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CONTROL ID: 1815949

TITLE: Land Surface Phenologies and Seasonalities Using Cool Earthlight in the Major Grain Production Areas of Russia, Ukraine, and Kazakhstan

ABSTRACT BODY: Phenology deals with timing of biotic phenomena and seasonality concerns temporal patterns of abiotic variables. Studies of land surface phenology (LSP) and land surface seasonality (LSS) have long been limited to visible to near infrared (VNIR) wavelengths, despite degradation by atmospheric effects and solar illumination constraints. Enhanced land surface parameters derived from passive microwave data enable improved temporal monitoring of agricultural land surface dynamics compared to the vegetation index data available from VNIR data. LSPs and LSSs in grain growing regions of Russia, Ukraine and Kazakhstan were characterized using AMSR-E enhanced land surface parameters for the period from April through October for 2003 through 2010. Growing degree-days (GDDs) were calculated from AMSR-E air temperature retrievals using both ascending and descending passes with a base of 0° C and then accumulated (AGDD) with an annual restart each April 1st. Tracking the AMSR-E parameters as a function of AGDD revealed the expected seasonal pattern of thermal limitation in high latitude croplands. Vegetation optical depth (VOD), a microwave analog of a vegetation index, was modeled as a function of AGDD with the resulting fitted convex quadratic models yielding both high coefficients of determination ($r2 > 0.90$) and phenometrics that could characterize cropland dynamics in our study sites. The AMSR-E data were also able to capture the effects of the 2010 heat wave that devastated grain production in European Russia. These results showed the potential of AMSR-E in monitoring and modeling cropland dynamics.

CURRENT SECTION/FOCUS GROUP: Global Environmental Change (GC)

CURRENT SESSION: GC049. Environmental, Socio-Economic and Climatic Changes in Northern Eurasia and their Feedbacks to the Global Earth System

INDEX TERMS: 1640 GLOBAL CHANGE Remote sensing, 0438 BIOGEOSCIENCES Diel, seasonal, and annual cycles , 0402 BIOGEOSCIENCES Agricultural systems.

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TITLE OF TEAM:

(No Image Selected)

(No Table Selected)

PRESENTATION TYPE: Poster Requested