Landsat ET Mapping Applications over Forested Landscapes

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TOOLS

- STARFM: Multi-sensor data fusion
- DMS: Thermal image sharpening
- ALEXI: Multi-scale ET modeling

ASSETS

- GEO: Hourly, 5km/5km
- MODIS: Daily, 250m/1km
- Landsat: 16 day, 30m/100m
- Lsat-like: ~20-60m/ --

APPLICATIONS (daily/30 m)

- Crop phenology metrics
- Crop water use (Evapotranspiration)
- Crop stress (drought early warning)
DATA FUSION:

daily ET at field scale

SURFACE TEMPERATURE

EVAPOTRANSPIRATION

GEO (ISCCP)

GEO (GOES Sounder)

GEO (GOES Imager)

Polar (MODIS)

Polar (Landsat)

Airborne (USU aircraft)

Global

Continental

Regional

Basin

Watershed

Field scale

Temperature (C)

Latent Heat (W/m²)

1 July 2002 – 10:30AM LST

1 LS – 16 day

2 LS – 8 day
GOES/MODIS/Landsat FUSION

Daily Evapotranspiration – Orlando, FL, 2002

Spatial Temporal Adaptive Reflectance Fusion Model (STARFM) (Gao et al, 2006)
Loblolly Pine Plantation, NC

**ALEXI/DisALEXI**

**LST:** GOES

**LAI:** MODIS

**HEIGHT:** Landcover, $f_c$

$$h_c = h_{c_{min}} \cdot (1-f_c) + h_{c_{max}} \cdot f_c$$

**MODIS/Landsat**
Gap-filling with STARFM

<table>
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<tr>
<th>STARFM</th>
<th>MODIS ET 104</th>
<th>MODIS ET 96</th>
<th>Landsat ET 104</th>
<th>STARFM ET 96</th>
<th>Gapfilled Landsat ET 96</th>
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mm/day

Landsat Science Team, July 2015
Flux evaluation on Landsat dates

NC2 (20yr)

NC3 (clearcut)

Overpass Time

Daytime

Landsat Science Team, July 2015
Effect of forest management

NC2: Loblolly Pine (2013)

ALEXI ET Observed ET Landsat retrievals Landsat-only Landsat-MODIS fusion

ET (mm/day)

Day of year
Effect of forest management

NC3: Clearcut Pine (2013)

ALEXI ET
Observed ET
Landsat retrievals
Landsat-only
Landsat-MODIS fusion

ET (mm/day)

Day of year
Effect of forest management

Landsat Science Team, July 2015
Pine Plantation Stand Age

Water use variability with stand age

Cumulative ET (mm) vs Stand Age (Year)

- R² = 0.60
- Stand Age 1 or 2

Legend:
- Blue diamonds: less than 20 years
- Red squares: more than 20 years
- Linear (less than 20 years)
Water use variability with land use

Landcover:
- Emergent Herbaceous Wetlands
- Woody Wetlands
- Cultivated Crops
- Pasture/Hay
- Barren Land
- Grassland/Herbaceous
- Shrub
- Mixed Forest
- Evergreen Forest
- Deciduous Forest
- Developed, High Intens
- Developed, Medium Intens
- Developed, Low Intens
- Developed, Open Spac
- Open Water

Landsat overpasses

7-Day Average ET (mm)

Cumulative ET (mm)

Day of Year
Goddard’s LiDAR, Hyperspectral and Thermal Airborne Imaging System

Collaborator B. Cook
Canopy height over Parker Tract

A) TSEB
B) GLiHT
C) Difference

Height (m)
Other G-LiHT inputs to TSEB

A) LST
B) Canopy Height
C) Fraction Cover
D) LAI

NASA G-LiHT airborne system

Landsat Science Team, July 2015
For further investigation:

- Study differences in water balances among different land cover types (natural/managed forests, crops).

- How has ET and runoff (P - ET) in the region changed over time?

- How does forest age affect ET and water yield? How might this kind of information impact management of water yield through forest cutting?

- Can we use Landsat ET to validate watershed/regional hydrological models?

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Bellefoungou Forest

MSG (3km)
MODIS (1km)
L7 (30m)

mm/day