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InfoAg Conference 2019

Session: Datum Update

Impact of Datum Update on Spatial Data Providers and Consumers

Who am I?

- Towfique Ahmed
- Denver, CO

- B.Sc. in Geomatics Engineering from the University of Calgary
- Trimble - 7 years
  - Graduate Rotation Program - 2 years
  - Correction Services Product Management - 5 years

Who are you?

- Data providers
- Service providers
- Software developers

- **Dealing with data that has a spatial aspect**

- What coordinate system is your data in? What datum? Realization? Epoch?

Agenda

- Background on Geospatial Data
  - Datums, and Coordinate Systems
  - Geographic, Cartesian, and Projected Coordinates
  - GNSS Basics and Correction Services
- Data
  - What dictates the datum and coordinate system of my data?
  - What do I need to consider when using Geospatial Data?
- Preparing for a datum transition
  - Users
  - Providers and Consumers

Geospatial Data

Geospatial Data

- Data that identifies geographic location of features, such as points, lines, and polygons

  Point: Asset
  Line: A-B lines
  Polygon: Boundary

  Represented by one or more coordinates

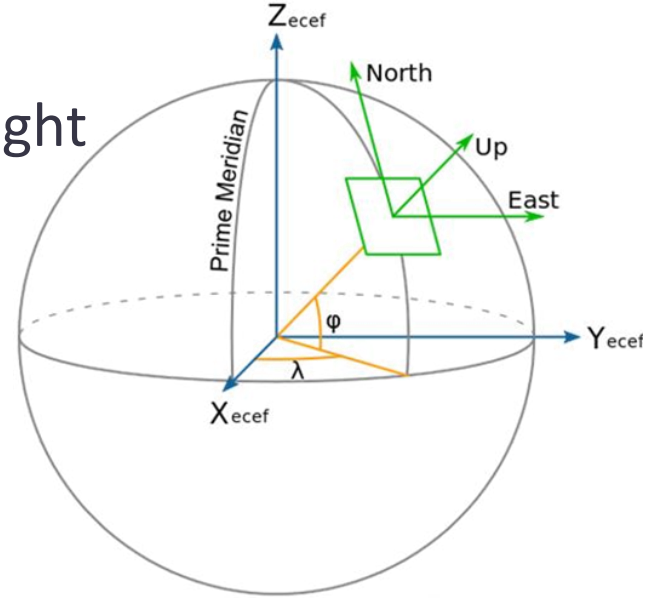
Geographic, Cartesian, and Projected Coordinates

- Coordinates: set of numbers that define the location of a point

Geographic: Latitude ϕ, Longitude λ, Height

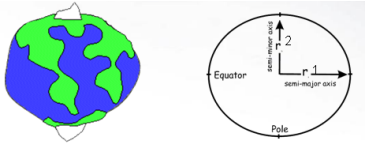
Cartesian: X_{ecef}, Y_{ecef}, Z_{ecef}

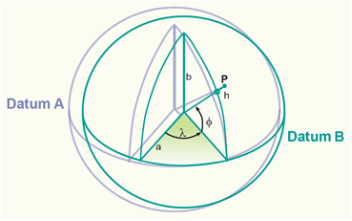
Projected: East, North, Up



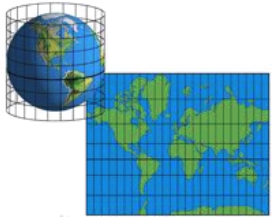
Coordinate Systems

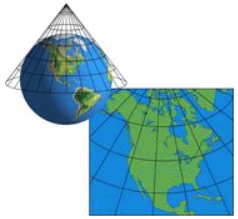
Datum



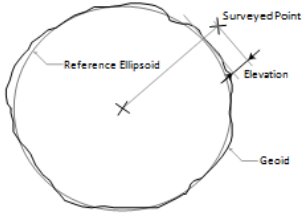


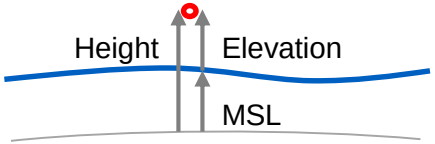
Projection





Geoid Model



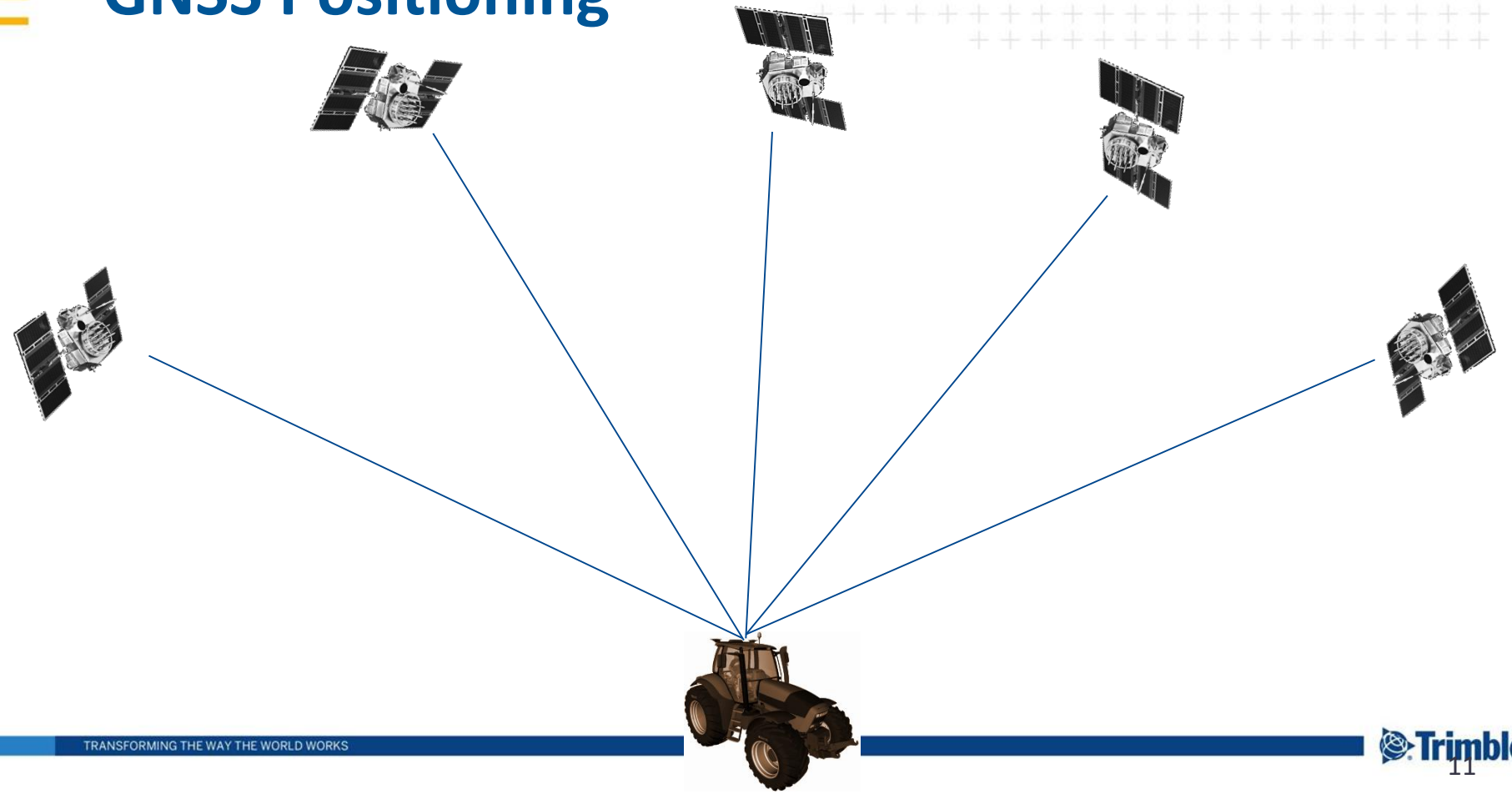


A better coordinate

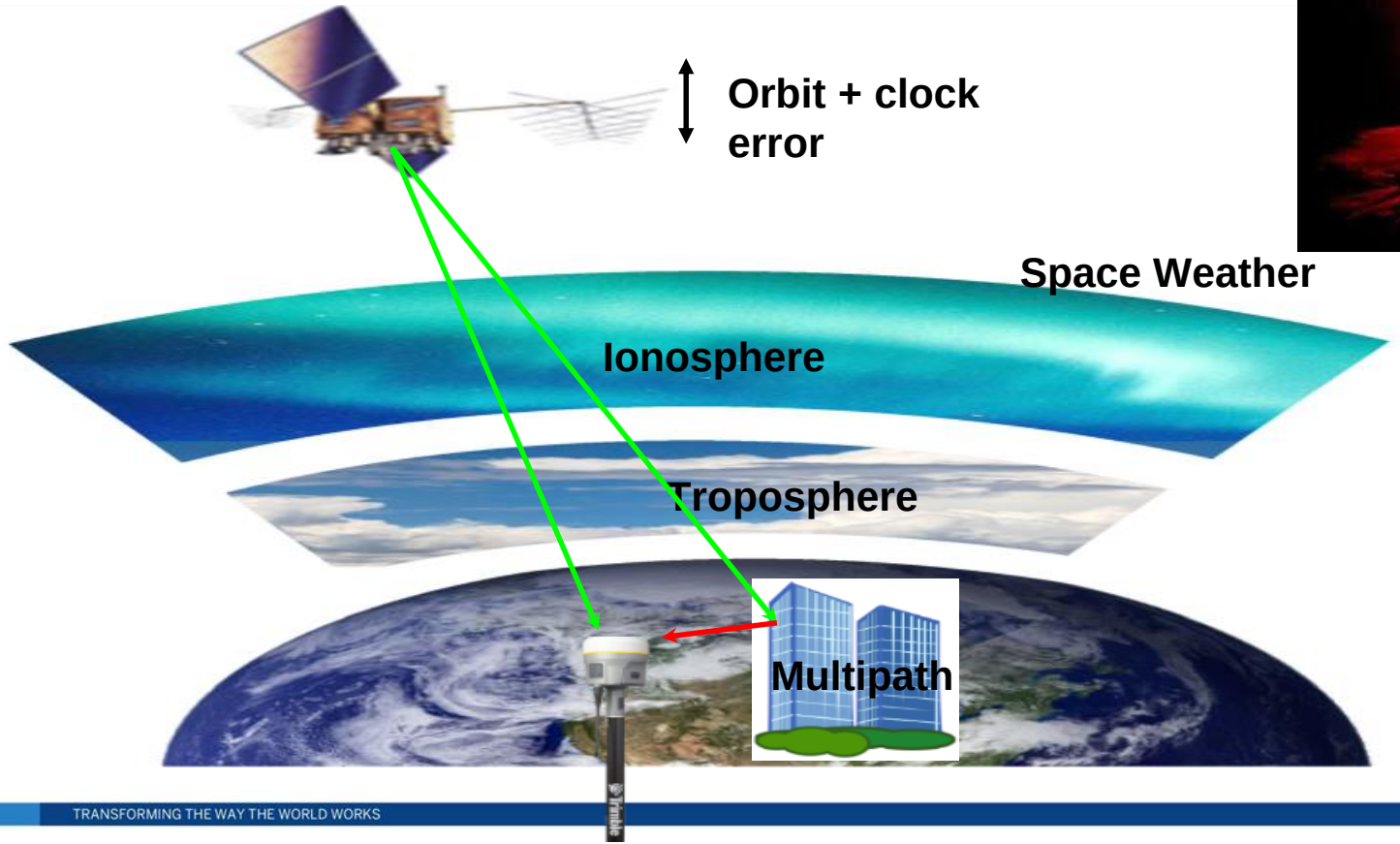
- Coordinates: set of numbers that define the location of a point
- Time when coordinate was captured
- Coordinate System of the coordinate
  - Datum, realization, and epoch
  - Projection
  - Geoid Model
- Source of coordinate
- Transformations applied

GNSS Basics and Correction Services

GNSS Positioning



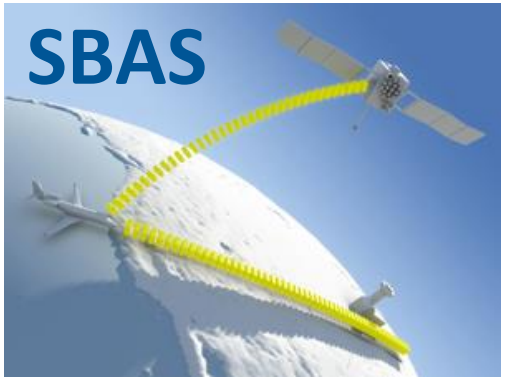
GNSS Error Sources



Error Sources:

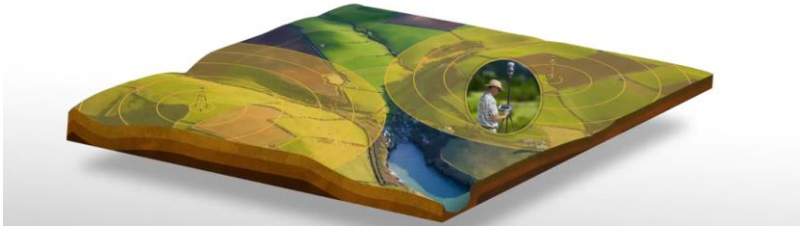
- Satellite orbit and clock
- Atmosphere
- Biases
- Solar effects

Types of GNSS Correction Sources



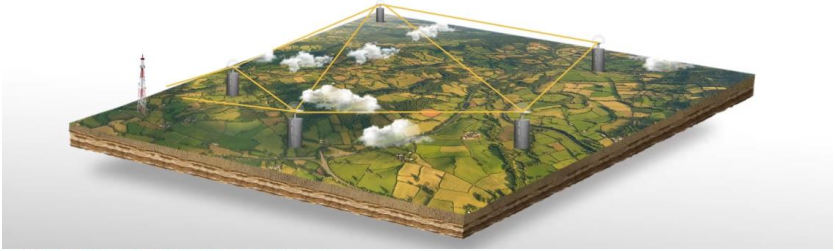
Trimble RTK

Centimeter-level accuracy within range of a base station

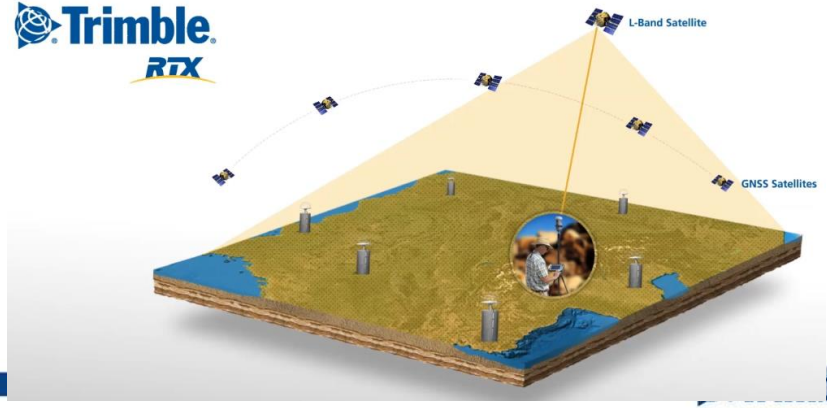


Trimble VRS

RTK-level accuracy without the need to set up your own base station



Trimble RTX



Data

What datum and coordinate system is my data in?

- Datum and coordinate system of data is dependent on the correction source, along with any transformations taking place

GNSS Correction Source (Accuracy?) **+** **Transformations** (Accuracy?) **=>** **Datum and Coordinate System of Data**

SBAS (e.g. WAAS)

- “WGS84”
- Which realization?
- Epoch?

Transformed:

- NAD83(2011) 2010.0
- Accuracy?

SBAS satellite

Corrections in “WGS84”

“WGS 84” position at rover

Transformation

Local position at rover (e.g. NAD83(2011) 2010.0)

Differential positioning (RTK and VRS) - 1

WGS 84 vector dX dY dZ

“WGS 84” position at base

“WGS 84” position at rover

Datum transformation

(e.g. NAD83(2011) 2010.0)

Local position at base

Datum transformation

(e.g. NAD83(2011) 2010.0)

Local position at rover

Differential positioning (RTK and VRS) - 2

WGS 84 vector dX dY dZ

“WGS 84” position at base

“WGS 84” position at rover

Datum transformation

(e.g. NAD83(2011) 2010.0)

Local position at base

Datum transformation

(e.g. NAD27)

Local position at rover

Differential positioning (RTK and VRS) - 3

NAD83(2011) 2010.0 vector dX dY dZ

(e.g. NAD83(2011) 2010.0)
Local position at base

(e.g. NAD83(2011) 2010.0)
Local position at rover

Differential positioning (RTK and VRS) - 4

NAD83(2011) 2010.0 vector dX dY dZ

NAD83(2011)
Epoch 2010.0
position at rover

Datum transformation

(????)

(e.g. NAD83(2011) 2010.0)
Local position at base

Local position at rover

Differential positioning (RTK and VRS) - 5

Unknown system vector dX dY dZ

(unknown system)

Local position at base

(?????)

Local position at rover

Trimble RTX

- ITRF2014 Current Epoch

Transformed:

- NAD83(2011) 2010.0
- Accuracy?

RTX satellite

Corrections in ITRF2014 Current Epoch

ITRF2014 Current Epoch position at rover

Transformation

Local position at rover

(e.g. NAD83(2011) 2010.0)

What do I need to consider when using Geospatial Data?

- Source of the GNSS correction data
  - Accuracy of position
  - Datum and Coordinate System
  - Accuracy of datum and coordinate system
- Intermediate transformations
  - What transformations are applied
  - Final datum and coordinate system
  - Accuracy of transformations → accuracy of datum and coordinate system

Coordinate Transformation

ITRF coordinates
RTX Position
or
NATRF2022
(Xecef, Yecef, Zecef)
ITRF2008 (epoch 2019.60)
NATRF2022 (epoch 2019.60)
NATRF2022 (epoch 2020)

GLOBAL coordinates
RTK Position
(Xecef, Yecef, Zecef)
NAD83 2011 (epoch 2010)
NATRF2022 (epoch 2020)

LOCAL coordinates

(Lat., Long., Height)

NAD83 or NAD27

GRID coordinates

(East., North., Up)

Colorado Central 0502

Time Dependent Datum Transformation

Fourteen parameter
+ displacement models
(NNR-MORVEL56 today)

Static Datum Transformations

Molodensky
Seven Parameter
Multiple Regression
Datum Grid
RTCM Datum

Projection & Site Calibration

Standard Projections
Projection Grid
Geoid Models
Ground Coordinates
Snake Grid
Horz.& Vert. adjustments

Preparing for a Datum Transition

Preparing for a datum transition as a user

- Do I need to switch datums or coordinate systems?
- What geospatial data am I currently using? What will I use in the future?
- What are my accuracy requirements?
- What is my GNSS Correction service provider doing?
  - Maybe I don't have one
- What are my data providers doing?
- What are the capabilities of my current software and/or hardware?

Who doesn’t need to switch?

- Single local base station user
- Network RTK user, where network isn’t switching
- No outside data sources

or

- No high-accuracy requirements (~3 metres)

Strategies for transition

- Switch at next opportune moment
- Transform existing data
  - What can my software do?
- Upgrade software and/or hardware

Preparing for a datum transition as a data provider

- Do I need to switch datums or coordinate systems?
- ….
- What are my **customers** doing?
- What are the capabilities of my **customers'** software and/or hardware?

Preparing for a datum transition as a data provider

- Do I need to switch datums or coordinate systems?
- ….
- What are my **customers** doing?
- What are the capabilities of my **customers'** software and/or hardware?
- **Store accurate and complete metadata**
- **Transform existing data**
- **How will new data be collected?**
- **Provide a transition plan**

Preparing for a datum transition as a data consumer (i.e. software)

- Do I need to switch datums or coordinate systems?
- ….
- What are my customers doing?

Preparing for a datum transition as a data consumer (i.e. software)

- Do I need to switch datums or coordinate systems?
- ….
- What are my customers doing?
- **Provide transformation tools**
  - **Real-time**
  - **In-office for existing data**
- **Automate transformations**

Contact Info

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