CORRIDORS AND CONNECTIONS: RECONSTRUCTING POTENTIAL HOMININ MIGRATION ROUTES IN ISLAND SOUTHEAST ASIA

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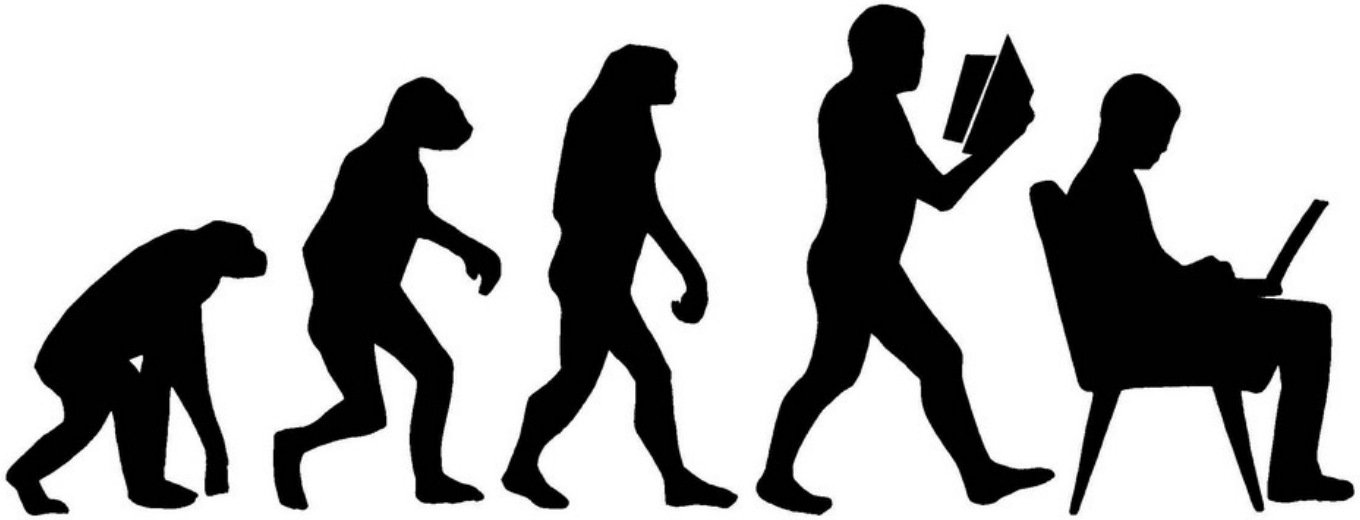
MGIS
Capstone Proposal

Problem Statement

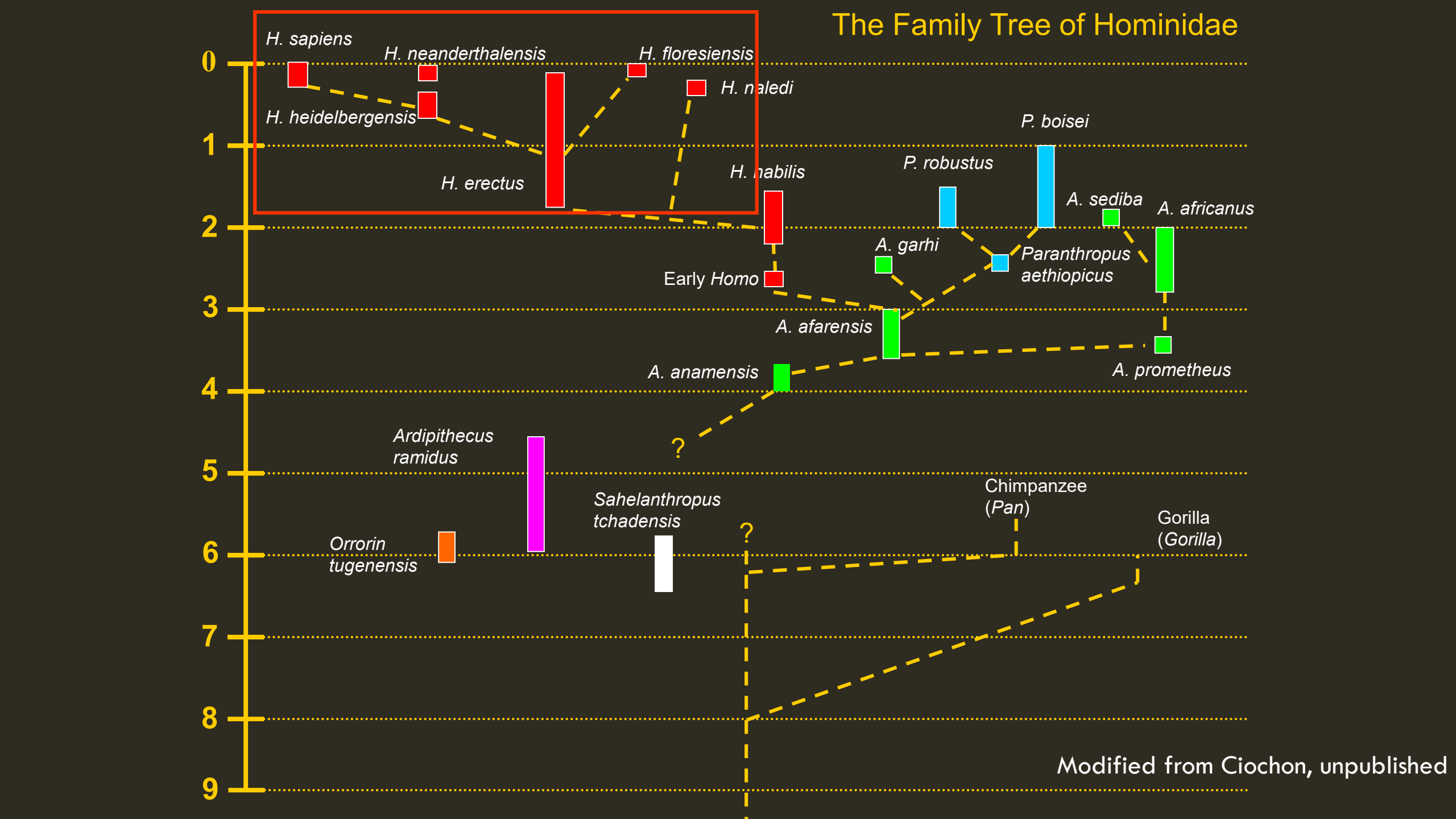
Previous studies of hominin migration routes did not include Early and Middle Pleistocene Island Southeast Asia (ISEA). This research will determine potential migration routes in ISEA to determine how hominins arrived on islands in ISEA and determine when these migration routes would have been open.



- Members of the Hominini tribe in the Primate order
- Modern humans and close fossil relatives

WHAT IS A HOMININ?

https://www.interaction-design.org/literature/article/social-evolution-and-why-we-need-to-communicate


The Family Tree of Hominidae
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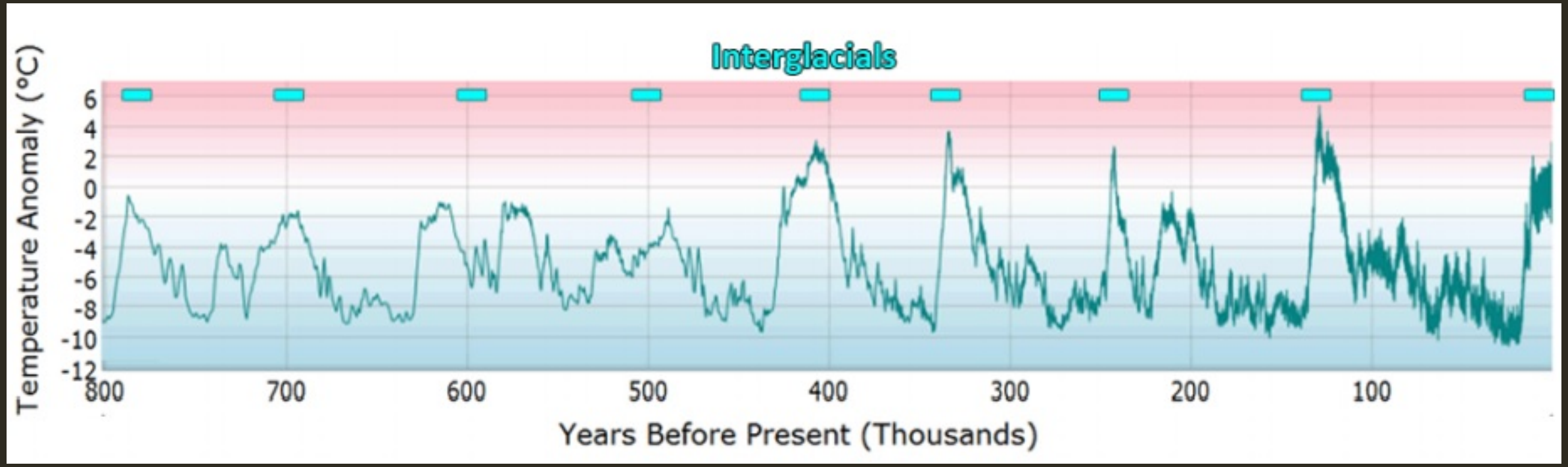
H. sapiens
H. neanderthalensis
H. floresiensis
H. naledi
H. heidelbergensis
H. erectus
H. habilis
P. boisei
P. robustus
A. sediba
A. africanus
A. garhi
Paranthropus aethiopicus
Early Homo
A. afarensis
A. anamensis
A. prometheus
?
Ardipithecus ramidus
Sahelanthropus tchadensis
Orrorin tugenensis
?
Chimpanzee (Pan)
Gorilla (Gorilla)
Modified from Ciochon, unpublished

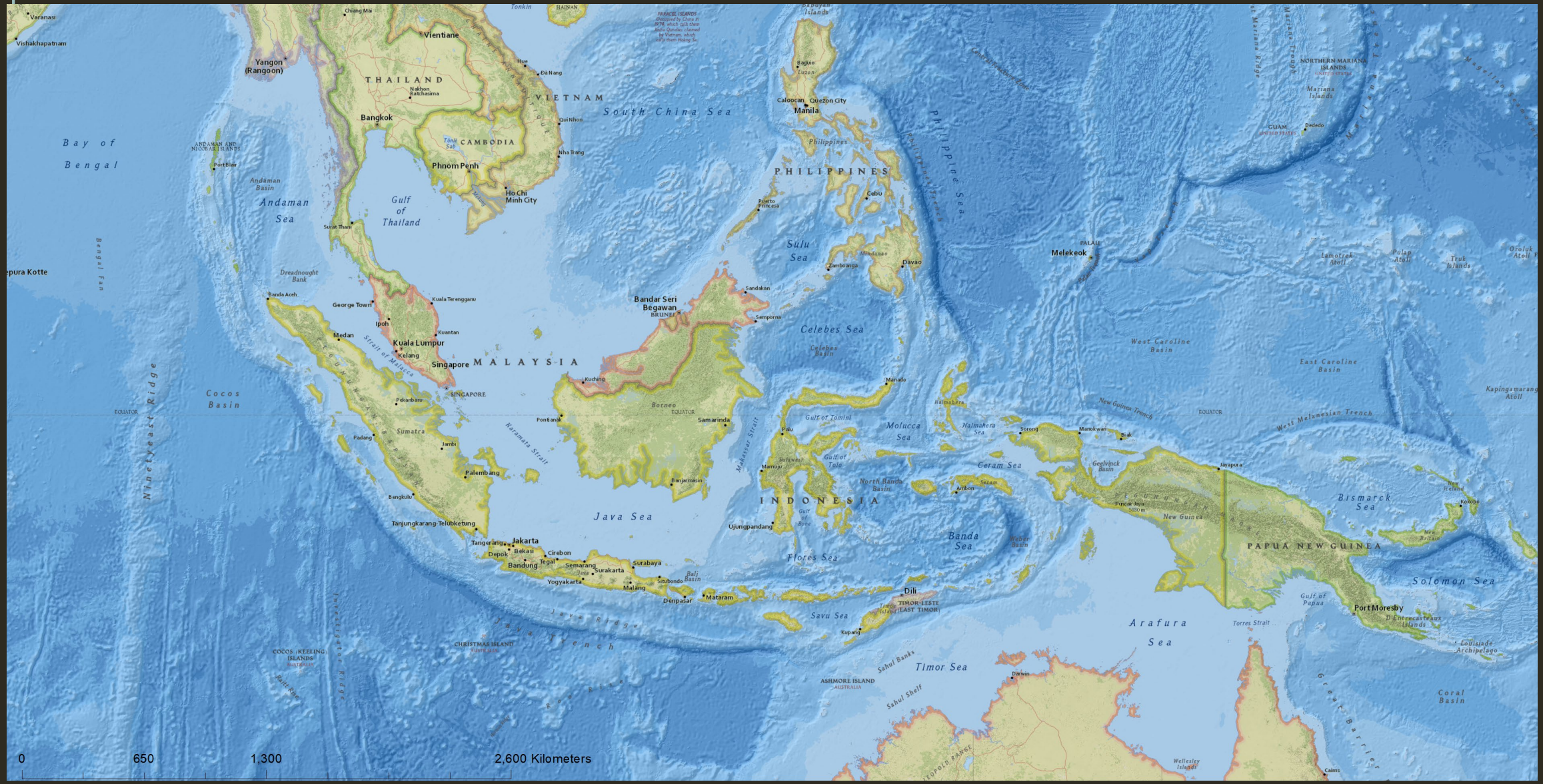
Pleistocene

- 2.580 mya to 11.7 kya
- Characterized by repeated glacial and interglacial cycles

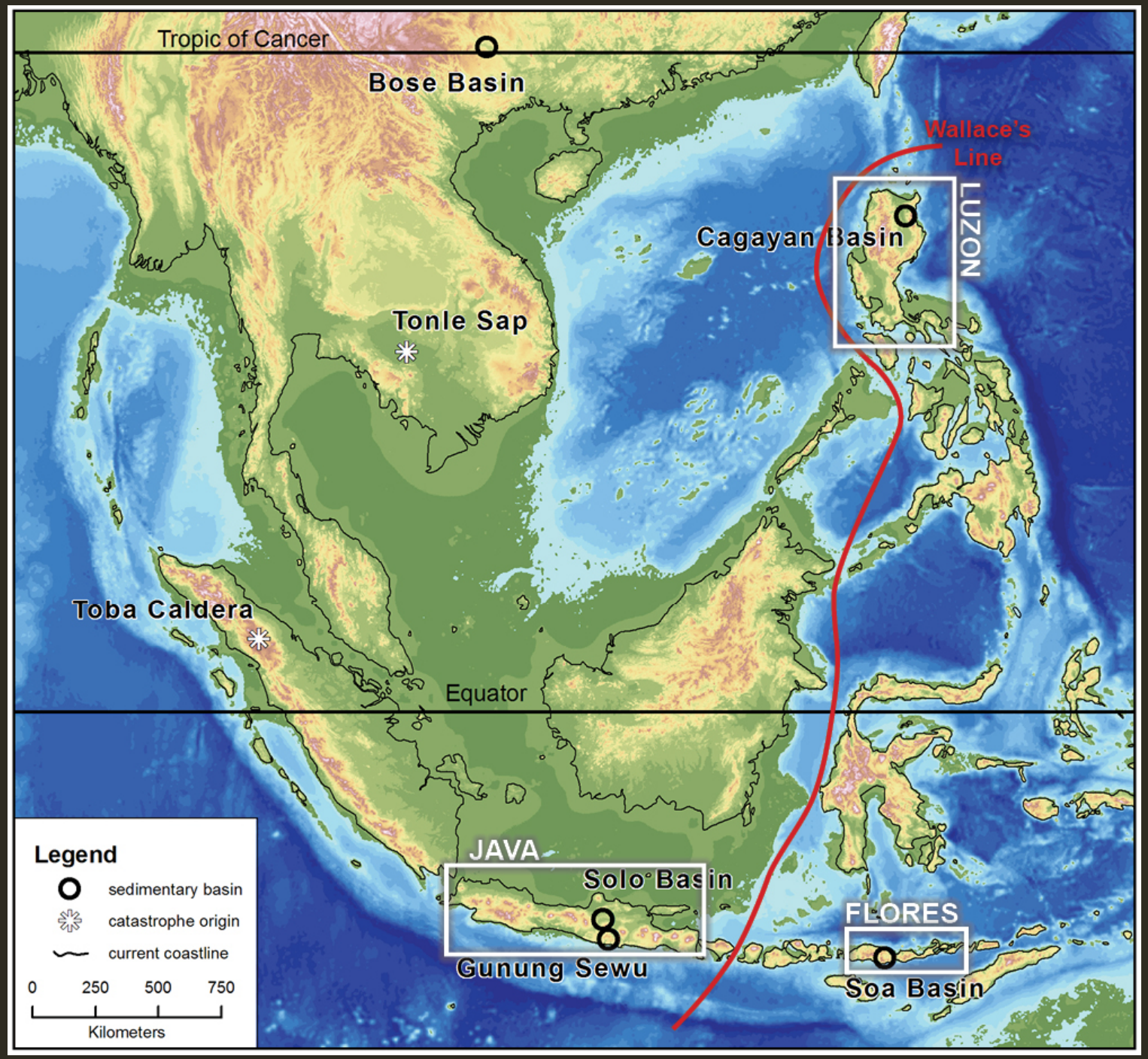


NASA, http://www.ces.fau.edu/nasa/impacts/warming-planet/index.php

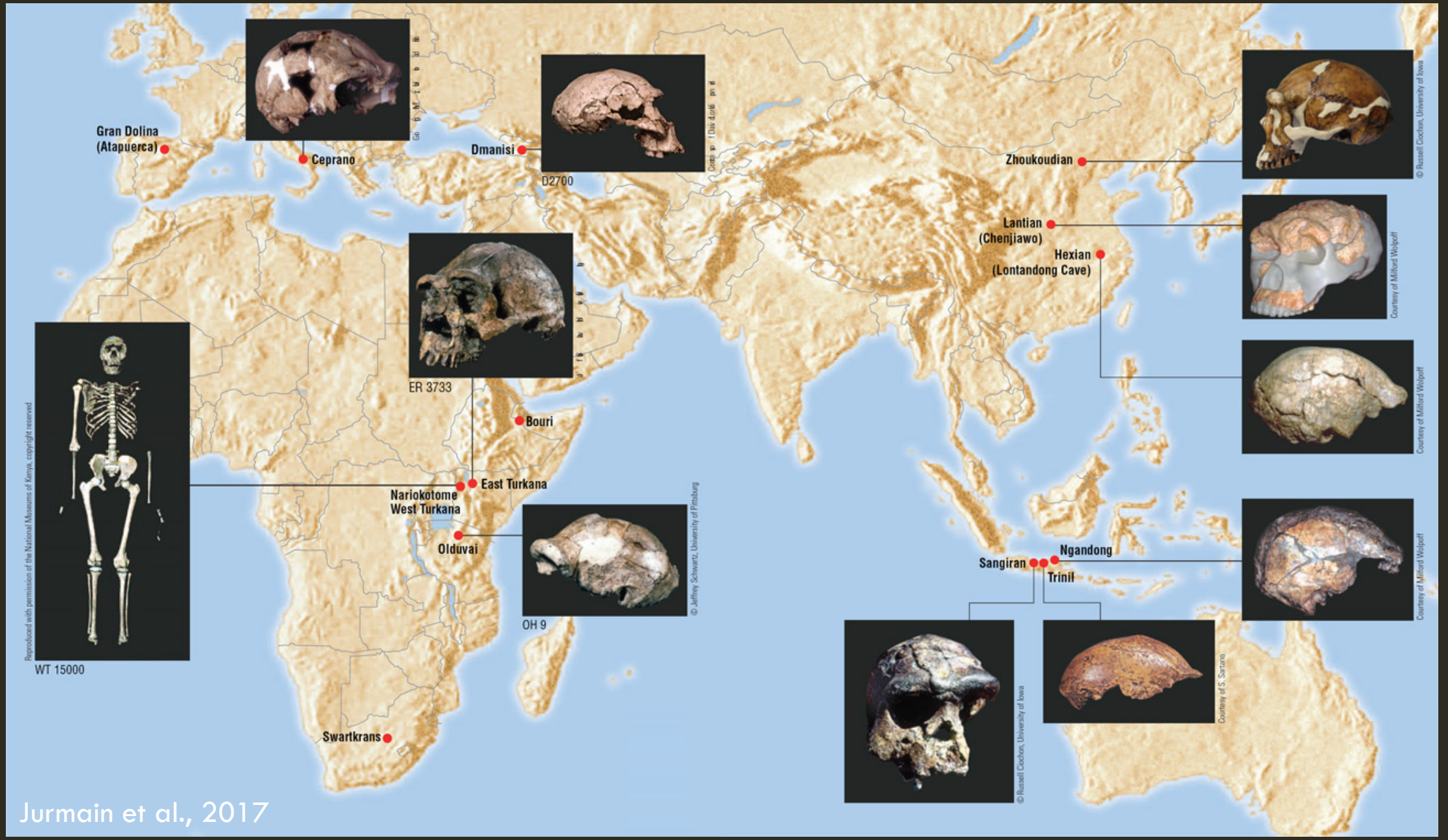
Island Southeast Asia



Last Glacial Maximum Coastlines and Key Hominin Sites



Map by Angelia Collins, UI-OSA



Geographic distribution of *Homo erectus* fossils

American Museum of Natural History

Homo erectus

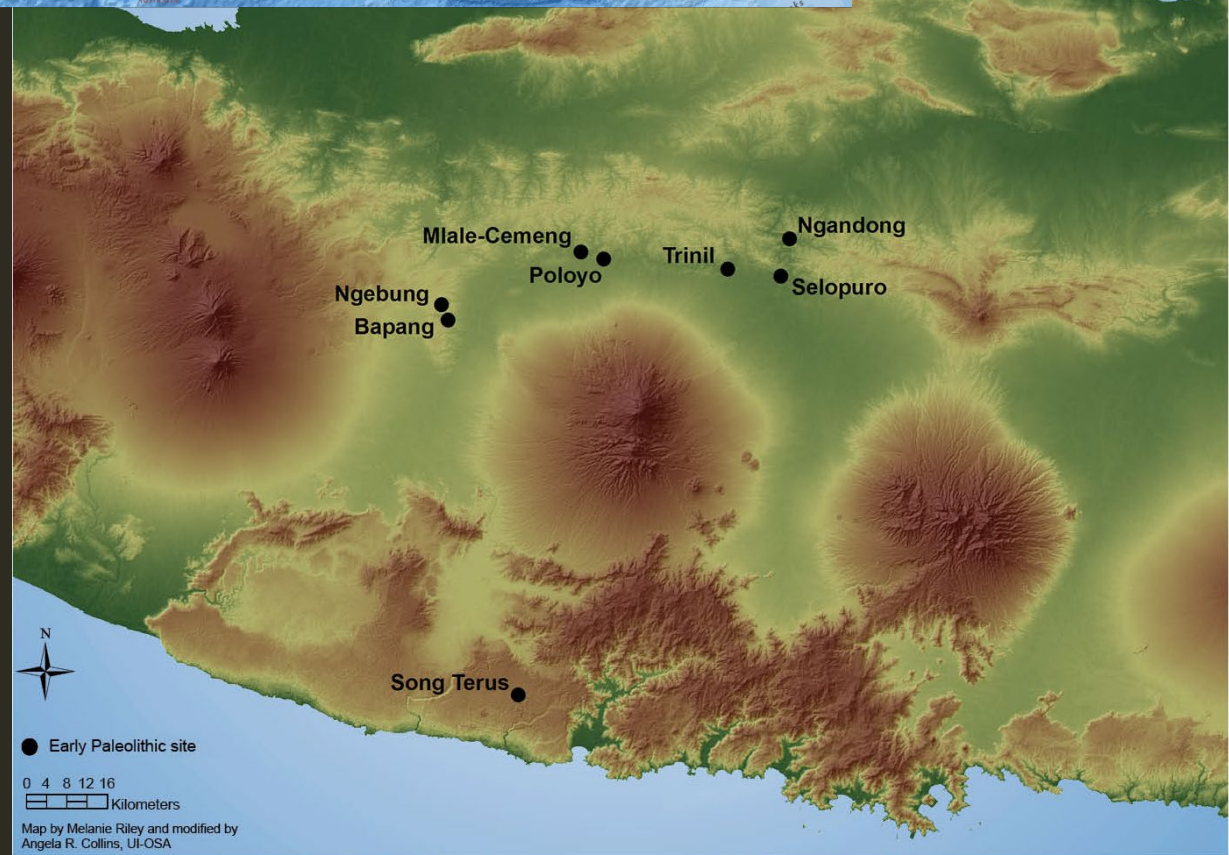
- Distinctive cranial features
- Smaller cranial capacity (brains) than modern humans
- Primitive stone tools
- Lower limbs indicating the ability for long-distance travel

Homo erectus sites on Java

Bapang: 1.51 mya

Trinil: 540-430 kya

Ngandong: ~130 kya

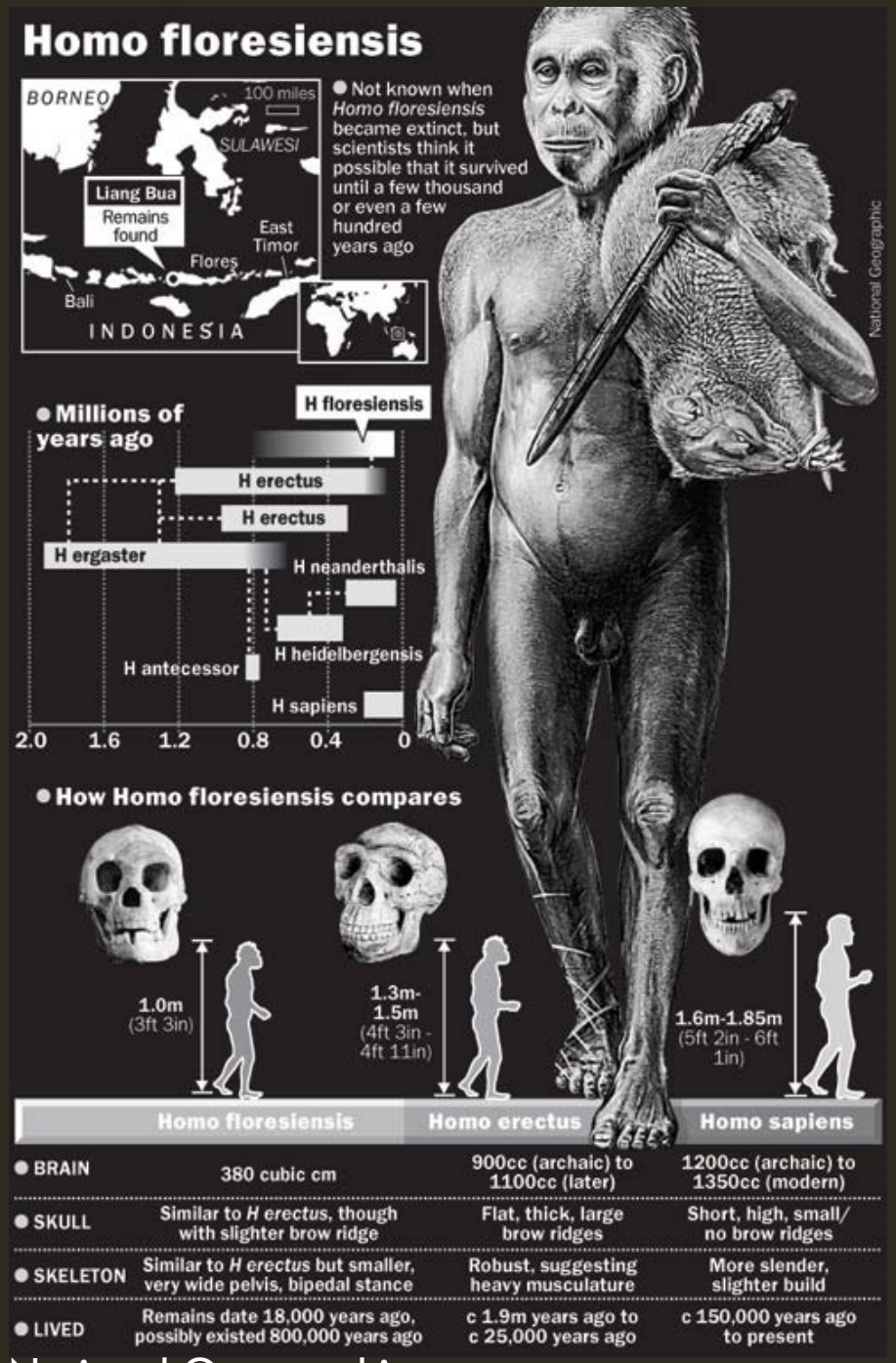


Dated hominin sites on Flores

- Mata Menge: Stone tools and hominin jaw and teeth dated to ~700 kya
- Liang Bua: *Homo floresiensis site* dated to 100 kya – 60 kya

Homo floresiensis

- Discovered in 2004
- Shares many cranial features with *Homo erectus*
- Tiny cranial capacity
- Small body (1 m)
- Proposed insular dwarf of *Homo erectus*



National Geographic

Homo erectus

Ciochon

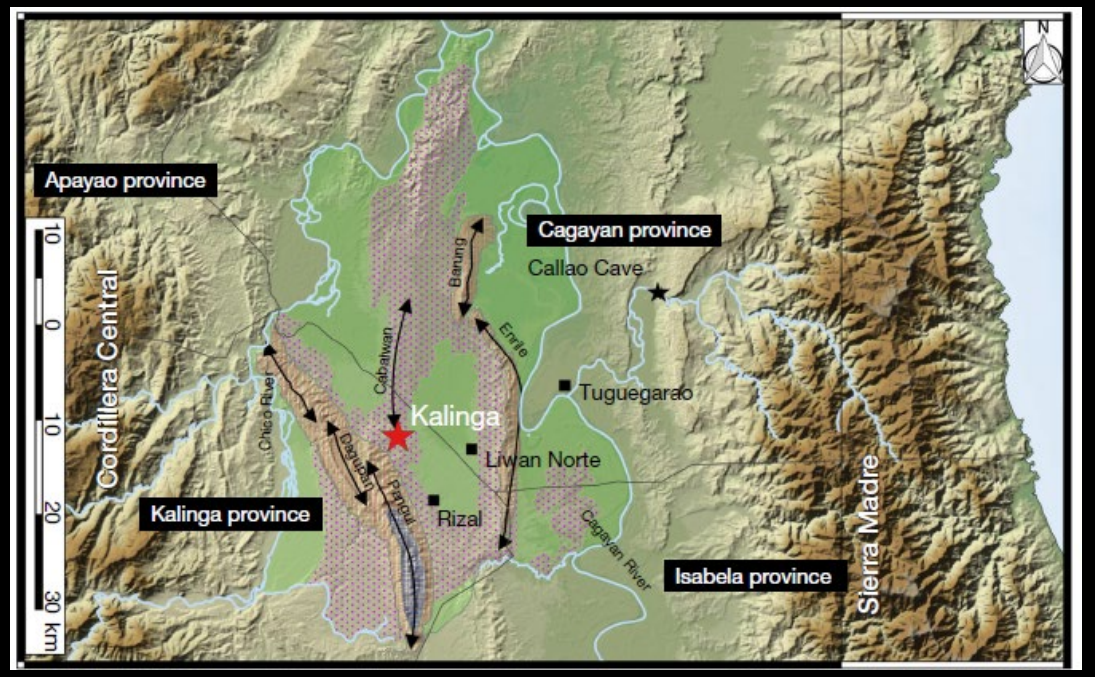
Homo floresiensis

Brown et al., *Nature* (2004)

Earliest evidence of hominins on Luzon

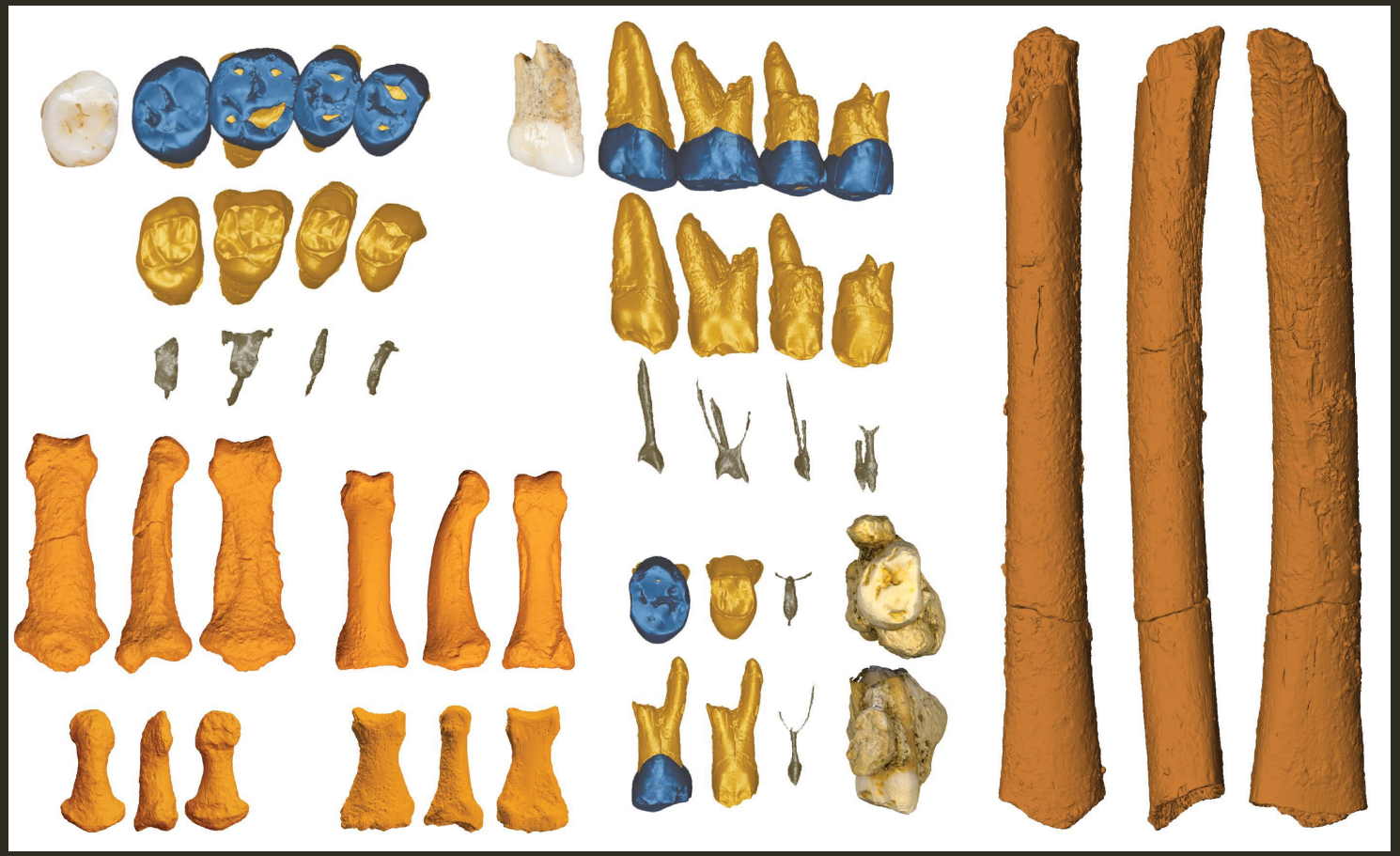
Kalinga, 709 kya

- 57 stone tools
- Disarticulated rhino cut marks and evidence of butchering dated



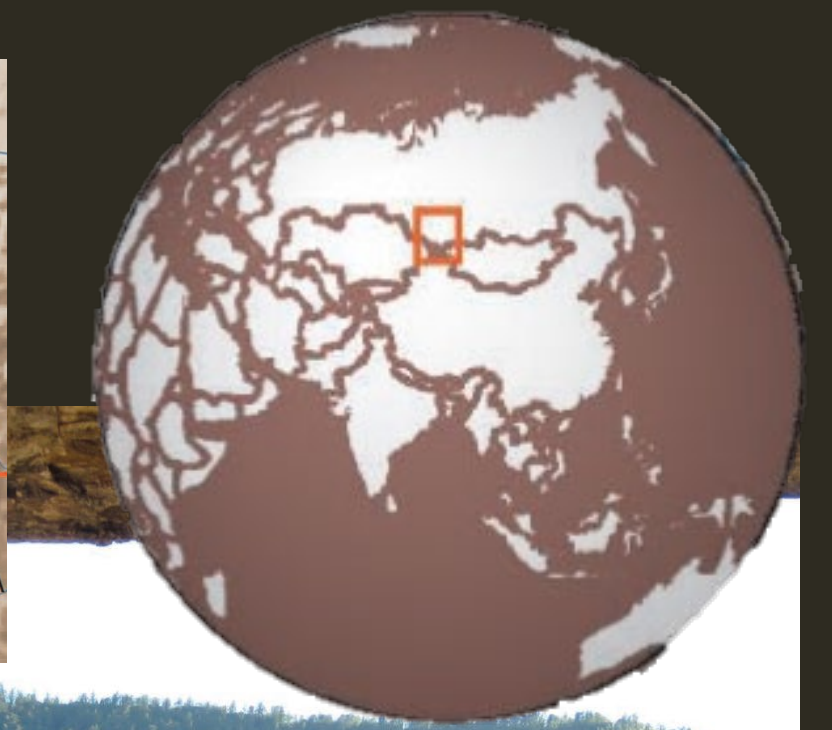
Ingicco et al., *Nature* (2018)

Homo luzonensis



Détroit et al., *Nature* (2019)

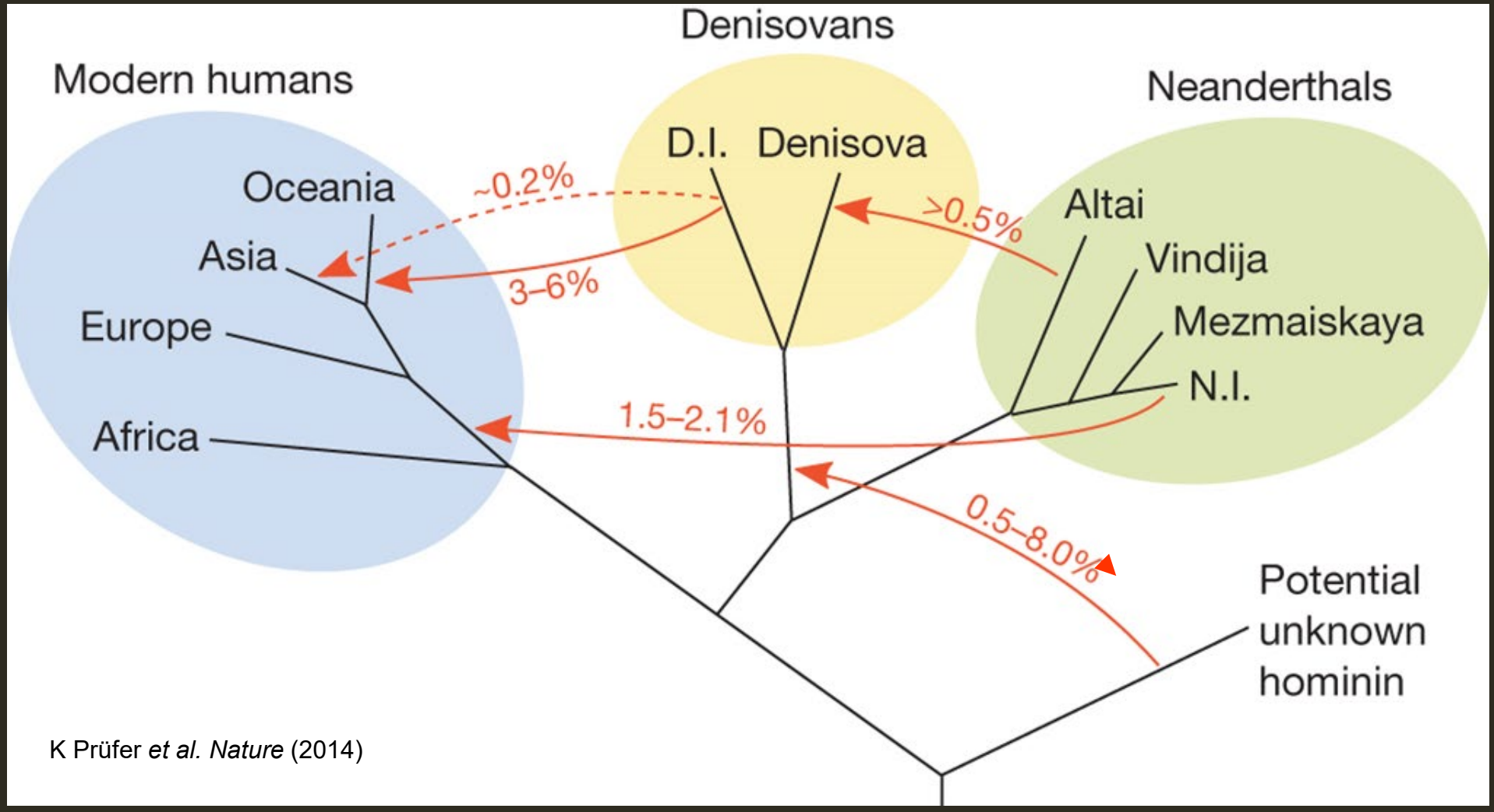
- Published in April 2019
- Fossils are dated to 67 kya
- Lack cranial bones
- Most similar to *H. erectus* and *H. floresiensis*
- Small size of teeth indicates possible insular dwarf



- Defined by genetics instead of fossils
- Ancient DNA from Denisova Cave
- Introgressive DNA from Neanderthal fossils
- Introgressive DNA from modern humans
- Possibly entered ISEA between ~363 kya and ~283 kya

Gibbons, *Science* (2011)

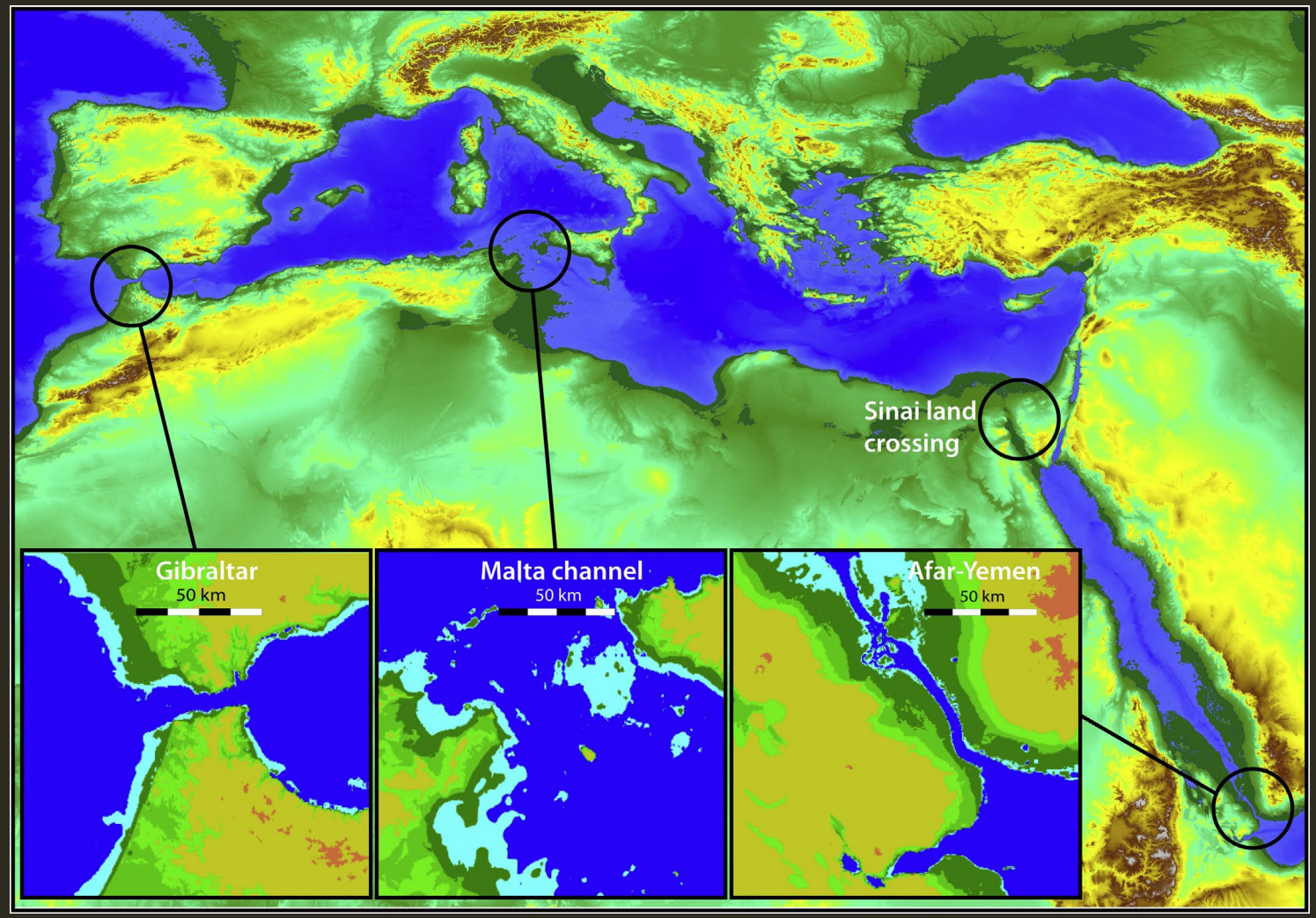
Model of gene flow events in the Pleistocene



K Prüfer *et al. Nature* (2014)

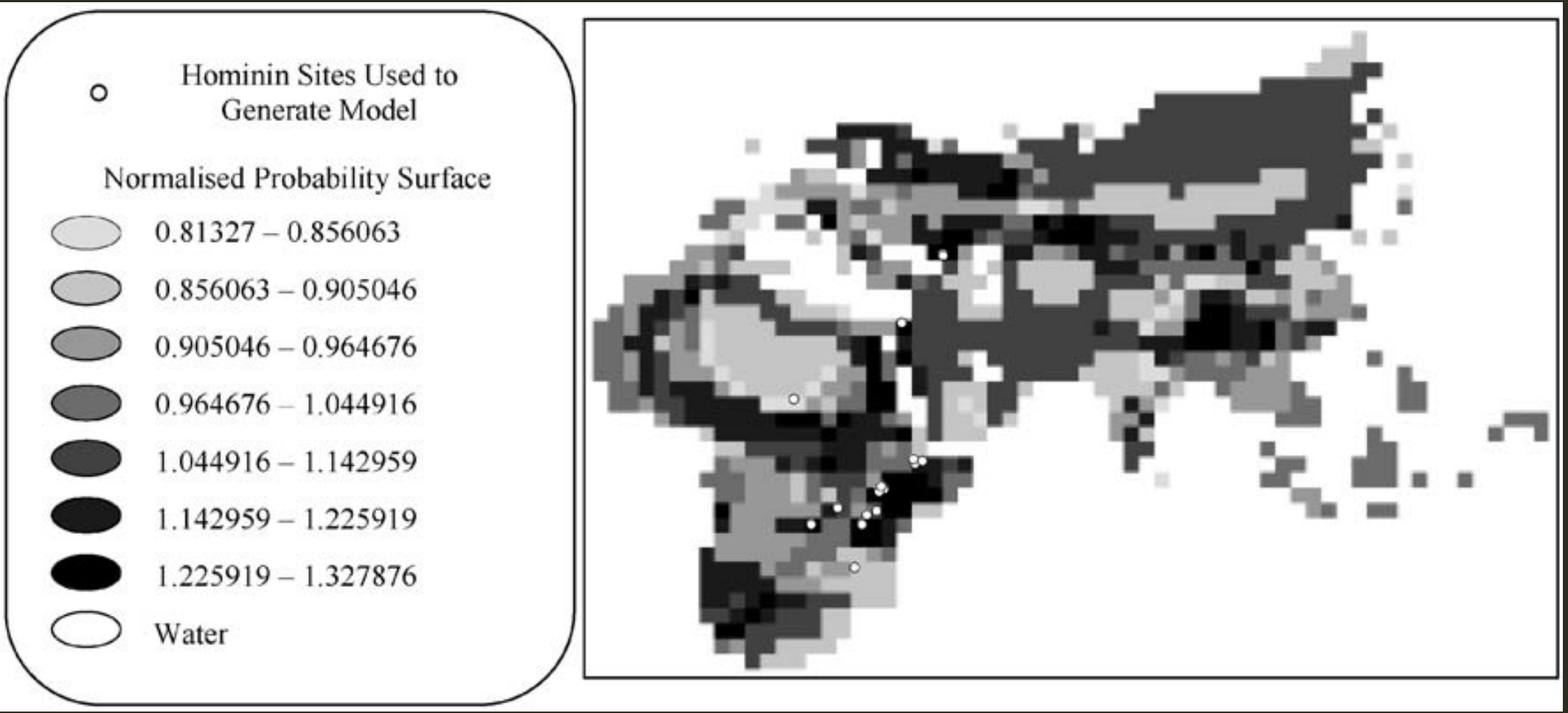
Previous hominin migration studies using GIS

GIS Model hominin migration out of Africa



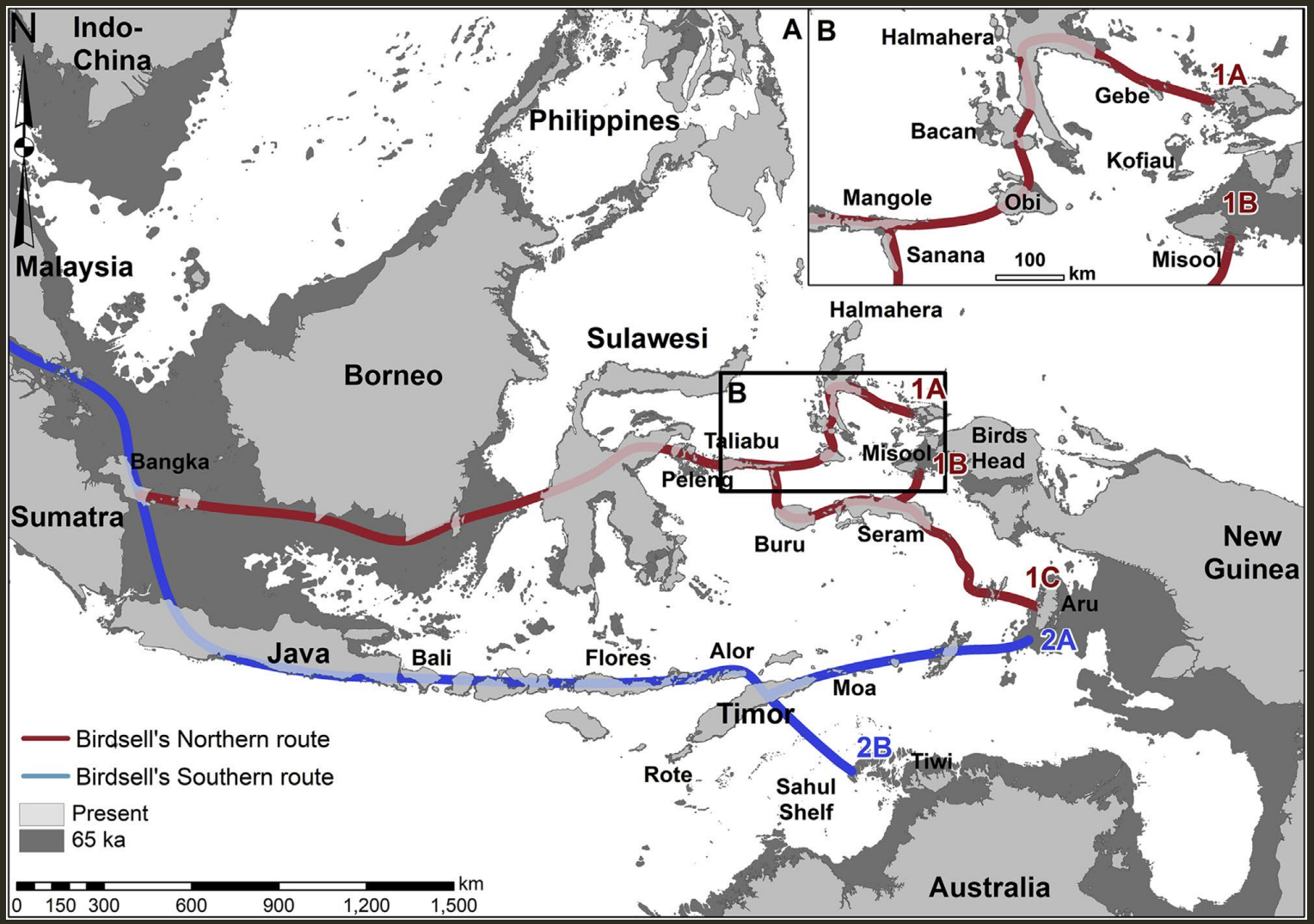
Winder et al. Journal of Human Evolution (2015)

Hominin expansion across Eurasia



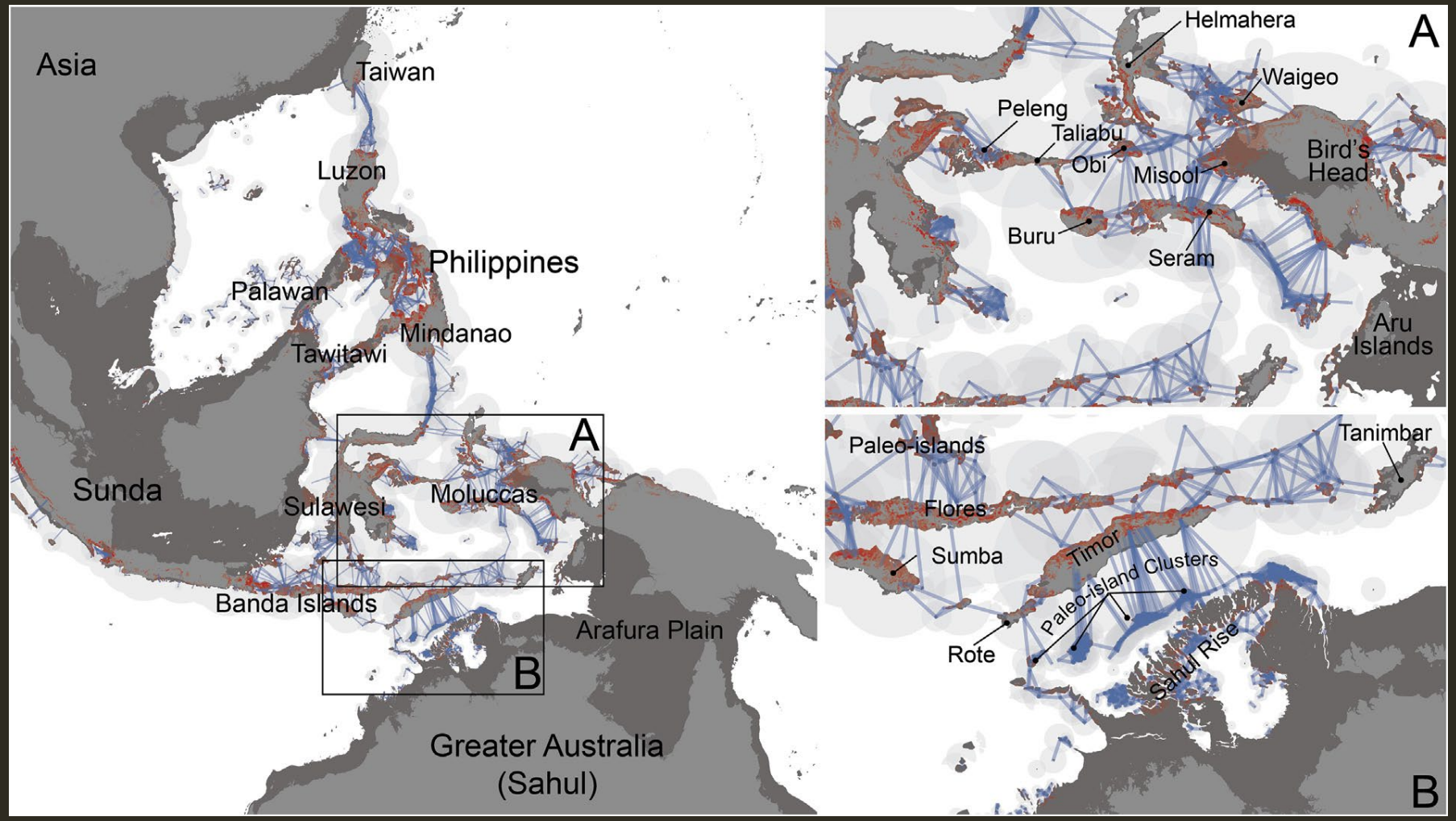
Holmes, Palaeogeography, Palaeoclimatology, Palaeoecology (2007)

Modern Human migration routes in ISEA



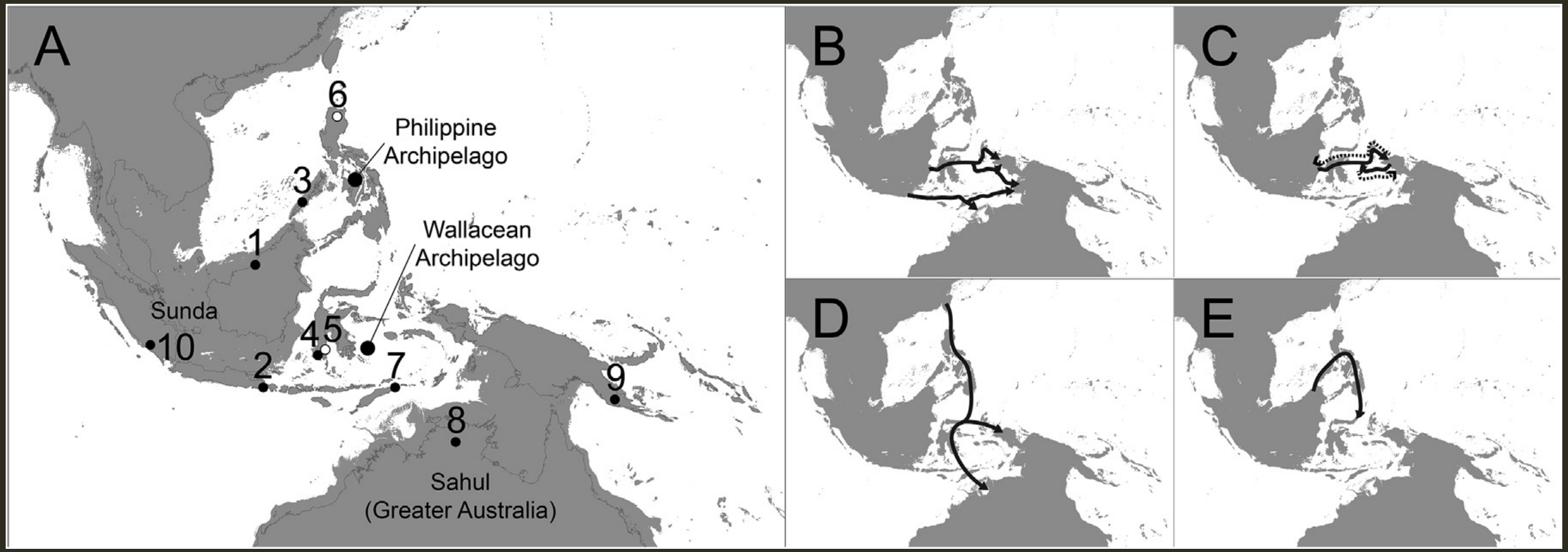
Kealy et al. *Journal of Human Evolution* (2018)

ABM Modern human migration routes



Norman et al. Quaternary Science Reviews (2018)

Other Proposed Migration Routes in ISEA



Norman et al. Quaternary Science Reviews (2018)

Problem Statement

Previous studies of hominin migration routes did not include Early and Middle Pleistocene Island Southeast Asia (ISEA). This research will determine potential migration routes in ISEA to determine how hominins arrived on islands in ISEA and determine when these migration routes would have been open.

Capstone Goals

- Determine when potential dispersal corridors for hominin migration where open between 800 kya and 100 kya for pre-modern human migration between islands in ISEA.
- Determine which dispersal corridors were more likely between 800 and 700 kya, for initial settlement of Flores and Luzon, as well as 360 kya to 280 kya for potential Denisovan sites.

Variables and Data Sources

- Bathymetry: General Bathymetric Chart of the Oceans (GEBCO) (https://www.gebco.net/).
- Sea level curve and uplift rates: The relative sea level curve and uplift rate will come from published sources such as Spratt and Lisiecki (2016) and Kealy et al. (2017).
- Elevation and inter-island visibility: USGS Earth Explorer (https://earthexplorer.usgs.gov/). Inter-land visibility is the ability to see an island from the neighboring island. This will be calculated in ArcGIS following the method used in Norman et al. (2018).
- Environmental reconstructions: Global paleoclimate reconstructions, such as IPCC (https://www.ipcc.ch/), WorldClim (www.worldclim.org), and PaleoClim (http://www.paleoclim.org/) (Brown et al., 2018) and published regional reconstructions such as Bird et al. (2005, 2007), Van der Kaars (1998), Whitten et al. (1996).

Methods

- Combine the bathymetric data with a relative sea level curve and uplift rates to determine the landmass extent and paleo-coastlines
- Determine inter-island visibility in ArcGIS
- Compare global paleoclimate reconstructions with published regional reconstructions such as Bird et al. (2005, 2007), Van der Kaars (1998), Whitten et al. (1996) to determine which models are most accurate in ISEA.
- Calculated least-cost pathways to reduce water crossings, increase inter-island visibility, and reduced total distance with Flores and Luzon as end points and starting points on Java and mainland Asia.

Anticipated Results

- Java is the most likely source for migration paths to both Flores and Luzon. While still controversial, the most parsimonious explanation for the origin for *Homo floresiensis* involves *Homo erectus* migrating along the southern islands to Flores where it underwent insular dwarfing. The origin of *Homo luzonensis* is unknown, but a similar decent from *Homo erectus* is possible.
- There is evidence that hominins were on Sulawesi prior to 200 kya which coincides with a potential ISEA Denisovan population.

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