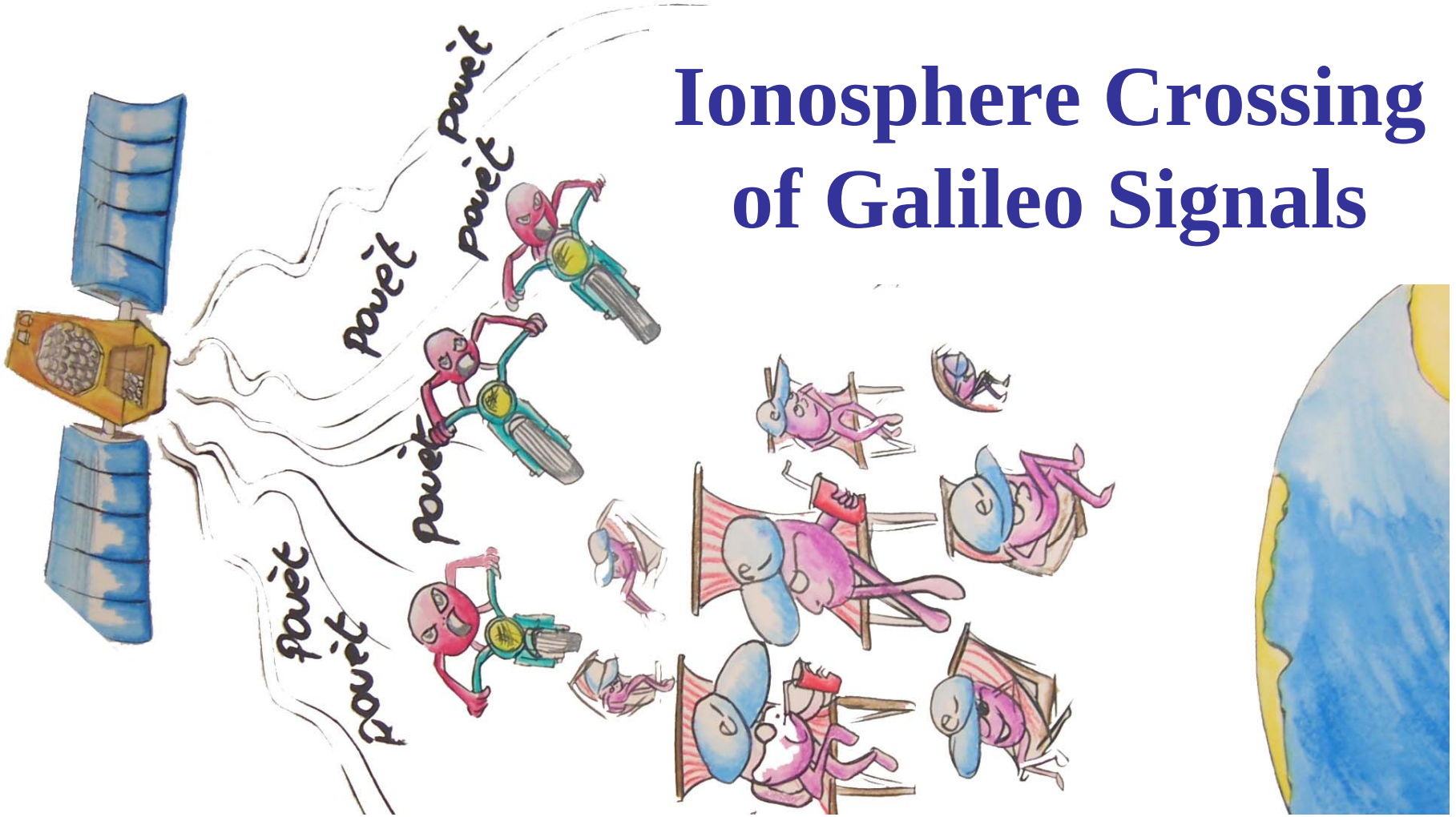
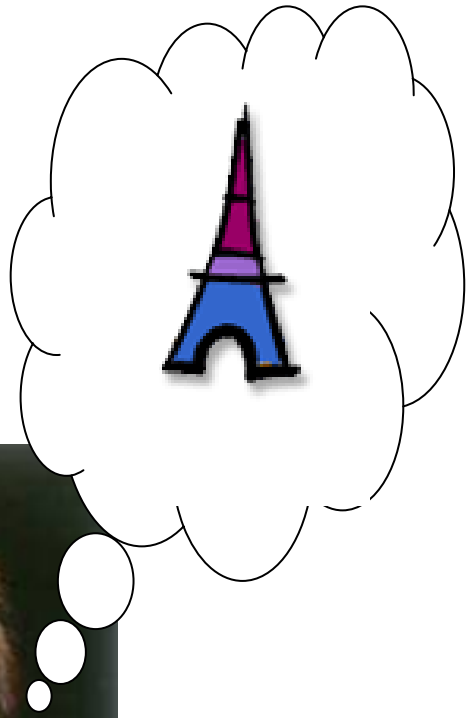
Ionosphere Crossing of Galileo Signals

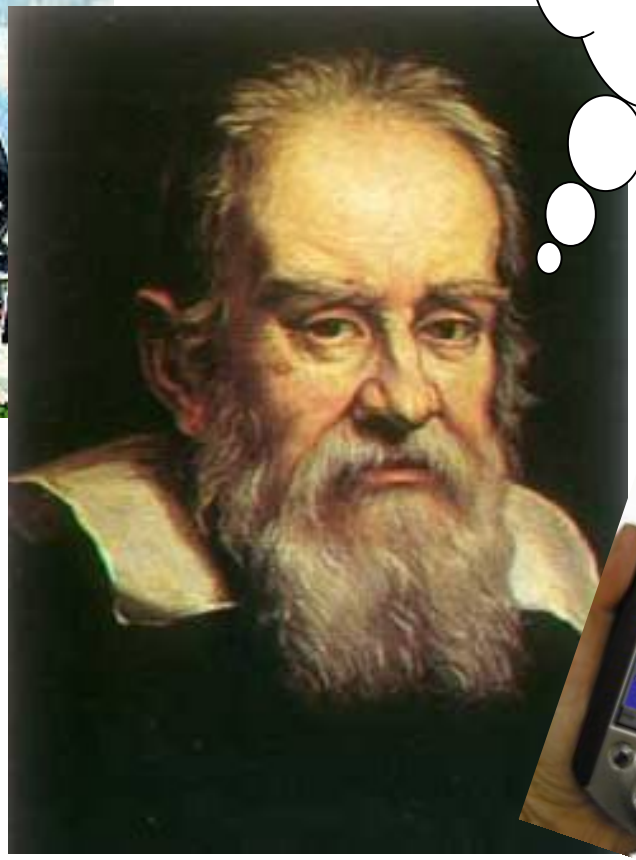


Benoît Bidaine (ULg, Belgium ; EUI-NG/TEC-EEP)

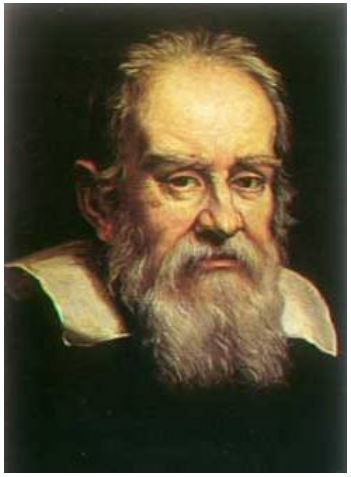
June 26th, 2006

ULg, Liège, Belgium





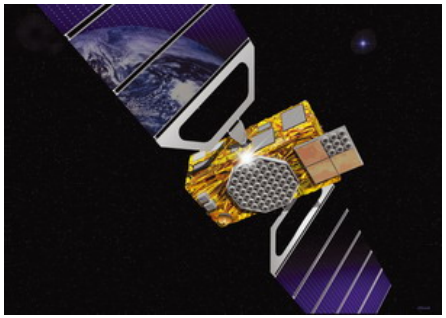

GALILEO



- “Please minimize the positioning error!”

esa

- “We think we could help you for ionospheric delay!”



1. Navigation

   Where does positioning error come from?

2. Ionosphere?

3. Modelling

4. Analysis

5. Tests

1. Navigation

   Where does positioning error come from?

2. Ionosphere?

   What does ionosphere look like?

3. Modelling

4. Analysis

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1. Navigation

   Where does positioning error come from?

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   What does ionosphere look like?

3. Modelling

   How is it modelled?

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   Where does positioning error come from?

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   What does ionosphere look like?

3. Modelling

   How is it modelled?

4. Analysis

   Let’s assess NeQuick!

5. Tests

1. Navigation

Where does positioning error come from?

2. Ionosphere?

What does ionosphere look like?

3. Modelling

How is it modelled?

4. Analysis

Let’s assess NeQuick!

5. Tests

A little drawing is better than a long speech…

1. Navigation

2. Ionosphere?

3. Modelling

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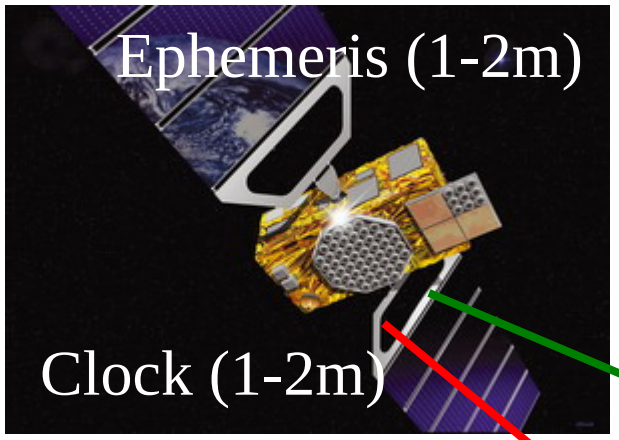
1. Navigation

Positioning error comes from systems and atmospheric issues…



Ionosphere (cm-50m)

Troposphere (dm)

Multipath (1-2m)

Receiver (0.3-2m)

…and is calculated on the basis of range errors.

- Position accuracy = DOP * UERE
- Iono delay = 40.3 * TEC / f^2

TEC → 1 TECu = 10^{16} el. m^{-2} ~ 0.16 m (L1)

f → need of model only for single frequency users

1. Navigation

2. Ionosphere?

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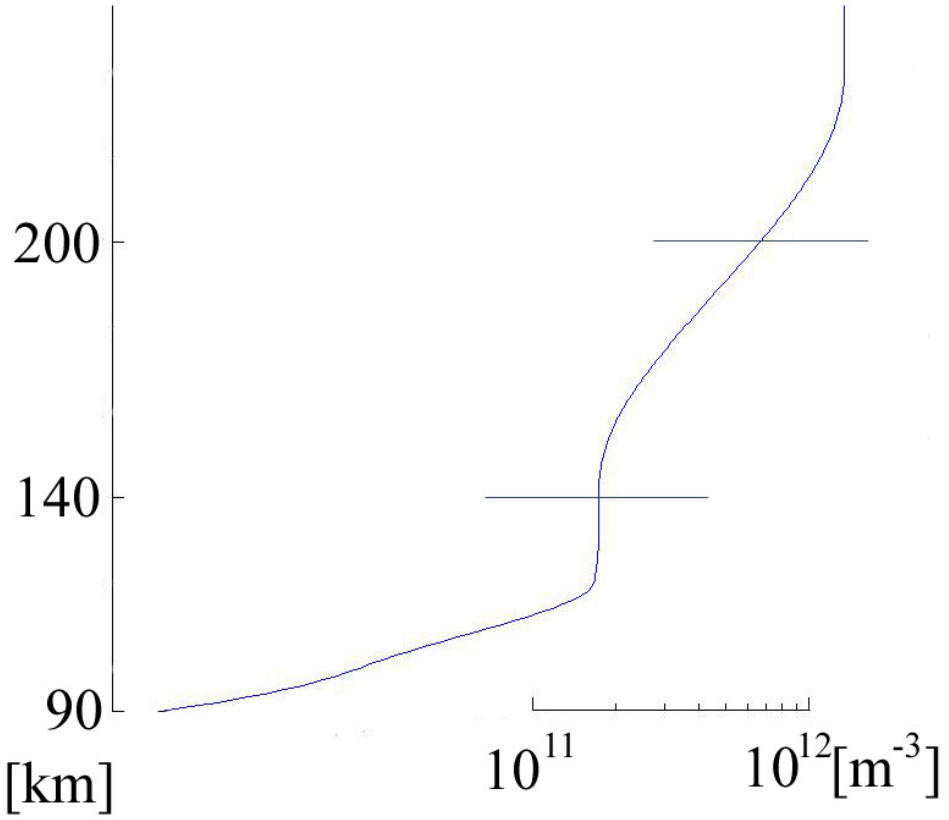
5. Tests

2. Ionosphere?

Atmosphere is ionized by sun radiations…

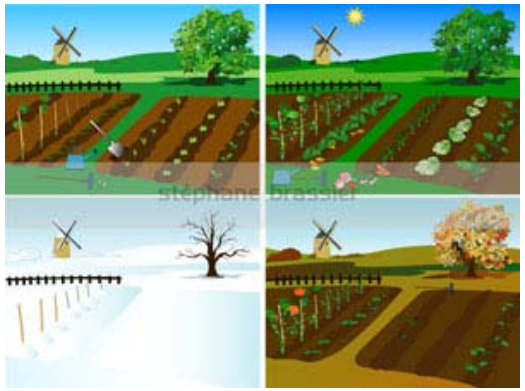
- Electrially charged part / dispersive
- F2
- F1
- E



2. Ionosphere?

…which influence varies according to different parameters.

→ lat, long



→ mth

→ F10.7/R

→ UT

1. Navigation

2. Ionosphere?

3. Modelling

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5. Tests

3. Modelling

The model chosen for Galileo is called NeQuick…

- « Profiler » → E, F1 and F2 peaks = anchor points
- Input = ionospheric variables
- Output = electron density

3. Modelling

…and is due to be used in a daily effective way.

- Monthly flux replaced by daily parameter (Az)

Measure sTEC

Optimize Az

Run NeQuick

1. Navigation

2. Ionosphere?

3. Modelling

4. Analysis

5. Tests

4. Analysis

How to use NeQuick for Galileo single-frequency receivers?

- Understand NeQuick → Questions
- Improve physical behaviour
- Effective use
- Implementation

4. Analysis

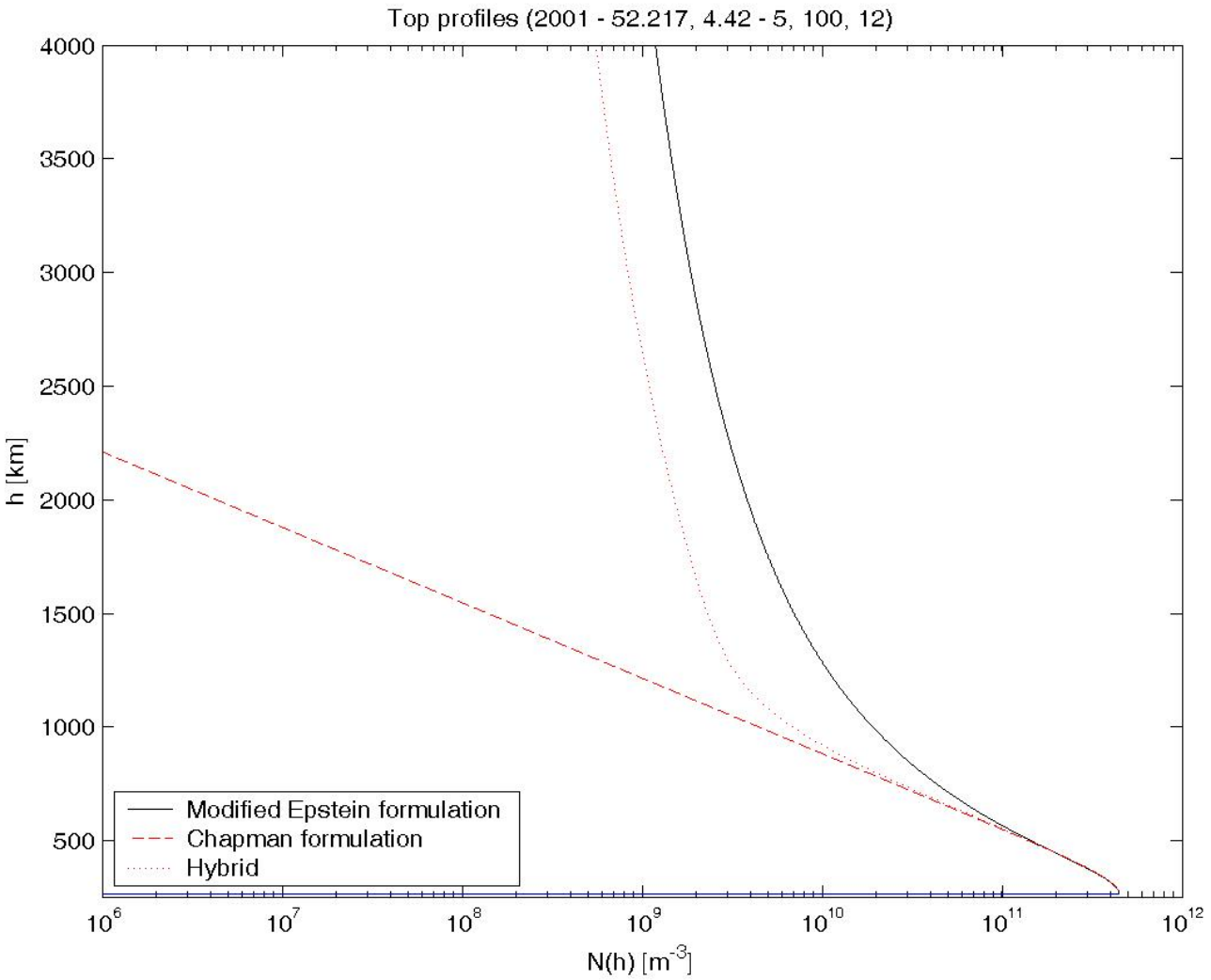
Physical related issues change between different versions…

- 2001: ITU-R baseline (v1)
- 2002: basic and intermediate parameters
- 2005a: topside (k parameter)
- 2005b: new files (v2)

4. Analysis

…and are currently studied.

- [illegible]
- [illegible]
- [illegible]
- [illegible]



1. Navigation

2. Ionosphere?

3. Modelling

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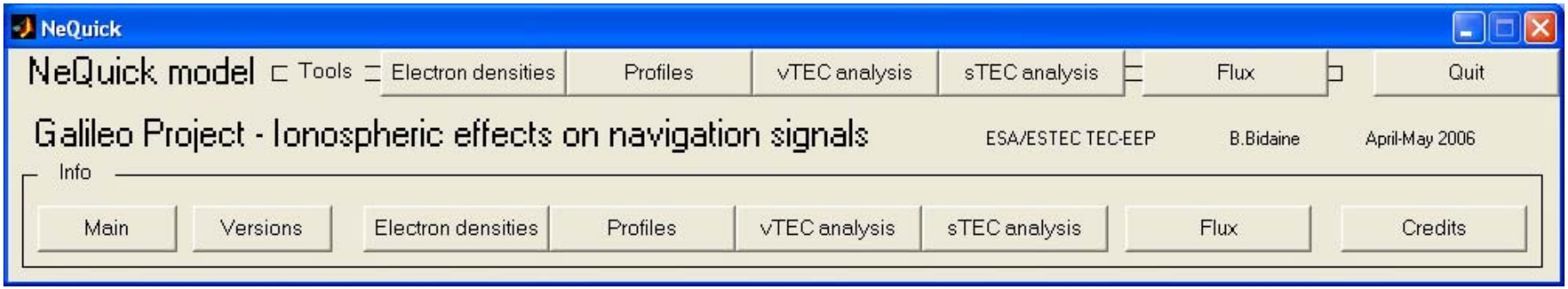
5. Tests

5. Tests

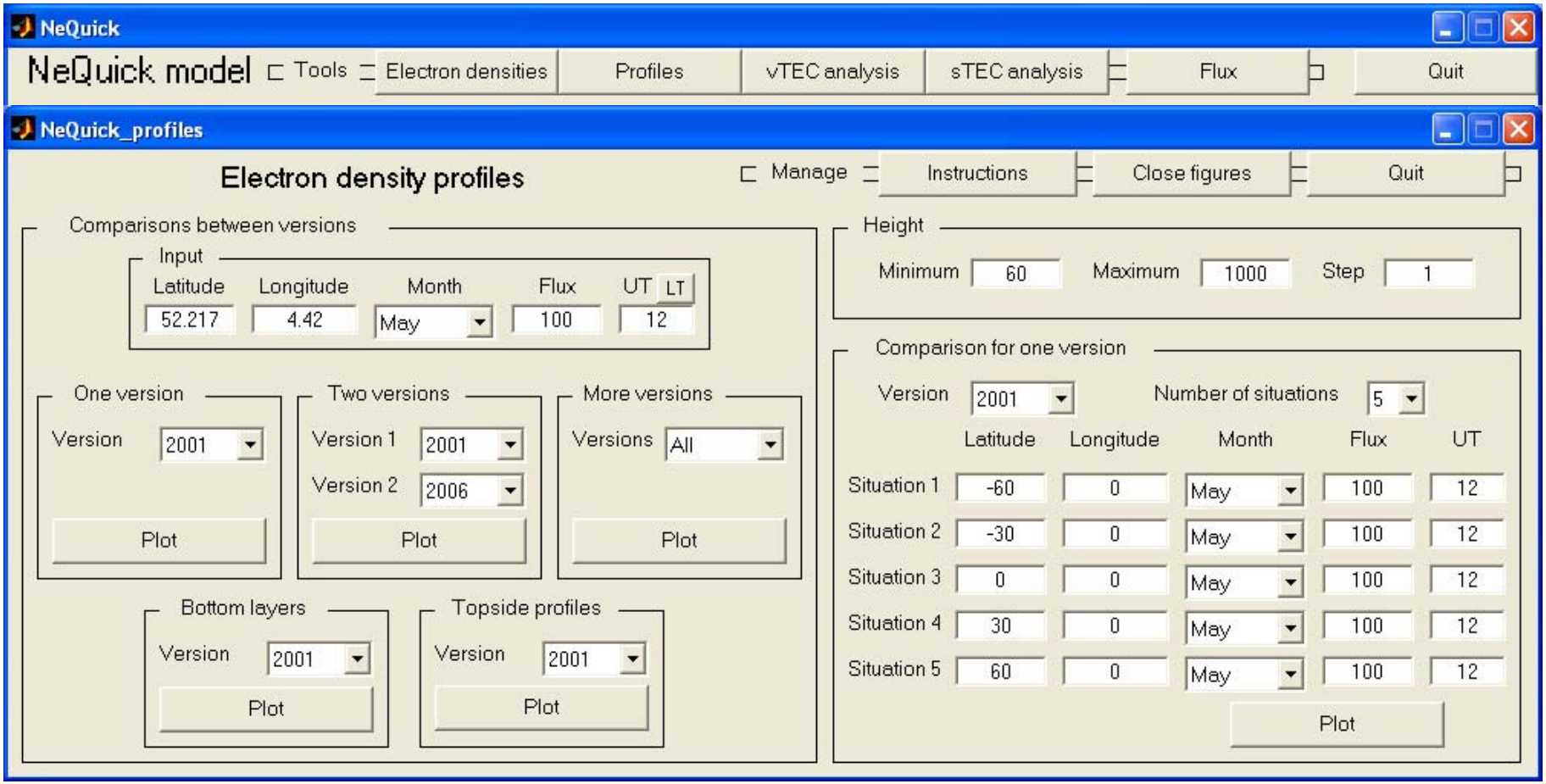
How could we investigate…



- FORTRAN drivers using NeQuick
- Matlab GUI

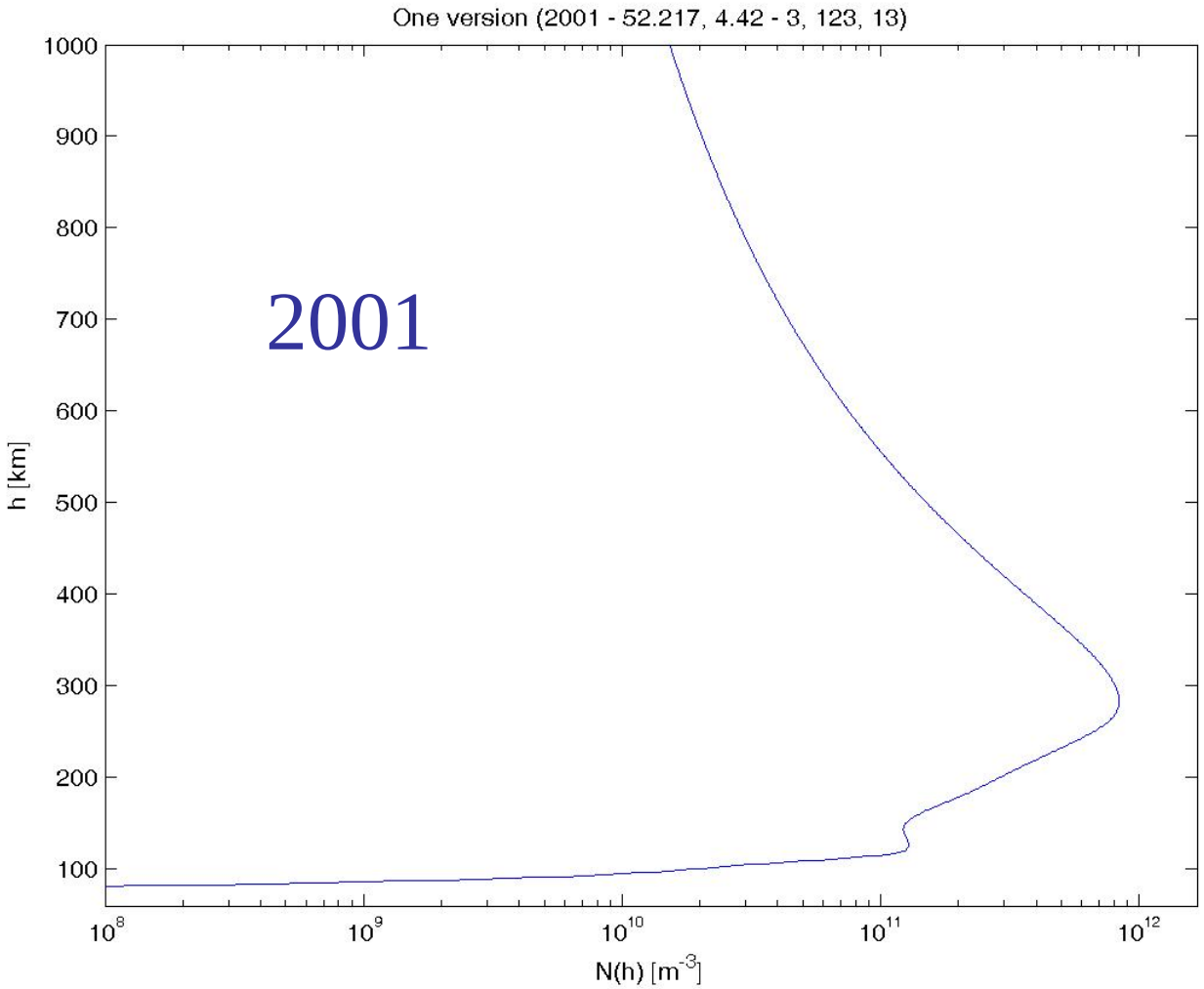
5. Tests

…profiles?



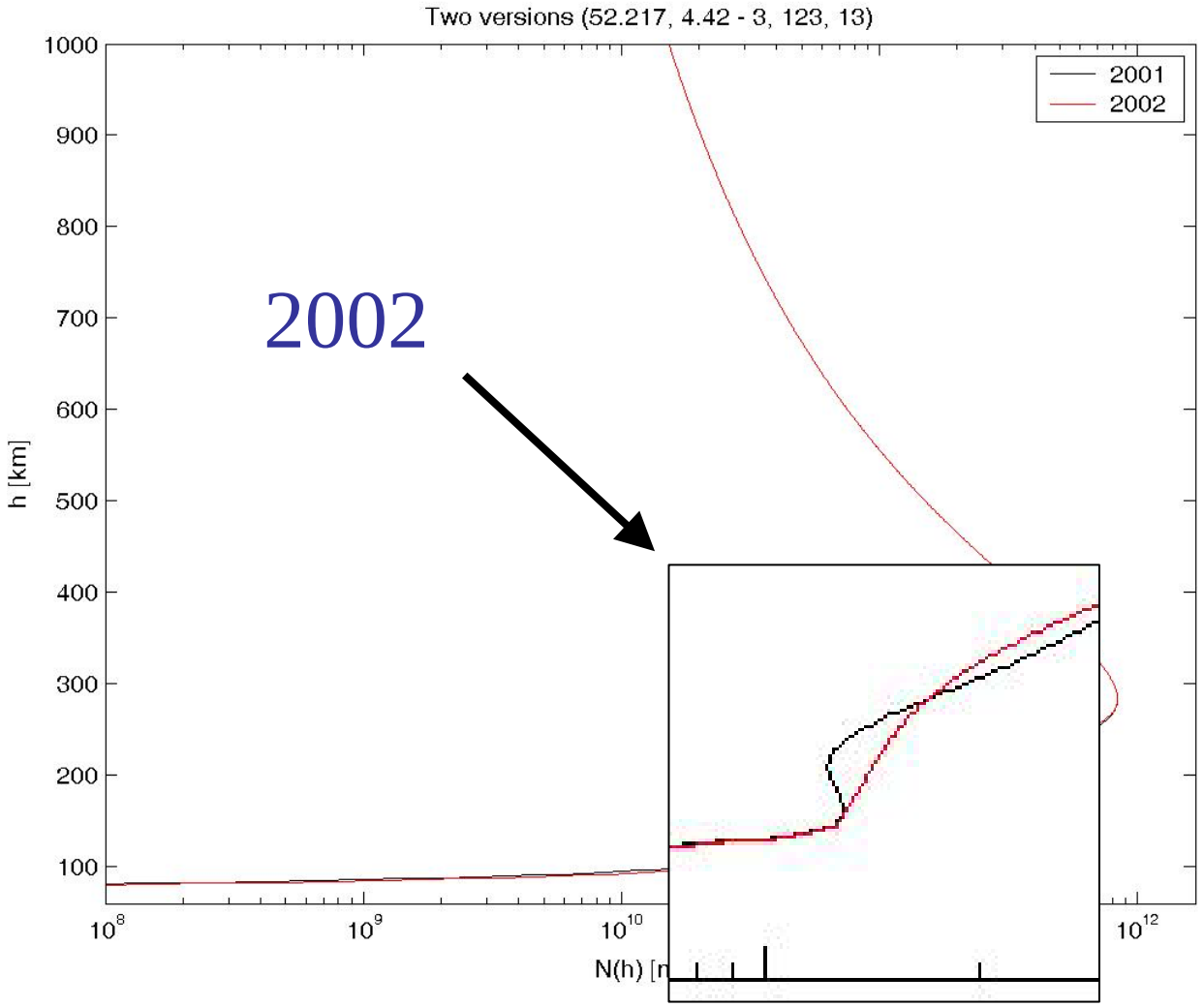
5. Tests

…profiles?



5. Tests

…profiles?



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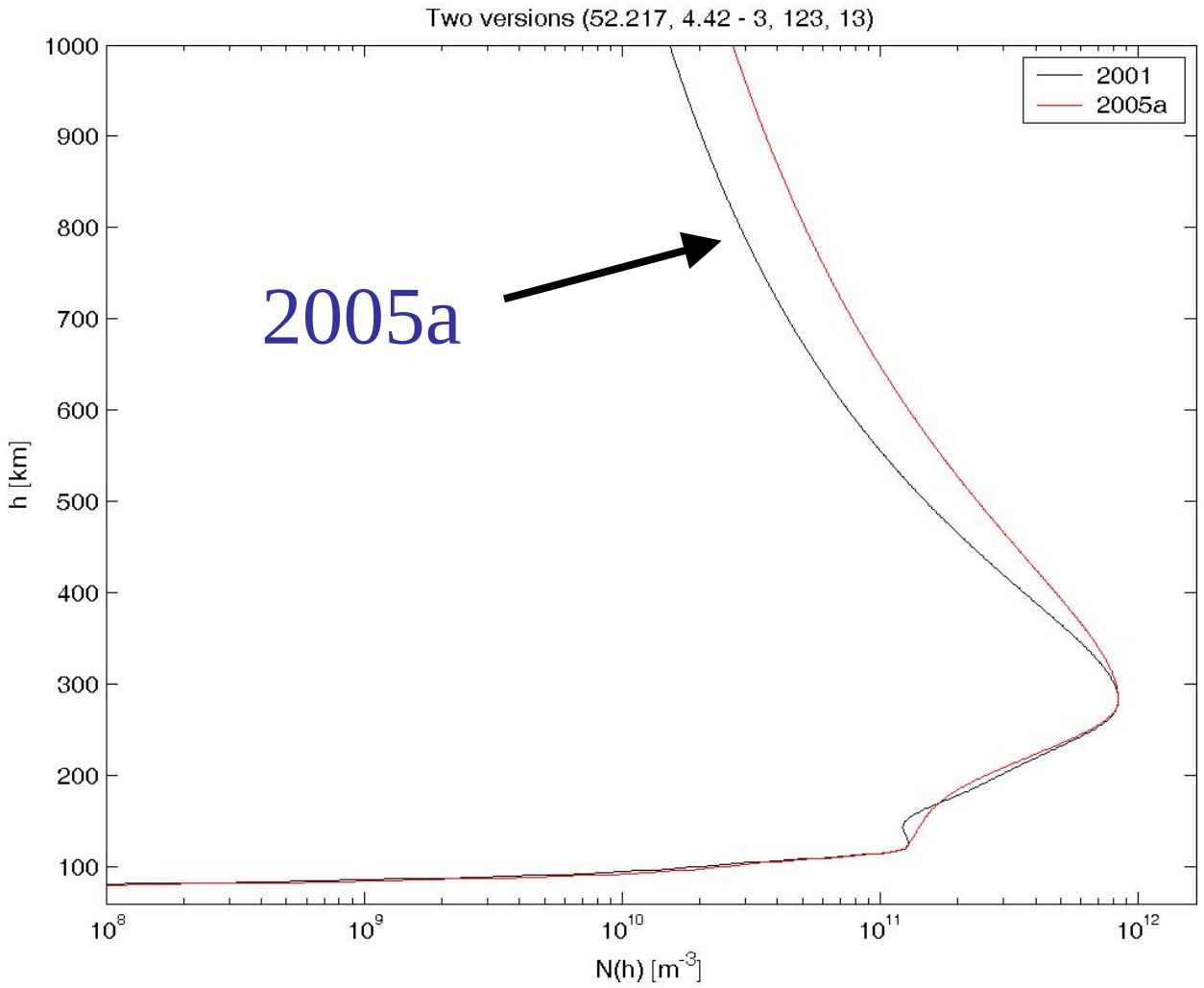

5. Tests

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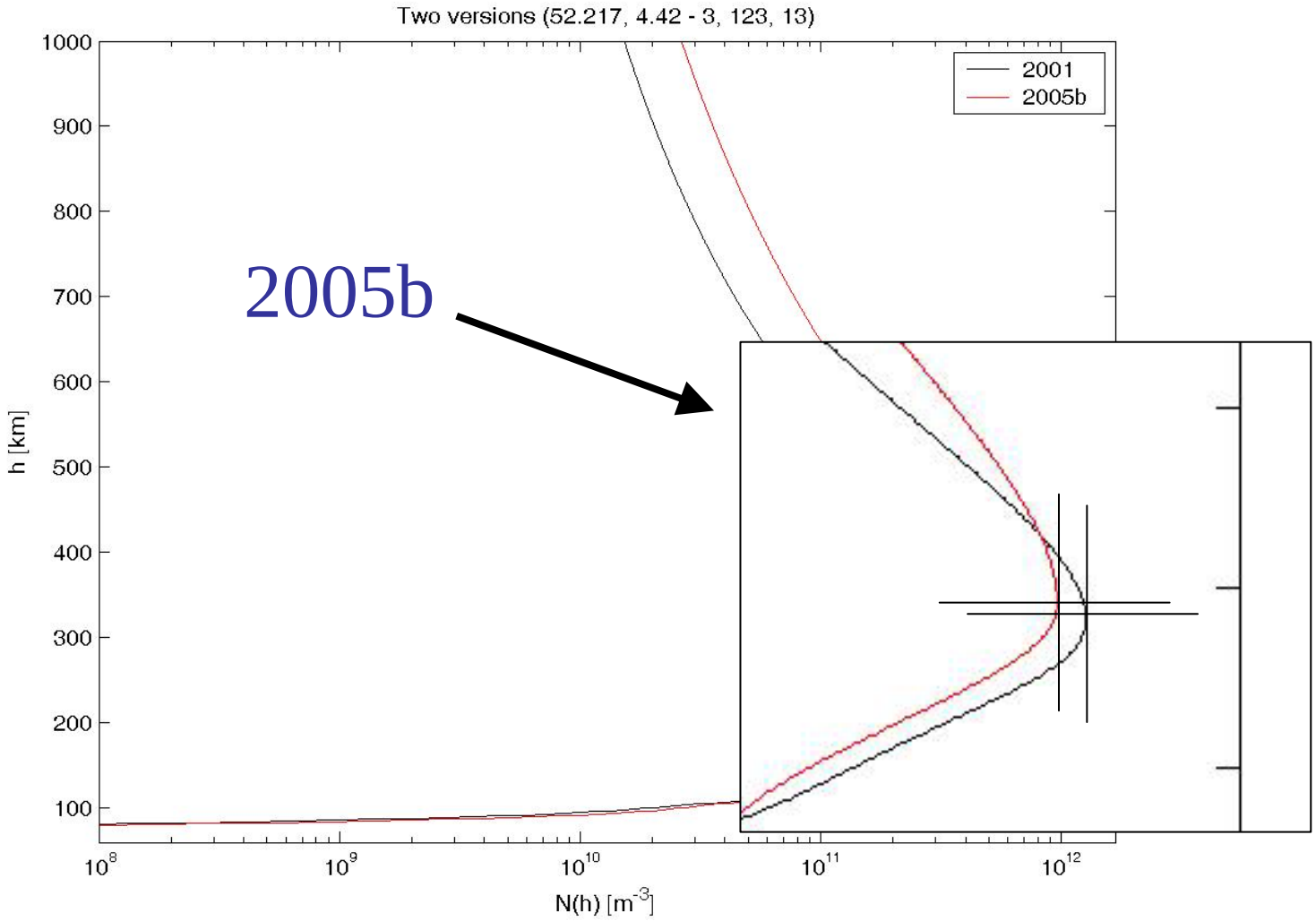
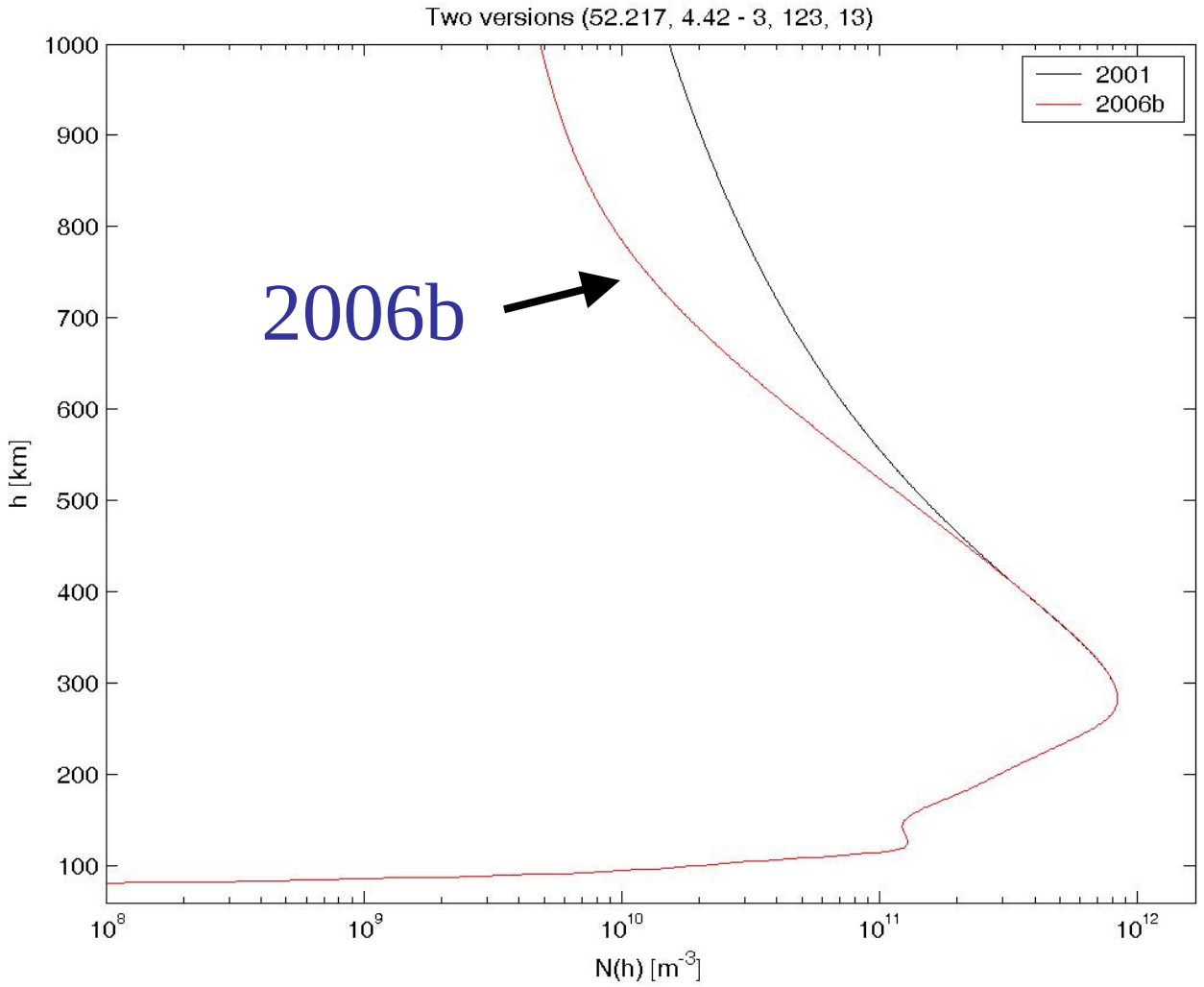


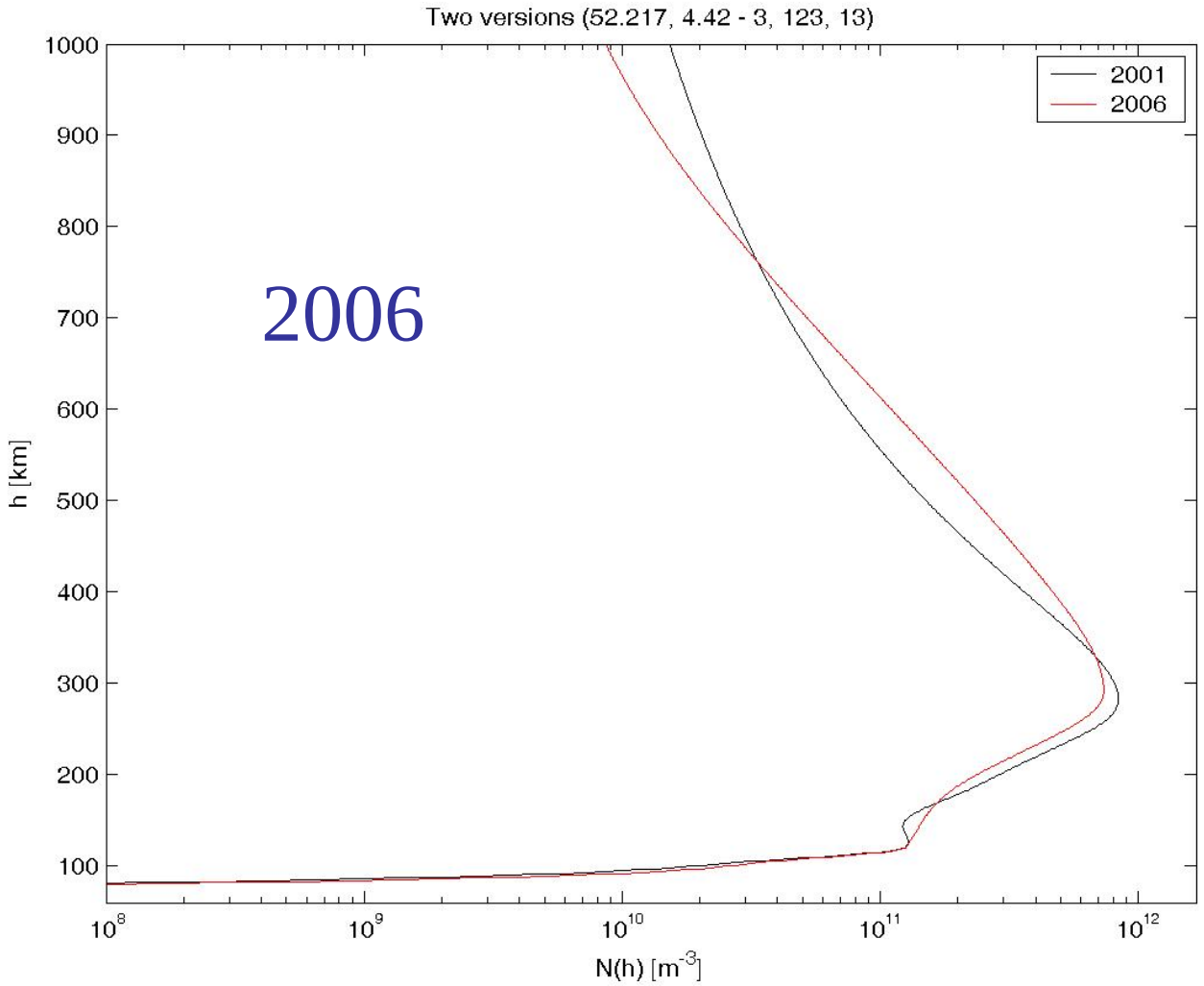
5. Tests

…profiles?



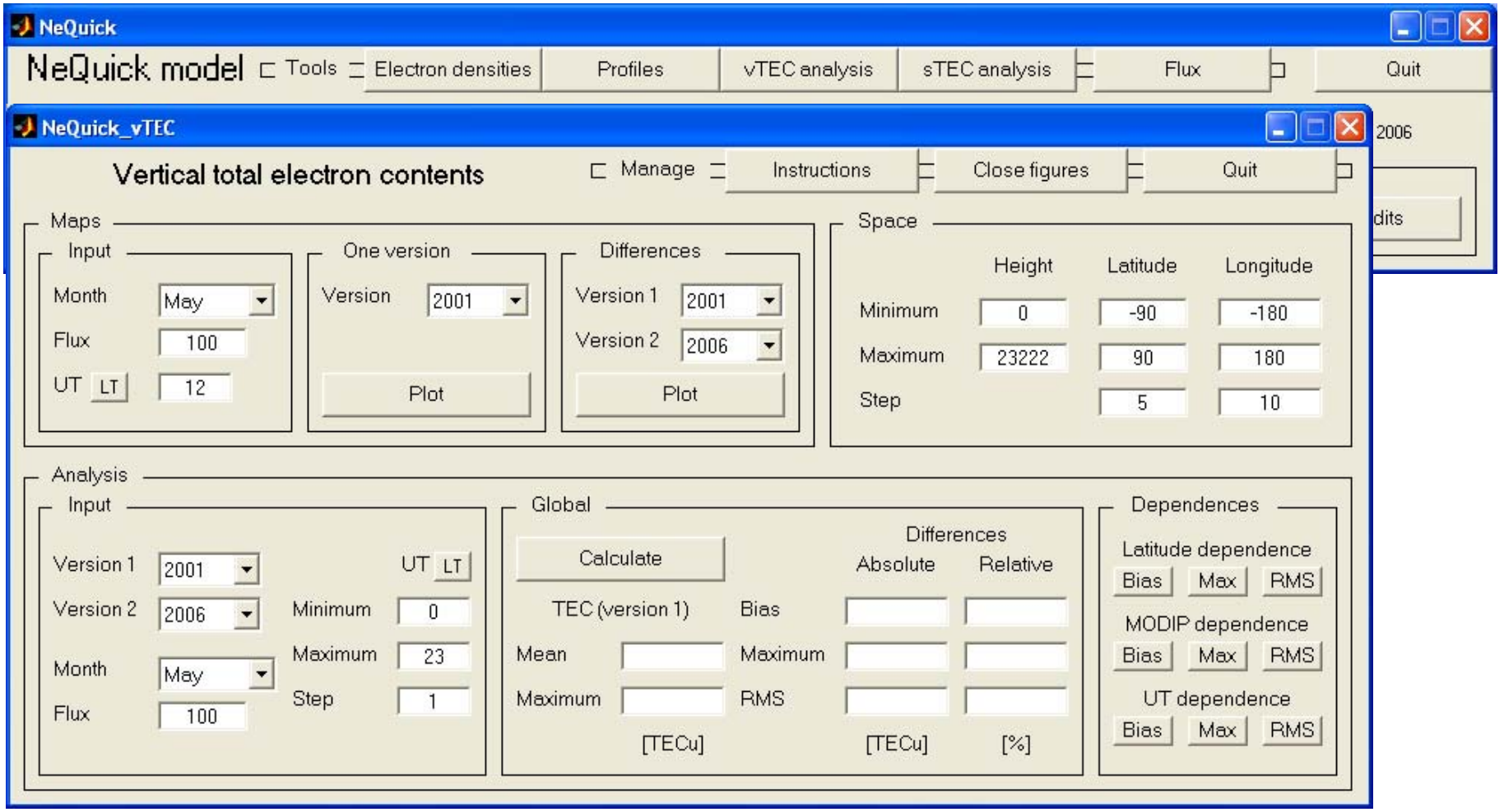
5. Tests

…profiles?



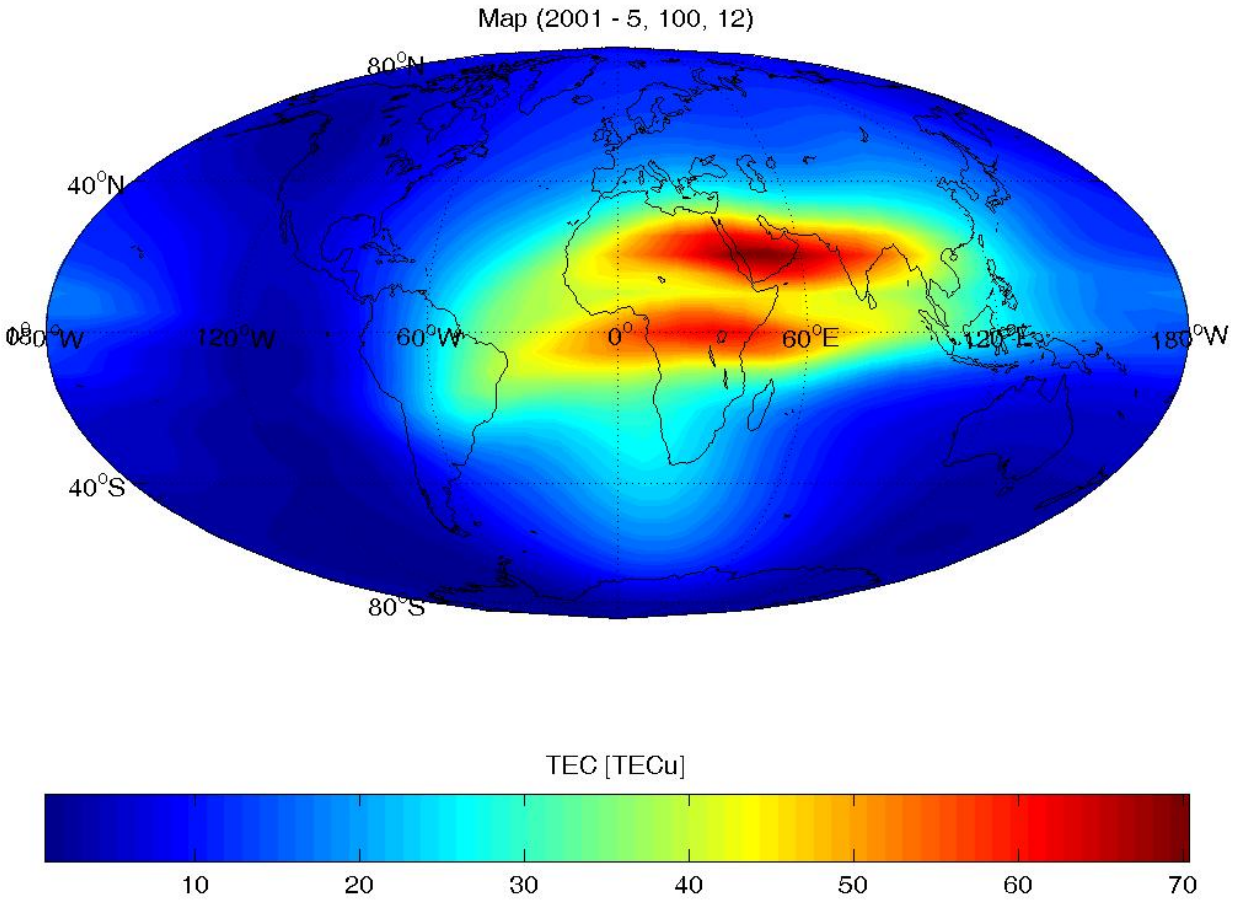
5. Tests

…vTEC maps?



…vTEC maps?

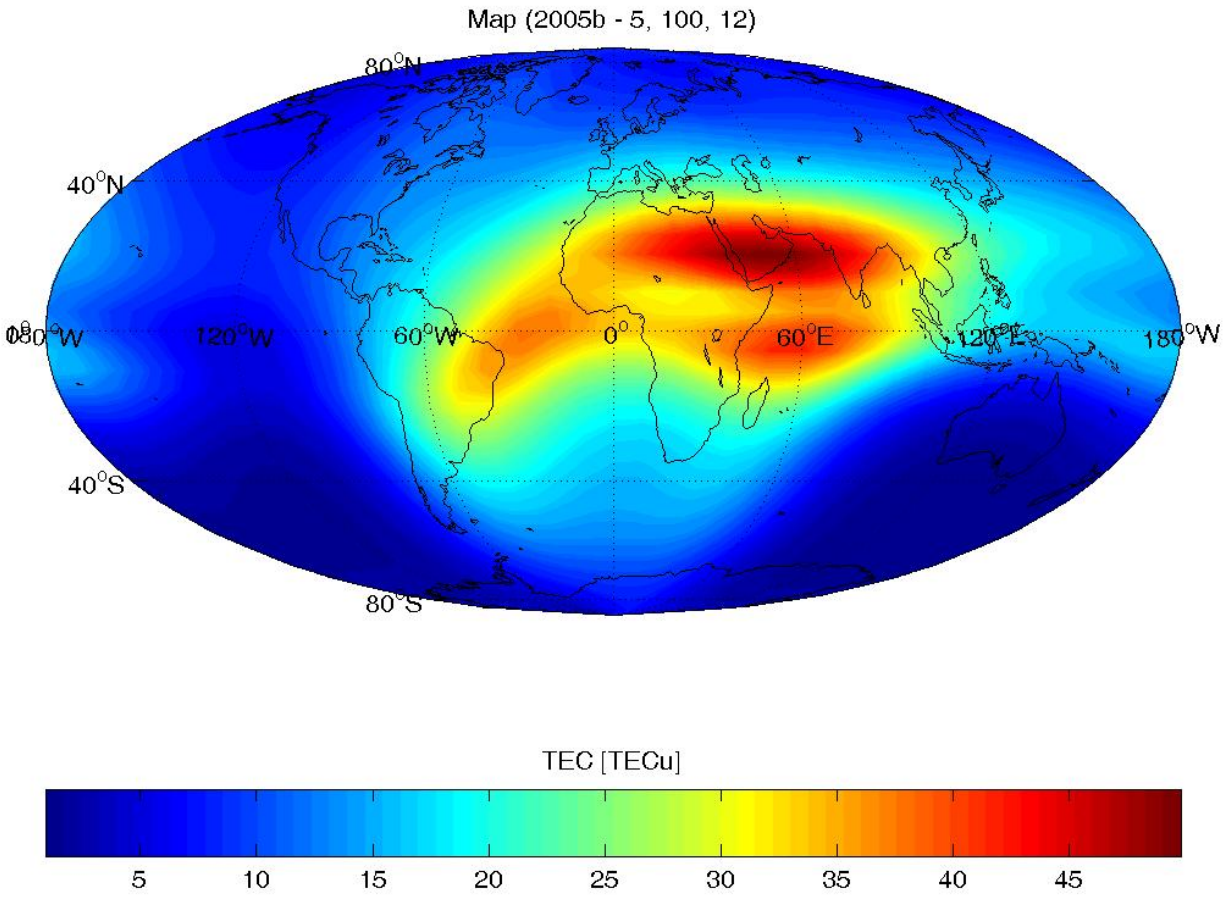
2001



Max = 70

…vTEC maps?

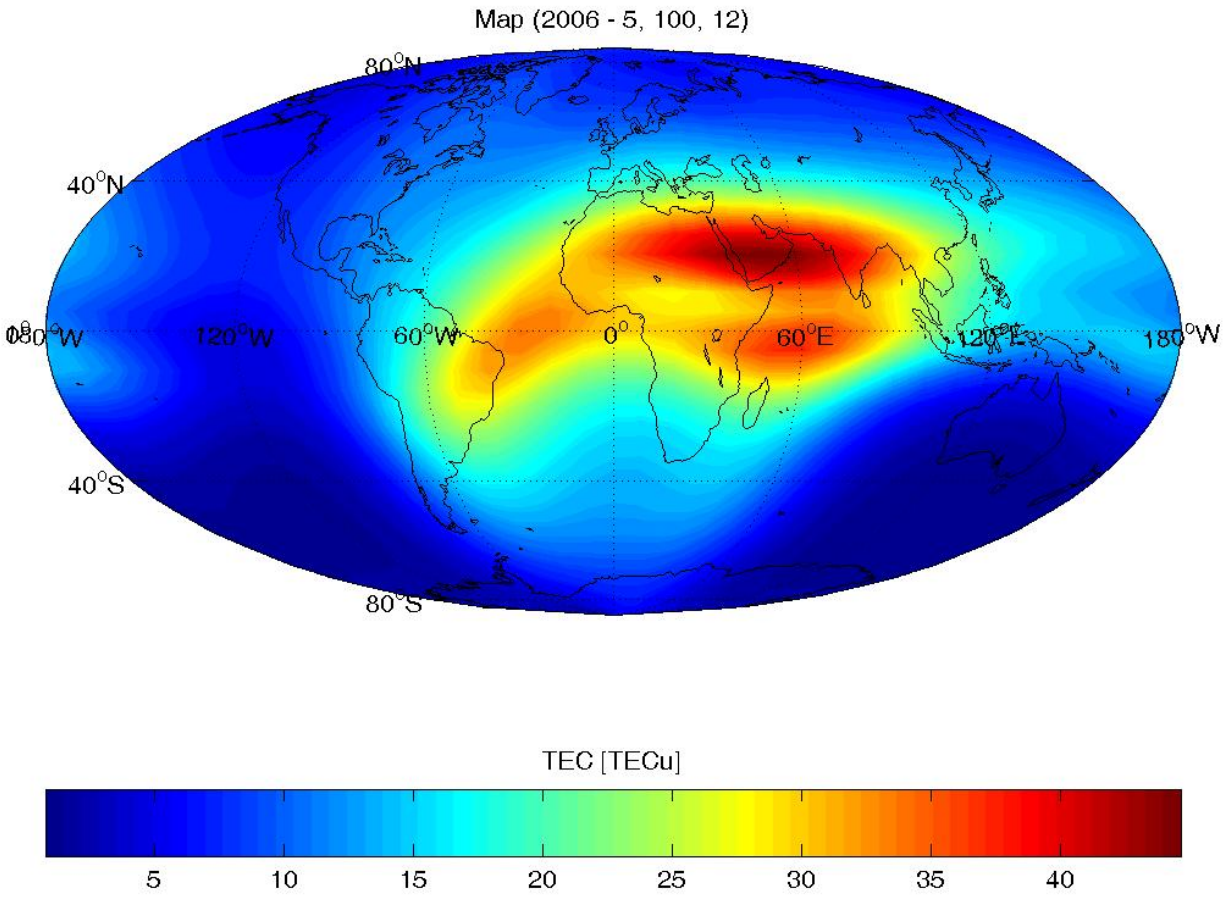
2005b



Max = 50

…vTEC maps?

2006



Max = 45

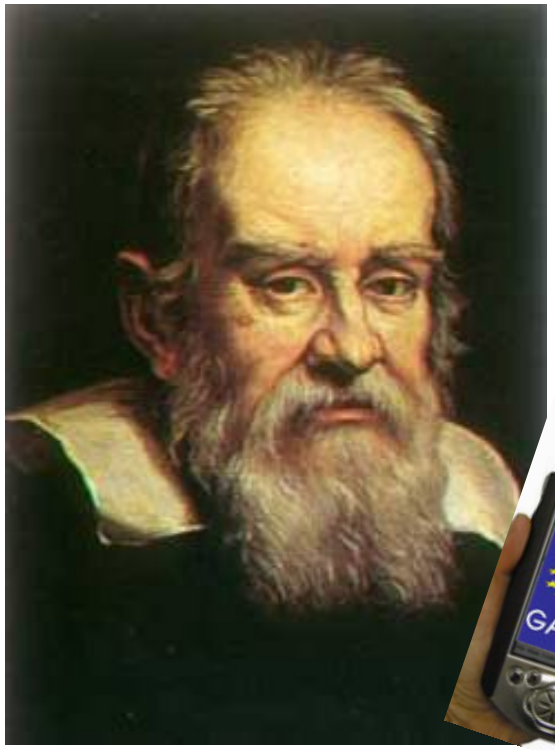
“We have now a complete basis…

- Understanding
- Check list
- Tools
- First results

… to be continued!”

- Broader physical behaviour analysis
- Topside

- Az calculation method
- Intrinsic modification for daily use
- Effective use analysis


GALILEO


GALILEO