DEVELOPING AND ENHANCING LANDSAT DERIVED EVAPOTRANSPIRATION AND SURFACE ENERGY PRODUCTS

Landsat Science Team Update

Toward Rapid & Accurate Remote Sensing of Evapotranspiration using Landsat

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Recent Work

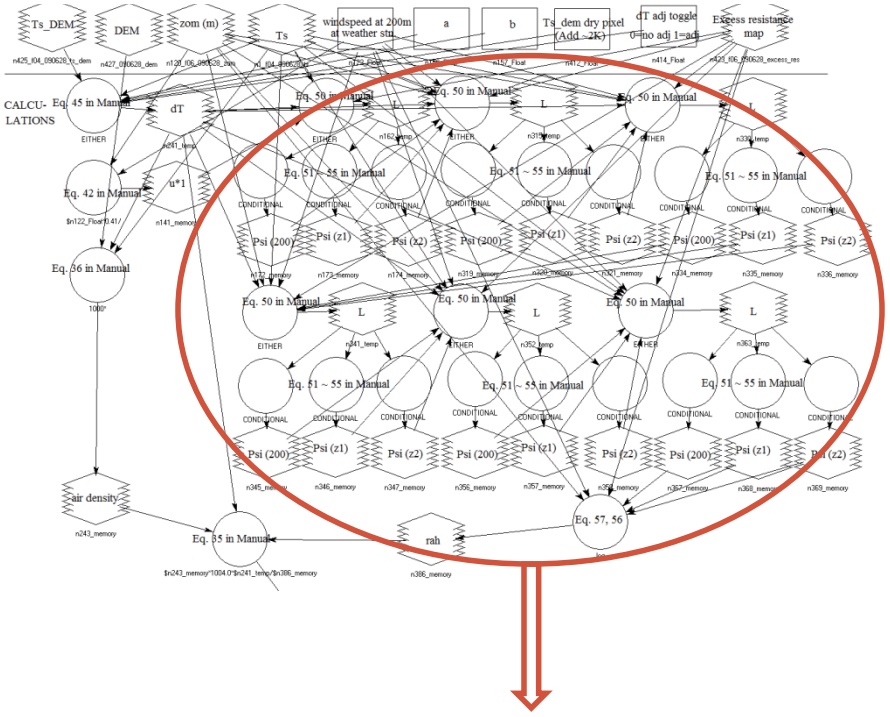
- Automation of Thermal Based Energy Balance Modeling for accurately estimating ET
  - METRIC
  - Integrating and testing automation using LEDAPS at surface reflectance and cloud mask products
  - Ingesting NLDAS gridded surface weather data products and validating against native veg. and agricultural weather station data
  - Conditioning NLDAS data to represent agricultural conditions where needed

- Why Automation and Rapid Processing? Big need to provide answers and solutions in a timely and costly manner

METRIC using ArcGIS, Python, & GDAL

- Easier operation
  - Entire model is run from command line using a single input file
- Improved documentation
  - All processes and parameters are saved to a log file
- Python
  - Open source / open platform programming language
  - Installed with ArcGIS 10
  - All ArcGIS functions can be called directly from Python scripts
- GDAL
  - Open source / open platform GIS libraries
  - ArcGIS is expensive

Traditional sensible heat flux METRIC model in Erdas

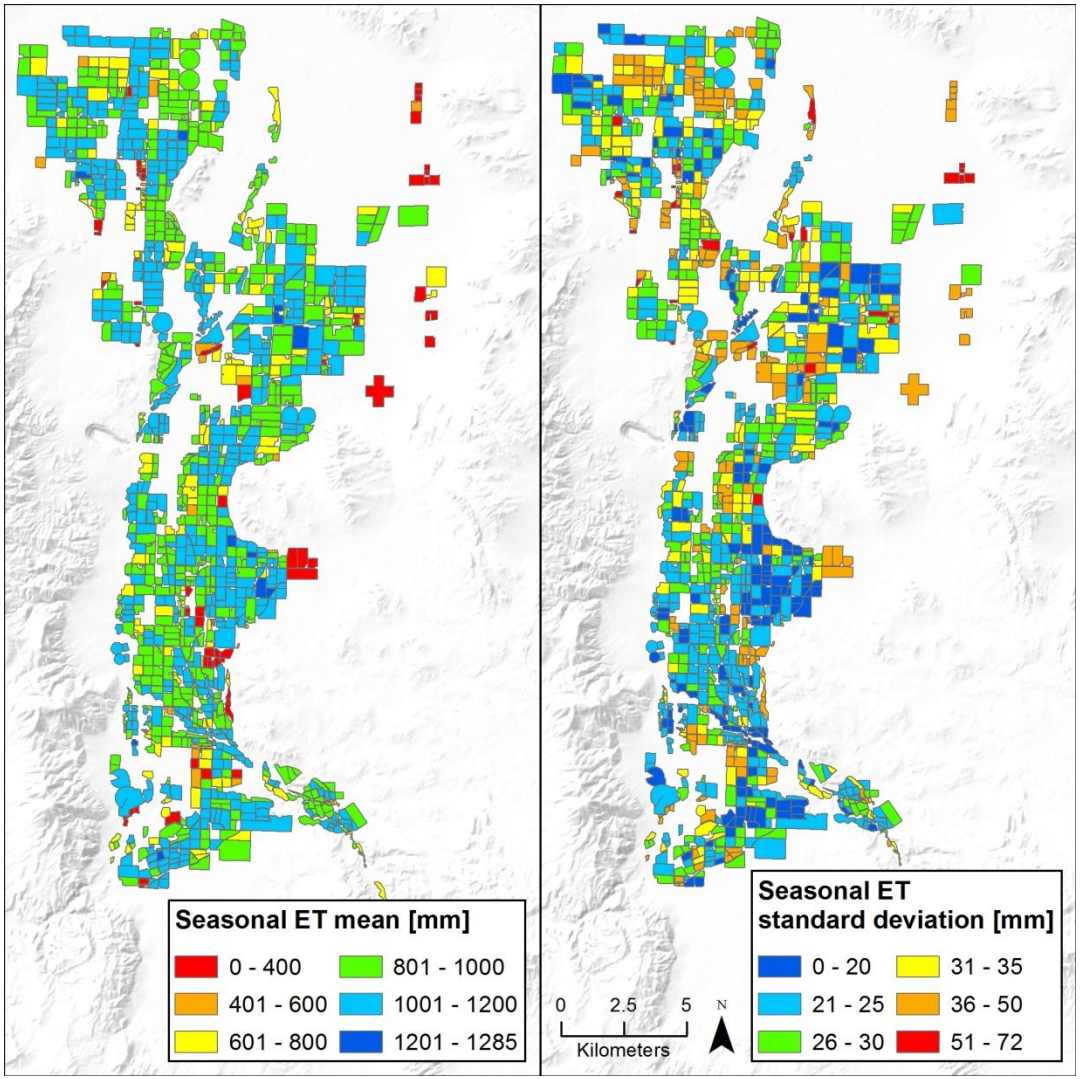


Clipped Python version of METRIC sensible heat flux model

```
for i in range(6):
    u*(u, z, zom, psi_z3)
    rah(z, psi, u*, ex_res)
    l(dt, u*, Ts, rah)
    psi_z3(l, z3)
    psi_z2(l, z2)
    psi_z1(l, z1)
    if stable(): break
```

METRIC Automation Benefits

- Monte Carlo calibration uncertainty of METRIC ET estimates
- Example of per field calibration variability in Mason Valley, NV

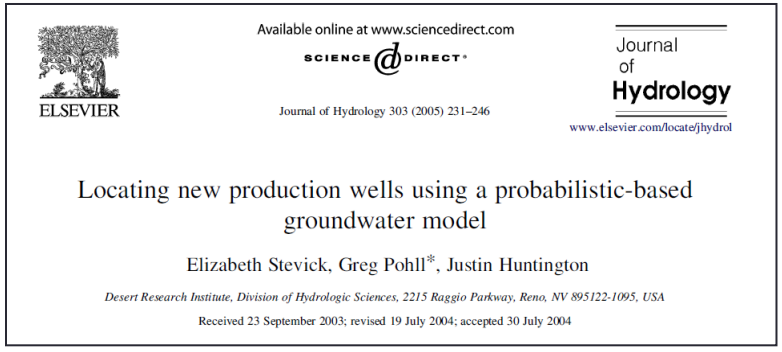


METRIC Automation Benefits

- Team is collaborating with NASA Ames/Cal State Monterey Bay (Forrest Melton)
- METRIC Python is running on the NASA Earth Exchange (NEX) high performance computer and testing ET in Central Valley, CA
- Goal - Run METRIC for entire states / years in one shot, BUT with human QAQC and oversight

Groundwater Recharge Change, Fernley, NV – Took ~ 2 Weeks of Time

- Refining existing groundwater model of Fernley, NV, for analyzing reduced irrigation recharge pumping impacts on TDS capture



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Journal of Hydrology 303 (2005) 231–246

Journal of Hydrology

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Locating new production wells using a probabilistic-based groundwater model

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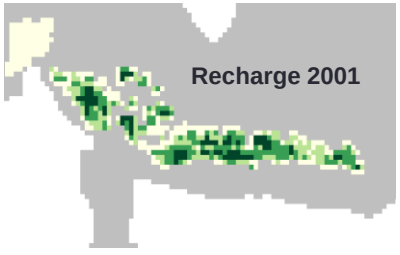
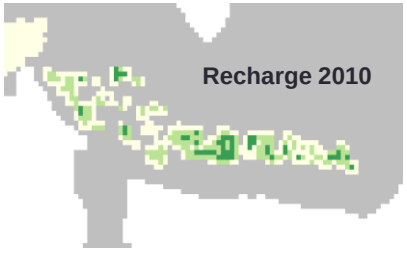
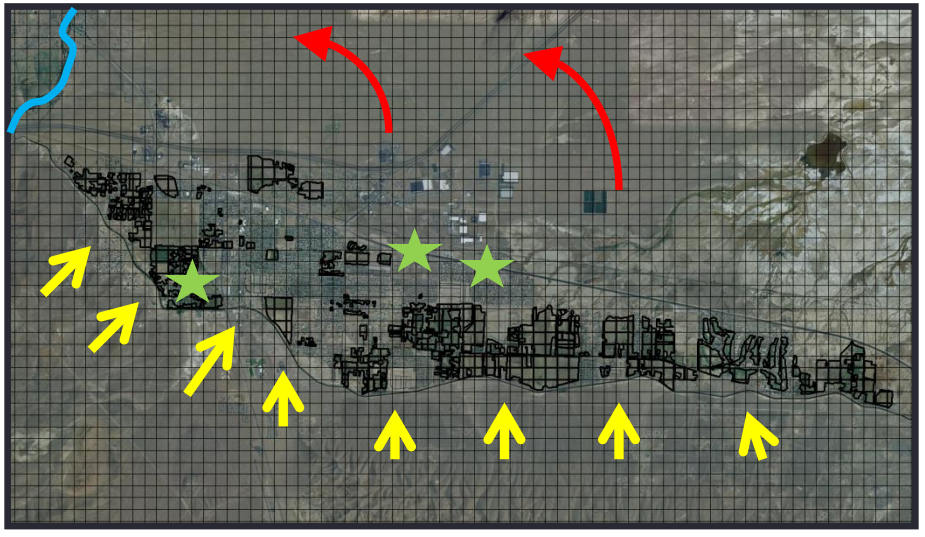
Received 23 September 2003; revised 19 July 2004; accepted 30 July 2004

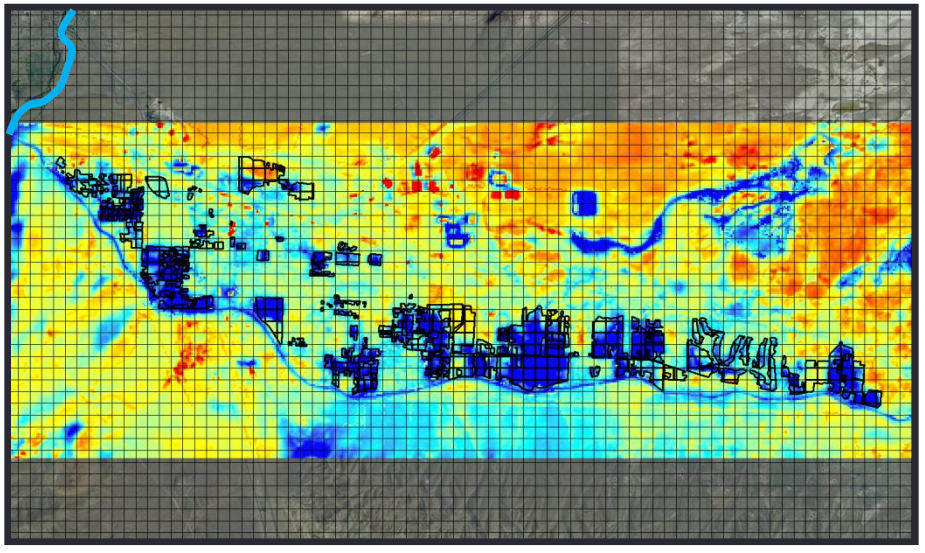
- Past estimates were simply based on a percentage of the diversion volume and adjusted during the calibration process

- Used METRIC ET estimates from irrigated lands to compute recharge from irrigation from 2001 – 2010 during a period when irrigation degreased significantly due to conversion to houses

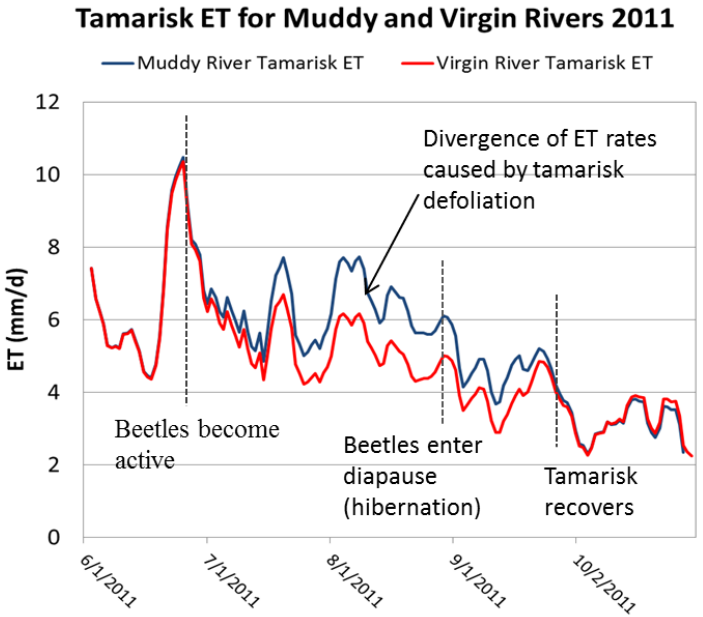








"Reduced ET from Tamarisk Defoliation along the Lower Virgin and Muddy Rivers" – Took Grad Student 2 weeks to complete and present poster



- Classified defoliated areas using a multi-temporal spectral angle mapper approach
- Tamarisk ET estimated using METRIC for 2011 in defoliated and non-defoliated Tamarisk areas
- Estimated total water savings from defoliation along Lower Virgin River in 2011 = 1,200 ac-ft = $10,000,000! (@$ 8,000 /ac-ft)

Summary

- Rapid and batch scene processing is allowing us to answer critical water resource questions in a timely and costly manner

- Future testing on super computers
  - Incorporating and conditioning gridded weather data (WRF, NLDAS, NARR, etc..)
  - Cloud masking and gap filling to replace lost data
  - Time integration between Landsat scenes to develop seasonal ET