Hydropower Solutions

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HYDROPOWER SECTOR IN ECUADOR
RENEXPO – HYDRO EVENT

VERONICA MINAYA

November 28th 2019, Salzburg - Austria

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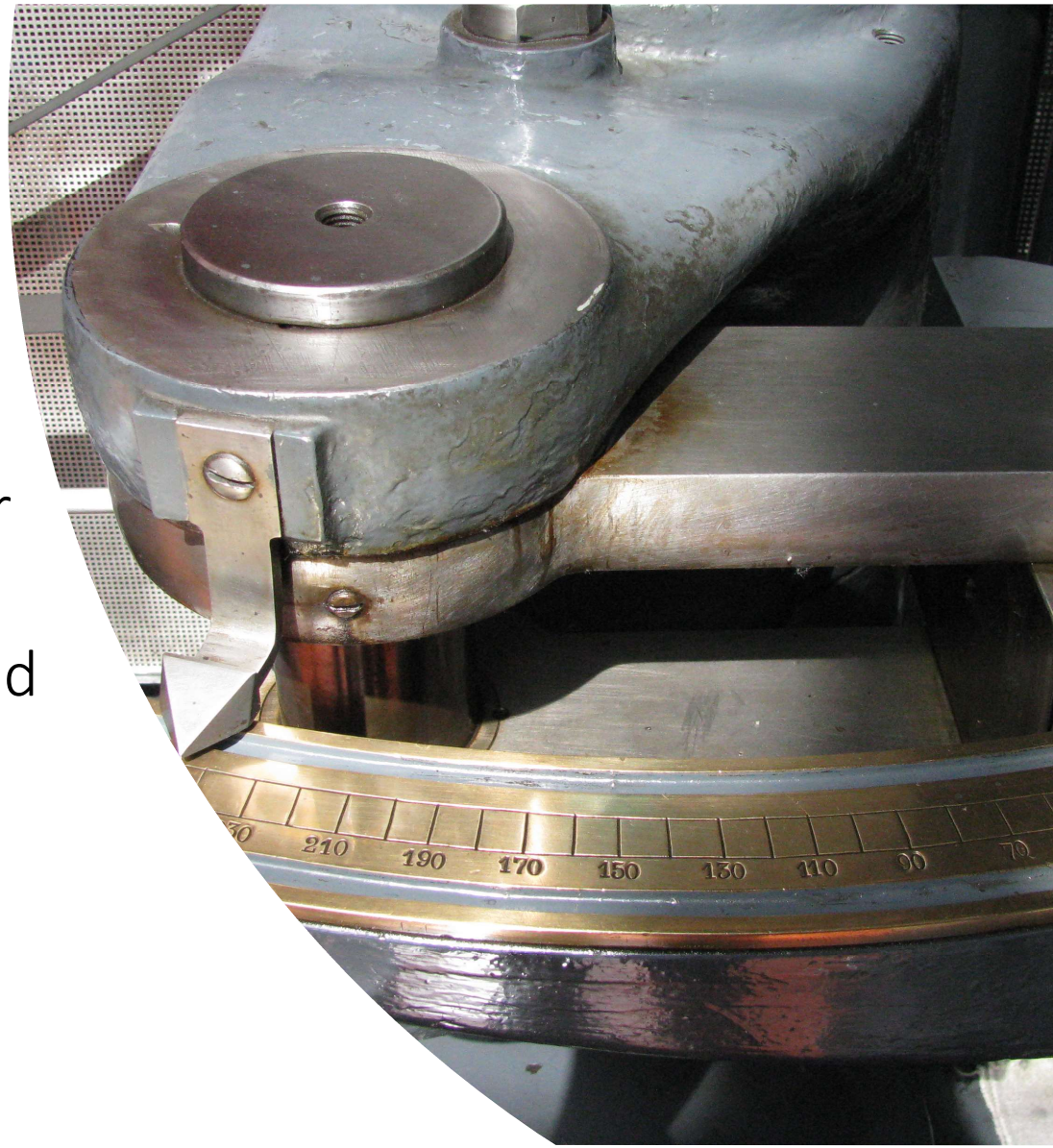
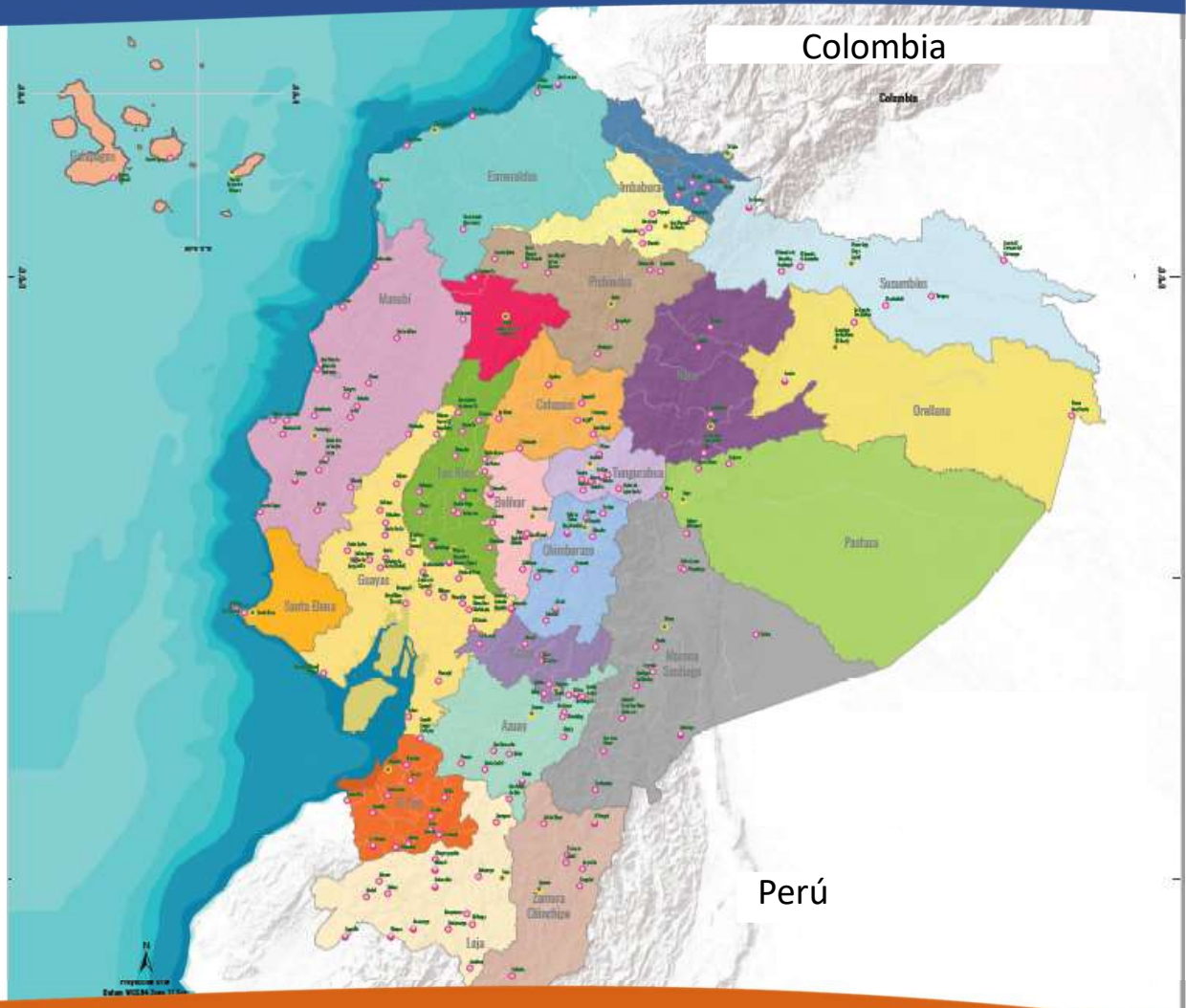
Content

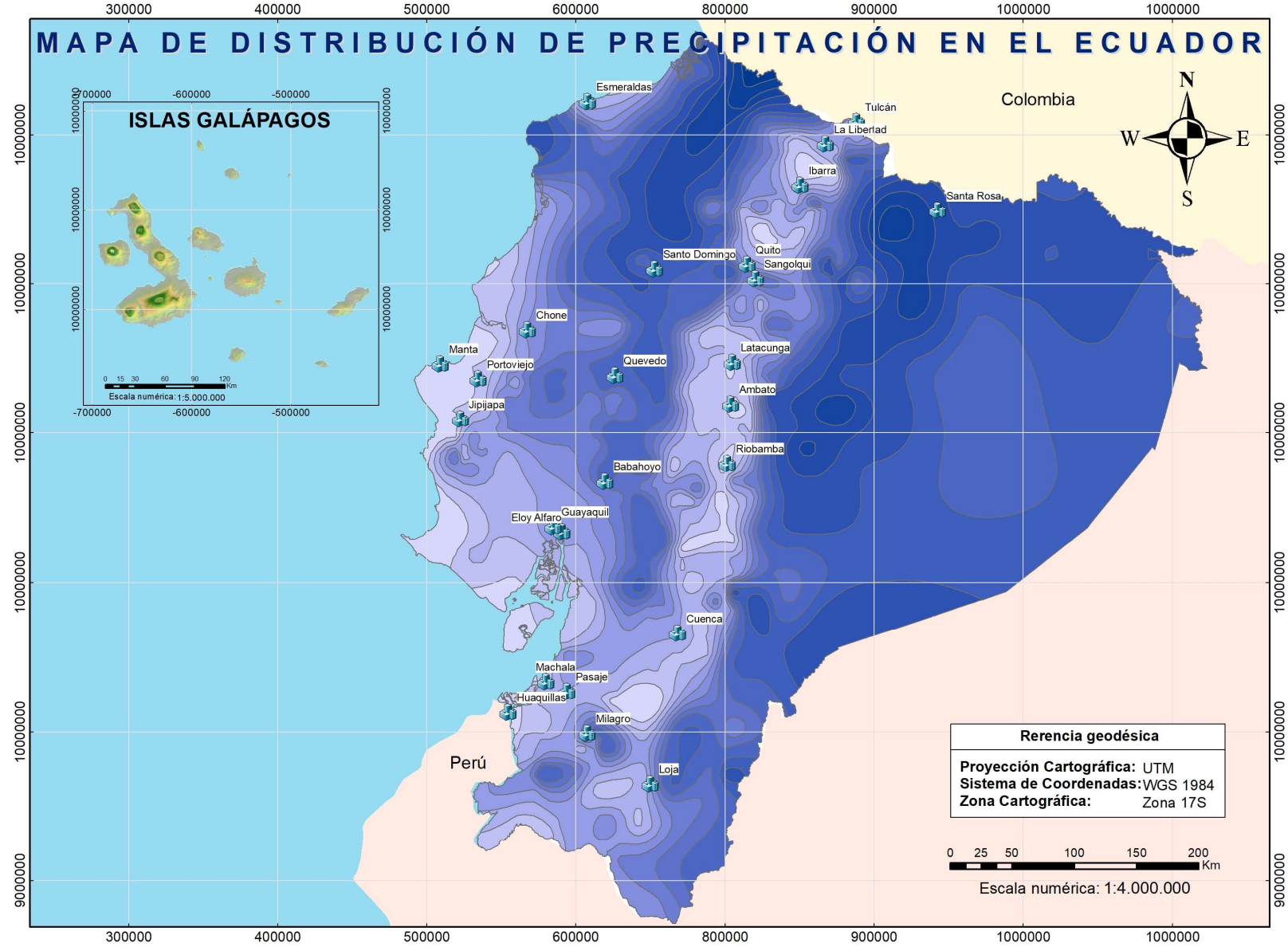
- Spatial distribution of climate variables
- Overview of the electric sector in Ecuador
- Overview of small, medium and large hydropower plants
  - In operation
  - In studies
- Relevant Stakeholders



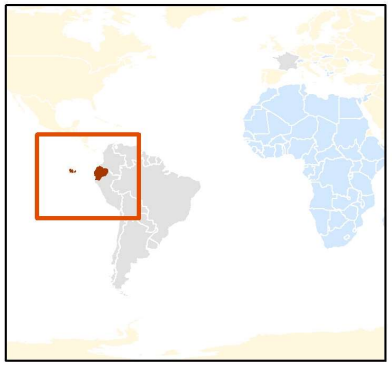


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857851.

MAPA DE DISTRIBUCIÓN DE PRECIPITACIÓN EN EL ECUADOR



Ubicación en el Mundo:



LEYENDA:

Ciudades

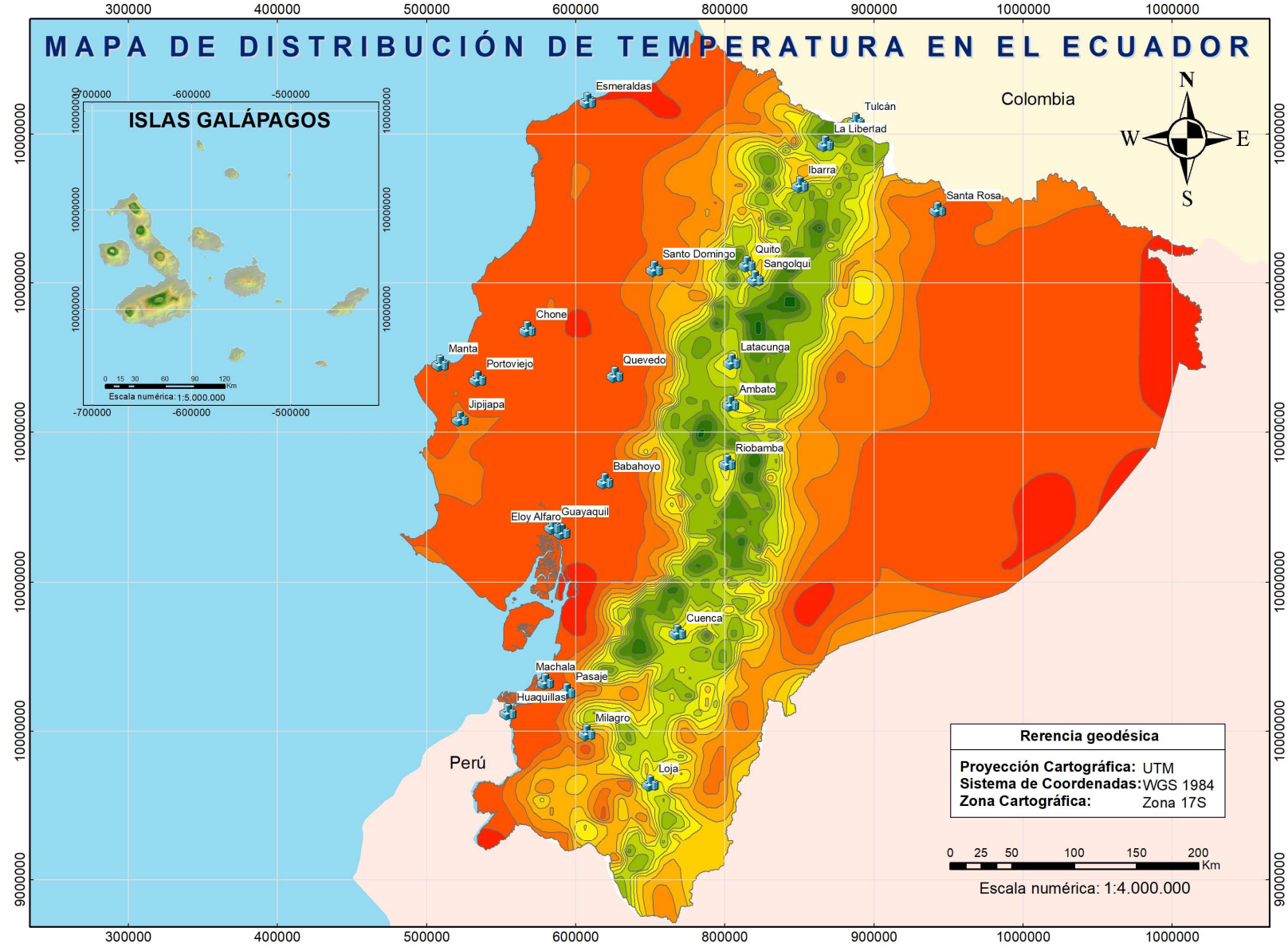
Rangos de precipitación media (mm):

0 - 500	2000 - 2500
500 - 750	2500 - 3000
750 - 1000	3000 - 4000
1000 - 1250	4000 - 5000
1250 - 1500	5000 - 6000
1500 - 1750	6000 - 7000
1750 - 2000	>7000

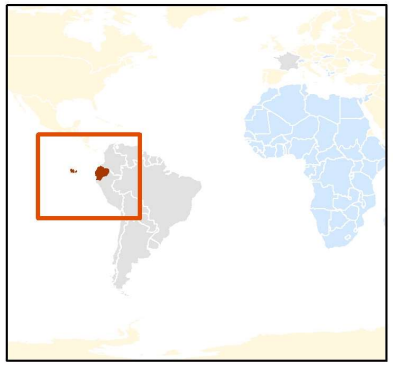
Representación de las precipitaciones medias

Fuente: Instituto Nacional de Meteorología e Hidrología - INAMHI

MAPA DE DISTRIBUCIÓN DE TEMPERATURA EN EL ECUADOR



Ubicación en el Mundo:



LEYENDA:

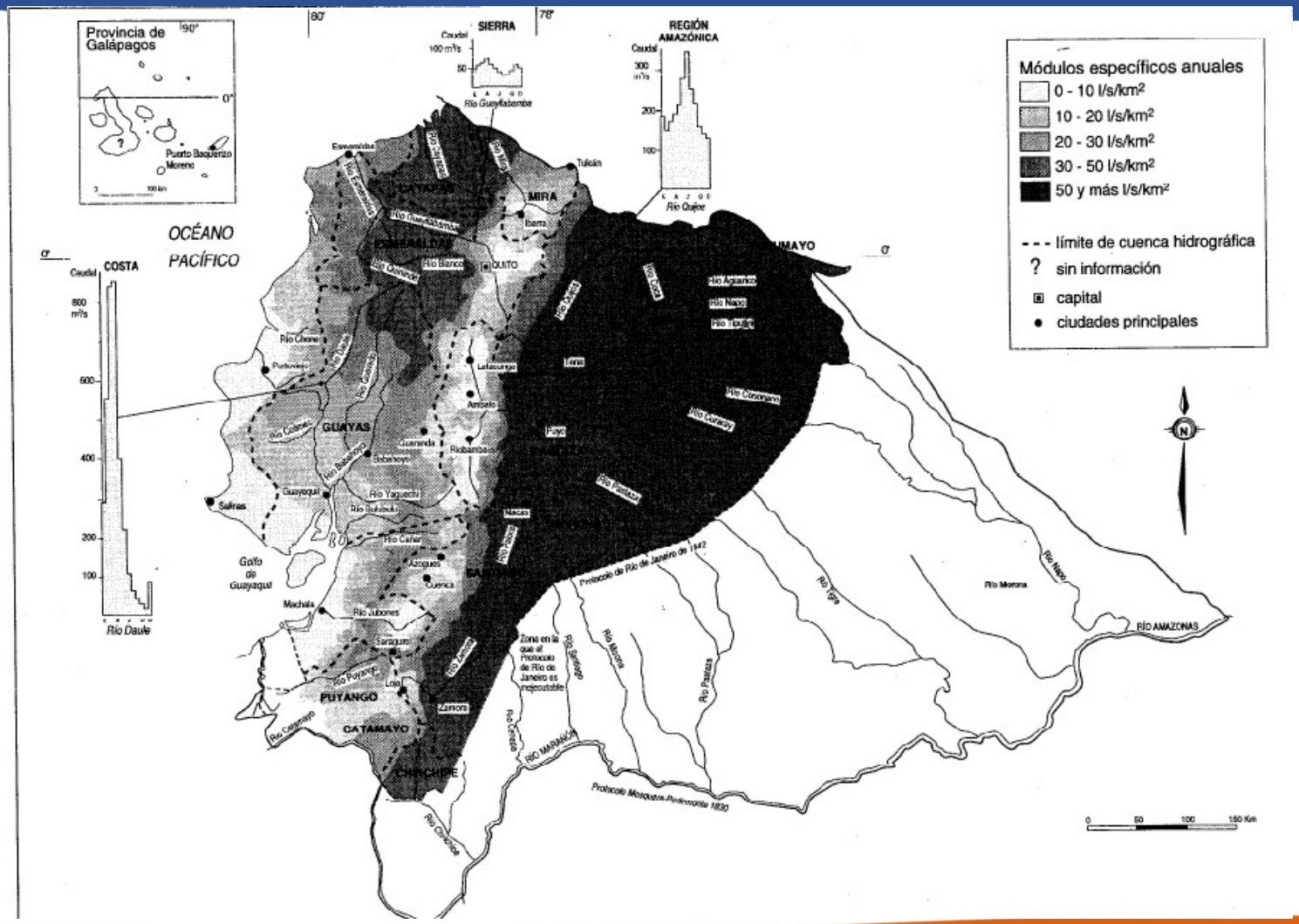
Ciudades

Rangos de temperatura media (°C):

0 - 2	14 - 16
2 - 4	16 - 18
4 - 6	18 - 20
6 - 8	20 - 22
8 - 10	22 - 24
10 - 12	24 - 26
12 - 14	26 - 28

Representación de las temperaturas medias

Fuente: Instituto Nacional de Meteorología e Hidrología - INAMHI



Specific discharge

Updated version under construction…

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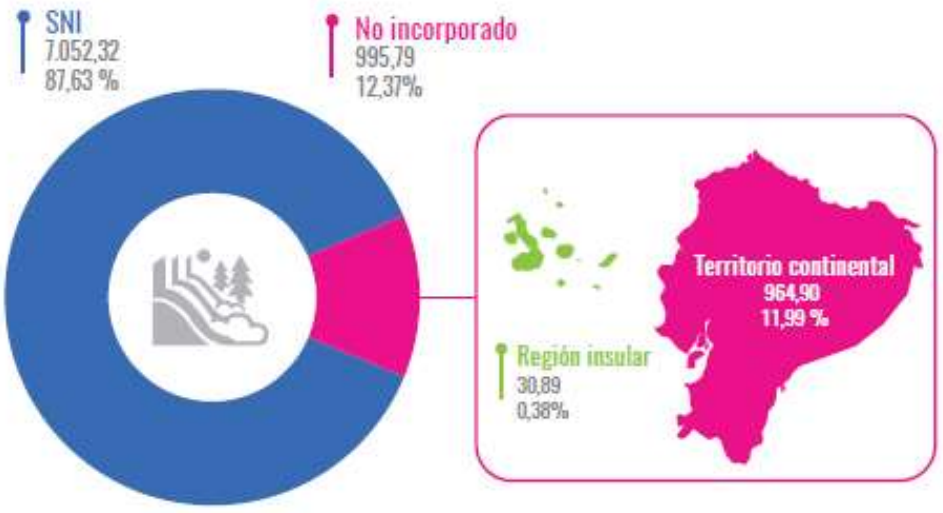
NATIONAL CONTEXT

Effective power by type of system (MW)



Renewable energy

Hydropower | Thermal biomass | Wind power | Thermal biogas | Photovoltaic

Non-renewable energy

Internal combustion engine | Turbo gas | Turbo steam

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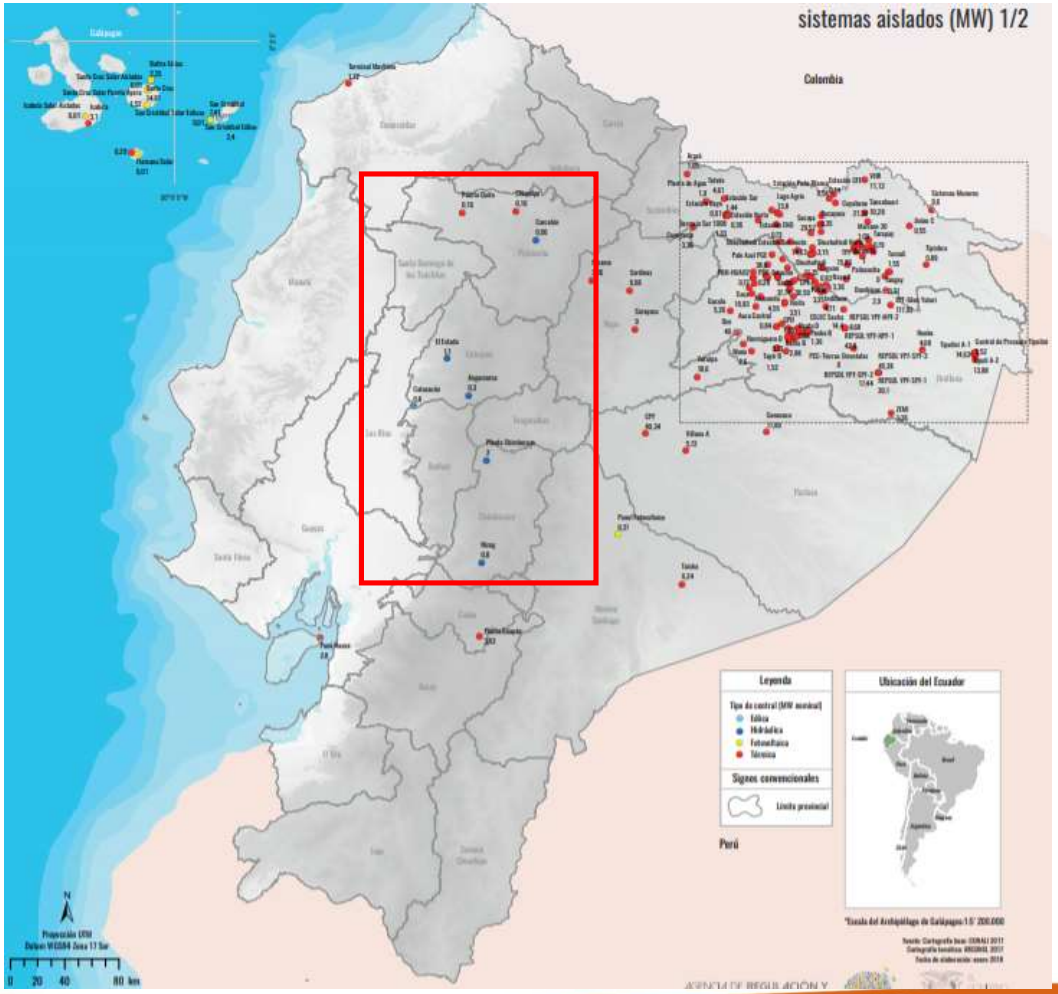
NATIONAL CONTEXT



Around 6 small hydropower plants are off-grid

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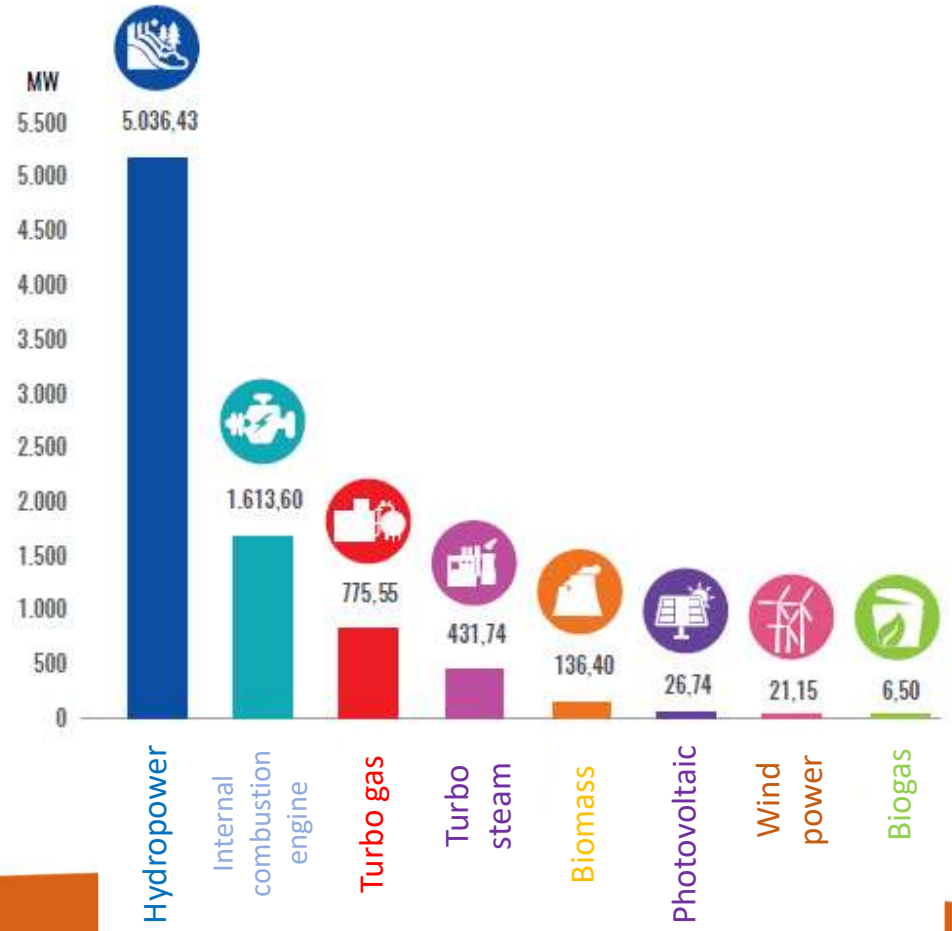
Nominal and effective power by type of source (MW)

Tipo Fuente	Tipo de Central	Tipo de Unidad	Potencia Nominal (MW)	Potencia Efectiva	
				(MW)	%
Renovable	Hidráulica	Hidráulica	5.066,40	5.036,43	62,58
	Biomasa	Turbovapor	144,30	136,40	1,69
	Fotovoltaica	Fotovoltaica	27,63	26,74	0,33
	Eólica	Eólica	21,15	21,15	0,26
	Biogás	MCI	7,26	6,50	0,08
Total Renovable			**5.266,74**	**5.227,22**	**64,95**
No Renovable	Térmica	MCI	2.011,44	1.613,60	20,05
		Turbogás	921,85	775,55	9,64
		Turbovapor	461,87	431,74	5,36
Total No Renovable			**3.395,15**	**2.820,89**	**35,05**
Total general			**8.661,90**	**8.048,11**	**100,00**

Effective power by type of source



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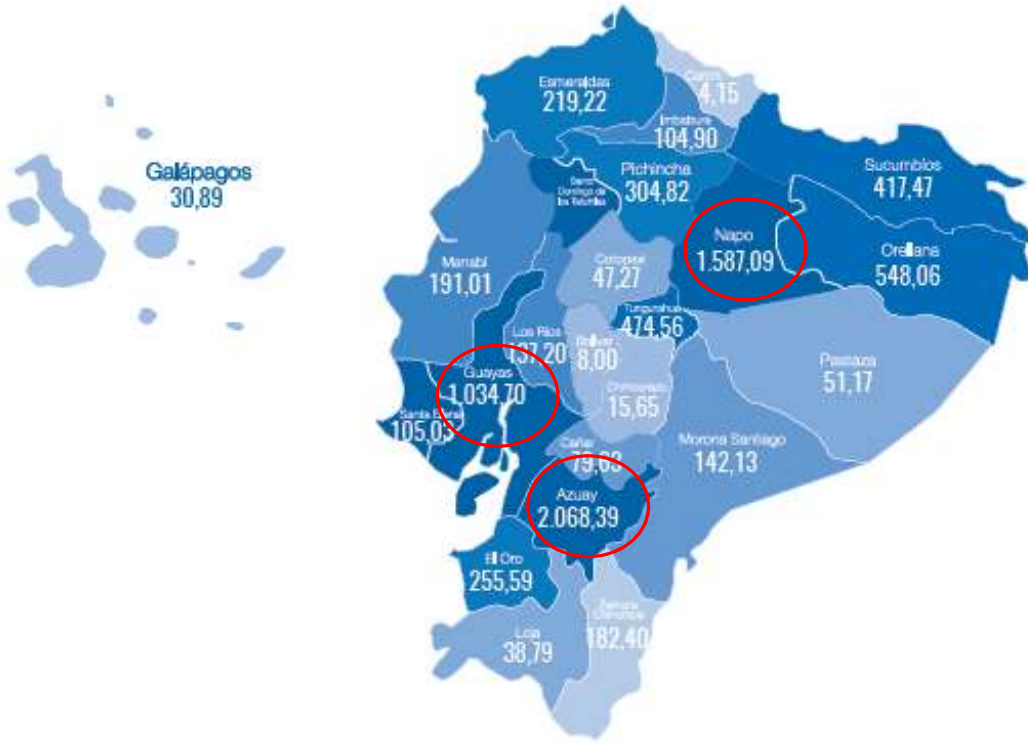
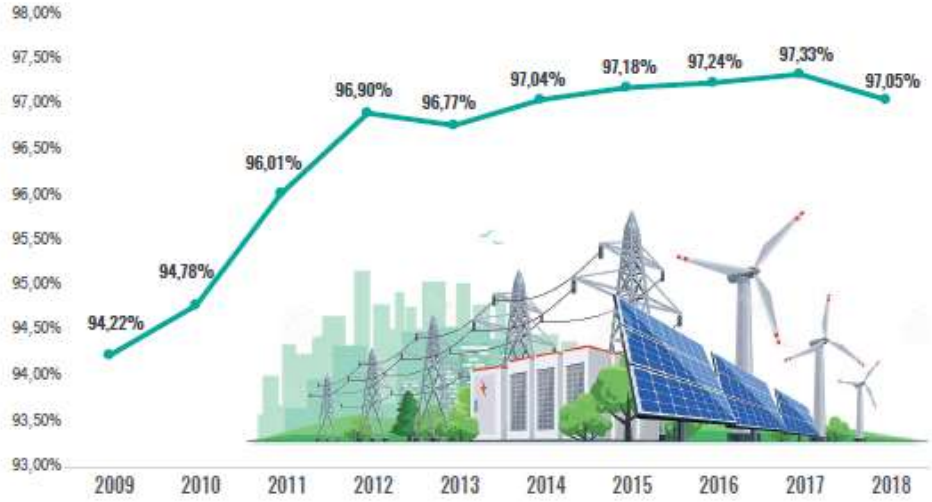
Effective power of hydropower generation (MW)



Electric service coverage



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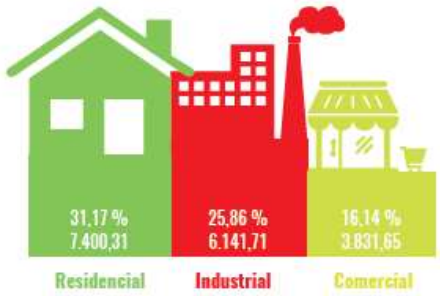
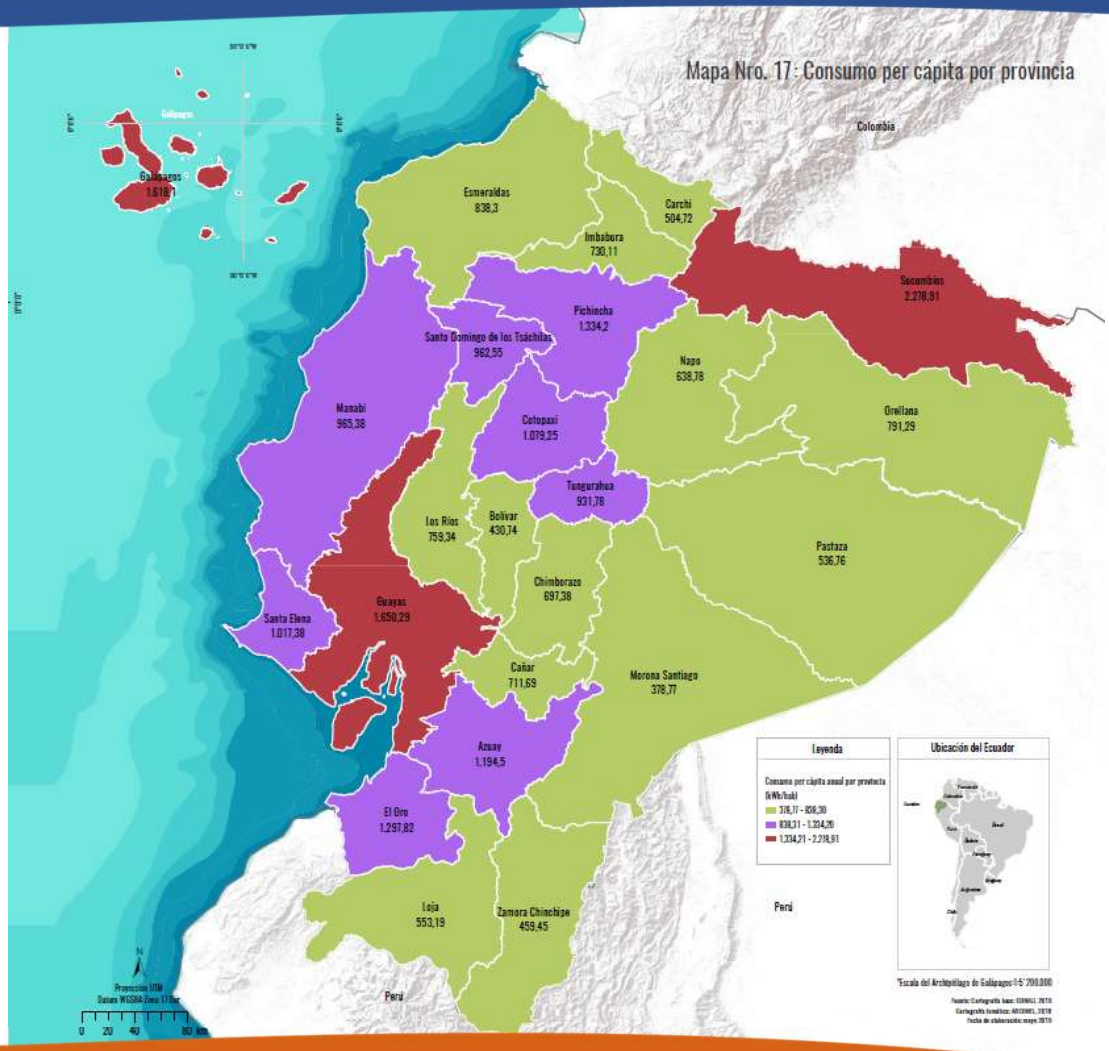
Energy consumption





More information:
https://www.regulacionelectrica.gob.ec/revistasd2/

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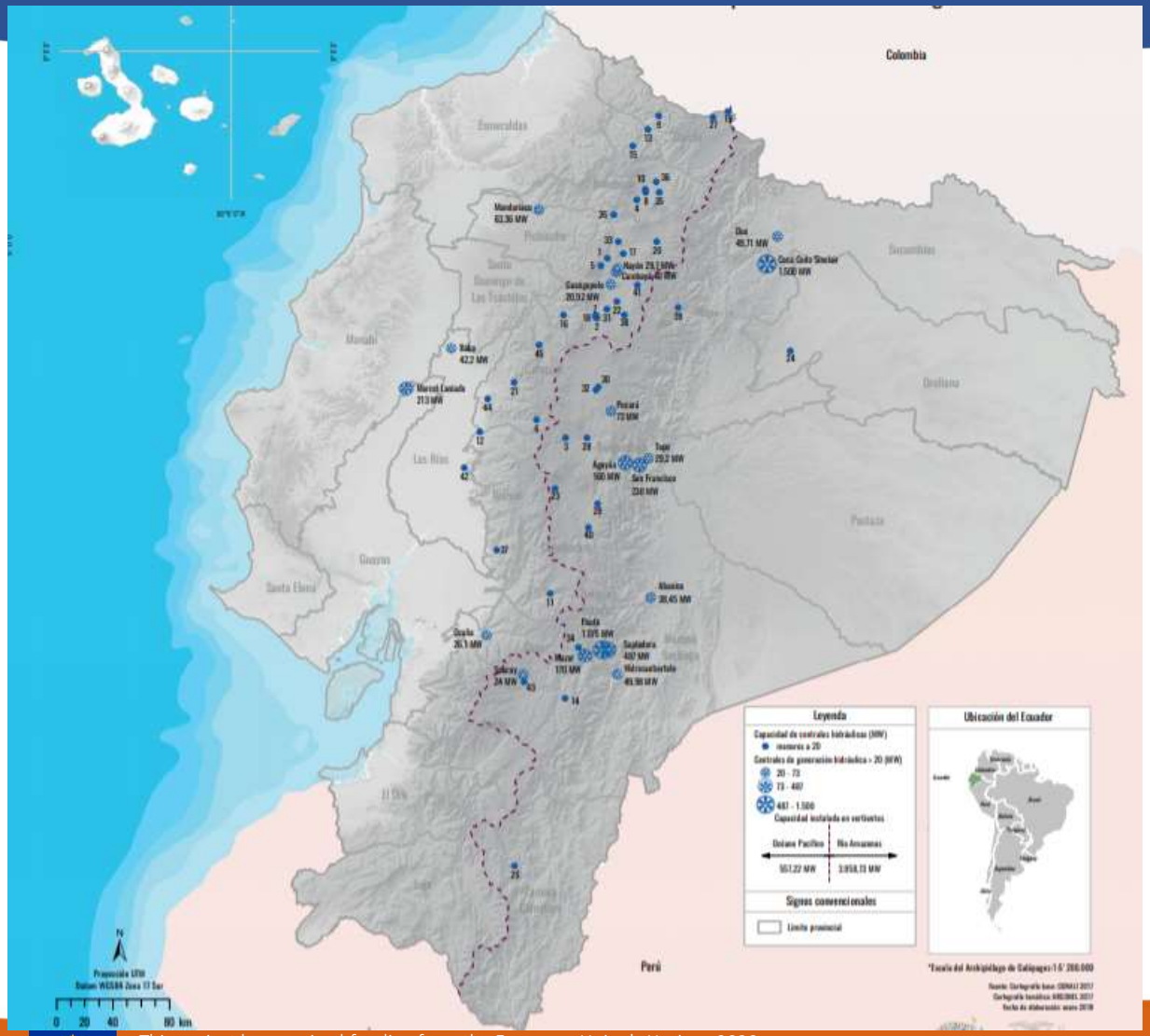
Hydropower plants in operation



Hydropower plants

< 20 MW	43 HPP
20 – 73 MW	11 HPP
73 – 487 MW	5 HPP
> 487 MW	2 HPP

Pacific Ocean	Amazon River
←	→
12% (energy in MW)	88% (energy in MW)

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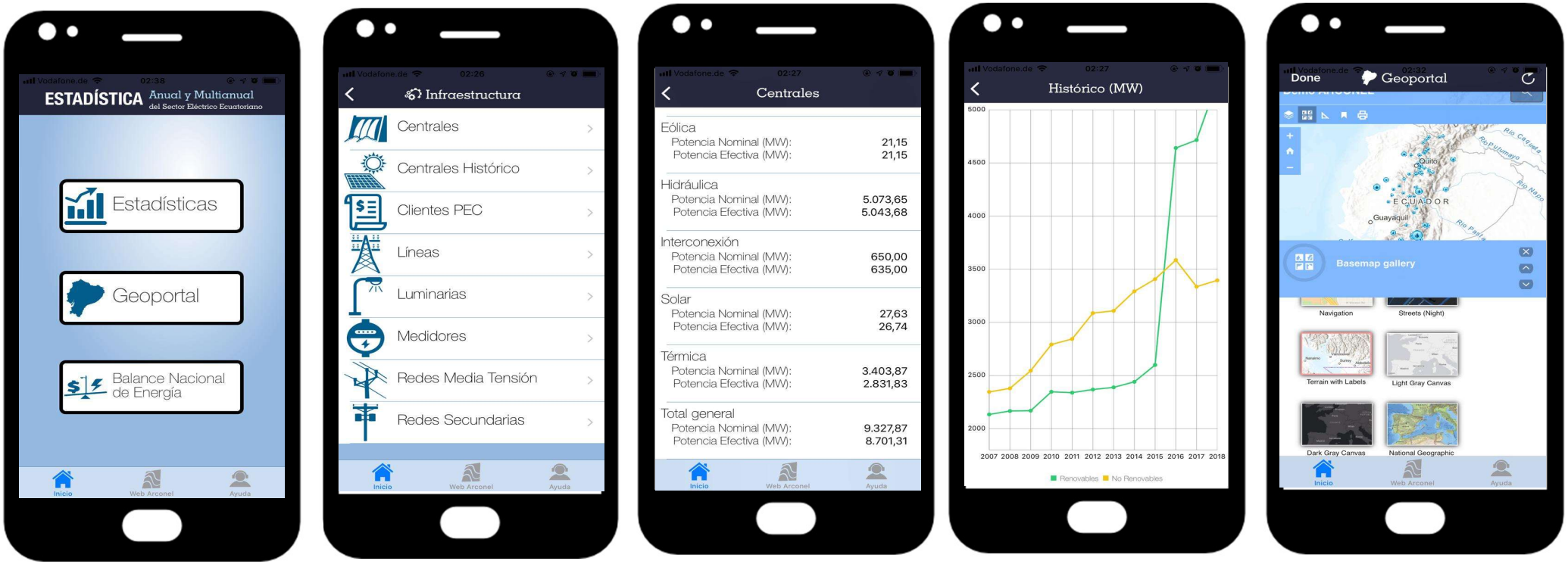
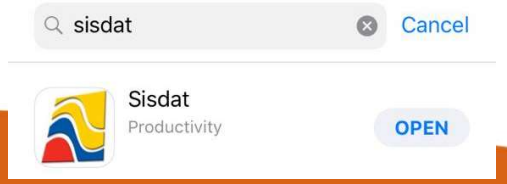
Data available to any device





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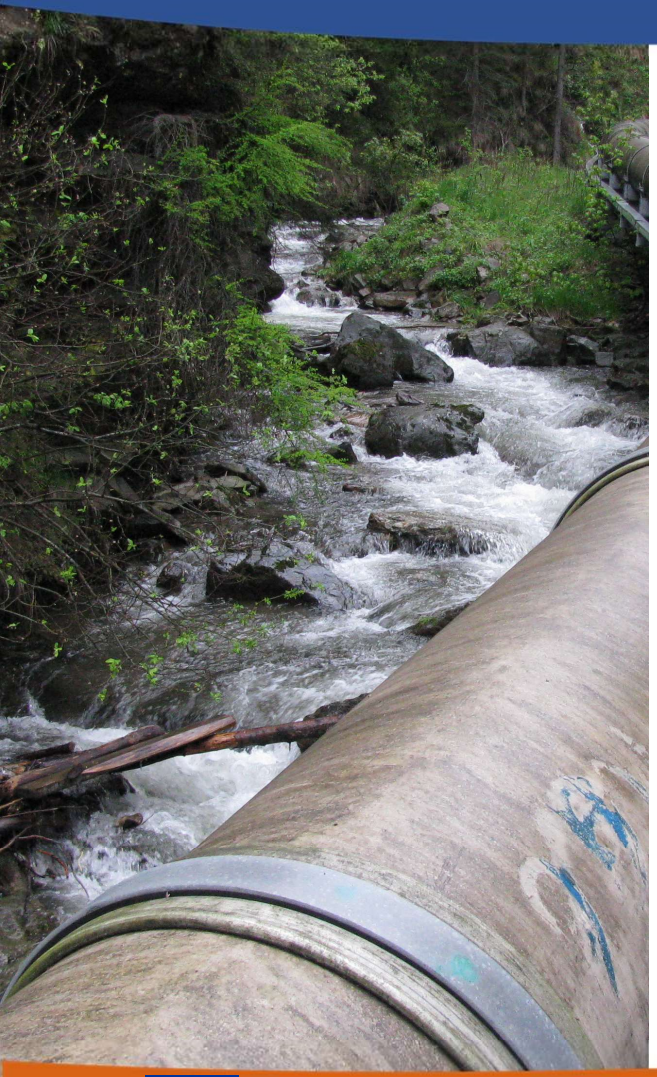

Hydropower projects

Hydropower [MW]	Inventory	Prefeasibility	Feasibility	Final design
0 - 1	1	-	1	-
1 – 10	48	16	5	4
10 – 100	66	8	3	3
> 100	6	7	2	4

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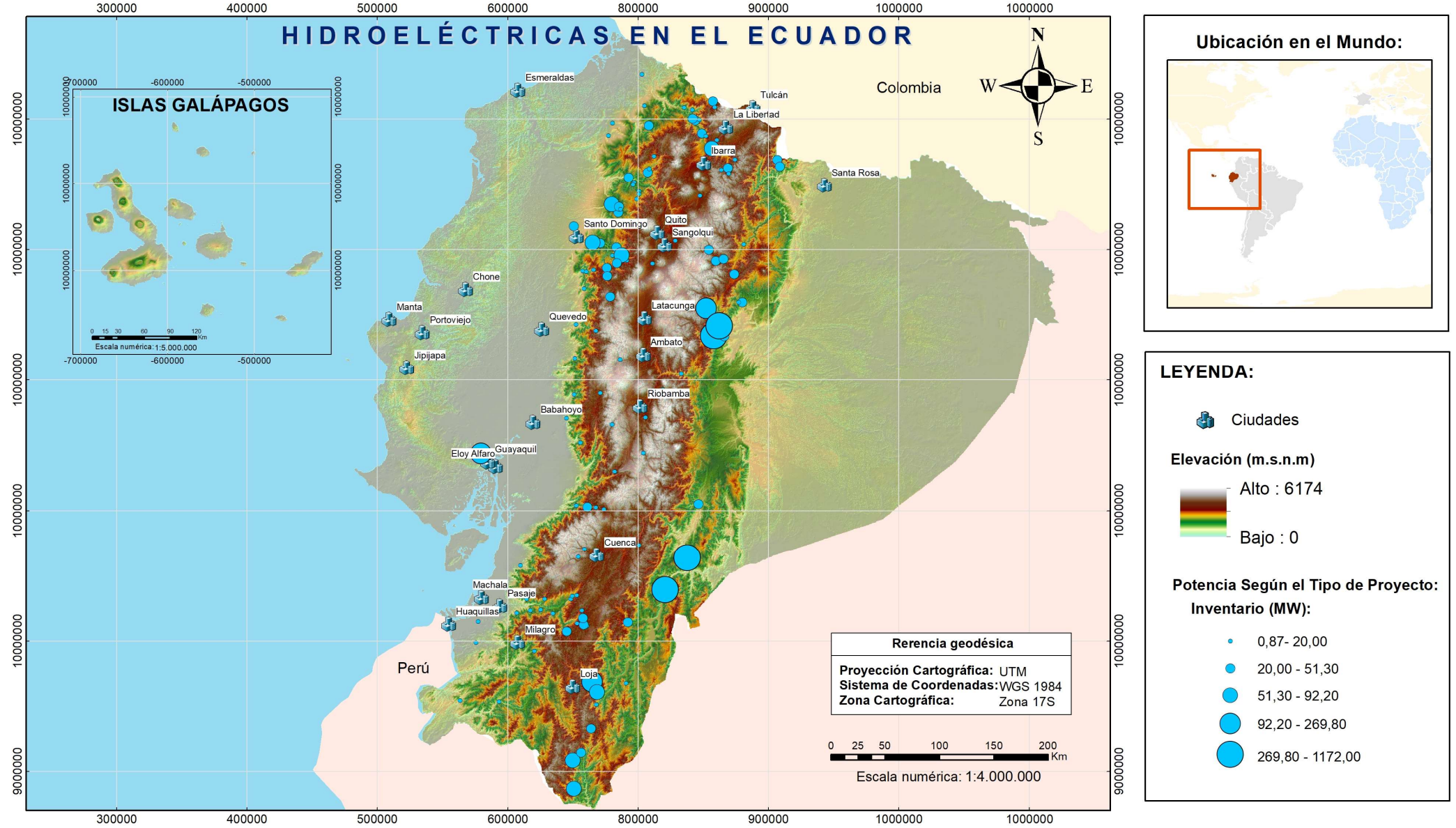


Ubicación en el Mundo:

LEYENDA:

Ciudades

Elevación (m.s.n.m)

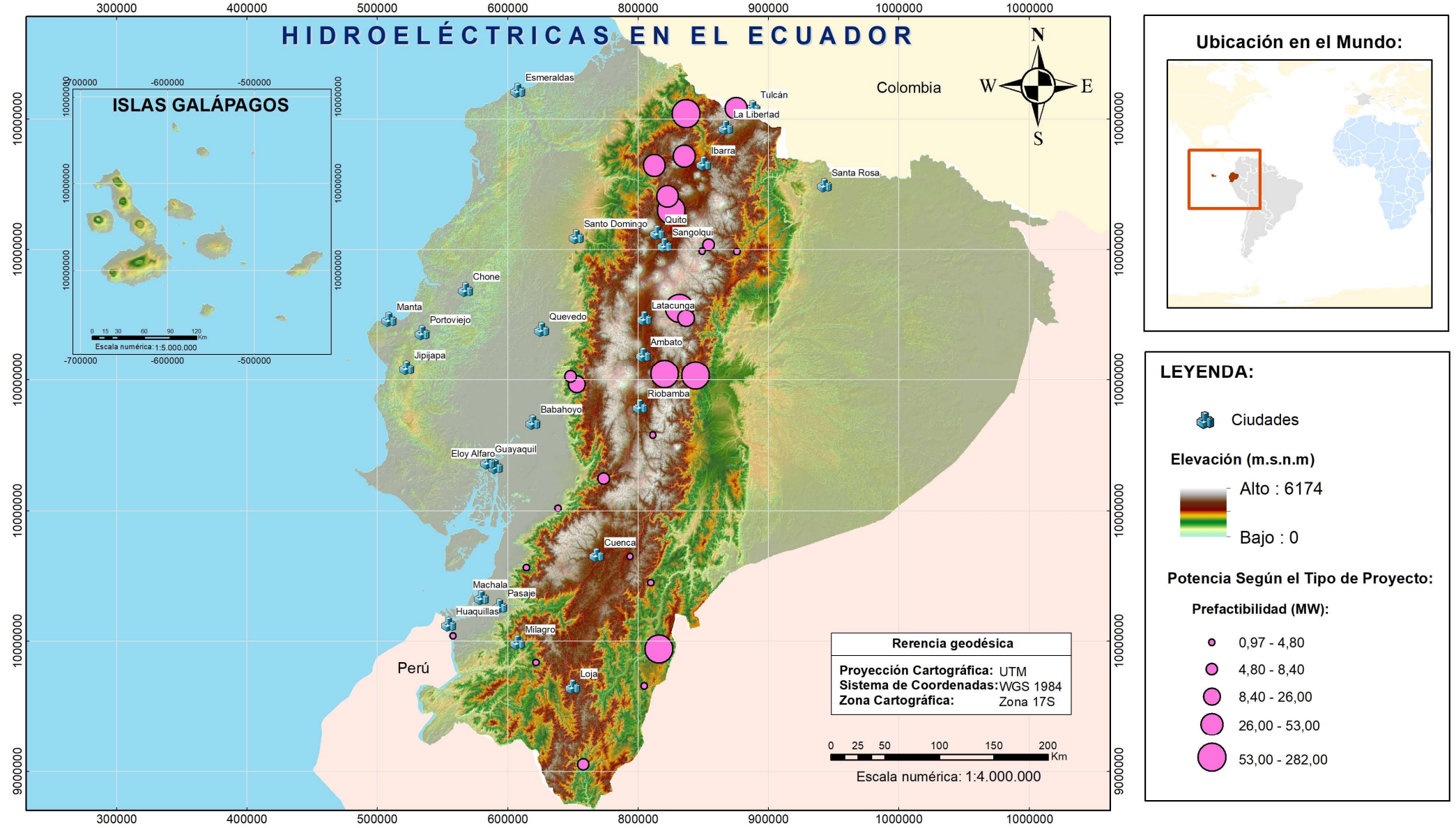
Alto : 6174

Bajo : 0

Potencia Según el Tipo de Proyecto:

Inventario (MW):

- 0,87- 20,00
- 20,00 - 51,30
- 51,30 - 92,20
- 92,20 - 269,80
- 269,80 - 1172,00



Ubicación en el Mundo:

LEYENDA:

Ciudades

Elevación (m.s.n.m)

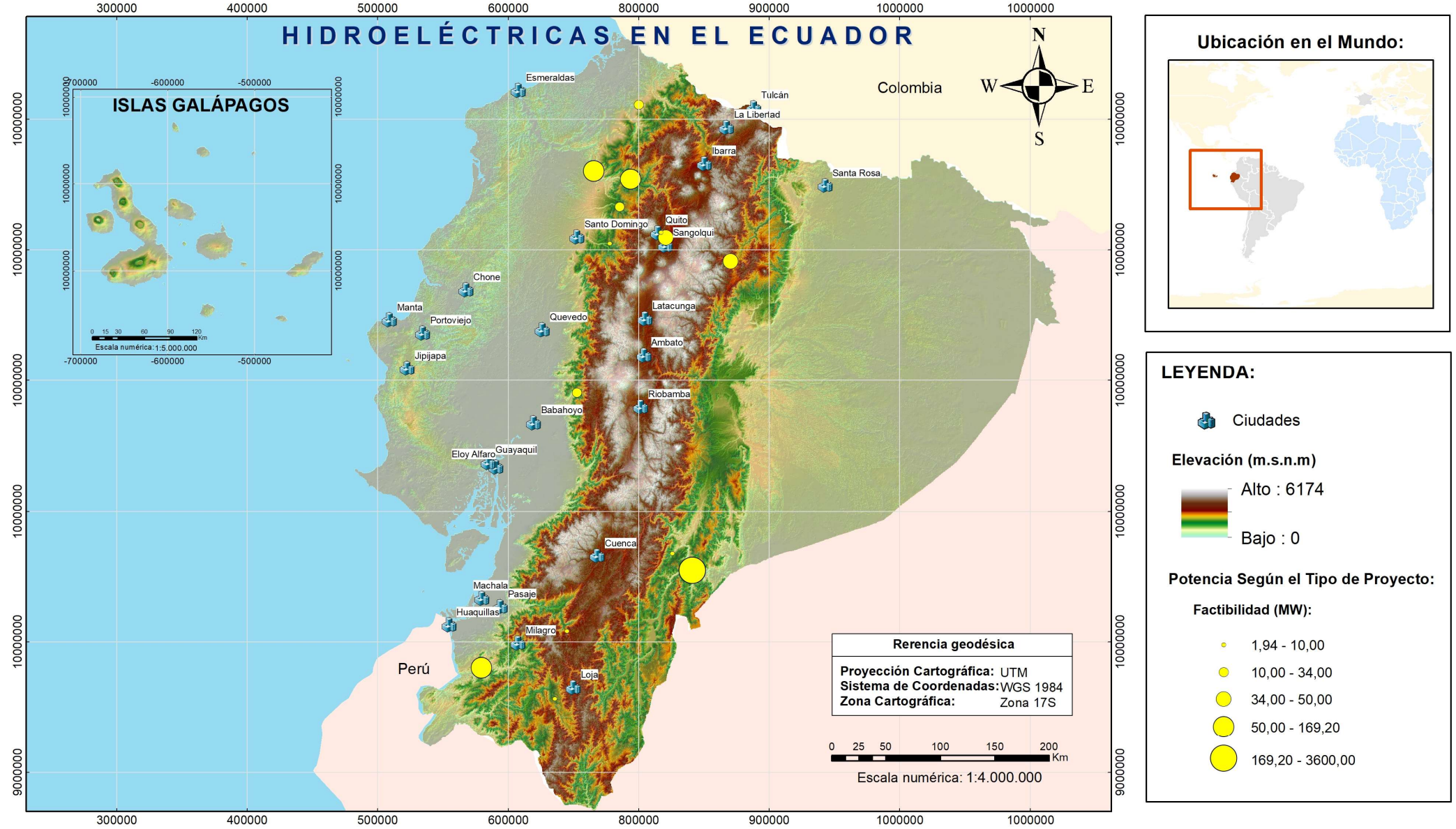
Alto : 6174

Bajo : 0

Potencia Según el Tipo de Proyecto:

Prefactibilidad (MW):

- 0,97 - 4,80
- 4,80 - 8,40
- 8,40 - 26,00
- 26,00 - 53,00
- 53,00 - 282,00



Ubicación en el Mundo:

LEYENDA:

Ciudades

Elevación (m.s.n.m)

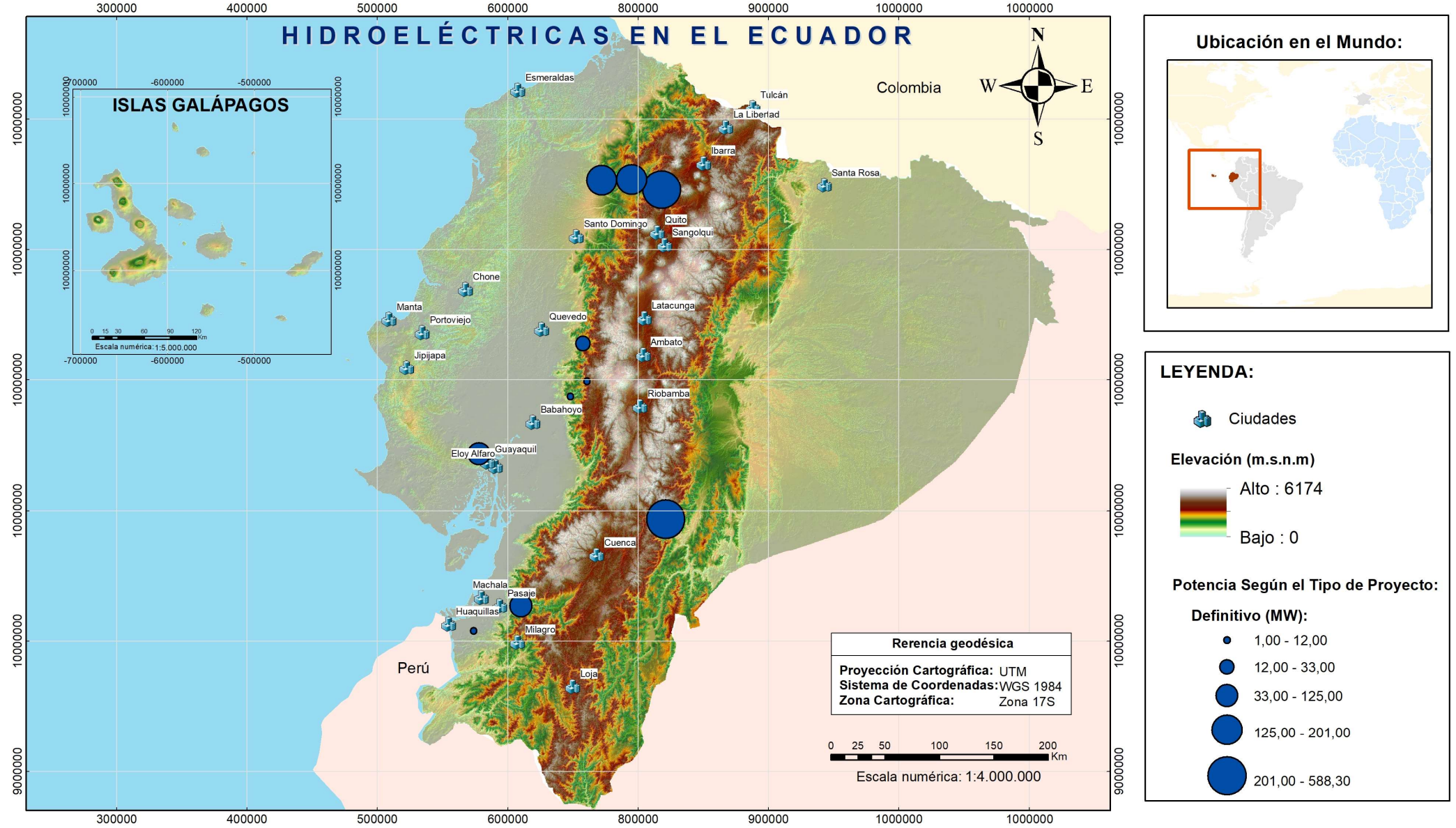
Alto : 6174

Bajo : 0

Potencia Según el Tipo de Proyecto:

Factibilidad (MW):

- 1,94 - 10,00
- 10,00 - 34,00
- 34,00 - 50,00
- 50,00 - 169,20
- 169,20 - 3600,00



Ubicación en el Mundo:

LEYENDA:

Ciudades

Elevación (m.s.n.m)

Alto : 6174

Bajo : 0

Potencia Según el Tipo de Proyecto:

Definitivo (MW):

- 1,00 - 12,00
- 12,00 - 33,00
- 33,00 - 125,00
- 125,00 - 201,00
- 201,00 - 588,30

RELEVANT STAKEHOLDERS

National authorities

MINISTERIO DE ENERGÍA Y RECURSOS NATURALES NO RENOVABLES

CELEC Corporación Eléctrica del Ecuador

GAD´S PROVINCIALES

EMPRESA ELÉCTRICA QUITO S.A.

AGENCIA DE REGULACIÓN Y CONTROL DE ELECTRICIDAD

CORPORACIÓN cenace CENTRO NACIONAL DEL CONTROL DE ENERGÍA

Academics

ESCUELA POLITÉCNICA NACIONAL

UNIVERSIDAD CENTRAL DEL ECUADOR

UNIVERSIDAD DE CUENCA

UNIVERSIDAD POLITÉCNICA SALESIANA ECUADOR

ESCUELA SUPERIOR POLITÉCNICA DEL LITORAL ESPOL

UNIVERSIDAD CATÓLICA DE SANTIAGO DE GUAYAQUIL

CIERHI CENTRO DE INVESTIGACIONES Y ESTUDIOS EN RECURSOS HÍDRICOS

Others

INGECONSULT

DELTA Delfini & Cia., S.A.

Panavial Vías seguras para el desarrollo del Ecuador

Consultant Companies

Industry

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Located in the center-east of Quito, campus Jose Ruben Orellana, área 15.2 Ha.

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CIERHI
CENTRO DE INVESTIGACIONES Y ESTUDIOS EN RECURSOS HÍDRICOS

Water Resources Research Center

- Production, implementation and research of hydraulic phenomena using **physical modeling.**
- Theoretical mechanics and **numerical modeling** of hydraulic phenomena

Hydraulic Research Laboratory.
1965

Science and Technology Programme BID-FUNDACYT.
1992

Water Resource Research Center CIERHI-EPN.
1997

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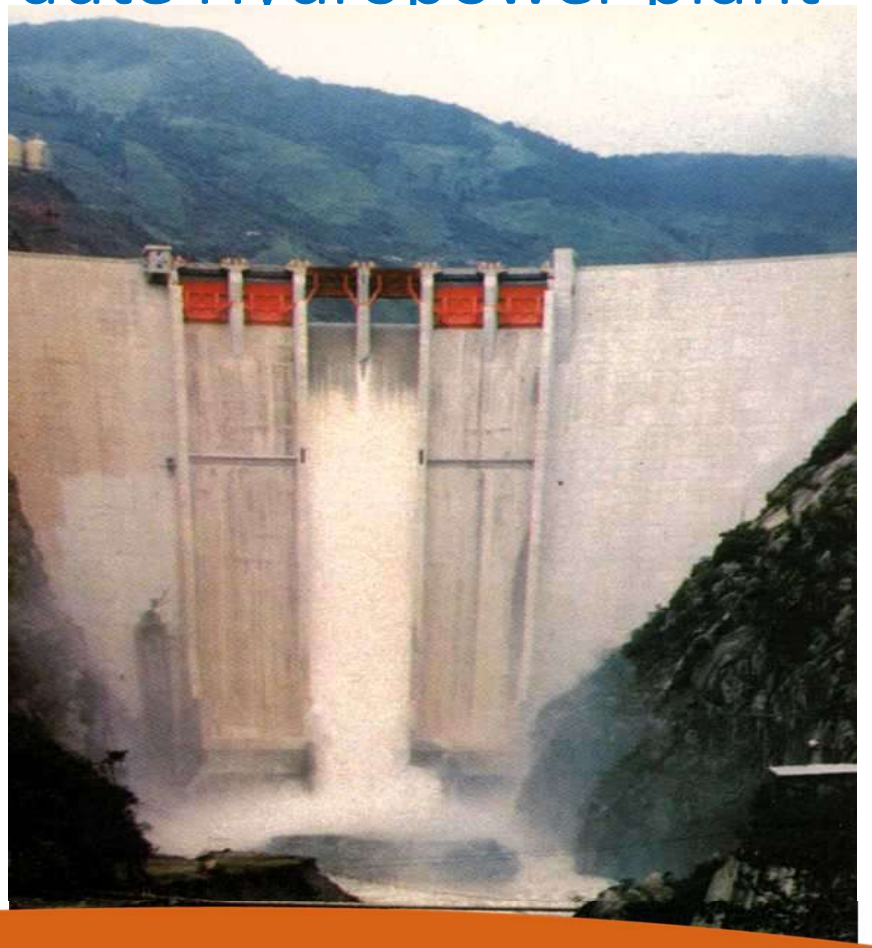
Physical model of a fast discharge with scaled profile 2015-2016

This project has received funding from the Europe
research and innovation programme under grant a

Outlet of Amaluza Dam – Paute Hydropower plant



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Spillway and sediment wash from the dam

Agoyan hydropower plant

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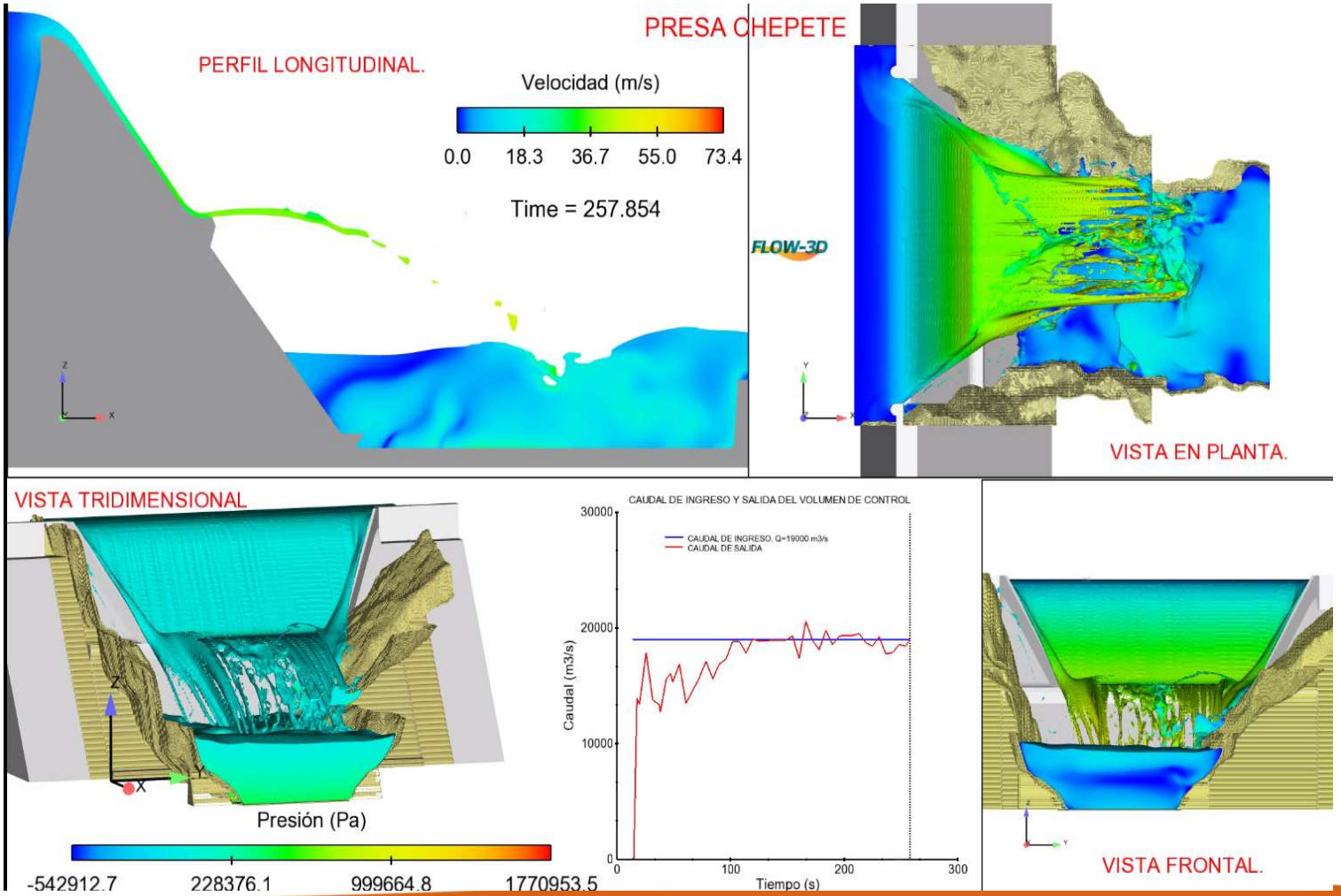
Numerical modelling of Flow in Dam Chepete

2017



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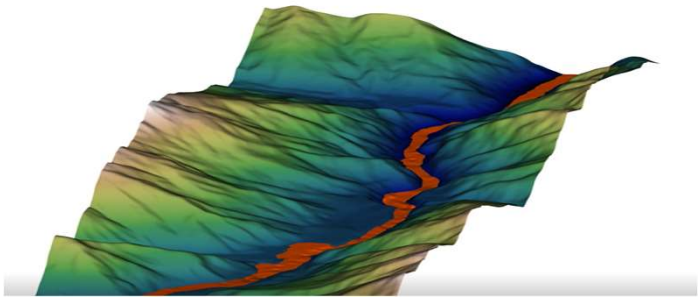
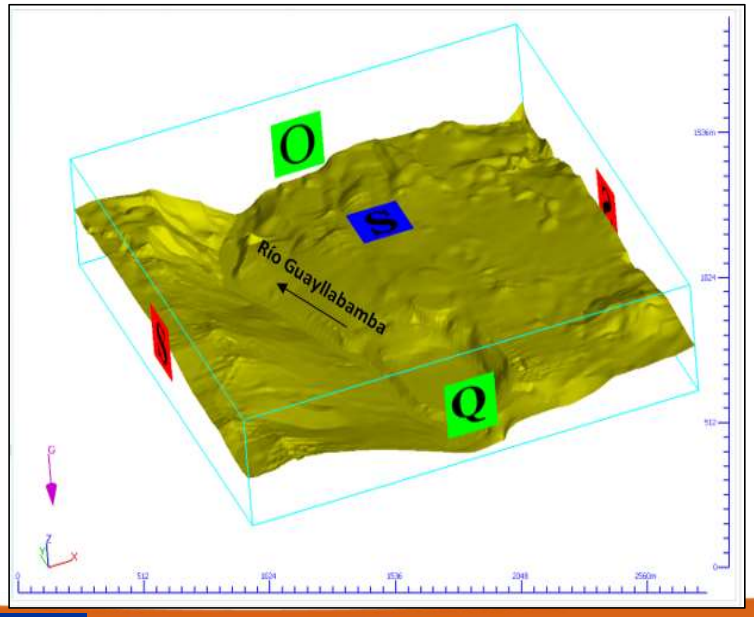
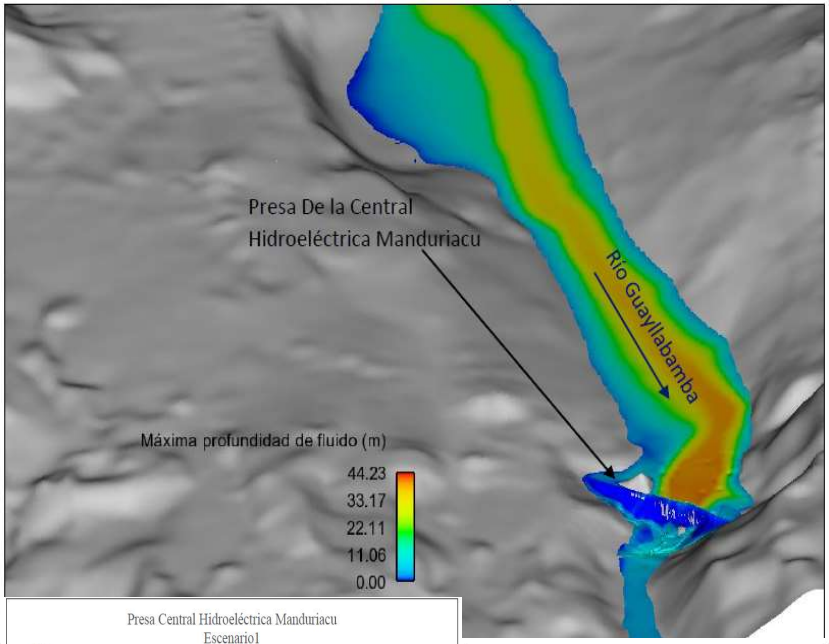
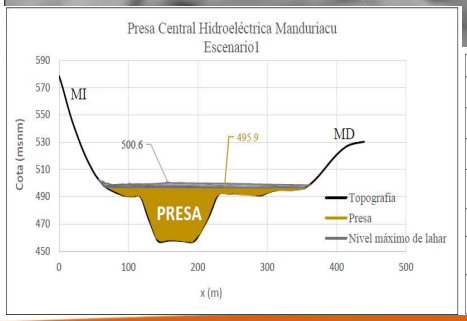
Numerical modelling of the main lahars to the hydropower plants San Francisco and Manduriacu 2017









Presa de La Central Hidroeléctrica Manduriacu	
Caudal pico del hidrograma de ingreso	2,989 m3/s
Volumen de ingreso	24´870,280 m3
Tiempo de llegada del lahar a la presa	6 horas 13 minutos
Tiempo de inicio de desborde sobre la presa (una vez que se llenó el embalse)	6 horas 58 minutos
Tiempo de llenado del Embalse	45 minutos
Velocidad de llegada del lahar a la presa (t = 6 horas 13 minutos)	13.53 (m/s)
Calado máximo de lahar sobre la corona de la presa	5.2 m

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Thank you!

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ESCUELA
POLITECNICA
NACIONAL

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