Applying Meteorological Data in GPS Measurements

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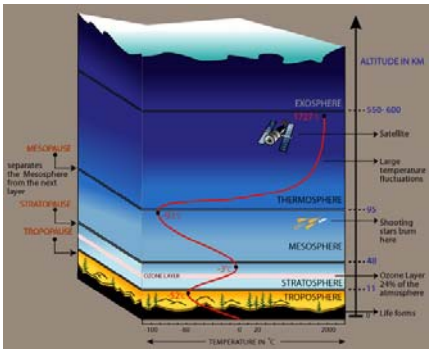
Tropospheric Delay

- Separated into wet and dry component.
- The dry component is the main error factor, being 90% of the delay.
- The wet component is only 10% of the delay, but it cannot be modeled easily.

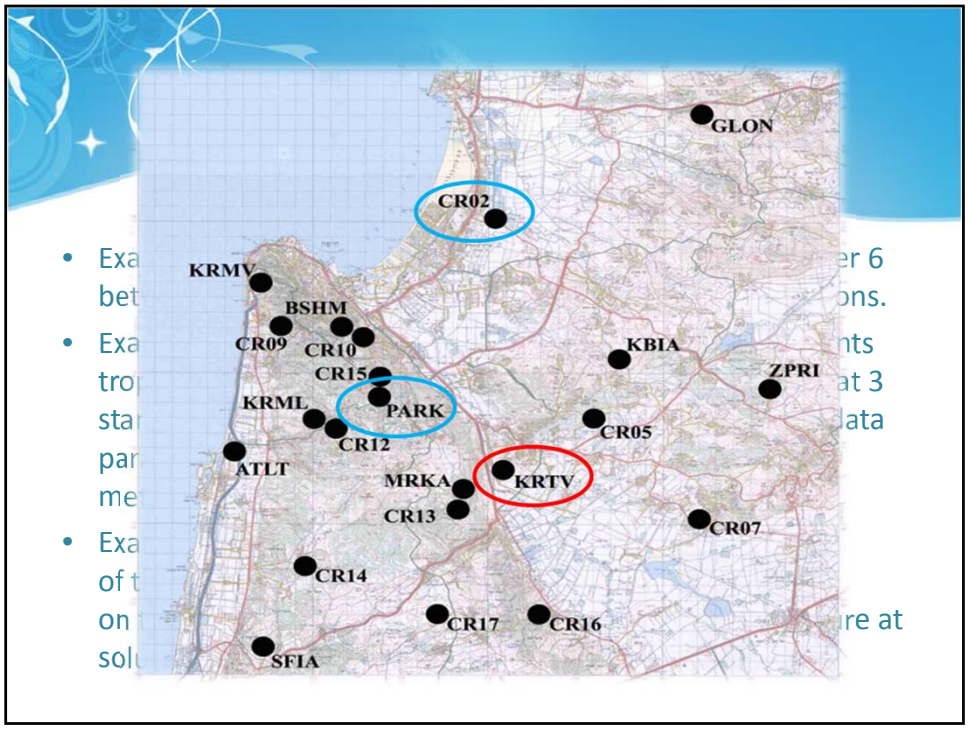
Tropospheric Delay

- Influenced by three factors:
  - Temperature
  - Air pressure
  - Humidity
- Standard atmospheric parameters :
  - 18°C
  - 1013 hPa
  - 50%



Tropospheric Delay Models

- Saastamoinen Model (1973)
  - Most popular due to his high accuracy.
  - Based on the assumption that water vapors behave as ideal gases, temperature changes linearly, neglects the height dispersal and the gravity is calculated as a function of height.
- Hopfield Model (1971)
  - Based on many meteorological measurements over the years.
  - Based on the same assumptions as Saastamoinen with the difference of gravity definition.
- Goad and Goodman (1974)
  - Hopfield Simplified Model.
  - Based on the assumption that the troposphere is polytropic layer.



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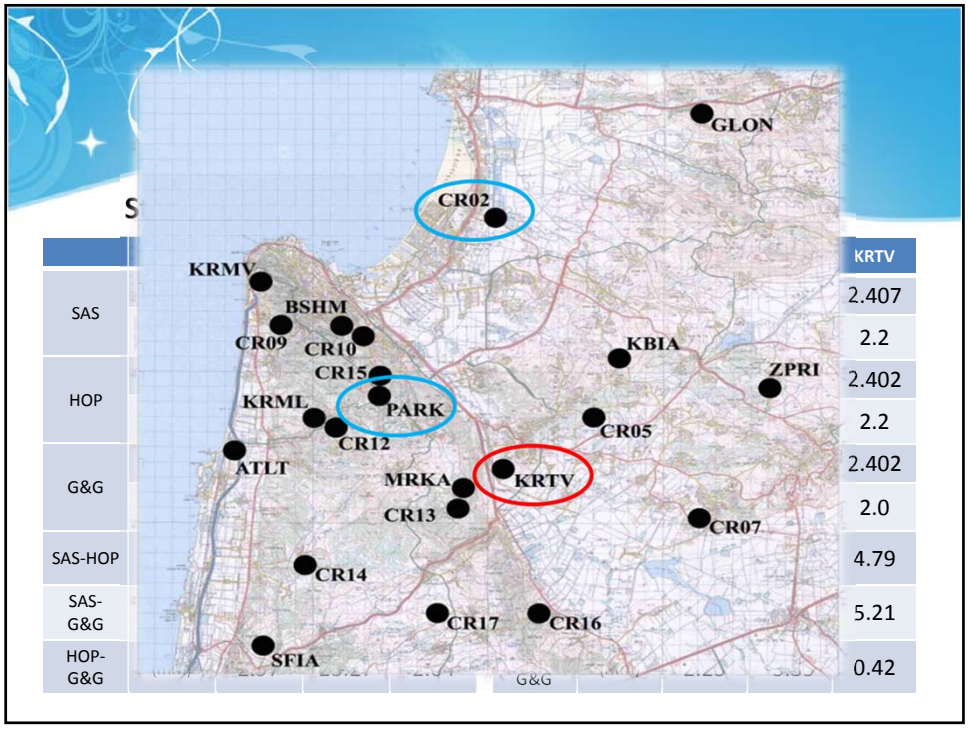

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	KRTV
SAS	2.407
	2.2
HOP	2.402
	2.2
G&G	2.402
	2.0
SAS-HOP	4.79
SAS-G&G	5.21
HOP-G&G	0.42

Results

Differences between meteorological data and standard parameters

	Sta.	CR02	PARK	KRTV
SAS	(mm)	-24.03	-37.67	-39.58
HOP	(mm)	-16.66	-45.06	-30.19
G&G	(mm)	-16.85	-18.44	-27.64

Average differences over the 6 measurement days

	SAS – HOP	SAS – G&G	HOP – G&G
Tropo (mm)	11.04	10.23	2.54
Meteo (mm)	3.22	7.25	2.12

Results

Different time resolution of meteorological data

		30 Minutes Interval		60 Minutes Interval		120 Minutes Interval		240 Minutes Interval	
Model	**Station**	**Tropo (m)**	**Diff (mm)**	**Tropo (m)**	**Diff (mm)**	**Tropo (m)**	**Diff (mm)**	**Tropo (m)**	**Diff (mm)**
SAS	CR02	2.458	-0.01	2.458	-0.03	2.458	-0.17	2.458	**-0.29**
	PARK	2.261	-0.01	2.261	-0.2	2.264	-3.29	2.265	**-4.32**
	KRTV	2.407	-0.03	2.407	-0.03	2.409	-2.49	2.408	**-0.72**
HOP	CR02	2.454	-0.05	2.454	-0.06	2.458	-3.72	2.459	**-5.03**
	PARK	2.264	-0.04	2.264	-0.07	2.265	-1.37	2.266	**-1.79**
	KRTV	2.402	-0.07	2.403	-0.13	2.404	-1.48	2.406	**-3.55**
G&G	CR02	2.452	-0.01	2.452	-0.07	2.453	-0.52	2.455	**-3.51**
	PARK	2.267	-0.04	2.268	-0.16	2.270	-2.34	2.272	**-4.33**
	KRTV	2.402	-0.08	2.402	-0.7	2.405	-2.53	2.408	**-5.99**

Conclusions

- No trend can be identified in the differences between the models.
- The obtained distinctions are up to 1.5cm on average, it can be assumed that all models are equally suitable. There is no way of determining the best model for the solution. All models have proven their quality and efficiency for this data set.
- Similar differences obtained between the Hopfield and the Goad & Goodman models whether meteorological data is used or standard atmospheric parameters.
- The differences between the different models lessen when using meteorological data.
- The time resolution of the meteorological differences influences the quality of the solution. There are difference up to 6 mm between 30 min resolution and 240 min resolution.