GOES Evapotranspiration and Drought (GET-D) Product System

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Introduction

Monitoring evapotranspiration (ET) and the extent and severity of agricultural drought is an important component of food and water security and world crop market assessment. We have developed an operational ET and drought monitoring system using a surface energy balance model Atmosphere–Land Exchange Inversion (ALEXI) model. This system is specifically adapted for Geostationary Operational Environmental Satellite (GOES) data and can provide daily ET and drought information for the North America. Currently the system is tested in the Office of Satellite and Product Operations (OSPO) and will be available to the public in early 2016.

Algorithm Theoretical Description

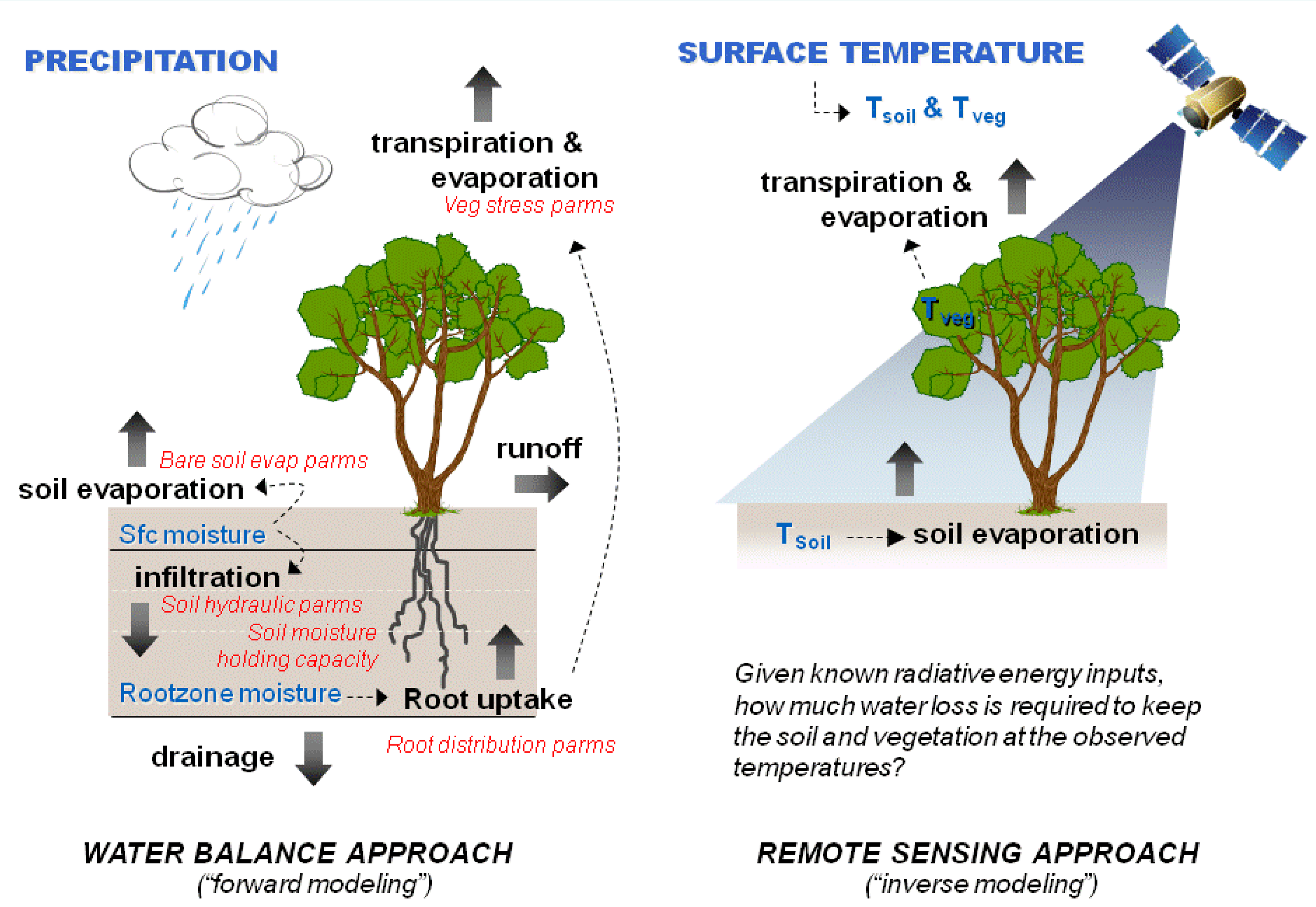

Figure 1. General algorithm of ET computation using water balance approach and remote sensing approach.

ALEXI provides a framework for interpreting LST and vegetation index remote sensing drought signals within the context of a physically based energy balance model. Using brightness temperature measurements at morning times, and initial estimates of near-surface temperature, the surface component of ALEXI yields instantaneous sensible heat flux estimates (Anderson et al. 1997). ALEXI uses a simple slab model to describe the dynamics of the atmospheric boundary layer (ABL) in its ABL component. The sensible heat flux estimates from both the surface and ABL components of ALEXI are iterated until the time-integrated sensible heat flux estimates from both components converge. Then the instantaneous satellite-based flux estimates is extrapolated to daily fluxes by assuming the evaporative fraction is constant during daylight ours for a given day.

GET-D System Architectures

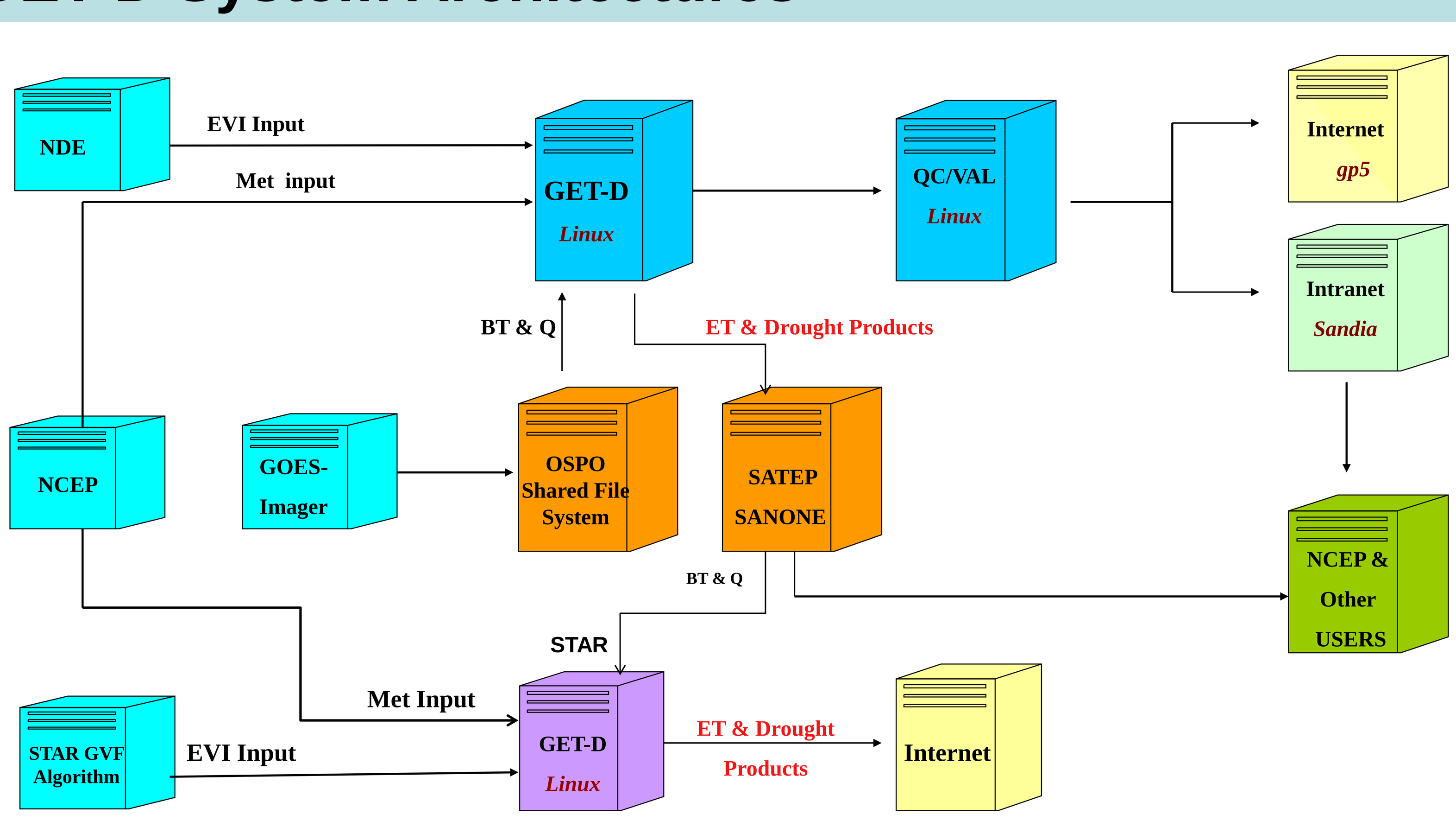

Figure 2. GET-D system architecture

The system uses meteorological inputs from Climate Forecast System reanalysis (CFS) and satellite inputs such as GOES micron channel brightness temperature and VIIRS Enhanced Vegetation Index (EVI) data, to compute the daily ET, potential ET (PET), and other fluxes. The results are then used to compute the Evaporative Stress Index (ESI) as the standardized anomalies in the ET/PET ratio from the climatology. The system has been delivered and tested within the OSPO environment.

Data inputs

Table 1. GET-D major data inputs.

Data Source	Variable Specifications	Resolution	Format	Size
GOES East and West	Band 1, 2, 4	4km	McIDAS	~25 MB
GSIP	Insolation	4km	NetCDF	~20-30 MB
CFS	Meteorological variables	50 km	GRIB2	~60 MB
VIIRS	Global GVF	375m	HDF5	~ 800 MB
IMS	Snow and ice mask	24km	ASCII	< 1MB

Results

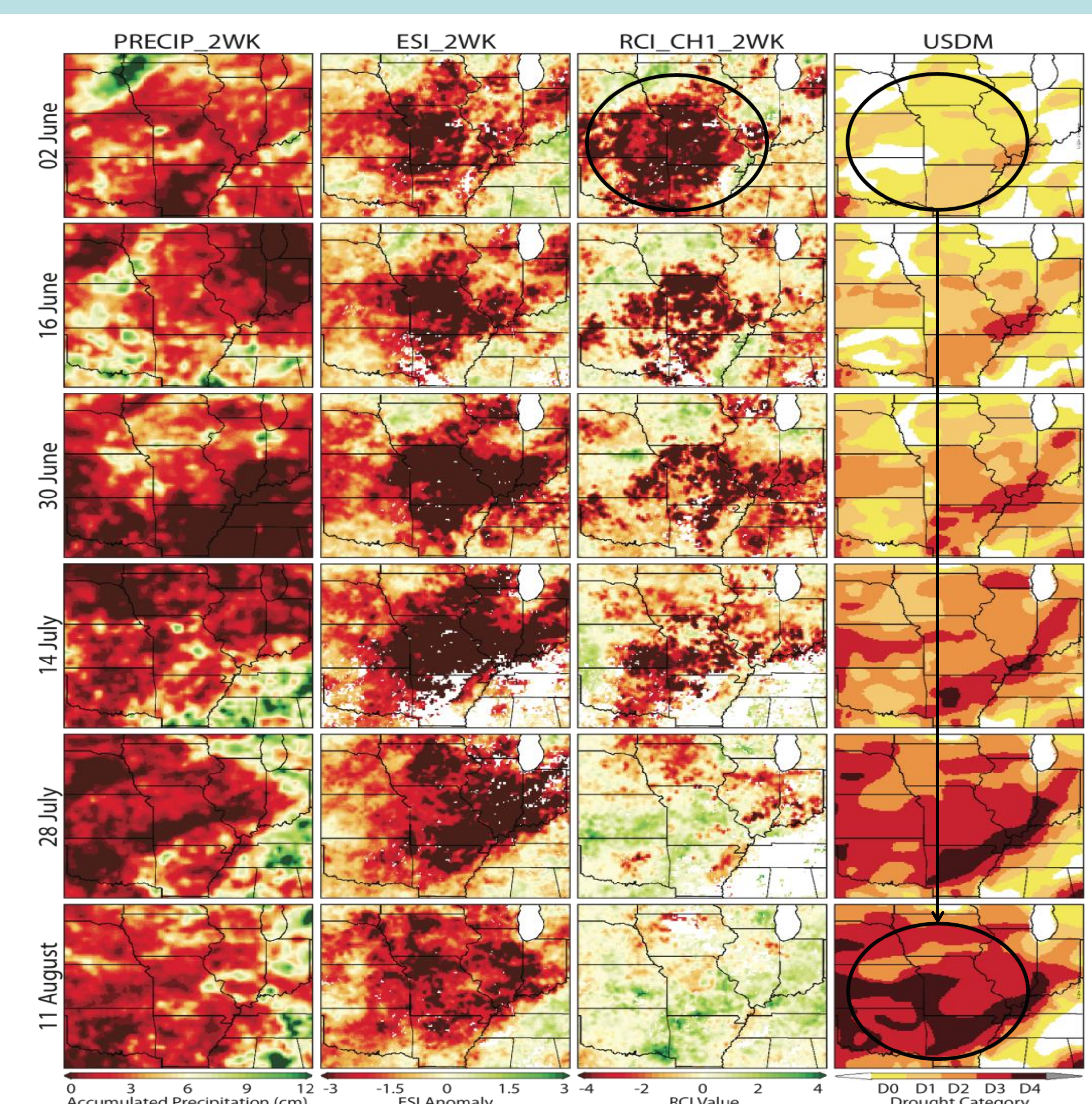

Figure 3. 2012 central U.S. flash drought example

- The ESI represents standardized anomalies in the ET/PET ratio: Negative anomalies indicate drier than normal conditions, whereas positive anomalies indicate wetter conditions
- Large negative RCI values in the top row indicate that moisture stress was rapidly increasing at the beginning of summer
- Impressive scope of the unusually rapid decrease in the ESI anomalies is clearly depicted by the large area of negative RCI values
- Initial appearance of negative RCI values led the introduction of severe drought in the USDM by more than 4 weeks

Summary and future work

- An operational drought monitoring system GETD was developed in NOAA to provide daily ET product and 2, 4, 8, 12 weeks composite ESI at a spatial resolution of 8 km.
- We have adapted the science code into operational software units that implement the GET-D algorithm in accordance with the system design. Currently the system is under final testing and the operational system will be online in early 2016.

Acknowledgements

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References

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