
Kyle C. McDonald

Department of Earth and Atmospheric Sciences
City College of New York
New York, NY

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Warrenton, VA
Primary Climate Controls to Vegetation Growth

Nemani et al., Science, 2003
Conceptualization of the relationship between landscape water content and the bulk surface resistance to land-atmosphere latent energy and water exchange, vegetation productivity and sequestration of atmospheric CO$_2$. Decreasing water content imposes increasing constraints to CO$_2$ exchange, as do seasonal and episodic freezing. Accumulation of snow during cold seasons allows for increased water availability (high water content) for growth processes after snow melt and landscape thaw.
High Resolution Soil Moisture from SMAP

9 km resolution radar/radiometer combined product
May 4 - May 11, 2015

Important caveat: Soil Moisture retrieval fails for dense vegetation cover
Science Implications

Importance of Freeze/Thaw

Conceptual diagram showing the general effects of freeze/thaw status and snow on meteorological, hydrological, and ecosystem processes throughout the year.

Cline, et al.
Freeze/Thaw and Moisture Influence on Carbon Flux in Arctic-Boreal Ecosystems
Peatland C Budget*

(NPP – Rh ≈ 200-300 Tg C/y)

CO₂

Living Biomass

Water Table

DOC

Fire

Outgassing

CO₂ (25-40 Tg C/y)

CO₂ (25-50 Tg C/y)

CH₄ (45 Tg C/y)

Aerobic Rh

Anaerobic Rh

DOC

Litter

Org C

Subsurface Flow (Qsb)

From Upslope

To Ocean

Streams

(25 Tg C/y)

Carbon balance = f(NPP, T, water table, fire, DOC export)

* Extremely crude estimates!

Bohn, et al.
Seasonal Methane Flux

Zona et al., PNAS, 2016
(a) high-frequency channels indicate snowmelt for the majority of Alaska, apart from the North Slope, (b) bulk thaw begins in the south-western marine-forest and tundra. (c) Snowmelt subsides for a majority of the boreal forest in May, 2004, (d) as the landscape thaw dominates. (e) During September, C and X-band spectral gradients indicate a bulk soil refreeze and the establishment of a snow-cover starting in the North-Slope, Brooks-Range and Mackenzie Delta. (f) In October, thawed soils persist over a majority of Western Alaska and southerly Boreal Forests.

Steiner et al., in prep
ALOS-PALSAR – Wetlands Product

Clewley et al
ALOS SCANSAR INUNDATED WETLANDS PRODUCTS

Fraction of $1^\circ \times 1^\circ$ area with inundated vegetation (seasonal maximum)

Chapman et al
Flood Pulse of Amazonian Wetlands: ALOS ScanSAR Time Series

An ALOS Kyoto & Carbon Initiative Wetlands Theme Product

Start date: 4 Nov 2006
End date: 7 Nov 2007
Repeat interval: 46 days

ALOS PALSAR, ScanSAR mode
L-band, HH-pol
350-km swath width
100 m pixel
Wetland vegetation and inundation period product is derived based on changes in flooding state on multi-date ScanSAR.

Temp [deg C x 10]
AMSR-E Climatology: LST Mean (2003-2011)
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