

A Longitudinal Evaluation of Heart Rate Efficiency for Amateur Runners

Evgeny V. Votyakov, Marios Constantinides, Fotis Liarokapis







POLAR

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WHICH ONE?!

HRE – Heart Rate Efficiency

Heart Rate \times Pace (beats/km)

Why HR and Pace (and not HRV, VO_2)?

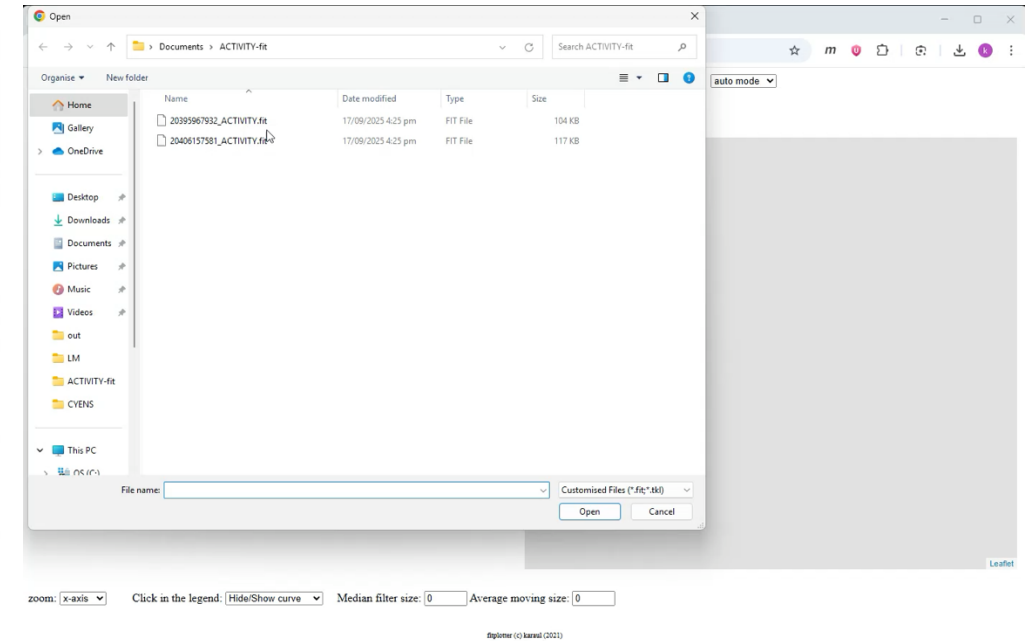
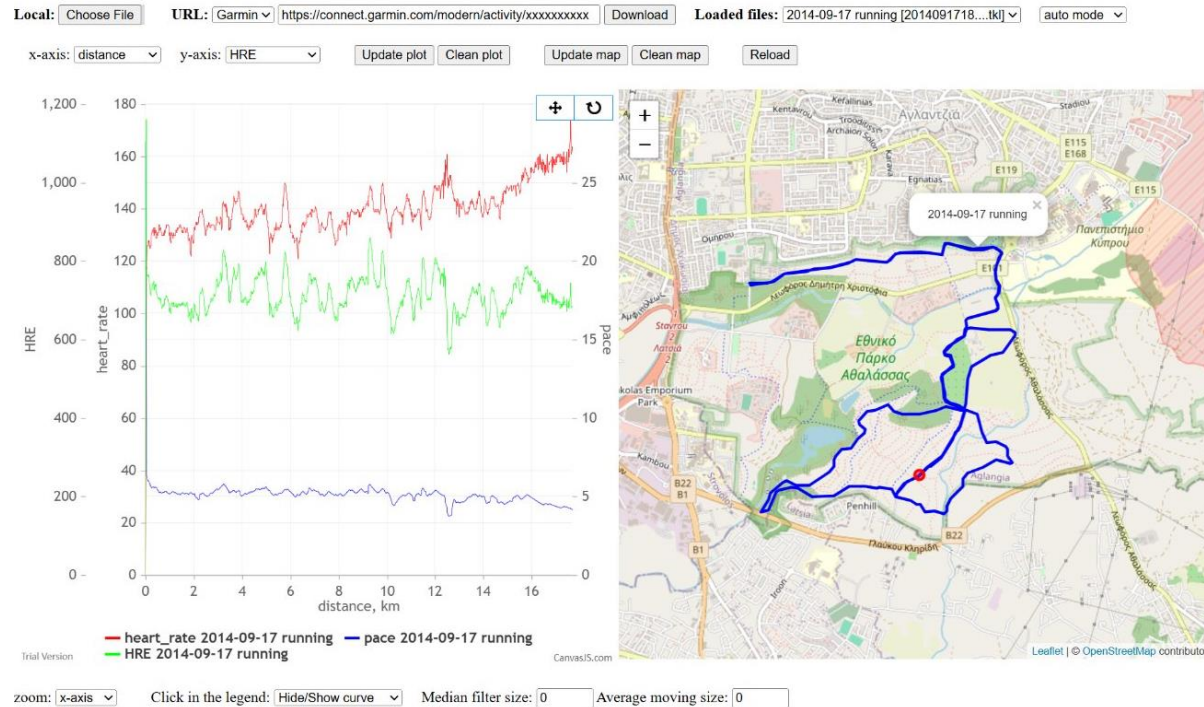
- HRV: better for stress recovery but not for running progress
- VO_2 max / lactate threshold / running economy: accurate but need lab tests and not so practical for amateurs
- Proprietary platform scores: black-box, opaque, inconsistent
- HR + Pace: accessible to everyone, explainable, efficient

Datasets

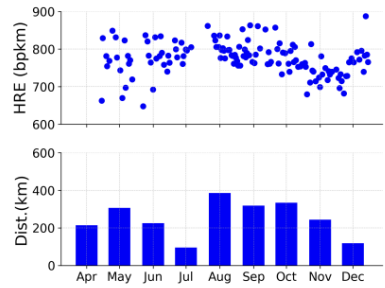
- **Athlete A:** 14 years of self-tracking (~4,000 runs)
 - HR, pace, distance, elevation, event type (marathon, ultra, trail, triathlon)
- **Public runners:** 12 anonymized logs (hundreds of sessions each) from *RunningAhead* community challenges
- **Marathon case studies:** 16 event records (recreational + semi-pro) from *Strava* event aggregations
- **Ethics:** all public / consented, anonymized



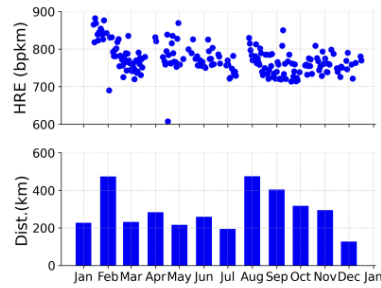
FitPlotter



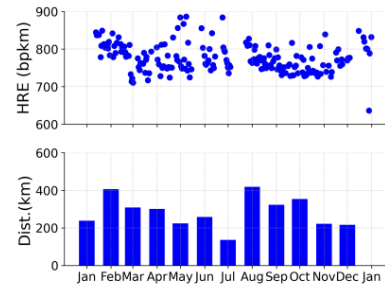
Results: Longitudinal Story (Athlete A)



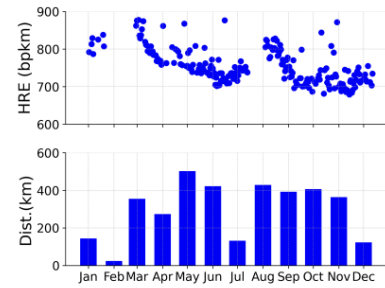
(a) 2011



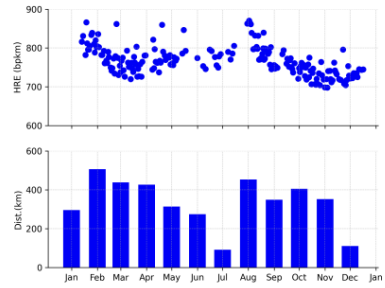
(b) 2012



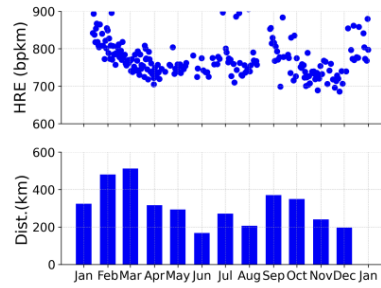
(c) 2013



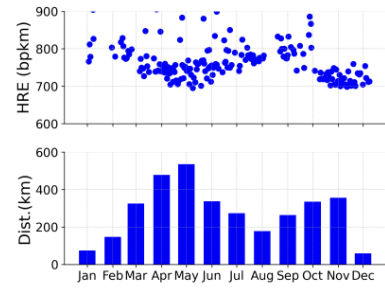
(d) 2014



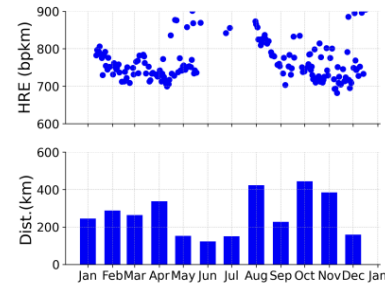
(e) 2015



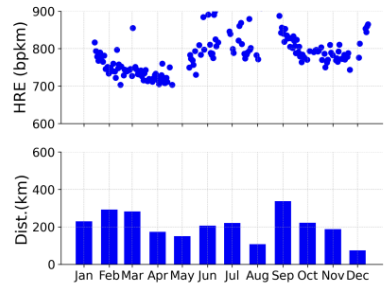
(f) 2016



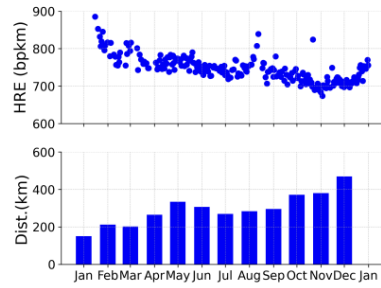
(g) 2017



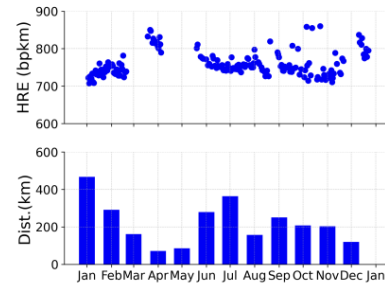
(h) 2018



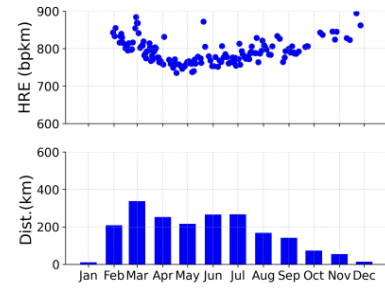
(i) 2019



(j) 2020

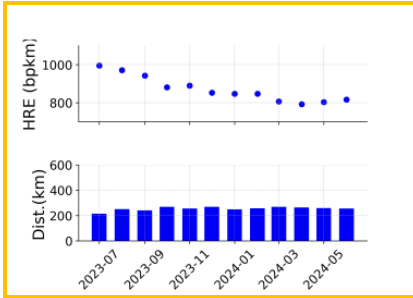


(k) 2021

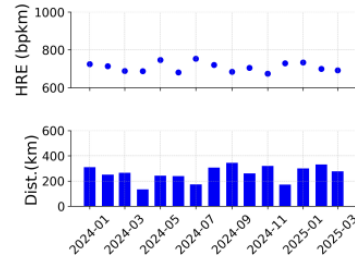


(1) 2022

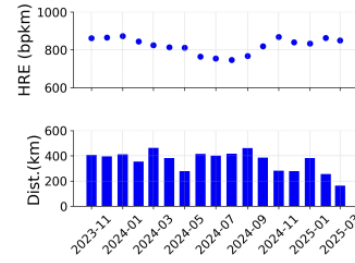
Results: Across Athletes



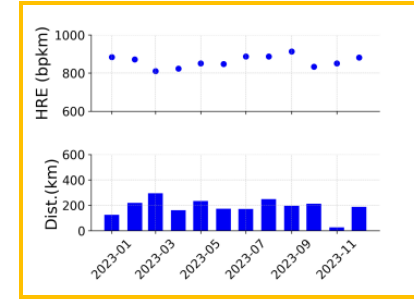
(a) Athlete B



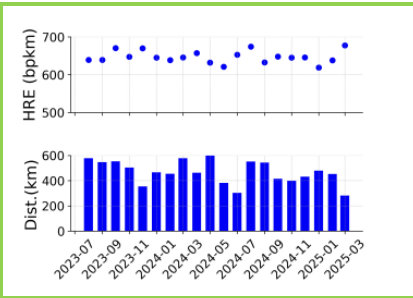
(b) Athlete C



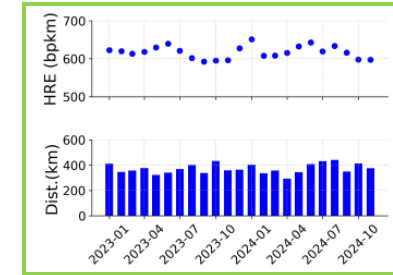
(c) Athlete D



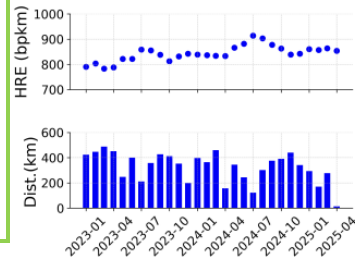
(d) Athlete E



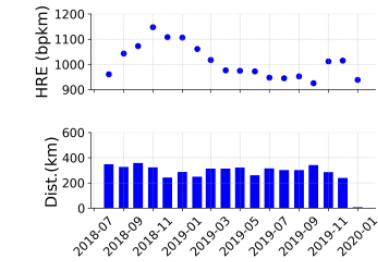
(e) Athlete F



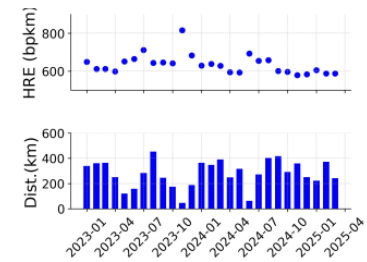
(f) Athlete G



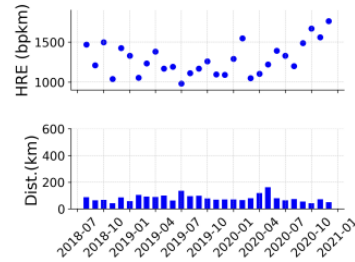
(g) Athlete H



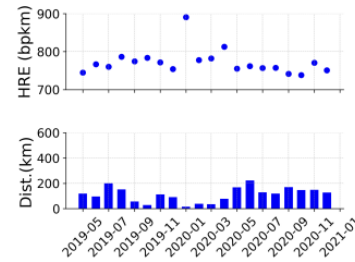
(h) Athlete I



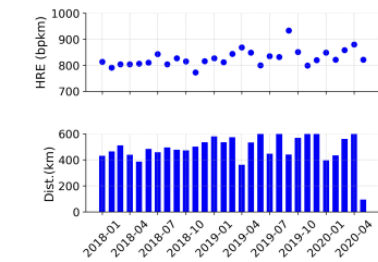
(i) Athlete J



(j) Athlete K

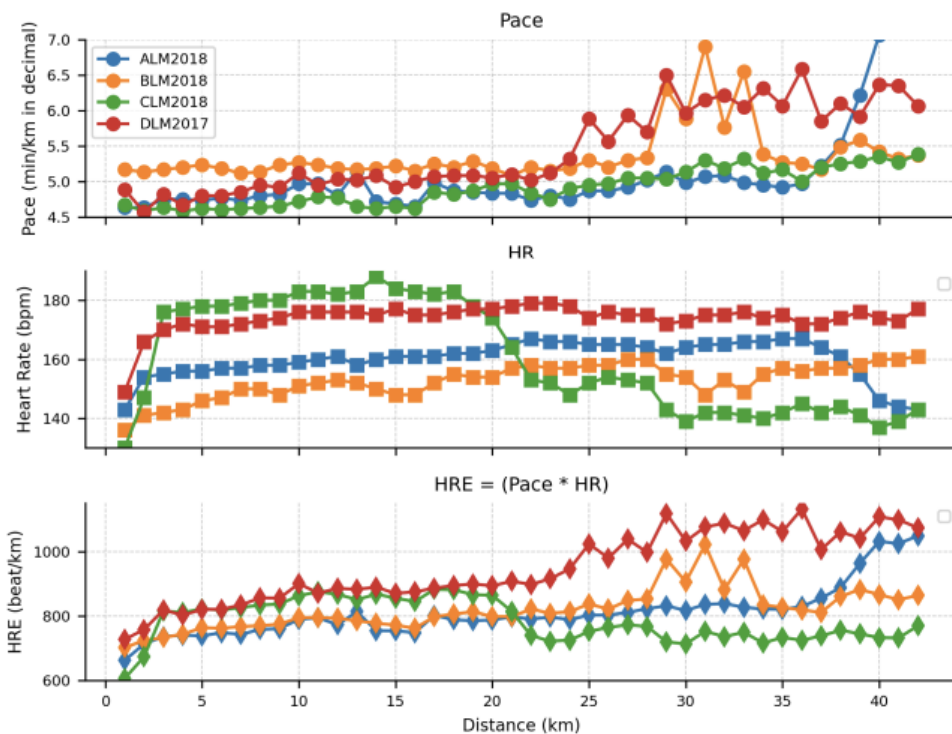


(k) Athlete L

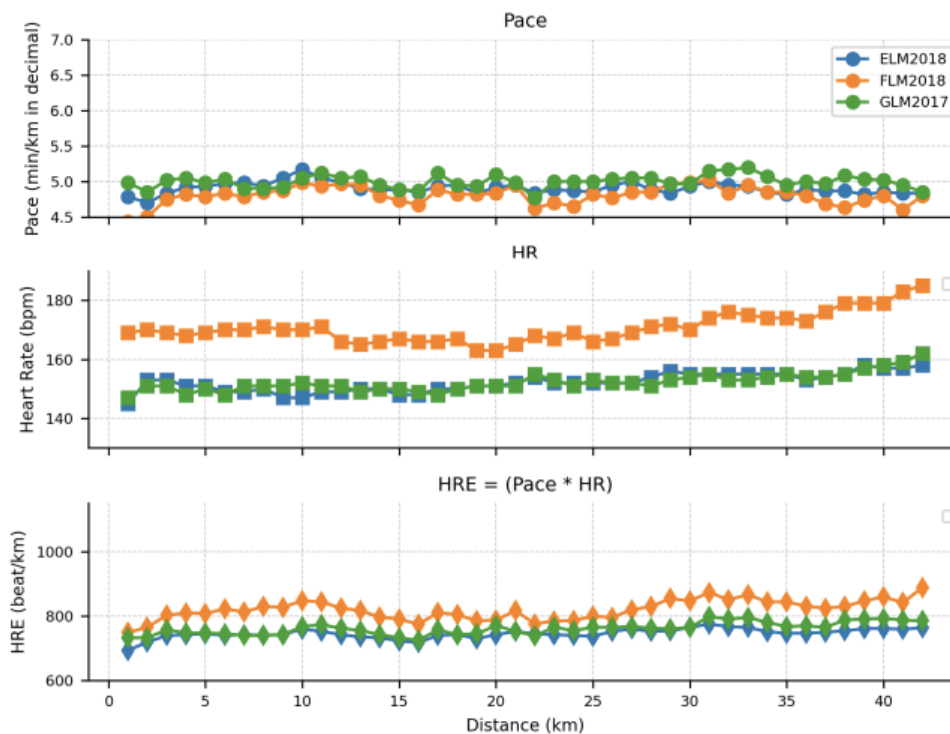


(l) Athlete M

Results: Marathons in Practice



(a) Poorly fitted runners



(b) Well-fitted runners

Implications for HCI

1. Transparency over black-box scores
2. Rethink long-term reflection and daily feedback
3. Empower users instead of prescribing training plans

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