CLIMATE CHANGE AND MAINE SOILS

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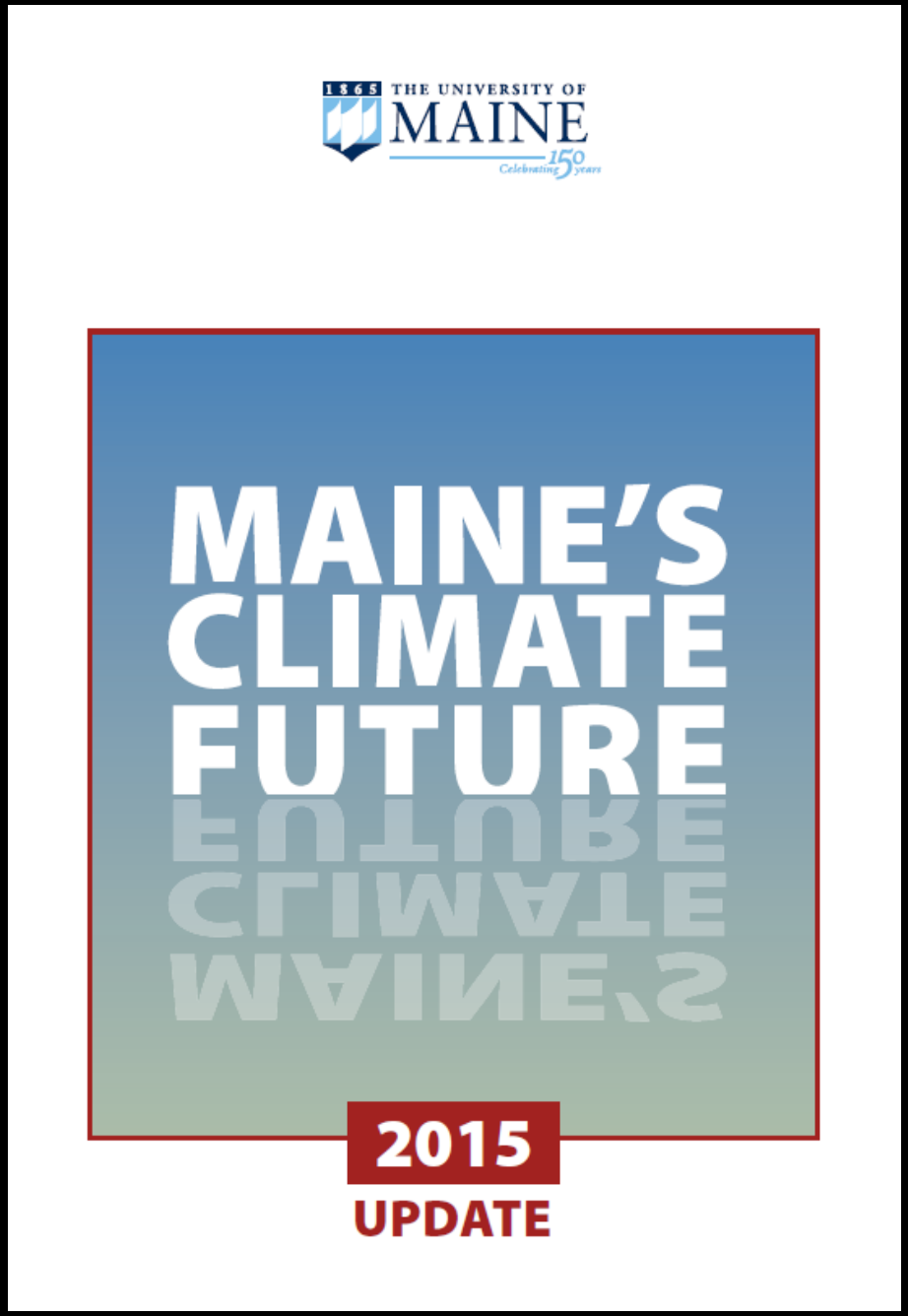
- What is the climate signal in Maine that influences our soil management decisions?
- How do these affect soils?
- How do we respond in managing our soils?



Fernandez, I.J., C.V. Schmitt, S.D. Birkel, E. Stancioff, A.J. Pershing, J.T. Kelley, J.A. Runge, G.L. Jacobson, and P.A. Mayewski. 2015. Maine's Climate Future: 2015 Update. Orono, ME: University of Maine. 24pp.

Maine's Climate Future Dashboard

	Last 100 years	By ≈2050
Air Temperatures	+3°F	+1-3°F
Warm Season	+2 wks	+2 wks
High Heat Index Days/Yr	0-5	1-15 (more coastal)
Precipitation	+13%	+5-10%
Snow	-7%	-20 to -40%
Ocean Temperature	+0.01°F/Yr	+0.41°F/Yr (>99% world)
Sea Level Rise	**+0.62 ft.**	**+0.5 to 2 ft. (3 ft. or >>!)**

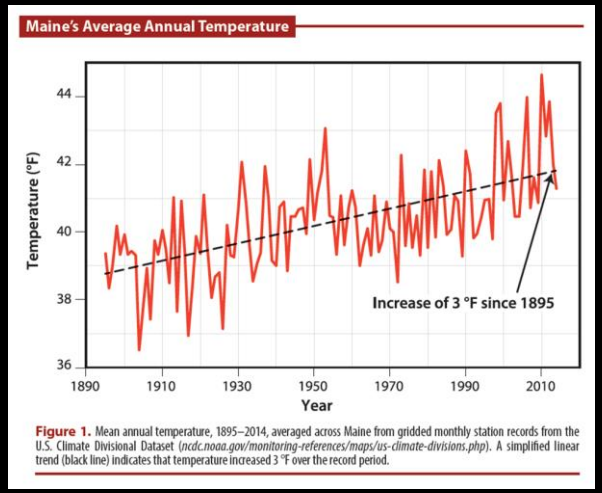


Figure 1. Mean annual temperature, 1895–2014, averaged across Maine from gridded monthly station records from the U.S. Climate Divisional Dataset (*ncdc.noaa.gov/monitoring-references/maps/us-climate-divisions.php*). A simplified linear trend (black line) indicates that temperature increased 3 °F over the record period.

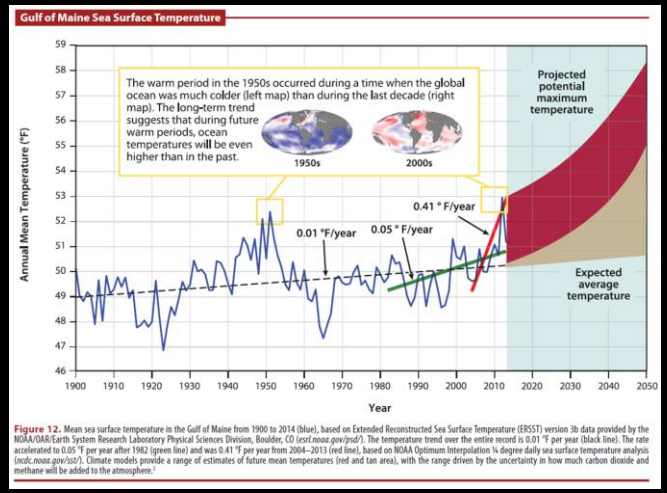


Figure 12. Mean sea surface temperature in the Gulf of Maine from 1900 to 2014 (blue), based on Extended Reconstructed Sea Surface Temperature (ERSST) version 3b data provided by the NOAA/OAR/Earth System Research Laboratory Physical Sciences Division, Boulder, CO (*esrl.noaa.gov/psd/*). The temperature trend over the entire record is 0.01 °F per year (black line). The rate accelerated to 0.05 °F per year after 1982 (green line) and was 0.41 °F per year from 2004–2013 (red line), based on NOAA Optimum Interpolation ¼ degree daily sea surface temperature analysis (*ncdc.noaa.gov/sst/*). Climate models provide a range of estimates of future mean temperatures (red and tan area), with the range driven by the uncertainty in how much carbon dioxide and methane will be added to the atmosphere.[2]

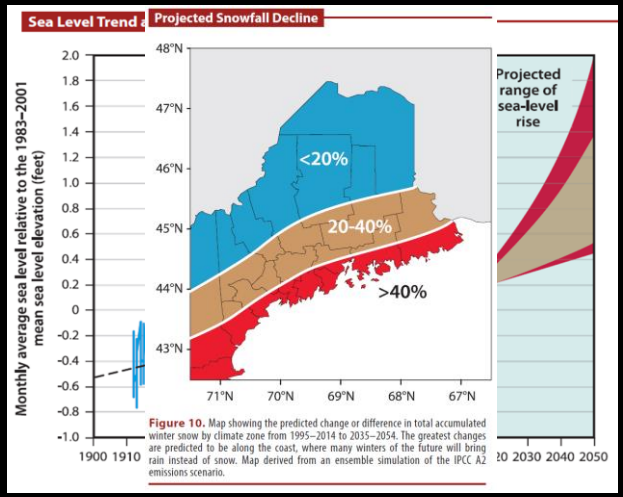


Figure 10. Map showing the predicted change or difference in total accumulated winter snow by climate zone from 1995–2014 to 2035–2054. The greatest changes are predicted to be along the coast, where many winters of the future will bring rain instead of snow. Map derived from an ensemble simulation of the IPCC A2 emissions scenario.

How does climate change affect Maine soils?

- **Higher temperatures →**
  - Warmer soils
  - Earlier spring
  - Longer growing season
  - Loss of snowpack
  - Risk of late spring frost
  - Drought stress
- **Intensified hydrology →**
  - More erosion!!
  - Wetter soils
  - More leaching

What do we want to achieve with our soils?

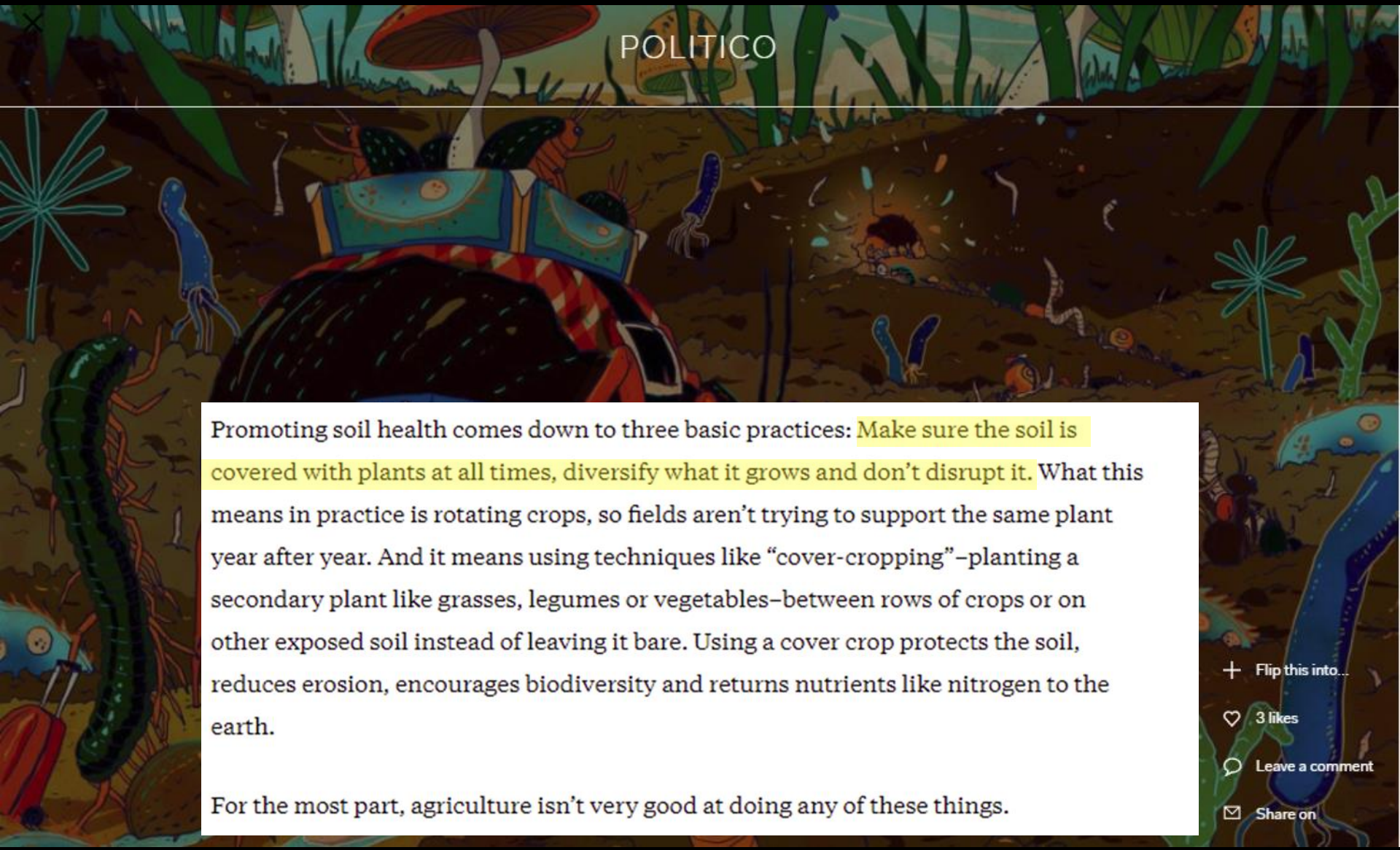
- Retain the soil in place
- Encourage a living soil
- Encourage organic matter accumulation
- Store water for biota
- Store water for flood control
- Readily dispense with excess water
- Avoid the accumulation of pollutants
- Provide for structural support
  - from roots to structural foundations

SOIL HEALTH - also referred to as soil quality, is defined as the continued capacity of soil to function as a *vital living ecosystem* that sustains plants, animals, and humans. This definition speaks to the importance of managing soils so they are sustainable for future generations. (USDA NRCS)

SOIL SECURITY - an overarching concept of soil motivated by sustainable development, is concerned with the maintenance and improvement of the *global soil resource* to produce food, fibre and fresh water, contribute to energy and climate sustainability, and to maintain the biodiversity and the overall protection of the ecosystem. Security is used here for soil in the same sense that it is used widely for food and water. (McBratney et al. 2014)

SOIL CONSERVATION – the protection of **soil** from *erosion* and other types of deterioration, so as to maintain **soil** fertility and productivity. It generally includes watershed management and water use. (OECD)

SOIL QUALITY – see Soil Health.
SOIL PROTECTION – see Soil Conservation.
SOIL SUSTAINABILITY – all of the above?



POLITICO

Promoting soil health comes down to three basic practices: Make sure the soil is covered with plants at all times, diversify what it grows and don't disrupt it. What this means in practice is rotating crops, so fields aren't trying to support the same plant year after year. And it means using techniques like "cover-cropping"–planting a secondary plant like grasses, legumes or vegetables–between rows of crops or on other exposed soil instead of leaving it bare. Using a cover crop protects the soil, reduces erosion, encourages biodiversity and returns nutrients like nitrogen to the earth.

For the most part, agriculture isn't very good at doing any of these things.

JOIN THE 4 PER 1000 INITIATIVE

Soils for food security and climate

4 PER 1000
SOILS FOR FOOD SECURITY AND CLIMATE

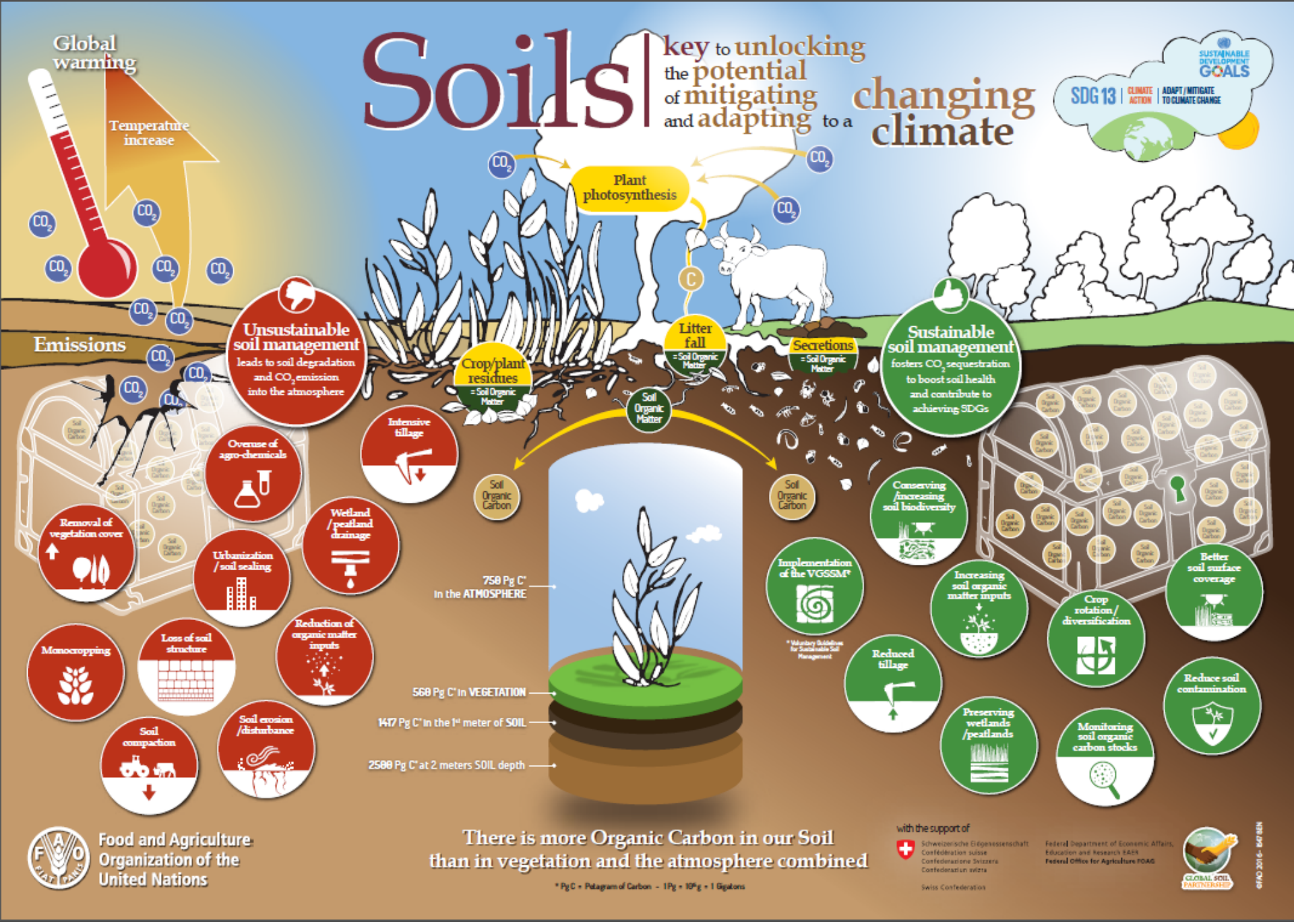
Building on solid, scientific documentation and concrete actions on the ground, the *"4 per 1000 Initiative: soils for food security and climate"* aims to show that **food security and combating climate change are mutually complementary** and to ensure that agriculture is a source of solutions. This initiative consists of a voluntary action plan under the **Global Climate Action Agenda (GCAA)**, backed by an ambitious research program

Table 2

Soil carbon sequestration rates under USDA Natural Resources Conservation Service (NRCS) conservation practices for cropland (adapted from Swan et al. [2015]).

Climate Change Mitigation Building Block	NRCS Conservation Practice Standard Number	NRCS Conservation Practice Standard	Atmospheric/soil benefit (Mg C ha^{-1} y^{-1})
Soil Health	327	Conservation cover (ac) – retiring marginal soils	0.42 to 0.94
	328	Conservation crop rotation (ac)	0.15 to 0.17
	329	Residue and tillage management, no-till (ac)	0.15 to 0.27
	329A	Strip till (ac)	0.07 to 0.17
	329B	Mulch till (ac)	0.07 to 0.18
	330	Contour farming (ac)	0.07 to 0.19
	332	Contour buffer strips (ac)	0.42 to 0.94
	340	Cover crop (ac)	0.15 to 0.22
	345	Residue and tillage management, reduced till (ac)	0.02 to 0.15
	386	Field border (ac)	0.42 to 0.94
	393	Filter strips (ac)	0.42 to 0.95
	412	Grassed waterways (ac)	0.42 to 0.96
	585	Strip-cropping (ac)	0.02 to 0.17
	601	Vegetative barriers (ft)	0.42 to 0.94
	603	Herbaceous wind barriers (ft)	0.42 to 0.95

Adams et al. 2016. Soil carbon sequestration potential of US croplands and grasslands: Implementing the 4 per Thousand Initiative. J. Soil Water Cons. 71(3):68A-74A.



Secure | https://umaine.edu/climate-ag/

Apps | University of Maine S | CCI | Google | Google Maps | Raymond H. Fogler L | Research.gov | Weather | ORSP | Orono, ME (04469) F | Other bookmarks

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Maine Climate and Ag Network

Home | Researchers | Publications | Additional Web Resources | Farm Response to Changing Weather | Spring 2017 Mini-Symposium

Who We Are

The Maine Climate and Agriculture Network was initiated by faculty at the University of Maine to increase communication and coordination among those working on issues related to climate and agriculture. This web site provides an initial portal to some of the climate related activities at the University of Maine, and serves as an invitation to those with an interest in this topic to participate. The Maine Climate and Agriculture Network is intended to be a transparent and inclusive framework that will represent agricultural concerns and activities in the broader conversations on climate change

Climate and Ag in the News

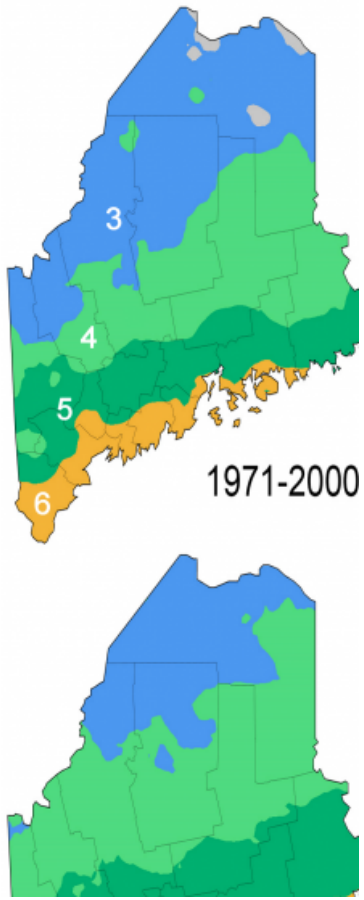
UMaine researchers to receive USDA funds for climate adaption project with UVM

Wet winter, spring alleviate drought conditions in state

UMaine report cited in Sun Journal article on Maine's changing climate

Farm Response to Changing Weather

Changes in average and extreme weather are affecting Maine agriculture, bringing both risks and potential opportunities. Here are some observations of how Maine weather is now different from the past, what may lie ahead, and examples of farmer choices and actions that can minimize risk and help ensure productivity.



Temperature

Longer Growing Season and Plant Hardiness Zone Shift

- The average length of Maine's frost-free growing season is now 12–14 days longer than in 1930, and is expected to further increase by 2–3 days per decade.
- Winter minimum temperatures that define plant hardiness zones are increasing faster than daily highs or temperatures in other seasons.

Potential Response Actions

- Choose longer season crops or varieties, or be flexible with earlier or later planting dates for current selections.
- Double cropping, inter-cropping, and greater use of cover crops.

Early Spring Warm-up Increases Frost/Freeze Risk

- Late winter/early spring temperature variability has caused early crop development before the last spring freeze date. This affected apple and other Maine crops in 2012 and 2016.

Questions?

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