

# Grids & Datums

## LAO PEOPLE'S DEMOCRATIC REPUBLIC

by Clifford J. Mugnier, C.P., C.M.S.

“Historical research shows that the rudimentary structures of a multi-ethnic state existed before the founding of the Kingdom of Lan Xang in the 13<sup>th</sup> century *A.D.* These pre-13<sup>th</sup> century structures consisted of small confederative communities in river valleys and among the mountain peoples, who found security away from the well-traveled rivers and overland tracks where the institutions and customs of the Laotian people were gradually forged in contact with other peoples of the region. During these centuries, the stirring of migrations as well as religious conflict and syncretism went on more or less continuously. Laos’s short lived vassalage to foreign empires such as the Cham, Khmer, and Sukhothai did nothing to discourage this process of cultural identification and, in fact, favored its shaping. In the thirteenth century ... the rulers of Louangphrabang (Luang Prabang) constituted a large indigenous kingdom with a hierarchical administration. Even then, migratory and religious crosscurrents never really ceased. The durability of the kingdom itself is attested to by the fact that it lasted within its original borders for almost four centuries. Today, the Lao People’s Democratic Republic (Lao PDR, or Laos) covers only a small portion of the territory of that former kingdom (*Library of Congress Country Study*).”

The Lao PDR is landlocked and bordered by Burma (235 km), Cambodia (541 km), China (*PE&RS, May 2000*) (423 km), Thailand (1,754 km), and Vietnam (*PE&RS, May 2002*) (2,130 km). Slightly larger than Utah, its terrain is comprised of mostly rugged mountains with some plains and plateaus; the lowest point is the Mekong River (70 m), and the highest point is Phou Bia (2,817 m). After centuries of gradual decline, the Lao PDR came under the control of Thailand from the late 18<sup>th</sup> century until the late 19<sup>th</sup> century when it became part of French Indochina (*The World Factbook*).

The first mapping of Indochina of any importance was performed by the *Bureau Topographique*, which was set up as a section of the General Staff after the French assumed control of the area in 1886. This organization started triangulation work in Indochina and compiled topographic maps at 1:100,000, 1:200,000, 1:500,000, and 1:1,000,000 scales as well as boundary and river maps. The 1:500,000 series, which was completed in 1899, was the most important of these early maps. The major mapping organizations were the *Service Géographique de l’Indochine – SGI*, the *Institut Géographique National – IGN*, in Paris; and the *Service Cartographique des Forces Terrestres d’Extrême Orient – F.T.E.O.* (Cartographic Service of the Far East Land Forces), (*Foreign Maps, TM 5-248*). France commenced the first substantial geodetic network in Laos in 1902. It took the form of a first-order triangulation network that comprised 47 stations. Although some of these stations were as far apart as 100 km, the average dis-

tance between them was 30 km. Unfortunately, many of the stations were not marked with durable materials. By 1955, approximately 65% of the points had been destroyed. During the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, the British Survey of India (SOI), extended their classical triangulation into neighboring Burma and the French triangulation in the Lao PDR was subsequently connected. A series of regional adjustments then “established” the Indian Datum in Laos.

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As a sidebar, I need to explain the presence of the “Indian Datum” in the Lao PDR. A good personal friend of mine of 30+ years is Dr. Muneendra Kumar, retired Chief Geodesist of the United States National Geo-spatial Intelligence Agency - NGA - (ex-AMS/TO-POCOM/DMA/NIMA). “Muni” tells me that there is no such thing as the “Indian Datum.” There is only a series of piecemeal regional “adjustments” of field observations and there has never (ever!) been a unified classical datum adjustment. Dr. Kumar should know – he retired from the Survey of India before he immigrated to the U.S., and he once personally walked 5,000 km in one year while performing a classical triangulation in Nepal as a junior SOI officer! Therefore, take the moniker “Indian Datum” with various dates with a grain of salt – these flavors only represent local adjustments “cobbled together” to assure a smooth-appearing consistency of various published map series. The legendary “origin” of the Indian Datum as defined in 1900 and labeled as Indian 1916 origin at Kalianpur Hill Station:  $\Phi_0 = 24^{\circ} 07' 11.26''$  N,  $\Lambda_0 = 77^{\circ} 39' 17.57''$  East of Greenwich, the initial azimuth to Surantal from south is:  $a_0 = 190^{\circ} 27' 05.10''$ . The ellipsoid of reference is the Everest 1830 where  $a = 6,377,276.345$  m, and  $1/f = 300.8017$ . John W. Hager tells me that “in 1954, the triangulation of Thailand was adjusted to Indian 1916 based on 10 stations on the Burma border. In 1960, the triangulation of Cambodia and Vietnam was adjusted holding fixed two Cambodian stations connected to the Thailand adjustment of stations from the Cambodian-Vietnam adjustment. North Vietnam was also adjusted to this system but with lower standards.” Note that the Lao PDR was the connecting link.

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Thanks to Andrew Dyson, Jones, Rohde, Lloyd, and Sougnatti in *GPS World, March 1999*, “between 1963 and 1975, AMS produced three series of 1:50,000 scale maps based on the remaining French control network. Most of the associated computations were performed on the Indian Datum of 1960 using the Everest Spheroid (*sic*). Some later maps were produced based on the Indian Datum of 1975. In 1982, in cooperation with the Soviet Union, the Lao National Geographic Department (NGD) initiated a new geodetic survey to provide control for small-scale mapping ... this survey defined a local geodetic datum, referred to as the **Vientiane Datum of 1982.**” The defining parameters are as follows:  $\Phi_0 = 18^\circ 01' 31.6301''$  N,  $\Lambda_0 = 102^\circ 30' 56.6999''$  East of Greenwich, ellipsoid height ( $h_0$ ) = 223.56 m., and the ellipsoid of reference is the Krassovsky 1940 where  $a = 6,378,245$  m, and  $1/f = 298.3$ . the ellipsoidal height was defined as being equal to the mean sea level height for the origin station. The geoid-ellipsoid separation at Vientiane (Nongteng) was therefore zero.

The **Lao Datum 1993** was created following completion of a national GPS survey in cooperation with the Socialist Republic of Vietnam. It is defined as follows: Origin Station is Pakxan (35203) where:  $\Phi_0 = 18^\circ 23' 57.0056''$  N,  $\Lambda_0 = 103^\circ 38' 41.802''$  East of Greenwich, ellipsoid height ( $h_0$ ) = 177.600 m., and the ellipsoid of reference again, is the Krassovsky 1940.

The cobbled series of local adjustments of SOI triangulations for various purposes (as explained to me by Dr. Kumar), have resulted in a number of transformations published by the Laos government involving “Indian Datum of 19XX” such as: **from** “Lao National Datum

1997” to “Indian Datum 1954 (Vientiane Area):  $\Delta X = -168.711 \text{ m} \pm 0.034 \text{ m}$ ,  $\Delta Y = -951.115 \text{ m} \pm 0.034 \text{ m}$ ,  $\Delta Z = -336.164 \text{ m} \pm 0.034 \text{ m}$ . From Lao National Datum 1997 to Indian Datum 1960:  $\Delta X = -153 \text{ m} \pm ? \text{ m}$ ,  $\Delta Y = -1012 \text{ m} \pm ? \text{ m}$ ,  $\Delta Z = -357 \text{ m} \pm ? \text{ m}$ . From Lao National Datum 1997 to Lao Datum 1993:  $\Delta X = +0.652 \text{ m} \pm 0.15 \text{ m}$ ,  $\Delta Y = -1.619 \text{ m} \pm 0.15 \text{ m}$ ,  $\Delta Z = -0.213 \text{ m} \pm 0.15 \text{ m}$ . Finally, from Lao National Datum 1997 to Vientiane Datum 1982:  $\Delta X = +2.227 \text{ m} \pm 0.79 \text{ m}$ ,  $\Delta Y = -6.524 \text{ m} \pm 1.46 \text{ m}$ ,  $\Delta Z = -2.178 \text{ m} \pm 0.79 \text{ m}$ . According to an official government statement, “The parameter generation assumed that Vientiane Datum 1982 spheroidal (*sic*) heights were the same as mean sea level heights in all parts of Laos. As this assumption is incorrect, **extreme caution** (*sic*) should be exercised when interpreting transformed height information.”

Thanks go to Dr. Muneendra Kumar, to John W. Hager and to Malcolm A. B. Jones for their infinite patience explaining these intricacies to me over the decades. Publications of the Australian Government’s Land Titling Project by Mr. Andrew Jones made this a whole lot easier for me to describe in detail.



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