Seminar Ad Hoc Networks

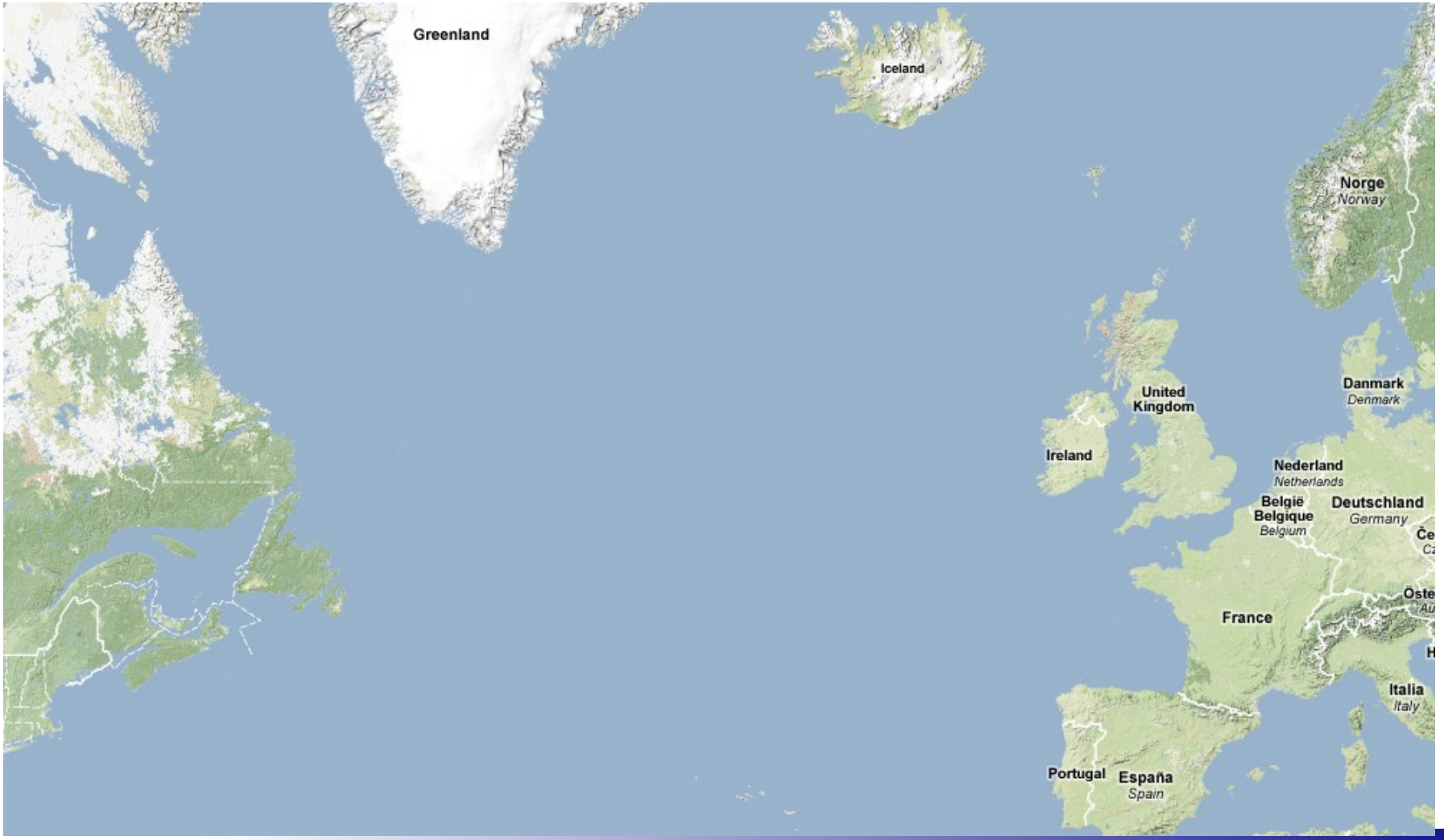
Feasibility of an Aeronautical Mobile Ad Hoc Network Over the North Atlantic Corridor

- Daniel Medina, Felix Hoffmann, Serkan Ayaz, (German Aerospace Center DLR)
- Carl-Herbert Rokitansky (University of Salzburg, Austria)

Konrad Meier

What is the idea?

- Ad Hoc Network in the North Atlantic Corridor



Motivation

- need for communication
  - information about the aircraft
    - e.g. delay, connecting flights, fuel consumption
  - passengers want to have access to the Internet
  - phone calls
- today: only possible over a satellite link
  - expensive, high delay

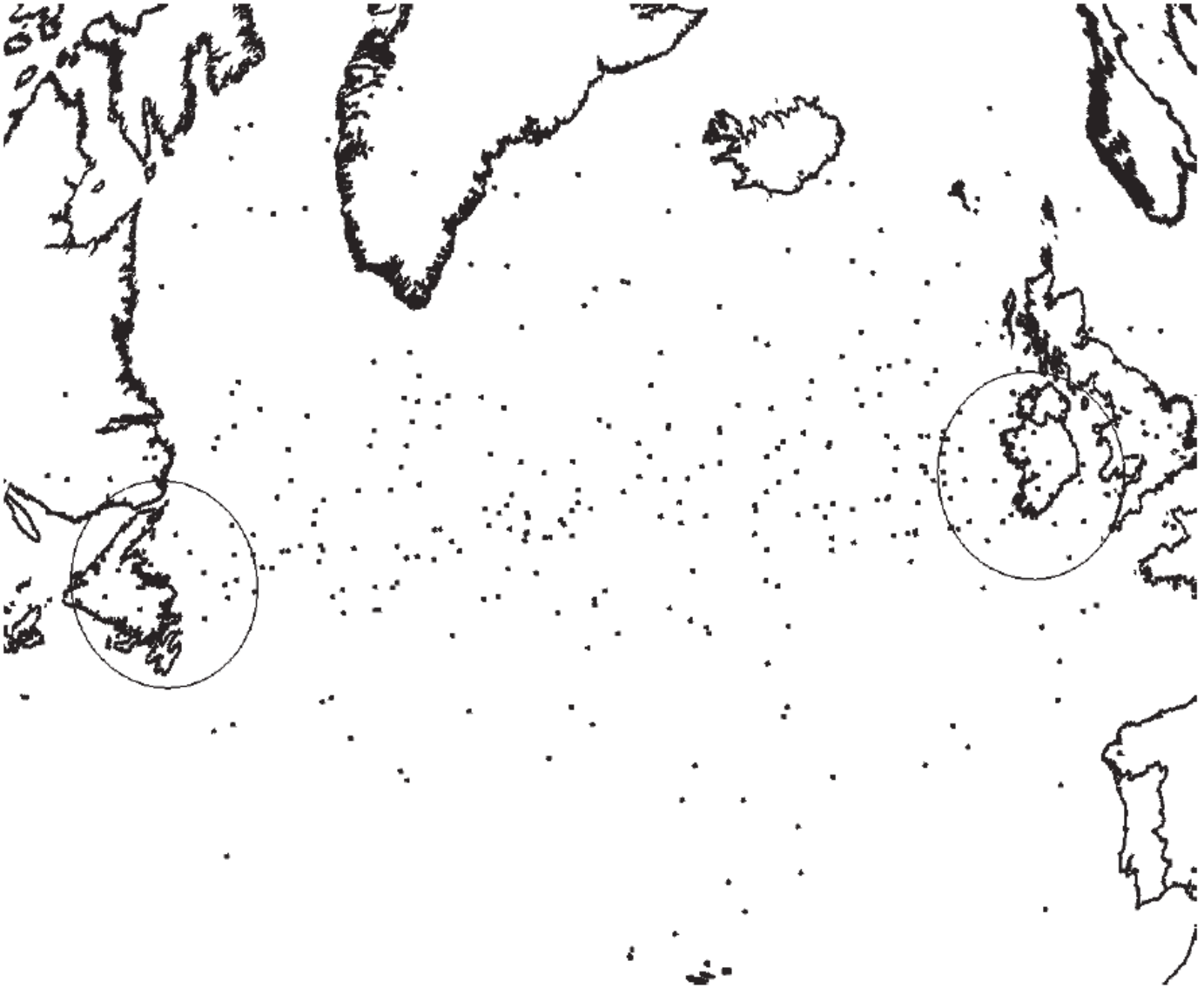
=> Ad Hoc Network between the aircrafts

Setup

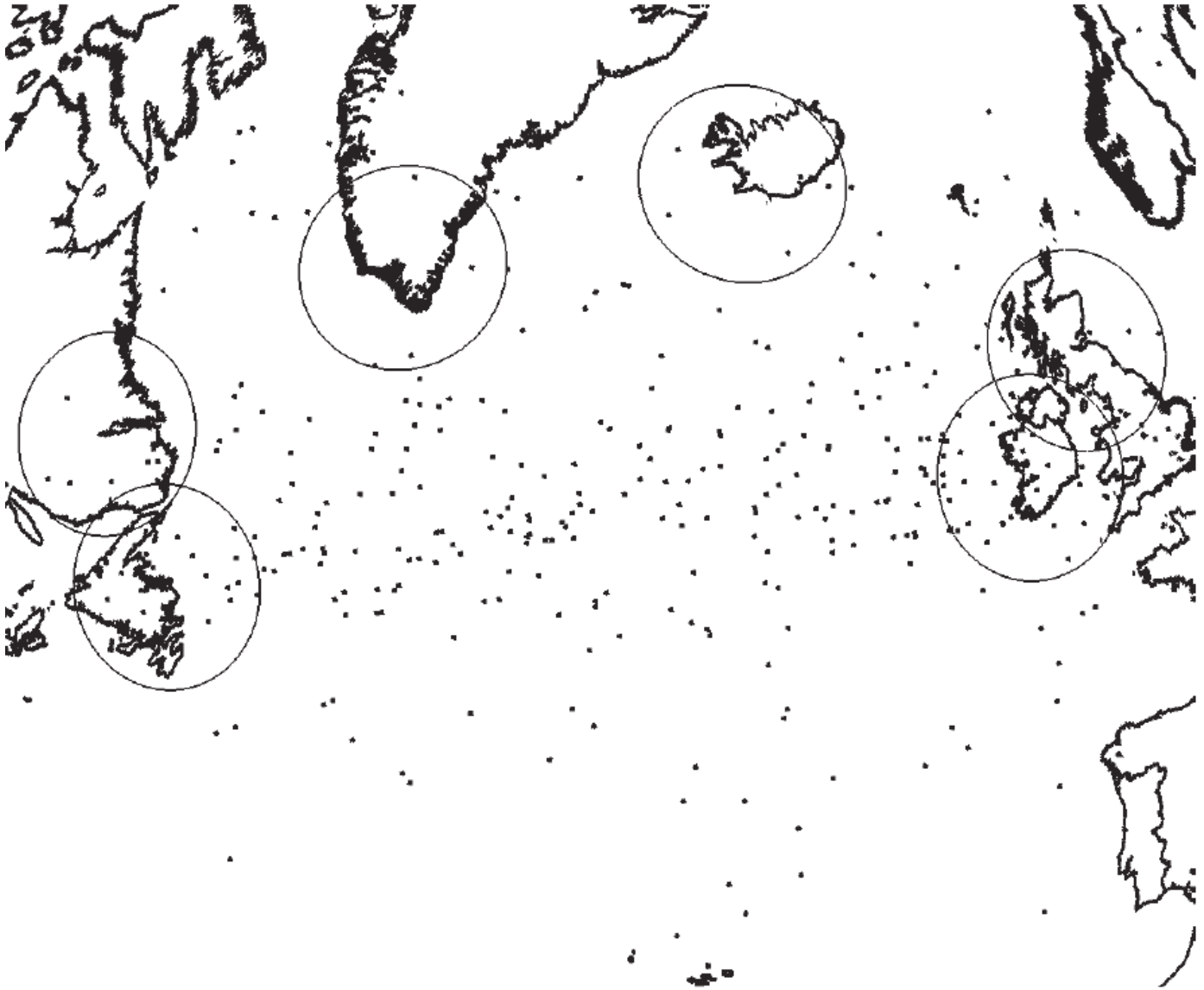
- two elements in the network:
  - aircraft and ground stations
- ground stations are operating as gateways
- two scenarios:
  - 2 ground stations
  - 6 ground stations

More details about the network structure will follow in the final presentation.

Scenario A

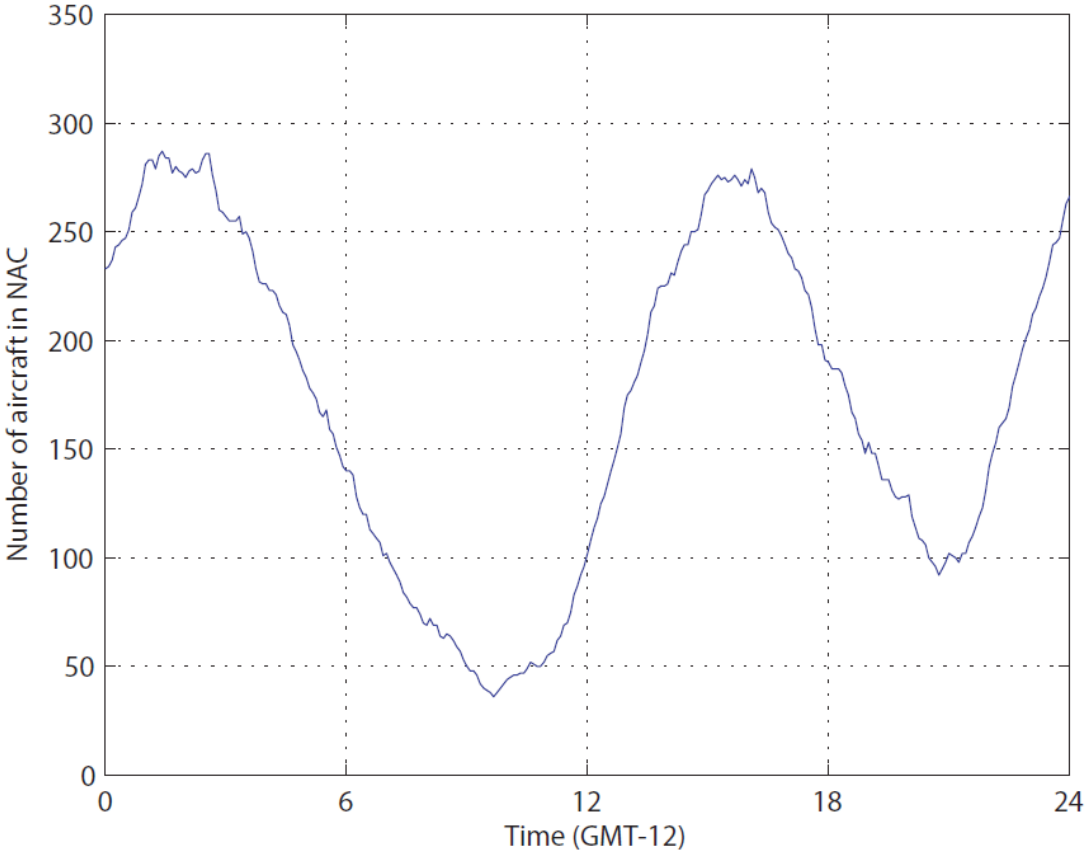


Scenario B



Network Topology

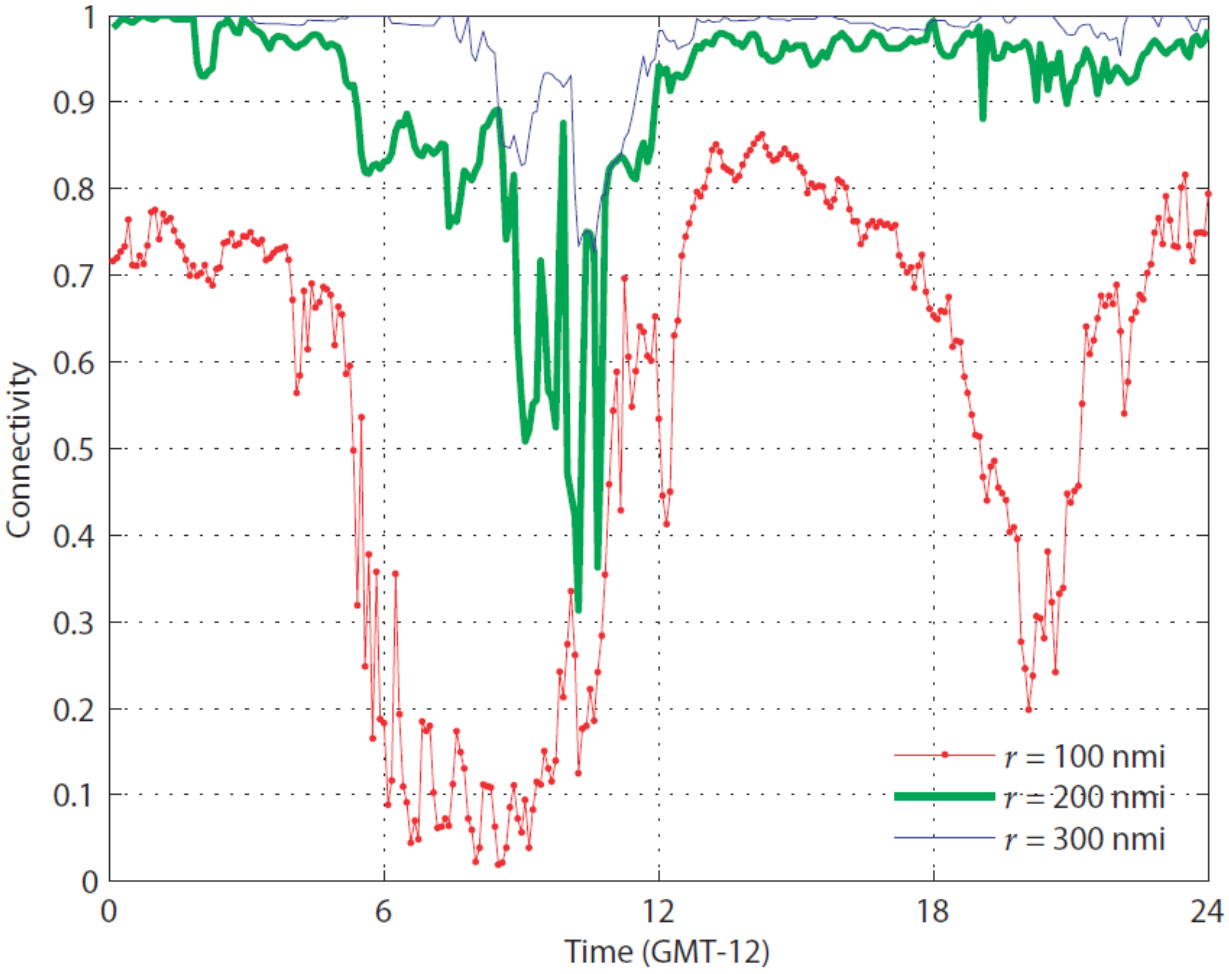
- realistic flight-data for simulation
- number of aircrafts in the NAC



Network Topology

- connectivity in the NAC

$$C(t) = \frac{number\ of\ connected\ aircrafts}{total\ number\ of\ aircrafts}$$



$$100\ nmi = 185{,}2\ km$$

Network Topology

- Link Stability
  - short links between eastbound and westbound aircrafts
  - long-lived links between aircrafts flying in the same direction (up to some hours)

=> stable network

Greedy Forwarding

- choose the local optimum for the next hop
- forward the packet to the next hop which is closest to the target (gateway)

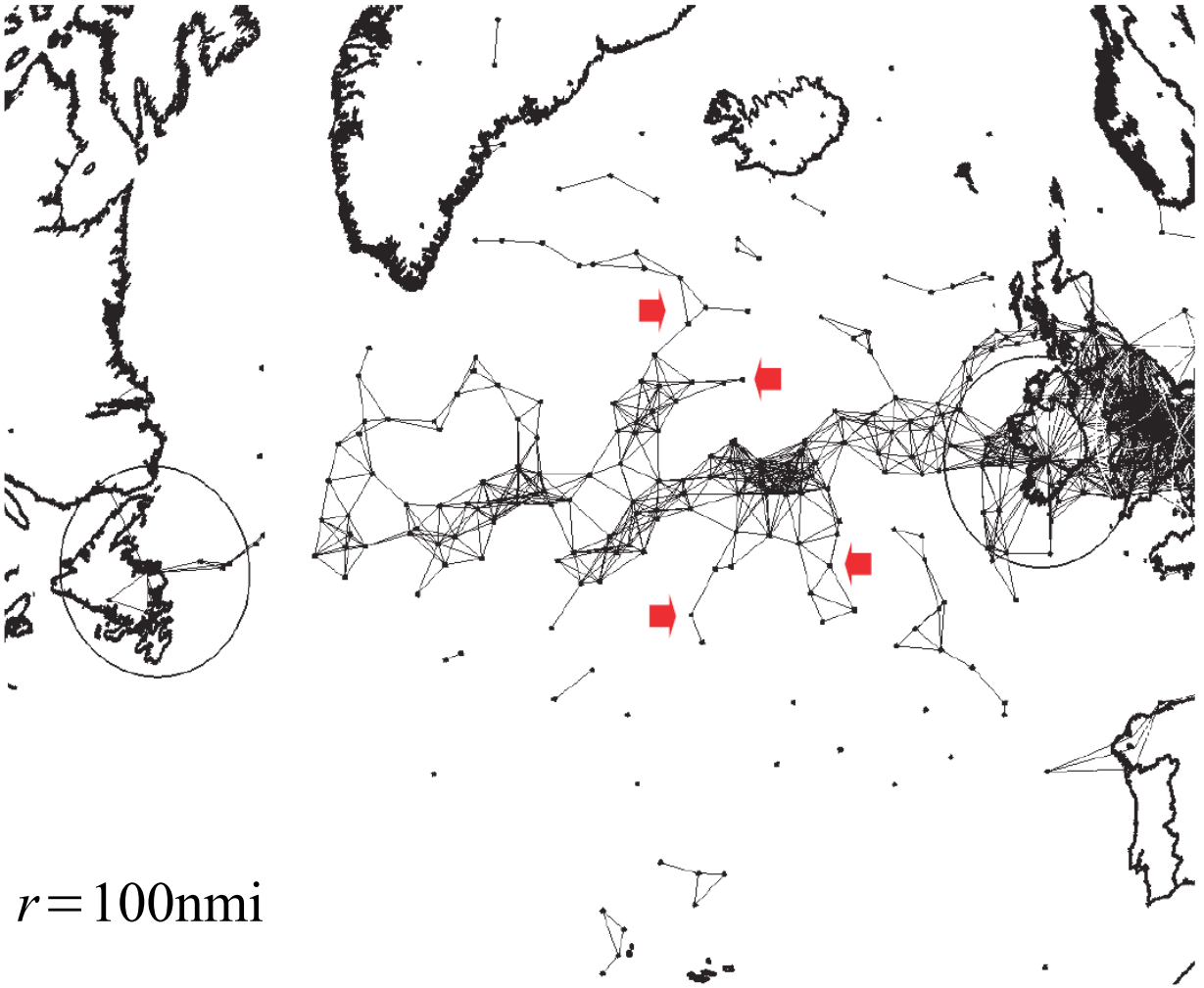
- Performance is measured by:
  - packet delivery ratio
  - average path length
- Is greedy forwarding sufficient?

packet delivery ratio

- Defined as percentage of transmitted packets which are successfully delivered.
- Why can a packet get lost?
  - source does not know that there isn't any route to destination
  - path to destination exists, but packet is delivered to a local maximum

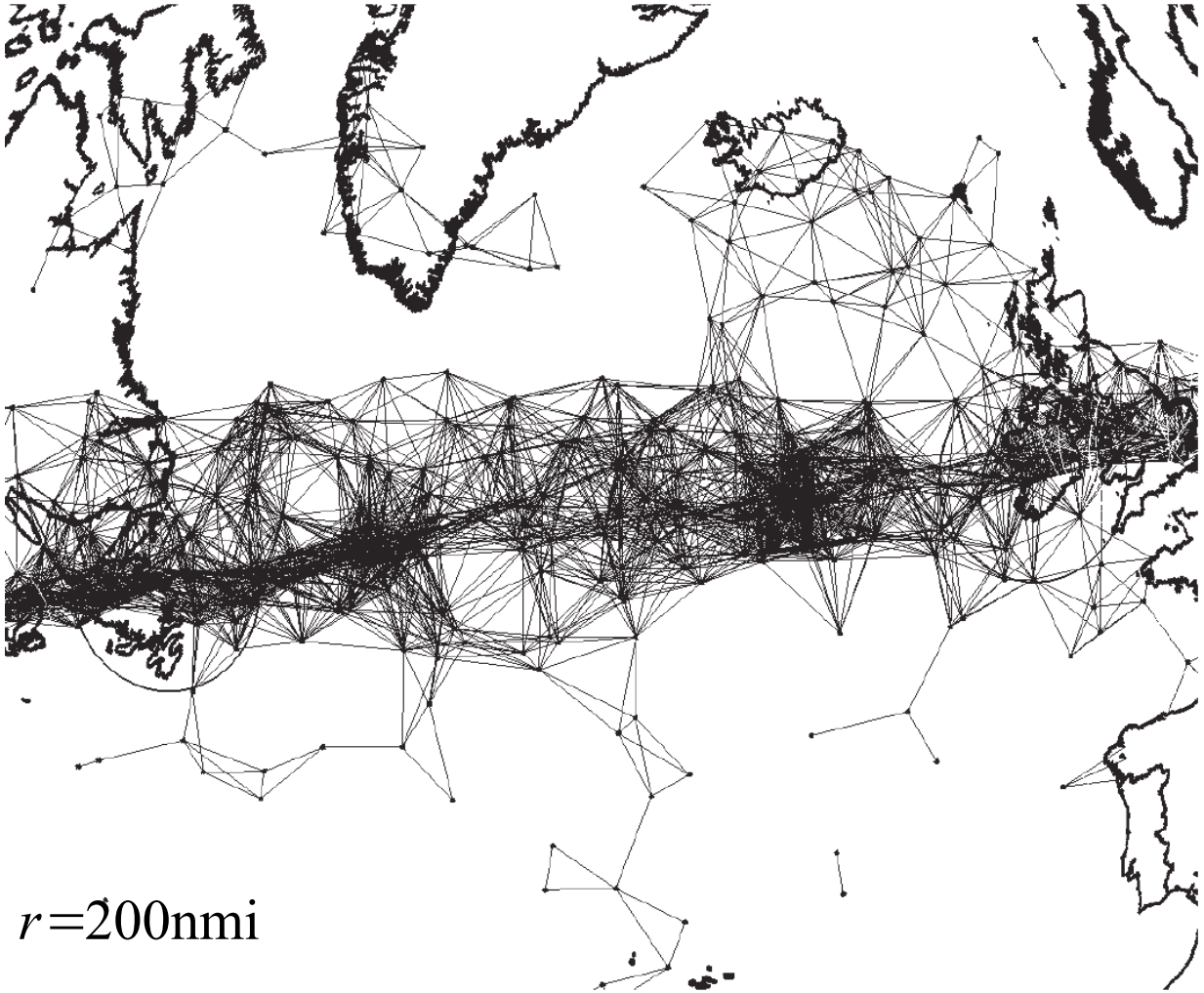
packet delivery ratio

- local maximum:



packet delivery ratio

- local maximum:



average path length

		100 nmi	200 nmi	300 nmi
Scenario A	SP	5,92 hops	3,91 hops	3,37 hops
	GF	6,00 hops	3,93 hops	3,38 hops
Scenario B	SP	5,74 hops	3,61 hops	3,14 hops
	GF	5,82 hops	3,63 hops	3,16 hops

- Greedy forwarding is on average only 0,1 hops longer.
- Greedy forwarding is sufficient.
- Scenario B reduces the average path length only by a small amount.

Conclusion

- With a communication range greater than 200nmi most of the flights have permanent connectivity.
- Greedy forwarding delivers almost all packets.
- Average number of hops is smaller than 4.

Thank you for your attention!

Questions?