



20 Years of Flux Observations at MMSF – Turbulent Tall Tower Tales

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SAL ZONE NO SUNS DO DOGS IND. DEPT. OF NATURAL RESO RCES

WILDLIFE IMPROVEMENT WOODLAND GAME MARG PROJECT INDIANA DEPARTMENT OF NATURAL RESOURCES







August 28-29, 1997



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Measurements of CO₂ and energy fluxes over a mixed hardwood forest in the mid-western United States

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Received 28 June 1999; received in revised form 13 March 2000; accepted 14 March 2000







Available online at www.sciencedirect.com

SCIENCE DIRECT.

AGRICULTURAL AND FOREST METEOROLOGY

Agricultural and Forest Meteorology 133 (2005) 140-152

www.elsevier.com/locate/agrformet

Flow divergence and density flows above and below a deciduous forest Part I. Non-zero mean vertical wind above canopy N.J. Froelich^a, H.P. Schmid^{a,*}, C.S.B. Grimmond^a, H.-B. Su^b, A.J. Oliphant^c ^a Atmospheric Science Program, Department of Geography, Indiana University, 701 E. Kirkwood Avenue, Bloomington, IN 47405, USA ^b East Carolina University, Greenfield, NC 27858, USA ^c San Francisco State University, San Francisco, CA 94132, USA Received 18 April 2005; accepted 13 September 2005 from the ground **(**) Available online at www.sciencedirect.com AGRICULTURAL ScienceDirect AND FOREST METEOROLOGY ELSEVIER Agricultural and Forest Meteorology 138 (2006) 29-43 www.elsevier.com/locate/agrformet Flow divergence and density flows above and below a deciduous forest Part II. Below-canopy thermotopographic flows N.J. Froelich*, H.P. Schmid Indiana University, Bloomington, IN 47405, USA Received 7 September 2005; accepted 2 March 2006



leaking" out of the box, e by the flux sensor?



Thermotopographic Flow – Leaf-On



- Night «—» Up-gully flow with lapse conditions
- Day «—» Down-gully flow with inversion conditions



Nocturnal cooling below a forest canopy: Model and evaluation

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Night «---» Down-gully flow with inversion conditions
Day «---» Up-gully flow with lapse conditions



Hourly Fluxes of CO₂ over 8 Years (MMSF)

NEE: Net Ecosystem Exchange = Respiration - Assimilation



Annual Net Ecosystem Productivity (NEP)



What could drive a decadal trend in NEP?

Dragoni et al. (2010), Global Change Biology 10.1111/j.1365-2486.2010.02281.x

Increasing Knowledge = Identifying Something Unusual and Trying to Explain it



Dragoni et al. (2010), Global Change Biology 10.1111/j.1365-2486.2010.02281.x

Were 2004 & 2005 Climatically Unusual?



- 2004 & 2005 do not stand out climatically
- (similarly "average" in PAR, humidity, etc.)
- NEE "pulse" is not due to climatic forcing

Unusual Physiology Indices in 2004/2005?



- 2004 & 2005 do stand out physiologically
- higher water use, and light use efficiencies

What can cause these Effects ? ... 2004 was the Year of the Brood X Cicada



17 year periodical cicada: next emergence in 2021



Periodical Cicada

- 17 years or 13 years
- Brood X (17 yr) is largest
- IN,IL,OH,KY; centered on southern Indiana
- other branch in DC area

- root xylem feeders
- no feeding after emergence
- emergence within a few days
- mate and die in ~ 2-3 weeks
- oviposition in tree-branches
- young nymphs fall off and enter soil after a few days
- nymphs grow over 17 years



Coming to a forest near here in 2021!

Annual Net Ecosystem Productivity (NEP)



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Global Change Biology

Evidence of increased net ecosystem productivity associated with a longer vegetated season in a deciduous forest in south-central Indiana, USA D Dragoni, HP Schmid, CA Wayson, H Potter, CSB Grimmond & JC Randolph (2010), doi: 10.1111/j.1365-2486.2010.02281.x

Trend in Net Ecosystem Productivity (NEP)?



NEP related to Season Length ?













8-Day Flux Footprint Composite

Hourly Footprints 2001: YD 217-YD 225 Aug 5 – Aug 13

Decadal Trends: Productivity and Phenology



and **2011**: subtle combination of variability



2012: Warm Early Spring... ... led to early growth season and possibly...



2012: Warm Early Spring... ... led to early growth season and possibly early water deficit



2012: Warm Early Spring... ... led to early growth season and possibly early water deficit



2009 and 2011: both extremely low NEP... ... no "extreme" events, but subtle combination of variability



Back to the original question:

Trend in Net Ecosystem Productivity (NEP) ?

