INCREaSE GEOWorkshop

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Wroclaw, Poland

Employing data from Numerical Weather Models in Space Geodesy

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Troposphere Modeling

Azimuthal Symmetry:

$$\Delta L_0(e) = \Delta L_h^z * mf_h(e) + \Delta L_w^z * mf_w(e)$$

Azimuthal Asymmetry:

$$\Delta L(a,e) = \Delta L_0(e) + mf_g(e) * [G_N \cos(a) + G_E \sin(a)]$$

- *e: elevation*
- *a: azimuth*
- *ΔL(e)*: total delay
- *$\Delta L^z(e)$*: zenith delay
- *$\Delta L_0(e)$*: total delay without regarding azimuthal asymmetry
- *mf(e)*: mapping function
- G_N, G_E: north and east gradient

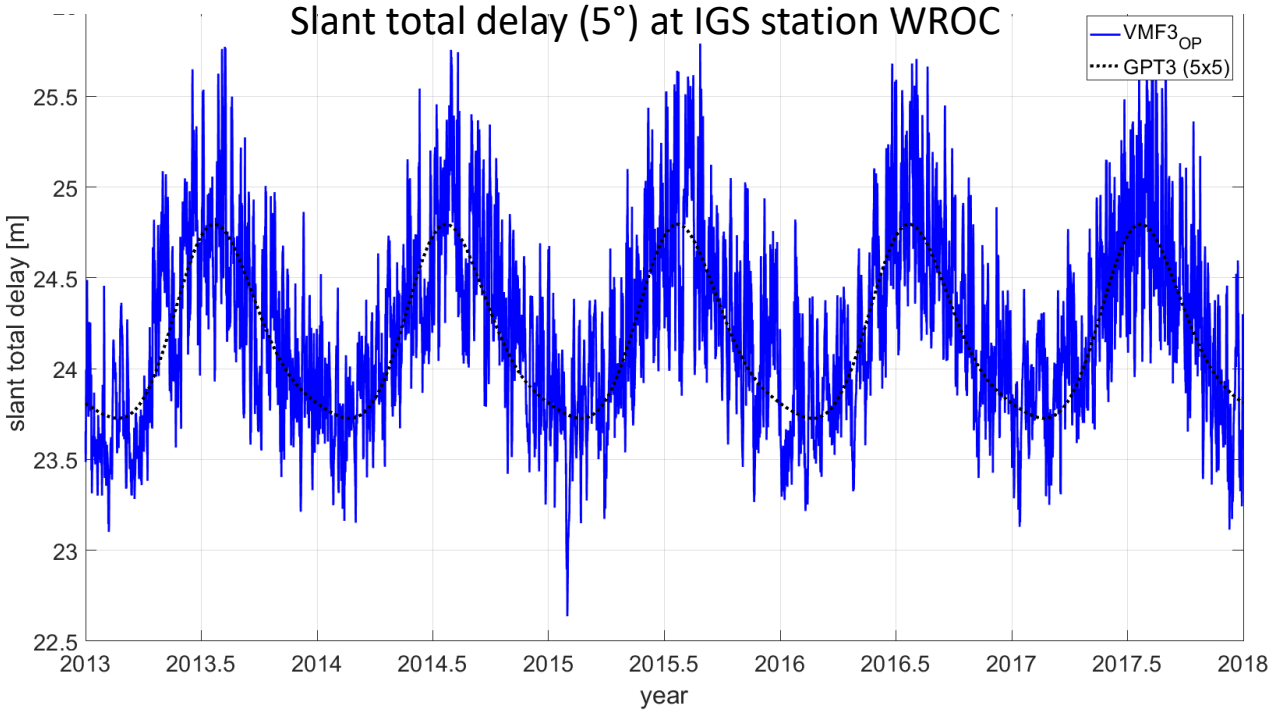
Difference discrete/empirical models

- Discrete models

  Based on real observations for a certain time and location

- Empirical models

  Based on experience values from climatology



Models by TU Wien (1)

Azimuthal Symmetry -> Mapping functions

- Discrete
  - VMF3 Vienna Mapping Functions 3 
  - VMF1 Vienna Mapping Functions 1 

- Empirical
  - GPT3 Global Pressure and Temperature 3 
  - GPT2w Global Pressure and Temperature 2 wet 
  - GPT2 Global Pressure and Temperature 2 
  - GMF Global Mapping Functions 

Models by TU Wien (2)

Azimuthal Asymmetry -> Horizontal Gradients

- Discrete
  - GRAD A priori horizontal gradients 
  - LHG Linear Horizontal Gradients 
- Empirical
  - GPT3 Global Pressure and Temperature 3 
  - APG A Priori Gradients 

Models by TU Wien (3)

Ray-traced delays: containing full tropospheric delay

- for all VLBI observations
- tool for production of individual ray-traced delays

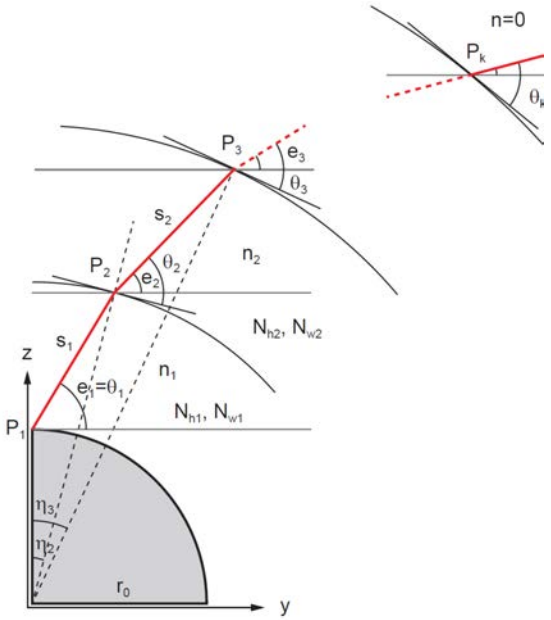
1. Enter your email address (the .radiate file will be sent to this address):
email address

2. Specify the space geodetic technique (the specified station(s) must occur in the respective station coordinate file gnss.ell , vlbi.ell or doris.ell):

- (•) GNSS
- ( ) VLBI
- ( ) DORIS

3. Input the observation specifications here:

```
57847.77125  tehn  0.352916723545060  0.948759486060269
```



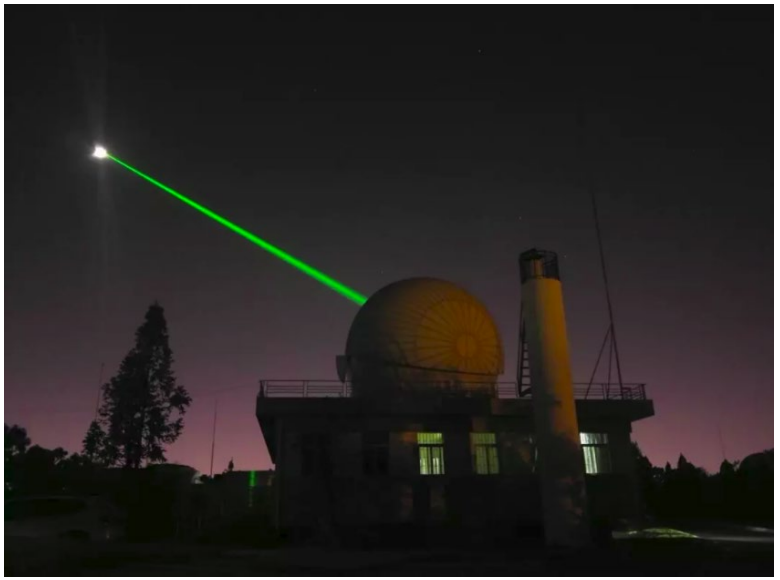
Models by TU Wien (4)

For optical frequencies (SLR):

VMF3o Vienna Mapping Functions 3 optical

GRADo A Priori Horizontal Gradients optical

To be released in 2019!



Numerical Weather Models

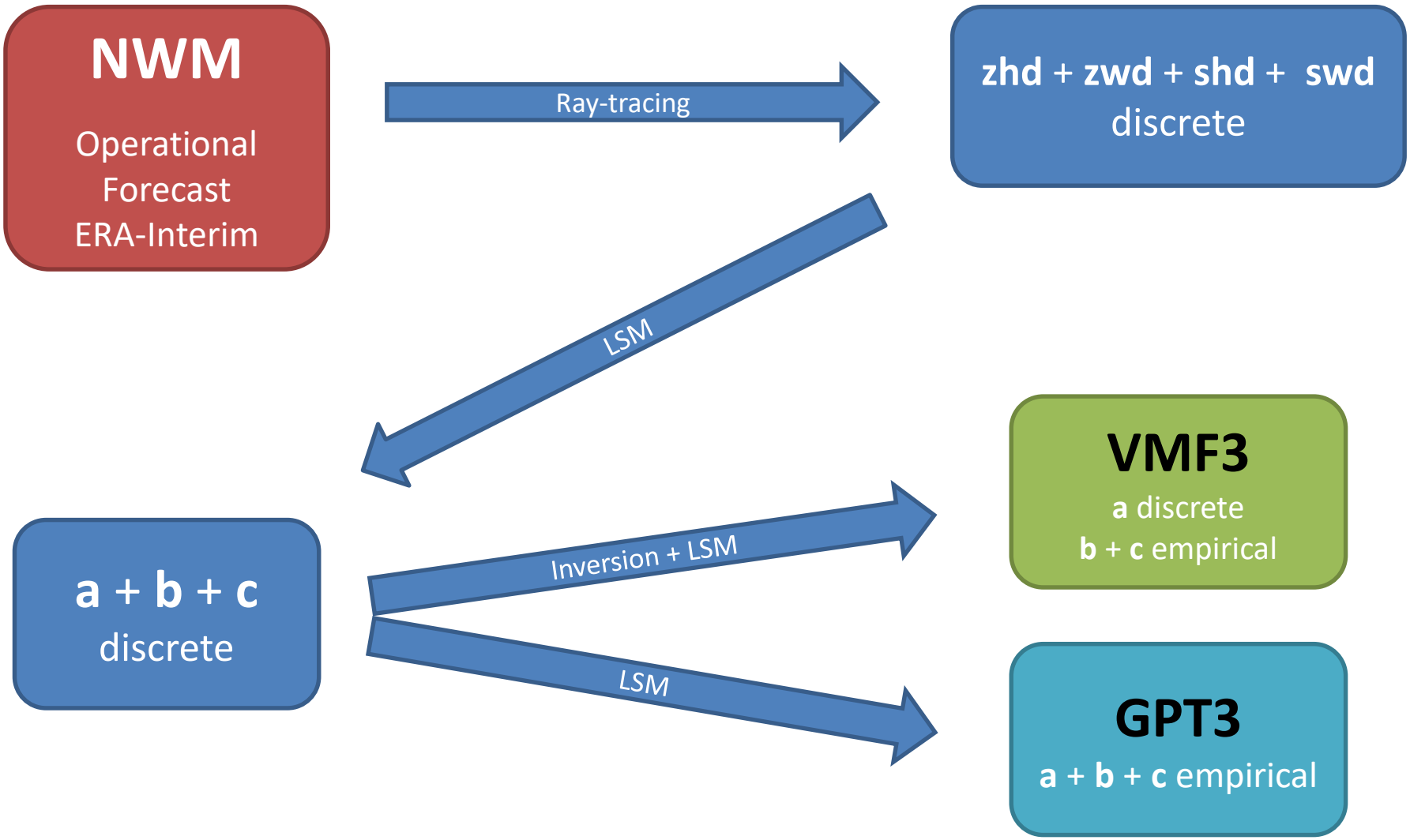
Describe the actual state of the atmosphere

1°x1° horizontal resolution, 25 pressure levels

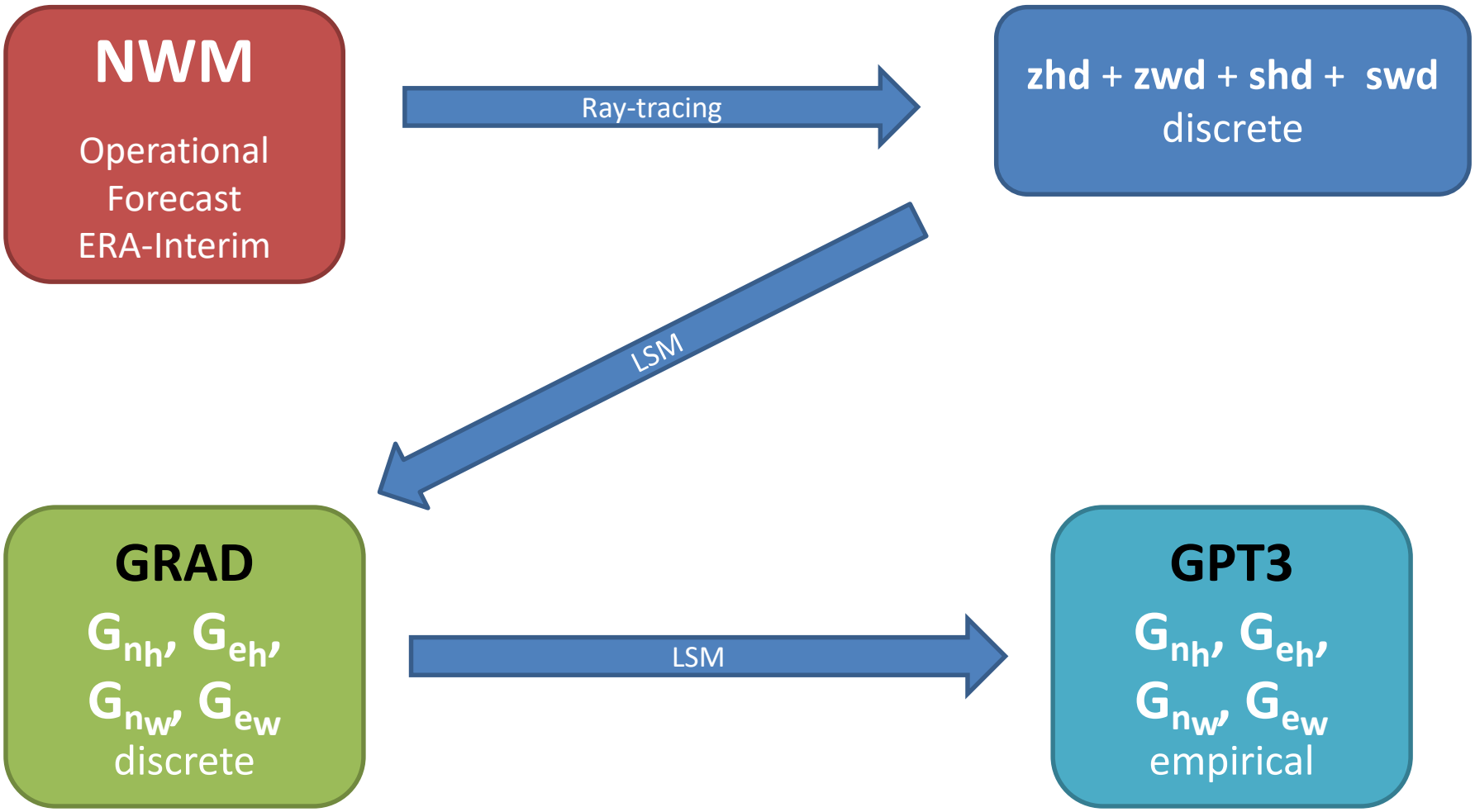
NWM by ECMWF:

- **Operational**: 1 day in retrospect
- **Forecast**: 1 day in advance
- **ERA-Interim**: reanalysis product; some months in retrospect

Workflow Mapping Functions



Workflow Horizontal Gradients



GNSS + DORIS users

Discrete products: VMF3 VMF1 GRAD

Empirical products: GPT3 GPT2w GPT2 GMF

IGS+IDS stations 

Arbitrary locations 

VLBI users

Discrete products: VMF3 VMF1 GRAD RAY

Empirical products: GPT3 GPT2w GPT2 GMF

IVS stations 

SLR users

Discrete products: VMF3o GRADo

ILRS stations 

All data and directions how to use it:

vmf.geo.tuwien.ac.at