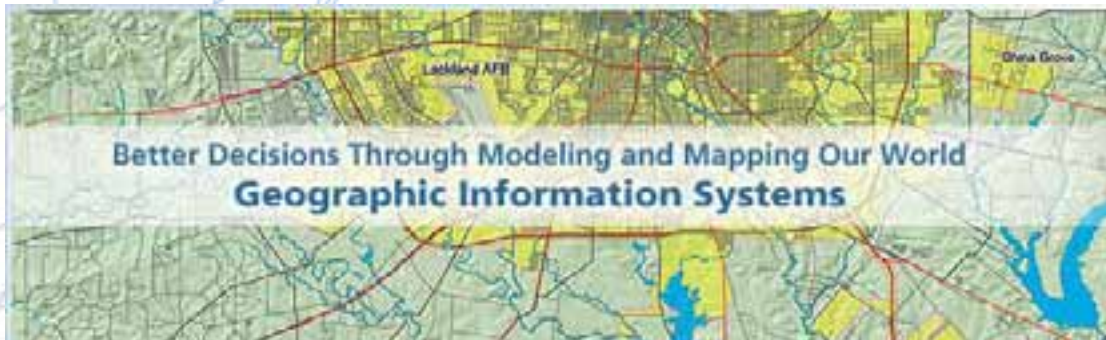


NGS SUPPORT FOR REAL TIME NETWORKS

2007 ESRI

**International User
Conference**



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REAL TIME POSITIONING

“ IT DEPENDS ”



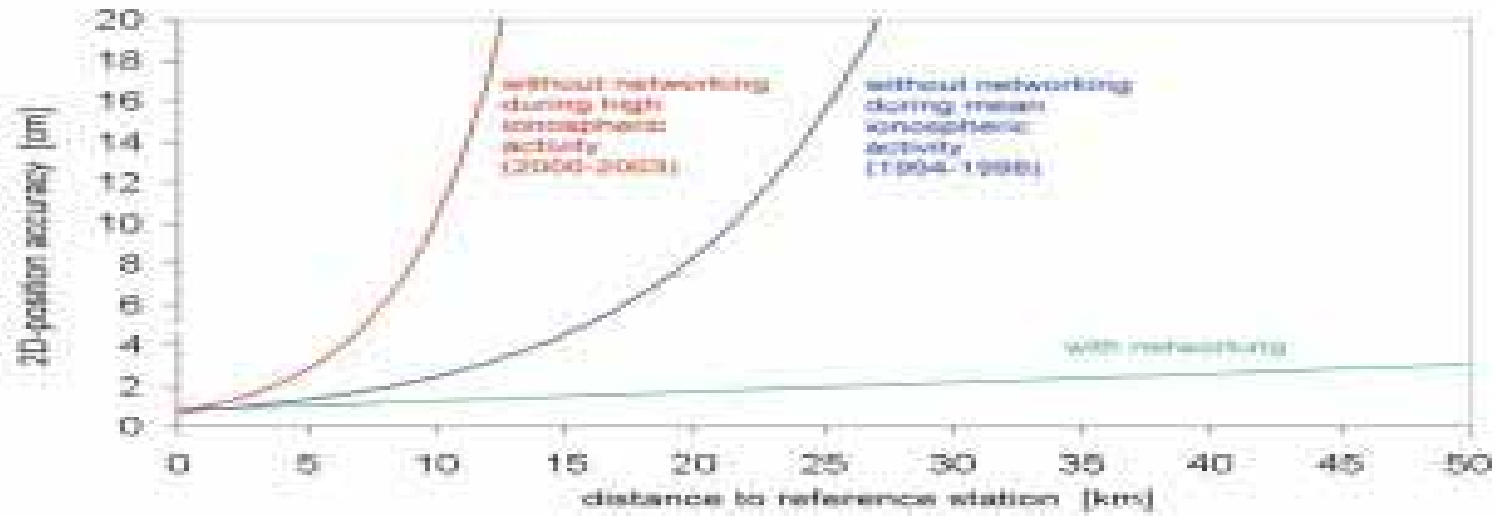
REAL TIME POSITIONING

- PDOP
- MULTIPATH
- SATELLITES
- BASE ACCURACY
- BASE SECURITY
- REDUNDANCY, REDUNDANCY, REDUNDANCY
- PPM – IONO, TROPO MODELS, ORBIT ERRORS
- SPACE WEATHER- “K” INDICES
- GEOID QUALITY
- RTN- TIED TO NSRS
- BUBBLE ADJUSTMENT
- LATENCY, UPDATE RATE

*KNOWLEDGE OF ALL THE ABOVE = OPERATOR
EXPERTISE*



IONOSPHERIC EFFECTS ON POSITIONING



TROPOSPHERE DELAY

The more air molecules, the slower the signal (dry delay)

High pressure, Low temperature

90% of total delay

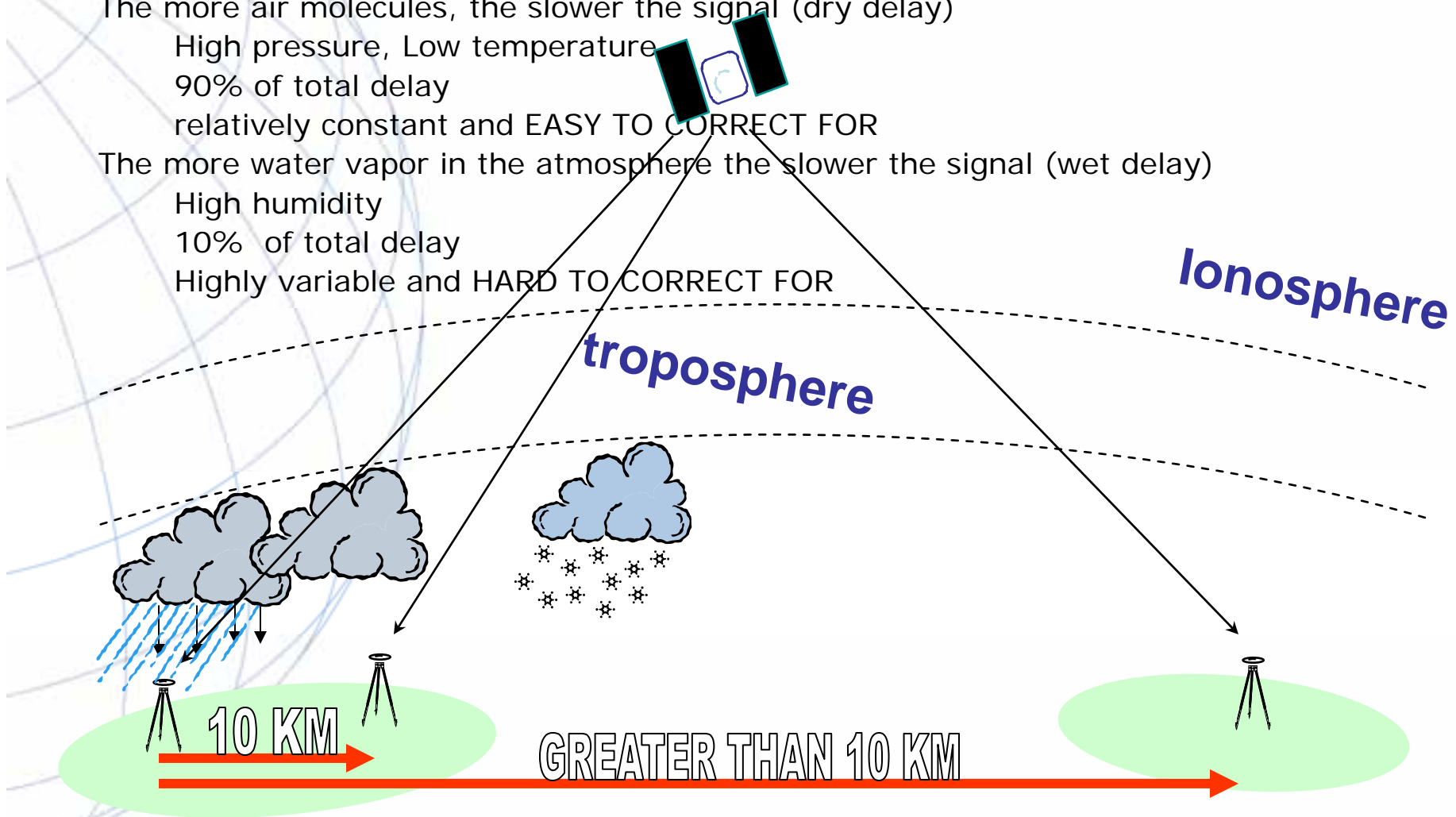
relatively constant and EASY TO CORRECT FOR

The more water vapor in the atmosphere the slower the signal (wet delay)

High humidity

10% of total delay

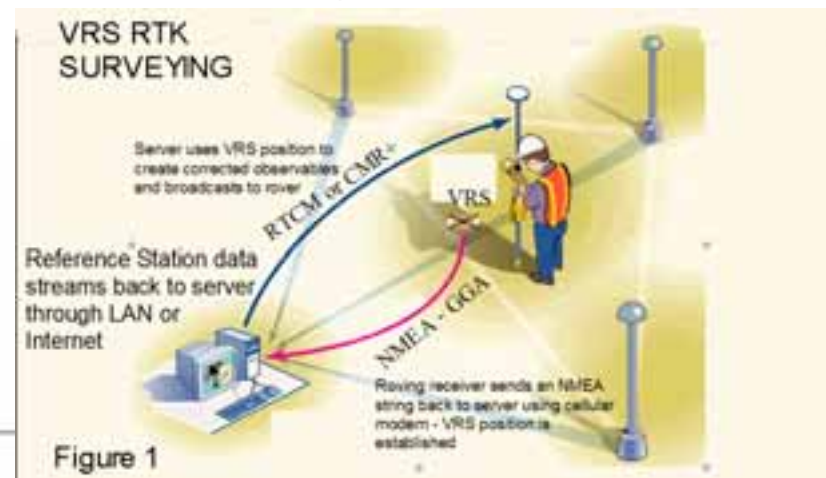
Highly variable and HARD TO CORRECT FOR



WHY NETWORK RTK (RTN)?

Because the requirement for a user base station is removed:

- **No reconnaissance/recovery of passive control**
- **No time lost setting up and breaking down a base static**
- **No base baby sitting, therefore labor cost is reduced**
No base means with two rovers the project is completed in half the time
- **= \$\$\$ savings**



WHY NETWORK RTK (RTN)?

- RTNS CAN BE SEAMLESSLY CONNECTED TO THE NSRS –
This means:
- Regional inter-GIS compatibility
- Continual accuracy and integrity monitoring
- Easy datum adjustment/change updates
- In other words - "Everything fits together"

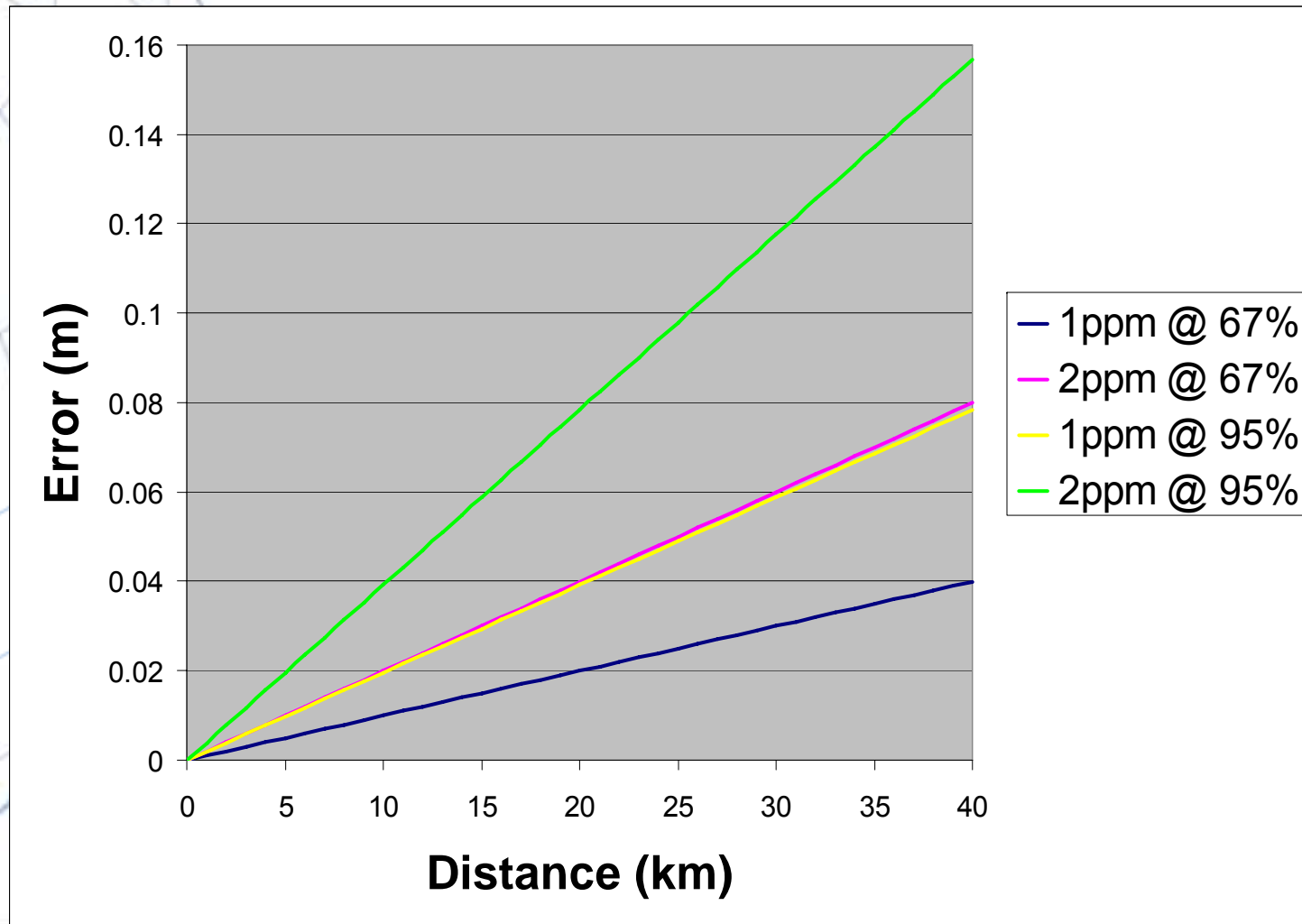


WHY NETWORK RTK (RTN)?

- NO DISTANCE CORRELATED ERROR -
Atmospheric, ephemeris corrections for the site of survey Data degrade gracefully outside of the network or if a reference station is down
- RTN RTK is easier than single base RTK



RTK PPM ERROR VS. BASELINE LENGTH



THE ROLE OF THE NGS IN SUPPORT OF RTN

- The NGS should provide real time **RAW** data streams (via NTRIP) from a subset of the National CORS network- perhaps in a 200 Km spacing grid. These data streams will aid in the establishment, validation and monitoring of the RTNs by network administrators.
NO CORRECTORS
- The NGS could assess and accredit proposed or even current RTN reference station sites for obstructions, multipath, positional integrity - in short, for anything that might affect optimal performance of the RTN.
- Additionally, NOAA/NGS could stream satellite ephemerides, satellite clock parameters, iono and tropo models and even crustal motion models for public use.
- The NGS, continuing its role in support of accurate, reliable positioning, would study temporal macro variations in positions (seasonal, daily, ocean loading, atmospheric loading, subsidence, tectonic, etc.) and would study phenomena affecting accurate positioning (satellite orbits, refraction, multipath, antenna phase centers, geoid, etc.)



THE ROLE OF THE NGS IN REAL TIME POSITIONING

- Testing for TEC cut-offs
- Testing for baseline lengths
- Minimum field conditions
- Minimum field procedures
- Positional Accuracy goals – 95% confidence of achieving 2-cm H, 4-cm V

DYNAMIC DOCUMENTS:

- 1. “NGS User Guidelines for Single Base GNSS Real Time Positioning”**
- 2. “NGS User Guidelines for GNSS Real Time Positioning in RTN”**
- 3. “NGS Guidelines for GNSS RTN Administrators”**



EXPECTED GNSS DERIVED NSRS ORTHOMETRIC HEIGHT ACCURACIES

- DGPS = 1-2 METERS, CODE PHASE, L1 SMOOTHING
- SINGLE BASE RTK = 2-5 CM (3-D), AVERAGE OF REDUNDANT POSITIONS \leq 10-15 KM
- RTN = 2-7 CM (3-D), WITHIN NETWORK
- OPUS = 2-5 CM, \geq 4-HOURS OF DATA
- OPUS-RS = 5 CM H, 10 CM V, \geq 15 MIN. DATA
- STATIC GPS = 2 CM LOCALLY USING GUIDELINES

EXPECTED CLASSICAL LEVELING NSRS ORTHOMETRIC HEIGHT ACCURACIES

- GEODETIC LEVELING = \leq 1 CM IN 10 KM (3RD ORDER)



