ECOSTRESS

ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station

An Earth Venture Instrument-2 Proposal
Submitted in response to
AO NNH12ZDA006O EVI2

Prepared for
National Aeronautics and Space Administration
Science Mission Directorate

L3/4 (PT-JPL) Processing and Products

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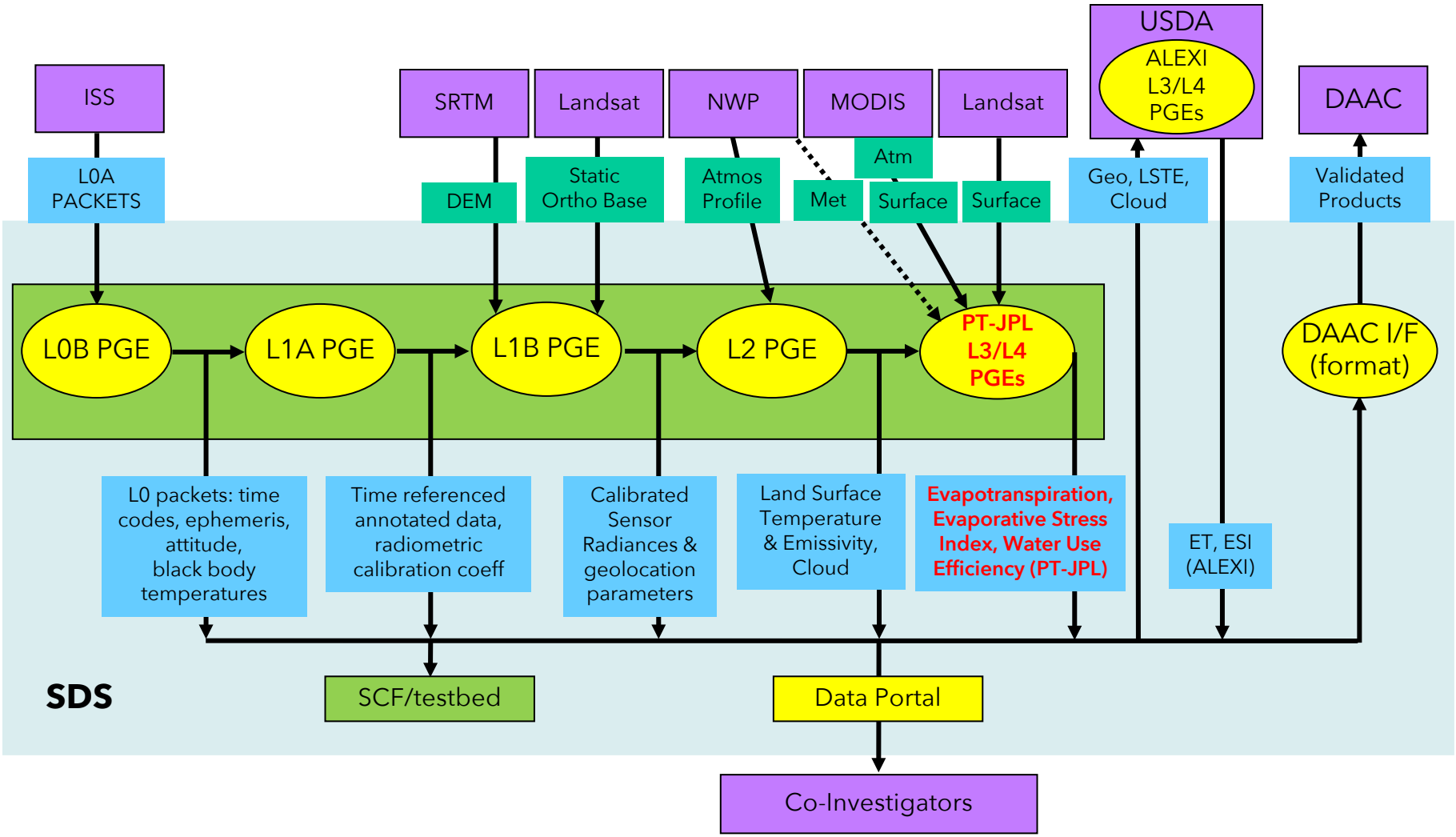
National Aeronautics and Space Administration

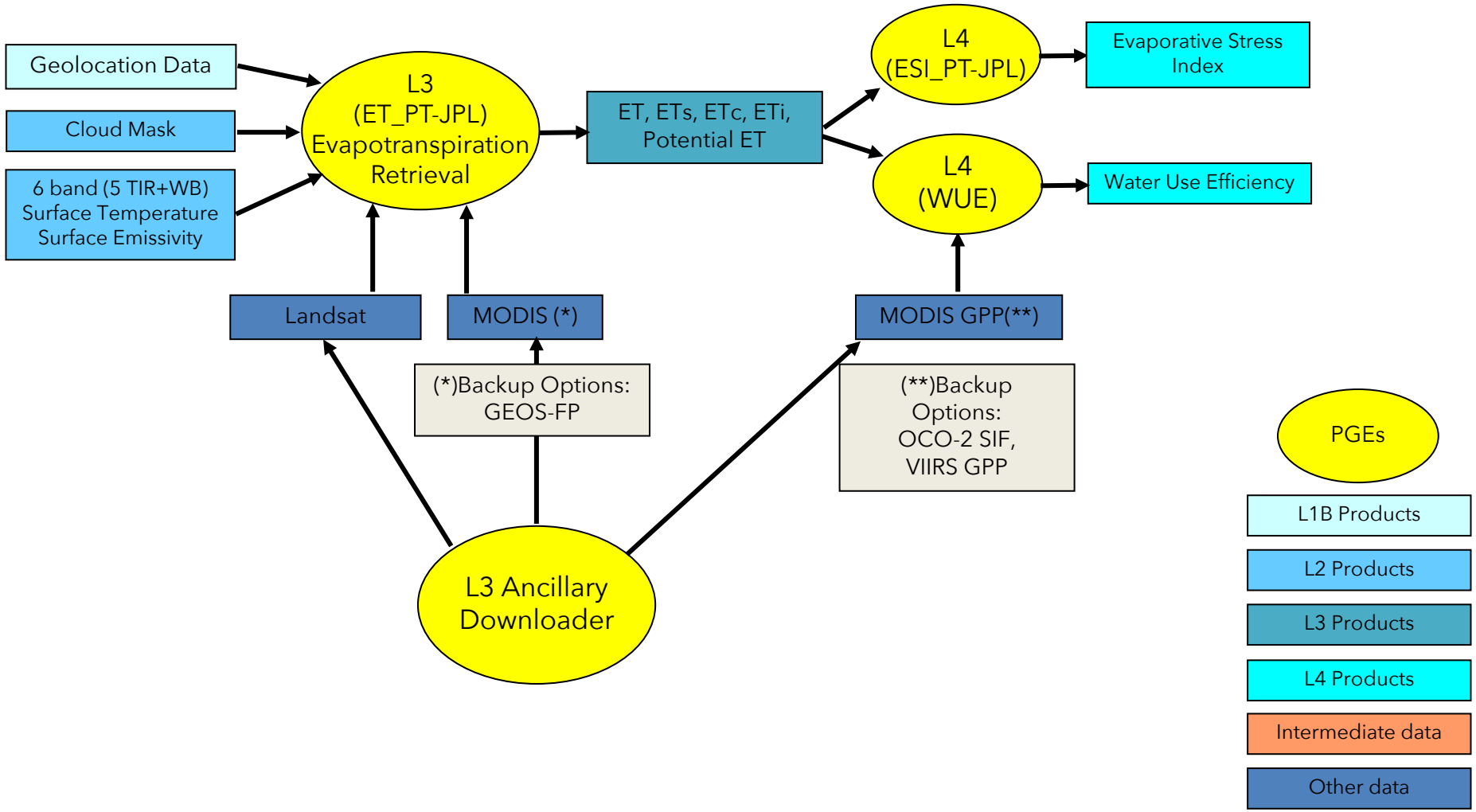
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

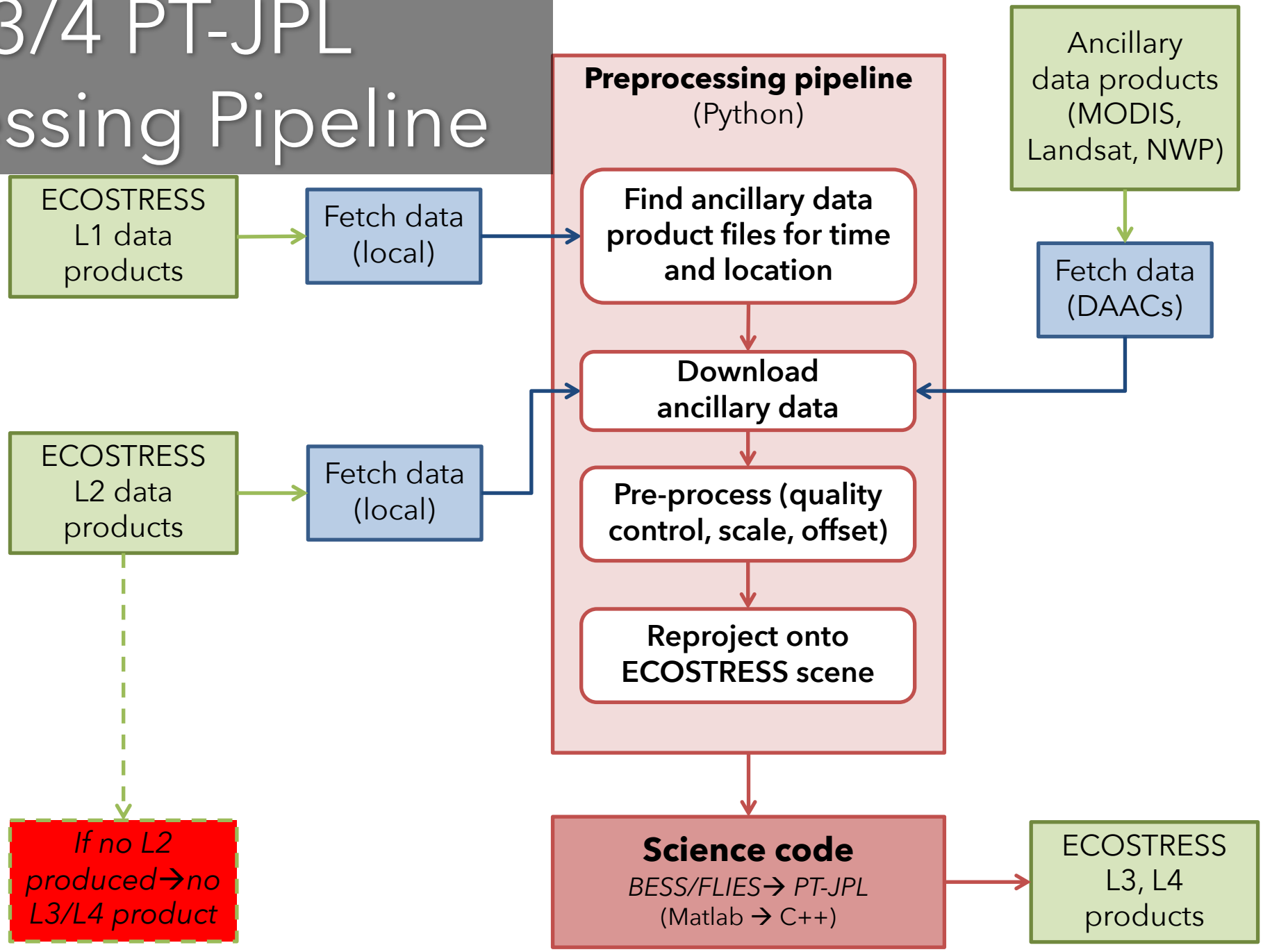
SDS High Level Processing Data Flow



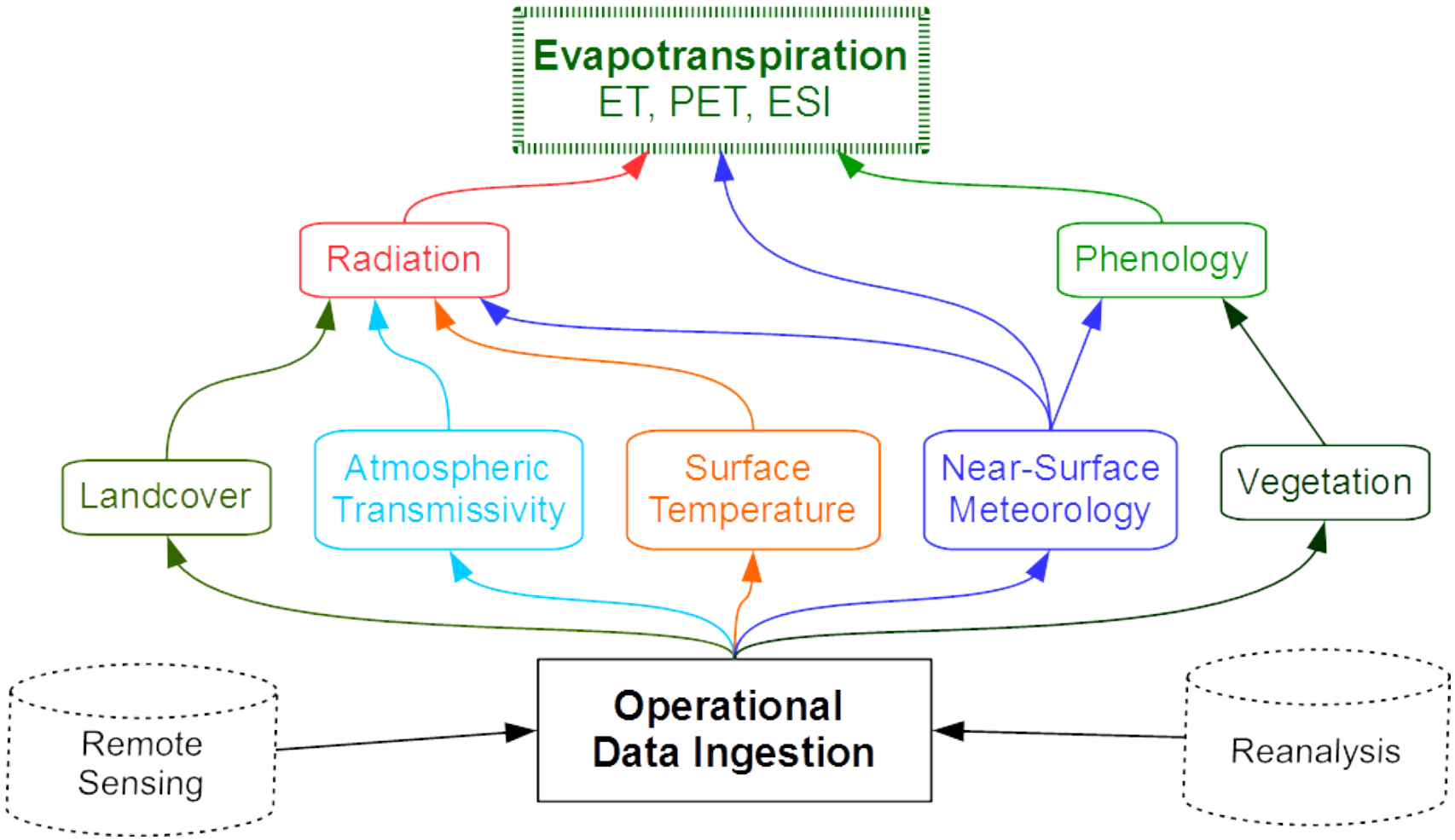
L3/4 PT-JPL Processing Data Flow



L3/4 PT-JPL Processing Pipeline



L3/4 PT-JPL Science Data Flow

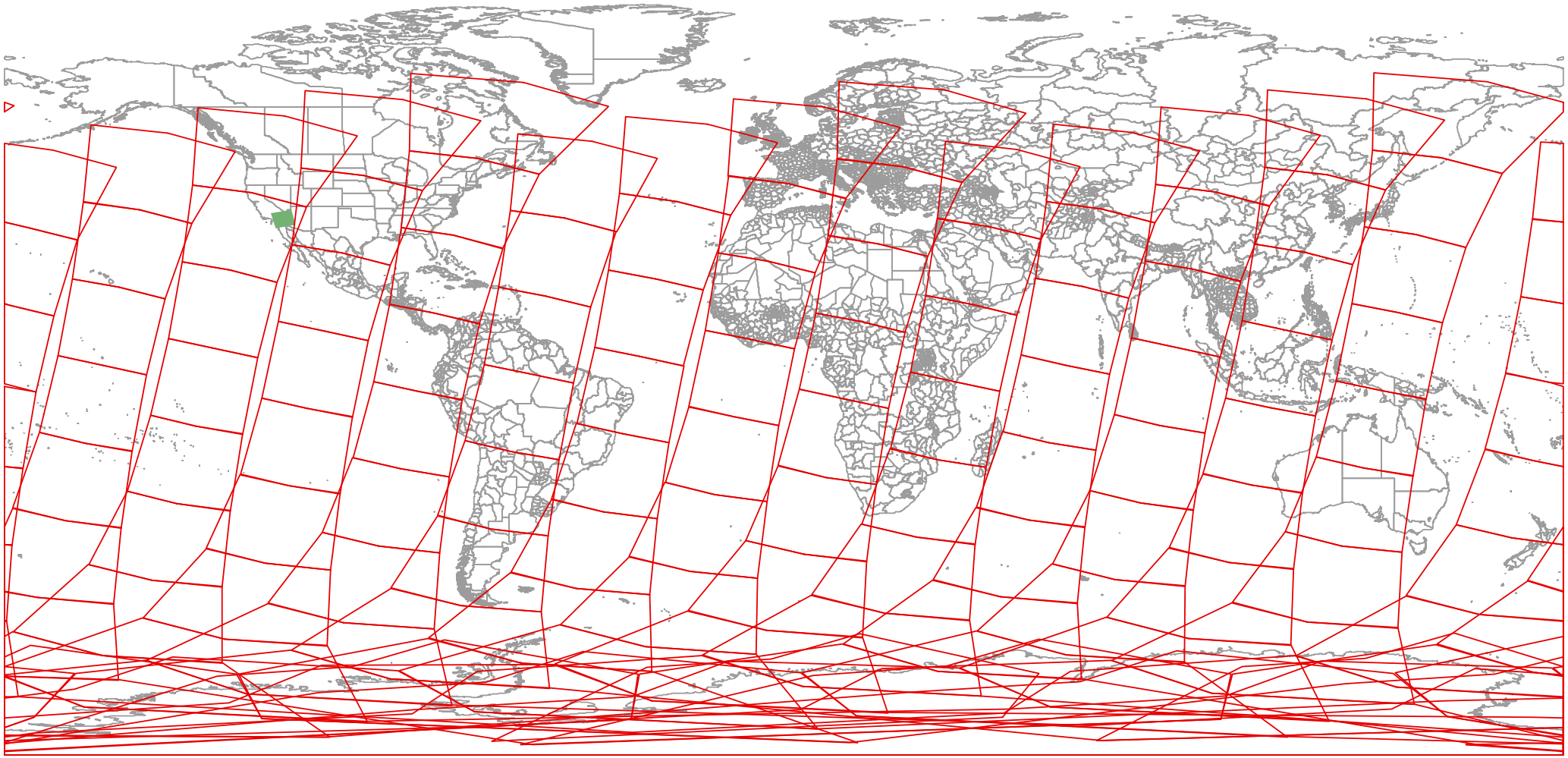


MODIS Ancillary Data

Variable	Description	Product	Resolution	Projection
LST	Land-Surface Temperature	ECOSTRESS	70 m	Swath
ε	Emissivity	ECOSTRESS	70 m	Swath
NDVI	Vegetation Index	Landsat	30 m	UTM
		MOD13	500 m	Sinusoidal
α	Albedo	Landsat	30 m	UTM
		MOD43	1 km	Sinusoidal
LAI	Leaf-Area Index	MOD15	1 km	Sinusoidal
fAPAR	Fraction of Absorbed Photosynthetically Active Radiation	MOD15	1 km	Sinusoidal
SZA	Solar Zenith Angle	MOD07	5 km	Swath
LC	Land-Cover Type	MCD12	500 m	Sinusoidal
KG	Climate Classification	Köppen-Geiger	30′	Geographic
AOT	Aerosol Optical Thickness	MOD04	5 km	Swath
COT	Cloud Optical Thickness	MOD06	5 km	Swath
Z_{top}	Cloud Top Height	MOD06	5 km	Swath
CF	Cloud Fraction	MOD06	5 km	Swath
$P_{surface}$	Surface Pressure	MOD07	5 km	Swath
T_a	Air Temperature	MOD07	5 km	Swath
T_d	Dew-Point Temperature	MOD07	5 km	Swath
T_{opt}	Optimum Temperature	LTM	5 km	Sinusoidal
$f_{APARmax}$	Photosynthetically Active Radiation	LTM	5 km	Sinusoidal

Ancillary Data Re-projection (MODIS)

Calculate Daytime Swath Ground Track
of Source Satellite in Temporal Search Radius

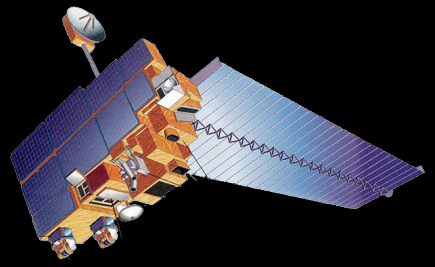


Ancillary Data Re-projection (MODIS)

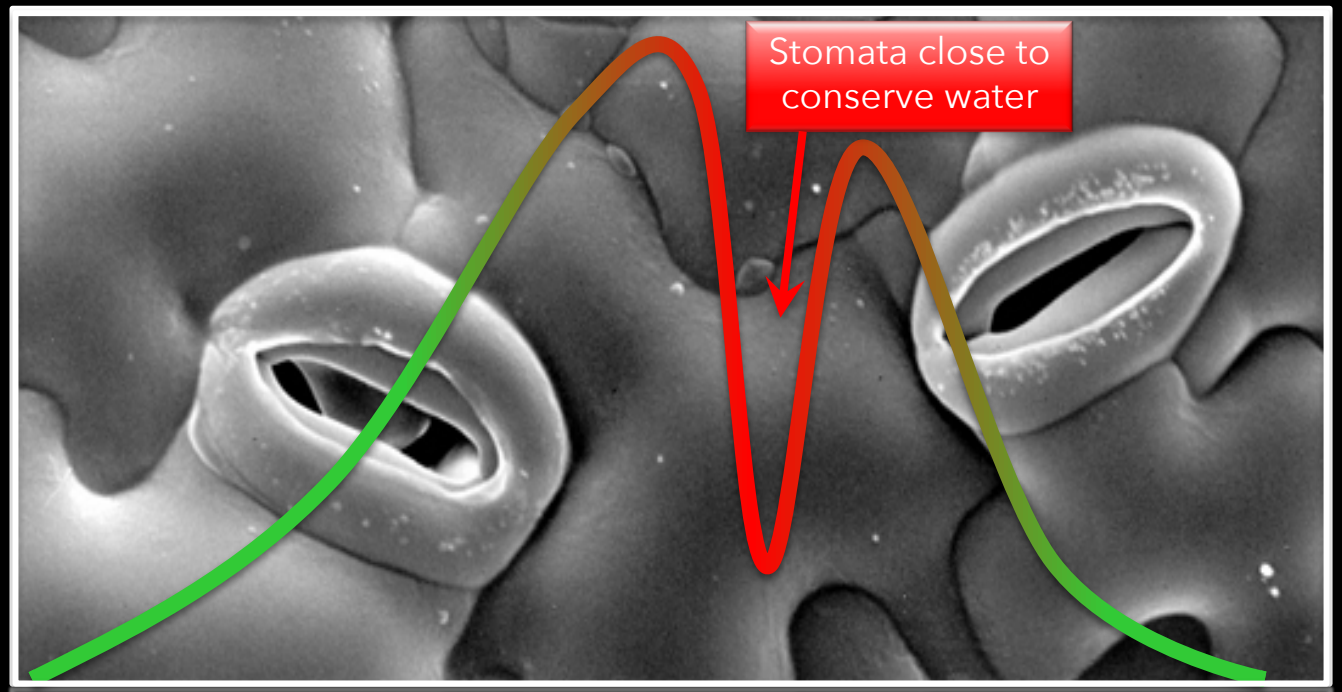
Intersect Source Data Regions with ECOSTRESS Scene

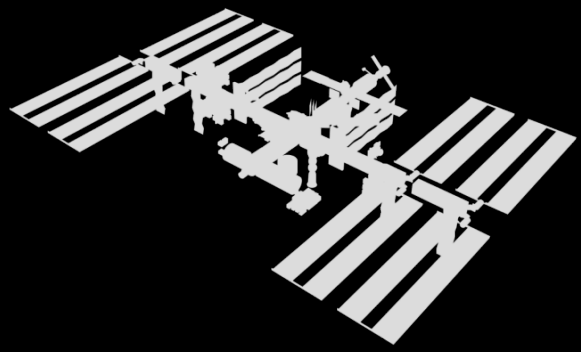
Diurnal Cycle

Water Stress Drives Plant Behavior



Terra
~10:30

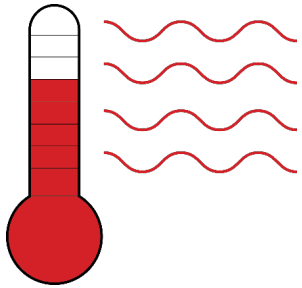




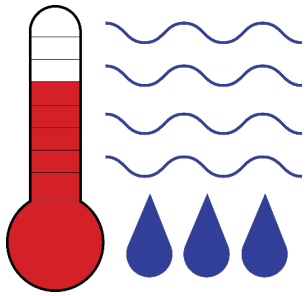
ISS
different
times of the day

Diurnal PT-JPL Inputs

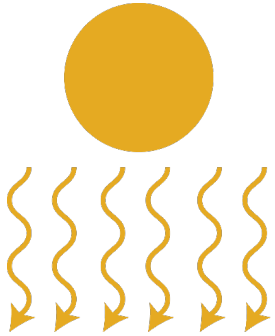
Air Temperature



Dew-Point Temperature

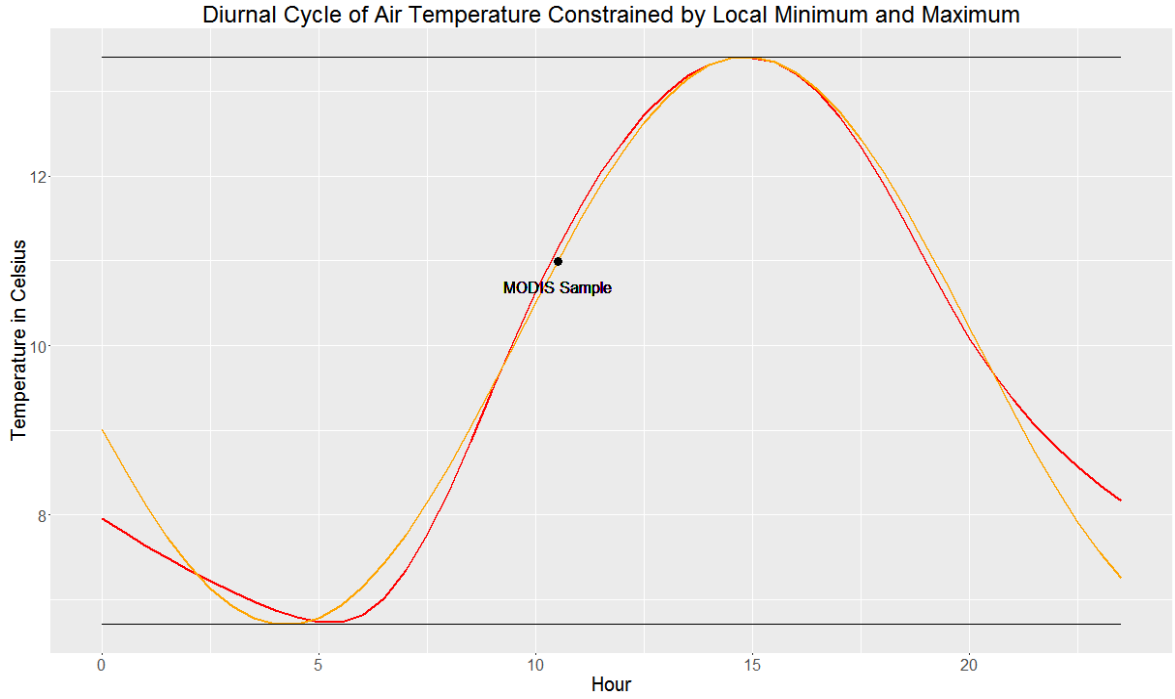


Incoming Shortwave Radiation

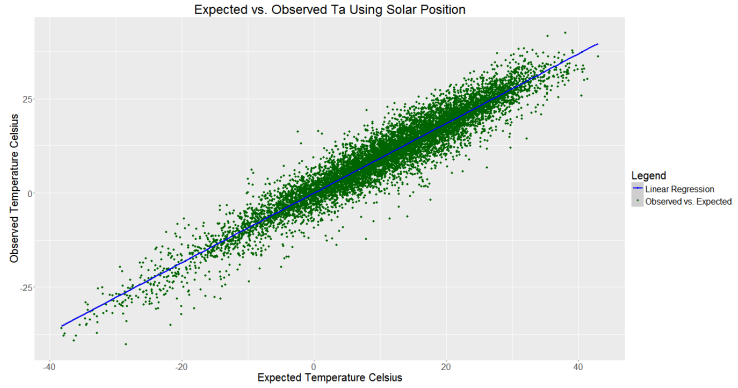


Incoming Longwave Radiation

Merging with NWP for T_a

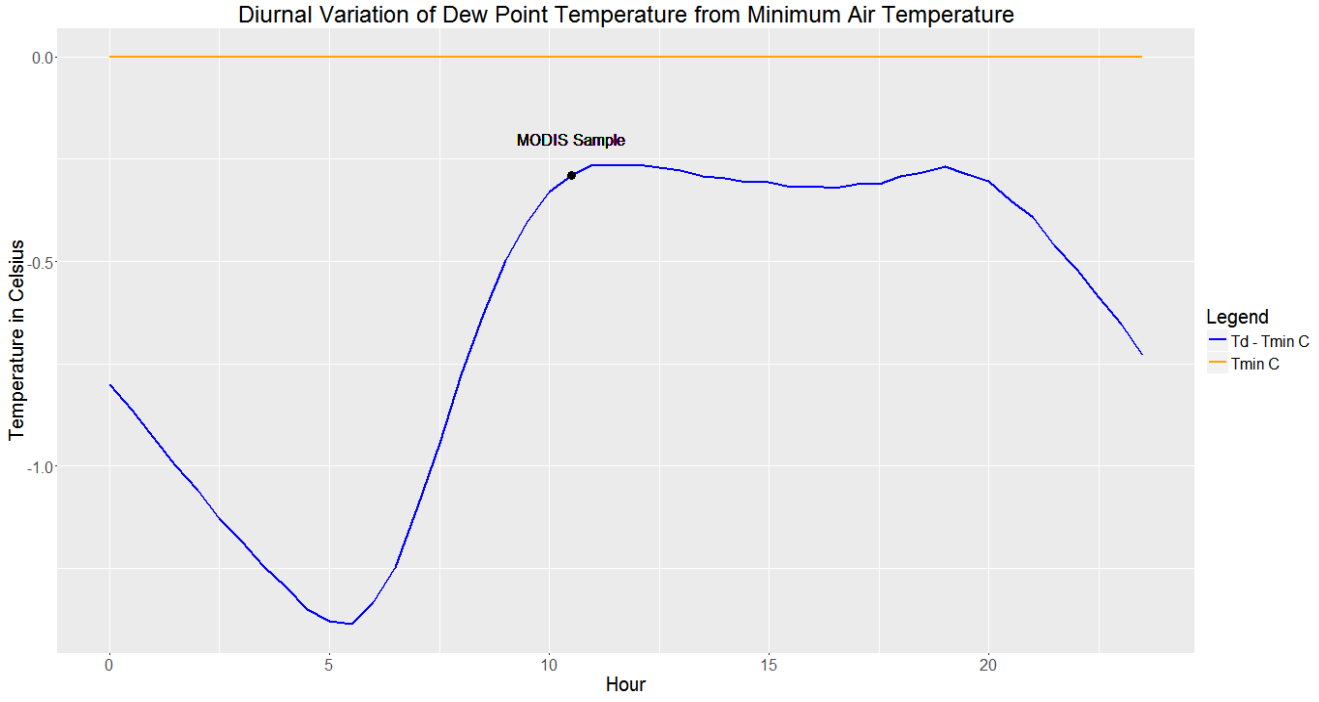


$$f(T_a, t_1, t_2) = T_a + \frac{1}{2}(T_{max} - T_{min})\left(\sin\left(\frac{\frac{DL}{12}\pi t_2}{12} + 2.33 + \frac{t_s}{12}\right) - \sin\left(\frac{\frac{DL}{12}\pi t_1}{12} + 2.33 + \frac{t_s}{12}\right)\right)$$



$\rho = 0.96$, $R^2 = 0.91$, RMSE = 3.51° C

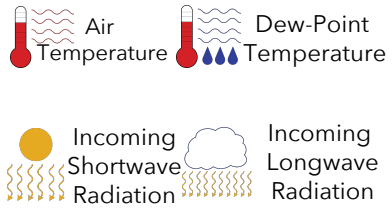
Merging with NWP for T_d



Dew point is similar to T_{min} (almost constant)

Diurnal Testing

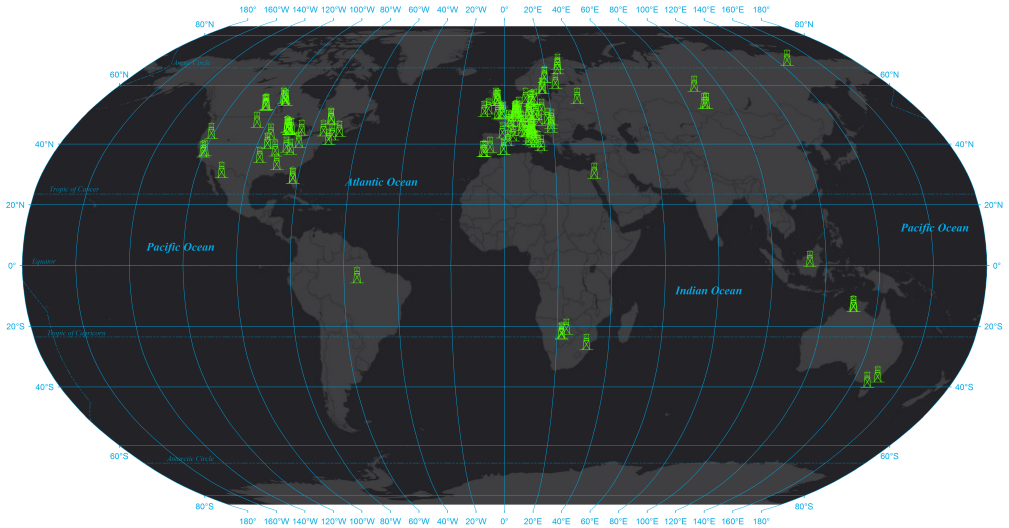
MERRA-2

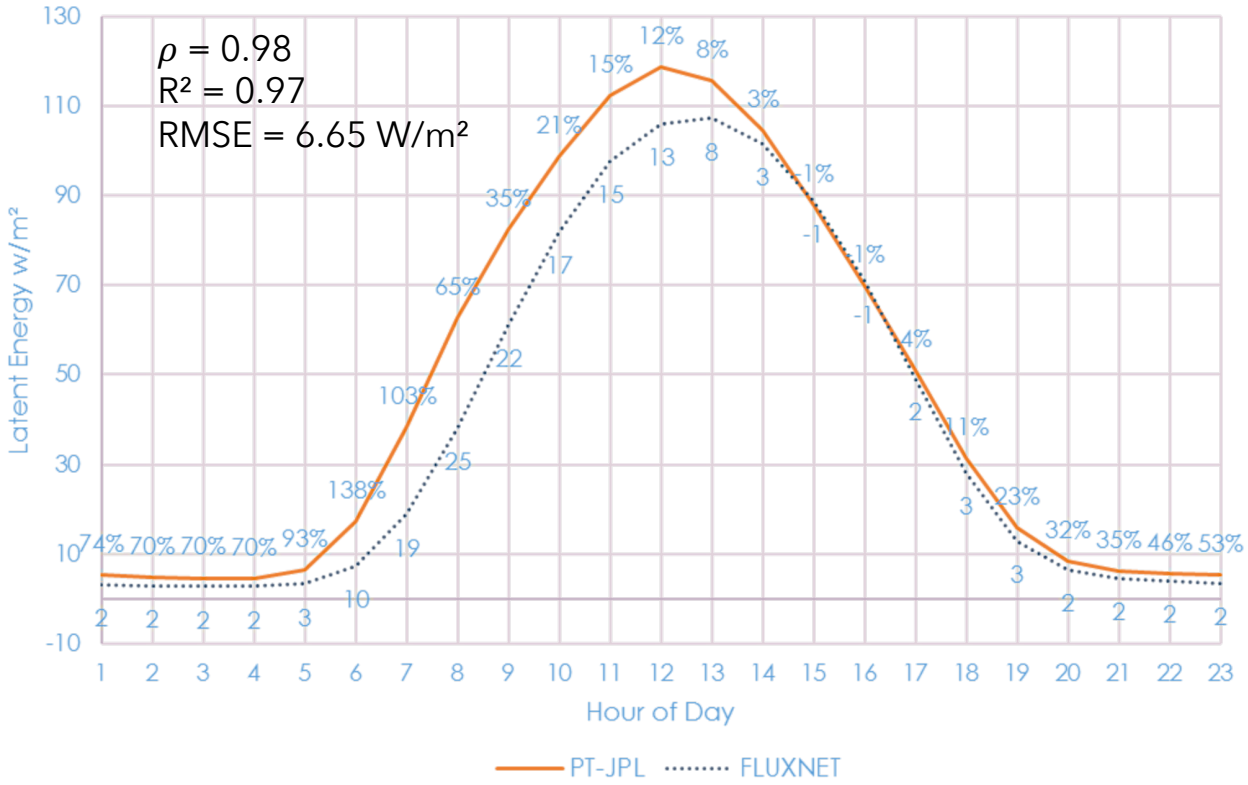


diurnal processing

PT-JPL

150 FLUXNET Sites

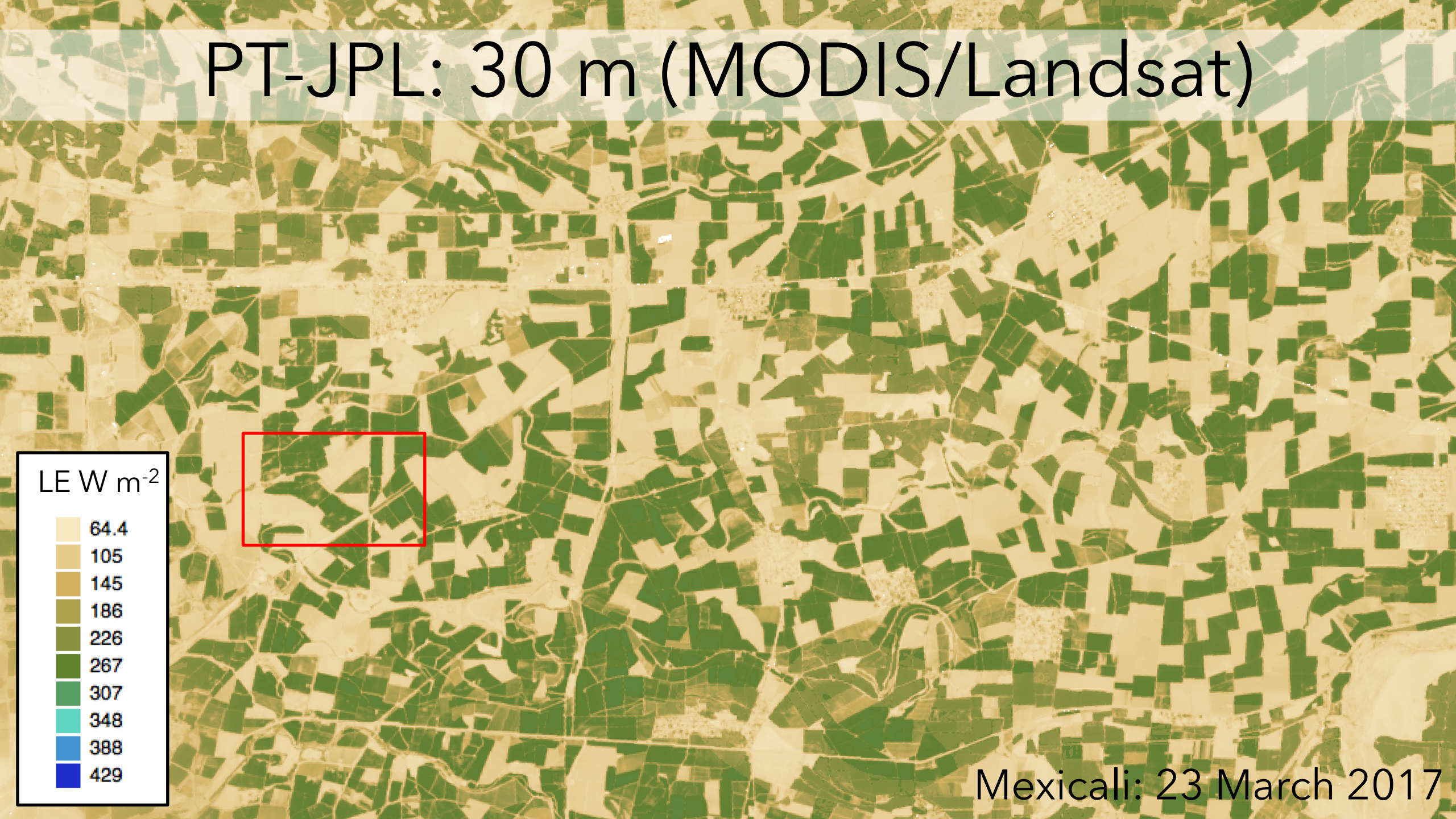




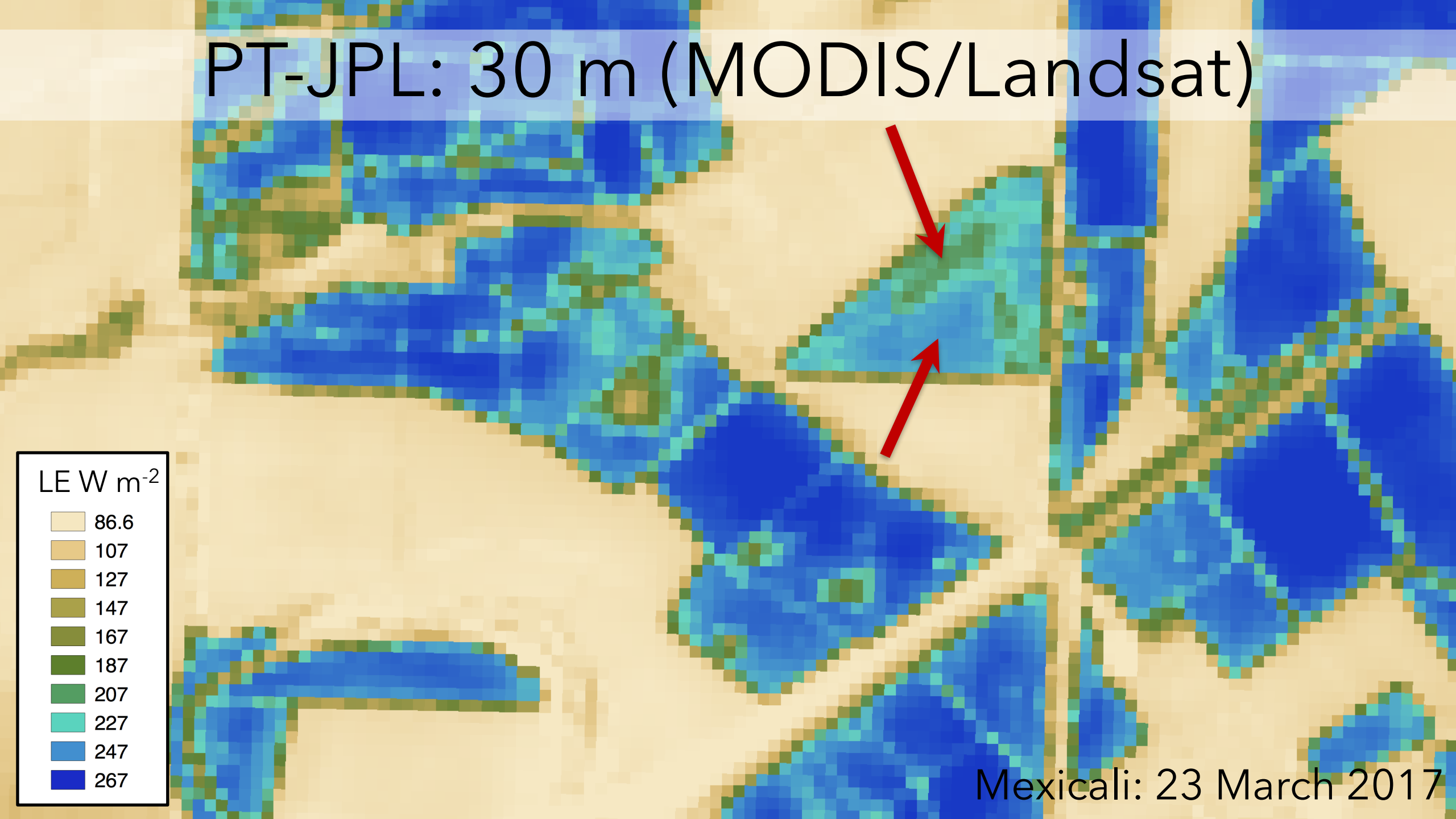
PT-JPL ET using MODIS and MERRA2 compared to La Thuile FLUXNET aggregated by hour at all sites with absolute and percentage bias

SIMULATED DATA

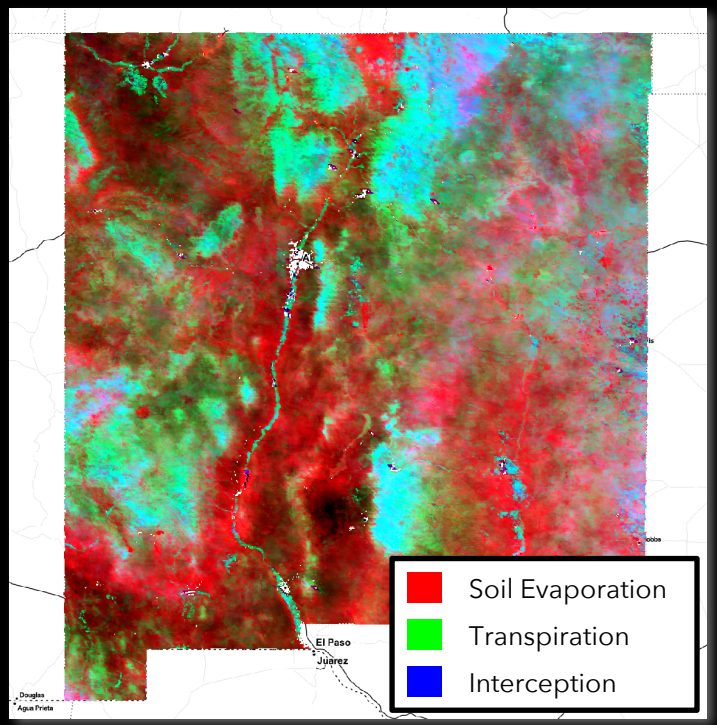
PT-JPL: 30 m (MODIS/Landsat)

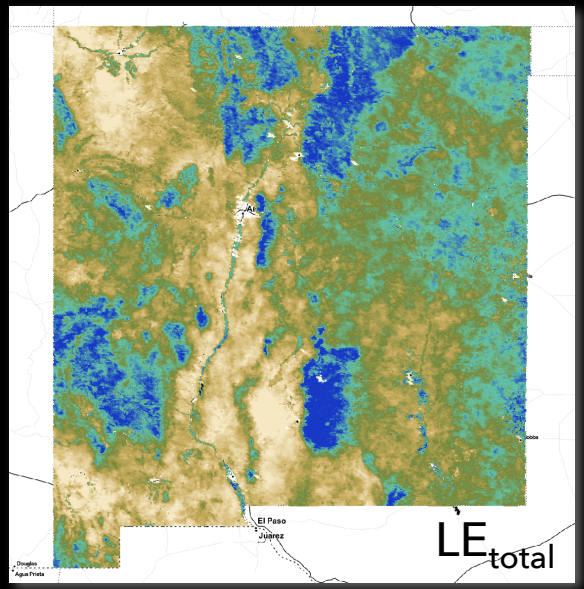


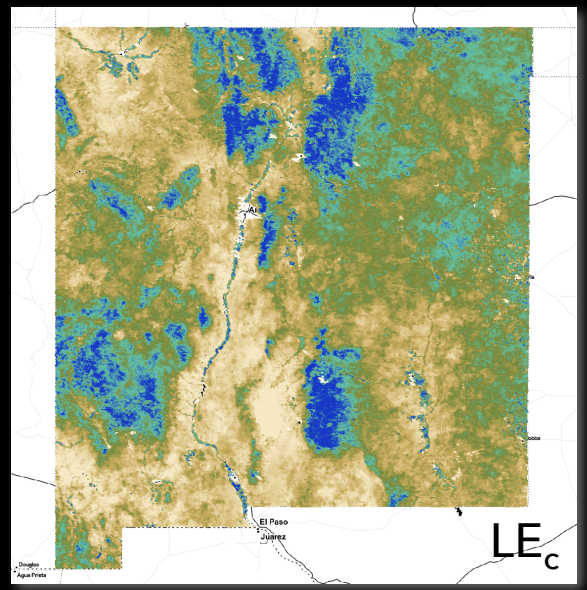
PT-JPL: 30 m (MODIS/Landsat)

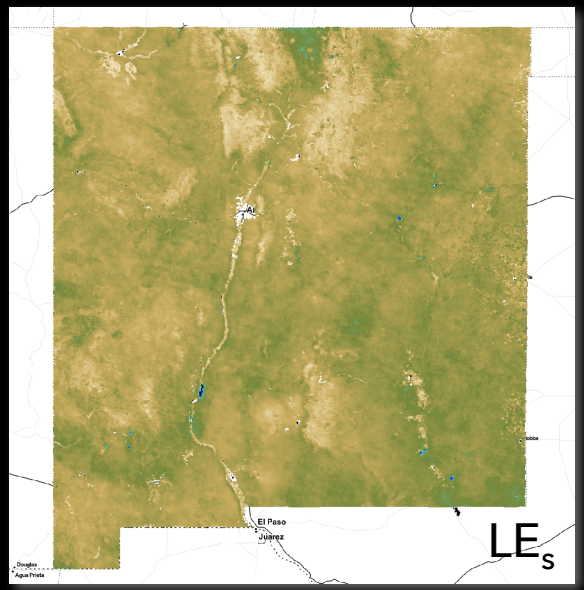


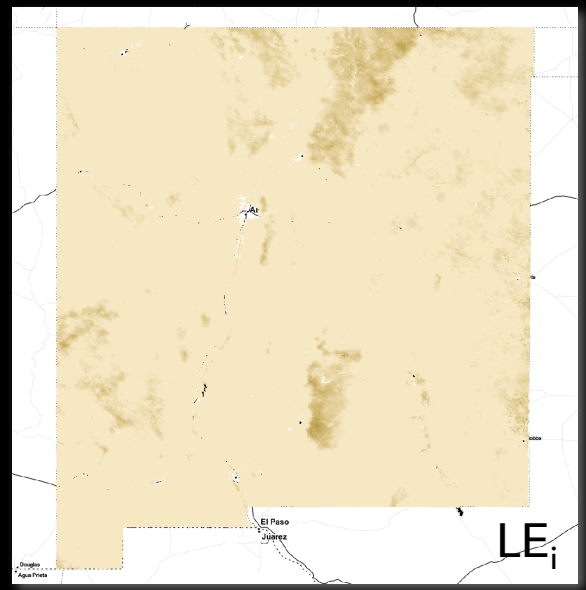
ET Partitioning







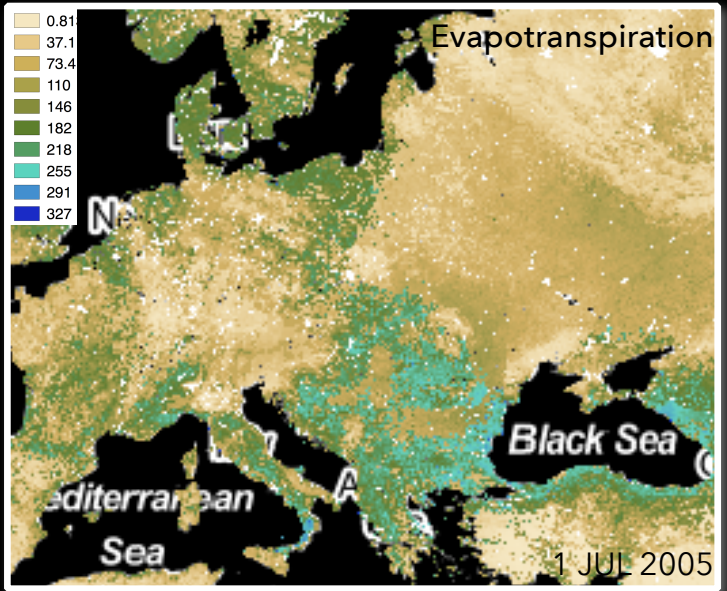


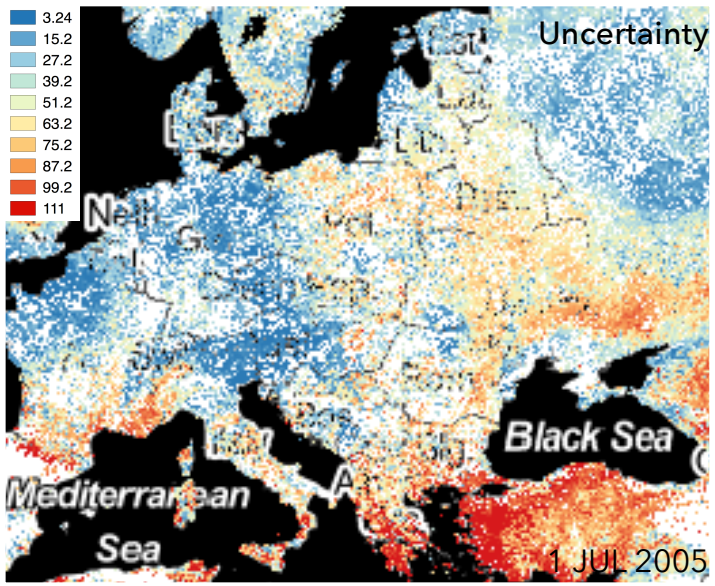


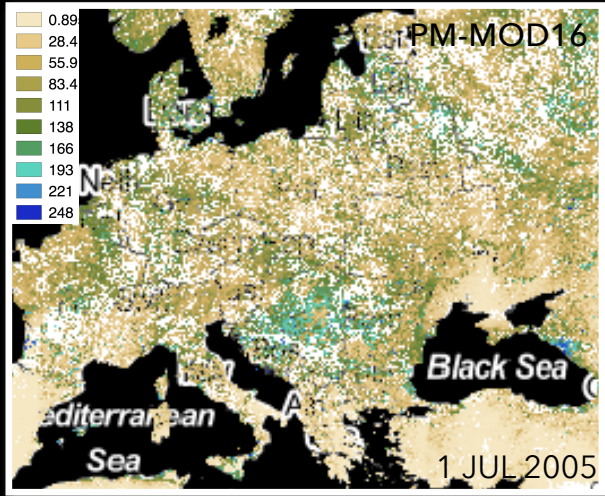
31
75
119
163
206

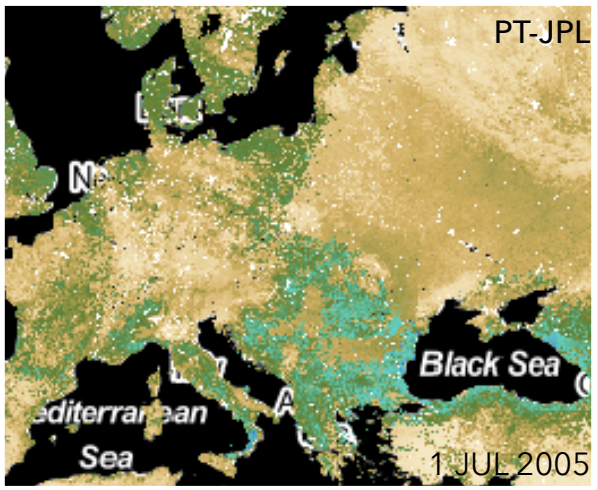
123
171
219
266
314

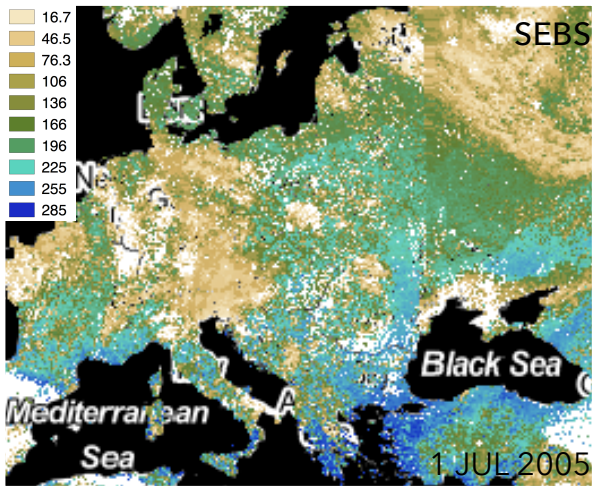
ET Uncertainty





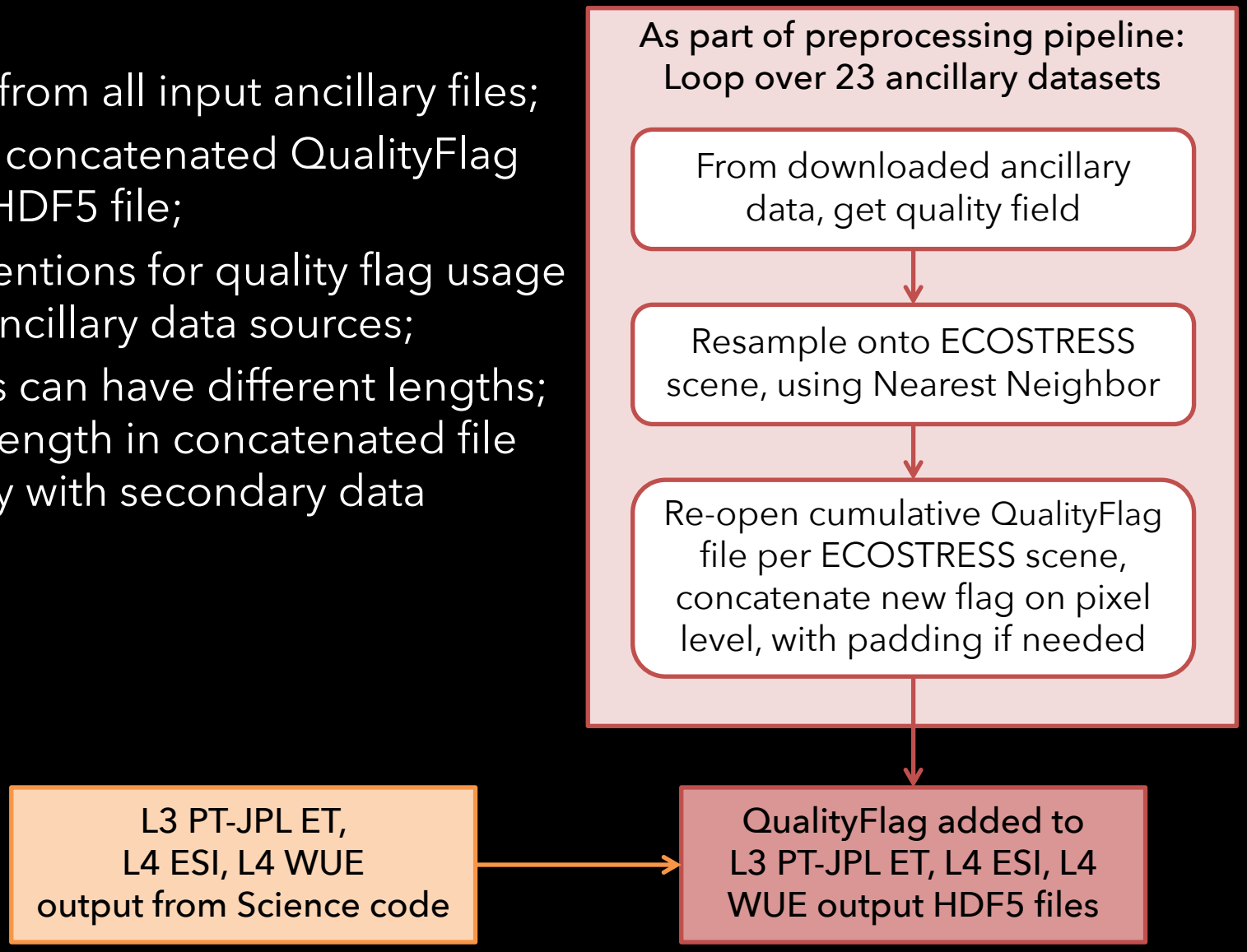






Quality Flags

- Collect quality flags from all input ancillary files;
- Place in pixel-based concatenated QualityFlag data field in output HDF5 file;
- Retain original conventions for quality flag usage and meaning from ancillary data sources;
- Original quality flags can have different lengths; padded to uniform length in concatenated file (ensure compatibility with secondary data sources).



Remaining Tasks

1. Swath boundaries correction. [1 week]
2. Diurnal cycle incorporation. [2 weeks]
3. Merge Landsat branch into Main branch. [3 weeks]
4. Finish quality flags coding. [3 weeks]
5. Back-up ancillary data incorporation. [3 weeks]
6. Validation of C++ code against Matlab version. [3 weeks]
7. Incorporation into automated ECOSTRESS SDS pipeline. [3 weeks]