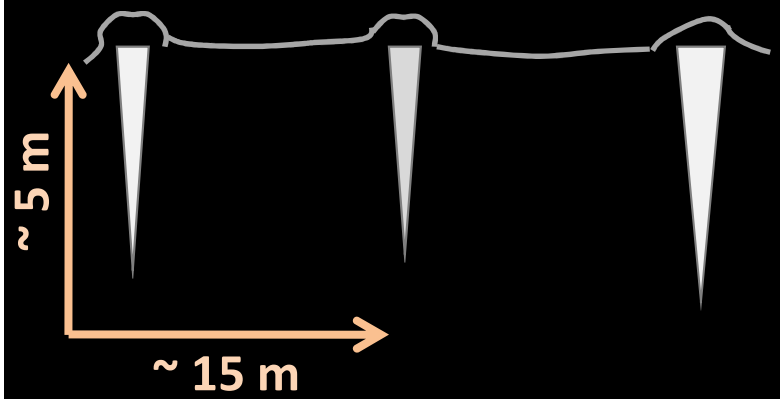
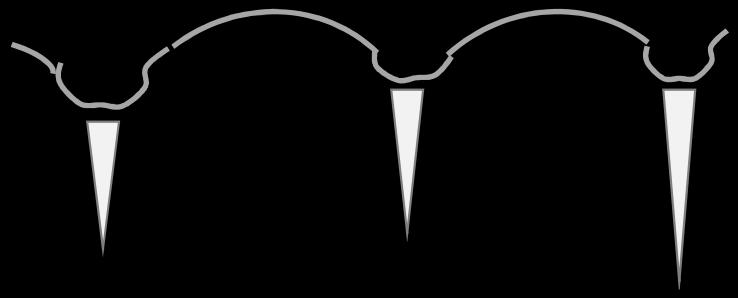
Photo: M. Nola

Ice wedge polygons – two major types

Low-centered polygon

High-centered polygon



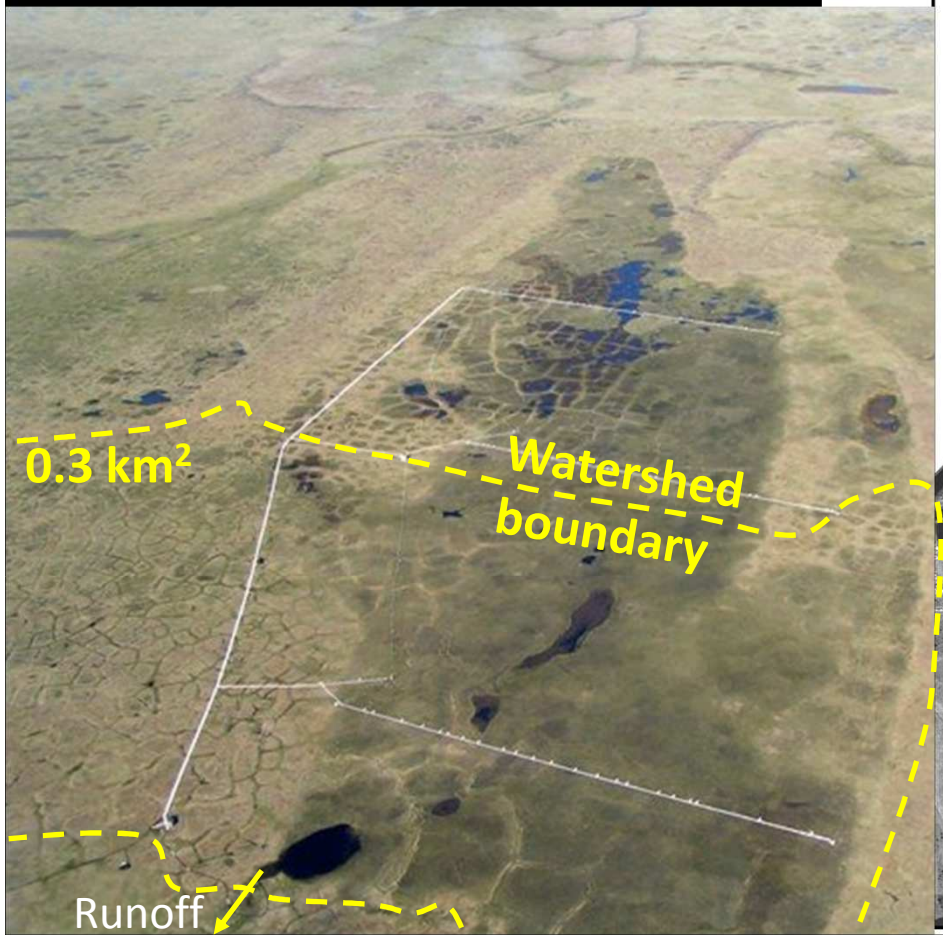


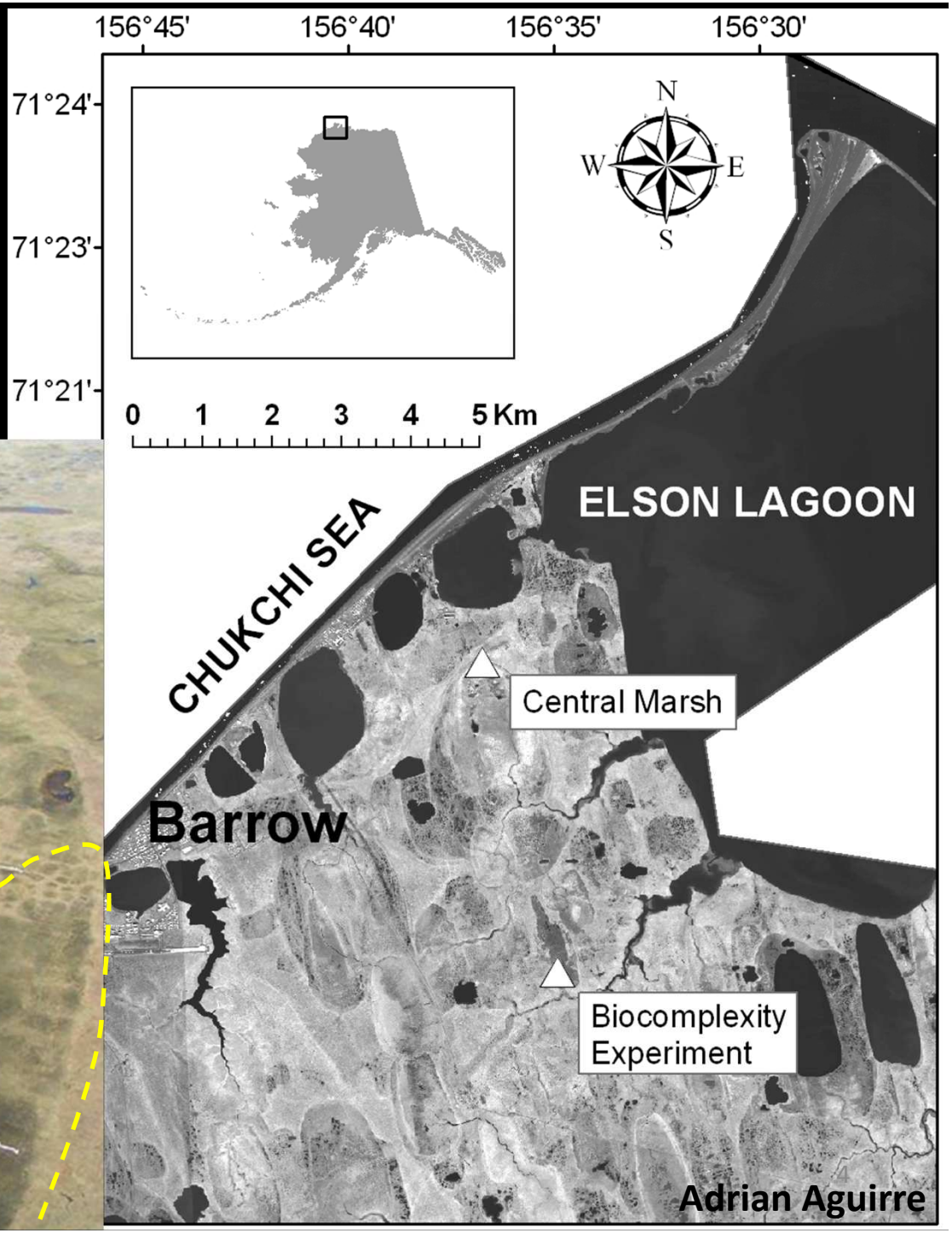
Question

How do ice wedge polygons (low and high-centered) affect watershed-scale hydrologic fluxes and stocks?

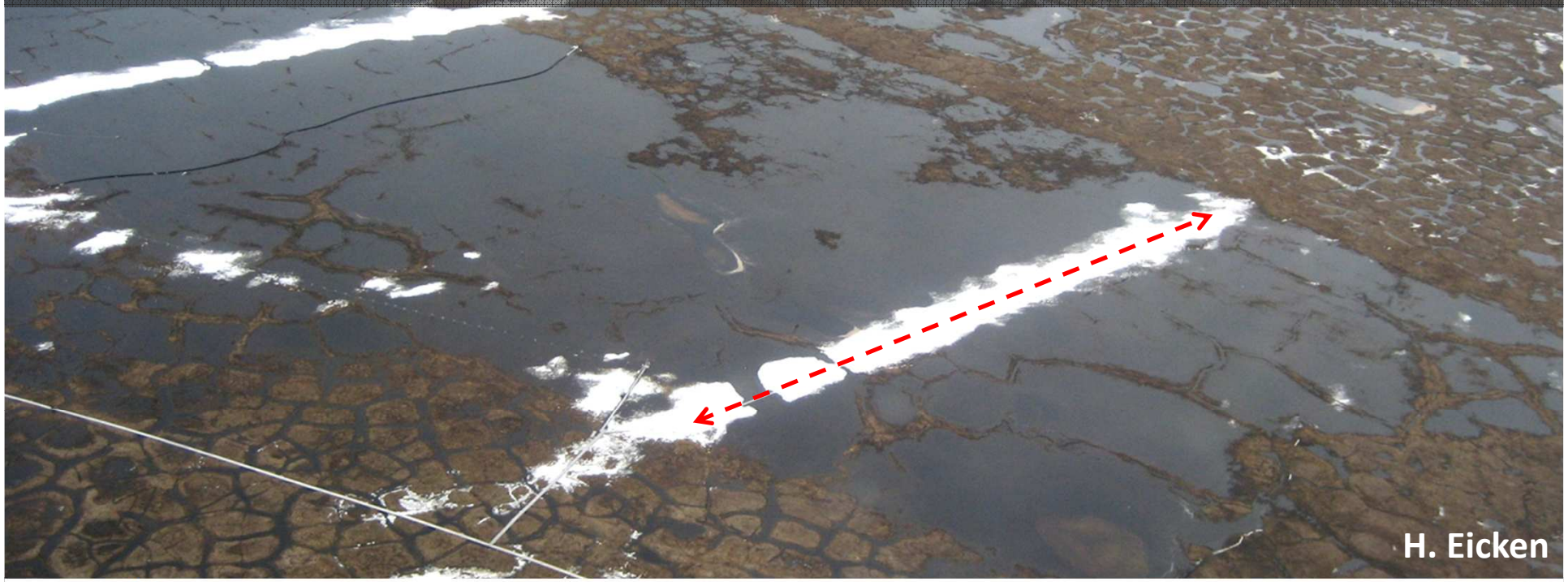
Study site:
Barrow, Alaska

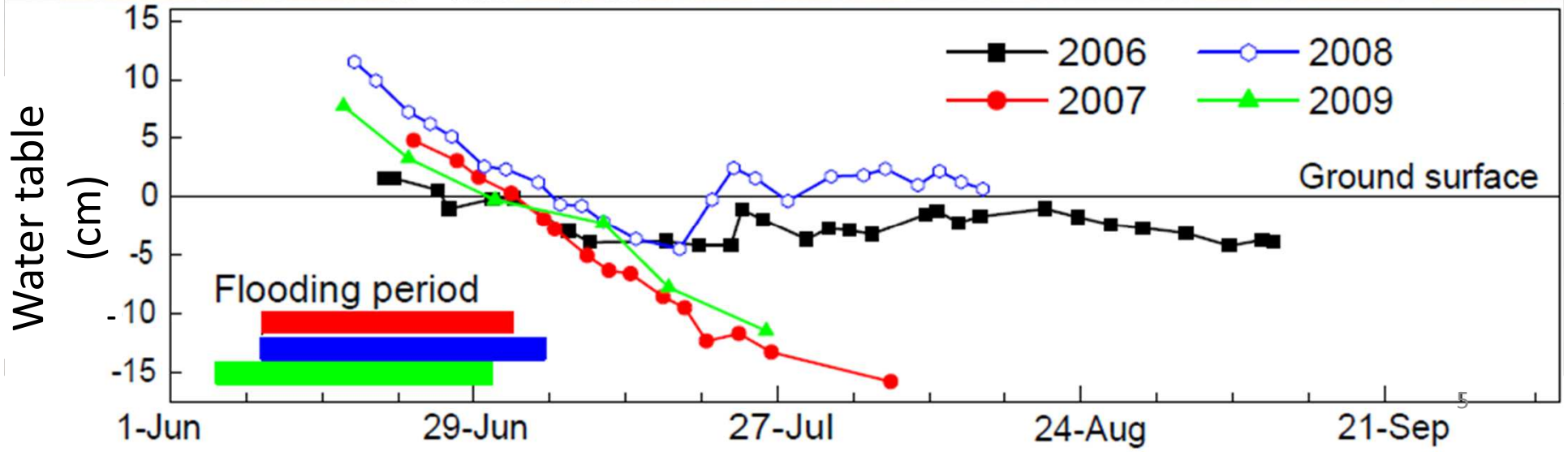
Biocomplexity Experiment



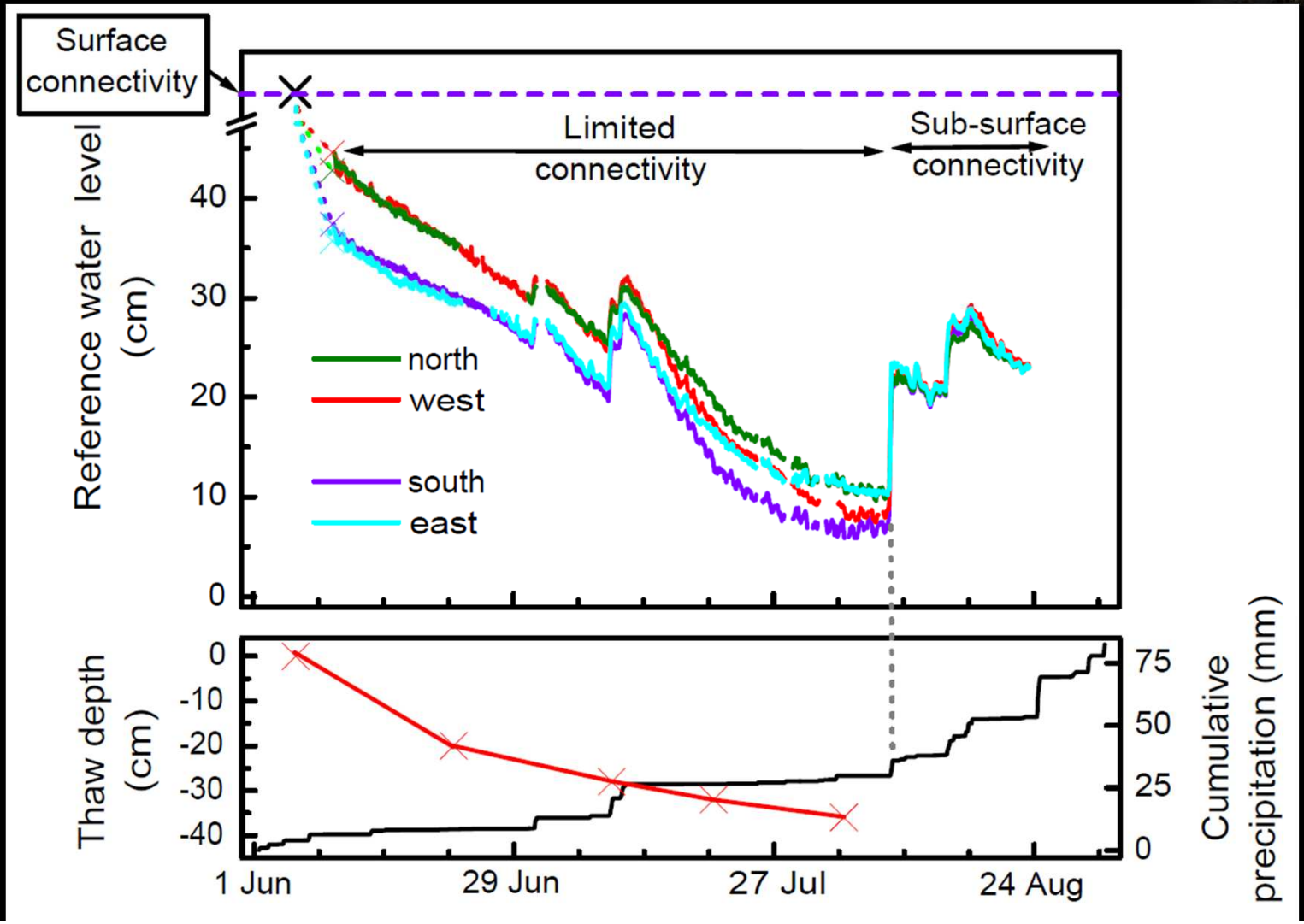


Month-long surface inundation



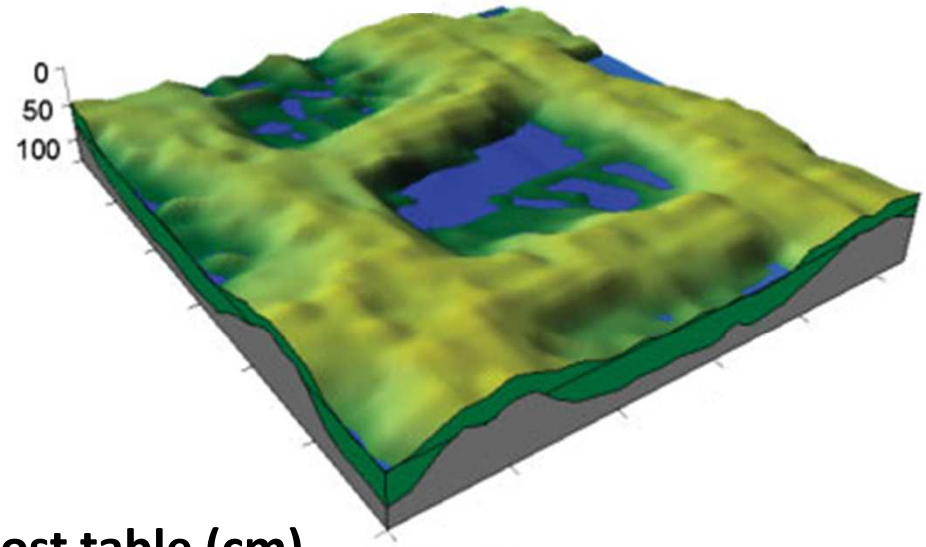


Lateral disconnection

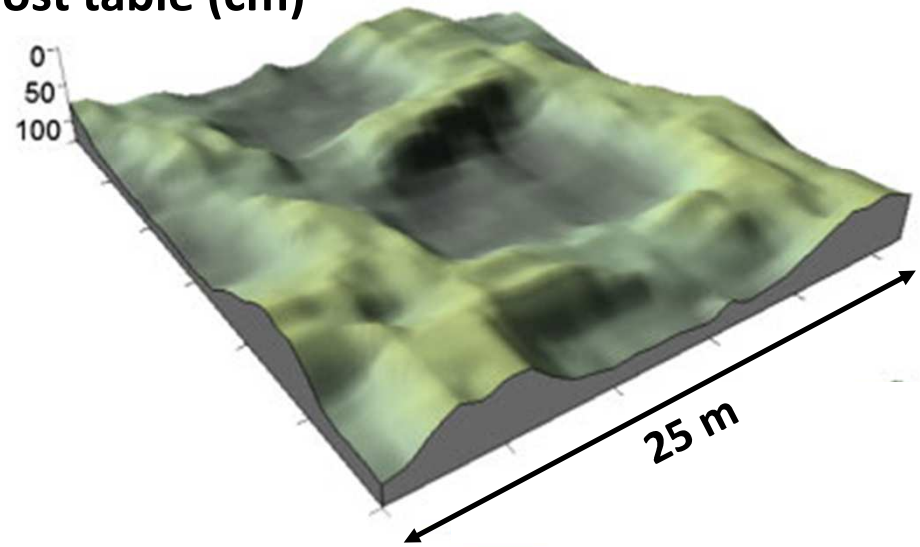


Lateral “barriers” in low-centered polygons

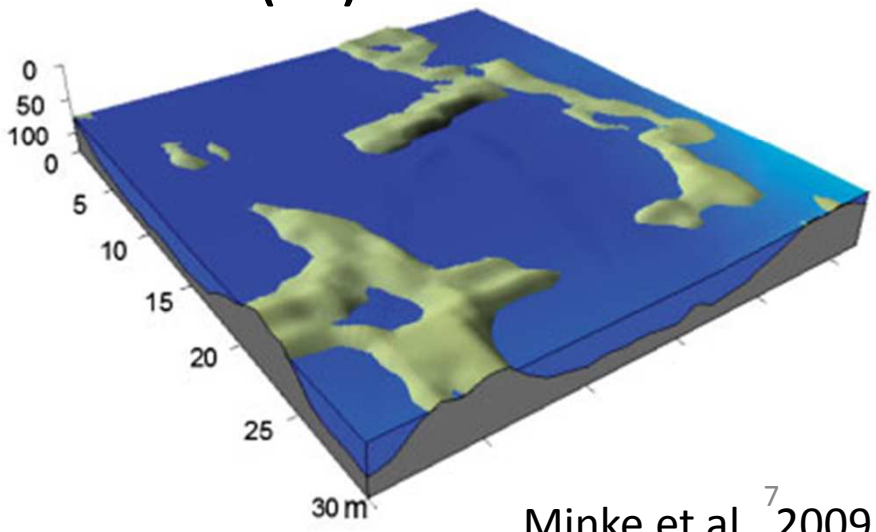
Ground surface (cm)



Frost table (cm)



Water table (cm)



Minke et al., 2009

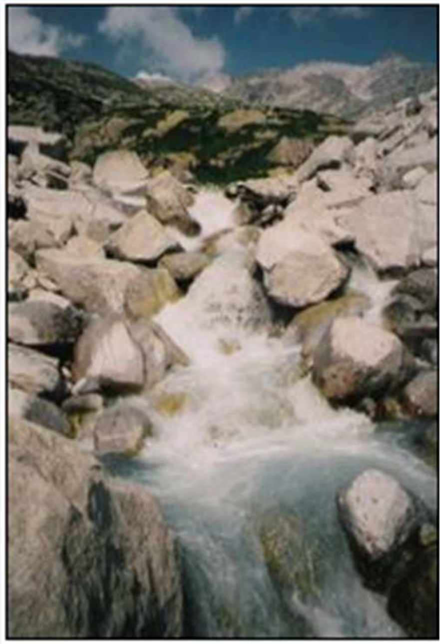
The hydrological model system

WaSiM-ETH

www.wasim.ch

The Model | Solutions | Services | Products | Dialog | [D] [E]

Navigation: Home



Welcome to the Website of WaSiM-ETH

The grid-based **Water** Flow and Balance **Simulation Model** WaSiM-ETH is a well-established tool for investigating the spatial and temporal variability of hydrological processes in complex river basins. The model can be seen as a reasonable compromise between detailed physical ...

... demonstrated that WaSiM-ETH is able to address successfully very different ...

Used by over 50 institutions

70+ peer-reviewed publications

At present WaSiM-ETH is used by over 50 institutions (universities, research centres, regional authorities and engineering offices). The results of model applications are shown in a large number of publications.

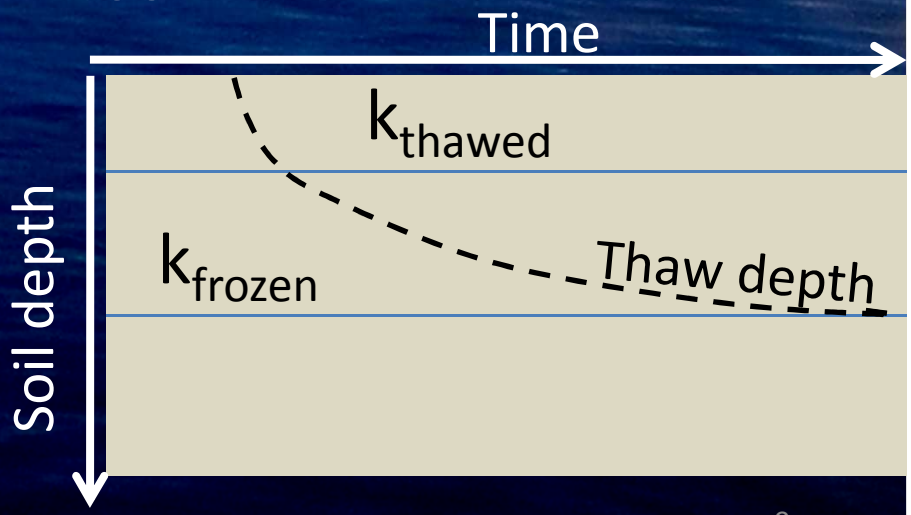
WaSiM News

19.10.2009
New Official Release
WaSiM-ETH 8.5.0 -> More »

WaSiM-ETH

- Penman-Monteith evapotranspiration
- Evaporation from top soil layer
- Richard's equation for movement of soil water
- Surface routing with multiple flow paths
  --> Dynamic generation of ponds
- Simple active layer dynamics:

$$Thaw\_depth = \mu\sqrt{n_{sf}}$$

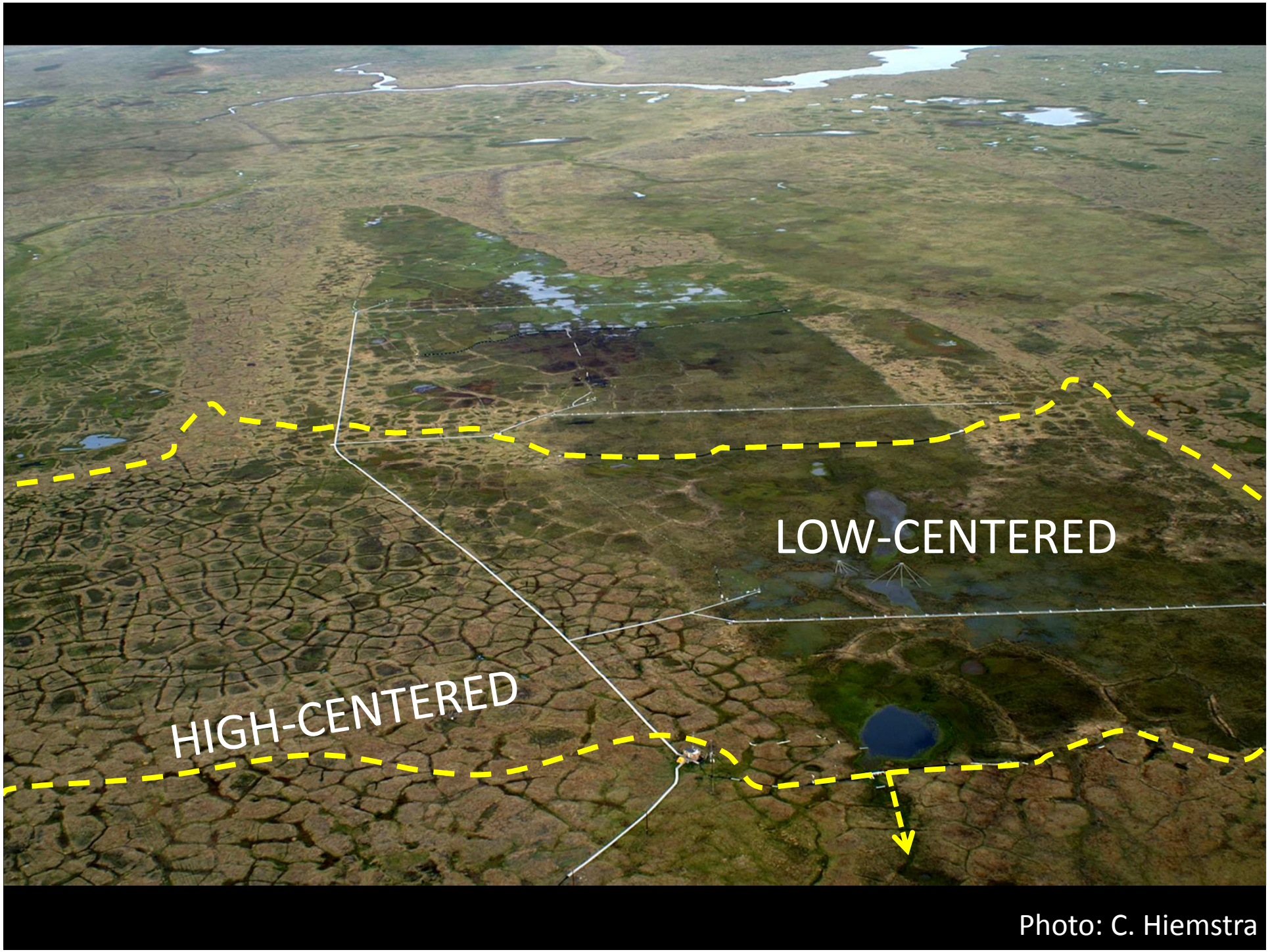


WaSiM-ETH model input:

- Precipitation
- Air temperature
- Wind speed
- Relative humidity
- Solar radiation

} Hourly (daily, monthly)

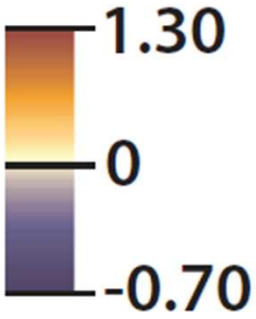
- Digital Elevation Model (DEM)
- Vegetation & soil map
- Parameters derived from literature & model calibration (yr 2006-2009)

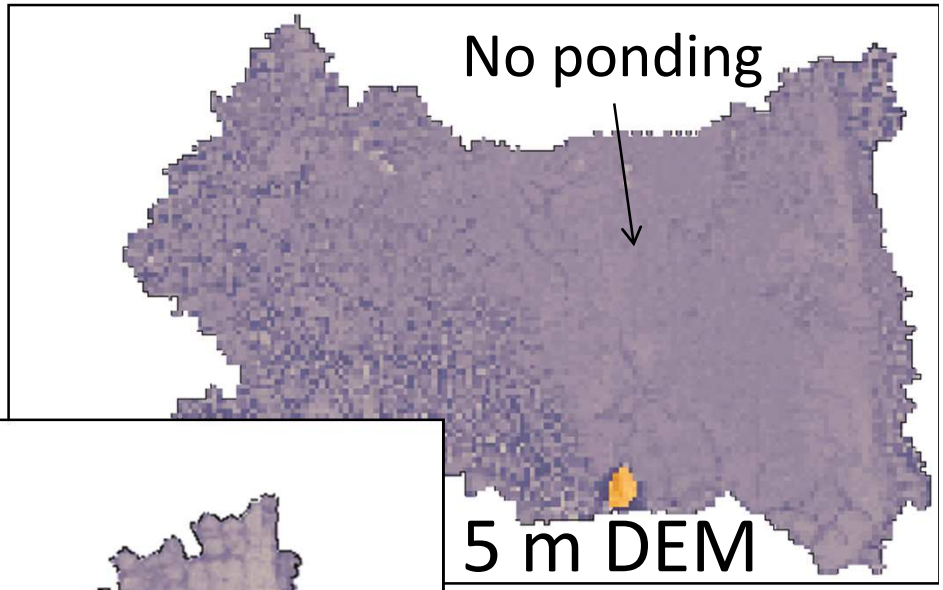

LOW-CENTERED
HIGH-CENTERED
Photo: C. Hiemstra

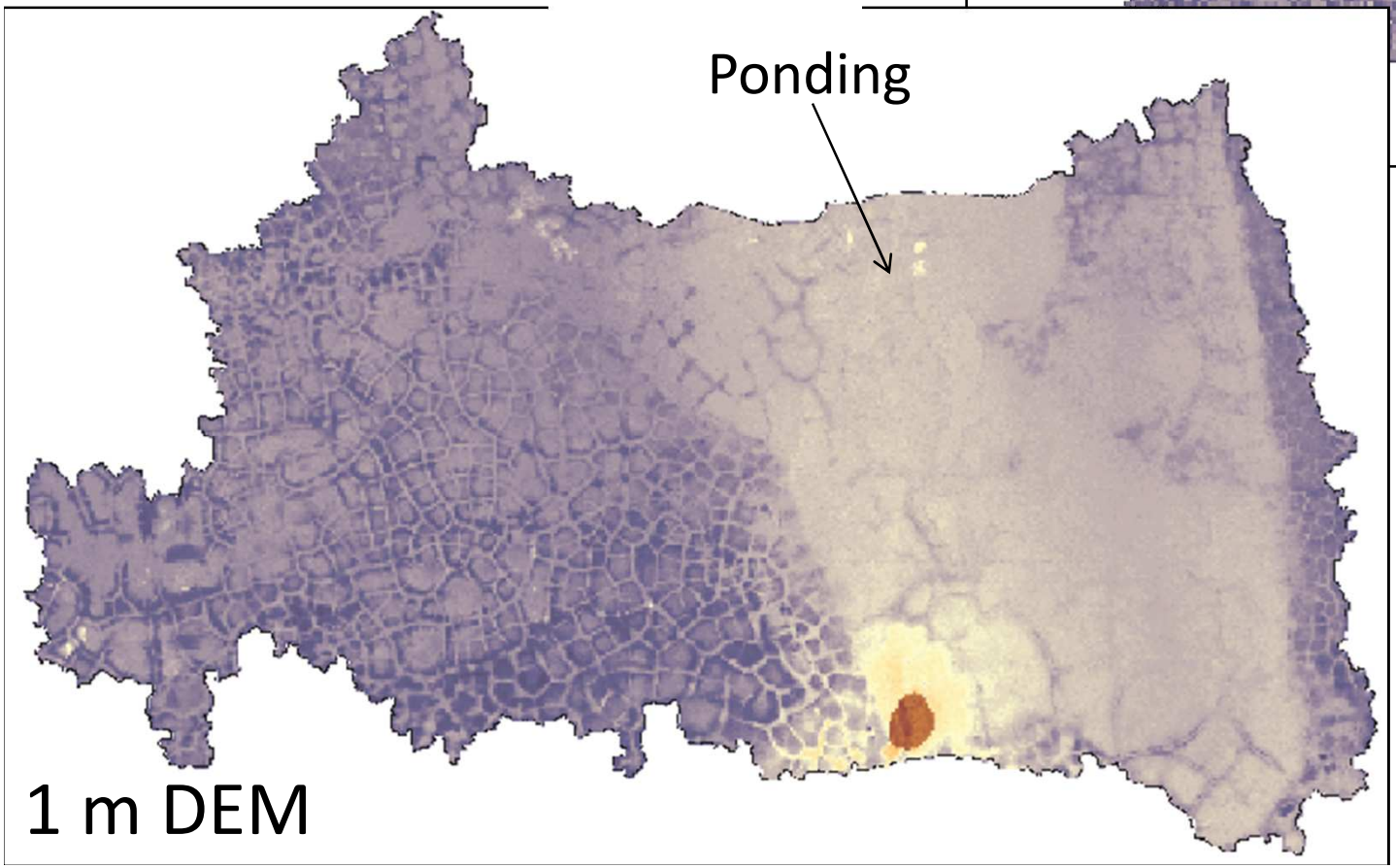
DEM resolution affect modeled water table

Water table elevation, m

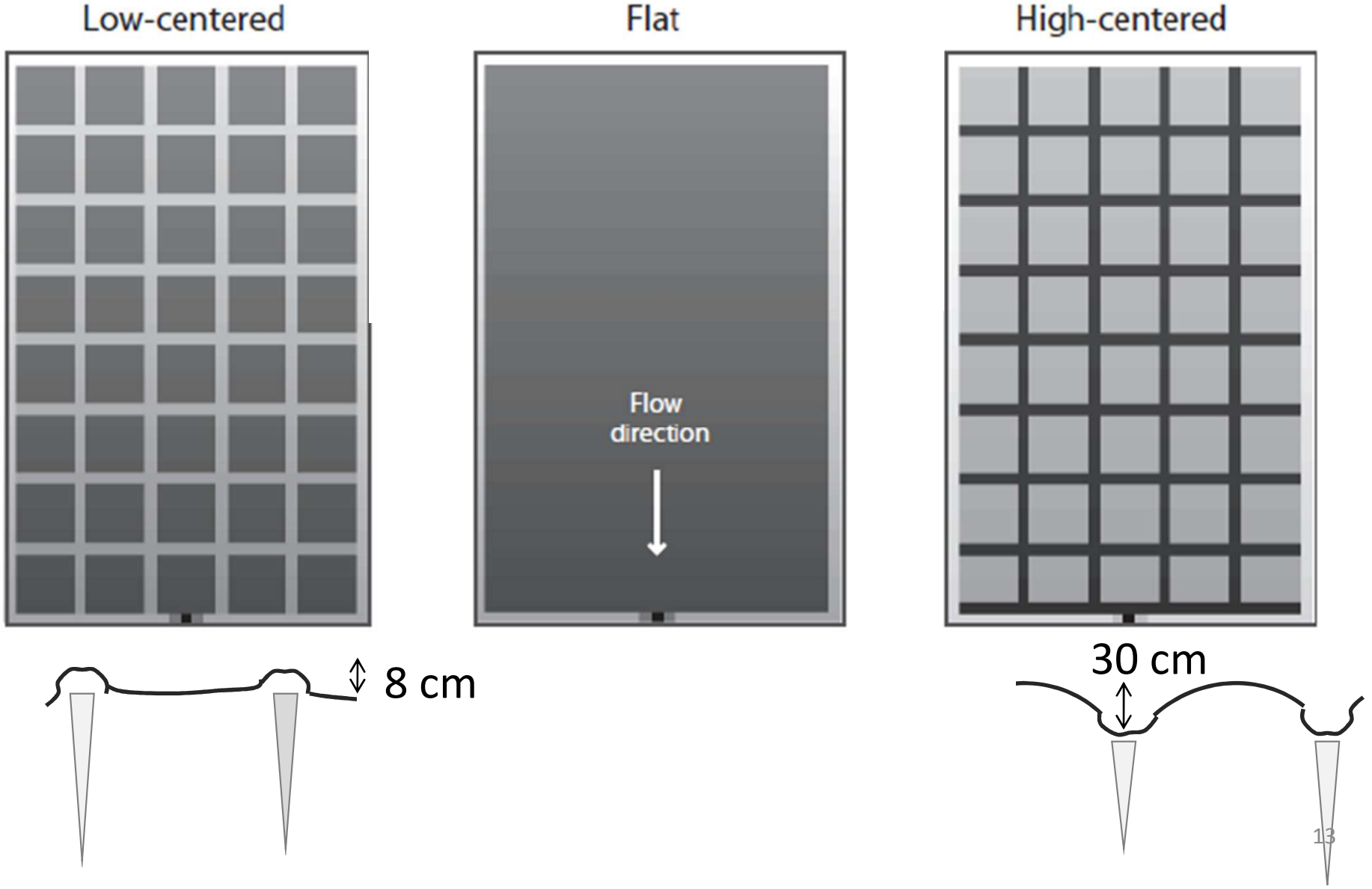
July 1st





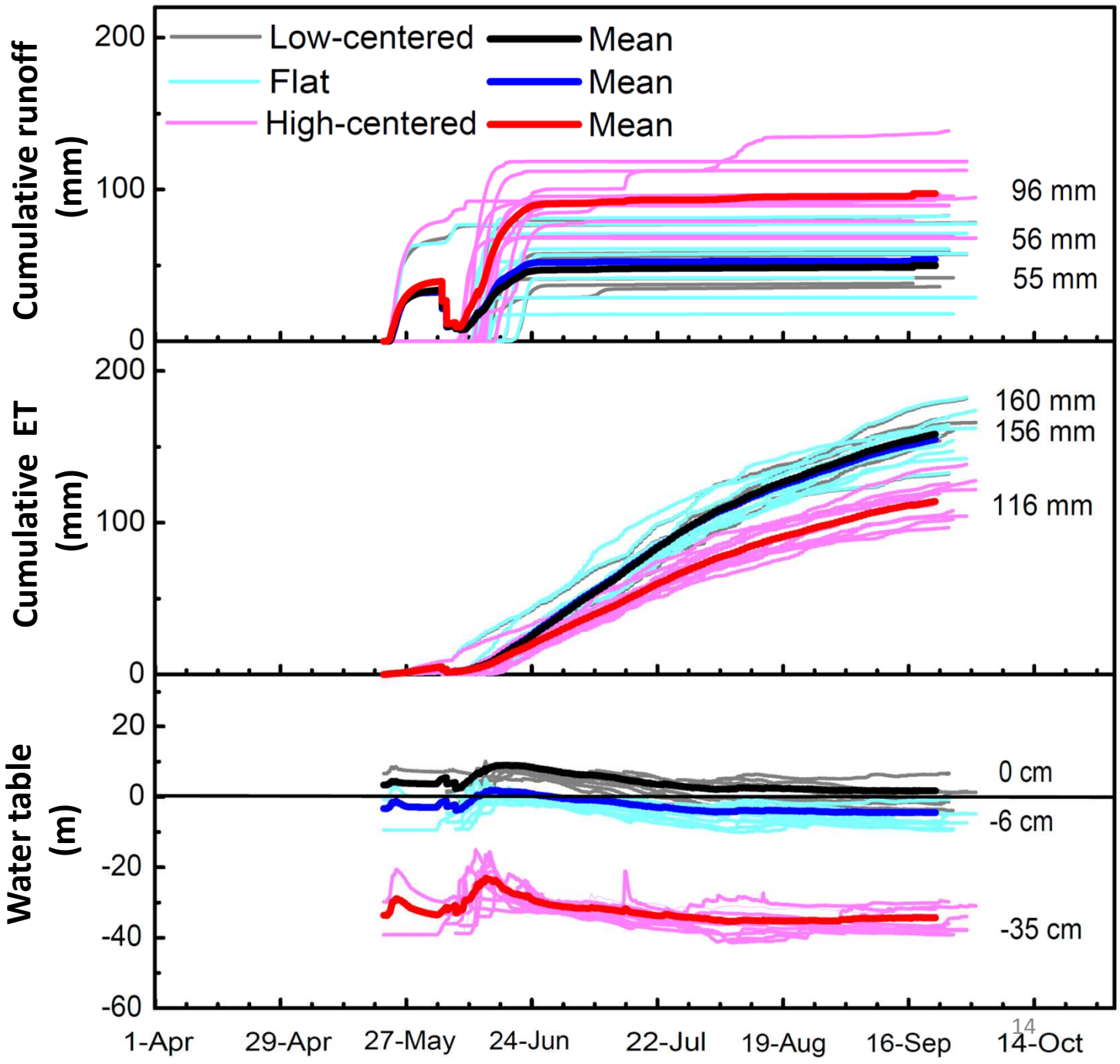


Model experiment: Schematic DEM's
- a 1st order approach -



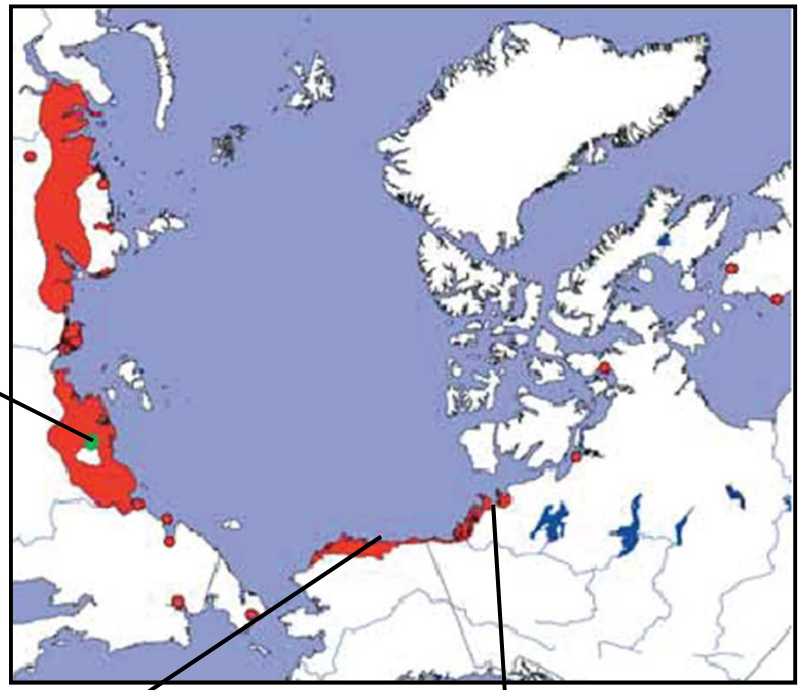
Model Experiment:

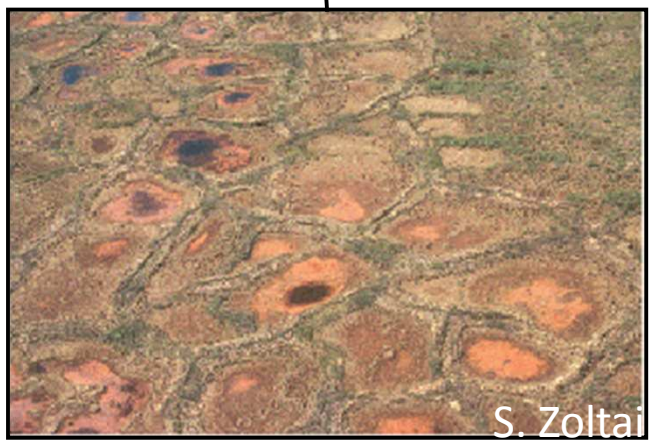
Polygon type control watershed hydrology



~400,000 km^2 = 5 % arctic land surface

Low-centered polygons





Walker et al., 2005; Figure modified after Minke et al., 2007

Take-away point

The type of ice wedge polygon (low- or high-centered) affects the watershed-scale water fluxes and stocks

Thank You

International Arctic Research Center
Water and Environmental Research Center
Sweden-America Foundation
National Science Foundation

Photo: M. Nola