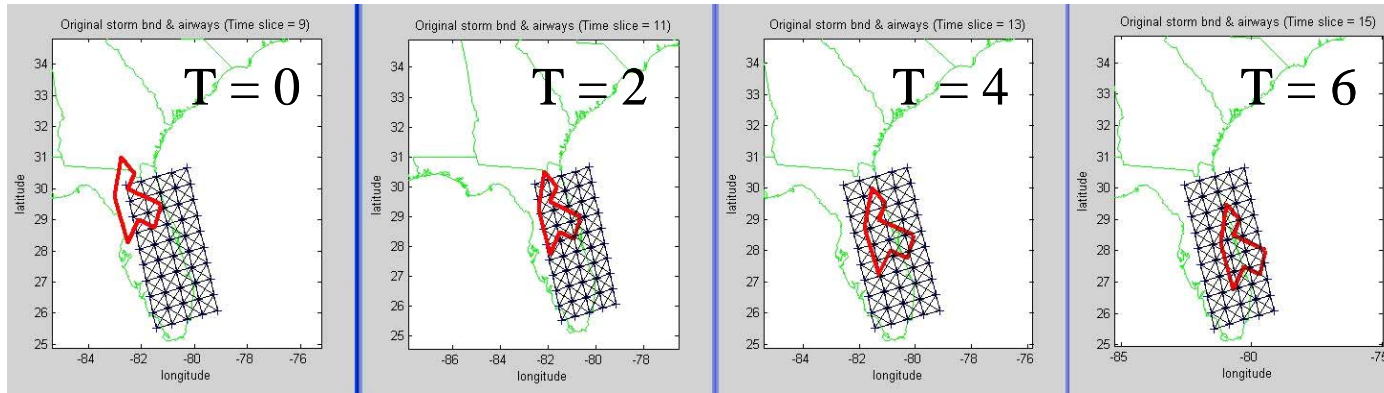
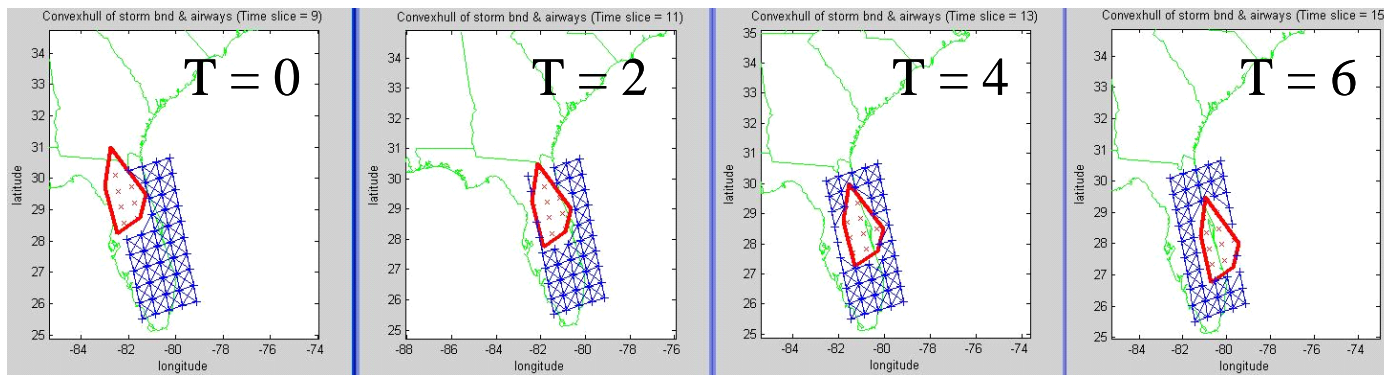


Severe Weather + Airways (over Time)



Severe Weather Boundary



Convex Hull of Severe Weather Boundary

Time-dependent Shortest Path (TDSP) Algorithm

- Direct modification of **Dijkstra's algorithm**.
- To facilitate computational speed, a **double-ended queue** structure is used for node selection scheme.

```
Call Initialize
while(SE list is not empty){
  u = Call deQueue;
  d_u = Label(r, u); // arrival travel at node u starting from r at time t.
  Compute timeSlice_d_u; // compute the time slice corresponding to d_u.
  for(v = all forward star of u){
    d_v = Label(r, v); // travel time from r to v.
    l_uv = Find travelTime(u, v, timeSlice_d_u) // find the travel time for link (u,v) at
                                                timeSlice_d_u

    if(d_v > d_u + l_uv){
      Label (r, v) = d_u + l_uv; // update travel time from r to v
      Predecessor(v) = u; // update predecessor node for node v
      Call enQueue(v);
    }
  } //end for
} // end while
```

```
Procedure Initialize:
for (j = all nodes){
  predecessor(j) = 0;
  if(j ≠ r) Label(r, j) = infinite;
}
Label(r, r) = t;
Predecessor(r) = r;
enQueue(r);
```

```
Procedure deQueue:
// find the closest node from the candidate
nodes set (i.e., SE list) using the quick-sort
algorithm.
```

```
Procedure enQueue(x):
// insert node x into the candidate nodes set
```

Aircraft Performance Data

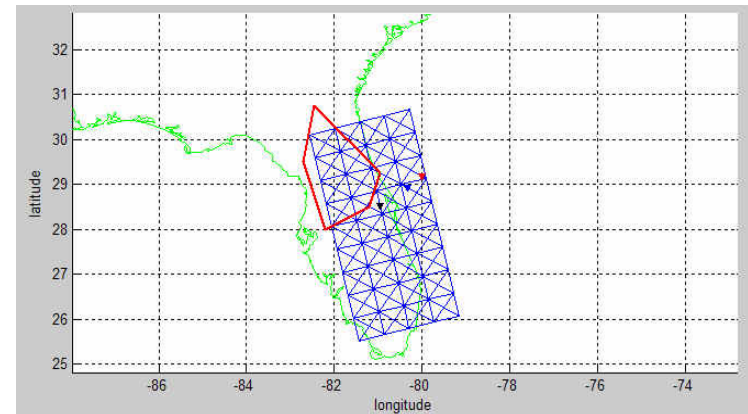
- Use Eurocontrol's the Base of Aircraft Data (BADA) 3.3, Dec. 2000.
- BADA was developed by Eurocontrol Experimental Centre (ECC) to model various Air Traffic Management (ATM) concepts:
 - 186 aircraft supported in BADA 3.3
 - 84 aircraft models are supported directly
 - 102 aircraft models are supported indirectly (equivalent models)
- Main outputs of the models are fuel consumption, aerodynamic, and speed procedure parameters.

Results (1): Flight Trajectories

<u>time(min)</u>	<u>latitude</u>	<u>longitude</u>	<u>altitude (FL)</u>
0	30.3833	-81.4167	0
0	30.3833	-81.4167	0
7.0937	29.8733	-81.2915	152.5146
11.8470	29.3633	-81.1664	229.1681
13.5750	29.1642	-81.1176	250.0000
16.2728	28.8533	-81.0413	250.0000
20.6291	28.3433	-80.9162	250.0000
24.9855	27.8333	-80.7910	250.0000
29.3419	27.3233	-80.6659	250.0000
33.2081	26.8760	-80.5562	250.0000
33.7502	26.8133	-80.5408	234.3474
38.6662	26.3033	-80.4157	121.8427
46.4110	25.7933	-80.2906	0

Path 2

Path 1



Results (2): Flight Cost

	Color	Dist. (nm)	Time (min)	Fuel (kg)
Static Path	—	282	46	2,376
TD Path-1	—	327	52	2,692
TD Path-2	—	350	57	2,850

