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The Freeze-Thaw Earth System Data Record (FT-ESDR)

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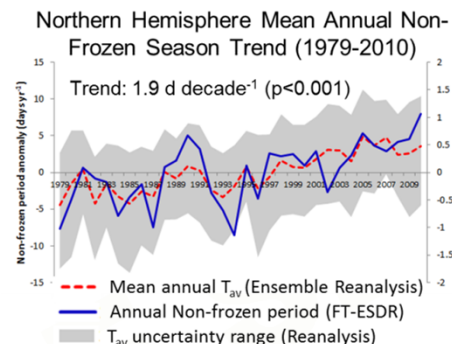


The Freeze-Thaw Earth System Data Record (FT-ESDR)

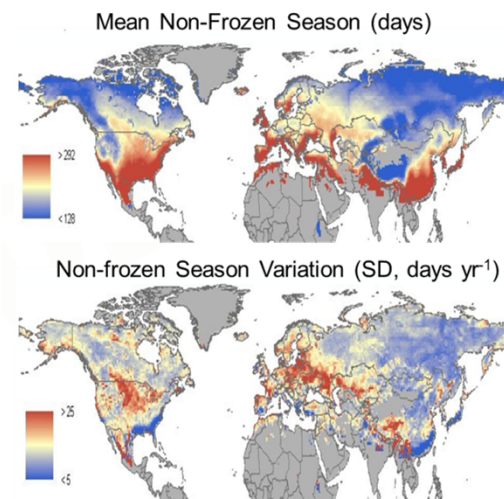
PI: John S. Kimball / The University of Montana

Objectives

- Construct consistent long-term global record of landscape freeze-thaw (FT) dynamics for areas where frozen temperatures are a major constraint to ecosystem processes;
- Distinguish FT heterogeneity in accordance with mesoscale climate, terrain & land cover variability;
- Establish FT links to productivity & net CO₂ exchange;
- Distinguish FT seasonal & annual variability from longer-term climate trends.



Source: Kim et al. 2012. *Rem. Sens. Environ.* 121.



Approach

- Calibration & integration of satellite microwave (37V GHz) brightness temperature (*T_b*) records from SMMR, SSM/I & AMSR-E;
- Temporal change classification of daily (AM & PM overpass) *T_b* series using seasonal frozen & non-frozen *T_b* reference states on a grid cell-wise basis;
- Four FT classification levels: **Frozen** (AM & PM); **Non-Frozen** (AM & PM); **Transitional** (AM frozen, PM non-frozen); **Inverse-Transitional** (AM non-frozen, PM frozen);
- Primary validation using in-situ temperatures from ~3700 global weather stations.

Co-Is: Y. Kim, J. Glassy (UMT), K. McDonald (JPL)

Key Milestones

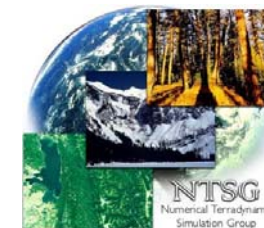
- Oct-2010: Release of FT-ESDR, Vers. 1 (1987-2008).
- Dec-2012: Release of FT-ESDR, V.2 (1979-2010)
- Jul-2013: FT-ESDR served >4,800 unique users; directly contributed to >16 peer-reviewed journal publications; used or cited in >28 other peer-reviewed publications.

FT-ESDR access at NSIDC DAAC:

<http://nsidc.org/data/nsidc-0477.html>

FT-ESDR methods paper:

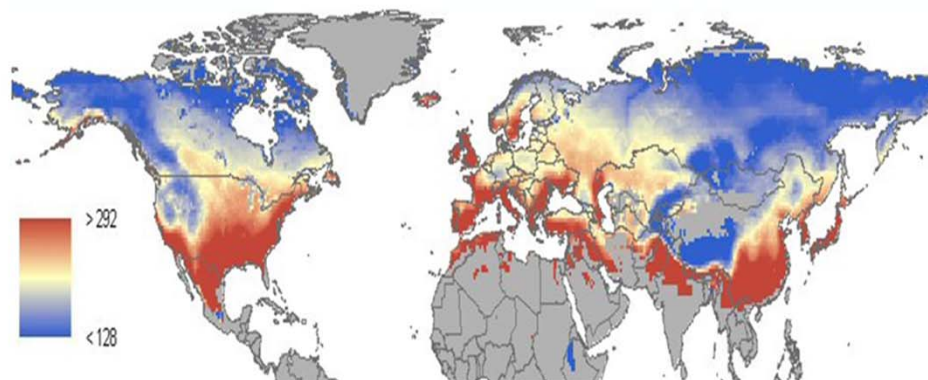
Kim et al. 2012. *Rem. Sens. Environ.* 121



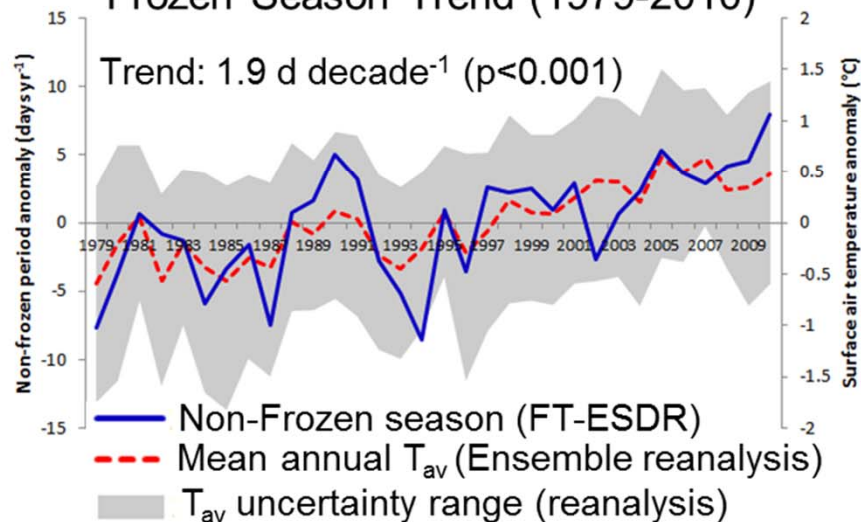
Satellite Detection of Recent Northern Hemisphere Non-Frozen Season Trends (1979-2010)

- 32-yr global daily freeze-thaw record (FT-ESDR) developed from overlapping satellite microwave (37V GHz) remote sensing (SMMR, SSM/I);
- Defines effective frozen temperature constraints to surface water mobility & vegetation growing seasons;
- Large spatial/temporal variability in non-frozen (NF) season timing & length (sum of classified NF days);
- Strong ($p < 0.001$) NH trend toward earlier, longer NF seasons ($1.9 \text{ d decade}^{-1}$) congruent with $\sim 0.3^\circ\text{C}$ decadal warming trend;

Mean Non-frozen Season (days)



Northern Hemisphere Mean Annual Non-Frozen Season Trend (1979-2010)



Non-frozen Season Variation (SD, days yr⁻¹)

