MODIS Data Processing System

MODAPS

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Presented at the THIC Meeting at the Sheraton Barcelo in Annapolis MD 21401-3094 on May 9, 2001

THIC Inc. The Premier Advanced Recording Technology Forum

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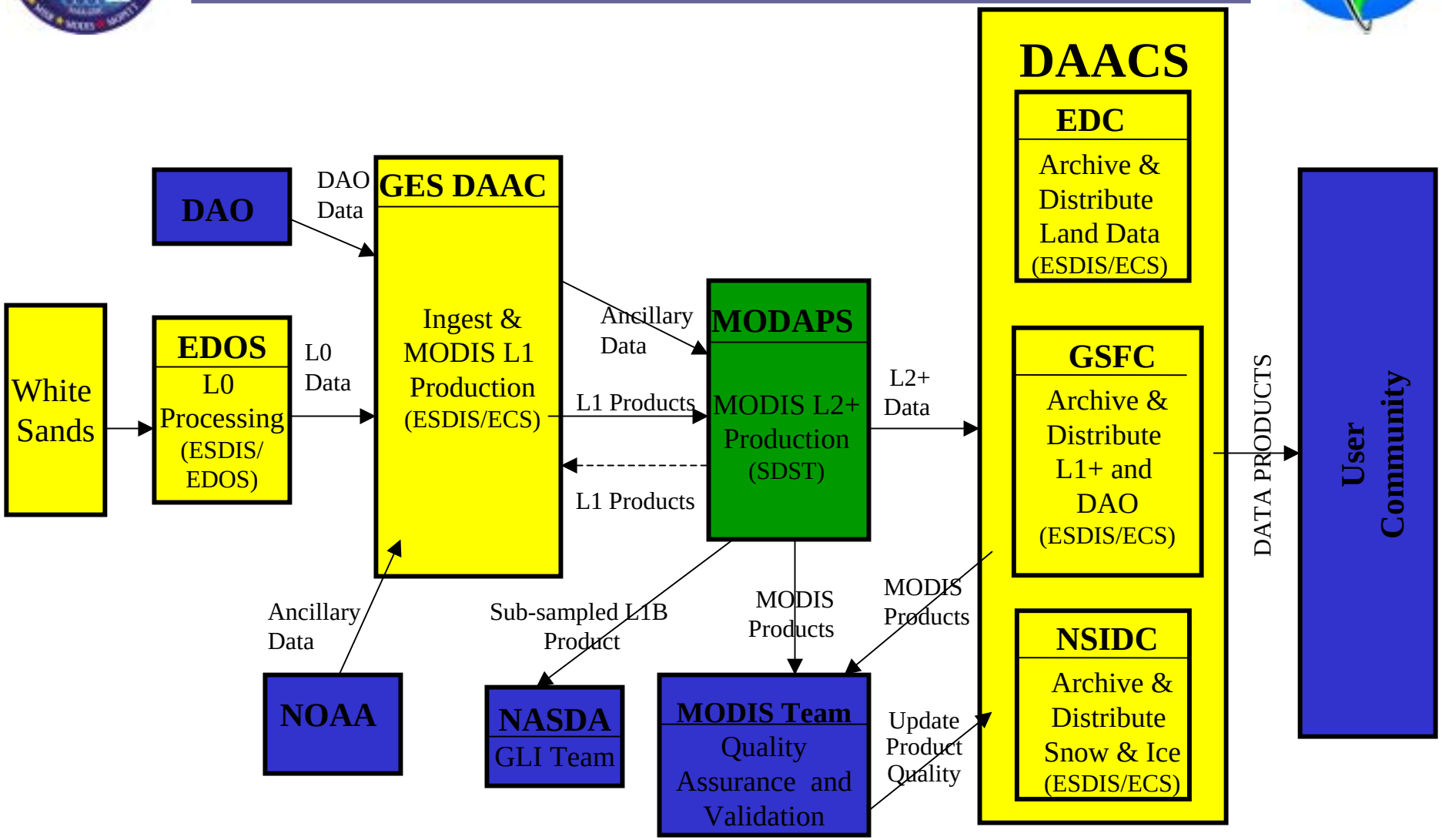
MODIS

- MODerate resolution Imaging Spectroradiometer
- Key instrument on EOS-Terra and EOS-Aqua Missions
- 36 spectral bands from the visible through thermal infrared
- Spatial resolution: 250m(2 bands), 500m(5 bands), 1km (29 bands)
- Nearly complete global coverage in 1 day, all of Earth in 2 days
- More than 40 earth science products including:
  - Sea Surface Temperature and Ocean Color, Cloud Properties and Aerosols, Land Surface Temperature, Vegetation Indices, Land Cover Change and Measures of Global Productivity

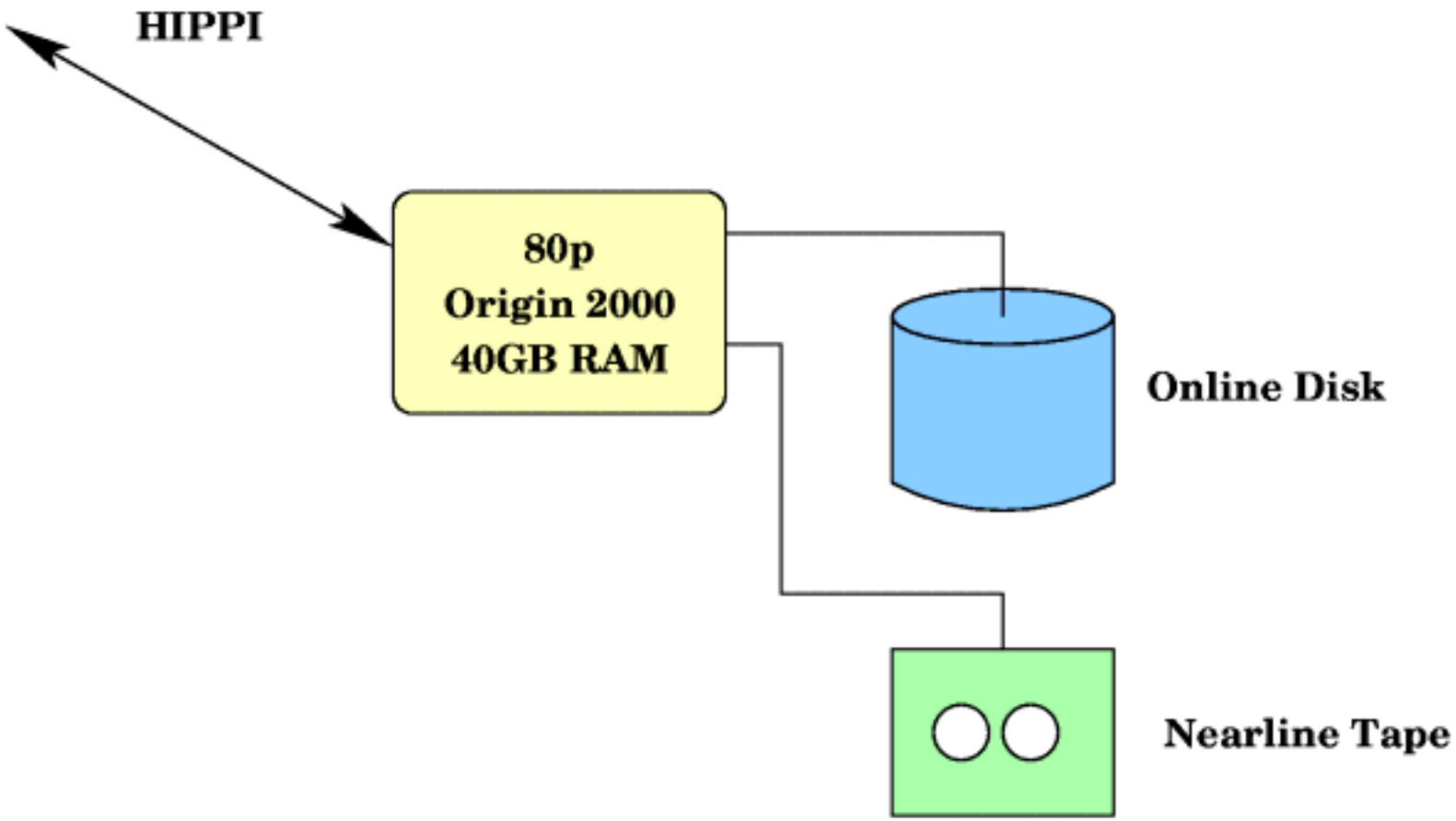
Product Volumes

- Each MODIS instrument produces **70GB** of raw data per day
- Goddard Earth Sciences Distributed Active Archive Center (GES DAAC) produces calibrated radiance, cloud mask and earth location products (**295GB/day**) and ships them to MODAPS
- MODAPS (MODIS Data Production System) makes the MODIS higher level science products (**400GB/day**) and ships them to the MODIS Science Team and to 3 DAACs for public distribution
- In 2003, the MODIS Team has a goal of producing up to **8TB** of products per day and shipping **15TB** per day to the community
  - Current requirements are 3TB/day produced and 3TB shipped
  - USGS EROS Data Center ships 55GB of Landsat 7 ETM+ scenes per day

Data Product Flow

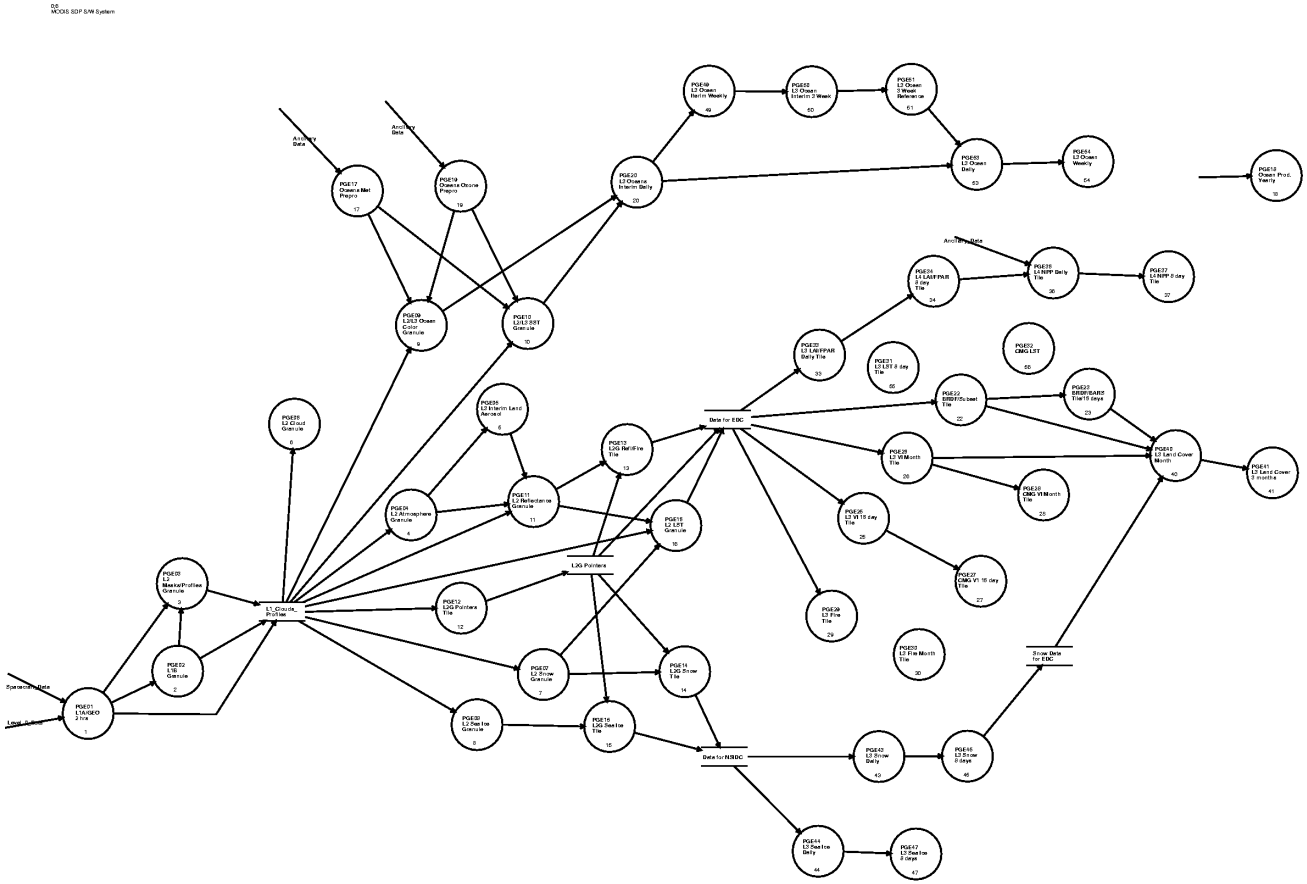


At Launch System

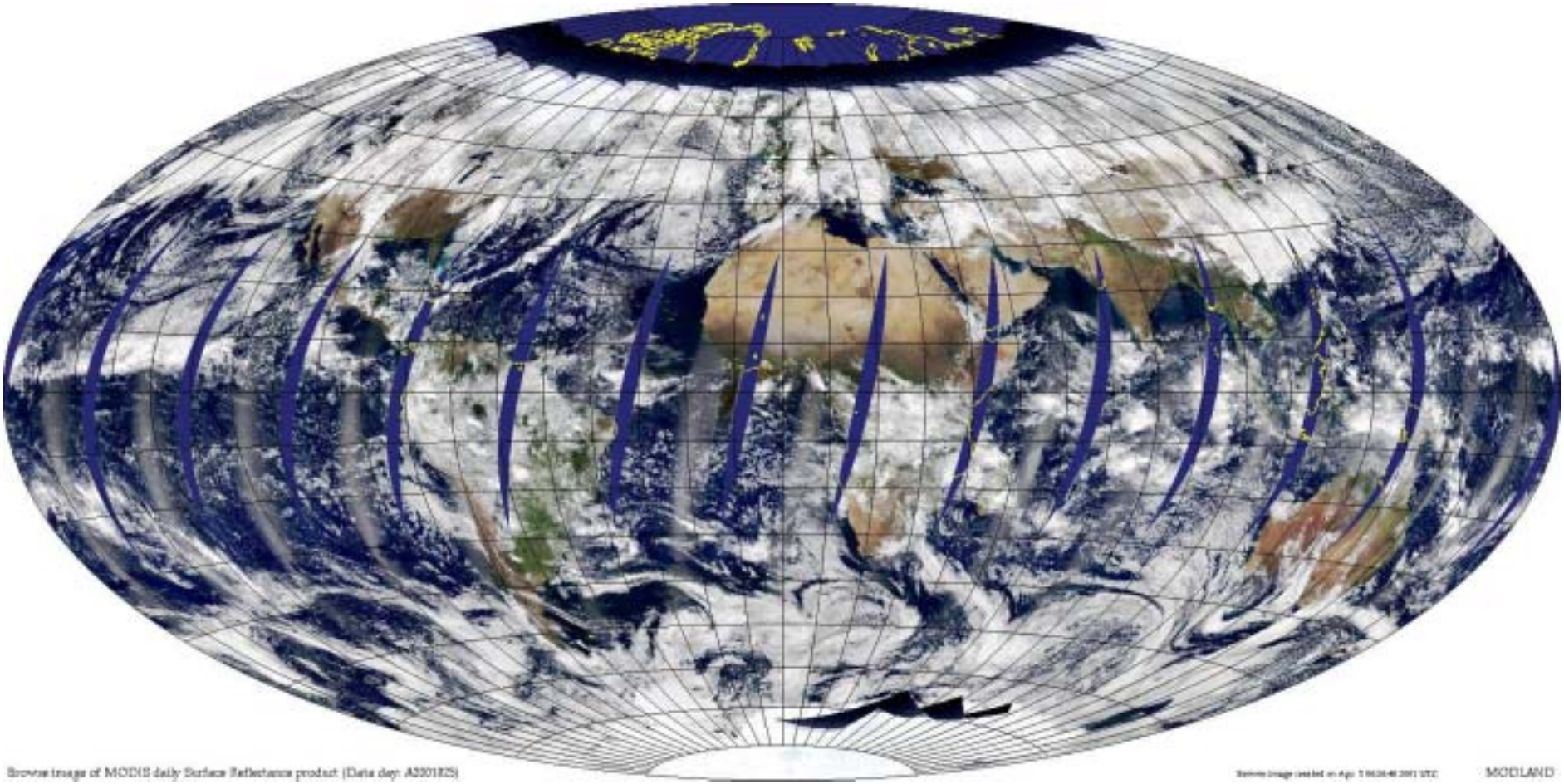


Process Flow

MODIS SDP S/W System



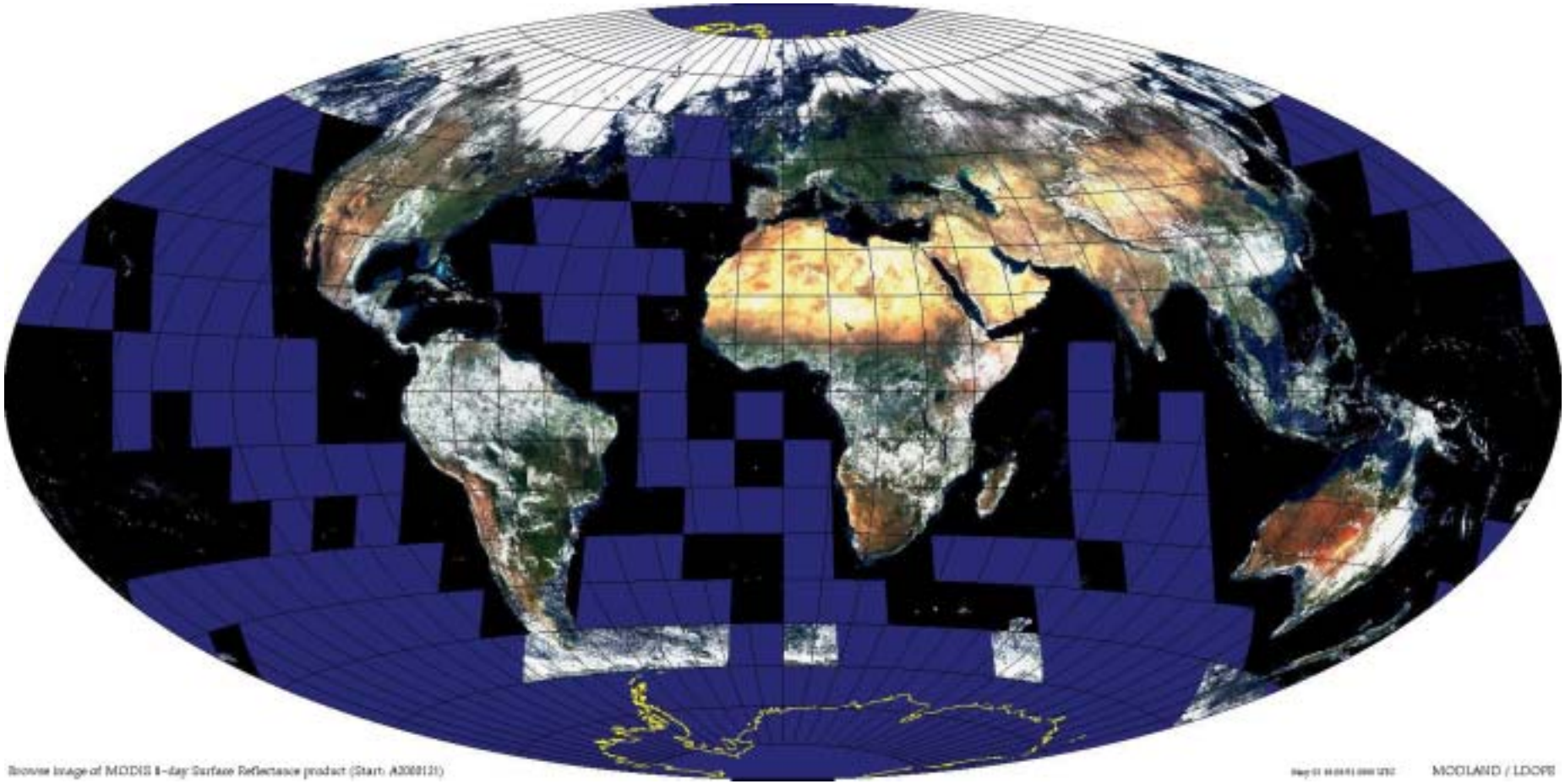
Level 2


Browse image of MODIS daily Surface Reflectance product (Data day: A2001125)
MODLAND

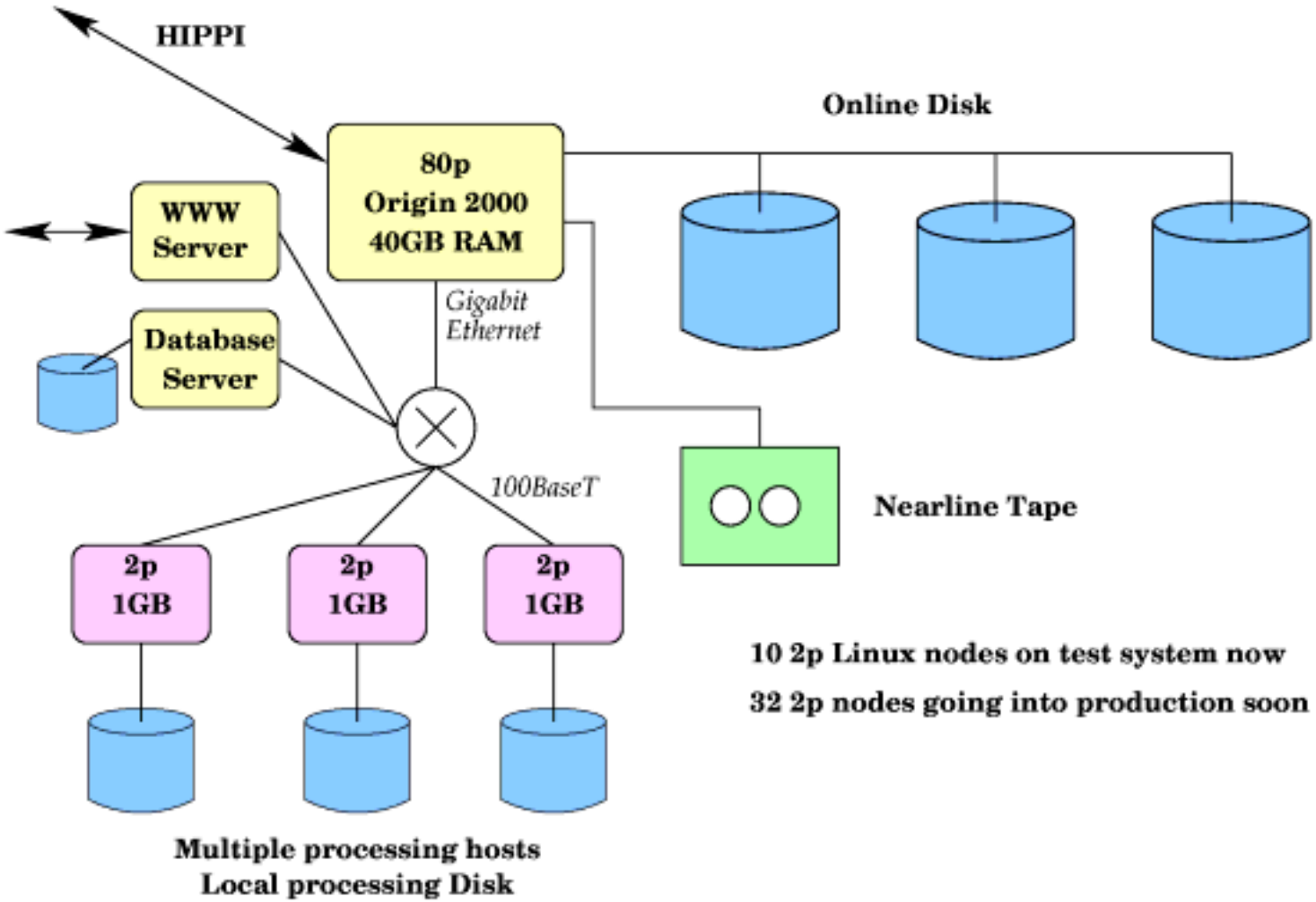
Level 2 Production

- 7 Level 2 PGEs
- Input 5 minute granules, output 5 minute granules
- 288 x 5 minute granules per day
- 144 day-mode, 144 night-mode executions
- Input ~730MB per 5 minutes
- Output ~580MB day-mode and 175MB night mode
- Around an hour of processing time for 5 minutes of data
- Very suited to distributed processing

Land Gridded Production



Distributed Architecture



Distributed Architecture

- Much cheaper per processor cost for 2p nodes than central node
- Local disk space on processing nodes
- Copy input files down through Multiple Gigabit Ethernet to switched 100BaseT
  - ~10MB/s, rcp in less than 2 minutes
- Read input files once on central node, then read repeatedly locally
- Process locally for a while, then copy outputs back to central node.
- 2GB RAM per node, caching benefit

Online Disk

- At launch 10TB of LSI Logic Metastor (1 Filesystem!)
- Added Data Direct San Data Director
- Connected through 8 Host Fibre Channel Interfaces
- 20 Drive Fibre Channel Interfaces
- Dual 8+1 RAID, plus 2 spares channels
- Currently 35TB on primary host
- Soon another 28TB on reprocessing host
- ~70TB total online
- Split into 1TB per filesystem.
- Database tracks location of each file.

Nearline Tape

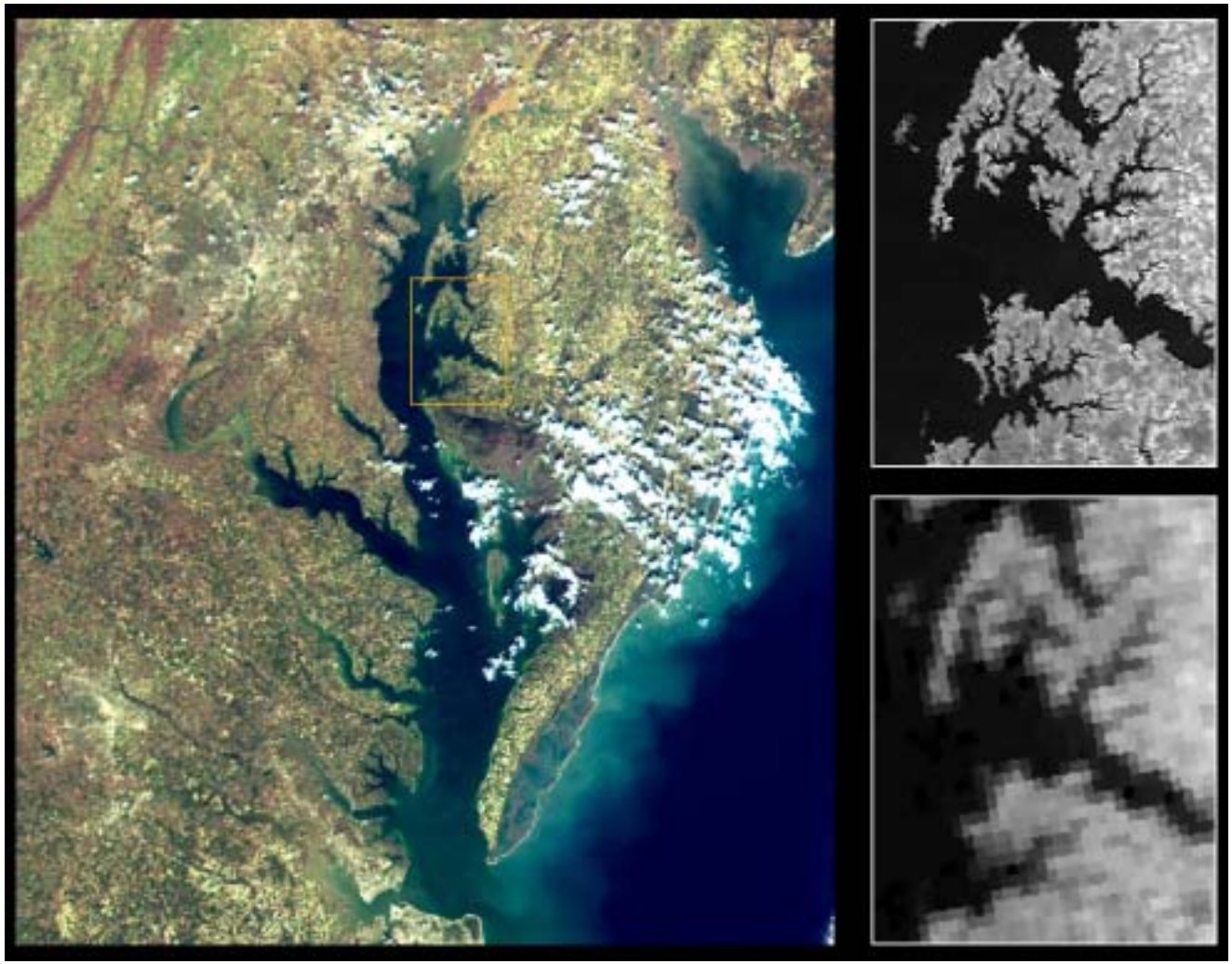
- ADIC Scalar 1000 with 12 AIT-2 drives on both primary and reprocessing system. 1182 tapes per jukebox.
- Connected via Chapparal Fibre Channel to SCSI bridges
- 50GB native, ~100GB with 2/1 compression
- 6MB/s native, we see 5-10MB/s
- About 2TB/day transfer to/from tape possible
- Retrieves take time mounting tapes, searching
- Not enough – adding another 12 drives to each jukebox.
- Driven by homegrown database driven scripts calling Legato Networker Archive Option

Summary

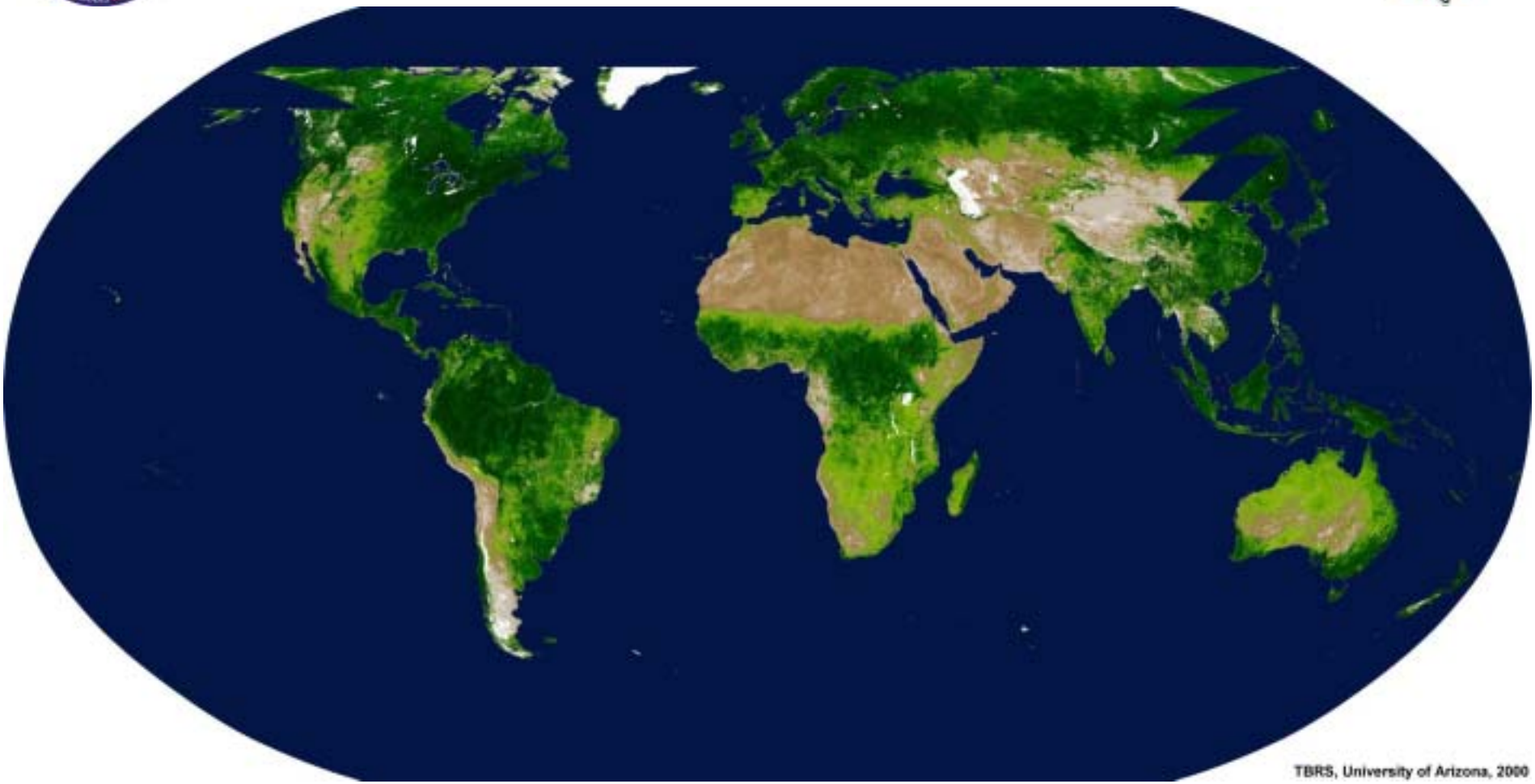
- With Aqua launching soon, and reprocessing needs growing, we need to continue scaling the whole system.
- Commodity Linux processors have good bang/$
- All Level 2 and 2G processes ported to Linux/Intel
- HIPPI link to DAACs ~75MB/s = 6TB/day per system, Two systems (processing and reprocessing).
- DAACs have a big job scaling enough to meet long term archive and distribution needs
- http://modis.gsfc.nasa.gov

MODIS Sample Images

250M vs. 1KM



16day 500M NDVI Composite



Fire Detection