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Research to Reality in Air Traffic Management

Oceanic Initiatives Portfolio – Determining Future Performance

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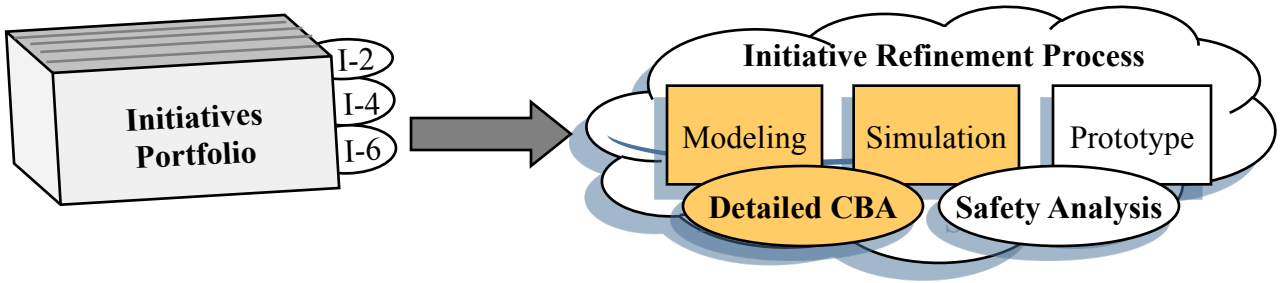
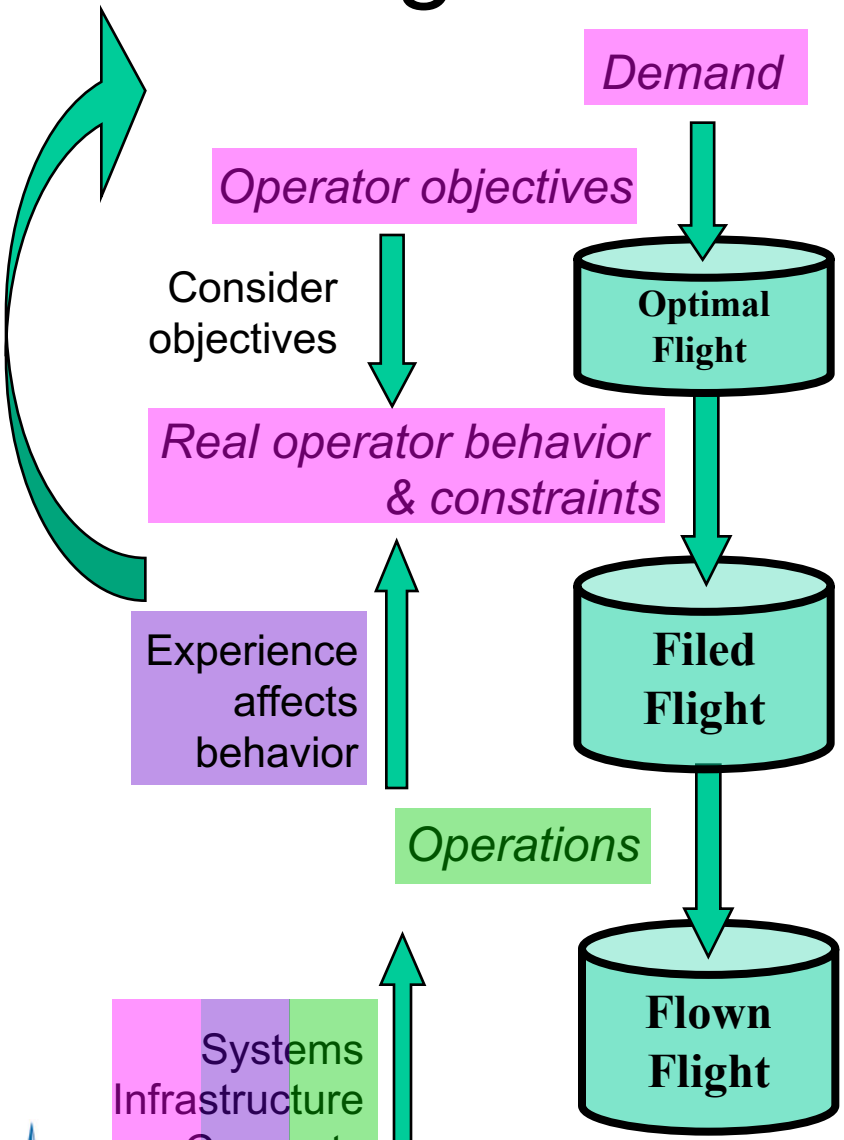
Overview



- Focus on analysis, modeling and simulation of initiatives in portfolio
- Apply system-level performance metrics
- How do we go about this?
- What are some of the elements required to do this?
- Why a human analyst is typically needed

High-level View of a Flight



- On-time performance
- Minimum Fuel
- Diversion avoidance
- Profit maximization

- Flight levels
- Track selection
- Boundary constraints
- TFM

- TFM/ATC
- Pilot execution
- Delays

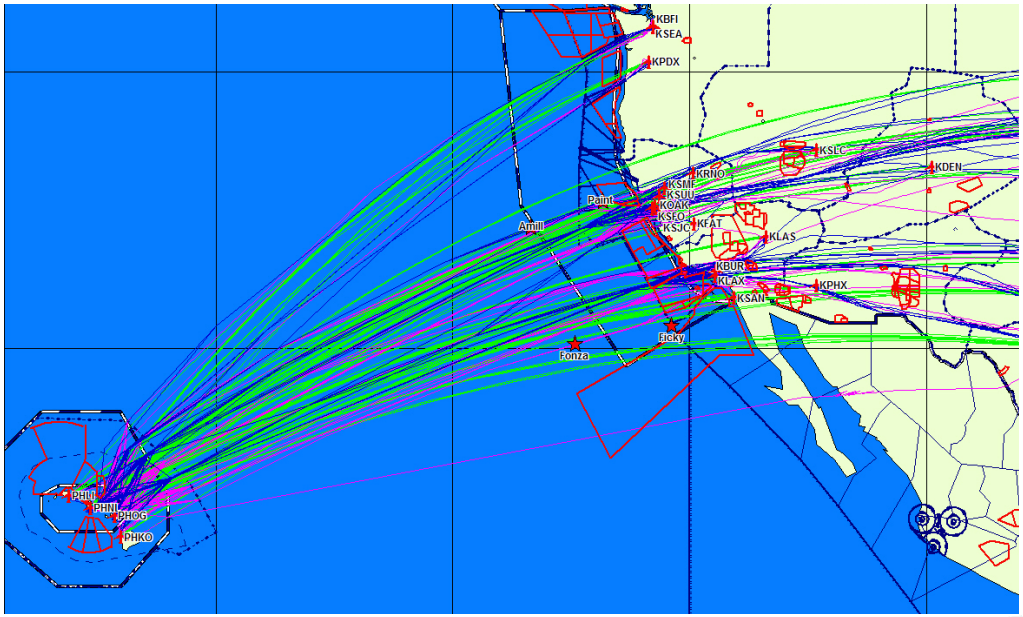
Typically apply:

- Modeling
- Analysis
- Simulation

Operational Data

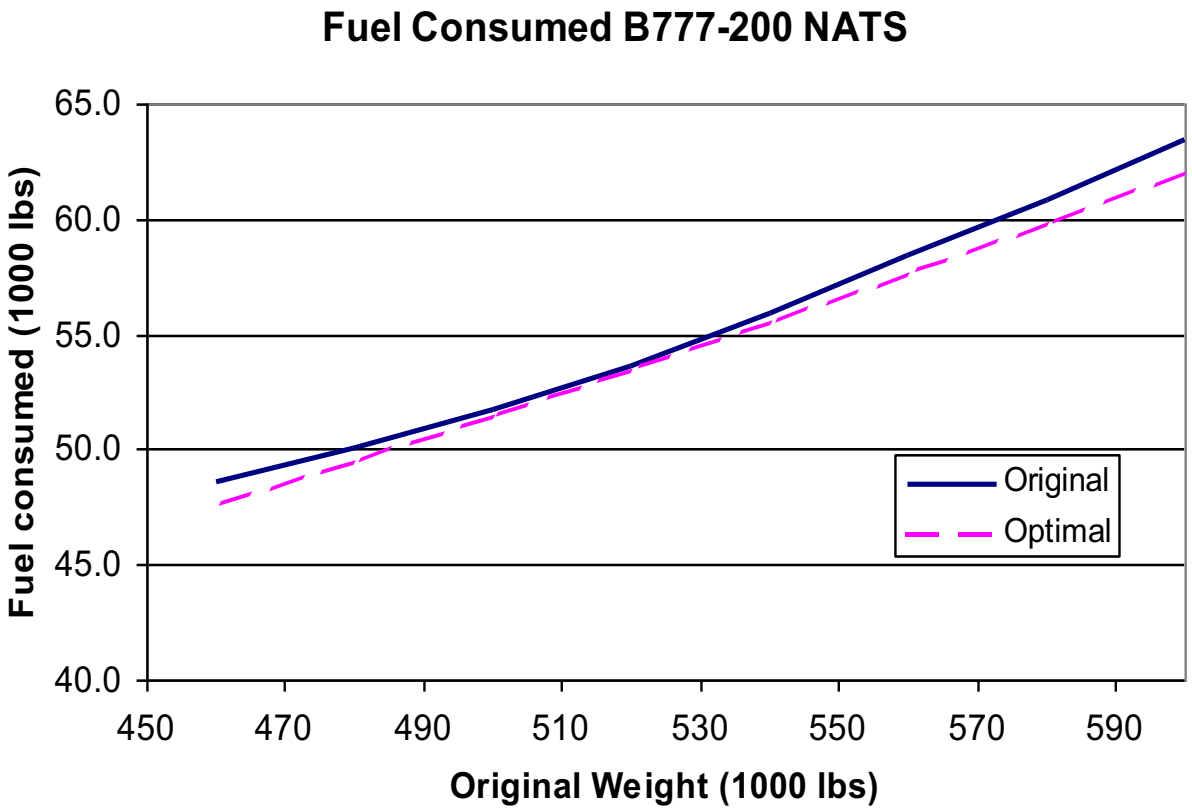
- Assessment of current system
  - Baseline performance
  - Validation
  - Data-driven investigation of operator concerns
- Data to drive analysis of changes
- Ability to extract/query/plot/animate

  - Traffic Information
    - Route filed / flown
    - Aircraft type
    - Capability
    - Weight (?)
    - Desired times
  - Tracks
  - Atmospheric
    - Actual
    - Forecast
  - SUA



Weight Sensitivity

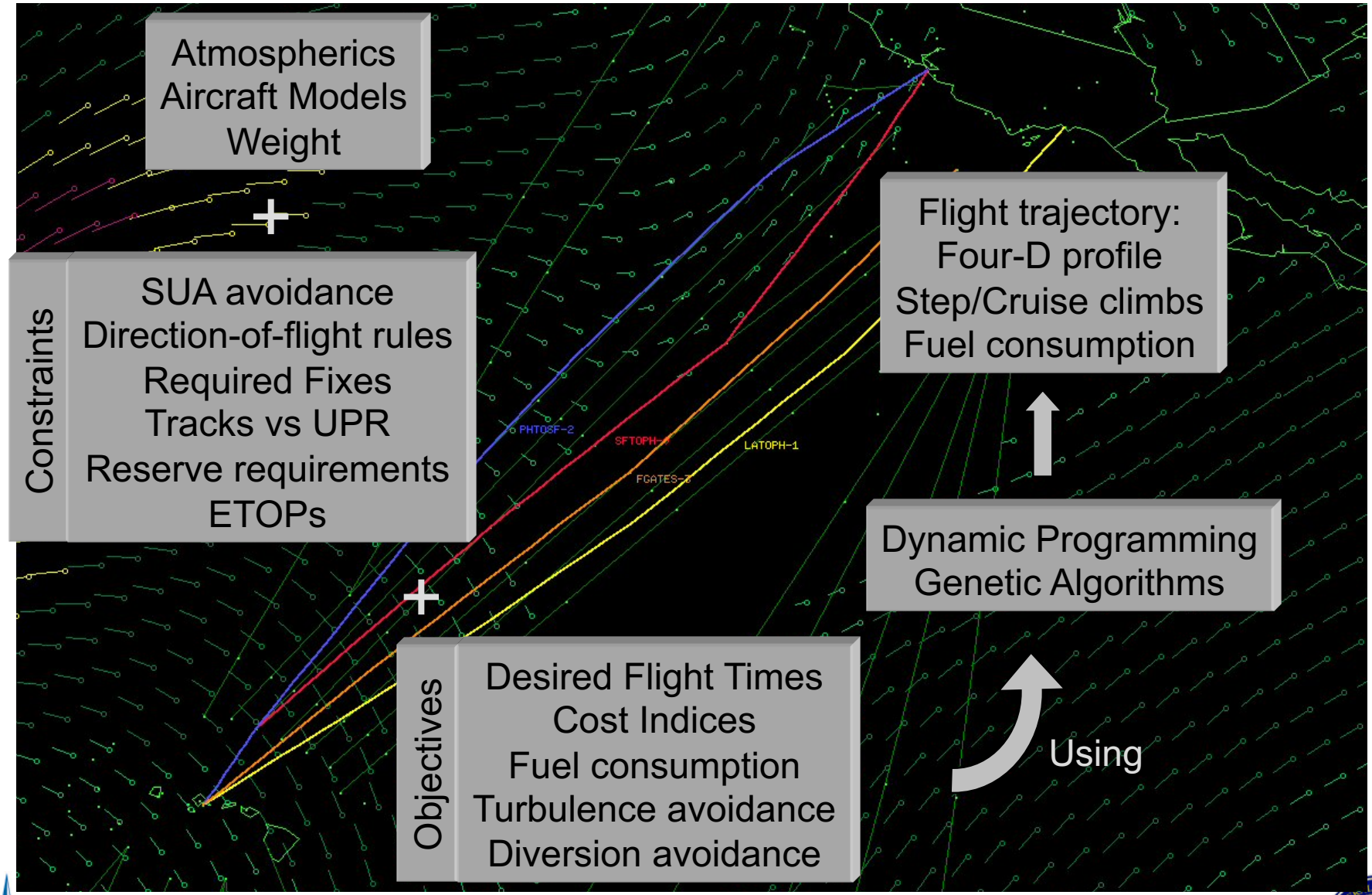
- Position reports show: enter at FL360, M 0.84 exit w/ same
- Fuel requirements and load factors provide a broad range of possible weights



Demand

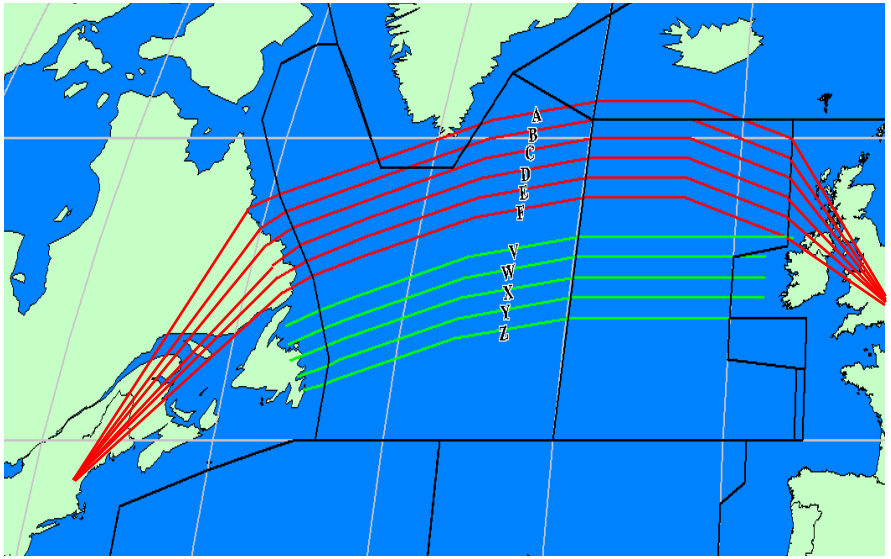
- Investigation of impact going forward requires growth in traffic and allocation of:
  - Origin, destination
  - Aircraft types
  - Equipage and/or capability levels
  - Schedules
- Exogenous high-level forecasts
- Approaches for High-level → required data
- Consideration of constraints
- Not a static world, perceived outcome of changes alters decisions that impact the future

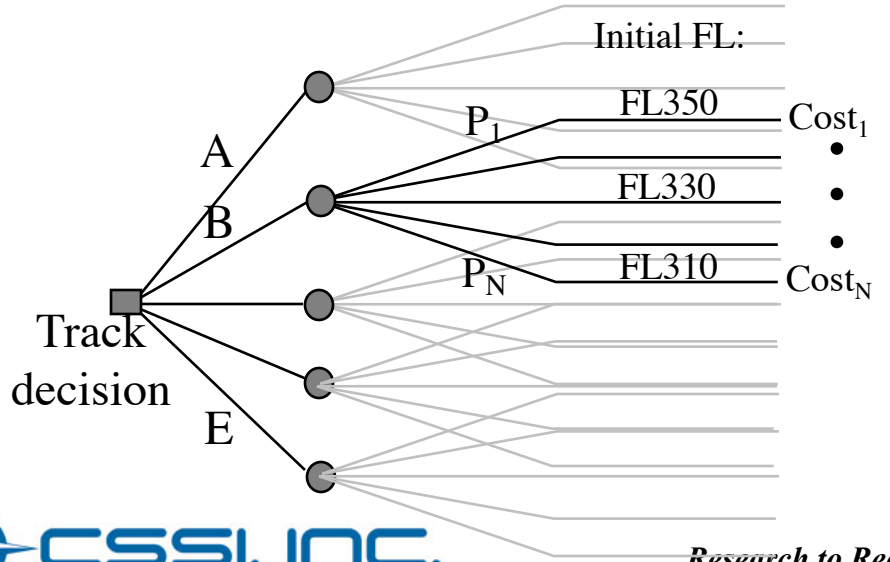
Flight Optimization



NATS Track Selection

- Track/altitude allocation balances user preferences with capacity limits
- Apply decision theory to select track based upon <u>expected</u> total costs
  - Fuel, time, addl. cargo cost
  - Probability-weighted





Obtain probabilities through: Monte Carlo Simulation "greedy" algorithm enforcing separation standards

$$E[Cost] = \sum_{i=1}^{N} P_i Cost_i$$

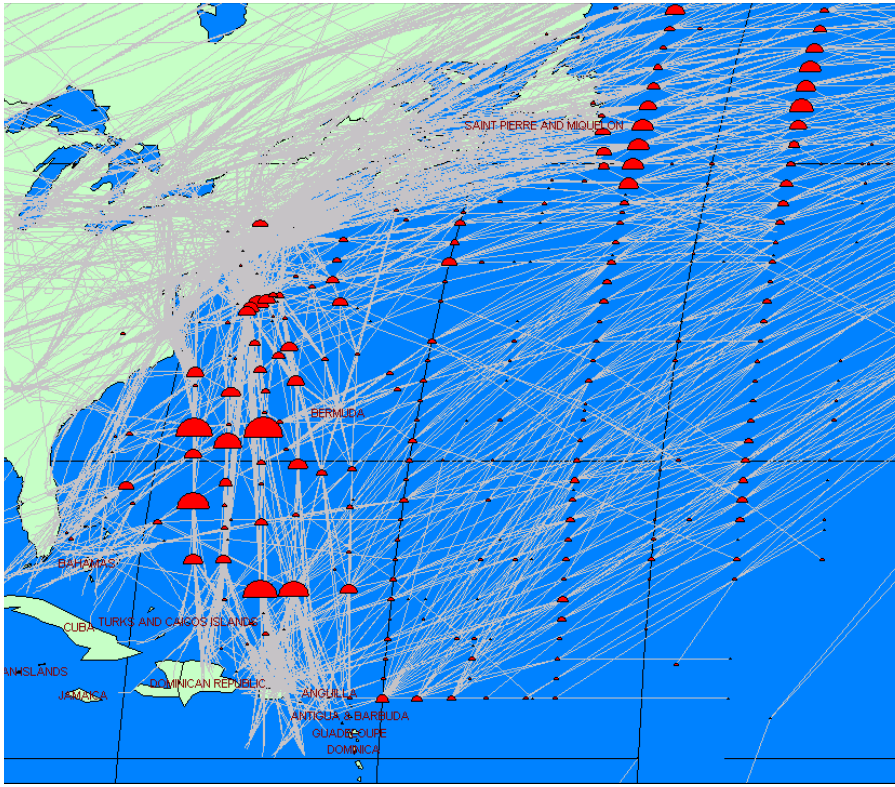
Track selection based on lowest expected cost

Operations

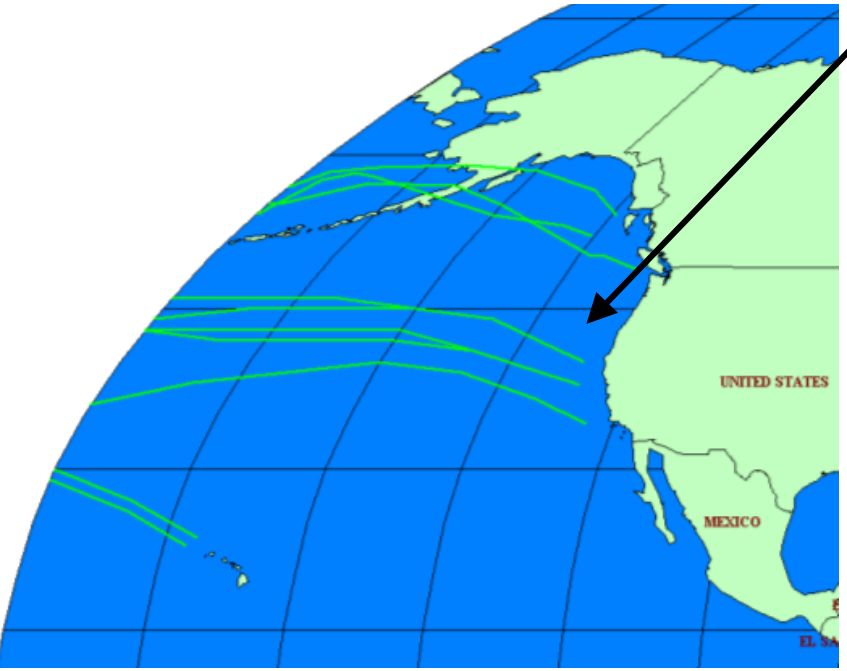
- Impact of "operations"
  - Consider regional differences
  - If applicable, process for loading tracks, reservations
  - Separation assurance, step climbs, other operational constraints
  - Variance of input
- Consider multiple days
  - Benefits can be variance-driven
  - Few errors can skew results

Regional Differences

- Diversions
- Cargo demand
- Fixed, published, UPR
- Crossing traffic
- Sporadic vs No Radar
- Step Climbs
- Altitude for direction
- Various FIRs
- Acft type variation
- ETOPS
- Reservations
- Etc…



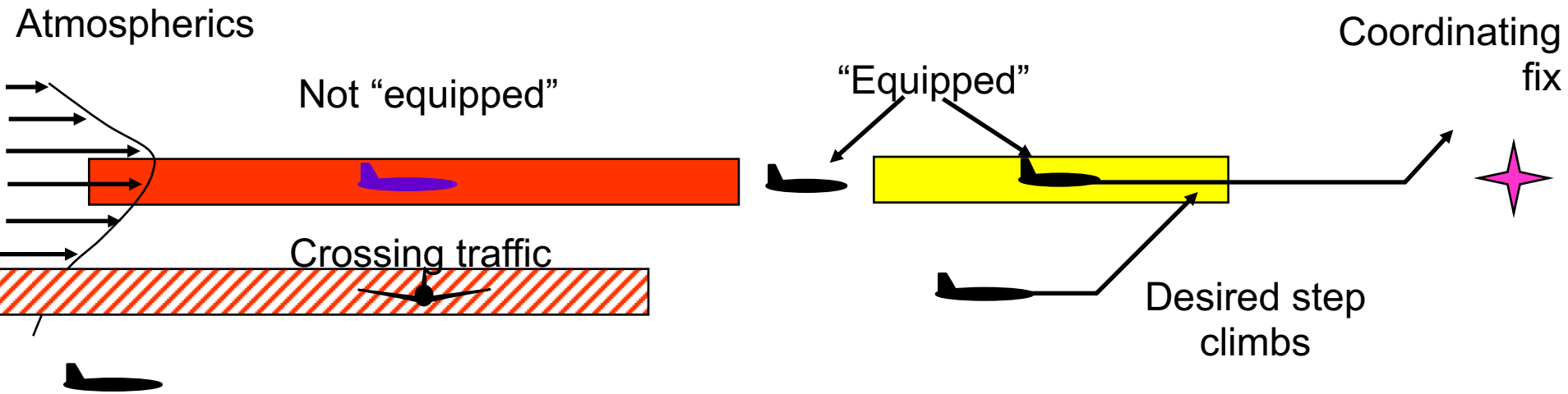
Track Loading / GRL



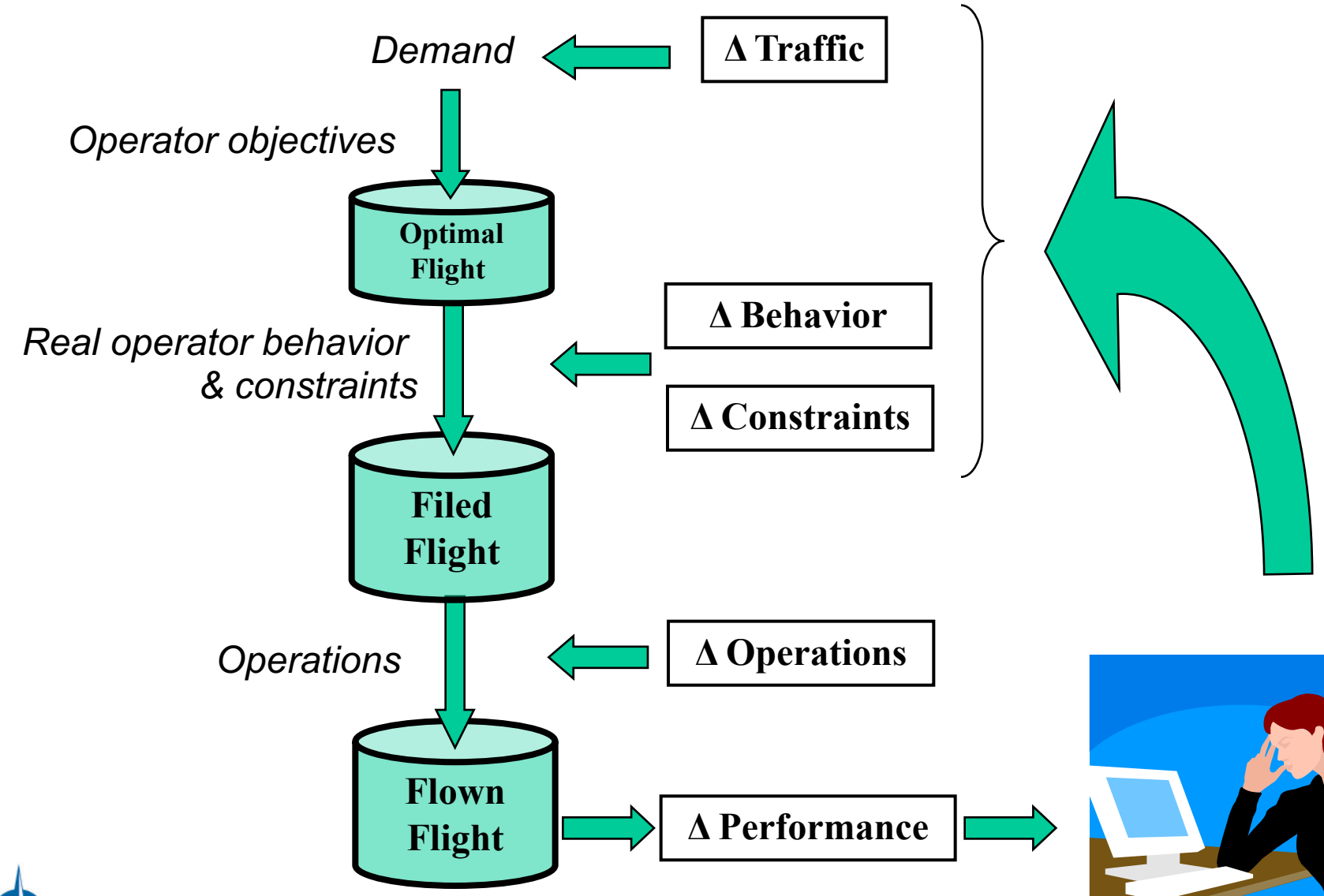
- NoPAC flights on track obtain slots via a reservation list:
  - Track
  - Estimated Time
  - Altitude
- Flights request reservations by specifying choices w/ max delay
  - GRL uses FCFS logic to assign first choices, then 2nd, etc.
  - Negotiation allows flexibility
- >80% get 1st choice w/o delay
- Controls departure time

Separation

- Separation services more “strategic”
- Pair-wise equipage may matter
- Step climbs and look-ahead
- Carrier considerations (more restrictive)

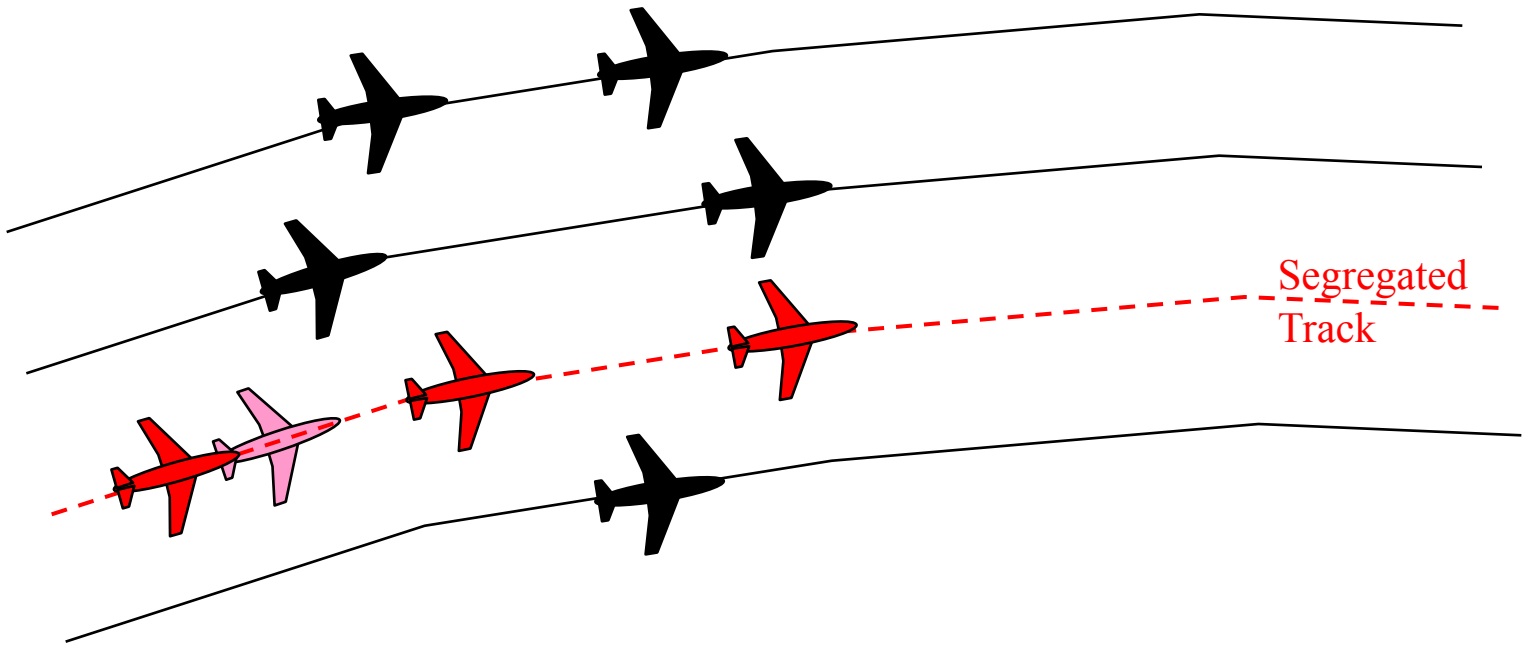


Putting it Together

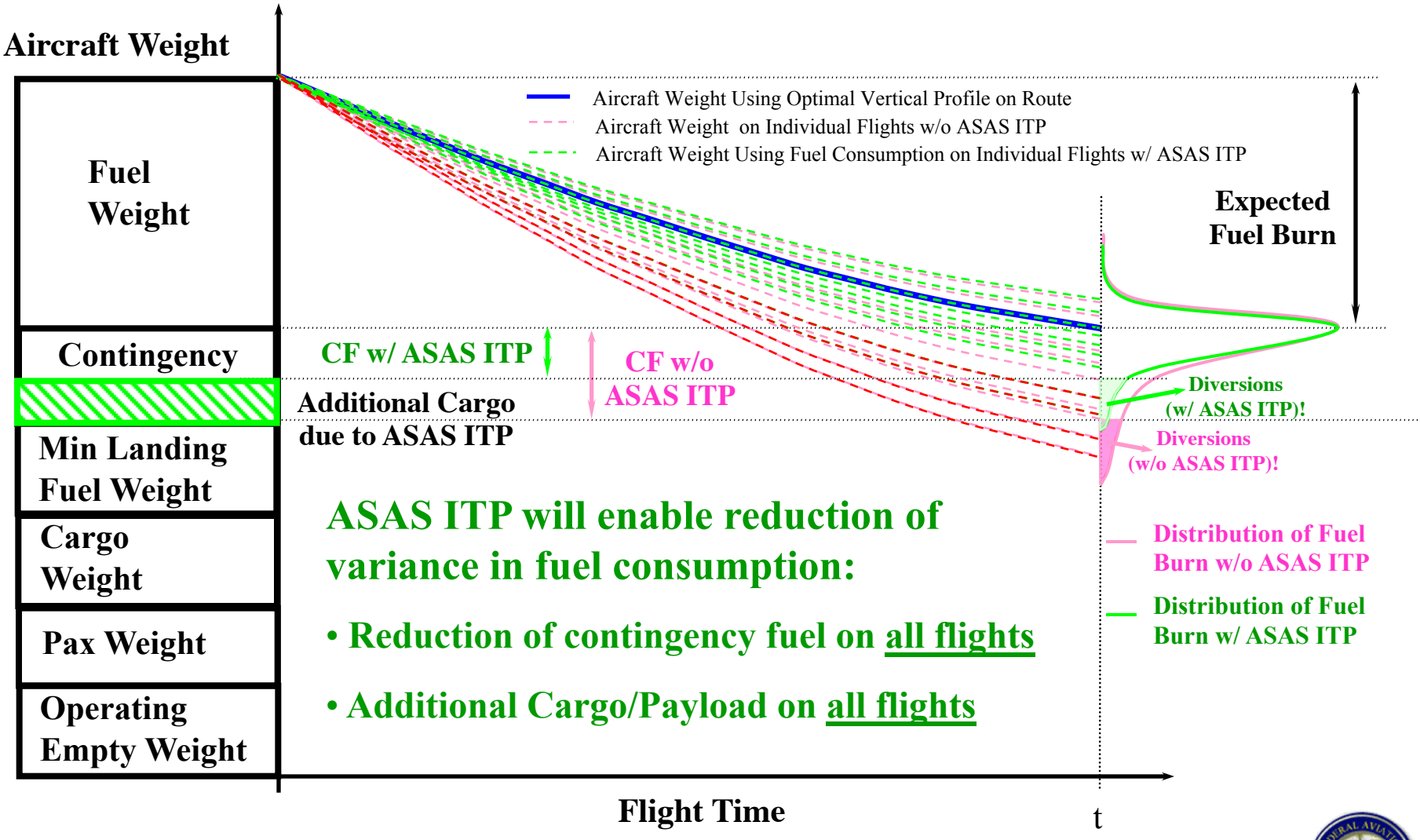


Track Selection – Segregated tracks

- Concept changes looking at "segregated tracks"
  - Tactical track allocation and designation of which track(s) are segregated
  - Strategic decisions to equip



Example from ITP - Flight Efficiency in SOPAC?



Future Steps

- Efforts underway
  - Ensuring that modeling capabilities capture required capabilities for evaluation of initiatives in portfolio
  - Incorporation of capabilities into models
  - Understanding and using new and improved data
- Seek:
  - Repeatability
  - Consistency
- Ultimately provides the prior presentation with the means to estimate differences between initiatives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