Atomic Data Specification: The DNA of the 30m Grid

Version: 1.1 (Production Spec)
Standard Coordinate System: EPSG:4326 (WGS 84)

1. Sub-Surface Layer (The Invisible)

- **NASA GRACE-FO (Gravimetric):**
  - *Primitive:* LWE_thickness (Liquid Water Equivalent).
  - *Resolution:* 300km (Native) downscaled to 30m via Texture Anchoring.
  - *Frequency:* Monthly.
- **Sentinel-1 (InSAR):**
  - *Primitive:* vertical_displacement_mm (Subsidence).
  - *Resolution:* 20m.
  - *Frequency:* 6–12 days.
- **CDSS REST API (Ground-Truth):**
  - *Primitive:* static_water_level_ft.
  - *Frequency:* Real-time (Telemetered) or Bi-annually (Manual).

2. Soil & Root Zone (The Buffer)

- **NASA SMAP (Soil Moisture):**
  - *Primitive:* volumetric_soil_moisture (9km downscaled).
  - *Frequency:* 3 days.
- **NRCS gSSURGO (Soil DNA):**
  - *Primitive:* ksat_r (Hydraulic Conductivity) and awc_r (Available Water Capacity).
  - *Note:* Static layer; updated annually.

3. Canopy & Physiology (The Pulse)

- **NASA ECOSTRESS (Thermal):**
  - *Primitive:* LST_k (Land Surface Temp) and ESI (Evaporative Stress Index).
  - *Resolution:* 70m resampled to 30m.
  - *Frequency:* Variable (precessing orbit).
- **HLS (Harmonized Landsat Sentinel):**
  - *Primitive:* B02, B03, B04, B08 (Blue, Green, Red, NIR).
  - *Calculated:* NDVI (Vigor) and NDMI (Moisture).
  - *Resolution:* 30m.

4. Atmospheric & Machine (The Driver)

- **Tomorrow.io (Weather):**
  - *Primitive:* VPD (Vapor Pressure Deficit) and solar_radiation.

    - *Frequency:* Hourly.
- **JDLink (Operational):**
    - *Primitive:* actual_app_rate (Gallons/Acre) and fuel_consumption_rate.
    - *Frequency:* Machine-active (1Hz).

5. Normalization Protocol

Every data point must be ingested into the **Spatio-Temporal Mesh**. If a sensor reading arrives off-cycle, the engine uses a **Kalman Filter** to predict the current state based on high-frequency atmospheric drivers (VPD) until the next physical "Truth" (Satellite pass) arrives.