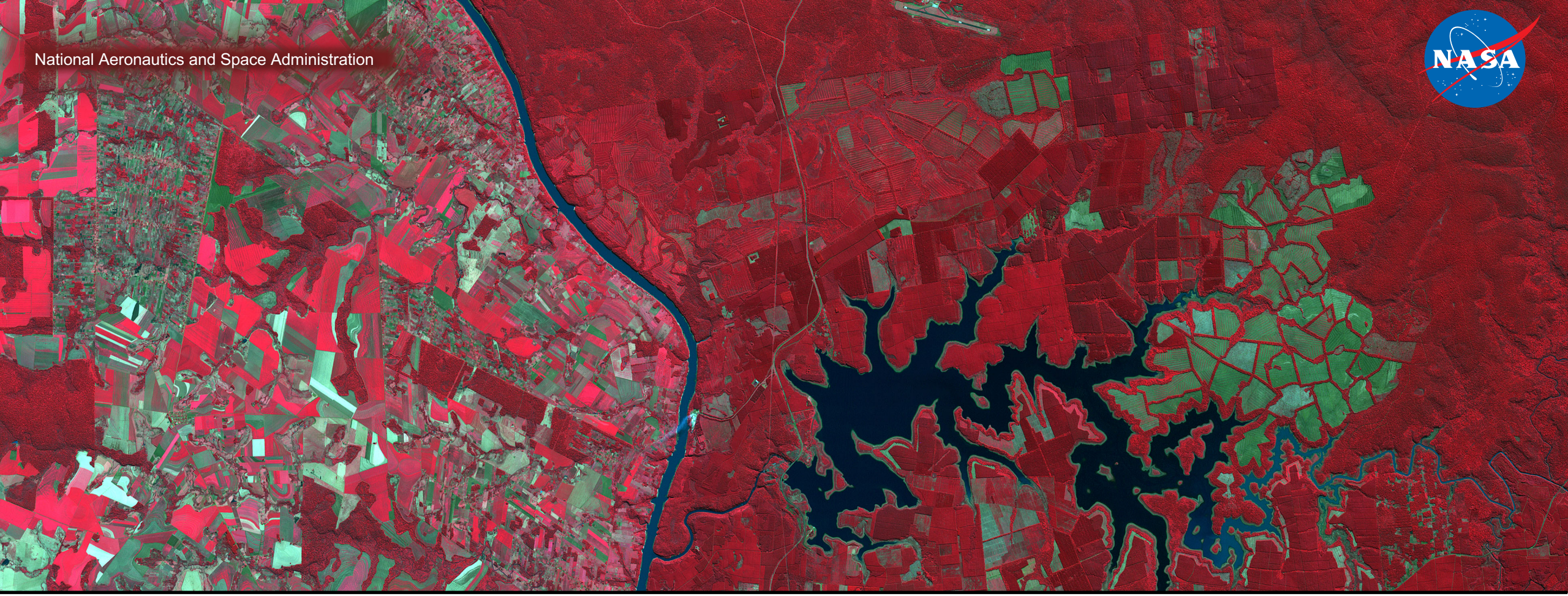


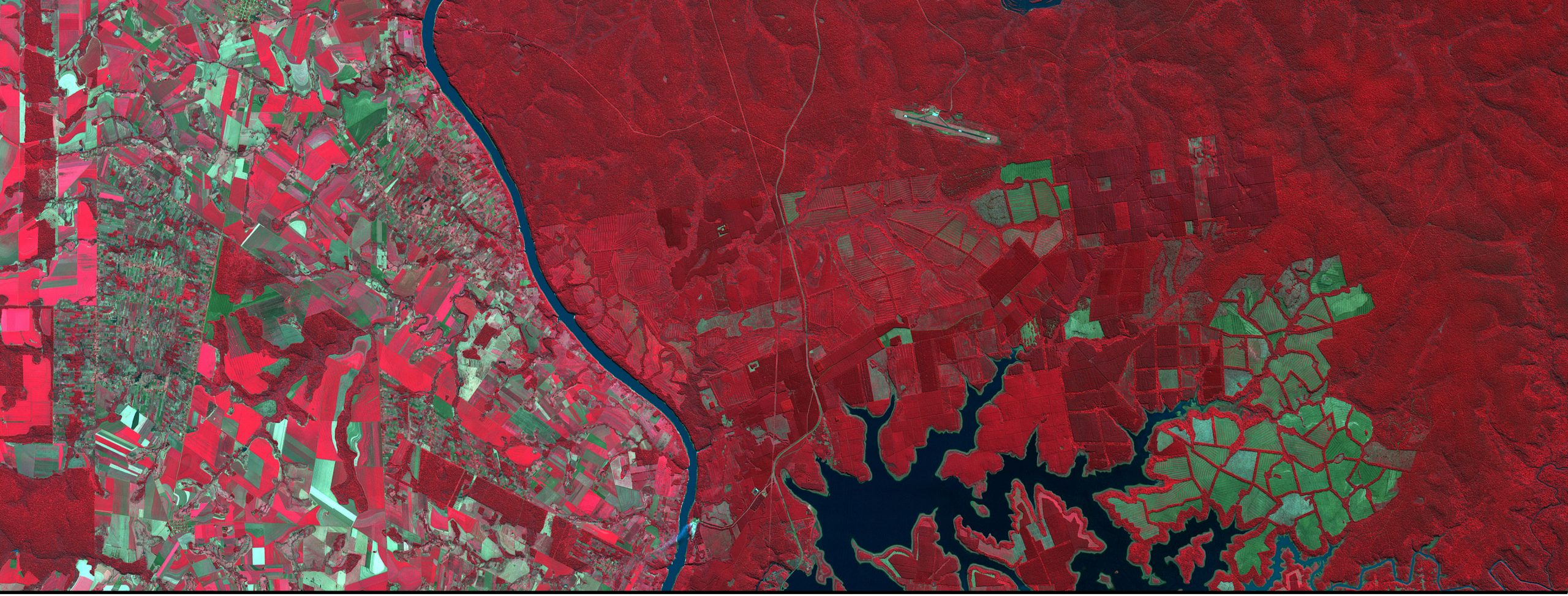
Summary of Surface Water Budget Components

Amita Mehta, Ana Prados, Erika Podest

December 4, 2017

Learning Objectives

- Summarize the water data covered in this training
- Describe advantages and challenges of remote sensing for watershed management



Summary of NASA Water Resources Data

Water Resource Management

Over a watershed, basin, or region:

- Precipitation (rain, snow) is the main source of fresh water
  - Other regional contributions: runoff, streamflow, lakes, soil moisture, ground water
- Depletion of water comes through:
  - Evaporation and evapotranspiration through loss of water to the atmosphere
  - runoff outflow
- Surface freshwater availability (W) is largely controlled by:

$$W = (\text{precipitation} + \text{regional runoff}) - \left(\frac{\text{evaporation}}{\text{evapotranspiration}} + \text{runoff outflow} + \text{soil moisture} + \text{infiltration} \right)$$

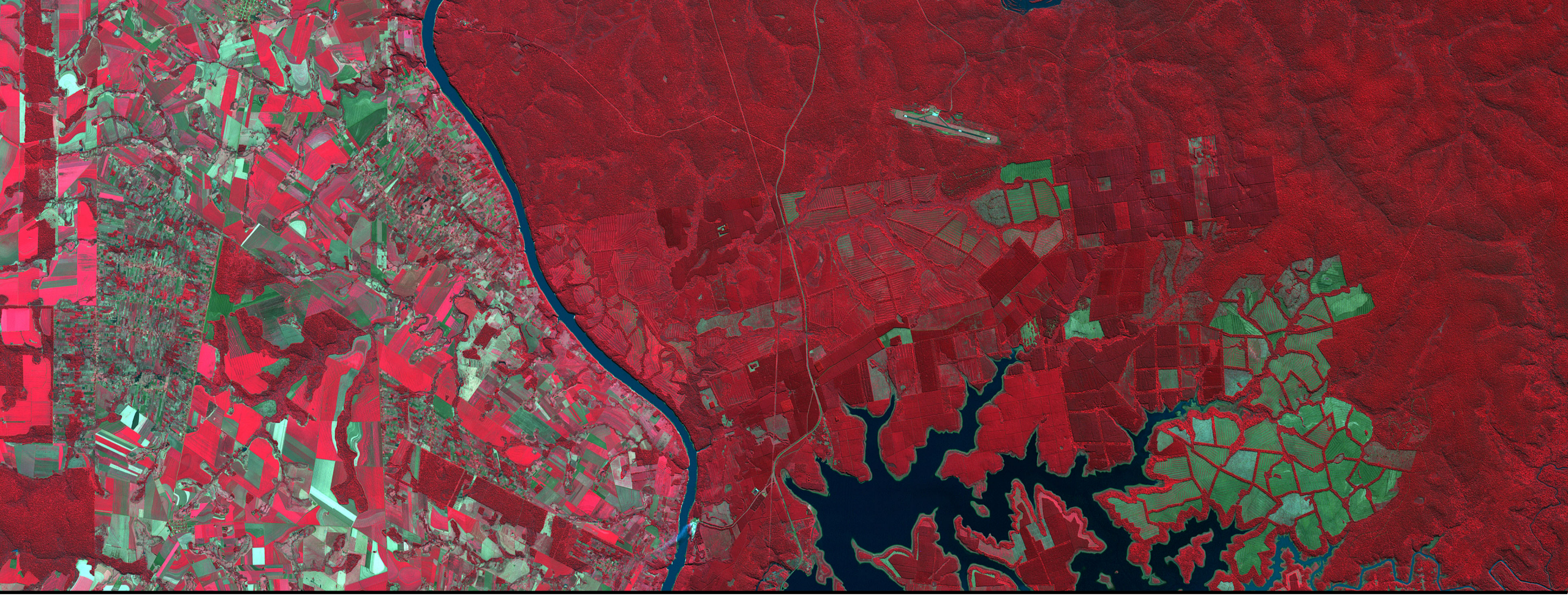
Water Resource Data Applications

Freshwater Components Required

Water Allocation	Agricultural & Irrigation Management	Flood & Drought Management	Reservoir & Dam Management
• Water budget	• Precipitation • Soil moisture • Evapo-transpiration	• Precipitation • Runoff & streamflow • Soil moisture • Evapo-transpiration • Groundwater	• Reservoir Height • Precipitation • Runoff & streamflow

NASA Satellites and Models for Surface Fresh Water Components

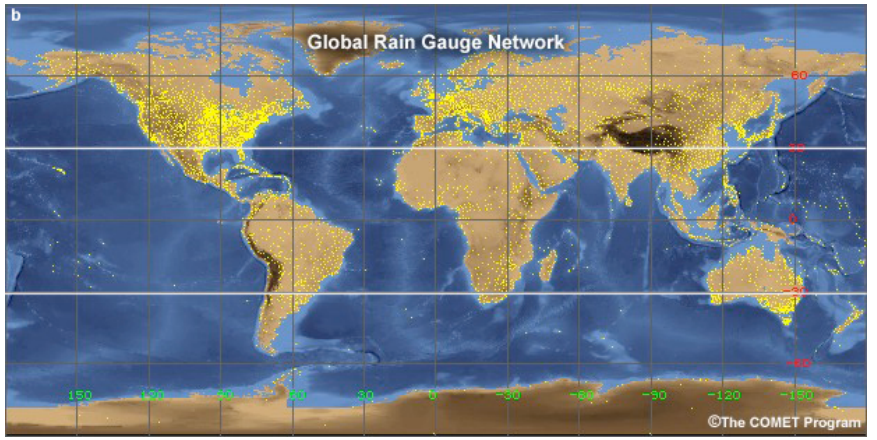
Freshwater Component	Satellite/Sensor or Model	Spatial & Temporal Resolutions and Coverage
Rain Amount	GPM /(GMI, DPR) & TRMM /(TMI, PR) – IMERG and TMPA Multi-satellite data	IMERG: 0.1°, 65°S to 65°N 30-minute, daily, monthly; 3/2014 to present TMPA: 0.25°, 50°S to 50°N 3-hourly, daily, monthly; 1/1998 to 4/2015 -- also 4/2015-presnt based in TRMM climatology
Soil Moisture	SMAP/(Microwave Radiometer)	36 km, global daily, monthly, 3/2015 to present
Land Cover NDVI (For ET Estimation)	Sentinel-/ SAR Landsat 7/ETM+ Landsat 8/OLI&TIRS Terra & Aqua/MODIS	5 km x 20 km, Global; 12-day, 4/2014 to present 30 m, Global; 16-day, 4/1999-present 30 m, Global; 16-day, 2/213-presnt 250m, Global, 16-Day, 2/2000 to present
Runoff	GLDAS- NOAH V2.1	0.25°, Global; 3-hourly, monthly; 2000 – present

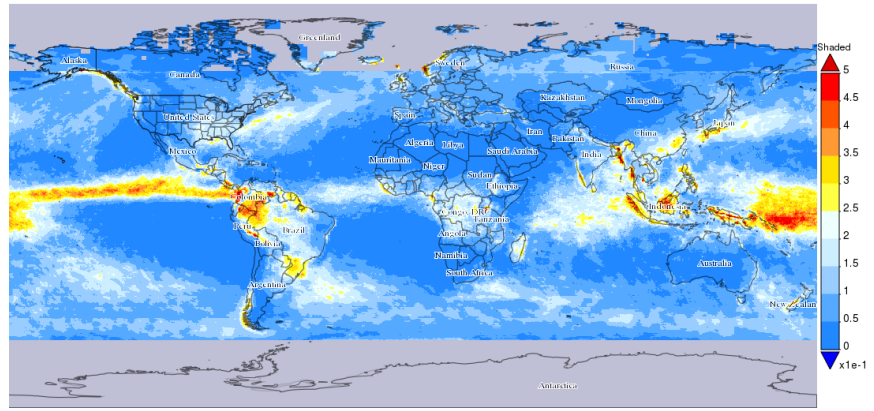


Advantages and Challenges of Remote Sensing for Watershed Management

Advantages of Remote Sensing Water Resources Data

- Remote sensing-based data provide near-global coverage compared to surface-based, spatially non-uniform point measurements
- Provides data where surface-based measurements are unavailable
- Earth system models integrate surface-based and remote sensing observations and provide uniformly gridded, frequent information
- Earth system models provide parameters that aren't directly observed by satellites (e.g. runoff, ET)
- Data are free and there are web-based tools





Top: Global rain gauge locations. Credit: Introduction to Tropical Meteorology, The COMET Program; Bottom: Annual Precipitation (2015) from NASA GPM

Challenges of Remote Sensing Water Resources Data

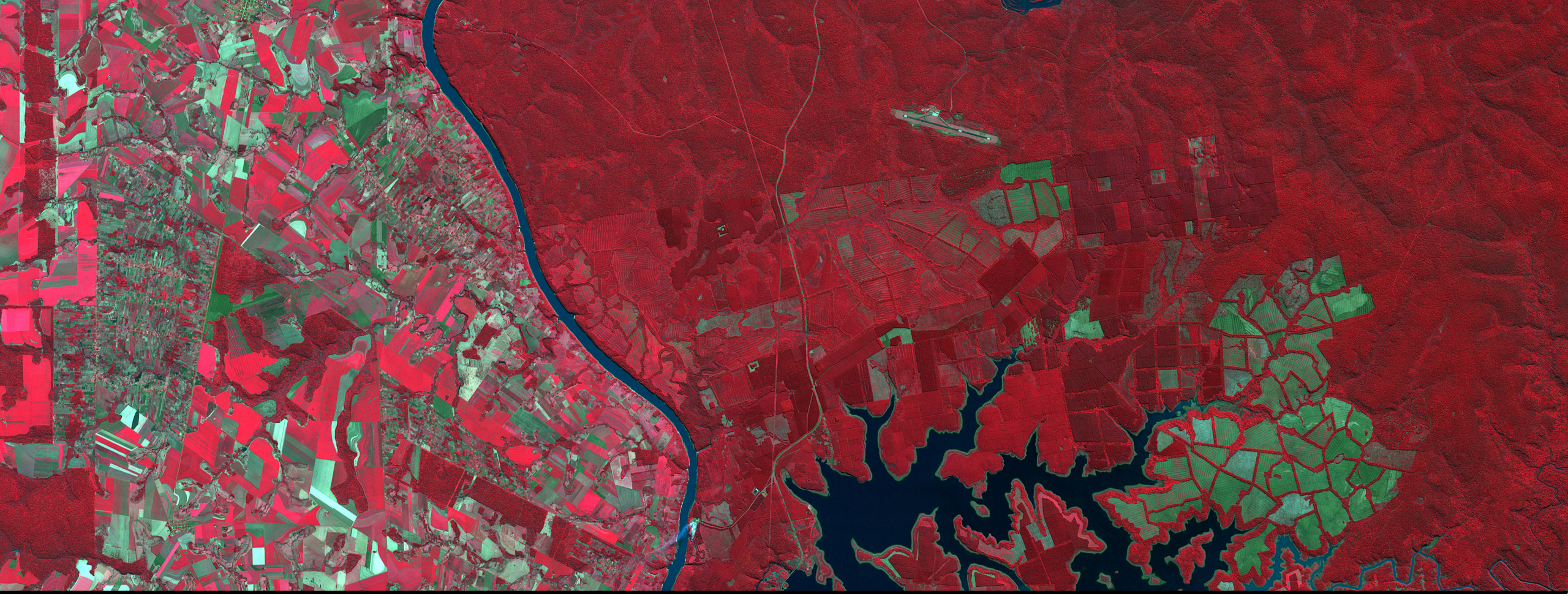
- All freshwater components are measured by different satellites and sensors with varying spatial and temporal resolutions, coverage, and quality
- There is trade-off between spatial and temporal resolutions
  - Landsat measurements are at 30 m
  - Sentinel-SAR at 5 km x 20 km, available every 16 and 12 days
  - GPM-IMERG data available every half hour but have 0.1° resolution
- Satellite and model data files are large and in different data formats: training is required to learn how to access them

Challenges of Remote Sensing Water Resources Data

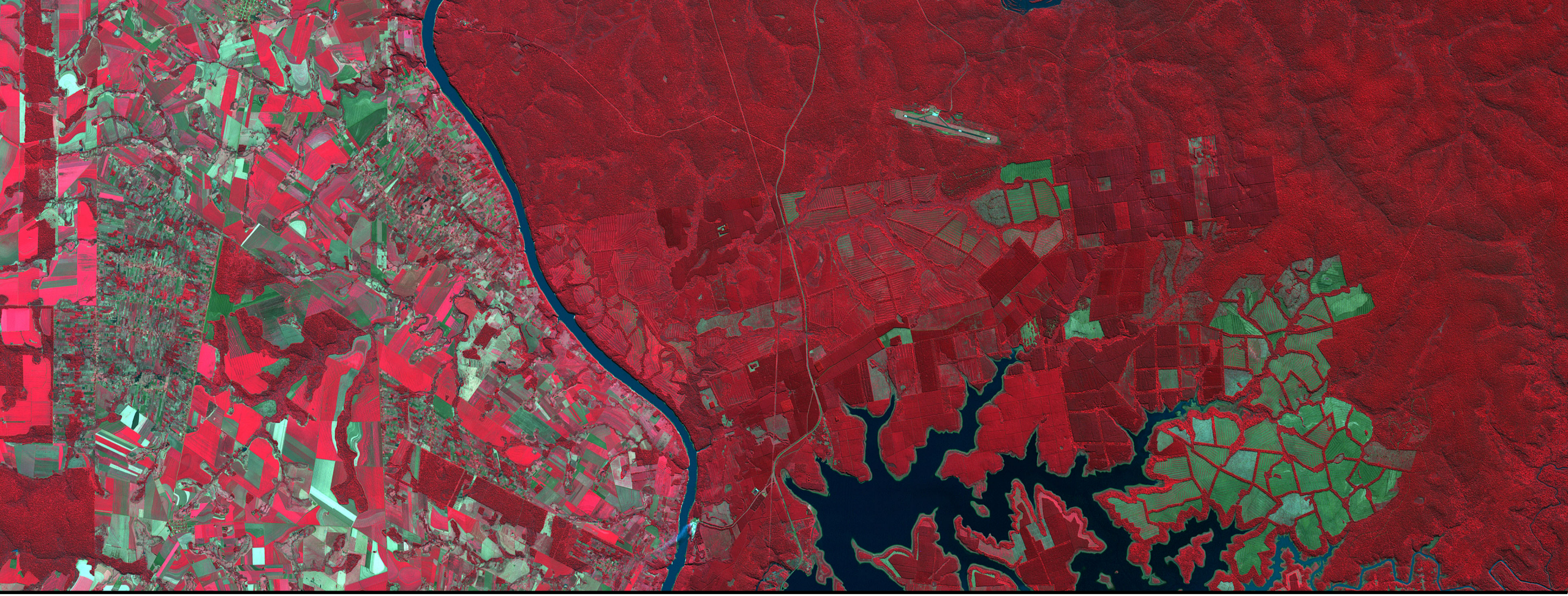
- Often additional processing may be needed for specific applications
  - e.g. Landsat-based ET has to be processed further to fill cloud gaps and also to estimate monthly and seasonal values based on additional information
- While the data are generally validated with selected surface measurements, regional and local assessment is recommended
- While individual freshwater components based on satellite observations are useful for many applications, accurate water budget estimation based on disparate data is not feasible

Hydrological Models for Watershed Management

- Integrating remote sensing data in hydrological models enables improved watershed management
  - Provides consistent fresh water components at uniform spatial and temporal resolutions
- ARSET is planning to conduct a webinar, *Introduction to the Variable Infiltration Capacity (VIC) Hydrology Model,* in February 2018
- Stay informed about upcoming trainings via the ARSET ListServ: https://lists.nasa.gov/mailman/listinfo/arset



Next: Hands-on Exercise for Seasonal Freshwater Components over SFV Watershed



Thank You