

# **SVD for Matrix Approximation**

## or, When Rank Deficiency is Good News

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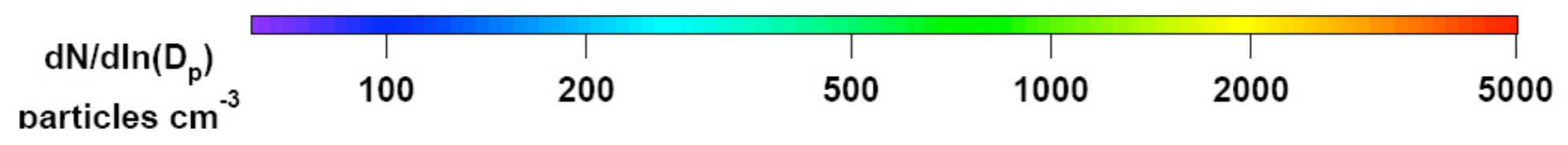
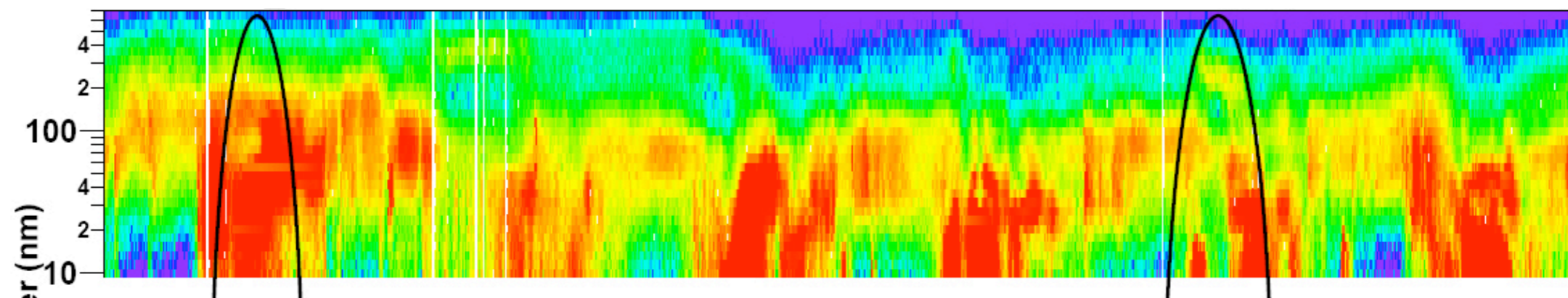
CS3220—1 Apr 2009

Figures from:

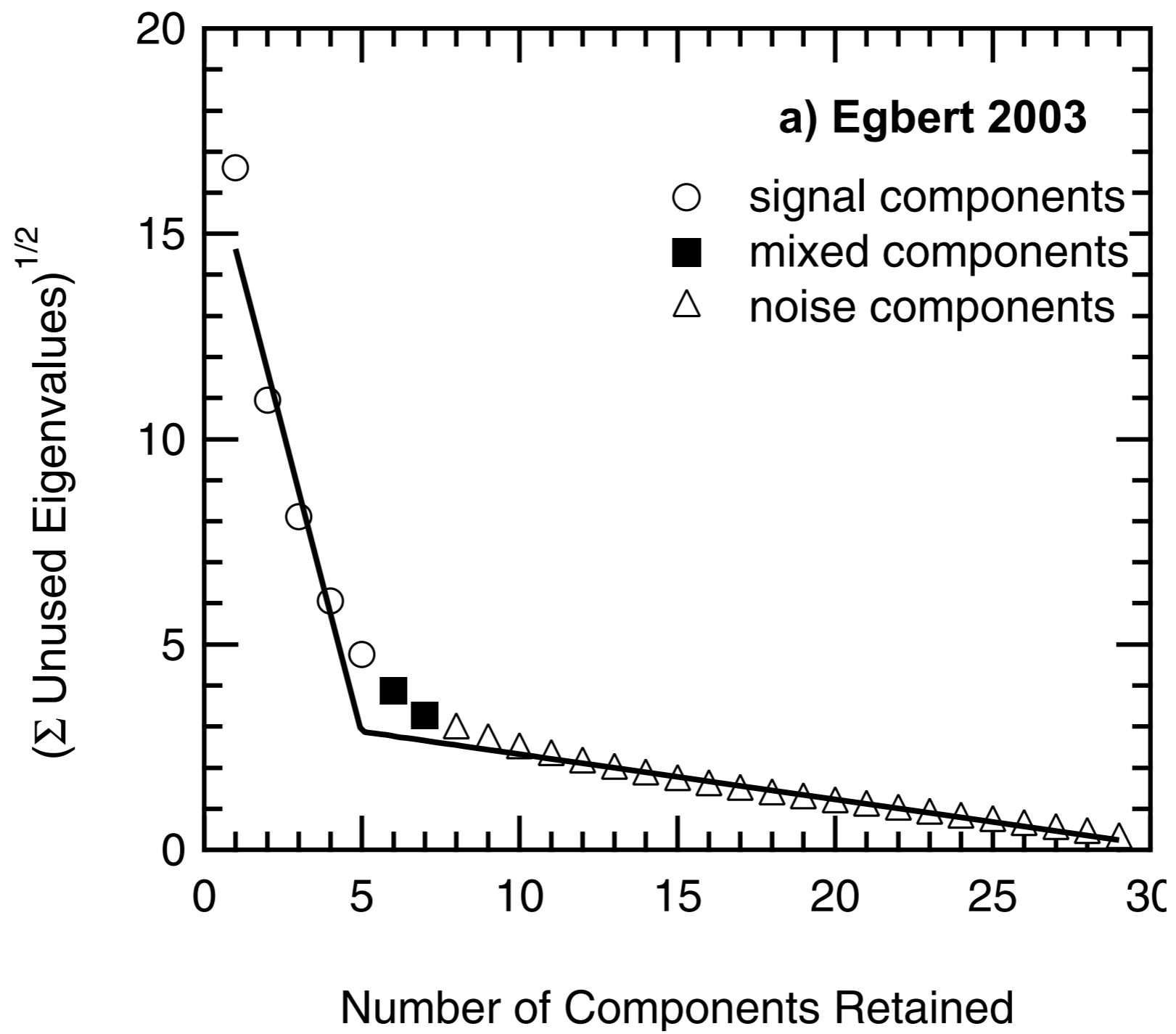
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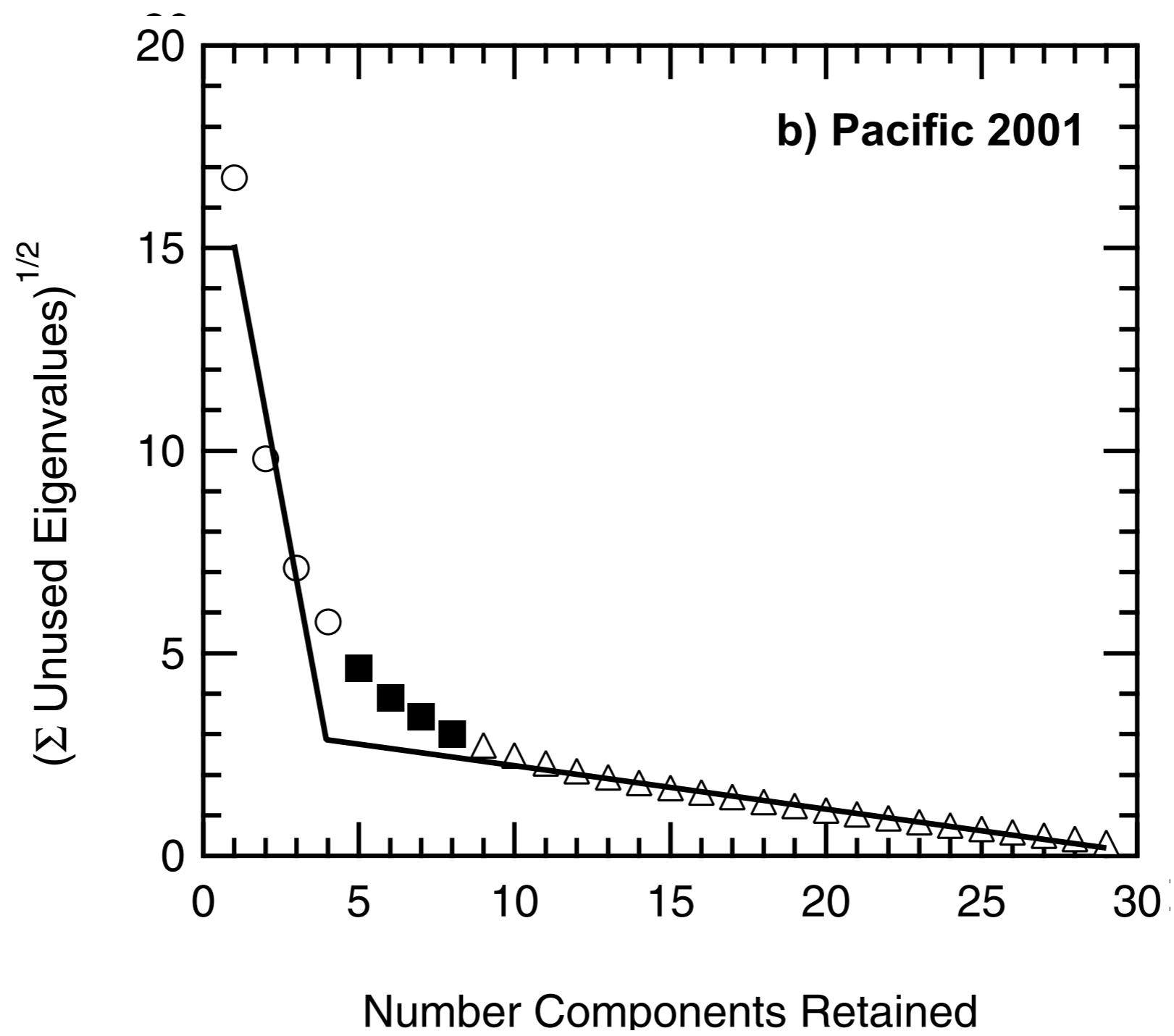
Chan & Mozurkewich, "Simplified representation of atmospheric aerosol size distributions using absolute principal components analysis." *Atmospheric Chemistry and Physics* **7**, 875–886, 2007.

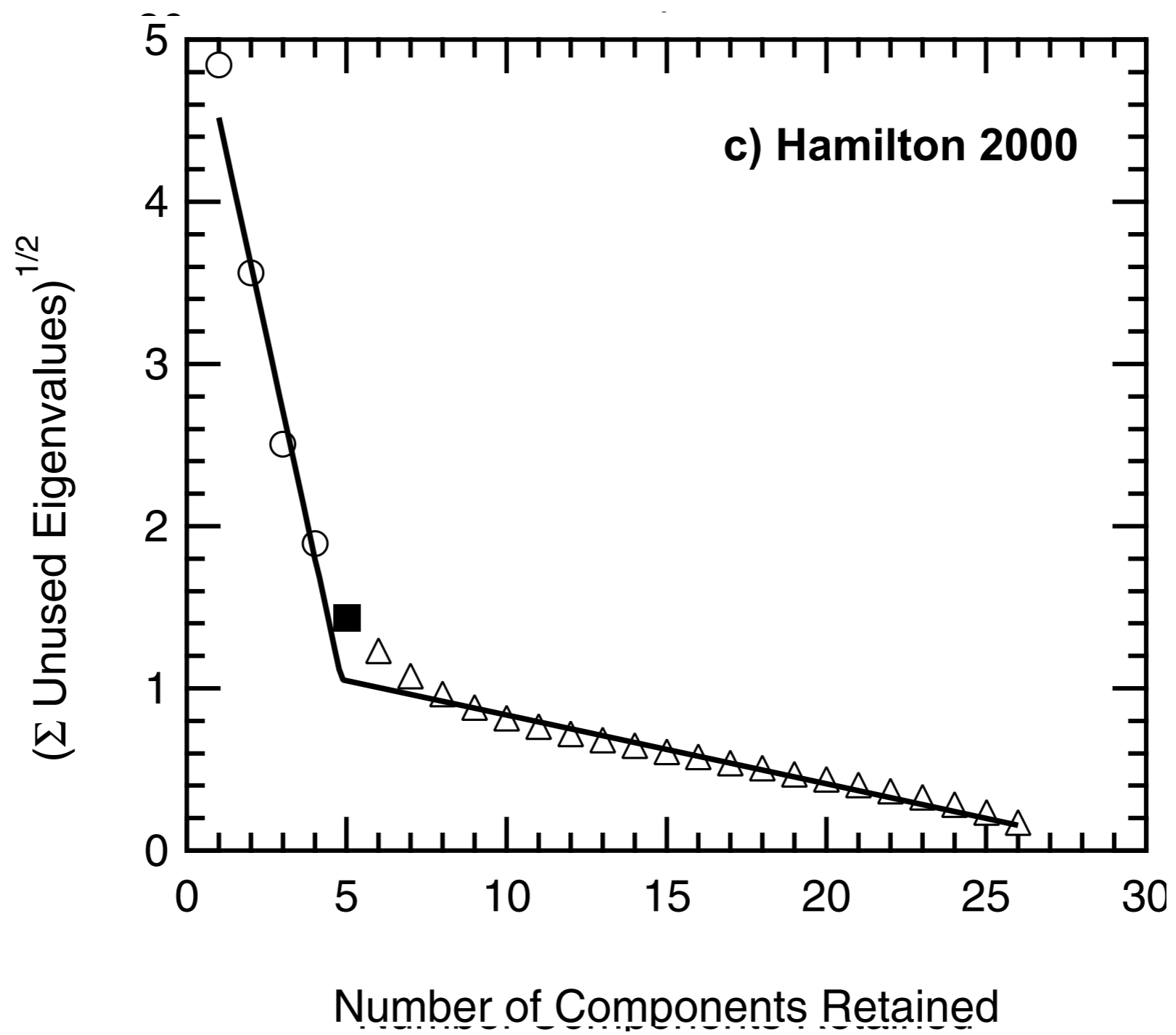
Tomasi & Kanadi, "Shape and Motion from Image Streams under Orthography: a Factorization Method," *International Journal of Machine Vision* **9**:2, 137–154, 1992.

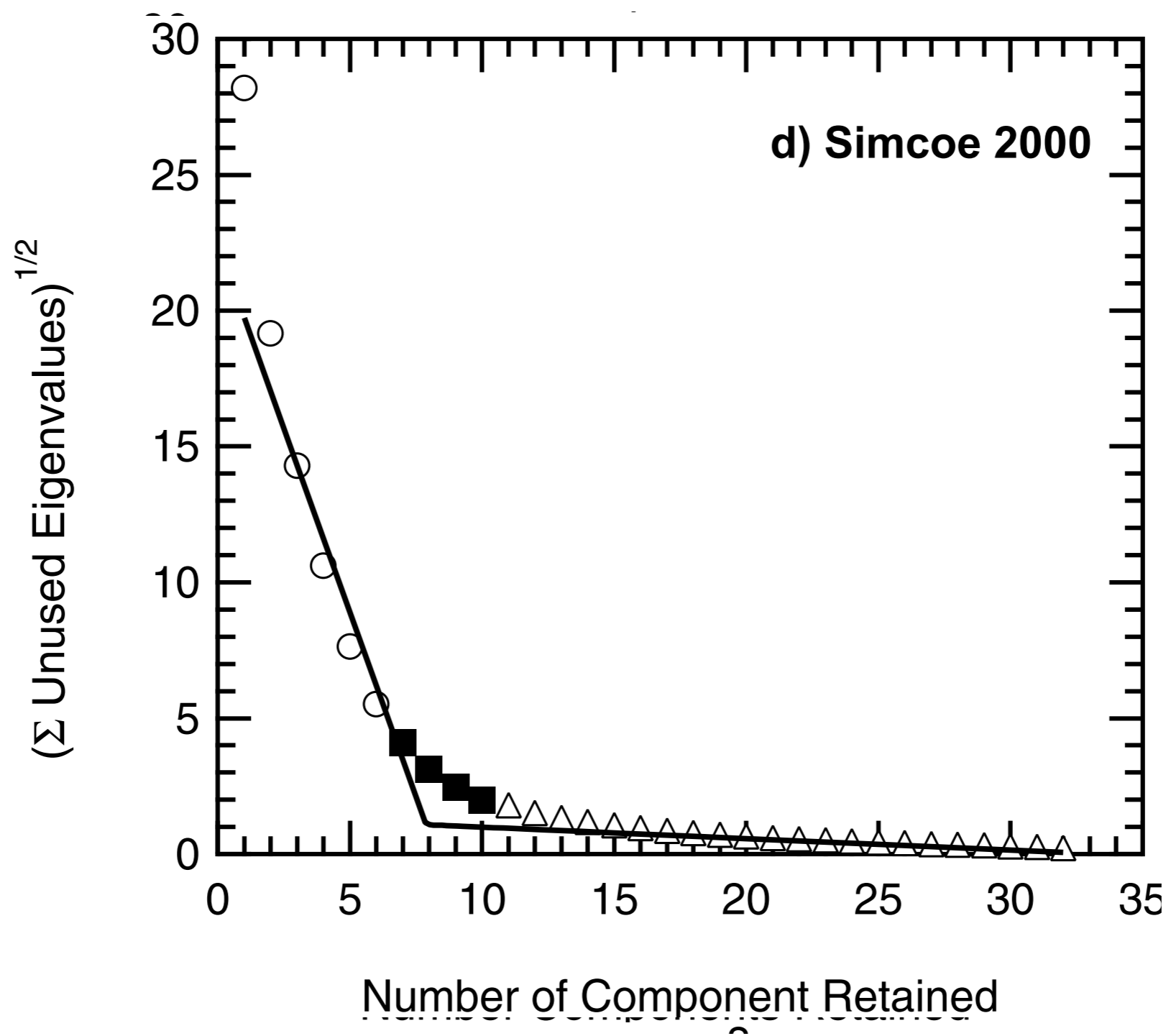




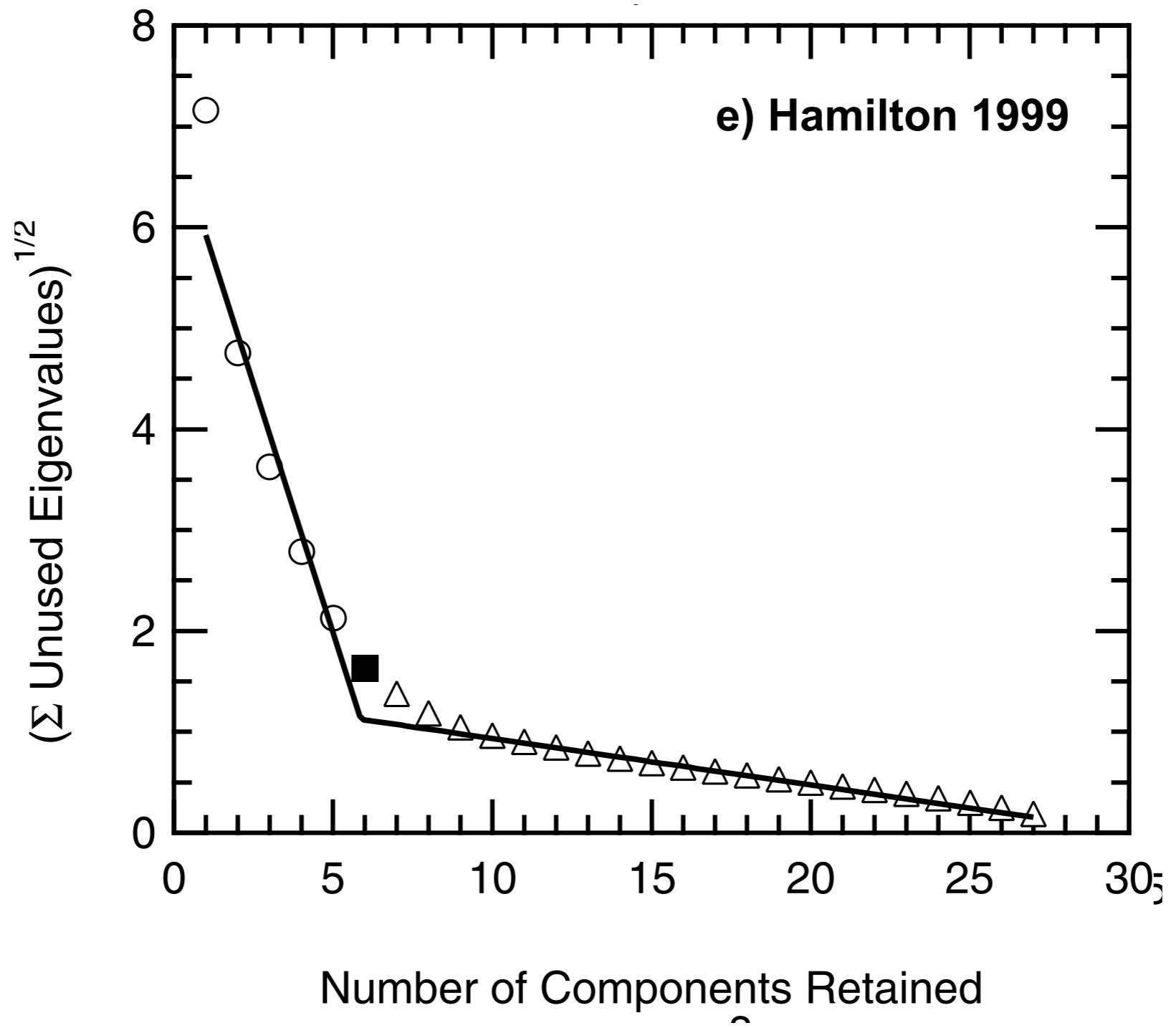


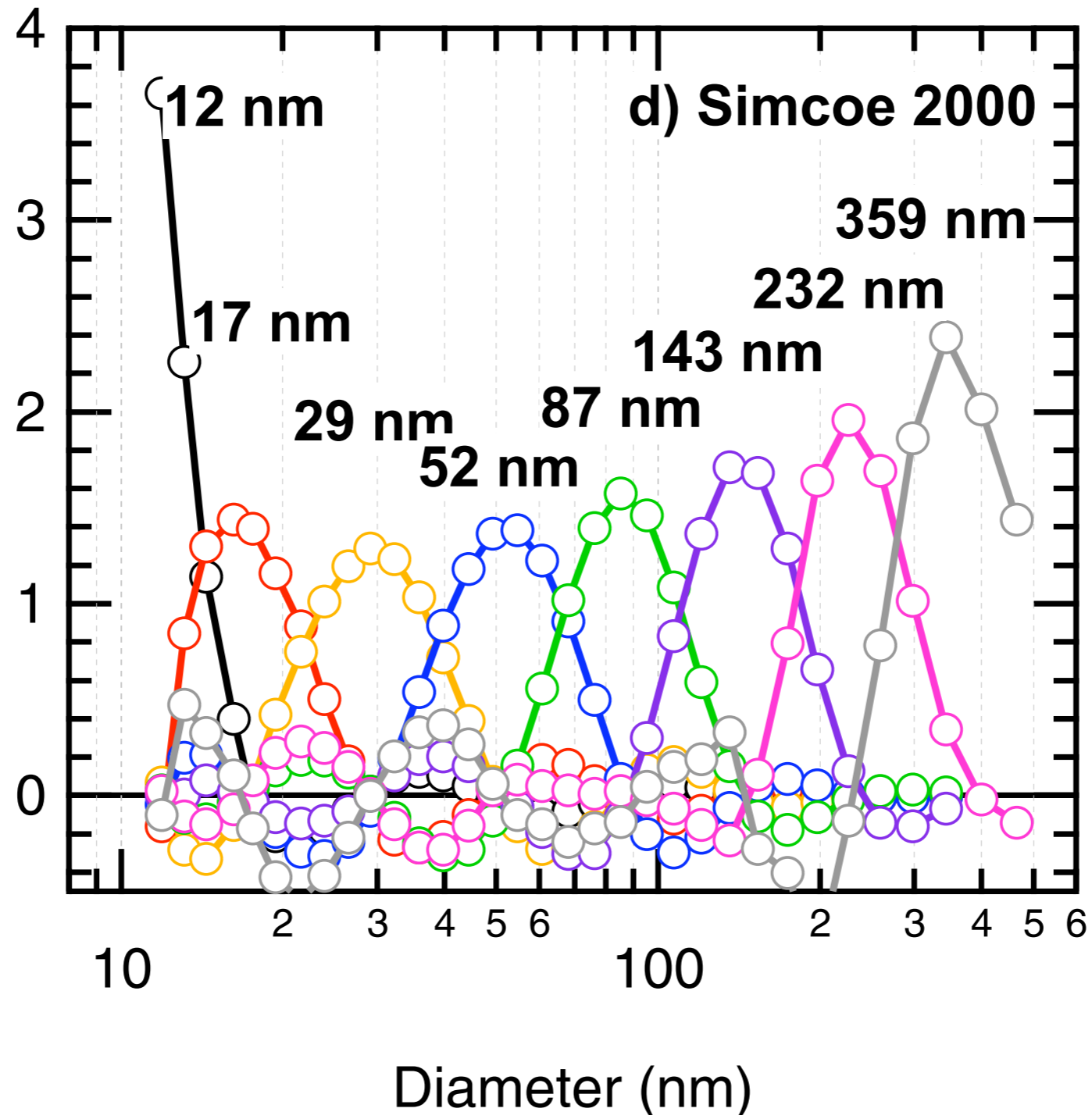


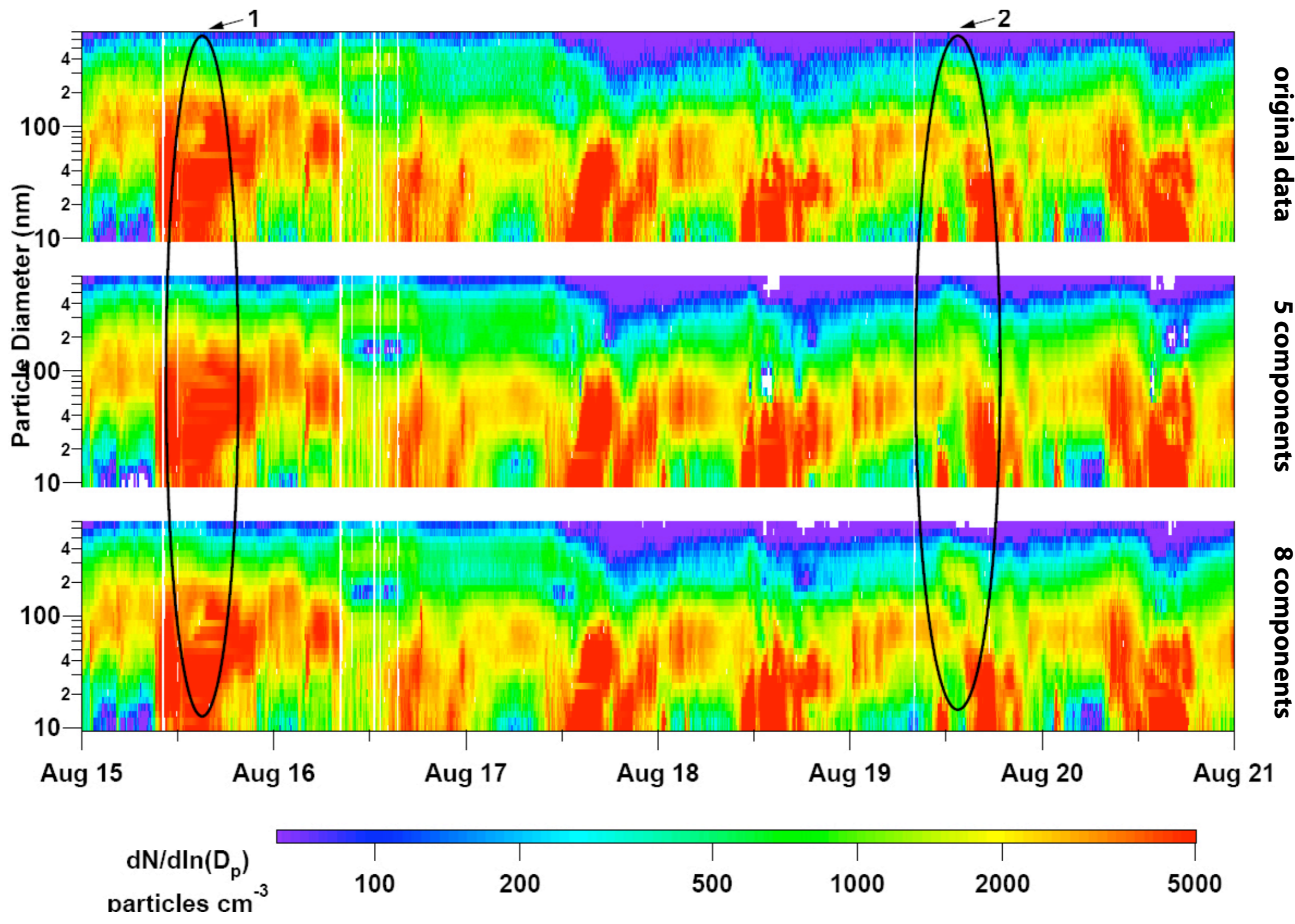








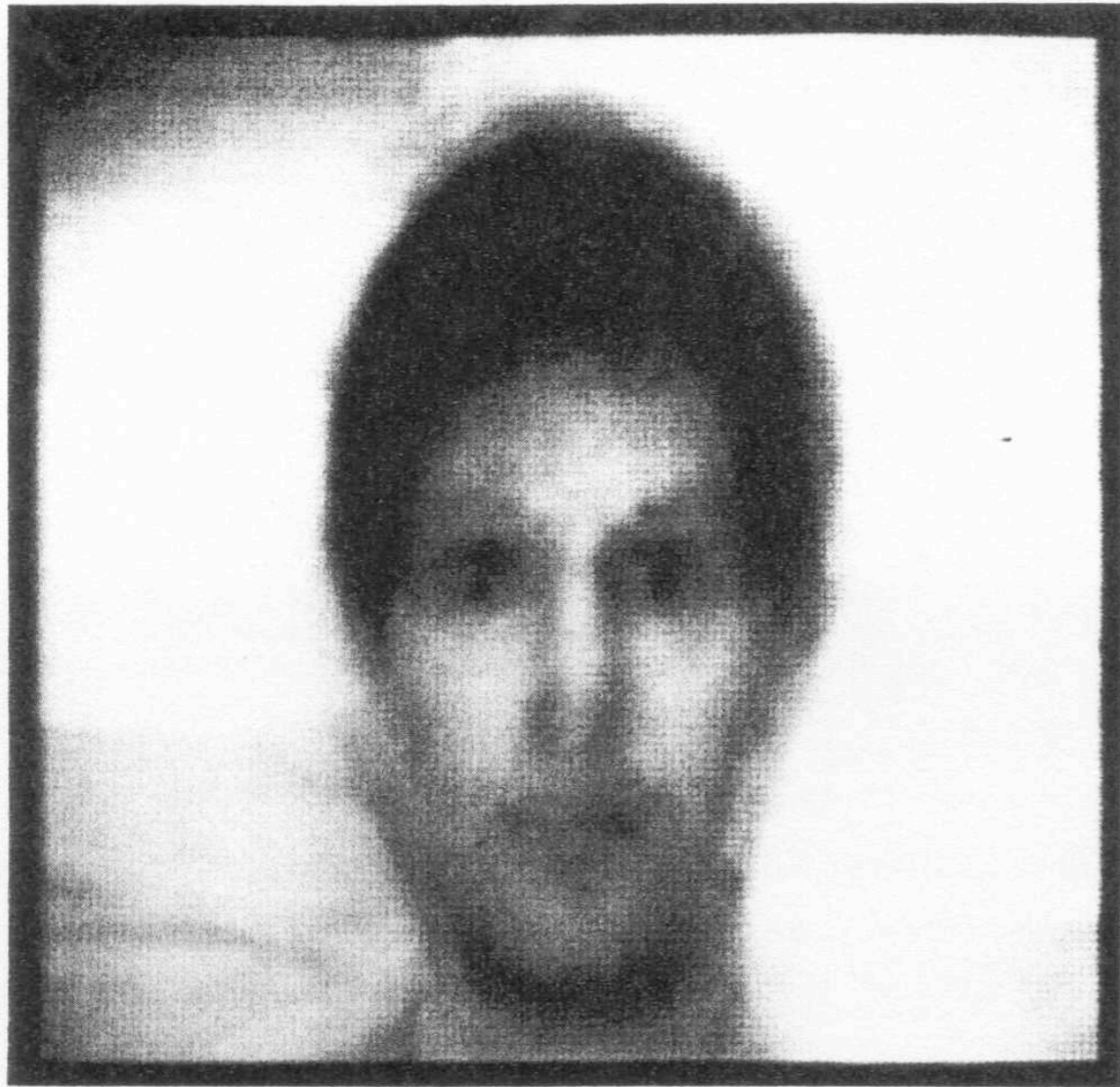








**Figure 1. (a)**Face images used as the training set.



**Figure 1. (b)** The average face  $\Psi$ .

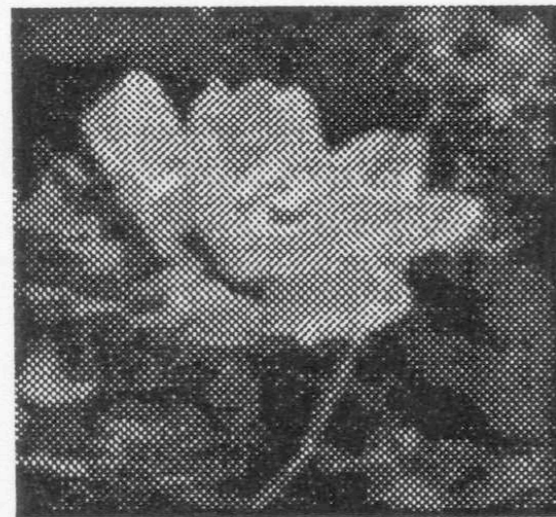


**Figure 2.** Seven of the eigenfaces calculated from the input images of Figure 1.



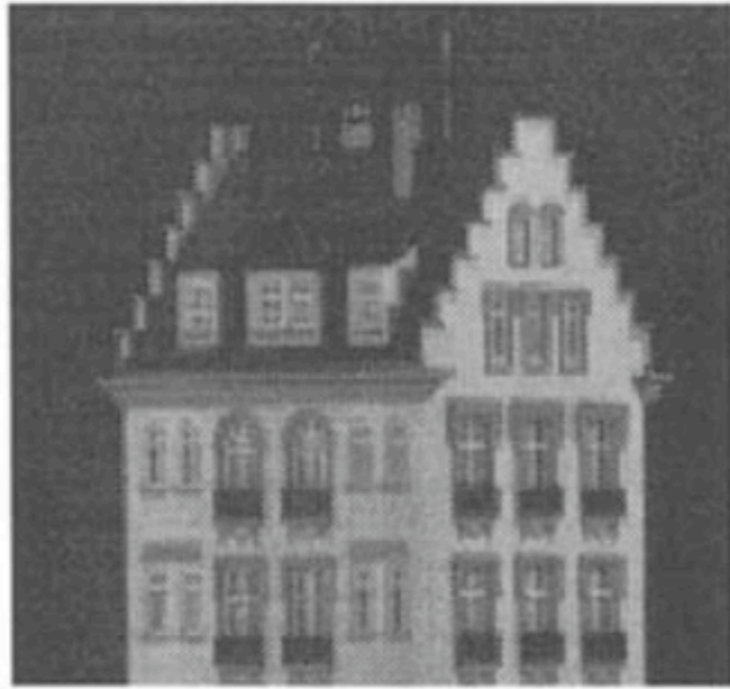
**Figure 3.** An original face image and its projection onto the face space defined by the eigenfaces of Figure 2.

**Figure 4.** Three images and their projections onto the face space defined by the eigen-faces of Figure 2. The relative measures of distance from face space are **(a)** 29.8, **(b)** 58.5, **(c)** 5217.4. Images **(a)** and **(b)** are in the original training set.









1



60



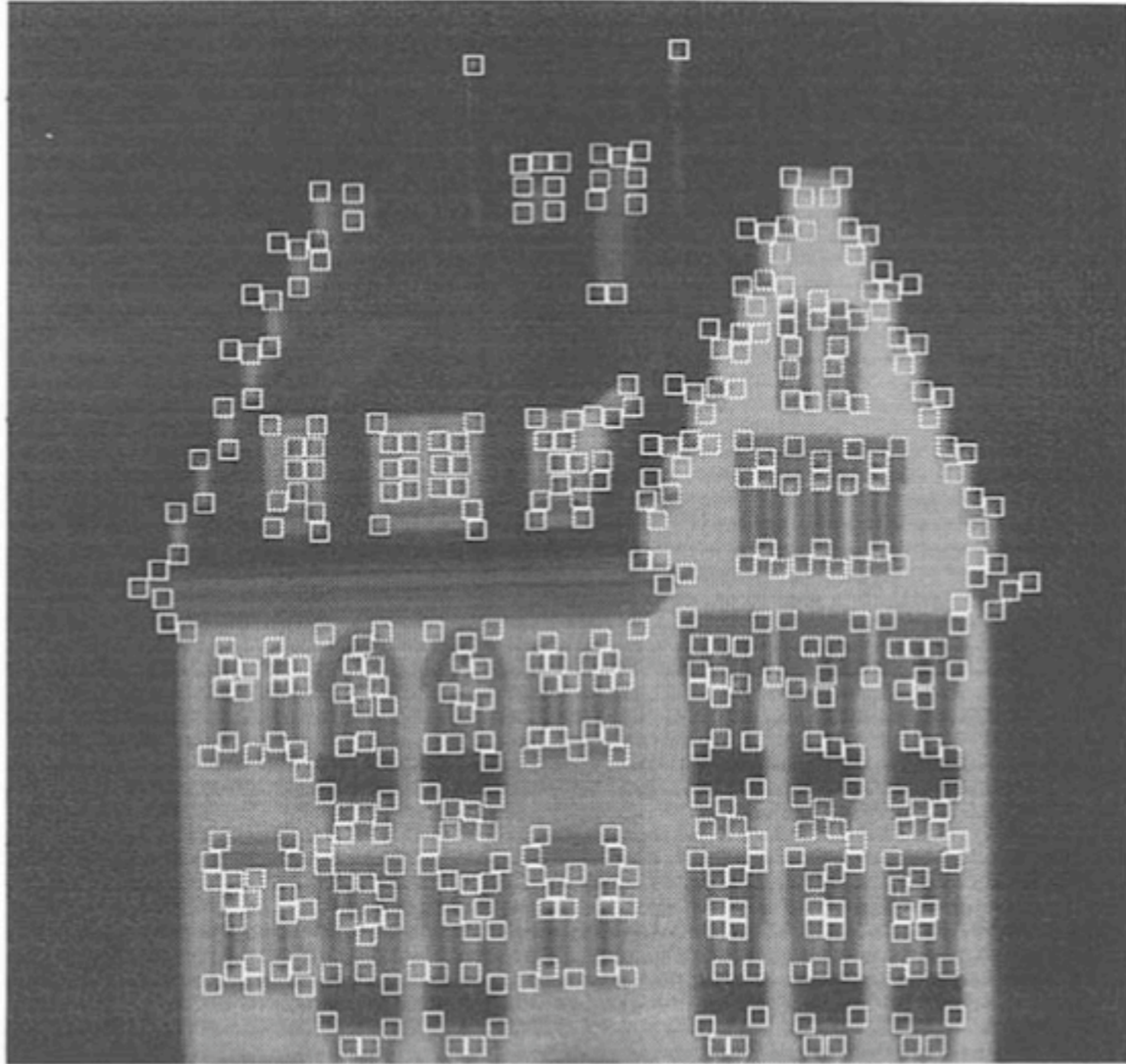
120



150

(a)

*Fig. 2a.* The "Hotel" stream: four of the 150 frames.

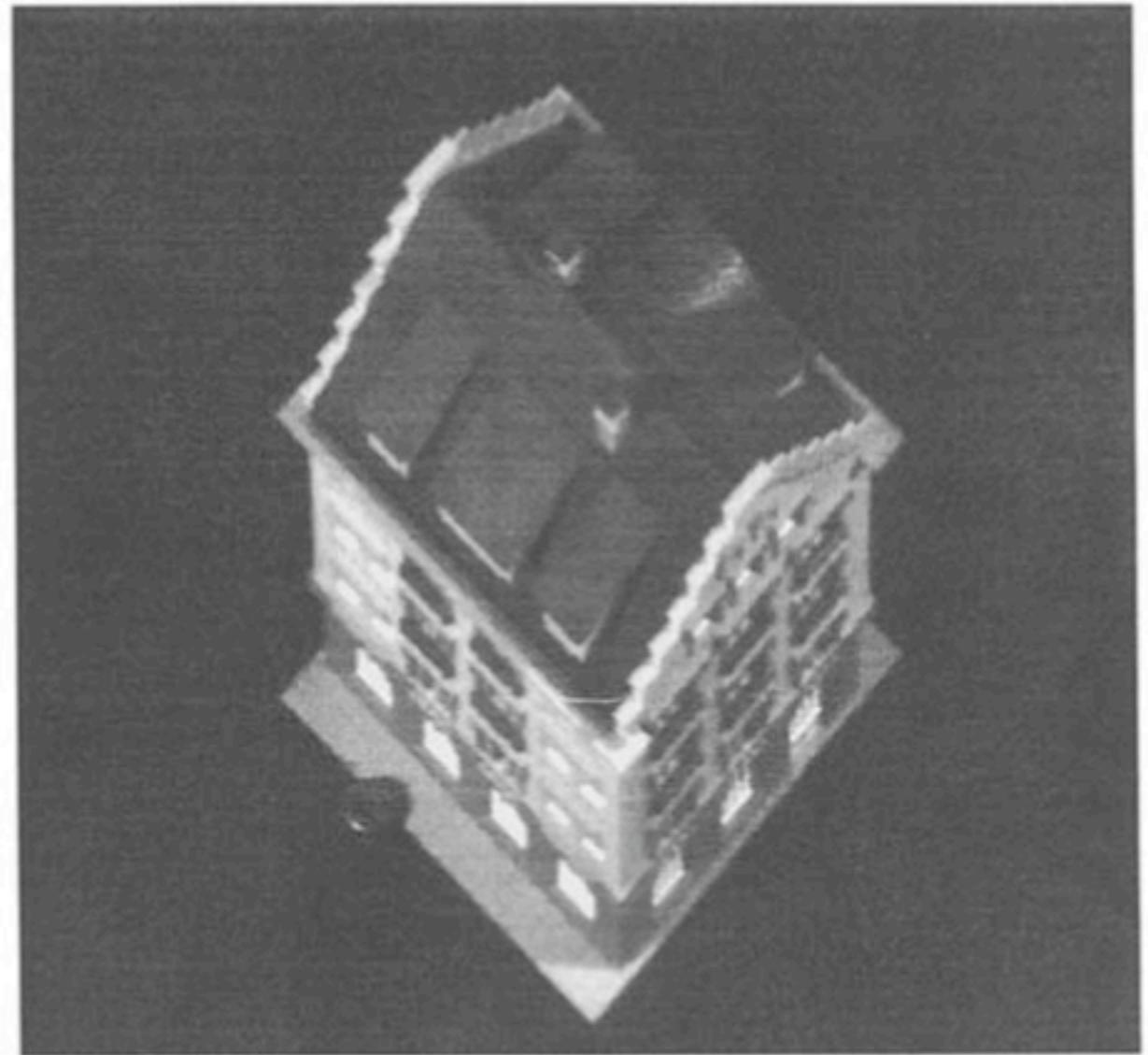


(b)

*Fig. 2b.* The "Hotel" stream: the 430 features selected by the automatic detection method.



(a)



(b)

*Fig. 4.* Qualitative shape results for the “Hotel” stream: top view of the (a) computed and (b) actual shape.