

9th SIRGAS SCHOOL

ON “REFERENCE SYSTEMS
AND REFERENCE FRAMES”

OFFICIAL *schedule*

VIRTUAL THEORY: OCTOBER 19–23 AND 26–30

IN-PERSON PRACTICALS: NOVEMBER 9–13

MILITARY GEOGRAPHIC INSTITUTE · FACULTY OF ENGINEERING (UDELAR)

GENERAL STRUCTURE OF THE PROGRAM

THREE SEQUENTIAL STAGES: TWO WEEKS OF VIRTUAL THEORETICAL SESSIONS AND ONE WEEK OF IN-PERSON PRACTICAL SESSIONS.

WEEK 1

OCT 19–23

THEORETICAL · VIRTUAL

DYNADJUST AND
NETWORK ADJUSTMENT

08:30–12:30

WEEK 2

OCT 26–30

THEORETICAL · VIRTUAL

GEODESY, REFERENCE
FRAMES, GNSS AND GRAVITY

08:30–12:30

WEEK 3

NOV 09–13

PRACTICAL · IN PERSON

GNSS, GRAVIMETRY AND
DYNADJUST

08:30–16:00

DAILY SCHEDULE

**1st
WEEK**

19/10

INTRODUCTION TO DYNADJUST SOFTWARE

08:30–08:40

WELCOME

Welcome

CNEL. GUSTAVO
CAUBARRÈRE

08:40–10:30

SESSION

Dynadjust: general features and applications
in geodetic networks / Rigorous adjustment
by least squares

WALTER SUBIZA

10:30–10:40

BREAK

Break

10:40–12:30

SESSION

Reference geodetic systems and fundamental
height concepts / Q&A and discussion

WALTER SUBIZA

THEORETICAL • VIRTUAL

DAILY SCHEDULE

**1st
WEEK**

20/10

PROJECT AND DATA MANAGEMENT

08:30–10:30

SESSION

Day 1 brief recap / Project creation, editing and processing / Import and export of geodetic networks

WALTER SUBIZA

10:30–10:50

BREAK

Break

10:50–12:30

SESSION

Data quality control

WALTER SUBIZA

THEORETICAL · VIRTUAL

DAILY SCHEDULE

1 st WEEK	21/10	NETWORK MODELING AND MANAGEMENT	
08:30-10:30	SESSION	Day 2 brief recap / Geoid models: import, interpolation and export	WALTER SUBIZA
10:30-10:50	BREAK	Break	
10:50-12:30	SESSION	Network segmentation	WALTER SUBIZA

THEORETICAL · VIRTUAL

DAILY SCHEDULE

1 st WEEK	22/10	MATHEMATICAL ADJUSTMENT MODELS	
08:30-10:30	SESSION	Day 3 brief recap / Mathematical modeling of adjustment	WALTER SUBIZA
10:30-10:50	BREAK	Break	
10:50-12:30	SESSION	Stochastic modeling	WALTER SUBIZA
THEORETICAL · VIRTUAL			

DAILY SCHEDULE

1st WEEK **23/10** **ESTIMATION AND ANALYSIS OF RESULTS**

08:30-10:30	SESSION	Estimation of parameters and uncertainties	WALTER SUBIZA
10:30-10:50	BREAK	Break	
10:50-12:30	SESSION	Verification of the adjustment by least squares / Final practical exercise	WALTER SUBIZA

THEORETICAL · VIRTUAL

DAILY SCHEDULE

2nd WEEK	26/10	GEODESY: FUNDAMENTAL CONCEPTS AND INTRODUCTION	
08:30–09:00	WELCOME	Cnel. Gustavo Caubarrère	
09:00–09:50	SESSION	Definition / Observation Techniques / Reference Surfaces	MAURICIO VARELA
09:50–10:10	BREAK	BREAK	
10:10–11:10	SESSION	Latin American Context: Geodetic Singularities of the Region	MAURICIO VARELA
11:20–12:30	SESSION	SIRGAS	MAURICIO VARELA
THEORETICAL · VIRTUAL			

DAILY SCHEDULE

THEORETICAL · VIRTUAL

2nd
WEEK

27/10

SISTEMAS Y MARCOS DE REFERENCIA

08:30–09:15

SESSION

General Overview, Reference Systems and Reference Frames (geodetic hierarchy, mathematical principles, definitions, Reference System and Reference Frame. Celestial and Terrestrial Reference Systems)

MAURICIO VARELA

09:15–09:50

SESSION

Sistema y Marco de Referencia Celeste, orientación y movimientos de la Tierra (ICRS, ICRF, precesión, nutación, movimiento del polo y mareas terrestres)

MAURICIO VARELA

09:50–10:10

BREAK

BREAK

10:10–11:20

SESSION

Terrestrial Reference System: global (ITRS) and continental (SIRGAS) / Terrestrial Reference Frame: global (ITRF), continental (SIRGAS-CON)

JOSÉ ANTONIO TARRÍO
MOSQUERA

11:20–12:30

SESSION

Deformation Models / Geodetic Databases: ISO GR and EPSG

JOSÉ ANTONIO TARRÍO
MOSQUERA

DAILY SCHEDULE

2nd WEEK	28/10	GNSS POSITIONING	
08:30-09:00	SESSION	Introduction / GNSS Structure / Reference Systems, Time and Reference Frames / Orbital Theory	JOSÉ ANTONIO TARRÍO MOSQUERA
09:00-09:50	SESSION	Observables / Mathematical Models for Positioning / Observation and Processing	JOSÉ ANTONIO TARRÍO MOSQUERA
09:50-10:10	BREAK	BREAK	
10:10-12:30	SESSION	GNSS Adjustment (MCC, Helmert Transformation, Accuracy Analysis)	JOSÉ ANTONIO TARRÍO MOSQUERA
THEORETICAL · VIRTUAL			

DAILY SCHEDULE

2nd
WEEK

29/10

INTERNATIONAL TERRESTRIAL GRAVITY REFERENCE SYSTEM AND REFERENCE FRAME (ITGRS/ITGRF)

08:30–09:00	SESSION	Definition of the ITGRS: International Terrestrial Gravity Reference System (ITGRS)	EZEQUIEL D. ANTOKOLETZ
09:00–09:50	SESSION	Definition of the International Terrestrial Gravity Reference Frame (ITGRF)	EZEQUIEL D. ANTOKOLETZ
09:50–10:10	BREAK	BREAK	
10:10–12:30	SESSION	Definition of the International Terrestrial Gravity Reference Frame (ITGRF)	EZEQUIEL D. ANTOKOLETZ

THEORETICAL · VIRTUAL

DAILY SCHEDULE

2nd WEEK	30/10	VERTICAL REFERENCE SYSTEMS	
08:30–09:00	SESSION	Operability, Coordination and Maintenance of the ITGRF	EZEQUIEL D. ANTOKOLETZ
09:00–09:50	SESSION	Regional Context of the ITGRF and Modern Vertical Reference System	EZEQUIEL D. ANTOKOLETZ + GABRIEL GUIMARÃES
09:50–10:10	BREAK	BREAK	
10:10–12:30	SESSION	Modernization of a Geodetic Network (Example from Uruguay)	WALTER SUBIZA

THEORETICAL · VIRTUAL

3RD WEEK — IN-PERSON PRACTICAL SESSION

NOVEMBER 9-13, 2026 • GENERAL SCHEDULE: 08:30-16:00

3rd WEEK

09-10- 11 NOV **SESSION 1**

GNSS PROCESSING:

- **BERNESE**
- **GAMIT/GLOBK**
- **GRAVIMETRÍA**

08:30-16:00

José Antonio Tarrío Mosquera
Demián Gomez
Gabriel Guimarães

*CLASSES HELD SIMULTANEOUSLY
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12 NOV - 13 NOV **SESSION 2**

**NETWORK ADJUSTMENT
IN DYNADJUST**

08:30-16:00

Walter Subiza

**NETWORK ADJUSTMENT IN
DYNADJUST + APPLIED
PRACTICE**

08:30-16:00

Walter Subiza

*BREAKS AND LUNCH ARE SHOWN WITHIN EACH DAY'S
SCHEDULE TO PRESERVE THE ACTUAL TIME FLOW.*

PRACTICAL • IN-PERSON

9/11 — GNSS PROCESSING

TIME	BLOCK 1 · BERNESE PROF. DR. ANTONIO TARRÍO MOSQUERA	BLOCK 2 · GAMIT / GLOBK PROF. DR. DEMIÁN GOMEZ	BLOCK 3 · GRAVIMETRY PROF. DR. GABRIEL GUIMARÃES
08:30–08:50	WELCOME / INTRODUCTION	WELCOME / INTRODUCTION	WELCOME / INTRODUCTION
08:50–09:30	FILE STRUCTURE AND BSW SOFTWARE PHILOSOPHY	UNIX/LINUX PHILOSOPHY AND FILE SYSTEM	PLANNING OF GRAVIMETRIC SURVEYS
09:30–10:00	BSW INSTALLATION / FOLDER AND DATA STRUCTURE	COMMAND LINE / GAMIT-GLOBK INSTALLATION	PLANNING OF GRAVIMETRIC SURVEYS
10:00–10:20		 BREAK	
10:20–11:20	PROGRAM FUNCTIONAL WORKFLOW. ROUTINES	OBTAINING ORBITS AND FILES REQUIRED FOR GNSS DATA PROCESSING	GRAVIMETER FIELDWORK
11:20–12:30	DIRECTORY STRUCTURE AND CAMPAIGN CONFIGURATION	GAMIT CONFIGURATION FILES	GRAVIMETER FIELDWORK
12:30–14:00		 LUNCH	
14:00–15:00	NOMENCLATURE	GAMIT CONFIGURATION FILES	PLANNING OF GRAVIMETRIC SURVEYS
15:00–15:15		 BREAK	
15:15–16:00	COMPARISON BETWEEN COMMERCIAL AND SCIENTIFIC SOFTWARE	GNSS METADATA	PLANNING OF GRAVIMETRIC SURVEYS

PRACTICAL · IN-PERSON

10/11 — GNSS PROCESSING AND GRAVIMETRIC DATA

TIME	BLOCK 1 · BERNESE PROF. DR. ANTONIO TARRÍO MOSQUERA	BLOCK 2 · GAMIT / GLOBK PROF. DR. DEMIÁN GOMEZ	BLOCK 3 · GRAVIMETRY PROF. DR. GABRIEL GUIMARÃES
08:30-08:45	DOUBLE-DIFFERENCE PHASE PROCESSING / INPUT/OUTPUT FILES	GLOB-K: COMBINATION OF MULTIPLE DAILY NETWORKS	GRAVDATA GRAVIMETRIC DATA PROCESSING
08:45-10:00	BPE VARIABLES / PCF STRUCTURE	UPDATE OF TABLES FOR PROCESSING	GRAVDATA GRAVIMETRIC DATA PROCESSING
10:00-10:20		 PAUSA CAFÉ	
10:20-11:20	CREATION OF A PRIORI COORDINATES / POLAR AND ORBITAL PREPARATION / DATA CONVERSION TO BSW FORMAT	HOW TO INVOKE THE SH_SETUP SCRIPT / HOW TO INVOKE THE SH_GAMIT SCRIPT	ADJUSTMENT OF GRAVIMETRIC OBSERVATIONS WITH GRAVNET
11:20-12:30	ESTABLISHMENT OF BASELINES	EVALUATION OF A GAMIT RESULT	ADJUSTMENT OF GRAVIMETRIC OBSERVATIONS WITH GRAVNET
12:30-14:00		 ALMUERZO	
14:00-15:00	PREPROCESSING AND FILTERING OF PHASE DATA	TROPOSPHERIC PARAMETERS / PROBLEM DIAGNOSIS	PREDICTION OF GRAVIMETRIC DATA WITH PREDGRAV
15:00-15:15		 PAUSA CAFÉ	
15:15-16:00	CALCULATION OF NON-FIXED AMBIGUITY SOLUTIONS	PROCESSING AN EXAMPLE GNSS NETWORK	PREDICTION OF GRAVIMETRIC DATA WITH PREDGRAV

PRACTICAL · IN-PERSON

11/11 — GNSS SOLUTIONS, GLOBK AND GRAVIMETRY

BLOCK 1 · BERNESE

BLOCK 2 · GAMIT / GLOBK

BLOCK 3 · GRAVIMETRY

SCHEDULE

PROF. DR. ANTONIO TARRÍO MOSQUERA

PROF. DR. DEMIÁN GOMEZ

PROF. DR. GABRIEL GUIMARÃES

08:30–09:00	AMBIGUITY RESOLUTION	INTRODUCTION TO GLOB-K / GLOB-K CONFIGURATION FILES / DAILY COMBINATION WITH GLOB-K	CALCULATION OF GEODETIC FUNCTIONALS USING THE ICGEM SERVICE
09:00–10:00	NETWORK SOLUTION CALCULATION WITH FIXED AMBIGUITIES / DATUM FIXING	WEEKLY COMBINATION OF SOLUTIONS	CALCULATION OF GEODETIC FUNCTIONALS USING THE ICGEM SERVICE
10:00–10:20		 COFFEE BREAK	
10:20–12:30	FINAL FILES: COORDINATES AND TROPOSPHERIC DELAYS	MEASUREMENT EPOCH AND CONVENTIONAL EPOCH / IGS-ALIGNED SOLUTION / EPOCH ALIGNMENT AND STACK ALIGNMENT	REDUCTIONS AND CALCULATION OF GRAVIMETRIC ANOMALIES
12:30–14:00		 LUNCH	
14:00–15:00	USE AND COMBINATION OF SIRGAS SEMI-FREE SOLUTIONS	FINAL PRACTICAL EXERCISE	
15:00–15:15		 COFFEE BREAK	
15:15–16:00	FODITS USE: NONLINEAR MODELS, KINEMATIC REFERENCE FRAMES: ADJUSTMENTS WITH NONLINEAR MODELS (CRUSTAL MOVEMENTS, DEFORMATIONS)	FINAL PRACTICAL EXERCISE	

PRACTICAL SESSION – IN PERSON

DAILY SCHEDULE

3rd
WEEK

12/11

NETWORK ADJUSTMENT IN DYNADJUST

08:30–09:00	WELCOME	Welcome / Introduction	WALTER SUBIZA
09:00–10:00	SESSION	Calculation of three-dimensional coordinates and their precisions from GNSS observations and conventional terrestrial measurements.	WALTER SUBIZA
10:00–10:20	BREAK	 BREAK	
10:20–12:30	SESSION	Least-squares adjustment, mathematical and stochastic modeling	WALTER SUBIZA
12:30–14:00	LUNCH	 LUNCH	
14:00–15:00	SESSION	Least-squares adjustment, mathematical and stochastic modeling	WALTER SUBIZA
15:00–15:15	BREAK	 BREAK	
15:15–16:00	SESSION	Least-squares adjustment, mathematical and stochastic modeling	WALTER SUBIZA
PRACTICAL · IN-PERSON			

DAILY SCHEDULE

3rd
WEEK

13/11 NETWORK ADJUSTMENT IN DYNADJUST AND APPLIED PRACTICE

08:30–09:00	WELCOME	Software practice in the context of geodetic networks associated with SIRGAS	WALTER SUBIZA
09:00–10:00	SESSION	Software practice in the context of geodetic networks associated with SIRGAS	WALTER SUBIZA
10:00–10:20	BREAK	 Break	
10:20–12:30	SESSION	Software practice in the context of geodetic networks associated with SIRGAS	WALTER SUBIZA
12:30–14:00	LUNCH	 Lunch	
14:00–15:00	SESSION	Processing of the participants' own data.	WALTER SUBIZA
15:00–15:15	BREAK	 Break	
15:15–16:00	SESSION	Processing of the participants' own data.	WALTER SUBIZA

PRACTICAL · IN-PERSON

TEACHING STAFF

CNEL. GUSTAVO CAUBARRÈRE

PRESIDENT SIRGAS · IGM – URUGUAY

DR. EZEQUIEL D. ANTOKOLETZ

FEDERAL AGENCY FOR CARTOGRAPHY AND
GEODESY – BKG, GERMANY

**PROF. DR. JOSÉ ANTONIO TARRÍO
MOSQUERA**

UNIVERSITY OF SANTIAGO, CHILE

PROF. DR. DEMIÁN GOMEZ

THE OHIO STATE UNIVERSITY, EARTH SCIENCES,
USA

PROF. DR. GABRIEL GUIMARÃES

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