Ae9Ap9 v1.35.001
Parallelized Architecture

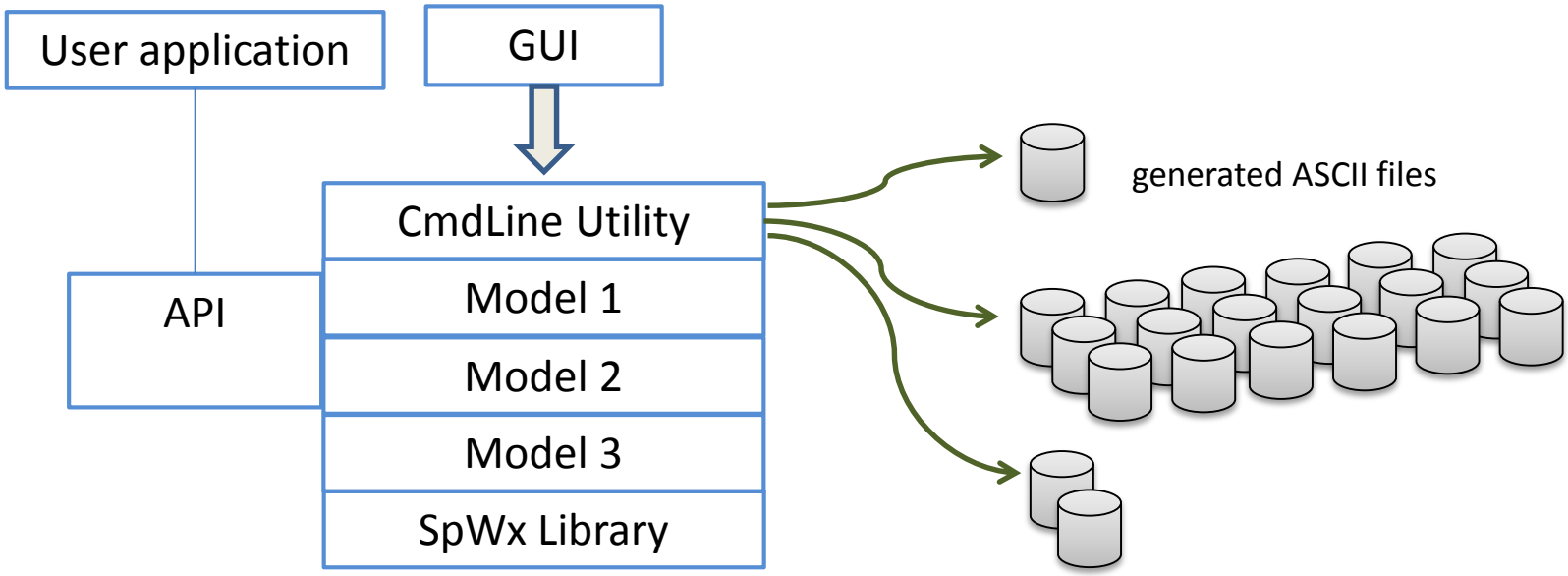
Feb 2017

Christopher Roth
Atmospheric and Environmental Research, Inc. (AER)
www.aer.com

Atmospheric and Environmental Research

Original Architecture = Monolithic

Initial C++ code development was done some seven years ago
Implementation for software versions 1.30.001 and earlier

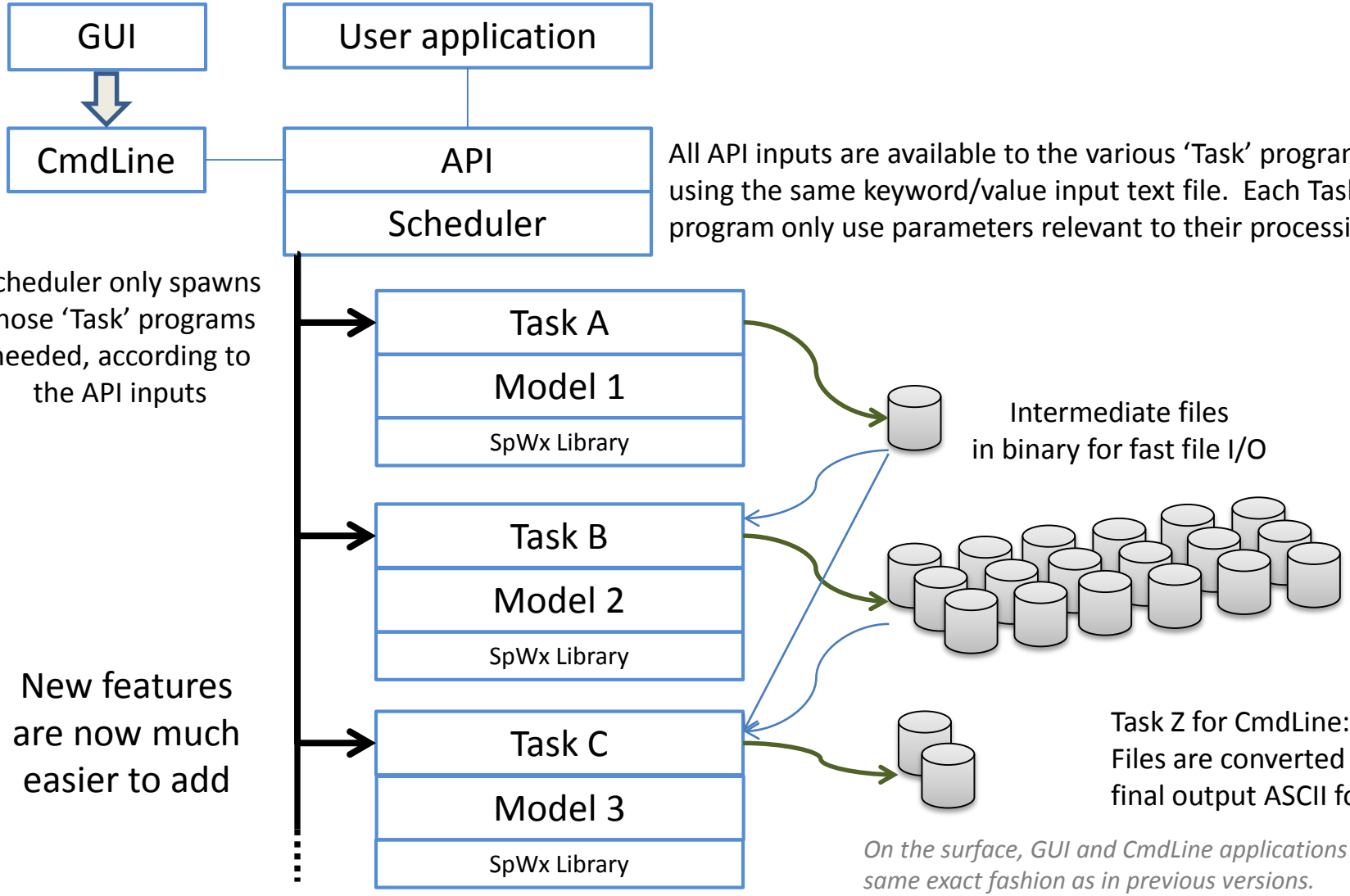


- API was limited to certain models and types of calculations
- Addition of new features was sometimes difficult, constrained by overall program structure.

CmdLine utility reads a user-constructed input file of keyword/value pairs, produces set of ASCII files of model results. GUI generates the input file, invokes the CmdLine utility, then accesses results from the files produced; the user application calls the API routines with the various model settings; the API returns the calculated values to the calling user application.

New Architecture = “Workflow”

Processing is broken up into several independent ‘task’ programs



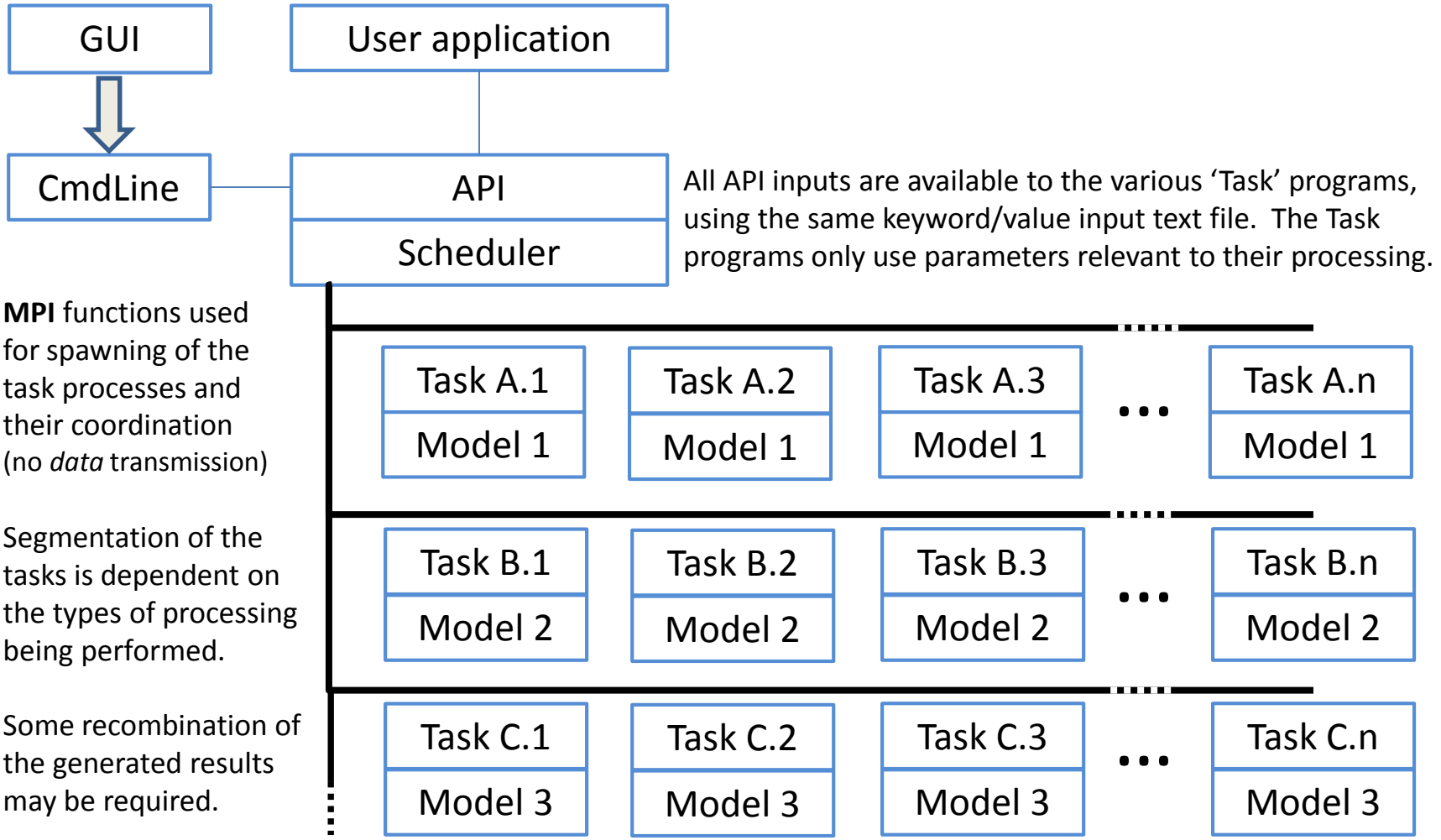
On the surface, GUI and CmdLine applications work in the same exact fashion as in previous versions.

Each of the ‘Task’ programs use common libraries for file I/O operations.

New features could be enhancements of existing Task programs, or the addition of entirely new Task programs into the Workflow

New Parallelized Architecture

"Workflow" arrangement is easily extended for parallelization



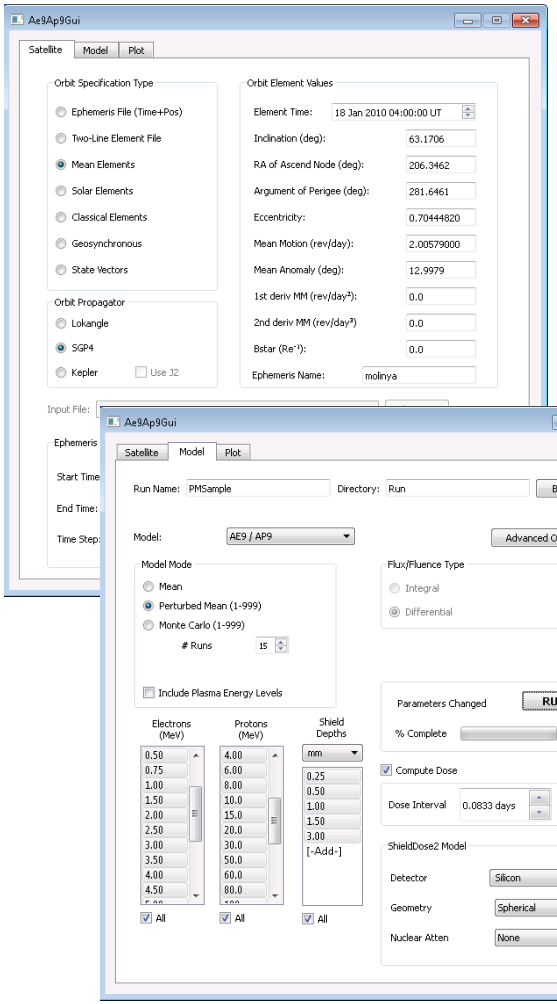
Ax9 : divides the model run into segments over time for first few tasks, then combines their segmented outputs, then processes the numerous output files, where each file treated as a segment

Extra Slides

AER's SpWx Library

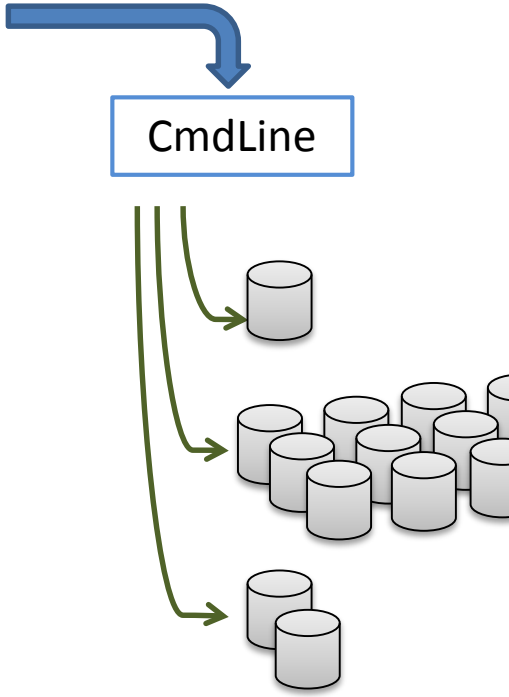
- Code origins largely from AFRL GeoSpace product
- Contains numerous models that describe the space environment encountered by satellites.
- Under an agreement with AFRL, AER has massively cleaned up, updated, converted much of the original model code to C++, and has continued to extend its capabilities to cover more topics of concern.
- Provides a clean and consistent interface to this collection of well-tested models.
- SpWx Library used in several AFRL projects, including GeoX, AE9/AP9, DSX and others.
  - Also used in AER's SEET product for STK

Ae9Ap9 GUI behind the scenes



“Keyword/Value” text input file

```
# AE9/AP9 Command Line Tool Input deck generated by Ae9Ap9Gui.
# Electrons version
OrbitFile: Run/ephem_molinya.dat
OrbPropType: SGP4
OrbMode: Improved
OrbDatum: 84
OrbElementTime: 55214.1666667
OrbInclin: 63.1706
OrbRAAN: 206.3462
OrbArgPerig: 281.6461
OrbEccen: 0.7044482
OrbMeanMot: 2.00579
OrbMeanAnom: 12.9979
Orb1stDerMM: 0
Orb2ndDerMM: 0
OrbBStar: 0
OrbStart: 55214.5000347
OrbEnd: 55215.25
OrbStep: 60
OutFile: Run/PMSample.AE9.CLoutput.txt
ModelType: AE9
FluxType: 1PtDiff
Energies: 0.04,0.07,0.1,0.25,0.5,0.75,1,1.5,2,2.5,3,3.5,4,4.5,5,5.5,6,6.5,7,8.5,10
ModelDB: ../../modelData/AE9V13_runtime_tables.mat
MagfieldDB: ../../modelData/igrfDB.h5
KPhiNNetDB: ../../modelData/fastPhi_net.mat
KHMinNNetDB: ../../modelData/fast_hmin_net.mat
FluxOut: perturbed,1-15
FlueOut: true
DoseOut: true
CDoseOut: true
Aggregate: percentile,50,75,95
DoseDepths: 0.250,0.500,1.000,1.500,3.000
DoseDepthUnits: millimeters
DoseDetector: Silicon
DoseGeometry: Spherical
DoseAttnMode: None
AccumInterval: 0.0833
TimeSpec: MJD
CoordSys: GEI
CoordUnits: Re
DataDelim: comma
```



Ae9Ap9 Model Class Overview