Investigation of SGP Atmospheric Moisture Budget for CLASIC -- Recycling Study

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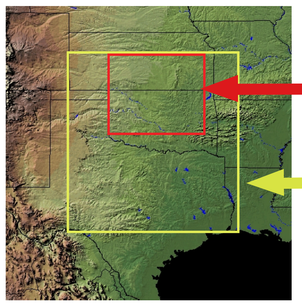
1. Introduction

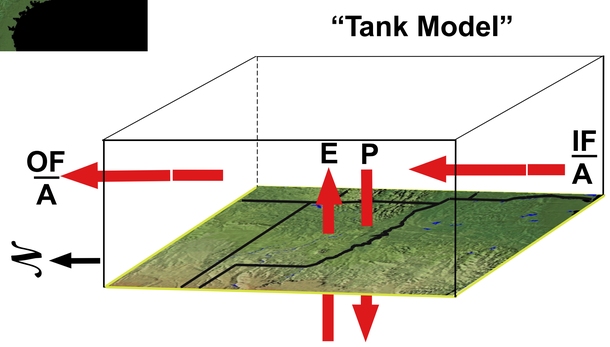
The motivation for this ongoing study is to provide larger-scale background information for the interpretation of the results from the Cloud and Land Surface Interaction Campaign (CLASIC) program that was conducted over the SGP ACRF during June 2007. Moisture budgets are estimated for a large area encompassing the winter wheat belt and the CLASIC field study for May-June periods with contrasting precipitation regimes. Emphasis will be given to the relative contributions to regional precipitation of local vs advective atmospheric water vapor.

2. Orientation Map -- Recycling Method



CLASIC Field Campaign

Study Area



Moisture Budget Equation

$$E - P \equiv \underbrace{\frac{1}{g}\frac{\partial}{\partial t}\int_T^S q\,dp}_{dPW} + \underbrace{\frac{1}{g}\int_T^S \mathbf{V}\bullet\nabla q\,dp}_{HA} + \underbrace{\frac{1}{g}\int_T^S q\nabla\bullet\mathbf{V}\,dp}_{HD}$$

(E-P)

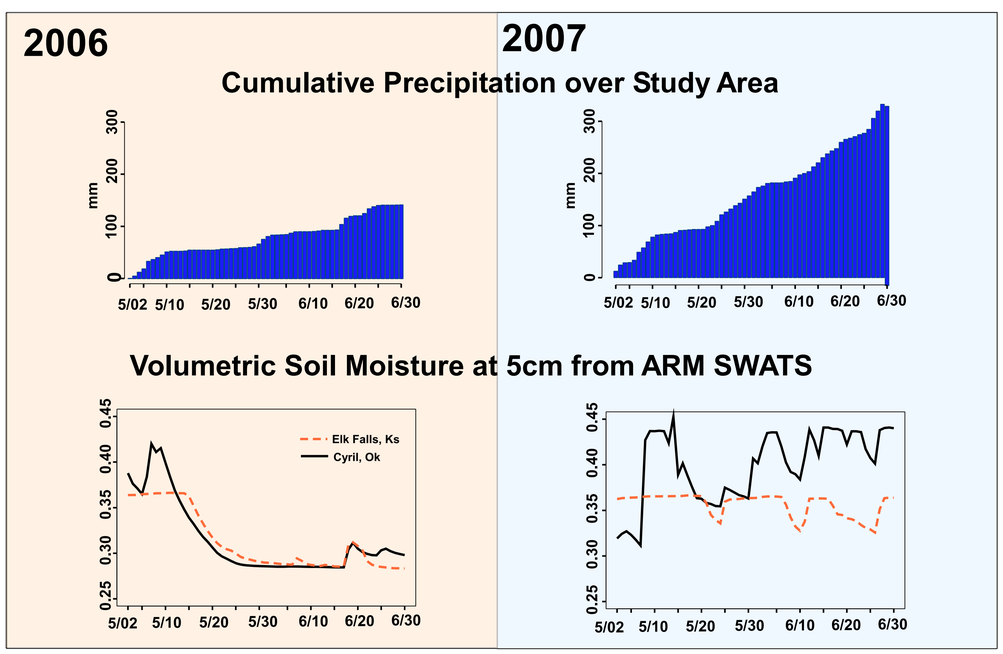
$$HA + HD = -\frac{1}{g}\int_T^S \nabla\bullet q\mathbf{V}\,dp = \frac{1}{Ag}\int_T^S\int q V_n\,dl\,dp = \frac{OF}{A} - \frac{IF}{A}$$

Recycling Ratio

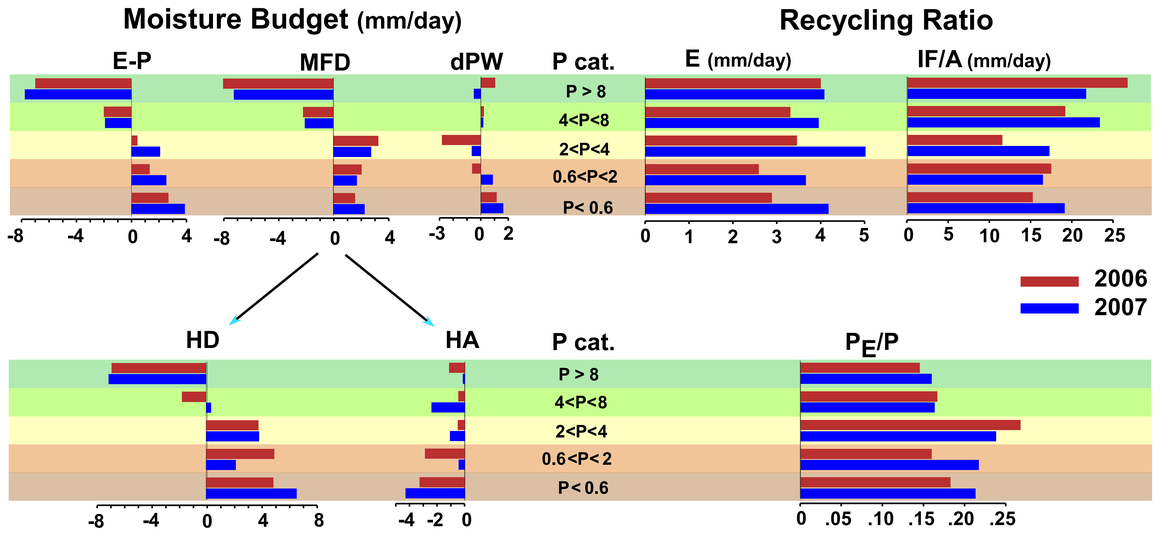
$$\frac{P_{(Local\ Origin)}}{P_{(Local + Advective)}} = \frac{P_E}{P} = \frac{E}{E + \frac{IF}{A}}$$

See Zangvil et al. 2004 for derivation

3. Two very different May-June Periods

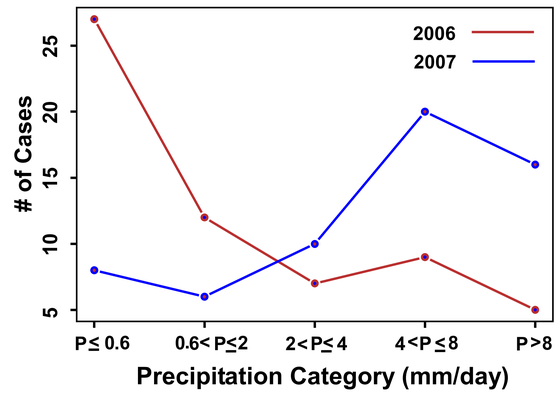


4. Results



Correlation Among Above Components for May - June 2006 and 2007

	E-P	E	P	MFD	HD	HA	dPW	IF/A	P_E/P
E-P	+1.00	+0.20	-0.91	+0.72	+0.76	-0.12	+0.13	-0.24	+0.35
E	+0.20	+1.00	+0.23	+0.08	-0.09	+0.19	+0.10	+0.15	+0.51
P	-0.91	+0.23	+1.00	-0.68	-0.80	+0.21	-0.09	+0.30	-0.13
MFD	+0.72	+0.08	-0.68	+1.00	+0.61	+0.36	-0.60	-0.40	+0.36
HD	+0.76	-0.09	-0.80	+0.61	+1.00	-0.52	+0.01	-0.38	+0.21
HA	-0.12	+0.19	+0.21	+0.36	-0.52	+1.00	-0.66	+0.02	+0.14
dPW	+0.13	+0.10	-0.09	-0.60	+0.01	-0.66	+1.00	+0.28	-0.11
IF/A	-0.24	+0.15	+0.30	-0.40	-0.38	+0.02	+0.28	+1.00	-0.62
P_E/P	+0.35	+0.51	-0.13	+0.36	+0.21	+0.14	-0.11	-0.62	+1.00



- > P is highly correlated with HD (-0.80) and MFD (-0.68)
- > The surplus of E over P is positively correlated with HD (+0.76)
- > Storage (dPW) is negatively correlated with HD (-0.66)
- > Recycling ratio comparison: wet 2007 vs dry 2006
  - P > 4 mm/day: P_E/P is ~ constant.
  - P ≤ 2 mm/day: P_E/P is greater for the wet 2007
  - 2 < P ≤ 4 mm/day: P_E/P is greater for dry 2006 due to reduced IF/A

5. Future Work

This study will be expanded with

- > Extended seasons and more years
- > Different timescales (e.g. diurnal, monthly, seasonal)
- > Inclusion of related environmental data (crop, downward solar, soil moisture)
- > Comparison of E estimates: model, measured, residual

6. References

Zangvil, A, D. H. Portis, and P. J. Lamb, 2004: Investigation of the large-scale atmospheric moisture field over the Midwestern United States in relation to summer precipitation. Part II: Recycling of local evapotranspiration and association with soil moisture and crop yields. *J. Climate*, 17, 3283-3301